

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, 2018) Quarter 2 (April 1 – June 30, 2018) Quarter 3 (July 1 – September 30, 2018) X Quarter 4 (October 1 – December 31, 2018)	
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
 Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Total Percentage of Work Completed
\$875,000	\$869,238.50	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.):

- A team meeting including Chris Brakke and Todd Hanson from the Iowa DOT was held November 2.
- A list of deliverables is attached. They are available in a CyBox.

Anticipated work next quarter:

- Despite the contract ending, we will honor our commitments to complete the project.
- A final report will be submitted.
- A web-based TAC meeting will be held
- A webinar will be held.

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 Meryman 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

List of Deliverables

Other Final Technical Reports – available on CyBox

1. Li, J., White, D.J., and Vennapusa, P. (2018). “Field Assessment of Variability in Pavement Foundation Properties,” DTFH 61-06-H-00011 Work Plan 18, National Concrete Pavement Technology Center and Center for Earthworks Engineering Research (CEER), Iowa State University, Ames, IA.
2. White, D.J., Vennapusa, P., and Zhang, Y. (2016). “Field Assessment of Jointed Portland Cement Concrete Pavement with Premature Distresses — Iowa US 34 Field Study”, DTFH 61-06-H-00011 Work Plan 18, National Concrete Pavement Technology Center and Center for Earthworks Engineering Research (CEER), Iowa State University, Ames, IA.
3. White, D.J., Vennapusa, P., and Zhang, Y. (2016). “Jointed Concrete Pavement Rehabilitation with Precast Concrete Pavement – California I-15 Field Study (Field Project Report),” DTFH 61-06-H-00011 Work Plan 18, National Concrete Pavement Technology Center and Center for Earthworks Engineering Research (CEER), Iowa State University, Ames, IA.
4. White, D.J., Vennapusa, P., Gieselman, H., Zhang, Y., Zhao, L., and Zhang, J. (2016). “Pavement Foundation Layer Reconstruction – Iowa I-35 Field Study,” DTFH 61-06-H-00011 Work Plan 18, National Concrete Pavement Technology Center and Center for Earthworks Engineering Research (CEER), Iowa State University, Ames, IA.
5. White, D.J., Vennapusa, P., Li, J., Wolfe, A., Douglas, S. (2016). “Pavement Foundation Layer Reconstruction – Pennsylvania US 22 Field Study,” DTFH 61-06-H-00011 Work Plan 18, National Concrete Pavement Technology Center and Center for Earthworks Engineering Research (CEER), Iowa State University, Ames, IA.
6. White, D.J., Vennapusa, P., Zhang, Y., Johnson, A. (2016). “Assessment of Seasonal Variations in Concrete Pavement Foundation layers – Multiple Test Sections in Iowa,” DTFH 61-06-H-00011 Work Plan 18, National Concrete Pavement Technology Center and Center for Earthworks Engineering Research (CEER), Iowa State University, Ames, IA.
7. White, D.J., Vennapusa, P., Zhang, Y., Gieselman, H., Prokudin, M. (2016). “Pavement Foundation Layer Reconstruction IA US 30 Field Study,” DTFH 61-06-H-00011 Work Plan 18, National Concrete Pavement Technology Center and Center for Earthworks Engineering Research (CEER), Iowa State University, Ames, IA.
8. White, D.J., Vennapusa, P., Franz, R., Gieselman, H., and Wolfe, A. (2015). “Pavement Foundation Layer Construction – Wisconsin US10 Field Study,” DTFH 61-06-H-00011 Work Plan 18, National Concrete Pavement Technology Center and Center for Earthworks Engineering Research (CEER), Iowa State University, Ames, IA.
9. White, D.J., Vennapusa, P., Gieselman, H., Wolfe, A.J., Douglas, S., and Li, J. (2015). “Pavement Foundation Layer Reconstruction Michigan I-94 Field Study,” DTFH 61-06-H-00011 Work Plan 18, National Concrete Pavement Technology Center and Center for Earthworks Engineering Research (CEER), Iowa State University, Ames, IA.
10. White, D.J., Vennapusa, P., Gieselman, H., Wolfe, A.J., Johnson, A., Franz, R., and Zhao, L. (2015). “Pavement Foundation Layer Reconstruction with Cement Treated Base Underlain by Geotextile – Michigan I-96 Field Study,” DTFH 61-06-H-00011 Work Plan 18, National Concrete Pavement Technology Center and Center for Earthworks Engineering Research (CEER), Iowa State University, Ames, IA.

11. White, D.J., Vennapusa, P., Wolfe, A. (2015). "Jointed Concrete Pavement Rehabilitation with Injected High Density Polyurethane Foam and Dowel Bar Retrofitting – Pennsylvania US 422 Field Study," DTFH 61-06-H-00011 Work Plan 18, National Concrete Pavement Technology Center and Center for Earthworks Engineering Research (CEER), Iowa State University, Ames, IA.
12. Vennapusa, P., Taylor, P., and White, D.J. (2015). "Field Evaluation of Premature Pavement Joint Deterioration – Iowa Urbandale Drive Field Study," DTFH 61-06-H-00011 Work Plan 18, National Concrete Pavement Technology Center and Center for Earthworks Engineering Research (CEER), Iowa State University, Ames, IA.
13. White, D.J., Vennapusa, P., Gieselmann, H., Wolfe, A.J., Johnson, A., and Douglas, S. (2015). "Pavement Foundation Layer Reconstruction Project – Iowa I-29 Field Study," DTFH 61-06-H-00011 Work Plan 18, National Concrete Pavement Technology Center and Center for Earthworks Engineering Research (CEER), Iowa State University, Ames, IA.
14. Brand, A.S., and Roesler, J. R. (2014). "Mechanistic-Empirical Pavement Design Guide (MEPDG) Sensitivity Analysis," DTFH 61-06-H-00011 Work Plan 18, National Concrete Pavement Technology Center and Center for Earthworks Engineering Research (CEER), Iowa State University, Ames, IA.
15. Brand, A.S., Roesler, J.R., Chavan, H.L., and Evangelista, F. (2014). "Effects of a Non-Uniform Subgrade Support on the Responses of Concrete Pavement," DTFH 61-06-H-00011 Work Plan 18, National Concrete Pavement Technology Center and Center for Earthworks Engineering Research (CEER), Iowa State University, Ames, IA.

Technical Papers

1. Zhang, Y., Horton, R. White, D.J., Vennapusa, P. (2018). "Seasonal frost penetration in pavements with multiple layers," *Journal of Cold Regions Engineering*, 32(2): 05018002. <https://ascelibrary.org/doi/10.1061/%28ASCE%29CR.1943-5495.0000159>
2. Zhang, Y., White, D.J., Vennapusa, P., Johnson, A., Prokudin, M. (2018). "Investigating Frost Heave Deterioration at Pavement Joint Locations," *Journal of Performance of Constructed Facilities*, ASCE, 2018, 32(2): 04018001. <https://ascelibrary.org/doi/10.1061/%28ASCE%29CF.1943-5509.0001143>
3. Vennapusa, P., Zhang, Y., and White, D.J. (2018). "Assessment of Support Conditions of Concrete Pavement Using FWD Deflection Basin Data," *Journal of Testing and Evaluation*, ASTM, <https://doi.org/10.1520/JTE20170226>. ISSN 0090-397. <https://doi.org/10.1520/JTE20170226>.
4. Zhang, Y., Vennapusa, P., White, D.J., and Johnson, A. (2017). "Seasonal variations and in situ assessment of concrete pavement foundation mechanistic properties," *International Journal of Pavement Research and Technology*, Vol. 11, 363-373. <https://doi.org/10.1016/j.ijprt.2017.09.007> <https://www.sciencedirect.com/science/article/pii/S1996681417300366>
5. Vennapusa, P., Zhang, Y., and White, D.J. (2016). "Comparison of Pavement Slab Stabilization Using Cementitious Grout and Injected Polyurethane Foam," *Journal of Performance of Constructed Facilities*, ASCE, 04016056. <https://ascelibrary.org/doi/10.1061/%28ASCE%29CF.1943-5509.0000916>
6. Roesler, J. R., Chavan, H., King, D., and Brand, A.S. (2016). "Concrete slab analyses with field- assigned non-uniform support conditions," *International Journal of Pavement Engineering*, 17:7, 578-589. <https://www.tandfonline.com/doi/abs/10.1080/10298436.2015.1007231?journalCode=g pav20>

7. Zhang, Y., Johnson, A., and White, D.J. (2015). "Laboratory freeze-thaw assessment of cement, fly ash, and fiber stabilized pavement foundation materials," *Cold Regions Science and Technology*, Vol. 122, 50-57.
<https://www.sciencedirect.com/science/article/pii/S0165232X15002657>
8. Vennapusa, P., and White, D.J. (2015). "Field assessment of a jointed concrete pavement foundation treated with injected polyurethane expandable foam." *International Journal of Pavement Engineering*, 16:10, 906-918.
<https://www.tandfonline.com/doi/abs/10.1080/10298436.2014.972917>
9. Brand, A. and Roesler, J. R. (2014). "Finite element analysis of a concrete slab under various non-uniform support conditions", *International Journal of Pavement Engineering*, 15:5, 460-470. <https://www.tandfonline.com/doi/abs/10.1080/10298436.2013.837463>

Thesis/Dissertations

1. Zhang, Y. (2016). "Assessing Seasonal Performance, Stiffness, and Support Conditions of Pavement Foundations," Ph.D. Dissertation, Iowa State University, Ames, IA.
<https://lib.dr.iastate.edu/etd/15474/>
2. Wolfe, A.J. (2011). "Behavior of composite pavement foundation materials subjected to cyclic loading," M.S. Thesis, Iowa State University, Ames, IA.
<https://lib.dr.iastate.edu/etd/12000/>
3. Li, J. (2013). "Permanent deformation and resilient modulus of unbound granular materials", M.S. Thesis, Iowa State University, Ames, IA. <https://lib.dr.iastate.edu/etd/13114/>
4. Li, J. (2017). "A study on the variability of pavement foundation properties," Ph.D. Dissertation, Iowa State University, Ames, IA. <https://lib.dr.iastate.edu/etd/16166/>
5. Zhang, Y. (2013). "Frost-heave and thaw-weakening of pavement foundation materials," M.S. Thesis, Iowa State University, Ames, IA. <https://lib.dr.iastate.edu/etd/13617/>
6. Johnson, A. (2012). "Freeze-thaw performance of pavement foundation materials," M.S. Thesis, Iowa State University, Ames, IA. <https://lib.dr.iastate.edu/etd/12824/>

