Thin Lift Asphalt Surfaces for Pavement Preservation
NCAT/FHWA NCAT/NAPA/FHWA
Outline

• Introduction
• Benefits  WHY?
• Project selection  WHEN?
• Mix design  HOW?
• Construction  HOW?
• Summary
What are thin lift asphalt pavements?

- 4.75 mm dense-graded
- 9.5 mm dense-graded
- 12.5 mm dense-graded
- 9.5 mm SMA
- 12.5 mm SMA
- 9.5 mm OGFC
- 12.5 mm OGFC
- Thin Bonded Wearing Course

- Less than/equal 0.75”
- Less than/equal 1.0”
- Less than/equal 1.25”
- Less than/equal 1.5”
- Less than/equal 2.0”
When thin lifts are used

- 7-10 years after new construction (preservation)
- Before pavement shows moderate/severe distress
- Temporary fix for poor pavement
- Any pavement, any time
NAPA Definition

Thinlays™ successfully extend the life of structurally sound pavements. Thinlays™ can be as thin as 5/8 inch and of greater thickness as surface conditions necessitate.
Unique thin lift mixes

State-specific mixtures
• Ohio – Smoothseal
• New Jersey – HPTO (high perf. thin overlay)
• Texas – TOM (thin overlay mix)

• Different mixtures?
• Different years of use?
• Different applications?
Thin Lift Asphalt Mixes

*dense graded mixtures* placed *1-inch thick or less*

- Common mixture type – dense graded
- Lower material cost – reduced thickness
- Conventional paving equipment
- Wide application potential
Benefits of thin lift surfaces

Why consider thin lift asphalt as a pavement preservation treatment?

- Improve smoothness
- Extend pavement performance
- Lower material cost
- Reduce noise
- Improve friction (limited)

Benefits vary by region and use (climate and traffic are key factors)
Asphalt mixture permeability

NCAT Report 03-02
NCAT Report 11-01
Benefits of thin lift surfaces

Compared with other preservation treatments

- Cost per square yard, per year of service
- Projected performance life
- Material and equipment availability
- Market competition
# Annual Cost of Preservation Treatment

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Expected Life, yrs</th>
<th>Range</th>
<th>Cost, $/SY</th>
<th>Range</th>
<th>Annual Cost, $/lane-mile</th>
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</thead>
<tbody>
<tr>
<td>Chip Seal</td>
<td>4.08</td>
<td>2.5 - 5</td>
<td>2.06</td>
<td>0.50 – 4.25</td>
<td>3,554.51</td>
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<tr>
<td>Slurry Seal</td>
<td>3.25</td>
<td>2 - 4</td>
<td>1.78</td>
<td>1.00 – 2.20</td>
<td>3,855.75</td>
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<tr>
<td>Microsurfacing</td>
<td>4.67</td>
<td>4 - 6</td>
<td>3.31</td>
<td>2.30 – 6.75</td>
<td>4,989.81</td>
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<td>Thin Surfacing</td>
<td>10.69</td>
<td>7 - 14</td>
<td>4.52</td>
<td>2.40 – 6.75</td>
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## SHRP2 Survey

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Initial Cost ($/SY)</th>
<th>Expected Life (yrs)</th>
<th>Annualized Cost ($/SY)</th>
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<tbody>
<tr>
<td>Chip Seal</td>
<td>1.50-2.00</td>
<td>3-7</td>
<td>0.35 NAPA</td>
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<tr>
<td>Microsurface</td>
<td>1.50-2.00</td>
<td>3-6</td>
<td>0.50 0.71</td>
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<td>Slurry Seal</td>
<td>0.75-1.00</td>
<td>3-5</td>
<td>0.22 0.55</td>
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<td>Thin Overlay</td>
<td>3.00-6.00</td>
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Mix Selection Based on Benefits

<table>
<thead>
<tr>
<th>traffic</th>
<th>High volume high speed HIGHWAYS</th>
<th>High volume low speed URBAN ARTERIAL</th>
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<tbody>
<tr>
<td>Climate</td>
<td>Wet Frz</td>
<td>Wet No frz</td>
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<tr>
<td>Extend pavement service life</td>
<td>S,U</td>
<td>D</td>
</tr>
<tr>
<td>Improve Ride (milling ?)</td>
<td>S,U</td>
<td>D</td>
</tr>
<tr>
<td>Eliminate Rutting (milling ?)</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Seal Surface cracking</td>
<td>U</td>
<td>D</td>
</tr>
<tr>
<td>Improve Friction</td>
<td>S,U</td>
<td>D,s</td>
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<tr>
<td>Thin lift mixture types</td>
<td>D=Dense, S=SMA, O=OGFC, U=UTBWC</td>
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</tbody>
</table>

D=Dense, S=SMA, O=OGFC, U=UTBWC
## Mix Selection Based on Benefits

<table>
<thead>
<tr>
<th>traffic</th>
<th>Low volume, high speed RURAL TWO-LANE</th>
<th>Low volume, low speed RESIDENTIAL</th>
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</thead>
<tbody>
<tr>
<td>Climate</td>
<td>NE Wet frz</td>
<td>SE Wet No frz</td>
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<tr>
<td>Extend pavement service life</td>
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Roadway System in the US

http://www.fhwa.dot.gov/policyinformation/statistics.cfm
Why use thin lifts for pavement preservation?

NAPA website
http://www.asphaltpavement.org

• improved ride quality
• reduce pavement surface distresses
• maintain surface geometrics
• reduce noise levels
• reduce life-cycle costs
• provide long-lasting service
Pavement Management

1. Pavement data collection
2. Pavement condition assessment
3. Maintenance/Rehab required?
   - YES
   - NO
5. Construction
4. Select preferred alternatives
   - Examine life-cycle costs
   - Consider non-monetary factors
Selecting the Proper Fix

Pavement Condition

- Good
- Fair
- Poor

Time / Traffic

Preservation

Rehabilitation

Terminal Service Life
Selecting Projects in PMS

1. Pavement data collection
2. Pavement condition assessment
3. Examine life-cycle costs
4. Select preferred alternatives
   - Examine life-cycle costs
   - Consider non-monetary factors
5. Construction

Options:
- Reconstruction
- Rehabilitation
- Preservation

Flowchart:
- (1) Pavement data collection → (2) Pavement condition assessment
- If NO, then RECONSTRUCTION → REHABILITATION → PRESERVATION
- If YES, then CONSTRUCTION
- (4) Select preferred alternatives
- (5) Construction
Project Selection Process

Key selection factors

- Pavement structural condition
- Pavement smoothness
- Visible pavement distress
- Safety considerations
Project Selection Process

When should pavement preservation be selected?

- Pavement structural condition - good
- Pavement smoothness – good to fair
- Visible pavement distress - low
- Safety considerations – good to moderate
Project Selection Process

When should pavement preservation **NOT** be selected?

- Pavement structural condition – fair to poor
- Pavement smoothness – poor
- Visible pavement distress – moderate to severe
- Safety considerations – poor
Lee Road 159 – NCAT study
Progression of cracking in control section
Wheel path cracking

Wheel path cores
Mix Design of Thin Lifts

What are key mixture factors?

- Aggregate
- Asphalt Binder
- Mixture criteria
- Adding RAP

How is each factor the same and/or different from conventional dense-graded mixture?
Mix Design

Key mixture factor – AGGREGATE

- **Same** as conventional
  - Most requirements are the same

- **Different** from conventional (4.75 mixes)
  - Typically uses two stockpiles
  - Higher dust target (6-13% passing No 200)
  - Higher FAA (for <3M ESAL)
  - Friction requirements?
Mix Design

Key mixture factor – ASPHALT BINDER

- **Same** as conventional
  - Climate range is important

- **Different** from conventional
  - Often uses a modified binder to resist rutting
  - Can use a modified binder to delay reflective cracks
Mix Design

Key mixture factor – MIXTURE CRITERIA

- **Same** as conventional
  - Still based on good volumetric design

- **Different** from conventional (4.75 mixes)
  - Va for 4.75 mix design is 4-6%
  - VFA slightly higher
  - Dust-to-Binder higher 1.0-2.0 (was 0.6-1.2)
Mix Design

Key mixture factor – Adding RAP

- **Same** as conventional
  - RAP can be added

- **Different** from conventional
  - Fractionate RAP – use small particle size
Construction of Thin Lifts

Key construction factors

- Handling fine aggregate
- Cold feed
- Tack coat
- Lift thickness
- Compaction
- Field density
- Smoothness
Construction

Key construction factor – Handling fine aggregate

- Stockpiles retain high moisture
- Higher moisture slows plant production
Construction

Key construction factor – Cold Feed

- Use at least two bins for each primary stockpile

Example:

Bin 3  35% Aggr-B
Bin 2  35% Aggr-B
Bin 1  30% Aggr-A
Construction

Key construction factor – Placing tack coat

- Correct application rate
- Uniform spray distribution
Construction

Key construction factor – Lift thickness

- Lift thickness: NMAS ratio under 3:1 used
  - 9.5 mm mix placed 1 inch thick
- Continuous and uniform paving operation
Construction

Key construction factor – Compaction

- Do not use vibratory compaction
- Window of time is limited for thin lifts

MULTICOOL3.0 Output

- 1.5 thk, 75F air, 5 wind, 80F pave
- 0.75 thk, 75F air, 5 wind, 80F pave
- 0.75 thk, 90F air, 0 wind, 100F pave
Construction

Key construction factor – Field Density

- Cannot use density measurement
- Specify rolling pattern
Construction

Key construction factor – Smoothness

- A single thin lift may reduce roughness by 60%
Thin Lift Asphalts are a cost-effective pavement preservation alternative when:

- Appropriate project selection
- Proper mix design
- Timely construction
- Quality construction
Roadway System in the US

- Local agency pavement network is 80% of the total network
- State agency network carries 85% of the vehicle-miles
Points to remember

- When to use
  - Select a sound pavement
  - Mill existing surface to improve ride

- Mixture requirements
  - Mixture requires higher binder content
  - Use a minimum of two aggregate stockpiles
  - Fractionate the RAP, use small size stockpile
Points to remember

- Construction practices
  - Surface preparation and tack coat are critical
  - Higher stockpile moisture lowers production rate
  - Short compaction window in cold temperatures
  - Modify field density QC

- Benefits
  - Cost-effective preservation alternative
Questions?