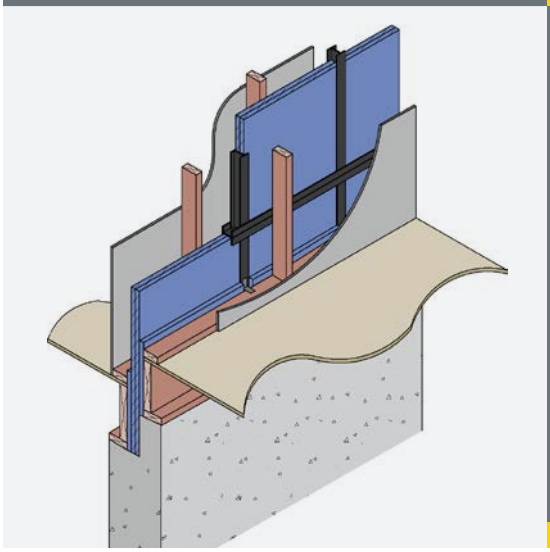

Building America Case Study

Field Testing of Compartmentalization Methods for Multifamily Construction

PROJECT INFORMATION

Construction: New construction

Partners:

Builder: K. Hovnanian Homes, *khov.com*

Building Science Corporation, *buildingscience.com*

Size: 1700–2000 ft^2 townhouses

Climate Zone: Mixed-humid (4A)

Building AMERICA U.S. Department of Energy SM

Several code and program requirements are driving the need for easier and more effective methods of compartmentalization that also meet code fire safety requirements. For example, the 2012 International Energy Conservation Code (IECC) requires airtightness of 3 ACH50 test pressure for single-family and multifamily construction in climate zones 3–8. Leadership in Energy & Environmental Design (LEED) has a similar compartmentalization requirement, as does ASHRAE Standard 189. ASHRAE Standard 62.2, which has an exceptionally stringent compartmentalization requirement, will soon be responsible for all low-rise and high-rise multifamily ventilation requirements.

Fire-resistance rated (or area separation) wall assemblies present a great difficulty in air sealing/compartmentalization, particularly in townhouse construction. To address this challenge, the U.S. Department of Energy Building America team, Building Science Corporation (BSC), partnered with builder K. Hovnanian Homes to determine whether taping exterior sheathing details improves air sealing in townhouse and multifamily construction, and to better understand air leakage pathways.

The team tested a building composed of five vertical townhomes, which were three-story, slab-on-grade units (1700–2000 ft^2). Each has a rear-facing "tuck under" garage. The walls between units are area separation walls (Underwriters Laboratories U347), with a 2-hour fire resistance rating. This assembly has a 1-in. vertical air cavity on each side, which results in an airflow network that is connected over multiple floors (despite nominal draftstopping), and has potential connections to the outside.

The townhomes were built with several experimental airtightness details, including taping of exterior sheathing as an air barrier closure detail (including at area separation walls), that were compared with a "control" conventional construction unit. Airtightness testing included "unguarded" testing, or total leakage of each unit (to the exterior and to adjacent units), and "guarded" testing, which nominally measured only leakage to the exterior (adjacent units run at equal test pressure in an attempt to eliminate interunit air leakage).

Garage Mechanical Room

Mechanical rooms are located in the rear-facing garage and house the furnace and water heater. This detail appeared to be the source of substantial air leakage. Blower door testing of these rooms' pressure revealed that they were consistently 40% to the exterior/60% interior. The team also ran a "guarded" test, simultaneously depressurizing the mechanical room and the unit. The results indicated that roughly 20% of the unit's total leakage originates at the mechanical room.

Each mechanical room is well connected to the interior (via a supply duct), and to the floor/ceiling cavity above (because of unsealed mechanical penetrations). The floor/ceiling cavity above connects across all framing bays of the garage ceiling, because of a dropped duct soffit. The mechanical penetrations are difficult to address, given the congestion and limited access for air sealing the ceiling and wall details.

Interior mechanical rooms or nonducted mechanical systems are possible options to address these air leakage issues.

For more information, see the Building America report, *Field Testing of Compartmentalization Methods for Multifamily Construction,* at: *buildingamerica.gov*.

Image credit: All images were created by the BSC team.

Front elevation, set up for multifan "guarded" testing.

In both the unguarded and guarded testing, no units met the 3 ACH50 target of the 2012 IECC. For reference, typical results for this builder were 4.8 ACH50 at this development, and 3.2 ACH50 at a development that had used a spray latex sealant (both unguarded tests). However, these units either achieved or were close to the normalized 0.30 CFM 50/ft^2 enclosure standard used by programs such as LEED midrise and ENERGY STAR® multifamily.

Middle units exhibited worse air leakage than end units; guarded testing showed greater reductions for middle units than end units, which is consistent with one versus two area separation walls. However, the fact that the units do not meet the requirements in the guarded test indicates that the issues are not isolated to area separation walls. The results show no improvement associated with taping of the exterior sheathing; in fact, some cases were slightly worse. Unfortunately, the experiment was hampered by other variables, such as unplanned additional air sealing in some units, and missing or incompletely executed air barrier details in others.

Interstitial pressure measurements indicated that many sections of the area separation wall are inadvertently connected to either the exterior or to other units, at areas such as garage ceilings, wall jogs, and attics. This was due to incorrect or missing details, and poor performance of existing details. Air leakage issues were found at the garages (50% interior/50% exterior) and mechanical rooms.

Further work needs to be conducted to develop airtightness details for area separation walls (or similar fire-resistance rated assemblies). Ideally, these details would be executed more consistently than current detailing, be easier to inspect, and would integrate with current construction practices and sequencing. Clear guidance to code officials on accepted air sealing materials in area separation walls would simplify the practice of providing airtightness at these troublesome details.

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