Asphalt Pavement Recycling & Pavement Preservation Essentials for Public Works Professionals:
Implementing Pavement Management, Asphalt Recycling and Preventive Maintenance into your Infrastructure

Blair Barnhardt
The Barnhardt Group, LLC
Welcome To St. Simons!
Course Introduction

- Course Agenda
  - Topics
  - Schedule
- Background of attendees (that means you!)
Cooperative Course Development

• Course Text
  *Basic Asphalt Recycling Manual (BARM)*
  Asphalt Recycling and Reclaiming Association (ARRA)
  www.arra.org

• Course Material
  Federal Highway Administration
  www.fhwa.dot.gov
  National Highway Institute
  www.nhi.fhwa.dot.gov
National Highway Institute Workshops (NHI/FHWA)

- 131050 Asphalt Recycling Technologies
- 131103 A, B, or C Pavement Preservation: Design & Construction of Quality PM Treatments (can be 2 days, 3 days or 4 days)
- 131115 Pavement Preservation: Treatment, Timing & Selection
- 131063 HMA Pavement Distress Evaluation
- www.nhi.fwha.dot.gov to sign up
The single most recycled material in the world is asphalt.

The U.S. highway community recycles more than 81% of all asphalt back into highway use.

Yet, we only recycle in place 3% of our roads.

FHWA has proven it costs less to maintain and preserve our roads than rebuilding them.
Pavement Preservation:

- “If cities and counties every truly adopt the concept of pavement preservation, the equipment manufacturers will never be able to supply the demand…. (PP ETG, Charleston, SC)”

Jim Sorenson, FHWA
Preventive Maintenance Timing

- **Good**: Preventive Maintenance
- **Poor**: Rehabilitation, Defer Action, Reconstruction

Time (Years)
Importance of Treatment Timing

Pavement Condition

Time or Traffic

Preventive Maintenance
Rehabilitation
Reactive Maintenance

1-2.15
Asphalt

- In 1837 a British patent was issued for a “mastic cement applicable for paving, road making, covering buildings and other purposes
- The first roadway in England was resurfaced with rock asphalt (from France) in 1869
- Emulsions have been available since 1903, and used extensively since the 1920’s
Asphalt Pavement Recycling

• 1916, Asphalt Heater, City of Toronto Archives
• 1930, Asphalt Heater, City of Chicago Archives
• 1956, Foamed Asphalt invented in Ohio
• 1980s 3\textsuperscript{rd} generation hot in place, milling machines invented for mining industry
• 1990s CIR equipment invented, FDR with foamed asphalt and emulsion technology deployed
• Some states have been doing FDR for 30 years
Pavement Preservation

- Slurry seals have been used in Europe since 1920s
- Late 70s saw modified slurry, namely micro surfacing on ADTs 20-40 K ADT range
- Spain, Germany, France were European pioneers
- Some GA Counties doing over 15 miles per year
- 1996 Olympics 600 K SY micro done for GDOT & City of Atlanta
Asphalt Pavement Recycling & Pavement Preservation Essentials – Course Objectives:

➢ Describe five asphalt recycling technologies & five pavement preservation techniques

➢ Describe various methods of recycling pavements and preserving them

➢ Determine when asphalt recycling is a viable pavement rehabilitation alternative
Introduction
Learning Objectives:

- List the advantages of recycling asphalt pavement & pavement preservation
- Describe common pavement distresses and their causes
- List key items in selecting a rehabilitation alternative and subsequent overlay
Advantages of Recycling

• Reduced cost of construction
• Conservation of aggregate and binders
• Preservation of existing pavement geometrics
• Preservation of environment
• Conservation of energy
• Less user delay
Advantages of Pavement Preservation

- Extending the service life of your investment
- Conservation of aggregate and binders
- Preservation of existing pavement geometrics
- Preservation of environment
- Conservation of energy
- Less user delay
PAVEMENT MANAGEMENT

Definition:
Pavement Management is the process of overseeing the maintenance and repair of a network of roadways at or above established values, within budget constraints, while meeting customer expectations.

“This is ideally accomplished by doing more with less, until you can do everything with nothing.”
Case Study Hillsborough Co., FL

- Roger Cox, P.E., Director of Public Works
- In house MicroPAVER pavement evaluations and pavement management
- Asphalt Pavement Recycling and Pavement Preservation are the reason for the improvements in PCI ratings across the County
The Pavement Management Process

Accomplished by
1-Inspecting all road segments
2-Planning for projects based on budget and need
3-Implementation of appropriate treatments and evaluate performance
Inspection/Specifics Case Study

- 0-100 Scale
- 19 Defects (cracking, rut, ravel, edge...etc.)
- Visual Inspections – does not use IRI as an index
- www.apwa.net to order MicroPAVER
MicroPAVER – Inspection Database
Hillsborough Pavement Inspections

Why MicroPAVER?

• Originally developed in the late 1970s to help the Department of Defense (DOD) manage M&R for its vast inventory of pavements.

• Continued support by the USACOE, and a user base of over 600 internationally.

• Training available through vendors and APWA.

• Available databases include MS – ACCESS.

• Customizable and capable of handling large inventories.

• Customizable deterioration curves as well as definitions for M&R, and Global treatments

• Modeling capability with budget and PCI forecasting

• Public domain program.
MicroPAVER - PMS
Hillsborough Pavement Inspections
Re-inspection Report

* MP
  * Report Generated Date: 2/10/2010
  * Site Name: ROADS

<table>
<thead>
<tr>
<th>Network</th>
<th>Branch</th>
<th>Section</th>
<th>Surface</th>
<th>Area</th>
<th>Length</th>
<th>Width</th>
<th>Use</th>
<th>Area</th>
<th>Last Const.</th>
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</thead>
<tbody>
<tr>
<td>ROADS</td>
<td>0329.00</td>
<td>0150</td>
<td>AAC</td>
<td>23639.006sqft</td>
<td>11619.000ft</td>
<td>20.000ft</td>
<td>ROADWAY</td>
<td>442300.005sqft</td>
<td>12/10/2006</td>
</tr>
</tbody>
</table>

**NOTE: ***Pre-Construction PCI ***

* Last Inspect Date: 5/27/2008
* Total Samples: 119
* Surveyed: 12
* Conditions: PCI=0.001

**Inspection Comments:** 2009 May 26 Inspection

**Sample Number:** 01
- **Type:** RA
- **Area:** 1,999.95 sqft
- **PCI:** 40

**Sample Comments:**
- 19 WEATHER/RAVEL
- 01 ALLIGATOR CR
- 11 PATCH/UT CUT

**Sample Number:** 11
- **Type:** RA
- **Area:** 1,999.93 sqft
- **PCI:** 53

**Sample Comments:**
- 19 WEATHER/RAVEL
- 11 PATCH/UT CUT

**Sample Number:** 26
- **Type:** RA
- **Area:** 1,999.93 sqft
- **PCI:** 53

**Sample Comments:**
- 19 WEATHER/RAVEL
- 01 ALLIGATOR CR
- 10 L & T CR

**Sample Number:** 26
- **Type:** RA
- **Area:** 1,999.93 sqft
- **PCI:** 75

**Sample Comments:**
- 19 WEATHER/RAVEL
- 10 L & T CR
- 01 ALLIGATOR CR
Tools of the Trade –
Step 3 – Implementation / Evaluations

Hillsborough Treatments (Current)

- Crackseal
- Microsurface
- Micropave
- Hot in Place Repaving
- Overlay
- Mill and Overlay
- Full Depth Reclamation
- Conventional Reconstruction
<table>
<thead>
<tr>
<th>PCI</th>
<th>Defect(s)</th>
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<tbody>
<tr>
<td>100</td>
<td>No Defects</td>
</tr>
<tr>
<td>93</td>
<td>% Ravel L</td>
</tr>
<tr>
<td>83</td>
<td>Ravel L</td>
</tr>
<tr>
<td>72</td>
<td>Block Cr Only</td>
</tr>
<tr>
<td>70</td>
<td>Ravel L, % Long and T</td>
</tr>
<tr>
<td>67</td>
<td>Ravel L, Block</td>
</tr>
<tr>
<td>56</td>
<td>Ravel M</td>
</tr>
<tr>
<td>48</td>
<td>Ravel M, Block</td>
</tr>
<tr>
<td>40</td>
<td>Ravel M, Lane Drop, Rutting</td>
</tr>
<tr>
<td>24</td>
<td>Ravel M, Block, Polished</td>
</tr>
<tr>
<td>23</td>
<td>Ravel Heavy</td>
</tr>
<tr>
<td>17</td>
<td>Ravel M, 50% Allig, Block, Potholes</td>
</tr>
<tr>
<td>9</td>
<td>Ravel M, Lane Drop, Edge Cr, Potholes</td>
</tr>
</tbody>
</table>
Tools of The Trade - Treatments

Micro Surface

PCI

67-Ravel-L, L&T

(Min acceptable)

72-Block

67-Ravel-L, L&T

Additional Life $/SY-Year

Years

0 1 2 3 4 5 6 7 8 9 10

0 25 50 75 100
Tools of The Trade - Treatments

Hot-in-Place

PCI

Years

Additional Life - $/SY-Year (min.)

(Ravel-M, Block L)

83 - Ravel, L

70 - Ravel L, Long Cr

(Min acceptable for Arterials)
Tools of The Trade - Treatments

Full Depth Reclaim

Hillsborough’s Oldest FDR
83 - Ravel, L

70 - Ravel L, Long Cr

Additional Life - $/SY-Year (min.)

PCI

Years

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

Ravel-M, Alligator, Rut

(Rol acceptable for Arterials)
Tools of The Trade – Treatments
Hillsborough’s Cost To Own

Micro-Surface - Local Road Treatment
Average life added = 5 to 7 years
Annualized cost = $0.56 to $0.40 per SY - Year

Micro-Pave (SP4.75) – Local Road Treatment
Average life added = 10 to 13 (est) years
Annualized cost = $0.40 to $0.31 per SY - Year

Hot-in-Place Re-Paving - Arterials (mostly)
Average life added = 13 plus years (possible)
Annualized cost = $0.53 per SY - Year

Mill and Resurface (2 inches) – SP12.5 (Arterials)
Average life added = 15 plus years (possible)
Annualized cost = $0.79 per SY - Year
Tools of The Trade – Treatments

Hillsborough’s Cost To Own

Micro-Surface
Annualized cost = $0.56 to $0.40 per SY - Year

Micro-Pave (SP4.75)
Annualized cost = $0.40 to $0.31 per SY - Year

Hot-in-Place Re-Paving
Annualized cost = $0.53 per SY- Year

Mill and Resurface (2 inches) – SP12.5
Annualized cost = $0.79 per SY- Year

Must utilize the correct treatment on the correct road to meet overall program goals!

Treatment selection is a function of defect, and function class.
Future – Prediction Modeling Curves

Real Data??
Prediction Modeling Curves
Case Study City of LA

- William Robertson, Director of Public Works, largest city road network in USA
- For the first time since 1952 their PCI ratings are increasing (getting better) instead of decreasing (getting worse)
- Asphalt Pavement Recycling and Pavement Preservation are the reason for the improvement
HOW BIG IS LOS ANGELES?

<table>
<thead>
<tr>
<th>City</th>
<th>Square Miles</th>
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<tr>
<td>Los Angeles</td>
<td>468.85</td>
</tr>
<tr>
<td>Boston, MA</td>
<td>48.6</td>
</tr>
<tr>
<td>Cleveland, OH</td>
<td>77.9</td>
</tr>
<tr>
<td>Manhattan, NY</td>
<td>22.8</td>
</tr>
<tr>
<td>Milwaukee, WI</td>
<td>95</td>
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<tr>
<td>Minneapolis, MN</td>
<td>58.7</td>
</tr>
<tr>
<td>Pittsburgh, PA</td>
<td>55.5</td>
</tr>
<tr>
<td>St. Louis, MO</td>
<td>61.3</td>
</tr>
<tr>
<td>San Francisco, CA</td>
<td>47</td>
</tr>
</tbody>
</table>
CITY OF LOS ANGELES

Largest municipal street system in the United States

6,500 Centerline Miles

28,000 Lane Miles

69,507 Segments
Current Condition Assessment

- Pavement Condition Index (PCI) 62
- Approximately 1,000 miles of failed streets
- $2.3 Billion Backlog (PCI 80)
- Overall system condition is a D+
Strategic Plan

1. Identify the goal.
2. Create a pavement preservation plan.
5. Innovations in Asphalt Technology
6. Telling the Story.
1. Identify The Goal

- Verify current condition of the street system.
- Where do you want to go?
- Where will current funding levels take you?
- With a $2.3 billion backlog LA had one choice...slow the rapid deterioration of the street system – Save Streets.
2. Pavement Preservation Plan

- Identify the elements of your program.
- What’s the mix...how much of each.
- What will get me the biggest bang for my buck – In LA it was Rubberized Slurry Seal.
- Look for innovative processes.
- Commit to the plan and stay flexible.
3. Budget Allocation

Where do I put my money to get the greatest benefit?

MicroPaver

- **Excellent**: A
- **Good**: B
  - Slurry Overlay
- **Fair**: C
- **Poor**: D
- **Failed**: F

- 80% of the budget allocation.
- 20% * of the budget allocation.

*Typically 20% of the budget is allocated towards failed streets.*
4. Pavement Management Program

- Justifies different funding level requests.
- Provides information to make efficient use of available resources.
- Produces quantified and accurate information.
- Tracks pavement performance.
- Identifies current and future maintenance & rehabilitation (M&R) needs.
- Selects cost-effective repair strategies.
- Predicts future pavement condition based on different budget scenarios.
4. Work Planning

Compare various budget scenarios
Fresh, clean, and new appearance for neighborhoods.
Where The Road Has Taken Us

• The Pavement Preservation Program has grown from 310 miles in 2002 to 735 miles in 2008...a 137 percent increase.
• Ten million dollars allocated to rebuild the Metro Asphalt Plant to run a 50-50 recycled mix.
• For the first time since World War II the overall street system’s PCI will not decline.
6. Telling The Story

- Public Outreach – 89 Certified Neighborhood Councils
- Outreach to Elected Officials and their staffs.
- Embrace the Media.
- Working with local Colleges and Universities.
Memorandum

U.S. Department of Transportation
Federal Highway Administration

Subject: INFORMATION: Formal Policy on the Use of Recycled Materials

From: Frederick G. Wright, Jr.
Executive Director

To: Core Business Unit Managers
Service Business Unit Directors
Directors of Field Services
Division Administrators Federal Lands Highway Division Engineers

Date: February 7, 2002

For your information and use, we have attached our formal policy on the use of recycled materials in highway applications. The policy outlines the importance of re-using materials previously used in constructing our Nation’s highway system, and calls upon us, and the State transportation departments, to explicitly consider recycling as early as possible in the development of every project. In addition, the policy acknowledges that recycling will not be appropriate in all cases, and provides guidance for making that determination.

The implementation of this policy will support our strategic goals of preserving and enhancing the human and natural environment, increasing mobility, raising productivity, and improving safety. Moreover, the new policy has the potential to strengthen the relationship between FHWA and the Environmental Protection Agency, and to forge new partnerships among government, industry, and academia. By providing leadership and technical guidance to the transportation community, FHWA will stimulate advancements in recycling technology and the discovery of new opportunities for the appropriate use of recycled materials.

For additional information or clarification, please contact Byron Lord, in the Office of Pavement Technology at (202)366-1325.

[Signature]

Frederick G. Wright, Jr.
Recycling is one of several rehabilitation alternatives, but will always be less expensive than conventional undercutting and reconstruction.
Reasons that Rehabilitation is Needed

• Inadequate ride quality
• Excessive pavement distress
• Reduced surface friction
• Excessive maintenance requirement
• Unacceptable user costs
• Inadequate structural capacity for planned use or projected traffic volumes
Why Rehabilitate?

By recycling at this point, pavement life is extended. 75% time.

Recycled Pavement

1st 40% drop in quality

2nd 40% drop in quality

12% Time

Total failure
Maintenance

- Corrective – corrects or prevents deterioration from environmental effects
- Preventive – activities intended to extend or preserve the service life of a pavement, no increase in structure
Reconstruction

• Most extreme type of rehabilitation
• Required to improve geometrics
• Essentially delivers a “new” pavement
Recycling Methods

- Module 2 - Hot In-place Recycling
- Module 3 - Cold planing
- Module 4 - Hot Mix Recycling (central plant)
- Module 5 - Cold Mix Recycling (central plant)
- Module 6 - Cold In-place Recycling
- Module 7 - Full Depth Reclamation
Hot In-place Recycling: Process

• Existing asphalt surface is heated
• Scarified to a depth from 20 to 60 mm
• Scarified material combined with aggregate, asphalt binder, and/or recycling agent
• Compaction
Hot In-place Recycling: Surface Recycling

- Preheater
- Heater/Scarifier
- Paver
- Roller

Preheater
HIR Construction

Surface Recycling—Process

1. Dry and heat upper layer
2. Scarify the heated/softened asphalt
3. Add recycling agent
4. Mix the loose recycled mixture
5. Spread and place material with free floating screed
6. Compact recycled mix
HIR Construction

*Surface Recycling—Benefits*

- Eliminates surface irregularities
- Eliminates cracks
- Restores uniform grade line and cross-section
HIR Construction

Surface Recycling—Characteristics

- Depth: 20 to 40 mm (0.75 to 1.5 in)
- No added aggregate or HMA
- Production rate: 1.5 to 15 m/min (5 to 50 ft/min)
- Single vs. two pass operations
HIR Construction

*Surface Recycling—Heaters*
HIR Construction

*Surface Recycling—Equipment*
HIR Construction

Surface Recycling—Scarifiers
Hot In-place Recycling: Remixing

- Remixing Machine
- Virgin Material
- Recycled Mix
- Pugmill
- Scarifier
- Heater
Loading Top Soil Airport
Trenching With Cold Planer
Cold In-place Recycling

Milling Machine

Crusher

Mixer-Paver
# Cold In-Place Recycling

<table>
<thead>
<tr>
<th>Partial Depth Recycling (50 to 100 mm)</th>
<th>Cold In-Place Recycling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Depth Recycling</td>
<td>Full Depth Reclamation</td>
</tr>
</tbody>
</table>
Full Depth Reclamation

Water Tanker

Reclaiming Machine

Roller
Project Evaluation

1. Pavement assessment
2. Historic information
3. Pavement properties
4. Distress evaluation
5. Preliminary rehabilitation selection
6. Economic analysis
Pavement Assessment

- Surface Deterioration
- Deformation
- Cracking
Sources for Pavement Evaluation
Sources for Pavement Evaluation

[Images of two books related to pavement management and evaluation]
Bleeding
Corrugation
Rutting
Condition Assessment

• Identify type / extent of pavement distress
  – Visual survey
  – Sampling and testing
  – Trenching

• Determine cause(s) of distress
  – unstable mixture
  – base failure
  – consolidation by traffic
Assessing the Problem

Four Types of Rutting

- Mechanical deformation
- Plastic flow
- Consolidation
- Surface wear
Trenching

- Reveals the type and vertical extent of deformed layers.

Replace all deformed layers
Ensuring Structural Integrity

• **Structural Capacity** to meet traffic needs

  – Existing pavements
    • Evaluate structural capacity of in-place material
    • Remove / replace any weak or failed areas

  – New Pavement Structure must be able to support present and future loads.
    • thickness design must account for normal factors such as subgrade strength, base thickness and traffic.
Thermal Cracking
Historic Information

- Original design
- As-built data
- QC/QA data
- PMS – pavement performance data
- Maintenance activity
Pavement Properties

- Roughness
- Rutting
- Friction
- Strength
- Material properties
# APPENDIX H

## Structural Coefficients for Pavement Design

<table>
<thead>
<tr>
<th>Material</th>
<th>Coefficient</th>
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<tbody>
<tr>
<td>Range of Expected Asphalt Base</td>
<td>0.34 - 0.39</td>
</tr>
<tr>
<td>Asphalitic Concrete (Top 4 1/2&quot;)</td>
<td>0.44</td>
</tr>
<tr>
<td>Asphalitic Concrete (-1 1/2&quot; from surface)</td>
<td>0.30</td>
</tr>
<tr>
<td>Calcium Chloride Stabilized Limestone Base</td>
<td>0.19</td>
</tr>
<tr>
<td>Cement Stabilized Chert Base</td>
<td>0.20</td>
</tr>
<tr>
<td>Cement Stabilized Graded Aggregate</td>
<td>0.22</td>
</tr>
<tr>
<td>Graded Aggregate and Crushed Limestone (Compacted to Modified Density)</td>
<td>0.16</td>
</tr>
<tr>
<td>Graded Aggregate and Crushed Limestone (Compacted to 96% of Modified Density)</td>
<td>0.14</td>
</tr>
<tr>
<td>Limestone Base (Compacted to Modified Density)</td>
<td>0.16</td>
</tr>
<tr>
<td>Limestone Base (Compacted to 96% of Modified Density)</td>
<td>0.12</td>
</tr>
<tr>
<td>Sand/Asphalt</td>
<td>0.18</td>
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<tr>
<td>Sand Bituminous Stabilized Base (6&quot;)</td>
<td>0.12</td>
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<tr>
<td>Soil Aggregate Base</td>
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<tr>
<td>Soil Cement</td>
<td>0.20</td>
</tr>
<tr>
<td>Surface Treatment (Triple)</td>
<td>0.20</td>
</tr>
<tr>
<td>Topsoil or Sand Clay Base</td>
<td>0.10</td>
</tr>
</tbody>
</table>

### Subgrade:
- Class I Soil (and Stabilized Subgrade) 0.05
- Class II Soil 0.02

### For Overlay Design:
- Old Asphalitic Concrete 0.30
- Old Portland Cement Concrete 0.40

*REVISED* 10-10-95
FOAMED ASPHALT STABILIZATION CHARACTERIZATION IN JEGEL NAT

AASHTO 93 $a_1$, STRUCTURAL LAYER COEFFICIENT FOR HOT-MIX ASPHALT AND FOAMED ASPHALT

$\begin{align*}
    a_1 & = 0.40 \log \left( \frac{E_{RT}}{450} \right) \\

\end{align*}$

$a_1$ DETERMINED FROM AS GIVEN IN FHWA-RD-97-077

$a_1$ IS DOTTED WHEN GREATER THAN 0.5
Distress Evaluation

- Determine where the weakness in a pavement is located
- BARM page 49
Preliminary Rehabilitation Selection (1 of 3)

- Distresses – type and severity
- Quality of material – adequate or needs improvement
- Design life
- Anticipated traffic
- Existing structural capacity
  - Sufficient for design life
  - Sufficient for rehabilitation equipment
Preliminary Rehabilitation
Selection (2 of 3)

• Adequate surface and subsurface drainage
• Expected performance standard
• Acceptable level of maintenance
• Geometric considerations
• Safety concerns
• Utilities
Preliminary Rehabilitation Selection (3 of 3)

- Construction considerations
  - Traffic
  - Work hour restrictions
  - Overhead clearance
  - Drainage structures
  - Experience of contractors
- Impact on adjacent business
Selecting a Rehabilitation Alternative

- Original Pavement Design and Construction Records
- Observed Pavement Distress
- Field Tests: surface condition, roughness, deflection, frictional resistance
- Field Samples, Laboratory Tests

Analysis: establish probable causes of pavement distress
Selecting a Rehabilitation Alternative, cont

Analysis

Evaluation: rehabilitation alternatives based on pavement design principles

Background: maintenance, performance, geometrics, environment, traffic, economics

Thin Overlay

Thick Overlay

Recycling

Reconstruction
Economic Analysis

- Initial rehabilitation cost – project budget
- Future rehabilitation cost
- Maintenance cost
- Salvage value
- User costs
- Life-cycle costs
  - Present worth (PW)
  - Equivalent annual uniform cost (EAUC)
Rehabilitation Considerations

• Engineering considerations, e.g.
  – Type of pavement distress
  – Capacity requirements
  – Environmental impacts
  – Material availability

• Economic considerations, e.g.
  – Project budget
  – Costs vs. Benefits
  – Impacts on adjacent businesses
Recycling Benefits vs. New Construction

- Life-cycle cost savings
- Reuses natural resources (aggregates, binders, energy)
- Maintains existing pavement geometrics as well as thickness
## Recycling Alternatives

<table>
<thead>
<tr>
<th>Type of Pavement Distress</th>
<th>Hot Recycling (HR)</th>
<th>Hot In-place Recycling(HIR)</th>
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</thead>
<tbody>
<tr>
<td><strong>Surface Defects</strong></td>
<td></td>
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<tr>
<td>Raveling</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Bleeding</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Skid Resistance</td>
<td>X</td>
<td>X</td>
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</table>
# Recycling Alternatives

<table>
<thead>
<tr>
<th>Type of Pavement Distress</th>
<th>HR</th>
<th>HIR</th>
<th>CIR</th>
<th>FDR</th>
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<tbody>
<tr>
<td>Deformation</td>
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<tr>
<td>Corrugations</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Rutting - Shallow</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Rutting - Deep</td>
<td>X</td>
<td></td>
<td>X</td>
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# Recycling Alternatives

## Type of Pavement Distress

<table>
<thead>
<tr>
<th></th>
<th>HR</th>
<th>HIR</th>
<th>CIR</th>
<th>FDR</th>
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<td>Cracking</td>
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<tr>
<td>Alligator</td>
<td>X</td>
<td></td>
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Load Associated Cracking
# Recycling Alternatives

<table>
<thead>
<tr>
<th>Type of Pavement</th>
<th>Distress</th>
<th>HR</th>
<th>HIR</th>
<th>CIR</th>
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<tr>
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<td>CIR</td>
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<td>Transverse Cracking</td>
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<td>Reflection Cracking</td>
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<td>Depressions</td>
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<td>Ride Quality</td>
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<tr>
<td>Strength</td>
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Legend:
- **Most Appropriate**
- **Appropriate**
- **Least Appropriate**
Introduction to Preventive Maintenance
Pavement Preservation Tool

- Crack Sealing and Filling
- Fog Sealing
- SteelGuard Surfacing
- Chip Seal
- Slurry Seal & Micro Surfacing
- CIR & HIR Asphalt Recycling
- Thin HMA Overlay
- Ultra Thin Bonded Wearing Course
Cities, counties, and homeowners associations across America are saving millions of dollars using in-place asphalt recycling and pavement preservation. To find out how, visit our website listed below.

www.thebarnhardtgroup.com
blair@thebarnhardtgroup.com
404-316-9792
Learning Outcomes

1. Explain the concept of preventive maintenance
2. Discuss the importance of treatment timing
3. List the benefits of a preventive maintenance program
4. Describe a good candidate pavement for preventive maintenance
Defining Preventive Maintenance

- *Planned* strategy
- Cost effective treatments
- Maintains or improves functional condition
- Does *not* increase structural capacity when using slurry and micro, one could say that HIR does increase SN
Keeping good roads in good condition!
Case Study: City of Santa Ana

- Did network rating of City, average was 47
- Thought it would take 5 years to do all his residential streets and 300 million dollars
- Now doing asphalt recycling and pavement preservation with slurry and micro surfacing
- Will do all roads in 3 years for 72 million dollars, saving 228 million for his City
http://www.youtube.com/watch?v=fxBiVi_1kuM
Preventive Maintenance and Safety

1. Treatments are excellent opportunity to improve safety characteristics
2. Potentially more frequent work zones present challenges to both workers and drivers
3. Safe practices should always be followed
How do *preventive* treatments differ from routine/reactive treatments?

Similar treatments…
different TIMING!
Preventive Maintenance Timing

- Age of pavement or surface
- Condition of pavement
- Next scheduled treatment
Preventive Maintenance Timing

- Preventive Maintenance
- Defer Action
- Rehabilitation
- Reconstruction

Pavement Condition (Functional or Structural)
- Good
- Poor

Time (Years)
Importance of Treatment Timing

Pavement Condition

Time or Traffic

Preventive Maintenance

Rehabilitation

Reactive Maintenance
Expected Benefits

• Preserve investment
  – Improved pavement performance
  – Long term cost savings/leveling

• High level of service
  – Increased safety
  – Greater customer satisfaction
Preserving the Investment

- Keep water out!
- Reduce debris infiltration into joints or cracks
- Slow aging effects of bituminous pavements
- Minimize dynamic loads
Maintaining High Level of Service

- Maintain good rideability
- Maintain good surface friction
- Minimize potentially dangerous surface characteristics
Impact on Distress

- *Prevent or slow* some distresses from occurring
- *Correct* minor surface deterioration
HMA Problems *Reduced*/*Slowed* with Preventive Maintenance

- Oxidation/raveling
- Block cracking
- Edge cracking
- Crack deterioration
- Roughness
- Potholes
HMA Problems *Corrected* with Preventive Maintenance

- Minor rutting
- Raveling
- Bleeding/flushing
- Surface friction loss
- Roughness
PCC Problems *Reduced*/*Slowed* with Preventive Maintenance

- Loss of fines (pumping)
- Corner breaks
- Joint faulting
- Joint spalling
- Crack deterioration
- Roughness
- Blow-ups
PCC Problems *Corrected* with Preventive Maintenance

- Joint seal damage
- Map cracking and scaling
- Surface friction loss
- Roughness
Evaluating Pavements for Preventive Maintenance

- Condition
- Friction
- Roughness
- Ability to carry loads

What you don't see may be more important than what you do see!
Good Candidate Pavements for Preventive Maintenance

- No structural failures
- Minimal distress (extent and severity)
- Relatively young in age
- *Minor* functional problems
- Few historical problems with similar projects
When is it too late for preventive maintenance?

<table>
<thead>
<tr>
<th>HMA Problems</th>
<th>PCC Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Potholes</td>
<td>■ Blow-ups</td>
</tr>
<tr>
<td>• Severely deteriorated cracks</td>
<td>■ Corner breaks</td>
</tr>
<tr>
<td>• Delamination</td>
<td>■ Severely deteriorated cracks</td>
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<tr>
<td>• Unstable rutting</td>
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</table>
Review: Learning Outcomes

1. Explain the concept of preventive maintenance
2. Discuss importance of treatment timing
3. List the benefits of a preventive maintenance program
4. Describe a good candidate pavement for preventive maintenance
Summary

Use the appropriate recycling method to address specific pavement distresses and pavement structural requirements. The put the most cost effective overlay treatment on that recycled asphalt base.
Summary

Keep your good roads good by implementation of an aggressive pavement preservation program, including crack filling, fog seals, chip seals, slurry, micro surfacing and thin asphalt overlays.
Pavement Management for Airports, Roads, and Parking Lots

SECOND EDITION

M. Y. SHAHIN
Review

 What are some of the advantages of recycling asphalt pavement?

 Describe some common pavement distresses and their causes?

 List some key items in selecting a rehabilitation alternative?
Review

- What are some of the advantages of recycling asphalt pavement?
  - Reduced cost of construction
  - Conservation of aggregate and binders
  - Preservation of existing pavement geometrics
  - Preservation of environment
  - Conservation of energy
  - Less user delay
Describe some common pavement distresses and their causes?

- Surface Deterioration
  - Weathering and raveling
  - Bleeding
- Deformation
  - Rutting
  - Shoving (corrugations)
- Cracking
  - Fatigue cracking
  - Transverse (thermal) cracking
Review

List some key items in selecting a rehabilitation alternative?

– Engineering considerations, e.g.
  • Type of pavement distress
  • Capacity requirements
  • Environmental impacts
  • Material availability

– Economic considerations, e.g.
  • Project budget
  • Costs vs. Benefits
  • Impacts on adjacent businesses
Asphalt Pavement Recycling & Pavement Preservation Essentials

Any Questions?
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