# 2018 Code Update Cycle – Resiliency Impact Analysis

In response to Executive Order 24, the Virginia Department of Housing and Community Development (DHCD) convened a Resiliency Subworkgroup that met throughout the 2018 code development cycle. The Subworkgroup was tasked with both developing proposals that focus on resiliency and analyzing proposals submitted by others for the 2018 Uniform Statewide Building Code (USBC) to determine effects on resiliency.

The hard labor of the Subworkgroup resulted in eleven proposals approved by the Board of Housing and Community Development (BHCD) for inclusion in the 2018 USBC. The majority of the proposals go beyond the already high levels of resiliency established by the 2018 I-Codes Collection[1], which the 2018 USBC amends, and bring forth provisions from the most current published model codes, the 2021 I-Codes Collection[2].

The proposals generated by the Resiliency Subworkgroup's efforts (summary attached) have received favorable vote by the BHCD for inclusion in the 2018 USBC.
It is also important to note that the Federal Emergency Management Agency (FEMA) not only endorses all the aforementioned proposals, as a Resiliency Subworkgroup Member, but also the original proponent for most of them.

Resiliency has always been at the heart of code development process, however, given the increase in natural disasters and other climate concerns, resiliency has re-emerged as a key factor in code development. It was only fitting then to add, for the 2018 USBC development cycle, a requirement for code change proponents to include a "Resiliency Impact Statement" along with the proposal. In reviewing these statements, it was evident the proponents did not appear to fully reflect the resiliency impact of the proposal.

As a result, the Resiliency Subworkgroup reviewed all the code change proposals submitted by others to determine their impact on resiliency.

An original two-part analysis (Proposed Regulations & Final Regulations) was performed by DHCD Staff and shared with the Subworkgroup for review and feedback.

While resiliency could appear to be very subjective at time, the industry as a whole has come together and developed several white papers on the subject.

The Alliance for National Community Resiliency[3] (ANCR) *"is a 501(c)(3) national coalition of public and private sector stakeholders working to advance community resilience"*; and one of the leaders in the resiliency arena. While there are multiple facets to resiliency, ANCR has developed three Community Resilience Benchmarks™, as follows: Building Benchmark, Housing Benchmark and Water Benchmark. As per ANCR, *"Community Resilience Benchmarks (CRB™s) allow cities to evaluate their resilience within and across these functions and chart a path towards increased resilience."*

> **Building Benchmark:** while the paper's content is very rich in relevant information, the Benchmark Requirement 1) - Adoption of Building Codes - is intimately related to the code development process. The Benchmark is organized across three tiers: Essential Requirements; Enhanced Requirements and Exceptional Requirements. Each level is judged based on the adoption of *"building codes substantially equivalent to the requirements contained in a model*

*code that are no more than"* 9, 6 and 3 years respectively, out of date. The 2018 USBC is based on the 2018 I-Codes. That would place Virginia in the "Enhanced Requirements" category. However, in addition to the proposals mentioned above submitted by the Resiliency Subworkgroup, there is a multitude of other proposals based on the 2021 I-Codes which have been approved by the BHCD for inclusion in the 2018 USBC. Therefore, in some categories, Virginia meets the "Exceptional Requirements" level.

**Water Benchmark:** one of the principal subjects covered is the conservation of water. This can be achieved in many ways, some of which are covered under *"adopted building codes, standards or guidelines for water conservation that are substantially equivalent to the requirements contained in a model code that is not more than 3 years out of date".* As previously noted, the 2018 USBC will meet and in some cases surpass this requirement.

A method commonly used for achieving such goal is rain water harvesting. As indicated on page 30 of the Water Benchmark paper, *"Standards for rainwater harvesting systems include CSA B805/ICC 805 Standard for Rainwater Harvesting Systems*". Code change proposal TP1303.1-18, which has been approved by the BHCD for inclusion in the 2018 USBC, allows CSA B805/ICC 805 to be used as an alternative standard to the provisions already contained in the VPC Section 1303.1 for rain water collection. This proposal constitutes another prime example of code changes based on the 2021 I-Codes as the proposal was modeled after similar 2021 International Plumbing Code[4] language.

**Housing Benchmark:** out of the nine Housing Benchmark Requirements covered by the paper, three of them are focused on affordability: Requirement 1. Housing Affordability and Availability; Requirement 2. Housing Affordability: Policies; and Requirement 6. Total Cost of Home Ownership/Rental.

Likewise, the study titled "Addressing the Impact of Housing for Virginia's Economy" – a joint research effort between four Virginia Universities (Virginia Tech, George Mason University, The College of William and Mary, and Virginia Commonwealth University), at the request of the **Housing Policy Advisory Council[5]** (HPAC), emphasizes the importance of affordable housing as well as the downside of housing unaffordability. An excerpt from the *Conclusions* drawn at the end of the report reads: "*Virginia faces serious challenges. Housing costs have risen faster than incomes, and nearly one million households need more affordable housing. This shortage of affordable housing reduces productivity, poses challenges for both the current and future workforce, and threatens our economic future".*

The USBC has also recognized the housing affordability issues underlined in the ANCR and HPAC publications. During the 2018 USBC development, the various stakeholders engaged in the process have continuously strived for reaching the fine balance between safety and affordability, and conform with § 36-99.01 of the Code of Virginia[6].

The ANCR Housing Benchmark, Preamble, partly reads: *"The safety, sustainability, resilience and affordability of a community's housing stock has a direct correlation to the community's overall resilience and the ability of a community to prepare for current and future risks*."

As reflected by the above white papers, while safety concerns are and should be at the core of building codes development, there are additional aspects and contributing factors to the overall resiliency of buildings, their occupants and communities as a whole. In performing the analysis summarized in the following report, every effort has been made to ensure that the proposals have been reviewed from all vantage points and a comprehensive analysis has been reported to support the resiliency impact as determined by the Subworkgroup.

The Resiliency Subworkgroup has concluded that 28.5% of proposals submitted to amend the Virginia Codes have a neutral impact on resiliency, 4% of the proposals have somewhat of a negative impact, and 67.5% have a positive impact on resiliency overall. Out of those code change proposals with an impact on resiliency – not including proposals with a neutral impact, 6% of the proposals have somewhat of a negative impact and 94% have a positive impact on resiliency overall.

In addition to the resiliency improvements that will result from the Virginia amendments analyzed in this report, it is important to note the final 2018 Virginia regulations also incorporate the resiliency improvements of the updated 2018 edition of the I-codes. As an addendum to this report, the following white papers issued by the International Code Council have been included herein:

- Resilience Contributions of the International Building Code
- The Important Role of Energy Codes in Achieving Resilience

The Resiliency Subworkgroup is committed and eager to continue to improve Virginia's resiliency through code development for the next code update cycle.

**RESOURCES**


1. 2018 I-Codes Collection[1] - https://codes.iccsafe.org/codes/i-codes
2. 2021 I-Codes Collection[2] - https://codes.iccsafe.org/codes/i-codes
3. The Alliance for National Community Resiliency[3] - http://www.resilientalliance.org/the-benchmarks/
4. 2021 International Plumbing Code[4] - https://codes.iccsafe.org/content/IPC2021P1
5. Housing Policy Advisory Council[5] - https://www.vchr.vt.edu/sites/vchr/files/publications/HPACReport_AddressingtheImpactofHousingforVirginiasEconomy.pdf
6. § 36-99.01 of the Code of Virginia[6] - https://law.lis.virginia.gov/vacode/title36/chapter6/section36-99.01/#:~:text=The%20General%20Assembly%20hereby%20declares,older%20residential%20buildings%20in%20the

| 2018 Code Update Cycle - Resiliency Impact Analysis | | | | |
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| **Code Change Proposal** | **Description** | **Resiliency Statement by Proponent** | **Resiliency Subworkgroup (RSW) Analysis** | **Resiliency Impact Positive (+) Negative (-) Neutral (0)** |
| **Proposed Regulations** | | | | |
| A103.2-18 | Clarifies the applicability of the Virginia Construction Code (VCC), Section 103.2. | Will not increase or decrease resiliency. | The proposal appears to clarify the Section's intent. As indicated by the proponent, the current code language has incorrectly been interpreted by some to mean that the section only applies to "new" construction. The proposal intends to rectify this by deleting the word "new". It is the RSW's opinion that the proposal could have a positive influence on resiliency by virtue of ensuring that the correct code editions are enforced as applicable. | + |
| A105.2.1-18 | Includes High School and College level training programs to the experience/education deemed equivalent to the minimum required years of experience for technical assistants. | This proposal will neither increase nor decrease Resiliency. This is not related to resiliency. | As noted by the reason statement, it is becoming much harder to attract new technical assistants to the code profession. Allowing High School and College graduates that have satisfactorily completed related training to meet the minimum qualifications for technical assistance should help overcome this obstacle. The ICC High School Technical Training Program has already produced many graduates that have successfully passed several ICC Certification Exams. Allowing such graduates to enter the code profession and furthering their already vast code knowledge should only improve the code enforcement as a whole, culminating in code compliant, resilient buildings/structures. It is the RSW's opinion that the proposal could positively impact resiliency. | + |
| A106.3.1-18 | Allows the Building Official to consider nationally recognized guidelines for code modification requests, or, alternative methods/materials. | This proposal will increase Resiliency. This proposal is intended to support the use of published guidelines, from nationally recognized sources, such as CC G5-2019 "Guideline for the Safe Use of ISO Intermodal Shipping Containers Repurposed as Buildings and Building Components" published by ICC, as supporting documentation for a code modification. The published container guideline provide valuable information that a building official can utilize to approve the use of shipping containers as building materials. Allowing the use of shipping containers will provide an additional option for affordable resilient housing. | The RSW agrees with the proponent's resiliency statement. | + |
| A108.4--18 | Deletes the affidavit requirements for permit applicants not subject to licensure. | None. | The proposal correlates the code with the current law; and it does not appear to have an impact on resiliency. | 0 |
| A110.5-18 | Removes the requirements for Building Official's signature on permits. | This proposal will neither increase nor decrease Resiliency. This has nothing to do with resiliency. | The Building Official's signature on the building permits does not appear to have an impact on resiliency. The RSW concurs with the proponent's resiliency statement. | 0 |
| A110.8--18 | Adds "non-compliance with provisions of this code and pertinent laws and ordinances" to the reasons for permit revocation. | No impact. | The proposal appears to clarify when the permit could be revoked by the Building Official. Allowing the Building Official to revoke a permit when the project is in non-compliance should aid in avoiding the construction of non-compliant and potentially unsafe projects. It is the RSW's opinion that the proposal could have a positive effect on resiliency. | + |
| A113.7(2)-18 | Requires the name and certification number of the elevator mechanic (performing the required tests) to be listed on the inspection report. | This proposal will neither increase nor decrease Resiliency. | Ensuring that the tests are performed by licensed mechanics is a critical component of a safe installation. Adding the name and certification number of the mechanic to the inspection report, provides for an avenue of verification with the licensure requirements. While test performance by licensed mechanics will not result in safer, more resilient buildings by default, the expectation is that licensed mechanics have obtained the necessary training and experience to perform said tests, thus, resulting in code compliant, resilient systems. It is the RSW's opinion that the proposal could positively influence resiliency. | + |
| A113.8-18 | Revamps VCC Sections 113.8 and 116.1. | This proposal will neither increase nor decrease Resiliency. This is not related to resiliency. | As reasoned by the proponent, the current language does not appear to fully express the Sections' intent. The proposal appears to rectify this issue, provide for much needed clarity and improve the code enforcement uniformity. It is the RSW's opinion that the resiliency could benefit from this proposal. | + |
| A115.2(3)-18 | Clarifies the party(ies) to whom Notices of Violation are to be served. | This proposal will neither increase nor decrease Resiliency. Nothing contained in this proposal impacts resiliency. | The proposal appears to be editorial in nature with no apparent changes to the already existing requirements. The RSW concurs with the proponent's resiliency statement. | 0 |
| A116.4-18 | Expands the scoping provisions of VCC Section 116.4 to also include post USBC buildings without a Certificate of Occupancy. | Will not increase or decrease resiliency. | The Certificate of Occupancy (CO) is a fundamental document for any building. While requiring this could impose additional stress on the already slim Building Departments, the information contained therein could be of tremendous help for potential future building owners and an invaluable resource for designers during the design phase of any project. Knowing the basic information which a CO contains (such as use/occupancy, construction type, sprinkler vs. no sprinkler, etc.) should aid in facilitating the design and approval of code compliant and resilient alteration/renovation/addition projects. It is the RSW's opinion that the proposal could positively impact resiliency. | + |
| A119.6-18 | Provides for alternative means (electronic) of communicating the time and place of LBBCA meetings. | This proposal will neither increase nor decrease Resiliency. | The code change proposal is administrative in nature and it does not appear to have an impact on resiliency. | 0 |
| AD30-18 | Adds institutional trampolines and trampoline courts to the list of regulated amusement devices. | This proposal will neither increase nor decrease Resiliency. | Currently, trampolines are not regulated as amusement devices. As such, there are no standards and provisions that they must comply with. This has resulted in multiple accidents and injuries. Regulating such devices and ensuring compliance with the applicable ASTM standard(s) should provide for much more safe and resilient trampolines; and help avoid accidents/injuries. It is the RSW's opinion that the proposal could increase the resilience of trampoline courts and institutional trampolines. | + |
| AD40-18 | Addition of ASTM F2461-18 to the list of applicable amusement device standards. | This proposal will neither increase nor decrease Resiliency. No impact on resiliency. | The addition of ASTM F2461 standard could prove to be very beneficial in the design/construction/enforcement of aquatic play equipment. This should also facilitate uniformity in the enforcement of provisions applicable to aquatic play equipment and provide for safer, more resilient equipment. It is the RSW's opinion that the proposal could have a positive impact on resiliency. | + |
| AD75-18 | Requires the permit application and pertinent documentation/information to be provided to the Building Department at least three days prior to the operation of certain amusement devices. | This proposal will neither increase nor decrease Resiliency. The information is currently required to be submitted. Doing so prior to operation will have no impact. | Providing the information ahead of time should enable the local Building Department to become more familiar with the devices; and be better prepared to inspect and ensure compliance with the applicable provisions. A comprehensive review of the applicable documentation coupled with a thorough inspection should ensure the safety of riders as well as the resiliency of said devices against adverse effects from wind, etc. It is the RSW's opinion that the proposal could positively affect resiliency. | + |
| B108.1-18 | Allows limited type of "barricade" devices on doors serving groups E and B educational. | This proposal will neither increase nor decrease Resiliency. | The number of active shooting events occurring in educational type occupancies in the recent years, has triggered an interest in allowing certain types of locking arrangements in such occupancies. Being able to shelter in place by locking the door(s) could deter the shooter from trying to enter the room and potentially save lives. Thus, although the installation of barricade type devices would not necessarily improve the resiliency of the buildings, it could improve the resiliency of occupants against shooters/other individuals intending to inflict harm onto occupants. It is the RSW's opinion that the proposal will increase resiliency as a whole. | + |

| Code Change Proposal | Description | Resiliency Statement by Proponent | Resiliency Subworkgroup (RSW) Analysis | Resiliency Impact Positive (+) Negative (-) Neutral (0) |
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| B202(1)-18 | Reverts the definition of "Walls" back to the definition found in the 2012 VCC. | Will not increase or decrease resiliency. | As per the reason statement, the Virginia Existing Building Code provisions could potentially be incorrectly interpreted should the 2015 VCC definition not be changed. Reverting back to the 2012 VCC definition should provide the needed clarity, avoid erroneous code interpretations and improve the code enforcement uniformity. It is the RSW's opinion that the proposal could have a positive effect on resiliency. | + |
| B408.2.1-18 | Updates reference to the correct section. | Will not increase or decrease resiliency. | This appears to be an editorial change and it does not appear to impact resiliency. | 0 |
| B428-18 | Rewrite of Higher Education Laboratories section based on the 2018 IBC but incorporating Virginia amendments. | Will not increase or decrease resiliency. | In addition to deleting conflicting requirements, the provisions covered by the proposal appear to be more stringent than the current code (i.e. Table 428.3 in the proposal vs. Table 430.3 in the 2015 VCC). The additional limitations imposed should increase the resiliency of buildings against hazards associated with laboratories. It is the RSW's opinion that the proposal will increase resiliency. | + |
| B703.3-18 | Editorial revision to reference the appropriate section. | Will not increase or decrease resiliency. | This appears to be an editorial change and it does not appear to impact resiliency. | 0 |
| B905.3.1-18 | Adds requirements for standpipes in buildings of four or more stories above grade plane. | This proposal will increase Resiliency. This proposal will ensure that all new structures that are four or more stories above or below grade are equipped to provide critical fire protection infrastructure for interior fire and rescue operations in multi-story buildings. | Improvements to the efficiency of fire fighting operations should provide for safer and more resilient buildings against fire events. The RSW agrees with the proponent's resiliency statement. | + |
| B907.5.2.3-18 | Deletes fire alarm provisions applicable to existing buildings. | Will not increase or decrease resiliency. | As indicated by the proponent, the current provisions have the potential of conflicting with the requirements set forth by the Virginia Existing Building Code (VEBC). Deleting the requirements from the VCC should avoid conflicts and improve consistency in the code interpretation and enforcement. It is the RSW's opinion that improving uniformity in the code enforcement could positively impact resiliency. | + |
| B912.2.2-18 | Removes signage requirements applicable to fire department connections associated with existing buildings. | Will not increase or decrease resiliency. | The proposal appears to delete requirements already found in the Statewide Fire Protection Code (SFPC). The RSW agrees with the proponent's resiliency statement. | 0 |
| B916.1-18 | Adds exemption from the In-Building Emergency Communication Coverage for buildings in localities which do not provide the required infrastructure. | This proposal will neither increase nor decrease Resiliency. This code provision is not related to resiliency. | Although the proponent makes a very compelling argument regarding resources used in vain, reducing the already impaired requirements, would appear to be against the intent and principles of the code. The proposal appears to be a way out for each jurisdiction from providing the necessary infrastructure for successful fire fighting operations. Weakening the requirements would appear to reduce the resilience of buildings, building occupants and fire fighting personnel against fire events. It this regard, it is the RSW's opinion that the proposal could negatively impact resiliency. However, many newer buildings incorporate newer technology infrastructures (e.g., wireless) or could more easily be retrofitted with wireless capabilities (in lieu of the outdated code required “wired/cabled” systems), thus potentially allowing such buildings to more easily accommodate such emergency systems in more and more existing buildings and to accommodate future considerations, which should have a positive effect on resiliency. It is the RSW's opinion that the proposal could have an overall positive impact on resiliency. | + |
| B1010.1.10-18 | Maintains the same locking arrangements as the 2015 VCC. | This proposal will neither increase nor decrease Resiliency. This change proposal is unrelated to resiliency. | The proposal deletes the additional locking option allowed by the 2018 IBC and reverts back to what the 2015 VCC currently allows. Given that no changes from the current code provisions occur, it is the RSW's opinion that the proposal does not impact resiliency. | 0 |
| B1026.2-18 | Intends to clarify the requirements for openings through floor assemblies associated with horizontal exits. | This proposal will neither increase nor decrease Resiliency. | The proposal intends to clarify the requirements of Section 1026.2 as it relates to floor openings. This appears to be achieved by specifically requiring openings to comply with the applicable code sections which are now referenced by Section 1026.2. The revised language and the listing of applicable code sections should avoid code misinterpretations and ensure that buildings are constructed in compliance with the intent of the code; thus, resulting in more resilient buildings.<br>Given the above, it is the RSW's opinion that the proposal could have a positive impact on resiliency. | + |
| B1030.4-18 | Relocation of eero (emergency escape and rescue opening) provisions applicable to existing buildings from the VCC to the VEBC. | Will not increase or decrease resiliency. | Given the mere relocation of same requirements from one code to another, it is the RSW's opinion that resiliency will not be impacted by the proposal. | 0 |
| B1103.2.8-18 | Modifications to raised and lowered areas in places of religious worship. | Will not increase or decrease resiliency. | The proposal appears to match the code language with the actual use of such areas; and it does not appear to have an impact on resiliency. The RSW agrees with the proponent's resiliency statement. | 0 |
| B1011.5.2--18 | Deletes non applicable reference to the International Existing Building Code (IEBC). | Will not increase or decrease resiliency. | In Virginia the code applicable to existing buildings is the VEBC and not the IEBC. Furthermore, Section 403.1 of VEBC does not cover stairway replacements. Keeping the reference to the IEBC could create conflicts, confusion and possibly misapplication of the code. The proposal intends to address those issues and improve the uniformity of code enforcement. It is the RSW's opinion that the proposal could have a positive effect on resiliency. | + |
| B3002.4-18 | Increases the requirements for the placement of international symbol for emergency services; and adds new exception from the fire resistance requirements of machine rooms/spaces. | Will not increase or decrease resiliency. | The current code provisions require machine rooms/spaces to have the same fire resistance rating as the hoist way enclosure. There currently is, however, an exception for buildings four or less stories above grade plane. Said exception eliminates the requirements for fire-resistance rating of rooms/spaces if certain conditions are met. The proposal adds a 2nd exception which would allow the reduction in fire resistance rating to no more than 1-hour. This exception would normally apply to buildings more than four stories above grade plane.<br>The reason statement indicates that the proposal is intending to get the VCC closer to the IBC in language; and that Virginia should allow for the utilization of another exception that is offered at the national level.<br>a. During the development of the 2012 VCC, by way of consensus for approval by the workgroups, a similar exception which existed in the 2009 VCC/2009 IBC has been deleted.<br>b. It appears that the proposed exception is closer in language to the 2009 VCC/2009 IBC/2012 IBC and not to the 2015/2018 IBC.<br>c. The 2015/2018 IBC, unlike the proposal under consideration, do not allow any of the two (2) exceptions to be applied to rooms/spaces associated with fire service access elevators and occupant evacuation elevators. This was a significant change (code change proposal G171-12) during the development of the 2015 IBC. As indicated by the G171-12 reason statement - which has been approved as submitted, "*Section 903.3.1.1.1, items 5 and 6 prohibit sprinklers in machine rooms of fire service access elevators and occupant evacuation elevators. Thus, they are unprotected. As such, they should not be allowed a reduction in enclosure protection.*"While Section 903.3.1.1.1 does not prohibit, it does allow for the omission of sprinklers in such rooms.<br>When comparing the proposal with the 2015 VCC/2018 IBC, it appears that the latter provide for more resilient fire service access elevators and occupant evacuation elevators.<br>Given the above, It is the RSW's opinion that the proposal could negatively impact the resiliency of buildings containing fire service access elevators or occupant evacuation elevators. | - |

| Code Change Proposal | Description | Resiliency Statement by Proponent | Resiliency Subworkgroup (RSW) Analysis | Resiliency Impact Positive (+) Negative (-) Neutral (0) |
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| B3007.6-18 | Clarifies that the section referenced is an IBC and not VCC section. | This proposal will not increase or decrease resiliency. It is a clarification to correct a reference to a deleted section in the Virginia Construction Code. | It is the RSW's opinion that clarifying which code section applies could positively influence resiliency by improving the consistency in the application of the code. | + |
| B3113-18 | Deletes the 2018 IBC provisions for Relocatable Buildings. | Will not increase or decrease resiliency. | As indicated by the reason statement, provisions for the relocation of buildings/structures already exist within the USBC. As per the reason statement associated with the IBC code change proposal resulted in the IBC Section 3113 (code change proposal G223-15) said provisions are intended for states that do not have a process in place for dealing with the relocation of modular buildings: *"Many states have statutes that govern the building and relocating of relocatable modular buildings. For those that do not have state mandated requirements, much confusion and inconsistency exists about the requirements for relocatable modular buildings as existing buildings."*Introducing one more section dealing with the relocation of buildings could create potential conflicts and non-uniformity in the USBC enforcement. It is the RSW's opinion that deleting Section 3113, as intended by the proposal, the resiliency could be positively influenced. | + |
| B3302.1-18 | Deletes certain VCC provisions (already in the VEBC) applicable to existing buildings. | Will not increase or decrease resiliency. | Having similar requirements in more than one code book could result in future potential conflicts and erroneous code enforcement; i.e. during the code development process, the provisions in one of the code books could be amended while those in the other code book could be overlooked. An example of this instance is the location of plumbing facilities located on cemetery properties , VCC Section 2902.3.2 vs. VPC Section 403.3.3. The proposal appears to prevent such occurrences. It is the RSW's opinion that the proposed change could have a positive effect on resiliency as a factor of correct code application. | + |
| B3310.1-18 | Deletes certain VCC provisions (already in the VEBC) applicable to existing buildings. | Will not increase or decrease resiliency. | Similar with B3302.1-18 above.<br>It is the RSW's opinion that the proposed change could have a positive effect on resiliency as a factor of correct code application. | + |
| BAQ104.1.2-18 | Several changes to the Appendix Q - Tiny Houses. | This proposal will neither increase nor decrease Resiliency. | The proposal modifies and adds new sections to the Appendix Q. The modifications and additions appear to clarify and increase the stringency of the requirements imposed by the 2018 IRC. I.e. it clarifies how the ceiling height must be measured; provides dimensions for intermediate and bottom landings; increases the loading requirements for ladders; specifically indicates that the guards must comply with the opening and loading requirements in Chapter 3; etc. While the amendments do not necessarily improve the resiliency of Tiny Houses, it appears to increase the resiliency of their occupants against possible falls and other types of accidents. It is the RSW's opinion that the code change will improve resiliency overall. | + |
| CS41-18 | Editorial change. | This proposal will neither increase nor decrease Resiliency. | The proposed change is editorial in nature and it does not appear to have an impact on resiliency. | 0 |
| E402.4-18 | Reduces the SHGC from 0.4 to 0.36. | This proposal will increase Resiliency. This proposal will make buildings more resilient. Low-SHGC windows maintain better occupant comfort by reducing the volatility of indoor temperature swings. Moreover, these windows will help maintain more livable conditions during power outages due to natural emergencies. These improvements fall squarely within the Governor's directive to the Department of Housing and Community Development to identify "resilience-specific improvements to the Uniform Statewide Building Code (USBC) for inclusion in the 2018 code update," in Executive Order 24 from November 2018.<br>At the macro level, buildings currently account for over 40% of the nation's energy use and over 70% of the nation's electricity use. A significant portion of that electricity comes from burning fossil fuels, which is one of the causes of climate change. Improvements in efficiency – particularly peak electric demand reductions – will help curb Virginia's need to build and site peak generation (which tends to be both more expensive and more carbon-intensive). Low-SHGC fenestration is designed to reduce cooling demand during the hottest hours and months of the year, providing these additional benefits to building owners and all Virginia's citizens. It is well within Virginia's interests in improving resiliency to a changing climate to reduce energy demand wherever possible. | The RSW agrees with the proponent's resiliency statement. | + |
| E403.2.8-18 | Deletes energy requirements associated with kitchen exhaust systems. | This proposal will neither increase nor decrease Resiliency.<br>It is possible that this will decrease resiliency, however it will most certainly increase life safety. | Deleting the existing Virginia Energy Conservation Code (VECC) requirements for kitchen exhaust systems - which have the potential to provide for significant energy savings, would appear to reduce resiliency. However, while aiding with energy savings, it appears that the current limitations prohibit the kitchen exhaust systems from functioning as required to produce the intended results. Not exhausting the smoke and grease laden vapors would defeat the purpose of installing such exhaust systems; and could potentially expose the buildings and their occupants to dangerous environments. Considering the above, it is the RSW's opinion that the proposal could have an overall neutral effect - at worst, or, a positive effect - at best, on resiliency. | + |
| EB103.5-18 | Clarifies the inspection requirements associated with the changing of fuel burning appliances/equipment. | This proposal will neither increase nor decrease Resiliency. No impact on resiliency. | As indicated by the proponent, the current language does not appear to correctly communicate the original intent of the Section. Deleting the provisions from the current location, will enable the reader to correctly determine which fuel burning equipment/appliances must be inspected by referring to VCC Section 113.3.1. Given the clarification and the expected improvement in the uniformity of code enforcement, it is the RSW's opinion that the proposal could have a positive effect on resiliency. | + |
| EB103.10-18 | Editorial change. | Will not increase or decrease resiliency. | This appears to be a minor editorial change with no effect on resiliency. | 0 |
| EB103.10 (Option B)-18 | Deletion of "Work Area" definition and significant revisions to Chapters 6 and 7 of the VEBC. | Some may suggest this proposal will decrease resiliency because less of the existing building will be updated/upgraded; however, it could also be argued that if that "other" work was required, the applicant might just walk away from the project and not do ANY new work - or greatly reduce the amount of the intended work to avoid the increased requirements anyway. So, in that respect, one might argue that this proposal incentivizes the rehabilitation of the building and therefore, increases the resiliency to the extent it would not otherwise have been done. | The RSW agrees with the proponent's resiliency statement. | + |
| EB302.1-18 | Removes retrofit type language pertaining to existing materials. | This proposal will neither increase nor decrease Resiliency.<br>This code change is not related to resiliency. | The USBC's intent has always been to allow the continuance use of existing building components, features, equipment, etc. so long as they are in compliance with the applicable code provisions in effect at the time of their construction/installation. The existing code language, however, goes against this principle. As indicated by the reason statement, this could result in potential high costs added to any given renovation. The additional expense triggered by this code section could actually deem potential renovation projects to be cost prohibitive. As such, buildings could be left to continue to deteriorate and reduce their resiliency. The proposal removes the retrofit type language and should assist in promoting the renovation of existing buildings/structures which otherwise would not be feasible to be renovated; thus increasing their resiliency. It is the RSW's opinion that the proposal could have a positive effect on resiliency. | + |

| Code Change Proposal | Description | Resiliency Statement by Proponent | Resiliency Subworkgroup (RSW) Analysis | Resiliency Impact Positive (+) Negative (-) Neutral (0) |
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| EB303-18 | Consolidation of the VEBC Section 303 -Fire Escapes | This proposal will neither increase nor decrease Resiliency.<br>Fire escapes do not impact resiliency. | In addition to consolidating the Section, the proposal also eliminates a conflict within it. Eliminating the conflict should streamline the interpretation and enforcement of the code provisions and result in more uniform code application. Also, the alleged reduction in construction cost, for some projects, could increase the eligibility of certain buildings to be renovated. It is the RSW's opinion that the proposal could positively impact resiliency. | + |
| EB304.1-18 | Editorial change regarding glass replacement. | This proposal will neither increase nor decrease Resiliency.<br>This is an editorial change. | Although the proposal rewrites and deletes (from certain VEBC Chapters) the replacement glass provisions, the requirements appear to remain the same. The RSW agrees with the proponent's resiliency statement. | 0 |
| EB304.3(1)-18 | Clarifies that sections referenced are VCC sections. | Will not increase or decrease resiliency. | Indicating that the sections referenced are from the VCC should avoid any confusion which the current provisions may create; and ensure that the intent of the section is achieved. The approval of the proposal should result in an improvement in the uniformity of code application. It is the RSW's opinion that the change could have a positive effect on resiliency. | + |
| EB304.3(2)-18 | Adds R-5 occupancies to the R-groups covered by this Section. | Will not increase or decrease resiliency. | This proposal compliments the previous one [EB304.3(1)-18] by including R-5 occupancies and the related VRC references. As reasoned by the proponent, the 2015 VEBC although could be used for work on existing buildings housing R-5 occupancies, Section 304.3 only covers R-2 and R-3 occupancies. The current provisions of Section 304.3 work fine for IEBC and/or IRC, however, given the fact that the R-5 occupancy is specific to Virginia, single family dwellings would not be covered by this Section. The proposal intends to fill this gap; thus, providing the reader with the necessary tools to address the replacement of windows serving as eero's. It is the RSW's opinion that the proposal could have a positive impact on resiliency. | + |
| EB305.1-18 | Editorial change. | Will not increase or decrease resiliency. | The proposal replaces the word "relocation" with the word "moving" which is more appropriate for Industrialized Buildings; and deletes no longer applicable code provisions/language. The RSW agrees with the proponent's resiliency statement. | 0 |
| EB307.3.1-18 | Section reformatting; and deletion of requirements applicable to existing materials. | This proposal will neither increase nor decrease Resiliency. This is editorial. | Current exceptions to the VEBC Section 307.3.1 are proposed to be relocated and converted from exceptions (to the requirements), to requirements themselves.<br>Additionally, it deletes the provisions applicable to existing materials set forth by Section 307.7.1.1. As indicated by the proponent, if the materials are not removed/repaired/altered or otherwise part of work under the scope of VEBC, are allowed to remain in use by default. The current language appears to give the Building Official the authority to determine whether any given existing material is "unsafe" and if deemed so, he/she could order the removal/replacement of said existing material. This appears to be in contrast with the intent of the code and a very subjective proposition; i.e. the same building material, in the same condition and location could potentially be viewed as "safe" or "unsafe" by different individuals. The proposal appears to correct this issue and promote code enforcement uniformity. Given the later part of the proposed change, it is the RSW's opinion that the proposal could have a positive influence on resiliency. | + |
| EB402.1-18 | Replaces the "aggregate area" with the "building area" | Will not increase or decrease resiliency. | The "aggregate area" are not code defined terms. The proposal suggests using "building area" instead, which is a defined term (in the VCC and therefore the VEBC per VEBC Section 201.3). Using a defined term should eliminate any confusion regarding the percentage of what area must not exceed 50. Incorrectly interpreting the section in question could lead to significant construction cost increases; and ultimately result in projects stagnant in the planning phases. It is the RSW's opinion that the proposal could positively affect resiliency. | + |
| EB403.1-18 | Editorial change. | This proposal will neither increase nor decrease Resiliency. This is editorial. | The change updates the referenced sections with the correct sections and it does not appear to have an impact on resiliency. | 0 |
| EB404.4.4-18 | Editorial change. | Will not increase or decrease resiliency. | While the proposal eliminates unnecessary and non applicable language, it appears to have a neutral effect on resiliency. | 0 |
| EB404.4.10-18 | Single-user toilet and bathing rooms added to the scoping provisions of the VEBC Sections 404.4.10 and 405.1.4. | Will not increase or decrease resiliency. | The proposal revises the scoping provisions to more accurately match the 2018 I-codes language; and it appears to eliminate the confusion in applying the requirements set forth by the sections under consideration. It is the RSW's opinion that the proposal could have a positive impact on resiliency. | + |
| EB501.1(1)-18 | Revisions to the scoping provisions. | Will increase resiliency, by allowing the repairs of existing facilities without the potential of having to forego the repairs or demolishing the building. | The RSW agrees with the proponent's resiliency statement. | + |
| EB501.1(2)-18 | Editorial change. | This proposal will neither increase nor decrease Resiliency. This is editorial. | The proposal deletes the Exception to VEBC 501.1, which appears to be non-necessary and redundant language; and re-numbers certain sections. The technical requirements do not appear to be altered by this proposal. The RSW concurs with the proponent's resiliency statement. | 0 |
| EB601.1(1)-18 | Editorial change. | Will not increase or decrease resiliency. | Redundant and/or non-applicable language is proposed for deletion. In addition, the scoping provisions are revised to include the entire Chapter 9 and not just Section 905.1. The proposal does not appear to have an impact on resiliency. | 0 |
| EB601.1(2)-18 | "Substantial structural alteration" caveat deletion. | This proposal will neither increase nor decrease Resiliency. | As indicated by the proponent, the current language could be misinterpreted as not allowing the exception to be utilized if substantial structural damages are present. If so, the added cost associated with this could be significant and prohibit owners from repairing the affected buildings/structures. As such, while the proposal could give the impression of reducing resiliency, considering the overall impact, it would appear that the resiliency could actually be improved by allowing the repairs to comply with the building code under which the buildings/structures were built. Any level of repair is better than no repairs at all. It is the RSW's opinion that the proposal will positively impact resiliency. | + |
| EB601.1(3)-18 | Editorial change. | Will not increase or decrease resiliency. | The proposal appears to be editorial in nature with no apparent impact on resiliency. | 0 |
| EB601.2.1-18 | Levels I and II alterations - scoping revisions. | This proposal will neither increase nor decrease Resiliency. This change corrects a hole in the code. The proposal reflects the way it is being taught in the DHCD course; therefore, it should not be a change in code application. | The change intends to codify an already existing practice. Without the added clarification, such scopes of work could be misinterpreted as requiring a higher level of alterations (Level 2 or even a Level 3, depending on how it is interpreted). If so, the added cost associated with this could be significant and prohibit owners from proceeding with any alterations. As such, considering the overall impact, it would appear that the resiliency could actually be improved by allowing the alterations to comply with Level 1 alteration requirements. Allowing such alterations is going to be better than no alterations at all. It is the RSW's opinion that the proposal will positively impact resiliency. | + |

| Code Change Proposal | Description | Resiliency Statement by Proponent | Resiliency Subworkgroup (RSW) Analysis | Resiliency Impact Positive (+) Negative (-) Neutral (0) |
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| EB603.4.3-18 | Flame spread index revisions. | Will not increase or decrease resiliency. | The proposal provides a direct reference to the VCC Table 803.13 and deletes the references to ASTM E84 and UL 723. The proposed reference is all encompassing by also including materials that could(ve) be(en) tested and classified in accordance with NFPA 286. This part of the change would appear to ensure that all the existing interior trim and finish materials will be provided with a minimum degree of protection against flame spread. Thus, have a positive influence on resiliency.<br>The change, however, also adds the words "permitted to be". As a result, it now appears that Section 906.9 of the 2018 VEBC, unlike 2015 VEBC, **does dot require** existing nonconforming interior finish and trim materials to be surfaced with a fire retardant coating, but it **allows** them to be coated. The question is then, if Section 906.9 permits the coating of materials, does it mean that a minimum threshold of compliance with the flame spread levels is no longer required? If so, and this was intentional in order to avoid costly construction with the expectation that more buildings will be renovated, perhaps it could improve the resiliency of certain buildings. However, eliminating the basic flame-spread requirements, would appear to make the buildings and their occupants more vulnerable to fire events. Considering all the above, it is the RSW's opinion that the change could have a negative impact on resiliency. | - |
| EB603.4.5-18 | Deletes the condition of "Where approved by the code official". | Will not increase or decrease resiliency. | The USBC has always been intended to be enforced uniformly throughout the Commonwealth, hence the title. The existing language is very subjective, however, and it appears to promote the non-uniformity of code application. The proposal appears to correct this matter and potentially avoid possible erroneous code interpretations. It is the RSW's opinion that the proposal could have a positive impact on resiliency. | + |
| EB802.2-18 | Clarifies the Exception's intent. | Will not increase or decrease resiliency. | Much needed clarification appears to be provided by the proposed change. In some instances the addition of stairways and/or elevator shafts would be required to be added onto a building due to a change of occupancy/space re-configuration/increased occupant load/etc. Prohibiting and/or requiring fire separation or a sprinkler system due to the mere construction of such spaces could stall the rehabilitation of existing buildings. In addition to an expected increase in the uniformity of code enforcement, the proposal also appears to support the renovation of existing buildings which should increase the resiliency of such buildings. It is the RSW's opinion that the proposal could have a positive effect on resiliency. | + |
| EB904-18 | Deletion of Section 904, revisions to Section 905 and re-write of Section 906. | Will not increase or decrease resiliency. | The proposal appears to clean up the provisions found throughout the Sections and removes non-applicable and in some instances - what would appear to be - retrofit requirements. As the proponent has reasoned, this chapter should "encourage" the rehabilitation of historical buildings not make it difficult to renovate them. The code change appears to achieve that goal, thus, having the potential of increasing the resiliency of historical buildings, which in many cases, are left in derelict conditions due to cost issues. It is the RSW's opinion that the proposal will positively impact resiliency. | + |
| EB904.10.1-18 | Clarifies the required guard height. | Will not increase or decrease resiliency. | As expressed by the proponent, the existing code requirements are ambiguous and could be misinterpreted. The proposal intends to satisfactorily address this issue by clarifying that the height of existing guards are to be deemed acceptable. This should improve the code enforcement uniformity and avoid incorrect code interpretations. It is the RSW's opinion that the proposal could have a positive effect on resiliency. | + |
| EB1401.6.1-18 | Editorial change. | Will not increase or decrease resiliency. | The proposal changes current reference to the IBC with a reference to the VCC; and it does not appear to affect resiliency. The RSW concurs with the proponent's resiliency statement. | 0 |
| EB1401.6.3-18 | Allows for interpolation in determining the compartmentation value. | Will not increase or decrease resiliency. | The current code is vague when it comes to this subject, which normally leads to varied code interpretations. The codification of this issue should increase the uniformity in the code interpretation and appears to ensure that the intent of the code is achieved. It is the RSW's opinion that the resiliency could benefit from this proposal. | + |
| EB3303.1-18 | Relocates Demolition provisions from VCC to VEBC. | Will not increase or decrease resiliency. | While the proposal relocates the Demolition provisions to the VEBC - the appropriate code, it does not appear to impact resiliency. The RSW agrees with the resiliency statement by the proponent. | 0 |
| FP103.2.1 (VFSB SFPC Edit Part 1)-18 | Extensive editing of several Statewide Fire Prevention Code (SFPC) Chapters. | This proposal will neither increase nor decrease Resiliency. No information from proponent. | This is a joint effort between several stakeholders (i.e. Fire Services Board, Virginia Building and Code Official's Association, Apartment and Office Building Association, etc.) to edit the provisions of the International Fire Code (IFC) - which is a code intended to be applied to new construction, to more accurately fit within the scoping provisions of the SFPC - a code meant to be applied to existing buildings, as a maintenance code. It is the RSW's opinion that the proposal could have a positive impact on resiliency via expected improvement in the uniformity of code enforcement across the Commonwealth. | + |
| FP202(1)-18 | Enhancement of "corrosive" definition. | This proposed change to a definition will neither increase nor decrease Resiliency. | Quantifiable physical properties are added to the "corrosive" definition which should aid plan reviewers in determining compliance with the applicable code requirements. It is the RSW's opinion that the improved definition could positively impact resiliency. | + |
| FP202(2)-18 | Revision of "Permissible Fireworks" definition. | This proposed update to a definition will neither increase nor decrease Resiliency. | The current definition is proposed to be amended to match the most current Code of Virginia changes. The proposed definition appears to set certain limitations on the effects of fireworks (i.e. burning effects distance, no explosion, no reloading, etc.), thus, potentially improving the resiliency of buildings and humans against such effects. It is the RSW's opinion that the proposed change could have a positive effect on resiliency. | + |
| FP202(3)-18 | Editorial change to "Restricted/unrestricted explosives manufacturing". | This proposal will neither increase or decrease resiliency. | This appears to be an editorial change with no impact on resiliency. | 0 |
| FP316.6-18 | Restricts storage underneath bridges or elevated roadways. | This proposal will neither increase nor decrease Resiliency. | Judging based on the example provided in the reason statement, it appears that storage underneath bridges and elevated roadways poses a significant danger to such structures. Introducing code language prohibiting this activity will provide the code enforcement personnel with the necessary tool to proactively avoid unfortunate events similar to that referenced in the reason statement. It is the RSW's opinion that the proposal will increase resiliency. | + |
| FP1031.2.1-18 | Removes the requirement for approval of security devices by the Fire Code Official. | No impact. | The installation of security devices affecting the means of egress require a building permit/review/approval by the Building Official and not the Fire Code Official. The proposal clarifies this provision which should help with improving the uniformity of code enforcement. It is the RSW's opinion that the proposal could have a positive impact on resiliency. | + |
| IB20-18 | Requires administrator's approval (via modification) for the use of intermodal freight containers. | This proposal will neither increase nor decrease Resiliency. This change is administrative in nature and does not impact resiliency. | The RSW agrees with the proponent's resiliency statement. | 0 |

| Code Change Proposal | Description | Resiliency Statement by Proponent | Resiliency Subworkgroup (RSW) Analysis | Resiliency Impact Positive (+) Negative (-) Neutral (0) |
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| IB260-18 | Revises the "Industrialized building" definition and adds "Closed panel construction" definition. | This proposal will neither increase nor decrease Resiliency. This change is administrative in nature and will not impact resiliency. | The RSW agrees with the proponent's resiliency statement. | 0 |
| MH10-18 | Adds new definition for "Certificate of installation" and revises the "Installer" definition. | This proposal will neither increase nor decrease Resiliency. None. | The RSW agrees with the proponent's resiliency statement. | 0 |
| MH60-18 | Requires the installer to provide a Certificate of Installation to the homeowner; and to the Building Official - when requested. | This proposal will neither increase nor decrease Resiliency. None. | The RSW agrees with the proponent's resiliency statement. | 0 |
| PM103.2.3-18 | Adds informational note for code officials regarding the responsible party; and the authority to request documentation. | This proposal will neither increase nor decrease Resiliency. | As per the reason statement, some code officials may not be aware that the General Assembly has authorized the transfer of certain duties and responsibilities from the landlord to the tenant. As such, without this knowledge, the code officials could possibly cite the incorrect party; and the party cited may (rightfully so) refuse to take corrective action. This could result in prolonged periods of time during which the buildings/structures will continue to be in a state of disrepair, potentially unsafe, or otherwise non-compliant. The proposed informational note appears to aid with avoiding such situations. Ensuring that the Notice of Correction/Violation is being issued to the appropriate/responsible party should expedite the necessary repairs, therefore improving the resiliency of buildings/structures. It is the RSW's opinion that the proposed code change could positively impact resiliency. | + |
| PM104.5.3.2-18 | Correlates the requirements with proposal A113.7(2). | This proposal will neither increase nor decrease Resiliency. This proposal is administrative in nature and will not impact resiliency. | Ensuring that the tests are performed by licensed mechanics is of utmost importance. Adding the name and certification number of the mechanic to the inspection report, provides for an avenue of verification with the licensure requirements. While test performance by licensed mechanics will not result in safer, more resilient buildings by default, the expectation is that licensed mechanics have obtained the necessary training and experience to perform said tests, thus, resulting in code compliant, resilient systems. It is the RSW's opinion that the proposal could positively affect resiliency. | + |
| PM106.3-18 | Deletes retrofitting provisions. | This proposal will neither increase nor decrease Resiliency. This has nothing to do with resiliency. | By removing the authority appeared to be given to code officials - by current code provisions, in mandating the retrofit of buildings, an argument could be made that the proposal would negatively impact resiliency. I.e. imposing certain repairs or improvements to existing buildings could make them more resilient. However, the current requirements are very subjective and appear to provide for an environment of great non-uniformity in the code enforcement. Considering the overall impact of the proposal, it is the RSW's opinion that the code change will have a neutral effect on resiliency. | 0 |
| PM302.5-18 | Rodent Harborage and Infestation amendments. | This proposal will neither increase nor decrease Resiliency. This proposal does not increase the potential for natural disasters or climate change. | After a first read, it would appear that the proposed text would make the requirements more stringent and the buildings could become more resilient to rodents, pests, insects, etc. However, the revised definition introduces - what would appear to be, a very biased term, "sufficient (number)". Such terms have the tendency to "promote" non-uniformity in the code enforcement; and potentially could lead to dilapidated structures based on one's understanding of "sufficient number to adversely affect the structure...". Considering the overall effect of the proposal, it is the RSW's opinion that the code change will have a neutral effect on resiliency. | 0 |
| PM304.1-18 | Deletes the "health, safety, welfare and sanitary" requirements. | No resiliency statement? | While the "health, safety, or welfare" provisions are currently also addressed by Section 102.1 as pointed out by the reason statement, the "sanitary" provisions do not appear to be covered somewhere else. As hinted by the proponent, the "sanitary" is being referred to by the IPMC Commentary as "accumulation of litter or debris on porches and other parts of the exterior structure." Excessive accumulation of debris, or materials of sorts, could be detrimental to the structure and it could promote rodent and insect infestation. None of which are good for the structures. Since debris accumulation on the exterior portions of the structures (i.e. porches, decks, etc.) or against the exterior walls would affect "the exterior of the structure", it would appear to be safe for Section 304 - Exterior Structure to contain such "sanitary" provisions. Removing them would appear to have a negative impact on the resiliency of buildings against rodents, insects, etc. However, given the fact that the Property Maintenance Code is an elect code and only certain jurisdictions across the Commonwealth chose to enforce it, the impact of the proposal will only be seen in said localities. Furthermore, 15.2-901 of the Code of Virginia allows localities to address the disposal of trash and similar items by means of local ordinance. It is the RSW's opinion that the proposal could have a slight negative impact on resiliency. | - |
| PM304.18-18 | Editorial change | This proposal will neither increase nor decrease Resiliency. This proposal is not related to resiliency. | The proposal updates the sections under consideration with correct code references; and removes non necessary ones. The RSW agrees with the proponent's resiliency statement. | 0 |
| PM602.4-18 | Reduces the maximum allowed temperature within R-2 apartment buildings from 80 to 77 degrees F. | This proposal will neither increase nor decrease Resiliency. | The change intends to codify the emergency cooling regulations adopted by the Board of Housing and Community Development and approved by the Governor. The reduction in temperature should increase the resiliency of the occupants of such buildings, especially the geriatric ones. In addition, the buildings should also benefit from the reduced temperature as a factor of lower humidity levels normally associated with lower temperatures/proper functioning Air Conditioning systems. Excessive humidity, if uncontrolled, could lead to mold and/or rot. It is the RSW's opinion that the proposed change will have a positive impact on resiliency. | + |
| PM603.7-18 | Introduces new maintenance requirements for fuel tanks and systems. | No resiliency statement? | The current Virginia Maintenance Code (VMC) appears to be silent as it relates to the subject at hand. The proposal intends to address this by providing the local jurisdictions - enforcing the VMC, with the necessary code language to address such systems. Fuel tanks, containers, piping, etc. if not properly maintained could lead to considerable damage to the surrounding buildings/structures and occupants. Maintaining said systems in proper working condition, in compliance with the code under which they have been installed should avoid such damages and increase the resiliency of said buildings/structures and occupants. It is the RSW's opinion that the proposal will improve resiliency. | + |
| PM702.1-18 | Deletion of IFC reference and coordination with the SFPC. | This proposal will neither increase nor decrease Resiliency. This proposal is not related to resiliency. | The proposal attempts to remove an incorrect reference to the IFC and requires the existing means of egress to be maintained in accordance with the applicable building code and the SFPC. Revising the language in a manner which clarifies the intent of the Section should lead to correct code enforcement and properly maintained and resilient buildings. It is the RSW's opinion that the proposal could have a positive effect on resiliency. | + |

| Code Change Proposal | Description | Resiliency Statement by Proponent | Resiliency Subworkgroup (RSW) Analysis | Resiliency Impact Positive (+) Negative (-) Neutral (0) |
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| RB311.3.2-18 | Changes the elevation of landings/floors at exterior doors other than the required egress doors. | This proposal will neither increase nor decrease Resiliency. No impact on resiliency. | While the proposal appears to provide for language consistent with other provisions of the code, it does not appear to have an impact on resiliency. The RSW agrees with the proponent's resiliency statement. | 0 |
| RB332-18 | Allows for alternative provisions for dwellings 400 square feet or less in area (aka Tiny Houses). | This proposal will neither increase nor decrease Resiliency. | The RSW agrees with the proponent's resiliency statement. | 0 |
| RB401.3-18 | Reduces the required slope of impervious surfaces from 2% to 1%. | This proposal will neither increase nor decrease Resiliency. Allows for flexibility to meet requirements of both code sections while still moving water away from foundation. No quantifiable impact on resiliency. | Although, the reduced slope will be quite difficult to adequately enforce, unless a digital level is used during inspections (which the majority of inspectors are not equipped with), the correct installation of impervious surfaces with the (reduced) minimum slope should not have an impact on resiliency. The RSW agrees with the proponent's resiliency statement. | 0 |
| RB403.1.6-18 | Revisions to coordinate with IBC language. | This proposal will neither increase nor decrease Resiliency. This clarifies the intent of the code and is not intended to impose requirements that are not already implied in the code. | The proposal intends to achieve three (3) results, as follows: (1) revise current language to match the text in the IBC; (2) specifically require that bolts are made out of steel and (3) that they must be embedded vs. extended into concrete or masonry. The clarifications regarding bolt material and embedment requirements coupled with language consistent with the IBC should eliminate any confusion and improve the uniformity and accuracy of code interpretation and application. Code compliant buildings are resilient buildings. It is the RSW's opinion that the proposal could positively impact resiliency. | + |
| RB408-18 | Clarifies the section's intent. | This proposal will neither increase nor decrease Resiliency. This code change clarifies current intent and therefore has no impact on resiliency. | The current code provisions provide the opportunity for misinterpretations due to duplicated and confusing language. The proposal appears to solve this issue by consolidating and reformatting the section. This should promote more uniformity in the enforcement and avoid the construction of potentially non-compliant buildings due to erroneous code interpretations. It is the RSW's opinion that the proposal will positively impact resiliency. | + |
| RE401.2-18 | Updates the REScheck to the 2018 IECC. | This proposal will neither increase nor decrease Resiliency. This proposal will not directly impact the resiliency of buildings. | Whilst using REScheck is not a requirement but an option, the 2018 IECC has increased the energy provisions. Using REScheck based on the 2018 IECC for demonstrating compliance, should yield buildings that are more energy efficient, thus improving their resilience against environmental conditions. It is the RSW's opinion that the proposal could positively impact resiliency. | + |
| RE401.3-18 | Restores the requirement for energy Certificate. | This proposal will neither increase nor decrease Resiliency. This proposal will have no direct impact on resiliency. | As indicated by the proponent, the energy features of a building are of great importance for owners and future renovations/alterations/etc. In accordance with the Library of Virginia, the building permit records are disposed off by the majority of local Building Departments, three years after the CO issuance/Final Inspection approval. As such, it would be nearly impossible for future building owners to determine the energy features of any given building. Posting a certificate containing said information could prove to be a very valuable resource for future building alterations/renovations/etc.; and could assist with maintaining and improving the resilient features of existing buildings. It is the RSW's opinion that the proposal could positively impact resiliency via future building renovations/alterations. | + |
| RE402.4.1.2-18 | Re-writing of the air sealing/air leakage provisions. | 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. These improvements fall squarely within the Governor's directive to the Department of Housing and Community Development to identify "resilience-specific improvements to the Uniform Statewide Building Code (USBC) for inclusion in the 2018 code update," in Executive Order 24 from November 2018. It is also critically important that the homebuilder and homeowner understand the actual air leakage rate of the home so that ventilation strategies can be employed in a manner that will maintain occupant health. Relying on a "visual inspection" instead of objective testing is not a safe, long-term strategy for making homes resilient and healthy for occupants. | The RSW concurs with the proponent's resiliency statement. | + |
| RE403.3.5-18 | Removes the prohibition of using building framing cavities as ducts or plenums. | This proposal will neither increase nor decrease Resiliency. This is a code correlation issue. | Current prohibition imposed by the section under consideration directly conflicts with other codes, which allow the use of building framing cavities as ducts or plenums. Conflicts lead to non-uniformity in the application of the code and potential non compliant buildings. The proposal intends to sort out this issue by removing the conflict. It is the RSW's opinion that the proposal could have a positive effect on resiliency as a result of improved code compliance. | + |
| RTP3011-18 | Adds new section for relining of existing sewers. | This proposal will increase Resiliency. Reducing open trench excavation, assisting with preservation of the natural environment and limiting destruction of private property will help increase resiliency. | Notwithstanding the alternative materials and methods provisions of the current code, replacing an existing sewer in compliance with the applicable "prescriptive" provisions of the current code is an expensive proposition, as indicated by the proponent. In many instances there are also additional permits required for digging up and replacing existing sewers, such as street cut permits, sidewalk cut permits, street closure permits, etc. Furthermore, many utilities are located on or crossing adjacent parcels; some are located on recorded easements and some are not. All of the aforementioned costs and "road blocks" have the potential of delaying the replacement of existing systems which show early signs of trouble. Waiting until the inevitable happens only adds to the costs. Providing for a codified alternative should be of great assistance for all the parties involved, i.e. building owners, contractors, code officials, etc. As a benefit, it could "encourage" the repair/relining of existing systems at an earlier stage, thus improving the resilience of said systems and the buildings they serve. The RSW agrees that the proposal could have a positive impact on resiliency. | + |
| TM505.6-18 | Allows other types of range hoods, besides domestic types, with certain conditions. | Will not increase or decrease resiliency. | The current language is very prohibitive in nature. The concept of the building codes has always been to set the minimum requirements and not the maximum requirements. This code section, however, limits anyone's wish to install a much safer hood system. The proposal eliminates said interdiction. Allowing for much more robust range hoods, with suppression systems, to be installed will improve the resiliency of buildings against fire and excessive moisture. It is the RSW's opinion that the proposal could increase resiliency. | + |
| TM506.5.6-18 | Updates the UL standard and further clarifies the section. | This proposal will neither increase nor decrease Resiliency. | The proposal appears to be based on I-codes proposal M52-18 which has been approved as submitted and included in the 2021 IMC. The Section under consideration is updated with the most current, all encompassing UL standard applicable to Pollution Control Units; and revises certain provisions to be more in line with the requirements for grease ducts. The revisions proposed should result in much more safer systems; thus, the resiliency of buildings should be improved. It is the RSW's opinion that the proposal could have a positive impact on resiliency. | + |
| TM510.7.1.1-18 | | This proposal will neither increase nor decrease Resiliency. | It appears that the intent of the proposal is to increase the stringency of current requirements as they relate to hazardous exhaust ducts penetrating fire-resistance-rated shafts. However, there is a slight possibility that the proposed language could lead to differing interpretations. It is the RSW's opinion that the overall resiliency impact of the proposal would be neutral. | 0 |

| Code Change Proposal | Description | Resiliency Statement by Proponent | Resiliency Subworkgroup (RSW) Analysis | Resiliency Impact Positive (+) Negative (-) Neutral (0) |
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| TP202-Service Sink Definition-18 | Adds new definition for "Sink". | This proposal will neither increase nor decrease Resiliency. | The proposed definition should aid in eliminating the confusion surrounding what a service sink is, which should improve consistency in the code interpretation. Furthermore, it should also increase the resiliency of building occupants against adverse effects of using a kitchen(ette) sink for "*building cleaning and associated caustic products*" - as indicated by the proponent. It is the RSW's opinion that the proposal could have an overall positive impact on resiliency. | + |
| TP410.4-18 | Clarifies the allowances for the substitution of required drinking fountains. | This proposal will neither increase nor decrease Resiliency. | As reasoned by the proponent, the current code language leaves much room for misinterpretation. This could result in buildings without the minimum required number of drinking fountains. Standing or wheelchair occupants could be left without the required drinking fountain. The proposed amendment, appears to correct this issue by ensuring that each building occupant is provided with the minimum required fixtures. While the buildings would not appear to become more resilient due to the proposed change, it is the RSW's opinion that the building occupants' resilience could benefit from this change. | + |
| TP423.1-18 | Requires backflow prevention for footbaths and pedicure baths. | This proposal will neither increase nor decrease Resiliency. | New equipment and technologies become available on the market at any given time. It is difficult, to say the least, for the codes to keep up with all the changes. This proposal appears to be an attempt for the code to catch up with more current equipment and popular social activities. The protection of the water supply against harmful effects of backflow is of utmost importance. The proposal intends to provide the means for ensuring such protection. It is the RSW's opinion that the proposal will have a positive impact on resiliency. | + |
| TP605.2.1-18 | Deletes unenforceable language applicable to lead content. | This proposal will neither increase nor decrease Resiliency. | Although the provisions are deleted from the code, as per the reason statement, the same provisions are found in the NSF 372. By verifying compliance with said standard, the code enforcement personnel would also indirectly verify the current weighted average content indicated in the code. The RSW agrees with the proponent's resiliency statement. | 0 |
| TP705.11.2-18 | Removes the exception allowing PVC joints made with solvent cement and no purple primer. | This proposal will neither increase nor decrease Resiliency. | If all manufacturer's do require the use of purple primer, the exception is not necessary. Thus, it would appear that the change does not introduce any actual changes to the current provisions. The RSW concurs with the proponent's resiliency statement. | 0 |
| TP717-18 | Adds new section for relining of existing sewers. | This proposal will increase Resiliency. Reducing open trench excavation, assisting with preservation of the natural environment and limiting destruction of private property will help increase resiliency. | Similar with RTP3011-18 above. In addition, the relining could provide for significant financial savings for commercial establishments via income that could otherwise be lost due to long periods of business closures required to facilitate open trenches type of repairs. The RSW agrees that the proposal could have a positive impact on resiliency. | + |
| TP1303.1-18 | Allows the provisions of CSA B805/ICC 805 as an alternative to the current requirements applicable to rainwater nonpotable water system. | This proposal will increase Resiliency. Planning, design, and management of rainwater harvesting and water storage, as well as considering the full range of water storage options would enable better opportunities for enhancing resilience against climate change. | The RSW agrees with the proponent's resiliency statement. | + |
| TP1101.7-18 | Deletes non applicable text. | This proposal will neither increase nor decrease Resiliency. | The text appears to be editorial in nature with no apparent impact on resiliency. The RSW agrees with the proponent's resiliency statement. | 0 |
| TP1105.2-18 | Deletes non applicable text. | This proposal will neither increase nor decrease Resiliency. | The text appears to be editorial in nature with no apparent impact on resiliency. The RSW agrees with the proponent's resiliency statement. | 0 |
| TP1110-18 | Adds new section addressing the method of calculating the equivalent roof area of continuous flow. | This proposal will neither increase nor decrease Resiliency. | As noted by the reason statement, the previous Virginia amendments have mistakenly deleted this section. Incorrectly sizing the roof drain system could lead to catastrophic building failures. Providing the means for correctly calculating the equivalent roof area of continuous flow helps ensure that the roof drain system is sized adequately. It is the RSW's opinion that the proposal will improve resiliency. | + |
| **Final Regulations** | | | | |
| A101.5 | Language added to clarify references to the I-family of codes. | This proposal will neither increase nor decrease Resiliency. | The proposed change adds new language clarifying that the references to the International Codes found throughout the VCC include the Virginia amendments to said sections. By doing so, it is ensured that the buildings/structures are constructed following the appropriate/enforceable requirements; thus, providing for more resilient buildings/structures. It is the RSW's opinion that the proposal could positively impact resiliency. | + |
| A101.6-18 | Order of precedence (between different model codes) clarification. | Generally, does not increase resiliency in most cases. However, as indicated in the reason statement, sometimes the VECC actually is LESS resilient than the iCode under which such elements or systems are typically regulated. | The Current USBC contains several conflicts between the energy requirements and the building/mechanical/electrical/plumbing/fuel gas provisions. The code change under consideration adds language to clarify that when such conflicts occur, the trade (building/mechanical/electrical/plumbing/fuel gas) specific requirements supersede the energy provisions. During the Code Development Workgroup meetings, the stakeholders have reached consensus for approval of proposed code change. While the energy is a very important factor to be considered, when conflicts occur, the building/mechanical/electrical/plumbing/fuel gas requirements generally provide for more resilient buildings/structures than the energy. The RSW agrees with the Resiliency Statement by Proponent. | + |
| A103.1-18 | Minor editorial change. | Will not increase or decrease resiliency. It is intended to be an editorial change only. | As indicated by the proponent, the code change is intended to clarify that the VEBC, Section 103.1 should reference the VEBC and not the IEBC as is the case currently. The RSW concurs with the proponent's Resiliency Impact Statement. | 0 |
| A109.3-18 | Adds requirements for engineering details where dry flood proofing is proposed. | This proposal will increase Resiliency. Having details on the construction documents improve efficiency for review from flood investigations and aids with compliance with national flood programs and regulations. | The RSW agrees with the proponent's resiliency statement. | + |
| A113.3-18 | Adds requirements concerning the lowest floor elevation and flood hazard documentation on buildings/structures located in flood hazard area. | This proposal will increase resiliency by allowing for additional clarification to the owner as to the lowest floor elevation and for certification purposes for flood documentation. | The RSW agrees with the proponent's resiliency statement. | + |
| A117.2-18 | Adds flood hazard documentation requirements for moved buildings/structures as one of the criteria for Certificate of Occupancy (CO) Issuance. | This proposal will increase resiliency by requiring documentation for moved buildings in flood hazard areas before a new CO can be issued | The RSW agrees with the proponent's resiliency statement. | + |
| A119.5-18 | New/clarified guidelines for the Technical Review Board (TRB). | Will not increase or decrease resiliency. | The proposal appears to enhance the current code provisions by providing much needed clarification/guidance related to the TRB proceedings. While at first glance, it would appear that the proposed code change does not have any impact on resiliency, one may argue that by clarifying and/or adding guidance to the TRB proceedings, the current code requirements would more accurately be applied. It is the RSW's opinion that the proposed change has the potential of improving resiliency. | + |

| Code Change Proposal | Description | Resiliency Statement by Proponent | Resiliency Subworkgroup (RSW) Analysis | Resiliency Impact Positive (+) Negative (-) Neutral (0) |
|---|---|---|---|---|
| AD40(2)-18 | Updating current provisions to reference the most current American Society for Testing and Materials (ASTM) standards. | This proposal will neither increase nor decrease Resiliency. | Similar to the code development process at the national/state level, the standards referenced throughout the codes are also being updated in order to keep up with new technology/materials/equipment. The proposed code change intends to incorporate by reference the most current/updated edition of the previously referenced standards, as well as adding new ones to the requirements (i.e. F2960-16: Standard Practice for Permanent Amusement Railway Ride Tracks and Related Devices; and F3054-18: Standard Practice for Operations of Amusement Railway Rides, Devices, and Facilities). It is the RSW's opinion that incorporating the most up to date standards, will increase resiliency by ensuring that the amusement devices will be installed/inspected/operated in accordance with the best known practices/requirements at the time, and not based on outdated/no longer relevant standards. | + |
| AD75(2)-18 | Recommends changes to the fee schedule for permits/inspections associated with amusement devices. | This proposal will neither increase nor decrease Resiliency. | Should the proposed code change be approved, the fees associated with building permits for amusement devices will increase. While the proposed fees increase - in most cases - may still not cover the cost associated with processing/reviewing/inspecting amusement devices, it should aid the local Building Departments in dedicating the necessary time and resources required for such tasks. It is the RSW's opinion that the overall outcome of this proposed code change will have, amongst others, a positive impact on resiliency. | + |
| B202(3)-18 | Proposes the addition of definition for "Permit Holder" . | This proposal will neither increase nor decrease Resiliency. There will be no impact on resiliency of the building. | The introduction of a new definition for "permit holder" does not appear to have an impact on resiliency. The RSW concurs with the Resiliency Statement by Proponent. | 0 |
| B202(4)-18 | Correlation of "building" definition with the 2018 International Building Code (IBC) definition. | Will not increase or decrease resiliency. | The scope of the change is to clarify that the creation of separate buildings by means of fire walls construction, does not have any implications on the building systems. G130-15 reason statement [code change proposal referenced by B202(4)-18] reads, in part, *"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."*<br>The proposal appears to eliminate the possibility of such misinterpretations of the code and improve uniformity in the code enforcement. As a result, it appears that the proposal will have a positive impact on resiliency. | + |
| B310.1-18 | Clarification of residential (R) uses provisions. | This proposal will neither increase nor decrease Resiliency | This code change is the product of the Residential Use Subworkgroup which has been convened - in part, to clarify the classification of R uses/occupancies. The current provisions have created much confusion and resulted in non-uniform interpretation/application of the requirements. By re-arranging/simplifying/elucidating the R use/occupancy requirements, the interpretation/application of those requirements should become more uniform across the Commonwealth; and it should aid the code officials in applying the correct R provisions. Hence, the buildings should be more resilient. It is the RSW's opinion that the proposed code change will increase resiliency. | + |
| B907.3.2-18 | Updating to reflect correct (relocated) Section. | This proposal will neither increase nor decrease Resiliency.<br>This proposal is an editorial correction. | The RSW agrees with the proponent's Resiliency Impact Statement. | 0 |
| B1709.5.2-18 | Garage doors and rolling doors acceptance criteria clarifications and addition of labeling requirements. | This proposal will increase Resiliency. Provides information on performance characteristics and compliance with the applicable industry standard for positive/negative wind design pressure ratings for garage and rolling doors. | The proposal appears to mirror the 2018 IBC code change proposal S109-19 which has been approved as modified by the committee. The RSW concurs with the proponent's resiliency statement as the labels would be specifically valuable to future building owners in cases where doors, or parts, must be replaced due to mechanical failure or other factors. | + |
| B101-18 (formerly BU101) | Proposes new types of construction (mass timber) under Appendix U. Same provisions have been approved at the national level and will be incorporated in the 2021 IBC. | This proposal will increase Resiliency. | The proposal allows for the construction of high-rise buildings comprised of mainly wood structural components, comparable in size/height with current Construction Types I and II. While this type of construction has been widely used throughout Europe for the past couple of decades, it has started to gain popularity in the US only in the past few years. Although similar buildings have been constructed in the US over one hundred years ago (i.e. Butler Bros Building, Minneapolis, built between 1906-1908), it could be considered fairly new to the US by some. However, extensive research has been done on the subject in the recent past. The research results suggest that the proposed new type of construction displays many resilient features.<br>1. Fire resistance: fire tests of cross laminated timber panels, which subjected the panel to temperatures in excess of 1,800 degrees Fahrenheit, revealed that the panel lasted 3 hours and 6 minutes. This is in part due to its mass and the charring effect which provides an "insulation" to the interior section of wood member. The combustion eventually stops due to oxygen depletion. Coupling the mass timber's inherent resistance to fire with the requirements for encasing the timber in gypsum panels (in some cases) would further improve its resilience against fire events. Another attribute of the mass timber construction is the reduction of concealed spaces which tend to promote the undetected spread of fire.<br>2. Seismic resistance: several seismic tests performed on mass timber - the most renowned one being the test of a seven story mass timber building performed on the world's largest shake table in Japan, have demonstrated the ability of such buildings to resist seismic effects with little to no damage. The reduced weight of mass timber buildings as compared to concrete and/or steel buildings will also aid during seismic events due to the reduced seismic forces imposed onto such buildings.<br>3. Construction effectiveness: unlike most of the construction methods currently utilized, the majority of components (i.e. walls, floors, roofs, etc.) are constructed off site, delivered and assembled on site. The construction effectiveness produced by this method would be invaluable in the aftermath of natural disasters. During such times the reconstruction via current types/methods of construction could be delayed due to the lack of local resources (i.e. concrete plants, building suppliers, etc.) which could also be affected by the disaster. The mass timber components, on the other hand, could be produced off site/in areas unaffected by the local natural disaster and delivered on site for assembly.<br>Given the above and other factors, such as alleged sustainability, cost-effectiveness, etc., it is the RSW's opinion that the proposed code change will increase resiliency. | + |
| CS10-18 | Addition of several defined terms and removal of "nongovernmental employee" definition. | This proposal will neither increase nor decrease Resiliency. | The change does not appear to have an effect on resiliency as it merely relocates/rewrites the same information in a different location, in definition form. | 0 |
| CS31-18 | Qualification and examination requirements section clean up. | This proposal will neither increase nor decrease Resiliency. | 13VAC5-21-31 Paragraphs A and B have been deemed unnecessary; thus, they have been removed; and the "Technical Assistance Services" have been replaced with "Virginia Building Code Academy Office" to accurately identify the certificate issuer. The updates do not appear to have an effect on resiliency; the RSW agrees with the proponent's resiliency statement. | 0 |
| CS41-18 | Reduction in the allowed time passed between completion of required training and certification application. | This proposal will neither increase nor decrease Resiliency. | Current provisions allow a prospective certification applicant to have had the required training completed as far back as six years prior to certification application. Given the code development schedule, in some instances, the training may have been based on code editions in effect two code cycles prior. As such, the training subject could potentially no longer be relevant. The reduction from six to four years should ensure that the training is based on current/enforceable editions of the code; thus, generating knowledgeable certificate holders. Considering this, it is the RSW's opinion that the proposed change will increase resiliency. | + |

| Code Change Proposal | Description | Resiliency Statement by Proponent | Resiliency Subworkgroup (RSW) Analysis | Resiliency Impact Positive (+) Negative (-) Neutral (0) |
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| CS45-18 | Grammatical correction. | This proposal will neither increase nor decrease Resiliency. | The proposal contains one minor grammatical correction; the RSW concurs with the proponent's resiliency statement. | 0 |
| CS51-18 | "Issuance of certificates" section clean up. | This proposal will neither increase nor decrease Resiliency. | The proponent's reason statement reads, in part, *"Certificate statuses have been consolidated into two statuses to mitigate misunderstanding between the statuses: active and inactive."* This action could have a positive effect on resiliency by way of easily identifying which certificates are in non compliance (i.e. "inactive" certificates), taking corrective action; and, thus, ensuring that only certified personnel will carry out the enforcement of the USBC. There is a reasonable expectation that enforcement by certified individuals will result in code compliant buildings. Code compliant buildings means resilient buildings.<br>It is the RSW's opinion that the proposal could have a positive impact on resiliency. | + |
| CS61-18 | Removal - from this section - of statements regarding noncompliant notice letters. | This proposal will neither increase nor decrease Resiliency. | This appears to be an administrative type change which does not appear to have an effect on resiliency. The RSW agrees with the proponent's resiliency statement. | 0 |
| E402.1.4.2-18 | Clarifies roof insulation requirements. | This proposal will increase Resiliency. Building energy efficiency can have a quantifiable impact on resiliency. To the extent that this proposal's clarifications will improve compliance and enforcement of the energy code, this proposal will result in improved building energy efficiency (especially for existing buildings undergoing a roof replacement) and will therefore improve resiliency. | RSW concurs with the proponent's resiliency statement. | + |
| E402.4.2-18 | Deletion of requirements for minimum skylight fenestration area. | This proposal will increase Resiliency. This proposal will help industry for compliance with the VECC, the number of possible skylights that could be required may not be practicable or improve energy efficiency. | Current code provisions require certain buildings with enclosed spaces greater than 2,500 square feet in area, to be provided with a certain minimum skylight fenestration area. While daylight zones created by the installation of skylights could eliminate the need for artificial lighting, thus, appearing to increase resiliency, it appears to limit the capacity of energy producing systems, such as photovoltaic (PV) systems, that could be installed on the roof of buildings. The roof real estate is already limited given the various items normally located on the roof. Items such as HVAC equipment, roof access hatches, penthouses, shafts extensions, etc. are commonly found on today's building roofs. Further limiting the area that could otherwise be utilized for the installation of PV systems, could deem the installation of such systems unworthy.<br>When comparing the potential in energy savings from skylights vs. PV systems and their resilient characteristics, while there are similarities between the two, there are some distinct differences. One evident similarity between the two is that both save/produce energy during daytime. The installation of either one would improve the resiliency of a given building. One distinct difference is exemplified below.<br>The energy savings from skylights are "in the moment", while the sun is shining brightly. The potential for energy savings increases and/or decreases throughout the day based on the location of the sun on the horizon. Additionally, during times the building is unoccupied; or, occupied at reduced levels, the potential for energy savings is very limited or non existent.<br>The PV systems, however, have the capability of storing energy and using it during peak demand and/or for other types of power utilization equipment (i.e. space conditioning; emergency lighting, etc.) during off hours such as night and/or weekends. Additionally, the PV technology is ever evolving. Unlike skylights, through the use of power optimizers, sun trackers and other similar technologies, PV systems are capable to fully harness the sun's energy anytime during daylight. Considering this, it is the RSW's opinion that the proposal will have a neutral impact on resiliency. | + |
| E404.5-18 | Deletes certain requirements for heated water supply piping. | Will not increase or decrease resiliency. | The requirements proposed to be deleted appear to be very cumbersome to design/review; and it would appear to be seemingly impossible to determine code compliance during inspections. This would result in non-uniformity in the code enforcement, as well as non-compliant systems. On the contrary, the correct enforcement of proposed alternative requirements appears to be much more palatable. Given this, it is the RSW's opinion that the proposal could have a positive effect on resiliency. | 0 |
| E501.1-18 | Removes energy provisions for existing buildings and refers the reader to the Virginia Existing Building Code. | This proposal will neither increase nor decrease Resiliency. This proposal is administrative by moving energy provisions relating to existing buildings from the VECC to the VEBC and will not impact resiliency. | The 2015 USBC contains - what appears to be - conflicting energy provisions applicable to existing buildings, as described herein. VECC, Section R501.1 (similar with VRC, Section 11070 reads, in part, *"The provisions of this chapter* ***shall control*** *the alteration, repair, addition and change of occupancy of existing buildings and structures."* The Virginia Construction/Residential Code, Section 103.1.1 states that existing buildings must comply with the VEBC. VEBC, Section 102.2.2 indicates that compliance with it is to be considered an acceptable alternative for reconstruction, alterations and repairs in Group R-5 occupancies. The proposal intends to correct this conflict by removing the technical provisions from the energy code and referring the reader to the existing building code. Doing so, should assist with avoiding non-uniform and possible incorrect code interpretation/application. It is the RSW's opinion that the proposed change will positively affect resiliency. | + |
| E502-18 | Relocates energy provisions, related to existing buildings, from the Virginia Energy Conservation Code to the Virginia Existing Building Code. | This proposal will neither increase nor decrease Resiliency. This proposal is administrative and will neither increase nor decrease resiliency. | The scope of this proposal appears to be the relocation of energy provisions, related to additions, from the VECC to the VEBC. The RSW agrees with the proponent's resiliency statement. | 0 |
| E503-18 | Relocates energy provisions, related to existing buildings, from the Virginia Energy Conservation Code to the Virginia Existing Building Code. | The code change proposal will not increase or decrease the cost of construction. This proposal is administrative and supports other proposals to move the requirements of Chapter 5 of the VECC to the VEBC | The scope of this proposal appears to be the relocation of energy provisions, related to alterations, from the VECC to the VEBC. The RSW agrees with the proponent's resiliency statement. | 0 |
| E504.1-18 | Relocates energy provisions, related to existing buildings, from the Virginia Energy Conservation Code to the Virginia Existing Building Code. | This proposal will neither increase nor decrease Resiliency. This proposal is administrative and does not impact resiliency. | The RSW is in agreement with the proponent's Resiliency Impact Statement. | 0 |
| EB102.2.3-18 | Clarification of "addition" vs. "separate building" as it relates to new fire walls in the context of VEBC. | This proposal will neither increase nor decrease Resiliency. | As the proponent has indicated in the reason statement, current code provisions appear to be unclear and provides for non-uniformity in the enforcement of the USBC. The proposed change appears to adequately address this issue. Thus, it should improve resiliency by ensuring uniform enforcement of the code. It is the RSW's opinion that the proposal appears to improve resiliency. | + |
| EB307-18 | Relocation of reroofing requirements and addition of "roof covering" definition. | Will not increase or decrease resiliency. | In addition to relocating the reroofing requirements to a more appropriate location, the proposal also adds a new definition for "roof covering", which - as the proponent indicated, " it is vital to how to apply the VEBC when it comes to roof recover and replacement". Ensuring that the code is applied as intended, should improve resiliency. It is the RSW's opinion that the proposal appears to positively impact resiliency. | + |

| Code Change Proposal | Description | Resiliency Statement by Proponent | Resiliency Subworkgroup (RSW) Analysis | Resiliency Impact Positive (+) Negative (-) Neutral (0) |
|---|---|---|---|---|
| EB402.1-18 | Removes the requirements for additional accessibility features triggered by the change of occupancy. | Will not increase or decrease resiliency. | a. The proposal removes the accessibility features that would currently be required for buildings undergoing a change of occupancy and refers the reader to the alteration provisions. The list of required accessible features currently includes, amongst others, an accessible building entrance; and an accessible route from the accessible entrance to the primary function areas. While the alteration provisions, namely Section 403.3 also requires an accessible route to the primary function, Exception #1 to said Section allows for the costs associated with providing the accessible route to not exceed 20% of the total alteration costs.<br>In the case of an R-5 conversion to a B use/occupancy, for instance, one potential costly alteration that would be required (in addition to the accessible toilet facilities and drinking fountains imposed by Section 403.3) is the re-enforcement of the floor system due to greater loading requirements for B use/occupancy. As a result, it is likely that the permit applicants would try to take advantage of Exception #1; thus, the building could end up without an accessible entrance, or, with a possible "partial accessible route" - at best.<br>Research has shown that persons with handicap disabilities face their own unique challenges during and after natural disasters. A couple examples would be the inability to take shelter in a nearby building due to the lack of accessible entrance; or, not being able to access buildings providing post-disaster aid due to the same shortcomings. Thus, in this regard, it would appear that the proposal would have a negative impact on resiliency.<br>b. The intent of the proposal appears to be, in part, bringing the 2018 VEBC more in line with the 2010 ADA and the 2021 IEBC, which do not require new accessibility features as a result of occupancy change. One of the primordial purpose of the VEBC is to aid with the rehabilitation of existing buildings at the least possible cost. Current code provisions could prove to be cost prohibitive and financially unworthy for the building owners and/or prospective business owners/tenants to tackle. That could result in an increase in the vacant commercial building stock. History has shown that the ongoing required maintenance of vacant buildings is not nearly performed at the same levels as for occupied buildings. An increase in the number of vacant buildings, as well as the deterioration of existing buildings would appear to be in direct conflict with § 36-99.01 of the Code of Virginia. Hence, it would appear that resiliency would be positively impacted by the proposal, in this regard.<br>Considering "a" and "b" above, it is the RSW's opinion that the proposed code change would have a neutral impact on resiliency. | 0 |
| EB404.3-18 | Clarifies the section's intent. | Will not increase or decrease resiliency. | Judging based on the example provided by the reason statement, it would appear that the current code language coupled with potentially erroneous interpretations, could provide for much more accessible buildings/structures. Thus, it would appear that the proposed language would negatively impact resiliency. However, the USBC has always been intended to be uniformly interpreted and enforced. The proposed language appears to provide the much needed clarity for code officials, designers and builders alike, in addition to using identical language as the ADA (which is another point of confusion among professionals due to accessibility requirements different than those imposed by the USBC). The proposed language will likely produce more uniformity in the enforcement of the USBC; thus, it would appear to improve resiliency. It is the RSW's opinion that the proposed change would positively affect resiliency. | + |
| EB405.1-18 | Removes the requirements for accessibility features triggered by the change of occupancy. | Will not increase or decrease resiliency. | Similar to EB402-18. Picture a change of occupancy from single family dwelling (R-5) to museum (A-3). It is the RSW's opinion that the proposed code change could have a negative impact on resiliency. | - |
| EB504.1.6-18 | New requirements for smoke alarms repair and replacement. | This proposal will increase Resiliency. | As indicated by the comprehensive reason statement, the new requirements should aid in avoiding nuisance alarms; prevent loss of life due to smoke alarm devices containing dead batteries or no batteries; and improve the overall safety of occupants. Additionally, correct and timely activation of devices could reduce the physical damage the buildings could incur during fire events. It is the RSW's opinion that the proposal will positively impact resiliency. | + |
| EB601.4(3)-18 | Complete re-write of the Section. | This proposal will increase Resiliency. This proposal is unique in that it will make existing buildings more resilient and will help VA address broader resiliency concerns due to a changing climate. These improvements fall squarely within the Governor's directive to the Department of Housing and Community Development to identify "resilience-specific improvements to the Uniform Statewide Building Code (USBC) for inclusion in the 2018 code update," in Executive Order 24 from<br>November 2018. At the macro level, buildings currently account for over 40% of the nation's energy use and over 70% of the nation's electricity use. A significant portion of that electricity comes from burning fossil fuels, which is one of the causes of climate change. Improvements in efficiency – particularly peak electric demand reductions – will help curb Virginia's need to build and site peak generation (which tends to be both more expensive and more carbon-intensive).<br>At the building-specific level, improvements to the building's thermal envelope will improve the resiliency of Virginia's buildings. For example, efficient windows maintain better occupant comfort by reducing the volatility of indoor temperature swings. Moreover, these windows will help maintain more livable conditions during power outages due to natural emergencies. Efficient fenestration is designed to reduce both heating and cooling demand, reducing the need to build and site peak generation, resulting in benefits to building owners and all of Virginia's citizens. Energy codes are increasingly being recognized as playing a role in maintaining resilience and passive survivability, particularly during extended power outages. A recent white paper released by the International Code Council (ICC) and the Alliance for National and Community Resilience (ANCR) recommended that "[a]ny policies, guidance or criteria that includes building codes as a strategy should explicitly incorporate energy codes as a fundamental resilience strategy." See International Code Council, The Important Role of Energy Codes in Achieving Resilience, at 15 (Dec. 2019). Among these resiliency benefits are improved habitability, more grid stability, moisture management, and improved durability of buildings, and others. It is well within Virginia's interests in improving resiliency to a changing climate to reduce energy demand wherever possible. | The RSW concurs that improvements of the thermal envelope would have a positive effect on resiliency. | + |

| Code Change Proposal | Description | Resiliency Statement by Proponent | Resiliency Subworkgroup (RSW) Analysis | Resiliency Impact Positive (+) Negative (-) Neutral (0) |
|---|---|---|---|---|
| EB704.1-18 | Clarifies the Section's intent. | This proposal will neither increase nor decrease Resiliency. | In accordance with the reason statement submitted, *"It appears a number of plan reviewers are interpreting that VEBC Section 704 requires compliance with the entire Chapter 9 of the VCC".* The alleged erroneous interpretation would impose more stringent requirements than what the code intends; thus, potentially providing for buildings/structures more resilient to fire events. As such, it could be said that the proposed change would decrease resiliency. However, imposing additional requirements is normally associated with an increase in the cost of construction. In some instances the increase in construction could prove to be unbearable, resulting in proposed projects not seen to fruition, but remaining stagnant at the proposed phase. The overall scope of the VEBC is to "recondition" old/dilapidated/vacant structures at the least possible cost. By clarifying the provisions, the proposal could prevent the abandonment of such rehabilitation projects due to considerable cost increases, thus, improving the overall resiliency of existing buildings.<br>Additionally, the proposal adds/addresses standpipes - which under previous editions was not addressed - so, in that respect, that part of this proposal would improve resiliency as well.<br>It is the RSW's opinion that the proposal will increase resiliency. | + |
| EB1101.18(2)-18 | Relocates requirements for Address Identification of existing buildings from the VCC to the VEBC; and adds retrofit requirements for existing buildings. | Will not increase or decrease resiliency. | For successful fire fighting operations, it is imperative that the emergency responders are able to easily identify the physical address where the event occurs; and even more so, the location of the Fire Department Connection (FDC). The introduction of retrofit requirements for the identification of FDC's, will enable the local Fire Departments to proactively ensure that the FDC's are easily visible to the approaching fire apparatus; thus improve the resilience of existing buildings/structures against fire events. It is the RSW's opinion that the proposed code change will improve resiliency. | + |
| EB1401.1-18 | VEBC Chapter 14 overhaul. | Will not increase or decrease resiliency. | The proposal reorganizes/restructures/rewrites certain sections as well as removes conflicting/non-applicable provisions related to I-2 occupancy. Notwithstanding the exception to current Section 1401.1, there are several provisions within the Chapter which would appear to (incorrectly) imply that said Chapter can be used to show compliance of I-2 use/occupancies. The use of I-2 provisions could have resulted in non-compliant buildings. Removing those I-2 requirements/allowances should lead to more uniformity in the application of Chapter 14 and have a positive effect on resiliency. It is the RSW's opinion that the proposal has the potential of improving resiliency. | + |
| FP101-18 | Companion proposal to BU101-18: new appendix "P" - Tall wood buildings. | This proposal will increase Resiliency. | Similar to BU101-18. | + |
| FP107.2(1)-18 | Adds requirements for operational permit for the operation of State-Regulated Care Facilities (SRCF's) | This proposal will increase Resiliency. | Due to administration regulation changes in the Department of Social Services, the frequency of inspections to be performed on SRCF's would increase. With an increase in inspections, there is a reasonable expectation that unexpected and unfortunate fire events will be prevented; thus, improving the resiliency of buildings housing SRCF's. The RSW agrees with the proponent's resiliency statement. | + |
| FP107.2(2)-18 | Adds operational permit requirements for commercial cooking appliances in occupancies other than assembly (which is already covered). | This proposal will increase Resiliency. | There is an abundance of commercial occupancies served by commercial type kitchens which are exempted from the operational permit requirements based on their use/occupancy designation. I.e. fast food type establishments with an occupant load of 49 are designated as B use/occupancies. As such, an operational permit is not required. As noted by the reason statement, the risk of fire is not reduced just because of a different use/occupancy designation. The proposal will enable the local Fire Departments, or the State Fire Marshal's Office respectively, to require operational permits for such establishments. The proactive Fire Inspections allowed to be performed under said permits should prevent future grease fires; thus, improve the resilience of such premises to fire events. It is the RSW's opinion that the proposed change will increase resiliency. | + |
| FP202(4)-18 | New "Cooking Tent" definition is proposed. | This proposal will neither increase nor decrease Resiliency. | The proposed definition should result in more uniformity in the application of the code; and, therefore, could improve resiliency by avoiding erroneous code interpretation. It is the RSW's opinion that the proposal could positively affect resiliency. | + |
| FP319.1.1-18 | Addition of wheel chock and fire separation requirements for Mobil food preparation vehicles. | This proposal will increase Resiliency. | New fire separation requirements and means to achieve them are introduced by this proposal. Requiring a minimum separation distance between these possible fire event producers should aid with avoiding unnecessary damages to nearby buildings/structures/other Mobil Food Vehicles and possible injuries to their occupants. It is the RSW's opinion that the proposal will increase resiliency. | + |
| FP319.2.1 | New "Permit Authority Having Jurisdiction (AHJ)" definition. | This proposal will increase Resiliency. | The proposal appears to clarify which is the entity responsible for the issuance of permits for the operation of Mobil Food Preparation Vehicles (MFPV). This should increase the uniformity in the enforcement of applicable code provisions; and it appears to make it easier for the MFPV owners to obtain the required permits. It is the RSW's opinion that the proposal could have a positive effect on resiliency. | + |
| FP405.2-18 | Adds requirement for emergency evacuation drills on R-2 buildings designed/marketed to senior citizens. | No statement? | As indicated by the reason statement, senior citizens are more prone to injury and loss of life during emergency events. While requiring emergency evacuation drills would not deem the existing buildings more resilient, it would aid their occupants to more easily evacuate the buildings during emergency events; thus, it would provide for more resilient occupants during such unfortunate events. It is the RSW's opinion that the proposal would have an overall positive effect on resiliency. | + |
| FP407.2-18 | Allows for electronic Safety Data Sheets submittal. | This proposal will increase Resiliency. By limiting the time necessary to find and retrieve SDS binders, first responders can use the business' SDS-on-demand program to retrieve applicable SDS information, therefore hastening response time and the safety of responders and the nearby community. This will help to minimize damages and the business/community to recover quicker as a result. | The RSW agrees with the proponent's Resiliency Impact Statement. | + |

| Code Change Proposal | Description | Resiliency Statement by Proponent | Resiliency Subworkgroup (RSW) Analysis | Resiliency Impact Positive (+) Negative (-) Neutral (0) |
|---|---|---|---|---|
| FP609.2-18 | Revised scoping provisions. | This proposal will neither increase nor decrease Resiliency. | The proposal appears to clarify the scoping provisions intended by the Section. Doing so, should aid with the uniformity of code enforcement throughout the Commonwealth and avoid erroneous code interpretation and applications. It is the RSW's opinion that the proposal could have a positive effect on resiliency. | + |
| FP807.5.4-18 | Adds exception allowing limited combustible decorative materials within I-3 Groups. | This proposal will neither increase nor decrease Resiliency. | While the proposal appears to allow for an exception to the rule, thus, lowering the levels of safety, in fact the exception appears to impose greater limitations than the current provisions, as explained herein. The exception allows for a maximum four square feet of wall area *"for personal items 0.025 inch (0.64 mm) or less in thickness applied directly to and adhering to the wall."* The items allowed, however, are not to be considered "decorative materials" based on the definition found in Chapter 2. Said "Decorative Materials" definition specifically indicates that items such as those "allowed" by the exception are not to be considered decorative materials. As such, the 2015 SFPC, Section 807.5.4, does not appear to impose any limitations on *"items 0.025 inch (0.64 mm) or less in thickness applied directly to and adhering to the wall"* as they are not to be considered decorative materials by definition. Given the limitations set forth by the proposal and the additional safety measures noted by the Reason Statement, it would appear that the proposed change would help improve resiliency by reducing the amount of combustible items that could add to the fire load of the building. It is the RSW's opinion that the proposal will have a positive effect on resiliency. | + |
| FP2306.2.1-18 | Provides pointers for State Water Control Board (SWCB) regulated tanks. | This proposal will neither increase nor decrease Resiliency. | The proposal adds pointers to the appropriate code sections dealing with tanks subject to the SWCB regulations. This is a good reminder for those familiar with such requirements; and an ever better tool for the code readers not aware that some tanks are covered by the SWCB regulations. The change should improve the uniformity of the USBC enforcement. It is the RSW's opinion that the proposal will have a positive impact on resiliency. | + |
| FP2306.2.1.1-18 | Removes the list of requirements for release detection and adds new section requiring compliance with the SWCB regulations. | This proposal will neither increase nor decrease Resiliency. | As noted by the reason statement, the list of requirements proposed to be removed were originally intended to regurgitate the SWCB provisions. Given the fact that USBC and the SWCB update cycles to not coincide, there is a potential for conflicting information. The proposal intends to address this issue and avoid misinterpretation of the USBC. Approval of the proposal should provide for more uniformity in the enforcement of the USBC; and have a positive effect on resiliency as a result. It is the RSW's opinion that the resiliency could benefit from this proposal. | + |
| FP2403.2.1.3-18 | Changes the horizontal dimension defining the area within which the equipment must be maintained. | This proposal will neither increase nor decrease Resiliency. There is no expected change to resiliency to this code change as the 3 foot horizontal dimension has been the standard by NFPA 70 since at least 1978. | As reasoned by the proponent, the purpose of the change is to create consistency with NFPA 70, NFPA 33 and 2018 IFC in defining the classified area outside of a spray booth. Unlike the aforementioned codes/standards, the SFPC has always been intended as a maintenance code and not a new construction code. As such, during previous code development cycles, tremendous efforts have been put into revising the "new construction" type language found throughout the SFPC to "maintenance" type language. Section 2403.2.1.3 is one such section that has been revised. The 2012 IFC/2015 IFC/2012 SFPC, Section 2403.2.1.3 (as well as Section 1503.2.1.3 of earlier editions) read *"Electrical wiring and equipment located outside of, but within 5 feet (1524 mm) horizontally and 3 feet (914 mm) vertically of openings in a spray booth or a spray room, shall be approved for Class I, Division 2 or Class II, Division 2 hazardous locations, whichever is applicable."* In contrast, the 2015 SFPC, requires equipment located within the same boundaries referenced above to be "maintained". This proposal, however, would only require equipment located *"...within 3 feet (915mm) horizontally and 3 feet (915mm) vertically..."* to be maintained; implying that the remainder of equipment does not have to be maintained in accordance with the applicable code. It would be reasonable to assume that buildings constructed prior to the 2015 USBC, contain equipment (approved for Class I, Division 2 or Class II, Division 2 hazardous locations) located within three to five feet from spray booths/rooms. By this proposal, the aforementioned equipment would no longer have to be maintained. This could potentially result in malfunctioning equipment located in an area considered to be a hazardous location by the SFPC in effect at the time of installation, which could lead to fire events. It is the RSW's opinion that the proposal could have a negative impact on resiliency. | - |
| FP5703.1.2-18 | Editorial change only to correct Section number. | This proposal will neither increase nor decrease Resiliency. This is an editorial correction that does not impact resiliency. | The RSW concurs with the proponent's resiliency statement. | 0 |
| FP5704.2.13.1.1-18 | Adds two exceptions applicable to tanks subject to the Virginia State Water Control Board regulation 9VAC25-580. | This proposal will neither increase nor decrease Resiliency. | The proposal intends to clarify the applicable requirements by referring the reader to the SWCB regulations for certain specific tanks. The added clarification should aid with the enforcement of correct/applicable provisions; and improve the enforcement consistency/uniformity. It is the RSW's opinion that the proposal could positively impact resiliency. | + |
| MH20-18 | Lists the specific federal regulations applicable to the enforcement of 13VAC5-95-20. | The code change proposal will not increase or decrease the cost of construction. | The current provisions indicate that the enforcement of the Chapter must be in accordance with the federal regulations; it does not, however, specify which regulations. The proposal intends to rectify this by listing the applicable regulations. While the proposal should streamline the enforcement process, it does not appear to have an effect on resiliency. | 0 |
| MH20(2)-18 | Updates an incorrect reference to the USBC. | This proposal will neither increase nor decrease Resiliency. | The current provisions contains reference to an incorrect/outdated USBC Section. The proposal updates the reference with the correct/applicable Section. Incorrect/outdated references could lead to erroneous code interpretations and non-compliant buildings/structures; the proposal should aid in avoiding those situations. It is the RSW's opinion that the proposal could positively affect resiliency. | + |
| PM105.2(2)-18 | Requires copy of the Notice of Violation (NOV) to be provided to the owner of the building/structure. | This proposal will neither increase nor decrease Resiliency.<br>This proposal is administrative and has no impact on resiliency. | As indicated by the reason statement, there have been situations in the past where the building/structure owners would/may have kept the buildings/structures in good condition had they known about the NOV and the issues associated with it. Providing the owners with a copy of the NOV should enable them to maintain the buildings/structures in good repair and avoid further damages due to fire and other detrimental events; thus, making the existing building stock more resilient to such events. It is the RSW's opinion that the proposed change will improve resiliency. | + |
| PM604.3.1.1-18 | Replaces the allowance for certification of equipment by third party licensed or certified electrician with allowance for certification by Third-party inspector. | This proposal will increase Resiliency.<br>This will increase the level of safety for all residential and commercial buildings that have been exposed to damaged electrical systems from flooding, exposure to water from Fire Fighting, and heat from exposure to fires. This allows the Building Official to determine the qualifications for the agency and/or inspectors performing the evaluations on these systems. | The current provisions are vague/broad/unclear as they relate to the allowance for a *"third-party licensed or certified electrician"* approval report of equipment. I.e.: licensed electrician by the Commonwealth of VA vs. other states; certified master electrician vs. journeyman vs. apprentice; certified by which entity; etc. As indicated by the proponent's resiliency statement, the proposal allows the Building Official to determine the minimum qualifications for the person evaluating the equipment. Furthermore, the qualifications would be based on a written policy already required by the code. This is consistent with other provisions of the code allowing for third-party inspection reports; and it would appear to aid with improving uniformity in the application of the USBC. The RSW agrees that the proposal will have a positive effect on resiliency. | + |

| Code Change Proposal | Description | Resiliency Statement by Proponent | Resiliency Subworkgroup (RSW) Analysis | Resiliency Impact Positive (+) Negative (-) Neutral (0) |
|---|---|---|---|---|
| RB200-18 | Adds and revise the definitions for "Substantial Damage" and "Substantial Improvement". | This proposal will neither increase nor decrease Resiliency. This change just incorporates additional definitions and does not increase or decrease resiliency. | The definitions are a very important part in the correct understanding and enforcement of the code. Revising/clarifying and adding definitions will likely improve the consistency of code enforcement and should result in more resilient buildings/structures as a factor of correct code enforcement. It is the RSW's opinion that the proposal could improve resiliency. | + |
| RB301.2.1-18 | Several changes intended to coordinate with the new wind speed requirements found in the referenced standard ASCE7-16. | No statement? | The coordination between the code and the referenced standard should help avoid potential erroneous code interpretations due to possible conflicting information. It is the RSW's opinion that the proposal could affect resiliency in a positive way. | + |
| RB301.2(1) | Companion proposal to RB301.2.1-18. | This proposal will increase Resiliency. Increases resiliency by updating basic wind speed maps for Risk Category II buildings and strengthens roof component loads for buildings with mean roof heights less than or equal to 60 feet. | The RSW agrees with the proponent's Resiliency Impact Statement. | + |
| RB301.2.1.1-18 | Clarifies the limitations of the prescriptive VRC wind provisions. | This proposal will increase Resiliency. This proposal clarifies and updates the sections for Ultimate Wind Design. | The proposal clarifies that some Virginia Regions may not be able to use the prescriptive wind provisions set forth by the VRC. Incorrectly using the wind provisions could result in catastrophic damages and potential life loss. The RSW agrees that the proposal will increase resiliency. | + |
| RB302.1-18 | Allows projections to be located anywhere within 5' of the property line. | This proposal will neither increase nor decrease Resiliency. This is not related to resiliency. | The 2015 VRC prohibits the installation of projections (i.e. roof overhangs) within 2' of the property line. The code change proposes to remove said requirements and allow projections to be located up to the property line. Although, said projections would be required to be provided with a one hour fire-resistance rating on the underside (alternatively they can be constructed of heavy timber, or fire-retardant-treated wood), it would appear that the proposal will increase their potential to fire exposure from neighboring buildings/structures. The reduction on safety would appear to negatively impact the buildings' resiliency against fire events. It is the RSW's opinions that the proposal appears to have a negative impact on resiliency. | - |
| RB302.2-18 | Adds pointers to additional sections that townhouses must comply with. | This proposal will neither increase nor decrease Resiliency. | The proposal does not appear to change the existing code requirements. It appears to just add pointers to specifically reemphasize that said sections must be complied with. The RSW agrees with the proponent's resiliency statement. | 0 |
| RB302.2.2-18 | Allows water-filled fire sprinkler piping to be installed within common walls separating townhouses. | This proposal will increase Resiliency. The reduced cost of installing fire sprinkler systems associated with this proposal and the allowance to run piping through and in interior walls separating townhouses will increase system reliability and performance. | Fire sprinkler systems are not currently mandatory for buildings under the scope of VRC. The main opposition to sprinkler systems, historically, has been due to the cost associated with the installation of sprinkler systems. The proposed code change appears to significantly reduce such costs, thereby "encouraging" the installation of sprinkler systems. Given this and the added system reliability alleged by the proponent, it would appear that the proposal will increase resiliency. It is the RSW's opinion that the proposal will increase resiliency. | + |
| RB302.2.6-18 | Adds exception from the structural independence requirements for townhouses protected by fire sprinkler system. | This proposal will neither increase nor decrease Resiliency. | The current structural independence requirement provides for a townhouse building to stand, while allowing for the collapse of adjacent townhouse succumbing to a fire event. While research has shown that fire sprinkler systems do aid with limiting the damages incurred by buildings/structures due to fire events, research has also revealed occasional shortcomings of said systems due to lack of maintenance, impeded coverage, etc. The proposal, although requires fire sprinklers, would eliminate the structural independence requirement. As such, should a townhouse collapse for whatever reason during a fire event, this proposal would allow for the collapse to bring down the adjacent building(s) and create a domino effect.<br>The reason statement references the IBC Section 706.1.1, Exception #2, and indicates that the IRC should not have more stringent requirements than the IBC. It appears, however, that there are two (2) distinct differences between section referenced and proposed exception, as follows: (1) buildings covered under IBC Section 706.1.1 are normally protected by NFPA 13 or NFPA 13R systems, while the exception proposed would allow NFPA 13D systems; and (2) the IBC Section requires *"dedicated access easements and contractual agreements..."* between the different owners of the buildings, while the proposed exception does not require such easements. Additionally, fire sprinkler systems in commercial buildings are normally maintained by trained technicians, unlike those in single family dwellings. Furthermore, NFPA13D systems allow for the omission of sprinkler heads from certain attics, crawlspaces, garages, etc. Considering the above, it would appear that the removal of the structural integrity requirement in favor of the proposed sprinkler system would reduce resiliency. It is the RSW's opinion that the proposed code change will decrease resiliency. | - |
| RB302.3(1)-18 | Adds NFPA 13R and NFPA 13D sprinkler systems to the exception allowing a fire separation reduction in two-family dwellings. | This proposal will neither increase nor decrease Resiliency. | While it would appear that the resilience could be reduced by allowing less robust sprinkler systems to take the same reduction in fire separation levels as the NFPA 13, in fact, similar reductions are already allowed for other R-uses when NFPA 13R systems are installed. Additionally, as indicated by the reason statement, NFPA13R and NFPA13D systems are allowed in two-family dwellings. By allowing the reduction in fire separation from one hour to 1/2 hour when NFPA13R and NFPA13D systems are installed, it could actually increase resiliency, as explained herein. Based on the common construction practice and in accordance with the applicable provisions of the VCC Section 722.6 (and VRC Section R329) the wall separating the two dwelling units from each other, in most cases, has a default fire resistance rating of 50 minutes with exposure from either side. Coupling the default fire resistance rating with the protection afforded by the sprinkler system, it would appear that the end result would be a product much more resilient to fire events than that which is required by the current provisions. Furthermore, allowing the much more cost effective NFPA 13R and NFPA 13D systems, would appear to "incentivize" the use of sprinkler system within the compounds of R-5 buildings. It is the RSW's opinion that the proposed change could have a positive effect on resiliency. | + |

| Code Change Proposal | Description | Resiliency Statement by Proponent | Resiliency Subworkgroup (RSW) Analysis | Resiliency Impact Positive (+) Negative (-) Neutral (0) |
|---|---|---|---|---|
| RB302.3(2)-18 | Allows R-5's to contain an Accessory Dwelling Unit. | This proposal will neither increase nor decrease Resiliency. | The first impression would be that the proposal would reduce the resiliency of buildings to fire events due to the elimination of required fire-separation between Two-family dwellings. One of the criteria for such an allowance, however, is the installation of a fire alarm system in compliance with the VRC Section R314.7. The commentary to aforementioned code section reads, in part, *"The detection and notification system requirements of Sections R314.7 through R314.7.4 provide early warning to occupants of the building in the event of a fire, thereby providing a greater opportunity for everyone in the building to evacuate or relocate to a safe area." and " Of all the provisions for safety features that have been placed within the code over the past few decades other than fire sprinkler system requirements, the provisions for these detection and alarm devices have probably offered the greatest benefit in increasing safety and reducing the loss of life".* Having a system that is electronically monitored in accordance with the applicable NFPA 72 standard will ensure prompt and effective fire fighting response. The RSW agrees with the proponent's resiliency statement. | + |
| RB302.13-18 | Correlation with RB302.3(1) and RB302.2.6. | This proposal will neither increase nor decrease Resiliency. | The proposal intends to correlate with other proposed changes by referencing the NFPA 13D, 13 and 13R in the appropriate sections. The RSW agrees with the proponent's resiliency statement. | + |
| RB313.1-18 | Requires fire sprinkler system in single family dwellings. | COV Executive Order Twenty-four speaks to increasing Virginia's resilience to sea level rise and natural hazards. The Executive Order goes further in saying, "We must act now to protect lives and property from multiple threats and reduce taxpayer exposure through fiscally responsible planning." According to the Resilient Design Institute, resilient design is defined as "the intentional design of buildings, landscapes, communities, and regions in response to vulnerabilities to disaster and disruption of normal life". Fire is a natural hazard to a community whether it is a single house or an entire neighborhood. I submit this proposal provides resilience but it is targeted only to the hazards of fire on a scale smaller than what may be intended or described in Executive Order 24. | Historically, it has been proven that sprinkler systems are capable of preventing loss of life, as well as reducing building damages due to fire events. The RSW agrees that the proposal would increase resiliency. | + |
| RB314.6(1)-18 | Allows smoke alarms with a 10-year, sealed battery. | This proposal will increase Resiliency. | As indicated by the comprehensive reason statement, the new requirements should aid in avoiding nuisance alarms; prevent loss of life due to smoke alarm devices containing dead batteries or no batteries; and improve the overall safety of occupants. Additionally, correct and timely activation of devices could reduce the physical damage buildings sustain during fire events. It is the RSW's opinion that the proposal will positively impact resiliency. | + |
| RB314.6(2)-18 | Deletes exception no longer applicable. | This proposal will neither increase nor decrease Resiliency. This proposal is an editorial correction that will not affect resiliency. | The proposal removes an exception referencing a section which has been deleted in the 2015 VRC. Said section used to be applicable to existing buildings which are now covered under the VEBC; thus, the exception is no longer valid. The RSW agrees that the proposal has no effect on resiliency. | + |
| RB322.2.1-18 | Clarifies requirements for garages and carports located within flood hazard areas. | This proposal will increase resiliency by ensuring garages and carports are not enclosed in Flood Hazard Areas. | The proposal appears to clarify requirements already in place for carports and garages. The revised language should help the reader to clearly understand the applicable requirements; and avoid potential erroneous code interpretations/application due to the apparent ambiguity of current language. It is the RSW's opinion that the proposal will have a positive impact on resiliency. | + |
| RB322.3.3-18 | Reorganization of section. | This proposal will neither increase nor decrease Resiliency. This is just a reorganization and makes no changes to increase or decrease resiliency. | The gist of the change appears to be the reorganization of existing requirements; and the addition of direct reference to the section including the requirements for documents which must be prepared and sealed by a Registered Design Professional (RDP). The proposed section format appears to be more reader friendly; and clearly indicating the requirements for RDP sealed documents should avoid any confusion regarding whom may prepare such documents. Given this, it is the RSW's opinion that the proposal could have a positive effect on resiliency by ensuring correct application of the code requirements. | + |
| RB403.1.6-18 | Revisions to the placement of required anchor bolts. | This proposal will neither increase nor decrease Resiliency. This is not related to resiliency. | The proposal appears to clarify proper securement of construction - in this case anchor bolts - so there is enough “bite” to withstand the implied loads and so things don’t fall down or come apart. It is the RSW's opinion that the proposal will have a positive effect on resiliency. | + |
| RE402.1.2(4) | Increases the R-value of ceiling/roof insulation. | This proposal will increase Resiliency. This proposal will make buildings more resilient by reducing the volatility of indoor temperature swings and maintaining more livable conditions during power outages due to natural emergencies. These improvements fall squarely within the Governor’s directive to the Department of Housing and Community Development to identify “resilience-specific improvements to the Uniform Statewide Building Code (USBC) for inclusion in the 2018 code | The RSW concurs with the proponent's resiliency statement. | + |
| RTE3902.16(2)-18 | Requires arc fault circuit interrupters (AFCI) throughout dwelling unit rooms with some exceptions (where GFCI's are required). | No resiliency statement? | Research has shown that one of the leading causes for residential fires is faulty electrical systems. An estimation by the Consumer Product Safety Commission (CPSC) indicates that more than 50% of electrical fires could be preventable by AFCI's. While the current code provisions do require the installation of AFCI's in sleeping rooms, it does not impose such requirements for outlets serving other rooms throughout the building. Expanding the requirements for AFCI's to other rooms could, as demonstrated by research, not only increase the buildings' resiliency against fire events but actually save lives. It is the RSW's opinion that the proposed change will increase resiliency. | + |
| RTP2801.6-18 | Prohibits the use of plastic pans below gas-fired water heaters. | This proposal will neither increase nor decrease Resiliency. | Storage tank-type water heaters are required to be installed in a pan so that it can prevent damage to the building caused by water leakage from the tank. Plastic pans could potentially melt; thus, damages could occur. Prohibiting such pans could avoid unnecessary damages, ensure that the intent of the code requiring pans will be met and increase the resiliency of buildings against floods due to water heater leakage. It is the RSW's opinion that the proposed code change will have a positive effect on resiliency. | + |
| T2701.1.1(2)-18 | Proposes the adoption of certain requirements set forth by the 2020 National Electrical Code (NEC). | This proposal will increase Resiliency. This proposal will allow for new wiring methods and equipment not permitted in the current 2014 NEC and going to the 2020 NEC will include 4 new articles not covered in the 2017 NEC. We are currently two code cycles behind on the National Electrical Code and products that are available will not be in the 2018 VUSBC if this change is not adopted. | Should the proposal be approved, Marinas, Boatyards and Commercial and Noncommercial Docking facilities will have to comply with the 2020 NEC requirements applicable to said facilities. Article 555 of the 2020 NEC has seen several improvements over the previous versions. Electric Shock Drowning is an ongoing issue which has yet to be entirely addressed and fully preventable. The improvements found in the 2020 Edition of the NEC, Article 555, is the best attempt thus far in helping correct this problem. It is the RSW's opinion that the proposal will positively affect resiliency. | + |

| Code Change Proposal | Description | Resiliency Statement by Proponent | Resiliency Subworkgroup (RSW) Analysis | Resiliency Impact Positive (+) Negative (-) Neutral (0) |
|---|---|---|---|---|
| TM403.3.1.1-18 | Provides prescriptive ventilation requirements for medical procedure rooms, patient rooms and physical therapy rooms not located in an ambulatory care facility or clinic, outpatient. | This proposal will neither increase nor decrease Resiliency. | Providing a prescriptive method for the calculation of required ventilation rates would be helpful to contractors, designers and code enforcement personnel alike as it would appear to be much easier to achieve compliance. This should increase the uniformity in the code application. As per the proponent's reason statement, however, the ASHRAE requirements are more rigorous. That would imply that the ventilation rates could be reduced if based on the prescriptive method. It is the RSW's opinion that the overall resiliency impact is neutral. | 0 |
| TM504.10-18 | Editorial change to fix a broken reference. | This proposal will neither increase nor decrease Resiliency. This is only an editorial change and will have no effect on resiliency. | The change proposes to update the exception number so that it will match the Virginia amendments to the referenced section. The RSW agrees with the proponent's resiliency statement. | 0 |
| TM505.5-18 | Deletes the prohibition of damper installations in the common exhaust systems for domestic kitchens located in multistory structures. | This proposal will neither increase nor decrease Resiliency. | Current provisions prohibit the installation of dampers. As indicated by the reason statement, *"logic would not prohibit this* (the installation of dampers) *in the common domestic kitchen exhaust duct"*. While the grease laden vapors removed by (individual) domestic kitchen exhausts could be considered minimal, the combined vapors exhausted by the common system could amount to significant quantities. If it was intended by the proposed change to allow the installation of dampers in the common exhaust (as implied by the reason statement) the installation of dampers could aid with the collection of grease along the common duct; thus, creating the possibility of grease fires. Considering this, it is the RSW's opinion that the proposal could have a negative impact on resiliency. | - |
| TP403.1(2)-18 | Increases the number of required plumbing facilities within airport terminals. | This proposal will neither increase nor decrease Resiliency. | The RSW agrees with the proponent's Resiliency Impact Statement. | + |
| TP403.3.3-18 | Adds exception for the location of required plumbing facilities in Storage occupancies. | This proposal will neither increase nor decrease Resiliency. | The proposal does not appear to have an effect on resiliency. | 0 |
| TP1209.3.1-18 | Adds provisions for Multi-user gender-neutral plumbing facilities. | Will not increase or decrease resiliency. | As per Industry statements, a growing number of owners/clients are requiring gender-neutral toilet facilities and with the recent Supreme Court decision, this proposal provides guidance to both designers and code officials on how to properly design, regulate, and enforce such toilet facilities. Thus, leading to consistent interpretation/application/enforcement when such toilet facilities are provided. It is the RSW's opinion that the proposal will increase resiliency. | + |
| TP2902.1-18 | Correlates the plumbing requirements found in the VCC with the ones in the VPC by deleting provisions in the VCC and referencing to the VPC. | This proposal will neither increase nor decrease Resiliency. | As indicated by the proponent's reason statement, having duplicated requirements in more than one code (book) could lead to misinterpretations and erroneous code enforcement. Maintaining the requirements in one location only, and provide pointers to it should prevent such occurrences and ensure correct, uniform code application. It is the RSW's opinion that the proposal could have a positive effect on resiliency. | + |
| TP2902.1.1-18 | Allows single-user toilet and bathing facilities to be identified as being available for use by all persons regardless of their sex. | This proposal will neither increase nor decrease Resiliency. | The proposal appears to clarify the intent of this section which should result in more uniformity in the application of the code. It is the RSW's opinion that the proposal could have a positive effect on resiliency. | + |
| | | **Total neutral impact: 28.5% (28.49)**<br>***Total negative impact = 4% (4.14)**<br>***Total positive impact = 67.5% (67.35)** | | |
| | * Out of those code change proposals with an impact on resiliency – not including proposals with a neutral impact, 6% of the proposals have somewhat of a negative impact and 94% have a positive impact on resiliency overall. | | | |

# 2018 CODE UPDATE CYCLE - RESILIENCY SUBWORKGROUP PROPOSALS
## (APPROVED BY BOARD OF HOUSING AND COMMUNITY DEVELOPMENT)

### USBC ADMINISTRATIVE (CHAPTER 1)

- **A109.3** – Where dry flood proofing is proposed, requires the engineering details to include details of the walls, floors and flood shields. **FEMA & DCR Supported**
- **A113.3** – Adds additional minimum inspections to establish lowest floor and elevation in flood hazard areas. **FEMA & DCR Supported**
- **A117.2** – Requires flood hazard documentation for moved buildings (if in flood hazard areas) before the buildings can be occupied. **FEMA & DCR Supported**

### VIRGINIA CONSTRUCTION CODE (VCC)

- **B1709.5.2** - Requires garage doors have a permanent label that provides a way for the owner to be able to determine their performance characteristics after the building has been occupied. **[From 2021 I-Code] FEMA Recommendation/DCR Supported**

### VIRGINIA RESIDENTIAL CODE (VRC)

- **RB200** – Add the existing VEBC definitions for "substantial damage" and "substantial improvement" to the IRC. **DCR Recommendation/FEMA Supported**
- **RB301.2(1)** – Coordinates the wind design criteria in the IRC with the currently referenced edition (2016) of ASCE 7. Updates basic wind speed maps for Risk Category II buildings and revises roof component and cladding loads for buildings with mean roof heights less than or equal to 60 feet. **[From 2021 I-Code] FEMA Recommendation/DCR Supported**
- **RB301.2.1** – Companion to proposal RB301.2(1), submitted by Glenn Overcash. **[From 2021 I-Code] FEMA & DCR Supported**
- **RB301.2.1.1** – Corrects errors regarding the applicability of the IRC to areas where wind speeds exceed the prescriptive provisions of the IRC. **[From 2021 I-Code] FEMA Recommendation/DCR Supported**
- **RB322.2.1** – Moves elevation requirements for garage and carport floors in flood hazard areas into Section R322 (was in R309.3). **[From 2021 I-Code] FEMA Recommendation/DCR Supported**
- **RB322.3.3** – Foundation section for coastal high-hazard areas and Coastal A Zones reorganized and clarified regarding pilings and columns. **[From 2021 I-Code] FEMA Recommendation/DCR Supported**
- **RB609.4 –** Requires garage doors have a permanent label that provides a way for the owner to be able to determine their performance characteristics after the building has been occupied. **[From 2021 I-Code] FEMA Recommendation/DCR Supported**

# Resilience Contributions of the International Building Code

INTERNATIONAL CODE COUNCIL

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## Introduction to Resilience

So far in 2019, communities across the United States have been exposed to numerous hazards including earthquakes, hurricanes, tornadoes, flooding, hail storms and extreme heat and cold. Few places are without some risk. In fact, the frequency and impact of hazard events is increasing. In 2017, the U.S. saw a record number of events causing over $1 billion in damages with 16, causing a total of over $300 billion in damages. Fourteen such events occurred in 2018, resulting in almost $100 billion in damage. See Figures 1 and 2. Governments, businesses and citizens cannot sustain the investments necessary to return devastated communities back to "normal."

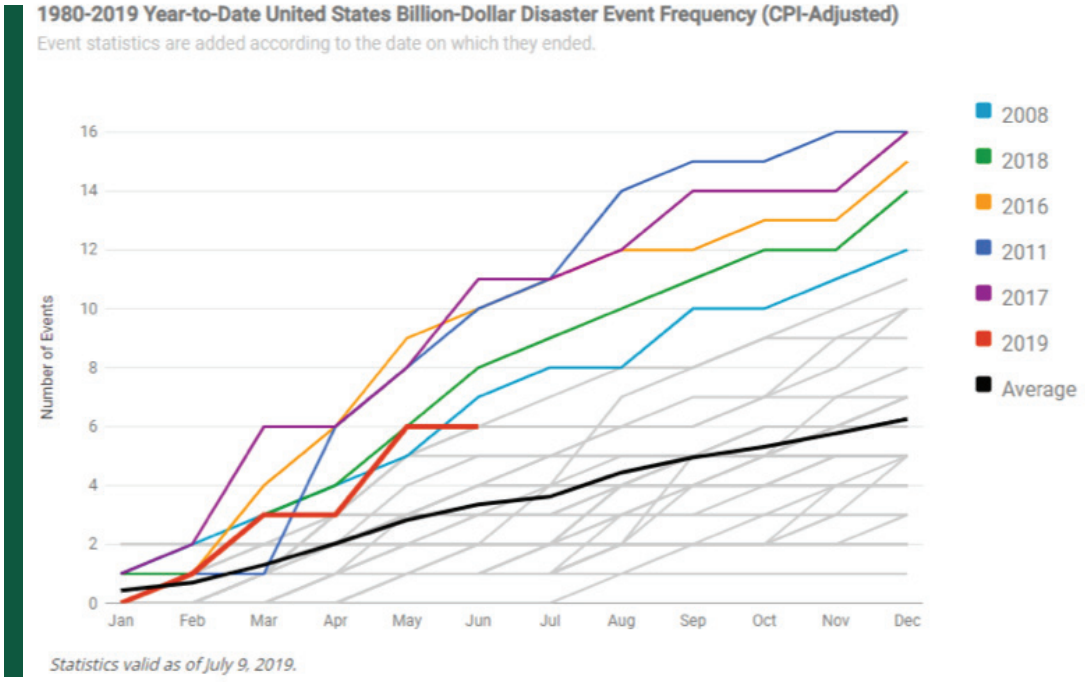



Figure 1: Number of Disasters Costing $1 Billion or More (NOAA)

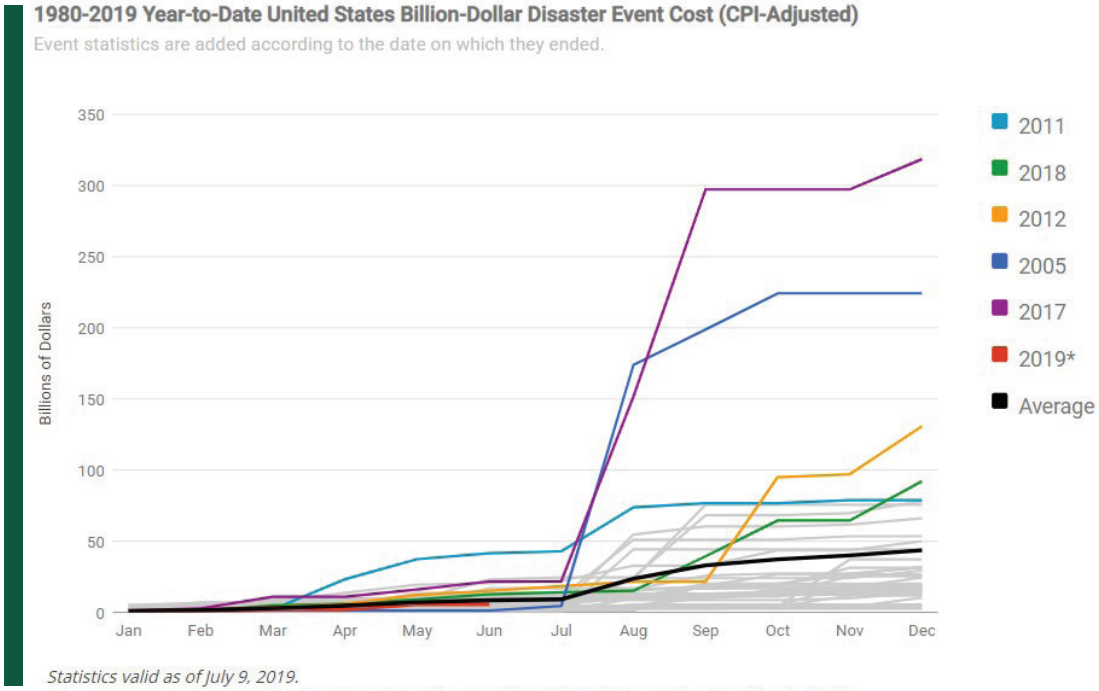



Figure 2: Cumulative Costs of Disasters of $1 Billion or More (NOAA)

A new approach is necessary—one that focuses on strategies that prepare and protect communities ahead of such potentially devastating events. This approach aims to enhance community resilience.

The National Academies (2012) have defined resilience as, "the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events." The building industry, including organizations representing planning, design, construction, ownership, operation, regulation and insurance, have embraced the definition put forward by the National Academies. Nearly 50 building industry organizations signed on to an Industry Statement on Resilience recognizing the need for coordinated action through research, advocacy, education, planning and response (AIA 2019).

To achieve resilience, communities must understand their risks and identify activities designed to reduce those risks. Communities often struggle to define what specific risks they should consider in defining their own resilience (e.g., resilient to what?). Risks vary by community based on geography and social, economic or organizational issues. Risks may be acute in the form of shocks from natural or man-made hazards or chronic in the form of stresses that develop over time. The American Institute of Architects has identified multiple shocks and stresses that impact communities (Figure 3). Some of these shocks and stresses are clearly tied to the condition of a community's building stock while others reflect other community characteristics.

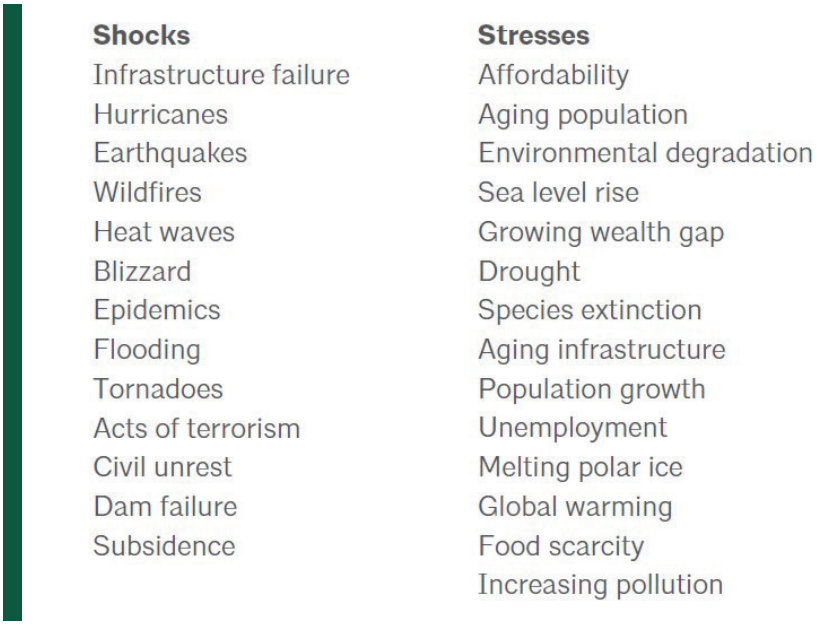



Figure 3: Community Shocks and Stresses (AIA 2017)

Some stresses clearly cut across both social and infrastructural aspects of communities. Buildings can play a part in contributing to their resolution. Many communities are struggling with providing access to affordable housing. Model building codes are developed with affordability in mind. Through a national consensus-based process, efficiencies are captured that help establish consistency across the design, construction, operations and regulatory process—thus saving money for all stakeholders.

The condition of the local environment can impact a community's resilience and the ability of its residents to thrive. During their design, construction and operations,

buildings can influence the environmental state of the community including through generation and management of waste products, contributions to both indoor and outdoor pollution, and their locational efficiency. Some of these influences can be addressed through building codes.

This report is the first of a multi-part series examining how the codes that make up the International Codes (I-Codes) contribute to resilience. It expands on the introductory report *Building Community Resilience through Modern Model Building Codes* (ANCR/ICC) released in December 2018.

## Building Codes and Resilience

Building codes are a fundamental contributor to community resilience. A community cannot be resilient without resilient buildings and the codes that support their development. As identified in the initial report on building codes and resilience, "Resilience in the built environment starts with strong, regularly adopted, and properly administered building codes." (ANCR/ICC 2018)

Numerous studies have been conducted to date to determine the effectiveness of codes and support updates based on lessons learned following disasters. A FEMA analysis estimated approximately $500 million in annualized loss avoided in eight southeastern states due to the adoption of modern building codes (FEMA 2014).

The National Institute of Buildings Sciences (NIBS) in its *Natural Hazard Mitigation Saves: 2018 Interim Report* found that adoption of the 2018 International Building Code (IBC) and the 2018 International Residential Code (IRC) provide an $11 benefit for every $1 invested when compared to codes in place around 1990 (NIBS). Higher benefits can accrue when benefits and costs are studied at a more localized level. See Figures 4 and 5 for benefit cost ratios (BCRs) by hazard and location.

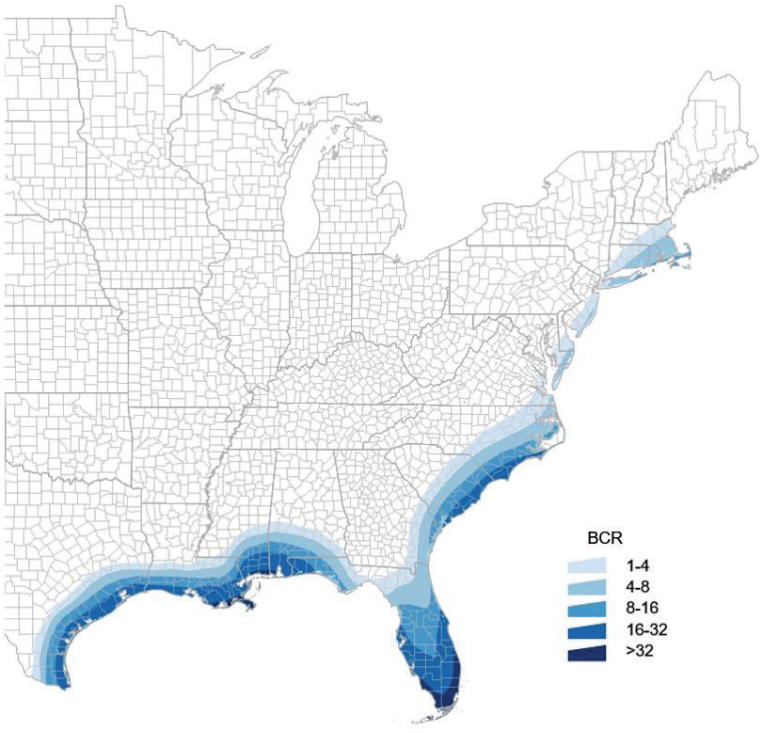
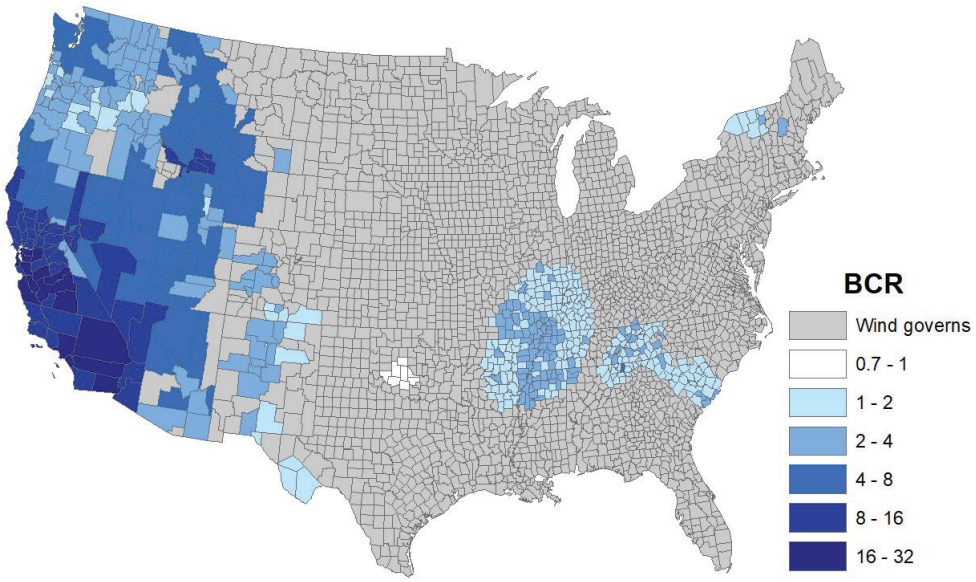



Figure 4: BCR of hurricane wind mitigation by increasing roof strength in new buildings to meet the 2018 IBC and IRC (by wind band) (NIBS)

Figure 5: BCR of earthquake mitigation by increasing strength and stiffness in new buildings (by county) to meet the 2018 IBC and IRC (NIBS)




Following major disasters, Federal Emergency Management Agency (FEMA) and National Institute of Standards and Technology (NIST) conduct field evaluations and studies to determine the common modes of failure. These studies help identify where additional guidance or code and standard updates would lead to improved outcomes. These feedback loops into the code development process assure that codes capture the latest knowledge. Through regular updates of codes at the state and local level, communities can capture the benefits associated with research findings and new technologies and practices.

Congress has also recognized that the adoption and enforcement of up-to-date building codes is a cost-effective strategy to address the growing costs of recovery placed on taxpayers. Through the Bipartisan Budget Act (BBA) passed in February 2018 and the Disaster Recovery Reform Act (DRRA) passed in October 2018 Congress directed FEMA to incentivize states and localities to adopt and enforce the latest codes. The specifics of such efforts are still being finalized, but key provisions are outlined below.

The BBA authorized an increase in the federal cost share amount following a disaster based on the resilience measures undertaken including mitigation planning, adoption and enforcement of codes, participation in the Community Rating System (CRS) under the National Flood Insurance Program (NFIP) and the establishment of incentive programs.

DRRA provides communities with additional resources for the implementation of building codes post-disaster, increases funding for competitive pre-disaster mitigation (PDM) grants, allows PDM grants to be used for code adoption and enforcement, increases jurisdictions' chances of receiving PDM awards based on their adoption of the latest codes, and codifies FEMA's requirement that federally assisted repair and rebuilding efforts be built to the latest code requirements.

## About the International Building Code

The IBC is a model code published by the International Code Council. It is developed through a consensus-based process conducted on a three-year cycle that allows for the incorporation of the latest technologies, practices and research findings. As a

model code, it is available for adoption by state and local governments and other entities that regulate or specify buildings.

In fact, the IBC is in use in every state, but how it is used and the editions adopted vary significantly. To learn more about the code adoption process visit www.iccsafe.org/CodesSave. Figure 6 includes information on the status of adoption of the 2018 IBC and IRC (as of May 2019).

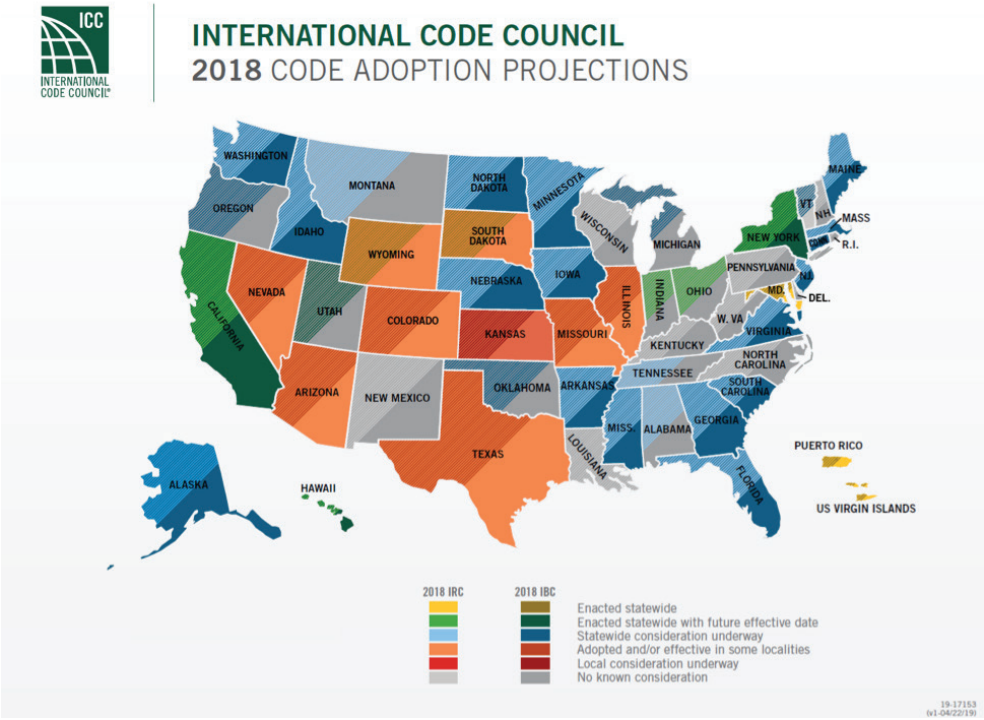



Figure 6: 2018 Code Adoption Projections

The federal government also relies on the IBC and other I-Codes. The Community Rating System (CRS), which provides federal flood insurance discounts for communities undertaking disaster mitigation measures, recognizes the flood mitigation value provided by the IBC and other I-Codes.[1] CRS also uses Building Code Effectiveness Grading Schedule (BCEGS) scores, which evaluates adoption and enforcement codes including the IBC. Finally, FEMA requires adherence to the latest edition of the IBC, IRC, and International Existing Building Code (IEBC) as minimum codes and standards for rebuilding using post-disaster public assistance funding (FEMA's "Minimum Standards Requirement").[2] The U.S. General Services Administration and the Department of Defense mandate use of the IBC for their building projects.

As identified in the scope and administration chapter of the IBC (Section 101.2), "The provisions of this code shall apply to the construction, alteration, relocation, enlargement, replacement, repair, equipment, use and occupancy, location, maintenance, removal and demolition of every building or structure or any appurtenances connected or attached to such buildings or structures."[3]

The intent of the IBC is (Section 101.3), "to establish the minimum requirements to provide a reasonable level of safety, public health and general welfare through structural strength, means of egress facilities, stability, sanitation, adequate light and

ventilation, energy conservation, and safety to life and property from fire, explosion and other hazards, and to provide a reasonable level of safety to fire fighters and emergency responders during emergency operations."

The IBC either incorporates or correlates with codes that address important building systems or characteristics—it provides a holistic approach. In the interest of keeping this report concise, the topics covered in the other codes will be addressed in greater depth in future reports in this series. The specific codes incorporated or correlated are listed in Table 1. In addition, the IBC captures the technical knowledge contained in multiple standards—particularly ASCE 7: Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

Table 1: Incorporated/ Correlated Codes within the IBC

| Incorporated/Correlated Code | IBC Chapter |
|---|---|
| *International Fire Code (IFC)* | Chapters 7-10, 27 |
| *International Energy Conservation Code (IECC)* | Chapter 13 |
| *International Mechanical Code (IMC)* | Chapter 28 |
| *International Fuel Gas Code (IFGC)* | Chapter 28 |
| *International Plumbing Code (IPC)* | Chapter 29 |
| *International Residential Code (IRC)* | Parts of Chapter 3 |

## The International Building Code and Resilience

The scope of the IBC is clearly focused on assuring that a community's building stock supports the resilience of the community. Reducing the impacts on people and property in the face of multiple shocks and stresses allows communities to survive and ultimately thrive.

Through its organization and the topics covered, the IBC takes several approaches to addressing risks posed by multiple hazards. Many of the requirements contained in the code are organized around the building's use and occupancy as defined in Chapter 3. As identified in the introductory pages to the IBC, "Defining the use of the buildings is very important as it sets the tone for the remaining chapters of the code. Occupancy works with the height, area and construction type requirements in Chapters 5 and 6, as well as the special provisions in Chapter 4, to determine "equivalent risk," or providing a reasonable level of protection or life safety for building occupants. The determination of equivalent risk involves three interdependent considerations: (1) the level of fire hazard associated with the specific occupancy of the facility; (2) the reduction of fire hazard by limiting the floor area and the height of the building based on the fuel load (combustible contents and burnable building components); and (3) the level of overall fire resistance provided by the type of construction used for the building. The greater the potential fire hazards indicated as a function of the group, the lesser the height and area allowances for a particular construction type."

In addition to the risks associated with a building's occupancy, the safety of a structure is determined by the characteristics of building materials and systems. The IBC includes chapters focused on materials typically used in building construction and how they should perform to meet the intent of the code. The materials are captured in chapters 19 through 26 (concrete; aluminum; masonry; steel; wood; glass and glazing; gypsum board, gypsum panel products and plaster; and plastic, respectively) whereas systems are covered in chapters 27 through 29 (electrical,

mechanical systems, and plumbing systems, respectively). Where applicable, industry standards and related I-Codes are referenced.

Hazard maps incorporated into the IBC help communities determine their risk exposure and identify the measures within the Code that will help them adequately respond to such risks. The maps cover risks associated with snow loads, wind loads (including both hurricanes and tornadoes), rain loads, seismic loads, and termite infestations.

Like all the I-Codes, the IBC is focused on life-safety, protecting occupants from adverse impacts from buildings. However, it also recognizes where buildings intersect with other important community functions that support overall safety including utility connections, the performance of community shelters, building codes and code departments as part of the emergency planning process, and the importance of critical facilities.

Specific sections of the IBC and their contributions to resilience are outlined in Table 2. However, the discussion that follows examines what the IBC covers regarding the shocks and stresses identified above.

**Hurricanes:** The IBC includes multiple strategies for protecting structures and occupants against hurricane events. These include provisions associated with structural strength including wind and rain loads, protection of openings from flying debris and preventing the creation of flying debris, elevating structures to mitigate flooding and storm surge, preventing water intrusion and providing for storm shelters. Provisions for building enclosures (exterior walls and roofs) help maintain their integrity including through nailing patterns for roof decks and wall sheathing along with wind resistance of exterior materials including shingles, metal or tile and siding, stucco and masonry.

*The IBC is focused on life-safety, protecting occupants from adverse impacts from buildings.*

**Tornadoes:** Like hurricanes, provisions for storm shelters, prevention of flying debris, and structural strength contribute to tornado resistance.

**Earthquakes:** Protection from earthquakes relies heavily on designing for structural loads. Soil conditions also contribute to seismic risk and are addressed within the IBC. Securing appliances such as water heaters help prevent them from separating or falling, causing fires due to gas leaks or severed electrical connections.

**Tsunami:** In addition to requirements focused on structural integrity, the IBC includes an appendix covering specific conditions associated with tsunami-related flooding.

**Fire:** Whether a primary hazard in and of itself or secondary to another hazard event, fire can have a significant impact. The IBC looks to provisions from the International Wildland-Urban Interface Code (IWUIC) and IFC to reduce fire risk. Egress provisions help assure that occupants (including those with disabilities) can safely evacuate in the case of fire.

**Heat Waves:** Protecting occupants from extreme heat and uncomfortable temperatures requires focus on a few strategies including ventilation and maintaining comfortable temperatures. Provisions in the IBC and the IECC protect occupant comfort through ventilation, insulation and reduction of solar heat gain and urban heat island. The IECC is incorporated into the IBC as Chapter 13 and its contribution to resilience will be examined in a future report in this series.

**Blizzards:** Like heat waves, temperature control is an important aspect of resilience in the face of blizzards and other extreme cold events. In addition to measures in the IECC, the IBC includes provisions to assure buildings can support anticipated snow loads and associated water management due to snow melt.

**Flooding:** The IBC includes provisions covering flood loads and elevation of structures to reduce impacts of flood events. The Code prescribes overall structural strength to withstand hydrostatic forces of water and wave action. The IBC's requirements for flood mitigation closely follow or exceed those of the National Flood Insurance Program (NFIP)/Community Rating System (CRS) to support a community's compliance with both. Grading of the building site is also included to reduce the impact of floods. Specific provisions covering flood-resistant design are included in an appendix.

**Subsidence:** Addressing soil characteristics, water drainage, site grading and foundation design is necessary to help avoid subsidence. All these matters are included within the IBC.

**Affordability:** Embedded within the development process for the I-Codes is the concept of affordability. All potential updates from edition to edition are examined for their cost effectiveness. This assures that building safety is achieved without overburdening contractors and building owners.

**Aging Populations:** In addition to means of egress and accessibility requirements that address a wide variety of occupant needs—including those of aging populations—the IBC includes provisions specifically applicable to healthcare facilities. Such facilities include assisted living and nursing home type environments. Code provisions applicable to these building types specifically address the needs of their occupants and the risks they may face.

**Environmental Degradation and Pollution:** A wide variety of practices within a community can contribute to environmental degradation. For buildings, community-level environmental degradation is addressed in multiple ways through building codes. Through a focus on reducing the impacts of disaster, the IBC limits the clean-up required post-disaster. It also addresses indoor environmental quality. The IECC and the International Green Construction Code (IgCC) address energy use and the associated greenhouse gas emissions. The IgCC also addresses construction waste and the impact of material choices on the environment.

*All potential updates from edition to edition are examined for their cost effectiveness.*

**Sea Level Rise:** Some degree of protection from sea level rise is captured in the elevation requirements within the IBC. As codes evolve to respond to changing risks, additional measures on addressing sea level rise will be developed.

**Drought:** Provisions specifically focused on water conservation appear within the IPC, IECC and IgCC, but the IBC does include provisions focused on soils which could be impacted by changing moisture content or water table levels. The IPC and IRC provide requirements governing the construction, installation, alteration, and repair of on-site nonpotable water reuse systems, nonpotable rainwater collection and distribution systems, and reclaimed water systems. CSA B805/ICC 805 Rainwater Harvesting Standard and ASABE/ICC 802 Landscape Irrigation Sprinkler and Emitter Standard provide additional criteria to support the safe use of nonpotable water.

Table 2: Select IBC Provisions Contributing to Resilience

| Selected Code Topic | Relevant Sections (2018 IBC) | Supported Resilience Strategy | Relevant Hazards |
|---|---|---|---|
| Critical facilities identification | 307 | • Emergency planning<br>• Community operations<br>• Response and recovery | • Flooding<br>• Hurricanes<br>• Tornadoes<br>• Blizzards<br>• Terrorist<br>• Wildfire |
| Hazardous or combustible materials | 413, 414 | • Isolating risks | • Terrorist<br>• Fire<br>• Flooding<br>• Hurricanes<br>• Tornadoes |
| Storm Shelters/Areas of Refuge | 423, 1009, 1026 | • Shelter in place/Refuge<br>• Robustness<br>• Community protection | • Tornado<br>• Terrorist<br>• Fire |
| Flammability of materials | Chapter 6, 7, 8 | • Fire resistance<br>• Egress<br>• Indoor environmental quality<br>• Smoke exposure | • Fire<br>• Secondary to other hazards |
| Protection of openings | Chapter 7, 1609.2 | • Structural integrity<br>• Debris impacts | • Hurricanes<br>• Tornadoes |
| Fire suppression/ protection. Smoke control | Chapter 9 | • Fire resistance<br>• Egress<br>• Property protection | • Fire<br>• Secondary to other hazards |
| Communication | 907, 908, 917 | • Public safety<br>• Evacuation | • Fire<br>• Terrorist<br>• Earthquake<br>• Tsunami<br>• Tornadoes |
| Means of egress | Chapter 10 | • Evacuation<br>• Fire protection<br>• Accessibility | • Flooding<br>• Hurricanes<br>• Tornadoes<br>• Blizzards<br>• Terrorist<br>• Wildfire |
| Accessibility | Chapter 11 | • Inclusive communities<br>• Community cohesion<br>• Evacuation | • Public welfare<br>• Secondary to other hazards |
| Occupant health | Chapter 12 | • Indoor environmental quality<br>• Indoor air quality<br>• Access to sanitation | • Public health<br>• Fire<br>• Extreme heat/cold |
| Exterior envelope performance | Chapter 14 | • Property protection<br>• Debris impacts<br>• Hazard spreading | • Fire<br>• Flooding<br>• Hurricanes<br>• Tornadoes |
| Roof assemblies | Chapter 15 | • Fire resistance<br>• Debris impacts<br>• Sealing | • Fire<br>• Hurricanes<br>• Tornadoes<br>• Extreme heat/cold |

Table 2 *continued*: Select IBC Provisions Contributing to Resilience

| Selected Code Topic | Relevant Sections (2018 IBC) | Supported Resilience Strategy | Relevant Hazards |
|---|---|---|---|
| Moisture protection | 1209, 1402, 1503 | • Durability<br>• Mold, mildew, rot<br>• Property protection | • Blizzards<br>• Hurricanes<br>• Flooding<br>• Thunderstorms |
| Hazard Maps | 1608, 1609, 1611, 1613, 2603 | • Identifying risk | • Tornado<br>• Hurricane<br>• Seismic<br>• Pests<br>• Snow<br>• Rain |
| Continuous load paths | Chapter 16 | • Structural integrity<br>• Anchorage and bracing | • Earthquake<br>• Tornadoes<br>• Hurricanes |
| Identification of risk | 1604.5 | • Public safety<br>• Emergency planning | • Earthquake<br>• Tornadoes<br>• Hurricanes<br>• Blizzards |
| Elevation of structures | 1612 | • Flood mitigation<br>• Property protection | • Flooding<br>• Hurricanes<br>• Sea level rise |
| Tsunami | 1615, Appendix M | • Identifying risk<br>• Elevation above inundation<br>• Minimum design loads<br>• Evacuation/refuge | • Tsunami |
| Special inspections | Chapter 17 | • Verification of performance<br>• Structural integrity<br>• Fire resistance | • Earthquake<br>• Fire<br>• Hurricanes<br>• Flooding<br>• Tornadoes<br>• Blizzards |
| Soils and foundations | Chapter 18 | • Load support<br>• Subsidence | • Earthquake<br>• Sea level rise<br>• Drought<br>• Flooding |
| Material performance | Chapters 19-26 | • Fire resistance<br>• Structural integrity<br>• Product safety | • Flooding<br>• Hurricanes<br>• Tornadoes<br>• Blizzards<br>• Terrorist<br>• Wildfire |
| Safety during construction | Chapter 33 | • Public safety<br>• Fire safety<br>• Means of egress | • Fire<br>• Civil unrest |
| Fire Districts | Appendix D | • Fire safety | • Fire |
| Flood Resistance | Appendix G | • Flood mitigation<br>• Property protection | • Flooding<br>• Hurricanes<br>• Sea level rise |

## Achieving Community Resilience

The Alliance for National & Community Resilience (ANCR) identified 19 functions that communities provide. The resilience of these functions contributes to the overall resilience of the community. These functions cut across social, organizational and infrastructural aspects of communities. See Figure 7. To be resilient, communities must address the resilience of each of these functions. ANCR is in the process of developing benchmarks for each of these functional areas to allow communities to assess and improve their resilience.


Figure 7: Community Functions

The first ANCR benchmark focused on buildings—an essential element of almost all community functions identified by ANCR. Utilities rely on structures to support their operational activities and represent a large portion of their customer base; schools, hospitals, governments and businesses rely on buildings to provide their services; and public safety officials rely on fire and police stations and emergency operations centers. As discussed above, buildings and the codes that govern their delivery of health, safety and welfare are an essential component of achieving a resilient community.

As recognized within ANCR's Community Resilience Benchmarks (CRBs), adopting model building codes is an essential first step to achieve a baseline level of safety and recoverability from disasters. Individual communities are at various stages in achieving resilience. With respect to their buildings, many regularly adopt and enforce up-to-date building codes, capturing the benefits identified in this white paper. These communities are encouraged to identify and implement strategies that further enhance their resilience through evaluation and rating of their existing building stock, high-performance design criteria for new buildings, and retrofit of older structures. The Enhanced and Exceptional requirements of the ANCR Building Benchmark can provide such strategies.

## Conclusion

Building codes will continue to evolve to meet the changing needs of communities. Several communities are looking to extend the role of codes beyond immediate life-safety to assure that buildings continue to support the social and economic needs of a community following a disaster event. These efforts at immediate occupancy or functional recovery will require the development of performance goals and accompanying strategies to achieve those goals. Codes will need to interact with other community-level policies to assure coordination in achieving resilience against all shocks and stresses faced by the community.

> *Building codes will continue to evolve to meet the changing needs of communities.*

Future editions of the IBC will include additional content aimed at improving community resilience. ICC-500: Standard for the Design and Construction of Storm Shelters will be updated in 2020 for inclusion in the 2021 edition of the IBC. ASCE 7: Minimum Design Loads and Associated Criteria for Buildings and Other Structures will include a new chapter on tornado loads in its 2022 edition and is planned for reference in the 2024 I-Codes. Additionally, a new ASCE/SEI/AMS standard on wind speed estimation for tornadoes is in development, significantly improving the current EF-scale.

As communities recognize the growing risks they face and the importance of implementing policies and practices that enhance their resilience, the adoption and enforcement of up-to-date building codes is a fundamental part of the solution. A community cannot be resilient without building codes. The International Building Code provides communities with essential requirements for addressing their risks.

## Endnotes

[1] National Flood Insurance Program Community Rating System Coordinator's Manual, FIA-15/2017 (2017).

[2] Public Assistance Program and Policy Guide, FP 104-009-2 (2018).

[3] Some residential structures may comply with either the IBC or the IRC.

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# The Important Role of Energy Codes in Achieving Resilience

# 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).

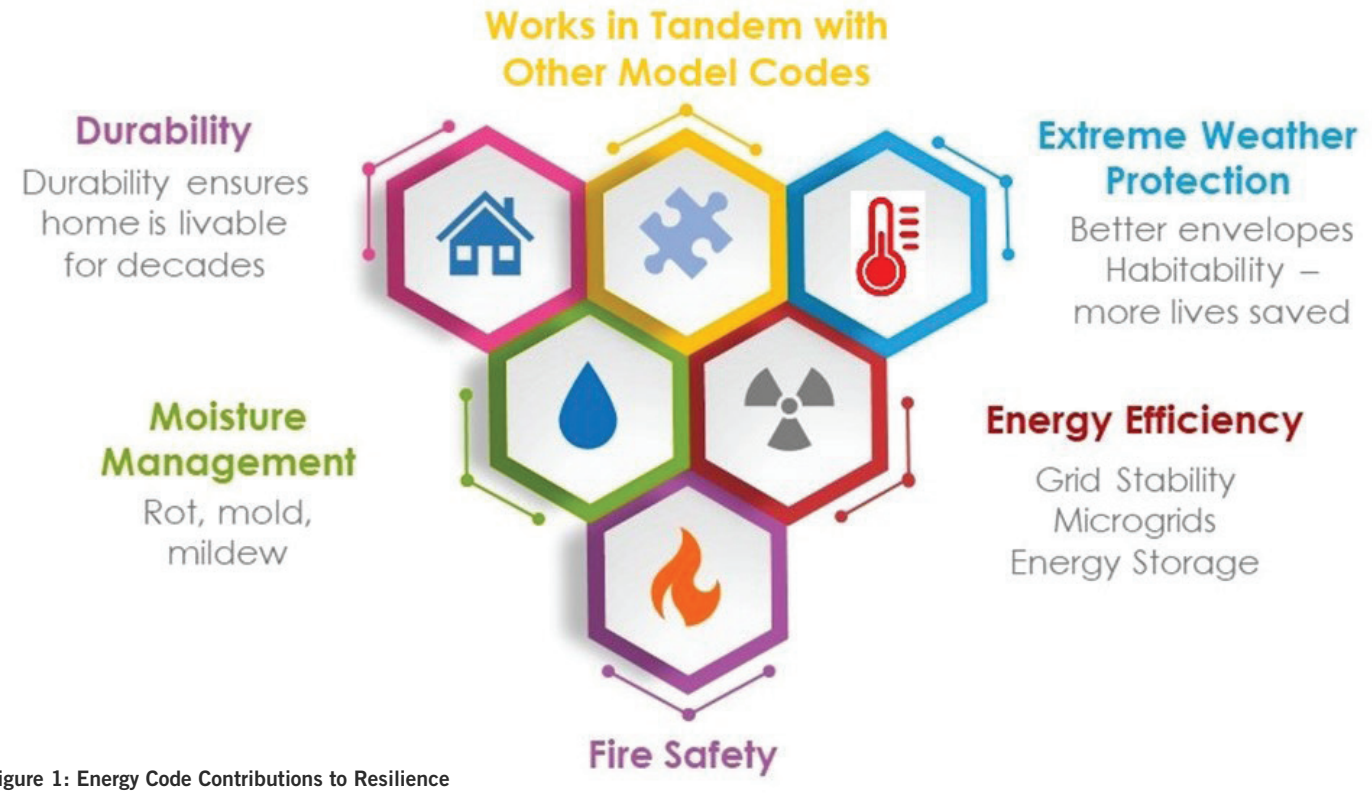


**Figure 1: Energy Code Contributions to Resilience**

## 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

AIA

National Institute of Building Sciences

## FOUNDERS

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

ACEC

APA

ASCE

American Society of Landscape Architects

American Society of Interior Designers

ASHRAE

ASPE

AGC of America

ABC

BOMA International

International Code Council

IFMA

IIDA

Construction Institute

National Society of Professional Engineers

NAHB

RICS

Urban Land Institute

USGBC

## AMPLIFIERS

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

air barrier association of america

AIBD

American Wood Council

Alliance for National & Community Resilience

American Society of Adaptation Professionals

CNU

BUILDSTRONG COALITION

CSI

CRSI

ECODISTRICTS

ERA

FLASH

Illuminating

GREEN BUILDING INITIATIVE

Insurance Institute for Business & Home Safety

IAPMO

NAMIC

National Concrete Masonry Association

NACE International

NIA National Insulation Association

NRMCA

NFPA

PCA America's Cement Manufacturers

PIMA

USRC

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.

| | |
|---|---|
| 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 Up-grades |
| 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)**

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).

| 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 lessoning 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 61ºF where respiratory resistance may be compromised. At 54ºF blood pressure rises leading to increased heart attack or stroke risk. Environments below 41ºF can lead to hyperthermia (Baker 2013). Hypothermia and heat stroke can set in when the internal body temperature reaches 104ºF (NIH 2012). The heat index, a combination of temperature and relative humidity, determines risk for hyperthermia. A heat index of 105ºF is considered dangerous and can occur when the dry bulb temperature exceeds 98ºF 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 | ▪ Passive survivability<br>▪ Reduced energy burden<br>▪ Reduced grid impact<br>▪ Reduced ice-dams<br>▪ Reduced condensation, limiting mold and mildew | ▪ Extreme heat<br>▪ Extreme cold<br>▪ Snow storms<br>▪ Social resilience<br>▪ Secondary impacts to all hazards |
| **Walk-In Coolers and Freezers** | C403.10 | ▪ Food safety/preservation | ▪ Extreme heat<br>▪ Secondary impacts to all hazards |
| **Daylighting** | C402.4.1 | ▪ Passive survivability<br>▪ Reduced grid impact | ▪ Extreme heat<br>▪ Secondary impacts to all hazards |
| **Window-to-Wall Ratios** | C402.4.1, R402.3 | ▪ Passive survivability<br>▪ Impact vulnerabilities | ▪ Extreme heat<br>▪ Extreme cold<br>▪ Hurricanes<br>▪ Tornadoes |
| **Solar Heat Gain Coefficient** | C402.4.3, R402.3.2 | ▪ Passive survivability<br>▪ Reduced grid impacts | ▪ Extreme heat<br>▪ Secondary impacts to all hazards |
| **Solar Reflectance of Roof** | C402.3 | ▪ Urban heat island<br>▪ Passive survivability | ▪ Extreme heat<br>▪ Secondary impacts to all hazards |
| **Air Leakage** | C402.5, R402.4 | ▪ Contaminants (secondary to wild-fire, earthquake, etc.)<br>▪ Mold and mildew (secondary to flooding, hurricane, extreme cold, etc.) | ▪ Secondary impacts to all hazards |
| **Pipe Insulation** | C404.4, R403.4 | ▪ Passive survivability<br>▪ Reduced energy burden | ▪ Extreme cold<br>▪ Drought<br>▪ Social resilience |
| **On-Site Renewable Energy** | C406.5, Appendix CA, Appendix RA | ▪ Contribute to distributed generation<br>▪ Facilitates islandability | ▪ 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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