



VIRGINIA SELF-CONSOLIDATING CONCRETE BRIDGE PROJECTS

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VDOT

Outline

- Why SCC
- Benefits and concerns
- Tests
- Bridge projects
 - Bebo arch
 - Bulb-T beams
 - Normal weight
 - Lightweight

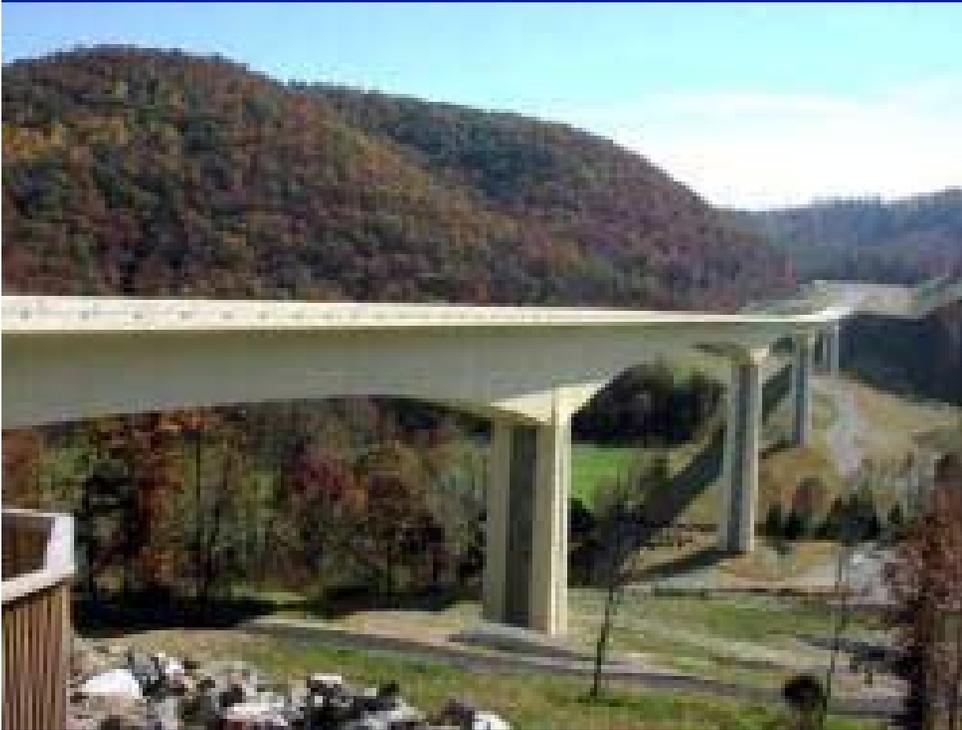
SCC



High Workability



Smart Road Bridge



**regular HPC column
exhibits poor
consolidation**



Corrosion



Poor consolidation



Benefits

- No consolidation concerns
- Faster construction
- Reduced noise and increased safety because vibrators are not used
- Less labor required
- Smoother surface finish

Regular Concrete



Smooth Surface Finish



SCC Mix Designs

- Higher cementitious material
- Lower coarse aggregate content
- Increased fine aggregate
- Smaller maximum size aggregate
- Polycarboxylate based HRWRA
- Viscosity modifying admixture

Aggregate

- Maximum size
- Shape, texture, void content
- Difference in density between the coarse and fine aggregates
- Grading
- Combined grading

Combined Grading



SCC Concerns

- Loss of stability, segregation
- Air-void system
- Increased shrinkage
- Formwork pressure and tightness
- Delivery

No Segregation



Tube of SCC 4 ft long

Freeze-Thaw Resistance

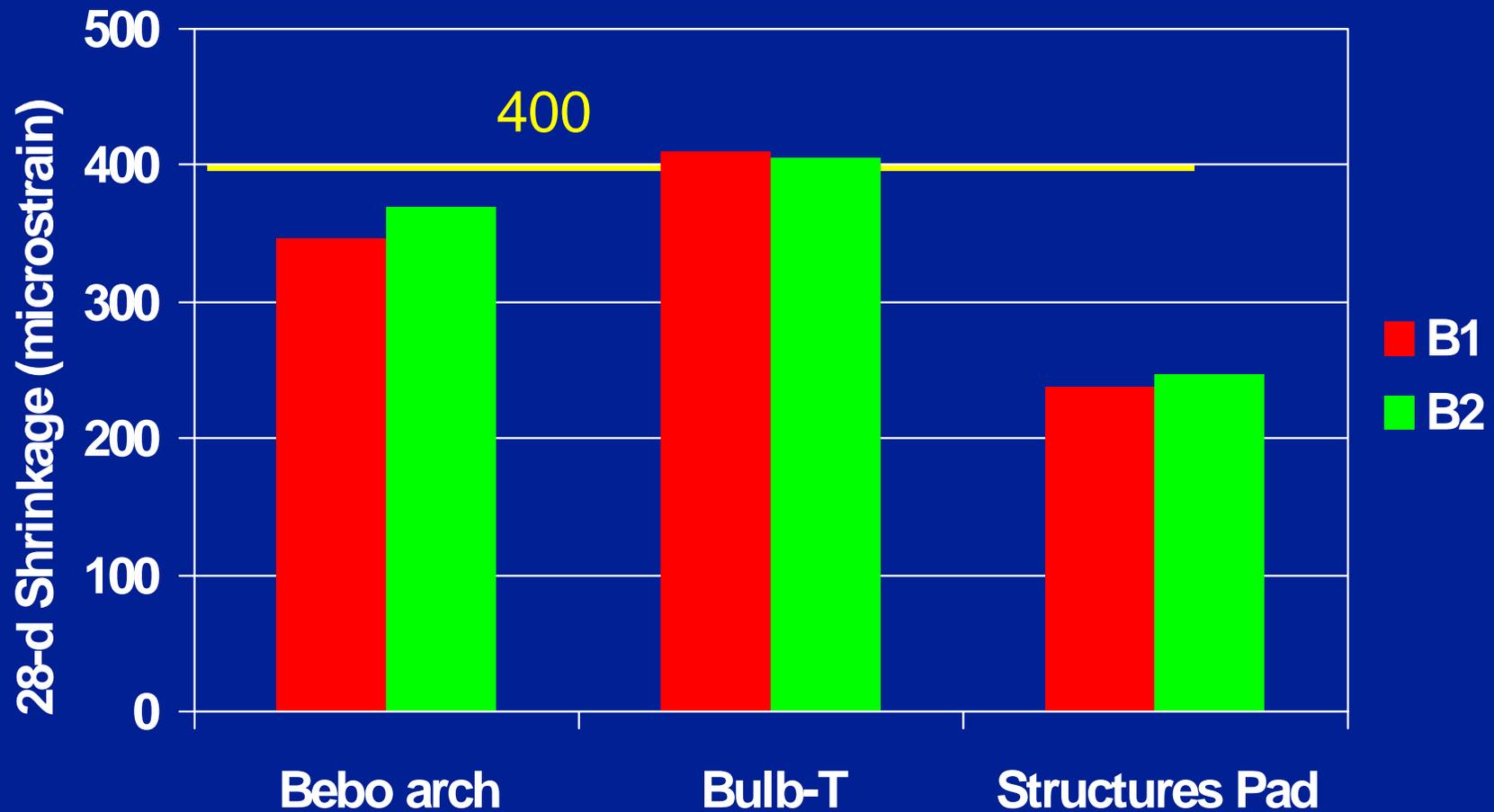


Poor resistance



Good resistance

Shrinkage – 28 Days



Formwork



SCC Tests



24 in



L-box and U-Box



Bridge Applications

- Arch Bridge, 2001
- Test Beams, 2003
- Rte 33 Beams, 2005



SCC Arch Bridge (2001)



Arch Bridge Mix Proportions (lb/yd³)

Material	Amount
Cement	488
Slag	262
Fine/Coarse aggregate	50/50
Coarse aggregate	#68
w/cm	0.37

AEA, HRWRA, no VMA

Arch Bridge Properties at 28 Days

Batch	Comp. Strength (psi)		Avg. Perm. (coul)
	Unrodded	Rodded	
Slag #1	7390	----	900
Slag #2	7670	8020	1724

SCC Bulb-T Beams (2003)



- 45 in deep
- 60 ft long



- 8,000 psi
- 1500 coulombs

Bulb-T Mix Proportions

Materials	Amount, lb/yd ³
PC	480
Slag	320
Fine/Coarse agg (%)	50/50
Coarse aggregate	#67
w/cm	0.33

AEA, HRWRA, and VMA

Bulb-T Properties at 28 Days

Property	B1	B2	B2 Rodded
Comp (psi)	8340	8800	8520
Permeability (coulomb)	750	533	664

SCC Test Beam

Short transfer length=Good bond



SCC Test Beam



Developed theoretical ultimate moment and shear capacity.

Rte 33 over Pamunkey River



Rte 33 Mix Proportions (lb/yd³)

Material	SCC	Regular
PC	480	510
Slag	320	340
CA	1451	1731
FA	1411	1029
Water	272	336
w/cm	0.34	0.40
VMA (fl. oz./yd ³)	23	0

AEA, WR+R, HRWRA, and DCI were used

Rte 33 Properties at 28 Days

Property	B1 (SCC)	B2 (SCC)	B3 (Regular)	B4 (Regular)
Comp. (psi)	10,110	10,700	7,960	7,610
E (10^6 psi)	4.86	5.35	5.26	4.98
Splitting (psi)	820	755	675	565
Perm (coul)	869	996	1,011	985

Bugholes – Rte 33

SCC



Regular

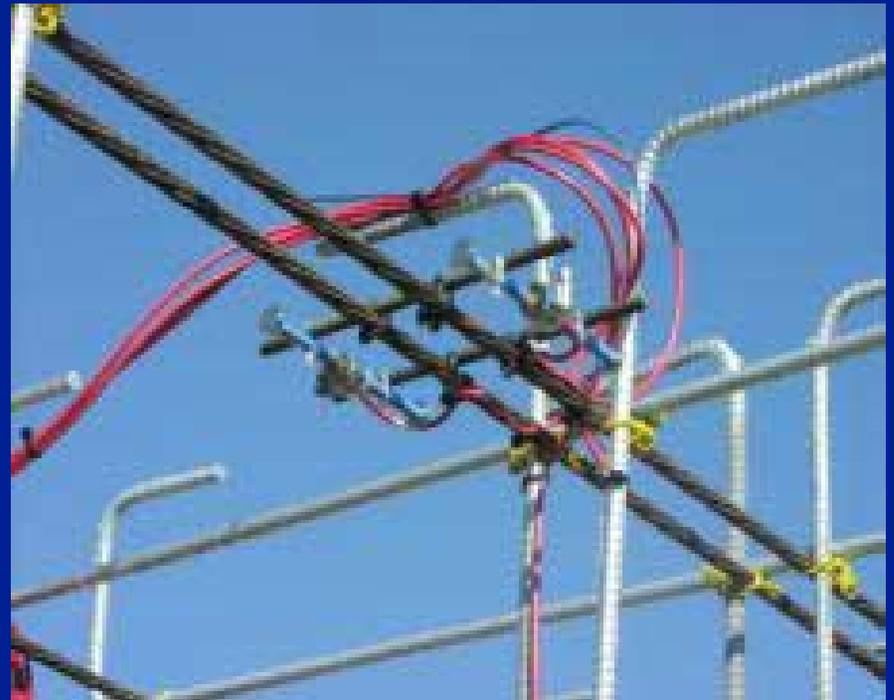


SCC Beams – Rte 33



Instrumentation

- Vibrating wire gages
- Thermocouples



Lightweight SCC

- Bridge: Rte 17 over Rte 15/29 in Fauquier County
- Two spans, each 97 ft 7 in.
- 53 in Bulb-T beams
- Minimum 8,000 psi and maximum 1500 coulombs

Lightweight SCC Lab Mixture

Material	lb/yd ³
Cement	508
Slag	338
Lightweight Coarse Agg	875
Fine Aggregate	1232
Water	275
w/cm	0.33

Lightweight SCC Properties

Cure	Age (days)	Strength (psi)
Moist Cure	1	4500
	7	8690
	28	10130
Steam Cure	1	8650
	7	8500
	28	9480

Conclusions

- SCC with high workability, proper strength, and adequate durability can be produced using locally available materials.
- Attention must be paid to formwork, segregation, the air-void system, and shrinkage

Conclusions

- Check the air-void system
- Increase air content or select the right combination of admixtures to obtain a satisfactory air-void system
- Reduce shrinkage by using more and larger coarse aggregate, and low water content
- Decrease segregation by using more fines and well-graded combined aggregates, and a VMA (if necessary).



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