A Strategy Guide for Air-Sealed Townhome Area Separation Walls That Meet Energy and Building Codes

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Prepared for

U.S. Department of Housing and Urban Development

Office of Policy Development and Research

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Foreword

Townhomes, characterized by their efficient use of space and shared amenities, hold a special place in our communities. Their ability to offer both comfortable living areas and a slice of outdoor space, often at a more attainable price point than traditional single-family homes, underscores their significance in promoting housing accessibility. The importance of townhomes in achieving housing affordability cannot be overstated, particularly as our nation strives to bridge the gap between income levels and housing costs.

Realizing the affordability and sustainability of townhomes, however, is not without its challenges. The interplay between the energy efficiency requirements of the International Energy Conservation Code (IECC) and the fire-rated assembly requirements of the International Residential Code (IRC), which help prevent fire from spreading to neighboring homes, has given rise to complex predicaments in construction practices and code enforcement. The tensions arising from these differing imperatives have at times impeded progress and innovation in townhome construction.

This report, *A Strategy Guide for Air-Sealed Townhome Area Separation Walls That Meet Energy and Building Codes*, serves as a guide for all stakeholders in the residential housing industry toward harmonizing the relationship between energy efficiency and building codes within the context of townhomes. By presenting pragmatic solutions for the design, construction, and inspection of townhome area separation walls (ASWs) aligned with health, safety, and energy standards, this report helps foster clarity, collaboration, and, ultimately, compliance.

The IECC and IRC are model codes that influence most construction practices across the United States. This study on ASWs provides code enhancements that states and jurisdictions can readily adopt to minimize confusion, mitigate delays, optimize costs, and improve energy efficiency. As the Inflation Reduction Act of 2022 and nationwide initiatives to curtail building-related greenhouse gas emissions through the embrace of zero-energy codes gain momentum, the demand for economically viable and code-conformant ASWs is poised to intensify.

Solomon Greene
Principal Deputy Assistant Secretary for Policy Development and Research
U.S. Department of Housing and Urban Development

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Executive Summary

Townhomes are an important part of the housing market, especially when it comes to affordability. They provide living space and some outdoor space, often at a lower relative cost to homebuyers than single-family detached homes. With smaller lots and shared interior walls, or area separation walls (ASWs), townhomes are often more cost-effective to construct than single-family detached homes (exhibit 1). However, the tension between air sealing requirements in the International Energy Conservation Code (IECC) and requirements for fire-rated assemblies between townhomes in the International Residential Code (IRC) has caused significant challenges in both construction and code enforcement (exhibit 2).

Exhibit 1. Townhome Area Separation Walls Under Construction

Photo Credit: Newport Partners

Exhibit 2. Code Tension Between Air Sealing Requirements in the IECC and Requirements for Fire-Rated Assemblies Between Townhomes in the IRC

IECC = International Energy Conservation Code. IRC = International Residential Code.

This report guides builders, architects, designers, contractors, code officials, home energy raters, and other stakeholders toward strategies that reduce the tension between meeting the energy and building codes. This report offers adoptable solutions to define, build, and inspect townhome ASWs that meet health, safety, and energy requirements. The IECC and the IRC are model codes that affect most construction in the United States. Improved clarity on ASW issues paves the way for model code updates and codes that states and jurisdictions can adopt that reduce confusion and delays and affect costs, while increasing energy savings and making townhomes more affordable to purchase and operate. With the Inflation Reduction Act of 2022 and efforts across the country to reduce building-associated greenhouse gas emissions by adopting zero energy codes, plus the strong market for townhomes, the need for cost-effective, code-compliant ASWs is likely to increase (exhibit 3).

Exhibit 3. Inflation Reduction Act of 2022

As part of the Inflation Reduction Act, the U.S. Department of Energy recently announced technical assistance for adopting the latest residential energy code—currently the 2021 International Energy Conservation Code—or other codes and standards that achieve equivalent or greater energy savings.

Introduction

Townhomes are houses that are attached to one another and share one or two adjacent walls with neighboring dwelling units. Multiple townhome units make up a building, which can be two to more than eight units. For fire safety, townhomes have area separation walls (ASWs) to reduce the risk of a fire in one unit spreading to an adjacent unit. In the more recent versions of the residential and energy codes, townhome ASWs are referred to as common walls or double walls. ASWs are typically fire-rated gypsum panel partition assemblies designed and tested to meet a particular level of fire resistance. This type of ASW assembly is commonly called a gypsum shaftliner and is easier and more cost-effective to construct than a concrete masonry unit ASW. In addition to providing fire protection, ASWs also limit sound transmission and can reduce the migration of odors and pollutants from one unit to the next to improve health, comfort, and indoor air quality (IAQ). ASWs are also integral to meeting the energy code in townhome buildings.

Energy code provisions save consumers energy and reduce utility bills, but they also require additional steps to test for and achieve specific air leakage rates through the building's thermal envelope. Consistently achieving cost-effective ASWs in townhomes that meet the fire protections in the residential code and air tightness requirements in the energy code can be a challenge for builders, architects, trade contractors, and code officials.

The energy code requires a stringent limit for how much air leakage can occur through the building envelope. The ASW in each townhome unit must be air-sealed for the overall townhome to meet this provision of the energy code. Unless the air sealing materials used within the ASW is part of the fire-rated gypsum shaftliner assembly, a chance exists that the townhome will not pass the inspection. Difficulties with ASWs include confusion about permissible air sealing methods and materials and testing methods. Construction delays that result from inadequate air sealing of townhomes and not meeting code requirements can increase costs and undermine housing affordability. This report seeks to address these challenges and promote strategies for overcoming barriers to cost-effective ASW construction.

The nine strategies in this report cover regulatory, material testing, and technology solutions to define and meet air leakage performance requirements consistently and cost-effectively (exhibit 4). The strategy or strategies used depend on the jurisdiction. Although many of the strategies are code-related, they are not intended to determine compliance with locally applicable codes and standards. Code compliance for specific projects is the responsibility of the project team and the local jurisdiction.

Exhibit 4. Strategies Covered in This Guide

Strategies for Consistent Cost-Effective ASWs

Regulatory

- Adopt 2021 IECC
  - Air Tightness Tradeoffs
  - Compartmentalization Test
  - Tradeoffs to 2012, 2015 or 2018 IECC
- Amend IRC with IBC Options
- Amend with Additional Materials

Material Testing

- Test a Broad Class of Materials
- Conduct Additional Testing of Individual Assemblies with Specific Sealants

Innovative Technology

- Apply Aerosolized Air Sealant Technology
- Utilize New Innovative Technologies as They Become Available on the Market.

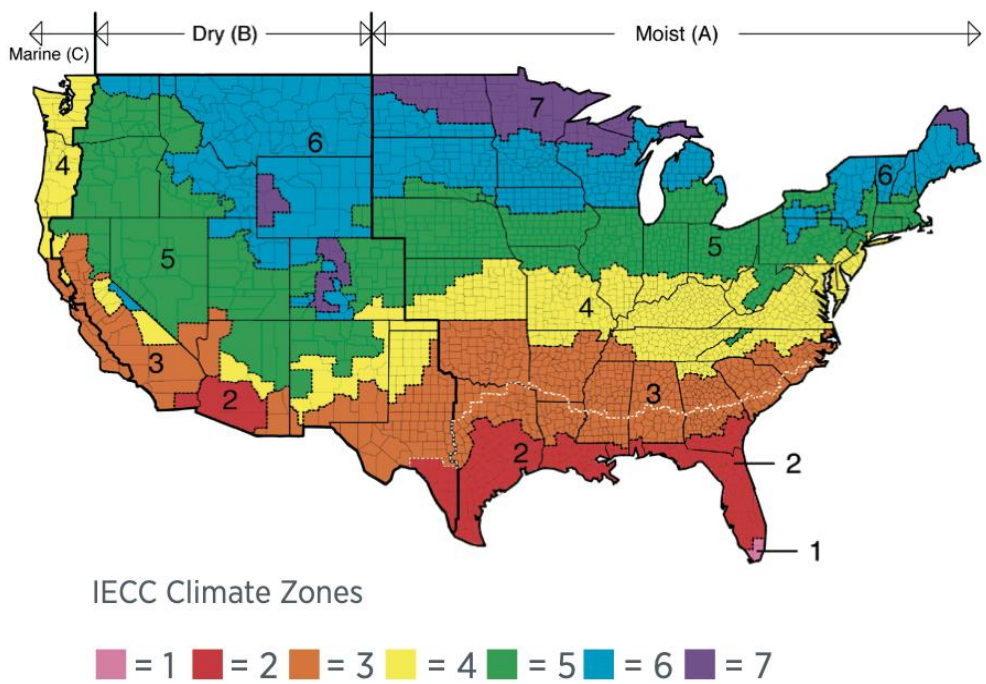
ASWs = area separation walls. IBC = International Building Code. IECC = International Energy Conservation Code. IRC = International Residential Code.

Background

The International Code Council (ICC), a membership-based association of building safety professionals, develops model codes and standards used in the design, construction, and compliance of buildings. "Model codes" are building codes that are available for states or other jurisdictions to adopt, and they may be adopted as-is or with amendments. Fire safety provisions for homes are found in the International Residential Code (IRC), which has long included requirements for tested fire-rated wall assemblies between townhomes. The purpose of these tested assemblies is to prevent or slow the spread of fire between units. The fire separation must be continuous from the foundation to the underside of the roof sheathing, and each unit must be structurally independent. Fire blocking and draft stopping are also part of the equation. Fire blocking is installed to form a barrier to resist the free passage of flames horizontally and vertically between floors and the top story and roof space. Draft stopping is installed at intervals to restrict air movement and impede the spread of flames.

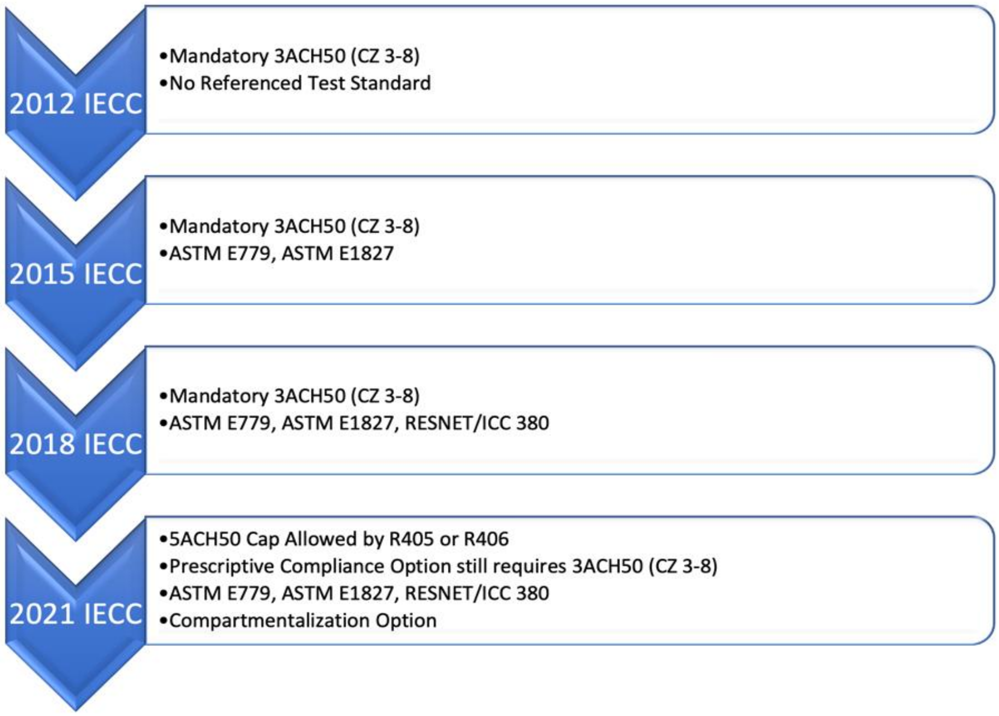
With the International Energy Conservation Code (IECC), reducing air leakage through the building envelope is a major focus for energy savings. According to the ICC website, 48 states, the District of Columbia, Puerto Rico, and the U.S. Virgin Islands have adopted some form of this model energy code (ICC, n.d.; 2018a). For the first time, the 2012 version of the IECC introduced a mandatory whole-building air leakage test, with an air-tightness requirement that was much more stringent than previous code editions. Prior to 2012, the IECC allowed either a visual inspection of air sealing details or a building envelope air leakage test. In addition, builders choosing the option of the air leakage test had only to meet a requirement of 7 air changes per hour (ACH) at 50 pascals pressure, or 7 "ACH50," a level that most of the industry could achieve without new strategies or technologies. In the 2012, 2015, and 2018 editions of the IECC, the residential provisions for climate zones 3 through 8, which cover roughly 90 percent of the United States, require that dwellings must be tested to demonstrate that air leakage is less than or equal to 3 ACH50 (ICC 2012a; 2015a; 2018a; exhibits 5 and 6).

Exhibit 5. 2012 International Energy Conservation Code (IECC) Climate Zone Map



Source: Building America Solution Center, https://basc.pnnl.gov

Exhibit 6. History of Air Leakage Limits and Testing Requirements in the IECC



ACH = air changes per hour. IECC = International Energy Conservation Code.

The term *ACH50* is the air changes per hour—or how many times the air volume in a home turns over with fresh air when the house is pressured to 50 pascals relative to outdoors. “A 50 pascal pressure is roughly equivalent to the pressure a 20-mile-per-hour wind generates blowing on the building from all directions” (The Energy Conservatory, 2017). One air change for a single-story, 2,000-square-foot home with 8-foot ceilings is 16,000 cubic feet of air, for example.

Blower door test results are used to demonstrate air leakage rates. The blower door test uses a large fan to elevate pressure within the home to 50 pascals and measures the flow rate at this pressure to allow the calculation of ACH50 (exhibit 7); It is also a diagnostic tool to find leaks that need to be sealed.

Exhibit 7. Blower Door Test

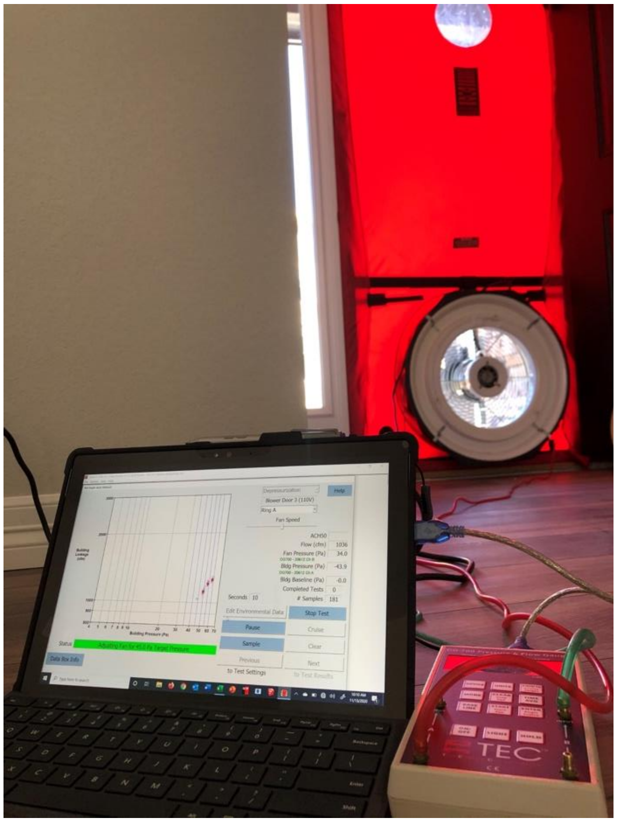


Photo Credit: Robby Schwarz, BuildTank

Conceptually, this code requirement to establish a field-verified air-tightness specification for new homes makes sense. It should reduce air infiltration and save energy. At the same time, limiting air leakage between adjacent dwelling units, like townhomes, improves fire safety, indoor air quality, and sound performance. Plus, field verification using the common blower door test gives the code official a clear pass or fail signal of compliance with this code requirement. This clear indicator helps to ensure that the building will function as intended and is easier to enforce than other aspects of the energy code. In practice, however, a lack of clarity sometimes arises about which air sealants are allowed in the assembly. This lack of clarity can result in confusion, lost energy savings, inconsistent code enforcement across jurisdictions, construction delays, cost impacts, and delayed certificates of occupancy if issues are not caught early.

The ICC model codes are updated through a rigorous process on a 3-year cycle. Engineers, architects, building scientists, manufacturers, building and trade association representatives, code experts, and other interested parties continually update building and energy codes—or push back against changes—based on evolving knowledge, climate issues, innovations, competitive forces, and cost impacts. As issues between codes arise, they are typically resolved in future code development cycles. Sometimes, however, issues arise that are not in direct conflict but create confusion during the construction process. The next section explores energy and building code requirements, air sealing area separation walls (ASWs), and the challenges they may present.

The Energy Code: Air Leakage Testing

The 2012 IECC section R402.4 covers air leakage requirements and includes both the requirement for visual inspection of air sealing details and the building envelope air leakage test. It does not reference a specific test standard for measuring the air leakage rate. The 2012 code also stipulates that each dwelling unit or the entire building can be tested. However, testing an entire townhome structure together (that is, the entire block of townhomes) is very challenging because the ASW separates the units; therefore, multiple blower door systems must be used simultaneously. In addition to specific air sealing measures to be verified during the visual inspection, homes must be tested to achieve a leakage rate of 5 ACH50 or lower in climate zones 1 and 2 and 3 ACH50 or lower in climate zones 3 through 8 (ICC, 2012a).

The 2015 IECC introduces the American Society for Testing and Materials (ASTM) standards E779 and E1827 as referenced standards for performing the building envelope air leakage tests. The 2018 code introduces a third reference standard option for conducting the building envelope air leakage test—RESNET/ICC 380. The 2021 IECC adds flexibility. It still requires 3 ACH50, but a builder can make a tradeoff up to 5 ACH50 when using certain compliance paths involving performance tradeoffs. It also includes optional compartmentalization testing to assess air leakage based on surface area rather than the dwelling's volume, which is the basis for the ACH50 metric. Additional detail on the 2021 IECC provisions is provided in the following Nine Strategies for Air Sealing Area Separation Walls in Townhomes section.

The Residential Code: Fire-Rated Assemblies

Although fire-rated assembly requirements existed before 2012 (exhibit 8), the tension between fire-resistance and air tightness was introduced at this time. In the 2012 IRC, fire-resistant construction requirements are in section R302. Fire-rated exterior wall requirements are in section R302.1. Section R302.2 requires each townhome ASW (or common wall, as they are referred to in the IRC) to be treated as an exterior wall in accordance with R302.1.

Exhibit 8. Example of a Fire-Rated Assembly

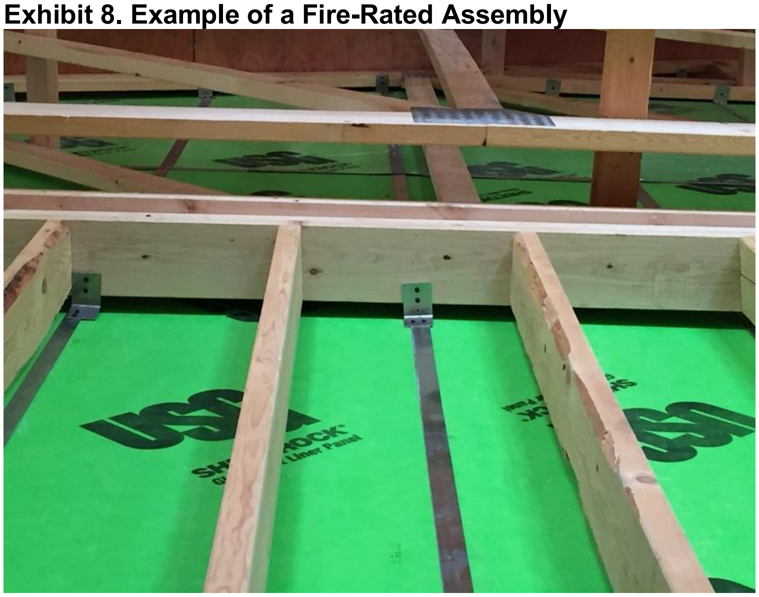


Photo Credit: Robby Schwarz, BuildTank

Options for homes with automatic fire sprinklers are in Table R302.1(2), in which each townhome unit requires a 1-hour rated wall tested with exposure from the outside of that unit. Options for homes without fire sprinklers are in Table R302.1(1), in which each townhome unit must have a 1-hour rated wall tested with exposures from both sides. This means that between townhome units, two 1-hour rated walls are required.

R302.2 allows an exception to the previously mentioned requirements for which a single common wall with 1-hour fire rating is tested with exposure from both sides, but no plumbing and mechanical systems, ducts, and vents can be in the cavity of the common wall.

In all these scenarios, the ASW assembly design must be tested according to the ASTM standard E119 or Underwriters Laboratories (UL) 263 to establish the fire rating. In addition, the fire rating must be continuous from foundation to the underside of the roof and must include the entire wall (ICC, 2012b).

This section is restructured in the 2015 IRC. The requirements for townhomes are in R302.2, with no reference to R302.1. Instead, 302.2 offers two options for townhome ASWs. Option 1 for homes with fire sprinklers requires the ASW between townhomes to meet a 1-hour fire resistance rating tested from both sides. Option 2, for homes without automatic fire sprinklers, requires the ASW between townhomes to meet a 2-hour fire rating tested from both sides. For both options, the ASW assemblies must be tested to ASTM E119 or UL 263. In addition, plumbing and mechanical systems, ducts, and vents are prohibited from being in the ASW cavity in all options. The continuity requirements for ASWs are unchanged (ICC, 2015b).

The 2018 IRC adds additional options for townhome ASWs. R302.2 now offers ASW options for a "double wall" in addition to the options for a "common wall" (same term as used in prior versions of the IRC). R302.2.1 requires double walls to have two 1-hour fire rated assemblies tested in accordance with ASTM E119, UL 263, or the International Building Code (IBC) section 703.3.

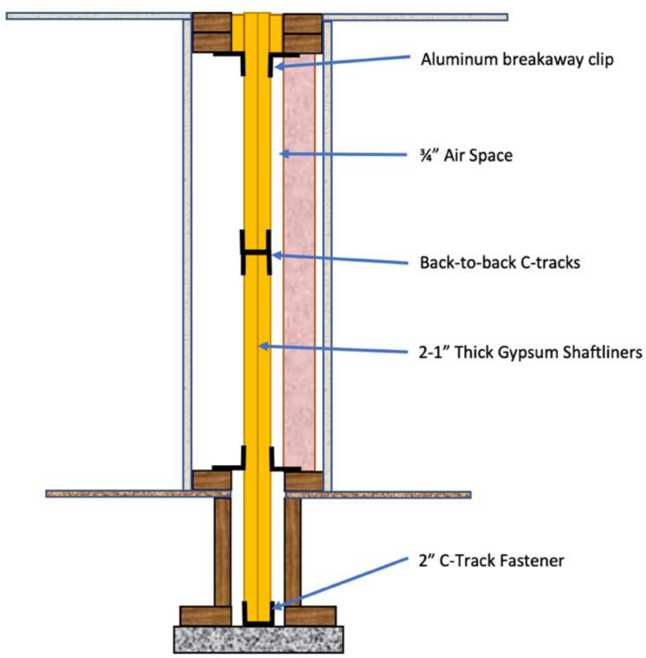
Section R302.2.2 continues to offer two options for townhome common walls. Option 1, for townhomes with automatic fire sprinklers, requires a 1-hour rating, tested from both sides to ASTM E119, UL 263, or IBC 703.3. Option 2, for townhomes without automatic fire sprinklers, requires a 2-hour rating, tested from both sides to ASTM E119, UL 263, or IBC 703.3. For both options under R302.2.2, plumbing and mechanical systems, ducts, and vents are prohibited from the cavity. In all options (R302.2.1 and R302.2.2) continuity requirements are unchanged (ICC, 2018b).

The 2021 IRC maintains the same options as the 2018 IRC, with small modifications to the language and clarifying edits. R302.2.1 continues to require double walls to have two 1-hour fire rated assemblies tested in accordance with ASTM E119, UL 263, or the IBC section 703.2.2 (formerly 703.3). The flexibility added by 2018 IBC 703.3 remains in this code but is not detailed in 703.2.2. Section R302.2.2 continues to offer two options for townhome common walls. Option 1, for townhomes with automatic fire sprinklers, requires a 1-hour rating, tested from both sides to ASTM E119, UL 263, or IBC 703.2.2 (formerly 703.3). Option 2, for townhomes without automatic fire sprinklers, requires a 2-hour rating, tested from both sides to ASTM E119, UL 263, or IBC 703.2.2. For both townhome common wall options, plumbing and mechanical systems, ducts, and vents are prohibited from being located within the cavity, but the 2021 code now exempts automatic water-filled fire sprinkler piping from this prohibition. All options require continuity, and minor changes are included to clarify the language. The 2021 IRC further defines the common wall area and adds an exception that Denver previously adopted, which provides some flexibility in how far the common wall must extend toward the exterior (ICC, 2021b).

Air-Sealing Area Separation Walls

Gypsum shaftliner ASW assemblies are constructed with two 1-inch thick, 24-inch-wide gypsum shaftliner panels fitted between metal studs. Gypsum is a naturally occurring mineral with good fire resistance properties. The gypsum panels are also known as drywall. Type X drywall has additives that increase the fire resistance of the panels. The adjacent wood-framed walls on either side of the shaftliner panels are attached to the metal studs using aluminum breakaway clips. The clips help maintain ASW stability and provide a three-quarters of an inch airspace gap between the gypsum shaftliner and the adjacent wood framing. The clips melt when exposed to high temperatures during a fire, allowing the affected wood-framed wall of the townhome to collapse without jeopardizing the ASW (exhibits 9 and 10).

Exhibit 9. Cross-Section of a Gypsum Shaftliner Assembly



Source: Newport Partners

Exhibit 10. Gypsum Shaftliner Assembly in a Townhome Under Construction

Photo Credit: Newport Partners

Gypsum manufacturers fire-test assemblies with accredited laboratories to achieve fire-rated ASW designs. Several testing agencies provide third-party certification. Shaftliner assembly designs used in townhome construction and tested to American National Standards Institute, or ANSI, and UL 263 include United States Gypsum (U336), National Gypsum (U347), CertainTeed Gypsum (U366), Georgia-Pacific Gypsum (U373), and American Gypsum (U375).

The core issue is that it is necessary to thoroughly air seal the entire building envelope, including ASWs, to meet the IECC's air leakage requirements, although the UL or other listed assemblies have not explicitly called out air-sealing materials until recently. This discrepancy has raised questions about which locations around an ASW can be air sealed and with which materials. Next, this guide explores regulatory and technical solutions to air-sealed ASWs in townhomes.

Nine Strategies for Air Sealing Area Separation Walls in Townhomes

Strategy 1: Adopt the 2021 IECC for Air Tightness Tradeoffs

The 2021 International Energy Conservation Code (IECC) allows for greater flexibility than previous IECC editions for compliance, with the building envelope air tightness testing requirements. For states and jurisdictions already using I-codes, or the suite of model codes developed through the International Code Council process, adopting the 2021 IECC for its air tightness tradeoffs may provide the clearest solution, although this version of the IECC is more stringent overall compared with prior versions (exhibit 11).

Exhibit 11. The Reality of Tradeoffs

Tradeoffs can be tricky and should be considered strategically. Although the use of tradeoffs can allow a townhome to have a somewhat higher infiltration rate under the 2021 International Energy Conservation Code, this added air leakage represents lost energy efficiency. To make up for this loss, upgrades might consist of additional insulation in the walls, foundation, or attic; upgrading to very efficient double-pane or even triple-pane windows; or higher efficiency mechanical systems. The energy impact and costs of these upgrades will vary, and the rules of sections R405 and R406 determine the allowance to use different tradeoffs. Therefore, leveraging tradeoffs will involve energy modeling and cost analysis to determine an optimal strategy.

Exhibit 11. Air Tightness Tradeoffs to 2012, 2015 or 2018 IECC

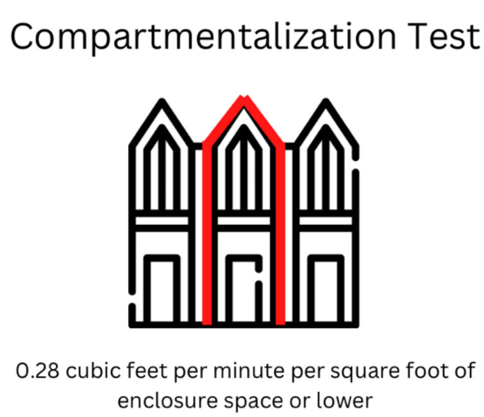
Although the visual inspection of air sealing details is still required, the 2021 IECC section 402.4.1.2 changes the air tightness test target to 5.0 air changes per hour, or ACH50, for all climate zones for buildings using either of these compliance path options: Total Building Performance Option (R405) or Energy Rating Index Option (R406). The 2021 IECC still requires builders using the Prescriptive Compliance Option to meet an air-tightness upper limit of 3.0 ACH50 for IECC climate zones 3 through 8 and 5.0 ACH50 for IECC climate zones 1 and 2. However, builders using sections 405 or 406 can get the flexibility of a more lenient envelope air leakage target if the dwelling still meets the overall performance targets of the respective compliance path.

In either sections R405 or R406, the builders should base their code compliance strategy on an air tightness level that they can reliably achieve in the field. This solution allows an energy neutral tradeoff as the rules of either R405 or R406 define, while easing the need to air seal challenging details in an area separation wall (ASW). It offers added flexibility for townhome builders in IECC climate zones 3 through 8 who can achieve 5 ACH50 or lower using code-compliant and repeatable air sealing strategies. Many builders already use R405 for compliance and hire an energy rater to model their homes, using the same methodology employed in R406. This solution uses a national model code that can be adopted without amendments.

Strategy 2: Adopt the 2021 IECC for the Compartmentalization Test

The 2021 IECC also allows the use of a compartmentalization test to evaluate the air leakage of a dwelling. In section R402.4.1.2, any home or dwelling unit has the option of the compartmentalization test, which requires a test result of 0.28 cubic feet per minute (CFM) per square foot of enclosure space or lower (exhibit 12). This approach is an alternative to the test requiring an "ACH50" measurement. The ACH metric normalizes air leakage based on the dwelling's volume. The compartmentalization test is performed at 50 pascals of pressure created by the blower door fan, but the compartmentalization test metric instead normalizes the air leakage based on the surface area of the enclosed space (see exhibit 7). The surface area of the compartment includes all six sides of the dwelling unit, including the ASWs and the foundation.

Exhibit 12. Compartmentalization Test for Individual Units



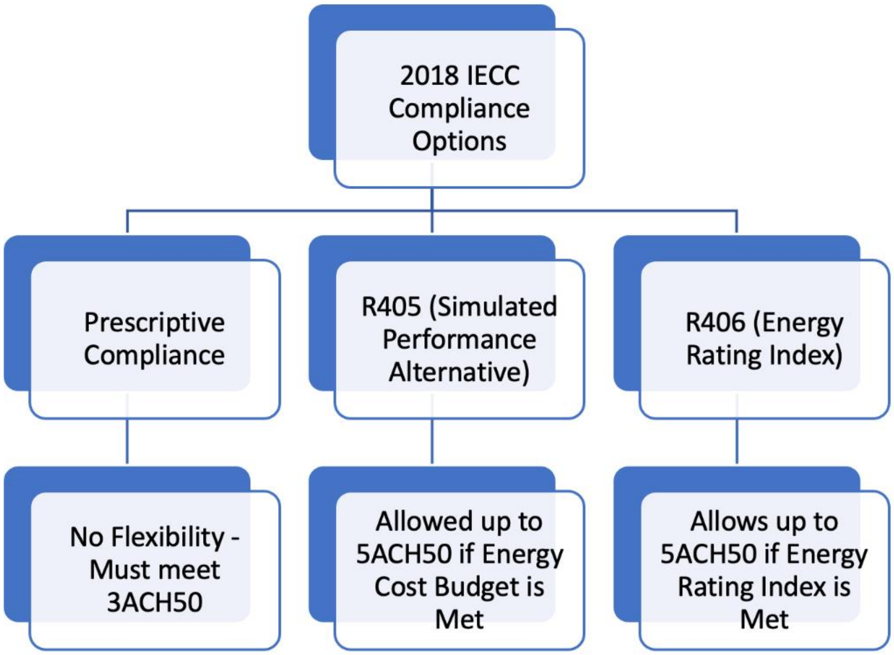
Source: Newport Partners

An IECC exception in section R402.4.1.2 allows 0.30 CFM per square foot of enclosure area or lower when testing *attached* single-family or multifamily dwelling units individually. The 0.30 CFM50 upper limit also applies to any building or dwelling unit smaller than 1,500 square feet. In general, depending on home size and layout, this target is easier to reach and requires less air sealing compared with the ACH50 target. In some cases, this flexibility may be enough to allow a home or unit that could not pass based on the ACH50 requirement to pass using the alternative test.

Strategy 3: Add Air Tightness Tradeoffs to 2012, 2015, or 2018 IECC

If a community is following 2012, 2015, or 2018 IECC, another solution is to adopt amendments at the state and local levels consistent with the 2021 IECC changes to add air leakage flexibility. The State of Maryland serves as a model for this strategy. When Maryland adopted the 2018 IECC, the state also adopted amendments to the code that were similar to the 2021 IECC language (State of Maryland, 2019). Maryland changed the 3 ACH50 requirement from a mandatory requirement to a prescriptive requirement. They then added a mandatory air tightness target of 5 ACH50 or lower. This approach allows builders using either sections R405 or R406 for compliance to have building air tightness as high as 5 ACH50 if they add greater efficiency in other areas to offset the higher leakage rate (exhibit 13).

Exhibit 13. Add 2021 IECC Air Tightness Tradeoffs to Earlier Code



ACH = air changes per hour. IECC = International Energy Conservation Code.
Source: Newport Partners

Strategy 4: Amend the Residential Code With Options From the International Building Code

Another option is to amend the residential code to duplicate the options listed in the 2018 or 2021 International Building Code (ICC 2018c; 2021c). The IBC allows six alternative options for demonstrating compliance of fire-rated assemblies. This flexibility could be especially useful to builders working with high volumes of townhomes. Although these design alternatives must match the fire performance of a wall tested to American Society for Testing and Materials (ASTM) E119 or Underwriters Laboratories (UL) 263, not having to conduct a new test when adding an air sealing material may save significant time and expense. IBC 703.3 allows the following options (exhibit 14).

- *Option 1* allows designs that have been documented to have a fire rating consistent with the requirements of ASTM E119 or UL 263 without having gone through those tests formally. The code official approves the source.

- *Option 2* allows for prescriptive designs based on IBC 721. It serves as a recipe book or instruction manual for building a unique fire-rated assembly based on the properties of its component parts.

- *Option 3* allows calculations based on IBC 722, which provides methods and equations for calculating the fire resistance rating of specific materials or groups of materials. In this way, a user could design a unique common wall assembly and then calculate its fire resistance rating.

- *Option 4* allows for an engineered analysis. This analysis would need to compare the common wall assembly being proposed with an assembly that has fire ratings already established by ASTM E119 or UL 263 procedures.

- *Option 5* references a broad exception in IBC 104.11, which allows the code official broad authority to approve equivalent alternative methods. This text is included in the code to allow innovation. A parallel allowance is included in International Residential Code (IRC) section R104.11, although it is not directly referenced in IRC section R302.

- *Option 6* allows an agency to approve designs as having fire ratings consistent with the requirements of ASTM E119 or UL 263 without having to go through those tests formally. The code official approves the agency to conduct such work.

Exhibit 34. Include Building Code Options in the Residential Code

Strategy 4: IBC 703.3 Options

1: Fire-Resistance Designs	Documented to be consistent with E119 or UL 263 by Approved Sources
2: Prescriptive Designs	Based on IBC 721/ a guide for building fire rated assemblies
3: Calculations	Based on IBC 722/calculated fire rated assembly
4: Engineered Analysis	Based on comparison to assembly tested to ASTM E119 or UL 263
5: Alternative Protection Methods	Based on IBC 104.11/approved equivalent alternative
6: Fire-Resistance Designs	Certified by Approved Agency/code official

IBC = International Building Code. UL = Underwriters Laboratories.
Source: Newport Partners

All these options are intended to allow the builder, designer, or code official flexibility to use equivalent approaches to avoid the effort and cost of testing an assembly. In many cases, a manufacturer of products used in fire-rated assemblies may be interested in pursuing some of these engineered or calculated options rather than testing new assemblies. Some manufacturers even offer "engineered solutions" for customers looking to use a specific assembly. During inspections, this approach may help clarify whether air sealing materials are allowed. It may also offer builders justification when explaining why they added any materials to a tested assembly.

Strategy 5: Amend the Code With Additional Materials

The primary regulatory challenge related to townhome ASWs is the fact that air sealing materials frequently have not been specified or were not included during the required ASTM E119 or UL 263 testing of the assembly. Therefore, adding any air sealing material as a measure to help pass the building envelope air tightness test, especially for interior townhome units, has the potential to make the assembly unacceptable to the code enforcement official. To resolve this issue, IRC sections R302.2.1 and R302.2.2 can be amended to specifically allow the addition of fire-rated foams and caulks to assemblies. In this way, the code is not altering the ASTM E119 or UL 263 testing, but merely allowing additional materials to be added to the tested wall. Performance criteria for the sealant materials can even be added to the air sealing material to ensure fire safety. Air sealants can be allowed but limited in amount by the code (exhibit 15).

Exhibit 15. Amend the Code With Additional Air Sealing Materials

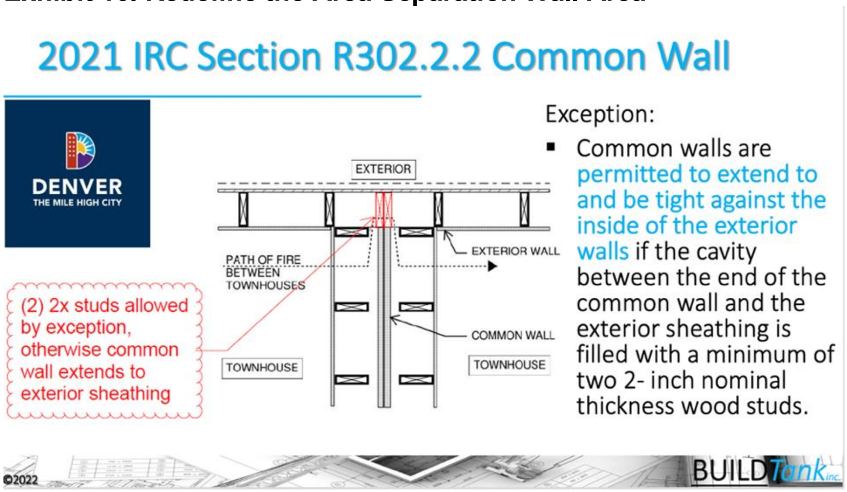
UL = Underwriters Laboratories.
Source: Newport Partners

A variety of examples demonstrate that the code provides exceptions to a primary requirement. For example, IRC section R302.9 requires a flame spread index of 200 or less for wall and ceiling finishes; however, trim such as baseboards are exempted from this requirement. The concept is that finishes should have a certain amount of flame spread protection, but that baseboard finishes can still be added to the wall without affecting the ability to meet the flame spread index requirement. The code has other examples in which materials with certain required properties are allowed to be added to an assembly. This approach provides an option to add air sealing materials (within limits) to a wall that has already been tested to meet the fire-resistance properties required by the code.

Strategy 6: Redefine the Area

During its adoption of the 2018 IRC, the City of Denver amended section 302.2.2 to redefine the area covered by the ASW or common wall for townhomes (exhibit 16). In the IRC, the common wall is required to extend to the exterior sheathing of the exterior wall. However, the City of Denver added an exception, allowing the common wall to extend to the *interior* of the edge of the exterior wall. The cavity between that edge and the exterior sheathing must be filled with wood studs. This amendment changes the defined area of the tested common wall so that it no longer includes the exterior wall. This approach allows the addition of air sealing measures at the intersection of the common and exterior walls. Violating the rated assembly is not a risk at this point, because it no longer is part of the common wall (City of Denver, 2020).

Exhibit 16. Redefine the Area Separation Wall Area



IRC = International Residential Code.
Source: Robby Schwarz, BuildTank

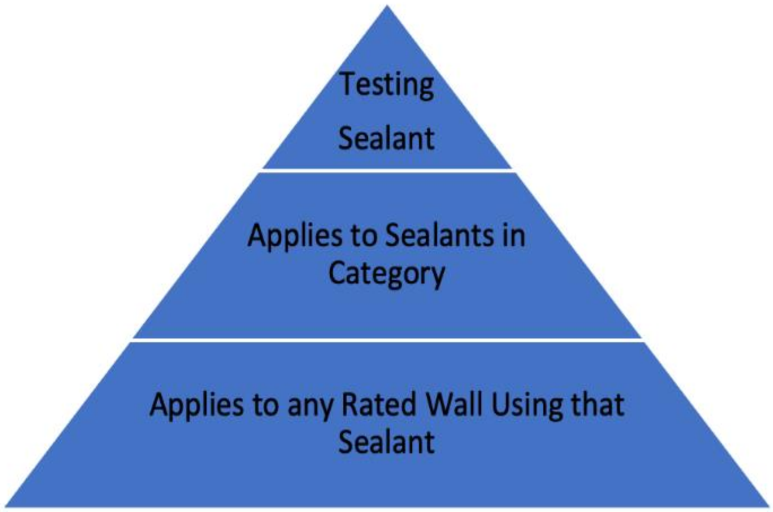
The 2021 IRC also includes this concept in new language added to section R302.2.2. It defines the common wall as extending to the exterior sheathing of framed walls or to the inside of nonframed walls. An exception allows the common wall to extend to the *interior* of the exterior wall if the framed cavity is filled with nominal 2-inch wood studs. The 2021 IECC exception language is identical to the City of Denver amendment (ICC, 2021b).

Amending the 2018 IRC or earlier editions using the Denver exception or adopting the 2021 IRC allows air sealing at a common point of air leakage. This code amendment is minor and does not require additional testing. This solution allows some air sealing, without any effect on the common wall fire rating. The intersection of the common and exterior walls is a point of significant air leakage; however, it is not the only point of leakage. It is possible that air leakage could be reduced using this option, and townhomes that are close to passing the ACH50 requirement would then meet the requirement.

Strategy 7: Test a Broad Class of Materials

Additional testing has always been a solution to show compliance with any wall assembly using any air sealing material if it passes the applicable ASTM and UL tests. Testing is expensive and time consuming. Rather than testing proprietary sealants in specific assemblies, another approach is to test a broad class of commonly used air-sealing materials to determine if they could be added to all rated assemblies without affecting the fire rating of the wall (exhibit 17). This approach requires interpretation from ASTM and UL organizations and testing through an approved laboratory. The benefit is that it could give builders a universal solution without code changes or differences across jurisdictions, resulting in more consistency with the potential for lower costs.

Exhibit 47. Test a Broad Class of Materials



Source: Newport Partners

Unlike many changes that offer partial solutions, this change presents a full solution for any builder using that class of product for air sealing. If a class of products is approved, then that approval can be listed in the notes of all assemblies and available for the reviewing code official.

Strategy 8: Additional Testing of Individual Assemblies With Specific Sealants Included in Approval

A recent industry effort led to updating UL assemblies that now call out the use of specific sealants. Several UL listed assemblies—National Gypsum (U347), Georgia-Pacific Gypsum (U373), and American Gypsum (U375)—specifically allow Dupont GREAT STUFF™ Gaps & Cracks, GREAT STUFF PRO™ Gaps & Cracks, and GREAT STUFF PRO™ Window & Door, as well as HandiFoam® Fireblock, HandiFoam® Fireblock West, and Fast Foam Fireblock by ICP Adhesives and Sealants. The sealant can be used for air sealing around the partition perimeter in the air space between the wood framing and the shaftliner panels. CertainTeed Gypsum (U366) allows the same sealants and locations, plus latex sealant in specific locations in addition to Knauf ECOSEAL™ Plus. This testing was privately funded. Although the approvals apply only to the specific listed assemblies, they cover the most used gypsum shaftliner ASW assemblies (exhibit 18). This process is relatively

Exhibit 18. Test Specific Sealants to Include in Approved Assemblies

Photo Credit: Newport Partners

costly, but it may be the best solution available outside of specific code changes.

Strategy 9: Use an Innovative Technology

Air sealing townhomes that use a drywall shaftliner assembly can become more predictable by using an aerosolized air sealing system (exhibit 19). An example is AeroBarrier, which is an aerosolized acrylic sealant that is pumped as an aerosol into the compartmentalized dwelling unit after drywall installation. The aerosolized sealant flows to the points of air leakage and seals openings less than one-half inch. AeroBarrier uses the drywall as the primary air barrier and fills in the gaps around edges and penetrations.

Exhibit 19. Air Sealing the Unit Using Aerosolized Sealant

Photo Credits: Robby Schwarz, BuildTank

Applying the aerosolized sealer takes 3 to 5 hours per townhome unit. First, the house is prepared (after installing drywall) by temporarily covering all openings that are not supposed to be permanently air sealed (for example, joints around window sashes, joints around door openings, fan vents, and so on). These locations are temporarily covered so that the sealant does not seal them (exhibit 20). Other points of air leakage are left exposed, allowing the aerosolized sealant to accumulate at these points as the home's interior is pressurized to create an air seal. The contractor sets up distribution nozzles for the aerosolized sealing throughout the house, enters a specific leakage level target into the computerized control system, then pressurizes the dwelling with a modified blower door to apply the sealant.

Exhibit 20. Temporary Covering

Notes: Temporary covering is placed over windows, dryer vent opening and ventilation fan. The plastic film does not cover the perimeter of the openings, allowing the product to seal those leakage points.
Photo Credits: Robby Schwarz, BuildTank

The contractor monitors the sealing process on the computer in real time, and the application of the sealant continues until the leakage target is met. After cleanup, construction can resume within 30 minutes.

Most air leakage in a townhome unit occurs at ASWs, exterior walls, ceiling to attic penetrations, the rim joist, exterior wall penetrations, stairs, stairwells, and stairs connected to the garage. Generally, many small cracks and gaps can collectively create significant amounts of air leakage before air sealing occurs. Interior townhome units, which have two ASWs, present a greater challenge.

The aerosolized sealant approach can provide consistent final blower door test results below 3 ACH50 for each townhome unit in which it is applied. This predictability is based on the fact that the air leakage rate is measured as the sealant is applied, so the final leakage rate is much more predictable. Use of the aerosolized sealant can also reduce the need to caulk at electrical boxes and around pipes, because the aerosolized sealant fills small gaps.

Scheduling this activity is a key consideration, and builders will often schedule two townhome units per contractor visit to optimize the cost of this service. This approach to air sealing townhomes can minimize the challenges encountered with ASWs and make the process more predictable. As a result, energy code requirements for air leakage rates can be reliably achieved.

CONCLUSION

Townhomes are an important part of the nation's housing supply and can be a solution for more affordable housing. Area separation walls (ASWs) are subject to building and energy code requirements and are critical to the health and safety of occupants. The tension between air sealing requirements in the energy code and requirements for fire-rated assemblies between townhomes in the residential code can cause significant challenges in both construction and code enforcement. Providing strategies for consistently and cost-effectively designing, constructing, and inspecting ASWs helps to maintain affordability by reducing construction and inspection delays and gets homeowners into their townhome more quickly (exhibit 21).

Exhibit 51. Completed Townhomes

Photo Credits: Newport Partners

Six of the nine strategies provided in this guide are regulatory in nature. Several viable regulatory solutions are available to mitigate the problem and provide a path forward toward simpler implementation. These regulatory strategies involve model code updates, state code amendments, additional testing, or even communication regarding existing solutions in the code. For any jurisdiction considering adopting a code, addressing this issue with one or more of the suggested solutions could ease the implementation of the code and result in better outcomes for affordable new home construction.

HUD's support of research on regulatory barriers and field research is critical for maintaining affordable housing. Improved clarity on technical and regulatory solutions to issues like ASWs can reduce housing construction costs and increase energy savings for homeowners. With the introduction of the Inflation Reduction Act, significant funding will be available to encourage states and municipalities to adopt both the latest energy codes and zero energy codes. This support will increase the pressure to harmonize codes from a building science perspective and adopt innovations while maintaining affordability.

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