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has no cooling loads, we see cooling being installed almost as a norm in new homes throughout the Vancouver and Victoria areas. That's not to say that there is no place for geothermal systems in locations without cooling loads, because there are still many good applications for geothermal, but they need to be carefully evaluated. It's important not to jump on the technology bandwagon simply because it looks good, without considering the other aspects of building design and energy loads.

Too many people are jumping on the green bandwagon with geothermal heat pumps, without putting them in context. Just installing geothermal is not "green" unless all the other conservation aspects are dealt with. ✪

Fire Resistance of Gypsum Board

Fire resistance is an important aspect of construction. Gypsum board is a key material used in all types of construction assemblies for finished surfaces and as a fire resistant finish. One or more layers of gypsum board can provide up to 90% protection against fire. The greater the density of the gypsum board, the greater the fire resistance.

The fire resistance of gypsum board is due to the board's makeup. It is made from calcium sulfate, a mineral crystal formed during the dinosaur age and found in all parts of the world. The crystals contain water molecules, and it is this water that gives gypsum board its fire resistance.

As heat is applied to the gypsum board, it starts to dehydrate by driving off the water contained in its chemical structure. The dehydration begins at about 80°C (176°F) and the heat energy goes into driving off water (turning it into water vapour), not into increasing the temperature of the mineral. Only when all the water has been removed, will the temperature of the board increase.

This ability of gypsum to remain at relatively low temperatures, even when a flame is applied directly to it for a short period of time gives drywall its fire resistance to the wood frame construction. Even with a fire directly on a sheet of drywall, the wood frame behind it will remain at a relatively low temperature until too much water has been lost from the gypsum, preventing the destruction of the wood and the collapse of the structure. Partially dehydrated gypsum, when the heat source is removed, has can reabsorb water.

For most construction assemblies the critical characteristic that determines the fire resistance is the delay in heat penetration provided by the evaporation of the water contained in the gypsum board. For practical purposes, the density of the board provides an indication of how much water is contained within the board, and hence its fire resistance. Crack-resistance and material shrinkage also play an important role in determining how well drywall assemblies are able to provide fire protection.

Traditionally, the gypsum board material used in fire-rated assemblies has been designated as Type X gypsum board, and can provide up to 90 minutes of fire resistance protection for building assemblies. The classification is based on the product simply meeting or exceeding a designated fire-resisting threshold established using a standard test method such as ASTM C 36/ 36M - 031. This sets a minimum standard, but does not fully take into account the variability in the material.

A multi-year study at the National Research Council of Canada (NRCC) looked at the fire resistance and acoustical performance of a range of wall and floor assemblies. The studies found that there is a wide range of density in the Type X products. This variation occurs both between products of different manufacturers and within an individual manufacturer. This wide variation in the materials could be a concern in how well construction using the materials actually performs. It also points to an area where more work is going to have to be done.

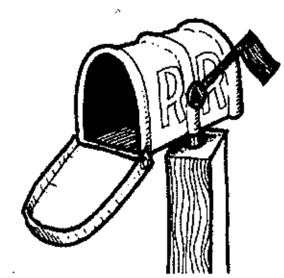
The variation in board density within and between manufacturers of Type X gypsum board was fairly large. Based on a sampling of Type X sheets purchased from local suppliers, they found the density of 12.5 mm (½ inch) sheets varied from 759 to 811 kg/m³, while 15.8 mm (5/8 inch) type X board varied from 687 to 750 kg/m³.

Although board density is only one of the factors, it is probably the key factor that defines the delay in the failure of the gypsum when subjected to a fire source. If material from one manufacturer were to be used to establish the performance of an assembly, using products made by another manufacturer could result in a 7 to 9% lower level of performance depending on which products were used.

As building and fire codes move towards a performance-based approach, rather than simple prescriptive requirements, the ability for designers to have a fairly high level of confidence in the performance of the specified material becomes more important. Designers, builders and fire officials have to clearly understand how best to be able to calculate the fire resistance with confidence. They will need more precise characterization of the gypsum board material itself and not as a part of a building assembly as has been the practice.

With the increased use of engineered fire resistant designs, it is important that designers have reliable information on the performance of materials that play a critical role in their designs. Products and materials with a high degree of variability associated with their performance will result in the designers having to over design their systems to compensate for the uncertainty and losing many of the benefits that could come from a performance design approach. ☼

Impact of the Variability of Type X Gypsum Board
Russ Thomas, Mohamed Sultan and John Latour NRCC-47635, Fire Research, National Research Council of Canada. A version of this paper was published in the proceedings of the Fire and Materials Conference, San Francisco, Jan. 31-Feb. 2, 2005



Letters to the Editor

I am a fan of Solplan Review magazine. I read each issue cover to cover, and file them away as reference material.

I am involved with residential window sales and renovation advice, so I find articles on humidity, insulation, ventilation, mould remediation, and high performance glazing to be very interesting.

We all look to the future of better insulated, better ventilated, efficient and comfortable homes wherever greater R-values and lower energy costs are achieved. Building code changes force us to design better products, methods, and systems all the time.

I believe, however, that the residential window has been overlooked. Why is it that we have raised the standards for wall structures and heating/ventilation systems but we still allow sealed, double-glazed window units with R-values of not much more than 2, and minimum A ratings for air leakage. Why are these still considered acceptable? I believe that the minimum acceptable residential window today should carry an A3 rating and incorporate soft coat Low E. What is the point of building a highly insulated wall and installing an inefficient window just to let the heat out?

Harold Bream
Terrace, BC

Re: High Performance Houses (Solplan Review No. 120, January 2005)

I fear that the insulation values for the UK you quoted are wishful thinking. It may not be that good in Ireland either. I think the numbers for Swiss and Danish housing can be relied on, but Switzerland and Denmark have a different culture where workers are trained for years before they're allowed to do construction work without supervision.

Thermal bridging is excluded from the UK and Irish figures. The real R-Values (one must use this for heat loss calculations) is worse than is currently quoted. A recent study for the government found that in a sample of new UK dwellings more than 50% did not meet the current energy regulations. This survey of as-built homes did not check actual wall or floor insulation, as these are covered up by the time a house is finished and occupied.

So, I fear the grass here and in Ireland seems a little greener than it really is!

The air leakage of a randomly-chosen new UK dwelling would probably be closer to around 12 m^3/m^2hr at 50 Pa (equivalent to about 12 air changes per hour on a small detached house). However, based on a 1999 database assembled by the BRE (Building Research Establishment) the assumption was that the mean for modern houses was between 8 and 10 ac/h.

The problem is that there has been very little air testing done on small buildings. The few tests that have been done have not been random. Of the tests that have been done most are done at the request of a specific developer or owner. The fact that the person asking for an air test is interested enough in the result to pay up to £400 for a test makes these rather unusual, and it