Center for Transportation Research
The University of Texas at Austin

CENTER FOR TRANSPORTATION RESEARCH
THE UNIVERSITY OF TEXAS AT AUSTIN

PROJECT SUMMARY REPORT

Project Summary Report 0-1778-S
Project 0-1778: TxDOT Rigid Pavement Database
Authors: Cesar Ivan Medina Chavez, B. Frank McCullough and Terry Dossey
August 2005

The Texas Rigid Pavement Database: Accomplishments and Trends

What We Did...

As of March 2004, Texas' highway network was made up of 79,513 centerline miles, not including city roads, county roads, or toll roads. Of the almost 80,000 centerline miles, 40 percent consists of Interstate, U.S., and state highways, which are the most trafficked routes. These arterial highways transport most of the goods from production to distribution centers. In other words, the highway system is a primary component of the state's strong economy, and therefore must be maintained and kept in optimum condition to secure the well-being of Texas' residents.

In 1998, the Center for Transportation Research at The University of Texas at Austin undertook a research project that would maintain and update the existing rigid pavement database (RPDB) in Texas. The RPDB, per se, began in 1974 with the primary objective of creating a database that would simulate the conditions of Texas' concrete pavement network, and since then, multiple research tasks have been conducted to accomplish that goal. During the last 6 years, a number of activities have been pursued to monitor and evaluate the conditions of the rigid pavement sections contained in the RPDB. At the same time, a photo database that contains selected images of pavements' distresses has been prepared and is available in Microsoft Access format (Fig. 1).

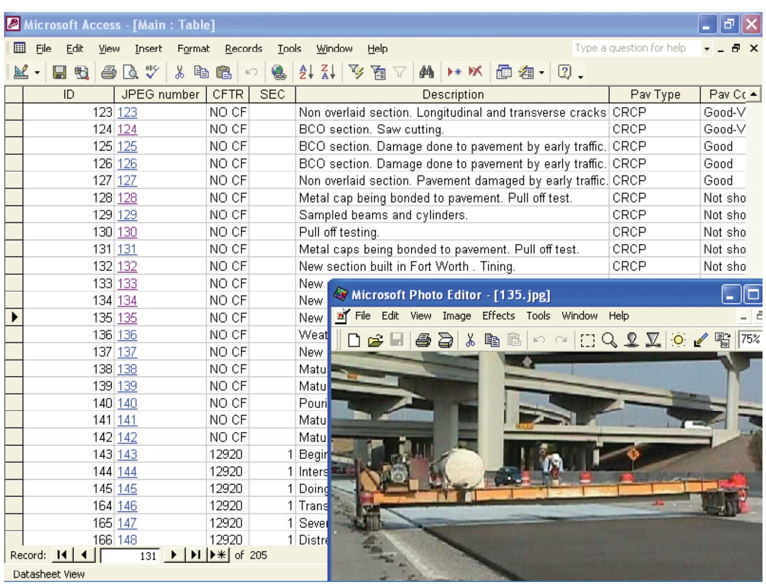

Figure 1: Photo Database—Concrete Placement and Curing

To evaluate the concrete pavement network in Texas, Project 0-1778 conducted hundreds of condition surveys across the state. The information obtained from this field work is invaluable and has aided researchers to better understand pavements' performance and the effect that different variables have on performance (Fig. 2.) This research has particularly investigated the effects on the performance of portland cement concrete pavements (PCCP) for different aggregate types and placement seasons. This condensed report summarizes some of the results presented in six previous technical reports, 0-1778-1 through 0-1778-6. These reports describe in more detail a variety of issues, such as influence of aggregate type on the performance of pavements and the effects of climatic factors such as ambient temperature, wind speed, and solar radiation on the develop-

Figure 2: Instrumentation of Hardened Concrete Pavement

ment of stresses in fresh and hardened concrete.

What We Found…

When project 0-1778 was started, the first priority focused on conducting the required tasks to reduce or eliminate inconsistencies in the RPDB. Due to the extent of information stored in the database and because field tasks were performed by many different crews over the years, the data were inconsistent at times. During the first 18 months of work, this project performed a comprehensive evaluation of the existing data from previous projects. Quality control activities allowed for eliminating errors and repetitions in the database. For instance, sections that were reconstructed, or where the pavement was widened to increase capacity, had to be deleted. To compensate for the eliminated data, more sections were added to the database with a justified criterion.

Demographic evaluations of the sections presented in previous reports for this project revealed that the RPDB was overpopulated with 8-inch-thick continuously reinforced concrete pavement (CRCP) sections. This was understandable because the majority of projects that were constructed during the 1970s and 1980s were 8 inches thick. Consequently, in an effort to balance this skewed trend, thicker sections that were constructed in the last 10 years were added to the database. Many of those sections are at least 12 inches thick and truly represent the sector of the rigid pavement network in Texas that was constructed in the last decade.

Among other objectives of this research was the investigation of the effect of coarse aggregate on the performance of concrete pavements. In this regard, research suggests that at least in Texas, CRCPs constructed with aggregates with a high coefficient of thermal expansion (CTE > 6 millionths) experience higher tensile stresses and deterioration when constructed during hot weather conditions than CRCPs constructed with aggregates with a low coefficient of thermal expansion (CTE £ 6 millionths). A special study conducted for two CRCP pavement sections in Houston, one constructed using silica-based aggregate and the other constructed using lightweight, showed that the performance of the lightweight section was much better than the one constructed with the silica-based aggregate (Fig. 3). On the other hand, another study compared the performances of two groups of jointed concrete pavement (JCP) sections located in the Dallas District: one constructed with siliceous river gravel (SRG) and the other with limestone (LS). The result showed that the performance of both groups was comparable; however, the sections constructed with SRG presented a slightly greater rate of failure. The researchers concluded that if similar trends exist in other parts of the state, then the standards for JCP should reflect the difference in aggregate types.

Other findings of this project showed that the minimum concrete temperature design values commonly used for pavement design are somewhat conservative, because the minimum pavement temperature is assumed to be equal to the minimum ambient temperature expected at the construction location. Research has shown that although the concrete tem-

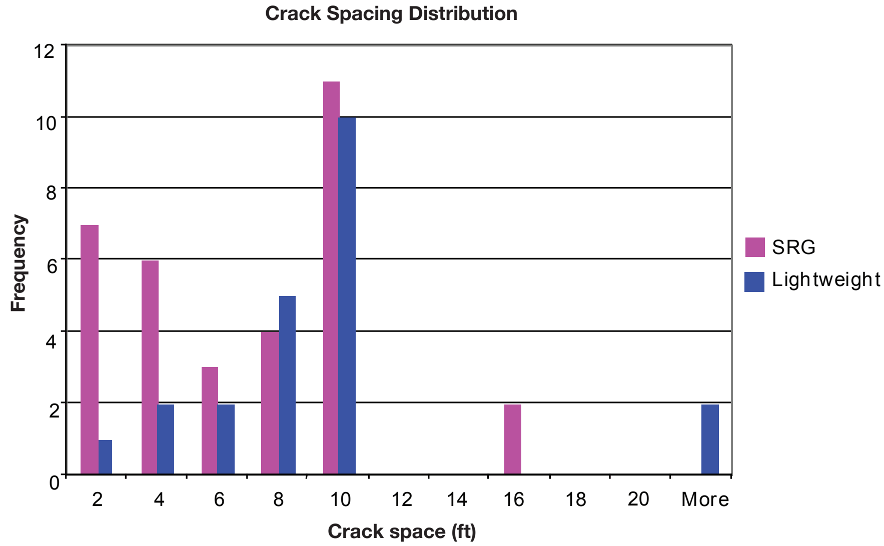

Figure 3: Crack Spacing Occurence for Silica-Based and Lightweight Aggregates

perature at the top fiber of the concrete slab is very comparable to the ambient temperature, the temperature at mid-depth of the slab, where reinforcement steel is located, is higher. This means that the content of reinforcement steel used in pavements might be higher than what is really required, causing a direct increase in the cost of the pavements.

It is hoped that the findings and contributions of this and past projects that managed and maintained the RPDB assist pavement engineers and researchers in designing and constructing more efficient and cost-effective pavements, not only in Texas, but nationwide.

The Researchers Recommend...

Data collected for the RPDB are mainly the result of visual inspections that record crack spacing and distresses on pavements. Additional information of traffic, concrete strength, soil properties, etc., is available for special projects or studies only. Although condition surveys represent an inexpensive and rapid way to evaluate a pavement, it is highly recommended that, according to possibilities, additional testing be performed other than simple visual assessment. Some valuable tests that could be performed to enhance the quality of the database are the following:

Deflection—a falling weight deflectometer (FWD) could be used to obtain deflection information of selected pavements.

Portable Seismic Pavement Analyzer (PSPA)—this equipment could be used to detect voids beneath the concrete pavement slab and delamination problems. It could be used to monitor pavement thicknesses as well.

Coring—this destructive test could be performed on a selective basis, when required by special studies and forensic analyses. The quality of the information that could be obtained from extracted cores is very valuable.

Additionally, some other characteristics about pavements that should be measured include the following:

Load transfer—deflections should be measured across cracks and joints of pavements and the load transfer capability should be estimated.

Crack width—measuring crack widths will allow determining whether or not load transfer across cracks is acceptable; mitigating activities could be planned accordingly.

Roughness—measuring roughness will allow estimating the international roughness index (IRI), which is an objective measurement of the serviceability of pavements.

Concrete temperature—the objective of this test will be to estimate temperature differentials (DT) across the depth of the slab, which translate into stresses in the pavement.

Following the recommendations above will assure the development of a more complete pavement database that will help to better understand the behavior of thicker pavements built nowadays.

For More Details...

Research Supervisor: B. Frank McCullough, Ph.D., P.E., (512) 232-3141
email: bfmccullough@mail.utexas.edu

Researchers: Cesar Ivan Medina-Chavez, Ph.D., (512) 232-3139
email: cimedina@mail.utexas.edu

Terry Dossey, BCS, (512) 232-3124
email: terry.dossey@mail.utexas.edu

TxDOT Project Director: Hua Chen, (512) 506-5846
email: HCHEN@dot.state.tx.us

TxDOT Research Engineer: German Claros, Ph.D., P.E., (512) 467-3881
email: GCLAROS@dot.state.tx.us

The research is documented in the following reports:

0-1778-1, *The Texas Rigid Pavement Database Annual Report*, 1999.

0-1778-2, *Updated Status of the Continuously Reinforced Concrete Pavement Database in Texas: Improvements and Trends.*

0-1778-3, *Accessing the Rigid Pavement Database through Microsoft Access.*

0-1778-4, *Assessment of Data Collection and Supplementary Tasks Conducted for the Texas Rigid Pavement Database.*

0-1778-5, *Analyses Performed Using the Rigid Pavement Database in Texas.*

0-1778-6, *Analysis and Validation of the Usefulness of the Rigid Pavement Database: Final Report.*

To obtain copies of a report: CTR Library, Center for Transportation Research,
(512) 232-3126, email: ctrlib@uts.cc.utexas.edu

Your Involvement Is Welcome!

Disclaimer

This research was performed in cooperation with the Texas Department of Transportation (TxDOT) and the Federal Highway Administration (FHWA). The contents of this report reflect the views of the authors, who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the FHWA or TxDOT. This report does not constitute a standard, specification, or regulation, nor is it intended for construction, bidding, or permit purposes. Trade names were used solely for information and not for product endorsement. The engineer in charge was B. Frank McCullough, Ph.D., P.E. (Texas No. 19914).

Center for Transportation Research
The University of Texas at Austin

The University of Texas at Austin
Center for Transportation Research Library
3208 Red River #115
Austin, TX 78705-2650