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 # TPF5-(521)	**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)

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	$30,060	18%

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 PTF team continued working on the characterization of the aggregate samples under AASHTO TP 144 (T-FAST) and the measurement of the individual alkali threshold (AT_{Ag}) under AASHTO T 416 (ATT). The T-FAST characterization was 90 percent complete, and the ATAg measurements were 62 percent complete. Tables 1 and 2 summarize the T-FAST and ATT results for coarse and fine aggregate samples.

Table 1. T-FAST and ATT results of coarse aggregates.

Sample ID	T-FAST Classification	AT_{Ag} (kg/m^3)
NC-CA1-57	MR/HR	
NC-CA1-78	HR	
NC-CA2-78	SR	
NC-CA2-67	MR	
NC-CA2-57	MR/HR	
NC-CA3-78		
NC-CA3-67		
NC-CA3-57		
NC-CA4	HR	
NC-CA5-57	HR	
NC-CA5-78	HR	
NC-CA6	MR	
CT-CA1	MR	2.8
SD-CA1	HR	
SD-CA2	HR	
MA-CA1	MR	4.2
PA-CA1	MR/HR	4.5
AR-CA1	HR	2.8
AR-CA2	SR	4.6
VA-CA1	SR	6.55

VA-CA2	HR	2.2
AK-CA1	HR	2.2

Table 2: T-FAST and ATT results of fine aggregates.

Sample ID	T-FAST Classification	AT_{Ag} (kg/m^3)
NC-FA1	NR	
NC-FA2	SR	
NC-FA3	NR	
CT-FA1	NR/SR	6.55
SD-FA1	MR	4.4
SD-FA2	MR	2.6
SD-FA3	MR	
MA-FA1	NR	6.55
PA-FA1	MR/HR	1.8
AR-FA1	MR/HR	2.1
AR-FA2	HR	2.7
VA-FA1	NR/SR	6.55
AK-FA1	MR/HR	3.8

The PTF Team started preparing the first samples to measure combined alkali thresholds (AT_{Mx}) as the first part of the evaluation of concrete mixes. Two A3a paving mixes containing 564 lb/yd³ of binder were selected by combining the three samples from Virginia (two coarse aggregates and one fine aggregate). Table 3 summarizes the aggregate combinations used in the two mixes. Table 3. Concrete Mix Design Containing Virginia Aggregates to Measure ATMx.

Table 3. Concrete Mix Design Containing Virginia Aggregates to Measure AT_{Mx}.

			Mix proportions, kg/m3			
Mix ID	**Coarse Agg ID**	**Fine Agg ID**	**Cement**	**Coarse Agg.**	**Fine Agg.**	**Water**
A3aPav Mix1	VA-CA1	VA-FA1	334	1110	848	145
A3aPav Mix2	VA-CA2	VA-FA1	334	1098	889	145

TASK 3: Prepare Concrete Samples

The PTF team collected 0-day and 3-month samples from the two Pennsylvania concrete mixes. A first group of the 0-day samples was used to measure the initial air void quantification, while the rest were prepared for microstructural analysis under the scanning electron microscope.

Anticipated work next quarter:

- Continue work on the ATT characterization of the aggregates alone.
- Evaluate the ATMx of different concrete mix designs.
- Continue evaluation of samples from the two Pennsylvania concrete mixes at 6 months.
- 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