CENTER FOR TRANSPORTATION INFRASTRUCTURE SYSTEMS
THE UNIVERSITY OF TEXAS AT EL PASO

The University of Texas at San Antonio

Project Summary Report 0-4188-S2
Project 0-4188: Development of Methods to Accelerate Construction and Opening of PCC Pavements
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PROJECT SUMMARY REPORT

A Study of Expediting Construction of Rigid Pavements in Urban Areas by Using Alternative Pavement Sections: Summary

Several TxDOT districts rely almost solely on portland cement concrete pavements (PCCP) for heavily traveled metropolitan highways and for the urban and suburban sections of the interstate system. Highway agencies tend to build pavement sections with several layers of high-quality or heavily stabilized materials to withstand the forecast design traffic. For TxDOT, this means one or more layers of stabilized subgrade and base, a layer of asphalt concrete pavement (ACP) to act as a bond breaker, and a PCC slab. The large number of layers may be cost-effective from the standpoint of initial costs; however, the number of steps involved increase the construction duration, increasing user costs borne by the motoring public, and also in some instances increasing the sensitivity of construction schedules to weather conditions, adding to their overall variability.

This research focused on developing a library of alternate pavement sections that would be as structurally sound as the traditional ones, while compressing the construction schedules.

Alternate cross-sections were compared to traditional cross sections using a full-cost analysis approach in which agency and user costs are combined.

What We Did…

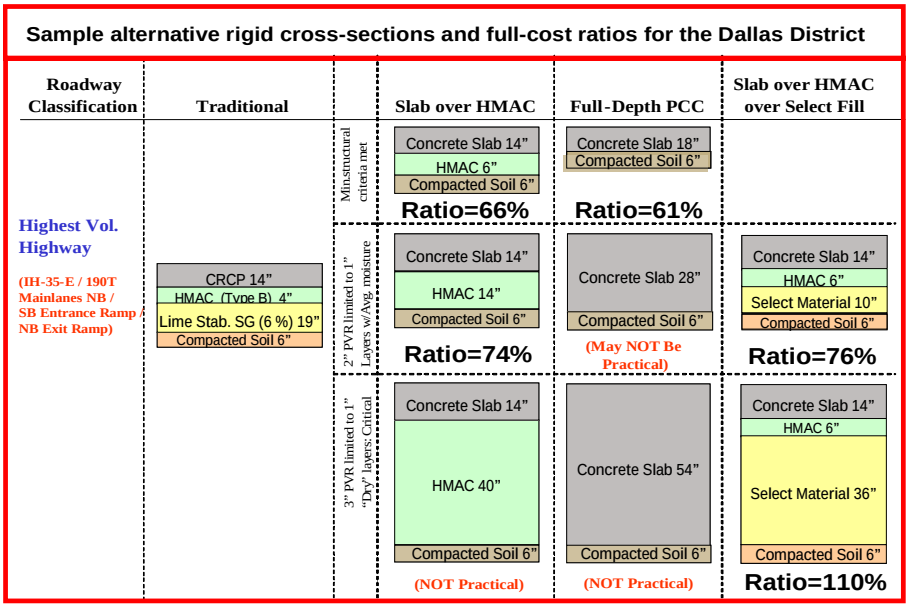
Initially, the goal of this project was to develop an expert system that would suggest pre-design pavement sections. The expert system would combine inter-district experience to expedite rigid pavement construction and would rank alternatives based on construction time or cost. After several attempts to acquire useful expertise from documented sources and a series of surveys among district pavement engineers, contractors, material

suppliers, and national experts, the development of the expert system did not appear feasible.

To still address the objectives of the project, however, a sensitivity study was carried out on a number of design and construction parameters related to rigid pavements to identify the pavement layers that may not significantly contribute to the long-term performance of a rigid pavement. Different alternatives were proposed for the Dallas, Fort Worth, Houston, Beaumont, and El Paso Districts. The alternate sections were designed based on a mechanistic approach using pavement layer properties based on local geotechnical data and interaction with district staff.

Two groups of alternate rigid cross-sections were developed: 1) alternate sections with a PCC slab over an HMAC layer; and 2) full-depth PCC slabs. When appropriate, the potential vertical rise (PVR) of the subgrade was also taken into account. Construction times and initial investment costs were determined for both traditional and alternate pavement structures using standard software.

The construction costs were combined with the user costs, calculated based on the construction time duration, in a full-cost analysis that compared alternate and traditional cross-sections based on a full-cost ratio.



What We Found...

For "Highest Volume" highways in the Dallas District, full-depth slab alternates or alternates with slabs over HMAC expedite construction up to 46%. For the sections with a 14-in. (355-mm) thick slab with a HMAC base of 14 in., with a time savings of 44% there is a cost increase when compared with the traditional. Alternate sections with select material always cost more than the corresponding traditional sections, due to the fact that their overall depth is determined to reduce the subgrade's PVR to allowable limits.

For the Forth Worth District, all alternate sections can reduce construction time up to 40 or 50%, as well as reduce cost.

For the Houston District, all alternatives reduce construction time between 40 and 50%. Whenever a high PVR (due to highly expansive clay soils) is expected, the alternatives built with layers of select material would be a better option to consider, since the other two options are not practical. However, they cost more and take longer to build.

For the Beaumont District, alternate sections can be built in about half the time as traditional sections. Cost savings on the order of 10 to 20% were observed.

For the El Paso District, alternate sections offer little or no time saving advantages compared to traditional practice.

When the comparison is approached from a full-costs analysis standpoint, combining the agency and user costs leads to the following conclusions.

For the Dallas District, the "Highest Volume" highways, full depth slab alternates, or alternates with slabs over HMAC reduce full-costs from 38% to 26%. For the "Arterial, Collector Roads" category, all alternates for traditional sections using 8-in. (205-mm) slabs over stabilized material can reduce the full-costs by a

maximum of 39% for the 9-in. slab over compacted soil and by a minimum of 10% for the 14-in. slab over compacted soil. For traditional sections consisting of slab over HMAC, the only reduction in full-costs is for the 8-in. slab over 8-in. HMAC at 23%. In all categories, alternate sections with select material always imply an increase of the full-cost ratios due to the fact that their overall depth is determined to reduce the subgrade's PVR to allowable limits.

For the Forth Worth District, a reduction across the board for the full-cost ratios is observed. Reductions in the full-cost ratio range from 40% for the 15-in. slab over compacted soil to 21% for the 13-in. slab over HMAC.

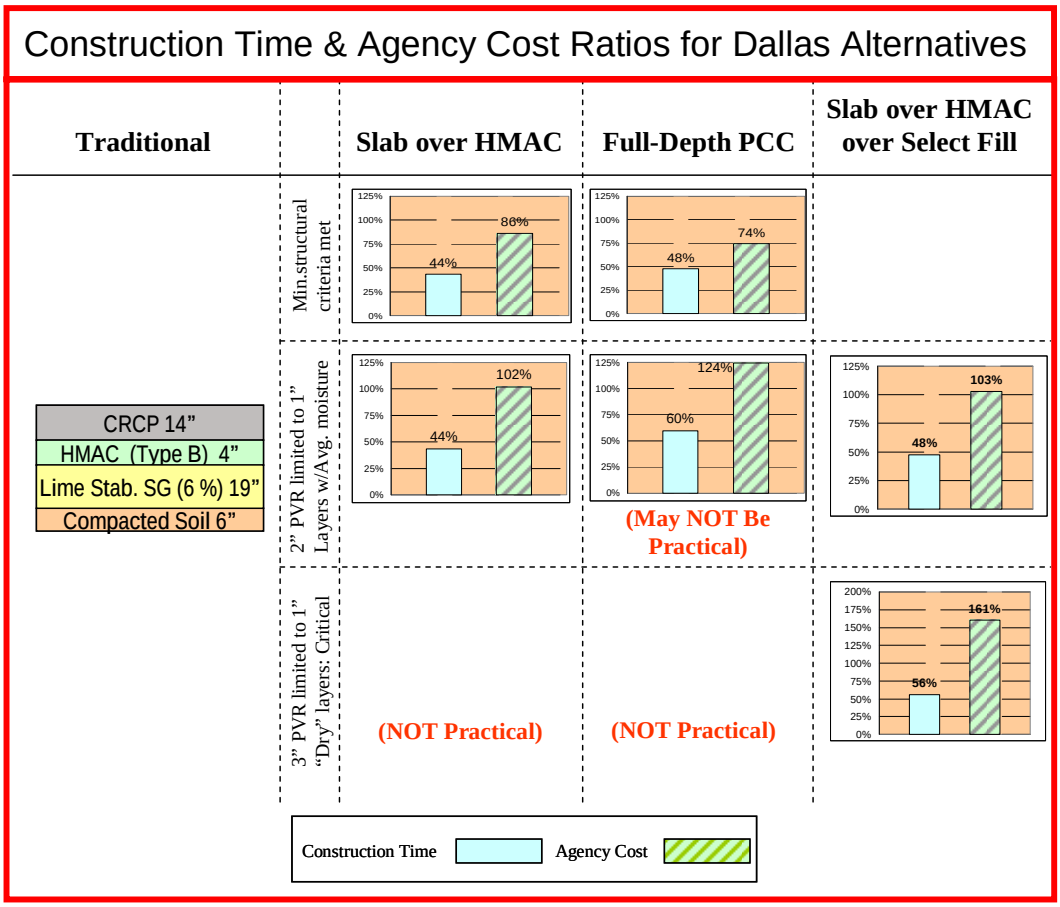
For the Houston District, all alternatives reduce full-costs from 14% to 35%, when we do not consider the slab over HMAC and select fill alternative, which does not appear economically feasible.

For the Beaumont District, alternate sections can be built in about half the time required for traditional sections. This fact, combined with the agency and user costs, leads to full-cost reductions from 34% to 26%.

In the El Paso District, alternate sections offer little or no full-cost savings when compared to traditional cross-sections. The 11-in. concrete slab over compacted soil shows a reduction of 11% in full-costs.

The Researchers Recommend…

In general, the alternate sections show noticeable improvements in time reduction as well as cost and provide cost reductions from the full-cost perspective other than those when a high PVR is expected. However, these sections need to be field evaluated from the standpoint of pavement performance and constructability, through the implementation of pilot test sections where these parameters would be carefully monitored.



For More Details…

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Former TxDOT Project Director: *James Hunt, P.E., Dallas District*

The research is documented in the following reports:

4188-1, Methods to Expedite Construction of PCC Pavements: An Overview
4188-3, A Study of Expediting Construction of Rigid Pavements in Urban Areas by Using Alternative Pavement Sections

To obtain copies of a report: Center for Transportation Infrastructure Systems, (915) 747-6925, email ctis@utep.edu.

TxDOT Implementation Status
October 2004

There is no plan for a formal implementation at this point of the new pavement sections developed by this research. Districts wanting to use these new sections should do so on a pilot basis so that constructability and pavement performance issues can be evaluated prior to wide implementation. Districts requiring technical support for implementation should contact RTI.

For more information, contact: Dr. German Claros, P.E., Research and Technology Implementation Office, (512) 465-7403, or e-mail gclaros@dot.state.tx.us.

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