Canada's Institute for Research in Construction

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Profile of an Organization

Canada's Institute for Research in Construction

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The following article is part of an occasional series appearing in TR News *in which transportation research organizations are profiled. The activities of the Institute for Research in Construction of the National Research Council of Canada are discussed here.*

Estimates place the cost of building and maintaining Canadian roadways between $6 billion and $8 billion annually. This strain on the public purse, substantial for a country of 27 million people, has prompted government to seek ways of improving the performance and durability of roadways and other aspects of Canada's infrastructure, such as buried works (sewer lines and water mains) and transportation-related structures.

Much of the responsibility for this research now rests with the Institute for Research in Construction (IRC). IRC is a division of the National Research Council of Canada, the country's leading science and technology agency, which was established in 1916.

The Institute was founded in 1947, when the National Research Council of Canada created its Division of Building Research. In 1986, the name was changed to the Institute for Research in Construction, reflecting an increasing involvement in all areas of construction research.

Research is carried out in Ottawa and in the field by the IRC staff of more than 200 engineers, architects, scientists, and technical experts.

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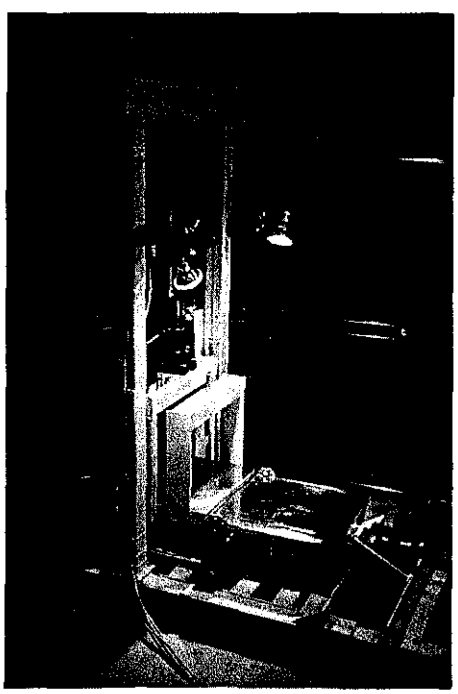
IRC conducts both strategic and client-funded research in all fields directly related to the needs of the construction industry. In addition to pavement and buried works, IRC research projects include the building envelope, the indoor environment, construction materials, fire safety, and structural rehabilitation and durability.

Research Partnerships

During the past seven years, IRC has made an effort to match carefully its research projects to the industry's needs. It has actively promoted industrial development through contracts and collaborative partnerships with private firms and associations and with federal, provincial, and municipal governments. IRC's list of clients includes Dupont Canada Inc., Bell Northern Research, Ontario Hydro, the Canadian Institute of Public Real Estate Companies, the cities of Montreal and Calgary, Lovat Tunnelling Equipment Inc., the Portland Cement Association, and Atomic Energy of Canada Limited. The institute also collaborates with companies and research organizations in Australia, Europe, Japan, and the United States.



New pavement-testing apparatus designed and built by IRC.

Contracts and partnerships not only strengthen the ties between IRC and industry, they also provide the institute with more than $6 million annually, about 25 percent of the institute's overall funding.

Transportation-Related Research

IRC is pursuing, through its Infrastructure, Structures, and Materials laboratories, a number of transportation-related construction research projects.

Infrastructure

More than half the resources of the Infrastructure Laboratory are dedicated to pavement research. The objectives are to develop better construction techniques for asphalt pavement, formulate nondestructive evaluation and test techniques for pavement, develop methods for improving performance and durability and ultimately for prolonging life of pavement, and develop a model for predicting roadway failures.

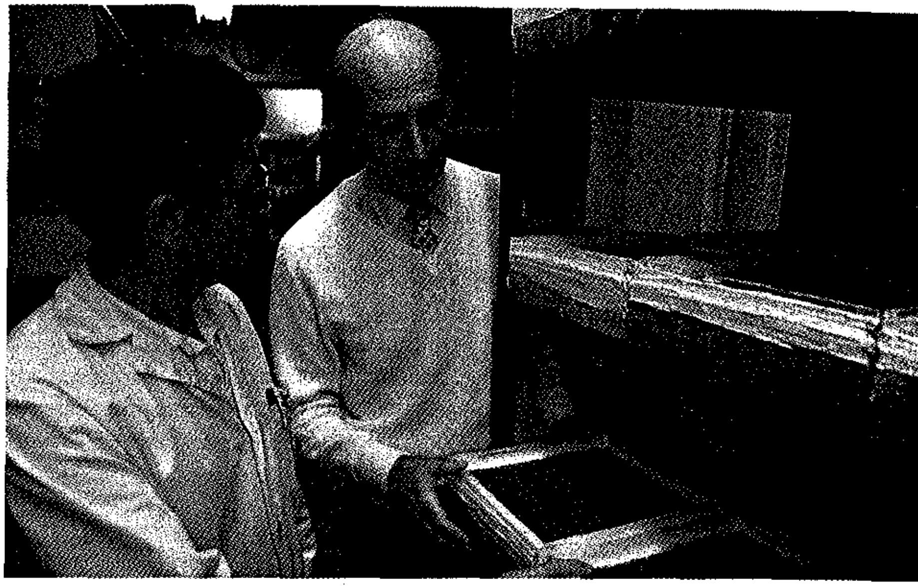
Among the recent and significant accomplishments is the development of a revolutionary pavement compacting machine. In a collaborative venture among IRC, Ottawa's Carleton University, Lovat Tunnelling Equipment Inc., and the National Research Council's Industrial Research Assistance Program, the Asphalt Multi-Integrated Roller (AMIR), in side-by-side field testing with traditional rollers, has compacted asphalt without the cracks produced by other rollers. The result is asphalt of higher density and tensile strength.

Although AMIR is not yet being mass produced (a manufacturer is being sought), it has become a valuable research tool. By using the roller, the laboratory team has been successful in compacting an asphalt mix composed of crushed aggregates up to 2.5 inches in diameter—a feat unmatched by other compactors on the market, according to the project leader. Mixes of large aggregate hold the potential to significantly decrease pavement rutting. With AMIR, it has also been possible to incorporate geogrids into asphalt mixes, thereby increasing the potential to control pavement cracking.

Researchers at the laboratory recently designed and built a unique apparatus for evaluating the strength of pavement crack repairs.

The staff are experienced in many facets of geotechnical engineering, and the laboratory is home to one of the best frost-heave test facilities in the country. Frost effects are a widespread and serious problem in Canada: municipalities spend significant portions of their budgets annually on repairing frost damage to roads, sidewalks, manholes, railway crossings, buried utilities, and water and sewage pipes. For this reason, the remainder of the resources of the Infrastructure Laboratory are being directed to improving construction methods and developing new technologies to combat cold climate effects on municipal infrastructure. Tests in western Canada, for example, validated the use of insulation for reducing the burial depth of water mains to less than two meters.

IRC has begun working with large cities to investigate the cracking of sidewalks. There are three types of cracking: longitudinal, transverse, and corner. The goal is to identify causes of cracking and to develop guidelines for cost-effective new construction.



Technical Officer Herman Schultz (*left*) and concrete researcher Gerard Litvan discuss samples from IRC study of repair strategies for parking garages.

Structures

Researchers at the IRC Structures Laboratory have done considerable work in identifying the causes and effects of traffic-induced building vibrations—increasingly the bane of homeowners living near major thoroughfares. A variety of factors that influence the intensity of traffic-induced vibrations have been identified. These factors include the presence of potholes, manholes, and pavement seams; the type, weight, and speed of vehicles; and local soil conditions. Armed with this knowledge, scientists hope to develop measures to alleviate the problem in existing roadways and, over the longer term, develop design and construction guidelines that will hold vibration problems in new roads to a minimum.

Materials

Researchers at the IRC Materials Laboratory are conducting field testing in the city of Montreal on approximately 14 types of sealers currently used for repairing asphalt cracks. The purpose of the tests, according to one researcher, is to develop a product that will sustain environmental and climatic stresses for at least 7 to 8 years, that can be more easily applied, and that renders more predictable performance than products now available.

Studies are also under way at the Materials Laboratory on cathodic protection of concrete in bridge decks and substructures. Through field trials carried out in collaboration with the Ontario Ministry of Transportation and Canadian zinc producers, researchers are studying the use of metallized zinc, arc sprayed directly on concrete for improved adhesion, and various mixes of shotcrete, including those that incorporate carbon fibers, as means of improving cathodic protection.

Also under investigation is the addition of preformed air voids to concrete to thwart freeze-thaw damage to roads and bridge decks—a costly product of the Canadian climate. Although air entrainment is the generally accepted mode of concrete protection, it has not proven entirely successful because the entrainment process is extremely sensitive to a number of field conditions. IRC research has revealed that the process of adding preformed air voids into concrete is much less sensitive to field conditions and therefore has the potential to offer greater protection against freeze-thaw damage.

This year marks the end of a five-year research partnership between the Materials Laboratory and the Canadian Institute of

Public Real Estate Companies, which represents the country's largest developers, and several federal and provincial partners. Researchers have been studying the widespread and costly problem of corrosion of reinforcing steel in parking garages throughout the course of the project. The problem is not an inability to build good parking garages. It is that builders in the 1920s and 1930s underestimated the level of protection needed. The level of use of deicing salts in the years ahead was also underestimated.

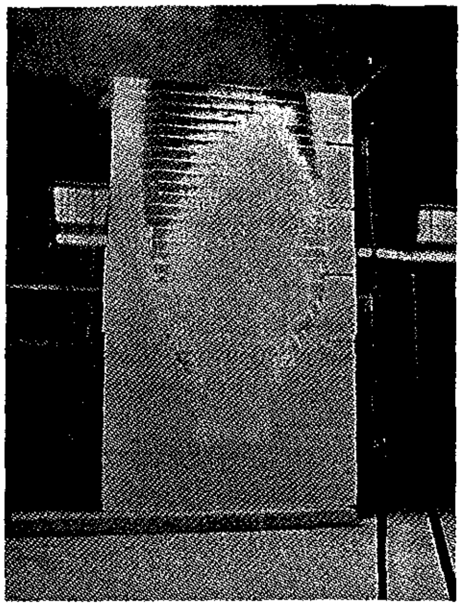
Although the problem has been identified, there is no blanket solution. What can be provided, however, is all the information necessary for garage owners to make the best possible decisions on how to repair existing damage. As for the construction of new parking garages, here too the Materials Laboratory has taken a lead role. On the basis of research and accumulated knowledge, IRC staff have been instrumental in developing and writing new standards that address the problem of corrosion of reinforcing steel.

Other Research

Through the years the Division of Building Research, as IRC was originally called, pioneered the study of building science. It was especially active in the study of the building envelope, particularly wall design for a cold climate, the load-bearing capacity of various soils, and the complex problem of building on permafrost. Today, the institute remains prominent in envelope research, employing excellent facilities such as full-scale wall and window chambers, a gamma ray spectrometer, a new guarded hot-plate apparatus, and a dynamic wall test facility. Closely related to envelope research is indoor environment research in lighting, ventilation, and acoustics.

The current contribution of the Materials Laboratory to concrete technology reflects a steady rise in prominence over the years, during which it has built one of the best concrete research teams anywhere. An extensive investigation of the use of microfibers to develop high-performance concrete for demanding repair applications is drawing wide interest.

Beginning in the 1950s, IRC's predecessor established fire research capability. Today, the National Fire Laboratory boasts such facilities as a 10-story tower for smoke-control studies and a large burn hall in which virtually any kind of full-scale fire test can be staged. Manufacturers, developers, engineering consultants, the aerospace industry, and shipbuilders are among the clients. A risk-cost model for assessing fire safety options in new construction and rehabilitation projects is being developed as an aid for designers and regulatory authorities.



Fire test on exterior wall at IRC National Fire Laboratory.

The study of traffic vibrations is but a small part of the work of the IRC Structures Laboratory, which now specializes in developing criteria and guidelines for the evaluation and rehabilitation of existing buildings. Seismic hazards in existing buildings are a prime concern. Researchers are also developing durability criteria for rehabilitation and for the design of new buildings. Current projects of note are a study of the effect of corrosion on the punching shear capacity of concrete slabs and research on the suitability of fiber-reinforced plastic for reinforcing slabs.

Much of the institute's research supports the development of codes and standards. What's more, IRC publishes the National Building Code, the National Fire Code, and several other national model codes, which are increasingly being adopted by Canadian provinces and municipalities as regulatory instruments. A related program that is gaining wide acceptance is the IRC materials evaluation service, established in 1988 to promote innovation in construction products and systems. Novel products that are not governed by standards are evaluated by means of special criteria to determine whether they will serve the use intended by the manufacturer and whether they will meet the intent of the National Building Code.

Research, codes, and evaluation services are the essence of IRC, but the job does not end there. It ends with technology transfer, the communication of new research findings to the construction industry. IRC's Industry Liaison Branch is charged with this mandate. A team of 25 people serves the industry's information needs through seminars, publications, and articles in professional and trade magazines. The branch cultivates technology networks with industry associations and chapters and with several construction technology centers. Another important IRC link to the industry at the local level is the construction technology advisors of the Industrial Research Assistance Program, operated across Canada by the National Research Council.

For more information on IRC's overall research program, readers may request a free copy of Working with the Construction Industry: Research in Action *from Client Services, Institute for Research in Construction, National Research Council of Canada, Ottawa, Ontario, Canada, K1A OR6 (telephone 613-993-2463, fax 613-952-7673). A list of recent publications is also available.*