Air Leakage and Ventilation

Reduce Air Leakage, Build it Tight

Air infiltration often accounts for 30% or more of a home's heating and cooling costs, and contributes to problems with moisture, noise, dust, and the entry of pollutants, insects, and rodents. *Reducing air infiltration can significantly cut annual heating and cooling costs, improve building durability, and create a healthier indoor environment.* Building tight may decrease the required size of HVAC equipment, saving additional dollars.

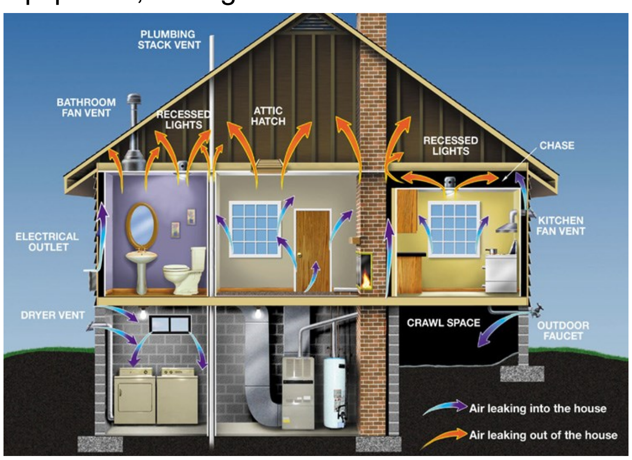

Fig. 1: Common building envelope air leakage sites
Source: EPA ENERGY STAR Program

Figure 1 diagrams some of the most common locations of air leaks. Creating a continuous air barrier around the conditioned portion of the home is necessary to reduce air leakage.

The more continuous the air barrier, the tighter the home. Air barriers keep outside air out and inside air in. Rigid materials such as gypsum board (drywall) and exterior sheathing materials like plywood are often effective air barrier systems, *if joints and seams are sealed*. Air barriers can be located anywhere in the building enclosure—at the exterior surface, the interior surface, or at any location in between. Wherever they are, air barriers should withstand construction abuse and remain durable over the expected building lifetime.

An air barrier is not necessarily a vapor barrier. A vapor barrier is a material that does not allow water vapor to pass through it. Breathability is the term used to refer to the ability of a material to allow water vapor to pass through it and is measured in perms. A material with a perm rating of less than 0.1 perms is considered a vapor barrier. OSB, plywood, most house wraps, and building paper can all act as air barriers, yet allow the passage of trapped water vapor that has entered the building enclosure system.

- The use of a vapor barrier should be avoided in ***mixed humid climates*** so that the wall assembly may dry to both the interior and exterior of the home.
- In ***hot humid climates***, no vapor barrier should be installed on the interior of the wall to allow for year round drying to the interior of the home.

Once construction is complete and most air sealing details are not visible, it is possible to test

AIR SEALING RESOURCES:

Air Sealing Overview (Building America)
www.nrel.gov/docs/fy00osti/26446.pdf

Air Sealing Guide (Southface)
www.habitat.org/env/pdf/air_sealing.pdf

Understanding Air Barriers (Building Science Corp.)
www.buildingscience.com/documents/digests/bsd-104-understanding-air-barriers

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the quality of the air barrier. This test uses an instrument known as a ***blower door*** (see ***Air Distribution Systems*** factsheet) and is performed by a Home Energy Rating System **(HERS) rater**. The result of this test assist sin predicting the energy efficiency of a home. A properly ventilated house cannot be too tight.

Ventilation

Designers and builders of energy efficient homes work hard to limit uncontrolled air infiltration through the walls, ceilings, and floors by creating a tight air barrier. The result of this is lower energy use and less fresh air finding its way into a home. The rate of natural infiltration is unpredictable and uncontrollable because it depends on pressure differences affected by the home's air tightness as well as outdoor temperatures, wind, and other factors. Natural infiltration can allow contaminated air to enter from a polluted area, such as a garage or crawlspace. The solution to these problems of natural ventilation is to install a **designed ventilation system** for providing fresh, clean air.

The most direct strategy is ***spot ventilation***, used to expel moisture or pollutant laden air at the source. This includes, at minimum, exhaust fans ducted to the outside and capable of adequate air movement in bathrooms and above kitchen cook tops. In a humid climate, spot ventilation should be a part of every ventilation system.

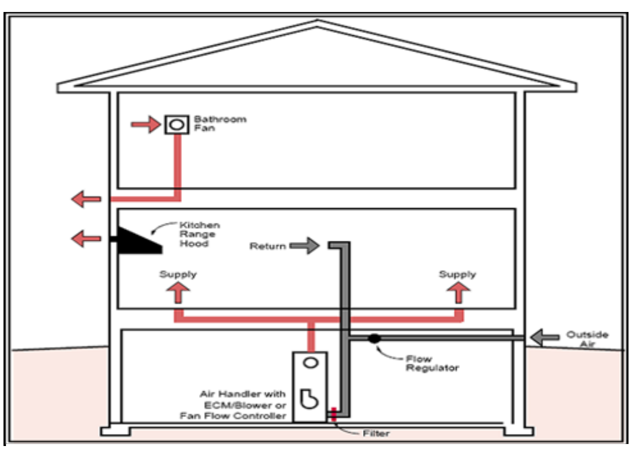

Fig. 2: Spot ventilation & HVAC integrated supply
Source: Asthma Regional Coordinating Council of New England

Whole-house ventilation strategy options are classified as:

- **supply ventilation** (fan(s) force outside air into the home)
- **exhaust ventilation** (fan(s) force inside air out)
- **balanced ventilation** (fan(s) force equal quantities of air in and out).

A common, recommended **supply ventilation** strategy uses the air handler of the HVAC system to provide a small amount of fresh air when the HVAC fan is operating. This strategy can be improved further with a fan **cycling** device that turns the air handler on using a time schedule to provide adequate ventilation even when no heating or cooling is needed. The energy to run the air handler fan in this manner has been shown to be small, less than $50 per year, depending primarily on the home's size. An example of supply ventilation coupled with spot ventilation appears in Figure 3.

Warm humid climates should avoid exhaust ventilation as their sole ventilation strategy. Why? As warm humid air from outside comes inside to replace the exhausted air, it contacts cool surfaces that can create condensation, thereby increasing the potential for mold growth and decay of the structure.

An option for creating a ***balanced ventilation strategy*** includes using an ***Energy Recovery Ventilator (ERV).*** ERVs are air-to-air heat and moisture exchangers that can reduce the energy needed to heat and cool the fresh air brought into the home via ventilation. ERVs, like other

VENTILATION RESOURCES:

Spot Ventilation (Building America)
www.nrel.gov/docs/fy03osti/26466.pdf

Whole House Ventilation Systems (Building America)
www.nrel.gov/docs/fy03osti/26458.pdf

Ventilation Activities in the Building America Program
www.nrel.gov/docs/fy01osti/30107.pdf