Changes Coming to the 2021 IBC Requirements for Exterior Walls on Commercial Buildings

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ABSTRACT

This paper will highlight how U.S. codes and standards specifically control the use of combustible building products in commercial buildings to create assurances that energy efficiency improvements do not compromise fire safety. Examples of approved assemblies in a variety of exterior walls for different construction configurations will be provided. Presenters will also focus on how fire safety can be maintained throughout the design process and construction phases using code-compliant techniques such as engineering judgments for wall assemblies. Time will be allotted for an interactive discussion of current industry resources and topics of interest to the audience.

SPEAKERS

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Lorraine Ross has been involved for over 30 years in all aspects of the building products industry, including manufacturing, technical service, and regulatory issues such as building code development, compliance, and testing laboratory experience. As president of Intech Consulting Inc., she is actively involved in building and fire code development through the International Code Council, the National Fire Protection Association, and a variety of state code development activities, particularly regarding foam plastic insulation. She is a member of the Florida Building Commission Roofing Technical Advisory Committee and has delivered many presentations on building code topics at a variety of industry conferences.

Changes Coming to the 2021 IBC Requirements for Exterior Walls on Commercial Buildings

The year 2020 delivered many unexpected changes in our personal lives as well as the way we do business. However, in the world of building codes, the usual three-year update cycle for building, fire, and energy codes continued as usual, leading to the publication of the 2021 International Code Council (ICC) suite of codes, which include the *International Building Code* (IBC)[1] and the *International Energy Conservation Code* (IECC).[2] Additionally, review of two major reference standards that affect commercial buildings resulting in updated versions were released in 2019:

- *ANSI/ASHRAE/IES Standard 90.1-2019: Energy Efficiency Standard for Buildings Except Low-Rise Residential Buildings*[3]
- *NFPA 285–2019: Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components*[4]

This paper highlights key code and standards revisions regarding the use of combustible building products in commercial buildings and reviews how code compliance techniques can be used to demonstrate fire safety for certain deviations from tested wall assemblies.

THE IMPORTANCE OF RESILIENCE

Although codes and reference standards are often viewed as "stand-alone" requirements, it is important to recognize the contribution of energy and building codes to improving the resilience of buildings in both the commercial and residential sectors. Some of the leaders in this effort include the American Institute of Architects, the U.S. Federal Emergency Management Agency, and ICC, among others. In the white paper "Resilience Contributions of the International Building Code [IBC],"[5] ICC noted,

> 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.

The ICC white paper identifies specific parts of the IBC that address the problems of hurricanes, earthquakes, floods, wildfires, and other natural disaster events.

Like building codes, energy efficiency codes are also important in mitigating the impacts of a changing climate. The origins of energy efficiency codes and standards were rooted in energy supply issues and the rising costs of heating and cooling buildings. While these two drivers are certainly still important, energy efficiency requirements are increasingly important for addressing resiliency.

Of course, a resilient building alone cannot deliver full protection from natural disasters. Community resources must be leveraged to provide the level of resilience that must be reached to mitigate these risks. To that end, the ICC, along with the U.S. Resiliency Council and the Meridian Institute, facilitated the formation of the Alliance for National and Community Resilience, a coalition aiming to develop a "system of community benchmarks—the first system of its kind in the United States—that will allow local leaders to easily assess and improve their resilience across all functions of a community."[6]

CODE UPDATES

ASHRAE 90.1-19 and 2021 IECC

Generally, minimum requirements for the energy efficiency of commercial buildings is established by the IECC, which recognizes the ASHRAE 90.1 standard as the most widely used compliance method. However, states may enforce specific codes, such as California's Title 24 Building Energy Efficiency Standards.[7] Further complicating matters, some green building rating systems, such as LEED, recognize ASHRAE 90.1 but not necessarily the IECC.

The latest revisions of ASHRAE 90.1 and IECC both include energy efficiency gains for commercial buildings. Some high-level changes for each are highlighted here.

The 2021 IECC energy efficiency gains are estimated to be in the range of 8% to 15%. The IECC revisions include the following:

- Disclosure of the energy compliance path (prescriptive, performance, etc.) on the construction documents
- Climate zones that are harmonized with ASHRAE 90.1
- For insulation materials, such as blown or draped products, without an observable R-value mark, an insulation certificate from the installer that documents the installed R-value of the material
- A permanent thermal envelope certificate, posted in specified locations, to document:

> Like building codes, energy efficiency codes are also important in mitigating the impacts of a changing climate.

International Building Code (IBC) Classification of Building Types

- **Types I and II:** The various building elements are made up of noncombustible materials.
- **Type III:** Exterior walls are made of noncombustible materials, and the interior building materials are of any material permitted by the IBC.
- **Type IV heavy timber:** Exterior walls are made of noncombustible materials, and the interior elements are made of solid or laminated wood without concealed spaces.
- **Type V:** Structural elements for both exterior and interior walls are of any materials permitted by the IBC—usually combustible construction.

Source: Chapter 6 of the *International Building Code*.[1]

  - — R-value of insulation installed in or on ceilings, roofs, walls, foundations and slabs, basement walls, crawl space walls and floors, and ducts outside conditioned spaces;
  - — U-factors and solar heat gain coefficients (SHGC) of fenestration; and
  - — Results from any building enclosure air-leakage testing
- Energy improvements in building enclosure U-values and R-values that result in increases in continuous wall insulation

ASHRAE 90.1-2019 changed over 100 measures from the 2016 version.[8] The U.S. Department of Energy is currently reviewing the updated standard to determine its energy efficiency improvements.

Some of the changes in ASHRAE 90.1-2019 include the following:

- For the first time, commissioning requirements in accordance with *ASHRAE/IES Standard 202: Commissioning Process for Buildings and Systems*[9] are mandatory.
- Minimum criteria have been upgraded for SHGC and U-factor for fenestration for all climate zones.
- Air-leakage requirements are clarified.
- Changes in building enclosure U- and R-values, resulting in likely increases in continuous wall insulation/
- All compliance paths have specific rules related use of renewables and lighting.

2021 IBC

The IBC is a model building code for commercial construction, which is then adopted by states and jurisdictions. Compliance with local building code regulations, which may vary from the IBC model code, is imperative.

The increasing use of energy efficient continuous insulation and innovative wall assemblies places a greater emphasis on fire performance of exterior walls, which is evaluated using NFPA 285.

Generally, IBC requires NFPA 285 testing for combustible exterior wall assemblies, including combustible cladding, foam plastic insulation, or combustible water-resistive barriers (WRBs), installed on Types I, II, III, IV buildings of certain heights (see **sidebar** for information on IBC classification of building types). Type V wood construction does not require NFPA 285 testing.

The 2021 IBC requirements for the fire safety of exterior walls containing combustible claddings, WRBs, and foam plastic insulation are found in Chapter 14, "Exterior Walls," and Chapter 26, "Plastic." Chapter 14 includes the minimum requirements for exterior walls; exterior wall coverings; openings in the exterior wall; exterior windows and doors; and architectural trim. The provisions detail performance requirements regarding weather protection, structural performance, moisture control, reaction to fire, and flood resistance. Other provisions in the chapter address materials of construction, installation of wall coverings, and use of combustible materials on the exterior side of exterior walls.

With respect to exterior walls, there are important revisions in the 2021 version of Chapter 14 regarding the use of moisture vapor retarders, particularly when used in combination with continuous insulation, spray foam insulation, and hybrid insulation systems. Other revisions clarify fire performance requirements and improve the consistency of fire testing of exterior walls containing combustible components. **Table 1** summarizes key changes in the 2021 IBC version of Chapter 14.

IBC Chapter 26 contains provisions for the use of foam plastic insulation in exterior walls, which were extensively described in a paper delivered at the 2019 RCI International Convention and Trade Show.[10] The 2021 IBC does not make substantive changes to use in exterior walls (Section 2603.5), but these revisions have been made to other sections:

- A definition for spray-applied foam plastic is added.
- New Section 2603.1.1 requires spray-applied foam plastic to comply with both Section 2603 and ICC 1100.[11]
- Section 2607.5 adds a height restriction of 75 ft above grade plane for light-transmitting plastic wall panels, where previously there was no height limitation.

NFPA 285-2019

As stated earlier, the IBC uses the NFPA 285 wall assembly fire test to evaluate the flammability characteristics of exterior, non-load-bearing wall assemblies/panels that contain combustible components, including combustible claddings, insulation, and many air- and water-resistive barriers. The multistory test assembly measures:

- Flame propagation over the exterior wall surface
- Vertical flame propagation within the combustible core or components
- Vertical flame propagation over the interior surface from one floor to the next
- Lateral flame propagation to adjacent compartments

NFPA 285 is a full wall assembly test conducted on a test specimen that is 18 ft high and 13 ft 4 in. wide, with a 78-in.-wide window

Section	Changes
1401: General	No changes
1402: Performance Requirements	Subsection 1402.5: • Title changed title from “Vertical and Lateral Flame Propagation” to “Water Resistive Barriers” • Clarifies that combustibility of components is determined in accordance with Section 703.5 • Clarifies Exception 2 fire testing for combustible WRBs, ASTM E1354 test conditions, and ASTM E84 (UL 723) test specimens
1403: Materials	Subsection 1403.2 (Water-Resistive Barrier): • Reorganized prescribed performance standards for WRBs into a list • Added ASTM E331 in accordance with Section 1402.2 as a prescribed performance standard New subsection 1403.14 (Attachments through Insulation): • Guides users to applicable sections under Section 2603 for situations when exterior wall covering attachments to the building structure are made through foam plastic sheathing
1404: Installation of Wall Coverings	Subsection 1404.3 (Vapor Retarders): • Editorial reorganization for ease of use • New and revised provisions regarding use of vapor retarders (Class I and II, and Class III) with continuous insulation, spray foam insulation, and hybrid insulation systems • New provisions regarding use of Class I and II vapor retarders (ASTM E96 Procedure A—desiccant method) that have vapor permeance >1.0 perm when tested using ASTM E96 Procedure B—Water Method • New and revised prescriptive guidance regarding permitted conditions (climate zone and wall configuration) and exceptions where Class I and II, and Class III vapor retarders are permitted in combination with continuous insulation
1405: Combustible Materials on the Exterior Side of Exterior Walls	No changes
1406: Metal Composite Materials	Subsection 1406.10 (Type I, II, III and IV Construction): • Simplified threshold for NFPA 285 testing to installations above 40 ft in height Subsection 1406.11 (Alternate Conditions): • Eliminated complex provisions regarding installations on buildings of Type I, II, III, and IV construction up to 50 ft in height and 75 ft in height
1407: Exterior Insulation and Finish Systems	No changes
1408: High-Pressure Decorative Exterior-Grade Laminates	Subsection 1408.11 (Alternate Conditions): • Revised to eliminate provisions regarding installations up to 50 ft in height
1409: Plastic Composite Decking	No changes

Abbreviation: WRB = water-resistive barrier.

Table 1. Notable revisions to Chapter 14 of the 2021 International Building Code[1]

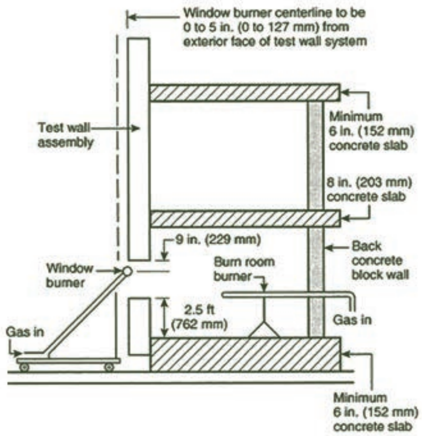

Figure 1. NFPA 285[4] test assembly.

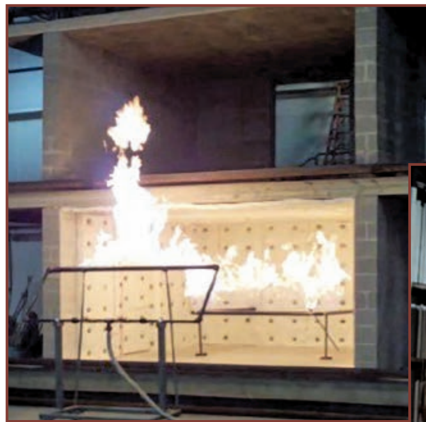

Figure 2. Two-story test with interior and exterior burners.

opening. The fire sources are two gas burners (one room burner located inside the first floor, and another window burner on the exterior side). Both of these burners are needed to simulate real conditions where a fire may originate from within the structure, all interior materials are burning (flashover), and the fire suppression system has failed (**Fig. 1**).

The wall assembly is mounted on the face of the apparatus (**Fig. 2**). Thermocouples are fitted on the exterior wall surface, in the wall cavity air space and stud cavity, and in the insulation.

After a testing period of 30 minutes, a successful test will show no flame propagation to the second story room and no thermocouple may exceed 1000°F. Flame spread cannot exceed 10 ft above the top of the window, nor more than 5 ft laterally from the centerline of the window (**Fig. 3**).

As with other standards-setting organizations, NFPA periodically updates its standards using a consensus-based process. For the 2019 edition of NFPA 285, substantial technical changes were made to the test method. The critical technical changes include an expanded scope to encompass any construction type, revisions to include both load-bearing and non-load-bearing assemblies, and new sections added to Chapter 5 to address window header construction and the location of joints and seams in the test specimen assembly. Additional information is required for NFPA 285 test reports. **Table 2** summarizes key changes in NFPA 285-2019.

COMPLIANCE PATHWAYS FOR EXTERIOR WALLS REQUIRING NFPA 285 TESTING

As described previously, combustible exterior wall assemblies must demonstrate compliance with the acceptance criteria of NFPA 285. To accomplish this, the exact wall assembly, with all components specified, is tested by an accredited laboratory. Taken at face value, the criteria seem to require that every wall assembly configuration undergo a separate test. However, considering the variables regarding foam plastic insulations, claddings, attachment methods, framing, and other factors, the number of tests quickly becomes unmanageable. The situation is more challenging because only a limited number of accredited testing laboratories perform NFPA 285 tests.

Another compliance route is through the use of an engineering judgment (EJ). For exterior wall assemblies complying with NFPA 285, an EJ is a report that provides a comparative analysis of the effects that one or more variations to a tested assembly will have on compliance with NFPA 285 acceptance criteria. These reports are prepared by qualified individuals and organizations, and must be based on full-scale test data. EJs may be general or specific to one construction project or project condition, and may include both qualitative and quantitative elements. EJs using an NFPA 285 full test report are within the scope and intent of IBC 104.11, "Alternative Materials, Design and Methods of Construction and Equipment." However, at the end of the process, the Authority Having Jurisdiction (AHJ) makes the final decision about whether such EJs are acceptable for use on a specific project.

In March 2018, efforts to improve the transparency and consistency of EJs led to the NFPA Committee on Fire Tests approving the formation of a task group to develop guidance for extending NFPA 285 test results. Under the task group, experts have collected experience and industry best practices in an annex to NFPA 285 for guidance when extending test results for assemblies meeting NFPA 285. The annex will provide guidance regarding items for which evaluation and EJ are more commonly requested or required today. These items include analyses regarding base walls, exterior sheathing, WRBs, air gaps, exterior insulations, drainage media, exterior claddings and attachment systems, and the window perimeter. Two key elements of the guidance will be that these wall assemblies are treated as systems that meet the requirements, and that analyses are based on assemblies meeting NFPA 285 acceptance criteria. The annex will likely also stipulate specific limitations to the scope of analysis. These stipulations will

Figure 3. NFPA 2854 fire test parameters and pass criteria.

Chapter	Changes
Title; Chapter 1: Administration	Language from the Title, Scope, Application, and Purpose revised to include: • Both load-bearing and non-load-bearing wall assemblies • All *International Building Code* construction types
Chapter 3: Definitions	• “Limited-combustible (material)” definition added • “Noncombustible material” definition revised • “Test specimen” definition revised
Chapter 5: Test Specimens	New section 5.7.1 (General): • Clarifies that the test specimen assembly shall be representative of field installations and installed in accordance with the manufacturer’s instructions • Adds that the test specimen wall framing system may be of wood studs (previously, only steel studs were permitted) New section 5.7.2 (Joints and Seams): • Includes new requirements that the exterior veneer of the test specimen must contain — At least one vertical joint/seam — At least one horizonal joint/seam — Exceptions are provided for EIFS systems, standard Stucco systems ≥ ¾ in. thick, and systems designed to not have horizontal joints or continuous vertical joints • The required joint/seam must be — For horizontal – Continuous across the specimen and located between 1 ft and 3 ft above the window opening — For vertical – Continuous up the full height above the window and located within 12 in. of the centerline over the window opening New section 5.7.3 (Window Headers): • Standardizes the material and configuration details for closure of the window opening—header, jambs, and sill • Allows for nonstandard closures of window opening, but it shall represent the as-constructed condition, and the details (drawings and descriptions) shall be included in the test report
Chapter 7: Calibration Procedure	Section 7.1.13: • Revised allowable limits on calibration temperature values to range of –10% to +20% (previously, limits were ±10%)
Chapter 8: Fire Test Procedure	New section 8.1.8: • Adds a ±10% tolerance for gas flow rates when it is demonstrated that burners must follow different flow rates to comply with the required calibration temperatures and heat fluxes
Chapter 9: Data Collection and Observation	Section 9.1.2: • Removes the 10-minute observation period after burner shutoff Section 9.4: • Revised and reorganized for clarity
Chapter 11: Report	Section 11.1: • Adds requirement for the report to include drawings, descriptions, and other details regarding the window opening and the closure of that opening • Adds requirement to report date and results (temperature and heat flux) of the most recent calibration

Table 2. Notable revisions in NFPA 285-2019[4]

likely indicate that changes to the assembly under evaluation are normal and reasonable within the limits of standard construction, explain how to analyze multiple changes, and, importantly, acknowledge that it is not possible to analyze every configuration, every potential change, or every combination of changes to a tested configuration.

The annex is on track for submission under the current (fall 2021) NFPA revision cycle for inclusion in the 2022 edition of NFPA 285. We can expect more detailed information on NFPA 285 EJs as the NFPA Fire Test Committee completes its work on the EJ guidance document.

REFERENCES

1. International Code Council (ICC). *2021 International Building Code*. Country Club Hills, IL: ICC, 2021.
2. ICC. *2018 International Energy Conservation Code*. Country Club Hills, IL: ICC, 2018.
3. American National Standards Institute (ANSI), ASHRAE, and Illuminating Engineering Society (IES). *ANSI/ASHRAE/IES Standard 90.1-2019: Energy Efficiency Standard for Buildings Except Low-Rise Residential Buildings*. Peachtree Corners, GA: ASHRAE, 2019.
4. National Fire Protection Association (NFPA). *NFPA 285–2019: Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components*. Quincy, MA: NFPA, 2019. https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=285
5. ICC. 2019. "Resilience Contributions of the International Building Code" white paper. Accessed April 24, 2021. https://www.iccsafe.org/wp-content/uploads/19-17804_IBC_Resilience_WhitePaper_FINAL_HIRES.pdf
6. Alliance for National and Community Resilience. "Who We Are and What We Do." Accessed April 24, 2021. http://www.resilientalliance.org/about
7. California Energy Commission. "2019 Building Energy Efficiency Standards." Accessed April 24, 2021. https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2019-building-energy-efficiency
8. ASHRAE. "ASHRAE Releases Expanded, Revised Version of Standard 90.1," news release, October 25, 2019. https://www.ashrae.org/about/news/2019/ashrae-releases-expanded-revised-version-of-standard-90-1
9. ASHRAE and IES. *ASHRAE/IES Standard 202: Commissioning Process for Buildings and Systems*. Peachtree Corners, GA: ASHRAE, 2018.
10. Koscher, J., and L. Ross. "Foam Plastic Insulation: Fire Safety for Exterior Walls on Commercial Buildings." 2019 RCI International Conference and Trade Show Proceedings. Accessed April 24, 2021. https://iibec.org/wp-content/uploads/2019-cts-koscher-ross.pdf
11. ICC. *ICC 1100-2019 Standard for Spray-applied Polyurethane Foam Plastic*. Country Club Hills, IL: ICC, 2019.