

# CDCC 2017

## TECHNICAL PROGRAM & REGISTRATION

5<sup>th</sup> International Conference on  
**DURABILITY OF FIBRE REINFORCED POLYMER (FRP) COMPOSITES  
FOR CONSTRUCTION & REHABILITATION OF STRUCTURES**

July 19-21, 2017  
Delta Hotel, Sherbrooke (Quebec) Canada

[www.civil.usherbrooke.ca/cdcc2017](http://www.civil.usherbrooke.ca/cdcc2017)

The free registration Pre-Conference **First International Workshop on Glass Fiber Reinforced Polymer Bar** will be held on Tuesday July 18<sup>th</sup>, 2017 from 8:15 to 17:45 at the same hotel.

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## MESSAGE FROM THE CHAIR

Applications of fibre reinforced polymer (FRP) composites in civil structures have increased significantly in recent years. Since most of these structures are designed with service lives of more than 50 years, the long term durability of FRP materials in these applications is a critical issue.

The present conference is the fifth of its kind focusing on the durability and field applications of fiber reinforced polymers (FRP) for construction and rehabilitation of structures (bridges, buildings, marine structures, etc.). The first conference was held in Sherbrooke, Québec, Canada on August 1998, followed by one in Montréal, Québec, Canada on May 2002. The third and fourth were held in Québec City, Québec, Canada on May 2007, and July 2011, respectively. The objective of this series of international conferences is to provide a forum to academics, researchers, engineers, structure owners, FRP manufacturers, and delegates from public and industrial institutions to present and exchange views on present and future research on long-term durability and sustainability of FRP composite materials in bridges and other infrastructure systems exposed to harsh environmental conditions.

A total of 60 peer-reviewed papers are included in the proceedings. They have been authored by various experts in the field from 16 different countries around the world, including Algeria, Australia, Canada, China, Egypt, France, Germany, Hungary, Ireland, Japan, Korea, New Zealand, Switzerland, United Arab Emirates, United Kingdom and USA. On behalf of the organizing committee, I am very thankful to the authors for their valuable contributions to the conference. I am also very grateful to the paper reviewers for their time and diligence.

I would like to thank all participants – without them this conference would not be successful.

Finally, I would like to invite you to attend the one day Pre-Conference ***First International Workshop on Glass FRP Bar*** which will be held on Tuesday July 18<sup>th</sup> 2017 at the same hotel. This workshop does not charge a registration fee. DO NOT MISS IT.

Sincerely,

**Dr. Brahim Benmokrane, P. Eng., FACI, FRSC, FCSCE, FIIFC, FCAE, FEIC Chair, CDCC 2017**

Professor of Civil Engineering

Fellow of the Royal Society of Canada (Academy of Science)

*Canada Research Chair* in Advanced Composite Materials for Civil Structures

*NSERC/Industry Research Chair* in Innovative FRP Reinforcement for Concrete

*Director*, Quebec-FQRNT Research Centre on Concrete Infrastructure

*Director*, The University of Sherbrooke Research Centre on FRP Composites

Department of Civil Engineering

University of Sherbrooke

Sherbrooke, Quebec, Canada J1K 2R1

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## **ORGANIZING COMMITTEE**

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## **GENERAL INFORMATION**

### **The venue**

The Conference will be hosted at the Delta Hotel Sherbrooke, which can accommodate up to 1200 guests with its numerous rooms located on several floors.

### **Registration**

The registration and information Desks will be open from 16:00 to 20:00 on Tuesday, July 18; and from 7:30 to 16:00 on Wednesday, July 19 and Thursday, July 20, in Lac Orford

## **NON-TECHNICAL PROGRAM**

### **Welcoming Reception**

18:00 to 20:00 Tuesday, July 18, in Foyer C

### **Luncheons**

Around 12:00 to 13:30 in Sherbrooke C

### **Refreshment Breaks**

Each day during the conference around 10:00 in the morning and 3:00 in the afternoon in Foyer ABC

### **Conference Banquet**

Thursday, July 20, Cocktail (cash bar) in Foyer C from 18:30; Conference Banquet starts at 19:30.

### **Social Program**

A variety of interesting and entertaining events are planned for participants and accompanying persons. Detailed information will be available in the final invitation and on the Conference web.

### **Registration Fees**

The registration fees for authors and delegates include cocktail reception, banquet, all luncheons, all refreshment breaks, and the conference proceedings. One-day registration includes lunch, refreshment breaks, and the conference proceedings. Student registration includes cocktail reception, all luncheons, refreshment

breaks, and the conference proceedings.

### **Badges**

Conference badges should be worn during all conference activities. Tickets will be required to meals and social events. Extra tickets for banquet may be purchased at the conference registration desk.

### **TECHNICAL EXHIBIT**

To familiarize the conference attendees with their products and services, several organizations will open exhibition stalls at the conference venue of FRP construction products and fibre optic sensors.

Open on Wednesday and Thursday from 8:00 to 17:30, in Foyer ABC, and on Friday from 8:00 to 12:00, in Foyer ABC. Refreshment breaks will be held in the same area.

## Conference Program at a Glance

<b>Tuesday July 18</b>		
<b>Registration and Welcoming Reception</b>		
Time	Location	Activity
16:00 – 20:00	Lac Orford	Registration
18:00 – 20:00	Foyer C	Welcoming Reception

<b>Wednesday July 19</b>		
Time	Activity	Location
8:00	Opening	Sherbrooke B
8:30	Session 1	Sherbrooke B
10:10	Refreshment break	Foyer ABC
10:30	Session 2	Sherbrooke B
12:30	Lunch	Sherbrooke C
13:30	Session 3	Sherbrooke B
15:10	Refreshment break	Foyer ABC
15:30	Session 4	Sherbrooke B

<b>Thursday July 20</b>		
Time	Activity	Location
8:00	Session 5	Sherbrooke B
10:00	Refreshment break	Foyer ABC
10:20	Session 6	Sherbrooke B
12:20	Lunch	Sherbrooke C
13:20	Session 7	Sherbrooke B
15:20	Refreshment break	Foyer ABC
15:34	Session 8: Visit of the FRP Materials/Concrete and Structural Engineering Laboratory	Department of Civil Engineering, University of Sherbrooke
19:30	Banquet	Sherbrooke B

<b>Friday July 21</b>		
Time	Activity	Location
8:00	Session 9	Sherbrooke B
10:20	Refreshment break	Foyer ABC
10:40	Session 10	Sherbrooke B
10:40	Session 11	Sherbrooke A
13:20	Conference Closing Session	Sherbrooke B
13:25	Lunch	Sherbrooke C

<b>Wednesday July 19, 2017</b>	<b>Opening Session</b>	<b>8:00 - 8:30</b>	<b>Sherbrooke B</b>
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*Session Chairs: Steve Arsenault and Brahim Benmokrane*

8:00	<b>Welcoming Remarks/Honorary Chair</b> <i>S. Arsenault, Director of Structures Department, Ministry of Transportation of Quebec</i>
8:05	<b>Opening Remarks/Ministry of Transportation of Quebec</b> <i>A.-M. Leclerc, Associate Deputy Minister</i>
8:10	<b>Opening Remarks/Université de Sherbrooke</b> <i>P. Doucet, Dean, Faculty of Engineering / University of Sherbrooke</i>
8:15	<b>Introduction to CDCC 2017</b> <i>B. Benmokrane, Chair CDCC 2017</i>
8:20	<b>Recent Advances in FRP Reinforcement in Concrete Infrastructure</b> <i>J. Busel, Vice President, Composites Growth Initiative, ACMA</i>

<b>Wednesday July 19, 2017</b>	<b>Session 1</b>	<b>8:30 - 10:10</b>	<b>Sherbrooke B</b>
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*Session Chairs: Larry Bank and Nemy Banthia*

8:30	<b>Behavior of Carbon and Glass FRP Bonded to Concrete Following Sustained Loading for Six Years</b> <i>C. E. Bakis, M. M. Lopez, T. E. Boothby, K. Artun, and M. B. Whitaker</i>
8:50	<b>Durability Field Study of GFRP Bars After 11 Years In- Service in Val-Alain Bridge on Highway 20 East, Quebec, Canada</b> <i>M.-A. Loranger, B. Benmokrane, C. Nazair, and A.C. Manalo</i>
9:10	<b>Effects of ageing on the bond properties of carbon fiber reinforced polymer /concrete adhesive joints</b> <i>M. Quiertant, K. Benzarti, J. Schneider, F. Landrin, M. Landrin, and F. Boinski</i>
9:30	<b>Environmental Effects on The Durability Performance of FRCM Composite Bonded to Concrete</b> <i>Z. R. Aljazaeri and J. J. Myers</i>
9:50	<b>Improving Strength and Durability of GFRP Composites Using Carbon Nanotubes</b> <i>R. Chennareddy, U. F. Kandil, and M. M. R. Taha</i>



Wednesday July 19, 2017

Session 2

10:30 - 12:30

Sherbrooke B

*Session Chairs: Antonio Nanni and Mark Green*

- 10:30     **Deflection of Cracked GFRP Prestressed Concrete Slabs Subjected to Sustained Loading**  
*A. Ghatfar, M. Singh, and D. Svecova*
- 
- 10:50     **Durability of Flax/Epoxy Composite Used for Concrete Structures Strengthening**  
*E. Ferrier, L. Michel, and A. Hallonet*
- 
- 11:10     **Durability Characteristics of Glass Fibre Reinforced Polymer (GFRP) Bars with Different Bar Diameters**  
*A. C. Manalo, B. Benmokrane, and J. C. Bouhet*
- 
- 11:30     **Bond Durability of GFRP Bars to Fiber-Reinforced Concrete Subjected to Combined Effects of Freezing-Thawing Cycles and Saline Solutions**  
*F. Yan and Z. Lin*
- 
- 11:50     **Selection of Proper FRP Reinforcements for Increasing Durability of Infrastructure**  
*A. Vaidya*
- 
- 12:10     **Long-Term Behaviour of GFRP Reinforced Concrete Beams Under Sustained Loads and Aggressive Environment**  
*H. Fergani, M. Di. Benedetti, M. Guadagnini, C. Lynsdale, and C. Mias*

Wednesday July 19, 2017

Session 3

13:30 - 15:10

Sherbrooke B

*Session Chairs: John Myers and Emmanuel Ferrier*

- 13:30     **Durability of GFRP Reinforcement in Built Structures: A 15-Year Old Concrete Bridge Deck**  
*O. Gooranorimi, T. Bradberry, and A. Nanni*
- 
- 13:50     **Synergistic Effects of Alkaline Environment on The Behavior of GFRP Bars under Sustained Load**  
*M. L. Keller, M. Schultz-Cornelius, and M. Pahn*
- 
- 14:10     **Bond Durability and Service Life Prediction of Basalt-FRP Bars Embedded in Concrete under Alkaline Environment**  
*M. Hassan, A. Elsafty, and B. Benmokrane*
- 
- 14:30     **Design of Externally Bonded Carbon Fiber Reinforced Polymer (CFRP) Reinforcement for Durability**  
*J. Tatar and H. R. Hamilton*
- 
- 14:50     **Rational Fire Scenarios for FRP Reinforced Concrete Slabs**  
*H. Hajiloo and M. F. Green*

Wednesday July 19, 2017

Session 4

15:30 - 17:50

Sherbrooke B

*Session Chairs: Adel ElSafty and Shamim Sheikh*

- 15:30     **Development of Physical and Mechanical Properties of a Cold-Curing Structural Adhesive in a Wet Bridge Environment**  
*M. Savvilotidou, A. P. Vassilopoulos, M. Frigione, and T. Keller*
- 15:50     **Integrated Non-Destructive Testing Of CFRP-Laminate Bond on RC Bridges**  
*K. C. Crawford*
- 16:10     **Durable FRP Composites for Navigational Infrastructure**  
*PV. Vijay and P. Soti*
- 16:30     **World's First Thermoplastic GFRP MFX-Bars Subjected to Creep Effects**  
*M. Sayed-Ahmed, B. Hajimiragha, B. Hajimiragha, K. Mohamed, and B. Benmokrane*
- 16:50     **Corrosion-Damaged Beams Repaired With Carbon- Fabric-Reinforced Cementitious Matrix**  
*M. Elghazy, A. El Refai, U. Ebead, and A. Nanni*
- 17:10     **Numerical Simulation of Thermal and Mechanical Loads Effects on The Behaviour of One-Way Concrete Slabs Reinforced with GFRP Bars**  
*S. Lardjane, A. Zaidi, H. Bellakehal, and R. Masmoudi*
- 17:30     **How do we determine the Sustainability of Concrete Structures Reinforced with GFRP Bars?**  
*L. Bank*

Thursday July 20, 2017

Session 5

8:00 - 10:00

Sherbrooke B

*Session Chairs: Chuck Bakis and Amir Fam*

- 8:00     **MTO's Policies and Practices for the Use of FRP Reinforcement**  
*D. Lai*
- 8:20     **Long-Term Durability of GFRP Bars and Bends**  
*S. A. Sheikh, E. Saqan, and K. Johal*
- 8:40     **Thermal-Stress Analysis of Reinforced Concrete Slabs Subjected to Hydrocarbon Fire**  
*R. A. Hawileh and V. K. Kodur*
- 9:00     **Corrosion Behavior of FRP Hybrid Bar in RC Structures Exposed to Sea Water**  
*K.-T. Park, D.-W. Seo, Y.-J. You, and J.-S. Park*
- 9:20     **Durability of Flax FRPs Exposed to Accelerated Environmental Conditions**  
*P. Sadeghian, D. Hristozov, and L. Wroblewski*
- 9:40     **Kolding Bridge in its 20th anniversary - proving the durability of composite structures**  
*D. Topuzi*

Thursday July 20, 2017

Session 6

10:20 - 12:20

Sherbrooke B

*Session Chairs: Thiru Aravintham and Ghani Razaqpur*

- 10:20 **Improvement in Epoxy-Cement Paste Adhesive Bond Durability Through Silane Surface Functionalization**  
*J. Tatar, C. Torrence, J. J. Mecholsky, C. R. Taylor, and H. R. Hamilton*
- 10:40 **Durability Study of Solid And Hollow Glass FRP Reinforcing Bars Exposed to Marine Environment and Elevated Temperature**  
*A. H. Ali, P. Cousin, H. M. Mohamed, A., ElSafty, and B. Benmokrane*
- 11:00 **Strengthening of Reinforced Concrete Beams in Flexure with Side Bonded CFRP Laminates**  
*R. Hawileh, A. Salameh, and J. Abdalla*
- 11:20 **Bond Performance of SRP-to-Concrete Subjected to Environmental Cycling and Sustained Loading**  
*W. Wang and J. J. Myers*
- 11:40 **Fibre Reinforced Polymers with Bioresins for Wind Turbine Towers - Material Investigation**  
*A. Watfa, M. F. Green, and A. Fam*
- 12:00 **Bond Testing of FRP Bars in Concrete Subjected to Reversed Cyclic Loading**  
*N. Mohamed, A. S. Farghaly, and B. Benmokrane*

Thursday July 20, 2017

Session 7

13:20 - 15:20

Sherbrooke B

*Session Chairs: Kent Harries and Marc Quiertant*

- 13:20 **More than 15 Years Successful Field Applications of FRP Bars in Canada**  
*G. Latour and B. Drouin*
- 13:40 **Long Term Testing of Sandwich Wall Panel GFRP Connectors under Constant Axial Load in Alkaline Solution**  
*V. Seshappa*
- 14:00 **Fatigue Performance of RC Beams Strengthened in Shear with EB-FRP: Comparison of Different Systems**  
*G. El-Saikaly, O. Chaallal, and B. Benmokrane*
- 14:20 **Durability of GFRP Reinforcement in the SEACON Project**  
*S. Khatibmasjedi and A. Nanni*
- 14:40 **Effect of Salt Solution Aging on Flax Fibre-Reinforced Polymer**  
*K. Mak and A. Fam*
- 15:00 **Durability & Long-Term Design Tensile Properties of Tokyo Rope CFCC under Stress and Alkaline Environment**  
*B. Benmokrane, A. Ali, H. Mohamed, and A. ElSafty*

**Thursday July 20, 2017    Session 8**

**Visit of the FRP Materials/Concrete and  
Structural Engineering Laboratory,  
Department of Civil Engineering,  
University of Sherbrooke**

**15:40 - 18:00**

**Shuttle buses will leave the Delta Hotel after the sessions at approx. 15:40 pm.**

This opportunity is offered to all CDCC participants to visit world-class research facilities for FRP/concrete materials characterization (particularly durability assessment) and full-scale structure testing equipped with cutting edge research equipment allowing graduate students and postdoctoral fellows to conduct unique studies using these facilities. **DO NOT MISS THIS TECHNICAL VISIT.**

**Friday July 21, 2017**

**Session 9**

**8:00 - 10:20**

**Sherbrooke B**

**Session Chairs: Jovan Tatar and Ehab El-Salakawy**

- |       |   |
|-------|---|
| 8:00  | <b>The Effect of Using Zirconia on The Wettability and The Moisture Absorption of Flax Fibers</b><br><i>L. Boulos, M. R. Foruzanmehr, A. Tagnit-Hamou, S. Elkoun, and M. Robert</i> |
| 8:20  | <b>Bio-Based Resin for Sustainable FRP Wetlayup Systems</b><br><i>A. McIsaac, L. Tauskela, and A. Fam</i>   |
| 8:40  | <b>Effect of Sample Preparation on Direct Tension Pull-off Tests of Materials Bonded to Concrete</b><br><i>K. A. Harries and M. E. Sweriduk</i>                                     |
| 9:00  | <b>Alkaline Resistance of Pultruded GFRP Profile in Outdoor and Immersion Tests</b><br><i>H. Sakuraba and I. Nishizaki</i>  |
| 9:20  | <b>Durability Study of Basalt-FRP Bars in Concrete Environment</b><br><i>M. Hassan, A. Fam, and B. Benmokrane</i>   |
| 9:40  | <b>Influence of Steel Fibers on The Seismic Behavior of GFRP-RC Rectangular Columns with Inadequate Lap-Splice</b><br><i>S. Naqvi, K. Mahmoud, and E. El-Salakawy</i>               |
| 10:00 | <b>Freeze-Thaw Cycling Effect on The Environmental Reduction Factor of CFFT Columns</b><br><i>H. El-Zefzafy, H. M. Mohamed, and R. Masmoudi</i>                                     |

**Session Chairs: P. Vijay and Murat Saatcioglu**

- 
- 10:40     **Determination of The Flexural and Shear Moduli of GFRP Composite Laminates Subjected to Elevated Temperatures**  
*G. Maranan, A. Manalo, and B. Benmokrane*
- 
- 11:00     **Durability of Bond Between BFRP Rebars and Concrete**  
*S. Sólyom, A. Szijártó, G. L. Balázs*
- 
- 11:20     **An Externally Bonded CFRP system for preventing fatigue damage of steel structures: developments in the framework the European FASSTbridge project**  
*K. Benzarti and S. Chataigner*
- 
- 11:40     **Seismic Behaviour of Interior and Exterior GFRP-RC Beam-Column Joints**  
*S. K. Ghomi and E. El-Salakawy*
- 
- 12:00     **Effect of Axial Load Ratio in The Seismic Behavior of GFRP-Reinforce Shear Wall**  
*A. Hassanein, N. Mohamed, A. S. Farghaly, M. Saatcioglu, and B. Benmokrane*
- 
- 12:20     **Bond Performance Evaluation of FRP Hybrid Bar for Marine Concrete**  
*J.-S. Park, K.-T. Park and Y.-J. You and D.-W. Seo*
- 
- 12:40     **Alternative Anchorage for CFRP Ground Anchors**  
*N. Elias, P. Rajeev R. Kalfat, and R. Al-Mahaidi*
- 
- 13:00     **Evaluation of Aged and Damaged Concrete Members Strengthened with CFRP and HFRP Systems**  
*P. V. Vijay and K. T. Gadde*
-

Friday July 21, 2017

Session 11

10:40 - 13:25

Sherbrooke A

**Session Chairs: Tim Bradberry and Riadh Al-Mahaidi**

- 10:40     **Durability of Carbon Fiber Reinforced Polymer Strands for Pre-Stressing of Concrete Members**  
*O. Khalafalla1, M. Pour-Ghaz, A. ElSafty, and S. Rizkalla*
- 11:00     **Development of physical and mechanical properties of a cold-curing structural adhesive in a dry bridge environment**  
*M. Savvilotidou, A. P. Vassilopoulos, M. Frigione, and T. Keller*
- 11:20     **Assessment of design life of FRP pultruded sections for civil infrastructure**  
*T. Aravinthan and G. Kahandawa*
- 11:40     **Optimization of Steel-to-GFRP Ratio of FRP Hybrid Bar Used as a Flexural Member**  
*D.-W. Seo, K.-T. Park and Y.-J. You, and Jun-Seok Park*
- 12:00     **Characterization and durability study of GFRP bars exposed to severe environments and under sustained loads**  
*Fergani, M. Di Benedetti, M. Guadagnini, C. Lynsdale, and C. Mias*
- 12:20     **Strength of GFRP-Reinforced Precast Concrete Deck Panels with Closure Strips Filled with Ultra-High Performance Fiber-Reinforced Concrete**  
*M. Sherif and K. Sennah*
- 12:40     **Tensile and Pull-Off Characterization for TRM Rehabilitation Systems**  
*U.A. Ebead, A. Younis, A. El Refai, and A. Nanni*

Friday July 21, 2017

Closing Session

13:20

Sherbrooke B

13:25     **Conference Closing Session**

13:30     **Lunch**

# CDCC 2017 — Registration

## Online Registration

To register online, please visit: <http://fourwav.es/cdcc2017>

## Registration Form

Last name: ..... First name: .....  
Employer or organization: .....  
Mailing address: .....  
City: ..... Province or State: .....  
Postal or Zip Code: ..... Country: .....  
Phone: ..... Fax: .....  
E-mail: ..... Speaker: Yes  No

## Registration fees for authors and delegates (in CDN \$):

Before May 1 <sup>st</sup> , 2017	775\$	.....
After May 1 <sup>st</sup> , 2017	875\$	.....
Students	275\$	.....
One Day Registration	500\$	.....
Ordre des Ingénieurs du Québec (OIQ) members	300\$	.....
Additional Proceedings	100\$	.....
Extra banquet ticket	100\$	.....

**Add 100\$** for Registration with  
**IIFC Membership** .....

**Total payment** .....

## Payment mode:

Cheque

Credit card: Visa  Master Card

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Registration fees for authors and delegates include welcome cocktail, banquet, all luncheons, all coffee breaks and the conference proceedings.

## REFUND:

A cancellation charge of \$150 will be deducted if notified before **June 1<sup>st</sup>, 2017**. After June 1<sup>st</sup>, 2017 no refund will be given.

**Credit card** payments, please email this form to:

[CDCC-2017@USherbrooke.ca](mailto:CDCC-2017@USherbrooke.ca)

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**Cheque** payments, please make your cheque payable to **Université de Sherbrooke - CDCC 2017** and mail this form to:

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