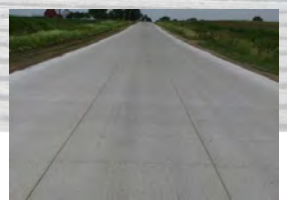
Maintenance of Concrete Overlays

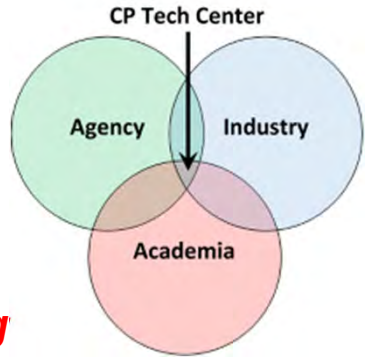


IOWA STATE UNIVERSITY
Institute for Transportation

National Concrete Pavement Technology Center

The National Concrete Pavement Technology Center (CP Tech Center) at Iowa State University

A primary resource for concrete pavement research and **TECHNOLOGY TRANSFER**.



www.cptechcenter.org

Who is supporting this webinar?

PCA Since 1916 America's Cement Manufacturers™

ACPA AMERICAN CONCRETE PAVEMENT ASSOCIATION

NCC NATIONAL CONCRETE CONSORTIUM

ICPA IOWA CONCRETE PAVING ASSOCIATION

IOWA DOT

3

Introductions

- Gordon Smith, glsmith@iastate.edu
- Matt Zeller, mjzeller@cpamn.com
- Steve Tritsch, stritsch@iastate.edu
- Mike Byers, mbyers@irmca.com

- **Questions are encouraged since we are practicing physical distancing!**

The Concrete Overlay Webinar Series

I. Introduction to Concrete Overlays
II. Overview of Concrete Overlays / Existing Pavement Evaluation and Overlay Selection
III. Concrete Overlay Design
IV. Plans, Maintenance of Traffic and Construction
V. Maintenance of Concrete Overlays and Resources Available to you.

And throughout - examples of how concrete overlays are performing around the country

Upcoming Webinar Schedule
May 12th & 19th

ADA WEBINAR SERIES

May 12 Planning and Design ADA Guidelines for DOT, and Municipalities (Understanding PROWAG 2011)

Every professional engaged in road construction becomes involved in ADA. The May 12 session centers on Planning and Design. Understanding the rules and requirements of PROWAG 2011 will be the stepping off point for this seminar. This seminar is ideal for DOT's, Cities and Municipalities.

Presenter: Jesse Jonas, PE.
Mr. Jonas is a Certified ADA Coordinator and is the former ADA Construction & Design Trainer for the Saint Louis County Department of Transportation and Public Works.

May 19 How are States Implementing PROWAG: An In-depth look at Wisconsin and Missouri's Approaches to ADA Compliance

In this webinar, we share a hands approach of the Planning and Design and turn it towards the Construction part of ADA. Looking at real life projects in both Wisconsin and Missouri.

Presenters: Ms. Jackie J. Spoor and Mr Jesse Jonas, PE

Ms Jackie J. Spoor is a pavement engineer with the Wisconsin Concrete Pavement Assoc. She has worked on several WisDOT urban reconstruction projects where her knowledge of ADA has been utilized.

Mr. Jonas is a Certified ADA Coordinator and is the former ADA Construction & Design Trainer for the Saint Louis County Department of Transportation and Public Works.

This ADA Webinar Series is offering Professional Development Hours (PDH's)

THANK YOU FOR PARTICIPATING

Participate Today in Topic Survey!

https://www.surveymonkey.com/r/Webinar-Int-4-2020

Today's Learning Objectives

Upon completion of this webinar, attendees will be able to:

- Discuss the basic concepts of repairing thin concrete overlays
- List alternatives for repairing thin concrete pavements
- Identify failure modes of thin concrete overlays
- Describe what factors drove Indiana to explore the use of PCC overlays on their state highway system,
- Identify design criteria, construction practice and maintenance of traffic options utilized by Indiana to build multiple thin concrete overlay projects

8

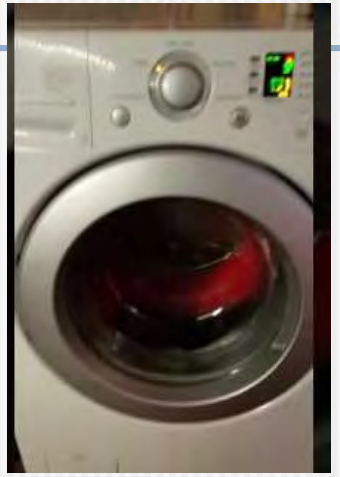
Repair of Concrete Overlays

ACPA / CP Tech Center Webinar Series
Tuesday, May 5, 2020

Matthew (Matt) Zeller, PE
Concrete Paving Association of MN

Repair BCOA? Why not?

- Start with what we know, standard CPR
- Learn from our mistakes



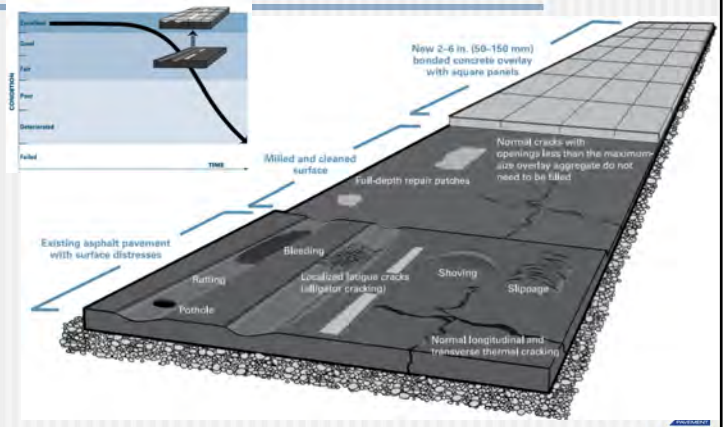
Count on Concrete

Presentation Outline

- What are Bonded Concrete Overlays
- Normal Concrete Pavement Preservation Activities
- Typical Distresses in Bonded Concrete Overlays
- Repair Techniques
- Success Story

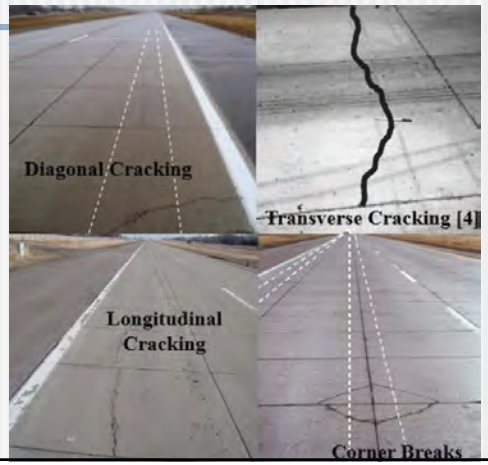
Count on Concrete

Bonded Concrete Overlay on Asphalt Pavement (BCOA)



Traditional Concrete Pavement Preservation Activities

BCOA Load Related Distresses

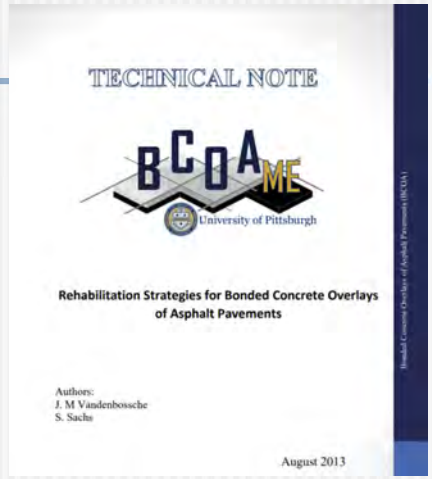


Count on Concrete Pavement

Reflective Cracking

Count on Concrete Pavement

Source of Most of the Material


TECHNICAL NOTE

BCOA ME

University of Pittsburgh

Rehabilitation Strategies for Bonded Concrete Overlays of Asphalt Pavements

Authors:
J. M Vandenbossche
S. Sachs

August 2013

https://www.engineering.pitt.edu/uploadedFiles/_Content/Sub_Sites/Faculty_Subsites/Vandenbossche/Documents/BCOA%20Rehabilitation%20Strategies.pdf

Count on Concrete Pavement

BCOA Repairs

- Isolated Repairs
  - Full Depth Repairs:
    - Pre -mill coring (optional)
    - Mill the distressed panel
- Uniform Distress Throughout
  - Mill and fill with PCC
  - Unbonded overlay

Isolated Repairs

- Take Cores to Estimate Milling Depth and to Determine Layer Lifts in AC
- Keep the lift below 0.75 in to 1 in from the top of the milled surface
- Mark out repair areas and mill out the slab interior leaving approximately a 4 in boundary between the milled region and the adjacent joints to prevent damaging joint
- Remove remaining material near joint with jack hammers

Count on Concrete

Removal of Remaining Material

- Use Small Jack Hammers Around Outer Perimeter to Remove the Remaining Material to Create a Vertical Edge
- Ensure Consistent Depth of Removal

Count on Concrete

Clean Repair Areas

- Clean Repair Area Completely to Ensure Good Bond When New Material is Placed
- Vacuums can remove debris easily

Count on Concrete

Replacing the Slab

- Use Compressed Air to Blow Out Repair Area Just Prior to Material Placement
- Mist Repair Area Bottom with Water to Cool AC and to Prevent Pulling Moisture from Mix
- Place and Consolidate Concrete, Striking off to Leveling Surface to Surrounding Slabs
- Re-establish Original Joint Spacing Sawing to T/3.
- Seal if specified

Repairing Panels with Reflective Cracking From AC Below

- Remove Concrete Consistant with the Procedures for Isolated Distresses Repair
- After Removal of the Concrete, Place a Tape Over the Reflective Crack Area to Minimize Bonding in this Area
- Re-establish the Joint Pattern Using the Same Procedures as Before, Except for the Location of the Reflective Crack
- A Joint Must be Placed Over the Reflective Crack. The longitudinal Joints That are Bisected by This Joint are Sawn Full Depth

Full Removal When Pavement is Distressed Over Entire Area

- Retrieve Cores to Establish Existing Thicknesses, Condition of AC, and to Establish Milling Depth
- Redesign Overlay Thickness using Current Procedure; Ensure Conformance to Surrounding Roadside Features
- Use Conventional Milling Operations to Remove Material to the Planned Elevation

Cleaning Milled Surface In Preparation of New BCOA

- After Milling to Proper Elevation, the Surface Should be Broomed to Remove All Left Over Material to Ensure a Good Bond to the New Material

Count on Concrete

Placing and Finishing

- Ensure AC Surface Remains Below 120 F to Prevent Fast Set Shrinkage Cracking
- Mist AC Surface to Prevent Absorption of mix water
- Placement is conducted using conventional paving methods
- After Placement and Finishing, Proper Curing Needs to be Applied Immediately

Sawing Joints

- Joints Are Sawn Using Conventional Techniques to 1/3 of the Depth
- Hot Pour Sealants Without Backer Rods are Typically Used

Partial Depth Repair

- Typical removal and repair processes

Diamond Grinding a Bonded Overlay

- Once the BCOA Repairs have Been Made the Project can be Diamond Ground

MnROAD Mainline 6” BCOA

Cell 914, 6’x6’ panel replacements

MnROAD Mainline 6” BCOA w/ Plate Dowels

Cell 614, 12’L x 6’W panel replacement (shows plate dowels on basket).

MnROAD Mainline 5” BCOA w/o Dowels

Cell 305 , Retrofit plate dowels in 5” UBOL

MnROAD LVR 5” on Agg Base (no dowels)

Cell 32, CoVex plate dowels (note failure in original panel, not repair)

MnROAD LVR 6” on Agg Base (Full Depth Repair)

Cell 38, CoVex plate dowels in repair. 6+ dowels successful.

MnROAD LVR 6” on Agg Base (Full Depth Repair)

Cell 38, CoVex plate dowels in repair. 5 dowels unsuccessful. Failed in exist PCC

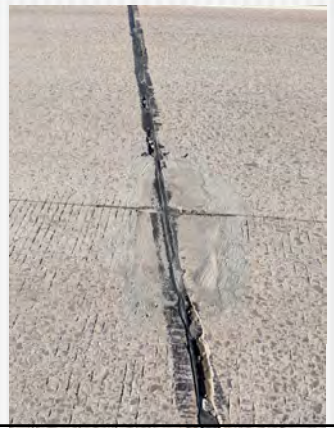
MN TH 30 Thin Concrete Overlay

- Constructed 1993
- 5” BCOA Control – 6 miles
- 4 test sections
  - 5” BCOA – 1 mile
  - 5” Doweled BCOA – 1 mile
  - 6” BCOA – 1 mile
  - 6” Doweled BCOA – 1 mile
- 12’ x 12’ joint spacing

MN TH 30 Thin Concrete Overlay

- Rehabilitated 2012
- 150,000 LF joint/crack seal
- 21,000 LF full depth repair
- 5,400 LF partial depth joint repair
- 3,400 SF spot partial depth repair
- 114,000 SY diamond grinding (80%)

MN TH 30 Thin Concrete Overlay



MN TH 30 Thin Concrete Overlay

MN TH 30 Thin Concrete Overlay

MN TH 30 Thin Concrete Overlay

Thank you

Resources/Publications

National Concrete Pavement Technology Center

Iowa State University
institute for Transportation

Innovation Spotlight

https://www.fhwa.dot.gov/federal-aidessentials/catmod.cfm?id=120

Federal Highway Administration
RESOURCE CENTER

Pavement & Materials
Technical Service Team

Concrete Repair Best Practices:
A Series of Case Studies

https://library.modot.mo.gov/RDT/reports/TR201618/cmr17-013.pdf

Published Nov 2017

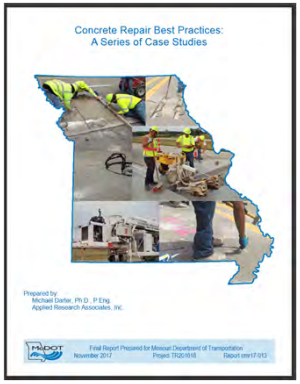
Michael Darter, Ph.D., P.E., Applied Research Associates, Inc.

119 pages

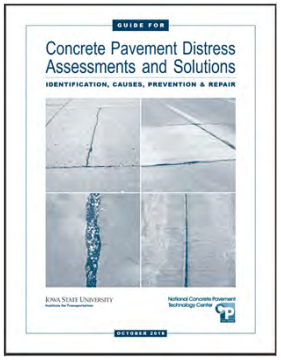
Links to the 6 tech briefs

27 figures

13 tables



Concrete Pavement Distress Assessments and Solutions Guide



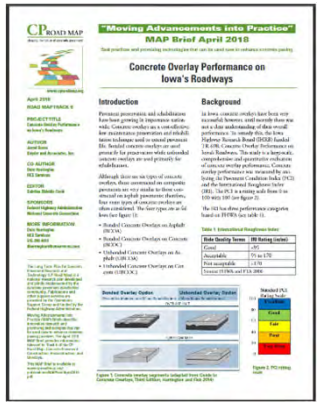
https://intrans.iastate.edu/app/uploads/2018/12/concrete_pvmt_distress_assessments_and_solutions_guide_w_cvr.pdf

1. Surface Defects
2. Surface Delamination
3. Material Related Cracks
4. Transverse & Diagonal Cracking
5. Longitudinal Cracking
6. Corner Cracking
7. Spalling
8. Faulting
9. Joint Warping and Curling
10. Blowups
11. Settlement and Heaves
12. Subgrades & Base Support Conditions
13. CRCP
14. Concrete Overlays, BCOA, BCOC, UBCOA, UBCOC
15. Laboratory & Field Testing

Focus:
- Identification
- Causes
- Prevention
- Rehabilitation

http://www.cproadmap.org/publications/MAPbriefApr2018.pdf

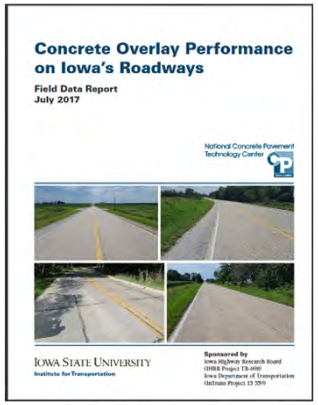
http://www.intrans.iastate.edu/research/documents/research-reports/Iowa_concrete_overlay_performance_w_cvr.pdf


"Moving Advancements into Practice"
MAP Brief April 2018

Concrete Overlay Performance on Iowa's Roadways

Introduction

Background


Concrete Overlay Performance on Iowa's Roadways

Field Data Report
July 2017

National Concrete Pavement Technology Center

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Sponsored by

WBT on-line – Free
NHI Contractor Training Courses

- FHWA-NHI-134207A *How to Construct Durable Full-Depth Repairs in Concrete Pavements*
- FHWA-NHI-134207B *How to Construct Durable Partial-Depth Repairs in Concrete Pavements*

Can be found on the NRRA website
mndot.gov/mnroad/nrra

Published April 2020

Andrea Blanchette, P.E.
Sheue Torng Lee
Tom Wood
WSB

25 Figures
8 Tables
51 Pages


NRRA

Concrete Pavement Restoration (CPR) for Bonded Concrete Overlay of Asphalt (BCOA) Synthesis

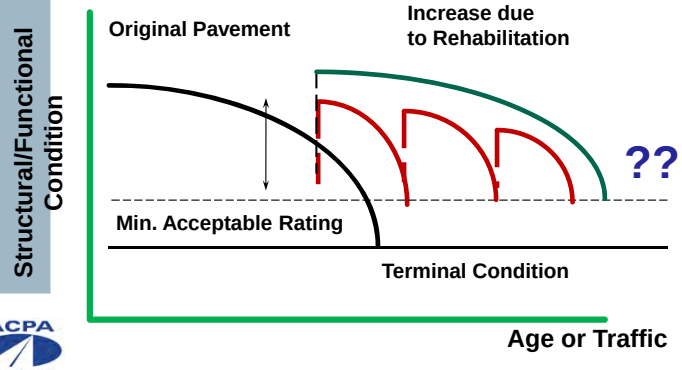
NRRA Preventive Maintenance Team

PCCP Overlays

- Indiana Experience

PCC Overlay Webinar
May 5, 2020

PCCP Overlay Preservation Option

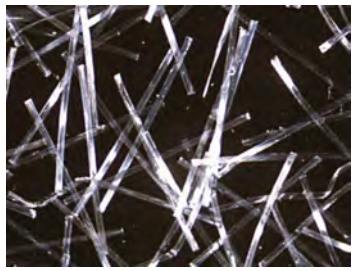


History of thin concrete overlays

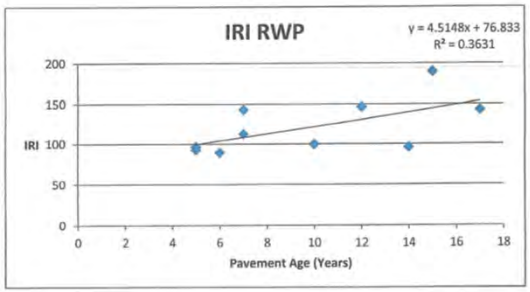
- 10+ years of thin PCC overlays on local roads & airports – but INDOT did not have a long running history of thin concrete overlay projects.
- 7 Local Road projects – 3.5”-6”
- 6 Airport Projects – 3.5”- 6”
- NOW – INDOT has built/building 10 projects to date

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



Performance Data



Pathways Van Data Collection of existing PCCP overlays

What are we considering??

- Structural Fiber Reinforced Concrete (SFRC) Overlays – 4" – 6"thick
- Concrete overlays over old asphalt pavements
- Concrete overlays over old composite pavements

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

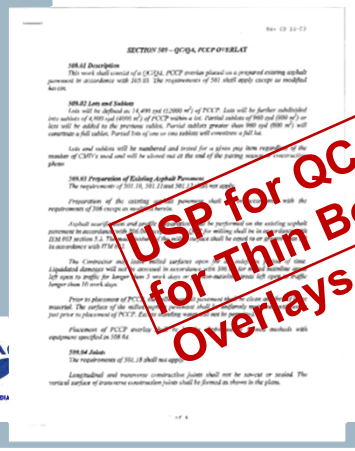
Concrete Overlays

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

INDOT Specification 509 & USP



USP for QC/QA PCC for Thin Bonded Overlays

SR 161, Dubois County

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:
  - 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 cementitous 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

PCC Overlay USP – Jointing Changes

- In gap areas ≥ 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 on 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 Composite

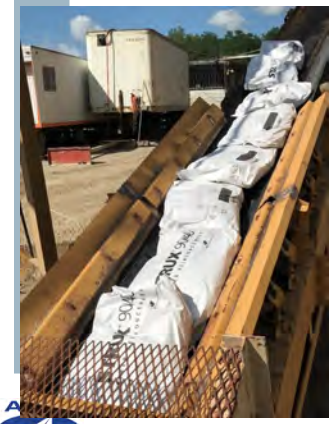
- SR 3 – US 67 S of Muncie to CR 300N N of New Castle – 4 lane divided highway
- 4.5” thick - Utilized Structural Macro fibers
- Overlay over milled existing HMA on PCCP
- Joints sawed at 6’ x 6’ panels
- No Dowels or tie bars
- Traffic maintained one-lane NB & SB
- Access maintained to residents
- 336,186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

SR 3

SR 3

SR 3

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

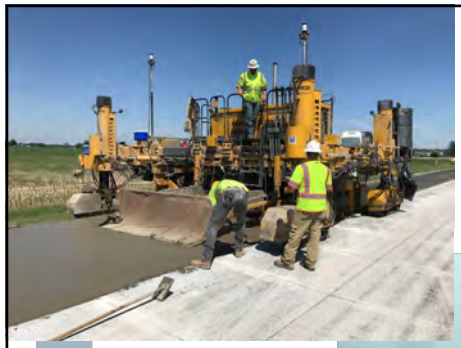
INDOT Overlay – Bonded over Asphalt

- 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

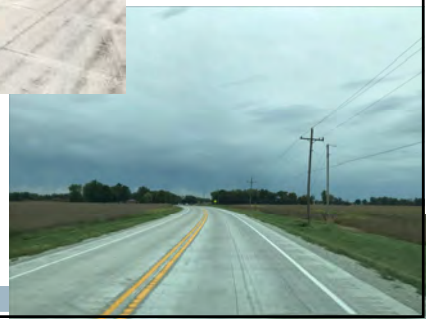
SR 9 - Marion

SR 9 - Marion

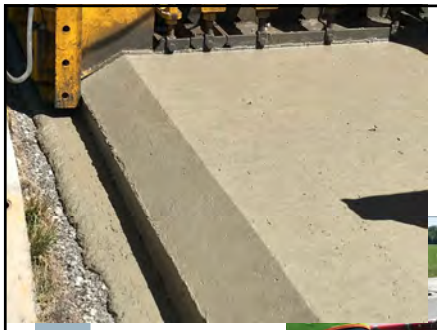
SR 9 - Marion



SR 9 - Shelbyville



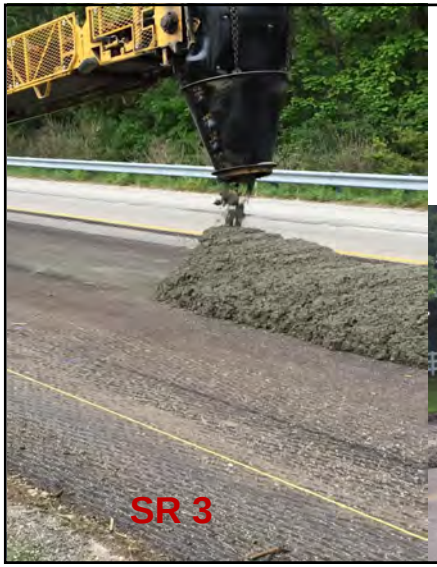
- 6” SFRC
- 2 lanes wide
- 9 mi long
- 142,456 sys
- Bid: 7/12/17
- $24.00/SY



SR 9 - Shelbyville

Slip formed with safety edge

Traditional Construction

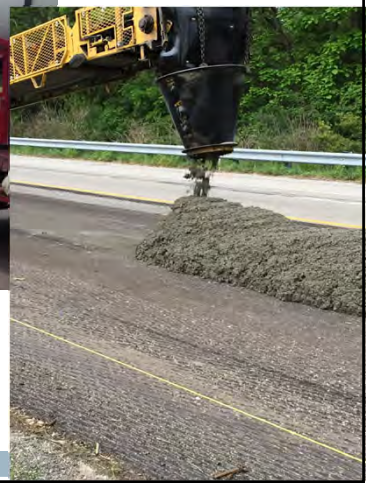


Surface Prep

All surfaces milled & cleaned

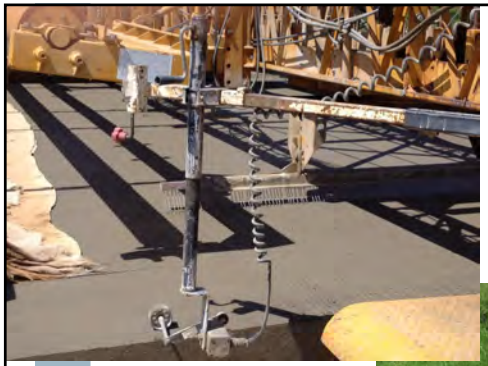
SR 9

Placement



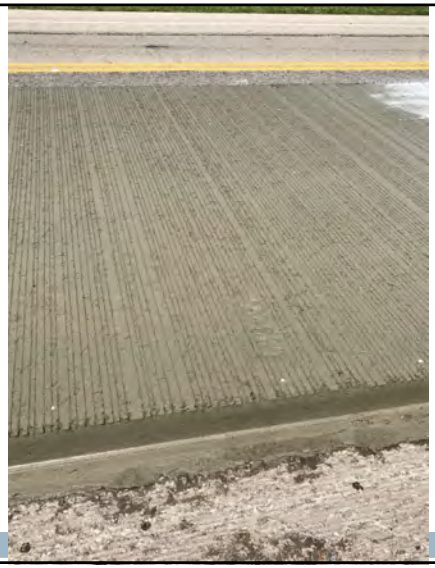
Placement

SR 161



Tined Surface

SR 3



SR 3

Curing

Sawing

SR 161 –
PH II

BE READY!!!

PCCP Overlays

- Indiana Lessons & Experience

Traffic Control Lessons of Note

Able to manage

Local Traffic – one-way thru project

One Lane Traffic – thru project – 4 lane

Closed to traffic – Pave Full Width – 30’

SR 9 – Used Portable Traffic Signals & Pilot Car – on South End of Project

PCCP Overlays

- Indiana – Next Steps

- Evaluating projects constructed
- Adjusting scoping & investigation requirements, design details & Specs
- Looking for future PCC overlay candidate projects

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 !!