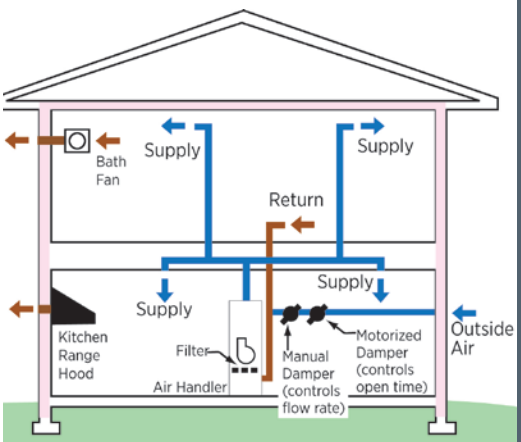

BUILDING AMERICA TOP INNOVATIONS HALL OF FAME PROFILE

INNOVATIONS CATEGORY:

1. Advanced Technologies and Practices
1.3 Assured Health, Safety, and Durability

Low-Cost Ventilation in Production Housing

Building America researchers developed simple, cost-effective techniques for providing fresh air throughout the home, including exhaust-only and central fan-integrated supply ventilation.

Building America has refined simple whole-house ventilation systems that cost less than $350 to install.

As high-performance homes get more air-tight and better insulated, attention to good indoor air quality becomes essential. Building America has effectively guided the nation's home builders to embrace whole-house ventilation by developing low-cost options that adapt well to their production processes.

When the U.S. Department of Energy's Building America research teams began working with builders to design more energy-efficient homes, two things became clear in regard to ventilation: 1) high-performance homes require mechanical ventilation to bring in fresh air and to exhaust stale air for removal of localized pollutants, and 2) cost-effective, reliable systems for mechanically introducing fresh air did not exist.

Some builders choose an exhaust fan as the only form of mechanical ventilation in the home. Building America research has shown this is the lowest-cost approach that can meet ASHRAE 62.2 ventilation requirements. The fan should be low-sone rated for quiet operation and rated for low power draw. Both of these attributes are assured with ENERGY STAR certified fans. The fan should be set for continuous operation or timer-controlled for consistent periodic operation, and it should be ducted to exhaust outdoors, not into the attic.

Researchers noted the following limitations of exhaust-only ventilation systems. They draw outdoor air into the building through cracks and leaks in the building enclosure. Outside air that comes through garages, attics, crawlspaces, or walls may be contaminated with soil gases, dust, insulation, and other particulates. If a house is very air tight, the exhaust fan may not be able to draw in as much air as it exhausts, thus the home can become depressurized. Any combustion appliances within the conditioned space should be sealed combustion to avoid back-drafting combustion gases.

An exhaust-only system is less likely to achieve whole-house distribution of ventilation air, especially for closed or distant rooms, since the air is pulled from one location in the home and replacement air will typically be drawn through envelope leaks closest to this location.

Central fan-integrated supply ventilation is a simple, cost-effective way to provide ventilation and fresh air in high-performance homes.

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.

To address these concerns, engineers at Building Science Corporation, a Building America research partner, invented and eventually commercialized a system that works with the home's central furnace air handler and duct system to introduce and distribute fresh air in the home.

The central fan-integrated supply system draws in fresh air from an outside vent to the return side of the air handler plenum using the air handler fan and distributes it throughout the house. Building America researchers configured electronic controllers with an automatic timer that operates the fan periodically during periods when the thermostat is not calling for heating or cooling to ensure adequate outside ventilation air.

While the fan could be set for continuous operation, that would consume more electricity than necessary and would oversupply outside air in warm, humid climates (Rudd 2011). A motorized damper on the outside air intake limits outside air intake during periods of constant central fan operation, such as mid-summer or mid-winter.

Fan energy consumption can be reduced by one-half or more by using a central fan that has an electronically commutated motor (ECM), rather than a permanent split capacitor (PSC) motor. However, proper duct design to manufacturer's specifications is critical to overcome airflow resistance at low speeds (Rudd 2011). The efficiency of the ventilation system can also be improved by using a properly designed duct system with right-sized, insulated, and air sealed ducts in a compact layout preferably located within the home's conditioned space.

Exhaust fans are still needed to provide spot ventilation in kitchens and bathrooms. When the exhaust fans are operated continuously or intermittently on a timer in conjunction with the central fan-integrated supply ventilation, they provide a "semi-balanced" ventilation that is a simple, cost-effective alternative to heat/energy recovery ventilators (HRVs /ERVs).

Key Lessons Learned

- In hot, humid climates, central fan-integrated supply creates slight positive pressures in the house, which helps reduce infiltration of unfiltered, humid outside air.
- The central fan-integrated supply can be balanced by exhaust fans set to periodic or continuous exhaust. This is especially important in cold climates where positive pressure can force heated air into building cavities, where it may cause moisture issues.
- The system also improves comfort and air quality by consistently mixing ventilation and conditioned air for more even temperatures and improved performance of dehumidification and air cleaning equipment.

(top) The outside air intake is located outside of the house, under a roof eave or in a porch ceiling, away from pollutant sources. The vent will be covered with a screen to prevent bird and insect entry.

(bottom) The fresh air intake duct of this sealed-combustion furnace is outfitted with a mechanical damper and electronic controller (metal band and box on white vertical duct to left). The furnace is located in an air-sealed closet in the garage.

REFERENCES

Rudd, A. 2011. *Local Exhaust and Whole House Ventilation Strategies*, prepared by Building Science Corporation for the U.S. Department of Energy. www.eeba.org/bookstore/prod-Ventilation_Guide-10.aspx

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