Texas A&M Transportation Institute

PROJECT SUMMARY

Texas Department of Transportation

0-6622: Implementation of a Texas Mechanistic-Empirical Thickness Design System (TxME)

Background

The current flexible pavement design system (FPS) used at the Texas Department of Transportation (TxDOT) has limitations in that it does not use any results from laboratory testing, so it is impossible to determine benefits from improved base materials or superior asphalt mixes. Developments over the last several decades have offered an opportunity for more rational and rigorous pavement design procedures. Substantial work has already been completed in Texas, nationally, and internationally in all aspects of modeling, materials characterization, and structural design. These and other assets provided the technical infrastructure that made it possible to develop a new mechanistic-empirical flexible pavement design system (TxME) specifically for Texas. This new system will enable Texas pavement designers to take full advantage of new or premium materials, with a full consideration of the influential factors, including pavement structure, traffic volume, and environmental conditions.

The main objectives of this project were to identify or propose performance models and implementation approaches, and develop the new TxME.

What the Researchers Did

To achieve the study objectives, researchers completed the following tasks:

- Identify available models and test procedures that allow mechanistic-empirical prediction of pavement performance for different Texas flexible pavement types and environmental conditions.
- Develop models to account for moisture variation in typical Texas base materials.

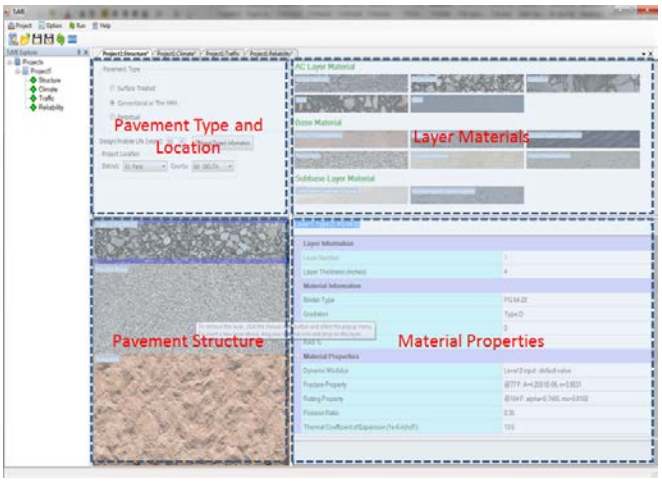

Figure 1.

- Develop subgrade soil rutting models.
- Identify and recommend the practical reliability analysis approach.
- Develop load spectrum analysis methodologies.
- Propose the framework, main user interface, and program specification of TxME.
- Develop default values for typical Texas materials and incorporate them into TxME.
- Preliminarily calibrate the performance models.
- Implement all the available models, load spectrum methodologies, climate inputs, and the reliability approach into TxME.

Research Performed by:
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The University of Texas at El Paso (UTEP)

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Project Completed:
10-31-2013

- Demonstrate and validate TxME through sensitivity analysis.
- Develop the connection between TxME and the current FPS.

What They Found

TxME is a comprehensive flexible pavement design and analysis system, which runs fast and is easy to use.

The reliability analysis approach implemented in TxME has high practical benefits since it determines the influence of the variability of each key input parameter in a very efficient way.

TxME provides a seamless tie with the current FPS—the design information of the FPS can be automatically imported into TxME. By using the FPS to conduct a trial pavement design and then using TxME to check this design, the benefits of improved base materials or superior asphalt mixes can be determined.

Through extensive sensitivity analysis, the researchers found:

- Traffic input has significant influence on all the performance predictions except the asphalt concrete (AC) thermal cracking.
- Climate has significant influence on AC layer performance predictions, but has minor influence on base rutting and subgrade rutting.
- AC thickness has significant influence on all pavement performance predictions. Pavements with thicker AC layers may have larger AC rut depth, but may have smaller total rut depth since the thicker AC layers lead to smaller rut depth in base and subgrade.
- Both AC mix type and asphalt binder type have significant influence on AC layer performance predictions, but have minor influence on base rutting and subgrade rutting.
- Base modulus has significant influence on all pavement performance predictions, except the AC thermal cracking.
- Base thickness mainly impacts base and subgrade rutting, and has minor influence on AC layer performance predictions.
- The subgrade modulus has significant influence on subgrade rutting but minor influence on other layer performance predictions.
- The vehicle loading scenario comparison results show that although the total traffic loading per day for each scenario is the same, the predicted distresses are completely different. The scenarios with overloaded trucks cause much more damage than that with legally loaded trucks.

What This Means

TxME will assist TxDOT engineers to take full advantage of superior/new materials and to make more economically reliable designs. Particularly relevant, TxME can be very helpful on rehabilitation projects in the oil and gas development areas, considering that the influence of overloaded trucks is very important to the success of these pavement designs.

Researchers recommend a pilot implementation of TxME for select candidate districts, and expansion of the current inventory of typical default values for asphalt mixes, granular bases, stabilized bases, and subgrade soils particular to those districts.

Researchers also recommend a statewide implementation and conducting further calibrations based on Texas field data.

For More Information

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