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## Introduction of Revised Specification for Shotcrete and Other Shotcrete Development

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**Phil T. Seabrook, P.Eng., PE, F.ACI.** A consulting materials engineer with over 50 years experience in the construction industry. Career has focused on concrete and shotcrete. Served ACI on Board, Certification Committee, and CONREF and chaired Committee 506, Shotcrete; currently chair of Subcommittee 506E which developed the new Shotcrete Specification, 506.2. Author of numerous papers and presentations. Chaired Canadian Standard Committee on concrete. Served as Adjunct Professor at UBC and as a Researcher for Concrete Canada. Recipient of APEGBC McLachlin Award and CEBC Award for Meritorious Service to Consulting Engineering. Current activities focus on failure investigations, sustainable construction, dispute resolution and QC/QA.

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### Basis of the Revisions to ACI 506.2 Specifications for Shotcrete Dallas, March 2012

Phil Seabrook, PE  
Phiz Engineering Ltd.  
Chair, Subcommittee on 506.2

### *Topics for Presentation*

- Status of 506.2
- Shortcomings of existing 506.2
- Principles incorporated into revisions
- Technical features added
- Responsibilities of parties in implementing
- Required submittals
- Checklist examples
- Challenges for users – examples
- Closing comments

### *Status*

Delayed because

- Debate over core strength assessment
- Attempts to replace present core grades for rebar encapsulations with some other meaningful criteria

Now approved for publication by ACI

Expect to be on the street in the fall

Metric version to be issued simultaneously

Shotcrete will be included in ACI 301

### *Shortcomings of existing 506.2*

Prescription base – some impractical / unnecessary / unenforceable requirements

Restricts contractor innovation

Outdated technology - ≠ accommodate new developments

Outdated scope / responsibilities of parties

Not metric

Does not integrate new ASTM test methods for shotcrete

Does not accommodate FRS

Incomplete checklists

### *Principles adopted by 506*

Shotcrete is an alternate way to place concrete, so same rules

Must shift to PBS consistent with ACI policy

Consider sustainability

Integrate new technology

Need a clear definition of responsibilities consistent with today's contracts

Contractor shall "say what proposed to do", then "do what they said"

Recognize that "one size does not fit all"

### *Important Features*

Hybrid of PBS and Prescription

No Commentary permitted so need to reference 506R, Guide, for guidance

Emphasis on contractor submittals and prequalification

506.2 has some default values if none are specified

### *New technology that needed to be accommodated*

Prerogative of Contractor to select method of shotcrete placement to suit his system

New admixtures – hydration stabilizers, superplasticizers, cohesion agents, extensive use of SF, AEA

More and relevant use of preconstruction testing

Air entrainment of dry-mix shotcrete

Use of better pumps and robots

Use of hybrid mixers

### *Implementation by Owner, A/E*

Address selections from Mandatory and Optional Checklists – make relevant to Project

Be prepared to address Contractor submittals

Define prequalification testing requirements including rebar encapsulation acceptance criteria

Need lead time for preconstruction functions

Define QC and Matching QA

Example – Specify location of control joints

### *Implementation by Contractor*

Need to assemble background for submittals

If proposing alternate methods, be in a position to document successful use

Have nozzle men certification in place (if structural)

Be prepared to implement effective and responsible QC

### *Examples of Compliance with PBS*

Requires certification (of Nozzlemen)

Extensive preconstruction submittals with verifiable technical content

Contractor does QC, Owner does QA (at their discretion)

### *Examples of submittals (some NA to all projects)*

- Mixture proportions, including supporting test results
- Admixture types
- Cementitious materials mill certificates
- Aggregate qualification
- Contractor experience in similar projects including experience of crew – more demanding for structural
- FRS properties
- QC testing agency certification
- Repair procedures

### *Test Panel Size*

ASTM C1140 – 24 X 24 X 3 ½” with square or sloped sides

ACI 506.2 – 16 X 16 X 5” with no specification for sides

### *Examples of Mandatory Checklist*

- Type of shotcrete – dry, wet, FRS, structural or non structural
- Type of reinforcement
- Test panel orientation (if not vertical)
- W/CM for wet-mix (∞ exposure)
- Compressive strength – 4000 psi default if not
- Air entrainment

### *Examples of Mandatory Checklist cont'd:*

- Limits on SCMs, if any
- Special properties – bond, voids and absorption, air voids
- Dimensional and surface finish tolerances
- Cover on rebar
- Cold weather procedures

### *Examples of Optional Checklists*

- Acceptance values for special properties
- Acceptance criteria for rebar encapsulation
- Nonpotable water acceptable?
- Admixtures permitted or required
- Type of fibers

### *Examples of Optional Checklists cont'd:*

- When reduction in rebar splice clearance is permitted
- Rebar permitted through construction joints
- Items that can deviate from the Specification if satisfactory preconstruction testing demonstrates suitability

*Examples of use for Preconstruction Testing*

“Unless otherwise specified, do not place shotcrete when shotcrete temperature is above 95°F unless prequalification testing in 1.5.1 shows that the required quality of shotcrete can be achieved at higher temperatures.”

*Example of Use of Contractor Innovation*

“Stop shooting when ambient temperature is 40°F and falling unless measures are taken to protect the shotcrete.”

*Closure*

Simply stating “...shotcrete in accordance with 506.2...” will leave holes

Appropriate guidance available from other 506 documents, specifically the Guide

***Thank You***