DRISI

Caltrans Division of Research,
Innovation and System Information

Research Results

Implementing the Mechanistic-Empirical Pavement Design Method

Improving pavement performance and cost efficiency using a more robust and complex design methodology

Pavement

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Project Title:
Mechanistic-Empirical Design—
Phase Two: Implementation

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WHAT IS THE NEED?

In the 1960s, Caltrans adopted methods to improve pavement design. Although these methods were innovative for their time, since then California roads handle far more traffic and heavier loads, and new materials for pavement construction, such as polymer- and nano-modified hot mix asphalt, have been introduced. Today, sustainable pavements that incorporate recycled materials and pavements with more adaptable structures are needed. However, the traditional pavement design method is not capable of integrating these new solutions or distinguishing cost-effective approaches for pavement rehabilitation, preservation, or new construction, because it can only analyze traffic load conditions, which does not provide enough information to understand the variations of a specific site.

In 2005, Caltrans, in partnership with the University of California Pavement Research Center, developed a mechanistic-empirical (ME) design method, a multistep process that uses detailed information about traffic loading, climate, material properties, and performance to gain a more detailed and accurate assessment of the specific project. The CalME and CalBack software tools can calculate deflections, strains, and stresses within the pavement structure. The calculation results can also be used to assess the reliability of the design, helping to predict the probability of failure as well as determine the cause of failure.

WHAT WAS OUR GOAL?

The goal was to implement the ME design method in the field and use the results from the investigations to analyze the effectiveness and use of the CalME and CalBack tools and refine the information-gathering techniques.

WHAT DID WE DO?

Three typical rehabilitation projects were chosen to assess the ME analysis and design process:

- District 2, Plumas County, Route 36, PM 6.3 through 13.9
- District 1, Lake County, Route 53, PM 3.1 through 6.9
- District 6, Kings County, Route 198, PM 9.2 through 17.9

Caltrans, in partnership with the University of California Pavement Research Center, collected information about the condition of the existing pavements using various techniques, such as deflection testing, coring, material sampling, and condition assessment. The researchers calculated the stiffness of existing pavements with the CalBack software. They then performed the design process based on the condition of the existing pavement using both the traditional design method and the new CalME software and compared the results from these two methods.

WHAT WAS THE OUTCOME?

The ME design method has the capability to recommend new, cost-effective rehabilitation designs that last longer. The traditional method cannot evaluate the same breadth of variables to take into account site-specific solutions. The ME design method accurately simulated the effects of the traffic levels and local climate. The ME approach examined the impact of different additives to concrete mixes to determine the best solution and avoid over-designing a project. The researchers were also able to perform a lifecycle cost analysis and select the most cost-effective choice among the new alternatives. For example, for one project, the ME analysis showed that by modifying the material being used, a 1-inch thinner layer could be applied to the pavement. Approximately $1 million can be saved for every inch of reduced thickness for that specific project.

An analysis can also be rerun to evaluate the remaining service life of the as-built pavement. This information can be used in the pavement management system to estimate when future maintenance might be needed.

WHAT IS THE BENEFIT?

Unlike the traditional design method, the Caltrans mechanistic-empirical design method can simulate the condition of existing pavement, the effects of climate, and the wear and tear of traffic levels and loads on the roads. With this information, innovative materials can be employed and new pavement structures designed for more cost-effective pavements with longer lifecycles.

LEARN MORE

To view the complete reports for the projects: www.ucprc.ucdavis.edu/PDF/UCPRC-TM-2008-03.pdf

IMAGES

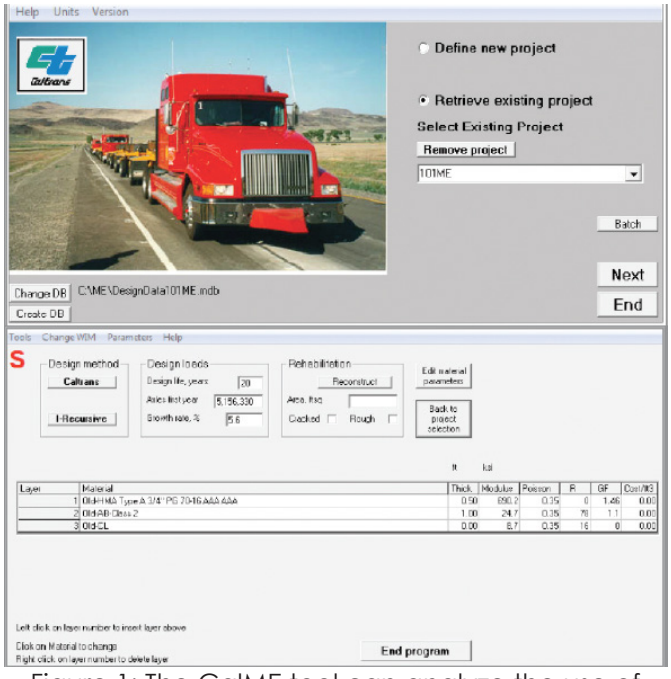

Figure 1: The CalME tool can analyze the use of different materials in the context of climate and load inputs and determine the cost.