PCCP Overlays
- Observations & Lessons Learned

Purdue Road School
March 6, 2019
What are we talking about??

• Structural Fiber Reinforced Concrete (SFRC) Overlays – 4” – 6” thick

• Concrete overlays over old asphalt pavements

• Concrete overlays over old composite pavements
New Technology – high strength macro synthetic fibers

• Dosage required to achieve 20% residual strength gain

• Residual strength = the load that damaged object can carry without failing

• ASTM 1399 & 1609

• 4 – 5 lbs. per cubic yard
Widely Used Across the Country

The National Concrete Overlay Explorer

1154 items

658 results out of 1154 cannot be plotted.

overlays.acpa.org
History of thin concrete overlays

• 10+ years of thin PCC overlays on local roads & airports – but INDOT did not have a long running history of thin concrete overlay projects.

• 7 Local Road projects – 3.5”-6”

• 6 Airport Projects – 3.5”-6”

• NOW – INDOT has built/building 10 projects to date
INDOT initiative

• Are thin concrete overlay's a good alternative as a preventative maintenance treatment type?
• Each INDOT District to identify 2-3 projects
• Bonded concrete on asphalt or composite pavement
  ▪ “Thin” classification = 4” - 6”
• Letting by the end of 2017 for all projects
  ▪ A few projects lagged into FY 2018
Performance Data

Pathways Van Data Collection of existing PCCP overlays
Concrete Overlays

Guidance on Design and Construction
Design criteria

- Design life of 20yrs
- Typical joint spacing is 6’x6’ to keep joint lines out of wheel paths
- Joints are saw cut not formed
  - Pressure relief joints required at gap pour locations
- Only patch major destresses
  - Not same approach as an HMA overlay
- No dowels or tie bars required unless tying into existing concrete pavement
Mechanics of PCCP Overlays

Unbonded

Neutral Axis

Bonded
Short Joints
Reduce Stresses
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.
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.
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
INDOT Specification 509 & USP

SECTION 509 – QC/QA, PCCP OVERLAY

509.01 Description
This work shall consist of a USP/USP, PCCP overlay placed on a prepared existing asphalt pavement in accordance with 365.03. The requirements of 509 shall apply except as modified herein.

509.02 Lots and Sublots
Lots will be defined as 14,400 yard (13,160 m²) of PCCP. Lots will be further subdivided into sublots of 4,800 yard (4,400 m²) of PCCP within a lot. Partial sublots of 960 yard (880 m²) or less will be added to the previous sublot. Partial sublots greater than 960 yard (880 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 listed for a given map area regardless of the number of USP’s used and will be closed out at the end of the paving season or construction plant.

509.03 Preparation of Existing Asphalt Pavement
The requirements of 201.10, 201.11 and 201.13 do not apply.

Preparation of the existing asphalt pavement shall be in accordance with the requirements of 301.1 except as modified herein.

Asphalt removal and portland cement base shall be performed on the existing asphaltic pavement in accordance with 201.10. The portland cement base (PCP) for milling shall be in accordance with INDOT Specification 228 802 section 5.3. The rear portion of the PCP surface shall be roughed in or removed from in accordance with INDOT Specification 228 802.

The Contractor may leave milled surfaces open for on-street periods of time. Liquidated damages will not be assessed in accordance with 201.14.1 if the milled asphalt roads left open to traffic for longer than 5 week days or 10 week days in the areas left open to traffic longer than 10 week days.

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

Placement of PCP overlay shall be by the slipformed or formed methods with equipment specified in 309.04.

509.04 Grade
The requirements of 201.13 shall not apply.

Levee and transverse construction joints shall not be sawed or sealed. The transverse surface of transverse construction joints shall be formed as shown in the plans.
PCC Overlay USP – Changes of Note

• New Lot & Sublot size
  ▪ Lot – 14,400 sys
  ▪ Sublot – 4800 sys

• Coring for thickness lot size
  ▪ 2 cores per 2400 sys

• Opening to traffic strengths
  ▪ 350 psi for local traffic
  ▪ 550 psi for construction traffic
PCC Overlay USP – Changes of Note

• Construction Engineering shall be provided to control milling operations *(A bid item)*
• The Contractor shall develop a design centerline profile that:
  ▪ optimizes pavement smoothness, maintains minimum overlay depth across the width of the pavement
  ▪ does not exceed the maximum allowable change in profile grade as shown on the plans
  ▪ optimizes the quantity of *QC/QA PCC, Additional*, as it relates to the material between the milled irregular surface of the asphalt pavement and the bottom of the thin PCC overlay
PCC Overlay USP Mix Changes of Note

- The CMD shall contain at least one, but no more than two SCM’s, and produce workable concrete mixtures having the following properties:

  - Minimum total cementitious ........................................500 lbs/cy
  - Allowable amount of single SCM, % of total cementitious, by weight.................................................................20.0 - 40.0% \(^A\)
  - Allowable amount of two SCM’s, % of total cementitious, by weight.................................................................25.0 – 40.0% \(^B\)
  - Min. portland cement content.................................350 lbs/cy
  - Allowable amount of silica fume SCM, % of total cementitious content.................................................................3.0 – 7.0%
  - Max. w/c – mixture with fly ash SCM.................................0.440
  - Max. w/c - mixture with ggbfs SCM.................................0.450
  - Target air content defined by CMDP.................................7.0%
  - Min. flexural strength, 1/3 point loading……570 psi at 7 days
Residual Strength

Residual strength = the load that damaged object can carry without failing

\[ R_{T, 150}^D = \frac{150 \times TD_{150}}{f_1 \times b} \]

Fiber dosage required for 20%
PCC Overlay USP – Jointing Changes

• In gap areas $\geq 60'$, pressure relief joint filler shall be installed at each end of the gap. (< 60’ only at one end)

• Joints shall be perpendicular to the finished surface of the PCC thin overlay, shall be 1/8 in. in width

• Shall have a minimum depth of $T/3$, where $T$ is the design thickness of the PCC thin bonded overlay.

• Joints are not filled/sealed
Other notable changes

• Curing of the thin PCC overlay shall be in accordance with 501.20 except that each of the two applications of white pigmented curing compound shall be at a rate not less than one gallon/100 sq. ft.

• Smoothness
  ▪ Posted ≥ 45 mph – profilograph spec
  ▪ Posted < 45 mph – 16’ straightedge
PCCP Overlays
- INDOT Project Case Studies
Projects & Lessons Learned
Selected & Bid thin PCC overlays

INDOT Projects

• SR 161- Ph I – 6” on asphalt
• SR 55 – 4” SFRC on asphalt
• SR 3 – 4.5” SFRC on composite
• SR 161- PH II – 4.5” SFRC on asphalt
• SR 9 Marion – 4.5” SFRC on composite
• US 50 – 4.5” SFRC on composite
• SR 9 Shelbyville – 6” SFRC on composite
• US 52 – 5” SFRC on composite
• US 52 – 4” & 4.5” SFRC on composite
• SR 9 Huntington – 4.5” SFRC on composite

Projects total approx. 1.5 million sys
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
INDOT Overlay – Bonded over Composite

- SR 3 – US 67 S of Muncie to CR 300N N of New Castle – 4 lane divided highway
- 4.5” thick - Utilized Structural Macro fibers
- Overlay over milled existing HMA on PCCP
- Joints sawed at 6’ x 6’ panels
- No Dowels or tie bars
- Traffic maintained one-lane NB & SB
- Access maintained to residents
- 336,186 sys – bid at $20.05/sy
- 45% Constructed in 2017 & remainder in 2018
SR 3 – Macro Structural Fiber Addition
INDOT Overlay – Bonded over Asphalt

- SR 161 Ph II – From Holland to SR 62 – 4.5”
- Overlay over milled existing HMA pavement
- Joints sawed at 6’ x 6’ panel
- No Dowels – No tie bars
- Road closed to thru traffic
- Local traffic maintained one way
- Access maintained to residents
- 56,626 sys – bid at $27.00/sy
- Project completed September 2017
SR 161 Ph II
INDOT Overlay – Bonded over Asphalt

• SR 9 - Marion – From SR 26 to SR 37 – 4.5”
• Overlay over milled existing HMA pavement
• Joints sawed at 6’ x 6’ panel
• No Dowels – No tie bars
• Road closed to thru traffic – south 4 mi
  paved full width – 30’ wide
• Local traffic maintained one way
• Access maintained to residents
• 101,178 sys – bid at $25.65/sy
• PCC paving completed 10/25/17
SR 9 - Marion
SR 9 - Marion
SR 9 - Marion
SR 9 - Shelbyville

- 6” SFRC
- 2 lanes wide
- 9 mi long
- 142,456 sys
- Bid: 7/12/17
- $24.00/SY
SR 9 - Shelbyville

Slip formed with safety edge
Construction Guidance
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
Traditional Construction
Placement
Placement
Placement

SR 161
Pay attention to finishing & its impact on smoothness
Finishing – SR 3

[Images of road construction workers and equipment]
Tined Surface
SR 3
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 – 2X = 2 coats

• Coat all exposed edges.

• Avoid extreme weather.

Avoid contact of cure with prepared surfaces – as it acts as a bond breaker
Sawing

SR 3
HAVE ENOUGH SAWS!!!
PCCP Overlays
- Indiana Lessons & Experience

Traffic Control
Lessons of Note
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
One Lane Traffic – thru project

SR 3
Closed to traffic – Pave Full Width – 30’

SR 9 - Marion
SR 9 – Used Portable Traffic Signals & Pilot Car – on South End of Project
Access to local drives/cross traffic
Access to local drives – SR 55

Make sure surface is clean & provide compression relief at construction joint
Freshly Cured PCCP – looks a lot like hardened PCCP traffic driving on
Focus: Extra attention to keep drivers off!!
PCCP Overlays
- Indiana Lessons & Experience

Issues/Problems
Experienced
Better Exploratory coring of existing roadway
Attention to proper anchoring of tie bars
SR 9 - Shelbyville

Tied 3’ shoulder - 8” thick
US 52 - Lafayette
SUMMARY

• Thin PCC Overlays are a viable pavement preservation option/solution
• Data shows have proven long term performance
• Cost competitive
• Constructable
• Can successfully manage traffic

Good Solution – Take a Look !!
Questions?

Contacts for further information

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