SPECIALTY CONCRETE MIXTURES AND THEIR USE

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Specialty Concretes

- Common attributes
  - All require contractor mixture design
  - Use of DOT approved materials
  - Performance requirements
    - Strength
    - Strength gain rate
    - Freeze / thaw
    - Scaling
    - Workability

Specialty Concretes

- Compressive strength
- Light weight
- Internal curing
- Self-consolidating
- Accelerated

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- Mass placement
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SCC

Three Key Characteristics of SCC

- Ability to flow into forms
- Ability to pass through reinforcement
- Resistance to segregation

State DOT Acceptance of SCC

Benefits

- These keys provide the benefits of:
  - Improved quality
  - Aesthetics
  - Reduced labor
  - Safety

SCC uses in NY

- Materials precast
  - Box culverts, drainage, walls, barriers
- Cast-In-Place construction
  - Substructure repairs, re-facing, aesthetics
  - New construction
- Structural precast
  - Segmental, 3 sided arches, beams
- Future considerations
  - Drilled shafts, mass placements, others???

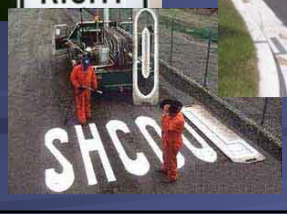
Limitations / Concerns

- Limited experience / expertise
- Construction practices
  - Pressure on Formwork
  - Loss of Flowability due to:
    - Hot Weather
    - Long Haul Distance
    - Delays at the Job Site
- Cost implications

CIP Applications

- 555 – Structural Concrete
- 582 – Substructure Repairs
  - Both allow SCC as an option to conventional concrete placement via Special Notes
- Both require proof of mix performance

QC – the name of the game!



Requirements

- QC Plan
  - Define performance criteria
  - Address how performance criteria will be maintained
  - Actions when tests yield out-of-tolerance results

Cast-In Place

- Included in project by Special Note
- Contractor intention identified early
- Contractor / Producer develop mix
  - QC Plan for production / acceptance
  - Performance criteria established per Special Note

Contractor developed QC targets

Spread:	Target:	24” to 28”
	Low action limit:	18” to 23”
	High Action limit:	29” to 30”
	Low rejection limit:	Less than 18”
	High rejection limit:	Greater than 30”
Mixing revolutions:	100 total	
	80 at the plant	
	Additional 20 upon arrival on site	

Contractor developed QC targets

Air Content: 6% to 9%

Visual Stability Observations:

No excessive mortar halo

No visual “rock pile” in center of spread

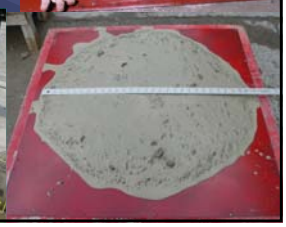
Standard temperature specification

Compressive strength cylinders:

Frequency determined by the region

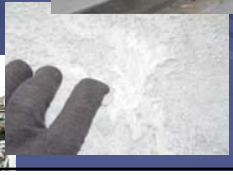
Sampling and Testing

– Slump flow (Spread)
– Air content
– Cylinder casting
– Visual Stability Index (VSI)



Batching / Delivery

- Provisions of 501 apply
- Need to consider:
  - Batching sequence
  - Shorter loads
  - Water control
    - Wash down control
    - Wash out control



Handling / Placement

- Provisions of 555 / 582 apply
- Need to Consider:
  - Solid / secure forming
  - Continuous flow of material
    - Consider pumping
  - Reduced labor / no vibration

Cast-In-Place Construction

- Mirror-like finish
- Replicates forms

Think SCC in your next project!

- SCC is good tool
  - Allows improved quality / productivity
  - Requires attention to details
  - Expect further uses / standardization

Cast-In-Place Construction

Accelerated Concrete

Drivers First

Achieving Accelerated Concrete

- Concrete w/ hot water and/or non-Cl- accelerator
  - Strengths in 4, 6, 12, 18 or 24 hrs
- UHPC
  - Structural need – 15+ hrs for strength
  - Attempt to accelerate w/ heating
- Rapid Hardening Cement
  - 1 – 2 hrs for strength
- Concrete with calcium chloride
  - Strength in 2 – 4 hrs but… can't reinforce

Types of Accelerated Concrete

- High Early Strength (HES) Portland Based Mixes
  - Type I/II ,
  - Type III Cement
  - Accelerator additions
- Ultra High Performance Concrete (UHPC)
- Very High Early Strength (VHES) Mixes with Rapid Hardening Cement

Applications

Application considerations

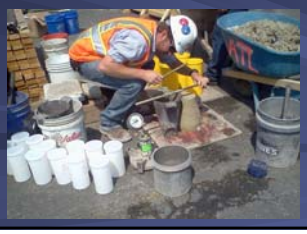
- Exposed finish *vs.* Overlay
  - Different F/T specs
- Rate of Strength Gain
  - Faster set = less durable
  - PCC *vs.* 701-09
- Ultimate strength
  - PCC / 701-09 *vs.* UHPC

Mixture Development

Specifications

- "Semi"- Performance Based Specifications
- Contractor/Producer developed mixture
  - Use DOT approved materials
  - Lab trials
- Mixture test data to DOT for review
- Field trial(s) w/ samples to DOT for test

Field Trial Batch



Mock Up Forms

Delivery method

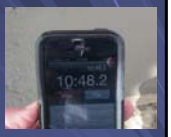
Performance Criteria

- Freeze thaw
- Scaling
- Ultimate strength
- Rate of strength gain

- Durability

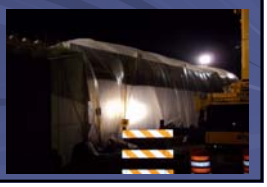
Working time

- Place quickly
  - Environment
    - Hotter = faster / Colder = slower
- Once set begins – discard excess
  - Can't consolidate / finish
  - Durability compromised



Temperature impacts

- Environmental conditions
  - Impact set time and strength gain
  - Hotter = faster / Colder = slower
- Can't always relay on cylinders
- Protect placement from extremes
  - Enclosures / insulation
  - External heat

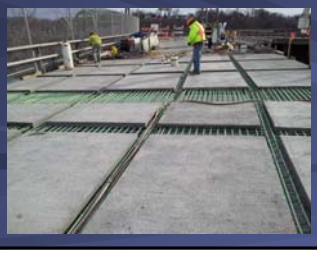


Constructability "Challenges"

- Difficult Working Environment
  - Night work
  - Limited access
  - Short work windows
- Material Variability in Field Performance
  - Set time / strength gain – temperature sensitivity
  - Consistency / water demand

Best Practices

- Develop mixtures early in the project
  - Consider application
  - Strength gain needs




Best Practices

- Controlled batching – maintain water content
  - Too much will lower strength / rate of strength
  - Calibration of equipment



Best Practices

- Trials in conditions expected during production
  - Cooler temps at night vs. trial during warm day
  - Use same crew / equipment
  - Mock-ups strongly recommended


Best Practices

- Placement
  - Have site ready before materials arrive
  - Preheat existing surfaces as needed / enclosures(?)
  - Control water content / batching


Best Practices

- Placement
  - Rapid placement / consolidation / finishing
    - ***Once set starts, discard remaining material***
  - Allow to set / cure as long as possible
  - Clean equipment promptly

Assessment of learning

- What test is used to measure flowability?

Slump flow (Spread) per ASTM C1611

Assessment of learning (a.k.a. Quiz)

- What are 3 key characteristics of SCC?

Ability to flow into forms
Ability to pass through reinforcement
Resistance to segregation

Assessment of learning

- What is a key to SCC placement necessary to avoid honey combs and voids?

Continuous flow of SCC material for a given placement area

Assessment of learning

- Can vibrators be used with SCC?

Yes – vibrators can be used with SCC. They can help reinitiate movement of SCC that has stopped flowing and will aid in consolidation of SCC with low spreads however, caution is necessary to avoid vibrating entrained air from the SCC.

Assessment of learning

Which of the following are reasons for the use of Accelerated Concrete?

A. Short working windows
B. Minimize disruption to public
C. Labor cost savings
D. All of the Above

D. All of the Above

Assessment of learning

- What impact will forms have on the aesthetic finish of SCC?

Every detail of a form will be transferred onto the SCC. Further, release agent application on forms will impact the finished surface of the SCC.

Assessment of learning

What are some types of Accelerated Concrete used on Department projects?

A. Ultra High Performance Concrete UHPC)
B. High Early Strength Concrete (HES)
C. Very High Early Strength (VHES)
D. All of the Above

D. All of the Above

Assessment of learning

High Early Mix Designs are prepared by the Contractor?

A. True
B. False

A. True

Assessment of learning

What are some important steps to follow when using Accelerated Concrete?

A. Use of Approved Materials
B. Thorough Mix Design Review
C. Never place concrete that has started to set
D. All of the Above

D. All of the Above

Assessment of learning

What are some Disadvantages of using Accelerated Concrete?

A. Can be difficult to work with
B. Project Staff needs to become familiar with it's use
C. Higher Cost
D. All of the Above

D. All of the Above

Thank You!