VIRGINIA QUIET PAVEMENT STUDY
(aka, DEPLOYMENT OF FUNCTIONALLY OPTIMIZED SURFACE MIXES)

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SURF 2012
Norfolk, VA
Directs VDOT to:

- Expedite the development of quiet pavement (QP) technologies such that applicable contract solicitations include specs for QP technology if sound mitigation is a consideration.

To that end, VDOT will:

- Construct demonstration projects to assess QP technologies.
- Evaluate functionality/safety in Virginia's climate over two full winters.
Quiet Pavement Technologies

Asphalt:

- Open-graded with 9.5mm top-size stone and rubberized AC (AR-PFC 9.5)/25mm
- Open-graded with 9.5mm top-size stone and polymer-mod. AC (PFC 9.5)/25mm
- Open-graded with 12.5mm top-size stone and polymer-mod. AC (PFC 12.5)/50mm

Concrete:

- Conventional Diamond Grind (CDG)
- Next Generation Conc. Surf. (NGCS)
Project Selection Criteria

- Four-lane divided, high-speed corridor
- Good overall pavement structure
- Good geometrics
- Limited at-grade intersections
- 1-mile per asphalt technology/ ½-mile for concrete
- No curb/gutter or existing sound mitigation measures
Demonstration Projects (2011)

1. SR 7 By-Pass in Leesburg (A)
2. SR 199 west of Williamsburg (A)
3. SR 288 near Chester (A)
4. I-64 Virginia Beach (C)
5. SR 76 Richmond (C)
Demonstration Projects (Asphalt)

- SMA 9.5 (40mm)
- AR-PFC 9.5 (25mm)
- PFC 9.5 (25mm)
- PFC 12.5 (50mm)

Plan View
Demonstration Projects (Conc)

- Exist. Finish
- Conv. Grind (CDG)
- Next Gen. Concrete Surface (NGCS)
- Exist. Finish

Plan View
Conventional Grind
Preliminary Findings – functional assessment of “new” materials and treatments
Noise Measurement

Wayside

Tire-Pavement (i.e. OBSI)
Wayside Noise ("Reduction")

<table>
<thead>
<tr>
<th>Material</th>
<th>AASHTO TP99-12, dB(A)</th>
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<tbody>
<tr>
<td>SMA (ctrl)</td>
<td>2.00</td>
</tr>
<tr>
<td>AR-PFC 9.5</td>
<td>3.00</td>
</tr>
<tr>
<td>PFC 9.5</td>
<td>4.00</td>
</tr>
<tr>
<td>PFC 12.5</td>
<td>7.00</td>
</tr>
<tr>
<td>NGCS</td>
<td>4.00</td>
</tr>
<tr>
<td>Conv. Grnd</td>
<td>3.00</td>
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</table>
QP Demonstration Projects – Spring 2012

OBSI (dBA)

Tire-Pavement Friction

Locked-Wheel System (LWS)  GripTester (GT)
Tire-Pavement Friction

<table>
<thead>
<tr>
<th>Material</th>
<th>LWT</th>
<th>GT</th>
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<tbody>
<tr>
<td>SMA 9.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AR 9.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PFC 9.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PFC 12.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NGCS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CDG</td>
<td></td>
<td></td>
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<tr>
<td>Control</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Macrotexture

![Graph showing MPD (mm) for different materials](image)

- SMA 9.5
- AR PFC 9.5
- PFC 9.5
- PFC 12.5
- NGCS
- CDG
- Control

ASTM E2157
Ride Quality

IRI (m/km)

<table>
<thead>
<tr>
<th>Material</th>
<th>IRI (m/km)</th>
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<tbody>
<tr>
<td>SMA-9.5</td>
<td>1.1</td>
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<tr>
<td>AR-PFC9.5</td>
<td>0.9</td>
</tr>
<tr>
<td>PFC 9.5</td>
<td>0.9</td>
</tr>
<tr>
<td>PFC 12.5</td>
<td>1.0</td>
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Pay Adjustment for Evenness

Incentive ($/ton)

<table>
<thead>
<tr>
<th>SMA-9.5</th>
<th>AR-PFC9.5</th>
<th>PFC 9.5</th>
<th>PFC 12.5</th>
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## Technology Costs

<table>
<thead>
<tr>
<th>Pavement Description</th>
<th>Average Costs</th>
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<tbody>
<tr>
<td></td>
<td>Per Ton ($)</td>
<td>Square Meter ($)</td>
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<tr>
<td>SMA 9.5 (Control)</td>
<td>108.50</td>
<td>11.00</td>
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<tr>
<td>AR-PFC 9.5</td>
<td>125.81</td>
<td>6.90</td>
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<tr>
<td>PFC 9.5</td>
<td>116.00</td>
<td>6.36</td>
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<tr>
<td>PFC 12.5</td>
<td>110.33</td>
<td>12.09</td>
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<tr>
<td>Diamond Grind</td>
<td>N/A</td>
<td>8.20</td>
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<tr>
<td>NGCS</td>
<td>N/A</td>
<td>12.96</td>
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Effectiveness (Noise Reduction)

Cost ($/dB/SM)

<table>
<thead>
<tr>
<th>Material</th>
<th>Cost ($)</th>
</tr>
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<tbody>
<tr>
<td>AR-PFC 9.5</td>
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<td>PFC 9.5</td>
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<td>CDG</td>
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Summary (Tire-Pavement Noise)

• Quiet asphalt technologies *measurably* less noisy on average than control (note: control technology NOT noisy)
• Next Generation Concrete Surface (NGCS) *noticeably* less noisy than control
• None of the surfaces became louder over the winter (note: milder than normal winter)
Summary (Other Properties)

- Ride quality is critical to quiet pavements and excellent ride quality was achieved in the projects.
- The QP technologies exhibit good resistance to skidding.
- The QP technologies have reduced splash and spray with improved wet-weather visibility.
- There were no reports of compromised safety during winter weather with QP.
Next Steps

- More demonstration projects and test section installs in 2012
  - AR-PFC 12.5 and AR-SMA 9.5 – NOVA and Culpeper Districts
  - National Center for Asphalt Technology (NCAT) – AR-PFC and PFC
- Noise (and other) testing continues
- Costs will continue to be evaluated
  - Life-Cycle Assessment (LCA)
Cost Components for LCA

• Allowable substitution – will FHWA permit QP strategy in lieu of noise barriers?
• “Acoustic longevity” – QP replacement cycle?
• Additional maintenance costs – winter and periodic cleaning/vacuuming
• Value of other functional benefits – e.g., reduced rolling resistance, improved safety & comfort, etc.
FOR MORE INFORMATION:
KEVIN.MCGHEE@VDOT.VIRGINIA.GOV

LINKS TO INTERIM REPORT:
HTTP://LEG2.STATE.VA.US/DLS/H&SDOCS.NSF/0/E0A4B50AD340248C8525787E0057D09A?OPENDOCUMENT

HTTP://WWW.VIRGINIADOT.ORG/VDOT/PROJECTS/ASSET_UPLOAD_FILE884_5721.PDF