Sustainable SMA in Urban Areas
Chicago-Michigan Avenue

Jay Behnke, P.E.
President
S.T.A.T.E. Testing, LLC
Behnke Materials Engineering

Environmental Leadership Award
2012 NAPA
Agenda

- An Evolution
  - RAP/FRAP
  - GTR
  - RAS
  - SMA
- Michigan Avenue SMA

Mich. Ave. SMA from Experience and Experiments

- RAP
- RAS
- GTR
- ABR
- SMA
- Michigan Avenue SMA
GTR - Ground Tire Rubber Modified Asphalt

No Draindown

Replacement for Fibers.
- Open Graded
- Pervious
- SMA
Terminal Blended GTR

Original Formula
PG 64-22 Base
+ 12% GTR
≈ PG 76-22

Hi-Recycle Formula
PG 58-28 Base
+ 12% GTR
≈ PG 70-28

- Consistent
- Stable
- Long Storage Time
- Locally Available

FRAP - Fractionated RAP

- Old – RAP was bad
- Then – RAP is OK
- Now – FRAP is great
IL FRAP Sizes (typical)

- < #4 (0.2 in.)
- #4 to 1/2 in.
- > 1/2 in.

RAS
Recycled Asphalt Shingles
RAS = Quality HMA Ingredient

- Consistent gradation
  - 100% < 3/8 in.
  - 90% < #4
- 25+% High Quality AC
- 30+% High Quality Fine Aggregate
- Mineral Filler
- Mineral/Organic Fibers

SMA - Working Hard since 1999

190,000 ADT
18,000 Trucks
Characteristics of SMA

- High Performance
  - Friction
  - Strength
- High Binder Content
  - Durability
- Relative High $$$
- IDOT preferred Expressway surface for 3 decades.
- Traditionally Steel Slag
- Highest IDOT Friction
- Stability prevents rutting
- Durability gives long life
- SBS PG 76-22
- VMA > 17

SMA Bus Pad Retrofit

2009
- 1 night construction
- Crushed Gravel SMA

6-inch Excavation
- 4.75mm level binder
- 2 SMA lifts

Traffic next a.m.
After 3 Years of busses

Risk and Reward
Top 10 Bridge

Dec. 13, 2007

GTR / Diabase SMA
PG 64-22 Tack
GTR 4.75mm Binder
5 years old

Pulling it Together
Michigan Avenue SMA
Original Play

1.5” N70 Surface
1” Poly 4.75mm Level Binder
Audible Called for NATO

BASE CONDITION

GREEN

$$$

TACK COAT

SCHEDULE

CURB APPEAL

BUSINESS IMPACT

MIX SELECTION

Examination

Given:
- Location
- Variable Base/Subbase
- 300 Structures to work around
- Time Constraints
- Green Objectives

Solve for:
1. Milling Thickness
2. Lift Thickness
3. Binder Mix
4. Surface Mix
5. Tack Coat
6. Paving Width
7. Maximum ABR
Factors favoring Single SMA Lift

- Uncertainty of Base
- Time
- Cost
- SMA Characteristics

Michigan Ave SMA Mix Design
Mix Design Details

<table>
<thead>
<tr>
<th>MIXTURE</th>
<th>OIL</th>
<th>VOLUMETRICS</th>
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<tbody>
<tr>
<td>Quartzite 12.5mm</td>
<td>50%</td>
<td>NDES = 80</td>
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<tr>
<td>Quartzite 9.5mm</td>
<td>24%</td>
<td>Voids = 3.5%</td>
</tr>
<tr>
<td>FM01 &amp; Mineral Filler</td>
<td>3.5%</td>
<td>VMA = 16.3%</td>
</tr>
<tr>
<td>RAP &lt; 9.5mm</td>
<td>15%</td>
<td>VFA = 78.5%</td>
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<tr>
<td>RAS</td>
<td>7.5%</td>
<td></td>
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<tr>
<td>PG 58-28 GTR+12</td>
<td>6.1%</td>
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</table>

\[\text{VMA} = 16.3\%\]
\[\text{VFA} = 78.5\%\]

Binder Replacement

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<tr>
<th>% MIX</th>
<th>AC Content</th>
<th>ABR</th>
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<tr>
<td>RAP (3/8”)</td>
<td>15%</td>
<td>5.2%</td>
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<tr>
<td>RAS</td>
<td>7.5%</td>
<td>26%</td>
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Design AC 6.1%
New AC 3.4%
Gradation - Classic SMA

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<tr>
<th>Sieve Size</th>
<th>0.075</th>
<th>0.3</th>
<th>2.36</th>
<th>4.75</th>
<th>9.5</th>
<th>12.5</th>
<th>19.0</th>
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<tr>
<td>28%</td>
<td>61%</td>
<td>87%</td>
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Coarse Aggregate Structure

- 2 sizes Quartzite
  - 50% 12.5mm NMAS
  - 24% 9.5mm NMAS
- High Friction
- 1% Soundness Loss
- 23% LA Abrasion Loss
- <0.5% Absorption
Torture Tested (cores)

< 4 mm rut @ 20,000 reps

Test Strip at Plant
Paving

Logistics & Traffic Control
Sweeping for Prime was an Art in Itself

+ Trackless Tack/Prime Coat
Completed in 6 consecutive nights of Paving

Daily Temperatures

Oct-2011

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<th>17</th>
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<tbody>
<tr>
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<td>52°</td>
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<td>57°</td>
<td>61°</td>
<td>62°</td>
<td>54°</td>
<td>60°</td>
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<td>Low</td>
<td>27°</td>
<td>27°</td>
<td>30°</td>
<td>27°</td>
<td>40°</td>
<td>31°</td>
<td>36°</td>
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Historic Averages

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<tr>
<td>54°/30°</td>
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Compaction – 3 static 3-wheeled; Large Tandem Finish

Street Returns
Hand Workable

Finished Product
SMA Growing Up

- Expressways...now local streets, intersections, bridges
- RAP/FRAP, RAS, and GTR add economy
- Next? FRAC – Friction Recycled Aggregate Component
The End – Thank You