



Building America Case Study

Project Overcoat: Airtightness Strategies and Impacts for 1½-Story Homes

Minneapolis, Minnesota

PROJECT INFORMATION

Project Name: Project Overcoat: A Focus on Cost-Effective Options for Roof Applications

Location: Minneapolis, MN

Partners:

Cocoon, cocoon-solutions.com

NorthernSTAR Building America Partnership, environment.umn.edu/forms/project_view.php?id=273

Building Components: Building envelope, roof/attic air seal, and insulation

Application: Retrofit, single-family

Year Tested: 2013

Climate Zones: Cold/Very Cold

AIRTIGHTNESS PERFORMANCE DATA

ETMMS St. Louis Park home percent reduction = 45%

ETMMS Edina home percent reduction = 20%

Market Homes average percent reduction = 18%

Weatherization Program homes percent reduction = 32%

Ice dams created by heat loss through the roof cause durability concerns about existing homes in cold climates. Especially vulnerable is the 1½-story Cape Cod with many challenges—finished interior walls, shallow rafter depths, thermal bridging, lack of raised heel energy truss, lack of roof deck ventilation, and lack of air barrier continuity—that prevent thorough insulation and air sealing from the interior.

The U.S. Department of Energy NorthernSTAR Building America Partnership team studied the effectiveness of the External Thermal Moisture Management System (ETMMS) as a solution for improving airtightness in a roof-only application (versus the whole-house application used in deep energy retrofits). An independent contractor provided airtightness data from two 1½-story homes that used the roof-only ETMMS process. The team analyzed and compared these data to ancillary data from market-rate utility and weatherization programs for more than 250 roof-only, interior-applied energy retrofits on 1½-story homes.

The air leakage (ACH 50) in the ETMMS retrofit where the roof planes and gable ends were air sealed according to protocol was reduced by nearly twice that of the ETMMS retrofit with limited access to the gable ends. Infrared imaging demonstrated the reduction in air leakage from the ETMMS protocol of continuous air barrier on the roof and gable ends and air sealing at the roof/wall connections.

The data from the ETMMS projects and ancillary retrofits showed that airtightness improvements (CFM 50) varied greatly in the field. The ancillary data showed that retrofits following a weatherization protocol reduced air leakage by almost double over the market-rate insulation retrofits.

In my experience, ETMMS provides a significantly greater opportunity than an interior approach to prevent heat loss and air leakage at the roof level, which is critical to mitigating ice dams. If we achieve a) 100% air leakage reduction at roof deck, b) continuous insulation without thermal bridging, and c) superior roof deck venting system, I can provide a guarantee to the homeowner there will be no ice dams from heat loss.

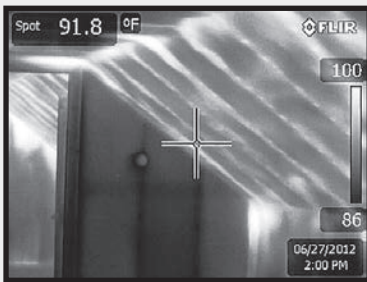
- Steve Schirber, President, Cocoon

Description

The following images, provided by Cocoon, illustrate a step in the roof-only ETMMS process.



Short (2-in × 4-in.) sleepers are placed over the insulation to create cross ventilation in valleys before the roof decking is added.



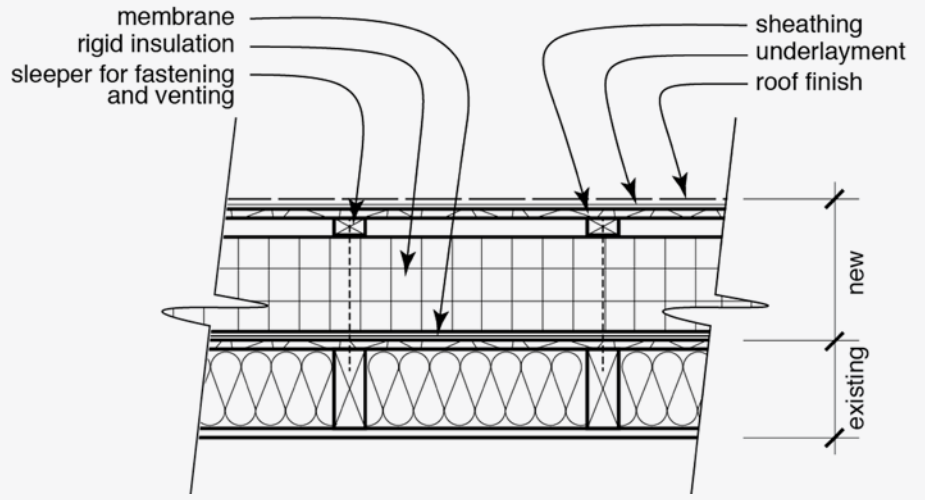
The light-colored areas of the infrared image taken before construction highlight air leakage and thermal bridging that can lead to heat loss, snow melt, and ice dam formation.



The infrared image taken after a roof-only ETMMS installation demonstrates the effectiveness of a continuous air barrier and insulation to reduce air leakage and thermal bridging at the roof level.

For more information, see the report, *Airtightness Results of Roof-Only Air Sealing Strategies on 1½-Story Homes in Cold Climates* at: buildingamerica.gov

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



In the ETMMS process, a continuous air/water barrier is applied to the existing roof decking. Insulation is then added over the air barrier with seams staggered to reduce air leakage. Sleepers are placed between the insulation and new roof decking to create an air space for venting. The gable ends are addressed in a similar manner.

Lessons Learned

- The ETMMS process, which does not disrupt the home's interior, can improve airtightness. It provides an opportunity to thoroughly air seal the roof deck and gable ends and to align the air barriers at the top plates and roof/wall connections. ETMMS appears to be most effective when the roof planes and gable ends are fully accessible.
- As a diagnostic tool, infrared thermal imaging provides a visual means to assess the effectiveness of air sealing strategies pre- and post- retrofit and to isolate areas that still need improving.
- An interior approach to air sealing may or may not improve airtightness. Data from the weatherization programs indicate that a repeatable protocol can enhance airtightness outcomes.
- The wide variation in air leakage reduction across the combined data indicates a continued need to help contractors understand best practices for air sealing 1½-story homes.

Looking Ahead

NorthernSTAR is currently completing a study on cost considerations for roof-only ETMMS to help building professionals and their clients weigh the financial impact against desired outcomes—namely ice dam mitigation. Alternate materials and processes that could help reduce costs will be explored.