PCCP Overlays
- a Pavement Preservation Option

Purdue Road School
March 7, 2017
Pavement Performance

Concrete Performance Curve

Asphalt Performance Curve

Serviceability

Traffic or Years
Rehabilitation Strategies

• Three categories:
  ➢ Restoration
  ➢ Resurfacing
  ➢ Reconstruction

• Which is used depends on existing condition.
Rehabilitation Timing

- **Restoration**
- **Resurfacing**
- **Reconstruction**

Min. Acceptable Rating

Age or Traffic

Structural/Functional Condition

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Pavement Rehabilitation

• Improves structural and/or functional condition of pavement.
  ➢ Structural condition - the ability to carry traffic.
  ➢ Functional condition - the ability to serve the user comfortably.
Rehabilitation Strategies

Concrete Pavements

- **Maintenance/Restoration**
  - Full-depth repair
  - Partial-depth repair
  - Diamond grinding
  - Joint & crack resealing
  - Retrofitting dowels
  - Cross-stitching long. cracks/joints

- **Resurfacing**
  - PCCP Overlays

- **Reconstruction**
PCCP Overlay Preservation Option

Structural/Functional Condition

Original Pavement

Increase due to Rehabilitation

Min. Acceptable Rating

Terminal Condition

Age or Traffic

??
Concrete Overlays

A VERY LONG History of Performance and Cost Effectiveness
Performance Data

Pathways Van Data Collection of existing PCCP overlays
Performance Data

Pathways Van Data Collection of existing PCCP overlays
What are we talking about??

• Concrete overlays over old concrete

• Concrete overlays over old asphalt pavements

• Concrete overlays over old composite pavements
Types of Concrete Overlays

Concrete Overlays

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

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

Thinner

Old pavement is subbase

Bond is integral to design

Thicker
Widely Used Across the Country
Historically – Unbonded Used

Number of Projects

1910s 1920s 1930s 1940s 1950s 1960s 1970s 1980s 1990s 2000s

Unbonded
Bonded
... but Bonded is Increasingly Common!
Historically, Mostly on Concrete

- On Concrete: 55%
- On Composite: 5%
- On Asphalt: 40%
... but More and More on Asphalt

![Chart showing the percentage of bonded and unbonded asphalt over different decades. The chart indicates a trend towards more bonded asphalt over time.]
Concrete Overlays

Guidance on Design and Construction
Mechanics of PCCP Overlays

Unbonded

Bonded
Short Joints
Reduce Stresses
PCCP Overlay Design Advancements
Design Methods Recommended

AASHTO, Guide for Design of Pavement Structures 1993

Windows Pavement Analysis Software (WinPAS) Guide
Based on the 1993 AASHTO Guide for the Design of Pavement Structures

Note: StreetPave12 & BCOA-ME released after guide was published
FHWA pooled fund TPF-5(165)

BONDED CONCRETE OVERLAY OF ASPHALT PAVEMENTS MECHANISTIC-EMPirical DESIGN GUIDE (BCOA-ME)

VALIDATION STUDIES

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FHWA Pooled Fund Project: TPF-5-165
http://apps.acpa.org/apps

ACPA Application Library

Welcome to ACPA’s online application library. Here you will find a collection of web- and desktop-based applications created to assist you in the design, construction, and analysis of concrete pavements.

ACPA Members and customers of affiliated ACPA Chapter/State Paving Associations:
Visit ACPA’s Concrete Pavement Resource Center to search and browse a collection of over 1,000 concrete pavement related technical references published by ACPA, FHWA, IPRF, IGGA, CP Tech Center, and other industry groups.

A New Look! Because there are now so many apps that it was becoming difficult to quickly find the one you need, we have redesigned this homepage. You can still sort by category or by using one of the other filters on the left. But, the easiest thing to do is to use the search feature. Start to type “evaporation rate” and see how quickly the relevant apps are found! Looking to convert in./mi to mm/km, search for “converter”.

Search

Category

13 Analysis
17 Construction
39 Design
12 General

Desktop or Web?
16 Desktop Software

Agency Practices Explorer
AirCost
Airfield Steel Calculator

AirCost LCCA

AirPave

Area and Volume Calculator

Bonded Concrete Overlay on Asphalt (BCOA) Calculator
New CP Tech Guide on Design

- Not a design procedure!
- Background on recommended overlay design techniques
  ➢ 18 pages
- Detailed design examples
  ➢ 35 pages
SECTION 509 - QCQA, PCPP OVERLAY

509.01 Description
This work shall consist of a UNDOA, PCPP overlay placed on a prepared existing asphalt pavement in accordance with 506.05. The requirements of 501 shall apply except as modified herein.

509.02 Lots and Sublots
Lots will be defined as 14,400 yd² (13,000 m²) of PCPP. Lots will be further subdivided into sublots of 4,800 yd² (4,200 m²) of PCPP within a lot. Partial sublots of 960 yd² (800 m²) or less will be added to the previous sublots. Partial sublots greater than 960 yd² (800 m²) will constitute a full sublot. Partial lots of one or two sublots will constitute a full lot.

Lots and sublots will be numbered and tested for a given pay item regardless of the number of UNDOA's used and will be closed out at the end of the paving season or construction phase.

509.03 Preparation of Existing Asphalt Pavement
The requirements of 501.10, 501.11, and 501.12 shall not apply.

Preparation of the existing asphalt pavement shall be in accordance with the requirements of 501 except as modified herein.

Asphalt rejuvenation and profile preparation shall be performed on the existing asphalt pavement in accordance with 506.04 except that the QCPC specification shall be in accordance with 225.802 section 5.5. The maximum thickness of the milled surface shall be equal to or greater than 1.8 in accordance with 225.812.

The Contractor may leave milled surfaces open for an indefinite period of time. Liquidated damages will not be incurred in accordance with 506.04 for milled non-maintenance areas left open to traffic for longer than 1 week days or for non-maintenance areas left open to traffic longer than 10 week days.

Prior to placement of PCPP, the milled asphalt pavement shall be clean and free of loose material. The surface of the milled asphalt pavement shall be uniformly saturated with water just prior to placement of PCPP. Excess standing water will not be permitted.

Placement of PCPP overlay shall be by the slipformed or formed methods with equipment specified in 508.04.

509.04 Jointing
The requirements of 501.18 shall not apply.

Lateral and transverse construction joints shall not be sawed or sealed. The vertical surface of transverse construction joints shall be formed as shown in the plans.
Bremen Highway – St. Joseph County

4.0 " PCCP Inlay
SR 161 – Dubois County

6.0 " PCCP Overlay of Existing HMA Pavement
CR 275W – Cass County

6.5” Unbonded PCCP Overlay of 50+ year old PCCP
CR 275W – Plate Dowels
SR 55 – 4” PCC Overlay w/ Structural Fiber

- 20% Residual Strength
- 2 lanes wide
- 8.7 mi long
INDOT Overlay – Bonded over Asphalt

- SR 161 – SR 64 to Freeman - 6”
- Overlay over milled existing HMA pavement
- Joints sawed at 10’ – 10’x12’ panel
- No Dowels – No tie bars
- Road closed to thru traffic
- Local traffic maintained one way
- Access maintained to residents
- 77,000 sys – bid at $14.00/sy
- Built 2010
SR 161 Concrete Overlay
INDOT Overlay – Bonded over Asphalt

- SR 55 – SR 2 to US 231 - 4”
- Utilized Structural Macro fibers
- Overlay over milled existing HMA pavement
- Joints sawed at 7’ – 7’x6’ panels
- No Dowels or tie bars
- Road closed to thru traffic
- Local traffic maintained one way
- Access maintained to residents
- 151,000 sys – bid at $21.00/sy
- Built 2015
SR 55 Concrete Overlay
SR 55
• Evaluation results can provide information on the stiffness of the asphalt pavement, subgrade support conditions, and variations of these properties over the length of the project, thereby identifying localized areas of weakness requiring strengthening.

• Milling can remove a number of asphalt surface distresses.
Bonded Resurfacing of Asphalt or Composite Pavements

- Use when existing pavement is in fair or better structural condition with surface distress.
- Use to eliminate any surface defects; increase structural capacity; and improve surface friction, noise, and rideability.

4”–6” thickness
Evaluations of Existing Pavements for Overlays

- An evaluation of the existing pavement is necessary to ensure it is a good candidate for resurfacing and structurally sound to carry the anticipated traffic loads.

- Information gathered through the evaluation is used to determine required repairs where needed and to establish the concrete overlay design thickness.

- Strongly suggest – take cores of existing pavement

- Concrete material condition can be obtained through analysis of cores taken from the existing pavement.
Also Evaluate/Core Shoulders
Pavement Evaluation:

On high-volume roads, falling weight defectometer (FWD) testing can provide subgrade k-values and variability, concrete modulus, load transfer efficiency, and presence of voids.
Jointing Different for Some Overlays

- Joint spacing depends on bond, stiffness of support, etc.

- Match Existing Joint Spacing/Location
- Joint Spacing based on Thickness; Shorter Panels = Less Curl/Warp
- Joint Spacing is Similar to New Concrete Pavement; Shorter Might be Used, Especially for Unbonded over Concrete

Bonded Concrete Overlay of Concrete Pavements
Bonded Concrete Overlay of Asphalt Pavements
Bonded Concrete Overlay of Composite Pavements
Unbonded Concrete Overlay of Concrete Pavements
Unbonded Concrete Overlay of Asphalt Pavements
Unbonded Concrete Overlay of Composite Pavements
Longitudinal Joint Layout

- 2 ft x 2 ft
- 3 ft x 3 ft
- 4 ft x 4 ft
- 6 ft x 6 ft

Traffic

Outer Shoulder
Surface Preparation
Cleaning the Surface to Prepare for Bonding

- Sweeping surface followed by compressed air cleaning in front of the paver.
- Air blasting or water blasting is only necessary to remove material that cannot be removed any other way.
- Water or moisture should not be on the surface prior to paving or de-bonding can occur.

Duct Tape Test
Milling: Bonded and Unbonded Resurfacing of Asphalt or Composite Pavements

• The amount of asphalt removal depends on the types and severity of distresses and the thickness of the asphalt pavement.

• The objective of removing material is not to obtain a perfect cross section. It is not necessary to completely remove ruts. Usually 1"–2" of asphalt is removed.

• A minimum of 3"–4" of asphalt should be left after milling because of the reliance on the asphalt pavement to carry a significant portion of the load.

• Profile mill helps achieve desired PCCP thickness
Too Much Preplacement Repairs
HMA Overlay Mindset
Traditional Construction
Traditional Construction
Placement
Placement

SR 55

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INDIANA CHAPTER
Placement

SR 161
Finishing – SR 161
Finishing – SR 55
Tined Surface
Pay attention to finishing & its impact on smoothness
Finishing

Too small – builds in roughness
Finishing

Use longer float/straightedge
Curing

- Curing is especially critical to concrete resurfacing because their high surface area to volume ratio makes them more susceptible to rapid moisture loss.

- Apply ASAP

- Coat all exposed edges.

- Avoid extreme weather.

- Avoid contact of cure with prepared surfaces because it is a bond breaker
Curing – Be Prepared!!

- Paving operation moves quickly on overlays
- Need curing crew on site ready to apply as paving starts
- Keep curing operation up close behind finishing operation
Curing – desired uniform coverage
Sawing – Be Prepared!!

- Paving operation moves quickly on overlays
- Shorter joint spacing = lot of joint to cut
- Need multiple saws
Traffic Control – Lessons learned

• Can manage traffic through the project
• Closed to thru traffic – local access only appears to work best
  ➢ One way thru work zone
  ➢ Contractor needs to aggressively manage
  ➢ Need adequate signage
  ➢ Need cones & warning tape
  ➢ Aggressive flaggers

• Can manage local access to home & businesses
  ➢ Requires regular communication with locals – discuss schedule & options
Local Traffic – one-way thru project
Make sure surface is clean & provide compression relief at construction joint
How Handle Overnight Lane Restriction??

• Portable Traffic Signals

• Pilot Vehicles
Need good MOT markings & barriers
Safety Focus – A MUST!!
Tight – restricted workzone

SR 161
Freshly Cured PCCP – looks a lot like hardened PCCP traffic driving on
CONCRETE OVERLAYS

Payment

Cubic Yard

Square Yard

Divided payment - most equitable and economic
Value Analysis

1 mile of pavement – 24’ wide = 2 lane miles = 14,080 sys

SR 161 PCCP Overlay – bid at $14.00/sys
Design life: 25 years - Cost/lane mile/year = $3942.40
Design life: 20 years – Cost/lane mile/year = $5280.00

HMA Overlay – expected life 11-13 years
165# HMA Surface = 0.0825T/sys - @$53.25/T = $4.39/sys
275# HMA Intermediate = 0.1375T/sys - @ $53.00/T = 7.29/sys
Cost/lane mile/year (at 11 years) = $7475.20
Cost/lane mil/year (at 13 years) = $6325.17
Value Analysis

1 mile of pavement – 24’ wide - = 2 lane miles = 14,080 sys

SR 55 PCCP Overlay – bid at $21.47/sys
Design life: 25 years - Cost/lane mile/year = $6045.95
Design life: 20 years – Cost/lane mile/year = $7557.44

HMA Overlay – expected life 11-13 years
165# HMA Surface = 0.0825T/sys - @$53.25/T = $4.39/sys
275# HMA Intermediate = 0.1375T/sys - @ $53.00/T = 7.29/sys
Cost/lane mile/year (at 11 years) = $7475.20
Cost/lane mil/year (at 13 years) = $6325.17
Summary - What Have Learned

• Cost competitive
• Good Performance History
• Don’t need dowels on bonded overlays
• Don’t need tie bars
• Keep panels sized properly
• Joints – single cut – unsealed
Summary – Best Practices

• Build with traditional construction practices
• Old surface must be clean – free of debris – duct tape test
• Traffic control is very manageable
• Must be attentive to signage & public communications
• Good finishing practices = smooth pavement for overlays
• Need curing & sawing plan
Questions?

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