Stone Matrix Asphalt
Best Management Practices

60th Annual Asphalt Contractors’ Workshop
MN Quality Initiative Workshop
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Brooklyn Center, MN
Background

• What is SMA?
  – “Stone Matrix Asphalt” is a tough, stable, rut-resistant mixture that relies on stone-on-stone contact to provide strength and a rich mortar binder to provide durability.

• What makes it different?
  – Gradation
  – Binder Content
  – Dust Content
  – Stabilizing Additives
Typical SMA Gradation

- **Superpave**
- **SMA**
- **Superpave Control Points**

<table>
<thead>
<tr>
<th>Sieve Size, mm</th>
<th>Percent Passing, %</th>
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<tbody>
<tr>
<td>0.075</td>
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<tr>
<td>0.60</td>
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<tr>
<td>1.18</td>
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<tr>
<td>2.36</td>
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<tr>
<td>4.75</td>
<td></td>
</tr>
<tr>
<td>9.5</td>
<td></td>
</tr>
<tr>
<td>12.5</td>
<td></td>
</tr>
<tr>
<td>19.0</td>
<td></td>
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</table>
What makes it different?

Stone Skeleton

Filler  Sand  Binder

Stabilizing Additives

Stones + Mastic

STONE  MASTIC  ASPHALT
Specifications, Materials, & Mix Design

• Proper specifications are a must!
  – Asphalt Binder & Modifiers
  – Aggregate Quality
  – Gradation
  – Mineral Fillers
  – Stabilizing Additives
  – Mix Volumetrics
Specifications, Materials, & Mix Design

- Asphalt Binder in SMA
  - Provide shear strength to maintain “stone-on-stone”
  - Provide internal cohesive strength
  - Perform at varying environmental conditions
    - Stability at high temperatures
    - Flexibility at intermediate temperatures
    - Resistance to cracking at low temperatures
- Modified asphalt binders necessary to accommodate temperature variations as well as extreme loading conditions
Aggregates in SMA

- Sound, durable, clean
- High angularity, cubical shape, no flat or elongated
- Proper grading
- Consistent production
- Proper handling for consistency
Gradation Concerns

- “Breakpoint” sieve has major influence
  - Typically the 4.75mm for surface mixes
- Sensitivity to fluctuations in dust content
- Potential for differences in specific gravity of coarse aggregates and mineral filler
  - Recommended to blend based on volume, not mass
• Mineral Fillers
  – Forms a stiff mastic or mortar with asphalt binder and stabilizing additive
  – Commonly used mineral fillers
    • Marble Dust
    • Agricultural Lime
    • Limestone Dust
    • Fly Ash
Stabilizing Additives

- Prevents the “draindown” or separation of the asphalt binder from the aggregate skeleton
- Also helps stiffen mastic or mortar
- Must be evenly distributed throughout mixture
- Historically, fiber additives have been used:
  - Cellulose Fibers (0.3% total mix)
  - Mineral Fibers (0.4% total mix)
- However, chemical additives are being evaluated and adopted in some states
Specifications, Materials, & Mix Design

• Mix Design for SMA
  – Blend aggregates based on volume, not mass
  – Trial blends to effectively target VMA (17-18%)
  – VCA measurement to ensure “stone-on-stone”
  – Target 4% air voids at optimum asphalt content
  – Verify TSR’s (≥ 80%)
  – Verify Draindown (< 0.3%)
• Evaluate Draindown
  – Anticipated plant temperature, and
    15°C above
  – < 0.30 %
## Specifications, Materials, & Mix Design

### Volumetric Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Recommended</th>
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</thead>
<tbody>
<tr>
<td>Air Voids</td>
<td>4.0%</td>
</tr>
<tr>
<td>VMA</td>
<td>17.0% min.</td>
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<tr>
<td>VCA\text{MIX}</td>
<td>&lt; VCA\text{DRC}</td>
</tr>
<tr>
<td>TSR</td>
<td>80% min.</td>
</tr>
<tr>
<td>Draindown</td>
<td>0.30 max.</td>
</tr>
</tbody>
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Production

- Material Storage & Handling
- Introduction of Materials
- Sampling of Mixture
- Continuous Production
Material Storage & Handling

- Proper techniques for building & maintaining aggregate stockpiles are a must
- Prevent aggregate stockpile contamination
  - Good base beneath stockpiles
  - Barriers or Distance to prevent cross-contamination
- Know what’s in your stockpiles
  - Stockpile verifications, prior to and during production
Production

- Material Storage & Handling
  - Mineral fillers must be kept dry
    - Coarser fillers may be treated as a cold-feed stockpile
    - Finer fillers most likely stored in silos and pumped
  - Store fiber additives in a ready-to-be-used state
    - Continuous production is critical to SMA quality
    - Minimize handling / Maximize efficiency
• Introduction of Materials
  – Proper calibration of aggregate cold-feed system
    • SMA is extremely sensitive to segregation
  – Proper feeding/metering of mineral fillers
    • If cold-feeding, watch for clumping/clogging
    • If pumping, proper calibration of metering
  – Proper metering of fibers
    • Setup guidelines for proper loading/unloading of feeder
• Sampling of Mixture
  – Proper techniques for obtaining representative samples
    • Gradation lends to segregation sensitivity
    • Keep shovels/scoops clean, scrape-off entirely during use
  – Minimize handling of samples
    • Sticky nature lends to sensitivity
    • Some recommend sampling directly into test container
Continuous Production

– May require more waste up-front than conventional
– Best to have dedicated plant
– Minimize storage times due to “draindown” potential
– Slow down production speed
Placement

• Mixture Delivery
  – Use insulated trucks with tarps
    • Mix temperature is critical to SMA quality, KEEP IT HOT!
  – Coordinate production rate with haul distance
    • Important for continuous plant operation
  – Keep the trucks clean
    • Utilize appropriate release agents
    • Provide truck clean-out area on job site
Placement

• Laydown
  – Utilize transfer devices
    • Keep the mixture consistent and hot
    • Prevents bumping of paver and keeps it moving
  – Pre-heat equipment (RELEASE AGENTS!!!)
  – Minimize or Eliminate handwork
  – Move at a pace to accommodate rollers
    • Coordinate paver speed with production, delivery, and compaction
Placement

- Compaction
  - Keep rollers close to paving machine
    - Typically 3 rollers utilized (2 breakdown and 1 finishing)
    - Compaction needs to be performed immediately while mixture is hot (+300°F)
  - Monitor mat temperatures
    - Nearly impossible to correct mat defects
  - Avoid stopping on hot mat!
Do We Really Need Those Expensive Stabilizing Additives?

- Maryland: Yes!
- Georgia: Yes!
- Alabama: Yes!
- Mississippi: Yes!
Questions?

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