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	5073982669	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:**
01/10/2027	01/10/2027	

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
$1,136,500	$703,152.01 (Including '21 data)	55%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
61.9% (added funds from FHWA)	$138,902.07	

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.):

There are references to the workplan throughout this quarterly update. The original workplans and live project update can be downloaded from here: http://www.dot.state.mn.us/materials/dps/workplan.html

Fourteen (14) government agencies have become the pooled fund study members to share their expertise and are learning about the new technology and methods to improve and expand upon transportation systems nationally.

Significant Progress this quarter includes:

1. Continued to respond to requests from others on help they need on DPS system operation and data analysis. Also, continue to work with the equipment vendor to provide our assistance to further improve Pavescan 2.0 system. For example, bugs in the new modules were observed, reported, and fixed for the next release of the software.

2. Continued testing and analysis of 2021 construction projects began in this quarter. TH 60 and TH30 was completed including both contractor and agency collected data. More details of the results of the analysis can be found in section 2c of the live workplan update linked above. TH30 showed good agreement between production mix puck conversion from dielectric to density and field cores. TH60 showed mostly good agreement but some days indicated bias. This continues to be investigated.

3. NCAT conducted initial testing of newly constructed sections and continued work on puck and slab precision and bias testing, effect of thickness, and operator certification. NCAT briefed the research team on results with power point presentations. More details will be given at the fall meeting and final task reports anticipated next quarter, but some significant progress includes showing a negligible effect of underlaying later when asphalt thickness is 2 inches or more in thickness, and ability to use pavement performance criteria when evaluating the necessary DPS equipment certification

Anticipated work next quarter:

The following is expected to be completed for next quarter.

1. The research team will begin merging the training documents with the data specification to outline a draft AASHTO specification. The draft specification(s) is anticipated to contain protocols for conversion from dielectric to density using production mix samples, checking the consistency of the DPS sensors for puck and field testing, guidance for field data collection including coverage and safety considerations, protocols for acceptance/rejection of dielectric to density accuracy, and minimum software analysis requirements to ensure the technology allows the user to conveniently make density assessments.

2. NCAT will be submitting final task reports, that will be incorporated into the live project update document. This is anticpated to give further guidance on effect of underlying layers on field collection as well as expected precision and bias of DPS equipment.

3. A 2 day project update and peer exchange is scheduled for the upcoming quarter. Results of this meeting including anticipated formulation of a technical working group and prioritized topics.

4. A vendor update and discussion with DPS users is also scheduled for the upcoming quarter. It is anticipated that this meeting will give insight on how close the technology is to meeting the necessary challenges, and give help to the research team in figuring out a realistic deployment timeline.

5. Finalize a workplan with UNH, and begin building a master database to determine the source of bias between dielectric to density conversions, and improve protocols to detect and correct for presence of bias.

6. Refine data analysis templates to address feedback from users.

7. Present in events such as SEAUPG and NEAUPG to communicate and promote the DPS method.

Significant Results:

The best way to get informed about significant results is to access the Live Workplan Progress Report here: http://www.dot.state.mn.us/materials/dps/workplan.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 discuss 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 of constructed layers. Therefore, density measurements from DPS can give agency much more confidence than cores in assessing overall pavement construction density, which also can help the agency better predicting pavement performance.

This project has seven specific tasks:

Task 1: Software and Hardware Improvements

Task 2: Development of AASHTO Data Collection and Analysis Specification (Ghost Implementation Protocol)

Task 3: Precision and Bias Testing

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).

To date, the focus of the research team has been on addressing technical challenges and making technical presentations and updates. However, as the DPS method gets closer to deployment there is a need for more frequent meetings, communication, and technology promotion to ensure technical challenges are met in a way that is acceptable nationally, and communication occurs between stakeholders such that a realistic roadmap toward implementation can be realized. The FHWA was able to secure and transfer $99,000, which will be extremely beneficial in addressing this need. The funds are planned to be used in contracting UNH and CTC associates to address these needs. The project workplan update linked above gives more information in how that is being accomplished.

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).