



Project Summary Report 0-4714-S  
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Project 0-4714: Development of a Strategic Plan  
for the Implementation of the AASHTO 2002 Design Guide  
for TxDOT Operations

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## Sensitivity Analysis and Strategic Plan for the Implementation of the M-E Design Guide in TxDOT Operations: Summary Report

In 2004, the National Cooperative Highway Research Program released a report describing the upcoming software for the Mechanistic-Empirical Design Guide (M-E Design Guide). The overall objective of the M-E Design Guide is to provide the highway community with a new, state-of-the-practice tool for the design of new and rehabilitated pavement structures, based on mechanistic-empirical principles.

The M-E Design Guide software represents a major change in the way pavement design is performed, and the new program requires over 100 separate inputs, many of which have never been collected by the Texas Department of

Transportation (TxDOT). In addition, the level of detail required is much, much higher even for the routine data that have been collected historically. Project 0-4714 evaluated beta versions of this software and was initiated to answer the following questions:

- Are the new input data significant under the climatic conditions and for the types of pavements typically built by TxDOT?
- What is the best path to pursue if TxDOT decides to adopt the new program?

### What We Did...

To find out which of the variables in the program were sensitive, a set of inputs

based on typical pavements built by TxDOT (thin hot mix asphalt pavement [HMAC], intermediate thickness HMAC, thick HMAC, continuously reinforced concrete pavement [CRCP], and jointed reinforced concrete pavement [JRC]) were developed for the northwest part of the state (dry-freeze climatic zone) and for the southeast area (wet-warm climatic zone). The program was calibrated for each case and then run for each case, changing a single variable each time, and the results were documented. The program was run several thousand times, and the significant and important variables were identified (see Table 1). For some variables or situations, in-depth studies



of the impacts of inputs were conducted to determine trends in the data and to establish guidelines for how to best use the program.

After identifying the significant and important variables, researchers conducted statistically based multi-variable analysis for each pavement type.

A review of TxDOT operations, especially with respect to current design procedures and testing capabilities, was conducted, and guidelines for the implementation of the program were developed. A small-scale pilot implementation, or demonstration, was conducted for ongoing pavement designs in two districts.

### What We Found...

With the variables that were found to be significant or important, researchers created numerous plots and tables to identify:

- which variables needed investigation, or were critical (Figure 1),
- which variables could be ignored (Figure 2), and
- which variables could be left as program defaults.

Through the use of these tables and plots, the pavement designer can better allocate

Table 1. Asphalt Concrete (AC) General Variables and Ranges for *M-E Pavement Design Guide* Sensitivity Analysis of Asphalt Concrete Pavements.

Asphalt General	Base	Min.	Max.
Reference Temperature (°F)	70	65	75
Effective Binder Content (% by Vol.)(DC/WW)	11	8	14
Air Voids (%)(DC/WW)	4.7	3.0	8.5
Total Unit Wt. (pcf)(DC/WW)	148	142	154
Poisson's Ratio	0.35	0.30	0.40
Thermal Conductivity (BTU/hr-ft-°F)	0.67	0.53	0.81
Heat Capacity (BTU/lb-°F)	0.23	0.31	0.40

resources to collect only the data that will have an impact on design.

Additional studies illustrated several examples of how to best use the program, especially the selection of weather stations, depth-to-water table, and some interesting trends in CRCP design. Guidelines for training pavement engineers in the many areas covered by the M-E Design Guide were included in the final report, along with performance criteria. A strategy for implementation was also developed.

### The Researchers Recommend...

The M-E Design Guide will be an excellent resource for forensic evaluations to compare the as-built values to the proposed values and determine the impact of out-of-specification materials. It is

perfectly suited to evaluate new materials and designs, including steel placement, modified asphalts, well-draining bases, etc. If a new material has certain unique properties, such as very low temperature susceptibility, the impact of that property on the theoretical performance can be evaluated, whereas the current design method has only one entry for the modulus of the material.

Although not recommended for routine design work in Texas, the M-E Design Guide should certainly be considered for high-end pavement designs. This type of design includes perpetual pavements (see Section 5.1.2 of Report 0-4714-1) and high-end concrete pavements. There is also tremendous potential to use the M-E Design Guide for comparing alternate designs.



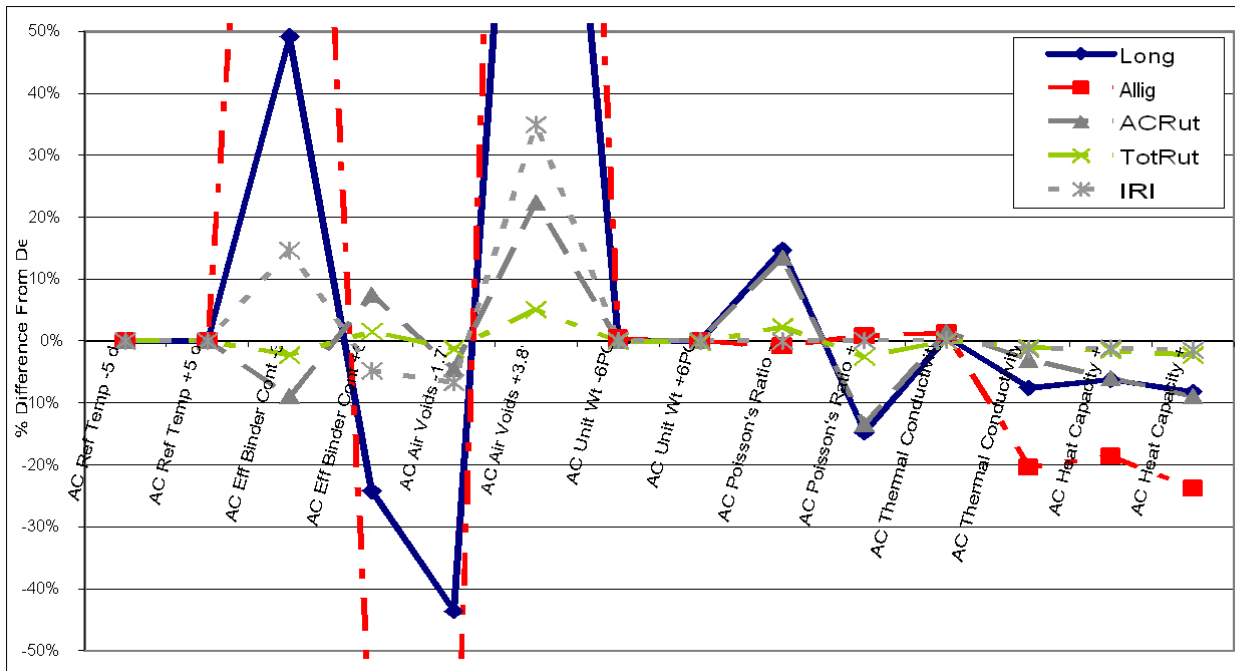


Figure 1. Dry-Cold, AC-Thin, General Variables.

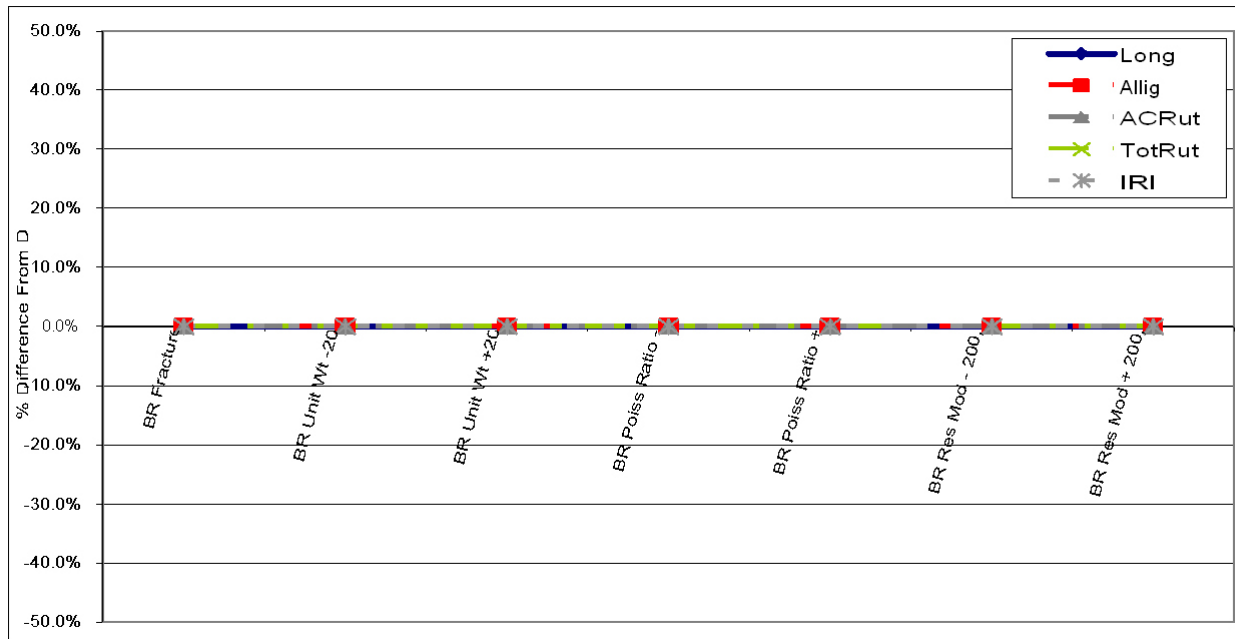


Figure 2. Dry-Cold, AC-Thin, Bedrock Variables.



## For More Details...

The research is documented in:

Report 0-4714-1, *Sensitivity Analysis of and Strategic Plan Development for the Implementation of the M-E Design Guide in TxDOT Operations*

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