

WELCOME

NATIONAL CONCRETE CONSORTIUM

ST. LOUIS, MO

OCTOBER 6-8, 2009



Mix Design and Analysis Track

Pooled Fund TAC Meeting

TTCC Oct 6, 2009

Mixtures that are consistently
long-lasting, constructible,
and cost efficient

CP ROAD MAP
shaping the future of concrete pavement



The CP Road Map – MDA Track

- 5(179) – Permeability
- MI - Air void system
- 5(117) – Ternary
- Optimizing cement content
- 5(205) – MDA
(This project)

Pooled Fund 5(205)

- Participating States (8)
 - IA, KS, MI, MO, NY, OK, TX, WI
- Contract Status
 - Pooled fund contract signed with IA DOT
 - \$125,000 year 1
 - FHWA contract pending
 - \$235,000 year 1

Pooled Fund - Tasks

- Tests
 - Mix Proportions in fresh concrete -
Portable XRF Year 1
 - Set time – calorimetry and/or acoustic
methods Year 1
- Models
 - What air do we really need Year 1-2
 - Mix proportioning Year 1
- Specifications
 - Guide specification Year 1-2

Staffing

- Masters student Ms. Ezgi Yurdakal started work this semester
- Sub-contracts waiting on FHWA funding
 - Gary Fick
 - Shiraz Tayabji
 - Tyler Ley

Portable Analysis Device

- Reportedly a device is available at ISU.
- Needs calibration for calcium silica systems
- Trick will be finding the right elements to analyze
 - Signature?



Acoustic Setting Time Device

- Needed because temperature is not sufficient indicator
- Speed of sound is a function of connectivity
- CTL is apparently re-invigorating their efforts with this



Mix Proportioning

- What is the question?
 - Fine tuning mixtures based on ongoing data?
 - Developing new mixtures using numerical models?
 - Finding a starting point for trials?
- Is there a right answer?
 - Optimize w.r.t. cost, materials availability, sustainability metrics, time, cost of testing?

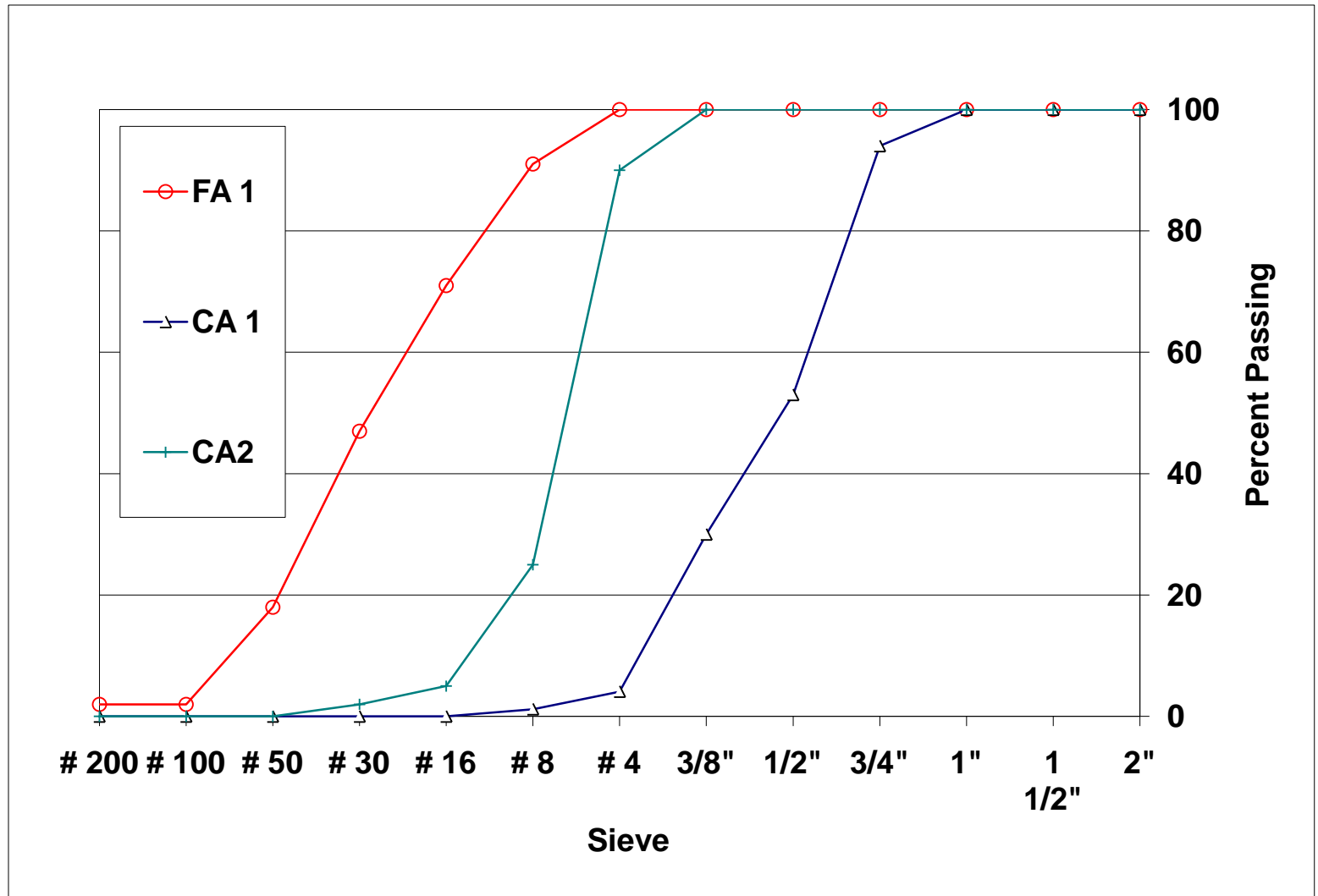
Mix Proportioning

- Many approaches published
 - Fineness modulus
Used by ACI, Hover, and PCA
 - Void density (Compass)
 - Specific surface (Day)
 - Workability factor (Shilstone)

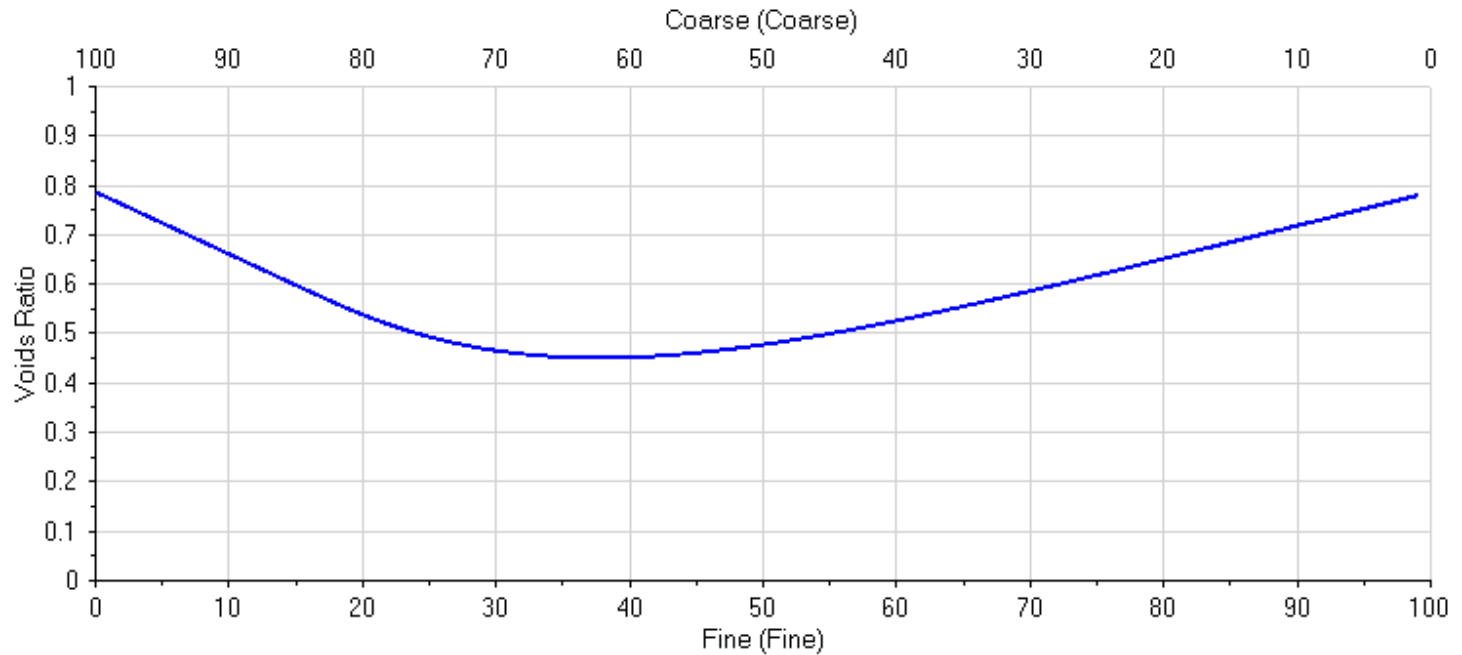
Mix Proportioning

- ICAR approach for SCC (Fowler):
 - Choose aggregate system
 - Choose paste quantity
 - Choose paste quality

Aggregate System



Aggregate System

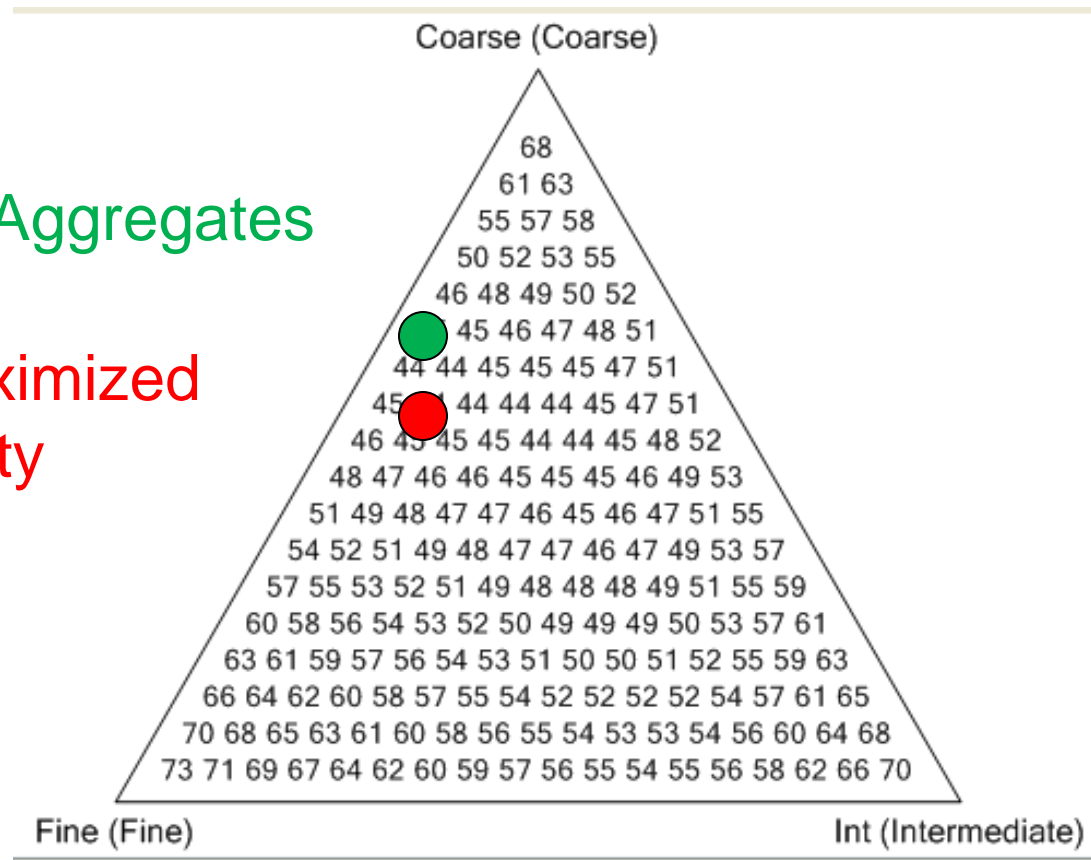


Using 2 aggregates – 62% coarse, 38% fine

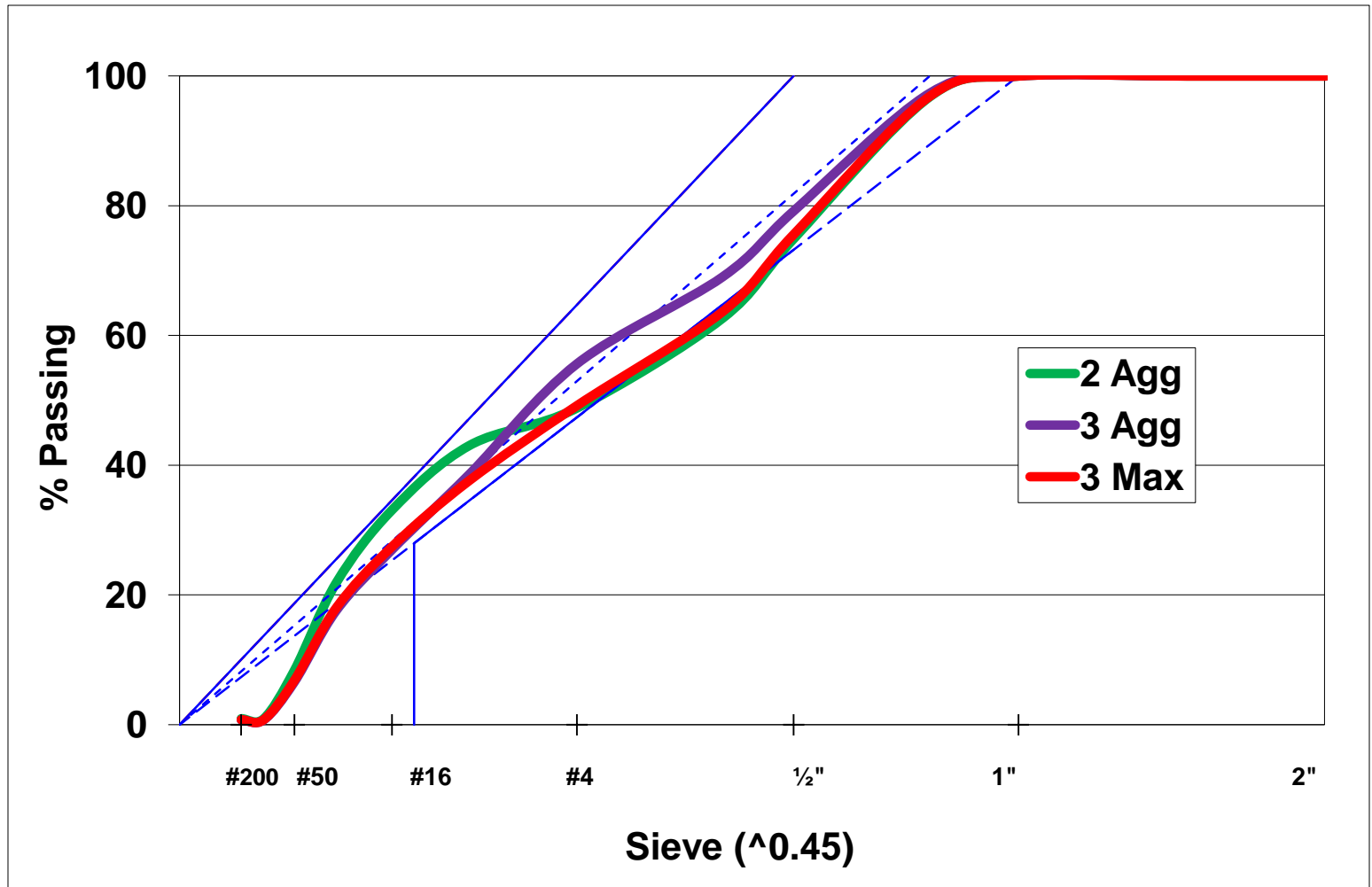
Aggregate System

2 Aggregates

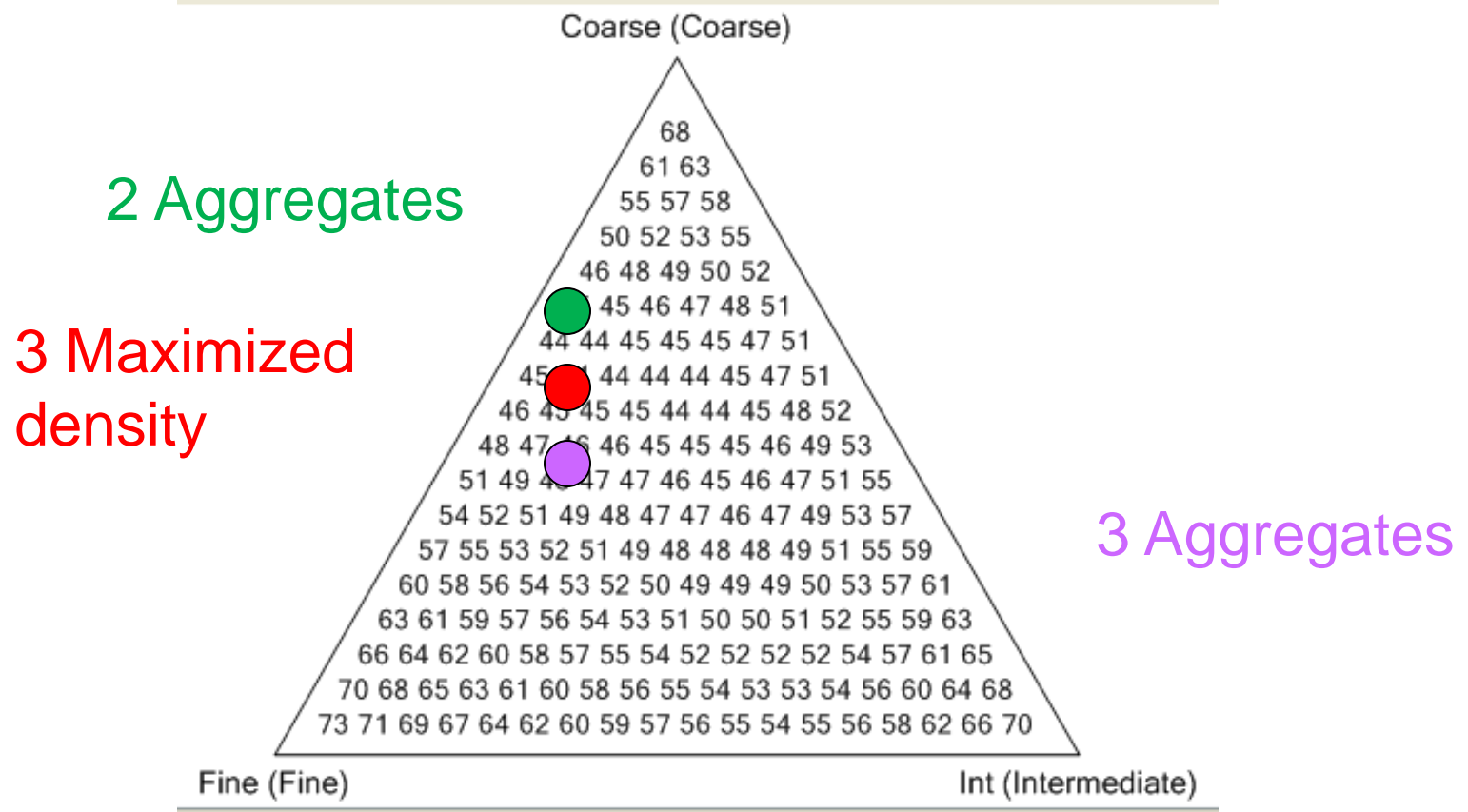
3 Maximized density



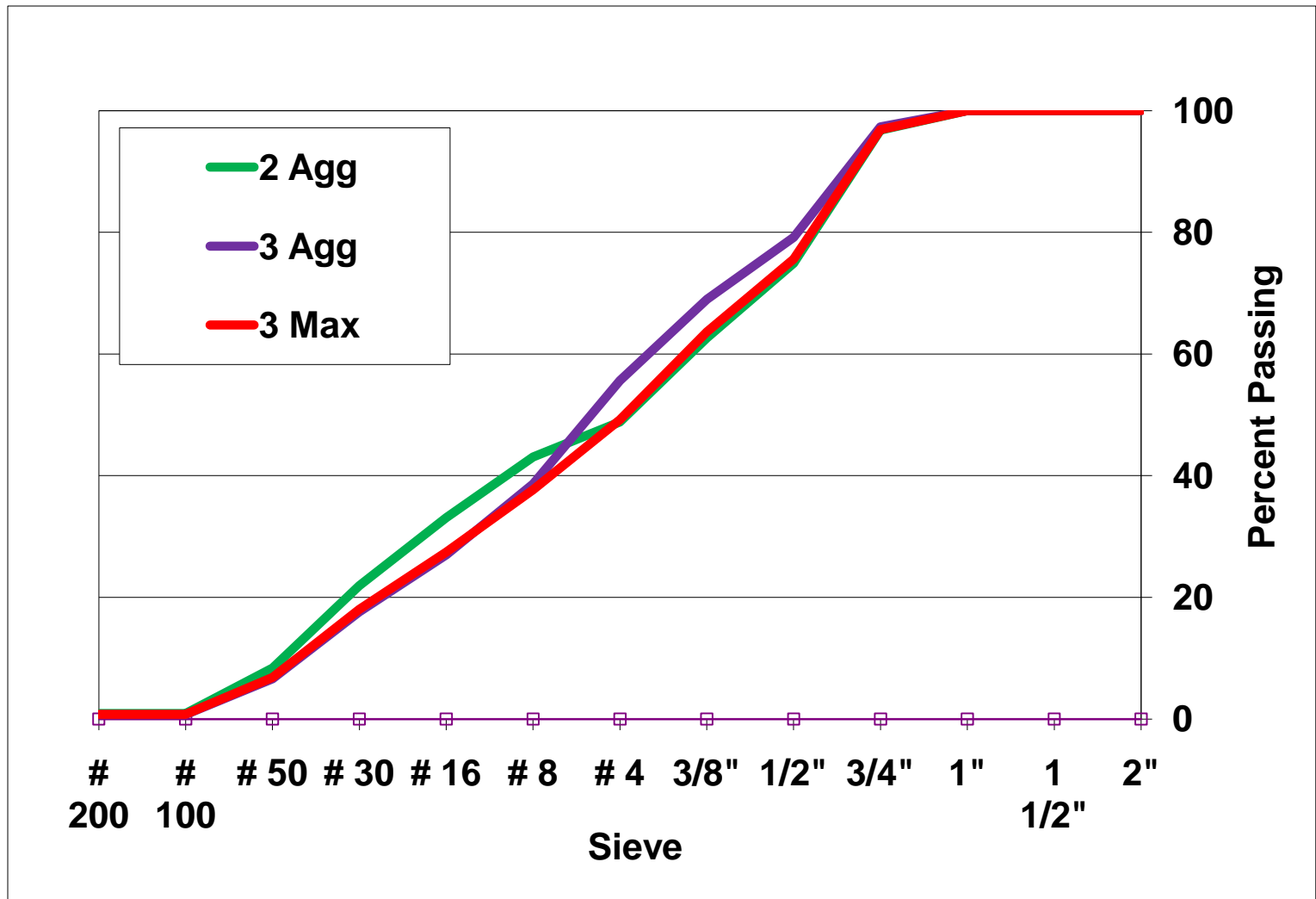
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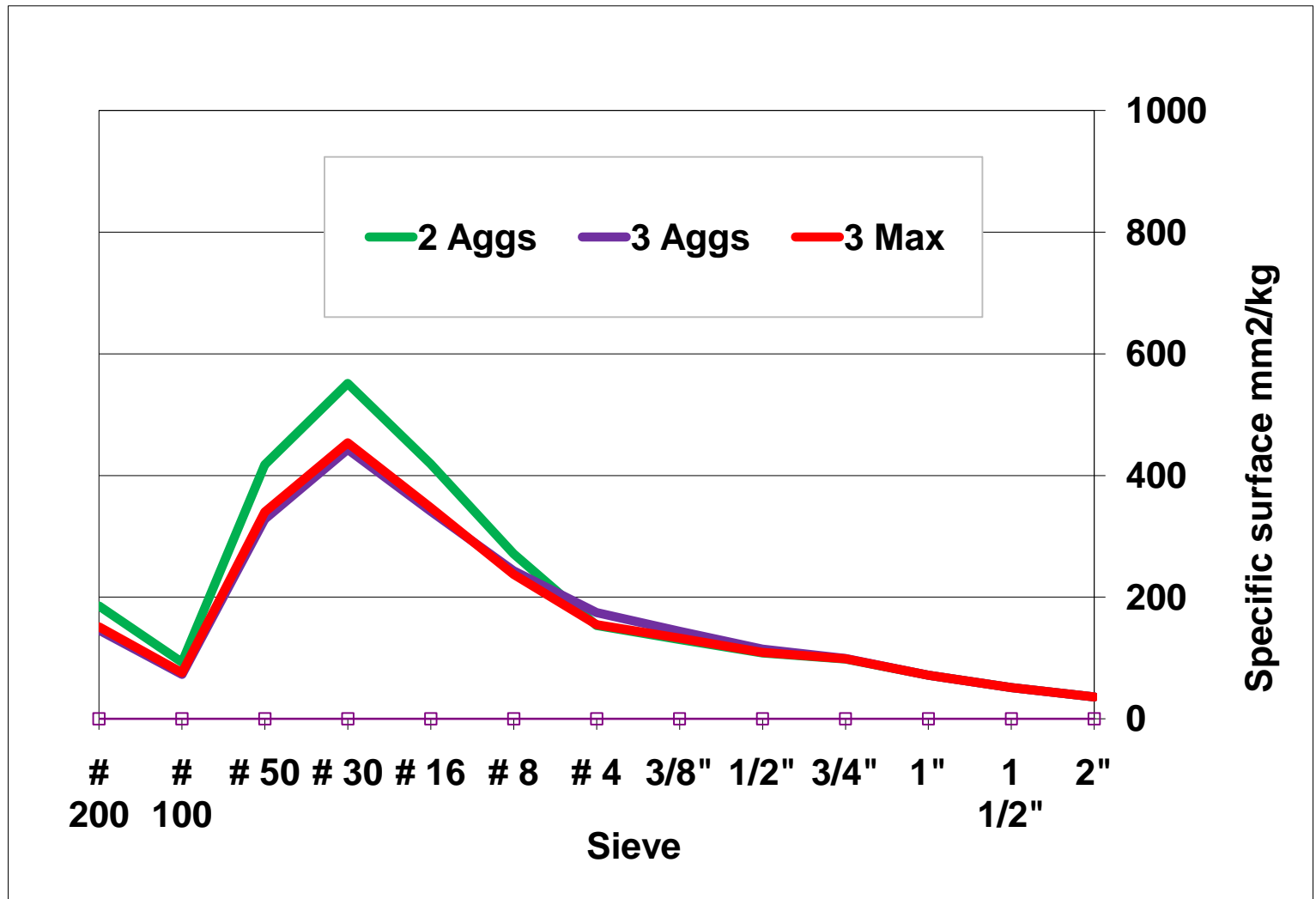
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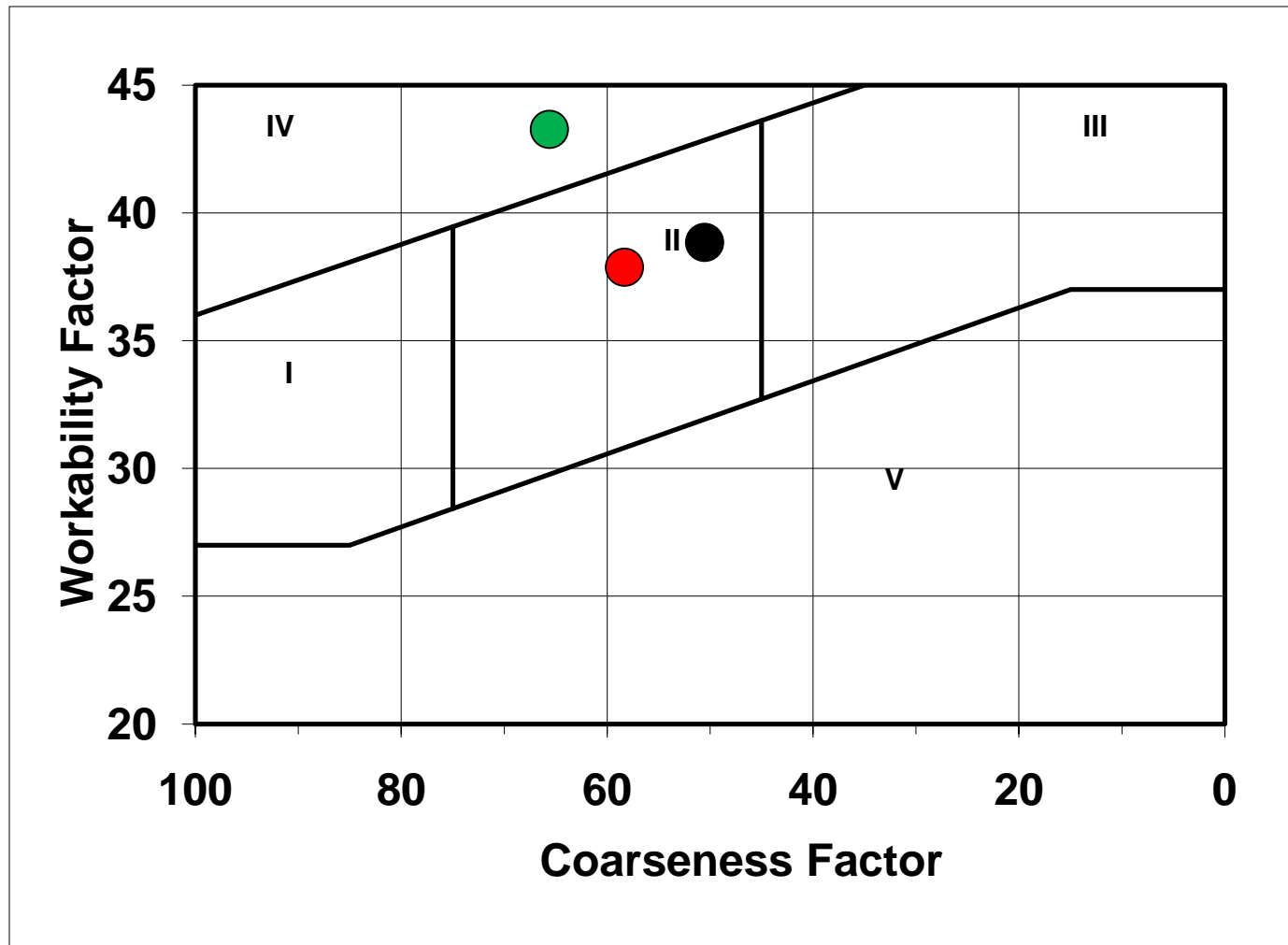
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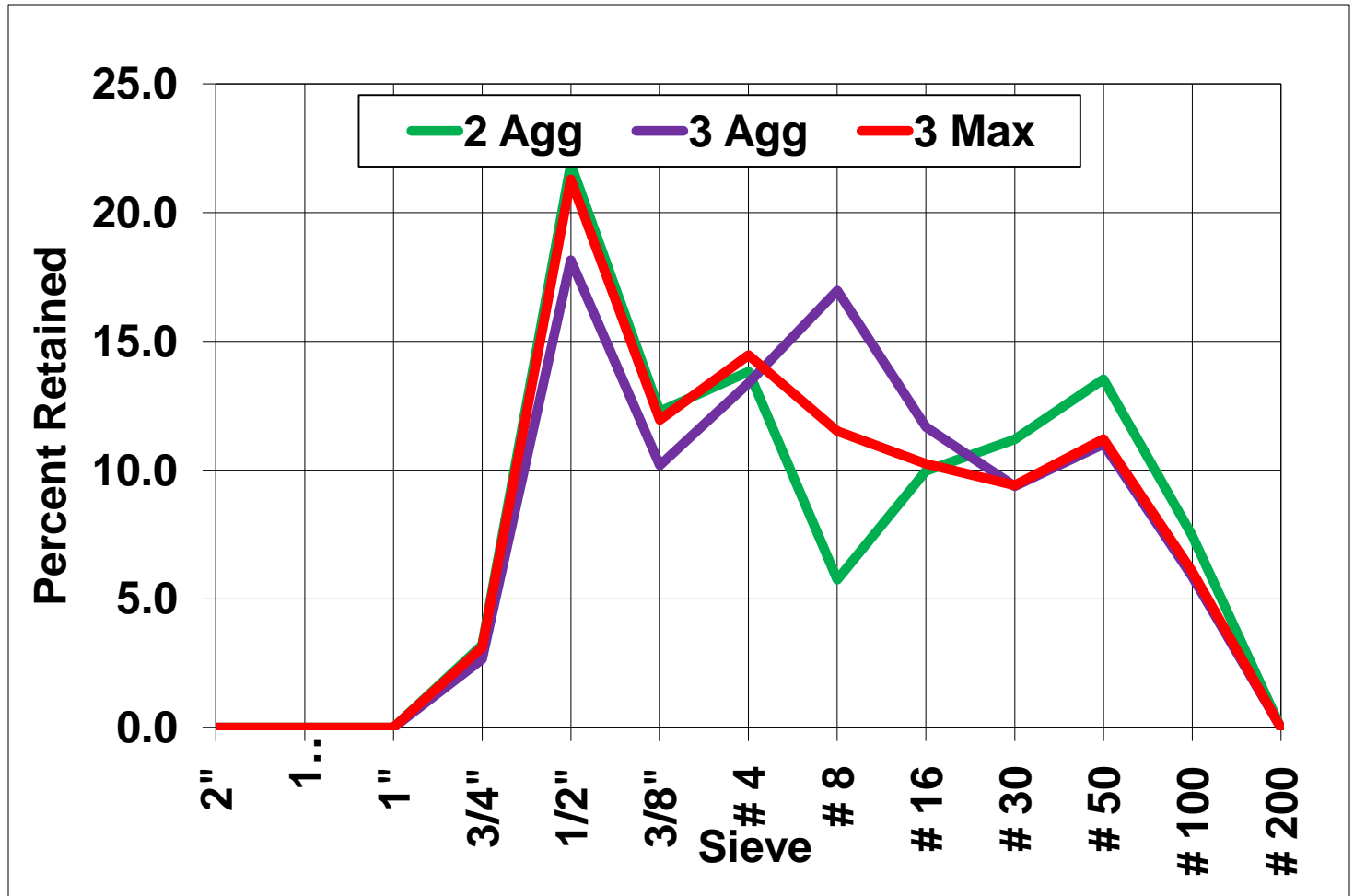
Aggregate System



Aggregate System

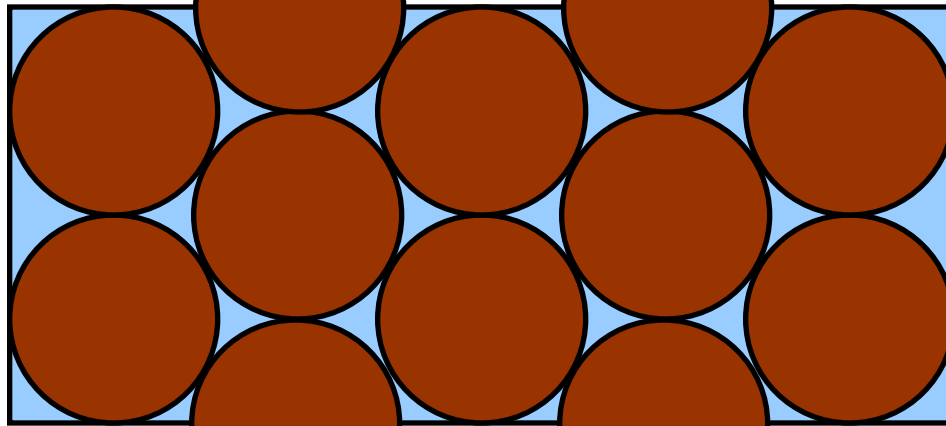


Aggregate System



Mix Proportioning

- Aggregate system:
 - Maximum density?
 - Power 45 curve?
 - Sensitivity?
 - Need to compare theory with mixtures



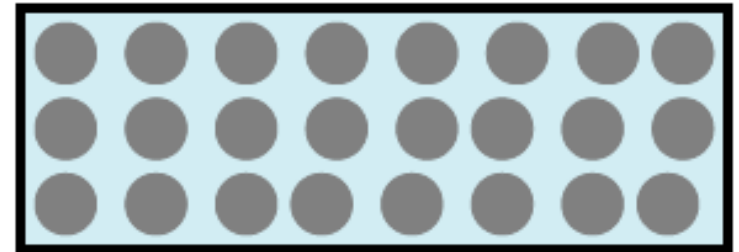
Mix Proportioning

- Paste quantity
 - Minimum – fill all the voids
 - Extra needed depends on workability needs and paste rheology
 - Being addressed in another project

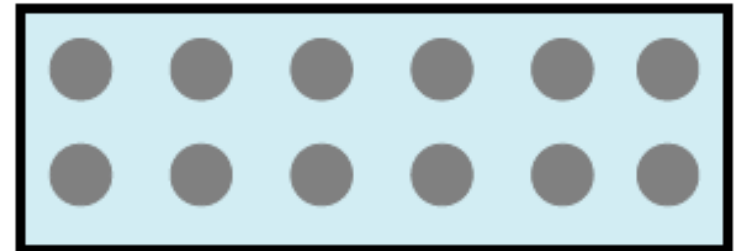
Mix Proportioning

- Paste quality
 - What cementitious materials?
 - How much?
 - What w/cm ?
 - Admixtures?

$w/c = \text{Low}$



$w/c = \text{High}$



Putting it all together...

- Precision needed?



Air Void System

- How much air do we need?
- What sort of bubble size?
- Do different admixtures make the right sort of air?
- Interactions?
- How do we measure it?