Volume 8 Number 2 **June 2003**

construction innovation

NRC · CNRC

National Infrastructure Guide now being used in municipalities across Canada

More than a dozen best practice documents that make up the *National Guide to Sustainable Municipal Infrastructure* are now being used in municipalities across Canada, with many others still to be delivered. IRC and the Federation of Canadian Municipalities (FCM) have been officially collaborating on the Guide since 2000 to provide municipalities of all sizes with the tools they need to solve today's infrastructure challenges quickly and efficiently (see box below for background information on the development of the Infrastructure Guide).

Municipal infrastructure is one of Canada's biggest assets—and liabilities. It's estimated that the value of the basic municipal services providing drinking water, transportation and wastewater collection and treatment across Canada exceeds a trillion dollars. Further, more than 80 per cent of current $12–15 billion in annual municipal investment goes to system repair, renewal and operation.

"Municipalities spend billions of dollars annually on basic civil infrastructure," says Nancy Schepers, Manager of the Guide project. "The Guide will assist them in setting funding priorities and in selecting the best available technologies to stretch their limited investment dollar."

Because of this importance, more than 125 of Canada's top infrastructure experts, including municipal managers and practitioners, elected officials, administrators, academics, researchers, consulting engineers, contractors, and the general public, have volunteered to work on the project. With representation from across the country, these experts are seeking out and sharing best practices in the planning, construction and maintenance of municipal infrastructure in five initial target areas. These areas are potable water systems, storm and wastewater systems, municipal roads and sidewalks, environmental protocols, and tools for decision-making and investment planning.

"This large network demonstrates FCM's commitment to municipal partnerships by serving as the principal source of knowledge on sustainable infrastructure," says Mike Badham, Chair of the Guide's Project Steering Committee and member of the Federation of Canadian Municipalities Board and Executive Committee. "We are partnering with NRC to create a guide that will assist communities across Canada to get the maximum return on every dollar invested in infrastructure—while being mindful of the social and environmental implications of their decisions."

Each target area has a technical committee to oversee the development of the best practice documents.

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For more information about the Infrastructure Guide see previous articles in *Construction Innovation*:

Volume 3 Number 2, Winter 1998

Volume 4 Number 4, Fall 1999

Volume 6 Number 1, Winter 2001

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Public consultation on proposed technical changes to national codes

A national consultation on proposed technical changes to the 1995 national model code documents has just been completed. The consultation was coordinated with all provincial/territorial jurisdictions, each of which included specific technical changes in the material provided for review. The next step in the preparation of the new editions of the codes involves the review of the public comments by the standing committees of the Canadian Commission on Building and Fire Codes (CCBFC). Each and every comment received will be included in this review.

The standing committees operate under strict rules regarding possible actions resulting from comments received. These actions include:

- proceeding with the change as originally developed;
- making editorial revisions that do not alter the technical content;
- withdrawing the change;
- withdrawing the change but reconsidering it for possible resubmission for public review in revised form; or
- revising the change if in the view of the committees such action would not result in substantial adverse reaction from the public.

The committees will then prepare their recommendations to the Commission regarding new and revised content for the codes for its consideration in the spring of 2004.

Public consultation on format and structure of objective-based codes

In parallel with the public consultation on proposed technical changes, a consultation on the format and structure of the new objective-based codes has been completed. This consultation provided an opportunity for code users to "test drive" the new codes.

A Joint CCBFC/Provincial/Territorial Task Group will address public comments received on the format and structure, and on any other concerns that were identified. The Joint Task Group will then make recommendations to the Commission and to the provincial and territorial jurisdictions based on these comments.

Even though the comment period has ended, the consultation documents, as well as those from the 2001 consultation on code objectives, are available for perusal on the national codes Web site at www.nationalcodes.ca.

National model codes committees need new members

The national model code system will have gone through an unusually long development cycle by the time the next edition of the codes—the National Building Code, the National Fire Code and the National Plumbing Code—is published in 2005. The longer than normal cycle has been necessitated by the development of the new objective-based codes. The standing committees responsible for this work are to be commended for completing the arduous task of analyzing each and every provision of all three codes as to their intent and application. The results will prove to be invaluable to code users in applying both current and future editions of these codes.

One impact of this work has been that the membership of the Canadian Commission on Building and Fire Codes, as well as that of its standing committees, has been extended well past its usual term. However, it will soon be time to renew the membership of the committees, and to provide members for several focused task groups taking on new code development work.

Members of the Commission and its standing committees are selected for their individual expertise and experience with the codes, and not as delegates from a particular interest group. The terms of reference of these committees require that there be representation from all of the regions of Canada, as well as from all of the sectors that use the codes or benefit from them. Information on the work of the Commission and its standing committees can be found at www.nationalcodes.ca.

With these complex conditions governing member selection, it is important that there be a large pool of good candidates to select from. Readers are encouraged to submit their own candidacy, or to propose the candidacy of someone else. Submissions should provide information on the candidate's qualifications and experience, as well as some indication of the area of code development work that is of interest. On request, confirmed members of the standing committees, task groups and working groups are reimbursed for travel and living expenses to attend meetings.

Submissions for candidacy can be sent to:

Secretary, Canadian Commission on Building and Fire Codes
Canadian Codes Centre
National Research Council Canada
Ottawa, ON K1A 0R6

Updating referenced standards in the national codes

The national code documents reference hundreds of standards prepared by Canadian standards development organizations (SDOs) and others. Referencing standards prepared by these bodies is an efficient way to make sure that the codes have access to the best available technical expertise and the latest technologies, and that the overall bulk of the documents is kept to a minimum.

Staff of the National Research Council's Canadian Codes Centre are members of many standards development committees and thus provide direct links between the standards development work and the work of the standing committees of the Canadian Commission on Building and Fire Codes (CCBFC). Additional links are provided in many cases by members of the standing committees who are also members of standards committees. However, the large number of standards committees makes it impossible for Codes Centre staff and standing committee members to participate in them all.

Despite these links, keeping the lists of standards referenced in the national code documents up to date is complicated by the fact that the standards development cycles of the various SDOs and the code documents are not always synchronous. As a consequence, it has been normal practice to make a formal request to the various SDOs to identify revised or new standards, or standards that are no longer supported.

SDOs and other interested parties should be aware that the editions of standards referenced in the 2005 codes will be the editions that the Canadian Codes Centre understands to be current as of June 30, 2004. The Codes Centre should be informed of any needed changes in the lists of referenced standards by the end of March 2004. If there is any difficulty with this timing, Codes Centre staff should be informed well ahead of time so that special arrangements can be made.

The above applies only to standards already referenced in the national code documents or to those for which references may be added as a consequence of code changes proposed during the recent public consultation. Adding references in the national code documents to standards not currently cited is considered a technical revision that requires undergoing the normal technical revision process; this includes a technical review by the responsible standing committees and public consultation. Documents that have not gone through this process cannot be included in the 2005 codes and will only be considered for subsequent editions.

Specific questions can be directed to Mr. John Archer at (613) 993-5569, fax (613) 952-4040, or e-mail john.archer@nrc-cnrc.gc.ca.

New Revisions and Errata to Building Codes

The Fifth Revisions to the *National Building Code of Canada 1995* (NBC) and to the *Quebec Construction Code – Chapter I, Building, and National Building Code of Canada 1995 (amended)* (QCC) are now available to all users of these codes. The revisions were approved by the Canadian Commission on Building and Fire Codes and provide information updates to facilitate the use of the codes.

The pertinent revisions packages are being mailed to binder and soft cover users who purchased their codes directly from NRC or who returned the reply cards at the front of their books to NRC. CD-ROM users will receive a notification of the availability of the revisions in electronic format on IRC's Web site at **http://irc.nrc-cnrc.gc.ca/codes/home_E.shtml**.

If you own any of these codes and do not receive your copy of the applicable revisions, you can either download and print the PDF files from **http://irc.nrc-cnrc.gc.ca/publications/downloadform.html**, or contact IRC's Publication Sales Department:

Tel.: 1-613-993-2463 or 1-800-672-7990
Fax: 1-613-952-7673
E-mail: IRC.Client-Services@nrc-cnrc.gc.ca

Codes upcoming events

September 6-7
Task Group on Snow and Wind Loads (Toronto)

September 8-9
Standing Committee on Building and Plumbing Services (Toronto)

September 14-16
CANCEE (Vancouver)

September 19
Standing Committee on Environmental Separation (Halifax) **tentative**

September 25-27
Standing Committee on Fire Safety and Occupancy (Montreal) **tentative**

October 17-19
Standing Committee on Houses (Ottawa) **tentative**

October 18-20
Standing Committee on Structural Design (Montreal)

October 27-29
Standing Committee on Hazardous Materials and Activities (Calgary) **tentative**

Support of provincial and municipal engineers for CITAC is growing

The purpose of the Canadian Infrastructure Technology Assessment Centre (CITAC) is to assist manufacturers in gaining product acceptance by providing independent technical data, by means of an evaluation, to those who make decisions about Canada's infrastructure at provincial, territorial and municipal levels. A third-party CITAC evaluation would provide a high quality technical opinion of the suitability of a product for its intended use and of the manufacturer's claims about its performance. The evaluation process accesses the best technical experts—both within IRC and at other technical organizations across Canada—to help proponents of new technologies achieve market acceptance quickly. These nationally focused evaluations would save manufacturers time and money by reducing the need for product demonstrations in different regions across Canada.

CITAC has been working with many agencies to gain that recognition of the service so that manufacturers can see the value in investing in an evaluation. At this time, a number of manufacturers are negotiating with CITAC to embark on evaluations.

Update on CITAC's growing recognition

- CITAC has now received recognition from nine provincial ministries of transportation (British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia and Newfoundland) and ten major municipalities (Vancouver, Edmonton, Winnipeg, Toronto, Niagara, Peel, Halton, Ottawa, Montreal and Halifax). These provincial and municipal decision-makers see the value of a national service and view CITAC as a technical evaluation tool in their product approval process.
- The City of Ottawa has written the following into its standard specifications: "Manufacturers requesting approval for new products are asked to provide any CITAC evaluation reports as documentation to support their submission." A CITAC application form is included as part of the specifications package.
- The Region of Halton has recognized CITAC's evaluation service and product reports in its new product approval procedures manual.
- The Niagara Regional Council "recognizes and endorses CITAC as an organization and resource to be referenced when decisions must be made by staff with regard to the suitability of new products and technology to be used in various construction and maintenance activities."
- The Municipal Engineers Association (Ontario) "recognizes and endorses CITAC as a third-party evaluator in support of new products being reviewed/approved by The Road Authority." The Road Authority (www.roadauthority.com) is the Ontario Good Roads Association's Internet-based product information service that stores, manages and classifies infrastructure products, services and technical solutions for the Ontario transportation and municipal public works sectors.
- A collaborative agreement was signed with the Quebec-based Service d'avis techniques en infrastructures (SATI). (See newsbrief.)

Specific questions can be directed to Mr. Harry Baker at (613) 993-3807, fax (613) 952-0268, or e-mail harry.baker@nrc-cnrc.gc.ca.

Check out our new Web site at http://irc.nrc-cnrc.gc.ca/ccmc/citac_intro_e.shtml.

Newsbrief

CITAC and SATI sign letter of agreement on joint evaluations

Canada's two organizations offering third-party technical evaluation services of new infrastructure products have signed a letter of agreement that will speed the acceptance and use of new and innovative products by Canada's provincial and municipal infrastructure sector. This cooperation will allow the two organizations to offer an efficient joint technical evaluation process that will lead to a common final joint evaluation report.

Before this agreement was in place, the Canadian Infrastructure Technology Assessment Centre (CITAC), part of IRC's Canadian Construction Materials Centre, offered a technical evaluation service for new infrastructure products with a national and international focus. The Service d'avis techniques en infrastructures (SATI), formed by the partnership of the Centre for Expertise and Research on Infrastructure in Urban Areas (CERIU) and the Bureau de normalisation du Québec (BNQ), supported the Quebec-based industry.

The agreement, signed in November 2002, allows the two organizations to offer joint technical evaluations to their respective clients. This involves developing a joint assessment protocol for determining the suitability of a technology for its intended use. The protocol will include both testing methodologies and performance criteria.

When the required testing for a technology has been completed, both CITAC and SATI will review the test results and compare them with the performance criteria to make an assessment. If the technology is satisfactory, they will issue a single final joint evaluation report available through each agency's publication service.

For more information, please contact Mr. Harry Baker at (613) 993-3807, fax (613) 952-0268, or e-mail harry.baker@nrc-cnrc.gc.ca.

Registry of Product Evaluations

Now on the Web!

Updated quarterly

http://irc.nrc-cnrc.gc.ca/ccmc

Study looks at ways of achieving worker satisfaction with acoustical conditions

Recent research at IRC has evaluated worker satisfaction with acoustical conditions in open-plan offices. The research was part of the institute's ongoing Cost-Effective Open Plan Environments project (COPE), which is conducting both laboratory and field studies to look at how all aspects of open-office design influence occupant satisfaction ratings. Partners and project objectives can be found at http://irc.nrc-cnrc.gc.ca/ie/cope/index.html.

These workstations at IRC's Indoor Environment Research Facility were the site of acoustical satisfaction studies conducted as part of the COPE project.

The studies related to acoustical satisfaction were carried out in IRC's Indoor Environment Research Facility (IERF), which allows various aspects of the indoor environment to be changed in a carefully controlled manner.

In these studies, participants hired from a staffing agency for the day experienced simulated ventilation noises in combination with simulated telephone conversations emanating from one of the six workstations in the IERF. The participants performed computer-based clerical tasks, involving memorization, and then completed a questionnaire concerning

- satisfaction with each noise condition
- speech intelligibility, and
- characteristics of the noise.

In the first experiment, subjects experienced 15 different simulated noise spectra (a range of frequencies) in combination with the speech from simulated telephone conversations. The noises were intended to be representative of different types of ventilation noise that could occur in real offices. In the second experiment, subjects experienced 15 different combinations of noise level and noise spectrum, again in combination with simulated telephone conversations.

The results of these experiments provide guidance on how to achieve acoustical conditions that would be more satisfying to occupants of open offices.

The overall goal of open-office acoustical design is to maximize speech privacy by a) reducing unwanted sound levels related to speech and b) having a combined level and spectrum shape (i.e., a specific balance of low, mid and high frequencies) of noise that masks unwanted speech sounds without being too disturbing itself. The results of these experiments provide guidance on how to achieve acoustical conditions that would be more satisfying to occupants of open offices.

As expected, the study showed that satisfaction with the acoustical environment increases as speech intelligibility decreases, a finding that supports the common practice of rating acoustical privacy using intelligibility measures such as the Articulation Index (AI) and its replacement, the Speech Intelligibility Index (SII). These measures reflect how loud speech sounds are relative to existing noise levels.

The Speech Intelligibility Index (SII) is a good predictor of acoustical satisfaction and speech privacy ratings, and the findings are consistent with the generally accepted principle that SII values greater than 0.20 are unacceptable. Researchers also found that noise levels of about 45 dB(A) are judged to be most acceptable, giving support to the commonly used rule of thumb that masking sounds should never exceed 48 dB(A). Although louder masking noise is more effective at making speech less intelligible, the improvement is diminished if the spectrum shape is a poor masker. Thus, sound-masking systems must balance the need for high-frequency sound to mask speech and the need to avoid excessive levels of high-frequency sound that can be disturbing.

Acoustical satisfaction was also influenced by the character of the ventilation noise as determined by the difference between high and low frequency components.

Specific questions can be directed to Dr. John Bradley at (613) 993-9747, fax (613) 954-1495, or e-mail john.bradley@nrc-cnrc.gc.ca.

Modelling used to study smoke movement in large and complex spaces

The interior space in modern buildings has become very complex, with the increasing use of large, open atrium spaces, multiple atriums and interconnected floor spaces. In addition, there are other facilities that are both large in area and that have high ceilings, including "big box" stores, sports facilities, warehouses and aircraft hangars. As buildings become larger and more complex, there is a greater need for engineering tools that can help those responsible for the design of such facilities to address fire-safety and smoke-management issues.

As buildings become larger and more complex, there is a greater need for engineering tools that can help those responsible for the design of such facilities to address fire-safety and smoke-management issues.

Researchers at IRC's Fire Risk Management Program recently completed a computational study to evaluate several of these tools, including:

- simple correlations;
- a two-zone model called FIERAsystem (**FI**re **E**valuation and **R**isk **A**ssessment **system**), being developed at IRC; and
- a CFD model, the Fire Dynamic Simulator (FDS), which was developed by the National Institute of Standards and Technology (NIST).

They investigated two different types of building: an aircraft hangar and an atrium space with a mechanical system used for smoke management.

For the aircraft hangar, researchers used a scenario with a fire in a paint shop adjacent to the main hangar and compared the results predicted by the three models. In general, they found that the results were comparable for all three. For example, the predicted temperature in the paint shop was comparable for all three tools during the initial development of the fire. But after flashover in the room, the simple correlation and zone model predicted higher temperatures than the CFD model. Typically, the zone model predicted higher values for both temperature and CO_2 concentrations.

Fire researchers at IRC are studying the capabilities of various modelling tools to predict smoke movement in different types of building. The aircraft hanger, which is very large (in both area and height), but also relatively simple, is one of the building types being investigated.

For the atrium fire scenario, researchers compared the predictions of the numerical models to experimental data for the following parameters:

- the height of the interface between the hot upper smoke layer and the cold lower layer;
- the temperature; and
- the CO_2 concentrations in the smoke layer.

In contrast to the zone-model results for the aircraft hangar, those for the atrium compared very well with the experimental data. The average smoke-layer temperature and CO_2 concentration predicted by the CFD model were also comparable to the experimental data. However, the CFD analysis did not show the distinct temperature zones (smoke layer, transition region and cold zone) that were found in the tests. Instead, the CFD model predicted a continuous increase in temperature in the upper portion of the atrium—that is, it was not able to pinpoint the smoke layer/ambient air interface, which is a critical piece of information in the design of smoke management systems. This means that care must be taken in determining the location of the smoke layer/ambient air interface when using CFD to design smoke-management systems and that further research in this area is required.

Overall, the three tools compare favourably to each other and to the experimental results. The engineering correlations and zone models are useful tools for smoke-management system design for atriums with simple geometry, such as aircraft hangars. However, for more complex buildings, such as those with interconnected atriums, CFD is an increasingly important tool, but warrants further investigation and refinement.

Specific questions can be directed to Dr. Ahmed Kashef at (613) 990-0646, fax (613) 954-0483, or e-mail ahmed.kashef@nrc-cnrc.gc.ca.

Unprotected plastic pipe sprinkler system tested for residential use

Working in the remote British Columbia village of Kemano, researchers in IRC's Fire Risk Management Program have tested a residential sprinkler system for its effectiveness in controlling fires in residential homes. This investigation was one of a series of experiments that IRC conducted in the deserted company town built by Alcan Smelters and Chemicals Ltd. during the 1950s and donated to BC's Office of the Fire Commissioner for training and research.

Furniture burns in one of the Kemano houses during tests to determine the effectiveness of a residential sprinkler system.

A residential sprinkler company designed and installed an unprotected plastic pipe (cross-linked polyethylene) sprinkler system for a furnished wood-framed two-level house with approximately 93 m^2 (1,000 square feet) per floor for a total of 186 m^2 (2,000 square feet). The system had a flow rate of 50 litres per minute for the most hydraulically remote sprinkler head and 55 litres per minute for the hydraulically closest sprinkler head, under a pressure of 240 kilopascals. Its goal was to prevent flashover in the room where the fire originated and to allow sufficient time for the fire department to respond.

To determine the effectiveness of the unprotected plastic pipe sprinkler system, the IRC researchers tested the system's performance on fires originating in a basement recreation room, a ground floor bedroom and the living room. In all experiments, they found that a single sprinkler head controlled and contained fires within the room of fire origin within one minute of activation. Fire damage was limited to furniture near the ignition source, with no structural damage to the residence.

In addition, the system held up well to fire exposure. In the recreation room, the plastic pipes and fittings for the sprinkler system were installed without protection on open wood joists. After exposure to temperatures above their rated temperature of 93°C under a pressure of 552 kilopascals for 140 seconds, the equipment was not visibly damaged and successfully controlled the fire. In some cases, the equipment was exposed to temperatures as high as 140°C without damage.

When conducting the sprinkler experiments, the IRC researchers also looked at the effectiveness of heat and smoke detectors. As expected, the heat detectors, which were rated for 57°C and a temperature rise of 8.4°C per minute, activated earlier than the sprinkler, triggered by the rate of temperature rise. Smoke detectors installed on the egress route also activated before the sprinkler when the door to the fire room was open, but after the sprinkler when it was closed.

Technical data obtained from the Kemano experiments will guide further studies, with an increased fire challenge to the sprinkler systems. The full report on this sprinkler investigation is available for downloading at http://irc.nrc-cnrc.gc.ca/fulltext/rr109. Specific questions can be directed to Dr. Joseph Su at (613) 993-9616, fax (613) 954-0483, or e-mail joseph.su@nrc-cnrc.gc.ca.

National Infrastructure Guide now being used in municipalities across Canada

Continued from cover page

Each committee follows a rigorous four-step process that includes identification of priorities, development of best practices, input from stakeholders and publication. The Infrastructure Guide Project Directorate, which blends personnel from IRC and FCM in one office located at an NRC site, is also important to ensuring that the documents are both technically sound and useful to municipalities.

To obtain a copy of the best practice documents that are ready for use, contact the National Guide Office at 1 866 330-3350, e-mail at infraguide@nrc-cnrc.gc.ca, and Internet at http://www.infraguide.gc.ca. The Infrastructure Guide Project Directorate encourages users to take part in the development of these continually evolving documents by submitting their comments, offering to become a peer reviewer for specific topics or participating in working groups.

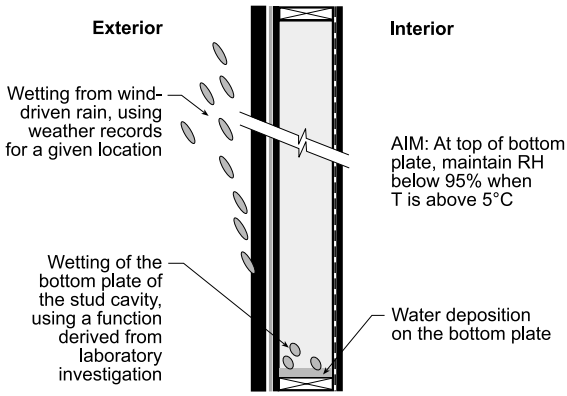
Researchers study effects of climate and design on wetting and drying of walls

Based on experience, we know that the moisture that goes into a wall must be able to get out again, but we haven't been able to quantify how much time it takes for a wall to rid itself of incidental water before deterioration sets in. Now we have methods that show just how sensitive certain components are and how significant climate is when designing to avoid conditions that can lead to deterioration of wall components. These new methods will allow designers to use new, innovative wall designs and products and to compare their performance to that of known, well-functioning walls, for a given amount of water in a given climate.

In the Moisture Management in Exterior Walls (MEWS) consortium project, IRC researchers conducted a large parametric study using IRC's two-dimensional hygrothermal (combined effects of heat, air and moisture) model *hyg*IRC to "expose" virtual wall assemblies to moisture loading from a range of outdoor climates found across North America (see *Construction Innovation* Volume 7 Numbers 2 and 3, and Volume 4 Number 1). The project's main objective was to study the factors that contribute to maintaining certain elements of these assemblies below 95% relative humidity (RH) when their temperature (T) was above 5°C. Threshold RH and T conditions were selected for their relationship to the onset of wood decay.

In the study, the virtual wall assemblies were subjected to moisture loading at two different locations: on the exterior cladding and at the bottom of the stud cavity (see figure). Hundreds of simulations were conducted on a variety of wall assemblies, combining different types of cladding systems, sheathing membranes and boards, insulations and vapour barriers. Here are some of the highlights derived from the results.

Inputs for the mathematical modelling, such as material properties and water leakage rates into the stud cavity, were based on laboratory experimentation. Wall composition, detailing and built-in deficiencies were developed in collaboration with industry specialists. Climate loads were defined through the analysis of weather records for a number of North American locations.



Researchers subjected the virtual wall assembly to wetting of the cladding and of the bottom of the stud cavity over a (simulated) two-year period, to examine the effect of this wetting on the drying of the assembly.

Reduce wetting

Researchers found that water in the stud cavity was detrimental to the adjacent wall materials (i.e., the bottom plate) even in Phoenix where wetting loads were low and the drying potential high. As the climate severity increased, so did the duration of wetness of the wall elements above the threshold conditions. The study showed that reducing the wetting of the stud cavity had the greatest effect on the RH levels at the bottom plate. Unless the wetting of the stud cavity was reduced significantly, designing the walls to dry out by evaporation offered small net benefits.

A matter of detailing

Obviously designers cannot change the severity of the moisture loads in a given geographical region. Nevertheless, the power of designers lies in the way they choose to acknowledge those loads and adapt the design and construction of wall assemblies to suit the severity of the climate. Maps of climate severity are available and the MEWS project has generated a map that characterizes climate, dividing North America into five zones according to net drying and wetting potential (see report at http://irc.nrc-cnrc.gc.ca/fulltext/rr113/).

Building envelope design and detailing affect the distribution and magnitude of the water load on the façade. However, designers and builders can deflect the loads from claddings and deficiencies—which typically develop at junctions between the wall and penetrating elements such as windows—by taking the following actions:

- providing positive slopes to horizontal elements that project from the plane of the façade (e.g. balconies, walkways and window sills), making sure to take the shrinkage of the wood framing after construction into account;
- projecting roof soffits over the façade to shed water and keep it away from low-rise walls;
- projecting the flashing above through-the-wall penetrations such as windows, doors and ducts.

The detailing of junctions between penetrating elements and the wall itself is critical to reduce wetting of the stud cavity, and the introduction of flashing membranes and pans to collect and drain water

to the outside or to a drained cavity behind the cladding can provide an extra measure of protection against any water leakage that might occur as a result of imperfections or aging of materials.

Increase drying

Researchers found that the net drying of the wall assemblies investigated was a function of

- the properties of the materials making up the assembly (construction related)
- the ways in which the layers of materials were put together (construction related)
- the magnitude of the forces providing a differential "drive" (climate related)
- the magnitude of the wetting rates of the stud cavity (climate and construction related).

A large part of the modelling study was done on virtual walls without a clear cavity behind the cladding system. In these cases, the drying potential of the wall assemblies occurring between events of water loading into the stud cavity was insufficient to maintain the bottom plate below 95% RH over the simulated two-year period. Another type of wall assembly exhibited substantial improvement in terms of the RH response at the bottom plate, even in climates of high moisture loads. It included a more air-permeable and more vapour-permeable sheathing board than the others investigated; it also included a clear cavity behind the cladding system. Further investigation into this type of wall construction is warranted.

The full report that presents and analyzes the methodology of the project, as well as an analysis of the parametric study results, can be found at http://irc.nrc-cnrc.gc.ca/fulltext/rr112/.

For more information about the MEWS project, go to http://irc.nrc-cnrc.gc.ca/bes/mews/index.html.

Summary of good practices confirmed by the study

- ***ACCEPT*** the climate loads present in the geographical region of interest
- ***DEFLECT*** the moisture loads away from the façade
- ***COLLECT*** the water that finds its way into the wall assembly by using flashing membranes and pans at penetrations, and
- ***DIRECT*** the water outside by means of an efficient drainage path.

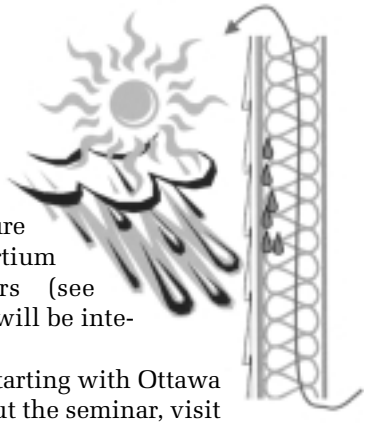
And

- ***DO NOT NEGLECT*** the maintenance of the wall system's components and interfaces, as this is critical to achieving long-term performance and service life.

Cross-Canada Building Science Insight 2003 (BSI) seminar: it's about moisture management for exterior walls

For the last forty years IRC has given seminars in cities across Canada, covering topics related to all aspects of building and infrastructure performance. This year, the BSI seminar will focus on moisture management in exterior walls of low-rise housing, and will discuss issues related to

- the assessment of climate loading
- rain penetration control
- condensation potential
- the drying of walls
- the use of hygrothermal modelling
- detailing at interfaces between components.



Results of the recently completed IRC Moisture Management in Exterior Walls (MEWS) consortium project, conducted with industry partners (see http://irc.nrc-cnrc.gc.ca/bes/mews/index.html), will be integrated into the technical program.

The seminar will be presented in 15 cities, starting with Ottawa in early October 2003. For more information about the seminar, visit our Web site at http://irc.nrc-cnrc.gc.ca/bsi/2003/index.html.

Dates and Locations

2003

October	7	Ottawa
	9	Toronto (West)
	24	St. John's
	27	Halifax
	29	Charlottetown
	31	Fredericton
November	6	Toronto (East)
	14	Whitehorse
	17	Vancouver
	19	Calgary
	21	Winnipeg
December	1	Yellowknife
	3	Edmonton
	5	Saskatoon

2004

January	13	Sainte-Foy
	15	Montreal

IRC begins development of potential water quality forensics tool

In the wake of several serious water quality failures in Canada, IRC's Urban Infrastructure Rehabilitation Program has started a project to develop a diagnostic tool to aid water utilities in maintaining a safe and sufficient water supply. Currently in its early stages, the project will eventually result in a computer model to aid in identifying the potential cause of water contamination and prioritizing the methods for remediation.

This diagnostic process, called the forensic examination of water quality failure, is extremely challenging because the water distribution network may consist of hundreds (sometimes even thousands) of kilometres of pipes. Generally inaccessible for direct inspection, these pipes may be made of different materials, be of different ages, and be found in different soil conditions.

Using pattern recognition techniques, the model will begin with the reported effects of water contamination (which can include changes in turbidity, odour, taste and colour, as well as illnesses ranging from minor to serious) and work backward to determine the cause of the water quality failure. Potential pathways for contamination (causes) include corrosion of system components, leaching of chemicals, permeation of organic compounds through non-metallic components of the system, intrusion of contaminants, regrowth of microbes in pipes and distribution storage tanks, and failure in the water treatment process.

Going even further, using a technique called "fuzzy logic," the model will determine the most probable source of the contamination and also prioritize the remedial measures for the candidate sections of pipe.

For example, if a municipality reports a high incidence of minor illness (e.g., gastro-intestinal cases), the computer model will be able to tell the user that there is a relatively high probability that the cause of this illness is microbial, that the microbes most likely came through intrusion, and that the intrusion most likely occurred in the sections of the pipe affected by cross connections or maintenance events, or broken pipes or sewers.

The benefits for water utilities should be faster identification of the causes of water quality failure, allowing for the containment of contamination in the domestic water supply and the prioritization of remedial actions.

For more information on this project, or to explore the possibilities for collaboration, please contact Dr. Rehan Sadiq at (613) 993-6282, fax (613) 954-5984, or e-mail rehan.sadiq@nrc-cnrc.gc.ca.

Newsbrief

Project to help water utilities manage the failure risk of large water transmission mains

The failure of large-diameter water transmission mains, though relatively rare, can have significant consequences, which can include the cost of repair, water losses and, at times, heavy damage to infrastructure, adjacent buildings and the environment. The risk of failure increases as these water mains age and deteriorate.

IRC, with the co-sponsorship of the American Water Works Association Research Foundation (AwwaRF) and nine water utilities from the U.S., Canada and Australia, has embarked on a research project aimed at helping water utilities manage the risk related to their large-diameter water transmission mains.

The project has two main undertakings:

1. to model the deterioration of these large water mains—a challenging proposition given the scarcity of pipe-condition data; and
2. to combine the deterioration model with the expected cost of failure and of rehabilitation to create a management strategy that would simultaneously minimize the risk of failure and be cost effective.

If you have data on inspection and condition assessment of large water mains, and are willing to provide them for the benefit of this project, please contact Dr. Yehuda Kleiner (613) 993-3805, fax (613) 954-5984, or e-mail yehuda.kleiner@nrc-cnrc.gc.ca.

Are you interested in commercializing IRC's water main renewal planner, WARP?

WARP is a new software tool that helps municipalities plan the renewal of their water mains by modelling the deterioration and breakage rates of these mains. The analysis of water main breakage patterns takes into consideration time-dependent factors such as:

- temperature
- soil moisture and rainfall deficit
- main replacement rates
- cathodic protection (CP) strategies, including both hot-spot and methodical retrofit CP.

WARP quantifies the influence of each of these factors on pipe-breakage rates to
a) identify the "true" deterioration rates of buried water mains, and
b) project the impact of various operational strategies on future breakage rates.

IRC is seeking software developers specializing in infrastructure management systems who might be interested in licensing WARP for commercialization. Letters of interest will be accepted until August 31, 2003. For more information, please contact Dr. Balvant Rajani at (613) 993-3810, fax (613) 954-5984, or e-mail balvant.rajani@nrc-cnrc.gc.ca.

IRC will host world building congress in Toronto

If your work depends on staying up to date on the latest trends and technology in the building and construction industry, reserve May 2 to 7, 2004 in your agenda. On those dates, the leading experts on building and construction from industry, education and the research community will meet in Toronto for the CIB World Building Congress 2004.

With its theme "Building for the Future," this action-oriented event will bring together both practitioners and researchers from among CIB's member organizations and beyond to discuss the latest research and advances in the building and construction industry, and to focus on creating solutions to the key issues affecting the sector.

CIB is the International Council for Research and Innovation in Building and Construction, a worldwide network of 5000 members and 500 member organizations active in all fields of building and construction-related research.

"As an organization, CIB is a relevant source of worldwide information on research and innovation in the building and construction field, an effective access point to the building and construction industry for the research community, and a reliable forum for practitioners and researchers," says Dr. Sherif Barakat, the current president of CIB.

In addition to the main conference, concurrent international conferences on indoor air quality, ventilation and energy conservation (see *Construction Innovation,* Volume 8, Number 1) and multi-purpose high-rise towers and tall buildings will be held, adding significantly to the substance of the event.

"CIB 2004 is a unique event, offering three conferences in one to provide a forum for communications among construction practitioners, building managers and researchers on a host of critical building-related issues," said Dr. Sherif Barakat, president of CIB and director general of IRC.

The congress will provide an excellent forum for the presentation and assessment of new research results on a wide range of timely issues in building construction. Topics will include

- the construction process
- trends in codes and regulatory systems
- construction in developing countries
- ventilation requirements
- strategies and control systems
- safety considerations in HVAC systems design
- indoor air quality and energy conservation
- occupant environment in high-rise buildings
- fire and structural safety
- security in tall buildings

Leading professionals from around the world make up the various committees responsible for organizing the congress, which is expected to draw around 700 participants from 40 countries.

As the countdown to the congress continues, regular updates will be posted on the Web site at www.cib2004.ca.

What we're hearing

Workshop focuses on new fire-suppression technologies

New fire-suppression technologies involving water mist and firefighting foam were recently discussed at the Workshop on Fire Suppression Technologies held in Mobile, Alabama. Technologies that generated particular interest included:

- A portable water-mist extinguisher that was recently patented by CAFS Unit Inc. and the National Research Council of Canada (NRC). Research has demonstrated its ability to extinguish many different types of fire inexpensively and with little impact on the environment. With further research this technology could have a wide range of applications.
- A new nano-scale water-mist technology that uses very fine water mist (1 to 5 microns), produced by ultrasound and developed by NanoMist Systems, LLC, acts like a gaseous agent and can effectively extinguish small-scale laboratory fires. With further research efforts, this system could represent a breakthrough, with the potential for many applications.
- Ice mist, another new technology developed by ICE-TEX uses a suspension of very small ice crystals in a water mixture, with six times the cooling capacity of water. This technology has demonstrated its capability in extinguishing wood fires; however, its cost of production is relatively high and its potential applications need to be studied further.

At the Workshop, attendees learned that 3M has stopped production of its aqueous film-forming foam (AFFF) firefighting agents containing perfluoro octyl sulphonate (pfos) because of both environmental and toxicological concerns. Systems that use environmentally friendly foams to extinguish liquid fuel fires—for example, NRC's compressed-air foam (CAF) technology—are attracting great interest in the fire-suppression community. This is particularly so since research carried out by the U.S. Naval Research Laboratory demonstrated that non-AFFF foams delivered using traditional systems are not able to extinguish this type of fire (liquid fuel).

For more information on these fire-suppression technologies, please contact Dr. Zhigang Liu at (613) 990-5075, fax (613) 954-0483, or e-mail zhigang.liu@nrc-cnrc.gc.ca.

Upcoming events

AUGUST

9-12
Insulating Glass Manufacturers Alliance (IGMA), Summer Meeting, Ottawa. Contact: Ms. Marg Webb at (613) 233-1510; www.igmaonline.org/upcoming_events/summer/

24-27
Futureworks: The Shape of Public Works to Come. 2003 APWA International Public Works Congress and Exposition. San Diego. http://www.apwa.net/Meetings/Congress/2003/

SEPTEMBER

17-20
2003 APTI Conference: 21st Century Preservation—Conservation and Craftsmanship. Association for Preservation Technology. Portland, ME. http://www.apti.org/

21-24
Transportation Association of Canada Annual Conference, "The Transportation Factor." St. John's. http://www.tac-atc.ca/english/annualconference/annualconference.cfm

OCTOBER

8-9
Construct Alberta 2003. Calgary. www.homebuilderexpo.com

19-21
3rd Forensic Congress 2003. ASCE. San Diego. http://www.asce.org/conferences/forensic2003/

22-25
16th Canadian Hydrotechnical Conference, Canada Centre for Inland Waters Burlington, ON. Contact: Saeed Choudhary at saeed.choudhary@mto.gov.on.ca

29
Expo-Contech 2003. Montreal. scorriveau@contech.qc.ca

NOVEMBER

3-5
Global Summit on Performance-Based Building Codes. Washington, DC. http://www.iccsafe.org/calendar/ircc.html

6-8
2nd International Symposium on Building Pathology, Durability and Rehabilitation "Learning from Errors and Defects in Building." Lisbon. http://www.lnec.pt/cib_symposium_lisboa03

12-15
Civil Engineering Conference and Exposition 2003. Nashville, TN. http://www.asce.org/conferences/annual03/

17-19
Infra 2003, "The Changing Infrastructure Rehabilitation Market: The Emergence of a New Dynamic." Montreal. http://www.ceriu.qc.ca

19-21
CIB 2003 International Conference on Smart and Sustainable Built Environment (SASBE2003). Brisbane, Australia. http://www.cmit.csiro.au/home/events/

DECEMBER

3-5
Construct Canada 2003. Toronto. www.constructcanada.com

7-10
Society for Risk Analysis 2003 Annual Meeting—Bridging Risk Divides. Baltimore. http://www.sra.org/events.htm#annual

This calendar does not include all events scheduled to take place during this time frame. For a more complete listing, see the Web version of "Upcoming events" at http://irc.nrc-cnrc.gc.ca/events.html

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Editor: Jane Swartz

Institute for Research in Construction
National Research Council Canada
Ottawa, Ontario K1A 0R6

Client Services:
Tel.: (613) 993-2607 **Fax:** (613) 952-7673
Internet: http://irc.nrc-cnrc.gc.ca

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