DRISI
Caltrans Division of Research, Innovation and System Information

Research Results

Pavement

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Project Title:
Design and Construction Guidelines for Thermally Insulated Concrete Pavements, TPF-5(149)

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Asphalt Overlays on New Concrete Pavements

Are composite pavements cost-effective?

WHAT IS THE NEED?

Thermally insulated concrete pavement (TICP) combines the structural longevity of portland cement concrete pavement with the serviceability of asphalt concrete pavement. TICP is a composite pavement consisting of a cement structure, either jointed or continuously reinforced, covered by an asphalt layer during or shortly after construction to provide easier maintenance and an insulating layer to reduce the magnitude of thermal loading. One of the perceived benefits of TICPs is that with the asphalt concrete overlay, it is possible to use a thinner portland cement layer and simplified concrete finishing and joint formation techniques. Despite these potential benefits, TICP has not been widely adopted, mainly because the initial construction costs are higher, and engineers have a limited understanding on the applications of mechanistic-empirical (ME) methodology for its design and construction. Improved design and construction guidelines based on ME methodology are needed for applications in which TICPs are economically advantageous.

WHAT WAS OUR GOAL?

The goal was to compare TICP life-cycle costs with alternative strategies and to develop guidelines for ME design and construction.

WHAT DID WE DO?

Caltrans supported this pooled fund study with the Minnesota and Washington departments of transportation. The research team at the University of Minnesota and the University of California, Davis Pavement Research Center jointly investigated the life-cycle costs and performance of TICPs. The research included evaluating how the behavior of concrete and asphalt layers and their interaction and environmental and climatic conditions affect performance. The researchers also reviewed the influence of design, material properties, and construction on performance using field data collected from the TICP test sections.

WHAT WAS THE OUTCOME?

The researchers uncovered the source of faulty predictions in transverse cracking in asphalt overlay projects and made corrective recommendations. The team developed new ME models for reflective cracking, rutting, faulting, and transverse cracking for composite pavements. The proposed construction guidelines include criteria for the asphalt mixture to mitigate reflective cracking, rutting, and low-temperature cracking.

The cost efficiency of TICP depends on several factors. For example, as the cost of asphalt increases, the cost of other materials, most notably the concrete used for the structural layer, must decrease to make the TICP competitive. However, lowering the cost of the portland cement concrete layer by making the layer thinner should not jeopardize the structural performance of the TICP. The life-cycle cost analysis case study indicated that the TICP designs considered were not a cost-effective alternative to jointed plain concrete pavement, unless the construction costs for the cement layer are reduced.

WHAT IS THE BENEFIT?

Although composite pavements have had success overseas, their use in the United States tailed off in the 1960s, and minimal research on design and construction practices has been conducted. Having updated guidelines based on direct experimental results rather than from models not calibrated for today's loads and tire configurations improves construction and design decisions. Understanding the life-cycle costs helps determine appropriate applications of composite pavements. This project led to research products that have immediate application for asphalt overlays on portland cement concrete pavements for both rehabilitation and new construction.

LEARN MORE

To view the complete report and other information regarding this pooled fund study:
www.pooledfund.org/Details/Study/376

IMAGES

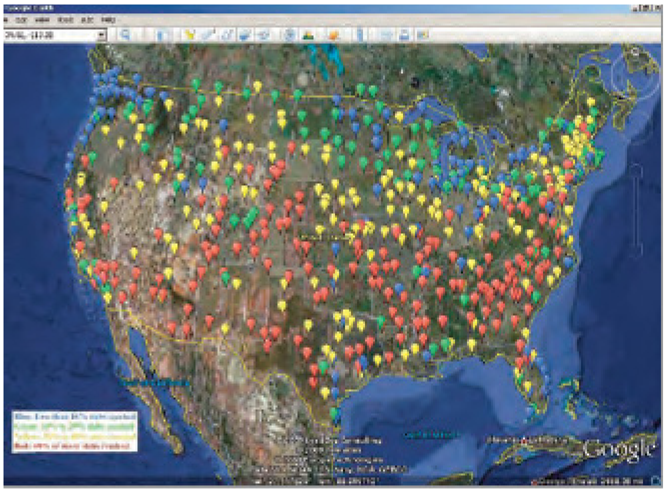

Figure 1: Locations of asphalt concrete and portland cement concrete projects. Icon color indicates the percentage of transverse cracking: blue less than 16%; green 16-25%; yellow 26-40%; red more than 40%.

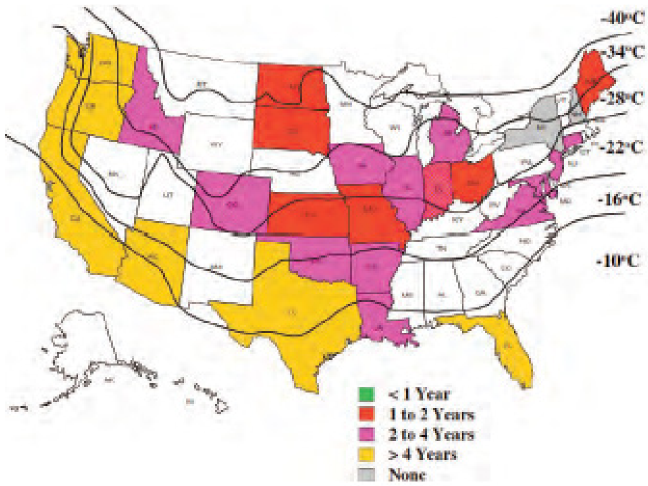

Figure 2: Time in years until reflective cracking occurs in asphalt concrete overlays of portland cement concrete pavements