BUILDING AMERICA TOP INNOVATIONS HALL OF FAME PROFILE

INNOVATIONS CATEGORY:

1. Advanced Technologies and Practices

1.1 Building Science Solutions: Thermal Enclosure

Ducts in Conditioned Space

A duct chase in a dropped hallway ceiling provides an affordable way to put ducts in conditioned space, a technique that saves energy and improves indoor air quality.

Moving ductwork into the home's conditioned space can save 8%-15% on homeowner air-conditioning bills. Thousands of homes are now applying this important best practice promoted by Building America research.

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.

Putting ducts in vented, unconditioned crawlspaces and attics makes almost no sense from a building science standpoint. Building America research has provided proven solutions for locating ducts in conditioned space that are being adopted by builders across the country.

Far too many homes are constructed with HVAC equipment and ductwork located in a vented crawlspace or a vented attic. Moving ducts inside the home's air and thermal boundaries will save energy and improve air quality. Building America research shows that installing ducts in conditioned space can significantly reduce energy loads and utility bills. In one study, moving ductwork into conditioned space in the hot-dry climate zone saved 8% to 15% on air-conditioning costs for homeowners.

Duct leakage in unconditioned spaces can be a cause of builder callbacks for comfort issues, moisture problems, and high energy bills. Indoor air quality can also be compromised since any air leaks will pull unconditioned replacement air into the living space from the attic, crawlspace, or basement. Even when ducts are tightly sealed, conduction losses can increase heating and cooling energy usage by 10% or more when ducts have to pass through the sometimes extreme temperature environments of vented attics and crawlspaces.

Building America researchers have worked with production builders across the country to develop three affordable approaches for moving HVAC equipment into conditioned space.

In a single-story home, ducts can be installed in a dropped ceiling or chase. In a multi-story home, ducts can be installed between floors in open-web floor joists. The air handler can be located in a utility closet inside the house or in an air-sealed closet in the garage. In any kind of home, the attic or crawlspace can be unvented, air sealed, and insulated at the perimeter, creating a conditioned or semi-conditioned space for the ducts and air handler.

In Moses Lake, Washington, Building America researchers worked with Habitat for Humanity in 2004 to design affordable homes with the ducts in a dropped hallway ceiling.

"It is easier for installers to do a quality job with ductwork when they are not lying in mud deep in a corner of the crawlspace where they know an inspector will not crawl around to inspect their work."

Wade Craig, Bob's Heating and Cooling

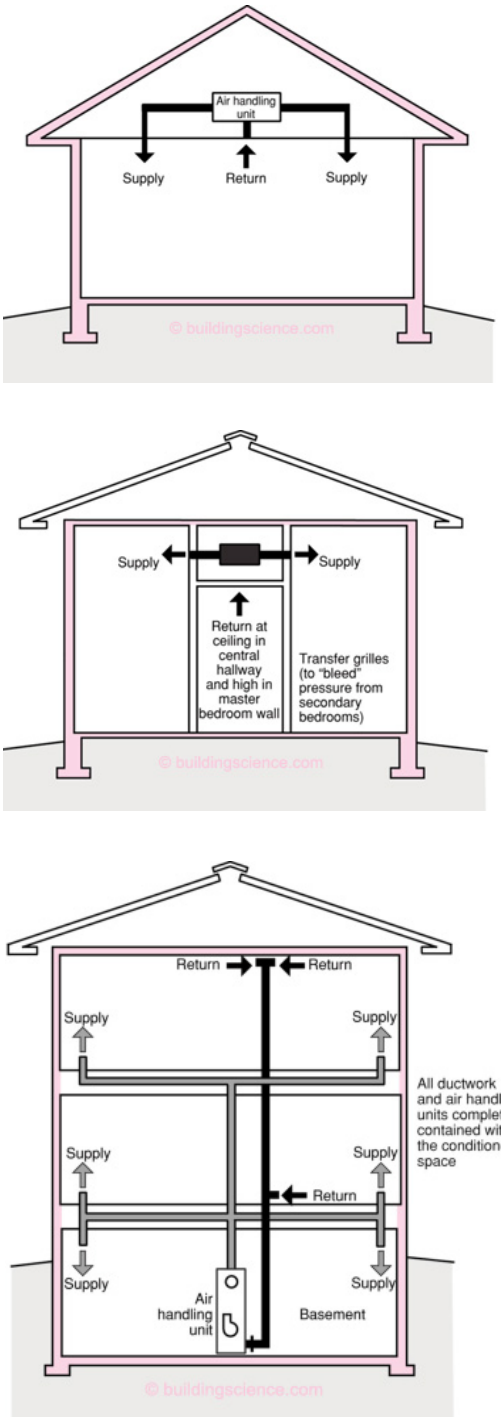
The cost of the materials and design revisions for the 1,000 ft² rambler was less than $500 (Lubliner et al. 2008). Building America researchers worked with Florida builders in 2009 to design and install interior duct systems in 2,250 ft² high-performance homes. The cost was about $0.40 per square foot of floor area (Fonorow et al. 2010).

In 2008, Imagine Homes of San Antonio, Texas, began building all its homes with sealed attics to house the ductwork. Imagine uses open-cell spray foam to air seal and insulate the attic at the roof deck, reducing attic temperatures by almost half (80°F instead of 140°F) and keeping air inside the ducts cooler. Sealing and insulating an attic with spray foam costs more than installing dropped duct chases. In a Florida study, Building America researchers estimated the cost at about $1.50 per ft² (Fonorow et al. 2010). However, the builder can avoid redesign costs with the attic or crawlspace approach.

Quadrant Homes, the largest production home builder in the Pacific Northwest, worked with Building America to redesign nearly all of its 300 house plans to install ducts in conditioned space as part of a package of 50% energy savings over code (Lubliner et al. 2008).

Key Lessons Learned

- The best opportunity to minimize costs is during the design phase.
- Even in conditioned space, ducts should be insulated to reduce the risk of condensation and mold. They should be tightly sealed and tested for leakage. In a dropped chase, metal ducts should carry the air, not an open chase.
- Strict attention should be paid to eliminating air leakage pathways in the space around the ducts.
- Electric and plumbing chases should be properly sealed and pressure-isolated from the HVAC chase.
- Adequate return-air pathways must be provided. In one-story homes, over-the-door transoms are an inexpensive approach.
- New research is exploring techniques for burying ducts in attic insulation in some climates with similar performance results to fully locating them in conditioned space.



Ducts can be located in conditioned space in A) an insulated attic, B) a dropped ceiling chase, or C) between floors.

Note: pink shading shows the home's thermal barrier enclosing the conditioned space.

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