

## 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> X Quarter 1 (January 1 – March 31, 2014) Quarter 2 (April 1 – June 30, 2014) Quarter 3 (July 1 – September 30, 2014) Quarter 4 (October 1 – December 31, 2014)	
<b>Project Title:</b> Improving the Foundation Layers for Concrete Pavement		
<b>Project Manager:</b> Linda Narigon	<b>Phone:</b> 239-1471	<b>E-mail:</b> linda.narigon@dot.iowa.gov
<b>Project Investigator:</b> David White	<b>Phone:</b> 294-1463	<b>E-mail:</b> djwhite@iastate.edu
<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> 3/15/2016	<b>Number of Extensions:</b> On-going pooled fund project

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
\$875,000	\$539,915.78	94

Quarterly Project Statistics:

Total Project Expenses This Quarter	Total Amount of Funds Expended This Quarter	Percentage of Work Completed This Quarter
\$34,741.18		2

**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.):**

A TAC meeting was conducted on February 20, 2014. Meeting minutes are attached below.

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

- Conducting in-situ test data analysis on field projects and developing field project reports [Sub Tasks 3.2 and 3.3]
- Preparing manual of professional practice and technology transfer materials [Sub Tasks 4.1, 4.2, and 4.3]
- Obtaining temperature sensor array data on Iowa Hwy 30 project and conducting in-situ testing [Sub Task 3.1].

Field Project Reports:

A table summarizing field project reports, laboratory testing data reports, and data analysis reports being developed as part of this project is provided below. New data and analysis results for these reports with regard to laboratory measurements and updated FWD data analysis were incorporated into these reports this quarter. Reports that have been drafted are currently being reviewed by the technical editing team. Performance monitoring data is requested for a few selected projects. Data received from DOTs is being reviewed by the research team.

Manual of Practice

The research management team held several meeting to develop the publication details for the Manual. The document layout, illustration needs, and content were discussed. Additional meeting will be conducted over the next quarter to fine-tune the publication details.

Instrumentation on US Highway 30, Iowa:

Temperature data is being continuously collected and periodically downloaded since fall 2011. The data is being analyzed and incorporated into the US30 project report.

**Anticipated work next quarter:**

- Complete technical editing on all project reports and submit to TAC.
- Continue developing content for the "Manual of Practice".

**Significant Results:**

No significant results to report during this quarter.

**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).**

TAC committee:

<b>Pooled Fund Members</b>		
Mehdi	Parvini*	California DOT
Mark	Dunn	Iowa DOT
Todd	Hanson	Iowa DOT
Linda	Narigon	Iowa DOT
Steve	Megivern*	Iowa DOT
Kevin	Merryman	Iowa DOT
Mark	Grazioli*	Michigan DOT
John	Staton	Michigan DOT
Josh	Freeman	Pennsylvania DOT
Lydia	Peddicord*	Pennsylvania DOT
Jeff	Horsfall*	Wisconsin DOT
Lisa	Rold	FHWA
Gina	Ahlstrom	FHWA
*Primary state contact		
<b>Research Team</b>		
Tom	Cackler	CP Tech Center/ISU
Barry	Christopher	Geotech Engr Consultant
Andrew	Dawson	Univ of Nottingham
Jeff	Roesler	Univ of Illinois U-C
Pavana	Vennapusa	CEER/ISU
David	White	CEER/ISU

## MEETING MINUTES

### Pavement Foundation: TPF-5(183)

Date: February 20, 2014 (2:00 to 3:30PM Central)

1. Welcome and introductions.

TAC reps present:

California: Mehdi Parvini

Iowa: Mark Dunn

Linda Narigon

Michigan: Mark Grazioli

Pennsylvania: Lydia Peddicord

Wisconsin: Jeff Horsfall

FHWA: Gina Ahlstrom

Team:

David White, CEER

Pavana Vennapusa, CEER

Tom Cackler, CP Tech Center

Jeff Roesler, University of Illinois-Champaign/Urbana

Barry Christopher, Geotechnical consultant

Andrew Dawson, University of Nottingham

2. Review scope of work (quick refresher) and highlights from recent progress (see QPRs).

David White:

- In the past few months, the research team has started to move past data analysis.
- Lots of information collected from the 12 field projects.
- In the last 18 months, significant amount of lab work has been on characterization of materials in terms of design input parameters, resilient modulus, permanent deformation, aggregate degradation, and freeze-thaw performance.
- Updates and a summary of the results from the lab testing will be sent to the TAC.

3. Discuss proposed final project schedule and needs from TWG and external reviewers.

Tom Cackler:

- The project began with 4 states and FHWA. Additional states and their funding were anticipated. Only one more state was added and the funding from that state constitutes the proposed budget.
- A work scope for the following 24 months, including a timeline and budget were sent out to the TAC.
- There has been a tremendous amount of field work done and the field reports are almost complete.
- The draft reports will be submitted on April 1<sup>st</sup> for TAC review. They will consist of field project reports, data analysis reports, and an executive summary. In particular, the TAC needs to review the executive summary.
- State reports and executive summary will be finalized and printed by July.
- Tech transfer material is being written and will be finalized by October.
- The major deliverable will be a manual of practice, a guide to implement the findings of this project.
- The TAC will have a chance to review the manual and depending on the number of comments there may be an additional TAC meeting to discuss.
- Each of the states can have a state based workshop after manual is printed.
- A high quality printed document is being recommended. The IMCP manual is being used as an example of the type of product being proposed. The manual will be available on-line but a high quality printed document will be of value and increase usage.

Comments:

- Linda Narrigon: Iowa DOT as lead state has reviewed the original contract and has no problems with the proposed scope of work, but wants the TAC to concur with printed copies.
- No concerns from any TAC reps.
- Noting no concerns, there is a consensus to move forward.

4. Final thoughts.

Dave White

- The manual will need to have external expert reviewers. If TAC has suggestions, send them to Dave White.

- The state reports will serve as an archive/appendix to the manual. The reports will contain extensive amount of data and analysis and can be overwhelming to review. I suggest each TAC member focus on the areas of their interest and provide feedback.
  - The Tech Briefs will be short snapshots from each project report, but won't be finalized until late summer, early fall. All of that info will be incorporated into the manual of practice.
  - The team has developed a detailed outline for the MOP. Goal is to keep the manual to 100 pages. Review of manual will be fall of 2015.
  - The projects completed a few years ago may have performance records that would be helpful to incorporate into the project reports (i.e. PCI measurements, IRI, etc.). Pavana will follow up with the states on the information needed.
  - Pennsylvania US422 Project: The project involved injecting polyurethane foam and our field data analysis indicated both advantages and limitations with implementing the technology. There is room for improvements in terms of field controlling the process to improve ride quality.
5. State DOT updates on new performance data from project site, specifications, and other new methods/materials relevant to research project.

At the beginning of the project existing specs and QC/QA were reviewed. Have there been new developments.

- Iowa: Mark Dunn. No big changes. There is a need to look at chemical treatments along with traditional foundation materials, but status quo at the moment.
- PA: No updated specs. But Lydia will help get IRI data from PA US422 project. Pavana will follow-up with Lydia.
- CA: CA doesn't have updated specs. But Mehdi had several questions.
  - New MEPDG guide: There has been a lot of discussion of the low sensitivity to foundations, materials and layer thicknesses. There are a couple of NCHRP projects looking at shortcomings from modeling. Have there been any changes to MEDPG since the analysis was done by UI.
    - Dave White: We can't design our way out of bad foundations. Even newer version of MEPDG doesn't deal with foundation problems. Jeff Roesler conducted detailed numerical study on this aspect and found that uniformity is key and is not accounted for in MEPDG.
    - Jeff Roesler: There have been no major changes in the MEPDG since 2007 with the exception of thermal coefficient properties of concrete. There is no need to redo the analysis. Foundation properties have low sensitivity. Uniformity was found to be the key in numerical analysis.
  - CA has been using precast concrete in many projects. There have been many issues with performance. Not sure if it is a grading issue in the bedding layer that is placed underneath? Also, lean concrete base is being extensively used for rapid construction, but early age cracking is a problem. Will these be addressed as part of this project or is should be dealt with separately?
    - Dave: The team monitored precast installation outside of LA. Initial observation was that the foundation from a stiffness standpoint was good, but had concerns about potential erosion and loss of support. Pavana/Dave will follow up to get performance information from the project.
    - Dave: There have been a variety of methods used around the country to stabilize materials. Cracking seems to be an issue and there is some literature on the benefits of micro-cracking. Practice of using these materials will be discussed in the manual of practice. CPTech Center has been working on early age micro-cracking in concrete.
    - Tom: Tom will follow up with Mehdi on this issue separately.

- WI: Specs are the same as before. Wisconsin is doing a pilot program in 2014 with a new QMC program where density will be monitored during construction to evaluate variability in placement.
- MI: No updated specs. Not aware of whether performance data from MI I-94 is available or not. Will look into it.
- Barry Christopher: Non-woven geotextile is being used as a separation layer between rigid bases and pavement layers in Europe extensively and in some places in the US. It essentially acts as a cushion between the two and minimizes reflective cracking.

Action items:

- Updates and a summary of the results from the lab testing will be sent to the TAC.
- CEER has produced a video from Central Iowa Expo Research site in Iowa. The video is applicable to pavement foundations and may be of interest to this group. The video link will be sent to the TAC.
- Pavana will follow up with PA, CA, and MI for performance data on field projects.
- Dave & Mehdi will discuss several issues that California is having:
  - Precast foundation issues
  - Lean concrete
  - CP Tech will follow up with Mehdi on early age cracking issues.
  - Barry, Dave and Mehdi will discuss work being done in Europe on separation.
- Names for expert external reviewers for manual
- After the meeting we will send detailed project report schedule.
- Send new performance records from completed state projects.

**TABLE: Summary of project reports being developed as part of TPF-5(183)**

No.	Project/Report Title	Location	Field Testing Dates	Pavement and Foundation Layer Description/Notes	Report Status
1	Pavement Foundation Layer Reconstruction – MI I-94 Field Study	St. Clair/Macomb Counties, MI	May 27 to 30, 2009 [Performance Data Needed]	<u>Existing Pavement:</u> 9 in PCC, 4 in. gravelly sand base, and 12 in. sand subbase, and silty clay subgrade. <u>New Pavement:</u> 11 in. PCC, 27 in. open graded drainage course with geotextile separation layer at subgrade/base interface. Field testing: FWD, LWD, DCP, APT, and IC. Lab testing: Index tests, resilient modulus, permanent strain, degradation.	Draft Completed
2	Pavement Foundation Layer Reconstruction – PA US22 Field Study	Clyde and Blairsville, PA	July 27 to Aug. 1, 2009	<u>New Pavement:</u> 10 in. PCC, 4 in. Asphalt treated base or Cement treated base, 2 in Class 2A leveling stone subbase, 18 in rock cap, and natural subgrade. Field testing: FWD, LWD, DCP, APT, and IC. Lab testing: Index tests, frost-heave, resilient modulus.	Report Underway
3	Pavement Foundation Layer Reconstruction – IA I-29 Field Study	Monona County, IA	Aug 31 to Sept 10, 2009	<u>New Pavement:</u> 12 in. PCC, 6 in. Open Graded Base, 18 in. Modified Subbase, 12 in. re-compacted subgrade. Field testing: FWD, LWD, DCP, and IC. Lab testing: Index tests, frost-heave, resilient modulus.	Draft Completed
4	Jointed Concrete Pavement Rehabilitation with Injected Polyurethane Foam and Dowel Bar Retrofitting – US422 Field Study	Indiana, PA	Oct. 1-2, Nov. 2-4, 2009, Apr. 28, Jul. 21, 2010 [Performance Data Needed]	11 in. PCC, 4 in. open-graded stone base layer, 4 in. well-graded subbase layer, and variable subgrade with mixed clay/shale/sandstone rock. Field testing: FWD, LWD, DCP, APT, and robotic total station. Lab testing: Index tests, resilient modulus.	Draft Completed
5	Pavement Foundation Layer Reconstruction – MI I-96 Field Study	Lansing, MI	May 18 to 23, 2010 [Performance Data Needed]	<u>New Pavement:</u> 11 in. PCC, 5 in. CTB, 11 in. sand subbase layer (geotextile separator at CTB and subbase interface), subgrade. Field testing: FWD, LWD, DCP, and IC. Lab testing: Index tests, frost-heave, resilient modulus.	Draft Completed
6	Pavement Foundation Layer Construction – WI US10 Field Study	Stephens Point, WI	May 25 to 26, 2010	<u>New Pavement:</u> 10 in. PCC, 6 in. dense graded base, 24 in. sand subbase layer, subgrade. Field testing: FWD, LWD, DCP, and IC. Lab testing: Index tests, frost-heave, resilient modulus.	Draft Completed
7	Pavement Rehabilitation Using Precast Prestressed Concrete Slabs – CA I-15 Field Study	Oakland, CA	Jun 28, 2010 [Performance Data Needed]	Precast PCC slabs over existing CTB base. Field testing: FWD and DCP.	Report Underway
8	Pavement Foundation Layer Reconstruction – IA I-35 Field Study	Jewell, IA	Sep. to Oct. 2010, July 2014	<u>New Pavement:</u> 12 in. PCC, open-graded RPCC, virgin, and RPCC+virgin limestone mixture base. Field testing: LWD, DCP, PLT, and APT during construction. Follow-up testing planned with FWD, DCP, and CHP in July 2014.	Draft Completed

				Lab testing: Index tests.	
9	Pavement Foundation Layer Reconstruction – IA US30 Field Study	Ames-Boone, IA	June 2010 and July 2011 - present	<u>New Pavement</u> : 12 in. PCC, open-graded RPCC subbase, RPCC+RAP mixture subbase, subgrade. Field testing: FWD, LWD, DCP, and temperature monitoring. Lab testing: Index tests, frost-heave, resilient modulus, aggregate degradation, permanent deformation.	Report Underway
10	Evaluation of Existing Jointed Concrete Pavement – IA US34 Field Study	Ottumwa, IA	July 25, 2012, June 2014	Evaluation of longitudinal cracks at various locations across pavement using FWD. Follow-up testing planned with FWD and DCP in June 2014.	Report Underway
11	Evaluation of Existing Jointed Concrete Pavement – IA NW Urbandale Drive	Urbandale, IA	October 30 to November 7, 2013	Forensic evaluation of pavement joint deterioration using FWD, CHP, and DCP testing.	Draft Completed
12	Comparison of Mechanistic Pavement Foundation Materials	CA, IA, MI, PA, WI	May 2010 to January 2014	Various pavement and foundation layer sections (pavements built in 1958 to 2011)	Report Underway
13	Finite Element Analysis with Non Uniform Support Conditions	N/A	N/A	U of I: Using field data obtained from MI I-94, MI I-96, WI US10 project sites	Draft Completed
14	MEPDG Sensitivity Analysis	N/A	N/A	U of I: N/A	Draft Completed
15	Final Report – Executive Summary	—	—	No longer than 25 pages that gives a summary of key findings from field projects, sensitivity analysis, and non-uniformity analysis	