Volume 10 Number 3 **September 2005**

construction innovation

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2005 National Construction Codes launch

"I am very pleased to announce the launch of the 2005 National Construction Codes. Much consultation and a great deal of work from dedicated volunteers has been invested in the preparation of this next generation of construction codes," said Bruce Clemmensen, Chair of the Canadian Commission on Building and Fire Codes (CCBFC).

The 2005 National Construction Codes are now available for purchase. They include the National Building Code of Canada 2005 (NBC), the National Fire Code of Canada 2005 (NFC) and the National Plumbing Code of Canada 2005 (NPC).

The printed versions of the 2005 NBC, NFC and NPC are available in two practical formats:

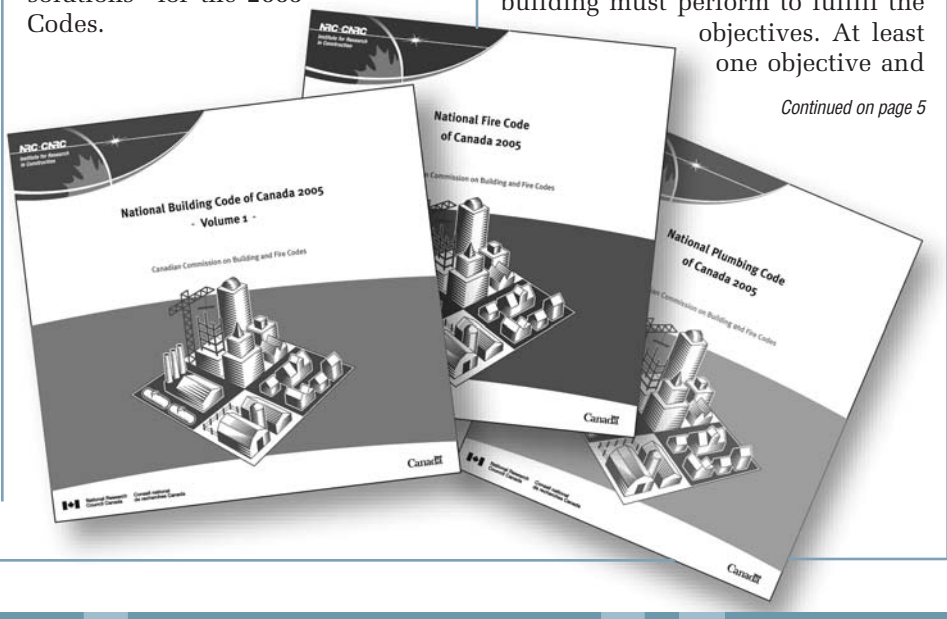
- A full-size binder (8.5 x 11 in.) that lies flat for easy reference. The binder easily accommodates updates.
- A soft-cover version (8.5 x 11 in.) that contains the same information as the binder, and weighs half as much. This format is ideal for the job site.

The CD-ROM versions of the 2005 NBC, NFC and NPC will be released in early 2006 and will be available for purchase at this time. They include:

- User's Guide – NBC 2005, Application and Intent Statements (CD-ROM only)
- User's Guide – NFC 2005, Application and Intent Statements (CD-ROM only)
- User's Guide – NPC 2005, Application and Intent Statements (CD-ROM only)
- User's Guide – NBC 2005, Structural Commentaries (Part 4 of Division B) (printed version and CD-ROM)

What's new?

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. The technical provisions have been renamed "acceptable solutions" for the 2005 Codes.



Highlights

The 2005 NBC, NFC and NPC will have a new organizational layout, with each Code comprising three divisions: Divisions A, B and C.

Division A includes the compliance options and new information called objectives and functional statements. The objectives of each Code describe the overall goals that the Code's provisions are intended to achieve. Functional statements describe the functions that a building must perform to fulfill the objectives. At least one objective and

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Significant technical changes in the 2005 NBC, NFC and NPC

The 2005 National Construction Codes, which have just been launched, contain many technical changes.

Over 1,300 technical changes were submitted to a joint national/provincial/territorial public consultation, which took place from January 15 to May 31, 2003 to consider the proposed technical changes to the three national construction codes. As a result of the comments received during the public consultation, some proposed changes were withdrawn while others were revised. Technical changes published in the three 2005 codes were approved by the Canadian Commission on Building and Fire Codes (CCBFC).

Here are some of the key changes.

2005 NBC

Part 3: Fire Protection, Occupant Safety and Accessibility

Noncombustible materials. Materials of limited combustibility that pose a low fire risk are now allowed based on specific new test criteria.

Firewalls. There has been a change from a prescriptive requirement to a more performance-based requirement to allow for materials other than masonry or concrete for the construction of firewalls requiring a rating of up to two hours. This would allow firewalls to be constructed of gypsum board provided certain conditions are met.

Mezzanines. A number of changes have been made regarding mezzanines including: allowing the enclosure of the space below open mezzanines, redefining the point of reference to calculate the area of open mezzanines, imposing an area limit of 10% of the suite in which the mezzanine is located, allowing an enclosed space on open mezzanines, and clarifying the provisions for means of egress from mezzanines.

Non-metallic raceways. Larger non-metallic conduits within a fire compartment (without penetrating a fire separation) are now permitted.

Part 4: Structural Design

Live loads. A live load is now limited to use and occupancy loads only. A snow load is no longer considered to be a live load.

Earthquake design. Earthquake data will be more in the form of spectral acceleration values (related to motion in the ground) and more geographically specific than the previous zonal values. Categories of structural irregularities have been defined to better categorize buildings for earthquake design, with provisions for each category of building. Dynamic analysis has been established as the default method for analyzing earthquake design. However, provisions make allowance for the use of static analysis for many buildings.

Importance categories and factors. To establish a harmonized approach for calculating the environmental design loads for different categories of buildings, a table of "Importance Categories" (i.e., "low," "normal," "high" and "post-disaster" categories delineating hazard in the event of failure or required functionality in the event of a disaster) based on their use and occupancy was created, with associated importance factors assigned for snow, wind and earthquake loads.

Working Stress Design. Working Stress Design is no longer considered an acceptable alternative to Limit States Design, and has been deleted from the design methodology provisions of Part 4 of the NBC.

Part 5: Environmental Separation

Air leakage and vapour diffusion. Requirements for controlling air leakage and vapour diffusion have been amended to present the basic requirements in more performance-based terms.

Heat transfer. There is now acknowledgement that providing the means to dissipate heat can be as important in some instances as providing the means to control heat transfer. This requirement recognizes the need in some cases for wall, attic or roof space venting.

Part 6: Heating, Ventilating and Air Conditioning

Ventilation. The wording has been revised to clarify the types of spaces in buildings that do not require mechanical ventilation, such as closets, storage rooms or other such spaces that are not continuously occupied.

Carbon monoxide alarms. Carbon monoxide alarms are now required in buildings that contain a residential occupancy and that also contain a fuel-burning appliance or a storage garage.

Part 9: Housing and Small Buildings

Application of Part 4 versus Part 9 structural requirements. 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.

Simplified snow load calculation. This was done to simplify the approach to structures where the structure has a high degree of redundancy created by closely spaced, repetitive members for frame construction. An additional criterion is that the roof area of the structure does not exceed that permitted for Part 9 buildings, whether the building is constructed with firewalls or not.

Support of decks. Several changes were made to clarify the requirements for foundations and lateral bracing for decks, and to identify exceptions and acceptable solutions.

Continued on page 3

Significant technical changes in the 2005 NBC, NFC and NPC

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Insulated concrete form (ICF) walls. Prescriptive requirements for engineered insulated concrete form walls for small houses have been added. These requirements apply to both foundations and above-ground walls.

How to keep the rain out of houses and small buildings. In order to better protect residential buildings from rain and snow, a new climatic indicator, the moisture index, has been adopted to identify regions of high moisture loads. It is now explicitly stated in which locations across the country cladding is required to be installed over an air space (open rainscreen principle). In addition, new requirements for flashing were introduced to describe the constructions in more detail and in which cases they apply.

2005 NPC

Harmonization of Venting Requirements
In the past, venting requirements were very different from one province to the other. With input from the various provinces, these requirements have been harmonized in the 2005 NPC.

Harmonization of CSA B64.10, "Standard for Backflow Prevention Devices"
Substantial changes to the backflow requirements in NPC Subsection 6.2. have been made: Article 6.2.4., which deals with backflow from fire protection systems, had been expanded to include new requirements and definitions related to different classes of fire protection systems.

2005 NFC

Part 2 – Plenum Cables
A requirement was added to control the accumulation of communication cables and other abandoned cables in plenums, to limit the amount of combustible material in plenums. This will limit the amount of cable permitted in ceiling spaces.

Part 3 – Table 3.2.7.1.
Changes were made to incorporate requirements related to segregation and quantity limitations for newly introduced Packing Group I and II oxidizers, such as pool chemicals, single trip propane cylinders, such as fuel used for camping, and flammable and combustible liquids displayed in large mercantile occupancies (i.e., "Big Box Stores"). For example, oxidizer pool chemicals will no longer be permitted to be stored in the same vicinity as flammable and combustible liquids.

Part 4 – Section 4.12.
The subsections on leakage detection of storage tanks and piping systems for flammable and combustible liquids were replaced by a new Section, which established new minimum required levels of system leakage testing at the commissioning stage, as well as minimum levels of continuous in-service monitoring. For example, double-walled underground storage tanks will require continuous interstitial space monitoring.

Part 5 – New NFPA Standards
The following NFC Sections and Subsections have each been replaced with an NFPA Standard:

Section 5.4., Spray Coating Operations, replaced with NFPA 33, "Spray Application Using Flammable or Combustible Materials."

Section 5.5., Dipping and Coating Processes, replaced with NFPA 34, "Dipping and Coating Processes Using Flammable or Combustible Liquids."

Subsection 5.6.1., Industrial Ovens, replaced with NFPA 86, "Ovens and Furnaces."

Part 6 – New NFPA Standards
The following NFC Sections have each been replaced with an NFPA Standard:

Section 6.2., Portable Extinguishers, replaced with NFPA 10 "Portable Fire Extinguishers."

Sections 6.4., Standpipe and Hose Systems, **6.5.**, Automatic Sprinkler Systems and **6.6.**, Water Supply Systems for Fire Protection, replaced with NFPA 25, "Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems."

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Seminars on 2005 National Construction Codes technical changes

Learn more about the changes in the 2005 National Construction Codes

Following the launch of the 2005 National Construction Codes (see article entitled, *2005 National Construction Codes launch*, on cover page), the National Research Council's Institute for Research in Construction, in coordination with the provinces and territories, will offer technical seminars starting December 2005 and extending into the first few months of 2006.

The seminars will give an overview of the most significant technical changes in the 2005 NBC, NFC and NPC, as well as a brief introduction to the new objective-based format. The seminars, which will be delivered by technical advisors from NRC-IRC's Canadian Codes Centre, will be held in sixteen cities across Canada. Because of the large volume of information, the entire content will be covered over two days. Participants will have the option to register for the full two days, for one day or even for half days according to which topics are of interest to them.

Registration

Go to the Web site at www.nationalcodes.ca/seminars for more details on dates and registration information. You are encouraged to pre-register by downloading the registration form **and faxing it to (613) 952-7673**.

Location and dates of seminars

Ottawa	Embassy West Hotel	December 5 and 6, 2005
Fredericton	Fredericton Inn	January 10 and 11, 2006
St. John's	Fairmount Newfoundland	January 12 and 13, 2006
Charlottetown	Delta Prince Edward	January 16 and 17, 2006
Halifax	Holiday Inn Select	January 18 and 19, 2006
Yellowknife	The Explorer Hotel	February 14 and 15, 2006
Edmonton	Coast Terrace Inn	February 16 and 17, 2006
Saskatoon	Sheraton Cavalier	February 20 and 21, 2006
Winnipeg	Winnipeg Convention Centre	February 22 and 23, 2006
Toronto (North)	Paramount Conference & Event Venue	March 8 and 9, 2006
Toronto (West)	Days Inn and Conference Centre	March 8 and 9, 2006
Whitehorse	West Mark Hotel	March 21 and 22, 2006
Vancouver	Vancouver Convention Centre	March 23 and 24, 2006
Victoria	Ambrosia Catering and Convention Centre	March 27 and 28, 2006
Calgary	Sheraton Cavalier	March 29 and 30, 2006
Quebec	Hotel Plaza	April 4 and 5, 2006
Montreal	La Plaza, Holiday Inn Midtown	April 6-7 and 10-11, 2006

New CCMC Evaluation Reports

Company	Product Name	CCMC #	Description
Hi-Tech Building Systems Corporation	Armopanel Concrete Wall System	13173-R	Concrete forms consisting of two expanded-polystyrene panels assembled by means of steel mesh that serve as a wall-forming system.
I.P.I. Inc.	Endur Roofing System	13174-R	Composite panels, manufactured from recycled crumb rubber and binders, used as roofing material in new and existing construction.
Lafarge North America	Drylar	13175-R	A liquid-applied, polymer-enhanced asphalt that is airless spray-applied to the exterior of foundation walls (concrete or block) to create a waterproof membrane.

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

Bob Bowen named as new Director General of IRC

Mr. Bob Bowen has recently been appointed to the position of Director General of the NRC Institute for Research in Construction (NRC-IRC), effective immediately. He has been acting in this position since August 2004. He succeeds Dr. Sherif Barakat, who has been named the National Research Council's Vice President, Renewal.

Mr. Bowen has over 30 years experience in the field of building and construction research. He arrived at NRC-IRC in 1980 where he participated in a major program on urea formaldehyde foam insulation (UFFI), and authored seminal work on UFFI-related problems and recommended remedial measures.

After a few years of research on the performance of window systems, in 1986, Mr. Bowen became head of the Building Performance Section of NRC-IRC. In that role, he brought an increased industry perspective to NRC-IRC's programs that enhanced the institute's ability to diversify revenue sources while continuing to develop core strengths.

Then in 1990 Mr. Bowen was appointed Director, Codes and Evaluation Branch, where he provided leadership and strategic direction to the development of model construction codes for Canada, the evaluation of new or innovative construction products and systems, and the identification of research priorities in support of safety and security. He was also responsible for the institute's role in international trade where he led major efforts in support of Canadian industry and government initiatives. His strong understanding of the federal/provincial policy environment as well as his leadership skills have helped position NRC-IRC as an international leader in this field.

Bob Bowen, IRC's newly appointed Director General

Looking for the latest information on municipal infrastructure best practices?

Visit the newly redesigned Web site for the National Guide to Sustainable Municipal Infrastructure to get the latest information on core infrastructure best practices in five disciplines: potable water, roads and sidewalks, decision-making and investment planning, environmental protocols, storm and waste water and, coming soon, transit!

InfraGuide is also pleased to announce the release of its highly anticipated education tool on asset management: *Managing Infrastructure Assets – Knowledge Product*.

To learn more, visit the education page on our Web site at www.infraguide.ca.

2005 National Construction Codes launch

Continued from cover

one functional statement are linked to each technical requirement to help users better understand the reason why a particular requirement must be met and to help them evaluate alternative solutions.

For a further description of objectives and functional statements, please refer to *Construction Innovation*, Volume 7, Number 2, June 2002 (http://irc.nrc-cnrc.gc.ca/pubs/ci/v7no2/v7no2_2_e.html) or go to www.nationalcodes.ca.

In **Division B**, Code users can find the "acceptable solutions," which consist of the 1995 Code provisions updated with technical changes. However, most of the code structure and vocabulary that users are familiar with will remain the same. For example, the Parts and provision numbering will also remain unchanged, which makes getting used to the new Codes much easier.

Finally, **Division C** contains the administrative provisions, which have been consolidated in one place.

Beginning in December, NRC-IRC, in coordination with the provinces and territories, will present seminars across Canada on the most significant technical changes in the 2005 NBC, NFC and NPC (see article on *Seminars on 2005 National Construction Codes technical changes, p. 4*).

The National Construction Codes are prepared under the auspices of the Canadian Commission on Building and Fire Codes and are published by the National Research Council of Canada.

To order the 2005 National Construction Codes, please visit NRC's Virtual Store at www.nrc.gc.ca/virtualstore or fill out the order form in the centre of this issue and fax it to (613) 952-7673.

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Institute for Research in Construction

Close to 1300 technical changes

Easy access to familiar Parts and provisions

Clarification of the rationale behind each provision

New information for evaluating alternative solutions

2005 NATIONAL CONSTRUCTION CODES

Blueprints for the Future

The 2005 editions of the National Building, Fire and Plumbing Codes of Canada offer many improvements over the 1995 editions, including technical updates and new information for understanding what must be done to satisfy the Codes' provisions. The new National Model Codes are clearer, easier to apply to existing buildings and more accommodating to innovation. Printed versions are now available in two practical formats: a binder and a soft cover version.

Current – Close to 1300 technical changes have been included in the Codes to address advances in technology and health and safety concerns raised since the 1995 editions.

Clear – Additional information explains the objectives that the Codes' provisions are intended to achieve and describes the functions that a building or its components must perform to fulfill these objectives.

Flexible – The additional information allows for flexibility by helping users evaluate alternative solutions. The 2005 Codes are therefore easier to apply to existing buildings and more responsive to innovation.

Familiar – Much of the Code structure and vocabulary remains the same, so getting used to the new Codes is quick and easy.

Coming soon: In early 2006, the CD-ROM version of the Codes will be released together with User's Guides available on CD-ROMs only, which will contain statements explaining the intent behind the Codes' provisions and what the provisions apply to. The User's Guide to Part 4 of the National Building Code will also be released in printed and CD-ROM formats.

Seminars: Beginning in December 2005, seminars on the most significant technical changes in the Codes will be held in major centres across Canada.

For more information: www.nationalcodes.ca
1-800-672-7990 or 1-613-993-2463 (Ottawa-Gatineau and U.S.)

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☆ NEW ☆	**National Fire Code 2005**	*$140*		*$130*					
☆ NEW ☆	**National Plumbing Code 2005**	*$120*		*$110*					
	1995 DOCUMENTS								
	National Building Code 1995	*$99*		*$94*		*$179*	*$358*	*$715*	*$1,073*
	Practical 1995 NBC User's Guides:								
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	Environmental Separation (Part 5)	*n/a*		*$47*		*$85*	*$170*	*$341*	*$511*
	Housing and Small Buildings (Part 9)	*n/a*		*$47*		*$71*	*$142*	*$284*	*$426*
	Application of Part 9 to Existing Buildings	*n/a*		*$47*		*$85*	*$170*	*$341*	*$511*
	Quebec Construction Code – Chapter 1, Building, and National Building Code 1995 (amended)	*$120*		*$110*		*$179*	*$358*	*$715*	*$1,073*
	National Housing Code 1998 and Illustrated Guide	*n/a*		*$94*		*$179*	*$358*	*$715*	*$1,073*
	National Fire Code 1995	*$69*		*$64*		*$125*	*$250*	*$500*	*$749*
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	User's Guide on the 1995 National Plumbing Code	*n/a*		*$47*		*$85*	*$170*	*$341*	*$511*
	National Farm Building Code 1995	*n/a*		*$34*		*$51*	*$102*	*$204*	*$306*
	Model National Energy Code 1997 – Buildings	*$79*		*n/a*		*$119*	*$238*	*$476*	*$714*
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**CD-ROM version of 2005 Codes available in early 2006*
*** n/a = not applicable*
**** Includes access to NBC 1995*
***** Includes access to NFC 1995*

To order, please visit the NRC-IRC Virtual Store at www.nrc.gc.ca/virtualstore or fill in this order form and fax it to 1 (613) 952-7673

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Roofing: Staying on Top of Technology and Change

Organized by: Institute for Research in Construction
National Research Council Canada

Attend this comprehensive one-day NRC seminar and you will obtain essential technical information on the evaluation, performance, maintenance and durability of roofing systems to help you make the right decisions for your roofing projects—both new and existing low-slope roofs.

Are you responsible for the design, construction, maintenance, inspection and repair of roofs, or the re-roofing of large buildings? IF SO, THIS SEMINAR IS FOR YOU!

The seminar will address eight topics:

Roofing Technology. The world of roofing assemblies and their design can be quite complex. Dr. Bas Baskaran, senior researcher at NRC-IRC, will cover the general characteristics of the various types of roofing systems available.

Criteria for Roofing System Selection and Material Properties. The success of a roofing project depends mainly on selecting the right roofing system for the job. Mr. Tom Smith, with TLSmith Consulting Inc., will discuss how the technical considerations of performance and durability, and others factors such as aesthetics, warranties and maintenance, come into play in selecting roofing systems. Mr. Smith will also discuss the pros and cons of using different roofing membranes in low-slope roofs.

Design Considerations for New Construction. Roofing design must meet minimum building codes and standards requirements for materials and systems. The detailing of junctions and terminations need special consideration at both the design and application stages. Mr. Paul Yurcich, with JPT Roofing Consultants Inc., will present the technical requirements found in the National Building Code and standards, and will provide examples of common roofing details.

Wind Design Guide. Wind failure is one of the major contributors to insurance claims for roofing. Dr. Baskaran and the SIGDERS consortium have been investigating this subject for more than 10 years and have just published a new wind design guide (registrants will get a free copy). His presentation will address the wind design procedure, i.e., relating the wind load calculation to the resistance evaluation.

Re-roofing Considerations and Case Studies. In Canada, the market share for re-roofing is comparable to that of new construction. In re-roofing projects, the condition of the existing roof and the extent of intervention (e.g., repair vs re-roof and tear-off vs recover) need to be assessed. Mr. Tom Smith will discuss some of these requirements with case studies.

Towards Sustainable Roofing. At NRC-IRC, a new program, Sustainable Built Environment, has been created to address industry needs, and roofing is a part of it. Dr. Karen Liu, an NRC-IRC researcher who is leading a consortium project on garden roof systems, will describe the tenets of sustainability and greener alternatives to conventional roofing systems (e.g., garden roofs) along with recent research findings on the performance of these alternative systems.

Maintenance. Maintenance is a key factor in ensuring a long service life for a roof. Paul Yurcich will illustrate the kinds of defects that can develop when maintenance is not performed; present a list of maintenance items; and demonstrate the cost benefits of timely maintenance.

Current Industry Issues. As the roofing industry is continuously evolving, Dr. Baskaran will close with a discussion of current industry issues and trends in technological change.

NB: This seminar will not cover issues specific to sloped (water-shedding) roofs.

The one-day seminar will be held in the following locations:

- ***Ottawa, October 4, 2005***
- ***Fredericton, October 12, 2005***
- ***St. John's, October 14, 2005***
- ***Charlottetown, October 17, 2005***
- ***Halifax, October 19, 2005***
- ***Toronto East, October 31, 2005***
- ***Vancouver, November 2, 2005***
- ***Whitehorse, November 4, 2005***
- ***Calgary, November 7, 2005***
- ***Winnipeg, November 9, 2005***
- ***Toronto West, November 17, 2005***
- ***Yellowknife, November 25, 2005***
- ***Edmonton, November 28, 2005***
- ***Saskatoon, November 30, 2005***
- ***Sainte-Foy (French), February 21, 2006***
- ***Montreal (French), February 23, 2006***

Continuing education (CE) credits
Many associations of registered professionals will recognize this NRC-IRC roofing seminar for CE credit purposes. To find out whether you can earn such CE credits by attending this seminar, contact your association.

For more information about this seminar and to register for it, go to http://irc.nrc-cnrc.gc.ca/bsi/2005.

Researchers study effects of daylighting with translucent sandwich panels

People spend over 90% of their time indoors and, as a result, receive little exposure to bright light. Research suggests that a higher light exposure than that typically experienced indoors could improve health and well-being. To be sustainable, however, these light exposures need to come from energy-efficient sources, of which daylight is one.

Being able to control direct sunlight is an important aspect of successful daylighting, and translucent fibreglass daylight sandwich panels offer one possible solution, with the potential to provide high levels of diffuse light that would be considered by occupants as providing good lighting quality.

IRC researchers conducted an experiment in which temporary office workers spent one day in an enclosed office with a translucent sandwich panel installation (Figure 1) and another day in an enclosed office that had a traditional window with a perforated roller blind (Figure 2). The work consisted of a set of tasks simulating regular office work and the filling out of questionnaires about satisfaction, mood and the office environment, including lighting. Lighting and supplemental electric heating energy use were also monitored.

When combined with a daylight-linked lighting-control system, the office with the translucent sandwich panel system consumed 29% less energy for lighting than the office with the window and blind. Average light levels in the translucent sandwich panel room were 2.6 times greater, and light exposure in the 450–470 nanometres (nm) range of the spectrum (which is thought to include the key wavelengths for potential health effects) was approximately eight times greater. Both rooms were judged to be equally satisfactory work environments with good overall lighting quality; however, there was a slight tendency to judge the East room as having more bothersome glare in the morning, and people preferred the view offered by the larger window in the West room. Supplemental heating energy use was in line with expectations based on the insulating properties (U-values) of the two façades.

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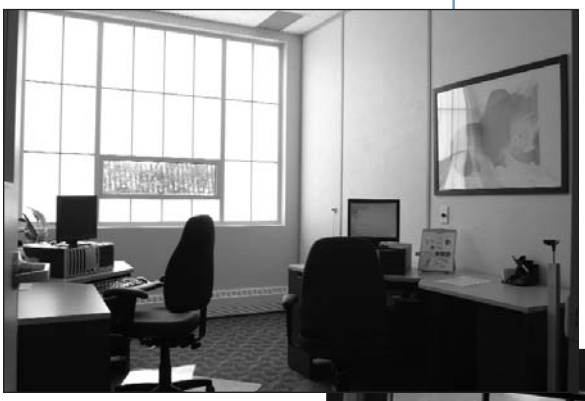

Figure 1. East room translucent sandwich panel installation. The photo was taken at noon on a sunny, mostly clear-sky day.

Figure 2. West room window and roller-blind installation with blind down. The photo was taken at noon on a sunny, mostly clear-sky day.

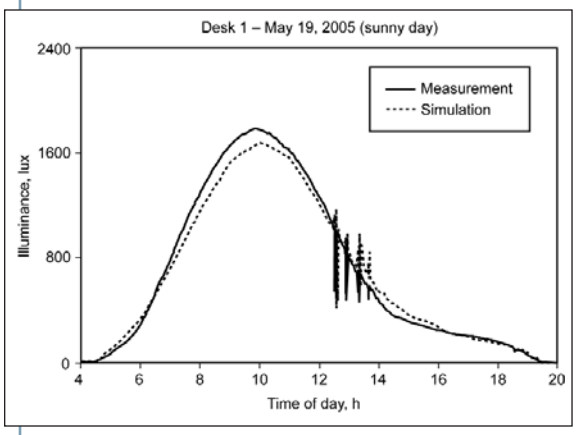

Figure 3. Comparison of measured and simulated illuminances on the desk plane in the East room for a sunny day. The simulation is based on the translucent sandwich panel model.

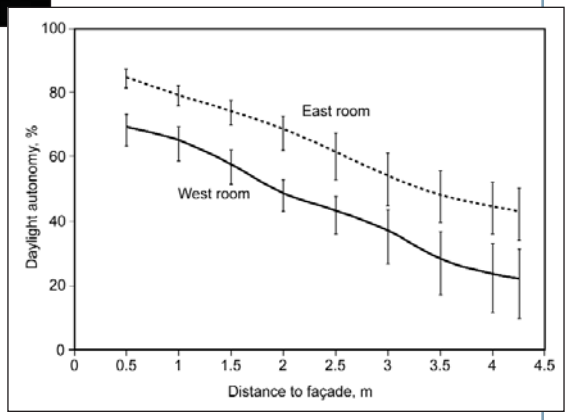

Figure 4. Comparison of the percentages of the annual occupied time (i.e., Mon.–Fri. from 8:30 to 16:30) in the East and West rooms during which time a minimum illuminance level of 450 lux is maintained by daylight.

Experiments demonstrate effects of task lighting on office workers and energy consumption

Many documents on recommended practice for office lighting suggest that substantial savings in lighting energy can be achieved by reducing ambient lighting levels and compensating with task lighting of much lower wattage (see sidebar). This recommendation assumes that the most important issue in satisfying the lighting preferences of office workers is maintaining the light level on the desktop. However, previous research to test this assumption is equivocal, and does not reflect modern North American office conditions, tasks, or cultural expectations.

As an example of this, research projects in the past often asked people to indicate their preferred lighting conditions with reference to a paper-based task on a horizontal desktop, whereas for most office workers today the primary tasks are on vertical, self-luminous computer screens. Therefore, there was a need to test the appropriateness of task-ambient lighting solutions for modern offices, to avoid possible problems related to satisfaction.

Researchers at NRC-IRC conducted two experiments in a full-scale office laboratory to test the hypothesis that task lighting can supplant ambient lighting to achieve energy savings, while at the same time respecting occupant lighting preferences (Figure 1). Ambient lighting was provided by dimmable, ceiling-recessed, deep-cell two-lamp parabolic luminaires.

Figure 1. The office laboratory where the experiments were conducted.

Figure 2. The task lights used in the experiments. The angle-arm task light on the left was used in both experiments; the luminous-shade task light on the right was used in the second experiment only.

In the first experiment, participants completed a variety of mostly computer-based office tasks and questionnaires over one day. For the first three-quarters of the day, the lighting conditions were fixed. After that, participants were able to control the ambient lighting to their preferred level. One group of participants had ambient light only, a second group had ambient light plus an angle-arm task light (Figure 2) at constant output. Despite the presence of the task light, the average preferred ambient light level of the two groups was the same, indicating that there were no energy savings (see sidebar). Intriguingly, the performance of participants on some tasks was improved with the task light (see sidebar).

The second experiment followed up on the energy aspect of the first experiment. Participants occupied an office with either an angle-arm or luminous-shade task light (Figure 2). The task light was set at one of three levels: off, on at 50%, or on at 100%. The participant then controlled the ambient lighting to the preferred level. Task performance was not measured, but participants were instructed to make their lighting choices considering the different tasks they might do in an office. They repeated this procedure for both types of task light.

The results confirmed the findings from the first experiment. Participants lowered the ambient lighting by a small amount when the task light was at 50% (compared to the situation when the task light was off), but the saving in ambient lighting energy was about the same as the energy required by the task light. There was no further reduction in preferred ambient lighting when the task light was increased to 100% output (see sidebar).

These results suggest that modern office workers prefer to have adequate lighting on all room surfaces and not just on their desks. One explanation may be that the combination of low ambient lighting with a high light level near the task light creates uncomfortable luminance ratios in the field of view. Previous research at NRC-IRC shows that exposing people in offices to lighting conditions that differ from their preferences produces negative

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Related publications

http://www.newbuildings.org/lighting.htm
http://www.gbcaus.org/greenstar/docs/tools/GreenStar_OfficeInteriors.xls
http://irc.nrc-cnrc.gc.ca/fulltext/rr165/
http://irc.nrc-cnrc.gc.ca/fulltext/rr166/
http://irc.nrc-cnrc.gc.ca/fulltext/nrcc48152/
http://irc.nrc-cnrc.gc.ca/fulltext/nrcc47069/

IRC and PWGSC team up to provide guidance on office design choices

For many organizations, office space is seen simply as a place to 'house' employees, and therefore as a cost that should be minimized. However, inappropriate office design choices that reduce workers' comfort and well-being, increase staff turnover, and make it harder for employees to complete their tasks effectively, could cost organizations more in the long run.

A recent guide, created jointly by IRC and Public Works and Government Services Canada (PWGSC)—"*Workstation Design for Organizational Productivity*"—explains how the indoor environment affects office employees and provides recommendations for designing open-plan offices that promote organizational productivity.

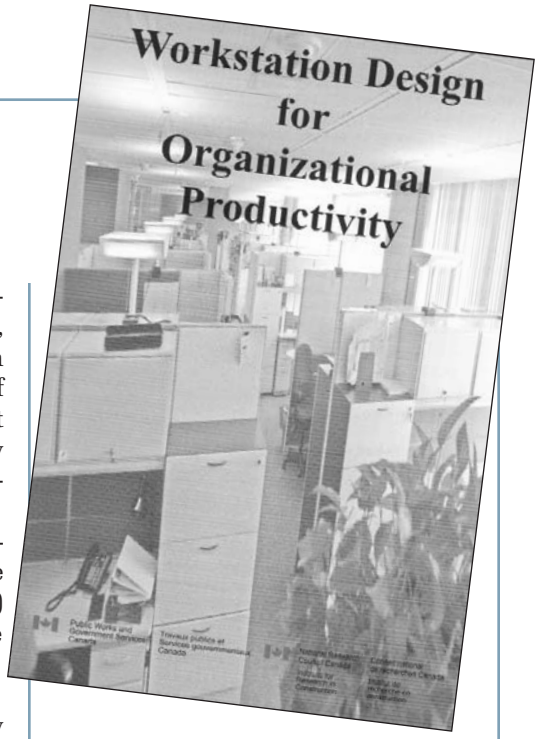
The guide provides practical advice on the design and management of open-plan offices, and addresses acoustics, indoor air quality and thermal comfort, lighting and daylighting, and workstation design and layout. The recommendations are based on objective, systematic research that is summarized in the guide, along with links to more detailed information. The guide also provides a summary of recommendations organized by office elements such as workstation partitions, luminaires and mechanical ventilation.

Many of the recommendations are based on research findings from IRC's Cost-effective Open-Plan Environments (COPE) project, a four-year multi-disciplinary project that examined the effects of the office environment on occupant satisfaction (see http://irc.nrc-cnrc.gc.ca/ie/cope/index_e.html). In addition, the guide draws on studies, by NRC-IRC and other organizations, that investigated other occupant outcomes such as task performance, health, physical comfort, mood, absenteeism, job satisfaction and staff turnover. These kinds of occupant responses are important because of the role they play in influencing organizational productivity.

The productivity of an organization is the value of its outputs (the products and services it provides) relative to the value of its inputs (the costs incurred to run the business). The employees make up the biggest cost to an organization (over 80% by some estimates, through salaries, recruitment, training, etc.); they are also responsible for creating its products and services.

It is often very difficult to estimate how 'productive' modern office workers are because their jobs typically consist of complex, knowledge-based work on a variety of non-uniform, often collaborative, projects. However, by considering the wider perspective of how employees think and behave at work, links between the indoor environment, office employees and organizational productivity can begin to be drawn. For example, IRC research has established that satisfaction with the physical environment is positively related to job satisfaction, and research conducted elsewhere has confirmed that more satisfied workers are more likely to be committed to their organization, more likely to put in extra effort at work and less likely to leave—all positive influences on the organization's productivity.

The guide elaborates on these relationships, and describes how office design choices that support employees also support the organization.



Workstation Design for Organizational Productivity is available for downloading at http://irc.nrc-cnrc.gc.ca/ie/productivity/index_e.html.

Specific questions can be directed to Dr. Kate Charles at (613) 991-0939, fax (613) 954-3733, or e-mail kate.charles@nrc-cnrc.gc.ca.

Experiments demonstrate effects of task lighting on office workers and energy consumption

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effects on satisfaction, comfort and mood (see sidebar). Therefore, the results from these task lighting experiments also suggest that pursuing substantial energy savings by cutting back considerably on ambient lighting and providing a task light may backfire in the long term by creating sub-optimal lighting conditions that compromise occupant satisfaction.

For more information, please contact Dr. Guy Newsham at (613) 993-9607, fax (613) 954-3733, or e-mail guy.newsham@nrc-cnrc.gc.ca.

What we're hearing

International efforts to enhance innovation in the construction industry: what do they mean for Canada?

In some cases, change is a constant; in others, it's an absolute necessity. The latter certainly seems to be the case in the construction industry, and not just in Canada. There are currently many initiatives around the world aimed at changing the way the construction sector operates as an industry. Some of these changes are about obtaining better value for clients, others about eradicating harmful practices, and still others are about increasing productivity and meeting the pressures of globalization.

The second international conference on Revaluing Construction took place in Rotterdam, The Netherlands, in March 2005. At this event, the leaders of industry change programs from many different countries gathered to share information and learn from the experiences of others, which show remarkable similarity worldwide. Topics for discussion included the respective roles of government and industry in achieving change; regulations as promoters or inhibitors of change; how to embed change in a workplace culture; and what technology will offer to encourage change in the future.

The exchange of ideas on these topics and other informal discussions showed that some countries' successful change initiatives presented at the last conference in Manchester, U.K., in 2003 are now facing new challenges. These were projects that had been receiving government funding support; however, that support is running out and there are few plans in place for alternative sustained funding. A good example of this trend is an industrialized building project in Denmark, where the industry lost interest when the government funding stopped.

These experiences of other countries suggest that Canada may be on the right track for encouraging change in its construction industry. Instead of seeking a government-funded initiative, Canada has opted to spur innovation through the newly created Canadian Construction Innovation Council (CCIC), which is looking for nominal seed funding and a government mechanism to collect resources. Once this mechanism is in place—a task not without its challenges—CCIC's funding will come from the industry for the industry, and will be self-perpetuating. (For more information about CCIC, see *Construction Innovation*, Volume 10, Number 2, June 2005).

A third conference in the Revaluing Construction series will likely take place in two years, with a number of countries already expressing interest in hosting. For more information, please contact John Berndt at (613) 993-5353, fax (613) 941-0822, or e-mail john.berndt@nrc-cnrc.gc.ca.

Researchers study effects of daylighting with translucent sandwich panels

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The researchers concluded that the translucent sandwich panel system, if designed to limit glare and provide an adequate view of outdoors, can yield high ratings for lighting quality and satisfaction, and high light exposures, while at the same time saving electric lighting and heating energy.

A related IRC project developed and validated an optical model for daylight simulation of the translucent sandwich panel using illuminance measurements collected in IRC's full-scale daylighting test rooms (shown in Figure 1). The transmittance properties of the panels were derived from integrating measurements from two different sources. The resulting, validated optical model (see Figure 3) of the translucent panel can easily be plugged into daylight simulation software, such as Radiance and IRC's Daysim (http://irc.nrc-cnrc.gc.ca/pubs/ci/v8no1/v8no1_4_e.html), to provide an annual daylight analysis of buildings that feature these panels.

The researchers concluded that the translucent sandwich panel system, if designed to limit glare and provide an adequate view of outdoors, can yield high ratings for lighting quality and satisfaction, and high light exposures, while at the same time saving electric lighting and heating energy.

Such an analysis is shown for the experimental installation at IRC (Figure 4). It demonstrates that the translucent panel can effectively deliver more useful daylight levels to the East room than the window and blind combination can to the West room. This finding confirms that the East room receives more annual daylight than the West one, which explains the lighting energy savings observed during the light exposure experiment. The optical model developed in this project can be adopted for comparable translucent materials once the required transmittance properties have been determined.

A detailed tutorial for those unfamiliar with simulation techniques was also developed as part of this project to encourage more widespread adoption of integrated design using daylight (http://irc.nrc-cnrc.gc.ca/ie/lighting/daylight/daysim_e.html).

IRC conducted this research with financial support from the Keller Companies, Inc./Kalwall Corporation. For more information, please contact Dr. Jennifer Veitch at (613) 993-9671, fax (613) 954-3733, or e-mail jennifer.veitch@nrc-cnrc.gc.ca. The simulation model and tutorial are available at http://irc.nrc-cnrc.gc.ca/ie/light/daysim.html; a paper based on part of the behavioural experiment is available at http://irc.nrc-cnrc.gc.ca/fulltext/nrcc47346/.

Upcoming events

CROSS-CANADA SEMINAR SERIES

Building Science Insight

http://irc.nrc-cnrc.gc.ca/bsi/2005/index_e.html

Seminar Series – 2005
Roofing: Staying on Top of Technology

Organized by:
Institute for Research in Construction
National Research Council Canada

For more information about this Seminar see page 7 of this issue.

October
Ottawa, October 4, 2005
Fredericton, October 12
St. John's, October 14
Charlottetown, October 17
Halifax, October 19
Toronto East, October 31

November
Vancouver, November 2
Whitehorse, November 4
Calgary, November 7
Winnipeg, November 9
Toronto West, November 17
Yellowknife, November 25
Edmonton, November 28
Saskatoon, November 30

February 2006
Sainte-Foy, February 21 (French)
Montreal, February 23 (French)

construction *innovation*

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OCTOBER

26-27
Distribution Rehabilitation. Niagara Falls, ON.
http://www.awwa.org/education/seminars/

NOVEMBER

15
Expo-Contech. Montreal.
http://www.contech.qc.ca/ie_accesclient.php

22-23
Construct Alberta. Calgary.
www.homebuilderexpo.com

30-Dec. 2
Construct Canada. Toronto.
www.constructcanada.com

29
Vulnerability Assessment Workshop for Water & Wastewater Facilities. Edmonton.
http://www.wcsawwa.net/Seminars/WCSeminar.html

2006 FEBRUARY

8-9
BC Construct. Vancouver.
www.bcconstruct.com

16-17
Protecting the Nation's Critical Infrastructures and Key Assets. ISBE 2006, Washington, DC.
http://www.protectinfrastructure.com/

Feb. 27-Mar. 1
2006 Geo Congress. Atlanta, GA.
http://www.asce.org/conferences/geocongress06/geocongress05.pdf

This calendar does not include all events scheduled to take place during this time frame. For a more complete listing, see the Web version of "Upcoming events" at http://irc.nrc-cnrc.gc.ca/events.html

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