Michigan's Unbonded Overlay Experience

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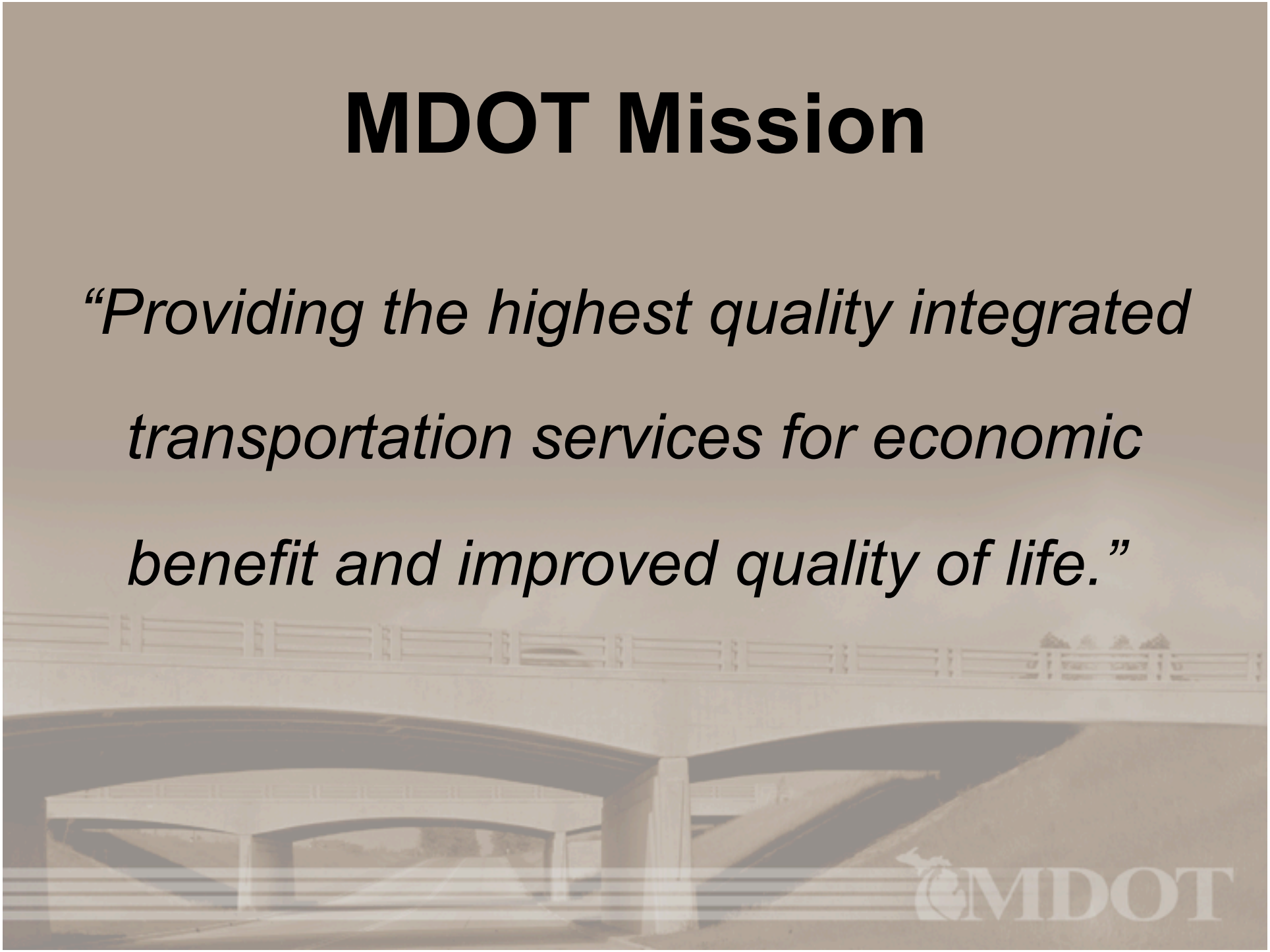
MDOT Mission

"Providing the highest quality integrated transportation services for economic benefit and improved quality of life."



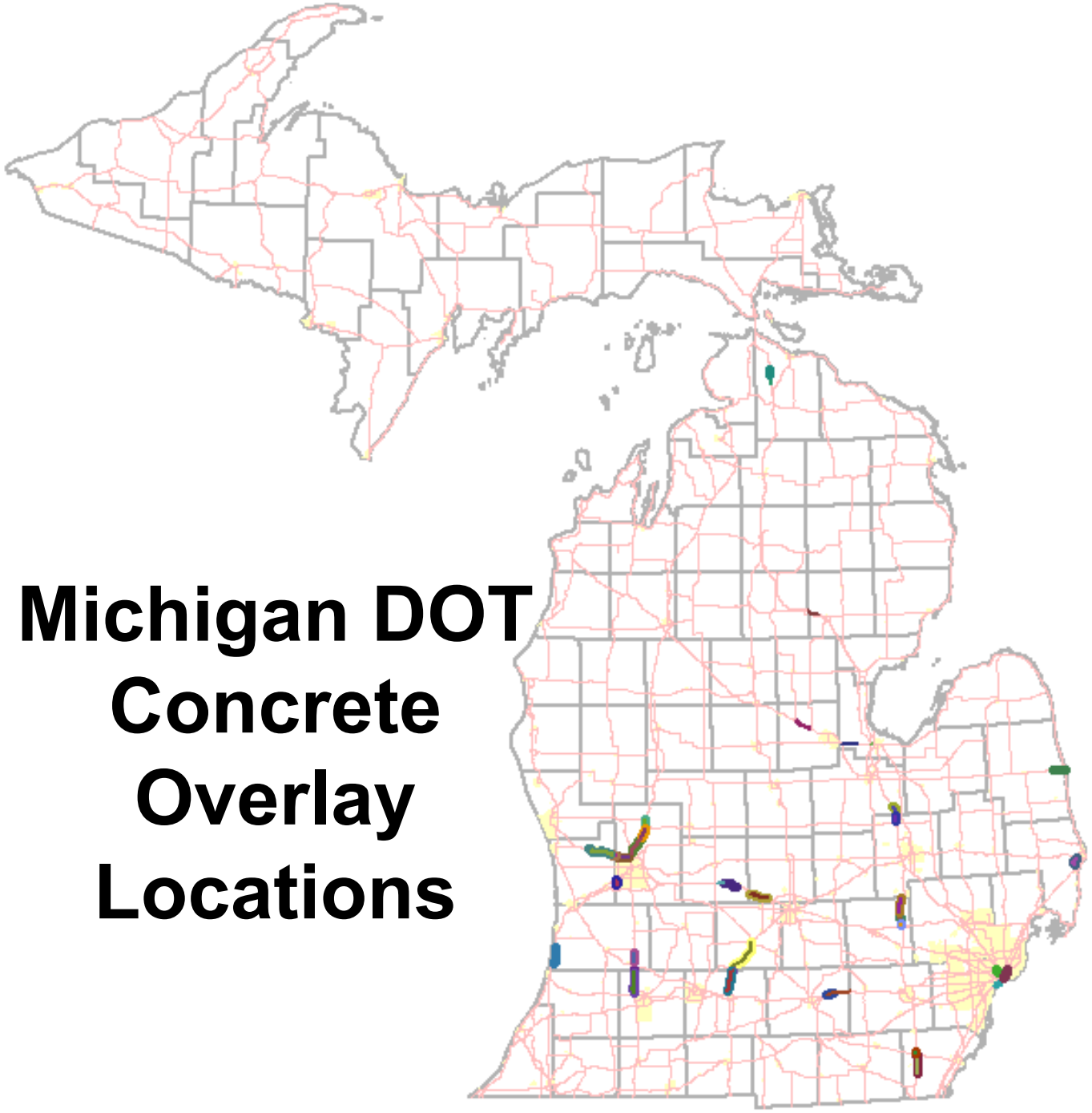
Overview

- 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

Michigan DOT Concrete Overlay Locations



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

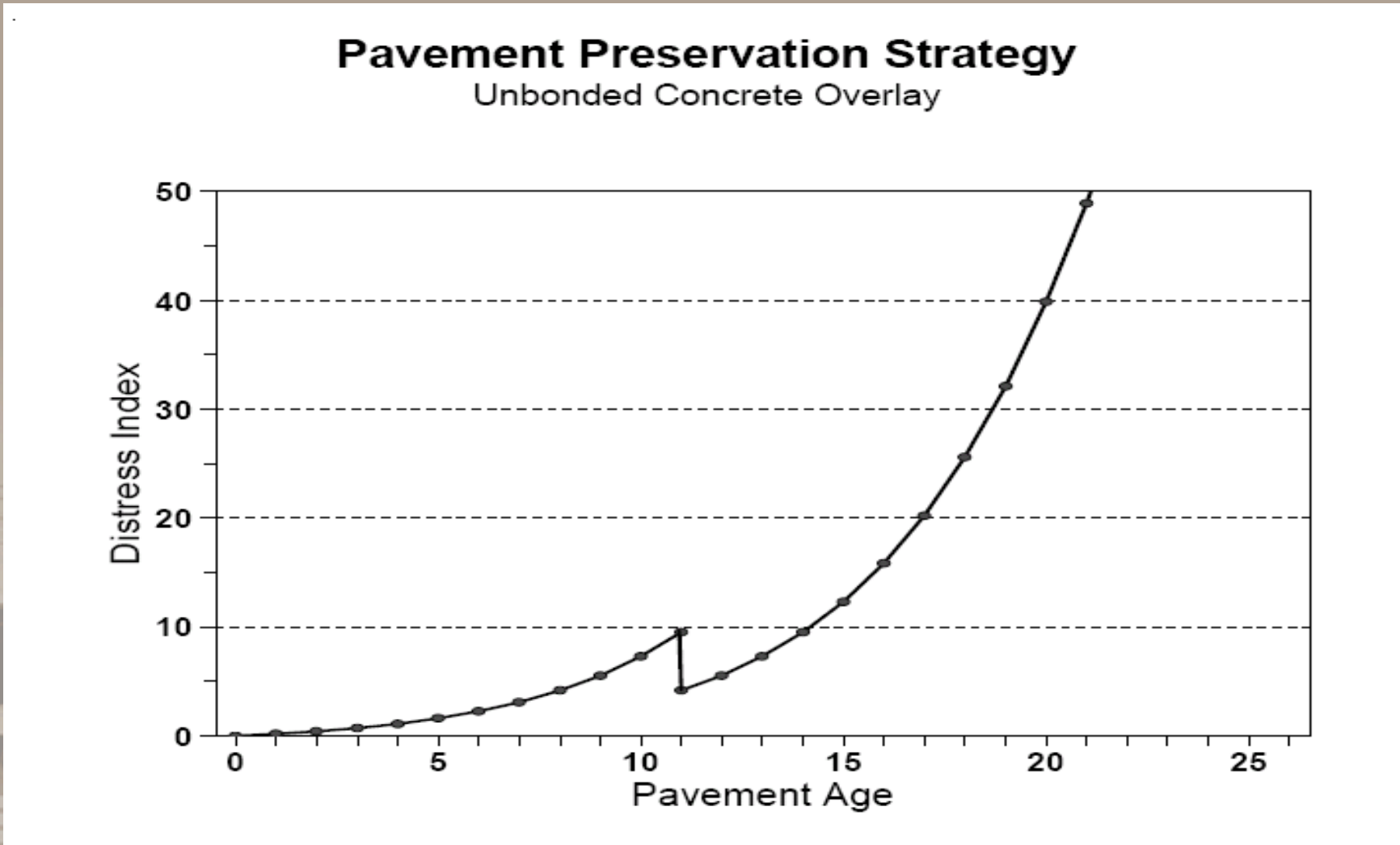
Performance Curve

- 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



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

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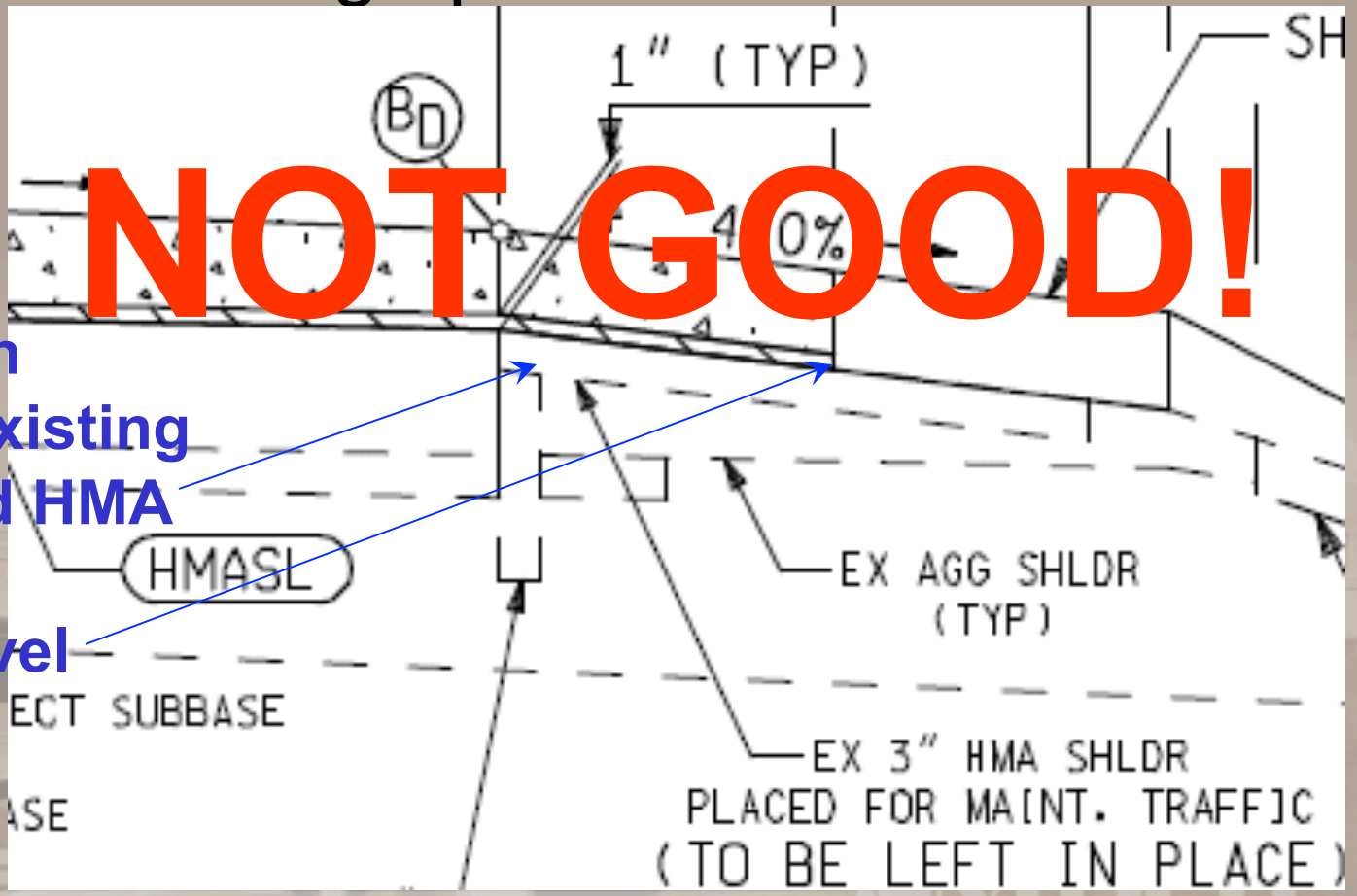
- Changed to a drainable HMA interlayer

Lessons Learned

- Make sure drainage path is clear



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

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

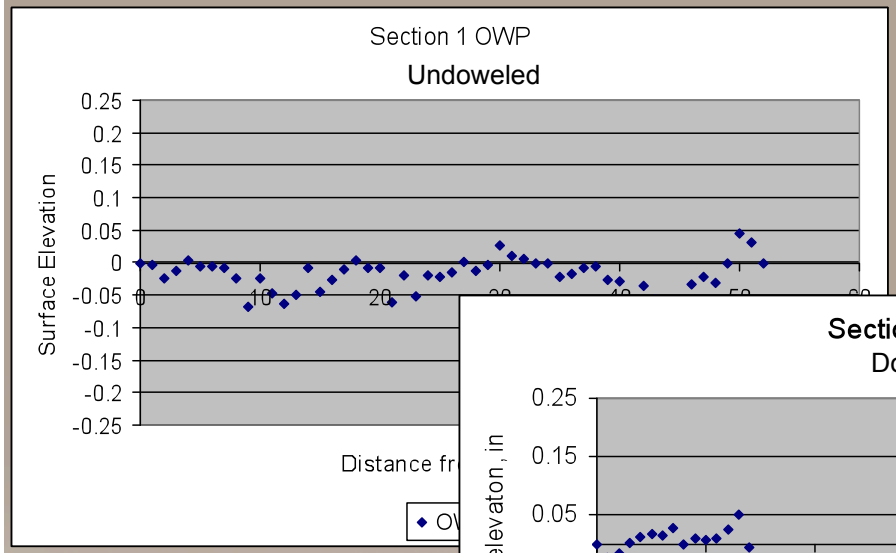
- Example of forensic study
  - I-75 near West Branch (built 2003)
  - 5 test sections
    - #1: 10’ joint spacing, undoweled, unsealed
    - #2: 10’ joint spacing, undoweled, sealed
    - #3: 12’ joint spacing, undoweled, unsealed
    - #4: 12’ joint spacing, undoweled, sealed
    - #5: 12’ joint spacing,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

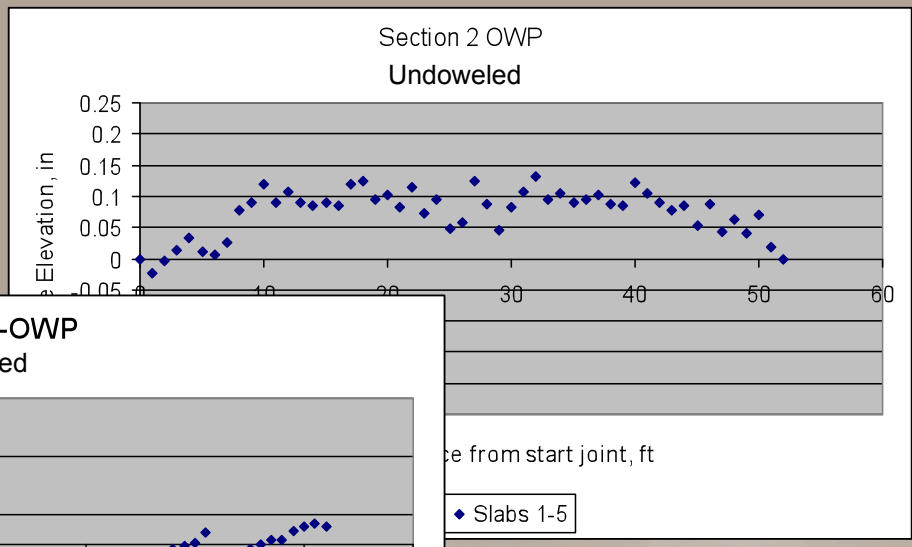
Research Project

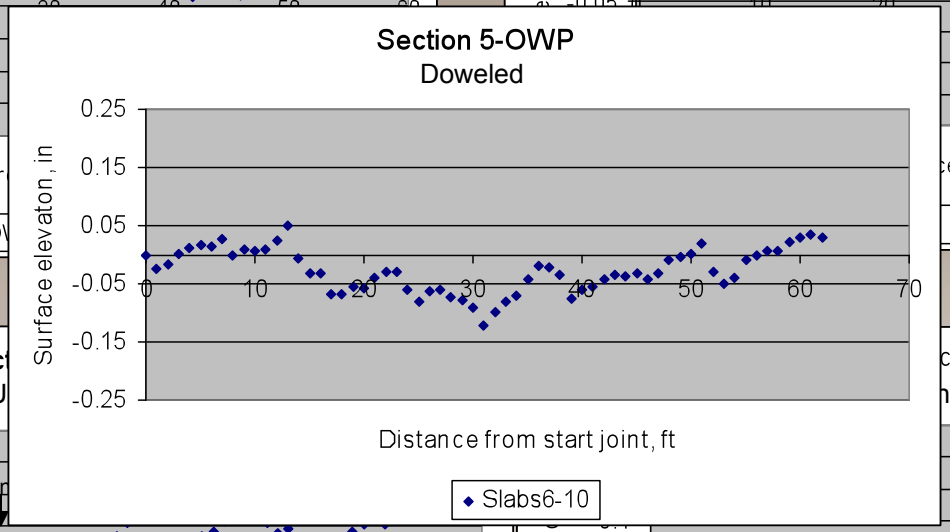
Research Project

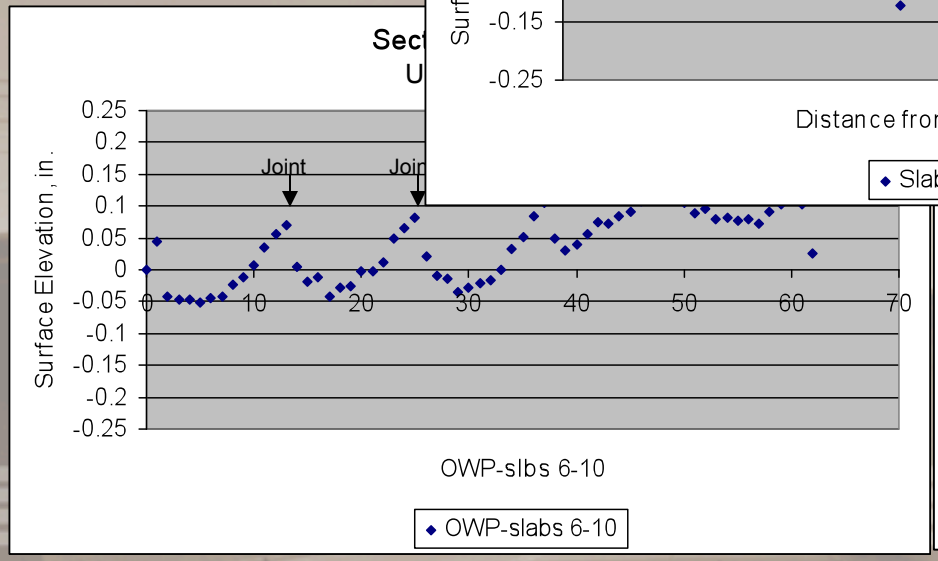
- FWD testing, Dipstick® profiling device, coring, pavement removal conducted
- Dipstick® found substantially more curl or warp at the joints in Sections 3 and 4
- Coring and pavement removal confirmed wet conditions in the HMA separator layer in those sections, and HMA stripping/erosion

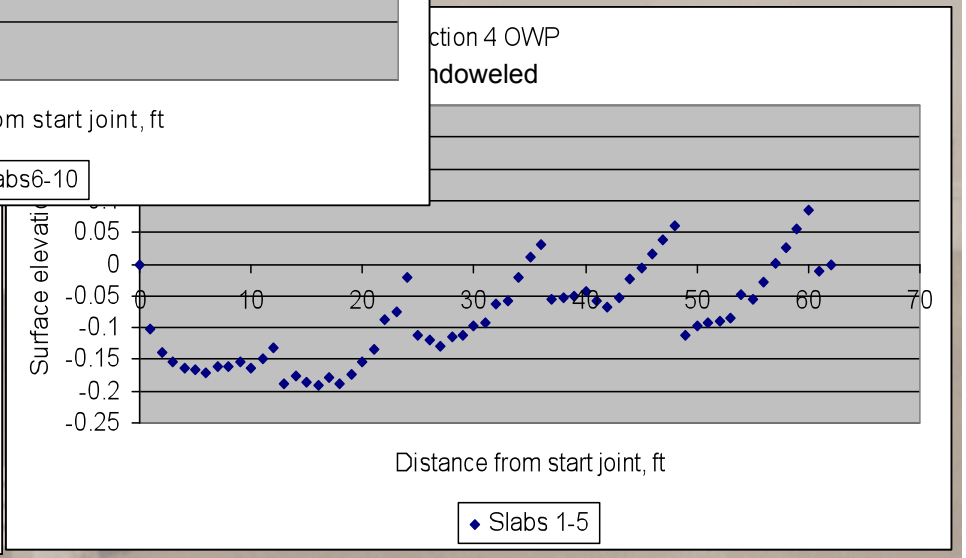
Research Project











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????

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