



COLD CLIMATE HOUSING RESEARCH CENTER

CCHRC

1000 Fairbanks St.
P.O. Box 82489
Fairbanks, Alaska 99708
(907) 457-3454
(907) 457-3456 Fax
www.cchrc.org

ENERGY FOCUS

Vapor Dive and Extreme Cold

By Ilya Benesch, Building Educator at CCHRC

The last few winters were relatively mild. The current cold spell, however, is a reminder to us all that we live in a place that experiences sustained periods of severe temperatures. For most of the winter, our homes become small oases of heat and moisture, floating in a vast desert of extreme cold. And, yes, our climate zone is indeed considered a desert, due to the low amount of annual precipitation we receive. This rather dramatic analogy brings us head-to-head with the laws of physics, which help to explain several of the issues that surface in and around our homes in wintertime.

The thermal envelope that surrounds our living space faces a big challenge in keeping the indoors and outdoors separated because nature is trying to reach equilibrium by doing the opposite. At colder temperatures, deficiencies in insulation or air sealing become more pronounced. There are two important forces at work here: heat is drawn to cold and areas of high pressure are drawn to areas of low pressure. Heated indoor air is more highly pressurized than outside air.

There is another wrinkle. Our indoor environments are very humid in contrast to the outdoors. Water vapor will move from an area of high concentration to an area of low concentration. In addition, warmer air can hold more moisture. All of these factors contribute to a phenomenon called “vapor drive.” This is a process by which moisture-laden indoor air tries to exit a house through all means possible. You can see an obvious example of vapor drive at work when you open a door or window on a higher level of the house at night and see a billowing cloud of air rushing out of the top of the window’s opening.

Vapor drive happens all the time in ways that may not be easy to see: through even the smallest openings in your house’s walls and ceiling. At very cold temperatures, improperly sealed electrical boxes and plumbing penetrations, especially those at ceiling level, can be major sources of vapor leaks. Moisture taking these routes can condense and freeze inside roofs and walls, going completely unnoticed until the spring thaw. Hoar frost is another sign of vapor drive. Think of the houses with the large frosty beards growing on the outsides of their upper walls. This is a relatively common sight in log structures where shrinkage and movement can create small gaps, as well as areas around gable vents on frame houses with leaky ceilings. As soon as the exiting air begins to cool it is no longer be able to hold all of its moisture and condensation forms on any cold surface. When things warm up, water will start running out of the ceilings, walls, and window openings. The first inclination is to blame it on roof leaks, but in this climate the culprit can be condensation from interior air that froze before it could leave the house.

Remember, air will always follow the path of least resistance. Hot air tends to rise and escape at higher locations and be replaced by cold air drawn from lower places, just like chimneys work. As a result, even the smallest cracks can cause a pipe to freeze because of the tremendous flow of cold air possible. From the glass-is-half-full perspective, which is a real stretch in this case, two weeks of cold weather can present an excellent diagnostic tool for any weak points in the heated envelope. Learn what lessons you can this winter so you're better prepared for the next. Find the sources of cold air and identify where warm air is escaping so those places can be sealed in the future.

Ilya Benesch is the Building Educator at the Cold Climate Housing Research Center (CCHRC).

For questions or comments please contact CCHRC at (907) 457-3454