EAR
Workshop

Cause and Effects

EAR Workshop

"Cause and Effect"

by: Howie Moseley

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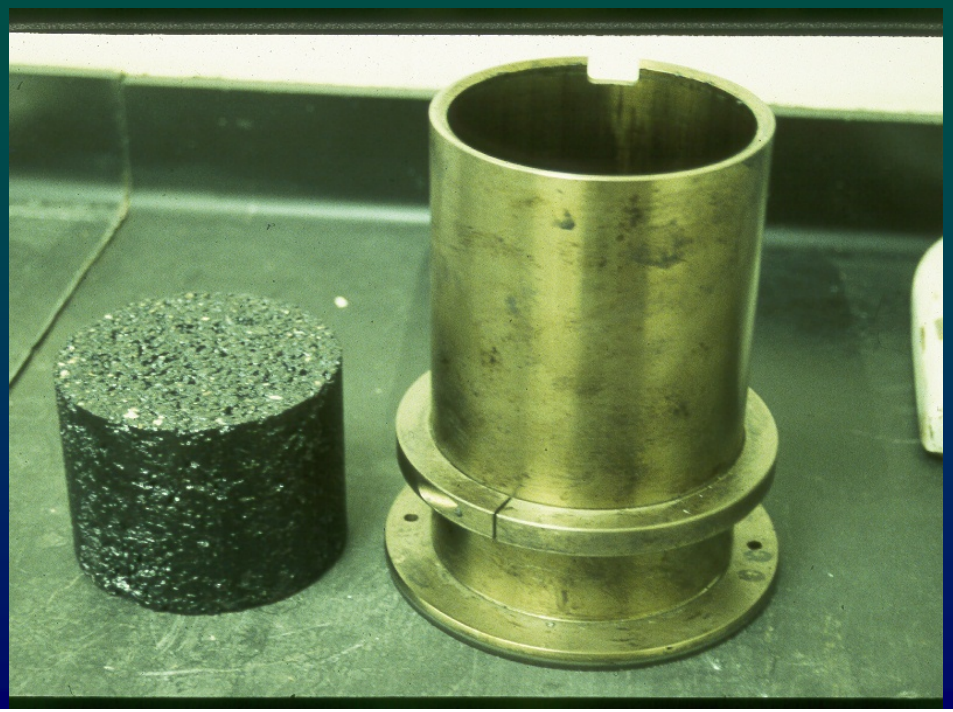
Definitions

- Air Voids – Air void content of a lab compacted specimen in the SGC.
  - Also called plant or lab air voids.
- $V_a = (G_{mm}-G_{mb})/G_{mm} \times 100$



Definitions

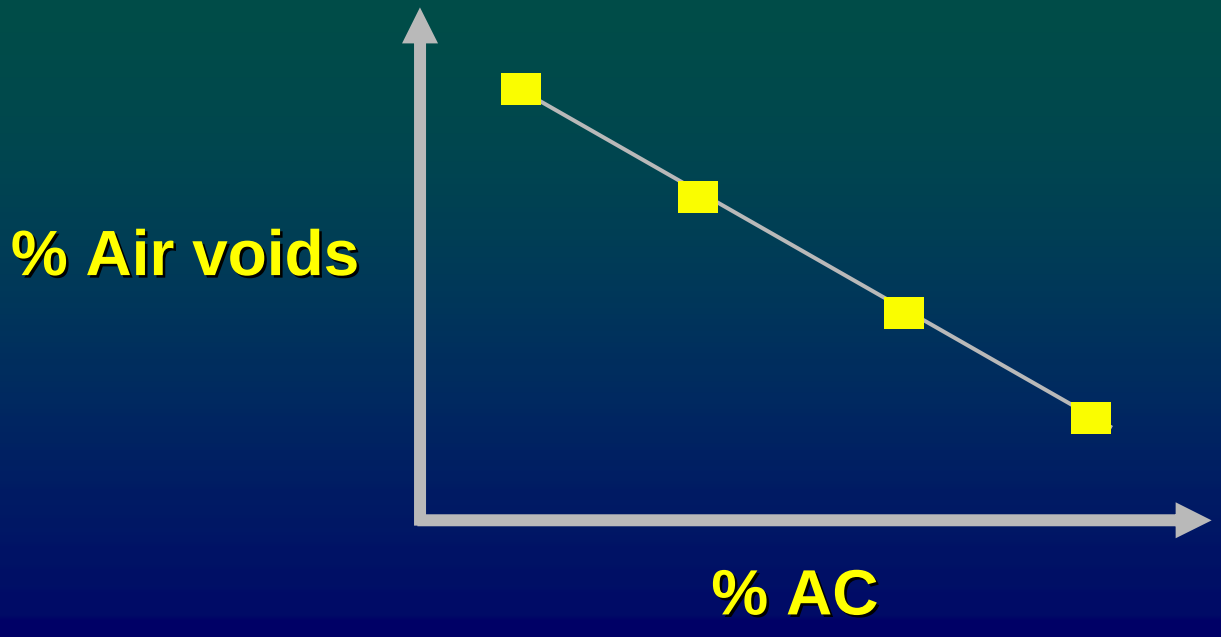
- Density – In-place air void content at the roadway expressed as $\%G_{mm}$.
  - Also called in-place air voids.
- Density = $(G_{mb} / G_{mm}) \times 100$

Definitions

- Percent passing the #200 sieve – Also called dust, mineral filler, -200 material, or P_{-200} material.

Air Voids and AC Content

- Air void content decreases as AC content increases.
  - No gradation change.
- Ratio is approximately 0.2 – 0.35% decrease in air void content for every 0.1% increase in AC content.
  - Mix dependant

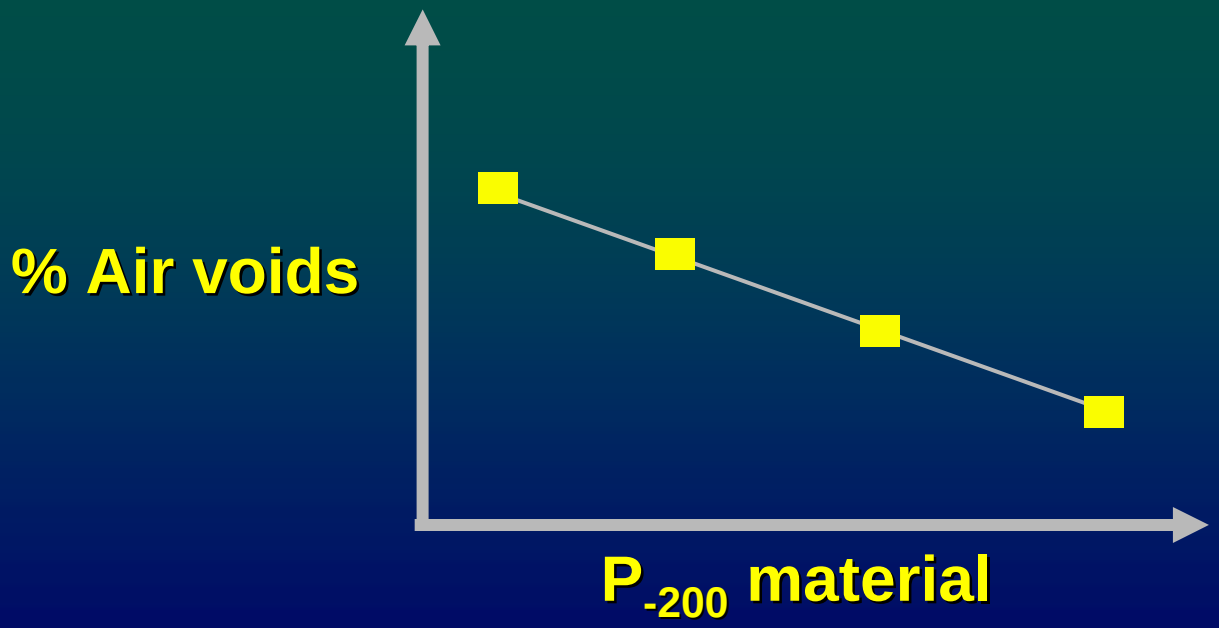


Air Voids and AC Content

- Increased AC content causes the G_{mm} to decrease.
- Increased AC content also causes the G_{mb} to increase.
- $V_a = (G_{mm}-G_{mb})/G_{mm}$ X 100
- At 4.6% AC: V_a = (2.576-2.470) / 2.576 x 100 = 4.1%
- At 5.1% AC: V_a = (2.565-2.504) / 2.565 x 100 = 2.4%
- (Real lab data)

Air Voids and P_{-200} Material

- Air void content decreases as P_{-200} material increases.
- Ratio is approximately 0.4 – 1.0% decrease in air voids for every 1.0% increase in P_{-200} material.
  - Mix dependant



Air Voids and P_{-200} Material

- Increased P_{-200} material causes the G_{mm} to decrease.
- Increased P_{-200} material also causes the G_{mb} to increase.
- $Va = (G_{mm}-G_{mb})/G_{mm} \times 100$
- At 4.7% P_{-200} material: $V_a = (2.575-2.481) / 2.575 \times 100 = 3.6\%$
- At 5.7% P_{-200} material: $V_a = (2.560-2.488) / 2.560 \times 100 = 2.8\%$
- (Real lab data)

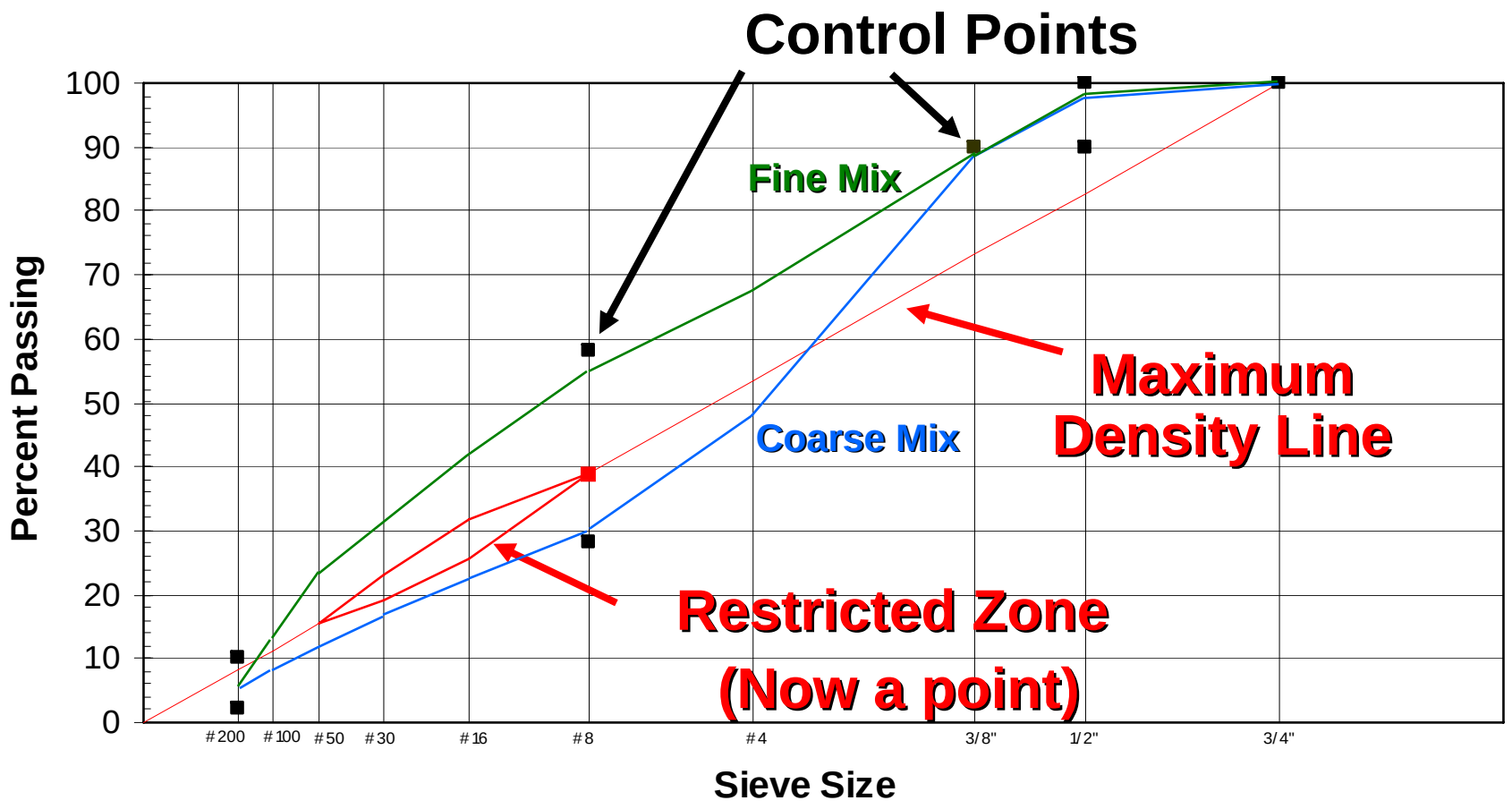
Density, AC, and P_{-200} Material

- Increased AC content and/or P_{-200} material in the mix will make it easier to achieve density in the field.
- Doesn't necessarily mean density will be high in the field, just that the mixture is easier to compact.
- The mixture will also be more susceptible to compaction/rutting by traffic after construction.

Coarse and Fine Gradations

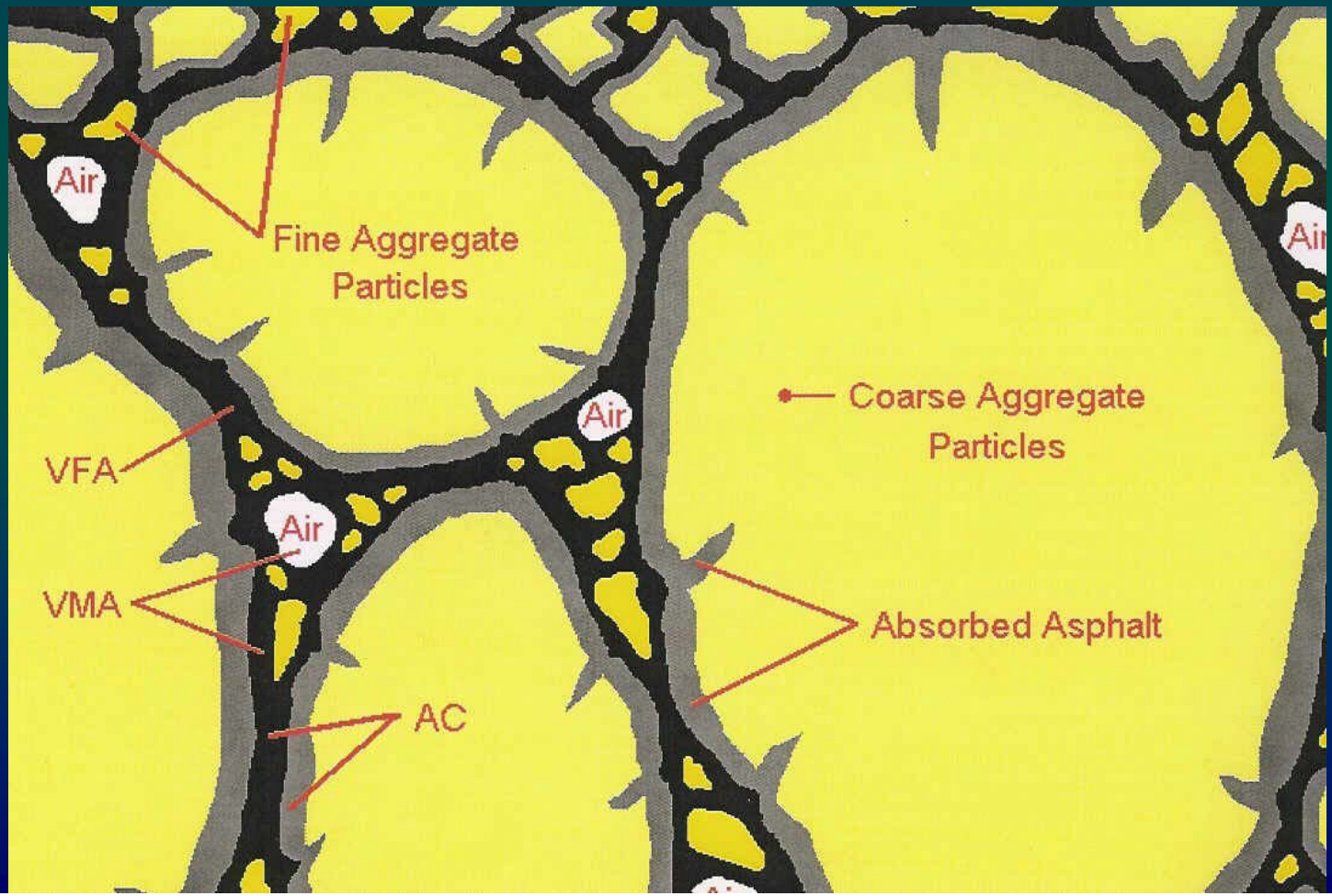
- Coarse gradations require a higher density level during construction.
  - Coarse mix target density is 94.5% G_{mm}.
  - Fine mix target density is 93.0% G_{mm}.
- Coarse mixes can have permeability issues if density is not achieved.
  - Problems can occur below 93.0% G_{mm}.
- Coarse mixtures are more difficult to compact during construction.
  - Tender zone

Coarse and Fine Gradations

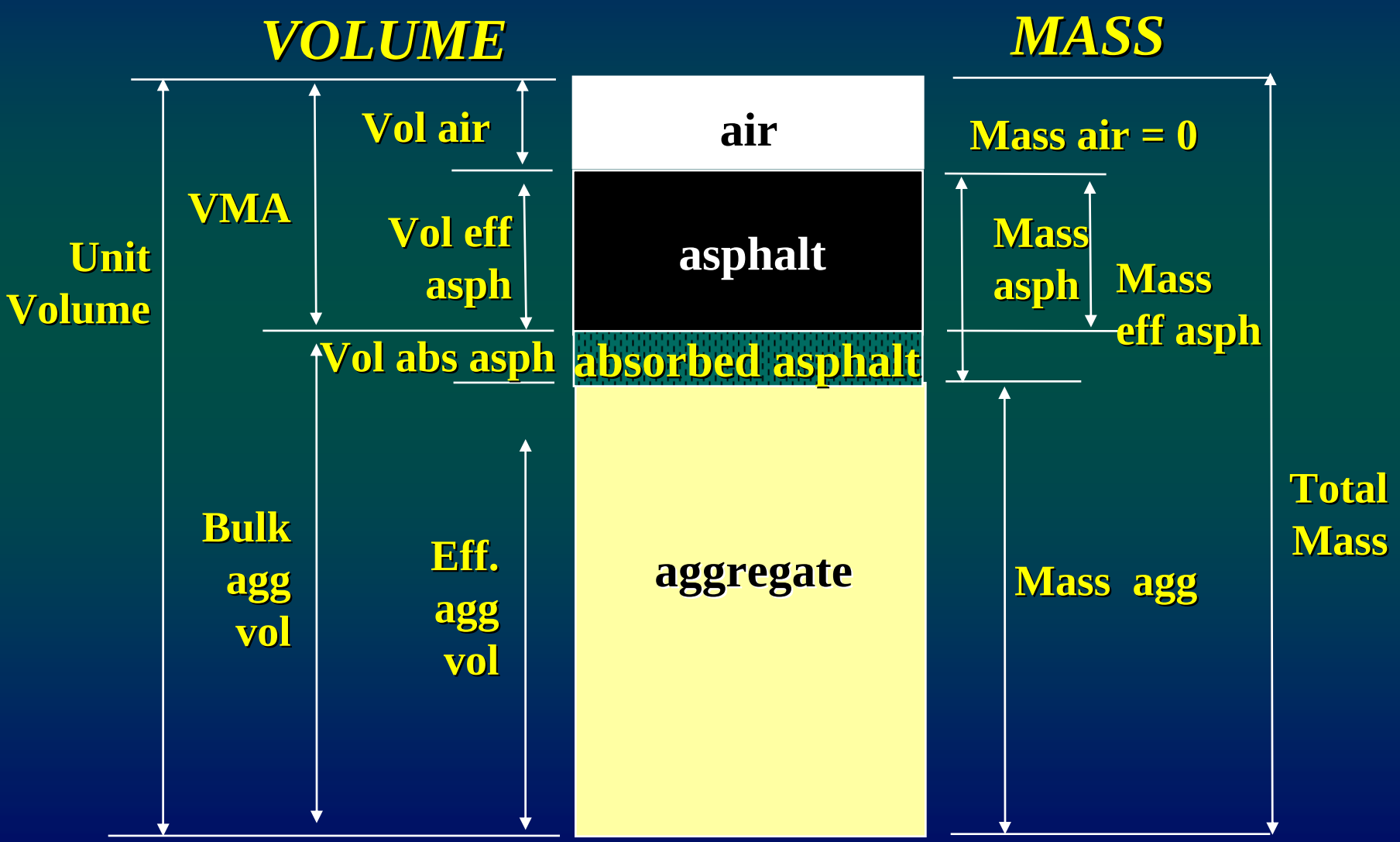


Gradation and VMA

- VMA = Voids in the mineral aggregate
- $VMA = 100 - \{[G_{mb} \times (100-P_b)]/G_{sb}\}$



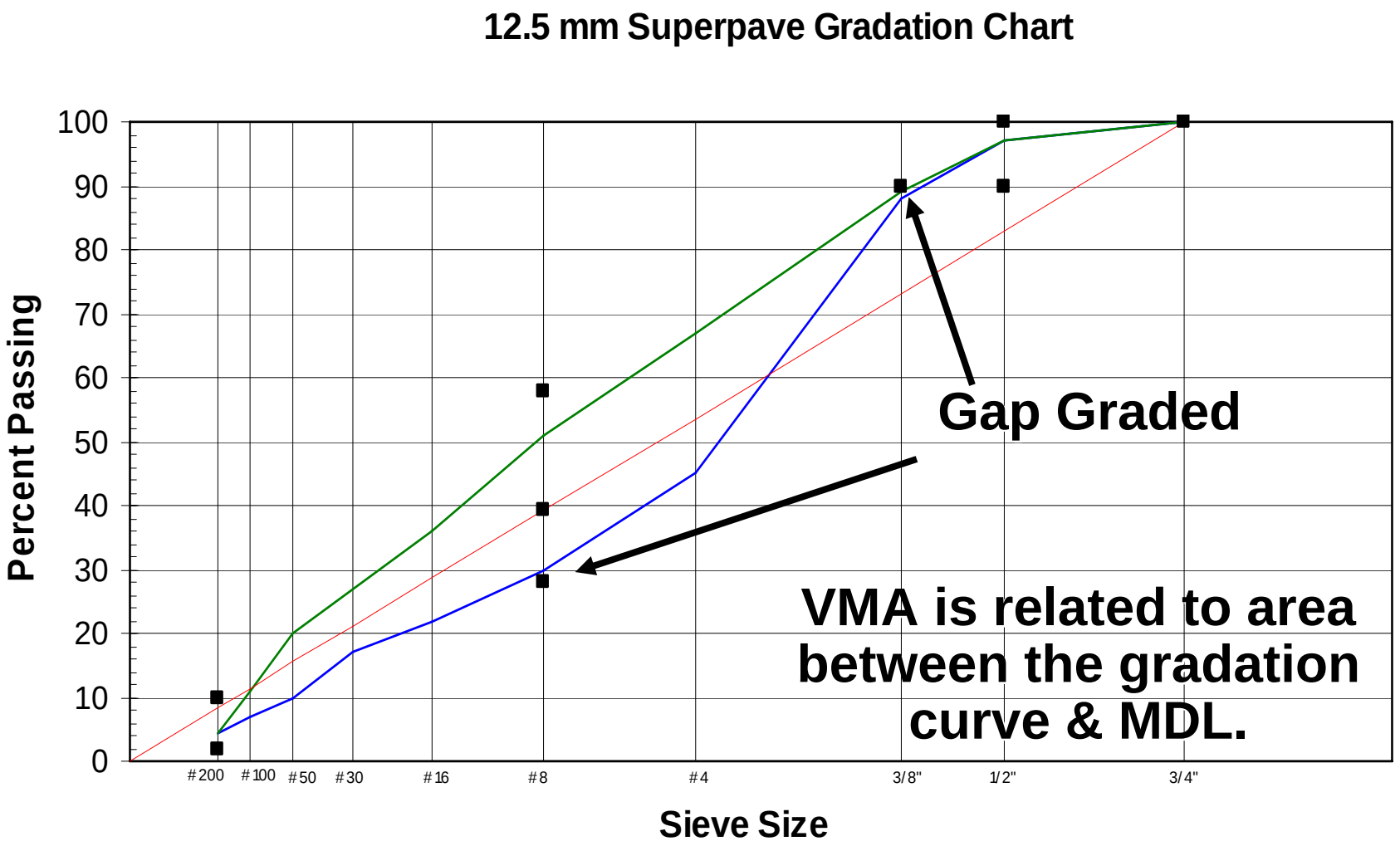
Asphalt Mixture Volumetrics



What affects VMA?

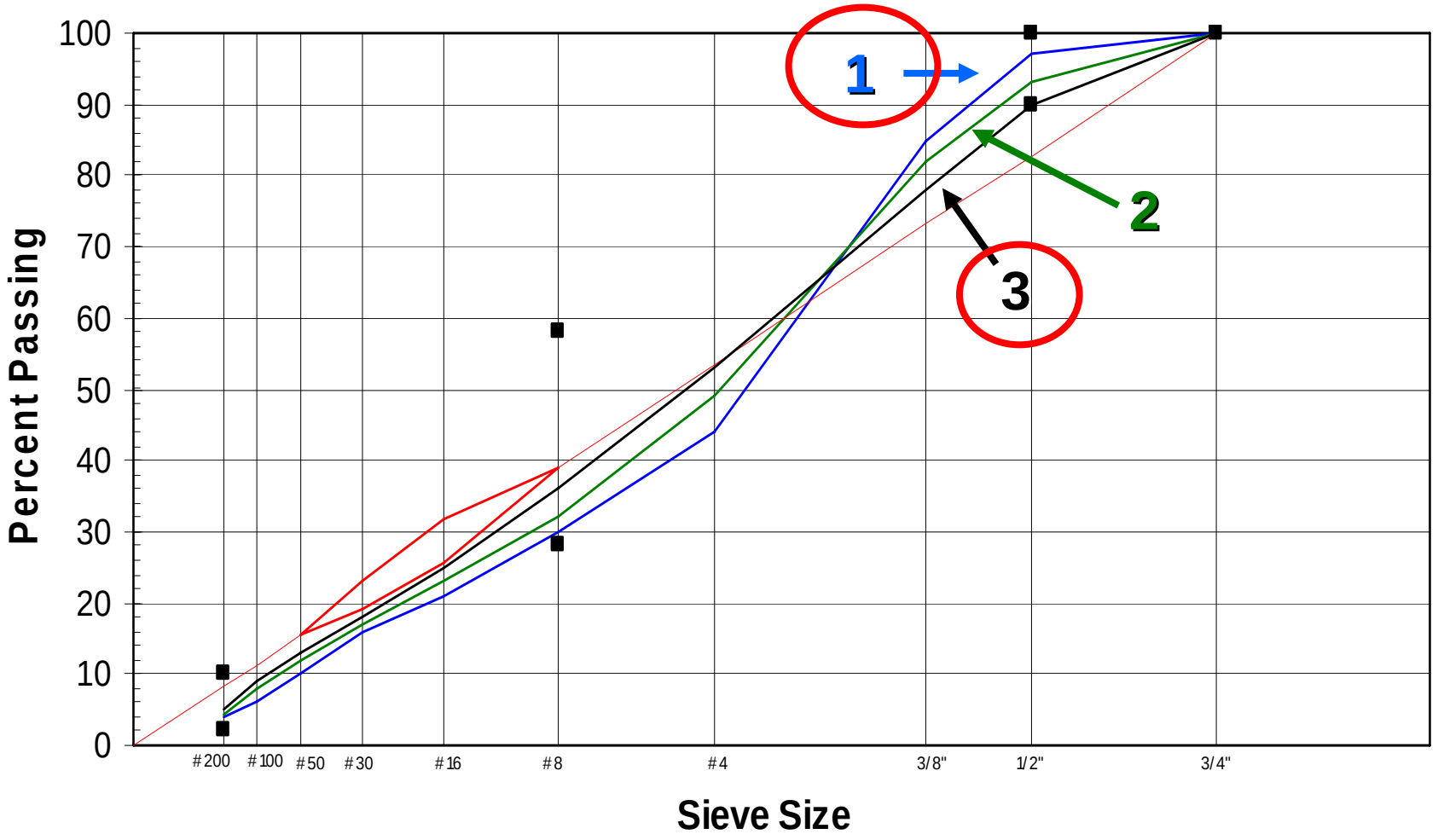
- Gradation
  - P_{-200} material
    - Lowers VMA
  - Maximum density line
    - Gradations closer to the maximum density line have lower VMA
    - Gap-graded mixes

What affects VMA?



Which Gradation will have the highest VMA?

Which Gradation will have the lowest VMA?



What else affects VMA?

- Aggregate type
  - Aggregate angularity or texture
  - Aggregate Shape
- Aggregate toughness
  - Aggregate breakdown at the plant
  - More P_{-200} material
  - Aggregate is less angular

Questions or Comments?