DRISI
Caltrans Division of Research, Innovation and System Information

Research Results

Evaluate Early Age and Premature Cracking for PaveM and Life Cycle Cost Analysis (LCCA)

Early age and premature cracking was evaluated by examining concrete slab-base interactions and performance of slab and lane replacement projects.

Pavement

MAY 2019

Project Title:
Evaluate Early Age and Premature Cracking for PaveM and Life Cycle Cost Analysis (LCCA)

Task Number: 2713

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WHAT IS THE NEED?

The need was to determine the main factors that can lead to early-age and premature cracking (EAPC) in slab replacement and concrete lane replacement projects and how to reduce the risks.

WHAT WAS OUR GOAL?

Under Caltrans' direction, the scope of this project was limited to review slab-base interaction, which is one of the key factors that affects EAPC. In addition, it was decided to first develop empirical models for slab replacement and lane replacement project performance. The project was combined with task 3.31, Improved Mechanistic-Empirical (ME) Design Algorithms to investigate whether Pavement-ME predicts the correct trends for performance of California rigid pavements.

WHAT DID WE DO?

- Review report of NCHRP 1-51 project on slab-base interaction and its effect on rigid pavement performance
- Collect thickness, traffic, age, climate and performance data for replaced slabs. Conduct statistical analysis to develop performance model for slab replacement.
- Collect thickness, traffic, age, climate and performance data for replaced lanes. Conduct statistical analysis to develop performance model for lane replacement.
- Collect shoulder type, slab length, doweled/Un-doweled, base type, slab thickness, traffic and performance data for rigid pavements. Run simulation using ME to compare the predicted and actual performance trends.

WHAT WAS THE OUTCOME?

- Assuming perfect vertical bond, a model was developed to describe the deterioration of horizontal friction along the slab-base interface in the NCHRP project. New models were developed to predict JPCP and CRCP performances incorporating the actual horizontal friction as alternatives to those currently in Pavement-ME.
- 17% of Caltrans replaced slabs failed within 4 years indicating that Caltrans does have an EAPC issue in slab replacements. 8 inch or thicker replaced slabs have significantly lower failure rate than those thinner than 8 inch. In general, most of the replaced slabs fail before the 10 year design life.
- Data for lane replacement projects have been collected and will be analyzed.
- Data for rigid pavement projects have been collected and will be used to evaluate the validity of Pavement-ME.

WHAT IS THE BENEFIT?

The review of NCHRP 1-51 project report led to the development of slab-base interaction performance models for use in mechanistic-empirical design of rigid pavements. The statistical analyses of slab replacement and lane replacement performances allow Caltrans to identify effective ways to improve their performance. The rigid pavement performance data is the starting point for Caltrans as it develops a mechanistic-empirical design method for rigid pavement that is calibrated under California conditions.

IMAGES

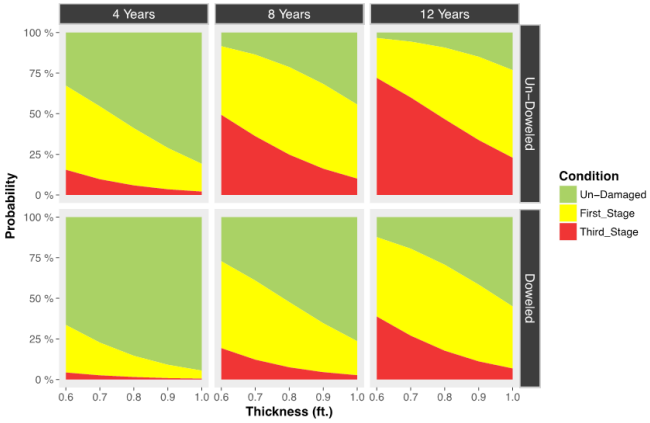

Image 1: Slab performance sensitivity with thickness changes