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FAST FACTS:

Carbon Fiber Reinforced Polymer Strands

PROJECT LOCATION:	Detroit, Michigan
AGENCY:	Michigan DOT
URL:	aii.transportation.org (select <i>Carbon Fiber Reinforced Polymer Strands</i>)
PROJECT NAME:	M-102 over Plum Creek Bridge Replacement
PROJECT DESCRIPTION:	Replacement of an existing earth-filled arch culvert with a pre-stressed spread box beam superstructure, pre-stressed and reinforced with carbon fiber reinforced polymer (CFRP) strands. The beams contain no steel materials.
PROJECT PURPOSE AND NEED:	In 2013, the Michigan Department of Transportation replaced an existing earth-filled arch culvert on M-102 (8 Mile Road) with a CFRP pre-stressed spread box beam structure. M-102 is a major urban route into the city of Detroit, with four lanes of traffic in each direction. Working on this route presents a major impact to regional mobility, so the decision to use durable, non-corrosive materials was deliberately made to ensure that life cycle rehabilitation actions can be delayed for as long as possible. The spread box beams are pre-stressed with CFRP strands and contain CFRP shear stirrups and mild reinforcement. The bridge deck is also reinforced with CFRP mild reinforcement. Each bridge consists of a single 70' span, with eight 33" deep by 48" wide, pre-stressed spread box beams.

OVERALL BUDGET/COST ESTIMATE:

Engineer's estimate for entire project (roadway work included) - \$18,305,000
Contractor's bid amount - \$19,456,000

WHAT WAS UNIQUE ABOUT THIS PROJECT?

The project used pre-stressed spread box beams with CFRP strands, shear reinforcement and mild reinforcement. No steel was used in the beams. The deck was also reinforced with CFRP mild reinforcement. The only steel reinforcement in the bridge deck was the barrier connection to the deck for impact loading.

DESCRIBE TRADITIONAL APPROACH:

The traditional approach on a similar structure is generally to use epoxy-coated reinforcement for the deck, and uncoated 7-wire pre-stressing steel strands for the longitudinal pre-stressing. The shear stirrups in the beams usually involve uncoated steel reinforcement.

DESCRIBE NEW APPROACH:

The new approach uses unconventional non-corrosive materials that are anticipated to require less life cycle maintenance when compared to traditional materials.

TOP INNOVATIONS EMPLOYED:

- CFRP deck reinforcement
- CFRP longitudinal pre-stressing strands
- CFRP shear reinforcement

PRIMARY BENEFITS REALIZED TO DATE:

- Performs comparably to steel in the finished product in terms of material handling, structural erection, constructability, etc.
- Lower anticipated life cycle cost for CFRP.
- Corrosion-free (not just corrosion-resistant).
- Cost to implement offset by maintenance savings. In addition, the cost of CFRP is decreasing.

OTHER BENEFITS REALIZED/ EXPECTED:

- Reduced maintenance and rehabilitation work translates to increased worker and motorist safety.
- The use of CFRP also means that cost savings stay in the roadway user's pocket in the form of less delay (and related fuel consumption) plus reduced vehicle wear and tear.

PROJECT START DATE/ SUBSTANTIAL COMPLETION DATE:

April 2013-November 2014

AFFILIATIONS:

C.A. Hull (bridge contractor)
StressCon Industries (pre-stressed box beam fabricator)
Tokyo Rope/Tokyo Rope USA (CFRP pre-stressing strand and mild reinforcement manufacturer)

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