Field Evaluation of Porous Asphalt Pavements

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Credits
- Project initiated by Heritage Research Group
- Approved by INDOT, FHWA
- Funded jointly by the Institute for Safe, Quiet and Durable Highways, INDOT, Milestone Contractors and HRG
- Conducted by NCSC, SQDH and HRG

The Project
- I74 Eastbound East of I465
  - Test Section located between Mount Comfort and Acton Road Interchanges
  - Constructed August 2003
- Steel Slag SMA and Steel Slag PFC
  - PFC = Porous Friction Course
  - Conventional HMA Section on US52, West Lafayette, constructed July 2003

Porous Friction Course
- PFC is similar to Georgia's Porous European Mix (PEM)
- Interconnected voids
  - High permeability provides drainage and prevents clogging
  - Increased friction, especially wet
  - Reduced noise
  - Improved wet weather visibility

Goal of Field Trial
- Evaluate use of PFC in Indiana
  - Need strong, durable aggregates
- Effects of PFC on friction, noise, splash and spray, pavement performance
  - Follow-up study to evaluate long-term durability and performance
- Comparison of PFC, SMA, Conventional HMA

The Materials
- 9.5mm mixtures used steel slag and PG76-22 binder
- PFC designed at 18-22% air voids
  - Old OGFC designed at 12-15% voids
  - Polymer modified binder and fiber
- SMA has fairly open aggregate structure, but voids are largely filled with matrix of binder and filler (fiber)
**Design Gradations**

<table>
<thead>
<tr>
<th>Sieve (mm)</th>
<th>PFC</th>
<th>SMA</th>
<th>HMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.075</td>
<td>0.075</td>
<td>0.075</td>
<td>0.075</td>
</tr>
<tr>
<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
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<tr>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>1.18</td>
<td>1.18</td>
<td>1.18</td>
<td>1.18</td>
</tr>
<tr>
<td>2.36</td>
<td>2.36</td>
<td>2.36</td>
<td>2.36</td>
</tr>
<tr>
<td>4.75</td>
<td>4.75</td>
<td>4.75</td>
<td>4.75</td>
</tr>
<tr>
<td>9.5</td>
<td>9.5</td>
<td>9.5</td>
<td>9.5</td>
</tr>
<tr>
<td>12.5</td>
<td>12.5</td>
<td>12.5</td>
<td>12.5</td>
</tr>
</tbody>
</table>

**Local Challenge**

- Georgia practice with PEM results in 19-25mm drop-off
  - Unacceptable in Indiana
- Use smaller nominal max size
  - 9.5 vs. 12.5mm mix
- Use thinner lift
  - 30mm vs. 40mm
- Taper lift thickness to 15mm at edge

**Construction**
**Conventional HMA**

**Performance**
- Friction and Surface Texture
- Noise Measurements
- Splash and Spray

**SMA vs. PFC**

**Dynamic Friction Tester**

**Circular Texture Meter**
DFT and CTM

- DFT readings influenced by both micro- and macrotexture
- CTM measures macrotexture
- DFT and CTM used together to determine International Friction Index
  - Correlates well with other standard devices

Field Data Comparison

<table>
<thead>
<tr>
<th>Surface</th>
<th>DFT 20</th>
<th>CTM</th>
<th>F60</th>
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</thead>
<tbody>
<tr>
<td>Porous</td>
<td>0.51</td>
<td>1.37</td>
<td>0.36</td>
</tr>
<tr>
<td>SMA</td>
<td>0.37</td>
<td>1.17</td>
<td>0.28</td>
</tr>
<tr>
<td>HMA</td>
<td>0.52</td>
<td>0.30</td>
<td>0.19</td>
</tr>
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</table>

Porous and SMA tested before trafficking.

Noise Measurements

- Sideline (Pass-By) Noise Measurements
- Close Proximity Trailer Measurements

- Remember, decibel readings are on logarithmic scale and readings are taken in different locations

Sideline Noise Measurements

<table>
<thead>
<tr>
<th>Vehicle</th>
<th>HMA</th>
<th>SMA</th>
<th>PFC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impala</td>
<td>72.6</td>
<td>74.8</td>
<td>68.1</td>
</tr>
<tr>
<td>Volvo</td>
<td>75.2</td>
<td>75.5</td>
<td>70.1</td>
</tr>
<tr>
<td>Silverado</td>
<td>74.5</td>
<td>77.0</td>
<td>71.6</td>
</tr>
</tbody>
</table>

Sideline Noise Data

At 80 kph (50 mph)
### CPX Data (dBA)

<table>
<thead>
<tr>
<th>Speed</th>
<th>HMA</th>
<th>SMA</th>
<th>PFC</th>
</tr>
</thead>
<tbody>
<tr>
<td>72 kph</td>
<td>93.0</td>
<td>94.2</td>
<td>89.7</td>
</tr>
<tr>
<td>97 kph</td>
<td>96.4</td>
<td>97.6</td>
<td>92.6</td>
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</tbody>
</table>

### Comparison of Noise Levels

<table>
<thead>
<tr>
<th></th>
<th>Surface</th>
<th>Sideline</th>
<th>CPX</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFC</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>HMA</td>
<td>2.1 dB higher</td>
<td>3.6 dB higher</td>
<td></td>
</tr>
<tr>
<td>SMA</td>
<td>5.9 dB higher</td>
<td>4.8 dB higher</td>
<td></td>
</tr>
</tbody>
</table>

### Preliminary Findings

- **PFC** significantly quieter than **SMA** or conventional **HMA**
- In-car noise significantly different and lower on **PFC**

### Splash and Spray

- **Video** by Wayne Jones, Asphalt Institute

### Preliminary Findings

- **PFC** provides higher macrotexture than **SMA** and much higher than **HMA**
- Friction levels are currently higher for **PFC** and **SMA** than **HMA**
  - Will traffic wear off film and increase IFI?
  - Will **PFC** lose macrotexture and friction?
Preliminary Findings

- PFC surface provided significantly lower noise levels than SMA or HMA
- Somewhat surprisingly, SMA was louder than HMA
- Sideline and CPX measurements ranked the pavements in the same order
- Splash and spray significantly reduced with PFC

Long Term Performance

- Question remains how long these effects will persist.
  - Does the PFC clog and lose effectiveness?
  - High permeability is supposed to help prevent that, but ...
- Long term monitoring of the test section has been suggested and appears likely to be funded.
- PFC appears to hold promise for safety and comfort.