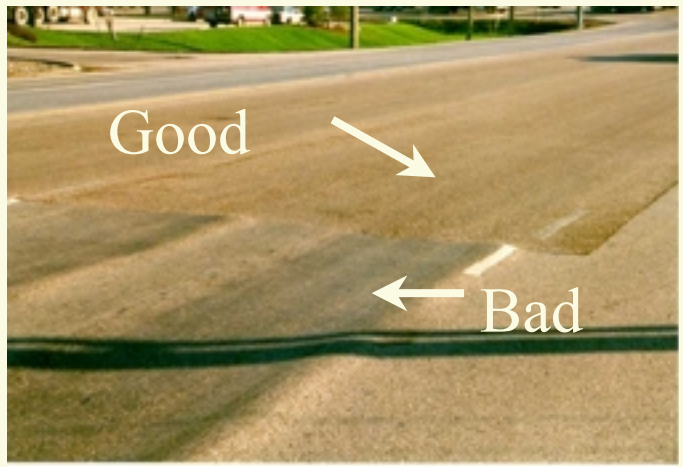
GRADATION EVALUATION

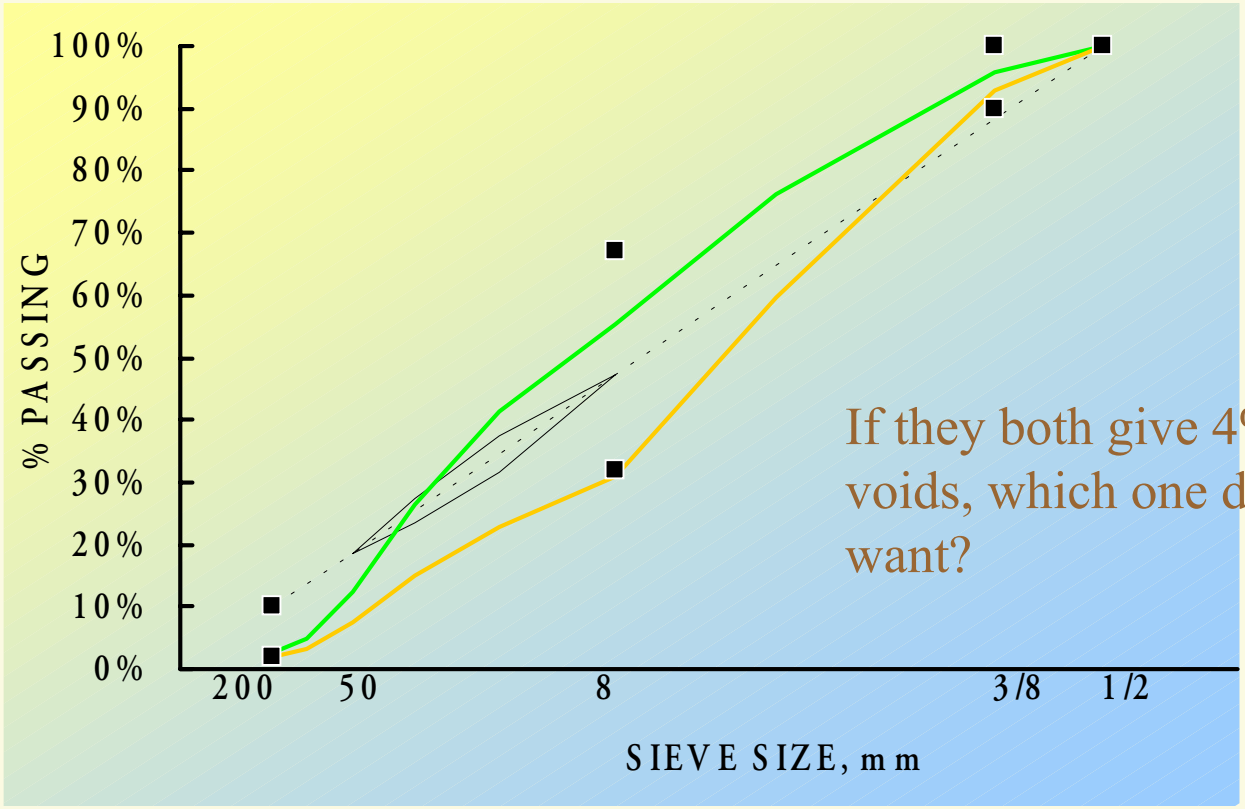
The Key to High Performance Asphalt Pavements

WHAT DOES IT TAKE?

- ✓Rut Resistance
  - Coarse aggregate skeleton locked together with strong fine aggregate and high stiffness binder.
- ✓Fatigue Resistance
  - Sufficient asphalt binder in thick stiff layers
- ✓Durability
  - Low air voids (high in place density) in moisture resistant mixture



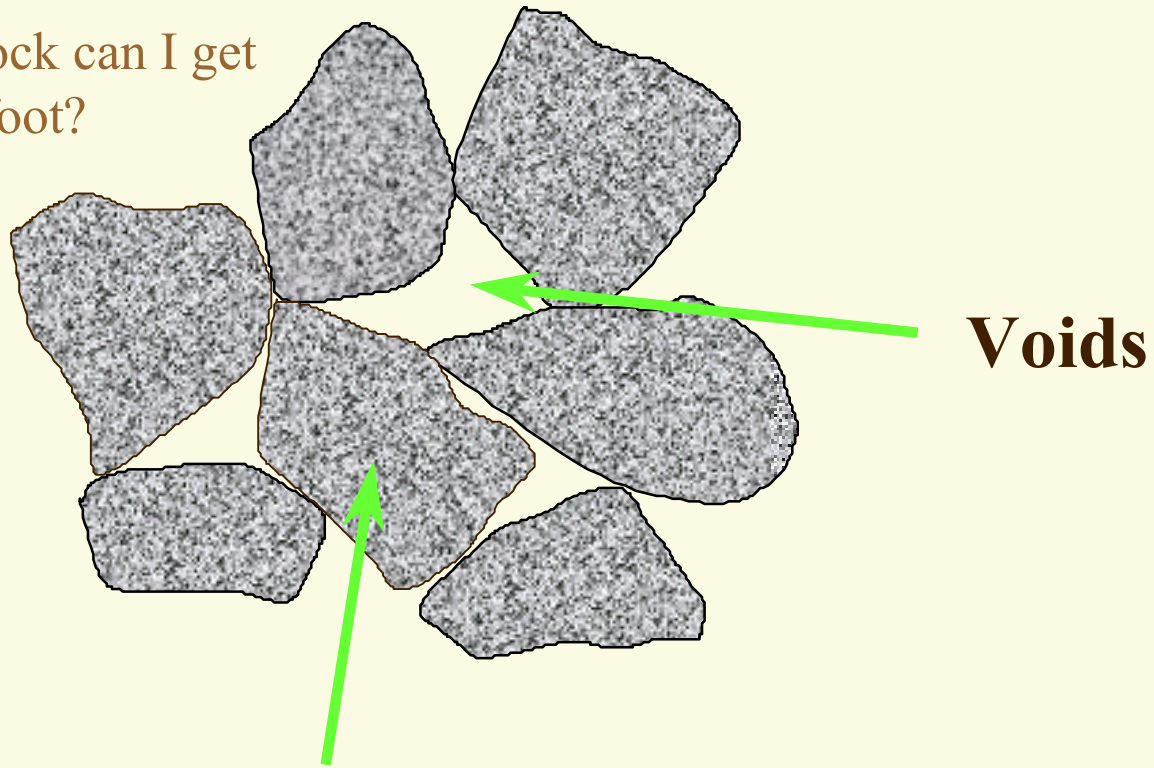
WHICH IS THE BEST?



If they both give 4% air voids, which one do I want?

AGGREGATE PACKING

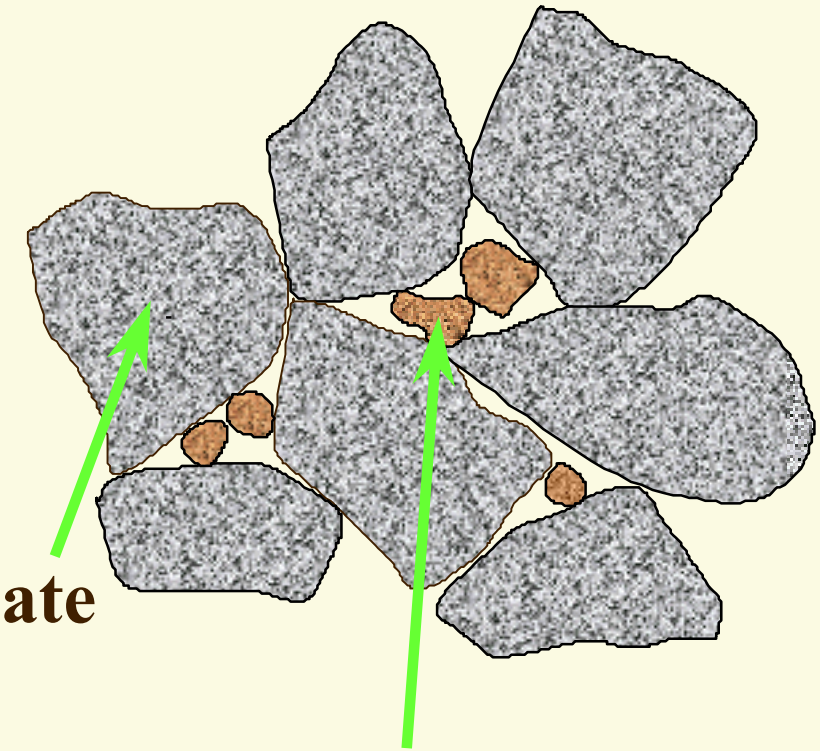
How much rock can I get into a cubic foot?



COARSE AGGREGATE SKELETON

How much room is there for fine aggregate?

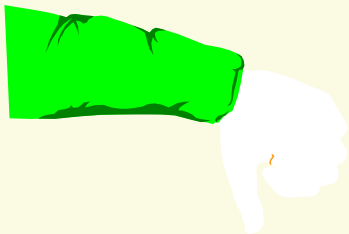
This is OK



Coarse Aggregate

Fine Aggregate

NO COARSE AGGREGATE SKELETON



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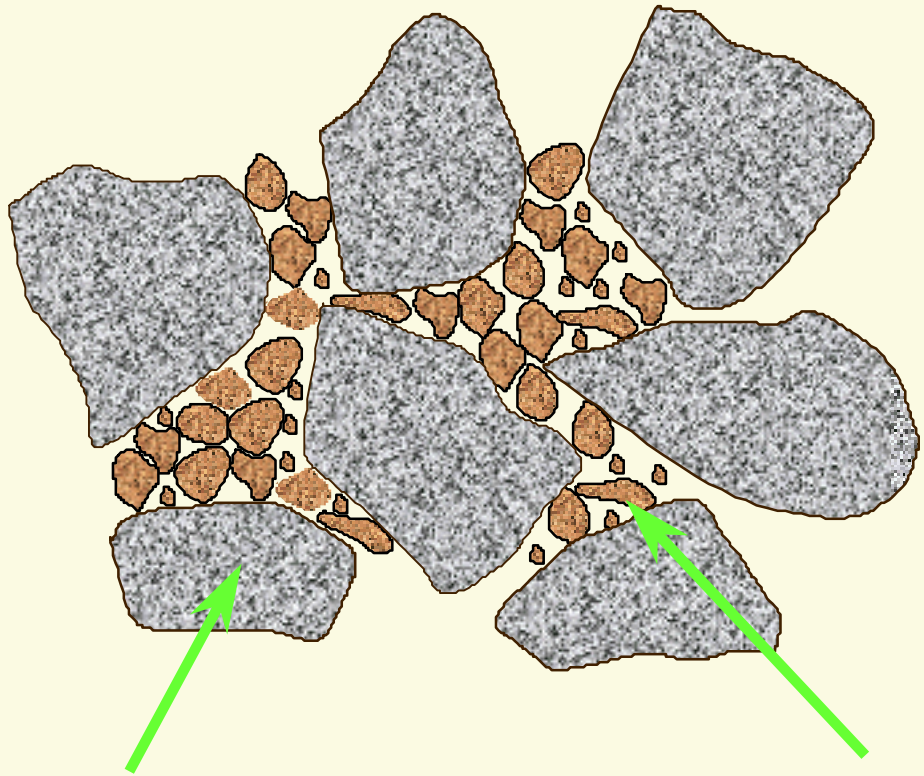
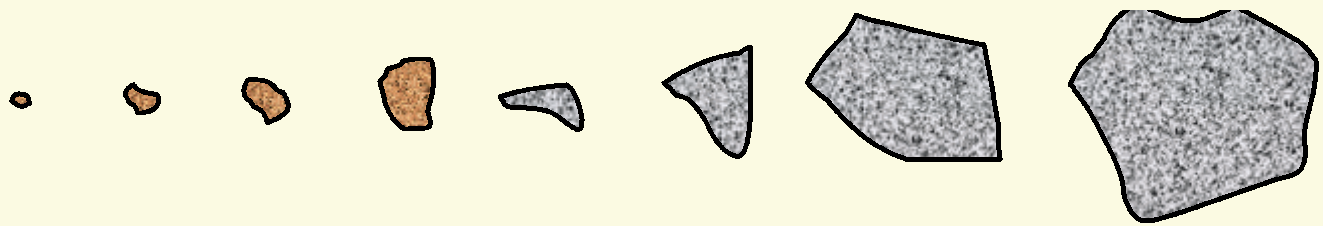


Coarse Aggregate

Fine Aggregate

What is Coarse and Fine?

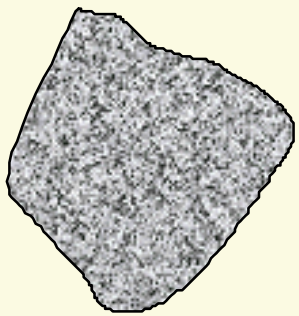
- ✓ 37.5mm mix versus 9.5mm mix
- ✓ All aggregate blends contain a certain amount and size of voids
- ✓ Determine the average void size according to the Nominal Maximum Particle Sieve (NMPS)
- ✓ **Determine the Primary Control Sieve (PCS)**
- ✓ Establish the volume of CA and corresponding amount of voids to be filled with FA



WHAT IS COARSE AGGREGATE?

- Split between coarse and fine is

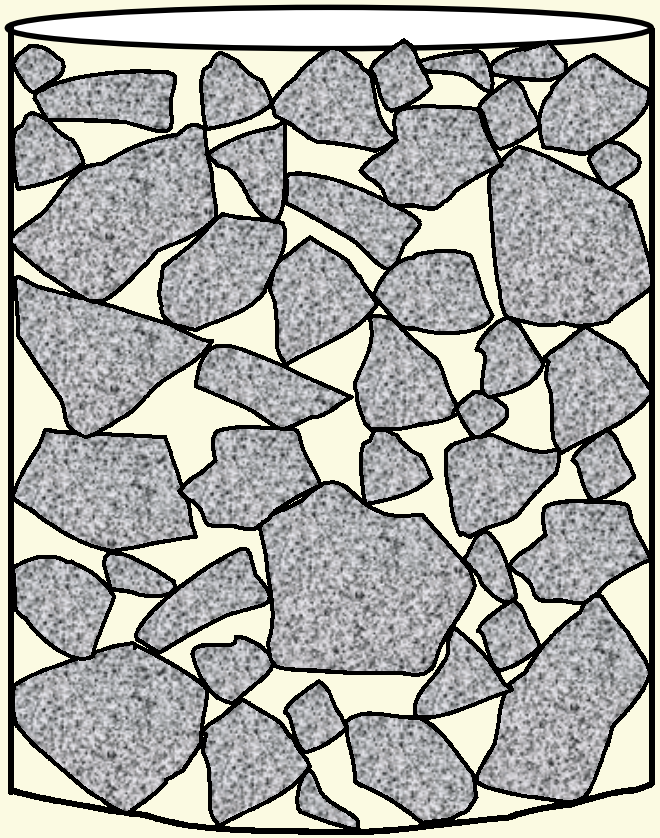
  0.22 times nominal maximum size



nominal maximum size

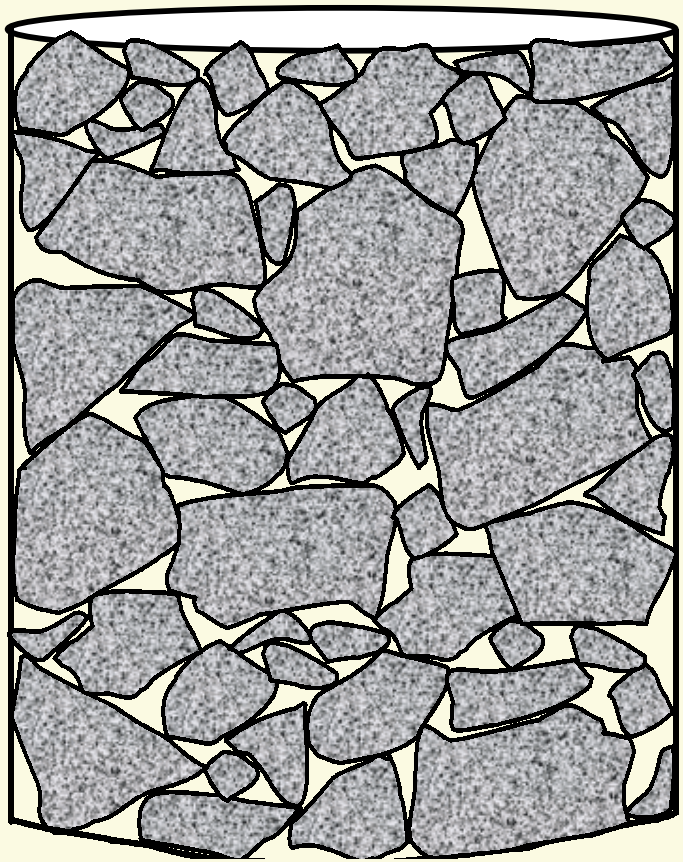
0.22 times nominal maximum size

Loose Unit Weight for CA



- The minimum amount of coarse aggregate per unit volume, **without any compactive effort applied**, that will provide particle to particle contact.

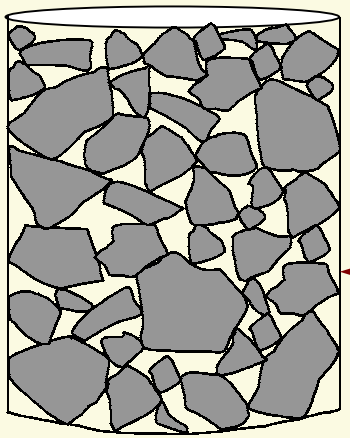
Rodded Unit Weight for CA



- The amount of coarse aggregate per unit volume, **with compactive effort applied**, to increase the particle to particle contact.

CA Interlock

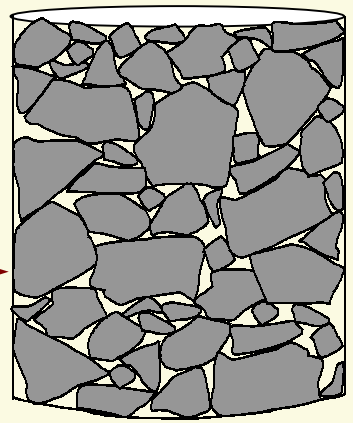
Loose
condition



Lower limit

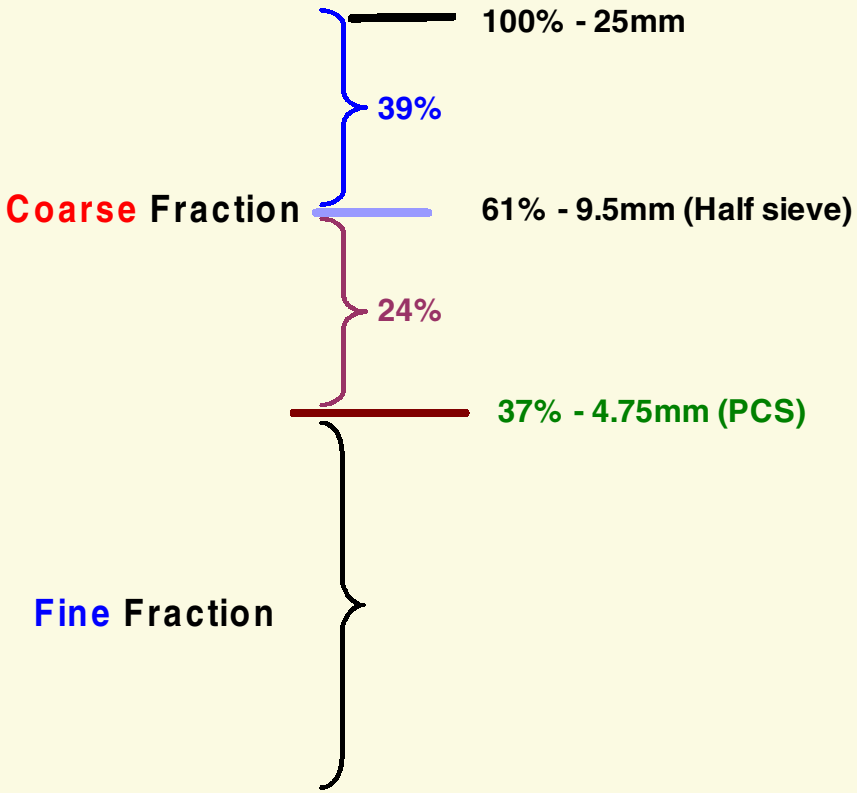
The loose and rodded conditions serve as boundaries for CA interlock

Rodded
condition



Upper limit

CA Ratio Example
19mm NMPS

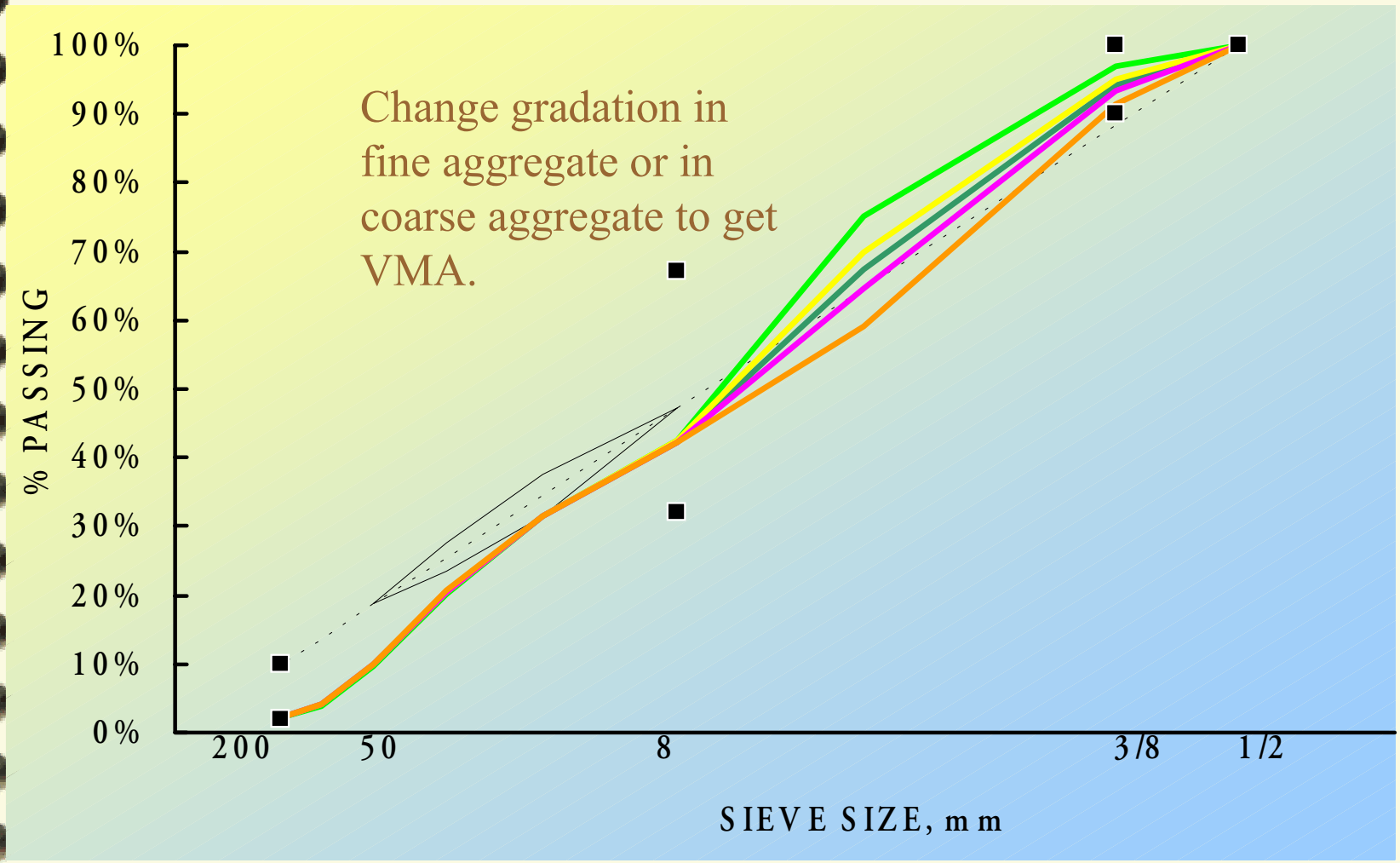


CA Ratio

$$\frac{24\ \%}{39\ \%}$$

0.615

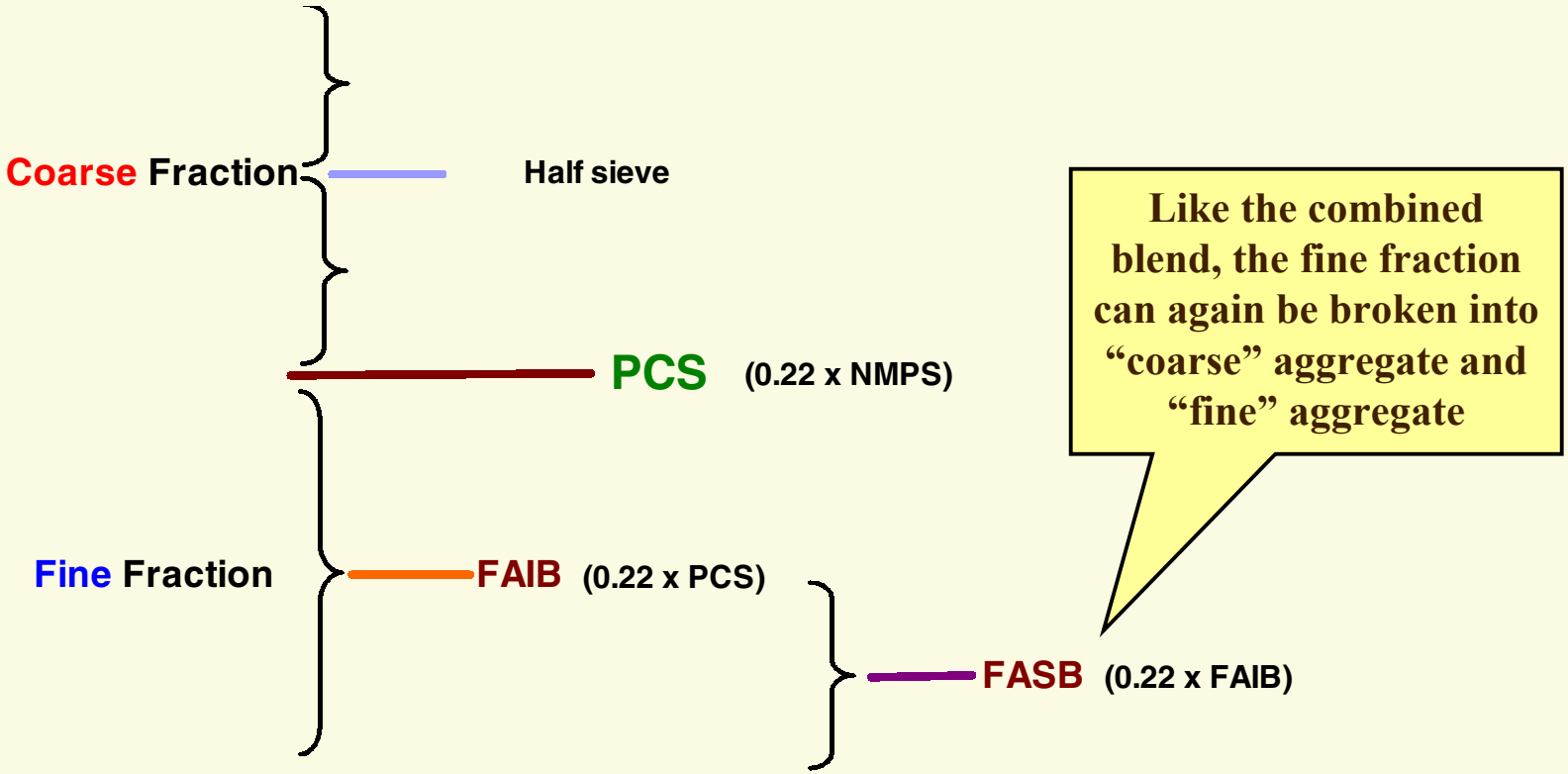
CHANGING COARSE SPLIT



CA Ratio Effects

- **As the CA ratio increases, the voids in the mix will increase**
- Generally, the ratio should be between 0.4 - 0.8
- Low ratios are more prone to segregation

Fine Fraction Evaluation (continued)



Fine Aggregate Evaluation

- ✓ As the **FA_C ratio** increases, the voids in the mix will **decrease** (ratio range ~ 0.25 - 0.5)
- ✓ As the **FA_F ratio** increases, the voids in the mix will **decrease** (ratio range ~ 0.25 - 0.5)
- ✓ The **FA_C** ratio has the **most** influence on VMA

GRADATION SELECTION

What to do?

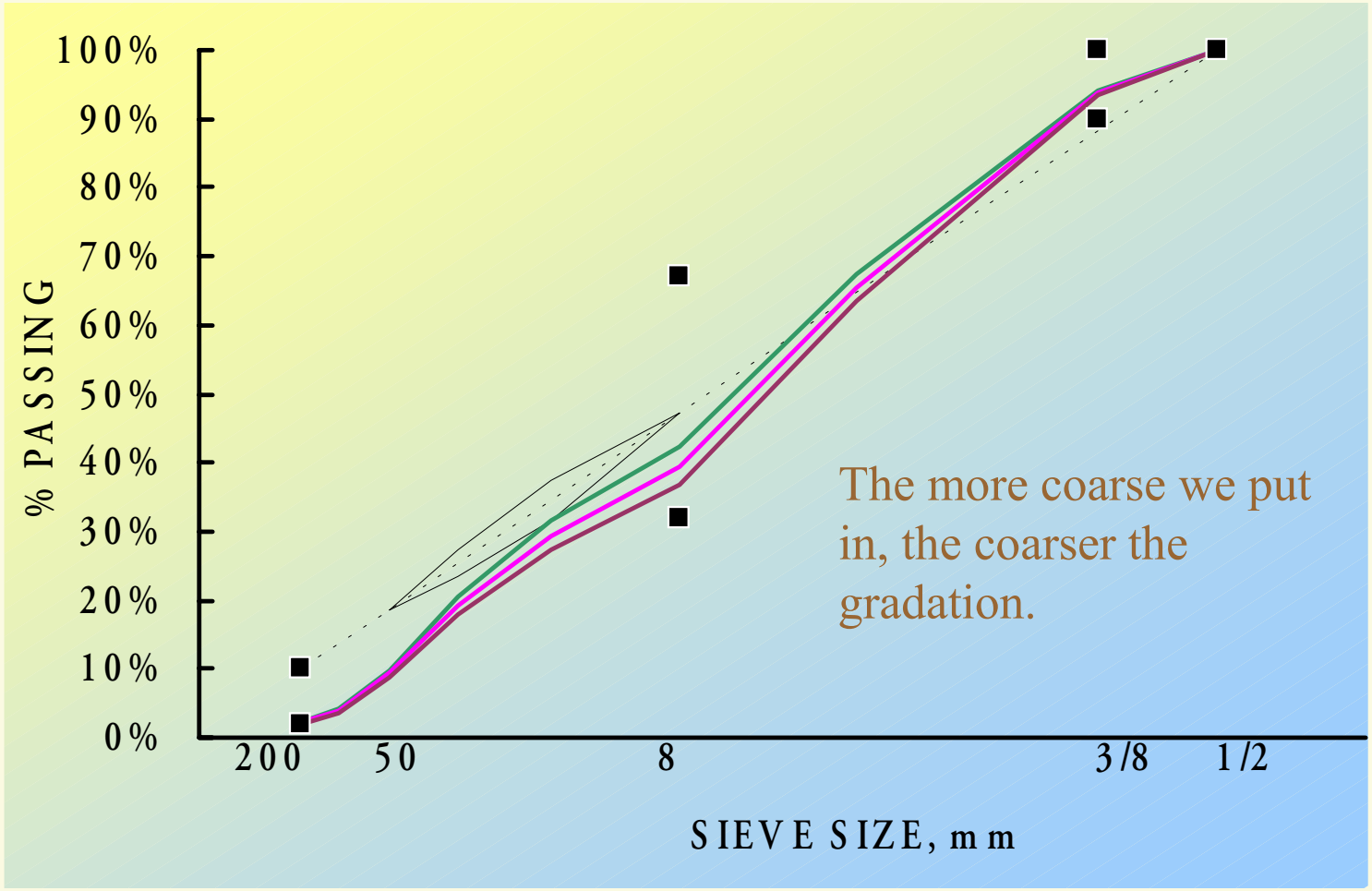
- ✓Loose weight coarse
- ✓Rodded weight coarse
- ✓Loose weight fine
- ✓Rodded weight fine

COARSE AGGREGATE

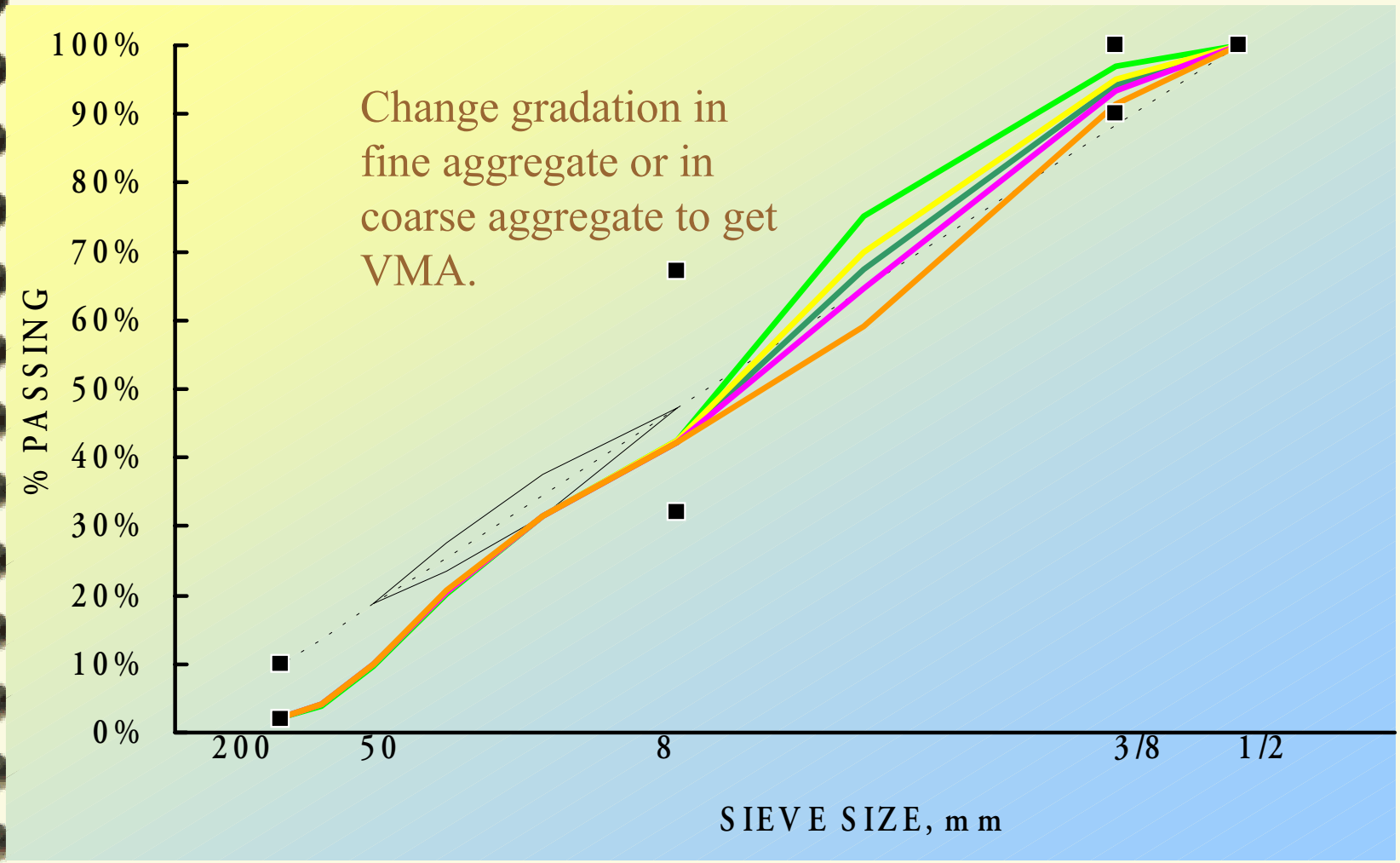
- ✓ Loose unit weight 75 pcf
- ✓ Rodded unit weight 84 pcf

- ✓ What do I want?
  - 75 pcf? rocks are just touching
  - 84 pcf? rocks are packed as tight as dry rodding
  - 60 pcf? rocks are not even touching
  - 90 pcf rocks tighter than rodded weight, too much

EFFECT OF CHOSEN WEIGHT ON GRADATION



CHANGING COARSE SPLIT



Field Value of the Bailey Method

- ✓ Design is starting point
- ✓ Same principles still apply
- ✓ Things will change!
- ✓ How do the design parameters relate to
  -VMA loss
  - compactibility
  -segregation

We want this

not this