Troubleshooting Your SCC
Presented by: Terry Harris, GCP Applied Technologies

Agenda
• SCC Review
• Managing Variables
• Troubleshooting
  – Expectations
  – Materials
  – Mixture
  – Placing
• Case Studies

Review
• What is SCC?

“Self Consolidaing Concrete is a highly flowable, non-segregating concrete that can flow into place, fill the formwork, and encapsulate the reinforcement without any mechanical consolidation.”

ACI International, Committee 237 SCC

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

Not Passing Ability!

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.
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.

Managing Variables

• Aggregate Moistures
• Mixing
• Aggregate Gradations
• Powders
• Air Content

Aggregate Moisture

• Cook Outs
• Moisture Probes
• Amp Meters
• Slump Meters

Mixing

• Time
• Sequence
• Water, Water, Water
• Speed

Aggregate Gradations

• Control Charts for Gradations
• Control Charts for FM on the Sand
• Managing the Stockpiles
Powders

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

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

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

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

Cement

- Fineness (Blaine)
- Alkali Content
- Sulfate Balance

Flyash

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

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

Metakaolin
- Stickiness
- Water Demand
- Admixture Demand

Limestone Powder
- Fineness
- Reactivity
- Water Demand

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

WRA
- Set Time
- Impact on Air
- Reaction with Powders
Workability Retaining Admixture
- Increases slump life but not slump
- Do you need it
- Slump Hump
- Impact on air
- Impact on Viscosity

Hydration Stabilizers/Retarders
- Set Time
- Impact on Air
- Slump Life
- Reaction with Powders
- Bleed Water

Accelerator
- Slump loss
- Impact on AEA

Air-Entraining
- Too Much
- Too Little

Viscosity modifying
- Type – how it behaves
- Impact on air

Rheology Modifying
- It’s either a benefit or it isn’t
Fine Aggregates
- Gradation
- 30, 50, 100 sieves
- Clean or dirty (clay)
- Particle shape

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

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

Hydration Control and Retarding
- Improved Strength
- Extended Set
- Improved Workability
- Extended Slump Life

Water Reducing
- Improved Strength
- Improved Workability
- Most often used with a HRWR
Set Accelerating

- Reduced set time
- Increase early strength

Tools for Proportioning SCC

- Experience
- Proportioning Software
- Aggregate Blending Spreadsheets

Software

Combined Aggregate Grading

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?

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
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

Inadequate Slump Flow
- Increase water content
- Increase HRWR
- Increase coarse aggregate content
  
  All of these will impact other properties of the mixture.

Inadequate Filling Ability
- Increase Slump Flow
- Reduce Viscosity

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

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
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)

Batching, Mixing & Placing SCC
- Consistency
- Consistency
- Consistency

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

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

Dynamic Segregation
- Pushing the concrete too far
  – 10’ from point of discharge is fine, 20’ isn’t
- Dropping too far

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
Inadequate Filling Ability & Blocking
- Lack of energy from placement method
  - Continuous energy

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

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

Case Study #1
- Mix Is Not Working
  - “We Just Can’t Make SCC”

Case Study #2
- My SCC looks great in the mixer but.....

Case Study #3
- Everything looks good until we strip the Forms.
Case Study #4

- Honeycomb?

Case Study #5

- Muck?

Case Study #6

- Bug Holes

Questions?

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