Rhode Island - The Great State of Pavement Preservation

2014
Providence, RI
From a potential problem...
... to a problem waiting to happen...
...that becomes a problem for everyone.
Rhode Island Department of Transportation Mission Statement

“...maintain and provide a safe, efficient, environmentally, aesthetically and culturally sensitive intermodal transportation network that offers a variety of convenient, cost-effective mobility opportunities for people and the movement of goods supporting economic development and improved quality of life.”
Introduction

1) Introduction
2) Program Development
3) Program History
4) Pavement Preservation Tools/Treatments
   a) Crack Seal
   b) Microsurfacing
   c) Asphalt Rubber Chip Seal (ARCS)
   d) Bonded Wearing Course
   e) Thin Overlay (Paver-Placed Elastomeric Surface Treatment - PPEST)
   f) SAMI (ARCS + Hot mix Overlay)
5) Concrete – Whitetopping
6) Reclamation with and without Emulsion
7) P² Monitoring Program
8) Final thoughts
Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991

- Provided federal funding to states for programmed preventive maintenance for the first time
- States could now utilize federal funding for pavement management systems
Concepts

- **Pavement Preservation** – All activities undertaken to provide and maintain a serviceable roadway
- **Routine Maintenance** – Refers to day-to-day highway maintenance operations
- **Preventive Maintenance** – Strategy and cost effective treatments that preserve the system
Welcome to Extending Pavement Life
Extending Pavement Life

- Why Extend Pavement Life?
  - Because it Maximizes the Return on the Taxpayers Investment

- Pavements represent a Trillion dollar investment
  - WE MUST PROTECT THEM!
PHILOSOPHY of MAINTENANCE
Timing of Preventive Maintenance

• **Timing is Everything !!!!!**

• Proper Maintenance is basically a timing issue
  – When should a road receive maintenance
  – Based upon the relationship between:
    • Deterioration Curves and,
    • Cost-Effectiveness of Maintenance Strategies
Maintenance Strategies can be grouped into:

- Routine Maintenance
- Preventive Maintenance
- Deferred Maintenance
  - Rehabilitation
  - Reconstruction
- Do nothing (Pay big $$$ later)
Deterioration Curve w/ Strategies & Costs

Very Good
Good
Fair
Poor
Very Poor

Design Life years

Rebuild ($$$$
Rehab ($$$$
Preventive ($$$
Routine ($)
The RIDOT Journey into Pavement Preservation
Formation of the Highway Assessment Committee (HAC) — 1995

• HAC: Incorporate members from various engineering divisions in RIDOT
• Study Focus: Five year old roads
• Purpose: Determine the impact of design and construction practice on highway maintenance
  – Minimize need for maintenance
  – Identify practices that improve highway durability
Highway Assessment Committee — 1996

- Produced comprehensive report
- Created database with information on roadway element conditions
- Created methods for assessing highway conditions
- Formulated recommendations for improvement
- Created a cadre of RIDOT Engineers/Technicians Familiar with P²
Highway Assessment Report for Five Year Old Roads

Conducted by the Highway Assessment Committee
December 1996

Prepared for the Rhode Island Department of Transportation by the Research and Technology Development Section
Pavement Preservation Program Development Initiated 1998
Pavement Preservation Program
Development – Data Management

• Road segments given LRS ID with beginning/end points
• Entered into Arcview (GIS) database with all pertinent information
• Arcview is used to graphically display layered information
Pavement Preservation Program Development – Road Selection Criteria

- Roads that are 5-15 years old are actively reviewed for P² treatment
- Roads that are in poor condition are forwarded to Highway Design for 3R/Reconstruction
- List of potential roads are solicited from Maintenance and other sections and reviewed against the database
Pavement Preservation Program Development – Road Selection Process

- Teams from the Department independently review and rate candidates (~150 roads)
- Short list obtained from field review/decision matrix
- Final list is culled after thorough coordination with RIDOT sections, cities/towns and utilities
# Decision Matrix

<table>
<thead>
<tr>
<th>Factors</th>
<th>CRACK SEAL</th>
<th>RUBBERIZED ASPHALT CHIP SEAL</th>
<th>BONDED WEARING SURFACE</th>
<th>ELASTOMERIC THIN OVERLAY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age of Road</strong></td>
<td>5 (+) Years</td>
<td>7 (+) Years</td>
<td>7 (+) Years</td>
<td>7 (+) Years</td>
</tr>
<tr>
<td><strong>Road Type</strong></td>
<td>C2,C3</td>
<td>C2,C4</td>
<td>C2,C3</td>
<td>C2,C3</td>
</tr>
<tr>
<td><strong>Traffic Volume</strong></td>
<td>All Types</td>
<td>High Car / (Medium/High) Truck</td>
<td>High Car / High Truck</td>
<td>High Car / High Truck</td>
</tr>
<tr>
<td><strong>Pavement Structure</strong></td>
<td>All Types</td>
<td>All Types</td>
<td>All Types</td>
<td>All Types</td>
</tr>
<tr>
<td><strong>Land Use</strong></td>
<td>All Types</td>
<td>Non Residential, Rural, Farm, Non City</td>
<td>City, Urban Upscale</td>
<td>City, Urban Upscale</td>
</tr>
<tr>
<td><strong>Pedestrian / Children</strong></td>
<td>OK to use</td>
<td>Do not use</td>
<td>OK to use</td>
<td>OK to use</td>
</tr>
<tr>
<td><strong>Road Features</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curbing</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
</tr>
<tr>
<td>Sidewalk</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
</tr>
<tr>
<td><strong>Distress Factors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rutting &gt; 3/4in.</td>
<td>OK with Shim course</td>
<td>OK with Shim course</td>
<td>OK with Shim course</td>
<td>OK with Shim course</td>
</tr>
<tr>
<td>Utility Trenches</td>
<td>OK</td>
<td>OK with Shim course</td>
<td>OK with Shim course or patching</td>
<td>OK with Shim course or patching</td>
</tr>
<tr>
<td>Crack Density</td>
<td>Light to Heavy</td>
<td>Medium/Heavy</td>
<td>Light/Medium</td>
<td>Light/Medium</td>
</tr>
<tr>
<td>Base Failure Alligator Cracks</td>
<td>Some</td>
<td>Yes with Shim course</td>
<td>Yes with Shim course</td>
<td>Yes with Shim course</td>
</tr>
<tr>
<td>Pothole / Raveling</td>
<td>Some</td>
<td>Yes with Patching</td>
<td>Yes with Patching</td>
<td>Yes with Patching</td>
</tr>
<tr>
<td><strong>Location</strong></td>
<td>All Types</td>
<td>Suburban, Rural, Commercial, Industrial</td>
<td>City, Urban</td>
<td>City, Urban</td>
</tr>
<tr>
<td><strong>Restrictions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermoplastic/epoxy striping</td>
<td>N/A</td>
<td>No (must be removed)</td>
<td>No (must be removed)</td>
<td>No (must be removed)</td>
</tr>
<tr>
<td>Rigid Base</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Intersections</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
RI DOT Pavement Preservation
Program History: 1998-2014
Pavement Preservation Program
($(P^3)$) — 1998

- Program initiation with statewide crack seal contracts using block sealer ASTM D 6690
- Created extensive databases on highway/highway conditions
- Geographical Information System
  - For selection of roads for $P^3$
  - For monitoring of $P^3$
- 4 contracts (Total Funds: $460K)
Pavement Preservation Program — 1999

- Utilized Pavement Management Systems to enhance database
- Researched and initiated preventive maintenance surface treatments
  - Microsurfacing
  - Asphalt rubber chip seal (ARCS)
- 5 Contracts awarded: 3 crack seal, 2 surface treatments (Total funds: $1.3M)
Pavement Preservation Program — 2000

- Performance monitoring of pavement preservation treatments initiated
- Added Bonded Wearing Course treatment to preventive maintenance arsenal
- Experimental test sections utilizing combination of surface treatments (Cape Seal/SAMI)
- 6 contracts awarded: 3 crack seal, 3 surface treatments (Total funds $3.3M)
Pavement Preservation Program — 2001

- **PPEST**: Elastomeric Thin Overlay (TO) using chemically modified crumb rubber asphalt (CMCRA) added to preventive maintenance arsenal
- Surface Treatment experimental test sections added
- 7 contracts: 3 crack seal, 4 surface treatment (Total funds $2.8M)
Pavement Preservation Program - 2002

- Crack sealing using (CMCRA) with fibers
- Surface Treatments
  - Asphalt rubber chip seal (ARCS)
  - PPEST : Elastomeric overlay using chemically modified crumb rubber
- 4 contracts valued at $3.0M
Pavement Preservation Program - 2003

- Crack sealing using rubberized asphalt with fibers
- Surface Treatments
  - Asphalt rubber chip seal (ARCS)
  - Elastomeric overlay using chemically modified crumb rubber (PPEST)
- 4 contracts valued at $3.2M
- Whitetopping valued at $1.1M
Pavement Preservation Program - 2004

- Crack seal using rubber asphalt with fibers
- Crack seal (Rout) limited access highways
- Surface Treatments
  - ARCS
  - Elastomeric overlay using chemically modified crumb rubber
- 5 Contracts valued at $4.2M
Pavement Preservation Program - 2005

- Crack seal using rubber asphalt with fibers
- Surface Treatments
  - Asphalt rubber chip seal
  - Elastomeric overlay using chemically modified crumb rubber
  - Special project – SAMI chip seal with PPEST overlay
- 4 Contracts valued at $4.4M
Pavement Preservation Treatments to Date

- Rhode Island experience to date
  - Crack Seal/Rout and Seal
  - Microsurfacing
  - ARCS-Asphalt Rubber Chip Seal
  - Bonded Surface Treatment
  - PPEST -Elastomeric Mix -Thin Overlay
  - Combination : Cape Seal/SAMI
Pavement Preservation
Treatments to Date

• Rhode Island experience to date (CONT)

  – SAMI (ARCS + PPEST)
  – PPEST with 40 mesh asphalt rubber
  – PPEST with asphalt rubber + Warm Mix Additive
  – Reclamation with Emulsion Stabilizer
  – White Topping – Experimental Section
SURFACE SEALS 1999 -2014

LEGEND
- ARCS
- PPE ST
- POWER PLACED
- MICROSURFACING
- SAMI
- RECLAMATION

1999-2014
Surface Seals
Pavement Preservation Tools/Treatment
Crack Sealing — Definition

- Crack Seal – Blow clean and heat crack; fill and overband with rubberized asphalt cover
- Rout and Seal – Grind out and heat crack; fill with rubberized asphalt
Crack Seal Material Composition

- Hot Applied Block Sealer– ASTM 6690 Type II
- Asphalt Rubber W/ Fibers:
  - Neat Asphalt – PG 58 – XX
  - Crumb Rubber – Minimum 5%, 80/40 mesh
  - Blend AC – PG 70-34/64-34
  - Blend Viscosity – 3 Pa · s @ 300°F
- Chemical Bonding Agent
- Fibers – 10 mm length polyester, 15 dpf
Crack Sealing
— Heating Kettle
Crack Sealing
— Preparation (Hot Air Lance)
Crack Sealing — Sealing Operation
Crack Sealing
— Sealing/Blinding Operation
Crack Sealing — Failure

Note: Sealant: Block Sealer ASTM D-3405
Crack Sealing — Failure
Surface seals

- All roads to be surface sealed are crack sealed
- Brought to profile and camber by shimming and milling
- Must be structurally sound
Microsurfacing
Microsurfacing
— Definition/Properties

A polymer modified asphalt slurry consisting of emulsion, aggregate and Portland cement. Applied with specialized equipment and is a relatively fast operation.

- Does not require much surface preparation
- Good skid resistance values
- Good for rut filling
- Mitigates aging of underlying HMA layer
- Prone to cold weather reflective cracking
Microsurfacing
Microsurfacing — Before
Microsurfacing — After
Microsurfacing — Equipment
Microsurfacing Issues
— Cracking Around Heads
Microsurfacing Issues — Cracking Propensity
Microsurfacing Issues — Washboarding
Microsurfacing Issues — Delam at Heads
Microsurfacing Issues
— Delam at Gutter Line
Microsurfacing Issues

- **Noise** (for the first season)
- Rough pavement texture
- Scalloping of pavement (plows)
- Delamination
Asphalt Rubber Chip Seal (ARCS)
Asphalt Rubber Chip Seal (ARCS) — Definition/Properties

The ARCS is a blend of 20% crumb rubber and asphalt. ARCS is hot spray-applied at the rate of 0.6 gallons per square yard. Then covered with 1/4”- 1/2" precoated stone, followed by rolling.

- Flexible - Good for moderately cracked roads.
- Relatively easy/fast to apply
- Ideal for cold wet climates
- Other unique applications
Material Composition

- PG 58 – 28
- Asphalt Rubber – Max size #10 sieve
- Rubber % - 20 ± 3
- Aggregate Size – ¼” to ½” (single size)
- Aggregate Coating – 100% coating w/PG 58 - 22
Asphalt Rubber Chip Seal
Asphalt Rubber Chip Seal Prep
- Shim and Crack Seal
Asphalt Rubber Chip Seal — Before
Asphalt Rubber Chip Seal — After
Asphalt Rubber Chip Seal — Sprayer
Asphalt Rubber Chip Seal — Chip Spreader
Asphalt Rubber Chip Seal — Rolling
Asphalt Rubber Chip Seal Issues — Bleeding @ Intersection
Asphalt Rubber Chip Seal Issues — Improper Roller
Asphalt Rubber Chip Seal Issues — Streaking
Asphalt Rubber Chip Seal Issues — Stone Kick Out
Asphalt Rubber Chip Seal Issues — Delam due to Thermoplastic
Asphalt Rubber Chip Seal Issues — Delam due to Thermoplastic
Asphalt Rubber Chip Seal — Unique Applications
Asphalt Rubber Chip Seal — Unique Applications
Asphalt Rubber Chip Seal — Unique Applications
Asphalt Rubber Chip Seal — Unique Applications

Concrete Pavement

Before

After
Paver Placed Surface Treatment
(Nova Chip)
Paver-Placed Surface Treatment (Nova Chip/PPST) - Definition

PPST is a polymer emulsion (applied at 0.25 gallons per square yard) sprayed immediately before placement of the hot mix overlay (3/4"). Followed by rolling.

- Efficient/fast operation
- Used on roads with sound foundation
- Good ride and aesthetically pleasing
Paver-Placed Surface Treatment
Paver-Placed Surface Treatment – Before
Paver-Placed Surface Treatment – After
Paver-Placed Surface Treatment — Train
Paver-Placed Surface Treatment — Emulsion/Mix Application
Paver-Placed Surface Treatment — Roller Compaction
Paver-Placed Surface Treatment

Issues — Cracking
Paver-Placed Surface Treatment

Issues — Bleeding
Paver-Placed Surface Treatment

Issues — Handwork (Open Mix)
Paver-Placed Surface Treatment

*Issues — Low Heads*
Paver-Placed Surface Treatment

Issues — Equipment Mobility
Paver-Placed Surface Treatment — Unique Applications (Shoulder)
Paver-Placed Surface Treatment — Unique Applications

Sakonnet River Bridge
Paver-Placed Surface Treatment — Unique Applications

Sakonnet River Bridge
Paver-Placed Surface Treatment — Unique Applications

Sakonnet River Bridge
Paver-Placed Surface Treatment — Unique Applications

Sakonnet River Bridge

Detail
Paver-Placed Elastomeric Surface Treatment - Thin Overlay (PPEST)
Paver-Placed Elastomeric Surface Treatment (PPEST) — Definition

PPEST is a mixture of coarse-graded 3/8 inch crushed aggregate and a chemically modified crumb rubber asphalt (CMCRA) binder. The binder is PG 70-28 and contains a minimum 5% CMCR. The mix has a binder content of 6.0 to 7.5%. PPEST is:

• Produced in a Conventional hot mix plant
• Applied to a tack-coated surface
• Placed to a one-inch compacted thickness
CMCRA Binder:
- Neat Asphalt: PG 58 – XX
- Crumb Rubber: 7% with Chemical Bonding Agent
- Asphalt Blend: PG 76 – 34/PG 70 - 28
  - Separation < 5%
  - PAV < 5000 KPa @ 7 °C
  - El Rec ≥ 70% @ 4°C

Aggregate: Maximum size ½”

Marshall Mix Design: Stability 1000 lbs, Flow 8-16
PPEST — *Before*
PPEST — After
PPEST — Train
PPEST — Roller
PPEST Issues — Proper Tacking
PPEST — Pavement Joint
PPEST Issues — Texture
PPEST Issues — Tack Streaking
PPEST Issues — Tearing
Special Treatment PPEST/ARCS SAMI
- Tack Coat
Special Treatment PPEST/ARCS SAMI - Paving
Whitetopping
Whitetopping - Definition

- Thin (~4”) concrete overlay over existing asphalt pavement
- Prevents rutting and shoving at intersections, particularly on downhill grades
- Useful in areas with traffic by heavy vehicles, such as truck stops
Whitetopping - Milled Surface
Whitetopping - Placement
Whitetopping - Screeding
Whitetopping - Finishing
Whitetopping - Handfinishing
Whitetopping - Sawcutting
Whitetopping - Traffic on Grade
Pavement Preservation Program Monitoring
Pavement Preservation Program – Monitoring

• Beginning in 2000, the P2 program has been monitored biannually by the Pavement Management section with 20 active sections to date
Pavement Preservation Program
– Monitored Treatments

- Crack seal
- Microsurfacing (MS)
- Novachip (NC)
- Asphalt rubber chip seal (ARCS)
- Elastomeric thin overlay (TO)/CMCR
  - Asphalt rubber w/40 mesh
  - Asphalt rubber w/Warm Mix Additive
- Compound seals: SAMI – ARCS w/NC
  Cape Seal – ARCS w/MS
Pavement Preservation Program – Distress Monitoring

- Crack mapping
- Rutting/raveling/bleeding
- Skid numbers/IRI

Note: Cracking has been the most prevalent distress noted and is being used as a comparator.
Pavement Preservation Program – Monitoring Goals

- Evaluate the efficacy and cost efficiency of the program
- Determine superior performing surface treatments
- Validate the methods and materials used
Pavement Preservation Program – Crack Distress Map
Pavement Preservation Program–Monitoring Examples

East Shore MS4202-1:
Crack Density vs. Time

Crack Density (ft/100 sq.ft)

Fall '00 Fall '01 Fall '02 Fall '03 Fall '04 Fall '05 Fall '06 Fall '07 Fall '08 Spr '10

crack density before surface improvement = 1.92
Pavement Preservation Program–Monitoring Examples

RI-126 (Old River Rd.) RCS1170-1:
Crack Density vs. Time

Crack Density (ft/100 sq.ft)

- Crack density before surface improvement = 16.93
Pavement Preservation Program–Monitoring Examples

Danielson Pike (Concrete)
SS2405(01)RCS-2:
Crack Density vs. Time

Crack Density (ft/100 sq.ft)

crack density before surface improvement = 4.72
**Pavement Preservation Program–Monitoring Examples**

RI-113 NC2165-1: Crack Density vs. Time

Crack Density (ft/100 sq.ft)

- Crack density before surface improvement = 15.61

![Graph showing crack density over time]
RI-1A (Kingstown Rd) SS3080(02)TO-1:
Crack Density vs. Time

Crack density before surface improvement = 18.20
Pavement Preservation Program–
Monitoring Examples

RI-98 SAMI-N: Crack Density vs. Time

No Available Data before surface improvement
Lessons Learned
P³ Lessons Learned - Databases

- Use Pavement Management techniques
- Use GIS /Create database for highway network
- Need for continually updated information/data
- Monitoring of surface treatment for efficacy and cost/benefit analysis
GIS has been incorporated into the P³ and is an indispensable tool for:

- Project selection
- Contract documentation and preparation
- Monitoring/tracking of pavement treatments
Final Thoughts on the RIDOT P³

- The program is growing in scope due to its effectiveness
- Continuing support from the Director and top management is critical to ensure dedicated funding
- Try new tools and technologies growth and experience are essential
- Periodic in depth assessments (fiscal/technical) are crucial to the health and direction of the program
The End…

…and yet, only the beginning, as the task of preserving our highways is
… never-ending!