



## Preserving Canada's Heritage Structures

Experience has shown that retrofit work within the context of heritage rehabilitation projects is a very complex challenge. These buildings are often constructed from materials that are no longer used in the construction industry and these "traditional" assemblies lack test data to support detailed analytical calculations. This situation has often led designers to use different approaches to deal with similar problems on similar buildings. ISIS Canada has embarked on research to demonstrate the efficacy of various seismic upgrade approaches.

ISIS Canada has been working with Public Works and Government Services Canada (PWGSC) through its network of universities, to provide an understanding of the seismic performance of heritage masonry walls. The team is working on techniques to evaluate the seismic performance of reinforcing methods in the laboratory that would be appropriate for the heritage character of the buildings. The objective is to develop methodologies that can be applicable to many heritage buildings across the country and around the world.

The main thrust of this collaboration requires ISIS Canada to study and provide an understanding of the following:

- Seismic capacity of mass masonry walls
- Masonry anchor performance
- Freeze-thaw performance
- Seismic performance of reinforced heritage masonry
- Testing on different anchor assemblies including cementitious, epoxy, and mechanical anchors to determine their compatibility with heritage stone wall assemblies. Different anchor materials are being tested including steel and FRP
- Design of an Structural Health Monitoring (SHM) system for heritage masonry walls



# SHMII-3 CONFERENCE

## INTERNATIONAL WORKSHOP A RESOUNDING SUCCESS

The 3rd International Conference on Structural Health Monitoring of Intelligent Infrastructure, **SHMII-3**, provided a forum for over 200 scientists, engineers, enterprisers and researchers from 22 different countries around the world to discuss recent advances in smart sensors, wireless sensor networks, signal acquisition and processing, and real-time data transferring and management. The conference, held in Vancouver, Canada from November 13-16, 2007, provided the opportunity to share innovative ideas on the state-of-the-art, state-of-the-practice and future trends of smart sensors, advanced sensor networks and integrated systems for structural health monitoring of intelligent infrastructures.

The high calibre papers presented at the conference were well received and two of them received awards. The first award was presented to Daniele Inaudi and Branko Glisic for their paper, "Distributed Fibre-Optic Sensing for Long-Range Monitoring of Pipelines" with the JMBT Structures Research Inc. Award for Best Paper in SHM Applications. The second award was presented to Yozo Fujino, Shuji Umemoto, Noriyuki Miyamoto, Takuji Okamoto,

Takefumi Hara, and Keita Kubota for their paper, "Verification of a High-Accuracy and Noncontact Measurement System FSF Laser Optical Coordinates" with the JMBT Structures Research Inc. Award for Best Paper in SHM Research.

ISHMII also took the opportunity to present its Fellowship awards to the first 6 inducted Fellows; Emin Aktan, Farhad Ansari, Baidar Bakht, Yozo Fujino, Jan-Ming Ko, and Urs Meier.

SHMII-3 built on the success of SHMII-1, held in Tokyo, Japan on November 13-15, 2003, and SHMII-2 in Shenzhen, China, November 16-18, 2005. Plans are underway for SHMII-4 in 2009, in Zurich, Switzerland.

*Structural health monitoring is an attractive and challenging area of intelligent infrastructure, integrating high-tech technologies. It is a concrete embodiment of modern testing technology so that a monitored infrastructure is, in fact, a long-term, full-scale and real-time testing system.*

### SHMII-3 Conference November 13-16, 2007 Vancouver, Canada



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From Left to right: Urs Meier, Jan-Ming-Ko, Aftab Mufri (presenter, ISHMII President), Emin Aktan, Yozo Fujino. (Missing from photo, Farhad Ansari and Baidar Bakht)



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# UPCOMING ISIS EVENTS

## ISIS DESIGN MANUAL WORKSHOP TOUR 2008

Workshops will take place in six cities to introduce the updated versions of ISIS Design Manual #3, "Reinforcing Concrete Structures with Fibre Reinforced Polymers" and Design Manual #4, "FRP Rehabilitation of Reinforced Concrete Structures", along with new Design Manual #5, "Prestressing Concrete Structures with FRPs". The ISIS guides "Specifications for FRP Product Certification" and the "Durability Monograph" will also be presented.

### Edmonton, Alberta

April 7, 2008

Contact Dr. Roger Cheng ([roger.cheng@ualberta.ca](mailto:roger.cheng@ualberta.ca))

Presentations by Dr. Gamil Tadros, Dr. Roger Cheng,  
Dr. Mohammed Boulfiza, Dr. Raafat El-Hacha  
Westin Hotel

### Toronto, Ontario

April 11, 2008

Contact Dr. Shamim Sheikh ([sheikh@ecf.utoronto.ca](mailto:sheikh@ecf.utoronto.ca))

Presentations by Dr. John Newhook, Dr. Shamim Sheikh,  
Dr. Brahim Benmokrane, Dr. Khaled Soudki  
Westin Harbour Castle

### Montreal, Quebec

April 25, 2008

Contact Dr. Brahim Benmokrane ([brahim.benmokrane@usherbrooke.ca](mailto:brahim.benmokrane@usherbrooke.ca))

Presentations by Dr. John Newhook, Dr. Kenneth Neale,  
Dr. Brahim Benmokrane, Dr. Bruno Massicotte  
The Queen Elizabeth Fairmont

### Winnipeg, Manitoba

April 28, 2008

Contact Dr. Aftab Mufti ([muftia@cc.umanitoba.ca](mailto:muftia@cc.umanitoba.ca))

Presentations by Dr. Aftab Mufti, Dr. Dagmar Svecova,  
Dr. Mohammed Boulfiza, Dr. Baidar Bakht  
Fort Garry Hotel

### Vancouver, British Columbia May 1, 2008

Contact Dr. Nemkumar Banthia ([banthia@civil.ubc.ca](mailto:banthia@civil.ubc.ca))

Presentations by Dr. Nemkumar Banthia, Dr. Aftab Mufti,  
Dr. Baidar Bakht, Dr. John Newhook  
Fairmont Waterfront Hotel

### Halifax, Nova Scotia

May 23, 2008

Contact Dr. John Newhook ([john.newhook@dal.ca](mailto:john.newhook@dal.ca))

Presentations by Dr. John Newhook, Dr. Brahim Benmokrane  
Prince George Hotel

## 2008 ISIS Canada Conference

Saskatoon, Saskatchewan May 8-9, 2008

Presentations by ISIS Graduates working in Government, Industry and Academia

For more information visit: [www.isiscanada.com/conference/conference08.htm](http://www.isiscanada.com/conference/conference08.htm)

## 5th International Conference on Advanced Composite Materials in Bridges and Structures (ACMBS-V)

Winnipeg, Manitoba September 22-24, 2008

For more information visit: [www.isiscanada.com/acmbs](http://www.isiscanada.com/acmbs)

Check the ISIS Canada website [www.isiscanada.com/events](http://www.isiscanada.com/events) for more information.

Visit our website at [www.isiscanada.com](http://www.isiscanada.com)





Dr. Nemkumar Banthia, P.Eng.,  
University of British Columbia

## Field Assessment of Structures Repaired with FRPs

A collaborative endeavor by Drs. N. Banthia, K. Neale and P. Labossière at the Universities of British Columbia and Sherbrooke is underway to conduct a field assessment of the bond behaviour and durability of FRP (fibre reinforced polymer) repairs employed on ISIS demonstration projects. Six structures across Canada with a wide range of environmental conditions and years of service since rehabilitation have been chosen from which to collect data. The investigation will comprise on-site non-destructive assessment followed by laboratory tests on samples taken from the six structures. A report on the performance, behaviour and durability of FRP repairs is of considerable importance to the user sector.



Dr. Kenneth Neale, Eng.,  
Université de Sherbrooke

## Development of a Resource Binder on SHM

Dr. J. Newhook of Dalhousie University is spearheading an initiative to develop a reference document for researchers and the user sector on the resources available within the ISIS civionics domain. As part of the project, Dr. X. Bao at the University of Ottawa will update ISIS Design Manual No. 1 regarding the "Installation, Use and Repair of Fibre Optic Sensors". At the same time Dr. Mufti will outline the capability and services available to the user sector through the Structural Health Monitoring Support Centre at the University of Manitoba. This Resource Kit will be a living document that initially includes: Installation, Use and Repair of FOS; Guidelines for SHM; Civionics Specifications; SHM Education Modules; Case Studies Related to SHM Applications; and International References.



Dr. John Newhook, P.Eng.,  
Dalhousie University

## Participation in the European FireGrid F7 Initiative

Through the leadership of Drs. M. Green and L. Bisby at Queen's University, ISIS Canada is collaborating with the University of Edinburgh to participate in a major initiative being launched in the European Community. This collaboration is expected to exchange results of research activities, developed technologies and findings in the areas of fire safety engineering, structural health monitoring, sensors, monitoring structures during fire, FRP composites and their application to systems and constructed facilities, and other aspects of innovative and intelligent structures and systems. ISIS has been invited to participate because of the extensive research it has carried out on structural components and systems under extreme fire conditions at the world class test facilities at NRC in Ottawa. The results of the European test program will complement ISIS findings and be the basis for further enhancements of Canadian fire codes.



Dr. Xiaoyi Bao,  
University of Ottawa

## Embedding Sensors Inside Corroded Steel Reinforcement to Measure the Stress Distribution in the Bond Region of FRP Wrapped Concrete Under Fatigue

Dr. K. Soudki is in the process of satisfying a user sector concern by employing a research technique that has never been used before. He is installing fibre optic sensors inside a corroded steel bar, rather than on the steel bar as employed in past research. He is using this structural health monitoring measurement technique so that it will not affect the bond between the bar and the concrete and the sensors will not be affected by the steel bar corrosion. This innovative methodology will significantly advance the knowledge of what happens inside a structural component rehabilitated using FRP wraps for the benefit of not only design engineers, but Canadians at large. Using FRP wraps to rehabilitate aging concrete structures is a cost effective means of ensuring their safety and extending service life by many years. The more that is known about performance, the more this technology will be used and the greater the savings realized.



Dr. Khaled Soudki, P.Eng.,  
University of Waterloo



## Field Repair of Post-Tensioned Concrete Slabs Using CFRP Strands

Drs. M. Green and C. MacDougall of Queen's University are involved in an exciting and innovative methodology to rehabilitate a building in Toronto in collaboration with Vector Construction, Halsall Associates, and Hughes Brothers. They are using this field application to investigate the feasibility of using CFRP (carbon fibre reinforced polymer) strands to replace corroded steel strands in an unbonded, post-tensioned concrete building. Replacement of corrosion damaged wire strands in aging buildings is a common occurrence and the use of non-corrosive CFRP tendons provides a more durable alternative to steel strands, which will eventually corrode again and have to be replaced. The project also makes use of anchor technology developed by ISIS project leader Dr. K. Soudki from the University of Waterloo. The performance of this innovative field application will be monitored for several years. To our knowledge, the use of such tendon replacement is the first of its kind anywhere.



Dr. Mark Green, P.Eng.,  
Queen's University

## Using ISIS Technologies to Rehabilitate a Major Parking Garage in Quebec City

The objective of this project, led by Dr. B. Benmokrane at the University of Sherbrooke, is to take advantage of ISIS technologies to benefit the rehabilitation of an aging parking structure in Quebec City. In preparation for this rehabilitation project scheduled for 2009, Dr. Benmokrane is endeavoring to incorporate ISIS Canada advanced design concepts including FRP (fibre reinforced polymer) non-corrosive materials and structural health monitoring. Life Cycle Engineering and Costing methodologies developed by ISIS will be used to compare alternative design parameters and structural systems to select the most cost effective design and construction solution. Such innovations will extend the service life of this structure for many years and will break the ongoing cycle of unnecessary and costly maintenance combined with premature rehabilitation.



Dr. Colin MacDougall, P.Eng.,  
Queen's University

## Providing Practical Guidelines for Repair of Damaged Structures Having FRP Reinforcement

Dr. E. El-Salakawy at the University of Manitoba is in the process of developing techniques in the laboratory that can be used in the field to repair damaged structural components that are reinforced with FRPs. This leadership is needed by the user sector because every bridge or overpass will require some kind of repair due to various kinds of damage such as freeze-thaw damage, surface scaling, vehicle impact damage, deck joints, excessive cracking, poor design details, poor quality construction and inadequate maintenance. The structural components having the new design materials cannot be repaired using traditional technologies for conventional steel reinforced structures. Although repairs for FRP reinforced concrete structures are not difficult, a different set of methodologies is needed that is appropriate for the materials involved. Dr. El-Salakawy is exploring a number of alternatives to provide guidelines for maintenance personnel.



Dr. Brahim Benmokrane Eng.,  
Université de Sherbrooke



Dr. Ehab El-Salakawy, P.Eng.,  
University of Manitoba

## CSA Embraces ISIS Product Certification of FRPs

Plans are underway for the Canadian Standards Association (CSA) to use the ISIS Canada Guidelines for Product Certification of FRPs, published in 2007, as a basis for producing a CSA Standard. ISIS is contributing to this effort with financial support and technical input throughout the process. Such a standard is of enormous importance to the user sector because it ensures that the quality of product delivered to the construction site is in accordance with the design parameters, and concerns regarding safety are satisfied.

# HONOURS & AWARDS

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## Collaboration Results in Scholarship at U of M

Through a gift from JMBT Structures Research Inc. (Dr. Leslie Jaeger, Dr. Aftab Mufti, Dr. Baidar Bakht and Dr. Gamil Tadros) and Vector Construction Group, a scholarship fund has been established at the University of Manitoba to support future graduate engineering students. The fund has been augmented by the addition of the NSERC Synergy Award, which was won by the University of Manitoba and Vector in 2005 for the research partnership that exists between the ISIS Canada Research Network and Vector Construction Group. Dr. Aftab Mufti received the cash award of \$25,000 on behalf of the University with discretionary powers over its allocation. He determined that the best use of the funds would be to direct them towards the establishment of the JMBT / Vector Scholarship. This scholarship, which now has an endowment exceeding \$100,000 will provide an annual scholarship for research in the field of Civionics Engineering. The scholarship will serve to stimulate, support and encourage research into the structural health monitoring of intelligent civil structures by a graduate student at the University of Manitoba in departments associated with the Structural Health Monitoring Support Centre.



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