What is the Thermal Stack Effect and Why Should You Care?

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The thermal stack effect is busy robbing heat from your home every winter. And in some cases it is also sucking nasty soil gasses such as radon into your home, which creates health risks for you and your family. The thermal stack effect is driven by a basic law of physics - hot air rises. If you have ever seen a hot-air balloon floating in the sky you have seen the physical evidence of this. The balloon pilot uses a torch to heat the air just below the opening at the bottom of the balloon. The hot air rises and is trapped within the balloon. Since the warmer air within the balloon is less dense than surrounding ambient air, it causes the balloon to rise up into the sky.

Now think about your house on a winter night when the outdoor temperature is very cold. While a house is not a hot-air balloon, it is a warm-air filled container surrounded by much colder outdoor air. And your furnace or boiler is working very hard to keep you and your family comfortable by keeping the air within this container, your home, at 65 to 70 degrees. The warm air within the house rises up through the building toward the ceiling. Once it hits the ceiling it gets pushed out into the unheated attic through any cracks and holes in the ceiling plane. House ceilings are full of cracks and holes around electrical boxes, attic access doors, plumbing vent pipes and wires inside partitions etc.

Along with pushing warm air out of the house at the ceiling plane, the stack effect is also responsible for actively sucking cold outdoor into the house through cracks and holes located in lower parts of the building. Much of this cold air infiltration occurs where the wood part of the house rests on the concrete foundation walls (see Figure 2 on page2 for a more detailed explanation of the stack effect).

Air leakage driven by the thermal stack effect can account for about 40% of the annual heating costs of a typical home. This air leakage is also responsible for several other negative impacts on the building, including:

- Leakage of warm air into unheated attics driven by the thermal stack effect is the primary cause of ice buildup and ice damming at roof edges (See Figure 1).
- Air flowing through insulation degrades the manufacturer’s stated R-value by as much as 60%. Since most insulation products do not block the flow of air this means that simply insulating an attic, or adding more insulation to an attic, will have little effect on reducing heat loss from your home. Insulation cannot adequately do its job unless air leaks are first found and sealed. (Note: R-value is a measure of an insulation material’s ability to resist heat flow through solid materials. The higher the R-value, the better the material is at resisting heat flow).
Figure 2: Thermal Stack Effect

How can the thermal stack effect be controlled? We cannot stop hot air from rising. But it is possible to reduce the warm air from quickly escaping out of the upper parts of the house and cold air from being sucked into lower parts. In existing homes, this is done by finding and sealing the many small holes and cracks. This is most important to do at the ceiling plane and at lower levels of the house. Gypsum board or plaster finish on ceilings and walls is relatively impervious to the passage of air. But a typical house has dozens of...
holes, cracks, and breaks in gypsum or plaster wall and ceiling surfaces. Cracks around electrical boxes, light fixtures, access doors into attics, and openings around plumbing vent pipes provide just a few examples (see Figure 3).

At lower levels of a house cold air gets drawn in at cracks where wood parts of the house rest on relatively uneven concrete foundation walls (See Figure 5). Air is also drawn in at lower levels where holes have been drilled in the lower wall or floor structure to allow for pipes and wires to be installed (see Figure 4).

You as a homeowner can take some fairly simple steps that will reduce air leakage related to the thermal stack effect. For example, weather stripping around attic doors and hatches and around doors and windows is easy to do and will help increase comfort levels and lower annual heating costs. However, special diagnostic equipment and the knowledge of a skilled professional are needed to significantly reduce the negative effects of air leakage driven by the thermal stack effect. Unfortunately many home builders and home improvement contractors do not know about basic building science issues such as the thermal stack effect and the negative effect it has on our homes. Yes, there are very proficient homebuilders and home improvement contractors that do, but if you, as the consumer of a building contractors services don’t know the basics of
what the thermal stack effect is, and how it is controlled, then you don’t have enough information to identify a qualified building professional to hire.

If you are considering having a new home built, it is important for you to know that the best time to take steps to reduce the thermal stack effect is when a house is being constructed. Sealing the areas where heated air can escape from a home is a primary requirement of the ENERGY STAR® labeled homes program, and this is a primary reason why ENERGY STAR® homes are significantly more energy efficient than non-ENERGY STAR® homes. ENERGY STAR® homebuilders also hire a neutral third-party firm to perform diagnostic tests on the new home to be certain air sealing efforts have attained minimum requirements set by the ENERGY STAR homes program. ENERGY STAR® homes also have ventilation systems designed to deliver the precise amount of fresh air to maintain good indoor air quality for the occupants of the home.

To obtain a list of homebuilders in your area that build ENERGY STAR® homes go to the NY Energy $mart Resource Locator Map at http://www.getenergysmart.org/Resources/FindPartner.aspx?t=4. In the “resource to find” box select “ENERGY STAR® Builders”, then click on your county.

As the owner of an existing home you must be aware that many home improvement contractors are not well informed about building science issues and do not know about the thermal stack effect and how it affects a building. Therefore, you must be very careful in hiring a contractor to improve to your home. If a contractor cannot describe what the thermal stack effect is, how it affects heating costs, indoor air quality and roof ice buildup, then you should find a more knowledgeable person to hire.

Contractors accredited by the Building Performance Institute (BPI) have demonstrated that they have the necessary knowledge, qualifications and diagnostic equipment to work on and retrofit existing houses to make them energy efficient, durable, safe and healthy. To obtain a list of BPI certified contractors in your area go to the NY Energy $mart Resource Locator Map at http://www.getenergysmart.org/Resources/FindPartner.aspx?t=4. In the “resource to find” box select “home performance contractors”, then click on your county.

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