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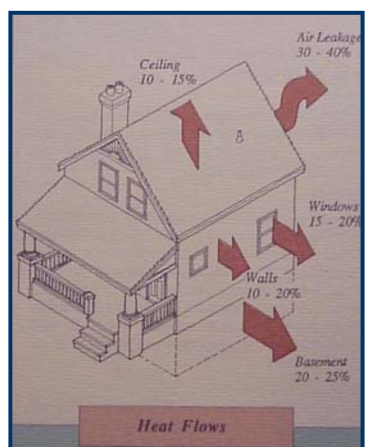
Historic Building Energy Issues

By Bill Hockey

Contemporary buildings are constructed as barriers against the outside environment, but older buildings act as a filter between the conditioned inside occupant environment and the outside environment that is controlled by nature. Older buildings that are in good condition are a collection of assembled filters that have reached a state of equilibrium. Any changes that one makes to these buildings or their uses, will ultimately affect how they perform and could have a negative effect on their ultimate survival.

The extent a building takes into account its site determines how efficiently it will use whatever energy is employed for making it habitable. Early buildings were related to their natural environments, taking advantage of solar gain, changes in use over the seasons and vegetation. These buildings were built considering site, environment and climate. They used landscape elements such as shade trees and foundation plantings to minimize heat gain/loss. You might conclude that the builders had read the Maritime Solar Shelter Manual.



The amount of heat lost through each component varies with every building and may be very different from the typical ranges shown here.

There must be a relationship between how much energy is used by a building and how this use permits occupancy. A typical uninsulated historic building loses 20 to 25% of its heat through the basement; 10 to 20% through the walls; 15 to 20% through the windows; 10 to 15% through the ceiling; and 30 to 40% through air leakage.

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There is no one right way to improve the energy conservation of historic buildings. Careful energy conservation requires an understanding of their construction details. These buildings are sensitive to alteration, so the approach to the work must be tempered by the nature of the resource.

It is very difficult to consider the application of modern energy standards because they are highly prescriptive, and flexibility to alter materials does not exist. Standards for existing buildings are needed. In a masonry building, heat is stored during the day and released slowly at night, complicating the calculation of determining the thermal resistance of materials. Most designers, engineers and architects are not familiar with the corrective factors for thermal mass and use the available tools incorrectly.

As air heat and moisture flow through and around a building they exert stresses to which the building responds. This means that one must be knowledgeable in the mechanics of heat transfer and the movement of water as well as the thermal-dynamic behaviour of air-vapour mixtures.

Heat constantly flows from masses of higher temperature to masses of lower temperature by three methods, conduction, radiation, and convection. It flows through materials by conduction and from one to another by radiation. Brick and stone both conduct and radiate heat well, wood to a lesser degree. Heat is transferred by convection through leakage and internal air movement. This causes higher temperatures at ceilings than at floors and draws in cold outside air at ground level. It is moisture not temperature that is the biggest issue when considering historic buildings. It permeates through capillary action; draws vapour from the wet to the dry. In its liquid form it leads to wood decay, as a solid it destroys masonry and as a vapour it blisters coatings.

Every cold draft that enters a building causes an equal amount of warm air to leave and the moisture in this air condenses either in or on cold materials, leading to possible damage to the building. Air barriers prevent leakage through the numerous small cracks in the envelope. They must be continuous and located on the warm side of the insulation to reduce convection currents. A vapour barrier has a similar function except that it stops diffusion of vapour through otherwise vapour permeable materials. Weather barriers are a building's exterior defence against wind and wind driven rain and snow. They must also allow moisture to escape from the building assemblies.

Ventilation is required in the occupied areas of a building both for health and comfort and to prevent excessively indoor humidity levels. Air-sealing a building without providing alternate means for ventilation can cause both discomfort to the occupants and condensation on the building materials. It is also critical to ventilate unheated attics, ceilings and crawl spaces to dilute any accumulated moisture to reduce the risk of moisture-related damage.

Insulation reduces heat loss by offering a high resistance to conducted and convected heat. It should always be used in conjunction with air, vapour and weather barriers to remain effective and reduce the risk of damage from condensation within the building envelope.

It is easier to deal with air loss when dealing with the various building envelope elements. Air sealing is the first approach one should take when planning & implementing work. With air sealing you gain the most at the lowest cost. In future issues we will discuss the retrofit of Doors and Windows; Ceilings, Attics and Roofs; Foundations, Basements and Crawl Spaces; and, Exterior Wall Systems.

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An article by Jennifer Barone in the December, 2008 issue of **Discover** entitled

The CARBON Trap

discusses the question *Can offsets, emissions caps, and complex trading schemes turn off the global spigot of greenhouse gases?*

The article discusses the emergence of a booming carbon market which was born out of the 1997 Kyoto Protocol, which mandates the curbing of carbon emissions. Many mainstream financial institutions are involved and it has been estimated that the global carbon trading system, a marked that barely existed five years ago, will have topped $100 billion by the end of 2008.

Behind this market is a mechanism called cap-and-trade, which has its roots in the US Clean Air Act ammendments of 1990. **A cap-and-trade tries to accomplish the most cost-effective way to achieve emissions reductions.** The government limits the total amount of greenhouse gasses that can be emitted by an industry, sector, region or the country; then sells or grants permits, each covering the release of the equivalent of one ton of carbon dioxide to businesses covered by the cap. The permits can then be traded among emitters. If you emit more you must buy, if you emit less then you can sell your extras on the open market. With this system, you must reduce your overall emissions, but how is up to you. That flexibility saves a lot of money.

Achieving a net reduction in emissions is not as easy as it appears. Carbon emissions are not well quantified. Under the Clean Air Act power plants were required to install instruments that record their acid-rain causing emissions and report those numbers to the EPA. The European carbon trading system, which is likely to be a model for the United States, allows business to determine their own emissions by calculation, not instrumentation. This is audited by third parties; however the margin for error is far to great to determine whether emitters are complying with regulations. There is also a lot of discression with reporting emissions.

The second issue is the validity of the offsets used under the regulations. Companies may change their fuel source, pay a company to reduce those tons for them, pay for a project that will plant enough trees to absorb the emissions that exceed their allotment.

To show that an offset project actually reduces emissions, it must be shown that overall emissions will be lower than they would have been without the project. That kind of measurement cannot be determined scientifically. If you reduce emissions in a place like China in lieu of reducing them in Europe by contributing to a wind farm or hydro-electric project, it must be shown that these projects would not be implemented without the offset money. In most cases the projects were likely to go ahead without it. The offcset value of destruction of HFC-23 was discovered to be far more lucrative than the sale of the refridgerant, creating the potential for more waste for offset credits.

It is generally felt that systems that exclude offsets would be more effective. Also, it is recommended that the US regulate cap-and-trade permits at the wellheads, mine mouths, and import points where, coal, oil and natural gas enter the economy instead of at the smokestacks. This would be easier to track because less companies are involved.

Laws governing greenhouse emissions should be enacted as soon as possible. Errors will be made, but even if we don't get it right the first time, it is necessary to learn by doing. This is the problem of the century.

Forum - Mar 6, 7& 8

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Show Times
Friday, Mar 27: Noon - 9pm
Saturday, Mar 28: 10am - 9pm
Sunday, Mar 29: 10am - 5pm
Exhibition Park, Halifax, N.S.

Upcoming Courses

Solar Nova Scotia - practical, how-to courses on designing and building solar greenhouses, solariums, additions and especially solar homes.

The six night Solar Practical Course, Don Roscoe Instructor:
Thursday, April 2 until Thursday May 5; NS Community College, Leeds Street, Halifax. (Enquiries and registration call 852-4758.)
Tuesday, April 7 until Tuesday, May 12; Bridgewater High School; Enquiries and registration contact Sandy Mair at 543-2274.).
Cost is $90.00 for an individual, $150.00 couples in both locations.

Don will also offer a one day Solar Construction Course at the Leeds Campus on **Saturday, April 18th**. Cost is $50.00.

Three Day Weekend Courses, Andy O'Brien Instructor. Get particulars, and register at: solarhomes@hotmail.com:
May 1, 2 & 3 – Truro; **May 15, 16 & 17** – Wolfville;
May 19, 20 & 21 – Middleton

Upcoming Events

March 11, 6:30pm - Don Roscoe public lecture, **Solar Basics** at the Hubbards Library.

March 19, 7:00pm – **AGM Location:** The **Hub,** http://thehubhalifax.ca/, a new shared office, 1673 Barrington Street, 2nd Floor, Halifax, NS.

March 24, 2009 we unveil the new **Canadian Solar Home Design Manual** at **The Hub.** All are welcome. Press conference and Q&A session - 3:00 to 5:00. Entertainment, refreshments, and more food will follow from 5:00 until 7:00pm. The new book will be available for purchase for $30.

March 31, Summerville – Save Energy, Money and GHG Emissions, Andy O'Brien [Citizen Action to Protect the Environment, (CAPE)]

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