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Institute for Research in Construction

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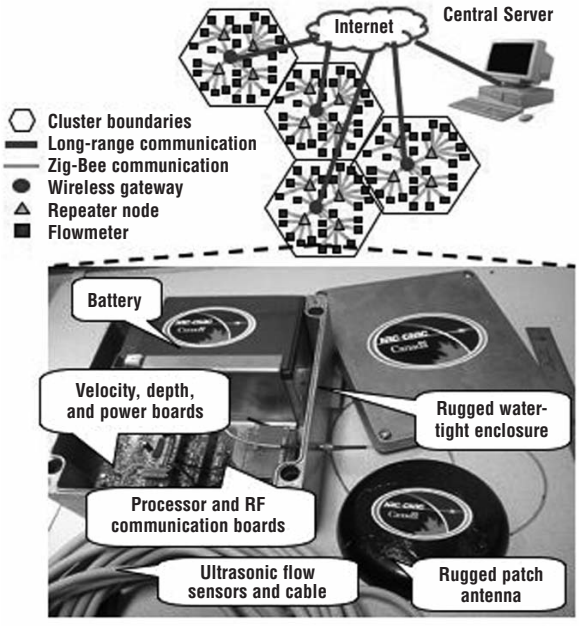
construction innovation

NRC-IRC researchers develop wireless sensor network technology for real-time sewer flow monitoring

Municipalities are coming under increasing pressure to improve the operational efficiency of aging sewer networks and comply with stricter regulations. They are also striving to reduce environmental and health risks and economic losses from sewer flooding, collapse, and excessive infiltration and inflow. Continuous real-time flow monitoring information can play a critical role in identifying potential capacity bottlenecks, enabling early detection of problems.

Given the vast geographic extent of sewer networks, gathering such information would require the deployment of tens or hundreds of online flowmeters. High installation and maintenance costs, coupled with the technical limitations of existing technologies, are major impediments to the implementation of real-time monitoring on a city-wide basis. Technical limitations include high power consumption and costly telecommunication options.



Clusters of wireless flowmeters communicating with a central server via repeaters and gateways mounted on street light poles

Researchers at the NRC Centre for Sustainable Infrastructure Research (NRC-CSIR) in Regina are developing an innovative wireless sensor network (WSN) technology to enable the implementation of real-time continuous flow monitoring in a cost-effective manner. The project addresses a number of design challenges to ensure long-term reliable and power-efficient operation of the WSN, to support efficient deployment and communication over large urban areas, and to minimize installation and maintenance requirements.

The research team developed and tested a prototype WSN in the laboratory. Small-scale field trials are planned for Spring 2009, to be followed by large-scale city-wide testing. The prototype consists of innovative hardware and embedded software components designed to optimize the use of limited power, computation, storage and communication resources within the network. Network architecture and communication protocols are designed to enable efficient and reliable message exchange and data transmission.

The WSN deployment will comprise sensor clusters, each of which will include a set of flowmeters and a wireless gateway. A prototype area-velocity flowmeter developed and tested by the researchers features

Continued on page 9

Highlights

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2005 NATIONAL CONSTRUCTION CODES

new On-line subscription service!

The 2005 National Building, Fire and Plumbing Codes and supplementary Guides, as well as the 2006 Alberta Building and Fire Codes, will be available on **January 26th, 2009** through an on-line Web-based subscription service.

Benefits of new on-line subscription service

- Access 24/7 to the most up-to-date Codes (html format)
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The 2005 National Building, Fire and Plumbing Codes of Canada are used as models for virtually all building and fire regulations in Canada. They establish the minimum requirements for a safe and healthy built environment and they contain new information describing the goals that the Codes' provisions are intended to achieve and the conditions that help satisfy the intended objectives. Considered as an indispensable source of information for building, fire and plumbing officials, as well as construction professionnals and educators, the Codes are also available in printed formats – binder and soft cover – and practical CD-ROM formats.

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CCBFC considering options for model code requirements for energy efficiency for houses

As previously announced (see *Construction Innovation* September 2007), the Canadian Commission on Building and Fire Codes (CCBFC) is currently updating the Model National Energy Code for Buildings for publication in 2011. This model code applies to all buildings regardless of size with the exception of housing within the scope of Part 9 of the National Building Code.

At its annual meeting held in February 2008, the CCBFC received requests to address energy efficiency in houses. It noted there is currently a will to address energy efficiency at the provincial and territorial levels. It reviewed these requests and confirmed a desire to undertake work to condiser energy efficiency in houses.

As is the case with all codes produced by the CCBFC, the energy efficiency requirements for houses would be included in an objective-based model code. The requirements would be suitable for consideration by all provinces and territories, thereby encouraging consistent regulations in energy efficiency in houses across Canada.

The CCBFC is inviting stakeholders to participate in a dialogue regarding model code requirements for energy efficiency for houses. Please send your comments to the Secretary of the CCBFC at 613-993-5569, fax 613-952-4040, or e-mail at codes@nrc-cnrc.gc.ca.

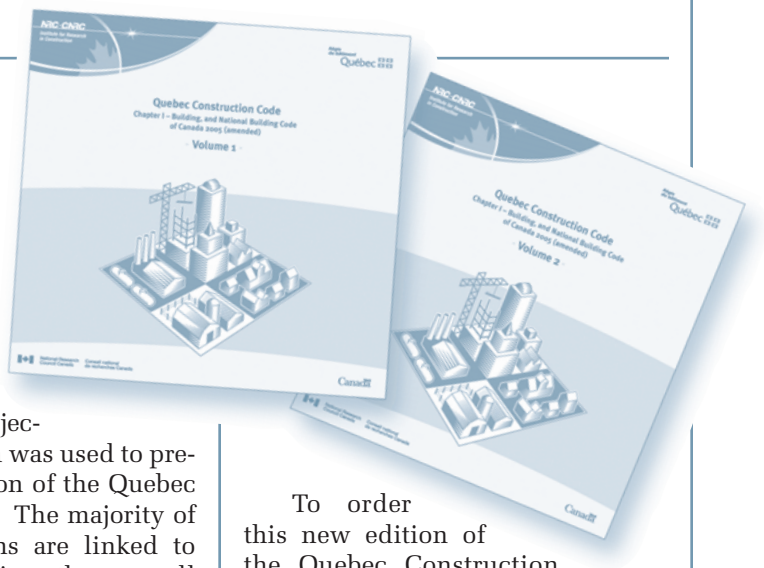
Publication of 2008 edition of Quebec Construction Code integrated into the 2005 National Building Code

Amendments to Chapter I, Building, of the Construction Code were adopted by the Province of Quebec on March 19, 2008 with an effective date of May 17, 2008. This Chapter comprises the National Building Code of Canada 2005 (NBC) and approximately 300 changes related to sprinkler systems, accessibility to buildings, and ventilation, among others. The Building Chapter is intended for designers, contractors responsible for carrying out building work, and owner-builders.

NRC-IRC, in collaboration with the Régie du bâtiment du Québec, is pleased to announce the publication of the *Quebec Construction Code, Chapter I – Building, and National Building Code of Canada 2005 (amended)*. This new document includes the amendments to Chapter I, Building, and the amended NBC provisions so as to indicate clearly to users the changes that apply to construction and renovation work in Quebec.

As in the case of the NBC, an objective-based approach was used to prepare this new edition of the Quebec Construction Code. The majority of the Code provisions are linked to objectives describing the overall goals that the provisions are intended to achieve and to functional statements describing conditions that help satisfy the objectives. This new information allows for flexibility by helping users evaluate alternative solutions to the acceptable solutions provided in the Code.

The *Quebec Construction Code with the amended NBC* is available now in print (binder format). It will be offered on CD-ROM and on the Web (on-line subscription service) in the spring of 2009.



To order this new edition of the Quebec Construction Code, please visit the NRC Virtual Store at www.nrc.gc.ca/virtualstore, or fill out the enclosed order form and fax it to 1-613-952-7673.

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NRC-CCMC: 20 years dedicated to advancing Canadian construction

In 1988, the National Research Council assumed responsibility for providing a national technical evaluation service for innovative building products by establishing the Canadian Construction Materials Centre (NRC-CCMC). Since then, NRC-CCMC has developed a solid reputation in Canada and abroad for the quality of its evaluations, the assistance it provides to help new products gain market acceptance, and the role it plays in assisting regulators to assess and accept new and innovative construction products and systems.

Where no standard exists, evaluation officers develop technical guides that manufacturers use to test and determine the performance of their products.

In advance of codes and standards, these evaluations offer a way for innovative materials and products to get a head start. Where no standard exists, evaluation officers develop technical guides that manufacturers use to test and determine the performance of their products. Over two decades many products and families of products have achieved common acceptance. These include innovative air barrier systems, sheathing membranes, claddings, foundation drainage (dimple membranes), insulating concrete forms, wood I-joists, steel framing, structural insulated panels, polyurethane spray foam insulations, joist hangers, bell-shaped foundation forms, PVC railing systems, and many others.

Helping provincial and municipal regulators assess whether new products meet the requirements of codes is a pivotal role played by NRC-CCMC. At the same time, evaluations give manufacturers a strong technical foundation for introducing new products, while giving specifiers and builders the confidence to use them. Since its inception, the evaluation service has produced and published hundreds of listings on standardized products and evaluation reports on innovative products that provide credibility for eventual acceptance by building officials, specifiers and builders.

With the move to objective-based codes in 2005, the link between the NBC and NRC-CCMC evaluations is now closer and clearer.

Evaluation officers also contribute to the development of Canadian product standards, identify needs for building research – often leading to improvements in the

New product evaluations

Company	Product Name	CCMC #	Description
A. Proctor Group	AirOutshield (Jutadach 115g) (Sheathing Membrane)	13320-R	Sheathing, Membrane, Breather-Type
Automatic Stamping, LLC	AS-20	13326-L	Metal Truss Connector Plates
Grant Forest Products Inc.	1 1/8" Grant Rim Board Ultra	13330-R	Wood-Based Rim Board for Floors
Intertape Polymer Corp.	FlexGard Aspire™, PermaGuard™, PeramGard™, Dri-Shield™ II Air Barrier Material	13329-R	Air Barrier Materials
Ispro, Division of Sealrez	Ispro Green System	13328-R	Exterior Insulation and Finish Systems (EIFS) Thin Rendering
Scapa North America	Scapa 827 Sheathing Tape	13327-R	Sheathing Tape
The Akron Products Company	Floor Jacks	13325-L	Adjustable Steel Columns

For further information on the performance, usage and limitations of these products, as well as for other reports and listings by NRC-CCMC, see the Web Registry of Product Evaluations located at **http://irc.nrc-cnrc.gc.ca/ccmc/regprodeval_e.html**.

National Building Code of Canada (NBC) – and provide technical support to building officials across the country.

Not satisfied with the strong reputation and the high level of recognition it has gained over the last 20 years, NRC-CCMC is planning a business review of its operations.

With the move to objective-based codes in 2005, the link between the NBC and NRC-CCMC evaluations is now closer and clearer. This means technical guides and evaluations can provide manufacturers with even clearer direction on the requirements that products need to meet and why, based on the explicit functional and objective statements in the NBC.

As a founding member of the World Federation of Technical Assessment Organizations, NRC-CCMC works with building product assessment organizations in other countries to assist those clients who are seeking acceptance of their evaluated products in foreign markets. Through international agreements and working relationships, it is able to help its registrants obtain access to these markets.

Not satisfied with the strong reputation and the high level of recognition it has gained over the last 20 years, NRC-CCMC is planning a business review of its operations. With the engagement of stakeholders, it hopes to build on its solid foundation and assure the continuing success of its services.

These changes and initiatives and its 20 years of experience position NRC-CCMC well to serve the future needs of Canada's building construction industry, the regulatory community and Canadians generally, who benefit because new products are scientifically evaluated before they go into service.

Specific questions can be directed to Dr. John Flack at 613-990-8518, fax 613-952-0268, or e-mail john.flack@nrc-cnrc.gc.ca.

Two new Construction Technology Updates now available

Visit http://irc.nrc-cnrc.gc.ca/ctus

CTU 71. Selecting Residential Window Glazing for Optimum Energy Performance

This Update reports the results of experiments conducted to determine the heating and cooling energy consumption experienced with two types of low-emissivity glazing: a low solar heat gain glazing and a high solar heat gain glazing. The results of the research, conducted in the twin houses of the Canadian Centre for Housing Technology, were then used in computer modelling to determine the most efficient type of glazing for various regions across Canada.

CTU 72. Duct Smoke Detectors: The Impact of Various Factors on Their Effectiveness

This Update presents the results of research examining the effectiveness of duct smoke detectors and the factors that have the greatest impact on their performance. It provides guidance for practitioners and regulatory authorities on the requirements and locations for duct smoke detectors.

Fire detection in roadway tunnels

Fire detection systems play a crucial role in ensuring safe evacuation and firefighting operations in road tunnels. Information on the performance of detection systems for tunnel fire detection, however, has been limited. Recently, the Fire Protection Research Foundation completed a two-year international research project, with the support of private and public-sector organizations. The purpose of the project was to determine some of the strengths and weaknesses of various types of detection systems and the factors that can affect their performance in tunnel environments (see *Construction Innovation* June 2006). The study also evaluated false alarm rates and maintenance requirements in tunnel environments. Although this research was conducted on road tunnels, the findings should apply to other tunnels, such as those in subway systems.

As part of the project, the National Research Council of Canada (NRC) conducted two series of tests in the Carleton University-NRC tunnel facility to investigate the performance of detection systems under minimal and longitudinal airflow conditions. In addition, NRC conducted tests in the Carré-Viger Tunnel in Montréal, as well as computer modeling studies. Hughes Associates conducted environmental and demonstration fire tests in the Lincoln Tunnel in New York City.

Fire detection experiments being conducted in the Carré-Viger Tunnel in Montréal.

The project studied nine fire detection systems covering five types of technologies currently available (linear heat detectors, flame detectors, video imaging detectors, spot heat detectors and air sampling smoke detectors). The system suppliers installed all the fire detection systems in the laboratory tunnel facility, as well as in the Carré-Viger and Lincoln tunnels.

Three types of fire scenario with various fire sizes, types, locations, and growth rates were used in the laboratory tunnel: flammable pool fires, stationary passenger vehicle fires, and moving vehicle fires. The fire scenarios included open fires, fires beneath a vehicle, fires behind a large vehicle and fires in the engine and passenger areas. Various types of fuel were used including gasoline, propane, wood crib, and polyurethane foam. For the moving vehicle fire, different directions and speeds were considered. These fire scenarios were considered representative of the majority of tunnel fires that present a challenge to fire detection systems.

The research program has provided valuable information to detection system manufacturers, which is leading to improvements in technology.

Roadway tunnels are difficult environments for fire detection systems, both in terms of the detection challenge itself and the environmental conditions under which the systems must operate. Each of the five currently available detection technologies has particular strengths and weaknesses for tunnel applications.

Fire Protection Research Foundation

The Fire Protection Research Foundation undertakes fire and life-safety research that supports the National Fire Protection Association's mission. The Foundation has engaged in major research programs, both domestic and international in scope, designed to provide the type of information that NFPA's technical committees and others can use to update fire safety codes and standards. Each project is guided by a technical panel that provides expertise and input from sponsors, the research community, the fire services, NFPA technical committees, and other stakeholders.

The research program has provided valuable information to detection system manufacturers, which is leading to improvements in technology. As well, tunnel specialists can use the information from this study to determine the most appropriate technology for a given application. The NFPA Technical Committee responsible for Standard 502, *Limited Access Highways, Road Tunnels, Bridges and Elevated Roadways*, will be considering this information in the further development of the standard.

Partners

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Ministry of Transportation of Ontario
Ministry of Transportation of Quebec
The City of Edmonton, Transportation Department, Transit
AxonX LLC
Siemens Building Technologies
Tyco Fire Products
VisionUSA
Sureland Industrial Fire Safety
Fire Protection Research Foundation
United Technologies Research Corporation
National Research Council of Canada
Port Authority of New York and New Jersey
A&G Consultants
PB Foundation
Micropack, Inc.
J-Power Systems and Sumitomo Electric U.S.A., Inc.
Honeywell Inc.
Hughes Associates Inc.

The reports on the project can be obtained at www.nfpa.org/Foundation. 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.

Wind-RCI: New Internet tool for calculating wind design loads for roofs

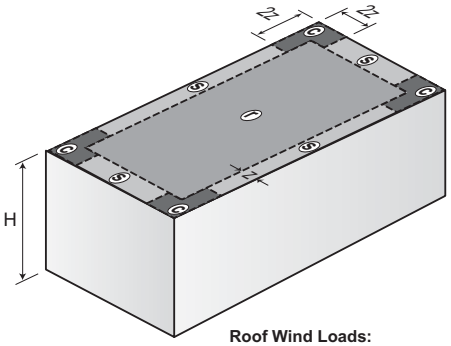
NRC-IRC recently released an Internet-based tool that simplifies the calculation of roof wind loads, the first, critical step for designing mechanically attached membrane roofs.

Called Wind-RCI, the calculator is based on a six-step procedure developed by the Special Interest Group on Dynamic Evaluation of Roofing Systems (SIGDERS) and researchers from NRC-IRC. That procedure was designed to do calculations based on the National Building Code of Canada (NBC 2005) or the American Society of Civil Engineers guide (ASCE 7-05). While the procedure was an effective aid for calculating wind design loads, it was tedious and time consuming.

Wind-RCI allows users to calculate building wind loads for all Canadian cities by entering the building type (high-rise or low-rise), height and roof dimensions, exposure and type.

Now the six-step procedure has been integrated into Wind-RCI. Developed in cooperation with partners – the Roof Consultants Institute Foundation and the Roofing Contractors Association of British Columbia – the bilingual version based on the NBC 2005 greatly simplifies wind load calculation and reduces the possibility of errors.

Wind-RCI allows users to calculate building wind loads for all Canadian cities by entering the building type (high-rise or low-rise), height and roof dimensions, exposure and type. Wind-RCI calculates roof cladding design loads and displays the wind load diagram for the field, perimeter and corner zones of the roof assembly (Figure 1).



Roof Wind Loads:
End Zone Width, z: 9 ft (3 m)
Corner, Ⓒ: -44 psf (-2.1 kPa)
Edge, Ⓔ: -28 psf (-1.3 kPa)
Field, ⓡ: -19 psf (-0.9 kPa)

Sample roof cladding wind design loads from Wind-RCI

Wind-RCI is easy to use and greatly simplifies and standardizes the calculation of wind loads on roofs. It has the potential to enhance the interpretation of the code by users, thereby increasing calculation accuracy.

The version based on the NBC 2005 is available at http://irc.nrc-cnrc.gc.ca/bes/prsi/calc_new/rciintro_e.html.

A version for the United States based on ASCE 7-05 is under development.

Wind-RCI is easy to use and greatly simplifies and standardizes the calculation of wind loads on roofs.

New phase of SIGDERS research

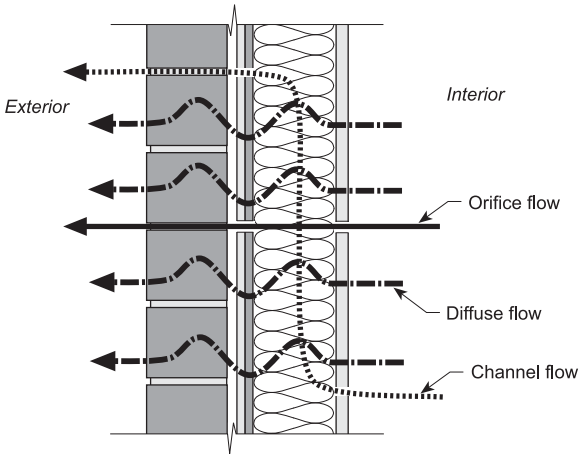
In addition to the creation of Wind-RCI, research done under SIGDERS Phases 1, 2, 3 and 4 produced two other significant contributions to improving the performance and reliability of roofs as follows:

1. National Dynamic Wind Uplift Standard
2. A Guide for the Wind Design of Mechanically Attached Flexible Membrane Roofs.

Links for information about these products are available at http://www.sigders.ca/

Now, SIGDERS consortium members have set objectives for Phase 5 research as follows:

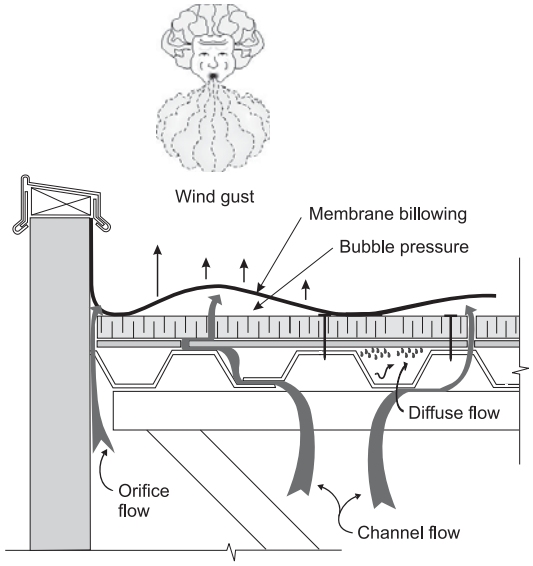
Objective 1: Monitoring the Wind Performance of Roofs: Three buildings located in a moderate wind zone will be selected and rooftop wind speeds acting on them will be measured and compared to weather data. Instrumentation will be installed and used to measure wind pressure in the field, edge and corner zones of the roofs, fastener forces and membrane deflections. The performance of the roofs will be compared to the performance of similar roofs under wind tunnel testing.



Air leakage flows in a typical brick cladding wall

2: Air Intrusion Quantification of Mechanically Attached Roofing Assemblies: Air intrusion will be measured for mechanically attached roofing systems with and without an air barrier/retarder and for roofing systems with multi-layer insulation arrangements (see the Newsbrief on this page).

Objective 3: Update CSA A123.21-04 Standard to Include Wind Uplift Resistance Evaluation of Fully Bonded Roof System: This research will determine the appropriate test specimen size for evaluating the wind uplift resistance of fully bonded roof systems. It will also evaluate the wind uplift resistance of rigid roofing systems with single-ply membranes, and finally, it will verify the existing CSA load cycle and its applicability to rigid systems.



Air intrusion in mechanically attached roofing assembly

These three Phase-5 objectives are scheduled for completion by August 2010. NRC-IRC is seeking consortium members for Objective 2 and more details are provided in the following section (see Energy Rating of Roofing Assemblies: Research Partners Sought).

Specific questions can be directed to Dr. A. Baskaran at 613-990-3616, or fax 613-998-6802, or e-mail bas.baskaran@nrc-cnrc.gc.ca.

NRC-IRC researchers develop wireless sensor network technology for real-time sewer flow monitoring

Continued from cover page

low cost, low power consumption, embedded intelligence, small size, and advanced data processing and communication capabilities. Real-time flow data will be transmitted to a central database management system.

An integral part of the technology is a suite of decision-support tools for data analysis and performance assessment. These tools help users identify flow trends, characterize network response under wet and dry weather conditions, investigate infiltration/inflow problems, and identify the location of bottlenecks and capacity constraints.

When fully developed, the new WSN technology has the potential to improve the reliability and cost-effectiveness of real-time monitoring and assessment of municipal sewer networks across Canada.

If you are interested in participating in this project, please contact Dr. Mahmoud Halfawy at 306-780-5396, fax 306-780-3421, or e-mail mahmoud.halfawy@nrc-cnrc.gc.ca.

Newsbrief

Energy Rating of Roofing Assemblies: Research Partners Sought

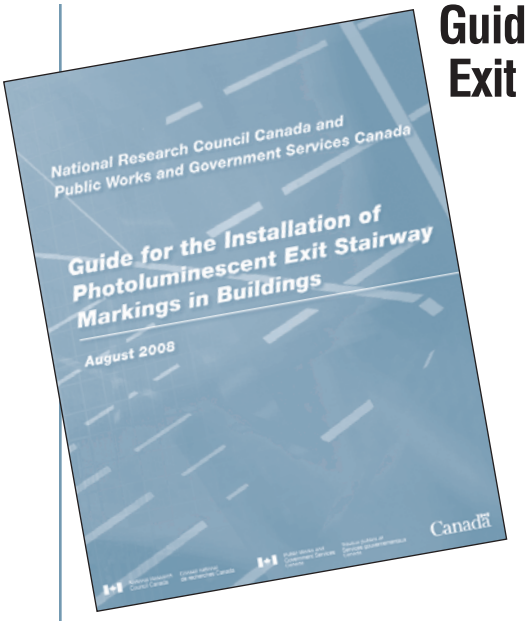
While SIGDERS research has advanced understanding of the wind uplift performance of membrane roofs, NRC-IRC is seeking new partners to quantify air movement into this type of roof construction and to determine its impact on the overall energy performance of the roof.

Owing to the flexible and elastic nature of mechanically attached membrane roofs, wind can cause the membrane to balloon or flutter. This change in shape leads to volume change, creating negative or bubble pressure under the billowed membrane and thereby drawing conditioned interior air into the roof assembly. This is called air intrusion, which differs from air leakage (air movement from one environment to the other) that is common to wall assemblies (see figures on pages 8 and 9). Damage from condensation and energy wastage are only some of the problems caused by air intrusion.

The research will focus on:

- Developing a test tool for analysing air intrusion characteristics for a variety of details, junctions and penetrations. As a first step toward the development of a test standard, the results of a pilot study have been submitted to ASTM.
- Generating air intrusion limits that may be used in the development of design guides, codes and standards.
- Identifying techniques to counter the impact of air intrusion on wind uplift performance and moisture transport.
- Studying the continuity of the roof/wall barrier and quantifying air movement.
- Relating air intrusion to energy performance and developing an analytical tool to predict changes in energy demand due to variations in the air intrusion characteristics of roof assemblies.

This research will benefit from the collaboration of researchers, regulatory authorities, manufacturers, roofing associations and organizations, and building professionals. NRC-IRC is seeking partners for the project. To learn more about the project and to explore becoming a partner, contact: Dr. Sudhakar Molleti (Suda) at 613-993-9673, fax 613-998-6802, or e-mail sudhakar.molleti@nrc-cnrc.gc.ca.



Guide for the Installation of Photoluminescent Exit Stairway Markings in Buildings

The National Research Council-Institute for Research in Construction has published a guide to provide information about the installation of photoluminescent markings in buildings and the requirements for satisfactory performance (see *Construction Innovation* March 2008).

Photoluminescent material emits light for a length of time following excitation by visible or invisible light after the light source has been removed. In fire safety, the most promising uses for photoluminescent materials are safety markings such as exit signs, directional signage, door markings, pathway markings, obstruction identification and other components that comprise a safety way-guidance system. In blackout situations resulting from power failures or fires, photoluminescent safety markings in the form of paint, plastic strips and signs can aid evacuation by guiding and directing people to safer locations.

While this guide was developed primarily for federal office buildings, it can be used to aid in the design and installation of photoluminescent markings in other types of buildings with enclosed exit stairways as means of egress.

To access the guide, visit http://irc.nrc-cnrc.gc.ca/pubs/fulltext/nrcc50818/.

Building Science Insight Webcasts

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The Building Science Insight national seminar series presented by the NRC Institute for Research in Construction provides practical information for construction professionals. Each seminar reports the results of NRC-IRC research, as well as related information from other organizations in North America and abroad.

You have told us that information presented at these seminars has enduring value. Accordingly, Webcasts of our two most recently completed seminars, BSI 2006/07 (Sustainable Infrastructure) and BSI 2007/08 (Fire Safety Research), are now available on the NRC-IRC Web site. They consist of complete audio and visual records of each presentation, allowing anyone anywhere, at any time, to stay current with this valuable information.

How to access these two Webcasts

Permanent access to each Webcast can be purchased from the NRC Virtual Store: **http://www.nrc.gc.ca/virtualstore**

The price is $125 per seminar. Once you have your password, access the Web site to view the seminars.

What you will learn

Building Science Insight 2007/08: Fire Safety Research for Better Building Design

Over the last decade, there have been significant advances in fire engineering and the understanding of human behaviour, which can contribute to better and safer buildings. BSI 2007/08 presented key advances for the benefit of those engaged in the design and construction of new and existing buildings, the management and operation of facilities, and the application of building and fire codes.

Building Science Insight 2006/07: Sustainable Infrastructure Techniques, Tools and Guidelines

The deterioration of Canada's civil infrastructure systems presents major challenges for the next decade. These systems consist of assets ranging from bridges to buildings, from buried services to overhead utilities. To help communities maintain sustainable infrastructure, this seminar addressed some of the challenges and opportunities for achieving quality, efficiency and durability. The seminar discussed the engineering techniques, tools and guidelines required to maintain and renew an aging and diverse infrastructure portfolio. More specifically, it examined what is required to sustain infrastructure assets for future generations.

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National Plumbing Code 2005	$120		$110		$180**		$720		$1,080	
Practical 2005 NBC User's Guides: Structural Commentaries (Part 4)	n/a***		$94		$94		$380		$560	
User's Guide – NBC 2005, Application and Intent Statements	n/a***		n/a***		$150		$600		$900	
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Upcoming events

Meetings of Canadian Commission on Building and Fire Codes

Contact Anne Gribbon at 613-993-5569, e-mail: anne.gribbon@nrc-cnrc.gc.ca

January 12-13, 2009
Executive Committee. Ottawa.

February 22-23, 2009
Commission Regular Meeting. Halifax.

September 20-21, 2009
Commission Regular Meeting. Saskatoon.

Spring 2009
Standing Committee Meetings. Consult Canadian Codes Centre website at http://www.nationalcodes.ca/ncd_calendar_e.shtml.

2009
JANUARY

26-28
International Air-Conditioning, Heating, Refrigerating Exposition (AHR Expo). Chicago. http://www.ahrexpo.com/

29-30
EnerHouse 2009. Halifax. www.nshba.ns.ca

FEBRUARY

11-12
BC Construction Show. Vancouver. http://www.bcconstruct.com/

27-March 1
Canadian Home Builders' Association National Conference. Quebec City. http://www.chba.ca/conference/index.php

APRIL

19-20
Second Symposium on Heat-Air-Moisture Transport: Measurements and Implications in Buildings. Vancouver. http://www.astm.org/SYMPOSIA/

29-May 1
International Conference on Sustainability in Energy and Buildings. Brighton, U.K. http://seb09.sustainedenergy.org/

30-May 1
Symposium on Building Envelope Sustainability. Washington, D.C. http://www.rci-online.org/Anno-RCIF-09Symp.html

MAY

6-8
12th Canadian Conference on Building Science and Technology. Montreal. http://cebq.org/NBEC.htm

12-15
2nd Climate Change Technology Conference (CCTC 2009). Hamilton. http://www.cctc2009.ca/en/index.html

18-19
Leveraging Innovation for Sustainable Construction. Edmonton. http://irc.construction.ualberta.ca/html

24-27
International Symposium on Automation and Robotics in Construction (ISARC 2009) http://www.caee.utexas.edu/isarc2009/Template/site_flash/index.html

in collaboration with

ASCE International Workshop on Computing in Civil Engineering. Austin, TX. http://www.caee.utexas.edu/asceIT2009/Template/site_flash/index.html

AUGUST

23-26
Inter-noise 2009. Ottawa. http://www.internoise2009.com/

2010
JUNE

27-30
ICBEST 2010–International Conference on Building Envelope Systems and Technology. Vancouver. http://www.icbest.ca/

For a more complete listing, see http://irc.nrc-cnrc.gc.ca/events_e.html

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