OKLAHOMA Transportation

TASK ORDER

PROJECT TITLE
MONITORING OF UHPC CONNECTIONS ON EUFAULA SPILLWAY BRIDGE

FINAL REPORT ~
ODOT TASK ORDER
2160-20-08

REQUEST THE FINAL REPORT:
odot-library@ou.edu
http://www.ou.edu/oktl

INVESTIGATORS
Royce W. Floyd
Omar Yadak
The University of Oklahoma

ODOT SPONSORS
Walt Peters
Bridge Engineer

Office of Research & Implementation

Oklahoma Department of Transportation
200 NE 21st Street,
Oklahoma City, OK
73105-3204

Implementation of Research for Transportation Excellence

MORE INFORMATION
odot-spr@odot.org

HIGHLIGHTER

MONITORING OF UHPC CONNECTIONS ON EUFAULA SPILLWAY BRIDGE

October 2022

OVERVIEW This Task Order involved the implementation of Ultra-High Performance Concrete (UHPC) in the replacement of the Eufaula Spillway Bridge on SH 71 by the U.S. Army Corps of Engineers (USACE). UHPC is a cementitious composite material with increased durability and strength compared to conventional concrete. Replaced joints or connections using UHPC are expected to have much better durability, improved resistance to impact and abrasion, and adequate load transfer capacity with reduced amount of material. The existing Eufaula Spillway bridge is an eleven-span steel girder bridge with a concrete deck. This composite bridge system consists of two primary steel girders and longitudinal and transverse floor beams. Significant deterioration of the girders was observed which prompted replacement (Figure 1). Due to the significant space constraints from the spillway gates and the associated equipment needed for replacement, the design for the replacement bridge was selected to have a two-girder system and utilize the original piers (with modification). Precast prestressed beams were utilized as the primary girders. Also, 14-in. thick full depth precast prestressed deck panels were designed to span between the two girders. The panels and girders were connected with UHPC to create a composite system. The primary contractor on this project had no previous experience using and placing UHPC. This Task Order allowed the University of Oklahoma (OU) team to provide input on the UHPC placement during the replacement process and to monitor performance of bridge joints after replacement.

Figure 1 Lake Eufaula spillway after demolition of existing bridge

RESULTS The full-depth precast deck panels, connected with UHPC, was the first application of UHPC in Oklahoma for this type of project. The U.S. Army Corps of Engineers required a mock-up test of a full slab panel connection before placement of the bridge deck joints. The mock-up section consisted of two representative girders and three full-depth precast panels matching the design of the bridge. This configuration resulted in two full width joints, twenty shear pockets, and haunches over each girder to be concreted with UHPC. The panels were cast with an exposed aggregate surface in the area of the UHPC joints and the connection was made with a non-contact lap splice of epoxy coated reinforcing bars. Several issues were

identified during the mock-up construction (Figure 2) that needed to be corrected before placement on the bridge. This included procedures used for charging the mixers, transport from the mixers to the formwork and materials used to form the joints. In general, the UHPC joints performed very well. Cores taken from the deck indicated excellent bond between the UHPC and deck panel concrete (Figure 3).

Figure 2 Placement of UHPC into transverse deck joints of the mock-up

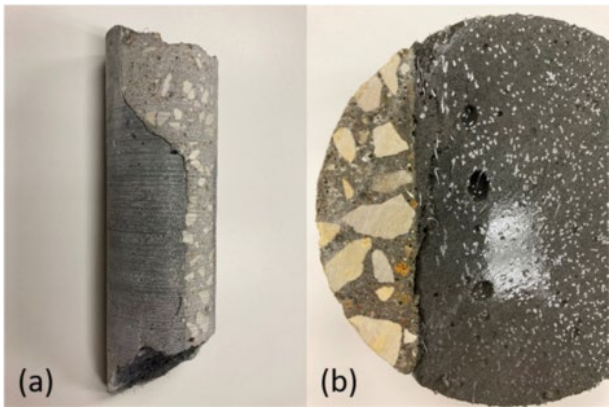

Figure 3 Core taken from the UHPC to deck concrete showing (a) the interface; (b) a section through the interface

UHPC joint placements for spans 1 through 9 were conducted between August and October 2021. Manufacturing issues for some of the panels on spans 10 and 11 led to a delay in the placement of those joints. After the mock-up construction, it was decided that the joints for the first few spans would be placed individually instead of the original plan of placing two spans at a time. The first three spans were placed individually. It was decided that placements would initially be at night due to high daytime temperature and to reduce drying effects from the sun observed during the mock-up placement. Approximately 11 yd^3 of UHPC was required for the joints in each span. Upon discussion with the OU team, it was decided to switch from the wheelbarrows to a concrete bucket moved using the overhead gantry crane for girder and panel placement. Also, it was decided to use pink insulation foam board to seal the bottom of the joints as it produced the tightest seal and provided adequate concrete cover during mock-up placement. Figures 4 (a), 4(b) and 4(c) show joints immediately before, during, and after UHPC placement. Completed deck panel joints were examined and appeared to be excellent, in an overall sense. No cracks due to formwork anchor placement were observed. The lessons learned during the mock-up construction and in the process of casting the joints are documented in the final report.

Figure 4 Bridge deck (a) immediately before; (b) during; and (c) after completion of joint placement

POTENTIAL BENEFITS This Task Order demonstrated that a contractor with limited experience in placing UHPC can quickly learn to work efficiently with this material. The experience gained and the lessons learned from this project are expected to help with the implementation of UHPC in the construction of new bridges and replacement and rehabilitation of existing bridges in Oklahoma.