Precast ... The Concrete Solution

Troubleshooting Your SCC

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1

Agenda

- SCC Review
- Managing Variables
- Troubleshooting
  - Expectations
  - Materials
  - Mixture
  - Placing
- Case Studies

2

Review

- What is SCC?

3

Terms

- Filling Ability - The ability of the concrete to flow freely under its own weight, and to completely fill formwork of any dimension and shape without leaving voids
- Passing Ability - The ability of concrete to flow freely in and around dense reinforcement without blocking

4

Not Passing Ability!

5

Terms

- **Viscosity - The property of a material which resists change in the shape or arrangement of its elements during flow, and the measure thereof.**
- **Rheology - The science dealing with flow of materials, including studies of deformation of plastic concrete, the handling and placing of freshly mixed concrete, and the behavior of slurries and pastes.**

6

Terms

- Dynamic Segregation – The resistance of SCC to the separation of constituents during placement into the formwork.
- Static Stability - The resistance of SCC to bleeding, segregation, and surface settlement after casting while the concrete is still in a plastic state.

7

Managing Variables

- Aggregate Moistures
- Mixing
- Aggregate Gradations
- Powders
- Air Content

8

Aggregate Moisture

- Cook Outs
- Moisture Probes
- Amp Meters
- Slump Meters

9

Mixing

- Time
- Sequence
- Water, Water, Water
- Speed

10

Aggregate Gradations

- Control Charts for Gradations
- Control Charts for FM on the Sand
- Managing the Stockpiles

11

12

Powders

- Mill Certs
- Sampling program
- Difficult to Identify ***Significant*** Changes

13

Troubleshooting

- Change 1 thing at a time
- If you have a significant problem make a significant change
- Test after making changes
- If you make a change in your materials or process, expect a change in performance

14

Expectations

- If you don't need a 30" flow, don't proportion for a 30" flow
- The Concrete will only look as good as the forms
- Perfection (no bugholes) doesn't exist consistently

15

Materials

- Powders – Cement, Flyash, Slag, Silica Fume, Metakaolin, Limestone
- Admixtures – HRWR, WRA, Workability Retaining, Hydration Stabilizers/Retarders, Accelerators, AEA, VMA, RMA
- Fine Aggregates
- Coarse Aggregates
- Water

16

Cement

- Fineness (Blaine)
- Alkali Content
- Sulfate Balance

17

Flyash

- Fineness
- Reactivity
- Amount used
- Specific Gravity (Relative Density)
- Carbon

18

Slag

- Fineness
- Amount

19

Silica Fume

- Issues with Silica Fume are typically related to getting the material to mix
- Stickiness
- Water Demand
- Admixture Demand

20

Metakaolin

- Stickiness
- Water Demand
- Admixture Demand

21

Limestone Powder

- Fineness
- Reactivity
- Water Demand

22

HRWR

- Too much
- Too little
- Changes Viscosity
- Impacts air content
- Slump Flow loss

23

WRA

- Set Time
- Impact on Air
- Reaction with Powders

24

Workability Retaining Admixture

- Increases slump life but not slump
- Do you need it
- Slump Hump
- Impact on air
- Impact on Viscosity

25

Hydration Stabilizers/Retarders

- Set Time
- Impact on Air
- Slump Life
- Reaction with Powders
- Bleed Water

26

Accelerator

- Slump loss
- Impact on AEA

27

Air-Entraining

- Too Much
- Too Little

28

Viscosity modifying

- Type – how it behaves
- Impact on air

29

Rheology Modifying

- It's either a benefit or it isn't

30

Fine Aggregates

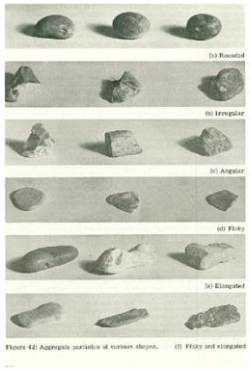
- Gradation
- 30, 50, 100 sieves
- Clean or dirty (clay)
- Particle shape

31

Coarse Aggregate

- Maximum size
- Gradation
- 3/8”, #4
- Clean or dirty (clay, excessive fines)
- Particle shape

32



33

Water

- Recycled water
  - Impact on air
  - Impact on strength
  - Impact on set time

34

Hydration Control and Retarding

- Improved Strength
- Extended Set
- Improved Workability
- Extended Slump Life

35

Water Reducing

- Improved Strength
- Improved Workability
- Most often used with a HRWR

36

Set Accelerating

- Reduced set time
- Increase early strength

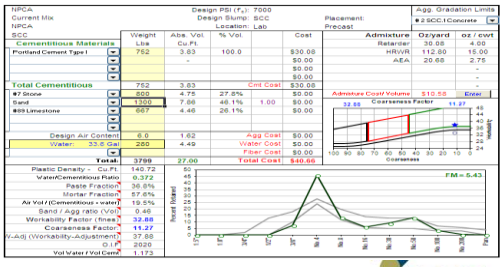
37

Tools for Proportioning SCC

- Experience
- Proportioning Software
- Aggregate Blending Spreadsheets

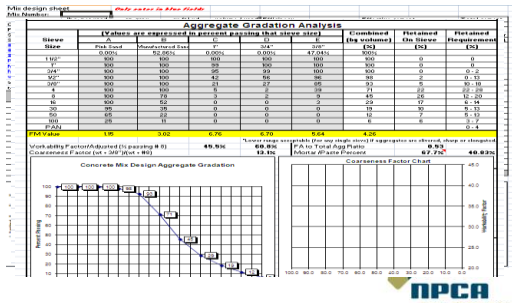
38

Software



39

Combined Aggregate Grading



40

Segregation

- Is it static or dynamic segregation?
- Confirm Robustness – Can your materials produce the slump flow & Viscosity you are targeting?
- Are the water and admixture amounts correct?
- Are all of the other plastic and hardened properties being met?

41

Static Segregation

- Decrease the water and increase the HRWR
- Increase the water and decrease the HRWR
- Increase or add VMA (Make sure it is going into the batch at the right time)
- Increase the powder content (100 pounds)
- Reduce coarse aggregate and increase fine aggregate (100 pounds)
- Try a smaller max coarse aggregate

42

Dynamic Segregation

- Try a smaller max aggregate size
- Reduce the coarse aggregate amount (100 pounds)
- Increase the viscosity of the mix
  - Less water
  - More powder
  - Increase or add VMA

43

44

Inadequate Slump Flow

- Increase water content
- Increase HRWR
- Increase coarse aggregate content

All of these will impact other properties of the mixture.

45

Inadequate Filling Ability

- Increase Slump Flow
- Reduce Viscosity

46

Blocking

- Try a smaller max coarse aggregate
- Increase Slump Flow
- Reduce Viscosity
- Reduce coarse aggregate content(100 Pounds)

47

Bug Holes

- Use as much water as you can to have the lowest viscosity possible
- Adjust the coarse and fine aggregate content (100 Pounds)
- Add AEA if not using
- Add RMA

48

Air Entrainment

- Determine the cause of the problem
- Add a VMA
- Increase the fine aggregate content (100 pounds)
- Try a different AEA(Talk to your Admixture Supplier)

49

Batching, Mixing & Placing SCC

- Consistency
- Consistency
- Consistency

50

Segregation

- Is it static or dynamic segregation?
- Are you mixing at the same speed and for the same time on each batch
- Are the placement methods correct for the application
- Are there other problems? Air, Slump Flow, Strength

51

Static Segregation

- Make sure that the mixture is homogenized
- Does the delivery vehicle cause segregation
  - Beginning and end of batch the same?
- Placing method
  - Drop height
  - Slide instead of drop
  - Place with a tremie
  - Speed of discharge

52

Dynamic Segregation

- Pushing the concrete too far
  - 10' from point of discharge is fine, 20' isn't
- Dropping too far

53

Inadequate Slump Flow

- Inadequate mixing – low water content mixtures take longer to homogenize
- Slump Flow loss in transit
- Slump Flow loss during placement
- Slow Flow doesn't match the placement method

54

Inadequate Filling Ability & Blocking

- Lack of energy from placement method
  - Continuous energy

55

Bug Holes

- Clean Forms
- Use correct form release
- Use correct amount of Form release
- Do not drop concrete, let it slide
- Don't place to quickly (Vortex)
- Place from the bottom up

56

Air Entrainment

- Mix Consistently
  - Same length of time
  - Same speed
  - Keep the mixer clean and in good working order
  - Optimize the batching sequence
  - If you change one of the other materials it will impact the air
  - If one of your materials changes it will impact air

57

Case Study #1

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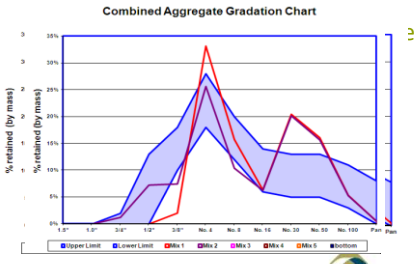

58

Case Study #2

- My SCC looks great in the mixer but…..

59

Case Study #3

- Everything looks good until we strip the Forms.

60

Case Study #4

- Honeycomb?

61

Case Study #5

- Muck?

62

Case Study #6

- Bug Holes

63

Questions?

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64

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65