

B102.3-21

VCC: 102.3

Proponents: Ronald Clements (clementsro@chesterfield.gov)

2018 Virginia Construction Code


Revise as follows:

102.3 Exemptions. The following are exempt from this code:

1. *Equipment* and wiring used for providing utility, communications, information, cable television, broadcast or radio service in accordance with all of the following conditions:
 - 1.1. The *equipment* and wiring are located on either rights-of-way or property for which the service provider has rights of occupancy and entry.
 - 1.2. Buildings housing exempt *equipment* and wiring shall be subject to the USBC.
 - 1.3. The *equipment* and wiring exempted by this section shall not create an unsafe condition prohibited by the USBC.
2. Support *structures* owned or controlled by a provider of publicly regulated utility service or its affiliates for the transmission and distribution of electric service in accordance with all of the following conditions:
 - 2.1. The support *structures* are located on either rights-of-way or property for which the service provider has rights of occupancy and entry.
 - 2.2. The support *structures* exempted by this section shall not create an unsafe condition prohibited by the USBC.
3. Direct burial poles used to support *equipment* or wiring providing communications, information or cable television services. The poles exempted by this section shall not create an unsafe condition prohibited by the USBC.
4. Electrical *equipment*, transmission *equipment*, and related wiring used for wireless transmission of radio, broadcast, telecommunications, or information service in accordance with all of the following conditions:
 - 4.1. Buildings housing exempt *equipment* and wiring and *structures* supporting exempt equipment and wiring shall be subject to the USBC.
 - 4.2. The equipment and wiring exempted by this section shall not create an unsafe condition prohibited by the USBC.
5. Manufacturing, processing, and product handling machines and equipment that do not produce or process hazardous materials regulated by this code, including those portions of conveyor systems used exclusively for the transport of associated materials or products, and all of the following service equipment:
 - 5.1. Electrical equipment connected after the last disconnecting means.
 - 5.2. Plumbing piping and equipment connected after the last shutoff valve or backflow device and before the equipment drain trap.
 - 5.3. Gas piping and equipment connected after the outlet shutoff valve.Manufacturing and processing machines that produce or process hazardous materials regulated by this code are only required to comply with the code provisions regulating the hazardous materials.
6. Parking lots and sidewalks that are not part of an accessible route.
7. Nonmechanized playground or recreational *equipment* such as swing sets, sliding boards, climbing bars, jungle gyms, skateboard ramps, and similar equipment where no admission fee is charged for its use or for admittance to areas where the *equipment* is located. However, children's play structures installed inside buildings shall be subject to the children's play structures section in VCC chapter 4.
8. *Industrialized buildings* subject to the Virginia Industrialized Building Safety Regulations (13VAC5-91) and *manufactured homes* subject to the Virginia Manufactured Home Safety Regulations (13VAC5-95); except as provided for in Section 427 and in the case of demolition of such *industrialized buildings* or *manufactured homes*.
9. Farm *buildings* and *structures*, except for a building or a portion of a building located on a farm that is operated as a restaurant as defined in § 35.1-1 of the Code of Virginia and licensed as such by the Virginia Board of Health pursuant to Chapter 2 (§ 35.1-11 et seq.) of Title 35.1 of the Code of Virginia. However, farm *buildings* and *structures* lying within a flood plain or in a mudslide-prone area shall be subject to flood-proofing regulations or mudslide regulations, as applicable.
10. Federally owned buildings and *structures* unless federal law specifically requires a permit from the *locality*. Underground storage tank installations, modifications and removals shall comply with this code in accordance with federal law.

11. Off-site manufactured intermodal freight containers, moving containers, and storage containers placed on site temporarily or permanently for use as a storage container.
12. Automotive lifts.

Reason Statement: This exemption is based on exempting play structures from the amusement device provisions associated to these structures and was developed prior to VCC section 424. The provisions of VCC chapter 4 regarding children's play structures regulate the fuel loading limitations and fire protection requirements associated with having these structures inside of buildings. Fire protection provisions related to installation of play structures in buildings should remain applicable.

 **Resiliency Impact Statement:** This proposal will neither increase nor decrease Resiliency

Cost Impact: The code change proposal will increase the cost of construction
This code change will increase cost in cases where equipment that does not meet the materials flammability and combustibility specifications of VCC 424.2 would be installed if exempted from code.

B110.9-21

VCC: 107.1, 110.9 (New)

Proponents: Ronald Clements (clementsro@chesterfield.gov)

2018 Virginia Construction Code

Revise as follows:

107.1 Authority for charging fees. In accordance with § 36-105 of the Code of Virginia, fees may be levied by the *local governing body* in order to defray the cost of enforcement of the USBC.

Note: See subsection D of § 36-105 of the Code of Virginia for rules for permit fees involving property with easements or liens.

107.1.1 Fee schedule.

The *local governing body* shall establish a fee schedule incorporating unit rates, which may be based on square footage, cubic footage, estimated cost of *construction* or other appropriate criteria. A permit or any amendments to an existing permit shall not be issued until the designated fees have been paid, except that the *building official* may authorize the delayed payment of fees.

107.1.2 Refunds.

When requested in writing by a *permit holder*, the *locality* shall provide a fee refund in the case of the revocation of a permit or the abandonment or ~~discontinuance~~ cancellation of a *building* project. The refund shall not be required to exceed an amount which correlates to work not completed.


107.1.3 Fees for generators used with amusement devices.

Fees for generators and associated wiring used with amusement devices shall only be charged under the VADR.

Add new text as follows:

110.9 Cancellation of permit. The building official shall cancel a permit at the request of the *permit holder* or the *owner*. An incomplete building or structure shall not be left as an *unsafe building or structure*.

Reason Statement: There is no provision in section 110 addressing proactive cancellation or discontinuance of building projects and permits by the permit holder or the owner. Abandonment of work and revocation provisions are provided, but neither of those code provisions address a simple request to cancel a permit. Section 107.1.2 lists "discontinuance" of a building project as separate and distinct from abandonment or revocation, but the concept is not addressed in Section 110. Either the permit holder or the owner should have authority to cancel a permit.

 **Resiliency Impact Statement:** This proposal will neither increase nor decrease Resiliency

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This code change will not impact cost of construction.

B310.6-21

VCC: 103.4, 310.6, 310.6.1

Proponents: Ronald Clements (clementsro@chesterfield.gov)

2018 Virginia Construction Code

Revise as follows:

103.4 Use of certain provisions of referenced codes. The following provisions of the IBC and of other indicated codes or standards are to be considered valid provisions of this code. Where any such provisions have been modified by the state amendments to the IBC, then the modified provisions apply.

1. *Special inspection* requirements in Chapters 2–35.
2. Testing requirements and requirements for the submittal of *construction documents* in any of the ICC codes referenced in Chapter 35 and in the IRC.
3. Section R301.2 of the IRC authorizing localities to determine climatic and geographic design criteria.
4. Flood load or flood-resistant *construction* requirements in the IBC or the IRC, including any such provisions pertaining to flood elevation certificates that are located in Chapter 1 of those codes. Any required flood elevation certificate pursuant to such provisions shall be prepared by a land surveyor licensed in Virginia or a registered design professional (RDP).
5. ~~Section R101.2 of the IRC.~~
6. Section N1102.1 of the IRC and Sections C402.1.1 and R402.1 of the IECC.

310.6 Residential Group R-5. Residential group R-5 occupancies shall include residential occupancies within the scope of the VRC, other occupancies specifically permitted in this code to be classified as Group R-5, Section 310.6.1, and manufactured homes in accordance with the Virginia Manufactured Home Safety Regulations (23VAC5-91).

~~The provisions of the IRC for one- and two-family dwellings shall apply to the construction, alteration, movement, enlargement, replacement, repair, equipment, use and occupancy, location, removal and demolition of the following when classified as Group R-5:~~

310.6.1 Virginia Residential Code. The provisions of the IRC for detached one- and two-family dwellings and townhouses as amended by VCC section 310.8, also referred to as the Virginia Residential Code (VRC) printed by the ICC, shall apply to construction, rehabilitation, and demolition of the types of buildings and structures listed below, and the equipment therein, provided the building or structure is not more than three stories above grade plane in height with a separate means of egress:

1. Detached single-family and two-family dwellings
2. Townhouses
3. Care facilities for five or fewer people
4. Owner- or proprietor-occupied lodging houses with no more than five guest rooms and 10 or fewer total occupants.
5. Accessory structures of Group R-5 occupancies.
6. Other occupancies specifically permitted in this code to be classified as Group R-5.

~~The amendments to the IRC set out in Section 310.8 shall be made to the IRC for its use as part of this code. In addition, all All references to the IRC and in the International Building Code (IBC) shall be considered to be references to this section.~~

~~**310.6.1 310.6.1.1 Additional requirements.** Methods of *construction*, materials, systems, *equipment* or components for Group R-5 structures not addressed by prescriptive or performance provisions of the ~~IRC~~ VRC shall comply with applicable ~~IBC~~ VCC requirements.~~

Reason Statement: The scope of the VRC (the IRC provisions adopted in Virginia) is not provided in VCC Section 310 where it belongs. The IRC scope is critical because it is based on a 3-story limit with a separate means of egress. The only reference to the scope of the IRC is in VCC Section 103.4 #5. This is an awkward code reference with Section 103.4 #5 referencing IRC R101.2 for scoping the IRC. To get to the IRC the code user starts in VCC Section 310, which begins with a reference to the VRC, then later in the section refers to provisions of the IRC. Furthermore, the scope in IRC R101.2 is not exactly consistent with the scope provided in 310.6 for use of the VRC/IRC in the USBC framework. Since VCC 310.6 is essentially the scoping section for use of the IRC based VRC in the USBC, it is simpler and clear to provide the full scope of the VRC in VCC Section 310, rather than rely on a somewhat disjointed assembly of VCC 103.4, ICC R101.2, and VCC 310.

The code changes proposed are all to consolidate IRC/VRC scoping in VCC 310. There is no intended change in scope nor are there any technical changes proposed. The scope provided in IRC section R101.2, the 3-story limit with a separate means of egress, is proposed to be moved to VCC Section 310.6.1. The section has been reformatted to remove the three separate disjointed paragraphs that made up 310.6.

This code change is **supported by the Virginia Building and Code Officials Association (VBCOA)** after review by the VBCOA Residential Code Committee.



Resiliency Impact Statement: This proposal will neither increase nor decrease Resiliency
This is a formatting/editorial code change that does not technically change the code; therefore, there is no impact on resiliency.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This is a formatting/editorial code change that does not technically change the code; therefore, there is no impact on cost.

B706.1-21

IBC@: 706.1

Proponents: Ronald Clements (clementsro@chesterfield.gov)


2021 International Building Code

Revise as follows:

706.1 General. Each portion of a building separated by one or more fire walls shall be considered a separate building. Fire walls shall be constructed in accordance with Sections 706.2 through 706.11. The extent and location of such fire walls shall provide a complete separation. Where a fire wall separates occupancies that are required to be separated by a fire barrier wall, the most restrictive requirements of each separation shall apply. Equipment and systems are permitted to serve multiple portions of a building separated by one or more fire walls.

Reason Statement: G130-15 (provided below) removed the code text from 706.1 that states fire walls create separate buildings. The result of G130-15 is that fire walls no longer create separate buildings per 706.1. Application of fire walls is now code section specific regarding what a fire wall does regarding application of that specific code provision. Section 503.1 was revised to address how fire walls impact application of allowable height and area provisions; but, as an example, no such provision was added to chapter 9 to address how fire walls impact application of chapter 9 provisions applicable to buildings. To my knowledge no other code sections throughout the I-codes were reviewed for this impact. The code change reason does not state the intent was to remove the ability to use fire walls to create separate buildings. The intent per the reason statement was to clarify that features and systems shared by buildings separated by fire walls need not be separated from each other other like building features in adjacent buildings. This code change makes it clear that fire walls create separate buildings for application of chapter 9 and other provisions beyond allowable height and area as was always intended. To address the issue of shared systems, the last line was added. I intent to submit this as an ICC change but, if approved, it will go into the 2027 IBC, which will not be adopted in Virginia until 2029 at the earliest.

G130-15 *The purpose of this proposal is to clarify the intent of these sections of the Code that the requirement for a fire wall in Sections 503.1 and 706.1 is predicated on the determination of the maximum allowable height and area calculations under Chapter 5. Using these sections of Code to control other building features or elements such as means of egress, building systems or building utilities is not intended or implied by these sections of the Code. However, by inclusion of the first sentence in Section 706.1 some code officials have incorrectly interpreted that language to mean that the portions of the various elements and systems on each side of a fire wall must be completely self-contained. There are no requirements in the I Codes that mandate that the placement of fire walls to create a separate building such that its building features need to be separated from other like building features in adjacent buildings. The scope of Section 706 is to provide the technical requirements for the construction of a fire wall. The added language in Section 503.1 along with the strikeout and added language in Section 706.1 will clarify application of these two sections.*

 **Resiliency Impact Statement:** This proposal will neither increase nor decrease Resiliency

Cost Impact: The code change proposal will decrease the cost of construction

This code change proposal will reduce the cost of construction though I don't know how to give a number. As an example: in prior code editions you could building a 30,000 sf warehouse without installing a sprinkler system by use of a fire barrier at 10,000 sf and a fire wall at 20,000 sf. With the 2015 amendment that same building would require a sprinkler system, even if fire walls were used at both 10,000 and 20,000 square foot area limits.

B1006.3.4-21

IBC®: TABLE 1006.3.4(1)

Proponents: Lyle Solla-Yates (lyle.sollayates@gmail.com)

2021 International Building Code

Revise as follows:

TABLE 1006.3.4(1) STORIES WITH ONE EXIT OR ACCESS TO ONE EXIT FOR R-2 OCCUPANCIES

STORY	OCCUPANCY	MAXIMUM NUMBER OF DWELLING UNITS	MAXIMUM EXIT ACCESS TRAVEL DISTANCE
Basement, first, second, or third, <u>fourth, fifth, or sixth</u> story above grade plane	R-2 ^{a, b}	4 dwelling units	125 feet
Fourth <u>Seventh</u> story above grade plane and higher	NP	NA	NA

For SI: 1 foot = 304.8 mm.


NP = Not Permitted.

NA = Not Applicable.

- a. Buildings classified as Group R-2 equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2 and provided with emergency escape and rescue openings in accordance with Section 1031.
- b. This table is used for R-2 occupancies consisting of dwelling units. For R-2 occupancies consisting of sleeping units, use Table 1006.3.4(2).

Reason Statement: Experience in Seattle and New York City has shown that this kind of development with a limited floorplan can be allowed safely, as well as in other countries. This allows more compact missing middle residential development that was historically common in Virginia but has not been permitted for many years. Reviewers note that there is still a need for reliable aerial access, sprinklers, and alarms.

For more on this see the attached articles "The Single-Staircase Radicals Have a Good Point" by writer Henry Grabar in Slate posted here <https://slate.com/business/2021/12/staircases-floor-plan-twitter-housing-apartments.html> and "The Case for More Single Stair Buildings in the US" by architect Michael Eliason in Treehugger posted here <https://www.treehugger.com/single-stair-buildings-united-states-5197036>

 **Resiliency Impact Statement:** This proposal will neither increase nor decrease Resiliency

Cost Impact: The code change proposal will decrease the cost of construction

Reducing the number of staircases required for smaller missing middle residential structures will reduce cost per square foot and make more sites and configurations feasible.

Attached Files

- **The Single-Staircase Radicals Have a Good Point Grabar.pdf**
<https://va.cdpass.com/proposal/944/1185/files/download/525/>
- **singlestaireliason.pdf**
<https://va.cdpass.com/proposal/944/1185/files/download/521/>

B1020.2.1-21

IBC: 1020.2.1


Proponents: Christopher Campbell

2021 International Building Code - Second Printing

Delete without substitution:

~~1020.2.1 Hoistway opening protection. Elevator hoistway openings shall be protected in accordance with Section 3006.2.1.~~

Reason Statement: The VCC has historically eliminated the requirement for hoistway opening protection in 3006. As long as that section is eliminated in the 2021 VCC, the reference to 3006 from 1020 is invalid.

 **Resiliency Impact Statement:** This proposal will neither increase nor decrease Resiliency

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This proposal is simply removing an invalid reference created by the removal of Section 3006, part of a separate code change.

EB102.2.2-21

VEBC: 102.2.2

Proponents: Ronald Clements (clementsro@chesterfield.gov)

2018 Virginia Existing Building Code

Revise as follows:


102.2.2 Reconstruction, alteration, or repair in Group R-5 occupancies. Compliance with this section shall be an acceptable alternative to compliance with this code at the discretion of the owner or owner's agent. The VCC may be used for the reconstruction, *alteration*, or *repair* of Group R-5 *buildings* or *structures* subject to the following criteria:

1. Any reconstruction, *alteration* or *repair* shall not adversely affect the performance of the *building* or *structure*, or cause the *building* or *structure* to become unsafe or lower existing levels of health and safety.
2. Parts of the *building* or *structure* not being reconstructed, altered, or repaired shall not be required to comply with the requirements of the VCC applicable to newly constructed *buildings* or *structures*.
3. The installation of material or *equipment*, or both, that is neither required nor prohibited shall only be required to comply with the provisions of the VCC relating to the safe installation of such material or *equipment*.
4. Material or *equipment*, or both, may be replaced in the same location with material or *equipment* of a similar kind or capacity.
5. In accordance with § 36-99.2 of the Code of Virginia, installation or replacement of glass shall comply with Section R308 or Chapter 24 of the VCC.

Exceptions:

1. This section shall not be construed to permit non-compliance with any applicable flood load or flood-resistant construction requirements of the VCC.
2. Reconstructed decks, balconies, porches, and similar *structures* located 30 inches (762 mm) or more above grade shall meet the current code provisions for structural loading capacity, connections, and structural attachment. This requirement excludes the configuration and height of handrails and guardrails.
3. Repair or replacement of smoke alarms shall be with devices listed in accordance with UL217 and that are no more than 10 years from the date of manufacture. Battery-only powered devices shall be powered by a 10-year sealed battery.

Reason Statement: VEBC section 302.3 has this requirement that replacement smoke alarms must meet UL 217 and requires 10 year sealed batteries for battery only replacements. If the R-5 exception is taken to use the VRC instead of the VEBC this requirement to have current technology replacement smoke alarms is lost. This code change brings application of the VRC to R-5 consistent with use of the VEBC for R-5.

 **Resiliency Impact Statement:** This proposal will neither increase nor decrease Resiliency
This code change has no impact on resiliency.

Cost Impact: The code change proposal will increase the cost of construction

The cheapest smoke alarm I could find on Amazon was an \$8.27 9V only alarm that would not meet this code provision. The cheapest smoke alarm I could find on Amazon that meets the requirement is \$15.99.

EB603.6-21

VEBC: 603.6


Proponents: Ronald Clements (clementsro@chesterfield.gov)

2018 Virginia Existing Building Code

Delete without substitution:

~~**603.6 Plumbing.** Where the occupant load of the story is increased by more than 20 percent, plumbing *fixtures* for the story shall be provided in quantities specified in the *International Plumbing Code* based on the increased occupant load.~~

Reason Statement: Any occupant load change that increases the number of required plumbing fixtures is a change of occupancy by definition and section 710.1 is applicable. This provision is not consistent with the exception to 710.1 creating a confusing conflict.

 **Resiliency Impact Statement:** This proposal will neither increase nor decrease Resiliency

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This section is already overridden by section 710.1 so this is effectively editorial.

EB707.2-21

VEBC: 707.2

Proponents: Ronald Clements (clementsro@chesterfield.gov)


2018 Virginia Existing Building Code

Revise as follows:

707.2 Exterior wall rating for change of occupancy classification to a higher hazard category. When a *change of occupancy* classification is made to a higher hazard category as shown in Table 707.1, exterior walls shall have fire resistance and exterior opening protectives as required by the VCC.

Exception: ~~A two-hour fire resistance rating shall be allowed where the building does not exceed three stories in height and is classified as one of the following groups: A-2 and A-3 with an occupant load of less than 300, B, F, M or S.~~

Reason Statement: The exception is never applicable because the listed occupancies are never required to have a rating greater than 2 hours. This error is even noted in the ICC commentary for this section (1011.6.1 in the IEBC).

 **Resiliency Impact Statement:** This proposal will neither increase nor decrease Resiliency

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal removes and moot exception so it will not affect cost.

P1003.3.2-21

IPC: CHAPTER 10, SECTION 1003, 1003.3.2

Proponents: Brent Werlein (bwerlein@vbgov.com)

2021 International Plumbing Code


CHAPTER 10 TRAPS, INTERCEPTORS AND SEPARATORS

SECTION 1003 INTERCEPTORS AND SEPARATORS

Revise as follows:

1003.3.2 Food waste disposers restriction. ~~A food waste disposer shall not discharge to a grease interceptor. Where food waste grinders are used, a solids interceptor shall separate the discharge before connecting to the grease interceptor. Solids interceptors and grease interceptors shall be sized and rated for the discharge of the food waste grinder. Emulsifiers, chemicals, enzymes and bacteria shall not discharge into the food waste grinder.~~

Reason Statement: The use of food waste grinders also become a dumping sink for all food wastes and the grinders break up the food into small particles that heavily contribute to Fats, Oils and Grease production. Grease interceptors are not designed to handle solids loading so a solids interceptor is needed before a grease interceptor. If food waste grinder drains are allowed to bypass a grease interceptor, then the grease is passed through to the sewer collection system.

 **Resiliency Impact Statement:** This proposal will neither increase nor decrease Resiliency

This proposal will not have an impact on the resiliency of the system in regards natural disasters, sea level rise and other climate concerns

Cost Impact: The code change proposal will increase the cost of construction

Having to add a solids separator within the series will increase the costs when compared to being able to bypass a grease interceptor.

RB324-21

IRC: R324.6.1

Proponents: Alan Larsen (alarsen120@aol.com)

2021 International Residential Code

Revise as follows:

R324.6.1 Pathways. ~~Not fewer than two pathways. One pathway of 18 inches width on separate roof planes~~ from lowest roof edge to ridge ~~and not less than 36 inches (914 mm) wide, shall be provided on all buildings. Not fewer than one~~ One pathway shall be provided on the street or driveway side of the roof. ~~For~~ For each roof plane with a photovoltaic array, a pathway ~~not less than 36 inches wide (914 mm) of 18 inches shall be provided from the lowest roof edge to ridge on the same roof plane as the photovoltaic array, on an adjacent roof plane, or straddling the same and adjacent roof planes. Pathways plane if the adjacent roof plane has a photovoltaic array. If the adjacent roof plane does not have a photovoltaic array, then no pathway is required.~~ Pathways shall be over areas capable of supporting fire fighters accessing the roof. Pathways shall be located in areas with minimal obstructions such as vent pipes, conduit, or mechanical equipment.

Reason Statement: We submit these written comments for the record in the 2021 Code Development Cycle, pursuant to the Notices of Intended Regulatory Action (NOIRA) approved by the Board of Housing and Community Development (BHCD) on October 25, 2021 and published in the Virginia Register of Regulations on November 22, 2021.

We represent solar installation companies and organizations that provide and install rooftop solar facilities for residential and commercial customers throughout the Commonwealth of Virginia. We are addressing IRC Code provision R324.6.1 that pertains to access (pathways) to rooftops for fire fighting purposes, and requirements that go beyond what is needed for safety to become impediments to solar installations.

Setbacks are meant for safety and accessibility for firemen to do their work. The code is written in terms that refer to the distance from the edge of the roofline to the side of the nearest solar panel. But across-the-board requirements that are stated merely as inches-of-width, without regard to where such set-backs would be placed and why, do not create safer conditions. Of course it's good practice to have a setback on roofs where firemen could have to operate in case of emergency, but what about the roofs where fire fighters would never walk?

Virginia has adopted a statutory mandate to encourage installation of rooftop solar and eliminate impediments to doing that. On the other hand, it has fire and safety requirements. The Code must balance those two policy goals and legal mandates. A provision that creates greater impediments to solar would undercut the solar imperative for no safety gain.

In 2014, our industry encountered a fire code setback issue in Arlington. We contacted the state, and the Commonwealth's Department of Housing and Community Development addressed the issue as follows:

"Chapter 23 of the IRC [International Residential Code] regulates the installation of residential photo voltaic roof systems and requires them to be installed in accordance with NFPA 70 (NEC) and the manufacturer's installation instructions. Specifically the IRC does nor reference the Fire Code, therefor photo voltaic requirements set forth in the Fire Code are not applicable to one and two family dwellings that fall within the scope of the IRC."

Aside from the issue of applicability of R324.6.1 to residential rooftop installations, this statement from the Commonwealth indicates the balance that the state brings to the issue of impediments to solar installations versus safety measures. And this was before the adoption by the 2020 session of the General Assembly of additional mandates to further solar installations, including the Virginia Clean Economy Act which made promotion and installation of solar facilities a state-wide priority and mandate.

Resiliency Impact Statement: This proposal will neither increase nor decrease Resiliency

Cost Impact:

None.

2015 VUSBC AND I-CODE PROVISIONS APPLICABLE TO CONSTRUCTION IN FLOOD HAZARD AREAS

Red underlined and ~~strikethrough~~ are proposed changes to provide resilience.

USBC Part I - Virginia Construction Code (VCC and IBC)

102.2.2 Flood and coastal wind hazard resilience areas. Notwithstanding the foregoing restrictions on scope, localities within Coastal Virginia may, but are not required to, establish flood and coastal wind hazard resilience areas. Within flood and coastal wind hazard resilience areas, all development in these coastal areas of the Commonwealth shall be designed and constructed to resist all forces placed on buildings related to tropical cyclones, Nor'easters, high-tide events, storm surge, flash floods, stormwater runoff, and the related impacts of sea-level rise. This shall require that for any new construction within Resilience Areas, the resulting structure shall be stronger, more resilient and less subject to risks from flooding and high winds than may otherwise be provided in this Code. The following shall be included in flood and coastal wind resilience areas:

1. A sea-level rise factor shall be incorporated into plans for all new construction subject to this Code. At a minimum, the factor shall consider 50 years of projected sea-level rise using a locally adopted method and projection. In the absence of a locally adopted method, the design of permanent structures shall include three feet (90cm) of sea level rise plus three feet (90cm) of freeboard to the lowest habitable floor elevation.
2. The mandated use of FEMA Technical Bulletin best practices for coastal construction shall be required within resilience areas.
3. A continuous load path from roof to foundation shall be provided in each new building subject to this Code and shall be certified by an RDP as sufficient to manage the lateral, twisting or racking, uplift and compression forces reasonably expected to act on the structure over the expected lifespan of the structure or 50 years, whichever is the greater timeframe.
4. The mandated use of recognized performance- and resilience-based codes shall be permitted by local adoption within resilience areas, provided that the relevant portions of such codes are used in their entirety.
5. Restrictions on the construction and use of basements shall be a permissible local adoption.

103.4 Use of certain provisions of referenced codes. The following provisions of the IBC and of other indicated codes or standards are to be considered valid provisions of this code. Where any such provisions have been modified by the state amendments to the IBC, then the modified provisions apply.

1. Special inspection requirements in Chapters 2 - 35.
2. Testing requirements and requirements for the submittal of *construction* documents in any of the ICC codes referenced in Chapter 35 and in the IRC.

3. Section R301.2 of the IRC authorizing localities to determine climatic and geographic design criteria.
4. 4. Flood load or flood-resistant *construction* requirements in the IBC or the IRC, including, but not limited to, any such provisions pertaining to flood elevation certificates that are located in Chapter 1 of those codes. Any required flood elevation certificate pursuant to such provisions shall be prepared by a land surveyor or engineer licensed in Virginia ~~or an RDP~~.

108.2 Exemptions from application for permit. Notwithstanding the requirements of Section 108.1, application for a permit and any related inspections shall not be required for the following; however, this section shall not be construed to exempt such activities from other applicable requirements of this code. In addition, when an owner or an owner's agent requests that a permit be issued for any of the following, then a permit shall be issued and any related inspections shall be required.

1. Installation of wiring and equipment that (i) operates at less than 50 volts, (ii) is for broadband communications systems, (iii) is exempt under Section 102.3(1) or 102.3(4), or (iv) is for monitoring or automation systems in dwelling units, except when any such installations are located in a plenum, penetrate fire rated or smoke protected constructed or are a component of any of the following:
 - 1.1. Fire alarm system.
 - 1.2. Fire detection system.
 - 1.3. Fire suppression system.
 - 1.4. Smoke control system.
 - 1.5. Fire protection supervisory system.
 - 1.6. Elevator fire safety control system.
 - 1.7. Access or egress control system or delayed egress locking or latching system.
 - 1.8. Fire damper.
 - 1.9. Door control system.
2. One story detached structures used as tool and storage sheds, playhouses or similar uses, provided the building area does not exceed 256 square feet (23.78 m²) and the structures are not classified as a Group F-1 or H occupancy.
3. Detached prefabricated buildings housing the equipment of a publicly regulated utility service, provided the floor area does not exceed 150 square feet (14 m²).
4. Tents or air-supported structures, or both, that cover an area of 900 square feet (84 m²) or less, including within that area all connecting areas or spaces with a common means of egress or entrance, provided such tents or structures have an occupant load of 50 or less persons.
5. Fences of any height unless required for pedestrian safety as provided for by Section 3306, or used for the barrier for a swimming pool.
6. Concrete or masonry walls, provided such walls do not exceed six feet (185 cm) in height above the finished grade. Ornamental column caps shall not be considered to contribute to the height of the wall and shall be permitted to extend above the six feet (185 cm) height measurement.

7. Retaining walls supporting less than three feet of unbalanced fill that are not constructed for the purpose of impounding Class I, II or III-A liquids or supporting a surcharge other than ordinary unbalanced fill.
8. Swimming pools that have a surface area not greater than 150 square feet (13.95 m²), do not exceed 5,000 gallons (19 000 L) and are less than 24 inches (~~610 mm~~ 60 cm) deep.
9. Signs under the conditions in Section H101.2 of Appendix H.
10. Replacement of above-ground existing LP-gas containers of the same capacity in the same location and associated regulators when installed by the serving gas supplier.
11. Flagpoles 30 feet (~~914 mm~~ 9 m) or less in height.
12. Temporary ramps serving dwelling units in Group R-3 and R-5 occupancies where the height of the entrance served by the ramp is no more than 30 inches (~~762 mm~~ 75 cm) above grade.
13. Construction work deemed by the building official to be minor and ordinary and which does not adversely affect public health or general safety.
14. Ordinary repairs that include the following:
 - 14.1. Replacement of windows and doors with windows and doors of similar operation and opening dimensions that do not require changes to the existing framed opening and that are not required to be fire rated in Group R-2 where serving a single dwelling unit and in Groups R-3, R-4 and R-5.
 - 14.2. Replacement of plumbing fixtures and well pumps in all groups without alteration of the water supply and distribution systems, sanitary drainage systems or vent systems.
 - 14.3. Replacement of general use snap switches, dimmer and control switches, 125 volt-15 or 20 ampere receptacles, luminaries (lighting fixtures) and ceiling (paddle) fans in Group R-2 where serving a single dwelling unit and in Groups R-3, R-4 and R-5.
 - 14.4. Replacement of mechanical appliances provided such equipment is not fueled by gas or oil in Group R-2 where serving a single-family dwelling and in Groups R-3, R-4 and R-5.
 - 14.5. Replacement of an unlimited amount of roof covering or siding in Groups R-3, R-4 or R-5 provided the building or structure is not in an area where the nominal design wind speed is greater than 100 miles per hour (44.7 meters per second) and replacement of 100 square feet (9.29 m²) or less of roof covering in all groups and all wind zones.
 - 14.6. Replacement of 256 square feet (23.78 m²) or less of roof decking in Groups R-3, R-4 or R-5 unless the decking to be replaced was required at the time of original construction to be fire-retardant-treated or protected in some other way to form a fire-rated wall termination.
 - 14.7. Installation or replacement of floor finishes in all occupancies.
 - 14.8. Replacement of Class C interior wall or ceiling finishes installed in Groups A, E and I and replacement of all classes of interior wall or ceiling finishes in other groups.
 - 14.9. Installation or replacement of cabinetry or trim.
 - 14.10. Application of paint or wallpaper.
 - 14.11. Other repair work deemed by the building official to be minor and ordinary which does not adversely affect public health or general safety.

15. Crypts, mausoleums, and columbaria structures not exceeding 1500 square feet (~~139.35~~ 140 m²) in area if the building or structure is not for occupancy and used solely for the interment of human or animal remains and is not subject to special inspections.
16. Billboard safety upgrades to add or replace steel catwalks, steel ladders, or steel safety cable.

Exceptions:

1. Application for a permit may be required by the building official for the installation of replacement siding, roofing and windows in buildings within a historic district designated by a locality pursuant to Section 15.2-2306 of the Code of Virginia.
2. Application for a permit ~~may~~ shall be required by the building official for ~~any~~ items ~~otherwise~~ exempted in this section which are located within a special flood hazard area.

109.3 Engineering details. When determined necessary by the building official, *construction* documents shall include adequate detail of the structural, mechanical, plumbing or electrical components. Adequate detail may include computations, stress diagrams or other essential technical data and when proposed buildings are more than two stories in height, adequate detail may specifically be required to include where floor penetrations will be made for pipes, wires, conduits, and other components of the electrical, mechanical and plumbing systems and how such floor penetrations will be protected to maintain the required structural integrity or fire-resistance rating, or both, including how such floor penetrations will be adequately dry floodproofed and designed for flood resistance as required by Section 1403.6 for structures located within any flood hazard area or special flood hazard area. All engineered documents, including relevant computations, shall be sealed by the RDP responsible for the design.

113.3 Minimum inspections. The following minimum inspections shall be conducted by the building official when applicable to the construction or permit:

1. Inspection of footing excavations and reinforcement material for concrete footings prior to the placement of concrete.
2. Inspection of foundation systems during phases of construction necessary to assure compliance with this code.
3. Inspection of preparatory work prior to the placement of concrete.
4. Inspection of the elevation of the lowest floor in accordance with Section 110.3.3 prior to further vertical construction located in any flood hazard area or special flood hazard area.
5. Inspection of structural members and fasteners prior to concealment.
6. Inspection of electrical, mechanical and plumbing materials, equipment and systems prior to concealment.
7. Inspection of energy conservation material prior to concealment.
8. Inspection of the elevation of the lowest floor in accordance with Section 110.3.10.1 prior to final inspection located in any flood hazard area or special flood hazard area.
9. Final inspection.

117.2 Moved buildings and structures. Any building or structure moved into a *locality* or moved to a new location within a *locality* shall not be occupied or used until a certificate of occupancy is issued for the new location and for any building or structure moved into or within a flood hazard area, the flood hazard documentation has been approved by the building official as required by Section 1612.5. Such moved buildings or structures shall be required to comply with the requirements of the VEBC.

[IBC] BASE FLOOD ELEVATION. The elevation of the base flood, including wave height, relative to the National Geodetic Vertical Datum (NGVD), North American Vertical Datum (NAVD) or other datum specified on the Flood Insurance Rate Map (FIRM), and as shown in the Flood Insurance Study.

[IBC] COASTAL A ZONE. Area within a special flood hazard area, landward of a V zone or landward of an open coast without mapped *Coastal High Hazard Areas*. In a *Coastal A Zone*, the principal source of flooding must be astronomical tides, storm surges, seiches or tsunamis, not riverine flooding. During the base flood conditions, the potential for breaking wave height shall be greater than or equal to 11/2 1.5 feet (457 mm cm), and not greater than three feet (90 cm). The inland limit of the *Coastal A Zone* is (a) the Limit of Moderate Wave Action if delineated on a FIRM, or (b) designated by the authority having jurisdiction.

[IBC] COASTAL HIGH HAZARD AREA. Area within the special flood hazard area extending from offshore to the inland limit of a ~~primary dune~~ Coastal Primary Sand Dune, as defined by state code (Code of Virginia Title 28.2), along an open coast and any other area that is subject to high-velocity wave action from storms or seismic sources, and shown in either the Flood Insurance Study, or on a the Flood Insurance Rate Map (FIRM) or other flood hazard map as velocity Zone V, VO, VE or V1-30 (areas subject to wave heights of 3 feet (90 cm) or more).

[IBC] DESIGN BASE FLOOD. The flood associated with the greater of the following two areas:

1. Area with a flood plain subject to a 1-percent or greater chance of flooding in any year (also known as the 100-year floodplain).
2. Area designated as a flood hazard area on a community's flood hazard map, or otherwise legally designated, including areas shown in either the Flood Insurance Study or on the Flood Insurance Rate Map (FIRM).

[IBC] DESIGN FLOOD ELEVATION. The base flood elevation of the "~~design~~ base flood," including wave height, plus three feet of freeboard, relative to the datum specified on the community's legally designated flood hazard map. In areas designated as Zone AO, the *design flood elevation* shall be the elevation of the highest existing grade of the building's perimeter plus the depth number (in feet) specified on the flood hazard map, plus 3 feet (90 cm) of freeboard. In areas designated as Zone AO where a depth number is not specified on the map, the depth number shall be taken as being equal to 2 feet (~~610 mm~~ 60 cm).

EXISTING STRUCTURE. A structure (i) for which a legal building permit has been issued under any edition of the USBC, (ii) which has been previously approved, or (iii) which was built prior to

the initial edition of the USBC. For application of provisions in flood hazard areas, an existing structure is any building or structure for which ~~the start of construction commenced~~ a complete building permit application was submitted, diligently pursued, before the effective date of the community's first flood plain management code, ordinance, or standard, provided that all work was carried out to completion without expiration of the legally issued building permit.

[IBC] [FLOOD or FLOODING].

1. A general and temporary condition of partial or complete inundation of normally dry land from either of the following:
 - 1.1 The overflow of inland or tidal waters.
 - 1.2 The unusual and rapid accumulation or runoff of surface waters from any source.
2. The collapse or subsidence of land along the shore of a lake or other body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels or suddenly caused by an unusually high water level in a natural body of water, accompanied by a severe storm, or by an unanticipated force of nature such as flash flood or an abnormal tidal surge, or by some similarly unusual and unforeseeable event which results in flooding as defined in subsection (1.1) of this definition.
3. Mudflows which are proximately caused by flooding as defined in subsection (1.2) of this definition and are akin to a river of liquid and flowing mud on the surface of normally dry land areas, as when earth is carried by a current of water and disposed along the path of the current.

FLOOD AND COASTAL WIND HAZARD RESILIENCE AREAS. A designation in the local government comprehensive plan of coastal communities in the Commonwealth which identifies one or more areas that experience coastal flooding due to extreme high tides and storm surge, tropical cyclones, Nor'easters, flash floods, stormwater runoff and that are vulnerable to the related impacts of rising sea level for the purpose of prioritizing funding for infrastructure needs and adaptation planning, including establishment of higher standards for building construction, reconstruction, alteration and repair within the Resilience Area. Examples of Flood and Coastal Wind Resilience Areas may include, but are not limited to designated floodplains and special flood hazard areas, Chesapeake Bay Preservation Areas, designated evacuation zones and routes, areas determined by modelling to be at risk from recurrent flooding resulting from sea level rise within fifty years, areas within 1000 feet of the coastline of the ocean, bay or estuarian reach of a tidal river and other similar areas designated within the local comprehensive plan. Any locality in Coastal Virginia may adopt Flood and Coastal Wind Resilience Areas but shall not be obligated to do so.

[IBC] FLOOD HAZARD AREA. The greater of the following two areas:

1. The area within a flood plain subject to a 1-percent or greater chance of flooding in any year (also known as the 100-year floodplain).

2. The area designated as a *flood hazard area* on a community's flood hazard map, or otherwise legally designated, including areas shown in either the Flood Insurance Study or on the Flood Insurance Rate Map (FIRM).

[IBC] FLOODWAY. The channel of the river, creek or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height as designated on a community's flood hazard map, or otherwise legally designated, including areas shown in either the Flood Insurance Study or on the Flood Insurance Rate Map (FIRM).

[IBC] FUNCTIONALLY DEPENDENT FACILITY. A facility that cannot be used for its intended purpose unless it is located or carried out in close proximity to water, such as a docking or port facility necessary for the loading or unloading of cargo or passengers, shipbuilding or ship repair. The term does not include long-term storage, manufacture, sales or service facilities.

[IBC] SPECIAL FLOOD HAZARD AREA. The land area subject to flood hazards and shown on a Flood Insurance Rate Map ~~or other flood hazard map~~ as Zone A, AE, A1-30, A99, AR, AO, AH, V, VO, VE or V1-30.

SUBSTANTIAL IMPROVEMENT. For the purpose of determining compliance with the flood provisions of this code, any improvement, including repair, reconstruction, rehabilitation, alteration, or addition, or other improvement of a building or structure or a portion thereof, located within a flood hazard area or special flood hazard area or flood and coastal wind resilience area, the cost of which equals or exceeds 50% of the market value of the building or structure before the improvement or repair is started. If the building or structure or portion thereof has sustained substantial damage, any improvements are considered substantial improvements regardless of the actual improvement performed. The term does not, however, include either:

1. Any project for improvement of a building or a structure or portion thereof required to correct existing health, sanitary, or safety code violations identified by the building official and that is the minimum necessary to assure safe living conditions; or
2. Any alteration of a historic structure, provided that the alteration will not preclude the building or structure's continued designation as a historic building or structure.
3. Buildings or structures located outside of the special flood hazard area but within a flood hazard area or flood and coastal wind resilience area designated by the locality, if the locality's regulatory standards specifically exempt such flood hazard area from the substantial improvement provisions of the VCC, or from any other locally adopted substantial improvement requirement.
4. Any improvements necessary with elevating a structure above the design flood elevation.

[IBC] 801.5 Applicability. For buildings in flood hazard areas as established in Section 1612.3, interior finishes, trim and decorative materials below the design flood elevation required by Section 1612 shall be flood-damage-resistant materials.

[IBC] 1203.4.2 Exceptions.

The following are exceptions to Sections 1203.4 and 1203.4.1:

1. Where warranted by climatic conditions, ventilation openings to the outdoors are not required if ventilation openings to the interior are provided.
2. The total area of ventilation openings is permitted to be reduced to 1/1,500 of the under-floor area where the ground surface is covered with a Class I vapor retarder material and the required openings are placed so as to provide cross ventilation of the space. The installation of operable louvers shall not be prohibited.
3. Ventilation openings are not required where continuously operated mechanical ventilation is provided at a rate of 1.0 cubic foot per minute (cfm) for each 50 square feet (1.02 L/s for each 10 m²) of crawlspace floor area and the ground surface is covered with a Class I vapor retarder.
4. Ventilation openings are not required where the ground surface is covered with a Class I vapor retarder, the perimeter walls are insulated and the space is conditioned in accordance with the International Energy Conservation Code.
5. For buildings in flood hazard areas as established in Section 1612.3, the openings for under-floor ventilation shall be deemed as meeting the flood opening requirements of ASCE 24 provided that the ventilation openings are designed and installed in accordance with ASCE 24 and FEMA TB-1.

[IBC] 1403.6 Flood resistance. For buildings in flood hazard areas as established in Section 1612.3, exterior walls extending below the elevation required by Section 1612 shall be constructed with flood-damage-resistant materials in accordance with ASCE 24 and FEMA TB-2.

[IBC] 1603.1.7 Flood design data. For buildings located in whole or in part in flood hazard areas as established in Section 1612.3, the documentation pertaining to design, if required in Section 1612.5, shall be included and the following information, referenced to the datum on the community's Flood Insurance Rate Map (FIRM), shall be shown, regardless of whether flood loads govern the design of the building:

1. Flood design class assigned according to ASCE 24.
2. In flood hazard areas other than *Coastal High Hazard Areas* or *Coastal A Zones*, the elevation of the proposed lowest floor, including the basement.
3. In flood hazard areas other than *Coastal High Hazard Areas* or *Coastal A Zones*, the elevation to which any nonresidential building will be dry floodproofed.
4. In a Coastal A Zone or Coastal High Hazard Area ~~and Coastal A Zones~~, the proposed elevation of the bottom of the lowest horizontal structural member of the lowest floor, including the basement, or the grade beam if not located below the depth of anticipated scour/erosion as determined by the 1% annual chance

coastal flood event caused by the combined effects of wind and water loads acting simultaneously on all building components in accordance with ASCE 7-10, Minimum Design Loads for Buildings and Other Structures.

[IBC] 1612.4 Design and construction. The design and construction of buildings and structures located in flood hazard areas, including a Coastal A Zone or Coastal High Hazard Areas and Coastal A Zones, shall be in accordance with Chapter 5 of ASCE 7 and ASCE 24.

[IBC] 1612.5 Flood hazard documentation. The following documentation shall be prepared and sealed by a registered design professional and submitted to the building official on an approved National Flood Insurance Program Elevation Certificate (FEMA Form 086-0-33):

1. For construction in flood hazard areas other than *Coastal High Hazard Areas* or *Coastal A Zones*:
 - 1.1. The elevation of the lowest floor, including the basement, as required by the lowest floor elevation inspection in Section 110.3.3 and for the final inspection in Section 110.3.10.1.
 - 1.2. For fully enclosed areas below the *design flood elevation* where provisions to allow for the automatic entry and exit of floodwaters do not meet the minimum requirements in Section 2.7.2.1 of ASCE 24, construction documents shall include a statement that the design will provide for equalization of hydrostatic flood forces in accordance with Section 2.7.2.2 of ASCE 24.
 - 1.3. For dry floodproofed nonresidential buildings, construction documents shall include a statement that the dry floodproofing is designed in accordance with ASCE 24.
2. For construction in a Coastal A Zone or Coastal High Hazard Areas and Coastal A Zones:
 - 2.1. The elevation of the bottom of the lowest horizontal structural member as required by the lowest floor elevation inspection in Section 110.3.3 and for the final inspection in Section 110.3.10.1.
 - 2.2. Construction documents shall include a statement that the building is designed in accordance with ASCE 24, including that the pile or column foundation and building or structure to be attached thereto is designed to be anchored to resist flotation, collapse and lateral movement due to the effects of wind and flood loads acting simultaneously on all building components, and other load requirements of Chapter 16.
 - 2.3. ~~For breakaway walls are prohibited designed to have a resistance of more than 20 psf (0.96 kN/m²) determined using allowable stress design, construction documents shall include a statement that the breakaway wall is designed in accordance with ASCE 24.~~

[IBC] 1805.1.2.1 Flood hazard areas. For buildings and structures in flood hazard areas as established in Section 1612.3, the finished ground level of an under-floor space such as a crawl space shall be equal to or higher than the outside finished ground level on at least one side.

~~**Exception:** Under floor spaces of Group R-3 buildings that meet the requirements of FEMA~~

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R106.1.4 Information for construction in flood hazard areas.

For buildings and structures located in whole or in part in flood hazard areas as established by Table R301.2(1), *construction documents* shall include **on an approved National Flood Insurance Program Elevation Certificate (FEMA Form 086-0-33)**:

1. Delineation of flood hazard areas, floodway boundaries and flood zones and the *design flood elevation*, as appropriate.
2. The elevation of the proposed lowest floor, including *basement*; in areas of shallow flooding (AO Zones), the height of the proposed lowest floor, including *basement*, above the highest adjacent *grade*.
3. The elevation of the bottom of the lowest horizontal structural member in *Coastal High Hazard Areas* (V Zone) and in *Coastal A Zones* where such zones are delineated on flood hazard maps identified in Table R301.2(1) or otherwise delineated by the jurisdiction.
4. If ~~design-base~~ *design-base flood elevations* are not included on the community's Flood Insurance Rate Map (FIRM), the *building official* and the applicant shall obtain and reasonably utilize any ~~design-base~~ *design-base* flood elevation and floodway data available from other sources deemed reliable in accordance with FEMA 265, *Managing Floodplain Development in Approximate Zone A Areas*.

R109.1.3 Floodplain inspections. For construction in flood hazard areas as established by Table R301.2(1), upon placement of the lowest floor, ~~including basement~~, and prior to further vertical construction, the *building official* shall require submission of ~~documentation~~ **an approved National Flood Insurance Program Elevation Certificate (FEMA Form 086-0-33)**, prepared and sealed by a registered *design professional*, of the elevation of the lowest floor, including *basement*, required in Section R322.

R322.1.3 Flood-resistant construction. Buildings and structures erected in areas prone to flooding shall be constructed by methods and practices that minimize flood damage in accordance with FEMA TB-2 and ASCE 24.

R322.1.4 Establishing the design flood elevation. The *design flood elevation* shall be used to define flood hazard areas. At a minimum, the *design flood elevation* shall be the higher of the following:

1. The base flood elevation at the depth of peak elevation of flooding, including wave height, that has a 1 percent (100-year flood) or greater chance of being equaled or exceeded in any given year; or
2. The elevation of the design flood associated with the area designated on a flood hazard map adopted by the community, or otherwise legally designated, including areas shown in either the *Flood Insurance Study* or on the *Flood Insurance Rate Map (FIRM)*.

R322.1.6 Protection of mechanical, plumbing and electrical systems. Electrical systems, *equipment* and components; heating, ventilating, air conditioning; plumbing *appliances* and plumbing fixtures; *duct systems*; and other service *equipment* shall be located at or above the elevation required in Section R322.2 or R322.3. If replaced as part of a substantial improvement, electrical systems, *equipment* and components; heating, ventilating, air conditioning and plumbing *appliances* and plumbing fixtures; *duct systems*; and other service *equipment* shall meet the requirements of this section. Systems, fixtures, and *equipment* and components shall not be mounted on or penetrate through walls intended to break away under flood loads.

Exception: ~~Locating electrical systems, equipment and components; heating, ventilating, air conditioning; plumbing appliances and plumbing fixtures; duct systems; and other service equipment is permitted below the elevation required in Section R322.2 or R322.3 provided that they are designed and installed to prevent water from entering or accumulating within the components and to resist hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding to the design flood elevation in accordance with ASCE 24.~~ Electrical wiring systems are permitted to be located below the required elevation provided that they conform to the provisions of the electrical part of this code for wet locations in accordance with FEMA P-348.

R322.1.8 Flood-resistant materials. Building materials and installation methods used for flooring and interior and exterior walls and wall coverings below the elevation required in Section R322.2 or R322.3 shall be flood damage-resistant materials that conform to the provisions of FEMA TB-2 and ASCE 24.

R322.1.9 Manufactured homes. The bottom of the frame of new and replacement *manufactured homes* on foundations that conform to the requirements of Section R322.2 or R322.3, as applicable, shall be elevated to or above the design flood elevations specified in Section R322.2 (flood hazard areas including A Zones) or R322.3 in *Coastal High Hazard Areas* (V Zones and *Coastal A Zones*). The anchor and tie-down requirements of the applicable state or federal requirements shall apply. The foundation and anchorage of *manufactured homes* to be located in identified floodways shall be designed and constructed in accordance with ASCE 24.

R322.2 Flood hazard areas (including A Zones). Areas that have been determined to be prone to flooding and that are not subject to high-velocity wave action shall be designated as flood hazard areas. Flood hazard areas that have been delineated as subject to wave heights between greater than or equal to 1 1/2 feet (457 mm cm) and 3 feet (914 mm) or otherwise designated by the jurisdiction ~~shall be~~ are designated as either Coastal A Zones or V, VE or V1-30 Zones and are subject to the requirements of Section R322.3. Buildings and structures constructed in whole or in part in flood hazard areas shall be designed and constructed in accordance with Sections R322.2.1 through R322.2.3.

R322.2.1 Elevation requirements.

1. Buildings and structures in flood hazard areas, not including flood hazard areas designated as Coastal A Zones, shall have the lowest floors elevated to or above either the base flood elevation plus ~~1 foot~~ 3 feet (305 90 mm cm), or the *design flood elevation*, whichever is higher.
2. In areas of shallow flooding (AO Zones), buildings and structures shall have the lowest floor (including basement) elevated to a height above the highest adjacent grade of not less than the depth number specified in feet (mm) on the FIRM plus ~~1 foot~~ 3 feet (305 90 mm cm), or not less than ~~3-5~~ feet (915 150 mm cm) if a depth number is not specified.
3. Basement floors that are below grade on all sides are prohibited shall be elevated to or above base flood elevation plus 1 foot (305 mm), or the design flood elevation, whichever is higher.

Exception: Enclosed areas below the *design flood elevation*, including basements with floors that are not below grade on all sides, shall meet the requirements of Section R322.2.2.

R322.2.2 Enclosed area below design flood elevation. Enclosed areas, including crawl spaces, that are below the *design flood elevation* shall:

1. Be used solely for parking of vehicles, building access or storage.
2. Be provided with flood openings that meet the following criteria and are installed in accordance with Section R322.2.2.1:
 - 2.1. The total net area of flood openings shall be not less than 1 square inch (645 mm²) for each square foot (0.093 m²) of enclosed area where the enclosed area is measured on the exterior of the enclosure walls, or the flood openings shall be designed as engineered flood openings and the *construction documents* shall include a statement by a registered *design professional* that the design of the flood openings will provide for equalization of hydrostatic flood forces on *exterior walls* by allowing for the automatic entry and exit of floodwaters as specified in Section 2.6.2.2 of ASCE 24 and in FEMA TB-1.
 - 2.2. Flood ~~o~~ openings shall be not less than 3 inches (~~76 mm~~ 8 cm) in any direction in the plane of the wall.
 - 2.3. The presence of louvers, blades, screens and faceplates or other covers and devices shall allow the automatic flow of floodwater into and out of the enclosed areas and shall be accounted for in the determination of the net open area.

R322.2.2.1 Installation of openings. The walls of enclosed areas shall have flood openings installed such that:

1. There shall be not less than two openings on different sides of each enclosed area; if a building has more than one enclosed area below the *design flood elevation*, each area shall have flood openings.
2. The bottom of each flood openings shall be not more than 1 foot (305 ~~mm~~ cm) above the higher of the final interior grade or floor ~~and or~~ the finished exterior grade immediately under each flood openings.

3. Flood Openings shall be permitted to be installed in doors and windows; doors and windows without installed flood openings do not meet the requirements of this section.

R322.2.4 Tanks. Underground tanks shall be anchored to prevent flotation, collapse and lateral movement under conditions of the base flood. Above-ground tanks shall be installed at or above the design flood elevation required in Section R322.2.1 or shall be anchored to prevent flotation, collapse and lateral movement under conditions of the base flood.

R322.3 Coastal A Zone or Coastal High Hazard Areas (including V Zones ~~and Coastal A Zones, where designated~~). Areas that have been determined to be subject to wave heights in excess of ~~3~~ 1 ½ feet (914-45 cm mm) or subject to high-velocity wave action or wave-induced erosion shall be designated as a Coastal A Zone or Coastal High Hazard Areas. ~~Flood hazard areas that have been designated as subject to wave heights between 1½ feet (457 mm) and 3 feet (914 mm) or otherwise designated by the jurisdiction shall be designated as Coastal A Zones.~~ Buildings and structures constructed in whole or in part in a Coastal A Zone or Coastal High Hazard Areas ~~and Coastal A Zones, where designated~~, shall be designed and constructed in accordance with Sections R322.3.1 through R322.3.7.

R322.3.1 Location and site preparation.

1. New buildings and buildings that are determined to be substantially improved pursuant to Section R105.3.1.1 shall be located landward of the reach of mean high tide.
Exception: Any functionally dependent facility.
2. For any alteration of sand dunes and mangrove stands, the building official shall require submission of an engineering analysis and a satisfactory Comment Document from FEMA for a Conditional Letter of Map Revision (CLOMR) that demonstrates that the proposed alteration will not increase the potential for flood damage.

R322.3.2 Elevation requirements.

1. Buildings and structures erected within a Coastal A Zone or Coastal High Hazard Areas ~~and Coastal A Zones~~, shall be elevated so that the bottom of the lowest horizontal structural members supporting the lowest floor, with the exception of piling, pile caps, columns, grade beams and bracing, is elevated to or above the base flood elevation plus ~~1 foot~~ 3 feet (305-90 cm mm) or the design flood elevation, whichever is higher.
2. Grade beams shall be located below the lowest expected eroded surface in accordance with Section R322.3.3.
3. Basement floors that are below grade on all sides are prohibited.
4. The use of fill for structural support is prohibited.

5. Minor grading, and the placement of minor quantities of fill, shall be permitted for landscaping and for drainage purposes under and around buildings and for support of parking slabs, pool decks, patios and walkways in accordance with FEMA TB-5.
6. Walls and partitions enclosing areas below the *design flood elevation* shall meet the requirements of Sections R322.3.4 and R322.3.5.

R322.3.3 Foundations. Buildings and structures erected in a Coastal A Zone or Coastal High Hazard Area ~~and Coastal A Zones~~ shall be supported on pilings or columns and shall be adequately anchored to such pilings or columns. The space below the elevated building shall be ~~either free of obstruction or, if enclosed with walls, the walls shall meet the requirements of Section R322.3.4~~. Pilings shall have adequate soil penetrations to resist the combined wave and wind loads (lateral and uplift). Water-loading values used shall be those associated with the design flood. Wind-loading values shall be those required by this code. Pile embedment shall include consideration of decreased resistance capacity caused by scour of soil strata surrounding the piling. Pile systems design and installation shall be certified in accordance with Section R322.3.6. Spread footing, mat, raft or other foundations that support columns shall not be permitted where soil investigations that are required in accordance with Section R401.4 indicate that soil material under the spread footing, mat, raft or other foundation is subject to scour or erosion from wave-velocity flow conditions. If permitted, spread footing, mat, raft or other foundations that support columns shall be designed in accordance with ASCE 24. Slabs, pools, pool decks and walkways shall be located and constructed to be structurally independent of buildings and structures and their foundations to prevent transfer of flood loads to the buildings and structures during conditions of flooding, scour or erosion from wave-velocity flow conditions, unless the buildings and structures and their foundations are designed to resist the additional flood load.

~~**Exception:** In Coastal A Zones, stem wall foundations supporting a floor system above and backfilled with soil or gravel to the underside of the floor system shall be permitted provided the foundations are designed to account for wave action, debris impact, erosion and local scour. Where soils are susceptible to erosion and local scour, stem wall foundations shall have deep footings to account for the loss of soil.~~

R322.3.4 Walls below *design flood elevation*. Walls and partitions ~~are permitted~~ below the elevated floor are prohibited in a Coastal A Zone or Coastal High Hazard Area, ~~provided that such walls and partitions are not part of the structural support of the building or structure and:~~

- ~~1. Electrical, mechanical and plumbing system components are not to be mounted on or penetrate through walls that are designed to break away under flood loads; and~~
- ~~2. Are constructed with insect screening or open lattice; or~~
- ~~3. Are designed to break away or collapse without causing collapse, displacement or other structural damage to the elevated portion of the building or supporting foundation system. Such walls, framing and connections shall have a resistance of not less than 10 (479 Pa) and not more than 20 pounds per square foot (958 Pa) as determined using allowable stress design; or~~

- ~~4.—Where wind loading values of this code exceed 20 pounds per square foot (958 Pa), as determined using allowable stress design, the *construction documents* shall include documentation prepared and sealed by a registered *design professional* that: 4.1. The walls and partitions below the design flood elevation have been designed to collapse from a water load less than that which would occur during the base flood. 4.2. The elevated portion of the building and supporting foundation system have been designed to withstand the effects of wind and flood loads acting simultaneously on structural and nonstructural building components. Water loading values used shall be those associated with the design flood. Wind loading values shall be those required by this code.~~
- ~~5.—Walls intended to break away under flood loads as specified in Item 3 or 4 have flood openings that meet the criteria in Section R322.2.2, Item 2.~~

R322.3.5 Enclosed areas below *design flood elevation*. Enclosed areas below the *design flood elevation* ~~are prohibited shall be used solely for parking of vehicles, building access or storage.~~

R322.3.5.1 Protection of building envelope. An exterior door that meets the requirements of Section R609 shall be installed at the top of stairs that provide access to the building ~~and that are enclosed with walls designed to break away in accordance with Section R322.3.4.~~

R322.3.7 Tanks. Underground tanks ~~are prohibited shall be anchored to prevent flotation, collapse and lateral movement under conditions of the base flood.~~ Above-ground tanks shall be installed at or above the *design flood elevation* required in Section R322.3.2. Where elevated on platforms, the platforms shall be cantilevered from or knee braced to the building or shall be supported on foundations that conform to the requirements of Section R322.3.

R408.7 Flood resistance. For buildings located in flood hazard areas as established in Table R301.2(1):

1. Walls enclosing the under-floor space shall be provided with flood openings in accordance with Section R322.2.2.
2. The finished ground level of the under-floor space shall be equal to or higher than the outside finished ground level on at least one side.

~~**Exception:** Under floor spaces that meet the requirements of FEMA TB 11-1.~~

DESIGN FLOOD ELEVATION. The elevation of the “design flood,” including wave height, relative to the datum specified on the community’s legally designated flood hazard map. In areas designated as Zone AO, the *design flood elevation* shall be the elevation of the highest existing grade of the *building’s* perimeter plus the depth number, in feet, plus 3 feet (90 cm) specified on the flood hazard map. In areas designated as Zone AO where a depth number is not specified on the map, the depth number shall be taken as being equal to ~~2.5~~ feet (150 cm ~~610 mm~~). [SECTION G2403 (202) GENERAL DEFINITIONS]

FLOOD HAZARD AREA. The greater of the following two areas:

1. The area within a floodplain subject to a 1 percent or greater chance of flooding in any given year (also known as the 100-year floodplain).
2. This area designated as a *flood hazard area* on a community's flood hazard map, or otherwise legally designated, including areas shown in either the *Flood Insurance Study* or on the *Flood Insurance Rate Map (FIRM)* and including areas added to account for future flooding conditions based on the locally adopted sea level rise projected to occur by 2070.

USBC Part II - Virginia Existing Building Code

102.2 Scope. The provisions of this code shall govern construction and rehabilitation activities in existing buildings and structures except in locally designated flood and coastal wind hazard resilience areas (see section 102.2.3 below).

102.2.3 Reconstruction, alteration or repair in locally-designated flood and coastal wind hazard resilience areas. Within flood and coastal wind hazard resilience areas, existing development in coastal areas of the Commonwealth related to tropical cyclones, Nor'easters, high-tide events, storm surge, flash floods, stormwater runoff, and the related impacts of sea-level rise shall be discouraged whenever opportunities arise. This shall require that for any reconstruction, alteration or repair of an existing building within Resilience Areas, the resulting structure shall be stronger, more resilient and less subject to risks from flooding and high winds than was the case prior to work commencing. The following shall be included in flood and coastal wind resilience areas:

1. A sea level rise factor shall be incorporated into plans for all existing structures that are proposed to be reconstructed, altered or repaired subject to the Code. At a minimum, the factor shall consider 30 years of projected sea level rise using a locally adopted method. In the absence of a locally adopted method, the design of such structures shall include two feet (60 cm) of sea level rise plus three feet (90 cm) of freeboard to the lowest habitable floor elevation.
2. The mandated use of FEMA Technical Bulletin Best Practices for coastal construction shall be permitted within resilience areas.
3. The mandated use of recognized performance- and resilience-based codes shall be permitted within resilience areas, provided that the relevant portions of such codes are used in their entirety.

103.4 Use of certain provisions of referenced codes. The following provisions of the IBC and of other indicated codes or standards are to be considered valid provisions of this code. Where any such provisions have been modified by the state amendments to the IBC, then the modified provisions apply.

1. Special inspection requirements in Chapters 2 - 35.
2. Testing requirements and requirements for the submittal of construction documents in any of the ICC codes referenced in Chapter 35 and in the IRC.
3. Section R301.2 of the IRC authorizing localities to determine climatic and geographic design criteria.
4. Flood load or flood-resistant construction requirements in the IBC or the IRC, including, but not limited to, any such provisions pertaining to flood elevation certificates that are located in Chapter 1 of those codes. Any required flood elevation certificate pursuant to such provisions shall be prepared by a land surveyor or professional engineer licensed in Virginia ~~or an RDP~~.
5. Section R101.2 of the IRC.
6. Section N1102.1 of the IRC and Sections C402.1.1 and R402.1 of the IECC.

113.3 Minimum inspections. The following minimum inspections shall be conducted by the building official when applicable to the construction or permit:

1. Inspection of footing excavations and reinforcement material for concrete footings prior to the placement of concrete.
2. Inspection of foundation systems during phases of construction necessary to assure compliance with this code.
3. Inspection of preparatory work prior to the placement of concrete.
4. Inspection of the elevation of the lowest floor in accordance with Section 110.3.3 of the VCC prior to further vertical construction when in any flood hazard area or special flood hazard area.
5. Inspection of structural members and fasteners prior to concealment.
6. Inspection of electrical, mechanical and plumbing materials, equipment and systems prior to concealment.
7. Inspection of energy conservation material prior to concealment.
8. Inspection of the elevation of the lowest floor in accordance with Section 110.3.10.1 of the VCC prior to final inspection when in any flood hazard area or special flood hazard area.
9. Final inspection.

VEBC Chapter 2 Definitions:

FLOOD AND COASTAL WIND HAZARD RESILIENCE AREAS. A designation in the local government comprehensive plan of coastal communities in the Commonwealth which identifies one or more areas that experience coastal flooding due to extreme high tides and storm surge, tropical cyclones, Nor'easters, flash floods, stormwater runoff and that are vulnerable to the related impacts of rising sea level for the purpose of prioritizing funding for infrastructure needs and adaptation planning, including establishment of higher standards for building construction, reconstruction, alteration and repair within the Resilience Area. Examples of Flood and Coastal Wind Resilience Areas may include, but are not limited to designated floodplains and special flood hazard areas, Chesapeake Bay Preservation Areas, designated evacuation zones and routes, areas determined by modelling to be at risk from recurrent flooding resulting from sea level rise within fifty years, areas within 1000 feet of the coastline of the ocean, bay or estuarian reach of a tidal river and other similar areas designated within the local comprehensive plan. Any locality in Coastal Virginia may adopt Flood and Coastal Wind Hazard Resilience Areas but shall not be obligated to do so.

SUBSTANTIAL IMPROVEMENT. For the purpose of determining compliance with the flood provisions of this code, any improvement, including repair, reconstruction, rehabilitation, alteration, or addition, or other improvement of a building or structure or a portion thereof, located within a flood hazard area or special flood hazard area or flood and coastal wind resilience area, the cost of which equals or exceeds 50% of the market value of the building or structure before the improvement or repair is started. If the building or structure or portion

thereof has sustained substantial damage, any improvements are considered substantial improvements regardless of the actual improvement performed. The term does not, however, include either:

1. Any project for improvement of a building or a structure or portion thereof required to correct existing health, sanitary, or safety code violations identified by the building official and that is the minimum necessary to assure safe living conditions; or
2. Any alteration of a historic structure, provided that the alteration will not preclude the building or structure's continued designation as a historic building or structure.
3. Buildings or structures located outside of the special flood hazard area but within a flood hazard area or flood and coastal wind resilience area designated by the locality, if the locality's regulatory standards specifically exempt such flood hazard area from the substantial improvement provisions of the VEBC, or from any other locally adopted substantial improvement requirement.
4. Any improvements necessary with elevating a structure above the design flood elevation.

B432-21

VCC: 432 (New), 432.1 (New)

Proponents: Andrew Milliken (amilliken@staffordcountyva.gov)

2018 Virginia Construction Code

Add new text as follows:

432

Plant Processing or Extraction Facilities

432.1 General. The installation of plant processing or extraction facilities in any occupancy group shall comply with Chapter 39 of the International Fire Code.

Reason Statement: During recent code development cycles, construction requirements have been added to the International Fire Code without a direct link from the International Building Code. This proposal provides the connection between the Virginia Construction Code and the International Fire Code for Plant Processing or Extraction Facilities (IFC Chapter 39).

Resiliency Impact Statement: This proposal will increase Resiliency

This proposal will increase resiliency by shoring up life safety and fire protection requirements between the Virginia Construction Code and the International Fire Code.

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

This proposal simply provides a pointer to the appropriate referenced code sections within the IFC.

EB502.1.1-21

VEBC: 502.1, 502.1.1 (New),

New Referenced Standard:

Chapter 13

(New)

Proponents: Kerry Sutton (kerry.sutton@concrete.org); Scott Campbell (scampbell@nrmca.org); Bill Horne (bhorne@ndtcorporation.com); Keith Kesner (kkesner3006@gmail.com); Matt Miltenberger (mattm@vcservices.com); David Whitmore (davidw@vector-corrosion.com); Jonathan Williams (jonathan.williams@easterassociates.com); Eric Edelson (eedelson@edelsonconsultinggroup.com); Jeff Jezzard (jeffj@vector-construction.com); John Catlett (catlettcodeconsulting@gmail.com)

2018 Virginia Existing Building Code

502.1 General. Structural repairs shall be in compliance with this section and Section 501.2. Regardless of the scope of *repair*, new structural members and connections used for *repair* or *rehabilitation* shall comply with the detailing provisions of the VCC for new *buildings* of similar *structure*, purpose and location.

Revise as follows:

502.1.1 Structural concrete. In addition, assessment, design, and repairs to structural concrete shall be in accordance with ACI CODE 562. Assessment and design of repairs of seismic force-resisting concrete elements that result in changes of strength, stiffness, or ductility from pre-damage conditions shall be in accordance with Section 305.

Add new text as follows:

New Referenced Standard:

Chapter 13

ACI

American Concrete Institute

38800 Country Club Drive

Farmington Hill, MI 48331

. ACI CODE 562-21: Assessment, Repair, and Rehabilitation of Existing Concrete Structures - Code Requirements 502.1

Reason Statement: Concept - This proposal amendment adds ACI CODE 562-21: *Assessment, Repair and Rehabilitation of Existing Concrete Structures*, to establish minimum requirements for the evaluation, design, construction, repair, and rehabilitation of concrete structural elements in buildings for various levels of desired performance as deemed appropriate for the project. This proposal is intended as a modification to the 2018 Virginia Existing Building Code (VEBC). In addition to improved life safety, the requirements clearly define objectives and anticipated performance for the code official, owners, designers, contractors, and installers. The proposed language is not exclusive as *Section 103.1 General* of the 2018 VEBC allows for alternate design and methods of construction when approved by the local building department. Citing this reference provides the building official a baseline for considering approval of design requirements and methods of construction. Further, the baseline is beneficial for product suppliers, owners, designers, contractors and most importantly the expectation of a reasonable level of safety for those residing and working in the Commonwealth of Virginia. It also assists with meeting the requirements of *Section 102.1 Purpose.*, as it provides for cost effective and timely repair options.

Scope - ACI 318 provides specific requirements for structural concrete in the International Building Code, similarly, ACI CODE 562 complements the IEBC by providing specific direction on how to evaluate, design and conduct concrete repairs and how to handle the unique construction problems associated with repairs to concrete elements. This standard provides more in-depth requirements needed by most entities addressing the repair of concrete structural elements than is provided in the IEBC. Further, the standard provides the requirements that bridge the inconsistencies and gaps in acceptable criteria that occur from the two following situations that a designer must solve: 1) repairing a structure according to the original building code used at the time it was built using today's construction methods and materials; or 2) repairing a structure built according to an older building code but repaired according to a more recent building code. ACI CODE 562 includes specifications and requirements for products commonly used for repairs, but not addressed elsewhere in the building codes, including but not limited to fiber-reinforced polymers and polymer concrete.

ACI CODE 562 permits flexibility in evaluation, design, construction and repair materials to provide economies while establishing expected performance for the service-life of the rehabilitation or repairs. Note that ACI CODE 562 does not address the evaluation of lateral-force resisting systems in high seismic areas. Thus, the proposed modification directs the user to the appropriate section of the VEBC, as *ASCE 41 Seismic Evaluation and Retrofit of Existing Buildings* is the appropriate standards as stated in ACI CODE 562.

Benefits - There are many benefits that ACI CODE 562 provides for the designer, owner, contractor, material provides, building officials and the citizens residing and working in the Commonwealth of Virginia. A few of these benefits are:

- Provides a level of expectation of life safety to the public in buildings where repairs or rehabilitation is performed on concrete structural elements.

- Provides clearly defined, uniform requirements aimed at extending the service life of existing structures.
- Provides minimum requirements for efficiency, safety, and quality of concrete repair.
- Establishes clear responsibilities between owners, designers, and contractors.
- Provides building code officials with a means to evaluate rehabilitation designs.
- Provides specific repair requirements that often result in less costly repairs compared to repairs required to meet only new construction requirements.
- References standards specifications for materials used in concrete repairs that are not addresses in the code requirements for new construction such as fiber reinforced polymer (FRP) reinforcement and polymer concrete.

Technical justification - It is noteworthy that ACI has been publishing and making available guidance documents on evaluation and repair of concrete for more than five decades and still it is reported that more than 50% of all structural concrete repairs are found to fail in 20 years or less and 20% of repairs to structural concrete fail within 5 years. Recognizing this as putting the public at risk, ACI Committee 562 saw the need for and developed the Code Requirements for Assessment, Repair, and Rehabilitation of Existing Concrete Structures as an ACI standard intended for adoption in building codes. ACI continues to maintain and develop additional resources to support assessment, repairs, and rehabilitation of structural concrete in accordance with ACI CODE 562. Among these are:

- [ACI 563-18, Specifications for Repair of Structural Concrete in Buildings \[LINK 1\]](#)
- [MNL-3\(20\) Guide to the Code for Assessment, Repair, and Rehabilitation of Existing Concrete Structures \[LINK 2\]](#)

These resources are readily available to provide greater understanding of assessment, repair and rehabilitation of concrete structural elements. ACI MNL-3 provides case studies demonstrating the ease of use of ACI CODE 562. Numerous technical notes, reports, guides, and specifications that provide background information and technical support are available through other organizations such as American Society of Civil Engineers, British Research Establishment, Concrete Society, International Concrete Repair Institute, National Association of Corrosion Engineers, Post Tensioning Institute, Society of Protective Coatings, and US Army Corps of Engineers. Many of these organizations' publications related to concrete repair can be found in the Concrete Repair Manual.

Sustainability - Reference to ACI CODE 562 in the VEBC will help improve confidence of owners, builders, and developers regarding effective repairs, upgrades, and reuse of existing buildings in lieu of demolition and replacement. Typically extending the life of existing buildings is substantially more sustainable than demolition and new construction. Adoption of ACI CODE 562 by reference is needed to help facilitate efforts that conserve energy and resources while maintaining a minimum level of requirements to ensure reasonable levels of life safety, and welfare are afforded to the public.

State and Local References - ACI CODE 562 is already being used in several jurisdictions:

- [2020 Florida Building Code, Existing Buildings, 7th Edition Section 301.3.4. \[LINK 3\]](#)
- [2018 Hawaii State Building Code, Code Item \(53\) Section 3401.6.\[LINK 4\]](#)
- [2017 Ohio Building Code with Aug 2018 Updates & Errata 02-08-19 Section 3401.6. \[LINK 5\]](#)
- [2018 North Carolina Existing Building Code, Section 606.1.1.](#)
- [City of Los Angeles California Design Guide Volume 1 City of Los Angeles Mandatory Earthquake Hazard Reduction in Non-Ductile Concrete Buildings \(NDC\), including Section 4.1 Retrofit Design Process.](#)
- [New York City Department of Buildings cites ACI 562 in BUILDINGS BULLETIN 2017-015. \[LINK 6\]](#)
- [City of Austin, Texas, Design and construction specifications Section 410S. \[LINK 7\]](#)

Resiliency Impact Statement: This proposal will increase Resiliency

Use of ACI CODE 562 standard helps ensure that repairs are properly performed and will satisfy an acceptable service life. Without minimum standards, repairs may not satisfy the intent of the code or the expectations of the owners or public. Proper evaluation and repairs will improve resiliency of the building. News coverage demonstrates the potential risk to life safety due to deteriorating concrete and inappropriate repairs. A [news investigation \[LINK 8\]](#) of parking structures in the City of Pittsburg, PA is an example of such coverage.

Cost Impact: The code change proposal will decrease the cost of construction

The use of this referenced standard should in many cases reduce the cost of repair. Too often in the process of repair, there is insufficient information to determine acceptance criteria that is amicable to both the owner and the building official. The result is the determination that the repair must meet the latest building code requirements for new construction. This standard increases the options available for repair and provides acceptance criteria necessary to permit these options. A case study that illustrates this point: " ACI 562 has been referenced in expert reports for litigation cases, resulting in significantly reduced financial settlements. Denver-based J. R. Harris & Company recently used the code as a standard in several litigation reports assessing damages in existing concrete structures. As an approved consensus standard, according to American National Standards Institute (ANSI) procedures, ACI 562-13 has been accepted as the source standard to use for damage assessment and repair on individual projects by Greenwood Village and Pikes Peak Regional Building Departments in Colorado. Based on this acceptance, the consulting engineer was able to cite the code in their recommendation for structural remediation and determination of damages. In one case involving rehabilitation work on four buildings with faulty construction, J. R. Harris was able to reduce the repair costs from \$12 million to \$3 million, with a

repair plan based on a lesser of the demand-capacity ratio based on either the original or current building code per ACI 562."

Attached Files

- **ICRI-562-Code-VA-National-Support-2022.pdf**
<https://va.cdpassess.com/proposal/936/1172/files/download/545/>
- **ICRI-562-Code-VA-ChapterSupport-2022.pdf**
<https://va.cdpassess.com/proposal/936/1172/files/download/544/>



CONCRETE REPAIR
Restore | Repurpose | Renew

January 6, 2022

Board of Housing and Community Development
600 East Main Street, Suite 300
Richmond, VA 23219

RE: Support for Adoption by Reference of ACI 562
in the Virginia Existing Building Code
Proposal #936, EB 502.1.1-2021

Dear Board Member:

I am writing this letter as President of the International Concrete Repair Institute (ICRI) in support of approval of adoption by reference of ACI 562-21 *Code Requirements for Assessment, Repair, and Rehabilitation of Existing Concrete Structures* into the *Virginia Existing Building Code* as presented in the code change proposal submitted by the American Concrete Institute (ACI).

ICRI is the only non-profit organization that is dedicated solely to the repair of concrete structures. ICRI has over 2500 members and 39 local chapters across the United States and Canada, with a local chapter in the state of Virginia.

For the past 33 years, ICRI has developed and promoted best practices for concrete repair and has developed consensus document guidelines for the repair of deteriorated concrete structures. These guidelines have been published and used to result in more durable concrete repairs. It has been proven that poor performance of concrete repairs is a serious issue in the industry, and improvements are needed in concrete repair practices. Several studies indicate that **less than 50%** of concrete repairs perform satisfactorily, posing a significant danger to the health, safety and welfare of the public. This is a tremendous burden on owners, municipalities and the economy.

As a repair industry professional and the President of an organization that represents contractors, design professionals and material manufacturers that are involved in the repair of existing concrete buildings, both I and ICRI as an organization recognize the need for standards that will help design professionals and contractors improve the design, implementation and performance of concrete repairs.

The ACI 562-21 code provides minimal requirements for assessment, design and construction, and implementation of repairs and rehabilitation, including quality assurance requirements, for structural concrete **in service**. ACI 562 encourages evaluation of the structure, and a better evaluated structure is potentially less risky to repair. ACI 562 also requires consideration of durability in design, likely leading to better repair performance and less premature repair failure.

The concrete repair industry utilizes many unique repair strategies. The Code provides latitude and flexibility to the licensed design professional to prepare a design to address the specific issues encountered on an existing building while still meeting the requirements of ACI 562. The ACI 562 code will serve to unify and strengthen concrete evaluation, repair, and rehabilitation projects while accommodating the diverse and unique repair strategies and materials used in the repair industry, making existing structures safer. All of these goals are consistent with the mission of ICRI.

In examining the cost of concrete repairs, the greatest cost to the owner is having to remove and replace previous repairs to a structure due to premature repair failure. I believe the adoption of the ACI 562-19 code has the potential to significantly reduce the long-term life cycle cost of maintaining a structure. I also believe it will provide safer structures with minimal impact on initial cost of repairs.

Any standard that improves the quality of the completed repair work will be a welcome addition to the building code and the concrete repair industry. Use of ACI 562 also contributes to increased sustainability, increasing the probability that a concrete structure will be restored rather than demolished and replaced.

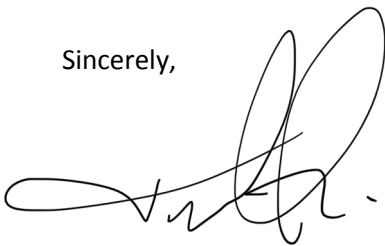
Many leaders in the repair industry support the ACI 562 code and other states, including Hawaii, Ohio, Florida, and North Carolina and jurisdictions have already adopted it. This code complements the *Virginia Existing Building Code* by providing specific direction on how to evaluate and design concrete repairs and how to address the unique construction methods and issues associated with repair. In addition, ACI 562 provides building code officials with a means to evaluate rehabilitation designs.

On behalf of the Board of Directors and members of ICRI, I recommend and hope that the State of Virginia will also realize the benefit of this code and adopt code change proposal into the Virginia Existing Building Code.

If you have any questions regarding my comments or would like to discuss my viewpoints in more detail, please feel free to contact me at your convenience.

Thank you in advance for your time and consideration of this recommendation for support of the proposed building code change.

Sincerely,

A handwritten signature in black ink, appearing to read 'John McDougall', with a large, stylized flourish at the end.

John McDougall, CCSRT
2022 ICRI President
919-500-2232
johnmcdougall27540@gmail.com



CONCRETE REPAIR
Restore | Repurpose | Renew

January 16, 2022

Board of Housing and Community Development
600 East Main Street, Suite 300
Richmond, VA 23219

RE: Support for Adoption by Reference of ACI 562
in the Virginia Existing Building Code
Proposal #936, EB 502.1.1-2021

Dear Board Member:

Please accept this letter of recommendation from the International Concrete Repair Institute (ICRI) Virginia Chapter Board of Directors in support of approval of adoption by reference of ACI 562-19 *Code Requirements for Assessment, Repair, and Rehabilitation of Existing Concrete Structures* into the *Virginia Existing Building Code* as presented in the code change proposal submitted by the American Concrete Institute (ACI).

The ACI 562 Code provides important information and direction to design professionals, contractors, materials manufacturers, and testing agencies. ACI 562, which was written and maintained by industry experts, will help the design professionals and contractors improve the design and execution of concrete repairs. This should ultimately deliver safer structures and could also reduce the life cycle cost of concrete structures.

ICRI is the only non-profit organization that is dedicated solely to the repair of concrete structures. ICRI has over 2,500 members and 39 local chapters across the United States and Canada, with a local chapter in the Commonwealth of Virginia. The ICRI Virginia chapter members include Virginia registered Professional Engineers, contractors, technicians, materials manufacturers, and material distributors. We are dedicated to improving the quality of concrete restoration, repair and protection, through education and communication among the members and those who use their services.

Other states and jurisdictions have supported the ACI 562 code and adopted it. The ICRI Virginia Chapter recommends that the Commonwealth of Virginia also realize the benefit of this code and adopt the proposed code change to the Virginia Existing Building Code.

Thank you in advance for your time and consideration of this recommendation for support of the proposed building code change.

Respectfully Submitted,

Kevin Higgins
ICRI's Virginia Chapter President
on behalf of the Board of Directors

EC404.2-21

VECC: R404.2 (New); VCC: N1104.2 (New)

Proponents: William Penniman (wpenniman@aol.com)

2018 Virginia Energy Conservation Code

Add new text as follows:

R404.2 SOLAR-READY CONSTRUCTION FOR DETACHED ONE- AND TWO-FAMILY DWELLINGS AND TOWNHOUSES. New detached one- and two-family dwellings, and townhouses with not less than 600 square feet (55.74 m²) of roof area oriented between 110 degrees and 270 degrees of true north shall comply with Appendix RA Solar Ready Provisions--Detached One- and Two-Family Dwellings and Townhouses. [NOTE: denominated Appendix RB in 2021 IECC].

Exceptions:

1. New residential buildings with a permanently installed on-site renewable energy system.
2. A building with a solar-ready zone that is shaded for more than 70 percent of daylight hours annually.



2018 Virginia Construction Code

Add new text as follows:

N1104.2 Solar Ready Construction for Detached One- And Two-Family Dwellings and Townhouses. New detached one- and two-family dwellings, and townhouses with not less than 600 square feet (55.74 m²) of roof area oriented between 110 degrees and 270 degrees of true north shall comply with Appendix RA Solar Ready Provisions--Detached One- and Two-Family Dwellings and Townhouses. [NOTE: denominated Appendix RB in 2021 IECC].

Exceptions:

1. New residential buildings with a permanently installed on-site renewable energy system.
2. A building with a solar-ready zone that is shaded for more than 70 percent of daylight hours annually.

Reason Statement: This proposed addition to the body of the building code is designed to require builders to make new one- and two-family dwellings and townhouses "solar ready", subject to certain specific exceptions. The proposal does not require builders to install solar. However, it would enable buyers to arrange for cheaper, easier installation of rooftop solar if they choose to do so in the future. It is a low-cost measure that will reduce the cost of adding solar at a later date. The proposal is based up on the Appendix RA in the 2018 Virginia building code, which has been updated as Appendix RB in the 2021 IECC. Since the Appendix is in the current code and has not been modified from the 2018 code, it will presumptively follow the 2021 IECC's equivalent appendix, Appendix RB.

Rooftop solar energy production will reduce occupants' utility bills by reducing the quantity of energy they need to purchase for heating, lighting and other purposes. That will tend to stabilize and reduce their annual energy costs. Further, distributed generation will reduce the quantity of energy that utilities need to generate or purchase, the generation and transmission facilities to be constructed, and the line losses that would result from transmitting energy to markets from central power stations. Distributed energy production will help to save overall energy costs.

Distributed zero-carbon generation will also reduce greenhouse gas emissions, which are the primary driver of climate change and its many harmful impacts, including rising seas, flooding, dangerous high temperatures, agricultural disruption and threats to infrastructure.

Resiliency Impact Statement: This proposal will increase Resiliency

This low-cost proposal will increase resiliency for residential customers who install solar and for the utility system. Residential customers with solar will generate energy on-site, which will lower energy and total occupancy costs, reducing risks of lease and mortgage defaults. In combination with on-site battery storage, the on-site solar can power the house during periods of power outages. Distributed solar can also support utility's regional reliability when power outages occur at remote central generating stations.

Solar generation is zero-carbon, which makes it a necessary measure to mitigate worsening climate impacts which harms Virginia and its residents generally. The most recent IPCC report confirms that rapid reductions of greenhouse gas emissions is essential to avoid catastrophic climate impacts around the world. *IPCC Sixth Assessment Report* (February 2022), <https://www.ipcc.ch/report/ar6/wg2/> Substantial harm has already occurred nationally and locally from global warming and much worse will follow without rapid reductions of greenhouse gases (particularly CO₂ and methane associated with fossil fuel production and combustion). Virginia's coastal areas are among the most

vulnerable to sea level rise and destructive storms. The most recent report from NOAA indicates that Virginia may face 2 feet of sea level rise by 2050 due to worsening climate change from human greenhouse gas emissions. <https://www.noaa.gov/news-release/us-coastline-to-see-up-to-foot-of-sea-level-rise-by-2050>

Growing climate dangers include harms to communities, infrastructure, people (e.g., heat-related illnesses, disease vectors and ability to work), agriculture, property (inland and coastal) and the economy. These result from many climate-driven forces, including rising temperatures and seas, wildfires, worsening storms, more severe rainfall events and damage to crops and infrastructure. In addition, by cutting greenhouse gas emissions, solar generation will help to mitigate the growing impacts that warming seas and ocean acidification have on sea life and Virginia's fisheries. Even if Virginia were not directly endangered, its residents, economy and access to resources would be endangered by the growing harms to the rest of the nation and the world.

Cost Impact: The code change proposal will increase the cost of construction

There will be a small increase in the initial cost of construction, which will be offset by encouraging building owners to install money-saving, GHG-reducing rooftop solar in the future. (Obviously, builders decide to install and profitably market the dwelling with rooftop solar if they desire to do so.) The principal material cost would be a 1-inch electrical conduit, which can be purchased for \$2.00/foot or less, i.e., less than \$100 from the roof to the electrical panel. During construction, the cost of installation will be a small increment given that the walls will be open and tradesmen will be installing similar conduits and/or wiring in the building. The costs of retrofitting are likely to be much higher after walls are closed and construction completed. Reopening and repairing walls could be required.

The small upfront costs will have little impact on a resident's annual mortgage costs, particularly when compared to the savings that will result from self-generated solar energy and from the much higher cost of retrofitting.

EC1301.1.1.1-21

VCC: 1301.1.1.1; VECC: TABLE C402.4, TABLE C402.4.3, TABLE R402.1.2, TABLE R402.1.4, TABLE R402.4.1.1

Proponents: William Penniman (wpenniman@aol.com)

2018 Virginia Construction Code

Delete without substitution:

~~1301.1.1.1 Changes to the International Energy Conservation Code (IECC). The following changes shall be made to the IECC:~~

- ~~1. Add Sections C402.1.4.2, C402.1.4.2.1, C402.1.4.2.2, C402.1.4.2.3, C402.2.1.2, C402.2.1.3, C402.2.1.4, C402.2.1.5 and Change Section C402.2.1.1 to read:~~

~~**C402.1.4.2 Roof/ceiling assembly.** The maximum roof/ceiling assembly U factor shall not exceed that specified in Table C402.1.4 based on *construction* materials used in the roof/ceiling assembly.~~

~~**C402.1.4.2.1 Tapered, above-deck insulation based on thickness.** Where used as a component of a maximum roof/ceiling assembly U factor calculation, the tapered roof insulation R value contribution to that calculation shall use the average thickness in inches (mm) along with the material R value per inch (per mm) for U factor compliance as prescribed in Section C402.1.4.~~

~~**C402.1.4.2.2 Suspended ceilings.** Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the assembly U factor of the roof/ceiling *construction*.~~

~~**C402.1.4.2.3 Multiple layers and staggered joints.** Continuous insulation board shall be installed in not less than two layers and the edge joints between each layer of insulation shall be staggered. Multiple layers and staggered joints are not required where insulation tapers to the *roof deck* at a gutter edge, roof drain or scupper.~~

~~**C402.2.1 Roof assembly** The minimum thermal resistance (R value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table C402.1.3, based on *construction* materials used in the *roof assembly*.~~

~~**C402.2.1.1 Tapered, above-deck insulation based on thickness.** Where used as a component of a roof/ceiling assembly R value calculation, the tapered roof insulation R value contribution to that calculation shall use the average thickness in inches (mm) along with the material R value per inch (per mm) for R value compliance as prescribed in Section C402.1.3.~~

~~**C402.2.1.2 Minimum thickness, lowest point.** The minimum thickness of above-deck roof insulation at its lowest point, gutter edge, roof drain or scupper, shall be no less than 1 inch (25 mm).~~

~~**C402.2.1.3 Suspended ceilings.** Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the minimum thermal resistance (R value) of roof insulation in roof/ceiling *construction*.~~

~~**C402.2.1.4 Multiple layers and staggered joints.** Continuous insulation board shall be installed in not less than two layers and the edge joints between each layer of insulation shall be staggered. Multiple layers and staggered joints are not required where insulation tapers to the *roof deck* at a gutter edge, roof drain or scupper.~~

~~**C402.2.1.5 Skylight curbs.** Skylight curbs shall be insulated to the level of roofs with insulation entirely above the deck or R -5, whichever is less.~~

~~**Exception:** Unit skylight curbs included as a component of a skylight listed and labeled in accordance with NFRC 100 shall not be required to be insulated.~~

- ~~2. Change the SHGC for Climate Zone 4 (Except Marine) of Table C402.4 to read:~~

3. Delete Section G402.4.1.2; change Sections G402.4.2, G402.4.2.1, G402.4.2.2 and G402.4.3:

G402.4.2 Skylight area with daylight response controls. The skylight area shall be permitted to be not more than 5 percent of the roof area provided daylight responsive controls complying with Section G405.2.3.1 are installed in daylight zones under skylights:

G402.4.2.1 Daylight Zone Controls under skylights. Daylight responsive controls complying with Section G405.2.3.1 shall be provided to control all electric lights within daylight zones under skylights.

G402.4.2.2 Haze factor. Skylights that are installed in office, storage, automotive service, manufacturing, nonrefrigerated warehouse, retail store and distribution/sorting area spaces shall have a glazing material or diffuser with a haze factor greater than 90 percent when tested in accordance with ASTM D1003.

Exception: Skylights designed and installed to exclude direct sunlight entering the occupied space by the use of fixed or automated baffles or the geometry of skylight and light well.

G402.4.3 Maximum U-factor and SHGC. The maximum U-factor and solar heat gain coefficient (SHGC) for fenestration shall be as specified in Table G402.4:

The window projection factor shall be determined in accordance with Equation 4-5:

$$PF = A/B$$

(Equation 4-5)

where:

PF = Projection factor (decimal):

A = Distance measured horizontally from the farthest continuous extremity of any overhang, eave, or permanently attached shading device to the vertical surface of the glazing:

B = Distance measured vertically from the bottom of the glazing to the underside of the overhang, eave, or permanently attached shading device:

Where different windows or glass doors have different PF values, they shall each be evaluated separately.

Where the fenestration projection factor for a specific vertical fenestration product is greater than or equal to 0.20, the required maximum SHGC from Table G402.4 shall be adjusted by multiplying the required maximum SHGC by the multiplier specified in Table G402.4.3 corresponding with the orientation of the fenestration product and the projection factor.

4. Add Table G402.4.3 to read:

5. Add an exception to the first paragraph of Section 403.7.7 to read:

Exception: Any grease duct serving a Type I hood installed in accordance with the *International Mechanical Code* (IMC) Section 506.3 shall not be required to have a motorized or gravity damper.

6. Add Section G403.2.2.1 to read:

G403.2.2.1 Dwelling unit mechanical ventilation. Mechanical ventilation shall be provided for *dwelling units* in accordance with the IMC.

7. Delete Section G403.7.5 and Table G403.7.5.

8. Delete Sections G404.5 through G404.5.2.1, including Tables.

9. Change Section G405.4 to read:

G405.4 Exterior lighting (Mandatory). All exterior lighting, other than low-voltage landscape lighting, shall comply with Section G405.4.1:

Exception: Where *approved* because of historical, safety, signage, or emergency considerations.

10. Change Section G502.1 to read:

G502.1 General. Additions to an existing building, building system or portion thereof shall conform to the provisions of Section 805 of the *Virginia Existing Building Code* (VEBC):

11. Delete Sections G502.2 through G502.2.6.2.

12. Change Section G503.1 to read:

G503.1 General. Alterations to any *building or structure* shall comply with the requirements of Chapter 6 of the VEBG.

13. Delete Sections G503.2 through G503.6.

14. Change Section G504.1 to read:

G504.1 General. *Buildings and structures*, and parts thereof, shall be repaired in compliance with Section 510 of the VEBG.

15. Delete Section G504.2.

16. Change Section R401.2 to read:

R401.2 Compliance. Projects shall comply with all provisions of Chapter 4 labeled "Mandatory" and one of the following:

1. Sections R401 through R404.
2. Section R405.
3. Section R406.
4. The most recent version of REScheck, keyed to the 2018 IECC.

17. Change Section R401.3 to read:

R401.3 A permanent certificate shall be completed by the builder or other *approved* party and posted on a wall in the space where the furnace is located, a utility room or an *approved* location inside the *building*. Where located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label, or other required labels. Where *approved*, certificates for multifamily *dwelling units* shall be permitted to be located off site at an identified location. The certificate shall indicate the predominant *R*-values of insulation installed in or on ceilings, roofs, walls, foundation components such as slabs, basement walls, crawl space walls and floors, and ducts outside conditioned spaces; *U*-factors of fenestration and the solar heat gain coefficient (SHGC) of fenestration; and the results from any required duct system and *building* envelope air leakage testing performed on the *building*. Where there is more than one value for each component, the certificate shall indicate the value covering the largest area. The certificate shall indicate the types and efficiencies of heating, cooling, and service water heating *equipment*. Where a gas-fired unvented room heater, electric furnace, or baseboard electric heater is installed in the residence, the certificate shall indicate "gas-fired unvented room heater," "electric furnace," or "baseboard electric heater," as appropriate. An efficiency shall not be indicated for gas-fired unvented room heaters, electric furnaces, and electric baseboard heaters.

18. Change the wood frame wall *R*-value categories for Climate Zone 4 (Except Marine) in Table R402.1.2 to read:

19. Change the frame wall *U*-factor categories for Climate Zone 4 (Except Marine) in Table R402.1.4 to read:

20. Change Section R402.2.4 to read:

R402.2.4 Access hatches and doors. Access doors from conditioned spaces to unconditioned spaces (e.g., *attics* and crawl spaces) shall be weatherstripped and insulated in accordance with the following values:

1. Hinged vertical doors shall have a minimum overall *R*-5 insulation value;
2. Hatches and scuttle hole covers shall be insulated to a level equivalent to the insulation on the surrounding surfaces; and
3. Pull down stairs shall have a minimum of 75 percent of the panel area having *R*-5 rigid insulation.

Access shall be provided to all *equipment* that prevents damaging or compressing the insulation. A wood framed or equivalent baffle or retainer is required to be provided when loose fill insulation is installed, the purpose of which is to prevent the loose fill insulation from spilling into the living space when the attic access is opened and to provide a permanent means of maintaining the installed *R*-value of the loose fill insulation.

21. Change Sections R402.4 and R402.4.1.1 to read:

R402.4 Air leakage. The *building* thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.5.

R402.4.1.1 Installation (Mandatory). The components of the *building* thermal envelope as listed in Table R402.4.1.1 shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table R402.4.1.1, as applicable to the method of *construction*. Where required by the code official, an *approved* third party shall inspect all components and verify compliance.

22. Change the title of the "Insulation Installation Criteria" category of Table R402.4.1.1; change the "Shower/tub on exterior wall" category of Table R402.4.1.1, and add footnotes "b" and "c" to Table R402.4.1.1 to read:

23. Change Section R402.4.1.2 to read:

R402.4.1.2 Testing. The *building* or *dwelling unit* shall be tested and verified as having an air leakage rate not exceeding five air changes per hour in Climate Zone 4. Testing shall be conducted in accordance with RESNET/IGC 380, ASTM E779, or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). A written report of the results of the test shall be signed by the party conducting the test and provided to the *building official*. Testing shall be conducted by a Virginia licensed general contractor, a Virginia licensed HVAC contractor, a Virginia licensed home inspector, a Virginia *registered design professional*, a certified BPI Envelope Professional, a certified HERS rater, or a certified duct and envelope tightness rater. The party conducting the test shall have been trained on the *equipment* used to perform the test. Testing shall be performed at any time after creation of all penetrations of the *building* thermal envelope.

Note: Should additional sealing be required as a result of the test, consideration may be given to the issuance of a temporary certificate of occupancy in accordance with Section 116.1.1.

During testing:

1. Exterior windows and doors and *fireplace* and stove doors shall be closed, but not sealed beyond the intended weatherstripping or other infiltration control measures;
2. Dampers, including exhaust, intake, makeup air, backdraft, and flue dampers, shall be closed, but not sealed beyond intended infiltration control measures;
3. Interior doors, if installed at the time of the test, shall be open;
4. Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
5. Heating and cooling systems, if installed at the time of the test, shall be turned off; and
6. Supply and return registers, if installed at the time of the test, shall be fully open.

24. Change Section R403.3.3 to read:

R403.3.3 Duct testing (Mandatory). Ducts shall be pressure tested to determine air leakage by one of the following methods:

1. Rough-in test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer's air handler enclosure if installed at the time of the test. All registers shall be taped or otherwise sealed during the test.
2. Postconstruction test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. Registers shall be taped or otherwise sealed during the test.

Exception: A duct air leakage test shall not be required where the ducts and air handlers are located entirely within the building thermal envelope.

A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. The licensed mechanical contractor installing the mechanical system shall be permitted to perform the duct testing. The contractor shall have been trained on the equipment used to perform the test.

25. Delete Section R403.3.5.

26: Change Section R403.7 to read:

R403.7 Equipment and appliance sizing. Heating and cooling equipment and appliances shall be sized in accordance with AGCA Manual S or other *approved* sizing methodologies based on *building* loads calculated in accordance with AGCA Manual J or other *approved* heating and cooling calculation methodologies.

Exception: Heating and cooling equipment and appliance sizing shall not be limited to the capacities determined in accordance with Manual S or other *approved* sizing methodologies where any of the following conditions apply:

1. The specified equipment or appliance utilizes multistage technology or variable refrigerant flow technology and the loads calculated in accordance with the *approved* heating and cooling methodology fall within the range of the manufacturer's published capacities for that equipment or appliance.
2. The specified equipment or appliance manufacturer's published capacities cannot satisfy both the total and sensible heat gains calculated in accordance with the *approved* heating and cooling methodology and the next larger standard size unit is specified.
3. The specified equipment or appliance is the lowest capacity unit available from the specified manufacturer.

27: Change footnote "a" in Table R406.4 to read:

- a. When onsite renewable energy is included for compliance using the ERI analysis of Section R406.4, the building shall meet the mandatory requirements of Section R406.2 and the building thermal envelope shall be greater than or equal to levels of energy efficiency and solar heat gain coefficient in Table R402.1.2, with a ceiling *R*-value of 49 and a wood frame wall *R*-value of 20 or 13 + 5, or Table R402.1.4, with a ceiling *U*-factor of 0.026 and a frame wall *U*-factor of 0.060.

28: Change Section R501.1 to read:

R501.1 Scope. The provisions of the *Virginia Existing Building Code* (VEBC) shall control the alteration, repair, addition and change of occupancy of existing *buildings* and *structures*.

29: Delete Sections R501.1.1 through R501.6.

30: Change Section R502.1 to read:

R502.1 General. Additions to an existing *building*, *building* system or portion thereof shall conform to the provisions of Section 811 of the VEBC.

31: Delete Sections R502.1.1 through R502.1.2.

32: Change Section R503.1 to read:

R503.1 General. Alterations to any *building* or *structure* shall comply with the requirements of Chapter 6 of the VEBC.

33: Delete Sections R503.1.1 through R503.2

34: Change Section R504.1 to read:

R504.1 General. *Buildings*, *structures* and parts thereof shall be repaired in compliance with Section 510 of the VEBC.

35: Delete Section R504.2.

2018 Virginia Energy Conservation Code

Delete without substitution:

TABLE C402.4 BUILDING ENVELOPE FENESTRATION MAXIMUM U-FACTOR AND SHGC REQUIREMENTS

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
Vertical fenestration								
U-factor								
Fixed fenestration	0.50	0.50	0.46	0.38	0.38	0.36	0.29	0.29
Operable fenestration	0.65	0.65	0.60	0.45	0.45	0.43	0.37	0.37
Entrance doors	1.10	0.83	0.77	0.77	0.77	0.77	0.77	0.77
SHGC								
SHGC	0.25	0.25	0.25	0.36	0.40	0.40	0.45	0.45
Skylights								
U-factor	0.75	0.65	0.55	0.50	0.50	0.50	0.50	0.50
SHGC	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

NR – No Requirement

Revise as follows:

TABLE C402.4.3 SHGC ADJUSTMENT MULTIPLIERS

PROJECTION- FACTOR	ORIENTED WITHIN 45- DEGREES OF TRUE NORTH	ALL OTHER ORIENTATIONS
$0.2 \leq PF < 0.5$	1.1	1.2
$PF \geq 0.5$	1.2	1.6

TABLE R402.1.2 INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT^a

CLIMATE ZONE	FENESTRATION U-FACTOR ^b	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC ^{b,e}	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE ⁱ	FLOOR R-VALUE	BASEMENT ^e WALL R-VALUE	SLAB ^d R-VALUE & DEPTH	CRAWL SPACE ^e WALL R-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.32	0.55	0.25	38	20 or 13+5 ^h	8/13	19	5/13 ^f	0	5/13
4 except Marine	0.32	0.55	0.40	40	15 or 13+1 ^h	8/13	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.30	0.55	NR	40	20 or 13+5 ^h	13/17	30 ^g	15/19	10, 2 ft	15/19
6	0.30	0.55	NR	40	20+5 ^h or 13+10 ^h	15/20	30 ^g	15/19	10, 4 ft	15/19
7 and 8	0.30	0.55	NR	40	20+5 ^h or 13+10 ^h	19/21	38 ^g	15/19	10, 4 ft	15/19

NR = Not Required.

For SI: 1 foot = 304.8 mm.

- a. R-values are minimums. U factors and SHGC are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall be not less than the R-value specified in the table.
- b. The fenestration U factor column excludes skylights. The SHGC column applies to all glazed fenestration.

Exception: In Climate Zones 1 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

- e. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation on the interior of the basement wall. "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. Alternatively, compliance with "15/19" shall be R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home.
- d. R-5 insulation shall be provided under the full slab area of a heated slab in addition to the required slab edge insulation R-value for slabs, as indicated in the table. The slab edge insulation for heated slabs shall not be required to extend below the slab.
- e. There are no SHGC requirements in the Marine Zone.
- f. Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.
- g. Alternatively, insulation sufficient to fill the framing cavity and providing not less than an R-value of R-19.
- h. The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, "13+5" means R-13 cavity insulation plus R-5 continuous insulation.
- i. Mass walls shall be in accordance with Section R402.2.5. The second R-value applies where more than half of the insulation is on the interior of the mass wall.

Delete without substitution:

TABLE R402.1.4 EQUIVALENT U-FACTORS^a

CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT U-FACTOR	CEILING U-FACTOR	FRAME WALL U-FACTOR	MASS WALL U-FACTOR^b	FLOOR U-FACTOR	BASEMENT WALL U-FACTOR	CRAWL SPACE WALL U-FACTOR
1	0.50	0.75	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.084	0.165	0.064	0.360	0.477
3	0.32	0.55	0.030	0.060	0.098	0.047	0.091 ^c	0.136
4 except Marine	0.32	0.55	0.026	0.079	0.098	0.047	0.059	0.065
5 and Marine 4	0.30	0.55	0.026	0.060	0.082	0.033	0.050	0.055
6	0.30	0.55	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	0.30	0.55	0.026	0.045	0.057	0.028	0.050	0.055

TABLE R402.4.1.1 AIR BARRIER AND INSULATION INSTALLATION^a

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA ^b
General requirements	A continuous air barrier shall be installed in the building envelope. The exterior thermal envelope contains a continuous air barrier. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	The air barrier in any dropped ceiling or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop-down stairs or knee wall doors to unconditioned attic spaces shall be sealed.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.
Walls	The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior walls shall be sealed. Knee walls shall be sealed.	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance, <i>R</i> -value, of not less than <i>R</i> -3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The space between framing and skylights, and the jambs of windows and doors, shall be sealed.	—
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.
Floors, including cantilevered floors and floors above garages	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing; and shall extend from the bottom to the top of all perimeter floor framing members.
Crawl space walls	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.	Crawl space insulation, where provided instead of floor insulation, shall be permanently attached to the walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	—
Narrow cavities	—	Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	—
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be sealed to the finished surface.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC-rated.
Plumbing and wiring	—	In exterior walls, batt insulation shall be cut neatly to fit around wiring and plumbing, or insulation, that on installation readily conforms to available space, shall extend behind piping and wiring.
Shower/tub on exterior wall ^c	The air barrier installed at exterior walls adjacent to showers and tubs shall be installed on the interior side and separate the exterior walls from the showers and tubs.	Exterior walls adjacent to showers and tubs shall be insulated.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.	—
HVAC register boots	HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.	—

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
Concealed sprinklers	Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	—

Reason Statement: This proposal is intended to fully adopt and implement the 2021 IECC by eliminating exceptions that the Base Document would cause to displace language in the 2021 IECC. Full adoption of the 2021 IECC will carry out Virginia law and protect both residents and the public generally.

The BHCD's NOIRA published November 22, 2021, <https://townhall.virginia.gov/L/viewstage.cfm?stageid=9475> states:

"The 2021 editions of the International Codes are now completed and available from ICC. The use of the newest available model codes and standards in the USBC assures that the statutory mandate is met to base the regulation on the latest editions of nationally recognized model codes to assure the protection of the health, safety and welfare of the residents of Virginia and that buildings and structures are constructed and maintained at the least possible cost."

The BHCD's NOIRA also states: "As the basis for Virginia's building code it is important to stay in sync with the national model codes." These statements are consistent with Section 36-99A of the Virginia Code has long prescribed that the purposes of the USBC are to protect the public and implement recognized standards of energy conservation and water conservation:

"The provisions of the Building Code and modifications thereof shall be such as to protect the health, safety and welfare of the residents of the Commonwealth, provided that buildings and structures should be permitted to be constructed, rehabilitated and maintained at the least possible cost consistent with recognized standards of health, safety, energy conservation and water conservation...."

Legislation (H2227), enacted by the General Assembly and signed by the Governor in 2021, supplements the pre-existing law's commitment to protecting residents and the public "consistent with recognized standards of ... energy conservation" by specifically endorsing adoption of energy standards "at least as stringent as" the latest IECC when the benefits "over time" to residents and the public exceed the incremental costs of construction.

In view of the NOIRA and applicable law, Virginia should adopt the full 2021 IECC. More stringent standards and non-weakening amendments may be proposed, but the expectation is that the code should be "at least as stringent" as the 2021 IECC. Adopting such standards would perform the important function of keeping Virginia's building code "in sync with the national model codes," except where more stringent standards are feasible and beneficial to residents and the public.

In further support of benefits residents and the public will gain from full implementation of the 2021 IECC, we note:

- The ICC process that produced the IECC was a multi-year effort that carefully vetted the amendments that were eventually adopted.
- DOE and the Pacific Northwest National Laboratory (PNNL) have already published findings demonstrating that the net savings to Virginia residents and to the public from implementing the full 2021 IECC exceed the incremental costs of construction. <https://www.energycodes.gov/technical-assistance/publications?page=29>
- DOE/PNNL has reached the same conclusion on a national basis. https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-31437.pdf
- The DOE/PNNL studies show that the public will benefit from reductions of air and climate pollution as measured by the Social Cost of Carbon.
- DOE/PNNL has previously found that earlier IECC updates dated 2012, 2015 and 2018 produced savings and benefits greater than construction costs. Consequently, moving implementation the 2021 IECC from pre-2012 standards that still apply to wall insulation and air leakage will result in net benefits and savings.
- Remaining more than a decade out of date in key areas, such as wall insulation and air leakage, is plainly inconsistent with Virginia law and the economic and health interests of residents and the public.
- Improved insulation, reduced air leakage and more efficient equipment will improve residents' comfort and health, reduce residents' problems of utility bill fluctuations, and improve their resiliency to low and high temperatures during power outages. Measures to reduce air leakage will have the added benefit of reducing access to dwellings by rodents and insects, which is a distinct concern identified in the Virginia Code.

Resiliency Impact Statement: This proposal will increase Resiliency

This proposal will increase resiliency in multiple ways, including:

- Local and regional power outages are a recurring problem that will get worse as climate impacts (storms, floods, rising seas, higher

temperatures) make power outages more frequent and consequential. Better insulated houses with lower air leakage will continue to provide comfort to residents for longer periods during power outages.

- Better insulated houses with lower air leakage will better protect residents from the economic consequences of rate and bill increases due to energy price increases and fluctuations. This enhanced economic resiliency is very important. High utility bills and energy consumption can result in residents falling behind on mortgages and rents, potentially resulting in eviction or loss of homes. Evictions have adverse impacts to people, especially seniors, parents and children, that extend beyond a need to change dwellings.
- Landlords, lenders and surrounding communities will indirectly benefit from energy conservation measures that reduce risks of customer defaults.
- By reducing health impacts from air pollution, temperature impacts of power outages or cost-driven reductions of heating or cooling, and evictions, conservation measures will improve health resiliency for residents and communities.

Cost Impact: The code change proposal will increase the cost of construction

The code change proposal will increase the cost of construction, but lower the cost of occupancy.

As documented by DOE/PNNL, the cost savings to residents from fully implementing the 2021 IECC exceed the increased cost of construction on both a life-cycle and simple payback basis. Their analysis also shows that the public savings even more greatly exceed the incremental costs of construction.

- <https://www.energycodes.gov/technical-assistance/publications?page=29>
- https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-31437.pdf

In addition to saving residents money and energy, adoption and implementation will create added benefits including greater comfort, less exposure to pests, and greater resiliency.

FP103.1 (SFPC SWG Proposal No.1)-21

Proponents: DHCD Staff (sbco@dhcd.virginia.gov) on behalf of the SFPC Sub-workgroup.

Reason Statement: This proposal includes items that were reviewed and decided on by the SFPC Sub-workgroup at their 02/16/2022 and 03/07/2022 meetings. For a complete list of proposed changes please see attached document "SFPC SWG Proposal No.1".

Resiliency Impact Statement: This proposal will increase Resiliency

The proposal will increase the resiliency by ensuring that the buildings will be maintained in accordance with the applicable codes and standards.

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

The intent of the changes is to ensure that buildings are maintained in accordance with the building codes and standards in effect at the time of construction. New construction requirements are not stipulated by these changes. Thus, the proposed changes should have a neutral effect on the construction cost.

2021 SFPC Base Document Corrections/Proposals 02/16/2022 & 03/07/2022

Page	Section	Base Document	VFSB CSC Proposal	SFPC Sub-workgroup Decision - Consensus for approval as noted below
45	603.1	603.1 General. Electrical equipment, wiring and systems shall be maintained in accordance with this section and the applicable building code.	603.1 General. Electrical equipment, wiring and systems shall be operated and maintained in accordance with this section and the applicable building code.	603.1 General. Electrical equipment, wiring and systems shall be operated and maintained in accordance with this section and the applicable building code.
45	603.1.1	603.1.1 Equipment and wiring. Electrical equipment, wiring, devices and appliances shall be maintained in accordance with this section and the applicable NFPA 70 standard.	603.1.1 Equipment and wiring. Electrical equipment, wiring, devices and appliances shall be listed and labeled, operated and maintained in accordance with this section and the applicable NFPA 70 standard.	603.1.1 Equipment and wiring. Electrical equipment, wiring, devices and appliances shall be listed and labeled, operated and maintained in accordance with this section and the applicable NFPA 70 standard.
45	603.2.1	603.2.1 Modified or damaged. Electrical wiring, devices, equipment and appliances that are modified or damaged, and constitute an electrical shock or fire hazard, shall not be used until repaired or replaced in accordance with NFPA 70.	603.2.1 Modified or damaged. Electrical wiring, devices, equipment and appliances that are modified or damaged, and constitute an electrical shock or fire hazard, shall not be used until repaired or replaced in accordance with this code and NFPA 70.	603.2.1 Modified or damaged. Electrical wiring, devices, equipment and appliances that are modified or damaged, and constitute an electrical shock or fire hazard, shall not be used until repaired or replaced in accordance with the applicable building code.
45	603.5	603.5 Relocatable power taps and current taps. The construction and use of current taps and relocatable taps shall be in accordance with NFPA 70.	603.5 Relocatable power taps and current taps. The construction and use of current taps and relocatable taps shall be in accordance with this code and NFPA 70.	603.5 Relocatable power taps and current taps. The construction and use of current taps and relocatable taps shall be in accordance with this code and the applicable building code.
	610.1.1	IFC 610.1.1 Installation. Clothes dryer exhaust duct systems shall be installed in accordance with the International Mechanical Code or the International Fuel Gas Code, and the manufacturer's installation instructions.	Delete 610.1.1	Delete 2021 IFC Section 610.1.1.
55	806.1.4	Delete section 806.1.4	IFC: 806.1.4 Fire-retardant treatments for natural cut trees. Where fire-retardant treatments are applied to natural cut trees, the fire-retardant treatment shall be tested by an approved agency and shall comply with both Test Method 1 and Test Method 2 of ASTM E3082	Incorporate the 2021 IFC Section 806.1.4.
55	806	Section 806 Decorative Vegetation in Buildings	Section 806 Natural Decorative Vegetation in Buildings	Section 806 (add "Natural" to the title to read) Natural Decorative Vegetation in Buildings
	808.5	808.5 Play structures added to existing buildings. Where play structures that exceed 10 feet (3048 mm) in height or 150 square feet (14 m2) in area are added inside an existing building, they shall comply with Section 424 of the International Building Code.	808.5 Play structures. Play structures shall be maintained in accordance with the applicable building code.	808.5 Play structures. Play structures shall be maintained in accordance with the applicable building code.
	901.4	901.4 Maintenance and alterations. Fire protection systems shall be maintained in accordance with the original installation standards for that system. Alterations and repairs to fire protection systems shall be done in accordance with the applicable building code and the applicable standards.	901.4 Maintenance and alterations. Fire protection systems and life safety systems shall be maintained in accordance with the original installation standards for that system. Alterations and repairs to fire protection systems shall be done in accordance with the applicable building code and the applicable standards.	901.4 Maintenance and alterations. Fire protection and life safety systems shall be maintained in accordance with the original installation standards for that system. Alterations and repairs to fire protection systems shall be done in accordance with the applicable building code and the applicable standards.
58	901.4.3	Delete section 901.4.3.	901.4.3 Alterations in buildings and structures. For any alteration within a building or structure, the fire protection and life safety systems shall be maintained to continue protection within the building or structure. Persons shall not remove or modify any fire protection or life safety system without approval of the Building Official in accordance with the applicable building code.	901.4.3 Alterations in buildings and structures. For any alteration within a building or structure, the existing fire protection and life safety systems shall be maintained to continue protection while the building or structure is occupied. Persons shall not remove or modify any fire protection or life safety system without approval from the Building Official in accordance with the applicable building code.
67	908.3	Delete section 908.3.	908.3 Fire alarm system interface. Where an emergency alarm system is interfaced with a building's fire alarm system, the signal produced at the fire alarm control unit is permitted to be a supervisory signal.	908.3 Fire alarm system interface. Where an emergency alarm system is interfaced with a building's fire alarm system, the signal produced at the fire alarm control unit is permitted to be a supervisory signal.
93	1001.1	1001.1 General. Means of egress systems for buildings or portions thereof shall be maintained in accordance with the applicable building code and Section 1031.	1001.1 General. Means of egress systems for buildings or portions thereof shall be maintained in accordance with the applicable building code and this chapter.	1001.1 General. Means of egress systems for buildings or portions thereof shall be maintained in accordance with the applicable building code and this chapter.
96	1004.7	1004.7 Outdoor areas. The means of egress for outdoor areas shall be maintained in accordance with the applicable building code.	1004.7 Outdoor areas. The means of egress for yards, patios, occupied roofs courts and similar outdoor areas accessible to and usable by the building occupants shall be maintained in accordance with the applicable building code.	1004.7 Outdoor areas. The means of egress for yards, patios, occupied roofs, courts and similar accessible and usable outdoor areas shall be maintained in accordance with the applicable building code.
108	1029	SECTION 1029 ASSEMBLY	SECTION 1029 EGRESS COURTS	SECTION 1029 EGRESS COURTS
			1029.1 General. Egress courts serving as an exit discharge component in the means of egress system shall be maintained in accordance with the applicable building code.	1029.1 General. Egress courts serving as an exit discharge component in the means of egress system shall be maintained in accordance with the applicable building code.
113	1201.2	1201.2 Electrical wiring and equipment. Electrical wiring and equipment used in connection with energy systems shall be maintained in accordance with Chapter 12, NFPA 70 and the applicable building code.	1201.2 Electrical wiring and equipment. Electrical wiring and equipment used in connection with energy systems shall be maintained in accordance with Chapter 12, this chapter, Section 603, NFPA 70 and the applicable building code.	1201.2 Electrical wiring and equipment. Electrical wiring and equipment used in connection with energy systems shall be maintained in accordance with this chapter, Section 603 and the applicable building code.
114	1203.2.5	Delete Section 1203.2.5	1203.2.5 Exhaust ventilation. Standby power shall be maintained for mechanical exhaust ventilation systems in accordance with the applicable building code.	1203.2.5 Exhaust ventilation. Where standby power for mechanical exhaust ventilation systems is provided or required by the applicable building code, the standby power shall be maintained.
127	2203.1	2203.1 Critical depth layer. The maximum dust layer on all surfaces, including but not limited to walls, ceilings, beams, equipment, furniture, pipes and ducts, shall not exceed the amount allowed by the applicable building code.	IFC: 2203.1 Critical depth layer. The maximum dust layer on all surfaces, including but not limited to walls, ceilings, beams, equipment, furniture, pipes and ducts, shall not exceed the critical depth layer specified in Table 2203.1. The critical depth layer is permitted to be adjusted for explosion hazard where further evaluated in accordance with one of the following: 1. Section 7.2.1.3 of NFPA 654. 2. Section 4.1.3.3 of NFPA 664 for wood flour. Accumulated combustible dust shall be collected by one of the methods listed in Section 2203.5	Incorporate 2021 IFC Section 2203.1
127	Table 2203.1	Table 2203.1 not deleted?? Error?	IFC: TABLE 2203.1 CRITICAL DEPTH LAYER	Incorporate 2021 IFC Table 2203.1
127	2203.3.3	Delete 2203.3.3	2203.3.3 Cleanouts. Openings in enclosed equipment and conveyors shall be maintained to allow access to all parts of the equipment and conveyors to permit inspection, cleaning, maintenance and the effective use of portable fire extinguishers or hose streams.	2203.3.3 Cleanouts. Openings in enclosed equipment and conveyors shall be maintained to allow access to all parts of the equipment and conveyors to permit inspection, cleaning, maintenance and the effective use of portable fire extinguishers or hose streams.
127	2203.4.1	2203.4.1 Classified electrical. Electrical equipment installed in classified locations, as defined by the applicable building code, shall be maintained in accordance with the applicable building code.	2203.4.1 Classified electrical. Classified electrical equipment shall be maintained in accordance with the applicable NFPA 70. Electrical motors and electrical components of the equipment shall not be operated in the dust-laden airstream unless listed for locations in accordance with the applicable building code.	2203.4.1 Classified electrical. Classified electrical equipment shall be maintained in accordance with the applicable NFPA 70. Electrical motors and electrical components of the equipment shall not be operated in the dust-laden airstream unless listed for locations in accordance with the applicable building code.
128	2203.4.5	2203.4.5 Powered industrial trucks. Powered industrial trucks used in electrically classified areas, listed in accordance with the applicable building code, shall maintain their listing.	IFC: 2203.4.5 Powered industrial trucks. Powered industrial trucks used in electrically classified areas shall be listed for such use.	Incorporate 2021 IFC Section 2203.4.5.
128	2203.4.6	2203.4.6 Smoking prohibited. Smoking shall be prohibited in or adjacent to dust-producing or dust-handling areas. "No Smoking" signs required by the applicable building code to be conspicuously posted in such areas, shall be maintained. Smoking shall be permitted only in designated areas.	IFC: 2203.4.6 Smoking prohibited. Smoking shall be prohibited in or adjacent to dust-producing or dust-handling areas. "No Smoking" signs complying with Section 310 shall be conspicuously posted in such areas. Smoking shall be permitted only in designated areas.	Incorporate 2021 IFC Section 2203.4.6.
128	2203.4.7	2203.4.7 Spark-producing devices. The clear distance, required by the applicable building code between spark-producing devices and areas requiring classified electrical, shall be maintained.	IFC 2203.4.7 Spark-producing devices. Portable spark-producing devices shall not be operated within 20 feet (6096 mm) of areas requiring classified electrical unless separated by a permanent partition or approved in accordance with the applicable building code. The clear distance required by the applicable building code between spark-producing devices and areas requiring classified electrical, shall be maintained.	2203.4.7 Spark-producing devices. Portable spark-producing devices shall not be operated within 20 feet (6096 mm) of areas requiring classified electrical unless separated by a permanent partition or approved in accordance with the applicable building code. The clear distance required by the applicable building code between spark-producing devices and areas requiring classified electrical, shall be maintained.

128	2203.4.9.2	2203.4.9.2 Space heaters. Unless otherwise allowed by the applicable building code, fuel-fired space heaters drawing local ambient air shall not be located within electrically classified areas. Space-heating appliances in dust-producing or dust-handling areas shall be located in accordance with the applicable building code.	IFC: 2203.4.9.2 Space heaters. <i>Portable fuel-fired space heaters drawing local ambient air shall not be located within electrically classified areas. Space-heating appliances in dust-producing or dust-handling areas shall be located where not subject to the accumulation of deposits of combustible dust.</i>	Incorporate 2021 IFC Section 2203.4.9.2.
129	2203.4.9.4	2203.4.9.4 Inspection and preventive maintenance. Inspection and maintenance of fuel-fired process equipment shall include verification that combustible dust accumulations within or around the equipment do not exceed the amounts allowed by the applicable building code.	IFC: 2203.4.9.4 Inspection and preventive maintenance. <i>Inspection and maintenance of fuel-fired process equipment shall include verification that significant combustible dust accumulations do not exist within or around the equipment.</i>	Incorporate 2021 IFC Section 2203.4.9.4.
129	2203.5	2203.5 Housekeeping. Accumulation of combustible dust on surfaces inside buildings shall be maintained below the critical depth layer allowed by the applicable building code. Pressurized air or similar methods shall not be used to remove dust from surfaces. Accumulated combustible dust shall be collected by one of the following methods:	IFC: 2203.5 Housekeeping. <i>Accumulation of combustible dust on surfaces inside buildings shall be maintained below the critical depth layer in Section 2203.1. Pressurized air or similar methods shall not be used to remove dust from surfaces. Accumulated combustible dust shall be collected by one of the following methods:</i>	Incorporate 2021 IFC Section 2203.5.
129	2203.7	2203.7 Emergency response plan. Written emergency response plans required by the applicable building code to be developed for preventing, preparing for and responding to work-related emergencies, including but not limited to fire and explosion, shall be maintained.	IFC: 2203.7 Emergency response plan. <i>A written emergency response plan shall be developed for preventing, preparing for and responding to work-related emergencies, including but not limited to fire and explosion. The following information shall be developed into the plan:</i> 1. Identification of dust hazards. 2. Identification and location of all utilities to affected areas. 3. Site plans or floor plans locating utility shutoff controls, including water, gas and power. 4. The potential for explosion. 5. Locations of fire-extinguishing equipment compatible with the hazards present.	Incorporate 2021 IFC Section 2203.7.
129	2205.1.1	Delete Section 2205.1.1.	IFC: 2205.1.1 Dust hazard analysis. <i>If a dust hazard analysis (DHA) is required by the fire code official for new or existing facilities and operations, it shall be in accordance with NFPA 652. The DHA for existing facilities shall be in accordance with Section 7.1.1 of NFPA 652.</i>	Incorporate 2021 IFC Section 2205.1.1.
170	3107.13.2	3107.13.2 Location of containers. LP-gas containers and tanks shall be located outside in accordance with Section 6104.1. Pressure relief devices shall be pointed away from the tent or membrane structure.	3107.13.2 Location of containers. <i>LP-gas containers and tanks shall be located outside in accordance with IFC Table 6104.3. Pressure relief devices shall be pointed away from the tent or membrane structure.</i>	3107.13.2 Location of containers. LP-gas containers and tanks shall be located outside in accordance with Table 3107.13.2. Pressure relief devices shall be pointed away from the tent or membrane structure. NOTE: see Table 3107.13.2 (same table as 2021 IFC Table 6104.3) at the end of this document.
175	3303.5	3303.5 Fire safety for buildings of Types IV-A, IV-B, and IV-C construction. Buildings of Types IV-A, IV-B, and IV-C construction designed to be greater than six stories above grade plane shall comply with the following: 1. Standpipes provided in accordance with the applicable building code shall be maintained. 2. A water supply	3303.5 Fire safety requirements for buildings of Types IV-A, IV-B and IV-C construction. <i>Buildings of Types IV-A, IV-B and IV-C construction designed to be greater than six stories above grade plane shall comply with the following requirements during construction unless otherwise approved by the fire code official:</i> 1. Standpipes shall be provided in accordance with Section 3313. 2. A water supply for fire department operations, as approved by the fire code official and the fire chief. 3. Fire safety construction features as required by the Building Official in accordance with the applicable building code.	3303.5 Fire safety requirements for buildings of Types IV-A, IV-B and IV-C construction. Buildings of Types IV-A, IV-B and IV-C construction designed to be greater than six stories above grade plane shall comply with the following requirements during construction unless otherwise approved by the fire code official: 1. Standpipes shall be provided in accordance with Section 3313. 2. A water supply for fire department operations, as approved by the fire code official and the fire chief. 3. Fire safety construction features as required by the Building Official in accordance with the applicable building code.
179	3904.2.1	Delete Sections...3904.2.1	3904.2.1 Listings. <i>Systems or equipment used for the extraction of oils from plant material shall be listed and labeled in accordance with the applicable building code, and be operated and maintained in accordance with the listing and the manufacturer's instructions.</i>	3904.2.1 Listings. Systems or equipment used for the extraction of oils from plant material shall be listed and labeled in accordance with the applicable building code, and be operated and maintained in accordance with the listing and the manufacturer's instructions.
179	3904.2.2	Delete Sections...3904.2.2	3904.2.2 Approvals. <i>Systems or equipment used for the extraction of oils from plant material shall be approved in accordance with the applicable building code.</i>	3904.2.2 Approvals. Systems or equipment used for the extraction of oils from plant material shall be approved in accordance with the applicable building code.
222	5704.2.13.1.1	5704.2.13.1.1 Temporarily out of service. Underground tanks temporarily out of service shall have the fill line, gauge opening, vapor return, and pump connection secure against tampering. Vent lines shall remain open and be maintained in accordance with Sections 5704.2.7.3 and Section 5704.2.7.4. Exception: Underground storage tank systems subject to the Virginia State Water Control Board regulation 9VAC25-580, Underground Storage Tanks—Technical Standards and Corrective Action Requirements, that are out-of-service shall comply with the temporary closure requirements of 9VAC25-580-310.	5704.2.13.1.1 Temporarily out of service. Underground tanks temporarily out of service shall have the fill line, gauge opening, vapor return, and pump connection secure against tampering. Normal and emergency vent lines shall remain open and be maintained in accordance with Sections 5704.2.7.3 and Section 5704.2.7.4. Exception: Underground storage tank systems subject to the Virginia State Water Control Board regulation 9VAC25-580, Underground Storage Tanks—Technical Standards and Corrective Action Requirements, that are out-of-service shall comply with the temporary closure requirements of 9VAC25-580-310.	5704.2.13.1.1 Temporarily out of service. Underground tanks temporarily out of service shall have the fill line, gauge opening, vapor return, and pump connection secure against tampering. Normal and emergency vent lines shall remain open and be maintained. Exception: Underground storage tank systems subject to the Virginia State Water Control Board regulation 9VAC25-580 that are out-of-service shall comply with the temporary closure requirements of 9VAC25-580-310.
222	5704.2.13.1.2	5704.2.13.1.2 Out of service for 90 days. Underground tanks not used for a period of 90 days shall be safeguarded in accordance with all the following or be removed in accordance with Section 5704.2.14: 1. Flammable or combustible liquids shall be removed from the tank. 2. All piping, including fill line, gauge opening, vapor return and pump connection, shall be capped or plugged and secured from tampering. 3. Vent lines shall remain open and be maintained in accordance with Section 5704.2.7.4.	5704.2.13.1.2 Out of service for 90 days. Underground tanks not used for a period of 90 days shall be safeguarded in accordance with all the following, or be removed in accordance with Section 5704.2.14: 1. Flammable or combustible liquids shall be removed from the tank. 2. All piping, including fill line, gauge opening, vapor return and pump connection, shall be capped or plugged and secured from tampering. 3. Normal and emergency vent lines shall remain open and be maintained.	5704.2.13.1.2 Out of service for 90 days. Underground tanks not used for a period of 90 days shall be safeguarded in accordance with all the following or be removed in accordance with Section 5704.2.14: 1. Flammable or combustible liquids shall be removed from the tank. 2. All piping, including fill line, gauge opening, vapor return and pump connection, shall be capped or plugged and secured from tampering. 3. Normal and emergency vent lines shall remain open and be maintained.
4	107.2	None	Industrial Additive Manufacturing. An operational permit is required to conduct additive manufacturing operations regulated by Section 320.3	Add an operational permit to Table 107.2, to conduct additive manufacturing operations regulated by Section 320.3.
	4003.1	IFC 4003.1 Spill control. Drainage or containment systems shall be provided by means of curbs, scuppers, special drains or other suitable means to prevent the flow of spills throughout the building.	4003.1 Spill control. <i>Where provided or required by the applicable building code, drainage or containment systems including curbs, scuppers, special drains or other suitable means to prevent the flow of spills throughout the building, shall be maintained.</i>	4003.1 Spill control. Where provided or required by the applicable building code, drainage or containment systems including curbs, scuppers, special drains or other suitable means to prevent the flow of spills throughout the building, shall be maintained.
	4003.2	IFC 4003.2 Ventilation. For rooms and spaces where distilled spirits and wines in barrels and casks are stored, ventilation shall be provided in accordance with the International Mechanical Code and one of the following: 1. The rooms and spaces shall be ventilated at a rate sufficient to maintain the concentration of vapors within the area at or below 25 percent of the lower flammable limit (LFL). This shall be confirmed by sampling the actual vapor concentration under normal operating conditions. The sampling shall be conducted throughout the enclosed storage area, extending to and toward the bottom and the top of the enclosed storage area. The vapor concentration used to determine the required ventilation rate shall be the highest measured concentration during the sampling procedure. The sampling shall be conducted manually or by installation of a continuously monitoring flammable vapor detection system. 2. The rooms and spaces shall be provided exhaust ventilation at a rate of not less than 1 cfm per square foot [0.00508 m ³ /(s × m ²)] of solid floor area. The exhaust ventilation shall be accomplished by natural or mechanical means, with discharge of the exhaust to a safe location outside the building.	4003.2 Ventilation. <i>For rooms and spaces where distilled spirits and wines in barrels and casks are stored, ventilation shall be operated and maintained in accordance with the applicable building code to prevent vapors from concentrating above 25 percent of the lower flammable limit.</i>	4003.2 Ventilation. For rooms and spaces where distilled spirits and wines in barrels and casks are stored, ventilation shall be operated and maintained in accordance with the applicable building code to prevent vapors from concentrating above 25 percent of the lower flammable limit.

4003.4	IFC 4003.4Lightning. Structures containing barrel storage should be protected from lightning. The lightning protection equipment shall be installed in accordance with NFPA 70 and NFPA 780.	4003.4Lightning. Lightning protection equipment shall be maintained in accordance with the applicable NFPA 70 and NFPA 780.	4003.4 Lightning. Lightning protection equipment shall be maintained in accordance with the applicable NFPA 70 and NFPA 780.
4004.3	IFC 4004.3Basement storage. Class I liquids shall be allowed to be stored in basements in amounts not exceeding the maximum allowable quantity per control area for use-open systems in Table 5003.1.1(1), provided that automatic suppression and other fire protection are provided in accordance with Chapter 9. Class II and IIIA liquids shall also be allowed to be stored in basements, provided that automatic suppression and other fire protection are provided in accordance with Chapter 9.	4004.3Basement storage. Class I liquids shall be allowed to be stored in basements in amounts not exceeding the maximum allowable quantity per control area for use-open systems where approved in accordance with the applicable building code and automatic suppression or other fire protection systems are maintained in accordance with Chapter 9. Class II and IIIA liquids shall also be allowed to be stored in basements where approved in accordance with the applicable building code and automatic suppression or other fire protection systems are maintained in accordance with Chapter 9.	4004.3 Basement storage. Class I liquids shall be allowed to be stored in basements in amounts not exceeding the maximum allowable quantity per control area for use-open systems where approved in accordance with the applicable building code and automatic suppression or other fire protection systems are maintained in accordance with Chapter 9. Class II and IIIA liquids shall also be allowed to be stored in basements where approved in accordance with the applicable building code and automatic suppression or other fire protection systems are maintained in accordance with Chapter 9.
4005.1	IFC 4005.1Automatic sprinkler system. The storage of distilled spirits and wines shall be protected by an approved automatic sprinkler systems required by Chapter 9.	Delete 4005.1	Delete 2021 IFC Section 4005.1.

Proposed 2021 SFPC Table 3107.13.2

(See amendment to Section 3107.13.2 above)

**TABLE 3107.13.2
LOCATION OF LP-GAS CONTAINERS**

LP-GAS CONTAINER CAPACITY (water gallons)	MINIMUM SEPARATION BETWEEN LP-GAS CONTAINERS AND BUILDINGS, PUBLIC WAYS ^g OR LOT LINES OF ADJOINING PROPERTY THAT CAN BE BUILT ON		MINIMUM SEPARATION BETWEEN LP-GAS CONTAINERS ^{b, c} (feet)
	Mounded or underground LP-gas containers ^a (feet)	Above-ground LP-gas containers ^b (feet)	
Less than 125 ^{c, d}	10	5 ^e	None
125 to 250	10	10	None
251 to 500	10	10	3
501 to 2,000	10	25 ^{e, f}	3
2,001 to 30,000	50	50	5
30,001 to 70,000	50	75	(0.25 of sum of diameters of adjacent LP-gas containers)
70,001 to 90,000	50	100	
90,001 to 120,000	50	125	

For SI: 1 foot = 304.8 mm, 1 gallon = 3.785 L.

- a. Minimum distance for underground LP-gas containers shall be measured from the pressure relief device and the filling or liquid-level gauge vent connection at the container, except that all parts of an underground LP-gas container shall be not less than 10 feet from a building or lot line of adjoining property that can be built on.
- b. For other than installations in which the overhanging structure is 50 feet or more above the relief-valve discharge outlet. In applying the distance between buildings and ASME LP-gas containers with a water capacity of 125 gallons or more, not less than 50 percent of this horizontal distance shall also apply to all portions of the building that project more than 5 feet from the building wall and that are higher than the relief valve discharge outlet. This horizontal distance shall be measured from a point determined by projecting the outside edge of such overhanging structure vertically downward to grade or other level on which the LP-gas container is installed. Distances to the building wall shall be not less than those prescribed in this table.
- c. Where underground multicontainer installations are composed of individual LP-gas containers having a water capacity of 125 gallons or more, such containers shall be installed so as to provide access at their ends or sides to facilitate working with cranes or hoists.
- d. At a consumer site, if the aggregate water capacity of a multiple-container installation, comprised of individual LP-gas containers having a water capacity of less than 125 gallons, is 500 gallons or more, the minimum distance shall comply with the appropriate portion of this table, applying the aggregate capacity rather than the capacity per LP-gas container. If more than one such installation is made, each installation shall be separated from other installations by not less than 25 feet. Minimum distances between LP-gas containers need not be applied.
- e. The following shall apply to above-ground containers installed alongside buildings:

1. LP-gas containers of less than a 125-gallon water capacity are allowed without a separation distance where in compliance with Items 2, 3 and 4.
 2. Department of Transportation (DOTn) specification LP-gas containers shall be located and installed so that the discharge from the container pressure relief device is not less than 3 feet horizontally from building openings below the level of such discharge and shall not be beneath buildings unless the space is well ventilated to the outside and is not enclosed for more than 50 percent of its perimeter. The discharge from LP-gas container pressure relief devices shall be located not less than 5 feet from exterior sources of ignition, openings into direct vent (sealed combustion system) appliances or mechanical ventilation air intakes.
 3. ASME LP-gas containers of less than a 125-gallon water capacity shall be located and installed such that the discharge from pressure relief devices shall not terminate in or beneath buildings and shall be located not less than 5 feet horizontally from building openings below the level of such discharge and not less than 5 feet from exterior sources of ignition, openings into direct vent (sealed combustion system) appliances, or mechanical ventilation air intakes.
 4. The filling connection and the vent from liquid-level gauges on either DOTn or ASME LP-gas containers filled at the point of installation shall be not less than 10 feet from exterior sources of ignition, openings into direct vent (sealed combustion system) appliances or mechanical ventilation air intakes.
- f. This distance is allowed to be reduced to not less than 10 feet for a single LP-gas container of 1,200-gallon water capacity or less, provided that such container is not less than 25 feet from other LP-gas containers of more than 125-gallon water capacity.
- g. Above-ground LP-gas containers with a water capacity of 2,000 gallons or less shall be separated from public ways by a distance of not less than 5 feet. Containers with a water capacity greater than 2,000 gallons shall be separated from public ways in accordance with this table.

M410.2-21

IFGC: 410.2

Proponents: Jonathan Sargeant (jonathan.sargeant@omegaflex.com)

2021 International Fuel Gas Code

Revise as follows:

410.2 MP regulators. MP pressure regulators shall comply with the following:

1. The MP regulator shall be *approved* and shall be suitable for the inlet and outlet gas pressures for the application.
2. The MP regulator shall maintain a reduced outlet pressure under lock-up (no-flow) conditions.
3. The capacity of the MP regulator, determined by published ratings of its manufacturer, shall be adequate to supply the *appliances* served.
4. The MP pressure regulator shall be provided with *access*. Where located indoors, the regulator shall be vented to the outdoors or shall be equipped with a leak-limiting device, in either case complying with Section 410.3.
5. A tee fitting with one opening capped or plugged shall be installed between the MP regulator and its upstream shutoff valve. Such tee fitting shall be positioned to allow connection of a pressure-measuring instrument and to serve as a sediment trap.
6. ~~A tee fitting with one opening capped or plugged shall be installed not less than 10 pipe diameters downstream of the MP regulator outlet. Such tee fitting shall be positioned to allow connection of a pressure-measuring instrument. The tee fitting is not required where the MP regulator serves an appliance that has a pressure test port on the gas control inlet side and the appliance is located in the same room as the MP regulator.~~ Means shall be provided downstream of the MP regulator for the connection of a pressure measuring instrument and shall be positioned to allow connection of a pressure measuring instrument. Such means shall be permitted to be a dedicated test port on a regulator, gas control, or manifold, or a plugged tee fitting or plugged manifold port.
7. Where connected to rigid *piping*, a union shall be installed within 1 foot (304 mm) of either side of the MP regulator.

Reason Statement: This proposal expands the list of acceptable pressure test ports beyond a simple tee fitting by recognizing that regulator, appliance gas control, and pre-fabricated manifold manufacturers provide integral test ports in their devices that meet the intent of the code. The proposal eliminates the requirement that the test port be 10 pipe diameters downstream of the MP regulator because this requirement is overly restrictive and provides no real world advantage. Bench testing reveals that, at maximum flow, the pressure differential between the regulator test port and a test port located 10 pipe diameters downstream of the regulator is within 1/4 inch water column. This proposal eliminates unnecessary fittings, joints, and potential leak paths in the gas piping system.

Resiliency Impact Statement: This proposal will increase Resiliency

This proposal would increase resiliency by eliminating unnecessary fittings, joints and potential leak paths in the gas piping system.

Cost Impact: The code change proposal will decrease the cost of construction

This proposal would decrease the cost of construction by eliminating unnecessary fittings and joints in the gas piping system.

REC-402.1.2-21

VECC: TABLE R402.1.2, TABLE R402.1.4; VRC: TABLE N1102.1.2 (R402.1.2), TABLE N1102.1.4 (R402.1.4); VCC: 1301.1.1.1, TABLE R402.1.2, TABLE R402.1.4

Proponents: Laura Baker (laura@reca-codes.com); Eric Lacey (eric@reca-codes.com)

2018 Virginia Energy Conservation Code

Revise as follows:

TABLE R402.1.2 INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT ^a

CLIMATE ZONE	FENESTRATION <i>U</i> -FACTOR ^b	SKYLIGHT ^b <i>U</i> -FACTOR	GLAZED FENESTRATION SHGC ^{b,e}	CEILING <i>R</i> -VALUE	WOOD FRAME WALL <i>R</i> -VALUE	MASS WALL <i>R</i> -VALUE ⁱ	FLOOR <i>R</i> -VALUE	BASEMENT ^c WALL <i>R</i> -VALUE	SLAB ^d <i>R</i> -VALUE & DEPTH	CRAWL SPACE ^c WALL <i>R</i> VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.30	0.55	0.25	38	20 or 13 + 5 <i>ci</i> or 0 + 15 <i>ci</i> ^h	8/13	19	5/13 ^f	0	5/13
4 except Marine	0.32	0.55	0.40	49	30 or 20 + 5 <i>ci</i> or 13 + 10 <i>ci</i> or 0 + 20 <i>ci</i> 15 or 13 + 1 ^h	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.30	0.55	NR	49	30 or 20 + 5 <i>ci</i> or 13 + 5 <i>ci</i> or 0 + 20 <i>ci</i> ^h	13/17	30 ^g	15/19	10, 2 ft	15/19
6	0.30	0.55	NR	49	20+5 ^h or 13+10 ^h	15/20	30 ^g	15/19	10, 4 ft	15/19
7 and 8	0.30	0.55	NR	49	20+5 ^h or 13+10 ^h	19/21	38 ^g	15/19	10, 4 ft	15/19

NR = Not Required.

For SI: 1 foot = 304.8 mm.

- a. R-values are minimums. U-factors and SHGC are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall be not less than the R-value specified in the table.
- b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

Exception: In Climate Zones 1 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

- c. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation on the interior of the basement wall.
"15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. Alternatively, compliance with "15/19" shall be R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home.
- d. R-5 insulation shall be provided under the full slab area of a heated slab in addition to the required slab edge insulation *R*-value for slabs. as indicated in the table. The slab edge insulation for heated slabs shall not be required to extend below the slab.
- e. There are no SHGC requirements in the Marine Zone.
- f. Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.
- g. Alternatively, insulation sufficient to fill the framing cavity and providing not less than an *R*-value of R-19.
- h. The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, "13+5" means R-13 cavity insulation plus R-5 continuous insulation.
- i. Mass walls shall be in accordance with Section R402.2.5. The second R-value applies where more than half of the insulation is on the interior of the mass wall.

TABLE R402.1.4 EQUIVALENT U-FACTORS ^a

CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT U-FACTOR	CEILING U-FACTOR	FRAME WALL U-FACTOR	MASS WALL U-FACTOR ^b	FLOOR U-FACTOR	BASEMENT WALL U-FACTOR	CRAWL SPACE WALL U-FACTOR
1	0.50	0.75	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.084	0.165	0.064	0.360	0.477
3	0.32	0.55	0.030	0.060	0.098	0.047	0.091 ^c	0.136
4 except Marine	0.32	0.55	0.026	0.079 <u>0.45</u>	0.098	0.047	0.059	0.065
5 and Marine 4	0.30	0.55	0.026	0.060 <u>0.45</u>	0.082	0.033	0.050	0.055
6	0.30	0.55	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	0.30	0.55	0.026	0.045	0.057	0.028	0.050	0.055

2018 Virginia Residential Code

Revise as follows:

TABLE N1102.1.2 (R402.1.2) INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT^a

CLIMATE ZONE	FENESTRATION U-FACTOR ^b	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC ^{b,e}	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE ⁱ	FLOOR R-VALUE	BASEMENT ^c WALL R-VALUE	SLAB ^d R-VALUE & DEPTH	CRAWL SPACE ^c WALL R-VALUE
1	NR	0.75	0.25	30	13	¾	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.32	0.55	0.25	38	20 or 13 + 5ci ^h or 0 + 15ci	8/13	19	5/13 ^f	0	5/13
4 except Marine	0.32	0.55	0.40	49	30 or 20 + 5ci or 13 + 10ci or 0 + 20ci 15 or 13 + 1 ^h	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.30	0.55	NR	49	30 or 20 + 5ci or 13 + 10ci or 0 + 20ci ^{5h}	13/17	30 ^g	15/19	10, 2 ft	15/19
6	0.30	0.55	NR	49	20 + 5 ^h or 13 + 10 ^h	15/20	30 ^g	15/19	10, 4 ft	15/19
7 and 8	0.30	0.55	NR	49	20 + 5 ^h or 13 + 10 ^h	19/21	38 ^g	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

NR = Not Required.

- a. R-values are minimums. U-factors and SHGC are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall be not less than the R-value specified in the table.
- b. The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

Exception: In Climate Zones 1 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

- c. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation on the interior of the basement wall. "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation on the interior of the basement wall. Alternatively, compliance with "15/19" shall be R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home.
- d. R-5 insulation shall be provided under the full slab area of a heated slab in addition to the required slab edge insulation R-value for slabs, as indicated in the table. The slab edge insulation for heated slabs shall not be required to extend below the slab.
- e. There are no SHGC requirements in the Marine Zone.
- f. Basement wall insulation shall not be required in warm-humid locations as defined by Figure N1101.7 and Table N1101.7.
- g. Alternatively, insulation sufficient to fill the framing cavity providing not less than an R-value of R-19.
- h. The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, "13+5" means R-13 cavity insulation plus R-5 continuous insulation.
- i. Mass walls shall be in accordance with Section N1102.2.5. The second R-value applies where more than half of the insulation is on the interior of the mass wall.

TABLE N1102.1.4 (R402.1.4) EQUIVALENT U-FACTORS^a

CLIMATE ZONE	FENESTRATION U- FACTOR	SKYLIGHT U- FACTOR	CEILING U- FACTOR	FRAME WALL U- FACTOR	MASS WALL U- FACTOR ^b	FLOOR U- FACTOR	BASEMENT WALL U- FACTOR	CRAWL SPACE WALL U- FACTOR
1	0.50	0.75	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.084	0.165	0.064	0.360	0.477
3	0.32	0.55	0.030	0.060	0.098	0.047	0.091 ^c	0.136
4 except Marine	0.32	0.55	0.026	0.079 0.045	0.098	0.047	0.059	0.065
5 and Marine 4	0.30	0.55	0.026	0.060 0.045	0.082	0.033	0.050	0.055
6	0.30	0.55	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	0.30	0.55	0.026	0.045	0.057	0.028	0.050	0.055

- a. Nonfenestration *U*-factors shall be obtained from measurement, calculation or an approved source.
- b. Mass walls shall be in accordance with Section N1102.2.5. Where more than half the insulation is on the interior, the mass wall *U*-factors shall not exceed 0.17 in Climate Zone 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.
- c. In warm-humid locations as defined by Figure N1101.7 and Table N1101.7, the basement wall *U*-factor shall not exceed 0.360.

2018 Virginia Construction Code

Revise as follows:

1301.1.1.1 Changes to the International Energy Conservation Code (IECC). The following changes shall be made to the IECC:

1. Add Sections C402.1.4.2, C402.1.4.2.1, C402.1.4.2.2, C402.1.4.2.3, C402.2.1.2, C402.2.1.3, C402.2.1.4, C402.2.1.5 and Change Section C402.2.1.1 to read:

C402.1.4.2 Roof/ceiling assembly. The maximum roof/ceiling assembly *U*-factor shall not exceed that specified in Table C402.1.4 based on *construction* materials used in the roof/ceiling assembly.

C402.1.4.2.1 Tapered, above-deck insulation based on thickness. Where used as a component of a maximum roof/ceiling assembly *U*-factor calculation, the tapered roof insulation *R*-value contribution to that calculation shall use the average thickness in inches (mm) along with the material *R*-value-per-inch (per-mm) for *U*-factor compliance as prescribed in Section C402.1.4.

C402.1.4.2.2 Suspended ceilings. Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the assembly *U*-factor of the roof/ceiling *construction*.

C402.1.4.2.3 Multiple layers and staggered joints. Continuous insulation board shall be installed in not less than two layers and the edge joints between each layer of insulation shall be staggered. Multiple layers and staggered joints are not required where insulation tapers to the *roof deck* at a gutter edge, roof drain or scupper.

C402.2.1 Roof assembly The minimum thermal resistance (*R*-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table C402.1.3, based on *construction* materials used in the *roof assembly*.

C402.2.1.1 Tapered, above-deck insulation based on thickness. Where used as a component of a roof/ceiling assembly *R*-value calculation, the tapered roof insulation *R*-value contribution to that calculation shall use the average thickness in inches (mm) along with the material *R*-value per inch (per mm) for *R*-value compliance as prescribed in Section C402.1.3.

C402.2.1.2 Minimum thickness, lowest point. The minimum thickness of above-deck roof insulation at its lowest point, gutter edge, roof drain or scupper, shall be no less than 1 inch (25 mm).

C402.2.1.3 Suspended ceilings. Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the minimum thermal resistance (*R*-value) of roof insulation in roof/ceiling *construction*.

C402.2.1.4 Multiple layers and staggered joints. Continuous insulation board shall be installed in not less than two layers and the edge joints between each layer of insulation shall be staggered. Multiple layers and staggered joints are not required where insulation tapers to the *roof deck* at a gutter edge, roof drain or scupper.

C402.2.1.5 Skylight curbs. Skylight curbs shall be insulated to the level of roofs with insulation entirely above the deck or R-5, whichever is less.

Exception: Unit skylight curbs included as a component of a skylight listed and labeled in accordance with NFRC 100 shall not be required to be insulated.

2. Change the SHGC for Climate Zone 4 (Except Marine) of Table C402.4 to read:

3. Delete Section C402.4.1.2, change Sections C402.4.2, C402.4.2.1, C402.4.2.2 and C402.4.3.

C402.4.2 Skylight area with daylight response controls. The skylight area shall be permitted to be not more than 5 percent of the roof area provided daylight responsive controls complying with Section C405.2.3.1 are installed in daylight zones under skylights.

C402.4.2.1 Daylight Zone Controls under skylights. Daylight responsive controls complying with Section C405.2.3.1 shall be provided to control all electric lights within daylight zones under skylights.

C402.4.2.2 Haze factor. Skylights that are installed in office, storage, automotive service, manufacturing, nonrefrigerated warehouse, retail store and distribution/sorting area spaces shall have a glazing material or diffuser with a haze factor greater than 90 percent when tested in accordance with ASTM D1003.

Exception: Skylights designed and installed to exclude direct sunlight entering the occupied space by the use of fixed or automated baffles or the geometry of skylight and light well.

C402.4.3 Maximum U-factor and SHGC. The maximum U-factor and solar heat gain coefficient (SHGC) for fenestration shall be as specified in Table C402.4.

The window projection factor shall be determined in accordance with Equation 4-5.

PF = A/B

(Equation 4-5)

Where different windows or glass doors have different PF values, they shall each be evaluated separately.

Where the fenestration projection factor for a specific vertical fenestration product is greater than or equal to 0.20, the required maximum SHGC from Table C402.4 shall be adjusted by multiplying the required maximum SHGC by the multiplier specified in Table C402.4.3 corresponding with the orientation of the fenestration product and the projection factor.
where:

PF = Projection factor (decimal).

A = Distance measured horizontally from the farthest continuous extremity of any overhang, eave, or permanently attached shading device to the vertical surface of the glazing.

B = Distance measured vertically from the bottom of the glazing to the underside of the overhang, eave, or permanently attached shading device.

4. Add Table C402.4.3 to read:
5. Add an exception to the first paragraph of Section 403.7.7 to read:

Exception: Any grease duct serving a Type I hood installed in accordance with the *International Mechanical Code (IMC)* Section 506.3 shall not be required to have a motorized or gravity damper.

6. Add Section C403.2.2.1 to read:

C403.2.2.1 Dwelling unit mechanical ventilation. Mechanical ventilation shall be provided for *dwelling units* in accordance with the IMC.

7. Delete Section C403.7.5 and Table C403.7.5.
8. Delete Sections C404.5 through C404.5.2.1, including Tables.
9. Change Section C405.4 to read:

C405.4 Exterior lighting (Mandatory). All exterior lighting, other than low-voltage landscape lighting, shall comply with Section C405.4.1.

Exception: Where *approved* because of historical, safety, signage, or emergency considerations.

10. Change Section C502.1 to read:

C502.1 General. Additions to an existing building, building system or portion thereof shall conform to the provisions of Section 805 of the *Virginia Existing Building Code (VEBC)*.

11. Delete Sections C502.2 through C502.2.6.2.

12. Change Section C503.1 to read:

C503.1 General. Alterations to any *building* or *structure* shall comply with the requirements of Chapter 6 of the VEBC.

13. Delete Sections C503.2 through C503.6.

14. Change Section C504.1 to read:

C504.1 General. *Buildings* and *structures*, and parts thereof, shall be repaired in compliance with Section 510 of the VEBC.

15. Delete Section C504.2.

16. Change Section R401.2 to read:

R401.2 Compliance. Projects shall comply with all provisions of Chapter 4 labeled "Mandatory" and one of the following:

1. Sections R401 through R404.
2. Section R405.
3. Section R406.
4. The most recent version of REScheck, keyed to the 2018 IECC.

17. Change Section R401.3 to read:

R401.3 A permanent certificate shall be completed by the builder or other *approved* party and posted on a wall in the space where the furnace is located, a utility room or an *approved* location inside the *building*. Where located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label, or other required labels. Where *approved*, certificates for multifamily *dwelling units* shall be permitted to be located off-site at an identified location. The certificate shall indicate the predominant *R*-values of insulation installed in or on ceilings, roofs, walls, foundation components such as slabs, basement walls, crawl space walls and floors, and ducts outside conditioned spaces; *U*-factors of fenestration and the solar heat gain coefficient (SHGC) of fenestration; and the results from any required duct system and *building* envelope air leakage testing performed on the *building*. Where there is more than one value for each component, the certificate shall indicate the value covering the largest area. The certificate shall indicate the types and efficiencies of heating, cooling, and service water heating *equipment*. Where a gas-fired unvented room heater, electric furnace, or baseboard electric heater is installed in the residence, the certificate shall indicate "gas-fired unvented room heater," "electric furnace," or "baseboard electric heater," as appropriate. An efficiency shall not be indicated for gas-fired unvented room heaters, electric furnaces, and electric baseboard heaters.

~~18. Change the wood frame wall *R*-value categories for Climate Zone 4 (Except Marine) in Table R402.1.2 to read:~~

~~19. Change the frame wall *U*-factor categories for Climate Zone 4 (Except Marine) in Table R402.1.4 to read:~~

20. Change Section R402.2.4 to read:

R402.2.4 Access hatches and doors. Access doors from conditioned spaces to unconditioned spaces (e.g., *attics* and crawl spaces) shall be weatherstripped and insulated in accordance with the following values:

1. Hinged vertical doors shall have a minimum overall R-5 insulation value;
2. Hatches and scuttle hole covers shall be insulated to a level equivalent to the insulation on the surrounding surfaces; and
3. Pull down stairs shall have a minimum of 75 percent of the panel area having R-5 rigid insulation.

Access shall be provided to all *equipment* that prevents damaging or compressing the insulation. A wood framed or equivalent baffle or retainer is required to be provided when loose fill insulation is installed, the purpose of which is to prevent the loose fill insulation from spilling into the living space when the attic access is opened and to provide a permanent means of maintaining the installed *R*-value of the loose fill insulation.

21. Change Sections R402.4 and R402.4.1.1 to read:

R402.4 Air leakage. The *building* thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.5.

R402.4.1.1 Installation (Mandatory). The components of the *building* thermal envelope as listed in Table R402.4.1.1 shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table R402.4.1.1, as applicable to the method of *construction*. Where required by the code official, an *approved* third party shall inspect all components and verify compliance.

22. Change the title of the "Insulation Installation Criteria" category of Table R402.4.1.1; change the "Shower/tub on exterior wall" category of Table R402.4.1.1, and add footnotes "b" and "c" to Table R402.4.1.1 to read:

23. Change Section R402.4.1.2 to read:

R402.4.1.2 Testing. The *building* or *dwelling unit* shall be tested and verified as having an air leakage rate not exceeding five air changes per hour in Climate Zone 4. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E779, or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). A written report of the results of the test shall be signed by the party conducting the test and provided to the *building official*. Testing shall be conducted by a Virginia licensed general contractor, a Virginia licensed HVAC contractor, a Virginia licensed home inspector, a Virginia *registered design professional*, a certified BPI Envelope Professional, a certified HERS rater, or a certified duct and envelope tightness rater. The party conducting the test shall have been trained on the *equipment* used to perform the test. Testing shall be performed at any time after creation of all penetrations of the *building* thermal envelope.

Note: Should additional sealing be required as a result of the test, consideration may be given to the issuance of a temporary certificate of occupancy in accordance with Section 116.1.1.

During testing:

1. Exterior windows and doors and *fireplace* and stove doors shall be closed, but not sealed beyond the intended weatherstripping or other infiltration control measures;
2. Dampers, including exhaust, intake, makeup air, backdraft, and flue dampers, shall be closed, but not sealed beyond intended infiltration control measures;
3. Interior doors, if installed at the time of the test, shall be open;
4. Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
5. Heating and cooling systems, if installed at the time of the test, shall be turned off; and
6. Supply and return registers, if installed at the time of the test, shall be fully open.

24. Change Section R403.3.3 to read:

R403.3.3 Duct testing (Mandatory). Ducts shall be pressure tested to determine air leakage by one of the following methods:

1. Rough-in test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer's air handler enclosure if installed at the time of the test. All registers shall be taped or otherwise sealed during the test.
2. Postconstruction test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. Registers shall be taped or otherwise sealed during the test.

Exception: A duct air leakage test shall not be required where the ducts and air handlers are located entirely within the building thermal envelope.

A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. The licensed mechanical contractor installing the mechanical system shall be permitted to perform the duct testing. The contractor shall have been trained on the equipment used to perform the test.

25. Delete Section R403.3.5.

26. Change Section R403.7 to read:

R403.7 Equipment and appliance sizing. Heating and cooling equipment and appliances shall be sized in accordance with ACCA Manual S or other *approved* sizing methodologies based on *building* loads calculated in accordance with ACCA Manual J or other *approved* heating and cooling calculation methodologies.

Exception: Heating and cooling equipment and appliance sizing shall not be limited to the capacities determined in accordance with Manual S or other *approved* sizing methodologies where any of the following conditions apply:

1. The specified equipment or appliance utilizes multistage technology or variable refrigerant flow technology and the loads calculated in accordance with the *approved* heating and cooling methodology fall within the range of the manufacturer's published capacities for that equipment or appliance.
2. The specified equipment or appliance manufacturer's published capacities cannot satisfy both the total and sensible heat gains calculated in accordance with the *approved* heating and cooling methodology and the next larger standard size unit is specified.
3. The specified equipment or appliance is the lowest capacity unit available from the specified manufacturer.

27. Change footnote "a" in Table R406.4 to read:

- a. When onsite renewable energy is included for compliance using the ERI analysis of Section R406.4, the building shall meet the mandatory requirements of Section R406.2 and the building thermal envelope shall be greater than or equal to levels of energy efficiency and solar heat gain coefficient in Table R402.1.2, with a ceiling *R*-value of 49 and a wood frame wall *R*-value of 20 or 13 + 5, or Table R402.1.4, with a ceiling *U*-factor of 0.026 and a frame wall *U*-factor of 0.060.

28. Change Section R501.1 to read:

R501.1 Scope. The provisions of the *Virginia Existing Building Code* (VEBC) shall control the alteration, repair, addition and change of occupancy of existing *buildings* and *structures*.

29. Delete Sections R501.1.1 through R501.6.

30. Change Section R502.1 to read:

R502.1 General. Additions to an existing *building*, *building* system or portion thereof shall conform to the provisions of Section 811 of the VEBC.

31. Delete Sections R502.1.1 through R502.1.2.

32. Change Section R503.1 to read:

R503.1 General. Alterations to any *building* or *structure* shall comply with the requirements of Chapter 6 of the VEBC.

33. Delete Sections R503.1.1 through R503.2

34. Change Section R504.1 to read:

R504.1 General. *Buildings*, structures and parts thereof shall be repaired in compliance with Section 510 of the VEBC.

35. Delete Section R504.2.

TABLE R402.1.2 INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT^a

CLIMATE ZONE	WOOD FRAME WALL R-VALUE
4 except Marine	15 or 13 + 1 ^b

TABLE R402.1.4 EQUIVALENT U-FACTORS*

CLIMATE ZONE	FRAME WALL U-FACTOR
4 except Marine	0.079

Reason Statement: This proposal improves the comfort, efficiency, and resiliency of Virginia homes by improving the wall insulation requirements. It will also make Virginia’s energy code consistent with the 2021 IECC requirements for wall insulation. The U.S. DOE found the 2021 IECC to be cost-effective for Virginia (see https://www.energycodes.gov/sites/default/files/2021-07/VirginiaResidentialCostEffectiveness_2021.pdf), and improvements to the thermal building envelope are important to the long-term efficiency and cost-effectiveness of new buildings. Using the U.S. Department of Energy methodology for reviewing code change proposals, and using BEopt modeling software, our analysis found that an improvement from R-15 to R-20+5 in wall insulation will result in a 13.1% improvement in efficiency, and a simple payback period of less than 5 years. Wall insulation is easiest (and most cost-effective) to install during construction. Given that there may only be limited opportunities to upgrade the walls in the future, it is important to construct well-insulated walls from the very beginning. Better-insulated buildings are clearly an investment in Virginia’s energy future. We recommend maintaining consistency with the 2021 IECC requirements.

The wall insulation R-values in the 2021 IECC do not require the use of any specific product and can be achieved with either 2X4 or 2X6 wall construction. The values in the prescriptive R-value table are only a few of many different options. For additional wall insulation options, builders can use one of several compliance paths, each of which provides multiple options and combinations for meeting the code requirements:

- The U-factor alternative table (R402.1.2)
- The Total UA Alternative (R402.1.5)
- U.S. DOE’s REScheck software (www.energycodes.gov)
- The Simulated Performance Alternative (R405)
- The Energy Rating Index (R406)

This proposal also updates the equivalent U-factors to be consistent with the 2021 IRC/IECC, which is important for builders and design professionals who intend to use DOE’s free REScheck compliance software or other energy rating programs. We recommend that Virginia adopt equivalent U-factor values that will be consistent with the latest version of the IECC, both to maximize cost-effective energy efficiency and to improve the resiliency of every new home built in the Commonwealth.

Resiliency Impact Statement: This proposal will increase Resiliency

This proposal will increase resiliency in Virginia’s residential buildings. The International Code Council published a white paper titled *The Important Role of Energy Codes in Achieving Resilience* regarding the role of energy efficiency in resiliency. See https://www.iccsafe.org/wp-content/uploads/19-18078_GR_ANCR_IECC_Resilience_White_Paper_BRO_Final_midres.pdf. Specifically, the ICC found that increased insulation requirements support passive survivability and reduce energy burdens on low-income families, grid impacts by reducing energy demand, ice-dams, and condensation, limiting mold and mildew.

Cost Impact: The code change proposal will increase the cost of construction

The improvement in wall insulation will increase initial construction cost, but is clearly cost-effective to the homeowner. Using the U.S. Department of Energy methodology for evaluating code change proposals, and using BEopt modeling software, we estimated that the average incremental increase in cost for climate zone 4 is \$735.00. The average improvement in energy cost savings is 13.1%, which means simple payback is achieved within 4.4 years, on average. Obviously, results will vary based on which compliance option is selected by the builder, unique characteristics of each building, and so on. But given that walls are unlikely to be altered over the expected 70-100 year useful lifetime of the building, wall insulation is a vitally important measure to incorporate at the time of construction.

REC-402.4.1.2-21

VECC: R402.4.1.2, R402.4.1.3 (New); VRC: N1102.4.1.2, N1102.4.1.3 (R402.4.1.3) (New); VCC: 1301.1.1.1

Proponents: Laura Baker (laura@reca-codes.com); Eric Lacey (eric@reca-codes.com)

2018 Virginia Energy Conservation Code

Revise as follows:

R402.4.1.2 Testing. ~~The building or dwelling unit shall be tested and verified as having an for air leakage . rate not exceeding five air changes per hour in Climate Zone 4. The maximum air leakage rate for any building or dwelling unit under any compliance path shall not exceed 5.0 air changes per hour or 0.28 cubic feet per minute (CFM) per square foot [0.0079 m³/(s x m²)] of the dwelling unit enclosure area. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779, or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the building official. Testing shall be conducted by a Virginia licensed general contractor, a Virginia licensed HVAC contractor, a Virginia licensed home inspector, a Virginia registered design professional, a certified BPI Envelope Professional, a certified HERS rater, or a certified duct and envelope tightness rater. The party conducting the test shall have been trained on the equipment used to perform the test. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope. envelope have been sealed .~~

Note: ~~Should additional sealing be required as a result of the test, consideration may be given to the issuance of a temporary certificate of occupancy in accordance with Section 116.1.1.~~

Exception: ~~For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above grade plane in height, building envelope tightness and insulation installation shall be considered acceptable where the items in Table R402.4.1.1, applicable to the method of construction, are field verified. Where required by the code official, an approved third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall be thermally isolated from all other habitable, conditioned spaces in accordance with Sections R402.2.12 and R402.3.5, as applicable.~~

During testing:

1. Exterior windows and doors and fireplace and stove doors shall be closed, but not sealed beyond the intended weatherstripping or other infiltration control measures;
2. Dampers, including exhaust, intake, makeup air, backdraft, and flue dampers, shall be closed, but not sealed beyond intended infiltration control measures;
3. Interior doors, if installed at the time of the test, shall be open;
4. Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
5. Heating and cooling systems, if installed at the time of the test, shall be turned off; and
6. Supply and return registers, if installed at the time of the test, shall be fully open.

Exception: ~~When testing individual dwelling units, an air leakage rate not exceeding 0.30 cubic feet per minute per square foot [0.008 m³/(s x m²)] of the dwelling unit enclosure area, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779, or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pa), shall be permitted in all climate zones for:~~

~~1. Attached single and multiple-family building dwelling units.~~

~~2. Buildings or dwelling units that are 1,500 square feet (139.4 m²) or smaller.~~

~~Mechanical ventilation shall be provided in accordance with Section M1505 of the International Residential Code or Section 403.3.2 of the International Mechanical Code, as applicable, or with other approved means of ventilation.~~

Add new text as follows:

R402.4.1.3 Leakage rate. ~~When complying with Section R401.2.1, the building or dwelling unit shall have an air leakage rate not exceeding 5.0 air changes per house in Climate Zones 0, 1 and 2, and 3.0 air changes per hour in Climate Zones 3 through 8, when tested in accordance with Section R402.4.1.2.~~

2018 Virginia Residential Code

Revise as follows:

N1102.4.1.2 (R402412) Testing. ~~The building or dwelling unit shall be tested and verified as having an for air leakage rate not exceeding five air~~

~~changes per hour in Climate Zone 4-4-. The maximum air leakage rate for any *building or dwelling unit* under any compliance path shall not exceed 5.0 air changes per hour or 0.28 cubic feet per minute (CFM) per square foot [0.0079 m³/(s x m²)] of the dwelling unit enclosure area. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779, or ASTM E1827 and reported at a pressure of 0.2 inches w.g. (50 Pa). Where required by the *code official*, testing shall be conducted by an *approved third party*. A written report of the results of the test shall be signed by the party conducting the test and provided to the ~~building~~ *code official*. Testing shall be conducted by a Virginia licensed general contractor, a Virginia licensed HVAC contractor, a Virginia licensed home inspector, a Virginia registered design professional, a certified BPI Envelope Professional, a certified HERS rater, or a certified duct and envelope tightness rater. The party conducting the test shall have been trained on the *equipment* used to perform the test. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope* have been sealed.~~

~~**Note:** Should additional sealing be required as a result of the test, consideration may be given to the issuance of temporary certificate of occupancy in accordance with Section 116.1.1.~~

~~**Exception:** For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above *grade plane* in height, building envelope tightness and insulation installation shall be considered acceptable where the items in Table R402.4.1.1, applicable to the method of construction, are field verified. Where required by the *code official*, an *approved third party* independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall be thermally isolated from all other habitable, conditioned spaces in accordance with Sections R402.2.12 and R402.3.5, as applicable.~~

During testing:

1. Exterior windows and doors and fireplace and stove doors shall be closed, but not sealed beyond the intended weatherstripping or other infiltration control measures;
2. Dampers, including exhaust, intake, makeup air, backdraft, and flue dampers shall be closed, but not sealed beyond intended infiltration control measures;
3. Interior doors, if installed at the time of the test, shall be open;
4. Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
5. Heating and cooling systems, if installed at the time of the test, shall be turned off; and
6. Supply and return registers, if installed at the time of the test, shall be fully open.

~~**Exception:** When testing individual *dwelling units*, an air leakage rate not exceeding 0.30 cubic feet per minute per square foot [0.008 m³/(s x m²)] of the dwelling unit enclosure area, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779, or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pa), shall be permitted in all climate zones for:~~

1. ~~Attached single and multiple-family building dwelling units.~~
2. ~~Buildings or dwelling units that are 1,500 square feet (139.4 m²) or smaller.~~

~~Mechanical ventilation shall be provided in accordance with Section M1505 of the *International Residential Code* or Section 403.3.2 of the *International Mechanical Code*, as applicable, or with other *approved* means of ventilation.~~

Add new text as follows:

~~**N1102.4.1.3 (R402.4.1.3) Leakage rate.** When complying with Section N1101.2.1 (R401.2.1), the building or dwelling unit shall have an air leakage rate not exceeding 5.0 air changes per hour in Climate Zones 0, 1, and 2, and 3.0 air changes per hour in Climate Zones 3 through 8, when tested in accordance with Section N1102.4.1.2 (R402.4.1.2).~~

2018 Virginia Construction Code

Revise as follows:

1301.1.1.1 Changes to the International Energy Conservation Code (IECC). Error creating auto-diffed output. (0x01)

The following changes shall be made to the IECC:

1. Add Sections C402.1.4.2, C402.1.4.2.1, C402.1.4.2.2, C402.1.4.2.3, C402.2.1.2, C402.2.1.3, C402.2.1.4, C402.2.1.5 and Change Section C402.2.1.1 to read:

C402.1.4.2 Roof/ceiling assembly. The maximum roof/ceiling assembly *U*-factor shall not exceed that specified in Table C402.1.4 based on *construction* materials used in the roof/ceiling assembly.

C402.1.4.2.1 Tapered, above-deck insulation based on thickness. Where used as a component of a maximum roof/ceiling assembly *U*-factor calculation, the tapered roof insulation *R*-value contribution to that calculation shall use the average thickness in inches (mm) along with the material *R*-value-per-inch (per-mm) for *U*-factor compliance as prescribed in Section C402.1.4.

C402.1.4.2.2 Suspended ceilings. Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the assembly *U*-factor of the roof/ceiling *construction*.

C402.1.4.2.3 Multiple layers and staggered joints. Continuous insulation board shall be installed in not less than two layers and the edge joints between each layer of insulation shall be staggered. Multiple layers and staggered joints are not required where insulation tapers to the *roof deck* at a gutter edge, roof drain or scupper.

C402.2.1 Roof assembly The minimum thermal resistance (*R*-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table C402.1.3, based on *construction* materials used in the *roof assembly*.

C402.2.1.1 Tapered, above-deck insulation based on thickness. Where used as a component of a roof/ceiling assembly *R*-value calculation, the tapered roof insulation *R*-value contribution to that calculation shall use the average thickness in inches (mm) along with the material *R*-value per inch (per mm) for *R*-value compliance as prescribed in Section C402.1.3.

C402.2.1.2 Minimum thickness, lowest point. The minimum thickness of above-deck roof insulation at its lowest point, gutter edge, roof drain or scupper, shall be no less than 1 inch (25 mm).

C402.2.1.3 Suspended ceilings. Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the minimum thermal resistance (*R*-value) of roof insulation in roof/ceiling *construction*.

C402.2.1.4 Multiple layers and staggered joints. Continuous insulation board shall be installed in not less than two layers and the edge joints between each layer of insulation shall be staggered. Multiple layers and staggered joints are not required where insulation tapers to the *roof deck* at a gutter edge, roof drain or scupper.

C402.2.1.5 Skylight curbs. Skylight curbs shall be insulated to the level of roofs with insulation entirely above the deck or R-5, whichever is less.

Exception: Unit skylight curbs included as a component of a skylight listed and labeled in accordance with NFRC 100 shall not be required to be insulated.

2. Change the SHGC for Climate Zone 4 (Except Marine) of Table C402.4 to read:

3. Delete Section C402.4.1.2, change Sections C402.4.2, C402.4.2.1, C402.4.2.2 and C402.4.3.

C402.4.2 Skylight area with daylight response controls. The skylight area shall be permitted to be not more than 5 percent of the roof area provided daylight responsive controls complying with Section C405.2.3.1 are installed in daylight zones under skylights.

C402.4.2.1 Daylight Zone Controls under skylights. Daylight responsive controls complying with Section C405.2.3.1 shall be provided to control all electric lights within daylight zones under skylights.

C402.4.2.2 Haze factor. Skylights that are installed in office, storage, automotive service, manufacturing, nonrefrigerated warehouse, retail store and distribution/sorting area spaces shall have a glazing material or diffuser with a haze factor greater than 90 percent when tested in accordance with ASTM D1003.

Exception: Skylights designed and installed to exclude direct sunlight entering the occupied space by the use of fixed or automated baffles or the geometry of skylight and light well.

C402.4.3 Maximum U-factor and SHGC. The maximum U-factor and solar heat gain coefficient (SHGC) for fenestration shall be as specified in Table C402.4.

The window projection factor shall be determined in accordance with Equation 4-5.

$$PF = A/B$$

(Equation 4-5)

where:

PF = Projection factor (decimal).

A = Distance measured horizontally from the farthest continuous extremity of any overhand, eave, or permanently attached shading device to the vertical surface of the glazing.

B = Distance measured vertically from the bottom of the glazing to the underside of the overhang, eave, or permanently attached shading device.

Where different windows or glass doors have different PF values, they shall each be evaluated separately.

Where the fenestration projection factor for a specific vertical fenestration product is greater than or equal to 0.20, the required maximum SHGC from Table C402.4 shall be adjusted by multiplying the required maximum SHGC by the multiplier specified in Table C402.4.3 corresponding with the orientation of the fenestration product and the projection factor.

4. Add Table C402.4.3 to read:

5. Add an exception to the first paragraph of Section 403.7.7 to read:

Exception: Any grease duct serving a Type I hood installed in accordance with the *International Mechanical Code (IMC)* Section 506.3 shall not be required to have a motorized or gravity damper.

6. Add Section C403.2.2.1 to read:

C403.2.2.1 Dwelling unit mechanical ventilation. Mechanical ventilation shall be provided for *dwelling units* in accordance with the IMC.

7. Delete Section C403.7.5 and Table C403.7.5.

8. Delete Sections C404.5 through C404.5.2.1, including Tables.

9. Change Section C405.4 to read:

C405.4 Exterior lighting (Mandatory). All exterior lighting, other than low-voltage landscape lighting, shall comply with Section C405.4.1.

Exception: Where *approved* because of historical, safety, signage, or emergency considerations.

10. Change Section C502.1 to read:

C502.1 General. Additions to an existing building, building system or portion thereof shall conform to the provisions of Section 805 of the *Virginia Existing Building Code (VEBC)*.

11. Delete Sections C502.2 through C502.2.6.2.

12. Change Section C503.1 to read:

C503.1 General. Alterations to any *building* or *structure* shall comply with the requirements of Chapter 6 of the VEBC.

13. Delete Sections C503.2 through C503.6.

14. Change Section C504.1 to read:

C504.1 General. *Buildings* and *structures*, and parts thereof, shall be repaired in compliance with Section 510 of the VEBC.

15. Delete Section C504.2.

16. Change Section R401.2 to read:

R401.2 Compliance. Projects shall comply with all provisions of Chapter 4 labeled "Mandatory" and one of the following:

1. Sections R401 through R404.
2. Section R405.
3. Section R406.
4. The most recent version of REScheck, keyed to the 2018 IECC.

17. Change Section R401.3 to read:

R401.3 A permanent certificate shall be completed by the builder or other *approved* party and posted on a wall in the space where the furnace is located, a utility room or an *approved* location inside the *building*. Where located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label, or other required labels. Where *approved*, certificates for multifamily *dwelling units* shall be permitted to be located off-site at an identified location. The certificate shall indicate the predominant *R*-values of insulation installed in or on ceilings, roofs, walls, foundation components such as slabs, basement walls, crawl space walls and floors, and ducts outside conditioned spaces; *U*-factors of fenestration and the solar heat gain coefficient (SHGC) of fenestration; and the results from any required duct system and *building* envelope air leakage testing performed on the *building*. Where there is more than one value for each component, the certificate shall indicate the value covering the largest area. The certificate shall indicate the types and efficiencies of heating, cooling, and service water heating *equipment*. Where a gas-fired unvented room heater, electric furnace, or baseboard electric heater is installed in the residence, the certificate shall indicate "gas-fired unvented room heater," "electric furnace," or "baseboard electric heater," as appropriate. An efficiency shall not be indicated for gas-fired unvented room heaters, electric furnaces, and electric baseboard heaters.

18. Change the wood frame wall *R*-value categories for Climate Zone 4 (Except Marine) in Table R402.1.2 to read:

19. Change the frame wall *U*-factor categories for Climate Zone 4 (Except Marine) in Table R402.1.4 to read:

20. Change Section R402.2.4 to read:

R402.2.4 Access hatches and doors. Access doors from conditioned spaces to unconditioned spaces (e.g., *attics* and crawl spaces) shall be weatherstripped and insulated in accordance with the following values:

1. Hinged vertical doors shall have a minimum overall R-5 insulation value;
2. Hatches and scuttle hole covers shall be insulated to a level equivalent to the insulation on the surrounding surfaces; and
3. Pull down stairs shall have a minimum of 75 percent of the panel area having R-5 rigid insulation.

Access shall be provided to all *equipment* that prevents damaging or compressing the insulation. A wood framed or equivalent baffle or retainer is required to be provided when loose fill insulation is installed, the purpose of which is to prevent the loose fill insulation from spilling into the living space when the attic access is opened and to provide a permanent means of maintaining the installed *R*-value of the loose fill insulation.

21. Change Sections R402.4 and R402.4.1.1 to read:

R402.4 Air leakage. The *building* thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.5.

R402.4.1.1 Installation (Mandatory). The components of the *building* thermal envelope as listed in Table R402.4.1.1 shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table R402.4.1.1, as applicable to the method of *construction*. Where required by the code official, an *approved* third party shall inspect all components and verify compliance.

22. Change the title of the "Insulation Installation Criteria" category of Table R402.4.1.1; change the "Shower/tub on exterior wall" category of Table R402.4.1.1, and add footnotes "b" and "c" to Table R402.4.1.1 to read:

23. Change Section R402.4.1.2 to read:

R402.4.1.2 Testing. The *building* or *dwelling unit* shall be tested and verified as having an air leakage rate not exceeding five air changes per hour in Climate Zone 4. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E779, or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). A written report of the results of the test shall be signed by the party conducting the test and provided to the *building official*. Testing shall be conducted by a Virginia licensed general contractor, a Virginia licensed HVAC contractor, a Virginia licensed home inspector, a Virginia *registered design professional*, a certified BPI Envelope Professional, a certified HERS rater, or a certified duct and envelope tightness rater. The party conducting the test shall have been trained on the *equipment* used to perform the test. Testing shall be performed at any time after creation of all penetrations of the *building* thermal envelope.

Note: Should additional sealing be required as a result of the test, consideration may be given to the issuance of a temporary certificate of occupancy in accordance with Section 116.1.1.

During testing:

1. Exterior windows and doors and *fireplace* and stove doors shall be closed, but not sealed beyond the intended weatherstripping or other infiltration control measures;
2. Dampers, including exhaust, intake, makeup air, backdraft, and flue dampers, shall be closed, but not sealed beyond intended infiltration control measures;
3. Interior doors, if installed at the time of the test, shall be open;
4. Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
5. Heating and cooling systems, if installed at the time of the test, shall be turned off; and
6. Supply and return registers, if installed at the time of the test, shall be fully open.

24. Change Section R403.3.3 to read:

R403.3.3 Duct testing (Mandatory). Ducts shall be pressure tested to determine air leakage by one of the following methods:

1. Rough-in test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer's air handler enclosure if installed at the time of the test. All registers shall be taped or otherwise sealed during the test.
2. Postconstruction test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. Registers shall be taped or otherwise sealed during the test.

Exception: A duct air leakage test shall not be required where the ducts and air handlers are located entirely within the building thermal envelope.

A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. The licensed mechanical contractor installing the mechanical system shall be permitted to perform the duct testing. The contractor shall have been trained on the equipment used to perform the test.

25. Delete Section R403.3.5.

26. Change Section R403.7 to read:

R403.7 Equipment and appliance sizing. Heating and cooling equipment and appliances shall be sized in accordance with ACCA Manual S or other *approved* sizing methodologies based on *building* loads calculated in accordance with ACCA Manual J or other *approved* heating and cooling calculation methodologies.

Exception: Heating and cooling equipment and appliance sizing shall not be limited to the capacities determined in accordance with Manual S or other *approved* sizing methodologies where any of the following conditions apply:

1. The specified equipment or appliance utilizes multistage technology or variable refrigerant flow technology and the loads calculated in accordance with the *approved* heating and cooling methodology fall within the range of the manufacturer's published capacities for that equipment or appliance.
2. The specified equipment or appliance manufacturer's published capacities cannot satisfy both the total and sensible heat gains calculated in accordance with the *approved* heating and cooling methodology and the next larger standard size unit is specified.
3. The specified equipment or appliance is the lowest capacity unit available from the specified manufacturer.

27. Change footnote "a" in Table R406.4 to read:

- a. When onsite renewable energy is included for compliance using the ERI analysis of Section R406.4, the building shall meet the mandatory requirements of Section R406.2 and the building thermal envelope shall be greater than or equal to levels of energy efficiency and solar heat gain coefficient in Table R402.1.2, with a ceiling *R*-value of 49 and a wood frame wall *R*-value of 20 or 13 + 5, or Table R402.1.4, with a ceiling *U*-factor of 0.026 and a frame wall *U*-factor of 0.060.

28. Change Section R501.1 to read:

R501.1 Scope. The provisions of the *Virginia Existing Building Code* (VEBC) shall control the alteration, repair, addition and change of occupancy of existing *buildings* and *structures*.

29. Delete Sections R501.1.1 through R501.6.

30. Change Section R502.1 to read:

R502.1 General. Additions to an existing *building*, *building* system or portion thereof shall conform to the provisions of Section 811 of the VEBC.

31. Delete Sections R502.1.1 through R502.1.2.

32. Change Section R503.1 to read:

R503.1 General. Alterations to any *building* or *structure* shall comply with the requirements of Chapter 6 of the VEBC.

33. Delete Sections R503.1.1 through R503.2

34. Change Section R504.1 to read:

R504.1 General. *Buildings*, structures and parts thereof shall be repaired in compliance with Section 510 of the VEBC.

35. Delete Section R504.2.

Reason Statement: The purpose of this code change proposal is to improve efficiency and maintain compliance flexibility for code users by modifying the air leakage testing requirements to be consistent with the 2021 IECC. Specifically, the proposal improves the baseline envelope tightness requirement from 5.0 ACH50 to 3.0 ACH50, but adds a performance path trade-off option for air tightness up to 5.0 ACH50, as long as the efficiency losses are accounted for. The proposal also adds a cfm/sq.ft. compliance option for attached dwelling units and small single-family dwelling units in order to provide more options for builders.

This proposal includes a cost-effective incremental improvement from Virginia's 2018 USBC by tightening the air leakage rate from 5.0 ACH50 to 3.0 ACH50. Based on an analysis of this code change using the U.S. Department of Energy's methodology and using BEopt modeling software, we estimate that this improvement will achieve 9.2% lower energy costs, with a simple payback period of less than 2 years. Results will obviously vary based on the characteristics and size of the home, as well as how much additional work is necessary to achieve the lower leakage rates, but given the long-term benefits of a tighter envelope -- lower energy costs, more efficient system operation, better indoor air quality, etc. -- this improvement is well-justified.

The prescriptive air leakage rate of 3.0 ACH50 has been in the code since the 2012 edition of the IECC. In the 2018 USBC update, Virginia implemented mandatory blower door testing at a rate of 5.0 ACH50, which was short of the full requirement in the 2018 IECC. Now that builders have had some additional experience with mandatory blower door testing and sealing techniques, we believe it is reasonable to further improve the

requirements. At the same time, for projects that are not yet able to achieve envelope air tightness of 3.0, there is an alternative to comply via the performance path or Energy Rating Index, which will allow leakage rates up to 5.0 ACH50. This proposal also clarifies the maximum air leakage rates as 3.0 and 5.0 air changes per hour. While most code users understand the maximum air leakage rates as already being at 3.0 and 5.0 changes per hour, the addition of another digit will pre-empt any "round up" vs. "round-down" arguments from code users, providing additional support for building code officials who are simply trying to enforce the code. This part of the proposal does not change any actual requirements, but rather provides clarification and reduces inconsistency and confusion.

Resiliency Impact Statement: This proposal will increase Resiliency

This proposal will increase the resiliency of homes. A properly sealed home will help maintain better indoor air quality and improve the long-term durability of the home. It will also reduce the volatility of indoor temperature swings and maintain more livable conditions during power outages due to natural emergencies.

Cost Impact: The code change proposal will increase the cost of construction

For buildings not already achieving 3 ACH50 or less, this code change will likely increase construction costs. Based on an analysis using the U.S. DOE methodology for reviewing code changes, and using BEopt modeling software, we estimate that the average marginal cost increase of this proposal is \$144. However, our analysis also showed a 9.2% improvement in overall efficiency, which would result in a simple payback of less than 2 years. We also note that for any project for which the prescriptive requirement may be infeasible, builders will have the flexibility to meet the current air leakage requirement from the 2018 USBC using tradeoffs under another compliance path.



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The Important Role of Energy Codes in Achieving Resilience

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INTRODUCTION

In mid-June 2017, the American southwest experienced stifling heat, breaking or tying numerous records for high temperatures (Masters 2017). Late-January 2019 saw a polar vortex entering midwest states, delivering “prolonged, life-threatening cold” (Pydynowski 2019). The 2017 Hurricane Season brought significant devastation along the Atlantic and Gulf coasts and islands in the Caribbean, leaving millions of people without power for extended periods of time.

These events and the growing frequency and intensity of disasters (NOAA 2019) in general point to the need to think and act differently. Enhancing community resilience has been identified as a key strategy for assuring communities are prepared for such events.

Building codes are an essential strategy in achieving resilience. Building codes provide minimum requirements to protect life-safety in the built environment—every day and particularly in the face of hazards. Energy codes are no exception. Code-based strategies to enhance community resilience must be coordinated across all building codes including energy, plumbing, mechanical, electrical and fire codes. While energy codes have primarily developed to enhance energy efficiency (a resilience goal in and of itself), they also are an important contributor to individual and community resilience in other ways. Figure 1 illustrates the contributions of energy codes to resilience. This paper examines the intersection of energy and resilience (here labeled the energy/resilience nexus) and the important role of energy codes in supporting community resilience. It is a supplement to the recent report *Building Community Resilience through Modern Model Building Codes* (ANCR and ICC 2018) and the second in a series of white papers on how various codes contribute to resilience (ICC 2019).



Figure 1: Energy Code Contributions to Resilience

DEFINING RESILIENCE

Nearly 50 organizations representing all aspects of the planning, design, construction, ownership, operations, management, regulation, and insurance of the built environment have signed on to an “Industry Statement on Resilience (AIA 2019).” Through the Statement the organizations have adopted a common definition for resilience based on one developed by the National Academies (2012), “the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events.”

The adverse events anticipated in the definition may take many forms including extreme, acute events like hurricanes, tornadoes, and earthquakes or more prolonged, chronic events like heat waves, cold snaps, and droughts. Adverse events could also include social challenges like loss of a major employer, growing poverty or homelessness, or economic downturns. Often, an initial adverse event may produce cascading impacts or secondary events that further stress a community. See Figure 3 for hazards and potential secondary hazard effects. The lack of power following a disaster (particularly in the middle of summer or winter) can lead to additional deaths as was the case in elder care facilities in Florida following Hurricane Irma (O’Matz, 2017).

Industry Statement on Resilience

Representing nearly 1.7 million professionals, America’s design and construction industry is one of the largest sectors of this nation’s economy, generating over \$1 trillion in GDP. We are responsible for the design, construction, and operation of the buildings, homes, transportation systems, landscapes, and public spaces that enrich our lives and sustain America’s global leadership.

We recognize that natural and manmade hazards pose an increasing threat to the safety of the public and the vitality of our nation. Aging infrastructure and disasters result in unacceptable losses of life and property, straining our nation’s ability to respond in a timely and efficient manner. We further recognize that contemporary planning, building materials, and design, construction and operational techniques can make our communities more resilient to these threats.

Drawing upon the work of the National Research Council, **we define resilience as the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events.**

As the leaders of this industry, we are committed to significantly improving the resilience of our nation’s buildings, infrastructure, public spaces, and communities.

- **We research** materials, design techniques, construction procedures, and other methods to improve the standard of practice.
- **We educate** our profession through continuous learning. Through coordinated and continuous learning, design, construction and operations professionals can provide their clients with proven best practices and utilize the latest systems and materials to create more resilient communities.
- **We advocate** at all levels of government for effective land use policies, modern building codes, and smarter investment in the construction and maintenance of our nation’s buildings and infrastructure.
- **We respond** alongside professional emergency managers when disasters do occur. Industry experts routinely work in partnership with government officials to survey damage, coordinate recovery efforts, and help communities rebuild better and stronger than before.
- **We plan** for the future, proactively envisioning and pursuing a more sustainable built environment.

The promotion of resilience will improve the economic competitiveness of the United States. Disasters are expensive to respond to, but much of the destruction can be prevented with cost-effective mitigation features and advanced planning. Our practices must continue to change, and we commit ourselves to the creation of new practices in order to break the cycle of destruction and rebuilding. Together, our organizations are committed to build a more resilient future.

CULTIVATORS

led the effort to establish and implement the Statement with their industry peers



FOUNDERS

united to define the goals and objectives of a resilient built environment



AMPLIFIERS

joined the founding signatories in committing to the advancement of Statement goals



Figure 2. Industry Statement on Resilience



Primary Hazards	Structural Damage	Utility Outage	Chemical Release/ Spill	Commodity Shortages	Emergency Comm. Failure	Erosion	Structural Fire	Mold	Carbon Monoxide Poisoning	Disease	Flooding	Landslide	Dam Failure	Storm Surge	Tornado	Wildfire	Hail	Tsunami
Coastal Erosion	x										x	x						
Coastal Flooding	x		x			x		x		x		x						
Inland Flooding	x	x	x			x		x		x		x	x					
Hurricane/ T.S.	x	x	x	x	x	x		x	x	x	x			x	x			
Tornado/ Downburst	x	x	x					x										
Major Thunderstorm/ lightning		x					x								x	x	x	
Earthquake	x	x	x	x	x		x		x			x	x					x
Winter Storms/nor'easters	x	x		x		x	x		x		x			x				
Ice Storms	x	x		x	x		x		x									
Ice Jam	x										x		x					
Landslide	x					x												
Wildfires	x						x											
Tsunami	x	x	x	x		x		x		x	x							
Major Urban Fire	x	x	x															
Drought				x												x		
Epidemic / Pandemic Disease				x														

Figure 3. Secondary Hazard Effects Matrix (Linnean 2013)

Source: MA Hazard Mitigation Plan (2010) p. 117 Table 14

In many cases, adverse events may have a particularly strong impact on vulnerable populations. Vulnerable populations are “any individual, group, or community whose circumstances create barriers to obtaining or understanding information, or the ability to react as the general population. Circumstances that may create barriers include, but are not limited to age; physical, mental, emotional, or cognitive status; culture; ethnicity; religion; language; citizenship; geography; or socioeconomic status (Iowa 2008).” These vulnerabilities may be particularly pronounced during chronic events where access to financial resources could serve to limit an event’s impact. For example, residents living paycheck to paycheck may need to make tough choices around whether to forgo other necessities to heat their home during a cold snap.

Resilience is not a strategy to be deployed in isolation. As recognized in the Energy Independence and Security Act of 2007, a high-performance building is one that, “integrates and optimizes on a life cycle basis all major high-performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations (EISA 2007).” High-performance communities should also take a holistic approach recognizing the need for integration and optimization.

Communities act as systems. A community is only as resilient as its weakest link (ANCR 2018). The Alliance for National & Community Resilience (ANCR) has identified 19 functions that contribute to a community and its resilience (See Figure 4). Identifying strategies that support the resilience of multiple community functions or help address other community priorities including energy efficiency can help reduce the overall cost of implementation and satisfy diverse stakeholder groups. Such an approach recognizes the potential for co-benefits and leverages potential synergies.



Figure 4. Functions that Define Community Resilience

THE ENERGY/RESILIENCE NEXUS

While significant attention is being paid to community resilience, the literature exploring linkages between resilience and energy, the “energy/resilience nexus,” have been limited. This is even more pronounced when considering how building energy codes contribute to resilience. After discussing the broad energy/resilience nexus literature to date, this white paper will focus on energy codes as a resilience strategy.

Energy plays a significant and varying role in modern life. It facilitates activities across the economy from transportation to buildings to manufacturing. Critical lifelines, water and wastewater systems, communications, emergency response and transportation networks all require energy to function. To date, the literature on resilience has either focused on addressing energy-related resilience needs broadly with buildings as a subset or building-related resilience literature has only touched on energy-related aspects.

The City of Boston undertook an effort to identify best practices for climate change adaptation and resilience in its existing building stock. The resultant study looked at the building stock in Boston and the potential vulnerabilities that would need to be addressed now and into the future. Floods and winter storms were identified as the most frequent potential events with hurricanes, severe storms, tornadoes and brush fires following. Based on these risks, the study identified specific strategies to address these risks. About one-third of the 30 recommendations related to building systems, building enclosures and other energy-related aspects of buildings (Linnean 2013). See Figure 5.

The American Council for an Energy-Efficient Economy (ACEEE) has developed multiple papers looking at the energy/resilience nexus. Its 2015 paper on *Enhancing Community Resilience through Energy Efficiency* takes a very comprehensive look at the resilience benefits of

energy efficiency (see Figure 6) and the energy efficiency measures that reduce vulnerability and increase capacity to cope (Figure 7). Building-related strategies feature prominently, but the paper does not delve into specifics around how building energy codes relate (Ribeiro et. al. 2015). In follow-on work ACEEE looked at potential metrics that could be used to understand the energy-resilience of a community. This 2017 paper did include discussion on multiple building-related and energy affordability strategies and potential metrics (Ribiero and Bailey 2017).

The National Association of State Energy Officials (NASEO) looked at the role of state energy offices in contributing to community resilience with a specific focus on residential structures. NASEO identified numerous challenges to integrating energy efficiency and resiliency into residential rebuilding including motivating property owners and developers to value energy efficiency and disaster resilience during the rebuilding process, identifying and understanding the various sources of rebuilding funding and assistance, and working with property insurance providers to allow upgrades above the value of the pre-existing structure. Despite these challenges, they identified six helpful strategies including leveraging existing programs and relationships, ongoing coordination and planning in advance of an event, and conducting evaluations to see what worked (NASEO 2015).

General Actions	Assess Vulnerability and Risk
	Create Places of Refuge
Site	Build for Higher Rainflow
	Create Cool Ground Surfaces
	Floodproof Building Site
	Floodproof Industrial Buildings
	Use Hard Infrastructure to Prevent Flooding
	Use Hazard Resilient Landscape Design
	Protect Entrances from Snow and Ice
	Provide Shade
	Reduce Vulnerability to Wind Damage
	Use Soft/Green Infrastructure to Prevent Flooding
	Stabilize Slopes Susceptible to Erosion, Landslide, Fire
Building Structure	Enhance Structural Elements for Extreme Loads
Building Enclosure	Use Cool Roofing
	Enhance Building Insulation
	Increase Resistance to High Winds
	Manage Heat Gain
Building Systems	Resilient Back-up Power and Systems
	Resilient Heating, Cooling and Ventilation Systems
	Resilient Water Systems During Outages
	Extend Emergency Lighting and Services
Building Operations	Have Emergency Communications Plans
	Protect Records and Inventory
	Secure Interior Environment
	Train Building/Facility Teams for Resilience Upgrades
People	Educate Households
	Partner with Local Community Organizations to Enhance Resilience
	Locate Vulnerable Populations
	Plan for Tenant Needs

Figure 5. Boston's Resilience Strategies for Existing Buildings (Linnean et. al. 2013)

Benefit type	Energy efficiency outcome	Resilience benefit
Emergency response and recovery	Reduced electric demand	Increased reliability during times of stress on electric system and increased ability to respond to system emergencies
	Backup power supply from combined heat and power (CHP) and microgrids	Ability to maintain energy supply during emergency or disruption
	Efficient buildings that maintain temperatures	Residents can shelter in place as long as buildings' structural integrity is maintained.
	Multiple modes of transportation and efficient vehicles	Several travel options that can be used during evacuations and disruptions
Social and economic	Local economic resources may stay in the community	Stronger local economy that is less susceptible to hazards and disruptions
	Reduced exposure to energy price volatility	Economy is better positioned to manage energy price increases, and households and businesses are better able to plan for future.
	Reduced spending on energy	Ability to spend income on other needs, increasing disposable income (especially important for low-income families)
	Improved indoor air quality and emission of fewer local pollutants	Fewer public health stressors
Climate mitigation and adaptation	Reduced greenhouse gas emissions from power sector	Mitigation of climate change
	Cost-effective efficiency investments	More leeway to maximize investment in resilient redundancy measures, including adaptation measures

Figure 6. Resilience Benefits of Energy Efficiency (Ribiero et.al. 2015)

Following Hurricane Sandy, the Urban Green Council undertook an effort to look specifically at how the temperatures inside buildings without power are impacted during both summer and winter. Details on this work are provided in the discussion below on passive survivability (Urban Green 2015).

The most specific paper looking at energy codes and resilience was published in 2013 and focused on individual residential code provisions and their impacts on resilience. The content remains relevant and is captured in the discussion below (Meres and Makela 2013).

INTRODUCTION TO ENERGY CODES

Energy codes were born out of a national crisis. The oil embargo and following energy crisis in the 1970s brought national attention to the need for criteria focused on building energy use. However, energy efficiency in homes caught the attention of the federal Housing and Home Finance Agency (a precursor to the U.S. Department of Housing and Urban Development) in 1950. HHFA developed requirements for residential energy efficiency following defaults on federally backed mortgages due to high energy bills. Development of standards for commercial building energy efficiency were triggered by a blackout in New York in 1970 (ASE 2013).

Today, those early efforts manifest themselves in model energy codes and standards intended for adoption by federal, state and local governments and as the basis for incentive and other programs. ASHRAE first published Standard 90: Energy Conservation in New Building Design in 1975. The standard has been regularly updated since then and is now known as ANSI/ASHRAE/IES Standard 90.1: Energy Standard for Buildings Except Low-Rise Residential. Predecessor organizations to the International Code Council published energy efficiency codes, but the International Energy Conservation Code (IECC) was released in 1998 as a national model code. The IECC and ASHRAE Standard 90.1 are updated on a three-year cycle.

In the Energy Policy Act of 1992 (EPAct 1992), Congress explicitly recognized the importance of national model energy codes in meeting national priorities. EPAct 1992 required states to report on their adoption of energy codes and whether they meet the currently published model codes. Similar requirements remain in law to this day.

Congress reaffirmed the importance of energy codes as it dealt with a national crisis of another form—recession. The American Recovery and Reinvestment Act of 2009 (ARRA) required states to commit to adopting the latest energy codes as a requirement of receiving certain energy stimulus funding. Plans to achieve high levels of code compliance were also required.

Energy codes have become an important component of building codes and support achievement of national and local priorities—including providing social, economic and infrastructural resilience as outlined in the sections that follow. Provisions from the IECC are directly incorporated into the International Building Code (IBC)(Chapter 13) and the International Residential Code (IRC)(Chapter 11). The IBC and IRC are adopted nationwide (all 50 states and 49 states respectively) and serve as the basis for federal, state and local incentive programs focused on advancing resilience. The IECC and Standard 90.1 are also widely adopted nationally—in 48 states for residential buildings and 41 states for commercial buildings.

Energy efficiency measure	Resilience implications
CHP	Provides backup power, allows facilities receiving backup power to double as shelter for displaced residents, reduces overall net emissions, and potentially increases cost savings
Microgrids	May disconnect from grid during power outage, maintaining power supply; allows facilities receiving backup power to double as shelter for displaced residents; reduces overall net emissions; and potentially increases cost savings
Transportation alternatives	Multiple transportation modes that can be used during evacuations and everyday disruptions
District energy systems	Provides heating, cooling, and electricity using local energy sources and reduces peak power demand through thermal energy storage
Utility energy efficiency programs	Increases reliability and reduces utility costs
Energy-efficient buildings	Allows residents/tenants to shelter in place longer, reduces annual energy spending, and reduces overall net emissions. Can help vulnerable populations avoid dangerous and occasionally life-threatening situations in which weather and economics present a dual threat
Green infrastructure	Reduces localized flooding due to storms, reduces energy demand, and reduces urban heat island (UHI) effect in cities and electricity demand
Cool roofs and surfaces	Reduces UHI effect and electricity demand and reduces overall net emissions
Transit-oriented development	Increases economic development opportunities; provides transportation cost savings and reduces impacts of price volatility; and may improve air quality

Figure 7. Energy Efficiency Measures that Reduce Vulnerability and Increase Capacity to Cope (Ribiero et.al. 2015)

ENERGY CODES AS A COMPONENT OF RESILIENCE POLICY

Community resilience focuses on deploying strategies that provide benefits before, during, and after disasters. The most commonly identified building-related strategies at the energy/resilience nexus have focused on passive survivability and reducing the urban heat island effect. While these approaches are a critical piece of the energy resilience nexus, they are not the only piece.

PRE-DISASTER/MITIGATION

SOCIAL RESILIENCE

Whole community resilience requires a focus on social, infrastructural and economic issues. Energy (and water) related policies and practices squarely fall within all three realms. Effective energy policies and practices contribute to the social resilience of a community and can help avoid significant burdens on vulnerable populations. Energy efficiency in particular supports local economies and local businesses by allowing funds otherwise spent on utility costs to remain in the community (Ribiero et. al. 2015).

Economically vulnerable populations must regularly balance energy costs with other important needs. The median energy burden for low-income households is more than twice that of average households (Drehobl and Ross 2016). High-energy burdens can mean that households have limited capacity to prepare for and respond to adverse events. They may also stress low-income residents, impacting their long-term health and well-being (in addition to the physical effects of inadequate housing).

In addition to the energy burden, volatility in energy prices may cause residents to become increasingly vulnerable and may hinder a business's ability to operate or expand. Overall energy costs may also fluctuate as extreme heat or cold require elevated use of heating or cooling. Again, energy efficiency provides a limit to the exposure level a homeowner or business owner may have to pricing volatility.

Reducing the energy burden through energy efficiency measures provided in energy codes can help reduce one potential source of vulnerability.

COMMUNITY HEALTH THROUGH REDUCED AIR POLLUTION

Energy generation produces multiple air pollutants including particulate matter (PM). Such pollutants can create or enhance health-related vulnerabilities in the form of asthma and other breathing issues. Such health impacts can influence the resilience of a community both pre- and post-disaster. An increased number of residents needing health care resources post-disaster can add unnecessary strain to the recovery effort. Such effects may even be further compounded when disasters have direct influence on health—extreme heat or cold for example.

Energy efficiency measures reduce energy generation and thus the pollutants associated with such generation. A reduction in health stressors can also reduce a potential source of vulnerability.

According to ACEEE, reducing electricity use by 15 percent for one year would result in saving six lives each day, up to \$20 billion in avoided health harms and nearly 3,000 fewer asthma episodes (Hayes and Kubes 2018).

URBAN HEAT ISLANDS

Urban environments tend to be several degrees warmer than the surrounding suburbs. This is due to a variety of factors, but certainly building energy efficiency measures including roofing material choices can help reduce these effects. Such measures could influence the severity of extreme heat events at a community level while also supporting passive survivability in individual buildings during such events.

DISASTER/LIFE-SAFETY

EXTREME TEMPERATURES

During extreme heat or cold events, energy infrastructure can be significantly stressed (DOE 2013). The polar vortex in 2014 caused increases in natural gas demand which could not be met by many utility systems. A 2016 Southern California heat wave ended up leaving 5,300 households without power for several hours as Los Angeles saw peak demand reach 50% higher than average (Ribeiro and Bailey 2017). Buildings constructed to be energy efficient maintain temperatures longer and require less energy to provide heating or cooling, resulting in less stress on the grid. This may allow the grid to remain functional during such an event, resulting in decreased overall impact to the entire community. A natural gas utility in Michigan recently experienced distribution challenges when a compressor station failed due to a fire. Residents were asked to lower their thermostats during freezing weather to allow continued service (Wisely and Hall 2019). Without energy efficiency measures like those contained in the energy code, the required use reductions would have been significantly higher, causing further reductions in service.

In conjunction with the decreased impact during extreme events, energy efficiency contributes to reductions in peak demand. During times of peak demand, the grid can also be significantly stressed. Smoother peaks can support resilience by lessening the extent of extreme conditions and allowing investments to be made to support everyday operations and reduced vulnerabilities (AEE 2015).

REDUCED IMPACTS FROM PRIMARY HAZARD EVENTS

In the midst of other hazard events including hurricanes and tornadoes, wind-borne debris can cause property damage or result in injuries. In earthquake and wind events, the structural stability of buildings is important. Wildfires or chemical release incidents can spread contaminants that may enter facilities causing health risks. During droughts, potable water use becomes a critical issue. In some cases, energy efficiency-focused measures can also contribute to the ability to withstand and remain operational during such events.

Highly-efficient windows can reduce the impact of projectiles either through the application of films or by nature of its multiple panes. Some insulation applications can also enhance building strength and stiffness. Controlled ventilation strategies can reduce the infiltration of outdoor contaminants. Pipe insulation can reduce the need to run water to achieve the desired temperature, thus resulting in less waste during drought.

POST-DISASTER/RECOVERY

The recovery process post-disaster is often a stressful time. Many residents and businesses may have suffered extensive damage to their homes and businesses. Often, the community is looking to “get back to normal.” If energy-related concerns (like those discussed below) are minimized, employees, business owners, first responders, and community leaders have one less challenge to address as the community recovers.

EXTENDING ON-SITE GENERATION AFTER LOSS OF POWER

Disaster events typically trigger loss of power for significant parts of the impacted community. This loss of power may linger for a significant time following the disaster, contributing to delays in recovery. Critical facilities would be particularly vulnerable to power outages, so many have deployed on-site generation and storage strategies to support continued operations. Non-critical facilities including businesses and homes also have installed generators to avoid the potential long-term challenges associated with power loss.

Coupled with on-site generation, energy efficiency measures deployed during design and construction and maintained in operations support both community and facility level resilience. Energy efficiency extends the supply of on-site power generation by reducing the overall energy needs to provide essential functions. This could result in either a reduction in on-site fuel storage needs and generator capacity or allow for longer operations without grid-provided electricity. Extended operating time reduces the burden on emergency shelters and emergency planners to implement contingency plans. Resources can be focused on more pressing community needs.

Further, if renewable energy generation (or CHP) is available on-site (with islanding capabilities) the facility may also continue to function post-disaster. Again, effective energy efficiency measures can reduce the burden placed on such systems (or allow the systems to cover the necessary loads). The renewable system may also fulfill a portion of a facility's electricity needs when the grid is under pressure (during an extreme heat event for instance).

PASSIVE SURVIVABILITY

Passive survivability is the ability for a building to remain habitable in the face of an event or crisis resulting in the loss of energy, water or sewage services. The need for passive survivability may surface during extreme heat or cold events when the grid is severely taxed or secondary to other hazard events. Temperature extremes can stress the grid, resulting in blackouts.

Incorporating measures related to passive survivability can help support resilience on two ends—reducing energy demands through increased efficiency thus reducing grid strain and keeping buildings occupiable for longer periods reducing shelter or other emergency services needs. Urban Green Council and Atelier Ten looked at passive survivability potential in New York City’s existing building stock (Urban Green 2014, Leigh et. al. 2014). The study found that during a winter blackout a typical high-rise apartment would drop to 45°F within three days and continue to fall. Buildings that met building codes in place at that time (ASHRAE 90.1-2007 and 2009 IECC) remained about 10°F warmer than older buildings. Subsequent improvements in the code likely lead to even greater improvements in performance relative to the existing building stock. In a summer blackout, a typical high-rise apartment would reach 95°F by the fourth day and peak at over 100°F. Code compliant buildings provided a few additional degrees of relief.

Extreme temperatures can lead to hypothermia and hyperthermia and other significant health risks. Impacts can begin at 61°F where respiratory resistance may be compromised. At 54°F blood pressure rises leading to increased heart attack or stroke risk. Environments below 41°F can lead to hyperthermia (Baker 2013). Hypothermia and heat stroke can set in when the internal body temperature reaches 104°F (NIH 2012). The heat index, a combination of temperature and relative humidity, determines risk for hyperthermia. A heat index of 105°F is considered dangerous and can occur when the dry bulb temperature exceeds 98°F and relative humidity is at 40 percent (Leigh et.al. 2014).

Power outages and extreme temperatures present particular challenges to vulnerable populations. The elderly and infirm are most susceptible to temperature extremes and may be unwilling or unable to leave their homes. The 1995 heat wave in Chicago saw hundreds of deaths—many elderly residents who were unwilling to leave their homes (Klineberg 2002). Economically vulnerable populations also may suffer as they make hard choices on whether to increase their energy spend in the face of extreme heat or cold.

Multiple provisions within the energy code contribute to conditions that support passive survivability. Enclosure criteria around insulation, air barriers, solar heat gain, glazing and fenestration support temperature-related aspects. While the building enclosure performance garners most of the attention around passive survivability, other code provisions are also relevant. Pipe insulation can prevent the freezing of pipes during extreme cold events. Daylighting can support continued use of spaces when emergency lighting is insufficient or when back-up power runs out. Access to daylight may also support occupant mental health during an otherwise stressful time.

Using energy codes to provide enhanced passive survivability provides significant co-benefits. Community and individual resilience is enhanced while building owners and tenants reap energy efficiency related rewards everyday in the form of lower energy bills and greater cost certainty.

ROT, MOLD AND MILDEW

In addition to power outages, communities may see secondary impacts affecting residents. Following extreme temperature and some water-related events (e.g., flooding, hurricanes, severe storms) incidents of mold, mildew and other indoor environmental quality issues may arise. Rot and durability issues are also of concern. To prevent rot, mold, and mildew, the energy code dives deep into the field of building science—controlling heat, air, and moisture transfer in building enclosures (Brinker 2017).

Warm air that comes in contact with a cooler surface can condense water onto that surface. Throughout different seasons and climate zones, houses are full of areas where warmer air and surfaces come in contact with cooler air and surfaces. Preventing that condensation through proper sealing, insulation materials, and construction techniques is what keeps the rot, mold, and mildew from running rampant. Energy code provisions that control moisture include:

- Air barriers. Air barriers prevent air—which carries moisture—from carrying and depositing that moisture right into the wall cavities.
- Slab-on-grade insulation. Take a cold slab in the winter and add warm conditioned air above it: you get condensation. Slab-edge insulation, if done properly according to code, reduces the risk of condensation.

- Sealing at rim joists. Rim joists are often easy to insulate but difficult to properly air seal. So, in colder climates, air (and moisture) passes through the insulation and condenses on the rim joists, keeping those rim joists moist for months on end. First the mold sets in, and then the rim joists get rotted out, making the building unsafe. Air sealing the rim joists according to code protects against this.
- Window U-factors and thermal barriers. Warm conditioned air that comes in contact with the cold surface of windows in winter months can condense, damaging nearby wall, ceiling, and floor materials over time. Better-quality windows specified by climate zone in the code significantly reduce this condensation.
- Insulation and sealing to avoid ice dams. Ice dams are thick ridges of ice that build up along the eaves. These can tear off shingles and cause water to build up and leak into the house. Ice dams form when warm air seeps through cracks and crevices into an unconditioned attic, causing snow to melt on the roof but refreeze at the cold eaves. Properly insulating and sealing the ceiling assembly, as specified in the energy code, is the solution.

ADDITIONAL BENEFITS

Energy codes may also help avoid additional cascading effects following a disaster. This is particularly true for provisions concerning the building envelope and ventilation. Wildfires and other disasters that generate airborne particulates could present health concerns for citizens still in the area. Controlled ventilation practices may reduce the level of air pollutants indoors, allowing for extended occupancy and reducing the potential incidents of illness like asthma in a health system already under stress.

Selected Code Topic	Relevant Sections (2018 IECC)	Supported Resilience Strategy	Relevant Hazards
Insulation	C402.2, R402.2	<ul style="list-style-type: none"> ▪ Passive survivability ▪ Reduced energy burden ▪ Reduced grid impact ▪ Reduced ice-dams ▪ Reduced condensation, limiting mold and mildew 	<ul style="list-style-type: none"> ▪ Extreme heat ▪ Extreme cold ▪ Snow storms ▪ Social resilience ▪ Secondary impacts to all hazards
Walk-In Coolers and Freezers	C403.10	<ul style="list-style-type: none"> ▪ Food safety/preservation 	<ul style="list-style-type: none"> ▪ Extreme heat ▪ Secondary impacts to all hazards
Daylighting	C402.4.1	<ul style="list-style-type: none"> ▪ Passive survivability ▪ Reduced grid impact 	<ul style="list-style-type: none"> ▪ Extreme heat ▪ Secondary impacts to all hazards
Window-to-Wall Ratios	C402.4.1, R402.3	<ul style="list-style-type: none"> ▪ Passive survivability ▪ Impact vulnerabilities 	<ul style="list-style-type: none"> ▪ Extreme heat ▪ Extreme cold ▪ Hurricanes ▪ Tornadoes
Solar Heat Gain Coefficient	C402.4.3, R402.3.2	<ul style="list-style-type: none"> ▪ Passive survivability ▪ Reduced grid impacts 	<ul style="list-style-type: none"> ▪ Extreme heat ▪ Secondary impacts to all hazards
Solar Reflectance of Roof	C402.3	<ul style="list-style-type: none"> ▪ Urban heat island ▪ Passive survivability 	<ul style="list-style-type: none"> ▪ Extreme heat ▪ Secondary impacts to all hazards
Air Leakage	C402.5, R402.4	<ul style="list-style-type: none"> ▪ Contaminants (secondary to wild-fire, earthquake, etc.) ▪ Mold and mildew (secondary to flooding, hurricane, extreme cold, etc.) 	<ul style="list-style-type: none"> ▪ Secondary impacts to all hazards
Pipe Insulation	C404.4, R403.4	<ul style="list-style-type: none"> ▪ Passive survivability ▪ Reduced energy burden 	<ul style="list-style-type: none"> ▪ Extreme cold ▪ Drought ▪ Social resilience
On-Site Renewable Energy	C406.5, Appendix CA, Appendix RA	<ul style="list-style-type: none"> ▪ Contribute to distributed generation ▪ Facilitates islandability 	<ul style="list-style-type: none"> ▪ Secondary impacts to all hazards

Table 1. Select Energy Code Provisions Contributing to Resilience

POTENTIAL FUTURE CODE-BASED SOLUTIONS, RESEARCH NEEDS AND POLICY PLANNING

While today's energy codes clearly contribute to community resilience, opportunities remain to further enhance these provisions and leverage future research to support increased linkages.

Discussion is emerging around the development of immediate occupancy codes or functional recovery standards that focus on keeping buildings occupiable and operational following a hazard event (rather than just immediate life-safety). As the conversation advances, participants should be cognizant of the important role energy plays in the functionality of buildings. As outlined above, energy efficiency and strategies contained in energy codes can contribute to keeping a building functional.

While today's energy codes contribute significantly to the achievement of passive survivability, they have not specifically been developed with such a result in mind. Such strategies should examine the role of operable windows, passive ventilation and other technologies. Targeted research along with the development of metrics focused specifically on human needs (not just comfort) and methodologies for testing the performance and achievement of passive survivability strategies will allow development of criteria that actively support the long-term occupation of buildings post-disaster.

Existing technology incorporated into energy codes can be further leveraged to enhance resilience. Occupancy and other sensors that help control things like lighting or ventilation could be enhanced to include features that help locate victims following a disaster event. The flexibility provided by solid-state lighting technology and the internet of things (IOT) could support enhanced communication methods before, during and after a disaster event.

The evolving electrical grid with the addition of distributed generation resources and smart meters can enhance community resilience. This evolution will certainly impact and be impacted by how buildings interact with the grid. Effectively managing distributed generation and capitalizing on the resilience such generation could provide requires increased focus on the connections between buildings and the grid. Buildings will need to be able to synthesize information they receive from the grid and respond. Building professionals will need education and training to understand these new dynamics. Codes and standards will need updating to address these changes (ASHRAE 2018).

Microgrids and islanding of facilities with on-site generation present a significant opportunity to enhance resilience that is not yet widely applied. As their use increases, codes and standards must develop to ensure that they effectively address resilience, energy efficiency and safety concerns and opportunities.

Expanding on the role energy efficiency serves in extending the supply or productivity of on-site power generation, the use of direct current (DC) from renewable generation may avoid energy losses associated with inverters. This allows more generated energy to be put to its intended use, allowing more essential needs to be filled when the grid goes down. To capture this benefit, DC-native products must be available. Again, codes and standards have an important role in this transition.

As federal, state and local governments look to advance resilience, strong, regularly adopted and properly administered building codes are fundamental (ANCR and ICC 2018). Energy codes are a key component of building codes and firmly contribute to individual and community-level resilience as demonstrated by the discussion above. Therefore, ICC makes the following recommendations to assure that these benefits are effectively captured:

- Any policies, guidance or criteria that includes building codes as a strategy should explicitly incorporate energy codes as a fundamental resilience strategy. This is particularly relevant as FEMA develops criteria in support of implementation of the Disaster Recovery and Reform Act (DRRA).
- Grant programs funding mitigation should look to include energy-related measures and where possible reward mitigation projects that include co-benefits of reduced energy use and enhanced resilience. These include high-performance building enclosures, combined heat and power, microgrids, energy storage, and islandable renewables.
- All federal agencies engaged in code-related initiatives should coordinate their activities and messaging to support a holistic approach on the importance of building codes.

CONCLUSION

From their initial creation through today, building energy codes have played a major role in reducing the impacts of adverse events. Before, during and after disasters building energy codes influence both individual and community capacity to withstand and bounce back from such events. As policymakers consider approaches that enhance resilience, energy codes should be a cornerstone.

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