Performance Mix Design: What Have We Learned?

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What is Performance Mix Design?

• Designing mixes using performance tests on appropriately conditioned specimens to address multiple modes of distress taking into consideration mix aging, traffic, climate and location within the pavement structure.

– from FHWA Balanced Mix Design Task Force
What is PMD – Practically?

• Designing mixtures to meet performance criteria:
  – Rutting
  – Cracking
  – Durability

• Ultimately involves using volumetrics as a tool, rather than a requirement
Design Approaches

• Volumetric Design w/ Performance Verification
  – Superpave design approach
  – Verify performance properties
    • If do not meet performance, re-design the mix

• Performance-Modified Volumetric Design
  – Use Superpave approach to select initial design binder content
  – Performance test results could modify mixture proportions and/or adjust the binder content
  – Final volumetric properties may be allowed to fall outside volumetric spec
Design Approaches

• Performance Design
  – Run performance tests at varying binder contents and select the design binder content from results
  – Volumetrics determined afterward and reported
  – No spec requirements on volumetrics
Performance Testing

• Cracking test
  – IFIT/SCB, Overlay test, Nflex, IDEAL-CT

• Rutting
  – APA, Hamburg

• Other
  – Cantabro - durability
  – Volumetrics
  – Binder grading
PMD – Phase I

• Framework / specification development
  – Benchmarking / shadow testing
    • Un-reheated & reheated materials, cores
  – Design optimization
    • Use performance testing to optimize mix designs
  – Field trials
    • Production experience
Benchmark Testing

- Plant-made specimens – un-reheated
  - Ideal-CT, APA, Cantabro
- Sampling for reheated specimens
  - Volumetrics, Cantabro
  - Ideal-CT, Nflex, IFIT/SCB, Overlay Test
  - APA, Hamburg
- Coring
  - Ideal-CT, APA
Mix Sampling

• VTRC projects
  – On-site compaction
    • Cantabro, Ideal-CT, APA rutting
  – Loose mix collection (14 boxes)
    • Volumetrics, binder extraction and grading
    • Cantabro, Ideal-CT, APA rutting
    • Nflex, IFIT, Overlay Test, Dynamic modulus
  – Coring (12 cores)
    • Ideal-CT, APA rutting, IFIT
Mix Sampling

• Producer volunteers
  – Plant compacted specimens
    • Cantabro, Ideal-CT, APA rutting
  – Loose mix collection
    • 4-5 *full* boxes, ~150lb
    • Cantabro, Ideal-CT, APA rutting
Current Sampling

• 6 VTRC-sampled mixtures
  – 3 SM-9.5 mixes
  – 3 SM-12.5 mixes
  – 4 Districts

• 6 Producer-sampled mixtures
  – 4 SM-9.5 mixes
  – 2 SM-12.5 mixes
  – 4 Districts
APA Rutting

![APA Rutting Chart]

Average Rut Depth, mm

- **Plant - Producer**
- **Reheat**

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What Have We Learned?

• Specimen fabrication
  – Consistently meeting target voids is difficult
  – Mass–void relationship is lacking

• Differences due to reheating
  – Binder absorption?
  – Aging?

• Test sensitivity to voids, mix properties
  – Not clear
Next Steps

• Continue analyses
  – Volumetric relationships
  – Improved estimates for mass/voids
  – Comparisons among tests

• Design optimization
  – Collaboration during design
  – What design choices impact performance

• Production trials
Thank you!

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