Volume 6 Number 3 **Summer 2001**

construction innovation

NRC · CNRC

Study of smoke movement in sprinklered malls and atria: enhancing shopper safety

Findings from an IRC joint study of smoke movement from fires in sprinklered malls and atria with the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) could eventually contribute to enhanced shopper safety. The project addresses concerns that smoke cooled by the sprinklers in these buildings could travel downward, where it could cause problems for people evacuating the building. Results from the study, however, indicate that, initially, the smoke is hot and rises towards the ceiling of the mall, where it can be removed by an exhaust system.

To conduct the study, the research team set up a large-scale test facility to simulate areas of particular concern: a retail outlet on the second floor of a mall and a section of a pedestrian mall in a shopping centre. Because North American fire statistics indicate that approximately 90% of retail fires activate four or fewer sprinklers, four sprinklers were used in the retail portion of the test facility. The mall portion included a smoke exhaust system.

Some tests simulated fire scenarios typical of retail stores in malls that involved clothing and toys in boxes, and stored or displayed bulk goods, such as paper towels.

Highlights

The first series of tests used a propane burner shielded from the sprinkler water spray to determine the impact of both fire and sprinkler scenarios typical of retail spaces on smoke movement. In general, these tests showed that for smaller fires (with a heat release rate of less than 1 megawatt) the smoke was cooled to near or below ambient temperature. The smoke was mixed throughout the fire compartment (retail portion of the test facility) and spilled through the opening and descended into lower areas of the mall portion of the facility. Smoke from larger fires (with a heat release rate of more than 1 megawatt) formed a hot layer near the ceiling of the compartment before entering the mall area.

The second series of tests simulated fire scenarios with the fuel shielded from direct water spray from the sprinklers. These scenarios were typical of those that occur in retail stores in malls and included clothing and toys in boxes located in display units, and stored or displayed bulk goods, such as paper

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Published by

Institute for Research in Construction IRC

Choosing the best Part 9 advisory document

Users of Part 9 of the National Building Code (NBC), Housing and Small Buildings, have three quite different advisory publications available to them:

- National Housing Code of Canada 1998 and Illustrated Guide
- User's Guide — NBC 1995 Housing and Small Buildings (Part 9)
- User's Guide — NBC 1995 Application of Part 9 to Existing Buildings.

Each has an entirely different focus and application, and choosing the right one depends on the job at hand.

National Housing Code of Canada 1998 and Illustrated Guide

This publication assists the house builder and related trade persons, as well as the building official, by extracting those NBC requirements that pertain only to detached, semi-detached and row houses. These houses do not have shared egress or service spaces; nor do they have dwelling units above one another.

The code requirements comprise the first half of the document; advice on how best to meet the requirements makes up the second half. Hundreds of illustrations are used to give a clear picture of what should be done. For the design and construction of new houses, this is the best code reference document of the three.

User's Guide — NBC 1995 Housing and Small Buildings (Part 9)

This publication addresses *all* types of small buildings permitted under Part 9, not just houses. It covers buildings of three storeys or less in height with an area of 600 m^2 or less. These buildings may contain residential, business and personal services, commercial or medium to low hazard industrial occupancies. Although this guide is also very well illustrated, it focuses on imparting an understanding of the principles behind the code requirements, information of particular interest to designers, building officials and homebuilders.

User's Guide — NBC 1995, Application of Part 9 to Existing Buildings

This guide addresses the challenges of applying the primarily prescriptive requirements of Part 9 to the varied conditions encountered when renovating a house or small building. It is of great value to renovators, inspectors and building officials, and is particularly useful when read in conjunction with the other Part 9 guides.

There are two chapters and an appendix in this guide. Chapter 1 thoroughly discusses the principles to be followed in regulating existing buildings. By concentrating on the principles, rather than on the letter of the requirements, the primary objective of the building code — that is, protecting the health and safety of people — can be focused on. Chapter 2 presents a collection of 50 typical challenges that may arise when a building is renovated or its occupancy changed. The appendix supports Chapter 1, containing a compilation of the intents of the nearly 1,000 requirements that constitute Part 9.

Each of these three publications responds to specific needs of users of Part 9, whether they are homebuilders, small contractors, designers, or building officials. Together, they offer comprehensive coverage of the scope and application of Part 9 of the National Building Code.

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

To order any of these documents, call our Publication Sales Department at 1 800 672-7990 (613 993-2463 for Ottawa-Hull and U.S.).

Do you want to know how to prevent back-siphonage in buildings?

One of the best ways to find out is to consult the new *User's Guide – National Plumbing Code of Canada 1995*. This easy-to-read guide helps you apply the requirements of the National Plumbing Code (NPC) by explaining the history of each requirement and relating the intent and rationale behind each Sentence in the NPC. The guide also contains supporting additional information and over 100 diagrams for further clarification. Where applicable, excerpts from the National Building Code of Canada and other referenced documents are included to provide users with a better understanding of the requirements of the NPC.

This guide has been prepared to assist people involved in the design, modification or approval of plumbing systems. It will be particularly useful to those in plumbing apprenticeship programs.

The *User's Guide – National Plumbing Code of Canada 1995* will be available in September. **You can purchase it at the special introductory price of $37 until November 30, 2001**. After this date, the price will be $47.

Here's how to order!

Fill out the enclosed order form or contact our Publication Sales department:
Tel.: (613) 993-2463 or 1 800 672-7990
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E-mail: Irc.Client-Services@nrc.ca

Codes-related Web sites

Canadian Commission on Building and Fire Codes
http://www.ccbfc.org

Canadian Codes Centre
http://codes.nrc.ca

Provincial/Territorial Committee on Building Standards
http://www.ptcbs.org

Newsbrief

Public consultation on objective-based codes

The Canadian Commission on Building and Fire Codes (CCBFC) and the provinces and territories have just completed a national public consultation on the format, structure, publication cycle and objectives of the new objective-based codes (see *Construction Innovation*, Volume 5, Number 3, Summer 2000). The CCBFC prepares the model National Building Code, National Fire Code and National Plumbing Code, and the provinces and territories adopt or adapt those codes for use in their regulation of the design, construction and operation of buildings and other facilities.

The consultation is a milestone because it marks the first time that the CCBFC and the provinces and territories have jointly consulted with stakeholders on a major code issue. A key element of this highly successful venture was the use of the Internet to provide Web-based access to the consultation materials, allowing people to review these materials and comment online.

The public response to the consultation indicates that there is broad support for objective-based codes and for the coordinated approach being used to develop them.

A variety of comments were received, many of them suggesting ways in which the new codes can be made to work better. An analysis of these comments is being carried out and will be reviewed by the provinces and territories and the CCBFC at their fall 2001 meetings. The findings from this analysis will be reflected in complete objective-based versions of the 1995 code documents that will be subject to a coordinated national/provincial/territorial public consultation in the spring of 2002.

Specific questions can be directed to Mr. John Haysom at (613) 993-0043, fax (613) 952-4040, or e-mail john.haysom@nrc.ca.

For more detailed information about the new objective-based codes, the consultation process and the codes development system, visit the Commission's Web site at http://www.ccbfc.org.

Call for candidates to serve on the CCCME

The National Research Council (NRC) is seeking candidates to serve on the Canadian Commission on Construction Materials Evaluation (CCCME).

The CCCME was established by NRC to support innovation, technology transfer, productivity and competitiveness in the Canadian construction industry, and to enhance public safety in the built environment. It is responsible for providing policy direction on all matters pertaining to the operation of the Canadian Construction Materials Centre (CCMC), and for ensuring the reliability and quality of technical decisions and reporting.

CCCME members are appointed by NRC. Such appointments do not carry remuneration, but expenses incurred to assist in Commission meetings, typically held once a year, are reimbursed by NRC. The term of appointment is normally three years; members may be re-appointed for further terms subject to maintaining a reasonable degree of membership rotation. In order to provide an opportunity for the Commission to benefit from new ideas and different points of view, its policies and procedures stipulate that one third to one half of the membership may be changed every three years. Such a rotation is about to be conducted. **New appointments and re-appointments will be effective November 1, 2002**.

CCCME members are selected from a mix of backgrounds to ensure that the Commission can address both policy and technical issues in a manner representative of the different regions of Canada, sectors of the construction industry, and users of the evaluation, technical information and listing services offered by CCMC. **Members are expected to exercise broad objective judgements and are chosen for their individual interests and abilities rather than as delegates or representatives of any particular association or group**. They are not permitted to name alternates.

The Commission is currently seeking representation from the following sectors:

- **Regulatory**
  provincial, territorial and municipal building officials; municipal infrastructure administrators; and provincial ministries of transport;
- **Manufacturing**
  members of the private sector involved in the manufacture of building and infrastructure materials, products and systems;
- **Major users**
  architects, engineers, contractors, specification writers, and private and federal agencies with an ownership mandate;
- **General**
  those associated with the construction industry in an independent capacity, which may include independent research, testing and certification agencies.

Those interested in serving on the Commission should submit a resumé with details of their personal history, by **December 31, 2001** to:

Mr. R. C. Waters, P. Eng.
Secretary, CCCMENational
Research Council of Canada
M-24, Montreal Road Campus
Ottawa, Ontario
K1A 0R6

Newsbrief

CCMC offers new service to its clients

Manufacturers of innovative construction products can now obtain a focused report known as a scope and evaluation plan (SEP), which lays the groundwork for a CCMC evaluation and summarizes the technical issues that must be addressed in the evaluation.

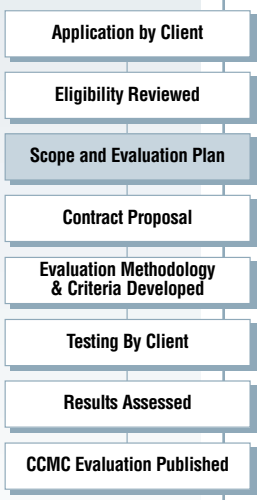
The SEP provides a valuable tool that allows manufacturers to understand what is involved in evaluating and gaining acceptance for their products in the Canadian marketplace and what the benefits of the evaluation are. One of these benefits is the reduction in overall time needed to evaluate a product because the scope of the evaluation process will have been clearly defined in the SEP.

Issues addressed by the SEP include:

- regulatory impacts to be assessed
- key parameters to be identified
- technical literature to be searched
- technical experts to be consulted.

In the development of the scope and evaluation plan, CCMC consults with all provinces and territories to ensure that any major provincial or territorial concerns are identified. It also seeks input from its external review committees, the Standing Committee on Technical Evaluations and the Standing Committee on Infrastructure Technology Assessments. As a result of this consultation and review process, technical issues, along with relevant requirements in the National Building Code or other applicable codes and standards, can be outlined in the SEP. Throughout the preparation of an SEP, there is an ongoing dialogue with clients, leaving room for discussion of any issues that might emerge.

When the SEP has been completed, it is sent to the manufacturer with a formal contract proposal outlining the cost and time frame for the evaluation. If the manufacturer accepts the contract proposal, half the cost of the SEP is reimbursed to the client and put towards the cost of the evaluation.



For more information about this new process, contact Mr. Ron Waters at (613) 993-6602, fax (613) 952-0268, or e-mail ron.waters@nrc.ca.

IRC Director General named President of major international building council

Dr. Sherif Barakat, Director General of the Institute for Research in Construction (IRC), has been elected President of the International Council for Research and Innovation in Building and Construction (CIB). The election of Dr. Barakat and the organization's new Board of Directors for the period 2001 to 2004 came at the meeting of CIB's General Assembly in Wellington, New Zealand, held in early April. Dr. Barakat was also elected as Treasurer of the new CIB Development Foundation, which provides the organization with the financial ability to accept and lead major funded activities for the benefit of its members and the world at large.

Since it was founded in 1953, CIB has developed into a worldwide network of more than 5,000 experts representing about 500 organizations active in all fields of building and construction research. The organization's international research groups cover a broad spectrum of technical, economic, environmental and other aspects of the built environment through the stages of its life cycle, addressing all steps in the process of basic and applied research, documentation and technology transfer, implementation and actual application.

> As part of his duties as CIB President, Dr. Barakat will host the triennial CIB Building Congress, to be held in Toronto in May 2004.

CIB is a reliable and effective access point to the global research community and provides a forum for achieving a meaningful exchange between researchers and building and construction stakeholders. Dr. Barakat's election to the organization's Board will ensure that IRC is connected to all activities of the CIB network, hence providing opportunities for collaboration with other research organizations and in the process levering Canada's investment in construction research. This kind of connection will also facilitate IRC's objectives of being a gateway to global construction technology and a champion for Canadian technology worldwide.

"It certainly is a great honour to lead such a prominent and world-renowned organization, and one with such vast reach and relevance," said Dr. Barakat in his inaugural address. "Our vision is to achieve recognition of CIB as the real and virtual network of the global construction community, and to maintain the reach, relevance and transparency of all CIB operations and outcomes. I look forward to working with the new Board and all members to achieve this goal."

Dr. Sherif Barakat, IRC's Director General, was recently elected President of CIB.

For more information about CIB and its activities, visit the CIB Web site: http://www.cibworld.nl.

IRAP boosts innovation in the construction industry

Need assistance to get your innovative new construction product to market? Have a technical problem but don't know whom to call for advice? NRC's Industrial Research Assistance Program (IRAP) can help.

IRAP enhances the innovation capability of Canadian small- and medium-sized enterprises (SMEs) across Canada, including the construction industry. A Canada-wide network of Industrial Technology Advisors (ITAs) delivers IRAP's programs and services, with a number of ITAs collaborating as a group to serve 10 specific industrial sectors and their unique needs.

The IRAP Construction Sector Group (CSG), for example, consists of 25 ITAs across the country, who have a variety of experience in the construction industry. Formed in 1997, this group is recognized for its leadership in advancing knowledge, technology and innovation among the many SMEs in the construction sector.

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Fire risk management

Study of smoke movement in sprinklered malls and atria: enhancing shopper safety

Continued from cover page

towels. The resulting fires had three distinct phases: fire growth and sprinkler activation, steady fire, and decay. During the growth phase, sprinklers typically activated within 5 minutes, and smoke began moving into the mall portion of the test facility.

During the steady phase, smoke flowed continuously into the mall section of the test facility. A smoke layer formed in the mall area even though the smoke exhaust system was in use. The density of the smoke layer and its carbon monoxide concentration both exceeded tenability limits. Any accumulation of this smoke in exit routes could limit evacuation.

During the decay phase, the smoke cooled and accumulated near the opening between the retail space and the mall space. Visibility in both areas became limited. The rapid mixing of smoke throughout the fire compartment during this phase could trap any occupants still in the area.

IRC researchers will provide the information collected as part of these tests to various organizations that establish North American fire codes and standards. Specific questions can be directed to Dr. Gary Lougheed at (613) 993-3762, fax (613) 954-0483, or e-mail gary.lougheed@nrc.ca.

The test facility simulated a retail outlet on the second floor of a mall and a section of a pedestrian mall.

Smoke fills the fire compartment (retail space) then rises towards the ceiling. As the smoke cools, it flows downward.

IRAP boosts innovation in the construction industry

Continued from page 5

Some ways in which the CSG helps its SMEs with technical and financial assistance include:

- evaluating technology and assisting with feasibility studies;
- linking clients to technology and business expertise across the country and internationally;
- assisting SMEs by providing financial assistance for high-risk R&D projects;
- helping with technology transfer;
- developing partnerships with organizations and agencies interested in the benefits of construction technology; and
- providing pre-commercialization assistance.

Many companies in the construction industry have benefited from IRAP's help. A good example is Royal Mat, a company that received funding, advice and assistance from IRAP. IRAP helped the company determine the feasibility of their product—an innovative recycling of rubber tires to make noise-reducing inserts for concrete floors called NEUTRA-PHONE©—improve it, and get it accepted for sale in Canada. As a result, Royal Mat more than quadrupled their sales in five years and became a Canadian construction industry success story. [If you would like to learn more about the evaluation of this product by the Canadian Construction Materials Centre (CCMC), see the article in *Construction Innovation*, Volume 5, Number 2, Spring 2000.]

For more information on IRAP, contact an IRAP ITA in your region by calling 1 877 994-4727 or visit the IRAP Web site at http://www.nrc.ca/irap.

Major international symposium tackles key industry innovation issues

The International Construction Innovation Symposium, held in Ottawa in June, represented a significant step forward for stakeholders in the construction industry worldwide. This unique international symposium brought together 100 of the most important and respected figures in the construction industry from 15 countries — representatives from private industry, the public sector, academia, and the research community — to discuss the key issues related to innovation in the industry. The symposium embraced all facets of the construction industry with the exception of issues related to low-rise residential construction, and labour, which will be addressed in other venues.

Traditionally, the construction industry has had a relatively conservative approach to innovation and the adoption of new technologies. However, major systemic forces such as information technology, performance-based regulation, sustainability, and new business practices are emerging, all of which are rapidly changing how the industry must operate.

In his keynote address to the symposium, Dr. Gilbert Normand, Canada's Secretary of State (Science, Research and Development) spoke of the great importance of innovation to the construction industry and to the countries of the world. He also issued a challenge to the Canadian representatives at the symposium, urging them to come forward with specific recommendations about how the industry and the Government of Canada can forge new partnerships to improve the industry's ability to innovate.

Dr. Normand said everyone benefits when an industry, or an economy, innovates. Like most other industrialized nations, Canada spends about 15 percent of its GDP on its built environment, he said. Find better ways to build, find ways to build at less cost, and resources will be freed up for other purposes, including improving the profitability of the construction industry.

Participants had these goals in mind as they set about discussing the vital issues that would help point the way to enhancing the industry's innovative capacity.

General consensus

Although the gathering, which was initiated and organized by the Institute for Research in Construction (IRC), was only a first step in what must be a long process of change, there was consensus on some important points.

It was agreed that to be a viable, sustainable, profitable and safe industry, those in construction must add value to their customers' business.

Symposium participants said the construction industry must be empowered to determine how to deliver the best products and services. The new business reality includes globalization, increased client demands and expectations, and new ways of doing business. There is a need, therefore, to build trust and partnerships among clients and industry partners, including designers, contractors and materials providers, and to move from risk aversion to risk sharing — a situation where innovation is rewarded.

There was broad consensus that the knowledge level of all industry stakeholders must be raised so that new processes may be introduced, and that the whole life cost of a project be considered, not just the initial cost. This upgrading of knowledge (best practices, new products and technologies, benefits and successes) will only be possible in a culture of information sharing and cooperation.

The entire process requires industry leadership and a new spirit of collaboration among clients, the private sector, governments and others, and it must be national with regional clusters and international links. A network of champions (stakeholders who have the stature and courage to take risks and lead the process), and roadmapping to point the way, are essential elements in moving forward.

Participants noted that business practices that financially reward innovation must be encouraged and that governments can provide support in various forms — as a client, a regulator or a facilitator. And finally, there was agreement on the need for benchmarking, and measurement methodologies to determine industry productivity gains.

Industry accepts Secretary of State's innovation challenge

Following the International Construction Innovation Symposium, Canadian participants gathered at a forum to discuss the symposium conclusions and their relevance to the Canadian construction industry. PCL Vice President Dev Fraser, acting as chair of the forum, was quick to accept the challenge that had been issued by Dr. Gilbert Normand, Secretary of State for Science, Research and Development, in his keynote address to the symposium. This challenge involves developing recommendations on how the Canadian industry and government can work together to promote innovation.

The forum, titled Construction Innovation Forum: Building an Action Plan for Canada, provided a unique opportunity for a sector-wide group to develop a systematic approach for improving the innovative capacity of Canadian construction.

Participants set to work laying the foundations of an action plan, identifying key players and their roles, and outlining pivotal steps and activities to be addressed in implementing such a plan. Out of the forum came a statement of what the next steps should be. As well, a significant number of people agreed to solicit wider input from the industry and work together to develop an action plan that will be taken back to Dr. Normand.

Indoor air quality — improving our understanding

The quest for energy efficiency has led to tighter building envelopes. This, combined with a host of new building materials, creates a challenge for maintaining indoor air quality (IAQ), a function of both contaminant-source control and effective ventilation. To achieve satisfactory IAQ, a thorough understanding of the emission characteristics of building materials and furnishings and a tool to predict the effect of emissions from specific materials on IAQ are needed.

IRC's initiative on material emissions and IAQ modelling

In 1995, IRC launched Phase I of the Material Emissions and Indoor Air Quality (MEIAQ) project. It was sponsored by IRC in association with government, universities, and the building industry, and included cooperation with other research organizations in the United States and Australia. The purpose of the project was to develop an emissions database and an IAQ prediction model.

Emissions database for common building materials. In the course of the project, researchers obtained emission data for 48 materials, including six types of wet materials (e.g., stain, paint and sealant) and nine types of dry materials (e.g., plywood and carpet). As well, researchers tested five building assemblies to determine the difference between emissions from individual materials and those from an assembly made of the same materials.

MEDB-IAQ (material emissions database and indoor air quality simulation program). This is a single-zone room simulation model that will help users make informed decisions about material selection and ventilation strategies. The model was validated using two test houses.

Members of Phase I of the project included:

- Canada Mortgage and Housing Corporation
- Natural Resources Canada (NRCan)
- Canadian Wood Council
- Chemical Manufacturers Association
- Gypsum Association
- The Building Center of Japan
- USG Corporation

In addition, the following organizations made significant contributions to the project:

- Carleton University
- Massachusetts Institute of Technology
- U.S. Environmental Protection Agency
- U.S. National Institute of Standards and Technology
- Australia Commonwealth Scientific and Industrial Research Organization.

Future plans

Phase II of the project, which is now underway, will establish a sound scientific basis for understanding emission processes that occur in various materials and will interpret the emission data collected in Phase I. To achieve this, the database will be expanded to cover contaminants known to have an effect on health and commonly found in buildings. The objectives of Phase II are to:

1. Establish a list of contaminants for testing, especially those known to affect people's health and to be present in buildings;
2. Determine the variation in emission rates between similar specimens;
3. Expand the database to include 70 materials;
4. Refine the IAQ prediction model.

This phase of the project will be supported mainly by government agencies (see box) and will have a technical advisory committee to obtain input from the building industry and other research organizations. In addition, a health advisory committee will be established to assist with the identification of the compounds described in project objective (1) above and with the interpretation of results.

For more information, contact Dr. John Shaw at (613) 993-9702, fax (613) 954-3733, or e-mail john.shaw@nrc.ca.

Phase II of the project is being supported by:

- Public Works and Government Services Canada
- NRCan
- Canada Mortgage and Housing Corporation
- Health Canada

IRC to develop software to analyze conventional and tubular skylight performance

The Institute for Research in Construction and several partners have launched a multi-year project to develop software to assess the optical characteristics and daylighting performance of skylights.

Skylights are found in many modern and retrofitted building types. In commercial and institutional buildings, they are typically used to simulate the outdoors and bring natural light and solar heat indoors. In residential buildings and houses, they are used mainly for illumination. While skylights have inherent potential to save on lighting, heating and cooling energy — along with their positive effects on building occupant satisfaction — they may result in high energy consumption in buildings if not properly designed.

Selecting the right skylights for a given building and use — that is, those that achieve an optimal balance between energy and daylighting performance — presents designers with a complex task. The great variety of shapes and sizes of the many different types of skylights on the market today results in widely varying optical properties among the various products, making choice difficult.

The project partners are:
The Institute for Research in Construction, the Panel on Energy Research and Development (PERD), Public Works and Government Services Canada (PWGSC), and Natural Resources Canada (NRCan)

Manufacturers also face a challenge: They need design tools to assess the optical and daylighting performance of skylight products that would allow them to determine the suitability of their products in meeting specific design requirements. In addition, because skylight products are often large, it can be difficult to fit them into test facilities. Measurements on some smaller products are possible, but they cannot be generalized to apply to other products.

Recently, tubular skylights (also known as light pipes) have emerged as a new technology with the potential to eliminate some of the drawbacks of conventional skylights, such as excessive solar heat gain, and to bring light into areas that are not reachable by conventional skylights and windows. The performance of both tubular and conventional skylights will be analyzed in the IRC-led project.

The software developed in the course of the multi-year project will provide architects, engineers, skylight designers and manufacturers, and manufacturers of related components with a tool to help them come up with an appropriate skylight design for a given building and use. It will permit these users to study the effects of such factors as skylight shape and dimensions, the height of the curb and light well, and the optical characteristics of the glazing, including transparency or translucence, and coatings.

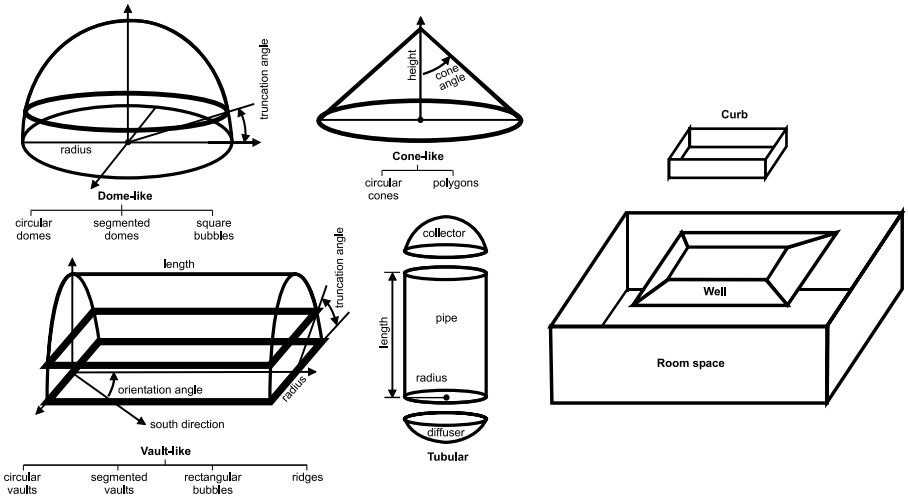
Once a designer has specified the required characteristics of the skylight, it will be possible to perform a daylighting analysis that takes into account various sky conditions — clear, partly cloudy, and overcast conditions — or various combinations of conditions that simulate the sequence of occurrences during a typical day. At the end of the analysis, the designer will receive feedback on how well the design performed in terms of providing daylight to the interior space and acceptable energy consumption for a given set of conditions.

Skylight manufacturers will be able to:

- precisely specify and build skylights
- accurately rate skylight products
- help building designers select skylight products that meet design criteria for achieving energy savings.

The first beta version of the software is expected to be ready by June 2002. Experimental and analytical validation of the software will follow. The complete software package should be available by the end of 2004.

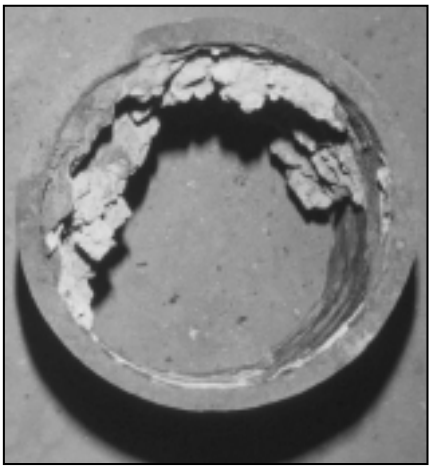
Comments and suggestions are appreciated and may be addressed to Dr. Aziz Laouadi at (613) 990-6868, fax (613) 954-3733, or e-mail aziz.laouadi@nrc.ca.



Various skylight shapes and a skylight/room interface

Collaborative project to study failure mechanisms in grey cast-iron pipes

IRC has undertaken a three-year, collaborative research project with the American Water Works Association Research Foundation to build a new understanding of the effect of corrosion pitting on grey cast-iron pipes used in water systems. ("Grey" refers to the colour produced by the graphite flakes in the cast iron, which can be seen along the broken surface of these pipes manufactured between 1850 and the early 1970s.)



Circumferential pipe failure from the City of Toronto

Each year, cities in Canada and the U.S. experience thousands of failures in small, grey cast-iron pipes. Over 80% of these failures occur when the pipes crack across the centre, which is similar to the way in which a twig breaks when it bends.

There are corrosion pits at the broken edges of more than 90% of these failed pipes but, at the present time, not much is known about the exact effect of this pitting on the mechanical strength of the pipes. To solve this problem, IRC researchers will combine experimental stress measurements with finite element computer modelling to investigate pipe behaviour under a wide variety of environmental conditions.

Working with researchers at NRC's Steacie Institute for Molecular Sciences (SIMS), IRC researchers will validate the modelling data using SIMS's neutron diffraction instruments at Atomic Energy of Canada Limited's Chalk River Laboratories. These instruments will help them to understand the strain on the pipe under different stresses, loads and deflections. The major benefit of the technique is that it allows non-destructive stress measurements to be made all through the pipe wall, rather than just at the surface.

The research is expected to result in estimates of the minimum sizes of corrosion pitting that will increase risk of pipe failure under different soil, loading and pitting conditions. These findings will be of particular interest to users of pipe inspection technology and utility managers responsible for making decisions about repairing and replacing water mains.

For more information, contact Dr. Jon Makar at (613) 993-3797, fax (613) 952-8102, or e-mail jon.makar@nrc.ca.

Newsbrief

Decision-making software to aid service-life prediction and rehabilitation of concrete bridge decks

The rehabilitation of deteriorated bridge decks accounts for one third to one half of bridge maintenance costs in North America.

IRC is looking for partners to join a two-year consortium project to develop an innovative and powerful new software tool to help highway agencies decide when and how to rehabilitate deteriorated concrete bridge decks. Highway agencies, bridge consultants and contractors, and rehabilitation system developers are all welcome.

The rehabilitation of deteriorated bridge decks accounts for one third to one half of bridge maintenance costs in North America. Corrosion of the structures results in excessive cracking and spalling, which affect riding quality, traffic safety and, ultimately, structural safety.

Approaches and guidelines for service-life prediction and rehabilitation exist, but these are based on expert opinion or simple, deterministic predictive models. Unfortunately, these models are limited in addressing several issues, including the complex mechanism of chlorides transport, the mechanical effects of corrosion, and the considerable uncertainty in the governing variables.

The main outcome of the consortium project will be a user-friendly software system that includes decision support tools that engineers can use to select cost-effective rehabilitation strategies. These tools—a reliability-based service-life prediction module and a life-cycle costing module—will allow the user to look at different types of simulations and analyses, including "what if" scenarios, to determine the best course of action.

For more information on the consortium project, contact Dr. Zoubir Lounis at (613) 993-5412, fax (613) 952-8102, or e-mail zoubir.lounis@nrc.ca.

What we're hearing

Fire safety research program launched at Carleton University will investigate fire risk in buildings

Carleton University, with support from the Natural Sciences and Engineering Research Council (NSERC), Forintek Canada Corporation and the Canadian Wood Council, has launched a new Industrial Research Chair in Fire Safety Engineering.

The program's research objective is to develop a comprehensive new system for evaluating fire risk in mixed occupancy buildings, which are typically two or three storeys high, often with shops on the main floor and offices or apartments above. Initially, the research will focus on the development of computer models to predict how lightweight wood-frame designs for these buildings stand up to the ravages of fire.

The tools to be developed through this research will help engineers and architects choose materials, designs and systems from a range of appropriate options while at the same time meeting the fire-safety objectives of building codes.

An important aspect of the Chair will be the establishment of a fire-safety engineering graduate program at Carleton University, with additional courses aimed at a broad range of construction practitioners and fire services personnel.

Chair of the program Dr. George Hadjisophocleous comes to the post from IRC's Fire Risk Management Progam, which will participate in collaborative projects.

For more information about the program, contact Dr. George Hadjisophocleous, Carleton University, at (613) 520-2600, ext. 5801; e-mail: george_hadjisophocleous @carleton.ca.

U.S. home builders conference puts spotlight on green building products and trends

At the Third Annual Green Building Conference of the National Association of Home Builders in the United States, delegates discussed a range of issues for advancing the U.S. green building market.

Seminar themes included techniques for maximizing energy efficiency in houses; new products and technologies for developing more energy efficient homes, such as alternative building methods, energy efficient appliances, lighting, and insulation materials; waste management in construction; land use practices for protecting wildlife habitats; and marketing — an area that many delegates viewed as the greatest challenge.

"In many ways, this is a segment of the construction industry that is waiting for the next big energy crisis in order to really explode its market share," notes Bill Semple, an Industrial Technical Advisor (ITA) with NRC's Industrial Research Assistance Program (IRAP) based at the Canadian Home Builders' Association (CHBA), who attended the conference. "Attendees wondered if the current California energy crisis might be that start."

For those at the conference there was an array of new products and technologies to see. A great deal of interest was given to products using recycled materials such as plastic wood and plastic shingles. The new product voted most innovative, however, was the Insulated Concrete Form building system.

"There is a perception within the U.S. industry that Canada is a leader in the green building technology field," says Mr. Semple, "and that's positive news for Canadian manufacturers. But, the U.S. building industry is becoming more innovative and Canada will need to keep improving and developing its own products to retain the edge."

For more information, check the National Association of Home Builders' Web site www.nahb.com or look under the Green Building Activities section at www.nahbrc.org.

Education and technology transfer are key to improved repair of concrete structures

In Canada, about $16 billion a year is spent for the repair and rehabilitation of buildings and other structures. Improving the durability of concrete structures is one of the keys to reducing these costs, but this in turn depends on achieving a better understanding of how repairs to concrete structures can be made to last. There is general agreement that improvement will only come about if all the players in the concrete repair industry — researchers, designers, specifiers, material manufacturers and those responsible for quality control — contribute and collaborate.

Representatives of these various groups within the industry recently came together to address the issue of repaired concrete durability at the Third International Workshop on Improving the Performance of Repaired Concrete Structures, held in Quebec City in April. The workshop resulted in a strong consensus among delegates: most repair failures are due mainly to inadequate condition assessment, poor repair design and implementation, and insufficient quality control — repair materials are seldom the problem.

What to do? Delegates agreed, the solution to this critical and very costly problem can be found in better education for all industry players, more concrete research in key areas, and increased technology transfer.

Some of the key recommendations put forward include:

- encouraging university engineering departments to offer specialized courses on concrete repair and motivating students to specialize in repairs upon graduation;
- urging stakeholders to offer more internships and cooperative programs in this area for engineering students;
- educating owners about the rehabilitation process and the need to properly maintain their structures.

Other recommendations were to urge licensing regulatory agencies to include repair in the examination for registration of professionals in charge of construction or repair projects; encourage manufacturers to provide technical support before and during a project and urge owners to establish job-site quality control programs; and have project engineers conduct follow-up inspections. Participants at the workshop generally agreed that the industry would benefit from consistently following these practices.

Although repair materials were not deemed a large part of the problem, delegates to the workshop thought they could still be improved, particularly with respect to cracking resistance and through instructions for the handling of repair materials. It was suggested that testing procedures and disclosure of product information be standardized across the industry.

For further information, please contact IRC's Dr. Daniel Cusson at (613) 998-7361, or e-mail daniel.cusson@nrc.ca.

Upcoming events

OCTOBER

11

Expo-Contech. Montreal.
http://www.info@contech.qc.ca/

11-12

North America Sewer Rehab, "New Challenges, Emerging Standards & Recent Advances." Atlanta.
http://www.cmtevents.com

16-17

Construct Alberta 2001. Calgary.
http://www.constructalberta.com/

28-November 2

American Concrete Institute 2001 Fall Convention. Dallas.
http://www.aci-int.net/convention/fall-convention/front.asp

NOVEMBER

19-21

Canadian Technical Asphalt Association 46th Annual Conference. Toronto.
http://www.ctaa.ca/home/conference/2001conference/index.shtml

26-28

Infra 2001, Technology Transfer from Tradition to Innovation. Montreal. Contact: Joseph Loiacono at (514) 848-9885

28-30

Construct Canada 2001.
Metro Toronto Convention Centre South Building. Toronto.
http://www.constructcanada.com/

2002 JANUARY

13-17

Transportation Research Board 81st Annual Meeting. Washington.
http://www4.trb.org/trb/annual.nsf

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