Carleton Now

Why does my house make loud cracking sounds in very cold weather?

Carleton University faculty and staff experts answer life's perplexing questions. Yvan Cazabon, Assistant Professor, School of Architecture, answers this month's question:

Why does my house make loud cracking sounds in very cold weather?

Ottawa Police received numerous calls reporting gunshots, noise bylaw violations and feared break-and-enters when the thermometre dropped drastically in late January. While most of these were false alarms, many residents were awakened by noises of unknown origin. The source may have been the very enclosure that protected the residents; their houses were quaking.

In extreme cold weather conditions we can learn rudimentary lessons in physics. Materials that make up our buildings change with their environment. In the winter, all exposed materials will slowly shrink as the temperature falls. In addition, fibrous or porous materials, such as wood, will also give up moisture to the surrounding dry winter air, accentuating their shrinking or contraction. In the spring, as the environment warms and the air gains moisture, wood will gradually swell and expand to its "normal" size and proportions.

The extreme and rapid shift from unseasonably warm temperatures (+/- 0° C) from one day, to deep-freeze temperatures (- 36° C) the next, causes a rapid shrinking in all exposed building materials. In addition, buildings are designed in such a way that many of its parts are exposed to warm environments (on the inside) and at the same time to cold environments (on the outside). Roofs and walls are both good examples of this. Wooden studs that make-up walls have one face close to the outside and one face

close to the inside, usually with insulation in between. Roofs have a more complex structure built from rafters or wooden trusses shaped in the form of a triangle. The top parts are exposed to near-outdoor temperatures (the temperature of the vented attic space) and the bottom part is wrapped in insulation near the ceiling of the warm living space below. Parts of the structure therefore, are shrinking while others are staying essentially the same. The differential temperatures cause the wall or roof assemblies to distort in shape. In principle, these systems (walls and roofs) are designed and built so they stay in place and are connected to each other in a sturdy and relatively tight manner. While the connectors that provide this structural assembly vary (nails, screws, metal plates, etc.), they are designed to resist excessive movement while allowing for some expansion and contraction of the component parts. When components of a building shrink quickly, an extreme amount of stress is produced in the connections and joints. Excessive pressure may lead to a slipping of the members within this joint. When stresses are released quickly, a loud popping sound can be heard as one member moves against or away from another (or from the connectors).

Softer creaking or popping sounds may have a similar origin as the components of a window, door, or the siding on a house contract in the cold and later expand due to the radiant heat gained from the sun's rays. Building systems, including plumbing pipes, heating pipes and hot air ducts will also appear to be more "restless" when they expand and contract with extreme shifts due to increased demands of hot water or hot air to heat our living spaces. Because most of these systems are interconnected with wall, floor and roof systems, which may also be expanding or contracting, a true symphony of creaks, cracks, pops and groans accompany our dreams and our early morning alarm clocks.

From – http://www.now.carleton.ca/2005-02/688.htm