DRISI

CALTRANS DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION

Research Results

Concrete Coefficient of Thermal Expansion Moisture-Dependency and Tensile Creep

Test to measure coefficient of thermal expansion (CTE)-moisture dependency

Pavement

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Project Title:
Performance Related Specifications

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WHAT WAS THE NEED?

The California Department of Transportation (Caltrans) employs a variety of strategies and materials in maintaining and rehabilitating the state highway system's pavements. This approach is necessary due to the diverse characteristics and properties of the pavements in use.

CTE is one of the most important variables controlling Jointed plain concrete pavement (JPCP) and continuously reinforced concrete pavement (CRCP). The current standard CTE test (AASHTO T 336) measures the specimen under saturated conditions. This is problematic since saturated concrete CTE is somewhat larger versus unsaturated condition. A test needs to be developed to measure concrete CTE-moisture dependency and what measurements are appropriate for concrete pavements.

WHAT WAS OUR GOAL?

The goal was to develop a test to measure concrete CTE-moisture dependency and determine what measurements were appropriate for concrete pavements.

WHAT DID WE DO?

This research reviewed relative measuring methods and developed a test to measure concrete CTE-moisture dependency.

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WHAT WAS THE OUTCOME?

The research focused on evaluating the impact of moisture-related shrinkage on jointed plain concrete pavements, particularly the concrete overlay of asphalt (COA) slabs. Through extensive monitoring and analysis of six COA sections over 15 months, the study addressed key questions regarding moisture-related shrinkage, shrinkage prediction models, the relationship between laboratory and field shrinkage, and the resulting stress on the pavement structure. Findings revealed significant levels of differential shrinkage in COA slabs treated with Portland cement mixes. Predictive models such as B3 and B4 underestimated laboratory shrinkage, while the ACI 209R-92 model showed closer agreement. A new model, B4-IR, successfully predicted moisture-related shrinkage in outdoor prisms and COA slabs with Portland cement mixes. Structural modeling indicated that accounting for the creep/relaxation capacity of concrete and asphalt reduces unrealistic tensile stresses. This suggests the importance of considering material properties in pavement design to mitigate the effects of moisture-related shrinkage. Additionally, surface microcracking acts as a stress-release mechanism, further supporting the durability of certain pavement sections under heavy loads without significant cracking.

WHAT IS THE BENEFIT?

The proposed test for measuring CTE-moisture dependency resulted in an increased life cycle for JPCP and CRCP pavements.

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