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: Terry Arnold	**Lead Agency Phone Number:** 202 493 3305	**Lead Agency E-Mail** Terry.arnold@dot.gov
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
$305,000	$11,000	7%

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

The selection and procurement of aggregate combinations, coarse and fine used in concrete, were the principal activities performed during this quarter. The selection was done based on input provided by the Technical Action Committee (TAC) members on the six criteria proposed in the research plan. The aggregate combinations were classified into three different classes depending on the number of meet criteria. Table 1 lists the six criteria and the three aggregate categories.

Table 1. Selection criteria and type of class of aggregate combinations

Selection Criteria	**Class 1**	**Class 2**	**Class 3**
Used in a pavement for more than 15 years.	Yes	Yes	Yes
Availability of accelerated ASR concrete/mortar test results.	Yes	Yes	Yes
Availability of mix design proportions and mill reports for concrete in which it was used.	Yes	Yes	No
Availability of samples of binders.	Yes	Yes	No
ASR field performance and other durability data of the concrete available.	Yes	No	No
Access to core the pavement or petrographic analysis of the concrete.	Yes	No	No

A total of 18 coarse and fine aggregate combinations were selected for the study from different locations within the United States.

- Alaska: one class 3 aggregate combination (1 coarse and 1 fine aggregate)
- Arkansas: two class 1 aggregate combinations (2 coarse and 2 fine aggregates).
- Connecticut: one class 2 aggregate combination (1 coarse and 1 fine aggregate).
- Massachusetts: one class 1 aggregate combination (1 coarse and 1 fine aggregate).
- North Carolina: six aggregate combinations (5 coarse and 3 fine aggregates). Two class 1, one class 2, and three class 3 aggregate combination.
- Pennsylvania: two class 2 aggregate combinations (2 coarse and 1 fine aggregate).

- South Dakota: three class 2 aggregate combinations (2 coarse and 3 fine aggregates).
- Virginia: two class 3 aggregate combinations (2 coarse aggregates and 1 fine aggregate).

The PTF team coordinated with different departments of transportation regarding shipment of materials. All the aggregates were received during this quarter.

In parallel to the aggregate procurement, the PTF team performed the AASHTO TP 144 (T-FAST) and AASHTO T 416 (ATT) characterization of the aggregates from Pennsylvania and Virginia. The characterization involved determining the T-FAST classification of the aggregates, and measuring their individual alkali thresholds (AT_{Ag}) and their combined alkali thresholds (AT_{Mx}).

TASK 2: Characterization of supplementary cementitious materials (SCM)

The PTF team developed a XRF and Raman imaging method for characterization of the SCM. While the XRF method will assist in determining the elemental composition of the SCM, the Raman imaging method will help in the characterization of the different glassy and crystalline phases in a SCM sample embedded in epoxy.

TASK 3: Prepare Concrete Samples

The PTF team cast the first two concrete mixes with the Pennsylvania aggregate combination as part of the evaluation of the new job mix test (JMT). The two concrete mix designs contained 15% and 25% of class F fly ash. The concrete samples of both mix designs are being stored at 100% relative humidity and 55°C for 2 years. The PTF team will perform periodically evaluations of the concrete specimens for any ASR signs in the microstructure and potential ASR gel migration into the air void system.

Anticipated work next quarter:

- Continue work on the T-FAST and ATT characterization of the aggregates alone and combined.
- Evaluate first concrete samples from the two Pennsylvania concrete mixes. Complete the SEM analysis of the microstructure and air void quantification at 0 day.
- Select the binders for new concrete mixes based on AT_{Mx} of the aggregate combinations.

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