TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): ____IOWA DOT_____

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 # *TPF-5(205)*	**Transportation Pooled Fund Program - Report Period:** Quarter 1 (January 1 – March 31) X Quarter 2 (April 1 – June 30), 2012 ☐ Quarter 3 (July 1 – September 30) Quarter 4 (October 4 – December 31)

Project Title: Concrete Pavement Mixture Design and Analysis (MDA)		
Project Manager: Peter Taylor	**Phone:** 294-9333	**E-mail:** ptaylor@iastate.edu
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Lead Agency Project ID: RT 0327	**Other Project ID (i.e., contract #):** Addendum 353	**Project Start Date:** 5/15/09
Original Project End Date: 6/30/13	**Current Project End Date:** Same	**Number of Extensions:**

Project schedule status:

X On schedule ☐ On revised schedule ☐ Ahead of schedule ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Total Percentage of Work Completed
$385,000	$252,470.58	70%

Quarterly Project Statistics:

Total Project Expenses This Quarter	Total Amount of Funds Expended This Quarter	Percentage of Work Completed This Quarter
$20,100.89		15%

Project Description:

The work to be covered by this pooled fund addresses focused activities under the Concrete Pavement Road Map (CP Road Map) Track 1, Mix Design and Analysis. The activities are intended to meet some of the needs identified by the track. These include the need for:

- Verification tests that are easier to perform or better characterize materials and mixtures, both for uniformity control and for acceptance.
- Relationships and models that predict the performance of a mixture based on knowledge of the characteristics and proportions of the materials in it.
- Guides and Specifications that help users make good decisions, and make clear who is responsible for what and how it will be measured and paid for.
- Communication and education tools that help practitioners stay abreast of innovations being developed under this pooled fund.

This pooled fund is being set up to address specific tasks within the Road Map, notably those tasks that can, and should, be addressed in the short term, with high probability of achieving significant improvements in the quality and uniformity of concrete mixtures.

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

- Discussions were held with the person who developed the acoustic device for setting time. He is negotiating with a developer to commercialize the device. He has agreed to lend us one when it is produced.
- A report on the work for developing a protocol for integral waterproofers was prepared.
- Foam drainage tests continued on new samples
- A report on the OK State work on the air void system requirements was received
- A report by OK State was received on the effects of the aggregate system on mixture performance
- Comments were received from reviewers of the Guide Specification

Anticipated work next quarter:

- The report on the work for developing a protocol for integral waterproofers will be completed
- Foam drainage tests will be completed and reported
- Work will begin on compiling and analyzing the data pertinent to the new proportioning approach
- The Guide Specification and associated documents will be completed

Significant Results:

- See attached report

Circumstance affecting project or budget (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).

Progress Statement for
Implementation of Concrete Pavement Mixture Design and Analysis (MDA)
Track of Concrete Pavement Road Map

1. Scope of Pooled Fund

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2. Detailed program

Evaluation of Emerging Testing Equipment

This project involves the evaluation and implementation of promising tests currently under development, and new tests needed, that can be used to evaluate concrete ingredients and mixtures.

Portable XRF Evaluation

If performance based specifications are to become more acceptable, there is a need to be able to verify that a mixture delivered to a given site contains the correct materials in the given proportions used in the verification testing during design stage. At present there is no good way to do this, but the topic is worth investigating. Portable XRF devices are reportedly available that may prove invaluable in this application

A device was borrowed from a manufacturer and tested on a variety of paste and mortar mixtures containing typical ranges of supplementary cementitious materials. This work has been completed and the device returned to the manufacturer. The findings showed that the system was sufficiently precise when testing paste mixtures, but the error when testing mortars was large. This error is introduced by

the variability inherent in a small portable device, and the effects of testing stsytems containing significant amounts of water.

These data have been presented to the TAC at NC2 in Spring 2011, and a technical paper submitted to an international conference scheduled for Summer 2012. A final report has been published.

Acoustic Device to Measure Set Time

Monitoring the rise in temperature due to hydration of a fresh mixture provides a tool to assess the uniformity between material and concrete batches, as well as indicating setting times useful for saw-cutting operations. An alternative approach that may be more fundamentally sound is to use acoustic methods to determine when the speed of sound in a mixture starts to accelerate – thus indicating that hydration is affecting the microstructure of the system.

Attempts were made to obtain such a device but the company was seeking to patent it, and was unwilling to release it for evaluation. At a meeting of the TAC at NC2, it was agreed that this work would be dropped and replaced with developing a testing protocol for integral waterproofing admixtures.

In recent discussions with the developer of the machine, he is negotiating with a manufacturer to commercialize the product. He has offered the loan of one when it is produced.

Integral Waterproofing Admixtures

A number of products are being marketed that reportedly act as integral waterproofing admixtures. There is no standard approach to assessing these products, and in a review of the manufacturers literature, it is not possible to compare data because different tests have been conducted. The aim of this task is to develop a standardized protocol that would enable specifiers and owners to consistently evaluated and compare different products.

Materials have been obtained from five manufacturers and included in mixtures with fixed proportions. The effects of the materials on fresh and hardened properties have been measured, including using several permeability tests. The tests are completed and are being analyzed. A report, guide specification, and technical paper have been prepared and are in review.

Foam Drainage Test.

This test shows promise as a means of assessing the risk of air void loss based on the ingredients in the mix. The correlation between lab data and field performance needs to be established.

Samples have been obtained from 11 construction sites in WI, where field data on air-void-systems before and after the paver have been collected by others under a WIDOT funded project. The samples have been used to run foam drainage tests in the laboratory. An initial look at the data shows that poor correlation between lab and field data, mainly because there was little difference between the various sites in field performance. Additional materials have been received from Oklahoma State University for comparison with their laboratory tests. Tests have been started.

Modeling

It is also planned that under this project some immediate issues such as "How much air is really necessary?" and "How do I specify a good grading" can be addressed.

Air Void System

Seminal work conducted by Klieger in the 50's on which we base our current limits on air content and air void system parameters was conducted using no supplementary cementitious systems and a single type of air entraining admixture. Some of the recommendations of this work need to be verified as still appropriate for current cements, SCM's and air entraining admixtures, all of which have changed significantly over time.

This work is has been completed at Oklahoma State University (OSU). All lab work is complete. A report has been prepared and is in final publication.

Mix proportioning

ACI 211 has recently dropped proportioning of slipform pavement mixtures from their scope of work. ACI 325 will likely pick it up. It would seem that there will be benefit in approaching mix proportioning from a more fundamental view point rather than simply modifying the empirical approach used by ACI 211.

Time has been spent developing the approach and procedure, including identifying the critical parameters. Laboratory work at ISU and OSU has been completed and reports are in final stages of publication. A preliminary philosophical paper was presented at an international conference in 2012.

Mixture Testing and Analysis Guidelines (Specifications)

Changes and innovations to the way we do things can only be achieved within the context of specifications. It is therefore critical that appropriate guides and specifications be developed and implemented.

Guide specification and commentary

A first draft of the guide specification has been prepared submitted to the TAC. Comments have been received and are being accommodated. Work has started on the commentary.

Check Sheets

As a supplement to the guide specification, it is planned to develop check-sheets for different parties involved in the development of a mix design. They will help inexperienced practitioners make appropriate selections for the tasks they are conducting (e.g. preparing a specification or selecting aggregates). It is also intended that decisions are made at the correct location (e.g. slump is selected by the contractor rather than the specifier).

This work continues.

Training, and Outreach

An integral part of any significant change to the methods or process of mix design is education. Users from all parties have to be made familiar with what has changed, why it was necessary, and how it affects the way they do things.

Activities that will be required to support the other tasks in this project include the following. Details of when and how these will be implemented will depend on progress in the other tasks.

- Field trials to demonstrate and validate new tests
- Field trials to demonstrate and validate new models
- Field trials to demonstrate and validate new specifications
- Training materials as needed

This work will be accelerated when other tasks are further developed.

3. Technical Advisory Committee

A Pooled Fund Technical Advisory Committee (TAC) has been established comprising representatives of states contributing funds to the project. The committee meets every six months in conjunction with the Technology Transfer Concrete Consortium (TTCC) pooled fund TAC meetings.