

4th International Conference on Advanced Composite Materials in Bridges and Structures

Final Program



Calgary, Alberta, CANADA
July 20-23, 2004



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A Word of Welcome

On behalf of the Organizing Committee and the Canadian Society for Civil Engineering, it is our great pleasure to welcome you and your companion(s) to Calgary and to the Fourth International Conference on Advanced Composite Materials in Bridges and Structures.

The technical program of the conference will include keynote lectures delivered by international authorities in the field who will review the state-of-the-art and will highlight new directions for research and applications. The contributed presentations will report original and high quality research and innovative applications. We wish to thank the Keynote Speakers for sharing their knowledge and expertise and to congratulate the authors for their excellent contributions. We are also thankful to the Session Chairs for the running of the anticipated interesting sessions.

Some of you have probably had a chance to explore Calgary and its vicinities. Calgary is a vibrant multi-cultural city located in the foothills of the magnificent Rocky Mountains. It is a prime destination for experiencing the sophistication of a dynamic urban center and the thrill of a backcountry adventure. Outstanding attractions include the Heritage Park, the Glenbow Museum, and the Olympic venues such as Canada Olympic Park, the Saddle Dome and the Speed Skating Oval. Banff, Lake Louise and the scenic Rocky Mountains are spectacular resorts to enjoy should you remain in the Calgary area after the conference.

We hope that your stay in Calgary will be pleasant and memorable and that you will find the conference intellectually stimulating. We hope that you will have the occasion to renew old friendships and make new ones.

Welcome once again and best wishes for an enjoyable stay.

Mamdouh El-Badry
Chair, ACMBBS-IV

Amin Ghali
Honourary Chair, ACMBBS-IV

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Program-AT-A-Glance

Tuesday, July 20

17:00 – 20:30 Registration
18:30 – 20:30 Welcoming Reception

Wednesday, July 21

07:30 – 17:00 Registration
08:10 – 08:40 Opening Ceremony
08:40 – 10:00 Plenary Session I
10:00 – 10:20 Refreshment Break
10:20 – 12:00 Parallel Sessions I-1
12:00 – 13:30 Lunch
13:30 – 15:10 Parallel Sessions I-2
15:10 – 15:30 Refreshment Break
15:30 – 17:30 Parallel Sessions I-3
18:30 Buses depart to Heritage Park

Thursday, July 22

07:30 – 17:00 Registration
08:20 – 09:40 Plenary Session II
09:40 – 10:00 Refreshment Break
10:00 – 12:00 Parallel Sessions II-1
12:00 – 13:30 Lunch
13:30 – 15:10 Parallel Sessions II-2
15:10 – 15:30 Refreshment Break
15:30 – 17:30 Parallel Sessions II-3
18:30 – 19:30 Cocktails (Cash Bar)
19:30 – 22:30 Conference Banquet
Guest Speaker: Professor Francis Hartman
Topic: Composite Designers and Others Who Help Bridge Gaps

Friday, July 23

07:30 – 14:00 Registration
08:20 – 09:40 Plenary Session III
09:40 – 10:00 Refreshment Break
10:00 – 12:00 Parallel Sessions III-1
12:00 – 13:30 Lunch
13:30 – 15:10 Parallel Sessions III-2
15:10 – 15:30 Refreshment Break
15:30 – 17:30 Parallel Sessions III-3
17:30 End of Conference

Technical Program

Wednesday, July 21, 2004

Plenary Session I 08:40 – 10:00		Parallel Sessions I-1 10:20 – 12:00			Parallel Sessions I-2 13:30 – 15:10			Parallel Sessions I-3 15:30 – 17:30		
Britannia / Belaire		Session I-1A Bonavista	Session I-1B Mayfair	Session I-1C Lakeview	Session I-2A Bonavista	Session I-2B Mayfair	Session I-2C Lakeview	Session I-3A Bonavista	Session I-3B Mayfair	Session I-3C Lakeview
Keynote I	Keynote II	Materials and Products	Applications in Structural Concrete	Strengthening, Repair and Rehabilitation	Bond, Anchorage & Connections	Applications in Structural Concrete	Analysis and Design	Fire Resistance / Thermal Effects	Durability and Long-Term Performance	Analysis and Design

Thursday, July 22, 2004

Plenary Session II 08:20 – 09:40		Parallel Sessions II-1 10:00 – 12:00			Parallel Sessions II-2 13:30 – 15:10			Parallel Sessions II-3 15:30 – 17:30		
Britannia / Belaire		Session II-1A Bonavista	Session II-1B Lakeview	Session II-1C Mayfair	Session II-2A Bonavista	Session II-2B Lakeview	Session II-2C Mayfair	Session II-3A Bonavista	Session II-3B Lakeview	Session II-3C Mayfair
Keynote III	Keynote IV	Seismic Performance & Retrofit	Innovative Structural Systems	Strengthening, Repair and Rehabilitation	Bond, Anchorage & Connections	Fatigue	Confinement and Ductility	Full-Scale Testing / Structural Health Monitoring	Field Applications & Case Studies	Strengthening, Repair and Rehabilitation

Friday, July 23, 2004

Plenary Session III 08:20 – 09:40		Parallel Sessions III-1 10:00 – 12:00			Parallel Sessions III-2 13:30 – 15:10			Parallel Sessions III-3 15:30 – 17:30		
Britannia / Belaire		Session III-1A Lakeview	Session III-1B Bonavista	Session III-1C Mayfair	Session III-2A Mayfair	Session III-2B Bonavista	Session III-2C Lakeview	Session III-3A Bonavista	Session III-3B Lakeview	Session III-3C Mayfair
Keynote V	Keynote VI	Structural Shapes & Fully Composite Systems	Applications in Masonry Structures	Strengthening, Repair and Rehabilitation	Design Guidelines / Life-Cycle Cost	Stay-in-Place Formwork / Confinement	Applications in Steel Structures	Applications in Structural Concrete	Field Applications & Case Studies	Strengthening, Repair and Rehabilitation

[Note:](#) For session locations see Hotel Floor Plan on Page 21

Technical Program Wednesday, July 21, 2004

08:10 – 8:40 Opening Ceremony Britannia / Belaire

08:40 – 10:00 Plenary Session I Britannia / Belaire
Chair: Mamdouh El-Badry

08:40 Second-Generation Steel-Free Bridge Decks
Professor Aftab Mufti, ISIS Canada

09:20 Development of New GFRP with High Alkali Resistivity
Professor Taketo Uomoto, University of Tokyo, Japan

10:00 – 10:20 Refreshment Break

10:20 – 12:00 Parallel Sessions I-1

Session I-1A Materials and Products Bonavista Room
Chair: Venkatesh Kodur, Institute for Research in Construction, NRC

10:20 Sustainable Biocomposite Beams and Plates from Natural Fibers and Unsaturated Polyester Resin
Burgueño, R., Quagliata, M.J., Mohanty, A.K., Mirsa, M., Mehta, G. (USA)

10:40 Development of New Heat-Resisting FRP Bars
Mutsuyoshi, H., Zin, T., Sumida, A. (Japan)

11:00 Mechanical and Chemical Characteristics of High Strength Concrete with Fiber Exposed to High Temperature
Takano, T., Horiguchi, T., Saeki, N. (Japan)

11:20 Basalt FRP: A New FRP Material for Infrastructure Market?
Patnaik, A.K., Puli, R.K., Mylavarapu, R.K. (USA)

11:40 Continuous Basalt Fiber Composite Materials and Bridge Members
Sukhanov, A.V., Dalinkevich, A.A., Sisauri, V.I., Aseev A.V. (Russia)

Technical Program Wednesday, July 21, 2004

Session I-1B Applications in Structural Concrete Mayfair Room
Chair: Ivan Campbell, Queen's University

10:20 FRP Element for Thermal Insulation and Load Transfer in Concrete Structures
Zhou, A., Riebel, F., Keller, T. (Switzerland)

10:40 Mechanical Behavior of High Performance Reinforced Fibers Concrete Beams with Mixed Steel and CFRP Reinforcement
Si-Larbi, A., Ferrier, E., Hamelin, P. (France)

11:00 Experimental Tests of High-Strength Concrete Beams Reinforced with CFRP Bars
Gross, S.P., Dinehart, D.W., Yost, J.R., Theisz, P.M. (USA)

11:20 Evaluation of Crack Width and Bond Strength in GFRP Reinforced Beams Subjected to Sustained Loads
Bakis, C.E., Boothby, T.E. (USA)

11:40 Shear Resistance of FRP Reinforced Concrete Members
Razaqpur, A.G., Isgor, O.B. (Canada)

Session I-1C Strengthening, Repair and Rehabilitation Lakeview Room
Chair: Makoto Kawakami, Akita University, Japan

10:20 Materials Variability and Reliability of FRP Rehabilitation of Concrete
Atadero, R.A., Lee, L.S., Karbhari, V.M. (USA)

10:40 Flexural Behavior of Initially Loaded RC Beams with CFRP Sheets
Takahashi, Y., Sato, Y. (Japan)

11:00 Limitations of Flexural Strengthening of RC Beams by Bonded CFRP Strips
Kotynia, R. (Poland)

11:20 Influence of Concrete Tensile Softening on the Performance of FRP Strengthened RC Beams: Experiments
Arduini, M., Romagnolo, M., Camomilla, G., Nanni, A. (Italy)

11:40 Influence of Concrete Tensile Softening on the Performance of FRP Strengthened RC Beams: Design Considerations
Arduini, M., Romagnolo, M., Camomilla, G., Nanni, A. (Italy)

12:00 – 13:30

Lunch

13:30 – 15:10 Parallel Sessions I-2

Session I-2A Bond, Anchorage and Connections Bonavista Room

Chair: Kent Harries, University of Pittsburgh

- 13:30 Investigation on Bond between GFRP Bars and Concrete under Sustained Loads in Aggressive Environments
Shahidi, F., Sparling, B.F., Wegner, L.D. (Canada)
- 13:50 Bond between FRP and Concrete Elements Exposed to Dynamic Loads while the Adhesive is Curing
Recuero, A., Gutiérrez, J.P., López, C., Arteaga, A., de Diego, A., Perera, R. (Spain)
- 14:10 Performance of Adhesively Bonded FRP Deck and Steel Bridge Girders
Keller, T., Gürtler, H., Zhou, A. (Switzerland)
- 14:30 A Test Method to Determine The Shear Capacity of Adhesively Bonded Restraints
Wolodko, J.D., Fawley, N.C., Cano, G. (Canada)
- 14:50 New Continuity Connection Using Fiber Reinforced Composites
Saadeghvaziri, M.A., Yin, L., Spillers, W.R. (USA)

Session I-2B Applications in Structural Concrete Mayfair Room

Chair: Luc Taerwe, University of Ghent, Belgium

- 13:30 Two-Way Concrete Slabs Reinforced with GFRP Bars
Hussein, A., Rashid, M.I., Benmokrane, B. (Canada)
- 13:50 Behaviour of FRP-Reinforced Concrete Bridge Decks under Concentrated Loads
El-Gamal, S.E., El-Salakawy, E.F., Benmokrane, B. (Canada)
- 14:10 Punching Shear Strength of GFRP Reinforced Deck Slabs in Slab-Girder Bridges
Hassan, T.K., Rizkalla, S.H., Rochelle, R. (USA)
- 14:30 Punching Shear Strength of Concrete Flat Plates Reinforced with CFRP Grids
Zaghloul, A.E.R., Razaqpur, A.G. (Canada)
- 14:50 Refined Prediction of Punching Shear Strength of Slab-Column Connections: Applications to Slabs Reinforced with Steel or FRP
Zaghloul, A.E.R., Razaqpur, A.G., Zaghloul, E.R. (Canada)

Session I-2C Analysis and Design Lakeview Room

Chair: Mostafa Hassanain, Earth Tech Canada Inc.

- 13:30 Stepped Isothermal Method to Predict the Stress-Rupture Behaviour of Aramid Fibres
Alwis, K.G.N.C., Burgoyne, C.J. (UK)
- 13:50 Modeling RC Beams Strengthened with Steel or FRP Plates
Wang, W.Q., Davalos, J.F. (USA)
- 14:10 Analysis of the Flexural Response of FRP-Strengthened Concrete beams
Abdel Baky, H.M., Ebead, U.A., Masmoudi, R., Neale, K.W. (Canada)
- 14:30 3D Finite Element Analysis of FRP-Wrapped Reinforced Concrete Cylinders
Zhang, X., Green, M.F., Hope, B.B. (Canada)
- 14:50 Shear Peeling Mechanism of FRP Plated RC Beams
Ali Sahib, M.S., Sharma, S.K., Sikdar, P.K. (India)

15:10 – 15:30 Refreshment Break

15:30 – 17:30 Parallel Sessions I-3

Session I-3A Fire Resistance / Thermal effects Bonavista Room

Chair: Walter Dilger, University of Calgary

- 15:30 The Performance of FRP-Strengthened Concrete Slabs in Fire
Williams, B.K., Kodur, V.K.R., Bisby, L.A., Green, M.F. (Canada)
- 15:50 Performance in Fire of FRP-Confined Reinforced Concrete Columns
Bisby, L.A., Kodur, V.K.R., Green, M.F. (Canada)
- 16:10 Simulation of Response of Composite Structures Under Fire Exposure
Halverson, H., Bausano, J., Case, S.W., Lesko, J. (USA)
- 16:30 Thermal Measurements of the FRP Composite Bridge Decks
Dutta, P.K. (USA)
- 16:50 Fire Resistance and Fire Protection Calculations for Polymer Composite Structural Bridge Elements
Strakhov, V.L., Kaledin, V.O., Kaledin, V.O., Sukhanov, A.V. (Russia)

Session I-3B Durability and Long-Term Performance Mayfair Room

Chair: *Vistasp Karbhari, University of California, San Diego*

- 15:30 Durability of GFRP-Concrete Interface Subjected to Alternate Wetting and Drying
Davalos, J.F., Kodkani, S.S., Ray, I. (USA)
- 15:50 Moisture Measurements in Concrete for Life Assessment of FRP Reinforcing bars
Theophanous, T., Lesko, J.J., Case, S.W., Wollmann, C.R. (USA)
- 16:10 Long Term Durability of Carbon FRP Composites Applied to RC Bridges: State Street Bridge on Interstate 80
Reay, J.T., Pantelides, C.P., Reaveley, L.D., Ring, T.A. (USA)
- 16:30 Creep Behavior of Composite Sheet Piles
Shao, Y., Shanmugam, J., Bdeir, Z. (Canada)
- 16:50 Effect of Creep and Environment on Long-Term Tensile Properties of Glass FRP Reinforcing Bars
Nkurunziza, G., Benmokrane, B., Debaiky, A.S., Masmoudi, R. (Canada)
- 17:10 Short- and Long Term Loading Behavior of RC Frames Strengthened with FRP
Okba, S.H., Abdelrahman, A.A., Abdellatif, H., Elkarmouty, H. (Egypt)

Session I-3C Analysis and Design Lakeview Room

Chair: *Ken McWhinnie, CH2M Hill Canada Ltd.*

- 15:30 Modeling of the Compressive Behavior of FRP-Confined Short Concrete Column: Application of Serviceability Behavior
Berthet, J-F., Ferrier, E., Hamelin, P., Al Chami, G., Thériault, M. (France)
- 15:50 Global-Local FEA Analysis of FRP Sandwich Deck
Wu, H.C., Fu, G., Yan, A., Warnemuende, K., Gibson, R.F. (USA)
- 16:10 Calculation of Deflection Using FRP Design Codes
Mota, C.P., Svecova, D. (Canada)
- 16:30 Optimum Design of FRP-Reinforced Concrete Flexural Members
Hassanain, M.A. (Canada)
- 16:50 A Computational Procedure for the Design of FRP-Strengthened Masonry Subjected to In-Plane Loading
Krevaikas, T., Triantafillou, T. (Greece)
- 17:10 Determination of Elastic Constants by Dynamic Analysis Using Higher Order Theory
Kai, J.P., Viola, E. (Italy)

08:20 – 09:40 Plenary Session II Britannia / Belaire

Chair: *Sami Rizkalla, North Carolina State University*

- 08:20 Use of Fiber Reinforced Polymers in Seismic Design and Blast Mitigation
Professor Frieder Seible, Dean, Jacobs School of Engineering, University of California, San Diego, USA
- 09:00 Conceptual Design of Hybrid-FRP and All-FRP Structures
Professor Thomas Keller, Swiss Federal Institute of Technology-Lausanne, Switzerland

09:40 – 10:00 Refreshment Break

10:00 – 12:00 Parallel Sessions II-1

Session II-1A Seismic Performance and Retrofit Bonavista Room

Chair: *TBA*

- 10:00 Seismic Retrofit of Circular and Square Bridge Columns with CFRP Jackets
Elnabesly, G., Saatcioglu, M. (Canada)
- 10:20 Seismic Performance of High-Strength Concrete Square Columns in Stay-in-Place FRP Formwork
Ozbakkaloglu, T., Saatcioglu, M. (Canada)
- 10:40 The Seismic Strengthening Effect of FRP Wrapping on the Circular Bridge Piers with Lap-splice
Kwon, T.G., Hwang, Y.K., Yoon, S.J., Choi, Y.M. (Korea)
- 11:00 Flexural Behaviour of FRP Reinforced Concrete Beams under Reversed Cyclic Loading
Sharbatdar, M.K., Saatcioglu, M. (Canada)
- 11:20 Seismic Upgrading of Gravity Load Designed Buildings Using Advanced Composite Materials
Abou Zeid, B.M., Mourad, S.A., El-Attar, A.G. (Egypt)
- 11:40 Reinforcement and Seismic Protection of Ancient Masonry Buildings with FRP Materials
Borri, A., Grazini, A., Trimoli, A. (Italy)

Session II-1B Innovative Structural Systems Lakeview Room

Chair: A. Ghani Razaqpur, Carleton University

- 10:00 Behavior of FRP Sandwich Panels for Transportation Infrastructure
Reis, E.M., Hassan, T.K., Rizkalla, S.H., Dickinson, L. (USA)
- 10:20 Hybrid FRP-Concrete Bridge Deck and Superstructure
Kitane, Y., Aref, A.J. (USA)
- 10:40 Membrane-Based Structural Forms for FRP Bridge Systems
Burgueño, R., Wu, J. (USA)
- 11:00 Development of Facesheet for Honeycomb FRP Sandwich Bridge Deck Panels
Chen, A., Davalos, J.F. (USA)
- 11:20 Development of FRP Composite Modular System for Slab-On-Girder Bridges
Cheng, L., Karbhari, V.M. (USA)
- 11:40 An Innovative Corrosion-Free Bridge System
Abe, H., Schonknecht, K., El-Badry, M.M., and Yoshioka, T. (Canada)

Session II-1C Strengthening, Repair and Rehabilitation Mayfair Room

Chair: J.J. Roger Cheng, University of Alberta

- 10:00 Strengthening and Rehabilitation of Structures Utilizing a PBO System
Danver, D., Smart, R. (USA)
- 10:20 Delamination in Reinforced Concrete Beams Retrofitted with CFRP Fabrics
Pham, H., Al-Mahaidi, R. (Australia)
- 10:40 CFRP-Strain Monitoring in Corroded Beams Repaired with Advanced Composite Laminates
El Maaddawy, T.A., Soudki, K.A. (Canada)
- 11:00 Jacketing Prestressed Concrete Beams with Glass FRP
Demers, M., Labossière, P., Bérubé, D., Mercier, C. (Canada)
- 11:20 Behavior of Reinforced Concrete Continuous Beams Repaired and/or Strengthened under Load Condition
Etman, E.E. (Egypt)
- 11:40 Experimental Investigation of Taper-Ended FRP Strips in FRP-Strengthened RC Beams
Gao, B., Kim, J.K., Leung, C.K.Y. (China)

12:00 – 13:30

Lunch

13:30 – 15:10 Parallel Sessions II-2

Session II-2A Bond, Anchorage and Connections Bonavista Room

Chair: Brahim Benmokrane, University of Sherbrooke

- 13:30 Applicability of Steel Anchor Plates for Prestressing Multilayered CFRP Sheets
Kim, Y.J., Bizindavyi, L., Green, M.F. (Canada)
- 13:50 Concept of System Ductility and Redundancy for FRP Beam Systems with Adhesive Joints
Keller, T., de Castro, J., Zhou, A. (Switzerland)
- 14:10 Behaviour of Adhesively Bonded Joints from Pultruded GFRP Laminates under Quasi-Static Loadings
Zhou, A., Vallée, T., Keller, T. (Switzerland)
- 14:30 Development of GFRP Bridge Deck – Transverse Connection
Shehata, E., Haldane-Wilsone, R., Dawood, M. Mufti, A. (Canada)
- 14:50 Deck-to-Girder Connections for GFRP Bridge Decks
Park, K.T., Hwang, Y.K., Kim, H.Y., Lee, Y.H., Kim, S.M. (Korea)

Session II-2B Fatigue Lakeview Room

Chair: Tamio Yoshioka, Oriental Construction Co. Ltd., Japan

- 13:30 Effect of FRP Sheets on Fatigue Bond Strength
Rteil, A.A., Soudki, K.A., Topper, T.H. (Canada)
- 13:50 Effect of High-level Fatigue Loading on RC-Beams Externally Reinforced with CFRPs
Gheorghiu, C., Labossière, P., Proulx, J. (Canada)
- 14:10 Comparison of Three CFRP Flexural Systems under Monotonic and Fatigue Loads
Quattlebaum, J.B., Harries, K.A., Petrou, M.F. (USA)
- 14:30 Behaviour of Reinforced Concrete Bridge Girders Retrofit with CFRP and Subjected to Monotonic and Fatigue Loading
Aidoo, J., Harries, K.A., Petrou, M.F. (USA)
- 14:50 Fatigue Behaviour of Concrete Bridge Deck slab Reinforced with CFRP and Steel Strap
Memon, A.H., Mufti, A.A. (Canada)

Session II-2C Confinement and Ductility

Mayfair Room

Chair: Murat Saatcioglu, University of Ottawa

- | | |
|-------|---|
| 13:30 | Experimental Investigation of Flexural Ductility of CFRP Strengthened Concrete Members
Kim, S.-H., Aboutaha, R.S. (USA) |
| 13:50 | Compressive Strength of Concrete Cylinders with Variable Widths CFRP Wraps
Issa, C.A., Karam, G.N. (Lebanon) |
| 14:10 | Strength and Ductility of FRP Wrapped Columns under Eccentric Loads
Hadi, M.N.S. (Australia) |
| 14:30 | Verification of Models for Concrete Columns Confined with FRP
Toutanji, H., Matthys, S., Taerwe, L. (Belgium) |
| 14:50 | Experimental Validation of Confinement Models and Design Guidelines for Columns Wrapped with FRP Composites
Hassan, M., Bousselham, A., Chaallal, O., Nollet, M.-J. (Canada) |

15:10 – 15:30

Refreshment Break

15:30 – 17:30 Parallel Sessions II-3

Session II-3A Full-Scale Testing / Structural Health Monitoring

Bonavista Room

Chair: Aftab Mufti, ISIS Canada

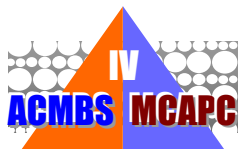
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|-------|--|
| 15:30 | Indoor Cable-Stayed GFRP Bridge at EMPA, Switzerland
Gsell, D., Motavalli, M. (Switzerland) |
| 15:50 | Modelling and Testing of the World's First Ductal Canopy
Adeeb, S.M., Scholefield, B.W.J., Brown, T.G., Shrive, N.G., Nowodworski, H., Rosiak, K., Perry, V.H., Kroman, J. (Canada) |
| 16:10 | Full-Scale Model Test of Carbon Fiber Reinforced Polymer Ground Anchors
Zhang, B., Benmokrane, B. (Canada) |
| 16:30 | NDT of Bonding Integrity Between Fiber-Reinforced Composite Layer and Structures Using Shearography
Hung, Y.Y., Hung, S.Y. (China) |
| 16:50 | Low-Cost Wireless Embedded MEMS Sensors for Conditioning and Durability Monitoring of FRP Repaired Civil Infrastructure
Saafi, M., Harris, J., Romine, P. (USA) |
| 17:10 | In-Situ Testing of an FRP Bridge Deck
Stiller, W.B., Gergely, J., Rochelle, R. (USA) |

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Session II-3B Field Applications and Case Studies Lakeview Room

Chair: Baidar Bakht, JMB Structures Research

- 15:30 Application of Advanced Composite Materials on Wood, Masonry and Steel Structural Components
Watson, R.J. (USA)
- 15:50 Applications of Advanced Composites to Steel Bridges: A Case Study on the Ashland Bridge (Delaware-USA)
Chacon, A., Chajes, M., Swinehart, M., Richardson, D., Wenczel, G. (USA)
- 16:10 Three Case Studies of Carbon Fibre Composite Strengthening of Metallic Structures on the London Underground
Moy, S.S.J. (UK)
- 16:30 Halgavor Bridge – A Case Study
Cooper, D.I. (UK)
- 16:50 Fibre Reinforced Polymer Bridge Decks in the UK
Sadka, B., Daly, A.F. (UK)
- 17:10 Damaged Bridge Grider Repaired Using Post-tensioned CFRP Sheets
Fallis, G.F., Eden, R., Kim, Y.J., Bizindavyi, L., Green, M.F. (Canada)

Session II-3C Strengthening, Repair and Rehabilitation Mayfair Room

Chair: Amin Ghali, University of Calgary

- 15:30 Prestressed CFRP Sheets for Strengthening Two-Way Slabs in Flexure
Longworth, J., Bizindavyi, L., Wight, R.G., Erki, M.-A. (Canada)
- 15:50 Steel-Free Slabs Strengthened with High Modulus of Elasticity and High Strength CFRP Sheets
Hassan, A., Kawakami, M., Iketani, J., Matsuoka, S. (Japan)
- 16:10 Strength and Ductility of Solid RC Slabs Strengthened by FRP Composites
Tann, D.B., Davies, P. (UK)
- 16:30 Punching Shear Strengthening of Reinforced Concrete Slabs Using CFRP L-Shaped Plates
Biddah, A. (UAE)
- 16:50 Punching Shear Strength of RC Slabs Externally Strengthened by CFRP Laminates
Rochdi, E.H., Bigaud, D., Ferrier, E., Hamelin, P. (France)
- 17:10 Strengthening Slab-Column Connections with Externally Bonded CFRP Strips
Sharaf, M.H., Soudki, K.A. (Canada)

08:20 – 09:40 Plenary Session III Britannia / Belaire

Chair: Ken Neale, University of Sherbrooke

- 08:20 Recent Research on Intermediate Crack-Induced Debonding in FRP-Strengthened RC Beams
Professor Jin-Guang Teng, The Hong Kong Polytechnic University, Hong Kong, China
- 09:00 Does FRP Have an Economic Future?
Professor Chris Burgoyne, University of Cambridge, UK

09:40 – 10:00 Refreshment Break

10:00 – 12:00 Parallel Sessions III-1

Session III-1A Structural Shapes and Fully Composite Systems Lakeview Room

Chair: Thomas Keller, Swiss Federal Institute of Technology-Lausanne

- 10:00 Flexural Strength of FRP Sheet Piling Panels under Simulated Surface Loads
Linzell, D.G., Boothby, T.E. (USA)
- 10:20 Short-Span Deployable GFRP Tapered Box-beam Bridge
Wight, R.G., Shyu, C.T., Tanovic, R., Erki, M.-A., Heffernan, P.J. (Canada)
- 10:40 Optimization and Experimental Behaviour of A GFRP Bridge Deck
Lee, Y.H., Hwang, Y.K., Kim, H.Y., Park, K.T., Kim, S.M. (Korea)
- 11:00 Experimental Study on Outside Filament Winding Reinforced FRP Bridge Decks
Feng, P., Ye, L.P., Zhang, L.W., Li, W.Z. (China)
- 11:20 An Alternative Housing System Using Advanced Composite Materials for the Communities of Northern Canada
Polyzois, D., McLeod, L., Philopulos, D. (Canada)
- 11:40 Torsion of a Pultruded GRP Beam with Bolted End Connections: Test Results and FE Analysis
Turvey, G.J., Zhang, Y. (UK)

Session III-1B Applications in Masonry Structures Bonavista Room

Chair: Nigel Shrive, University of Calgary

- 10:00 A Review of Retrofitting of Unreinforced Masonry Walls Using Composites
ElGawady, M.A., Lestuzzi, P., Badoux, M. (Switzerland)
- 10:20 Experimental and Analytical Evaluation of an FRP Anchorage System for Masonry Walls
Beigay, M.R., Young, D.T., Gergely, J. (USA)
- 10:40 Tests on Eccentrically Loaded Slender Masonry Walls Reinforced Externally with CFRP Sheets
Kuzik, M.D., Elwi, A.E., Cheng, J.J.R. (Canada)
- 11:00 Assessment of the Shear Behaviour of FRP-Strengthened Hollow Brick Masonry Panels
Gabor, A., Ferrier, E., Jacquelin, E., Hamelin, P. (France)
- 11:20 In-Plane Resistance of URM Walls with Openings Strengthened by FRP Composites
Li, T., Galati, N., Nanni, A., Tumialan, T.G. (USA)
- 11:40 Masonry Walls Retrofitted with FRP Reinforcement in Out-of-Plane Bending for Cyclic Loading
Wallace, J., Gergely, J. (USA)

Session III-1C Strengthening, Repair and Rehabilitation Mayfair Room

Chair: Pierre Labossière, University of Sherbrooke

- 10:00 Shear Strengthening of Concrete Structures with Advanced Composite Systems
Basler, M., Clénin, R., Desroches, M. (Switzerland)
- 10:20 Retrofit of Reinforced Concrete T-Beams in Shear with U-Shaped CFRP Wrap
Bousseth, A., Hassan, M., Chaallal, O., Nollet, M.-J. (Canada)
- 10:40 Shear Retrofitting of Reinforced Concrete Beams Using CFRP Straps
Hoult, N.A., Lees, J.M. (UK)
- 11:00 Development of Appropriate Design Limits for Externally Bonded FRP for Shear Strengthening
Schuman, P.M., Karbhari, V.M. (USA)
- 11:20 Shear Strengthening of RC Beams by Continuous Fiber Reinforcing Materials Using Polymer-Cement Pastes and Mortars as Bonding Agents
Pareek, S., Kuroda, K. (Japan)
- 11:40 Upgrading Shear Resistance of Deep RC Beams with Composite Fabrics
Kabir, M.Z., Khoshhal, A.K. (Iran)

12:00 – 13:30

Lunch

13:30 – 15:10 Parallel Sessions III-2

Session III-2A Design Guidelines / Life-Cycle Cost Mayfair Room

Chair: Jadwiga Kroman, The City of Calgary

- 13:30 Comparison between ACI 440 and FIB 14 Design Guidelines in Using CFRP for Strengthening of a Concrete Bridge Headstock
Nezamian, A., Setunge, S. (Australia)
- 13:50 Design Guidelines for the Strengthening of Metallic Structures Using Carbon Fibre Composites
Moy, S.S.J. (UK)
- 14:10 Economic Viability of Structures with FRP Reinforcement and Prestress
Balafas, I., Burgoyne, C.J. (UK)
- 14:30 Development of Life-Cycle Cost Equations for Structural Concrete Repairs
Ibrahim, N., Bonacci, J.F. (Canada)
- 14:50 A Proposed Method for Life Cycle Engineering and Costing
Christensen, P.N., Sparks, G.A., Kostuk, K.J. (Canada)

Session III-2B Stay-in-Place Formwork / Confinement Bonavista Room

Chair: TBA

- 13:30 Alternative RC Sections Using Rectangular Concrete-Filled GFRP Tubes
Mandal, S., Fam, A., Rizkalla, S.H. (Canada)
- 13:50 Axial Loading Tests on FRP Confined Concrete of Different Compressive Strengths
Mandal, S., Fam, A. (Canada)
- 14:10 Shear Stresses in Concrete Filled FRP Cylindrical Shells in Bending
Burgueño, R., Bhide, K.M. (USA)
- 14:30 Confinement Model for Columns with Stay-in-Place FRP Formwork
Sheikh, S.A., Samdani, S., Mardukhi, J., Zhang, B. (Canada)

Session III-2C Applications in Steel Structures Lakeview Room

Chair: Laszlo Dunaszegi, Earth Tech Canada Inc.

- 13:30 CIRIA Report C595 – Strengthening Metallic Structures Using Externally-Bonded FRP
Stratford, T.J., Cadei, J.M.C., Hollaway, L.C. (UK)
- 13:50 Study of the Tensile Strength of CFRP/Steel Double Lap Joints
Lam, C.C.A., Cheng, J.J.R., Yam, C.H.M. (Canada)
- 14:10 Strengthening of Thin-Walled Steel I-Section Beams Using CFRP Strips
Sayed-Ahmed, E.Y. (Qatar)
- 14:30 Strengthening of Short HSS Steel Columns Using FRP Sheets
Shaaf, A., Fam, A. (Canada)
- 14:50 Strengthening of Steel Beams with Carbon FRP Laminates
Patnaik, A.K., Bauer, C.L. (USA)

15:10 – 15:30 Refreshment Break

15:30 – 17:30 Parallel Sessions III-3

Session III-3A Applications in Structural Concrete Bonavista Room

Chair: Charles Bakis, Penn State University

- 15:30 Effect of temperature on Concrete Cover of FRP Prestressed Elements
Vogel, H., Svecova, D. (Canada)
- 15:50 Feasibility of Using Fiber Reinforced Polymers as Reinforcement in Concrete Constructions in Kuwait
Sadek, A.W. (Kuwait)
- 16:10 Innovative Approach in Manufacturing and Application of CFRP Rods with U-Anchor for Concrete Structures
Djamaluddin, R., Hino, S., Yamaguchi, K. (Japan)
- 16:30 New Carbon FRP Stirrups as Shear Reinforcement for Concrete Beams
El-Sayed, A.K., El-Salakawy, E.F., Benmokrane, B. (Canada)
- 16:50 Strength of Partially Bonded Prestressed Concrete Beams Containing FRP Tendons
Campbell, T.I., Gangkatharan, J. (Canada)
- 17:10 Mechanical and Sensing Properties of Concrete Beams Reinforced with FRP Bars
Wang, B., Ou, J., Zhang, X., He, Z., Zhou, Z., Qian, M. (China)

Session III-3B Field Applications and Case Studies Lakeview Room

Chair: Peter Brett, KRM Consulting Ltd.

- 15:30 Field Performance of Concrete Bridge Deck Slabs Reinforced with Glass FRP Bars
El-Salakawy, E., Benmokrane, B., El-Ragaby, A., Lackey, T., Desgagné, G., Goulet, S. (Canada)
- 15:50 The Spanish PUMACON 46 m Long Bridge: A Cost-Competitive FRP Alternative
Mieres, J., Calvo, I., Gutierrez, E., Shahidi, E., Mirabete, A., López, C. (Spain)
- 16:10 GFRP Retrofit Design for Better Seismic Performance of Oak Street Bridge
Ding, Y., Hamersley, B. (Canada)
- 16:30 Fifteen Years of Using Fibre Reinforced Polymers for Seismic Retrofit
Fyfe, E.R., Milligan, P., Witt, S. (USA)
- 16:50 Canada's First Truly Composite Bridges (Glass, Steel, Wood, Epoxy)
Finkelshteyn, I., Salzsauler, R., Lyakhovsky, M., Dewar, C. (Canada)
- 17:10 Design, Fabrication, and Load Testing of an Advanced Composite Materials Superstructure
Ji, H.S., Chun, K. S., Son, B.J., Chang, S.Y. (Korea)

Session III-3C Strengthening, Repair and Rehabilitation Mayfair Room

Chair: TBA

- 15:30 Effective and Fast Rehabilitation of a Concrete Bridge by Bonding CFRP Sheets
Kawakami, M., Hassan, A., Morohashi, K., Toyoda, A. (Japan)
- 15:50 Characterization of Effectiveness of Bridge Deck Rehabilitation
Ghosh, K.K., Lee, L., Karbhari, V.M., Sikorsky, C. (USA)
- 16:10 Pre-Construction Investigation for the Rehabilitation of a Bridge Using Internal FRP Technologies
Galati, N., Boschetto, G., Rizzo, A., Nanni, A. Parretti, R. (USA)
- 16:30 Bridge Strengthening with prestressed CFRP plate systems
Basler, M., Clénin, R., Desroches, M. (Switzerland)
- 16:50 Effectiveness of Near Surface Mounted FRP Reinforcement for Flexural Strengthening of Reinforced Concrete Beams
El-Hacha, R., Filho, J.N., Melo, G.S., Rizkalla, S.H. (USA)
- 17:10 Near Surface Mounted CFRP Reinforcement for the Structural Retrofit of Concrete Flexural Members
Yost, J.R., Gross, S.P., Dinehart, D.W., Mildenberg, J. (USA)

General Information

Registration

The registration and information desk, on the Hotel's Conference level will be open:

Tuesday, July 20th 17:00-20:30
Wednesday, July 21st 07:30-17:00
Thursday, July 22nd 07:30-17:00
Friday, July 23rd 07:30-14:00

Proceedings

The Conference Proceedings include four of the keynote papers plus all other contributed papers. The Proceedings are published on a CD-ROM and a printed volume of abstracts. These will be available to the delegates at registration. The cost of one set of Proceedings CD and printed abstracts is included in the registration fee. Additional Proceedings are available at a cost of \$30 each.

If there is enough interest, the Conference Proceedings, printed in two volumes, will be available after the Conference at a cost of \$150 each set.

Individuals interested in purchasing the Proceedings should complete the Proceedings Order Form included in this booklet (see centre pull-out) and return it to the Registration Desk before the end of the Conference or send it by fax or mail as indicated on the order form.

Exhibit Hours

Wednesday, July 21st 08:30-17:00
Thursday, July 22nd 08:30-17:00
Friday, July 23rd 08:30-14:00

See pages 26-27 for information and booth location of participating Exhibitors.

Language

The official language of the Conference is English. No simultaneous interpretation will be provided.

Dress

Casual wear is suggested for all events of the Conference except the Banquet on Thursday evening, for which business attire and dresses would be appropriate.

Currency

The monetary unit in Canada is the Canadian Dollar, \$. On July 10, 2004, the exchange rate was approximately \$1 US = \$ 1.32 CDN. All visitors are recommended to use Canadian currency when traveling within Canada.

Credit Cards

Most major credit cards are accepted in Canada. However, visitors are advised to check with the vendor before making a purchase. Cash machines with 24 hour access are available in many locations throughout Calgary.

Tipping

Customary gratuity should be calculated at 15 percent.

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The GST on goods purchased in Canada may be reclaimed by non-Canadians upon return to their own country through completion of a form obtained upon departure from Canada.

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Insurance and Liability

ACMBS-IV is not insured to meet any claims arising from any incidents during the Conference. It is the responsibility of delegates and accompanying persons before arriving to be properly and adequately insured for personal injury, sickness, loss of baggage, etc.

Climate

At an altitude of 1,048 meters or 3,396 feet above sea level and because of its proximity to the mountains, Calgary has extremely changeable weather. The average summer (June-August) temperature is 20° Celsius or 68° Fahrenheit, but be prepared for cool days and evenings just in case. If you are planning some outdoor activities, consider packing rain gear and good walking shoes. For current weather conditions visit www.theweathernetwork.com.

Transportation

Downtown Calgary is about a 20-minute ride from Calgary International Airport. You can take the "Airporter Bus", a frequently running shuttle bus costing approximately \$10.00 one way or \$15.00 round trip. A taxi from the Westin Hotel to the Airport will cost approximately \$25.00. Calgary is well served with a public transportation network (buses and City Train, known as LRT). You will not need a car during the Conference, but if you wish to rent a car, a few companies located in downtown include:

Budget: 226-1550 or 1-800-268-8900
Avis: 269-6166 or 1-800-879-2847
Hertz: 221-1676 or 1-800-263-0600
Thrifty: 262-4400 or 1-800-847-4389

About Calgary

For information about the City of Calgary and the Rocky Mountains, please contact Tourism Calgary:

Suite 200, 238 - 11th Avenue S.E.
Calgary, Alberta, T2G 0X8
Tel: (403) 263-8510
Fax: (403) 262-3809
or 1-800-661-1678 (Canada and U.S.)

In addition, the following are web sites for Calgary and Banff with links to information on the Rocky Mountains:

www.discovercalgary.com
www.discoverbanff.com
www.tourismcalgary.com
www.explorealberta.com
www.viewcalgary.com

Social Events

Welcoming Reception

Tuesday, July 20 18:30 – 20:30

A special welcome to Calgary is arranged for Delegates and Accompanying Persons featuring hors d'oeuvres and beverages. Start off the Conference by greeting friends and colleagues and meeting new acquaintances.

Cost: Included in the delegate's fee
\$20.00 Accompanying person/Guest

BBQ/Fun Night – Heritage Park

Wednesday, July 21 Buses depart 18:30

Enjoy authentic Western spirit, a down-home BBQ and entertainment, music and dancing.

Cost: NOT included in fee
\$45.00 per person (includes transportation)

Conference Banquet

Thursday, July 22 18:30 – 22:30

Delegates and accompanying persons are invited to attend celebration of a successful conference with a banquet featuring superb cuisine and a Guest Speaker. Join colleagues and friends for a night to remember with exquisite food and great atmosphere.

Guest Speaker: Francis Hartman, Professor of Project Management, University of Calgary

Topic: Composite Designers and Others Who Help Bridge Gaps

Cost: Included in the delegate's fee
\$55.00 Accompanying person/Guest/Student

Lunches

Wednesday, Thursday, and Friday 12:00 – 13:30

Cost: Included in the delegate/student fee
\$35.00 Accompanying person/Guest (daily)

Accompanying Person's Program

The accompanying person's program events are priced individually. Tours are subject to cancellation unless minimum numbers are achieved.

Welcoming Reception

Tuesday, July 20 18:30 – 20:30

See Social Events.

Cost: \$20.00 per person

The Royal Tyrrell Museum

www.tyrrellmuseum.com

Wednesday, July 21 09:00 – 16:00

Situated within the spectacular badlands of the Red Deer River Valley, The Royal Tyrrell Museum of Paleontology is a major research and exhibition centre housing the complete skeletons of more than 30 dinosaurs. It also contains the remains of flying reptiles, prehistoric mammals and marine invertebrates that hailed from the Bearpaw Sea, a water mass that vanished millions of years ago. Hands-on displays, computer simulations, dynamic exhibits and multi-media shows await you at this UNESCO World Heritage Site.

Cost: \$30.00 per person (includes admission and transportation)
Lunch on own – facilities on site.

BBQ/Fun Night – Heritage Park

Wednesday, July 21 Buses depart 18:30

See Social Events.

Cost: \$45.00 per person (includes transportation)

Banff and the Rocky Mountains

www.BanffLakeLouise.com

Thursday, July 22 09:00 – 17:00

This one day tour to Banff National Park, the largest and most vibrant of Alberta's three mountain national parks is just one hour west of Calgary. Sightseeing stops will provide an excellent opportunity to experience the picturesque Rocky Mountains and enthralling scenery including wildlife.

Time will allow for lunch and touring the various shops and attractions of Banff.

Cost: \$40.00 per person (includes transportation); lunch on own.

Conference Banquet

Thursday, July 22 18:30 – 22:30

See Social Events.

Cost: \$55.00 per person

Exhibitors

C-FER Technologies

Booth #3

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Edmonton, AB T6N 1H2
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Fax: (780) 450-3700
Contact: Susan Zimmerman
Email: cfer@cfertech.com
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C-FER Technologies provides research and development, performs full-scale testing and provides engineering consulting to the energy, transportation, defense and civil infrastructure sectors. C-FER Technologies has expertise in the areas of composite materials and structures, advanced finite element analysis, fatigue, fracture mechanics, materials durability and cold regions engineering

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Email: fletcher@ms.umanitoba.ca
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Lafarge Canada Inc.

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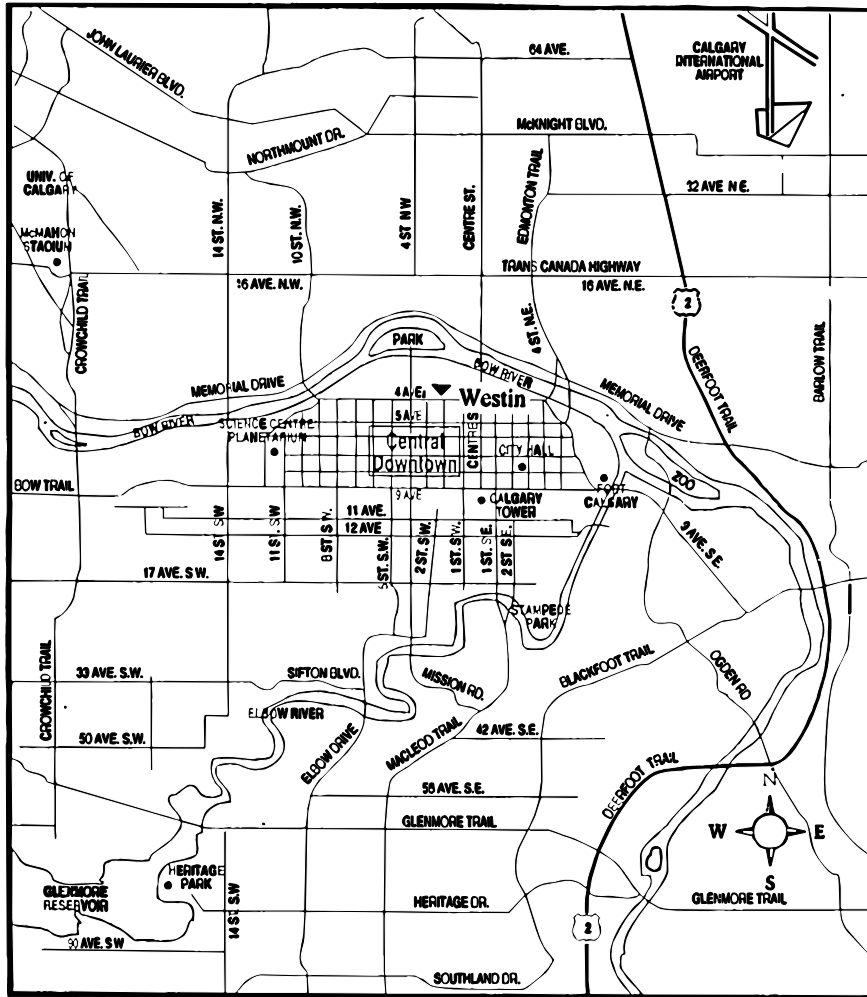
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Booth #6

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Calgary Downtown Map



Also visit <http://www.mapquest.com/maps/map.adp>

