2008 – 2010 TRIAL SECTIONS

Laboratory & Field Evaluations
# Trial Sections Guidelines

## Mix Properties

<table>
<thead>
<tr>
<th>Test Procedures</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Materials Moisture</td>
<td>Total Evaporable Moisture Content of Aggregate T255</td>
</tr>
<tr>
<td>2. Mixes residual moisture</td>
<td>Moisture Content of Asphalt Mixes T329</td>
</tr>
<tr>
<td>3. Volumetrics</td>
<td>Comparative VMA and air voids R35</td>
</tr>
</tbody>
</table>
| 4. Moisture Sensitivity | - Tensile Strength Ratio with Freeze/Thaw T283  
- Hamburg Loaded Wheel Test, HLWT T324 |
| 5. Mix Mechanical Performances | - APA rut susceptibility / HLWT TP63  
- SPT Dynamic Modulus and Flow number TP62 |
| 6. Mix Low T° cracking | - Thermal Stress Restrained Specimen Test / DC(T) Fracture En. TP10 |
| 7. Binders Properties | - Recovered binders’ comparative PG study, including viscosity and the Multi Stress Creep & Recovery (MSCR) test. T315 |

## Production Data

- Plant set-up  
- Actual % Water added, Actual % RAP added  
- Production rate, Fuel Consumption per ton  
- Mix T° in Chute and in trucks  
- Silo retention time  
- Gas T° @ Dryer exit, Baghouse Inlet & Outlet  
- O2, CO, NOx readings at fan

## Construction Data

- Temperature in-coming Trucks  
- Density vs. Mat temperature vs. Number of roller passes.  
- Cores densities
I-55 / 57 WMA Project
2009-2010 Missouri

Project:

- I-55-57 PCC highway rehabilitation
- 260,000 tons Asphalt Mix in 2 years.
- 66 lanes-miles / 106 km
- Binder course design: SP 190 PG 76-22
  0% RAP – 125 Gyrations
- Surface Course: Hot Mix Stone Matrix
- Shoulders: Marshall Design
- Mobile Plant: 400 t/h Parallel Flow Cedar Rapids
  70 tons surge bin
- Foam Device: MAXAM – AQUABLACK.
Project

- Rte 132 Clermont Co, Ohio - 10.2 miles
- Part of 2008 ODOT 6 WMA DG Field Trials
- Plant: Double Drum ASTEC w/ DG
- 7,500 tons intermediate course PG 64-28P;
- 6,500 tons surface course: Type 1H Heavy Traffic - 75 blows 10% RAP PG 70-22P
Foamed AC expansion facilitates coating at lower T°

Foamed AC is “Shear Thinning”:

- High Viscosity without Shear
- Low Viscosity with Shear
I-55 / 57 WMA Project

- FHWA Mobile Laboratory on site
- AMPT Asphalt Material Performance Testing
I-55 / 57 WMA Project

Contract Specifications Control

Volumetrics

<table>
<thead>
<tr>
<th></th>
<th>Gsb</th>
<th>AC (%)</th>
<th>Gmm</th>
<th>Gse</th>
<th>Pba (%)</th>
<th>VMA (%)</th>
<th>Va (%)</th>
<th>VFA (%)</th>
<th>Lab Comp. T°</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMA</td>
<td>2.689</td>
<td>4.4</td>
<td>2.520</td>
<td>2.698</td>
<td>1.0</td>
<td>13.5</td>
<td>3.4</td>
<td>74.4</td>
<td>315°F</td>
</tr>
<tr>
<td>WMA</td>
<td>2.687</td>
<td>4.5</td>
<td>2.519</td>
<td>2.705</td>
<td>1.9</td>
<td>13.4</td>
<td>3.2</td>
<td>75.9</td>
<td>290°F</td>
</tr>
</tbody>
</table>

Field Density

<table>
<thead>
<tr>
<th></th>
<th>I-55 - I-57</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HMA</td>
</tr>
<tr>
<td>Average Production T°</td>
<td>347°F / 175°C</td>
</tr>
<tr>
<td>Compaction T° range</td>
<td>320-230°F / 160-110°C</td>
</tr>
<tr>
<td>Average final compaction, % Gmm</td>
<td>94%</td>
</tr>
</tbody>
</table>
Moisture Sensitivity

Tensile Retained Strength Test – ASTM D4867

Delta I-55 / 57
Delta Company
Missouri

Rte 132
Barrett Paving
Ohio
**Hamburg Loaded Wheel Test**

Classifies asphalt mixtures in terms of rutting potential and moisture susceptibility.
APA Rutting susceptibility
Classifies asphalt mixtures in terms of rutting potential

Delta I-55 SP190 PG 76-22 MAXAM Trial
APA, 100lbs. 45.4 kg, 100 PSI 689.5 kPa, 64°C,

BPMI MWS Rte 132 PG 70-22 DG Trial
APA, 100lbs. 45.4 kg, 100 PSI 689.5 kPa, 64°C
AMPT Dynamic Modulus

Measures the stiffness of the mixtures at service loading frequencies and temperatures.

**Delta 1-55 HMA & WMA E* Mastercurves @ 20°C reference Temperature**

**Rte 132 HMA & DG WMA E* Mastercurves @ 20°C reference Temperature**

Dynamic Modulus: -10% in average
Low Temperature Cracking
Disc-Shaped Compact Tension Test DC(T) ASTM D7313
Fracture Energy – ATREL – Rantoul IL.

I-55 HMA Control – WMA Average Fracture Energy

DC (T) Fracture Energy at PG Low T°C +10°C vs. Cracking - From Buttlar et al. (2010)

Fracture Energy +25%
I-55 / 57 WMA Project

Binder Testing Results

- Superpave PG results

<table>
<thead>
<tr>
<th>Site Information</th>
<th>I-55</th>
<th>I-57</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original PG binder</td>
<td>PG 76-22 (80.1 - 23.9)</td>
<td>PG 76-22 (76.4 - 23.2)</td>
</tr>
<tr>
<td>Recovered from HMA</td>
<td>PG 82-16 (82.8 - 21.7)</td>
<td>PG 76-22 (77.8 - 24.0)</td>
</tr>
<tr>
<td>Recovered from WMA</td>
<td>PG 76-16 (80.6 - 21.3)</td>
<td>PG 76-22 (78.8 - 23.7)</td>
</tr>
</tbody>
</table>

Multi-Stress & Recovery Test (MSCR)

- Jnr Creep Compliance MCR 64°C
- % Recovery MSCR 64°C
I-55 / 57 WMA Project

Gel Permeation Chromatography

- Progressive Degradation of the Polymer Network with Temperature

![Graph showing decreasing molecular weight with temperature](image-url)
Field Compaction Control

Mat Temperature and density at recorded vs. compaction energy (roller passes)

- WMA full density achieved @ -30°F
- Below 212°F - 200°F similar compactability as HMA

I-55 / 57 WMA Project

Mat Density vs. Surface Temperature & Roller Passes

5 vibratory passes 2 Break Down rollers close to each other

2 Break Down rollers in tandem behind paver 6 passes vibratory + 1 static
## I-55 / 57 WMA Project

### Plant Controls: Emissions & Energy

<table>
<thead>
<tr>
<th></th>
<th>Av. HMA</th>
<th>Av. WMA</th>
<th>Δ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mix chute T°</td>
<td>350°F</td>
<td>307°F</td>
<td>-43°F</td>
</tr>
<tr>
<td></td>
<td>177°C</td>
<td>153°C</td>
<td>-24°C</td>
</tr>
<tr>
<td>CO ppm</td>
<td>1308.0</td>
<td>465.2</td>
<td>-64%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Av Mix T°</th>
<th>Av. Agg. Moist (%)</th>
<th>Av. KBTUs/ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>June through December 2009</td>
<td>347°F 175°C</td>
<td>1.8</td>
<td>241</td>
</tr>
<tr>
<td>HMA</td>
<td>85,467</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WMA</td>
<td>70,644</td>
<td>300°F 149 °C</td>
<td>205</td>
</tr>
<tr>
<td></td>
<td>156,111</td>
<td>-47°F -26°C</td>
<td>-15%</td>
</tr>
</tbody>
</table>
MAIN FINDINGS

Laboratory Volumetrics – Laydown & Field Compaction:
- Lab volumetrics & Field Compaction duplicated @ -30°F in average
- Below 212°F, similar compactability as HMA

Polymer-Modified WMA Performance:
- Slightly lower Moduli in the linear viscoelastic domain of very small deformations
  - Due to lesser binder aging > better resistance to low T cracking
- Better resistance to non-linear plastic deformations
  - Due to the lesser degradation of the Polymer network

Emissions & Energy
- Average 25°C / 45°C drop > -64% CO & -15% Energy