Fine-Graded Mixes

Illinois Asphalt Pavement Association
Annual Meeting

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What is a **Fine-Graded** Mix?

- In the past...it was called a "sand" mix

- Today...most use the % passing the Primary Control Sieve relative to the Maximum Density Line

- With the *Bailey Method*...it’s a function of **CA** and **FA** Volume
### Typical Fine-Graded Designation

<table>
<thead>
<tr>
<th>Nominal Maximum Aggregate Size</th>
<th>Primary Control Sieve Above is Fine-Graded</th>
<th>Below is Coarse-Graded</th>
<th>IDOT Max % Passing N90 &amp; N105 Mixes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1” (25mm)</td>
<td>40% Passing 4.75mm</td>
<td></td>
<td>40%</td>
</tr>
<tr>
<td>3/4” (19mm)</td>
<td>47% Passing 4.75mm</td>
<td></td>
<td><strong>40%</strong></td>
</tr>
<tr>
<td>1/2” (12.5mm)</td>
<td>39% Passing 2.36mm</td>
<td></td>
<td><strong>40%</strong></td>
</tr>
<tr>
<td>3/8” (9.5mm)</td>
<td>47% Passing 2.36mm</td>
<td></td>
<td><strong>40%</strong></td>
</tr>
</tbody>
</table>

Info from Fine-Graded Literature Review Performed by Murphy Pavement Technology
With the **Bailey Method**

A **Fine-Graded** Mix...

- CA Volume < CA LUW
- Little to No particle-to-particle contact of CA
- **Fine** fraction carries most of the load
- Increased amount of FA support needed
Do Other States Specify *Fine-Graded* Mixes?

- No...
  - Typically gradation bands allow the Contractor to choose C-G or F-G.
  - Often...HMA used for Federal Aviation Admin. are *fine-graded*.
  - But even their gradation bands typically allow a choice.
Should *Fine-Graded* Mixes Be Specified?

- No...

- *Except*... when lift thickness is too thin to allow a *Coarse-Graded* mix to be compacted adequately without causing degradation of the aggregate structure.

- *Examples*...
  - 9.5mm (3/8”) Level Binder
  - 19.0mm (3/4”) Binder
# HMA Lift Thickness vs. NMAS and Mix Type

<table>
<thead>
<tr>
<th>Nominal Maximum Aggregate Size</th>
<th>NCAT Coarse-Graded 4 x NMAS</th>
<th>NCAT Fine-Graded 3 x NMAS</th>
<th>IDOT Specification 3 x NMAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.5mm (3/8&quot;)</td>
<td>1-1/2&quot;</td>
<td>1-1/8&quot;</td>
<td>1-1/4&quot;</td>
</tr>
<tr>
<td>12.5mm (1/2&quot;)</td>
<td>2&quot;</td>
<td>1-1/2&quot;</td>
<td>1-1/2&quot;</td>
</tr>
<tr>
<td>19.0mm (3/4&quot;)</td>
<td>3&quot;</td>
<td>2-1/4&quot;</td>
<td>2-1/4&quot;</td>
</tr>
<tr>
<td>25.0mm (1&quot;)</td>
<td>4&quot;</td>
<td>3&quot;</td>
<td>3&quot;</td>
</tr>
</tbody>
</table>

Info from Fine-Graded Literature Review Performed by Murphy Pavement Technology
Stretching Our Comfort Zone...

- Rutting Potential?
- Require More AC?
- Less AC Film Thickness?
- Stripping Potential?
- Less Friction?
- Issues Meeting VMA?
- Crushed FA Availability?
- Use of RAP?

Superpave...

- Gradation Control Points
- ESAL Driven Items:
  - CA Angularity
  - FA Angularity
  - Flat & Elongated
  - Depth in Structure
  - Volumetrics (NMAS)
  - TSR (Stripping)
  - Dust to Effective AC Ratio
VMA = Voids + Effective AC
The **Key** to *Fine-Graded* Mixes

- Properties of the **FINE** fraction...
  - Gradation
  - Shape
  - Strength
  - Texture

- IDOT addresses with a minimum 67:33 sand blend requirement for Manufactured vs. Natural
Fine Aggregate Angularity

- **Method A**
  - **Fixed** Gradation
  - Measures **Loose** Voids that are a function of:
    - **Shape and Texture**
  - **Natural** 37 – 44%
  - **Manufactured** 42 – 52%
  - **Combined** **FAA** requirement a function of Traffic Level
Advantages of Fine-Graded Mixes

- Less permeability at the same density
- Less susceptible to segregation
- Less sensitive to gradation variability on the PCS
- More compactable...
- Improved Aesthetics (Less Macro-texture)
Advantages of *Fine-Graded* Mixes

- Generally easier to compact, primarily due to lift thickness vs. NMAS
  - Min and Max lift thickness for **C-G** and **F-G**
    - 4 to 8 x NMAS for **Coarse-Graded**
    - 3 to 6 x NMAS for **Fine-Graded**
  - Less degradation during field compaction?
  - Improved smoothness because the mix isn’t being over-rolled?

Impact for PFP?
Impact on LJT Performance?
Designing, Producing & Constructing **Fine-Graded** Hot Mix Asphalt on IL Roadways  
*(IHR27-79)*

- **Phase 1: Literature review**
  - Review historical development of IDOT HMA specs
  - Interview various IDOT Personnel
  - Gather info from other states, FAA, and intermodal uses with similar traffic, climate, and aggregate resources

- **Phase 2: Mix Designs**
  - Development of the various aggregate structures for the Fine-Graded mixes using the Bailey Method

- **Phase 3: Lab Performance Testing**
  - Hamburg wheel and the AMPT

- **Phase 4: Field Testing**
  - Mixes placed and tested with ATLAS loading at ICT
  - Potential use on IDOT project

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**Matt Mueller**

**Patty Broers**

**Steve Hefel**

**Steve Robinson**

**Laura Shanley**

**Hal Wakefield**

**Brett Williams**

**Frank Mathewson**

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**Imad Al-Qadi**

**Sam Carpenter**

**Tim Murphy**

**Bill Pine**
Thin, Quiet, Long Lasting, High Friction, Surface Layer (IHR 27-42)

- Task 1: Literature Review
- Task 2: Field Data Survey and Analysis
  - Collect info on various pavement surfaces
- Task 3: Laboratory Experiment Program
  - Fine-Graded SS/Dolomite with Fibers
  - Fine-Graded Quartzite/Dolomite
  - Fine-Graded Dolomite for use with Sprinkle Treatment
  - SMA 4.75mm NMAS Quartzite with CRM AC
  - Various Lab Performance Tests
- Task 4: Field Testing
  - DRAFT Special Provision in Progress
  - Proposed 2010 District 1 Project
- Task 5: Engineering Benefit Analysis

- Tom Zehr
- Abdul Dahhan
- Patty Broers
- Jim Trepanier
- Dave Lippert
- LaDonna Rowden
- Hal Wakefield
- John Lavalee
- Bill Pine
- Imad Al-Qadi
- Sam Carpenter
- Jeff Kern