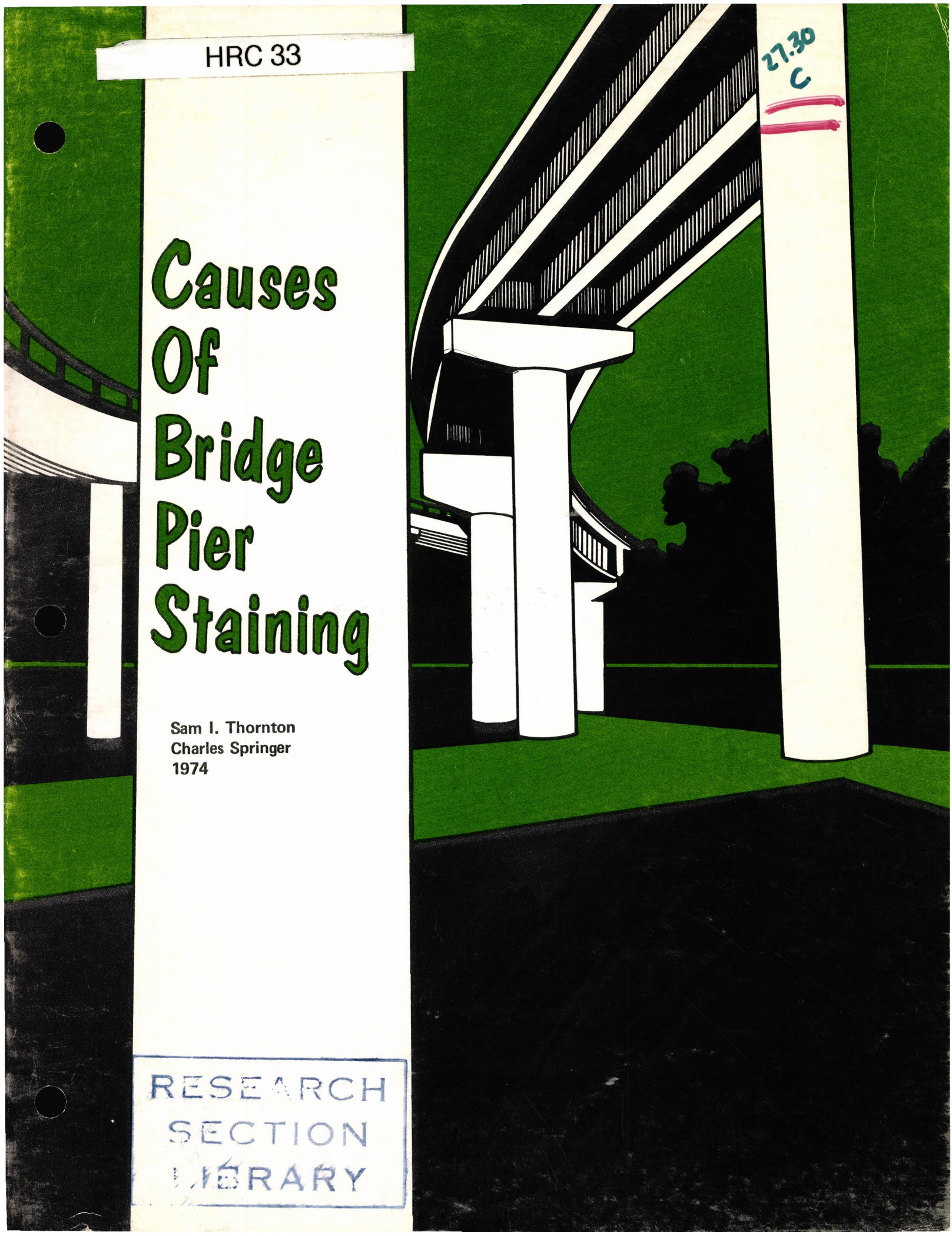
Causes Of Bridge Pier Staining

Sam I. Thornton
Charles Springer
1974



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16. Abstract

Four types of bridge stains exist in Arkansas: Rust stains – those stains directly traceable to rust; Red Stains – broad stains which are not directly traceable to rust; Gray stains – similar to red stains except for color; and graffiti.

Except for graffiti, bridge stains are the result of weathering and runoff from the bridge deck. The stains contain the elements normally found in soil, rust, and tires. Bridge stains in Arkansas cause no significant structural damage, i.e., they do not accompany a deterioration of aggregate.

Red and gray stains, which comprise over three-fourths of all stain on most bridges, can be effectively removed by sandblasting, washing with soap, water and a brush, or application of certain acids then rinsing.

Stains on new structures can be greatly reduced by eliminating or sealing expansion joints above bridge piers.

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CAUSES OF BRIDGE PIER STAINING

by
Sam I. Thornton
Charles Springer

FINAL REPORT
HIGHWAY RESEARCH PROJECT 33

conducted for
The Arkansas State Highway Department
in cooperation with
The U.S. Department of Transportation
Federal Highway Administration

FEBRUARY, 1974

ABSTRACT

Four types of bridge stains exist in Arkansas: Rust stains – those stains directly traceable to rust; Red stains – broad stains which are not directly traceable to rust; Gray stains – similar to red stains except for color; and graffiti.

Except for graffiti, bridge stains are the result of weathering and runoff from the bridge deck. The stains contain the elements normally found in soil, rust, and tires. Bridge stains in Arkansas cause no significant structural damage, i.e., they do not accompany a deterioration of aggregate.

Red and gray stains, which comprise over three-fourths of all stain on most bridges, can be effectively removed by sandblasting, washing with soap, water and a brush, or application of certain acids then rinsing.

Stains on new structures can be greatly reduced by eliminating or sealing expansion joints above bridge piers.

GAINS, FINDINGS, AND CONCLUSIONS

This study shows that most bridge stains are a result of weathering and storm runoff from the bridge deck. Stains, other than graffiti, are composed of the elements which make up road grime, i.e., soil, rubber and rust. Due to their superficial nature, stains cause no significant structural damage to the bridge piers.

Stains on new structures can be greatly reduced by eliminating or sealing the expansion joints above bridge piers. By eliminating runoff, stains (except for graffiti) will be stopped at their sources.

Ninety to ninety-five percent of bridge stains can be removed. Rust stains, however, can only be removed by a time consuming and costly chemical procedure. Graffiti, and sometimes rust stains, can be removed by sandblasting. Sandblasting has the disadvantage of removing part of the concrete matrix. Red and gray stains, which comprise over three-fourths of the stains on most bridges, can be removed by washing with soap, water and a brush, sandblasting, or application of certain acids then rinsing.

IMPLEMENTATION STATEMENT

Bridge pier stains can be effectively prevented by eliminating runoff from the bridge deck to the concrete below. Use of continuous span bridges, placing expansion joints away from the bridge piers, or sealing the joint with the new compressible joint sealers, angle trough drains, or neoprene belt type troughs. New bridge structures should incorporate methods to eliminate runoff over the concrete substructure.

Stains from existing structures can, for the most part, be removed by cleaining. Cleaning will not prevent the stains from recurring, however, unless a method is found to eliminate discharge through the existing expansion joints. For this reason, and because the costs and effectiveness of a regular cleaning program are not known, a pilot bridge cleaning program should be initiated. Information from the pilot study can be used to determine the frequency of a routine cleaning program.

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INTRODUCTION

The pleasing appearance of highway structures, particularly grade separations, is a vital part of highway beautification efforts. A stained or discolored bridge can look old before its time and will give the appearance of being dirty or unkept.

Concrete stains on grade separations, and in some instances damage due to some undefined cause, prompted the Arkansas Highway Department to seek solutions to the problem particularly along Interstate Highways 30, 40 and 55 where most grade separations exist. The objectives sought include the following:

1. To determine the composition of the stain.
2. To determine the origin of the stain.
3. To determine the effects of the stain on the structure.
4. To make recommendations as to methods of remedying and preventing the staining.

ARKANSAS STUDY

In an effort to find solutions to the problem of bridge pier staining, the Arkansas Highway Department in cooperation with the Federal Highway Administration, funded this study. The method of study included a survey of staining problems in other states, classification of the types of stains in Arkansas, determination of the origin, chemical and physical properties of the stains, and evaluation of evidence from testing and attempts to clean bridge piers.

Letter Survey

A letter survey on bridge stains was sent to the other forty-nine states and District of Columbia. The survey asked for experience on composition, origin, effects, and prevention of bridge pier stains. Forty of the states replied but five of the replies reported that they had no information to offer.

The most common reports of stain composition are of iron and salt. Rust was the most common stain but weathering of iron pyrite in aggregate was also reported. Salt from roadway de-icing is reported as the second most common cause of stain.

Stains are also reported from fungus, bird drippings, water borne minerals, petroleum products, dust, clay, marine growth, calcium carbonate, concrete or grout salts, and joint sealants.

Leakage of expansion joints is reported as by far the most common source of stain. Weathering of concrete and paint breakdown were also reported.

Of the respondents to the letter survey, fifteen reported only aesthetic damage and eight reported serious deterioration in some cases. Four of the eight reporting damage listed salt or salt wastes as the cause. From the remaining four, one blamed scaling and spalling, one drainage and one weathering. The other respondent did not list a cause. Most of the remaining respondents considered structural damage as a minor problem only.

Most suggestions to prevent stain or discoloration are to eliminate water through the joints. Designing more effective drainage systems, sealing all joints,and elimination of joints by use of continuous span bridges were all suggested.

Other preventive measures include using waterproof membranes to seal concrete and galvanizing exposed anchor bolts and bearing plates. Where weathering is involved, limiting the amount of iron pyrites and shale in aggregates is suggested.

Only two systems of treating bridges which were already stained were suggested. One suggested removing stains with muratic acid then treating with a 50%–50% solution of boiled linseed oil and mineral spirits. The other respondent suggested either sandblasting and treating the caps with epoxy paint or bi-annual washing of areas and treating with a solution of linseed oil and mineral spirits.

Composition of the Stains

Four general types of concrete stains were found: rust stain, graffiti, red stain, and gray stain (Figure 1). These stain types account for more than 99 percent of all discoloration on bridge piers, aprons and supporting members.

Composition of the stains were determined by chemical and X–ray analysis. Samples of the four stain types were taken by scraping the surface of the stained concrete. Each stain type was tested (except graffiti) by X–ray analysis, qualitative chemical tests, and combustion.

Rust stains are those stains which are directly traceable to metal rust. For example, the stains which are found under the columns of Corten steel or below exposed reinforcing steel. As expected, rust stains contained iron compounds and were the familiar burned red or rust color.

Graffiti stains are mostly paint stains from pressurized cans.

Rust

Graffiti

Gray

Red

Figure 1. Types of Stain

Origin of the Stain

Rust stains, by the way they were identified, are a result of rusting from steel in the bridge structure. Rust stains occured at the anchor bolts, bridge expansion joints, bridge piers, and on the apron at the end of bridges. Several examples of rust stains which occured before the bridge deck was placed were found on concrete aprons. Almost all of the rust stains on bridges were below places on the bridge which are difficult if not impossible to paint.

Red and gray stains are the result of weathering and surface runoff. The stains occur in areas where runoff from the bridges wets the concrete surfaces. In addition, The composition of the stains, i.e. iron, silica, aluminum, sulfur, indicate that soil and road grime are the origin. The presence of sulfur is not surprising because it is used in the manufacture of tires (1 to 1½% by weight) and occurs naturally in asphalts (usually less than 1% by weight). Inspection trips during and just after showers confirmed that areas of red and gray stains are wet by surface runoff.

Graffiti is the result of vandalism. Graffiti's origin, therefore, is people. Graffiti stain, therefore, can best be controlled by a sense of public responsibility.

Extent of the Stain

In order to determine the extent of bridge staining, inspection trips were made in the fall of 1973. All the bridges along Interstate Highway I–30, I–40 and I–55 were included.

Generally, stains on bridge columns, aprons, bents and superstructure averaged ten to thirty percent of the total area but varied between almost no stain to eighty percent of the total area.

Appendix B is a compilation of the survey. Stains are listed by stain type, i.e. gray, red, rust or graffiti, and location. For example, the approximate amount of gray stain on columns of the I–40 bridge at log mile 4.42 on I–55 in Crittenden County was 10% of the surface area. No rust, red or graffiti stains are reported on these columns.

Effects of the Stains on Structures

No significant structural damage as a result of stains was found on Arkansas bridges during the inspection trips. Stains were superficial and did not penetrate the concrete or accompany a deterioration of aggregate.

A small amount of deterioration was present, however, above the rust stains. Rocker arms, anchor bolts and bearing plates were the most frequent cause of rust stains.

Cleaning

Once the stains were classified as rust, graffiti, red or gray, and their composition was determined, various cleaning methods and agents were tried. Several

cleaning agents and methods were tried on a one square foot area to test their effectiveness.

Graffiti and rust stains were very difficult to remove. Sandblasting is an effective method of stain removal but has the disadvantage of removing part of the concrete. When repeated often, sandblasting removes the concrete matrix. Derrington, Stowe and Miller in the Corps of Engineers paper C–68–8, "Investigation of Methods for Removing Stains from Mortar and Concrete" recommend using sodium citrate–sodium hydrosulfite for removing iron stains. Details of this method are included in Appendix C. The method, however, is expensive and time consuming.

Red and gray stains were relatively easy to remove in the initial test sections. Application of commercial alkaline detergents and moderate mechanical action removed almost all of the stain in the one square foot test area. Dry brushing and rinsing also removed most of the deposit.

Because red and gray stains comprise over three-fourths of the stain on most bridges and they were relatively easy to remove, a field test using a cleaning agent, water, and mechanical action or combination of these was made. The Seventh Street overpass of I–40 in North Little Rock was selected because it was extensively stained with red and gray stains and it could be cleaned from Seventh Street where only low velocity, low volume traffic existed.

The most effective method of cleaning the I–40 bridge combined the use of mechanical action with a brush, cleaning agent, and rinse water. An estimated 95 percent of the stain was removed this way. Use of mechanical action alone removed

approximately 60 percent of the stain. A sprayed application of soap, rinsed 5 minutes later removed only 20 percent of the stain.

Application of one commercial cleaning agent to the I—40 bridge, then rinsing, also removed 90—95 percent of the stain. Cleaning was accomplished with or without broom brushing. The cleaning agent (Removox—a product of I. Schneid, Inc., Atlanta, Ga.) is a mixture of hydrochloric acid, gluconic acid, 9—10 molar ethylene oxide nonionic, 12—15 molar ethylene oxide nonionic, and an inhibitor. This cleaning agent, because of the acid it contains, also removes some of the concrete matrix.

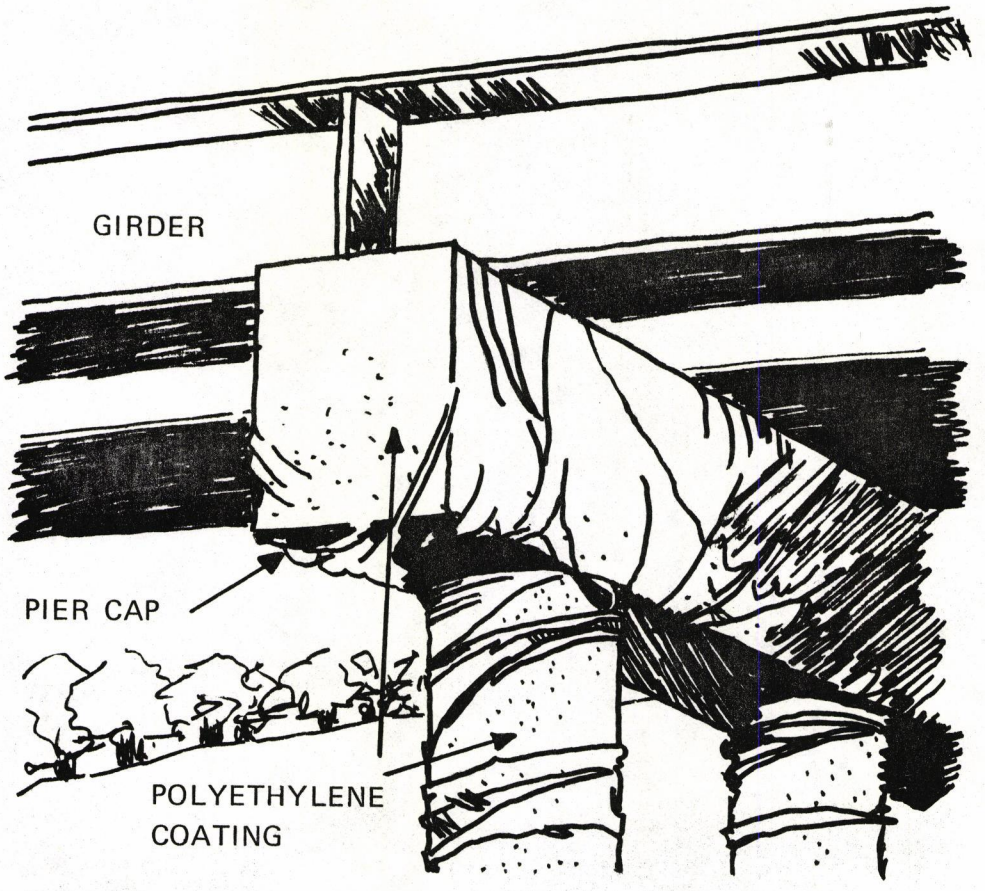
Prevention of Stains

Prevention of stains, other than graffiti, is accomplished by keeping the water off of the concrete. The most effective of methods is the use of continuous span bridges or to place the expansion joint away from the bridge piers. Elimination of expansion joints over bridge piers, however, is not always economical.

Coatings and sealers are effective in prevention of stains over short periods of time (Figure 2). Polyethylene and vinyl can effectively prevent stains during the construction period before the bridge deck is poured. With time, coatings and sealers break down and expose the concrete to stains.

A sloping abutment with drain (Figure 3) is effective for eliminating stains from the bridge ends. Drip pans, also shown in Figure 3, are only moderately successful because wind which accompanies the storms will blow water on the bridge piers.

Expansion joints between sections of bridges can effectively be sealed in one of three ways (Figure 4). Where expansions are large, as in the finger type joints, the



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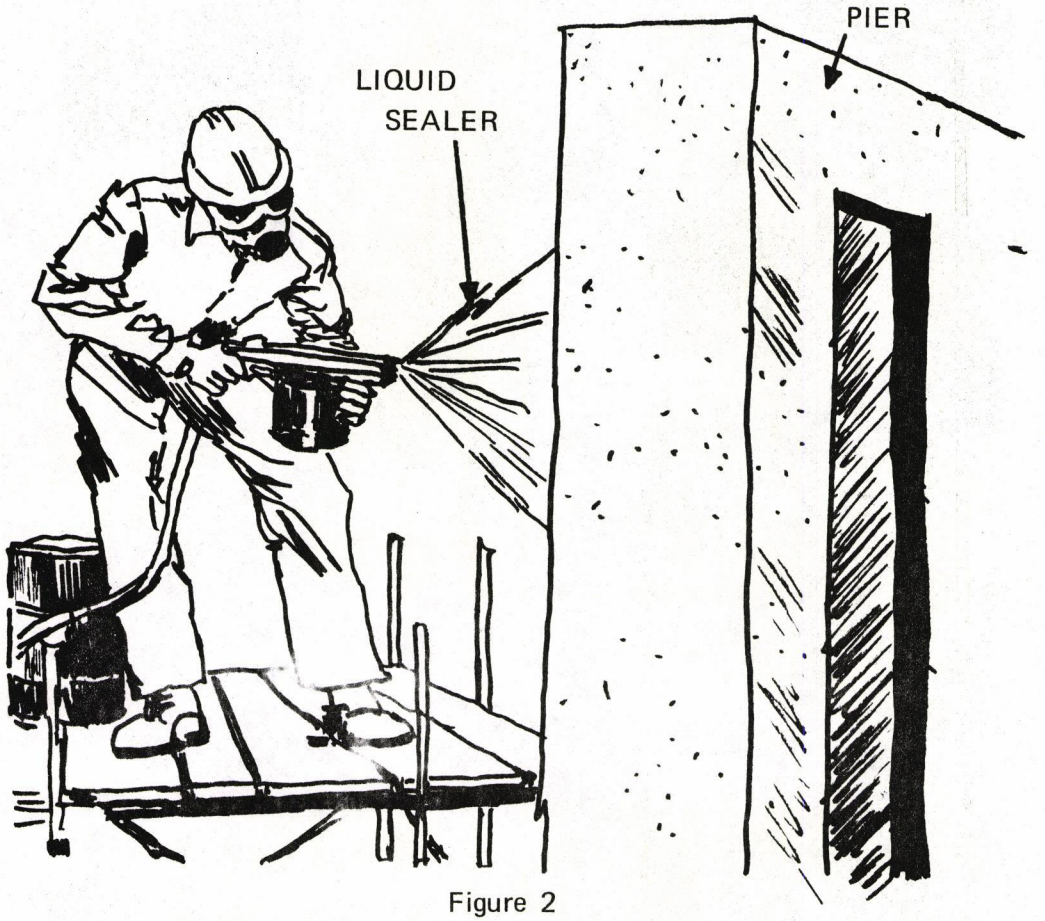

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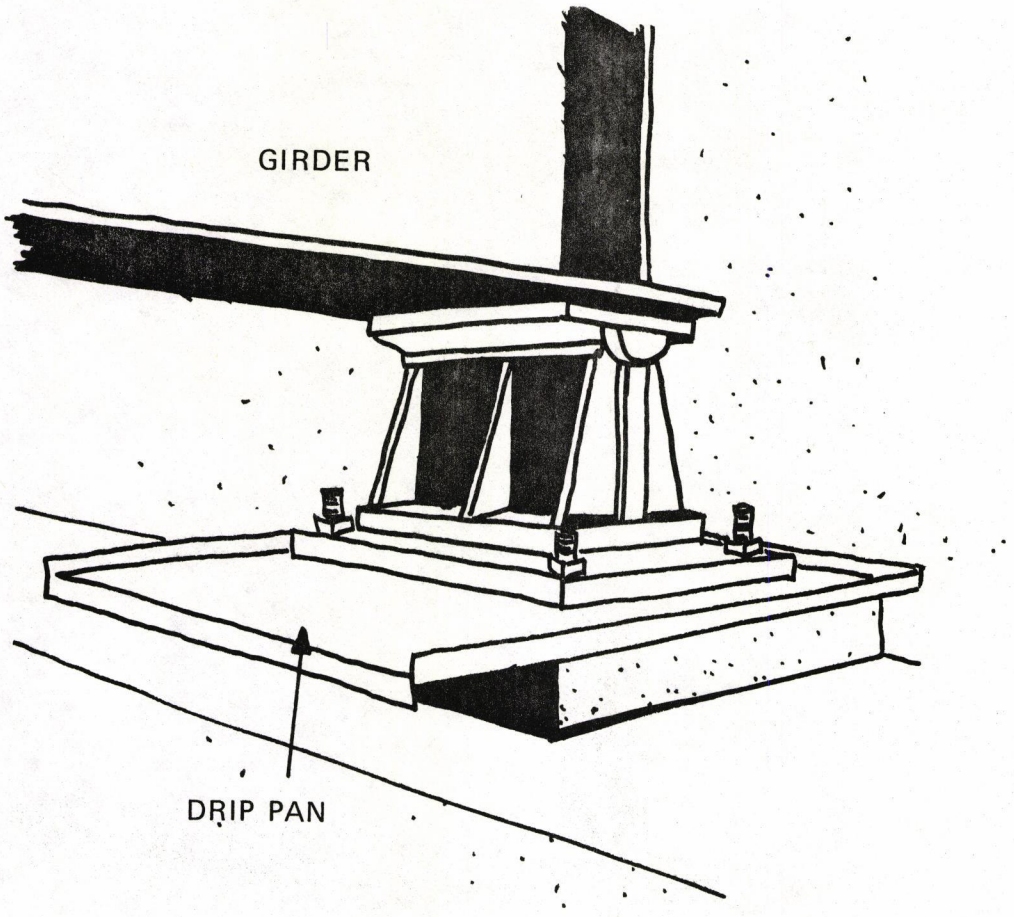
Figure 2



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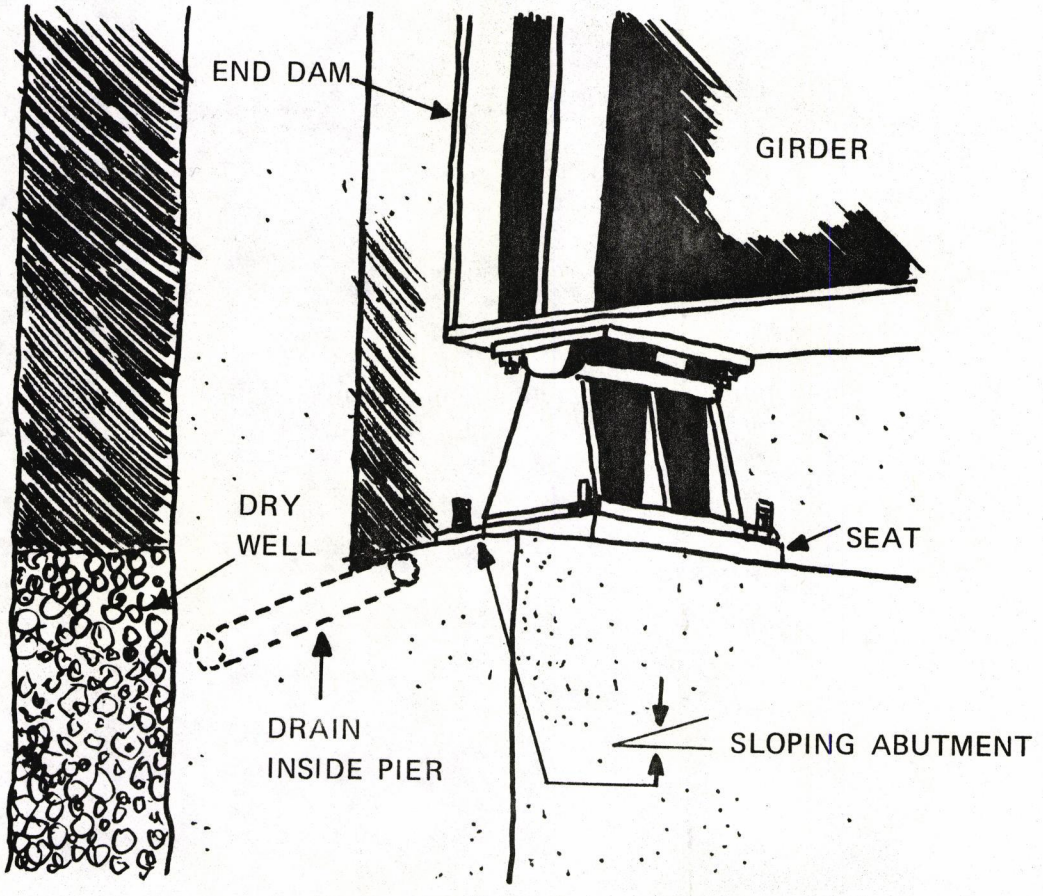

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Figure 3

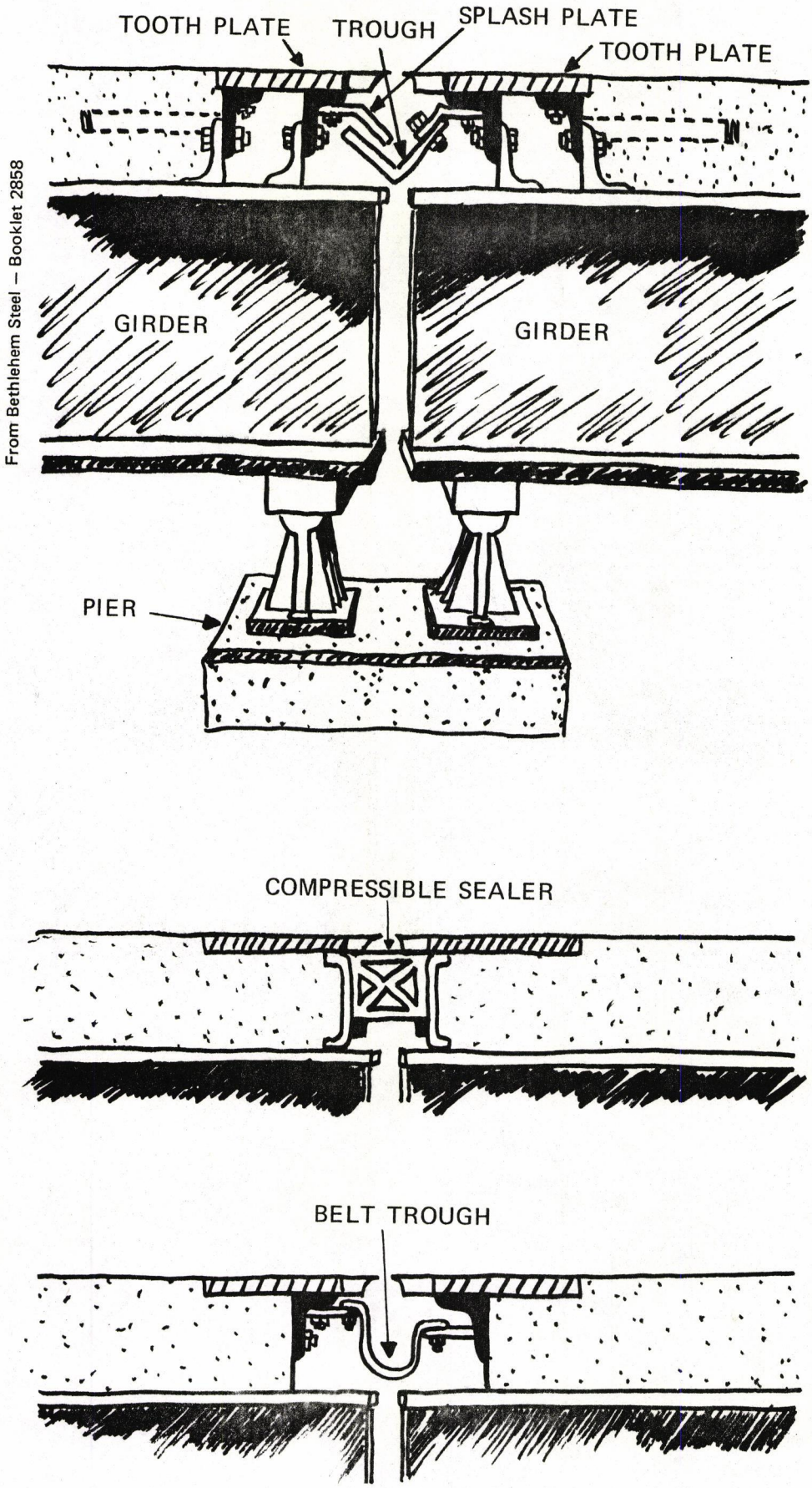

TOOTH PLATE
TROUGH
SPLASH PLATE
TOOTH PLATE
From Bethlehem Steel – Booklet 2858
GIRDER
GIRDER
PIER
COMPRESSIBLE SEALER
BELT TROUGH

Figure 4

neoprene or conveyor belt type trough is effective. Care must be taken, however, that the belt type trough has sufficient room to flex so it will not become clogged. Intermediate movements can be absorbed with the angle troughs and still remove water which passes the joint. Small expansions can be absorbed with the compressible block type joint sealers. Compressible joint sealers must be installed with care or leaks will develop.

CONCLUSIONS

1. Except for graffiti, bridge pier stains contain the elements found in soil, iron rust and tires.
2. Stains on bridges in Arkansas were not damaging to the structures.
3. The natural stains, i.e. all stains except graffiti, were the result of weathering and surface runoff.
4. Natural stains, other than rust stains, can be effectively removed by sandblasting, washing with soap, water and a brush, or application of certain acids then rinsing. These stains will recur, however, unless their source is stopped.
5. Bridge pier stains can be greatly reduced by preventing rainfall runoff from reaching the concrete below the bridge deck.

RECOMMENDATIONS

1. Incorporate in the design of all new bridge structures a method to drain surface runoff away from the exposed concrete substructure.
2. Initiate a pilot bridge cleaning program within the Arkansas Highway Department of 5 to 10 bridges in order to evaluate the costs, effectiveness and benefits of a regular cleaning program.

APPENDIX A

The material in Appendix A is a summary of the scanning electron microscope and X–ray examination of red and dark gray stains at the I–40 and I–55 intersection in West Memphis. Micrographs and X–ray patterns for both red and gray stains were similar. For this reason, only results from the red stain are included.

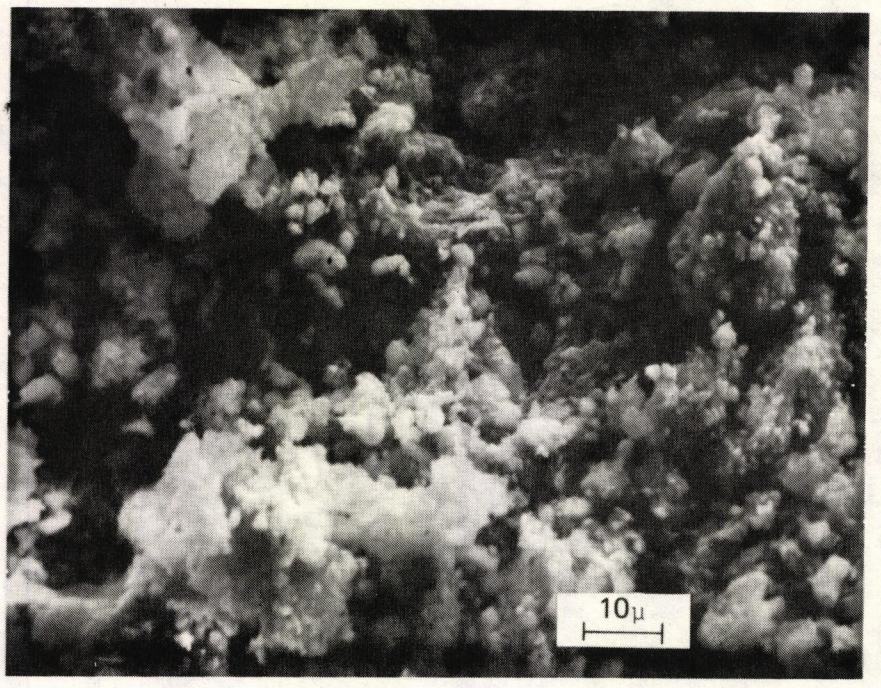
Samples were taken by scraping the stained surface of the bridge piers. The micrographs, therefore, contain stained concrete particles in the sand and silt size range and X–rays reveal those elements normally found in concrete as well as the possible source of stain.

Two micrographs taken at 1000 power of representive samples are shown in Figure A–1. The samples are coated with a thin coat of gold, a conductive metal, to give better pictures.

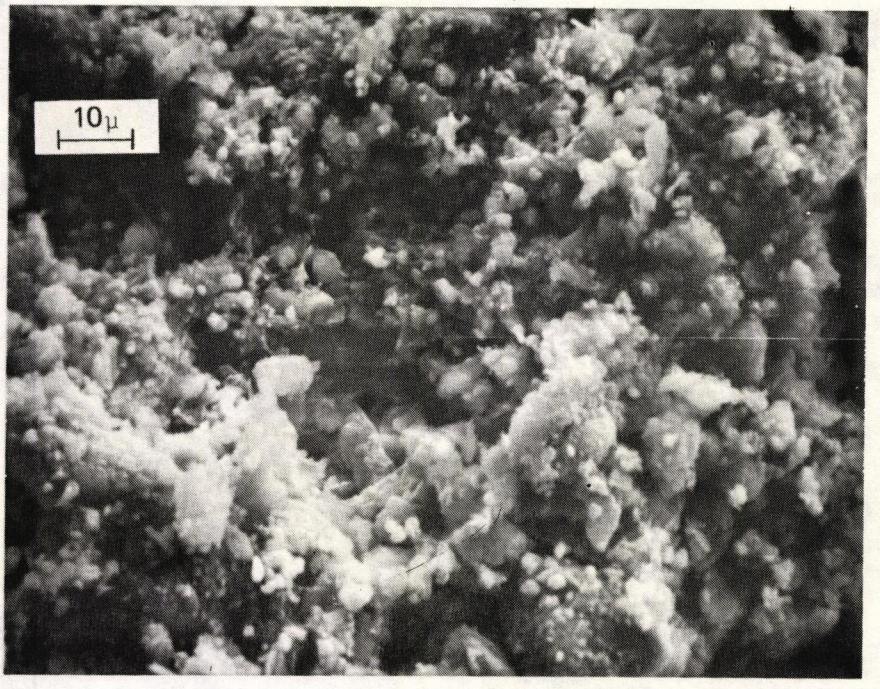
Figure A–2, like Figure A–1, contains micrographs of the samples except that they are not coated with gold in order thay they might be subjected to X-ray examination. In addition, the micrographs are at 500 and 2000 power in Figure A–2 (a) and A–2 (b) respectively.

X–ray analyses, comparing the relative intensity of X–ray with energy in Kev is shown in Figures A–3 and A–4.

Iron, Sulfur and Potassium are the elements found which might be stain related. Aluminum, Silica, and Calcium were also found but are common in concrete.

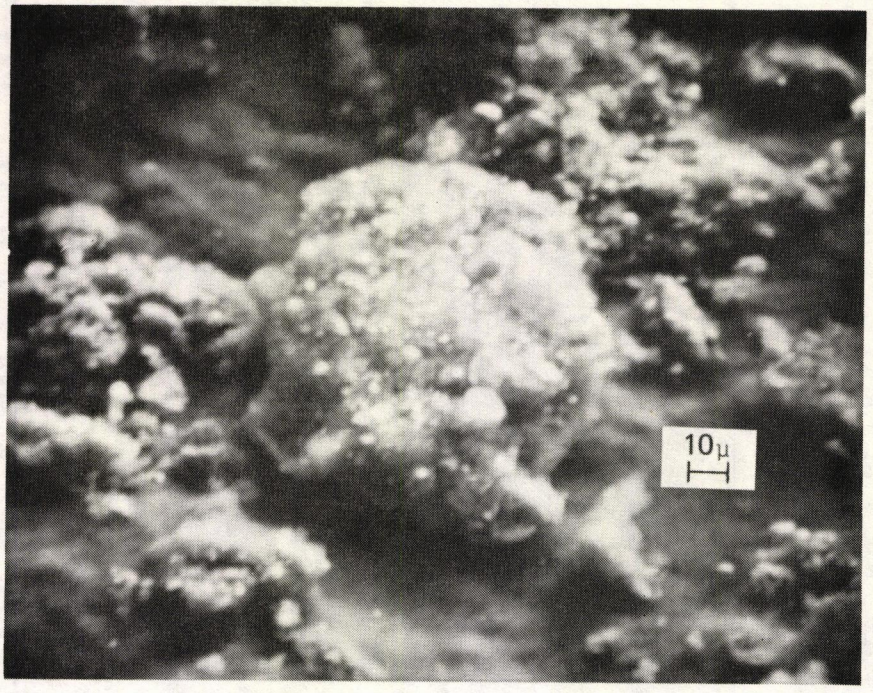


1,000X



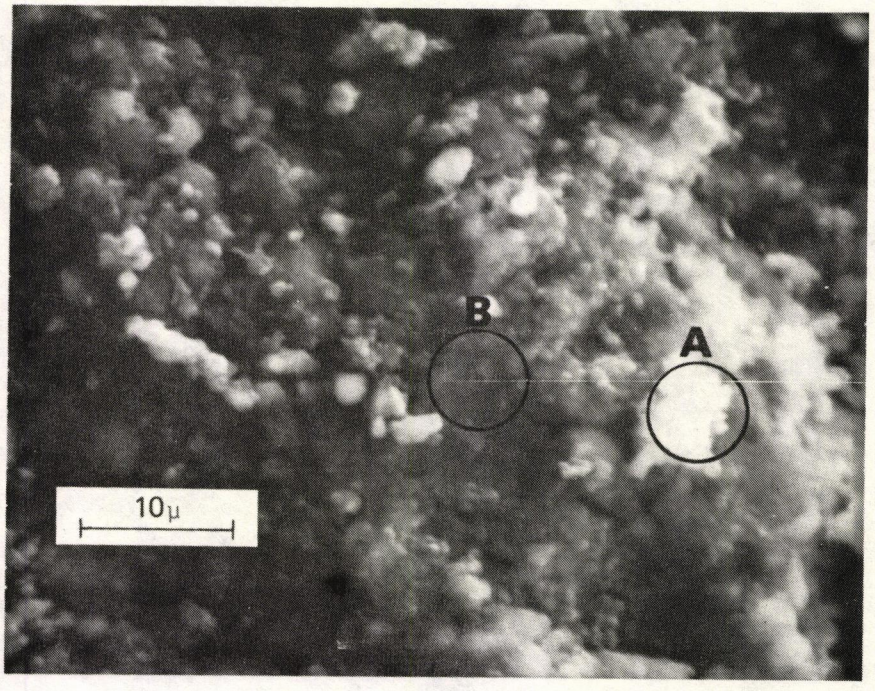
1000X

Figure A–1



500X

Figure A–2 (a)



2000X

Figure A–2 (b)

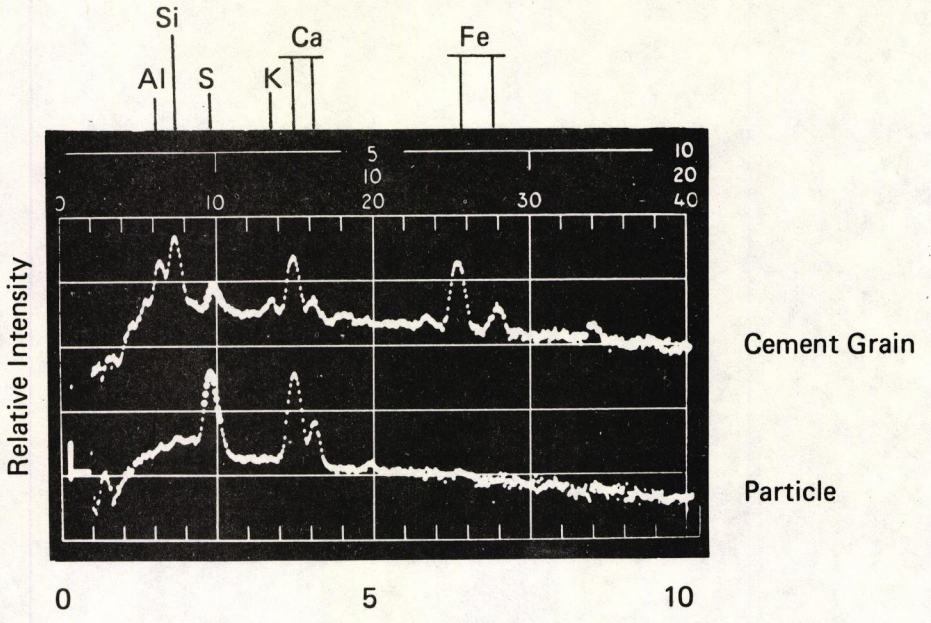


Figure A–3 (a)

Comparison of the X–rays gathered from a "cement grain" and a small particle on the surface of the same grain.

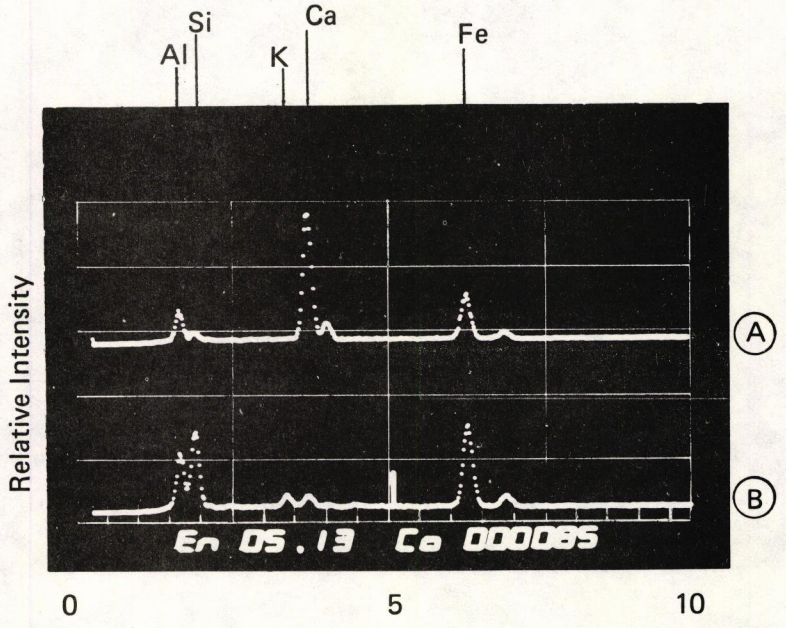


Figure A–3 (b)

Analysis from areas A and B shown in Figure A–2 (b).

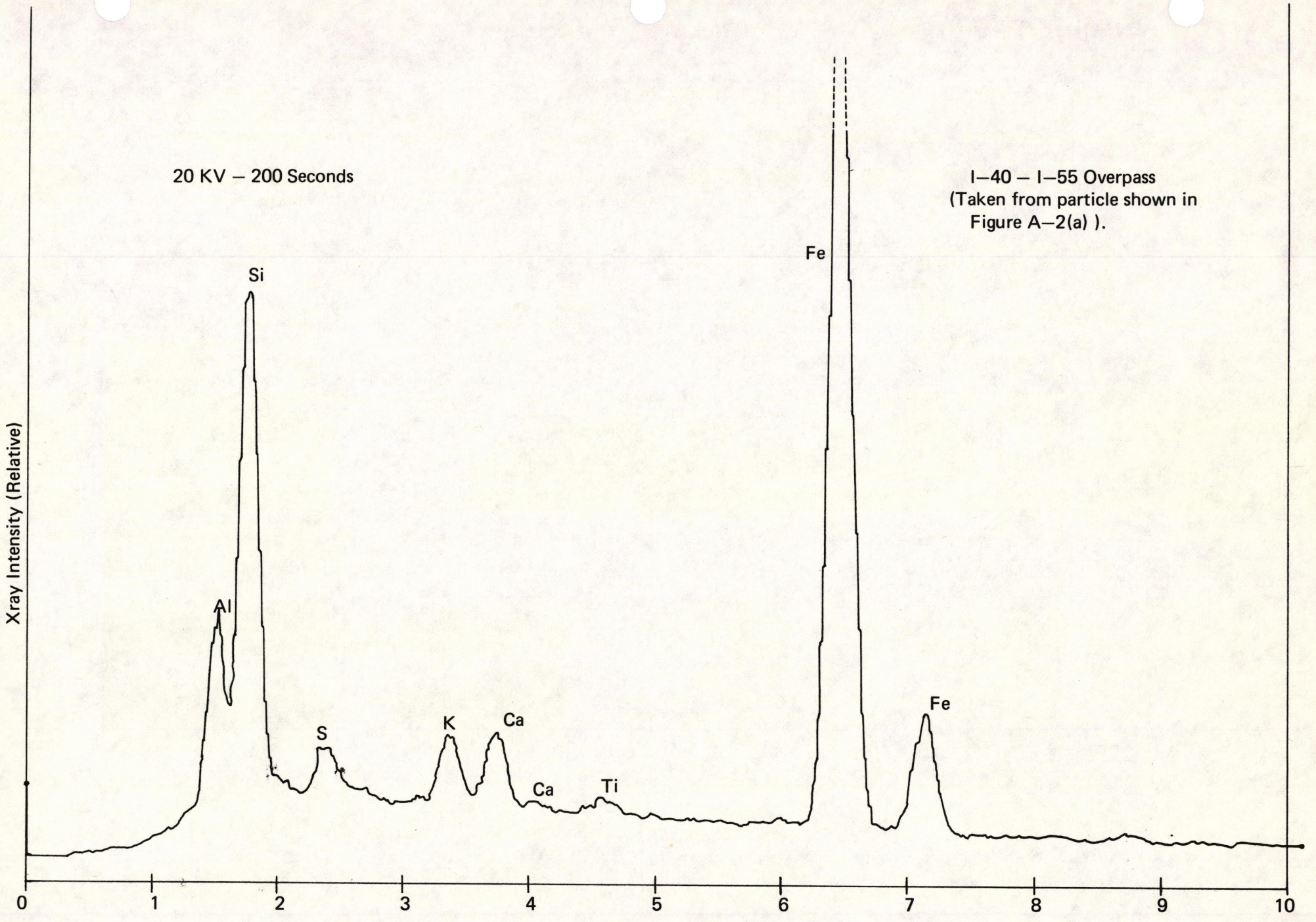


Figure A–4 – X–ray Microprobe Spectrum

APPENDIX B

The material in Appendix B is an evaluation of the extent of stain on overpasses along Interstate Highways 30, 40, and 55. The bridges are listed by log mile along the Interstate and discribed by the route crossing and bridge type.

Stains are listed by stain type, i.e. gray, red, or rust, and location. For example, the approximate amount of gray stain on columns at the I-40 bridge at log mile 4.42 on Interstate 55 in Crittenden County is 10% of the surface area. No rust, red, or graffiti stain is reported on these columns. Total stain is the % of area stained, not necessarily the sum of red, gray, rust, and graffiti stains (overlaping excluded).

The inspection trips, from which this appendix is formed, were made in the fall of 1973.

HIGHWAY: INTERSTATE 30

DESCRIPTION				STAIN TYPE				TOTAL	
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti	STAIN	COMMENTS
		MILLER COUNTY							
0.0	Continuous	US 71	Superstructure	5%	10%			10%	Rust on flange from side drainage
			Bent						
			Column			10%		10%	
			Apron	*20%		*20%		30%	
2.12	I Beam	Bypass	Superstructure	5%				5%	
		IC	Bent	*10%	*20%			20%	
		SH 245	Column	5%	20%			20%	
			Apron			5%		5%	
4.33	I Beam	Sugar	Superstructure						Clay on bottom of concrete barrier walls protecting piers
		Hill	Bent	*20%	*10%			25%	
			Column		*10%	*15%		20%	
			Apron			10%		10%	
6.51	I Beam	SH 108	Superstructure						
			Bent		15%			15%	
			Column		10%			10%	
			Apron	5%		30%		30%	
7.98	I Beam	County	Superstructure						
		Road	Bent		5%	20%		25%	
			Column		*10%	*10%		10%	
			Apron	5%				5%	
9.87	I Beam	County	Superstructure	5%		5%		10%	Small spawling on columns
		Road	Bent		*10%	*10%		15%	
			Column						
			Apron	5%				5%	
13.86	I Beam	County	Superstructure						Rebars exposed, bottom of bent
		Road	Bent		5%			5%	
			Column	30%				30%	
			Apron			30%		30%	

* Overlapping Stains

General Note: Approcimately 95% of all Over Passes had a small amount of gray stain directly beneath each guardrail support. This stain was on the concrete portion of the superstructure.

HIGHWAY: INTERSTATE 30

DESCRIPTION				STAIN TYPE				TOTAL	
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti	STAIN	COMMENTS
		HEMPSTEAD COUNTY							
17.79	I Beam	Red Lake IC	Superstructure						Rebars on bent & column exposed
			Bent	*15%	*20%			30%	
			Column		10%			10%	
			Apron	*20%		*70%		70%	
19.95	I Beam	County	Superstructure	* 5%	*10%			10%	Rebars exposed bottom of bent
			Bent	5%	5%			10%	
			Column		5%			5%	
			Apron			20%		20%	
22.24	I Beam	FAS 1672	Superstructure						
			Bent			5%		5%	
			Column			5%		5%	
			Apron			30%		30%	
25.26	I Beam	SH 353	Superstructure						Very badly exposed rebars on bottom of pier
			Bent	*15%		*30%		40%	
			Column	5%		20%		20%	
			Apron		5%			5%	
28.19	I Beam	County Road	Superstructure	5%				5%	Same as above
			Bent		* 5%	*10%		10%	
			Column			10%		10%	
			Apron	10%		5%		15%	
28.63	I Beam	FAS 1672	Superstructure						
			Bent	15%		10%		25%	
			Column	15%		5%		20%	
			Apron	5%		5%		10%	
29.99	I Beam	SH 4 @ Hope	Superstructure						A few rebars in bent (side) exposed
			Bent	*15%	* 5%	* 5%		20%	
			Column	20%				20%	
			Apron	*30%		*10%		30%	

* Overlapping Stains

HIGHWAY: INTERSTATE 30

DESCRIPTION				STAIN TYPE				TOTAL	
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti	STAIN	COMMENTS
32.31	Girder	Deann Gr.	Superstructure						
		S.	Bent	5%		5%		10%	
			Column			5%		5%	
			Apron	*20%		*80%	5%	80%	
36.34	Girder	Emmett	Superstructure						
		I.C.	Bent	10%		5%		15%	
			Column	5%		5%		10%	
			Apron	*20%		*40%		50%	
39.34	Continuous	County	Superstructure						
			Bent	5%	5%			10%	Grass on apron
			Column						
			Apron			5%		5%	
	NEVADA COUNTY								
40.77	Continuous	County	Superstructure						
			Bent	5%		10%		15%	
			Column			5%		5%	
			Apron			20%		20%	
42.46	Girder	County	Superstructure						
			Bent	*15%	* 5%	* 5%		20%	
			Column	*10%		* 5%		10%	
			Apron			30%		30%	
43.95	Girder	SH 24	Superstructure						
			Bent	10%		5%		15%	
			Column	10%				10%	
			Apron						
44.57	RR Girder	RR	Superstructure						
			Bent	*20%	*20%			30%	
			Column		15%			15%	
			Apron	20%		20%		40%	

* Overlapping Stains

HIGHWAY: INTERSTATE 30

DESCRIPTION				STAIN TYPE				TOTAL	
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti	STAIN	COMMENTS
46.14	Continuous	SH 19	Superstructure		10%			10%	Rusting under point on flange under drain
			Bent	* 5%		*10%		10%	
			Column						
			Apron			20%		20%	
47.93	I Beam	Nubbin H.G.S.	Superstructure						
			Bent		5%			5%	
			Column						
			Apron	5%		20%		25%	
51.28	I Beam	Bought on G.S.	Superstructure	5%			5%	10%	
			Bent			5%		5%	
			Column			5%	5%	10%	
			Apron	*10%		*20%	* 5%	30%	
	CLARK COUNTY								
53.67	I Beam	SH 51	Superstructure	5%				5%	Rebars exposed on bottom of bent
			Bent	*15%	*15%			25%	
			Column		5%			5%	
			Apron	*10%		*30%	* 5%	40%	
60.59	I Beam	FAS 1571	Superstructure		5%			5%	Rust on flange Rebars on bottom exposed
			Bent		* 5%	*10%		10%	
			Column			10%		10%	
			Apron	*30%		*10%		35%	
62.84	I Beam	SH 53	Superstructure						
			Bent	*15%		*20%		30%	
			Column	* 5%		*20%		20%	
			Apron	*10%		*10%		15%	
65.10	I Beam	County	Superstructure	5%			5%	5%	Stain on flange under drain
			Bent	20%	15%	10%		45%	
			Column	*30%	*15%	*15%		50%	
			Apron	*10%		*25%		30%	

* Overlapping Stains

HIGHWAY: INTERSTATE 30

DESCRIPTION				STAIN TYPE				TOTAL	
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti	STAIN	COMMENTS
69.27	I Beam	SH 26	Superstructure	5%				5%	Rebars exposed on side of bent
			Bent	*15%	* 5%			15%	
			Column	5%				5%	
			Apron	10%				10%	
70.77	I Beam	County Road	Superstructure	5%				5%	Stains on I Beam under drains
			Bent	10%	5%			15%	
			Column			5%	5%	10%	
			Apron	5%			5%	10%	
72.86	I Beam	SH 8 & SH 51	Superstructure						Same as above
			Bent	*15%	* 5%	*10%		25%	
			Column	10%		10%		20%	
			Apron	*20%		* 5%		20%	
74.59	I Beam	FAS 1576	Superstructure						Same as above
			Bent	5%		5%		10%	
			Column	5%				5%	
			Apron	5%		10%		15%	
76.64	I Beam	County Road	Superstructure						
			Bent	5%		10%		15%	
			Column			10%		10%	
			Apron			10%	5%	15%	
	HOT SPRINGS COUNTY								
82.59	I Beam	SH 283	Superstructure						No aprons
			Bent	10%		5%		15%	
			Column	10%				10%	
			Apron						
87.32	I Beam	Carrol Road	Superstructure						Snail slime on barrier
			Bent	10%	5%			15%	
			Column	5%				5%	
			Apron			5%		5%	

* Overlapping Stains

HIGHWAY: INTERSTATE 30

DESCRIPTION				STAIN TYPE				TOTAL	
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti	STAIN	COMMENTS
91.11	I Beam	Old SH 84	Superstructure						
			Bent		* 5%	*20%		20%	
			Column			*20%	* 5%	20%	
			Apron			5%	5%	10%	
92.75	I Beam	County Road	Superstructure						
			Bent	5%		20%		25%	
			Column			20%		20%	
			Apron			5%		5%	
96.69	I Beam	SH 84	Superstructure						
			Bent	*10%	* 5%	*30%		40%	
			Column	* 5%		*40%		40%	
			Apron			30%		30%	
97.98	Concrete I	US 270	Superstructure						Algae on barrier wall spalling of concrete
			Bent	*40%	* 5%	* 5%		45%	
			Column	40%				40%	
			Apron	5%				5%	
98.86	Girder	URI & P	Superstructure						Paint on girder peeling
			Bent						
			Column	15%	5%			20%	
			Apron			5%		5%	
100.22	I Beam	County Road	Superstructure	15%				15%	Stain & rust below drain
			Bent	* 5%	* 5%	* 5%		10%	
			Column			5%		5%	
			Apron	20%				20%	
101.80	I Beam	County Road	Superstructure						
			Bent			5%		5%	
			Column			5%		5%	
			Apron	5%			5%	5%	
SALINE COUNTY									

* Overlapping Stains

HIGHWAY: INTERSTATE 30

DESCRIPTION				STAIN TYPE				TOTAL	
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti	STAIN	COMMENTS
106.35	I Beam	Military Road	Superstructure		10%			10%	I beams rusting
			Bent	*40%	* 5%	* 5%		40%	
			Column	40%				40%	
			Apron	10%				10%	
108.47	I Beam	County Road	Superstructure				5%	5%	
			Bent	10%				10%	
			Column			5%		5%	
			Apron		5%		10%	15%	
110.1	I Beam	County Road	Superstructure						Steel stains
			Bent	10%				10%	Rebars bottom of
			Column	10%				10%	bent
			Apron	10%		5%		15%	
115.82	I Beam	Sevier Street	Superstructure		5%			5%	Same as above
			Bent	* 5%	*10%	* 5%		15%	
			Column	5%				5%	
			Apron	20%				20%	
116.69	I Beam	Carpenter	Superstructure	10%				10%	
			Bent	*50%	*10%	* 5%		50%	
			Column	*35%	*10%	* 5%		35%	
			Apron	10%				10%	
118.31	I Beam	Congo Road	Superstructure	10%				10%	Concrete spalling.
			Bent	50%	10%			60%	Rebars exposed
			Column	20%	10%	30%		50%	bottom bent
			Apron	10%				10%	
120.65	I Beam	Alcoa Road	Superstructure	10%				10%	Repainted steel
			Bent	*10%	* 5%	* 5%		15%	
			Column	10%				10%	
			Apron	10%		10%		15%	
122.96	I Beam	SH 183	Superstructure	10%				10%	Rebars exposed
			Bent	30%	5%	15%		35%	bottom of bent
			Column	25%		15%		35%	No Apron (Dirt
			Apron						& Grass)

* Overlapping Stains

HIGHWAY: INTERSTATE 30

DESCRIPTION				STAIN TYPE				TOTAL	
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti	STAIN	COMMENTS
		PULASKI COUNTY							
126.35	Concrete	SH 111	Superstructure	15%				15%	Rebars exposed side of bent Steel repainted
			Bent	*20%	* 5%	* 5%		20%	
			Column	20%	5%			25%	
			Apron	*15%		*30%		35%	
128.63	I Beam	Mablevale I.C.	Superstructure	10%				10%	Spalling on bent
			Bent	20%	5%	5%		25%	No apron
			Column	25%		5%		25%	Rebars exposed on bent
			Apron				5%	15%	
130.42	I Beam	SH 338	Superstructure	15%				15%	
			Bent	*15%	*10%			20%	
			Column	15%				15%	
			Apron			15%		15%	
133.46	I Beam	Stanton Road	Superstructure	5%				5%	Rebars on bottom exposed
			Bent	10%	10%			15%	
			Column	10%				10%	
			Apron			10%		10%	
134.22	I Beam	Scot Hamilton	Superstructure	5%				5%	Rebars in bottom exposed
			Bent	10%	5%			10%	
			Column	*10%	* 5%	* 5%		15%	
			Apron	10%		20%		30%	
137.80	I Beam	W. Leg US 65	Superstructure	10%				10%	
			Bent	*20%	* 5%			20%	
			Column	*20%	* 5%			20%	
			Apron	10%				10%	
137.98	I Beam	N.S. Leg US 65	Superstructure	10%				10%	
			Bent	15%	5%			20%	
			Column	*15%	* 5%			15%	
			Apron	10%				10%	

* Overlapping Stains

HIGHWAY: INTERSTATE 30

DESCRIPTION				STAIN TYPE				TOTAL	
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti	STAIN	COMMENTS
139.24	I Beam	21st St.	Superstructure	10%				10%	
			Bent	*10%	* 5%			10%	
			Column	5%	5%			5%	
			Apron	5%				5%	
139.67	I Beam	14th St.	Superstructure	10%				10%	
			Bent	15%				15%	
			Column	*15%	*10%			20%	
			Apron	10%				10%	
140.04	I Beam	9th St.	Superstructure	10%				10%	Felt falling down
			Bent	20%	5%			25%	from expansion
			Column	10%				10%	joint
			Apron	5%				5%	
140.21	I Beam	6th St.	Superstructure	10%				10%	Same as above
			Bent	*30%	* 5%			30%	
			Column	25%				25%	
			Apron	20%				20%	
142.54	I Beam	I 40	Superstructure	5%	5%			10%	Rust on flange
			Bent	25%				25%	
			Column	20%				20%	
			Apron	10%				10%	
			Superstructure						
			Bent						
			Column						
			Apron						
			Superstructure						
			Bent						
			Column						
			Apron						
			Superstructure						
			Bent						
			Column						
			Apron						

* Overlapping Stains

HIGHWAY: INTERSTATE 40

DESCRIPTION				STAIN TYPE				TOTAL	
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti	STAIN	COMMENTS
		CRAWFORD COUNTY							
0.05	I Beam	Dora Road	Superstructure		10%		5%	15%	
			Bent			90%		90%	
			Column			90%	5%	95%	
			Apron			30%		30%	
3.13	I Beam	2212	Superstructure						
			Bent			80%		80%	
			Column			75%		75%	
			Apron						
6.12	I Beam	County Road	Superstructure						6 span 5 column
			Bent	*15%		*60%		80%	Paint stains on bottom of deck (orange)
			Column			60%		60%	
			Apron						
7.38	Concrete	1540	Superstructure						
			Bent	*20%	*10%	*50%		65%	
			Column			50%		50%	
			Apron						
7.40	I Beam	1540	Superstructure						
			Bent	*15%	*10%	*50%		70%	
			Column		5%	50%		55%	
			Apron						
7.97	Concrete	SH 282	Superstructure						
			Bent	*30%		*80%		90%	
			Column	5%		80%		80%	
			Apron						
9.31	I Beam	Crawford County	Superstructure						One Column gray (80%)
			Bent	*30%		*20%		40%	
			Column	*40%		*10%		45%	
			Apron			5%		5%	

* Overlapping Stains

General Note: Approximately 95% of all Over Passes had a small amount of gray stain directly beneath each guardrail support. This stain was on the concrete portion of the superstructure.

HIGHWAY: INTERSTATE 40

DESCRIPTION				STAIN TYPE				TOTAL	
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti	STAIN	COMMENTS
10.96	I Beam	West Rudy Road	Superstructure						
			Bent	*20%		*30%		45%	
			Column	*10%		*20%		25%	
			Apron			80%		80%	
12.66	I Beam	East Rudy Road	Superstructure						
			Bent	*20%		*30%		45%	
			Column	*20%		*25%		40%	
			Apron						
13.61	I Beam	Mt. Grove Road	Superstructure	5%				5%	Note: Deck drained thru sides of concrete super-structure. No gray
			Bent		10%	30%		40%	
			Column			30%		30%	
			Apron	5%				5%	
15.86	I Beam	Crawford County Road	Superstructure		5%			5%	Rebars rusting
			Bent	20%		20%		40%	
			Column	10%		20%		30%	
			Apron						
17.90	I Beam	Dyer G. S.	Superstructure						Hwy Dept. painted over graffiti
			Bent	10%	5%	40%		55%	
			Column			40%	10%	50%	
			Apron			*20%	*20%	40%	
20.05	I Beam	Georgia Ridge Road	Superstructure	20%	10%			30%	Rust bottom para pet walls; rebars sticking out
			Bent	*80%	* 5%	*80%		90%	
			Column			80%		80%	
			Apron	10%				10%	
21.98	I Beam	County Road	Superstructure						
			Bent		5%			5%	
			Column						
			Apron			50%		50%	
24.02	I Beam	SH 215	Superstructure						
			Bent		10%	10%		20%	
			Column			5%		5%	
			Apron			50%		50%	

* Overlapping Stains

HIGHWAY: INTERSTATE 40

DESCRIPTION				STAIN TYPE				TOTAL STAIN	COMMENTS
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti		
	FRANKLIN COUNTY								
29.00	Girder Continuous Concrete	Toney Road	Superstructure Bent Column Apron	 20%	5%	 	 10%	5% 10% 20%	Rust around drains, Graffiti painted over (covered)
32.75	Girder Continuous Concrete	Cravens	Superstructure Bent Column Apron	 10%	 	 5%	 	 15%	
37.36	Cor-Ten	SH 219	Superstructure Bent Column Apron	 	 30%	 	 	 30%	Rust on footings
40.93	Cor-Ten	Altus IC	Superstructure Bent Column Apron	 	 20%	 10%	 	 30%	Rust on footings
	JOHNSON COUNTY								
46.51	Concrete	SH 164	Superstructure Bent Column Apron	 5% 20%	 	 10% 5% 	 	 15% 5% 20%	
51.01	I Beam	County	Superstructure Bent Column Apron	5% 	 	 40% 5% 5%	 	5% 40% 5% 5%	

* Overlapping Stains

HIGHWAY: INTERSTATE 40

DESCRIPTION				STAIN TYPE				TOTAL	
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti	STAIN	COMMENTS
53.19	Concrete	SH 352	Superstructure	5%				5%	
			Bent		10%	30%		40%	
			Column			10%		10%	
			Apron						
54.83	I Beam	US 64	Superstructure	5%				5%	
		West	Bent		*60%	*100%		100%	
		Clarksville	Column		*55%	*100%	5%	100%	
			Apron	30%		30%		60%	
57.14	I Beam	SH 194	Superstructure	5%			5%	10%	
			Bent	*10%	*10%	*20%		30%	
			Column			20%		20%	
			Apron	30%				30%	
58.18	I Beam	SH 103	Superstructure	5%				5%	
		Jamestown	Bent	*20%	*10%	*30%		50%	
		IC	Column		5%	30%		35%	
			Apron						
59.98	I Beam	County	Superstructure	5%				5%	Rust around drains.
		Road	Bent		*20%	*80%		80%	White mold or
			Column		*20%	*80%		80%	clacium on bottom
			Apron	20%				20%	of bridge deck
61.67	I Beam	County	Superstructure						
		Road	Bent	*10%	*40%	*60%		70%	
			Column	* 5%	*10%	*30%		45%	
			Apron	10%		20%		30%	
66.62	Concrete	SH 315	Superstructure				30%	30%	
			Bent		5%	35%		40%	
			Column			20%		20%	
			Apron	40%		10%		50%	
POPE COUNTY									

* Overlapping Stains

HIGHWAY: INTERSTATE 40

DESCRIPTION				STAIN TYPE				TOTAL	
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti	STAIN	COMMENTS
72.88	I Beam	County Road	Superstructure		5%			5%	
			Bent	20%	10%	30%		60%	
			Column			20%		20%	
			Apron	15%				15%	
77.75	Concrete	County Road	Superstructure		30%			30%	Rebar & Steel Rusting (severe)
			Bent	20%	40%	20%		80%	
			Column	50%		10%		60%	
			Apron	40%				40%	
81.05	Concrete	SH 7 Russellville IC	Superstructure		20%			20%	
			Bent	*20%		*70%		*70%	
			Column			50%		50%	
			Apron	45%				45%	
82.29	Concrete	SH 124	Superstructure	10%	10%			20%	Rebar exposed in column
			Bent	*40%	*20%	*90%		90%	
			Column	*30%	* 5%	*80%		90%	
			Apron	40%	10%			50%	
83.15	Concrete	SH 326	Superstructure	30%				30%	Rebar on bottom of bent
			Bent	20%	20%	30%		70%	
			Column	5%		10%		15%	
			Apron	40%		10%		50%	
84.12	Concrete	SH 331	Superstructure	20%				20%	Small spalling on bent. Rebars exposed on bottom bent
			Bent	30%	20%	20%		70%	
			Column	20%	5%	20%		45%	
			Apron	40%		10%	10%	60%	
87.04	I Beam	County Road	Superstructure	5%				5%	
			Bent		10%	10%		20%	
			Column			10%		10%	
			Apron	30%				30%	
88.16	I Beam	County Road	Superstructure	20%				20%	
			Bent		*20%	*70%		70%	
			Column			70%		70%	
			Apron	40%				40%	

* Overlapping Stains

HIGHWAY: INTERSTATE 40

DESCRIPTION				STAIN TYPE				TOTAL	
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti	STAIN	COMMENTS
93.87	Concrete	SH 105	Superstructure						
			Bent		5%	30%		35%	
			Column	10%		10%		20%	
			Apron	40%				40%	
96.58	I Beam	County Road	Superstructure						
			Bent			20%		20%	
			Column			10%		10%	
			Apron	30%				30%	
97.60	I Beam	County Road	Superstructure						
			Bent	*20%	*20%	*10%		40%	
			Column		10%	10%		20%	
			Apron	30%				30%	
	CONWAY COUNTY								
100.70	I Beam	Blackwell I.C.	Superstructure						
			Bent		10%			10%	Bird nests on beams. Rust from rockers.
			Column						
			Apron		30%	10%		40%	
103.79	I Beam Continuous	County Road	Superstructure						
			Bent						
			Column						
			Apron	10%	5%			15%	
105.82	I Beam Continuous	County Road	Superstructure	5%				5%	
			Bent						
			Column						
			Apron	5%				5%	
106.51	Concrete	West Morrilton I.C. SH 95	Superstructure						
			Bent						
			Column						
			Apron	5%				5%	

* Overlapping Stains

HIGHWAY: INTERSTATE 40

DESCRIPTION				STAIN TYPE				TOTAL STAIN	COMMENTS
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti		
107.01	I Beam	SH 247	Superstructure						
			Bent						
			Column				10%	10%	
			Apron	10%				10%	
108.01	Concrete	SH 9	Superstructure						
			Bent						
			Column						
			Apron						
117.56	I Beam	Menifee	Superstructure	10%				10%	
		I.C.	Bent	*10%	*30%	*10%		40%	Rust from rebars on bottom of Bent Gray stains on drains.
		County	Column						
		Road	Apron	20%				20%	
	FAULKNER COUNTY								
126.13	Concrete	SH 266	Superstructure						
			Bent	*30%	*10%	*20%		30%	
			Column	10%		5%		15%	
			Apron	40%				40%	
126.74	I Beam	S. Conway	Superstructure						
		I.C.	Bent	*10%	* 5%	*20%		30%	
		US 658	Column	10%		5%		10%	
			Apron	30%				30%	
131.58	I Beam	County	Superstructure	10%				10%	
		Road	Bent	*10%	*10%	*10%		20%	
			Column	5%	5%			10%	
			Apron	*35%		*20%		40%	
132.10	I Beam	County	Superstructure	5%				5%	
		Road	Bent	* 5%	*10%	* 5%		15%	
			Column	* 5%	* 5%	* 5%		10%	
			Apron						

* Overlapping Stains

HIGHWAY: INTERSTATE 40

DESCRIPTION				STAIN TYPE				TOTAL	
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti	STAIN	COMMENTS
134.61	I Beam	County Road	Superstructure	5%				5%	
			Bent		5%	10%		15%	
			Column		5%	5%		10%	
			Apron	*70%		*30%		70%	
135.46	I Beam	SH 89	Superstructure	10%				10%	
			Bent	* 5%	* 5%	*40%		40%	
			Column	10%		10%		20%	
			Apron	60%				60%	
	PULASKI COUNTY								
142.07		Morgan I.C.	Superstructure	10%				10%	Rebar showing thru Bent on sides and bottom
			Bent	20%	* 5%	*40%		30%	
			Column	*15%		10%		20%	
			Apron	90%				90%	
144.04	I Beam	County Road	Superstructure						
			Bent	*40%		*20%		40%	
			Column	30%		5%		35%	
			Apron	40%				40%	
147.07	Concrete	Norman Street	Superstructure						
			Bent	*30%	*20%			40%	
			Column	15%	5%	5%		25%	
			Apron	40%		5%		45%	
147.37	Concrete	I 430	Superstructure						
			Bent						
			Column						
			Apron	5%				5%	
147.61	Girder	I 430	Superstructure						
			Bent						
			Column						
			Apron		20%			20%	

* Overlapping Stains

HIGHWAY: INTERSTATE 40

DESCRIPTION				STAIN TYPE				TOTAL	
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti	STAIN	COMMENTS
148.20	I Beam	Crystal Hill I.C.	Superstructure	10%				10%	
			Bent	*40%	*10%	*10%		60%	
			Column	*40%	* 5%	*10%		50%	
			Apron	*30%		*25%		40%	
148.75	I Beam	Crystal Hill SE	Superstructure						
			Bent	*20%	*20%			30%	
			Column	*10%	*10%			10%	
			Apron	30%				30%	
149.50	I Beam	Burns Park Sep.	Superstructure						
			Bent	*60%	* 5%			60%	
			Column	*60%	* 5%			60%	
			Apron	40%				40%	
150.34	Concrete	Burns Park I. C.	Superstructure						Rebar exposed in Bent
			Bent	30%	5%			35%	
			Column	10%				10%	
			Apron	10%		5%		15%	
152.89	Concrete	SH 107	Superstructure	10%	10%		5%	25%	Rust on Rocker
			Bent	60%				60%	
			Column	60%				60%	
			Apron	20%				20%	
153.25	Concrete	SH 107	Superstructure	10%				10%	
			Bent	60%				60%	
			Column	60%				60%	
			Apron	30%				30%	
153;40	Concrete	I 30N LEG	Superstructure	*10%			* 5%	10%	
			Bent	60%				60%	
			Column	60%				60%	
			Apron	20%				20%	
154.31	I Beam	Old US 67	Superstructure	10%				10%	Rebars exposed on bottom of bent on all piers
			Bent	*40%	*10%	*10%		50%	
			Column	*40%	*10%	*10%		50%	
			Apron	30%				30%	

* Overlapping Stains

HIGHWAY: INTERSTATE 40

DESCRIPTION				STAIN TYPE				TOTAL	
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti	STAIN	COMMENTS
157.29	I Beam	County Road	Superstructure		5%			5%	Rebars on bottom of bent
			Bent	*10%	*10%	* 5%		25%	
			Column	5%	5%	5%		15%	
			Apron	30%				30%	
158.02	I Beam	County Road	Superstructure				5%	5%	Rebars on bottom of bent
			Bent	10%	5%			15%	
			Column	5%				5%	
			Apron	20%				20%	
158.94	I Beam	County Road	Superstructure		10%			10%	Rusting on wf under drains. Possible green algae mixed with gray stain
			Bent	10%				10%	
			Column	5%				5%	
			Apron	30%				30%	
160.81	I Beam	Galloway I.C.	Superstructure	10%				10%	Rust under drains rebars exposed on bottom of bent
			Bent	*40%	*20%			50%	
			Column	*40%	*10%			40%	
			Apron	60%				60%	
162.39	I Beam	FAS 1862	Superstructure	30%				30%	Same as above
			Bent	*50%	*20%			50%	
			Column	*40%	*10%			40%	
			Apron	30%				30%	
	LONOKE COUNTY								
164.81	Concrete	SH 5	Superstructure		20%			20%	wf need paint Rusting around drains
			Bent	*10%	*10%			15%	
			Column	*10%	*10%			15%	
			Apron	30%				30%	
168.58	I Beam	County Road	Superstructure						
			Bent	*10%	*40%			45%	
			Column		40%			40%	
			Apron			5%		5%	

* Overlapping Stains

HIGHWAY: INTERSTATE 40

DESCRIPTION				STAIN TYPE				TOTAL	
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti	STAIN	COMMENTS
171.16	I Beam	County Road	Superstructure						
			Bent	5%	5%			10%	Rust under drains
			Column	5%	5%			10%	
			Apron	30%		10%		40%	
173.15	I Beam	SH 89	Superstructure						Stain on I Beam
			Bent	10%	20%			30%	Rust under drains
			Column	5%	15%			20%	and under (apron)
			Apron	15%				15%	
174.58	I Beam	SH 31	Superstructure						
			Bent	*20%	*20%	* 5%		35%	
			Column	*20%	*20%			30%	
			Apron	40%				40%	
177.29	I Beam	County Road	Superstructure						
			Bent	*20%		*30%		40%	
			Column	*10%		*10%		15%	
			Apron	80%				80%	
179.34	I Beam		Superstructure				5%	5%	Graffiti & Rebars
			Bent	5%	10%			15%	
			Column	5%	10%			15%	
			Apron	20%				20%	
182.51	Concrete	SH 13	Superstructure						Spalled off chunks
			Bent	*20%	*30%	*10%		50%	under Bent because
			Column	*10%	*20%	*10%		30%	of rusting rebars
			Apron	30%				30%	
183.54	I Beam	Airport Road	Superstructure	5%				5%	
			Bent			10%		10%	
			Column			5%		5%	
			Apron	20%				20%	
PRAIRIE COUNTY									

* Overlapping Stains

HIGHWAY: INTERSTATE 40

DESCRIPTION				STAIN TYPE				TOTAL	
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti	STAIN	COMMENTS
186.94	I Beam	New Bethel Road	Superstructure						
			Bent	* 5%	*20%	* 5%		25%	
			Column			5%		5%	
			Apron	10%				10%	
189.10	I Beam	Anderson Road	Superstructure						
			Bent		20%	5%		25%	
			Column			5%		5%	
			Apron	10%				10%	
191.12	Concrete	SH 249	Superstructure						Stain on I Beam from drain above
			Bent	10%	10%			20%	
			Column	10%	5%			15%	
			Apron	40%				40%	
193.22	I Beam	SH 11	Superstructure				5%	5%	Rebars exposed bottom of bent
			Bent	*30%	*20%	* 5%		50%	
			Column	*10%	*10%	* 5%		20%	
			Apron	40%		5%		45%	
196.32	I Beam	County Road	Superstructure						Same as above
			Bent	10%		5%		15%	
			Column	10%				10%	
			Apron	20%				20%	
202.22	I Beam	BISCOE I.C. SH 33	Superstructure				5%	5%	Rebars showing on bent
			Bent	10%	40%			50%	
			Column	10%	20%			30%	
			Apron	10%			5%	15%	
203.50	I Beam	County Road	Superstructure	10%			5%	15%	
			Bent			10%		10%	
			Column			10%		10%	
			Apron						
MONROE COUNTY									

* Overlapping Stains

HIGHWAY: INTERSTATE 40

DESCRIPTION				STAIN TYPE				TOTAL	
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti	STAIN	COMMENTS
213.70	I Beam	County Road	Superstructure		10%			10%	Drains onto flange
			Bent		*10%	*10%		15%	
			Column						
			Apron	10%				10%	
215.74	I Beam	Brinkley I.E. US 49	Superstructure	20%				20%	
			Bent	*60%		* 5%		60%	
			Column	*60%		* 5%		60%	
			Apron	10%				10%	
	ST. FRANCIS COUNTY								
218.38	I Beam	County Road	Superstructure						Rebars in bottom of bent exposed
			Bent	*10%	*10%	*20%		30%	
			Column			5%		5%	
			Apron	5%				5%	
220.85	I Beam	Wheatley I.C. SH 78	Superstructure						
			Bent	20%	5%	10%		35%	
			Column	20%		5%		25%	
			Apron						
224.72	I Beam	County Road	Superstructure						Rebars on bottom of bent exposed
			Bent	5%		10%		15%	
			Column	5%		10%		15%	
			Apron						
226.70	I Beam	County Road	Superstructure						Same as above
			Bent		5%	15%		20%	
			Column			20%		20%	
			Apron	5%	5%			10%	
230.96	I Beam	County Road	Superstructure				5%	5%	
			Bent	*10%		*40%		45%	
			Column			30%		30%	
			Apron		10%			10%	

* Overlapping Stains

HIGHWAY: INTERSTATE 40

DESCRIPTION				STAIN TYPE				TOTAL	
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti	STAIN	COMMENTS
233.22	Concrete	SH 261	Superstructure				5%	5%	
			Bent	*40%	*30%			60%	
			Column	20%				20%	
			Apron	40%		10%		50%	
236.50	I Beam	County Road	Superstructure	5%				5%	
			Bent	10%	5%	5%		20%	
			Column			5%		5%	
			Apron	5%				5%	
238.68	I Beam	County Road	Superstructure						
			Bent	*20%	*20%	* 5%		40%	
			Column		5%			5%	
			Apron	30%				30%	
244.00	PRST	County Road	Superstructure				5%	5%	Rebars showing thru on bent
			Bent	*80%	*10%	*10%		90%	
			Column	80%				80%	
			Apron	40%				40%	
247.05	I Beam	Widener I.C. SH 38	Superstructure				5%	5%	
			Bent	20%	10%	5%		35%	
			Column	*10%		* 5%	* 5%	15%	
			Apron	20%				20%	
250.00	I Beam	FAS 1357	Superstructure						
			Bent	20%		10%		30%	
			Column	10%				10%	
			Apron						
252.39	I Beam	FAS 1348	Superstructure						Spalling of Apron 2' x 2'
			Bent			10%		10%	
			Column						
			Apron						
259.50	I Beam	County Road	Superstructure				5%	5%	Rebars under bent exposed
			Bent		10%	5%		15%	
			Column						
			Apron	5%				5%	

* Overlapping Stains

HIGHWAY: INTERSTATE 40

DESCRIPTION				STAIN TYPE				TOTAL	
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti	STAIN	COMMENTS
259.89	I Beam	Shell Lake I.C. SH 149	Superstructure						Rebars under bent exposed
			Bent	*30%	*10%	* 5%		40%	
			Column	30%	5%			35%	
			Apron	40%				40%	
261.01	Concrete	County Road	Superstructure						Same as above
			Bent	*20%	*15%			30%	
			Column	5%	5%			10%	
			Apron	40%				40%	
262.27	Concrete	FAS 1969	Superstructure						
			Bent	5%	20%			25%	
			Column		10%			10%	
			Apron	20%				20%	
	CRITTENDEN COUNTY								
265.08	I Beam	Shearerville SH 218	Superstructure		10%			10%	Rust on beam
			Bent	*15%		*20%		30%	
			Column	*10%		*20%		25%	
			Apron	20%				20%	
267.17	I Beam	FAS 1955	Superstructure						
			Bent			30%		30%	
			Column			5%		5%	
			Apron	10%				10%	
273.37	I Beam	Ebony Road	Superstructure						
			Bent		20%			20%	
			Column						
			Apron	10%				10%	
274.37	I Beam	Bolling	Superstructure						
			Bent	20%				20%	
			Column						
			Apron				5%	5%	

* Overlapping Stains

HIGHWAY: INTERSTATE 40

DESCRIPTION				STAIN TYPE				TOTAL	
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti	STAIN	COMMENTS
275.24	I Beam	Kuhn Road	Superstructure		10%			10%	Rebars on side of structure
			Bent	60%				60%	
			Column	*30%	* 5%		* 5%	35%	
			Apron						
277.06	Concrete	I55 at I40 WYE	Superstructure						Spalling away of old concrete
			Bent	*40%	*10%	* 5%		50%	
			Column	20%	5%			25%	
			Apron	30%				30%	
277.19	Concrete	I55	Superstructure						
			Bent	*40%	*15%			50%	
			Column	20%				20%	
			Apron	20%				20%	
278.23	Concrete	Jct. SH 191 in West Memphis	Superstructure						
			Bent	*70%	*10%	*10%		80%	
			Column	80%				80%	
			Apron	20%				20%	
279.32	Concrete	Jct. Ingram Blvd.	Superstructure						
			Bent	*90%	* 5%			95%	
			Column	80%				80%	
			Apron	60%				60%	
			Superstructure						
			Bent						
			Column						
			Apron						
			Superstructure						
			Bent						
			Column						
			Apron						
			Superstructure						
			Bent						
			Column						
			Apron						

* Overlapping Stains

HIGHWAY: INTERSTATE 55

DESCRIPTION				STAIN TYPE				TOTAL STAIN	COMMENTS
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti		
		CRITTENDEN COUNTY							
3.92	I Beam	Club Road	Superstructure		10%			10%	Rebars exposed on bottom of bent
			Bent	40%				40%	
			Column	20%				20%	
			Apron	70%				70%	
4.42	I Beam	I 40	Superstructure						
			Bent	10%	5%			15%	
			Column	10%				10%	
			Apron	5%				5%	
13.79	I Beam	Jct. James Mill Road	Superstructure	10%				10%	Discoloration of steel
			Bent	*40%	* 5%			40%	
			Column	40%				40%	
			Apron	5%				5%	
16.00	I Beam	Jct. Jericho Road	Superstructure						Rust from pins & rockers
			Bent	*40%	*40%			60%	
			Column	40%	5%			45%	
			Apron						
17.11	Concrete	Jct. Clarksdale Road	Superstructure						Rust
			Bent	*40%	*50%			65%	
			Column	*40%	*10%			45%	
			Apron						
21.50	Concrete	SH 42	Superstructure						Roller Rust
			Bent	*50%	*20%			70%	
			Column	*50%	*10%			55%	
			Apron	30%				30%	
23.48	Concrete	US 63 SH 77	Superstructure	10%	30%			35%	Rebar rust concrete spalling Steel Rusting
			Bent	*20%	*20%			35%	
			Column	*20%	*10%			20%	
			Apron	20%				20%	

* Overlapping Stains

General Note: Approximately 95% of all Over Passes had a small amount of gray stain directly beneath each guardrail support. This stain was on the concrete portion of the superstructure.

HIGHWAY: INTERSTATE 55

DESCRIPTION				STAIN TYPE				TOTAL STAIN	COMMENTS
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti		
23.87	GIRD - Railroad	SL & SF	Superstructure						Rebars exposed in column
			Bent	*30%	*40%			60%	
			Column				40%	40%	
			Apron						
26.75	I Beam	County Road	Superstructure						Rebars in column, Grass in apron
			Bent	10%	20%			30%	
			Column	10%				10%	
			Apron						
	MISSISSIPPI COUNTY								
30.03	I Beam	FAS 1283	Superstructure						
			Bent	10%	10%			20%	
			Column	10%	10%			20%	
			Apron						
33.52	I Beam	SH 118	Superstructure						Rebars exposed
			Bent	10%	20%			30%	
			Column	*10%	*20%		* 5%	30%	
			Apron	5%				5%	
33.55	I Beam	SH 181	Superstructure						Steel rusting
			Bent	10%				10%	
			Column						
			Apron		5%			5%	
39.71	I Beam	FAS 1288	Superstructure						
			Bent	*30%	*10%			35%	
			Column	*20%	*10%			25%	
			Apron						
41.36	I Beam	SH 14	Superstructure						
			Bent	*40%	*10%			45%	
			Column	40%			10%	45%	
			Apron						

* Overlapping Stains

HIGHWAY: INTERSTATE 55

DESCRIPTION				STAIN TYPE				TOTAL STAIN	COMMENTS
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti		
50.16	I Beam	SH 119	Superstructure						Rebar exposed in column. Rubber tracks from mowers on apron
			Bent	*20%	*30%			45%	
			Column	*20%	*20%			30%	
			Apron				5%	5%	
52.88	I Beam	SH 158	Superstructure						
			Bent	*20%	*20%			35%	
			Column	10%				10%	
			Apron						
55.16	I Beam	County Road	Superstructure						
			Bent	10%	5%			15%	
			Column						
			Apron						
57.44	I Beam	SH 148	Superstructure						
			Bent	5%	20%			25%	
			Column		5%			5%	
			Apron						
59.75	I Beam	County Road	Superstructure	10%				10%	
			Bent	*20%	*20%			35%	
			Column		10%			10%	
			Apron						
61.97	I Beam	SH 312	Superstructure						
			Bent	5%	10%			15%	
			Column				5%	5%	
			Apron						
65.24	I Beam	SH 239	Superstructure						
			Bent	15%	20%			35%	
			Column	5%	5%			10%	
			Apron						
66.1	GIRD		Superstructure						
			Bent	5%	15%			20%	
			Column		5%			5%	
			Apron						

* Overlapping Stains

HIGHWAY: INTERSTATE 55

DESCRIPTION				STAIN TYPE				TOTAL STAIN	COMMENTS
Log Mile	Bridge Type	Route	Bridge Part	Gray	Rust	Red	Graffiti		
67.33	I Beam	18	Superstructure						
			Bent	40%				40%	
			Column	20%				20%	
			Apron		5%			5%	
71	I Beam	SH 150 Yarbro Exit	Superstructure						
			Bent	10%	20%			30%	
			Column	5%	5%			10%	
			Apron						
			Superstructure						
			Bent						
			Column						
			Apron						
			Superstructure						
			Bent						
			Column						
			Apron						
			Superstructure						
			Bent						
			Column						
			Apron						
			Superstructure						
			Bent						
			Column						
			Apron						
			Superstructure						
			Bent						
			Column						
			Apron						
			Superstructure						
			Bent						
			Column						
			Apron						

* Overlapping Stains

APPENDIX C

This appendix contains the method for removing iron stains as taken from the October 1968 report by C.F. Derrington, R.L. Stowe, and W.G. Miller, "Investigation of Methods for Removing Stains from Mortar and Concrete". This report is listed as Miscellaneous Paper C–68–8, Corps of Engineers, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

IRON STAINS

The most common stain found on concrete is iron stain, which is usually caused by excessive amounts of iron salts deposited from the curing water or by weathering of unprotected structural steel. Usually this type of stain is confined to the surface if the concrete is not permitted to dry appreciably before application of the curing water. Surface condition, length of exposure to heat and light, the concentration of iron salts in the curing water, and the rate of flow of the curing water are factors that determine the severity of the stain that is produced. Rust from structural steel produces localized areas of stain. These stains may become severe because the concrete is usually dry, and penetration of the surface will occur. The treatment necessary to remove iron stains is, of course, dependent upon the severity and penetration of the stain. The following chemical methods of iron stain removal are recommended.

Surface stains. The surface is mopped with a solution consisting of one pound of oxalic acid in one gallon of water. After two or three hours, the treated surface is scrubbed well with stiff brushes and clear water. The surface is then flushed with clear water until all traces of the acid have been removed. The stained surface should be saturated with water before application of the acid solution so that the acid will not migrate too deeply into the concrete pores.

Deeper stains.

a. Treatment with sodium citrate, water, glycerin, and calcium carbonate. One part of sodium citrate is dissolved in six parts of water that has been mixed with seven parts of glycerin; sufficient $CaCO_3$ is then added and mixed well to form a paste just stiff enough to adhere adequately to the surface. The paste is applied to the stained surface with a trowel

or putty knife to a thickness of about ¼ inch and allowed to remain for at least two days. At the end of this period, the poultice is scraped off, and the concrete surface is rinsed thoroughly with clear water. This treatment produces no injurious effects and can be repeated for stubborn stains.

b. Mixture of ammonium citrate, water, glycerin, and calcium carbonate. Treatment of stains and the method of mixing the chemicals are identical with those described in subparagraph a above. However, the mixture should be removed from the stained area sooner (perhaps after one day), since the ammonium citrate produces results more quickly but may cause the concrete surface to become slightly etched.

c. Sodium hydrosulfite, sodium citrate, water, and $CaCO_3$. First the surface should be soaked with a solution of one part sodium citrate and six parts water. Soaking can be done by dipping white cloth or cotton batting into this solution and placing the cloth over the stain for 10 to 15 minutes. On horizontal surfaces, after the cloth has been removed, crystals of sodium hydrosulfite are sprinkled over the stained area, moistened with water, and covered with a stiff paste made of $CaCO_3$ and water. On vertical surfaces, the $CaCO_3$ paste is applied with a trowel after the sodium citrate treatment; then a layer of the sodium hydrosulfite is sprinkled onto the paste and moistened slightly. The poultice is removed after one hour, and the surface is rinsed with clear water. If the mixture is left longer than one hour, a black stain may develop. If the iron stain persists, treatment should be repeated, using fresh material.