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VMA CRITERIA VERIFICATION

Dr. Donald Christensen

Senior Engineer
Advanced Asphalt Technologies,
LLC
814-278-1991
dwcaat@aol.com

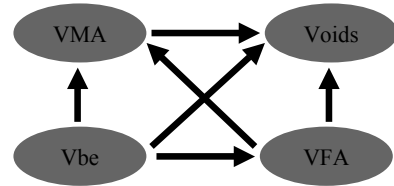
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NCHRP 9-25 AND 9-31

- NCHRP 9-25: VMA
- NCHRP 9-31: Air Voids



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Superpave Specifications

- Design aggregate gradation
- 4% Voids
- Minimum VMA requirements
- VFA range 65 – 75%
- Dust/binder ratio 0.6-1.2
- No film thickness requirement
- No maximum VMA



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WesTrack



- Many mixtures at WesTrack exhibited premature rutting
- Several causes
- High VMA noted as significant problem

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9-25/31 Objectives

- Evaluate Superpave mix design criteria:
 - VMA
 - VFA, and/or
 - Binder film thickness
- Revise, if needed, to ensure adequate rut resistance, fatigue resistance, and resistance to age hardening



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Research Approach

- Phase I
 - Literature Review
 - Interim Report and Lab Work Plan
- Phase II
 - Execute Laboratory Work
 - Analyze Data
 - Extended Work Plan
 - Final Report

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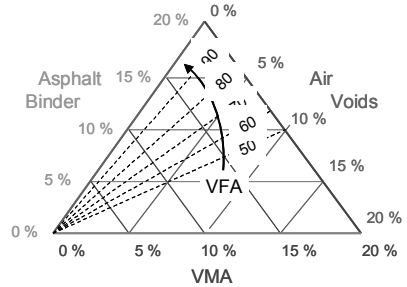
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Research Approach

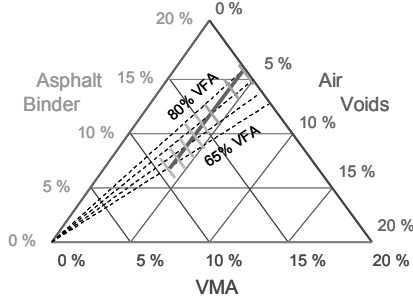
- Identify performance models
- Evaluate models & specs
- Triangular charts & property maps
- Perform laboratory testing
- Re-evaluate models & specs
- Develop conclusions & recommendations

Don't fix it if it ain't broke!

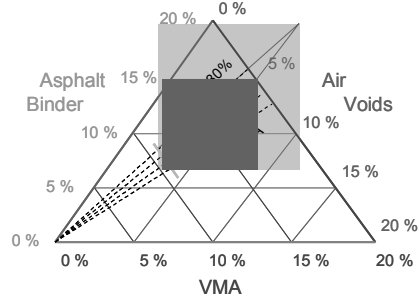
Triangular Chart



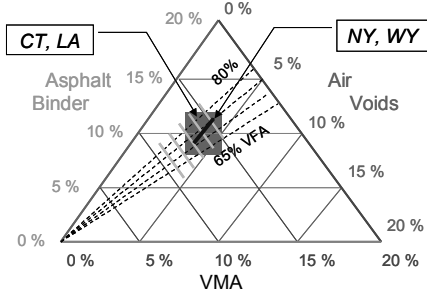
Current Superpave Specifications



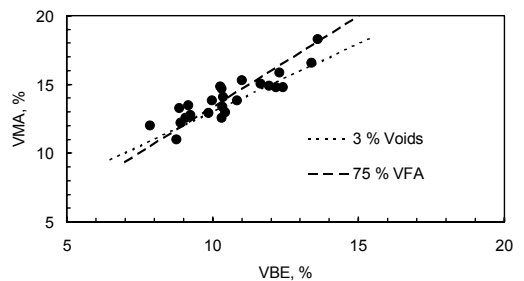
Control at 3 to 5 % Voids, 65 to 75/80 % VFA



Survey of State Practice: Typical Modifications, 19-mm



Optimum Volumetrics



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Performance/Property Models

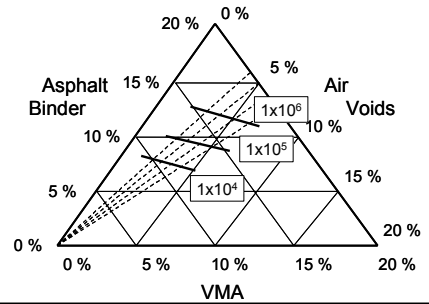
- Modulus—Bonnaure, Witczak, Hirsch
- Fatigue life—Bonnaure, TAI, SHRP, Medani & Molenaar, Westrack
- Permanent deformation—Leahy & Witczak, Koulash & Witczak, Westrack
- Permeability—related to VFA and aggregate fineness

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Fatigue Resistance: Shell Equation, 25 °C, 0.0004

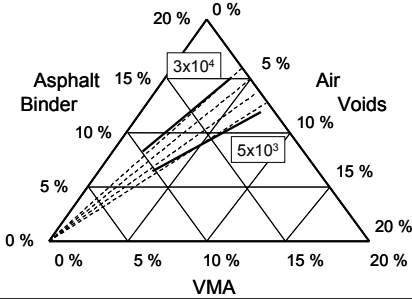


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Fatigue Resistance: Asphalt Institute, 25 °C, 0.0004

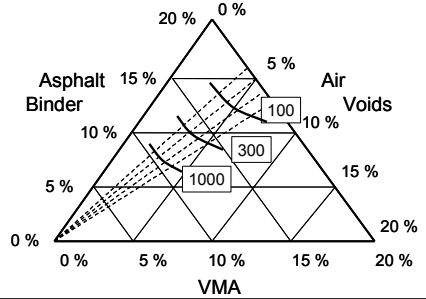


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Rut Resistance: Kaloush and Witczak, N-flow

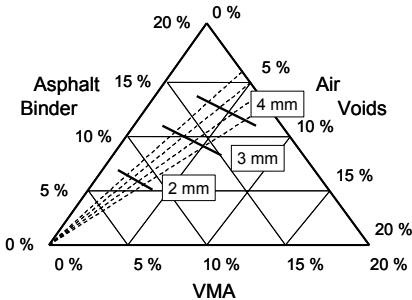


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Rut Resistance: Westrack Coarse, Rut Depth



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Lab Testing

- Mixtures
 - Four aggregates
 - Three gradations
 - Optimum AC +/- 1 %
 - Four compaction levels
- Tests
 - IDT, compressive strength
 - Uniaxial fatigue
 - Repeated shear

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Lab Testing: Results to Date

- 4.0 % Design voids OK
- Current VFA range OK
- Rut resistance increases with decreasing VMA relative to aggregate fineness
- Fatigue resistance increases with increasing asphalt binder content

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VMA and Aggregate Fineness

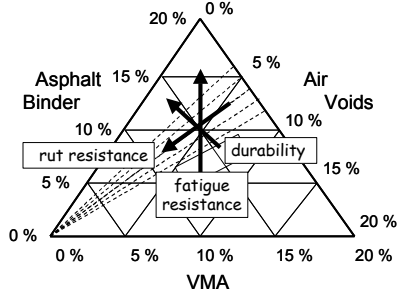
- VMA should be function of aggregate surface area, not maximum size
- Surface area can be found
 - from gradation data
 - from permeability test
- Control of VMA & aggregate fineness
 - 2-3 % range for VMA
 - Target VMA for given aggregate S.A., or
 - Specify range for aggregate S.A.

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Summary



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Conclusions: Possible Specification Revision

- Design air voids & VFA: no change
- VMA
 - Maximum and minimum
 - Linked to aggregate fineness, or
 - Specify aggregate fineness
- Vbe
 - Minimum values
 - Linked to design traffic level

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Remaining Activities

- Complete lab testing
- Complete analysis
 - Lab data
 - In-situ fatigue resistance
- Re-evaluation of specification
- Refine recommendations
- Final Report

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Acknowledgments

- SEAUPG
- NCHRP
- Team members
- Consultants
- Materials suppliers

Thanks!

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