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PROJECT TITLE
EVALUATION OF THE ENHANCED INTEGRATED CLIMATIC MODEL FOR SPECIFICATION OF SUBGRADE SOILS IN OKLAHOMA

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EVALUATION OF THE ENHANCED INTEGRATED CLIMATIC MODEL FOR SPECIFICATION OF SUBGRADE SOILS IN OKLAHOMA

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OVERVIEW Environmental conditions have a significant effect on pavement performance. Of all the environmental factors, temperature and moisture have direct effect on the pavement layer and subgrade properties. As a result, improving the understanding of environmental interactions with pavement systems and developing predictions about the changes in pavement material properties over time can enhance pavement design. The current study provides estimation of site specific variation in environmental factors that can be used in predicting seasonal and long-term variations in moduli of unbound materials in the Mechanistic Empirical Pavement Design Guide (MEPDG).

RESULTS The performance of a pavement depends on many factors such as structural integrity, material properties, traffic loading, construction method, and climatic conditions. Among the climatic variables, temperature, precipitation, relative humidity, percent sunshine, and wind speed make up the climatic input files for the Enhanced Integrated Climatic Model (EICM) model in the MEPDG. Furthermore, the depth to ground water table and Thornthwaite Moisture Index (TMI) control the boundary conditions in the pavement profile.

This study evaluated the appropriateness of using the EICM, which plays a significant role in defining the material properties in the design guide, for Oklahoma climatic conditions. The main objective was to collect and evaluate Oklahoma climate and soil data for the EICM in the MEPDG that involves analysis of water and heat flow through pavement layers in response to climatic, soil, and boundary conditions above and below the ground surface in the pavement structure. Oklahoma has several microclimates and a large spatial variation in subgrade soils. Large clusters of raw climate and soil moisture data were obtained from the Oklahoma Mesonet and the USDA Web Soil Survey for evaluation and used in creating the necessary input parameters for the climatic model (Figure 1). Using site specific estimates, the EICM climatic input files were updated and extended over a large area covering Oklahoma. This study created 77 EICM input files representing the climate of each of the Oklahoma counties, which were verified and are ready to be used in the EICM model in MEPDG. This study validated the EICM model, which is critical for Oklahoma because of the state's unique topographical,

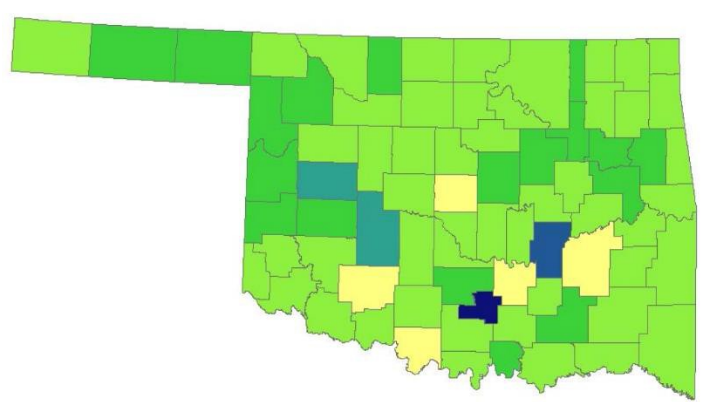

Figure 1 Six Soil Regions (Weighted Average)

geological, and geographical settings. The validation compared the moisture migration processes in the EICM with commercially available software using the Oklahoma climate and soil data.

Thornthwaite Moisture Index (TMI) contour maps were created for Oklahoma using three different models, the climatic data and ArcGIS software. The research project produced maps of ground water table using raw data obtained from the Oklahoma Water Resources Board (OWRB). These color and line contour maps can be used to determine the required lower bound moisture boundary conditions in the pavement analysis in the MEPDG.

This study established soil matric suction versus time history plots for 71 counties across Oklahoma using field measurements conducted by Mesonet over a long period of time. Some of these plots were employed in the validation of the moisture migration model in the EICM model as compared to the well-established model in the commercially available software SVFLUX. In the analysis, the predictions were compared to the measured values for the BOWL, STIL, WAUR, and WIST weather stations. In general, measured and predicted pore water pressures show more variation near the surface. Overall trends in pore water pressures and therefore moisture contents are predicted reasonably well by SVFLUX (Figure 2).

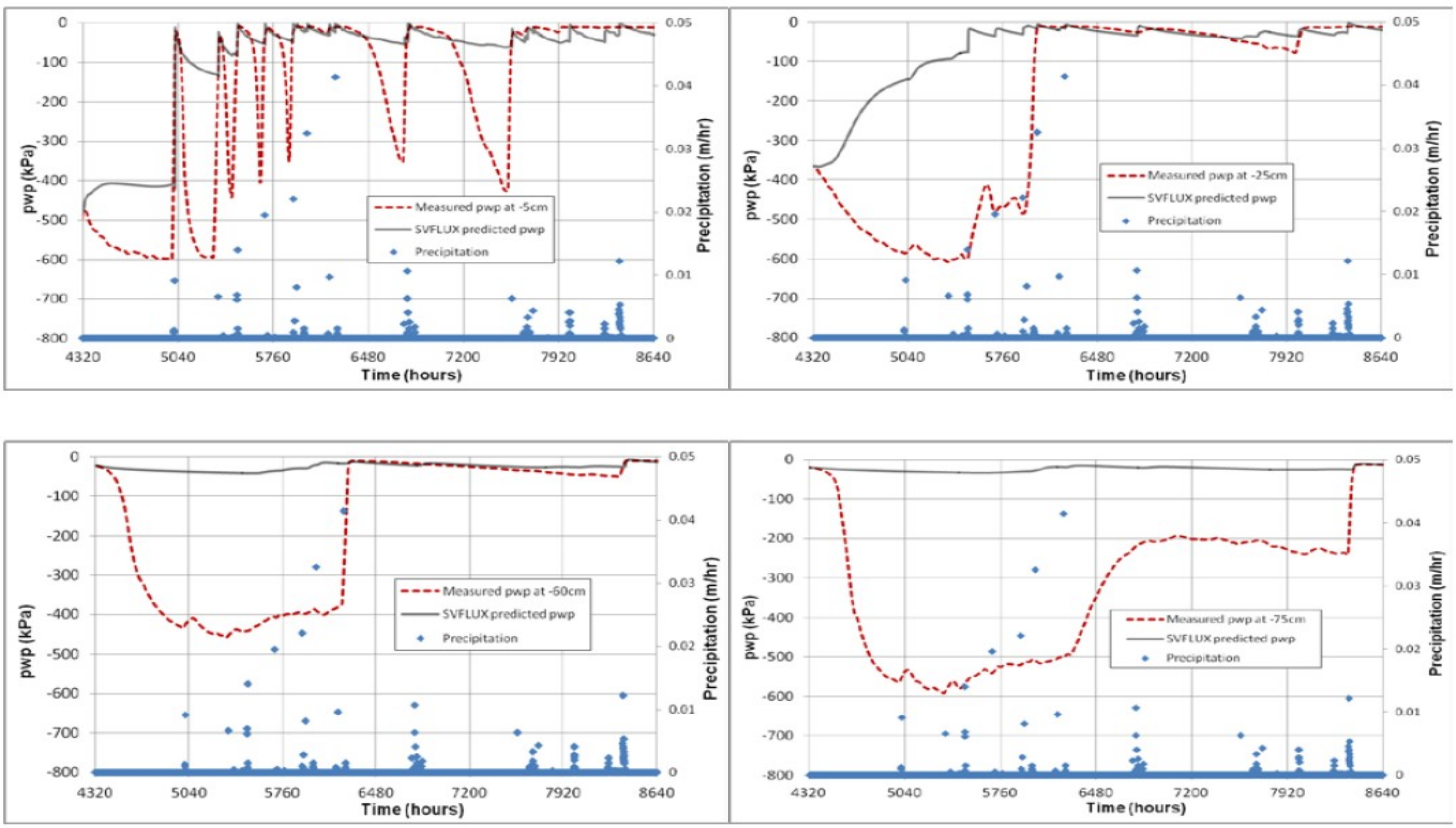

Figure 2 Measured and Predicted Pore Water Pressures Investigated in this Study

The results of this study can support recommendations that could be considered in improving the climate data and moisture (suction) boundary conditions for the MEPDG. Using the current and historical climate data pertaining to Oklahoma future trends of the climatic parameters could be predicted using improved models. It is also believed that a careful analysis and interpretation of the climate and soil data could be used in establishing realistic depths to constant suction and equilibrium suction profiles that are essential in establishing the envelope values of the moisture regime.

POTENTIAL BENEFITS This study provides improvement in the understanding of environmental interactions with pavement systems and an approach for predicting the changes in pavement material properties over time. The current study provides estimation of site specific variation in environmental factors that can be used in predicting seasonal and long-term variations in moduli of unbound materials in the Mechanistic Empirical Pavement Design Guide (MEPDG) to enhance pavement design.