Pavement Preservation

Ohio Township Association (OTA) Winter Conference
February 7, 2020
Columbus, Ohio

Pavement Preservation

Speakers:

Aric Morse, P.E. – (614) 995-5994
ODOT Office of Pavement Engineering

Mike Fitch, P.E. – (614) 387-7358
ODOT Local Technical Assistance Program (LTAP)
Opening Remarks

How many Townships here are maintaining:
   – Unpaved (gravel) roads?
   – Chip seal roads?
   – Asphalt (flexible) pavements?
   – Concrete (rigid) pavements?

In this session, we’ll primarily focus on asphalt pavements and related treatments.
Free! eLearning (Online Courses)

New! Click here to view a PDF Catalog of all available eLearning courses and their descriptions.

The Ohio LTAP Center is pleased to offer eLearning courses at NO CHARGE for our customers.

You must have a MyODOT username and password to sign-in to the eLearning system. If you don’t have one already, click here for instructions on how to set one up. If you have a MyODOT username and password go to the eLearning system link below.

Free! eLearning (Online Courses)

**Flexible Pavement Preservation Treatment Series**

- Introduction to Pavement Preservation
- Materials
- Crack Sealing and Fillings
- Localized Pavement Repairs
- Chip Seals
- Fog Seals
- Slurry Seals
- Micro-Surfacing
- Thin Functional HMA Overlay
- Ultra-Thin HMA Bonded Wearing
- Selecting the Right Treatment
Session Outline

- Introduction & Distress Identification
- Flexible Pavement Preservation Treatments
  - Preventive Maintenance Concept & Strategies
  - Drainage Maintenance; Pavement Seals
  - Thin HMA Overlays; Pavement Repairs
- Wrap-Up
  - Topics for further study
  - Resources for additional information

Flexible Pavement

Basic Components of a Flexible Pavement

Asphalt Concrete Surface Course
Asphalt Concrete Intermediate Course
Asphalt Concrete Base Course
Aggregate Base
Subgrade (below Aggregate Base)
Asphalt Pavement Performance

Performance

Traffic

Environment

Subgrade Strength

Materials

Thickness

Variability

Asphalt Pavement Distress
Distress Identification Manuals


Purpose of Distress Survey

- Document pavement condition.
- Identify pavement distress.
- Group areas of similar performance.
- Gain insight into cause of deterioration.
- Identify additional testing needs.
- Identify possible rehabilitation treatments.
- Identify repair areas and quantities.
Pavement Coring

Asphalt Pavement Distress

• Functional vs. Structural

  – Functional distresses are a result of environmental effects, age, material deficiencies, and other deterioration modes.

  – Structural distresses are a result of loading that exceeds the strength characteristics of the pavement.
Possible Distress Types Include ...

- Base Failures
- Bleeding / Flushing
- Block Cracking
- Debonding
- Edge Cracking
- Longitudinal Cracking
- Longitudinal Joint Deterioration
- Potholes
- Raveling
- Rutting
- Shoving
- Thermal Cracking
- Wheel Track Cracking
Base Failures / Potholes

- Moisture: Excess moisture in the subbase and/or subgrade, reduces the strength of the overall pavement section.
- Insufficient Pavement Thickness: Localized weak pavement areas bend more and crack, creating the opportunity for more water to infiltrate.
- Weather: Freezing and thawing of the pavement, subbase, and subgrade, coupled with heavy trucks destroys the structure of the pavement and induces potholes.
Base Failures / Potholes - Treatments

- Full Depth Patching
- Minor Rehabilitation
- Major Rehabilitation
Raveling

Disintegration of the pavement from the surface downward due to the loss of aggregate particles.

Raveling - Causes

• Density: Improper compaction provides increased air voids.
• Construction Practice: Segregation can be the result of mixture handling practices.
• Mix Q/C: Production control of P200 dust and proper gradation control.
• Materials: Clay content in gravels.
• Age: Binders oxidize.
• Materials: Poor aggregate quality can lead to disintegration of the surface.
Raveling - Treatments

- Crack Sealing
- Rejuvenators/Sealers
- Fog Seal
- Sand Seal
- Chip Seal
- Microsurfacing
- Thin Overlay
- Mill & Fill
Bleeding / Flushing

- The presence of excess asphalt binder on the pavement surface.

- Can result in a slick surface (lack of friction / low skid resistance) => traffic safety concern.
Bleeding / Flushing - Causes

• Mix Design: High A.C. content, improper air voids, and wrong type of A.C. can lead to bleeding.

• Truck Traffic: High truck counts will work excess A.C. to the surface.

• Construction: Allowing traffic on the pavement before it has cooled sufficiently can cause bleeding.

Bleeding / Flushing - Treatments

• Spot overlays

• Micro-surfacing

• Functional Overlay
  – Thin HMA overlay with or without milling
Block Cracking

Interconnected cracks which divide the pavement into rectangular blocks.
Block Cracking - Causes

• Thermal Movement: Asphalt pavement expands and contracts with temperature changes.

• Age: As asphalt cement ages it looses elasticity and becomes more brittle.

Block Cracking - Treatments

• Crack Sealing

• Chip Seals

• Thin Overlays
Rutting

Vertical deformations in the pavement surface along the wheel path.
Rutting - Causes

- Density: Improper compaction provides space for further densification from traffic. As the mix densifies, rutting results.
- Wrong asphalt cement. High truck volume with soft AC can allow rutting to take place.
- Unstable Mixes: Lack of stone-on-stone contact allows aggregates to ‘float’ in the asphalt. As traffic pushes aggregates around rutting results, especially in hot weather.
- Lack of Structure: The pavement must be capable of protecting the subgrade, otherwise rutting can be found in the subgrade.

Rutting - Treatments

- Microsurfacing
- Mill and Fill
- High Stress Guidelines
Debonding - Raveling - Edge Cracking - Rutting
Debonding - Raveling - Edge Cracking - Rutting

- Poor Compaction, oxidation, aging, possible tacking problem. Looks like maybe some truck load segregation. Minor rutting – densification of mix. Some distress appears to be structural.
- Coring and deflection testing is appropriate, especially if truck count is high.
- Mill and overlay – Minor rehabilitation.
Raveling - Block Cracking

- The primary cause is oxidation, moisture damage, and aging of the asphalt concrete.
- Since no rutting is evident and the cracking is accompanied by high severity raveling, it may be only a surface, not structural, problem.
- Coring could be used to determine if the cracking is top down (surface) or bottom up (structural).
- Depending on traffic levels, a mill and fill is likely to be the best alternative.
- Too far gone to chip seal or microsurface.
Session Outline

• Introduction & Distress Identification

• Flexible Pavement Preservation Treatments
  – Preventive Maintenance Concept & Strategies
  – Drainage Maintenance; Pavement Seals
  – Thin HMA Overlays; Pavement Repairs

• Wrap-Up
  – Topics for further study
  – Resources for additional information

PAVEMENT PRESERVATION

Ohio DOT / LTAP
Pavement Preservation

- Reactive Maintenance
  - Corrective
  - Unplanned
  - Poor performance

- Preventive Maintenance
  - Planned strategy
  - Cost Effective

Asphalt Pavement Behavior

Flexible pavements behave very differently from rigid pavements
Pothole Patching

- Materials Available
  - Hot Mix Asphalt
    - Spring, Summer and Fall only
  - Cold mix
    - Locally available
    - High-Performance, proprietary

Pothole Patching

- High Performance Proprietary Material Options
  - UPM
  - Perma-Patch
  - QPR2000
Spray Patching

Spray Patching

Crafco
Mastic Repair

- Mastic products are hot applied polymer modified asphalt concrete mixtures capable of being poured into place without the need for compaction.
  - Fill wide cracks and joints
  - Fill shallow de-bonded areas
  - Seal utility cuts or permanent patches
  - Level approaches to bridges, manhole covers, etc.
  - Appropriate for cracks greater than 1” wide
  - Can be applied in lifts at thick as 2-1/2”
Mastic Repair

Drag Patching

- Generally intended for long continuous edge problems.
- Consists of HMA placed by dump as thick as 4”
  – Spread by Motor Grader and Rolled
- Inexpensive strategy for poor condition pavements with long sections of edge distress that need an overlay.
- Creates distorted cross section which inhibits drainage, and makes for a rough riding pavement.
- Can be a long lasting repair strategy for low volume roadways.
Drag Patching
Drag Patching

Drag Patching
Asphalt Pavement Preventive Maintenance

Preventive Maintenance Concept
Preventive Maintenance Concept

Asphalt Pavement Preventive Maintenance Strategies

- Drainage maintenance
- Tree trimming
- Rejuvinators/Sealers
- Crack sealing
- Fog sealing
- Chip sealing
- Micro-surfacing
- Thin asphalt overlays
  - With or without milling
Drainage Maintenance

• Keep ditches open.

Eliminate Shade

• Pavements that do not dry out will ravel faster.
Pavement Seals

Crack Sealing

• Used to minimize the intrusion of water into a pavement system. Also referred to as crack filling.
  – Erosion of mix is minimized.
  – Deterioration of the crack face is slowed.
  – Less water is available to permeate into the base material.
  – Helps with functional distress – not structural.
Crack Sealing

• The placement of a mixture of a neat or modified binder, such as PG64-22, into existing cracks in the pavement. Binder may be mixed with fibers, rubbers, and/or fillers.

  – Type I – No fibers → Rubberized crack fill
  – Type II – Polyester fibers → Over-band crack seal
  – Type III – Polypropylene → Over-band crack seal
  – Type IV – Polyester fiber w/rubber → Crack fill
Rejuvinators/Sealers

Marketed for recently placed HMA to:
• Retard oxidation
• Prevent water infiltration
• Reduce raveling
• Extend service life

Rejuvinators/Sealers

• Proprietary Products on the Market
  – GSB-88
  – Reclamite
  – Biorestore
  – Replay
Rejuvinators/Sealers

- ODOT Study
  - Reclamite
  - Biorestore
  - Replay
- Friction Concerns – up to 30 days
  - May be appropriate for lower speed roadways
- Cost Effectiveness
  - ODOT study indicated these products could be considered marginally cost effective.

Fog Seal
Fog Seal

- Used as a tool to add asphalt to an existing asphalt concrete surface in order to:
  - Improve sealing (waterproofing) of the surface.
    - Can seal small cracks
  - Prevent stone loss by holding aggregate in place.
  - Improve the appearance of the surface.
  - Rejuvenate oxidized asphalt concrete.
  - Used to treat premature raveling.

Fog Seal

- Fog seals should be used only where surface penetration of the emulsion can be expected.
  - Aged and raveled hot mix surfaces
  - Chip-sealed surfaces
  - Open graded asphalt surfaces
Chip Seal

• A sprayed application of asphalt binder covered with a washed aggregate, rolled and swept.

• Intended for low volume roadways to provide a new wearing course, eliminate raveling, retard oxidation, reduce the intrusion of water, and improve surface friction.
• Seals cracks.
• Erosion of the surface mix is stopped.
• Deterioration of the crack face is slowed.
• Less water is available to permeate into the base material.
• Helps with functional distress – not structural.
#8’s

Micro-Surfacing / Slurry Seal

- A thin cold-applied paving mixture composed of polymer-modified asphalt emulsion, 100% crushed aggregate, mineral filler, water, and other additives.
Micro-Surfacing / Slurry Seal

Slurry Seals are intended to:
• Retard raveling and oxidation
• Fill ruts
• Improve surface friction
• Restore serviceability
• Reduce aging susceptibility
• Lower permeability to water and air

Thin Hot Mix Asphalt Overlays

• Dense graded hot mix asphalt concrete (<2” typ.). May include milling and/or a scratch course.
Thin Hot Mix Asphalt Overlays

• Thin HMA overlays are intended to:
  – Protect the pavement structure
  – Reduce the rate of pavement deterioration
  – Correct surface deficiencies
  – Reduce permeability
  – Improve the ride quality

Thin Hot Mix Asphalt Overlays

• Specifications
  – Acceptance
    • Item 401 & Item 403
    • Item 446
    • Item 448
  – Conventional Hot Mix - Material
    • Item 441
    • Item 442
    • Item 424
    • Item 860
    • SS 823
    • HMA 404 LVT. HMA 404 LVT-PMA
Thin Hot Mix Asphalt Overlays

• Item 441 Asphalt Concrete
  – Gradations intended for Medium Truck Traffic
    • 50 < ADTT < 1500
  – Surface Course placed at 1-1/4” (preferred)
  – Surface placed with min. 5.8% binder
    • PG 64-22 or 70-22M binder
  – Acceptance using either 446 or 448
  – Marshall Mix Design

Thin Hot Mix Asphalt Overlays

• Item 442 Superpave
  – Gradations intended for Heavy Truck Traffic
    • ADTT > 1500 trucks per day
    • High Stress Locations
  – Surface Course placed at 1-1/2” (preferred)
  – Surface placed with min. 5.7% binder
    • PG 70-22M is automatic by specification
  – Acceptance using either 446 or 448
  – Superpave Mix Design
Thin Hot Mix Asphalt Overlays

**Item 424 Fine Graded Polymer Asphalt Concrete, Type A**
- Surface Course for Light or Medium truck traffic
- Placed as thin as 5/8” thick, but more often at 1”
- Placed with conventional paving equipment
- Natural sand with min 50% silicon dioxide for skid resistance
- Rich mix with 8.5% Binder
- PG 76-22M or PG 64-22 W/5% polymer
- 401/403 Acceptance
- Recipe mix

Thin Hot Mix Asphalt Overlays

**Item 424 Fine Graded Polymer Asphalt Concrete, Type B**
- Surface Course for Medium or Heavy Truck Traffic
  - Medium truck traffic: 10% two fractured faces coarse aggregate
  - Heavy truck traffic: 100% two fracture faces coarse aggregate
- Placed as thin as ¾”, but more frequently at 1” thick
- Rich mix with minimum 6.4% binder
- PG 76-22M or PG 64-22 W/5% polymer
- Up to 10% RAP
- 448 Acceptance
- Marshall Mix Design
Fine Graded Polymer Asphalt Concrete

Type A  Type B

Item 860 Thinlay Asphalt Concrete

Designer Note:

Use of this item requires prior approval from the Office of Pavement Engineering.

- This item is for use on General or Urban System routes only.
- Minimum lift thickness is 0.75 inches (19 mm) and maximum is 1.25 inches (32 mm).
- Type LT is restricted to routes with less than 2500 ADT and less than 250 trucks.
- Type MED is restricted to routes with less than 1500 trucks.
- Use of non-tracking tack coat is preferred.
- The weather restrictions of this specification may limit opportunities for late season paving. This should be taken into account when determining project completion dates.

<table>
<thead>
<tr>
<th>Mix Type</th>
<th>HT (High Traffic)</th>
<th>MED (Medium Traffic)</th>
<th>LT (Light Traffic)</th>
<th>ULT (Ultralight Traffic)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADT:</td>
<td></td>
<td></td>
<td>&lt;2,500</td>
<td>&lt;500</td>
</tr>
<tr>
<td>ADTT:</td>
<td>&gt;1,500</td>
<td>250-1,499</td>
<td>&lt;25</td>
<td>&lt;25</td>
</tr>
</tbody>
</table>
Thin Hot Mix Asphalt Overlays

• **Supp. Spec. 823 Light Traffic Asphalt Mixture**
  – Surface Course Light Truck Traffic
    • Little or no truck traffic
    • ADTT < 50
    • Not intended for State Highways
  – Preferred Lift thickness of 1-1/4”
  – Minimum 6.4% binder using PG 64-22
  – 448 Acceptance
  – Marshall Mix Design

Thin Hot Mix Asphalt Overlays

• **404 LVT or 404 LVT-PMA Asphalt Concrete**
  – Surface Course for Light Truck Traffic
    • Little or no truck traffic
    • ADT < 1500
    • Not intended for State Highways
  – Preferred Lift thickness of 1”
  – Minimum 6 % binder using PG 64-22
  – PMA version includes 2% polymer
  – 401/403 Acceptance
  – Recipe Mix
Flexible Pavement Repair

- Full Depth Repairs
- Partial Depth Repairs

Full Depth Repairs

- Intended to treat:
  - potholes
  - base failures
  - edge failures

- ODOT Item 253: Can be detailed to accomplish almost any intent.
Full Depth Repairs

Partial Depth Repairs

• Intended to treat localized surface failures:
  – Debonding
  – high severity raveling
The Economics of Pavement Preservation

- HMA overlay w/out repair
  - Cost is approximately 4$/SY
  - On a problematic pavement section with structural distress – Potholes and repairs needed throughout life

- Extensive repairs & a Chip Seal/Fog Seal
  - 5% by surface area - full depth pavement repair
  - Chip Seal & fog seal
  - Very similar cost – better performance!
Session Outline

• Introduction & Distress Identification

• Flexible Pavement Preservation Treatments
  – Preventive Maintenance Concept & Strategies
  – Drainage Maintenance; Pavement Seals
  – Thin HMA Overlays; Pavement Repairs

• Wrap-Up
  – Topics for further study
  – Resources for additional information

Topics for Further Study ...

• Safety is an important consideration for any roadway maintenance activity.

• Part 6 of the Ohio Manual of Uniform Traffic Control Devices (OMUTCD) provides the Temporary Traffic Control (TTC) guidelines and standards to be used for roadway construction, maintenance, utility and incident zones (“work zones”).

• “Experience has shown that following the fundamental principles of Part 6 will assist road users and help protect workers in the vicinity of TTC zones.”

Topics for Further Study ...

• The Temporary Traffic Control Manual (TTCM) includes a reprint of OMUTCD Part 6.
• The current TTCM is the 2012 Edition. It can be downloaded free of charge, at:
• Printed copies of the 2012 TTCM are available from the ODOT Office of Contracts (1-800-459-3778). The cost is $12.00 per copy plus shipping and tax.

Topics for Further Study ...

Effective pavement preservation also requires proper maintenance of the adjacent berms/shoulders. A lack of this maintenance can lead to progressive deterioration of the pavement.
Topics for Further Study …

Roadway berms/shoulders have several important functions, which include:

- Providing a safe area for stopped vehicles or emergency use.
- Facilitating lateral (side) drainage of surface water from the travel lanes to the roadside/ditch.
- Providing lateral support to the pavement layers.
- Minimizing ‘drop-off’ conditions along the edge of the pavement.

Topics for Further Study …

- **Pavement edge drop-offs can be hazardous.**
- When a tire drops off a paved surface, sometimes just inches from the travel lane, a driver can have difficulty re-entering the roadway if the pavement edge is nearly vertical—especially if the height difference is significantly more than 2 inches.

*Sharp, steep pavement edge drop-offs can contribute to crashes.*
How Pavement Edges Affect Crash Severity

- When a driver drifts onto the roadway shoulder and tries to steer back onto the pavement, the vertical pavement edge can create a "tire scrubbing" condition that may result in over-steering.
- If drivers over-steer to return to the roadway without reducing speed, they are prone to lose control of the vehicle.

Graphic Source: AAA Foundation for Highway Safety
• Routine maintenance should be conducted to maintain a flush shoulder.

ODOT’s Maintenance Inspection Process for State-Maintained Highways

• The Ohio Department of Transportation defines Pavement Drop-Offs in the ODOT Maintenance Quality Survey (MQS) Manual, and records Pavement Drop-Offs as a Maintenance OPI deficiency. (Note: OPI = Organizational Performance Index)

The Safety Edge – Pavement Edge Treatment

- In recent years, the Federal Highway Administration (FHWA) has recommended the use of a Safety Edge when paving to help reduce the risk of pavement drop-off hazards.
- The Safety Edge is not an alternative to a flush shoulder. It is a temporary safety measure during construction, and a long-term feature for where edge rutting occurs in the future. Routine maintenance should still be conducted to maintain a flush shoulder.
- For more information: http://www.fhwa.dot.gov/innovation/everydaycounts/edc-1/safetyedge.cfm

Topics for Further Study ...

Full-Depth Reclamation (FDR) as a possible option for Major Rehabilitation
“What is Full-Depth Reclamation?”

**CONSTRUCTION PROCESS**

1. Uniformly spread additional material on the surface of existing asphalt layers.
2. Pave new asphalt and compact.
3. Blend additional material with existing asphalt and base layers.
4. Compact with vibratory asphalt roller and grade as needed.
5. Compact with vibratory drum roller.
6. Allow mix to harden, then cure and apply prime coat, sealant or concrete surface.

**Ohio Example: Cement-Treated FDR**

For low-volume local roads, Defiance County has had success using **full-depth reclamation (FDR) treated with Portland cement** as a base course, which is then paved with hot-mix asphalt (HMA).
Ohio’s Research Initiative for Locals (ORIL)
http://oril.transportation.ohio.gov

• ORIL Project Summaries/Reports
  – Strength of Road Widening Materials
  – Best Practices for Chip Sealing
  – Pavement Restoration of Utility Cut Installations
  – Partial-Depth Pavement Repairs of Amish Buggy Routes

• Other topics relating to Pavements & Materials, Hydraulics, Structures, Traffic, and Policy, Legal & Revenue.

• Opportunity to submit research ideas to the ORIL Board for consideration (Summer/Fall 2020).

Ohio Local Technical Assistance Program (LTAP)
http://www.dot.state.oh.us/ltap

• LTAP Workshops
  – Asphalt Pavement Preservation
  – Concrete Pavement Preservation
  – Pavement Condition Rating (PCR)
  – Many topics throughout the year!

• Free – Online Publications
• Free – Webinars
• Free – eLearning Courses
Thank you for attending this session!

Pavement Preservation

Ohio Township Association (OTA) Winter Conference

February 7, 2020
Columbus, Ohio