Today’s Presenters

• **Moderator**
  Julie Kliewer, Arizona DOT

• **Thin Asphalt Concrete Overlays**
  Don Watson, National Center for Asphalt Technology

• **Selecting the Right Mix for the Right Conditions**
  Michael Heitzman, National Center for Asphalt Technology
NCHRP is...

A state-driven national program

- The state DOTs, through AASHTO’s Standing Committee on Research...
  - Are core sponsors of NCHRP
  - Suggest research topics and select final projects
  - Help select investigators and guide their work through oversight panels
NCHRP delivers...

Practical, ready-to-use results

- Applied research aimed at state DOT practitioners
- Often become AASHTO standards, specifications, guides, manuals
- Can be directly applied across the spectrum of highway concerns: planning, design, construction, operation, maintenance, safety
A range of approaches and products

- Traditional NCHRP reports
- Syntheses of highway practice
- IDEA Program
- Domestic Scan Program
- Quick-Response Research for AASHTO
- Other products to foster implementation:
  - Research Results Digests
  - Legal Research Digests
  - Web-Only Documents and CD-ROMs
NCHRP Webinar Series

- Part of TRB’s larger webinar program
- Opportunity to interact with investigators and apply research findings.
Today’s First Presenter

• Thin Asphalt Concrete Overlays
  Don Watson, National Center for Asphalt Technology
Thin Asphalt Concrete Overlays
NCHRP Synthesis 464

TRB Webinar
June 20, 2016
Outline

- Purpose/Scope
- Use
- Design and Construction
- Performance, Maintenance, Rehab
- Case Studies
- Conclusions
Purpose/Scope

- Document current experience/research
  - Literature review
  - Agency/industry survey
    - 43 States
    - 8 Private Industry companies
Advantages of Thin Overlays

• Provides long service life (when placed over structurally sound pavements)
• Provides good riding surface
• Reduces noise (fine-graded mixes)
• Maintains grade and slope geometry
• Is easily maintained
• Is recyclable
Previous Research

- NAPA – (Newcomb, 2009) IS 135
- Zubek – Cold Regions, 2012
- Montana – (Cuelho, 2006)
- NCHRP Synthesis 222 – (Zimmerman, 1995)

Project/Treatment selection
NAPA Information Series 135

- Character of pavement construction has changed
- Thin Overlays meet a funding need
- New technologies and improved materials extend service life
Zubek- Cold Regions

- Thin overlays common for roads with heavy studded-tire use
- Average service life in such environment – 6 yrs
## Montana Survey

<table>
<thead>
<tr>
<th>Preventive Maintenance Treatment</th>
<th>Average Service Life (Years)</th>
<th>Cost per Lane Mile (12 feet wide)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thin Overlay</td>
<td>8.4</td>
<td>$14,600</td>
</tr>
<tr>
<td>Double Chip Seal</td>
<td>7.3</td>
<td>$12,600</td>
</tr>
<tr>
<td>Microsurfacing</td>
<td>7.4</td>
<td>$12,600</td>
</tr>
<tr>
<td>Slurry Seal</td>
<td>4.8</td>
<td>$6,600</td>
</tr>
</tbody>
</table>
Most important basis for treatment selection—find treatment that most effectively addresses deficiencies

Automated models used for “what if” scenarios
Types of Thin Overlays

- 9.5 and 12.5mm Superpave
- 9.5 and 12.5mm SMA
- UTBWC
  - Arkansas
  - Illinois, Kansas, Louisiana, Minnesota, Vermont
- 4.75mm Superpave and SMA
- OGFC/PFC
## NCAT Pavement Preservation Study

<table>
<thead>
<tr>
<th>Section</th>
<th>18</th>
<th>19</th>
<th>20</th>
<th>21</th>
<th>22</th>
<th>23</th>
<th>24</th>
<th>25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td>4.75/PG 67-22</td>
<td>4.75/PG 67-22</td>
<td>4.75/PG 76-22</td>
<td>4.75/PG 76-22</td>
<td>UTBWC</td>
<td>4.75 50% RAP</td>
<td>4.75 5% Shingles</td>
<td>4.75 PG 88-22</td>
</tr>
<tr>
<td>Subsurface</td>
<td>Fibermat</td>
<td>Existing</td>
<td>Full-Depth Reclamation</td>
<td>Existing</td>
<td>Existing</td>
<td>Existing</td>
<td>Existing</td>
<td>Existing</td>
</tr>
</tbody>
</table>
Where are Thin Overlays Used?

Percent of Responses

Interstate | Pri.-Sec. | Local | Low Traffic

0 | 35 | 20 | 25
Are Thin Overlays Typically Used?

![Bar Chart]

- Yes: [Bar]
- No: [Bar]

Percent of Responses
PennDOT Use of Thin Overlays
Where Not To Use Thin Overlays
Use of Thin Overlays

Pavements that are failing, or have already failed, cannot be successfully treated with a thin overlay alone.
Design and Construction

- Aggregate – Superpave quality standards
- Binder – Often modified
- Compaction level – 50 gyrations, locking point, other
- Testing constraints
Maximum RAP Allowed

<table>
<thead>
<tr>
<th>Percent of Responses</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>15%</td>
<td>25%</td>
<td>40%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Percent of Responses

0 | 10 | 20 | 30 | 40 |
---|----|----|----|----|
None | 15% | 25% | 40% |
40%
Typical Thickness

Percent of Responses

NMAS

1.5 x

2 x

3 x
RAP May Need to be Fractionated
Beneficial to Keep Aggregate Dry

1% increase in moisture = 10-12% increase in drying cost while reducing production about 11%.
Surface Preparation is Critical
Thin Overlays Can Improve Smoothness

As a general rule, only 40-60% improvement in ride quality can be expected with a single layer of asphalt mix.
Performance, Maintenance, Rehab

How Service Life is Monitored

% of Responses

0% 5% 10% 15% 20% 25% 30% 35% 40% 45%

Threshold Values  Performance Curves  Video Log  Manual Survey
Maintenance
(Fog Seal/Rejuvenator Application)

Application Rate

Responses

<table>
<thead>
<tr>
<th>Application Rate</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Rate</td>
<td>20%</td>
</tr>
<tr>
<td>Based on Distress</td>
<td>10%</td>
</tr>
<tr>
<td>Not Used</td>
<td>70%</td>
</tr>
</tbody>
</table>
Service Life

- LTPP Data (Liu, 2013)
  - 341 Thin Overlay Sections
  - 40 States, 8 Canadian Provinces
- Median life expectancy – 7 to 9.5 years
Service Life

<table>
<thead>
<tr>
<th>Years</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5</td>
<td>10%</td>
</tr>
<tr>
<td>5-8</td>
<td>35%</td>
</tr>
<tr>
<td>8-10</td>
<td>20%</td>
</tr>
<tr>
<td>10-12</td>
<td>15%</td>
</tr>
<tr>
<td>&gt; 12</td>
<td>5%</td>
</tr>
</tbody>
</table>
Explanations for Range in Service Life

Environmental Differences
Explanations for Range in Service Life

Construction Quality Standards - Interstate versus Secondary
Explanations for Range in Service Life

Variation in material quality
Explanations for Range in Service Life

Temporary Fix
Cost/Benefit of Preservation Treatments

- Wang, 2012 – 29 state agencies
  - Thin Overlays cost more initially
  - Extended pavement life the longest
- Oregon (Parker, 1993) – 87 sites within state
  - Thin overlays most cost-effective
  - Particularly more effective for heavy traffic
## Bid Prices for Preservation Treatments

### Microsurfacing

<table>
<thead>
<tr>
<th>Year</th>
<th>4.75 mm NMAS</th>
<th>4.75 mm NMAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>2.02</td>
<td>2.02</td>
</tr>
<tr>
<td>2011</td>
<td>2.41</td>
<td>2.41</td>
</tr>
<tr>
<td>2009</td>
<td>2.15</td>
<td>2.15</td>
</tr>
</tbody>
</table>
Case Studies - Ohio
Mileage vs Service Life of Thin Overlays

Total Miles = 4075.2
No. of Projects = 764
Mean = 9.1 years
Case Studies - Louisiana

- Compared UTBWC to Conventional Overlay
  - UTBWC – 0.75 inch Thick
  - Conventional – 3.5 inch thick
- UTBWC would save $3.34/sy
- Consider UTBWC for new or surface rehab, concrete overlays, alternate to mill/fill
Case Studies - Georgia
Tips for Successful Practice

- Select the right candidate
  - Condition of existing structure is critical
  - Target resurfacing before structural failure
- Adequate tack coat is critical
- Avoid coarse mixes with low AC
- Avoid <1 in for turn lanes and intersections
- Avoid placement rate that is too thin
Conclusions

- Thin overlays routinely used as preservation tool
- Thin overlays are economical/competitive
- Success depends on existing distresses
- Service life generally in 7 – 11 year range
NCHRP Synthesis 464
Thin Asphalt Concrete Overlays
“Selecting the Right Mix for the Right Conditions”

Webinar
June 20, 2016
Outline

- Defining thin asphalt concrete
- Factors influencing mix selection
- Pavement condition categories
- Selection process
Defining thin asphalt concrete

- OGFC/PFC
- UTBWC
- SMA (12.5, 9.5)
- Dense Graded (12.5, 9.5 and 4.75)
- Unique Agency Mixes
4.75mm Dense

12.5mm OGFC
Thin Overlay Thickness

<table>
<thead>
<tr>
<th>Thin Overlay Thickness (in)</th>
<th>Synthesis Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;2.0</td>
<td>2</td>
</tr>
<tr>
<td>1.5-2.0</td>
<td>5</td>
</tr>
<tr>
<td>1.0-1.5</td>
<td>16</td>
</tr>
<tr>
<td>0.75-1.5</td>
<td>16</td>
</tr>
<tr>
<td>≤1.0</td>
<td>17</td>
</tr>
<tr>
<td>≤0.75</td>
<td>6</td>
</tr>
</tbody>
</table>
NAPA Thinlays™ Definition

- NAPA 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.
Factors Influencing Mix Selection

- Type of route
- Traffic
- Climate
- Pavement condition
- Desired pavement performance
- Cost-effective
- Availability
Factors Influencing Mix Selection

- Type of route
  - Rural / Urban
  - Residential / Commercial / Industrial
- Traffic
  - Volume
  - Speed
Factors Influencing Mix Selection

- Climate
  - Temperature (no freeze / freeze)
  - Precipitation (dry / wet)
Factors Influencing Mix Selection

- Pavement Condition
  - Type of distress
    - Rutting
    - Fatigue cracking
    - Thermal cracking
  - Extent of distress
    - Unit of measure per lane length
  - Severity of Distress
    - Low / moderate / high
Factors Influencing Mix Selection

- Desired Pavement Performance
  - Short-term “stop-gap” versus long-term “optimum”
  - Ride quality
  - Safety
  - Structure
Factors Influencing Mix Selection

- Cost-Effective
  - Use of pre-overlay actions
    - crack sealing/filling
    - patching
    - milling
  - traffic control costs
  - Compare to other preservation treatment options
    - Cost/year service
    - Performance (ride, safety, noise)/year service
Defining Service Life

Existing pavement performance; (“Do-Nothing”)

Performance of Pavement Preservation Treatment

Target Service Condition

Service Life Benefit

Service Life Extension

Good

Fair

Poor

Time
Factors Influencing Mix Selection

- Availability
  - Materials
    - Aggregate
    - Binder / emulsion
  - Equipment
    - Conventional asphalt paving
    - Slurry truck, chip spreader
- Experience (agency, contractor, performance)
Spray Paver for UTBWC
Slurry Paving
Pavement Condition Categories

- Maintenance (isolated distress)
  - Thin asphalt overlay is not cost-effective
- Preservation (low distress)
  - Thin asphalt overlay is cost effective alternative
- Rehabilitation (moderate distress)
  - Thin asphalt surface may be part of rehabilitation package
Pavement Condition Categories

- Type/extent/severity of distress
  - Rutting (construction, asphalt mixture, pavement structure)
  - Fatigue (Bottom-up)
  - Fatigue (Top-down)
  - Thermal cracking (asphalt binder)
  - Reflective cracking
Pavement Condition Categories

- type/extent/severity of distress
  - Safety (friction, geometry)
  - Ride (construction or lagging indicator)
  - Raveling/moisture (construction, mixture)
  - Block cracking (age/oxidation)
Lee Road 159 – NCAT Study
## Performance Measures (Purdue Study)

<table>
<thead>
<tr>
<th>Performance Indicator</th>
<th>Roughness (IRI)</th>
<th>Condition (PCR)</th>
<th>Rut Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threshold Used</td>
<td>110 in/mi (1.74 m/km)</td>
<td>85</td>
<td>0.25 in (6 mm)</td>
</tr>
<tr>
<td>Expected Life (Yrs.)</td>
<td>7 - 10</td>
<td>7 - 11</td>
<td>8 - 11</td>
</tr>
</tbody>
</table>
Selection Process

- Type of Route (use)
- Traffic (speed and volume)
- Climate (fixed for some regions, variable for other regions)
- Current Pavement Condition
- Desired Performance (often to correct distress)
Project/Treatment Selection Strategies (NCHRP Synthesis 222)

- Current condition rating
- Prediction models (“What if” scenario)
- Network Optimization models
- Find treatment that addresses deficiencies (may be affected by local policies/mandates)


Ohio Decision Tree

PCR ≥ 80

| Y | Bin G120 Do Nothing |
| N | Bin G121 Activity 60 |

PCR <55
Or
Str. Ded.≥20

| Y | Bin G121 Activity 60 |
| N | Bin G122 Activity 60 |

ADT ≥5000
Or
ADTT ≥750

| Y | Bin G122 Activity 60 |
| N | Bin G123 Activity 30, 31, 38, or 50 |

Distress Check D
1) Raveling= MF,ME,HF,HE or
2) Bleeding= HF,HE or
3) Patching= LF,LE,LF,ME,HF,HE or
4) Surface Debond= LF,LE,MO,LF,ME,HO,HF,HE or
6) Rutting= ME,HF,HE or
9) Wheel Track Crack= MF,ME,HF,HE or
10) Block & Transverse Crack= ME,HF,HE or
11) Longitudinal Crack= ME,HE or
12) Edge Cracking= LE,LF,ME,HF,HE or
14) Thermal Cracking= MF,ME,HF,HE or
15) Potholes= LE,ME,ME,HF,HE

Bin G124 Activity 38 or 50
# Thin Asphalt Mix Selection

<table>
<thead>
<tr>
<th>Traffic</th>
<th>High volume, high speed HIGHWAYS</th>
<th>High volume, low speed URBAN ARTERIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dry Frz</td>
<td>Wet Frz</td>
</tr>
<tr>
<td>Climate</td>
<td>Precipitation Temperature</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dry</td>
<td>Wet</td>
</tr>
<tr>
<td>Extend Service Life</td>
<td>S,U</td>
<td>S,U</td>
</tr>
<tr>
<td>Improve Ride</td>
<td>S,U</td>
<td>S,U</td>
</tr>
<tr>
<td>Eliminate Rutting</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Seal Surface Cracks</td>
<td>U</td>
<td>U</td>
</tr>
<tr>
<td>Improve Friction</td>
<td>S,U</td>
<td>S,U</td>
</tr>
</tbody>
</table>

**Mixture Types**
D=Dense, S=SMA, O=OGFC, U=UTBWC
# Thin Asphalt Mix Selection

<table>
<thead>
<tr>
<th>Traffic</th>
<th>Low volume, high speed RURAL TWO-LANE</th>
<th>Low volume, low speed RESIDENTIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Climate</strong></td>
<td><strong>Precipitation</strong></td>
<td><strong>Temperature</strong></td>
</tr>
<tr>
<td></td>
<td>Dry Frz</td>
<td>Wet Frz</td>
</tr>
<tr>
<td></td>
<td>Dry No frz</td>
<td>Wet No frz</td>
</tr>
<tr>
<td></td>
<td>Dry Frz</td>
<td>Wet Frz</td>
</tr>
<tr>
<td></td>
<td>Dry No frz</td>
<td>Wet No frz</td>
</tr>
<tr>
<td><strong>Extend service life</strong></td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td><strong>Improve Ride</strong></td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td><strong>Eliminate Rutting</strong></td>
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<td>S</td>
</tr>
<tr>
<td><strong>Seal Surface Cracks</strong></td>
<td>D</td>
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</tr>
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<td>S</td>
<td>S</td>
</tr>
<tr>
<td><strong>Mixture Types</strong></td>
<td>D=Dense, S=SMA, O=OGFC, U=UTBWC</td>
<td></td>
</tr>
</tbody>
</table>
Right Mix, Right Conditions

- Selection Process must consider:
  - Traffic
  - Climate
  - Pavement condition
  - Intended pavement performance
  - Available thin asphalt concrete mixtures

Build a selection process for agency conditions.