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Build Tight, Ventilate Right

"Build tight, ventilate right" is an often-repeated motto of those who consider energy efficiency and comfort as critical to the success of any building project.

"Build tight" refers to building a well-insulated, ***and airtight***, envelope (walls, roof, floor, etc.) to separate uncomfortable outdoor weather from comfortable interior air.

"Ventilate right" recognizes that human occupants need clean fresh air to breathe but refers to ***intentional controlled ventilation*** rather than relying on leaky construction and wind.

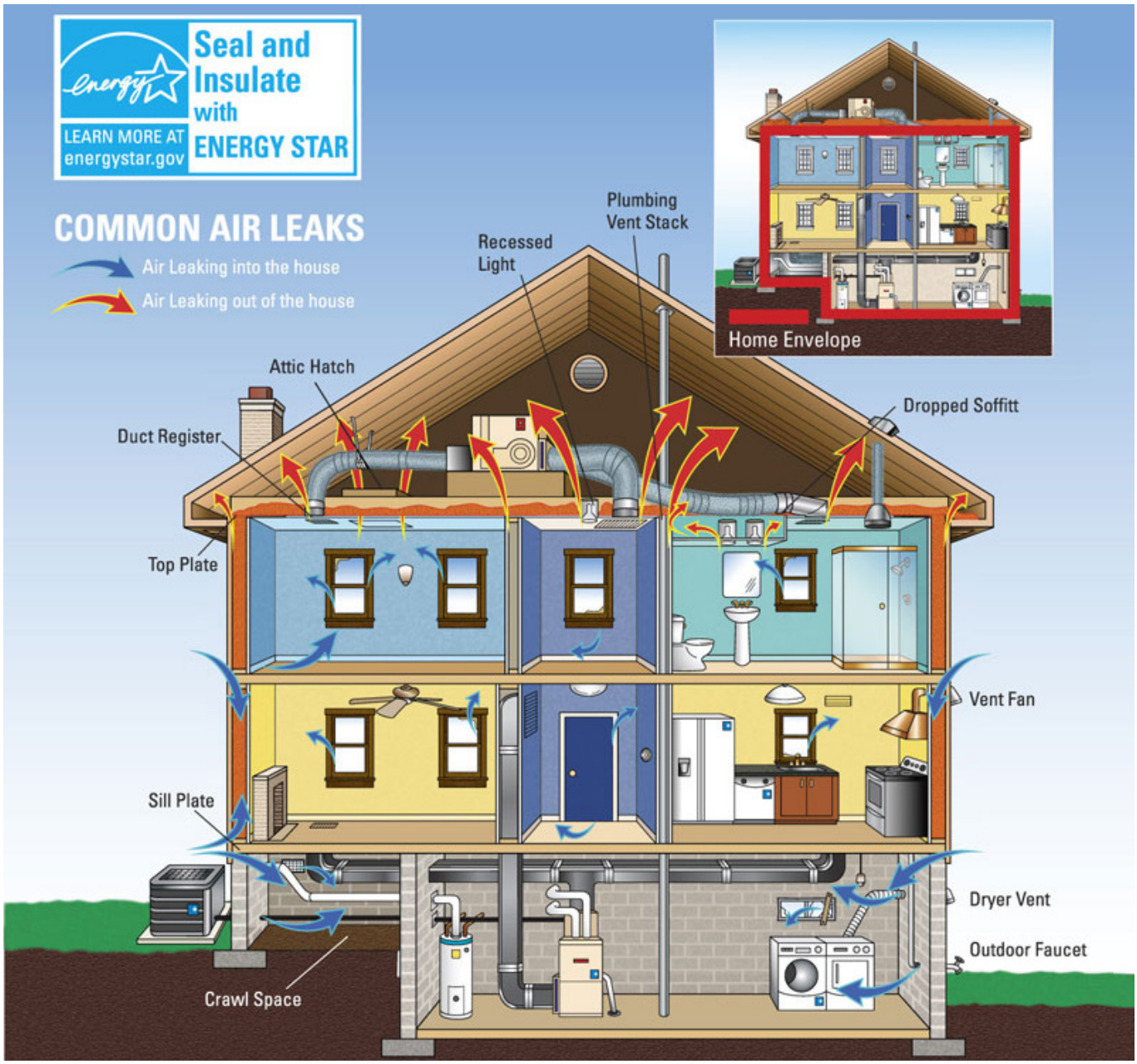

Image credit: www.basc.pnnl.gov

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Built Tight, Ventilate Right: **Benefits**

Comfort

An **air-tight**, **well ventilated** building is typically a comfortable building. **Sealing air leaks** results in fewer drafts, less outdoor noise intrusion, and a reduction in outdoor airborne pollutants, allergens, and insects. **Proper ventilation** results in better temperature distribution, more humidity control, and reduced airborne odors.

Image credit: www.basc.pnnl.gov

Improved Indoor Air Quality

Ventilation helps remove or dilute airborne pollutants from the air in your home. Dust/dander, radon, volatile organic compounds (VOCs), and other indoor pollutants, including bacteria and virus particles, can lead to negative health effects if they remain concentrated within the building envelope. An air-tight envelope with no ventilation could result in what's known as sick building syndrome. Building occupants contribute to these indoor pollutants during their day to day activities such as cooking, showering, cleaning, and even exhaling CO2. Proper ventilation, with air filtration, ensures indoor air quality is maintained.

Durability

Air-tight construction and proper ventilation are key components of controlling moisture and humidity within a structure. Too much moisture or humidity can be uncomfortable for occupants and could lead to material degradation over time. Moving air, from the interior or exterior, carries moisture into building assemblies. Proper air sealing prevents significant air movement and thus prevents moisture from traveling within assemblies where it can cause condensation. Preventing condensation and material wetting prevents corrosion, rot, mold, and mildew. The mold growth shown in the image to the right was likely caused by improper ventilation and/or a lack of insulation in the adjacent walls that may have led to warm air condensing on cool wall surfaces.

Image shows mold growth above a shower/bath surround.
Image credit: www.basc.pnnl.gov

Energy Efficiency and Cost Savings

A tight building envelope reduces air infiltration and heat transfer. Air entering and leaving through cracks, damaged seals, and envelope penetrations results in the use of more energy resources than necessary to maintain the occupants' desired interior conditions. According to EPA estimates, **homeowners can save an average of 15% on heating and cooling costs** (or an average of 11% on total energy costs) by air sealing their homes to limit uncontrolled air movement. Focusing on air sealing at the attic or roofline and floors over crawl spaces and unconditioned basements prevents the majority of leakage caused by pressure differences in buildings.

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Build Tight, Ventilate Right: **Best Practices**

Air Sealing

This is the process of minimizing unintentional air movement in and out of a building. Detailing a cohesive air barrier is a critical component of the building design phase. In ***new construction*** the air barrier typically consists of house wrap or sheet goods with all seams and penetrations sealed by tape, caulking, or a fluid applied barrier system.

Improving the air sealing of an ***existing building*** relies on identifying points of leakage in the building envelope. Once these points have been identified they can be sealed in a variety of ways using caulk, weather stripping, liquid flashing, or spray foam, depending on the situation.

Image credit: www.basc.pnnl.gov

Image shows an assembled blower door unit connected to the pressure monitoring equipment needed to perform a blower door test.
Image credit: SEDAC

Blower Door Test

A blower door is a diagnostic tool used to determine building tightness. An energy efficiency professional will use one or more fans and monitoring devices to measure how much air is entering or escaping a building at a particular pressure differential. **Beginning with the 2021 IECC, blower door tests for new residential and commercial buildings in Illinois' climate zones are now required**.
It is a best practice to conduct this test as early as possible during construction so that any air leaks can be sealed easily before assemblies are fully enclosed. This test can be done as soon as the air barrier is complete and penetrations are made and sealed, as seen in the image below.

Envelope Commissioning

This process is a quality assurance system that aims to ensure a building's envelope meets performance requirements. Commissioning involves reviewing building assembly specifications, installation, and field-testing of performance to ensure envelope air tightness. Field testing can include blower door testing, smoke testing, ultrasonic leak testing, and/or thermal imaging, among other options. **Envelope commissioning is required by the energy code for new construction** and is usually met using blower door testing, but the process also involves reporting of deficiencies and corrective actions taken.

Image shows a flexible tape used to air seal around wiring holes in the exterior sheathing.
Image credit: www.basc.pnnl.gov

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Build Tight, Ventilate Right: **Types of Ventilation**

Mechanical Ventilation

Airflow is controlled by a mechanical device or process, such as an HVAC system. The result can be negative, positive, or balanced ventilation. **Negative ventilation** uses a single fan to exhaust air from a building and relies on leaks to bring in fresh air. **Positive ventilation** uses a fan to bring in fresh air from outside and relies on leaks to vent air to the outside. This is most often achieved by using the fan in the air handler of the heating and cooling unit. **Balanced ventilation** uses one, or more commonly two, fans to exhaust air from the building and to bring in fresh air. As incoming and outgoing air is balanced, the leakage across the envelope is kept to a minimum. Balanced ventilation often incorporates heat or energy recovery to minimize the energy needs for conditioning outside air.

The 2021 IECC now requires commissioning of ventilation systems, regardless of type, to ensure systems achieve their design airflow.

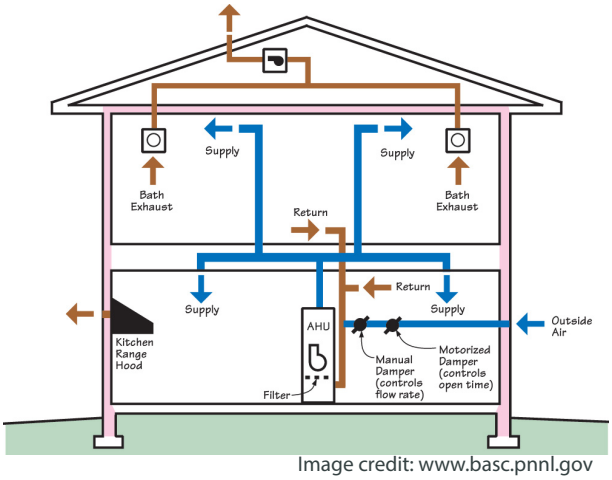


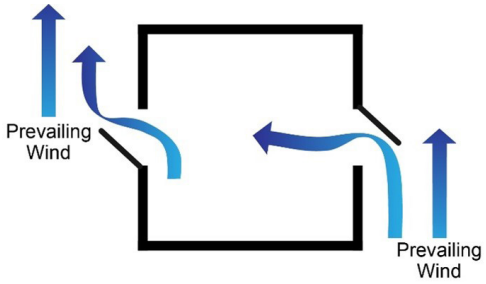
Image credit: www.basc.pnnl.gov

Natural Ventilation

Airflow is induced by existing pressure differences through doors and windows that are typically operated by occupants. This type of ventilation depends on wind speed and direction, temperature differences, and pressure differences which are all uncontrolled and highly variable. Few modern buildings are designed to utilize natural ventilation, and those that do are often supplemented with mechanical ventilation. Purely passive natural ventilation is possible; examples of this concept can be seen in buildings built before the common use of mechanical ventilation. Designing for passive natural ventilation in modern buildings requires detailed and careful design as well as an appropriate site or climate. The concept of natural ventilation is a reviving trend in the building industry due to the potential for lower equipment and operating costs as well as reduced maintenance and mechanical failures.

Potential downsides to natural ventilation:

- *Air pollution, such as wildfire smoke, can enter the building unfiltered and affect indoor air quality.*
- *Energy or heat recovery of the outgoing air may be difficult or impossible.*



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Have a Question About the Energy Code? Contact Us.

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