hygIRC software for designing better envelopes

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By John Burrows and Jim Gallagher

This article outlines the features and benefits of the *hyg*IRC software, which simulates the hygrothermal response of the building envelope to changing conditions on either side.

Controlling the deposition of water in wall cavities is an important consideration that has taken on even more importance with the advent of tighter construction. For this reason, the NRC Institute for Research in Construction (NRC-IRC) has developed information and design software, *hyg*IRC, to help practitioners design and construct optimal building envelope assemblies.

Designed for engineers, architects, building scientists, contractors and other professionals, the program simulates the hygrothermal responses of each envelope element to changing conditions on either side of the building envelope. While allowing the user to vary interior conditions and select outdoor climate conditions, *hyg*IRC is able to:

• Predict temperature and moisture response within the various layers of a given wall assembly over time;
• Compare the hygrothermal response of different wall assemblies for different scenarios of climate loading (indoor and outdoor).

The software is founded on two comprehensive databases. The climate database contains 30 to 40 years of hourly weather data for 19 Canadian and 6 US cities. The materials database contains the hygrothermal properties of more than 80 common construction materials. The user can view all the relevant hygrothermal properties of any material including water vapour permeance, liquid diffusivity, air permeability, heat capacity, and thermal conductivity, all of which have been verified at NRC-IRC's thermal and moisture performance laboratory.

An upgraded version of the software, *hyg*IRC 1-D v.1.1, has recently been released, reflecting its continual development and improvement. In addition to including climate data for six additional North American locations, the update has several new features that improve the program's function and versatility such as the ability to:

· Alternate between SI and I-P units at any time while running the program;
· Use same-year multiple times from the weather database;
· Provide more flexibility in setting the exterior boundary conditions.

*hyg*IRC 1-D makes it possible to conduct case studies in which several parameters such as climate, material, and configuration are changed one at a time to gauge the sensitivity of wall hygrothermal performance to these changes. This allows designers to explore various "what-if" scenarios – for example, what if the stucco cladding were replaced with acrylic stucco. (Situations involving air leakage, water leakage or gravity, or any others that need to be examined in two dimensions are still best handled using *hyg*IRC 2-D.)

*hyg*IRC 1-D can simulate the response of each building envelope element to changing environmental conditions on either side of the envelope on an hourly basis, producing information on the temperature and relative humidity distributions within the wall assembly and the changes in both over time.

In addition to the extensive weather and material properties databases available with *hyg*IRC 1-D, the model allows users to input their own data on weather, interior conditions and material properties and also provides them with easy-to-use tools for output analysis.

In March 2007 NRC-IRC researchers in charge of the development of the software conducted a one-day training clinic on the applications of the software for the design of exterior walls. The participants – a mix of building scientists, building envelope consultants, architects, engineers and public building owners and managers – appreciated the hands-on approach of the clinic along with the coaching from NRC-IRC software developers. It provided ample opportunity to explore the capabilities of the software and relate these to their needs. The team is planning to offer a similar clinic in French in the fall.

For more information about *hyg*IRC, contact Khaled Abdulghani at (613) 998-6807, or e-mail at Khaled.Abdulghani@nrc-cnrc.gc.ca. To learn more about *hyg*IRC, view a demo version or order, visit: http://irc.nrc-cnrc.gc.ca/bes/software/hygIRC/index_e.html

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