EVALUATION OF PYRAMENT BRIDGE DECK OVERLAY

Final Report
November 1996

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16. ABSTRACT

The Oklahoma Department of Transportation (ODOT) has been using high density Portland cement (HDPC) overlays for more than twenty years to minimize spalls and delaminations in concrete. Since HDPC overlays were introduced, additives were incorporated into these mixtures to increase concrete strength and durabilty as well as decrease the time needed for curing.

Pyrament, marketed and manufactured by Lonestar Industries, is a concrete comprised of 65% Portland Cement, 30% fly ash, and 5% trademark additive. In 1990, Pyrament concrete was used on a bridge reconstruction project. The Research,Development, and Technology Transfer (RD&T) of ODOT monitored the construction process and documented their findings. In order to assess the long term performance of Pyrament, RD&T has been evaluating this bridge deck since the completion of construction at regular intervals.

Four tests were used to evaluate the condition of the two inch Pyrament overlay: visual, delamination, chloride ion content and half cell corrosion surveys. While there was widespread cracking, the chloride and half cell survys did not yield unusually high chloride contamination or corrosion levels.

Pyrament is no longer available for commercial use. This will be the final report on the long term performance of the Pyrament overlay system applied in Oklahoma County.

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SI (METRIC) CONVERSION FACTORS

Approximate Conversions to SI Units

Symbol	When you know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	25.40	millimeters	mm
ft	feet	0.3048	meters	m
yd	yards	0.9144	meters	m
mi	miles	1.609	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm
ft^2	square feet	0.0929	square meters	m^2
yd^2	square yards	0.8361	square meters	m^2
ac	acres	0.4047	hectares	ha
mi^2	square miles	2.590	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.0283	cubic meters	m^3
yd^3	cubic yards	0.7645	cubic meters	m^3
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.4536	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
		TEMPERATURE (exact)		
°F	degrees Fahrenheit	(°F-32)/1.8	degrees Celsius	°C
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.448	Newtons	N
lbf/in^2	poundforce per square inch	6.895	kilopascals	kPa

Approximate Conversions from SI Units

Symbol	When you know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.0394	inches	in
m	meters	3.281	feet	ft
m	meters	1.094	yards	yd
km	kilometers	0.6214	miles	mi
		AREA		
mm^2	square millimeters	0.00155	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.196	square yards	yd^2
ha	hectares	2.471	acres	ac
km^2	square kilometers	0.3861	square miles	mi^2
		VOLUME		
mL	milliliters	0.0338	fluid ounces	fl oz
L	liters	0.2642	gallons	gal
m^3	cubic meters	35.315	cubic feet	ft^3
m^3	cubic meters	1.308	cubic yards	yd^3
		MASS		
g	grams	0.0353	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams	1.1023	short tons (2000 lb)	T
		TEMPERATURE (exact)		
°C	degrees Celsius	9/5+32	degrees Fahrenheit	°F
		FORCE and PRESSURE or STRESS		
N	Newtons	0.2248	poundforce	lbf
kPa	kilopascals	0.1450	poundforce per square inch	lbf/in^2

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Executive Summary

The Oklahoma Department of Transportation (ODOT) has been using high density Portland cement (HDPC) overlays for more than twenty years to minimize spalls and delaminations in concrete. Since HDPC overlays were introduced, additives were incorporated into these mixtures to increase concrete strength and durability as well as decrease the time needed for curing.

Pyrament is a concrete containing 65% Portland Cement, 30% fly ash and 5% trademark additive. According to the manufacturer, Pyrament offers a combination of high strength, durability and reduced permeability in concrete.

Pyrament was applied to a reconstructed bridge deck in Oklahoma County in 1990. Research, Development and Technology Transfer (RD&T) monitored the construction process and documented the procedures. Since the time of reconstruction, RD&T has evaluated this bridge deck one year and three years after construction. The purpose of this evaluation was to assess the long term performance of Pyrament.

Visual, delamination sounding, corrosion and chloride surveys were performed on this bridge deck to detect physical abnormalities, corrosion levels and chloride ion content. Three years after reconstruction, there was less than 0.3 percent corrosion on the bridge deck and the chloride ion levels were below the critical levels for chloride contamination.

Pyrament is no longer available for commercial use. This will be the final report on the long term performance of the Pyrament overlay system applied in Oklahoma County.

Introduction

The Oklahoma Department of Transportation (ODOT) is constantly in search of ways to reduce surface defects and physical signs of distress in bridges and pavements. ODOT has been using high density Portland Cement (HDPC) overlays for more than twenty years in the construction and more recently the reconstruction of bridge decks. HDPC overlays purportedly minimize spalling and delaminations that occur in concrete due to reinforcing steel corrosion. Many of the overlays on some other bridge decks have performed well, but there has been evidence of severe cracking and delamanations within ten years of service.

When HDPC overlays were introduced, Portland Cement was the primary component in the mixtures. After some time, companies developed additives to the overlays to improve the concrete properties. Lonestar Industries developed Pyrament Concrete.

Pyrament is a made up of 65% Portland cement, 30% fly ash, and 5% trademark additive. According to the manufacturer, Pyrament offers a combination of high strength, durability and reduced permeability in concrete as well as ultra-rapid curing. With the addition of Pyrament, concrete is more resistant to shrinkage during curing, sulfate attack and damage caused by de-icing chemicals.

In 1990, Pyrament was used on a bridge reconstruction project in Oklahoma. Research, Development and Technology Transfer (RD&T) monitored the construction then documented the procedures in "The Construction of a Pyrament Bridge Deck Overlay," by David C. Streb. RD&T has monitored the Pyrament overlay system to evaluate the long term performance of high strength concrete overlays. This final report presents the test results, conclusions and recommendations for the above mentioned deck four years after reconstruction.

Background

"The Construction of a Pyrament Bridge Deck Overlay," was written in 1991 detailing reconstruction operations to a bridge deck in Oklahoma County. Throughout the remainder of this text, the bridge in this study will be referred to as two separate structures; the north and south structure. Before presenting the testing procedures and results, it is important to note some of the details during the reconstruction phase of the project.

Reconstruction was done in two phases. During phase one, the outside lanes in both the east and west directions were closed off and widened three meters (ten feet). Severe cracking occurred in the overlay during the curing portion of the reconstruction phase. These cracks were not repaired; however, the curing process was modified before the second phase. A fifty millimeter (two inch) Pyrament overlay was placed over the existing concrete, tined, cured with linseed emulsion, then covered with cotton blankets. This curing process caused severe cracking in the Pyrament overlay so it was modified for the second phase of this project to prevent this type of cracking that occurred in phase one. The cracks were not repaired.

During phase two of the reconstruction, the remaining two inside lanes and shoulder were closed to traffic. The Pyrament overlay was set in place and the concrete tined. In order to prevent cracking in the overlay, the curing process was changed. A resin curing compound was placed on the concrete along with burlap, cotton and plastic blankets and left for twenty-four hours. The result was a finished surface with no cracking.

In Oklahoma, silane penetrating waterproof sealers are applied to bridge decks to prevent the intrusion of chlorides and moisture. After curing and an appropriate amount of drying time, the northwest section of the north structure was treated with a silane. The rest of the deck was left untreated to evaluate the permeability of Pyrament.

Project Location

The bridge decks that were repaired with the Pyrament overlay are located over Air Depot Boulevard in Midwest City on Interstate 40 as shown on the map in Figure 1. This bridge was constructed in 1962. The deck is 57.2 meter (187.5 feet) in length, a total of 34 meter (110 feet) in width and presently has three driving lanes in the east and west bound directions.

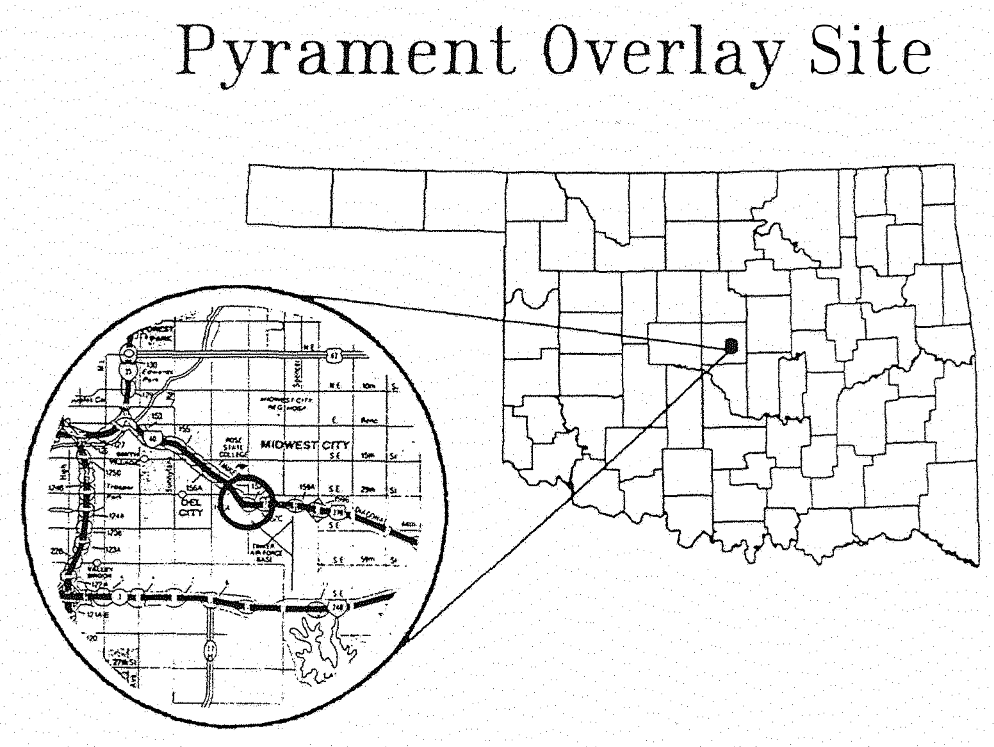

Figure 1. Project Location.

Testing Procedures and Analysis of Data

One of the benefits of HDPC overlays is the minimization of the surface defects on bridge decks and pavements. Spalls, delaminations, and cracks occur in concrete when the reinforcing steel corrodes in the deck. Corrosion is typically caused by the ingress of salt and moisture into concrete that eventually finds its way to the steel bars. In order to assess the long term performance of Pyrament, tests were performed to monitor the corrosion and chloride levels and visually illustrate the condition of the bridge deck. Four tests were employed to gage the status of the decks: visual, delamination sounding, corrosion, and chloride surveys. The tests were performed, data recorded and results will be presented throughout this report in figures and tables in customary US units.

Visual and Delamination Sounding Surveys

The primary objectives of visual and delamination sounding surveys are to evaluate the appearance of the decks and note any physical abnormalities in the concrete. These surveys note cracks, delaminations, spalls, and other surface anomalies.

A crack survey, shown in Figures 2 and 3, was performed on each bridge deck. The maps also show the areas that were patched during reconstruction. The surface areas of the patches are noted on Tables 1 and 2 following each crack survey. Figures 4 and 5 are photographs of widespread cracking and abrasions found on the decks.

The delamination sounding or chain drag survey is used to locate delaminated areas on the deck. The test is conducted using the supplies and procedures outlined in ASTM designation D 4580 "Standard Practice for Measuring Delaminations in Concrete Bridge Decks by Sounding." Delaminated areas found on the deck are marked off and noted in the visual survey notes. A photograph of this section is shown in Figure 6.

Crack Map Survey: North Structure

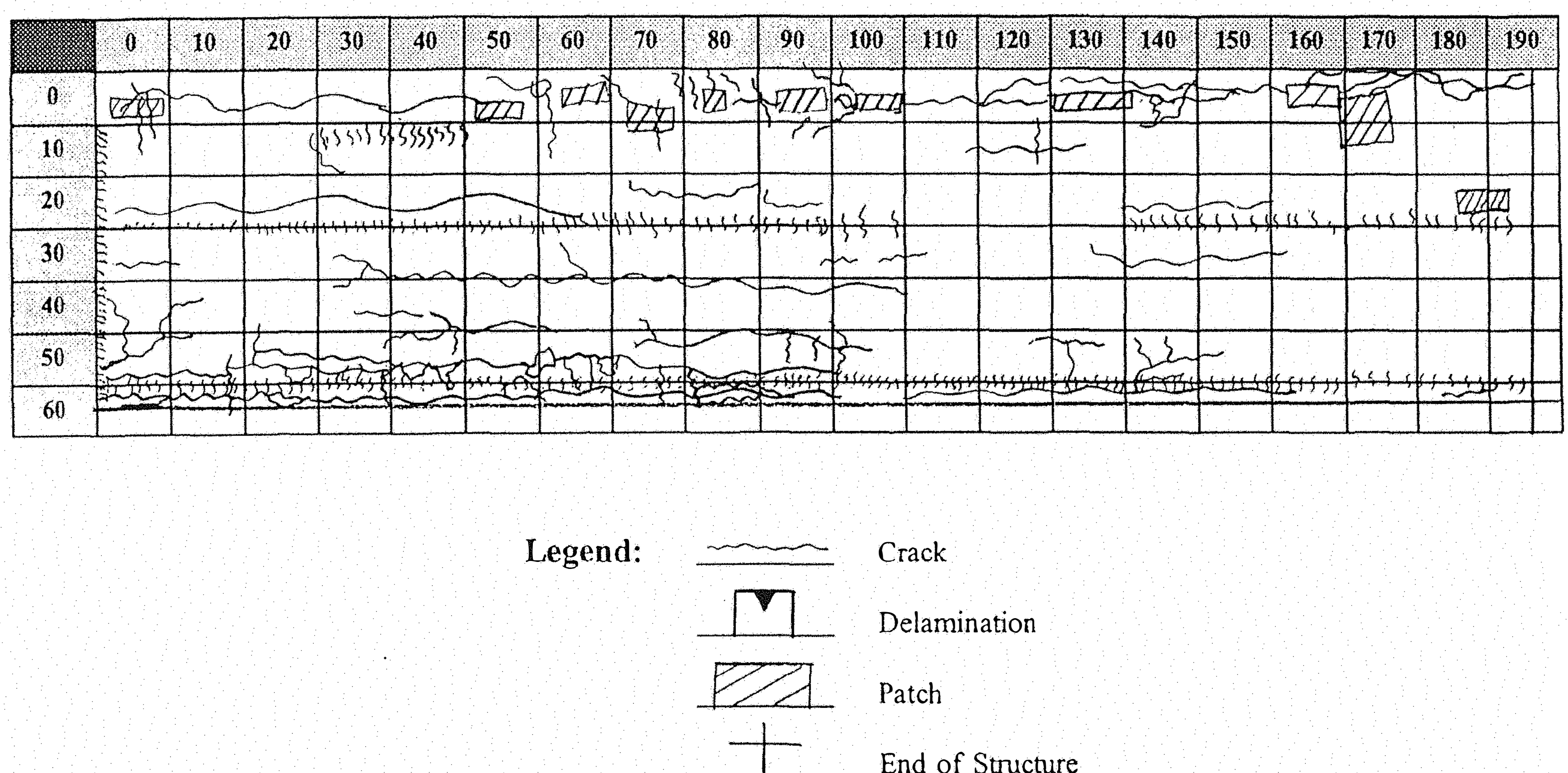

Figure 2. Visual Survey and Crack Map of North Bridge.

Table 1. Surface Area of Patches: North Structure.

Patch Number	Length (Feet)	Width (Feet)	Area (Square Feet)
1	7.20	1.80	12.96
2	6.90	2.30	15.87
3	3.10	1.30	4.03
4	4.70	2.50	11.75
5	2.90	2.50	7.25
6	5.11	1.80	9.20
7	4.90	1.10	5.39
8	10.60	2.20	23.32
9	5.80	2.10	12.18
10	6.80	9.10	62.00
11	6.00	4.00	24.0

The crack map surveys for each structure are shown in feet. The northwest corner of the north structure treated with the silane penetrating water sealer is located on the top left corner of the crack map. Deteriorated areas that were patched during reconstruction are listed in the table above numbered from left to right. Patch five, for example, is located at approximately 0 x 60 on the survey grid and measures 0.88 meters (2.90 feet) in length and 0.76 meter (2.50 feet) in width. The patches are located near the outside lane on the shoulder.

Most of the longitudinal and block cracks on this structure are located on the shoulders. Transverse cracks generally show up near the edge of the lanes.

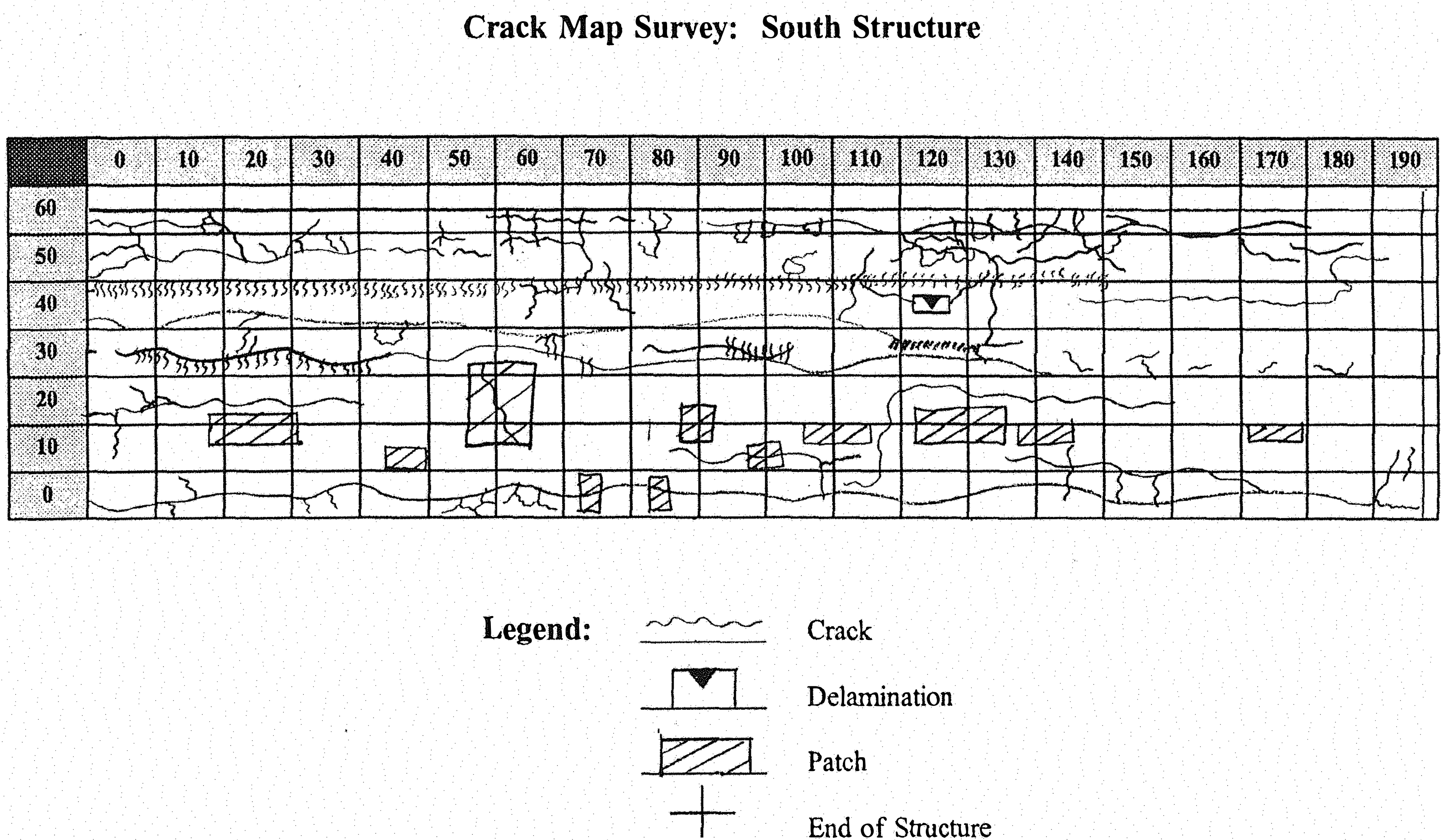

Figure 3. Visual Survey and Crack Map of South Bridge.

Table 2. Surface Area of Patches: South Structure.

Patch Number	Length (Feet)	Width (Feet)	Area (Square Feet)
1	14.40	4.00	57.6.
2	4.80	4.00	19.20
3	7.90	14.20	112.18
4	2.40	7.00	16.80
5	3.20	4.10	13.12
6	2.60	2.40	6.24
7	4.70	1.40	6.58
8	16.00	6.40	102.40
9	6.00	4.20	25.20
10	9.20	1.20	11.04

The grid on the survey is numbered differently from the grid on the north structure. Patch 10 is located in the southeast, or bottom right corner of the grid at the 10 x 170 location. The patches are near the wall on the outside shoulder.

There is one delamination on this deck at approximately 40 x 120 on the survey grid. Generally speaking, the cracking trends for this deck are theesame as for the north structure; however, there is more longitudinal cracking in the driving lanes for this deck.

Figure 4. Cracks in Pavement.

Figure 5. Cracks and Concrete Abrasion on the Deck.

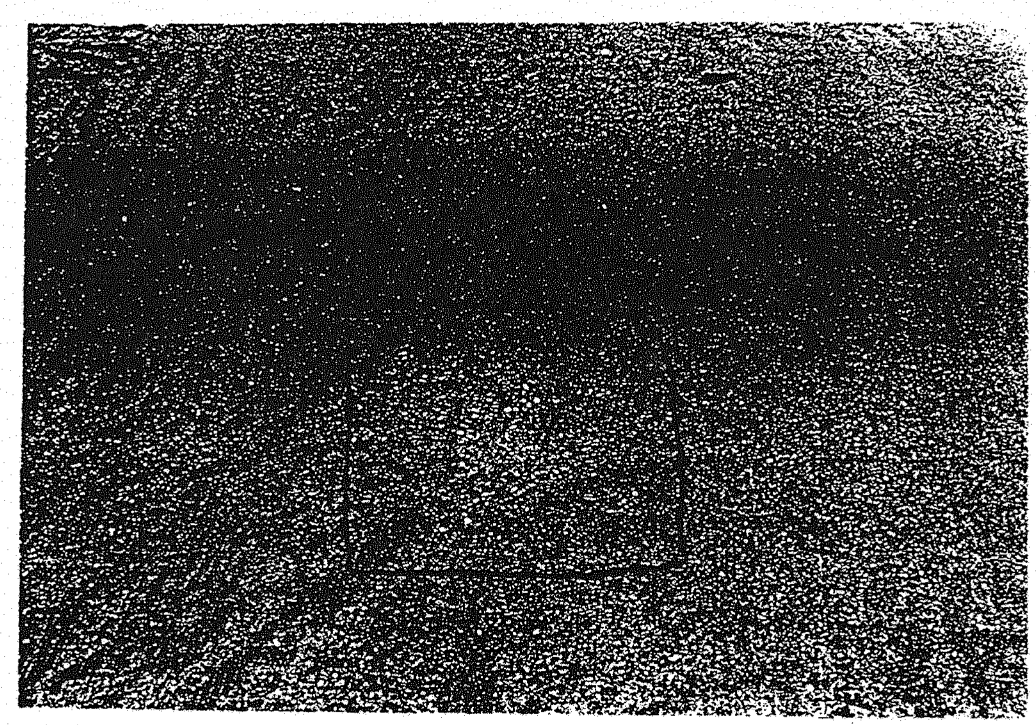

Figure 6. Delamination on the Deck.

Corrosion Survey

In order to locate areas of corrosion, the half-cell corrosion survey was performed using the procedures outlined in ASTM Designation C 876 "Standard Test Method for Half-Cell Potentials of Uncoated Reinforcing Steel in Concrete." Half-cell readings fall into one of three categories:

1. Readings that are more positive than -200 millivolt (mV) indicate that there is a greater than 90% probability that steel corrosion is not present.

2. Readings that are more negative than -350 mV indicate that there is a greater than 90% probability that steel corrosion is present.

3. For readings that fall between the first two categories, the probability of corrosion activity in reinforcing steel is uncertain.

For purposes of this report, emphasis will be on readings more negative than -350 mV.

The grids shown in Figures 7 and 8 list the readings taken every one and one-half meter (five feet) for the bridge decks in this study. Figures 9 and 10 summarize the data for the corrosion readings from the total deck area. Figure 11 graphically shows the change in corrosion levels for each structure between the time of reconstruction and the year that the test was performed.

Half-Cell Corrosion Potential Readings
North Structure: 0 to 100 Feet

	0	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**	**95**	**100**
0	100	100	110	90	100	80	80	50	80	60	90	50	50	60	60	80	50	120	120	90	110
2.5	210	160	190	180	120	130	140	130	150	120	120	130	130	130	140	120	***120***	150	180	100	170
5	230	180	150	160	130	130	150	140	140	130	100	140	120	120	110	140	140	130	130	140	130
10	300	210	160	170	150	160	150	150	130	130	110	130	90	120	130	120	140	160	170	200	160
15	410	250	190	180	170	170	180	170	170	140	160	150	150	140	110	160	200	210	200	180	190
20	360	250	250	220	210	180	190	190	190	180	170	160	20	170	160	190	200	210	200	200	190
25	380	270	210	170	170	150	130	120	150	120	130	160	140	160	150	160	190	180	190	170	190
30	350	290	230	210	190	190	190	190	190	180	180	190	180	170	180	180	170	200	210	200	210
35	350	300	250	230	210	210	210	200	200	200	210	200	200	200	180	190	200	220	220	230	220
40	400	300	230	210	200	200	200	200	200	190	200	180	190	190	190	200	210	200	230	210	200
45	340	300	250	220	220	220	210	210	***190***	210	190	190	190	200	210	200	230	220	230	***250***	220
50	430	300	260	240	220	220	210	200	210	210	190	200	210	230	210	220	220	240	250	240	220
55	360	290	300	260	220	230	230	210	230	230	250	200	240	230	250	230	240	230	250	230	230

All readings are negative; values are measured in millivolts (mV). The reading at location 0 x 0 is -100 mV.

The bold numbers in the shaded areas indicate the location on the bridge deck where readings were taken.

Readings that are italicized, printed in bold text, and underlined (e.g. ***190*** at grid location 45 x40) indicate the location of chloride sampling.

Half-Cell Corrosion Potential Readings
North Structure: 100 to 187.5 Feet

	105	**110**	**115**	**120**	**125**	**130**	**135**	**140**	**145**	**150**	**155**	**160**	**165**	**170**	**175**	**180**	**185**	**187.5**
0	120	110	70	10	120	90	80	120	90	140	100	90	130	190	240	180	160	160
2.5	160	160	150	160	160	160	130	150	190	120	180	140	170	260	300	220	200	200
5	160	150	170	180	170	170	190	220	210	210	150	170	160	250	270	210	230	230
10	180	210	270	280	250	230	250	330	250	280	230	190	180	210	210	200	320	260
15	190	220	290	***300***	230	260	230	260	270	250	230	220	140	140	200	210	280	330
20	230	200	280	240	220	220	250	260	260	***240***	200	220	190	190	240	210	330	340
25	200	170	160	170	170	160	190	180	210	200	230	210	190	190	240	210	330	390
30	200	190	180	180	190	200	190	210	240	230	240	230	230	250	240	***270***	340	320
35	190	180	210	180	220	220	210	250	210	230	220	220	200	220	240	260	300	300
40	210	210	210	190	190	220	200	220	210	220	210	240	250	250	240	270	340	320
45	200	200	200	200	190	210	220	240	240	230	240	240	230	220	230	250	320	320
50	190	180	210	180	220	220	210	250	210	230	220	220	200	220	240	260	300	300
55	220	200	240	210	240	230	230	230	230	210	200	200	260	250	260	250	320	280

Figure 7. Half-Cell Readings - North Structure.

Half-Cell Corrosion Potential Readings

South Structure: 0 to 100 Feet

	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
55	-	280	250	210	180	200	280	190	180	280	240	310	340	300	210	240	190	180	250	200	230
50	-	190	200	200	160	190	180	210	240	310	200	190	310	190	250	180	190	160	210	160	210
45	-	150	150	100	180	190	190	160	190	190	190	210	250	230	400	190	190	130	180	130	190
40	-	240	210	190	180	230	230	190	210	210	150	210	310	250	300	260	210	250	230	260	310
35	-	140	110	130	230	100	60	130	150	130	150	230	180	180	180	180	180	130	180	180	230
30	-	190	190	160	230	100	130	160	200	230	210	90	210	90	160	160	180	160	180	190	150
25	440	260	270	270	260	260	270	270	310	240	230	240	230	210	230	250	260	270	260	250	240
20	390	280	280	260	270	310	300	350	310	290	250	210	***250***	220	220	250	300	290	300	300	280
15	470	350	300	260	240	300	320	420	***440***	330	270	240	240	260	270	340	390	360	330	310	310
10	290	310	270	290	250	290	370	400	380	360	270	300	250	250	290	320	380	340	330	290	330
5	170	340	230	230	220	250	290	310	290	280	250	230	210	240	240	220	250	260	240	270	240
2.5	100	240	220	240	240	250	250	300	290	260	240	220	220	230	230	220	240	250	230	270	250
0	170	210	190	220	180	220	240	260	270	220	230	210	200	180	200	220	210	250	210	260	220

All readings are negative; values are measured in millivolts (mV). The reading at location 55 x 10 is -250 mV.

The bold numbers in the shaded areas indicate the location on the bridge deck where readings were taken.

The symbol - indicates no readings were taken from this location.

Readings that are italicized, printed in bold text, and underlined (e.g. ***440*** at grid location 15 x 40) indicate the location of chloride sampling.

Half-Cell Corrosion Potential Readings

South Structure: 100 to 187.5 Feet

	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	185	187.5
55	230	250	290	250	250	300	310	250	240	230	250	200	250	230	210	250	310	-
50	190	240	210	310	230	280	230	250	190	210	180	230	200	190	160	240	310	-
45	190	230	160	240	150	230	200	200	250	190	150	260	180	190	180	210	260	-
40	230	250	200	290	240	310	200	300	240	300	310	340	190	240	240	280	430	-
35	130	160	110	75	210	130	180	180	200	240	200	130	130	110	110	160	230	-
30	150	210	140	160	190	180	180	190	190	240	240	260	180	150	150	190	350	-
25	250	260	230	250	230	240	260	270	260	320	320	260	270	250	250	260	320	370
20	280	250	270	260	250	250	270	280	280	270	270	280	280	260	260	270	320	360
15	270	620	290	310	280	270	310	330	300	300	310	290	280	260	250	290	360	400
10	290	250	270	290	400	260	290	340	420	290	290	240	280	250	230	260	330	320
5	250	230	220	270	240	240	250	270	270	220	270	240	230	220	220	260	310	280
2.5	230	230	230	230	240	240	230	260	250	270	270	240	240	230	210	260	310	260
0	210	210	220	210	190	210	210	240	250	210	240	240	200	200	220	220	280	240

Figure 8. Half-Cell Readings - South Structure.

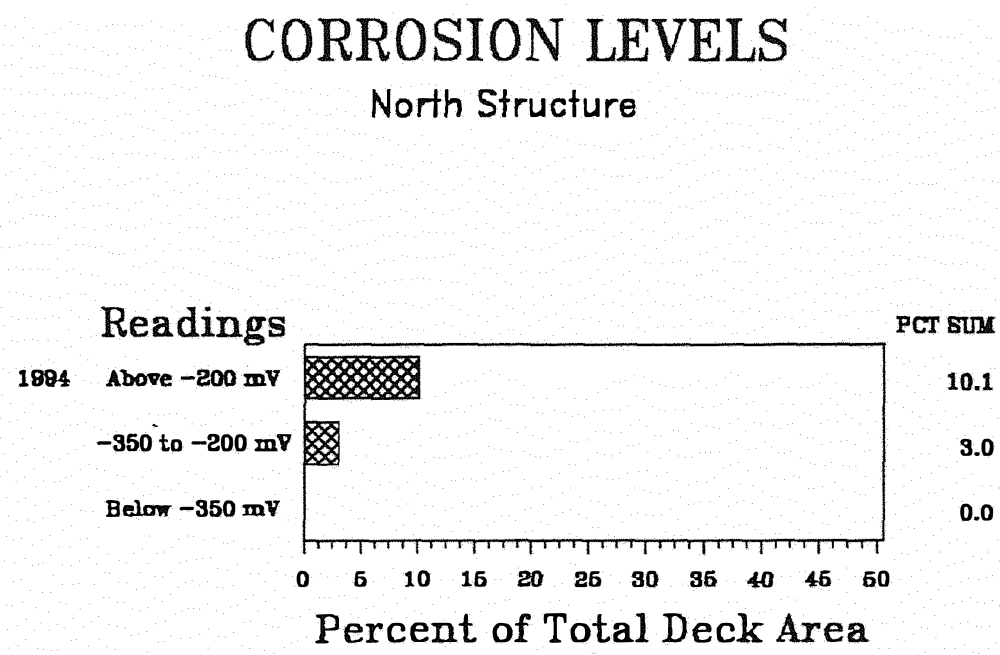

Figure 9. Percentage of Deck Corrosion on North Structure.

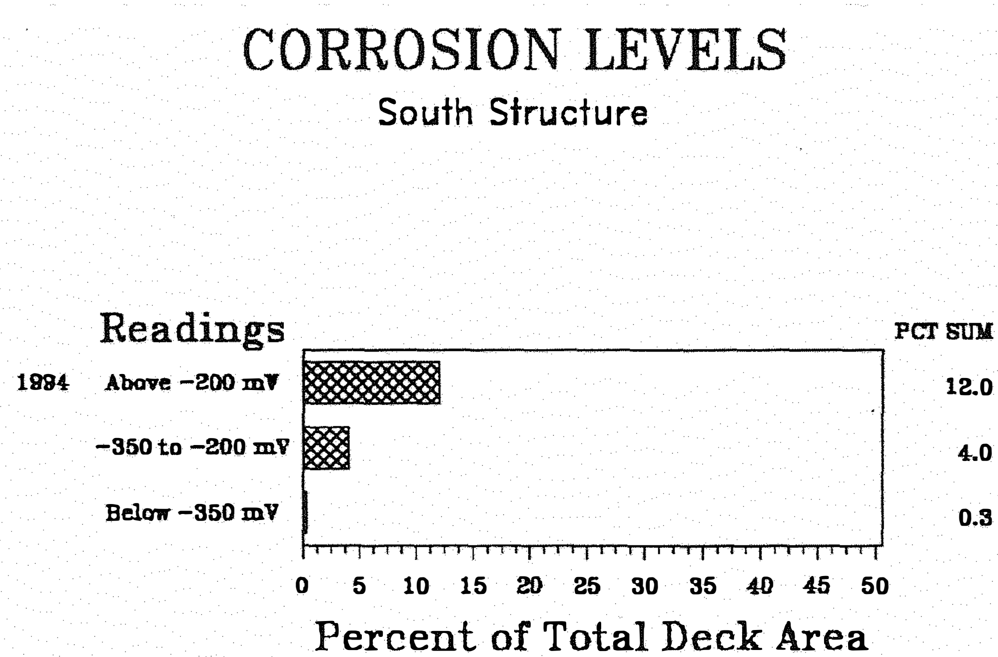

Figure 10. Percentage of Deck Corrosion on South Structure.

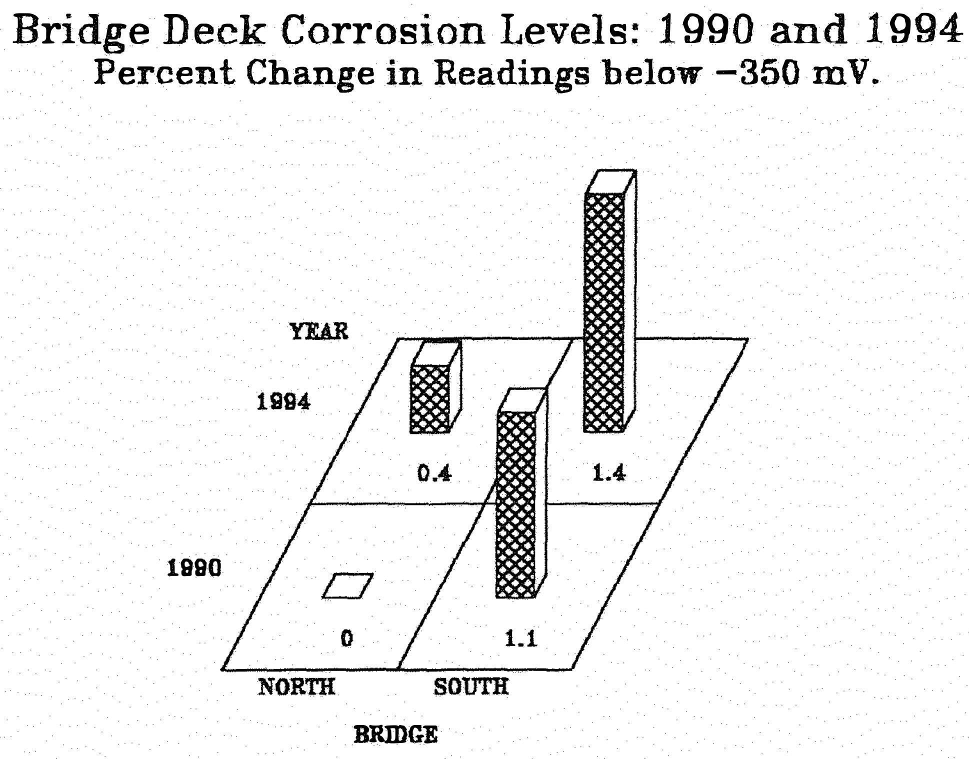

Figure 11. Change in Corrosion Levels between 1990 and 1994.

In order to make any accurate inferences, the orientation of the grids in Figures 7 and 8 should be explained. The grids show the layout of the decks. For the north deck, the section that was patched and widened is located on the top four rows of the grid from 0 to 3 meters (0 to 10 feet) away from the parapet wall, read from top to bottom. The location of the section that was widened for the south structure is located on the bottom four rows of the grid from 3 to 0 meters (10 to 0 feet), read from top to bottom.

Some general trends can be established from the grids. On both the north and south structures, the higher readings, above -250 mV, are located near the outside walls where the deck was widened and patched with the Pyrament concrete. Lower readings, below -300 mV, were located near the joints on the deck.

The graphs in Figures 9 and 10 indicate that a very small percentage of the deck is showing signs of corrosion activity. Increases in the level of corrosion activity from the time that the decks were reconstructed until 1994 are less than 0.5 percent, shown in Figure 11, for each structure when only readings lower than -350 mV are considered.

Chloride Survey

Chloride samples were taken from each deck to determine the chloride ion content in the concrete. The sampling and testing procedures are conducted in accordance with AASHTO designation T 260 "Sampling and Testing for Total Chloride Ion in Concrete and Raw Materials."

Chloride samples were taken from spots on the deck that had a low, high, or average corrosion cell reading or an area where chloride samples were previously collected. The locations of the samples relative to the bridge deck are shown in Figures 7 and 8. The test results are listed in Tables 3 and 4. The maximum acceptable level for chloride ion content is 40 kilograms per cubic meter (2.5 pounds per cubic yard) before serious problems develop. Figure 12 shows a comparison between the average chloride content of both bridge decks at the time of reconstruction and 1994.

Table 3. Chloride Data: North Structure.

Sample Number	Half-Cell Reading (mV)	Ion Content Above Rebar (lbs./c.y.)	Ion Content Below Rebar (lbs./c.y.)	Average Chloride Ion Content (lbs./c.y.)
1	-120	0.4083	0.4051	0.4067
2	-300	0.3971	0.3822	0.3897
3	-240	0.6023	0.7794	0.6909
4	-190	0.6475	0.6096	0.6286
5	-250	3.4455	2.6445	3.0457
6	-270	0.8767	0.7887	0.8327

Table 4. Chloride Data: South Structure.

Sample Number	Half-Cell Reading (mV)	Ion Content Above Rebar (lbs./c.y.)	Ion Content Below Rebar (lbs./c.y.)	Average Chloride Ion Content (lbs./c.y.)
1	-250	2.1933	1.7646	1.9790
2	-440	1.9378	2.1765	2.0572

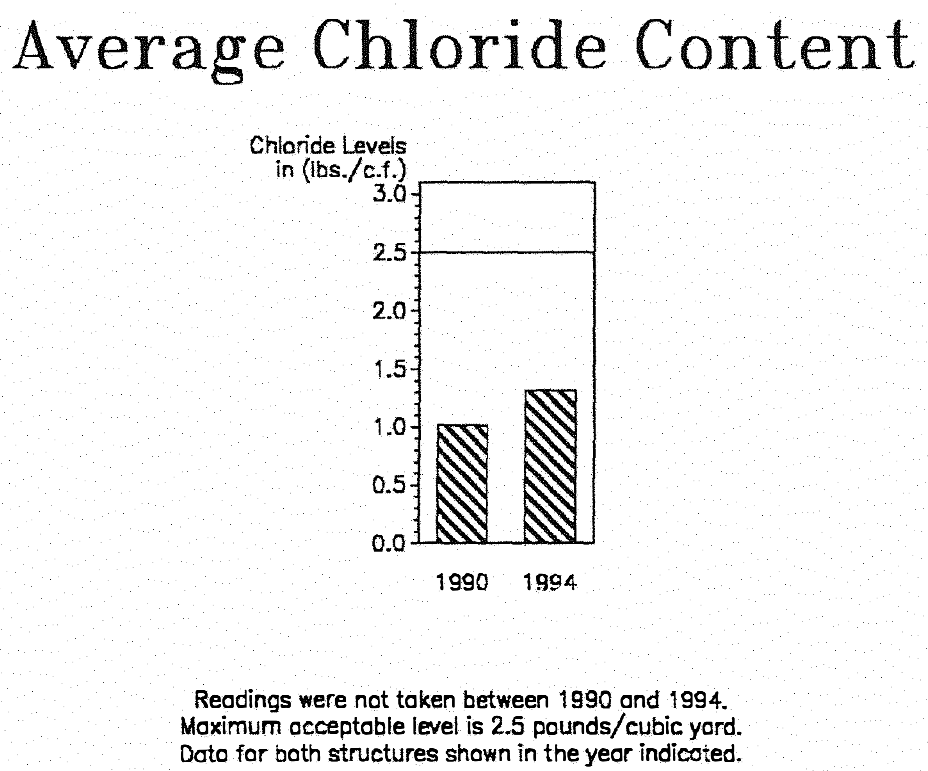

Figure 12. Change in Chloride Levels between 1990 and 1994.

Sample 5 from the north structure had an unusually high chloride ion content reading. Other readings from this deck were well below the maximum acceptable level for chloride contamination. The chloride content results from the south structure were higher than the readings from the north structure; only two samples were taken.

Discussion

It is somewhat difficult to gage changes in the visual condition of the bridge deck with respect to cracking since it is widespread. Many of the cracks were present immediately following reconstruction. Crack surveys would have to be meticulously accurate to determine minor changes in the size of small transverse cracks at the lane edges and new cracks that have developed on the outside lane and shoulder of the bridge. Major differences in the more pronounced cracks and the appearance of high intensity cracks were easy to identify over time.

Less than two percent of both bridge decks surveyed in this study had half-cell readings below -350 mV, the generally accepted standard for deck corrosion. There was a 0.3% increase in corrosion levels between 1990 and 1994. Readings were lower, below -300 mV, near the joints on the deck and higher, above -200 mV, where the outside lanes were widened during reconstruction.

The average chloride ion content for both decks did not exceed the maximum acceptable level for severe chloride contamination. Test results for the north structure were relatively low. The increase in the average chloride ion content of both bridge decks was less than eight kilograms per cubic meter (one-half pound per cubic yard) between the time of the initial test and the most recent test in 1994. While the results from the south structure did not exceed the maximum levels, the chloride content was high; only two samples were taken from this deck.

Conclusions and Recommendations

In the results presented in this text, there does not always seem to be a direct relationship between very low half-cell corrosion readings and very high chloride ion content levels sampled from the deck as expected. One sample from the north bridge deck had results that exceeded the 40 kilograms per cubic meter (2.5 pounds per cubic yard) limit. While this was a rare exception, half-cell readings and visual survey information do not explain the disparity in the results.

There was not a marked difference between chloride and corrosion levels from the northwest section of the north structure that was treated with a silane penetrating sealer and the rest of the bridge deck. Unfortunately, the permeability of the decks was not tested so no information regarding this item can be reported.

In sum, chloride ion content levels were below critical levels for and corrosion levels were less than two percent for each each structure in this evaluation. In this respect, Pyrament performed within acceptable levels for at least four years after application.

The only particularly noticeable problems with this product were associated with the physical appearance. Cracking in both structures was evident. This could have been the result of application techniques, product performance over time, or a combination of two factors. There is no accurate and precise way to measure product performance in this respect.

Currently, Pyrament is not available for commercial use. Lonestar Industries, the manufacturers of Pyrament, is no longer in business. In light of this development, further research on the performance of Pyrament applied to new reconstruction projects is not warranted. Continued monitoring of the structures in this study may yield results that can be compared with other overlay systems; however, it is not advisable for Research Development and Technology Transfer to pursue further investigation of this product with regard to implementation since it is no longer available.

References

Streb, David C. The Construction of a Pyrament Bridge Deck Overlay. Report, Research and Development Division, Oklahoma Department of Transportation, May, 1991.