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IRC celebrates 50 years: *the institute's major achievements*

From the institute's beginnings as the Division of Building Research, it was clear that climate was a crucial factor influencing the design and performance of Canada's buildings and structures. Obviously, one dominant climatic element in Canada is snow. One of the first snow-related projects undertaken was an investigation of the properties of the annual snow cover across the country. Researchers, using a kit of instruments they designed specially for the task, took measurements of snow depth, density, temperature, grain size, grain type, and compressive strength.

Snow loads on roofs was an issue of critical importance to designers and builders. A Canada-wide survey led to rationalized design snow loads in the 1965 National Building Code. The work also led to the calibration of wind-tunnel and water-flume tests for obtaining snow loads on unusual roofs, and to the calibration of an analytical model for snow drifting, developed by a private firm.

The impact of snow is also felt in a large way in avalanches, another area of study in which IRC researchers gained global acclaim. Their research, which began in the late 1950s, found practical application when roads and railways were being constructed and maintained in avalanche-prone areas, such as Rogers Pass in the Canadian Rockies. Disruptions to the rail line through the pass were so frequent and serious that a tunnel was later constructed to avoid the danger. When the Trans-Canada Highway was built, IRC research was instrumental in developing appropriate defence systems such as snow sheds.

Also in the geotechnique arena, there was considerable research conducted on permafrost, muskeg, soil and ice. In every one of these areas, this research had a profound effect on Canadian construction practices, and indeed, on the location of facilities and even towns. For example, virtually all current design guidelines for using ice surfaces for load-bearing purposes, such as roads and airfields, is based on work by IRC researchers, who spent many years studying the microstructure and properties of ice.

The results of IRC's extensive field work — begun in the 1950s in the permafrost zones in Canada's North — were drawn together in books such as "Permafrost in Canada: Its Influence on Northern Development," and "Permafrost: Engineering Design and Construction."

Photo: courtesy of IRC

Wind pressure on low- and high-rise buildings was measured to confirm and calibrate wind-tunnel tests used to obtain wind loads for design. This work also led to research on the structural strength of windows under wind loads and to the first standard in North America for structural design of glass for buildings.

Early work on building materials and design focused on testing insulation materials for their insulation value. Studies of the building envelope as a system greatly advanced the understanding of heat, air and moisture transport through walls, leading to the development of improved wall construction techniques. One revolutionary system pioneered and promoted by IRC was the rainscreen wall for controlling the effects of rain (and other exterior moisture) on walls. This work also demonstrated the importance of air barriers, which are vital to controlling air leakage, the main carrier of moisture entering walls from the inside.

Significant advances have occurred in window technology, especially sealed glazing units. Today part of the work in this area entails the use of warm-edge technology to control condensation and the development of techniques to assure the integrity and long-term performance of units filled with inert gases such as argon.

The 1970s saw a rapid expansion in research aimed at improving the energy efficiency of buildings. IRC made major advances in this area, particularly in the air-tightening of building enclosures. When air-tightness led to concerns about indoor-air quality and condensation, IRC was there with ventilation research.

Acoustics, an important aspect of the indoor environment, has been a hallmark of IRC work since the earliest days, when researchers developed guidelines for house construction near airports, railways and roads, specifying how to minimize noise intrusion. A more recent product has been publication of sound-insulation data for gypsum-board and concrete-block walls. For those who design and build the world's concert halls, the work of IRC acoustics researchers made the evaluation of concert-hall acoustics a quantitative science.

Since building research extends from top to bottom, IRC sought to advance the technology of foundation design and construction. This work, of particular significance for residential and small-building construction, and for buildings and structures in the North, was incorporated into the National Building Code and the Canadian Foundation Engineering Manual.

Developments in limit-states design brought together research on structural loads, materials and their variabilities and failure probabilities, to give a new approach to structural design in the National Building Code and Canadian standards.

Thanks to the efforts of IRC researchers, guidelines for the seismic evaluation and upgrading of building structures are now available for engineers to use in Canada's pockets of seismic activity, especially in British Columbia, Ontario and Quebec. Recent research on building vibration caused by buses, freight trains and subway trains has led to a clear understanding of the problem and to development of remedial measures. Floor vibration in buildings caused by the activities of people has also been studied: design criteria have been incorporated into the National Building Code.

A research paper published in 1970, "A New Model For Hydrated Portland Cement," is another IRC research effort that had a profound impact on the construction industry, vastly increasing our knowledge of cement — its chemical, physical and mechanical properties — and making possible the whole range of concrete research and development that has followed. Some of that research deals with the repair and protection of reinforced-concrete structures, and the use of fibre-reinforced plastic to prevent corrosion damage.

Obviously, a vast range of IRC research advances the National Building Code, which stands as one of the most significant contributions of this institute to Canadians and our construction industry. Founding director Robert Legget saw the benefit in linking code-development with research: IRC researchers continue to support the work of the industry committees that develop the National Building Code and other national codes.

The many books and publications that have come out of IRC have served not only as guides for practising engineers, architects and builders, but also as reference texts in post-secondary educational institutions. The Canadian Building Digest series, which ran from 1960 until 1988, and "Building Science for a Cold Climate," are still used in schools of engineering, architecture and building studies. "Roofs" is another major IRC book that has enjoyed great popularity, and numerous other works penned by IRC staff have been published privately throughout North America.

In our May/June issue Robert Bullis will trace the evolution of some of IRC's recent consortium projects. A review of IRC fire research will appear in the July/August issue of CCE.