2016 UDOT RESEARCH PROBLEM STATEMENT

****** Problem statement deadline is March 14, 2016. Submit statements to Tom Hales at tahales@utah.gov. ******

Title: Inverted Base Pavement - Pooled Fund Participation **No. (office use):** 16.01.07

Submitted By: Jason Richins **Organization:** UDOT

Email: Jtrichins@utah.gov **Phone:** 801 360-4985

UDOT Champion (suggested): Scott Andrus, Jason Richins & Georgia DOT

Select One Subject Area

- ☒ Materials/Pavements
- ☐ Maintenance
- ☐ Traffic Mgmt/Safety
- ☐ Preconstruction
- ☐ Planning
- ☐ Public Transportation

1. Describe the problem to be addressed.

Inverted base pavements are a potentially cost-efficient alternative pavement structure. Many states are using alternate bidding to accommodate the most cost effective pavement alternatives, thus with the availability of a viable design approach for inverted pavements, they can also be utilized in alternate pavement bids. Inverted pavements could also be used in conjunction with full depth reclamation to provide for reuse of pavement sections that have exceeded their useful life. Inverted base pavements can help reduce the cost of highway construction, provide a longer design/service life, and reduce maintenance costs. Recent research on inverted base pavements, conducted primarily on behalf of Georgia Department of Transportation (GDOT), has provided new insights into their response under traffic loading and led to the identification of possible enhanced design methods for superior performance (Cortes and Santamarina 2013; Papadopoulos and Santamarina 2014).

2. Explain why this research is important.

Research in the USA on inverted base pavements has remained an academic exercise, with limited practical experience to compare against. Industry-scale implementation of inverted base pavements will require:

- Additional study of field cases with detailed construction records and long-term performance monitoring data.
- Advanced material characterization and modeling with emphasis on the granular base.
- Numerical simulation of inverted base pavement performance.
- Relevant calibrations for use of the design method within the framework of the Mechanistic-Empirical Pavement Design Guide (MEPDG).

The proposed Transportation Pooled-Fund (TPF) study addresses these needs and will provide industry and state DOTs nationwide, with the knowledge required to confidently use inverted base pavements based on experimental and field evidence complemented by numerical simulations to predict their performance. Furthermore, certain issues regarding the performance of inverted base pavements, such as the enhanced compaction of the granular base, will be elucidated and explained in mechanistic terms. Georgia currently has two inverted pavement test sections, one on a private quarry road and one on an industrial parkway public highway. Virginia DOT recently constructed an inverted pavement section (Highway 659 Bypass) in Bull Run, VA, and New Mexico DOT also constructed an inverted pavement section on Interstate 25 near Raton, NM, in the northeast portion of the state. Other test sections are in various stages of consideration and/or under construction.

3. List the research objective(s):

The overall goal for this Transportation Pooled Fund (TPF) study is to expedite the implementation of inverted base pavements design specifications for state DOTs and to make inverted base pavements a practical and reliable alternative design approach for highway pavements.

4. List the major tasks:

The TPF study is organized in six main tasks:

Task #1: Knowledge Compilation and Synthesis: An extensive compilation of published studies has already taken place as part of the completed GDOT studies (Cortes 2010; Papadopoulos 2014). The next phase will include polling prominent pavement designers and contractors to extract and distill the national experience with granular bases and inverted base pavement implementation and performance. This exercise will also involve contacting and interviewing researchers from the Council for Scientific and Industrial Research (CSIR) in South Africa, that country's leading pavement research institution, to learn from their 40 years of accumulated experience.

Task #2: Test Section Assessment: Evaluation of several existing inverted base pavement sections along with adjacent conventional

pavement test sections for direct comparison will be continued and expanded. This task will be implemented in direct collaboration with participating state DOTs and industry partners. Available information on conventional and inverted base pavement test section performance in Georgia will be expanded by acquiring, high- resolution, quantitative pavement distress information as well as other test data using recently developed Automated Plate Load Testing methods. Similar measurements could be performed on test sections in other states.

Task #3: Long-term Performance Monitoring and Validation: Perform laboratory and field tests, complemented with numerical simulations, to assess critical conditions that can affect or determine the long-term behavior of inverted base pavements. Subtasks will address:

- Assessment of cracking and degradation of the cement treated base (CTB)
- Long-term performance of the granular base under traffic and environmental loads (wetting, freeze-thaw cycles)
- Long-term performance of thin asphalt surface layers (less than 2 in.)
- Optimal maintenance strategies, including drainage of the granular base

Task #4: Advanced Material Characterization and Modelling: Laboratory experimental studies complemented with numerical modeling devoted to understanding the response of unbound granular bases (i.e. graded aggregate base, or GAB) will be performed with an emphasis on:

- The effect of compaction on top of the rigid CTB
- The effect of slushing on GAB fabric and long term performance
- Requirements to preserve the integrity of the CTB during compaction

Task #5: MEPDG Implementation: This task will center on the integration of inverted base pavement design into the MEPDG approach. First, we will carefully analyze the capabilities of the AASHTOWare Pavement ME Design software and its adaptability to adequately simulate inverted base pavement structures, with emphasis on material models. Second, we will advance material model calibrations and damage functions suitable for inverted base pavement designs. Third, we will simulate known pavement designs to assess their performance.

Task #6: Implementation Guidelines: Results from all tasks will be systematically organized in a final report in the form of implementation guidelines. This document will include detailed information on the design, construction and maintenance of inverted base pavements, and a catalogue of proven potential cross-sections for various traffic and environmental conditions.

5. List the expected results:

Expected results are included in Section 4 above.

6. Describe how this research will be implemented.

Industry-scale implementation of inverted base pavements will require:

- Additional study of field cases with detailed construction records and long-term performance monitoring data.
- Advanced material characterization and modeling with emphasis on the granular base.
- Numerical simulation of inverted base pavement performance.
- Relevant calibrations for use of the design method within the framework of the Mechanistic-Empirical Pavement Design Guide (MEPDG).

7. Requested from UDOT: $50k or $10-15k for 4 years **Other/Matching Funds:** $200,000
Total Cost: $
(or UTA for Public Transportation)

8. Outline the proposed schedule, including start and major event dates.

Start of project is dependent on additional funding from other states but GDOT hopes to begin in 2016 and finish in 2020. Once the project is funded a more detailed schedule will be available. (http://www.pooledfund.org/Details/Solicitation/1416)