RESEARCH
PROJECT CAPSULE [12-3ST]
September 2012
TECHNOLOGY TRANSFER PROGRAM

Repair of Morganza Spillway Bridge Bent Pile Cap Using Carbon Fiber Reinforcement (CFR)

JUST THE FACTS:

Start Date:
June 1, 2012

Duration:
24 months

End Date:
June 30, 2014

Funding:
State TT-Reg

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Sponsored jointly by the Louisiana Department of Transportation and Development and Louisiana State University

POINTS OF INTEREST:

Problem Addressed / Objective of Research / Methodology Used Implementation Potential

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PROBLEM

The pile cap of an end bent of the Morganza Spillway Bridge suffered extensive damage at the girder bearing locations on one side, due to the pounding of the girders at these locations by the adjacent concrete deck located on the approach side of the bent. The lack of a gap or an expansion joint between the two adjacent bridge decks contributed to the distress in the pile cap. The pounding caused heavy spalling of the concrete on the west face of the pile cap at the girder bearing locations and the spalling extended all the way to bearing plates. In conjunction with a major repair that was being undertaken on the bridge, the repair of the damaged pile cap (Bent 458) is proposed using the latest technology.

The primary repair of the damaged pile cap and the replacement of the bearing plates were completed by the contractor working on the project. Structural grade high-adhesive material, epoxy concrete, was utilized to patch the damaged areas of the pile cap. In the proposed effort, the repaired areas of the pile cap, namely the bearing plate locations, will be strengthened by preventing delamination of the repair material by confining it with high modulus carbon composite wrapping. An inorganic polymer coating that provides UV protection and prevents mold and mildew growth will be utilized. This coating also has self-cleaning properties. The project is conducted to demonstrate the application of high strength composites for rehabilitation of the transportation infrastructure.

Figure 1
Spalling of concrete at bearing locations

OBJECTIVE

The primary objective of the proposed retrofit is to prevent the delamination of the repair material by confinement using high modulus carbon composite. The retrofit operation will be carried out as part of a demonstration of the use of high-strength composites for transportation infrastructures.

METHODOLOGY

An inorganic polymer will be used to provide compatibility with concrete and long-term durability. Carbon fiber-inorganic polymer composite will be oriented both in "X" patterns and vertical directions to provide complete and effective confinement. The fibers in the vertical direction will be provided in either direction of the piers.

After the completion of the fiber composite placement, the entire bent will be coated with inorganic polymer and short carbon fibers composite. This coating will prevent the ingress of chemicals and block UV rays and hence increase the durability of the entire repair. The coating is self-cleaning, so organic matter such as mildew growth will not occur.

Since the composite will have complete chemical adhesion and the modulus is very high, the fibers will not allow the repair to separate from the parent concrete material. The fibers will be bonded to the top and bottom of bent to generate more than needed anchorage.

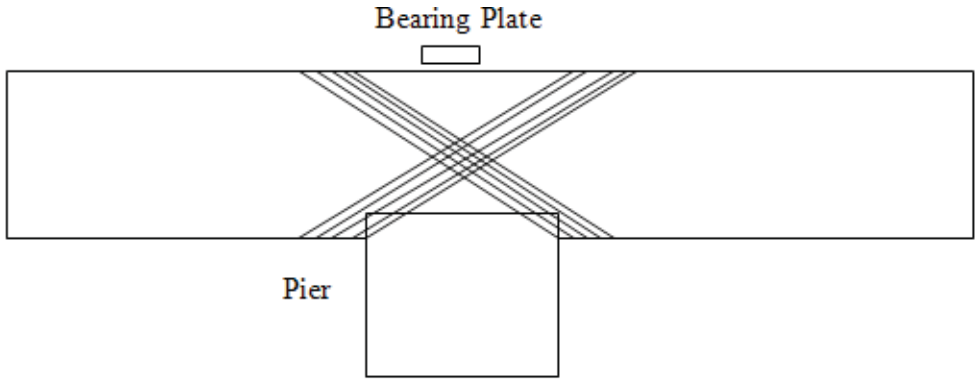

Figure 2
"X" –Pattern of fiber composites over the pier: 4 tows will be placed in each direction

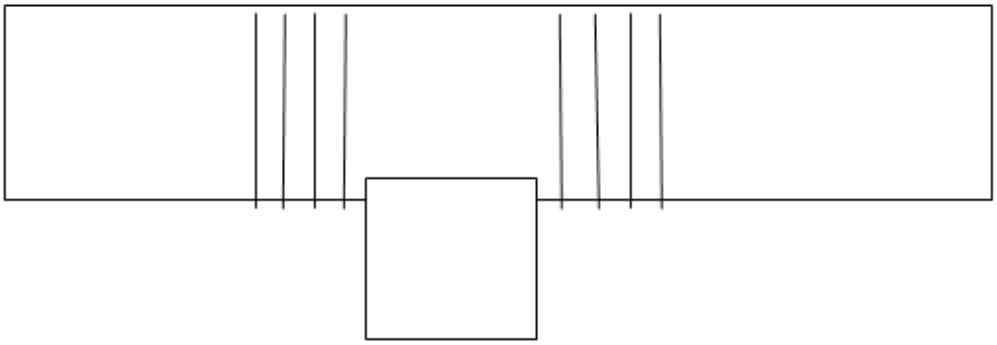

Figure 3
Vertical pattern of the composite near the pier: 2 tows each will be placed on both sides of the pier

IMPLEMENTATION POTENTIAL

A verification of satisfactory performance of the repair with carbon fiber-inorganic polymer composite material will enable LADOTD to utilize this repair methodology for accelerated repair and strengthening of damaged/deteriorated elements in highway bridge super- and sub-structures. The repair method is very cost-effective and can lead to substantial savings in the cost of repair/maintenance of damaged structural members.