VOID DETECTION AND GROUTING PROCESS

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SUMMARY REPORT 249-3(S)

SUMMARY OF

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Foreword

Research Report 249-3, "Void Detection and Grouting Process," presents the results of an experiment focused on the development of a procedure which provides the optimum results for void detection and the grouting operation. This report is the third in a series which describes work done on Project 3-8-79-249, Implementation of Rigid Pavement Overlay and Design System.

Introduction

In the design of pavements, it is assumed that full support is obtained through the length of the pavement. When a void develops beneath the pavement, this support condition is lost and, therefore, this assumption is no longer valid. As a result, the stress level in a pavement with a void increases significantly and, thus, the fatigue life of the pavement is substantially reduced.

Voids can develop in a number of ways, but the most significant factors creating void conditions beneath concrete pavements are

(1) erosion and pumping of the subgrade material;
(2) differential soil movements developed by swelling or settlement action; and
(3) mudjacking, which causes the pavement to raise excessively, thus producing a high point with a void on each side.

The occurrence of such voids beneath CRCP eventually results in punchouts and failures with a consequent increase in maintenance cost.

The first step from an engineering standpoint is detection of the voids prior to development of a condition that is excessively detrimental to the pavement. Over the past few years several different methods have been proposed for investigation, including the use of density measurement equipment, vibratory equipment, deflection measurement equipment, infrared thermography, radioactive tracers, and the visual observation of distress manifestations, such as pumping. Various Districts in Texas have experimented on a very limited basis with the different techniques, but detailed studies have not been made or reported to date.

In addition to detecting the voids, it is necessary to fill them in some way. In recent years, several different grout mixtures have been successfully used for undersealing the slab jacking. The method that Mississippi has applied with some success has been used by the SDHPT on both experimental and contract bases.

This report presents the results of a series of analyses regarding alternative methods for detecting the voids beneath the CRCP, the evaluation of the capabilities for undersealing the pavement, and the long-term performance of pavements that were undersealed.

Summary of Approach

The general objectives of this study are to ascertain the feasibility of detecting voids beneath concrete pavements as well as of the grouting process used to fill the voids. Specifically the objectives of this study are

(1) to evaluate, in a controlled experiment, the feasibility of using the Dynaflect to select the areas with high probability of voids;
(2) to analyze the influence of the grouting process on pavement deflections;
(3) to predict future performance; and
(4) to evaluate economic aspects of using the process.

Developing a Procedure

These are the steps involved in the proposed procedure for locating voids beneath the pavement, filling voids, and evaluating the results.

(1) *Analysis of Data.* To locate the areas with probability of voids, condition survey data recorded from a particular project have to be analyzed. In this analysis special attention should be given to areas in which patches, punchouts, and evidence of pumping exist.

Having identified these areas, a combined analysis of normalized Dynaflect deflections of sensor 1 and sensor 5 of the Dynaflect device recorded at one foot from the pavement edge and field observations of pumping has to be made. From this analysis the specific areas with voids beneath the pavement can be identified. After the identification of areas with voids has been made, a pattern defining the location of the holes in which the grout will be pumped has to be elaborated. It is important to remember during the elaboration of the hole pattern that the optimum benefits are obtained when the grout is applied just beneath the pavement slab and at one foot from the pavement edge.

(2) *Execution of the Grouting Operation*. Once the areas have been identified and a hole pattern has been defined, the next step is to locate these areas in the field. For this purpose special care should be given to marking the separation between holes and the distance from the pavement edge at which holes should be drilled. The depth to which the holes are drilled must be very carefully supervised to insure that the grout will be pumped just beneath the pavement slab. During the grouting operation, the slab has to be continuously monitored to avoid slab lifting. If that occurs the operation must be stopped at that point.

(3) *Evaluation of Results*. When the grouting operation is finished, an evaluation has to be made. The evaluation is achieved by first comparing the deflection measurements recorded before and after the grouting operation and then determining whether or not any improvement in the deflections was obtained. Second, profile measurements recorded before and after the experiment should be compared to determine if any slab lifting occurred.

Conclusions

Based on the results obtained in this study it can be said that voids beneath the pavement can be successfully detected and filled. From evaluation of the analyses and results the following specific conclusions were obtained.

(1) The Dynaflect deflections recorded at one foot from the edge provide more sensitivity in detecting areas in which voids exist beneath the pavement.

(2) A combined analysis of Dynaflect deflections and field observations of pumping has proved to be the optimal procedure for void area detection.

(3) The grout applied just beneath the pavement slab provides the optimum benefits for the structural capacity of the pavement. An improvement of 41 percent in the deflections recorded before and after the grout was applied was obtained.

(4) Taking into account the improvement in deflections obtained at Victoria, an overlay design using the RPRDS1 computer program showed that the overlay thickness required for a 20-year design period before the grout is applied is 6 in., whereas the overlay thickness required once the grout has been applied is 5 in.

(5) Based on cost information provided by the SDHPT and a private construction company, a reduction in the total net present value of the optimal design strategy of about 13 percent is obtained when a grouting operation is performed.

KEY WORDS: Continuously reinforced concrete pavement (CRCP), void detection, grouting operation, Dynaflect, pumping, normalized Dynaflect deflection.

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

The full text of Research Report 249-3 can be obtained from Mr. Phillip L. Wilson, State Transportation Planning Engineer, Transportation Planning Division, File D-10R; State Department of Highways and Public Transportation; P. O. Box 5051; Austin, Texas 78763.

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