NRC·CNRC
Institute for Research in Construction

Volume 12 Number 2 **June 2007**

construction innovation

Construction a key sector in new NRC corporate strategy

NRC has recently released its new corporate strategy—Science at Work for Canada—which maps out NRC's next five years and takes an industry-centred approach to stimulating economic growth and improving the lives of Canadians. More than a year in the making, the strategy is based on in-depth analysis and extensive consultations with stakeholders and decision makers in government, and the academic and business communities.

The strategy's goals include contributing to the competitiveness of Canadian industry in key sectors, strengthening Canada's innovation system, and making significant contributions to national priority areas: health and wellness, sustainable energy, and the environment.

Focusing on the organization's strengths, NRC will step up its efforts to develop highly valued technologies and transfer them to industry, increase innovation and commercialization support to industry, and align research and development priorities with industry needs. In addition, NRC will continue to emphasize a collaborative approach to research both inside and outside the organization, and strengthen national and international collaborations.

Much of this work will take place in nine key sectors that NRC has identified as important to the Canadian economy. Of particular interest to NRC-IRC and the construction industry is the inclusion of construction on this list of key sectors. This inclusion recognizes the importance of the construction industry to the Canadian economy. The other sectors are pharmaceuticals and biotechnology; aerospace; agriculture; information and communications technologies; chemicals; automotive; electronic instruments; and manufacturing and materials engineering.

Highlights

The new strategy, with its multi-disciplinary, collaborative approach, increases the potential for connecting with NRC's broader expertise in areas such as biotechnology, information technology and nanotechnology, which will benefit both the construction sector and NRC-IRC.

NRC-IRC is presently developing its three-year business plan in alignment with the overall NRC strategy. This plan outlines how NRC-IRC will continue its efforts to seek partnerships and conduct research to develop technologies and knowledge that respond to the construction industry's evolving priorities and needs, and that support the development of Canada's national construction codes.

For the complete text of NRC's corporate strategy, go to http://www.nrc-cnrc.gc.ca/aboutUs/corporatereports/strategy/strategy_e.html.

Read *Construction Innovation* on the Web at **http://irc.nrc-cnrc.gc.ca/ci**

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NRC-IRC researchers study thermal comfort with help of 3-D robot

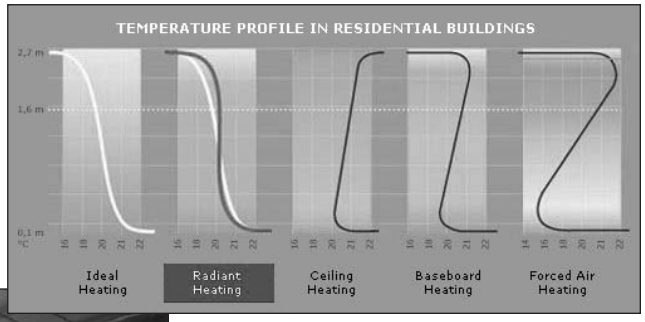
Thermal comfort is important to the well being of building occupants, and there are international standards that define the values required to achieve optimal conditions. Normally, the recommended range in air temperature for people who are seated is limited to 3°C between the ankles and head. The standards stipulate an indoor temperature of 23°C for offices, with a range of 20–24°C in the winter and of 23–26°C in the summer. The relative humidity should be between 50 and 60% and, to prevent drafts, the air velocity experienced by a seated person should be less than 0.15 m/s.

Researchers at NRC-IRC are simultaneously evaluating various thermal comfort parameters in two identical rooms in their Ventilation and Wall Research House (see *Construction Innovation*, December 2006), with the help of a new innovative tool they have developed.

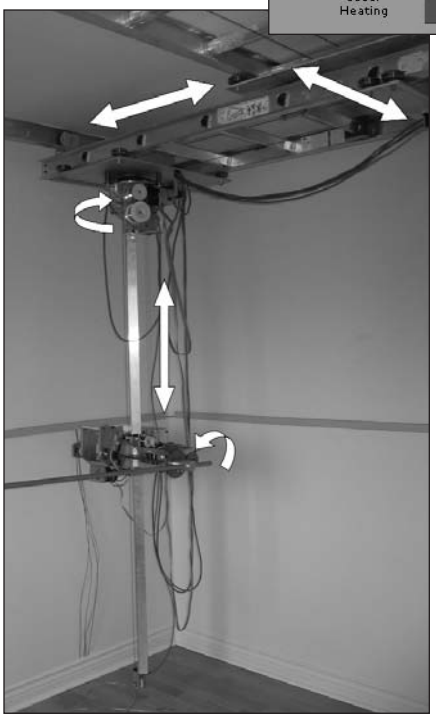
In the Ventilation and Wall Research House, one room is heated by a forced-air heating system and the other by a hydronic radiant-heating system. One of the main features of the latter is that it has the potential to provide more uniform temperature conditions from floor to ceiling than a convective system (see graph). Due to the physical properties of water, a hydronic system can transport a given amount of heating energy using less than 5% of the energy required by a conventional motor paired with a fan-set. Combined with more efficient forced-air systems, hydronic systems also have the potential to offer improved comfort and substantial energy savings.

The objective of the current research project is to confirm the features of the different systems and their potentials for improved comfort and energy savings. To help them in their work, the researchers are using two automated 3-D robotic systems to measure spatially distributed indoor environment parameters. Each system permits the computer-controlled placement and movement of sensors in space, providing continuous monitoring, and each has movement in five directions—three linear (longitudinal, lateral and vertical axis) and two rotational (pitch/yaw, which is the rotation around the vertical and horizontal axes).

Industry partners:
Roth Canada
Flexco



Vertical temperature profile
Graph courtesy Roth Canada



3-D robotic system with movement in five directions

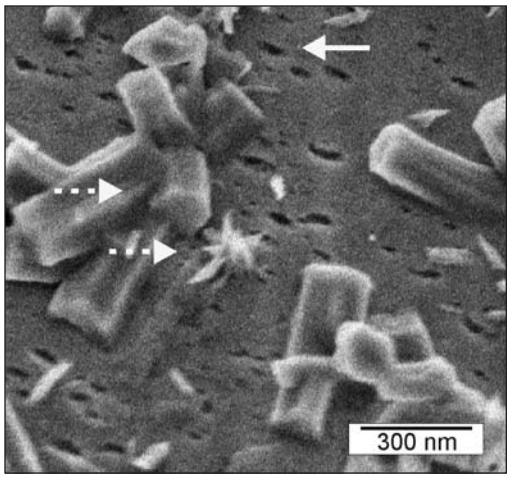
To allow measurements to be made in the corners, the boom can be rotated and "pitched" in any direction, making it possible to reach any place in the room. On one side the vertical carriage has an arm that carries five boom-mounted sensors (for air and mean radiant temperatures, plane radiant asymmetry, air velocity and relative humidity) to take detailed location measurements, and on the other side it has an infrared camera for thermographic surveys of surface temperatures.

The 3-D systems are able to do a side-by-side evaluation of the thermal comfort that can be achieved with the two different heating systems (the forced-air system and the hydronic radiant-heating system). The evaluation involves comparing the vertical air temperature (which should not exceed 3°C), the floor temperature (which should be between 19 and 29°C) and drafts, or air velocity, (which should be lower than 0.2 m/s).

Current experiments are expected to run into Fall 2007, and the project team is seeking partners with an interest in similar technologies that could lead to improved thermal conditions in rooms. For further information about the study, please contact Dr. Boualem Ouazia at 613-993-9613, fax 613-954-3733, or e-mail boualem.ouazia@nrc-cnrc.gc.ca.

Nanotechnology tools for designing better cements

NRC-IRC is exploring new routes to optimize the performance of ordinary Portland cement (OPC) and supplementary cementing materials (SCMs), using its expertise in nanotechnology. The project is expected to produce OPC products that hydrate more quickly—of particular importance in repair applications—or that are stronger than standard OPC. Researchers will also develop new ways to evaluate and improve the hydration performance of SCMs such as fly ash and blast furnace slag.



Scanning electron microscope image of ordinary Portland cement after 150 minutes of hydration showing nanoscale pores in cement grain surface (solid arrow) and hydration products (dashed arrows).

The combination of techniques enables the researchers to examine hydration behaviour at the surface of individual cement grains and provides new insight into the role played by cement constituents in the hydration process.

The concrete made from the materials being developed is expected to be stronger, less porous and more durable than existing products and, in addition, less concrete will be needed to carry the same loads. As a result, end users will benefit from longer lasting structures that have a reduced impact on the environment.

Nanotechnology, the engineering of materials and structures to take advantage of their behaviour at scales of 1–100 nanometres (a nanometre is one billionth of a metre), is a key part of NRC-IRC's research in materials for the construction industry, offering new opportunities to make stronger, more durable and more economical materials.

Using nanotechnology tools, NRC-IRC researchers can study cement hydration, with the aim of engineering cements for specific niches such as repair and high-strength applications. The research combines the use of high-resolution scanning electron microscopy with new, in-house methods for analyzing cement hydration behaviour and with traditional methods for evaluating cement and concrete performance. The combination of techniques enables the researchers to examine hydration behaviour at the surface of individual cement grains (see figure) and provides new insight into the role played by cement constituents in the hydration process. This information will be used to develop the improved OPC.

NRC-IRC is seeking partners for this research project. If you are interested in participating, please contact Dr. Jon Makar at 613-993-3797, fax 613-954-5984, e-mail jon.makar@nrc-cnrc.gc.ca or visit http://irc.nrc-cnrc.gc.ca/nano/concrete2_e.html.

Newsbrief

New sound insulation projects support Canadian wood industry in domestic and foreign markets

NRC-IRC recently completed a project to develop sound insulation details and an associated guide for achieving sound insulation in wood-frame construction for the North American market (see *Construction Innovation*, September 2006). Now this project has spawned two new projects.

The first is a 24-month joint research project between NRC-IRC and industry partners with the objective of expanding the set of wood-frame assemblies listed in the recently published Guide. This enhanced Guide will use a Web-based format that will allow users—such as builders, engineers, and architects—to evaluate specific design scenarios, and easily assess the effect of specific changes in construction details.

The main objective of the second project is to develop design details for wood-frame construction that can achieve Japan's and Korea's demanding requirements for low-frequency insulation against impact sound. The larger objective of this project is to improve market access for the Canadian lumber industry.

In partnership with the Council of Forest Industries (COFI), NRC-IRC has begun Phase 1, which will establish the scope and magnitude of the study necessary to develop these design details. Phase 1 will run until December 2007; it will be followed by a much larger experimental phase to optimize promising constructions and demonstrate their performance. Phase 2 will last between 18 and 24 months, and will include collaborators from Canada, Japan and Korea.

NRC-IRC is seeking additional industry partners for both projects. For more information, please contact Dr. Trevor Nightingale at 613-993-0102, fax 613-954-1495, or e-mail trevor.nightingale@nrc-cnrc.gc.ca.

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Institute for Research in Construction
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Ottawa, ON K1A 0R6
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Tel: 613-993-2607
Fax: 613-952-7673
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CCBFC Joint Task Group on Spatial Separation between Buildings of Combustible Construction

In the fall of 2006, the Standing Committees on Housing and Small Buildings and on Fire Protection of the Canadian Commission on Building and Fire Codes (CCBFC) formed a joint task group to evaluate the current requirements of the 2005 National Building Code of Canada with respect to spatial separation between buildings of combustible construction, and to recommend revisions if needed.

Concerns had been raised regarding the vulnerability of buildings adjacent to a building that catches fire. The City of Calgary, after experiencing a number of fires in combustible buildings where fire spread to adjacent buildings, undertook a study of construction materials typically found in exposing building faces. The findings, which identified a potential issue of national scope, were submitted late in the 2005 code cycle for review by the appropriate standing committees, leaving insufficient time to undertake work on them. However, the CCBFC agreed that this matter should be considered a priority for the current code cycle.

The joint task group and the standing committees have been reviewing requests for code changes made by the City of Calgary and the material supporting these requests. The mandate of the joint task group is to investigate various factors related to this issue, including limiting distance between buildings; wall construction; distribution of openings; protection of soffits; and fire-service response time.

To date, meetings of the joint task group have attracted a great deal of interest among stakeholders, a number of whom have presented their positions at these meetings and are closely following the task group's work.

The joint task group plans to report to the parent standing committees at their meetings in the fall of 2007.

Those interested in receiving more information on the progress of this project can contact Adaire Chown at 613-993-9960, fax 613-952-4040, or e-mail adaire.chown@nrc-cnrc.gc.ca.

Are you floored by the objective-based approach of the 2005 national model construction codes?

Let the on-line basic awareness course enlighten you!

NRC-IRC, in conjunction with the provinces/territories and the Canada Mortgage and Housing Corporation, has developed a basic awareness course designed to help code users understand the new objective-based approach of the 2005 national building, plumbing and fire codes (see *Construction Innovation*, Fall 2000 and December 2003). This free on-line course consists of the following seven modules:

Module 1	Introduction to the course
Module 2	Organization of the 2005 code
Module 3	Applying the code using Division B
Module 4	Intent Statements*
Module 5	Application Statements*
Module 6	History of objective-based codes
Module 7	Introduction to Alternative Solutions

* These modules introduce code users to helpful content available on the 2005 code CD-ROMs.

The course briefly yet thoroughly explains the new terminology and concepts of the objective-based approach supported by real examples using code provisions. Clear and concise wording leads you effortlessly through the content and important information is highlighted in bold characters within text boxes. A summary at the end of each module can serve as a quick reference in the future. Upon completion of the course, you will have a new appreciation for the flexibility and advantages offered by the objective-based approach.

Whether you're a builder, an inspector, an engineer, an architect, a building or product designer, or a student, you will find this course useful. Complete each module on-line at your leisure or print all seven to read anywhere—how convenient! All you need is Adobe Reader 7.0, which can be downloaded free of charge.

Go to **www.nationalcodes.ca** and graduate to a better understanding of the objective-based approach of the 2005 national model construction codes!

To purchase the 2005 codes, please visit NRC's Virtual Store at **www.nrc.gc.ca/virtualstore** or complete the order form (see facing page) and fax it to 1-613-952-7673.

New Evaluation Reports

Company	Product Name	CCMC #	Description
Certainteed Corporation	OPTIMA Wall Insulation System	13272-R	"OPTIMA Wall Insulation System" comprises pneumatically installed mineral fibre insulation in cavity walls behind netting to serve as thermal insulation.

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

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By mail: Publication Sales, M-20, National Research Council of Canada, Institute for Research in Construction, Ottawa, Ontario, Canada K1A 0R6

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* Includes application and intent statements
** n/a = not applicable

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new **National Plumbing Code 2005**	$120		$110		$180*		$720		$1,080	
Practical 2005 NBC User's Guides: new Structural Commentaries (Part 4)	n/a**		$94							
new User's Guide – NBC 2005, Application and Intent Statements	n/a**		n/a**		$150		$600		$900	
Practical 2005 NFC User's Guide: new User's Guide – NFC 2005, Application and Intent Statements	n/a**		n/a**		$110		$440		$660	
Practical 2005 NPC User's Guide: new User's Guide – NPC 2005, Application and Intent Statements	n/a**		n/a**		$60		$240		$360	
Quebec Construction Code 2001	$120		$110		$179		$715		$1,073	
National Farm Building Code 1995	n/a**		$34		$51		$204		$306	
Alberta Building Code 1997 on CD	n/a**		n/a**		$149		$596		$894	
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Fire Safety Research for Better Building Design: *Building Science Insight 2007*

www.bsi.gc.ca

Every year, NRC-IRC presents a national seminar to provide construction professionals with practical information. Each seminar focuses on a single topic and reports the results of recent NRC-IRC research. In 2007 the seminar will focus on fire safety in buildings.

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 will summarize some of these 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. Please note that this seminar will not deal with code compliance issues.

The seminar will address several topics:

Design Fires

Designing buildings to minimize the impact of fires requires the use of computational design tools, which are based on design fires, a quantitative description of the characteristics of a fire. This session will present some results from research aimed at developing design fires that can be used to evaluate the likely impact of fires on life safety, fire-safety systems and building elements. The presentations will also provide information on the types, quantities and burning characteristics of combustibles typically found in commercial buildings, which is required in order to develop suitable design fires.

Smoke Management and Control

Combustion products, including smoke and carbon monoxide, can have major effects on the life safety of occupants. This presentation will examine our understanding of the dynamics of smoke movement in the built environment. It will also report on recent research on issues arising from various technologies and approaches to smoke management, and on the interaction between smoke control and sprinkler systems.

Fire Alarms, Occupant Response and Evacuation

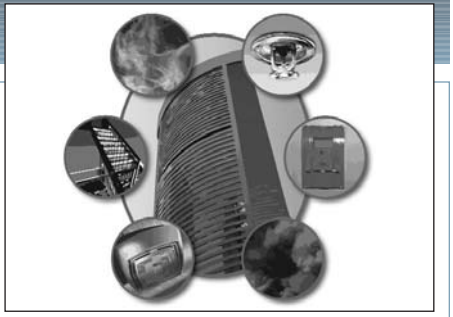
Improving our understanding of the likely behaviour of occupants during an emergency is a key component of reducing fire risk. NRC-IRC researchers will discuss occupant behaviour in fire and how this information can be integrated into a building's design and operation. They will also discuss some typical occupant responses in fires and how these could be incorporated into strategies for ensuring the safety of occupants during fire emergencies as well as into the development of building emergency action plans.

Fire-Suppression Systems

The use of halon as a fire-suppression agent is being discontinued because it has been found to contribute to the depletion of ozone in the atmosphere. However, newly developed replacement fire-suppression systems are available, including halocarbon and inert gaseous agents, water-mist systems, compressed-air-foam systems, and gas generators (solid propellants that convert to inert gases for fire-suppression purposes). All of these systems perform well in terms of extinguishing fires, but no one system is best for all applications. This presentation will provide brief descriptions of these fire-suppression systems, provide technical information on the performance of each, and describe limitations or concerns related to their use.

Case Studies

Two case studies will be presented: one on the use of photoluminescent material for emergency evacuation, and another on the use of sprinkler-protected window systems.



Speakers

The roster of speakers includes NRC-IRC fire researchers Noureddine Bénichou, Alex Bwalya, Andrew Kim, Gary Lougheed, Guylène Proulx and Russ Thomas, and building science generalist Luc Saint-Martin.

This one-day seminar will be held in the follow locations:

English Seminars

- ***Whitehorse, Oct. 2, 2007***
- ***Vancouver, Oct. 4, 2007***
- ***Yellowknife, Oct. 30, 2007***
- ***Edmonton, Nov. 1, 2007***
- ***Iqaluit, Nov. 14, 2007***
- ***Winnipeg, Nov. 28, 2007***
- ***Regina, Nov. 30, 2007***
- ***St. John's, Dec. 11, 2007***
- ***Halifax, Dec. 13, 2007***
- ***Fredericton, Jan. 15, 2008****
- ***Ottawa, Jan. 24, 2008****
- ***Calgary, Feb. 5, 2008***
- ***Toronto, Feb. 7, 2008***

French Seminars

- ***Quebec City, Feb. 19, 2008***
- ***Montreal, Feb. 21, 2008****

***** With simultaneous translation

The cost of the seminar is $349 plus tax. Please visit the Web site at **http://bsi.gc.ca** for more details and registration information.

Regina firm's landslide victory earns CCA Excellence in Innovation Award

How do you stop a landslide? Until recently, this was a question with only difficult, expensive answers involving excavation and reconstruction. Two years ago, however, Morsky Industrial Services Ltd. of Regina, Saskatchewan, developed an innovative technique for launching nails as part of its soil stability remediation system. The technique offers a quick, easy and aesthetically pleasing solution to holding slopes in place—and earned Morsky the Excellence in Innovation Award from the Canadian Construction Association (CCA) this past March.

As the nails enter the ground, they displace the soil, which then rebounds and binds tightly with the nails. This action causes sufficient resistance to stabilize the soil and prevent the slope from sliding any further.

In 2005, a 50-metre section of Highway 20 near Lumsden, Saskatchewan, was in danger of sliding into the adjacent Qu'Appelle River. Officials with the Saskatchewan Department of Highways and Transportation determined that the slope was in urgent need of remediation and stabilization, and that emergency measures were warranted.

Enter Morsky, which had recently introduced its unique "launched" soil nailing system to the Canadian marketplace. Originally designed for military applications, the technology uses a customized excavator outfitted with a compressed-air cannon to launch nail-like rods into a failing slope. As the nails enter the ground, they displace the soil, which then rebounds and binds tightly with the nails. This action causes sufficient resistance to stabilize the soil and prevent the slope from sliding any further.

Nail shooting work in progress

The results of the Highway 20 project are impressive. Completed in three days, the nailing process moved little soil beyond the direct nailing point and caused no disturbance to the river or the riverbank. The bank is now stable and includes erosion protection to avoid future contamination of the river system.

Each year, the CCA honours outstanding contributions to the Canadian construction industry with a series of awards given to individuals, companies and organizations. NRC-IRC is proud to be on the jury for the Excellence in Innovation Award because the development and promotion of innovative solutions in the construction sector is one of the institute's top priorities.

D-WARP (beta version) is now available!

For free download, go to **http://irc.nrc-cnrc.gc.ca/ui/software/dwarp/index_e.html**

The D-WARP (Distribution Water main Renewal Planner) software was developed by NRC-IRC to assist water utilities in the planning and management of distribution water mains (see *Construction Innovation*, June 2003 for more details).

This full beta version is available **free** for a one-year evaluation period.

Upcoming events

JULY

8-13
12th International Congress on the Chemistry of Cement (ICCC 2007). Montreal. http://www.iccc2007.org/Internet-English/index_e.shtml. *This event is co-hosted by the National Research Council Institute for Research in Construction and the Cement Association of Canada.*

25-28
ASCE Workshop on Computing in Civil Engineering. Pittsburgh, PA. http://www.ce.cmu.edu/~ASCE2007/

SEPTEMBER

4-5
CISBAT 2007. Renewables in a Changing Climate—Innovation in the Built Environment. Lausanne. Switzerland. http://cisbat.epfl.ch/

9-12
* American Public Works Association Annual Congress. San Antonio, TX. http://www.apwa.net/meetings/congress/2007/

OCTOBER

14-17
2007 Annual Transportation Association Conference, "Transportation—an Economic Enabler." Saskatoon. http://www.tac-atc.ca/english/annualconference/annualconference.cfm

28-30
Sustainable Northern Shelter in a World of Diminishing Resources. Fairbanks, AK. http://www.cchrc.org/forum.html

NOVEMBER

1
* Contech Quebec. http://www.contech.qc.ca/eng/index_batiment.php

6-7
* Construct Calgary. http://www.constructcalgary.com/

8-9
2007 RCI Symposium on Building Envelope Technology "Designing, Detailing & Specifying the Building Envelope for Today & Tomorrow." Boston, MA. http://www.rci-online.org/rci_event_display.cfm?eventid=267

28
Contech Montreal. http://www.contech.qc.ca/eng/index_batiment.php

28-30
* Construct Canada. Toronto. http://www.constructcanada.com/

DECEMBER

2-7
Thermal Performance of the Exterior Envelopes of Whole Buildings X International Conference. Clearwater Beach, FL. http://www.ornl.gov/sci/buildings/

2008 JANUARY

22-24
International Air-Conditioning, Heating, Refrigerating Exposition (AHR Expo). New York, NY. http://www.ahrexpo.com/

* *NRC-IRC is a participant in this event. You are invited to visit our booth for more information about our research expertise.*

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_e.html

construction *innovation*

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

Client Services:
Tel.: 613-993-2607 **Fax:** 613-952-7673

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