TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Michigan Department of Transportation

INSTRUCTIONS:
Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.

Transportation Pooled Fund Program Project # *(i.e, SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX)* TPF-5(363) [CY 2019]	**Transportation Pooled Fund Program - Report Period:** ☐ Quarter 1 (January 1 – March 31) ☑ Quarter 2 (April 1 – June 30) ☐ Quarter 3 (July 1 – September 30) ☐ Quarter 4 (October 1 – December 31)	
Project Title: Evaluation of 0.7″ Diameter Carbon Fiber Reinforced Polymer (CFRP) Pretensioning Strands in Prestressed Beams		
Name of Project Manager(s): Steve Kahl	**Phone Number:** 517-636-5708	**E-Mail** kahls@michigan.gov
Lead Agency Project ID: OR15-541	**Other Project ID (i.e., contract #):** 2016-0065/Z3	**Project Start Date:** 10/01/2017
Original Project End Date: 09/30/2020	**Current Project End Date:**	**Number of Extensions:** None

Project schedule status:

☐ On schedule ☑ On revised schedule ☐ Ahead of schedule ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
$358,732.00	$99,934.41	51%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
$99,934.41 and TBD	TBD	58%

Project Description:

Background:

MDOT has been working with Lawrence Technological University [in Michigan] for many years to develop carbon fiber reinforced polymer (CFRP) prestressed concrete beams. Recent research developments on demonstration projects have shown that 0.6 inch diameter CFRP strands have smaller nominal area and lower allowable capacity than steel 0.6 inch diameter steel strands; thus requiring more strands for a given design. This makes it difficult for bridge designers to find projects where we can fit enough CFRP strands in a beam to meet load carrying requirements.

Currently, 0.7 inch diameter CFRP strands are available; thus, making the use of CFRP pre-tensioning in pre-stressed beams more viable. The proposed research is necessary in order to evaluate the safe use of 0.7 inch diameter CFRP strands in a beam to meet load carrying requirements.

Objectives:

1. To evaluate material properties, details, and design criteria to use 0.7 inch diameter CFRP strands for pretensioning of prestressed AASHTO I girders, bulb-t, and box beams.

2. To evaluate performance of 0.7 inch diameter CFRP strands for environmental conditions and extreme events.

3. To prepare design procedures and examples.

4. To prepare construction specifications for 0.7 inch CFRP strands and identify fabrication concerns with the larger diameter strands.

Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):

During this quarter, the research team worked on Tasks # 4, 5, 7 and 9 of the research project:

Task #4: Creep/relaxation/prestress loss: The test specimens for creep and relaxation have been under continuous monitoring since the start of the project. The research team evaluated the prestress loss in relaxation specimens and performed the necessary maintenance on the test setup to ensure that the creep specimens are still subjected to a constant load level.

Task # 5: the research team continued to test the new set of pull-out specimens that contained diameters of steel and CFCC strands to compare the bond strength between CFCC and steel strands. Based on the test results, it was found that the bond capacity between CFCC and concrete is approximately 150 % that between steel and concrete. In addition, bond specimens were prepared for extreme heat and extreme cold testing. Five pull-out bond specimens will be subjected to cycles of elevated temperature, while five specimens will be subjected to cycles of freezing and thawing. After concluding the cycles of high temperatures or freezing/thawing, the specimens will be subjected to static pull-out test to evaluate the effect of temperature increase/decrease on the bond strength between CFCC and concrete.

Task # 7: Testing of Full-scale beams: The testing of full-scale beams included fire testing of beam specimens in the fire chamber and also included building two more beam specimens for a complete bridge model. During the last quarter, the fire testing continued, and two more full-scale beams specimens were tested under fire. The first beam specimen was prestressed with CFCC strands, while the second beam specimen was prestressed with steel strands. The fire endurance of a beam with CFCC strands was approximately 50 % of that for beam with steel strands. Failure took place due to the loss of bond between CFCC and concrete. Nevertheless, the beam with CFCC strands supported the applied load for two hours under fire conditions. In addition, the research team is currently working on constructing four half-scale beams that

Anticipated work next quarter:

The research team will continue to work on different research items according to the proposed work schedule. During the next quarter, it is expected that the research team will work on Tasks 4, 5, 7, & 9 and will continue to share and discuss the test results with MDOT Engineers.

Significant Results:

The research team also performed completed thermal heating and cooling test on the freeze-thaw beams and the team is now preparing to start the freeze-thaw cycles on the beams.

The research team continued to share the test results and discuss the progress of the research project with MDOT Engineers. In addition, the research team had two visits from MDOT. The first visit was on Apr. 24th, as MDOT Director Mr. Paul Ajegba toured the CIMR and learned about different research activities. The second visit was on May 15th, as Engineers from MDOT and industry visited the CIMR during a half-day workshop that focused on the design of highway bridge beams with CFRP strands.

Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).

Potential Implementation: