

## 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.*

<b>Transportation Pooled Fund Program Project #</b> TPF-5(183)	<b>Transportation Pooled Fund Program - Report Period:</b> Quarter 1 (January 1 – March 31, 2013) X Quarter 2 (April 1 – June 30) Quarter 3 (July 1 – September 30) Quarter 4 (October 4 – December 31)	
<b>Project Title:</b> Improving the Foundation Layers for Concrete Pavement		
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<b>Lead Agency Project ID:</b> RT 0314	<b>Other Project ID (i.e., contract #):</b> Addendum 352	<b>Project Start Date:</b> 3/16/09
<b>Original Project End Date:</b> 3/15/14	<b>Current Project End Date:</b> 3/15/2014	<b>Number of Extensions:</b>

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	Total Percentage of Work Completed
\$700,000	\$418,210.35	90

Quarterly Project Statistics:

Total Project Expenses This Quarter	Total Amount of Funds Expended This Quarter	Percentage of Work Completed This Quarter
\$42,022.29		10

## **Project Description:**

The objective of this research is to improve the construction methods, economic analysis and selection of materials, in-situ testing and evaluation, and development of performance-related specifications for the pavement foundation layers. The outcome of this study will be conclusive findings that make pavement foundations more durable, uniform, constructible, and economical. Although the focus of this research will be PCC concrete pavement foundations, the results will likely have applicability to ACC pavement foundations and, potentially, unpaved roads. All aspects of the foundation layers will be investigated including thickness, material properties, permeability, modulus/stiffness, strength, volumetric stability and durability. Forensic and in-situ testing plans will be conceived to incorporate measurements using existing and emerging technologies (e.g. intelligent compaction) to evaluate performance related parameters as opposed to just index or indirectly related parameter values. Field investigations will be conducted in each participating state. The results of the study will be compatible with each state's pavement design methodology and capable for use with the Mechanistic-Empirical Pavement Design Guide (MEPDG). Evaluating pavement foundation design input parameters at each site will provide a link between what is actually constructed and what is assumed during design. There are many inputs to the pavement design related to foundation layers and this project will provide improved guidelines for each of these. The study will benefit greatly from maximizing the wide range of field conditions possible within the framework of a pooled fund study.

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

The main research activities during this quarter involved the following [related research task number is in the parenthesis].

- Conducting laboratory testing (frost-heave/thaw-weakening) [Sub Task 1.5],
- Conducting in-situ test data analysis on field projects and developing field project reports [Sub Tasks 1.5, 1.7, 3.1, 3.2, 3.4,]
- Obtaining temperature sensor array data on Iowa Hwy 30 project and conducting in-situ testing [Sub Task 3.1].

### Laboratory frost-heave and thaw-weakening testing:

Subgrade materials collected from a project site in Boone, Iowa have been stabilized using different stabilizers (fly ash, cement, fibers) to assess its frost-heave and thaw-weakening testing. This work extends the work that was previously done, focusing on stabilized materials.

### Instrumentation on US Highway 30, Iowa:

A summary of instrumentation installed on the US30 project is provided in the last QPRs. One of the main objectives of this instrumentation was to identify temperature fluctuations in the foundation layers with depth and across the pavement, and to assess thermal shielding of road edge due to snow cover. Temperature data is being continuously collected and periodically downloaded since fall 2011. The data is being analyzed and incorporated into the project report.

Activities and products that are being developed as part of the project, focused on three key areas of current work: (1) project level data reports that are being finalized and updated with new information (e.g., recent resilient modulus test results and updated FWD data analysis); (2) additional laboratory testing that is on-going related to freeze-thaw performance testing for various pavement foundation materials with a focus on using stabilizers, and (3) developing the manual of practice document. With the exception of monitoring an array of embedded sensors, all field testing is complete. A total of 14 reports are being developed as part of this project. Of these, ten are field project reports summarizing field and laboratory test results and analysis pertaining to each field project, one compares mechanistic properties of pavement foundation layers from all the field projects as well as seven field sites that were tested for seasonal variations in Iowa, two presents results of finite element analysis and MEDPG sensitivity analysis, and one will provide an executive summary of the field testing. Of these 14 reports, draft versions of 8 reports have been completed and the remaining 6 reports are underway.

**Anticipated work next quarter:**

- Complete data analysis for the field projects and update field project reports.
- Develop content for the “Manual of Practice” reflecting changes discussed by the project team at the January team meeting at TRB.

**Significant Results:**

Analysis of the in situ test results is revealing how poorly common empirical relationships used in pavement design are at determining actual field values. It has also become apparent that there is extensive variability and that field control around moisture and density does not necessarily ensure that the pavement design values are achieved. Recommendation on how to deal with these factors are being developed within the manual of practice report. Another aspect of this project has been to fully characterize material properties from the various project sites. To complete this characterization tests have been performed to determine: index properties; resilient modulus; degradation and permanent strain characteristics; freeze-thaw durability; mineralogy and micro-features, and hydraulic conductivity. The various measurements are being analyzed in conjunction with the field tests, and compared with the design input parameters specifically used on each project and also to different design methodologies (e.g., MEPDG, AASHTO 1972, 1986, 1993, PCA 1985). While most of the field work was completed in 2012 and draft versions of some of the reports have been developed in the previous quarters, they are being updated with new and additional analysis, particularly with the FWD data. Just recently, the approach to calculating elastic modulus from the raw FWD data has been updated requiring that results for all project reports be updated. Three graduate students have completed their MS thesis so far (including one this quarter) and their results are now being integrated into the reports.

**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).**

Note: although the project as a whole is 90% completed, it should be noted that the manual which will comprise the “final report” is 50% complete.