Increasing Innovation and Affordability in Housing: A Case Study on Townhome Area Separation Walls

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Abstract

Consistently achieving cost-effective area separation walls (ASW) in townhomes that meet the fire protection requirements in the residential building code and air tightness provisions in the energy code can be a challenge for builders, architects, designers, trade contractors, and code officials. Townhome ASWs are complex and must serve several functions, including fire separation, limiting sound transmission, and limiting airflow. The typical townhome ASW is a 2-hour fire-rated gypsum assembly. Because townhomes are often a more affordable housing solution, cost is important. The energy code provisions reduce air leakage through the building envelope for energy and cost savings to the consumer and, at the same time, require additional steps to achieve and test reduced air leakage rates.

For cost-effective construction, builders need predictability and consistency. The fragmentation of the construction and inspection process with so many players with different roles means that the installation of any product or material may have unintended effects or consequences on the overall building performance. Historical examples, such as moisture accumulation within highly insulated walls or complications with attaching cladding over exterior foam insulation on walls, are often related to increases in one code that are not immediately reflected in other codes. In the case of ASWs, the gypsum assemblies are designed for fire protection. When the energy code is adopted, sealing the ASWs is needed to meet the air leakage requirements. This research demonstrates that air leakage is higher at the ASWs than the exterior walls on the end units, so ASWs must be air sealed to reach the air leakage requirements. Unless the air sealing material is part of the fire-rated gypsum assembly, a chance exists that the townhome will not pass the inspection.

Abstract (continued)

To meet the fire protection and energy code requirements, a builder might face issues that can impact construction costs, including additional inspections that affect project scheduling, different interpretations of ASW requirements by various jurisdictions, construction setbacks, delays in certificates of occupancy, and lost energy savings. With the Inflation Reduction Act of 2022 and efforts across the country to reduce building 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. This article summarizes field and regulatory solutions to consistently design and construct cost-effective ASWs and serves as an example of the need to harmonize codes through a holistic lens and adopt innovations to reduce complexity and maintain affordability.

Introduction

Townhome area separation walls (ASW) serve as a case study for larger issues related to innovation and affordability in the housing industry. Townhomes are an important part of the housing mix, especially when it comes to affordability. They provide living space and some outdoor space like single-family homes and often at a lower relative cost. With energy-efficient construction, townhomes are even more affordable to own and operate. Consistently achieving cost-effective ASWs in townhomes that meet the fire protection requirements in the residential building code and air tightness provisions in the energy code can be a challenge. ASWs must serve several functions, including fire separation, limiting sound transmission, and limiting airflow. It is complex to design, build, and code-approve ASW assemblies that clearly meet all these requirements. The challenge for builders is achieving consistently low air leakage rates while maintaining affordability.

Builders are responsible for managing townhome projects from blueprints to completed homes. They hire architects, designers, trade contractors, and hopefully energy raters or consultants. They procure the products and materials and coordinate the scheduling and sequencing of trade contractors and code inspections. On average, it takes 22 trade contractors to build a home (Emrath, 2015). A townhome has the added complexity of an ASW.

ASWs are typically 2-hour fire-rated assemblies designed and tested to meet this standard by gypsum manufacturers. They are commonly called gypsum shaftliner assemblies (exhibit 1). Shaftliner assemblies have advantages over concrete masonry units, because they create more usable space, have better sound attenuation, can be installed by the framing crew in the same sequence as building construction without the need for scaffolding, and have lower labor and material costs (Rodriguez, 2018). Several trade contractors are involved in the construction and air sealing of ASWs—framers, air sealing and insulation contractors, and drywallers—plus the energy rater.

Exhibit 1

Shaftliner Area Separation Wall

Example of a 2-hour fire-rated gypsum shaftliner assembly. Photo credit: Newport Partners.

Energy raters or consultants are a neutral third party sometimes hired by the builder to analyze construction plans and provide onsite inspections and use diagnostic testing to facilitate the inspection and demonstrate meeting the requirements of above-code energy efficiency programs. The energy rater looks at the home from the perspective of building science, or the "house as a system." Energy raters can be important for quality control.

The code official follows and enforces building codes adopted by local jurisdictions or states to ensure the health and safety of future occupants, a process that can be just as fragmented as the construction process. Building codes, which include commercial, residential, fire, mechanical, plumbing, sanitation, and energy codes, are based on International Code Council (ICC) model codes in most states. They often have local amendments adopted by the state or the municipality. Townhome builders must not only adhere to several different codes, but they must also coordinate inspections throughout the construction process. Builders are required to have their building plans reviewed to get a permit. Then, several inspections are necessary—foundation, underground or slab, rough, and final inspections—prior to a certificate of occupancy.

Limited industry research or analysis of the ASW issue has been completed due to its diffuse nature. Previous U.S. Department of Energy (DOE) Building America efforts circa 2015–16 included an industry meeting that established the parameters of the issue. More recent efforts involve worst-case scenario assembly testing, resulting in updates that acknowledge the use of air leakage sealants (discussed further in this article). This effort to develop and publicly disseminate broader industry guidance on code barrier solutions and field innovation is only possible due to the support of the U.S. Department of Housing and Urban Development (HUD). HUD's support is vitally important, because this national-scale housing industry issue negatively affects affordability, energy efficiency, safety, indoor air quality and health, and the consistency of code compliance in townhomes.

With HUD's support, Newport Partners collaborated with a regional builder, a manufacturer, an energy rater, and an industry advisory committee to conduct field research, analyze regulatory barriers, and develop solutions for cost-effective ASWs that satisfy code requirements. The results of this project give builders and municipalities a clearer understanding of these issues and enable them to apply balanced technical and regulatory solutions, as the energy code landscape rapidly accelerates to meet climate change goals. It also provides solutions for builders working in multiple jurisdictions with no statewide code or states in which different requirements may be open to different interpretations.

The market impact of this effort is significant. According to a National Association of Home Builders (NAHB) analysis, townhome construction surged to 28 percent in 2021 compared with the previous year (Dietz, 2022). NAHB predicted positive long-term prospects for townhomes as homebuyers look for medium-density walkable neighborhoods, and first-time homebuyers need solutions in high-cost areas (Dietz, 2022). Improved clarity on technical and regulatory solutions to issues like ASWs can improve the likelihood of energy code adoption occurring at the state level to increase energy savings. With the introduction of the Inflation Reduction Act, significant funding will be available to encourage states and municipalities to adopt zero energy codes. This advancement will increase the pressure to harmonize codes from a building science perspective and adopt innovations while maintaining affordability.

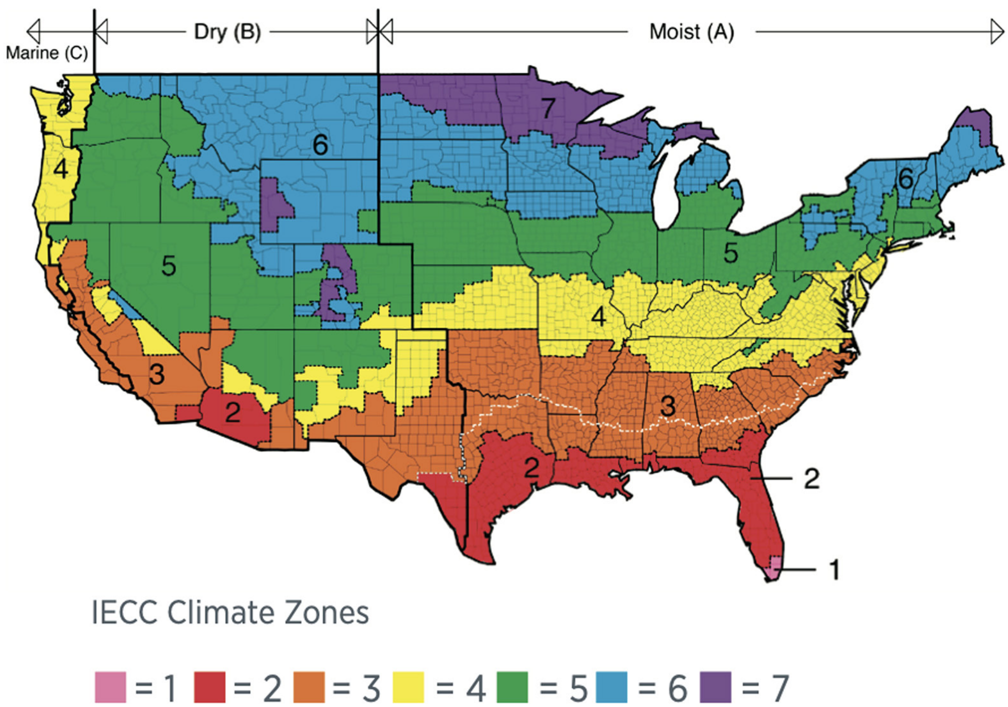
Model Codes

For fire safety, the International Residential Code (IRC) 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. ASW is an industry term for a wall separating townhomes. They are also called double walls or common walls. 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. Forty-eight states, the District of Columbia, Puerto Rico, and the U.S. Virgin Islands have adopted some form of this model energy code (ICC, 2022). The 2012 version of the IECC, for the first time, 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 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 (exhibit 2).

Exhibit 2

International Energy Conservation Code (IECC) Climate Zone Map



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

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 generated by a 20-mph wind 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. It is also a diagnostic tool to find the leaks that need to be sealed.

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, such as 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 assure 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 if no state code exists, construction delays, cost impacts, and delayed certificates of occupancy if issues were not caught early.

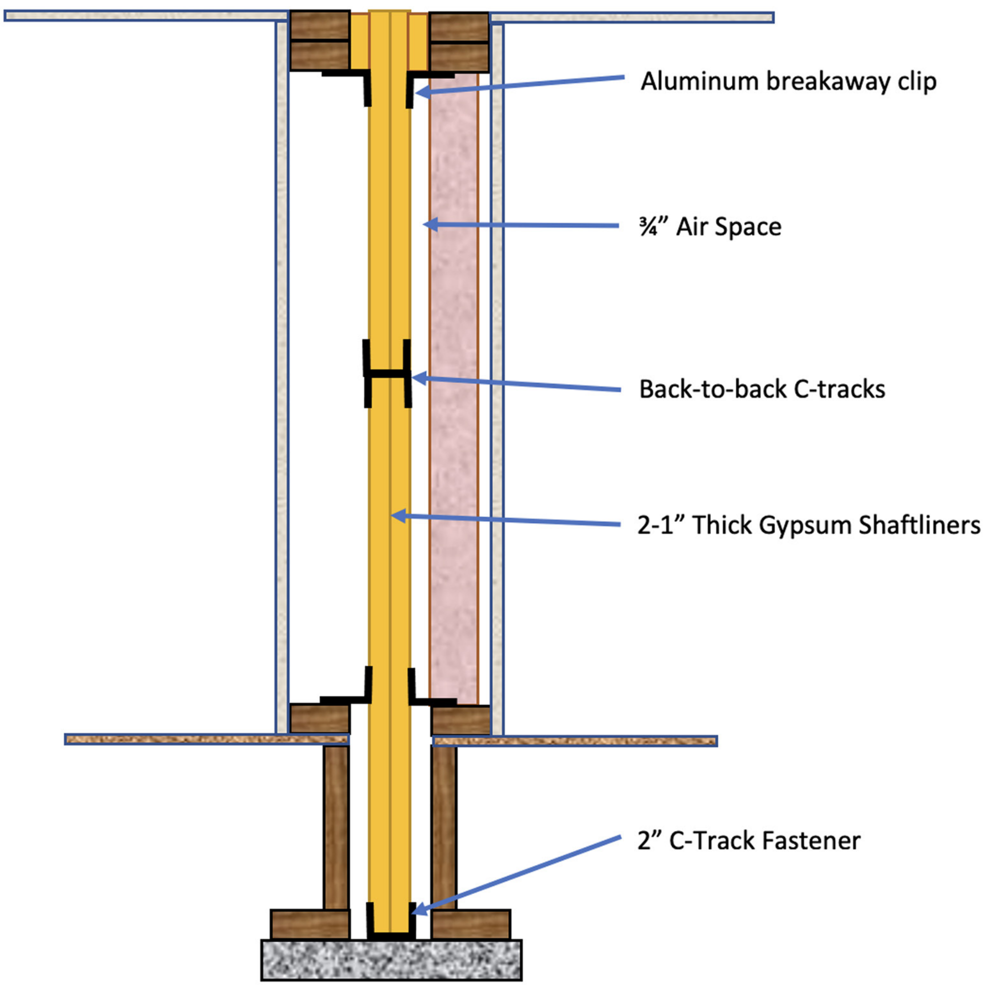
The model codes are updated through a rigorous process on a 3-year cycle. Engineers, architects, building scientists, manufacturers, building and trade association representatives, code experts, and other interested parties continually update building and energy codes—or push back against changes—based 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 integration of the house as a system.

Air-Sealing of Area Separation Walls that Modifies the Fire-Rated Assembly

ASW gypsum assemblies are constructed with two 1-inch thick, 24-inches wide gypsum shaftliner panels fitted between metal studs. 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 ensure a minimum of three-fourths 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 and not spread to the next unit (exhibit 3).

Exhibit 3

Gypsum Shaftliner Assembly Drawing



Design details for a gypsum shaftliner assembly include aluminum breakaway clips that melt when exposed to high temperatures during a fire, allowing the affected wood-framed wall of the townhome to collapse and not spread to the next unit.
Source: Newport Partners

Gypsum manufacturers fire-test assemblies with accredited laboratories to achieve fire-rated ASW designs. Several testing agencies provide third-party certification that a gypsum shaftliner assembly meets regulatory and market requirements. The fire-rated assemblies tested by Underwriters Laboratories (UL), for example, are numbered, and those numbers are associated with a proprietary assembly tested by a specific gypsum manufacturer. Proprietary shaftliner assemblies include United States Gypsum (U336), National Gypsum (U347), CertainTeed Gypsum (U366), Georgia-Pacific Gypsum (U373), and American Gypsum (375).

The core issue is that it is necessary to thoroughly air seal the entire building envelope to meet the IECC's ACH50 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.

A significant amount of air leakage in a townhome occurs where the ASW meets the exterior walls, the ceiling to attic, the rim joist, penetrations, stairs, stairwells, and stairs connected to the garage. Generally, a lot of little gaps can add up to the issues seen with ASWs. To cost-effectively air seal around the ASW without going beyond what is explicitly permitted in the listed assembly, builders air seal ASWs with a wide variety of methods and materials to meet the energy code. Methods and materials applied in the field include picture framing the perimeter with spray foam, using fire-blocking sealant at all seams, adding strips of drywall to create blocking at air leakage points, using gaskets to close gaps between the ASW and framing, or variations and combinations of these methods. A possible implication of these efforts is an effect on the fire performance of a separation wall that has been modified for the purpose of air sealing. For example, in the case of a shaftliner assembly, the aluminum breakaway clips may be covered with an air-sealing material like spray polyurethane foam, and the air space called for in the rated assembly may be partly or fully filled with air-sealing materials that could theoretically affect the melting of the clips that break off in the event of a fire and prevent one dwelling's fire-damaged framing from pulling down the separation wall.

Lost Energy Savings and Inconsistent Code Enforcement

The enforcement of the 3 ACH50 specification can vary from one jurisdiction to the next and even from one code enforcement officer to the next. Anecdotes exist of blower door results close to 3 ACH50 being good enough at times. In other cases, code enforcement officers are more concerned with the fire code and may not pay close attention to blower door test results. Potential outcomes include homes with higher air leakage rates with permanent, built-in energy losses and higher energy costs. The higher air leakage can present performance issues such as indoor air quality problems as well. The authors estimate that a well air-sealed separation wall assembly, compared with the typical leakage levels seen in the field from noncomplying sites, results in energy savings of more than $1,000 during 7 years in a moderate climate with significant heating and cooling.

Guarded blower door tests can be done on attached dwellings, in which multiple blower door systems pressurize the adjacent units so that the measured air leakage in the test dwelling is only flowing outdoors (and not to adjacent dwellings). However, even guarded blower door testing of this type has shown substantial leakage to the outdoors from the perimeter joints of typical ASWs. In fact, a 2015 DOE report concluded, "Even with the nominal elimination of unit-to-unit leakage [through guarded blower door testing], none of the [townhome] units reached the 3 ACH50 target. The end units were closest at 3.4–3.5 ACH50. The middle units reached 4.2–4.5 ACH50" (Ueno and Lstiburek, 2015). Guarded blower door tests are expensive and impractical, because work on all units within a building must stop to prepare and run the tests (exhibit 4).

Exhibit 4

Guarded Blower Door Tests with Pressurization Fan in Each Townhome Doorway

Guarded blower door testing, with a blower door on the doorway of each townhome, is expensive and impractical, because construction on the entire building must be temporarily halted. Photo credit: Newport Partners.

Construction Delays and Cost Impacts

The IECC's mandatory air leakage limit of 3 ACH50 is assessed based on a pass-or-fail diagnostic test that occurs at the end of construction. At this point in the construction cycle, the ability to improve the air-sealing of the building shell is severely limited, because most of the air leakage points are concealed. If a blower door test reveals a result of 4.5 ACH50, for example, a townhome will fail, the dwelling will not pass its final energy code inspection, and a certificate of occupancy cannot be granted. Builders, their contractors, and energy raters often attempt to air-seal anything that might reduce the air leakage through the shell, such as attic hatches or the dampers on bath exhaust fans. Retesting occurs, and gradually the ACH50 value may decrease to reach 3 ACH50. This arduous process consumes days in some cases, causing missed milestones with buyers, contractual problems, and ultimately costing builders hundreds or thousands of dollars. These challenges also put code enforcement officers under pressure to approve noncompliant buildings.

Area Separation Wall Field Evaluation

In 2019, Newport Partners convened an advisory committee comprising industry experts in construction innovations, codes, fire safety, and energy efficiency to provide guidance and input into the research design. Newport Partners worked with Thrive Home Builders and BUILDTank to conduct an ASW field evaluation in two buildings with a total 11 townhome units in Wheat Ridge, Colorado (exhibit 5). Wheat Ridge, a home rule municipality in Jefferson County, follows the 2018 I-codes and IECC (Colorado Energy Office, 2021). Wheat Ridge is a cold climate (IECC climate zone 5).

Exhibit 5

WestRidge Townhomes, Wheat Ridge, Colorado

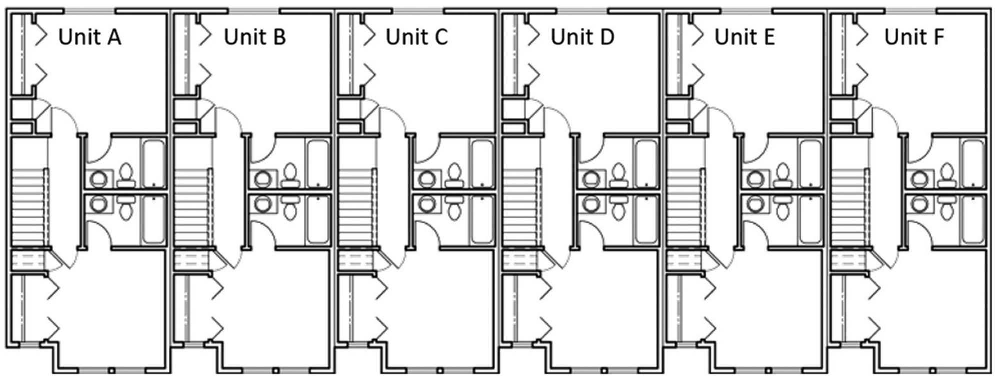
WestRidge Townhomes by Thrive Home Builders in Wheat Ridge, Colorado, where the field evaluation took place. Photo credit: BUILDTank.

Thrive Home Builders uses gypsum shaftliner assemblies, a commonly used ASW described previously in this article. To meet energy code requirements, this assembly requires air sealing contractors to manually caulk and spray foam at points of air leakage that need additional labor, and the blower door test results may vary. The lack of predictability and increased labor costs impact affordability.

The field study evaluated two gypsum shaftliner assembly options for ASWs. The first option, building one, with six townhome units described as A through F, incorporated the builder's typical ASW approach with the addition of an innovative aerosolized sealant (exhibit 6). The comparative option, building two, with five townhome units described as A through E, incorporated an alternative blocking method plus the innovative aerosolized sealant (exhibit 7). The study evaluated which method resulted in more cost-effective, easier to construct ASWs, with consistent blower door test results.

Exhibit 6

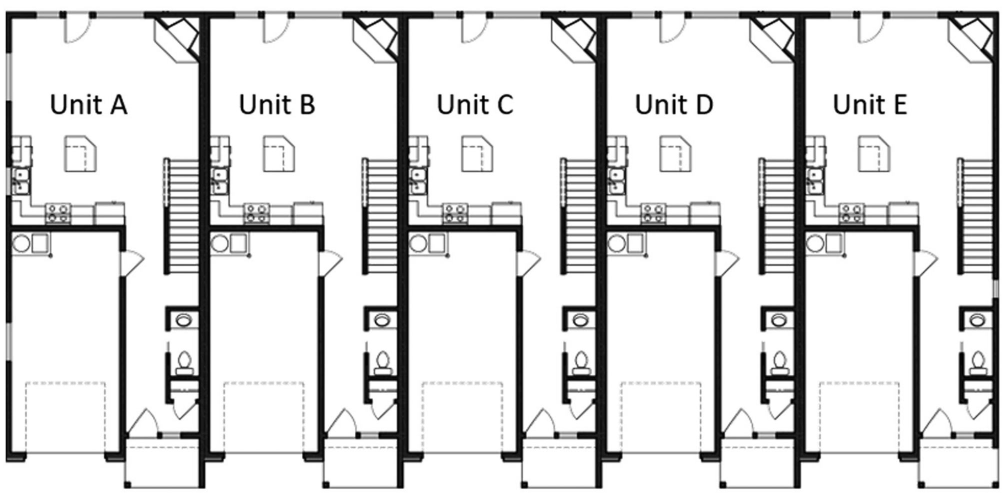
Building One Layout



Source: BUILDTank

Exhibit 7

Building Two Layout



Source: BUILDTank

Air Sealing Innovation

The air sealing contractor prepared each townhome and applied the aerosolized sealant to achieve a specified air leakage rate. AeroBarrier, an aerosolized acrylic sealant, was pumped into the compartmentalized townhome unit after drywall installation to seal all openings less than one-half of an inch. Applying the aerosolized sealant took 3 to 5 hours per unit.

The process for applying AeroBarrier is as follows.

1. Prepare the house after drywall by temporarily covering all openings that are not meant to be air sealed (for example, bathroom fan grille, joint between window sashes, and so on), allowing the aerosolized sealant to air seal all openings less than one-half of an inch (exhibit 8).

2. Set up nozzles throughout the house.

3. Enter a specific energy performance goal into the computer control system and pressurize and seal with a modified blower door. The aerosol sealant accumulates in holes that leak air from the building and ultimately closes those holes. This process takes 1 to 2 hours.

4. Monitor the progress of the sealing on the computer.

5. Clean up and resume construction within 30 minutes, which is significantly less time than it takes for caulking to dry.

Exhibit 8

Preparation for AeroBarrier Aerosolized Sealant Application

Temporary covering is placed over windows and ventilation fan. The plastic film does not cover the perimeter of the openings, allowing the product to seal those leakage points. The blower door is put in place and aerosolized sealant is applied, and the process is monitored on a computer. Photo credit: BUILDTank.

Test Results

The typical air leakage in townhomes prior to applying AeroBarrier ranged from 4 to 7 ACH50. As part of the AeroBarrier installation process, temporary coverings were added by taping off joints, such as window sashes where the accumulation of the aerosolized sealant was not intended. The result was additional temporary air sealing of the building shell down to an average of 1.7 ACH50. Exhibits 9 and 10 show these data in the rows labeled "blower door after AeroBarrier." For this reason, air sealing is often conducted to an ACH50 rate less than what is necessary, because an increase in the blower door test value will present once the temporary coverings are removed, as can be seen in the leakage values shown in the exhibits the rows labeled "final code blower door."

Exhibit 9

Building One Blower Door Test Results

BUILDING 1 Dwelling Unit	A	B	C	D	E	F
Blower Door Pre-AeroBarrier (some air sealing performed)	4.96 ACH50	5.97 ACH50	6.23 ACH50	4.81 ACH50	6.44 ACH50	3.76 ACH50
Blower Door After AeroBarrier (temporary air sealing)	1.64 ACH50	1.50 ACH50	1.88 ACH50	1.53 ACH50	1.67 ACH50	1.60 ACH50
Final Code Blower Door	2.19 ACH50	2.39 ACH50	2.75 ACH50	2.05 ACH50	2.34 ACH50	2.02 ACH50

ACH50 = air changes per hour at 50 pascals pressure.

Exhibit 10

Building 2 Blower Door Test Results

BUILDING 2 Dwelling Unit	A	B	C	D	E
Blower Door Pre-AeroBarrier (some air sealing performed)	4.63 ACH50	7.24 ACH50	6.43 ACH50	6.62 ACH50	5.10 ACH50
Blower Door After AeroBarrier (temporary air sealing)	1.83 ACH50	1.80 ACH50	1.90 ACH50	1.70 ACH50	1.59 ACH50
Final Code Blower Door	2.88 ACH50	3.00 ACH50	2.54 ACH50	2.64 ACH50	2.31 ACH50

ACH50 = air changes per hour at 50 pascals pressure.

After AeroBarrier was applied, all townhome units met the code requirements with final blower door tests between 2 and 3 ACH50. They could go lower, but it would cost more. This project was bid to ensure that the builder could reliably meet the 3 ACH50 energy code requirement, and this objective was achieved.

Applying AeroBarrier aerosolized sealant successfully minimizes worries about how well previous contractors sealed air gaps. It also reduces the need to caulk at electrical boxes, because the

AeroBarrier fills small gaps. Scheduling the trades remains important, because the builder needs to schedule two units per visit to avoid additional AeroBarrier fees. AeroBarrier serves as an example of a successful innovation, because its application provides consistently low air leakage rates and enables the builder to confidently meet energy code requirements.

Regulatory Barriers

After careful analysis of the 2012, 2015, 2018, and 2021 IRC, IBC, and IECC, Newport Partners identified regulatory barriers and developed strategies to create clearer paths to constructing and approving ASWs that satisfy both the fire protection requirements in the residential building code and air tightness provisions in the energy code.

Building Envelope Air Tightness Flexibility

The 2021 IECC allows for greater flexibility in compliance with the building envelope air-tightness testing requirements. For states and jurisdictions already using I-codes, adopting the 2021 IECC for its air tightness tradeoffs may provide the clearest solution, although this version of the IECC requires a higher overall efficiency level compared with prior IECC versions.

Although the visual inspection of air sealing details is still required, the 2021 IECC changed the air tightness test target to 5 ACH50 for all climate zones for buildings using one of two performance path options: Total Building Performance Option–R405 or Energy Rating Index Option–R406. A townhome builder who can consistently reach a 4 ACH50, for example, can adjust their design to make up for the energy that a leakier structure loses by adding efficiency elsewhere. In section R405, the most likely way builders can achieve equivalent energy performance is to add building envelope insulation or better windows. Section R406 uses an Energy Rating Index, defined by Residential Energy Services Network and ICC, as the energy target for the proposed building. This path offers significant flexibility beyond section R405. Heating, cooling, water heating, ventilation, lighting, and other building efficiency measures are all accounted for using the Energy Rating Index. Again, the townhome builder who can consistently reach 4 ACH50, or even 5 ACH50, can use higher efficiency mechanical equipment and achieve the required Energy Rating Index.

This approach offers added flexibility for townhome builders in IECC climate zones 3 through 8 who can achieve 5 ACH50 or lower using allowable and repeatable air sealing strategies. Many builders already use R405 for compliance and hire an energy rater to model their homes as part of this compliance strategy.

Compartmentalization

The 2021 IECC also allows for the use of a compartmentalization test to evaluate the air leakage of dwellings. It allows for a leakage level of 0.30 cubic feet per minute (CFM) per square foot of enclosure area or lower when testing attached single-family or multifamily dwelling units. CFM50 is the amount of air flow through leakage at gaps, joints, and so on, when the dwelling is being pressurized by a fan to a level of 50 pascals (a unit of pressure). The 0.30 CFM50 upper limit is also allowed for any building or dwelling unit smaller than 1,500 square feet. This alternative to the ACH50 measurement is easier to reach and requires less air sealing compared with the ACH50 target. The air changes per hour metric normalizes air leakage based on the dwelling's volume. The compartmentalization metric normalizes leakage based on the surface area of the enclosed space, which includes all six sides of the dwelling and the ASW (on one or both sides). This flexibility may be enough to allow a home that could not pass by volume to pass using the new test.

Add Air Tightness Tradeoffs

When adopting a previous version of the IECC, municipalities can consider amending it to add language from the 2021 IECC to add air leakage flexibility. Maryland serves as a model for providing flexibility by meeting a whole house target for the same overall energy savings. 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 includes the 3 ACH50 requirement in the prescriptive path, with an air tightness target of 5 ACH50 or lower for a performance path. This requirement allows for builders using either section R405 or R406 for compliance to have a building air tightness level as high as 5 ACH50 if they add greater efficiency in other areas to offset the higher leakage rate.

Redefine the Area

During its adoption of the 2018 IRC, Denver, Colorado amended section 302.2.2 to redefine the area covered by the common wall for townhomes. In the IRC, the common wall is required to extend to the exterior sheathing of the exterior wall. However, 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 change allows for adding air sealing measures at the intersection of the common wall and the exterior wall. Using air-sealing materials not included in the rated assembly at this point will not be an issue, because it is no longer part of the common wall (City of Denver, 2020).

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 for the common wall to extend to the interior of the exterior wall if the framed cavity is filled with nominal 2-inch wood studs.

Amending the 2018 IRC, or previous editions using the Denver exception or the 2021 IRC, allows air sealing at a common point of air leakage between townhomes. This minor code amendment does not require additional testing. This solution allows for some air sealing without any effect on the common wall fire rating. The intersection of the common wall and the exterior wall is a point of significant air leakage, but 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.

Amend the Code with Additional Materials

The primary regulatory barrier is that air-sealing materials are not detailed or included during the required American Society for Testing and Materials (ASTM) E119 or UL 263 testing of the assembly. Therefore, adding any air sealing material to pass the building envelope air tightness test, especially for interior townhome units, has the potential to invalidate the assembly. 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.

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 ASTM and UL tests. Testing is expensive and time consuming, and with nonproprietary assemblies, no organization may be available to pay for that testing. 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. 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.

Additional Testing of Individual UL Assemblies with Specific Sealants

A recent industry effort led to updating UL assemblies that now call out the use of specific sealants. 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. These sealants are optional but are allowed in the three-fourths of an inch perimeter gap and in the shaftliner. 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 commonly used gypsum shaftliner ASW assemblies.

Recommendations

This article outlines a field evaluation of an innovation to improve air sealing of a gypsum shaftliner ASW and explores regulatory solutions for industrywide effect. The best regulatory solutions are enacted at a level that will be broadly accepted, such as at the ICC level. Any jurisdiction adopting the 2021 ICC codes will automatically have access to the flexibility in air tightness requirements described in that code. For many jurisdictions, adopting the newest codes may take time, so adopting amendments to the code may be a more viable option. Including approved air-sealing materials in assemblies is another solution that is now available for several listed ASWs. For production builders working in multiple jurisdictions with different codes, adopting an innovative field solution may be the quickest strategy for maintaining townhome affordability.

Broad-scale solutions to support innovation and maintain housing affordability include creating an interagency collaborative—for example, HUD, DOE, and the U.S. Environmental Protection Agency—to sponsor a building science-based code review every 3 years and screen for potential issues, particularly for attached and multifamily homes. Such collaboration could identify and proactively address disconnects between evolving codes that affect constructability, building performance, or code enforceability. Groups like National Fire Protection Agency, American Wood Council, Air Conditioning Contractors of America, NAHB, and others could participate in the discussion. Another recommendation is to monitor hotlines and chat rooms for early identification of field issues. Federal and state governments should continue to train stakeholder groups on basic building science and the most recently adopted codes, as well as conduct field evaluations to test and support the adoption of innovations that reduce complexity and fragmentation and make housing more affordable

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