Improving Concrete Overlay Construction

tech transfer summary

With improved concrete overlay construction methods, transportation agencies can improve mobility, safety, and access to property.

Objectives

Improve construction techniques for concrete overlays in order to provide effective solutions to road preservation problems.

Problem Statement

As the U.S. highway system ages and available funding diminishes, transportation agencies are studying effective methods for preserving and extending the life of existing pavements. These agencies are also being encouraged to minimize construction times and reduce the inconvenience to the traveling public.

Due to the emphasis on preservation activities and minimal disruption, concrete overlays are being proposed as a viable method of strengthening pavements and improving driving surfaces. However, concrete overlay construction techniques can be improved to provide effective answers to preservation problems.

Critical construction elements include, for example, addressing concerns about concrete yield, minimizing paving train width/length, controlling traffic, meeting traffic and concrete delivery demands with proper opening-strength staging, preparing the existing pavement surface, and using innovative materials as bond breakers on unbonded overlays.

Finished pavement in Osceola County

Two-lane stringless paving in Poweshiek County

Single-lane stringless paving in Worth County

Single-lane paving with stringline in Johnson County

IOWA STATE UNIVERSITY
Institute for Transportation

April 2010

RESEARCH PROJECT TITLE
Improving Concrete Overlay Construction

SPONSORS
Iowa Highway Research Board
(IHRB Project TR-600)
Federal Highway Administration
(DTFH61-06-H-00011, Work Plan 17)

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The mission of the Institute for Transportation (InTrans) at Iowa State University is to develop and implement innovative methods, materials, and technologies for improving transportation efficiency, safety, reliability, and sustainability while improving the learning environment of students, faculty, and staff in transportation-related fields.

Research Description

Four ongoing construction projects in Iowa were selected to study ways to improve concrete overlay construction. The projects, one each in Osceola, Poweshiek, Worth, and Johnson counties, were selected based on certain characteristics and availability.

Seven research objectives for improving concrete overlay construction were investigated across the four projects:

1. Evaluate machine control systems.
2. Evaluate the longitudinal joint forming operation.
3. Study the need for milling of the existing surface.
4. Evaluate the use of innovative materials, such as geotextiles for bond breakers.
5. Determine innovative ways of controlling traffic.
6. Find ways to minimize the construction time.
7. Determine required opening strength for local traffic.

Saw equipped with a GPS unit in Poweshiek County

Installing geotextile material as an innovative bond breaker in Poweshiek County

Summary of Recommendations

GPS Pavement Surface Mapping

- Use GPS with lasers, ultrasonic, radar, etc. to map the existing pavement surface before placing the overlay.
- At minimum, profile the existing surface along the edges and at the centerline before final design.

Sawing Longitudinal Joints Using GPS Control

- Use GPS-controlled saws to align the longitudinal joints in the overlay and the underlying pavement.

Milling

- During design, compare the cost of milling to the concrete yield savings.
- Use a 12-foot-wide milling machine with closely spaced teeth to improve cross-slope and concrete yield.
- Use a mill head wider than the pavement widening unit to improve the paver pad line, drainage, and ride quality.

Slipform Paver Machine Control

- Improve concrete yield by accounting for agency goals, mapping the existing surface, and developing tight vertical control systems before design/construction.
- Consider demonstrating stringless controls with a combination of GPS, lasers, and total stations.

Geotextile Bond Breaker

- Consider using a geotextile bond breaker for unbonded concrete overlays.
- Reduce potential for wind/traffic damage by installing the geotextile less than one day before paving.

Concrete Opening Strength for Local Traffic

- Use maturity data to open local resident access within 24 hours of paving (350 psi flexural strength).
- Use maturity data to begin shouldering less than 48 hours after paving (500 psi flexural strength).
- Develop maturity curves specific to the materials used for each project.

Traffic Control for One- and Two-Lane Construction

- Analyze the costs of maintaining through traffic and building in stages versus the inconvenience of closing the roadway and placing a single- or dual-lane overlay.

Overlay Construction Operation Timing

- Relocate utilities, improve drainage, and survey the pavement before overlay to minimize road closure.
- Maintain through traffic with flaggers during initial improvements, e.g., subdrain installation or milling.
- Consider total closure to through traffic and two-lane overlay construction to minimize project duration.

Falling Weight Deflectometer (FWD) Testing

- Perform FWD testing before and after overlay to verify deflection reduction and overlay depth adequacy.