Asphalt Pavement Durability
The Role of Superpave5

Gerry Huber
Heritage Research Group
October 22, 2020
Why is it?
That roads start like this?
And end up looking like this
First of All

Asphalt

Let’s Talk About
How Does Asphalt Work?
How does asphalt age?
Film Thickness:
- Purdue University
- Open-Graded mixes
- Air voids
  - 21.0 to 35.0%
- Film Thickness
  - 5.1 to 43.9 µm

How can asphalt aging be controlled?

Purdue Research Paper 1976-19
Effective Volume Asphalt?

- Shows medium strength relationship with penetration after aging.

\[ R^2 = 0.49 \]

Purdue Research Paper 1976-19
Permeability

- Correlation of asphalt aging to mixture permeability
  - Different film thickness
  - Different asphalt contents
  - Different air voids

$$R^2 = 0.9863$$
Air Voids (in-place)

- Purdue University
- Dense-graded mix
- 5.5% asphalt
- Vary compaction
- Air voids
  - 1.0% to 11.1%

Does Control Aging

Purdue Research Paper 1976-19
Superpave 5 Concept

- Mix Design
  5% air voids

- Field Compaction
  95% Gmm
SR 13, Middlebury, Indiana

- 2013 Trial Project
- 13,400 AADT
- 19% heavy trucks
Counter-Flow Drum Mix Plant
Material Transfer
## Mix Construction Properties

<table>
<thead>
<tr>
<th></th>
<th>Superpave4</th>
<th></th>
<th></th>
<th>Superpave5</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Design</td>
<td>QC</td>
<td>QA</td>
<td>Design</td>
<td>QC</td>
<td>QA</td>
</tr>
<tr>
<td>Asphalt, %</td>
<td>5.1</td>
<td>5.1</td>
<td>5.0</td>
<td>5.4</td>
<td>5.5</td>
<td>5.2</td>
</tr>
<tr>
<td>Air Voids, %</td>
<td>4.0</td>
<td>3.5</td>
<td>4.1</td>
<td>5.0</td>
<td>4.5</td>
<td>4.0</td>
</tr>
<tr>
<td>Density, %Gmm</td>
<td>-</td>
<td>-</td>
<td>91.6</td>
<td>-</td>
<td>94.7</td>
<td>96.9</td>
</tr>
</tbody>
</table>
Cores Taken 2018
Permeability

Permeability, CM/DAY vs. Air voids, %

- Superpave4
- Superpave5
Asphalt Binder Grade

<table>
<thead>
<tr>
<th>Temperature, °C</th>
<th>Superpave4</th>
<th>Superpave5</th>
</tr>
</thead>
<tbody>
<tr>
<td>HT</td>
<td>100</td>
<td>94</td>
</tr>
<tr>
<td>LT</td>
<td>-16</td>
<td>-21</td>
</tr>
</tbody>
</table>
Correlation PG High Temp to In-Place Air Voids

\[ R^2 = 0.9117 \]
Correlation PG Low Temp to In-Place Air Voids

\[ R^2 = 0.8885 \]
Correlation Delta Tc to In-Place Air Voids

\[ R^2 = 0.9544 \]
Specification Revisions

- Air Voids at $N_{\text{des}} = 5.0\%$
- Design Gyrations
  - $100 \rightarrow 50$
  - $75 \rightarrow 30$
- Density LSL = 93.0\%
INDOT Implementation

- 10 pilot projects in 2018
- Allowed by “opt-in” basis for 2019
- Effective for all mixes in 2020
Superpave5 Density (2019)

- Superpave4
  - Average = 93.19%
  - 899 sublots

- Superpave5
  - Average = 94.53%
  - 1000 sublots
Superpave5 Air Voids (2019)

- Superpave4
  - 3.91%
  - 899 sublots
- Superpave5
  - 4.71%
  - 1000 sublots
What does it all mean?

- Asphalt Binder Aging
  - Most strongly related to permeability
- Superpave 5
  - Increase in-place density
  - Reduce in-place permeability
  - No increase in cost
Thank You!