Concrete Overlays Helping to Address the Nation’s Preservation/Rehabilitation Needs

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ABSTRACT

This presentation will discuss how concrete overlays can help address the need to cost-effectively renew the nation’s 4 million mile transportation system. The products developed through the research to date, the field application support program, and outcomes expected from the balance of the program of work will be presented.

This presentation is part of the Sustainable Concrete Pavement Technologies session.

Key words: concrete overlays—cost-effective—rehabilitation
National Concrete Pavement Technology Center

Sustainable Concrete Pavement Technologies

Concrete Overlays Helping to Address the Nations Preservation/Rehabilitation Needs

Mid Continent Research Symposium

Ames, Iowa
August 20-21, 2009
Nations Transportation Needs

- Thousands of miles of 30, 40, 50, year-old pavements are still in service
- 1/3 of the Nations 4 million miles are in poor condition
- Poor roadway conditions cost US motorist $54 billion per year in vehicle repair and operating costs
- To address the roadway problems require $65-100 billion per year for several years
- Current revenue supplies less than $40 billion per year
Fix now or pay a lot more later
Value of US Highway System $1.75 Trillion

Pavement Condition Rating (PCR)

- 40% at PCR 60-100
- 75% at PCR 50-60
- 40% at PCR 40-50
- 12% at PCR 0-40

Costs:
- $4.80 to $7.00 at PCR 50-60
- $20.00 at PCR 40-50
- $48.00 at PCR 0-40

Years (age):
- 10
- 15
- 20

Harrington  4
What If?

- New or improved sustainable technologies could solve some of these challenges.

- Country’s 1.3 million miles of deteriorated pavements rehabilitated quickly and sustainably at a fraction of the cost of reconstruction.

- Agencies could extend the return on their original investment by taking advantage of the equity remaining in deteriorated pavements.

- Pavement structural capacity could be enhanced to meet the demands of the ever increasing traffic volumes (240% increase 1965 to 2005).

- Get in, get out, and stay out – construction is a major source of traffic delays.
We Know There Are Solutions

- Concrete overlays reuses the existing pavement
- As long as existing pavement remains stable and uniform a concrete overlay can be placed, replaced or recycled as needed
- Where pavement needs to carry heavy loads a thin bonded overlay creates a thicker monolithic section
- If pavement is deteriorating a thicker unbonded overlay acts like a new pavement with the old pavement as a base
- Concrete overlays reuses the existing pavement
- Life cycle costs are some of the best
Why Concrete Overlays?

- Consistently provide cost-effective solutions
- Constructed quickly and conveniently
- Few preoverlay repairs are necessary
- Placed using normal concrete pavement construction practices
- Can be opened to traffic within a short time using standard mixes
- Easy to repair
- Cost-effective maintenance tool and valuable rehabilitation tool
- Can serve as complete preventive maintenance or rehabilitation solutions or can be used in conjunction with spot repairs of isolated distresses
Minor Rehabilitation - Thin Overlays (2"-4")
Major Rehabilitation

Major Rehabilitation
Structural Concrete Overlays (>4”)

[Image of construction site with machinery and workers]
Across the Country, Most States Have Used at Least One Type of Concrete Overlay

- To rehabilitate aging pavements
- Been in service for decades in many locations
- Experience has shown that well designed and constructed concrete overlays provide excellent performance
Why are we not using Concrete Resurfacing Technology more?

Perception:

- Pavement design theories for bonded and unbonded overlays (resurfacing) are difficult to understand
- There is lack of confidence in overlays because of lack of understanding on how they work
- They are not perceived to be fast track construction like HMA
- They are expensive to remove and replace
CP Technology Center Advisory Board (Spring 2006)

- Develop a user friendly “go to” manual with training to provide the user with a simple, but educated choice.

- Form partnerships between states to share experiences and knowledge and there needs to be assistance provided to those states.

- There needs to be one single comprehensive document
# Concrete Overlays Program

<table>
<thead>
<tr>
<th>Program</th>
<th>Products</th>
<th>Schedule</th>
<th>Funding</th>
</tr>
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</table>
| **Part 1**
• Clarify Terminology
• Additional topics                           | 2006-2008               | CP Tech Center                   |
| **Part 2**
One to six hour presentations through out the country | 30 Power point presentations and workshops                                | 2007-2010 | CP Tech Center/FHWA APTP         |
| **Part 3**
Field Application Program
Expert teams completes field review for evaluation, and helps with design, specs, pre construction issues. | • 10 state projects
• Technical Assistance
• Lessons learned
• Lessons shared                            | 2008-2010               | FHWA/ISU Cooperative Agreement   |
| **Part 4**
IHRB/FHWA Field Research Program            | • Field research on early opening, traffic control, interlayer, string-less paving | 2009-2010 | FHWA/ISU Cooperative Agreement   |
| **Part 5**
Design Guide for Concrete Overlays          | Design Guide to be developed for bonded and unbonded overlays with examples of current programs | 2009-2011 | FHWA/ISU Cooperative Agreement   |
Concrete Overlay Guide second edition

Contents

1. Overview of Overlay Families
2. Overlay types and uses
3. Evaluations & Selections
4. Six Overlay Summaries (11”x17 “sheets)
5. Design Section
6. Miscellaneous Design Details
7. Overlay Materials Section
8. Work Zones under Traffic
9. Key Points for Overlay Construction
10. Accelerated Construction
11. Specification Considerations
12. Repairs of Overlays
Family of Concrete Overlays

Thinner

Concrete Overlays

Thicker

Bonded Overlay Family

- Bonded Concrete Overlay of Concrete Pavements
- Bonded Concrete Overlay of Asphalt Pavements
- Bonded Concrete Overlay of Composite Pavements

Unbonded Overlay Family

- Unbonded Concrete Overlay of Concrete Pavements
- Unbonded Concrete Overlay of Asphalt Pavements
- Unbonded Concrete Overlay of Composite Pavements

Bond is integral to design

Old pavement is base
Maintenance & Rehabilitation Curve

The real challenge is identifying the right treatment at the right time

<table>
<thead>
<tr>
<th>Existing pavement condition</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td></td>
</tr>
<tr>
<td>Fair</td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td></td>
</tr>
<tr>
<td>Deteriorated</td>
<td></td>
</tr>
<tr>
<td>Failed</td>
<td></td>
</tr>
</tbody>
</table>

- Preventive maintenance
- Minor rehabilitation
- Major rehabilitation
- Preservation
- Reconstruction
Concrete Overlay Field Application Program

The overall objective of the program is to increase the awareness, knowledge and strengthen confidence in concrete overlay applications among state DOTs, cities, counties, contractors, and engineering consultants.
Expert Team

Experts on concrete overlays will provide informational assistance to each participating state.

- Conduct initial field site review
- Walk through the evaluation process
- Walk through the design phase
- Attend pre-pour, pre-bid or pre-construction conference
- Attend during construction & may use mobile lab
Technical Working Group (TWG) Meetings

- Exchange of lessons learned between participating State DOT’s
- Held first TWG conference call May 18, 2009 with nine states participating
  - Review uses & benefits
  - States share evaluation criteria and overlay selection process
  - States share their issues, solutions and lessons learned
  - Suggestions on update of Overlay Guide
  - Overall information sharing among states
Concrete Material and Pavement Testing Mobile Laboratory

• With the concurrence of each State DOT, the CP Tech Center’s Mobile Concrete Lab will be on-site during construction of the overlay demonstration projects.

• Will perform comprehensive concrete testing (for each type of overlay) as well as offer technical support to the State DOT.
Concrete Overlay
Field Application States

- **Joined the Program**
  1. Delaware
  2. Louisiana
  3. Maryland
  4. Nevada
  5. New Mexico
  6. North Dakota
  7. Pennsylvania
  8. South Dakota
  9. Texas
  10. Washington
  11. West Virginia

- **Interested States**
  1. Arkansas
  2. California
  3. Georgia
  4. Kentucky
  5. Maine
  6. Minnesota
  7. Nebraska
  8. North Carolina
  9. Virginia

- Iowa – 2009-2010
- Field Application
- Research Projects

5 States – 6” Bonded Overlays over HMA (6’x6’ joints)
3 States – 6” Unbonded Overlays over Concrete (6’x6’ joints)
1 State – 7” Bonded CRCP over Plain Jointed Concrete
## Overlay Program Impacts

<table>
<thead>
<tr>
<th>State</th>
<th>Route</th>
<th>Length</th>
<th>Overlay</th>
<th>Sq. Yds.</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Dakota</td>
<td>Hwy 11</td>
<td>8 miles</td>
<td>5” Bonded</td>
<td>77,500</td>
</tr>
<tr>
<td>New York Port Authority</td>
<td>JFK Airport</td>
<td></td>
<td>18” Unbonded</td>
<td>323,822</td>
</tr>
<tr>
<td>Minnesota</td>
<td>8 State Routes</td>
<td></td>
<td>Varies from 5” to 10”</td>
<td>1,305,000</td>
</tr>
<tr>
<td>South Dakota</td>
<td>Vermillion Airport</td>
<td></td>
<td>7” Unbonded</td>
<td>34,000</td>
</tr>
<tr>
<td>South Dakota</td>
<td>SD 50</td>
<td>2.5 miles</td>
<td>7” Unbonded</td>
<td>40,000</td>
</tr>
<tr>
<td>Michigan</td>
<td>6 City Projects</td>
<td></td>
<td>4” Unbonded</td>
<td>205,000</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td>1,985,322</td>
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Iowa Highway Research Board / CP Tech Center/FHWA on Overlay Research

- There is a need to improve upon the construction techniques for the construction overlays to meet the public needs for mobility and access.

- Tested ways of project development, site preparation, construction methods and traffic control work well for thick overlays and closed road construction.

- New methods are needed in each area to meet the needs of the public we serve.
Iowa Highway Research Board / CP Tech Center / FHWA on Overlay Research

The research elements are:

- Establish profile grades & machine control before or immediately after letting
- Determine ways to guide longitudinal joint forming operation to match the underlying joint alignment
- Determine the appropriate opening strength for depths of concrete of 6 inches or less
- Determine ways of handling traffic control for construction of single lane overlays as part of a two lane or multilane overlay
- Determine the best way to establish the level of need and timing of milling for existing asphalt surface preparation
- Minimizing pavement train width
- Use of innovative materials, such as geotextile layers, for use as bond separator layers
Guide for Existing Concrete Overlay Design Methodology

- The AASHTO Guide and many of the other procedures have been in existence for over two decades
- Due to the lack of data on the interaction between the underlying pavement, interlayer, and concrete overlay, a conservative design approach is often taken, which results in suboptimal costs.
- Design programs are not always user friendly
- Programs take a significant amount of input
Guide for Existing Concrete Overlay Design Methodology

• What is needed is straightforward and simple guidance for concrete overlay design

• More specifically, guidance is needed in how to use the AASHTO and other design procedures that are most commonly used today

• Proper use of computer software

• With guidance, DOT’s can rest assured that their concrete overlay designs are based on sound engineering fundamentals, and validated by field performance
THANK YOU!

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