NRC-IRC's housing activities for 2005: a report prepared for the Canadian Home Builders' Association

National Research Council of Canada. Institute for Research in Construction

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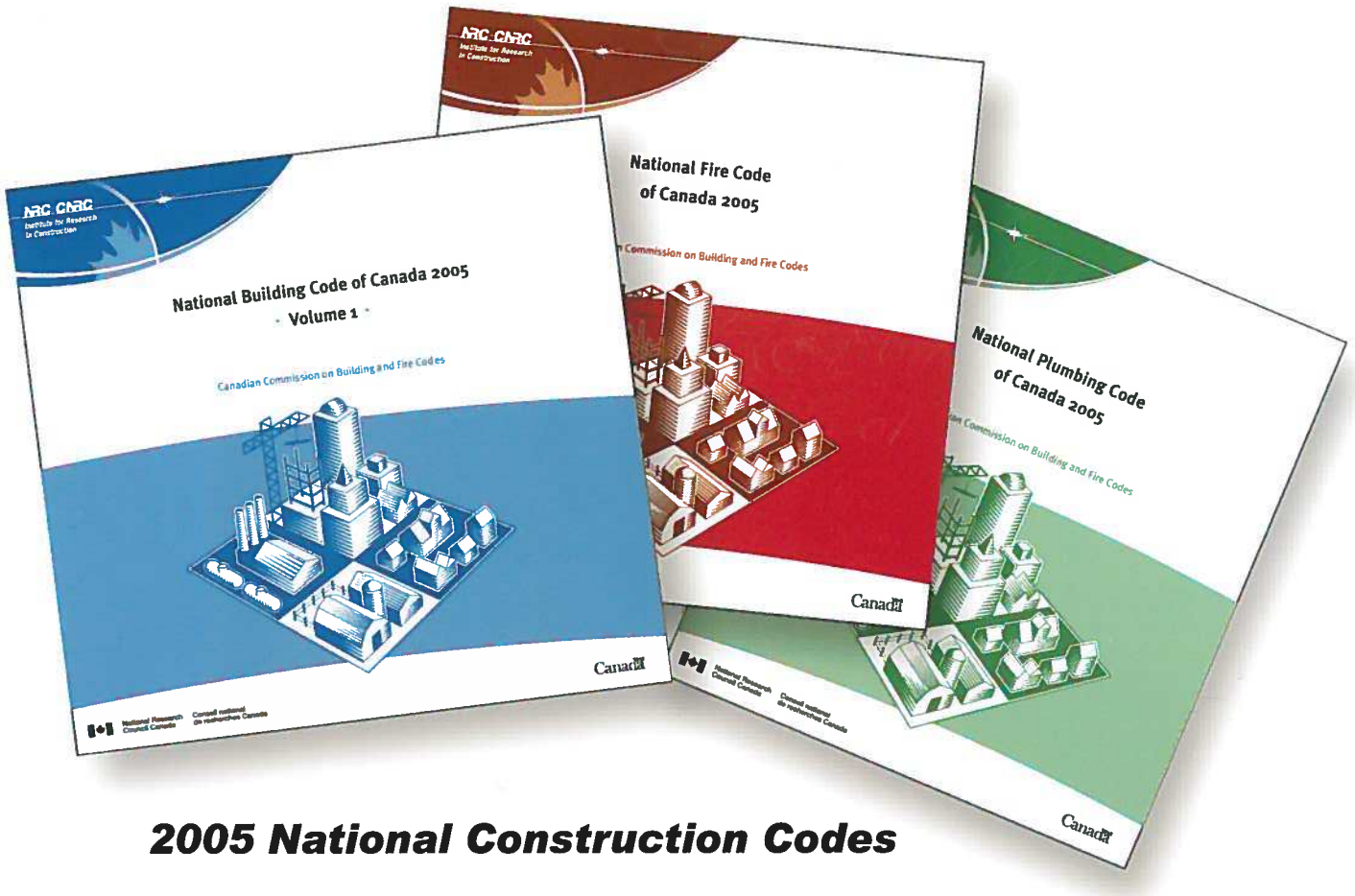
Bringing quality to the built environment

NRC-IRC's Housing Activities for 2005



2005 National Construction Codes

A Report Prepared for the Canadian Home Builders' Association
February 2006

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Canada

NRC-IRC's Housing Activities for 2005

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February 2006

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NRCC 48613

The NRC Institute for Research in Construction

The National Research Council's Institute for Research in Construction (NRC-IRC) is Canada's leading construction research agency. It provides research, code development, and materials evaluation services. Working with partners, IRC addresses issues that have a significant economic impact, assisting industry to innovate and develop technologies that are safe, durable and cost-effective. Issues such as sustainability, energy efficiency and indoor health are receiving greater attention.

With almost 60 years experience serving the construction industry, NRC-IRC is an objective, authoritative source of technology. Employing state-of-the-art facilities and equipment and drawing on its strong network of collaborators in Canada and abroad, IRC is able to bring together the resources and expertise necessary to carry out significant research projects that produce reliable results to meet the challenges of building successfully in a demanding climate like Canada's.

IRC's research work is organized as follows:

- The *Building Envelope and Structure* program is Canada's leading research authority on durable, energy-efficient, and cost-effective building envelope systems.
- The *Indoor Environment* program examines lighting, acoustics, temperature, ventilation and air quality and their effects on occupant satisfaction and comfort.
- The *Fire Research* program performs research to reduce the risks and costs associated with fire in Canada and to help ensure the fire safety of Canadians.
- The *Urban Infrastructure* program directs its research toward improving the evaluation and performance of infrastructure systems, which helps keep the costs of subdivision servicing in check.
- The *Canadian Codes Centre* of IRC provides leadership to the construction industry and the provinces and territories in the development and updating of Canada's National Construction Codes to provide a consistent and logical regulatory framework across the country.
- The *Canadian Construction Materials Centre* (CCMC) provides a national service for evaluating all types of innovative construction materials, products, systems and services. One of its primary objectives of is to help the construction industry be competitive by evaluating construction products with respect to their suitability for intended use and conformance to applicable codes and standards.

The Canadian Centre for Housing Technology (CCHT), a partnership involving NRC-IRC, CMHC and NRCan, features twin research houses to evaluate the whole-house performance of new technologies for the purpose of accelerating their acceptance in the marketplace.

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A Message from the Director General of NRC-IRC

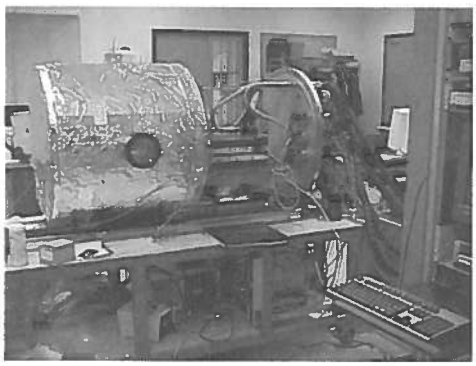
For over 60 years, the Canadian Home Builders' Association has served its members and the Canadian public by pursuing its goals of promoting housing quality, affordability and choice, and building vibrant, prosperous and healthy communities. The NRC Institute for Research in Construction (NRC-IRC) is a world-renowned research organization with a history almost as long as CHBA's. Indeed, NRC-IRC was founded in 1947 for the very purpose of providing a research service to the construction industry, especially the housing sector during its rapid expansion in the post-war years. The Institute's mandate was also to assist CMHC in its work and to develop the model National Building Code, endeavours in which home builders have been both contributors and beneficiaries.

As the newly appointed Director General of NRC-IRC, I wish to build on and strengthen the long history of cooperation we have enjoyed with CHBA. We will continue to use our expertise and research capabilities to develop knowledge that supports CHBA's goals. We will continue to organize research projects that marshall the diverse pools of expertise available in industry and government. We are confident that the results will, as in the past, provide more options for builders and product manufacturers, and advance Canadian housing technology.

This past year marked the highly anticipated publication of the 2005 National Construction Codes. The new editions saw the introduction of an objective-based format, making Canada a world leader in the regulatory field. This was a true team effort, a major achievement for NRC-IRC, the provinces and territories, and industry, including CHBA. Our product evaluation service, provided by the Canadian Construction Materials Centre (CCMC), is finding an ever-increasing demand, as we work to help industry to innovate and bring new technologies into a quality-driven marketplace.

This annual report is intended to provide information about NRC-IRC's activities on behalf of the housing sector. I welcome your comments on any of the projects reported herein and your suggestions on better ways of working together.

Bob Bowen
Director General



Vacuum guarded hot plate for insulation studies

Building Envelope and Structure

New High-performance Insulation Being Studied

IRC is continuing its research on vacuum insulation panels (VIPs) filled with new high-performance thermal insulation, such as micro and nano-porous materials. Though these materials can be up to ten times more energy efficient than currently used insulations of the same thickness, technical limitations are preventing their use in building construction.

Using newly installed equipment, IRC is working to evaluate the short- and long-term thermal resistance of these high-performance materials. The ultimate objective is to publish guidelines on the application and use of VIPs in buildings.

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Window/Wall Interface Details for Managing Rainwater

Poor window installation can create the risk of building envelope failure. In cooperation with CMHC, IRC is continuing its work on a project to evaluate how well various window/wall construction details can manage rainwater. In the past year, a number of full-scale wall sections incorporating specific window types and wall cladding systems were tested against simulated wind-driven rain conditions. Tests will continue in 2006. The results will apply to low-rise wood-frame construction, with high-rise residential buildings to be considered in the final phase of the research. The outcome of this work will be information to aid in the development of a best practice guide on window installation.

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Basement Guidelines Report Now Available

A comprehensive publication compiled from the results of the basement study conducted at IRC is now available free on the IRC Web site.
(http://irc.nrc-cnrc.gc.ca/pubs/rr/rr199/index_e.html

IRC is in the process of preparing two new publications covering two specific basement issues. These publications, expected to be available in the late summer of 2006, form part of the Institute's Construction Technology Update series and will address the following:

1) Proper draining and site grading for successful housing construction;
2) Selection of materials for basement construction.

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Better Building Envelopes for the North

Work is progressing on this new project to develop the building science knowledge necessary to construct energy-efficient and durable building envelopes that will perform well in the extreme conditions of Canada's North. In the past year, researchers completed their review of current technologies, practices, and issues regarding construction, heating, ventilating, moisture management and energy use in extreme climates. This review provided information for selecting building envelope technologies that warrant further investigation as good candidates for high performance. Field surveys are underway to establish indoor parameters and outdoor climatic conditions against which the technologies would be expected to perform.

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New Software for Assessing Wall Moisture Performance

IRC has released a powerful new software, *hyg*IRC 1-D, which can compare the moisture and thermal performance of a proposed wall design to that of another wall with a known performance track record. The software enables designers to explore various "what-if" scenarios – for example, what if the stucco cladding were replaced with acrylic stucco.

This program is intended for building science consultants and engineers, who can use it to simulate the performance of many building envelope types under a wide variety of temperature and humidity conditions. Their use of the program will generate new information for the construction of better building envelopes, including those for housing.

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New Information on Repointing Mortars

The proper selection and application of repointing mortars are critical for preserving older masonry buildings, many of which have heritage value. IRC researchers have long been carrying out research and working with industry experts to help provide better guidance in this regard. They are planning for publication in late 2006, two Construction Technology Updates, one addressing the selection of repointing mortars and the other, the application.

The IRC Web site contains further information:
http://irc.nrc-cnrc.gc.ca/bes/masonry

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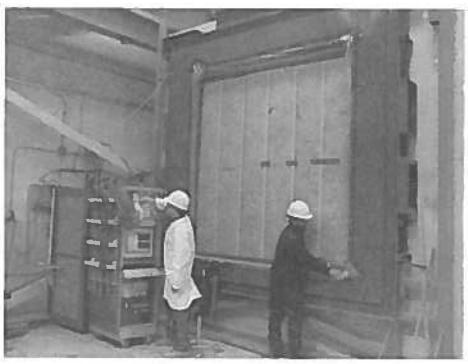

IRC researchers prepare a full-scale wall specimen for an experiment in the Envelop Environmental Exposure Facility

Garden roof system on Toronto City Hall

Garden Roof Studies Continue

As garden roofs increase in popularity, IRC is carrying out research to develop a better understanding of their performance. Most recently, researchers have partnered with the Urban Ecology Centre to study the energy performance of an extensive green roof on a residential duplex in downtown Montreal.

IRC is also working with Environment Canada and Public Works and Government Services Canada to enhance garden roof technology for optimal thermal performance and to develop a building simulation model for garden roofs. In a continuing project with the British Columbia Institute of Technology, the performance of garden roofs in the mild west coast climate is under study.

IRC's first work in this area was a study at its research facility in Ottawa which showed that garden roofs can improve the roof system's energy efficiency, extend the membrane's service life and help address storm water management issues in urban areas.

Although most green roofs are found on commercial and institutional buildings, similar benefits can be realized in low-rise residential housing.

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Improving the Properties and Performance of Concrete

IRC has a long history in concrete and cement science research. One of its current thrusts in this field is the development of new technologies that address product innovations aimed at sustainability and include the use of renewable and waste materials and development of new pozzolanic additive materials. Emphasis is given to the development of both eco-efficient construction products and nano-based cement materials.

Projects are wide-ranging and aimed at improving the properties and performance of concrete. Initial efforts are focused on developing mix designs that would meet the strength, workability and frost resistance requirements for sustainable concrete products. The potential for improving performance through the use of mineral additives such as fly ash, cement kiln dust, zeolites, and geopolymers is a key focus of the study.

Fly ash is a mineral by-product of the combustion of coal in power plants and is known as a pozzolan (reacts with calcium hydroxide to form compounds possessing cementitious properties). Cement kiln dust is a by-product of cement manufacturing. Natural and synthetic zeolites have many useful purposes and have already been used in the making of lightweight concrete. Geopolymers are produced by the conversion of industrial wastes, such as fly ash and slag, and natural products such as clays, into mechanically strong and chemically durable construction materials.

Nanotechnology is a new research field in construction, involving studying and working with matter on an ultra-small scale. One nanometre, for example, is about 1/80,000 of the diameter of a human hair. In the field of cement and concrete, in order to acquire a much better understanding of the properties of construction materials, it is necessary to apply nanotechnology concepts that control material behaviour at this small scale and develop the skills needed to incorporate these concepts into practice. Such enhanced understanding for a material as complex as cement/concrete will translate into a better use of construction materials of higher performance.

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Better Design against Natural Disasters

For many years, researchers at IRC have been contributing their expertise to help designers, builders, product manufacturers, insurance companies and building owners to ensure that buildings are properly designed and built to withstand natural disasters such as earthquakes, tornadoes, and hurricanes. Frequently researchers participate in teams investigating disaster-ravaged areas in North America and elsewhere.

Most recently, a researcher visited areas stricken by Hurricane Katrina to study its effects on roofing systems. As was the case with a survey conducted after Hurricane Charlie in August 2004, hundreds of roofs were inspected, 70% of them residential. The findings of these surveys help determine best practices for improved design.

IRC reached a major milestone in 2005 with its publication of *A Guide for the Wind Design of Mechanically Attached Flexible Membrane Roofs*, a culmination of ten years of research and the development of a new wind uplift testing protocol.

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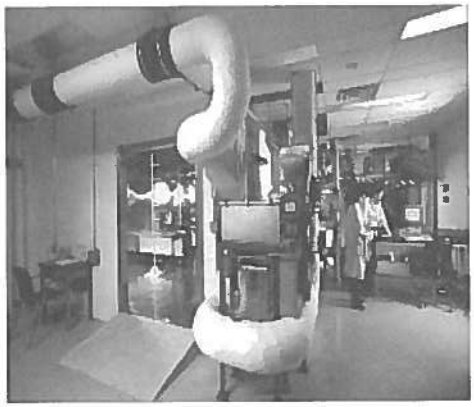
An IRC researcher surveys roof damage caused by Hurricane Katrina



Full-scale emission testing facility at IRC

The Indoor Environment

Emissions from Building Materials and Products

This comprehensive research project is nearing completion. The research team has developed significant new information about emissions from materials and products used in building construction and furnishings and their possible effects on indoor air quality.

In their most recent work, the researchers increased the number of chemicals in the database to about 90 and the number of materials to 69. They also enhanced the reliability of an emission prediction software they had developed earlier. Once the final verification of the results has taken place, the software will be made available on the IRC Web site.

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Sensor Technology for Demand-Controlled Ventilation

Demand-controlled ventilation is activated when sensors indicate indoor air has exceeded the parameters monitored by the sensors. Despite advances in sensor technologies for such parameters as carbon dioxide, formaldehyde, volatile organic compounds, odours, particles, radon, and relative humidity, sensor reliability remains an issue. This, coupled with cost, is limiting the widespread implementation of DCV.

This project examined the cost and reliability of sensor technologies for potential use in demand controlled ventilation.

The research team is proposing a follow-up project to address an identified research gap, a lack of application studies on sensors other than for CO_2.

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Efficient Air Movement and Heat Delivery

Because of higher energy costs, there is strong interest in technologies to reduce energy use in homes. This project, which began in 2004, has two elements. One is looking at ways to improve the energy efficiency of fans in forced-air heating systems. This work, to be carried out by staff at Natural Resources Canada, involves developing a furnace fan with improved aerodynamic efficiency and coupling it with a suitably sized electronically commutated motor for testing.

The other aspect of the project, being done at IRC, is to determine the relative energy efficiency and thermal comfort benefits of a hydronic radiant floor heating system. The work will be carried out in a two-storey test house during the 2005/06 heating season. The performance will be compared to that of forced-air systems as well as that of hybrid systems combining radiant and forced-air heating.

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Energy-Efficient Hybrid Ventilation Systems

Hybrid ventilation systems are those that use both passive and mechanical ventilation at different times of the day or season to improve ventilation and potentially reduce energy use. They take advantage of natural ventilation when it is available, and supplement it as necessary with mechanical. This research project, initiated in 2004, began with a review of what is already known about hybrid systems, their benefits and limitations. During the 2005/06 heating season, a hybrid system complete with automated controls is being evaluated in the test house. Its performance will be compared with that of passive and mechanical ventilation systems. The study is assessing parameters such as energy use, indoor air quality, moisture control, comfort, ventilation rate, and air distribution.

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SkyVision: Predicting the Performance of Skylights

SkyVision is a Windows™-based computer tool that calculates the overall optical characteristics and indoor daylight availability of conventional and tubular skylights, and predicts their energy-saving potential. The software is available free of charge from the IRC web site:
http://irc.nrc-cnrc.gc.ca/ie/lighting/daylight/skyvision_e.html

In a new phase of work, IRC plans to upgrade the capabilities of SkyVision to handle complex and innovative skylight glazing (such as glazing with built-in shading, transparent or translucent insulation, etc.), and to include calculation of the thermal performance of skylights.

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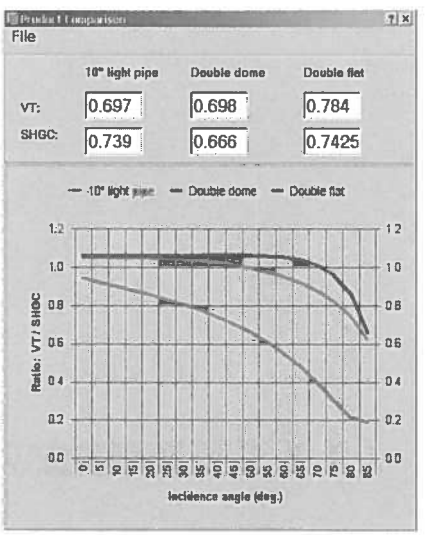

Output from the use of IRC's SkyVision software

Complex Fenestration Systems

The need for energy conservation has spurred innovations in window design, including shading devices, complex glazings, translucent and transparent insulation, and patterned glass. To assess the effect of these innovations on natural light transmission and view through windows, IRC researchers have developed additional glazing performance indices related to luminance, view in and view out.

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Sound and Fire Performance of Floors

IRC's full-scale facility for acoustical testing of floor assemblies

Phase II of this major research initiative was recently completed, adding to the project's already large pool of information to help designers and builders select and construct suitable floor assemblies, particularly for multi-family dwellings.

The first phase resulted in a database of fire resistance and sound transmission characteristics of many types of floor assemblies and an updating of the National Building Code, increasing the number of floor assemblies from 12 (in the 1995 NBC) to over 700 (all assemblies have sound ratings while only 200 have fire resistance ratings).

The Phase II acoustics Research Report (RR 103), which adds more floor assemblies to the database, is available at:
http://irc.nrc-cnrc.gc.ca/fulltext/rr/rr103

The Phase II fire resistance Research Report (RR 184), which also adds more floor assemblies to the database, was published in 2005: see
http://irc.nrc-cnrc.gc.ca/fulltext/rr/rr184

Phase II also produced software for estimating sound transmission class, impact insulation class, and some related ISO ratings, which was developed for floors with resilient metal channels and insulating material. Users can select sub-floor materials, framing and ceiling details, resilient channel disposition, and the thickness and type of sound-absorbing material for common floor assemblies. The beta version of the program is now available on the IRC Web site at:
http://irc.nrc-cnrc.gc.ca/ie/floors/index_e.html

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Flanking Sound Transmission in Multi-Family Dwellings

Flanking sound, the transmission of structure-borne sound through a floor and around a separating wall, can significantly reduce the apparent sound insulation between dwellings or rooms, and cause occupant dissatisfaction. Flanking is even more pronounced when additional structural elements are needed to resist earthquake or high-wind forces. IRC has now completed its initial research addressing how sound transmission through the structural connections at the wall/floor interfaces affects the apparent sound insulation of some common wood-framed apartment constructions. Further projects using IRC's new experimental facilities will address additional complications typical of apartment and row housing construction.

Study findings are available in two forms. The first, a Best Practice Guide (Research Report RR-193), is designed to aid builders, architects and engineers select details consistent with the sound insulation design goal for the completed assembly. The second is a detailed technical report from which the Guide was developed (Research Report RR 168). Both are available on the IRC Web site free of charge: http://irc.nrc-cnrc.gc.ca/fulltext/rr/rr193/, and http://irc.nrc-cnrc.gc.ca/fulltext/rr/rr168/.

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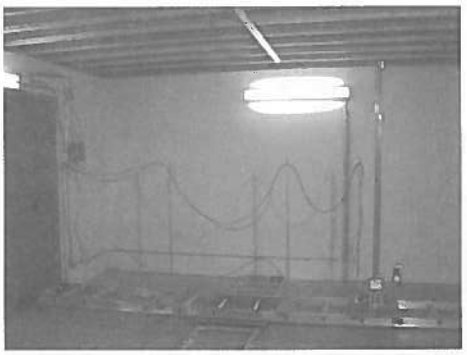
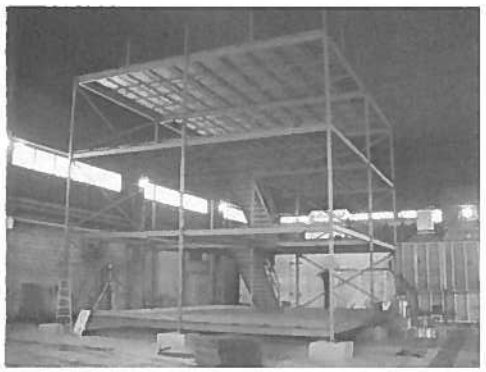


One of the test rooms in IRC's new world-leading flanking research facility

Fire Research

Fire Performance of Houses



Early construction phase of an IRC facility (now completed and in use) for a study of the fire performance of Canadian houses, representing a two-storey house with basement

IRC is continuing its study of the fire performance of single-family dwellings and the factors affecting fire safety. The work involves tests representing the possible fires that would be expected to occur in the basement of a single-family house. A basement fire is one of the likely fires to challenge the structural integrity of the floor unit and cause the migration of smoke and gases throughout the house and the egress paths.

The research is taking place in a three-level experimental facility, representing a two-storey single-family house with a basement. The new facility allows IRC to study structural fire performance, smoke movement and tenability. The primary objective is to better understand the potential fire safety impact of innovative residential construction products and systems. Two key questions to be answered are:

- How long do egress routes from the house remain passable in a fire?
- How long do people take to respond and evacuate their home after a smoke alarm sounds during a winter night?

Thus far, tests have been done on a number of floor assemblies. The project is expected to be completed in December 2006.

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Fire Protection of Housing in the North

The fire protection of housing in Canada's North is made difficult because of limited water supply and access to municipal water systems. For this reason, sprinklers are not a viable option. A possibility, however, is fire suppression systems based on the use of compressed air foam (CAF).

Over the past 15 years IRC has made significant advances in the development and enhancement of CAF systems for a number of applications. It is now using this expertise to carry out a feasibility study for a compressed air foam system for use in the North. The project, supported by CMHC and industry, began with laboratory research on a prototype system in 2005, to be followed by field testing of the system in a vacant house in the Northwest Territories under a typical fire scenario. The project is expected to be completed in late 2006.

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Technical Support in Reducing Cigarette-Ignited Fires

The unintentional dropping of a lit cigarette onto a bed or upholstered furniture is a leading cause of residential fires and related injuries and deaths. Fire researchers at IRC recently provided technical support to Health Canada in its efforts to develop regulations to limit the likelihood of a cigarette igniting upholstered furniture, mattresses and bedding. This contribution included the building of a new test facility, expertise to determine cigarette ignition propensity, and a series of background studies to investigate the ignition propensity of all cigarettes sold in the Canadian market. The background studies helped Health Canada to promulgate Cigarette Ignition Propensity Regulations under the Tobacco Act. As of October 1, 2005, Canada became the first country in the world to require less-fire-prone cigarettes, regulating the ignition propensity of cigarettes determined using the ASTM E2187-04 method.

Data from the background studies will also be used to evaluate the regulatory impact in relation to the reduction of cigarette-ignited fires and associated fatalities and property damage. IRC's ongoing partnership with Health Canada to reduce cigarette-ignited fires will have a positive impact on public health and safety.

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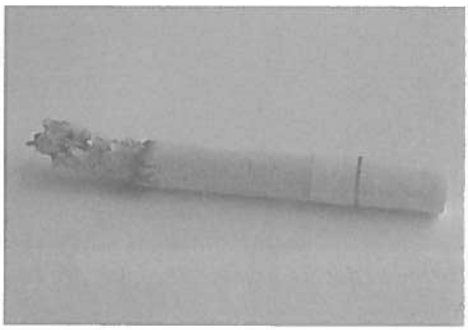
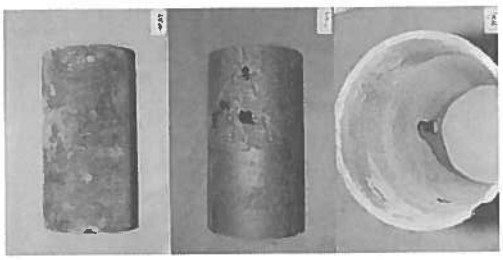


Many residential fires are accidentally started by burning cigarettes



Corroded ductile iron water mains are being evaluated in one of many infrastructure research projects at IRC

Urban Infrastructure

IRC's extensive program of research in urban infrastructure supports the creation and maintenance of efficient communities, including new housing developments. The work is directed toward buried works, roads and concrete structures, particularly bridges. Many projects are underway in areas such as leak detection and repair of pipes, restoration of utility cuts in roads, sealing of cracks in asphalt, inhibition of corrosion in bridges, and management of infrastructure systems.

IRC's new Centre for Sustainable Infrastructure Research (CSIR) is now operational and working closely with IRC colleagues in Ottawa and with partners in Saskatchewan.

Information on the research projects on urban infrastructure may be found at:
http://irc.nrc-cnrc.gc.ca/ui/projectlist_e.html

Code Development

2005 National Construction Codes Now Available

The National Research Council recently published the 2005 editions of the National Construction Codes in a new "objective-based" format.

The National Building Code, the National Fire Code and the National Plumbing Code were released in September 2005 after a ten-year review by industry and provincial/territorial representatives, in collaboration with the NRC Institute for Research in Construction. The new editions contain not only numerous technical changes, but significant new information that makes the codes clearer, enables easier application to existing buildings and removes barriers to innovation.

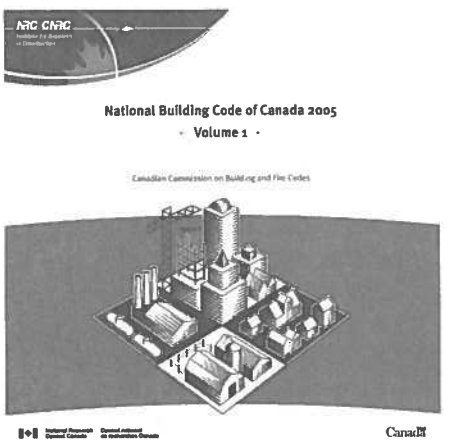
Although this new information will facilitate the work of many users, such as designers and regulators, most users such as builders should experience little change from the way they previously used the codes. For their day-to-day work, builders will find the same code provisions – now referred to as "acceptable solutions" – as they found in the 1995 editions, updated with technical changes.

An "objective-based" code means all provisions will be tied directly to the code's objectives. For the National Building Code, for example, these objectives are safety, health and accessibility of occupants, and fire and structural protection of buildings. The new objective-based format will help users understand why a particular provision must be met. It will also provide information that will assist designers to evaluate "alternative solutions" should they wish to propose one, and help building officials determine conformity.

Past editions of the national codes have always permitted what were called "equivalents" or "equivalencies." This means code users could devise a different solution from what the code prescribed, as long as they could prove to a regulatory official that it would work just as well. The new objective-based codes continue that tradition but make the process clearer by providing information that will help users, mostly designers, develop alternative solutions and, as well, help building officials to review and approve them.

What's New in the Codes?

In order to accommodate this new information, the 2005 NBC, NFC and NPC have a new organizational layout. Each code comprises three divisions: **A, B and C**.



The new National Building Code has a revised format

Close to 1,300 technical changes have been incorporated in the 2005 National Construction Codes

Division B is where users will find the code provisions, which are essentially the same as in the previous editions. For most projects, users will likely rely on the acceptable solutions in Division B because they have been in effect and proven to work over many years. What is more, most of the code structure and vocabulary familiar to users with will remain in place.

Division A will include compliance options and new components called "objectives" and "functional statements." Most provisions in Division B will be linked to at least one objective and one functional statement to help users better understand why a particular provision must be met and to help them evaluate alternative solutions.

Division C will contain administrative provisions, which have all been consolidated into this one place from the 1995 Codes.

The printed versions of the 2005 NBC, NFC and NPC are available in binder and soft cover versions. In March 2006, the CD-ROM versions will be released together with User's Guides (on CD-ROMs only), which will contain statements explaining the intent behind the code provisions and what the provisions apply to. The User's Guide to Part 4 of the National Building Code will also be released in both printed and CD-ROM formats.

Significant Technical Changes in the 2005 NBC

All in all, close to 1,300 technical changes have been incorporated in the 2005 National Construction Codes to address the many technological advances and health and safety concerns raised since the 1995 editions were published. Here are some of the most significant changes for builders in Part 9 of the NBC.

Changes have been made to clarify when Part 9 applies, when Part 9 loads can be used for design under Part 4, and when the design must be done under Part 4. Other changes are discussed below.

Simplified snow load calculation

The simplified approach previously applicable only to wood-frame construction has been extended to structures of any material where there is a high degree of redundancy created by closely spaced, repetitive members and the total roof area does not exceed that for Part 9 buildings (regardless of firewalls) and there are no obstructions that contribute to significant snow accumulation.

Support of decks

Several changes clarify the requirements for foundations and lateral bracing for decks, and identify exceptions and alternative solutions to existing requirements.

Insulated concrete form walls

Detailed prescriptive requirements for engineered insulated concrete form (ICF) walls for small houses have been added, applying to both foundations and above-ground walls. Other changes permit higher masonry foundation walls for a given thickness if the masonry incorporates reinforcing.

New climatic indicator

A new climatic indicator, the moisture index, has been added to identify high-moisture-load regions. The indicator is a single number that reflects both the amount of rainfall that a location receives and the duration of drying periods. Two planes of protection are required to provide protection from precipitation—the first is the cladding and the second is the sheathing membrane and flashing, with or without a drained and vented air space. All residential buildings are required to be constructed with two planes of protection (no face-sealed cladding). In high-moisture-load regions, the two planes of protection need to be separated by a capillary break.

IRC, in collaboration with the provinces and territories, is giving users an overview of the technical changes in the three codes through seminars organized in major cities across Canada. The provinces and territories are working together to develop training for builders and building officials on the objective-based aspect of the codes.

Next Code Development Priorities

Now that the objective-based 2005 National Construction Codes have been published, preparations for the next national code cycle have already begun.

At its meeting in June 2005, the Canadian Commission on Building and Fire Codes (CCBFC) adopted the initial priorities for the technical development of the codes during the next cycle. The decisions on priorities were made in consultation with the Provincial Territorial Policy Advisory Committee on Codes (PTPACC). These priorities were selected from recommendations of a report developed by a joint CCBFC/PTPACC task group. Thirty-seven initial priority technical issues were identified, with the possibility of more being added as the cycle progresses.

The joint CCBFC/PTPACC task group report and these priorities are currently posted on the national codes Web site at www.nationalcodes.ca/ccbfc/twojointtg_e.shtml.

New standing committees are being formed to undertake the work on the initial priorities adopted by the CCFBC. If other issues are identified, they will be considered by the CCBFC at a later date.

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The 2005 NBC has incorporated a new climate indicator called the moisture index to help address the issue of protection of housing against precipitation

IRC is assisting in efforts to develop a harmonized Canada-U.S. standard for windows

Harmonizing Window Standards

Following publication of the 2000 edition of the CAN/CSA-A440 "Windows" standard, the window industry has focused its attention on the development of a harmonized Canada-U.S. standard for windows, doors and unit skylights, drawing on requirements from the CSA standard and standards developed by the American Architectural Manufacturers Association (AAMA) and the Window and Door Manufacturers Association (WDMA). As such, the current (2005) edition of AAMA/WDMA/CSA-101/I.S.2/A440 provides requirements that go beyond those needed to define minimum acceptable technical performance levels and also addresses marketing and industry competition issues. As the industry wishes to have the standard referenced in the National Building Code (NBC), IRC codes staff are devoting much time and effort to help develop and support changes to the standard to improve its chances of being referenced.

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ULC Committee on Air Barriers

In November 2005 IRC hosted the inaugural meeting of the ULC Committee on Air Barriers. ULC staff and the National Air Barrier Association (NABA), as well as staff from CCMC and the Canadian Codes Centre were instrumental in setting the first agenda and getting the committee together. The committee was formed to address a longstanding need for air barrier standards. The family of standards that the committee is proposing to develop would include an overall standard to describe Air Barrier Systems (ABS) followed by a list of standards related to the design of ABS, the inspection and testing of air barrier materials and systems as well as separate material specification standards for each of the material categories that are typically used in air barriers (liquid applied, board stock, sheet material, etc.). The committee set an ambitious schedule to have the most critical standards ready to be referenced in the 2010 National Building Code. IRC codes staff will provide extensive guidance to the committee to help craft the standards in a way that aligns them well with the objectives and functional statements attached to the existing requirements in the 2005 NBC that are related to air leakage resistance.

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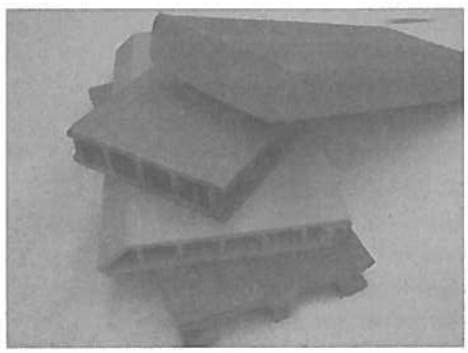
Canadian Construction Materials Centre (CCMC)

Evaluation of Composite Exterior Decking and Guards

New products made of plastic composite extrusions are now being used more and more instead of traditional wood to build exterior balconies and decks in residential construction. These include products made of thermoplastic wood, profiled PVC and foamed PVC. While popular with do-it-yourself projects in home renovations because of their aesthetic appeal and low maintenance, many of these products are now raising structural performance issues for builders and building officials. The problem is that very little is known about their performance, even less about their degradation mechanisms such as resistance to UV radiation, temperature extremes, and moisture effects.



CCMC is evaluating many new decking and railing products

As proof of these performance concerns, CCMC in recent years has been inundated with requests to evaluate composite decking and railing products. While the performance of traditional wood products can be predicted based on established material properties and calculation procedures, this is not the case with the performance of non-traditional materials, which do not have established physical and mechanical properties. CCMC has developed performance-based technical guides for evaluating products composed of wood thermoplastic composite lumber of solid cross-section and of cellulosic/ polymer composite extrusions of hollow cross-section. As it is impossible to produce evaluation protocols that would address all physical, mechanical and design characteristics of each proprietary product, the guides are modified as needed on a case-by-case basis to address the performance of each element and component of a product that CCMC is asked to evaluate. It should be noted that with thermoplastic wood decking currently evaluated by CCMC (CCMC 13191-R and CCMC 13200-R) the performance was deemed to be equivalent to sub-floor sheathing, as a minimum, not equivalent to lumber decking.

With the changes introduced in the 2005 National Building Code to clarify the loading requirements for guards or railings, the evaluation of new composite products will be facilitated, easing the concerns of builders and building officials.

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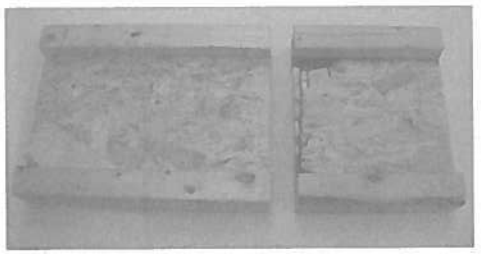
Evaluation of Structural Wood Adhesives

The choice of adhesive plays an important role in the performance of engineered wood products. Phenolics have had a longstanding record of good performance, but in the 1990s new adhesives began to appear. These newcomers offered a cleaner look and paler colours compared to the dark brown phenolic adhesives, as well as advantages in the manufacturing plant. Adhesive manufacturers claimed



New adhesives for engineered wood products have a cleaner look (left) than the darker phenolic ones (right). CCMC is evaluating a number of these new products in terms of their performance

equivalent performance to that of the darker adhesives. However, the prescriptive nature of the existing standards could not automatically be applied to the new innovative adhesives that manufacturers wanted to get accepted by the market.

In 2004, CSA published a performance-based standard for qualifying new adhesives, CSA O112.9, *Standard Specification for Evaluation of Adhesives for Structural Wood Products (Exterior Exposure).* Since then, CCMC reports and listings have included the innovative adhesives meeting the new standard and the engineered wood products making use of these adhesives. In addition, as this standard is intended for severe in-service wet environmental conditions, there is an initiative to produce a dry-service class adhesive standard (CSA O112.10) intended for protected assemblies (i.e. enclosed buildings). CCMC will be participating in this initiative and will keep users informed on the growing classification of adhesives and their appropriate intended use in the field. Structural wood adhesives must meet structural and durability requirements as stated in a new standard. For builders there are now limitations on products depending on the application.

In addition, some new adhesives may perform satisfactorily for strength and durability, but may not perform as well as phenolics when subjected to high temperatures. Thus, CCMC is in the process of assisting a CSA task group to develop a small-scale test for investigating the high-temperature performance of adhesives for fire-rated assemblies. Once this work is complete, adhesives qualifying under this protocol may be able to be substituted for adhesives currently in fire-rated engineered wood assemblies without requiring retesting of the assembly. For unrated assemblies (e.g., houses) the larger IRC project will address the fire performance of exposed floor assemblies.

In the meantime, builders and building officials alike are directed to this page on the CCMC website for an *Important Notice* concerning fire performance in houses:
http://irc.nrc-cnrc.gc.ca/ccmc/importnotes_e.shtml

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Evaluation of Cladding Systems

CCMC is working in conjunction with IRC building envelope researchers to evaluate the moisture management of cladding systems that are not presently prescribed in the National Building Code.

The role of cladding systems is to restrict the entry of rain and snow into the wall assembly. Thus, in evaluating their performance one must assess the extent to which water getting past the cladding will affect the long-term performance of in-board wall elements. The evaluation should determine where water is deposited and accumulates after it

gets behind the cladding, the amount that enters, and the length of time it dwells in the interstitial spaces. These factors are significant as they determine the vulnerability of the sheathing board to becoming and remaining moist. They establish the susceptibility of the board to premature deterioration. Consequently, any unacceptable amounts of liquid water getting past the sheathing membrane is considered a failure of the wall system.

The research work consists of the development of experimental and analytical assessment procedures as well as the pass/fail criteria needed to assess the capability of a cladding system to manage rainwater penetration in relation to minimum requirements of the National Building Code.

CCMC's development of the experimental and analytical assessment protocol to validate the ability of cladding systems to adequately protect underlying wood-based components or other water-susceptible substrates in wood-frame wall assemblies under specified climate load includes a six-step approach.

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CCMC Revises Product Evaluation Guidelines

The Canadian Construction Materials Centre (CCMC) has streamlined its approach to the evaluation of new and innovative construction materials, products, systems and services. Four new objective-based guidelines focus primarily on health and safety and point directly to the objective-based National Building Code of Canada 2005 for product requirements. This new approach promises to smooth the evaluation process for evaluators and clients alike by providing clearer expectations for product evaluation.

This will make the evaluation process more consistent. It will help manufacturers better understand what information they need to provide to complete their evaluations. For builders, the result will be faster access to innovative products.

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Researchers assist in CCMC evaluations using realistic simulations of climatic conditions in full-scale facilities

The twin research houses of the Canadian Centre for Housing Technology

Canadian Centre for Housing Technology (CCHT)

The Canadian Centre for Housing Technology (CCHT) is a partnership involving NRC, CMHC and Natural Resources Canada.

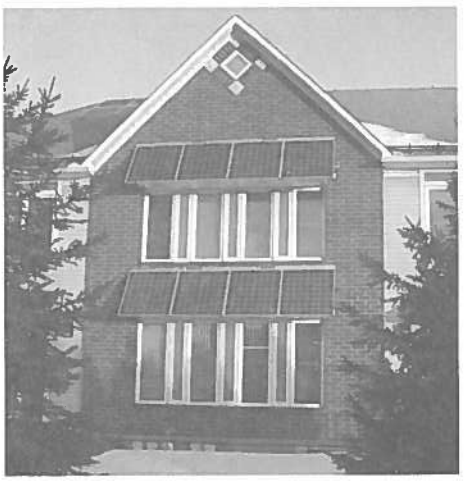
The year 2004/2005 was CCHT's busiest year to date with a record number of projects and technologies using both the twin houses and the InfoCentre. Overall, many technologies were assessed through both winter and summer conditions.

CCHT Projects and Facility Modifications

- **Compact fluorescent lighting.** A study of the overall electrical savings from the use of compact fluorescent lighting in summer conditions was continued during the 2004/05 heating season. A final report is being prepared.
- **Novel heat and humidity recovery ventilator.** A proprietary novel approach to heat and humidity recovery ventilation was assessed for its ability to help manage indoor relative humidity on warm and humid summer days, while saving cooling energy with secondary savings in air-circulation electricity. (CONFIDENTIAL)
- **Moisture Generation for Simulated Occupancy.** A novel means of simulating moisture generation by occupants was developed. This allowed for a more realistic simulated occupancy as it concerns the relative humidity in houses, and was deployed to help a client assess the performance of its system on humidity control in the shoulder season.
- **The first Canadian residential fuel cell.** Made by an Ontario firm, the cell was delivered and installed at CCHT in February 2005. The fuel cell was successfully connected to thermal and electrical systems of one of the research houses and operated through winter, spring and summer conditions. Through this period, the fuel cell successfully generated electricity for the house, exported electricity to the grid, and generated heat for water and space heating. Analysis of data continues and a final report is in preparation.
- **RAD zone control system for houses.** An innovative controller for individual room control on a forced air system will be assessed, to measure its impact on energy consumption, and room characteristics such as room temperature, wall and window surface temperatures, room RH and dewpoint temperatures.
- **Japanese ground source heat recovery system.** This novel system was subjected to more detailed tests in the winter of 2004/05, the spring of 2005 and winter of 2006. This represented CCHT's first direct international client (a Japanese manufacturer).

- **Thermostat setback and set-forward.** A detailed report was produced, documenting the results of a study of thermostat setback in winter and set-forward in summer. Articles were published in several magazines including *Solplan Review.*
- **Photovoltaic Panels.** Photovoltaic panels were installed on the roof and canopies of the CCHT InfoCentre. The power and quantity of electricity generated was monitored trough several seasons, and the compatibility of the PV with another power generation system – the Stirling Engine – was assessed.
- **Field trial preparation for Stirling engine.** Preparations were made to install a demonstration of the Stirling engine in combined heat and power mode in the CCHT InfoCentre, as a field trial of the technology. The Stirling engine was received during the winter of 2004/2005, installed and connected to the InfoCentre's thermal and electrical systems. It has been generating substantial amounts of heat and electricity through this trial. A report on the Stirling Engine and the PV performance is in final preparation.
- **Roof temperature measurement.** Thermocouples were deployed on the roof of both research houses to measure the operating temperatures of roofing materials and components, as a function of location on a roof and orientation, and time of day. Phenomena such as solar-temperature rise, thermal gradients through the roof and night-sky radiation effects on clear nights have been documented. This work is providing new information that could help to assess durability issues of roofing products for houses, as well as strategies to reduce air-conditioning loads by reducing roof and attic temperatures.
- **Instantaneous combo water heater.** The performance of an instantaneous water heater was assessed in two separate projects in the winter of 2004/2005, first in COMBO mode, generating space heating and hot water, and second, in water heating mode only. Testing continued during the summer of 2005, and was completed by the end of 2005.

During the year, the CCHT web site was redesigned and can be found at: http://www.ccht-ctr.gc.ca/



Photovoltaic panels installed on the InfoCentre of the Canadian Centre for Housing Technology

CCHT Research Reports

In accordance with confidentiality agreements, only results that are generic or that have been released by all parties are published. The following reports can be downloaded from the CCHT Web site:

- Modified Air Circulation and Ventilation Practice to Achieve Energy Savings and Fuel Switching
- Benchmarking the Performance of Natural Gas Combination Systems
- Assessment of the Energy Performance of a Photocell-activated Blind Control System at the Canadian Centre for Housing Technology
- Effects of ECM Furnace Motors on Electricity and Gas Use: Results from the CCHT Research Facility and Projections
- Development of Micro Combined Heat and Power Technology Assessment Capability at the Canadian Centre for Housing Technology
- The Effects of Thermostat Setting on Seasonal Energy Consumption at the CCHT Research Facility

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IRC Collaborations With Other Groups

CABA: Continental Automated Buildings Association

IRC serves on the board of CABA, a not-for-profit industry association that promotes advanced technologies in homes and buildings in North America. Its mission is to encourage the development, promotion, pursuit and understanding of integrated systems and automation for homes and large buildings. It primarily offers information resources and industry intelligence to its membership. CABA's resources cover areas such as building and climate control, lighting, security, A/V, communications technologies and energy management, drawing on the knowledge of experts in these fields in North America. They include a wide series of publications and two major industry events.

Currently, the association is engaged in a number of initiatives including the development of an intelligent building ranking system and a life-cycle costs analysis tool. It is also leading the creation of a Connected Home Roadmap, an important piece of research designed to encourage the rapid adoption of smart home technologies and applications.

Please visit www.caba.org for further information.

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National Guide to Sustainable Municipal Infrastructure

Part of IRC's urban infrastructure activity is devoted to supporting the National Guide to Sustainable Municipal Infrastructure (InfraGuide), which helps Canadian municipalities address their infrastructure challenges through the development of best practices and knowledge products. InfraGuide is a combined effort of the Federation of Canadian Municipalities, Infrastructure Canada, the National Research Council, along with its founding partner, the Canadian Public Works Association.

At the present time, InfraGuide has developed over 50 Best Practice documents and a knowledge product based on *Managing Infrastructure Assets*. Other knowledge products to be published before March 2006 include: *Water Distribution System Renewal Plan* and *An Integrated Approach to Assessment and Evaluation of Municipal Road, Sewer and Water Networks*. These innovations are made possible by InfraGuide's extensive network of experts from across Canada who participate on a voluntary basis.

To date, there are 119 endorsers across Canada who have passed motions and are developing collaborative relationships with InfraGuide.

All the completed Best Practices and a list of pending ones can be viewed at: www.infraGuide.ca

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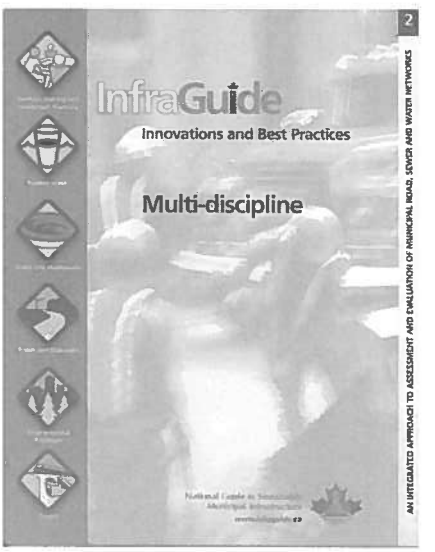


The InfraGuide program is helping municipalities improve their infrastructure through best practices

NRC-IRC Information Resources for Home Builders

Publications Sales Number: 1-800-672-7990; or 613-993-2463 (Ottawa-Gatineau and U.S.A.)

Web Site Information

IRC has an extensive Web site with a wealth of free information. The Table of Contents can be found at

http://irc.nrc-cnrc.gc.ca/pubs/index_e.html

Here are some shortcuts that will get builders quickly to some key information:

Construction Technology Updates (see below for a list of Updates most relevant to builders): a collection of 4-6 page publications that are IRC's main source of current, practical information for builders: http://irc.nrc-cnrc.gc.ca/pubs/ctus/index_e.html

Canadian Building Digests: a collection of 250 short building science publications published from 1960 to 1990 on a wide spectrum of building design and construction topics. Many are still relevant today: http://irc.nrc-cnrc.gc.ca/pubs/cbd/index_e.html

Seminar Publications. This series of publications and other documents captures some important building science and construction principles: http://irc.nrc-cnrc.gc.ca/pubs/bsi/index_e.html

Construction Innovation: a newsletter that keeps the industry informed of NRC-IRC activities and findings: http://irc.nrc-cnrc.gc.ca/pubs/ci/toc_e.html

Registry of Product Evaluations: a collection of reports on product evaluations done by CCMC. The electronic version is updated quarterly: http://irc.nrc-cnrc.gc.ca/ccmc/regprodeval_e.shtml

Printed Publications

This section lists the titles of the publications and construction codes of greatest interest to builders.

Construction Technology Updates (CTU's)

The topics most relevant to residential construction are:

Sound Control

No. 1 Control of Sound Transmission through Gypsum Board Walls
No. 13 Controlling Sound Transmission through Concrete Block Walls
No. 16 Sound Isolation and Fire Resistance of Assemblies with Fire Stops
No. 25 Controlling the Transmission of Airborne Sound through Floors
No. 27 Effect of Electrical Outlet Boxes on Sound Isolation of Gypsum Board Walls
No. 35 Controlling the Transmission of Impact Sound through Floors

Fire Safety

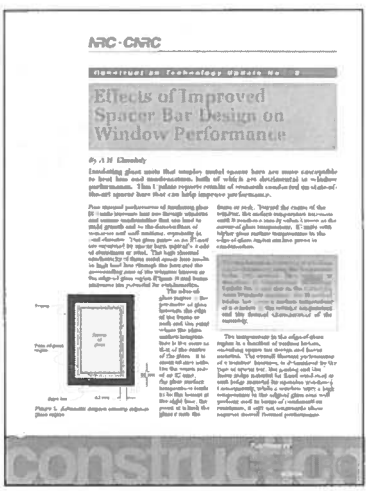
No. 2 Fire Resistance of Gypsum Board Wall Assemblies
No. 16 Sound Isolation and Fire Resistance of Assemblies with Fire Stops
No. 20 Fire Resistance of Floor Assemblies in Multi-Family Dwellings
No. 57 Fire Resistance and Sound Insulation of Load-Bearing Steel Stud Wall Assemblies

Concrete and Masonry

No. 7 Corrosion of Metal Ties in Masonry Cladding
No. 8 Six Axioms for Building Durable Concrete Structures
No. 23 Water-Shedding Details Improve Masonry Performance
No. 24 Surface Preparation of the Concrete Substrate
No. 44 Curling of Concrete Slabs on Grade
No. 59 Repairs to Restore Serviceability in Concrete Structures

Building Envelope and Structure

No. 9 Evolution of Wall Design for Controlling Rain Penetration
No. 17 Pressure Equalization in Rainscreen Wall Systems
No. 28 Performance Issues with Muntin Bars in Sealed Insulating Glass Units
No. 34 Designing Exterior Walls According to the Rainscreen Principle
No. 36 Performance of Thermal Insulation on the Exterior of Basement Walls
No. 41 Low-Permeance Materials in Building Envelopes
No. 45 Ensuring Good Seismic Performance with Platform-Frame Wood Housing
No. 46 A Method for Evaluating Air Barrier Systems and Materials
No. 55 Dynamic Wind Testing of Commercial Roofing Systems
No. 58 Effects of Spacer Bar Design on Window Performance
No. 65 Using Garden Roof Systems to Achieve Sustainable Building Envelopes


NRC·CNRC

Effects of Improved Spacer Bar Design on Window Performance

Ventilation

No. 14 Why Houses Need Mechanical Ventilation Systems

No. 15 Current Approaches for Mechanical Ventilation of Houses

Sidewalks

No. 53 Behaviour and Performance of Concrete Sidewalks

No. 54 Best Practices for Concrete Sidewalk Construction

Construction Innovation

To receive this quarterly newsletter in the mail, please contact IRC's Publication Sales.

National Construction Codes and Guides

- National Building Code of Canada 2005
- National Fire Code of Canada 2005
- National Plumbing Code of Canada 2005
- National Building Code of Canada 1995
- National Fire Code of Canada 1995
- National Plumbing Code of Canada 1995
- National Housing Code of Canada 1998 and Illustrated Guide
- User's Guide – NBC 1995: Application of NBC Part 9 to Existing Buildings
- User's Guide – NBC 1995: Housing and Small Buildings (Part 9)
- User's Guide – NBC 1995: Environmental Separation (Part 5)
- User's Guide – NBC 1995: National Plumbing Code of Canada 1995
- Model National Energy Code 1997 – Houses

To order any IRC print publication or code online, access the IRC virtual store at:

www.nrc.gc.ca/virtualstore