A Road Map for Transportation System Preservation R&D (Bridges & Pavements)
TSP R&D Road Map Project

- Sponsored by the FHWA Office of Asset Management
  - Program Managers
    - Jim Sorenson
    - Chris Newman
- In cooperation with AASHTO & TRB
Project Objective

To develop a road map for Research, Development and Implementation related to bridge and pavement preservation by:

• Identifying gaps in knowledge and practice of bridge preservation and pavement preservation

• Identifying critical R&D needs that would fill those gaps

• Writing R&D needs statements

• Creating a road map for an R&D program to meet those needs
Why Preservation?

- **Funding** for transportation improvements
  - Highway budgets are flat or shrinking
  - Construction costs are rapidly increasing
  - Concerns about safety, congestion and environmental impacts increase work costs

At the same time,

- **Demand for service** is increasing
  - Increased traffic volumes
  - Increased volumes of heavy trucks
  - The public is impatient with delays due to worksites
But, Why Preservation?

- Traditional strategies are no longer effective
  - Resources applied first to pavements and bridges in worst condition
  - Benign neglect of pavement and bridges in good condition?
  - Rehab or rebuild to address backlog of deficient pavements & bridges

Therefore,

- New strategies are needed for pavements and bridges in good condition
  - Intervene early in life cycle
  - Apply preservative treatments before deterioration begins
  - Goal - extend service life at minimum cost
Why R&D?

- Many uncertainties exist about preservation
  - Effectiveness (initial & long term) of preservation actions
  - How much is service life extended?
  - Cost effectiveness – are life cycle costs reduced?
  - Much anecdotal information exists, but few long term studies have been done to support anecdotal conclusions

This is partly the result of . . . . .
Why R&D?

- Data necessary to resolve uncertainties is not systematically recorded
  - Condition of element before preservation actions
  - Type & specifics of preservation actions
  - Treatment costs
  - Condition over long term

As a result,

- Useful deterioration and cost models are not available and it is difficult to account for preserved elements in management systems
Project Scope

- Establish a Technical Panel – FHWA, DOTs, TRB, Private Sector
- Literature search on existing knowledge of bridge preservation and pavement preservation
- Identification of key topic areas related to bridge preservation and pavement preservation
- White papers on the key topic areas
  - 6 – 10 pages
  - 2 co-authors (usually 1 DOT engineer)
Project Scope, Cont’d

• Brainstorming Workshops to:
  • Identify critical R&D needs
  • Draft R&D needs statements
• Peer review & prioritization of R&D needs
• Development of road maps
• Final report
Technical Panel – Bridge Group

James Sorenson, Team Leader-Office of Asset Management, FHWA

Christopher Newman, Systems Preservation Engineer, FHWA

Ian Friedland, Technical Director for Structures (R&D), FHWA

Tom Everett, Senior Engineer for Bridge Programs, FHWA

Wade Casey, Bridge Management Engineer, FHWA

Shay Burrows, Structural Engineer, FHWA

Steve Varnedoe, Chief Engineer – Operations NC Department of Transportation

Pete Weykamp, Bridge Maintenance Program Engineer, New York State DOT

William R. Cox, Director, Bridge Division Texas Department of Transportation

Frank Lisle, Engineer of Maintenance Transportation Research Board
Technical Panel – Pavement Group

James Sorenson, Team Leader - Office of Asset Management, FHWA

Christopher Newman, Systems Preservation Engineer, FHWA

Cheryl Richter, Technical Director for Pavements (R&D), FHWA

Bob Orthmeyer, Pavement Engineer, FHWA

Colin Franco, Managing Engineer – Research Rhode Island DOT

Steve Varnedoe, Chief Engineer – Operations NC Department of Transportation

Gerry Eller, Executive Director Foundation for Pavement Preservation

Larry Galehouse, Director National Center for Pavement Preservation

R. Gary Hicks, Technical Director California Pavement Preservation Center

Frank Lisle, Engineer of Maintenance Transportation Research Board
Panel’s Role

- Provide direction and keep project focused on the objectives
  - 17 virtual (web-based) meetings between Nov 2006 and May 2007
  - Review and approve
    - Key preservation topic areas
    - White papers and co-authors
    - Workshop plans
- Review and edit white papers
- Participate in project workshops:
  - Help identify critical R&D needs
  - Help draft R&D needs statements
- Review and comment on project deliverables
Preservation White Papers

- **Pavements**
  - Asset Management & Preservation
  - Design
  - Materials
  - (Concrete Pavement)
  - Construction
  - Contracting Methods
  - Surface Characteristics
  - Performance

- **Bridge**
  - Asset Management & Preservation
  - Bridge Decks
  - Bridge Deck Joints
  - Concrete Superstructures & Substructures
  - Steel Superstructures & Substructures
  - Selection of Preservation Actions
  - Performance of Preservation Actions
### Workshops

<table>
<thead>
<tr>
<th>Location</th>
<th>Topic</th>
<th>Dates</th>
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<tbody>
<tr>
<td>Phoenix, Az</td>
<td>Pavements</td>
<td>February 4 – 6, 2007</td>
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<tr>
<td>Orlando, FL</td>
<td>Pavements</td>
<td>February 25 – 27, 2007</td>
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<tr>
<td>Arlington, TX</td>
<td>Bridge</td>
<td>May 22 – 23, 2007</td>
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<tr>
<td>Arlington, TX</td>
<td>Pavements*</td>
<td>May 24, 2007</td>
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*Meeting to review needs statements from Phoenix & Orlando*
## Workshop Participants

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<thead>
<tr>
<th>Category</th>
<th>Texas</th>
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<tr>
<td>State &amp; local DOTs</td>
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<td>FHWA</td>
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<td>TRB &amp; AASHTO</td>
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<td>4</td>
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<td>Industry &amp; Consultant</td>
<td>11</td>
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<td><strong>Pavements (2)</strong></td>
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<td><strong>TOTALS</strong></td>
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Workshop Format

- Presentation of White Papers
- Breakout groups for six topic areas
- Identification of critical R&D needs
- Development of needs statements
- Reports from breakout groups
Breakout Groups

**Pavements**
- Asset Management & Preservation
- Design
- Materials
- Construction
- Contracting Methods
- Performance of Preservation Actions

**Bridge**
- Asset Management & Preservation
- Bridge Decks & Joints
- Concrete & Steel Superstructures
- Concrete & Steel Substructures
- Selection of Preservation Actions
- Performance of Preservation Actions
## Needs Statements Developed

<table>
<thead>
<tr>
<th>PAVEMENTS</th>
<th>Draft</th>
<th>Final</th>
<th>BRIDGES</th>
<th>Draft</th>
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<tr>
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<td>Decks &amp; Joints</td>
<td>4</td>
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<tr>
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<td>10</td>
<td>7</td>
<td>Superstructures</td>
<td>6</td>
<td>5</td>
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<td><strong>7</strong></td>
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<td>Substructures</td>
<td><strong>5</strong></td>
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<td>3</td>
<td>Selection</td>
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<td>2</td>
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<td><strong>TOTAL #</strong></td>
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<td><strong>40</strong></td>
<td><strong>TOTAL #</strong></td>
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Transportation System
Preservation R&D Road Map
## Estimated Funding Required

<table>
<thead>
<tr>
<th>Topic Area - Pavements</th>
<th>Estimated $$$</th>
<th>Topic Area – Bridges</th>
<th>Estimated $$$</th>
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<tr>
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<td>$ 3.4 M</td>
<td>Asset Management</td>
<td>$ 2.7 M</td>
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<tr>
<td>Design</td>
<td>$ 3.8 M</td>
<td>Decks &amp; Joints</td>
<td>$ 2.2 M</td>
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<tr>
<td>Construction</td>
<td>$ 5.1 M</td>
<td>Superstructures</td>
<td>$ 4.0 M</td>
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<tr>
<td><strong>Materials</strong></td>
<td><strong>$11.1 M</strong></td>
<td>Substructures</td>
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<tr>
<td>Performance</td>
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<td>Performance</td>
<td>$ 0.8 M</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$ 28.3 M</strong></td>
<td><strong>TOTAL</strong></td>
<td><strong>$12.8 M</strong></td>
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Key System Preservation Issues

Overarching Issues

- Lack of standard terminology & definitions for preservation
- Lack of reliable, useable data on:
  - Degree of preservation achieved by treatment
  - Costs of treatments
- What factors and what values of these factors should trigger application of preservation treatments
- Effectiveness of preservation treatments
  - Extended service life
  - Lower life cycle costs – including user costs
Key System Preservation Issues

Overarching Issues

- How to account for preservation in decision-making processes, e.g., management systems
- Proof of benefits to present to upper management and legislatures
- How to secure funding for dedicated preservation programs
<table>
<thead>
<tr>
<th>Title</th>
<th>Est. Cost</th>
<th>Est. Time</th>
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<tbody>
<tr>
<td>Mechanical Binder Properties to Predict Surface Treatment Performance</td>
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<td>3 to 5 Yrs</td>
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<tr>
<td>Acceptance Criteria for Surface Treatments</td>
<td>$ 600</td>
<td>3 to 5 Yrs</td>
</tr>
<tr>
<td>Appropriate Installation Geometry for Crack Treatments</td>
<td>$ 250</td>
<td>3 Yrs</td>
</tr>
<tr>
<td>Cost-Effectiveness of Quality Aggregates</td>
<td>$ 250</td>
<td>9 mos</td>
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<tr>
<td>Performance Grading System for Asphalt Emulsions</td>
<td>$ 4,500</td>
<td>5 Yrs</td>
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<tr>
<td>Performance-Graded Aggregate System for Pavement Preservation Surface Treatments</td>
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<td>5 Yrs</td>
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<tr>
<td>Triggers” for the Timing of Surface Treatments</td>
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<td>TOTALS</td>
<td>$21,100</td>
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</table>
MT 01 - Mechanical Binder Properties to Predict Surface Treatment Performance

OBJECTIVES:
- Develop key performance metrics.

- Identify appropriate testing protocols to accurately measure key performance metrics.

- Assess different emulsion evaporation methods to identify techniques which will yield residue test results that are representative of actual field conditions, while remaining sensitive to time and cost constraints.

- Develop prototype performance specifications for the selection of binders.
MT 02 - Acceptance Criteria for Surface Treatments

OBJECTIVES:

• Development of reliable acceptance criteria and to ensure adequate performance of thin surface treatments.

• Allow contractors more flexibility, thereby increasing innovation, potentially resulting in lower costs.

• Validate the prototype specifications.
MT 03 - Appropriate Installation Geometry for Crack Treatments

OBJECTIVES:

• Develop typical crack movement estimates for various climate zones and applied loadings.

• Develop a model to estimate crack movements for various climate and loading conditions.

• To develop appropriate installation geometries based upon the crack movement, traffic, climate conditions, and sealant properties.
OBJECTIVES:

• Define the principal aggregate quality indicators that influence treatment performance under various climate and operational conditions (e.g., chains, studded tires, etc.).

• Evaluate life cycle costs for treatments using local or higher quality imported aggregate.
MT 05 - Performance Grading System for Asphalt Emulsions

OBJECTIVES:

• Modify existing binder testing equipment and protocols to achieve accurate, representative, and repeatable estimates of performance of the residual asphalt.

• Create practical and cost-effective testing protocols, which build upon existing PG methodologies and equipment.

• Develop appropriate residue recovery methods for testing.
MT 06 - Performance-Graded Aggregate System for Pavement Preservation Surface Treatments

OBJECTIVES:
1. Development of testing protocols and performance criteria to define texture and friction characteristics, which will optimize motorist safety.

2. Development of performance criteria for functional surface characteristics such as splash and spray, durability for winter operations, and noise.

3. Document the effects of physical characteristics of aggregates on performance
4. Establish criteria for all aggregate physical characteristics (e.g., size, shape, fracture, absorption, durability, etc.) and mineralogy to improve the performance of surface treatments. Some specific issues which should be examined as part of this objective, include:

a. Examine existing durability tests (e.g., LA abrasion versus Nordic abrasion or Micro Deval) to determine their suitability to different environments and traffic conditions including the use of studded tires.

b. Evaluate existing testing methods used to determine aggregate shape for cost-effectiveness, ease of use, and practicality.

c. Determine the quality and quantity of P200 materials as they relate to the performance of specific surface treatments.
5. Develop methodologies, which will match the appropriate aggregate characteristics to the intended treatment, environmental conditions, and traffic volumes.
MT 07 - Triggers for the Timing of Surface Treatments

OBJECTIVES:

• Determine the mode and mechanisms of pavement failure as driven by pavement aging such as the changes in the physical properties of pavements/binders with depth.

• Determine the material property changes which lead to failure.

• Characterize and quantify the appropriate time windows of opportunity for the application of various treatments in relation to these trigger events.

• Determine variability in materials characteristics and climate and their impact on timing triggers.

• Incorporate the results and data sources such as the WRI Field Validation Study into this research.
Next Steps

- Priority Rating of Needs Statements
- Finalize Report & R&D Road Map
- Present to AASHTO Committees
  - Bridge
  - Maintenance
  - Materials
  - Research
- Get Beaucoup funding $$$!
That’s My Story & I’m Sticking to It!

Questions?