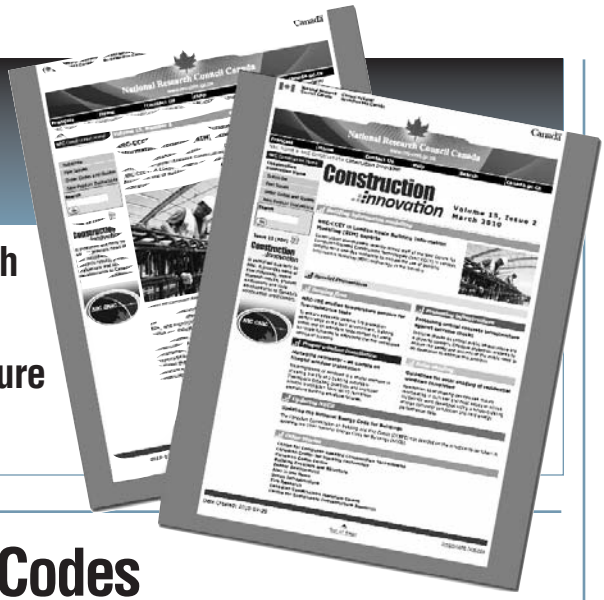
NRC·CNRC
Institute for Research in Construction

Volume 15 Number 3 **September 2010**

construction innovation

This is the last print edition of *Construction Innovation.*



Here's a peek at the free, online-only version which will be launched in December.

Subscribe now at www.nrc-cnrc.gc.ca/irc/ci to ensure you don't miss an issue!

2010 National Model Construction Codes available this November

The 2010 National Model Construction Codes will be available for purchase **November 29, 2010**. Prepared under the auspices of the Canadian Commission on Building and Fire Codes (CCBFC) and published by the National Research Council of Canada (NRC), they comprise the National Building Code of Canada (NBC), the National Fire Code of Canada (NFC) and the National Plumbing Code of Canada (NPC).

"I am very pleased to announce the launch of the 2010 National Model Construction Codes," says Bruce Clemmensen, Chair of the CCBFC for the 2005-2010 code cycle. "Their development is the result of broad consultation, a great deal of work from many dedicated volunteers, and the excellent staff support provided by NRC's Canadian Codes Centre. This work has benefited from, and been informed by, our ongoing partnership with the provinces and territories through the Provincial Territorial Policy Advisory Committee on Codes."

What's new?

Close to 800 technical changes have been incorporated in the 2010 National Model Construction Codes. They address the many technological

Continued on page 2

Highlights

National Research Council Canada
Conseil national de recherches Canada
Canada

Public review taking place for the National Energy Code for Buildings 2011

A public review is taking place this fall to provide Canadians with an opportunity to participate in updating the technical content of the National Energy Code of Canada for Buildings (NECB) and shaping it into an objective-based format, where every technical requirement achieves one or more of that code's stated objectives and functional statements. This is the same format now used for Canada's other National Model Construction Codes.

The Canadian Commission on Building and Fire Codes (CCBFC) is holding this review to seek your comments on a new objective, functional statements, and proposed technical changes for the revised NECB, scheduled to be published in 2011. The NECB 2011 will offer intent and application statements as well as objectives and functional statements for all technical requirements.

The public review will run from October 4 to November 26, 2010 on the National Codes website (**www.nationalcodes.ca**). An explanation of the proposed changes, as well as instructions on how to submit comments, will be provided.

If you are interested in receiving more information, please contact Anne Gribbon, Secretary to the CCBFC, at 613-993-5569 or email anne.gribbon@nrc-cnrc.gc.ca.

New members needed for committee updating the National Energy Code for Buildings

NRC Institute for Research in Construction (NRC-IRC) is seeking volunteers to serve on the Canadian Commission on Building and Fire Codes' Standing Committee on Energy Efficiency in Buildings (SCEEB). The term for current members expires February 28, 2011.

This committee is responsible for keeping the National Energy Code of Canada for Buildings (NECB) up to date. Appointments are for a term ending August 31, 2014. NRC-IRC will reimburse travel and accommodation expenses for members to attend committee meetings.

If you are interested in becoming a member and participating in important national code development work, please send an expression of interest and brief resume, before October 31, 2010, using the online form at **www.nationalcodes.ca/eng/volunteer.shtml**

If you are not available but know of someone who, in your judgment, would be a good contributor, please invite that person to submit an expression of interest.

For more information on the CCBFC's standing committees, please go to: **www.nationalcodes.ca/eng/ccbfc/committees.shtml**

2010 National Model Construction Codes available this November

Continued from cover page

advances and health and safety concerns raised since the 2005 editions were published.

Overviews of the most significant technical changes in the 2010 NBC, NFC and NPC will be provided by the NRC Institute for Research in Construction (NRC-IRC) as online presentations on the National Codes Website (**www.nationalcodes.ca**) next winter. These presentations will replace the seminars held across the country for the 2005 codes.

Printed versions of the 2010 NBC, NFC and NPC will be available in two practical formats:

- A full-size binder (8.5 x 11 in.) that lies flat, for easy reference, and easily accommodates updates.
- A soft-cover version (8.5 x 11 in.) that contains the same information as the binder but weighs half as much. This format is ideal for the job site.

Electronic versions of the 2010 NBC, NFC and NBC will also be available as downloadable PDF documents, which will replace the CD-ROM versions. On-line subscriptions to the 2010 NBC, NFC and NPC will also be offered. Two User's Guides will be added later, namely the User's Guide – NBC 2010, Structural Commentaries (Part 4 of Division B) and the Illustrated User's Guide to Part 9 of the 2010 NBC.

To order the 2010 National Model Construction Codes, please visit NRC's Virtual Store at www.nrc.gc.ca/virtualstore starting on November 29.

Report recommends changes to the NRC Canadian Construction Materials Centre

The NRC Canadian Construction Materials Centre (NRC-CCMC) has completed a business review carried out to determine whether its evaluation service was meeting the needs of clients (see *Construction Innovation*, June 2009, September 2009 and March 2010). The Montreal-based consulting firm Brio Conseils surveyed industry stakeholders to ascertain their needs and identify issues that concerned them with regard to the NRC-CCMC evaluation process.

The review report shows that a majority of users are satisfied with NRC-CCMC services. Respondents, however, identified four key issues that need to be addressed. They involve misconceptions regarding NRC-CCMC's role and services; a poorly understood evaluation process that is perceived as taking too long; dissatisfaction with response times and follow-ups; and building officials' use of evaluation reports.

The report recommends reviewing the evaluation process to confirm that it is meeting the changing demands of today's construction sector and to eliminate confusion over listings and reports as well as the role and process of re-evaluations. It also suggests that NRC-CCMC consider recognizing other organizations that provide evaluation services.

Improvements to the evaluation and decision-making process were also recommended. These included clearly defining expectations in terms of timeframe, cost and quality. Risk management and conflict resolution could be improved, and a simpler evaluation for low-risk products considered (such as fast-tracking). Other suggestions included expanding the use of external resources and placing more emphasis on internal peer review and staff cross-training.

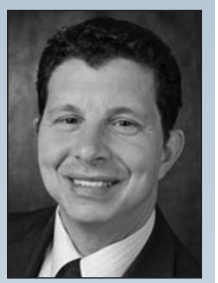
The overriding concern, however, was the need to improve communication with stakeholders. Two different approaches were recommended to provide more personalized services: one for manufacturers, who view NRC-CCMC as a service provider, the other for decision makers, who view the centre as a partner. A client care program, as well as one-stop-shop service, could be established for manufacturers, while decision makers would benefit from a support program that provided clearer documentation and assistance in using the information provided. All stakeholders would profit from a customer-relations approach to enquiries and complaints.

The report concludes by recommending that NRC-CCMC consider expanding its services to encompass energy efficiency, green, water conservation, and sustainability/conservation issues, as these are under development, or consideration, in the National Building Code of Canada. Brio Conseils' report and comments from the Canadian Commission on Construction Materials Evaluation (CCCME) will be considered by NRC-IRC management this fall.

The complete report is available at: **www.nrc-cnrc.gc.ca/eng/services/irc/ccmc.html**. For more information, contact John Flack at 613-990-8518 or john.flack@nrc-cnrc.gc.ca.

Newsbrief

New NRC-IRC Director General



Dr. Morad Atif

Dr. Morad Atif has been appointed Director General of the NRC Institute for Research in Construction (NRC-IRC). He succeeds Bob Bowen, who retired in May 2010 after 30 years of service at NRC-IRC, the last six as Director General.

Dr. Atif joined NRC-IRC as a research officer in 1993, after spending two years as a faculty member at Texas A&M University's College of Architecture and Department of Construction Science, where he earned a PhD in Architecture and Construction Science. He also holds a masters degree in Architectural Technology from the University of California.

Since 1999, Dr. Atif had been Director of NRC-IRC's Indoor Environment Research Program. In this capacity, he was a member of the NRC-IRC management team and the director responsible for the Canadian Centre for Housing Technology, a partnership between NRC, Natural Resources Canada, and Canada Mortgage and Housing Corporation.

The chair of several international conferences and an active contributor to many committees and associations, Dr. Atif currently chairs the Executive Committee of the International Energy Agency's (IEA) Energy Conservation in Buildings and Community Systems, a collaborative research partnership involving 26 countries. He also serves on the Board of Directors of the Continental Automated Buildings Association.

construction *innovation*
Publications Mail Agreement No. 40062591

Return undeliverable Canadian addresses to:

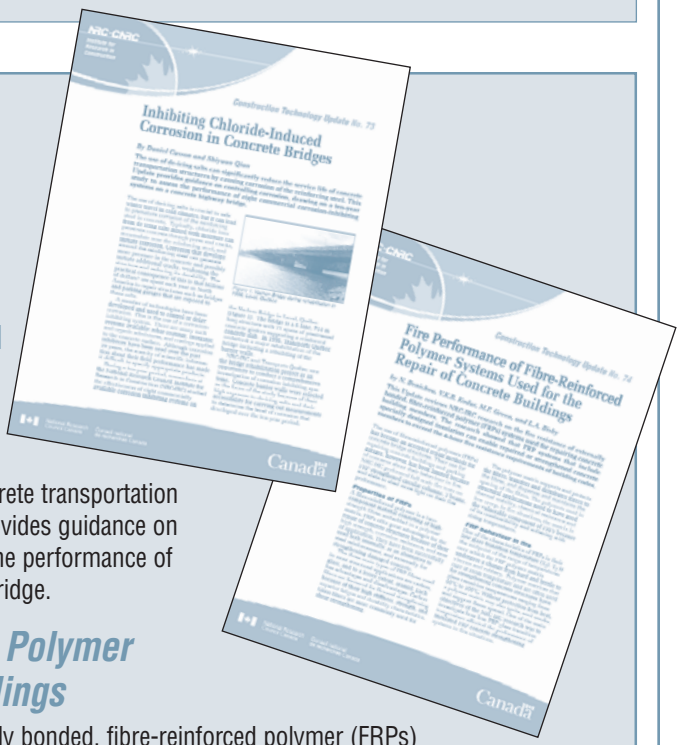
Institute for Research in Construction
National Research Council Canada
Ottawa, ON K1A 0R6
E-mail: IRCpubsales@nrc-cnrc.gc.ca
Tel: 613-993-2607
Fax: 613-952-7673
www.nrc-cnrc.gc.ca/eng/ibp/irc.html

New product evaluations from NRC-CCMC

Company	Product Name	CCMC #	Description
CertainTeed Corporation	Symphony™ Slate	13448-R	Recycled Thermoplastic Composite Simulated Roofing, Slate Tiles
RedBuilt, LLC	RedLam™ LVL	13485-R	Structural Composite Lumber
RedBuilt, LLC	Red-I™ Series Joists	13487-R	Prefabricated Wood I-Joists
CGC Inc.	CGC SECUROCK™ Glass-Mat Sheathing, CGC SECUROCK™ Firecode Type X Glass-Mat Sheathing	13491-L	Glass Mat Gypsum Board
CertainTeed Corporation	Form-A-Drain	13492-R	Interior Foundation Drainage System
Jager Engineered Wood Products Ltd.	JSI 2000, 3000 and 4000 Series I-joist	13493-R	Prefabricated Wood I-Joists
International Bildrite, Inc.	RoofRite	13498-L	Insulating Fibreboard (ULC S-706)
Temple-Inland	GreenGlass	13499-L	Glass Mat Gypsum Board
AMC Foam Technologies Inc.	Poly Pro	13521-L	Extruded Expanded Polystyrene Insulation Board
Amvic Inc.	Silver Board	13524-L	Extruded Expanded Polystyrene Insulation Board

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 **www.nrc-cnrc.gc.ca/eng/services/irc/ccmc/registry-product-evaluations.html**.

Two new Construction Technology Updates now available



Visit www.nrc-cnrc.gc.ca/eng/ibp/irc/ctus/ctus-index.html

CTU 73. Inhibiting Chloride-Induced Corrosion in Concrete Bridges

The use of de-icing salts can significantly reduce the service life of concrete transportation structures by causing corrosion of the reinforcing steel. This Update provides guidance on controlling corrosion, drawing on a ten-year NRC-IRC study to assess the performance of eight commercial corrosion-inhibiting systems on a concrete highway bridge.

CTU 74. Fire Performance of Fibre-Reinforced Polymer Systems Used for the Repair of Concrete Buildings

This Update reviews NRC-IRC research on the fire resistance of externally bonded, fibre-reinforced polymer (FRPs) systems used for repairing concrete building members. The research shows that FRP systems that include specially designed insulation can enable repaired or strengthened concrete members to exceed the 4-hour fire resistance requirements of building codes.

Evaluating fire behaviour or characteristics of residential furnishings

Residential building fires are the most fatal of all structural fires and account for the largest proportion of property loss. With new materials and construction styles constantly being introduced into the marketplace, continuing research on fire behaviour of residential furnishings is needed to better understand fire hazards.

The NRC Institute for Research in Construction (NRC-IRC) initiated a collaborative project with industry and municipal partners in 2006 to determine the characteristics of residential fires and typical combustible furnishings (fire loads), and to eventually portray them as design fires (simulation fires increasingly used to solve fire-safety problems). This research is used to develop predictive methods for evaluating the potential impact of fires on life safety, the performance of building elements, and on fire-safety systems. As well, fire safety engineering practitioners can use the results in evaluating residential fire scenarios.

In Phase 1 of the project completed at the NRC-IRC fire research facility in Mississippi Mills, Ontario, experiments were conducted to determine the burning characteristics of typical residential furnishings, particularly those that are frequently first-ignited items, such as upholstered seating furniture and beds. The experimental set-up included a test room with a window opening, which represented an average size living room or bedroom in a multi-family house. The furnishings tested included mattresses, bedclothes, bed assemblies, upholstered seating furniture, clothing arrangements, books, plastic audio/video media and storage cases, toys, shoes and a computer workstation setup.

Resulting fire intensity caused by some furnishings studied in the project.

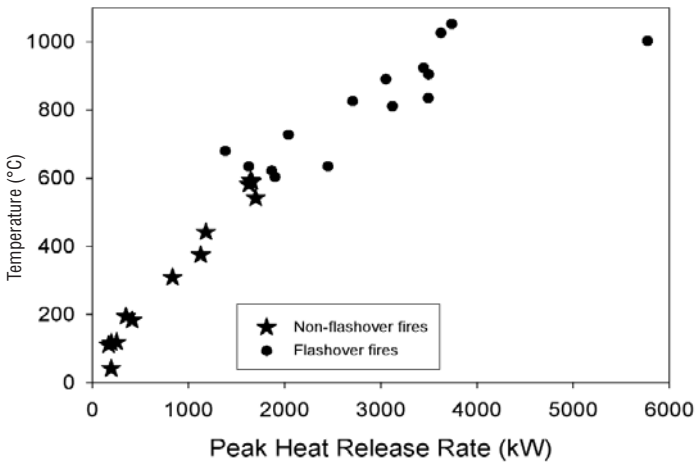


Figure 1: Many of the experiments with mattresses, beds and sofas gave rise to conditions that can cause flashover.

Numerous sensors were placed throughout the test set-up to measure the heat release rate (HRR), an important indicator of the size of a fire as well as its destructive potential, since it causes temperature rise. Heat flux, temperature and fire effluent (smoke and combustion gases such as carbon dioxide and carbon monoxide) were also measured.

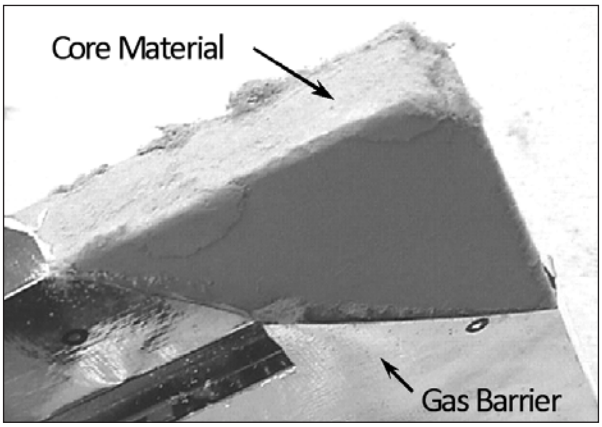
The experiments showed that variations in the configuration of a bed assembly and the amount of polyurethane foam (PUF) affected the rate of fire growth and the intensity of the resulting fires, as well as the time to reach flashover conditions in the test room. Flashover, a dangerous stage in the growth of a fire, occurs when all of the exposed surfaces of all combustible materials within the room are ignited owing to elevated room temperatures exceeding a critical value (approximately 600 °C). Following flashover, the potential for a fire to cause damage and fatalities in adjacent rooms is greatly increased. Many of the experiments with mattresses, beds and sofas gave rise to conditions that can cause flashover, as shown in Figure 1.

The results are now being used in the second phase of the project, involving fully furnished room design fire experiments. Detailed reports can be found at **www.nrc-cnrc.gc.ca/obj/irc/doc/pubs/rr/rr253/rr253.pdf** and **www.nrc-cnrc.gc.ca/obj/irc/doc/pubs/rr/rr302/rr302.pdf**.

For more information about this study, contact Dr. Alex Bwalya at (613) 993-9739 or e-mail alex.bwalya@nrc-cnrc.gc.ca.

Adapting vacuum insulation panels for construction – barriers and opportunities

The use of higher levels of insulation is one way to reduce the amount of energy used to heat and cool buildings. High-performance systems using vacuum insulation panels (VIPs) have thermal insulating capability five to ten times better than conventional materials of the same thickness. Based on research to date, it appears that use of VIPs is an attractive technological option for substantially increasing the energy efficiency of the built environment.



Gas barrier cut from a corner

VIPs have been slow to gain acceptance in construction because of three issues – cost, the need to protect them against puncturing, and a lack of long-term performance data. The NRC Institute for Research in Construction (NRC-IRC), in collaboration with other national and international research bodies, has been working on these and other issues in an effort to advance the technology.

Because the high-level performance of VIPs is based on maintenance of the vacuum, they must be well protected from mechanical damage due to wind loads or construction activities such as nailing.

The high insulating value of VIPs is based on the fact that the reduction of gaseous pressure inside a porous material increases its thermal insulating potential. A VIP consists of an open-pored core material able to withstand the external load caused by atmospheric pressure. A gas barrier/facer foil provides an airtight and vapour-tight enclosure for the core material. A desiccant (drying agent) is added inside the core material to adsorb residual atmospheric gases or water vapour in the VIP enclosure.

In the near term, it is likely that several products such as floor heating systems, exterior doors and prefabricated façade elements will make use of the high insulating value and slim profile of VIPs.

The relatively high cost of the core material has been a deterrent, so researchers at NRC-IRC have examined alternative materials as a way of reducing the cost of VIPs. A recent study reveals that fibre-powder composites, made with traditional fibre insulation materials and volcanic powders, show promise for use as core materials for VIPs. Furthermore, the use of bio-fibres for the construction of VIPs was also found to have potential.

Because the high-level performance of VIPs is based on maintenance of the vacuum, they must be well protected from mechanical damage due to wind loads or construction activities such as nailing. This means the VIP development process needs to include handling and quality control procedures and standards. When VIPs are used in precast or prefabricated constructions, mechanical protection is provided to the insulation by the rigid cover.

VIP materials are expected to remain more expensive than conventional insulating materials with the same R-value over the next five to ten years. But, the cost should decrease as a result of research advances, larger production volume and the automation of manufacturing processes, making VIPs more economically attractive.

In the near term, it is likely that several products such as floor heating systems, exterior doors and prefabricated façade elements will make use of the high insulating value and slim profile of VIPs. Several prototype projects have been completed or are being carried out in Europe using VIP technology and at least one in Canada. For information about VIP research, properties and uses, visit: **www.ecbcs.org/annexes/annex39.htm#p**.

For further information about NRC-IRC research and partnership opportunities for VIP-related projects, contact Phalguni Mukhopadhyaya at 613-993-9600 or phalguni.mukhopadhyaya@nrc-cnrc.gc.ca.

Removing sediment from urban stormwater runoff

In cities, stormwater runoff transports accumulated soil, sand and debris to a receiving body of water, which can potentially harm an ecosystem. The NRC Centre for Sustainable Infrastructure Research (NRC-CSIR) is working with AECOM Canada Limited, the City of Calgary, and the University of Calgary to come up with a solution to this stormwater runoff problem.

A common best management practice for decreasing the amount of particulate in urban stormwater runoff is to direct it through one or more retention ponds before it enters a main body of water. By directing runoff into a pond, the flow velocity is dramatically reduced, allowing time for particulates to settle out before the water exits the pond.

Designing a retention pond to remove specific particulate pollution requires knowing the residence time (amount of time water needs to remain in a pond) before it is released. If the flow through the pond is assumed to be in one direction only (from the inlet to the outlet), then a residence time can be computed using one-dimensional flow analysis.

However, in reality, one-dimensional flow throughout an entire pond is seldom achieved. Pond flow is affected by factors such as wind, pond shape, inlet and outlet locations, and shear stresses on the sides and bottom of the pond, which cause zones with different velocity profiles to develop. Some designs address this issue by increasing the pond size to try to lengthen the residence time, but this conflicts with the desire to minimize the footprint of a retention pond, to reduce construction and operational costs, and to make best use of available land.

A CFD model is being used to assist with the design of a stormwater management facility in Calgary.

Maximizing the residence time while minimizing the land requirements requires a better understanding of how the above factors influence water movement and particulate removal in the pond. The relationship between these factors and pond performance can be studied with multi-dimensional Computational Fluid Dynamics (CFD) models. Using CFD models to analyze sediment removal in stormwater ponds is relatively new and confidence in this type of application needs to be established.

A CFD model is being used to assist with the design of a stormwater management facility in Calgary. This is part of a retrofit program that is aimed at providing a higher degree of particulate removal from stormwater before it enters a receiving water body, such as the Bow River. Once the facility is operational, NRC-CSIR will lead the effort to validate the CFD model for this type of application by comparing data from flow monitoring and bathymetric surveys to results predicted by the CFD calculations. (Bathymetric surveys provide information about the unique shape and features of submerged terrain, which can be used to develop detailed maps of a riverbed, lakebed, or seafloor.)

To participate in this initiative or for more information, contact Darryl Dormuth at (306) 780-5510 or darryl.dormuth@nrc-cnrc.gc.ca. Information on other projects related to the sustainable management of urban stormwater drainage can be found at **www.nrc-cnrc.gc.ca/eng/projects/irc/stormwater-drainage.html**.

New Collaboration with the Canadian Construction Association Announced

The NRC Centre for Computer-assisted Construction Technologies (NRC-CCCT) is one of the founding members of the new Institute for Building Information Modeling in Canada, officially launched by the Canadian Construction Association (CCA) on August 11, 2010. The Institute's mission is to lead and facilitate the coordinated use of Building Information Modeling (BIM) in the design, construction and management of the Canadian built environment (see related story in *Construction Innovation*, March 2010).

Joining CCA and NRC-CCCT as members are Defence Construction Canada, the Ontario Association of Architects, the Association of Consulting Engineering Companies, and the Royal Architectural Institute of Canada. NRC-CCCT is an initiative of the NRC Institute for Research in Construction.

NRC-CCCT has signed a contract with CCA to assist the association in supporting the adoption of BIM and in developing the detailed scope of the project. For more information, contact Shafee Ahamed of NRC-CCCT at (519) 430-7087 or shafee.ahamed@nrc-cnrc.gc.ca.

Improving air quality through stratified air ventilation

Supplying fresh air directly into a room, at a temperature slightly lower than room temperature, can save energy and improve air quality. These are key reasons why stratified air ventilation systems are being installed in buildings across Canada.

Stratified ventilation systems take a fundamentally different approach from those found in the majority of non-residential buildings, which currently use a fully mixed and dilution approach to ventilation. Stratified air is introduced to a space close to floor level at a lower temperature than the set point. The air is then heated by occupants and equipment and the upward movement of the warming air removes contaminants from the breathing zone and exhausts them at ceiling level. This creates a non-uniform environment in terms of temperature and pollutant distribution, but acceptable conditions at the breathing zone.

Previous research has shown that this type of system works well for regions where buildings require year-round cooling. There are also a growing number of buildings using this approach in Canada, where buildings require heating during winter months. Providing supplemental heating can destroy the stratified conditions causing the ventilation air to rise to ceiling level, which affects the conditions experienced by the occupants.

To evaluate the effect of supplemental heating, the NRC Institute for Research in Construction is conducting field studies in existing buildings with stratified ventilation systems, along with detailed studies in the Indoor Environment Research Facility or IERF (see box).

Two field studies have been completed to date. The results show that the measured contaminant removal efficiency is better than that predicted in previous studies for heating conditions. In addition, key predictors of thermal comfort (the measured vertical air temperature difference and draft rating at ankle and head height) are also generally within limits set by ASHRAE standards. (ASHRAE develops standards for both its members and others professionally concerned with the design and maintenance of indoor environments.) However, the design of these systems varies from existing best practice guidelines of ASHRAE and REHVA (Federation of European Heating and Air-conditioning Associations) and the full benefits of a stratified ventilation system may not be fully realized. Control issues as well as localized thermal discomfort have been identified in the field.

To better understand the control of stratified ventilation systems and the interaction between core areas near the middle of the building and perimeter areas next to windows, the IERF has been retrofitted with a stratified ventilation system. This will allow researchers to examine the air flow patterns and thermal environment in detail over the 2010/11 heating season. Once the physical experiments are completed, human studies experiments will be conducted to evaluate the response of occupants to the stratified ventilation system compared to an overhead system.

For more information, contact Iain Macdonald at 613-993-9676 or ian.macdonald@nrc-cnrc.gc.ca.

Indoor Environment Research Facility Upgrade

Acoustics, lighting, ventilation and thermal comfort are the focus of studies at the Indoor Environment Research Facility (IERF), located on the National Research Council campus in Ottawa. A unique facility where both subjective and objective aspects of indoor environmental quality are assessed, the IERF has been the site of groundbreaking research for more than a decade. It has a floor area of 89 m^2 and can be configured to simulate a variety of full-scale building interiors.

New curtain wall system in IERF.

Originally constructed in 1996, this Institute for Research in Construction (NRC-IRC) facility has been extensively renovated over the last year. Upgrades include:

- **HVAC system:** The new 'state-of-the-art' system can easily be programmed to control temperature and ventilation conditions.
- **Exterior wall:** A new curtain wall system was selected. Operable windows at high and low levels are now an option, to permit the evaluation of natural ventilation.
- **Interior blinds:** Two sets of motorized interior roller blinds (opaque and semi-opaque) have been installed. This lets the occupants or the Building Energy Management System (BEMS) control the amount of daylight (and solar gain) entering the space.

For more information on the IERF, visit the website at **www.nrc-cnrc.gc.ca/eng/facilities/irc/environment-research.html**.

Workshop on Aircraft Cabin Environment Technologies

The Indoor Environment program at the NRC Institute for Research in Construction and the Canadian aerospace industry are working together on a new initiative to meet aircraft cabin environment technology (ACET) challenges. Developing, applying and evaluating technologies for healthy and comfortable fixed wing and pressurized aircraft cabin environments are the goals.

NRC will host a workshop to gather information on the challenges and technology gaps that need to be addressed to achieve the next generation of aircraft cabin and environmental control systems. Defining how best the NRC-ACET program can assist industry in meeting these challenges will also be discussed.

One-on-one industry consultations with original equipment manufacturers and Tier 1 suppliers are underway to identify the three highest-ranking aircraft environment technology priorities that can be resolved by working with Canadian businesses. These challenges will be the topic of three presentations to stimulate discussion at the workshop.

This workshop will serve as the first step in developing a long-range strategic plan and identifying possible short-term ACET projects. For more information or to register, visit **www.nrc-cnrc.gc.ca/acet** or contact Paul Lebbin at 613-991-4644 or paul.lebbin@nrc-cnrc.gc.ca.

Do supply air registers really need to be under windows?

Conventional thinking for residential forced air systems is that supply air registers should be located under exterior windows. There were good reasons for this in the past (primarily to counteract the cold downdraft from the window) but new construction standards (well-insulated walls, better glazing and air tight wall/window interface) mean that there is now less downdraft.

The NRC Institute for Research in Construction (NRC-IRC) is conducting experiments in a new, well-constructed building to evaluate whether the supply registers can be moved away from the traditional location without impacting indoor air quality, predicted thermal comfort, or energy loads.

Experiments have been completed for the heating season. Testing took place at the Ventilation and Wall Research Facility, located on the NRC campus in Ottawa. It has R-20 walls and R-40 attic insulation, triple-glazed, double low-emissivity, argon-filled windows and moderately airtight construction. Heating season experiments were supplemented by computational fluid dynamics (CFD) simulations. The physical experiments showed that in both traditional and non-traditional placement:

1) there are minimal changes in predicted thermal comfort (a measure of thermal discomfort – vertical air temperature difference much lower than 3°C), and
2) contaminant-removal effectiveness (a measure of indoor air quality) values were in the same range. The mean values for contaminant removal effectiveness were 1.14 for a register location at a window and 1.10 for a location at an interior wall.

Positioning the supply air register away from a window could have a large impact for new construction as duct lengths could be shortened (saving materials and construction time).

The CFD results agreed with the physical experiment results. This would indicate that, in terms of thermal comfort and indoor air quality, there is no significant benefit to positioning the supply air register under the windows in a well-insulated and constructed building during the heating season.

In the second phase of the project, the research team is examining supply register results during summer (cooling) conditions to determine whether they will have a similar performance to that of the heating season. The results will also be expanded using simulation.

Positioning the supply air register away from a window could have a large impact for new construction as duct lengths could be shortened (saving materials and construction time). This could allow greater architectural freedom as the forced air system would not need to be ducted to the building perimeter.

For more information on the Ventilation and Wall Research Facility, go to the website at **www.nrc-cnrc.gc.ca/eng/facilities/irc/ventilation-wall.html**. For more information on the project, contact Iain Macdonald at 613-993-9676 or iain.macdonald@nrc-cnrc.gc.ca.

Learning through interactive simulations

The transfer of knowledge is a key process in which the construction sector has an opportunity for improvement. This is a challenge faced by contractors, builders, suppliers and training colleges as they try to engage the next wave of construction workers.

The NRC Centre for Computer-assisted Construction Technologies (NRC-CCCT) is leading the way in developing a network to promote the research, evaluation and adoption of new tools and training. These will result in more effective and efficient teaching and knowledge transfer methods to support a progressive construction sector.

One promising solution is the use of visual-based simulation to give inexperienced practitioners the opportunity to hone their skills before they step onto the job site. Using many of the same technologies found in video games, these interactive tools allow discrete pieces of knowledge to be shared and acquired.

Using interactive tools to teach safety procedures.

Eight colleges and polytechnics from across Canada have already joined with NRC to coordinate and conduct research. A pilot study is underway to evaluate the effectiveness of using interactive visual tools for teaching safety procedures. Early results from a prototype trenching safety tool, for example, indicate that both students and educators see tremendous potential in the value of these technologies.

Organizations that see a benefit in this network and these technologies are encouraged to contact Paul Woodard at (519) 430-7061 or paul.woodard@nrc-cnrc.gc.ca.

Focus on the Canadian Centre for Housing Technology

The Canadian Centre for Housing Technology (CCHT) is operated jointly by the National Research Council, Natural Resources Canada, and Canada Mortgage and Housing Corporation. CCHT's mission is to accelerate the development of new technologies and their acceptance in the marketplace.

Since its launch in 1998, CCHT has supported manufacturers in their energy-related product research and development, and brought insight to builders and homeowners alike. With its twin R-2000 house facilities (a Reference House and a Test House) and accompanying InfoCentre on the NRC campus in Ottawa, CCHT has been the assessment site for more than 40 housing-related technologies.

CCHT has launched an electronic newsletter to bring you the latest information on the centre's projects. The first edition features articles including: *Assessing the energy performance of an integrated mechanical system*, and *Does running your fireplace cost you energy?*. To find out more and to subscribe to the newsletter visit: **www.ccht-cctr.gc.ca/eng/subscribe.html**.

The CCHT website at **www.ccht-cctr.gc.ca** has been revamped to include new project descriptions and publications, as well as a video tour. For more information, contact Marianne Armstrong at 613-991-0967 or marianne.armstrong@nrc-cnrc.gc.ca.

CONSTRUCTION CODES ORDER FORM

To Order Construction Codes

By Internet: www.nrc.gc.ca/virtualstore By fax: 1-613-952-7673

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

For more information, please call 1-800-672-7990 or 1-613-993-2463 (Ottawa-Gatineau and U.S.)

Discounts: Package Deals (2)

- $60 discount on minimum order of 3 different 2005 National Codes (same printed format)
- Bulk orders: 10% discount on minimum order of 10 copies of same printed document
- Bookstores: 25% discount on minimum order of 10 printed documents

Note: Discounts may not be combined.

Low Shipping Charges (4)

Add all shipping charges (CD and documents) to the calculation of your order.

PRINTED DOCUMENTS

ORDER VALUE		CANADA	U.S.	OTHER
$60 or less	add	$9	$13	$15
$61 - $199	add	$11	$15	$30
$200 - $499	add	$15	$25	$55
$500 - $999	add	4%	10%	12%
$1000 - $1999	add	3%	8%	10%
over $2000	add	2%	6%	8%
CD-ROM				
per disk	add	$8	$10	$12

Courier services available at cost
GST/HST No. 1214918007RT0275

Tax Table (6 & 7)

5% GST or 5% HST applicable on printed documents and 5% GST + PST/QST or HST applicable on CD-ROMs. Printed copies are PST/QST exempt. In Quebec, QST is calculated on price + GST. For US and international orders, do not add taxes.

PROVINCE	PST/QST	HST
AB, NT, YT, NU, PEI, MB	–	–
SK	5%	–
NS	–	15%
NB, ON, NL	–	13%
BC	–	12%
QC	7.5%	–

About Payment

Prepayment is required on all orders. Please note that all prices are in Canadian dollars and may change without notice. Make out cheques or money orders to Receiver General for Canada." Please allow 4 to 6 weeks for delivery.

Note: All sales are final. No refunds will be issued.

Publications

* On-line subscriptions now available at www.nrc.gc.ca/virtualstore
** Includes application and intent statements
*** n/a = not applicable

TITLE	Printed Copy: Binder	Specify Quantity	Soft Cover	Specify Quantity	Electronic Formats*: CD-ROM: 1 User	Specify Quantity	Concurrent Users: 1-5 Users	Specify Quantity	1-10 Users	Specify Quantity
National Building Code 2005	$200		$190		$350**		$1,400		$2,100	
National Fire Code 2005	$140		$130		$250**		$1,000		$1,500	
National Plumbing Code 2005	$120		n/a***		$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	
Practical 2005 NFC User's Guide: User's Guide – NFC 2005, Application and Intent Statements	n/a***		n/a***		$110		$440		$660	
Practical 2005 NPC User's Guide: User's Guide – NPC 2005, Application and Intent Statements	n/a***		n/a***		$60		$240		$360	
Quebec Construction Code, Chapter I – Building, and National Building Code 2005 (amended)	$240		n/a***		$240		$960		$1,440	
Quebec Construction Code, Chapter III – Plumbing, and National Plumbing Code 2005 (amended)	$144		n/a***		$144		$576		$864	
National Farm Building Code 1995	n/a***		$34		$51		$204		$306	
Alberta Building Code 2006 on CD	n/a***		n/a***		$240		$960		$1,440	
Alberta Fire Code 2006 on CD	n/a***		n/a***		$170		$680		$1,020	

	PRINTED COPY – Calculations		CD-ROM – Calculations		
1 - Subtotal	a	b	e	f	g
2 - Discount (see right)	c	d			
3 - Total (printed | CD-ROM)	a+b-c-d		e+f+g		
4 - Total shipping (see right) (printed | CD-ROM)					
5 - Subtotal (including shipping)					
6 - 5% GST or HST (of subtotal – line 5)					
7 - PST/QST/HST for CD-ROMs – line 5 (see right – tax table)					
8 - Subtotal (lines 5+6+7)	h		i		
TOTAL	(h+i) (Cdn $)				

Please Check (√) One

- ❑ Architect/Specification Writer
- ❑ Contractor
- ❑ Municipal Government
- ❑ Home Builder/Renovator
- ❑ Engineer/Consultant
- ❑ Owner/Manager
- ❑ Manufacturer/Supplier
- ❑ Educator/Student
- ❑ Building Official/Inspector
- ❑ Federal/Prov. Gov.
- ❑ Technologist
- ❑ Bookstore
- ❑ Fire Service

Please Print

NAME

ORGANIZATION

STREET

CITY PROVINCE/STATE POSTAL CODE/ZIP

E-MAIL

( ) TELEPHONE ( ) FAX

❑ Check here if you do NOT wish to receive future updates and other notices

Payment Method

❑ VISA ❑ MasterCard ❑ AMEX

SIGNATURE

PRINT NAME

CARD NUMBER

ORDER DATE (DD/MM/YY) EXPIRY DATE

or please enclose: ❑ Cheque ❑ Money order

Please contact Publication Sales

National Research Council Canada Conseil national de recherches Canada

Canada

CI REVISED SEPTEMBER 2010

Upcoming events

OCTOBER

10-13

2010 IEEE International Conference on Systems, Man, and Cybernetics, Istanbul, Turkey. http://www.smc2010.org/

NOVEMBER

2

2nd ACM Workshop on Embedded Sensing Systems for Energy-Efficiency in Buildings (BuildSys 2010), Zurich, Switzerland. http://www.buildsys.org/2010/

2011 JANUARY/FEBRUARY

31 Jan. – 2 Feb.

12th Fire and Materials Conference 2011, San Francisco. http://www.intersciencecomms.co.uk/html/events/fm11cfp.htm

JUNE

21-26

International Structural Engineering and Construction Conference (ISEC-6), Zurich, Switzerland. http://www.isec-society.org/ISEC_06/index.htm

JULY

3-8

2011 ICCC – XIII International Conference on the Chemistry of Cement, Madrid, Spain. http://www.icccmadrid2011.org/

NRC-IRC construction research and codes information becoming more accessible!

Have you ever wanted more story details but didn't know how to proceed? By moving to a free, online-only design, *Construction Innovation* will now be able to provide hyperlinks in every story. You can find out more about interesting topics and answer your questions with a click of the mouse. You will be able to draw from a huge repository of online research reports and construction codes information.

Look for the new online-only design in December.

Subscribe now at www.nrc-cnrc.gc.ca/irc/ci so you don't miss out!

construction *innovation*

www.nrc-cnrc.gc.ca/irc/ci

construction *innovation* is published quarterly by the NRC Institute for Research in Construction.

Editor: Claudine Laforce

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

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

ISSN 1203-2743

Ce document est également offert en français.

National Research Council Canada
Conseil national de recherches Canada

Ottawa, Canada
K1A 0R6

MAIL POSTE
Canada Post Corporation / Société canadienne des postes
Publication Mail / Postes- Publications

40062591
OTTAWA