DRISI

Caltrans Division of Research, Innovation and System Information

Research Results

Mechanistic Empirical (M-E) Design Algorithms and Field Characterization

Continue Improving the M-E Design System Developed by UCPRC for California Pavement Design

Pavement

SEPTEMBER 2022

Project Title:
PPRC 17 Mechanistic-Empirical Design

Task Number: 3200

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WHAT WAS THE NEED?

In order to accomplish its mission of providing an efficient transportation system to enhance California's economy and livability, The California Department of Transportation (Caltrans) is transitioning from using empirical method to mechanistic-empirical (M-E) method for pavement design so that local conditions such as material, climate and traffic can be effectively accounted for. M-E methods involve using computer models to describe various physical processes that change pavement conditions and ultimately simulating pavement deterioration over time. M-E design method needs to be continuously improved by conducting research to better understand various physical processes affecting pavement deterioration and implementing the findings.

WHAT WAS OUR GOAL?

The goal of this project is to gain more knowledge on pavement behaviors and to continue improving M-E design methods for California pavements. The ultimate objective for the continuous research is to increase the understanding of physical processes in pavements and to minimize the need to use empirical factors to cover critical processes affecting pavement performance.

WHAT DID WE DO?

Through several previous research projects, computer models have been continuously improved to enhance critical physical processes for California pavements. This continuous research helps to identify critical but not yet well understood physical processes related to M-E design and critical subject areas that need further study. It includes the following tasks:

- Develop critical models for flexible pavements
- Develop critical models for rigid and composite pavements
- Implement improvements in M-E design tools
- Improve field characterization procedures
- Update deflection back-calculation tool CalBack

WHAT WAS THE OUTCOME?

Accomplishments of this project included:

- Completed a preliminary set of models for different pavement types.
- Reviewed laboratory testing on binder and fine aggregate mixture rest period effects. Drafted report on aging protocol for consistent performance evaluation. Completed laboratory testing to assess asphalt concrete aging. Finished modelling for estimating rest period of truck traffic on Caltrans highway.
- Prepared for building an alternative coefficient of thermal expansion (CTE) testing device. Conducted pilot laboratory testing.
- Continued lane distribution factor calculations for truck traffic with revised approach. Developed a workplan for developing a roughness progression model. Prepared for field calibration of in-place recycling models.
- Reviewed field characterization procedures for subgrades as part of overlay design.

WHAT IS THE BENEFIT?

Caltrans has been looking to expand the use of M-E methods for flexible pavement design and rehabilitation. Compared to empirical methods, M-E method is better at accommodating new materials and construction processes. M-E methods account for local conditions such as climate, traffic, and material and can therefore optimize pavement designs for the specific conditions rather than having to cover the worst-case scenario. The transition to M-E design helps Caltrans design more cost-effective pavements and accomplish the mission of providing an efficient transportation system to enhance California's economy and livability.

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To view the complete report:
https://escholarship.org/uc/item/6sr85541