TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT):
________FHWA______________________________________

INSTRUCTIONS:
Lead Agency contacts 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 #	**Transportation Pooled Fund Program - Report Period:**
TPF5-(521)	☐ Quarter 1 (January 1 – March 31) ☐ Quarter 2 (April 1 – June 30) ☐ Quarter 3 (July 1 – September 30) ■ Quarter 4 (October 1 – December 31)

TPF Study Number and Title:
TPF5(521) New Performance Approach to Evaluate ASR in Concrete

Lead Agency Contact:	**Lead Agency Phone Number:**	**Lead Agency E-Mail**
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Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:**
Original Project Start Date: 07/23/2023	**Original Project End Date:** 12/31/2028	**If Extension has been requested, updated project End Date:**

Project schedule status:

■ On schedule ☐ On revised schedule ☐ Ahead of schedule ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	**Total Funds Expended This Quarter**	**Percentage of Work Completed to Date**
$315,000	$91,374	52%

Project Description:
The Turner-Fairbank Highway Research center has developed two new alkali–silica reaction (ASR) tests, the AASHTO TP-144-23 (T-FAST) and the AASHTO T 416-24 (ATT). The T-FAST is sensitive method capable of accurately detecting the presence of alkali–silica reactive phases in any type of aggregate. The ATT is a simple and reliable method to determine the alkali threshold (AT) of any aggregate combination. The AT is defined as the specific alkali level at which the ASR reaction is triggered in an aggregate. Knowing the AT of an aggregate combination is an important piece of

information that provides insight into the field behavior of the aggregates when used in a concrete of specific alkali loading.

A new performance and prescriptive approach have been proposed based on the information provided by the T-FAST and ATT to predict the alkali–silica susceptibility of any concrete mix design. The two newly proposed approaches are based in the widely accepted notion that any given combination of aggregates will develop ASR inside of a specific concrete only when the alkali loading (AL) of the concrete is higher than the AT of the aggregates. The AL of the concrete depends on the mix design proportions, type and content of the cement, and the presence of supplementary cementitious materials. While previous research supports the theory that ASR can be prevented by limiting AL below AT, there is a need to understand the extent of the influence played by available alkalis and aluminum released by SCM in the AL of the concrete and AT of the aggregates, respectively. Lastly, it is also necessary to expand T-FAST capabilities to evaluate ASR mitigation strategies. This is a requirement because it is not always possible to avoid the use of reactive aggregates due to lack of availability or other reasons.

The principal objective of the project is to evaluate a wide selection of concrete mix designs to validate the use of T-FAST and ATT methods in conjunction with mix design data, cement mill reports and SCM properties to determine the likelihood of ASR gel formation in concrete.

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

Task 1: Selection of Aggregates and characterization using TFHRC toolkit tests
During this quarter, the TPF team identified two additional coarse–fine aggregate combinations of interest for the project. These two new mixes, AK Mix CA835LA and AK Mix CA740LA, were pre-classified under the first objective of the project (validation of the No-ASR criteria in the ASR risk-assessment chart) and categorized as Class 2 mixes (mixes used in pavement for more than 15 years, with available accelerated physical expansion data and original mix design information).

AK Mix CA835LA is a self-consolidating concrete used to cast box-culvert sections. The TPF team received three 4×8 cylinders of the original concrete mixture, cured for 3 years. AK Mix CA740LA is a Class P concrete used to cast a bridge girder. The TPF team received a total of six 4×8 cylinders of the original mixture, cured for 3.5 years. One set of three cylinders was steam-cured for the first 16 hours, while the second set received standard curing. The team prepared the AT_{Mx} analysis for both coarse–fine aggregate combinations. Table 1 summarizes the key information for these two new mix designs.

Table 1. Additional Concrete Mix Designs selected for Task 3.

Task 3 Objective	**Mix Class**	**Mix ID**	**AT_{Mx} (lb Na_2O_{eq}/yd^3)**	**Binder Content (lb/yd^3)**	**Cement Type (Na_2O_{eq} %)**	**Alkali loading (lb Na_2O_{eq}/yd^3)**
1	2	AK Mix CA835LA		835	Type I/II (0.53)	4.43
	2	AK Mix CA740LA		740	Type I/II (0.54)	4

Task 2. Characterization of supplementary cementitious materials (SCM)
Based on the characteristics of the coarse–fine aggregate combinations selected for Objectives 2 and 3 of the project, the team identified a total of five SCMs of interest—two Class C fly ashes and three Class F fly ashes. During this quarter, the team focused on obtaining these five SCMs. One of the two Class C fly ashes was received and will be used to prepare the two concrete mixes in Objective 2 (NC Mix CA176CMD2-25 and NC Mix CA176CMD2-15).

The team also analyzed eight Class F fly ash samples, received from different Departments of Transportation, as potential candidates for the study using XRF. The XRF results will be used in conjunction with pore solution extraction and the AT_{Mx} values from the concrete mix design to select specific Class F fly ash samples for further testing.

Task 3: Prepare Concrete Samples

The team completed planning for three new concrete mixes: TX Mix C6-708, TX Mix C16-708, and AK Mix CA564LA. Preparation included batching plans, procurement of cements, and measurement of the specific gravity and moisture absorption of the aggregates. Two Type I/II cements were procured, one with an alkali content of 1% Na_2O_{eq} for TX Mix C6-708 and TX Mix C16-708, and another with an alkali content of 0.44% Na_2O_{eq} for AK Mix CA564LA.

The team also conducted microstructural analysis and Damage Rating Index (DRI) evaluation on SEM samples from the 12-month mixes PA Mix GTC15 and PA Mix GTC25.

Anticipated work next quarter:

- Continue XRD analysis of the 8 in house SCMs.
- Batch three concrete mixes (TX Mix C6 708, TX Mix C16 708, and AK Mix CA564LA).
- Cut samples of the AK Mix CA835LA, AK Mix CA740LA, and 2-year PAMix GTC15 samples, and prepare epoxy embedded specimens.

Significant Results:

None

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).

None

Potential Implementation:

None