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Responsibility for Mix Design

Getting what you want

The Current System for Concrete Specification

- Specification is prepared which lays out all requirements
- A submittal is prepared to address those requirements
- Testing Laboratories are hired to check what is being supplied is what was submitted.
- There are no problems so everthing is great.

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Failures

- A failure occurs for only 2 reasons:

- The contractor did not follow the specification, or
- The specification was in error

Bryant Mather

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Proportion or Design ?

- PROPORTIONING
  - to adjust in proper proportion or relation, as to size, quantity, etc
  - to balance or harmonize the proportions of
- DESIGNING
  - showing or using forethought.
  - the act of making designs.
- to prepare the preliminary sketch or the plans for (a work to be executed), especially to plan the form and structure of:

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Problem – two masters

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Unwritten Owner Requirements

- Shrinkage
- Curling
- Cracking
- Appearance
- Longevity

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Constructor Requirements

- Workability
- Finishability
- Setting Characteristics
- Strength Gain for Stripping and Stressing
- Cold and Hot Weather

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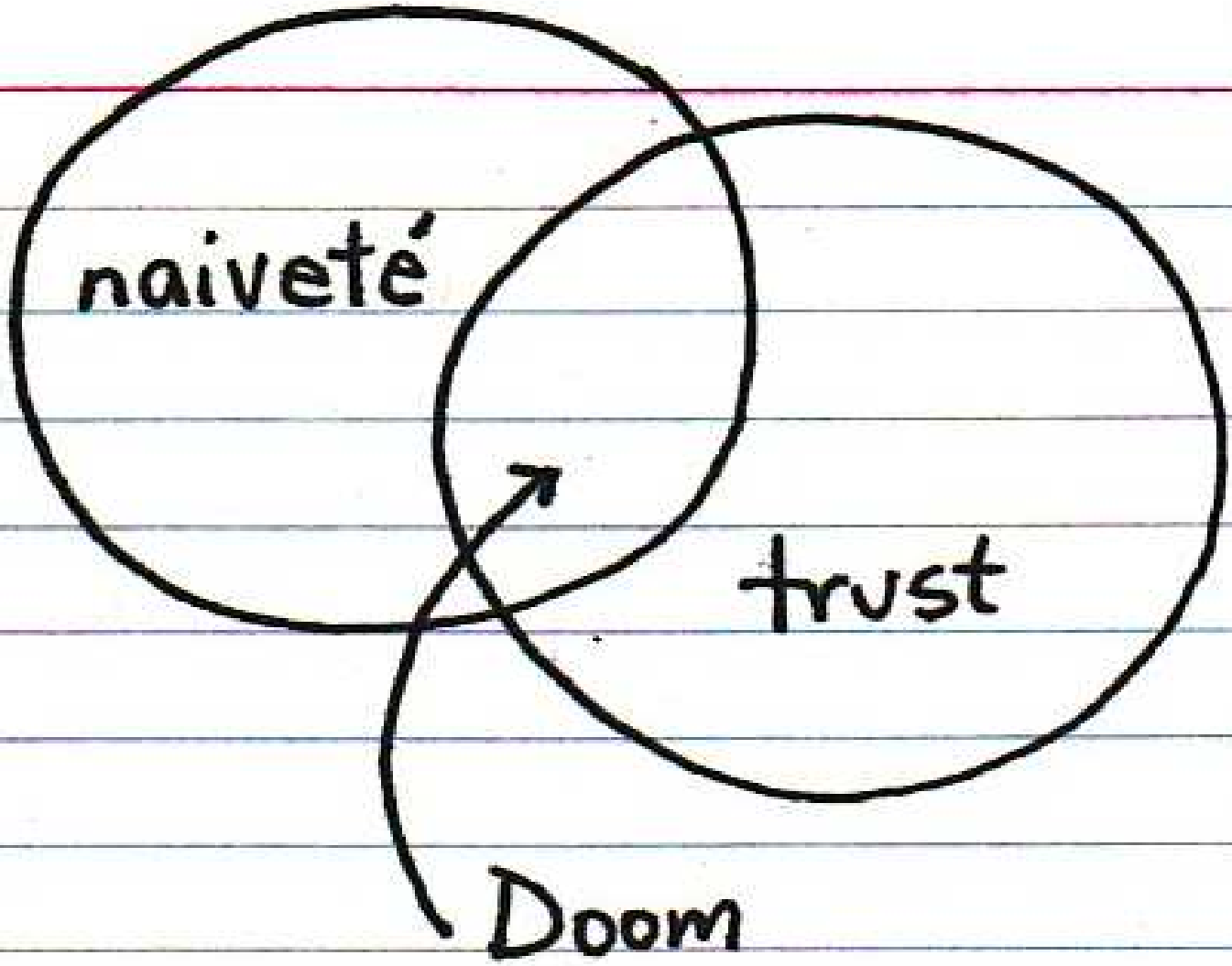
naiveté
trust
Doom

Strength Issues

- IBC 1905.6.2.4 A test is the average of two cylinders

IBC 1905.6.3.3

- Strength is an average of three sets of two cylinders
- No individual set more than 500 psi low

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N. Slump Limits: All concrete shall have a maximum slump of 4 inches, except concrete containing HRWR admixture (super plasticizer): Not more than 8" after addition of HRWR to site verified 2"-3" slump concrete.

- Can't the slumps be as required and proportioned?
- 4" maximum slump is too restrictive.
- Most HRWR are not site added.
- Why is there an 8" maximum if testing confirms the mix performs properly?
- Who know what workability is required best?

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Flow Test not Slump

No mortar

–

aggregate separation

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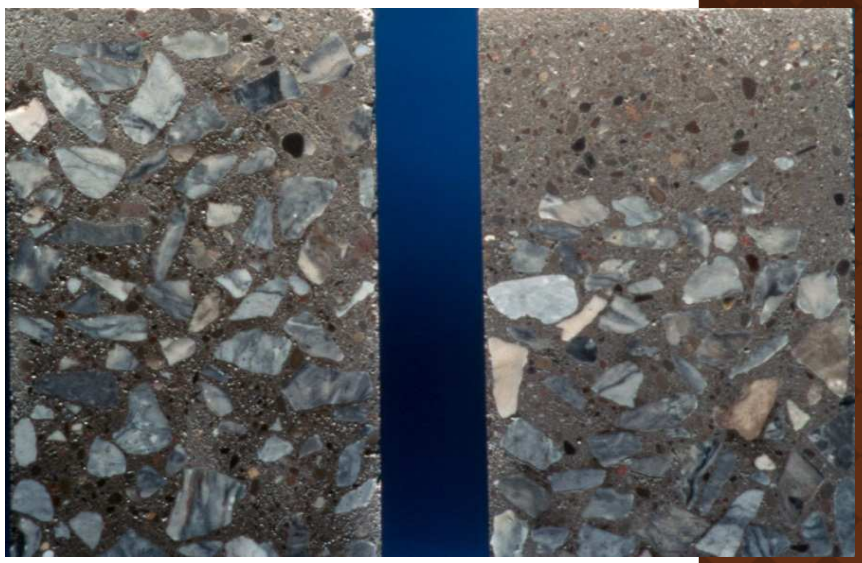
SEGREGATION

- cement chemistry
- insufficiently mixed
- admixture overdosing
- aggregate gradation gaps
- aggregate moisture content

viscosity modifier can overcome most segregation problems . . .



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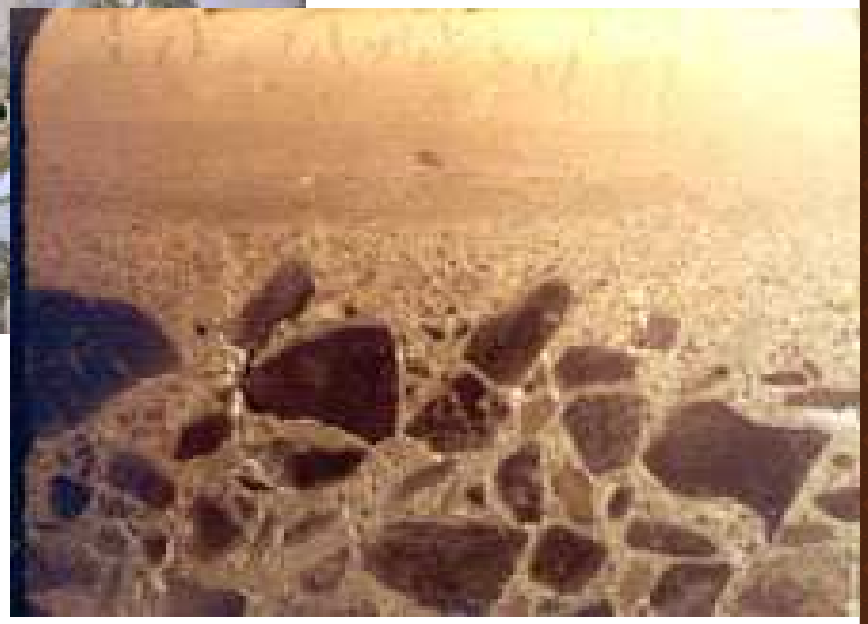
Concrete



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Problems and Pitfalls

- Lack of connection between strength and w/c ratio
- 3500 psi, 0.40 w/c ratio
- Which one do you want?

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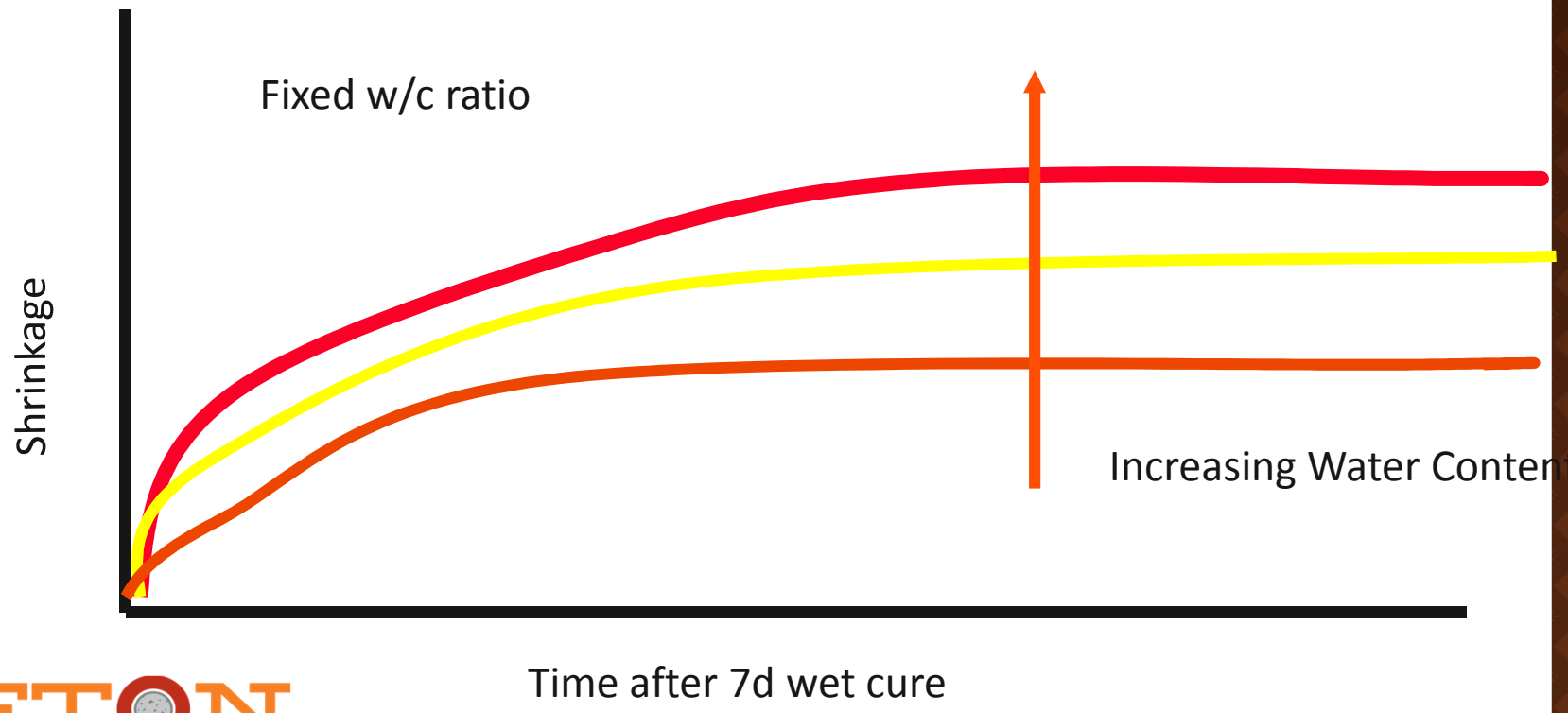
Problems and Pitfalls

- w/c ratio and shrinkage are not connected



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Problems and Pitfalls

- 800 lb cement and 320 lb of water
- 600 lb cement and 240 lb of water

- Same w/c ratio

- Latter has much less shrinkage than the former
- Strength is the same or similar
- Permeability higher in the former

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CEMSTONE CONCRETE PLACING


CEMSTONE CONCRETE PLACING

Finishing Problems

- Use of “Sack” Mixes and Low water : Cement ratio leads to uncloseable surfaces
- Relief may be needed to get the structure in place as required by the contract
- Addition of flyash or pozzolans can improve workability and reduce “rubberiness” of some low water – high flow concrete.

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Floors Gone Bad

Epoxy system in Airport Hanger

Vinyl Tile in Retail Store

Rubberized Floor in Health Center

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So what should the designer be responsible for?

Performance

- the designer has control – if her design does not work, that is where the fault lies.
- Unless - the construction team failed to follow the instructions

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What Type of Specification do we have?

- Prescriptive
- Perfromance
- Common – Both (or Neither)

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Prescriptive

The concrete supplier is responsible for

- supplying concrete in accordance with the prescribed requirements
- conducting appropriate and sufficient quality control to demonstrate and document compliance.

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Prescriptive

The use of the prescriptive approach transfers responsibility for the prescribed materials and processes from the contractor and supplier to the owner and design authority. The owner is therefore responsible for ensuring that the prescribed materials and processes will meet the performance requirements.

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Performance Based Specifications

The designer is responsible for

- establishing the performance criteria, usually in consultation with the owner;
- preparing the technical specification that states the performance criteria in appropriate terms; and
- under the direction of the owner, conducting quality assurance and reviewing quality assurance reports, or both, to ascertain on the owner's behalf that the performance criteria have been met.

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Performance

The concrete supplier is responsible for procuring materials and producing concrete that will, in its plastic and hardened states, meet the performance requirements. This includes responsibility for implementing a quality control program to demonstrate and document that the product as delivered is of appropriate quality and will meet the performance requirements..

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Performance

Since in a typical construction project the custody of the concrete transfers from the supplier to the contractor while in its plastic state, a high degree of coordination is required between supplier and contractor to ensure that the final product meets the performance criteria and that the quality control processes are compatible and demonstrate compliance.

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The Common Alternative

The “common” alternative has become a much less viable option, due to the lack of clarity in defining the roles and responsibilities for specifying the various mix design parameters and for assuming responsibility for the concrete mix proportions.

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Questions?

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Questions?

- Thanks for the time and attention

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