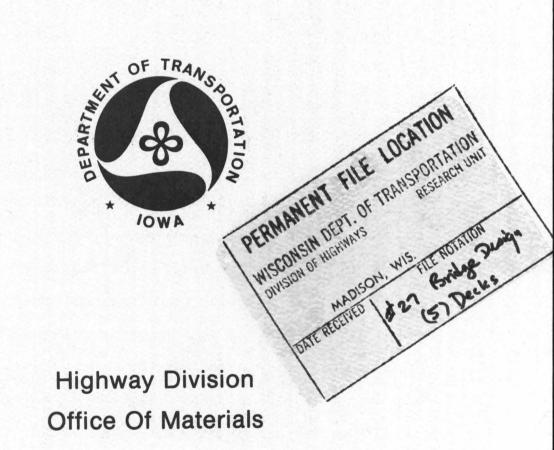
SPECIAL REPORT

A Further Evaluation Of Concrete Bridge Deck Surfacing In Iowa



March 1979

DISCLAIMER

The contents of this report reflect the view of the author and do not necessarily reflect the official views or policy of the Iowa Department of Transportation. This report does not constitute a standard, specification or regulation.

A FURTHER EVALUATION OF CONCRETE BRIDGE DECK SURFACING IN IOWA

by

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March 1979

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ABSTRACT

The Iowa Department of Transportation has overlaid 446 bridge decks with low slump dense concrete from 1964 through October 1978. The overall performance of these decks has been satisfactory.

Nineteen bridges that were resurfaced with either low slump dense concrete (LSDC) or latex-modified concrete were analyzed for chloride content, electrical corrosion potential, delaminations or debonding, and deck surface condition. The resurfacing ages of these bridges range from 5 to 13 years.

None of the bridges showed any evidence of surface distress and the chloride penetration into the resurfacing concrete is relatively low. There are delaminations in the original decks below the resurfacing on the majority of bridges examined. The delaminations are concluded to be caused by either (A) reinforcing steel corrosion, (B) not removing all delaminated concrete prior to placing the resurfacing concrete, or (C) creating an incipient fracture in the top surface of the original deck through the use of scarification equipment.

The active corrosion of the reinforcing steel is predominately in the gutter line on the majority of bridges evaluated.

Recommendations for future deck repairs include removal of concrete to the top layer of reinforcing steel in areas where an electrical corrosion potential of -0.35V or more is detected, providing more positive methods of locating delaminated concrete, and treating the curb and gutter line to reduce the potential damage from salt water.

INTRODUCTION

The Iowa Department of Transportation has been using low-slump, dense concrete for several years as a standard repair and resurfacing technique on bridge decks. From 1964 through October 1978 a total of 446 bridges have been overlaid with the dense concrete system. The overall performance of these overlays has been satisfactory.

In June 1974, a report entitled "An Evaluation of Concrete Bridge Deck Resurfacing in Iowa" was released by the Iowa Departof Transportation. This report documented the history, use and performance of low-slump, dense concrete (LSDC)* for bridge deck repair and resurfacing in Iowa from 1964 through 1973.

*LSDC will be the terminology used throughout this report because of the widespread use of term. The reader should be aware that whenever LSDC is used it is considered to be synonymous with the "Iowa Method" which includes specific methods of deck preparation, grouting, curing, etc.

Sixteen bridges were studied for chloride penetration in 1974. Fifteen of the bridges had been resurfaced with LSDC and the other has been resurfaced with latex-modified concrete containing Dow Chemical Corporation's Modifier "B". The age of the resurfacing on the bridges selected for the study ranged from one to nine years. Data was also presented as an indication of the physical properties of the resurfacing concretes as well as the rideability of the finished structure.

Only limited data was presented at that time concerning electrical potential corrosion measurements and no data was presented

to indicate the amount of concrete delamination or debonding that was present in the decks.

In 1978, the bridges detailed in the original report were resurveyed for the purpose of updating the information on the performance of the concrete resurfacing systems. Three additional bridges were also added to the study.

SCOPE

Bridge Selection

Sixteen bridges had decks repaired and resurfaced with the LSDC system. The ages of the resurfacing at the time of the 1978 evaluations were: one deck 13 years old, one 12 years, three 11 years, two 10 years, one 9 years, three 8 years, two 7 years, two 6 years, and one 5 years.

Three bridges included in the study had been repaired and resurfaced with latex-modified concrete. One of these contained a Dow Modifier "B" latex which is no longer used because of a high chloride content. This bridge was included in the 1974 report and has been in service 6 years. The other bridges had been repaired and resurfaced with latex-modified concrete containing Dow Modifier "A" and had been in service 5 years at the time of the 1978 survey.

As previously mentioned three bridges were added to the survey in 1978. These included a set of twin bridges on Interstate 35 over the Raccoon River in Polk County. One of these bridges was was resurfaced in 1973 with the LSDC system and the other bridge

was resurfaced in 1973 with the latex-modified concrete system.

Both bridges were inspected by the same personnel and have received similar salt applications since resurfacing. These bridges provide an ideal opportunity to directly compare the performance of the two systems. The other bridge added to the study is on Interstate 235 westbound across the Des Moines River. This bridge was repaired and resurfaced in 1973 with latex-modified concrete. It was selected to provide additional data on the performance of this resurfacing method.

Survey Methods

All bridges were surveyed for chloride content of both the resurfacing concrete and the old deck, delaminations of the concrete in the old deck or debonding of the resurfacing from the old deck, and corrosion of the reinforcing steel in the old deck.

Two-inch diameter cores were drilled on each deck in the approximate locations originally sampled to determine the chloride level of the resurfacing concrete and the old, underlying deck. The cores were drilled wet with a diamond bit, however, the amount of water used in the drilling operation was held to a minimum to minimize the loss of water soluble chloride from the sample.

The cores were dry sawed in 1/2 inch increments with a carborundum blade in the laboratory to establish the chloride profile at each location. Where it was possible, the concrete in the old deck was also sliced for chloride analysis. In some instances, the original deck concrete was not analyzed due to fracturing of

the concrete at or slightly below the original concrete during the core removal operation.

Each concrete slice was coarse ground in a Chipmunk jaw crusher and fine ground to pass the No. 50 sieve in a Micropulverizer. After pulverizing each sample was dried in an oven for at least one hour at 105° C.

The chloride concentration was obtained by utilizing the procedure described by Clear & Harrington in Report No. FHWA-RD-77-85.² The Gran endpoint determination method was selected due to the relative ease associated with this method. The equipment employed was a Corning Research Model No. 12 pH meter with an Orion chloride electrode Model 96-17.

The chloride content of the concrete sample was converted to pounds of chloride per cubic yard of concrete by assuming a dry-concrete weight of 140 pounds per cubic foot.

Each bridge deck was surveyed with a Delamtect testing device manufactured by S.I.E. Inc. of Fort Worth, Texas. The Delamtect is a small mobile, electronic, acoustical device which imparts a tapping impulse into the surface of the concrete. An oscillating solenoid mounted on two steel wheels generates this impulse. The receivers that "listen" to locate the hollow areas are two oil filled inner tube tires. A hydraphone (pressure transducer) is mounted near the bottom within each of these oil-filled tires and monitors the response from the tapping. A response from each wheel is transmitted to a dual-channel, strip-

chart recorder. Each steel transmitter wheel operates three inches from the receiver tire, thus, evaluating a three inch wide strip. The two three inch wide strips traverse nine inches center to center for each pass. The operation of the testing device in Iowa has been well documented by Marks.³

Seventeen of the nineteen bridges surveyed were sounded for delaminations on nine-inch centers for the full width and length of the deck. Only representative deck sections on I-235 in Des Moines and US 20 in Sioux City were tested because of the traffic control problems encountered at these locations.

When unsound areas on a deck were encountered, two-inch diameter cores were drilled to examine the source of the indicated delamination. It was noted whether there was debonding of the resurfacing from the original deck or if there were delaminations of the concrete in the original deck.

Electrical corrosion potential measurements were obtained on sections of all bridges included in the study in accordance with Iowa Test Method 1008. This test method utilizes the coppercopper sulfate half cell in common use for this type of measurement. A four-foot grid system of test points was laid out on each deck section to be tested. If a reading of -0.35 volts or greater was observed, the four-foot grid system was reduced to a two-foot grid to better define the limits of where active corrosion may be occurring. The areas surveyed were selected to include as much delaminated concrete as possible.

Each bridge was also photographed to provide a visual reference as to the surface condition of the deck. Any apparent surface distress was to be noted by the testing crew.

RESULTS

Detailed results of each bridge surveyed are shown in Appendix A. Data from each bridge was plotted to illustrate chloride contents, delamination results and corrosion potential readings. Photographs illustrate general deck condition and delamination locations on the cores obtained for this purpose.

Chloride Penetration

Table No. 1 summarizes the chloride contents at various levels in the LSDC overlay concrete. It is common to find chloride contents of 3-6 lbs. per cubic yard of concrete in the underlying original decks as shown in the Appendix. When these decks were overlaid no effort was made to remove sound concrete with a high chloride content. Because of the high chloride content of the original deck, it is also common to find a relatively high chloride content in the overlay concrete directly in contact with the original. In all likelihood, the chloride migrates from the original deck upward rather than penetrating from the surface due to salting operations.

To present a more meaningful evaluation of chloride penetration properties, the chloride content of the concrete directly in contact with the original deck was not used in averaging the chloride content of the overlay concrete. Plymouth County

Design 169 was not included in Table No. 1 because the thickness of the overlay was not sufficient to plot a meaningful chloride penetration profile.

Table No. 2 summarizes the chloride data available on the latex-modified concrete deck overlays. The latex-concrete overlay on Story County bridge Design 172 contains Modifier "B". This modifier was high in chloride content and was reflected by the high chloride content in the cores from this deck. The concrete on other bridges listed contains Modifier "A".

Table No. 1
Chloride Content of LSDC System

Bridg		Resurfacing			Content	
	Design	Age	The second secon		g Depth -	
County	No.	Years	0-1/2	1/2-1	1-1-1/2	1-1/2-2
Polk	3265	13	5.0	1.6	_	_
Woodbury	1065	12	14.1	3.2	0.7	0.3
Polk	866	11	11.7	1.9	0.9	-
Clay	267	11	4.0	0.7	0.6	_
Clay	167	11	14.9	5.0	1.5	0.3
Monona	268	10	5.1	1.2	1.2	-
Woodbury	168	10	8.6	2.1	1.2	_
Calhoun	170	8	7.4	1.5	0.9	0.7
Cherokee	370	8	8.9	5.5	0.8	0.4
Woodbury	369	8	6.1	1.3	0.5	0.2
Plymouth	271	7	6.3	2.6	1.0	0.6
Plymouth	171	7	2.6	0,6	0.7	_
Cherokee	172	6	6.6	1.7	_	-
Cherokee	272	6	7.6	2.4	1.0	0.7
Polk	273 NB	5	7.3	1.2	0.7	-
		Avg.	7.7	2.2	0.9	0.5

	${f T}$ a	able	e No. 2	
Chloride	Content	of	Latex-Modified	System

Bride	ge	Resurfacing	Avg. Chloride C	ontent - lbs/y	d ³
County	Design No.	Age Years	Resurfacing 0-1/2		
Story Polk Polk	172* 273 SB** 573**	6 5 5	21.3 8.4 8.2	18.4 1.8 0.6	

^{*}Concrete in resurfacing contains Modifier "B"

Delaminations

Unsound areas as detected by the Delamtect have been plotted for each bridge deck and are summarized in Table No. 3 for the LSDC system and in Table No. 4 for the latex-modified concrete system.

Table No. 3
Delamtect Survey Results - LSDC System

Bri County	dge Design No	Resurfacing Age Years	Deck Area-Ft ²	Percent of Deck Area Delaminated
Polk	3265	13	15,444	11.8
Woodbury	1065	12	15,120	15.0*
Polk	866	11	9,436	12.7
Clay	267	11	9,724	11.3
Clay	167	11	20,256	28.5
Monona	268	10	7,410	16.4
Woodbury	168	10	13,891	6.9
Plymouth	169	9	9,828	2.6
Calhoun	170	8	5,496	44.9
Cherokee	370	8	5,376	9.9
Woodbury	369	8	4,200	7.0
Plymouth	271	7	3,250	1.2
Plymouth	171	7	6,240	5.2
Cherokee	172	6.	9,600	18.5
Cherokee	272	6	2,448	2.2
Polk	273 NI	3 5	18,368	0.0
		Total	156,087	,

^{*}Representative area surveyed (5,616 Ft²)

^{**}Concrete in resurfacing contains Modifier "A"

Table No. 4
Delamtect Survey Results
Latex-Modified Concrete System

Br	idge	Resurfacing	Deck Area-Ft ²	Percent of Deck
County	Design No.	Age Years		Area Delaminated
Story Polk Polk	172 273 SB 573	6 5 5 Total	6,720 18,368 44,720 69,808	9.7* 0.0 4.9**

^{*}Contains Modifier "B"

Table No. 3 and 4 contain a column entitled "Percent of Deck Area Delaminated." The Delamtect device does not distinguish the difference between delaminated concrete in the underlying deck or from a lack of bond between the two concretes.

A linear regression analysis was performed utilizing resurfacing age and percentage of deck area delaminated as the independent variables for the LSDC system. A correlation coefficient of 0.265858 indicates no meaningful correlation exists. Due to the limited data a similar analysis was not conducted for the latexmodified concrete system.

Core photographs shown in Appendix A are included to indicate the location in the system which caused the Delamtect to respond. A careful examination of the cores reveals a failure in the concrete from the original deck below the bond line on all bridges surveyed.

^{**}Representative area surveyed (13,780 ft²)

It is difficult to ascertain from the photographs in Appendix A whether the failure was debonding or delamination when the fracture plane is close to the interface of the two concretes.

To avoid confusion it would be well to define debonding and delamination as used in this report. Debonding is considered to be an actual failure of the grout to bond the overlay concrete to the prepared surface of the underlying deck. Delamination will be used to describe a fracture in the original deck below the interface of the two concretes.

Most of the delaminations were located in the old concrete within 1/4" of the bonded interface. To better illustrate this type of delamination a core from the Calhoun Co. Design No. 170 bridge is shown in Figures Nos. 1 and 2. Figure No. 1 does not provide sufficient detail to indicate the exact fracture location. Figure No. 2 shows the fracture location in the old deck as evidenced by the separation of the coarse aggregate particle from the old deck.

Electrical Potential

Tables No. 5 and No. 6 summarize the results of the electrical potential measurements on the decks overlaid with LSDC and latex-modified concrete, respectively. The tables indicate:

1) the number and percentage of measurements -0.35V or greater for the total deck area surveyed, 2) the number and percentage of measurements of -0.35V or greater in the delaminated areas only, and 3) the number and percentage of measurements of -0.35V or greater in the gutter line only.

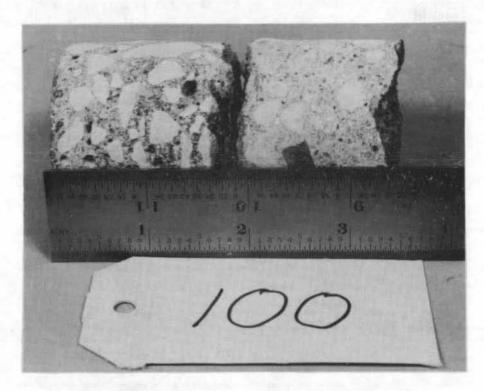


Fig. 1 Delamination core - side view



Fig. 2 Delamination core - end view of fracture

Table No. 5
Electrical Corrosion Potential Results
LSDC System

			Total	Area Surve	yed	Delami	nated Area	Only	Gutt	er Line Onl	<u>.y</u>
				No. of			No. of			No. of	
Bri	dge	Resurfacing		Readings	%		Readings	%		Readings	%
	Design	Age	No. of	-0.35V	-0.35V	No. of	-0.35V	-0.35V	No. of	-0.35V	-0.35V
County	No.	Years	Readings	or More	or More	Readings	or More	or More	Readings	or More	or More
Po1k	3265	13	392	14	3.6	92	12	13.0	52	0	0.0
Woodbury	1065	12	247	62	25.1	66	1	1.5	63	45	71.4
Po1k	866	11	222	11	5.0	66	6	9.1	58	6	6.9
Clay	267	11	219	3	1.4	56	1	1.8	55	0	0.0
Clay	167	11	510	129	25.3	198	62	31.3	85	31	36.5
Monona	268	10	237	25	10.5	104	11	10.6	58	6	10.3
Woodbury	168	10	212	4	0.9	36	1	2.8	55	3	5.4
Plymouth	169	9	302	101	33.4	30	11	36.7	141	98	69.5
Calhoun	170	8	256	92	35.9	147	38	25.9	129	73	56.6
Cherokee	370	8	241	51	20.8	50	17	34.0	120	39	32.5
Woodbury	369	8	211	16	7.6	11	0	0.0	74	14	18.9
Plymouth	271	7	364	196	53.8	13	7	53.8	158	148	93.7
Plymouth	171	7	233	48	20.6	42	2	4.8	104	48	46.2
Cherokee	172	6	302	70	23.2	145	23	15.9	108	55	50.9
Cherokee	272	. 6	331	138	41.7	16	9	56.3	145	76	52.4
Po1k	273 h	N 5	239	14	5.9	0	0	0	79	13	16.5
		Tota1	4,518	974	21.6%	1,072	201	18.8%	1,484	653	44.0%

Percent of Readings -0.35V or more in non-delaminated area = $\frac{974-201}{4,518-1,072}$ = 22.4%

Percent of Readings -0.35V or more outside gutter line = $\frac{974-653}{4,518-1,484}$ = 10.6%

Table No. 6
Electrical Corrosion Potential Results
Latex-Modified-Concrete System

			Total	Area Surv	eyed	Delami	nated Area	a Only	Gutt	er Line Onl	-У
				No. of			No. of			No. of	
Bri	idge	Resurfacing		Readings	%		Readings	%		Readings	%
	Design	Age	No. of	-0.35V	-0.35V	No. of	-0.35V	-0.35V	No. of	-0.35V	-0.35V
County	No.	Years	Readings	of More	or More	Readings	or More	or More	Readings	or More	or More
Story	172	6	317	75	23.7	60	17	28.3	78	24	30.9
Po1k	273 SB	5	218	4	1.8	0	0	0 ,	58	3	5.2
Po1k	573	5	434	30	6.9	64	4	6.2	85	17	20.5
		Total	969	109	11.2%	124	21	16.9%	221	44	19.9%
	Perce	nt of Reading	gs -0.35V oi	r more in	non-delami	nated area	$= \frac{109-21}{969-124}$	= 10.4%			

Percent of Readings -0.35V or more outside gutter line = $\frac{109-44}{969-221}$ = 8.7%

A regression analysis was conducted on the LSDC system with the percentage of readings at or exceeding -0.35V for the total deck area surveyed and resurfacing age as the independent variables. A correlation coefficient of -0.405693 indicates no meaningful correlation exists.

Deck Surface Condition

None of the bridges included in the study showed any evidence of surface distress.

DISCUSSION

All of the bridge-deck overlays examined in this investigation were constructed utilizing specifications that are not currently in use, they have since been revised. The main differences in the specifications are:

- 1. The overlay thickness in the bridges studied was designed at 1-1/4" exclusive of areas which required deeper patching caused by the removal of unsound concrete. The present standard overlay thickness is 1-3/4" with the same exclusions.
- 2. There were no consolidation requirements for the LSDC placed on these bridges. The current specification requires the concrete be consolidated to a minimum of 98% of rodded unit weight.
- 3. No criterion concerning electrical corrosion potential had been established to dictate concrete removal

at the time these overlays were placed. The present standard requires that the concrete in the deck be removed to the top layer of reinforcing steel where a corrosion potential measurement of -0.45 volt or more is encountered.

All of the specification changes instituted since the evaluated bridges were resurfaced are designed to increase the service life of the decks.

There has been no significant change in the levels of chloride ions in the LSDC system during the 4-year period since the decks were originally surveyed. The chloride level of the concrete in the majority of original decks under the resurfacing is considerably above the established corrosion threshold level of approximately 1.5 lbs. of chloride per cubic yard of concrete. Why the electrical corrosion potential readings did not indicate active corrosion of the reinforcing steel to a great degree over the entire deck areas surveyed is not fully explainable. A possible reason is that there is not sufficient moisture or oxygen at the reinforcing steel level to initiate corrosion or allow it to continue in any widespread manner.

The delamination survey provided data which indicate the amount of delamination in the original concrete decks is quite variable and is generally more widespread than had originally been thought. Unfortunately, no data is available to indicate whether or not delaminated areas existed immediately after construction; consequently, the progression of the delaminations

cannot be quantitatively analyzed. While some areas of unsound concrete may have remained in the old deck at the time of resurfacing, it is very doubtful that as high a percentage as found by the Delamtect on some bridges could have been overlooked in normal project inspection.

Assuming this is the case, it is probable that the delaminated areas under the resurfacing is increasing. How far this can increase prior to being manifested by surface deterioration is unknown.

Two bridges were void of delaminations. These are twin bridges that were overlaid in 1973 and are located on Interstate 35 across the Raccoon River in Polk County. One bridge was resurfaced with LSDC and the other was resurfaced with latexmodified concrete. It has been reported that the inspector on these bridges did an extremely conscientious job of insuring all unsound concrete was removed prior to resurfacing. The results from these bridges point out the importance of thorough inspection and the removal of all delaminated concrete in the underlying deck. These bridges will be monitored on a yearly basis.

It was intended to establish whether or not delaminated areas of the deck would show more active corrosion of the reinforcing steel than non-delaminated areas.

It is generally agreed that electrical potential measurements at or exceeding -0.35V indicate active corrosion of the reinforcing steel. Readings between -0.20V and -0.35V are generally

concluded to be in the "gray area"; that is, active corrosion may or may not be present.

Since readings of -0.35V or more definitely indicate corrosion, the percentage of readings at this level were tabulated for delaminated and non-delaminated areas. The results exhibited in Table No. 5 show that for the LSDC system the percent of readings of -0.35V or more are nearly equivalent in the delaminated and non-delaminated areas with 18.8% and 22.4%, respectively. It should not be concluded, based upon this tabulation, that the delaminations in the underlying deck concrete are not the result of continued reinforcing steel corrosion. Conversely, it does not provide sufficient evidence to positively conclude that the increase in delaminated areas can solely be attributed to re-bar corrosion.

As mentioned earlier, the majority of the delaminations were located within 1/4" of the bonded interface. It is not unusual to find this type of delamination approximately 2 inches above the reinforcing steel with the concrete between the delamination and the re-bar appearing sound. When these cores were taken directly over the reinforcing steel there was no visual evidence of corrosion on the bar. The exact cause of this type of delamination is not known. There is a distinct possibility that an incipient fracture in the surface of the old concrete may have been created due to the impact of the scarification equipment in use at that time.

There is also a possibility that all delaminated concrete was not removed at the time of resurfacing and this area is increasing due to the mechanical action created by traffic on the bridges.

Table No. 5 also compares corrosion potential measurements in the gutter line with other areas. It is not surprising to observe the high percent (44%) of readings indicating active corrosion in the gutter line since there is a likelihood of more salt and moisture in this area. There is also a distinct possibility of the readings being influenced by corrosion of the reinforcing steel in the curb.

Table No. 6 contains comparable data for the latex-modified concrete system of deck overlays. There is only limited data available on this system; however, it does not appear the analysis of this system would be significantly different than the LSDC system.

CONCLUSIONS

The results from this study would support the following conclusions:

- The LSDC system of resurfacing over chloride contaminated bridge decks has exhibited adequate performance through 13 years.
- 2. The performance of the LSDC system and the latex-modified concrete system are equivalent through 6 years.

- 3. Chloride penetration into the LSDC and latex-modified concrete systems is similar and not significantly changed from the previous survey. Both systems are successful in reducing chloride penetration from surface applied deicing chemicals.
- 4. Delaminated areas exist in the original deck under the resurfacing on the majority of bridges investigated.
- 5. The delaminations are probably caused by either;
 (A) reinforcing steel corrosion, (B) not removing all delaminated concrete prior to resurfacing, or
 (C) creating an incipient fracture in the top surface of the original deck through the use of scarification equipment.
- 6. The majority of the delaminations are within 1/4" of the bonded interface and are probably not corrosion related.
- 7. The areas of delamination are increasing and may eventually result in distress of the resurfacing.
- 8. The grouting system used to bond the overlay to the original deck is adequate as evidenced by the fact that no bond failures were noted on any of the nineteen bridges studied.
- 9. Steel corrosion is more prominent in the gutter line than on other areas of the bridges.

- 10. There is no meaningful correlation between resurfacing age and delaminations or corrosion of the reinforcing steel.
- 11. Thorough inspection will lessen the likelihood of the formation of delaminated areas.

RECOMMENDATIONS

The following recommendations are being offered for consideration:

- 1. Increased emphasis should be placed upon intensive inspection to insure all delaminated concrete in the decks being resurfaced is removed. If sufficient funds are available, Delamtect testing devices should be purchased and used on decks just prior to scarification of the deck surface. This would result in more objective determinations in locating areas of unsound concrete that should be removed. Delamtect testing should also be conducted after the placement of the overlay.
- 2. Concrete should be removed to the top layer of reinforcing steel if an electrical corrosion potential measurement of -0.35V or more is observed.
- Increased protection of the concrete in the gutter line and curb should be required. This may be done by treating these areas with high quality concrete sealers.

REFERENCES

- 1. Bergren, J. V. and Brown, B. C., "An Evaluation of Concrete Bridge Deck Surfacing in Iowa", Special Report, Iowa Department of Transportation, June, 1974.
- 2. Clear, K. C. and Harrigan, E. T., "Sampling and Testing for Chloride Ion in Concrete", Report No. FHWA-RD-77-85, Federal Highway Administration, August, 1977.
- 3. Marks, V. J., "Bridge Deck Delamination Study" Final Report Research Project HR-179, Iowa Department of Transportation, April, 1978.

APPENDIX A

Bridge Analysis Details

Des. No. 3265

Location: 9th St. in Des Moines Over I-235

Year Overlaid 1965

Bridge Deck Dimensions

Width - 52 ft.

Length - 297 ft.

Deck Area - 15,444 ft.²

Delaminated Area - 1,830.63 ft.

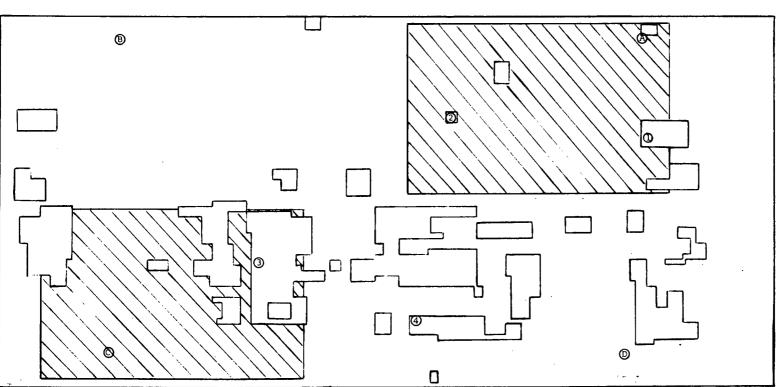
% Delamination - 11.85%

Indicates area where Electrical Potential Readings were taken

Details next page.

Letters indicate chloride cores.
Numbers indicate delamination cores.





Not to scale

Blocked out areas indicate delamination

<u>}</u>

POLK COUNTY

M-1209

Des. No. 3265

Location: 9th St. in Des Moines Over I-235

Year Overlaid 1965

Electrical Potential Negative Voltage - Copper Sulfate Half Cell Detail Sheet No. 1

																					19				
] 30	26	30	28	28	30	33	26	33	30	26	32	26	33	26	23	25	25	-33	31-	28 2	8 40 21 36	3 23	26	29	33
30 35 2	25 24	23	26	29	30	26	27	24	24	26	26	22	26	29	30	24	20	24	27	24 2	6 38 3	8 28	28	23] 25
40 26	24	24	25	30	24	26	25	26	32	28 3	30 3 38 2	6 28	28	28	27	29	23	26	28	27 3	40 0 38 2	34 7 36 2	g 25	28	 7
26	23										39				<u> </u>						30 .	35			7
26	23	29	23	27	32	29	28	26	25	27	25	26	23	24	23	29	26	24	23	29	27 3	1 35 2 30	2 27	25	24
30	34	27	20	24	26 -	22	22	20	22	22	18	19	21	27	16	24	<u>eo</u> _	21	20	20	27	31	16	19	20
18 	26	18	16	16	16	19	19	16	16	16	15	17	16	15	18	15	16	16	17	16	19	16	13	13	14
2,7	30	27	25	27	24	26	27	27	28	23 .	28	26	22	26	28	29	24	27	26	26	25	20	26	2	24

100 Ft.

Represents S.E. Cross Hatched Area

Blocked out areas indicate delamination

Polk County

M-1209

Des No. 3265

Location: 9th St. in Des Moines Over I-235

Year Overlaid 1965

Electrical Potential Negative Voltage - Copper Sulfate Half Cell Detail Sheet No. 2

19	18	3 22	26	22	20	24	24	24	22	26	19	17	20	18	21	16	20	21	20	2	17	1	18	15	14
1:	10	11	10	11	10	14	11	12	11	10	10	12	11	09	12	12	16	10	10	08	13	11	12	08	1.1
10	15	13	12	15	15	19	18	18	21] 11	11	15	11	24	20	20	18	17	17	13	16	13	14	16	15
14	13	3 11	14	12	14	18	22	14	16	17	15	16	15	18	17	14	18	16	18	17	19	16	19	18	15
15	15	14	13	15	16	24	20	15	15	16	12	15	16	14	14	16	18	16	18	17	20	18	24	18	14
11	16	5 15	14	14	18	16	16	20	17	16	15	14	16	15	16	16	16	17	20	18	19	19	24	27 25432 23	317
12	13	19	19	13	18	13	17	18	18	1.4	14	13	16	17-	22	16	1.3	15	16	17	13	16	20	18	14

100 ft.

Represents N.W. Cross Hatched Area

Blocked out areas indicate delamination

Polk County

M-1209 Des. No. 3265

Location: 9th St. in Des Moines over I-235

Year Overlaid: 1965



Conc.			Test	Location	
Depth Inches		A	В	c	D
0.50		4.27	6.27	4.69	4.95
	-	0.99	0.73	2.79	1.89
1.00		1.21	1.05	1.99	2.92
1.50	-	Old Dack	old beck	man Back	Old Deck
2.00	-	2.39	1.72	3.25	4.04
2.50		4 1 4			
	-				

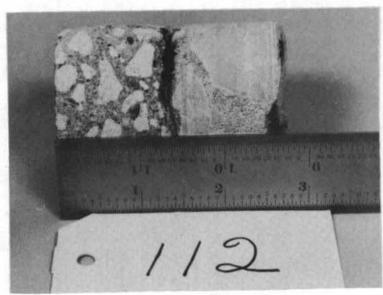
Polk County

M-1209 Des. No. 3265

Location: 9th St. in Des Moines Over I-235

Year Overlaid: 1965

DELAMINATION CORES



Core #1



Core #3



Core #2



Core #4

Year Overlaid: 1966

Bridge Deck Dimensions Indicates areas where Width - 70 ft. Electrical Potential Readings Length - 216 ft. were taken Details next page Deck area - 15,120 ft.² Delaminated Area - 837.75 ft. Letters indicate chloride cores. % Delamination - 14.98% * Numbers indicate delamination cores. * 26' x 216' Test Section in EB Lane

Blocked out areas indicate delamination

A-6

Not to Scale

Woodbury County

UN-20-1(2)--41-97 Des. No. 1065

Location: U.S. 20 Over CM St. P & P RR in Sioux City

Year Overlaid: 1966

Electrical Potential Negative Voltage-Copper Sulfate Half Cell Detail Sheet

	3 2	32	6 36	33	37 35	33	- 25		25	2	5	22	23	19	_20	17	19	24	30	<u></u> 20-	- T 70	0 25	35 39	5 23	26	40 ,5	33 37 42	32 -	38 7	734	
			19		22 =							1		[כ				1.	7_	11			13	18		-		
	19	22	13	:	20	1.3	1.		14	7		¹⁹ [_22	25	24	7	19	21	22	20	_ 1:	5_]	14	20	16	14	15	16	12	14	
	157	33	12	:	15	10	10		22	L ₂	5	, -15—_ —]	_14	15	217		, _R \	_23 	28	1.4		8 · · ·	10	11	11	12	11	09	19	10	A-7
نب	23	22	. 15		13	13	19)	28			20	18	23	19	21		27 💆	23_	19 -{3	— ; ₃	1	23		18	14.	14	1.2	:3	12	
24 F	2	13	16		13	13	2	L	22	1	7	18	21	_33	-22	20	<u></u>	ے۔33 ۔۔۔	<u>2</u> 7_31	35	26 2	5 []24	15	21	17	18	16	13	13	
	312	24 2	8 44	42	29	18 2	2. 4 31	7 41	32	2	3	16	19	20	17	ا 18 ا	21-		-24-	 23-	1	9	19	18	26	20	20	19	14	20	
	49	50	60		45	32	63	2	57	4	€	30									3	3	36		34	31	30	37	31	35	
41	57 63	60 5	2 57	59	53 45	48 5	6 5 9	62	58	57 5	7 52	36 29	23	25	21	16	24	26	24	32	35 3	8 47	44 30	0 28 4	10 38	38 40	40 44 4	7 47 45	40 31	B 39 4	40

100 Ft.

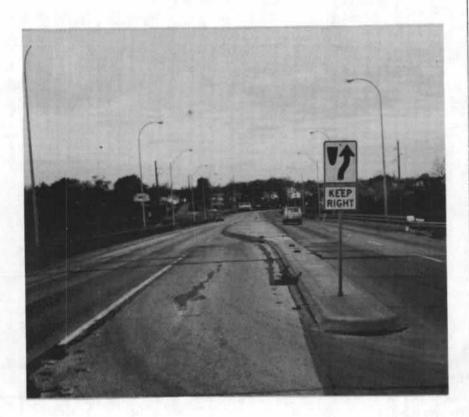
Blocked out areas indicate delamination

Woodbury County

UN-20-1(2)--41-97 Des. No. 1065

Location: U.S. 20 Over CM St. P & P RR In Sioux City

Year Overlaid: 1966



Conc.		Test Location			
Depth Inches		Α	В	C	D
0.50	-	17.23	10.69	13.65	14.86
0.50	7	1,53	1.62	6.05	3.45
1.00	1	0,20	1.33	11.68	0.53
1.50	+		E M	mmmmmmm 01d Deck	+
2.00	1	0.28	0.21	6.31	0.39
2.50	+	0.79	1.98		2.22
2.30	7	0.16	5.03		
3.00		Old Deck	5.63		
3.50	-				
4.00	1	8,43			
	-	10 4 7 30	100		

Woodbury County

UN-20-1(2)--41-97 Des. No. 1065

Location: U.S. 20 Over CM ST. P & P RR In Sioux City Year Overlaid: 1966

DELAMINATION CORES



Core #1



Core #2



Core #3

Bridge Deck Dimensions
Width - 28 ft.
Length - 337 ft.

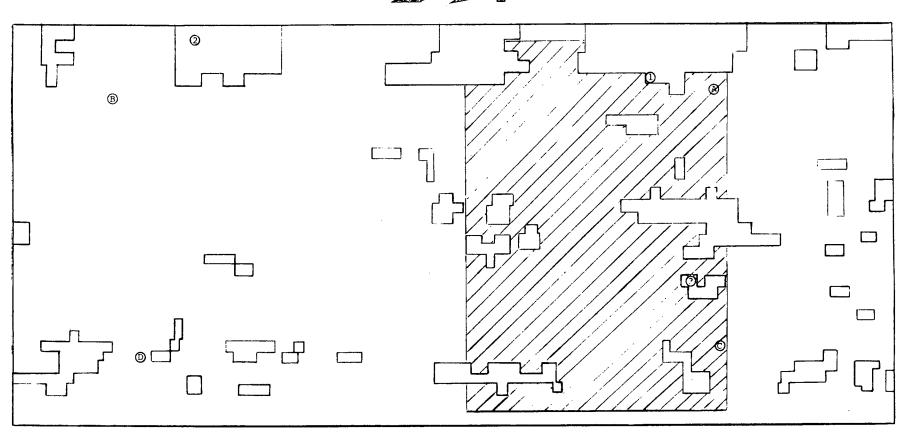
Deck Area - 9,436 ft.

Delaminated Area - 1,200.63

Delamination - 12.72%

Indicates areas where Electrical Potential Readings were taken.
Details next page.

Letters indicate chloride cores.
Numbers indicate delamination cores.



Not to scale

Blocked out areas indicate delamination

A-10

Polk County FN-60-4(2)--21-77 Des. No. 866 Location IA. 141 Over Little Beaver Creek Year Overlaid: 1967

Electrical Potential Negative Voltage - Copper Sulfate Half Cell Detail Sheet

15 4	0 36 1 25	9 28	21	L ₁₉	<u>-16</u>	17	27	29	14	22	27_	30	22	19	17	32	33	25	18	16	28	15	15	21	25
17	17	14	13	12	15	19	14	24	14	10	11	11	09 C	10	10	12	20	19	10	10	-06	09	10	15	19
16	28	15	17	14	15	17	1 22 点	24	14	11	08	10	09	09	15	12	15	12	16	28	—23 —33	12	1.2	11	21
14	13	17	16	13	13	16	18 N	20	14	12	10	08	09	08	07	11	11	11	17 2		3 41 1	4 12	12	09	 13
12	12	_19	<u> </u>	12	09	 16 	19-6NA	20	13	10	80	80	10	07	10	12	11	14	21 5	54 59 5 44	5 19	13	—1 ⁵	99	
[18 [17	15	15	13	17	24	27 I	23	14	14	18	13	10	13	16	15	11	10	12	25	23	18		12	27
16 16 1	09	10	08	08	10	11	18 ,	20	12 1	11	10	10	08	06	12	11	08	08	07		709	14	07	11	22
29	26 2	3 / 7 40 2	7 26	22	28	31	33	30	24	22	21	32	20	22	24	22	27	23	28	22	31	27	23	21	28

100 Ft.

* 4" Core Hole

Polk County

FN-60-4(2)--21-77 Des. No. 866

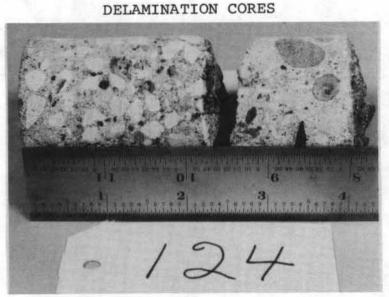
Location: IA. 141 Over Little Beaver Creek

Year Overlaid: 1967

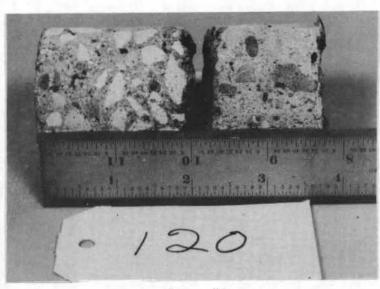


Conc.		Test Loca	tion	
Depth Inches	A	В	C	D
	12.29	11.87	8.77	13.72
0.50_	0.73	2.79	0,59	3.65
1.00_	0.49	1.13	1.33	0.76
2.00	0.26	3.58	1.39	0.39
-	1.39		urthir thilling	e 97
2.50	Old Deck	2.62	2.92	0.59
3.00_	3.65			
3.50_				1

Polk County
FN-60-4(2)--21-77 Des. No. 866
Location: IA. 141 Over Little Beaver Creek
Year Overlaid: 1967



Core #1



Core #2



Core #3

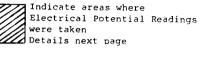
Clay County FN-374-1(1)--21-21 Des. No. 267

Location: IA 374 over Little Sioux River

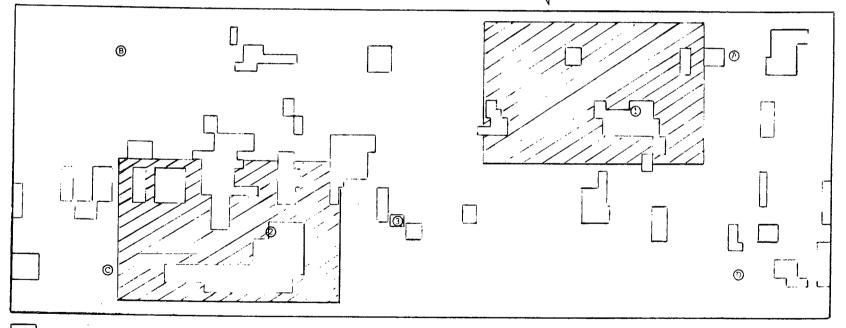
Year Overlaid: 1967

Bridge Deck Dimensions
Width - 26 ft.
Length - 374 ft.

Deck Area - 9,724 ft. ²
Delaminated Area - 1,103.13 ft. ²
% Delamination - 11,34%



Letters indicate chloride cores Numbers indicate delamination cores



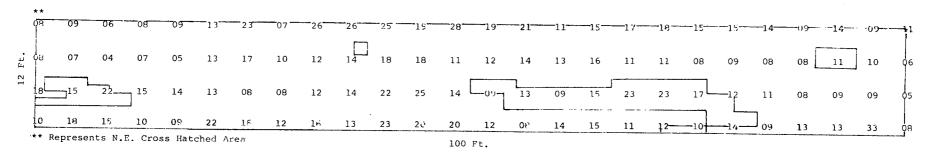
Not to scale

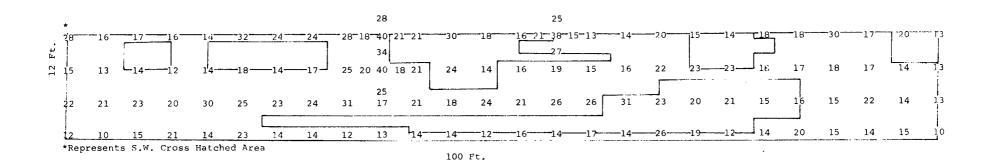
Clay County FN-374-1(1)--21-21 Des. No. 267

Location: IA. 374 Over Little Sioux River

Year Overlaid: 1967

Electrical Potential Negative Voltage - Copper Sulfate Half Cell Detail Sheet





Clay County

FN-374-1(1)--21-21 Des. No. 267

Location: IA. 374 Over Little Sioux River

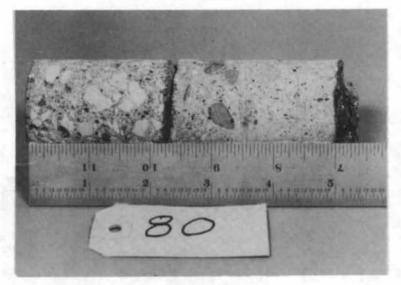
Year Overlaid 1967



onc.		Test Loca	tion	
epth nches	A	В	С	D
-	5,71	2,62	3.78	3.97
0.50	0.83	0.33	1.19	0.46
1.00	0.83	0.63	0.21	0.33
1,50	1.46	0.39	Old Deck	0.39
2.00 —	Old Deck	0.79	4.04	Old Deck
2,50 —	4.04	Old Deck		0.39
3,00 _				
-		3.18		
3,50				

Clay County
FN-374-1(1)--21-21 Des. No. 267
Location: IA 374 Over Little Sioux River
Year Overlaid 1967

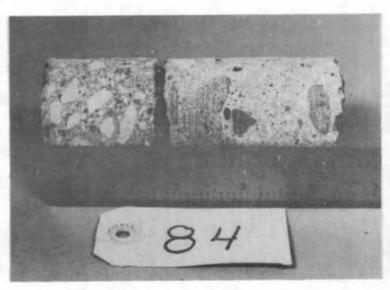
DELAMINATION CORES



Core #1



Core #2



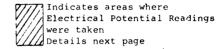
Core #3

UN-18-2(5)--41-21 Des. 167

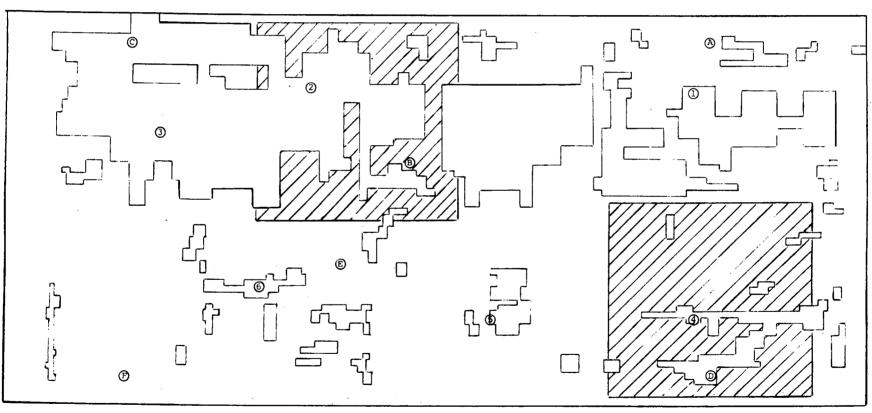
Location: U.S. 18 Over Little Sioux River in Spencer Year Overlaid 1967

Bridge Deck Dimensions
Width - 48 Ft.
Length - 422 Ft.

Deck Area 20,256 ft. Delaminated Area- 5,780.38 ft Delamination - 28.54%



Letters indicate chloride cores Numbers indicate delamination cores



Not to Scale

UN-18-2(5)--41-21 Des. 167

Location: U.S. 18 Over Little Sioux River in Spencer Year Overlaid 1967

Electrical Potential Negative Voltage - Copper Sulfate Half Cell Detail Sheet No. 1 25 28 37 37 29 25 37 24 Ft. 20 21 36 36 32 22 -26-37----18----21 37 41 35 36 27 36 35 32 *Manhole 100°Ft.

Represents N.E. Cross Hatched Area

Blocked out areas indicate delamination

A-LS

UN-18-2(5)--41-21 Des. 167

Location: U.S. 18 Over Little Sioux River in Spencer Year Overlaid 1967

Electrical Potential Negative Voltage - Copper Sulfate Half Cell Detail Sheet No. 2

23 24 25 26 30 26 26 25 27 23 25 28 27 19 20 19 18 19 21 28 21 34 2 35 31 26 25 25 25 22 16 27 28 32 31 34 34 34 33 38 33 28 33 28 30 24 25 22 22 27 28 32 30 41 51 60 58 61 63 65 60 43 33 36 36 38 41 35 35 28 31 33 30 38 34 31 28 30 30 33 38 38 31 26 30 27 28 34 28 27 33 41 51 60 58 61 63 65 60 43 33 33 34 35 35 38 36 36 38 41 35 35 28 31 33 30 38 34 31 28 30 30 33 38 38 31 26 30 27 28 34 28 27 33 41 51 60 58 61 63 65 60 60 60 53 33 36 36 24 28 33 33 30 36 39 35 35 35 32 32 32 32 32 32 32		26		26 	30	3	0-44	-44-2	10-29	,	23	-27	28	- 3 ₁ 1:=5 1	=46 ₁ 70	9 - 30	 30 2	10-36-	26-22-	17	-24	—31−5∺	·· - 40 - -37	-30-26	-36 -4 5	5 1 5 9	-59 - 6	o 51	- 46-4	1-38-	34	
25 25 32 31 28 27 30 34 33 28 33 28 30 24 25 22 22 27 23 23 20 20 23 34 40 37 47 54 55 20 20 23 34 40 37 47 54 55 20 20 20 23 34 40 37 47 54 55 20 20 20 23 34 40 37 47 54 55 20 20 20 20 20 20 20 20 20 20 20 20 20		_		-				38							34		· · ·	729					24		25	40	48	39	2	5	ŀ	
25		23		24	25	2	6	30	26	•	26	25	27	23	25	28	27	19	20	19	18	19	21	28	21	34 42	35 3	31 26	2	5 :	25	
32 36 31 31 34 34 34 33 33 30 38 34 31 28 30 30 33 38 38 31 26 30 27 28 34 28 27 33 41 51 60 58 61 63 65 60 33 36 36 35 30 36 39 35 30 36 39 35 33 30 27 30 29 30 28 25 31 33 36 36 24 28 33 33 30 37 30 27 30 29 30 28 25 31 33 36 36 24 28 33 32 32 32 32 32 28 30 26 30 25 26 26 26 30 30 37 30 28 27 30 30 24 24 27 23 25 27 27 28 37 35 38 35 38 35 37 30 25 45 37 38 37 36 36 36 38 31 34 38 41 38 31 25 28 29 35 44 35 32 26 30 31 31 * 36 43 41 40 43 31 25 22 24 21 22 24 27		.			\neg					_,]								Ì								22		1	6 ;	<u>የ</u> ነ	
32 36 31 31 34 34 34 33 33 30 38 34 31 28 30 30 33 38 38 31 26 30 27 28 34 28 27 33 41 51 60 58 61 63 65 60 35 36 36 35 30 36 39 35 32 32 32 32 32 32 32 32 32 32 32 32 32		25		25	32	3	1	28	27		30	34	33	28	33	28	30	24	25	22	22	27		23	20	_20]	23	34	-4 0-3	7-47-0	4 55	
36 36 35 30 36 39 35 35 30 36 39 35 35 35 36 36 24 28 33 33 30 27 30 29 30 28 25 31 33 36 34 28 28 27 21 25 25 24 26 34 45 48 57 58 63 59 55 32 32 32 32 32 32 32 32 32		32		36	31	3	1	34	34	ļ			33			i_		·3 17									25	47	5	5 . (-, þ	
33 36 36 24 28 33 33 30 27 30 29 30 28 25 31 33 36 34 28 28 27 21 25 25 24 26 34 45 48 57 58 63 50 55 33 24 34 36 35 35 32 32 32 28 30 26 30 25 26 26 30 30 37 30 28 27 30 30 24 24 27 23 25 27 27 28 37 35 38 35 37 30 25 45 37 38 37 38 37 38 37 30 28 27 30 30 30 30 30 30 30 30 30 30 30 30 30	. 31	35	36	40 35	38	36 3	6 38	41 3	35 35	28	31	33 30	38 34	31	28	30	30 3	33 38	38 31	26	30	27	28	34	28	27 33	41 5	31 6b	58 6	1 63 6	5 60	
33 24 32 34 36 35 35 32 32 32 28 30 26 30 25 26 26 30 30 37 30 28 27 30 30 24 24 27 23 25 27 27 28 37 35 38 35 37 30 25 45 37 38 28 25 28 31 34 38 41 38 31 25 28 29 35 44 35 32 26 30 31 31 * 36 43-41 40-43-31 25 22 24 21 22 24 27] 36		36	35	3	0	36	39)			35					35		,		ľ					43	5 b	6	0 1	1 50	
32 34 36 35 35 32 32 32 28 30 26 30 25 26 26 30 30 37 30 28 27 30 30 24 24 27 23 25 27 27 28 37 35 38 35 37 30 25 45 37 38 37 38 37 38 37 38 37 38 37 38 37 38 37 38 37 38 37 38 38 39 39 39 39 39 39 39 39 39 39 39 39 39	7	3 3	36	36 24	28	3	3	<u>-33</u>	30)——	27	30	-29 7	30	28	25	31	33 36	34 28	28	27	21	25	25	24	26	34 4	15 48	57 5	8 63 9	5 55	
38 35 37 30 25 45 37 38 37 38 37 38 37 38 37 38 37 38 37 38 37 38 37 38 37 38 37 38 37 38 37 38 37 38 37 38 38 38 38 38 38 38 38 38 38 38 38 38				33	24								į					41								1		34	3	6!	23 1	
28 25 28 31 34 38 41 38 31 25 28 29 35 44 35 32 26 30 31 31 * 36 43-41 40-43-31-25 22 24 21 22 24 27		32	34	36 39	35	32 3	2	32	28	3	30	26	30	_ ₂₅	26	26	30 3	30 37	30 28 _	27	30	_30	24	24	27	23	25	_ 27	2	7 28	37 35	
				38	35				37	,				30	25			45 L			37	38		_	ι						3//	
* Manhole 25 25 25 31 30		28		25	28	3	1	34	38 41	38	31	25	28 29	35 44	35 33	2 26	30	31	31	* 36	74 3 -4 1	40-43	-3 I ⁻	25	22	24	21	22	2	4	رُ	
100 Ft.		*	Man	hole					25	i				25	25						31	30										

Represents S.W. Cross Hatched Area

UN-18-2(5)--41-21 Des. 167

Location: U.S. 18 Over Little Sioux River in Spencer

Year Overlaid: 1967



Conc.			Test	Location		
Depth Inches	A	В	c	D	Е	F
-	19.05	5.71	19.77	19.05	6.76	18.82
0.50_	- 1446	E		101.1		7 10
	13.64	0.66	10.81	6.05	1.06	6.35
1,00	Old Deck				-	
* 7		1.43	2.87	1.53	0.36	1,06
1.50-	4.57	rorte in			-	
-		4.73	0.36		154	0.66
2.00_	S 92.3			3.61	0.33	Old Dec
-	14.3		0,60	H.,.	0.93	Old Dec
2.50_	1	Old Deck	-		-	100
1	5	5.14	0.89		4.12	1.83
3.00_	4.		Old Deck		old Deck	
	100				4.31	3
3.50_	4	37 4	2.65			
+				-		
	7 1					1

A-2

UN-18-2(5)-41-21 Des. No. 167

Location: U.S. 18 Over Little Sioux River in Spencer Year Overlaid: 1967

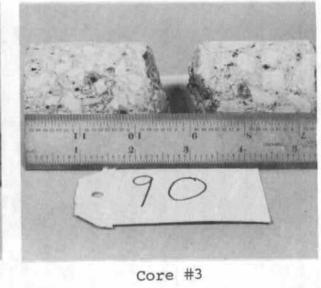
DELAMINATION CORES

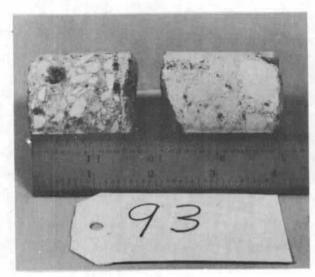


Core #1



Core #2





Core #4



Core #5



Core #6

INP-29-6(27)114--15-67 Des. No. 268

Location: IA. 175 Over I-29 Year Overlaid: 1968

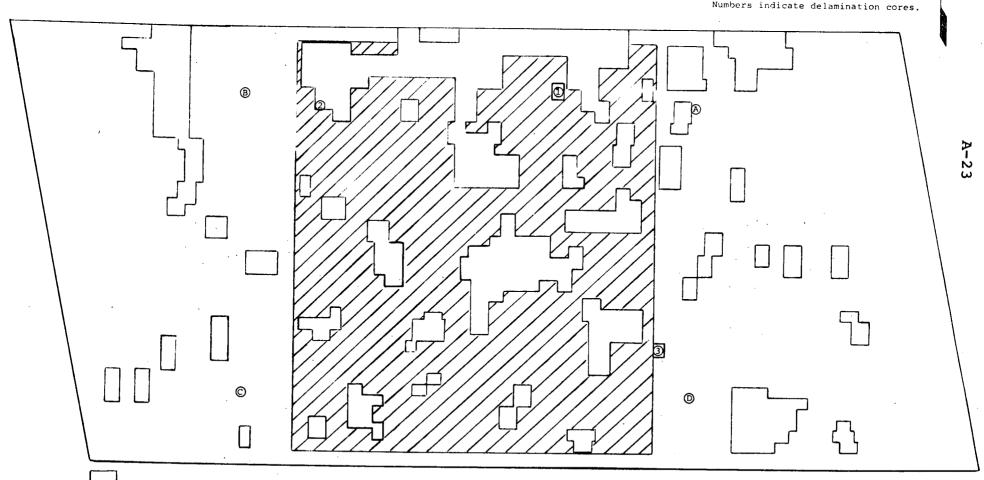
Bridge Deck Dimensions
Width - 30 ft.
Length - 247 ft.

Deck Area - 7,410 ft.²
Delaminated Area - 1,219.25 ft.²
% Delamination - 16.45 %

Monona County
INP-29-6(27)114--15-67 Des. No. 269
Location: IA. 175 Over I-29
Year Overlaid: 1968

Indicates areas where
Electrical Potential Readings
were taken
Details next page

Letters indicate chloride cores. Numbers indicate delamination cores.



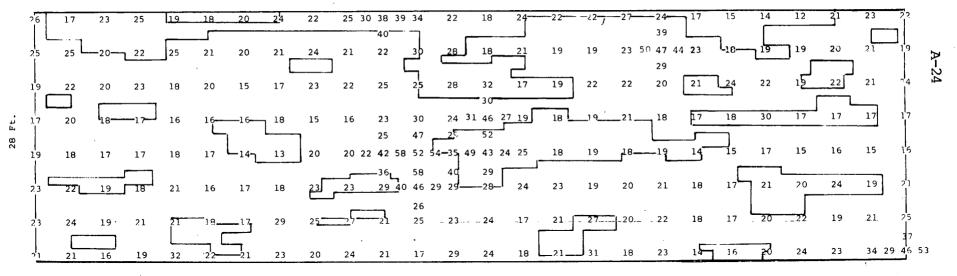
Not to Scale

INP-29-6(27)114--15-67 Des. No. 268

Location: Ia. 175 Over I-29

Year Overlaid: 1968

Electrical Potential Negative Voltage - Copper Sulfate Half Cell Detail Sheet



100 Ft.

INP-29-6(27)114--15-67 Des No. 268

Location: IA. 175 Over I-29

Year Overlaid: 1968



Conc. Depth		Test Loc	ation	1000
Inches	A	В	c	D
-	4.68	3.82	4.04	7,79
0.50	0.81	2.28	0.94	0.60
1,00	0.94	1.41	minganggam	2.11
1.50	-		1.44	माराह्यसम्बद्धाः
Conce	1,21	0.82		3.47
2,00	1.41	0.77		
2.50	1250	Old Deck		
-				
3.00 _		0.87	1 1	2
3.50		0.07		1 4
			1 7	

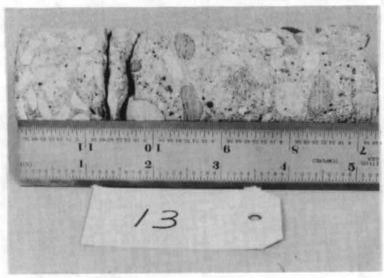
A-2

INP-29-6(27)114--15-67 Des. No. 268

Location: IA. 175 Over I-29

Year Overlaid: 1968

DELAMINATION CORES



Core #1



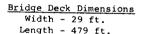
Core #2



Core #3

Location: I-29 Over C & NW R.R. & Wall St.

Year Overlaid: 1968

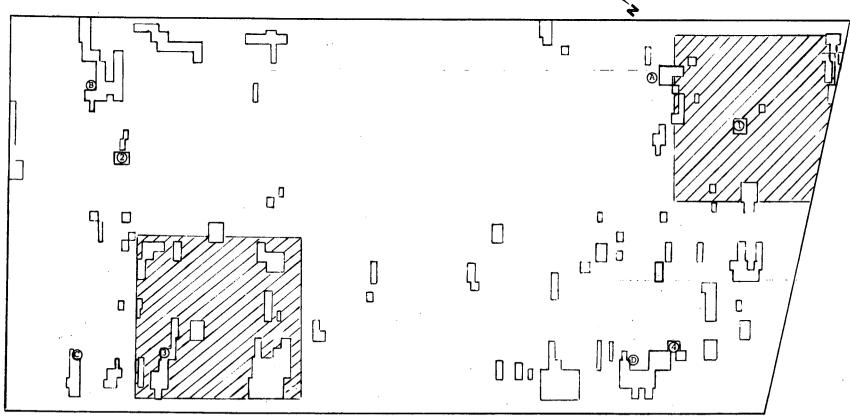


Deck Area - 13,891 ft. ²
Delaminated Area - 960.75 ft. ²
% Delamination - 6.92 %

Woodbury County INP-29-6(28)143--15-97 Des. No. 168 Location: I-29 Over C & NW R.R. & Wall St. Year Overlaid: 1968

Indicates areas where Electrical Potential Readings were taken Details next page

Letters indicate chloride cores. Numbers indicate delamination cores.

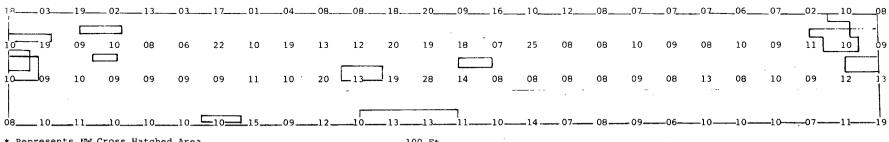


Not to Scale

Location: I-29 Over C & NW R.R. & Wall St.

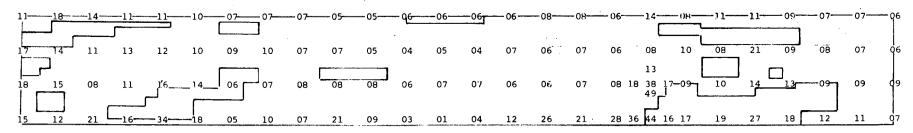
Year Overlaid: 1968

Electrical Potential Negative Voltage - Copper Sulfate Half Cell Detail Sheet



* Represents NW Cross Hatched Area

100 Ft.



** Represents SE Cross Hatched Area

100 Ft.

INP-29-6(28)143--15-97 Des. No. 168

Location: I-29 Over C & NW R.R. & Wall St.

Year Overlaid: 1968



Conc.			Test Loc	ation	
Depth Inches		A	В	С	D
	-	4.88	10.43	10.85	8.09
0.50	-				
	-	0.70	0.90	2.45	4.42
1.00	-	1 16 8			
	-	0.23	3.22	3.58 777777777777777777777777777777777777	2.08
1.50	-		mmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmm		1.01
	-	1.19	1 1 1 1 1	3,42	1.01
2,00	-	Old Deck	2.78		Old Beck
	1	100			0.94
2.50	-				
	-	1.87			
3.00	-				
	-				

A-29

Woodbury County

INP-29-6(28)143-15-97 Des. No. 168

Location: I-29 Over C & NW R.R. & Wall St.

Year Overlaid: 1968

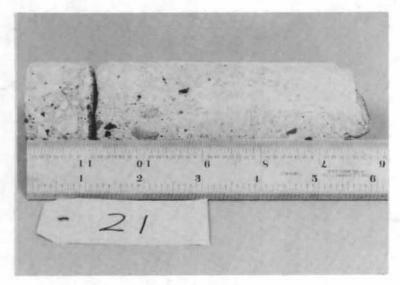
DELAMINATION CORES



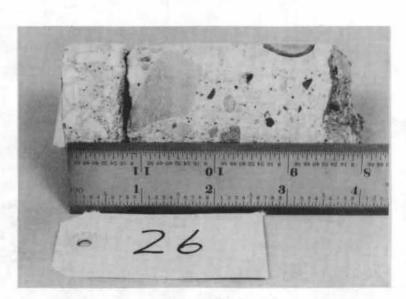
Core #1



Core #3



Core #2



Core #4

Plymouth County

FN-75-5(4)--21-75

Des. No. 169

Location: U.S. 75 Southbound Over Floyd River in LeMars
Year Overlaid 1969

Bridge Deck Dimensions
Width - 28 Ft.
Length - 351 Ft.

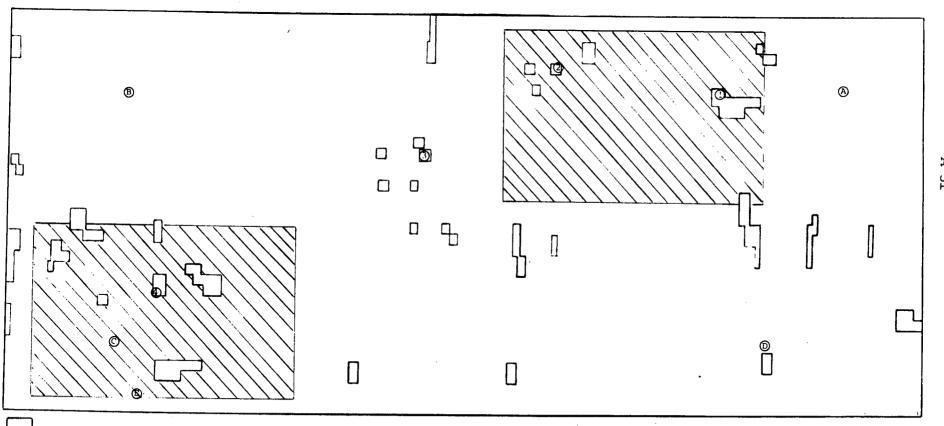
Deck Area - 9,828 Ft.²
Delaminated Area 254.50 Ft.²
% Delamination - 2.59 %



Indicates areas where
Electrical Potential Readings
were taken
Details next page

Letters indicate chloride cores.

Numbers indicate delamination cores.



Blocked out areas indicate delamination

Not to Scale

Plymouth County

FN-75-5(4)--21-75

Des. No. 169

Location: U.S. 75 Southbound Over Floyd River in LeMars Year Overlaid 1969

Electrical Potential Negative Voltage - Copper Sulfate Half Cell Detail Sheet

32-3	4-38-3	954	34-33-	31	27 42 5	2 38	35-4	<u> 40 30 3</u>	3 - 4	5 33 4	0 44 3	2 27	 27	25 3	2 38 4	9 2/	3 1.	27 -2	8 41 3	4 38 4	8 57 3	9 42 3	<u>3 38 4</u>	4 43 3 C	<u>1 5 3 31</u>
	32	51			44	38	40	L	39		47				44				53	33	3.0	37	38	28	48
22	21	27-	26	⊐ ²³	25	30	27	26	27	27	26	23	20	24	28	24	22	25	27	22 2	0 3° 2	6 25		24	$\exists^{3\frac{1}{2}}$
12 18	21	19	21	18	21	24	20	18	19	20	19	20	20	20	21	19	19	19	19	21	28	25	22	17	2
2]	24	25	24	23	23	23	21	19	21	22	25	22	23_	28	23	20	20	23	22	23	27	23	23	25	
**	Repre	esents	N.W. C	ross	Hatched	Λrea					100	Ft.													

	*																									
;	30	2 4	- 6	-28	=21==	21	21		15	20_	3 1.	-24	20]	_2U	24	3 I.	-3!	21	18	1.5	²⁰	16	1.7	15	15	7:
		r	┙,										22				\neg									
	28	22	27	27	18	19	20	27	21	21	20	20 2	0 35 20	17	18	28	32-1	23	19	17	19	20	16	18	19	20
Ft													28													
12	2 !	22	24	24	17	10	25	20	20	24	21	21	24	10	23	24	23	21	23	21	22	18	20	20	19	-:5
	1 39	41	34	34	35	29	38	34	30	47	31	28	38	30	46	35	44	33	33	26	26	29	27	35	30	3 1
35 4	 41.35	39 41	2 48 47	40 42	41 20	a 35 4	1 48 3	6 39 5	0 45 4	6 50	34 53 55	37 3	<u>∟</u> 5 47 37	40 59		51 57	/ 54, 53	46 46	42 4	2 38 44	41 4	3 41 4	2 41 ÷	35 42	37_36	
22			ts S.F					· · · · · · ·															-			

Plymouth County FN-75-5(4)--21-75 Des. No. 169

Location: U.S. 75 Southbound Over Floyd River in LeMars Year Overlaid: 1969



Conc.	A LINE		Test Location		
Depth Inches	A	В	С	D	Е
-	10.69	9,79	10.58	11.37	15.61
0.50	2.32	6,62	3.89	6.58	13.61
1.00	Old Deck	Old Deck		my gla beck	mgi a peck
1.50_	3.57		3.82	5.10	7.03
-		The state of			
2.00—	1				
-		8 3 7		1 - 6	

Plymouth County

FN-75-5(4)--21-75 Des. No. 169

Location: U.S. 75 Southbound Over Floyd River

Year Overlaid: 1969

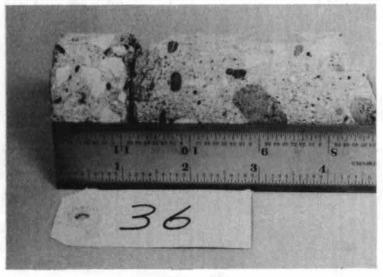
DELAMINATION CORES



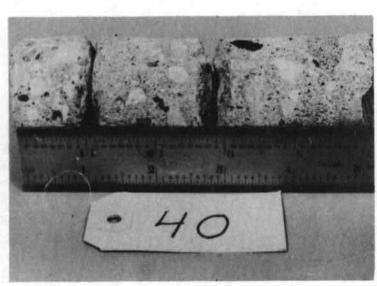
Core #1



Core #3



Core #2



Core #4

FN-175-5(3)--21-13

Des. No. 170

Location: Ia. 175 Over Raccoon River

Year Overlaid: 1970

Bridge Deck Dimensions Width - 24 Ft.

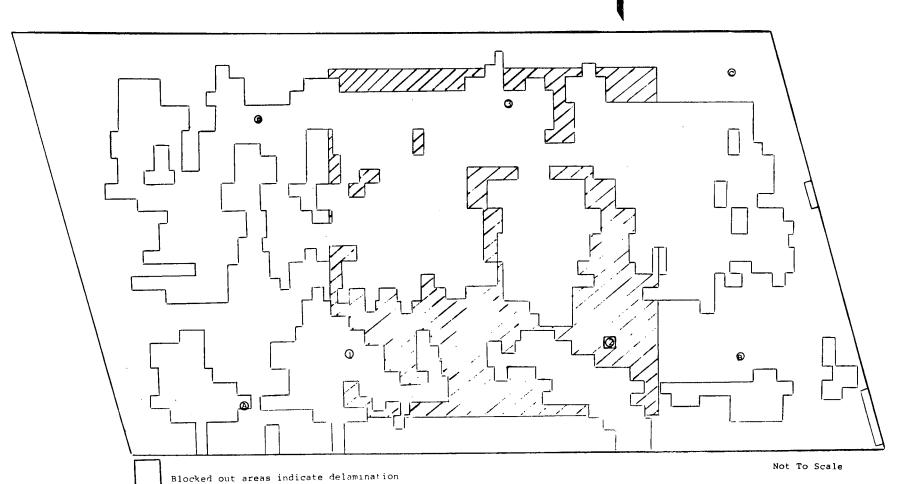
Length - 229 Ft.

Deck Area - 5,496 Ft. Delaminated Area - 2,469.25 Ft. Delamination - 44.93 %



Indicates areas where Electrical Potential Readings were taken Details next page

Letters indicate chloride cores. Numbers indicate delamination cores.



A-35

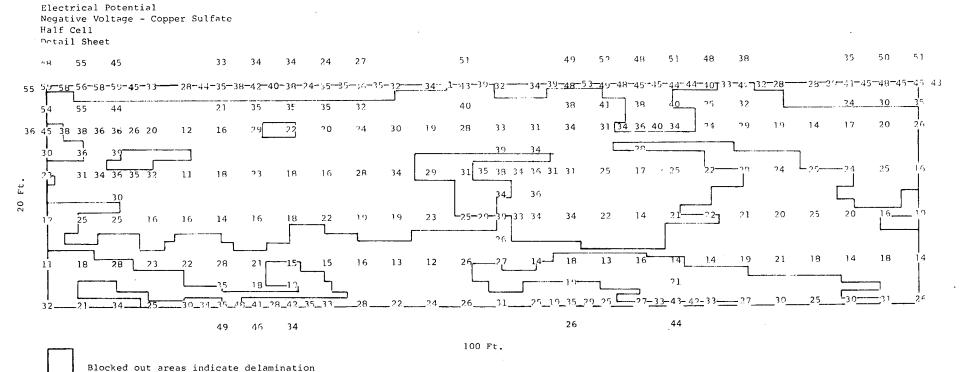
Calhoun County

FN-175-5(3)--21-13

Des. No. 170

Location: IA. 175 Over Raccoon River

Year Overlaid: 1970



Calhoun County

FN-175-5(3)--21-13 Des. No. 170

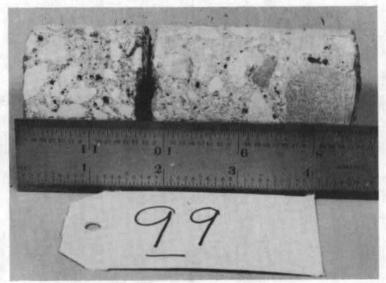
Location: IA. 175 Over Raccoon River Year Overlaid: 1970



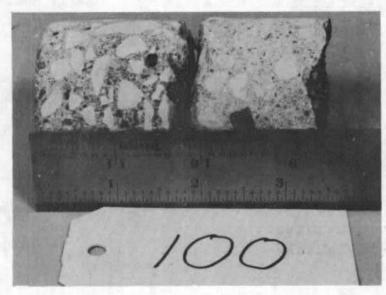
Conc. Depth		Test	Location	
Inches	A	В	С	D
	6.50	6,50	7.86	8.69
0.50	2.09	1.49	1.26	1.13
1.00	0.39	0.39	1.99	1.63
2.00	0.99	0.39	4.91 Old Deck	3.97
	1.53	0.99	2.79	41
3.00	Old Deck	3.05		
3.50				
-		1701-		

Calhoun County FN-175-5(3)--21-13 Des. No. 170 Location: IA. 175 Over Raccoon River Year Overlaid: 1970

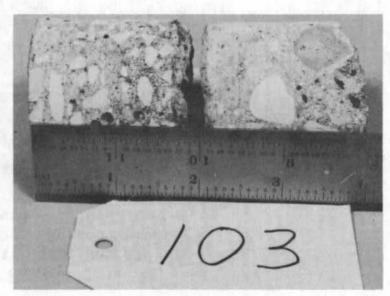
DELAMINATION CORES



Core #1



Core #2



Core #3

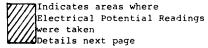
Cherokee County

FN-59-7(11)--21-18 Des. No. 370

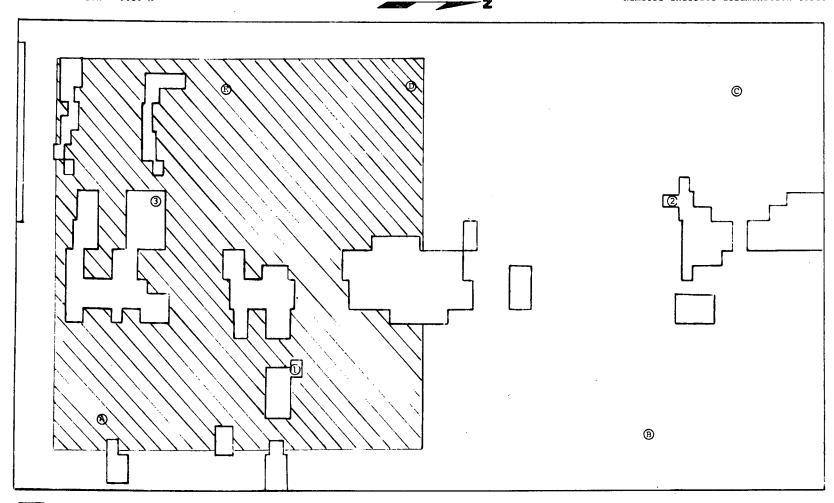
Location: U.S. 59 Over Gray Creek Year Overlaid: 1970

Bridge Deck Dimensions
Width - 24 ft.
Length - 224 Ft.

Deck Area - 5,376 ft.²
Delaminated Area - 531.70 ft.²
% Delamination - 9.89 %



Letters indicate chloride cores Numbers indicate delamination cores

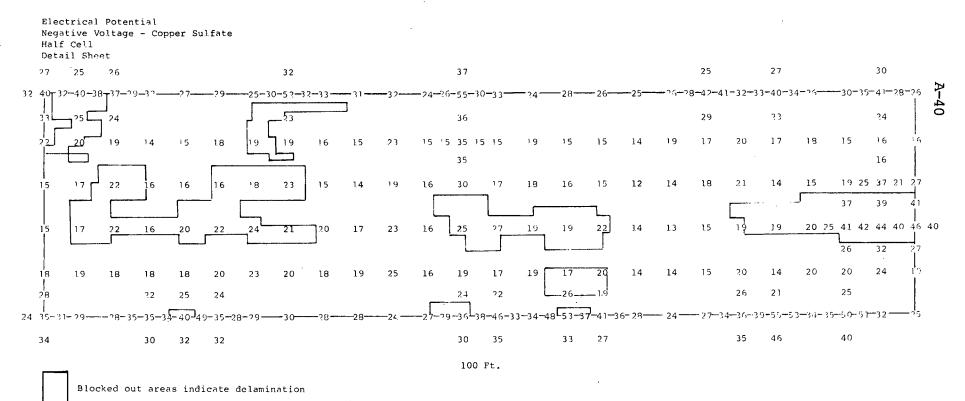


Cherokee County FN-59-7(11)--21-18 Des

Des. No. 370

Location: U.S. 59 Over Gray Creek

Year Overlaid: 1970



Cherokee County
FN-59-7(11)--21-18 Des. No. 370
Location: U.S. 59 Over Gray Creek
Year Overlaid: 1970



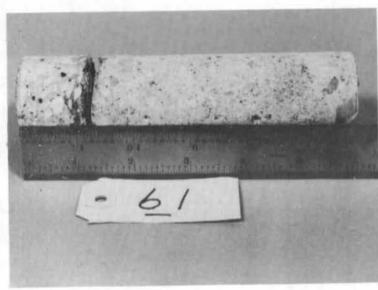
Conc.		T	est Locatio	on .	
Depth Inches	A	В	c	D	E
	10.84	8.99	8.88	6.88	6.73
0.50	3,67	3.09	2.39	1.26	Old Deck
1.00	Old Deck	0.81	0.86	Old Deck	1.76
1.50	1.07	0.40	0.53	2.29	7.
2.00		0.26	0,49	-	
2.50		0.23	0.67		

Cherokee County
FN-59-7(11)--21-18 Des. No. 370
Location: U.S. 59 Over Gray Creek
Year Overlaid: 1970

DELAMINATION CORES



Core #1



Core #2



Core #3

Woodbury County

FN-20-1(20)--21-97 Des. No. 369

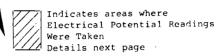
Location: U.S. 20 Over Elliott Creek WB Bridge

Year Overlaid: 1970

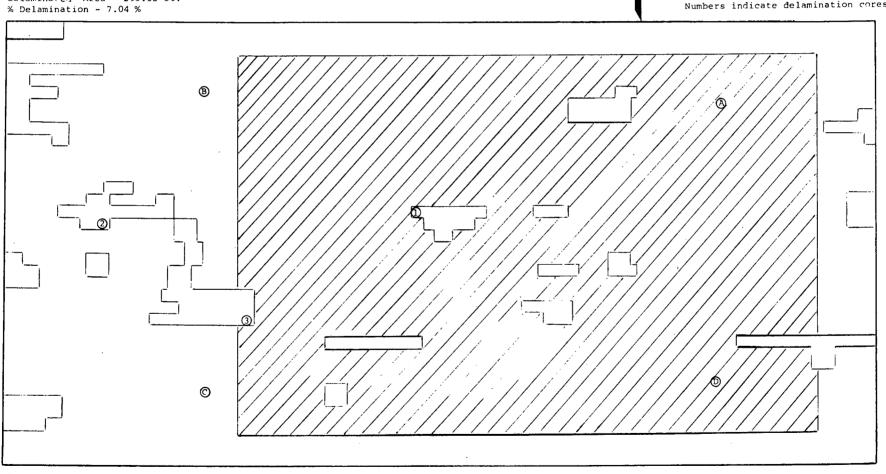
Bridge Deck Dimensions
Width - 28 Ft.

Width - 28 Ft. Length - 150 Ft.

Deck Area - 4,200 Ft.²
Delaminated Area - 295.68 ft.²



Letters indicate chloride cores. Numbers indicate delamination cores.



Woodbury County FN-20-1(20)--21-97 De

Des. No. 369

Location: U.S. 20 Over Elliott Creek W.B. Bridge

Year Overlaid: 1970

Electrical Potential Negative Voltage - Copper Sulfate Half Cell Detail Sheet

25	34	34	23	20	11	24	17	16	20	17	19	18 1	7 38	1 3.5	26	32	П	19	21	20	20	16	14	12	14
16	14	13	16	13	16	10	11	11	15	11	11	09	20 15	15	 16 		_[3	24	14	11	10	10	13	07	12
12	13	11	15	13	14	09	13	11	14	13	08 1	07	10	1 1	14	13	07	08	08	05	12	14	09	09	14
12	12	14	18	17	12	13	13	13	_10	15	15	24	11	18	12	29	_l4	14 31	20	13	16	09	17	10	09
34	23	18	17	18	18	17	17	20	19	20	. 21	19-	20-	25	23	19 23	21 2	21 38 29 24	5 25	19	24	18	17	16	17
24	22	23	30	27	23	21	21	24	26	22	25	28	23	25	30 3	2 38 25	31	20	27	21	19	17	21	21	25
	30] 40	29										47			40			28	32		
192	3 45 2	9 28	24	32 5	2 53 3	1 41 3	2 26	30	23	27	34_	29	29	32	31 3	3 49 32	2 28	26 3	0 48 4	0 28	2.4 2	7 41 4	8 39 2	8 27	24

100 Ft.

FN-20-1(20)--21-97 Des. No. 369

Location: U.S. 20 Over Elliott Creek WB Bridge

Year Overlaid: 1970



Conc.	Test Location										
Depth Inches	Α	В	С	D							
	10.01	2.95	10.58	0.99							
0.50 —			17.71								
	0.74	0.27	4.08	0.10							
1.00	-										
	0.23	1.50	0.87	0.40							
1.50	46 34	Old Deck									
1	0.07	3.89	0.33	0.30							
2.00 —				-							
	0.40		0.30	0.21							
2,50	Old Deck			_							
-			0.20	0.34							
3.00											
-											
3.50 —	0.33										
	De 2										
4.00											
Jac de v	1 / 14 7										

Woodbury County
FN-20-1(20)--21-97 Des. No. 369
Location: U.S. 20 Over Elliott Creek W.B. Bridge
Year Overlaid: 1970



Core #1



Core #2



Core #3

Plymouth County

FN-3-1(8)--21-75

Des.No. 271

Location: IA. 3 Over Mink Creek

Year Overlaid: 1971

Bridge Deck Dimensions
Width - 26 ft.
Length - 125 ft.

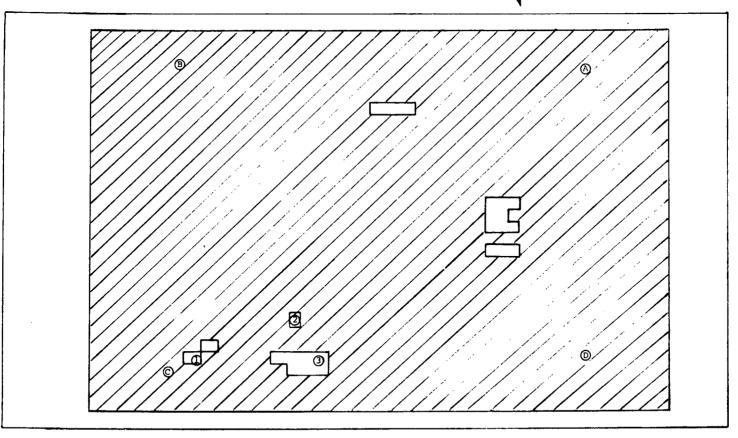
Deck Area - 3,250 ft.²
Delaminated Area - 40.63 ft.²
% Delamination - 1.25%



Indicates areas where Electrical Potential Readings were taken Details next page

Letters indicate chloride cores.

Numbers indicate delamination cores.



Not To Scale

Plymouth County

FN-3-1(8)-21-75 Des. No. 271

Location: Ia. 3 Over Mink Creek

Year Overlaid: 1971

Electrical Potential Negative Voltage - Copper Sulfate Half Cell Detail Sheet

2.0		43		. 1	42.4	12	12 1	2	4 5	20	40	47	5 1	5.2	40	17 (50 5	56	5.0	52	53	47	44 4	42 4	11 42	39	9 44	40 4	4 4	13 46	5 5	3 48	3 4	3 39	38	39	41	43	46	48	46	49	49	42 4	0 42	42	40 4	0 3	7
39	411. '									20				32	41		44 44		35	٠.	39		37		33	35		39		37	4		4		32		35		37		36		36		4	34		4	
	3 1		33		30		31		36 30		37 32		3 7 29		28		31			36			29		.5 26 [-2	,	291	2	28	3	3	3	0	31	31	35	32	34		26		24	2	5	25	2	27	
	24		31	•	32		30				32		29		20		31			30											2	9					34												
	2/3	:	28	:	29		31 3		32 36	30	33		26		25		28						29	2	24	2	7	31	;	30 3:	2 3	5 32	2 3	1	3 1		34		32		23		20	1	.9	21	, 2	2 3	
					32				27		3%		27	22	2.2		32		36	20	3.7		32) R 37	3:		33 43		29 38 45		5 4 4]	3 1 3	8 38	3 32		34 42		33 36	35	32		26	2	17	25	ĩ	2 7	
	28		27 .		36 3 35	32	3 L		2 /	32	35 27		36 33	32	23		32		33		32		32		.0 3.			32		29		6	3	4		\equiv	31		33										
	24	:	28	:	25		32		31		31		30		26		28	33	35	36	32		29	:	28	2	В	33	;	31	3	2 29	9 3	5 38	3 29)	29		28		29		24	2	23	23	7	72	
	217		25		28		33		22	22.	25 - 35		25 38	33	33		29 37		39 38		36 38		31	:	28	2	7	30		28	3	11. 3	-	2 5 30	36)	30	ı	32	35	26 35	33	34	2	26	27		30	
	2/									32	33	_7°	38		45		4.7		·4 1-				38		37	3	7	38		35	3	19		18	42		49		56		52		43	_	35	35] 35	
40	310 44		38 48 -		37 48 <i>4</i>		41 41 3	٤٤	41	40	41	41	40	39	40	14	45	47	44	38	40	42	40	40	43 4	1 4	1 40	40 4	40	40 4	4 4	2 4	3 4	1 4	1 44	48	49	47	44	40	41	43	41	41 4	11 39	40	38 4	4 0 4	, I.

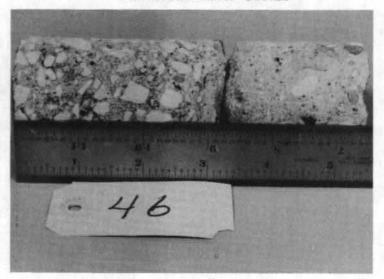
100 Ft.

Plymouth County
FN-3-1(8)--21-75 Des. No. 271
Location: Ia. 3 Over Mink Creek
Year Overlaid: 1971



	State Mary	Chloride Content	t - Lbs/cu.yd.	
Conc.		Test Loc	cation	
Depth Inches	A	В	С	D
	6.43	8.58	6.84	3.49
0.50	2.99	4.95	1.47	0.84
1.00				
	0.74	1.81	0.47	0.87
1.50	1			
2.00	0.77	0.43	0.67	2.11
2.00	Old Deck			4.99
2.50	1,11	0.54	2 .21	Old Dec
		Old Deck	Old Deck	3.48
3.00				
3.50		3.49	4.08	
4.00	A ST.			

Plymouth County FN-3-1(8)--21-75 Des. No. 271 Location: IA. 3 Over Mink Creek Year Overlaid: 1971



Core #1



Core #2



Core #3

FN-3-1(8)--21-75

Des. No. 171

Location: IA. 3 Over W. Branch of Floyd River

Year Overlaid: 1971

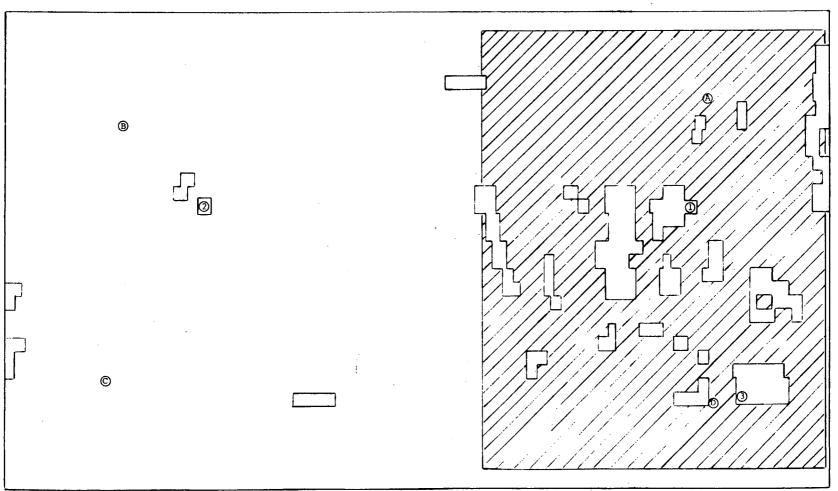
Bridge Deck Dimensions Width - 26 ft.

Length - 240 ft.

Deck Area - 6.240 ft.²
Delaminated Area - 327.75 ft.²
% Delamination - 5.25 %

Indicates areas where
Electrical Potential Readings
were taken
Details next page

Letters indicate chloride cores. Numbers indicate delamination cores.



Not to Scale

Blocked out areas indicate delamination

A-51

Plymouth County

FN-3-1(8)--21-75 De

Des. No. 171

Location: Ia. 3 Over W. Branch of Floyd River

Year Overlaid: 1971

Electrical Potential Negative Voltage - Copper Sulfate Half Cell Detail Sheet

24	25	24	26	30	37 39	43 4	7 39	39 4	2 37 4	4 37 45	52 6	3 64 6	3 57 5	6 56 5	57 53	50 56 60	54 5	9 51 5	5 53 5	3 51	46 51 5	0 40	19 43 41	42 4	4 42 م	- 49
L	1				1.5	18	3	16	17	19	24	34	30	22	24	25	21	21	25	22	31	23	20	21	26	29
1 3	15	18	17	12	15	2	1	15	14	15	25	28	18	16	16	۲1-	17	18	19	16	20	1.7	15	14	רליון	20
14	25 I	22	17	25	23	20	0	22	21	23	21	25	24	23	28		23	25	26-	20	21	22	19	22	722	23
12]		19	15	17	1	7	24	⊐ 21 —	21	34	34-	34	26	20	17	24	19	16	14	29	32	17	15	12	33
13	13	20	16	20	21	19	<u>_</u>		23	19	_23_		24		18	19	24	16	16	18			15 _	15	. 13	3,3
	13	16	15	14	12			14	16	12	j 17	16	14	20	16	19	14	⊐	21 [ב. 21 ר	15	11	10	11	11	28
	13	10	13	1.1	12		•		• • •		14	,,						_]		L				18	13	3 3
18	20	32	22	24	22	25	5	31	., .	30 1	38.	05.054	21	26	27	18	18	13	10	18	19	25	21 29	39 4	3 40 41	. 5,2

100 Ft.

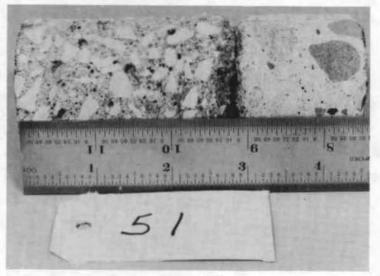
Plymouth County
FN-3-1(8)--21-75 Des. No. 171
Location: Ia. 3 Over W. Branch of Floyd River
Year Overlaid: 1971



Conc.		Test Loc	ation	
Depth Inches	A	В	С	D
0.50	2.56	2.32	2,12	3.28
1,00	0,63	0.53	0.42	0.79
	0.62	0.63	0.59	0.91
1.50 _	0.62	1.46	1.16	0.33
2.00	0.39	Old Deck	Old Deck	Old Deck
2.50	0.46 7///////////////Old Deck			- 16
3.00	0.36			2

Plymouth County FN-3-1(8)--21-75 Des. No. 171

Location: IA. 3 Over W. Branch of Floyd River Year Overlaid: 1971



Core #1



Core #2



Core #3

Location: Ia. 3 over Little Sioux River

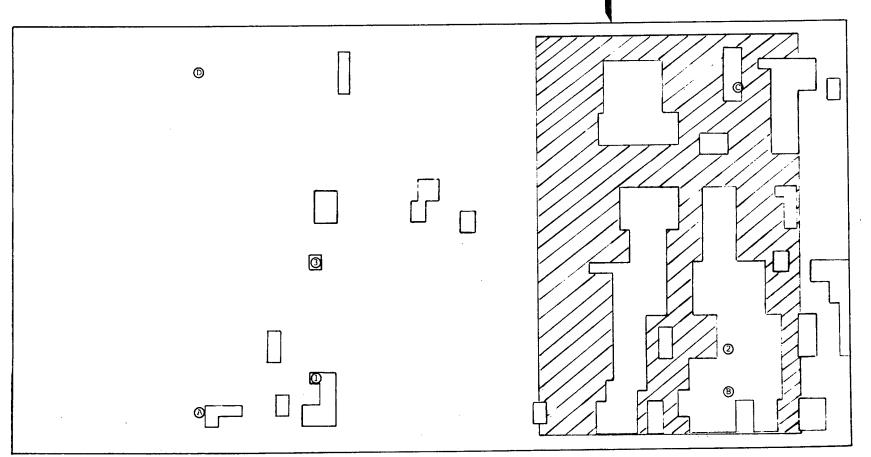
Year Overlaid: 1972

Bridge Deck Dimensions Width - 30 ft. Length - 320 ft.

Deck Area - 9,600 ft.² Delaminated Area - 1,296 ft.² % Delamination - 13.5%

Indicate areas where Electrical Potential Readings were taken Details next page

> Letters indicate chloride cores Numbers indicate delamination cores.



Not to scale

Location: IA. 3 Over Little Sioux River

Year Overlaid: 1972

Electrical Potential Negative Voltage - Copper Sulfate Half Cell Detail Sheet

32	30	33 3	2 40 3	6 48 40	41 4	0 40 46	43 39	38 41	40 33	36 3	4 28	34	36 36 4	4 43	38 38	41	38 37	32 35	43 43	35_38	32	33	31	25	34	3:
			44	46	36	43	33	32	28	31" "		\neg	39	30	37	,	34		47	33			7		•	
25 25	24	26	26	30	24 3	6 38 27	27	25	25	27	23	22	21 35 2	0 25	20 35	25	26	24	30	_23J	29	32	22	24	24	2
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3)1	28	22	26	30	26	32	28	31	_28	27	30	20	25 2	25 38	21_26		32	32	20	22		36	ـ ا			
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22	20	22	23	23	24	28	29	33	28	23				21				١				44		ļ		
26	21	21	26	19	20	32	25	26	19	21	18	22		23	25	<u> </u>	28	_] 23	20	27	18 22	40 24	18	18,	18	l
26	21	/1	39	1.9	36	32		31	32 Г	23	10	30			_ ا		-	25				22				
41-38		32 3		84 30 30	37 3	——∠£— 8 39 34	43 40	36 35	45 37	35 4	1 28 35	7-	 29 33—	33	ם 2'	7	32 32	45 30	25	27	27	24	30	1 34	34	2

100 Ft.

Cherokee County

FN-3-2(7)--21-18 Des No. 172

Location: Ia. 3 Over Little Sioux River Year Overlaid: 1972



Conc.		Test Lo	cation	
Depth Inches	Α	В	С	D
- 1-	4.31	6.88	8.28	6.96
0.50 -			-	
	0.53	6.09	1.92	2.65
1.00 -		old Deck		
+	0.56		4.19	5.97
1.50	The state of	9.05	Old Deck	Old Deck
-	3.86		Old Deck	6.62
2.00 _	Old Deck		7.94	4-171
	5.63			
2.50 —	5.63	-		
-	1 1 2 2 2 2 2 2			
3.00 —				
	P. P. S. S.			

Cherokee County

FN-3-2(7)--21-18 Des. No. 172

Location: IA. 3 Over Little Sioux River

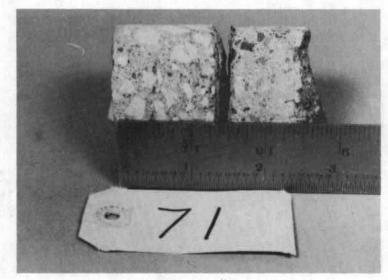
Year Overlaid: 1972



Core #1



Core #2



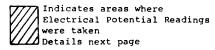
Core #3

Cherokee County FN-59-7(14)--21-18 Des. No. 272 Location U.S. 59 Over Gray Creek Year Overlaid 1972

Cherokee County
FN-59-7(14)--21-18 Des. No. 272
Location U.S. 59 Over Gray Creek
Year Overlaid 1972

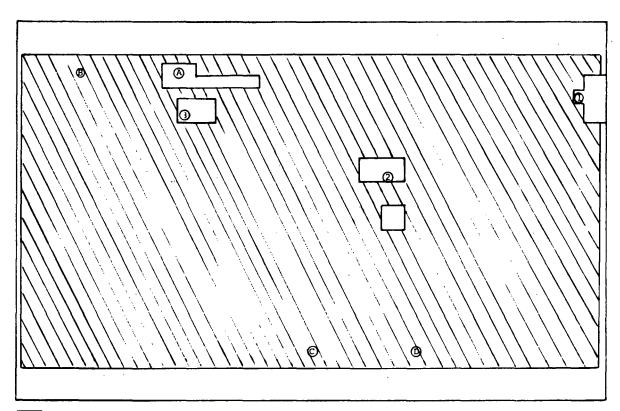
Bridge Deck Dimensions
Width - 24 ft.
Length - 102 ft.

Deck Area - 2,448 ft.²
Delaminated Area - 53.25 ft.²
% Delamination - 2.18%



Letters indicate chloride cores.
Numbers indicate delamination cores.





Not to scale

FN-59-7(14)--21-18 Des. No. 272

Location: US 59 Over Gray Creek

Year Overlaid: 1972

Electrical Potential Negative Voltage - Copper Sulfate Half Cell Detail Sheet

49	30	30	33 ?8	42 41				1.1	27	42 49
40-31	1 - 39-27-3132-	30-35-31-28-3	3 -3 -43-3-3	<u>4-43-35-34-33-</u>	 30 	-33 30	2723283 6-	- 17-27-32-29-27-	— 28-27-15-25-	25-30-35-42-52
 3,7	30	37	35 36	33 33		35		39 27 27	26 37	33 47
2,7	31 33 29	37 38 30 27	31 39 36 41 3	1 38 35 32 33	32 78	36 34 32	23 25 30 33	10 36 33 30 35 35 39 3	3 36 77 79	25 21 35 45 51
	45	29	ne 36	35		28	31 34	48 30 -29	25	32 34 50
3,0	27 28 43 25 25	24 30	27 25 39 3	6 35 41 27 26	25	?5 32 30	6 32 32 39 32 36 42	46 36 30 27 32	22 25.25	36 24 27 32 50
	35		12	39			43 7327	50		29 52
27	24 27 35 25 26	22 29	30 32 3	35 35 40 30 32	24	25 31	28 31 27 37	40 35 27 28 32	21 25	33 27 34 46
	36			38			26	39		49
28 	26 27 37 23 23	26 29	30 29 3	33 40 38 31 34	30	30 34 3	3 37 28 34 26 36	42 39 28 28 27	27 27	30 31 40 47
3.0	39 42	33	33	45		34 31	44 38 28	39 32 29		39 52
36-31	2-43-32-43-35-33-	33_3_39	13_37_40_32_4	16_48_5?_3134	33_31	37_ 26 _36_3	0_38_38_40_38_38_42	_35_44_37_39_35_34_34_	25 33_33_	40_34_33_45_51
40	34 33	. 37	41	44		29 34	28 31 42	39 37 34		46 46

100 Ft.

A-

Cherokee County
FN-59-7(14)--21-18 Des. No. 272
Location U.S. 59 Over Gray Creek
Year Overlaid 1972



Conc.		Test	Location	
Depth Inches	A	В	C	D
0.50	3.31	9.07	9.29	8.77
1.00	0.39	2.19	5.37	1.72
	0.20	0.79	2.52	0.66
1.50	0.66	0.33	1.92	1.13
2.00	4.42	1.23	3.38	Old Deck
2.50	Old Deck	0.84	6.88	3.45
3.00	4.54		01d Deck	
3.50				FAR TO

Cherokee County FN-59-7(14)--21-18 Des. No. 272 Location: U.S. 59 Over Gray Creek Year Overlaid: 1972



Core #1



Core #2



Core #3

I-35-2(129)69--01-77

Des. No. 273

Location: I-35 Over Raccoon River Northbound

Year Overlaid: 1973

Bridge Deck Dimensions
Width - 28 Ft.
Length - 656 Ft.

Deck Area - 18,368 ft. 2
Delaminated Area - 0.00 ft. %
Delamination - 0.00 %

Polk County

I-35-2(129)69--01-77 Des. No. 273

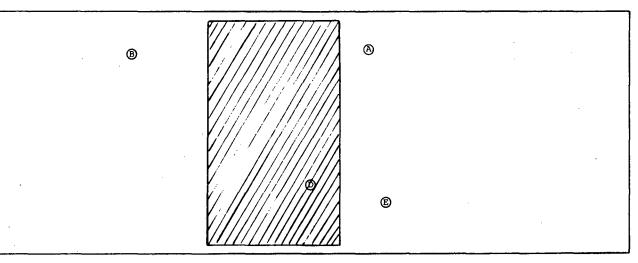
Location: I-35 Over Raccoon River Northbound
Year Overlaid: 1973



Indicates areas where Electrical Potential Readings were taken Details next page

Letters indicate chloride cores.

2



Not to Scale

I-35-2(129)69**--**01**-**77

Des. No. 273

Location: I-35 Over Raccoon River Northbound

Year Overlaid: 1973

Electrical Potential Negative Voltage - Copper Sulfate Half Cell Detail Sheet

	34	30	29 3	2 38 2	5 28	31	29 2	9 46 2	9 28	28 3	30 37 2	8 30	34	29	27	26	28	30	24	25	28	32	30	27	32 28	38 24	7
				28				25		• •	23	25	2.1	17	17	21	20	20	20	20	21	20	22	19	26	2] 2 1	9
	23	34	20	25	19	21	18	24	18	19	19	25	21	17	17	21	20	20	20	20							42
	21	22	21	20	21	23	24	24	18	17	19	25	21	23	21	22	18	19	14	17	19	16	23	18	17	29	
26 Ft	2]	23	20	19	18	21	21	16	17	20	18	21	17	16	22	14	23	17	15	11	13	14	15	14	19	17 	
2	15 .	23	19	19	23	27	22	18	17	22	22	24	16	18	20	13	13	13	13	1 2 19	09	11	12	11	13	14	
	21	1,8	23	23	24	31	18	2.7	20	18	18	30	22	29	19	16	17	17	23 1	7 41 1: 16	2 10	15	15	18	13	15	
	25	21	30	28	30	23	22	18	18	18	18	19	20	21	25	21	19	. 18	22	12	11	13	20	12	17	19	
	35			35			34				20					23											
2	7 42 3	2 27	32 2	9 38 3	38 34	34 2	28 46 3	35 31	19	21	33 41 3	3 32	25	34	26 2	1 36 2	25 27	19	27	16	15	29	23	14	25	_22	

100 Ft.

I-35-2(129)69--01-77 Des. No. 273

Location: I-35 Over Raccoon River Northbound

Year Overlaid: 1973

	-		and a second	1	4
				-	
-	-	-	-	-	100

Conc.			Test Location		
Depth Inches	Α	В	с	D	Е
-	3.61	8.77	10.81	5.78	7.41
0.50-					
-	0.26	0.49	1.19	3.97	0.33
1.00-					
-	1.69	1.26	2.65	0.26	0.5
1.50_	1,924,999Kin		mmumm Old Deck		
	4 12 2 1	4.76	01d Deck	0.20	3.78
2.00-	1.99	Old Weck	4.76		रहाक् क्राइस्टर
		4.69		0.20	Old Deck.
2.50-				0.20	5.78
25.	1			1.33	-
3.00_				Old Deck	11
1	1 4				
3.50_		100		2.19	
	1000			44, 1	175

A-6

FN-65-5(5)--21-85 Des. No. 172

Location: U.S. 65 Over U.S. 30

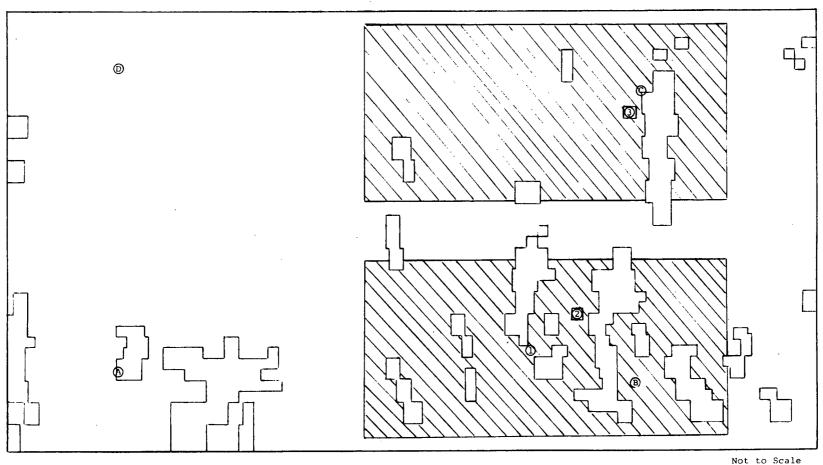
Year Overlaid: 1972

Bridge Deck Dimension Width - 30 ft. Length - 224 ft.

Deck Area - 6,720 ft.² Delaminated Area - 650.13 ft.² % Delamination - 9.67%

Indicates areas where Electrical Potential Readings were taken Details next page

> Letters indicate chloride cores. Numbers indicate delamination cores.



Story County

FN-65-5(5)--21-85

Des. No. 172

Location: US. 65 Over US 30

Year Overlaid: 1972

Electrical Potential Negative Voltage-Copper Sulfate Half Cell Detail Sheet

27	3.4	20	72	19	10	31	-3.5	- 3-4															1
Ti .	24	20	20	19	19	21	22	24	24	29	26	22	25	., 5	25 -	33 3	9 37 3	36 46 42	43 36 34	22 19	33	24	24
	30																26	23	46				
21 36	35 37	22	30	26	17	19	19	21	24	20	. 19	19	27	1.8	17	20	30 3	32 35 34	40 38_25	22 19	17	19	19
	38	21				16									24			32	40	. L.,			
26 	28 31	4,1 27	2.	34	16 15	36 28	21	16	19	27	18	21	20	16 15	48 16	34	32	32 34	46 28 29	17	16	15	18
<u> </u>	32	29		ن 3		21									41				40	<u> </u>			
2 <u>7 22</u>	35 28	22	30 24	39 24	18	32	21	19	20	20	25	22	16	16	33	21	33	21 25	36 3 3n	14 18	20	· 19	2\3
	. 32 .	•		43		·	-												38				

* Represents NW Cross Hatched Area

100 Ft.

	32	•	38 46
30-2	6-37-32-21-3433-	2618193 3	-22-28-19-22-28-29-32-22-33-39-23-40-24-21-22-28-23-25
ļ	36	31 <u>48</u>	33 41 37 35
29	29 25 21 23	25 38 39 27 19 15 23 43 41 23	26 31 32 23 42 31 32 31 37 49 26 30 25 35 36 23 30 22 27 25 28
ļ	28	L24-1 L1 L37-1	34 24 32 32 32 40 27
34 2	1 39 31-21 34 19	22 29 20 25 26 25	31
30	43 48	28	22 39 37 36 34 35
32 <u>36 2</u> 1	8 42 40 33 28 45 25 25	28 30 21 27 27 44 39 25	23 27 24 27 27 39 39 25 23 -27 25 39 29 32 36 37 31 34 32 31 25

** Represents NII cross Hatcher - ----

.00 Ft.

Story County

FN-65-5(5)--21-85 Des. No. 172

Location: U.S. 65 Over U.S. 30

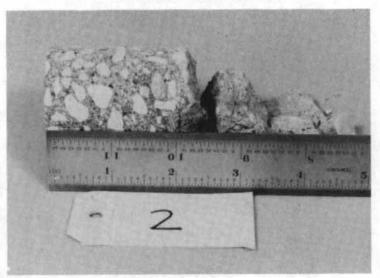
Year Overlaid: 1972



onc.		Test Loc	ation	
epth nches	A	В	С	D
	20.11	21.32	22.11	21.69
0.50				
	10.00	14.01	10.00	22.22
	19.09	14.21	18.09	22,37
1.00				
	4.65	10.47	15.96	19.95
1.50 —	Old Deck		014 beck	min neck
	Old Deck	12.20	02.7 NOCK	0.4.4604
23737		12.39	11.98	
2.00	11.23	FE HE	11.98	7.37
and the		14.40	1	
2.50 —		Old Deck		
		Old Deck	1 1	
4		1 1		
3.00 —	4		A 4.1	N
		6.05	3 7 3	917
3,50		150		

A-6

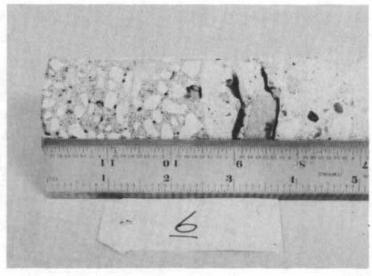
Story County
FN-65-5(5)--21-85 Des. No. 172
Location: U.S. 65 Over U.S. 30
Year Overlaid: 1972



Core #1



Core #2



Core #3

I-35-2(129)69--01-77 Des. No. 273

Location: I-35 Over Raccoon River Southbound

Year Overlaid: 1973

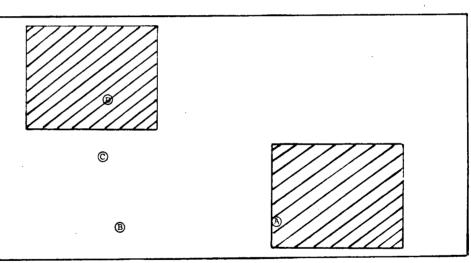
Bridge Deck Dimensions Width - 28 ft. Length - 656 ft.

Polk County Des. No. 273 1-35-2(129)69--01-77 Location: I-35 Over Raccoon River Southbound Year Overlaid: 1973

Indicates areas where Electrical Potential Readings were taken Details next page

Deck Area -18,368 ft.² Delaminated Area - 0.00 ft. 2 % Delamination - ∩.00 %

Letters indicate chloride cores.



Not to Scale

I-35-2(129)69--01-77 Des. No. 273

Location: I-35 Over Raccoon River Southbound

Year Overlaid: 1973

Electrical Potential Negative Voltage-Copper Sulfate Half Cell Detail Sheet

	D																									
24 24		19	19_	20	19	20	19	24	23	20	23	18	29 21	22	23	18	17	20	19	21	28	23	23	26	20	16
2 14	;	24	25	31	29	34	28	23	26	25	26	24 29	3524	29	25	25	19	24	20	27	20	25 -	28	26	23	18
i.													21													Ĩ
ļο)	24	22	19	17	30	21	20	20	23	20	21	25	21	19	21	19	23	16	28	20	22	21	24	22	 18
			27		28																					I
30)	31 30	35 36	5 25 3	138 ?	9 3 0	20	26	25	16	30	21	33	26	20	24	21	25	15	18	19	21	23	20	17	\mathbb{T}_7

Represents N.E. Cross Hatched Area

100 Ft.

	**																									
	17	20	26	28	18	15	16	15	15	14	14	16	23	18	14	.15	16	25	18	10	10	16	17	1 -,	7.7	<u> </u>
rt.	20	21.	23	24	27	18	16	13	14	13	15	15	15	15	14	14	16	16	19	. 15	16	19	21	19	18	31
71	9	21	33	20	18	16	15	14	14	14	16	15	16	16	15	15	15	17	19	15	15	17	18	20	1.7	27
	31	34	?4	22	25	27	22	2	16	20	21	22	22	26	20	16	15	22	15	20	15	21	19	24	23	

**Represents S.W. Cross Hatched Area

100 Ft.

Polk County

I-35-2(129)69--01-77 Des.No. 273

Location: I-35 Over Raccoon River Southbound

Year Overlaid: 1973



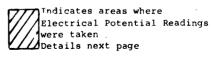
Conc.		Test Lo	cation	E COMMON TOWN
Depth Inches	A	В	С	D
-	6.04	9.11	9.75	8.69
0.50	-	H. L. TH	_	
	1,34	0.94	3.08	1.98
1.00 —	-	-		
	1.09	0.78	3.97	1.31
1.50	Old Deck	4 7 7 7	Old Deck	Old Deck
1		0.91	100	
2.00			3.42	0.66
-	5.48	0.81		
2.50—		Old Dec		They a
3.00 —		1,16		47 6 8 7
				1 1 1

Year Overlaid: 1973

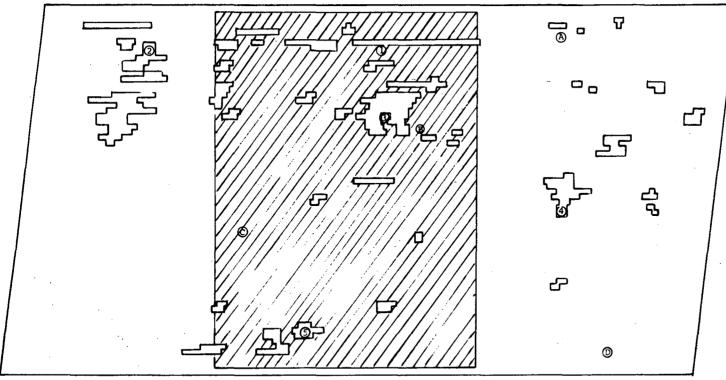
Bridge Deck Dimensions Width - 52 ft. Length - 860 ft.

Deck Area - 44,720 ft.²
Delaminated Area - 669.75 ft.²
% Delamination - 4.86% *

* 52' x 265' Test Section in Westbound Lane From East Abutment to First Expansion Joint



Letters indicate chloride cores.
Numbers indicate delamination cores.



Not To Scale

Blocked out areas indicate delamination

A-/3

I-235-2 (134)81-01-77

Des. No. 573

Location: I-235 Over Des Moines River Westbound Bridge Year Overlaid: 1973

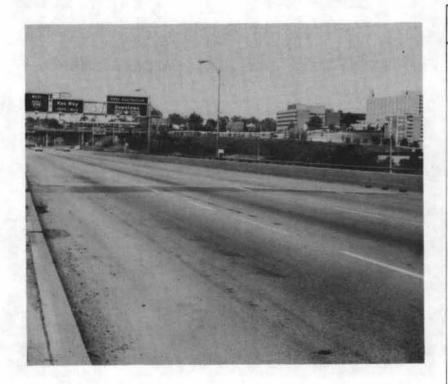
Electrical Potential
Negative Voltage - Copper Sulfate
Half Cell
Detail Sheet

3 6 35	31 35 2	9 27	30	34 3	32 38 3	1 28	31	30	30 3	0 37 32	40 3	28 26	28	27 28	39 2	7 26	24	31	20	25	25	30 30	37 29	24	26
24	37	г-			3€				29	30	34			ב	24			·					25		_
17	28	29	24	32	□32	22	27	30 2	6 36 2	1 24	31	26	2.7	- 23	_29	30	_26	_27	31	-30	-20	2 2 _	28	—25 ——	— 25
L								-	. 22						<u></u>									28	
34. L	23	32.	25	28	26	21	22	19	22	23	28	24	26	22 L	24	34	25	30	32	28	25	25	25 1	7 37 30) 25
		7																		72			21	28 21	
22	20	28	19	20	32	19	22	20	_[2].	27	27	27	[20	20	32	24	-31	3 <u>1_5</u> 1_	35 12 14	25	19	21	21	18
							0.1	22	28	26	28	19			28	28	21	26	2 5	20	19	22	31	27	17
28	21	24	30	21	25	20	21	22	26	20	20	19	2/	Τ΄,	20 ل	ميُّتِّ	7	5						コー	
20	19	19	17	. 15	17	14	16	15	17	16	17	28	19	19	25	 24	17	23	18	19	20	13	 . 30	15	12
1	1,	17	1,	. 13	• '		10														1.4			14.	
16	27	17	20	17	18	24	17	15	18	28	24	26	25	-34	 29	-24	28	25	20	24 23	38 39	24	21 1	9 35 25	5 23
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2 1.	20	29	24	24	26	33	28	28 2	4 40 2	7 29	27	28	28 35	36 2	27	28	<u>32</u>	25	24	22	29	20	23	24	26
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2 3	27	30	31	30	26	29	27 ا	29	34 3	4-35-2		34	29	26	26	19	23	32	27 31	38 22	21	23	27 2	5 38 24	4 26
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28	22 .	28	28	26	27	25	27	26	.27	26 3	3 35	26 34	31 4	1 36 3	2 41 3	6 31 4	39 30	J 25	30 .	28	23		2.5		'ئشس

100 Ft.

I-235-2(134)-81-01-77 Des. No. 573 Location: I-235 Over Des Moines River Westbound Bridge

Year Overlaid: 1973



	1	Chloride Conten	t - Lbs/cu. yd.	100
Conc.		Test Lo	cation	1 19
Depth Inches	A	В	c	D
7.	8.47	10.17	8.01	6.19
0.50				
100	0.20	0.66	3.02	0.79
1.00	111111111111111111111111111111111111111		old beck	
-	4.46	4.01		0.13
1.50	Old Deck	monning	4.84	-
1		2.86		0.19
2.00 —	5.78	100		
1		1 4 5 7		0.13
2.50 —				
4				0.2

I-235-2(134)81-01-77 Des. No. 573

Location: I-235 Over Des Moines River Westbound Bridge

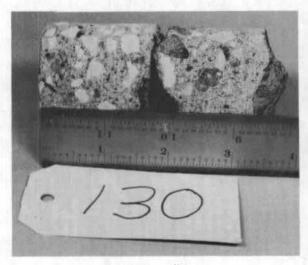
Year Overlaid: 1973



Core #1



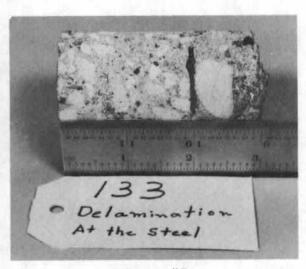
Core #2



Core #3



Core #4



Core #5