Lessons Learned from Research in Innovative Resurfacing and Pavement Preservation Techniques on Roadways in Metro Nashville – Davidson County

Using The Right Treatment - At The Right Place - At The Right Time

Mr. Donald Reid
Paving Operations Manager,
Public Works Department
The Metropolitan Government of Nashville – Davidson County

Metro Nashville
PUBLIC WORKS
Our Presentation Covers 3 Main Topics

- **The Business Case for Innovation in Paving & Pavement Preservation Techniques**
- **Industry Research Behind Pavement Preservation Techniques**
- **Results of New Pavement Preservation & Resurfacing Techniques on Nashville Streets & Roads**
The Business Case for Innovation in Paving & Pavement Preservation Techniques
Old-School Paving Operations

- Identify the bad roads.
- Pave them until the budget runs out.
- Repeat.

- Smart management of this process keeps things within budget, but it’s still *pave me now or pave me later*.
- Worked fine until resurfacing costs went through the roof (and the street network grew so quickly).
New-School Paving Operations

- Traditional paving is not enough.
- Until recently, the cost of roadway resurfacing increased along a gentle, natural curve that reflected normal increases in the cost of asphalt concrete (AC).
- Increases sloped gently around 4%-10% per year from 1997 through mid-2005.

### Average Local Government Resurfacing Costs in Tennessee 1996-2007 YTD

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<tr>
<td>Cost Per Ton In Place</td>
<td>$27.00</td>
<td>$28.00</td>
<td>$29.75</td>
<td>$31.00</td>
<td>$32.30</td>
<td>$29.82</td>
<td>$32.36</td>
<td>$34.13</td>
<td>$35.68</td>
<td>$43.00</td>
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<td>% Increase/Decrease</td>
<td>3.70%</td>
<td>6.25%</td>
<td>4.20%</td>
<td>4.19%</td>
<td>-7.68%</td>
<td>8.58%</td>
<td>5.40%</td>
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<td>$48,403</td>
<td>$58,334</td>
<td>$85,466</td>
<td>$84,109</td>
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Prices Are On the Rise, and the Market is Volatile

- From 2005 through 2006, volatility in the price of crude oil caused AC prices to double.
- Hurricane Katrina and other unforeseeable events helped spur huge cost increases.
- More recently, prices have dropped from those peaks, but the trend is still generally upward.
The Cost of Resurfacing Is Radically Increasing

It doesn’t look like crude oil will be getting any cheaper and the market is very volatile.

In addition to base price, think about the “soft” costs:

• Diesel for transport vehicles, machinery.
• Energy cost for heating the hot mix asphalt.
• Equipment cost.
Industry Research
Behind Pavement Preservation Techniques
EXPERT RESEARCH HAS ALREADY BEEN DONE

- Technology has come to the rescue, and the results are positive.
- But where do you start? Learn from the current research.
- LTPP = Long Term Paving Performance
- SHRP = Strategic Highway Research Program
- FP² = Foundation for Pavement Preservation
Long Term Paving Performance (LTTP)

- Under the Federal Highway Administration (FHWA), the largest pavement performance research program ever undertaken.
- Data from 2,000 pavement test sections over a 20-year test period.
- Web site for current and historical information on environment, traffic, inventory, monitoring, maintenance, materials, and rehabilitation for each test section.
About LTPP

Understanding "why" some pavements perform better than others is key to building and maintaining a cost-effective highway system. That's why in 1987, the Long-Term Pavement Performance (LTPP) program - a comprehensive 20-year study of in-service pavements - began a series of rigorous long-term field experiments monitoring more than 2,400 asphalt and portland cement concrete pavement test sections across the U.S. and Canada. [More]

LTPP has recently added a forum for discussion at the FHWA Highway Community Exchange. Please take a look and feel free to post a question or discussion item!

How to Get LTPP Data, contact LTPP Customer Support Service at lttpinfo@fhwa.dot.gov, new phone (202) 493-3035.

LTPP Technical Services Contractor and Regional and Other Important Links

The LTPP Newsletter

Publications

- Highway Concrete Pavement Technology Development and Testing: Volume V Field Evaluation of SHRP C-206 Test Sites (Bridge Deck Overlays), FHWA-RD-02-086 2006
- Highway Concrete Technology Development and Testing: Volume IV Field Evaluation of SHRP C-206 Test Sites (Early Opening of Full-Depth Pavement Repairs), FHWA-RD-02-085 2006
<table>
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<tr>
<th>Publication Title</th>
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<th>FHWA #</th>
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<td>2007</td>
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<td>Multiple Corrosion Protection Systems for Reinforced Concrete Bridge Components</td>
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<td>Corrosion Resistant Alloys for Reinforced Concrete</td>
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<td>Long-Life Concrete Pavements in Europe and Canada</td>
<td>2007</td>
<td>FHWA-PL-07-027</td>
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Strategic Highway Research Program (SHRP)

• Established by Congress in 1987 as a 5-year, $150-million research program to improve the performance, durability, and safety of U.S. highways.
• Under the umbrella of the National Research Council and the Transportation Review Board (TRB), independent research targeted four areas:
  – asphalt,
  – concrete and structures,
  – highway operations,
  – and long-term pavement performance.
SHRP Implementation

Seven technology areas encompass the products of the Strategic Highway Research Program, which was active from 1983 to 1993. Products within those technology areas are now being evaluated and implemented by the nation’s transportation agencies. In-depth information on the seven technology areas, including the results of tests, trials, and surveys, is available through the Innovative Highway Technologies web site maintained by the Texas Transportation Institute. The seven technology areas include:

- Alkali-Silica Reactivity
- Anti-Long/Road Weather Information Systems (RWIS)
- Concrete Assessment and Rehabilitation
- High Performance Concrete
- Innovative Pavement Maintenance Materials
- Pavement Preservation
- Superpave.

- The 237 SHRP research reports are now available online in searchable PDF format.
- Innovative Highway Technologies web site at leadstates.tamu.edu

A Lead States program enabled state transportation agencies with early and extensive experience with SHRP products to share their practical knowledge with others. The Lead State experience is captured in the final report of the AASHTO Task Force on SHRP Implementation.

- Read From Research to Reality: Encouraging the Implementation of Innovative Technologies, a final report.
- Contact Neil Hawks, Director, Special Programs Division, for information about SHRP activities: nhawks@nas.edu

A new SHRP program is being developed to address transportation issues that are likely to be of concern in the next 20 years. A study is in progress to select focus areas for a future research program, develop a research agenda, identify funding needs, and develop an administrative structure.
SHRP Reports: Long-Term Pavement Performance Reports

LONG-TERM PAVEMENT PERFORMANCE REPORTS

Distress Identification Manual for the Long-Term Pavement Performance Project
By using this manual, accurate, consistent, and repeatable distress evaluation surveys can be performed. Color photographs and drawings illustrate the distresses found in three basic pavement types: asphalt concrete surfaced, jointed (plain and reinforced) portland cement concrete; and continuously reinforced concrete. Drawings of the distress types aid as a reference for severity assessment, and detailed instructions tell how to measure the distresses. Describes how to conduct the distress survey, from obtaining traffic control to measuring the cracks in the pavement. Sample forms are included for data collection. Appendices tell how to calibrate and operate profile and fault measurement devices. 147 pages. SHRP-P-338

Manual for Profile Measurement: Operational Field Guidelines
Describes procedures to be followed when measuring pavement profiles for the LTPP program using the K.J. Law Profilometer, Face Technologies Diostick, and a rod and level. Field testing procedures, data collection procedures, calibration of equipment, record keeping, and maintenance of equipment for each of the profiling methods are described. 130 pages. SHRP-P-376

SHRP-LTPP Traffic Data Collection and Analysis: Five-Year Report
Presents the evolution of the traffic data collection methodology by recounting the work of the SHRP Traffic Data Collection and Analysis Expert Task Group. Traffic load data was a key factor in the research conducted under the long-term pavement performance program. Automated vehicle classification and weigh-in-motion systems for the program are discussed. 39 pages. SHRP-P-396

SHRP-LTPP General Pavement Studies: Five-Year Report
Documents the development, evolution, and current status of the general pavement studies. Pavement sites were planned with the goal to develop a database on materials, traffic, environment,
Hot-Mix Asphalt Paving Handbook 2000

Responding to recommendations from industry, government, and academic officials, the first edition of the Hot-Mix Asphalt Paving Handbook was prepared by the Transportation Research Board in 1981 with financial support from the American Association of State Highway and Transportation Officials, the Federal Aviation Administration, the Federal Highway Administration, the National Asphalt Pavement Association, and the U.S. Army Corps of Engineers. Although field manuals and handbooks were then available from many sources, none had been adopted by all major industry segments. Since its appearance, the Hot-Mix Asphalt Paving Handbook has been widely accepted as a standard training aid throughout the major segments of the paving industry.

In the 1990s, asphalt paving practices evolved rapidly, and TRB has updated the handbook at the request of its sponsors to address this evolution. This second edition of the handbook addresses recent research findings, including those of the Strategic Highway Research Program, new paving equipment, the growth in recycling, changes in quality control practices, and the introduction of new techniques from Europe and elsewhere.

This second edition is available in both print and CD formats from the following sources:

AASHTO Publications
444 North Capitol Street, NW
Suite 249
Washington, DC 20001
Tel: 202-624-5800
Fax: 202-624-5936
Email: aashto@aashto.org

Federal Highway Administration
Report Center
9701 Philadelphia Court, Unit Q
Broomfield, CO 80021
Tel: 303-637-3310
Fax: 303-637-3500
Email: report_center@fhwa.dot.gov
Foundation for Pavement Preservation (FP²)

Non-profit consortium of PP-related vendors and agencies created to

- Identify and pursue industry/agency research needs
- Coordinate with industry and agency partners - AASHTO and FHWA
- Identify "Best Practices" for pavement preservation programming and techniques
- Promote pavement preservation internationally
- Develop activities for highway users and auto industry groups
Welcome to the Foundation for Pavement Preservation Web Site!

The Foundation is a non-profit organization supported by the pavement preservation industry, contractors, material suppliers, equipment manufacturers, consulting engineers, and academia.

The Foundation supporters are passionate about advocating the importance of protecting and preserving the huge investment in pavements throughout the United States of America and the world.

Read About the 2006 FP² Awards
Results of New Pavement Preservation & Resurfacing Techniques on Nashville Streets & Roads
Metro Public Works underwent a performance audit by Maximus in May 2002.

Auditors said traditional paving is old-school; use slurry seal to increase pavement life.

Auditors were forward-thinking, but slurry seal is not a cure-all.

Luckily, we had official sources of relevant research (LTPP, SHRP, FP²) to learn from.
NASHVILLE GETS WITH THE PROGRAM

Nashville reviewed the findings of LTPP, SHRP, and FP².

Conduct product testing under real conditions.

Applied various treatments according to vendor specs – *with the vendor rep on-site in each case.*

Established a 500’ test surface just outside the Public Works offices.
Also testing various treatments and techniques on other segments across Nashville according to factors like:

- **Type of surface**
- **Average traffic volume/speed**
- **Type & severity of surface defects**
  - Pop-outs
  - Alligator cracking
  - Shoving
  - Joint separation
  - Raveling
- **Last-paved date**
- **Public impact, safety, project coordination, etc.**
MULTIPLE TREATMENT TYPES EXIST FOR VARYING ROAD CONDITIONS

• Industry experts recommend a phased approach.
• Use the treatment type that is appropriate for the location, pavement age, traffic, etc.
• These treatments can elevate the overall condition rating of a road, extending its life until resurfacing is a real requirement.
• The trick is to understand which treatments are available, how they work, and when to use them.
• This is why Nashville is doing its own research!
2007 ESTIMATED COST TO BRING A PAVEMENT BACK TO EXCELLENT CONDITION

11 Ft. Wide
LANE MILE

- Fog Seal Rejuvenator: $4200 ($0.65 SY)
- Fog Seal Coating: $5800 ($0.90 SY)
- Slurry Seal: $7100 ($1.10 SY)
- Micro-Surface: $9,700 ($1.50 SY)
- 1/2-Inch Hot-Mix Overlay: $11,700 ($1.81 SY)
- 1-Inch Hot-Mix Overlay: $23,400 ($3.62 SY)
- 1.5-Inch Overlay: $35,100 ($5.43 SY)
- 1.5" Hot In-Place Recycle: $55,000 ($8.52 SY)
- Reconstruct: $77,000 ($12.00 SY)

CONDITION vs TIME

0 1 2 3 4 5 6 7 8 9 10

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

TIME
Review of treatment performance is ongoing, with useful results so far about a variety of surface treatments.

“Your mileage may vary”, but maybe our results can help you in your own pavement preservation program.
## PRODUCT TESTING IN NASHVILLE, TN

<table>
<thead>
<tr>
<th>Product</th>
<th>Application</th>
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<tbody>
<tr>
<td>Reclamite</td>
<td>Crack Seal</td>
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<tr>
<td>GSB 88</td>
<td>GSB-Restore</td>
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<tr>
<td>Rejuvaseal</td>
<td>Slurry / Micro</td>
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<tr>
<td>PASS</td>
<td>Joint Bond</td>
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<tr>
<td>Re-Play (Soy)</td>
<td>Infrared Patching</td>
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<tr>
<td>NovaChip</td>
<td>Warm Mix</td>
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<tr>
<td>Polymer-Modified Asphalt</td>
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<tr>
<td>Geogrid</td>
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</table>
INNOVATIVE PAVEMENT REJUVENATION & PRESERVATION TECHNIQUES
RECLAMITE –
The Marketing Blurb

- Made from the same light oils and resins used in making asphalt, many of which are burned off due to the heat required for applying AC.
- A one-step method for restoring plasticity and durability of the asphalt binder.
- Used on newly constructed pavements (0-3 years) to improve durability of the mix, while providing an in-depth seal to reduce permeability.
- On older pavements (3-5 years), it will reverse the effects of aging due to environmental damage from sunlight and water intrusion.
RECLAMITE –
Our Experience

- Pink surface while curing; color fades away within 24 hours.
- Requires aggregate (sand or slag) to be spread to retain skid resistance. This material coating can affect the visual appearance of the road.
- Nashville has adopted the use of pavement rejuvenators like Reclamite to protect pavement that is 3-5 years old.
Nashville - Oaklawn Ave.

RECLAMITE Application
5-10-05
Oaklawn Ave. - Reclamite Just Applied
Crack sealing is the most common maintenance option used to help protect the pavement structure.

First, the cracks are cleaned and dried using a hot compressed air heat lance. Then, the cracks are filled with hot poured rubberized joint and crack sealant.

It is often placed in advance of overlays and surface treatments to improve performance.
CRACK SEAL – Our Experience

- Joint separation is biggest failure on roadway.
- Crack sealant does just what its name implies.
- Nashville has adopted crack sealing.
GSB 88 –

The Marketing Blurb

GSB Rejuvenating Sealant Binder is a low cost method to keep pavements in good condition longer by slowing the oxidation/deterioration process of your roads.

Gilsonite - a natural, unrefined asphalt ore that’s rich in resins to help replenish the pavement's surface where oxidation first starts.

Sealer - very resistant to oxidation; keeps water out and pavement oils and flexibility in.

Binder -"glues" in an asphalt pavement's fines to help stop ravel and premature cracking.

Army Corp of Engineers found it to be four times more effective in holding a pavement's surface together than the leading saturate oil rejuvenator.
GSB 88 –
Our Experience

• Very tacky. Cure time not conducive to quick traffic-readiness.

• Thin material composition – high water content in emulsion.

• Metro Nashville pursuing alternative methods more aggressively.
Use on asphalt pavements within the first few years of their existence to provide many of the elements lost to asphalt cement during the refining process, and as a preservative in retarding the natural oxidation process. Also effective in solving specific pavement problems such as raveling and oxidation.
Our Experience

- Greater material composition than GSB-88. Less watery.
- Penetrates better than GSB-88.
- Asphalt “clogs” were left on our finished surface during our test section.
- Outperforms GSB-88, but Metro still undecided on its use within Nashville.
• Seals, protects, and revitalizes asphalt pavement.

• Penetrates the surface of asphalt; becomes integral part of the binder.

• Reduces viscosity and brittleness in the top 3/8” of asphalt while significantly increasing ductility and flexibility.

• Asphalt surfaces treated with RejuvaSeal are fuel, water, and chemical resistant.
REJUVASEAL –
Our Experience

• Strong coal-tar smell calls attention to itself, caused unfavorable public perception.

• Nashville’s opinion is that the smell is too strong for application on residential streets.
• Slurry seal is a mixture of emulsified asphalt oil, rock, water, and additives such as aluminum sulfate, Portland cement, lime, latex or carbon black. Which additives are used depends on many factors including location, condition of surface, and the type of surface.

• Micro-Surface = Slurry Seal + Additional Aggregate to increase skid resistance, color contrast, surface restoration, and service life to high-speed, heavy-traffic roadways.
Micro-Surfacing creates a thin, restorative surface course on urban arterials and heavy traffic intersections does not alter drainage, and there's no loss of curb reveal.

Applied to roads or runways to eliminate hydroplaning problems that occur during periods of rain. The Micro-Surfacing restores the proper surface profile and makes the area safe for use.

Micro-Surfacing creates a new, stable surface that is resistant to rutting and shoving in summer and to cracking in winter.
MICRO-SURFACE – Our Experience

• A step up from slurry seal.

• Finish looks rough; highly textured.

• Finished surface is thin and brittle.

• Reflective cracking soon comes through.
The Marketing Blurb

- **Polymer-modified Asphalt Surface Sealer**, a type of fog seal.
- Rejuvenates and seals worn asphalt.
- Fills cracks; adds durable membrane to resist reflective cracking.
- It’s got substance: 50% asphalt; 20% rejuvenator; 3% polymer. (Remaining composition is emulsifier + water.)
PASS –
Our Experience

- Cures to black appearance in 2-3 hours, allowing traffic back onto roadway.
- Little impact on residents:
  - Requires no aggregate coating
  - Little or no odor
- PASS works well to stop raveling, seal out water, fill small cracks, and extend the lifetime of roadways that were last paved 7-10 years ago.
- Requires re-striping.
- Metro Nashville has adopted the use of polymer-modified asphalt surface sealants like PASS.
PASS – Adopted by Metro Nashville

• Using PASS costs us about $0.60-$0.70 per sq yard.

• Traditional mill & fill costs us about $6.00 per sq yard.

(Numbers assume 1.5” overlay, and do not include striping/marking costs.)

• Using PASS lets Metro Nashville extend a roadway’s lifetime by about 5 years before resurfacing is needed.
## PASS – Relative Costs

<table>
<thead>
<tr>
<th>ROAD NAME</th>
<th>ACTUAL SQ YDS</th>
<th>LAST PAVED DATE</th>
<th>FOG SEAL COST</th>
<th>OVERLAY COST</th>
<th>MILLING COST</th>
<th>SAVINGS: FOG SEAL vs MILL &amp; FILL</th>
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<td>IVY POINT</td>
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<td>RIDGEWOOD RD</td>
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<td>$19,050.51</td>
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<td>GREENTREE RD</td>
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<td>OLD HICKORY BLVD</td>
<td>36372</td>
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<td>GREER ROAD</td>
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<td>$39,049.74</td>
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<td><strong>$61,472.25</strong></td>
<td><strong>$1,060,600.89</strong></td>
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Applying PASS to these 10 example streets costs around 1/8 the cost of traditional resurfacing.

PASS = $139K where MILL & FILL = $1.1M
JOINT BOND – The Marketing Blurb

- To be applied just after resurfacing, while the pavement is new.
- Forms a strong construction joint if applied prior to initial separation.
- Prevents water from penetrating construction joints.
JOINT BOND –
Our Experience

• Currently testing on 1, 2, and 3 year-old roadways.

• Will evaluate for 2-3 more years before making a decision on its adoption.
RE-PLAY – The Marketing Blurb

- Soy-based sealant product.
- Light odor; not unpleasant.
- More environmentally friendly than most options.
RE-PLAY – Our Experience

- Currently under testing.
- Not enough experience with it yet to gauge its value to our program.
INFRARED PATCHING – The Marketing Blurb

- Uses infrared to heat existing blacktop; blends new blacktop to create a joint-free integral patch.
- The machine is capable of heating the existing blacktop to a depth of approximately two inches without oxidation or burning.
- No flame in direct contact with the existing blacktop surface.
INFRARED PATCHING – Our Experience

- Infrared patching seems to work very well.
- New enough that there is not enough competition for bidding.
- Machinery is advancing quickly for ease of application.
- Newer units perform scoring via automated means – no more raking.
- Need experienced contractors to level the playing field.
OUR PLAN TO CONTINUE PRESERVING PAVEMENT

- Pave streets that need it.
- Use products like Reclamite on streets 0-3 years old, while they are in good condition.
- Use products like PASS on streets that were last paved 7-10 years ago, that are severely raveled and have little or no cracking.
- Crack seal streets that have severe construction joint separation.
- Continue to learn from the research of the experts, investigate new technologies, and test treatments on our own roadways.
Nashville is actively researching ways to effectively manage the pavement on its roadways, and it is paying off.

We are doing our homework to ensure we are USING THE RIGHT TREATMENT AT THE RIGHT PLACE AT THE RIGHT TIME.

QUESTIONS?

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