CENTER FOR
PORTLAND CEMENT CONCRETE
PAVEMENT TECHNOLOGY

IOWA STATE UNIVERSITY

Measuring Pavement Profile During Construction

tech transfer summary

RESEARCH PROJECT TITLE
Measuring Pavement Profile at the Slip-Form Paver

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The Center for Portland Cement Concrete Pavement Technology (PCC Center) is housed at the Center for Transportation Research and Education (CTRE) at Iowa State University. The mission of the PCC Center is to advance the state of the art of portland cement concrete pavement technology.

Objective

This project evaluated equipment and methods to measure pavement profile at the slip-form paver. The evaluation considered the impact of various pieces of paving equipment and processes on the resulting pavement ride values. Construction guidelines were also developed.

Problem Statement

Pavement profile or smoothness has been identified nationally as a good measure of highway user satisfaction. This has led highway engineers to measure profiles of both operating and new highways. Operational highway profiles are typically measured with high-speed inertial profilers. New highway profiles are usually measured with profilographs in order to establish incentives or disincentives for pavement construction. In most cases, these two processes do not measure the same value from the "cradle to grave" life of pavements.

In an attempt to correct the inconsistency between measuring techniques, several lightweight profilers are being made that can measure pavement profile at the slip-form paver during construction. This research produced a field evaluation of two such systems.

Another portion of the pavement smoothness/profile problem is the lack of understanding about what causes undulations in the pavement surface and how to prevent these undulations from occurring. The findings from this project expand our understanding of the causes and solutions to common pavement profile problems.

Technology Description

GOMACO Smoothness Indicator (GSI)

The GSI is a noncontact pavement profiler that can be used to measure the pavement profile of either wet or hardened concrete. The system includes a computer and wheel path sensors that can be mounted on the slip-form paver or on a GSI vehicle that follows the paver. The computer displays and records the data as they are collected by the sensors. The GSI provides the data in a variety of useful formats, including as International Roughness Index (IRI) and Profilograph Index (PI) values.

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Measuring pavement profile during construction using the GOMACO Smoothness Indicator (GSI)

Measuring pavement profile during construction using the Ames Engineering Real Time Profiler (RTP)

Ames Engineering Real Time Profiler (RTP)

The RTP is a laser-based profiler system that uses wheel path sensors and a computer to measure and record the pavement profile during construction. The sensors can be mounted on the slip-form paver or other equipment such as the curing and tining machine in a number of different arrangements. A laptop computer on the paver displays and records the data as they are collected. The RTP provides the data in a variety of useful formats, including as International Roughness Index (IRI) and Profilograph Index (PI) values.

Research Method

The GSI system was evaluated using three different configurations on a section of new construction of U.S. Highway 30 near LeGrand, Iowa. The RTP system was evaluated using two different configurations on a section of new construction of U.S. Highway 34 near Rockbridge, Iowa.

The Iowa DOT profiler was used to gather pavement ride values on each of the test sections immediately after construction. This provided a way of relating profile measurements obtained on plastic concrete using the two systems under evaluation to measurements obtained on the hardened concrete using a standard method.

Key Findings

- The profilers evaluated in this study are able to detect roughness in the final profile, including localized roughness and roughness at joints.
- Dowel basket ripple is a significant source of pavement surface roughness. The profilers evaluated in this study are able to detect dowel basket ripple with enough clarity to warn the paving crew.
- String-line disturbances degrade smoothness. The profilers evaluated in this study are able to detect some string-line disturbances during paving operations.
- The profilers evaluated in this study are not currently able to produce the same absolute IRI values on the plastic concrete that can be measured by inertial profilers on the hardened concrete.
- When these devices are used in a slip-form paving train, shrouds should be placed around the sensors to prevent concrete and curing material splatter from damaging the sensors or affecting the profile measurements.

Implementation Benefits

- The profilers evaluated in this study are able to provide real-time warnings for most surface roughness problems.
- The profilers evaluated in this study can be used to take corrective action prior to set of concrete.
- The profilers evaluated in this study can be used to measure pavement thickness, reducing or eliminating the need for quality assurance coring for pavement depth.

Implementation Readiness

- The profile values recorded by the systems evaluated in this study cannot yet be used for construction acceptance or incentives/disincentives.
- The profilers evaluated in this study generated erroneous content in some instances. An automated warning system is recommended to help detect obvious measurement problems.