



Performance Evaluation of Rubblized Pavements in Iowa

tech transfer summary

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RESEARCH PROJECT TITLE

Rehabilitation of Concrete Pavements Utilizing Rubblization and Crack and Seat Methods (Phase II): Performance Evaluation of Rubblized Pavements in Iowa

SPONSORS

Iowa Highway Research Board (TR-550)
Iowa Department of Transportation

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This project evaluates the structural condition of rubblized portland cement concrete pavements overlaid with hot mix asphalt in Iowa.

Objective

The objective of this project was to evaluate the structural condition of existing rubblized concrete pavements in Iowa through Falling Weight Deflectometer (FWD) tests, Dynamic Cone Penetrometer (DCP) tests, and visual pavement distress surveys.

Problem Statement

In Iowa, a significant portion of surfaced highway pavements are composed of portland cement concrete (PCC). These pavements deteriorate over time due to distresses caused by a combination of traffic loads and weather conditions. The most common method for rehabilitating distressed PCC pavements is to overlay the existing PCC with hot mix asphalt.

However, experience has shown that in order to prevent the occurrence of reflective cracking from joints and cracks in the PCC pavement and the reflection of other PCC distresses into the overlaying HMA layers, it is necessary to destroy the slab action of the PCC slabs. Rubblization is the process of breaking the existing pavement slabs into pieces and overlaying them with hot mix asphalt (HMA).

The HMA overlay thickness design procedures for rubblized PCC pavements proposed by the National Asphalt Pavement Association and the Asphalt Institute are based on the structural number-layer coefficient principles used in the existing 1993 AASHTO design guide.

The AASHTO design guide requires the determination of a layer coefficient for the rubblized PCC. This coefficient varies considerably depending on the state agency and the design procedure used, giving rise to a wide range of HMA overlay thicknesses.

In a June 1991 report, PCS/LAW Consulting Services recommended layer coefficient values in the practical range of 0.23 to 0.31. These recommendations were based on the analysis of 19 existing sections in different states; therefore, they reflect differences in material specifications and construction practices. Thus, there is a need to estimate the in-situ layer coefficient of rubblized concrete pavements in Iowa to provide recommendations for future design.

Technique Description

The researchers selected 29 Iowa pavement sections with rubblization projects. Core samples of each section were taken during a field evaluation to verify that each section was a rubblized project.



This PCC pavement overlaid with HMA without rubblization of the existing pavement slabs exhibited high levels of reflective cracking.

To evaluate the performance of each rubblized project, three test methods were used. These methods included FWD tests, DCP tests, and visual distress surveys.

For this project, the FWD was used as the main non-destructive testing equipment to evaluate the structural condition of rubblized PCC pavement sections. Deflection data were collected using the Iowa DOT's JILS-20 FWD by applying a step loading sequence at the start, middle, and end of each test section.

DCP tests were conducted at the same three locations (start, middle, and end) of each test location. These tests were conducted to collect additional information about the in-situ subgrade soil properties.

Visual distress surveys were conducted over the entire area of each section, rather than at just three locations. The survey methodology employed was similar to that of the Strategic Highway Research Program's "Distress Identification Manual for the Long-Term Pavement Performance Project."

Key Findings

- Rubblization is a valid option to use in the rehabilitation of PCC under the good support or strength of the foundation.
- Iowa's rubblized pavement sections are performing very well. The predominant distresses exhibited on HMA-overlaid rubblized PCC sections are non-load associated distresses, such as low-temperature cracking and/or longitudinal cracking.
- The average rubberized PCC layer coefficient value in this study was found to be 0.19, which was consistent with that used by Arkansas, Michigan, Mississippi, Ohio, and Pennsylvania.



This rubblized PCC pavement overlaid with hot mix asphalt exhibited no cracking.

- The average rubberized PCC modulus of the rubblized layer in this study was found to be 78 ksi which was close to the modulus value of 65 ksi recommended by a Wisconsin DOT study.
- The M-E HMA overlay thickness design software developed during the first phase of this study can estimate the HMA overlay thickness reasonably well to achieve long-lasting performance of HMA overlay pavements with rubblization.
- The average tensile strain value of 74- microstrain at the bottom of HMA layer and the average vertical strain of 235-microstrain on top of subgrade are close to values of 70- microstrain and 200- microstrain recommended for long-lasting HMA pavements.
- The ISU artificial neural network-based backcalculation program provides good predictions for subgrade modulus.

Recommendations

The research team made the following recommendations to suggest activities that the Iowa DOT could consider to confirm the design criteria and decision factors for use of rubblization in Iowa.

- The Iowa DOT should continue to use PCC rubblization as a valid pavement rehabilitation strategy
- The Iowa DOT should confirm the minimum foundation support condition or elastic modulus of the foundation. Wisconsin DOT specifies this value as 10 ksi.
- A structural layer coefficient of 0.19 is recommended for use in AASHTO design method and a layer modulus value of 78 ksi is recommended for use in MEPDG design method.