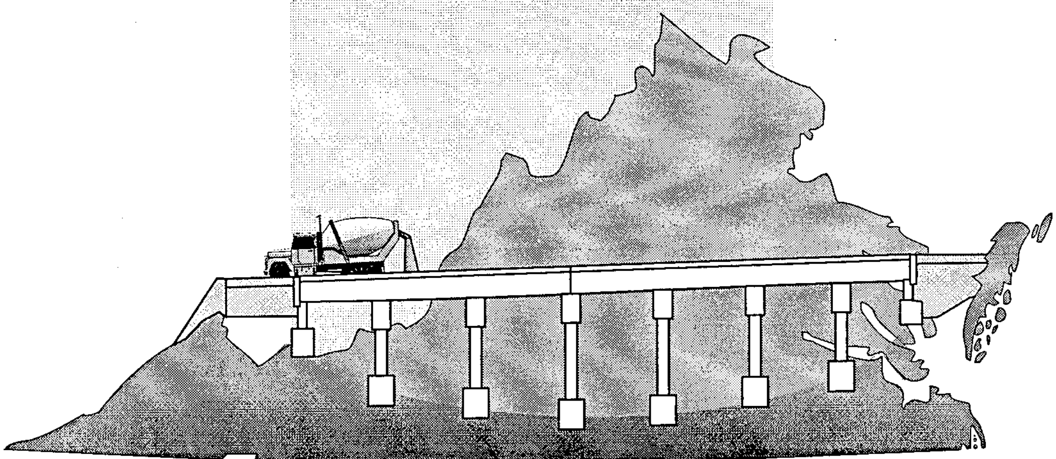
INTERIM REPORT

PB99-157232

FIELD EVALUATION OF CORROSION INHIBITORS FOR CONCRETE: INTERIM REPORT 2: EVALUATION OF INSTALLATION AND INITIAL CONDITION OF BRIDGE REPAIRS DONE WITH CORROSION-INHIBITING ADMIXTURES AND TOPICAL TREATMENTS



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Abstract

Four bridge decks were overlayed and patched and one bridge pier was patched using concrete with and without corrosion-inhibiting admixtures. Some concrete surfaces received topically applied corrosion-inhibiting treatments prior to placement of the concrete.

The repairs were successfully completed, and the initial condition of the repairs is good. Corrosion probes were installed in many of the repairs, and measurements are being made each quarter to determine macrocell current, macrocell potential, and resistance. The probe indicates that corrosion is occurring in repairs done with and without corrosion-inhibiting treatments. No conclusions can be drawn at this time, and the study will continue for a total of 5 years.

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(The opinions, findings, and conclusions expressed in this report are those of the authors and not necessarily those of the sponsoring agencies.)

Virginia Transportation Research Council
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ABSTRACT

Four bridge decks were overlayed and patched and one bridge pier was patched using concrete with and without corrosion-inhibiting admixtures. Some concrete surfaces received topically applied corrosion-inhibiting treatments prior to placement of the concrete.

The repairs were successfully completed, and the initial condition of the repairs is good. Corrosion probes were installed in many of the repairs, and measurements are being made each quarter to determine macrocell current, macrocell potential, and resistance. The probes indicate that corrosion is occurring in repairs done with and without corrosion-inhibiting treatments. No conclusions can be drawn at this time, and the study will continue for a total of 5 years.

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INTRODUCTION

Rehabilitating corrosion-damaged and chloride-contaminated concrete structures has become a major part of state construction and maintenance programs. In many cases, only portions of a structural element are damaged or contaminated, allowing it to be repaired rather than replaced. Conventional repair techniques usually include removing deteriorated concrete and placing new concrete in the form of patches or overlays. Although new concrete generally restores a more passive environment, corrosion of the original reinforcing steel often continues or begins at other locations. Differences in chloride content between the adjacent old and new concretes result in corrosion around the patch area, further deteriorating the concrete element and significantly reducing the service life of the repaired structure.

Various types of corrosion inhibitors have been developed and marketed to mitigate continued corrosion in newly rehabilitated structures. When physical damage is repaired, these materials are usually incorporated into the repair procedure by applying them to the surface of the original concrete and allowing them to penetrate before patching, by including them as an admixture in the patch material, or both. These applications seem benign compared to other corrosion protection methods. They add relatively little work to the conventional repair activity. Initial costs are lower, and there are essentially no future maintenance costs directly associated with inhibitors. However, the question whether inhibitor performance meets expectations with minimal side effects remains to be answered.[1]

PURPOSE AND SCOPE

This project will evaluate the performance of corrosion inhibitors by the long-term monitoring of structures and exposure slabs. A literature review, development of plans and specifications for construction, construction of exposure slabs and bridge overlays and patches, observation of construction activities, periodic condition evaluations over a 5-year period, and preparation of reports will be included. Interim Report 1 described the construction and initial condition of the exposure slabs.[2] This report describes the installation and initial condition of the bridge repairs.

METHODOLOGY

Repairs were made to various bridges in Virginia to allow the evaluation of various repair treatment processes, inhibitor formulations, and chloride-to-inhibitor ratios. The repairs included control sections and corrosion probes.

The effectiveness of each inhibitor will be based on evaluations that include:

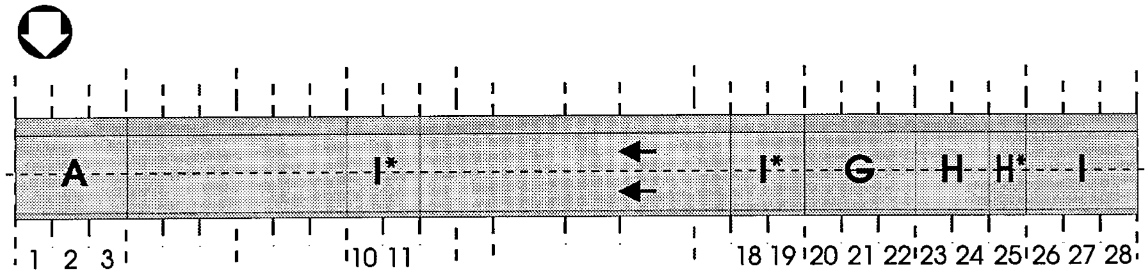
- delamination surveys
- potential surveys
- corrosion rate measurements
- sampling and testing for chloride concentration
- sampling and testing for inhibitor concentration
- bond strength tests
- corrosion probe readings.

Corrosion-inhibiting admixtures and topical treatments of corrosion inhibitors were used to construct overlays and patches in Virginia Beach, Abingdon, Wytheville, and Marshall and to make shotcrete repairs on bridge piers on I-77 at Big Walker Mountain. The mixture proportions, properties of freshly mixed and hardened concrete, bond strength of repairs, and corrosion measurements to determine the corrosion-inhibiting performance of the repairs are described in this report.

Virginia Beach

Corrosion-inhibiting admixtures were used in the concrete overlays placed on selected spans of the eastbound lane of Rte. 60 over Lynnhaven Inlet in Virginia Beach in May 1996. The bridge is 1,525 ft (465 m) long and has 28 spans, as shown in Figure 1. The spans are 50 ft (15 m) long with the exception of the center spans. Prior to placement of the overlays, the half-cell potentials were measured using 4 in x 4 in (100 mm x 100 mm) grids and chloride samples were taken to determine the chloride content.

The surface of the base concrete was prepared by shotblasting to remove the top 1/8 in (3.1 mm) of concrete. Then, the surface was wetted and maintained in a moist condition until the overlays were placed. Topical treatments of Armatec 3020 and Postrite were applied to spans 23, 24, 26, 27, and 28, as shown in Figure 1. Two applications of Armatec 3020 were applied to spans 23 and 24. The surface was power washed after the second application dried and maintained in a wet condition until the overlay was placed. Three applications of Postrite were applied to spans 26, 27, and 28 and maintained in a wet condition until the overlay was placed. Spans 1, 2, and 3 were the control spans.



A: 7% silica fume (SF), spans 1,2 & 3

G: 7% silica fume, rheocrete corrosion inhibitor (SF, RCI), spans 20, 21 & 22

H: 7% SF, armatec corrosion inhibitor (ACI), armatec application (A), spans 23 & 24

H*: 7% SF, ACI, span 25

I: 7% SF, inorganic corrosion inhibitor (DCI), postrite application (P), spans 26, 27 & 28

I*: 7% SF, DCI, spans 10, 11, 18 & 19

Figure 1. Route 60 EBL. over Lynnhaven Inlet

Concrete mixture proportions used in the overlays are given in Table 1 (see the Appendix for tables). Concretes were mixed and delivered in truck mixers. The slump and air content were determined prior to placement. The temperature of the air and concrete, relative humidity, wind speed, placement times, and locations were also determined. Samples of concrete were prepared for testing in the hardened state. Samples included 4 in x 8 in (100 mm x 200 mm) cylinders for compression tests, 3 in x 4 in x 16 in (75 mm x 100 mm x 400 mm) beams for freeze thaw tests, and 4 in x 4 in (100 mm x 100 mm) cylinders for permeability tests. Following completion of the overlays, cores 2.25 in (56 mm) in diameter were taken for tensile bond tests and cores 4 in (100 mm) in diameter were taken for permeability tests. Tensile bond tests were conducted after installation using a modified version of ACI 503R and VTM 92. The modification was that cores were removed from the deck and saw cut in the laboratory to provide a specimen 102 mm high with 51 mm on each side of the bond line, a pipe cap was bonded to both sawn surfaces, and the specimen was subjected to tension.

Abingdon and Wytheville

Corrosion-inhibiting admixtures and topical treatments were used in the bridge decks carrying the southbound lanes in Abingdon and Wytheville. The bridge in Abingdon was overlaid in May 1998. It contained a control span and three experimental spans with corrosion-inhibiting admixtures, as shown in Figure 2. Two of the spans had topical applications of corrosion inhibitor. The bridge at Wytheville was overlaid in June and September 1997. It also has four spans and contains control and experimental spans as shown in Figure 3. The bridges were milled, and a deck survey was conducted. The survey included laying out 4 ft x 4 ft (1.2 m x 1.2 m) grids, taking half-cell potential readings, collecting chloride samples, and selecting probe locations.

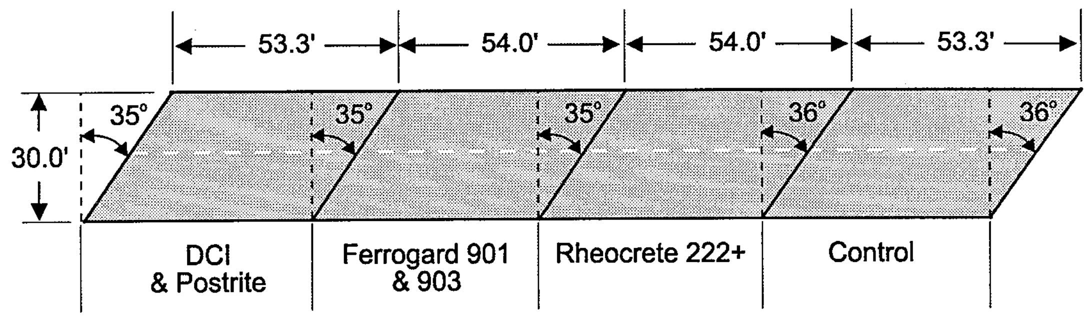


Figure 2. Rte. 81, Abingdon

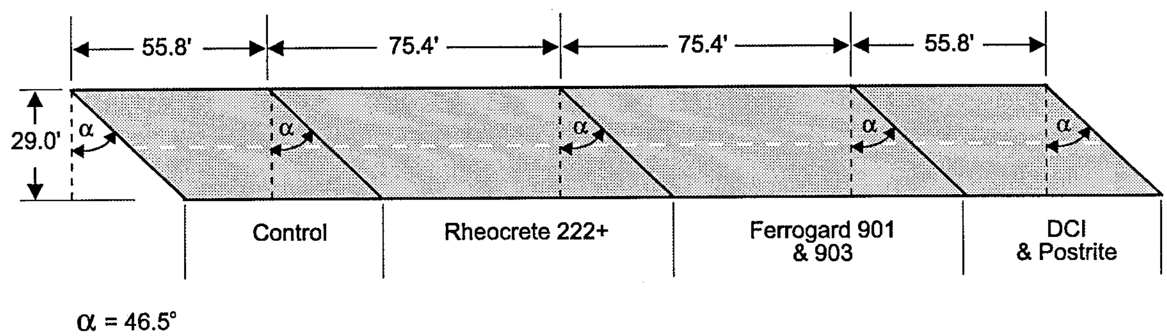


Figure 3. Rte. 81, Wytheville

At each intersection of the 4 ft x 4 ft (1.2 m x 1.2 m) grid, half-cell potential measurements were made. These measurements were used to select locations for the probes. A total of six probe locations were selected for each span. Three locations were selected that had high half-cell potential readings (>35), and three locations were selected that had low half-cell potential readings (<20). Of the three high readings, two probe locations were in original concrete and one probe location was in a patch adjacent to and on the same bar as the selected bar in the original concrete, as shown in Figure 4. The same was done for probe locations that had low half-cell potential readings.

At each probe location, chloride samples were taken at ½ and 1 in depths, and four additional half-cell readings were taken around each probe location (within a 2 ft x 2 ft [0.6 m x 0.6 m] grid).

The probes were constructed by locating transverse reinforcing steel using a pachometer. After the bar was located, two saw cuts were made completely through the bar about 7.5 in apart. Concrete was then chipped approximately 2 to 3 in (50 to 75 mm) from one of the saw cut ends to expose the transverse bar. After the bar was exposed, a 3/16 in (5 mm) hole was drilled into the bar at a depth sufficient to hold a pop rivet (Figure 5). The saw cuts were filled with epoxy, and the drill hole was covered with putty for protection. Prior to placement of topical applications and concrete, electrical leads were attached to each probe and ground location with a pop rivet gun. Quick-set epoxy was then placed over exposed rebar and wire connections. After all the leads were in place, the wires were fed through conduit and attached to a previously installed electrical box (Figure 4). The color scheme of the wires going from north to south was

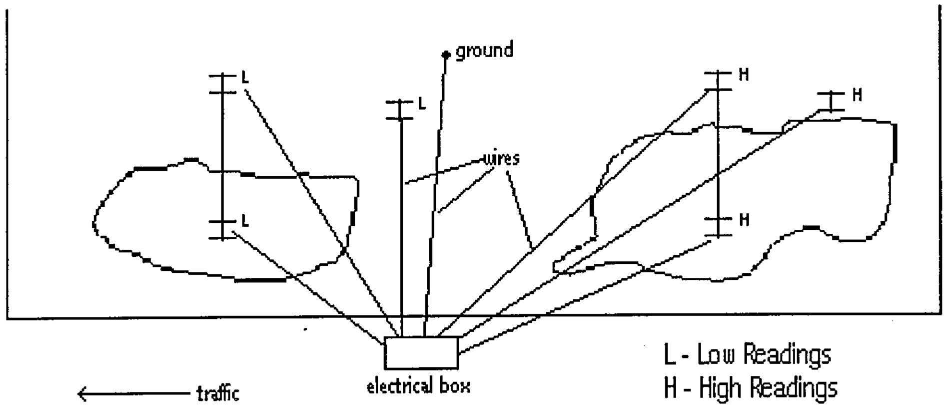


Figure 4. Probe Locations

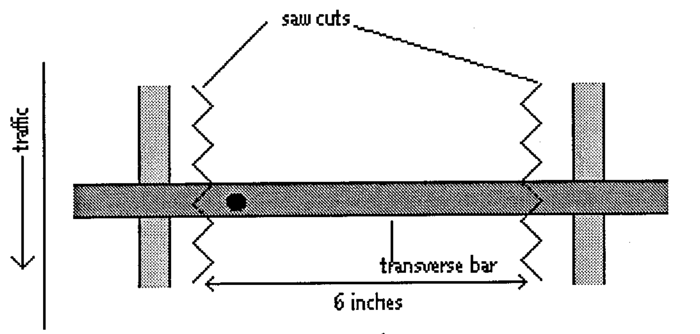


Figure 5. Probe

red, white, blue, gray, brown, pink. The black (ground) wire location floated depending on the location of its connection to the reinforcement. Prior to the placement of concrete, field personnel monitored topical applications of inhibitors for correct rate of application. Concretes were mixed and delivered in truck mixers. Concrete proportions used in the overlays are given in Table 1. The slump and air content values were determined prior to placement. Samples of concrete were prepared for testing at the hardened state. Samples included three 4 in x 8 in (100 mm x 200 mm) cylinders for compression tests, and two 4 in x 4 in (100 mm x 200 mm) cylinders for permeability tests. The temperature of air and concrete, relative humidity, wind speed, placement times, and locations were also determined. Approximately 1 month after completion of the overlays, cores 2.25 in (56 mm) in diameter were taken for tensile bond tests and cores 4 in (100 mm) in diameter were taken for permeability tests.

Big Walker Mountain

The bridge at the Big Walker Mountain has three spans. The second pier in the northbound lanes was repaired with shotcrete in September 1997. As shown in Figure 6, some

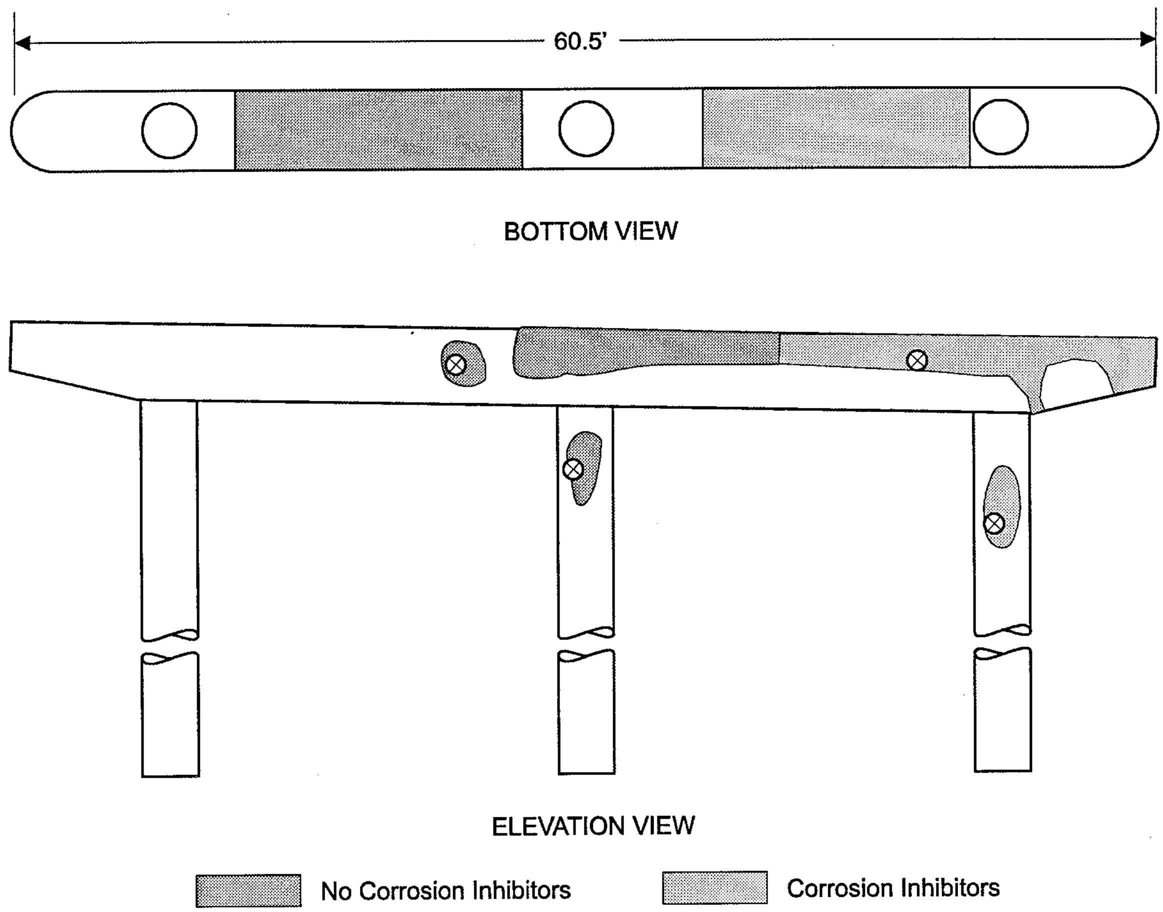


Figure 6. I-77, Big Walker Mountain

areas had shotcrete with silica fume, and in other areas the silica-fume shotcrete contained a calcium nitrite corrosion inhibitor. The deteriorated concrete was removed by pneumatic hammer. Prior to shotcreting, the area was sandblasted, probe areas were selected, and wires were connected. The area that contained the shotcrete with the corrosion inhibitor also had the topical application of Postrite.

The shotcrete mixture proportions are shown in Table 1.

Marshall

The bridge at Marshall has three spans, as shown in Figure 7. The northbound lane was overlaid with silica-fume concrete in July 1998, and the southbound lane with silica fume concrete containing corrosion inhibitors in August 1998. Two of the spans with corrosion inhibitors had the topical applications.

The deck was milled close to the steel, and the contaminated concrete around the steel was removed by a pneumatic hammer. In the northbound lanes, probes were prepared after the

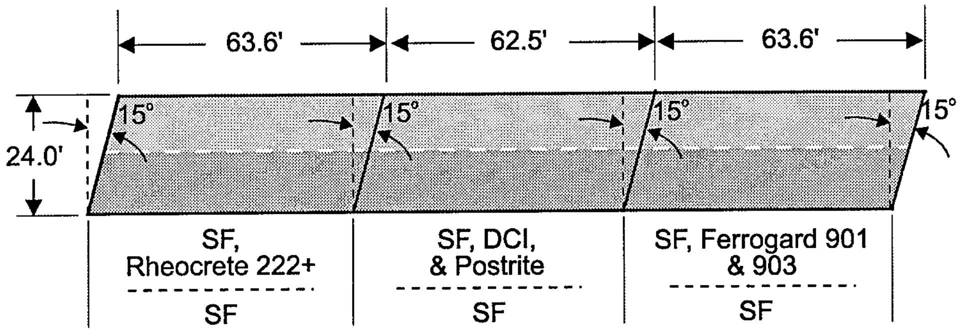


Figure 7. Rte. 710, Marshall

overlay because of a scheduling problem. In the southbound lanes, probes were located prior to placement of the overlay.

Concrete proportions are given in Table 1. Concrete was tested for slump, air content, and concrete temperature. Specimens were prepared for strength and permeability tests.

RESULTS

Virginia Beach

The slump and air content data are given in Table 2. Slump values ranged from 130 to 200 mm, providing workable concretes. The air content ranged from 3.0 to 6.8 percent. The specified air content was 7 + 2 percent with the use of a high-range water-reducing admixture. In each section with the corrosion-inhibiting admixture, at least one measured air content was below the specified value.

Silica fume concretes have a minimum 28-day design compressive strength of 5,000 psi. As shown in Table 3, all the strengths exceeded the minimum design strength.

The permeability results at 90 days are given in Table 4. Values are in the very low or low permeability range, except for the two concretes with DCI, which have high values. It is expected that concretes with DCI would yield high values because of the effect of DCI on electrical conductance. In overlays, a maximum coulomb value of 1,500 is desired. The values obtained were close to 1,500 coulombs or less, except in most of the DCI concretes. The permeability of cores taken after installation is given in Table 5. All cores except most of those containing DCI had values less than 1,500 coulombs. In general, the values for cores were lower than those for cylinders. Cores were taken at 6 months, whereas cylinders were tested at 90 days.

Tensile bond test results are given in Table 6. The bond strengths were fair to good. The majority of the failures were at the bond interface and in the base concrete close to the bond interface, which indicates that surface preparation could have been better. Spans that received topical treatments of corrosion-inhibiting admixtures had the lowest bond strengths.

Electric half-cell potential measurements (ASTM C876) are given in Table 7. The data show that there is a 90 percent or greater probability that corrosion is occurring in a small percentage of the area of some of the spans. On the majority of spans, there is a 90 percent or greater probability that corrosion is not occurring in most of the span.

The chloride data given in Table 8 show that there is not sufficient chloride at the level of the top mat of reinforcement (approximately 500 mm) to cause corrosion since the chloride contents are much lower than the corrosion threshold value of 0.77 kg/m^3(1.3 lb/yd^3) except for the control span.

The results of freezing and thawing tests shown in Table 9 indicate that all concretes failed the durability factor (< 60) and weight loss (<7%) criteria except one of the concrete batches with Armatec 2000 inhibitor. The average cycles at failure are given in Table 10. The highest cycles were achieved with the concretes containing Armatec; one of the batches with Armatec reached 300 cycles.

No corrosion probes were installed at Virginia Beach.

Abington and Wytheville

The slump values ranged from 1.25 to 4.5 in (31 to 112 mm). Even though some of the values were lower than the specification limit, satisfactory consolidation was achieved with mechanical vibration. The air content ranged from 4.2 to 10 percent. Most of the air contents were above 5 percent, the minimum limit.

The compressive strengths were in excess of the required 5,000 psi (34470 kPa), and a couple of them were above 4,000 psi (27576 kPa) (Table 3). These concretes did not contain silica fume. The permeability values were in the low and moderate range (Table 4). The permeability of cores after 3 months (TL Wytheville), 6 months (PL Wytheville), and 7 months (Abingdon) of placement showed variable results from very low to high. The tensile bond test results in Table 6 show from fair to good bond strengths, with failures occurring more in the base concrete but also in the bond area and the overlay.

Electric half-cell potential measurements (ASTM C876) are given in Table 7. The data show that there is a 90 percent or greater probability that corrosion is occurring in a large percentage of the area of many spans. On one span, there is a 90 percent or greater probability that corrosion is not occurring.

The chloride data given in Table 8 show that for most of the locations sampled there is sufficient chloride at the level of the top mat of reinforcement to cause corrosion since the chloride contents are higher than the corrosion threshold value of 0.77 kg/m^3(1.3 lb/yd^3).

Corrosion probe locations are shown in Table 11, and probe readings in Table 12. No conclusions can be drawn from the data at this time.

Marshall

The slump values ranged from 4.5 to 7 in (112 to 175 mm), providing workable concretes. The air contents ranged from 7.4 to 12.1 percent; some exceeded the 9 percent upper limit (Table 3). Compressive strengths exceeded 5,000 psi (34470 kPa) (Table 4). The permeability values were low or very low, with the highest value of 1510 coulombs in the batch with DCI (Table 5). Higher values are expected when DCI is used. Cores taken 2 months (NBL) and 1 month (SBL) after installation also indicated low or very low values, with the highest value being 1286 coulombs. The tensile bond test showed fair to poor values, with the majority of the failures in the base concrete rather than the overlay and the bond layer.

Electric half-cell potential measurements (ASTM C876) are given in Table 7. The data show that there is a 90 percent or greater probability that corrosion is occurring in a large percentage of the area of many spans.

The chloride data given in Table 8 show that for most of the locations sampled there is sufficient chloride at the level of the top mat of reinforcement to cause corrosion since the chloride contents are higher than the corrosion threshold value of 0.77 kg/m^3(1.3 lb/yd^3).

Corrosion probe locations are shown in Table 11, and probe readings in Table 12. No conclusions can be drawn from the data at this time.

Big Walker Mountain

The shotcrete repairs were done as expected. Test data are reported in Tables 1, 3, 4, 7, 8, 11, and 12. Compressive strengths were high, and permeability was low. Half-cell potential and chloride data indicated corrosion. The half-cell data suggested that the Postrite treatment provided some benefit as the potentials were less negative following the repair; the potentials for the control section were more negative. It is too early to draw a conclusion.

CONCLUSIONS

Construction was done as expected. The initial condition of the repairs is fair to good, and no difference between repairs with and without corrosion-inhibitor treatments can be seen at this time. The probes indicate that corrosion is occurring in repairs done with and without corrosion-inhibiting treatments.

REFERENCES

1. Sprinkel, M. M., Clemeña, G. G., and Ozyildirim, C. *Field Evaluation of Corrosion Inhibitors for Concrete.* VTRC 97-RP6, National Pooled Fund Study No. SPR-2 (184) (S-95-7). Virginia Transportation Research Council, Charlottesville, August 1996.

2. Sprinkel, M. M., and Ozyildirim, C. *Field Evaluation of Corrosion Inhibitors for Concrete: Interim Report 1: Evaluation of Exposure Slabs Repaired with Corrosion Inhibitors.* VTRC 99-IR1. Virginia Transportation Research Council, Charlottesville, December 1998.

APPENDIX

TABLES

Table 1. Concrete Mixtures

Location	Cement	Fly Ash	SF	Sand	No. 8 Stone	No. 7 Stone	Water	Fibers
VA Beach								
SF	612	-	46	1381	-	1515	255	-
SF, RCI	612	-	46	1381	-	1515	228	-
SF, ACI	612	-	46	1381	-	1515	255	-
SF, DCI	612	-	46	1381	-	1515	281	-
Wytheville	559	132	-	1579	1207	-	280	-
Abingdon	540	127	-	1608	-	1161	300	-
Marshall	728	-	50	1326	-	1495	292	-
Walker Mountain	845	-	84.5	2925	-	-	380	7.4

Table 2. Slump and Air Content Data

Bridge	Section	Mix	Slump (in)	Air %
VA Beach	EBL, Span 2, Truck 2	7% SF	7.5	6.8
VA Beach	EBL, Span 1, Truck 3	7% SF	7.25	5.6
VA Beach	EBL, Span 11, Truck 4	7% SF, DCI	6	6.0
VA Beach	EBL, Span 10, Truck 5	7% SF, DCI	6	6.0
VA Beach	EBL, Span 18, Truck 1	7% SF, DCI	7.25	3.0
VA Beach	EBL, Span 19, Truck 2	7% SF, DCI	8	5.2
VA Beach	EBL, Span 21, Truck 2	7% SF, Rheocrete 222	8	3.0
VA Beach	EBL, Span 22, Truck 3	7% SF, Rheocrete 222	6.75	4.0
VA Beach	EBL, Span 24, Truck 5	7% SF, Armatec 3000/3020	8	6.0
VA Beach	EBL, Span 25, Truck 6	7% SF, Armatec 3000	8.5	8.0
VA Beach	EBL, Span 27, Truck 2	7% SF, DCI/Postrite	6	5.0
VA Beach	EBL, Span 28, Truck 3	7% SF, DCI/Postrite	5	4.0
Wytheville	SBPL, Span 1, Truck 1	A4 Patches	No Data	No Data
Wytheville	SBPL, Span 1, Truck 1	A4	3.25	8
Wytheville	SBPL, Span 1, Truck 2	A4	2.25	7.8
Wytheville	SBPL, Span 2, Patch	1 gcy Rheocrete 222+ Patches	2.75	5.2
Wytheville	SBPL, Span 2, Truck 1	1 gcy Rheocrete 222+	2.5	5.6
Wytheville	SBPL, Span 2, Truck 2	1 gcy Rheocrete 222+	1.75	7
Wytheville	SBPL, Span 3, Patches	2 gcy Ferrogard 901/903 Patches	3	8
Wytheville	SBPL, Span 3, Truck 1	2 gcy Ferrogard 901/903	1.25	10
Wytheville	SBPL, Span 3, Truck 2	2 gcy Ferrogard 901/903	2.75	7.5
Wytheville	SBPL, Span 4, Truck 1	4 gcy DCI/Postrite Patches	No Data	No Data
Wytheville	SBPL, Span 4, Truck 1	4 gcy DCI/Postrite	4.25	9.4
Wytheville	SBPL, Span 4, Truck 2	4 gcy DCI/Postrite	2.75	7.5
Wytheville	SBTL, Span 1, Truck 1	A4	2.75	6.2
Wytheville	SBTL, Span 1, Truck 2	A4	2.25	6.4
Wytheville	SBTL, Span 2, Truck 1	1 gcy Rheocrete 222+	4	5.4
Wytheville	SBTL, Span 2, Truck 2	1 gcy Rheocrete 222+	3	6
Wytheville	SBTL, Span 2, Truck 3	1 gcy Rheocrete 222+	2	5.5
Wytheville	SBTL, Span 3, Truck 1	2 gcy Ferrogard 901/903	4	8.2
Wytheville	SBTL, Span 3, Truck 2	2 gcy Ferrogard 901/903	4.25	7.5
Wytheville	SBTL, Span 4, Truck 1	4 gcy DCI/Postrite	3.75	5.4
Wytheville	SBTL, Span 4, Truck 2	4 gcy DCI/Postrite	4	4.5
Abingdon	SBTL, Span 1+2, Truck 1	A4 Patches	No Data	No Data
Abingdon	SBTL, Span 1, Truck 1	4 gcy DCI/Postrite	2.25	5.8
Abingdon	SBTL, Span 1, Truck 2	4 gcy DCI/Postrite	4	7.2
Abingdon	SBTL, Span 1, Truck 3	4 gcy DCI/Postrite	4	7.6
Abingdon	SBTL, Span 2, Truck 1	2 gcy Ferrogard 901/903	5	6.8
Abingdon	SBTL, Span 2, Truck 2	2 gcy Ferrogard 901/903	4.5	10
Abingdon	SBTL, Span 3, Truck 1	A4 Patches	No Data	No Data
Abingdon	SBTL, Span 3, Truck 1	1 gcy Rheocrete 222+	3.5	7
Abingdon	SBTL, Span 3, Truck 2	1 gcy Rheocrete 222+	4.5	8.2
Abingdon	SBTL, Span 4, Truck 1	A4	4.5	6.2
Abingdon	SBTL, Span 4, Truck 2	A4	3.5	4.4
Abingdon	SBPL, Span 1, Truck 1	4 gcy DCI/Postrite	2	4.2
Abingdon	SBPL, Span 1, Truck 2	4 gcy DCI/Postrite	3.25	5
Abingdon	SBPL, Span 2, Truck 1	2 gcy Ferrogard 901/903	2	5
Abingdon	SBPL, Span 2, Truck 2	2 gcy Ferrogard 901/903	2.5	7.2
Abingdon	SBPL, Span 3, Truck 1	1 gcy Rheocrete 222+ Patches	No Data	No Data
Abingdon	SBPL, Span 3, Truck 1	1 gcy Rheocrete 222+ Patches	No Data	No Data
Abingdon	SBPL, Span 3, Truck 1	1 gcy Rheocrete 222+	2	8.2
Abingdon	SBPL, Span 3, Truck 2	1 gcy Rheocrete 222+	3.5	9.6
Abingdon	SBPL, Span 4, Truck 1	A4	2.5	7.2
Abingdon	SBPL, Span 4, Truck 2	A4	2	7.4
Marshall	SBTL, Span 1, Truck 1	2 gcy Ferrogard 901/903	7	12.1
Marshall	SBTL, Span 2, Truck 1	4 gcy DCI/Postrite	7	11
Marshall	SBLT, Span 3, Truck 1	1 gcy Rheocrete 222+	4.5	7.4

Bridge	Section	Mix	Slump (in)	Air %
Marshall	NBLT, Span 1, Truck 1	A4	6.75	7.7
Marshall	NBLT, Span 2, Truck 2	A4	N/A	N/A
Marshall	NBLT, Span 3, Truck 3	A4	N/A	N/A
I-77	Pier	Shotcrete	-	-
I-77	Pier	Shotcrete w/DCI + Postrite	-	-

Table 3. Compressive Strength Data

Bridge	Section	Treatment	Fresh Concrete Samples 28-Day Compressive Strength, psi
VA Beach	EBL, Span 2, Truck 2	7% SF	6810
VA Beach	EBL, Span 1, Truck 3	7% SF	6780
VA Beach	EBL, Span 11, Truck 4	7% SF, DCI	6750
VA Beach	EBL, Span 10, Truck 5	7% SF, DCI	7510
VA Beach	EBL, Span 18, Truck 1	7% SF, DCI	5900
VA Beach	EBL, Span 19, Truck 2	7% SF, DCI	5500
VA Beach	EBL, Span 21, Truck 2	7% SF, Rheocrete 222	6620
VA Beach	EBL, Span 22, Truck 3	7% SF, Rheocrete 222	7680
VA Beach	EBL, Span 24, Truck 5	7% SF, Armatec 3000/3020	7810
VA Beach	EBL, Span 25, Truck 6	7% SF, Armatec 3000	7610
VA Beach	EBL, Span 27, Truck 2	7% SF, DCI/Postrite	8110
VA Beach	EBL, Span 28, Truck 3	7% SF, DCI/Postrite	8330
Wytheville	SBPL, Span 1, Truck 1	A4 Patches	6550
Wytheville	SBPL, Span 1, Truck 1	A4	5240
Wytheville	SBPL, Span 1, Truck 2	A4	5870
Wytheville	SBPL, Span 2, Truck 1	1 gcy Rheocrete 222+ Patches	6760
Wytheville	SBPL, Span 2, Truck 1	1 gcy Rheocrete 222+	5720
Wytheville	SBPL, Span 2, Truck 2	1 gcy Rheocrete 222+	5450
Wytheville	SBPL, Span 3, Truck 1	2 gcy Ferrogard 901/903 Patches	6020
Wytheville	SBPL, Span 3, Truck 1	2 gcy Ferrogard 901/903	5620
Wytheville	SBPL, Span 3, Truck 2	2 gcy Ferrogard 901/903	5700
Wytheville	SBPL, Span 4, Truck 1	4 gcy DCI/Postrite Patches	None Cast
Wytheville	SBPL, Span 4, Truck 1	4 gcy DCI/Postrite	5360
Wytheville	SBPL, Span 4, Truck 2	4 gcy DCI/Postrite	7000
Wytheville	SBTL, Span 1, Truck 1	A4	5400
Wytheville	SBTL, Span 1, Truck 2	A4	6120
Wytheville	SBTL, Span 2, Truck 1	1 gcy Rheocrete 222+	6550
Wytheville	SBTL, Span 2, Truck 2	1 gcy Rheocrete 222+	6160
Wytheville	SBTL, Span 2, Truck 3	1 gcy Rheocrete 222+	6360
Wytheville	SBTL, Span 3, Truck 1	2 gcy Ferrogard 901/903	5620
Wytheville	SBTL, Span 3, Truck 2	2 gcy Ferrogard 901/903	6100
Wytheville	SBTL, Span 4, Truck 1	4 gcy DCI/Postrite	7190
Wytheville	SBTL, Span 4, Truck 2	4 gcy DCI/Postrite	6530
Abingdon	SBTL, Span 1+2, Truck 1	A4 Patches	5600
Abingdon	SBTL, Span 1, Truck 1	4 gcy DCI/Postrite	6300
Abingdon	SBTL, Span 1, Truck 2	4 gcy DCI/Postrite	6260
Abingdon	SBTL, Span 1, Truck 3	4 gcy DCI/Postrite	5400
Abingdon	SBTL, Span 2, Truck 1	2 gcy Ferrogard 901/903	5000
Abingdon	SBTL, Span 2, Truck 2	2 gcy Ferrogard 901/903	3800
Abingdon	SBTL, Span 3, Truck 1	A4 Patches	5460
Abingdon	SBTL, Span 3, Truck 1	1 gcy Rheocrete 222+	5650
Abingdon	SBTL, Span 3, Truck 2	1 gcy Rheocrete 222+	4660
Abingdon	SBTL, Span 4, Truck 1	A4	5230
Abingdon	SBTL, Span 4, Truck 2	A4	5980
Abingdon	SBPL, Span 1, Truck 1	4 gcy DCI/Postrite	7050
Abingdon	SBPL, Span 1, Truck 2	4 gcy DCI/Postrite	5940
Abingdon	SBPL, Span 2, Truck 1	2 gcy Ferrogard 901/903	7160
Abingdon	SBPL, Span 2, Truck 2	2 gcy Ferrogard 901/903	7290
Abingdon	SBPL, Span 3, Truck 1	1 gcy Rheocrete 222+ Patches	5870
Abingdon	SBPL, Span 3, Truck 1	1 gcy Rheocrete 222+ Patches	5390
Abingdon	SBPL, Span 3, Truck 1	1 gcy Rheocrete 222+	4110
Abingdon	SBPL, Span 3, Truck 2	1 gcy Rheocrete 222+	4300
Abingdon	SBPL, Span 4, Truck 1	A4	5680
Abingdon	SBPL, Span 4, Truck 2	A4	5740
Marshall	SBTL, Span 1, Truck 1	2 gcy Ferrogard 901/903	5200
Marshall	SBTL, Span 2, Truck 1	4 gcy DCI/Postrite	5940

Bridge	Section	Treatment	Fresh Concrete Samples 28-Day Compressive Strength, psi
Marshall	SBLT, Span 3, Truck 1	1 gcy Rheocrete 222+	7290
Marshall	NBLT, Span 1, Truck 1	A4	N/A
Marshall	NBLT, Span 2, Truck 2	A4	7030
Marshall	NBLT, Span 3, Truck 3	A4	N/A
I-77	Pier	Shotcrete	10,700
I-77	Pier	Shotcrete w/DCI + Postrite	8,200

Table 4. 90-day Permeability Data

Bridge	Section	Treatment	90-day Permeability, Coulombs
VA Beach	EBL, Span 2, Truck 2	7% SF	678
VA Beach	EBL, Span 1, Truck 3	7% SF	704
VA Beach	EBL, Span 11, Truck 4	7% SF, DCI	1652
VA Beach	EBL, Span 10, Truck 5	7% SF, DCI	1284
VA Beach	EBL, Span 18, Truck 1	7% SF, DCI	4591
VA Beach	EBL, Span 19, Truck 2	7% SF, DCI	3605
VA Beach	EBL, Span 21, Truck 2	7% SF, Rheocrete 222	980
VA Beach	EBL, Span 22, Truck 3	7% SF, Rheocrete 222	849
VA Beach	EBL, Span 24, Truck 5	7% SF, Armatec 3000/3020	472
VA Beach	EBL, Span 25, Truck 6	7% SF, Armatec 3000	368
VA Beach	EBL, Span 27, Truck 2	7% SF, DCI/Postrite	1645
VA Beach	EBL, Span 28, Truck 3	7% SF, DCI/Postrite	1603
Wytheville	SBPL, Span 1, Truck 1	A4 Patches	1422
Wytheville	SBPL, Span 1, Truck 1	A4	2225
Wytheville	SBPL, Span 1, Truck 2	A4	1772
Wytheville	SBPL, Span 2, Truck 1	1 gcy Rheocrete 222+ Patches	1664
Wytheville	SBPL, Span 2, Truck 1	1 gcy Rheocrete 222+	2714
Wytheville	SBPL, Span 2, Truck 2	1 gcy Rheocrete 222+	2245
Wytheville	SBPL, Span 3, Truck 1	2 gcy Ferrogard 901/903 Patches	2276
Wytheville	SBPL, Span 3, Truck 1	2 gcy Ferrogard 901/903	3453
Wytheville	SBPL, Span 3, Truck 2	2 gcy Ferrogard 901/903	2802
Wytheville	SBPL, Span 4, Truck 1	4 gcy DCI/Postrite Patches	1803
Wytheville	SBPL, Span 4, Truck 1	4 gcy DCI/Postrite	2542
Wytheville	SBPL, Span 4, Truck 2	4 gcy DCI/Postrite	2307
Wytheville	SBTL, Span 1, Truck 1	A4	2138
Wytheville	SBTL, Span 1, Truck 2	A4	2423
Wytheville	SBTL, Span 2, Truck 1	1 gcy Rheocrete 222+	1935
Wytheville	SBTL, Span 2, Truck 2	1 gcy Rheocrete 222+	1800
Wytheville	SBTL, Span 2, Truck 3	1 gcy Rheocrete 222+	1192
Wytheville	SBTL, Span 3, Truck 1	2 gcy Ferrogard 901/903	3489
Wytheville	SBTL, Span 3, Truck 2	2 gcy Ferrogard 901/903	2678
Wytheville	SBTL, Span 4, Truck 1	4 gcy DCI/Postrite	2644
Wytheville	SBTL, Span 4, Truck 2	4 gcy DCI/Postrite	3979
Abingdon	SBTL, Span 1+2, Truck 1	A4 Patches	None Cast
Abingdon	SBTL, Span 1, Truck 1	4 gcy DCI/Postrite	3026
Abingdon	SBTL, Span 1, Truck 2	4 gcy DCI/Postrite	3372
Abingdon	SBTL, Span 1, Truck 3	4 gcy DCI/Postrite	4084
Abingdon	SBTL, Span 2, Truck 1	2 gcy Ferrogard 901/903	3478
Abingdon	SBTL, Span 2, Truck 2	2 gcy Ferrogard 901/903	3920
Abingdon	SBTL, Span 3, Truck 1	A4 Patches	None Cast
Abingdon	SBTL, Span 3, Truck 1	1 gcy Rheocrete 222+	1713
Abingdon	SBTL, Span 3, Truck 2	1 gcy Rheocrete 222+	2410
Abingdon	SBTL, Span 4, Truck 1	A4	2058
Abingdon	SBTL, Span 4, Truck 2	A4	2354
Abingdon	SBPL, Span 1, Truck 1	4 gcy DCI/Postrite	3314
Abingdon	SBPL, Span 1, Truck 2	4 gcy DCI/Postrite	4112
Abingdon	SBPL, Span 2, Truck 1	2 gcy Ferrogard 901/903	3068
Abingdon	SBPL, Span 2, Truck 2	2 gcy Ferrogard 901/903	2597
Abingdon	SBPL, Span 3, Truck 1	1 gcy Rheocrete 222+ Patches	2953
Abingdon	SBPL, Span 3, Truck 1	1 gcy Rheocrete 222+ Patches	2536
Abingdon	SBPL, Span 3, Truck 1	1 gcy Rheocrete 222+	3457
Abingdon	SBPL, Span 3, Truck 2	1 gcy Rheocrete 222+	4251
Abingdon	SBPL, Span 4, Truck 1	A4	2335
Abingdon	SBPL, Span 4, Truck 2	A4	1669
Marshall	SBTL, Span 1, Truck 1	2 gcy Ferrogard 901/903	1009*

Bridge	Section	Treatment	90-day Permeability, Coulombs
Marshall	SBTL, Span 2, Truck 1	4 gcy DCI/Postrite	1510*
Marshall	SBLT, Span 3, Truck 1	1 gcy Rheocrete 222+	944*
Marshall	NBLT, Span 1, Truck 1	A4	N/A
Marshall	NBLT, Span 2, Truck 2	A4	N/A
Marshall	NBLT, Span 3, Truck 3	A4	N/A
I-77	Pier	Shotcrete	926
I-77	Pier	Shotcrete w/DCI + Postrite	423

Table 5. Permeability of Cores After Installation

Bridge	Overlay Thickness	Section	Treatment	Permeability of Cores After Installation	Date Cores Taken
VA Beach	1.5625	EBL, Span 2	7% SF	527	11/19/96
VA Beach	1.875	EBL, Span 11	7% SF, DCI	1418	
VA Beach	1.6875	EBL, Span 18	7% SF, DCI	1614	
VA Beach	1.6875	EBL, Span 21	7% SF, Rheocrete 222	1031	
VA Beach	1.6875	EBL, Span 24	7% SF, Armatec 3000/3020	393	
VA Beach	1.6875	EBL, Span 25	7% SF, Armatec 3000	327	
VA Beach	1.5	EBL, Span 27	7% SF, DCI/Postrite	1695	
Wytheville	2.00+	SBPL, Span 1	A4	3262	12/18/97
Wytheville	2.00+	SBPL, Span 2	1 gcy Rheocrete 222+	1973	
Wytheville	2.00+	SBPL, Span 3	2 gcy Ferrogard 901/903	1099	
Wytheville	2.00+	SBPL, Span 4	4 gcy DCI/Postrite	2519	
Wytheville	2.00+	SBTL, Span 1	A4	1532	
Wytheville	2.00+	SBTL, Span 2	1 gcy Rheocrete 222+	205	
Wytheville	2.00+	SBTL, Span 3	2 gcy Ferrogard 901/903	4101	
Wytheville	2.00+	SBTL, Span 4	4 gcy DCI/Postrite	4127	
Abingdon	2.00+	SBTL, Span 1	4 gcy DCI/Postrite	723	12/16/97
Abingdon	2.00+	SBTL, Span 2	2 gcy Ferrogard 901/903	529	
Abingdon	2.00+	SBTL, Span 3	1 gcy Rheocrete 222+	3479	
Abingdon	2.00+	SBTL, Span 4	A4	391	
Abingdon	2.00+	SBPL, Span 1	4 gcy DCI/Postrite	6506	
Abingdon	2.00+	SBPL, Span 2	2 gcy Ferrogard 901/903	708	
Abingdon	2.00+	SBPL, Span 3	1 gcy Rheocrete 222+	6192	
Abingdon	2.00+	SBPL, Span 4	A4	111	
Marshall	2.02	Span 1, RWPS	2 gcy Ferrogard 901/903	919	9/3/98
Marshall	2.33	Span 1, CLS	2 gcy Ferrogard 901/903	1103	
Marshall	2.67	Span 2, RWPS	4 gcy DCI/Postrite	1145	
Marshall	2.77	Span 2, CLS	4 gcy DCI/Postrite	2160	
Marshall	3.98	Span 3, CLS	1 gcy Rheocrete 222+	987	
Marshall	2.56	Span 3, RWS	1 gcy Rheocrete 222+	919	
Marshall	2.44	Span 1, RWPN	A4	396	
Marshall	3.00	Span 1, CLN	A4	472	
Marshall	2.83	Span 2, RWPN	A4	644	
Marshall	3.08	Span 2, CLN	A4	582	
Marshall	2.42	Span 3, CLN	A4	1070	
Marshall	2.73	Span 3, RWPN	A4	1286	
I-77		Pier	Shotcrete	N/A	-
I-77		Pier	Shotcrete w/DCI + Postrite	N/A	

Table 6. Tensile Bond Test Data After Installation

Bridge	Section	Treatment	Overlay Thickness	Tensile Bond Test Data After Installation	Failure Area, %		
					Overlay	Bond	Base
VA Beach	EBL, Span 2A	7% SF	1.5625	247	0	20	80
VA Beach	EBL, Span 2B	7% SF	1.125	196	0	90	10
VA Beach	EBL, Span 2C	7% SF	1.8125	252	10	10	80
VA Beach	EBL, Span 2D	7% SF	1.25	240	0	10	90
VA Beach	EBL, Span 2E	7% SF	1.5625	207	0	20	80
VA Beach	EBL, Span 11A	7% SF, DCI	1.875	258	5	45	50
VA Beach	EBL, Span 11B	7% SF, DCI	1.4375	266	0	0	100
VA Beach	EBL, Span 11C	7% SF, DCI	1.875	169	5	55	40
VA Beach	EBL, Span 11D	7% SF, DCI	1.8125	228	0	0	100
VA Beach	EBL, Span 11E	7% SF, DCI	1.625	212	0	15	85
VA Beach	EBL, Span 18A	7% SF, DCI	1.5625	326	5	45	50
VA Beach	EBL, Span 18B	7% SF, DCI	2.0625	235	5	25	70
VA Beach	EBL, Span 18C	7% SF, DCI	1.75	271	5	50	45
VA Beach	EBL, Span 18D	7% SF, DCI	1.6875	287	0	0	100
VA Beach	EBL, Span 18E	7% SF, DCI	1.75	274	5	55	40
VA Beach	EBL, Span 21A	7% SF, Rheocrete 222	1.8125	223	10	10	80
VA Beach	EBL, Span 21B	7% SF, Rheocrete 222	1.3125	215	0	10	90
VA Beach	EBL, Span 21C	7% SF, Rheocrete 222	1.25	222	0	30	70
VA Beach	EBL, Span 21D	7% SF, Rheocrete 222	1.25	212	0	10	90
VA Beach	EBL, Span 21E	7% SF, Rheocrete 222	1.5	262	0	30	70
VA Beach	EBL, Span 24A	7% SF, Armatec 3000/3020	1.875	153	0	50	50
VA Beach	EBL, Span 24B	7% SF, Armatec 3000/3020	1.8125	149	0	10	90
VA Beach	EBL, Span 24C	7% SF, Armatec 3000/3020	1.25	103	0	25	75
VA Beach	EBL, Span 24D	7% SF, Armatec 3000/3020	1.625	292	10	75	15
VA Beach	EBL, Span 24E	7% SF, Armatec 3000/3020	1.375	185	0	50	50
VA Beach	EBL, Span 25A	7% SF, Armatec 3000	1.6875	232	0	0	100
VA Beach	EBL, Span 25B	7% SF, Armatec 3000	1.9375	209	0	30	70
VA Beach	EBL, Span 25C	7% SF, Armatec 3000	2.25	209	5	50	45
VA Beach	EBL, Span 25D	7% SF, Armatec 3000	2.0625	227	0	0	100
VA Beach	EBL, Span 25E	7% SF, Armatec 3000	1.75	323	0	0	100
VA Beach	EBL, Span 27A	7% SF, DCI/Postrite	1.5	76	0	50	50
VA Beach	EBL, Span 27B	7% SF, DCI/Postrite	1.6875	251	0	50	50
VA Beach	EBL, Span 27C	7% SF, DCI/Postrite	1.4375	109	0	70	30
VA Beach	EBL, Span 27D	7% SF, DCI/Postrite	1.4375	266	5	45	50
VA Beach	EBL, Span 27E	7% SF, DCI/Postrite	1.875	109	5	45	50
Wytheville	SBPL, Span 1, Core 1	A4	2.50	236	30		70
Wytheville	SBPL, Span 1, Core 2	A4	1.75	156	20		80
Wytheville	SBPL, Span 2, Core 1	1 gcy Rheocrete 222+	1.6875	217	30		70
Wytheville	SBPL, Span 2, Core 2	1 gcy Rheocrete 222+	1.875	229	25	25	50

Bridge	Section	Treatment	Overlay Thickness	Tensile Bond Test Data After Installation	Failure Area, %		
					Overlay	Bond	Base
Wytheville	SBPL, Span 3, Core 1	2 gcy Ferrogard 901/903	2.0	225	50		50
Wytheville	SBPL, Span 3, Core 2	2 gcy Ferrogard 901/903	2.0625	250	70		30
Wytheville	SBPL, Span 4, Core 1	4 gcy DCI/Postrite	2.125	242	30		70
Wytheville	SBPL, Span 4, Core 2	4 gcy DCI/Postrite	2.375	212	55	5	40
Wytheville	SBTL, Span 1, Core 1	A4	2.625	206			100
Wytheville	SBTL, Span 1, Core 2	A4	2.75	196			100
Wytheville	SBTL, Span 2, Core 1	1 gcy Rheocrete 222+	2.50	226		5	95
Wytheville	SBTL, Span 2, Core 2	1 gcy Rheocrete 222+	2.4375	216	20		80
Wytheville	SBTL, Span 3, Core 1	2 gcy Ferrogard 901/903	2.50	252	15	35	50
Wytheville	SBTL, Span 3, Core 2	2 gcy Ferrogard 901/903	2.375	231	10	20	70
Wytheville	SBTL, Span 4, Core 1	4 gcy DCI/Postrite	2.25	58	10	15	75
Wytheville	SBTL, Span 4, Core 2	4 gcy DCI/Postrite	2.375	191	20	50	30
Abingdon	SBTL, Span 1, Core 1	4 gcy DCI/Postrite	2.5625	153		95	5
Abingdon	SBTL, Span 1, Core 2	4 gcy DCI/Postrite	2.625	302	50	50	
Abingdon	SBTL, Span 2, Core 1	2 gcy Ferrogard 901/903	2.25	392	100		
Abingdon	SBTL, Span 2, Core 2	2 gcy Ferrogard 901/903	2.375	192			100
Abingdon	SBTL, Span 3	1 gcy Rheocrete 222+	No samples taken, Full Depth Patch				
Abingdon	SBTL, Span 4, Core 1	A4	2.75	304			100
Abingdon	SBTL, Span 4, Core 2	A4	2.00	266			100
Abingdon	SBPL, Span 1, Core 1	4 gcy DCI/Postrite	2.5625	102	40	20	40
Abingdon	SBPL, Span 1, Core 2	4 gcy DCI/Postrite	2.3125	165	5	95	
Abingdon	SBPL, Span 2, Core 1	2 gcy Ferrogard 901/903	2.125	276		20	80
Abingdon	SBPL, Span 2, Core 1b	2 gcy Ferrogard 901/903	2.5	224	10	30	60
Abingdon	SBPL, Span 2, Core 2	2 gcy Ferrogard 901/903	2.3125	158	30	20	50
Abingdon	SBPL, Span 3, Core 1	1 gcy Rheocrete 222+	2.625	5	40	20	40
Abingdon	SBPL, Span 3, Core 2	1 gcy Rheocrete 222+	2.5	378	100		
Abingdon	SBPL, Span 4, Core 1	A4	2.5	209	15	35	50
Abingdon	SBPL, Span 4, Core 2	A4	2.25	126	30	30	40
Marshall	Span 1, RWS1	2 gcy Ferrogard 901/903	2.00	Samples broke when cored			100
Marshall	Span 1, RWS2	2 gcy Ferrogard 901/903	2.75		30		70
Marshall	Span 1, RWPS	2 gcy Ferrogard 901/903	2.75	305	10	20	70
Marshall	Span 1, CLS2	2 gcy Ferrogard 901/903	1.92	250	40	10	50
Marshall	Span 1, RWPN	A4	2.08	525	30	0	70
Marshall	Span 1, CLN	A4	3.56	330	20	5	75
Marshall	Span 2, CLS	4 gcy DCI/Postrite	2.52	105	5	10	85
Marshall	Span 2, CLS2	4 gcy DCI/Postrite	2.67	X	5		95
Marshall	Span 2, RWS 8'	4 gcy DCI/Postrite	3.00	150	30		70
Marshall	Span 2, RWPN	A4	2.90	215	30	40	30
Marshall	Span 2, CLN	A4	2.06	310	20		80

Bridge	Section	Treatment	Overlay Thickness	Tensile Bond Test Data After Installation	Failure Area, %		
					Overlay	Bond	Base
Marshall	Span 2, RWPN	A4	2.88	X	5		95
Marshall	Span 3, RWS 15'	1 gcy Rheocrete 222+	2.75	160	50		50
Marshall	Span 3, RWS 8'	1 gcy Rheocrete 222+	2.83	305	50	35	15
Marshall	Span 3, CLS	1 gcy Rheocrete 222+	4.75	X			
Marshall	Span 3, CLS 2	1 gcy Rheocrete 222+	3.04	135			100
Marshall	Span 3, RWS	1 gcy Rheocrete 222+	2.71	X	20		80
Marshall	Span 3, RWPN	A4	2.15	175	10	30	60
Marshall	Span 3, CLN	A4	2.31	360	30		70
I-77	Pier	Shotcrete		N/A			
I-77	Pier	Shotcrete w/DCI + Postrite		N/A			

Table 7A. Half-cell Potentials < 0.20 (-VCSE)

	% of Potentials < 0.20 (-VCSE) and Year of Potential Measurement						
Bridge and Section	**Treatment**	**1996 (Apr.)[1]**	**1997 (mid)[1]**	**1997 (late)[2]**	**1998 (Aug.)**	**1998 (Sept.)**	**1999**
VA Beach, EBL, Spans 1, 2, 3	7% SF	81					
VA Beach, EBL, Spans 10, 11	7% SF, DCI	76					
VA Beach, EBL, Spans 18, 19	7% SF, DCI	80					
VA Beach, EBL, Spans 20, 21, 22	7% SF, Rheocrete 222	87					
VA Beach, EBL, Spans 23, 24	7% SF, Armatec 2000/3020	100					
VA Beach, EBL, Spans 26, 27, 28	7% SF, DCI/Postrite	95					
Wytheville, SBPL, Span 1	A-4		15	33			
Wytheville, SBPL, Span 2	Rheocrete 222+		19	27			
Wytheville, SBPL, Span 3	Ferrogard 901/903		2	6			
Wytheville, SBPL, Span 4	DCI/Postrite		0	4			
Wytheville, SBTL, Span 1	A-4		36	9			
Wytheville, SBTL, Span 2	Rheocrete 222+		63	20			
Wytheville, SBTL, Span 3	Ferrogard 901/903		36	0			
Wytheville, SBTL, Span 4	DCI/Postrite		29	0			
Abingdon, SBPL, Span 1	DCI/Postrite		44	82			
Abingdon, SBPL, Span 2	Ferrogard 901/903		17	43			
Abingdon, SBPL, Span 3	Rheocrete 222+		12	65			
Abingdon, SBPL, Span 4	A-4		15	39			
Abingdon, SBTL, Span 1	DCI/Postrite		13	29			
Abingdon, SBTL, Span 2	Ferrogard 901/903		18	24			
Abingdon, SBTL, Span 3	Rheocrete 222+		3	69			
Abingdon, SBTL, Span 4	A-4		61	58			
Marshall, SBTL, Span 1	2 gcy Ferrogard 901/903				0	0	
Marshall, SBTL, Span 2	4 gcy DCI/Postrite				0	0	
Marshall, SBTL, Span 3	1 gcy Rheocrete 222+				0	0	
Marshall, NBTL, Span 1	A4				0	0	
Marshall, NBTL, Span 2	A4				0	1	
Marshall, NBTL, Span 3	A4				0	0	
I-77 at Walker Mountain, Pier	Gunite		0	0			
I-77 at Walker Mountain, Pier	Gunite w/ DCI/Postrite		0	86			

1 – Before placement of overlay   2 – After placement of overlay

Table 7B. Half-cell Potentials from 0.20 to 0.35 (-VCSE)

	% of Potentials from 0.20 to 0.35 (-VCSE) and Year of Potential Measurement						
Bridge and Section	**Treatment**	**1996 (Apr.)[1]**	**1997 (mid)[1]**	**1997 (late)[2]**	**1998 (Aug.)**	**1998 (Sept.)**	**1999**
VA Beach, EBL, Spans 1, 2, 3	7% SF	14					
VA Beach, EBL, Spans 10, 11	7% SF, DCI	20					
VA Beach, EBL, Spans 18, 19	7% SF, DCI	15					
VA Beach, EBL, Spans 20, 21, 22	7% SF, Rheocrete 222	11					
VA Beach, EBL, Spans 23, 24	7% SF, Armatec 2000/3020	0					
VA Beach, EBL, Spans 26, 27, 28	7% SF, DCI/Postrite	5					
Wytheville, SBPL, Span 1	A-4		82	67			
Wytheville, SBPL, Span 2	Rheocrete 222+		74	72			
Wytheville, SBPL, Span 3	Ferrogard 901/903		72	89			
Wytheville, SBPL, Span 4	DCI/Postrite		54	96			
Wytheville, SBTL, Span 1	A-4		58	91			
Wytheville, SBTL, Span 2	Rheocrete 222+		33	79			
Wytheville, SBTL, Span 3	Ferrogard 901/903		58	94			
Wytheville, SBTL, Span 4	DCI/Postrite		63	97			
Abingdon, SBPL, Span 1	DCI/Postrite		56	18			
Abingdon, SBPL, Span 2	Ferrogard 901/903		70	42			
Abingdon, SBPL, Span 3	Rheocrete 222+		70	31			
Abingdon, SBPL, Span 4	A-4		68	59			
Abingdon, SBTL, Span 1	DCI/Postrite		76	67			
Abingdon, SBTL, Span 2	Ferrogard 901/903		74	57			
Abingdon, SBTL, Span 3	Rheocrete 222+		89	20			
Abingdon, SBTL, Span 4	A-4		36	38			
Marshall, SBTL, Span 1	2 gcy Ferrogard 901/903				12	24	
Marshall, SBTL, Span 2	4 gcy DCI/Postrite				0	22	
Marshall, SBTL, Span 3	1 gcy Rheocrete 222+				13	14	
Marshall, NBTL, Span 1	A4				13	41	
Marshall, NBTL, Span 2	A4				24	59	
Marshall, NBTL, Span 3	A4				23	51	
I-77 at Walker Mountain, Pier	Gunite		50	25			
I-77 at Walker Mountain, Pier	Gunite w/ DCI/Postrite		86	14			

1 – Before placement of overlay 2 – After placement of overlay

Table 7C. Half-cell Potentials > 0.35 (-VCSE)

Bridge and Section	% of Potentials > 0.35 (-VCSE) and Year of Potential Measurement						
	Treatment	1996 (Apr.)[1]	1997 (mid)[1]	1997 (late)[2]	1998 (Aug.)	1998 (Sept.)	1999
VA Beach, EBL, Spans 1, 2, 3	7% SF	5					
VA Beach, EBL, Spans 10, 11	7% SF, DCI	4					
VA Beach, EBL, Spans 18, 19	7% SF, DCI	5					
VA Beach, EBL, Spans 20, 21, 22	7% SF, Rheocrete 222	2					
VA Beach, EBL, Spans 23, 24	7% SF, Armatec 2000/3020	0					
VA Beach, EBL, Spans 26, 27, 28	7% SF, DCI/Postrite	0					
Wytheville, SBPL, Span 1	A-4		3	0			
Wytheville, SBPL, Span 2	Rheocrete 222+		7	1			
Wytheville, SBPL, Span 3	Ferrogard 901/903		26	5			
Wytheville, SBPL, Span 4	DCI/Postrite		46	0			
Wytheville, SBTL, Span 1	A-4		6	0			
Wytheville, SBTL, Span 2	Rheocrete 222+		4	1			
Wytheville, SBTL, Span 3	Ferrogard 901/903		6	6			
Wytheville, SBTL, Span 4	DCI/Postrite		8	3			
Abingdon, SBPL, Span 1	DCI/Postrite		0	0			
Abingdon, SBPL, Span 2	Ferrogard 901/903		13	15			
Abingdon, SBPL, Span 3	Rheocrete 222+		18	4			
Abingdon, SBPL, Span 4	A-4		17	2			
Abingdon, SBTL, Span 1	DCI/Postrite		11	4			
Abingdon, SBTL, Span 2	Ferrogard 901/903		8	19			
Abingdon, SBTL, Span 3	Rheocrete 222+		8	11			
Abingdon, SBTL, Span 4	A-4		3	4			
Marshall, SBTL, Span 1	2 gcy Ferrogard 901/903				88	76	
Marshall, SBTL, Span 2	4 gcy DCI/Postrite				100	78	
Marshall, SBTL, Span 3	1 gcy Rheocrete 222+				87	86	
Marshall, NBTL, Span 1	A4				87	59	
Marshall, NBTL, Span 2	A4				76	40	
Marshall, NBTL, Span 3	A4				77	49	
I-77 at Walker Mountain, Pier	Gunite		50	75			
I-77 at Walker Mountain, Pier	Gunite w/ DCI/Postrite		14	0			

1 – Before placement of overlay 2 – After placement of overlay

Table 8. Chloride Ion Content at Reinforcing Steel, lb/yd^3

			Probe Location											
Bridge	**Span**	**Lane**	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**4A**	**4B**	**5A**	**5B**	**6A**	**6B**
VA Beach	2	T	1.59	-	-	-	-	-	-	-	-	-	-	-
VA Beach	11	T	<0.30	-	-	-	-	-	-	-	-	-	-	-
VA Beach	18	T	0.85	-	-	-	-	-	-	-	-	-	-	-
VA Beach	21	T	1.22	-	-	-	-	-	-	-	-	-	-	-
VA Beach	24	T	<0.30	-	-	-	-	-	-	-	-	-	-	-
VA Beach	27	T	<0.30	-	-	-	-	-	-	-	-	-	-	-
Wytheville	1	P	1.00	0.55	3.45	3.01	3.64	2.70	3.20	2.47	-	-	-	-
Wytheville	2	P	4.15	2.95	1.44	2.06	2.23	1.84	2.61	1.82	-	-	-	-
Wytheville	3	P	0.77	0.54	0.48	0.83	3.84	2.93	1.99	1.28	-	-	-	-
Wytheville	4	P	0.98	0.55	1.49	0.98	2.87	2.69	1.18	0.93	-	-	-	-
Wytheville	1	T	1.03	0.36	0.88	0.41	2.07	1.42	0.76	0.56	0.96	0.55	1.18	0.91
Wytheville	2	T	2.02	1.43	0.71	0.54	1.22	<0.3	2.18	1.79	0.75	0.43	2.50	1.62
Wytheville	3	T	1.52	0.55	2.24	1.75	2.00	1.33	1.53	0.94	-	-	-	-
Wytheville	4	T	2.38	1.13	2.37	1.01	1.15	0.80	1.68	0.40	-	-	-	-
Abingdon	1	P	1.52	1.30	3.18	2.63	1.87	1.56	<0.3	<0.3	-	-	-	-
Abingdon	2	P	<0.3	<0.3	2.32	1.62	2.62	2.81	2.19	1.81	-	-	-	-
Abingdon	3	P	<0.3	<0.3	3.78	2.91	2.04	1.82	2.12	1.94	-	-	-	-
Abingdon	4	P	1.31	1.55	2.51	2.36	1.92	2.15	<0.3	<0.3	-	-	-	-
Abingdon	1	T	1.22	1.95	0.60	0.60	1.12	1.14	0.93	1.82	-	-	-	-
Abingdon	2	T	2.04	1.39	-	-	2.11	1.46	-	-	2.34	2.32	1.32	0.60
Abingdon	3	T	-	-	-	-	-	-	-	-	-	-	-	-
Abingdon	4	T	1.82	2.14	-	-	1.81	1.70	<0.3	<0.3	1.85	1.64	0.39	<0.3
Big Walker	Pier	-	15.73	5.67							-	-	-	-
Big Walker	Pier	-	3.43	8.96							-	-	-	-
Marshall	1	-	7.13	7.76	-	-	-	-	-	-	-	-	-	-
Marshall	2	-	5.07	5.53	-	-	-	-	-	-	-	-	-	-
Marshall	3	-	4.05	8.01	-	-	-	-	-	-	-	-	-	-

Table 9. Weight Loss, Durability, and Surface Scaling Performance

Rapid Freezing And Thawing Data At 300 Cycles (Test C 666 - Procedure A)					
Route 60 Over Lynnhaven Inlet					
Batch #	**Mix**	**WL (%)**	**DF**	**SS**	**P/F**
15	7% SF Span #2 System A	4.59	115	1.90	P
16	7% SF Span #1 System A	8.41 (250)	No Reading (250)	1.29 (250)	F
23	7% SF Span #2 System A	6.07 (150)	78 (150)	3.01 (150)	F
24	7% SF Span #1 System A	2.44 (50)	61 (50)	1.36 (50)	F
27	7% SF w/ Rheocrete Span #21 System G	31.55 (50)	-	5.00 (50)	F
28	7% SF w/ Rheocrete Span #22 System G	7.24 (50)	-	1.79 (50)	F
29	7% SF w/ Armatec 2000 Span #24 System H, Armatec 3020	1.85 (50)	78 (50)	0.86 (50)	F
30	7% SF w/ Armatec 2000 Span #25 System H*	1.11	106	0.69	P
31	7% SF w/ DCI Span #18 System I*	14.85 (50)	-	-	F
32	7% SF w/ DCI Span #19 System I*	4.9 (50)	-	1.71 (50)	F
33	7% SF w/ DCI Span #27 System I, Postrite	11.71 (50)	-	2.96 (50)	F
34	7% SF w/ DCI Span #28 System I, Postrite	9.18 (50)	-	2.64 (50)	F
35	7% SF w/ DCI Span #11 System I*	5.06 (50)	-	2.24 (50)	F
36	7% SF w/ DCI Span #10 System I*	3.98 (50)	-	2.11 (50)	F

-No value at the first reading (50 cycles).

Number of cycles in parentheses.

Table 10. Average Cycles at Failure

Location	Mix Design	Cycles to Failure
VA Beach Spans 1, 2, 3	7% SF	Failed at 110 cycles
VA Beach Spans 10, 11	7% SF, DCI	Failed at 50 cycles
VA Beach, Spans 18, 19	7% SF, DCI	Failed at 50 cycles
VA Beach, Spans 20, 21, 22	7% SF, Rheocrete 222	Failed at 50 cycles
VA Beach, Spans 23, 24	7% SF, Armatec 2000/3020	Failed at 190 cycles
VA Beach, Spans 26, 27, 28	7% SF, DCI/Postrite	Failed at 50 cycles

Table 11A. Probe Locations on I-81, Wytheville
Bridge: Wytheville I-81 (South)

Lane: Passing

	Span 1				Span 2				Span 3				Span 4			
	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d
Probe 1	16	8	-0.19	nc	27	7	-0.17	oc	19	5	-0.37	oc	19	11	-0.24	oc
Probe 2	16	10	-0.19	oc	35	13	-0.32	oc	43	7	-0.18	oc	35	10	-0.33	oc
Probe 3	33	3	-0.17	oc	35	5	-0.31	nc	53	9	-0.23	oc	35	6	-0.34	nc
Probe 4	43	3	-0.24	oc	55	5	-0.33	oc	53	5	-0.34	nc	39	3	-0.32	oc
Probe 5	47	2	-0.34	nc	67	6	-0.26	oc	63	5	-0.26	oc	47	6	-0.25	nc
Probe 6	47	9	-0.20	oc	67	10	-0.28	nc	63	7	-0.31	nc	47	10	-0.23	oc

a – distance from upstream end of span (ft)
b – distance from parapet (ft)
c – average half-cell reading at probe location (V, CSE)
d – (oc) old concrete / (nc) new concrete

Bridge: Wytheville (South)

Lane: Travel

	Span 1				Span 2				Span 3				Span 4			
	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d
Probe 1	16	8	-0.18	oc	20	4	-0.13	oc	16	4	-0.17	oc	24	8	-0.19	oc
Probe 2	24	4	-0.25	oc	20	8	-0.16	oc	20	12	-0.18	oc	28	4	-0.32	oc
Probe 3	37	8	-0.25	oc	24	12	-0.18	nc	28	8	-	nc	28	12	-0.19	oc
Probe 4	44	4	-0.19	nc	28	8	-0.15	oc	44	8	-0.18	oc	32	4	-	nc
Probe 5	48	12	-0.24	oc	52	8	-0.17	nc	56	4	-0.26	oc	48	4	-0.19	nc
Probe 6	52	12	-0.39	nc	64	12	-0.20	oc	68	12	-	nc	48	12	-	nc

a – distance from upstream end of span (ft)
b – distance from parapet (ft)
c – average half-cell reading at probe location (V, CSE)
d – (oc) old concrete / (nc) new concrete

Table 11B. Probe Locations on I-81, Abingdon
Bridge: Abingdon I-81 (South)

Lane: Travel

Span 1				
	a	b	c	d
Probe 1	23	9	-0.18	oc
Probe 2	32	7	-0.28	oc
Probe 3	32	3	-0.32	nc
Probe 4	44	7	-0.21	nc
Probe 5	45	4	-0.26	oc
Probe 6	56	9	-0.28	oc

Span 2				
	a	b	c	d
Probe 1	17	9	-0.21	oc
Probe 2	19	3	-0.33	nc
Probe 3	23	12	-0.26	oc
Probe 4	43	10	-0.24	nc
Probe 5	43	6	-0.17	oc
Probe 6	51	6	-0.19	oc

Span 3				
	a	b	c	d
Probe 1	12	10	-	oc
Probe 2	12	5	-0.23	nc
Probe 3	32	11	-0.34	nc
Probe 4	40	3	-0.24	nc
Probe 5	48	11	-0.39	nc
Probe 6	48	3	-0.24	nc

Span 4				
	a	b	c	d
Probe 1	13	9	-0.26	oc
Probe 2	25	13	-0.19	nc
Probe 3	25	9	-0.21	oc
Probe 4	32	6	-0.16	oc
Probe 5	46	10	-0.30	oc
Probe 6	46	3	-0.28	nc

a – distance from upstream end of span (ft)
b – distance from parapet (ft)
c – average half-cell reading at probe location (V, CSE)
d – (oc) old concrete / (nc) new concrete

Bridge: Abingdon I-81 (South)

Lane: Passing

Span 1				
	a	b	c	d
Probe 1	18	8	-0.23	nc
Probe 2	18	4	-0.19	oc
Probe 3	28	11	-0.24	oc
Probe 4	32	9	-0.19	nc
Probe 5	32	4	-0.22	oc
Probe 6	56	11	-0.28	oc

Span 2				
	a	b	c	d
Probe 1	13	10	-0.22	oc
Probe 2	13	5	-	nc
Probe 3	18	10	-0.30	oc
Probe 4	28	9	-0.20	oc
Probe 5	41	10	-	nc
Probe 6	41	5	0.19	oc

Span 3				
	a	b	c	d
Probe 1	24	13	-	nc
Probe 2	24	10	-0.29	oc
Probe 3	28	1	-0.19	oc
Probe 4	30	11	-	nc
Probe 5	30	6	-0.26	oc
Probe 6	58	10	-0.27	oc

Span 4				
	a	b	c	d
Probe 1	17	10	-0.26	oc
Probe 2	17	2	-	nc
Probe 3	22	9	-0.19	oc
Probe 4	39	12	-0.31	nc
Probe 5	39	8	-	oc
Probe 6	51	13	-0.38	oc

a – distance from upstream end of span (ft)
b – distance from parapet (ft)
c – average half-cell reading at probe location(V, CSE)
d – (oc) old concrete / (nc) new concrete

Table 11C. Probe Locations on I-77, Big Walker Mountain
Bridge: I-77 (North) at Big Walker Mountain

Right Column			
	a	b	c
Probe 1	89	-	-0.29

Cap			
	a	b	c
Probe 2	12	103	-
Probe 3	24	176	-0.37

Center Column			
	a	b	c
Probe 4	18	-	-

a – distance from bottom of cap (in)
b – distance from right side of cap (in)
c – average half-cell reading (V, CSE)

Table 11D. Probe Locations on Rte. 710, Marshall
Bridge: Rte. 710 Over Goose Creek, Marshall

Lane: NBL

Span 1				
	a	b	c	d
Probe 1	8	8	-.52	oc
Probe 2	28	2	-.38	oc
Probe 3	48	6	-.49	oc

Span 2				
	a	b	c	d
Probe 1	12	6	-.49	oc
Probe 2	32	3	-.38	oc
Probe 3	56	9	-.48	oc

Span 3				
	a	b	c	d
Probe 1	12	8	-.40	oc
Probe 2	20	6	-.43	oc
Probe 3	52	4	-.36	oc

Lane: SBL

Span 1				
	a	b	c	d
Probe 1	43	2	-.37	oc
Probe 2	43	6	-.41	oc

Span 2				
	a	b	c	d
Probe 1	43	2	-.44	oc
Probe 2	43	6	-.43	oc

Span 3				
	a	b	c	d
Probe 1	33	2	-.40	oc
Probe 2	33	6	-.49	oc

a – distance from upstream end of span (ft)
b – distance from parapet (ft)
c – average half-cell reading at probe location (V, CSE)
d – (oc) old concrete / (nc) new concrete

Table 12A. Probe Data, I-81, Wytheville, September 1998
Bridge: I-81 SBTL Over Rte. 52 @ Wytheville

Span 1			
Wire Color	a	b	c
Red	.001	-1.71	620
White	.002	-4.36	870
Blue	.003	.03	.17
Gray	.003	-1.65	360
Brown	.002	-6.53	660
Orange	.002	-1.47	290

Span 2			
Wire Color	a	b	c
Red	.009	-4.76	515
White	.003	26.87	635
Blue	.006	1.83	760
Gray	.007	4.30	540
Brown	.006	2.42	610
Orange	.007	2.96	390

Span 3			
Wire Color	a	b	c
Red	.011	2.63	450
White	.005	-14.02	480
Blue	-.681	-133.70	130
Gray	.006	-4.73	530
Brown	.002	-39.07	300
Orange	-.550	-252.76	415

Span 4			
Wire Color	a	b	C
Red	.005	2.82	470
White	.004	-5.99	430
Blue	.004	1.67	380
Gray	.005	1.60	410
Brown	.006	6.88	480
Orange	.005	1.44	350

Bridge: I-81 SBPL Over Rte. 52 @ Wytheville

Span 1			
Wire Color	a	b	c
Red	.006	2.02	250
White	.007	6.35	1100
Blue	.006	2.58	370
Gray	-.040	-15.94	315
Brown	.003	1.46	410
Orange	-.017	-17.54	940

Span 2			
Wire Color	a	b	c
Red	.012	5.41	570
White	.033	14.46	350
Blue	.044	26.13	600
Gray	-.064	-23.87	280
Brown	.009	5.91	740
Orange	.012	5.63	460

Span 3			
Wire Color	a	b	c
Red	.225	56.14	210
White	.004	1.86	340
Blue	.019	6.33	330
Gray	.072	55.40	705
Brown	.020	15.05	780
Orange	.120	53.27	360

Span 4			
Wire Color	a	b	C
Red	.021	12.78	505
White	.088	119.27	540
Blue	.069	70.16	1100
Gray	-.053	-25.23	350
Brown	.026	8.65	405
Orange	.024	7.19	310

a – Macrocell Current (mA) (Connected w/ 10 Ω Resistor)
b – Macrocell Potential (mV) (Disconnected w/o 10 Ω Resistor)
c – AC Resistance(Ω) (Disconnected)

Table 12B. Probe Data, I-81, Abingdon, September 1998
Bridge: I-81 SBTL Over Rte. 808 @ Abingdon

Span 1			
Wire Color	a	b	c
Red	-.015	-9.71	380
White	-.095	-33.49	295
Blue	.044	90.37	2200
Gray	.010	18.06	1700
Brown	.010	4.49	420
Orange	.008	2.85	290

Span 2			
Wire Color	a	b	c
Red	.007	3.15	410
White	.055	82.00	1500
Blue	.062	20.55	350
Gray	.006	6.71	1300
Brown	-.008	-3.46	345
Orange	.003	2.21	920

Span 3			
Wire Color	a	b	c
Red	.017	9.14	430
White	.016	35.56	2100
Blue	-.020	-66.34	2600
Gray	.004	10.48	2500
Brown	.005	11.87	2000
Orange	0	.46	2200

Span 4			
Wire Color	a	b	C
Red	.009	3.11	290
White	.003	4.85	1300
Blue	-.006	-2.68	320
Gray	.013	5.68	415
Brown	-.044	-26.17	540
Orange	.022	47.15	2100

Bridge: I-81 SBPL Over Route 808 @ Abingdon

Span 1			
Wire Color	a	b	c
Red	.001	1.45	330
White	-.007	-3.21	475
Blue	.023	7.89	290
Gray	-.025	-5.88	265
Brown	.012	5.7	360
Orange	.075	52.20	620

Span 2			
Wire Color	a	b	c
Red	.195	79.36	365
White	.061	56.17	895
Blue	.001	.94	200
Gray	.078	16.9	180
Brown	.076	31.65	370
Orange	.003	2.11	465

Span 3			
Wire Color	a	b	c
Red	.015	5.04	410
White	.003	2.23	330
Blue	.022	8.5	320
Gray	.001	.93	260
Brown	.009	.02	6.5
Orange	.238	111.05	290

Span 4			
Wire Color	a	b	C
Red	.082	46.20	560
White	.063	24.24	370
Blue	.009	2.70	360
Gray	.067	23.96	340
Brown	.021	7.51	340
Orange	.16	104.25	620

a – Macrocell Current (mA) (Connected w/ 10 Ω Resistor)
b – Macrocell Potential (mV) (Disconnected w/o 10 Ω Resistor)
c – AC Resistance(Ω) (Disconnected)

Table 12C. Probe Data, I-77, Big Walker Mountain, September 1998
Bridge: I-77 over 717 @ Big Walker Tunnel

Pier				
Probe No.	**Wire Color**	**a**	**b**	**c**
2	Red	-.018	-26.18	5400
1	White	.021	-.04	1100
3	Blue	.025	25.83	1100
4	Gray	.048	199.98	1900

a – Macrocell Current (mA) (Connected w/ 10 Ω Resistor)
b – Macrocell Potential (mV) (Disconnected w/o 10 Ω Resistor)
c – AC Resistance(Ω) (Disconnected)

Table 12D. Probe Data, Rte. 710 Over Goose Creek in Marshall, September 1998
Rte. 710, Marshall, NBL

Span 2			
Wire Color	**a**	**b**	**c**
Red	.47	18.7	185
White	.065	45.155	1050

Span 3			
Wire Color	**a**	**b**	**c**
Red	-.084	-30.04	350
White	.099	21.615	200

Rte. 710, Marshall, SBL

Span 1			
Wire Color	**a**	**b**	**c**
Red	.041	9.79	205
White	.009	0.355	160

Span 2			
Wire Color	**a**	**b**	**c**
Red	-.004	-0.975	145
White	.119	24.41	180

Span 3			
Wire Color	**a**	**b**	**c**
Red	.066	12.265	170
White	.065	13.465	190

a – Macrocell Current (mA) (Connected w/ 10 Ω Resistor)
b – Macrocell Potential (mV) (Disconnected w/o 10 Ω Resistor)
c – AC Resistance(Ω) (Disconnected)

Table 12E. Probe Data, I-81, Wytheville, December 1998
Bridge: I-81 SBTL Over Rte. 52 @ Wytheville

	Span 1				Span 2				Span 3				Span 4		
Wire Color	a	b	c	Wire Color	a	b	c	Wire Color	a	b	c	Wire Color	a	b	c
Red	-.001	.02	630	Red	-.005	-3.96	600	Red	0	.93	530	Red	.002	.02	420
White	.001	1.65	1000	White	.002	4.42	940	White	-.003	-2.76	675	White	-.019	-8.53	430
Blue	.001	0	.18	Blue	-.001	.97	1000	Blue	-.04	5.07	140	Blue	.001	.53	430
Gray	0	.49	350	Gray	.001	2.84	645	Gray	0	-.95	760	Gray	.001	.03	600
Brown	.007	5.16	740	Brown	-.001	1.87	820	Brown	-.085	-40.71	400	Brown	0	1.6	450
Orange	-.001	.64	280	Orange	-.001	.67	565	Orange	-.01	-7.87	665	Orange	.001	.02	550

Bridge: I-81 SBPL Over Rte. 52 @ Wytheville

	Span 1				Span 2				Span 3				Span 4		
Wire Color	a	b	c	Wire Color	a	b	c	Wire Color	a	b	c	Wire Color	a	b	c
Red	-.001	.76	410	Red	.001	.1	960	Red	.016	-.01	350	Red	.006	4.11	780
White	0	.38	2000	White	.012	8.27	520	White	-.001	.03	525	White	.014	28.31	2300
Blue	0	.27	580	Blue	.001	5.06	1100	Blue	.004	2.58	520	Blue	.003	3.63	1700
Gray	-.002	-.06	500	Gray	-.017	-6.58	380	Gray	.009	13.37	1300	Gray	-.009	-9.63	610
Brown	-.001	-.05	650	Brown	.002	.02	1200	Brown	0	1.82	1300	Brown	.002	.86	650
Orange	-.002	4.73	1800	Orange	.002	.04	790	Orange	.002	2.98	660	Orange	.005	1.79	500

a – Macrocell Current (mA) (Connected w/ 10 Ω Resistor)
b – Macrocell Potential (mV) (Disconnected w/o 10 Ω Resistor)
c – AC Resistance(Ω) (Disconnected)

Table 12F. Probe Data, I-81, Abingdon, December 1998
Bridge: I-81 SBTL Over Rte. 808 @ Abingdon

Span 1			
Wire Color	a	b	c
Red	-.002	-2.03	300
White	-.008	-3.03	285
Blue	.006	10.85	1600
Gray	.001	1.72	1400
Brown	0	.4	320
Orange	0	.49	240

Span 2			
Wire Color	a	b	c
Red	.002	.68	290
White	.013	14.31	1350
Blue	.003	1.26	310
Gray	0	.48	1000
Brown	-.003	-.88	270
Orange	.001	1.21	830

Span 3			
Wire Color	a	b	c
Red	0	0	280
White	.001	1.89	1700
Blue	.001	-14.39	2000
Gray	-.003	-2.08	2100
Brown	-.002	2.55	1700
Orange	-.001	-.53	1300

Span 4			
Wire Color	a	b	C
Red	.003	.83	245
White	.001	.70	1200
Blue	-.001	-.92	265
Gray	-.003	-2.31	365
Brown	-.015	-9.96	450
Orange	.002	3.98	2000

Bridge: I-81 SBPL Over Rte. 808 @ Abingdon

Span 1			
Wire Color	a	b	c
Red	.002	.78	300
White	0	-.45	460
Blue	.001	-.02	320
Gray	.002	.01	285
Brown	.002	-.04	400
Orange	.006	3.49	740

Span 2			
Wire Color	a	b	c
Red	.039	14.59	410
White	.008	9.39	1150
Blue	-.009	-3.43	225
Gray	.003	.05	200
Brown	.009	3.69	400
Orange	.001	.05	560

Span 3			
Wire Color	a	b	c
Red	.003	1.56	385
White	.001	.72	390
Blue	.001	.09	320
Gray	-.001	-.07	260
Brown	.008	.02	1
Orange	.008	2.79	300

Span 4			
Wire Color	a	b	c
Red	.002	1.81	640
White	.003	1.37	400
Blue	.002	1.24	390
Gray	.001	.7	380
Brown	.006	2.22	330
Orange	.019	12.45	760

a – Macrocell Current (mA) (Connected w/ 10 Ω Resistor)
b – Macrocell Potential (mV) (Disconnected w/o 10 Ω Resistor)
c – AC Resistance(Ω) (Disconnected)

Table 12G. Probe Data, I-77, Big Walker Mountain, December 1998
Bridge: I-77 Over Rte. 717 @ Big Walker Tunnel

		Pier		
Probe No.	**Wire Color**	**a**	**b**	**c**
2	Red	-.13	-30.24	1300
1	White	.02	-13.97	8300
3	Blue	.14	9.81	645
4	Gray	.04	121.25	5700

a – Macrocell Current (mA) (Connected w/ 10 Ω Resistor)
b – Macrocell Potential (mV) (Disconnected w/o 10 Ω Resistor)
c – AC Resistance(Ω) (Disconnected)

Table 12H. Probe Data, Rte. 710 Over Goose Creek in Marshall, December 1998
Rte. 710, Marshall, NBL

Span 2			
Wire Color	**a**	**b**	**c**
Red	.106	34.86	300
White	.041	61.02	1400

Span 3			
Wire Color	**a**	**b**	**c**
Red	.082	50.76	620
White	.069	24.99	345

Rte. 710, Marshall, SBL

Span 1			
Wire Color	**a**	**b**	**c**
Red	.006	2.44	315
White	.032	9.57	290

Span 2			
Wire Color	**a**	**b**	**c**
Red	-.030	-10.61	285
White	-.062	-25.20	360

Span 3			
Wire Color	**A**	**b**	**c**
Red	.035	10.15	310
White	.053	20.36	370

a – Macrocell Current (mA) (Connected w/ 10 Ω Resistor)
b– Macrocell Potential (mV) (Disconnected w/o 10 Ω Resistor)
c– AC Resistance(Ω) (Disconnected)

Table 12I. Probe Data, I-81, Wytheville, March 1999
Bridge: I-81 SBTL Over Rte. 52 @ Wytheville

Span 1			
Wire Color	a	b	c
Red	-.050	-29.57	470
White	.002	2.11	920
Blue	.002	.01	.19
Gray	.002	.35	300
Brown	.007	3.92	530
Orange	.003	.74	250

Span 2			
Wire Color	a	b	c
Red	.004	1.74	520
White	.012	12.09	840
Blue	.003	1.23	830
Gray	.006	2.58	550
Brown	.004	2.55	720
Orange	.003	.69	485

Span 3			
Wire Color	A	b	c
Red	.003	.73	430
White	.002	.63	610
Blue	-.029	-3.84	120
Gray	0	-1.33	650
Brown	-.042	-18.18	340
Orange	.001	.05	620

Span 4			
Wire Color	a	b	c
Red	.002	.03	300
White	-.033	-11.8	340
Blue	.003	.61	300
Gray	.003	.05	540
Brown	.002	1.02	320
Orange	.003	.04	480

Bridge: I-81 SBPL Over Rte. 52 @ Wytheville

Span 1			
Wire Color	a	b	c
Red	-.034	-20.98	345
White	.002	1.69	1400
Blue	.003	.06	450
Gray	-.001	-2.36	380
Brown	.004	.06	580
Orange	-.001	-5.61	1200

Span 2			
Wire Color	a	b	c
Red	.003	1.64	680
White	.022	10.43	420
Blue	.01	9.25	940
Gray	-.204	-65.81	240
Brown	.005	1.20	1000
Orange	.012	8.00	610

Span 3			
Wire Color	A	b	c
Red	.034	9.75	240
White	.004	.09	430
Blue	.005	2.68	450
Gray	.012	14.09	980
Brown	.004	2.56	1000
Orange	.005	3.24	525

Span 4			
Wire Color	a	b	c
Red	.005	3.68	635
White	.014	16.61	200
Blue	.004	6.73	1200
Gray	-.04	-23.26	490
Brown	.003	.76	565
Orange	.004	1.63	440

a – Macrocell Current (mA) (Connected w/ 10 Ω Resistor)
b – Macrocell Potential (mV) (Disconnected w/o 10 Ω Resistor)
c – AC Resistance(Ω) (Disconnected)

Table 12J. Probe Data, I-81, Abingdon, March 1999
Bridge: I-81 SBTL Over Rte. 808 @ Abingdon

Span 1			
Wire Color	a	b	c
Red	-.076	-14.36	230
White	-.042	-10.95	200
Blue	.001	3.02	1300
Gray	.001	1.50	1200
Brown	-.017	-4.70	240
Orange	.001	.03	200

Span 2			
Wire Color	a	b	C
Red	-.005	-1.29	230
White	.012	21.27	1200
Blue	.002	1.21	270
Gray	-.004	-1.90	830
Brown	-.091	-23.03	225
Orange	-.001	1.86	670

Span 3			
Wire Color	a	b	c
Red	-.090	-24.56	220
White	.001	4.02	1500
Blue	-.085	-69.85	800
Gray	-.003	.06	1700
Brown	.002	5.83	1400
Orange	-.003	-.49	1100

Span 4			
Wire Color	a	b	C
Red	-.003	-.06	200
White	.000	2.16	1000
Blue	-.128	-41.53	220
Gray	-.034	-10.27	310
Brown	-.226	-88.68	345
Orange	.000	-4.98	2000

Bridge: I-81 SBPL Over Rte. 808 @ Abingdon

Span 1			
Wire Color	a	b	c
Red	-.010	-3.61	240
White	.004	-.01	390
Blue	.003	-.47	250
Gray	.004	-.02	230
Brown	.003	-.63	290
Orange	.006	3.22	550

Span 2			
Wire Color	a	b	c
Red	.042	16.48	370
White	.011	11.52	1000
Blue	.005	1.20	190
Gray	.003	.08	175
Brown	.012	4.68	350
Orange	.005	.04	490

Span 3			
Wire Color	a	b	c
Red	.007	1.96	270
White	.013	5.21	350
Blue	.001	-1.35	260
Gray	-.005	-2.09	200
Brown	.043	.77	1
Orange	.003	-.02	255

Span 4			
Wire Color	a	b	c
Red	.005	2.34	570
White	.004	1.38	360
Blue	.004	1.64	350
Gray	.003	.04	340
Brown	.009	3.68	300
Orange	.023	14.28	660

a – Macrocell Current (mA) (Connected w/ 10 Ω Resistor)
b – Macrocell Potential (mV) (Disconnected w/o 10 Ω Resistor)
c – AC Resistance(Ω) (Disconnected)

Table 12K. Probe Data, I-77, Big Walker Mountain, March 1999
Bridge: I-77 Over Rte. 717 @ Big Walker Tunnel

		Pier		
Probe No.	**Wire Color**	**A**	**b**	**c**
2	Red	-.023	.08	1500
1	White	-3.828	31.01	5800
3	Blue	.013	113.06	690
4	Gray	.017	17.57	6300

a – Macrocell Current (mA) (Connected w/ 10 Ω Resistor)
b – Macrocell Potential (mV) (Disconnected w/o 10 Ω Resistor)
c – AC Resistance(Ω) (Disconnected)

Table 12L. Probe Data, Rte. 710 Over Goose Creek in Marshall, March 1999
Rte. 710, Marshall, NBL

Span 2			
Wire Color	**a**	**b**	**c**
Red	.076	36.07	480
White	.010	5.96	860

Span 3			
Wire Color	**a**	**b**	**c**
Red	-.027	-27.92	880
White	.056	14.60	400

Rte. 710, Marshall, SBL

Span 1			
Wire Color	**a**	**b**	**c**
Red	.007	2.83	490
White	-.027	-10.57	350

Span 2			
Wire Color	**a**	**b**	**c**
Red	.022	8.38	400
White	.036	20.46	490

Span 3			
Wire Color	**a**	**b**	**c**
Red	.020	16.59	665
White	.012	7.50	690

a – Macrocell Current (mA) (Connected w/ 10 Ω Resistor)
b – Macrocell Potential (mV) (Disconnected w/o 10 Ω Resistor)
c – AC Resistance(Ω) (Disconnected)