Fixing Air Leakage in Connecticut Town Houses

After energy improvements were made to some town houses, a second look revealed big opportunities for energy and money savings.

by Courtney Moriarta

Skyrocketing energy costs are driving the owners of many residential buildings to dig deeper than ever for energy-saving opportunities. Even in buildings that have undergone energy-related improvements in the past, it is possible to find previously missed opportunities—as was the case with one building located in rural Connecticut. Thanks to an owner/manager who agreed to cut access openings in a series of invasive inspections, and to funding provided by the gas and electric utilities, Steven Winter Associates, Incorporated (SWA), succeeded in finding and fixing an envelope problem that had previously gone undiscovered.

Mill Pond Village is a 360-unit affordable housing development built in 1975 and located in Broad Brook, Connecticut. Owned and managed by Winn Companies, this property has undergone many improvements over the past few years, but energy costs continue to concern the company. Winn Companies is committed to providing high-quality housing for its low-income tenants. By purchasing properties in decline and investing in a wide range of improvements, Winn is able to bring new life to properties that would otherwise languish in neglect. In 2000, when Winn acquired this property, the buildings were in disrepair and crime was a serious problem. Winn's initial investments went to cleaning up the property, building a new community building, and making cosmetic improvements to the interior and exterior of the units. In April 2007, on the heels of gas and electric rate increases of as much as 40%, Winn engaged SWA to evaluate the site for additional energy-related improvements.

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A blower door was set up in this typical townhouse unit. Testing indicated substancial leakage under the porch roof.

There is not much space to access the existing attic.

Workers open the porch roof for inspection.

The porch roof connection has a gap in the wall sheathing.

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Uncovering Serious Infiltration

Although many energy conservation measures had already been completed, including photo-luminescent exit signs, new windows, and cellulose insulation in the attic spaces, SWA's diagnostic team uncovered a previously overlooked air infiltration path in the 121 town house units.

Blower door tests were conducted on a sample of these units. They were found to have an average air leakage rate of 1,700 CFM_{50}. Based on the size of the units, the target CFM_{50} for these apartments without adding mechanical ventilation is approximately 1,000. An air leakage rate of 1,700 CFM_{50} is enough to justify efforts to tighten the building envelope to reduce uncontrolled infiltration and exfiltration.

Normally in a town house, air-sealing efforts would focus first on sealing penetrations through the top-floor ceiling from the attic. At Mill Pond, there are no attic access panels, so an alternative means of getting into the attics was required. At first, the SWA team attempted to enter the attics through the gable end vents. This proved impossible, because it turned out that the vent openings were blocked with framing members. The owner/manager then agreed to cut an access through the ceiling of a closet in an unoccupied unit. The attic space was very tight, with approximately 20 inches of clearance between the top of the ceiling joists and the bottom of the roof rafters. Additional cellulose insulation had been blown over the original insulation, making it more difficult to move through the attics. The observable air leakage paths in the attic were minimal. The top plates were already covered in a manner similar to that used in modular construction. There was a gap of approximately 2–3 inches around the plumbing vent stack that could be sealed, but SWA determined that to access the gap for sealing would be more trouble than it was worth. At this point, it looked as if not much air sealing could be done in the town house attics.

As part of the diagnostic testing, an infrared scan was conducted to verify the existence and proper performance of insulation in the ceilings and walls. With the blower door running, a second infrared scan allows the diagnostician to locate air leakage paths through the building envelope (see "Infrared Thermography: (Nearly) A Daily Tool," *HE* Mar/Apr '08, p. 31). Some typical air leakage paths were noted, including air movement around plumbing pipe chases. However, our team was surprised to find a large leakage path in the exterior wall under the hallway window on the second floor (see photos, p. 30). The blue area in the infrared photograph shows where cold air is being drawn into the building and up the wall cavity through an opening near the baseboard. To determine

Hundreds of pieces of insulation are cut for air sealing.

The sheathing is being sealed with rigid insulation and spray foam.

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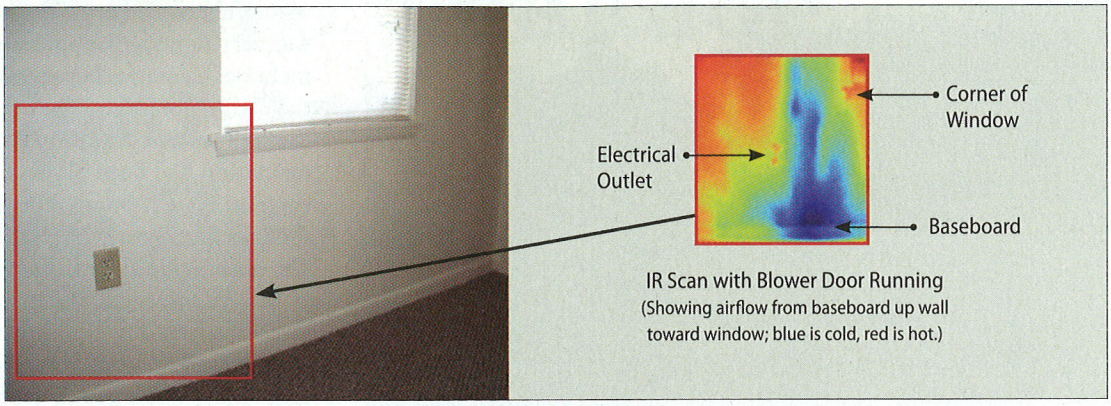
The finished product—the gap in the sheathing after sealing.



A leakage path was discovered *(above)* in the interior wall *(left)*.

the actual source of this air infiltration, additional inspections from the exterior were required.

The main entrance to the town house unit has a small porch roof above it. This porch roof is located directly below the hallway window seen in the infrared photo. When the perforated-vinyl soffit panel was removed to access the area above this porch roof, it was found that entire sections of sheathing, some as large as 3–4 square feet, were missing, leaving the fiberglass insulation in the walls directly exposed to outside air (see photos, p. 28). As the photos show, the insulation in these areas is discolored with dirt from years of air passing through it. This windwashing reduces the effective R-value of the insulation in the wall in addition to being a source of air leakage.

The back of each townhouse unit was designed with a one-story bump-out roof to accommodate the kitchens. Given the gaps that were found in the sheathing above the porch roofs, we suspected that a similar condition might exist above these bumpout roofs as well. The presence of cabinets along the exterior wall makes it difficult to get a good indication of thermal deficiencies in this roof space using the infrared camera, so we made an access to allow for a visual inspection. Pressure diagnostics were also conducted in this space to determine how well connected it was to the living space, and where the current air barrier was located. By conducting pressure differential tests with the roof open and closed, we found that the roof itself was acting as the air barrier. We found no gaps in the exterior wall sheathing in the back of the building As a result of this inspection and diagnostic testing, we determined that no additional treatment was needed in this area.

The Fix

SWA worked with Winn and the local electric utility, Connecticut Light and Power (CL&P), to secure funding to repair these buildings through Connecticut Energy Efficiency Fund programs. Yankee Gas Company provided additional funding for the repair project.

To seal the leaks, each porch roof had to be opened up for access. A carpenter was hired to make temporary openings, and to close them up after the air sealing crew had done its work. The crew used rigid foam insulation and expandable foam sealant to seal each area. Blower door test results indicate that this work alone reduced envelope leakage by over 200 CFM_{50} per unit. In addition, this work will protect the existing fiberglass wall insulation from windwashing, so it will now perform at its rated R-value.

In addition to sealing the envelope, SWA crews installed CFLs and domestic hot water-saving devices in each unit. Over 4,000 CFLs were installed in the apartments alone. CL&P is also working with Winn to provide energy-saving lighting for the community building and the other common areas.

The individual unit savings for the air sealing completed on this site is relatively small—perhaps $200 a year in heating costs. But the air sealing only cost $267 per unit. The cumulative savings for the management company is over $24,000, or about 7% of current heating costs. For a site that had already undergone major energy improvements, this savings is significant. It is also highly cost-effective. Assuming a 20-year lifetime, the savings-to-investment ratio (SIR) for the air sealing alone is approximately 15. In other words, this measure will pay for itself in savings in less than 2 years.

While this is not a typical story of air sealing, it is a story of finding opportunities to save energy that might previously have been missed. It is a story of how being tenacious in your diagnostics can lead you to places you might not expect. And it is a story of how a little bit of teamwork can lead to significant savings.

Residents at Mill Pond Village can expect to enjoy warmer, more comfortable living conditions in the future, and Winn can expect its operating costs to be reduced as a result of this work. HE

Courtney Moriarta is a senior engineer with Steven Winter Associates, Incorporated. She has been fixing residential buildings of all shapes and sizes since 1993.

For more information:

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