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Use of SCC for the Repair of Bridge Substructures

H. Celik Ozyildirim, Ph.D., P.E.
Principal Research Scientist

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Outline

SCC applications

- New construction
  - arch bridge, bridge beams, drilled shafts
  - Normal weight and lightweight
- Substructure repairs
  - Pile
  - Column
  - Cap

SCC Arch Bridge in Fredericksburg, VA 2001

- 5,000 psi
- Low permeability

- Arch length of 45 ft

SCC Arch Bridge – 2001
Smooth surface finish

Wing wall from the arch bridge

SCC Beams – Rte 33 (2005)

Over Pamunkey River

Project planned 8 SCC beams; however, producer used SCC in 32 more beams

- 8,000 psi
- Low permeability

Drilled Shaft – Route 28 (2007)

Placement of concrete and removal of casing were easy.

Lack of consolidation is a problem with conventional concrete.

Lightweight SCC - 2012

- Two 128 ft spans
- 4 beams per span, one test for each beam (8 tests)
- Average compressive strength: 10,724 psi, 5 out of 8 batches had over 11,000 psi.
- Low permeability (< 1,000 coulombs)

FHWA Pile Repair - 2009

At Colonial Parkway a pile was hit by a barge.

Colonial Parkway

Concrete pumped from bottom up.
Drum to catch the overflow.

Colonial Parkway

Repaired pile

VDOT Lynchburg District Substructure Repair, 2010

- Two bridge substructures at Altavista repaired with SCC
  - Route 699 bridge
  - Route 712 over Route 29 bypass

Route 699

Route 712

Route 699 - Backwall

Bucket is used to place SCC in the backwall.

Route 699

Backwall construction

Route 699

Smooth SCC finish on the support buttress

Finished backwall

Route 712 – Column and Pier Cap

Removal of deteriorated concrete

Route712

Evaluating anodes: sections had anodes with and without embedment mortar

Route 712

Formwork

Foam to close gaps

Route 712

SCC delivery through funnel and flexible tube

Strength 4,880 psi,
Permeability 1,347 coulombs

Route 712

Shoring up the bulged formwork

Route 712

Using buckets to place SCC is not a good method!

Route 712

Void at the bottom due to stiffening mixture, shy cover, and congested reinforcement

Route 712

Completed SCC repair.

Lynchburg, 2013

Encasing columns

Column 2 ft 8 in
increased to
3 ft 8 in

NOVA Bridge - 2011

Repair of a new pier cap that had consolidation problem

NOVA

Pier Cap Soffit Repaired with SCC

interface between SCC and existing concrete

NOVA, I-95 over Furnace Road

SCC pumped

Increase in size of an existing column

NOVA, I-95 over Furnace Road

Completed pier cap

Staunton, I-81 (2011)

SCC pumped

Strength 5,310 psi,
Permeability 1,503 coulombs

I-81

Small pump is sufficient for SCC repairs

Staunton, I-81 (2011)
Shotcrete

Adjacent pier caps repaired by shotcrete

Shotcrete - concrete pneumatically projected at high velocity onto a surface.

SCC and Shotcrete @ I-81

Smooth surface

Rough surface

SCC Consolidation @ I-81

Loss of workability necessitated internal vibration

Conclusions

- SCC with high workability, proper strength and durability can be produced using locally available materials.

- Attention must be paid to the mixture and the placement procedures.

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Thank you.

For more information:

H. Celik Ozyildirim

Celik@vdot.virginia.gov