CENTER FOR TRANSPORTATION RESEARCH
THE UNIVERSITY OF TEXAS AT AUSTIN

Project Summary Report 0-4035-S
Project 0-4035: Further Development of Post-Tensioned Prestressed Concrete Pavements
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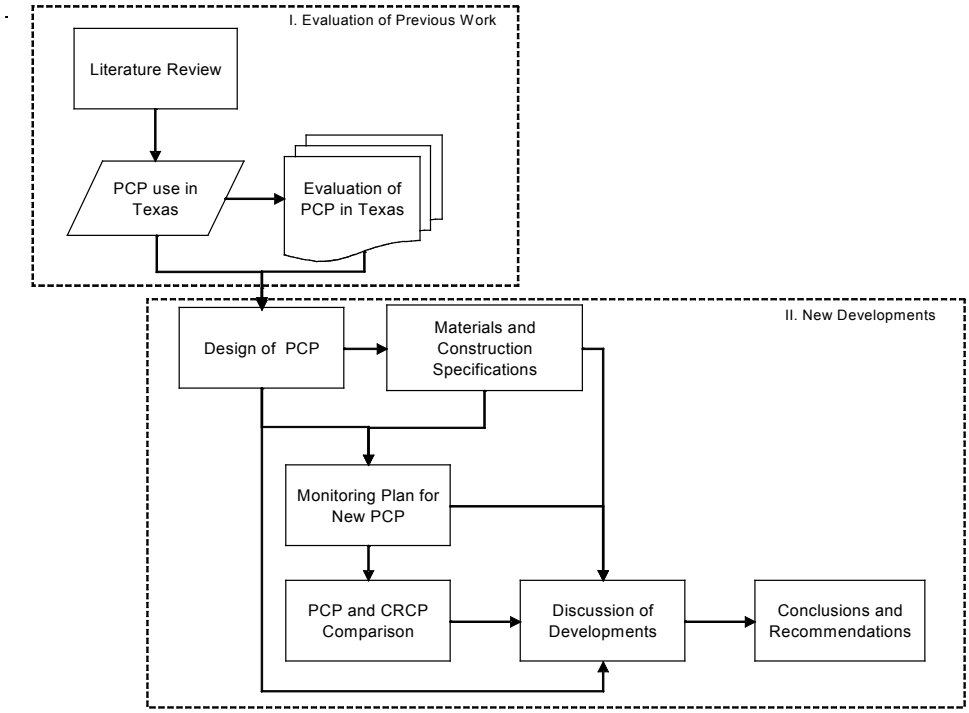
PROJECT SUMMARY REPORT

A Cast in Place Post-Tensioned Prestressed Concrete Pavement in Texas: Design and Specifications

Prestressed concrete pavement (PCP) application started in the early 1940s in Europe. At that time, most of the PCPs were constructed at airports for runways and taxiways. Domestic applications were also initiated in military airports. The first PCP in the United States was constructed in 1953 at Patuxent River Naval Air Station, Maryland. Later, two more PCPs were constructed in Texas; one was built in 1955 at the San Antonio International Airport, the only nonmilitary application in the 1950s, and the other was constructed in 1959 in El Paso at Biggs Air Force Base. Later, in the 1970s, three more PCPs were built in Pennsylvania, Mississippi, and Arizona, using funding from the Research and Development Demonstration Projects Program of the Federal Highway Administration (FHWA). The objective of that program was to construct a zero-maintenance pavement, as conceptualized by the FHWA, that would demonstrate competitiveness with other pavement types.

Although these early PCPs performed relatively well, some flaws had to be corrected in subsequent projects. The three early projects experienced moderate to severe problems at the transverse joints and the adjacent concrete. Other distresses included cracking and spalling.

In 1983, the former Texas State Department of Highways and Public Transpor-



Approach Followed for Project Development

Deflection Testing Using FWD and RDD Equipment

tation (SDHPT), now the Texas Department of Transportation (TxDOT), requested that the Center for Transportation Research (CTR) of The University of Texas at Austin oversee the design and construction of two PCP experimental sections in Texas. In 1985 and due to funding constraints, only one PCP was constructed in McLennan County on IH 35 under TxDOT Research Project 9-556.

The design of the new PCP introduced innovations and improvements over previous designs; the three most critical aspects introduced were: 1) construction of a central stressing pocket instead of gap slabs, 2) use of transverse prestress, and 3) design of an efficient transverse joint. After almost twenty years of service and working under heavy traffic conditions, the PCP section has performed exceptionally well, with few problems.

What We Did...

In fiscal year 2000, TxDOT Project 0-4035 was initiated with one main objective: develop and recommend an improved design for a cost-effective state-of-the-art PCP that will be constructed in Texas. To accomplish this goal, the researchers developed a mechanistic-empirical design procedure and prepared special specifications for construction and evaluation of the PCP for both short-term and long-term. To pursue the objectives in this project, a well-planned strategy was devised. First, previous work performed in the United States and overseas was evaluated, and successes and failures of that work were pondered. Such an examination should help avert future mistakes. Special attention was given to the section built in Texas in 1985 and its performance. Next, new developments were originated and implemented that will result in an improved PCP. Some of those new developments included the design approach of the PCP, recommendations for materials, a proposed monitoring plan, a methodology to compare the PCP with a conventional continuously reinforced concrete pavement (CRCP) that will serve as a control section, the improvement of an existing computer program that predicts stresses and displacements of the PCP slabs, and a methodology to estimate the financial feasibility of the PCP technology.

Field testing was conducted in two locations, the existing PCP section and the location where the new pavement will be constructed. Among the tests performed were detailed condition surveys of the pavements, which helped to calculate a pavement distress index (PDI). Structural evaluation of the structures was done using a falling weight deflectometer (FWD) and a rolling dynamic deflectometer, and dynamic cone penetrometer (DCP) to estimate the strength characteristics of the natural soil and embankment material used in the location where the new PCP will be constructed.

What We Found...

The literature review conducted for this project and the findings from the previous experience in Texas suggest that the PCP technology is very promising. However, it was found that particular characteristics of this type of technology impede its

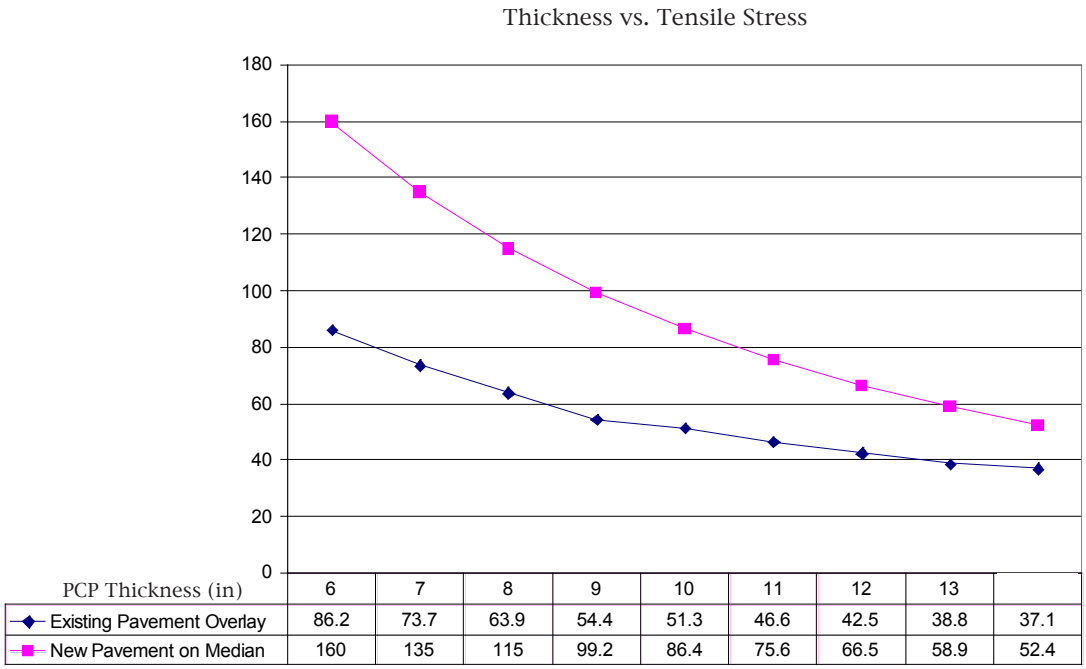
widespread application—characteristics including its initial higher cost, the lack of a standardized design method, and the unfamiliarity of some pavement engineers with the design and construction of PCP. It is hoped that the growing interest from state agencies on this technology plus the outstanding performance of some previous PCP projects will lead to new improvements in design methods, and design and construction standards that will promote this paving technique.

In general, there is consensus that construction of PCP suggests better utilization of materials, particularly concrete, which in turn means a reduction of problems associated with temperature differentials common in conventional concrete pavements. Prestressing the PCP slab implies that the outstanding compressive strength of the concrete is used to reduce or even eliminate undesired tensile stresses in the material that cause cracking. It is also well known that if the design and construction of PCP are successful, the performance of the pavement will be assured, and it may well become a real zero-maintenance pavement.

The effort conducted under this research project represents a significant attempt to improve the previous work done in this area. It is believed that once performance data about the new PCP are collected and analyzed, probably ten or fifteen years after construction, the PCP will definitely prove to be a long-term cost-effective state-of-the-art paving alternative.

The Researchers Recommend...

An implementation project is being pursued for formal application of the concept developed in this research project. If the new PCP is constructed in Texas, it will be the second of probably many potential projects that will use this technology. It should be noted that although this pavement type is not a panacea, it provides a feasible alternative with no absolute solution. Instead, the flexibility of the design of PCP allows engineers to provide rational solutions based on requirements and restrictions. In the end, any type of high performance concrete pavement should be able to provide many years of service at the best projected cost with minimum maintenance, and PCP is committed to that principle.



PCP Thickness (in)	6	7	8	9	10	11	12	13	
Existing Pavement Overlay	86.2	73.7	63.9	54.4	51.3	46.6	42.5	38.8	37.1
New Pavement on Median	160	135	115	99.2	86.4	75.6	66.5	58.9	52.4

Variation of PCP Slab Thickness and Tensile Stresses at Bottom of Slab

For More Details...

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The research is documented in the following reports:

0-4035-1 *Design of a Post-Tensioned Prestressed Concrete pavement, Construction Guidelines, and MonitorinPlan*
0-4035-2 *Application of PSCP 3.0 Program to Predict Stresses in Prestressed Concrete Pavements*
0-4035-3 *Plan for Post-Construction Evaluation and Special Specifications for a PCP*

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