# 2011 International Bridge Conference®

David L. Lawrence Convention Center, Pittsburgh, PA

## Workshop W2:
## FRP Composites Hybrid Systems Advancing Sustainable Solutions for Bridges

On February 17, 2009, President Obama signed into law the $787 billion American Recovery and Reinvestment Act. Of this total investment, approximately $48 billion was allocated towards transportation projects including $27.5 billion for highways and bridges. Through April 2011, 96% of the highway and bridge projects have either been completed or are currently underway. On the surface this sounds like a successful program for rebuilding our infrastructure, but the troubling part is that 2/3 of the total budget has been spent on pavement improvements and pavement widening.

In the United States alone, approximately 25% of the nearly 600,000 bridges are considered to be structurally deficient or functionally obsolete, as determined by U.S. Department of Transportation. According to the American Society of Civil Engineers' (ASCE) 2009 Report Card for America's Infrastructure, bridges were given a grade of C with no improvement since the last report in 2005. A $17 billion annual investment is needed to substantially improve current bridge conditions. Currently, only $10.5 billion is spent annually on the construction and maintenance of bridges.

For over 20 years, FRP composite products used in new bridge construction and rehabilitation has provided bridge engineers and owners with innovative and cost effective solutions. In new construction, features such as lightweight, corrosion resistance, and prefabrication has contributed to the goals of accelerated bridge construction by reducing assembly and installation time resulting in lower costs for deploying FRP composites technology. In rehabilitation, features such as speed and minimal disruption to the structure while in service have provided bridge owners with solutions for extending the service life of bridge structures. The technology continues to evolve with better products and solutions for many new applications.

The design and construction of products for bridges with long-term durability and low maintenance requirements is a significant challenge for bridge engineers and is an important component in the life cycle costs of bridges constructed in the U.S. This workshop will present case histories on FRP composites used in both new construction and repair where the bridge spans are longer and job sites are more challenging than any time in the past. The presentations will cover hybrid structural systems, deck retrofits for movable bridges, FRP rebar performance testing in concrete decks, and structural strengthening of bridge structures. Attendees will also be given a technical overview of a recently published document by ASCE titled ***Pre-Standard for Load & Resistance Factor Design (LRFD) of Pultruded Fiber Reinforced Polymer (FRP) Structures***. This Pre-standard was developed using principles of probability-based limit states design to provide uniform practice in the design of pultruded FRP structural systems and will help structural engineers design FRP composites for bridge deck systems.


**Workshop Details**
**Monday, June 6, 2011**
**1:00–4:00 pm**
**Room: 327**
**Presented by:**

ACMA
American Composites Manufacturers Association

**FRP Deck Helps Preserve Historic Landmark**
Dan Richards, PhD, P.E.
1:00 - 1:30 pm

**HCB– Breaking the Mold**
John R. Hillman, P.E., S.E.
1:30 - 2:00 pm

**Pre-Standard for LRFD**
Michael McCarthy,
2:00 - 2:30 pm

**Bridge-in-a-Backpack**
Jonathon Kennerson
2:30 - 3:00 pm

**Structural Strengthening & Repair of Bridges**
David E. White, P.E.
3:00 - 3:30 pm

**Successful Application of FRP Bars in Canada**
Bernard Drouin
3:30 - 4:00 pm

## Presentation Descriptions

**FRP Deck Helps Preserve Historic Landmark**

Movable bridges are a prime candidate for FRP bridge decks. The historic Broadway Bridge in Portland now features street car rails and a composite bridge deck on the movable span. During the 2010 construction, the two-part FRP deck system was easily adapted to the unique structure while also offering a lighter weight, corrosion free, cost efficient, easy and fast to install, and environmentally friendly solution for this high profile project. Details of the installation will be provided. The same FRP deck system will be used for a larger movable bridge project in Portland in 2011.

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**HCB – Breaking the Mold**

Throughout the evolution of FRP bridge systems, the various technologies developed have for the most part been relegated to niche markets that can justify the value added cost for superior performance. Recent projects using HCB technology demonstrate that FRP offers a viable technology to compete in the mainstream of infrastructure construction worldwide. This presentation will provide a status update on recent advancements by HCB technology and how the applications and span ranges have increased over the last twelve months. Specific case studies will be discussed regarding highway, rail and marine infrastructure projects that are exploiting that advantages of HCB Bridges.

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## About the Session Sponsor

ACMA is the world's largest trade association representing the FRP composites industry. Formed in 1979, ACMA is the foremost leader in regulatory compliance and formulation, education, training and market development of FRP composites. ACMA also hosts the largest composites conference/trade show in North America. In 2012, the conference will be held on February 21-23 at Mandalay Bay, Las Vegas.
**www.acmashow.org**

## Transportation Structures Council

Specialty councils are formed under the ACMA umbrella to handle the unique needs of major FRP composite markets. The Transportation Structures Council (TSC) was established to educate practitioners on FRP composites used in civil engineering and construction applications. The TSC coordinates the development and promotion of composites technology materials and products used in the repair or replacement of transportation structures. TSC partners with professional, technical and trade organizations in order to promote awareness of composites technology, and industry leadership in the development of codes and standards. For more information, please visit:
**www.acmanet.org/dac/tsc.cfm**

### Pre-Standard for Load & Resistance Factor Design (LRFD) of Pultruded Fiber Reinforced Polymer (FRP) Structures

A new pre-standard for FRP pultruded structures has been developed under sponsorship by ACMA's Pultrusion Industry Council (PIC) and the American Society of Civil Engineers (ASCE). This presentation will cover how the pre-standard was developed and how the Load and Resistance Factor Design (LRFD) basis compares to current design practices in the industry. The presentation will also cover each chapter in depth and show the controlling design equations for all critical failure modes of pultruded structures. The balloting and review process used to produce the pre-standard will be discussed as well as the supplements and design aids that can be introduced and future implications the standard will have on the industry.

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### Bridge-in-a-Backpack: Implementation of an Innovation

Advanced Infrastructure Technologies' Bridge-in-a-Backpack™ system takes an innovative approach to bridge design and construction. The novel buried arch bridge system uses advanced composite materials to fully realize the benefits of traditional materials - an approach know as hybrid composites - by filling hollow composite arch tubes with traditional concrete. This technology has been under development in the laboratory for almost ten years and is now gaining widespread acceptance in the civil engineering field as the winner of a 2011 ACEC Award for Engineering Excellence and the ASCE Charles Pankow Award for Innovation. The presentation will provide an explanation of the unique system, its development, and the advances it has brought to the construction site.

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### Structural Strengthening & Repair of Bridges – Sustaining our Nation's Infrastructure

Repairing and strengthening existing structures is considered a sustainable method of restoring the nation's crumbling infrastructure, especially taking into account the environmental, social and economic benefits. FRP Composites offer many advantages over traditional building materials, including cost/scheduling savings, long-term durability, reduced maintenance cost, excellent strength to weight performance and negligible impact on the footprint of the existing structures. They also offer the ability to upgrade existing structures for seismic, impact and blast type loading conditions. To date, thousands of projects have been repaired, upgraded and strengthened with composites. Their use has become well accepted by DOT's as a result of their excellent performance records over the past two decades. This presentation will highlight some of ways FRP Composites can help repair the nation's infrastructure and illustrate through case studies its broad acceptance around the world.

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### More than 10 Years Successful Field Applications of FRP Bars in Canada

Noncorrosive fibre-reinforced polymers (FRP) reinforcing bars for concrete structures are seeing an upsurge of use in places where the corrosion of steel reinforcement has typically led to deterioration and rehabilitation needs. Significant developments from the manufacturer, various researchers and Design Codes in combination with numerous successful installations have led to a much higher comfort level and exponential use FRP bars with designers and owners across Canada. After years of investigating, public agencies and regulatory authorities such as the Public Works and Government Services Canada (PWGSC) and Ministry of Transportation at different provinces across Canada have now included GFRP as a premium corrosion resistant reinforcing material in its corrosion protection policy. In the last decade, the field applications indicated that the V-ROD FRP rebar has been used as internal reinforcements in more than 100 bridges across Canada. This presentation presents a summary of different field applications of FRP rebar reinforcements in different types of concrete structures. In addition, the new accessories and continuing research and development in the field of FRP reinforcement will be presented.

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