In an age of rapidly evolving technology, the National Research Council’s Institute for Research in Construction continues to meet the changing needs of the construction industry. Since its establishment as the Division of Building Research thirty years ago, the essential philosophy has been and remains unchanged: to serve Canada’s largest industry, one that represents over $64 billion or 14 percent of the GNP every year. As a research and information centre to the construction industry, IRC solves technical problems and develops new technology—providing the best combination of building science principles to ensure sound, durable construction at reasonable cost.

At the core of IRC is the Canadian Construction Research Board, a unique governing body that keeps IRC in close touch with the industry it is intended to serve. Composed primarily of members from the industrial sector—developers, architects, engineers, materials manufacturers, contractors—the Board sets policy and determines priority areas of research. This link enables IRC to develop programs that are sensitive to industry’s needs and responsive to change.

Although IRC focuses primarily on the client’s needs, it also serves the industry by identifying key trends and developing an appropriate research strategy. Research in emerging technologies such as building ergonomics (building/human interaction) and the application of expert systems for use in building facilities management, will take the construction industry in new directions and help it remain competitive.

The industry uses IRC’s testing facilities and services on a contract basis or works jointly with the Institute on research projects. Dynamic testing in the laboratory complements field investigations for solutions to engineering problems, materials testing, product development or improvement, testing of new products, and the development of systems and test methods relating to construction technology.

IRC research also goes into developing uniform standards and codes for construction. Indeed, one of IRC’s major responsibilities is the National Building Code and the associated National Fire Code, which provide a framework for the construction of economic and safe buildings in Canada.

To make it easier to access IRC’s expertise, a breakdown of our operations and services follows.

IRC’s research activities reflect the complex nature of the construction industry, a disparate group of over 100,000 firms that involves people engaged in the design, construction,
and operation of structures. Developers, architects, engineers, contractors, manufacturers and suppliers of construction equipment and materials, as well as owners all benefit from the research at IRC.

IRC researchers examine the building system in three principal ways: as a structure that undergoes environmental loading; as an envelope that protects occupants, facilities and processes; and as a milieu that provides services to satisfy the requirements of the users. They also study building materials, investigate fire and buildings, and critical to the stability of any construction in Canada, study soils and the geotechnical effects of ice and snow.

The building structure . . .

To be structurally reliable, buildings and engineering works must be able to withstand environmental loads and vibration. To what limit will the roof support snow loads? How is the structure affected by wind, one of the most severe forces on towers and tall buildings? What is the strength of glass in the face of gusting wind pressures?

Scientists at IRC monitor structural behavior in the field and conduct laboratory tests to provide builders, designers, owners, and manufacturers with information on structural safety and reliability. Research focuses on good design criteria, the impact of climatic loads (snow, ice, wind, and earthquakes), and the behavior of materials such as masonry and glass under those loads. Researchers also examine the effect of traffic vibration on structures and develop vibration design criteria for long-span floors.

Laboratory facilities include two long-span test floors, a structural test installation, and wind pressure transducers.

The Experts:
Snow loads on roofs: Don Taylor (613) 993-0103
Wind loads on walls: Udeepta Ganguli (613) 993-9720
Masonry design: Paul Maurenbrecher (613) 993-0073
Structural glass design: Don Taylor (613) 993-0103
Failure analysis: Dave Allen (613) 993-0104
Vibration response of structures: Hans Rainer (613) 993-9751
Section Head, Structures: Alf Warneck (613) 993-2305

The building envelope . . .

The envelope, which controls the flow of heat, moisture, and air through the building, plays a major role in ensuring the durability of a structure and the comfort of its occupants. A well designed system can avoid problems such as exterior wall damage, rain penetration, poor indoor temperature control, and high energy costs which are the result of air leakage.

Researchers assess the performance of the envelope and the thermal characteristics of various materials and components that make up the system, for product development, standards, and design criteria to help builders, designers, and manufacturers. Two environmental chambers for full-scale testing of wall and roof sections, windows, glazings, and doors under controlled conditions of temperature and humidity, permit high precision measurement of the thermal performance of components. Other specialized equipment is used to determine the moisture content and thermal resistance of insulating materials.

In existing buildings, air barriers call be employed to eliminate problems associated with the building envelope. In one project, researchers are assessing construction materials such as gypsum board, fiber board, rigid insulation panels, thin films, and membranes to see how they function as air barriers when incorporated into a wall assembly.
The Experts:
Walls: Bill Brown (613) 993-9673
Windows: Hakim Elmahdy (613) 993-9752
Roofing: Om Dutt (613) 993-4584
Insulation: Mark Bomberg (613) 993-9672
Air leakage: John Shaw (613) 993-9702
Section Head, Building Services: Bob Bowen (613) 993-9580

THE BUILDING ENVIRONMENT

Building services . . .

Not only does the building provide protection from the elements, but it creates an environment according to the occupants’ comfort, safety, and design requirements. To improve building performance in terms of this indoor environment and to maximize efficiency, researchers focus on the design and operation of building services, such as ventilation and lighting systems, and the development of expert systems for the management of building facilities. IRC has also worked with the disabled to develop standards for barrier-free design which have now been incorporated into the National Building Code.

Airtightness in buildings, although an effective energy conservation measure, may adversely affect indoor air quality, which is critical to the building environment. Researchers study all aspects of building ventilation (air leakage, air infiltration, air tightness, air change) and the dynamics of air movement within the building from one area to another, to develop guidelines for improved ventilation and distribution systems. Specialized equipment and techniques allow them to assess ventilation systems, air tightness, and air change rates in large buildings. Smoke control in tall buildings is another aspect of the work in this area. Facilities include two ventilation-system test rooms with HVAC equipment, and air/leakage, air/change equipment.

Lighting scientists study factors that affect visual performance such as contrast, glare, light sources, subjective response, and a person’s age to establish visual criteria and develop standards for lighting practice. They also provide guidelines for efficient use of lighting (the position of light switches, or choice and position of blinds, for example).

For a broader picture of building performance, scientists are studying the operation and use of building services, to develop criteria for incorporation into knowledge-based systems. The application of computer technology to building facilities management will maximize benefits for occupants, while increasing efficiency and minimizing costs.

One aspect of facilities management is problem diagnosis. Researchers have recently developed a software program to diagnose and solve window prob-
lems; the ‘window failure diagnos-
tician’ or WINDERS (for window
diagnostic expert knowledge system)
will be of interest to homeowners,
manufacturers, and retailers.

The Experts:
Ventilation and air movement: Sherif
Baraket (613) 993-9538
Smoke control: George Tamura (613)
993-9616
Lighting practise: Mark Rea (613)
993-9677
Expert systems: Kalev Ruberg (613)
993-9711
Barrier-free design: Jean-Remi Cham-
pagne (613) 993-0247
Section Head, Building Services: Bob
Bowen (613) 993-9580

Acoustic environment . . .

Noise control in buildings and the
acoustical design of interior spaces to
meet the needs of occupants are the
focus of acoustics research at IRC.
Scientists are studying the vibration
characteristics of buildings and
building elements such as walls, win-
dows, doors, and floors to see how
they transmit sound, and are looking
at the absorption properties of
materials such as carpets and ceiling
tiles. An evaluation of these com-
ponents as they interact in a system
helps researchers understand how
sound is transmitted from the outside
to the inside of the building through
the facade and, within the building,
from one room to another.

Scientists also analyze the behavior
of sound within rooms to develop
acoustic design criteria for large areas
such as concert halls, theatres,
auditoria, or meeting rooms such as
classrooms, lecture rooms, or con-
ference rooms.

Facilities include three reverberation
rooms and an anechoic chamber for
commercial testing according to
ASTM or ISO standards. Researchers
can assist industrial clients at the design
stage, or help correct problems in ex-
isting buildings, whether it is to do with
noise emanating from fans, enclosures
for heat pumps, or finding the best
location for smoke alarms.

The Experts:
Noise control in buildings: Alf War-
nock (613) 993-2305

Enclosure design: Dave Quirt (613)
993-9746
Design of halls and conference rooms:
John Bradley (613) 993-9747
Section Head, Acoustics: Alf Warnock
(613) 993-2305

Building materials . . .

Building material are treated harshly
by Canada’s climate, and tend to
deteriorate prematurely. Researchers
at IRC are studying the properties and
durability of concrete and concrete
admixtures, clay bricks, roofing mater-
ials, plastics, paints, varnishes, sealants
and other materials to understand the
process of deterioration caused by
temperature change, moisture, and
freezing.

Specialized equipment and outdoor
exposure sites allow scientists to
monitor changes in materials and
evaluate their effect on long-term
durability. The laboratory works to
develop or improve products, develops
new test methods, and will assess a
manufacturer’s new product if no stan-
dards yet exist, or analyze problems
with a material.

One problem that has surfaced
recently is the deterioration of concrete
parking garages and corrosion of the
reinforcing steel by de-icing salts. In a
joint program with commercial garage
owners, Canada Mortgage and Hous-
ing, and Public Works, IRC is work-
ning on a cost-effective repair strategy
to extend the service life of damaged
structures, and preparing guidelines for
the design of new structures.

The Experts:
Durability of concrete: Gerard Litvan
(613) 993-0128
Durability of masonry: Mark Arnott
(613) 933-0123
Coatings and sealants: Harry Ashton
(613) 993-0129
Section Head, Materials: Vangi
Ramachandran (613) 993-1596

Fire and buildings . . .

IRC’s National Fire Laboratory
near Almonte, Ontario (60 km west of
Ottawa), is the only one of its kind in
Canada, and one of few such facilities
in the world. The laboratory, con-
sisting of a ten-storey tower and a burn
hall something the size of a four-storey
football field (1670 square metres, 12.5
m clear height to the ceiling) allows
scientists to burn large quantities of
fuel and conduct full-scale controlled
fire testing.

The tower is designed for the study
of fire propagation and smoke move-
ment in tall buildings, whereas the
burn hall can accommodate burn
rooms for studies on room lining materials and furnishings, the toxic products of combustion, automatic sprinkler systems, and the flammability of external cladding materials.

The aim of the fire research program is to maximize design safety and introduce fire protection measures to reduce the loss of life and property to fire. Researchers study how fires start, how they spread, the flammability of materials, the toxic products of combustion, the smoke produced and smoke control—in short, anything to understand fire. They look at the geometry of walls or of windows, for example, to see how it affects fire spread from one floor to another or to the adjacent building. They examine ways of containing the fire and study fire protection measures such as detection and alarm systems, sprinklers, and smoke-free escape routes.

Scientists examine the fire resistance of structural components, which are often severely tested during a fire. The Ottawa laboratories, used extensively for small-scale and standard testing, have a test furnace that can accommodate full-scale steel or concrete columns up to 4.3 m long, and test furnaces for the study of beams, floors, walls, and doors under simulated fire conditions.

Government agencies, engineering consultants, and manufacturers benefit from long term research, but may also request specialized testing. The laboratory has also conducted studies of fire-fighting equipment and methods, to provide information to fire departments.

**The Experts:**
- Resistance of building elements: Tiam Lie (613) 993-9759
- Design for safety: Igor Oleszkiewicz (613) 993-9555
- Ken Richardson (613) 993-9775
- Toxicity: Yoshio Tsuchiya (613) 993-9777
- Smoke control: George Tamura (613) 993-9616

**Geotechnical research—soils, ice and snow . . .**

Geotechnical research—the study of the behavior of earth materials and the effect of environmental conditions on those properties—is important in a country such as Canada which is subject to extreme ranges of climatic and terrain conditions. The stability of buildings and engineering structures depends on good design based on a thorough understanding of soil mechanics, ice engineering, and permafrost.

Geotechnical research at IRC also encompasses foundation design for both normal loads and earthquake forces, tunnelling techniques, and engineering in avalanche-prone areas.

Bemuse of the destructive influence of frost heave on engineering structures such as roads, railways, runways, and foundations, frost action in soils is an important aspect of soils research. Another area of concern, especially in the face of disasters such as the recent earthquake in Mexico, is soil mechanics—the strength, stability, and performance of soils as a foundation.

Permafrost, ‘perennially frozen ground’ that is sensitive to even small changes in temperature, demands special building practices. The expertise gained over the years has allowed engineers to build roads, bridges, pipelines, and buildings, with the same degree of confidence in the North as in the rest of Canada. Scientists are now developing a new technique for slab-on-grade construction, one that could revolutionize building on permafrost by eliminating the need for pile foundations or gravel pads.

At the other end of the scale, scientists examine the interaction between ice and structures. An understanding of ice mechanics—the nature of the pressures exerted by ice—improves design criteria for ships, bridge piers, buoys, and other offshore structures.

Although the research approach is multifaceted, field investigations are emphasized to provide engineering consultants with information on the
nature of soil deposits and on the performance of actual structures. Unique testing equipment (combining electronic instruments, a 10 tonne drill rig, and computer equipment) permits on-site soils testing and immediate analysis of the soil profile. Laboratory facilities include a frost heave laboratory, low temperature laboratory (consisting of four walk-in cold rooms), and a soil test laboratory.

**The Experts:**
Soils: Tim Law (613) 993-3803
Permafrost: Harry Baker (613) 933-3807
Ice engineering—Forces on structures: Bob Frederking (613) 993-3792
Frost action: Otto Svec (613) 993-3806
Deep foundations and excavations: Mike Bozozuk (613) 993-3801
Tunelling: Laverne Palmer (613) 993-3782
Avalanche engineering and hazard evaluation: Peter Schaerer (604) 666-6741
Section Head, Geotechnical: Laverne Palmer (613) 993-3782

**Technology transfer—getting the information out . . .**

Getting the information to industrial users where it counts most, is critical in a world of rapidly evolving technology. As the research arm of the construction industry, IRC acts as both troubleshooter and creator of new knowledge, and is also committed to transferring that knowledge to the private sector.

**Construction technology service . . .**

Industry can access technical information through several networks. The Construction Technology Service, which includes groups concerned with publications, building codes, marketing, and contracts, has a special mandate to put IRC expertise at the disposal of industry. To obtain information, call: (613) 993-2607.

Or write to: Construction Technology Service, Institute for Research in Construction, Bldg. M-20, National Research Council Canada, Montreal Road, Ottawa, Ontario K1A 0R6.

Besides answering inquiries, the Service organizes conferences and seminars, as well as visits to the Institute. One of the most popular seminar series is Building Science Insight; each fall, from September through to the end of November, one-day sessions are presented in twelve cities across Canada. The seminars are organized around specific themes and bring up-to-date technical information to people engaged in all aspects of building, whether owners, architects, engineers, builders, materials suppliers, building officials, or educators.

The 1986 seminar dealt with air barriers as a solution to air leakage in the building envelope, a problem that can result in deterioration of the building. Participants explored questions concerning the air barrier through morning lecture sessions and afternoon workshops.

For more information on Building Science Insight, call Rick Quirouette at (613) 993-4028.

**Publications . . .**

A series of IRC publications are available. For example, the Institute regularly publishes Canadian Building Digests (CBD’s) which deal with a wide range of technical subjects, and building practice notes which explore problems associated with current building techniques. A newsletter is produced three times a year. The Research Program, published annually, gives an outline of IRC research projects.

Other documents such as books (e.g., the Concrete Admixture Handbook 1985), committee reports, proceedings, translations, and special publications, are published on an irregular basis.

If you wish to receive the various publications, as well as an annual source list of what is available, call (613) 993-2463 or write the Publications Section, Institute for Research in Construction, Bldg. M-20, National Research Council Canada, Ottawa, Ontario K1A 0R6.

**Code publications . . .**

Publications pertaining to codes and standards for buildings are issued by the Associate Committee on the National Building Code, and are available through NRC’s Publications Sales and Distribution Office. Orders must be accompanied by a cheque or money order made payable to the Receiver General for Canada (credit National Research Council) and sent to: Publications Sales and Distribution, Bldg., R-88, National Research Council Canada, Montreal Road, Ottawa, Ontario K1A 0R6.
Code documents include:
National Building Code of Canada
Administrative Requirements for the Code
Supplement to the National Building Code
Canadian Plumbing Code
Building Standards of the Handicapped
National Fire Code (NFC)

A codes newsletter is published quarterly, free of charge. Pricing information on code documents can be obtained by calling (613) 993-2054.

Technical inquiries concerning building codes and standards should be addressed to IRC’s Codes and Standards group at (613) 993-9960.

Library . . .

Another important resource for the construction industry is the IRC library, which contains Canada’s largest collection of information on building science. As a branch of the Canada Institute for Scientific and Technical Information (CISTI), it also has links with building research and related technical libraries around the world. Open during regular working hours, the library invites clients to use its services directly (location: Bldg. M-20, Montreal Road in Ottawa), or they may request information by telephone ((613) 993-2466, or by writing to the IRC Library, Bldg. M-20, National Research Council Canada, Montreal Road, Ottawa, Ontario K1A 0R6.

Anyone in Canada can also obtain IRC documents through the inter-library loan facilities of most university, company, or public libraries.

Clients with a terminal, a telephone, and a CAN/OLE account (Canadian Online Enquiry System), have access to bibliographic references and can choose the documents they need. For more information on how to open an account, and to identify, locate, and order documents through your terminal, contact Client Services, CAN/OLE CAN/SDI, CISTI, Bldg. M-55, National Research Council Canada, Ottawa, Ontario K1A 0R6. Telephone: (613) 993-1210.

Electronic networking . . .

The National Research Council, in cooperation with a consortium formed by Descon International Ltd. and Southam Communications Limited, is developing an electronic network that will provide access to virtually all information sources and services of interest to the construction industry. Funded in part by NRC’s IRAP program, the Canadian Construction Information Service (C.C.I.S.) will serve as an ‘electronic gateway’ to other information networks, providing the first comprehensive information source available on construction. A key
feature will be the listing of technical experts, cross-referenced to each item of information. IRC is participating fully in the project, providing specialized databases and a list of services. Designed to operate on most personal computers, the Directory will be available by late 1988. For information on demonstrations of the Directory, call (613) 238-6777 or write Canadian Construction Information Services Limited, 251 Laurier Avenue West, Ottawa, Ontario K1P 5J6.

Advisory services . . .

As a part of a cross-country information network, NRC maintains a Field Advisory Service in major cities across Canada (look in the white pages of the phone book under National Research Council) and Construction Technology Offices in Vancouver and Halifax:

Construction Technology
(613) 666-6735
National Research Council Canada
3650 Wesbrook Mall
Vancouver, British Columbia
V6S 2L2

Construction Technology
(902) 426-8255
National Research Council
1411 Oxford Street
Halifax, Nova Scotia
B3H 3Z1

IRC also has a regional station in Saskatoon that studies building problems specific to the prairie provinces, and a group in Vancouver, British Columbia, that specializes in avalanche engineering. This group provides information to resource-based industries and utilities in avalanche areas, and advises professionals involved in highway design and maintenance, for example. The address of the Saskatoon office is:

Prairie Regional Station
Institute for Research in Construction
National Research Council Canada
(306) 975-4200
Saskatoon, Saskatchewan
S7N 0W9

The B.C. Avalanche Centre may be reached through the Construction Technology Office in Vancouver.

(Reprinted with the permission of Construction Canada).