FRP INTERNATIONAL

the official newsletter of the International Institute for FRP in Construction

Vol. 12, No. 3, July 2015

IIFC Past-President Larry Bank elected ASCE Distinguished Member

IIFC immediate past-president Lawrence C. Bank, Ph.D., P.E., Dist.M.ASCE, FIIFC, was elected a member of the 2015 Class of Distinguished Members for his work in significantly advancing the research and application of fibre reinforced plastics in design and construction engineering of civil infrastructure, and for advocating for a broader understanding of sustainability research and public policy changes.

Bank, a preeminent scholar and leader in the field of structural engineering, has served as a leader in the study and implementation of fibre reinforced plastics. He has authored more than 140 technical publications, holds 5 patents/pending patents, and wrote the textbook *Composites for Construction Structural Design with FRP Materials*. Bank was founder and editor-in-chief of the *Journal of Composites for Construction*, the first scholarly journal devoted to the infrastructure composites research field.

Bank is the recipient of ASCE's Richard R. Torrens Award (2001), honouring his work as a volunteer journal editor and outstanding contributions to the ASCE publications program, ASCE's Walter L. Huber Civil Engineering Research Prize (1999), which honours notable achievements in research related to civil engineering, and ASCE's Thomas Fitch Rowland Prize (2002), which recognizes accomplished works of construction or valuable contributions to construction management and construction engineering. Bank was elected a Fellow of IIFC in 2004 and awarded the IIFC Medal in 2012.

Bank earned a bachelor's degree from Israel Institute of Technology, and a Master of Science degree, a Master of Philosophy degree, and a Ph.D. from Columbia University. He is on leave from the City College of New York and currently serves at the National Science Foundation as program director for materials engineering and processing.

Prof. Bank will be inducted as a Distinguished Member Monday, Oct. 12, in New York City at the ASCE Annual Convention, Oct. 10-14, 2015.

[Adapted from ASCE NEWS, May 21, 2015: http://blogs.asce.org/bank-elected-asce-distinguished-member/#sthash.WdunNJ1O.dpuf.]

FRPRCS-12 and APFIS-2015

On behalf of the FRPRCS Steering committee and the International Institute for FRP in Construction (IIFC), it gives us great pleasure to invite you to participate in the Joint Conference of The 12th International Symposium on Fiber Reinforced Polymers for Reinforced Concrete Structures **(FRPRCS-12)** & The 5th Asia-Pacific Conference on Fiber Reinforced Polymers in Structures **(APFIS-2015)** which will take place in Nanjing, China, from December 14-16, 2015. For more information, please contact frprcs-apfis2015@seu.edu.cn or visit the joint conference website at: http://iiuse.seu.edu.cn/frprcs12_apfis2015/

Zhishen Wu, Conference Chair
Gang Wu and Xin Wang, Conference Co-Chairs
International Institute for Urban Systems Engineering/School of Civil Engineering
Southeast University

IIFC Webinars

Emmanuel Ferrier, Université Lyon 1
Chair, IIFC Education Task Group
emmanuel.ferrier@univ-lyon1.fr

The IIFC webinar series, consisting of short – one hour – online seminars on specialized topics as been an excellent opportunity for students and researchers to familiarise themselves with the state-of-the-art in FRP use in construction. While the 2015 series is now complete, the webinars are archived and available and free to the public. Thanks to the 2015 series speakers!

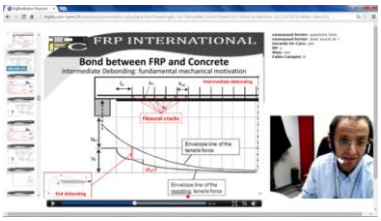
2015 Webinar Series

8 January 2015 - *FRP material for strengthening of structures in the field of construction, mechanical properties and bond*, E. Ferrier, University LYON1, France.

http://bigbb.univ-lyon1.fr/playback/presentation/playback.html?meetingId=5a75fe0cd68c10a3d70da61d31765b53e18e9c4e-1420729042717

14 January 2015 - *RC beam strengthened for flexure*, E. Martinelli, University of Salerno, Italy.

http://bigbb.univ-lyon1.fr/playback/presentation/playback.html?meetingId=5a75fe0cd68c10a3d70da61d31765b53e18e9c4e-1421247425198

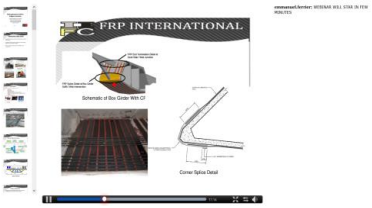


26 February 2015 - *RC beam strengthened for shear*, J. Barros, University of Minho, Portugal.

http://bigbb.univ-lyon1.fr/playback/presentation/playback.html?meetingId=5a75fe0cd68c10a3d70da61d31765b53e18e9c4e-1424954795316

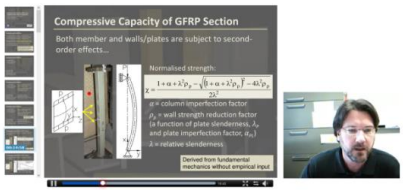
1 April 2015 - *Field applications of FRP in bridges in Australia*, R. Al-Mahaidi, Swinburne University of Technology Australia.

http://bigbb.univ-lyon1.fr/playback/presentation/playback.html?meetingId=5a75fe0cd68c10a3d70da61d31765b53e18e9c4e-1427900280960



10 April 2015 @ 1400 UCT - *Development of Standard Design Equations for Pultruded GFRP Members Subject to Compression*, K. Harries, University of Pittsburgh, USA.

http://bigbb.univ-lyon1.fr/playback/presentation/playback.html?meetingId=5a75fe0cd68c10a3d70da61d31765b53e18e9c4e-1428673996588

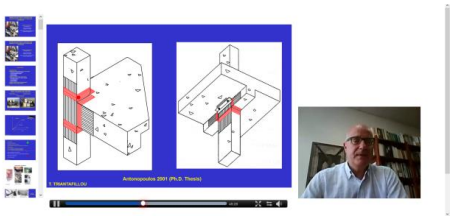


10 June 2015 - *Durability of FRP*, B. Benmokrane, University of Sherbrooke, Canada.

http://bigbb.univ-lyon1.fr/playback/presentation/playback.html?meetingId=5a75fe0cd68c10a3d70da61d31765b53e18e9c4e-1433947866938

11 June 2015 - *Seismic behavior of structures strengthened by FRP*, T. Triantafillou, University of Patras, Greece.

http://bigbb.univ-lyon1.fr/playback/presentation/playback.html?meetingId=5a75fe0cd68c10a3d70da61d31765b53e18e9c4e-1434034205609



Rocks Village Bridge

Andy Loff, Composite Advantage
aloff@compositeadvantage.com

Historic and notable bridges in the U.S. currently number 54,957. Preservation activity - the cyclical work that keeps these special structures in good repair – is as crucial as regular oil changes are to vehicle longevity and performance. Rehabilitation on the other hand can sometimes present a conundrum. When these protected causeways need an overhaul, area DOTs and local organizations are often scrambling to find solutions that can strike a delicate balance between retaining historic character and making the necessary modifications or additions needed for continued use.

Rock Village Bridge 18 months after deck replacement.

The Massachusetts DOT found its answer in Fibre Reinforced Polymer composite material when aging timber put the state's Rocks Village Bridge at risk in 2013. The six-span structure was built in 1883 and rebuilt in 1914. It supports heavy vehicle traffic over the Merrimack River and is a connecting link for West Newbury, Merrimac and Haverhill residents as well as several southern New Hampshire towns. Rocks Village bridge is also equipped with a hand-operated swing span to accommodate boats; making it the oldest movable bridge in the state.

Massachusetts DOT and its design and engineering team along with three historical societies with overlapping jurisdiction wanted to preserve the bridge's original outer steel truss latticework by cleaning and recoating the metal. To upgrade the bridge's structural capabilities, six new interior longitudinal steel beams were chosen in lieu of total bridge replacement.

Two factors dictated a lightweight bridge deck solution: the exterior metalwork which carried some load as part of the overall structure and the need to retain the swing span's hand crank operation.

"FRP material was really the only option for producing the lightweight decking they needed," says Scott Reeve, president of Composite Advantage. "It would have been nearly impossible otherwise to achieve a bridge that functioned according to current safety standards yet maintained the largest percentage of both the character and the original aspects of the bridge."

A typical concrete deck weighs 100 pounds per square foot, creating a dead load a "historic steel truss can't tolerate." Steel grate is lighter weighing in at just 25 pounds per square feet. "But grating has other issues such as its susceptibility to corrosion," Reeve notes. FRP weighs just 19 pounds per square foot and provides a solid surface that is watertight and resistant to corrosion, moisture and chemicals.

Continuous transverse FRP deck on new steel girders.

The FRP deck design called for a continuous transverse span to carry vehicle loads over the new steel longitudinal beams. Because the original latticework was comprised of uneven trapezoidal shapes, CA engineers had to work closely with the designer and

the contractor who surveyed the bridge to determine correct dimensions for the new deck. "One end of the bridge was actually narrower than the other end," says Reeve. "Anytime you are dealing with older structures, this type of information is crucial to ensure deck panels fit tightly."

Design parameters also called for the deck to support loads transferred from the guardrail. In the event of impact, guardrails on three of the spans were attached to the top of the FRP deck while rails for the other three spaces were attached to the deck's sides.

"This is where the design flexibility of FRP is an advantage," Reeve explains. "We prefabricate panels at our manufacturing facility. By coordinating design and construction specifications upfront we're able to accommodate special requirements at the fabrication phase instead of on the job site. In the case of the guardrails, actual load path travelled through steel box tubing that we moulded inside the FRP deck panels."

Deck panels fabricated to accommodate swing span.

Deck specifications called for design live loading of AASHTO HS-25 vehicle plus impact. An environmental durability factor was applied to material properties to account for degradation over time. "Like any material there is always a small degree of material scatter," Reeves says. "We account for those deviations with statistical reduction factors."

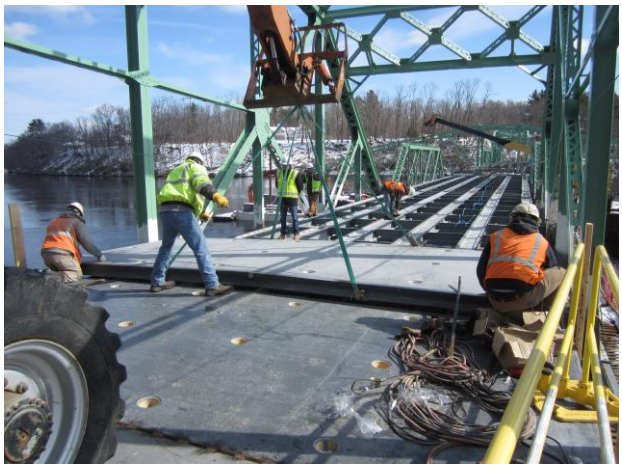
Panel strain under full dead and live load was calculated not to exceed 20 percent of FRP's ultimate capacity. Strain under dead load alone was not permitted by the client to exceed 10 percent. The deck system was designed for a minimum fatigue life of 2,000,000 load cycles. Thermal loading for panels accounted for a temperature differential of 100 degrees Fahrenheit.

With L defined as the distance between the centreline of adjacent girders, deck deflection due to live loads plus impact was limited to L/500.

"The relative stiffness of our fiberglass material makes deflection the driving factor in deck sizing with FRP," says Reeve. "We analysed different loads and conditions, but the influence of deflection on sizing is greater than all other design parameters. Because of this unique aspect, FRP bridges and bridge decks are built to safety and strength factors much higher than that of conventional material."

The FRP panels, weighing just 5,000 pounds each, were delivered to the job site in sequential order. "With a truss bridge there isn't room to navigate a crane," says Reeve "FRP allows the contractor to start at one end of the bridge moving, positioning and setting the panels with nothing more than light equipment."

FRP deck panels delivered to jobsite.



FRP deck installation.

Shear studs welded to the top of the beam connect panels. The FRP panels are then joined together by welding steel edge members. "This was a cold weather installation," explains Reeve referring the joining method used for Rock's Village. "Traditionally FRP panels are joined by adhesive bonding."

Following installation the deck received a polymer concrete overlay versus asphalt. Thinner and lighter, the overlay met bridge weight restrictions and helped minimize dead load.

"As with any material, FRP included, reflective cracking of the wear surface is always a concern," Reeve says. "With the polymer concrete overlay we recommended a control joint be used in the overlay surface and sealed, otherwise it may need to be redone if reflective cracking does occur. New polymer concretes are being introduced that offer higher elongation as a means of overcoming this problem which is inherent on all types of bridge decks."

The new six-span FRP bridge deck totalled 809 feet long with two widths at 21.25 feet and 25.3 feet. Deck area totalled 18,776 square feet. Individual panel dimensions were 9.25 feet long by 21.25 feet wide and 9.25 feet by 25.3 feet. Rocks Village's bridge deck had a depth of 7 inches with a deck weight of 19 psf.

Completed deck replacement.

The Rock's Village Bridge reopened in October 2013. "We inspected the FRP deck 18 months later and it looked good," Reeve says.

New Publication

ACI SP-301 Modeling of FRP Strengthening Techniques in Concrete Infrastructure

This CD contains 8 papers that were presented at a session sponsored by Joint ACI-ASCE technical committee 447 at the ACI Fall Convention, October 2011 in Cincinnati, Ohio. The papers cover the modeling for strengthening for flexure, shear, torsion, and confinement of concrete. Where applicable, the papers cover comparisons of modeling results with experimental tests performed around the world.

Document may be ordered at:
http://www.concrete.org/store/productdetail.aspx?ItemID=SP301CD&Format=OPTICAL_DISK

ASCE *Journal of Composites for Construction*

The American Society of Civil Engineers (ASCE) Journal of Composites for Construction (JCC) is published with the support of IIFC. As a service to IIFC members and through an agreement with ASCE, *FRP International* provides an index of ASCE JCC. The ASCE JCC may be found at the following website:

http://ascelibrary.org/cco/

ASCE JCC subscribers and those with institutional access are able to obtain full text versions of all papers. Preview articles are also available at this site. Papers may be submitted to ASCE JCC through the following link:

http://www.editorialmanager.com/jrncceng/

ASCE Journal of Composites for Construction
Volume 19, No. 3. June 2015.

Bond Performance of Basalt Fiber-Reinforced Polymer Bars to Concrete
Ahmed El Refai, Mohamed-Amine Ammar, and Radhouane Masmoudi

Accelerated Hygrothermal Aging of Bond in FRP–Masonry Systems
Bahman Ghiassi, Paulo B. Lourenço, and Daniel V. Oliveira

Evaluation of the Flexural Response of CFRP-Strengthened Unbonded Posttensioned Members
F. El Meski and M. Harajli

Corrosion Aging of Reinforced Concrete T-Girders Strengthened with Near-Surface-Mounted Composites
Tamer El-Maaddawy, Anes Bouchair, Amr S. El-Dieb, and Ashraf Biddah

Stress-Strain Behavior of FRP-Confined Recycled Aggregate Concrete
J. L. Zhao, T. Yu, and J. G. Teng

Experimental Evaluation of Static Cyclic In-Plane Shear Behavior of Unreinforced Masonry Walls Strengthened with NSM FRP Strips
K. M. C. Konthesingha, M. J. Masia, R. B. Petersen, and A. W. Page

Review Study on the Durability of FRP-Confined Concrete
F. Micelli, R. Mazzotta, M. Leone, and M. A. Aiello

Nonlinear Finite Element Analyses of FRP-Strengthened Concrete Slabs under Fixed-Point Cyclic Loading
Xiaodan Teng and Y. X. Zhang

Prediction of Long-Term Performance and Durability of BFRP Bars under the Combined Effect of Sustained Load and Corrosive Solutions
Gang Wu, Zhi-Qiang Dong, Xin Wang, Ying Zhu, and Zhi-Shen Wu

Shear Modulus of Cylindrical CFRP Tendons Exposed to Moisture
Eleni Toumpanaki, Janet M. Lees, and Giovanni P. Terrasi

Behavior of Concrete-Filled FRP Tubes under Cyclic Axial Compression
B. Zhang, T. Yu, and J. G. Teng

Performance of Carbon-Fiber-Reinforced Polymer Stirrups in Prestressed-Decked Bulb T-Beams
Nabil F. Grace, Soubhagya K. Rout, Kenichi Ushijima, and Mena Bebawy

Experimental Investigation of Pullout Behavior of Fiber-Reinforced Polymer Reinforcements in Sand
Cheng-Cheng Zhang, Hong-Hu Zhu, Bin Shi, Fang-Dong Wu, and Jian-Hua Yin

Experimental Study of Bond Behavior of CFRP-to-Brick Joints
Tommaso Rotunno, Luisa Rovero, Ugo Tonietti, and Silvia Briccoli Bati

Discussion of "Web Buckling in Pultruded Fiber-Reinforced Polymer Deep Beams Subjected to Concentrated Loads" by David T. Borowicz and Lawrence C. Bank
Abdul-Hamid Zureick

IIFC Conference Proceedings to be indexed

The IIFC is pleased to announce that Elsevier is now indexing post-2012 IIFC conference proceedings in the Scopus and Compendex indices.

Upcoming Conferences and Meetings

ICCM20 – 20th International Conference on Composite Materials, July 19-24, 2015, Copenhagen, Denmark. www.iccm20.org.

NOCMAT 2015 – Nonconventional Materials: Construction for Sustainability – Green Materials and Technologies, August 10-13, 2015, Winnipeg, Canada. umanitoba.ca/conferences/nocmat2015/

ICCST/10 – Tenth International Conference on Composite Science and Technology, 2-4 September 2015, Lisbon, Portugal.
http://www.dem.ist.utl.pt/iccst10/

SMAR 2015 – Third Conference on Smart Monitoring, Assessment and Rehabilitation of Civil Structures , 7–9 September 2015, Antalya Turkey. www.smar2015.org

ACIC 2015 – 7th International Conference in the Advanced Composites in Construction, 9–11 September 2015, Cambridge UK. acic-conference.com

CAMX: Composites and Advanced Materials Expo, October 26-29, 2015, Dallas TX, USA. www.thecamx.org

PLSE 2015 – Second International Conference on Performance-based and Lifecycle Structural Engineering, 9-11 December 2015, Melbourne, Australia. plse2015.org

Early Registration before September 16 2015

JOINT CONFERENCE

FRPRCS-12 ***12th International Symposium on Fiber Reinforced Polymer for Reinforced Concrete Structures***, and

APFIS 2015 – 5th ***Asia-Pacific Conference on FRP in Structures***, December 14-16, 2015, Nanjing, China.

http://iiuse.seu.edu.cn/frprcs12_apfis2015/

Early Registration before July 15 2015

Concrete Solutions 2016, 5th International Conference on Concrete Repair, June 20-22, 2016, Thessaloniki, Greece. http://www.concrete-solutions.info/

7th International Conference on Advanced Composite Materials in Bridges and Structures, August 22-25, 2016 Vancouver, Canada.

CICE 2016 ***8th International Conference on FRP Composites in Civil Engineering***
December 2016, Hong Kong

CICE 2018 ***9th International Conference on FRP Composites in Civil Engineering***
July 2018, Paris

CICE 2014 Proceedings available on IIFC website SOON!

Proceedings of the following official IIFC conferences are archived on the IIFC website, www.iifc-hq.org:

CICE 2014, Vancouver, 20-22 August 2014

CICE 2012, Rome, Italy, 13-15 June 2012

APFIS 2012, Sapporo, Japan, 2-4 February 2012

CICE 2010, Beijing, China, 27-29 September 2010

APFIS 2009, Seoul, Korea, 9-11 December 2009

CICE 2008, Zurich, Switzerland, 22-24 July 2008

APFIS 2007, Hong Kong, 12-14 December 2007

CICE 2006, Miami, USA, 13-15 December 2006

BBFS 2005, Hong Kong, 7-9 December 2005

International Institute for FRP in Construction

Membership Application and Renewal

IIFC Member Number (if applicable): _____

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email: _____ alternate email (optional): _____

Education/Experience: ***Please attach a current resume or CV (new members only)***

I/we wish to join the International Institute for FRP in Construction (IIFC) as a (please tick one box)

☐ Member (US$100) ☐ Student Member (US$25) ☐ Patron Member (US$500)

Patron Membership includes two designated individuals who shall have all the privileges of IIFC membership. If applying for a Patron Membership, please nominate one additional colleague to receive the privileges of membership:

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Surname First/Middle Names

Job Title/Position: _____ email: _____

METHOD OF PAYMENT (Payable in US Funds) Cheques and money orders to be made payable to "IIFC"

☐ Check / Money Order

☐ Visa ☐ Mastercard

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Tel: (613)533-6000 (Ext. 79359) • Fax: (613)533-2128
Email: treasurer@iifc-hq.org • Website: www.IIFC-hq.org

By submitting this application you agree to share your contact information with fellow IIFC members and any conference/organization associated with IIFC.

FRP INTERNATIONAL

the official newsletter of the International Institute for FRP in Construction

FRP International needs your input…

As IIFC grows, we seek to expand the utility and reach of *FRP International*. The newsletter will continue to report the activities of IIFC and focus on IIFC-sponsored conferences and meetings. Nevertheless, we also solicit short articles of all kinds: research or research-in-progress reports and letters, case studies, field applications, book reviews or anything that might interest the IIFC membership. Articles will generally run about 1000 words and be well-illustrated. Submissions may be sent directly to the editor. Additionally, please utilize *FRP International* as a forum to announce items of interest to the membership. Announcements of ***upcoming conferences***, ***innovative research or products*** and ***abstracts from newly-published PhD dissertations*** are particularly encouraged. All announcements are duplicated on the IIFC website (www.iifc-hq.org) and all issues of the *FRP International* are also available in the archive at this site.

FRP International is yours, the IIFC membership's forum. The newsletter will only be as useful and interesting as you help to make it. So, again, please become an *FRP International* author.