



BUILDING AMERICA TOP INNOVATIONS HALL OF FAME PROFILE

INNOVATIONS CATEGORY:

1. Advanced Technologies and Practices
- 1.1 Building Science Solutions

Unvented, Conditioned Attics

The additional heat loss and gain of ducts in unconditioned, vented attics increases energy use for heating and cooling 10%. Additionally, duct air leakage has been measured to commonly exceed 20% of conditioned air flow, which results in a significant energy loss when ducts are in unconditioned space. In addition to influencing builders across the country to adopt unvented, conditioned attics, Building America research has helped influence code acceptance of this innovation since 2006.



BUILDING AMERICA TOP INNOVATIONS

Recognizing Top Innovations in Building Science – The U.S. Department of Energy's Building America program was started in 1995 to provide research and development to the residential new construction and remodeling industry. As a national center for world-class research, Building America funds integrated research in market-ready technology solutions through collaborative partnerships between building and remodeling industry leaders, nationally recognized building scientists, and the national laboratories. Building America Top Innovation Awards recognize those projects that have had a profound or transforming impact on the new and retrofit housing industries on the road to high-performance homes.

The preference for a large segment of the U.S. housing industry has been to locate HVAC systems in unconditioned attics, but this is highly inefficient. Building America research has demonstrated unvented, conditioned attics can substantially improve energy performance while allowing home builders to continue locating HVAC systems in the attic space.

Traditionally, building codes have required attic ventilation. The intended purpose was to allow warm air and moisture to escape. Vented attics can be effective, as long as HVAC ducts are not located in them and the ceiling deck is well air sealed and insulated. These are significant challenges. First, the housing industry has demonstrated a strong preference for locating HVAC systems in attic spaces above insulated ceilings to accommodate design and cost concerns. Second, typical roof slopes often leave inadequate height at the top plates for full-depth insulation. Third, there are extensive penetrations and cracks that require air sealing and air barriers including attic hatches, flues, piping, lighting, wiring, chases, attic eaves, dropped ceilings, and knee walls. Air leakage that is not addressed can lead to several problems. The loss of conditioned air increases heating and cooling demand. Humid indoor air that escapes into the attic can condense on cold roof sheathing, resulting in potential moisture problems. Warm air that escapes into the attic in winter can warm the roof deck and increase the risk of ice dams.

When the HVAC system is located in a vented attic, it is exposed to extremes of hot and cold. The energy needed for air conditioning and heating typically goes up 10% when ducts are in the attic (Ueno 2003). Furthermore, leaky ducts can lose as much as 20% of conditioned air flow to the attic (BSC 2009). Oversized heating and cooling units are often installed to make up for the inefficiency of leaky ducts, further increasing the purchase cost and energy bills. Leaky ducts can also contribute to condensation and mold.

“Unvented attics make a lot of sense. In humid climates, venting attics brings a great deal of moisture into the structure. In cold climates, venting attics brings in a great deal of snow. Not venting makes these problems go away.”

Joe Lstiburek,
Building Science Corporation

Insulating and air sealing along the roof line offers several advantages over insulating along the ceiling deck:

- **Energy Savings** - An unvented attic is warmer in winter and cooler in summer, reducing the HVAC load. The equipment will be more durable and more efficient, especially if ductwork is in the attic (Rudd 2005).
- **Moisture Resistance** - The attic will stay dry, avoiding problems with mold and wood rot, and thus can serve as living or storage space.
- **Disaster Resistance** - Roofs over unvented attics are less likely to be blown off in high winds because the wind cannot readily enter the attic. In addition, a house in wildfire zones is less likely to catch fire from floating embers since there are no soffit vents for the embers to enter. In coastal areas, an unvented roof keeps out wind-driven rain and better protects metal connectors in the roof assembly against salt spray and corrosion (Lstiburek 2006).

Unvented, conditioned attics and their advantages have been extensively documented with Building America field tests in numerous states including Minnesota, Massachusetts, and California (Rudd 2005). In the process, builders have worked with researchers to identify combinations of materials that perform well in all climate zones.

Key Lessons Learned

- The acceptance of unvented, conditioned attics continues to grow among builders and building officials. Code requirements vary across the country. The IRC has permitted unvented, conditioned attics since 2006, with certain requirements.
- The roof deck in an unvented attic must be exceptionally airtight.
- Insulation approaches for unvented attics vary by climate. Fibrous insulation (e.g., batt or blown-in) can be installed under the roof deck in the hot-dry climate zone, but this will cause moisture problems in all other climates (Straube and Grin 2010). Humid or cold climates require either rigid foam insulation above the roof deck (to keep its temperature above 45°F throughout the year) or spray foam insulation under the roof deck (to keep interior moist air from contacting it).
- Closed-cell spray foam can be used in any climate. It has the highest R-value of any insulation material, is a vapor retarder, and provides a tight air seal.
- In cold climates, installing enough rigid or spray foam insulation to reach the recommended R-value may be expensive. To reduce costs, foam can be supplemented with less expensive insulation materials. However, to ensure moisture control, care must be taken to use the climate-specific proportions of foam and non-foam insulation (Straube et al. 2010).
- All foam on the interior should be protected by a fire-rated material, such as ½-inch gypsum board.
- Vapor retarders on the floors of unvented attics are prohibited under the 2009 International Residential Code® (IRC).

“We were already testing and getting a tight duct system, but now it is all inside the building envelope, and in a hot, humid climate this makes a tremendous difference.”

John Friesenhahn,
Owner of Imagine Homes of San Antonio

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