

Mix Design and Analysis Track Pooled Fund TAC Meeting

**National Concrete Consortium
TTCC
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Representing

The National Concrete Pavement Technology Center



Mix Proportioning

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

Assumptions

- The mixture is durable
- The mixture performs as required



Trouble is

- There are many different materials available
- Each is variable day to day
- Mixture performance is sensitive to:
 - Chemistry
 - Dosage
 - Environment
 - Workmanship
- Reactions and Interactions are complex

What do we want?

- Contractor is worried about fresh (plastic) properties
 - Uniformity
 - Workability
 - Air content
 - Segregation
 - Bleeding
 - Setting



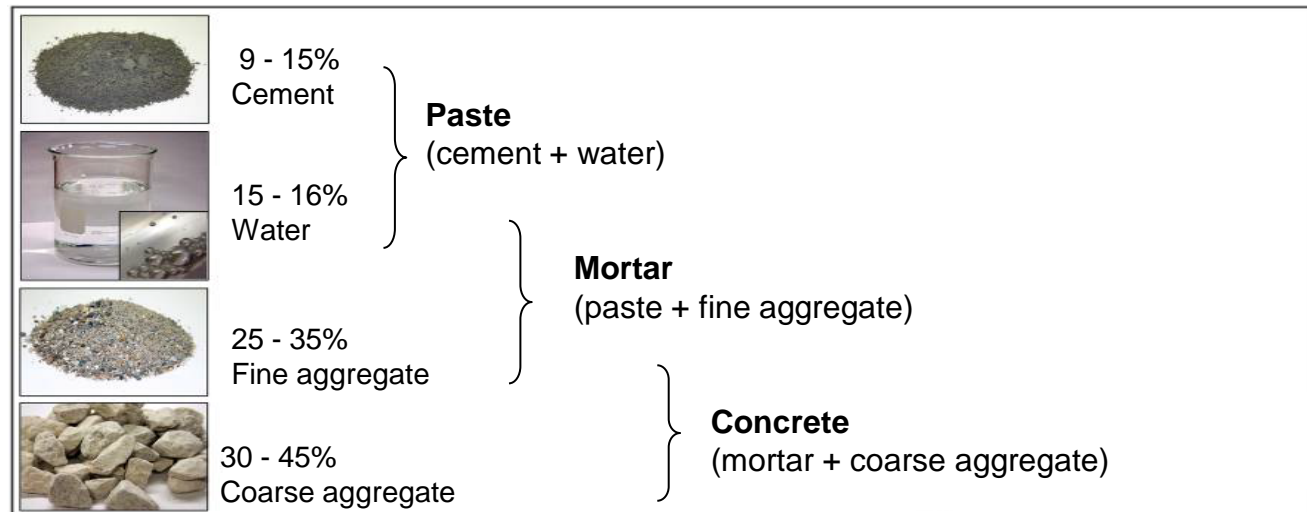
What do we want?

- Owner is worried about hardened properties
 - Strength
 - Cracking
 - Durability



What goes into it?

- Aggregates
- Cements
- Supplementary cementitious materials
- Water
- Admixtures



Mixture Design

- Process of determining required and specifiable characteristics of a concrete mixture:
 - i.e. Choosing what you want



Mixture Proportioning

- Process of determining the quantities of concrete ingredients available
 - i.e. choosing what to use to get what you want



Design and Proportioning

- Who should choose what?
 - Strength
 - Slump
 - Air content
 - w/cm
 - Cement content
 - SCM percentage
 - Aggregate grading
 - Admixture dosage

Basic Principles

- Combine aggregates to “maximize” volume
- Choose SCM type and dose
- Choose w/cm
- Choose air content
- Add sufficient paste to fill all the voids and line aggregates

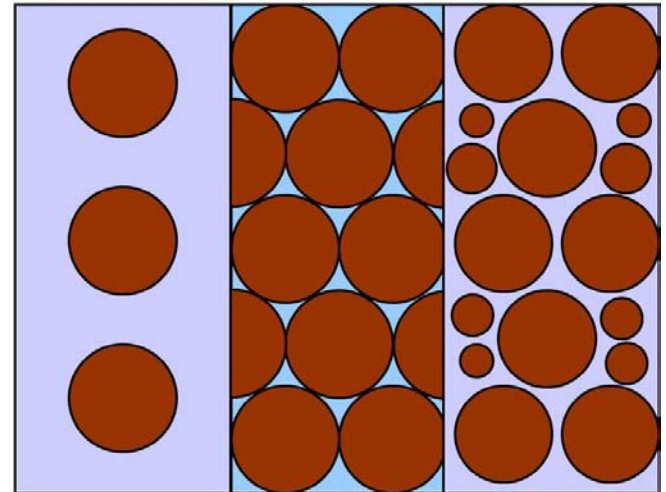
Mix Proportioning

- ICAR approach for SCC:
 - Choose aggregate system
 - Choose paste quantity
 - Choose paste quality
 - Choose SCM type and dose
 - Choose air content
 - Choose w/cm



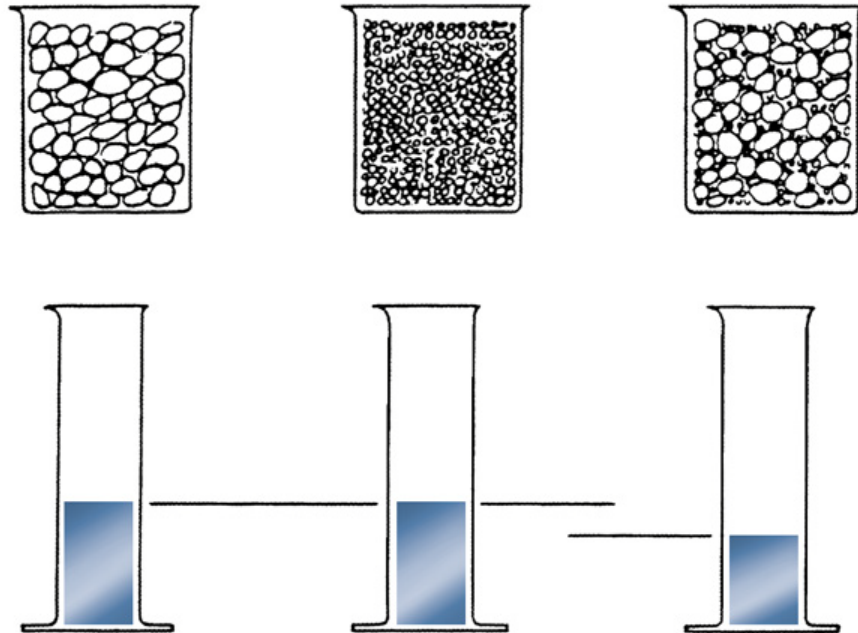
Mix Proportioning

- Paste quantity
 - Minimum – fill all the voids
 - Extra needed depends on workability needs and paste rheology

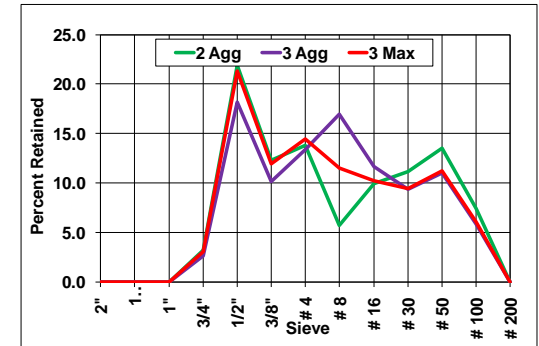
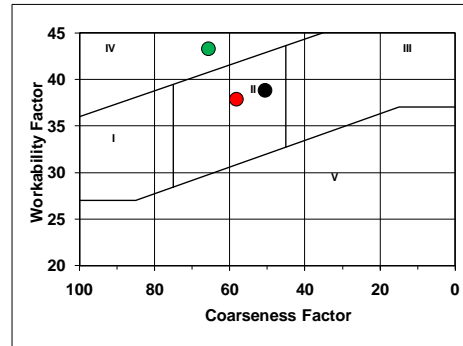
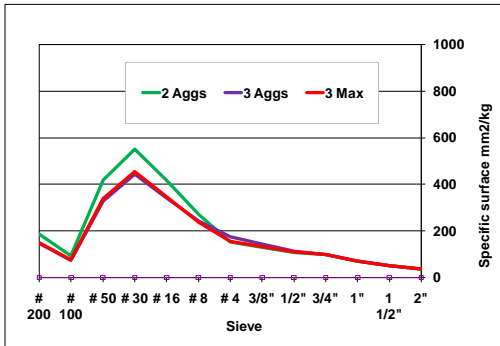
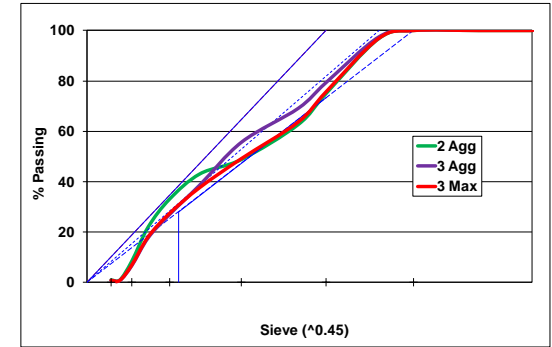
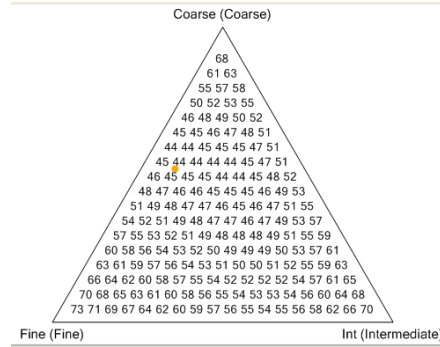
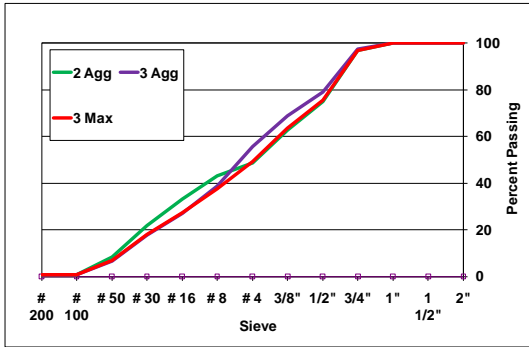


Aggregates

- Combined grading is used to obtain the increased aggregate density with the materials at hand



Aggregate System



Limits to Doing it Better

- Models / Relationships
- Data
- Test methods
- Specifications
- Education




Guide Specification With Commentary

- Follow the work developed by IPRF for airfield concrete paving (P-50X)
- Commentary provides explanation of why certain items are specified/included

An **IPRF** Research Report
Innovative Pavement Research Foundation
Airport Concrete Pavement Technology Program
Report IPRF-01-G-002-04-1

A Proposed Specification for
Construction of Concrete
Airfield Pavement




Programs Management Office
5420 Old Orchard Road
Skokie, IL 60077

July 2007

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Supplemental Report for
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