Porous Open Stone Graded Friction Matrix Course Asphalt Pavement

Stone Matrix Asphalt, Porous Open-Graded Friction Course, Friction Matrix Course Asphalt Porous Pavement

NAPA
NATIONAL ASPHALT PAVEMENT ASSOCIATION
Stone Matrix Asphalt (SMA)

• Premium Surface Mix
• Stone-on-Stone Contact
• Voids Filled
  – Asphalt
  – Filler
• Long Lasting
  – Minimize Rutting
  – Minimize Cracking
Components of SMA

- Aggregate
- Asphalt Cement
- Polymer Modifier
- Mineral Filler
- Fiber Stabilizer
- Hydrated Lime (as needed)
Aggregate Skeleton
Stone Matrix Asphalt Mix
No more than 20%  3:1
No more than 10%  5:1
Asphalt Matrix

- Asphalt Cement
- Polymer
- Fiber
- Mineral Filler
Increased Film Thickness

SMA has 25% thicker film coating than conventional dense graded mix.
HOV Construction in Atlanta

- 330 Lane Miles
- $41 Million Project
- 200,000 Tons SMA
- 20% Increased Traffic Capacity
- Improved Air Quality
Smoothness of SMA Southbound Lanes

Inches/Mile

Project Mileposts

Specification Correction Level

Project Average
SMA Test Results

Sieve Size (mm)

<table>
<thead>
<tr>
<th>Sieve Size (mm)</th>
<th>Percent Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.5</td>
<td>6.0</td>
</tr>
<tr>
<td>9.5</td>
<td>5.5</td>
</tr>
<tr>
<td>4.75</td>
<td>4.5</td>
</tr>
<tr>
<td>2.36</td>
<td>3.5</td>
</tr>
<tr>
<td>0.300</td>
<td>2.5</td>
</tr>
<tr>
<td>0.075</td>
<td>1.5</td>
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<tr>
<td>% AC</td>
<td>0.5</td>
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SMA Annualized Costs are 37% lower than Conventional Mix

Annualized Cost per Mile

SMA: $50,095
Conventional: $79,532
Stone Matrix Asphalt
Intrinsic Benefits

• 30-40% less rutting than conventional mixes
• 3-5 times greater fatigue life
• Europeans experience 30-40% longer service life
• Lower annualized cost
Michigan Noise Study

Range is 98 to 101 {3 dB(A)}
Some States Using SMA

- Georgia
- Maryland
- Illinois
- Indiana
- Louisiana
- Michigan
- Wisconsin
- Colorado
- Virginia
Reference:
Open-Graded Friction Course (OGFC)
What we want:
Materials

- Hot Mix Asphalt
  - Open Graded Aggregate
  - Crushed Faces
    - 100% 1-face
    - >90% 2-faces
  - Modified Binder - Recommended
  - Fibers - Recommended
  - Void Content > 18%

<table>
<thead>
<tr>
<th>Size</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>3/4&quot;</td>
<td>100%</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>85 to 100%</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>35 to 60%</td>
</tr>
<tr>
<td>No. 4</td>
<td>10 to 25%</td>
</tr>
<tr>
<td>No. 8</td>
<td>5 to 10%</td>
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<tr>
<td>No. 200</td>
<td>2 to 4%</td>
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Georgia OGFC

- All Interstates and State Routes with ADT > 25,000
- 850,000 tons since 1993
- Characteristics
  - Gap-grading
  - Fibers
  - Polymer Modified AC
  - 20 - 24% Air Voids
- 12.5 mm PEM
- 12.5 mm SMA
- 19.0 mm SMA
- 25.0 mm (Base)
- Coarse Superpave Mix
- Stone Matrix Asphalt Mix
- Open Graded Friction Course
<table>
<thead>
<tr>
<th>Noise Levels By Surface Type</th>
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<tr>
<td>104.9</td>
</tr>
<tr>
<td>102.5</td>
</tr>
<tr>
<td>99.1</td>
</tr>
<tr>
<td>95.5</td>
</tr>
<tr>
<td>91.8</td>
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</table>
Some States Using OGFC

- Georgia
- Florida
- Alabama
- Texas
- Arizona
- California

- New Jersey
- Rhode Island
- Massachusetts
- Oregon
Design, Construction, and Maintenance of Open-Graded Asphalt Friction Courses
Porous Pavement

- Porous Surface
- Porous Base
- Allow Infiltration
- Reduce Drainage Features
- Save Land and Trees
What We Usually Do.
Storm Sewer Inlet

Drainage Field

What We Usually Do.
RAINFALL
45"/YR

REDUCED INFILTRATION
THROUGH REGRADOED AND
COMPACTED SOILS IN
GRASSES

0" OF INFILTRATION
UNDER IMPERVIOUS
SURFACES

REDUCTION IN BASE
FLOW BY 15"/YR
UNDER IMPERVIOUS
SURFACES

2"
EVAPORATIVE
LOSS FROM
IMPERVIOUS
SURFACES

43" RUNOFF FROM
IMPERVIOUS COVERAGE
Advantages

- Reduced surface runoff
- Better erosion control
- Better water quality
- Reduced storm sewer requirements
- Maintain natural drainage paths
- Reduced standing water nuisance
- Better GWT recharge
- Better skid resistance
RIVERJACKS OPEN INTO RECHARGE BED

POROUS ASPHALT PAVEMENT

UNCOMPACTED SUBGRADE IS CRITICAL FOR PROPER INFILTRATION

FILTER FABRIC LINES THE SUBSURFACE BED

UNIFORMLY GRADED STONE AGGREGATE WITH 40% VOID SPACE FOR STORMWATER STORAGE AND RECHARGE
Walden Pond
Concord, MA

- Paved in 1977
- 600,000 visitors per year
- Freezing winter conditions
- Still in use 26 years later
University of North Carolina
Chapel Hill
Friday Center Park & Ride

- University - City Agreement - No increase in GW pollution
- Design: Cahill Associates and Rose Group
- Construction: Mangum Group
- 800 vehicle lot
- $2500/stall vs $3000/stall conventional
- Grand Conceptor Award - Am. Council of Engrg. Companies of NC
Placement of Fabric
Paving Operation
Drainage Demonstration
Design Considerations

• Soils
  – Full infiltration needs $k \geq 0.50\text{ inches/hr}$
  – Partial infiltration needs $k \geq 0.25\text{ inches/hr}$
• Frost - Consider in reservoir depth
• Blowing dust - avoid
• Erosion from surrounding terrain - avoid
Design Considerations

- Slope \( \leq 5\% \)
- Typically use 6-mo/24-hr event
  - More conservative 25-yr/24-hr event
- Layers
  - Porous Asphalt (>18% voids)
  - Top Filter - Crushed Stone
  - Reservoir - 1.5 - 3" Crushed Stone (min 8 - 9")
  - Bottom Filter - Crushed Stone
  - Fabric
Vehicle Loading

• Best for:
  – Parking lots
  – Recreational areas
  – Sports complexes

• High volume automobile traffic or truck traffic - Consider using Asphalt Treated Permeable Base
Conclusions

• Numerous Advantages to Porous Asphalt Pavements
• Examples of Successful Facilities
• Need Flat Site with Permeable Soils and Low GWT
• Need Low Traffic
• Attention to Detail in Construction
• Maintenance is Important