Board of Building Standards

CODE COMMITTEE MEETING
AGENDA

DATE:	MARCH 30, 2023
TIME:	1:00 PM
LOCATION:	TRAINING ROOM 3, 6606 TUSSING ROAD, REYNOLDSBURG, OHIO, 43068

Click here to join the meeting

Call to Order

Approval of Minutes

MIN-1	February 16, 2023 Code Committee Meeting Minutes

Petitions

P-1	Petition #23-02 - OBC Section 427 (Section 429 in 2024 OBC) Privacy Pods/Booths - Charles Moore of Framery Acoustics
P-2	Petition #23-03 - OBC Ch 19 & 35 Add ACI 440.11 for structural concrete - Kerry Sutton of American Concrete Institute
P-3	Petition #23-04 - RCO 311.7.1 Two handrails - Robert Kramer
P-4	Petition #23-05 - OBC Ch 13 Add ACI/TMS 122.1 to IECC & ASHRAE 90.1 for thermal bridging - Kerry Sutton of American Concrete Institute

Recommendations of the Residential Construction Advisory Committee

Old Business

OB-1	Review of Stakeholder Comments for AG 100 (OBC, OMC, & OPC)
OB-2	Review of Stakeholder Comments for AG 101 (RCO)

New Business

Adjourn

Ohio Board of Building Standards
6606 Tussing Road
Reynoldsburg, OH 43068-9009

614-644-2613
Fax 614 -644-3147
TTY/TDD 800-750-0750
com.ohio.gov

File Attachments for Item:

MIN-1 February 16, 2023 Code Committee Meeting Minutes

OHIO BOARD OF BUILDING STANDARDS
CODE COMMITTEE MINUTES
February 16, 2023

The Code Committee met on February 16, 2023 with the following members present: Mr. Denk, Mr. Johnson, Mr. Miller, Mr. Pavlis, Mr. Samuelson, Mr. Stanbery, Mr. Tyler, and Mr. Yankie. Board Chairman, Tim Galvin, was also present.

The following staff members were present: Regina Hanshaw, Debbie Ohler, Rob Johnson, Jay Richards, and Laura Borso

Guests present: Corbin Johnson and Dave Collins
Guests present via Teams: Charles Huber, Howard Blaisdell, Ed Lisinski, Denise Kipfstuhl, and Code Committee member Julie Cromwell

CALL TO ORDER

The meeting was called to order by Mr. Denk at 1:07 P.M.

APPROVAL OF MINUTES

Mr. Tyler made the motion to approve the minutes of the Code Committee meeting held on January 19, 2023. Mr. Stanbery seconded the motion. The motion passed unanimously.

PETITIONS

No items for consideration

RECOMMENDATIONS OF THE RESIDENTIAL CONSTRUCTION ADVISORY COMMITTEE

No items for consideration

OLD BUSINESS

OBC, OMC, OPC Draft rule review

Staff presented the 2021 I-code based Ohio draft rule packages to the committee, highlighted some items that may be of interest to the committee members, mentioned that there will be time to make further revisions to the draft rules prior to filing the rules with JCARR and LSC, and asked that the committee give staff permission to start the stakeholder process.

- Mr. Pavlis made the motion to start the stakeholder process with the draft OBC rule package including adding open parking garage sprinkler and standpipe exceptions in Chapter 9 and clarifying the committee intent with the ASHRAE 90.1 modification #1 in Chapter 13. Mr. Johnson seconded the motion. The motion passed unanimously. Staff was directed to bring proposed language fixes for distilleries, wineries, and breweries and for dual smoke alarm technologies to the next meeting.
- Mr. Pavlis made the motion to start the stakeholder process with the draft OMC rule package. Mr. Tyler seconded the motion. The motion passed unanimously.
- Mr. Pavlis made the motion to start the stakeholder process with the draft OPC rule package including keeping model code in Sections 1003.3.2 and 1003.3.3. Mr. Miller seconded the motion. The motion passed unanimously.

NEW BUSINESS

No items for consideration

ADJOURN

Mr. Pavlis made the motion to adjourn at 4:23 P.M. Mr. Stanbery seconded the motion. The motion passed unanimously.

File Attachments for Item:

P-1 Petition #23-02 - OBC Section 427 (Section 429 in 2024 OBC) Privacy Pods/Booths - Charles Moore of Framery Acoustics

Ohio Building Code - Application for Rule Change
Charles H. Moore
Framery Acoustics
3/13/2023

Acoustic Privacy Pod/Booths are becoming more popular. These are a necessary addition to most open office environments. They provide a space for a person to take a phone call, video call, or a quiet space to concentrate on a given task or assignment.

This proposal provides a means for building officials to approve these installations and allow the use of these prefabricated structures. This proposal treats Privacy Pod/booths, as products that can be installed in a building, and not as building construction, while not losing applicable code requirements. The proposal covers: Section 427.1 places limitations on the size of Privacy Pod/booths that are more appropriate for listed products. Privacy Pod/booths that exceed these size limitations will not fall under Section 427, and will be addressed with other building code requirements, including internal wirings, lighting, and other construction. Section 427.2 - The UL 962 listing covers the fabrication and safety of the modular room. UL 962 includes requirements for insulation, finish materials, internal wiring, lighting, ventilation, and other construction features. Markings are to be provided on the listed products to document the Chapter 8 and 26 ratings, such as the ASTM E84 (UL 723) flame spread and smoke developed indexes. This makes it easy to determine their suitability for use in the specific areas of the building. Section 427.3 allows the building official to approve the installation locations, to make sure the means of egress is not compromised and other code requirements are not adversely impacted. Section 427.4 addresses potential tripping hazards, and is based on Section 3.1.3, Item D in ICC ES AC519, “Enclosed Booths for Installation Inside New and Existing Buildings”.

2022 OHIO BUILDING CODE
Add new definition as follows:

Privacy Pod/Privacy Booth. An occupiable prefabricated structure, consisting of walls and a ceiling, with or without an integrated floor, designed and intended for use as an office or privacy space, which may include integral electrical wiring, ventilation, and furnishings

SECTION 427
PRIVACY PODS / BOOTHS

427.1 General.

Definition:
Privacy Pod/Booth: 100 square feet (9.3 m^2) or less in floor area and 8ft (2438mm) or less in height.

Privacy Pods exceeding these dimensions shall comply with all applicable requirements in this code.

427.2 Listing.
Privacy pod/booths shall be listed and labeled in accordance with UL 962 and installed in accordance with the listing and the manufacturer's instructions.

427.3 Locations.
Privacy pod/booths shall only be installed in approved locations and shall not obstruct required means of egress.

427.4 Elevation change.
Privacy pod/booths with integral floors shall be permitted to have an elevation change measured from the finished floor that is a maximum of 5 inches (127 mm) higher than the floor of the existing structure outside the modular booth.

427.5 Fire suppression.
Sleep pods shall be installed in rooms or spaces equipped with an automatic sprinkler system in accordance with Section 903.3.1.1. Installation of booths must not interfere with clearances of existing sprinkler heads.

Exceptions:
1. Booth installations that meet the requirements of Section 9.2.10, NFPA 13, 2022 Edition and the following:
    a. Where multiple booths are proposed, the booths are separated by a distance of 18 inches from one another.
    b. The clearance between the top of the booth(s) and ceiling sprinklers is a minimum of 18 inches.
    c. Per Section 9.2.10.2 of NFPA 2022 Edition, the area of any booth does not exceed 24 square feet. The area is to be the interior area of the booth, excluding the area of the enclosing walls.
    2. Booth installations where the top of the booth has louvers that open automatically on the activation of the fire alarm or with the loss of power.
    3. Where the booth has an applicable testing report accompanied by full-scale fire testing report showing that ceiling sprinklers control a fire originating from inside the booth, as allowed by ICC-ES Acceptance Criteria 519 section 6.8 D.

429.5.1 Smoke detection.
An automatic smoke detection system complying with Section 907 shall be provided in the rooms or spaces in which the privacy pod/booth's are located. The system shall activate the occupant notification system in accordance with Section 907.5.

429.5.2 Smoke alarms.

Audibility requirements of NFPA 72 and IFC 907.5.2.1 apply to the privacy pod/booth's. If these requirements are not met, an alarm should be placed inside the pod.

G101-21

Proposed Change as Submitted

Proponents: Jonathan Roberts, representing UL LLC (jonathan.roberts@ul.com)

2021 International Building Code

Add new definition as follows:

MODULAR ROOM. An occupiable prefabricated structure, consisting of walls and a ceiling, with or without an integrated floor, designed and intended for use as an office or privacy space, which may include integral electrical wiring, ventilation, and furnishings.

SLEEP POD. A modular room that is designed and used for sleeping purposes.

Add new text as follows:

SECTION 429
MODULAR ROOMS AND SLEEP PODS

429.1 General.
Modular rooms and *sleep pods* shall comply with Sections 429.2 through 429.5.5 and other applicable requirements in the code. *Modular rooms* and *sleep pods* shall comply with one of the following:

1. *Modular rooms* 100 square feet (9.3 m^2) or less in floor area and 8 feet (2438 mm) or less in height.
2. *Sleep pods* 36 square feet (3.3 m^2) or less in floor area, 8 feet (2438 mm) or less in height and 4 feet (1219 mm) or less in width.

Modular rooms and sleep pods exceeding these dimensions shall comply with all applicable requirements in this code.

429.2 Listing.
Modular rooms and *sleep pods* shall be *listed* and *labeled* in accordance with UL 962 and installed in accordance with the *listing* and the manufacturer's instructions. *Modular rooms* and *sleep pods* shall be marked with the following ratings:

1. Wall and ceiling interior finish ratings as established in accordance with Chapter 8.
2. Plastic material ratings as established in accordance with Chapter 26.

429.3 Locations.
Modular rooms and *sleep pods* shall only be installed in *approved* locations and shall not obstruct required *means of egress.*

429.4 Elevation change.
Modular rooms and *sleep pods* with integral floors shall be permitted to have an elevation change measured from the finished floor that is a maximum of 5 inches (127 mm) higher than the floor of the existing structure outside the modular booth provided a sign is installed on each side of the door warning about the elevation change, and a distinctive marking stripe is installed across the threshold having a width of not less than 1 inch (25 mm) but not more than 2 inches (51 mm).

429.5 Sleep pods.
The installation of *sleep pods* shall comply with Sections 429.5.1 through 429.5.5.

429.5.1 Locations.
Where *approved, sleep pods* shall be permitted to be installed in all occupancies. Individual *sleep pods* exceeding the dimensions in Section 429.1 shall be treated as *sleeping units* and shall only be installed in locations in which *sleeping units* are allowed.

429.5.2 Multiple sleep pod installations.
The installation of more than one sleep pod in a room or space shall comply with the following:

1. The area in which sleep pods are installed shall not exceed 10 percent of the building area of the story in which they are located.
2. A maximum of four sleep pods can be located adjacent to each other, and each group of sleep pods shall be separated from other groups by a minimum of 10 feet (3048 mm).
3. Stacking of sleep pods shall only be done in accordance with the manufacturer's instructions and the listing.

Exception:
Installations exceeding these limitations shall be permitted based on an approved risk assessment of the installation.

429.5.3 Fire suppression.
Sleep pods shall be installed in rooms or spaces equipped with an *automatic sprinkler system* in accordance with Section 903.3.1.1.

429.5.4 Smoke detection.
An *automatic smoke detection system* complying with Section 907 shall be provided in the rooms or spaces in which *sleep pods* are located. The system shall activate the occupant notification system in accordance with Section 907.5.

429.5.5 Smoke alarms.
Smoke alarms shall be provided in sleep pods in accordance with Section 907.2.11. Where multiple sleep pods are located in the same room or space, the smoke alarms shall be interconnected in such a manner that the activation of one alarm will activate alarms in all of the sleep pods in the group that is installed in accordance with Section 429.5.2.

Reason: Modular rooms and sleep pods are becoming increasingly popular, and are showing up in a variety of different occupancies. This proposal provides a means for building officials to approve these installations and allow the use of these prefabricated structures.
This proposal treats modular rooms and sleep pods, such as those shown in the attached pictures, as products that can be installed in a building, and not as building construction, while not losing applicable code requirements. The proposal covers:

Section 429.1 places limitations on the size of modular rooms and sleep pods that are more appropriate for listed products. Modular rooms and sleep pods that exceed these size limitations will not fall under Section 429, and will be addressed with other building code requirements, including internal wirings, lighting, and other construction.

Section 429.2 - The UL 962 listing covers the fabrication and safety of the modular room. UL 962 includes requirements for insulation, finish materials, internal wiring, lighting, ventilation, and other construction features. Markings are to be provided on the listed products to document the Chapter 8 and 26 ratings, such as the ASTM E84 (UL 723) flame spread and smoke developed indexes. This makes it easy to determine their suitability for use in the specific areas of the building.

Section 429.3 allows the building official to approve the installation locations, to make sure the means of egress is not compromised and other code requirements are not adversely impacted.

Section 429.4 addresses potential tripping hazards, and is based on Section 3.1.3, Item D in ICC ES AC519, "Enclosed Booths for Installation Inside New and Existing Buildings".

Section 429.5 includes additional requirements that are applicable to sleep pods, a type of modular room that are showing up in occupancies such as airports and office buildings. The proposal provides protection for these products by requiring the room or space in which they are installed to be provided with fire suppression and fire detection, smoke alarms in the units, and addresses multiple sleep pod installations.

These come in a variety of forms. For some examples see these links:

- https://www.sleepinginairports.net/blog/airport-sleeping-pods.htm
- https://www.aviationpros.com/airports/press-release/12339876/dubai-airports-airport-sleep-lounge-sleep-n-fly-opens-at-dxb
- https://www.flightcentre.com.au/travel-news/destinations/airport-sleeping-options
- https://www.pinterest.com/pin/340584790540317201/
- https://dickinsonstatenews.com/dickinson-state-is-making-life-a-little-easier-for-parents-of-young-children/

Cost Impact: The code change proposal will increase the cost of construction
The cost of these construction will increase since these products are not currently regulated.

G101-21

Public Hearing Results

This proposal includes the following errata

Chapter 35:

UL 962 -2014 Includes all amendments and changes through Revision Page(s) , January 12, 2021 - UL Standard for Safety Household and Commercial Furnishings

Review of the standard is as follows:

Appears to be written in enforceable language. Does not appear to require proprietary materials or agencies. Promulgation by a consensus process stated in preface

Committee Action: **Disapproved**

Committee Reason: This proposal was disapproved. The referenced standard, UL962, was not provided to the committee. What is required for risk assessment? It is not clear if modular rooms and sleep pods were considered rooms or furniture. The 5 inch step up permitted is an issue for accessibility requirements. If the sleep pods are stacked, there is an egress issue that is not currently addressed. There was concern that these would be permitted in all occupancies. Criteria is needed for what would be an approved location. The installation limits in Section 429.5.2 is unclear and does not address modular rooms, only sleep pods. There is a concern about seismic anchorage if the sleep pods are stacked. There is a concern about fire alarm notification in the enclosed sleep pods and modular rooms. Do these need to be sprinklered? (Vote: 13-0)

G101-21

Individual Consideration Agenda

Public Comment 1:

IBC: 429.1, 429.4, 429.5, 429.5.1, 429.5.2, 429.5.3, 429.5.4, 429.5.5, [F] 903.3.3 (IFC: 903.3.3), UL Chapter 35

Proponents: Jonathan Roberts, representing UL LLC (jonathan.roberts@ul.com) requests As Modified by Public Comment

Modify as follows:

2021 International Building Code

MODULAR ROOM . An occupiable prefabricated structure , consisting of walls and a ceiling, with or without an integrated floor. It is typically intended for use as an indoor privacy space, and may include integral electrical wiring, ventilation, and furnishings.

SLEEP POD . A *modular room* that is designed and used for sleeping purposes.

SECTION 429
MODULAR ROOMS AND SLEEP PODS

429.1 General . Modular rooms and sleep pods <u>installed in indoor locations</u> shall comply with Sections 429.2 through <u>429.5</u> ~~429.5.5 and other applicable requirements in the code~~. Modular rooms and sleep pods shall ~~comply with one of the following:~~ <u>not exceed the following dimensions:</u>

1. Modular rooms 100 square feet (9.3 m^2) or less in floor area and 8 feet (2438 mm) or less in height.
2. Sleep pods 36 square feet (3.3 m^2) or less in floor area, 8 feet (2438 mm) or less in height and 4 feet (1219 mm) or less in width.

~~Modular rooms and sleep pods exceeding these dimensions shall comply with all applicable requirements in this code.~~

<u>**Exceptions:**</u>

1. <u>Precast concrete construction in accordance with Chapter 17 and Chapter 19 shall not be required to comply with this section.</u>
2. <u>*Modular rooms* constructed under an off-site or modular construction program approved by the Building Official shall not be required to comply with this section.</u>

429.2 Listing . Modular rooms and sleep pods shall be listed and labeled in accordance with UL 962 and installed in accordance with the listing and the manufacturer's instructions. Modular rooms and sleep pods shall be marked with the following ratings:

1. Wall and ceiling interior finish ratings as established in accordance with Chapter 8.
2. Plastic material ratings as established in accordance with Chapter 26.

429.3 Locations . Modular rooms and sleep pods shall only be installed in approved locations and shall not obstruct required means of egress.

~~**429.4 Elevation change .** *Modular rooms and sleep pods* with integral floors shall be permitted to have an elevation change measured from the finished floor that is a maximum of 5 inches (127 mm) higher than the floor of the existing structure outside the modular booth provided a sign is installed on each side of the door warning about the elevation change, and a distinctive marking stripe is installed across the threshold having a width of not less than 1 inch (25 mm) but not more than 2 inches (51 mm).~~

~~**429.5 Sleep pods .** The installation of *sleep pods* shall comply with Sections 429.5.1 through 429.5.5.~~

~~**429.5.1 Locations** . Where *approved*, *sleep pods* shall be permitted to be installed in all occupancies. Individual *sleep pods* exceeding the dimensions in Section 429.1 shall be treated as *sleeping units* and shall only be installed in locations in which *sleeping units* are allowed.~~

~~**429.5.2 Multiple sleep pod installations** . The installation of more than one sleep pod in a room or space shall comply with the following:~~

1. ~~The area in which sleep pods are installed shall not exceed 10 percent of the building area of the story in which they are located.~~
2. ~~A maximum of four sleep pods can be located adjacent to each other, and each group of sleep pods shall be separated from other groups by a minimum of 10 feet (3048 mm).~~
3. ~~Stacking of sleep pods shall only be done in accordance with the manufacturer's instructions and the listing.~~

~~**Exception:**~~
~~Installations exceeding these limitations shall be permitted based on an approved risk assessment of the installation.~~

~~**429.5.3 Fire suppression** . *Sleep pods* shall be installed in rooms or spaces equipped with an *automatic sprinkler system* in accordance with Section 903.3.1.1.~~

~~**429.5.4 Smoke detection** . An *automatic smoke detection system* complying with Section 907 shall be provided in the rooms or spaces in which *sleep pods* are located. The system shall activate the occupant notification system in accordance with Section 907.5.~~

429.4 Fire alarm notification . Where modular rooms or sleep pods are provided in areas with occupant notification systems, the required audible and visible signal shall be extended into the interior of these units in accordance with Section 907.5.

429.5 ~~429.5.5~~ Smoke alarms . Smoke alarms shall be provided in sleep pods in accordance with Section 907.2.11. Where multiple sleep pods are located in the same room or space, the smoke alarms shall be interconnected in such a manner that the activation of one alarm will activate alarms in all of the sleep pods in the room or space ~~group that is installed in accordance with Section 429.5.2~~.

Exception: Smoke alarms are not required where smoke detection systems complying with Section 907.4 provide alarm notification in the sleep pods.

[F] 903.3.3 Obstructed locations . Automatic sprinklers shall be installed with regard to obstructions that will delay activation or obstruct the water distribution pattern and shall be in accordance with the applicable automatic sprinkler system standard that is being used. Automatic sprinklers shall be installed in or under covered kiosks, displays, booths, concession stands, modular rooms, sleep pods, or equipment that exceeds 4 feet (1219 mm) in width. Not less than a 3-foot (914 mm) clearance shall be maintained between automatic sprinklers and the top of piles of combustible fibers.

Exception: Kitchen equipment under exhaust hoods protected with a fire-extinguishing system in accordance with Section 904.

UL

UL LLC
333 Pfingsten Road
Northbrook, IL 60062

UL 962 - 2014 Household and Commercial Furnishings - with Revisions through 2020

Commenter's Reason: At the committee action hearings there was strong support for the concept of covering modular rooms and sleep pods, but concerns with how the original proposal was crafted. This public comment addressed the major concerns raised including the following:

1. Clarified that the requirements do not cover precast concrete construction in accordance with Chapter 17 and Chapter 19, including units used in detention facilities.
2. Clarified that the requirements do not cover off-site or modular construction where the program is approved by the Building Official.
3. Deleted the confusing reference to elevation change for door sills.
4. Deleted criteria for the percentage of floor area that can be devoted for sleep pod installation.
5. Removed occupancy criteria for acceptable sleep pod installation. The 429.3 criteria allows the building official to evaluate and approve the intended locations.
6. Removed the criteria for sleep pods to only be provided in rooms containing automatic sprinklers.
7. Removed unnecessary criteria related to the maximum number and stacking of sleep pods. Existing Code requirements address these concerns.
8. Clarified that where alarm notification is provided in the room or area in which the units are installed, that it shall extend into the privacy room and sleep pod, since the sound insulation in these units would typically obstruct the notification.
9. Added references to modular rooms and sleep pods to the Section 903.3.3 obstructed location section.
10. Added the referenced standard that was provided to the committee, UL 962, into Chapter 35.

Cost Impact: The net effect of the public comment and code change proposal will increase the cost of construction
Since modular rooms and sleep pods are not currently covered by the Code the public comment could increase the cost to install these products in a building.

CRITERIA FOR SUBMITTING RULE CHANGES TO THE BOARD OF BUILDING STANDARDS

The Ohio Board of Building Standards processes all petitions for changes to the rules of the Board of Building Standards (Building, Mechanical, Plumbing, Boiler, Elevator, or Residential Codes) pursuant to ORC Chapter 119.

When anyone desires to petition the Board of Building Standards to adopt, amend, or annul a provision of rules of the Board, they must complete an application and provide supporting information submitted to the Secretary of the Board of Building Standards.

The application must include the following:

(1) The date the application is prepared;
(2) The rule number or section that is proposed for amendment, adoption, or annulment;
(3) The rule numbers of all other rules that will be affected by the matter proposed;
(4) The name, address, contact information, affiliation of the applicant, and of any representative;
(5) The provisions that are proposed for adoption, amendment, or annulment;
(6) The reason and technical justification for the proposed change;
(7) All text to be eliminated shall be shown deleted by means of strikethrough, e.g., ~~matter to be eliminated~~;
(8) All proposed new text to be inserted into a rule shall be shown as underlined, e.g., <u>proposed new matter</u>; and
(9) One copy of the completed application and attachments.
(10) An estimate of the increase or decrease in cost that would occur with the adoption of the proposed code change.

When the Secretary of the Board of Building Standards receives a completed application for an adoption, amendment, or annulment of rules of the Board, the Secretary will promptly deliver or mail a copy of the application to each member of the Board.

After receiving an application for the adoption, amendment, or annulment of rules of the Board, the Board of Building Standards shall proceed under sections 3781.101 and 3781.12 of the Revised Code.

APPLICATION
FOR
RULE CHANGE

Pursuant to section 3781.12 of the Revised Code and rules adopted by the Board of Building Standards, application is herewith submitted to adopt, amend, or annul a rule adopted by the Board pursuant to section 3718.10 of the Revised Code.

BOARD OF BUILDING STANDARDS
6606 Tussing Road, P.O. Box 4009
Reynoldsburg, Ohio 43068-9009
(614) 644-2613
bbs@ohio.gov
www.com.state.oh.us/dico/bbs/default.aspx

For BBS use:	
Petition #:	23-02
Date Recv'd:	March 14, 2023

Submitter: Charles H. Moore (Contact Name) Framery Acoustics (Organization/Company)

Address: 44 W. Zane Ave. (Include Room Number, Suite, etc.)

Salt Lake City (City) UT (State) 84103 (Zip)

Telephone Number: 801-386-2762 **Fax Number:**

Date: 3/13/2023 **E-mail Address:** charles.moore@framery.fi

Code Section: 427 (new section)

General Explanation of Proposed Change (attach additional sheets if necessary):

see attached sheet.

Explanation of Cost Impact of Proposed Code Change*: N/A, Not currently covered in Building Code

N/A, Not currently covered in Building Code

N/A, Not currently covered in Building Code

***Attach additional cost information as necessary to justify any statement of cost increase or cost decrease.**

Information on Submittal (attach additional sheets if necessary):	
1. Sponsor:	Framery Acoustics, Inc. Organization sponsoring or requesting the rule change (if any)
2. Rule Title:	Section 427, Privacy Pods / Booths Title of rule change
3. Purpose/ Objective:	This proposal provides a means for building officials to approve these installations and allow the use of these prefabricated structures. This proposal treats Privacy Pod/booths, as products that can be installed in a building, and not as building construction, while not losing applicable code requirements. The proposal covers: Section 427.1 places limitations on the size of Privacy Pod/booths that are more appropriate for listed products. Privacy Pod/booths that exceed these size limitations will not fall under Section 427, and will be addressed with other building code requirements, including internal wirings, lighting, and other construction. Section 427.2 - The UL 962 listing covers the fabrication and safety of the modular room. UL 962 includes Technical justification for the proposed rule change
4. Formatted Rule Language **(Using Strike-out for Deleted Text and Underline for Added Text)**	**SECTION 427** **PRIVACY PODS / BOOTHS** **427.1 General.** Definition: Privacy Pod/Booth: 100 square feet (9.3 m^2) or less in floor area and 8ft (2438mm) or less in height. Privacy Pods exceeding these dimensions shall comply with all applicable requirements in this code. **427.2 Listing.** Privacy pod/booths shall be listed and labeled in accordance with UL 962 and installed in accordance with the listing and the manufacturer's instructions. Privacy pod/booths shall be marked with the following ratings: Use strike-out for deleted text and underline for added text
5. Notes:	1. To encourage uniformity among states using model codes, it is recommended that the submitter first submit any code change directly to ICC and participate in the national model code development process. 2. Please provide a copy of application and documentation. 3. Use a separate form for each code change proposal.

File Attachments for Item:

P-2 Petition #23-03 - OBC Ch 19 & 35 Add ACI 440.11 for structural concrete - Kerry Sutton of American Concrete Institute

S174-22

IBC: 1901.2, 1901.2.1 (New), ACI Chapter 35 (New), ASTM Chapter 35 (New)

Proposed Change as Submitted

Proponents: Stephen Szoke, representing American Concrete Institute (steve.szoke@concrete.org); Jerzy Zemajtis, representing NEx, An ACI Center of Excellence for Nonmetallic Building Materials (jerzy.zemajtis@nonmetallic.org); John Busel, representing American Composites Manufacturers Association (jbusel@acmanet.org); Scott Campbell, representing NRMCA (scampbell@nrmca.org); Doug Gremel, representing Owens Corning Infrastructure Solutions (douglas.gremel@owenscorning.com); Carl Larosche, representing ACI (clarosche@wje.com); William O'Donnell, representing DeSimone Consulting Engineers (william.odonnell@de-simone.com); Matthew D'Ambrosia, representing MJ2 Consulting (matt@mj2consulting.com); Keith Kesner, representing CVM (kkesner3006@gmail.com); antonio de luca, representing Thornton Tomasetti

2021 International Building Code

1901.2 Plain and reinforced concrete. Structural concrete shall be designed and constructed in accordance with the requirements of this chapter and ACI 318 as amended in Section 1905 of this code. Except for the provisions of Sections 1904 and 1907, the design and construction of slabs on grade shall not be governed by this chapter unless they transmit vertical *loads* or lateral forces from other parts of the structure to the soil.

Add new text as follows:

1901.2.1 Structural concrete with GFRP reinforcement. Cast-in-place structural concrete internally reinforced with glass fiber reinforced polymer (GFRP) reinforcement conforming to ASTM D7957 and designed in accordance with ACI CODE 440 shall be permitted only for structures assigned to Seismic Design Category A.

Add new standard(s) as follows:

ACI

American Concrete Institute
38800 Country Club Drive
Farmington Hills, MI 48331-3439

CODE 440-22	Structural Concrete Buildings Reinforced Internally with Fiber Reinforced Polymer (FRP) Bars – Code Requirements

ASTM

ASTM International
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken, PA 19428

D7957/D7957M-17	Standard Specification for Solid Round Glass Fiber Reinforced Polymer Bars for Concrete Reinforcement

Reason: This proposal adds a new referenced standard: ACI CODE 440-22: *Structural Concrete Buildings Reinforced Internally with Fiber Reinforced Polymer (FRP) Bars – Code Requirements*.
The addition of this new standard allows the design and construction of cast-in-place reinforced concrete using non-metallic reinforcement bars. Currently the design and construct requirements contained in the standard are limited to use in Seismic Design Category A. ACI Committee 440 developed this standard to provide for public health and safety by establishing minimum requirements for strength, stability, serviceability, durability, and integrity of GFRP reinforced concrete structures.

The standard not only provides a means of establishing minimum requirements for the design and construction of GFRP reinforced concrete, but for acceptance of design and construction of GFRP reinforced concrete structures by the building officials or their designated representatives.

The standard applies to GFRP reinforced concrete structures designed and constructed under the requirements of the general building code.

GFRP reinforced concrete is especially beneficial for satisfying a demand for improved resistance to corrosion in highly corrosive environments, such as reinforced concrete exposed to salt water, salt air, or de-icing salts.

This standard establishes minimum requirements for GFRP reinforced concrete in a similar fashion as ACI 318 Building Code Requirements for Structural Concrete establishes minimum requirements for structural concrete reinforced with steel reinforcement. A separate standard is needed, as GFRP reinforcement behaves differently than steel reinforcement.

Currently GFRP is accepted for use to reinforce highway bridge decks. Acceptance is primarily in areas where deicing salts are used on the roads and cause severe corrosion to conventional steel reinforcement. This proposed change provides minimum requirements for other applications where GFRP reinforced concrete is being considered, such as marine and coastal structures, parking garages, water tanks, and structures supporting MRI machines. Design reasons to use GFRP bars in structures are: resistance to corrosion in the presence of chloride ions, lack of interference with electromagnetic fields, and low thermal conductivity.

Currently the standard prohibits the use concrete internally reinforced with GFRP for applications where fire resistance ratings are required. Chapter 6 of the International Building code cites applications for floors, roofs, walls, partitions and primary and secondary structural frames where a fire resistance ratings are not required.

The code requirements may be viewed at: https://www.concrete.org/publications/standards/upcomingstandards.aspx

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This proposal adds alternative materials for the design and construction of reinforced structural concrete in Seismic Design Category A and does not preclude the use of conventional reinforced concrete. Thus there is no cost impact.

Staff Analysis: A review of the standard proposed for inclusion in the code, ACI CODE 440-22 Structural Concrete Buildings Reinforced Internally with Fiber Reinforced Polymer (FRP) Bars – Code Requirements, with regard to some of the key ICC criteria for referenced standards (Section 3.6 of CP#28) will be posted on the ICC website on or before March 16, 2022.
A review of the standard proposed for inclusion in the code, ASTM D7957/D7957M-17 Standard Specification for Solid Round Glass Fiber Reinforced Polymer Bars for Concrete Reinforcement, with regard to some of the key ICC criteria for referenced standards (Section 3.6 of CP#28) will be posted on the ICC website on or before March 16, 2022.

S174-22

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Disapproved as the proposed new standard, ACI Code 440-22, is not complete and was submitted in draft format only. The committee commented that testimony indicated the final version of the standard, ACI Code 440-22, may have substantive changes related to fire resistance of FRP. (Vote: 14-0)

S174-22

Individual Consideration Agenda

Public Comment 1:

IBC: 1901.2.1, ACI Chapter 35

Proponents: Stephen Szoke, representing American Concrete Institute (steve.szoke@concrete.org); John Busel, representing American Composites Manufacturers Association (jbusel@acmanet.org); Doug Gremel, representing Owens Corning Infrastructure Solutions (douglas.gremel@owenscorning.com); Keith Kesner, representing CVM (kkesner3006@gmail.com); Antonio Nanni, representing University of Miami (nanni@miami.edu); William O'Donnell, representing DeSimone Consulting Engineers (william.odonnell@de-simone.com) requests As Modified by Public Comment

Modify as follows:

2021 International Building Code

1901.2.1 Structural concrete with GFRP reinforcement. Cast-in-place structural concrete internally reinforced with glass fiber reinforced polymer (GFRP) reinforcement conforming to ASTM D7957 and designed in accordance with ACI CODE 440.11 shall be permitted where fire resistance ratings are not required and only for structures assigned to Seismic Design Category A.

ACI

American Concrete Institute
38800 Country Club Drive
Farmington Hills, MI 48331-3439

CODE 440.11-22	Structural Concrete Buildings Reinforced Internally with Fiber Reinforced Polymer (FRP) Bars – Code Requirements

Commenter's Reason: The committee voted for disapproval for two reasons: 1) the ACI CODE 440.11 Structural Concrete Buildings Reinforced Internally with Fiber Reinforced Polymer (FRP) Bars - Code Requirements was in public review draft and 2) there was concern about application where fire resistance ratings are required. ACI CODE 440.11-22 has been completed and the revised designation is reflected in this pulbic comment. Further, this public comment adds clear language precluding design of structural concrete in accordance with ACI CODE 440.11 where fire resistance ratings are required. This public comment addresses both concerns expressed by the committee. There are many applications where the use of GFRP reinforcement in concrete can enhance durability and long term life safety.

Cost Impact: The net effect of the public comment and code change proposal will not increase or decrease the cost of construction
This proposal as modified with public comment provides an additional option for the design and consturction of reinforced structural concrete.

Staff Analysis: In accordance with Section 3.6.3.1.1 of ICC Council Policy 28, the new referenced standard ACI Code 440-22, must be completed and readily available prior to the Public Comment Hearing in order for this public comment to be considered.

Public Comment# 3212

CRITERIA FOR SUBMITTING RULE CHANGES TO THE BOARD OF BUILDING STANDARDS

The Ohio Board of Building Standards processes all petitions for changes to the rules of the Board of Building Standards (Building, Mechanical, Plumbing, Boiler, Elevator, or Residential Codes) pursuant to ORC Chapter 119.

When anyone desires to petition the Board of Building Standards to adopt, amend, or annul a provision of rules of the Board, they must complete an application and provide supporting information submitted to the Secretary of the Board of Building Standards.

The application must include the following:

(1) The date the application is prepared;
(2) The rule number or section that is proposed for amendment, adoption, or annulment;
(3) The rule numbers of all other rules that will be affected by the matter proposed;
(4) The name, address, contact information, affiliation of the applicant, and of any representative;
(5) The provisions that are proposed for adoption, amendment, or annulment;
(6) The reason and technical justification for the proposed change;
(7) All text to be eliminated shall be shown deleted by means of strikethrough, e.g., ~~matter to be eliminated~~;
(8) All proposed new text to be inserted into a rule shall be shown as underlined, e.g., proposed new matter; and
(9) One copy of the completed application and attachments.
(10) An estimate of the increase or decrease in cost that would occur with the adoption of the proposed code change.

When the Secretary of the Board of Building Standards receives a completed application for an adoption, amendment, or annulment of rules of the Board, the Secretary will promptly deliver or mail a copy of the application to each member of the Board.

After receiving an application for the adoption, amendment, or annulment of rules of the Board, the Board of Building Standards shall proceed under sections 3781.101 and 3781.12 of the Revised Code.

APPLICATION
FOR
RULE CHANGE

Pursuant to section 3781.12 of the Revised Code and rules adopted by the Board of Building Standards, application is herewith submitted to adopt, amend, or annul a rule adopted by the Board pursuant to section 3718.10 of the Revised Code.

BOARD OF BUILDING STANDARDS
6606 Tussing Road, P.O. Box 4009
Reynoldsburg, Ohio 43068-9009
(614) 644-2613
bbs@ohio.gov
www.com.state.oh.us/dico/bbs/default.aspx

For BBS use:

Petition #: **# 23-03**

Date Recv'd: **March 21, 2023**

Submitter: Kerry Sutton, PE (Contact Name) American Concrete Institute (Organization/Company)

Address: 38800 Country Club Drive (Include Room Number, Suite, etc.)

Farmington Hills (City) Michigan (State) 48331 (Zip)

Telephone Number: 734-673-2195 **Fax Number:** 248-848-3161

Date: 03-15-2023 **E-mail Address:** kerry.sutton@concrete.org

Code Section: New Section to amend the 2021 IBC: 1901.2.1 Structural concrete with GFRP reinforcement.

General Explanation of Proposed Change (attach additional sheets if necessary):

See attached Background and rationale.

Explanation of Cost Impact of Proposed Code Change*: The proposal will not increase or decrease the cost of construction.

The proposal will not increase or decrease the cost of construction.

The proposal will not increase or decrease the cost of construction.

***Attach additional cost information as necessary to justify any statement of cost increase or cost decrease.**

Information on Submittal (attach additional sheets if necessary):	
1. Sponsor:	American Concrete Institute Ohio Concrete (Co-Sponsor) ACI Central Ohio Chapter (Co-Sponsor) Organization sponsoring or requesting the rule change (if any)
2. Rule Title:	2021 IBC Option for ACI 440.11 Title of rule change
3. Purpose/ Objective:	The purpose of this code change proposal is to add a New Section to amend the 2021 IBC: 1901.2.1 Structural concrete with GFRP reinforcement. Technical justification for the proposed rule change
4. Formatted Rule Language **(Using Strike-out for Deleted Text and Underline for Added Text)**	1901.2 Plain and reinforced concrete. Structural concrete shall be designed and constructed in accordance with the requirements of this chapter and ACI 318 as amended in Section 1905 of this code. Except for the provisions of Sections 1904 and 1907, the design and construction of slabs on grade shall not be governed by this chapter unless they transmit vertical loads or lateral forces from other parts of the structure to the soil. Add new text as follows: 1901.2.1 Structural concrete with GFRP reinforcement. Cast-in-place structural concrete internally reinforced with glass fiber reinforced polymer (GFRP) reinforcement conforming to ASTM D7957 and designed in accordance with ACI CODE 440.11 shall be permitted where fire resistance ratings are not required and only for structures assigned to Seismic Design Category A. Add new standard(s) as follows: ACI American Concrete Institute 38800 Country Club Drive Farmington Hills, MI 48331 ACI CODE-440.11-22: Structural Concrete Buildings Reinforced Internally with Glass Fiber Reinforced Polymer (GFRP) Bars - Code Requirements ASTM ASTM International 100 Barr Harbor Drive, PO Box C700 West Conshohocken, PA 19428 D7957/D7957M-17 : Standard Specification for Solid Round Glass Fiber Reinforced Polymer Bars for Concrete Use strike-out for deleted text and underline for added text
5. Notes:	1. To encourage uniformity among states using model codes, it is recommended that the submitter first submit any code change directly to ICC and participate in the national model code development process. 2. Please provide a copy of application and documentation. 3. Use a separate form for each code change proposal.

ATTACHMENT

2021 IBC Option for ACI 440.11

Chapter 19 – Concrete

Section – 1901 General

1901.2 Plain and reinforced concrete. Structural concrete shall be designed and constructed in accordance with the requirements of this chapter and ACI 318 as amended in Section 1905 of this code. Except for the provisions of Sections 1904 and 1907, the design and construction of slabs on grade shall not be governed by this chapter unless they transmit vertical *loads* or lateral forces from other parts of the structure to the soil.

Add new text as follows:

1901.2.1 Structural concrete with GFRP reinforcement. *Cast-in-place structural concrete internally reinforced with glass fiber reinforced polymer (GFRP) reinforcement conforming to ASTM D7957 and designed in accordance with ACI CODE 440.11 shall be permitted where fire resistance ratings are not required and only for structures assigned to Seismic Design Category A.*

Add new standard(s) as follows:

ACI		American Concrete Institute 38800 Country Club Drive Farmington Hills, MI 48331
Standard reference number	Title	Referenced in code section number
440.11-22	*ACI CODE-440.11-22: Structural Concrete Buildings Reinforced Internally with Glass Fiber Reinforced Polymer (GFRP) Bars* – *Code Requirements*	1901.2.1

ASTM		ASTM International 100 Barr Harbor Drive, PO Box C700 West Conshohocken, PA 19428
Standard reference number	Title	Referenced in code section number
D7957/D7957M-17 Reinforcement	*Standard Specification for Solid Round Glass Fiber Reinforced Polymer Bars for Concrete*	1901.2.1

Background and rationale - This proposal adds a new referenced standard: ACI CODE 440.11-22: *Structural Concrete Buildings Reinforced Internally with Glass Fiber Reinforced Polymer (GFRP) Bars – Code Requirements.* The addition of this new standard allows the design and construction of cast-in-place reinforced concrete using non-metallic reinforcement bars. While the design and construct requirements contained in the standard are limited to use in structures assigned to Seismic Design Category A and structural elements not part of seismic force-resisting systems in SDC B and C, for simplicity this proposal limits the use to structures assigned to SDC A. ACI Committee 440 developed this standard to provide for public health and safety by establishing minimum requirements for strength, stability, serviceability, durability, and integrity of GFRP reinforced concrete structures.

The standard not only provides a means of establishing minimum requirements for the design and construction of GFRP reinforced concrete, but for acceptance of design and construction of GFRP reinforced concrete structures by the building officials or their designated representatives.

Due to the performance of other types of FRP reinforcement and the lack of research and testing of other types, the standard only applies to reinforced concrete structures designed and constructed with GFRP manufactured in accordance with ASTM D7957 Standard Specification for Solid Round Glass Fiber Reinforced Polymer Bars for Concrete

GFRP reinforced concrete is especially beneficial for satisfying a demand for improved resistance to corrosion in highly corrosive environments, such as reinforced concrete exposed to water and de-icing salts.

This standard establishes minimum requirements for GFRP reinforced concrete in a similar fashion as ACI CODE 318 Building Code Requirements for Structural Concrete establishes minimum requirements for structural concrete reinforced with steel reinforcement. A separate standard is needed, as GFRP reinforcement behaves differently than steel reinforcement. Results of the ICC Online Governmental Consensus Voting show approval of the inclusion of ACI CODE 440.11 in the 2024 International Building Code.

Currently GFRP is accepted for use to reinforce highway bridge decks. Acceptance is primarily in areas where deicing salts are used on the roads and cause severe corrosion to conventional steel reinforcement. This proposed change provides minimum requirements for other applications where GFRP reinforced concrete is being considered, such as parking garages, water tanks, marine structures and structures supporting MRI machines. Design reasons to use GFRP bars in structures are: resistance to corrosion in the presence of chloride ions, lack of interference with electromagnetic fields, and low thermal conductivity. The use of GFRP reinforcement is accepted by the State of Ohio Department of Transportation and its use is specified in the January 1, 2023 online version of the **ODOT Construction and Materials Specification.**

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This proposal adds alternative materials for the design and construction of reinforced structural concrete in Seismic Design Category A and does not preclude the use of conventional reinforced concrete. Thus, there is no cost impact.

File Attachments for Item:

P-3 Petition #23-04 - RCO 311.7.1 Two handrails - Robert Kramer

APPLICATION
FOR
RULE CHANGE

Pursuant to section 3781.12 of the Revised Code and rules adopted by the Board of Building Standards, application is herewith submitted to adopt, amend, or annul a rule adopted by the Board pursuant to section 3718.10 of the Revised Code.

BOARD OF BUILDING STANDARDS
6606 Tussing Road, P.O. Box 4009
Reynoldsburg, Ohio 43068-9009
(614) 644-2613
bbs@ohio.gov
www.com.state.oh.us/dico/bbs/default.aspx

For BBS use:	
Petition #:	23-04
Date Recv'd:	03/27/2023

Submitter: ROBERT KRAMER (Contact Name) CITIZEN (Organization/Company)

Address: 5690 GENEVIEVE PLACE (Include Room Number, Suite, etc.)

FAIRFIELD (City) OHIO (State) 45014 (Zip)

Telephone Number: 513-885-4600 **Fax Number:** ____

Date: MARCH 26, 2023 **E-mail Address:** KEYNOTEMAN@HOTMAIL.COM

Code Section: 101

General Explanation of Proposed Change (attach additional sheets if necessary):

311.7.1 Stairways shall not be less than 36 inches (914 mm) in clear width at all points above the permitted handrail height and below the required headroom height. Handrails must be installed on both sides of all stairways and shall not project more than 4.5 inches (114 mm) on either side of the stairway and the minimum clear width of the stairway at and below the handrail height, including treads and landings, shall not be less than ~~31½ inches (787 mm) where a handrail is installed on one side and~~ 27 inches (698 mm). ~~where handrails are provided on both sides~~

1. Around 24,760,843 patients were admitted to emergency departments due to staircase-related injury during a 23 year-long study by NEISS.
2. In an average year, 1,076,558 people in the US suffer from a staircase-related injury.
3. More than 12,000 people meet death from falling down stairs every year. This itself tells how fatal a fall could be. Simple tripping down stairs or falling off the stairs can rewrite one's destiny. Since the fall will be very fast, the speed of impacting your head or back will occur in a fraction of a second.

The cost should be no more than $200.00 per home.

Explanation of Cost Impact of Proposed Code Change*: ____

*Attach additional cost information as necessary to justify any statement of cost increase or cost decrease.

File Attachments for Item:

P-4 Petition #23-05 - OBC Ch 13 Add ACI/TMS 122.1 to IECC & ASHRAE 90.1 for thermal bridging - Kerry Sutton of American Concrete Institute

CRITERIA FOR SUBMITTING RULE CHANGES TO THE BOARD OF BUILDING STANDARDS

The Ohio Board of Building Standards processes all petitions for changes to the rules of the Board of Building Standards (Building, Mechanical, Plumbing, Boiler, Elevator, or Residential Codes) pursuant to ORC Chapter 119.

When anyone desires to petition the Board of Building Standards to adopt, amend, or annul a provision of rules of the Board, they must complete an application and provide supporting information submitted to the Secretary of the Board of Building Standards.

The application must include the following:

(1) The date the application is prepared;
(2) The rule number or section that is proposed for amendment, adoption, or annulment;
(3) The rule numbers of all other rules that will be affected by the matter proposed;
(4) The name, address, contact information, affiliation of the applicant, and of any representative;
(5) The provisions that are proposed for adoption, amendment, or annulment;
(6) The reason and technical justification for the proposed change;
(7) All text to be eliminated shall be shown deleted by means of strikethrough, e.g., ~~matter to be eliminated~~;
(8) All proposed new text to be inserted into a rule shall be shown as underlined, e.g., <u>proposed new matter</u>; and
(9) One copy of the completed application and attachments.
(10) An estimate of the increase or decrease in cost that would occur with the adoption of the proposed code change.

When the Secretary of the Board of Building Standards receives a completed application for an adoption, amendment, or annulment of rules of the Board, the Secretary will promptly deliver or mail a copy of the application to each member of the Board.

After receiving an application for the adoption, amendment, or annulment of rules of the Board, the Board of Building Standards shall proceed under sections 3781.101 and 3781.12 of the Revised Code.

APPLICATION
FOR
RULE CHANGE

Pursuant to section 3781.12 of the Revised Code and rules adopted by the Board of Building Standards, application is herewith submitted to adopt, amend, or annul a rule adopted by the Board pursuant to section 3718.10 of the Revised Code.

BOARD OF BUILDING STANDARDS
6606 Tussing Road, P.O. Box 4009
Reynoldsburg, Ohio 43068-9009
(614) 644-2613
bbs@ohio.gov
www.com.state.oh.us/dico/bbs/default.aspx

For BBS use:	
Petition #:	23-05
Date Recv'd:	03/28/2023

Submitter: Kerry Sutton, PE (Contact Name) — American Concrete Institute (Organization/Company)

Address: 38800 Country Club Drive (Include Room Number, Suite, etc.)

Farmington Hills (City) — MI (State) — 48331 (Zip)

Telephone Number: 734-673-2195 **Fax Number:** 248-848-3161

Date: 03-28-2023 **E-mail Address:** Kerry.Sutton@concrete.org

Code Section: 2021 IECC Section C402 Building Envelope Requirements (pg. C4-1) and ASHRAE 90.1 -2019

General Explanation of Proposed Change (attach additional sheets if necessary):

Please see attached explanation.

Explanation of Cost Impact of Proposed Code Change*: Use of this code will incur additional expenses in commercial building design and construction but will help mitigate thermal bridges.

Use of this code will incur additional expenses in commercial building design and construction but will help mitigate thermal bridges.

Use of this code will incur additional expenses in commercial building design and construction but will help mitigate thermal bridges.

***Attach additional cost information as necessary to justify any statement of cost increase or cost decrease.**

<table>
<tr><th colspan="2">Information on Submittal (attach additional sheets if necessary):</th></tr>
<tr><td>1. Sponsor:</td><td>American Concrete Institute
Ohio Concrete (Co Sponsor)
ACI Central Ohio Chapter (Co Sponsor)

Organization sponsoring or requesting the rule change (if any)</td></tr>
<tr><td>2. Rule Title:</td><td>2021 IECC Section C402.1. Add Item 5 to Section 402.1
ASHRAE 90.1, Section 5.4, add section 5.4.1.1
Title of rule change</td></tr>
<tr><td>3. Purpose/ Objective:</td><td>Brings ACI-TMS 122.1 code on thermal bridge mitigation requirements into the IECC as an alternate compliance path.

Brings ACI-TMS 122.1 code on thermal bridge mitigation requirements into ASHRAE 90.1 as an alternate compliance path.

Technical justification for the proposed rule change</td></tr>
<tr><td>4. Formatted Rule Language

(Using Strike-out for Deleted Text and Underline for Added Text)</td><td>IECC:
C402.1 General. Building thermal envelope assemblies for buildings that are intended to comply with the code on a prescriptive basis in accordance with the compliance path described in Item 1 of Section C401.2.1 shall comply with the following:
1. The opaque portions of the building thermal envelope shall comply with the specific insulation requirements of Section C402.2 and the thermal requirements of either the R-value-based method of Section C402.1.3; the U-, C- and F-factor-based method of Section C402.1.4; or the component performance alternative of Section C402.1.5.
2. Roof solar reflectance and thermal emittance shall comply with Section C402.3.
3. Fenestration in building envelope assemblies shall comply with Section C402.4.
4. Air leakage of building envelope assemblies shall comply with Section C402.5.
5. Compliance with ACI/TMS 122.1 shall be permitted for mitigating the effects of thermal bridges in concrete or masonry buildings.
Alternatively, where buildings have a vertical fenestration area or skylight area exceeding that allowed in Section C402.4, the building and building thermal envelope shall comply with Item 2 of Section C401.2.1 or Section C401.2.2.

Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.11.

ASHRAE 90.1:
5.4 Mandatory Provisions
5.4.1 Insulation
Where insulation is required in section 5.5 or Section 5.6, it shall comply with the requirements found in section 5.8.1
5.4.1.1
Compliance with ACI/TMS 122.1 shall be permitted for mitigating the effects of thermal bridges in concrete or masonry assemblies.

Use strike-out for deleted text and underline for added text</td></tr>
<tr><td>5. Notes:</td><td>1. To encourage uniformity among states using model codes, it is recommended that the submitter first submit any code change directly to ICC and participate in the national model code development process.
2. Please provide a copy of application and documentation.
3. Use a separate form for each code change proposal.</td></tr>
</table>

ATTACHMENT

2021 IECC Option for ACI-TMS 122.1

CHAPTER 4 [CE]
COMMERCIAL ENERGY EFFICIENCY

SECTION C402

BUILDING ENVELOPE REQUIREMENTS

Section C402.1 Add Item 5 to Section 402.1 as follows:

C402.1 General. *Building thermal envelope* assemblies for buildings that are intended to comply with the code on a prescriptive basis in accordance with the compliance path described in Item 1 of Section C401.2.1 shall comply with the following:

1. The opaque portions of the *building thermal envelope* shall comply with the specific insulation requirements of Section C402.2 and the thermal requirements of either *R*-value-based method of Section C402.1.3; the *U*-, *C*- and *F*- factor-based method of Section C402.1.4; or the component performance alternative of Section C402.1.5.

2. Roof solar reflectance and thermal emittance shall comply with Section C402.3.

3. Fenestration in building envelope assemblies shall comply with Section C402.4.

4. Air leaking of building envelope assemblies shall comply with Section C402.5.

5. Compliance with ACI/TMS 122.1 shall be permitted for mitigating the effects of thermal bridges in concrete or masonry buildings.

Alternatively, where buildings have a vertical fenestration area or skylight area exceeding that allowed in Section C402.4, the building and building thermal envelope shall comply with Item 2 of Section C401.1 or Section C403.11.

Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.11.

Option for ACI-TMS 122.1 Thermal Bridging Amendment

AHSRAE 90.1-2019
Energy Standard for Buildings Except Low-rise Residential Buildings

Section 5.4 Add Section 5.4.1.1 as follows:

5.4 Mandatory Provisions
5.4.1 Insulation
Where insulation is required in section 5.5 or Section 5.6, it shall comply with the requirements found in section 5.8.1
5.4.1.1
Compliance with ACI/TMS 122.1 shall be permitted for mitigating the effects of thermal bridges in concrete or masonry assemblies.

Add new referenced standard to Chapter 6 [CE] of IECC and Section 5 of ASHRAE 90.1 as follows:

ACI/TMS		American Concrete Institute 38800 Country Club Drive Farmington Hills, MI 48331 The Masonry Society 105 South Sunset Street, Suite Q Longmont, CO 80501
Standard reference number	Title	Referenced in code section number
ACI-TMS Code 122.1-21	*Thermal Bridge Mitigation for Buildings having Concrete and Masonry Walls and Masonry Veneer – Code Requirements and Commentary*	C402.1

Reason: **This proposal to the IECC and ASHRAE 90.1 brings the ACI-TMS 122.1 code on thermal bridge mitigation requirements into the IECC and ASHRAE 90.1 as an alternate path.** It includes requirements at slab edges, for parapets, and for shelf angles.

ACI-TMS CODE 122.1-21 is a code written by a joint committee of the American Concrete Institute and The Masonry Society. It is written using ACI's consensus process including a public comment period and numerous committee ballots at each stage of the process. ACI is an American National Standards Institute standards development organization. ACI and TMS are not trade associations, but professional societies. The professionals serving on ACI/TMS committees identified the need to have minimum requirements to mitigate thermal bridges that are unique to thermal mass construction and are easy to understand. The new standard reflects the professional leadership in advancing technology related to the thermal performance of concrete and masonry buildings by mitigating heat transfer through balconies, shelf angles, parapets, and other thermal anomalies penetrating insulation layers in the building envelope.

Benefits – This standard provides constructable options that are easy to understand and implement. The 2021 IECC or ASHRAE 90.1-2019 currently does not specifically address thermal bridge mitigation options for buildings having concrete or masonry walls or masonry veneer. The use of this standard provides the most benefit to those jurisdictions located in climate zones 5 through 7. Since the State of Ohio encompasses climate zone 5, adoption by reference of ACI-TMS CODE 122.1 would be beneficial in saving energy in commercial buildings across the State.

Additional benefits are:

- Assist the State of Ohio and its local jurisdictions in reaching goals for improved commercial building energy efficiency.
- Provide designers with a methodology for addressing thermal bridge mitigation for buildings having concrete and masonry veneer.
- Provides building code officials with a means to evaluate designs.

Financial Impact – Use of the code will incur additional expenses in commercial building design and construction but will help mitigate thermal bridges. More energy efficient commercial buildings will ultimately reduce energy costs, decrease greenhouse gas emission and reliance on fossil fuels, and manage energy demand.

CED1-93-22

Proponents: Martha VanGeem, representing Masonry Alliance for Codes and Standards (martha.vangeem@gmail.com); Cortney Fried, representing Brick Industry Association (cfried@bia.org); Scott Campbell, representing NRMCA (scampbell@nrmca.org); Stephen Szoke, representing American Concrete Institute (steve.szoke@concrete.org); Nicholas Lang, representing Masonry Alliance for Codes & Standards (nlang@ncma.org)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C103.2 Information on construction documents. Construction documents shall be drawn to scale on suitable material. Electronic media documents are permitted to be submitted where *approved* by the *code official.* Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment as herein governed. Details shall include, but are not limited to, the following as applicable:

1. Energy compliance path.
2. Insulation materials and their *R*-values.
3. Fenestration *U*-factors and solar heat gain coefficients (SHGCs).
4. Area-weighted *U*-factor and solar heat gain coefficient (SHGC) calculations.
5. Mechanical system design criteria.
6. Mechanical and service water-heating systems and equipment types, sizes and efficiencies.
7. Economizer description.
8. Equipment and system controls.
9. Fan motor horsepower (hp) and controls.
10. Duct sealing, duct and pipe insulation and location.
11. Lighting fixture schedule with wattage and control narrative.
12. Location of *daylight* zones on floor plans.
13. Air barrier and air sealing details, including the location of the air barrier.
14. Location of pathways for routing of raceways or cable from the on-site renewable energy system to the electrical distribution equipment.

~~15.~~ ~~Thermal bridges as identified in Section C402.6.~~

~~16.~~ 15. Location reserved for inverters, metering equipment, ESS, and a pathway reserved for routing of raceways or conduit from the renewable energy system to the point of interconnection with the electrical service and the ESS.

~~17.~~ 16. Location and layout of a designated area for ESS.

~~18.~~ 17. Rated energy capacity and rated power capacity of the installed or planned ESS.

~~**CHI-FACTOR (χ-FACTOR).** The heat loss factor for a single thermal bridge characterized as a point element of a building thermal envelope (Btu/h × °F)[W/K].~~

~~**PSI-FACTOR (ψ-FACTOR).** The heat loss factor per unit length of a thermal bridge characterized as a linear element of a building thermal envelope (Btu/h × ft × °F)[W/(m × K)].~~

C402.1 General. *Building thermal envelope* assemblies for buildings that are intended to comply with the code on a prescriptive basis in accordance with the compliance path described in Item 1 of Section C401.2.1 shall comply with the following:

1. The opaque portions of the *building thermal envelope* shall comply with the specific insulation requirements of Section C402.2 and the thermal requirements of either the U-, C- and F-factor based method of Section C402.1.2; the R-value based method of C402.1.3; or the component performance alternative of Section C402.1.4. Where the total area of the through-wall penetrations of mechanical equipment is greater than 1 percent of the opaque above-grade wall area, the building thermal envelope shall comply with Section C402.1.2.4.
2. Wall solar reflectance and thermal emittance shall comply with Section C402.3.
3. Roof solar reflectance and thermal emittance shall comply with Section C402.4.
4. Fenestration in building envelope assemblies shall comply with Section C402.5.
5. Air leakage of the building thermal envelope shall comply with C402.6.
6. Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.12.

~~7. *Thermal bridges in above-grade walls* shall comply with Section C402.7.~~

Alternatively, where buildings have a vertical fenestration area or skylight area exceeding that allowed in Section C402.5, the building and *building thermal envelope* shall comply with Item 2 of Section C401.2.1 or Section C401.2.2.

C402.1.4 Component performance alternative. Building envelope values and fenestration areas determined in accordance with Equation 4-1 shall be an alternative to compliance with the *U*-, *F*-, ~~psi-, chi-~~, and *C*-factors in Tables C402.1.2, ~~C402.1.5,~~ and C402.5 and the maximum allowable fenestration areas in Section C402.5.1. *Fenestration* shall meet the applicable SHGC requirements of Section C402.5.3.

$$A_P + B_P + C_P + \cancel{T_P} \leq A_T + B_T + C_T + \cancel{T_T} - V_F - V_S$$

(Equation 4-1)

A_P = Sum of the (area x U-factor) for each proposed building thermal envelope assembly, other than slab-on-grade or below-grade wall assemblies

B_P = Sum of the (length x F-factor) for each proposed slab-on-grade edge condition

C_P = Sum of the (area x C-factor) for each proposed below-grade wall assembly

~~T_P = Sum of the (ψL_P) and (χN_P) values for each type of thermal bridge condition of the building thermal envelope as identified in Section C402.6 in the proposed building. For the purposes of this section, the (ψL_P) and (χN_P) values for thermal bridges caused by materials with a thermal conductivity less than or equal to 3.0 Btu-in/h-ft^2-F shall be assigned as zero. For buildings or structures located in Climate Zones 0 through 3, the value of T_P shall be assigned as zero.~~

~~ψL_P = psi-factor x length of the thermal bridge elements in the proposed building thermal envelope.~~

~~χN_P = chi-factor x number of the thermal bridge point elements other than fasteners, ties, or brackets in the proposed building thermal envelope.~~

A_T = Sum of the (area x U-factor permitted by Tables C402.1.2 and C402.5) for each proposed building thermal envelope assembly, other than slab-on-grade or below-grade wall assemblies

B_T = Sum of the (length x F-factor permitted by Table C402.1.2 for each proposed slab-on-grade edge condition

C_T = Sum of the (area x C-factor permitted by Table C402.1.2) for each proposed below-grade wall assembly

~~T_T = Sum of the (ψL_T) and (χN_T) values for each type of thermal bridge condition in the proposed building thermal envelope as identified in Section C402.6 with values specified as "compliant" in Table C402.1.4. For the purposes of this section, the (ψL_T) and (χNT) values for thermal bridges caused by materials with a thermal conductivity less than or equal to 3.0 Btu-in/h-ft^2-F shall be assigned as zero. For buildings or structures located in Climate Zones 0 through 3, the value of T_T shall be assigned as zero.~~

~~ψL_T = (psi-factor specified as "compliant" in Table C402.1.5) x length of the thermal bridge elements in the proposed building thermal envelope.~~

~~χN_T = (chi-factor specified as "compliant" in Table C402.1.5) x number of the thermal bridge point elements other than fasteners, ties, or brackets in the proposed building thermal envelope.~~

P_F = Maximum vertical fenestration area allowable by Section C402.5.1, C402.5.1.1, or C402.5.1.2

Q_F = Proposed vertical fenestration area

$R_F = Q_F - P_F$, but not less than zero (excess vertical fenestration area)

S_F = Area-weighted average U-factor permitted by Table C402.5 of all vertical fenestration assemblies

T_F = Area-weighted average U-factor permitted by Table C402.1.2 of all exterior opaque wall assemblies

$U_F = S_F - T_F$ (excess U-factor for excess vertical fenestration area)

$V_F = R_F \times U_F$ (excess UxA due to excess vertical fenestration area)

P_S = Maximum skylight area allowable by Section C402.1.2

Q_S = Actual skylight area

$R_S = Q_S - P_S$, but not less than zero (excess skylight area)

S_S = Area-weighted average U-factor permitted by Table C402.5 of all skylights

T_S = Area-weighted average U-factor permitted by Table C402.1.2 of all opaque roof assemblies

$U_S = S_S - T_S$ (excess U-factor for excess skylight area)

$V_S = R_S \times U_S$ (excess UxA due to excess skylight area)

~~A proposed psi- or chi-factor for each thermal bridge shall comply with one of the following as applicable:~~

1. ~~Where the proposed mitigation of a thermal bridge is compliant with the requirements of Section C402.6, the "compliant" values in Table C402.1.4 shall be used for the proposed psi- or chi-factors.~~
2. ~~Where a thermal bridge is not mitigated in a manner at least equivalent to Section C402.6, the "non-compliant" values in Table C402.1.4 shall be used for the proposed psi- or chi-factors.~~
3. ~~Where the proposed mitigation of a thermal bridge provides a psi- or chi-factor less than the "compliant" values in Table C402.1.4, the proposed psi- or chi-factor shall be determined by thermal analysis, testing, or other approved sources.~~

Staff note existing items removed

~~TABLE C402.1.4 PSI- and CHI-FACTORS TO DETERMINE THERMAL BRIDGES FOR THE COMPONENT~~ PERFORMANCE ALTERNATIVE

~~Thermal Bridge per Section C402.6~~	~~Thermal Bridge Compliant with Section C402.6~~		~~Thermal Bridge Non-Compliant with Section C402.6~~	
	~~psi-factor (Btu/h-ft-°F)~~	~~chi-factor (Btu/h-ft-°F)~~	~~psi-factor (Btu/h-ft-°F)~~	~~chi-factor (Btu/h-ft-°F)~~
~~C402.6.1 Balconies, slabs, and decks~~	~~0.2~~	~~n/a~~	~~0.5~~	~~n/a~~
~~C402.6.2 Cladding supports~~	~~0.2~~	~~n/a~~	~~0.3~~	~~n/a~~
~~C402.6.3 Structural beams and columns~~	~~n/a~~	~~1.0 carbon steel 0.3 concrete~~	~~n/a~~	~~2.0 carbon steel 1.0 concrete~~
~~C402.6.4 Vertical fenestration~~	~~0.15~~	~~n/a~~	~~0.3~~	~~n/a~~
~~C402.6.5 Parapets~~	~~0.2~~	~~n/a~~	~~0.4~~	~~n/a~~

~~For SI: W/m-K = 0.578 Btu/h-ft-°F; 1 W/K = 1.90 Btu/h-°F~~
~~n/a = not applicable~~

~~C402.7 Thermal bridges in above-grade walls.~~ ~~Thermal bridges in above grade walls shall comply with the section or an approved design.~~

Exceptions:

1. ~~*Buildings* and structures located in Climate Zones 0 through 3.~~
2. ~~Any *thermal bridge* with a material thermal conductivity not greater than 3.0 Btu/h-ft-°F.~~
3. ~~Blocking, coping, flashing, and other similar materials for attachment of roof coverings.~~
4. ~~*Thermal bridges* accounted for in the *U*-factor or *C*-factor for a *building thermal envelope*.~~

~~C402.7.1 Balconies and floor decks.~~ ~~Balconies and concrete floor decks shall not penetrate the building thermal envelope. Such assemblies shall be separately sup-ported or shall be supported by structural attachments or elements that minimize thermal bridging through the building thermal envelope.~~

~~Exceptions:~~ ~~Balconies and concrete floor decks shall be permitted to penetrate the *building thermal envelope* where:~~

1. ~~an area weighted *U*-factor is used for *above grade wall* compliance which includes a *U*-factor of 0.8 Btu/h-°F-ft² for the area of the *above grade wall* penetrated by the concrete floor deck, or~~
2. ~~an approved thermal break device of not less than R-10 is installed in accordance with the manufacturer's instructions.~~

~~C402.7.2 Cladding supports.~~ ~~Linear elements supporting opaque cladding shall be off-set from the structure with attachments that allow the continuous insulation, where present, to pass behind the cladding support element.~~

~~Exceptions:~~

1. ~~An *approved* design where the above-grade wall *U*-factor used for compliance accounts for the cladding support element *thermal bridge*.~~
2. ~~Anchoring for curtain wall and window wall systems.~~

~~C402.7.3 Structural beams and columns.~~ ~~Structural steel and concrete beams and columns that project through the *building thermal envelope* shall be covered with not less than R-5 insulation for not less than 2 feet (610 mm) beyond the interior or exterior surface of an insulation component within the *building thermal envelope*.~~

Exceptions:

1. ~~Where an approved thermal break device is installed in accordance with the manufacturer's instructions.~~
2. ~~An approved design where the above grade wall U-factor used to demonstrate compliance accounts for the beam or col-umn thermal bridge.~~

~~C402.7.4 Vertical fenestration.~~ ~~Vertical fenestration intersections with above grade walls shall comply with one or more of the following:~~

1. ~~Where above-grade walls include continuous insulation, the plane of the exterior glazing layer or, for metal frame fenestration, a non-metal thermal break in the frame shall be positioned within 2 inches (610 mm) of the interior or exterior surface of the continuous insulation.~~

2. ~~An approved design where the above-grade wall U-factor used to demonstrate compliance accounts for the beam or column thermal bridge.~~
3. ~~The surface of the rough opening, not coved by the fenestration frame, shall be insulated with insulation of not less than R-3 material or covered with a wood buck that is not less than 1.5 inches (457 mm) thick.~~
4. ~~For the intersection between vertical fenestration and opaque spandrel in a shared framing system, manufacturer's data for the spandrel U-factor shall account for *thermal bridges*.~~

Exceptions:

1. ~~Where an approved design for the above-grade wall *U*-factor used for compliance accounts for *thermal bridges* at the intersection with the vertical fenestration.~~
2. ~~Doors~~

~~**C402.7.5 Parapets.** Parapets shall comply with one or more of the following as applicable:~~

1. ~~Where continuous insulation is installed on the exterior side of the *above-grade wall* and the roof is insulated with insulation entirely above deck, the continuous insulation shall extend up both sides of the parapet not less than 2 feet (610 mm) above the roof covering or to the top of the parapet, whichever is less. Parapets that are an integral part of a fire-resistance rated wall, and the exterior continuous insulation applied to the parapet, shall comply with the fire resistance ratings of the building code.~~
2. ~~Where continuous insulation is installed on the exterior side of the above-grade wall and the roof insulation is below the roof deck, the continuous insulation shall extend up the exterior side of the parapet to not less than the height of the top surface of the roof assembly.~~
3. ~~Where continuous insulation is not installed on the exterior side of the *above-grade wall* and the roof is insulated with insulation entirely above deck, the wall cavity or integral insulation shall extend into the parapet up to the exterior face of the roof insulation or equivalent R-value insulation shall be installed not less than 2 feet (610 mm) horizontally inward on the underside of the roof deck.~~
4. ~~Where continuous insulation is not installed on the exterior side of the *above-grade wall* and the roof insulation is below the roof deck, the wall and roof insulation components shall be adjacent to each other at the roof-ceiling-wall intersection.~~

~~**Exception:** An *approved* design where the *above-grade wall U*-factor used for compliance accounts for the parapet *thermal bridge*.~~

TABLE C407.4.1(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of table not shown remain unchanged.

BUILDING COMPONENT CHARACTERISTICS	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Space use classification	Same as proposed	The space use classification shall be chosen in accordance with Table C405.3.2(1) or C405.3.2(2) for all areas of the building covered by this permit. Where the space use classification for a building is not known, the building shall be categorized as an office building.
Roofs	Type: insulation entirely above deck	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table C402.1.2	As proposed
	Solar absorptance: 0.75, except as specified in Section C402.4 and Table C402.4 for Climate Zones 0, 1, 2, and 3	As proposed
	Emittance: 0.90, except as specified in Section C402.4 and Table C402.4 for Climate Zones 0, 1, 2, and 3	As proposed
Walls, above-grade	Type: same as proposed	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table C402.1.2	As proposed
	~~*Thermal bridges:* Account for heat transfer consistent with compliant *psi* and *chi* factors from Table C402.1.4 for *thermal bridges* as identifiedin Section C402.7 that are present in the proposed design.~~	~~As proposed; *psi* and *chi* f actors for proposed *thermal bridges* shall be determined in accordance with requirements in Section C402.1.4.~~
	Solar absorptance: 0.75	As proposed
	Emittance: 0.90	As proposed
Walls, below-grade	Type: mass wall	As proposed
	Gross area: same as proposed	As proposed
	U-Factor: as specified in Table C402.1.2 with insulation layer on interior side of walls	As proposed
Floors, above-grade	Type: joist/framed floor	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table C402.1.2	As proposed
Floors, slab-on-grade	Type: unheated	As proposed
	F-factor: as specified in Table C402.1.2	As proposed
Opaque doors	Type: swinging	As proposed
	Area: Same as proposed	As proposed
	U-factor: as specified in Table C402.1.2	As proposed
Vertical fenestration other than opaque doors	Area 1. The proposed vertical fenestration area; where the proposed vertical fenestration area is less than 40 percent of above-grade wall area. 2. 40 percent of above-grade wall area; where the proposed vertical fenestration area is 40 percent or more of the above-grade wall area.	As proposed
	U-factor: as specified in Table C402.5	As proposed
	SHGC: as specified in Table C402.5 except	

	that for climates with no requirement (NR) SHGC = 0.40 shall be used	As proposed
	External shading and PF: none	As proposed
Skylights	Area 1. The proposed skylight area; where the proposed skylight area is less than that permitted by Section C402.1. 2. The area permitted by Section C402.1; where the proposed skylight area exceeds that permitted by Section C402.1.	As proposed
	U-factor: as specified in Table C402.5	As proposed
	SHGC: as specified in Table C402.5 except that for climates with no requirement (NR) SHGC = 0.40 shall be used.	As proposed
Lighting, interior	The interior lighting power shall be determined in accordance with Section C405.3.2. Where the occupancy of the building is not known, the lighting power density shall be 1.0 watt per square foot based on the categorization of buildings with unknown space classification as offices.	As proposed
Lighting, exterior	The lighting power shall be determined in accordance with Tables C405.5.2(1), C405.5.2(2) and C405.5.2(3). Areas and dimensions of surfaces shall be the same as proposed.	As proposed
Internal gains	Same as proposed	Receptacle, motor and process loads shall be modeled and estimated based on the space use classification. End-use load components within and associated with the building shall be modeled to include, but not be limited to, the following: exhaust fans, parking garage ventilation fans, exterior building lighting, swimming pool heaters and pumps, elevators, escalators, refrigeration equipment and cooking equipment.
Schedules	Same as proposed **Exception:** Thermostat settings and schedules for HVAC systems that utilize radiant heating, radiant cooling and elevated air speed, provided that equivalent levels of occupant thermal comfort are demonstrated by means of equal Standard Effective Temperature as calculated in Normative Appendix B of ASHRAE Standard 55.	Operating schedules shall include hourly profiles for daily operation and shall account for variations between weekdays, weekends, holidays and any seasonal operation. Schedules shall model the time-dependent variations in occupancy, illumination, receptacle loads, thermostat settings, mechanical ventilation, HVAC equipment availability, service hot water usage and any process loads. The schedules shall be typical of the proposed building type as determined by the designer and approved by the jurisdiction.

For SI: 1 watt per square foot = 10.7 w/m^2.

SWHF = Service Water Heat Recovery factor, DWHR = Drain Water Heat Recovery.

a. Where no heating system exists or has been specified, the heating system shall be modeled as fossil fuel. The system characteristics shall be identical in both the standard reference design and proposed design.

b. The ratio between the capacities used in the annual simulations and the capacities determined by sizing runs shall be the same for both the standard reference design and proposed design.

c. Where no cooling system exists or no cooling system has been specified, the cooling system shall be modeled as an air-cooled single-zone system, one unit per thermal zone. The system characteristics shall be identical in both the standard reference design and proposed design.

d. If an economizer is required in accordance with Table C403.5(1) and where no economizer exists or is specified in the proposed design, then a supply-air economizer shall be provided in the standard reference design in accordance with Section C403.5.

e. The SWHF shall be applied as follows:

1. Where potable water from the DWHR unit supplies not less than one shower and not greater than two showers, of which the drain water from the same showers flows through the DWHR unit then SWHF = [1 – (DWHR unit efficiency × 0.36)].
2. Where potable water from the DWHR unit supplies not less than three showers and not greater than four showers, of which the drain water from the same showers flows through the DWHR unit then SWHF = [1 – (DWHR unit efficiency × 0.33)].
3. Where potable water from the DWHR unit supplies not less than five showers and not greater than six showers, of which the drain water from the same showers flows through the DWHR unit, then SWHF = [1 – (DWHR unit efficiency × 0.26)].
4. Where Items 1 through 3 are not met, SWHF = 1.0.

Reason: We are asking that the thermal bridge mitigation portion of the draft that was added by the committee be deleted throughout the draft.
The thermal bridge mitigation proposal in the draft was a committee-developed document, CECPI-4-21, and was developed in the last month or so before the committee action. It was developed primarily by the proponents of conflicting proposals CEPI 33-21, CEPI 40-21, and CEPI 45-21. It was not developed with input from other important stakeholders such as structural engineers who would need to comply with this or the industries who assist designers with design.

We are asking that it be **deleted** or made a non mandatory appendix for the following reasons:

- **This hasn't been tried anywhere for any building.**

- **It hasn't been modeled as a whole building to see if it actually saves energy** under actual weather conditions. Cooling energy costs are now on par with heating energy costs in mild to cold climates through Climate Zone 5. This means that the thermal mass effects of thermal bridges have the potential to reduce peak loads and reduce cooling costs. This proposal focuses on steady-state effects. There is no indication that all these years of modeling buildings without thermal bridges has any impact on predicted loads or sizing calculations.

- **ASHRAE has developed addendum av**, likely to soon be published as part of 90.1-2022. This IECC draft is a severely truncated version of 90.1 addendum av. While this draft content is shorter than addendum av, many assume it is simpler, but it is challenging for compliance for many types of typical construction.

- **ASHRAE addendum av was developed over 8 years**, with significant input from many professionals. This draft in the IECC is oversimplified to the point of not allowing common construction methods.

- **Constructability was not considered and costs were not provided.** Cost effectiveness was not provided as required by ICC in the original proposal. The cost statement indicated it provides "*practical mitigation which does not require significant changes to current practices, setting a relatively low performance bar.*" While certain types of construction can easily comply, **typical construction cannot easily comply, which means the draft is not practical**.

- **The 20 to 70% savings in the reason statement of the original proposal for the current draft is not related to this proposal (it is an often repeated myth)**. Just because thermal bridges in some buildings in some climates can result in significant energy loss doesn't mean that this proposal saves that amount of energy. California wanted to verify this and did a detailed analysis available online and showed 1% savings; they decided it was not worth the effort in training and compliance because it was so complex. Granted, California is generally warmer and uses different criteria but at least they did an analysis and considered compliance and enforcement. **This proposal will cost the commercial building industry huge design and construction costs with little or no energy saving value.** Just because a concept sounds good doesn't mean a proposal on the topic saves energy.

- **This IECC draft will result in some very forward-thinking jurisdictions attempting to require it** and the rest of the jurisdictions not knowing how to construct buildings or enforce it. It will require education on the new requirements for the design and regulatory communities. Every structural and envelope designer and every plan reviewer and building inspector will need education on these provisions and it takes a long time for the various professional associations to develop and deliver that new content. Big new concepts in a code trigger big new needs for education development and administration.

- **There is no analysis by climate zone.** As we tighten the envelope, more air conditioning and less heating is needed. This changes what saves energy in mixed climate zones.

- As an example of the simple flaws in the document, compliance is required for all fasteners, no matter how small, unless the performance alternative is used.

- Designers are not familiar with **psi and chi factors**. They cannot be calculated except as part of an expensive research project and they are variable depending on the type of thermal bridge and amount of insulation in the adjacent assembly. Values are not available for most assemblies. We do not support the default psi and chi factors in the table because they do not take into account these complexities. The performance alternative of this draft truncates the number of psi and chi factors resulting in significant inaccuracies. **Since users will not be familiar with these, they will think they are accurate when they are not.** They can be off by many multiples.

- **The performance alternative C402.1.4 does not allow the use of actual psi and chi factors for actual thermal bridges.**

- **In Section C402.7.1, Balconies and floor decks, exception 2, an approved thermal break of R-10 is allowed but is much more than what is necessary for a thermal break.** Consider that wood blocking, which is allowed as an exception, has an R-value of about R-1 or less. Even smaller thermal breaks in windows are effective.

- **In Section C402.7.2, Cladding supports, the language is flawed** as it does not allow for structural attachments for cladding systems, as allowed for anchoring in exception 2 for curtain walls. It is not clear how brick cladding on off-set shelf angles can be supported.

- **C402.7 allows exceptions for flashing on the roof but not around windows or dissimilar wall materials.** This proposal does not have input from the construction industry.

- **ACI/TMS 122.1,** "Thermal Bridge Mitigation for Buildings Having Concrete and Masonry Walls and Masonry Veneer— Code Requirements," is the code for mitigating thermal bridges developed by concrete and masonry professionals. This should be considered an alternate path. ASHRAE 90.1-2022 or ASHRAE 90.1-2019, addendum av (both have the same criteria), are also an acceptable, stakeholder developed method.

- **The biggest thermal bridge in a building is the fenestration.** To put this in perspective, a slab edge has the same steady state heat transfer as a strip of fenestration one foot high. Granted a slab edge has thermal mass and glass has other benefits, but this is an example of the oversimplification of this proposal.

- The thermal bridge mitigation requirements in the current draft is applicable for walls with board insulation on the outside of the building, but this is not the way many buildings are constructed. Many buildings have a hard exterior surface for security, durability, resilience, or local reasons. ACI/TMS 122.1 provides an alternative for these types of construction and cladding attachments.

- The proposal does not provide industry time to adapt to radical changes in the way buildings are constructed.

Cost Impact: The code change proposal will decrease the cost of construction.
This removes the thermal bridge mitigation requirements that were added with no cost and energy savings justification. It will reduce the cost of construction.

Workgroup Recommendation

Proposal # 691

CED1-94-22

Proponents: Jay Crandell, representing Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C402.1 General. *Building thermal envelope* assemblies for buildings that are intended to comply with the code on a prescriptive basis in accordance with the compliance path described in Item 1 of Section C401.2.1 shall comply with the following:

1. The opaque portions of the *building thermal envelope* shall comply with the specific insulation requirements of Section C402.2 and the thermal requirements of either the U-, C- and F-factor ~~based~~ method of Section C402.1.2; the R-value ~~based~~ method of C402.1.3; or the component performance method ~~alternative~~ of Section C402.1.4. Where the total area of the through-wall penetrations of mechanical equipment is greater than 1 percent of the opaque above-grade wall area, the building thermal envelope shall comply with Section C402.1.2.4.
2. Wall solar reflectance and thermal emittance shall comply with Section C402.3.
3. Roof solar reflectance and thermal emittance shall comply with Section C402.4.
4. Fenestration in building envelope assemblies shall comply with Section C402.5.
5. Air leakage of the building thermal envelope shall comply with C402.6.

~~6.~~ 7. Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.12.

~~7.~~ 6. *Thermal bridges* in *above-grade walls* shall comply with Section C402.7.

Alternatively, where buildings have a vertical fenestration area or skylight area exceeding that allowed in Section C402.5, the building and *building thermal envelope* shall comply with Item 2 of Section C401.2.1 or Section C401.2.2.

C402.1.2 Assembly U-factor, C-factor or F-factor~~-based~~ method. *Building thermal envelope* opaque assemblies shall have a *U*-, *C*- or *F*-factor not greater than that specified in Table C402.1.2. Commercial buildings or portions of commercial buildings enclosing *Group R* occupancies shall use the *U*-, *C*- or *F*-factor from the "*Group R*" column of Table C402.1.2. Commercial buildings or portions of commercial buildings enclosing occupancies other than *Group R* shall use the *U*-, *C*- or *F*-factor from the "All other" column of Table C402.1.2

C402.1.3 Insulation component R-value method ~~alternatives~~. For opaque portions of the *building thermal envelope* using this section as an alternative to Section C402.1.2, the *R*-values for cavity insulation and continuous insulation shall be not less than that specified in Table C402.1.3. Commercial buildings or portions of commercial buildings enclosing *Group R* occupancies shall use the *R*-values from the "*Group R*" column of Table C402.1.3. Commercial buildings or portions of commercial buildings enclosing occupancies other than *Group R* shall use the *R*-values from the "All other" column of Table C402.1.3.

TABLE C402.1.3 OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD ~~ALTERNATIVES~~ [a]

Portions of table not shown remain unchanged.

C402.1.4 Component performance method ~~alternative~~. Building envelope values and fenestration areas determined in accordance with Equation 4-1 shall be an alternative to compliance with the *U*-, *F*-, psi-, chi-, and *C*-factors in Tables C402.1.2, C402.1.5, and C402.5 and the maximum allowable fenestration areas in Section C402.5.1. *Fenestration* shall meet the applicable SHGC requirements of Section C402.5.3.
(remainder of section unchanged)

Reason: This proposal is a clean-up so that the U-factor, R-value, and component performance methods are all titled the same and referenced the same in Section C402.1. These editorial changes also make the section titles consistent with the titles of Tables C402.1.2 and C402.1.3. Also, two items listed in Section C402.1 are re-ordered to align with the sequence of requirements and sections in C402.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal is editorial in making section and table titles consistent. There are no changes in requirements.

Workgroup Recommendation

Proposal # 720

CED1-96-22

Proponents: Martha VanGeem, representing Masonry Alliance for Codes and Standards; Cortney Fried, representing Brick Industry Association (cfried@bia.org); Scott Campbell, representing NRMCA (scampbell@nrmca.org); Stephen Szoke, representing American Concrete Institute (steve.szoke@concrete.org); Nicholas Lang, representing Masonry Alliance for Codes & Standards (nlang@ncma.org)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C402.1 General. *Building thermal envelope* assemblies for buildings that are intended to comply with the code on a prescriptive basis in accordance with the compliance path described in Item 1 of Section C401.2.1 shall comply with the following:

1. The opaque portions of the *building thermal envelope* shall comply with the specific insulation requirements of Section C402.2 and the thermal requirements of either the U-, C- and F-factor based method of Section C402.1.2; the R-value based method of C402.1.3; or the component performance alternative of Section C402.1.4. Where the total area of the through-wall penetrations of mechanical equipment is greater than 1 percent of the opaque above-grade wall area, the building thermal envelope shall comply with Section C402.1.2.4.
2. Wall solar reflectance and thermal emittance shall comply with Section C402.3.
3. Roof solar reflectance and thermal emittance shall comply with Section C402.4.
4. Fenestration in building envelope assemblies shall comply with Section C402.5.
5. Air leakage of the building thermal envelope shall comply with C402.6.
6. Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.12.
7. *Thermal bridges* ~~in above-grade walls~~shall comply with <u>one of the following</u>:

   <u>7.1</u> Section C402.7

   <u>7.2</u> <u>ASHRAE/IES Standard 90.1, Section 5.5.5 Linear Thermal Bridges and Point Thermal Bridges.</u>

Alternatively, where buildings have a vertical fenestration area or skylight area exceeding that allowed in Section C402.5, the building and *building thermal envelope* shall comply with Item 2 of Section C401.2.1 or Section C401.2.2.

Reason: This proposal to the IECC brings the prescriptive portion of the ASHRAE 90.1 thermal bridge mitigation requirements into the IECC as an alternative path. During the last eight years, the ASHRAE 90.1 committee has developed a comprehensive proposal to reduce heat losses through thermal bridges in buildings (addendum av to ASHRAE 90.1-2019 which will be included in 90.1-2022 to be published soon). It is being added as a reference to a section because the requirements are comprehensive and extensive. It is more comprehensive and accurate than the requirements in the current IECC draft. This section number with the requirements is in ASHRAE/IES 90.1-2022, to be published soon. It is also available on the ASHRAE website as addendum av at this link. (or go to ASHRAE.org for technical resources/standards & guidelines/standards addenda/90.1-2019/addendum av)
<u>https://www.ashrae.org/file%20library/technical%20resources/standards%20and%20guidelines/standards%20addenda/90_1_2019_av_20220729.pdf</u>
The ASHRAE standing standards project committee SSPC 90.1 received public review from stakeholders and resolved many of their comments through an ANSI public review process over many years. The individual criteria measures that were analyzed were found to be **cost effective** on their own using the ASHRAE method for cost effectiveness. The proposal covers reduction of heat losses through roof edges, parapets, floor edges, projections including balconies, exterior cladding supports including shelf angles, wall/window interfaces, and other large penetrations through the building envelope. It is more detailed than the current draft but is more applicable to actual construction.

The thermal bridge mitigation criteria in the current draft was developed quickly and has some flaws, which is why this proposal should be considered as an alternative. The thermal bridge mitigation proposal in the draft was a committee-developed document, CECPI-4-21, and was developed in the last month or so before the committee action. It was developed primarily by the proponents of conflicting proposals CEPI 33-21, CEPI 40-21, and CEPI 45-21. It was not developed with input from other important stakeholders such as structural engineers who would need to comply with this or the industries that guide the design.

- The current IECC draft is a severely truncated version of 90.1 addendum av. While it is shorter, many assume that it is simpler, but it is challenging for compliance for many types of typical construction.

- The current draft **hasn't been tried anywhere for any building.**

- The current draft **hasn't been modeled as a whole building to see if it <u>actually saves</u> energy** under actual weather conditions. Cooling energy costs are now on par with heating energy cost in mild to cold climates through Climate zone 5. This means that the thermal mass effects of thermal bridges have to potential to reduce peak loads and reduce cooling costs. There is no indication that all these years of modeling buildings without thermal bridges has any impact on predicted loads or sizing calculations.

- **Constructability was not considered and costs were not provided for the requirements in the current draft.** Cost effectiveness was not provided as required by ICC. The cost statement indicates it provides "*practical mitigation which does not require significant changes to current practices, setting a relatively low performance bar.*" While certain types of construction can easily comply, **typical construction cannot easily comply, which means the IECC draft is not practical.**

- **The 20 to 70% savings in the reason statement provided with the requirements in the current draft is an often-repeated myth**. Just because thermal bridges in some buildings in some climates can result in significant energy loss doesn't mean that this proposal saves that amount of energy. California wanted to verify this and did a detailed analysis available online and showed 1% savings; they decided it was not worth the effort in training and compliance because it was so complex. Granted, California is generally warmer and uses different criteria but at least they did an analysis and considered compliance and enforcement.

- **This current requirements in the draft will cost the commercial building industry huge design and construction costs with little or no energy saving value.** Just because a concept sounds good doesn't mean a proposal on the topic saves energy.

- **There is no analysis by climate zone** for the current requirements in the draft – as we tighten the envelope, more air conditioning and less heating is needed. This changes what saves energy for mixed climate zones.

- As an example of the simple flaws in the current requirements, compliance is required for all fasteners, no matter how small, unless the performance alternative is used.

- **The performance alternative C402.1.4 does not allow the use of actual psi and chi factors for actual thermal bridges.**

- In Section C402.7.1, **Balconies and floor decks, exception 2, an approved thermal break of R-10 is allowed but is much more than what is necessary for a thermal break.** Consider that wood blocking, which is allowed as an exception, has an R-value of about R-1 or less. Even smaller thermal breaks in windows are effective.

- **In Section C402.7.2, Cladding supports, the language is flawed** as it does not allow for structural attachments for cladding systems, as allowed for anchoring in exception 2 for curtain walls. It is not clear how brick cladding on offset shelf angles can be supported.

- **C402.7 allows exceptions for flashing on the roof but not around windows or dissimilar wall materials.**

- The thermal bridge mitigation requirements in the current draft work for walls with board insulation on the outside of the building, but this is not the way many buildings are constructed. Many buildings have a hard exterior surface for security, durability, resilience, or local reasons. ASHRAE 90.1 provides an alternative for these types of construction and cladding attachments.

- The current draft does not provide industry time to adapt to radical changes in the way buildings are constructed.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal contains an alternative that will not increase the cost of construction compared to what is in the current draft.

Workgroup Recommendation

Proposal # 730

CED1-97-22

Proponents: Martha VanGeem, representing Masonry Alliance for Codes and Standards; Scott Campbell, representing NRMCA (scampbell@nrmca.org); Stephen Szoke, representing American Concrete Institute (steve.szoke@concrete.org); Nicholas Lang, representing Masonry Alliance for Codes & Standards (nlang@ncma.org); Cortney Fried, representing Brick Industry Association (cfried@bia.org); Brian Trimble, representing International Masonry Institute (btrimble@imiweb.org)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C402.1 General. *Building thermal envelope* assemblies for buildings that are intended to comply with the code on a prescriptive basis in accordance with the compliance path described in Item 1 of Section C401.2.1 shall comply with the following:

1. The opaque portions of the *building thermal envelope* shall comply with the specific insulation requirements of Section C402.2 and the thermal requirements of either the U-, C- and F-factor based method of Section C402.1.2 ; the R-value based method of C402.1.3; or the component performance alternative of Section C402.1.4. Where the total area of the through-wall penetrations of mechanical equipment is greater than 1 percent of the opaque above-grade wall area, the building thermal envelope shall comply with Section C402.1.2.4.
2. Wall solar reflectance and thermal emittance shall comply with Section C402.3.
3. Roof solar reflectance and thermal emittance shall comply with Section C402.4.
4. Fenestration in building envelope assemblies shall comply with Section C402.5.
5. Air leakage of the building thermal envelope shall comply with C402.6.
6. Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.12.
7. *Thermal bridges* ~~in above-grade walls~~ shall comply with one of the following:

    7.1. Section C402.7.

    7.2. ACI/TMS 122.1

Alternatively, where buildings have a vertical fenestration area or skylight area exceeding that allowed in Section C402.5, the building and *building thermal envelope* shall comply with Item 2 of Section C401.2.1 or Section C401.2.2.

CHAPTER 6 [CE]
REFERENCED STANDARDS

Add new text as follows:

ACI American Concrete Institute, 38800 Country Club Dr., Farmington Hills, MI 48331. ACI Code 122.1-2021 Thermal Bridge Mitigation for Buildings Having Concrete and Masonry Walls and Masonry Veneer—Code Requirements
C402.1

Reason: This proposal to the IECC brings the ACI/TMS 122.1 code on thermal bridge mitigation requirements into the IECC as an alternative path. It includes requirements at slab edges, for parapets, and for shelf angles.
ACI-TMS 122.1-21 is a joint code written using ACI's consensus process including a public comment period and numerous committee ballots at each stage of the process. ACI is an ANSI standards developer and also uses this process for ACI 318 which is the concrete building code. Work began in 2018 to develop a consensus standard by the industry that pushed the concrete and masonry industry further to mitigate thermal bridges but was easier to understand, and therefore would find adoption. The concrete and masonry industry considers themselves leaders in developing this. Use of this code will incur additional expenses in building design and construction but will help mitigate thermal bridges.

ACI-TMS 122.1-21 is free to all code officials as are all ACI codes and standards referenced in codes. Code officials can send an email to codes @concrete.org to obtain a complimentary copy. ACI-TMS 122.1-21 is also added to the reference section.

Alternatives. It is not unusual for the IECC to have separate criteria for separate kinds of walls systems developed by an industry following ANSI procedures. Section R402.1 has an exception for log homes designed according to ICC 400, Standard on the Design and Construction of Log Structures. Using this exception, log homes do not have to follow the IECC residential insulation requirements for walls.

It is common for alternatives and exceptions in the IECC to have different energy savings. For instance, in the IECC 2021, Section C402.4.1 on maximum vertical fenestration area provides alternatives with different energy savings as does section C402.4.2 on minimum skylight fenestration area. Complying with the U factor table (Table C402.1.4) or the R-value table (Table C402.1.3) will provide different energy savings. Exception 2 in section C402.7 of the current draft (for low thermal conductivity materials such as wood) to the thermal bridging requirements provides different energy savings because it allows extensive wood thermal bridges. Compliance with ICC 400 provides different energy savings than the IECC.

Different methods, alternatives, and exceptions consider various costs of construction and are also provided for easy of compliance.

Benefits. The benefit of this standard is that it provides constructible options, and it is easy to understand and implement. This will lead to better adoption, compliance by industry, and enforcement by code officials. The thermal bridge mitigation requirements in the current draft work for walls with board insulation on the outside of the building, but this is not the way many buildings are constructed. Many buildings have a hard exterior surface for **security, durability, resilience**, or local reasons. ACI 122.1 provides an alternative for these types of construction and cladding attachments.

The thermal bridge mitigation criteria in the current draft were developed quickly and have some flaws, which is why this proposal should be considered as an alternative. The thermal bridge mitigation proposal in the draft was a committee-developed document, CECPI-4-21, and was developed in the last month or so before the committee action. It was developed primarily by the proponents of conflicting proposals CEPI 33-21, CEPI 40-21, and CEPI 45-21. It was not developed with input from other important stakeholders, such as structural engineers who would need to comply with this or the industries that guide the design.

- The current draft hasn't been tried anywhere for any building.

- **The current draft hasn't been modeled as a whole building to see if it actually saves energy** under actual weather conditions. Cooling energy costs are now on par with heating energy costs in mild to cold climates through Climate Zone 5. This means that the thermal mass effects of thermal bridges have the potential to reduce peak loads and reduce cooling costs. There is no indication that all these years of modeling buildings without thermal bridges has any impact on predicted loads or sizing calculations.

- **Constructability was not considered and costs were not provided for the requirements in the current draft.** Cost effectiveness was not provided as required by ICC. The cost statement for the current draft indicates it provides "practical mitigation which does not require significant changes to current practices, setting a relatively low performance bar." While certain types of construction can easily comply, typical construction cannot easily comply, which means the current draft is not practical.

- The 20 to 70% savings in the reason statement provided with the requirements in the current draft is an often-repeated myth. Just because thermal bridges in some buildings in some climates can result in significant energy loss doesn't mean that this proposal saves that amount of energy. California wanted to verify this and did a detailed analysis available online and showed 1% savings; they decided it was not worth the effort in training and compliance because it was so complex. Granted, California is generally warmer and uses different criteria but at least they did an analysis and considered compliance and enforcement. This current requirements in the draft will cost the commercial building industry huge design and construction costs with little or no energy saving value. Just because a concept sounds good doesn't mean a proposal on the topic saves energy.

- There is no analysis by climate zone for the current requirements in the draft – as we tighten the envelope, more air conditioning and less heating is needed. This changes what measures save energy for mixed climate zones.

- As an example of the simple flaws in the current draft requirements, compliance is required for all fasteners, no matter how small, unless the performance alternative is used.

- The performance alternative C402.1.4 **does not allow the use of actual psi and chi factors** for actual thermal bridges.

- In Section C402.7.1, Balconies and floor decks, exception 2, an approved thermal break of R-10 is allowed but is much more than what is necessary for a thermal break. Consider that wood blocking, which is allowed as an exception, has an R-value of about R-1 or less. Even smaller thermal breaks in windows are effective.

- In Section C402.7.2, Cladding supports, the language is flawed as **it does not allow for structural attachments** for cladding systems, as allowed for anchoring in exception 2 for curtain walls. It is not clear how brick cladding on offset shelf angles can be supported.

- C402.7 allows exceptions for flashing on the roof but not around windows or dissimilar wall materials.

- The thermal bridge mitigation requirements in the current draft work for walls with board insulation on the outside of the building, but this is not the way many buildings are constructed. Many buildings have a hard exterior surface for security, durability, resilience, or local reasons. ACI/TMS 122.1 provides an alternative for these types of construction and cladding attachments.

- The current draft does not provide industry time to adapt to radical changes in the way buildings are constructed.

In addition, this needs to be added to Chapter 6:

ACI.

American Concrete Institute, 38800 Country Club Dr., Farmington Hills, MI 48331

ACI Code 122.1-2021 Thermal Bridge Mitigation for Buildings Having Concrete and Masonry Walls and Masonry Veneer—Code Requirements

Section C402.1.6

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal contains an alternative that will not increase the cost of construction compared to what is in the current draft.

Workgroup Recommendation

Proposal # 732

CED1-135-22

Proponents: Greg Johnson, representing National Multifamily Housing Council (gjohnsonconsulting@gmail.com)

2024 International Energy Conservation Code [CE Project]

Add new text as follows:

APPENDIX DD
THERMAL BRIDGES IN ABOVE-GRADE WALLS

Delete and substitute as follows:

~~**C402.7 Thermal bridges in above-grade walls.** Thermal bridges in above-grade walls shall comply with the section or an approved design.~~

~~**Exceptions:**~~

1. ~~*Buildings* and structures located in Climate Zones 0 through 3.~~
2. ~~Any *thermal bridge* with a material thermal conductivity not greater than 3.0 Btu/h-ft-°F.~~
3. ~~Blocking, coping, flashing, and other similar materials for attachment of roof coverings.~~
4. ~~*Thermal bridges* accounted for in the *U*-factor or *C*-factor for a *building thermal envelope*.~~

DD101.1 Thermal bridges in above-grade walls. Thermal bridges in above-grade walls shall comply with the section this appendix or an approved design.

Exceptions:

1. *Buildings* and structures located in Climate Zones 0 through 3.
2. Any *thermal bridge* with a material thermal conductivity not greater than 3.0 Btu/h-ft-°F.
3. Blocking, coping, flashing, and other similar materials for attachment of roof coverings.
4. *Thermal bridges* accounted for in the *U*-factor or *C*-factor for a *building thermal envelope*.

Revise as follows:

~~**C402.7.1**~~ **DD101.1.1 Balconies and floor decks.** Balconies and concrete floor decks shall not penetrate the building thermal envelope. Such assemblies shall be separately sup-ported or shall be supported by structural attachments or elements that minimize thermal bridging through the building thermal envelope.
Exceptions: Balconies and concrete floor decks shall be permitted to penetrate the *building thermal envelope* where:

1. an area-weighted *U*-factor is used for *above-grade wall* compliance which includes a *U*-factor of 0.8 Btu/h-°F-ft^2 for the area of the *above-grade wall* penetrated by the concrete floor deck, or
2. an approved thermal break device of not less than R-10 is installed in accordance with the manufacturer's instructions.

~~**C402.7.2**~~ **DD 101.1.2 Cladding supports.** Linear elements supporting opaque cladding shall be off-set from the structure with attachments that allow the continuous insulation, where present, to pass behind the cladding support element.

Exceptions:

1. An *approved* design where the above-grade wall *U*-factor used for compliance accounts for the cladding support element *thermal bridge*.
2. Anchoring for curtain wall and window wall systems.

~~**C402.7.3**~~ **DD101.1.3 Structural beams and columns.** Structural steel and concrete beams and columns that project through the *building thermal envelope* shall be covered with not less than R-5 insulation for not less than 2 feet (610 mm) beyond the interior or exterior surface of an insulation component within the *building thermal envelope*.

Exceptions:

1. Where an approved thermal break device is installed in accordance with the manufacturer's instructions.
2. An approved design where the above-grade wall U-factor used to demonstrate compliance accounts for the beam or col-umn thermal bridge.

~~C402.7.4~~ DD101.1.4 **Vertical fenestration.** Vertical fenestration intersections with above grade walls shall comply with one or more of the following:

1. Where above-grade walls include continuous insulation, the plane of the exterior glazing layer or, for metal frame fenestration, a non-metal thermal break in the frame shall be positioned within 2 inches (610 mm) of the interior or exterior surface of the continuous insulation.
2. An approved design where the above-grade wall U-factor used to demonstrate compliance accounts for the beam or column thermal bridge.
3. The surface of the rough opening, not coved by the fenestration frame, shall be insulated with insulation of not less than R-3 material or covered with a wood buck that is not less than 1.5 inches (457 mm) thick.
4. For the intersection between vertical fenestration and opaque spandrel in a shared framing system, manufacturer's data for the spandrel *U*-factor shall account for *thermal bridges*.

Exceptions:

1. Where an approved design for the above-grade wall *U*-factor used for compliance accounts for *thermal bridges* at the intersection with the vertical fenestration.
2. Doors

~~C402.7.5~~ DD101.1.5 **Parapets.** Parapets shall comply with one or more of the following as applicable:

1. Where continuous insulation is installed on the exterior side of the *above-grade wall* and the roof is insulated with insulation entirely above deck, the continuous insulation shall extend up both sides of the parapet not less than 2 feet (610 mm) above the roof covering or to the top of the parapet, whichever is less. Parapets that are an integral part of a fire-resistance rated wall, and the exterior continuous insulation applied to the parapet, shall comply with the fire resistance ratings of the building code.
2. Where continuous insulation is installed on the exterior side of the above-grade wall and the roof insulation is below the roof deck, the continuous insulation shall extend up the exterior side of the parapet to not less than the height of the top surface of the roof assembly.
3. Where continuous insulation is not installed on the exterior side of the *above-grade wall* and the roof is insulated with insulation entirely above deck, the wall cavity or integral insulation shall extend into the parapet up to the exterior face of the roof insulation or equivalent R-value insulation shall be installed not less than 2 feet (610 mm) horizontally inward on the underside of the roof deck.
4. Where continuous insulation is not installed on the exterior side of the *above-grade wall* and the roof insulation is below the roof deck, the wall and roof insulation components shall be adjacent to each other at the roof-ceiling-wall intersection.

Exception: An *approved* design where the *above-grade wall U*-factor used for compliance accounts for the parapet *thermal bridge*.

C402.1 General. *Building thermal envelope* assemblies for buildings that are intended to comply with the code on a prescriptive basis in accordance with the compliance path described in Item 1 of Section C401.2.1 shall comply with the following:

1. The opaque portions of the *building thermal envelope* shall comply with the specific insulation requirements of Section C402.2 and the thermal requirements of either the U-, C- and F-factor based method of Section C402.1.2; the R-value based method of C402.1.3; or the component performance alternative of Section C402.1.4. Where the total area of the through-wall penetrations of mechanical equipment is greater than 1 percent of the opaque above-grade wall area, the building thermal envelope shall comply with Section C402.1.2.4.
2. Wall solar reflectance and thermal emittance shall comply with Section C402.3.
3. Roof solar reflectance and thermal emittance shall comply with Section C402.4.
4. Fenestration in building envelope assemblies shall comply with Section C402.5.
5. Air leakage of the building thermal envelope shall comply with C402.6.
6. Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.12.
7. ~~*Thermal bridges in above-grade walls* shall comply with Section C402.7.~~

Alternatively, where buildings have a vertical fenestration area or skylight area exceeding that allowed in Section C402.5, the building and *building thermal envelope* shall comply with Item 2 of Section C401.2.1 or Section C401.2.2.

Reason: The original code change, CECPI-4-21, was committee developed in the few months before the vote. It was developed mainly by the proponents of conflicting proposals CEPI-33-21, CEPI-40-21, and CEPI-45-21. It was developed without input from key stakeholders – structural engineers who would need to comply with this.

- This has **not been tried anywhere** for any building to see if it is realistic.

- **It hasn't been modeled as a whole building** to see if it saves energy under actual weather conditions. Cooling energy costs are now on par with heating energy costs in mild to cold climates through climate zone 5 per PNNL reports, meaning thermal bridges have less effect than steady state analysis may indicate. Also, thermal mass effects of thermal bridges have the potential to reduce peak loads and reduce cooling costs. There is no indication that these many years of modeling buildings without consideration of thermal bridges has any impact on predicted loads or sizing calculations.

· **There is no analysis by climate zone** – as the envelope is tightened more air conditioning and less heating is needed. This changes the lens for mixed climate zones and what measures save energy.

· ASHRAE has developed Addendum av, likely to soon be published as part of 90.1-2022. CECPI-4-21 is a very truncated version of Addendum av and possibly violates ASHRAE copyright.

The simplification of CECPI-4-21 compared to Addendum av impacts constructability and the ability to comply. Addendum av was developed over 12 years, starting in 2010, with significant input from stakeholders whereas CECPI-4-21 was just developed without input from those primarily affected. It is oversimplified to the point of not allowing common construction methods.

· **Constructability was not considered, and costs and cost effectiveness were not provided** as required by ICC. The cost statement indicates it provides "*practical mitigation which does not require significant changes to current practices, setting a relatively low performance bar.*"

This statement is not true.

While certain types of construction can easily comply, some typical construction cannot – these provisions are not practical. The (20 to 70%) energy savings in the reason statement is not related to this proposal (it is an oft-repeated myth).

California wanted to verify this and did a detailed analysis available online (beginning on slide 68) and showed 1% savings; it was decided that adopting comparable requirements was not worth the effort in training and compliance because it was so complex. Additional detail:

"The Statewide CASE Team is not pursuing this measure due to significant concerns about the absence of a nonresidential registry or third-party entity ready to perform field inspection and verification by 2022 nor an established format for professionals to sign off that calculations had been properly performed."

Granted, California is generally warmer, and uses different criteria, but its analysis considered compliance and enforcement. **This proposal will have extraordinary design and construction costs for the commercial building industry with little or no energy saving value.** Even though a concept sounds good doesn't mean a related proposal saves energy. **This proposal still allows thermal bridges – it just discriminates against some in favor of others.** It favors point connections through insulation which increases the potential for corrosion.

· The predictable result of this proposal will be that some forward-leaning jurisdictions will require it and find it has **unintended consequences.** Remaining jurisdictions and developers will not know how to enforce it or comply with it. It will require extensive education on the new requirements for the design and regulatory communities. Every structural and envelope designer, and every plan reviewer and building inspector, will need education on these provisions. It takes a long time for the various professional associations to develop and deliver new content. Big new concepts in code trigger big new education development and administration.

· An example of the basic flaws in the thermal bridging language: compliance is required for all fasteners, no matter how small, unless the performance path is used. Section C402.6.1, Balconies and floor decks, which requires an excessive thermal break of R-10, is another example. Consider that wood blocking, which is allowed as an overall exception, has an R-value of about R-1.25 Very small thermal breaks in window frames are effective and are a fraction of an R-value.

· **Designers are not familiar with psi and chi factors.** These factors cannot be calculated except via costly research, and they are variable depending on the type of thermal bridge and insulation in adjacent assemblies. **Values are not available for most assemblies.** The default psi and chi factors in 90.1 Addendum av are problematic; they do not account for these complexities. The performance alternative of this proposal truncates the number of psi and chi factors compared to Addendum av, resulting in even more significant inaccuracies. Since users will be new to these, they will think they are accurate when they are not. They can be off by many multiples.

· The component performance alternative in Section C402.1.5 does not allow the use of actual psi and chi factors for actual thermal bridges. Actual values from the major source of values - Morrison Hershfield, should be allowed.

· CEPI-30-21, which was disapproved, would have allowed for the ACI/TMS 122.1 as the standard for mitigating thermal bridges. This standard was developed by concrete and masonry professionals. This should be considered an alternate path.

· **The biggest thermal bridge in a building is the fenestration.** For perspective, a concrete slab edge has the same steady state heat transfer as a strip of one-foot-high fenestration. Granted, a slab edge has thermal mass, and glass has other benefits, but this shows the oversimplification of this proposal.

· The proposal does not provide industry time to adapt to radical changes in the way buildings are constructed.

Proposed resolution:

Make a non-mandatory appendix, which would permit beta testing by forward-leaning jurisdictions, and identification of needed improvements of the provisions, as well as development of critical educational offerings by the professional associations of the affected parties.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
It is currently uncertain what cost impacts this proposal may have. Proponent did not provide a detailed analysis.

Workgroup Recommendation

Proposal # 676

CED1-136-22

Proponents: Vladimir Kochkin, representing NAHB (vkochkin@nahb.org)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C402.7 Thermal bridges in above-grade walls. Thermal bridges in above-grade walls shall comply with the section or an approved design.
Exceptions:

1. *Buildings* and structures located in Climate Zones 0 through ~~3~~ 4.
2. Any *thermal bridge* with a material thermal conductivity not greater than 3.0 Btu/h-ft-°F.
3. Blocking, coping, flashing, and other similar materials for attachment of roof coverings.
4. *Thermal bridges* accounted for in the *U*-factor or *C*-factor for a *building thermal envelope.*

Reason: There was no cost-effectiveness analysis provided with the proposal for thermal bridging. The statement that these provisions are already implied by the code is incorrect and inadequate. Until a cost-effectiveness analysis is provided, at a minimum climate zone 4 should be added to the list of exceptions.
The provisions should be vetted through the IBC structural committee – the structural engineering community will have to meet these requirements.

The state of California considered adding thermal bridging provisions but after conducting an analysis did not adopt such provisions. This supports adding Climate Zone 4 as there are parts of California in CZ 4 and 5.

Requirements for balconies are overly restrictive. An ASHRAE version of this proposal offered allowances for balconies by climate zone to make these requirements more feasible. For Climate Zone 4, up to 35% of the floor perimeter can be allocated to balconies in 90.1.

These highly complex provisions have not been tried on any design projects in the field and are not part of any above-code programs. Demonstrated experience with the newly proposed energy modeling provisions should be accumulated before locating them in the main body of the code.

This proposal offers to resolve these concerns by extending the exception to Climate Zone 4.

Cost Impact: The code change proposal will decrease the cost of construction.
This proposal will reduce the cost of construction in climate zone 4.

Workgroup Recommendation

Proposal # 812

CED1-137-22

Proponents: Bob Zabcik, representing Metal Construction Association (bob@ztech-consulting.com)

2024 International Energy Conservation Code [CE Project]

Revise as follows:

PSI-FACTOR (ψ-FACTOR). The heat loss factor per unit length of a *linear* *thermal bridge* ~~characterized as a linear element of a building thermal envelope~~ (Btu/h × ft × °F)[W/(m × K)].

THERMAL BRIDGE. An element or interface of elements that has a higher thermal conductivity than the surrounding *building thermal envelope*, which creates a path of least resistance for heat transfer.

Add new definition as follows:

LINEAR THERMAL BRIDGE. A *thermal bridge* characterized as a linear element of a *building thermal envelope* which penetrates the insulation.

POINT THERMAL BRIDGE. A *thermal bridge* characterized as a point element of a *building thermal envelope* which penetrates the insulation

2024 International Energy Conservation Code [CE Project]

Revise as follows:

CHI-FACTOR (χ-FACTOR). The heat loss factor for a single *point thermal bridge* ~~characterized as a point element of a building thermal envelope~~ (Btu/h x °F)[W/K].

C402.7 Thermal bridges in above-grade walls. *Point* *thermal bridges* and *linear thermal bridges* in above-grade walls shall comply with the section or an approved design.

Exceptions:

1. *Buildings* and structures located in Climate Zones 0 through 3.
2. Any *linear* *thermal bridge* with a material thermal conductivity not greater than 3.0 Btu/h-ft-°F.
3. Blocking, coping, flashing, and other similar materials for attachment of roof coverings.
4. *Point* *thermal bridges* and *linear thermal bridges* accounted for in the *U*-factor or *C*-factor for a *building thermal envelope*.

C402.7.2 Cladding supports. Linear elements supporting opaque cladding shall be off-set from the structure with attachments that allow the continuous insulation, where present, to pass behind the cladding support element.

Exceptions:

1. An *approved* design where the above-grade wall *U*-factor used for compliance accounts for the cladding support element *linear* *thermal bridge*.
2. Anchoring for curtain wall and window wall systems.

C402.7.3 Structural beams and columns. Structural steel and concrete beams and columns that project through the *building thermal envelope* shall be covered with not less than R-5 insulation for not less than 2 feet (610 mm) beyond the interior or exterior surface of an insulation component within the *building thermal envelope*.

Exceptions:

1. Where an approved thermal break device is installed in accordance with the manufacturer's instructions.
2. An approved design where the above-grade wall U-factor used to demonstrate compliance accounts for the beam or column *point* *thermal bridge*.

C402.7.4 Vertical fenestration. Vertical fenestration intersections with above grade walls shall comply with one or more of the following:

1. Where above-grade walls include continuous insulation, the plane of the exterior glazing layer or, for metal frame fenestration, a non-metal thermal break in the frame shall be positioned within 2 inches (610 mm) of the interior or exterior surface of the continuous insulation.
2. An approved design where the above-grade wall U-factor used to demonstrate compliance accounts for the beam or column thermal bridge.

3. The surface of the rough opening, not coved by the fenestration frame, shall be insulated with insulation of not less than R-3 material or covered with a wood buck that is not less than 1.5 inches (457 mm) thick.
4. For the intersection between vertical fenestration and opaque spandrel in a shared framing system, manufacturer's data for the spandrel *U*-factor shall account for *thermal bridges*.

Exceptions:

1. Where an approved design for the above-grade wall *U*-factor used for compliance accounts for <u>*point*</u> *thermal bridges* <u>and</u> ~~*linear thermal bridges*~~ at the intersection with the vertical fenestration.
2. Doors

TABLE C407.4.1(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT CHARACTERISTICS	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Space use classification	Same as proposed	The space use classification shall be chosen in accordance with Table C405.3.2(1) or C405.3.2(2) for all areas of the building covered by this permit. Where the space use classification for a building is not known, the building shall be categorized as an office building.
Roofs	Type: insulation entirely above deck	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table C402.1.2	As proposed
	Solar absorptance: 0.75, except as specified in Section C402.4 and Table C402.4 for Climate Zones 0, 1, 2, and 3	As proposed
	Emittance: 0.90, except as specified in Section C402.4 and Table C402.4 for Climate Zones 0, 1, 2, and 3	As proposed
Walls, above-grade	Type: same as proposed	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table C402.1.2	As proposed
	Thermal bridges: Account for heat transfer consistent with compliant *psi*- and *chi*-factors from Table C402.1.4 for *linear thermal bridges* and *point thermal bridges* as identified in Section C402.7 that are present in the proposed design.	As proposed; *psi*- and *chi*-factors for proposed *linear thermal bridges* and *point thermal bridges* shall be determined in accordance with requirements in Section C402.1.4.
	Solar absorptance: 0.75	As proposed
	Emittance: 0.90	As proposed
Walls, below-grade	Type: mass wall	As proposed
	Gross area: same as proposed	As proposed
	U-Factor: as specified in Table C402.1.2 with insulation layer on interior side of walls	As proposed
Floors, above-grade	Type: joist/framed floor	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table C402.1.2	As proposed
Floors, slab-on-grade	Type: unheated	As proposed
	F-factor: as specified in Table C402.1.2	As proposed
Opaque doors	Type: swinging	As proposed
	Area: Same as proposed	As proposed
	U-factor: as specified in Table C402.1.2	As proposed
Vertical fenestration other than opaque doors	Area 1. The proposed vertical fenestration area; where the proposed vertical fenestration area is less than 40 percent of above-grade wall area. 2. 40 percent of above-grade wall area; where the proposed vertical fenestration area is 40 percent or more of the above-grade wall area.	As proposed
	U-factor: as specified in Table C402.5	As proposed
	SHGC: as specified in Table C402.5 except that for climates with no requirement (NR) SHGC = 0.40 shall be used	As proposed
	External shading and PF: none	As proposed

Skylights	Area 1. The proposed skylight area; where the proposed skylight area is less than that permitted by Section C402.1. 2. The area permitted by Section C402.1; where the proposed skylight area exceeds that permitted by Section C402.1.	As proposed
	U-factor: as specified in Table C402.5	As proposed
	SHGC: as specified in Table C402.5 except that for climates with no requirement (NR) SHGC = 0.40 shall be used.	As proposed
Lighting, interior	The interior lighting power shall be determined in accordance with Section C405.3.2. Where the occupancy of the building is not known, the lighting power density shall be 1.0 watt per square foot based on the categorization of buildings with unknown space classification as offices.	As proposed
Lighting, exterior	The lighting power shall be determined in accordance with Tables C405.5.2(1), C405.5.2(2) and C405.5.2(3). Areas and dimensions of surfaces shall be the same as proposed.	As proposed
Internal gains	Same as proposed	Receptacle, motor and process loads shall be modeled and estimated based on the space use classification. End-use load components within and associated with the building shall be modeled to include, but not be limited to, the following: exhaust fans, parking garage ventilation fans, exterior building lighting, swimming pool heaters and pumps, elevators, escalators, *refrigeration equipment and cooking equipment.*
Schedules	Same as proposed **Exception:** Thermostat settings and schedules for HVAC systems that utilize radiant heating, radiant cooling and elevated air speed, provided that equivalent levels of occupant thermal comfort are demonstrated by means of equal Standard Effective Temperature as calculated in Normative Appendix B of ASHRAE Standard 55.	Operating schedules shall include hourly profiles for daily operation and shall account for variations between weekdays, weekends, holidays and any seasonal operation. Schedules shall model the time-dependent variations in occupancy, illumination, receptacle loads, thermostat settings, mechanical ventilation, HVAC equipment availability, service hot water usage and any process loads. The schedules shall be typical of the proposed building type as determined by the designer and approved by the jurisdiction.
Outdoor airflow	Where the proposed design specifies mechanical ventilation: 1. For systems 1-4 as specified in Tables C407.4.1(2) and C407.4.1(3), the outdoor airflow rate shall be determined in accordance with Section C403.7 and *International Mechanical Code* Section 403.3.1.1.2.3.4 Equation 4-8, using a system ventilation efficiency (Ey) of 0.75._ 2.For systems 5-11 as specified in Tables C407.4.1(2) and C407.4.1(3), the outdoor airflow rate shall be determined in accordance with Section C403.7 and *International Mechanical Code* Section 403.3._ Where the proposed design specifies natural ventilation, as proposed.	As proposed, in accordance with Section C403.2.2.
Heating systems	Fuel type: same as proposed design	As proposed
	Equipment type[a]: as specified in Tables C407.4.1(2) and C407.4.1(3)	As proposed
	Efficiency: as specified in the tables in Section C403.3.2.	As proposed

	Capacity[b]: sized proportionally to the capacities in the proposed design based on sizing runs, and shall be established such that no smaller number of unmet heating load hours and no larger heating capacity safety factors are provided than in the proposed design.	As proposed
Cooling systems	Fuel type: same as proposed design	As proposed
	Equipment type[c]: as specified in Tables C407.4.1(2) and C407.4.1(3)	As proposed
	Efficiency: as specified in Tables C403.3.2(1), C403.3.2(2) and C403.3.2(3)	As proposed
	Capacity[b]: sized proportionally to the capacities in the proposed design based on sizing runs, and shall be established such that no smaller number of unmet cooling load hours and no larger cooling capacity safety factors are provided than in the proposed design.	As proposed
	Economizer[d]: same as proposed, in accordance with Section C403.5.	As proposed
Service water heating[e]	Fuel type: same as proposed	As proposed
	Efficiency: as specified in Table C404.2	For Group R, as proposed multiplied by SWHF. For other than Group R, as proposed multiplied by efficiency as provided by the manufacturer of the DWHR unit.
	Capacity: same as proposed	As proposed
	Where no service water hot water system exists or is specified in the proposed design, no service hot water heating shall be modeled.	
<u>Energy Recovery</u>	Where the proposed design specifies mechanical ventilation, as specified in Section C403.7.4 based on the *standard reference design* airflows. Where the proposed design specifies natural ventilation, as proposed.	As proposed
Fan power	As specified in Section C403.8 for the proposed design. **Exceptions:** 1. Where the fan power of the proposed design is exempted from the requirements of Section C403.8, as proposed. 2. Fan systems addressed by Section C403.8.1: Fan system BHP power shall be as proposed or to the limits specified in Section C403.8.1, whichever is smaller. If the limit is reached, the power or each fan shall be reduced proportionally until the limit is met. 3. Fan systems serving areas where the mechanical ventilation is provided in accordance with an engineered ventilation system design of Section 403.2 of the *International Mechanical Code* shall not use the particulate filtration or air cleaner pressure drop adjustment available in Table C403.8(1) when calculating the fan system BHP limit for the portion of the airflow being treated to comply with the engineered ventilation system design.	As proposed
	Where a system providing on-site renewable energy has been modeled in the proposed design the same system shall be modeled identically in the *standard reference design* except the rated capacity shall meet the requirements of Section C405.15.1	

On-site Renewable Energy	Where no system is designed or included in the proposed design, model an unshaded photovoltaic system with the following characteristics: **Size:** Rated capacity per Section C405.15.1 **Module Type:** Crystalline Silicone Panel with glass cover, 19.1% nominal efficiency and temperature coefficient of -0.35%/°C, Performance shall be based on a reference temperature of 77°F (25°C), airmass of 1.5 atmosphere and irradiance of 317 Btu/h x ft^2 (1000 W/m^2). **Array Type:** Rack mounted array with installed nominal operating cell temperature (INOCT) of 103°F (45°C). Total System Losses (DC output to AC output): 11.3%. **Tilt:** 0-degrees (mounted horizontally). **Azimuth:** 180 degrees.	As proposed

For SI: 1 watt per square foot = 10.7 w/m^2.

SWHF = Service Water Heat Recovery factor, DWHR = Drain Water Heat Recovery.

a. Where no heating system exists or has been specified, the heating system shall be modeled as fossil fuel. The system characteristics shall be identical in both the standard reference design and proposed design.

b. The ratio between the capacities used in the annual simulations and the capacities determined by sizing runs shall be the same for both the standard reference design and proposed design.

c. Where no cooling system exists or no cooling system has been specified, the cooling system shall be modeled as an air-cooled single-zone system, one unit per thermal zone. The system characteristics shall be identical in both the standard reference design and proposed design.

d. If an economizer is required in accordance with Table C403.5(1) and where no economizer exists or is specified in the proposed design, then a supply-air economizer shall be provided in the standard reference design in accordance with Section C403.5.

e. The SWHF shall be applied as follows:

1. Where potable water from the DWHR unit supplies not less than one shower and not greater than two showers, of which the drain water from the same showers flows through the DWHR unit then SWHF = [1 – (DWHR unit efficiency × 0.36)].
2. Where potable water from the DWHR unit supplies not less than three showers and not greater than four showers, of which the drain water from the same showers flows through the DWHR unit then SWHF = [1 – (DWHR unit efficiency × 0.33)].
3. Where potable water from the DWHR unit supplies not less than five showers and not greater than six showers, of which the drain water from the same showers flows through the DWHR unit, then SWHF = [1 – (DWHR unit efficiency × 0.26)].
4. Where Items 1 through 3 are not met, SWHF = 1.0.

C103.2 Information on construction documents. Construction documents shall be drawn to scale on suitable material. Electronic media documents are permitted to be submitted where *approved* by the *code official*. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment as herein governed. Details shall include, but are not limited to, the following as applicable:

1. Energy compliance path.
2. Insulation materials and their *R*-values.
3. Fenestration *U*-factors and solar heat gain coefficients (SHGCs).
4. Area-weighted *U*-factor and solar heat gain coefficient (SHGC) calculations.
5. Mechanical system design criteria.
6. Mechanical and service water-heating systems and equipment types, sizes and efficiencies.

7. Economizer description.
8. Equipment and system controls.
9. Fan motor horsepower (hp) and controls.
10. Duct sealing, duct and pipe insulation and location.
11. Lighting fixture schedule with wattage and control narrative.
12. Location of *daylight* zones on floor plans.
13. Air barrier and air sealing details, including the location of the air barrier.
14. Location of pathways for routing of raceways or cable from the on-site renewable energy system to the electrical distribution equipment.
15. *Point thermal bridges* and *linear thermal bridges* as identified in Section C402.~~6~~7.
16. Location reserved for inverters, metering equipment, ESS, and a pathway reserved for routing of raceways or conduit from the renewable energy system to the point of interconnection with the electrical service and the ESS.
17. Location and layout of a designated area for ESS.
18. Rated energy capacity and rated power capacity of the installed or planned ESS.

Reason: The current definition of thermal bridge is too broad and needs further distinction in order to properly link thermal bridges to their respective psi and chi factors.
The definition of Building Thermal Envelope includes all wall and roof assembly components, not just insulation. Yet it is only the penetration of the insulation that is relevant to a thermal bridge. So, if an element with a thermal conductivity in excess of 3 Btu/hr-ft-F (From Exception 2 of Section C402.7) penetrates the sheathing but not the insulation, it meets the definition of thermal bridge and very well might require the calculation of a psi- or chi-factor, yet the energy use impact of such a penetration is inconsequential.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This is simply a clarification to the current proposed language and will not impact the cost of construction.

Workgroup Recommendation

Proposal # 887

CED1-138-22

Proponents: Alyson Hallander, representing Schoeck

2024 International Energy Conservation Code [CE Project]

Revise as follows:

C402.7.1 Balconies and floor decks. Balconies and concrete floor decks shall not penetrate the building thermal envelope. Such assemblies shall be separately sup-ported or shall be supported by structural attachments or elements that minimize thermal bridging through the building thermal envelope.
Exceptions: Balconies and concrete floor decks shall be permitted to penetrate the *building thermal envelope* where:

1. an area-weighted *U*-factor is used for *above-grade wall* compliance which includes a *U*-factor of 0.8 Btu/h-°F-ft^2 for the area of the *above-grade wall* penetrated by the concrete floor deck, or
2. an approved structural thermal break device ~~of~~ with not less than R-10 insulation material is installed in accordance with the manufacturer's instructions.

C402.7.5 Parapets. Parapets shall comply with one or more of the following as applicable:

1. Where continuous insulation is installed on the exterior side of the *above-grade wall* and the roof is insulated with insulation entirely above deck, the continuous insulation shall extend up both sides of the parapet not less than 2 feet (610 mm) above the roof covering or to the top of the parapet, whichever is less. Parapets that are an integral part of a fire-resistance rated wall, and the exterior continuous insulation applied to the parapet, shall comply with the fire resistance ratings of the building code.
2. Where continuous insulation is installed on the exterior side of the above-grade wall and the roof insulation is below the roof deck, the continuous insulation shall extend up the exterior side of the parapet to not less than the height of the top surface of the roof assembly.
3. Where continuous insulation is not installed on the exterior side of the *above-grade wall* and the roof is insulated with insulation entirely above deck, the wall cavity or integral insulation shall extend into the parapet up to the exterior face of the roof insulation or equivalent R-value insulation shall be installed not less than 2 feet (610 mm) horizontally inward on the underside of the roof deck.
4. Where continuous insulation is not installed on the exterior side of the *above-grade wall* and the roof insulation is below the roof deck, the wall and roof insulation components shall be adjacent to each other at the roof-ceiling-wall intersection.
5. Where an approved structural thermal break device with not less than R-10 insulation material aligned with the above-grade wall and roof insulation is installed in accordance with the manufacturer's instructions.

Exception: An *approved* design where the *above-grade wall U*-factor used for compliance accounts for the parapet *thermal bridge*.

TABLE C402.1.4 PSI- and CHI-FACTORS TO DETERMINE THERMAL BRIDGES FOR THE COMPONENT PERFORMANCE ALTERNATIVE

Thermal Bridge per Section C402.7	Thermal Bridge Compliant with Section C402.7		Thermal Bridge Non-Compliant with Section C402.7	
	psi-factor (Btu/h-ft-°F)	chi-factor (Btu/h-~~ft-~~°F)	psi-factor (Btu/h-ft-°F)	chi-factor (Btu/h-~~ft-~~°F)
C402.7.1 Balconies, slabs, and decks	0.2	n/a	0.5	n/a
C402.7.2 Cladding supports	0.2	n/a	0.3	n/a
C402.7.3 Structural beams and columns	n/a	1.0-carbon steel 0.3-concrete	n/a	2.0-carbon steel 1.0-concrete
C402.7.4 Vertical fenestration	0.15	n/a	0.3	n/a
C402.7.5 Parapets	0.2	n/a	0.4	n/a

For SI: W/m-K = 0.578 Btu/h-ft-°F; 1 W/K = 1.90 Btu/h-°F
n/a = not applicable

Reason: C402.7.1 reasons:
The proposed wording will make it feasible to meet thermal performance requirements with current structural thermal break products on the market.

The tweaks to the wording clarify that a manufactured structural thermal break is acceptable and that the R-value applies only to the **insulated material** of the manufactured assemblies.

Typical manufactured structural thermal breaks incorporate at least R-15 insulation material; however, when the thermal properties of the stainless steel reinforcement and the compression material of the devices are considered, the resulting assembly R-value is less than R-10 for nearly all structural thermal break assemblies.

C402.7.5 reasons:

Regarding parapets with adding C402.7.5.5, incorporating a structural thermal break within the parapet ensures a truly continuous building envelope compared to extending insulation 2' up along the parapet.

See below image for where a structural thermal break can be incorporated at a parapet to maintain continuous insulation:

ADDENDA

ANSI/ASHRAE/IES Addendum av to
ANSI/ASHRAE/IES Standard 90.1-2019

Energy Standard for Buildings Except Low-Rise Residential Buildings

Approved by the ASHRAE Standards Committee on June 25, 2022; by the ASHRAE Board of Directors on June 29, 2022; by the Illuminating Engineering Society on June 17, 2022; and by the American National Standards Institute on July 29, 2022.

This addendum was 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. Instructions for how to submit a change can be found on the ASHRAE® website (https://www.ashrae.org/continuous-maintenance).

The latest edition of an ASHRAE Standard may be purchased on the ASHRAE website (www.ashrae.org) or from ASHRAE Customer Service, 180 Technology Parkway, Peachtree Corners, GA 30092. E-mail: orders@ashrae.org. Fax: 678-539-2129. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

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SPECIAL NOTE

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ASHRAE obtains consensus through participation of its national and international members, associated societies, and public review.

ASHRAE Standards are prepared by a Project Committee appointed specifically for the purpose of writing the Standard. The Project Committee Chair and Vice-Chair must be members of ASHRAE; while other committee members may or may not be ASHRAE members, all must be technically qualified in the subject area of the Standard. Every effort is made to balance the concerned interests on all Project Committees.

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b. participation in the next review of the Standard,
c. offering constructive criticism for improving the Standard, or
d. permission to reprint portions of the Standard.

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FOREWORD

Work on Addendum av was initiated following the publication of ASHRAE Research Project (RP) 1365 "Thermal Performance of Building Envelope Details for Mid- and High-Rise Buildings." The RP found that unaccounted heat flow through the cumulative impact of thermal bridges can increase the annual energy consumption associated with the building envelope when compared to a building without thermal bridges.

Addendum av incorporates numerous comments from multiple public review periods. Exceptions are added for overhangs, additional compliance options are added for mass walls, allowances are increased for unmitigated thermal bridges, and clarifying language is added to Section 11 and Normative Appendix G.

The options shown were considered cost effective based on the methodology agreed to by SSPC 90.1, except for the large elements, in which case an allowance is provided. The current standard assumes a near-perfect building with no large elements passing through the thermal envelope. Addendum av therefore offers the user two options: construct a near-perfect wall or take advantage of the allowances.

Addendum cr to Standard 90.1-2019, which was published during the development of this addendum, provides requirements that limit building envelope tradeoffs in the performance paths in Section 11 and Normative Appendix G (aka building envelope backstops). Projects can comply with the proposed building envelope tradeoff limits either by meeting the prescriptive envelope requirements in Section 5.5 or using Section 5.6 "Building Envelope Trade-Off Option" to demonstrate that the energy cost penalty from the proposed envelope does not exceed the set margins. The backstop margins are 15% for residential building area types and 7% for nonresidential building area types.

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

Addendum av to Standard 90.1-2019

Revise Section 3.2 as shown (I-P and SI).

<u>***chi-factor (χ or Chi):*** thermal transmittance of a *point thermal bridge* in units of Btu/(h·°F) [W/K]</u>

[. . .]

<u>***clear-field thermal bridge:*** see *thermal bridge.*</u>

[. . .]

<u>***linear thermal bridge:*** see *thermal bridge.*</u>

[. . .]

<u>***point thermal bridge:*** see *thermal bridge.*</u>

[. . .]

<u>***psi-factor (ψ or Psi):*** thermal transmittance per unit length of a *linear thermal bridge* in units of Btu/(h·ft·°F) [W/(m·K)]</u>

[. . .]

<u>***thermal bridge:*** an element that has higher thermal conductivity than the surrounding materials, which creates a path of least resistance for heat transfer. For the purposes of determining *building envelope* requirements, the classifications for *thermal bridges* are defined as follows:</u>

<u>***clear-field thermal bridge:*** elements of a *building envelope* assembly that are distributed over the area of the assembly and addressed in determining the thermal performance of the assembly in accordance with Normative Appendix A. Examples of *clear-field thermal bridges* include studs, webs and face shells of masonry units, ties, tracks, plates, girts and purlins for metal building envelopes, and fasteners. Fasteners used to construct assemblies in accordance</u>

with Normative Appendix A are not considered nor separately defined as *point thermal bridges*.

linear thermal bridge: a length-based element associated with horizontal, vertical, or diagonal elements that penetrates the insulation in the *building envelope* and with length measured along the exterior surface of the *building envelope*. Examples of *linear thermal bridges* include edges of *floors*, balconies, columns and beams in the plane of an assembly, parapets, *roof-wall-floor* intersections, *fenestration* interfaces, shelf angles, and similar conditions not otherwise defined as a *clear field thermal bridge* or *point thermal bridge*.

point thermal bridge: a discrete element that penetrates the insulation in the *building envelope*. Examples of *point thermal bridges* include a beam penetrating a *wall,* a column penetrating a *roof* or *floor*, and an anchor or connection used to attach an element to the *building* and not otherwise defined as a *clear field thermal bridge* or *linear thermal bridge*. The cross-sectional area of the *point thermal bridge* is measured at the outer surface of the outermost layer of insulation that is penetrated by the element.

Revise Section 3.3 as shown (I-P and SI).

χ *chi-factor*, thermal transmittance of a *point thermal bridge*

[. . .]

L length of a *linear thermal bridge*

[. . .]

min. minimum

[. . .]

n number of occurrences a *point thermal bridge*

[. . .]

Ψ *psi-factor*, thermal transmittance per unit length of a *linear thermal bridge*

Revise Section 5.5.3.2 as shown (I-P and SI).

5.5.3.2 Above-Grade Wall Insulation. Above-grade walls shall comply with the insulation values specified in Tables 5.5-0 through 5.5-8. For the purposes of this provision, wall top plates, tracks, headers, or bond beams are considered part of the base wall assembly.

Exception to 5.5.3.2: ~~Alternatively, f~~For mass walls, where the requirement in Tables 5.5-0 through 5.5-8 is for a maximum assembly U-0.151 (U-0.857) followed by footnote "b," concrete masonry unit (CMU) walls complying with ASTM C90 ~~concrete block *walls*~~ that are ungrouted or partially grouted at 32 in. (800 mm) or greater~~less~~ on center vertically and 48 in. (1200 mm) or greater~~less~~ on center horizontally shall have their ungrouted openings (e.g., cores, cells) filled with insulating material having a maximum thermal conductivity of 0.44 Btu·in/ h·ft^2·°F (0.063 W/(m·K)). ~~Other *mass walls* with integral insulation shall meet the criteria when their *U-factors* are equal to or less than those for the appropriate thickness and density in the "Partly Grouted, Cells Insulated" column of Table A3.1.3.~~

Add new Section 5.5.5 as shown (I-P and SI).

5.5.5 Linear Thermal Bridges and Point Thermal Bridges. Where *linear thermal bridges* and *point thermal bridges* occur as described in Sections 5.5.5.1 through 5.5.5.5, they shall

a. comply with the applicable requirements of Sections 5.5.5.1 through 5.5.5.5 or
b. not exceed the mitigated *psi-factors* and *chi-factors* in Table A10.1, where the *psi-factors* and *chi-factors* for the *thermal bridges* are determined in accordance with Appendix A, Section A10.

For the purposes of Section 5.5.5, linear elements that are connected to the building structure by a series of point connections shall be permitted to be characterized as *linear thermal bridges* or as individual *point thermal bridges*.

Exceptions to 5.5.5:

1. *Buildings* located in Climate Zones 0 through 3.
2. *Semiheated spaces* in *buildings* located in Climate Zones 0 through 6.
3. *Clear-field thermal bridges*.
4. *Thermal bridges* in uninsulated assemblies.

5. *Linear and point thermal bridges* that have a material thermal conductivity less than 3.0 Btu·in/ h·ft^2·°F (0.433 W/[m·K]).
6. *Alterations* to *existing buildings* other than *additions.*
7. *Roofs* that project over *exterior walls.*

Informative Note: For *linear thermal bridges* and *point thermal bridges* that fall under the provisions of Section 2.4 and cannot comply prescriptively with the provisions of Sections 5.5.5.1 through 5.5.5.4, projects can use Section 5.5.5.5, Section 11, Normative Appendix C, or Normative Appendix G.

5.5.5.1 Roof and Wall Intersections. Where a *roof with insulation entirely above deck* intersects an exterior *wall,* the intersection shall comply with Sections 5.5.5.1.1, 5.5.5.1.2, 5.5.5.1.3, and 5.5.5.1.4, as applicable. Blocking, nailers, and similar elements shall be permitted to interrupt insulation for securement of the *roof covering*, coping, flashing materials, or similar elements.

5.5.5.1.1 Roof Edges. At *roof* edges without parapets or overhangs, the *roof* insulation and the *wall* insulation shall comply with the following, as applicable to the location of the insulation:

a. Where a *wall* has exterior *continuous insulation*, the *roof* insulation shall extend to the exterior of the *wall* insulation and the *wall* insulation shall extend to the *roof* insulation.
b. Where a *wall* has cavity or integral insulation that represents more than 50% of the total wall insulation *R-value*, the roof-to-wall insulation shall comply with one of the following:
   1. The cavity or integral insulation shall extend to the underside of the roof insulation.
   2. The cavity or integral insulation shall extend to the underside of the roof deck, and the *roof* insulation shall extend to the exterior face of the *wall*. The *wall* insulation shall be permitted to be interrupted by roof framing members.
   3. Additional insulation having a *rated R-value of insulation* not less than R-5 (R-0.9) shall extend inward on the underside of the roof deck for not less than 2 ft (0.6 m) and be permitted to be interrupted by roof framing members.
   4. Insulation having a *rated R-value of insulation* not less than R-5 (R-0.9) shall be placed at the exterior of the *roof* edge and be located between the bottom plane of the roof insulation and the plane of the bottom of the roof deck.
   5. The *wall* insulation values in Tables 5.5-1 through 5.5-8 shall be adjusted in accordance with Table 5.5.5.1.2.1.
   6. The *roof* insulation values in Tables 5.5-1 through 5.5-8 shall be adjusted in accordance with Table 5.5.5.1.2.2.
c. Where a *mass wall* has interior insulation that represents more than 50% of the total wall insulation *R-value*, the interior insulation shall extend to the underside of the roof deck, shall be permitted to be interrupted by framing members, and shall comply with one of the following:
   1. Additional insulation having a *rated R-value of insulation* not less than R-5 (R-0.9) shall extend inward on the underside of the roof deck for not less than 2 ft (0.6 m) and be permitted to be interrupted by roof framing members.
   2. Additional insulation having a *rated R-value of insulation* not less than R-5 (R-0.9) shall be placed at the exterior of the *roof* edge and be located between the bottom plane of the roof insulation and the plane of the bottom of the roof assembly in contact with the exterior *wall.*
   3. The *wall* insulation values in Tables 5.5-1 through 5.5-8 shall be adjusted in accordance with Table 5.5.5.1.2.1.
   4. The *roof* insulation values in Tables 5.5-1 through 5.5-8 shall be adjusted in accordance with Table 5.5.5.1.2.2.

   (***Informative Note:*** See Informative Appendix J, Figures J-1.)

5.5.5.1.2 Parapets. At *roof* edges with parapets, the *exterior wall* insulation shall comply with one or more of the following as applicable to the location of the insulation and *wall* assembly:

a. Where a *wall* has exterior *continuous insulation*, such *insulation* shall be applied to both vertical sides of the parapet.

   (***Informative Note:*** See Informative Appendix J, Figure J-2[a].)
b. Where a *wall* has cavity or integral insulation that represents more than 50% of the total wall insulation *R-value*, the *roof* to *wall* intersections at parapets shall comply with one of the following:

Table 5.5.5.1.2.1 Additional Wall Insulation Required for *Mass Walls* with Insulation on the Interior or Integral at Intersections with Roof Edges and Parapets

Climate Zone	*R-Value* Increase	*U-factor* % Decrease
4	R-1.0 (R-0.18)	8%
5	R-1.0 (R-0.18)	8%
6	R-1.5 (R-0.26)	10%
7	R-1.5(R-0.26)	10%
8	R-2.5 (R-0.44)	14%

Table 5.5.5.1.2.2 Additional *Roof* Insulation Required for *Mass Walls* with Insulation on the Interior or Integral at Intersections with Roof Edges and Parapets

Climate Zone	*R-Value* Increase	*U-factor* % Decrease
4	R-7.0 (R-1.23)	24%
5	R-7.0 (R-1.23)	24%
6	R-7.0 (R-1.23)	26%
7	R-9.0(R-1.58)	26%
8	R-9.0 (R-1.58)	26%

1. The *wall* insulation shall extend within the cavity of the parapet not less than the height of the top of the *roof* insulation. The *wall* insulation shall be permitted to be interrupted by roof framing members.
2. Additional insulation having a *rated R-value of insulation* not less than R-5 (R-0.9) shall extend inward on the underside of the roof deck for not less than 2 ft (0.6 m) and be permitted to be interrupted by roof framing members.
3. Insulation having a *rated R-value of insulation* not less than R-5 (R-0.9) shall be placed at the exterior of the *roof* edge and be located between the bottom plane of the roof insulation and the plane of the bottom of the roof deck.
4. The *wall* insulation values in Tables 5.5-1 through 5.5-8 shall be adjusted in accordance with Table 5.5.5.1.2.1
5. The *roof* insulation values in Tables 5.5-1 through 5.5-8 shall be adjusted in accordance with Table 5.5.5.1.2.2.

(***Informative Note:*** See Informative Appendix J, Figure J-2[b].)

c. Where a *mass wall* has interior insulation that represents more than 50% of the total wall insulation *R-value*, the interior insulation shall extend to the underside of the roof deck, shall be permitted to be interrupted by framing members, and shall comply with one of the following:
   1. Additional insulation having a *rated R-value of insulation* not less than R-5 (R-0.9) shall extend inward on the underside of the roof deck for not less than 2 ft (0.6 m) and be permitted to be interrupted by *roof* framing members.
   2. Additional insulation having a *rated R-value of insulation* not less than R-5 (R-0.9) shall be placed at the exterior of the *roof* edge and be located between the bottom plane of the roof insulation and the plane of the bottom of the roof assembly in contact with the exterior *wall*.
   3. The *wall* insulation values in Tables 5.5-1 through 5.5-8 shall be adjusted in accordance with Table 5.5.5.1.2.1.
   4. The *roof* insulation values in Tables 5.5-1 through 5.5-8 shall be adjusted in accordance with Table 5.5.5.1.2.2.

   (***Informative Note:*** See Informative Appendix J, Figure J-2[c] and J-2[d].)

5.5.5.1.3 Parapets within the Field of a *Roof*. Exterior *continuous insulation* having a minimum *rated R-value of insulation* not less than R-5 (R-0.9) shall be applied to both vertical sides of the parapet and extend from the coping at the top of the parapet to not less than the top of the roof insulation below.

Informative Notes:

1. See Informative Appendix J, Figure J-3.
2. Parapets that are an integral part of a fire-resistance-rated wall, and the exterior continuous insulation applied to the parapet, shall comply with the fire resistance ratings of the building code.

5.5.5.2 Walls and Intermediate Floor Intersections. At floor and *exterior wall* intersections, the *exterior wall* insulation shall comply with Sections 5.5.5.2.1, 5.5.5.2.2, and 5.5.5.2.3 as applicable to the type of floor intersection, *exterior wall* assembly and location of the *exterior wall* insulation.

5.5.5.2.1 Intermediate floor edges that do not serve as balconies or floor overhangs shall comply with the following as applicable:

a. Where a *wall* has *exterior continuous* insulation, such insulation shall extend continuously past the floor edge.
b. Where a *wall* has cavity insulation that represents more than 50% of the total wall insulation *R-value*, the cavity insulation shall extend to the underside of the floor deck and shall be permitted to be interrupted by floor framing members and *wall* top and bottom plates or tracks.
(***Informative Note:*** See Informative Appendix J, Figure J-4[a] and J-4[b].)
c. Where a *mass wall* has integral insulation that represents more than 50% of the total wall insulation *R-value*, the intermediate floor intersection shall comply with one of the following:
 1. The full thickness of integral insulation shall extend past the floor edge.
 2. Where the intermediate floor deck extends through the integral insulation, insulation having a *rated R-value of insulation* not less than R-5 (R-0.9) shall be maintained to the full depth of the floor edge on the exterior side of the floor edge.

 (***Informative Note:*** See Informative Appendix J, Figure J-4[c] and J-4[d].)
d. Where a *mass wall* has interior insulation that represents more than 50% of the total wall insulation *R-value*, the interior insulation shall extend to the underside of the floor deck, shall be permitted to be interrupted by framing members, and shall comply with one of the following:
 1. Additional interior insulation having a *rated R-value of insulation* not less than R-5 (R-0.9) shall cover the full depth of the floor edge. Such insulation shall be permitted to be interrupted by floor framing members. Fire safing applied to the full depth of the floor edge meets this requirement.
 2. Additional insulation having a *rated R-value of insulation* not less than R-5 (R-0.9) shall cover the full depth of the floor edge on the exterior side of the wall.
 3. The *wall* insulation values in Tables 5.5-1 through 5.5-8 shall be adjusted in accordance with Table 5.5.5.2.1.

 (***Informative Note:*** See Informative Appendix J, Figure J-4[e] and J-4[f].)
e. Where *mass walls* have not less than 50 percent of the *rated R-value of insulation* on the exterior side of the *wall* and the remainder on the interior side, the insulation on the interior side of the *wall* shall be permitted to be interrupted by an intermediate floor.
(***Informative Note:*** See Informative Appendix J, Figure J-4[g].)

5.5.5.2.2 The total length of *mass* floor assembly projections serving as balconies or floor overhangs that penetrate the *building envelope* shall not exceed the percentages of the total *building* perimeter depicted in Table 5.5.5.2.2. For this calculation, total building perimeter is the sum of the perimeters of each above grade floor where it intersects the *exterior building envelope*.

Exceptions to 5.5.5.2.2:

1. *Mass floor* assembly projections located directly above and providing protection to a pedestrian walkway at street-level.
2. *Mass* floor assembly projections thermally broken with a continuous thermal spacer block not less than R-12 (R-2.1). The thermal spacer block shall be permitted to be interrupted by structural connections.

5.5.5.3 Exterior Cladding Support. Shelf angles that support masonry exterior cladding shall be offset from the floor edge or primary structural frame using point connections to accommodate the full depth of any exterior *continuous insulation* between the support and floor or structure, exclusive of the point connections. The cross-sectional area of point connections shall not exceed 1.5 in.^{2} /lin ft (3200 mm^2/lin m) for carbon steel connections or 2.3 in.^{2} /lin ft (4900 mm^2/lin m) for stainless steel. Other cladding supports that penetrate the exterior *continuous insulation* shall be subject to the provisions of Section 5.5.5.5 and be mounted away from the backup construction

Table 5.5.5.2.1 Additional *Wall* Insulation Required for *Mass Walls* With Insulation on the Interior Complying with Section 5.5.5.2(d)(3)

Climate Zone	*R-Value* Increase	*U-factor* % Decrease
4	R-1.5 (R-0.26)	13%
5	R-2.0 (R-0.35)	15%
6	R-2.5 (R-0.44)	16%
7	R-3.0 (R-0.53)	20%
8	R-4.0 (R-0.70)	25%

Table 5.5.5.2.2 *Mass Floor* Balcony or Floor Overhang Allowances

Climate Zone	Maximum Percent of *Building* Perimeter
4	35%
5	30%
6	20%
7	10%
8	0%

using point connections to accommodate the full depth of any exterior *continuous insulation* exclusive of the point connections.

Exception to 5.5.5.3: Girts in *metal building walls* as described in Normative Appendix A.

(***Informative Note:*** See Informative Appendix J, Figure J-5.)

5.5.5.4 Opaque Wall and Vertical Fenestration Intersection. *Vertical fenestration* shall be installed in accordance with one or more of the following:

a. For *vertical fenestration*, the outermost glazing layer shall be aligned within the thickness of or within 2 in. (50 mm) of either face of the *continuous insulation* layer.

   (***Informative Note:*** See Informative Appendix J, Figure J-6[a] and J-6[b].)

b. For *vertical fenestration*, where *continuous insulation* is not present, the outermost glazing layer shall be aligned within the thickness of the *wall* insulation layer and not more than 2 in. (50 mm) from the exterior side of the outermost insulation layer.

   (***Informative Note:*** See Informative Appendix J, Figure J-6[c].)

c. Intersections between *vertical fenestration* and *opaque walls* where the surfaces of the rough opening located between the edge of the frame of the *vertical fenestration* and the *opaque wall* insulation shall be

   1. covered with a material having an *R-value* not less than R-3 (R-0.5), or
   2. covered with wood framing not less than 1.5 in. (38 mm) thick, or
   3. covered with a material having a thermal conductivity of not more than 3.0 Btu·in/ h·ft^2·°F (0.433 W/[m·K]).

   (***Informative Note:*** See Informative Appendix J, Figure J-6[d] and J-6[e].)

d. Intersections between *vertical fenestration* and *opaque* spandrel in a shared fenestration framing system shall have a thermal break with a thermal conductivity of 3.6 Btu·in/ h·ft^2·°F (0.519 W/(m·K)) or less.

Exception to 5.5.5.4: Intersections between *vertical fenestration* and uninsulated *opaque walls*.

5.5.5.5 Other Elements and Building Assembly Intersections. Individual *point thermal bridges* and *linear thermal bridges* not addressed in Sections 5.5.5.1 through 5.5.5.4 shall comply with Equation 5.5.5.5.

$$347\ \text{Btu·in./(ft}^2\text{·h·°F)} \times 0.003\% \times \textit{Above grade}\text{ area of the }\textit{building envelope} \geq (k_1 \times A_1) + (k_2 \times A_2) + (k_3 \times A_3)\ ... \quad (5.5.5.5\ \text{I-P})$$

Table 5.5.5.5 Allowable *Point Thermal Bridge* Cross-Sectional Area

Allowable Area per *Point Thermal Bridge*, in.^{2} (mm^2)	Common Material Name
3 (1935)	Carbon steel
9 (5800)	Stainless steel
65 (41935)	Concrete and masonry

$$50\ \text{W/(m·K)} \times 0.003\% \times \textit{Above grade}\ \text{area of the}\ \textit{building envelope} \geq (k_1 \times A_1) + (k_2 \times A_2) + (k_3 \times A_3) \ldots \quad (5.5.5.5\ \text{SI})$$

where

$k_1, k_2, k_3 \ldots$ = thermal conductivity of material 1, material 2, material 3, etc., expressed in Btu·in./(ft^2·h·°F) (W/[m·K]) for point thermal bridge material 1, material 2, material 3, etc. (e.g., concrete, carbon steel, stainless steel, wood)

$A_1, A_2, A_3, \ldots$ = the total cross-sectional area of *point thermal bridges* and *linear thermal bridges* of material 1, material 2, material 3, etc., expressed in ft^2 (m^2)

Exceptions to 5.5.5.5:

1. Service penetrations, including mechanical, electrical, plumbing, telecommunications, and fire services, that pass through the *opaque building envelope*.
2. Insulated roof curbs and blocking.
3. Individual *point thermal bridges* that are less than the allowances in Table 5.5.5.5.

(***Informative Note:*** See *ASHRAE Handbook—Fundamentals* Appendix A, Chapter 26, or Chapter 33 for typical material thermal conductivity.)

Revise Section 5.6.1.1 as shown (I-P and SI).

5.6.1.1 All components of the *building envelope* shown on architectural drawings or installed in *existing buildings* shall be modeled in the *proposed design*. The *simulation program* model *fenestration* and *opaque building* envelope types and area shall be consistent with the *construction documents*. Any *building envelope* assembly not subject to the provisions of Section 5.5.5 that covers less than 5% of the total area of that assembly type (e.g., *exterior walls*) need not be separately described, provided it is similar to an assembly being modeled. If not separately described, the area of a *building envelope* assembly shall be added to the area of an assembly of that same type with the same *orientation* and thermal properties.

[. . .]

Revise Section 5.7.2 as shown (I-P and SI).

5.7.2 Permit Application Documentation. Application documents shall include, at a minimum, the type and *rated R-value of insulation* for each product; *opaque door* schedule showing the *U-factor* for each *opaque door* product as determined in accordance with Section 5.8.2; *fenestration* schedule showing the manufacturer, model number, orientation, area, *U-factor*, *SHGC*, and *VT* for each *fenestration* product as determined in accordance with Section 5.8.2; *air leakage* details in accordance with Section 5.4.3; and *point* and *linear thermal bridge* details in the *proposed building* shall be represented on the compliance documents in accordance with Section 5.5.5.

[. . .]

Insert new Section 5.8.2 as shown, and renumber subsequent sections accordingly (I-P and SI).

5.8.2 Fenestration and Doors

[. . .]

5.8.2.3 Manufacturer's Installation Instructions. Fenestration products shall be installed in accordance with *manufacturers*' instructions.

Modify Section 11, Table 11.5.1 as shown (I-P and SI).

Table 11.5.1 Modeling Requirements for Calculating *Design Energy Cost* and *Energy Cost Budget*

Proposed Design **(Column A)** ***Design Energy Cost*** **(DEC)**	***Budget Building Design*** **(Column B)** ***Energy Cost Budget*** **(ECB)**
[. . .]	
5. *Building Envelope*	
All components of the *building envelope* in the *proposed design* shall be modeled as shown on architectural drawings or as installed for *existing building envelopes*. All *opaque building envelope* components shall be modeled accounting for thermal mass effects. **Exceptions:** The following *building* elements are permitted to differ from architectural drawings. 1. Each *linear thermal bridge* and *point thermal bridge* as identified in Section 5.5.5 shall be modeled using either of the following techniques: a. A separate model of the assembly within the *energy* simulation model. b. Adjustment of the clear-field *U-factor* in accordance with Appendix A10.2. 2. Each uninsulated assembly not identified in Section 5.5.5 shall be modeled using either of the following techniques: a. A separate model of the assembly within the *energy* simulation model. b. The *U-factors* of uninsulated assemblies can be averaged with larger adjacent surfaces of the same *class of construction* using an area-weighted average method. This average *U-factor* is modeled within the *energy* simulation model. ~~1~~3. Any other *building envelope* assembly, not subject to the requirements of Section 5.5.5, that covers less than 5% of the total area of that ~~assembly type (e.g., *exterior walls*)~~ *class of construction* need not be separately described, provided that it is similar to an assembly being modeled. If not separately described, the ~~area of a *building envelope* assembly must be added to the area of the adjacent assembly of the same type~~ U-factors of these assemblies shall be averaged with larger adjacent surfaces using an area-weighted average method. This average U-factor shall be modeled within the energy simulation model. [. . .]	The *budget building design* shall have identical *conditioned floor area* and identical exterior dimensions and orientations as the *proposed design*, except as follows: a. *Opaque* assemblies, such as *roof*, *floors*, *doors*, and *walls*, shall be modeled as having the same heat capacity as the proposed design but with the minimum U-factor required in Section 5.5 for new *buildings* or *additions* and Section 5.1.3 for *alterations*. b. Where *linear thermal bridges* and *point thermal bridges*, as identified in Section 5.5.5.1 through 5.5.5.5, are included in the *proposed design*, they shall be modeled by adjusting the *U-factor* of the parent assembly in accordance with the default values in Section A10. If the proposed design does not have *linear thermal bridges* and *point thermal bridges*, as identified in Sections 5.5.5.1 through 5.5.5.5, they shall not be modeled in the *budget building design*. If the balcony length in the *proposed design* exceeds the maximum allowed by Section 5.5.5.2.2, the area shall be reduced proportionally for each balcony until the limit set in Section 5.5.5.2.2 is met. ~~b~~c. The exterior *roof* surfaces shall be modeled with a solar reflectance and thermal emittance as required in Section 5.5.3.1.1(a). All other *roofs*, including *roofs* exempted from the requirements in Section 5.5.3.1.1, shall be modeled the same as the *proposed design*. [. . .]

Modify Section 12 as shown (I-P and SI).

Reference	**Title**
[. . .]	
International Organization for Standardization (ISO) **1, rue de Varembe, Case postale 56, CH-1211 Geneve 20, Switzerland**	
[. . .]	
ISO 10211 (2017)	Thermal bridges in building construction—Heat flows and surface temperatures—Detailed calculations
[. . .]	
ISO 14683 (2017)	Thermal bridges in building construction—Linear thermal transmittance—Simplified methods and default values
[. . .]	

Revise Normative Appendix A as shown (I-P and SI).

A1. GENERAL

[. . .]

A1.3 Applicant-Determined Psi-Factors and Chi-Factors for Thermal Bridges. The applicant shall determine values for *point thermal bridges* and *linear thermal bridges* using the assumptions in Section A10.

[. . .]

A10. THERMAL BRIDGING CHI FACTORS AND PSI FACTORS

A10.1 Determination of Psi-Factors and Chi-Factors. *Psi-factor* (ψ) and *chi-factor* (χ) values representative of an as-designed *thermal bridging* condition shall be determined in accordance with one of the following:

a. From simulation models compliant with ISO 10211 using details representative of the actual construction and modeling assumptions consistent with generally accepted architectural and engineering practice.
b. From ISO 14683.
c. From testing of the assembly in accordance with ASTM C1363 with and without the presence of the *thermal bridge* condition to determine a linear transmittance value or point transmittance value for the *thermal bridge* condition.
d. From application of heat transfer theory in accordance with generally accepted engineering practice and where approved by the a*uthority having jurisdiction*.
e. As indicated in Table A10.1. The default column shall be used where the thermal bridge meets prescriptive requirements. The unmitigated column shall be used where the thermal bridge does not meet the prescriptive requirements.

(***Informative Note:*** In Table A10.1, the values for *thermal bridge* details prescribed in Section 5.5.5 are based on data from ASHRAE Research Project 1365 and the BC Hydro Thermal Bridging Guide listed in Informative Appendix E.)

A10.2 Assembly U-Factor Adjustment for Simulation of Thermal Bridges. For the purpose of incorporating the effects of thermal bridges in simulations as required by Section 11 and Normative Appendix G, where a thermal bridge is not modeled as a separate element, the clear-field U-factors of modeled assemblies shall be modified in accordance with Equation A10.2. This modification shall be achieved in the simulation model by altering the conductance value assigned to any one or more insulation layers within the modeled assembly without altering the properties of modeled building material layers.

$$U_{tot} = \{[(\sum \psi_i \times L_i) + (\sum \chi_j \times n_j)]/A_{total}) + U_o\} \quad \text{(A10.2)}$$

where

U_{tot} = overall thermal transmittance, including the effect of *linear thermal bridges* and *point thermal bridges* not included in the *construction* assembly U_o-factor, Btu/(h·ft^2·°F) W/(m^2·K)

U_o = clear-field thermal transmittance of the *construction* assembly as determined in accordance with Section 5, Btu/(h·ft^2·°F) (W/[m^2·K])

A_{total} = total *opaque* projected surface area of the *construction* assembly, ft^2 (m^2)

ψ_i = *psi-factor*, thermal transmittance for each type of *linear thermal bridge*, Btu/(h·ft·°F) (W/[m·K])

L_i = length of a particular *linear thermal bridge* as measured on the outside surface of the *building envelope*, ft (m)

χ_i = *chi-factor*, thermal transmittance for each detail type of *point thermal bridge*, Btu/(h·°F) (W/K)

n_i = number of occurrences a particular type of *point thermal bridge*

Table A10.1 Thermal Bridging Psi-Factors and Chi-Factors for *Thermal Bridges* (I-P)

			Unmitigated		Default	
Class of Construction—Wall, above Grade	**Thermal Bridge Type**	**Section**	**Psi-Factor Btu/(h·ft·°F)**	**Chi-Factor Btu/(h·°F)**	**Psi-Factor Btu/(h·ft·°F)**	**Chi-Factor Btu/(h·°F)**
Steel framed and *metal buildings*	Roof edge	5.5.5.1.1	0.450	N/A	0.140	N/A
	Parapet	5.5.5.1.2	0.289		0.151	
	Intermediate floor to *wall* intersection	5.5.5.2.1	0.487		0.177	
	Intermediate floor balcony or overhang to opaque *wall* intersection	5.5.5.2.2	0.487		0.177	
	Intermediate floor balcony in contact with *vertical fenestration*	5.5.5.2.2	0.974		0.177	
	Cladding Support	5.5.5.3	0.314		0.217	
	Wall to *vertical fenestration* intersection	5.5.5.4	0.262		0.112	
	Other element and assembly intersections	5.5.5.5	N/A	1.73	N/A	0.91
Mass (exterior or integral)	Roof edge	5.5.5.1.1	0.500	N/A	0.100	N/A
	Parapet	5.5.5.1.2	0.238		0.125	
	Intermediate floor to *wall* intersection	5.5.5.2	0.476		0.179	
	Intermediate floor balcony or overhang to opaque *wall* intersection	5.5.5.2.2	0.476		0.179	
	Intermediate floor balcony in contact with *vertical fenestration*	5.5.5.2	0.974		0.177	
	Cladding support	5.5.5.3	0.270		0.186	
	Wall to *vertical fenestration* intersection	5.5.5.4	0.188		0.131	
	Other element and assembly intersections	5.5.5.5	N/A	0.91	N/A	0.19
Mass (interior)	Roof edge	5.5.5.1.1	0.500	N/A	0.100	N/A
	Parapet	5.5.5.1.2	0.511		0.227	
	Intermediate floor to *wall* intersection	5.5.5.2	0.476		0.286	
	Intermediate floor balcony or overhang to opaque *wall* intersection	5.5.5.2.2	0.476		0.286	
	Intermediate floor balcony in contact with *vertical fenestration*	5.5.5.2	0.974		0.177	
	Cladding support	5.5.5.3	Same as *mass* (exterior)			
	Wall to *vertical fenestration* intersection	5.5.5.4	0.313	N/A	0.083	N/A
	Other element and assembly intersections	5.5.5.5	Same as *mass* (exterior)			
Wood-framed and other	Roof edge	5.5.5.1.1	0.450	N/A	0.140	N/A
	Parapet	5.5.5.1.2	0.032		0.032	
	Intermediate floor to *wall* intersection	5.5.5.2.1	0.336		0.049	
	Cladding support	5.5.5.3	0.186		0.043	
	Wall to *vertical fenestration* intersection	5.5.5.4	0.150		0.099	
	Other element and assembly intersections	5.5.5.5	N/A	0.33	N/A	0.07

N/A = not applicable

Table A10.1 Thermal Bridging Psi-Factors and Chi-Factors for *Thermal Bridges* (SI)

			Unmitigated		Default	
Class of Construction—Wall, above Grade	**Thermal Bridge Type**	**Section**	**Psi-Factor W /m K**	**Chi-Factor W /m K**	**Psi-Factor W /m K**	**Chi-Factor W /m K**
Steel framed and *metal buildings*	Roof edge	5.5.5.1.1	0.650	N/A	0.020	N/A
	Parapet	5.5.5.1	0.500		0.260	
	Intermediate floor to *wall* intersection	5.5.5.2	0.842		0.307	
	Intermediate floor balcony or overhang to opaque *wall* intersection	5.5.5.2.2	0.842		0.307	
	Intermediate floor balcony in contact with *vertical fenestration*	5.5.5.2	1.686		0.307	
	Cladding support	5.5.5.2	0.554		0.376	
	Wall to *vertical fenestration* intersection	5.5.5.3	0.505		0.194	
	Other element and assembly intersections	5.5.5.~~5~~4	N/A	0.92	N/A	0.48
Mass (exterior or integral)	Roof edge	5.5.5.1.1	0.750	N/A	0.150	N/A
	Parapet	5.5.5.1	0.412		0.217	
	Intermediate floor to *wall* intersection	5.5.5.2	0.824		0.205	
	Intermediate floor balcony or overhang to opaque *wall* intersection	5.5.5.2.2	0.824		0.205	
	Intermediate floor balcony in contact with *vertical fenestration*	5.5.5.2	1.686		0.307	
	Cladding support	5.5.5.2	0.476		0.322	
	Wall to *vertical fenestration* intersection	5.5.5.3	0.325		0.226	
	Other element and assembly intersections	5.5.5.~~5~~4	N/A	0.46	N/A	0.33
Mass (interior)	Roof edge	5.5.5.1.1	0.750	N/A	0.150	N/A
	Parapet	5.5.5.1.2	0.884		0.393	
	Intermediate floor to *wall* intersection	5.5.5.2	0.824		0.495	
	Intermediate floor balcony or overhang to opaque *wall* intersection	5.5.5.2.2	0.824		0.495	
	Intermediate floor balcony in contact with *vertical fenestration*	5.5.5.2	1.686		0.307	
	Cladding support	5.5.5.3	Same as *mass* (exterior)			
	Wall to *vertical fenestration* intersection	5.5.5.4	0.543	N/A	0.143	N/A
	Other element and assembly intersections	5.5.5.5	Same as *mass* (exterior)			
Wood-framed and other	Roof edge	5.5.5.1.1	0.150	N/A	0.020	N/A
	Parapet	5.5.5.1	0.056		0.056	
	Intermediate floor to *wall* intersection	5.5.5.2	0.582		0.084	
	Cladding support	5.5.5.2	0.322		0.074	
	Wall to *vertical fenestration* intersection	5.5.5.3	0.260		0.171	
	Other element and assembly intersections	5.5.5.4	N/A	0.33	N/A	0.04

N/A = not applicable

Modify Normative Appendix C, Section C1 as shown (I-P and SI).

C1.2.7 For Thermal Bridges Identified in Section 5.5.5. *Thermal bridge* inputs and specifications shall be individually identified for the thermal bridges indicated in Section 5.5.5 according to one of the following:

a. Where the thermal bridge complies with one of the requirements of Sections 5.5.5.1 through 5.5.5.5, no additional inputs shall be required.
b. Where the thermal bridge does not comply with one or more of the requirements of Sections 5.5.5.1 through 5.5.5.5, the *linear thermal bridge* type or *point thermal bridge* type, length or count, the assembly interrupted by this *thermal bridge*, and the *Psi-factor* or *Chi-Factor* shall be specified. The input shall be a user-defined value or one of the unmitigated values from Table A10.1.
c. Where Section 5.5.5 and Sections 5.5.5.1 through 5.5.5.5, including exceptions, are not applicable to the *thermal bridge,* no additional inputs shall be required.

Modify Normative Appendix C, Section C2 as shown (I-P and SI).

C2.9 For thermal bridges,

a. confirmation that the proposed design complies with the each of the requirements of Sections 5.5.5.1 through 5.5.5.5 including exceptions or
b. where the proposed design does not comply with each of the individual requirements of Sections 5.5.5.1 through 5.5.5.5, list the *thermal bridges*, the proposed *psi-factors*, proposed *chi-factors*, and source information.

Modify Normative Appendix C, Section C3.5.5.4 as shown (I-P and SI).

C3.5.5.4 Thermal Bridges. *Linear* and *point thermal bridges* in the *proposed design* shall be either of the following:

a. Not modeled where option (a) or (c) is selected in Section C1.2.7.
b. Entered as individual *thermal bridge* inputs of length or count where option (b) is selected in Section C1.2.7 and addressed as follows:
   1. Individual *thermal bridges* in the proposed design that are indicated to comply with the requirements of Sections 5.5.5.1 through 5.5.5.5 need not be modeled.
   2. Individual *thermal bridges* in the proposed design that are indicated to not comply with the requirements of Sections 5.5.5.1 through 5.5.5.5 shall be modeled.
   3. Individual *thermal bridges* in the proposed design that are indicated to be not applicable with the requirements of Sections 5.5.5.1 through 5.5.5.5 need not be modeled.

Modify Normative Appendix C, Section C3.6 as shown (I-P and SI).

C3.6 Calculation of Base Envelope Performance Factor. The simulation model for calculating the *base envelope performance factor* shall modify the simulation model for calculating the *proposed envelope performance factor* as follows:

a. All *opaque* assemblies shall be modeled with ~~maximum~~ the *U-factor* not greater than that required in Section 5.5.3 for the appropriate *class of construction*, *space-conditioning category*, and climate zone. *Mass walls* and *mass floors* shall be modeled with HC equal to 7.2 Btu/ft^2·°F (147 kJ/m^2·K). All other *opaque* assemblies shall be modeled with the same HC as the *proposed design*. *Mass walls* shall be modeled with equal mass on each side of the insulation. All other *opaque* assemblies shall be modeled with insulation on the exterior. *Thermal bridges* shall modify assembly *U-factors* in accordance with item C3.6b.
b. *Thermal bridges*:
   1. Where option (a) is selected in Section C1.2.7, no modifications to the assembly *U-factors* are required.
   2. Where option (b) is selected in Section C1.2.7, the *U-factor* of the assembly interrupted shall be modified per Section A10.2 using the default values in Table A10.1 for the appropriate *class of construction*. Each of the *linear thermal bridges* or *point thermal bridges* identified in Sections 5.5.5.1 through 5.5.5.5 shall be modeled in the simulation model for calculating the proposed envelope performance. Where the balcony length in the proposed

design is greater than allowed by Section 5.5.5.2.2, the area shall be reduced proportionally along each exposure until the limit set in Section 5.5.5.2.2 is met.

3. Where option (c) is selected in Section C1.2.7, no modifications to the assembly *U-factors* are required.

~~b~~c. The exterior *roof* surfaces shall be modeled [. . .]

Revise Informative Appendix E as shown (I-P and SI).

ASHRAE
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~~Atlanta, GA 30329-2305~~
~~(*After 10/30/2020:*~~
180 Technology Parkway
Peachtree Corners, GA 30092~~)~~

[. . .]

BC Hydro
Corporate Head Office
333 Dunsmuir Street
Vancouver, B. C. V6B 5R3

Subsection No.	Reference	Title/Source
[. . .]		
Table A10.1	BC Hydro New Construction Program Orientation Manual (June 2016)	https://www.bchydro.com/powersmart/business/programs/new-construction.html#thermal
Table A10.1	ASHRAE Research Project 1365	The Impact of Thermal Bridges on Effective Thermal Resistance and Energy Use in Mid and High Rise Buildings
[. . .]		

Modify Appendix G, Table G3.1 as follows:

Table G3.1 Modeling Requirements for Calculating *Proposed Building Performance* and *Baseline Building Performance*

No. Proposed Building Performance	Baseline Building Performance
[. . .]	
5. *Building Envelope*	
a. All components of the *building envelope* in the *proposed design* shall be modeled as shown on architectural drawings or as built for *existing building envelopes*. All *opaque building envelope* components shall be modeled accounting for thermal mass effects. **Exceptions:** The following *building* elements shall be permitted to differ from architectural drawings: 1. ~~All uninsulated assemblies (e.g., projecting balconies, perimeter edges of intermediate floor slabs, concrete floor beams over parking garages, *roof* parapet)~~ Each *linear thermal bridge* and *point thermal bridge* as identified in Section 5.5.5 shall be ~~separately~~ modeled using either of the following techniques: a. A s~~S~~eparate model of ~~each of these assemblies~~ the assembly within the *energy* simulation model. b. Adjustment of the clear-field *U-factor* in accordance with Section A10.2. 2. Each uninsulated assembly not identified in Section 5.5.5 shall be modeled using either of the following techniques: a. A separate model of the assembly within the *energy* simulation model. b. ~~Separate calculation of the *U-factor* for each of these assemblies.~~ The *U-factors* of ~~these~~ uninsulated assemblies ~~are then~~ can be averaged with larger adjacent surfaces of the same *class of construction* using an area-weighted average method. This average *U-factor* is modeled within the *energy* simulation model. 3. Any other *building envelope* assembly, that covers less than 5% of the total area of that *class of construction* (e.g., *exterior walls*) need not be separately described, provided that it is similar to an assembly being modeled. If not separately described, the *U-factors* of these assemblies are then averaged with larger adjacent surfaces using an area-weighted average method. This average *U-factor* is modeled within the *energy* simulation model. ~~2~~4. Exterior surfaces whose azimuth *orientation* and tilt differ by less than 45 degrees and are otherwise the same may be described as either a single surface or by using multipliers. [. . .]	Equivalent dimensions shall be assumed for each *building envelope* component type as in the *proposed design*; i.e., the total gross area of *walls* shall be the same in the *proposed design* and *baseline building design*. The same shall be true for the areas of *roofs*, *floors*, and *doors*, and the exposed perimeters of concrete *slab on grade floors* shall also be the same in the *proposed design* and *baseline building design*. The following additional requirements shall apply to the modeling of the *baseline building design*: [. . .] c. ***Linear* and *Point Thermal Bridges.*** Where *linear thermal bridges* and *point thermal bridges*, as identified in Section 5.5.5, are modeled in the *proposed design*, they shall not be modeled in the *budget building design*. [. . .]

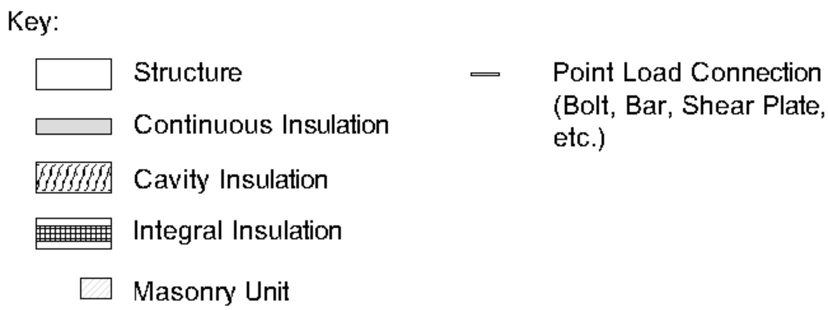
Add Informative Appendix J as shown (I-P and SI).

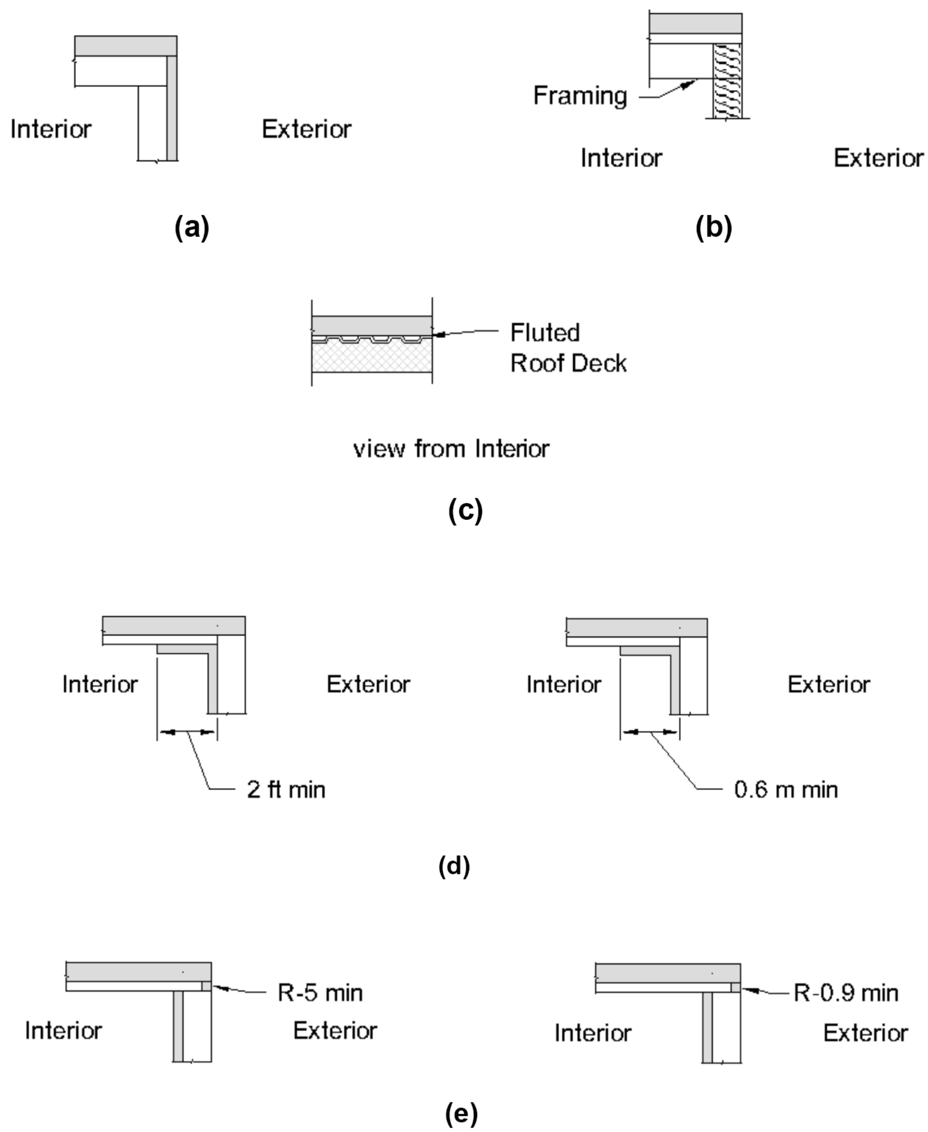
(This appendix is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus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

INFORMATIVE APPENDIX J
INFORMATIVE FIGURES

This appendix contains informative reference figures for Sections 5.5.5.1 through 5.5.5.4 for the convenience of users of Standard 90.1 and not for use as specific details required for compliance. These figures are not intended to include all detailed variations that may meet the requirements. It is not intended that the figures represent all possible compliant configurations. The figures do not show roof membrane or wall cladding.

SYMBOLS





<u>**Figure J-1 Key:**</u>

<u>a. Wall with exterior continuous insulation (Section 5.5.5.1.1[a])</u>
<u>b. Wall with cavity insulation (Section 5.5.5.1.1[b])</u>
<u>c. Wall with interior or cavity insulation (Sections 5.5.5.1.1[b] and [c])</u>
<u>d. Mass wall with interior insulation—I-P, SI (Section 5.5.5.1.1[c][1])</u>
<u>e. Mass wall with interior insulation—I-P, SI (Section 5.5.5.1.1[c][2])</u>

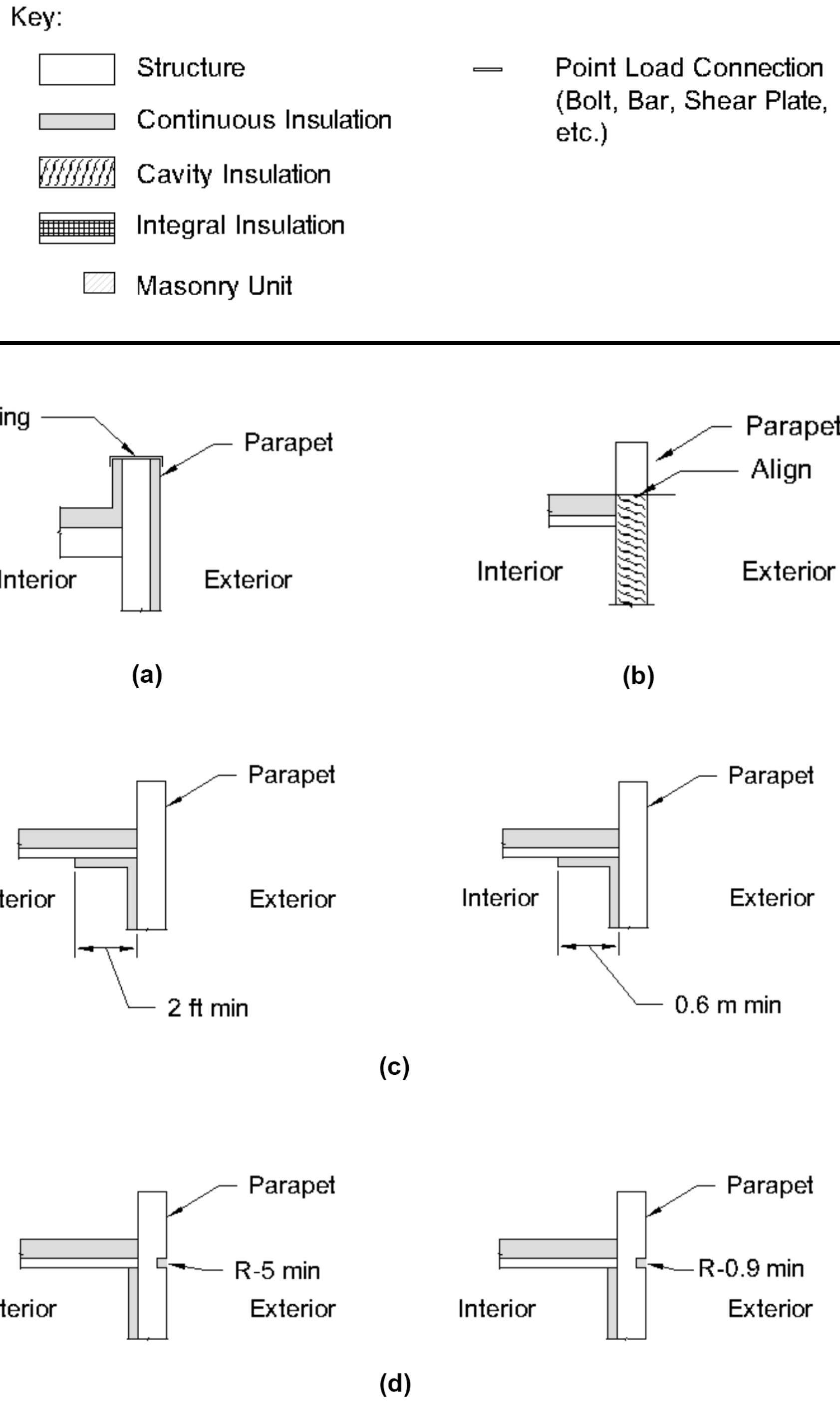
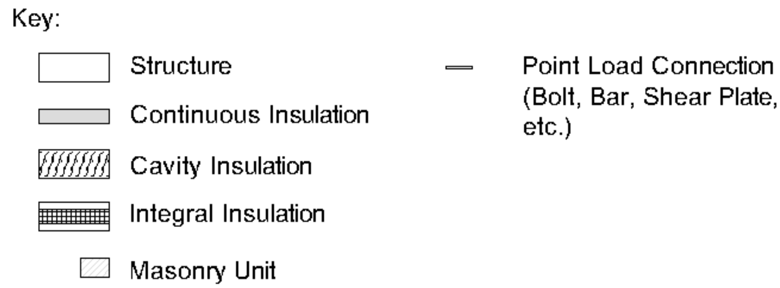
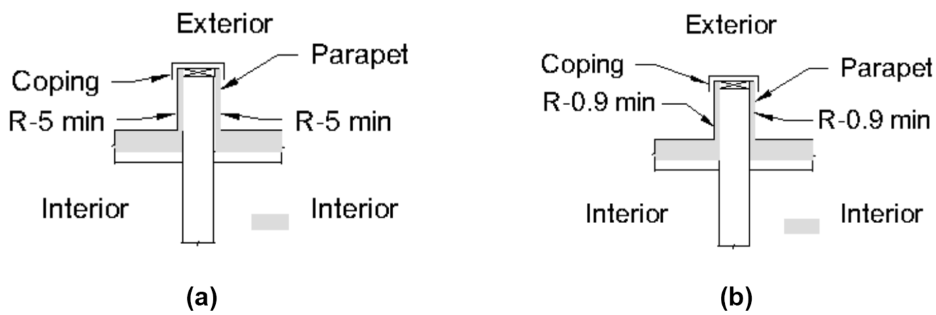


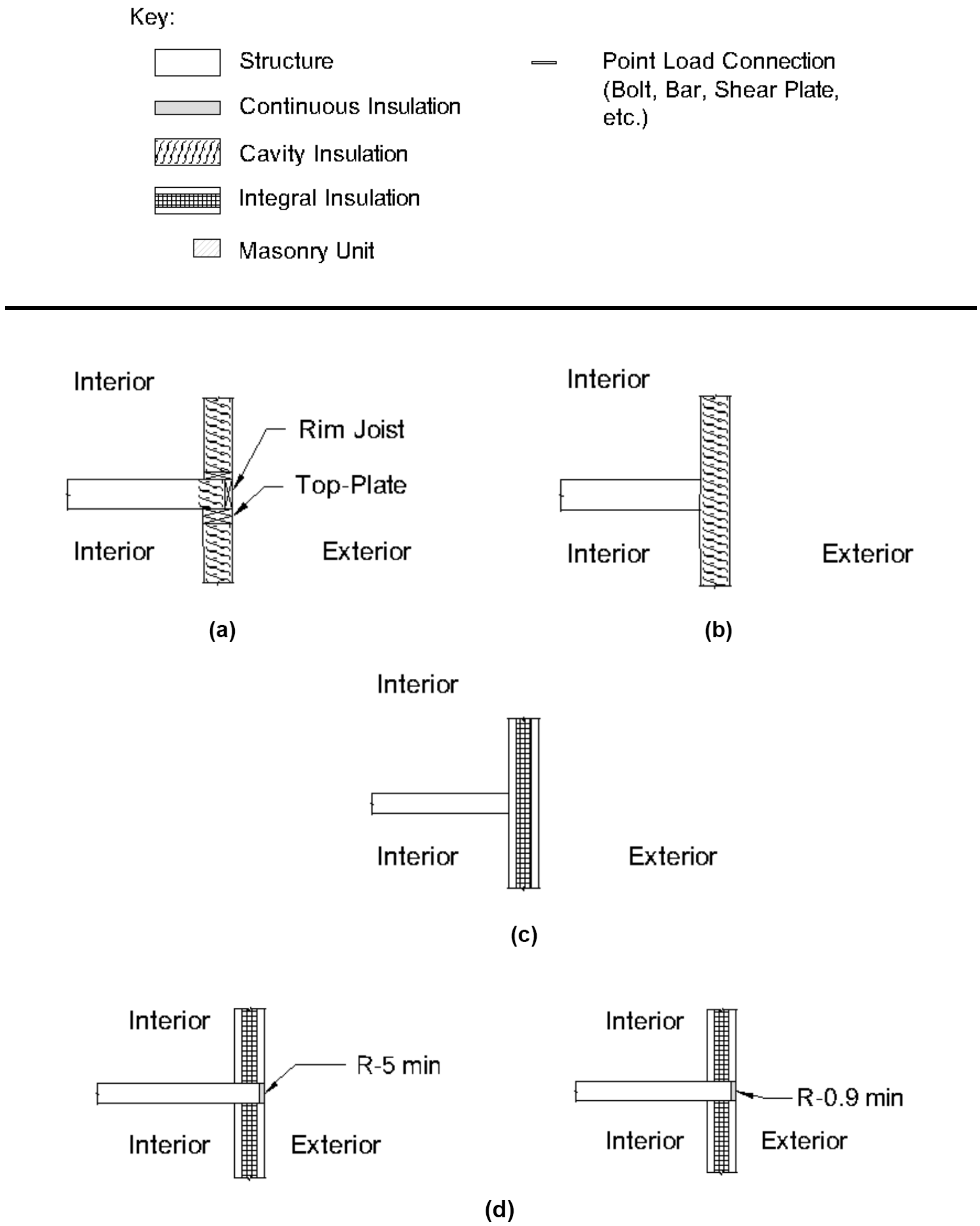
Figure J-2 Key:

a. Wall with exterior continuous insulation (Section 5.5.5.1.2[a])
b. Wall with cavity insulation (Section 5.5.5.1.2[b][1])
c. Mass wall with interior insulation—I-P, SI (Section 5.5.5.1.2[c][1])
d. Mass wall with interior insulation—I-P, SI (Section 5.5.5.1.21[c][2])



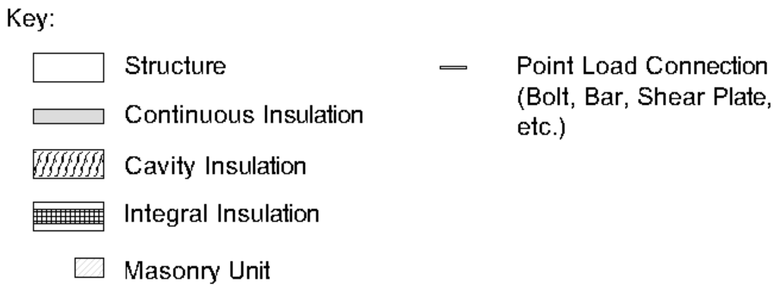


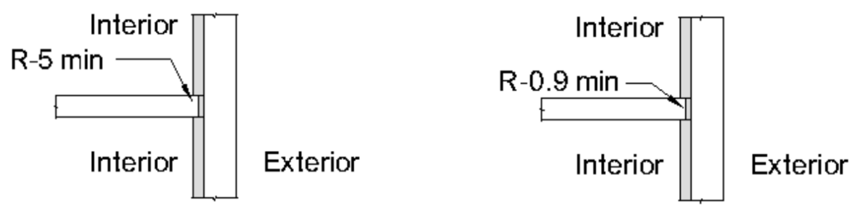
<u>**Figure J-3 Parapet within field of roof (a) I-P and (b) SI (Section 5.5.5.1.3).**</u>



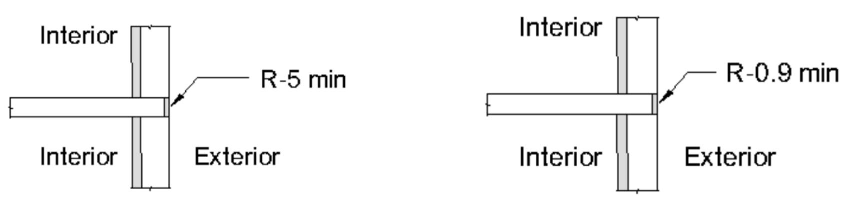
<u>**Figure J-4 Key:**</u>

<u>a. Wall with cavity insulation (Section 5.5.5.2.1[b])</u>
<u>b. Wall with cavity insulation (Section 5.5.5.2.1[b])</u>
<u>c. Wall with integral insulation (Section 5.5.5.2.1[c])</u>
<u>d. Mass wall with integral insulation—IP, SI (Section 5.5.5.2.1[c])</u>

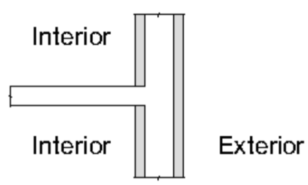




(e)



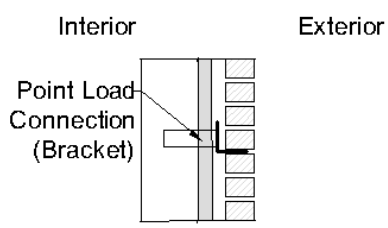
(f)



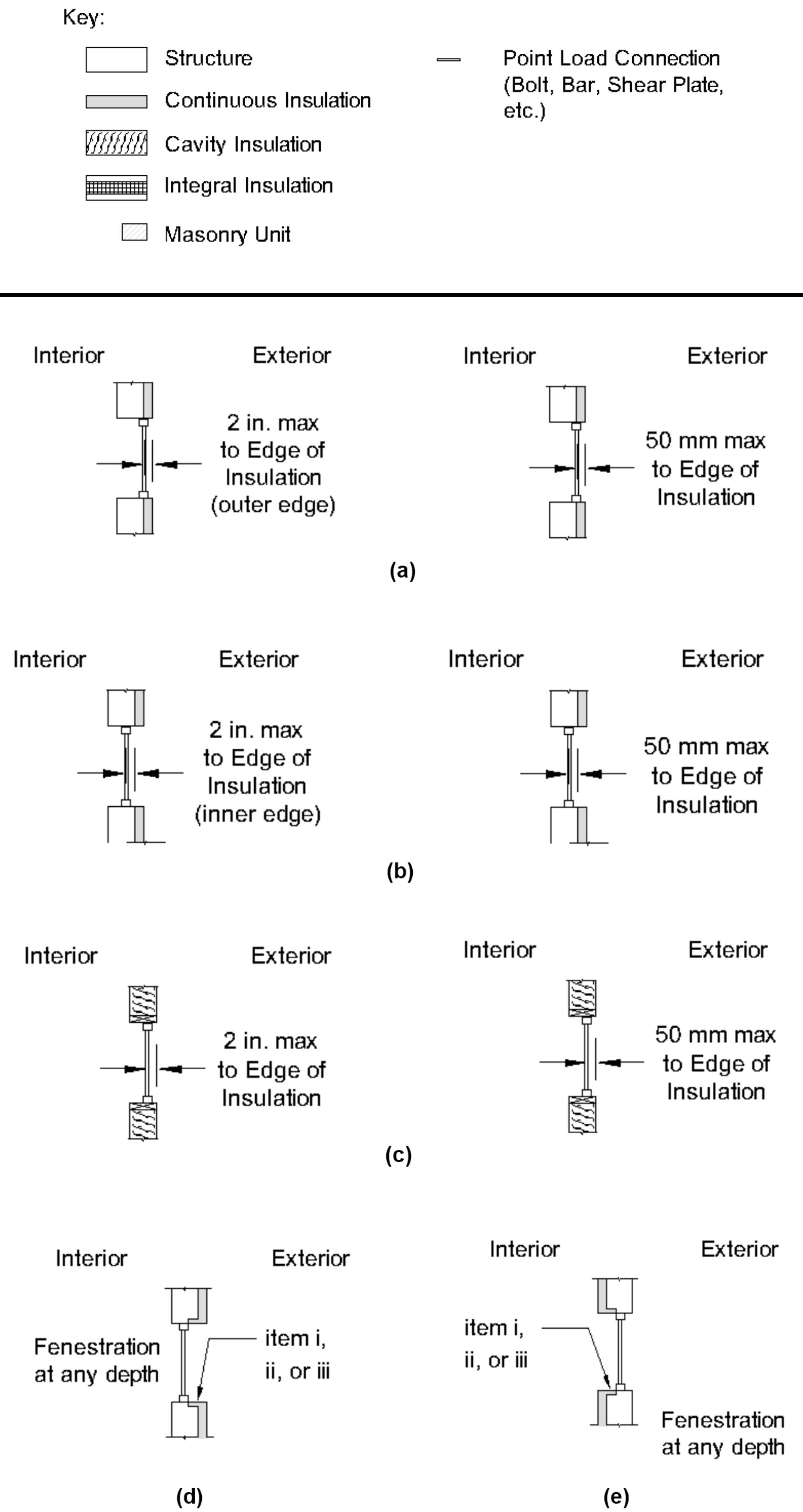
(g)

<u>**Figure J-4 (continued) Key:**</u>

<u>e. Mass wall with interior insulation—I-P, SI (Section 5.5.5.2.1[d][1])</u>
<u>f. Mass wall with interior insulation—I-P, SI (Section 5.5.5.2.1[d][2])</u>
<u>g. Mass wall with exterior continuous insulation plus interior insulation (Section 5.5.5.2.1[e])</u>



<u>**Figure J-5 Shelf angles supporting exterior cladding (Section 5.5.5.3).**</u>



<u>Figure J-6 Key:</u>

<u>a. Fenestration and continuous insulation—I-P, SI (Section 5.5.5.4[a])</u>
<u>b. Fenestration and continuous insulation—I-P, SI (Section 5.5.5.4[a])</u>
<u>c. Fenestration and no continuous insulation—I-P, SI (Section 5.5.5.4[b])</u>
<u>d. Insulation between fenestration and wall (Section 5.5.5.4[c])</u>
<u>e. Insulation between fenestration and wall (Section 5.5.5.4[c])</u>

POLICY STATEMENT DEFINING ASHRAE'S CONCERN FOR THE ENVIRONMENTAL IMPACT OF ITS ACTIVITIES

ASHRAE is concerned with the impact of its members' activities on both the indoor and outdoor environment. ASHRAE's members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted Standards and the practical state of the art.

ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the Standards and Guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive Technical Committee structure, continue to generate up-to-date Standards and Guidelines where appropriate and adopt, recommend, and promote those new and revised Standards developed by other responsible organizations.

Through its *Handbook*, appropriate chapters will contain up-to-date Standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating Standards and Guidelines.

The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

ASHRAE's primary concern for environmental impact will be at the site where equipment within ASHRAE's scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.

ASHRAE · 180 Technology Parkway · Peachtree Corners, GA 30092 · www.ashrae.org

About ASHRAE

Founded in 1894, ASHRAE is a global professional society committed to serve humanity by advancing the arts and sciences of heating, ventilation, air conditioning, refrigeration, and their allied fields.

As an industry leader in research, standards writing, publishing, certification, and continuing education, ASHRAE and its members are dedicated to promoting a healthy and sustainable built environment for all, through strategic partnerships with organizations in the HVAC&R community and across related industries.

To stay current with this and other ASHRAE Standards and Guidelines, visit www.ashrae.org/standards, and connect on LinkedIn, Facebook, Twitter, and YouTube.

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7/22

File Attachments for Item:

OB-1 Review of Stakeholder Comments for AG 100 (OBC, OMC, & OPC)

2024 Ohio Building Code Comments					
Commenter	Email	Code Section	Comment	Staff Comments	Code Committee Action
Arthur, Dan	arthurteam.realestate@gmail.com	1110.18, 1113	Support for adoption of adult changing tables provisions		
Baker, Kayla	kbaker@mybvls.org	1110.18, 1113	Support for adoption of adult changing tables provisions		
Beasley, Audra	docprep@adbparalegal.com	1110.18, 1113	Support for adoption of adult changing tables provisions		
Bielanski, Joe	joebielanski@kw.com	1110.18, 1113	Support for adoption of adult changing tables provisions		
Beres, Kurt	kurtb@designwithma.com	General	I am so excited to see the state of Ohio making the leap to the 2021 model code. The update is extremely important to adopt for our state's long term financial security and promotion of new businesses. As an architect, CBO, and MPE familiar with the OBC and 2021 model code I have compiled the following list of recommended changes for consideration as part of the adoption.		
Beres, Kurt		AGRICULTURAL BUILDING.	A structure designed and constructed to house farm implements, hay, grain, poultry, livestock or other horticultural products. This structure is not to be a place of human habitation or a place of employment where agricultural products are processed, treated or packaged, nor is it to be a place used by the public. (See definition of “AGRICULTURAL PURPOSES”, section 101.2, and section 312 of this code).	Typo. Will fix.	
Beres, Kurt		406.5.2.1	Recommendation - to align with the requirements of table 705.5 Revise as follows "Where openings below grade provide required natural ventilation the outside horizontal clear space shall be one and one half times the depth of the opening up to 10' wide. The width of the horizontal clear space shall be maintained from grade down to the bottom of the lowest required opening."	Concern that 10' max width may not provide adequate natural ventilation for below grade garages and that this proposal conflicts with OBC 1202.5.1.2	
Beres, Kurt		406.5.2.1	As discussed during the stakeholders meeting I have revised the proposed change below to align 406.5.2.1 with 406.5.2.1 Recommendation - to align with the requirements of 1206 Revise as follows "Where openings below grade provide required natural ventilation the outside horizontal clear space shall be one and one half times the depth of the opening up to 23' wide. The width of the horizontal clear space shall be maintained from grade down to the bottom of the lowest required opening."	IBC Section 1205 (not 1206) deals with above-grade yards and courts. In contrast, IBC Section 406.5.2.1 is specifically addressing below grade natural ventilation requirements	
Beres, Kurt		406.6.2	Can you clarify the intent of deleting 406.6.2 ventilation is generally a basic requirement for enclosed garages.	The exception was proposed to be deleted because garages accessory to 1- and 2-family dwellings are within scope of the RCO, not the OBC	

Beres, Kurt		507.14	To mimic 507.13 From the 2017 OBC to allow for use of property deeded or dedicated on adjacent properties be used for use in determining the compliance of an unlimited area building. This code section has been a mainstay of the OBC for several code cycles now and has been the envy of many of our sister states.	The code language was moved to OBC Section 106.1.2.7	
Beres, Kurt		705.5	Add an exception to mimic the 2017 OBC to allow for property on an adjacent property to be deeded or dedicated as a no build zone and contribute to the fire separation distance. See above.	The code language was moved to OBC Section 106.1.2.7	
Beres, Kurt		705.6	Add the following exception to 705.6 - Reasoning this is in keeping with 706.2 and allows the floor sheathing to act structurally. Exception - Floor and roof sheathing not exceeding 3/4" thickness are permitted to be continuous through the exterior wall assembly to interior face of the exterior wall sheathing in light frame construction.	2021 IBC Commentary states that this exception is intended to allow the roof and floor diaphragms to remain in-tact through a double fire-wall because there is only a small risk that the other fire wall (the non-fire side) would fail in a double-fire wall situation.	
Beres, Kurt		706.8.1	Revise Proposed Language for 706.8.1 to add the following exceptions (Reasoning the vestibule requirement impacts the ability of the fire walls to act independently and the code language for Horizontal Exits provides numerous additional protections further the existing language conflicts with the exception to 705.3) Exception 1: Openings in double fire walls complying with section 1026 for Horizontal Exits. Exception 2: Openings complying with 705.3 Exception 2	The proposed OBC Section 706.8.1 language was brought in before the model code recognized double fire walls. Perhaps we should simply refer to NFPA 221 and delete the Ohio change.	
Beres, Kurt		903.2.10	Recommendation - (This proposed exception opens up existing opening parking garages to be have partial adaptive reuses while as written might be technically infeasible and allows them to be modified in the future and addresses the majority of concerns raised by fire departments concerning electric vehicles, 1: Early Detection of thermal runaway and 2: The ability to apply as much water as possible to the source of the fire which sprinklers are incapable of providing) Add exception 2: Open Parking Garages provided with additional stand pipes such that all parking spaces with vehicle charging stations are fully covered by two standpipes and any space equipped with an electric vehicle charging station is provided with heat detectors tied to a fire alarm system with automatic notification of the local fire department.		

Beres, Kurt		1020.2	The proposed table 1020.2 is confusing and is not in keeping with past OBC sections, as proposed it is identical in application to the table in the model code. Recommend eliminating in the table the words "or provided with a partial sprinkler system" and adding footnote C to 13R and footnote D to 13D while adding I-1 to the footnote and applying C to the 13 column in similar locations as the 2017 OBC.	Staff was proposing this table reorganization to recognize unique Ohio exceptions for Group R and to clarify intent of footnote c which sparked many questions.	
Beres, Kurt		1102.2	The language does not do a good job for the purposes of ICCA117.1- 2017 to identify existing buildings. Recommend adding language referencing that existing buildings for the purposes of the application of requirements for existing buildings identified in ANSI A117.1 shall be buildings constructed using the 2017 Ohio Building Code or earlier.	The definition of "existing building" in the ICCA117.1 standard is the same as the 2021 IBC. BBS staff is proposing a different definition.	
Beres, Kurt		1110.18.1	References to Adult Changing Stations. 1110.18.1 - Recommend Revising #3 to include Group E occupancies serving special need students above the 6th grade. Recommend revising item 1 to make the requirement a tier above what is required for a family restroom since this would be a double burden or excluding M all together except for open and enclosed malls.	Proposed language was intended to mirror the 2024 IBC and A117.1 in scope.	
Beres, Kurt		1210.3.1	1210.3.1 Revise Exception 2 (Reasoning most child care uses provide low or no toilet partitions for younger children to allow staff to assist in potty training). New Section to read - Toilets rooms located in child day care facilities must provide facilities dedicated for the privacy of staff but may provide additional facilities without enclosing compartments solely for assisting with potty training as determined by the building official.	IBC allows for only one unenclosed water closet, recognizing that an adult may need to assist a child	
Campbell, Meahan	m.campbell.6492@gmail.com	1110.18, 1113	Support for adoption of adult changing tables provisions		
Chase, Steve	chief@ashtabulafire.com	903.4 & 913.4	IBC Section 903.4 requires electrical supervision and monitoring of backflow prevention assembly valves, however, Section 913.4 allows locking of the same valves. Which is it?	The NFPA 13 Section 8.16.1.1.2.1 allows locking of the valves	
Collins, dave	dcollins@preview-group.com	1002.2	The reference is to the IBC, not the building code. I saw no rule change for that? Still working on it?	The rules of construction is intended to change references from the IBC to the OBC	
Combs, Pamela/Montgomery Cty Board of Developmental Disabilities Services		1110.18, 1113	Support for adoption of adult changing tables provisions		
Dowll, Sophia	sophiardowell@gmail.com	1110.18, 1113	Support for adoption of adult changing tables provisions		

Dugan, Kelly	kellydugan117@gmail.com	1110.18, 1113	Support for adoption of adult changing tables provisions		
Earl, Jennifer	jennearl.re@gmail.com	1110.18, 1113	Support for adoption of adult changing tables provisions		
Emch, Theresa	temch@kw.com	1110.18, 1113	Support for adoption of adult changing tables provisions		
Flanery, Anne	annemarie2109@gmail.com	1110.18, 1113	Support for adoption of adult changing tables provisions		
Fox, Faith	naomigracerapha@gmail.com	1110.18, 1113	Support for adoption of adult changing tables provisions		
Goss, Natlie	nataliegoss8@gmail.com	1110.18, 1113	Support for adoption of adult changing tables provisions		
Gott, Heather	hgott@kw.com	1110.18, 1113	Support for adoption of adult changing tables provisions		
Harmon, Kristin	kharmon@iamboundless.org	1110.18, 1113	Support for adoption of adult changing tables provisions		
Hinkel, Jill		1110.18, 1113	Support for adoption of adult changing tables provisions		
Hopkins, Madeline	mhopkins@mybvls.org	1110.18, 1113	Support for adoption of adult changing tables provisions		
Huber, Charles	Charles.Huber@lakewoodoh.net	105.3, 105.4	Draft Ohio Building Code (OBC) 105.3 "Conditional approval" accurately reflects the statutory language at Ohio Revised Code (ORC} 3791.04(0) (extract attached). Draft OBC 105.4 "Phased approval" accurately reflects the statutory language at ORC 3791.04(G) (extract attached).	Draft Chapter 1 rule proposes to keep "Conditional approval", but proposes to delete "Nonconformance approval"	
Huber, Charles		105.3.1	Renumber, Draft OBC 105.3.1 to read 105.4.1 and revise text to read, "Incomplete fire protection system drawings. For fire protection system drawings, if actual fire protection system details or product listing information is not known at the time of plan examination, conditional phased plan approval shall be granted subject to subsequent submission of the information prior to installation of any part of the fire protection systems." This more accurately reflects the statutory language at ORC 3791.04(D) & (G).	A "phased approval" may be more appropriate for fire protection system documents because it appears that "conditional approval" is intended for conflicting interpretations of the code.	
Huber, Charles		OBC Table 2902.1 & OPC Table 403.1	Draft OBC Table 2902.1 & Draft OPC Table 403.1, Add Footnote Pointing to ORC 3318.038 Water Bottle Filling Stations in Schools. 133rd Session Ohio General Assembly Senate Bill 259 (133 GA SB 259), revised by 134 GA House Bill 110 (134 GA HB 110) enacted/revised Ohio Revised Code (ORC) 3318.038 (attached) providing requirements for water bottle filling stations and drinking fountains. Revise draft Ohio Building Code (OBC) Table 2902.1 and draft Ohio Plumbing Code (OPC) Table 403.1 by adding footnote to each reading, "See Section 3318.038 of the Revised Code for water bottle filling station and drinking fountain additional requirements for schools approved by Ohio Facilities Construction Commission."	Staff has removed many pointers in order to reduce the content of the rules. It appears that this requirement is applicable only to schools approved by the Ohio Facilities Construction Commission for funding. This is similar to another agency licensing requirement that is not intended to be enforced by the building departments.	
Jackson, Julie	namaste.julie@gmail.com	1110.18, 1113	Support for adoption of adult changing tables provisions		
Jenkins, Dewayne	Dewayne.Jenkins@ketteringoh.org	General	I am in full support of the proposed updates in code editions as proposed by the Board of Building Standards.		
Jenson, Lindsey	talula@gmail.com	1110.18, 1113	Support for adoption of adult changing tables provisions		
Kemp, Brian	briankemp@kw.com	1110.18, 1113	Support for adoption of adult changing tables provisions		
Kidd, Scott	SKidd@mcbdds.org	1110.18, 1113	Support for adoption of adult changing tables provisions		

Kirkwood, Sandy	sandykirkwood2005@gmail.com	1110.18, 1113	Support for adoption of adult changing tables provisions		
Kowalczyk, Paul	pkowalczyk@pepperpike.org	1110.18, 1113	1. Under the adult changing station Section 1110.18.1, was it ever discussed to make this required under the Group I-4 adult daycares? It seems this would be a logical place to require these. 2. Is there any provision that would allow the adult changing station to be a substitute for the baby changing station? Could the adult changing station serve both purposes, therefore eliminating the need to have (1) child and (1) adult? 3. For E occupancies, should that sentence end with "but no less than 1 required for the building"? Based on the square footage of a room or space, you may not reach the requirements of six or more and then you would not need to provide one. I think the one Mom who spoke may it clear that these buildings should at least be provided with one.	1. Proposed language was intended to mirror the 2024 IBC for scope and proposed A117.1 for accessibility requirements. 2. In my opinion, it could serve for both; however, neither the IBC/OBC nor A117.1 require a baby changing station. The authority that requires a baby changing station should answer the question. 3. The charging paragraph requires at least one. Not the intent of the ICC code change to require for all Group E buildings.	
Lacey, Eric	eric@reca-codes.com	Chpt 35	Support for adoption of the 2021 IECC and 2019 ASHRAE 90.1		
Lehman, Tracey	tjlehman@hotmail.com	1110.18, 1113	Support for adoption of adult changing tables provisions		
Martin, Latish		1110.18, 1113	Support for adoption of adult changing tables provisions		
Martin, Garet		1110.18, 1113	Support for adoption of adult changing tables provisions		
Martin, Bree	breemcvean@gmail.com	1110.18, 1113	Support for adoption of adult changing tables provisions		
Martin, Lisa	lbmartin64@gmail.com	1110.18, 1113	Support for adoption of adult changing tables provisions		
Morison, Jed/Franklin Cty Board of Dev Disabilities	Jed.Morison@fcbdd.org	1110.18, 1113	Support for adoption of adult changing tables provisions		

Parmalee, Chris	christopher.parmelee@lakewoodoh.net	107.6.1, 107.6.2	Draft Ohio Building Code (OBC) 105.1 et seq. deletes existing OBC 105.1.1 Nonconformance approval. If this deletion's adopted, then: a. Existing and draft OBC 107.6.1 & 107.6.2 shows the building official determines whether the plans examiner's comments are to be communicated to the owner's representative asking whether the drawings will be revised and resubmitted. Estimated date of resubmission's obtained. b. Existing and draft OBC 107.6.2 reads in part, "The building official ... determines whether any approvals are possible, and issue the appropriate approval as described in Section 105." That section describes "Conditional approval." and "Phased approval." These descriptions (definitions) are driven by statute, Ohio Revised Code 3791.04(G) and 3791.04(D) respectively. c. It's unlikely that conditional approval (defined by statute) will be appropriate. That leaves either: (1) Phased approval, or (2) Disapproval of Plans Adjudication Order (no approval). 2. One or a series of phased approvals is a clumsy method where the issues are items such as: a. Accessible signage. b. Door hardware. c. Occupant load information in each room. d. Structural design loads. e. Occupancy Group(s)/Division(s)f. Exit signs, emergency powered means of egress lighting, conventional and emergency powered exit discharge lighting. Therefore, deleting nonconformance approval removes a tool building officials now have toxpedite plan approval and construction	A "phased approval" may be more appropriate in most cases because it appears that "conditional approval" is intended for conflicting interpretations of the code and "nonconformance approval" was only good for 30 days, creating a tracking requirement for the department.	
Reed, Madison	miracleformadison1@icloud.com	1110.18, 1113	Support for adoption of adult changing tables provisions		
Reed, Madison	uysports21@gmail.com	1110.18, 1113	Support for adoption of adult changing tables provisions		
Rogowski, Andrea, Mike & Ben		1110.18, 1113	Support for adoption of adult changing tables provisions		
Senseman, Marilou	marilousen@yahoo.com	1110.18, 1113	Support for adoption of adult changing tables provisions		
Sheldon, Marisa	sheldon.127@osu.edu	1110.18, 1113	Support for adoption of adult changing tables provisions		
Simmons, Tom/Dept of Aging	TSimmons@age.ohio.gov	1110.18, 1113	No comment		
Sunderman, Mary	Mary@sunderman.org	1110.18, 1113	Support for adoption of adult changing tables provisions		
Sykes, Laura	mswheelchairoh2020@outlook.com	1110.18, 1113	Support for adoption of adult changing tables provisions		
Van Winkle, Juliana		1110.18, 1113	Support for adoption of adult changing tables provisions		
Warne, Savannah	savannah@holisticws.com	1110.18, 1113	Support for adoption of adult changing tables provisions		
Wilkinson, Ed	edwilkinson771@gmail.com	1110.18, 1113	Support for adoption of adult changing tables provisions		
Wilson, Shauna	sshunter03@yahoo.com	1110.18, 1113	Support for adoption of adult changing tables provisions		

Young, Benjamin	benwestohio@outlook.com	1110.18, 1113	Support for adoption of adult changing tables provisions		
Young, Janet		1110.18, 1113	Support for adoption of adult changing tables provisions		
Zender, Amy	amybethzender@gmail.com	1110.18, 1113	Support for adoption of adult changing tables provisions		

From: Dan, Team Arthur Realtors
To: BBS, BBSOfficAsst3
Subject: Support for Building Code Section 1110.18 and 1113
Date: Friday, March 17, 2023 3:32:11 PM

I am writing to you to show my support for adding the new proposed sections to the building code Section 1110.18 and 1113 pertaining to adult changing stations.

Dan Arthur
Worthington OH
614-778-3700

From: Kayla Baker
To: BBS, BBSOfficAsst3
Subject: Adult Changing tables availability
Date: Tuesday, March 21, 2023 1:10:49 PM

Hi there!

My name is Kayla Baker. I am a paraprofessional, I have several students that require changing needs outside of the use of a toilet. I am writing to advocate for the need for adult changing tables in all buildings.

We often take field trips in the community. Almost all of these community places have changing tables in the female restrooms. These changing tables are ONLY for children that are under the age of 3 and weigh less than 50 lbs. Due to this, my students often have to be changed within the confinement of their wheelchair. This is not sanitary because if the student were to have a large movement it can get onto their wheelchair, then we have no space for the student and the wheelchair to get clean. I have experienced this first hand at several locations in the community, like the Columbus Zoo.

I also noted that most changing tables are found in female restrooms. This does not allow male children to be changed in an appropriate area.

Please let me know if you have any questions or would like to discuss this further.

Thank you,

Kayla Baker

From:	Audra Beasley
To:	BBS, BBSOfficAsst3
Cc:	Rep. Frank Lucas
Subject:	Equal Restroom Access
Date:	Tuesday, March 21, 2023 11:02:36 AM
Attachments:	USDOJ Response to Complaint re Capitol.pdf US Department of Justice Complaint and Exhibits 5 3 2021.pdf US DOJ Complaint1.jpg ODOT Electronic Fillable Form T2-504 8 24 2022.pdf Acknowledgement Letter for ADA and Section 504 complaints.pdf 2018 IBC OKC Amendments Draft - Working 2.24.22.docx Changing Stations IBC-E142-21 PC.pdf

Hello and good morning.

I've attached some reading material to help guide your decision as to whether or not updated building standards that include all is an issue the Ohio Building Code Commission is willing to address for your citizens and those, like my family, who might visit.

I've attached the following for your review:

A letter in response to my ADA grievance filed with Yellowstone National Park and Mount Rushmore after a National Park ranger directed my son and I to the floor in the restroom. The US Department of Interior is removing the barrier.

A letter in receipt of my Complaint with the US Dept. of Justice after lawmakers in Oklahoma refused to acknowledge my ADA grievances regarding armed Oklahoma Highway Patrol directing my son to the floor in the restroom at the Oklahoma State Capitol.

A letter in response to my ADA Grievance with the Oklahoma Department of Transportation regarding having to have my son half naked in a parking lot of the Blackwell Visitor Center for lack of restroom access and after a Senator killed a bill that would have provided such access for disabled American requiring caregiver assistance with toileting needs.

A document 2018 IBC... see line item 67, pages 14-16. It's what Oklahoma City Council is set to hear within weeks. It's word for word and aligns with the ICC's language. Shouldn't all cities be so thoughtful in panning.

I hope you'll read Ms. Geffen Treiman's student essay: STUDENT ESSAY No Dignity on the Floor: A Human Rights Argument for Adult-Sized Changing Tables in Public Restrooms in the United States – Health and Human Rights Journal (hhrjournal.org)

I'm a mother and caregiver of a six year old boy who loves to go and do all things all little boys do and the lack of restroom access everywhere we go is a barrier to our participation as a family. I hope you'll take a moment and read what I've sent you and know there is five years of work and many many hours invested in advocating for my son's right that was granted decades ago - some just refuse to acknowledge it. I hope you'll consider adopting the ICC's proposal as it intends to adopt. It aligns with my sons federal right to restroom access while visiting the buildings mentioned. Caregivers need the burden relieved. We carry a heavy load as is.

I've cced my Congressman, Frank Lucas, a I'm asking him to help relieve this burden too.

No One should be naked in parking lots or directed to the floor in a restroom for lack of private, safe and appropriate accommodations.

Thank you for your time and consideration.

--

Audra D. Beasley, Paralegal

7204 S. Blackwelder Avenue

Oklahoma City, OK 73159

www.adbparalegal.com

Cell: (405) 474-8464

From: Joseph Bielanski
To: BBS, BBSOfficAsst3
Subject: Adult Sized Changing Tables
Date: Thursday, March 16, 2023 3:52:58 PM

Dear , Whomever it may concern

I am writing to express my concern and bring to your attention the need for adult-sized changing tables in public spaces.

Currently, most public restrooms are equipped with baby changing tables, but unfortunately, there are no facilities available for adults with special needs or disabilities who require assistance with changing. This makes it very difficult for people with disabilities, their caregivers, and parents of children with special needs to access public places, as they are forced to limit their time outside of their homes.

Having adult-sized changing tables in public spaces will go a long way in providing support and enhancing the dignity of people with disabilities. Such facilities will make it easier for caregivers to provide assistance to their loved ones in a safe, clean, and hygienic environment. This will, in turn, promote social inclusion and provide a sense of independence for people with disabilities, which is essential for their overall well-being.

Moreover, having adult-sized changing tables in public spaces will promote the inclusivity of people with disabilities, and this will send a positive message to the community at large that people with disabilities are valued members of society.

Therefore, I am urging the government to take appropriate steps to ensure that public spaces are equipped with adult-sized changing tables. This will make a significant difference in the lives of people with disabilities and their caregivers. Thank you for taking the time to consider my request.

Sincerely,

Joe

--

From:	Beres, Kurt
To:	BBS, BBSOfficAsst3
Cc:	Jim Mitchell; David Prentice
Subject:	Comments on Draft Rules
Date:	Sunday, March 5, 2023 4:43:16 PM

I am so excited to see the state of Ohio making the leap to the 2021 model code. The update is extremely important to adopt for our state's long term financial security and promotion of new businesses. As an architect, CBO, and MPE familiar with the OBC and 2021 model code I have compiled the following list of recommended changes for consideration as part of the adoption.

Revise the proposed definition for Agricultural Building:

AGRICULTURAL BUILDING. A structure designed and constructed to house farm implements, hay, grain, poultry, livestock or other horticultural products. This structure is not **to** be a place of human habitation or a place of employment where agricultural products are processed, treated or packaged, nor is it to be a place used by the public. (See definition of "AGRICULTURAL PURPOSES", section 101.2, and section 312 of this code).

406.5.2.1 Recommendation - to align with the requirements of table 705.5 Revise as follows "Where openings below grade provide required natural ventilation the outside horizontal clear space shall be one and one half times the depth of the opening **up to 10' wide**. The width of the horizontal clear space shall be maintained from grade down to the bottom of the lowest required opening."

406.6.2 Can you clarify the intent of deleting 406.6.2 ventilation is generally a basic requirement for enclosed garages.

507.14 To mimic 507.13 From the 2017 OBC to allow for use of property deeded or dedicated on adjacent properties be used for use in determining the compliance of an unlimited area building. This code section has been a mainstay of the OBC for several code cycles now and has been the envy of many of our sister states.

705.5 Add an exception to mimic the 2017 OBC to allow for property on an adjacent property to be deeded or dedicated as a no build zone and contribute to the fire separation distance. See above.

705.6 Add the following exception to 705.6 - Reasoning this is in keeping with 706.2 and allows the floor sheathing to act structurally.
Exception - Floor and roof sheathing not exceeding 3/4" thickness are permitted to be continuous through the exterior wall assembly to interior face of the exterior wall sheathing in light frame construction.

Revise Proposed Language for 706.8.1 to add the following exceptions (Reasoning the vestibule requirement impacts the ability of the fire walls to act independently and the code language for Horizontal Exits provides numerous additional protections further the existing language conflicts with the exception to 705.3)
Exception 1: Openings in double fire walls complying with section 1026 for Horizontal Exits.
Exception 2: Openings complying with 705.3 Exception 2

903.2.10 Recommendation - (This proposed exception opens up existing opening parking garages to be have partial adaptive reuses while as written might be technically infeasible and allows them to be modified in the future and addresses the majority of concerns raised by fire departments concerning electric vehicles, 1: Early Detection of thermal runaway and 2: The ability to apply as much water as possible to the source of the fire which sprinklers are incapable of providing) Add exception 2: Open Parking Garages provided with additional stand pipes such that all parking spaces with vehicle charging stations are fully covered by two standpipes and any space equipped with an electric vehicle charging station is provided with heat detectors tied to a fire alarm system with automatic notification of the local fire department.

The proposed table 1020.2 is confusing and is not in keeping with past OBC sections, as proposed it is identical in application to the table in the model code. Recommend eliminating in the table the words "or provided with a partial sprinkler system" and adding footnote C to 13R and footnote D to 13D while adding I-1 to the footnote and applying C to the 13 column in similar locations as the 2017 OBC.

1102.2 - The language does not do a good job for the purposes of ICCA117.1- 2017 to identify existing buildings. Recommend adding language referencing that existing buildings for the purposes of the application of requirements for existing buildings identified in ANSI A117.1 shall be buildings constructed using the 2017 Ohio Building Code or earlier.

References to Adult Changing Stations. 1110.18.1 - Recommend Revising #3 to include Group E occupancies serving special need students above the 6th grade. Recommend revising item 1 to make the requirement a tier above what is required for a family restroom since this would be a double burden or excluding M all together except for open and enclosed malls.

1210.3.1 Revise Exception 2 (Reasoning most child care uses provide low or no toilet partitions for younger children to allow staff to assist in potty training). New Section to read - Toilets rooms located in child day care facilities must provide facilities dedicated for the privacy of staff but may provide additional facilities without enclosing compartments solely for assisting with potty training as determined by the building official.

Kurt Beres
RA, CBO, MPE, LEED AP
Principal - Studio Lead - Technical Services / Industrial

MA Design
775 Yard Street, Suite 325
Columbus, Ohio 43212
D. 614 764 0407 C. 614 259 7695
www.designwithma.com

From:	Beres, Kurt
To:	BBS, BBSOfficAsst3
Cc:	Jim Mitchell; David Prentice
Subject:	Re: Comments on Draft Rules
Date:	Friday, March 24, 2023 12:21:42 PM

As discussed during the stakeholders meeting I have revised the proposed change below to align 406.5.2.1 with

406.5.2.1 Recommendation - to align with the requirements of 1206 Revise as follows "Where openings below grade provide required natural ventilation the outside horizontal clear space shall be one and one half times the depth of the opening **up to 23' wide**. The width of the horizontal clear space shall be maintained from grade down to the bottom of the lowest required opening."

Kurt Beres
RA, CBO, MPE, LEED AP
Principal - Studio Lead - Technical Services / Industrial

MA Design
775 Yard Street, Suite 325
Columbus, Ohio 43212
D. 614 764 0407   C. 614 259 7695
www.designwithma.com

On Sun, Mar 5, 2023 at 4:42 PM Beres, Kurt <kurtb@designwithma.com> wrote:

> I am so excited to see the state of Ohio making the leap to the 2021 model code. The update is extremely important to adopt for our state's long term financial security and promotion of new businesses. As an architect, CBO, and MPE familiar with the OBC and 2021 model code I have compiled the following list of recommended changes for consideration as part of the adoption.
>
> Revise the proposed definition for Agricultural Building:
>
> AGRICULTURAL BUILDING. A structure designed and constructed to house farm implements, hay, grain, poultry, livestock or other horticultural products. This structure is not **to** be a place of human habitation or a place of employment where agricultural products are processed, treated or packaged, nor is it to be a place used by the public. (See definition of “AGRICULTURAL PURPOSES”, section 101.2, and section 312 of this code).
>
> 406.5.2.1 Recommendation - to align with the requirements of table 705.5 Revise as follows "Where openings below grade provide required natural ventilation the outside horizontal clear space shall be one and one half times the depth of the opening **up to 10' wide**. The width of the horizontal clear space shall be maintained from grade down to the bottom of the

lowest required opening."

406.6.2 Can you clarify the intent of deleting 406.6.2 ventilation is generally a basic requirement for enclosed garages.

507.14 To mimic 507.13 From the 2017 OBC to allow for use of property deeded or dedicated on adjacent properties be used for use in determining the compliance of an unlimited area building. This code section has been a mainstay of the OBC for several code cycles now and has been the envy of many of our sister states.

705.5 Add an exception to mimic the 2017 OBC to allow for property on an adjacent property to be deeded or dedicated as a no build zone and contribute to the fire separation distance. See above.

705.6 Add the following exception to 705.6 - Reasoning this is in keeping with 706.2 and allows the floor sheathing to act structurally.
Exception - Floor and roof sheathing not exceeding 3/4" thickness are permitted to be continuous through the exterior wall assembly to interior face of the exterior wall sheathing in light frame construction.

Revise Proposed Language for 706.8.1 to add the following exceptions (Reasoning the vestibule requirement impacts the ability of the fire walls to act independently and the code language for Horizontal Exits provides numerous additional protections further the existing language conflicts with the exception to 705.3)
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The proposed table 1020.2 is confusing and is not in keeping with past OBC sections, as proposed it is identical in application to the table in the model code. Recommend eliminating in the table the words "or provided with a partial sprinkler system" and adding footnote C to 13R and footnote D to 13D while adding I-1 to the footnote and applying C to the 13 column in similar locations as the 2017 OBC.

1102.2 - The language does not do a good job for the purposes of ICCA117.1- 2017 to identify existing buildings. Recommend adding language referencing that existing buildings for the purposes of the application of requirements for existing buildings identified in ANSI A117.1 shall be buildings constructed using the 2017 Ohio Building Code or earlier.

References to Adult Changing Stations. 1110.18.1 - Recommend Revising #3 to include Group E occupancies serving special need students above the 6th grade. Recommend revising item 1 to make the requirement a tier above what is required for a family restroom since this would be a double burden or excluding M all together except for open and enclosed malls.

1210.3.1 Revise Exception 2 (Reasoning most child care uses provide low or no toilet partitions for younger children to allow staff to assist in potty training). New Section to read - Toilets rooms located in child day care facilities must provide facilities dedicated for the privacy of staff but may provide additional facilities without enclosing compartments solely for assisting with potty training as determined by the building official.

Kurt Beres
RA, CBO, MPE, LEED AP
Principal - Studio Lead - Technical Services / Industrial

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775 Yard Street, Suite 325
Columbus, Ohio 43212
D. 614 764 0407   C. 614 259 7695
www.designwithma.com

From: Meaghan Campbell
To: BBS, BBSOfficAsst3
Subject: Adult Changing Stations
Date: Thursday, March 16, 2023 8:54:32 AM

To Whom it May Concern,

I am writing in support of adopting adult changing stations into the Ohio Building Code. As someone who works with children and adults with disabilities and works to include these individuals into community recreation programs, I believe this is an important issue of accessibility and equity in public spaces. We strive to include children and adults of all abilities into our programs, but people frequently share with me that they have been unable to access events, programs, and locations out in the community due to a lack of accessible restrooms. People with lifelong or acquired disabilities should not lose access to public places and events because there is no place for them to be able to change, and they should not be required to have to change on the floor or in the back of a car. Please adopt adult changing stations into the Ohio Building Code and show Ohioans with disabilities that they are valued and welcomed in public spaces in Ohio.

Thank you for your time and consideration.
Sincerely,

Meaghan Campbell

From:	Hanshaw, Regina
To:	Ohler, Deborah
Subject:	RE: Chapter 10, Section 1002.2
Date:	Tuesday, February 14, 2023 2:50:13 PM
Attachments:	image001.jpg

Good catches. I will make notes for correction/additions as well.

From: Ohler, Deborah <debbie.ohler@com.ohio.gov>
Sent: Tuesday, February 14, 2023 2:44 PM
To: David Collins <dcollins@preview-group.com>
Cc: Hanshaw, Regina <Regina.Hanshaw@com.ohio.gov>
Subject: RE: Chapter 10, Section 1002.2

Hi Dave.
Yes, we are still working on quality control and coordination of the draft rules.
We have created a new "rules of construction" section in OBC Section 101.1.1 that is intended to take care of these general reference substitutions.
We may need to add this to the OBC Chapter 34 rule where we replace the IEBC Chapter 1. We might add the "rules of construction" language as OEBC Section 101.4.1 if we don't modify OBC Ch 1 to take care of the IEBC substitutions.

I see that the OBC Chapter 1 rule, Section 101.1.1 section number needs fixed, too, to actually say 101.1.1 (not 101.1).
Thank you for the reminder and we welcome your input when you find any other coordination issues such as this.
Debbie

Deborah D. Ohler, P.E., Construction Codes Administrator
Ohio Board of Building Standards
PO Box 4009, 6606 Tussing Rd.
Reynoldsburg, OH 43068-9009
Office phone: 614-644-2613 Fax: 614-222-2147
dohler@com.state.oh.us
https://com.ohio.gov/divisions-and-programs/industrial-compliance/boards/board-of-building-standards
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From: David Collins <dcollins@preview-group.com>
Sent: Tuesday, February 14, 2023 1:33 PM
To: Ohler, Deborah <debbie.ohler@com.ohio.gov>

Subject: Chapter 10, Section 1002.2

The reference is to the IBC, not the building code. I saw no rule change for that? Still working on it?

Get [Outlook for iOS]

Board of Developmental Disabilities Services

MONTGOMERY COUNTY

A Human Services Levy-Funded Agency

Northview Center
8114 North Main Street
Dayton, OH 45415
(937) 890-0730
www.mcbdds.org

March 22, 2023

To the members of the Ohio Board of Building Standards:

My name is Dr. Pamela Combs, and I am the Superintendent of the Montgomery County Board of Developmental Disabilities Services. I am writing to add my voice to the many who are asking that the Ohio Board of Building Standards adopt Section 1113 Adult Changing Station Accessibility into the Ohio Building Code.

My organization provides services to more than 5,200 people with developmental disabilities in Montgomery County, Ohio, many of whom face mobility and self-care issues. These people deserve to have access to the community, yet many cannot take part in everyday activities that we all take for granted because there are not safe, hygienic restroom facilities that meet their needs and those of their families and caregivers. Instead of sharing their talents and gifts with the community, they either choose not to go out *or* face the humiliation of being changed on public restroom floors or in the back of vehicles, in full view of passersby. No adult should have to face such circumstances. Yet sadly, this is the case across Ohio, the U.S., and around the world.

There is a simple solution: Height-adjustable universal changing tables for restrooms can be added to the Ohio Building Code. These tables can be used by anyone—from parents of infants and toddlers to families and caregivers of teenagers, adults and the elderly. They will also benefit visitors with disabilities who come to our great State.

By adopting Section 1113 into the Building Code, you will give the three percent of Ohioans with disabilities who need help with self-care the chance to live a more normal life. They will be able to go to libraries, parks, movies, museums, sporting events, concerts, restaurants, and even shopping within their own communities. They will also be able to travel without fear of soiling themselves when such tables are installed in airports, highway rest areas, and bus stations.

Accessibility and inclusion are fundamental rights of all citizens, and should be the rule, not the exception. I urge you all to adopt this measure into the Ohio Building Code as soon as possible. By addressing this basic human need, you will have a life-changing impact on so many.

Sincerely,

Dr. Pamela Combs

Dr. Pamela Combs
Superintendent

From: Sophia Dowell
To: BBS, BBSOfficAsst3
Subject: Equal human rights
Date: Friday, March 17, 2023 11:45:56 AM

Ohio Building Codes and Standards,

I am writing to you to show my support for adding the new proposed sections to the building code Section 1110.18 and 1113 pertaining to adult changing stations

My dear friend will need to change her child for their entire life and not having the proper resources to do so while in public, is against fair human rights. Please do the right thing and make it easier on these people to leave their homes and do everyday things like you and I have the pleasure doing.

Thank you,
Sophia Dowell

From:	Kelly Dugan
To:	BBS, BBSOfficAsst3
Subject:	Changing Spaces
Date:	Sunday, March 19, 2023 2:40:16 PM

Dear Ohio Building Codes and Standards,

I am writing to you to show my support for adding the new proposed sections to the building code Section 1110.18 and 1113 pertaining to adult changing stations.

I am an speech-language pathologist for a pediatric hospital. With my specializations, I often work with children and young adults who need various assistance in their days. A common challenge I see my families face, is changing their child in public spaces. The hospital I work for, is slowly changing spaces to have more appropriate tables however there are many locations that do not have these yet. The building I spend most of my time in, does not have an adult changing table and it means families must use a mat on the floor or wait until they can access a more appropriate space. I see families having to unsafely lift and move their loved ones. I see them not receiving the privacy the deserve. I see them having to accept less for a simple necessity in life.

A more regulated protocol for adult changing tables would allow families to live more freely. They could rely on attending events, visiting buildings and traveling without the extreme stress of accessible restroom needs. I endlessly see families I work with having to choose daily routines based on their access to restrooms. This is not something most people have to think about in their day. Imagine having to choose your days based on your restroom needs and privacy.

I’m aware these renovations can be expensive and time consuming. I understand that not all facilities will be able to accommodate or financially support it. I do think we can create significant progress in standardized changing tables into accessibility efforts.

The biggest factor I consider is how do we have ADA accessibility regulations such as ramps/elevators etc but then we do not have spaces to support the individual once there?

Thank you for your review and consideration! I know this would highly impact day-to-day life for many individuals.

From:	Jennifer Earl
To:	BBS, BBSOfficAsst3
Subject:	PROPOSED CODE CHANGE TO THE OHIO BUILDING CODE Petition #22-04
Date:	Saturday, March 18, 2023 2:59:07 PM

Ohio Building Codes and Standards,

I am writing to you to show my support for adding the new proposed sections to the building code Section 1110.18 and 1113 pertaining to adult changing stations. We have friends who would greatly benefit from the availability of adult changing stations. This would allow them to participate in many more activities, while maintaining their dignity. I also believe that this would have a positive impact on Ohio businesses by allowing more of the population to shop/dine without added stress.

Thank you,
Jennifer Earl, Keller Williams Capital Partners
614.439.9210

From: Theresa Emch
To: BBS, BBSOfficAsst3
Subject: Support Equitable Restrooms
Date: Wednesday, March 15, 2023 2:09:26 PM

Dear Board Members,
Please consider updating the code on bathroom regulations to support those who need different assistance. While supporting the specific individual keep in mind you are showing support to the families and caregivers.
If our buildings do not support hygiene care most likely these folks are not leaving their home or care facilities. Not only is that disheartening, but consider it on the flip side of a business potentially losing that additional business. Maybe short term the growing pains are uncomfortable and the cost up front may be as well, but long term I only see this as a win-win for our residents, businesses and the visiting states. Put us on the map for being a true handicap accessible state!
Thank you!
Theresa Emch

March 20, 2023

Ohio Building Codes and Standards,

I am writing to you to show my support for adding the new proposed sections to the building code Section 1110.18 and 1113 pertaining to adult changing stations.

As an advocate for and ally of people with disabilities, it is incredibly important that we update Ohio Revised Code to support inclusion of all people in our community.

Readily accessible adult changing tables in public restrooms allows people who need assistance with toileting access to our community. Using the restroom is a basic human need that we **all** should have, regardless of the type of restroom needed. Adult changing tables in public restrooms should not be a luxury, it should be a requirement.

For those of us who do not require assistance with the restroom we might not understand why this is so important. Have you ever spent the day at the zoo, worked a full day at the job of your choice, or gone for a long car trip? Did you use the bathroom during any of these activities? The answer is yes. But the answer for someone who needs access to an adult changing table is probably no.

So, what do people do who need an adult changing table? Some plan their days around proximity to a place with an adult changing table or distance from their home. Others have been changed on the floor of public restrooms by their care provider, stripping them of their dignity and basic right to privacy.

If the above examples are not enough to convey just how important adult changing tables are, consider the positive economic impact this can have. If there were more of these types of restrooms around the State of Ohio, Ohioans would be able to spend more time (and money) going out to eat, enjoying tourist destinations, shopping, visiting places like the zoos, and amusement parks. If more places of work had adult changing tables, we would increase the number of contributing members in our society who earn a living wage and pay taxes.

Adult changing tables benefit the individuals who use them, their care providers, and their loved ones who wish to spend time making memories out in the community like everyone else.

Updating the Ohio Revised Code matters.

Thank you,
Anne Flanery

From: Naomi Grace
To: BBS, BBSOfficAsst3
Cc: Changing Spaces Ohio
Subject: Changing Spaces/for Naomi Fox and all
Date: Wednesday, March 22, 2023 12:06:38 PM
Attachments: IMG_20230318_190842.jpg
IMG_20230318_190848.jpg

To Whom It May Concern:

I would like to ask that it becomes law the public places also have adult changing spaces available. My daughter is 9 with Spastic Quad Cerebral Palsy. She's big for her age and we've already been limited for years in how long we can stay in public places. She deserves the same rights as everyone else within our society.

Thanks for your consideration,

Faith Fox
4477 N. Section Line Rd.
Radnor, Oh.
43066
740-803-4048

*Attached you will find a picture of my daughter, Naomi, within Ohio's Travel Guide. Let's make Ohio a truly accessibility friendly state that all people can enjoy

From: Natalie Varga Goss
To: BBS, BBSOfficAsst3
Subject: OHIO BUILDING CODE Petition #22-04
Date: Tuesday, March 21, 2023 2:41:39 PM

Ohio Building Codes and Standards,

I am writing to you to show my support for adding the new proposed sections to the building code Section 1110.18 and 1113 pertaining to adult changing stations.

I am a mother who is raising a disabled toddler. I'm trying to create an inclusive world for my daughter so she can grow up knowing she is worthy and a valued member of society.

Once she was too large for baby changing tables in public restrooms, we have had to get very creative in how and where we are able to change her. And frankly sometimes have had to resort to laying down towels we had brought from home and changing her on the floors public restrooms. Now, this is not only humiliating and dehumanising for both me and my sweet and kind daughter, but it also shows that the world does not view her as a valued member of society because she cannot use a toilet like able bodied children her age.
Because of this experience we really have to research where we can change her whenever we plan a trip anywhere, even somewhere Simple like going to the grocery store. And often times we have had to miss out on certain experiences because the facilities did not support our family's needs. Because there were no adult changing tables that could support my toddler's weight.

I have also cried tears of joy and gratitude whenever I have spotted adult changing facilities. That is how important adult changing stations are to us and many more families like ours. You see, they don't only benefit disabled adults but also disabled children. They provide dignity and privacy to those who need it the most.

I want my daughter to be able to have the same experiences her able bodied peers have, and having adult changing stations available help make this more possible.

Please help us make the world more inclusive and accessible by creating more adult changing stations in Ohio. This may seem like a small change to you, but for us it means the world.

Thank you for your time.

Best,
Natalie Goss

From: Heather Gott
To: BBS, BBSOfficAsst3
Date: Wednesday, March 15, 2023 1:24:37 PM

Dear Ohio Building and Code Standards,

I am writing to you to show my support for adding the new proposed sections to the building code Section 1110.18 and 1113 pertaining to adult changing stations. As a society, we have made great strides in increasing accessibility for individuals with disabilities, but there is still much work to be done.

Installing adult changing tables in new buildings can make a significant difference in the lives of these individuals and their caregivers. Without these facilities, it can be incredibly challenging to provide adequate care for adults who need assistance with toileting and changing. Additionally, adult changing tables can benefit families with young children who require changing facilities, as well as pregnant women and individuals with medical conditions that require additional support.

By including adult changing tables in new buildings, we can ensure that Ohio is a welcoming and inclusive state that prioritizes the needs of all its citizens. I strongly urge you to consider implementing this change in building codes and regulations.

Thank you for your time and consideration.

Sincerely,
Heather Gott
Realtor
The Columbus Team
Keller Williams Capital Partners
614-329-2651

boundless
inspiring the potential of people

I Am Boundless, Inc.
445 E. Dublin Granville Road
Worthington, OH 43085
614-844-3800
iamboundless.org

March 21st, 2023

To whom it may concern,

I Am Boundless, Inc. is a statewide nonprofit organization who serves individuals with intellectual and developmental disabilities (I/DD) and behavioral health challenges. We have served this population for more than 41 years and our mission is to build a world that realizes the boundless potential of *all* people.

We applaud the efforts of Changing Spaces Ohio to increase the number of public places that have height adjustable changing tables that can accommodate adults. More of these tables are needed throughout the state to allow those with disabilities the privacy and dignity they deserve.

From residential support and job training to counseling and autism services, we proudly offer person-centered care that celebrates each individual and encourages them to become active participants in the communities where they live, work, and play. Many of our adult day programs regularly go out into the community and these changing spaces would be a huge help to our staff members when someone needs a place to get changed.

Please consider the value of offering more public changing spaces in Ohio so restrooms are more inclusive to all. We know this is something that would positively affect those individuals in the I/DD community we serve.

Thank you,

Patrick Maynard, PhD
President & CEO

March 15, 2023

I am writing to the Board of Building Standards in support of adding requirements for adult changing stations outlined in the petition submitted by Changing Spaces Ohio.

My son is 10 years old and has a medical condition that requires him special restroom accommodations. As a baby, we were able to trouble shoot, changing his bags on changing tables, and even in the trunk of our car when needed. He is older and bigger and more aware of his need for privacy. Unfortunately, we do not live in a world where such accommodations are the norm. We have had times where I have had to lift him onto a small changing table, not only for fear we break the table, but also worry for his privacy which is very important. I urge you to please consider this accommodation for your bathrooms. My son is just one example of who needs to use there. So many people young and old are out there are walking or wheeling around with need for this type of accommodation. I wish for a world where universal design is the norm. I encourage you to be a leader in this movement and consider installing adult changing tables for people like Isaac.

Sincerely,
Jill Hinkel

From: Madeline Hopkins
To: BBS, BBSOfficAsst3
Subject: Support Adult Changing Tables
Date: Tuesday, March 21, 2023 12:49:45 PM

Hi there!

My name is Madeline Hopkins. I am a Special Education Teacher, I have several students that require changing needs outside of the use of a toilet. I am writing to advocate for the need for adult changing tables in all buildings.

We often take field trips in the community. Almost all of these community places have changing tables in the female restrooms. These changing tables are ONLY for children that are under the age of 3 and weigh less than 50 lbs. Due to this, my students often have to be changed within the confinement of their wheelchair. This is not sanitary because if the student were to have a large movement it can get onto their wheelchair, then we have no space for the student and the wheelchair to get clean. I have experienced this first hand at several locations in the community, like the Columbus Zoo.

I also noted that most changing tables are found in female restrooms. This does not allow male children to be changed in an appropriate area.

Please let me know if you have any questions or would like to discuss this further.

Thank you,

MAIN (216) 529-6270
FAX (216) 529-5930

DIRECT TO DESK (216) 529-6689
charles.huber@lakewoodoh.net

DIVISION OF HOUSING AND BUILDING
12650 DETROIT AVE • LAKEWOOD OH 44107-2832
lakewoodoh.gov

Board of Building Standards (BBS)
PO Box 4009
Reynoldsburg OH 43068-9009
Via e-mail BBS@com.ohio.gov

March 16, 2023

Subject: BBS Common Sense Initiative Stakeholders' Meeting March 22, 2023; Draft OBC 105.3.1 Incomplete Fire Protection System Drawings

1. Reference Pamella Butts e-mail March 2, 2023. Draft Ohio Building Code (OBC) 105.3 "Conditional approval" accurately reflects the statutory language at Ohio Revised Code (ORC) 3791.04(D) (extract attached). Draft OBC 105.4 "Phased approval" accurately reflects the statutory language at ORC 3791.04(G) (extract attached).

2. Renumber, Draft OBC 105.3.1 to read 105.4.1 and revise text to read, "Incomplete fire protection system drawings. For fire protection system drawings, if actual fire protection system details or product listing information is not known at the time of plan examination, ~~conditional~~ <u>phased</u> plan approval shall be granted subject to subsequent submission of the information prior to installation of any part of the fire protection systems." This more accurately reflects the statutory language at ORC 3791.04(D) & (G).

Sincerely,

Charles E Huber

Charles E. Huber
Residential Plans Examiner

Atch
ORC 3791.04(D) & (G)

OHIO REVISED CODE (ORC) 3791.04(D) & (G) EXTRACTS

Extract ORC 3791.04(D)
... The board of building standards ... may adopt rules to provide for the approval, ... of the plans for construction of a foundation or any other part of a building ... before the complete plans and specifications for the entire building ... are submitted. ...

Extract ORC 3791.04(G)
... if the agency having jurisdiction objects to any portion of the plans or specifications, the owner or the owner's representative may request the agency to issue conditional approval to proceed with construction up to the point of the objection. Approval shall be issued only when the objection results from conflicting interpretations of the rules of the board ... rather than the application of specific technical requirements of the rules. ...

MAIN (216) 529-6270
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DIRECT TO DESK (216) 529-6689
charles.huber@lakewoodoh.net

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lakewoodoh.gov

Board of Building Standards (BBS)
PO Box 4009
Reynoldsburg OH 43068-9009
Via e-mail BBS@com.ohio.gov

March 19, 2023

Subject: BBS Common Sense Initiative Stakeholders' Meeting March 22, 2023; Draft OBC Table 2902.1 & Draft OPC Table 403.1, Add Footnote Pointing to ORC 3318.038 Water Bottle Filling Stations in Schools

Reference Pamella Butts e-mail March 2, 2023. 133rd Session Ohio General Assembly Senate Bill 259 (133 GA SB 259), revised by 134 GA House Bill 110 (134 GA HB 110) enacted/revised Ohio Revised Code (ORC) 3318.038 (attached) providing requirements for water bottle filling stations and drinking fountains. Revise draft Ohio Building Code (OBC) Table 2902.1 and draft Ohio Plumbing Code (OPC) Table 403.1 by adding footnote to each reading, "See Section 3318.038 of the Revised Code for water bottle filling station and drinking fountain additional requirements for schools approved by Ohio Facilities Construction Commission."

Sincerely,

Charles E. Huber

Charles E. Huber
Residential Plans Examiner

Atch
ORC 3318.038

Section 3318.038 | Water bottle filling stations and drinking fountains.

Ohio Revised Code / Title 33 Education-Libraries / Chapter 3318 School Facilities

Effective: *September 30, 2021* ***Latest Legislation:*** *House Bill 110 - 134th General Assembly*

(A) As used in this section:

(1) "Drinking fountain" means a fountain to which all of the following apply:

(a) The fountain is designed to allow an individual to drink from the fountain.

(b) The fountain dispenses filtered, clean drinking water.

(c) The fountain is equipped with a protective cowl.

(d) The fountain is equipped with a water spout at least one inch above the overflow rim of the fountain.

(2) "Water bottle filling station" means a station to which all of the following apply:

(a) The station is designed to fill a bottle with water.

(b) The station dispenses filtered, clean drinking water.

(c) The station is accessible to all people in compliance with the "Americans With Disabilities Act of 1990," 42 U.S.C. 12101 et seq.

(d) The station may be integrated into a drinking fountain as a combination unit.

(B) When reviewing design plans for a classroom facility construction project proposed under this chapter, the Ohio facilities construction commission shall require that each classroom facility included in the project shall contain, or provide for in the design plans, all of the following as a condition of approval of the project:

(1) A minimum of two water bottle filling stations in each building;

(2) A minimum of one water bottle filling station or combination unit on each floor and wing of each building;

(3) A minimum of one water bottle filling station or combination unit for every one hundred students projected to attend the building upon completion of the project;

(4) A minimum of one water bottle filling station in or near each cafeteria, gymnasium, outdoor recreation space, or other high-traffic area.

(C) Each school district board of education or school governing body shall ensure that each drinking fountain , water bottle filling station, or combination unit installed in a classroom facility included in a project under this chapter is regularly cleaned and maintained.

(D) Each district board or school governing body shall permit students, teachers, and other school staff to carry and use water bottles that are made of material that is not easily breakable, have lids to prevent spills, and are filled exclusively with water. However, a district board or school governing body may prohibit water bottles from a library, computer lab, science lab, or other location where the district board or school governing body determines it is dangerous to have drinking water. A district board or school governing body may issue a disciplinary action for misuse of a water bottle.

(E) The requirements of this section are in addition to the requirements of Chapters 3781. and 3791. of the Revised Code and any rule adopted pursuant to those chapters.

Last updated August 11, 2021 at 1:27 PM

Available Versions of this Section

April 12, 2021 – Enacted by Senate Bill 259 - 133rd General Assembly

September 30, 2021 – Amended by House Bill 110 - 134th General Assembly

From: Julie Jackson
To: BBS, BBSOfficAsst3
Subject: Building code section 1110.18 and 1113
Date: Friday, March 17, 2023 12:33:21 PM

Ohio Building Codes and Standards,
I am writing to you to show support for adding the new proposed sections to 1110.8 and 1113 for adult changing stations. As an occupational therapist I work with many clients who have to sacrifice their dignity and safety or choose to not go out in public. This is both detrimental to the clients physical and mental health but also their caregivers and family. This bill will provide the inclusivity for all to be able to access public places with ease of knowing there are adult changing stations. It is time for Ohio to set the bar for other states and show through passing that we value each individual's rights! Thank you and let's make this happen!

--
Kindly,
Julie Jackson

From:	Dewayne Jenkins
To:	BBS, BBSOfficAsst3
Subject:	March 22 BBS Stakeholder Meeting
Date:	Wednesday, March 22, 2023 8:43:22 AM
Attachments:	Jenkins, Dewayne.vcf

I am in full support of the proposed updates in code editions as proposed by the Board of Building Standards.

Dewayne

Dewayne Jenkins,
Senior Building Inspector
Plans Examiner
City of Kettering
Planning & Development
Phone 937.296.2419
E-Mail Dewayne.Jenkins@ketteringoh.org

KETTERING is home

From: Lindsey Jensen
To: BBS, BBSOfficAsst3
Subject: Please install adult changing stations
Date: Tuesday, March 21, 2023 10:54:52 AM

Hello,
My name is Lindsey Jensen, and I am writing to voice my support for the absolute necessity for adult changing stations in public spaces. My son, Gabriel, has cerebral palsy, and we often found ourselves trying to change him in the most uncomfortable places. Usually there was nowhere for us to change him, which would lead to us trying to maneuver things around in our van, which was really hard for us and incredibly awkward for those walking by, who would see him in random states of undress.

Please consider how much adult changing stations would help everyone in the community, in ways previously not considered.
Thanks,
Lindsey Jensen
(614)546-7078

From: Brian Kemp
To: BBS, BBSOfficAsst3
Subject: Adult changing tables.
Date: Tuesday, March 14, 2023 2:03:05 PM

Dear Ohio Building and Standards committee,

I am writing to advocate for the implementation of building code changes to include adult changing tables in public spaces throughout Ohio. This is an important issue that affects many members of our community, particularly those with disabilities or medical conditions that require assistance with toileting.

People with disabilities deserve to enjoy public spaces, such as parks, libraries, and community centers. This issue affects individuals of all ages and backgrounds, and it is particularly challenging for older adults who may have limited mobility. As our population continues to age, it is important that we take proactive steps to ensure that our public spaces are accessible and welcoming to everyone.

I strongly urge you to take action on this issue and work to implement adult changing tables in public spaces throughout Ohio. This is an important step in promoting accessibility, inclusivity, and dignity for all members of our community.

Thank you for your attention to this matter.

Sincerely,

Brian Kemp

Board of Developmental Disabilities Services
MONTGOMERY COUNTY

A Human Services Levy-Funded Agency

Northview Center
8114 North Main Street
Dayton, OH 45415
(937) 890-0730
www.mcbdds.org

March 15, 2023

To the members of the Ohio Board of Building Standards:

My name is Dr. Scott Kidd. I am a clinical psychologist and the Director of Mental Health and Behavior Support Services with the Montgomery County Board of Developmental Disabilities Services. I am writing to offer my encouragement and support for adoption of Section 1113 Adult Changing Station Accessibility into the Ohio Building Code by the Ohio Board of Building Standards.

Our agency provides services to over 5,000 people with developmental disabilities just in Montgomery County alone, and as you know, there are 88 counties in Ohio. As a clinical psychologist, I have seen the physical and emotional toll it takes on families to plan their weeks around tasks that are simple to most of us, but complicated for them due to the inaccessibility of public spaces and services to their family members with developmental disabilities.

To give just one comparable example, we worked with a single mother who had to schedule her entire week around grocery shopping with her daughter. Grocery trips were extremely challenging because there were no accessible grocery carts, and she could not push a grocery cart and her daughter's wheelchair at the same time. A local store agreed to buy two accessible carts. This was a game changer and made grocery shopping more manageable and less stressful. And for the cost of two carts, the store gained a customer for life and likely new customers. I see adult changing tables as a very similar issue.

I am familiar through my work with families and from research that stress levels of parents who have children with developmental disabilities are significantly higher than parents of children without disabilities. Just a few reasons include caring for their child's intensive medical needs, assisting with daily living tasks, and not having accessible facilities in their community, such as proper changing tables.

Personally, I can't imagine if I had to lay my head and body on the floor of a public bathroom every time I used the restroom outside of my own home. Adults with developmental and other disabilities deserve to be part the community without having to go through such a denigrating experience.

The solution to this problem is to adopt Section 1113 to add height-adjustable universal changing tables to the Ohio Building Code. These tables can be used by anyone, including parents of young children and families and caregivers of teenagers, adults and the elderly. Accessibility and inclusion are fundamental rights of all citizens. I urge you to adopt this measure into the Ohio Building Code.

Sincerely,

Psy.D.

Dr. Scott Kidd
Director of Mental Health and Behavior Support Services
Montgomery County Board of Developmental Disabilities Services

From: Sandy Kirkwood
To: BBS, BBSOfficAsst3
Subject: Proposed Code Change to the Ohio Building Code Petition #22-04
Date: Friday, March 17, 2023 11:50:13 AM

Dear Ohio Code and Standards Members,

I am writing to show my support for adding the new proposed sections to the building code Section 1110.18 and 1113 pertaining to adult changing stations.

My grandson is now 10 years old and has cerebral palsy (CP). Because of this, he is unable to speak, walk or eat normally. He has to wear diapers due to incontinence. Our daughter is very

vigilant about including him in as many activities as possible. He goes to wheelchair dance class, adaptive snow skiing, Buddy Ball (base ball), birthday parties at venues, the zoo, class trips for

bowling, traveling by air, and just to a community park for a fun day outside. It can be very difficult to find a safe and sanitary place to change him. He is too big now to use a baby sized changing

table that is available in most routine bathrooms.

Adding adult changing stations, as a code requirement, would positively impact so many children and adults with mobility problems. It can be the difference between being

isolated at home and going out to experience the world!

Thank you,

Sandy Kirkwood, loving Gigi to my grandson, Aiden

From:	Richards, Jay
To:	Hanshaw, Regina
Cc:	Ohler, Deborah
Subject:	FW: Proposed Rule Changes
Date:	Thursday, March 23, 2023 2:04:04 PM
Attachments:	image001.png

Regina,
Paul sent these comments to me after attending the stakeholder meeting yesterday. I told him thank you and that we'll move these comments into the stakeholder record that is shared with the code committee

Jay Richards
Assistant Construction Code Administrator

Ohio Board of Building Standards
6606 Tussing Road, PO Box 4009
Reynoldsburg, OH 43068-9009
P 614.644.2613
jay.richards@com.state.oh.us
com.ohio.gov/dico/bbs/

com.ohio.gov

From: Paul Kowalczyk <pkowalczyk@pepperpike.org>
Sent: Thursday, March 23, 2023 11:38 AM
To: Richards, Jay <Jay.Richards@com.ohio.gov>
Subject: Proposed Rule Changes

Jay,

I was online yesterday watching the discussion unfortunately I did not register to speak (although I wish I had). I just wanted to make a few comments, not sure if they can be included but I thought I would pass along just in case there was more discussion on the subject of adult changing stations.

1. Under the adult changing station Section 1110.18.1, was it ever discussed to make this required under the Group I-4 adult daycares? It seems this would be a logical place to require these.
2. Is there any provision that would allow the adult changing station to be a substitute for the baby changing station? Could the adult changing station serve both purposes, therefore eliminating the need to have (1) child and (1) adult?
3. For E occupancies, should that sentence end with "but no less than 1 required for the building"? Based on the square footage of a room or space, you may not reach the requirements of six or more and then you would not need to provide one. I think the one Mom who spoke may it clear that these buildings should at least be provided with one.

Just my thoughts. Thanks.

Paul Kowalczyk
Building Official

City of Pepper Pike
Village of Moreland Hills

CAUTION: This is an external email and may not be safe. If the email looks suspicious, please do not click links or open attachments and forward the email to csc@ohio.gov or click the Phish Alert Button if available.

From:	Eric Lacey
To:	BBS, BBSOfficAsst3
Cc:	Hanshaw, Regina
Subject:	Supplemental RECA Comments Supporting 2021 IECC Adoption
Date:	Tuesday, March 21, 2023 12:17:20 PM
Attachments:	Supplemental RECA Comments Supporting 2021 IECC in OH 3-21-23.pdf RECA Comments Supporting 2021 IECC in OH 7-13-21.pdf 2021_IECC_Commercial_Analysis_Final_2022_09_02 (2).pdf Cost-effectiveness_of_ASHRAE_Standard_90-1-2019-Ohio.pdf

Dear Ms. Hanshaw,

Please see the attached comments of the Responsible Energy Codes Alliance in support of the proposed incorporation of the 2021 IECC provisions into the Ohio Building Code (and attachments). If you have any questions, please call or email me.

Thank you,
Eric

Eric Lacey, Chairman
Responsible Energy Codes Alliance
1850 M Street, NW, Suite 610
Washington, DC 20036
(202) 339-6366 office
(703) 409-0681 cell
(202) 342-0807 fax
www.reca-codes.com
eric@reca-codes.com

Submitted Via Email to BBS@com.ohio.gov

March 21, 2023

Regina Hanshaw
Executive Secretary
Ohio Board of Building Standards
P.O. Box 4009
6606 Tussing Road
Reynoldsburg, OH 43068

RE: Supplemental Comments of the Responsible Energy Codes Alliance (RECA) Supporting the Adoption of the 2021 International Energy Conservation Code for Commercial and Multifamily Residential Buildings

Dear Ms. Hanshaw,

We are writing to re-submit and supplement comments that RECA[1] submitted on July 16, 2021 in support of Ohio's adoption of the 2021 *International Energy Conservation Code* (*IECC*) for commercial and multifamily residential construction as part of the proposed update to the Ohio Building Code. Since we submitted those comments, additional analyses have provided further confirmation that the 2021 *IECC* will provide unprecedented energy and cost savings, job creation, and pollution reduction benefits for Ohioans.

1. Energy Savings and Cost-Effectiveness

The U.S. Department of Energy recently published an analysis that compares the 2021 *IECC* commercial provisions to previous editions of the code, along with a comparison between the 2021 *IECC* and *ASHRAE* Standard 90.1-2019. The updated table below supplements a table we submitted in our 2021 comments, and it includes DOE's most recent analyses of national average energy savings of the three most recent editions of the model energy codes for commercial construction.

[1] RECA is a broad coalition of energy efficiency professionals, regional efficiency organizations, product and equipment manufacturers, trade associations, and environmental organizations with expertise in the development, adoption, and implementation of building energy codes nationwide.

Model Code	National Avg. Energy Cost Savings over previous model code		National Avg. Energy Cost Savings over previous model code
***ASHRAE* 90.1-2013**	**8.7%**[2]	**2015 *IECC***	**11.5%**[3]
***ASHRAE* 90.1-2016**	**8.3%**[4]	**2018 *IECC***	**5.3%**[5]
***ASHRAE* 90.1-2019**	**4.3%**[6]	**2021 *IECC***	**10.6%**[7]

Because *ASHRAE* Standard 90.1-2019 is referenced in the 2021 *IECC* as an acceptable compliance alternative, by incorporating the provisions of the 2021 *IECC* into the Ohio Building Code, Ohio will be providing design professionals and builders two compliance paths—both of which will save energy and reduce the cost of owning and operating commercial buildings. Notably, **DOE found that the 2021 *IECC* actually saves an additional 6.5% more energy as compared to Standard 90.1-2019.**[8]

For Ohio specifically, DOE found that privately-owned buildings constructed to *ASHRAE* Standard 90.1-2019 will **save building owners $3.57-4.02/sq.ft. over the useful lifetime of the building.**[9] This analysis also found that *ASHRAE* Standard 90.1-2019 is cost-

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[2] *See* U.S. Dep't of Energy, *ANSI/ASHRAE/IES Standard 90.1-2013 Determination of Energy Savings: Quantitative Analysis*, at iv (Aug. 2014), *available at* https://www.energycodes.gov/sites/default/files/documents/901-2013_finalCommercialDeterminationQuantitativeAnalysis_TSD.pdf.

[3] *See* U.S. Dep't of Energy, *Energy and Energy Cost Savings Analysis of the 2015 IECC for Commercial Buildings*, at vi (Aug. 2015), *available at* https://www.energycodes.gov/sites/default/files/documents/2015_*IECC*_Commercial_Analysis.pdf.

[4] *See* U.S. Dep't of Energy, *Energy Savings Analysis: ANSI/ASHRAE/IES Standard 90.1-2016*, at iv (Oct. 2017), *available at* https://www.energycodes.gov/sites/default/files/documents/02202018_Standard_90.1-2016_Determination_TSD.pdf.

[5] *See* U.S. Dep't of Energy, *Energy and Energy Cost Savings Analysis of the 2018 IECC for Commercial Buildings*, at vi (Dec. 2018), *available at* https://www.energycodes.gov/sites/default/files/documents/2018_*IECC*_Commercial_Analysis_Final.pdf.

[6] *See* U.S. Dep't of Energy, *Preliminary Energy Savings Analysis: ANSI/ASHRAE/IES Standard 90.1-2019*, at vi (Apr. 2021), *available at* https://www.energycodes.gov/sites/default/files/documents/20210407_Standard_90.1-2019_Determination_TSD.pdf.

[7] See U.S. Dep't of Energy, *Energy and Energy Cost Savings Analysis of the 2021 IECC for Commercial Buildings*, at ii (Sep. 2022), available at https://www.energycodes.gov/sites/default/files/2022-09/2021_*IECC*_Commercial_Analysis_Final_2022_09_02.pdf.

[8] See U.S. Dep't of Energy, *Energy and Energy Cost Savings Analysis of the 2021 IECC for Commercial Buildings*, at ii (Sep. 2022), available at https://www.energycodes.gov/sites/default/files/2022-09/2021_*IECC*_Commercial_Analysis_Final_2022_09_02.pdf.

[9] *See* U.S. Dep't of Energy, *Cost-Effectiveness of ANSI/ASHRAE/IES Standard 90.1-2019 for Ohio*, at 2 (July 2021), available at https://www.energycodes.gov/sites/default/files/2021-07/Cost-effectiveness_of_*ASHRAE*_Standard_90-1-2019-Ohio.pdf.

effective to the consumer within a reasonable period; in many cases, the payback period for the code improvements would be immediate. The following is a summary table from the DOE cost-effectiveness analysis[10]:

Table 6. Simple Payback for Ohio (Years)

Climate Zone	Small Office	Large Office	Stand-Alone Retail	Primary School	Small Hotel	Mid-Rise Apartment	All Building Types
4A	Immediate	Immediate	Immediate	Immediate	9.4	Immediate	Immediate
5A	Immediate	Immediate	Immediate	Immediate	9.7	Immediate	Immediate
State Average	Immediate	Immediate	Immediate	Immediate	9.6	Immediate	**Immediate**

These energy cost reductions will grow exponentially over time. DOE found that within the first year, **the statewide impact of adopting *ASHRAE* Standard 90.1-2019 would provide 1,501,000 in energy cost savings, and that over the next 30 years the savings would balloon to $649,900,000 statewide.**[11] Based on the parallel DOE analysis of the 2021 *IECC*, we expect the energy and cost savings to be even greater for users of the 2021 *IECC* commercial provisions. Regardless of the compliance path selected, the 2021 *IECC* will provide substantial energy and cost savings for Ohioans.

2. Job Creation

Building efficiency not only benefits the owners and occupants of buildings, but will also spur additional economic activity and create jobs within Ohio. As part of its analysis of cost-effectiveness, U.S. DOE found that adopting *ASHRAE* Standard 90.1-2019 will result in a net increase in jobs. Improved building efficiency brings about a net increase in jobs in two ways: (1) through an increase in construction-related activities associated with the improvements contained in the latest codes; and (2) through a reduction in utility bills, which will result in an increase in disposable household income, which can be spent on other goods and services within the local economy. The following is a summary of DOE's findings:

Summary of U.S. DOE Analysis[12] of Job Creation as Result of Ohio Adopting *ASHRAE* Std. 90.1-2019 (Statewide Avg Impacts)		
Statewide Impact	**First Year**	**30 Years**
Jobs Created – Reduction in Utility Bills	**134**	**4,230**
Jobs Created – Construction Related Activities	**336**	**10,613**

[10] *Id*. at 5.
[11] *Id*. at 1.
[12] *Id*. at 1.

3. Pollution Reduction

According to the U.S. Energy Information Administration, residential and commercial buildings account for about 40% of greenhouse gas emissions.[13] By adopting the 2021 *IECC* (and by reference, *ASHRAE* Standard 90.1-2019), Ohio can move ahead and capture the important energy-saving and pollution-reducing improvements incorporated into the latest model energy codes. For Ohio specifically, DOE found that if the state adopts *ASHRAE* Standard 90.1-2019, CO2 emissions will be reduced by 9,239,000 metric tons over the first 30 years.[14] **This is equivalent to eliminating the annual CO2 emissions of 2,009,000 cars.**

Summary of U.S. DOE Analysis[15] of GHG Comparing Current Ohio Building Code to *ASHRAE* Std. 90.1-2019 (Statewide Avg Impacts)		
Residential		**Commercial**
Model Code	CO2 Reduction – 1 Year	CO2 Reduction – 30 Years
***ASHRAE* Std. 90.1-2019**	**13,250 Metric Tons**	**9,239,000 Metric Tons**

Conclusion

We continue to believe that the best path forward for Ohio is a clean adoption of the 2021 *IECC*, including *ASHRAE* Standard 90.1-2019 as a referenced compliance option. Please contact us if you have any questions or would like to discuss how RECA can be of assistance.

Sincerely,

Eric Lacey
RECA Chairman

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13 *See Frequently Asked Questions (FAQs): How Much Energy is Consumed in U.S. Buildings,* U.S. Energy Infrastructure Admin., available at https://www.eia.gov/tools/faqs/faq.php?id=86&t=1s.

14 *See* U.S. Dep't of Energy, *Cost-Effectiveness of ANSI/ASHRAE/IES Standard 90.1-2019 for Ohio*, at 2 (July 2021), available at https://www.energycodes.gov/sites/default/files/2021-07/Cost-effectiveness_of_ASHRAE_Standard_90-1-2019-Ohio.pdf.

15 *Id.*

Submitted Via Email

July 16, 2021

Regina Hanshaw
Executive Secretary
Ohio Board of Building Standards
P.O. Box 4009
6606 Tussing Road
Reynoldsburg, OH 43068

RE: Comments of the Responsible Energy Codes Alliance (RECA) Supporting the Adoption of the 2021 International Energy Conservation Code for Commercial and Multifamily Residential Buildings

Dear Ms. Hanshaw,

We understand that the Ohio Board of Building Standards is in the process of reviewing the 2021 *International Building Code* (*IBC*) for adoption as the Ohio Building Code. The Responsible Energy Codes Alliance supports the full adoption of the 2021 *IBC*, including Chapter 13, which would incorporate the 2021 *International Energy Conservation Code* (*IECC*) for commercial and multifamily residential construction. The 2021 version of the *IECC* is a clear and substantial improvement over the 2015 and 2018 versions of the *IECC* and will provide a range of energy efficiency, resiliency, and environmental benefits for the owners and occupants of commercial and multifamily residential buildings.

The need for decisive action to reduce energy demands is clearer than ever before. Buildings are a significant source of energy use and emissions, and the 2021 *IECC* provides a solution focused on improving the energy performance of buildings that will save money, promote local job creation, and improve the state's building infrastructure for generations to come. Updating Chapter 13 of the Ohio Building Code from the 2012 *IECC* to the 2021 *IECC* presents an important leadership opportunity that will place Ohio on the forefront of building efficiency. As a result, we recommend that the Board consider the full range of long-term benefits of adopting the 2021 *IECC* for commercial and multifamily residential buildings in the state.

Energy and Cost Savings

The *IECC* is the most widely adopted model energy code for residential and commercial construction, and earlier versions have been adopted in Ohio and nearly every state that has a statewide energy code. For the last fifteen years, the *IECC* has improved in efficiency with every new edition, providing straightforward energy and cost savings for the owners of homes and commercial buildings, and providing an important policy tool for state and local governments to achieve energy efficiency goals.

Like previous editions of the code, the 2021 *IECC* incorporates *ASHRAE* Standard 90.1 by reference as a compliance option, providing additional flexibility for design professionals and builders without sacrificing energy efficiency. In accordance with federal law, the U.S. Department of Energy analyzes efficiency improvements in each edition of *ASHRAE* Standard 90.1. The *IECC* commercial requirements are historically similar to Standard 90.1 in terms of overall efficiency, and the vast majority of states adopt the *IECC* (including the reference to Standard 90.1) and allow design professionals to use both codes. The table below summarizes DOE's analyses of national average energy savings, showing that building owners and occupants stand to benefit from over 20% lower energy costs, on average, with the adoption of the three most recent editions of the model codes.

Model Code	National Avg. Energy Cost Savings over previous model code		National Avg. Energy Cost Savings over previous model code
***ASHRAE* 90.1-2013**	**8.7%[1]**	**2015 *IECC***	**11.5%[2]**
***ASHRAE* 90.1-2016**	**8.3%[3]**	**2018 *IECC***	**5.3%[4]**
***ASHRAE* 90.1-2019**	**4.3%[5]**	**2021 *IECC***	**Not yet released**

[1] *See* U.S. Dep't of Energy, *ANSI/ASHRAE/IES Standard 90.1-2013 Determination of Energy Savings: Quantitative Analysis*, at iv (Aug. 2014), *available at* https://www.energycodes.gov/sites/default/files/documents/901-2013_finalCommercialDeterminationQuantitativeAnalysis_TSD.pdf.

[2] *See* U.S. Dep't of Energy, *Energy and Energy Cost Savings Analysis of the 2015 IECC for Commercial Buildings*, at vi (Aug. 2015), *available at* https://www.energycodes.gov/sites/default/files/documents/2015_IECC_Commercial_Analysis.pdf.

[3] *See* U.S. Dep't of Energy, *Energy Savings Analysis: ANSI/ASHRAE/IES Standard 90.1-2016*, at iv (Oct. 2017), *available at* https://www.energycodes.gov/sites/default/files/documents/02202018_Standard_90.1-2016_Determination_TSD.pdf.

[4] *See* U.S. Dep't of Energy, *Energy and Energy Cost Savings Analysis of the 2018 IECC for Commercial Buildings*, at vi (Dec. 2018), *available at* https://www.energycodes.gov/sites/default/files/documents/2018_IECC_Commercial_Analysis_Final.pdf.

By adopting the 2021 *IECC*, Ohio can capture the important energy-saving improvements incorporated into the 2015, 2018, and 2021 versions of the *IECC*.[6]

State-Specific Weakening Amendments

As noted earlier, in the most recent update to Chapter 13 of the Ohio Building Code, several state-specific weakening amendments were adopted, leaving the statewide code short of its full potential for energy and cost savings. Weakening amendments make the code less efficient by watering down specific code requirements and substituting requirements from previous codes for more up-to-date provisions. The *IECC* has undergone a considerable number of interrelated changes since the 2012 edition, so carrying forward the current Ohio amendments could create conflicts (in addition to lost energy savings).

The most straightforward approach to address such potential amendments in this code update would be to start with a clean slate by eliminating all state-specific amendments at the start and then add back only the administrative amendments necessary to align section numbers and other necessary state amendments. If substantive amendments are to be considered, each such amendment to the model code should be carefully analyzed to determine if it is an improvement to the 2021 *IECC.* In our view, only improvements should be adopted and incorporated into Chapter 13 of the Ohio Building Code. For example, the current amendment to Section 1301.2 allows new multifamily residential buildings to be air leakage tested to ≤4 ACH50, whereas the *IECC* has required these buildings to be tested to ≤3 ACH50 since the 2012 edition. In Ohio's varying climate conditions, tighter envelopes provide energy savings and comfort benefits for occupants. And since the current requirement has been in place for several years now, we expect that builders could easily achieve improved air tightness levels in the next edition of the code. We recommend that Ohio adopt the air tightness testing requirement and other improvements as they are published in the 2021 *IECC* so that owners and occupants of these buildings can enjoy the full benefits of the latest model energy codes.

Broad Support for the 2021 *IECC*

Like previous versions of the *IECC*, the 2021 edition was developed with the direct input of the nation's leading architects, building code officials, builders, manufacturers, environmental groups, and sustainability experts in a consensus-based code development

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[5] *See* U.S. Dep't of Energy, *Preliminary Energy Savings Analysis: ANSI/ASHRAE/IES Standard 90.1-2019*, at vi (Apr. 2021), *available at* https://www.energycodes.gov/sites/default/files/documents/20210407_Standard_90.1-2019_Determination_TSD.pdf.

[6] For an estimate of energy and carbon savings associated with the latest model energy codes, download the Building Energy Codes Emissions Calculator at https://www.imt.org/resources/building-energy-codes-emissions-calculator/.

process. During this process, the efficiency improvements proposed for the 2021 *IECC* were endorsed by a broad range of organizations, including mayors, code officials, state energy officials, sustainability directors, and other governmental representatives from every region of the U.S. For example, the U.S. Conference of Mayors unanimously adopted a Resolution endorsing proposals that would achieve a 10% improvement in the 2021 *IECC*, finding that:

> "… building energy codes, by setting minimum efficiency requirements for all newly constructed and renovated residential, multi-family, and commercial buildings, provide measurable and permanent energy savings and carbon emissions reductions over the century-long life spans of these buildings …"[7]

The 2021 *IECC* is the result of voting by governmental members who participated directly in the ICC process. These members voted in record numbers to improve almost every aspect of the *IECC*, paving the way for a more efficient, more sustainable future.

The 2021 *IECC* contains reasonable energy-saving improvements for the entire building, including:

- Improved building envelopes, providing year-round energy savings and comfort for occupants;
- Improved requirements for verification, certificates, and other consumer protections;
- More efficient mechanical and lighting systems and automated controls designed with occupant health and safety in mind;
- Additional flexibility for builders and design professionals to optimize their design choices without reducing efficiency;
- Improved resilience, protecting occupants from environmental and climate-related risks and helping protect the investment of building owners; and
- A framework for jurisdictions to customize efficiency and net-zero requirements to adapt the *IECC* to meet energy and climate goals.

Delaying the adoption of potential efficiency improvements in the energy code could also have significant long-lasting negative consequences. Buildings constructed today are expected to last 70 years or more, and the vast majority of features that affect efficiency will be chosen and set in place at construction. The failure to grasp the opportunity to build more efficient buildings at the outset is a tremendous loss; any delay in adoption will result in the

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[7] *See* U.S. Conference of Mayors, *Meeting Mayors' Energy and Climate Goals by Putting America's Model Energy Code on a Glide Path to Net Zero Energy Buildings by 2050*, USCM Resolution 59 (July 1, 2019) (emphasis added), *available at* https://energyefficientcodes.org/wp-content/uploads/2019-07-1-Putting-the-*IECC*-on-a-Glide-Path-to-Net-Zero-Energy-Buildings-by-2050.pdf.

construction of buildings with less efficiency, a condition that will last for many years and possibly for the life of such buildings. The owners and occupants of commercial and multifamily residential buildings depend on the state to regulate buildings in a way that optimizes energy and cost savings and that will be consistent with Ohio's long-term energy goals. The 2021 *IECC* provides a consensus-driven, adaptable blueprint for Ohio's future.

Conclusion

RECA's members and supporters have been involved in energy code development and adoption for decades, and we offer our assistance and experience as you work to maximize building energy efficiency. Please contact us if you have any questions or would like to discuss how RECA can be of assistance.

Sincerely,

Eric Lacey
RECA Chairman

RECA is a broad coalition of energy efficiency professionals, regional efficiency organizations, product and equipment manufacturers, trade associations, and environmental organizations with expertise in the development, adoption, and implementation of building energy codes nationwide. RECA is dedicated to improving the energy efficiency of homes throughout the U.S. through greater use of energy efficient practices and building products. It is administered by the Alliance to Save Energy, a non-profit coalition of business, government, environmental and consumer leaders that supports energy efficiency as a cost-effective energy resource under existing market conditions and advocates energy-efficiency policies that minimize costs to society and individual consumers. Below is a list of RECA Members that endorse these comments.

Air Barrier Association of America

Alliance to Save Energy

American Chemistry Council

American Council for an Energy-Efficient Economy

CertainTeed LLC

EPS Industry Alliance

Extruded Polystyrene Foam Association

Institute for Market Transformation

Johns Manville Corporation

Knauf Insulation

National Fenestration Rating Council

Natural Resources Defense Council

North American Insulation Manufacturers Association

Owens Corning

Polyisocyanurate Insulation Manufacturers Association

PNNL-32816

Energy and Energy Cost Savings Analysis of the 2021 IECC for Commercial Buildings

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Prepared for the U.S. Department of Energy
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PNNL-32816

Energy and Energy Cost Savings Analysis of the 2021 IECC for Commercial Buildings

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D Maddox
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Prepared for
the U.S. Department of Energy
under Contract DE-AC05-76RL01830

Pacific Northwest National Laboratory
Richland, Washington 99354

Summary

The U.S. Department of Energy (DOE) Building Energy Codes Program supports the development and implementation of building energy codes and standards, which set minimum requirements for the energy-efficient design and construction of new and renovated buildings, consequently reducing energy use and providing related environmental benefits over the lives of buildings. As required by federal statute (42 U.S.C. 6833), DOE recently issued a determination that ANSI/ASHRAE/IES[1] Standard 90.1-2019 would achieve greater energy efficiency in buildings compared to the 2016 edition of the standard. In support of DOE's determination, Pacific Northwest National Laboratory (PNNL) conducted an energy savings analysis for Standard 90.1-2019 (DOE 2021). While Standard 90.1 is the national model energy standard for commercial buildings (42 U.S.C. 6833), many states have historically adopted the International Energy Conservation Code (IECC) for both residential and commercial buildings.

This report provides an assessment as to whether new buildings constructed to the commercial energy efficiency provisions of the 2021 IECC would save energy and energy costs as compared to the 2018 IECC. The Commercial Energy Efficiency chapter in the 2021 IECC allows users to either follow the provisions in the IECC or use Standard 90.1-2019 as an alternative compliance path. As such, PNNL also compared the energy performance of the 2021 IECC with the corresponding Standard 90.1-2019 to help states and local jurisdictions make informed decisions regarding model code adoption.

The analysis builds on previous work completed by PNNL that assessed the energy performance of the 2018 IECC compared to the 2015 edition of the IECC (Zhang et al. 2018). For this analysis, PNNL first reviewed all code changes from the 2018 to 2021 IECC and identified those having a quantifiable impact on energy. These changes were then implemented in a suite of 16 prototype building models covering all 16 climate zones in the United States. This results in a total of 512 building models – 256 models each for the 2018 and 2021 editions of the IECC. Prototype models for the 2021 IECC were developed by implementing code changes to the 2018 IECC models. The 16 prototype building models represent approximately 75% of the total floor area of new commercial construction in the United States, including multi-family buildings more than three stories tall.

Whole-building energy simulations were conducted using DOE's *EnergyPlus Version 9.0.1* (DOE 2018) building simulation software. The resulting energy use from the complete suite of 512 simulation runs was converted to site energy use intensity (EUI, or energy use per unit floor area), source EUI, energy cost index (ECI), and carbon emissions for each simulation. For each prototype, the resulting EUIs and ECIs in each climate zone were weighted to calculate the aggregate national level site EUI, source EUI, ECI, and carbon emissions. Weighting factors were developed using commercial construction data and are based on new construction floor area of the different building types in each climate zone. Finally, the energy indexes were aggregated across building types to the national level using the same weighting data.

Overall, the 2021 edition of the IECC results in site energy savings of 12.1% at the aggregate national level compared to the 2018 IECC edition. In addition, on a national weighted average basis, the 2021 IECC is 6.5% *more* efficient for site energy use than Standard 90.1-2019 (see Appendix B in this report for the full comparison of the 2021 IECC and Standard 90.1-2019).

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[1] ANSI – American National Standards Institute; ASHRAE – American Society of Heating, Refrigerating, and Air-Conditioning Engineers; IES – Illuminating Engineering Society (previously identified as the Illuminating Engineering Society of North America, IESNA)

Savings from the 2018 to 2021 IECC vary significantly by prototype and climate. This is expected because code requirements differ by building type and climate.

A few high-impact changes resulting in significant energy savings are listed below:

- Envelope:
  - Air leakage testing (C402.5)
  - Operable openings interlocking with HVAC systems (C402.5.11)
- HVAC:
  - Demand controlled ventilation (C403.7.1)
  - Data center mechanical load components (C403.1.2)
  - Heating and cooling equipment efficiencies (C403.3.2)
- Lighting and receptacle loads:
  - Lighting power allowance reduction (C405.3.2)
  - Automatic control of receptacle loads (C405.11)
  - Secondary sidelit area daylighting control (C405.2.4)
- Additional efficiency requirements:
  - Lighting power reduction (C406.3)
  - Heating and cooling efficiencies (C406.2)
  - Heat pump water heaters (C406.7.4)
  - Infiltration reduction (C406.9).

Table ES.1 provides a high-level summary of differences between the 2018 IECC and the 2021 IECC, in terms of EUI, ECI and emissions. The analysis shows an estimated site energy savings of 12.1% and energy cost savings of 10.6% on a national aggregated basis. Figure ES.1 illustrates the national weighted savings between the 2018 IECC and the 2021 IECC for all metric types and for each prototype.

Table ES.1. Energy and Emission Savings between the 2018 and 2021 IECC

	Site EUI kBtu/ft^2-yr	Source EUI kBtu/ft^2-yr	Site ECI \$/ft^2-yr	Emissions ton/ksf-yr
2018 IECC National Weighted	51.1	118.7	1.32	8.24
2021 IECC National Weighted	44.9	106.1	1.18	7.40
National Weighted Savings	12.1%	10.6%	10.6%	10.2%
Minimum Building Type Savings	2.9%	1.8%	1.6%	1.6%
Maximum Building Type Savings	28.7%	21.4%	21.3%	20.3%

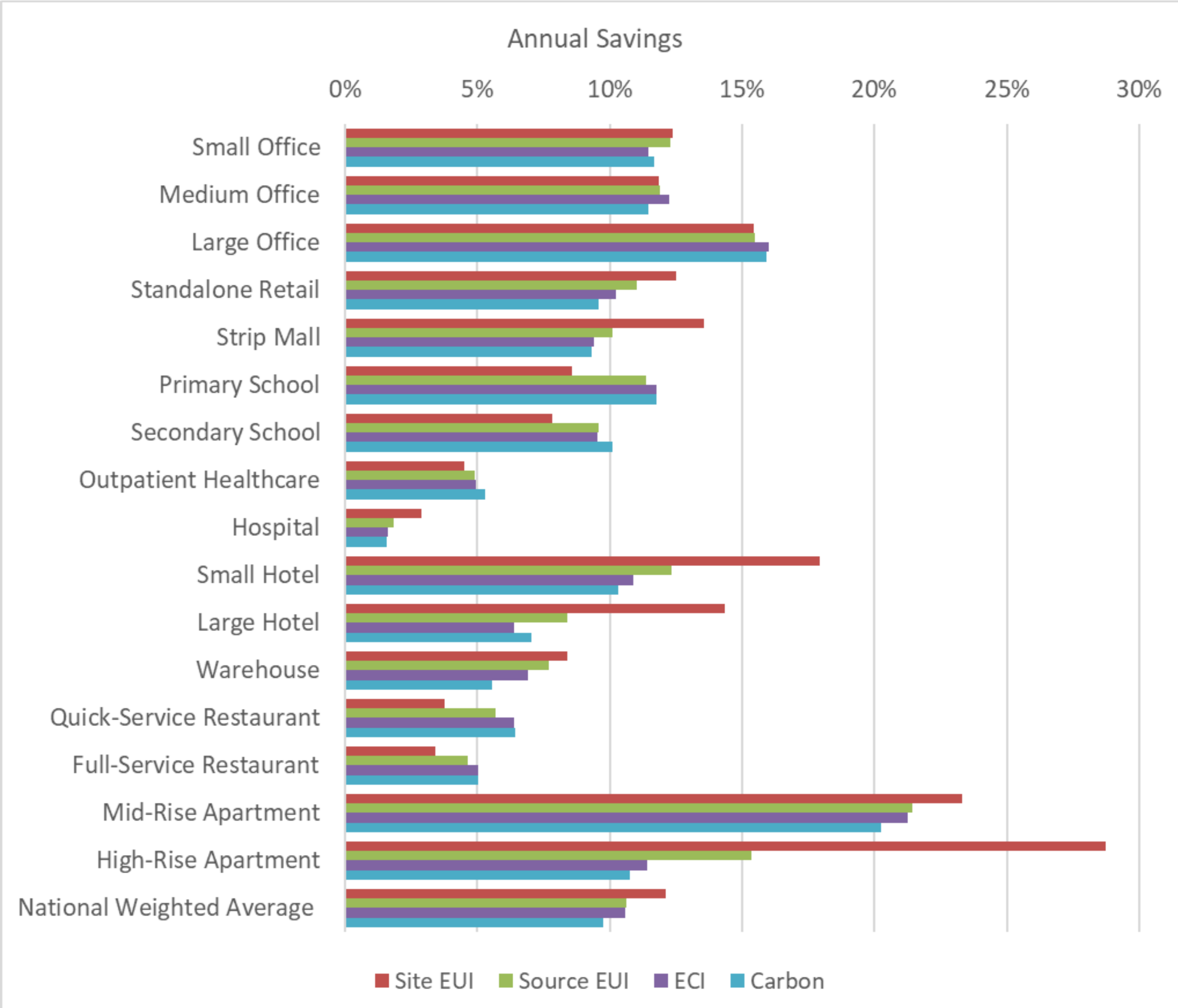

Figure ES.1. National Average Energy, Cost and Emissions Savings for all IECC Prototypes

Acknowledgments

This report was prepared by Pacific Northwest National Laboratory (PNNL) for the U.S. Department of Energy (DOE) Building Energy Codes Program. The authors would like to thank Jeremiah Williams at DOE for providing oversight. The authors would also like to thank the numerous PNNL contributors to the Commercial Prototype Building Models, who built a technical foundation for this analysis project.

The authors sincerely thank their PNNL colleagues Reid Hart and Marye Hefty, as well as Jerica Stacey and Kristopher Stenger of the International Code Council, who provided insightful review comments on an earlier draft of this report.

Acronyms and Abbreviations

AEO	Annual Energy Outlook
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
BECP	Building Energy Codes Program
Btu/h	British thermal unit(s) per hour
CBECS	Commercial Building Energy Consumption Survey
CFM	cubic feet per minute
CFR	Code of Federal Regulations
CO_2	carbon dioxide
DCV	demand control ventilation
DOE	U.S. Department of Energy
ECI	energy cost index
ECPA	Energy Conservation and Production Act
EIA	Energy Information Administration
EMS	energy management system
EPA	U.S. Environmental Protection Agency
ERE	energy recovery effectiveness
ERR	energy recovery ratio
ERV	energy recovery ventilator
EUI	energy use intensity
ft^2	square feet
hp	horsepower
HPWH	heat pump water heater
HSPF	Heating Seasonal Performance Factor
HVAC	heating, ventilation, and air-conditioning
ICC	International Code Council
IECC	International Energy Conservation Code
IEER	Integrated Energy Efficiency Ratio
IES	Illuminating Engineering Society
INOCT	installed nominal operating cell temperature
in wc	inches of water column differential pressure
ITE	information technology equipment
$kBtu/ft^2$-yr	thousand British thermal unit(s) per square foot per year
kBtu/h	thousand British thermal unit(s) per hour
ksf	thousand square feet

kWh	kilowatt hour(s)
LPD	lighting power density
MLC	mechanical load component
PNNL	Pacific Northwest National Laboratory
OA	outside air
SEER	Seasonal Energy Efficiency Ratio
SHGC	solar heat gain coefficient
supp	supplemental heater
SWH	service water heating
Tmains	temperature of unheated service water entering the building
USC	United States Code
VAV	variable air volume
WWR	window-to-wall ratio

Contents

Figures

Tables

1.0 Introduction

The U.S. Department of Energy (DOE) Building Energy Codes Program supports the development and implementation of building energy codes and standards, which set minimum requirements for energy-efficient design and construction for new and renovated buildings, consequently reducing energy use and providing related environmental impacts for the lives of buildings.

As required by federal statute (42 U.S.C. 6833), DOE recently issued a determination that ANSI/ASHRAE/IES[1] Standard 90.1-2019 would achieve greater energy efficiency in buildings subject to the code compared to the 2016 edition of the standard.[2] Pacific Northwest National Laboratory (PNNL) conducted an energy savings analysis for Standard 90.1-2019 in support of the determination (DOE 2021). While Standard 90.1 is the national model energy standard for commercial buildings (42 U.S.C. 6833), many states adopt the full suite of International Codes, and thus also adopt the International Energy Conservation Code (IECC), which includes energy conservation requirements for both residential and commercial buildings. Of the 42 states with statewide commercial building energy codes currently, 33 use a version of the IECC (BECP 2022). The Commercial Energy Efficiency chapter of the 2021 IECC (International Code Council, ICC 2021) allows users to either follow the provisions in the IECC or use Standard 90.1-2019 as an alternative compliance path. This report provides an assessment as to whether new buildings constructed to the commercial energy efficiency provisions of the 2021 IECC would save energy and energy costs compared to the 2018 IECC (ICC 2018). Because PNNL used the same methodology for both the 2021 IECC analysis and the previous Standard 90.1-2019 analysis, comparisons between the estimated energy performance of the 2021 IECC and that of its referenced Standard 90.1-2019 are presented in Appendix B of this report. The goal of this comparison is to help states and local jurisdictions make informed decisions regarding model code adoption.

This report documents the approach and results for PNNL's analysis for energy and energy cost savings of the 2021 IECC for commercial buildings. PNNL first reviewed all code changes from the 2018 to 2021 IECC and identified those having a quantifiable impact. PNNL then compared two suites of building prototypes, each suite complying with one edition of the IECC. Each suite consists of 256 building prototypes; a combination of 16 building prototypes in all 16 U.S. climate zones. The 2018 IECC prototypes were taken from PNNL's previous analysis of the energy performance of the 2018 IECC compared to its previous edition, which was documented in *Energy and Energy Cost Savings Analysis of the* 2018 *IECC for Commercial Buildings* (Zhang et al. 2018), referred to here as *Analysis of the* 2018 *IECC*.

The remainder of this report is organized in three sections. Section 2.0 summarizes the general development and methodology related to the building prototypes and simulation for energy use and cost. The same methodology was applied in the previous *Analysis of the* 2018 *IECC* and the Standard 90.1-2019 determination (DOE 2021). Section 3.0 describes how PNNL developed the 2021 IECC prototypes using the 2018 IECC prototypes as the basis. Finally, Section 4.0 summarizes the results of the comparison of the two editions of the IECC. Appendix A summarizes the identified code changes between the 2018 and 2021 IECC (with quantified

[1] ANSI – American National Standards Institute; ASHRAE – American Society of Heating, Refrigerating, and Air-Conditioning Engineers; IES – Illuminating Engineering Society (previously identified as the Illuminating Engineering Society of North America, IESNA)
[2] For more information on the DOE Determination of energy savings, see http://www.energycodes.gov/development/determinations.

energy impacts) and identifies which building prototypes are impacted by each change. Appendix B provides energy and energy cost comparisons between Standard 90.1-2019 and the 2021 IECC.

2.0 Methodology

To support the development and implementation of building energy codes, PNNL researchers have developed building prototypes that comply with various editions of model energy codes including both Standard 90.1 and the IECC. These building prototypes represent the majority of new commercial building stock and were developed using DOE's *EnergyPlus Version 9.0.1* building energy simulation software (DOE 2018). The results allow comparison of the national weighted average savings of one code to its earlier edition and the relative performance differences between the codes. This section summarizes the general methodology used for this 2021 IECC analysis, which is consistent with that used for the *Analysis of the* 2018 *IECC*.

2.1 Building Prototypes

For this analysis, PNNL used a suite of building prototypes (DOE and PNNL 2022) representing the first seven principal building activities in the Commercial Buildings Energy Consumption Survey (CBECS; EIA 2003). These seven principal building activities represent 76% of the energy usage of all commercial buildings. In addition, two multifamily prototypes (Mid-Rise and High-Rise Apartments), which are not included in CBECS, were added into the suite of prototypes because they are also regulated by the commercial provisions of the IECC. Table 2.1 shows the seven principal activities as defined in CBECS and the added apartment activity. These building activities were further divided into 16 building prototypes, which are listed in Table 2.1 along with their floor area. Together, these prototypes represent 75% of new construction floor area in the United States (Lei et al. 2020). Detailed descriptions of the prototypes and enhancements are documented in Thornton et al. (2011) and Goel et al. (2014).

Table 2.1. Commercial Prototype Building Models

Building Type	Prototype Building	Floor Area (ft^2)	Floor Area (%)
Office	Small Office	5,502	3.8%
	Medium Office	53,628	5.0%
	Large Office	498,588	3.9%
Retail	Stand-Alone Retail	24,692	10.9%
	Strip Mall	22,500	3.7%
Education	Primary School	73,959	4.8%
	Secondary School	210,887	10.9%
Healthcare	Outpatient Health Care	40,946	3.4%
	Hospital	241,501	4.5%
Lodging	Small Hotel	43,202	1.6%
	Large Hotel	122,120	4.2%
Warehouse	Non-Refrigerated Warehouse	52,045	18.6%
Food Service	Quick-Service Restaurant	2,501	0.3%
	Full-Service Restaurant	5,502	1.0%
Apartment	Mid-Rise Apartment	33,741	13.7%
	High-Rise Apartment	84,360	9.6%
Total			100%

2.2 Climate Zones

The 2021 IECC includes nine climate zones (0 through 8) and three moisture regimes (marine, dry, and humid). Each combination of climate zone and moisture regime defines a climate subzone, resulting in 16 climate subzones in the United States, which are the same as those defined in ASHRAE Standard 169-2013, *Climatic Data for Building Design Standards* (ASHRAE 2013), which assigns U.S. counties to climate zones, as shown in Figure 2.1. There are currently no counties in the U.S. assigned to Climate Zones 0A, 0B, or 1B.

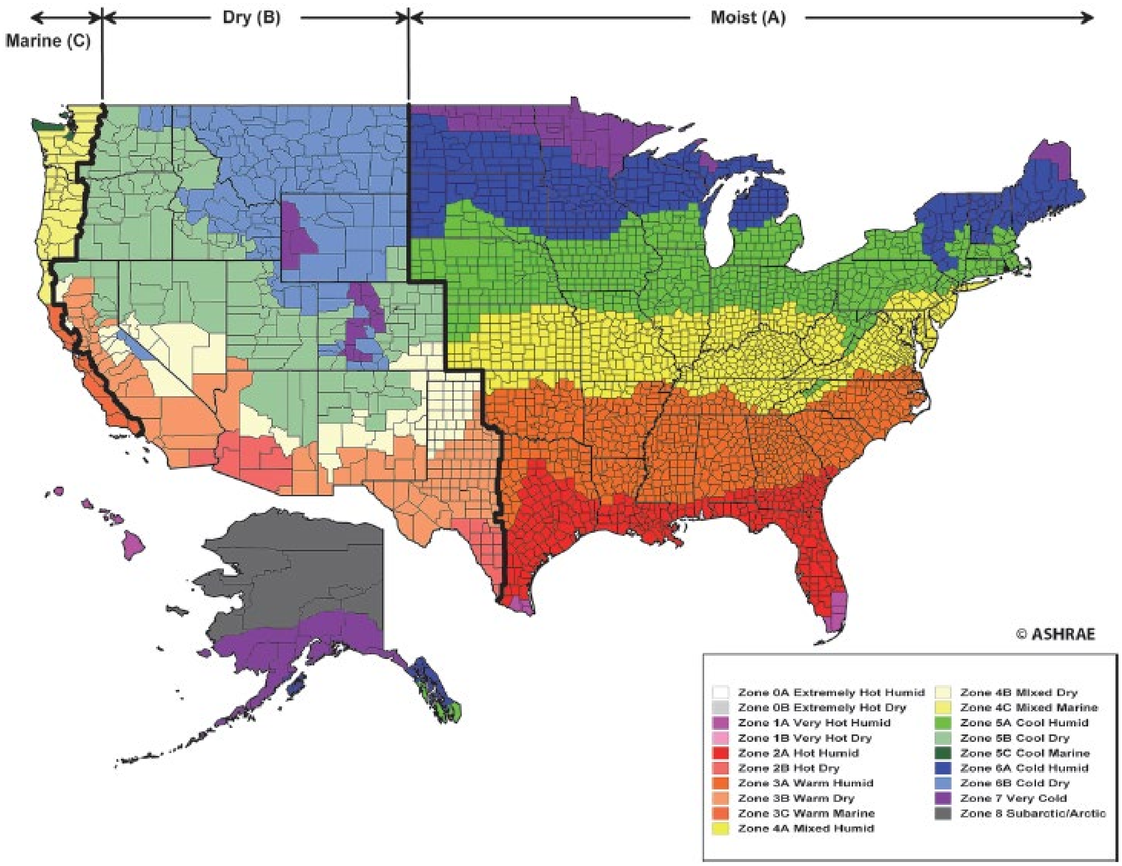

Figure 2.1. United States Climate Zone Map (ASHRAE 2013)

For this analysis, a specific climate location (city) was selected as a representative of each of the 16 climate/moisture zones found in the United States. These are consistent with representative cities approved by the ASHRA E 90.1 Standing Standard Project Committee (SSPC) for setting the criteria for Standard 90.1-2019. One change from the 2018 IECC analysis is that climate zone 1A is now represented by Miami, Florida instead of Honolulu, Hawaii.

The 16 cities used in the current analysis are:

- 1A: Miami, Florida (very hot, humid)
- 2A: Tampa, Florida (hot, humid)
- 2B: Tucson, Arizona (hot, dry)
- 3A: Atlanta, Georgia (warm, humid)
- 3B: El Paso, Texas (warm, dry)
- 3C: San Diego, California (warm, marine)
- 4A: New York, New York (mixed, humid)
- 4B: Albuquerque, New Mexico (mixed, dry)
- 4C: Seattle, Washington (mixed, marine)
- 5A: Buffalo, New York (cool, humid)
- 5B: Denver, Colorado (cool, dry)
- 5C: Port Angeles, Washington (cool, marine)
- 6A: Rochester, Minnesota (cold, humid)
- 6B: Great Falls, Montana (cold, dry)
- 7: International Falls, Minnesota (very cold)
- 8: Fairbanks, Alaska (subarctic)

2.3 Comparison Metrics and Construction Weights

Annual electricity and natural gas energy use in each building prototype were simulated across 256 buildings, a combination of 16 prototypes in all 16 U.S. climate zones. The simulated site energy use is utility electricity and natural gas delivered to and used at the building site. The site energy use was converted to site energy use intensity (site EUI, or energy use per unit floor area). Results are also presented in terms of source energy consumption at the level of the power generation facility, site energy cost, and carbon emission reductions. Conversion factors are described in the following paragraphs.

The electric energy source conversion factor of 9,707 Btu/kWh was calculated using Table 2[1] from EIA's Annual Energy Outlook (AEO) 2022 (EIA 2022) as follows:

- Delivered commercial electricity, 2021: 4.50 quads
- Commercial electricity related losses, 2021: 8.30 quads
- Total commercial electric energy use, 2021: 12.80 quads
- Commercial electric source ratio, U.S. 2021: 2.84
- Source electric energy factor[2] (3,413 Btu/kWh site): 9,707 Btu/kWh

Natural gas EUIs in the prototype buildings were converted to source energy using a factor of 1.094 Btu of source energy per Btu of site natural gas use, based on the 2021 national energy use estimate shown in Table 2 of the AEO 2022 as follows:

- Delivered total natural gas, 2021: 28.41 quads
- Natural gas used in well, field, and pipeline: 2.66 quads
- Total gross natural gas use, 2021: 31.06 quads
- Total natural gas source ratio, U.S. 2021: 1.094 Btu source/Btu site
- Source natural gas energy factor (100,000 Btu/therm site): 109,400 Btu/therm

To calculate the energy cost, PNNL relied on national average commercial building energy prices based on EIA statistics for 2021 in Table 3, "Energy Prices by Sector and Source," of the AEO 2022 for commercial sector natural gas and electricity of:

- $0.1132/kWh of electricity
- $8.74 per 1000 cubic feet ($0.843/therm) of natural gas.

PNNL recognizes that actual energy costs will vary somewhat by building type within a region, and even more between regions. However, the use of national average figures sufficiently illustrates energy cost savings and the effect on energy efficiency in commercial buildings. The same methodology was used for the DOE determination for Standard 90.1-2019 (DOE 2021).

Carbon emissions in the quantitative analysis are based on the source energy consumption on a national scale. Carbon emission metrics are provided by the U.S. Environmental Protection

[1] Available at https://www.eia.gov/outlooks/aeo/.

[2] The final conversion value is calculated using the full seven-digit values available in Table 2 of AEO 2022. Other values shown in the text are rounded.

Agency (EPA) Greenhouse Gas Equivalencies Calculator.[1] The EPA greenhouse calculator reports the national marginal carbon emission conversion factor for electricity at 7.07 x 10^{-4} metric tons carbon dioxide (CO_2)/kWh. For natural gas, the carbon emission conversion factor is 0.0053 metric tons CO_2/therm. Table 4.2 summarizes the carbon emission factors. For a detailed discussion of the estimates of the monetized benefits of carbon emission reductions due to implementation of commercial model energy codes see Tyler et al. (2021).

Weighting factors that allow aggregation of the energy impact from an individual building and climate zone level to the national level were developed from construction data purchased from McGraw Hill. Details of the development are further discussed in a PNNL report (Lei et al. 2020). New construction weights were determined for each building type in each climate zone based on the county-climate zone mapping from ASHRAE Standard 169-2013. Table 2.2 lists the weighting factors assigned to each prototype in all 16 U.S. climate zones.

[1] See the EPA webpage at https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.

Table 2.2. Relative Construction Volume Weights for 16 Prototype Buildings by Climate Zone (percent)

Building Type	1A	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8	Weights by Bldg Type
Large Office	0.11	0.54	0.07	0.54	0.26	0.23	1.13	0.00	0.24	0.48	0.15	0.00	0.09	0.00	0.01	0.00	3.86
Medium Office	0.14	0.78	0.19	0.73	0.45	0.16	0.95	0.03	0.17	0.88	0.31	0.00	0.17	0.03	0.02	0.00	5.01
Small Office	0.11	0.77	0.15	0.70	0.27	0.05	0.58	0.03	0.09	0.67	0.21	0.00	0.13	0.02	0.02	0.00	3.80
Stand-Alone Retail	0.29	1.79	0.31	1.78	0.85	0.12	1.92	0.08	0.26	2.37	0.54	0.01	0.49	0.06	0.06	0.01	10.94
Strip Mall	0.16	0.63	0.14	0.70	0.42	0.09	0.66	0.02	0.09	0.61	0.12	0.00	0.06	0.01	0.01	0.00	3.71
Primary School	0.13	0.98	0.12	0.94	0.36	0.04	0.88	0.03	0.12	0.77	0.23	0.00	0.16	0.05	0.02	0.00	4.83
Secondary School	0.26	1.86	0.19	2.16	0.77	0.14	1.98	0.07	0.27	2.18	0.51	0.01	0.37	0.09	0.06	0.01	10.92
Hospital	0.09	0.75	0.11	0.63	0.32	0.10	0.92	0.03	0.13	0.95	0.23	0.01	0.20	0.03	0.03	0.00	4.52
Outpatient Health Care	0.05	0.54	0.09	0.53	0.17	0.04	0.62	0.02	0.10	0.80	0.20	0.00	0.18	0.03	0.03	0.00	3.42
Full-Service Restaurant	0.03	0.18	0.03	0.17	0.08	0.01	0.16	0.01	0.02	0.19	0.04	0.00	0.03	0.00	0.00	0.00	0.97
Quick-Service Restaurant	0.01	0.07	0.01	0.06	0.02	0.00	0.06	0.00	0.00	0.07	0.02	0.00	0.01	0.00	0.00	0.00	0.33
Large Hotel	0.18	0.71	0.10	0.56	0.55	0.09	0.82	0.02	0.13	0.65	0.19	0.00	0.14	0.04	0.02	0.00	4.22
Small Hotel	0.03	0.30	0.02	0.27	0.11	0.02	0.30	0.01	0.03	0.27	0.10	0.00	0.08	0.03	0.02	0.00	1.59
Non-Refrigerated Warehouse	0.53	3.53	0.63	2.77	2.23	0.18	3.69	0.05	0.54	3.14	0.82	0.00	0.37	0.03	0.04	0.00	18.56
High-Rise Apartment	1.44	1.19	0.08	0.57	0.63	0.29	3.26	0.00	0.49	1.36	0.19	0.00	0.11	0.01	0.00	0.00	9.64
Mid-Rise Apartment	0.36	2.24	0.27	1.78	1.18	0.49	3.02	0.03	0.71	2.22	0.73	0.01	0.57	0.05	0.04	0.00	13.69
Weights by Zone	3.94	16.85	2.52	14.89	8.67	2.06	20.94	0.43	3.39	17.60	4.59	0.05	3.17	0.49	0.38	0.03	100.00

3.0 2021 IECC Building Prototype Development

The starting point for the 2021 prototypes was the 2018 prototypes that were developed for the *Analysis of the 2018 IECC* (Zhang et al. 2018). PNNL reviewed all code changes from the 2018 to 2021 IECC. In this section, PNNL compares code changes in commercial energy efficiency provisions between the 2018 and 2021 IECC and documents how they were implemented in the 2021 IECC prototypes and modeled in *EnergyPlus*.

3.1 Review of Code Changes

Chapter 4 Commercial Energy Efficiency of the IECC provides three alternative paths for a new building to demonstrate compliance: (1) the prescriptive requirements in the IECC, (2) the total building performance requirements in the IECC, or (3) the requirements in the referenced Standard 90.1. This analysis looks only at the prescriptive compliance path (1), comparing the energy performance of the mandatory and prescriptive requirements in the 2018 IECC relative to those in the 2021 IECC, which is consistent with how DOE has traditionally evaluated model code updates when issuing its statutorily-directed *Determinations of Energy Savings.*[1]

PNNL classified the changes to the prescriptive compliance path into three categories: 1) changes that provide clarifications, are administrative, or update references to other documents, and thusdo not directly impact energy use; 2) changes that result in energy efficiency impacts but are not quantified using the building prototypes; and 3) changes that result in energy efficiency impacts that can be quantified. Only those in the third category were incorporated into the 2021 IECC prototypes. Changes in the second category were not quantified when they met one of the following criteria:

1. The changes impact features not found in typical building designs. The prototype models include the most common design features found in each building type in the United States. Therefore, there are many less common features that are not represented in the prototypes, such as enclosed parking garages and large diameter ceiling fans. Changes affecting these features of buildings were not captured via the prototypes in order to preserve representation of the typical building stock.
2. The changes apply only to building retrofits or alterations instead of newly constructed buildings.
3. The changes cannot be modeled with currently available tools and data. One example of this is the increased Integrated Energy Efficiency Ratio (IEER) requirements for packaged direct expansion cooling systems. There is currently no performance data available to characterize the impact of IEER changes on part load energy performance.

Table 3.1 lists the changes that have been quantified through the prototype analysis, and Appendix A identifies both the location of each change in the IECC and the list of prototypes that are impacted. The following sections describe these changes in more detail, as well as their modeling strategies in the prototypes.

[1]The latest DOE determinations are available at https://www.energycodes.gov/development/determinations.

Table 3.1. Changes Between the 2018 and 2021 IECC with Quantified Energy

2021 IECC Section	Description of Code Changes
C402.1.4 Assembly U-factor, C-factor, or F-factor	Imposes more stringent requirement on the insulation requirements for opaque constructions.
C402.4 Fenestration	Imposes more stringent requirement on the window thermal properties.
C402.4.5 Doors	Increases allowable U-factor requirements for opaque non-swinging doors. Also decreases U-factors for swinging doors in some climates.
C402.5 Air leakage - thermal envelope	Adds requirement for air barrier testing, which sets specific limits on air leakage for specific climates.
C402.5.11 Operable openings interlocking	Requires that operable openings be interlocked with HVAC setpoints.
C403.1.2 Data centers	Adds requirement that data center systems comply with Sections 6 and 8 of ASHRAE 90.4-2016 (ASHRAE 2016), with IECC-specific values for mechanical load component (MLC).
C403.3.2 HVAC equipment performance requirements	Increases required HVAC efficiency values for several equipment categories.
C403.4.2.3 Automatic start and stop	Adds automatic stop for near the end of occupied periods, where thermostat is set back by 2°F.
C403.6.5 Supply air temperature reset	Adds exceptions to supply air temperature reset for some hot climates based on design outside air flow.
C403.7.1 Demand control ventilation	Expands the applicability of demand control ventilation (DCV) to all single-zone systems that also require economizer and reduces occupant density threshold.
C403.7.4 Energy recovery systems	Adds new requirements for energy recovery ventilator (ERV) in non-transient dwelling units.
C403.8.5 Low-capacity ventilation fans	Adds efficacy requirements for low-capacity fans.
C403.11.1 Commercial refrigerators and freezers	Decreases maximum daily energy consumption for commercial refrigerators and freezers.
C403.11.2 Walk-in coolers and walk-in freezers	Decreases maximum daily energy consumption for walk-in coolers and freezers.
Future	Adds new federal requirements for clean water pump efficiency.[1]
C405.2.1 Occupant sensor controls	Extends lighting occupancy sensor requirement to corridor spaces.
C405.2.4.2 Sidelit daylight zone	Adds requirement for secondary sidelit daylight zone.
C405.2.7.3 Exterior lighting setback	Increases exterior lighting control setback amounts to 50% and adds occupancy-based control to outdoor parking areas.
C405.3.2 Interior lighting power allowance	Decreases lighting power allowance for most space types.
C405.11 Automatic receptacle control	Adds requirement for automatic control of receptacle loads in selected space types.
C406 Additional Efficiency Requirements	Establish energy efficiency credit requirements with more optional efficiency requirements with new point values.

[1] Clean water pump requirements in the CFR section 431.465 have been in effect since January 27, 2020.

Sections 3.2 through 3.4 of this report summarize new prescriptive code requirements in the 2021 IECC. Section 3.5 describes updates to the Additional Efficiency section of the IECC and how that section was applied to the prototypes for the 2021 IECC.

3.2 Building Envelope

3.2.1 Opaque Envelope

Code Change Description. Tables C402.1.3 and C402.1.4 of the 2021 IECC include several significant performance improvements for opaque envelope relative to the 2018 IECC.

Modeling Strategy. Key changes that are relevant to the prototypes were made for above grade walls, below grade walls, metal building walls and roofs, and unheated slabs, and all prototypes are affected by the changes. Changes in U-factor requirements of walls, roofs, and floors were implemented in the prototype models by adjusting the insulation R-value to provide the target overall U-factors as needed. Doors are modeled as massless objects in the prototypes, and thus changes to the code requirements were implemented directly as R-value of the doors.

3.2.2 Vertical Fenestration U-factor and Solar Heat Gain Coefficient (SHGC)

Code Change Description. The 2021 IECC decreases the maximum U-factor and SHGC requirements of vertical fenestration in Table C402.4 for several climate zones. In addition, the window type categories for specification of SHGC were changed from an orientation basis to be based on fixed versus operable window types.

Modeling Strategy. All the prototypes have vertical fenestration; therefore, this code change has energy impacts on all prototypes. To capture the window type categories of fixed and operable, weighting factors were developed as shown in Table 3.2 based on recent market data from Ducker[1] to calculate weighted U-factor and SHGC values for each prototype. The previous analysis for the 2018 IECC neglected the alternative SHGC values for the north orientation because the prototypes are oriented true east, south, west, and north, and the impact of relaxed SHGC for a true north-facing facade is negligible.

[1] Detailed market data from https://www.ducker.com/ were processed by the ASHRAE SSPC90.1 Envelope Subcommittee.

Table 3.2. Weighting Factors for Fixed and Operable Windows

Building Prototype	Vertical fenestration categories	
	Fixed	Operable
Small Office	96.9%	3.1%
Medium Office	96.9%	3.1%
Large Office	96.9%	3.1%
Stand-Alone Retail	97.8%	2.2%
Strip Mall	97.8%	2.2%
Primary School	89.8%	10.2%
Secondary School	89.8%	10.2%
Outpatient Healthcare	95.9%	4.1%
Hospital	95.9%	4.1%
Small Hotel	92.0%	8.0%
Large Hotel	92.0%	8.0%
Non-Refrigerated Warehouse	97.4%	2.6%
Quick-Service Restaurant	97.8%	2.2%
Full-Service Restaurant	97.8%	2.2%
Mid-Rise Apartment	75.4%	24.6%
High-Rise Apartment	75.4%	24.6%

3.2.3 Skylight U-factor and Solar Heat Gain Coefficient (SHGC)

Code Change Description. The 2021 IECC decreases the maximum U-factor requirements for skylights in Table C402.4 for climate zones 0, 1, 7, and 8. In addition, skylight SHGC values are decreased for climate zones 0 through 3.

Modeling Strategy. Skylights are included in the Stand-Alone Retail, Primary School, Secondary School, and Warehouse prototypes. The changes were implemented as new skylight property values for these prototype models in the affected climate zones.

3.2.4 Infiltration

Code Change Description. Under the requirements of Section C402.5 of the 2021 IECC, air leakage testing is no longer optional for specified building types, building sizes, and climate zones. In the 2018 IECC, the air leakage testing was not required if specified design and construction practices were followed.

Modeling Strategy. Table 3.3 lists the new 2021 IECC requirements for air leakage testing as applied to the prototypes. For the 2018 IECC, the infiltration values were set at 1.0 cfm/ft^2 at 0.3 inches of water column differential pressure (in wc) for all climate zones except 2B, which was at 1.8 cfm/ft^2 at 0.3 in wc. These values are based on recommendations made by the ASHRAE Envelope Subcommittee, where 1.8 cfm/ft^2 represents a building without advanced air barriers, and 1.0 cfm/ft^2 represents a building with advanced air barriers, but without air leakage testing (Thornton et al., 2011). It should be noted that the infiltration rate specified in 2021 IECC for dwelling and sleeping units of 0.3 cfm/ft^2 at 0.2 in wc is equivalent to 0.4 cfm/ft^2 at the higher pressure difference of 0.3 in wc, as reported in Table 3.3.

The test condition values from Table 3.3 were converted to natural conditions for the model using the methods described by Gowri et al. (2009). The infiltration rates were further reduced for some prototypes to satisfy the additional efficiency requirements as described in Section 3.5 of this report.

Table 3.3. New IECC 2021 Estimated Infiltration Rates for Prototypes based on Climate, cfm/ft^2 at 0.3 in wc

Group	Prototypes	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A to 8
Group R and I	High-Rise Apartment, Mid-Rise Apartment, Hospital, Large Hotel, Small Hotel Outpatient Health Care	0.4	0.4	0.4	0.4	0.4	1.8	0.4	0.4	1	0.4	0.4	0.4	0.4	0.4	1	0.4
< 5,000 ft^2	Fast Food Restaurant	0.4	0.4	0.4	0.4	0.4	1.8	0.4	1	1	0.4	0.4	0.4	0.4	0.4	1	0.4
5,000 to <50,000 ft^2	Office Small, Stand-Alone Retail Strip mall Retail, Sit-Down Restaurant	0.4	1	1	1	1	1.8	0.4	1	1	0.4	1	1	0.4	0.4	1	0.4
>= 50,000 ft^2	Medium Office, Large Office, Primary School, Secondary School, Warehouse	1	1	1	1	1	1.8	1	1	1	0.4	1	1	0.4	1	1	0.4

3.3 Building Mechanical Systems

3.3.1 Operable Opening Interlock With HVAC

Code Change Description. The 2021 IECC adds a new section (C402.5.11) to require the interlock of HVAC thermostat setpoints with the position of operable openings, such as doors and windows. The code makes this requirement mandatory for operable openings with direct access to the outdoors and a larger than 40-ft^2 opening area. The interlock requires resetting the space cooling setpoint to 90°F and heating setpoint to 55°F whenever the operable opening is open. Exceptions apply to the zoned areas associated with food preparation, warehouse, and doors in the vestibule area. Prior to this update, there was no requirement to interlock HVAC with operable openings in the 2018 IECC.

Modeling Strategy. The doors in the Mid-Rise Apartment, High-Rise Apartment, Large Hotel, and Small Hotel are impacted by this code change, since they have a larger than 40-ft^2 opening area, which meets the requirements in Section 402.5.11. Capturing this technology in the prototypes first requires the use of operable doors for natural ventilation in response to favorable weather. This was first implemented for ASHRAE 90.1-2013 as described by Halverson et al. (2014). Where applicable, sliding doors are opened in the model when outdoor temperatures are between 60°F and 80°F, and the doors remain open as long as indoor temperatures are between 66°F and 78°F. There is an additional probability factor of 33% applied to account for the likelihood that the doors will be opened when conditions are favorable.

An energy management system (EMS) is utilized by the EnergyPlus models to simulate the interlock control. The EMS detects the natural ventilation air volume flow rate in the zones where doors are located and resets the HVAC cooling setpoint and heating setpoint to 90°F and 55°F, respectively, when natural ventilation air flow in those zones is detected.

3.3.2 Data Center HVAC Efficiency

Code Change Description. The 2021 IECC has added a requirement in C403.1.2 for data center systems to comply with Sections 6 and 8 of ASHRAE Standard 90.4-2016 (ASHRAE 2016), with modified values for design and annual mechanical load component (MLC) tables. The MLC methodology is a performance-based approach that sets limits on both peak and annual energy use with respect to the information technology equipment (ITE) load. A new definition is added to IECC-2021 for a data center, which specifies a zone that has ITE power density exceeding 20 W/ft^2 and total design ITE equipment load greater than 10 kW. In the 2018 IECC, data center HVAC systems were regulated by prescriptive requirements for component efficiencies and controls.

Modeling Strategy. The only zone in the prototypes that has ITE power exceeding both of the criteria in the 2021 IECC to trigger the MLC requirement is the large basement data center in the large office prototype, as shown in Table 3.4.

Table 3.4. Loads for ITE Zones in Large Office Prototype

Zone	Area Per Zone	Peak ITE Load Per Zone, kW	W/ft^2
Large Data Center	8,435	379.6	45.0
Small IT Closets	390	7.8	20.0

In order to better understand the implications of the new MLC requirements, several simulations were run with the large office prototype with measures such as an economizer, water cooled chiller, variable air volume (VAV) air handlers, and removal of humidification. The full set of measures surpassed code requirements for some climate zones but failed to meet them for hot and humid climates. Possibly the hot climates could have been satisfied with further exploration of high-efficiency chiller options.

Due to the complexity of exactly meeting the code requirements in different climates with different combinations of HVAC measures, a more simplistic modeling approach was established wherein the MLC concept was implemented into the large office prototype by two changes. The first was to add a dummy electrical equipment load into the zone equal to the product of the peak ITE load and the required maximum annualized MLC. A submeter was assigned to this load to indicate that it represents the HVAC energy associated with the zone, and the load schedule was set to be the same as the ITE load schedule. The second change was to convert the HVAC system to an Ideal Loads system in EnergyPlus, which does not directly consume electric or gas energy. Since the annualized MLC is always lower than the design MLC, this approach will satisfy both MLC requirements.

3.3.3 HVAC Equipment Efficiency Updates

Code Change Description. The 2021 IECC includes improvements to HVAC equipment efficiencies from the 2018 IECC as summarized in Table 3.5. One code change that was not incorporated into the 2021 IECC update is the increase in IEER values for larger unitary air conditioners and heat pumps. These were deferred to a future update because performance curves are not currently available to characterize the annual energy impacts of changes to IEER in EnergyPlus. The PNNL team has an ongoing research project to develop these curves, and the IEER improvements will be incorporated when those are available.

Table 3.5. Summary of HVAC Efficiency Changes for IECC-2021

Equipment Category	IECC-2021 Table	Description of Change
Air-cooled split air conditioners, < 65 kBtu/h	C403.3.2(1)	Change from SEER rating values to SEER2. Equivalent SEER value increases from 13 to 14. Only affects Mid-Rise Apartment.
Air-cooled unitary air conditioners and heat pumps, cooling mode, < 65 kBtu/h	C403.3.2(1) & C403.3.2(2)	Change from SEER and HSPF rating values to SEER2 and HSPF2. Actual performance requirement does not change.
Air-cooled unitary air conditioners and heat pumps, cooling mode, >= 65 kBtu/h	C403.3.2(1) & C403.3.2(2)	EER is unchanged from IECC-2018. IEER decreases for most categories and sizes. Not modeled due to unavailability of performance curves.
Air-cooled unitary heat pumps, heating mode, >= 65 kBtu/h	C403.3.2(2)	Increase heating COP.
Warm-air furnace, gas fired, >= 225 kBtu/h	C403.3.2(5)	Increase thermal efficiency.[1]
Water-cooled computer room air conditioner, downflow, < 80 kBtu/h	C403.3.2(16)	Increase efficiency
Reach-in refrigerator/freezer	C403.11.1	Decrease maximum daily energy consumption. Prototypes use self-contained units, vertical closed solid.
Walk-in cooler and freezer	C403.11.2.1	Decrease maximum daily energy consumption.

A key change in the definitions used by the standards is the shift from Seasonal Energy Efficiency Ratio (SEER) and Heating Seasonal Performance Factor (HSPF) to SEER2 and HSPF2 for unitary systems with capacity less than 65,000 Btu/h. The new metrics are

[1] Note that the 2021 IECC has a typographical error in Table C403.3.1(5) for warm air furnace, where the size category is erroneously listed as "< 225,000 Btu/h". This can be verified by reviewing section 431.77 of the CFR.

determined using higher indoor fan static during the lab tests to better represent actual typical installed conditions. The relationship between the new rating metrics and the original metrics is illustrated by the values in Table 3.6.

Table 3.6. Mapping of SEER and HSPF to SEER2 and HSPF2 based on Federal Register Vol. 82

Product Class	SEER	SEER2	HSPF	HSPF2
Split system air conditioners	14.0	13.4	NA	NA
Packaged air conditioners	14.0	13.4	NA	NA
Packaged heat pumps	14.0	13.4	8.0	6.8

Modeling Strategy. Efficiency values were converted to model rated conditions following the same methods as were used for the 2018 IECC prototypes. Where efficiency is dependent on system capacity, sizing simulations were conducted, and the results of those simulations were used to select the appropriate efficiency values. HVAC equipment efficiencies were further increased for some prototypes to satisfy the additional efficiency requirements as described in Section 3.5 of this report.

3.3.4 Automatic Stop

Code Change Description. Section C403.4.2.3 of the 2021 IECC requires an HVAC system to have automatic start and stop controls, whereas the 2018 IECC only required automatic start control. The new language states that the automatic stop controls shall be configured to reduce the HVAC system's heating temperature setpoint and increase the cooling temperature setpoint by not less than 2°F before the scheduled unoccupied period.

Modeling Strategy. The automatic stop requires the HVAC systems to reset the temperature setpoint based on thermal lag and acceptable drift in space temperature. Thus, it is important to understand how much time is required for a thermal zone to stabilize the indoor thermal condition after the setpoint change. A small set of simulations on the Small Office prototype model was conducted to investigate the control strategy. Figure 3.1 and Figure 3.2 show the indoor air temperature behaviors when the heating or cooling setpoint changed an hour before the unoccupied hour. Both cases show that the space temperature responds quickly to the change in thermostat setpoint (< 10 min). Based on these test results, the optimum stop schedule has been implemented in the prototypes to set back the space temperature setpoint by 2°F 1 hour before the unoccupied period.

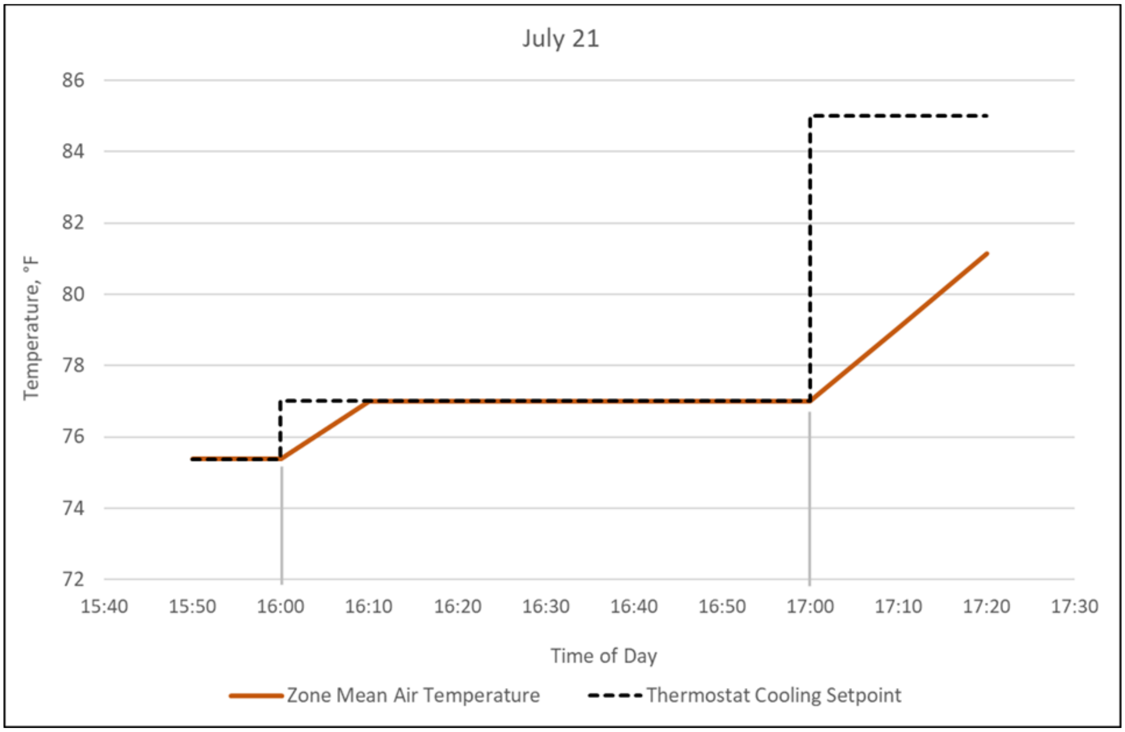

Figure 3.1. Indoor Air Temperature Response to the Cooling Setpoint Change in the Afternoon on July 21

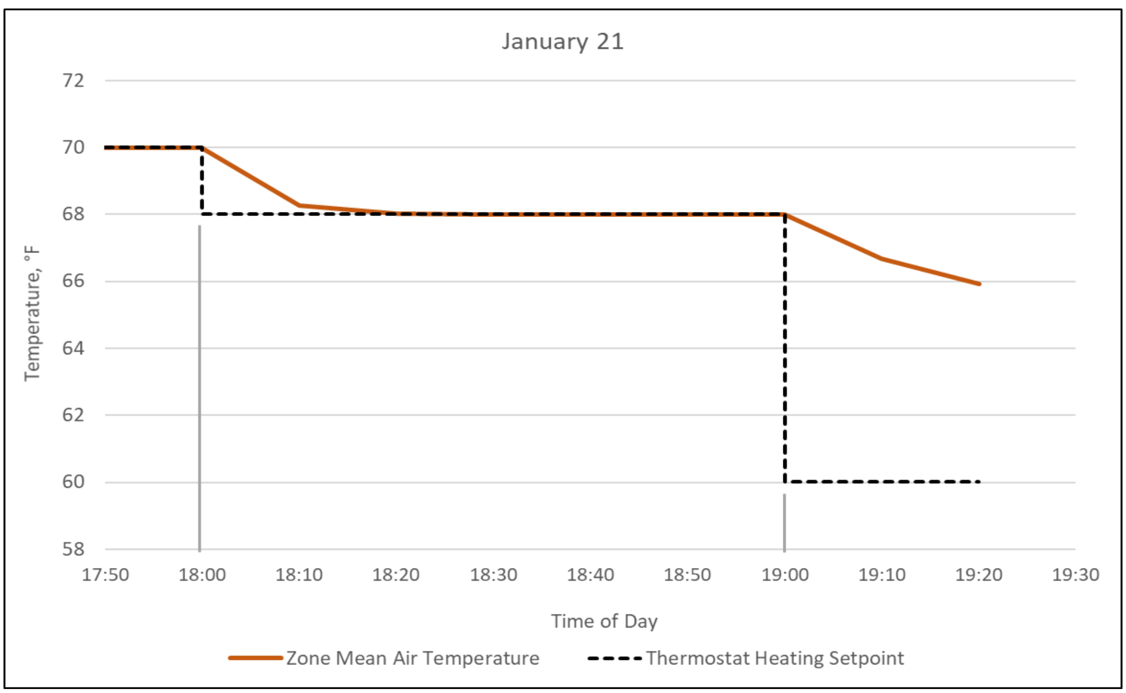

Figure 3.2. Indoor Air Temperature Response to the Heating Setpoint Change in the Afternoon on January 21

3.3.5 Supply Air Temperature Reset

Code Change Description. Section 403.6.5 of IECC 2021 has added new exceptions to the requirement for supply air temperature reset for hot climates based on system outside air requirements. These exceptions align with the existing requirements of ASHRAE 90.1-2019.

Modeling Strategy. The applicability of the exceptions to supply air temperature reset for the prototypes is shown in Table 3.7. For these prototypes and climates, a constant supply air temperature is modeled.

Table 3.7. Supply Air Temperature Reset Exceptions for Prototypes

Outside Air (OA) Requirement	Climate Zone Exceptions	Applicable Prototypes
Design OA < 3,000 cfm	0A, 1A, 2A, 3A	Medium Office
Design OA < 10,000 cfm	2A	Large Office, Outpatient Health Care, Primary and Secondary Schools: non-classroom systems
Design OA at least 80% and employing ERV	0A, 1A, 2A, 3A	Primary and Secondary Schools: classroom pods

3.3.6 Demand Control Ventilation (DCV)

Code Change Description. Section C403.7.1 of the 2021 IECC introduces a new category of DCV compliance that requires single-zone systems with economizers to have DCV installed. Other single-zone and multi-zone systems follow a similar compliance path as in the 2018 IECC, but with more stringent requirements. For those systems, the average occupant load threshold is reduced from greater than 25 people per 1,000 ft^2 to equal or greater than 15 people per 1000 ft^2. In addition, the outdoor airflow threshold for multi-zone systems was reduced from 1,200 cfm in the 2018 IECC to 750 cfm in the 2021 IECC.

Section C403.7.1 also modifies the equation for calculating the makeup air exception. In the 2018 IECC, the exception only applied if the supply airflow rate minus makeup airflow rate is smaller than 1,200 cfm. In the 2021 IECC the updated equation triggers the exception when the makeup airflow rate is over 75% of the supply airflow rate. Another exception was updated in the 2021 IECC regarding spaces with ventilation provided for process load. This exception was modified to exempt spaces that match specific occupancy classifications as defined in Table 403.3.1.1 of the International Mechanical Code.

Modeling Strategy. The code changes in the 2021 IECC affect almost all the prototype buildings except Hospital, Restaurant Fast Food, Restaurant Sit Down, and Medium Office. Retail Stand-Alone, Retail Strip Mall, and Small Hotel have the most significant impact among the affected prototypes due to the newly added DCV requirements on single-zone HVAC systems with economizers. With the existing ERV framework, the modeling approach for those zones is to turn on the demand control ventilation option under the mechanical ventilation controller of a HVAC system in the EnergyPlus model. Since the presence of economizers in single-zone systems depends on capacity, the decision regarding DCV for these systems was made after the sizing run and economizer determination were complete for each simulation.

3.3.7 Energy Recovery in Non-Transient Dwelling Units

Code Change Description. The 2021 IECC Section C403.7.4.1 includes new ERV requirements for non-transient dwelling units (e.g., apartments). There is a complete exemption from this requirement in climate zone 3C. In other climate zones, the ERV selection is based on heating-only in climate zones 4 through 8 and cooling-only in climate zones 0 through 2, while climate zone 3A and 3B have both heating and cooling requirements. In addition, dwelling units smaller than 500 ft^2 are exempted from the ERV requirements in climate zone 0 through 3 and 4C and 5C. In the 2018 IECC, there was no specific ERV requirement for residential HVAC systems, and the general ERV requirements were not normally triggered by the design ventilation and supply air flow quantities needed for residential systems.

Modeling Strategy. All apartment units modeled in the Mid-Rise and High-Rise Apartments are qualified as non-transient dwelling units larger than 500ft^2. Following the same modeling strategy performed in the prototypes for ASHRAE 90.1 2019 (DOE 2021), ERVs are added to all dwelling units except for climate zone 3C. Based on the market product review conducted during the ASHRAE implementation, energy recovery ratio (ERR) requirements are converted to the energy recovery effectiveness (ERE), as summarized in Table 3.8.

Table 3.8. Heat Recovery Effectiveness Based on Required Design ERR for Mid-Rise and High-Rise Apartment Prototypes

Climate Zone	0, 1, 2A, 3A	2B	3B	4 thru 8
ERR at local design condition	Cooling 50%	Cooling 50%	Cooling 50%	Heating 60%
Sensible Effectiveness at 100% Heating Air Flow	0.666	0.632	0.620	0.600
Latent Effectiveness at 100% Heating Air Flow	0.364	0.294	0.270	0.0
Sensible Effectiveness at 75% Heating Air Flow	0.700	0.668	0.657	0.623
Latent Effectiveness at 75% Heating Air Flow	0.401	0.330	0.305	0.0
Sensible Effectiveness at 100% Cooling Air Flow	0.661	0.621	0.607	0.596
Latent Effectiveness at 100% Cooling Air Flow	0.407	0.334	0.309	0.0
Sensible Effectiveness at 75% Cooling Air Flow	0.695	0.657	0.643	0.618
Latent Effectiveness at 75% Cooling Air Flow	0.454	0.381	0.354	0.0

3.3.8 Low-Capacity Ventilation Fans

Code Change Description. The low-capacity ventilation fan efficacy (Section C403.8.5) is a new requirement in the 2021 IECC. It sets efficacy requirements for mechanical ventilation system fans with motors less than 1/12 hp (0.062 kW) in capacity.

Modeling Strategy. ERV and bathroom exhaust fans in the Mid-Rise Apartments and High-Rise Apartments are affected by this newly introduced section in the 2021 IECC. The minimum efficacy (cfm/W) is 1.2 cfm/W for ERV fans with no airflow constraints and 2.8 cfm/W for bathroom fans when airflow is within 10 to 90 CFM. The fan power used in the prototypes prior to the new requirements was based on a survey of data for products available in the marketplace. The fan static in the models was established at 0.25 in wc, and the fan power was selected from the manufacturer data corresponding to that pressure. The fan power values specified in Section C403.8.5 are required to be determined at a rated static pressure of at least

0.2 in wc for ERV fans and 0.1 in wc for bathroom exhaust fans. To convert these rated values to the installed pressure of 0.25 in wc, additional manufacturer data at varying installed pressure conditions were evaluated to determine the pressure-power relationship as shown in Table 3.9. The ratios calculated for the product data columns in Table 3.9 were applied to the 2021 IECC columns to determine the typical installed efficacy for the prototype models.

Table 3.9. Conversion of Low-Capacity Ventilation Fan Power from Code Spec Condition to Typical Installed Condition

Condition	Bathroom Fans			ERV Fans		
	Static in wc	Product data cfm/W	IECC 2021 cfm/W	Static in wc	Product data cfm/W	IECC 2021 cfm/W
Code Specification	0.1	1.4	2.8	0.2	1.14	1.20
Typical Installed	0.25	1.24	2.48	0.25	1.07	1.13
	Ratio	88.6%	88.6%	Ratio	93.9%	93.9%

3.3.9 Clean Water Pump Efficiency

Code Change Description. The DOE 10 CFR has a requirement for clean water pump system efficiency that is not included in the 2021 IECC. Since the new requirement is applicable to all general HVAC pumps in the marketplace, it has been incorporated into the prototype models for the 2021 IECC.

Modeling Strategy. The new DOE clean water pump requirements were included in ASHRAE 90.1-2019, and thus have previously been implemented in the prototype models (Zhang et al. 2021). The implementation for the 2021 IECC follows the same methodology, by increasing the modeled pump motor efficiency by 1% relative to the 2018 IECC efficiency values.

3.4 Electrical Power and Lighting Systems

3.4.1 Automatic Receptacle Control

Code Change Description. Section C405.11 has been introduced in the 2021 IECC for automatic receptacle control, which needs to be applied to (1) at least 50% of all 125V, 15- and 20-amp receptacles installed in enclosed offices, conference rooms, rooms used primarily for copy or print functions, breakrooms, classrooms, and individual workstations; and (2) at least 25% of branch circuit feeders installed for modular furniture not shown on the construction documents. The receptacles need to be controlled either by a schedule-based shut-off or an occupancy-based controller to turn off receptacles within 20 minutes after the space is unoccupied. The 2018 IECC did not have any receptacle control requirements.

Modeling Strategy. All prototypes and national analysis locations are affected. In Thornton et al. (2011), it was explained how to determine (1) the area percentage of affected space types based on typical building design data; (2) the total fraction of the receptacle load power that can be controlled; and (3) savings percentage from occupancy sensors during occupied hours for each space type. Occupancy sensor control is selected because it is already required for the lighting controls in the relevant space types. Based on (1)-(3), the power density reduction factors for each prototype were calculated, which were multiplied to the prototypes' receptacle load schedules. Halverson et al. (2014) followed the same approach to calculate the power density reduction factors for more space types, including the ones required by the IECC-2021 code change, in each prototype. Therefore, the same modeling strategy has been followed, and the reduction factors in the 2nd and 3rd columns from Halverson et al. (2014) Table 5.19 have been applied.

3.4.2 Occupancy Sensor Lighting Control

Code Change Description. In Section C405.2.1, corridors have been added to the space types where occupant sensor controls are required in the 2021 IECC. The occupant sensor controls shall uniformly reduce lighting power to not more than 50% of full power within 20 minutes after all occupants have left the space.

Modeling Strategy. All the prototypes, except for Retail Strip Mall and Retail Stand-Alone, and all the national analysis locations are affected by this code change. To implement the new occupancy sensor control, PNNL applied a 25% reduction to the 2018 IECC lighting schedule fractions for corridor zones. For zones that represent a composite of corridor and other space types, the 2018 IECC lighting schedule was reduced based on a 25% reduction applied only to the portion of lighting associated with the corridor space type.

3.4.3 Interior Lighting Power

Code Change Description. The lighting power density (LPD) allowances for all building area types and space types in Tables C405.3.2(1) and C405.3.2(2) are modified by this code change. Most of them have been reduced to decrease the energy use of lighting systems from 2018 to 2021 IECC, while a few building area types and space types related to medical use, kitchen, fire station and exercise have increased LPD allowances for safety considerations.

Modeling Strategy. The change affects all prototypes as an adjustment to the installed lighting power of individual zones. Each thermal zone in the prototypes is either mapped to a single space-by-space category or is assumed to be a mix of two or more space types. The lighting power densities were further reduced for some prototypes to satisfy the additional efficiency requirements as described in Section 3.5 of this report.

3.4.4 Secondary Sidelit Daylighting Control

Code Change Description. In the 2021 IECC, daylight-responsive control requirements are in Section C405.2.4. Compared to the 2018 IECC, new definitions for primary and secondary sidelit daylight zones are introduced consistent with ASHRAE Standard 90.1. Daylight-responsive controls are required when the total lighting power (1) in the primary sidelit area is larger than 150 W, and (2) in the secondary sidelit area is larger than 300 W. The lights in these two types of sidelit zones should be controlled independently. When occupant sensor controls are present, it is explicitly mentioned that daylight responsive controls should continue to adjust electric light levels further even to levels that are below the unoccupied setpoints. Also, continuous dimming from full light output to 15% light output shall be applied to all space types in daylight zones, and Section C405.2.4.4 further clarifies on how to identify daylight zones when multistory atriums are present.

Modeling Strategy. The code change is applicable to all prototypes except for Mid-rise Apartment, High-rise Apartment and Retail Strip Mall where daylight-responsive controls are not applicable. All the national analysis locations are affected. Primary and secondary sidelit daylight zones and the minimum wattage of lighting power limits are consistent with the current requirements in ASHRAE Standard 90.1, the modeling strategy of which is documented in Halverson et al. (2014). The fractions of lighting power controlled by primary/secondary sidelit zone daylighting sensors in each prototype, illuminance setpoints, and the sensors' location coordinates can be found in Table 5.20 and Table 5.21 of Halverson et al. (2014). Since the occupant sensor controls are modeled by the factors multiplied by the lighting schedule fractions, the daylight-responsive controls modeled are able to continue adjusting electric light levels even when occupant sensor controls are active.

3.4.5 Exterior Lighting Setback Control

Code Change Description. Setback control for exterior lighting systems other than façade and landscape lighting have been updated in Section C405.2.7.3 of the 2021 IECC. The setback requirement has changed from a reduction of 30% in the 2018 IECC to 50% in the 2021 IECC. The general requirement is to use a timeclock-based setback control between midnight and 6 a.m. Outdoor parking areas have an additional requirement to setback to 50% whenever activity has not been detected for 15 minutes or more. Thus, the applicability for parking areas is extended beyond the midnight to 6 a.m. time window.

Modeling Strategy. Changes to exterior lighting control for the 2021 IECC are summarized in Table 3.10. These changes are applicable to all prototypes that include building entrances and uncovered parking areas, except those with 24/7 operation. The prototypes that are included are the three office building types, the retail buildings, and the restaurants. For implementation, the lighting objects in the prototype models were reconfigured so that building entrances and uncovered parking could be controlled separately. Due to the use of occupancy-based control for parking areas, the reduction schedule for that lighting load is extended to the period from 7 p.m. to 6 a.m.

Table 3.10. Change in Exterior Lighting Control Between the 2018 and 2021 IECC

Lighting Category	2018 IECC	2021 IECC
Building Entrance	30% reduction midnight to 6 a.m.	50% reduction midnight to 6 a.m.
Uncovered Parking Area	30% reduction midnight to 6 a.m.	50% reduction 7 p.m. to 6 a.m.

3.5 Additional Efficiency Requirements

3.5.1 Credit Selections

Code Change Description. Section C406 of the 2018 IECC includes a list of eight additional efficiency measures in excess of those required by the prescriptive sections of the code, from which one must be selected for inclusion in each building. The 2021 IECC has been updated with new tables of credit values and some additional credit categories. Each category is assigned credit points based on savings specific to each building group and climate, and the building must select one or more categories as needed to achieve a total of at least 10 points. While the points were designed to make selections more relatively equivalent for energy savings, any combination of measures can be used to achieve the required savings. Measure choices leading to 10 points generally result in much more savings than the options in the 2018 IECC.

Modeling Strategy. For each prototype and climate location a number of possible measure combinations are available to achieve 10 points. In order to make selections of energy credit categories for the prototype models in this analysis, PNNL used the following general rules as guidelines for prioritizing selection of measures.

1. Highest priority -- Categories with relative low construction costs, for example:
    a. C406.1(2) Reduced lighting power in accordance with Section C406.3
    b. C406.1(8) Reduced air infiltration in accordance with Section C406.9
2. Medium priority -- Heat pump water heaters (HPWHs) in Group R & I buildings based on their high service water heating loads:
   C406.1(6) High-efficiency service water heating/HPWH in accordance with C406.7.4
3. Medium priority -- Cooling and heating efficiency improvements:
   C406.1(1) More efficient HVAC performance in accordance with C406.2
    a. Heating efficiency improvements are not practical for rooftop gas furnace equipment, which serves most smaller commercial buildings in the north, due to condensate freezing issues.
    b. Cooling efficiency and heat pump efficiency improvements are generally available
    c. One improvement in the 2021 IECC was to separate heating and cooling efficiency credits so that cooling efficiency could be pursued separately from heating efficiency
4. Lower priority -- Onsite renewable, since roof space is sometimes not available or is shaded:
   C406.1(4) Onsite supply of renewable energy in accordance with Section C406.5
5. Avoid categories that do not have quantifiable impacts through energy modeling of the prototypes:
    a. C406.1(3) Enhanced lighting controls in accordance with Section C406.4
    b. C406.1(9) Energy monitoring system in accordance with Section C406.10
    c. C406.1(10) Fault detection and diagnostics in accordance with C406.11
6. Avoid C406.1(5) Dedicated outdoor air system because of modeling complexity and a cascade of other impacts due to changes in HVAC system type
7. Avoid categories where lower cost-effectiveness is anticipated:
    a. C406.1(7) Enhanced envelope performance in accordance with C406.8.

Final selections for each building type and climate zone are listed in Table 3.11 through Table 3.17. For most cases, the combination of selections achieves a total in the range of 10 to 13 points, For the retail prototypes, the range is higher, due to the logical selection of the single reduced lighting power category. For 4 of the 112 building/climate zone combinations, the limitations of the strategy for measure selection results in total credits 1 or 2 points below the target of 10.

Table 3.11. Energy Credit Selections for Group B: Large Office, Medium Office, and Small Office

SECTION	1A	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.2: 5% cooling efficiency improvement							3				2	1				
C406.2.4: 10% cooling efficiency improvement										4			4	3	3	
C406.3.1: Reduced lighting power by 10%	9	9	9	9	9	10	8	9	9	7	8	8	6	7	7	6
C406.9: Reduced air infiltration	2	1	2	4	1			2	3			1				6
Total points from selections	11	10	11	13	10	10	11	11	12	11	10	10	10	10	10	12

Table 3.12. Energy Credit Selections for Group R & I: Apartments, Hotels, Hospital

SECTION	1A	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% heating efficiency improvement												1				
C406.2.2: 5% cooling efficiency improvement						1				1						
C406.2.4: 10% cooling efficiency improvement			3									1				
C406.3.1: Reduced lighting power by 10%		2	2		2	2		2	2			2			2	2
C406.7.4: Heat pump water heater	6	5	5	5	5	5	5	5	5		5	5		5		5
C406.9: Reduced air infiltration	6	3		6	4		7	3	3	9	5	1	13	6	8	3
Total points from selections	12	10	10	11	11	8	12	10	10	10	10	10	13	11	10	10

Table 3.13. Energy Credit Selections for Group R & I: Outpatient Health Care

SECTION	1A	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.2: 5% cooling efficiency improvement	3						1							1		
C406.2.4: 10% cooling efficiency improvement		4		2	3											
C406.3.1: Reduced lighting power by 10%	2	2		2	2	2	2			2		2		2	2	
C406.5: Onsite renewable energy						8		7	7		7	7		7		7
C406.9: Reduced air infiltration	6	3	11	6	4		7	3	3	9	5	1	13		8	3
Total points from selections	11	9	11	10	9	10	10	10	10	11	12	10	13	10	10	10

Table 3.14. Energy Credit Selections for Group E: Schools

SECTION	1A	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.2: 5% cooling efficiency improvement	4	3	3	2	2	2	2	1	1		1					
C406.2.4: 10% cooling efficiency improvement										2		1		2		
C406.3.1: Reduced lighting power by 10%	8	8	9	8	9	9	8	9	9	8	9	8	7	8	7	7
C406.9: Reduced air infiltration													4		4	3
Total points from selections	12	11	12	10	11	11	10	10	10	10	10	9	11	10	11	10

Table 3.15. Energy Credit Selections for Group M: Retail

SECTION	1A	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.3.1: Reduced lighting power by 10%	13	15	14	16	14	17	15	15	14	12	14	14	16	16	14	12
Total points from selections	13	15	14	16	14	17	15	15	14	12	14	14	16	16	14	12

Table 3.16. Energy Credit Selections for Group Other: Restaurant

SECTION	1A	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.2: 5% cooling efficiency improvement							2									
C406.2.4: 10% cooling efficiency improvement												2	2	2	2	
C406.3.1: Reduced lighting power by 10%	8	9	9	9	9	10	8	9	9	7	8	8	8	8	8	7
C406.9: Reduced air infiltration	3	2	4	4	2			2	2	6	4					4
Total points from selections	11	11	13	13	11	10	10	11	11	13	12	10	10	10	10	11

Table 3.17. Energy Credit Selections for Group Other: Warehouse

SECTION	1A	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.2: 5% cooling efficiency improvement							2	2	1		2					
C406.2.4: 10% cooling efficiency improvement												2	2	2	2	
C406.3.1: Reduced lighting power by 10%	8	9	9	9	9	10	8	9	9	7	8	8	8	8	8	7
C406.9: Reduced air infiltration	3	2	4	4	2					6						4
Total points from selections	11	11	13	13	11	10	10	11	10	13	10	10	10	10	10	11

3.5.2 Heating and Cooling Efficiency Improvement

Code Change Description. Section C406.2 lists efficiency improvement options of 5% and 10% better than minimum code requirements for both heating and cooling equipment.

Modeling Strategy. The heating and cooling efficiency measures were implemented by applying a multiplier of 1.05 or 1.10 to the prescriptive efficiency values used in the prototype models.

3.5.3 Reduced Lighting Power

Code Change Description. Section C406.3.1 indicates a requirement for a reduction in lighting power of at least 10% compared to the lighting power allowance calculated in accordance with Section C405.3.2.

Modeling Strategy. This credit was applied to all prototypes and in most climate zones. The implementation of the credit in the prototype models was accomplished by applying a multiplier of 90% to the LPD of all affected spaces.

3.5.4 Reduced Infiltration

Code Change Description. Section C406.9 specifies an air leakage rate of no more than 0.25 cfm/ft^2 at a pressure differential of 0.3 in wc, as verified by pressurization testing. No exceptions to the required rate are included in the code based on building size or climate zone. The baseline leakage rates that would be required if this credit were not taken were shown previously in Table 3.3.

Modeling Strategy. The test condition value of 0.25 cfm/ft^2 at 0.3 in wc was converted to natural conditions for the model using the methods described by Gowri et al. (2009).

3.5.5 Heat Pump Water Heater (HPWH)

Code Change Description. The HPWH energy credit indicates that all service water heater (SWH) requirements shall be met using heat pump technology with a combined input-capacity weighted average energy factor of 3.0. In addition, there is a requirement that the HPWHs not draw conditioned air from within the building.

Modeling Strategy. Based on the relatively simplistic requirements for the measure, a number of assumptions were needed to characterize and model the heat pump water heaters in the prototypes. For implementation of the HPWH into the prototypes, large central storage systems were assumed. Following are key elements of the system configurations and controls that were assumed for the model.

3.5.5.1 Sizing

When sizing a HPWH system, the tank is generally larger than for a gas system so the relatively expensive heat pump unit can be sized smaller. For simulation, it is important that the heat pump units are not significantly oversized because that would underestimate the time during which supplemental electric resistance heat is required. For the apartment prototypes, sizing of the HPWH systems was accomplished using the internet-based Ecosizer tool (Ecosizer, 2022). The results of this exercise are listed in Table 3.18.

Table 3.18. Ecosizer Results for Apartment Prototypes

Prototype	People	Apt Units	Gal/ day/ per	Design Tmains, °F	Supply T, °F	Storage T, °F	Primary tank		Secondary tank	
							gal	kBtu/h	gal	kBtu/h
Apartment Mid-Rise	79	31	25	50	125	140	465	85	80	19
Apartment High-Rise	197	79	25	50	125	140	1,175	215	120	48

Table 3.19 summarizes the sizing of both the tank and the heat pump unit for all systems where HPWHs were implemented in the prototypes. The Ecosizer unit system sizing values for the apartment prototypes are assumed to follow common practice. For reference the ratio of the

tank size for the heat pump system to the corresponding tank size for a gas system is listed in the table. The usual high-rise apartment prototype gas water heater volume of 600 gallons is on the low side of the volume-versus-recovery capacity trade-off chart in the ASHRAE HVAC Applications Handbook (ASHRAE 2019). A more middle of the road volume is 948 gallons, denoted by the row labeled “Highrise Apartment ASHRAE” in Table 3.19. The “Midrise Apartment ASHRAE” case was sized by the same middle of the road approach. In both cases, the ratio of Ecosizer HPWH tank volume to the middle-of-road sized gas system tank volume is approximately 1.25. Thus, this same ratio was used for the other general use water heaters to size the HPWH tank relative to the prototype gas system tank volume.

For the laundry water heaters, it was found that the prototype gas units were sufficiently oversized such that it was not reasonable to increase tank volume for the HPWH versions, so the HPWH tanks were set to have the same volume as the gas system tanks.

Once the tank sizes were established for each of the general HPWH systems, the sizing charts from the ASHRAE HVAC Applications Handbook (ASHRAE, 2019) were used to determine the required heat pump capacity. For the laundry systems, the heat pump capacity was set based on the original gas water heater capacity prorated to the target intermediate setpoint of 125°F for the heat pump unit. The supplemental electric resistance heater for the laundries was sized to raise the water temperature from 125°F to 180°F.

Table 3.19. Sizing for Gas and Heat Pump Water Heaters

Heater Description	Gas System Sizing		Heat Pump System Sizing				
	Tank volume gal	Burner output, kBtu/h	Tank volume gal	tank vol ratio: gas/ HPWH	Heat pump output, kBtu/h	Minimum supp capacity kBtu/h	Maximum supp capacity kBtu/h
High-Rise Apartment	600	600	1,175	1.96	215	47	262
High-Rise Apartment ASHRAE	948	279	1,175	1.24	215	47	262
Mid-Rise Apartment ASHRAE	372	161	465	1.25	87	19	106
Hospital General	600	600	750	1.25	140	460	600
Hospital Laundry	300	300	300	1.00	113	187	300
Small Hotel General	300	300	375	1.25	128	28	156
Small Hotel Laundry	200	200	200	1.00	83	117	200
Large Hotel General	600	600	750	1.25	262	58	320
Large Hotel Laundry	300	557	300	1.00	332	225	557

3.5.5.2 System Configuration

All of the HPWH systems included in the prototypes were modeled based on the assumption of a single pass primary HPWH and a multi-pass secondary water heater to handle pipe loss. Supplemental heat is used in cold weather as needed when heat pump capacity is diminished. The fuel for supplemental heat was selected to match the base case water heater fuel: electric resistance for mid-rise apartment, natural gas for all others.

The primary heat pump system for laundry water heating is sized to heat the water to 125°F on a peak summer day. Supplemental heating is used to bring the temperature up to the laundry setpoint of 180°F.

For all models, it was assumed that partial stratification occurs such that heat pump inlet water temperature is one third of the temperature distance from the mains temperature to the tank outlet temperature. This was modeled in EnergyPlus using an EMS control with hourly adjustment of entering temperature calculated from the mains temperature.

3.5.5.3 Heat Pump Efficiency

As there currently are no federal minimum standards specifically for commercial HPWHs, the efficiency of the commercial HPWH units was determined based on a market survey. Data were collected for 17 products from three manufacturers for capacities ranging from 45 to 605 kBtu/h. The results are shown in Figure 3.3, with lines showing the average and one standard deviation below the average values. For the prototype models, the unit efficiency was set to 3.1 COP, based on the average of the manufacturer data minus one standard deviation.

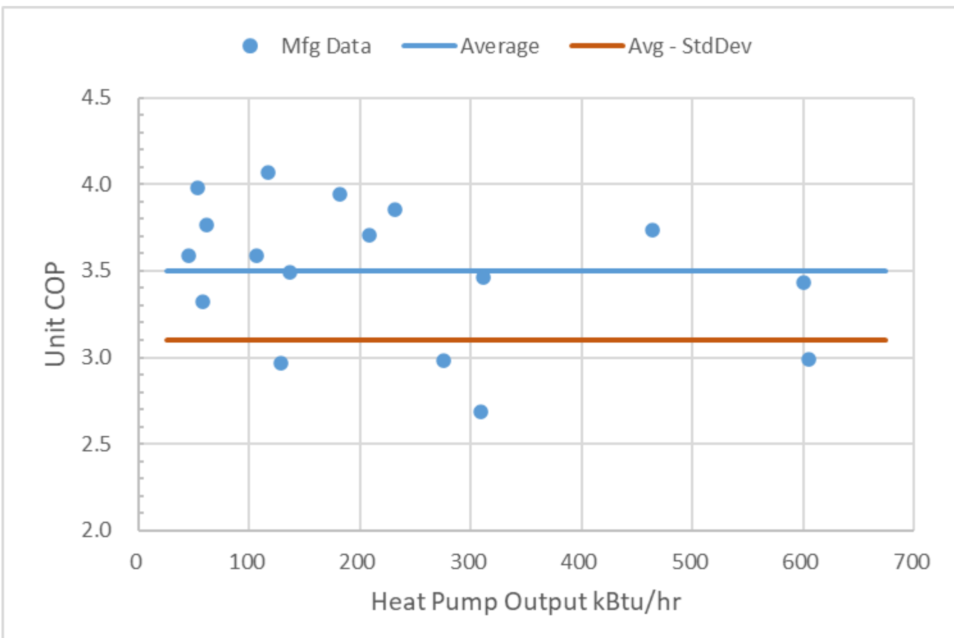

Figure 3.3. Heat Pump Water Heater Market Data for Unit Coefficient of Performance at Rating Conditions of 72.4°F Entering Air Wet Bulb and 130°F Entering Water Temperature

3.5.5.4 HPWH System Location

For all HPWH models, it was assumed that the heat pump units and the storage tanks are located in an unconditioned parking garage. The temperature in the garage was adjusted monthly based on data collected by Heller and Oram (2015) for garage temperature versus daily average outdoor temperature for two buildings in Seattle, WA, which led to the following relationship:

GarageT = OA_T * 0.62 + 10.13, where values are given in °C.

The EnergyPlus weather files were processed to obtain average daily outdoor temperature and humidity for each climate, and those were then applied to the garage temperature curve to calculate monthly garage dry bulb temperature for each climate. It was assumed that the garage humidity ratio would be the same as the average outdoor humidity ratio for each month, due to the low latent load in a garage relative to its ventilation rate. These calculated garage temperature and humidity values were then used as the ambient conditions for both the storage tanks and the heat pump evaporator coils.

3.5.6 Onsite Renewable Energy

Code Change Description. The basic renewable credit is described in C406.5.1 as using an installed renewable capacity of at least 0.25 W/ft^2 of conditioned floor area.

Modeling Strategy. The measure was applied only to the outpatient health care prototype, which has a conditioned floor area of 40,946 ft^2, and thus an installed capacity of 10,236 W. The measure was implemented as a photovoltaic system in the prototype model, and the PVWatts feature was used to model the system performance in EnergyPlus. The following additional design parameters assumed for the simulation are based on requirements in Addendum ck to ASHRAE 90.1-2019 (ASHRAE 2020):

- Module Type: Crystalline Silicon Panel with a glass cover, 19.1%nominal efficiency and temperature coefficient of -0.47%/°C. Performance shall be based on a reference temperature of 77°F (25°C) and irradiance of 317 Btu/ft2-hr (1,000 W/m2)
- Array Type: Rack mounted array with installed nominal operating cell temperature (INOCT) of 03°F (45°C).
- Total System losses (DC output to AC output): 11.3%
- Tilt: 0-degrees (mounted horizontally)
- Azimuth:180 degrees.

4.0 Site Energy and Energy Cost Savings Results

This section summarizes the estimated energy, emissions, and energy cost savings for the 2021 IECC compared to the 2018 IECC. The site energy and source energy savings results of the analysis are summarized in Table 4.1. This table groups the building prototypes by their principal activity and shows the construction weighting factors by building prototype. The table provides a side-by-side comparison of the site Energy Use Index (EUI) and Energy Cost Index (ECI) for the 2018 and 2021 editions of the IECC. Site energy is utility electricity and natural gas delivered and used at the building site. When the renewable energy credit is used by a prototype, the generated electricity is used by the building without storage or feeding electricity back to the grid. The EUI and ECI are the net of site energy consumption and renewable production. The EUI and ECI shown in Table 4.1 for each prototype are national weighted averages across climate zones in the United States. The percent savings (reduction) in EUI and ECI are presented as well. A negative percentage reflects increases in EUI or ECI. The last row of Table 4.1 shows the national weighted average results from all 16 prototypes and 16 climate zones using the construction weighting factors (see Table 2.2 in this report). As shown in Table 4.1, on a weighted national basis, the 2021 IECC results in 12.1% site energy savings and 10.6% energy cost savings over the 2018 IECC. These savings include federally mandated efficiency improvements of appliances and equipment that have taken effect since (but independent of) the publication of the 2018 IECC. Table 4.2 shows similar results for energy cost and emissions savings for the 2021 IECC compared to the 2018 IECC.

Table 4.1. Site and Source Energy Savings between the 2018 and 2021 IECC

Building Activity	Building Prototype	Floor Area Weight (%)	Site EUI (kBtu/ft^2-yr)		Site EUI Savings (%)	Source EUI (kBtu/ft^2-yr)		Source EUI Savings (%)
			2018 IECC	2021 IECC		2018 IECC	2021 IECC	
Office	Small Office	3.8%	29.9	26.2	12.4%	83.0	72.8	12.3%
	Medium Office	5.0%	32.0	28.2	11.9%	85.0	74.9	11.9%
	Large Office	3.9%	56.3	47.6	15.5%	155.7	131.6	15.5%
Retail	Stand-Alone Retail	10.9%	47.1	41.2	12.5%	106.3	94.6	11.0%
	Strip Mall	3.7%	50.1	43.3	13.6%	122.7	110.3	10.1%
Education	Primary School	4.8%	48.9	44.7	8.6%	120.6	106.9	11.4%
	Secondary School	10.9%	44.6	41.1	7.8%	111.5	100.8	9.6%
Healthcare	Outpatient Healthcare	3.4%	112.8	107.7	4.5%	270.0	256.8	4.9%
	Hospital	4.5%	123.9	120.3	2.9%	279.3	274.2	1.8%
Lodging	Small Hotel	1.6%	70.3	57.7	17.9%	145.1	127.2	12.3%
	Large Hotel	4.2%	93.4	80.0	14.3%	190.8	174.8	8.4%
Warehouse	Warehouse	18.6%	13.1	12.0	8.4%	27.2	25.1	7.7%
Food Service	Quick-Service Restaurant	0.3%	525.6	505.8	3.8%	912.6	860.6	5.7%
	Full-Service Restaurant	1.0%	349.7	337.8	3.4%	665.9	634.9	4.7%
Apartment	Mid-Rise Apartment	13.7%	41.2	31.6	23.3%	110.1	86.5	21.4%
	High-Rise Apartment	9.6%	43.5	31.0	28.7%	95.7	81.0	15.4%
National Weighted Average		100%	51.1	44.9	12.1%	118.7	106.1	10.6%

Table 4.2. Energy Cost and Emissions Savings between the 2018 and 2021 IECC

Building Activity	Building Prototype	Floor Area Weight (%)	ECI ($/ft²-yr)		ECI Savings (%)	Emissions (ton/kft²-yr)		Emission Reduction (%)
			2018 IECC	2021 IECC		2018 IECC	2021 IECC	
Office	Small Office	3.8%	$0.96	$0.85	11.5%	6.0	5.3	12.3%
	Medium Office	5.0%	$0.98	$0.86	12.2%	6.1	5.4	11.8%
	Large Office	3.9%	$1.81	$1.52	16.0%	11.3	9.5	15.5%
Retail	Stand-Alone Retail	10.9%	$1.17	$1.05	10.3%	7.3	6.6	10.5%
	Strip Mall	3.7%	$1.38	$1.25	9.4%	8.6	7.8	9.3%
Education	Primary School	4.8%	$1.36	$1.20	11.8%	8.5	7.5	12.1%
	Secondary School	10.9%	$1.26	$1.14	9.5%	7.9	7.1	10.1%
Healthcare	Outpatient Healthcare	3.4%	$3.02	$2.87	5.0%	18.9	18.0	5.0%
	Hospital	4.5%	$3.08	$3.03	1.6%	19.2	18.9	1.6%
Lodging	Small Hotel	1.6%	$1.56	$1.39	10.9%	9.7	8.7	10.6%
	Large Hotel	4.2%	$2.04	$1.91	6.4%	12.8	11.9	6.5%
Warehouse	Warehouse	18.6%	$0.29	$0.27	6.9%	1.8	1.7	7.1%
Food Service	Quick-Service Restaurant	0.3%	$9.20	$8.61	6.4%	57.6	53.9	6.5%
	Full-Service Restaurant	1.0%	$6.95	$6.60	5.0%	43.5	41.3	5.1%
Apartment	Mid-Rise Apartment	13.7%	$1.27	$1.00	21.3%	7.9	6.3	21.0%
	High-Rise Apartment	9.6%	$1.05	$0.93	11.4%	6.6	5.8	11.6%
National Weighted Average		100%	$1.32	$1.18	10.6%	8.2	7.4	10.2%

As can be seen from Table 4.1, the savings vary significantly by prototype. This is expected as code requirements are different by building type and by climate. PNNL did not explicitly quantify the national impacts of individual code changes. Although this approach does not allow the ranking of all code changes based on their energy savings impacts, a few high-impact changes resulting in significant energy savings were identified by examining individual prototype implementation results and are listed below (categorized by end use).

- Envelope:
  - Air leakage testing (Section 3.2.4)
  - Operable opening interlock with HVAC (Section 3.3.1)
- HVAC:
  - Demand controlled ventilation (Section 3.3.6)
  - Data center MLC requirement (Section 3.3.2)
  - Heating and cooling efficiencies (Sections 3.3.4)
- Lighting and receptacle loads:
  - Lighting power reduction (Sections 3.4.3)
  - Automatic control of receptacle loads (Section 3.4.1)
  - Secondary sidelit daylighting control (Section 3.4.4)

- Additional efficiency requirements:
  - Lighting power reduction (Sections 3.5.3)
  - Heating and cooling efficiencies (Sections 3.5.2)
  - Heat pump water heater (Section 3.5.5)
  - Infiltration reduction (Section 3.5.4)

Figure 4.1 illustrates the weighted percent change in the national weighted values for EUI, ECI, and emissions due to the change from the 2018 IECC to the 2021 IECC.

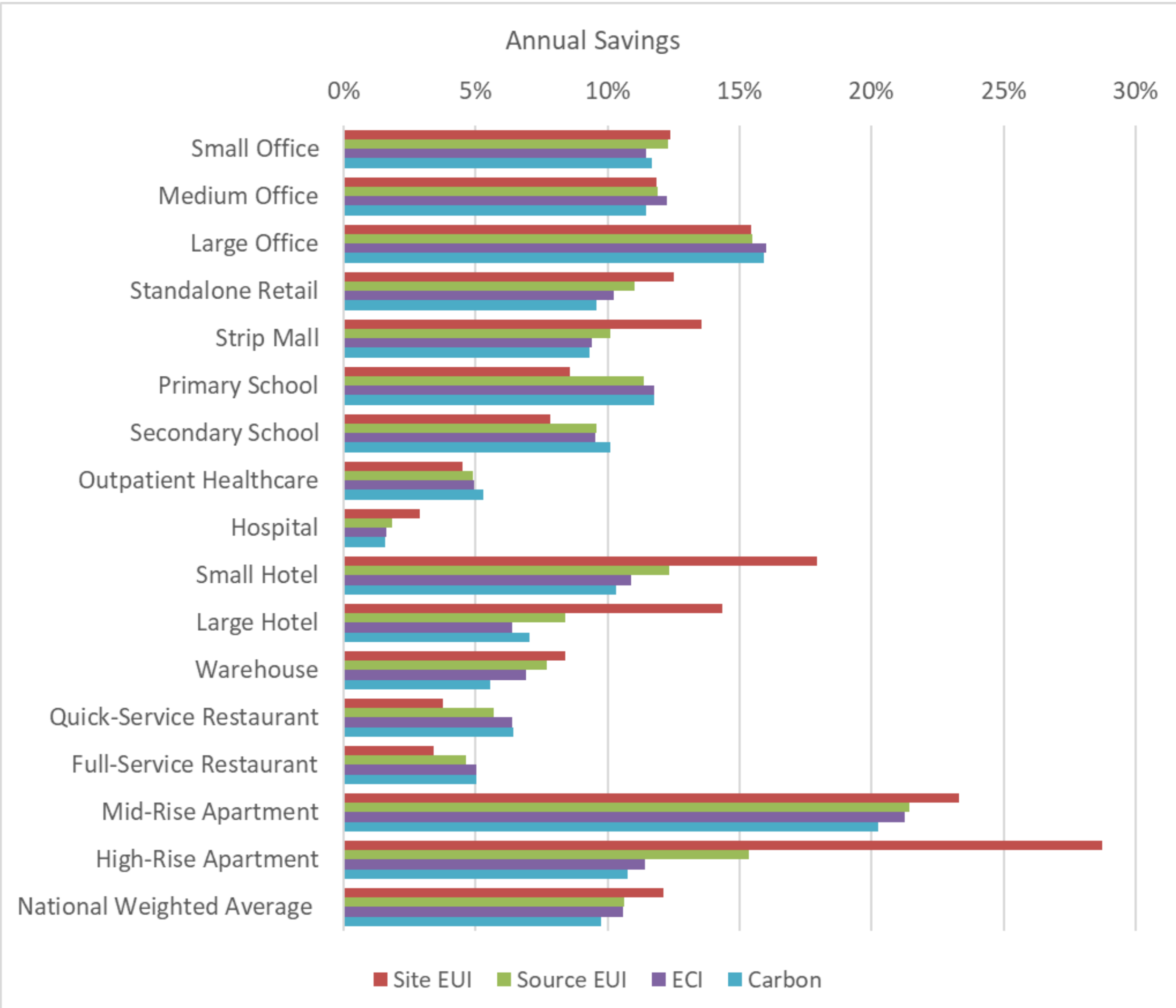

Figure 4.1. National Average Energy, Cost and Carbon Intensity for all IECC Prototypes

Table 4.3 presents the 2021 IECC savings for all prototype buildings aggregated by climate zone. The energy and energy cost savings vary by climate zone. The site energy savings in most climate zones are greater than 9% and the savings in the coldest two climate zones (i.e., 7 and 8) are 5.8 and 7.3%, respectively. The energy cost savings in all climate zones are over 8% except for climate zones 7 and 8. For most climate zones, the percentages of energy cost savings are somewhat lower than the site energy savings. The savings variance is attributed to the applicability of the code changes to different climate zones and the construction weights of the building types within the climate zones.

Table 4.3. Site Energy and Energy Cost Savings between the 2018 and 2021 IECC by Climate Zone

Climate Zones	Site EUI (kBtu/ft^2-yr)		Site EUI Savings (%)	Source EUI (kBtu/ft^2-yr)		Source EUI Savings (%)	ECI ($/ft^2-yr)		ECI Savings (%)	Emissions (ton/kft^2-yr)		Emission Savings (%)
	2018 IECC	2021 IECC		2018 IECC	2021 IECC		2018 IECC	2021 IECC		2018 IECC	2021 IECC	
1A	49.5	41.8	15.6%	125.5	110.9	11.6%	1.43	1.27	11.2%	8.91	7.95	10.8%
2A	49.6	44.0	11.3%	124.8	111.7	10.5%	1.41	1.27	9.9%	8.84	7.93	10.3%
2B	44.9	40.3	10.2%	113.5	102.3	9.9%	1.29	1.16	10.1%	8.05	7.26	9.8%
3A	49.4	44.0	10.9%	118.3	106.5	10.0%	1.33	1.19	10.5%	8.28	7.47	9.8%
3B	42.6	37.1	12.9%	104.4	92.9	11.0%	1.18	1.05	11.0%	7.35	6.58	10.5%
3C	43.4	36.3	16.4%	108.5	92.7	14.6%	1.23	1.05	14.6%	7.67	6.59	14.1%
4A	50.6	42.7	15.6%	114.8	100.5	12.5%	1.27	1.12	11.8%	7.92	7.00	11.6%
4B	53.7	48.5	9.7%	125.4	114.2	8.9%	1.39	1.27	8.6%	8.71	7.95	8.7%
4C	44.1	36.6	17.0%	102.2	88.5	13.4%	1.13	0.99	12.4%	7.09	6.20	12.6%
5A	57.8	52.6	9.0%	122.8	112.5	8.4%	1.33	1.22	8.3%	8.31	7.63	8.2%
5B	52.3	45.8	12.4%	118.4	105.2	11.1%	1.31	1.17	10.7%	8.16	7.28	10.8%
5C	58.1	51.9	10.7%	130.0	117.4	9.7%	1.43	1.29	9.8%	8.93	8.09	9.4%
6A	68.1	61.8	9.3%	140.9	129.5	8.1%	1.51	1.39	7.9%	9.45	8.72	7.7%
6B	64.2	57.1	11.1%	137.2	123.8	9.8%	1.49	1.35	9.4%	9.30	8.43	9.4%
7	73.7	69.4	5.8%	151.1	141.3	6.5%	1.62	1.51	6.8%	10.12	9.43	6.8%
8	91.7	85.0	7.3%	170.2	158.1	7.1%	1.76	1.64	6.8%	11.02	10.24	7.1%
National Weighted Average	51.1	44.9	12.1%	118.7	106.1	10.6%	1.32	1.18	10.6%	8.24	7.40	10.2%

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Appendix A – Code Changes from the 2018 to 2021 IECC Included in Analysis and their Impact on Building Prototypes

The following table lists the code changes to the 2018 IECC that result in energy savings that were quantified in the analysis, as well as the relevant section of the IECC and which prototypes were affected.

Table A.1. Changes Between the 2018 and 2021 IECC with Quantified Energy Impacts and Impacted Prototypes

Section Number in the 2021 IECC	Description of Code Changes	Small Office	Medium Office	Large Office	Stand-Alone Retail	Strip Mall	Primary School	Secondary School	Outpatient Health Care	Hospital	Small Hotel	Large Hotel	Non-Refrigerated Warehouse	Quick-Service Restaurant	Full-Service Restaurant	Mid-Rise Apartment	High-Rise Apartment
C402.1.4 Assembly U-factor, C-factor or F-factor-based method	Imposes more stringent requirement on the insulation requirements for opaque constructions.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
C402.4 Fenestration	Imposes more stringent requirement on the window thermal properties.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
C402.4.5 Doors	Increases allowable U-factor requirements for opaque non-swinging doors. Also decreases U-factors for swinging doors in some climates.	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
C402.5 Air leakage - thermal envelope	Adds requirement for air barrier testing, which sets specific limits on air leakage for specific climates.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
C402.5.11 Operable openings interlocking	Requires that operable openings be interlocked with HVAC setpoints.										X	X				X	X
C403.1.2 Data centers	Adds requirement that data center systems comply with Sections 6 and 8 of ASHRAE 90.4-2016, with IECC-specific values for MLC.			X													

Section Number in the 2021 IECC	Description of Code Changes	Small Office	Medium Office	Large Office	Stand-Alone Retail	Strip Mall	Primary School	Secondary School	Outpatient Health Care	Hospital	Small Hotel	Large Hotel	Non-Refrigerated Warehouse	Quick-Service Restaurant	Full-Service Restaurant	Mid-Rise Apartment	High-Rise Apartment
C403.3.2 HVAC equipment performance requirements	Increases required HVAC efficiency values for several equipment categories.				X		X	X					X	X	X	X	
C403.4.2.3 Automatic start and stop	Adds automatic stop for near the end of occupied periods, where thermostat is set back by 2°F.	X	X	X	X	X	X	X	X				X	X	X	X	X
C403.6.5 Supply air temperature reset	Adds exceptions to supply air temperature reset for some hot climates based on design outside air flow.		X	X			X	X	X								
C403.7.1 Demand control ventilation	Expands the applicability of DCV to all single zone systems that also require economizer and reduces occupant density threshold.				X	X					X		X				
C403.7.4 Energy recovery systems	Adds new requirements for ERV in non-transient dwelling units.															X	X
C403.8.5 Low-capacity ventilation fans	Adds efficacy requirements for low-capacity fans.															X	X
C403.11.1 Commercial refrigerators and refrigerator-freezers	Decreases maximum daily energy consumption for commercial refrigerators and freezers.						X	X		X		X		X	X		
C403.11.2 Walk-in coolers and walk-in freezers	Decreases maximum daily energy consumption for walk-in coolers and freezers.						X	X		X		X		X	X		
Future	Adds new federal requirements for clean water pump efficiency.			X			X	X	X	X		X					X
C405.2.1 Occupant sensor controls	Extends requirement to corridor spaces.	X	X	X			X	X	X	X	X	X	X	X	X	X	X
C405.2.4.2 Sidelit daylight zone	Adds requirement for secondary sidelit daylight zone.	X	X	X	X		X	X	X	X	X	X	X	X	X		

Section Number in the 2021 IECC	Description of Code Changes	Small Office	Medium Office	Large Office	Stand-Alone Retail	Strip Mall	Primary School	Secondary School	Outpatient Health Care	Hospital	Small Hotel	Large Hotel	Non-Refrigerated Warehouse	Quick-Service Restaurant	Full-Service Restaurant	Mid-Rise Apartment	High-Rise Apartment
C405.2.7.3 Exterior lighting setback	Increase setback amount to 50% and add occupancy-based control to outdoor parking areas.	X	X	X	X	X	X	X	X				X	X	X		
C405.3.2 Interior lighting power allowance	Decrease lighting power density for most space types.	X	X	X	X	X	X	X	X	X	X	X	X			X	X
C405.11 Automatic receptacle control	Adds requirement for automatic control of receptacle loads in selected space types.	X	X	X			X	X	X	X	X		X			X	X
C406 Additional Efficiency Requirements	Adds new categories for efficiency credits and new point values.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Appendix B – Energy and Energy Cost Savings for the 2021 IECC and Corresponding Standard 90.1-2019

Section 304(b) of the ECPA (Energy Conservation and Production Act), as amended, requires the Secretary of Energy to make a determination each time a revised edition of Standard 90.1 is published with respect to whether the revised standard would improve energy efficiency in commercial buildings. When DOE issues an affirmative determination on Standard 90.1, states are statutorily required to certify within 2 years that they have reviewed and updated the commercial provisions of their building energy code, with respect to energy efficiency, to meet or exceed the revised standard (42 U.S.C. 6833).

In support of DOE's determination, PNNL conducted an energy savings analysis for Standard 90.1-2019 compared to Standard 90.1-2016 (DOE 2021). Based on that analysis, DOE issued a determination that Standard 90.1-2019 would achieve greater energy efficiency in buildings compared to the 2016 edition of the standard.

As many states have historically adopted the IECC for both residential and commercial buildings, PNNL has also compared energy performance of Standard 90.1-2019 with the 2021 IECC to help states and local jurisdictions make informed decisions regarding model code adoption. Of the 42 states with statewide commercial building energy codes currently, 33 use a version of the IECC (BECP 2022).

Table B.1 shows side-by-side comparisons of the site EUI and ECI for Standard 90.1-2019 and the 2021 IECC for each of 16 prototype buildings along with the percent difference between the two. The national weighted average of all prototypes combined is also shown. Negative percentage differences indicate higher energy usage or energy costs for buildings designed to the 2021 IECC compared to those designed to Standard 90.1-2019. Figure B.1 shows the same results graphically. For some prototypes, EUIs or ECIs were lower using Standard 90.1-2019 but the 2021 IECC resulted in both lower energy use and lower energy costs in the national weighted average.

Table B.1. Site Energy and Energy Cost Savings between Standard 90.1-2019 and the 2021 IECC

Building Prototype	Site EUI (kBtu/ft²-yr)			Source EUI (kBtu/ft²-yr)			ECI ($/ft²-yr)			Emissions (ton/ft²-yr)		
	Standard 90.1-2019	2021 IECC	Difference (%)	Standard 90.1-2019	2021 IECC	Difference (%)	Standard 90.1-2019	2021 IECC	Difference (%)	Standard 90.1-2019	2021 IECC	Difference (%)
Small Office	26.8	26.2	2.2%	74.7	72.8	2.5%	$0.87	$0.85	2.3%	5.4	5.3	2.4%
Medium Office	30.3	28.2	6.9%	78.7	74.9	4.8%	$0.90	$0.86	4.4%	5.6	5.4	4.3%
Large Office	53.3	47.6	10.7%	146.8	131.6	10.4%	$1.70	$1.52	10.6%	10.6	9.5	10.3%
Stand-Alone Retail	46.2	41.2	10.8%	102.9	94.6	8.1%	$1.13	$1.05	7.1%	7.1	6.6	7.2%
Strip Mall	49.2	43.3	12.0%	120.1	110.3	8.2%	$1.35	$1.25	7.4%	8.4	7.8	7.1%
Primary School	43.2	44.7	-3.5%	101.5	106.9	-5.3%	$1.13	$1.20	-6.2%	7.1	7.5	-5.7%
Secondary School	38.8	41.1	-5.9%	93.5	100.8	-7.8%	$1.05	$1.14	-8.6%	6.6	7.1	-8.2%
Outpatient Healthcare	108.4	107.7	0.6%	259.6	256.8	1.1%	$2.91	$2.87		18.2	18.0	1.2%
Hospital	106.4	120.3	-13.1%	254.4	274.2	-7.8%	$2.85	$3.03	-6.3%	17.8	18.9	-6.4%
Small Hotel[1]	63.5	57.7	9.1%	125.7	127.2	-1.2%	$1.33	$1.39	-4.5%	8.3	8.7	-4.6%
Large Hotel	86.9	80.0	7.9%	173.2	174.8	-0.9%	$1.84	$1.91	-3.8%	11.5	11.9	-3.7%
Warehouse	13.6	12.0	11.8%	26.7	25.1	6.0%	$0.28	$0.27	3.6%	1.8	1.7	4.0%
Quick-Service Restaurant	499.2	505.8	-1.3%	854.8	860.6	-0.7%	$8.57	$8.61	-0.5%	53.6	53.9	-0.4%
Full-Service Restaurant	337.9	337.8	0.0%	636.9	634.9	0.3%	$6.63	$6.60	0.5%	41.5	41.3	0.4%
Mid-Rise Apartment	39.3	31.6	19.6%	106.5	86.5	18.8%	$1.23	$1.00	18.7%	7.7	6.3	18.6%
High-Rise Apartment	43.2	31.0	28.2%	91.9	81.0	11.9%	$1.00	$0.93	7.0%	6.2	5.8	6.9%
National Weighted Average	48.0	44.9	6.5%	110.4	106.1	3.9%	$1.22	$1.18	3.3%	7.6	7.4	3.1%

[1] The hotel prototypes show positive savings for site EUI and negative savings for the other metrics due to the switch of a portion of service water heating energy from gas to electric heat pump.

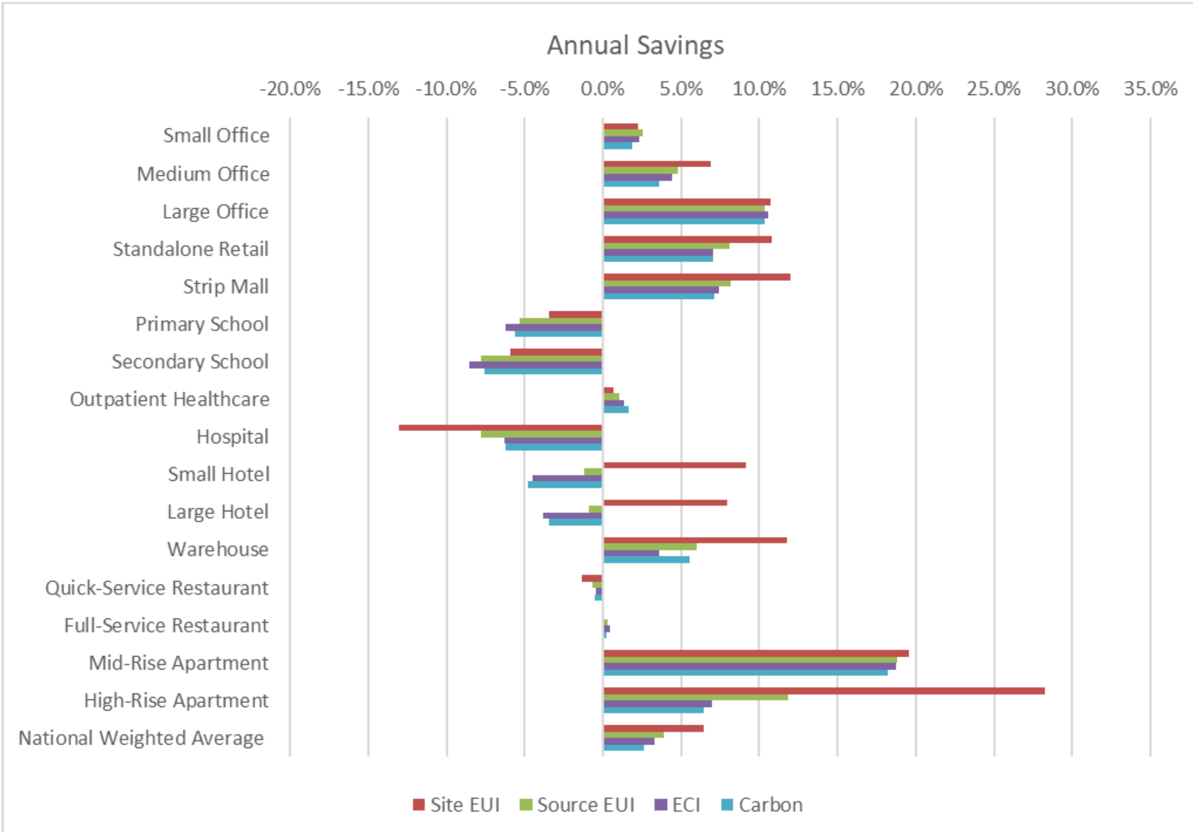

Figure B.1. National Average Site Energy Use Intensity for Standard 90.1 and IECC Prototypes

The comparisons show the combined energy impacts of differences between the 2021 IECC and Standard 90.1-2019. Although the current analysis does not compare or rank the individual differences based on their energy savings, a few high-impact differences by category can be identified as follows:

- Envelope
  - Prescriptive window-to-wall ratio (WWR) limit: the 2021 IECC allows a WWR up to 30% unless a significant portion of the building is equipped with daylight-responsive controls, in which case up to 40% is allowed. Standard 90.1-2019 requires WWR less than 40%.
  - Semi-heated space envelope requirements: the 2021 IECC does not have separate envelope requirements for semi-heated spaces. Semi-heated spaces are required to follow conditioned space requirements. Standard 90.1-2019 has less stringent insulation requirements for semi-heated spaces.
  - Vestibule exceptions: the 2021 IECC exempts building entrance doors that open up to a space less than 3,000 ft^2; Standard 90.1-2019 does not. The 2021 IECC also includes an exception from vestibule requirements if an air curtain is installed instead; Standard 90.1-2019 does not have such an exception.
  - Fenestration orientation: the 2021 IECC does not limit the distribution of fenestration area. Standard 90.1-2019 limits the proportion of fenestration area on the east and west façades.

  - Skylights: the 2021 IECC has an exception for spaces with daylighting control that allow higher U-factor and SHGC for skylights. This exception does not exist for Standard 90.1-2019.
  - Infiltration: Testing for infiltration is no longer optional for the 2021 IECC in certain cases, so air leakage limits are now set at 0.4 cfm/ft^2 for some prototypes in some climate zones. This is significantly lower than the value of 1.0 cfm/ft^2 used for Standard 90.1-2019.
- Building mechanical systems
  - Transfer air: the 2021 IECC requires the use of transfer air to kitchen exhaust systems. Standard 90.1-2019 expands the requirement to more exhaust systems, including restroom and laundry exhaust.
  - Pipe sizing: Standard 90.1-2019 includes requirements for pipe sizing to reduce pump power. IECC 2021 does not have similar requirements, and thus pump pressure loss is higher.
  - Occupied-standby controls: Standard 90.1-2019 includes a thermostat/VAV box control requirement that is connected to automatic lighting controls. IECC 2021 does not have a similar requirement.
  - Chilled water flow: Standard 90.1-2019 has a requirement for sizing chilled water coils based on a 15°F temperature difference. The 2021 IECC prototypes used 12°F temperature difference for air cooled chillers and 10°F temperature difference for water cooled chillers.
  - Minimum damper position for VAV terminals: Standard 90.1-2019 sets the minimum air flow setting based on the Simplified Procedure of ASHRAE Standard 62.1, whereas IECC-2021 sets the minimum based on the larger of 20% and the ventilation requirements.
  - One pump per chiller: Standard 90.1-2019 has a provision that requires each chiller to have its own primary chilled water pump, but the 2021 IECC does not have this requirement. Thus, in the 2021 IECC prototypes, a single larger pump is run, even if only one chiller operates.
  - Chilled and hot water reset control: The 2021 IECC prototypes are modeled with both chilled and hot water reset control, and the Standard 90.1-2019 models do not include this control.
  - Optimal stop control: The 2021 IECC has a requirement for optimal stop control which is not shared by Standard 90.1-2019. This amounts to a partial thermostat set back that occurs one hour before the end of the occupied period.
  - Demand controlled ventilation: The 2021 IECC has new language that requires demand controlled ventilation for all single zone HVAC systems that include economizer controls and that do not require energy recovery ventilation. This blanket requirement is not included in Standard 90.1-2019, so the 2021 IECC has greater use of the technology.
  - Heat recovery chiller: Heat recovery chillers are included in the Standard 90.1-2019 hospital prototype, but are not required for the 2021 IECC.

- Lighting
  - Dwelling unit (apartment) lighting power: the 2021 IECC requires 90% of all permanently installed luminaires in dwelling units to be high efficacy. Standard 90.1-2019 requires only 75%.
  - Egress lighting control: Standard 90.1-2019 requires lighting connected to emergency circuits to be turned off in spaces that comply with the automatic full off or scheduled off requirements when there are no occupants. It provides an exception to the automatic full off and scheduled off requirements for egress lighting by allowing 0.02 W/ft^2 or less lighting power to remain on during the unoccupied period. The 2021 IECC does not have such a requirement.
  - Daylighting minimum ratio: Where daylighting controls are required, IECC 2021 specifies a minimum light output of 15%, whereas Standard 90.1-2019 specifies a minimum output of 20%.
  - Building façade lighting: Standard 90.1-2019 has lower allowances for building façade lighting than the IECC 2021.
- Additional efficiency package options: Additional efficiency package requirements are in the 2021 IECC, but not in Standard 90.1-2019.
  - Interior lighting power: The lighting power allowances specified in the 2021 IECC are almost the same as the corresponding requirements in Standard 90.1-2019. The lighting efficiency package was selected for all prototypes and in most climate zones. Consequently, the lighting power for the 2021 IECC prototypes is typically 10% lower than Standard 90.1-2019.
  - Cooling efficiency: The cooling efficiency package was selected for most climates for the school prototypes, and for a few climates in all other prototypes except retail. The prescriptive requirements for cooling efficiency in the 2021 IECC are nearly identical to 90.1-2019, so the cooling efficiency improvements of 5% to 10% are primarily due to the efficiency package.
  - Heating efficiency: The heating efficiency 5% improvement package was applied only for the apartments, hotels, and hospital, and only in climate zone 5C. The prescriptive requirements for heating efficiency in the 2021 IECC for these prototypes are identical to those of Standard 90.1-2019. The heating efficiency 10% improvement package was not used.
  - Infiltration: The infiltration energy credit was selected for all prototypes except retail, and in several climate zones. To achieve the infiltration credit, the 2021 IECC prototype air leakage rates are based on 0.25 cfm/ft^2, as compared with 1.0 cfm/ft^2 for 90.1-2019.
  - Heat pump water heater: The HPWH credit was selected for the apartments, the hotels, and the hospital. The corresponding water heating systems in the 90.1-2019 prototypes were electric storage for the mid-rise apartment and gas storage for all the others.
  - Onsite renewable energy: The credit for onsite renewable energy was selected only for the outpatient health care prototype, and only is seven climates. The corresponding 90.1-2019 prototypes did not include onsite renewable energy.

Table B.2 shows the comparison of the analysis results for Standard 90.1-2019 and the 2021 IECC by climate zone. The EUI, ECI, and emissions factor shown in the table for each climate zone are weighted averages across the 16 prototypes within that climate zone in the United States. For all climate zones, the table shows buildings designed to the 2021 IECC have lower energy consumption and costs than those designed to Standard 90.1-2019 based on a weighted average. On a national average basis for all prototypes combined, the 2021 IECC is 6.5% more efficient for site energy use and 3.3% more for energy costs than Standard 90.1-2019.

Table B.2. Site Energy and Energy Cost Savings between Standard 90.1-2019 and the 2021 IECC by Climate Zone

Climate Zones	Site EUI (kBtu/ft²-yr)			Source EUI (kBtu/ft²-yr)			ECI ($/ft²-yr)			Emissions (ton/kft²-yr)		
	Standard 90.1-2019	2021 IECC	Difference (%)	Standard 90.1-2019	2021 IECC	Difference (%)	Standard 90.1-2019	2021 IECC	Difference (%)	Standard 90.1-2019	2021 IECC	Difference (%)
1A	47.1	41.8	11.3%	117.6	110.9	5.7%	1.33	1.27	4.5%	8.32	7.95	4.4%
2A	46.0	44.0	4.3%	115.5	111.7	3.3%	1.31	1.27	3.1%	8.18	7.93	3.1%
2B	41.7	40.3	3.4%	105.3	102.3	2.8%	1.19	1.16	2.5%	7.46	7.26	2.7%
3A	46.1	44.0	4.6%	109.5	106.5	2.7%	1.22	1.19	2.5%	7.64	7.47	2.2%
3B	39.9	37.1	7.0%	97.1	92.9	4.3%	1.09	1.05	3.7%	6.83	6.58	3.7%
3C	40.4	36.3	10.1%	100.8	92.7	8.0%	1.14	1.05	7.9%	7.13	6.59	7.6%
4A	48.0	42.7	11.0%	107.3	100.5	6.3%	1.18	1.12	5.1%	7.38	7.00	5.1%
4B	49.7	48.5	2.4%	114.8	114.2	0.5%	1.27	1.27	0.0%	7.96	7.95	0.1%
4C	41.2	36.6	11.2%	95.6	88.5	7.4%	1.06	0.99	6.6%	6.63	6.20	6.5%
5A	54.7	52.6	3.8%	114.5	112.5	1.7%	1.23	1.22	0.8%	7.71	7.63	1.0%
5B	48.8	45.8	6.1%	109.4	105.2	3.8%	1.20	1.17	2.5%	7.52	7.28	3.2%
5C	54.9	51.9	5.5%	121.5	117.4	3.4%	1.33	1.29	3.0%	8.32	8.09	2.8%
6A	64.3	61.8	3.9%	131.5	129.5	1.5%	1.41	1.39	1.4%	8.79	8.72	0.8%
6B	60.2	57.1	5.1%	125.7	123.8	1.5%	1.35	1.35	0.0%	8.46	8.43	0.4%
7	69.9	69.4	0.7%	140.8	141.3	-0.4%	1.50	1.51	-0.7%	9.37	9.43	-0.6%
8	85.9	85.0	1.0%	157.3	158.1	-0.5%	1.62	1.64	-1.2%	10.13	10.24	-1.1%
National Weighted Average	48.0	44.9	6.5%	110.4	106.1	3.9%	1.22	1.18	3.3%	7.64	7.40	3.1%

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Acronyms and Abbreviations

AVERT	U.S. EPA AVoided Emissions and geneRation Tool
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BECP	Building Energy Codes Program
CH_4	Methane
CO_2	Carbon Dioxide
DOE	U.S. Department of Energy
E.O.	Executive Order
eGRID	EPA Emissions & Generation Resource Integrated Database
EIA	Energy Information Administration
EPA	Environmental Protection Agency
FEMP	Federal Energy Management Program
HVAC	Heating, Ventilating, and Air-Conditioning
LCC	Life-Cycle Cost
MMT	Million Metric Tons
N_2O	Nitrous Oxide
NOx	Nitrogen Oxides
NIST	National Institute of Standards and Technology
PNNL	Pacific Northwest National Laboratory
SOx	Sulfur Oxides
UPV	Uniform Present Value

1.0 Highlights

Moving to the ASHRAE Standard 90.1-2019 (ASHRAE 2019) edition from Standard 90.1-2016 (ASHRAE 2016) is cost-effective for Ohio. Standard 90.1-2019 will provide an annual energy cost savings of $0.054 per square foot on average across the state. It will reduce statewide CO_2 emissions by 9.2 MMT (30 years cumulative), equivalent to the CO_2 emissions of 2,009,000 cars driven for one year.

Updating the state energy code based on Standard 90.1-2019 will also stimulate the creation of high-quality jobs across the state. Standard 90.1-2019 is expected to result in buildings that are energy efficient, more affordable to own and operate, and based on current industry standards for health, comfort, and resilience.

The tables below show the expected impact of upgrading to Standard 90.1-2019 from a consumer perspective and statewide perspective. These results are weighted averages for all building types in all climate zones in the state, based on weightings shown in Table 4. The methodology used for this analysis is consistent with the methodology used in the national cost-effectiveness analysis.[1] Additional results and details on the methodology are presented in the following sections.

Consumer Impact	
Annual (first year) energy cost savings, $/ft²	$0.054
Added construction cost, $/ft²	-$1.225
Publicly-owned scenario LCC Savings, $/ft²	4.02
Privately-owned scenario LCC Savings, $/ft²	3.57

Statewide Impact - Emissions	First Year	30 Years Cumulative
Energy cost savings, 2020$	1,501,000	649,900,000
CO_2 emission reduction, Metric tons	13,250	9,239,000
CH_4 emissions reductions, Metric tons	1.35	938
N_2O emissions reductions, Metric tons	0.191	133
NOx emissions reductions, Metric tons	6.99	4,875
SOx emissions reductions, Metric tons	8.99	6,271

Statewide Impact - Jobs Created	First Year	30 Years Cumulative
Jobs Created Reduction in Utility Bills	134	4,230
Jobs Created Construction Related Activities	336	10,613

[1] National cost-effectiveness report: https://www.energycodes.gov/development/commercial/cost_effectiveness

The report provides analysis of two LCC scenarios:

- **Scenario 1**, representing *publicly-owned* buildings, considers initial costs, energy costs, maintenance costs, and replacement costs—without borrowing or taxes.
- **Scenario 2**, representing *privately-owned* buildings, adds borrowing costs and tax impacts.

Figure 1 compares annual energy cost savings, first cost for the upgrade, and net annualized LCC savings. The net annualized LCC savings per square foot is the annual energy savings minus an allowance to pay for the added cost under scenario 1. Figure 2 shows overall state weighted net LCC results for both scenarios. When net LCC is positive, the updated code edition is considered cost-effective.

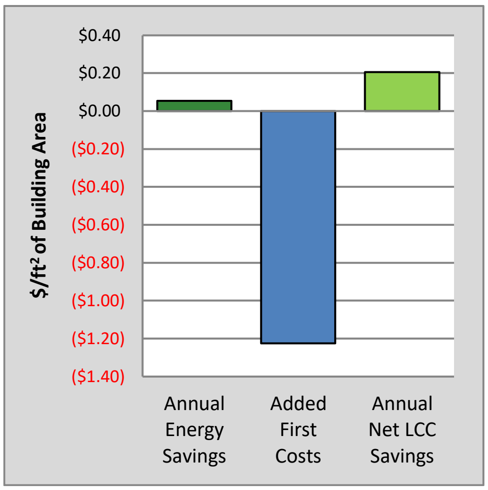

Figure 1. Statewide Weighted Costs and Savings

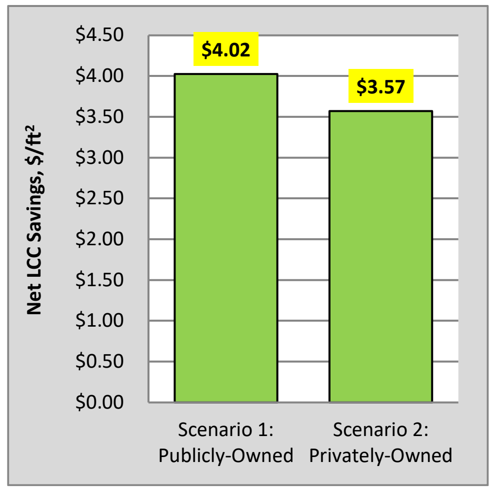

Figure 2. Overall Net Life-Cycle Cost Savings

2.0 Cost-Effectiveness Results for ASHRAE Standard 90.1-2019 in Ohio

This section summarizes the cost-effectiveness analysis results applicable to the building owner. Life Cycle Cost (LCC) savings is the primary measure established by the U.S. Department of Energy to assess the cost effectiveness and economic impact of building energy codes. Net LCC savings is the calculation of the present value of energy savings minus the present value of non-energy incremental costs over a 30-year period. The non-energy incremental costs include initial equipment and construction costs, and maintenance and replacement costs, less the residual value of components at the end of the 30-year period. When net LCC is positive, the updated code edition is considered cost-effective. Savings are computed for two scenarios:

- **Scenario 1:** represents *publicly-owned buildings*, includes costs for initial equipment and construction, energy, maintenance and replacement and does not include loans or taxes.
- **Scenario 2:** represents *privately-owned buildings*, includes the same costs as Scenario 1, with the initial investment financed through a loan amortized over 30 years and federal and state corporate income tax deductions for interest and depreciation.

Both scenarios include the residual value of equipment with remaining useful life at the end of the 30-year assessment period. Totals for building types, climate zones, and the state overall are averages based on Table 4 construction weights. Factors such as inflation and discount rates are different between the two scenarios, as described in the Cost-Effectiveness Methodology section.

LCC is affected by many variables, including the applicability of individual measures in the code, measure costs, measure lifetime, replacement costs, state cost adjustment, energy prices, and so on. In some cases, the LCC can be negative for a given building type or climate zone based on the interaction of these variables. However, the code is considered cost-effective if the weighted statewide LCC is positive.

Table 1 shows the present value of the net LCC savings over 30 years for buildings in scenario 1 averages $4.02 per square foot for Standard 90.1-2019.

Table 1. Net LCC Savings for Ohio, Scenario 1 ($/ft^2)

Climate Zone	Small Office	Large Office	Stand-Alone Retail	Primary School	Small Hotel	Mid-Rise Apartment	All Building Types
4A	$3.78	$3.79	$3.99	$4.54	$12.83	$1.90	$3.76
5A	$3.73	$3.79	$4.06	$4.50	$12.79	$1.88	$4.22
State Average	$3.75	$3.79	$4.04	$4.51	$12.80	$1.89	**$4.02**

Table 2 shows the present value of the net LCC savings over 30 years averages $3.57 per square foot for scenario 2.

Table 2. Net LCC Savings for Ohio, Scenario 2 ($/ft²)

Climate Zone	Small Office	Large Office	Stand-Alone Retail	Primary School	Small Hotel	Mid-Rise Apartment	All Building Types
4A	$3.26	$3.21	$3.51	$3.91	$12.37	$1.73	$3.33
5A	$3.21	$3.21	$3.57	$3.88	$12.33	$1.72	$3.74
State Average	$3.23	$3.21	$3.55	$3.89	$12.34	$1.73	**$3.57**

2.1 Energy Cost Savings

Table 3 shows the economic impact of upgrading to Standard 90.1-2019 by building type and climate zone in terms of the annual energy cost savings in dollars per square foot. The annual energy cost savings across the state averages $0.054 per square foot.

Table 3. Annual Energy Cost Savings for Ohio ($/ft²)

Climate Zone	Small Office	Large Office	Stand-Alone Retail	Primary School	Small Hotel	Mid-Rise Apartment	All Building Types
4A	$0.039	$0.048	$0.077	$0.056	$0.069	$0.017	$0.049
5A	$0.038	$0.048	$0.078	$0.056	$0.067	$0.016	$0.057
State Average	$0.038	$0.048	$0.078	$0.056	$0.068	$0.017	**$0.054**

2.2 Construction Weighting of Results

Energy and economic impacts were determined and reported separately for each building type and climate zone. Cost-effectiveness results are also reported as averages for all prototypes and climate zones in the state. To determine these averages, results were combined across the different building types and climate zones using weighting factors shown in Table 4. These weighting factors are based on the floor area of new construction and major renovations for the six analyzed building prototypes in state-specific climate zones. The weighting factors were developed from construction start data from 2003 to 2018 (Dodge Data & Analytics) based on an approach documented in Lei, et al.

Table 4. Construction Weights by Building Type

Climate Zone	Small Office	Large Office	Stand-Alone Retail	Primary School	Small Hotel	Mid-Rise Apartment	All Building Types
4A	4.3%	3.8%	13.2%	6.9%	1.6%	12.4%	42.1%
5A	7.7%	1.9%	24.7%	11.9%	2.9%	8.6%	57.9%
State Average	12.0%	5.8%	37.9%	18.8%	4.5%	21.0%	100.0%

2.3 Incremental Construction Cost

Cost estimates were developed for the differences between Standard 90.1-2016 and Standard 90.1-2019 as implemented in the six prototype models. Costs for the initial construction include material, labor, commissioning, construction equipment, overhead and profit. Costs were also estimated for replacing equipment or components at the end of the useful life. The costs were developed at the national level for the national cost-effectiveness analysis and then adjusted for local conditions using a state construction cost index (Hart et al. 2019, Means 2020a,b).

Table 5 shows incremental initial cost for individual building types in state-specific climate zones and weighted average costs by climate zone and building type for moving to Standard 90.1-2019 from Standard 90.1-2016.

The added construction cost can be negative for some building types, which represents a reduction in first costs and a savings that is included in the net LCC savings. This is typically due to the interaction between measures and situations such as the following:

- Fewer light fixtures are required when the allowed lighting power is reduced. Also, changes from fluorescent to LED technology result in reduced lighting costs in many cases and longer lamp lives, requiring fewer lamp replacements.
- Smaller heating, ventilating, and air-conditioning (HVAC) equipment sizes can result from the lowering of heating and cooling loads due to other efficiency measures, such as better building envelopes. For example, Standard 90.1-2019 has more stringent fenestration U-factors for some climate zones. This results in smaller equipment and distribution systems, resulting in a negative first cost.

Table 5. Incremental Construction Cost for Ohio ($/ft^2)

Climate Zone	Small Office	Large Office	Stand-Alone Retail	Primary School	Small Hotel	Mid-Rise Apartment	All Building Types
4A	($1.722)	($1.967)	($1.266)	($1.990)	$0.646	($0.362)	($1.158)
5A	($1.701)	($1.975)	($1.297)	($1.973)	$0.651	($0.366)	($1.274)
State Average	($1.708)	($1.970)	($1.286)	($1.979)	$0.649	($0.364)	**($1.225)**

2.4 Simple Payback

Simple payback is the total incremental first cost divided by the annual savings, where the annual savings is the annual energy cost savings less any incremental annual maintenance cost. Simple payback is not used as a measure of cost-effectiveness as it does not account for the time value of money, the value of energy cost savings that occur after payback is achieved, or any replacement costs that occur after the initial investment. However, it is included in the analysis for states who wish to use this information. Table 6 shows simple payback results in years.

Table 6. Simple Payback for Ohio (Years)

Climate Zone	Small Office	Large Office	Stand-Alone Retail	Primary School	Small Hotel	Mid-Rise Apartment	All Building Types
4A	Immediate	Immediate	Immediate	Immediate	9.4	Immediate	Immediate
5A	Immediate	Immediate	Immediate	Immediate	9.7	Immediate	Immediate
State Average	Immediate	Immediate	Immediate	Immediate	9.6	Immediate	**Immediate**

3.0 Societal Benefits

3.1 Benefits of Energy Codes

It is estimated that by 2060, the world will add 2.5 trillion square feet of buildings, an area equal to the current building stock. As a building's operation and environmental impact is largely determined by upfront decisions, energy codes present a unique opportunity to assure savings through efficient building design, technologies, and construction practices. Once a building is constructed, it is significantly more expensive to achieve higher efficiency levels through later modifications and retrofits. Energy codes ensure that a building's energy use is included as a fundamental part of the design and construction process. Making this early investment in energy efficiency will pay dividends to residents of Ohio for years into the future.

3.2 Greenhouse Gas Emissions

The urban built environment is responsible for 75% of annual global greenhouse gas (GHG) emissions while buildings alone account for 39%.[2] While carbon dioxide emissions represent the largest share of greenhouse gas emissions, building electricity use and on-site fossil fuel consumption also contribute to other emissions, two of which, methane (CH_4) and nitrous oxide (N_2O), are significant greenhouse gases in their own right.

For natural gas combusted on site, emission metrics are developed using nationwide emission factors from U.S. Environmental Protection Agency publications for CO_2, NOx, SO_2, CH_4 and N_2O (EPA 2014).

For electricity, marginal carbon emission factors are provided by the U.S. Environmental Protection Agency (EPA) AVoided Emissions and geneRation Tool (AVERT) version 3.0 (EPA 2020). The AVERT tool forms the basis of the national marginal emission factors for electricity also published by EPA on its Greenhouse Gas Equivalencies Calculator website and are based on a portfolio of energy efficiency measures examined by EPA. AVERT is used here to provide marginal CO_2 emission factors at the State level.[3] AVERT also provides marginal emission factor estimates for gaseous pollutants associated with electricity production, including NOx and SO_2 emissions. While not considered significant greenhouse gases, these are EPA tracked pollutants. The current analysis uses AVERT to provide estimates of corresponding emission changes for NOx and SO_2 in physical units but does not monetize these.

AVERT does not develop associated marginal emissions factors for CH_4 or N_2O. To provide estimates for the associated emission reductions for CH_4 and N_2O, this report uses emission factors separately provided through the U.S. Environmental Protection Agency (EPA) Emissions

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[2] Architecture 2030, https://architecture2030.org/2030_challenges/2030-challenge

[3] AVERT models avoided emissions in 14 geographic regions of the 48 contiguous United States and includes transmission and distribution losses. Where multiple AVERT regions overlap a state's boundaries, the emission factors are calculated based on apportionment of state electricity savings by generation across generation regions. The most recent AVERT 3.0 model uses EPA emissions data for generators from 2019. Note that AVERT estimates are based on marginal changes to demand and reflect current grid generation mix. Emission factors for electricity shown in Table 7 do not take into account long term policy or technological changes in the regional generation mix that can impact the marginal emission benefits from new building codes.

& Generation Resource Integrated Database (eGRID) dataset. eGRID is a comprehensive source of data on the environmental characteristics of almost all electric power generated in the United States and the emission characteristics for electric power generation for each of the above emissions can also be found aggregated down to the state level in eGRID (EPA 2021a). The summary emission factor data provided by eGRID does not provide marginal emission factors, but instead summarizes emission factors in terms of total generation emission factors and non-baseload generation emission factors. Non-baseload emission factors established in eGRID are developed based on the annual load factors for the individual generators tracked by the EPA (EPA 2021b). Because changes in building codes are unlikely to significantly impact baseload electrical generators, the current analysis uses the 2019 non-baseload emission factors established in eGRID by state to estimate CH_4 or N_2O emission reductions due to changes in electric consumption.

Table 7 summarizes the marginal emission factors available from AVERT, eGRID and the EPA Greenhouse Gas Equivalencies Calculator.

Table 7. Greenhouse Gas Emission Factors by Fuel Type

GHG	Electricity lb/MWh	Natural Gas (lb/mmcf)
CO_2	1,567	120,000
SO_2	1.194	0.6
NO_X	0.774	96
N_2O	0.025	0.23
CH_4	0.175	2.3

Table 8 shows the annual first year and projected 30-year energy cost savings. This table also shows first year and projected 30-year greenhouse gas (CO_2, CH_4, and N_2O) emission reductions, in addition to NOx and SO_2 reductions.

Table 8. Societal Benefits of Standard 90.1-2019

Statewide Impact	First Year	30 Years Cumulative
Energy cost savings, 2020$	1,501,000	649,900,000
CO_2 emission reduction, Metric tons	13,250	9,239,000
CH_4 emissions reductions, Metric tons	1.35	938
N_2O emissions reductions, Metric tons	0.191	133
NOx emissions reductions, Metric tons	6.99	4,875
SOx emissions reductions, Metric tons	8.99	6,271

3.3 Jobs Creation through Energy Efficiency

Energy-efficient building codes impact job creation through two primary value streams:

1. Dollars returned to the economy through reduction in utility bills and resulting increase in disposable income, and;
2. An increase in construction-related activities associated with the incremental cost of construction that is required to produce a more energy efficient building.

When a building is built to a more stringent energy code, there is the long-term benefit of the ratepayer paying lower utility bills.

- This is partially offset by the increased cost of that efficiency, establishing a relationship between increased building energy efficiency and additional investments in construction activity.
- Since building codes are cost-effective, (i.e., the savings outweigh the investment), a real and permanent increase in wealth occurs that can be spent on other goods and services in the economy, just like any other income, generating economic benefits and creating additional employment opportunities.

Table 9 shows the number of jobs created because of efficiency gains in Standard 90.1-2019.

Table 9. Jobs Created from Standard 90.1-2019

Statewide Impact	First Year	30 Years Cumulative
Jobs Created Reduction in Utility Bills	134	4,230
Jobs Created Construction Related Activities	336	10,613

4.0 Overview of the Cost-Effectiveness Methodology

This analysis was conducted by Pacific Northwest National Laboratory (PNNL) in support of the DOE Building Energy Codes Program. DOE is directed by federal law to provide technical assistance supporting the development and implementation of residential and commercial building energy codes. The national model energy codes – the International Energy Conservation Code (IECC) and ANSI/ASHRAE/IES Standard 90.1 – help adopting states and localities establish minimum requirements for energy-efficient building design and construction, as well as mitigate environmental impacts and ensure residential and commercial buildings are constructed to modern industry standards.

The current analysis evaluates the cost-effectiveness of Standard 90.1-2019 relative to Standard 90.1-2016. The analysis covers six commercial building types. The analysis is based on the current prescriptive requirements of Standard 90.1. The simulated performance rating method is not in the scope of this analysis, as it is generally based on the core prescriptive requirements of Standard 90.1, and due to the unlimited range of building configurations that are allowed. Buildings complying via this path are generally considered to provide equal or better energy performance compared to the prescriptive requirements, as the intent of these paths is to provide additional design flexibility and cost optimization, as dictated by the builder, designer, and owner.

The current analysis is based on the methodology by DOE for assessing building energy codes (Hart and Liu 2015). The LCC analysis perspective described in the methodology appropriately balances upfront costs with longer term consumer costs and savings and is therefore the primary economic metric by which DOE evaluates the cost-effectiveness of building energy codes.

4.1 Cost-Effectiveness

DOE has established standard economic LCC cost-effectiveness analysis methods in comparing Standard 90.1-2019 and Standard 90.1-2016, which are described in *Methodology for Evaluating Cost-effectiveness of Commercial Energy Code Changes* (Hart and Liu 2015). Under this methodology, two metrics are used:

- **Net LCC Savings:** This is the calculation of the present value of energy savings minus the present value of non-energy incremental costs over a 30-year period. The costs include initial equipment and construction costs, maintenance and replacement costs, less the residual value of components at the end of the 30-year period. When net LCC is positive, the updated code edition is considered cost-effective.
- **Simple Payback:** While not a true cost-effectiveness metric, simple payback is also calculated. Simple payback is the number of years required for accumulated annual energy cost savings to exceed the incremental first costs of a new code.

Two cost scenarios are analyzed:

- **Scenario 1** represents publicly-owned buildings, considers initial costs, energy costs, maintenance costs, and replacement costs without borrowing or taxes.
- **Scenario 2** represents privately-owned buildings and includes the same costs as Scenario 1 plus financing of the incremental first costs through increased borrowing with tax impacts including mortgage interest and depreciation deductions. Corporate tax rates are applied.

The cost-effectiveness analysis compares the cost for new buildings meeting Standard 90.1-2019 versus new buildings meeting Standard 90.1-2016. The analysis includes energy savings estimates from building energy simulations and LCC and simple payback calculations using standard economic analysis parameters. The analysis builds on work documented in *Energy Savings Analysis: ANSI/ASHRAE/IES Standard 90.1-2019* (DOE 2021), and the national cost-effectiveness analysis documented in *National Cost-effectiveness of ANSI/ASHRAE/IES Standard 90.1-2019* (Tyler et al. 2021).

4.2 Building Prototypes and Energy Modeling

The cost-effectiveness analysis uses six building types represented by six prototype building energy models. These six models represent the energy impact of five of the eight commercial principal building activities that account for 74% of the new construction by floor area covered by the full suite of 16 prototypes. These models provide coverage of the significant changes in ASHRAE Standard 90.1 from 2016 to 2019 and are used to show the impacts of the changes on annual energy usage. The prototypes represent common construction practice and include the primary conventional HVAC systems most commonly used in commercial buildings.[4]

Each prototype building is analyzed for each of the climate zones found within the state. Using the U.S. DOE EnergyPlus software, the six building prototypes summarized in Table 10 are simulated with characteristics meeting the requirements of Standard 90.1-2016 and then modified to meet the requirements of the next edition of the code (Standard 90.1-2019). The energy use and energy cost are then compared between the two sets of models.

Table 10. Building Prototypes

Building Prototype	Floor Area (ft^2)	Number of Floors
Small Office	5,500	1
Large Office	498,640	13
Stand-Alone Retail	24,690	1
Primary School	73,970	1
Small Hotel	43,210	4
Mid-Rise Apartment	33,740	4

4.3 Climate Zones

Climate zones are defined in ASHRAE Standard 169, as specified in ASHRAE Standard 90.1, and include eight primary climate zones in the United States, the hottest being climate zone 1 and the coldest being climate zone 8. Letters A, B, and C are applied in some cases to denote the level of moisture, with A indicating humid, B indicating dry, and C indicating marine. Figure 3 shows the national climate zones. For this state analysis, savings are analyzed for each climate zone in the state using weather data from a selected city within the climate zone and state, or where necessary, a city in an adjoining state with more robust weather data.

[4] More information on the prototype buildings and savings analysis can be found at www.energycodes.gov/development/commercial/90.1_models

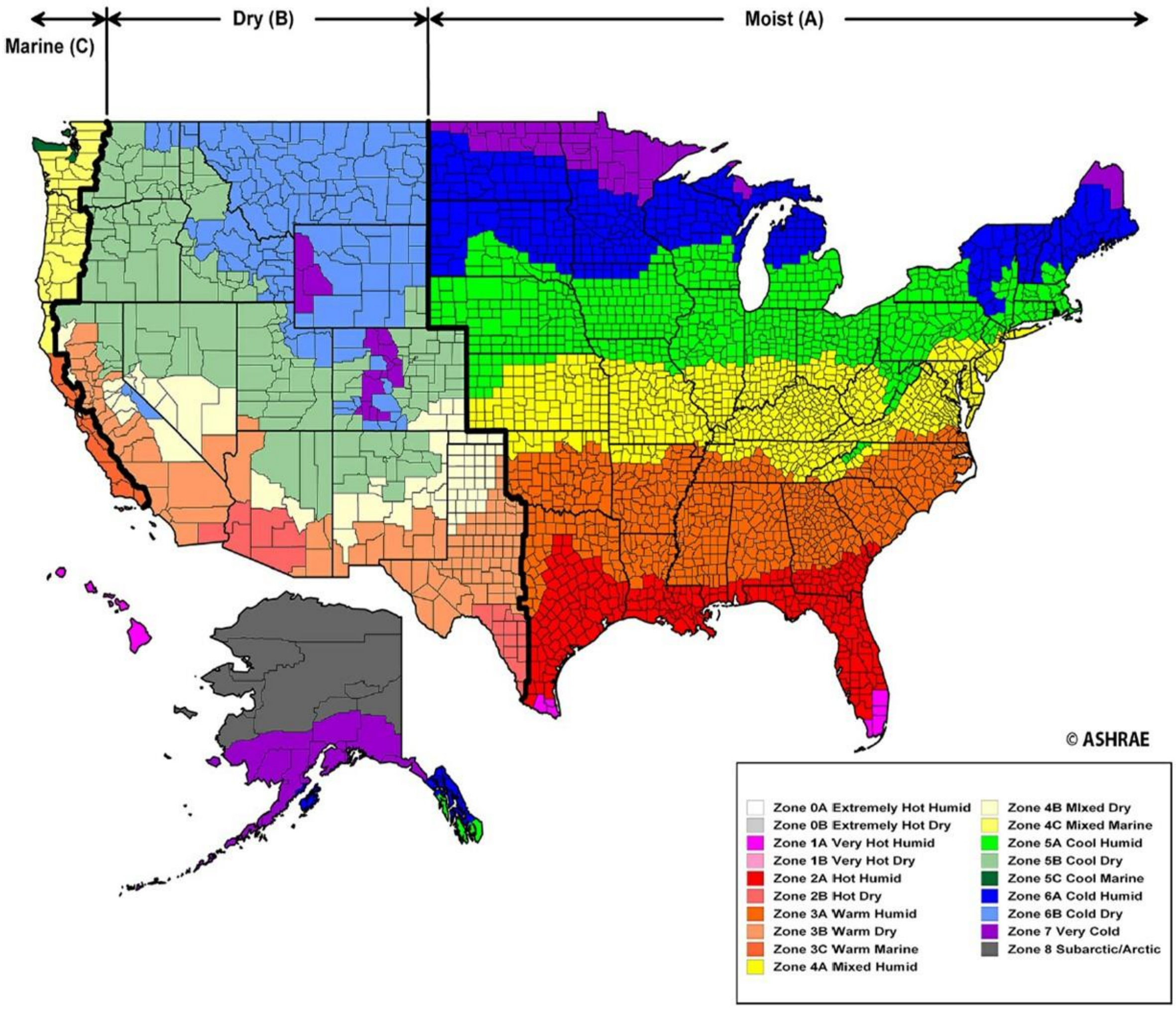

Figure 3. National Climate Zones

4.4 Cost-Effectiveness Method and Parameters

The DOE cost-effectiveness methodology accounts for the benefits of energy efficient building construction over a multi-year analysis period, balancing initial costs against longer term energy savings. DOE evaluates energy codes and code proposals based on LCC analysis over a multi-year study period, accounting for energy savings, incremental investment for energy efficiency measures, and other economic impacts. The value of future savings and costs are discounted to a present value, with improvements deemed cost-effective when the net LCC savings (present value of savings minus cost) is positive.

The U.S. DOE Building Energy Codes Program has established LCC analysis criteria similar to the method used for many federal building projects, as well as other public and private building projects (Fuller and Petersen 1995). The LCC analysis method consists of identifying costs (and revenues if any) and in what year they occur; then determining their value in today’s dollars (known as the present value). This method uses economic relationships about the time value of money. Money in-hand today is normally worth more than money received in the future, which is why we pay interest on a loan and earn interest on savings. Future costs are discounted to the present based on a discount rate. The discount rate may reflect the interest rate at which money can be borrowed for projects with the same level of risk or the interest rate that can be earned on other conventional investments with similar risk.

The LCC includes incremental initial costs, repairs, maintenance, and replacements. Scenario 2 also includes loan costs and tax impacts including mortgage interest and depreciation deductions. The residual value of equipment (or other component such as roof membrane) that has remaining useful life at the end of the 30-year study period is also included for both scenarios. The residual value is calculated by multiplying the initial cost of the component by the years of useful life remaining for the component at year 30 divided by the total useful life, a simplified approach included in the Federal Energy Management Program (FEMP) LCC method (Fuller and Petersen 1995). A component will have zero residual value at year 30 only if it has a 30-year life, or if it has a shorter than 30-year life that divides exactly into 30 years (for example, a 15-year life).

The financial and economic parameters used for the LCC calculations are shown in Table 11.

Table 11. LCC Economic Parameters

Economic Parameter	Scenario 1	Scenario 2
Study Period – Years[1]	30	30
Nominal Discount Rate[2]	3.10%	5.25%
Real Discount Rate[2]	3.00%	3.34%
Effective Inflation Rate[3]	0.10%	1.85%
Electricity Prices[4] (per kWh)	$0.0941	$0.0941
Natural Gas Prices[4] (per therm)	$0.5352	$0.5352
Energy Price Escalation Factors[5]	*Uniform present value factors*	*Uniform present value factors*
Electricity Price UPV[5]	19.17	17.37
Natural Gas Price UPV[5]	23.45	21.25
Loan Interest Rate[6]	NA	5.25%
Federal Corporate Tax Rate[7]	NA	21.00%
State Corporate Tax Rate[8]	NA	0.00%
Combined Income Tax Impact[9]	NA	21.00%
State and Average Local Sales Tax[10]	7.17%	7.17%
State Construction Cost Index[11]	0.925	0.925

[1] A 30-year study period captures most building components useful lives and is a commonly used study period for building project economic analysis. This period is consistent with previous and related national 90.1 cost-effectiveness analysis. It is also consistent with the cost-effectiveness analysis that was done for the residential energy code as described in multiple state reports and a summary report (Mendon et al. 2015). The federal building LCC method uses 25 years and the ASHRAE Standard 90.1 development process uses up to 40 years for building envelope code improvement analysis. Because of the time value of money, results are typically similar for any study periods of 20 years or more.

[2] The Scenario 1 real and nominal discount rates are from the National Institute of Standards and Technology (NIST) 2019 annual update in the *Report of the President's Economic Advisors, Analytical Perspectives* (referenced in the NIST 2019 annual supplement without citation) (Lavappa and Kneifel 2019). The Scenario 2 nominal discount rate is taken as the marginal cost of capital, which is set equal to the loan interest rate (see footnote 6). The real discount rate for Scenario 2 is calculated from the nominal discount rate and inflation.

[3] The Scenario 1 effective inflation rate is from the NIST 2019 annual update for the federal LCC method (Lavappa and Kneifel 2019). The Scenario 2 inflation rate is the 30-year average Producer Price Index for non-residential construction, June 1990 to June 2020 (Bureau of Labor Statistics 2021).

[4] Scenario 1 and 2 electricity and natural gas prices are state average annual prices for 2020 from the United States Energy Information Administration (EIA) *Electric Power Monthly* (EIA 2021a) and *Natural Gas Monthly* (EIA 2021b).

[5] Scenario 1 energy price escalation rates are from the NIST 2019 annual update for the FEMP LCC method (Lavappa and Kneifel 2019). The NIST uniform present value (UPV) factors are multiplied by the first-year annual energy cost to determine the present value of 30 years of energy costs and are based on a series of different annual escalation rates for 30 years. Scenario 2 UPV factors are based on NIST UPVs with an adjustment made for the scenario difference in discount rates.

[6] The loan interest rate is estimated from multiple online sources listed in the references (Commercial Loan Direct 2021; Realty Rates 2021).

[7] The highest federal marginal corporate income tax rate is applied.

[8] The highest marginal state corporate income tax rate is applied from the Federation of Tax Administrators (FTA 2021).

[9] The combined tax impact is based on state tax being a deduction for federal tax and is applied to depreciation and loan interest.

[10] The combined state and average local sales tax is included in material costs in the cost estimate (Tax Foundation 2020).

[11] The state construction cost index is based on weighted city indices from the state (Means 2020b).

5.0 Detailed Energy Use and Cost

On the following pages, specific detailed results for Ohio are included:

- Table 12 shows the average energy rates used.
- Table 13 shows the per square foot energy costs for Standard 90.1-2016 and Standard 90.1-2019 and the cost savings from Standard 90.1-2019.
- Table 14 shows the per square foot energy use for Standard 90.1-2016 and Standard 90.1-2019 and the energy use savings from Standard 90.1-2019.
- Tables 15.A and 15.B show the energy end use by energy type for each climate zone in the state.

Table 12. Energy Rates for Ohio, Average $ per unit

Electricity	$0.0941	kWh
Gas	$0.5352	Therm

Source: Energy Information Administration, annual average prices for 2020 (EIA 2021a,b)

Table 13. Energy Cost Saving Results in Ohio, $ per Square Foot

Climate Zone:	4A				5A			
Code:	90.1-2016	90.1-2019	Savings		90.1-2016	90.1-2019	Savings	
Small Office								
Electricity	$0.703	$0.663	$0.039	5.5%	$0.715	$0.676	$0.039	5.5%
Gas	$0.007	$0.008	$0.000	0.0%	$0.009	$0.010	-$0.001	-11.1%
Totals	$0.710	$0.671	$0.039	5.5%	$0.724	$0.686	$0.038	5.2%
Large Office								
Electricity	$1.409	$1.361	$0.048	3.4%	$1.414	$1.368	$0.047	3.3%
Gas	$0.016	$0.015	$0.001	6.3%	$0.019	$0.018	$0.001	5.3%
Totals	$1.425	$1.377	$0.048	3.4%	$1.434	$1.386	$0.048	3.3%
Stand-Alone Retail								
Electricity	$0.859	$0.776	$0.083	9.7%	$0.862	$0.778	$0.084	9.7%
Gas	$0.110	$0.116	-$0.006	-5.5%	$0.130	$0.136	-$0.006	-4.6%
Totals	$0.969	$0.892	$0.077	7.9%	$0.991	$0.914	$0.078	7.9%
Primary School								
Electricity	$0.840	$0.786	$0.055	6.5%	$0.839	$0.784	$0.054	6.4%
Gas	$0.065	$0.063	$0.002	3.1%	$0.073	$0.071	$0.002	2.7%
Totals	$0.905	$0.849	$0.056	6.2%	$0.912	$0.856	$0.056	6.1%
Small Hotel								
Electricity	$0.850	$0.782	$0.069	8.1%	$0.859	$0.792	$0.067	7.8%
Gas	$0.131	$0.131	$0.000	0.0%	$0.134	$0.134	$0.000	0.0%
Totals	$0.982	$0.913	$0.069	7.0%	$0.992	$0.926	$0.067	6.8%
Mid-Rise Apartment								
Electricity	$0.939	$0.920	$0.019	2.0%	$0.943	$0.925	$0.018	1.9%
Gas	$0.018	$0.020	-$0.002	-11.1%	$0.024	$0.027	-$0.003	-12.5%
Totals	$0.956	$0.940	$0.017	1.8%	$0.968	$0.952	$0.016	1.7%

Table 14. Energy Use Saving Results in Ohio, Energy Use per Square Foot

Climate Zone:	4A				5A			
Code:	90.1-2016	90.1-2019	Savings		90.1-2016	90.1-2019	Savings	
Small Office								
Electricity, kWh/ft^2	7.469	7.050	0.419	5.6%	7.601	7.188	0.413	5.4%
Gas, therm/ft^2	0.013	0.014	-0.001	-7.7%	0.017	0.018	-0.001	-5.9%
Totals, kBtu/ft^2	26.841	25.486	1.355	5.0%	27.634	26.327	1.307	4.7%
Large Office								
Electricity, kWh/ft^2	14.973	14.467	0.506	3.4%	15.030	14.533	0.497	3.3%
Gas, therm/ft^2	0.030	0.028	0.001	3.3%	0.036	0.034	0.002	5.6%
Totals, kBtu/ft^2	54.060	52.226	1.833	3.4%	54.887	53.036	1.851	3.4%
Stand-Alone Retail								
Electricity, kWh/ft^2	9.127	8.246	0.881	9.7%	9.157	8.266	0.891	9.7%
Gas, therm/ft^2	0.206	0.217	-0.011	-5.3%	0.242	0.254	-0.012	-5.0%
Totals, kBtu/ft^2	51.796	49.873	1.922	3.7%	55.490	53.634	1.856	3.3%
Primary School								
Electricity, kWh/ft^2	8.932	8.348	0.584	6.5%	8.914	8.335	0.579	6.5%
Gas, therm/ft^2	0.121	0.118	0.003	2.5%	0.136	0.133	0.003	2.2%
Totals, kBtu/ft^2	42.545	40.263	2.283	5.4%	44.053	41.773	2.280	5.2%
Small Hotel								
Electricity, kWh/ft^2	9.038	8.306	0.731	8.1%	9.124	8.416	0.707	7.7%
Gas, therm/ft^2	0.245	0.245	0.000	0.0%	0.250	0.250	0.001	0.4%
Totals, kBtu/ft^2	55.344	52.820	2.524	4.6%	56.162	53.692	2.470	4.4%
Mid-Rise Apartment								
Electricity, kWh/ft^2	9.977	9.776	0.200	2.0%	10.023	9.827	0.196	2.0%
Gas, therm/ft^2	0.033	0.037	-0.004	-12.1%	0.046	0.051	-0.005	-10.9%
Totals, kBtu/ft^2	37.325	37.079	0.246	0.7%	38.771	38.640	0.131	0.3%

Table 15.A. Annual Energy Usage for Buildings in Ohio in Climate Zone 4A

Energy End-Use	Small Office		Large Office		Stand-Alone Retail		Primary School		Small Hotel		Mid-Rise Apartment	
	Electric kWh/ $ft^2 \cdot yr$	Gas therms/ $ft^2 \cdot yr$	Electric kWh/ $ft^2 \cdot yr$	Gas therms/ $ft^2 \cdot yr$	Electric kWh/ $ft^2 \cdot yr$	Gas therms/ $ft^2 \cdot yr$	Electric kWh/ $ft^2 \cdot yr$	Gas therms/ $ft^2 \cdot yr$	Electric kWh/ $ft^2 \cdot yr$	Gas therms/ $ft^2 \cdot yr$	Electric kWh/ $ft^2 \cdot yr$	Gas therms/ $ft^2 \cdot yr$
ASHRAE 90.1-2016												
Heating, Humidification	0.641	0.013	0.715	0.018	0.000	0.170	0.000	0.058	0.698	0.016	0.000	0.033
Cooling	0.682	0.000	1.648	0.000	1.400	0.000	1.327	0.000	1.575	0.000	0.750	0.000
Fans, Pumps, Heat Recovery	0.900	0.000	1.383	0.000	1.719	0.000	1.500	0.000	1.060	0.000	0.612	0.000
Lighting, Interior & Exterior	1.898	0.000	1.959	0.000	3.822	0.000	1.406	0.000	2.118	0.000	1.054	0.000
Plugs, Refrigeration, Other	2.439	0.000	9.269	0.000	2.186	0.000	4.602	0.046	3.587	0.092	4.209	0.000
Service Water Heating (SWH)	0.910	0.000	0.000	0.011	0.000	0.037	0.097	0.016	0.000	0.136	3.351	0.000
Total	7.469	0.013	14.973	0.030	9.127	0.206	8.932	0.121	9.038	0.245	9.977	0.033
ASHRAE 90.1-2019												
Heating, Humidification	0.649	0.014	0.714	0.017	0.000	0.181	0.000	0.056	0.789	0.016	0.000	0.037
Cooling	0.642	0.000	1.531	0.000	1.305	0.000	1.252	0.000	1.467	0.000	0.720	0.000
Fans, Pumps, Heat Recovery	0.826	0.000	1.324	0.000	1.648	0.000	1.383	0.000	1.003	0.000	0.595	0.000
Lighting, Interior & Exterior	1.585	0.000	1.630	0.000	3.107	0.000	1.158	0.000	1.461	0.000	0.900	0.000
Plugs, Refrigeration, Other	2.438	0.000	9.269	0.000	2.186	0.000	4.458	0.046	3.587	0.092	4.209	0.000
Service Water Heating (SWH)	0.910	0.000	0.000	0.011	0.000	0.037	0.097	0.016	0.000	0.136	3.352	0.000
Total	7.050	0.014	14.467	0.028	8.246	0.217	8.348	0.118	8.306	0.245	9.776	0.037
Total Savings	0.419	-0.001	0.506	0.001	0.881	-0.011	0.584	0.003	0.731	0.000	0.200	-0.004

Table 15.B. Annual Energy Usage for Buildings in Ohio in Climate Zone 5A

Energy End-Use	**Small Office**		**Large Office**		**Stand-Alone Retail**		**Primary School**		**Small Hotel**		**Mid-Rise Apartment**	
	Electric kWh/ $ft^2 \cdot yr$	Gas therms/ $ft^2 \cdot yr$	Electric kWh/ $ft^2 \cdot yr$	Gas therms/ $ft^2 \cdot yr$	Electric kWh/ $ft^2 \cdot yr$	Gas therms/ $ft^2 \cdot yr$	Electric kWh/ $ft^2 \cdot yr$	Gas therms/ $ft^2 \cdot yr$	Electric kWh/ $ft^2 \cdot yr$	Gas therms/ $ft^2 \cdot yr$	Electric kWh/ $ft^2 \cdot yr$	Gas therms/ $ft^2 \cdot yr$
ASHRAE 90.1-2016												
Heating, Humidification	0.812	0.017	0.766	0.024	0.000	0.206	0.000	0.074	0.848	0.019	0.000	0.046
Cooling	0.671	0.000	1.650	0.000	1.374	0.000	1.290	0.000	1.517	0.000	0.741	0.000
Fans, Pumps, Heat Recovery	0.877	0.000	1.386	0.000	1.776	0.000	1.522	0.000	1.056	0.000	0.620	0.000
Lighting, Interior & Exterior	1.893	0.000	1.959	0.000	3.821	0.000	1.403	0.000	2.117	0.000	1.054	0.000
Plugs, Refrigeration, Other	2.439	0.000	9.269	0.000	2.186	0.000	4.602	0.046	3.587	0.092	4.209	0.000
Service Water Heating (SWH)	0.910	0.000	0.000	0.011	0.000	0.037	0.097	0.016	0.000	0.138	3.399	0.000
Total	7.601		15.030	0.036	9.157	0.242	8.914	0.136	9.124	0.250	10.023	0.046
ASHRAE 90.1-2019												
Heating, Humidification	0.819		0.766	0.023	0.000	0.217	0.000	0.071	0.955	0.019	0.000	0.051
Cooling	0.634	0.000	1.529	0.000	1.279	0.000	1.226	0.000	1.415	0.000	0.713	0.000
Fans, Pumps, Heat Recovery	0.805	0.000	1.339	0.000	1.694	0.000	1.395	0.000	1.000	0.000	0.605	0.000
Lighting, Interior & Exterior	1.582	0.000	1.631	0.000	3.106	0.000	1.158	0.000	1.460	0.000	0.900	0.000
Plugs, Refrigeration, Other	2.439	0.000	9.269	0.000	2.186	0.000	4.458	0.046	3.587	0.092	4.209	0.000
Service Water Heating (SWH)	0.910	0.000	0.000	0.011	0.000	0.037	0.097	0.016	0.000	0.138	3.400	0.000
Total	7.188		14.533	0.034	8.266	0.254	8.335	0.133	8.416	0.250	9.827	0.051
Total Savings	0.413	-0.001	0.497	0.002	0.891	-0.012	0.579	0.003	0.707	0.001	0.196	-0.005

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Pacific Northwest National Laboratory

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www.pnnl.gov

From:	Tracey Lehman
To:	BBS, BBSOfficAsst3
Subject:	Adult Changing Stations
Date:	Sunday, March 19, 2023 6:12:30 PM

To whom it may concern:

This letter is in regards to the Ohio building code. I live in Delaware county and am the mother of two young men with Down syndrome. We're fortunate that they do not need assistance or accommodations for using public restrooms. However, they have several friends who use wheelchairs and are unable to use the restroom without assistance. These young people require someone to change their diapers, and it's very undignified to have to do this on the floor. It's also laborious and potentially injurious for parents and caregivers. It is vital that the Ohio building code be modified so that restrooms are able to accommodate people with disabilities and their caregivers in the most respectful and safe manner possible.

Respectfully,

Tracey Lehman
6926 Plumb Rd
Galena, OH 43021

From: Bree Martin
To: BBS, BBSOfficAsst3
Cc: Garet Martin
Subject: Adult Changing tables
Date: Tuesday, March 21, 2023 1:26:47 PM

Hello, I forgot to include my husband's letter in my last email:

Hello,

As a father of a child with disabilities, I am writing to express my support for adding adult changing tables to public buildings. The absence of such facilities makes it very difficult for people with disabilities and their families to engage in everyday activities like going to the movies, shopping, or visiting friends and family. As my son grows our access to public spaces dwindles because of the lack of changing tables that can support his growing size.

For these individuals, using a standard restroom stall or changing table is simply not possible without significant assistance, which can be embarrassing and uncomfortable. As my son has gotten older and bigger, it has become increasingly difficult to find suitable facilities when we are out and about. Many public restrooms do not have changing tables that can support their weight or accommodate their size, which means that we are often forced to change them on the floor of a bathroom stall. This is not only unhygienic and unsafe, but it also takes away their dignity and makes them feel ashamed.

They would also help to promote greater inclusivity and accessibility for people with disabilities, allowing them to participate more fully in their communities and enjoy the same opportunities as everyone else.

Thank you for your attention to this important issue.

Sincerely,

Garet Martin

--

March 17, 2023

To the members of the Ohio Board of Building Standards:

My name is Latisha Martin. I am a person with cerebral palsy. I am also a self-advocate and an advocate for the disability community. I am from Dayton, Ohio and I live in Montgomery County. I am in support of the Ohio Building Codes, so please include the height adjustable adult changing tables. They will allow individuals with disabilities who cannot transfer themselves be able to attend the activities in the community that they want to attend. The Dragons Game would be an example.

I think this is important because as a person with a disability, if I was in the position of one of my friends who has to be physically lifted out of her chair to be changed, I would not want her family member to be injured while lifting her. So, if these height adjusted changing tables are available, it would allow her to be able to complete the outing or activity that she is attending without having to be soiled for several hours. The Montgomery County Board of Developmental Disabilities has a facility with medically fragile individuals who can only go into the community if the tables are available. The lack of tables cause them to miss out on something they paid for or to stay soiled for several hours, which can cause skin breakdown and other skin related complications.

It would really make my community and other surrounding communities to be more inclusive if these were added to the new buildings. The founders and co-leads of Changing Spaces Ohio who originally petitioned for the code change have worked with the International Code Council in developing the scope and specs, as well as personal experience with their sons, who also need these tables. Without the tables, they and others like them would not have the best quality of life that they could. I would really appreciate your assistance in making this happen.

Sincerely,

Latisha Martin
937-559-7974

From: Lisa Martin
To: BBS, BBSOfficAsst3
Subject: Support for Equitable Restrooms
Date: Wednesday, March 15, 2023 5:17:31 PM

Codes and Standards,

I am writing to you to show my support for adding the new proposed sections to the building code Section 1110.18 and 1113 pertaining to adult changing stations.

Please consider adding the proposed sections to your building. Everyone deserves the right to maintain their dignity and privacy when needing to use the facilities. Without these adult changing tables, the caregiver for individuals with disabilities or medical conditions that require assistance are forced to use the floor or other unsafe and unsanitary means. By adding the changing tables you can help promote safety and better hygiene. We are a civilized society and every single member of this society should be able to visit any public place or attraction without worry of whether there are appropriate restroom facilities that will accommodate their needs. This to me is a no brainer. Please consider moving forward with this.

Thanks, Lisa Martin

Sent from my iPhone

From: Bree McVean
To: BBS, BBSOfficAsst3
Subject: Building code proposal for adult changing tables
Date: Tuesday, March 21, 2023 1:22:08 PM

Hello,

I am so grateful that you are considering the proposal to change the building code to include adult restrooms.

This issue is one I never thought of until my son was born. He has multiple disabilities and is only 3 years old. As he ages the things we love to do like go to target, visit the Metroparks, go on road trips will slowly stop happening because we won't have a place to change him. Even now he is too big and doesn't understand how to be still and safe so we cannot use a baby changing table.

He loves being out and about and we love being a part of the community. If this code change takes place we will be able to continue to do the things we love and as my son ages, he can be a part of the community. Ohio is lucky to have people pushing this issue and helping to make restrooms equitable for everyone.

Thank you so much,
Bree Martin

Franklin County Developmental Disabilities

Franklin County Board of Developmental Disabilities

Helping people to live, learn and work in our community

2879 Johnstown Road • Columbus, Ohio 43219 • 614-475-6440 • www.fcbdd.org

Jed W. Morison
Superintendent/CEO

March 15, 2023

Dear Ohio Building Codes and Standards,

I am writing to you to show my support for adding the new proposed sections to the building code Section 1110.18 and 1113 pertaining to adult changing stations.

In the Columbus area, many public places cannot accommodate an older child or adult who is unable to safely use a toilet. People with disabilities should not have to be changed on the floor, or exposed in the back of a vehicle. They deserve privacy and dignity, just like anyone else.

Including appropriate changing areas for older children or adults with a disability or medical condition that requires assistance with toileting would allow all of those in our community to be a part of our community without the obstacle to a need that we all experience on a daily basis.

Thanks so much for your consideration. Please feel free to call if questions or additional information is needed.

Sincerely,

Jed Morison

Jed Morison
Superintendent/CEO

MAIN (216) 529-6270
FAX (216) 529-5930

DIRECT TO DESK (216) 529-6295
christopher.parmelee@lakewoodoh.net

DIVISION OF HOUSING AND BUILDING
12650 DETROIT AVE • LAKEWOOD OH 44107-2832
lakewoodoh.gov

Board of Building Standards (BBS)
PO Box 4009
Reynoldsburg OH 43068-9009
Via e-mail BBS@com.ohio.gov

March 16, 2023

Subject: BBS Common Sense Initiative Stakeholders' Meeting March 22, 2023; Draft OBC 105.1 et seq. Deletion of Existing OBC 105.1.1 Nonconformance Approval and OBC 107.6.1 Item 4 Communication Process for Items of Non-compliance.

1. Reference Pamella Butts e-mail March 2, 2023. Draft Ohio Building Code (OBC) 105.1 et seq. deletes existing OBC 105.1.1 Nonconformance approval. If this deletion's adopted, then:

    a. Existing and draft OBC 107.6.1 & 107.6.2 shows the building official determines whether the plans examiner's comments are to be communicated to the owner's representative asking whether the drawings will be revised and resubmitted. Estimated date of resubmission's obtained.

    b. Existing and draft OBC 107.6.2 reads in part, "The building official ... determines whether any approvals are possible, and issue the appropriate approval as described in Section 105." That section describes "Conditional approval." and "Phased approval." These descriptions (definitions) are driven by statute, Ohio Revised Code 3791.04(G) and 3791.04(D) respectively.

    c. It's unlikely that conditional approval (defined by statute) will be appropriate. That leaves either:
    (1) Phased approval, or
    (2) Disapproval of Plans Adjudication Order (no approval).

2. One or a series of phased approvals is a clumsy method where the issues are items such as:

    a. Accessible signage.

    b. Door hardware.

    c. Occupant load information in each room.

    d. Structural design loads.

    e. Occupancy Group(s)/Division(s)

f. Exit signs, emergency powered means of egress lighting, conventional and emergency powered exit discharge lighting.

3. Therefore, deleting nonconformance approval removes a tool building officials now have to expedite plan approval and construction commencement thereby avoiding unnecessary project costs. Also, Existing and draft OBC 107.6.1 Item 4 reads, "If the owner or owner's representative indicates that he work will not be brought into compliance with the rules of the board or requests an adjudication order, the plans examiner reports to the building official in accordance with section 107.6.2." This item was carried over from the original concept that the plans examiner would perform this communication. Before being adopted, OBC 107.6 was revised to show the building official (not the plans examiner) would perform this nonconformance communication. Delete OBC 107.6.1 Item 4.

Sincerely,

Christopher S. Parmelee
Building Commissioner/Building Official

From: Carl Reed
To: BBS, BBSOfficAsst3
Subject: Adult Changing tables BBS meeting 3/22
Date: Wednesday, March 15, 2023 12:33:34 PM
Attachments: image0.jpeg

To who it may concern!
Adult changing stations are needed in all public places. I am 26 years old and have lived my whole life with Spinal Muscular Atrophy type 1. I need to lay down to use the bathroom and public places like stadiums, malls, museums, zoos, amusement parks, grocery stores, Ohio State Fair etc. do not have a place for me to use the bathroom and require me to go back out into my van or not even go out at all at times. I love concerts and plan to attend several this summer throughout Ohio. I will need a place to lie down to use the bathroom or get permission from the venue to go out to my van possibly missing the concert. I do not go anywhere during germ season so this is my only chance to get out and enjoy things I love to do. Please help to get adult changing stations in all public buildings.

Thank you!
Madison Reed

Sent from my iPhone

From: Unstoppables Youth Sports
To: BBS, BBSOfficAsst3
Subject: Statement of support for changing tables
Date: Sunday, March 12, 2023 9:29:15 AM

Hello my name is Lindsay Roberts and I am a parent of two boys with autism. I am also the founder of Unstoppable Youth Sports in Bellville, OH, a special needs sports league that brings all kids together despite any differences or disabilities. We have 84 children playing in 4 locations and children traveling from 5 surrounding counties some as far as an hour away. Unfortunately there is no place in central Ohio to change our children, teens or even adults. I have changed my children in the back of our minivan for years as I watch all the other parents take their children to the restroom. I have watched grandparents and parents in wheelchairs unable to access the aging restrooms in the community and have to return home and miss their child's game because of it. We can DO BETTER. We were recently donated 74 acres to build a fully inclusive 100% accessible sports park where there will be NO BARRIERS to participation or even use of facilities. We will install adult size changing tables. Change has to start somewhere and if we start now, think how different things could look for your children and grandchildren if they need to access these facilities. Please consider making restrooms accessible for all. It's no different than requiring handicap access in new construction. Everyone has the right to safely and respectfully use a restroom.

Thank you,
Lindsay Roberts
Mom and founder of Unstoppable Youth Sports.

--

Lindsay Roberts
President
Unstoppable Youth Sports
P.O. Box 581
Bellville, OH 44813
(419)566-1224
UYSports21@gmail.com

We are writing in support of the petition to the BBS to add requirements for adult/universal changing stations into the Ohio Building Code.

Imagine it, not being able to speak, being dependent on other people to dress you, feed you, move you without being able to tell them that you have an itch, that you "don't like that" or that you simply are cold or hot. There are good days and bad days, but again you may not be able to express yourself to tell your caregiver how you feel.

Now imagine that maybe you're having a good day and you go to a park to play with your family or friends, but alas you have the urge to use the bathroom, as do most human beings. Your caregiver takes you to the closest restroom to the accessible playground, but there is not an accessible changing station. The standard infant changing station is too small to hold your larger frame and the only available option is the dirty, disgusting floor where people have stepped with their germ filled shoes. Also, when was the last time the public park's bathroom floor was cleaned! If you were able to communicate verbally, wouldn't you want to scream "NO!", throw a tantrum, or cry? Not to mention, everyone can "see" you being changed on said floor as there is no privacy even if you're in the accessible stall.

Doesn't everyone deserve privacy and decency while out an about trying to have a nice day at the park or public space? Please consider installing an adult changing table in all public spaces where everyone has access to it! My son, Ben, below, is why I'm asking for inclusion for ALL!

Andrea, Mike and Ben Rogowski, Lewis Center, OH

From: marilou senseman
To: BBS, BBSOfficAsst3
Subject: Adult Changing Tables
Date: Monday, March 13, 2023 4:10:44 PM

Hello,

I an writing to support the adoption of adding Adjustable Height Changing Tables into the new building codes .

For too long our children and family members with disabilities have been left behind at home and left out of activities and social events that every person should have the right to attend simply because they do not have the acsess to a restroom that accommodates their needs.

Our loved ones want to travel and shop and eat out just like any other individual.

Over the past few years even airports have passed legislation to accommodate dogs in airports for their needs. I believe its time we make restroom needs available to individuals with disabilities too.

The time has come for change!

Thank you,
Marilou Senseman

Sent from my iPhone

THE OHIO STATE UNIVERSITY

AGE-FRIENDLY COLUMBUS AND FRANKLIN COUNTY

March 17, 2023

Ohio Building Codes and Standards,

On behalf of the Age-Friendly Innovation Center (AFIC) and Age-Friendly Columbus and Franklin County, a program of The Ohio State University College of Social Work, I am writing to you to show my support for adding the new proposed sections to the building code Section 1110.18 and 1113 pertaining to adult changing stations.

The mission AFIC is to innovate with older adults through research, education, and engagement to ensure inclusion and build resiliency to make our communities age-friendly. Alongside this mission, AFIC is committed to a set of principles that guide and ground the work. These principles are 1) Diversity, Equity, Inclusion, 2) Accessibility, 3) Community Engagement and 4) Interdisciplinary Collaboration.

Updates to the current building codes to include adult changing stations will have a significant impact on the ability of older adults, caregivers, and people with disabilities to have equity and equal access to public spaces in our community. While some local municipalities in Ohio have proactively adopted these standards, consistency and direction from the state would broaden the ability for Ohioans to access their own communities.

AFIC believes creating a community that works better for older adults, creates communities that work better for people of all ages. The adoption of the new proposed sections to the building code Section 1110.18 and 1113 pertaining to adult changing stations would be a major step towards the creation of a more Age-Friendly Ohio,

Thank you,

Marisa Sheldon

Marisa Sheldon, MSW, LISW-S
Director, Age-Friendly Innovation Center
Director, Age-Friendly Columbus and Franklin County
College of Social Work, The Ohio State University

From: Simmons, Tom
To: BBS, BBSOfficAsst3
Subject: RE: Proposed Board of Building Standards Rules
Date: Friday, March 17, 2023 12:48:19 PM
Attachments: image002.png
image003.jpg

BBS,

Thank you for the opportunity to review the building ode, mechanical code, and plumbing code. At this time, we do not have any comments to make on these rules.

If you maintain a list of email addresses for notifications of rule reviews, please add rules@age.ohio.gov to that list.

Thank you!

Tom Simmons

Policy Development Manager

Legal Division

Ohio Department of Aging

30 E Broad St, 22nd Floor
Columbus, OH 43215-3414

614-202-7971

tsimmons@age.ohio.gov

www.aging.ohio.gov

Vision: *Ohio - The best place to age in the nation.*
Mission: *Foster sound public policy, research, and initiatives that benefit older Ohioans*

From: Butts, Pamella <Pamella.Butts@com.ohio.gov>

Sent: Thursday, March 2, 2023 11:58 AM
To: Pamella Butts <pamella.butts@yahoo.com>
Subject: Proposed Board of Building Standards Rules

BBS Stakeholder:

The Board of Building Standards proposes to update the Ohio Building, Plumbing and Mechanical Codes to the 2021 edition of the International Code with amendments. The proposed draft rules are available for review and comment. The draft rules along with information on how to submit comments are available here: Proposed 2024 Ohio Building, Mechanical & Plumbing Code Rules | Ohio Department of Commerce

The Board also proposes to amend the 2019 Residential Code of Ohio. The proposed amendments are available for review and comment. The draft rules along with information on how to submit comments are available here: Proposed 2019 Residential Code of Ohio Amendments | Ohio Department of Commerce

Sincerely,

Regina Hanshaw

Regina S. Hanshaw
Executive Secretary
Ohio Board of Building Standards
6606 Tussing Road
PO Box 4009
Reynoldsburg, Ohio 43068-9009
(614) 644-2613

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This message and any response to it may constitute a public record and thus may be publicly available to anyone who requests it.

From:	Mary Sunderman
To:	BBS, BBSOfficAsst3
Subject:	Need for adult changing tables in public restrooms
Date:	Wednesday, March 15, 2023 4:11:53 PM

To whom it may concern:

Adult changing tables in public restrooms are important because they provide a safe and accessible option for individuals with disabilities or mobility issues who require assistance with changing or personal care.

Many individuals with disabilities or elderly people may require assistance with toileting or changing their clothes, and without an adult changing table in a public restroom, their caregivers may need to resort to unhygienic or unsafe alternatives such as changing them on the floor or in a car.

By providing adult changing tables in public restrooms, businesses and organizations can promote inclusivity and accessibility for all individuals, regardless of their abilities. This can help ensure that everyone is able to use public restrooms with dignity and comfort and can participate fully in public life.

It is worth noting that some jurisdictions have passed legislation requiring the installation of adult changing tables in certain types of public facilities, such as airports or government buildings, to ensure accessibility for all.

Respectfully,

Mary K. Sunderman

From: Laura Sykes
To: BBS, BBSOfficAsst3
Subject: Support for Adult Changing Stations
Date: Monday, March 20, 2023 7:24:37 PM
Attachments: B464026B9DBB4F49B11C86552A35B564.png

Ohio Building Codes and Standards,

I am writing to you to show my support for adding the new proposed sections to the building code Section 1110.18 and 1113 pertaining to adult changing stations. Please consider the following:

1. Personal experience: In 2015, a car-versus-semi, head-on collision rendered me a C5 complete quadriplegic, paralyzed from the chest down with limited use of my arms and without hand and wrist function. Not only does complete paralysis affect ability, but it also results in a neurogenic bladder and bowels, often causing incontinence of one or both systems. The need to remove soiled clothing from one's body is necessary to prevent skin breakdown, whether they are disabled or nondisabled. However, without access to an adult changing station in public facilities, my caregiver has frequently changed me in my partially-reclined power chair, which has proven itself to be extremely difficult and potentially dangerous. I fear the instance when attempting to roll me leads to a fall on a hard tile floor and fractured bones.
2. Safety: Moreover, I recognize having a reclining power chair is a privilege not everyone has. Other safety concerns include transferring to unsanitary surfaces, such as the bathroom floor.
3. Dignity: Dignity is a right for nondisabled and disabled people alike. In buildings with insufficient facilities and space, people with disabilities are forced to tend to their needs wherever necessary. If not floors, some resort to using benches or tables in public view. Imagine relieving yourself with an audience.
4. Inclusivity: People with disabilities or medical conditions that require assistance with toileting are restricted from participating in their communities. Requiring buildings to meet these proposed standards promotes inclusivity, thus liberating this marginalized group by providing a privilege unrecognized by many nondisabled people – access to public restrooms.
5. Business benefits: Complete inclusivity appeals to everyone in the disability community, even those who do not utilize the accommodations others do. Therefore, disabled people are an entire demographic of customers that businesses can attract by including adult changing stations in their buildings.

Thank you,

Laura Sykes

Former Ms. Wheelchair Ohio 2020-2021
Ms. Wheelchair Ohio Organization President & State Coordinator
MsWheelchairOH.org

CAUTION: This is an external email and may not be safe. If the email looks suspicious, please do not click links or open attachments and forward the email to csc@ohio.gov or click the Phish Alert Button if available.

To whom it may concern:

Our son has spastic, quadriplegic cerebral Palsy and other medical diagnoses that will impact him for the rest of his life.

One of the hardest struggles we face as a family is the lack of accessible restrooms with adult sized changing tables.

Baby changing tables are for babies and small toddlers up to 35 pounds. Our son passed that weight limit seven years ago. Our son is eleven years old, already over 70 pounds, he is 4 feet 9 inches tall and will continue to grow into adulthood.

Universally designed changing tables are inclusive and accessible for ALL people. Not only for my son, but for hundreds of individuals across our County/School District that have chronic medical conditions, disabilities, injuries and other health issues.

Not having adult sized changing tables, limits what he can do, how he can explore the world and what we can do as a family. Our only recourse is to change our son on public restroom floors, which are everything but hygienic even when something is put on the ground between him and the floor. We could also change him in the back of our car but it is in public view. Both ways are unacceptable and undignified. Our son is cognitively typical and understands everyone can see him- this is embarrassing for him. The last option which is also terrible, is that he is left soiled until we get home. No matter the option he is in a losing situation as are we as a family. Why can't we win? My son's life is difficult enough.

As it is we are extremely limited to where we can go in our community and the list is growing by the minute for individuals like my son as they continue to age and grow. They deserve to be an active part of society, their rights are as important as able bodied individuals in this room today.

What we are discussing here is not for one person here or there, this is for an entire vulnerable population including the elderly or disabled veterans who are also often forgotten. When a segment of the population is forgotten you can assert they are being discriminated against.

Continuing to put our loved ones on dirty restroom floors is not an option. Making them sit in soiled and uncomfortable is also not a dignified option. Adult sized changing spaces tables will be life changing and create a dignified and accessible space for all. Human dignity is an absolute priority for everyone.

I hope you can find it in your heart to understand our position today. Adult changing spaces have been long overdue in our community and something needs to change.

Sincerely,
Juliana Van Winkle

From: Savannah Warne
To: BBS, BBSOfficAsst3
Subject: STATMENT FOR OHIO BUILDING CODE
Date: Tuesday, March 21, 2023 12:26:19 PM

I am writing to you to show my support for adding the new proposed sections to the building code Section 1110.18 and 1113 pertaining to adult changing stations.

1. My sister is 35 years old with Rett Syndrome, she is nonverbal and needs complete assistance when changing her briefs. My family and I have been in several situations out in public where we didn't have such a great experience with the set up of the restrooms. It's a two man job to assist her in typical bathrooms, if we get lucky we will use the handicap bathroom so we have more space but it's still not enough. Having an adult changing table would make the process of changing her much easier and could potential make it a one person job. We have been to several places where we didn't feel like we would be able to go back because of the set up of the bathrooms, such as concert venues, dentist offices, doctors offices, and even hospitals.
2. I also wonder how things will work for my family if one of my parents were to pass and the other parent has to change her independently out in public.

Thank you,
Savannah Warne

--
Holistic Wellness Solutions
Savannah Warne, BA
Case Manager
Tel. (614) 371-2303

From:	Ed Wilkinson
To:	BBS, BBSOfficAsst3
Subject:	New Proposed Building code Section 1110.18 and 1113
Date:	Friday, March 17, 2023 1:40:43 PM

Ohio Building Codes and Standards,

I am writing to you to show my support for adding the new proposed sections to the building code Section 1110.18 and 1113 pertaining to adult changing stations.

I am a small business owner in Columbus Ohio who also has a son on the Autism Spectrum. As he's grown over the years and we do things or travel as a family, I've noticed a painful lack of facilities that are supplied with acceptable equipment for people with special needs, especially changing tables that suits older kids, as well as adults.

We struggle with toileting and I was hard pressed to find any establishments with a universal changing table, where I could take care of my older son's bathroom needs. We are then forced to basically change him on the floor or other unsanitary surfaces. This not only causes a meltdown that can ruin his entire day, but it robs him of his dignity as a human being.

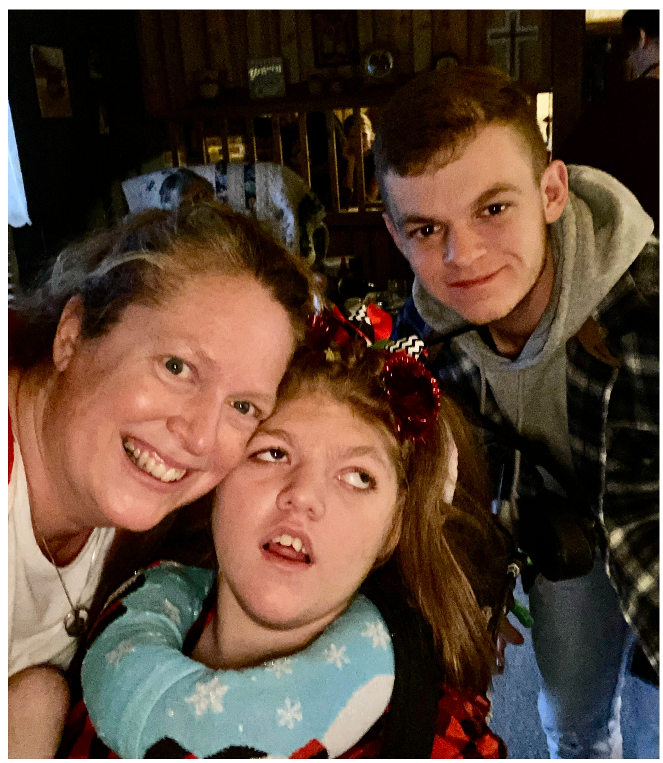
Including universal changing tables in all facilities, would solve this problem and promote inclusion, which is critical to a special-needs person's development. This would benefit businesses, as well, attracting a wider range of customers and improving overall customer satisfaction as socially conscious establishments.

Thank you,
Ed Wilkinson
Owner We Rock the Spectrum - Columbus.

I am writing in support of the proposed changes to the Ohio Building code to require adult changing stations in certain new buildings.

This is Ella and she is 14 years old. She enjoys being out in the public and likes long walks. Changing Ella's diaper/briefs in public is just not possible anymore. She is too big to put on the infant changing tables. Our entire family must completely work around Ella's schedule. After a diaper change, we are able to leave home for a couple hours, but must quickly return home to change her diaper. If public bathrooms would have an adult size changing station available, life would be much easier to go out and about. A recent trip to a blue jackets game was a huge reminder that this is needed. Ella had to sit in a wet diaper for a long time until we came all the way home. This could cause skin break down and lead to other medical problems like urinary tract infections which could easily be solved with a changing table.
Life is difficult enough for people with special needs. Let's try to ease the burden by installing handicapped changing tables in all public restrooms.

Sincerely,
Shauna Wilson
Delaware, OH



March 14, 2023

Dear State Legislators,
I am writing to bring to your attention the lack of adult changing tables in our state.

Unfortunately, despite the numerous benefits of these tables, they are not widely available in our state. This is a major concern as it means that many adults are missing out on the opportunity to engage in our communities .
I'm 39 and incontinent . I like to do things in my community and I can't do the day to day activities I enjoy, because of needed to have my diaper change .

Moreover, as our population ages, it is becoming increasingly important to provide resources that support healthy aging. Like a baby an adult's skin can get irritated from being in a soiled diaper. When out in public places where facilities aren't available I suffer . Adult challenging tables are an excellent way to do this, as they are low-cost, accessible, and can be used by people of all ages.

Therefore, I am calling on you to take action to address this issue. I believe that the state has a responsibility to provide resources that promote the health and wellbeing of its citizens, and adult challenging tables should be a part of this effort.

Thank you for taking the time to consider my request. I hope that you will take action to ensure that all adults in our state have access to the benefits of adult challenging tables.

Sincerely,

Benjamin Young
Belmont Design
980 Wilmington Ave # 6c
Dayton, Ohio 45420
937-279-4058
E-mail benwestohio@outlook.com

From:	Changing Spaces Ohio
To:	BBS, BBSOfficAsst3
Subject:	Fwd: adult changing tables
Date:	Tuesday, March 21, 2023 9:39:14 AM

Dear BBS,
Please see the letter below. Thank you.
---------- Forwarded message ----------
From: janmckinneyyoung@aol.com <janmckinneyyoung@aol.com>
Date: Mar 20, 2023 at 12:09 PM -0400
To: changingspacesoh@gmail.com <changingspacesoh@gmail.com>
Subject: adult changing tables

> Dear Board of Building Standards,
>
> I am writing to urge the Ohio Board of Building Standards to adopt Section 1113 Adult Changing Station Accessibility into the Building Code. As an advocate for disability rights, I believe that access to public spaces should be universal and accommodating for people with disabilities.
>
> One area that requires immediate attention is the lack of adult changing tables in public spaces. Currently, many public restrooms in the Dayton and surrounding areas are not equipped with the necessary equipment to assist individuals with disabilities who require assistance with toileting and personal hygiene. This has created a significant barrier for many people with disabilities, making it challenging for them to participate in daily activities, including work, education, and leisure activities.
>
> The lack of adult changing tables also poses a significant health and safety risk to people with disabilities. Without access to appropriate facilities, individuals with disabilities may be forced to remain in dirty or wet clothing, leading to infections, rashes, and other health concerns. As a parent and caregiver, there were many times when the only option was to try to maneuver my adult son out of his wheelchair onto the floor of our van to change his diaper and clothing.
>
> I strongly urge the Board of Building Standards to adopt Section 1113 Adult Changing Station Accessibility into the Building Code. This will ensure that all public spaces are equipped with the necessary equipment to accommodate individuals with disabilities, promoting universal accessibility and improving the overall quality of life for people with disabilities.
>
> Thank you for your attention to this matter.
>
> Sincerely,
>
> Janet Young

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From: Amy Zender
To: BBS, BBSOfficAsst3
Subject: Adult changing staging building code revision
Date: Tuesday, March 21, 2023 12:51:22 PM

To whom it may concern,

I am a mother to a 7 1/2 year old autistic son. Whose's height is rapidly competing with mine. Now Autism is a diagnosis that affects everyone differently, however on average they tend to toilet train almost a year later than typical children. Meaning 1:44 children, if not more, are already maxing out the weight limits of standard infant changing tables. Then you have the kids and the young adults like my son, where only time will tell if they will ever master the skill. My sons limited verbal comprehension means for me that he doesn't follow most verbal commands. His anxiety seems to always put his body into fight or flight in small unfamiliar places, so getting him to lay on the floor, while touching as little a possible, and also getting myself in the position to tend to his needs is well… impossible. However leading him to sit then lie back is much easier for him and me.
Thank you for the time put in to hear these stories, and about this need. Leaving the house shouldn't be a luxury for my family.
Thanks again,
Amy Zender

Sent from my iPhone

2024 Ohio Existing Buildings Code Comments					
Commenter	Email	Code Section	Comment	Staff Comments	Code Committee Action
Collins, Dave	dcollins@preview-group.com	506, 507	I am impressed with you've done to develop the rules package! Thank you for your response to my email yesterday. Greg, Sarah and I are still of an opinion that what Ohio has done with Chapter 34 is far better than what is included in the IEBC. 34 is clear, concise and successful for those that deal with existing buildings (we've done tons of them). Adding thresholds for significant upgrades to portions of buildings beyond the scope of the planned alterations to create three levels complicates design and enforcement doesn't achieve anything! To make them understand that it is the owner's (applicant) option will be fun. The reason for the development of "Levels" when the IEBC was created is derived from the attitude in some east coast states that wanted to retroactively apply code compliance, and used this to bolster what they were doing. Ohio Law not permitting any changes (design or compliance) retroactively once the approval is issued, and the project is constructed is unique (attitude wise). This became a major issue in 1978 when Ohio adopted the BOCA Code, and lead directly to the creation of Chapter 34. Your rule on 506.1 leaves the exception and 506.1.1 intact. The exception to 506.1 includes reference to the IBC. 506.1.1 includes language that is odd and includes a reference to I Codes. Same references are still in 506.4. Perhaps it is just clumsy language, but IEBC Section 507 indicates that "provisions of this code that require improvements (to) existing conditions." That language does not include alterations or change of occupancy	References to the I-codes within the IEBC are being addressed through the "Rules of construction" Section 101.1.1 in paragraph (A) of the Ch 34 rule (4101:1-34-01). The language in IEBC 507 for historic buildings, while not identical, seems very similar to the current OBC 3409.1. It provides needed flexibility to the code official to address distinct life safety hazards (current language) while, at the same time, exempting an historic building from most provisions of the code.	
Collins, Dave		Chpts 6-12	Thank you! I have reviewed the draft rules and am impressed by what you have done to incorporate the Chapter 34 specific criteria. However, I personally still do not see the benefit of adding the provisions for the "work area" compliance, as the prescriptive means have been exhaustively handling the scope of work. I understand that you have made it allowable by choice, I just do not have any understanding why any designer/owner would do so. I believe it would create new mandatory criteria in Chapters 6 through 12 that I believe are contrary to 3781 and 3791 authority given to the BBS that were the basis for the modifications of Chapter 5. The historic buildings provisions have some strange areas where a building official is required to make a decision regarding means of egress. Similar "alternative signs" and "alternative life-safety system" opens a can of worms. Thank you again for sharing this up-to-date information! How would you see simply deleting Chapters 6 through 12 when adopting the IEBC. Similarly, do you intend to modify Chapter 13 at all?	There is nothing in RC 3781. or 3791. that prohibits an owner from exceeding the minimum prescriptive requirements of the code. Some owners may have the resources and desire to incrementally improve the safety of their building. The Work Area Compliance Method provides that guidance. The owner always has the option to choose the Prescriptive Compliance Method. The IEBC Ch 12 for historic buildings is part of the optional Work Area Compliance Method.	

Collins, Dave			When you said that the IEBC "levels" combined with the "prescriptive" requirements for existing buildings provide the same options as the OBC, I've gone back to look at what equates to alterations in the OBC and have the following questions: • Are you considering that the "prescriptive method" using Chapter 5 of the IEBC equates to the "limitation" on code application to alterations in section 3404 of the OBC? • Does Chapter 5 cover historic buildings appropriately, or are you planning considerable modifications to Chapter 5 in order to cover everything that the OBC includes as an alteration? • Will the fire escape provisions in Chapter 8 of the IEBC (Alterations Level 2) also be referenced in Chapter 5, or not permitted per the IBC? • Existing fire escapes are only mentioned in 804.4.1.2. I am seriously concerned with maintaining the "prescriptive method" which is close to what the OBC considered alterations and IEBC alterations are only considered included in the "levels" option. Chapter 12 of the IEBC includes a great number of "code official may" and references to things like "construction requirements specified in this code." What does construction requirements "in this code" mean? In Section 101.2.1 it references the IFC Chapter 11. Will Ohio reference the fire code? Section 1203.12 states: Every historic building that cannot be made to conform to the construction requirements specified in the International Building Code for the occupancy or use that constitutes a distinct fire hazard ....." The entire sentence doesn't make sense as an existing building. Just because it is historic the existing building MUST meet the construction requirements of the IBC for that occupancy? Where is the distinct hazard to be found in the building that triggers compliance here. Section 102.6 states that "provisions of this code relating to the construction, alteration, repair, enlargement, restoration, relocation or moving of buildings or structures shall not be mandatory for existing buildings or structures identified and classified by the state or local jurisdiction as historic buildings where such buildings or structures do not constitute a distinct hazard"	The language in paragraph (2) of this rule proposes to modify the IEBC Section 503, Alterations, to be similar to the language in the current OBC Section 3404.1. The IEBC Section 507 addresses historic buildings in a similar way as found in the current OBC Section 3409. The IEBC Chapter 8, Section 804.4.1.2 provisions for fire escapes are applicable when the Work Area Compliance Method is chosen and recognizes existing and newly constructed fire escapes. The IEBC Section 504 addresses the prescriptive compliance method fire escape requirements and are very similar to current OBC Section 3406 requirements for fire escapes. Again, Chapter 12 of the IEBC is part of the optional Work Area Compliance Method to incrementally improve the safety of the existing building. The proposed BBS rule	
Collins, Dave		303.1.3	303.1.3 establishes that the method “as selected by the applicant” is the path that it must conform to. Selecting Level 1, 2 or 3 would have significant impact on an owners obligation under the code and creates conflicts of intent easily.	The 2021 IEBC Section 303.1.3 does not exist. Yes, much like the energy conservation code, the 2021 IEBC Section 301.3 requires the owner/owner's representative to select a compliance method	
Collins, Dave		303.3	303.3 It is not clear what is supposed to happen with Storm Shelters in Group E under Section 303.3 IEBC (which only addresses Group E additions), and while the Group E portions are deleted nothing is clarified about what is required for Group E with only alterations or change of occupancy.	The 2021 IEBC Section 303.3 does not exist. Section 303.2 is proposed to be deleted because Ohio law prohibits the BBS from requiring storm shelters in Group E occupancies, regardless of the type of work proposed.	

Collins, Dave		306.2	Section 306.2 of the amendments should read, "the applicable <u>portions of</u> the ICC A117.1" I see why you took out using the ICC A117.1 for alterations and existing buildings, but I believe the intent was that only portions applying to the rules for alterations, additions, etc. were to be enforced.	The proposed rules are allowing for different editions of the standard to be used, depending upon the scope of work. The suggested clarification makes sense.	
Collins, Dave		Chpt 5	Chapter 5 You indicated that this chapter is essentially what is in Ch. 34, it goes far beyond that in the following sections. Replacement section 503.1 references "the code for new construction." Should it not be the OBC? There are multiple references to building code in 503.1 exceptions. 503.10 has a threshold for the "work area" exceeds 50% of the building area. There is no such provision in Chapter 34! 503.11 has provisions establishing requirements when the "work area" exceeds 50% of the building. There are no such provisions in Chapter 34! 503.11 deals with reroofing more than 50% of the diaphragm. Section 1511 of the OBC addresses reroofing, but has no such threshold! No reroofing requirements are in Chapter 34, its scope would refer back to Section 1511 of the OBC.	We could replace that phrase with the name of every code (OBC, OMC, OPC, IECC, etc.) that is applicable to new construction, but the point is that compliance with those codes is only required to the extent of the alteration. Making reference only the OBC leaves out the building systems (mechanical, plumbing, fuel gas, etc). Yes, the 2018 and 2021 IEBC has added some additional mandatory structural requirements in Ch 5 (503.5-503.11) that exceed current OBC prescriptive requirements for alterations. There are also some new Ch 5 mandatory requirements that may be triggered related to accessibility (enhanced classroom acoustics, two-way communication systems, areas of refuge, etc.) if alterations exceed certain thresholds.	

Collins, Dave		Chpt 8	Chapter 8 The requirements of Sections 802.5.1 and 802.5.2 shall apply in all work areas. They require every portion of a floor, that is more than 30 inches (762 mm) above the floor or grade below and is not provided with guards, shall be provided with guards. Then it says the guards shall be designed and installed in accordance with the International Building Code. In the IBC guards are not required in 8 specific locations: 1. On the loading side of loading docks or piers. 2. On the audience side of stages and raised platforms, including stairs leading up to the stage and raised platforms. 3. On raised stage and platform floor areas, such as runways, ramps and side stages used for entertainment or presentations. 4. At vertical openings in the performance area of stages and platforms. 5. At elevated walking surfaces appurtenant to stages and platforms for access to and utilization of special lighting or equipment.	Again, Ch 8 is part of the optional Work Area Compliance Method. It provides guidance to owners wishing to incrementally improve the safety of their building.	
Collins, Dave		Chpts 6-12	Chapters 6-12 should be totally eliminated. Building officials and designers will have a hard time understanding that using the work area method for compliance forces that include retroactive requirements not otherwise required in the prescriptive method. The most dangerous portions are Chapters 7 and 8. The 50% threshold of the “floor area” or “area of the building”, totally ignores the tenant interest where there may be more than one or multiple tenants affected by the work in one tenant area. (802.2.2.3 – floor openings (at a minimum, be enclosed with smoketight construction on the highest work area floor and all floors below.), 802.3.1.1 – high rise, Retroactively applying provisions to areas of the building not involved in the work, in areas where other tenants are affected, etc. violates Ohio Law. We’ve been involved in projects even now where a sprinkler	Chapters 6-12 are part of the optional Work Area Compliance Method.	
Collins, Dave		Chpt 10	Chapter 10 Prescriptive compliance has no provisions for Part Change of Occupancy, so it appears to apply to the entire building no matter what method of separation when going to a higher hazard level. Height and area for change of occupancy is more restrictive than for new construction, and only allows fire walls and a fire wall alternative with sprinklers. The limits on exterior wall and vertical opening ratings for a change of occupancy to a higher hazard also appear to be for the entire building. These requirements will make a part change of occupancy so difficult to interpret and apply that uniform application is not possible and strict reading will kill most all attempts at a change of occupancy to a higher hazard level. Section 1011 has scattered provisions which allow some requirements to be separated and not comply and not others. Sprinkler coverage can be separated, but fire alarms don’t need any rated separation. Means of egress is not clear on what extent the MOE has to comply – but appears to take into consideration the entire building and not just the change of occupancy areas and their paths of egress.	Chapter 10 is part of the optional Work Area Compliance Method. The 2021 IEBC modified Section 1011.2 clarified how far to extend the sprinkler system when only a part of the building is undergoing a change of occupancy. It's already clear what is intended for fire alarm systems in buildings undergoing a part change of occupancy. The 2021 IEBC Section 1011.6 does a good job of helping owners/owners representatives understand which occupancies are more hazardous than others. An analysis of this type is already a requirement in the OBC 3408.	

Collins, Dave		Chpt 13	Chapter 13 – Performance Compliance The amendments don't include the current OBC exception to Section 3412.2 OBC, which limits the comparative analysis to buildings built before July 1, 1979. The IEBC has no limiting dates, so it could be used for a building built last year which was not its intended purpose. Ohio established the limiting date, will it not be used here?	Staff proposes to eliminate the date and allow all existing buildings to qualify for the performance compliance method, just as the IEBC does.	
Oeflein, William	woeflein@gmail.com	General	I'm very much in favor of the new IEBC. We are renovating an old building and the new language in the IEBC clearly has been written to clear up the confusing challenge of deciding what needs to be brought up to code and why. I'm not sure why you would want to retain anything about Chapter 34. That scoring system as an option for a		
Rice, Sarah	srice@preview-group.com	604.1	Associated with this whole "building area" I want to circle back to IEBC 604.1 – and what they mean by the term "building area. Does "building area" mean "per story" in this context OR does it means "aggregate building area??" Without some kind of elaboration to just what "building area" is here in the IEBC you will have people going back to the "per story" dimension in the IBC. THIS IS AN IMPORTANT DISTINCITON - The commentary on the IEBC reads "aggregate building area" (see below) So logically shouldn't the code read to say "aggregate	The proposed Chapter 34 rule paragraph (FF) adds the word "aggregate" to clarify the intent, as suggested.	

From:	David Collins
To:	Ohler, Deborah
Cc:	Hanshaw, Regina; Sarah Rice; Greg Nicholls
Subject:	Re: Chapter 10, Section 1002.2
Date:	Tuesday, February 14, 2023 3:50:15 PM
Attachments:	image001.jpg

Debbie,

I am impressed with you've done to develop the rules package! Thank you for your response to my email yesterday.

Greg, Sarah and I are still of an opinion that what Ohio has done with Chapter 34 is far better than what is included in the IEBC. 34 is clear, concise and successful for those that deal with existing buildings (we've done tons of them). Adding thresholds for significant upgrades to portions of buildings beyond the scope of the planned alterations to create three levels complicates design and enforcement doesn't achieve anything! To make them understand that it is the owner's (applicant) option will be fun.

The reason for the development of "Levels" when the IEBC was created is derived from the attitude in some east coast states that wanted to retroactively apply code compliance, and used this to bolster what they were doing. Ohio Law not permitting any changes (design or compliance) retroactively once the approval is issued, and the project is constructed is unique (attitude wise). This became a major issue in 1978 when Ohio adopted the BOCA Code, and lead directly to the creation of Chapter 34.

Your rule on 506.1 leaves the exception and 506.1.1 intact. The exception to 506.1 includes reference to the IBC. 506.1.1 includes language that is odd and includes a reference to I Codes.

Same references are still in 506.4.

Perhaps it is just clumsy language, but IEBC Section 507 indicates that "provisions of this code that require improvements (to) existing conditions." That language does not include alterations or change of occupancy to existing buildings that are historic. OBC Section 3409 clearly does include all categories of work. But there is no rule on 507?

Greg, Sarah and I are working further on this, but may not be done before the meeting on Thursday! I plan to be there.

Dave

From: debbie.ohler@com.ohio.gov <debbie.ohler@com.ohio.gov>

Sent: Tuesday, February 14, 2023 2:44 PM
To: David Collins <dcollins@preview-group.com>
Cc: Regina.Hanshaw@com.ohio.gov <Regina.Hanshaw@com.ohio.gov>
Subject: RE: Chapter 10, Section 1002.2

Hi Dave.
Yes, we are still working on quality control and coordination of the draft rules.
We have created a new "rules of construction" section in OBC Section 101.1.1 that is intended to take care of these general reference substitutions.
We may need to add this to the OBC Chapter 34 rule where we replace the IEBC Chapter 1. We might add the "rules of construction" language as OEBC Section 101.4.1 if we don't modify OBC Ch 1 to take care of the IEBC substitutions.

I see that the OBC Chapter 1 rule, Section 101.1.1 section number needs fixed, too, to actually say 101.1.1 (not 101.1).
Thank you for the reminder and we welcome your input when you find any other coordination issues such as this.
Debbie

Deborah D. Ohler, P.E., Construction Codes Administrator
Ohio Board of Building Standards
PO Box 4009, 6606 Tussing Rd.
Reynoldsburg, OH 43068-9009
Office phone: 614-644-2613 Fax: 614-222-2147
dohler@com.state.oh.us
https://com.ohio.gov/divisions-and-programs/industrial-compliance/boards/board-of-building-standards
Better Codes, Better Buildings, Safer Ohio

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From: David Collins <dcollins@preview-group.com>
Sent: Tuesday, February 14, 2023 1:33 PM
To: Ohler, Deborah <debbie.ohler@com.ohio.gov>
Subject: Chapter 10, Section 1002.2

The reference is to the IBC, not the building code. I saw no rule change for that? Still working on it?

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From: David Collins
To: Ohler, Deborah; Sarah Rice
Cc: Hanshaw, Regina
Subject: Re: IEBC v Chapter 34
Date: Thursday, February 2, 2023 11:58:01 AM
Attachments: image001.jpg

Debbie,

Thank you! I have reviewed the draft rules and am impressed by what you have done to incorporate the Chapter 34 specific criteria. However, I personally still do not see the benefit of adding the provisions for the "work area" compliance, as the prescriptive means have been exhaustively handling the scope of work.

I understand that you have made it allowable by choice, I just do not have any understanding why any designer/owner would do so. I believe it would create new mandatory criteria in Chapters 6 through 12 that I believe are contrary to 3781 and 3791 authority given to the BBS that were the basis for the modifications of Chapter 5.

The historic buildings provisions have some strange areas where a building official is required to make a decision regarding means of egress. Similar "alternative signs" and "alternative life-safety system" opens a can of worms.

Thank you again for sharing this up-to-date information! How would you see simply deleting Chapters 6 through 12 when adopting the IEBC. Similarly, do you intend to modify Chapter 13 at all?

Dave

From: debbie.ohler@com.ohio.gov <debbie.ohler@com.ohio.gov>
Sent: Thursday, February 2, 2023 8:02 AM
To: David Collins <dcollins@preview-group.com>; Sarah Rice <srice@preview-group.com>
Cc: Regina.Hanshaw@com.ohio.gov <Regina.Hanshaw@com.ohio.gov>
Subject: RE: IEBC v Chapter 34

Good morning!
I have attached the remaining cross reference guide that I was struggling to create yesterday. Adobe finally cooperated this morning!

We recognize that the IEBC is not a perfect document. None of the I-Codes are perfect.
Looking at the big picture, however, we believe that the IEBC is a good document that has value, provides options for owners/designers, is familiar to many designers who practice outside of Ohio, and is consistent with the direction that the Ohio legislature and the Governor’s office have given us for the adoption of administrative rules.

Please review and provide comments/concerns with that in mind.

Sincerely,
Debbie

Deborah D. Ohler, P.E., Construction Codes Administrator
Ohio Board of Building Standards
PO Box 4009, 6606 Tussing Rd.
Reynoldsburg, OH 43068-9009
Office phone: 614-644-2613 Fax: 614-222-2147
dohler@com.state.oh.us
https://com.ohio.gov/divisions-and-programs/industrial-compliance/boards/board-of-building-standards
Better Codes, Better Buildings, Safer Ohio

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From: David Collins <dcollins@preview-group.com>
Sent: Wednesday, February 1, 2023 4:32 PM
To: Ohler, Deborah <debbie.ohler@com.ohio.gov>; Sarah Rice <srice@preview-group.com>
Cc: Hanshaw, Regina <Regina.Hanshaw@com.ohio.gov>
Subject: Re: IEBC v Chapter 34

Thank you Debbie!

Dave

From: debbie.ohler@com.ohio.gov <debbie.ohler@com.ohio.gov>
Sent: Wednesday, February 1, 2023 4:29 PM
To: David Collins <dcollins@preview-group.com>; Sarah Rice <srice@preview-group.com>
Cc: Regina.Hanshaw@com.ohio.gov <Regina.Hanshaw@com.ohio.gov>
Subject: RE: IEBC v Chapter 34

Hi Dave and Sarah.
I have attached the first draft of the proposed OBC Ch 34 rule (which references and amends the 2021 IEBC), the updated cross reference guides, and the flowchart for your reference.
This should give you a good idea of our intent and should answer most of your questions.
Hopefully, many of your concerns will go away once you see what we are proposing.
Please

Regards,
Debbie

Deborah D. Ohler, P.E., Construction Codes Administrator
Ohio Board of Building Standards
PO Box 4009, 6606 Tussing Rd.
Reynoldsburg, OH 43068-9009
Office phone: 614-644-2613 Fax: 614-222-2147
dohler@com.state.oh.us
https://com.ohio.gov/divisions-and-programs/industrial-compliance/boards/board-of-building-standards
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From: Ohler, Deborah
Sent: Monday, January 23, 2023 10:32 AM
To: David Collins <dcollins@preview-group.com>; srice@preview-group.com
Cc: Hanshaw, Regina <Regina.Hanshaw@com.ohio.gov>
Subject: RE: IEBC v Chapter 34

Thank you for your comments last week and this morning, Dave and Sarah.

I can't answer all of your questions right now. I'll have a better idea of what the draft rule will look like at the end of this week.
However, rest assured that the intent of BBS staff is to keep the substantive content of the current OBC Chapter 34 and bring it into the new OBC Chapter 34 draft rule. The content will obviously be in a different format and location if published as part of the IEBC. That's why I have started the creation of the cross reference guide. We have also had thoughts of asking ICC to publish a unique Ohio Existing Buildings Code for us, if we decide to move in that direction.
As I mentioned to you, Dave, we have no intention of keeping the generic reference to the OFC Chapter 11, for all paths, because of the retroactive nature of the OFC Chapter 11.

Thank you for bringing our attention to the IBC "building area" issue that you have discovered in Chapter 5. We will discuss whether any Ohio changes are warranted.
I'll be in touch and answer your specific questions early next week.

Deborah D. Ohler, P.E., Construction Codes Administrator
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PO Box 4009, 6606 Tussing Rd.
Reynoldsburg, OH 43068-9009
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Better Codes, Better Buildings, Safer Ohio

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From: David Collins <dcollins@preview-group.com>
Sent: Monday, January 23, 2023 9:55 AM
To: Ohler, Deborah <debbie.ohler@com.ohio.gov>
Cc: Greg Nicholls <gnicholls@preview-group.com>; Sarah Rice <srice@preview-group.com>
Subject: IEBC v Chapter 34

Debbie,

When you said that the IEBC "levels" combined with the "prescriptive" requirements for existing buildings provide the same options as the OBC, I've gone back to look at what equates to alterations in the OBC and have the following questions:

- Are you considering that the "prescriptive method" using Chapter 5 of the IEBC equates to the "limitation" on code application to alterations in section 3404 of the OBC?
- Does Chapter 5 cover historic buildings appropriately, or are you planning considerable modifications to Chapter 5 in order to cover everything that the OBC includes as an alteration?
- Will the fire escape provisions in Chapter 8 of the IEBC (Alterations Level 2) also be referenced in Chapter 5, or not permitted per the IBC?
- Existing fire escapes are only mentioned in 804.4.1.2.

I am seriously concerned with maintaining the "prescriptive method" which is close to what the OBC considered alterations and IEBC alterations are only considered included in the "levels" option.

Chapter 12 of the IEBC includes a great number of "code official may" and references to things like "construction requirements specified in this code." What does construction requirements "in this code" mean? In Section 101.2.1 it references the IFC Chapter 11. Will Ohio reference the fire code?

Section 1203.12 states:

> Every historic building that cannot be made to conform to the construction requirements specified in the International Building Code for the occupancy or use that constitutes a distinct fire hazard ....."

The entire sentence doesn't make sense as an existing building. Just because it is historic the existing building MUST meet the construction requirements of the IBC for that occupancy? Where is the distinct hazard to be found in the building that triggers compliance here.

Section 102.6 states that "provisions of this code relating to the construction, alteration, repair, enlargement, restoration, relocation or moving of buildings or structures shall not be mandatory for existing buildings or structures identified and classified by the state or local jurisdiction as historic buildings where such buildings or structures do not constitute a distinct hazard" ....

A distinct hazard is not defined in the I-codes, dangerous is! Distinct hazard isn't found anywhere in the OBC.

Debbie, I think this is going to a very difficult task to resolve the major differences with current code provisions! Help me understand how this will be transformed to do the same thing that Chapter 34 of the OBC does.

Dave

David S. Collins, FAIA, NCARB

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Web: www.preview-group.com

click links or open attachments and forward the email to csc@ohio.gov or click the Phish Alert Button if available.

****

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****

From: David Collins
To: Ohler, Deborah
Cc: Greg Nicholls; Sarah Rice
Subject: IEBC v Chapter 34
Date: Monday, January 23, 2023 9:56:00 AM

Debbie,

When you said that the IEBC "levels" combined with the "prescriptive" requirements for existing buildings provide the same options as the OBC, I've gone back to look at what equates to alterations in the OBC and have the following questions:

- Are you considering that the "prescriptive method" using Chapter 5 of the IEBC equates to the "limitation" on code application to alterations in section 3404 of the OBC?
- Does Chapter 5 cover historic buildings appropriately, or are you planning considerable modifications to Chapter 5 in order to cover everything that the OBC includes as an alteration?
- Will the fire escape provisions in Chapter 8 of the IEBC (Alterations Level 2) also be referenced in Chapter 5, or not permitted per the IBC?
- Existing fire escapes are only mentioned in 804.4.1.2.

I am seriously concerned with maintaining the "prescriptive method" which is close to what the OBC considered alterations and IEBC alterations are only considered included in the "levels" option.

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A distinct hazard is not defined in the I-codes, dangerous is! Distinct hazard isn't found anywhere in the OBC.

Debbie, I think this is going to a very difficult task to resolve the major differences with current code provisions! Help me understand how this will be transformed to do the same thing that Chapter 34 of the OBC does.

Dave

David S. Collins, FAIA, NCARB

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Web: www.preview-group.com

From: David Collins
To: Ohler, Deborah
Subject: Updated Notes:
Date: Thursday, February 16, 2023 6:12:16 PM
Attachments: NOTES 2 16 23.docx

Debbie,

Here are our comments to date.

Dave

David S. Collins, FAIA, NCARB

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Fundamental – “this code” v “the Building Code”, would it not make sense to use OEBC and OBC so that it is clear which it is talking about?

303.1.3 establishes that the method “as selected by the applicant” is the path that it must conform to. Selecting Level 1, 2 or 3 would have significant impact on an owners obligation under the code and creates conflicts of intent easily.

303.3 It is not clear what is supposed to happen with Storm Shelters in Group E under Section 303.3 IEBC (which only addresses Group E additions), and while the Group E portions are deleted nothing is clarified about what is required for Group E with only alterations or change of occupancy.

Section 306.2 of the amendments should read, “the applicable portions of the ICC A117.1” I see why you took out using the ICC A117.1 for alterations and existing buildings, but I believe the intent was that only portions applying to the rules for alterations, additions, etc. were to be enforced.

Chapter 5 You indicated that this chapter is essentially what is in Ch. 34, it goes far beyond that in the following sections.

Replacement section 503.1 references “the code for new construction.” Should it not be the OBC? There are multiple references to building code in 503.1 exceptions.

503.10 has a threshold for the “work area” exceeds 50% of the building area. There is no such provision in Chapter 34!

503.11 has provisions establishing requirements when the “work area” exceeds 50% of the building. There are no such provisions in Chapter 34!

503.11 deals with reroofing more than 50% of the diaphragm. Section 1511 of the OBC addresses reroofing, but has no such threshold! No reroofing requirements are in Chapter 34, its scope would refer back to Section 1511 of the OBC.

Chapter 8 The requirements of Sections 802.5.1 and 802.5.2 shall apply in all work areas. They require every portion of a floor, that is more than 30 inches (762 mm) above the floor or grade below and is not provided with guards, shall be provided with guards. Then it says the guards shall be designed and installed in accordance with the International Building Code.

In the IBC guards are not required in 8 specific locations:

1. On the loading side of loading docks or piers.
2. On the audience side of stages and raised platforms, including stairs leading up to the stage and raised platforms.
3. On raised stage and platform floor areas, such as runways, ramps and side stages used for entertainment or presentations.
4. At vertical openings in the performance area of stages and platforms.

5. At elevated walking surfaces appurtenant to stages and platforms for access to and utilization of special lighting or equipment.
6. Along vehicle service pits not accessible to the public.
7. In assembly seating areas at cross aisles in accordance with Section 1030.17.2.
8. On the loading side of station platforms on fixed guideway transit or passenger rail systems.

Chapters 6-12 should be totally eliminated. Building officials and designers will have a hard time understanding that using the work area method for compliance forces that include retroactive requirements not otherwise required in the prescriptive method. The most dangerous portions are Chapters 7 and 8. The 50% threshold of the "floor area" or "area of the building", totally ignores the tenant interest where there may be more than one or multiple tenants affected by the work in one tenant area. (802.2.2.3 – floor openings (at a minimum, be enclosed with smoketight construction on the highest work area floor and all floors below.), 802.3.1.1 – high rise,

Retroactively applying provisions to areas of the building not involved in the work, in areas where other tenants are affected, etc. violates Ohio Law. We've been involved in projects even now where a sprinkler system was required by code officials throughout a high-rise building simply because of one tenant improvement.

Chapter 10 Prescriptive compliance has no provisions for Part Change of Occupancy, so it appears to apply to the entire building no matter what method of separation when going to a higher hazard level.

Height and area for change of occupancy is more restrictive than for new construction, and only allows fire walls and a fire wall alternative with sprinklers. The limits on exterior wall and vertical opening ratings for a change of occupancy to a higher hazard also appear to be for the entire building. These requirements will make a part change of occupancy so difficult to interpret and apply that uniform application is not possible and strict reading will kill most all attempts at a change of occupancy to a higher hazard level.

Section 1011 has scattered provisions which allow some requirements to be separated and not comply and not others. Sprinkler coverage can be separated, but fire alarms don't need any rated separation. Means of egress is not clear on what extent the MOE has to comply – but appears to take into consideration the entire building and not just the change of occupancy areas and their paths of egress.

Chapter 13 – Performance Compliance The amendments don't include the current OBC exception to Section 3412.2 OBC, which limits the comparative analysis to buildings built before July 1, 1979. The IEBC has no limiting dates, so it could be used for a building built last year which was not its intended purpose. Ohio established the limiting date, will it not be used here?

From: William Oeflein
To: Hanshaw, Regina
Subject: Re: FW: New submission for Contact Us.
Date: Thursday, February 16, 2023 8:50:55 AM

I'm very much in favor of the new IEBC. We are renovating an old building and the new language in the IEBC clearly has been written to clear up the confusing challenge of deciding what needs to be brought up to code and why.

I'm not sure why you would want to retain anything about Chapter 34. That scoring system as an option for a alteration is a nightmare to work with.

Thanks for asking.

William Oeflein, RA, LEED AP
216.905.7150
woeflein@gmail.com

On Thu, Feb 16, 2023 at 8:35 AM Regina.Hanshaw@com.ohio.gov <Regina.Hanshaw@com.ohio.gov> wrote:

> William,
>
> While the Board is considering adopting the 2021 IEBC, the final decision has not been made. If the Board does adopt the IEBC, it will be modified to be consistent with Ohio requirements including retention of current options in OBC Chapter 34 and effective on or about January 2024. Are you in support of Ohio's adoption of the IEBC? If so, why or why not? I would like to pass along your comments as the Board is considering its adoption.
>
> Thanks,
>
> Regina Hanshaw
>
> OBBS
>
> ---
>
> **From:** noreply@das.ohio.gov <noreply@das.ohio.gov>
> **Sent:** Wednesday, February 15, 2023 7:57 AM
> **To:** WebInquiries <inquiries@com.ohio.gov>
> **Subject:** New submission for Contact Us.
>
> ## There is a new submission for Contact Us.
>
> | | |
> |---|---|
> | **Who are you contacting?** | General Inquiries |
> | | |

Section	
What is the purpose of your message?	Administrative Leadership
Mail Submission	inquiries@com.state.oh.us
Disclaimer	
First Name	William
Last Name	Oeflein
Email	woeflein@gmail.com
Phone Number	
Company / Financial Institution Name	
Message	When do you think Ohio will adopt the 2021 IEBC? (International Existing Building Code)
Attachment	

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From: Sarah Rice
To: Ohler, Deborah; David Collins
Subject: More for IEBC
Date: Thursday, January 19, 2023 2:41:35 PM
Attachments: image001.png
image002.png
image003.png
image004.png
image005.png
image006.png
image007.png
image008.png

Associated with this whole “building area” I want to circle back to IEBC 604.1 – and what they mean by the term “building area. Does “building area” mean “per story” in this context OR does it means “aggregate building area??”

Without some kind of elaboration to just what “building area” is here in the IEBC you will have people going back to the “per story” dimension in the IBC.

THIS IS AN IMPORTANT DISTINCITON - The commentary on the IEBC reads ”aggregate building area” (see below) So logically shouldn’t the code read to say “aggregate building area” or maybe it should be “actual aggregate building area”????

Have fun!!

Sarah

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From: Amber Armstrong <alacadd@gmail.com>
Sent: Friday, January 6, 2023 1:26 PM
To: Sarah Rice <srice@preview-group.com>
Cc: Eirene Knott <Eirene.Knott@brrarch.com>
Subject: Re: This is what happens when you READ the code - something for BCAC

I have always thought it strange that we instinctively think of the whole building when thinking of "building area" but when calculating allowable area, we have to limit it to each story. THEN, we only count floor area for up to three stories.... so, if you go above three floors, the allowable area is "per story" but divided among more than three stories. So is it really "per story"??

Back to my original question, the level of alteration is based on the amount of the building that is being affected. Above 50 % of floor area does not account for volume. If I take a restaurant that has three dining areas and remodel it into one large dining room, I have taken three "cubes" and turned it into one "cube". But if I go into that same restaurant with three dining areas and take out the fixed booth seating and rearrange so that I have fewer seats, is that the same level of alteration? Technically, yes because I have affected the same floor area, but realistically, I have affected far less of the building in the second scenario.

In my auditorium example, is it the same level of alteration to change out seats over 15,000 square feet or take that same 15,000 square feet and divide it into two smaller performance spaces? In both situations the work area is over 50% of the building area.

Amber

On Fri, Jan 6, 2023 at 12:03 PM Sarah Rice <srice@preview-group.com> wrote:

> In responding to Amber's question about the IEBC, you know I looked at the definition of "building area" in the IBC.
>
> I was looking for where in the IBC it says that "building area" is a "per story" dimension – something we all know is right. Logically I started with the definition, But it was no help.
>
> **[BG] AREA, BUILDING.** The area included within surrounding *exterior walls,* or *exterior walls* and *fire walls,* exclusive of vent *shafts* and *courts*. Areas of the building not provided with surrounding walls shall be included in the building area if such areas are included within the horizontal projection of the roof or floor above.
>
> So then I searched the IBC for the term "building area"
>
> OH boy have I found another OOPS that is tied to what the BCAC did when the revised the 2012 IBC – not me, I worked on the 2021 & 2024.
>
> EIRENE – you are going to have your work cut out for you!!!!
>
> So the big change the BCAC did was to reconfigure & rewrite the sections in Chapter 5 to separate height and area.
>
> So here is the OOPS:
> In the 2012 IBC this topic was covered by a single table – Table 503.
>
> With the following footnotes:
>
> NOTE the that the term "building area" is both in the title and in the footnotes.
>
> Now let's go to the 2015 IBC (and all subsequent editions) where the topic of height and area is now covered by 3 tables:

The ONLY one I want to talk about is Table 506.2. NO WHERE – NO WHERE – NO WHERE in that table or the section associated with the table EVER says that "building area" is per story!!!

The first place the term shows up in Chapter 5 is in Section 508 – mixed use, and specifically in 508.4.2.

Am I the only one who thinks this is a BIG BIG BIG deal!!!!?????

Sarah

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2024 Ohio Mechanical Code Comments					
Commenter	Email	Section	Comment	Staff Comments	Code Committee Action
Glass, Robert	Robert.Glass@daikincomfort.com	Chpt 15	At the very least I would like to get ASHRAE 15-2022, ASHRAE 34-2022 and UL/CSA 60335-2-40-2022 updated to reflect the current standards and as has already been approved by ICC for the 2024 IMC.	Requested changes are included in the draft rules.	
Holland, Jerry	jerry.holland@bureauveritas.com	1001.2	I would like clarification on the proposed changes with regard to Ohio Mechanical Code 4101:2-10-01(C) and (D). 1.Will the Jurisdiction be required to enforce the adopted NBIC/NFPA/ASME CSD-1 standards in full, without exception per 4101:4-3-01? Specifically, NBIC, NFPA and ASME CSD-1 requirements regarding lockable electrical disconnects and emergency shutdown switches.	Staff contacted Mr. Holland and explained that the boiler rules will be going through the revision process later this year and that BBS has no control over boiler enforcement decisions, but that we would contact John Sharier the boiler chief to learn more. Mr. Holland stated that he would send an email which outlines the relevant code sections in the NBIC/NFPA/ASME CSD-1.	
Sandman, Joseph	josephs@fioptics.com	General	I support the State Of Ohio 2024 Mechanical Code adopting the 2021 International Mechanical Code 607.4 (607.4.1, 607.4.1.1, 607.4.1.2) as show without any changes.		
Tossey, Steve	steve.tossey@kzf.com	Conditioned space, 602.2.1.1, 908.3	Typos in conditioned space and 602.2.1.1 and question regarding ASHRAE Guideline 12 in 908.3 -whether it it required	Will fix typos. The "Note" is intended to be informational, not enforceable.	

From:	Glass, Robert S.
To:	Ohler, Deborah
Cc:	Hanshaw, Regina
Subject:	RE: [EXTERNAL] RE: Status and Timing of Final Processes to Adopt Approved Code Changes
Date:	Wednesday, February 15, 2023 9:36:12 AM
Attachments:	image001.jpg image002.png image003.png image004.png image005.png

Debbie,

Just following up on my last e-mail to you. What can I submit for consideration as OH is reviewing the 2021 I-Codes for adoption?

At the very least I would like to get ASHRAE 15-2022, ASHRAE 34-2022 and UL/CSA 60335-2-40-2022 updated to reflect the current standards and as has already been approved by ICC for the 2024 IMC.

Please let me know so I can submit the necessary information ASAP to ensure consideration.

Thanks,

Robert

From: Glass, Robert S.
Sent: Friday, January 27, 2023 10:35 AM
To: debbie.ohler@com.ohio.gov
Cc: Regina.Hanshaw@com.ohio.gov
Subject: RE: [EXTERNAL] RE: Status and Timing of Final Processes to Adopt Approved Code Changes

Debbie,

No there would be no conflicts. This actually makes things less restrictive by adding these updated codes – allow for new A2L equipment to be sold into the state. This is not requiring equipment to be listed to these newest standards, it simply allows equipment to be certified to these newest standard (U:/CSA 60335-2-40-2022) and the installation requirements in ASHRAE 15-2022 have been updated addressing A2L refrigerants.

Focusing on the Mechanical Code, the code also needs to be updated for A2L refrigerants being used in refrigeration equipment. That was not addressed in my earlier petitions. All things considered, my company does not make refrigeration equipment, but I am trying to do this on behalf of AHRI and the industry.

If you would like as proposal to address adding A2L refrigeration proposal, please let me know and I will get you something.

Thanks,

Robert

From: debbie.ohler@com.ohio.gov <debbie.ohler@com.ohio.gov>
Sent: Friday, January 27, 2023 10:01 AM
To: Glass, Robert S. <Robert.Glass@daikincomfort.com>
Cc: Regina.Hanshaw@com.ohio.gov
Subject: RE: [EXTERNAL] RE: Status and Timing of Final Processes to Adopt Approved Code Changes

Good morning, Robert.
We are currently focusing on updates to Ohio's mechanical and fuel gas codes to reflect the content that is located in the 2021 IMC and the 2021 IFGC.

If we update to the UL/CSA 60335-2-40-2022, the ASHRAE 15-2022, and the ASHRAE 34-2022 standards, are you aware of any conflicts that might be created between the 2021 IMC/2021 IFGC code text and the newer standards?

Debbie

Deborah D. Ohler, P.E., Construction Codes Administrator
Ohio Board of Building Standards
PO Box 4009, 6606 Tussing Rd.
Reynoldsburg, OH 43068-9009
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From: Glass, Robert S. <Robert.Glass@daikincomfort.com>
Sent: Friday, January 27, 2023 10:34 AM
To: Hanshaw, Regina <Regina.Hanshaw@com.ohio.gov>
Cc: Ohler, Deborah <debbie.ohler@com.ohio.gov>
Subject: RE: [EXTERNAL] RE: Status and Timing of Final Processes to Adopt Approved Code Changes

Great! I look forward to your thoughts.

Appreciate your assistance.

Robert

From: Regina.Hanshaw@com.ohio.gov <Regina.Hanshaw@com.ohio.gov>
Sent: Friday, January 27, 2023 9:31 AM
To: Glass, Robert S. <Robert.Glass@daikincomfort.com>
Cc: debbie.ohler@com.ohio.gov
Subject: RE: [EXTERNAL] RE: Status and Timing of Final Processes to Adopt Approved Code Changes

Robert,

Debbie and I will review your suggested approach and get back with you with direction.

Thanks,

Regina

From: Glass, Robert S. <Robert.Glass@daikincomfort.com>
Sent: Friday, January 27, 2023 10:24 AM
To: Hanshaw, Regina <Regina.Hanshaw@com.ohio.gov>
Cc: Ohler, Deborah <debbie.ohler@com.ohio.gov>
Subject: RE: [EXTERNAL] RE: Status and Timing of Final Processes to Adopt Approved Code Changes

Regina,

In looking into things further, I think that I would like to address things in 3 ways, if acceptable.

First, I would like to request updating the standard references that were previously approved as part of my earlier petitions. These have been approved as part of the ICC 2024 IRC & IMC:

- UL/CSA 60335-2-40-2022
- ASHRAE 15-2022
- ASHRAE 34-2022

- Justification: The UL/CSA 60335-2-40-2022 edition include coverage for computer room air conditioning equipment with A2Ls that does not exist in any other standard. ASHRAE 34-2022 include more updates for A2L refrigerants. ASHRAE 15-2022 includes more updated information on the safe application of A2L refrigerants in both refrigeration and air conditioning equipment.

Second, I would like to submit new petitions for consideration that add the U:/CSA 60335-2-89-2021 which addresses refrigeration equipment. Existing UL standards for refrigeration are being withdrawn by UL in pace of this UL/CSA 60335-2-89 standard. The 2021 standard is the current standard and this will be referenced in the 2024 IMC.

Third, I would like to submit Fire Code proposals to align the code with the 2024 IFC in regards to MAQs, storage, etc. of A2L refrigerants.

Please let me know if this will work and when I need to have the additional proposals submitted for consideration.

Thanks,

Robert

From: Regina.Hanshaw@com.ohio.gov <Regina.Hanshaw@com.ohio.gov>
Sent: Thursday, January 5, 2023 3:20 PM
To: Glass, Robert S. <Robert.Glass@daikincomfort.com>
Cc: debbie.ohler@com.ohio.gov
Subject: RE: [EXTERNAL] RE: Status and Timing of Final Processes to Adopt Approved Code Changes

Yes, Ohio does adopt the IFC but that is done through the State Fire Marshal's office, not ours. Debbie can probably let you know any technical considerations you should consider regarding the fire code as we do work with Marshal's office to coordinate the codes, but they are further behind on adoption of the '21 than us so I am unsure of their timeframe. They have their own process for petitioning and review of code update rules, so you will need to work with them regarding any changes to the fire code when the time comes.

From: Glass, Robert S. <Robert.Glass@daikincomfort.com>
Sent: Thursday, January 5, 2023 4:14 PM
To: Hanshaw, Regina <Regina.Hanshaw@com.ohio.gov>
Subject: RE: [EXTERNAL] RE: Status and Timing of Final Processes to Adopt Approved Code Changes

Let me review the information and I will get back to you. Does Ohio also adopt the IFC? There have been some changes to the MAQs relating to A2L refrigerants and I might want to submit a code change proposal to address that. If so, is there a deadline for submissions?

Thanks for your help through this entire process.

Regards,

Robert

From: Regina.Hanshaw@com.ohio.gov <Regina.Hanshaw@com.ohio.gov>
Sent: Thursday, January 5, 2023 2:53 PM
To: Glass, Robert S. <Robert.Glass@daikincomfort.com>
Subject: RE: [EXTERNAL] RE: Status and Timing of Final Processes to Adopt Approved Code Changes

If it's just referencing the newer edition in the referenced standards chapter, rather than do a formal petition, just send Debbie and I information regarding updated standards which we may just be able to update as a matter of course, since we typically do try to reference the most recent edition of standards when we do an update. But if you can send the info to us we can make sure to flag them for updating.

From: Glass, Robert S. <Robert.Glass@daikincomfort.com>
Sent: Thursday, January 5, 2023 3:48 PM
To: Hanshaw, Regina <Regina.Hanshaw@com.ohio.gov>
Subject: RE: [EXTERNAL] RE: Status and Timing of Final Processes to Adopt Approved Code Changes

There have been some changes in editions of the standards which were approved for mt petitions earlier. Is there an opportunity to submit another proposal for both the IRC and IMC for consideration during this process? These changes have been reviewed and approved by ICC for the 2024 I-codes.

Thanks,

Robert

From: Regina.Hanshaw@com.ohio.gov <Regina.Hanshaw@com.ohio.gov>
Sent: Thursday, January 5, 2023 2:40 PM
To: Glass, Robert S. <Robert.Glass@daikincomfort.com>
Subject: RE: [EXTERNAL] RE: Status and Timing of Final Processes to Adopt Approved Code Changes

We are making progress and hope to start the rule-making process soon with a planned effective date of 1/1/24 as well. But this is good information to know as we move through the rule review process to explain the importance of the update.

Thanks,

Regina

From: Glass, Robert S. <Robert.Glass@daikincomfort.com>
Sent: Thursday, January 5, 2023 3:34 PM
To: Hanshaw, Regina <Regina.Hanshaw@com.ohio.gov>
Subject: RE: [EXTERNAL] RE: Status and Timing of Final Processes to Adopt Approved Code Changes

Regina,

Happy New Year!

I just wanted to follow up in the new year to see if you know anything further in regards to plans for review and adoption of the 2021 I-Codes along with my approved petitions.

There are already 21 states which allow for the use of A2L refrigerants and due to the AIM Act, there will be a 40% reduction in R-410A refrigerant starting 1/1/2024. The industry needs states to update their building codes ahead of this date to avoid a shortage of refrigerant and available products for the market. There are already some manufacturers selling the new low GWP refrigerant equipment in these 21 states.

Thanks,

Robert

From: Glass, Robert S.
Sent: Thursday, August 11, 2022 2:41 PM
To: Regina.Hanshaw@com.ohio.gov
Subject: RE: [EXTERNAL] RE: Status and Timing of Final Processes to Adopt Approved Code Changes

Regina,

Thanks for the update. I also would appreciate you raising this concern to the Board to see if there is anything that can be done since the Approved Petitions allow for the use of these new alternate refrigerants.

Thanks again for getting back to me.

Regards,,

Robert

Robert Glass
Manager, State Regulatory Affairs

T: (205) 759-9638 | **M:** (205) 860-0551 | **E:** Robert.Glass@daikincomfort.com

Daikin	Amana	Goodman

12680 Lock 15 Road | Tuscaloosa, AL 35406

https://northamerica-daikin.com

From: Regina.Hanshaw@com.ohio.gov <Regina.Hanshaw@com.ohio.gov>
Sent: Thursday, August 11, 2022 1:47 PM
To: Glass, Robert S. <Robert.Glass@daikincomfort.com>

Subject: RE: [EXTERNAL] RE: Status and Timing of Final Processes to Adopt Approved Code Changes

Robert,

Sorry for my delay in getting back with you. However, I do not have any update for you since my last email. We are still reviewing the 2021 I-Codes and no date has been set yet for 2020 NEC adoption. I will pass on your concerns though to the Board so they are aware of factors being affected by code adoption.

Thanks,

Regina

From: Glass, Robert S. <Robert.Glass@daikincomfort.com>
Sent: Tuesday, August 2, 2022 10:21 AM
To: Hanshaw, Regina <Regina.Hanshaw@com.ohio.gov>
Subject: RE: [EXTERNAL] RE: Status and Timing of Final Processes to Adopt Approved Code Changes

Regina,

I hope that you are doing well.

I just wanted to follow up with you to see if anything has changed since your last update to me in April concerning the adoption of the 201 I-Codes and the 2020 NEC.

I am trying to track this activity to know when the HVAC industry might be able to start selling A2L products into Ohio. Due to the AIM Act, the phase down of higher GWP refrigerants (R-410A for HVAC equipment) is 10% in 2022, but jumps to 40% in 2024. The HVAC industry believes that there will be a shortage of R-410A in 2024 and this will adversely affect the ability to sell comfort conditioning equipment without the building codes being updated and AHJs allowing for the new lower GWP A2L refrigerants.

Please let me know at your convenience.

Regards,

Robert

Robert Glass
Manager, State Regulatory Affairs

T: (205) 759-9638 | **M:** (205) 860-0551 | **E:** Robert.Glass@daikincomfort.com

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https://northamerica-daikin.com

From: Regina.Hanshaw@com.ohio.gov <Regina.Hanshaw@com.ohio.gov>
Sent: Monday, April 25, 2022 9:01 AM
To: Glass, Robert S. <Robert.Glass@daikincomfort.com>
Subject: RE: [EXTERNAL] RE: Status and Timing of Final Processes to Adopt Approved Code Changes

Robert,

There has been no change on the status of the adoption of the 2021 I-codes. Additionally, we have not yet set a date for adoption of the 2020 NEC in the OBC, OMC & OPC.

Thanks,

Regina

From: Glass, Robert S. <Robert.Glass@daikincomfort.com>
Sent: Tuesday, April 19, 2022 9:22 PM
To: Hanshaw, Regina <Regina.Hanshaw@com.ohio.gov>
Subject: RE: [EXTERNAL] RE: Status and Timing of Final Processes to Adopt Approved Code Changes

Regina,

I am just following back up with you to see what the status of OH reviewing the 2021 I-Codes for adoption might be and if a new timeline may have been established.

I have been unable to find any related information on the Ohio.gov website.

Thanks,

Robert

Robert Glass
Manager, State Regulatory Affairs

T: (205) 759-9638 | **M:** (205) 860-0551 | **E:** Robert.Glass@daikincomfort.com

Daikin	Amana	Goodman

12680 Lock 15 Road | Tuscaloosa, AL 35406

https://northamerica-daikin.com

From: Regina.Hanshaw@com.state.oh.us <Regina.Hanshaw@com.state.oh.us>
Sent: Monday, August 23, 2021 12:10 PM
To: Glass, Robert S. <Robert.Glass@goodmanmfg.com>
Subject: RE: [EXTERNAL] RE: Status and Timing of Final Processes to Adopt Approved Code Changes

At this time we are only planning on moving forward with approved petition 20-01 which adopts the 2020 NEC in the OBC, OPC & OMC. All the other approved petitions will likely be held until we move forward with adoption of the 2021 I-Codes. Also, the Board recently updated its plans on adoption of the 2021 I-Codes. As we continue to review the model codes for adoption and due to the impact of COVID on construction industry, the January 2023 is no longer a tentative adoption date. We do not currently have a planned adoption date. We will revisit our adoption timeline in mid-2022.

Thanks.

Regina

From: Glass, Robert S. <Robert.Glass@goodmanmfg.com>
Sent: Monday, August 23, 2021 1:04 PM
To: Hanshaw, Regina <Regina.Hanshaw@com.state.oh.us>
Subject: RE: [EXTERNAL] RE: Status and Timing of Final Processes to Adopt Approved Code Changes

Regina,

I am following up to see if there has been any activity in regards to creating/submitting an amendment package to the Ohio Legislature in regards to approved building code petitions as you noted below back in November 2020?

If not, will these approved petition be held in abeyance until OH reviews and adopts the 2021 ICC codes to be effective on or about 1/1/2023?

Thanks,

Robert

Robert Glass
Manager, State Regulatory Affairs
Goodman Manufacturing Company, L.P.
A member of ***Daikin group***

12680 Lock 15 Road
Tuscaloosa, AL 35406
205-759-9638 office
205-860-0551 cell

From: Regina.Hanshaw@com.state.oh.us <Regina.Hanshaw@com.state.oh.us>
Sent: Friday, November 20, 2020 12:38 PM
To: Glass, Robert S. <Robert.Glass@goodmanmfg.com>
Subject: [EXTERNAL] RE: Status and Timing of Final Processes to Adopt Approved Code Changes

Robert,

As approved petitions, they will just be included in the next rule package. But we do not have any current plans for new rule package other than tentatively planning on next code update to the 2021-based code on or about January 2023. Its possible we will have an amendment package before then, but nothing planned right now.

Thanks,

Regina Hanshaw
OBBS

From: Glass, Robert S. <Robert.Glass@goodmanmfg.com>
Sent: Friday, November 20, 2020 1:25 PM
To: Hanshaw, Regina <Regina.Hanshaw@com.state.oh.us>
Subject: Status and Timing of Final Processes to Adopt Approved Code Changes

Regina,

With the approval of the Residential Code proposals submitted by Mr. Julius Ballanco at the Conference Committee meeting today, what is the timing and next steps in the process of final adoption into OH code?

I believe that all code changes have to be submitted to the OH Legislature for final approval. If so, when do you expect this to happen and for the legislature to take action on them?

Based on approval by the Legislation, when would the codes be finalized, released and effective?

Thanks for your help in this matter.

Regards,

Robert

Robert Glass
Manager, State Regulatory Affairs
Goodman Manufacturing Company, L.P.
A member of ***Daikin group***
12680 Lock 15 Road
Tuscaloosa, AL 35406
205-759-9638 office
205-860-0551 cell

From:	Jerry HOLLAND
To:	BBS, BBSOfficAsst3
Subject:	Comments/Questions on Proposed Rules
Date:	Friday, March 17, 2023 2:48:42 PM
Attachments:	image001.jpg image003.png image007.png

Greetings,

I would like clarification on the proposed changes with regard to Ohio Mechanical Code 4101:2-10-01(C) and (D).

1. Will the Jurisdiction be required to enforce the adopted NBIC/NFPA/ASME CSD-1 standards in full, without exception per 4101:4-3-01? Specifically, NBIC, NFPA and ASME CSD-1 requirements regarding lockable electrical disconnects and emergency shutdown switches.

Thank you for your consideration in this matter. I look forward to attending this meeting.

Jerry D. Holland II
South East Regional Manager
Infrared Thermographer Level 1

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A Bureau Veritas North America, Inc. Company
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From: josephs
To: Hanshaw, Regina
Subject: Ohio 2024 Mechanical Code
Date: Wednesday, March 8, 2023 11:01:09 AM

Hello Regina

I support the State Of Ohio 2024 Mechanical Code adopting the 2021 International Mechanical Code 607.4 (607.4.1, 607.4.1.1, 607.4.1.2) as show without any changes.

Thank You
Joseph Sandman
Mobile 513 678 6825

From:	Steve Tossey
To:	BBS, BBSOfficAsst3
Subject:	Comments on OMC updates
Date:	Friday, March 10, 2023 10:35:10 AM
Attachments:	image001.png image002.png image003.png emaillogo_eb4cb266-5984-47ea-af7d-2bdbeb1f51d5.png LinkedIn_9117a627-75ee-4d55-add8-414c949e1321.png Facebook_6126e6d3-24ba-4ec7-91ba-b09280c3e4d6.png Twitter_92b579e1-b9bf-4c88-af5e-1ccbf1ea37d5.png Instagram_3b7b1bb7-c6a7-4fca-87b9-24a2545ef0f9.png d2b8b1b8-d99f-49a8-859c-9487a41bea6e_4640238e-ae1e-4cfd-9196-2e7c903692f0.png

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Board of Building Standards

This is to make the following comments on the review of the proposed changes to the Ohio Mechanical Code to be included in the next edition.

1. Section 4101:2-2-01 Definitions. In the last sentence of the CONDITIONED SPACE definition, it appears that the word “hey” should be “they”.

2. Section 4101:2-6-01 (A) – In the second sentence, there appear to be extra words, i.e. “to is”.

3. Section 4101:2-9-01 Specific appliances, fireplaces and solid fuel-burning equipment. (B) – Please clarify if the note makes ASHRAE Guideline 12 a mandatory part of the code.

Thanks,

Steve Tossey, PE
Senior Mechanical Engineer

steve.tossey@kzf.com
main 513.621.6211 ▪ *direct* 513.864.8680
kzf.com

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2024 Ohio Plumbing Code Comments					
Commenter	Email	Code Section	Comment	Staff Comments	Code Committee Action
Allen, Mark	mallen@phdmc.org	915.1	O.P.C. Combination waste & vent system section 915.1 propose Modified food waste disposer may discharge into a combination waste and vent system. Since 1998 when Ohio adopted this code the combination waste & vent system been working great with no problems because the type of plumbing fixtures allowed on the system all water discharge plumbing fixtures allowing air over water in the drain sizing chart. By allowing a garbage disposer on the Combination waste and vent system the solids from the disposal will take up more of the pipe inside volume less air to vent the plumbing system . I think this will cause many problems .	American Society of Plumbing Engineers (ASPE) researched this issue and demonstrated that system works when food waste disposer discharges into CW&V system	
Allen, Mark	MAllen@phdmc.org	1003.3.2	Modified – Prohibits a food waste disposer from discharging to a grease interceptor. This is a big mistake the current 2018 O.P.C. Section 1003.3.2 allowing the food waste disposal connect to the grease interceptor , a solid interceptor shall separate the discharge before connecting to the grease interceptor. This installation works great ! In a commercial kitchen when they scape all the plates off into a food waste disposal before they enter the dish washer this is where all the grease drains to. This section of code should remain the same.	Food particles could block the flow of the small openings and baffles within the hydromechanical grease interceptor. Because of the small size of hydromechanical grease interceptors, manufacturers of this type of interceptor state that food particles from a disposal should not be discharged into a hydromechanical interceptor.	

Richardson, Jim	JARichardson@columbus.gov	Chapters 13 & 14	just an FYI about how ODH views their authority regarding water reclamation systems (see email thread below). With this in mind as Ohio moves forward in the code adoption process, it would seem that we should adopt chapter 13 and chapter 14 by reference as well. Without any proper enforcement/regulation of these types of systems people can be put at risk. I do understand why OBBS adopted the code the way they did and maybe fixing this would require ODH to amend their definitions. Note #10 should be removed from the OAC 3701-28-01 definition of “Private Water System” because it is not intended for human consumption. OAC 3701-28-01 Definitions(XXX) "Private water system" means any water system, other than a public water supply system, for the provision of water for human consumption, if the system has fewer than fifteen service connections and does not regularly serve an average of at least twenty-five individuals daily at least sixty days each year. A private water system includes the following:(10) Auxiliary water sources that enter a structure to supplement flushing toilets or laundry washing;ORC rule 3701.344 clearly defines “private water system” as being for human consumption, so the reference to “recycled water” would only apply if the water was intended for human consumption. I do not necessarily endorse removing this reference because this could come into play if Ohio at some point allows for rainwater catchment systems to be used for a potable water source. There are some systems out there now which are designed	ODH law includes recycled water and ODH definition of "human consumption" includes flushing toilets and washing laundry	

From:	Allen, Mark
To:	BBS, BBSOfficAsst3
Subject:	prohibits food waste disposar
Date:	Tuesday, March 7, 2023 10:42:41 AM
Attachments:	0.png 1.png 3.png 4.png 5.png 6.png

O.P.C SECTION 1003.3.2 Modified – Prohibits a food waste disposer from discharging to a grease interceptor. This is a big mistake the current 2018 O.P.C. Section 1003.3.2 allowing the food waste disposal connect
to the grease interceptor , a solid interceptor shall separate the discharge before connecting to the grease interceptor. This installation works great ! In a commercial kitchen when they scape all the plates off
into a food waste disposal before they enter the dish washer this is where all the grease drains to.
This section of code should remain the same.

A Human Services Levy Funded Agency

Accredited Health Department

Mark Allen
Plumbing Supervisor

Public Health - Dayton & Montgomery County

117 S. Main Street

Dayton Ohio 45422

Phone : 937-225-6443

Fax : 937-496-3072

Web : www.phdmc.org

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From: Ohler, Deborah
To: mallen@phdmc.org
Cc: BBS, BBSOfficAsst3
Subject: FW: purpose 2024 O.P.C.
Date: Tuesday, March 7, 2023 9:16:00 AM
Attachments: 0.png
1.png
3.png
4.png
5.png
6.png
image001.jpg
IPC 915.1 commentary.pdf
IPC 915.1 Sig Change.pdf
IPC 915.1 proposal P118-18.pdf

Good morning, Mark.
If I read your comment correctly, you are questioning the intent of the 2021 IPC model code change that now allows a combination waste and vent system to receive the discharge from a food waste disposer.

For your information, I have attached the 2021 IPC Significant Changes excerpt, the 2021 IPC Commentary excerpt, and the ICC code change proposal (P118-18) that initiated the change. Hopefully, knowing that this issue has been researched and studied by the American Society of Plumbing Engineers (ASPE) will help to ease your concern.

Please let us know if you have further questions or concerns.
Regards,
Debbie

Deborah D. Ohler, P.E., Construction Codes Administrator
Ohio Board of Building Standards
PO Box 4009, 6606 Tussing Rd.
Reynoldsburg, OH 43068-9009
Office phone: 614-644-2613 Fax: 614-222-2147
dohler@com.state.oh.us
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From: BBS, BBSOfficAsst3 <BBS@com.ohio.gov>
Sent: Monday, March 6, 2023 3:52 PM

To: Ohler, Deborah <debbie.ohler@com.ohio.gov>
Subject: FW: purpose 2024 O.P.C.

Please respond.

From: Allen, Mark <MAllen@phdmc.org>
Sent: Monday, March 6, 2023 11:11 AM
To: BBS, BBSOfficAsst3 <BBS@com.ohio.gov>
Subject: purpose 2024 O.P.C.

O.P.C. Combination waste & vent system section 915.1 propose Modified food waste disposer may discharge into a combination waste and vent system. Since 1998 when Ohio adopted this code the combination waste & vent system
been working great with no problems because the type of plumbing fixtures allowed on the system all water discharge plumbing fixtures allowing air over water in the drain sizing chart. By allowing a garbage disposer on the
Combination waste and vent system the solids from the disposal will take up more of the pipe inside volume less air to vent the plumbing system . I think this will cause many problems .

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Accredited Health Department

Mark Allen
Plumbing Supervisor

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Dayton Ohio 45422
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Fax : 937-496-3072
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From: Ohler, Deborah
To: Richardson, James A.
Cc: Hanshaw, Regina
Subject: RE: Non-potable water reuse systems
Date: Monday, February 13, 2023 10:06:00 AM
Attachments: image003.jpg
image004.jpg
image005.jpg

Good morning, Jim.

The rules of the ODH include a definition of "Human Consumption". See paragraph (CCC) of rule 3701-28-01 of the Administrative Code:

> (CCC) "Human consumption" means the ingestion or absorption of water or water vapor as the result of drinking, cooking, dishwashing, hand washing, bathing, showering, oral hygiene, or other domestic uses such as flushing toilets and doing laundry.

This definition is consistent with their paragraph (XXX) definition of "Private Water System" that includes #10 Auxiliary water sources that enter a structure to supplement flushing and laundry washing.

Deborah D. Ohler, P.E., Construction Codes Administrator
Ohio Board of Building Standards
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From: Richardson, James A. <JARichardson@columbus.gov>
Sent: Monday, February 13, 2023 7:33 AM
To: Ohler, Deborah <debbie.ohler@com.ohio.gov>; Hanshaw, Regina <Regina.Hanshaw@com.ohio.gov>
Subject: FW: Non-potable water reuse systems

Debbie/Regina,

Just an FYI about how ODH views their authority regarding water reclamation systems (see email thread below). With this in mind as Ohio moves forward in the code adoption process, it would seem that we should adopt chapter 13 and chapter 14 by reference as well. Without any proper enforcement/regulation of these types of systems people can be put at risk.

I do understand why OBBS adopted the code the way they did and maybe fixing this would require ODH to amend their definitions. Note #10 should be removed from the OAC 3701-28-01 definition of "Private Water System" because it is not intended for human consumption.

OAC

3701-28-01 Definitions

(XXX) "Private water system" means any water system, other than a public water supply system, for the provision of water for human consumption, if the system has fewer than fifteen service connections and does not regularly serve an average of at least twenty-five individuals daily at least sixty days each year. A private water system includes the following:

(10) Auxiliary water sources that enter a structure to supplement flushing toilets or laundry washing;

ORC rule 3701.344 clearly defines "private water system" as being for human consumption, so the reference to "recycled water" would only apply if the water was intended for human consumption. I do not necessarily endorse removing this reference because this could come into play if Ohio at some point allows for rainwater catchment systems to be used for a potable water source. There are some systems out there now which are designed for human consumption though they are not currently permitted in Ohio.

ORC

3701.344 Rules for private water systems

(A) As used in this section and sections 3701.345 and 3701.347 of the Revised Code, "private water system" means any water system for the provision of water for human consumption, if the system has fewer than fifteen service connections and does not regularly serve an average of at least twenty-five individuals daily at least sixty days out of the year. "Private water system" includes any well, spring, cistern, pond, hauled water, or recycled water and any equipment for the collection, transportation, filtration, disinfection, treatment, or storage of such water extending from and including the source of the water to the point of discharge from any pressure tank or other storage vessel; to the point of discharge from the water pump where no pressure tank or other storage vessel is present; or, in the case of multiple service connections serving more than one dwelling, to the point of discharge from each service connection. "Private water system" does not include the water service line extending from the point of discharge to a structure.

Regards,

James A. Richardson Jr., CPD

City of Columbus
Building and Zoning Services
Plumbing Inspection Supervisor
plumbinginfo@columbus.gov
http://www.columbus.gov/bzs/inspections/Plumbing/

RGB Gradient

From: Mary.Shaffer@odh.ohio.gov [mailto:Mary.Shaffer@odh.ohio.gov]
Sent: Friday, February 10, 2023 7:52 PM
To: Richardson, James A. <JARichardson@columbus.gov>
Cc: Audrey.Blakeman@odh.ohio.gov
Subject: [EXTERNAL] RE: Non-potable water reuse systems

James,

I have discussed this with our interim manager of the private water systems program here at ODH. The private water systems rules pertain to potable drinking water and do not cover collecting storm water for irrigation purposes. Recycled water systems for the purpose of providing potable drinking water does fall under ODH. It is my understanding that is not what is happening at this location and therefore the reclaiming or catching of storm water for irrigation does not fall under the purview of ODH private water program.

Take care,

Mary

Mary Shaffer, MA, REHS

Recreation, Engineering, And Community Health (REACH) Unit Administrator
Bureau of Environmental Health & Radiation Protection
Ohio Department of Health
614-981-1566

Act as if what you do makes a difference. It does. ~William James

---

From: Richardson, James A. <JARichardson@columbus.gov>
Sent: Tuesday, February 7, 2023 12:48 PM
To: Shaffer, Mary <Mary.Shaffer@odh.ohio.gov>
Subject: Non-potable water reuse systems

Mary,

The purpose of the communication you received regarding 171 N. 4th St. relates back to the Ohio Plumbing Code. Since ODH already has "rules" for potable and non-potable water systems and considers them "Private Water Systems", the Ohio Board of Building Standards removed the language from the model code the plumbing code is based upon and instead defers the regulation of these systems to ODH, which includes approving the design of the systems. Since the regulation and approval of the systems was removed from the code, we need ODH to provide approvals of these systems, much like ODH does for public swimming pools.

1301.1 Scope
The content of this model *code* chapter has been deleted. On-Site Nonpotable Water Reuse Systems, Nonpotable Rainwater Collection and Distribution Systems, and Reclaimed Water Systems are considered Private Water Systems as defined in Section 3701.344 of the Revised *Code*. Private water systems and recycled water systems are regulated by the *Ohio Department of Health* rules found in Chapter 3701-28 of the *Administrative Code*.

Regards,

James A. Richardson Jr., CPD

City of Columbus
Building and Zoning Services
Plumbing Inspection Supervisor
plumbinginfo@columbus.gov
http://www.columbus.gov/bzs/inspections/Plumbing/

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File Attachments for Item:

OB-2 Review of Stakeholder Comments for AG 101 (RCO)

2019 Residential Code of Ohio Amendments Comments						
Commenter	Email	Code Section	Comment	Staff Comments	RCAC Recommendation	Code Committee Action
Joe Bargdill	joe.bargdill@westerville.org	317.1, 328.1, 507.2.1	Section 403.1.2. Wood Treatment for pressure treated lumber below grade shall have a label showing rating UC4B according to AWPA U1. Note: most pressure treated lumber on the market (other than 4 x 4 or heavier) are only rated for ground contact. When used as a wood foundation material or pole building lumber below grade, the lumber should reflect a direct burial rating. Sections 317.1, 328.1, and 507.2.1 should also note this change.			
mark ichrist	1171cplichristmd@gmail.com	Chpts 34 & 44	It is my belief that the 2023 NEC be adopted for both the commercial and residential codes. One reason is it can be confusing keeping track of all of them. By the time they are adopted, there will be buildings still being inspected under the 2017 NEC. Having to remember the changes for the 2020 and 2023 as well as the 2017 will be more time consuming, and contractors as well as inspectors may get confused. I also believe they that it is an additional burden both on contractors and building departments spend money on both books, when the most recent standard is already published. Finally I believe the code should be adopted in full. There is not a reason in my opinion to take things out, when the code is a minimum safety standard as written.			

Stehlin, Micha	Michael.Stehlin@hamilton-co.org	403.1.4.1	I am writing in support of the proposed changes to the 2019 RCO. Specifically, I wholly support reinsertion of the exceptions that allow freestanding accessory structures under 600 and 400 SF to have footings less than frost depth. It is common in our jurisdiction to have detached garages and sheds of 200-600SF built with monolithic slabs with a turn down edge of 18" in depth. It was totally unnecessary to remove these exceptions in the 2019 RCO, and I am extremely supportive of their reintroduction. Detached accessory structures have been built this way for decades without any problem.			
Bill Toole	wrt@tooleinspectors.com	Chpts 34 & 44	I would propose not accepting the 2020 NEC and go to the 2023 NEC for use in review and inspection for the residential sector to match the acceptance of the 2023 NEC proposed for the 2024 OBC. Uniformity in the review and inspections process, the use of one referenced standard, ease of use for the installing contractor to only have to use one referenced standard, elimination of confusion for owners, designers and contractors rapidly come to mind in utilizing the same referenced standard year for review and regulation.			

From:	mark ichrist
To:	BBS, BBSOfficAsst3
Subject:	NEC changes for the residential and commercial codes of Ohio.
Date:	Thursday, March 2, 2023 3:05:52 PM

It is my belief that the 2023 NEC be adopted for both the commercial and residential codes.

One reason is it can be confusing keeping track of all of them. By the time they are adopted, there will be buildings still being inspected under the 2017 NEC.
Having to remember the changes for the 2020 and 2023 as well as the 2017 will be more time consuming, and contractors as well as inspectors may get confused.

I also believe they that it is an additional burden both on contractors and building departments spend money on both books, when the most recent standard is already published.

Finally I believe the code should be adopted in full. There is not a reason in my opinion to take things out, when the code is a minimum safety standard as written.

Sent from my iPhone

From: Joe Bargdill
To: BBS, BBSOfficAsst3
Subject: New Revisions To The 2019 RCO
Date: Thursday, March 2, 2023 1:17:47 PM

Section 403.1.2. Wood Treatment for pressure treated lumber below grade shall have a label showing rating UC4B according to AWPA U1.
Note: most pressure treated lumber on the market (other than 4 x 4 or heavier) are only rated for ground contact. When used as a wood foundation material or pole building lumber below grade, the lumber should reflect a direct burial rating.

Sections 317.1, 328.1, and 507.2.1 should also note this change.

From:	Bill Toole
To:	BBS, BBSOfficAsst3
Cc:	Foley, Megan; Hanshaw, Regina
Subject:	Comments to proposed amendments to 2019 RCO
Date:	Saturday, March 11, 2023 12:05:57 PM

I would propose not accepting the 2020 NEC and go to the 2023 NEC for use in review and inspection for the residential sector to match the acceptance of the 2023 NEC proposed for the 2024 OBC. Uniformity in the review and inspections process, the use of one referenced standard, ease of use for the installing contractor to only have to use one referenced standard, elimination of confusion for owners, designers and contractors rapidly come to mind in utilizing the same referenced standard year for review and regulation.

Bill Toole

From: Stehlin, Michael
To: BBS, BBSOfficAsst3
Subject: Comment on Proposed Rule Change RCO 403.1.4.1
Date: Thursday, March 2, 2023 1:54:42 PM
Attachments: image001.png

Dear OBBS;

I am writing in support of the proposed changes to the 2019 RCO. Specifically, I wholly support reinsertion of the exceptions that allow freestanding accessory structures under 600 and 400 SF to have footings less than frost depth. It is common in our jurisdiction to have detached garages and sheds of 200-600SF built with monolithic slabs with a turn down edge of 18” in depth. It was totally unnecessary to remove these exceptions in the 2019 RCO, and I am extremely supportive of their reintroduction. Detached accessory structures have been built this way for decades without any problem.

Sincerely,

Michael Stehlin

Michael Stehlin, AIA
Chief Building Official, Planning + Development
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