Michigan’s Unbonded Overlay Experience

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Michael Eacker
Pavement Design Engineer
Michigan Department of Transportation
MDOT Mission

“Providing the highest quality integrated transportation services for economic benefit and improved quality of life.”
Overview

• Introduction
• Performance Curve
• Lessons Learned
• Research Project
• Other Concrete Overlays
• Local Agency Work
Introduction

- Michigan DOT has used unbonded concrete overlays to rehabilitate concrete and composite pavements since 1984.
- 23 projects totaling 240+ centerline miles.
  - Two projects in 1984
    - US-23 near Dundee – reconstructed in 2003
    - I-96 in Ionia County – still in service
  - Remaining 21 projects from 1990 to present
Introduction

• Thickness from 6” to 8”
• Joint spacing has been 27’ and 41’ for JRCP and 12’ for JPCP (1998 to present).
• 1” to variable thick separator layer
  – Started with variable thickness
  – Moved to uniform 1” thickness
  – Moved to drainable HMA in 2003
• 20 year design life
• Life-cycled against rubblize projects
Performance Curve

• Distress Index (DI) is Mich DOT’s condition measure for modeling performance
• DI is an increasing scale of points assigned to surface distresses and then indexed to 0.1 mile segments
• DI of 50 is considered to be the time to rehab or reconstruct the pavement
• Pre-maintenance DI points modeled with logistic growth curve
Performance Curve

• Average age and DI drop is found for all maintenance work
• Initial growth curve is adjusted based on maintenance averages
• Result for unbonded overlays:
  – Service life = 21 years including one maintenance cycle
Performance Curve

Pavement Preservation Strategy
Unbonded Concrete Overlay

Distress Index vs. Pavement Age
Lessons Learned

- Crown correction
  - Existing pavement = parabolic
  - New pavement = 2% cross-slope
- Initially corrected crown with HMA
- HMA separator layer was a fine mix
  - Edge distress due to HMA compaction under traffic
  - Moved to uniform 1” separator layer with crown correction in the concrete
Lessons Learned

• Poor drainage
  – Water sitting on the separator layer eroding the HMA
  – Edge distresses
Lessons Learned
Lessons Learned
Lessons Learned
Lessons Learned

• Changed to a drainable HMA interlayer
Lessons Learned

- Make sure drainage path is clear

Drainage path stopped by existing dense-graded HMA and shoulder gravel

NOT GOOD!
Lessons Learned

• High side of superelevations very thick due to crown correction
Lessons Learned

- Pre-overlay repair work
  - MDOT has traditionally been very aggressive with repairing all distresses in a concrete pavement
  - Found that we don’t need to have that same level of repair work for the overlay – could save money without loss of performance
  - Now only the most severe cracks/joints are repaired prior to the overlay
Research Project

• “Improved Performance of Concrete Overlays”
• Principle Investigator: Dr. Will Hansen, Univ. of Michigan
• Initiated October 2009
• Completion expected May 2012
• Objectives:
  – Forensic study of existing concrete overlay distresses
  – Recommend changes to pavement design and construction practices
Research Project

• Example of forensic study
  – I-75 near West Branch (built 2003)
  – 5 test sections
    • #1: 10’ joint spacing, undoweled, unsealed
    • #2: 10’ joint spacing, undoweled, sealed
    • #3: 12’ joint spacing, undoweled, unsealed
    • #4: 12’ joint spacing, undoweled, sealed
    • #5: 12’ joint spacing, doweled, sealed
  – Sections 3 and 4 exhibiting longitudinal cracking and slightly more faulting
Research Project
Research Project

- FWD testing, Dipstick® profiling device, coring, pavement removal conducted
- Dipstick® found substantially more curl or warp at the joints in Sections 3 and 4
- Coring and pavement removal confirmed wet conditions in the HMA separator layer in those sections, and HMA stripping/erosion
Research Project

- Also placed temperature sensors in various layers of two projects in 2010
Other Concrete Overlays

• Whitetopping
  – One project on mainline pavement built in 1999
    • 6” w/o fibers, 6” w/fibers, 5” w/fibers, 3” ultra-thin over composite pavement
    • No milling or repair work to existing 4” HMA
    • 10’ transverse joint spacing
    • Some longitudinal cracking
    • Very little difference between sections with and without fibers
    • Some materials related distress at joints
Other Concrete Overlays

– M-46 (cont.)

• Ultra-thin performing poorly
• Large number of 1 meter X 1 meter panels replaced in 2004. Primarily over the edge of the old 20’ wide concrete.
Other Concrete Overlays

– M-46 (cont.)
Other Concrete Overlays

- Whitetopping (cont.)
  - A few intersections
  - Rest area parking lot in 2009
Other Concrete Overlays

• Thin Unbonded Overlays
  – M-3 (2005) and M-1 (2010) in Detroit
  – 4” concrete, 1” separator layer, existing composite pavement (milled 5”)
  – M-3 had several test sections
    • Sealed and unsealed joints
    • Two different HMA separator layers
      – Drainable
      – Standard dense-graded HMA
    • 5.5’ X 5.5’ joint spacing
Other Concrete Overlays

– M-3 (cont.)
  • 200+ drainage/utility structures
  • Many intersections – some at extreme angles
    – Joint layout was very difficult
  • Some cracking of panels
    – Many around structures
    – Some shattered areas found to be very thin (<2”)
  • At this point, still less than 1% of panels showing distress
Local Agency Work

• Whitetopping
  – 45+ locations
  – First project (1996, Traverse City) still in service; in good condition
  – 96% are still in service; most in good or very good condition

– Lessons learned:
  • Line up joints in whitetopping with transitions (widening) below
  • Use lower cement content mixtures
  • In summer, spray down milled HMA to cool down and bring to SSD condition

Courtesy: Michigan Concrete Association
Local Agency Work

Whitetopping Overlays
On Streets & Roads
In Michigan

Courtesy:
Michigan Concrete Association
Local Agency Work

- Thin unbonded overlays
  - 14 projects
  - First project (Coolidge in Royal Oak) still in service; rehabbed (approx 1.5% of project received full depth repairs) for first time in 2008 after 25 years
  - Lessons learned:
    - Use durable (ASR-resistant) mixtures
    - Proper use of expansion joints (needed where Exp. joints located in existing pavement)
    - Spring & fall paving – use cold weather protection, heated water, cover with plastic

Courtesy: Michigan Concrete Association
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Questions???

Michael Eacker
eackerm@michigan.gov
(517) 322-3474