Basics of a Good Road
Hot Mix Asphalt Pavement
Materials Selection

Presented at 2004 Road School
By M. Dudley Bonte
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Basics of HMA Pavement
Performance

• Appropriate Specifications
• Adequate and Properly Prepared Base
• Adequate Thickness for Traffic Use
• Appropriate and Quality Materials
• Appropriate Blend of Materials (Mix Design)
• Plant Production Control (Mixture QC)
• Placement Control (Transporting, Paving and Compaction QC)

Performance Characteristics in a Hot Mix Asphalt (HMA) Pavement

• Stable
• Durable
• Flexible
• Fatigue Resistant

• Crack Resistant
• Workable
• Smooth and Safe (skid resistant)
• Impermeable

So how do you make hot mix asphalt?
Composition of Hot Mix Asphalt Pavement

- Aggregates (coarse, fine, mineral filler)
- Binder (petroleum asphalt refined from crude oil, AKA asphalt cement)
- Air
- RAP (recycled asphalt pavement)
- Additives, Modifiers (fibers, polymers)
- Blended in the correct proportions

Approximate Blend in HMA Pavement

<table>
<thead>
<tr>
<th>Material</th>
<th>% by Weight</th>
<th>% by Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate</td>
<td>95</td>
<td>80</td>
</tr>
<tr>
<td>Binder (AC)</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Air</td>
<td>-</td>
<td>8</td>
</tr>
</tbody>
</table>

Aggregate Types in Indiana

- Limestone
- Dolomite Limestone
- Sandstone
- Blast Furnace Slag (BFS)
- Steel Furnace Slag (SFS)
- Sand and Gravel
AGGREGATE PROPERTIES

- Quality (INDOT CAPP Producer)
  - Soundness (Freeze/thaw)
  - Abrasion Resistance (toughness)
  - Deleterious/Non-durable
  - Specific Gravity/Absorption

AGGREGATE PROPERTIES

- Shape and Texture
  - CAA Crushed Content
  - FAA Fine Aggregate Angularity
  - Texture Skid resistance

AGGREGATE PROPERTIES

- Size
  - Maximum Nominal Particle Size
  - Gradation (particle size distribution)
  - Dust (#200 sieve, decant+)
    - Type, Sand Equivalent
    - Atterberg Limits (LL, PL, PI)

Usual PG Grades

- PG64-22 Most Common
- PG70-22
- PG76-22
- Use 1 Grade lower for >15% RAP (e.g., use PG58-28 when PG64-22 is specified and mixture contains greater than 15% RAP)

One size does not fit all...
What Determines Mix Type

- ESAL’s
  - Traffic Type and Volume
  - Design life
- Traffic Speed
  - High, Slow or Stopped
- Layer
  - Base, Intermediate, Surface, Drainage
- Design Thickness

18 kip - ESAL’s

One

= 6000

Superpave Aggregate Table

<table>
<thead>
<tr>
<th>ESAL Cat.</th>
<th>&lt;0.3M</th>
<th>3-3M</th>
<th>3-10M</th>
<th>10-30M</th>
<th>&gt;30M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Gyrations</td>
<td>50</td>
<td>75</td>
<td>100</td>
<td>100</td>
<td>125</td>
</tr>
<tr>
<td>CAA top 4”</td>
<td>55</td>
<td>75</td>
<td>85/80</td>
<td>95/90</td>
<td>100</td>
</tr>
<tr>
<td>CAA below 4”</td>
<td>-</td>
<td>50</td>
<td>75</td>
<td>85/80</td>
<td>100</td>
</tr>
<tr>
<td>FAA Top 4”</td>
<td>-</td>
<td>40</td>
<td>45</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>FAA Below 4”</td>
<td>-</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>45</td>
</tr>
</tbody>
</table>

HOW DO WE DETERMINE THE COMPOSITION?

- Trial and Error
  - Generic JMF from historical experience (cookbook, pre 1985 in Indiana)
- Mix Design Methods
  - Superpave® System (SP Gyratory Compactor)
  - Marshall Method

Who does mix designs?

- INDOT approved labs
  - Contractors
  - Binder Suppliers
  - Consulting Engineers
- AASHTO Inspections
- AMRL Reference Samples
- AASHTO Accreditation

What is an HMA Mix Design?

- A laboratory process for material selection and proportioning to develop a job mix formula (JMF)
SUPERPAVE LABORATORY DESIGN METHODS

- Gyratory Compactor (SGC)
- Superpave Gradation Master Bands
- Traffic Categories (ESAL’s)
- Aggregate properties (consensus)
- Trial blends (trial and error)
- Blend selection and binder content
- Stripping test verification
- Advanced performance testing

HMA Mix Design Process

- Specifications
- Material availability
- Aggregate histories and properties
- Predict plant production influence
- Trial aggregate blends (paper blends)
- Laboratory trial batches (compacted)
- Analysis of trials and final design testing

Design Test Properties

- Maximum Specific Gravity
- Bulk Specific Gravity
- Voids in the Mineral Aggregate (VMA, packing of the aggregates)
- Air Voids (AV)
- Voids filled with Asphalt (VFA)
- Moisture sensitivity

Mix Design is only the start of HMA performance........

It also takes....
INDIANA DEPARTMENT OF TRANSPORTATION

STANDARD SPECIFICATIONS

EFFECTIVE FOR LETTINGS ON OR AFTER SEPTEMBER 1, 2003

Includes November 14, 2002 Minutes

1999

Proper Specifications

Test Methods

Appropriate and Quality Materials

Including Aggregates

PG Binders

Proper Proportioning and Mixing
Proper Transportation and Placement

Quality Sampling and Testing

Sufficient Compaction

A Helping Hand.......
APAI Guide Specification for Local Governments

Thank you
Any Questions?