



RESEARCH NEED STATEMENT

Call for Projects 2015

Project Research Title: Phase 2: Calibration with updated weather and Validation of E*

TDOT Sponsor Director: Jennifer Lloyd

List TDOT Research Team Lead: Sampson Udeh

List TDOT Research Team Members: Ataur Rahman, Darrell Bridges

1. Define the problem or research requested. What is the goal/objective of the research?

Mechanistic-Empirical Pavement Design Guide(MEPDG) requires detailed climate data as part of the analysis input files and uses historic climate data records as the future predicted climate. Some studies have shown that the use of historic climate data is not adequate for predicting future pavement performance. A virtual/future climate data is needed to properly project future climates and predict future pavement performance. In addition, limited weather stations in a few counties of Tennessee are not enough to cover the whole state. Recently, National Aeronautics and Space Administration (NASA) center for Climate Simulation published a new climate prediction system through the Modern-Era Retrospective analysis for Research and Applications (MERRA) project. The MERRA project analyzed more than 30 years of data and is now proceeding forward in near real-time as a climate analysis. MERRA has the potential to provide proper spatial and temporal coverage for MEPDG.

Recently, research has found that the current practice for testing dynamic modulus of asphalt mixtures deviates from the initial suggestion by Dr. M.W.Witczak, leading to erroneous dynamic modulus results. This implies that the current nationwide dynamic modulus databases of state DOTs are incorrect and inappropriate for MEPDG, and will cause significant errors if used in MEPDG. Since dynamic modulus is one of the most important inputs in MEPDG, there is a strong need to identify the differences between current practice and correct protocol as well as to explore the ways to correct this issue..

2. Is this research a continuation of a past or present project?

No Yes

If yes, provide current research project title, RES # and reason for the project continuation.

Develop Typical Material Input Values for Mechanistic-Empirical Pavement Design in Tennessee Phase 1, RES2010-06. Develop Typical Material Input Values for Mechanistic Empirical Pavement Design in Tennessee, Phase II RES2011-15. Local Calibration of Mechanistic-Empirical Pavement Design in Tennessee, RES2013-33.

The weather history information required by the MEPDG is obtained currently from ground base operating weather station (OWS) located near the project sites. Approximately only 800 OWS are available throughout United States. Studies have shown that the use of historic climate data is not adequate for predicting future pavement performance. MERRA for instance employs Gridpoint statistical Interpolation (GSI) system over a

vast number of Observations. MERRA process more than four millions observations during a 6-hour data assimilation cycle. The extension will utilize available climate models like MERRA as recommended in the Federal Highway Administration (FHWA) report to predict a more precise pavement performance.

For E*, this part is already a concluded research (Materials input Phase 1).

3. Describe anticipated benefits/expected deliverables.

Climate data is an essential parameter required in MEPDG to effectively utilize the innovation to achieve a précised pavement for each location. Initially, weather stations which were limited were relied upon but later discovered that the information extracted were inadequate. A virtual/future climate data can assist in projecting future climates and predict future pavement performance.

Though there are improvement in the local calibration and material library, the variation of the predicted value and observed pavement performance values, part of the reason could be caused by incorrect input.

4. What is your timeline for completion of the research?

24 months

5. List the anticipated tasks for this research.

Collect historical data for Tennessee by using Modern-Era Retrospective analysis for Research and Applications (MERRA) to assist in the data collection.

Climate Task

- A. Utilize current Operating Weather Stations in Tennessee
- B. Utilize available models
- C. Validate available models and select most suitable ones
- D. Divide Tennessee into grids
- E. Establish best weather database for the future
- F. Final report.

E* Task

- A. Collect similar material as in previous research
- B. Compare E* test between current approach and Dr. Witczak's approach
- C. Note approach differences and develop recommendations
- D. Update material database and calibration coefficients
- E. Final report

6. Describe how the project results will be implemented?

This data will be used as part of the analysis for future MEPDG. This is the final stage of the MEPDG implementation process.

7. Will this study produce software, web page or other technology that will involve the Information Technology Division?

No Yes, please describe:

An extension of the MEPDG software license will be required as the current license expires in July 2015.

8. Will training be provided to employees as a result of this research?

No Yes, please describe:

9. Will this research involve equipment or materials purchase?

No Yes, please describe:

10. Research must support the Long Range Transportation Plan Policy Recommendations **and/or** TDOT Operational Goals and/or Strategic Initiative. (*See attachments for additional information*)

Please indicate which categories the research will support:

Transportation Long Range Plan Policy Recommendations

(A) Accessibility

(B) Safety, Security, and Transportation
Resilience

(C) Coordination, Cooperation, and Consultation

(D) Demographic and Employment Changes and Trends

(E) Freight Logistics and Planning

(F) Financial

(G) Mobility

(H) Travel Trends and System Performance

TDOT Operational Goals and/or Strategic Initiative

(A) Deliver transportation projects on schedule and within budget

(B) Maintain the state transportation system to protect the long term investment in our infrastructure assets

(C) Operate and manage Tennessee's transportation system to provide a high level of safety and service to our customers and workers

(D) Expanding mobility choices to maximize access

(E) Dramatically change the paradigm for delivery of transportation products and service to improve the efficiency and effectiveness of Tennessee's transportation network

11. Please explain how the research supports the Long Range Transportation Plan Policy Recommendations **and/or** TDOT Operational Goals and/or Strategic Initiative selected above:

Pavement design will always be a deliverable for transportation projects. TDOT must continue to research the best pavement designs and always be the lead in new pavement types and technology. Continuous improvements to pavement designs will enable TDOT to maintain our transportation system by providing more efficient, longer lasting pavement designs which will require less maintenance on our transportation network which in turn decreases the amount of workers on projects sites thus increasing safety for both the public and our workers.

For additional information, please contact:

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