High Recycled Content Asphalt Mixtures – *Pilot Program*

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Why Use RAP?

- Interest in recycling/reclaiming materials
  - Cost reduction
  - Industry factors
  - Environmental impacts

- Goals
  - Encourage material recycling/reclaiming
  - Encourage cost reduction measures
  - Ensure quality materials & performance
Evolution of Surface/Intermediate RAP Use by VDOT

- **1979**: Initial use of RAP
- **1980-1981**: Follow-on projects
- **1984**: Specification
  - 25% RAP
- **1997**: Superpave design adopted
  - 20% RAP
- **2007-2008**: Special Provision $\rightarrow$ Specification
  - 30% RAP
- **2013-2014**: Trial projects
  - 40%, 45% RAP

$\rightarrow$ 40-45% RAP
Why Higher RAP Contents?
High RAP Pilot Program

• Surface mixtures with 40%+ RAP content
  – Performance-designed
  – Rejuvenators?
• Volumetric acceptance, QC/QA
  – Still under discussion
• Performance testing during production
  – Assess changes during production vs. design
• Long-term performance evaluation
Specification Development

- Performance (Balanced) Mix Design framework
- Steps
  - Benchmark current mix performance properties
  - Set target performance parameters
  - Use parameters to evaluate designs
    - Adjust designs as needed
  - Assess changes in performance parameters during production/construction
    - Adjust at plant and/or site as needed
  - Long-term validation
Field Acceptance Processes

1. Volumetric
   - Volumetrics
   - Field Density

2. Volumetrics + Performance
   - Volumetrics
   - Field Density
   - Performance

3. Performance
   - Field Density
   - Performance

Note: "Performance" Tests may include fundamental tests and/or empirical tests.

Ranges from minimal ($P_a$ only) to robust ($P_b, P_a, VMA$)

Discretionary Frequency And Actions

Required Frequency; Specified Actions

Graphic developed by Kevin Hall, 9/14/2017
Asphalt Pavement Analyzer

- Rutting test
- Test temperature of 64°C (baseline binder grade)
- Measure rut depth
- Tests ongoing…”
Cantabro Test

- Mix durability test
- Originally used for porous friction courses
- Measure mass loss
  - Less mass loss = increased durability
- Test protocol
  - 150 mm gyratory pill, height = 115 ± 5 mm
  - Compact to $N_{\text{design}}$
  - LA Abrasion device without spheres
  - 300 rotations at 30-33 rot/min
  - Calculate mass loss

- Testing complete
Cantabro Test Results

Average Mass Loss, %

A B C D E F G H I J K
Overlay Test

• Cracking test
• Cycles to failure
  – More cycles = less crack susceptible
• Test protocol
  – 150mm gyratory pill
  – Compact to 7.0% air voids
  – Cut faces and sides, 76 mm across, 38 mm height
  – Apply cyclic direct tension

• Testing complete
Overlay Test Results

- Mean
- NJ method (avg 4, remove high and low)
- TX method (avg 3, lowest COV)
Semi-circular Bend (I-FIT)

• Cracking test
• Measures a “Flexibility Index”
  – Higher index = less crack susceptible
• Test protocol
  – 150 mm gyratory pill, 50 ± 5 mm height
  – Compact to 7.0% air voids
  – Cut in half, notch in center
  – Marshall press or similar with data logger
  – Analyze load vs. displacement data

• Testing complete
Semi-circular Bend (I-FIT) Results

![Bar Chart]

- **Flexibility Index, FI**

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IDEAL-CT

• Cracking test
  • Provides a “Cracking Test index” (CTindex)
    – Higher index = less crack susceptible
  • Test protocol
    – 150mm gyratory pill, 62 ± 2 mm height
    – Compact to 7.0% air voids
    – No cut faces
    – Marshall press or similar with data logger
    – Analyze load vs. displacement data

• Testing ongoing
Nflex

- Cracking test
- Provides an “Nflex factor”
  - Higher factor = less crack susceptible
- Test protocol
  - Gyratory pill – diameter = 150 mm
  - Compacted to Ndesign
  - Cut faces to height = 50 ± 5.0 mm
  - Marshall press or similar with data logger
  - Analyze stress vs. strain data

- Testing ongoing
Next Steps

• Complete benchmark testing
  – Set target performance parameters for design
  – Determine acceptance criteria

• Site selection

• Mix design and analysis
  – Interactive with Contractor/VTRC

• Production & Construction
  – Testing
  – Acceptance
Thank you!

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