TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Minnesota 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)*	**Transportation Pooled Fund Program - Report Period:**
TPF 5(443)	☑ 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:		
Continuous Asphalt Mixture Compaction Assessment using Density Profiling System (DPS)		
Name of Project Manager(s):	**Phone Number:**	**E-Mail**
Kyle Hoegh	507-398-2669	Kyle.Hoegh@state.mn.us
Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:**
		Jan 13, 2020
Original Project End Date:	**Current Project End Date:**	**Number of Extensions:**
01/10/2023	12/31/2023	1

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
$1,211,500 (GA Joined)	$850,121	77%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
3%	$35,103	81% (using revised schedule)

Project Description:

Background:

It is well known that having adequate and uniform asphalt mixture compaction is critical for pavement life. Multiple studies have estimated that a 1% decrease in density can reduce pavement life by approximately 10%. Currently, a target compaction density is widely used for asphalt mixture compaction acceptance. However, common quality control and acceptance practices for density reply on randomly checking density with nuclear density gauges or cores taken on spot locations. This approach is labor intensive and provide limited information on overall pavement compaction quality, many times missing insufficiently compacted areas. Research conducted by the 2nd Strategic Highway Research Program (SHRP2) R06C has demonstrated a breaking new technology, where a DPS system can be used for routine operation to evaluate density and uniformity of asphalt mixture compaction with continuous pavement coverage of the entire pavement area.

As part of SHRP2 R06C, several state DOTs have evaluated a particular Ground Penetrating-Radar (GPR) DPS system, called the Rolling Density Meter (RDM) with overall, very promising results. A calibration method for the RDM system has been developed and recommended. In addition, a probability histogram of measured dielectric constant is found to be an effective tool for assessing pavement compaction quality and uniformity. Based on this evaluation, state DOTs have found that the system can be used for compaction assessment of essentially the entire pavement area as part of Quality Assurance. However, some additional research and improvements are still needed to use DPS systems for acceptance.

Objectives:

The objective of the proposed pooled-fund project is to establish a research consortium focused on A) further advancing and improving the system based on experience and needs from participants so that the system can effectively and efficiently support their Quality Assurance Programs; B) support communication; C) provide training and technical assistance that includes providing support for specification development and strategies for agency full implementation; and D) conduct technology promotion and marketing for the system. Specific tasks within this multi-year program will be

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

1. The UNH research team progress this quarter:

Task 1 Worked with MnDOT research team to refine a draft AASHTO procedure for conducting dielectric measurement of compacted asphalt mixture specimens.

Task 2 Evaluation of Sensor Bias for Field Dielectric Measurements:

The UNH research team performed analysis for evaluating sensor bias for collected field quality assurance (QA) dielectric measurements. This analysis involved identification of comparison combinations in terms of individual sensors and sensor combinations and used dielectric averages, medians, standard deviations of the measurements of the individual sensors and sensor combinations as the main parameters for evaluation. The analysis also evaluated the current protocol that the TPF 5(443) Pooled Fund Study uses for conducting QA measurements and validating sensor measurements. The research team is finalizing the Task 2 deliverable for submission.

Task 3 Data Correlation Analysis Between Laboratory and Field Dielectric Measurements:

Nothing to report at this time.

Task 4 Data Variability Analysis and Recommendations for Extent of Measurement:

Nothing to report at this time

Task 5 Development of Data Processing Tool:

The UNH research team continued to refine the data processing tool for evaluating sensor bias for field dielectric measurements.

Task 6 Development of Draft Specification and Implementation Materials:

Nothing to report at this time.

Task 7 Final Report: Nothing to report at this time.

2. Held technical working group meeting on February 13th 2023 which can be found here:

Anticipated work next quarter:

The following is expected to be completed for next quarter.

1. Continue meetings with the FHWA Mobile Asphalt Technology lab focused on their efforts related to the DPS. Set up meeting with vendors to present simulation results and gain new directions.
2. Work with Contractors from Minnesota and other States to plan data collection for 2023 construction projects using the update protocols, and to try to advance the DPS usage to inform construction process control. Get contractors nationwide more familiar with the technology. Simplify current protocol with focus on acceptable minimum amount of longitudinal joint and mat data and how to handle payment giving flexibility to contractor on how much data is collected. Example: Contractor will propose single pass with 2 systems/6 sensors for trial.
3. Work to develop data collection specification for contractor collected data as a supplement for quality management in special cases, for example when water table and moisture conditions do not allow for vibration of roller compactors
4. Continue to build on precision/bias results using controlled MnROAD experiment and 40 cores, and further investigate effect of changing density with depth using controlled MnROAD experiment and 40 cores sliced to various depths.
5. Finalize CY 2023 data collection workplan
6. Start data collection and analysis on live projects.
7. Assist FHWA MATC on-site for DPS data collection.
8. Develop draft workplan for highest priority tasks to present to the DPS group.
9. Conduct TWG/Workplan development meeting May 17th.
10. Publish 4th DPS Digest article.

Significant Results:

The best way to get informed about significant results is to access the DPS website:
https://www.dot.state.mn.us/materials/dps/index.html

Specifically, the member and friend presentations including project update presentations given here are the best way to stay apprised of the latest significant results:
https://www.dot.state.mn.us/materials/dps/meetings.html

More birds eye view significant DPS topics can be found in the DPS Digest Series located here:
https://www.dot.state.mn.us/materials/dps/digest.html

Currently this pooled fund is working well for all the members. We have shared results and our experience with each other related to the DPS technology and have discussed a number to topics in the technical teams.

In-place density is a critical factor in ensuring the durability of hot-mix asphalt (HMA) pavement. Currently, a target compaction density is widely used to evaluate asphalt mixture compaction quality. But density is commonly assessed in core samples that are extracted at random locations along a pavement. This approach is not only labor-intensive and destructive, but provides little information about the pavement's overall compaction quality.

DPS is a non-destructive testing technology that can be used to evaluate the density and uniformity of asphalt mixture compaction. It identifies the real-time, in-place compaction level of pavement by measuring the surface dielectric profile, which is dependent on the compaction level. Unlike coring, DPS measures continuously, providing nearly 100% coverage

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).

Both UNH and CTC were granted time-extensions to be able to accomplish their work as part of the larger DPS Pooled Fund workplan. Work is progressing with a new revised end date of December 2023, as indicated in the time extension amendment from UNH. This extension has allowed for use of added additional funds from FHWA and additional State contributions since the original workplan was developed that allows for accommodation of this additional scope of work. Additionally, the data collection costs and travel reimbursement costs originally estimated have been lower than originally estimated. This change in timeline was presented at the Fall/Winter workplan update and peer exchange, and the resulting timeline is reflected in this quarterly report.

Potential Implementation:

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The results (AASHTO specifications) from this pooled fund study can potentially be used for routine quality control and assurance (QC/QA) process in pavement construction to evaluate density and uniformity of asphalt mixture compaction with continuous pavement coverage. Therefore, the construction process provides a continuous and full coverage assessment method at each stage, from mixture placement to post-construction:

• Mixture placement: Use IR to measure compaction temperature to minimize mixture segregation (QC).
• Mixture compaction: Use IC to ensure compaction uniformity (QC).