



Market Fit After 25 Years of Vehicular Bridge Decks

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Presentation Objectives

1. Summary overview
 - a. Evolution leading to current state of the industry
 - b. Recognized benefits and challenges
2. Build awareness and confidence of what is available
3. Identify appropriate opportunities for consideration



Introduction of FRP materials to Infrastructure market

Introduction of FRP materials to Infrastructure market

1) 1990's

- Technology Transfer Initiatives

- Military/Defense industry to private sector (Infrastructure)
 - Carbon Composites Invented at WPAFB
 - Almost 40% of the USA's 577,000 bridges are structurally deficient or functionally obsolete (FHWA 1992)
 - Construction represents the largest potential U.S. market for composites

2) Build awareness and confidence of what is available

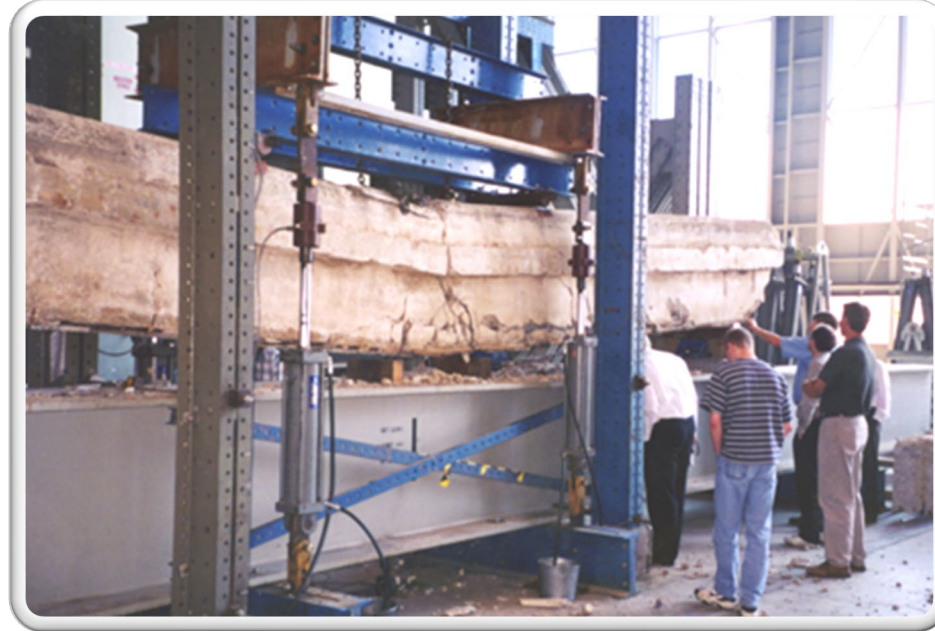
- Recognized benefits and challenges
- Something for designers & contractors to touch/feel/experience

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Early FRP Infrastructure Applications

- **Rehabilitation & Strengthening**



- 1997 - WPAFB
 - Carbon tendons epoxied in sawn grooves increased capacity and stiffness of deteriorated bridge beam by 60%

Early FRP Infrastructure Applications

- **Concrete Reinforcement**



Pierce Street over the Ottawa River - Lima, Ohio

- Glass fiber reinforcing bars

Early FRP Infrastructure Applications

- All Composite Short Span Bridge



1997 - Tech 21 - Butler County Ohio

Early FRP Infrastructure Applications

- **All Composite Short Span Bridge**



1997 - Tech 21 - Butler County Ohio

Recognized Challenges

- Public Sector, slow to accept change
 - Liability & **Cost**
- Proof of performance to same level as traditional materials
- Efficient Delivery Process
- Design & Construction Specifications
- **Cost**
 - Few projects have shown real benefits or justification of competitive use

Recognized Challenges

- Pre-engineered products could help accelerate acceptance



Similar approach as precast concrete

Enter – FRP Deck Panels

- Quick installation to reduce labor costs
- High durability
- Light weight
- Similar to precast



Enter – FRP Deck Panels

Bridge Deck Replacement

- Deterioration and/or widening
- Heavier loads, HS20 or HS25 (BD50)
- Common to salvage girders and substructure
- Opportunity must reduce labor through quick installation
 - Reduces labor costs



Early FRP vehicular deck projects

Early FRP vehicular deck projects

2000 & 2001 - Five Mile Road, Cincinnati, Ohio



Early FRP vehicular deck projects

2001 - Hebble Creek Bridge, WPAFB (Low Profile Deck)



Early FRP vehicular deck projects

2002 - Fairgrounds Road, Greene County Ohio



Early FRP vehicular deck projects

2002 - Fairgrounds Road, Greene County Ohio

- 3 span, 225-foot, steel beam bridge
- 9'-3" beam spacing
- Beam seats stepped down for cross slope
- Positive and negative moment zones
- Installed in 3 days compared to 4 weeks for a conventional concrete deck

Early FRP vehicular deck projects

1999 - Salem Avenue over the Great Miami River, Dayton, Ohio



Early FRP vehicular deck projects

2001 - Salem Avenue over the Great Miami River, Dayton, Ohio

- Built in 1951 over Great Miami River on SR49 west of downtown Dayton, OH
- Five-spans, 679 ft. overall length
- Six lanes of traffic
- 38 ft. wide traffic pavement and 7 ft. of sidewalk in each direction
- Innovative replacement strategy:
 - Use of fiber reinforced polymer (FRP) composites
 - **Four different deck systems**

Early FRP vehicular deck projects

2001 - Salem Avenue over the Great Miami River, Dayton, Ohio

- Four different deck systems

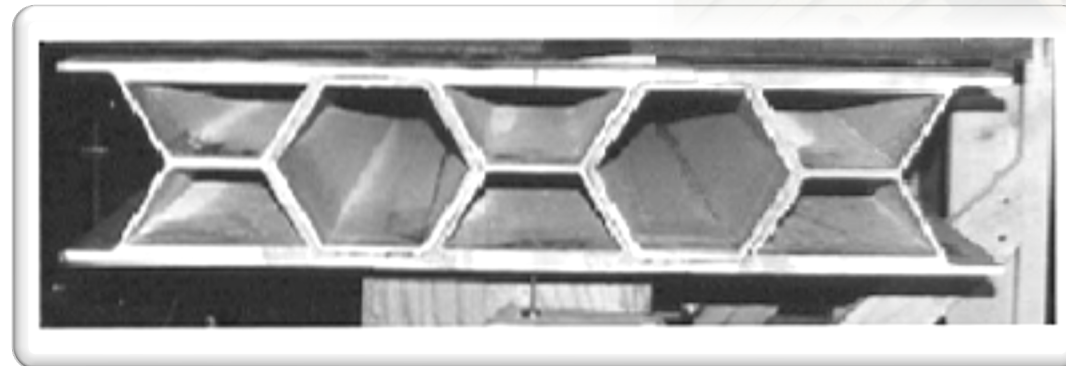
FRP stay-in-place form

- Glass fiber reinforcing bars
- High performance concrete



Pultruded interlocking tubes

- 3/8 inch polymer wearing surface



Early FRP vehicular deck projects

2001 - Salem Avenue over the Great Miami River, Dayton, Ohio

- Four different deck systems

Honeycomb (VARTM) panel

- vacuum assisted resin transfer molding



Honeycomb panel

- corrugated web





Recent FRP vehicular deck projects

Recent FRP vehicular deck projects

2018 - Blackfriars Bridge, London, Ontario, Canada

- 143 year old wrought iron bowstring arch-truss



Recent FRP vehicular deck projects

2013 - Rocks Village Bridge, Haverhill, Massachusetts

- Historic, 6-span steel truss with swing span for Span 3



Recent FRP vehicular deck projects

2015 - Minto Centre Bridge, Ottawa, Ontario, Canada

- Originally built in 1990, 3 trusses which connect two small islands to the shores on either side of the Rideau River



Recent FRP vehicular deck projects

2004 – Malmo, Klaffbron, Sweden

- Existing wood deck replaced and widened to include new pedestrian walkways



Recent FRP vehicular deck projects

2015 – Spiering Bridge near Muiden, North Holland

- Unique unbalanced bridge, requires lightweight deck



CONCLUSION SUMMARY

- Great option for the right applications
 - CHALLENGE - Higher initial material cost of FRP requires the right application
- Prefabricated decking for accelerated construction
 - Design flexibility
 - Installation of pre-assembled bridge section.
- Light weight for bridges with dead load restrictions
 - Movable
 - Historic steel truss
 - Steel grate replacement



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