Maintaining your roads with Asphalt

HMA – America’s Most Versatile Product
Maintaining your roads with Asphalt

- Asphalt Overlays
- Rehabilitation of Concrete Roads
- Asphalt for Preventive Maintenance
Asphalt Overlays

• Functional overlays
  • Typically used to address surface distresses or improve ride quality
  • Generally not designed and rely on past experience

• Structural overlays
  • Correct structural deficiencies and are designed
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Asphalt Overlays

Thin Overlay

Surface Defects

Thick Overlay

Structural Defects
Functional Overlays

• Remedy functional deficiencies
• Minimum constructible thickness
• May involve surface milling and repair with overlay
Functional Deficiencies

- Adversely affect highway user
  - Poor surface friction
  - Hydro-planing
  - Excess surface distortion
    - Rutting
    - Potholes
    - Faulting
    - Settlement
Options for Correcting Functional Deficiencies

• Thin overlay
• Milling plus thin overlay
• Full-depth or partial-depth repairs
Structural Overlays

- Remedy structural deficiencies
- Minimum design thickness
- May involve surface milling and repair with overlay
Structural Deficiencies

- Adversely affect the load-carrying capability of the pavement
- Indicators
  - Cracking
  - Distortion (rutting)
  - Disintegration
Options for Correcting Structural Deficiencies

- Structural overlay
- Pre-overlay repair and structural overlay
- Rehabilitation and structural overlay
- Reconstruction
Pre - overlay Repairs

- Amount and type depends on
  - Type of overlay
  - Structural adequacy
  - Distress types and severity
  - Future traffic loadings
  - Physical constraints
  - Overall project funding
Pre - overlay Repairs

• Consider trade-offs between
  • Overlay type
  • Overlay thickness
  • Pre - overlay repair extent
Reflection Cracking

- Appear above joints or cracks in underlying pavement layer
  - AASHTO design equations do not consider directly
  - Additional steps must be taken to reduce the rate and severity
Reflection Cracking

- Causes
  - Low temperature cycles
  - Traffic loads
- Excessive tensile stresses developed in overlay due to movement of existing pavement
- Initiates at bottom of overlay
Stresses from Low Temperatures

Lower temperatures

Thermal stress

Higher temperatures

Joint or crack

Overlay

Old pavement

Subgrade

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Stresses from Traffic Loads

- Tip of the joint or working crack
- AC overlay
- Old AC pavement
- AC bending stress
- Stress at the tip of the crack
- Shearing stress

Stresses:
- Shearing stress at the tip of the crack
- AC bending stress
- Void in the old AC pavement
Reflection Cracking Control Measures

- Increased overlay thickness
- Fabrics
- Crack-arresting interlayers
- Pre-overlay treatments
Increased Overlay Thickness

- Does not prevent the occurrence of reflection cracking
- Reduces the rate and severity of reflection cracking
- Cost-effectiveness must be considered relative to other techniques
Fabrics

- Provide physical restraint (reinforcing layer) to resist formation of cracks
- Not as effective with substantial horizontal and vertical movements
- Most effective at longitudinal joints and in warm climates
Crack-Arresting Interlayers

Aggregate lift or ASCRL (HMA)

Overlay

Crack arresting layer High voids

Old pavement

Subgrade

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Pre-overlay Repair Treatments

• Any method that reduces movement at joints and cracks can potentially reduce reflection cracking
• Possible treatments
  • Surface milling
  • Crack Repair
  • Crush and Shape (rehab strategy)
Summary

- Examine the feasibility of an overlay as most effective alternative vs. major rehab
- There is more to overlay design than just thickness design
  - Pre-overlay repairs
  - Sub-drainage
  - Reflection crack control
- Need to have reasonable performance expectations
Maintaining your roads with Asphalt

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• Asphalt for Preventive Maintenance
Rehabilitation of Concrete Roads

- By far, the biggest problem in HMA overlays of PCC pavement
- Caused by movement at PCC joints and cracks
Design Issues

- Rate of propagation through overlay
- Number of reflected cracks
- Rate of deterioration of reflected cracks
- Amount of water that can infiltrate through the cracks
Reflection Crack Control Measures

- Fabrics
- Pre-overlay treatments
- Slab repair or replacement
- Sawing and sealing joints
- Increased overlay thickness
Crack Control Effectiveness

- Delay the occurrence of cracking
- Reduce the number of cracks
- Control the crack severity
- Provide other benefits
  - Reduce overlay thickness
  - Enhance waterproofing capabilities
Pre-overlay Repairs

- Slab stabilization
- Fractured slabs
- Slab repair / replacement
- Load transfer restoration
Fractured Slab Techniques

- Crack and seat (JPCP)
- Break and seat (JRCP)
- Rubblize (JPCP, JRCP, CRCP)
Cracking and Seating

- Shortens effective slab length
- Standard practice in many States
- Not “generally” recommended for use on poor subgrades
- Design methods (overlay thickness)
Cracking and Seating

Overlay

Subbase

Subgrade Soil

Cracks

Short slab length (~2’)

Good granular interlock

Firm Foundation
Cracking and Seating
Cracking and Seating - crack pattern
Cracking and Seating

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ASPHALT PAVEMENT ASSOCIATION OF MICHIGAN

SMOOTH | DURABLE | SAFE | QUIET
Rubblization

- Fracturing:
  - Eliminates slab action
  - Destroys bond between concrete and steel
- Rubblized base responds as a tightly keyed, interlocked high-density, unbound layer
  - Layer cannot crack; already fractured
Why Rubblize?

• Fracturing PCC to segments less than 10” precludes reflection of:
  – Joints
  – Cracks
  – Faults

• Production Rates up to 1 lane-mile/day
Rubblization

Larger Pieces = Larger Movement = Cracking

HMA

PCC

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Rubblization

Smaller Pieces = Smaller Movement = No Cracking

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Rubblization

Benefits

• Time savings
  – Choose work hours
  – High production rates

• Economic Savings
  – Reduce user delay costs
  – Reduce construction costs
Rubblization

Benefits (continued)

• Environmentally friendly
  – Reduce landfill
  – Reduce fuel consumption/air pollution

• Smoothness
  – Eliminate reflection cracking/faulting
Rubbllization

Construction Procedure

• Install/replace existing edge drainage system as required
• Remove existing overlay (if present)
• Remove existing HMA patches, replace with aggregate base as required
• Fracture the concrete pavement
• Roll
• Place HMA overlay
Rubblization – Resonant Breaker
Rubblization – Multiple Head Breaker

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Rubbblization

Rolling

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Particle Size

- PCC fractured into 10 in.-minus pieces
- Most pieces are 2 - 6 in. diameter
- Aggregate interlock maintained beneath surface
- Rolling knits together surface particles
Assessing Suitability of Project for Rubblization

• Not All Pavements Are good Candidates
• Marginal Candidates Are Thin Slabs (< 9”) With Poor Underlying Support
  – Thin to No Subbase or Select Fill
  – Weak Subgrade (often saturated)
    • Will show up immediately
Conclusions on Rubblization

- Provides excellent base for a new pavement
- Expedient and environmentally friendly
  - Recycles existing pavement in place
  - Thinner new pavement cross section
- Economical
  - Less than half the time, half the cost of remove/replace
- Must use caution on “marginal candidates”
Rehabilitation of Concrete Roads

Sawing and Sealing Joints

- Concede appearance of reflection cracking
- Objective: control rate of deterioration
- Reduces spalling of reflection cracks
- Candidates should have well-defined joints
- Sawcut must be directly above underlying joint
Sawing and Sealing Joints

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Sawing and Sealing Joints
HMA Overlays on PCC Pavements

Sawcut and sealing over joints

- **Controls** reflection cracking
  - Provides maintainable joint
  - Reduces spalling
  - Keeps crack edges square
Procedure Illustrated

Reference

Establish Template

Sawcut/Clean

Pour/tool sealant

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Sawcut and Sealed Overlay

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Asphalt for Preventive Maintenance

Thin Asphalt Overlays

• Shift from new construction to renewal and preservation
• Functional improvements for safety and smoothness needed more than structural improvements
Asphalt for Preventive Maintenance

1999 AASHTO Survey

- Mill & Overlay
- Asphalt Overlay
- Chip Seal
- Crack Treatment
- Microsurfacing
- CIPR
- HIPR
- Whitetopping
- Full Depth CIPR

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Benefits of Thin Asphalt Overlays

- Long service, low lifecycle cost
- Maintain grade and slope
- Handles heavy traffic
- Smooth surface
- Seal the surface
- No loose stones
- Minimize dust
- Minimize traffic delays

- No curing time
- Low noise generation
- No binder runoff
- Can be recycled
- Can use in stage construction
- Easy to maintain
- Restore skid resistance
Preventive Maintenance

WHAT EXACTLY IS YOUR PREVENTIVE MAINTENANCE PROGRAM PREVENTING?

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Asphalt for Preventive Maintenance

HMA Ultra-Thin:

- Extends Pavement Service Life
- Protects the Pavement Structure
- Restores Pavement Smoothness
What does HMA Ultra-Thin do:

• Protects the pavement structure
• Adds structural value
• Corrects surface deficiencies
• Improves skid - resistance
• Improves ride quality (restores crown)

**HMA Ultra Thin**

<table>
<thead>
<tr>
<th>GUIDE SPECIFICATION FOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMA Ultra-Thin</td>
</tr>
</tbody>
</table>

1 of 4

a. **Description.** This special provision provides acceptance testing requirements for use on HMA Ultra-Thin Overlay mixture.

b. **Material.** The HMA and materials shall meet the following requirements:

1. Bond Coat. The bond coat material will be unclassified asphalt conforming to the requirements of Section 904 of the Michigan Department of Transportation (MDOT) 2003 Standard Specifications for Construction, Type 501.

2. HMA Ultra-Thin Overlay. The Ultra Thin HMA Overlay shall be composed of a mixture of aggregate, asphalt binder, and if required, mineral filler, as listed in Table 1.

<table>
<thead>
<tr>
<th>Table 1 - HMA Ultra-Thin Overlay Mixture Requirement:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter</td>
</tr>
<tr>
<td>Marshall Air Voids %</td>
</tr>
<tr>
<td>VMA % (max.) based on 5%</td>
</tr>
<tr>
<td>Fine Binder %</td>
</tr>
<tr>
<td>Max. Flow (0.01 m)</td>
</tr>
<tr>
<td>Stability Min. (lbf)</td>
</tr>
</tbody>
</table>

3. Aggregate Gradation and Physical Properties. The combined gradation of the aggregate portion of the mixture, including the mineral filler, shall be within the limits of Table 2. The physical properties of the combined aggregates shall meet the criteria of Table 3.

<table>
<thead>
<tr>
<th>Table 2 - HMA Ultra-Thin Overlay Aggregate Graduation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve Size</td>
</tr>
<tr>
<td>------------</td>
</tr>
<tr>
<td>¾ inch</td>
</tr>
<tr>
<td>3/4 inch</td>
</tr>
<tr>
<td>No. 4</td>
</tr>
<tr>
<td>No. 8</td>
</tr>
<tr>
<td>No. 20</td>
</tr>
<tr>
<td>No. 200</td>
</tr>
</tbody>
</table>

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## Table 4 - Asphalt Binder Selection for HMA Ultra-Thin Overlay

<table>
<thead>
<tr>
<th>Low Volume Comm. ADT</th>
<th>Medium Volume Comm. ADT</th>
<th>High Volume Comm. ADT</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;380</td>
<td>380 - 3400</td>
<td>&gt;3400</td>
</tr>
<tr>
<td>PG 64-22*</td>
<td>PG 64-28P**</td>
<td>PG 70-22P*</td>
</tr>
</tbody>
</table>

* In areas North of M-46, May use PG 58-28 (Low) or PG 70-28P (High)

** May use another “readily available” polymer modified (P) grade.
HMA Ultra Thin

Existing Pavement Conditions:

- Good cross section
- Good base, structurally sound
- Visible surface distress may include:
  - Moderate cracking, ≤ 1/2” wide
  - Raveling and surface wear
  - Slight to moderate flushing or polishing
  - Occasional patch in good condition
HMA Ultra Thin

4 – 6 Paser rating
# HMA Ultra Thin

<table>
<thead>
<tr>
<th></th>
<th>HMA UT</th>
<th>Chip Seal</th>
<th>Microsurfacing</th>
</tr>
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<tbody>
<tr>
<td>Increase skid resistance</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Minimizes curb loss</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Corrects surface distress</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Can be applied in one pass</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Increases structural strength</td>
<td>✔</td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Improves ride quality</td>
<td>✔</td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Improves pavement draining</td>
<td>✔</td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Corrects minor rutting</td>
<td>✔</td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Eliminates dust, loose aggregate</td>
<td>✔</td>
<td></td>
<td>✔</td>
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<tr>
<td>Minimizes delamination</td>
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# HMA Ultra Thin

## Prevention Maintenance Treatments Cost Comparison

<table>
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<tr>
<th>Treatment</th>
<th>$/syd</th>
<th>Cost/mile (24’ wide)</th>
<th>MDOT Life extension range* (years)</th>
<th>Life extension range average (years)</th>
<th>Cost/mile per year</th>
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<tr>
<td>Double chip seal</td>
<td>$2.58</td>
<td>$36,325</td>
<td>3-5</td>
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<td>5-9*</td>
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<tr>
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<td>$36,466</td>
<td>5-9*</td>
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</tr>
<tr>
<td>Ultra-thin high</td>
<td>$2.95</td>
<td>$41,534</td>
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<td>7</td>
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*Average Life Extension estimated by APAM Unit Prices based on MDOT Information as of Jan. 2011
# HMA Ultra Thin

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Asphalt for Preventive Maintenance

HMA Ultra-Thin:

• Extends Pavement Service Life
• Protects the Pavement Structure
• Restores Pavement Smoothness
Maintaining your roads with Asphalt

Asphalt is the popular solution to pavement maintenance. Asphalt overlays are economical, long-lasting, and effective in treating a wide variety of surface distresses to restore ride quality, skid resistance, and overall performance.
Maintaining your roads with Asphalt

Thank You!

Questions??

www.apa-mi.org

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