NEW BRIDGE MATERIAL DESIGN OPTIONS:

- BRIDGE IN A BACKPACK
- HYBRID COMPOSITE BEAMS (HCB)

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NYS DOT
TIG Member

19th Statewide Conference on Local Bridge
Thursday, October 31, 2013
THE CHALLENGE:

Crumbling Infrastructure
POSIBLE SOLUITION

Rigidified FRP Arch Bridges ("Bridge in a Backpack")

Hybrid Composite Beam
The concept of a composite arch shape filled with concrete was originally started in 2001. The University of Maine Advanced Structures & Composites Center (AEWC) in partnership with Maine DOT and the Maine Composites Alliance conducted extensive testing and modeling leading to development and implementation of the variety of innovative composite solutions for transportation. One of those solutions is **Bridge in a Backpack**.
The **Hybrid Composite Beam** (HC Beam) was developed by John Hillman and is being manufactured by Harbor Technologies, a Maine composites company. Two highway bridges, using this innovative beam of composite shell, concrete arch and tension reinforcement, have been constructed: one in Illinois and the other in New Jersey. Maine DOT has embraced this technology and used HC Beams in the construction of the Knickerbocker Bridge in Boothbay. A total of 4300 linear feet of the HC Beams were installed with a traditional reinforced concrete deck. This is the first in US multi-span continuous beam using this technology.
Each year, AASHTO's Technology Implementation Group (TIG) selects a highly valuable, but largely unrecognized procedure, process, software, device, or other innovation that has been adopted by at least one agency, is market ready and is available for use by other interested agencies. TIG's objective is to share information with AASHTO member agencies and their industry partners to improve the transportation system.

In 2011 two bridge–related technologies were selected:

- Rigidified FRP Arch Bridges
- Hybrid Composite Bridges

http://tig.transportation.org/Pages/NewBridgeMaterialDesignOptions.aspx
WHAT IS BRIDGE IN A BACKPACK?

“Hybrid bridge system combining benefits of high-performance composites with cast-in-place concrete”
First Installation of Composite Arch System

Neal Bridge Maine DOT Demonstration Project 2008
The first bridge was constructed at Neal Bridge in Pittsfield in the fall of 2008.

- The 27 ft. long arch structure
- 23 Arches spaced at approximately 2-feet (0.6m)
- A corrugated FRP composite decking installed on top
- The head walls were constructed with a FRP sheet pile system
NEW GENERATION BRIDGES

Jenkins Bridge
Bradley, ME

28’ Span
Composite Panel Headwall
14 Arches (12” Diameter)

Royal River Bridge
Auburn, ME

38’ Span
Precast T-Wall Headwall
13 Arches (12” Diameter)
NEW GENERATION BRIDGES

Perkins Bridge
Belfast, ME

48’ Span
Precast T-Wall Headwall
16 Arches (15” Diameter)

Tom Frost Memorial Bridge
Hermon, ME

45’ Span
Snowmobile/Pedestrian
3 Arches (12” Diameter)
EXPANDING IN NEW ENGLAND: 2011

Fitchburg, MA

Part of MASS DOT
Accelerated Bridge Program

38’ Span
Composite Panel Headwall
15 Arches (12” Diameter)
Pinkham Notch, NH
24’ Span
Composite Panel Headwall
6 Arches (12” Diameter)
Largest Span Bridge to Date

Caribou, ME
54’ Span
Precast Panel Headwall
22 Arches (15” Diameter)
U.S. Interest

- States that have already built bridges: ME(9), NH (1), MA (1) & MI(2)
- Projects underway in states: CT, RI, VT
- States that will try technology by 2018: VA, MT, IA, IN, CA, TX, LA, UT, NJ, FL

International Interest

- Built in: Trinidad
- Working on proposals, and/or in discussion on future work in the following countries:
  - United Arab Emirates
  - Russia
  - Nigeria
  - Panama
  - Mexico
  - Canada
AASHTO LRFD Guide Specifications for Design of Concrete-Filled FRP Tubes for Flexural and Axial Members approved and published in December 2012.
HYBRID COMPOSITE BEAMS (HCB®)
WHAT IS THE HCB?

“Tied Arch in A Fiberglass Box”

Structural Member Using Different Building Materials

Cost-Effective Composite Beam

Stronger, Lighter, Corrosion Resistant

Tension Reinforcement
- Galvanized P/S Strand
- Fiberglass Cloth

Compression Arch

Shear Connectors

FRP Shell
WORLD’S 1st COMPOSITE RAIL BRIDGE

First Installation of an HCB

Completed through HSR and NCHRP IDEA Program of Transportation Research Board

30’ Span for Class 1 Railroads

Subjected to 237 Million Gross Tons of Heavy Axle Freight Traffic

FAST Loop at Transportation Technology Center
Pueblo, CO
Nov 2007
1st HCB HIGHWAY BRIDGE

First Commercial Installation of an HCB Bridge through FHWA-IBRD Grant. Entire Bridge shipped on One Truck.

High Road Bridge
Lockport, IL
Aug 2008

57’ Span
STAGED CONSTRUCTION USING HCB

Easy installation in congested urban environment
6’ wide planks at 2,000 lbs. per pick
31’ Span

Route 23
Cedar Grove, NJ
Oct 2009
HELPING WITH SAFE & SOUND

Three HCB bridges included as part of Missouri DOT Safe & Sound Project

Bridge B0439
Jackson Mill, MO
Nov 2011

B0410 – 106’ Single-Span Bridge
B0478 – 100’ Two-Span Bridge
B0439 – 180’ Three-Span Bridge
WORLD’S LONGEST COMPOSITE BRIDGE

Funded by Maine Composite Initiative

8-Span Bridge with 70’ Spans for total length of 540’

Competitive on 1st Cost Basis

Knickerbocker Bridge
Boothbay, ME
June 2011
<table>
<thead>
<tr>
<th>Date</th>
<th>Length</th>
<th>Location Description</th>
<th>Location</th>
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<tbody>
<tr>
<td>11/2007</td>
<td>30’</td>
<td>Pueblo, Railroad</td>
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<tr>
<td>08/2008</td>
<td>58’</td>
<td>Lockport Township</td>
<td>Illinois</td>
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<td>10/2009</td>
<td>32’</td>
<td>Cedar Gove 23 Bridge</td>
<td>New Jersey</td>
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<td>06/2011</td>
<td>540’</td>
<td>Boothbay Harbor</td>
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<tr>
<td>07/2011</td>
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<tr>
<td>12/2011</td>
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<td>Blacksburg</td>
<td>Virginia</td>
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<td>11/2011</td>
<td>180’</td>
<td>Shannon Co</td>
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<tr>
<td>05/2012</td>
<td>106’</td>
<td>Dade Co</td>
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<tr>
<td>06/2012</td>
<td>100’</td>
<td>Raynolds Co</td>
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<tr>
<td>10/2012</td>
<td>39’</td>
<td>Ft. Knox</td>
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<tr>
<td>03/2013</td>
<td>47’</td>
<td>Colonial Beach</td>
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<tr>
<td>09/2013</td>
<td>107’</td>
<td>Charleston</td>
<td>W. Virginia</td>
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<tr>
<td>10/2013</td>
<td>33’</td>
<td>Fernie</td>
<td>British Columbia</td>
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## UNDERWAY PROJECTS

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<td>Bangor</td>
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<td>Thomstan</td>
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## UPCOMING PROJECTS

- Prince Rupert Sound
- Kittimat
- Seaside Heights
- Vancouver
- Maine Turnpike
- South Saugeen River
- Jansen

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<tr>
<th>Location</th>
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<tbody>
<tr>
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<td>Ontario</td>
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<tr>
<td>Saskatchewan</td>
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PDH QUESTION # 1

What is the largest diameter of composite tubes used in a bridge projects?

ANSWER: 15” diameter tubes used for the Caribou Bridge in Maine.
PDH QUESTION # 2

How long is the longest bridge constructed in the U.S. using HCB?

ANSWER: The 8-Span Knickerbocker Bridge with total length of 540’ in Boothbay, Maine
PDH QUESTION # 3

Which state is the leader in implementing “Bridge in a Backpack” technology?

ANSWER: Maine has already constructed 9 bridges using “Bridge in a Backpack” technology.
Rigidified FRP Arch Bridges
(“Bridge in a Backpack”)  

Hybrid Composite Beam

For more information including videos visit
http://tig.transportation.org/Pages/NewBridgeMaterialDesignOptions.aspx