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(183)*	**Transportation Pooled Fund Program - Report Period:** Quarter 1 (January 1 – March 31, 2020) x Quarter 2 (April 1 – June 30, 2020) Quarter 3 (July 1 – September 30, 2020) Quarter 4 (October 1 – December 31, 2020)
Project Title: Improving the Foundation Layers for Concrete Pavement	
Project Manager: Brian Worrel **Phone:** 239-1471 **E-mail:** brian.worrel@dot.iowa.gov	
Project Investigator: Peter Taylor (David White) **Phone:** 294-3781 **E-mail:** ptaylor@iastate.edu	

Lead Agency Project ID: RT 0314	**Other Project ID (i.e., contract #):** Addendum 352	**Project Start Date:** 3/16/09
Original Project End Date: 3/15/14	**Current Project End Date:** 12/31/2018	**Number of Extensions:** On-going pooled fund project

Project schedule status:

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

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Total Percentage of Work Completed
$875,000	$875,000	98

Quarterly Project Statistics:

Total Project Expenses This Quarter	Total Amount of Funds Expended This Quarter	Percentage of Work Completed This Quarter

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.):

- Chapters 1, 2 and 3 have been updated and are being internally reviewed for sharing with other co-authors by July 15.
- Chapter 2 updates included a complete re-writing of the chapter from an earlier version that included key findings from each field project site, to a broader "Lessons Learned" write-up. The revision was important and done based on feedback received from CPTech Center, with a need to synthesize information. The new version highlights 5 broader lessons learned from the field and lab testing work and includes examples to support the assertions. The following is a list of the subsections in the revised Chapter 2:

  CHAPTER 2: LESSONS LEARNED FROM FIELD STUDIES

  - Field Verification of Foundation Layer Design Mechanistic Parameter Values
    - Design Parameters used by Different State Agencies
    - Field Testing and Interpretation Methods
    - Field Testing Results and Comparisons with Design Input Values
  - Spatial Non-Uniformity of Foundation Layer Mechanistic Properties
    - Field Testing Results
    - Influence of Foundation Input Properties on Design and Performance Predictions
    - Impact of Nonuniform Support Conditions on Mechanistic Pavement Responses
    - Impacts of Loss of Support on Mechanistic Pavement Responses
  - In Situ Assessment of Distressed Pavement Sections
    - Assessment of Frost Heave and Joint Deterioration on US30 near Ames, IA
    - Assessment of Joint Deterioration on Urbandale Drive in Urbandale, IA
    - Evaluation of Premature Pavement Distresses on US34 near Mount Pleasant, IA
  - In Situ Assessment of Rehabilitated Pavement Sections
    - Pennsylvania SR-422 Pavement Rehabilitation Project
    - California I-15 Pavement Rehabilitation using Precast Concrete Panels
  - Impact of Seasonal Variations on Pavement Foundations and Performance
    - Seasonal Temperature Variations and Frost Depth
    - Seasonal Variations in In Situ Foundation Layer Properties
    - Laboratory Characterization of Frost-Heave and Thaw-Weakening Susceptibility

- Chapter 3 has been developed to provide the a historical background of pavement design, foundation design inputs, how they influence pavement distress/performance, how they were originally measured during the development of the design equations, and the current state of the practice. This historical background provides important perspective to readers to understand importance of proper testing methods, and also aids in selection of the appropriate testing devices/methods to verify design input parameters. Much of this information has been lost in translation over the years, that has resulted in wide-spread use of empirical equations without understanding the uncertainties associated with those equations. The state of practice has drifted to a highly empirical methodology and "top-down" mindset. Chapter 3 synthesizes this information, and informs the reader on quantitative approach to evaluating the risks (statistically) in using the different empirical approaches, and indirect versus direct testing methods. Chapter 3 establishes the framework for recommendations/implementation to be provided Chapter 4. The new outline for Chapter 3 is as follows:

  CHAPTER 3: MECHANISTIC CHARACTERIZATION OF PAVEMENT FOUNDATION LAYERS

  - A Brief History of Rigid Pavement Design Evolution
  - Geotechnical Input Parameters in Rigid Pavement Design
    - Modulus of Subgrade Reaction k-value
    - Foundation Layer Resilient Modulus
    - Foundation Layer Drainage Properties
  - Why Using Empirical Relationships Require Understanding Error?
  - Summary

Anticipated work next quarter:

- We plan to complete Chapter 4 by mid-August.
- Chapter 5 will be completed in early September
- TAC meeting will be scheduled for October

Significant Results:

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:

Brian Worrel Iowa DOT
Todd Hanson Iowa DOT
Kevin Merryman Iowa DOT
Mark Grazioli Michigan DOT
Mehdi Parvini California DOT
Brian Williams Missouri DOT
Georgene Geary Georgia DOT
Jim Brennan Kansas DOT
Wan Chen Texas DOT
David White, Researcher
Peter Taylor, CP Tech Center
Tom Cackler, Woodland Consulting