The Perfect SCC Project

gcp applied technologies

The Perfect SCC Project??

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Definition of a “Perfect” SCC Project

A project where the SCC mixture meets the project specifications and by using proper formwork and placement techniques results in a finished product that serves its intended purpose and meets the expectations of the project owner.

Realistic Expectations

- Specifications
- Concrete Finish (Aesthetics)
- Concrete Mixture
- Concrete Placement

Project Specifications

- **Materials**
  - Cementitious materials should comply with applicable specifications.
  - Aggregates should meet ASTM C33 in general but aggregates that do not meet the standard gradation requirements may be required to obtain the needed combined gradation.
  - Admixtures should meet ASTM C494
- **Strength & Air**
  - Specified to meet necessary requirements.
  - SCC may be air-entrained to improve the mix properties even though it isn't required by project specifications.
- **Slump flow**
  - Do not specify a maximum or a range until after mixture development and trial placement.
  - The slump flow range should be based on the range at which in place performance is acceptable.

Project Specifications

- **VSI**
  - In general a VSI of 1 is acceptable
- **Other SCC test methods**
  - Numerous other test methods can be used during mix development but test during production should be limited to those intended for that purpose.

Expectations

- **Formed Finish**
  - Agree on a measurement for bughole acceptance, not “bughole free”
  - Agree on limits for other defects such as form transference, form lines, sand streaks, color
- **Slump Flow**
  - Specify and proportion for the slump flow required (Don’t ask for 30” flow if 25” will work)
- **Flow**
  - Determine the maximum distant the mix can flow from the placement point and remain stable.
- **Passing ability**
  - Test placement should include the least rebar spacing expected and minimal clearance between forms and rebar

Concrete Mixture

ACI 237-07 offers advice on selecting slump flow requirements for various applications.

Table 2.5—Slump flow targets (Daczko and Constantiner 2001)

Member characteristics			Slump flow		
			<22 in. (<550 mm)	22 to 26 in. (550 to 650 mm)	>26 in. (>650 mm)
	Reinforcement level	Low			
		Medium	■		
		High	■		
	Element shape intricacy	Low			
		Medium	■		
		High	■	■	
	Element depth	Low			
		Medium			
		High			
	Surface finish importance	Low			
		Medium	■		
		High	■	■	
	Element length	Low			
		Medium	■		
		High	■	■	
	Wall thickness	Low	■	■	
		Medium	■		
		High			
	Coarse aggregate content	Low			
		Medium			
		High			
	Placement energy	Low	■	■	
		Medium	■		
		High			

Note: SCC mixtures with slump flows less than 22 in. (550 mm) may require minor vibration.

"In general, the lowest slump flow consistency should be chosen to reduce the potential for instability and optimize the performance/cost relationship."

Concrete Mixture

- **Proportion for performance before cost**
  - Slump flow
  - Slump flow life
  - Passing ability
  - Filling ability
  - Dynamic stability
  - Static stability
- **Determine the limitations of the local materials**
  - Maximum slump flow achievable
  - Robustness testing
  - A more robust mixture may result in lower in place cost

Concrete Placement

- **Conduct a trial placement (Mock up)**
  - Form material
  - Form release
  - Freefall
  - Time
  - Placement techniques
    - Pump, bucket, tremie, chutes, timing, lift height, placement locations
  - Finishing

Conducting the trial placement at the high and low end of the slump flow range is ideal. If this is not possible then the mid-point of the slump flow range should be used.

Quality Control

- **The Ready-Mix producer and the Contractor should have a QC Plan and should include a pre-construction meeting**

- **Ready-Mix QC Plan**
  - Aggregate moisture – testing and or probe calibration frequency
  - Aggregate gradation testing schedule
  - Process to ensure no leftover concrete or wash water in the drum
  - Initial batch of the day testing
  - Maximum and minimum batch sizes
  - Mixing time
  - Mixing speed
  - Load Spacing*
  - Visual Acceptance?
  - Who can accept
  - Who can reject
  - Slump flow life (weather impact)
  - On site adjustments to a load

Quality Control

- **Contractor QC Plan**
  - Trial placement
  - Form construction
  - Reuse of forms
  - Form release application
  - Form pressure
  - Placement locations
  - Pump prime disposal
  - No vibration in the pump hopper
  - No water added to the pump hopper
  - Ordering concrete*

Perfect SCC Project

Quality Control Tests that were performed are:

- The Spread test –Results were 26” to 28” on all tests
- The J-Ring test – Results were 25 1/2” to 28”
- Air Test – Results were between 4.5% and 6.0%
- 28-day compressive strength 11,300 psi

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- Ready-Mix producer was awarded a cast-in-place residential housing project. After awarding, the producer was informed that the contractor wanted a ***finish free of bugholes***. Testing was undertaken determining the effects of aggregates and aggregate combinations, eventually leading to the producer importing both coarse and fine aggregate. Additionally, a VMA was required to stabilize the mix.

- Ready-Mix producer is working with developer on a project for a high-rise building. The design team focused in on the need for f'c of 18 ksi with an MOE of 6.2 Mpsi. Multiple lab trials were undertaken looking at effects of aggregates and aggregate combinations, cementitious materials and cementitious combinations, and admixtures and admixture combinations. The target, based upon conversations with the design team, was to achieve the required strength while maintaining a 30" spread for more than two hours.

Perfect SCC

- Columns placed in August in Florida – Hot!
- Volume of concrete in each column is small
- High slump flow (28”) and long slump flow life required

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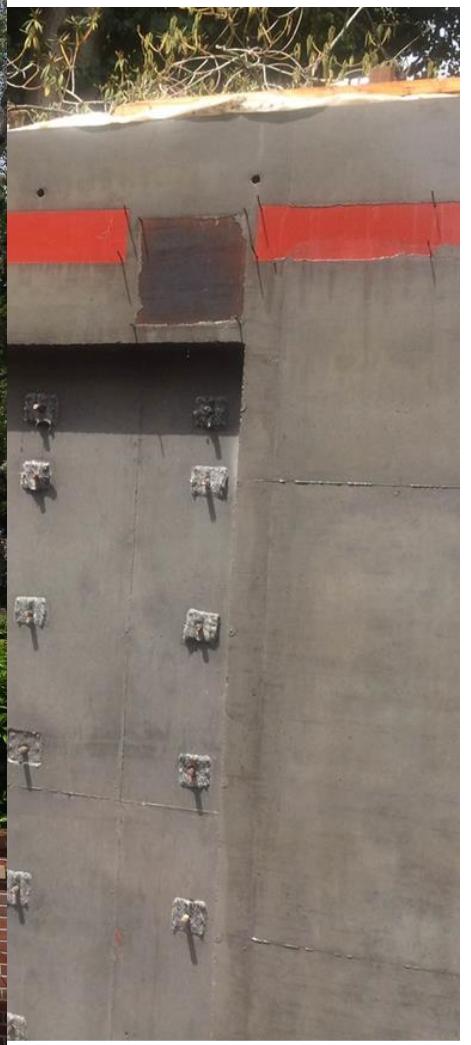
Perfect



$300,000 spent on trial placements!

Thank you

For the most up-to-date information please visit the American Concrete Institute at:
www.concrete.org