SMA - Stone Mastic Asphalt

A Wearing Course for High Traffic/High Load Applications

North Dakota Asphalt Conference
April 2, 2013
Bismarck, ND
Layered Pavement Design

Start with foundation but also start with the “end in mind”..the wearing course
Stone Matrix Asphalt is a coarse graded rut resistant engineered hot mix asphalt surface layer.

It is composed of a strong aggregate skeleton, and a binder mastic composed of a high asphalt cement content, a cellulose or mineral fiber and high percentage of mineral filler.
Comparison
SMA - Dense Graded
HBP
USA History

* Result of 1990 European Asphalt Study Tour
* Used in Europe for more than 20 years
* 1991 TWG
* 1994 first guidelines printed
* 1991 first SMA placed in US ~ 4 states
* 1997 over 28 states had tried
* 1999 NCAT developed mix design
SMA in the USA

(100 projects/28 States/2 million tons)

* Marshall- 50 blow design
* 80% used 19 mm gradation
* 2/3 of projects 6% or more asphalt cement
* 65% used fiber
* Thickness 1.5 to 2 inches, typical surface layer
* Majority had 95% or better in-place MTD
. Summary of History
. TWG Guidelines
. Current Practices
. NCHRP 9-8 Results
NCAT Study (85 Projects)

- Rutting: 90% Projects < 4mm
- 25% of Projects = No Measurable Rutting
- More resistant to cracking
- No evidence of ravelling
Performance

• **Georgia**
  - 30%-40% Less rutting
  - 3 - 5 times greater fatigue cracking resistance

• **Germany**
  - 20 - 30 year service life

• **Noise**
  - 2 - 7 dB(A) quieter than dense graded HMA
# Typical Aggregate Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Requirement Value</th>
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</thead>
<tbody>
<tr>
<td>LA Abrasion</td>
<td>30 Max.</td>
</tr>
<tr>
<td>Flat &amp; Elongated</td>
<td>20% max. (3:1)</td>
</tr>
<tr>
<td></td>
<td>5% max. (5:1)</td>
</tr>
<tr>
<td>Soundness ($\text{Na}_2\text{So}_4$)</td>
<td>15 % max.</td>
</tr>
<tr>
<td>Crushed Face</td>
<td>100% min.</td>
</tr>
<tr>
<td>FAA</td>
<td>45 min.</td>
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<tr>
<td>PL/LL</td>
<td>NV/NP</td>
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</tbody>
</table>
Typical Aggregate Requirements

Nominal Maximum Aggregate Size SMA Mixes

4.75 mm (1/4”)
9.5 mm (3/8”)
12.5 mm (1/2”)
19 mm (3/4”) - Non Surface/Wearing Course
25 mm (1”) - Non Surface/Wearing Course
Typical Aggregate Requirements

12.5 mm SMA

Percent Passing

0  20  40  60  80  100

0.075  1.18  4.75  12.5  19  25  37.5
## Typical Mixture Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Value</th>
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<tbody>
<tr>
<td>Design Compaction</td>
<td>Marshall 50 blow</td>
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<tr>
<td></td>
<td>SGC 75 Ndes</td>
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<tr>
<td>Asphalt Content</td>
<td>6% Min.</td>
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<tr>
<td>Air Voids</td>
<td>4.0%</td>
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<tr>
<td>VMA</td>
<td>17.0 min.</td>
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<tr>
<td>TSR</td>
<td>70 min.</td>
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<tr>
<td>Draindown</td>
<td>0.3% Max.</td>
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</table>
Production

- Calibrate mineral filler, fiber and antistrip & maintain interlock
- Establish and maintain mixing time
  - It may be longer
- Use multiple drops when loading trucks
- Minimize storage time
  - Temperature and draindown
Summary

- SMA is a premium high performance surface
  - Rut resistant
  - Crack resistant
- Requires high quality materials
  - Hard cubical aggregates
  - Polymer modified asphalts
  - Fibers and quality mineral filler
- Provides a high friction/low wear surface (eliminating chip seals or surface treatments)
- Can be placed at a lift thickness of 1-1/2” to 1-3/4” (12.5 mm NMAS)
- Yield = 1,300 ton/mile for 1-1/2” thickness @ 26’
SMA: Stone Mastic Asphalt
A Look at the Evolution of Class S Mix in South Dakota

First “Designed” SMA in SD:
Class S “Modified”
Interstate 29 Beresford-Canton
2004
## Class S Modified Tonnages in SD

<table>
<thead>
<tr>
<th>Year</th>
<th>Tonnage</th>
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<tr>
<td>2012</td>
<td>33,450</td>
</tr>
<tr>
<td>2011</td>
<td>208,700</td>
</tr>
<tr>
<td>2010</td>
<td>121,700</td>
</tr>
<tr>
<td>2009</td>
<td>243,700</td>
</tr>
<tr>
<td>2008</td>
<td>46,500</td>
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<td>2007</td>
<td>0</td>
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<tr>
<td>2006</td>
<td>98,000</td>
</tr>
<tr>
<td>2005</td>
<td>50,000</td>
</tr>
<tr>
<td>2004</td>
<td>60,000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>862,050</td>
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