Flexible Pavement Preservation
Industry Perspective
Rod Birdsall, P.E.
PRDOT PP Conference – 11.15.2011
ASMG Family of Companies
ASMG Locations
Outline of Presentation

• What is Pavement Preservation
• Why Pavement Preservation
• Components of Successful Projects
• How do we do it
• How do we sell it
• What is in it for the Agency
• What is in it for the Contractor
• Summary
What is Pavement Preservation

- A **Planned Network Strategy** of Treating Pavements in **Good Condition** to **Maximize their Useful Life** as **Cost Effective as Possible**
Planned Network Strategy of Treating Pavements

- Network Level
- Proactive not Reactive
- Pavement Management System is Critical
  - Can be simple or detailed
- Long Term Thinking/Planning
- Remaining Service Life of Pavement
In Good Condition to Maximize Life

• Keep Good Roads in Good Condition
• Preventative Maintenance rather than Corrective Maintenance
• Planned early Strategies
• Timing of Treatment is Critical
• **GOAL** - Improve Condition Rating of Network
Cost Effective

• Annualized Cost not Initial Cost
• Must evaluate all alternative Treatments
• Must determine service life of Treatment
• Service Life is a function of project selection and Treatment applied
• Annualized Cost = Initial Cost / Service Life
• Optimize Budget Dollars
Life of a Pavement

$1 of preventive maintenance here..

Eliminates or delays spending $8 - $10 on rehabilitation here.

40% Drop in Quality

75% of Life

40% Drop in Quality

12% of Life

PCI (Pavement Condition Index)
Asphalt Deterioration Curve

Applying the Right Treatment, to the Right Road, at the Right Time...

1. Fog Seal Rejuvenation
2. Slurry Seal, Chip Seal or Microsurfacing (Single)
3. Chip Seal or Microsurfacing (Double)
4. Cape Seal; AR SAM/SAMI
5. HMA Overlay; Bonded Pavements
6. Mill & HMA Overlay
7. In-Place Recycling & Overlay
8. Full Depth Reconstruction
9. Crack Filling (as needed)
## NHDOT
### 2011 Equivalent Annual Pavement Management Costs

<table>
<thead>
<tr>
<th>Treatment Alternative</th>
<th>2011 Approx. Costs</th>
<th>Estimated Service Life</th>
<th>Equivalent Annual Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micro or 4.75mm HMA</td>
<td>$22,810</td>
<td>$3.24</td>
<td>$0.54</td>
</tr>
<tr>
<td>Double Chip Seal</td>
<td>$28,301</td>
<td>$4.02</td>
<td>$0.57</td>
</tr>
<tr>
<td>3/4&quot; Paver Shim</td>
<td>$25,281</td>
<td>$3.59</td>
<td>$0.60</td>
</tr>
<tr>
<td>1&quot; HBP Overlay</td>
<td>$33,708</td>
<td>$4.79</td>
<td>$0.60</td>
</tr>
<tr>
<td>Chip Seal</td>
<td>$21,120</td>
<td>$3.00</td>
<td>$0.60</td>
</tr>
<tr>
<td>15% AR Chip Seal</td>
<td>$35,482</td>
<td>$5.04</td>
<td>$0.63</td>
</tr>
<tr>
<td>1-1/2&quot; HBP Overlay</td>
<td>$50,561</td>
<td>$7.18</td>
<td>$0.72</td>
</tr>
<tr>
<td>1-1/2&quot; HBP Inlay</td>
<td>$67,457</td>
<td>$9.58</td>
<td>$0.96</td>
</tr>
<tr>
<td>FDR with 4&quot; HBP</td>
<td>$147,502</td>
<td>$20.95</td>
<td>$1.40</td>
</tr>
<tr>
<td>2&quot; TW Inlay with 1-1/2&quot; FW Overlay</td>
<td>$134,872</td>
<td>$19.16</td>
<td>$1.47</td>
</tr>
<tr>
<td>4&quot; CIP with 3&quot; HBP Overlay</td>
<td>$156,035</td>
<td>$22.16</td>
<td>$1.48</td>
</tr>
</tbody>
</table>

**Notes:**
1. Costs per lane mile based on 12-foot lane width.
2. Costs shown here include a 20% multiplier to account for fixed costs.
### Equivalent Annual Cost by Strategy

#### Preservation or Repair Strategy from NYBIT

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Cost/SY/Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fog Seal Rejuvenation</td>
<td>$0.33</td>
</tr>
<tr>
<td>1/4&quot; Chip Seal (CRS-2 emulsion)</td>
<td>$0.36</td>
</tr>
<tr>
<td>3/8&quot; Chip Seal (CRS-2 emulsion)</td>
<td>$0.36</td>
</tr>
<tr>
<td>15 lbs/s/y. Quick Set Slurry Seal</td>
<td>$0.41</td>
</tr>
<tr>
<td>Cape Seal (3/8&quot; chip seal, plus 25 lb. slurry)</td>
<td>$0.49</td>
</tr>
<tr>
<td>Paver Placed Surface Treatment</td>
<td>$0.52</td>
</tr>
<tr>
<td>1-3/4&quot; Hot Mix Asphalt Overlay</td>
<td>$0.66</td>
</tr>
<tr>
<td>1-3/4&quot; Mill &amp; Hot Mix Overlay</td>
<td>$0.73</td>
</tr>
<tr>
<td>Cold In-Place Recycling with 2&quot; HMA Pavement</td>
<td>$0.91</td>
</tr>
<tr>
<td>Full Depth Stabilized Reclamation with 4&quot; HMA Pavement</td>
<td>$1.07</td>
</tr>
<tr>
<td>2&quot; Cold In-Place Repair with 2&quot; HMA Pavement</td>
<td>$1.20</td>
</tr>
<tr>
<td>4&quot; Full Depth Stabilized Reclamation with 4&quot; HMA Pavement</td>
<td>$1.25</td>
</tr>
</tbody>
</table>
Remaining Service Life

- **RSL = 9 years**
- **RSL = 4 years**
- **RSL = 12 years**
- **RSL = 2 years**

**Terminal Threshold**
- 5 year life ext.
- 10 year life extension

**Time (Years)**
- 0
- 5
- 10
- 15
- 20
- 30

**Distress Index (DI)**
- 0
- 20
- 40
- 60
- 80
- 100
Two ALF’s with 12 Pavement Lanes Constructed in the Summer and Fall of 2002
## ALF Project Test Sections

<table>
<thead>
<tr>
<th>CRMA</th>
<th>70-22</th>
<th>AB</th>
<th>SBS</th>
<th>TB</th>
<th>CR</th>
<th>Elvo</th>
<th>70-22</th>
<th>SBS</th>
<th>AB</th>
<th>SBS</th>
<th>Elvo</th>
</tr>
</thead>
<tbody>
<tr>
<td>70-22</td>
<td></td>
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</tr>
</tbody>
</table>

1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
Percentage of Area Cracked vs. ALF Wheel Load Passes
<table>
<thead>
<tr>
<th>Lane</th>
<th>Treatment</th>
<th>Mileage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lane 1</td>
<td>CR-AZ</td>
<td>300,000</td>
</tr>
<tr>
<td>Lane 2</td>
<td>Control</td>
<td>100,000</td>
</tr>
<tr>
<td>Lane 3</td>
<td>Air Blown</td>
<td>100,000</td>
</tr>
<tr>
<td>Lane 4</td>
<td>SBS LG</td>
<td>300,000</td>
</tr>
<tr>
<td>Lane 5</td>
<td>CR-TB</td>
<td>100,000</td>
</tr>
<tr>
<td>Lane 6</td>
<td>TP</td>
<td>200,000</td>
</tr>
</tbody>
</table>
Integrating Preservation into Design:
A Beginning with Top Down Cracking

nelson.gibson@dot.gov
Objectives

• Illustrate well-documented cases of top-down fatigue cracking
  – Reflect on the mechanisms
  – Compare and contrast with classical bottom-up cracking

• Illustrate delay of top-down fatigue cracking with thin overlay
Objectives

• Stimulate a discussion on research needs
  – Transportation System Preservation Research, Development, and Implementation Roadmap
  – Positive direction of NCHRP 1-42 and 1-42(A)
  – Initiation more key than propagation??

• Goal: Apply 1-42(A) and future techniques to preservation selection and timing
Objectives

• All of the activity is at the surface where preservation is applied
  – Aging is key – can not address top-down cracking without considering aging
Extracted Binder Rheology

• Use of Toluene solvent rather than TCE

• Top 1-inch and bottom 1-inch

• More cores to obtain sufficient binder for CTOD characterization as well as DSR $|G^*|$ and phase angle
• Top-Down Cracking Contributing Factors from NCHRP 1-42, Phase I
  – **Mix Properties**: high stiffness, low fracture resistance, poor low temperature properties, moisture susceptible, compactability/permeability
  – **Load Related**: distortional tensile and shear stresses at surface and near surface
  – **Environmental**: age hardening, oxidation, moisture damage, thermal stresses, thermal/stiffness gradients
  – **Structural**: pavement thickness(?)
  – **Construction**: segregation, compaction
Why Pavement Preservation?

- Keep ‘GOOD’ pavements in “Good” Condition
- Corrects minor surface deficiencies
- Preserves the pavement system
- Retards water intrusion and future deterioration
- Maintains or improves the functional condition of the pavement system
- $$$ Saves Budget Dollars.
Benefits of Pavement Preservation

• Financial

• Environmental

• User Satisfaction
Benefits of Pavement Preservation

Financial

- Extending pavement life to preserve investment in pavement
- More predictable system maintenance costs
- Lower long term lifecycle costs
- Better use of Budget Funds
Progressive Pavement Management

**Preservation vs. Rehabilitation**

**Preservation Strategy:**
- Years 3 & 38: Rejuvenation
- Years 8 & 43: Microsurfacing (Single)
- Years 15 & 50: Microsurfacing (Double)
- Year 25: Cape Seal
- Year 35: 1-3/4” Hot Mix Overlay

**Total Cost/SY over 50 years = $28.65**

**Rehabilitation Strategy:**
- Year 15: CIPR with 2” HMA Overlay
- Year 30: CIPR with 2” HMA Overlay
- Year 45: CIPR with 2” HMA Overlay

**Total Cost/SY over 50 years = $48.00**

**Note:** The graph illustrates the condition of pavement over time under different management strategies.
Benefits of Pavement Preservation

Environmental

• Requires fewer natural resources – aggregates, petroleum products
• Less energy usage
• Less greenhouse gas emissions
• Less worker fatigue and exposure
Energy Consumption per Ton of Laid Material

- Chip Seal
- Microsurfacing
- Hot Mix Asphalt
- Full Depth

Energy (MJ)

- Laying
- Transport
- Manufacture
- Aggregates
- Binders
GHG Emissions per Ton of Laid Material

Chip Seal

Microsurfacing

Hot Mix Asphalt

Full Depth Reclamation w/HMA (Composite)
### Energy Consumption

**Microsurfacing vs. HMA**

*For 1 Mile of Highway (2 Lanes) - 1 application each*

<table>
<thead>
<tr>
<th>Method</th>
<th>Tons</th>
<th>Energy</th>
<th>Total*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microsurfacing</td>
<td>225</td>
<td>460/tn</td>
<td>103,500</td>
</tr>
<tr>
<td>Hot Mix Asphalt</td>
<td>1188</td>
<td>670/tn</td>
<td>795,960</td>
</tr>
</tbody>
</table>

**Advantage of Preservation**
- *a reduction of* 87.00%
- *(per application)*

*For 50 Years of Maintenance*

<table>
<thead>
<tr>
<th>Method</th>
<th>Times Needed</th>
<th>Total*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microsurfacing</td>
<td>6.25</td>
<td>646,875</td>
</tr>
<tr>
<td>Hot Mix Asphalt</td>
<td>4.55</td>
<td>3,621,618</td>
</tr>
</tbody>
</table>

**Advantage of Preservation**
- *a reduction of* 82.14%
- *(over 50 years)*

*Energy is Measured in Megajoules*
Greenhouse Gas Emissions
Microsurfacing vs. HMA

For 1 Mile of Highway (2 Lanes) - 1 application each

<table>
<thead>
<tr>
<th>Method</th>
<th>Tons</th>
<th>GHG (kg/tn)</th>
<th>Total*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microsurfacing</td>
<td>225</td>
<td>35/tn</td>
<td>7,875</td>
</tr>
<tr>
<td>Hot Mix Asphalt</td>
<td>1188</td>
<td>55/tn</td>
<td>65,340</td>
</tr>
</tbody>
</table>

Advantage of Preservation
- A reduction of 87.95%

For 50 Years of Maintenance

<table>
<thead>
<tr>
<th>Method</th>
<th>Times Needed</th>
<th>Total*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microsurfacing</td>
<td>6.25</td>
<td>49,219</td>
</tr>
<tr>
<td>Hot Mix Asphalt</td>
<td>4.55</td>
<td>297,297</td>
</tr>
</tbody>
</table>

Advantage of Preservation
- A reduction of 83.44%

*GHG Emissions are Measured in Kilograms and include CO2 and other miscellaneous greenhouse gases.
Benefits of Pavement Preservation

User Satisfaction

• Better overall system condition
• Reduced vehicle damage and construction delays
• Some techniques improve ride and reduce noise
• Improved aesthetics
• Projects are quicker to complete than reconstruction
How do you Implement a Pavement Preservation Program?

- Fill up your Toolbox
- Look at alternatives
- Be receptive to new ideas and applications
- Commit to a Pavement Preservation Management System
- Partner with your Suppliers/Contractors
Pavement Preservation Tools

- Crack Sealing
- Fog Seal/Rejuvenation
- Chip Seal
- Quick Set Slurry
- Microsurfacing
- FiberMat®
- AR SAM/SAMI
- Thin Bonded Wearing
- Single Course HMA/WMA
- Single Course PM/AR HMA
- Mill and Fill
- Hot In-Place Recycling
- Cold In-Place Recycling
Pavement Management Systems

• Helps manage the networks condition
• Determine Remaining Service Life
• Looks at alternate treatments
• Manages alternatives based on cost and service life
• Maximizes budget allocation
• Consultants/ Software/ Visual
• FHWA Distress Identification Manual
Selling Pavement Preservation

• Believe in the Concept - Make the Commitment
• Educate and Train your Staff
• Work with Administration and Finance
• Communicate to the Users What you are doing and Why – PP is not Worst First
• Get Media Involved
• Notify Homeowners and Businesses that will be affected of your Plan of Work
Implementing Pavement Preservation

Simple (but effective) planning, education and communication tool:

A Quick Check of Your Highway Network Health

By Larry Galehouse, Director, National Center for Pavement Preservation
and
Jim Sorenson, Team Leader, FHWA Office of Asset Management

Available at: www.fhwa.dot.gov/preservation/library.cfm
Implementation of Pavement Preservation

• based on the Remaining Service Life (RSL) concept

• every roadway segment in a network has a Remaining Service Life

• if you have 500 lane–miles of pavements in your network and do no repairs or maintenance in a given year, the network will lose 500 lane–mile–years of Remaining Service Life

• Develop an annual work plan to achieve the agency’s pavement condition goals (outcome-based budgeting)
Limit Costly Rehabilitation or Structural Overlays

Pavement Preservation can...

- Extend the life of structurally sound pavement.
- Prevent future deterioration.
Key Components to Successful PP

- Selecting the Right Candidate
- Using the Right Treatment at the Right Time
- Defined Specifications
- Proper Materials
- Calibrated Equipment
- Trained Workers
- Quality Workmanship
- QA/QC Plan
- Inspection/ Compliance
- What are your Expectations ?????
I-78 – Good Candidate for PP

- Longitudinal Joint - Microsurfacing
Good Candidate for Pavement Preservation
Good Candidate for Pavement Preservation
Not a Candidate for PP
## Typical Life Extensions

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Good Condition (PCI=80)</th>
<th>Fair Condition (PCI=60)</th>
<th>Poor Condition (PCI=40)</th>
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</thead>
<tbody>
<tr>
<td>Crack Fill</td>
<td>1 - 3</td>
<td>0 - 2</td>
<td>0</td>
</tr>
<tr>
<td>Crack Seal</td>
<td>1 - 5</td>
<td>0 - 3</td>
<td>0</td>
</tr>
<tr>
<td>Fog Seal</td>
<td>1 - 3</td>
<td>0 - 1</td>
<td>0</td>
</tr>
<tr>
<td>Chip Seal</td>
<td>4 - 10</td>
<td>3 - 5</td>
<td>0 - 3</td>
</tr>
<tr>
<td>Micro-Surfacing</td>
<td>4 – 8</td>
<td>3 - 5</td>
<td>1 - 4</td>
</tr>
<tr>
<td>Thin HMA</td>
<td>4 - 10</td>
<td>3 - 7</td>
<td>2 - 4</td>
</tr>
</tbody>
</table>
Specifications

• Association/ Agency Specs to Reference
• Precise
• Define Expectations and Outcomes
• Hold Contractor Accountable
• May Include Incentives/Disincentives
Quality Materials

- Asphalt binders
  - Asphalt emulsions
  - Asphalt and Asphalt Rubber (AR)
- Aggregate
  - High Quality – Agency approved, durable
  - Required Gradation, Shape, Cleanliness
- Mix Design
  - Asphalt Content, Gradation, Air Voids
Well Maintained Equipment

• Sweeper
• Asphalt Distributor/Paver/Micro Paver/ Milling Machine
• Aggregate haul vehicles w/ clean bodies
• Rollers
• Note – All Equipment should be calibrated before using
Calibrations

• Asphalt Distributor
  – Bar Height
  – Nozzle size
  – Nozzle Angle
  – Pump pressure
  – Speed measurement

• Chip Spreader
  – Uniform application across box
  – Rate per square yard
Calibrations- Continued

• Asphalt Pavers
  – Screed
  – Automation

• Micropaver/Slurry Paver
  – Proportioning Capabilities
  – Rate per square yard
  – Auger Box

• Roller
  – Tire pressure on rubber tire roller
  – Weight
Training/Workmanship

• Require Trained/ Experienced Work Crew
• Train Inspection Staff for Process
• Do not Accept Shoddy work
QA/QC and Inspection

• Make Contractor Responsible
• Require Detailed QA/QC Plan
• Develop Inspection Check List
• Insure Contractor Meets Specifications
• Sample and Test Materials
Pavement Preservation Techniques

- Crack Seal
- Conventional Chip Seals
- Asphalt Rubber SAM & SAMI
- FiberMat®
- Slurry Seal
- Micro-Surfacing
- Bonded Pavements
- Modified HMA Thin Overlays
- Cold In-Place Recycle
- Hot In-Place Recycle
- Thin HMA Overlays w/ or w/out milling
Crack Seal
Conventional Chip Seals
Crumb Rubber Modified Binder – Blending

Auger Crumb Rubber into Mixer

Heat Exchanger for PG Binder
Asphalt Rubber SAM/SAMI
FiberMat® Machine
FiberMat® Application
SAMI in a three layer system

Pre-existing Pavement

Leveling Course

SAMI

HMA Overlay

Pre-existing Pavement
Crumb Rubber SAMI
Bonded Pavements
Microsurfacing/ Slurry
HMA Paving
AR Gap Graded WMA
Cold Milling
Hot In-Place Recycling
Cold In-Place Recycling
What is in it for the Agency

• Better Pavements
• Improved System Rating
• Better utilization of Budget Dollars
• Satisfied Customers – Driving Public
• Reduced Environmental Impact
What is in it for the Contractor

• More opportunities for work
• Opportunity to develop new techniques and Processes
• Opportunity to Grow Business and Employ more people
Summary

- Pavement Preservation is a Proactive, Planned, Economical Means of Keeping a Pavement Network in “GOOD” Condition
- Long term performance of Pavement Preservation Treatments are a function of prior pavement condition, type application and the above construction criteria
- A Network Pavement Management System is essential for the Success of Pavement Preservation
- There are many techniques to Preserve Flexible Pavements
Summary- Continued

• Successful projects require Planning, Training, Proper Specifications, Materials, Equipment and QC/QA
• Remaining Service life is a Key Concept
• Annualized Cost of Treatments must be Considered in Application Selection
• Pavement Preservation has Many Benefits –Financial, Environmental, User Satisfaction
• Great Potential for both the Agency and Contractor
Additional Resources

• The National Center for Pavement Preservation
  (www.pavementpreservation.org)
• The Foundation for Pavement Preservation
  (www.fp2.org)
• Federal Highway Administration
  (www.fhwa.dot.gov/pavement/pres.cfm)
• All States Materials Group
  (www.asmg.com)
THANK YOU

All States Materials Group®

Products & Services

- ECObIT® WMA Binder
- CRMB for HMA
- Asphalt Rubber SAM & SAMI
- FiberMat® SAM & SAMI
- Bonded Wearing Courses
- Chip Seals
- Liquid Calcium/Magnesium Chloride
- Full Depth Reclamation
- Hot & Cold Mix Asphalt
- Asphalt Emulsions
- Aggregates

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