CLASS S MIX

Rick Rowen
SDDOT Bituminous Engineer
• AC Driving Surface Options (Higher ESALs)
  – Stone Matrix Asphalt (SMA)
  – Class S (in past used with limestone out West)
  – Micro-surfacing
  – Macro-surfacing
  – Open Graded Friction Course (OGFC)

• AC Driving Surface Option (Lower ESALs)
  – Class Q (gyratory design used on most projects)
  – Chip seal (needed on Q mixes)
- South Dakota Standard S Aggregate since 1965
- Gradation Bands

<table>
<thead>
<tr>
<th>Gradation Bands</th>
<th>S Type 1</th>
<th>S Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Passing</td>
<td>% Passing</td>
<td></td>
</tr>
<tr>
<td>3/4&quot; (19mm)</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1/2&quot; (12.5mm)</td>
<td>86 – 100</td>
<td>100</td>
</tr>
<tr>
<td>3/8&quot; (9.5mm)</td>
<td>66 – 80</td>
<td>80 – 100</td>
</tr>
<tr>
<td>#4 (4.75mm)</td>
<td>24 – 34</td>
<td>24 – 45</td>
</tr>
<tr>
<td>#8 (2.36mm)</td>
<td>10 – 20</td>
<td>10 – 22</td>
</tr>
<tr>
<td>#200 (.075mm)</td>
<td>4.0 – 8.0</td>
<td>2.0 – 5.0</td>
</tr>
</tbody>
</table>
### South Dakota Gradation Bands

<table>
<thead>
<tr>
<th></th>
<th>SMA % Passing</th>
<th>S Modified % Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>¾ “ (19mm)</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>½ “ (12.5mm)</td>
<td>85 – 95</td>
<td>86 - 100</td>
</tr>
<tr>
<td>3/8” (9.5mm)</td>
<td>50 – 72</td>
<td>66 - 80</td>
</tr>
<tr>
<td># 4 (4.75mm)</td>
<td>20 – 28</td>
<td>24 - 34</td>
</tr>
<tr>
<td># 8 (2.36mm)</td>
<td>15 – 25</td>
<td>10 - 20</td>
</tr>
<tr>
<td># 200 (.075mm)</td>
<td>8.0 – 12.0</td>
<td>6.0 – 10.0</td>
</tr>
</tbody>
</table>
### Class S Tonnage in SD

<table>
<thead>
<tr>
<th>Year</th>
<th>Tonnage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>50,000</td>
</tr>
<tr>
<td>2006</td>
<td>98,000</td>
</tr>
<tr>
<td>2007</td>
<td>0</td>
</tr>
<tr>
<td>2008</td>
<td>46,500</td>
</tr>
<tr>
<td>2009</td>
<td>90,250</td>
</tr>
<tr>
<td>2010</td>
<td>121,700</td>
</tr>
<tr>
<td>2011</td>
<td>211,600</td>
</tr>
<tr>
<td>2012</td>
<td>70,100</td>
</tr>
</tbody>
</table>
• **Overlay Decisions**
  – Desire for a surface course with a texture that would not require a chip seal
  – Durability and strength to withstand the impact of high ESALs and have good fatigue resistance

• **S used since 1970’s for surface course ½” to 1.5”**
• **Mainly used in Hills Area with limestone**
• **Euclid Ave. in Pierre is 1 ¼” Class S Mod. (1996)**
• **Need to have stone on stone contact**
SMA, OGFC, Superpave or Q

4” to 6” Zone Of High Compression

High Modulus Rut Resistant Material

Max Tensile Strain

Flexible Fatigue Resistant Material

Pavement Foundation
• Contractor and DOT employee training
• SDDOT mix design using gyratory compactor
• Plant modifications, lower production rate
• Accurate fiber and mineral filler feeds
• Constant high mix delivery temperature (polymer)
• Placement (little if any hand work)
• In place density DOT controlled (vibratory breakdown rolling and then static steel)
• Avoid aggregate fracture from excessive vibratory roller passes
• SDDOT S Modified mix design
  – Gyratory compactor  75 to 100 gyrations
  – Stone on stone contact (NAPA Publication 1999)
    • Calculation for VCA_{drc} > VCA_{mix} in AASHTO R46
  – Absorption for + #4 aggregate (< 1.5%)
  – Draindown test  SD 306 (<0.3%)
    • Cellulose fibers
  – Asphalt Pavement Analyzer
    • Rutting test
Asphalt Pavement Analyzer (TP 63-03)

• Gyratory samples compacted to Ndes (4 % Air Voids)
• test at High PG binder temperature
• 8000 cycles, hose 100 psi and load 100 lbf
• record average of rut depth measurements
»Field sample tested in APA for rutting
• Plant modifications, lower production rate
• Accurate fiber and mineral filler feeds
• Constant high mix delivery temperature
• Do not fracture rock with vibratory rollers
• Placement (little if any hand work)
• Workability may be improved with Warm Mix Additive
• Uniform and warm mix delivery temperature
• Placement (little if any hand work)
• In place density DOT controlled (vibratory breakdown rolling and then static steel)
• Avoid aggregate fracture from excessive vibratory roller passes
• S Mod in 2005
  • (aggregate)– $23.50
  • 6.7 % PG 70-28 Binder - $20.10
  • 0.3 % Fibers - $1.58
  • Total $ 45.18
  • 11% higher

• Superpave in 2005
  • (aggregate)– $21.71
  • 6.0 % PG 64-34 Binder - $18.00
  • 0.5 % Lime - $0.54
  • Total $ 40.25
• S Mod in 2005
  • (aggregate)– $27.80
  • 5.7 % PG 64-34 Binder - $25.99
  • 0.3 % Fibers - $1.70

  • Total $ 55.49

  • 11% higher

• Q HVT in 2005
  • (aggregate)– $26.80
  • 5.0 % PG 64-34 Binder - $22.80
  • 0.5 % Lime - $0.54

  • Total $ 50.14
• S Mod in 2012
  • (aggregate) – $57.00
  • 5.7 % PG 64-34 Binder - $41.38
  • 0.3 % Fibers - $2.89
  • Total $ 101.27
  • 14% higher

• Q4 in 2012
  • (aggregate) – $50.00
  • 4.9 % PG 64-34 Binder - $35.57
  • 1.0 % Lime - $3.40
  • Total $ 88.97
• S Mod in 2012
  • (aggregate)– $37.00
  • 5.7 % PG 64-34 Binder - $44.40
  • 0.3 % Fibers - $2.01
  • Total $ 83.41
  • 13% higher

• Q4 in 2012
  • (aggregate)– $34.00
  • 5.0 % PG 64-34 Binder - $38.94
  • 0.5 % Lime - $0.58
  • Total $ 73.52
• S Mod in 2012
  • (aggregate)– $54.99
  • 6.4% PG 64-34 Binder - $53.58
  • 0.3% Fibers - $1.85
  • Total $110.42
  • 20% higher

• Q3 in 2012
  • (aggregate)– $44.10
  • 5.5% PG 64-34 Binder - $46.04
  • 1.0% Lime - $1.76
  • Total $91.90
Lessons Learned
OFFICE OF MATERIALS & SURFACING