



A summary of the presentation on **January 1, 2023**

Stack Effect



The Heating Season -
The stack effect is strongest

Energy Efficient & Healthy Homes

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Introduction

Assumptions About Your Residence

1. Assume you are living in an existing home east of 72 St. (pre-1960).
2. You are the owner/occupant
3. If new construction or deep retrofit, this is a slightly different conversation.
4. Single-family, multiplex, multi-family, & three stories or less in height.
5. You have a natural gas furnace, boiler, gas hot water heater, and electric AC or heat pump.
6. You have a forced air system with leaky duct work located in the basement or water/steam system with boiler in the basement.

Before You Begin, Safety First

Check for safety hazards including lead paint, mold, structural issues, asbestos, critters and radon.

Building Science

Building Science Group of Four

Characteristics of air and moisture

Heat goes from warm to cold

Moisture goes from warm to cold

Moisture goes from more to less

Air goes from high to low pressure

Measures to control air and moisture

Bulk moisture control layer

Air barrier or control layer

Energy transfer barrier (i.e. insulation)

Vapor barrier or control layer

Building Science for Older Residences

1. Pre-2000 residential dwellings (& later) were designed & built to "breathe".
2. Construction materials were all natural – wood, stone, metal, etc. These materials were accessible, durable, pliable, & energy & moisture permeable.
3. Post 1960(ish) and specifically post 2000 most construction materials are partially or completely engineered materials.
4. These materials are designed to resist the flow of energy, and therefore moisture) impermeable or significantly less permeable. Therefore, they have lower drying potential (higher risk of mold).

Achieving Sustainability

Sustainability will mean more engineered materials, more insulation, less air transfer.

More engineered materials, less air transfer, more insulation will mean more risk of high moisture content & higher risk of mold.

Air Sealing

Why Air Sealing is SOOO Important

1. Building envelope dominates residential heating and cooling loads:
 - 16-40% of load from air infiltration
 - 15-30% of load from lack of insulation
 - 10-15% of load from duct leakage
 - 8% of load from people
2. Air sealing is THE dominant parameter related to both perceived indoor comfort and indoor air quality (IAQ).
3. Can be quantitatively measured and easily corrected.
4. Air sealing is cheap and easy to perform, but labor intensive.

How to Detect Air Leaks

- Residential door blower test can be used to determine air changes per hour.
- Infrared imaging will detect locations of air leaks.
- Attics tend to be the most leaky. Area of dirty insulation are indicative of an air leak.

How to Air Seal Your Home

- Caulk around electrical boxes
- Use canned spray foam to seal larger openings around plumbing and electrical penetrations.
- Weatherstrip windows and doors.

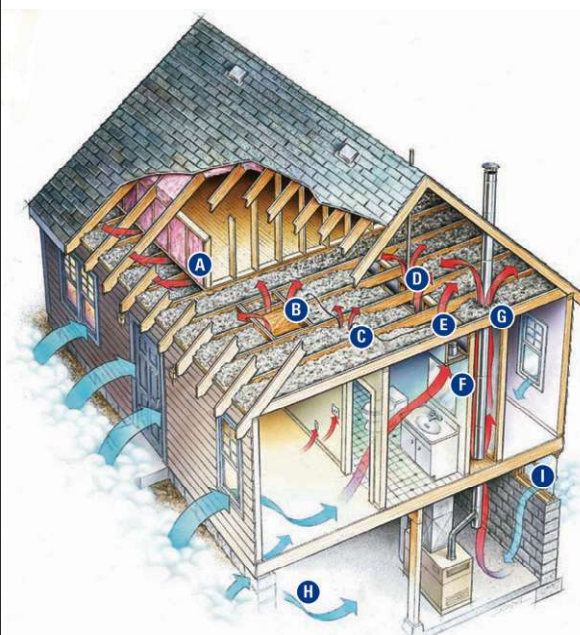
The air pressure within a house decreases with height, so air pressure on the ground floor is higher than the air pressure on the top floor. Air always flows from areas of high pressure areas of low pressure. During the winter, the difference in air pressure between the ground level and the top floor of a three-story house will be a lot more severe outside than inside, where the air is warmer and less dense. Cracks and openings throughout the building shell allow the pressure difference between indoor and outdoor spaces to drive air out of the top floor and suck air in through the first floor.



The Cooling Season -
The reverse occurs

During the summer, when indoor air is cooled, the stack effect occurs in reverse. The outdoor temperature is often warmer than the indoor temperatures, so the top floors of the house will have a lower air pressure relative to the outdoors. This creates air infiltration higher in the house as air moves from high pressure to low pressure and causes exfiltration on the lower floors. The temperature difference between indoors and outdoors may only be 20° F, so the stack effect - and the airflow through the building shell - isn't as great as in winter.

Where to Air Seal Your Home



Effects of Air Leaks

- Cold outside air drawn into the house
- Heated inside air drawn into the attic

Common Household Air Leaks

- A** Behind kneewalls
- B** Attic hatch
- C** Wiring holes
- D** Plumbing vent
- E** Open soffit (the box that hides recessed lights)
- F** Recessed light
- G** Furnace flue or duct chaseways (the hollow box or wall feature that hides ducts)
- H** Basement rim joists (where the foundation meets the wood framing)
- I** Windows and doors

Insulation

- Insulation is the second easiest and cheapest upgrade to make.
- Most often messed up, poor installation techniques are common.
- Insulation addresses conductive heat transfer.
- Ideally, the air, thermal, & vapor barrier are aligned and touching each other.
- In general, do not mix insulation types.
- Insulation needs to touch exterior surface and fill the box or cavity (all 4 sides).

Attic Insulation

First priority after air sealing is attic insulation.

Attic Floor Insulation with Vented Attic

- Used for low pitched roofs and unoccupied attic spaces.
- Requires air vents at soffits and roof ridge.
- To achieve R-50, requires at least 16" of fiberglass and 14" of cellulose insulation.
- HVAC equipment and ducts located in the attic must be insulated.
- If there is existing vermiculate insulation, check for asbestos before disturbing.
- Bathroom vents should vent to the outdoors, not to the attic.
- Attic insulation must be distributed evenly.
- Attic insulation should be continuous, including attic hatch.

- Air seal attic before installing attic floor insulation. Insulation performance is greatly reduced if attic is not air sealed.

Roof Insulation with Unvented Attic

- Used for occupied attics with steep roof pitch.
- Does not require exterior ventilation at attic.
- Use closed cell spray foam insulation which also acts as vapor barrier.

Spray Foam Insulation

- NOT DIY – get bids, hire a professional.
- Only use closed cell spray foam (ccSFP) on inside of roof decks or above grade walls. Min. 2-3 inches thick.
- Ensure water & ice barrier on exterior side of decking.
- Ventilate house during application and do not be there.
- Huge variability on the market - thoroughly research installer and product used.
- Closed cell spray foam best choice for rim joists.
- Building code requires an ignition barrier (1/2" gypsum) over foam insulation.

Wall Insulation

- It is difficult to insulated wall cavity if plaster is intact.
- Insulated walls require an interior vapor barrier to prevent moisture condensation inside the wall cavity.

- If house has balloon framing, fire stops must be added at each floor level.
- Old electrical wiring should be replaced before insulating wall cavity.
- Don't mix insulation types.
- Remember, 26% of wall are studs.
- Blown in works well in older homes, but must dense pack (>2.5 lbs/ft³).
- If you have to install a vapor retarder, make it a one-way class II vapor retarder.
- Insulation installation is key! Insulation must touch on all six sides of cavity.
- Mineral wool batt insulation must not be compressed. Compression reduces R-value.

Below Grade Insulation

- Never use insulation in the basement that can hold moisture. Avoid cellulose or fiberglass batts.
- Use rigid insulation, spray foam (open or closed depending on where moisture barrier is), or mineral wool batts.
- Closed cell spray foam best choice for rim joists.
- For foundation walls, best place to add insulation is the exterior side, but often not feasible for older homes.
- Leave a 1" gap between exterior foundation wall and insulation.

Moisture Management

- Avoid condensation on exterior wall.
- Allow interior framed wall to dry towards the interior.
- Install vapor barrier only when necessary and use smart vapor barrier if possible.
- Perform Condensation Test: Securely tape a 1' X 1' piece of thick plastic onto the basement wall an/or floor in 2-3 locations and check it daily for 2-4 weeks. If you get moisture on the "wall" side you got a leak in the wall. If you get moisture on the room side, you've got condensation.

Indoor Environmental Quality Radon

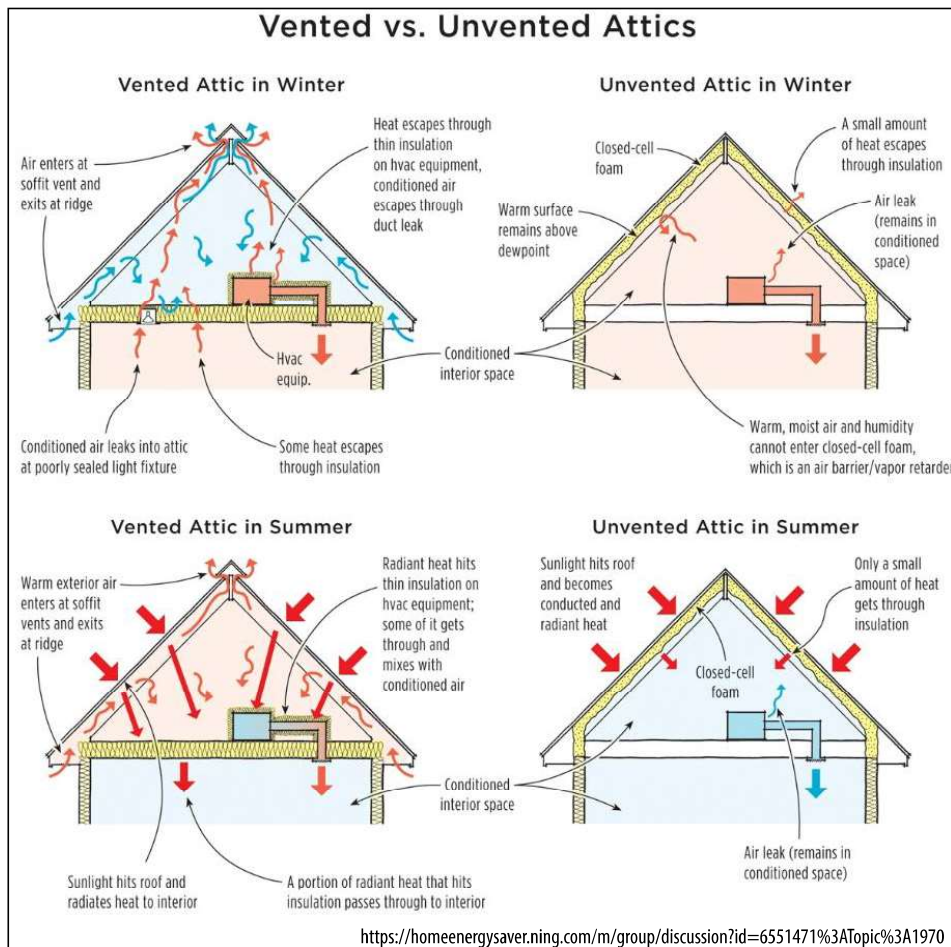
- Use detection kit to test for radon in a home.
- If results are >4 pCi/L then mediation is necessary.

Carbon Monoxide

- Install CO monitors on every level of home.
- Obtain an electronic data logger and record basement temperature and relative humidity for at least one month.
- The data logger should be located on the exterior wall.

Air Quality

- Use air filters with a Minimum Efficiency Report Value (MERV) rating of 10-13.
- A DIY method of improving air quality is to install a Corsi-Rosenthal box fan filter.
- Indoor relative humidity should be maintained at 35-55% to minimize microbial growth and air pollutants.



<https://homeenergysaver.ning.com/m/group/discussion?id=6551471%3ATopic%3A1970>