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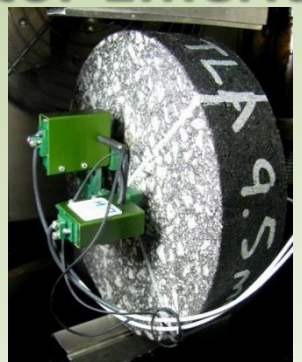
Why the SMA Mix Design Procedure (AASHTO R 46) Works

Ray Brown

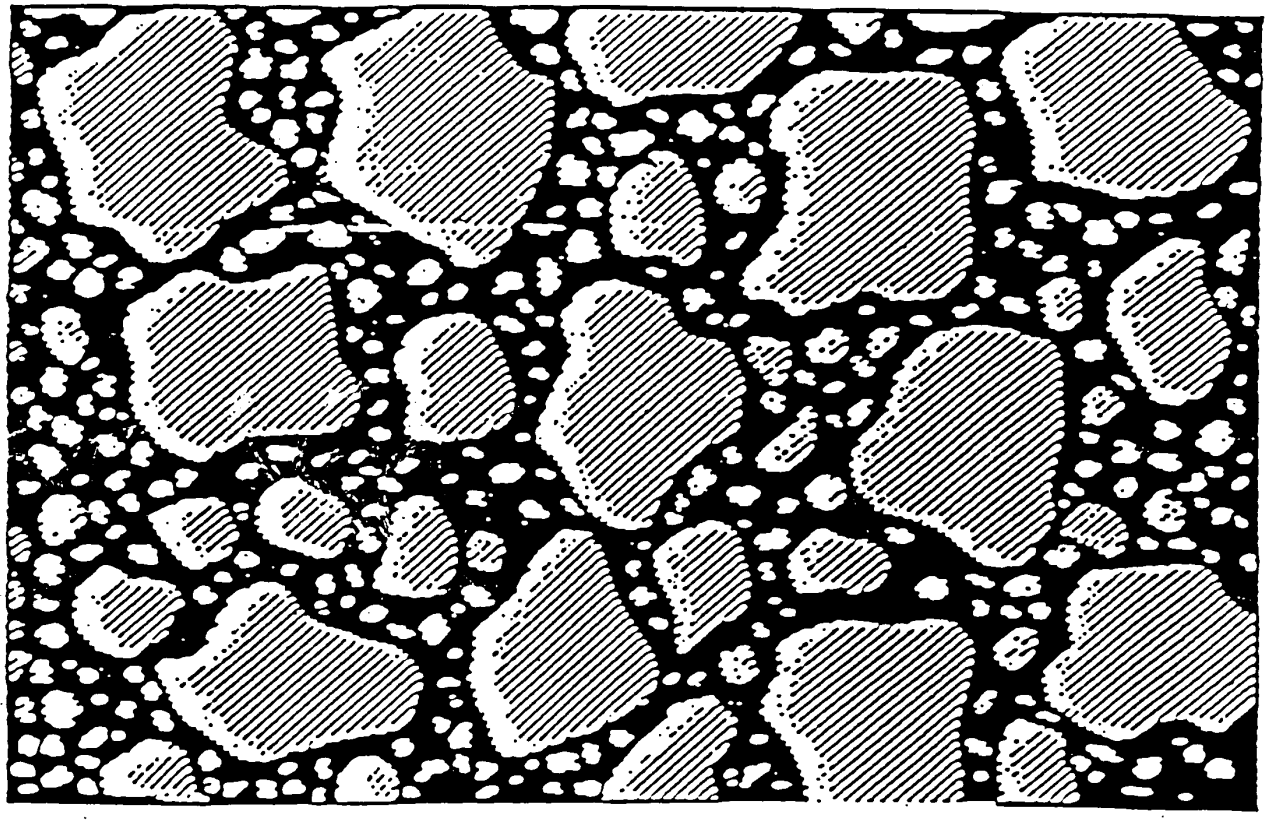
Director Emeritus



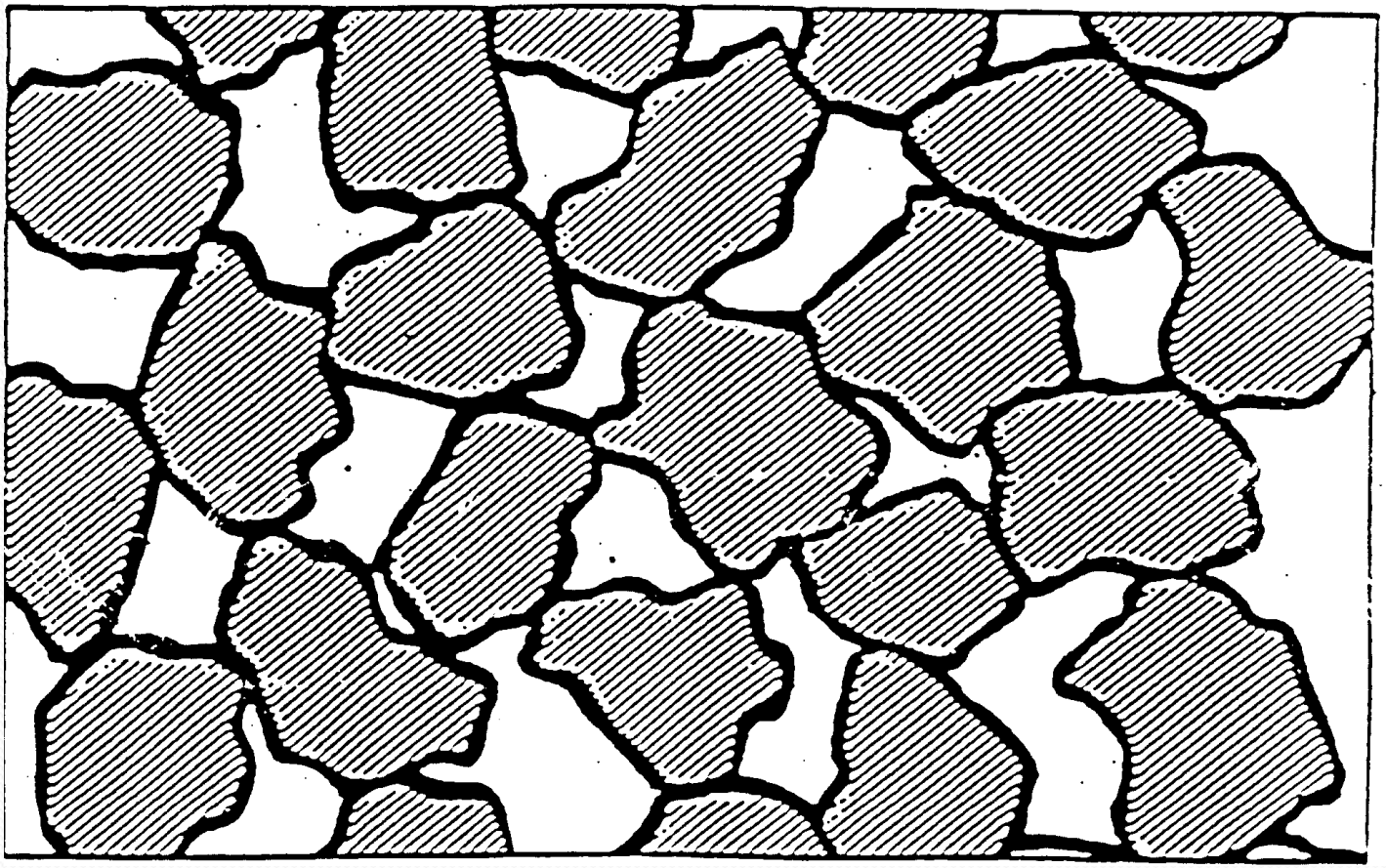
SMA Description

- Gap-graded mixture
- Stone on stone contact
- Polymer modified asphalt binder
- Fibers to prevent draindown
- High filler content
- Designed to lower void content
- High asphalt content

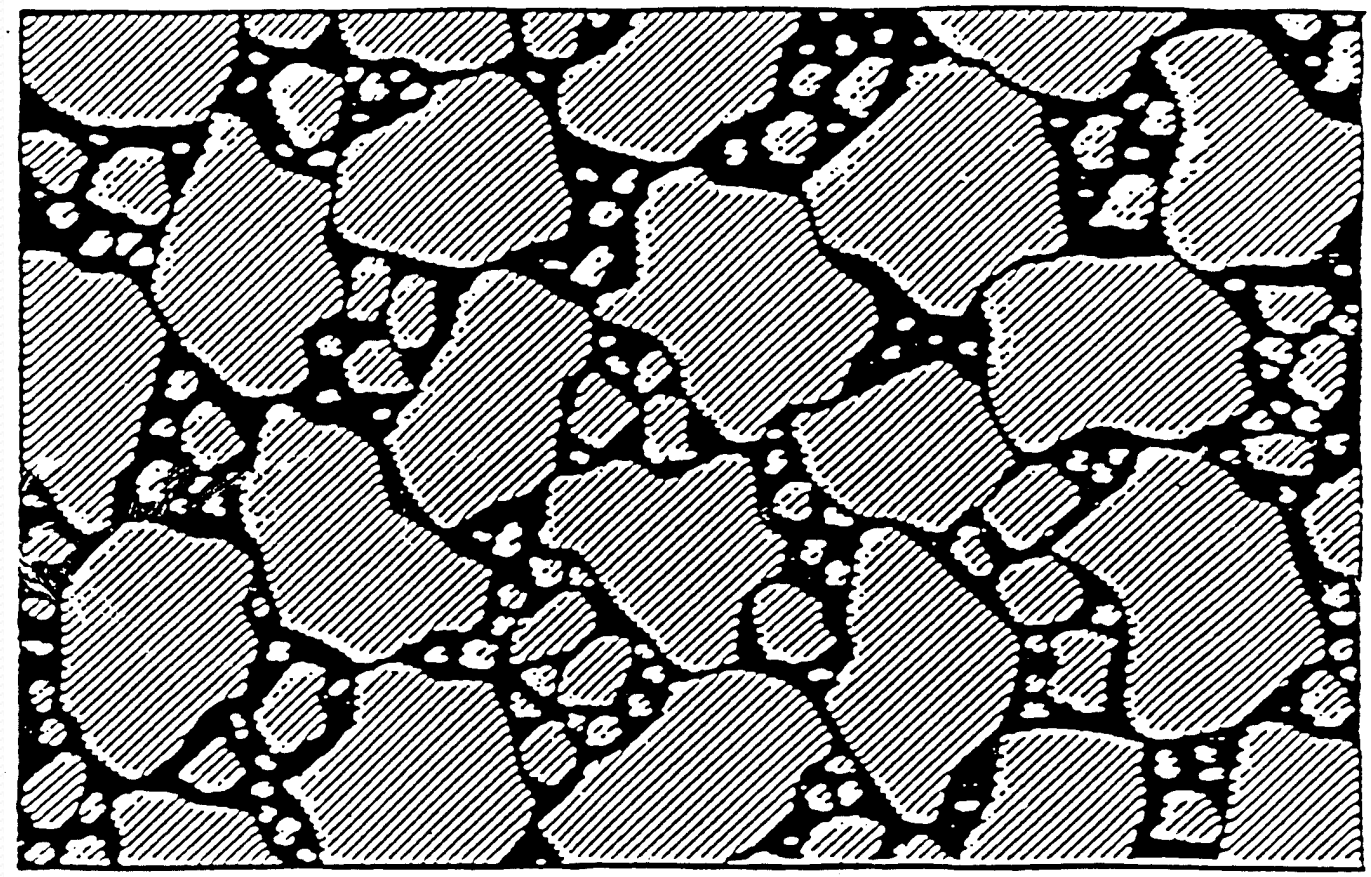
Dense-Graded Asphalt Mix



Stone-on-Stone Structure of SMA



Filled SMA Structure



SMA Aggregate Composition

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Reasons for using SMA

- Improved durability
- Improved resistance to rutting

Methods to Improve Durability

- Higher Asphalt Content
  - Increase VMA---difficult to do with dense-graded mixes
  - Lower design air voids-likely to cause rutting with dense-graded mixes
- Lower in-place air voids
  - Difficult to compact dense-graded mixes to low voids plus may lead to rutting, easier to compact SMA

Improved Resistance to Rutting

- Increase use of polymer modified asphalts
  - This has been done with PG graded ACs, Superpave, SMA
- SMA and Superpave have improved aggregate quality
- SMA and Superpave have resulted in better volumetric control

Draindown has been Significant Problem with SMA

Draindown

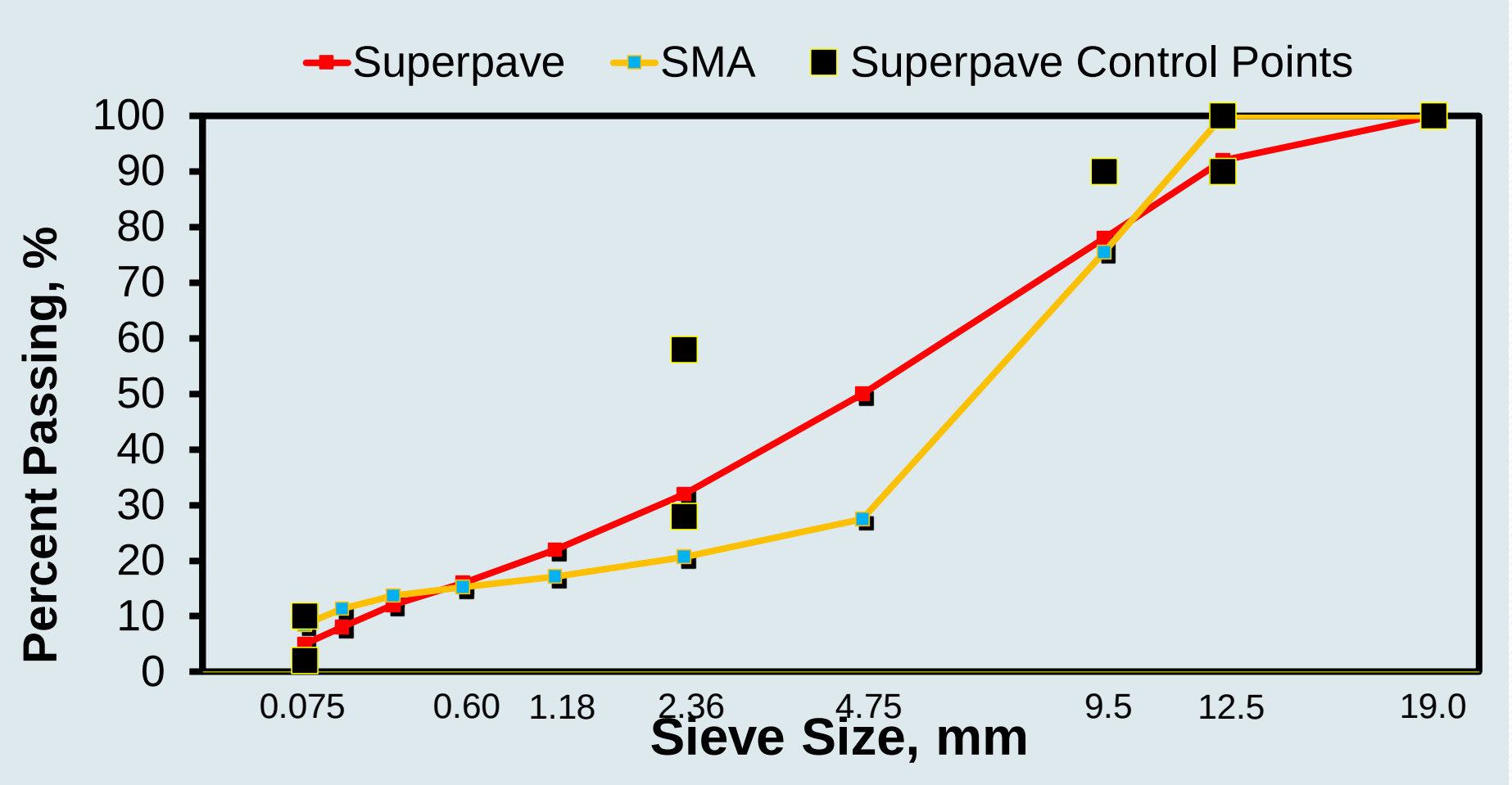
Why does the Mix Design Procedure Work?

Gap-graded Mix to provide higher VMA and higher AC

Typical 12.5 mm SMA Gradation

Sieve	% Passing
19.0 mm	100
12.5 mm	90-100
9.5 mm	50-75
4.75 mm	20-28
2.36 mm	16-24
0.075 mm	8-12

Gradation



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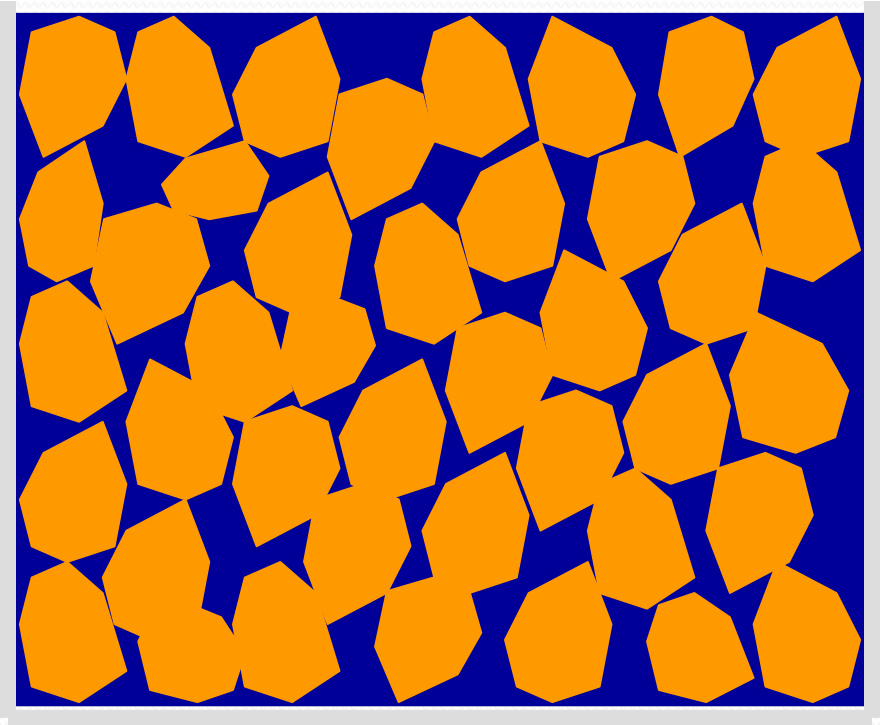
Stone on Stone Contact

- Stone on stone contact is defined to exist when the voids in coarse aggregate (VCA) in mix is less than VCA in the dry rodded condition.

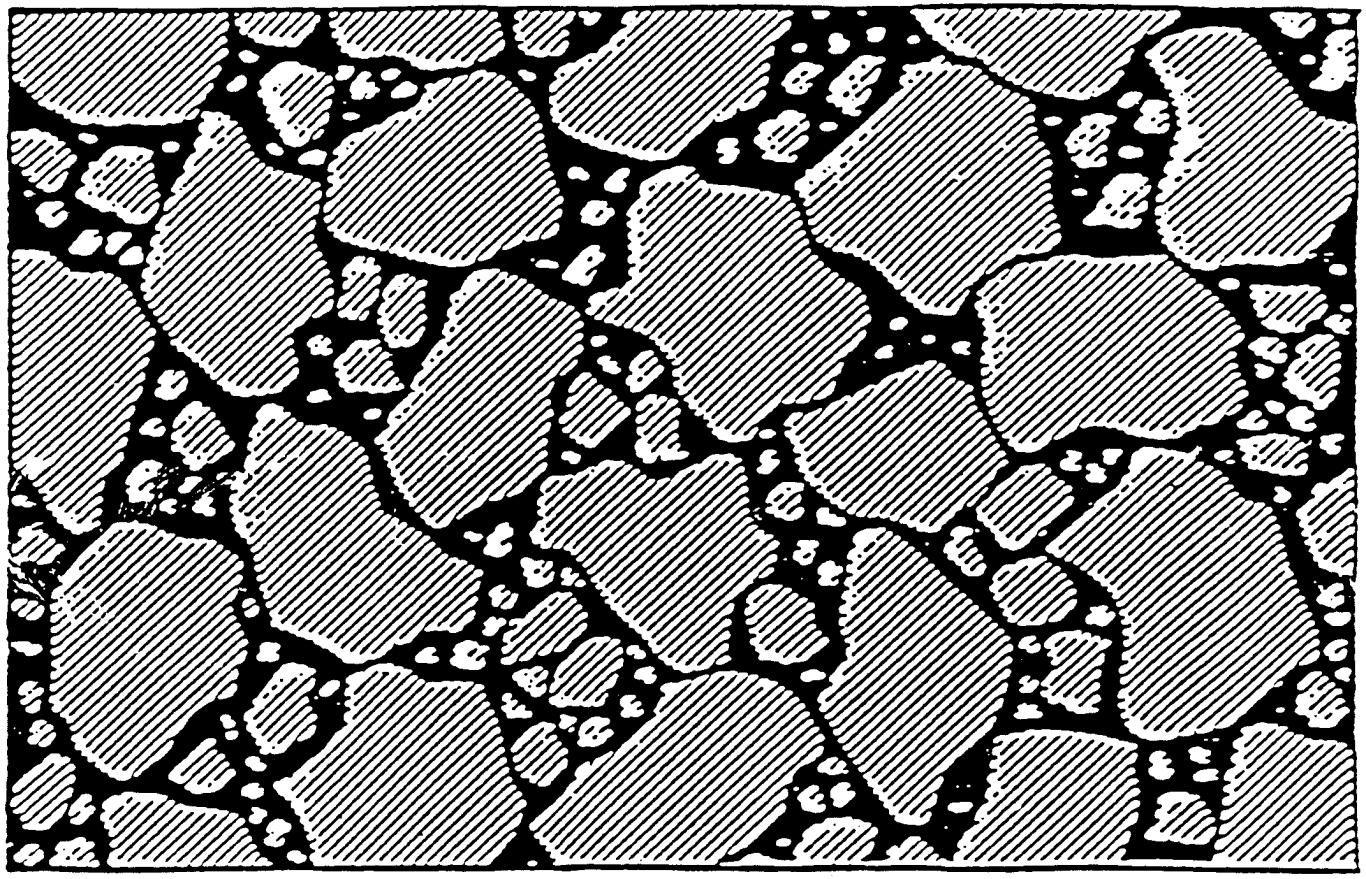
Voids in Coarse Aggregate (VCA)

- Volumetric property to ensure stone-on-stone contact
- VCA in rodded coarse aggregate (AASHTO T19)
- Calculate VCA in compacted SMA
- Mix VCA should be less than rodded VCA

Voids in Coarse Aggregate - DRC



Filled SMA Structure



Select PG Grade to Ensure Polymer Modified Asphalt is used to Provide Stiff, Resilient Mortar to Resist Rutting

Use Cellulose or Mineral Fiber to Prevent Draindown, Typically 0.3 percent Cellulose or 0.4 percent Mineral Fiber

Use high Filler Content to Provide a Stiff Mortar to Resist Rutting

Typical 12.5 mm SMA Gradation

Sieve	% Passing
19.0 mm	100
12.5 mm	90-100
9.5 mm	50-75
4.75 mm	20-28
2.36 mm	16-24
0.075 mm	8-12

Typically Design at 3.5 percent Air Voids with 75 to 100 Gyrations to Improve Durability

- These Adjustments to Design Air Voids, and VMA result in higher Optimum Asphalt Content, 6 percent Minimum often used

Guide to Adjust Minimum Binder Content

Aggregate Sp Gr	Minimum Binder Content, %
2.40	6.8
2.60	6.3
2.80	5.9
3.00	5.5

Typically Compact to 4 to 6 percent In-place Air Voids to Improve Durability

Prevent Draindown during Production and Handling

- AASHTO T305
- Conduct test at temp expected during plant operation

Test for Draindown

Draindown Basket

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Mix Design Requirements

- Voids in coarse aggregate (VCA) of mix less than VCA in dry rodded condition
- VMA (17% minimum)
- Air voids (3-4%)
- Draindown (0.3% maximum)

Mix Design Procedure for SMA (AASHTO R46) has provided good Performance of SMA Mixtures

The End