WA-RD 87.2

Cathodic Protection For Reinforced Concrete Bridge Decks Yakima River Bridge 24/5

Demonstration Project 34

Post Construction Report

April 1986



Washington State Department of Transportation Planning, Research and Public Transportation Division

In Cooperation With
United States Department of Transportation
Federal Highway Administration

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12. Sponsoring Agency Name and Address		13. Type of Repo	ort and Period Covered
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Demonstration Project No. 34 Cathodic Protection for Reinforced Concrete Bridge Decks Yakima River Bridge No. 24/5

BY
TOM H. ROPER
EDWARD H. HENLEY, JR.
BRIDGE AND STRUCTURES BRANCH

Post Construction Report
Demonstration Project DTFH 71-85-34-WA-12

PREPARED FOR

Washington State Transportation Commission
Department of Transportation
AND IN COOPERATION WITH
U.S. Department of Transportation
Federal Highway Administration

The contents of this report reflect the views of the author(s) who is (are) responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Washington State Transportation Commission, Department of Transportation of the Federal Highway Administration. This report does not constitute a standard, specification, of regulation,

TABLE OF CONTENTS

		Page
Synopsis		
Vicinity Map	• • •	1
Project Planning	• • •	2
Project Planning	• • •	3
Project Design		3
Project Construction		3
Problem Areas		4
Conclusions	· • •	5
Appendix A (Bridge Deck Survey Report)		7
Appendix B (Contract Special Provisions)		28
Appendix C (Project Change Orders)	• •	20
Appendix D (Project Photographs)	• •	33
premark D (k toject Filotographs)		40

SYNOPSIS

Under FHWA Demonstration Project No. 34, "Cathodic Protection for Reinforced Concrete Bridge Decks," a non-slotted cathodic protection system was installed on the deck of the Yakima River Bridge 24/5, near Yakima, Washington, in the summer of 1985. The project involved repairing the deck, then fastening Raychem pre-manufactured anodes to the deck to impress current to the top mat rebar. Impressing current through the concrete to the top mat steel prevents further corrosion of the steel. A latex modified concrete overlay was placed over the deck anode.

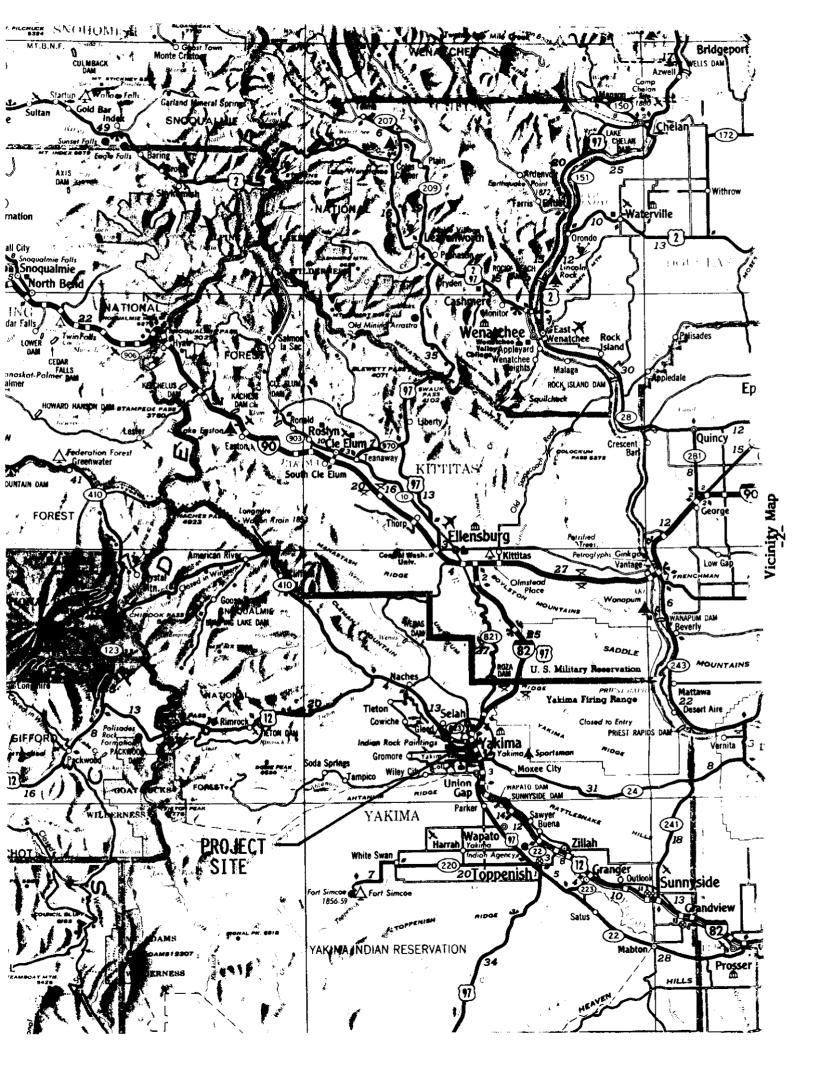
The objective of the demonstration project was to familiarize the Washington State DOT with this new technology. This objective was fulfilled.

Some problem areas with the system were identified during the work:

- 1. A more positive method of finding electrical grounding locations from the anode to rebar nicks, ties, etc., needs to be developed. Some ties were exposed during the scarifying operation. Perhaps an instrument can be used to supplement visual inspection.
- 2. An effective technique of allowing concrete trucks to drive on the anode without damaging it needs to be developed.
- 3. An effective method needs to be developed to locate breaks in the anode as well as shorts.
- 4. In remote areas, sources of electrical power may not be available. It will be necessary for sources of power, such as solar panels or long-lasting batteries to be developed for this system.
- 5. Since the project, once it has started, moves along very rapidly, there is very little time for on-the-job training of workers. Workmen should have prior experience at this work.

These problems need to be overcome to obtain a better quality product.

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



PROJECT PLANNING

The deck of the Yakima River Bridge No. 24/5 needed extensive repairs, including a suitable overlay. Per the WSDOT policy concerning overlays, latex modified concrete was selected for the bridge. Since the bridge is a box girder bridge, the top slab is a part of the longitudinal girder system. Deterioration of the top slab could result in a reduced load carrying capacity, and in the extreme case, a structure failure. It was therefore desirable to give the bridge deck maximum protection against corrosion.

Through Demonstration Project No. 34, the FHWA has encouraged the use of cathodic protection. WSDOT elected to install a non-slotted cathodic protection system. The system manufactured by Raychem appeared suitable for the bridge.

PROJECT DESIGN

For this special project, it was considered desirable to contract the work by performance specification rather than detailed plans. This provided the contractor with some flexibility in accomplishing the work, and established his responsibility for the final product. Per special provisions, suppliers of the system were limited to those firms that had demonstrated expertise in the cathodic protection field. Supervision of the work by a licensed engineer (NACE qualified) was required by the contract.

Submittals by the supplier of the system included a project proposal, shop plans, maintenance and operation manuals, and as-built drawings. All submittals were subject to engineer approval.

PROJECT CONSTRUCTION

General Description: This bridge is a box girder bridge 31½ feet wide and 600 feet long. The bridge is a two-lane structure. It was necessary during this project to keep one lane open to traffic at all times. This complicated the construction somewhat.

The first phase of the project was to scarify the deck %-inch to remove surface contaminants such as oil and grease. The deck was then chain dragged to locate delaminations. Delaminated areas were marked out in red paint on the deck. Many of the previously patched areas were again delaminated.

Next, pneumatic equipment was used to remove the delaminated areas per contract special provisions. Premixed fondu was used to repair the delaminated areas by hand. This patch material was found somewhat unsatisfactory, since it came loose under traffic around the periphery of the patch. Extra patching was therefore necessary.

Expansion dams were found loose in some cases and were epoxy injected. This item of work was not foreseen in the contract and had to be performed under change order.

Cutouts were made in the deck to install the reference cells and rebar probes. In this project, deck instruments were used to monitor the system, not to control the system. The deck was further prepared by sandblasting.

The deck was then ready for the installation of the cathodic protection anode. The first step in the process was to fasten the panel mounting rod to the deck near the curb line. This rod served to hold down and align the ferex anode strand. Next, the ferex anode panels were rolled out on the deck. The panels came in large rolls wrapped in plastic. These pre-manufactured anodes are basically copper wires coated with a conductive polymer. The anode wire looks like regular electrical wire. The ferex anode was manufactured by the Raychem Company. To our knowledge, this is the only company that makes this type of anode.

Next, the anode panel was stretched to size and fastened to the deck with plastic fastener inserts. The deck was further cleaned by water blast just prior to pouring the latex modified concrete overlay. The Bidwell paving machine screed vertical alignment was tested prior to the LMC pour by moving the machine over the entire length of the bridge.

Night pour of the latex modified concrete was desirable because deck temperatures were cooler and traffic volumes were lower. Cooler decks mean less cracking of the LMC. Plywood on the deck was used to distribute the weight of the LMC truck on the anode. Some damage to the anode did occur, but it was quickly repaired. Slurry was brushed on the deck prior to placement of the LMC.

Latex modified concrete from the truck chute was deposited directly on the deck in front of the paver. Further spreading of the LMC by hand in front of the paver was generally necessary to ensure no voids would be left around the anode material. The last operation was to cover the LMC behind the paver with wet burlap. The wet burlap is necessary for curing the LMC. Curing for 96 hours was specified before restoration of traffic.

<u>Project Costs:</u> Bid prices for the cathodic protection system were \$130,000. Only two bids were submitted. This amounts to \$6.88 per square foot. This figure is comparable with other commercially available bridge deck cathodic protection systems.

Shop Plans: Cathodic protection shop plans submitted by the system supplier needed very few corrections. Most of the changes to the shop plans concerned details involving electrical equipment. All plans were returned approved or approved as noted from the Washington State Department of Transportation.

PROBLEM AREAS

Problem areas that need to be addressed for this system:

- 1. A more positive method of finding electrical grounding locations from the anode to rebar nicks, ties, etc., needs to be developed. Some ties were exposed during the scarifying operation. Perhaps an instrument can be used to supplement visual inspection.
- 2. An effective technique of allowing concrete trucks to drive on the anode without damaging it needs to be developed.

- An effective method needs to be developed to locate breaks in the anode as well as shorts.
- 4. In remote areas, sources of electrical power may not be available. It will be necessary for sources of power, such as solar panels or long-lasting batteries to be developed for this system.
- 5. Since the project, once it has started, moves along very rapidly, there is very little time for on-the-job training of workers. Workmen should have prior experience at this work.

CONCLUSIONS

For a first-of-its-kind project in the state, the installation went relatively smooth. This type of deck protection system appears to have promise for future projects. Some areas of concern, as listed in the "PROBLEM AREAS" section, need to be overcome to obtain a better quality product. Personnel involved in the project gained considerable experience with this type of work.

APPENDIX

APPENDIX A BRIDGE DECK SURVEY REPORT

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

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wept. of transportation daterials Laboratory P.O. Box 167 Olympia, WA 98504

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Job No. 🗸	-7774	SR 24	c.s		
Date Samp	led / -	13-84	Crew W/	205	
			REEDA	,	

Bridge YAKIMA RIVER BRIDGE	No. 24/5
Length 600 Width 30 Skew No Curve No	Sealed No
Stationing measured along Existing 2 STRIPE	
Beginning at WEST SIDE ON I	

PORTLAND CEMENT CONCRETE SAMPLES FOR CHLORIDE CONTENT ANALYSIS

SAMPLE	STATION	OFFSET (Feet)	SAMPLE DE	PTH REBAR DEPTH	CHLORIDE LB/YD3
	0426	3'27	1/2"-2"	"	2.09
<u> </u>	0+60	10'27	j		3.16
_3	1+38	927			5.83
2 3 4 5 6 7 8	1+71	725		· ·	0.71_
_5	2+41	10:27			14.11
6	2475	127			3.95
7	3 + 50	フンア			4.16
_ 8	3187	10'17			
9	4+46	227			2.34
10	4178	7'17			6.11
	5+40	10'27			2.97
12	5+75	3.17			3.03
13	0+16	11'87			4.51
14	0+47	7'87			4.8.5
15	1+58	1'87			2.77
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17	2+56	2'87	———		1:38

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DISTRICT MATERIALS ENGINEER BY

District Soils Engineer

A. J. Peters, P.E.

Proj. Engr. WASHBURN 2X

Hunziker 3-6-84

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

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SAMPLE	STATION	OFFSET	CAMPI C PROTEI	REBAR	CHLORIDE
		(Feet)	SAMPLE DEPTH	DEPTH	FB/AD3
18	2+94	10' RT	1/2"-2"	·	
19	3162	6'RT		·	(4.03)
20	3+89	1'87			7.51
21	4+24	11'85			3.40
22	4151	6' PT		•	3.23
23	4187	3'87			5.54
24	5+34	8'AT			6.60
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Yakıma Kiver Bridge

L-7774 Jan 13, 1984

station	offset	Longth	width	Avea
3+11	3.0 Rt	3.5	2.0	7.0
3+12	9.0 Rt	3.0	25	7.5
3+19	2.0 Rt	2.0	2.0	4.0
3 +18	3.0 Rt	2.5	2.0	5-0
3+16	8.5 Rt	2.0	2.0	4.0
3412	3.0 Rt	1.5	1.5	2.25
3+10	4.0 Rt	1.5	1.5	2.25
3+05	8.5 Rt	٦. ٥٠	2.5	6.25
2+94	2.5 RX	2.5	2.5	6.25
2188	3.0 Rt	3.0	2.5	7.5
2482	3.0 Rt	1.5	1.5	2.25
2+66	2.5 12+	3.5	1.5	5.25
2+64	8.5 Rt	6.0	3.0	18.0
2+59	3.5 RX	3.5	<i>⊋.</i> o	7.0
2458	6.5 Rt	2.0	2.5	5.0
2+55	25 Rd	٦.٥	2.5	6.25
1+70	40 Rt	26.5	<i>3.</i> 0	79.5
1+76	8.5 R	2.5	2.5	6.25
1+62	3.5 Rt	21.0	3.5	73.5
1+50	to et	1.5	1.5	2.25
1+46	8.0 Rt	2.5	2.5	6.25
0 + 45	3.5 DH	1.0	1.0	1.0
0+17.5	3.5 RH	38.5	3.0	115.5
0+17.5	8.5 Pd.	38.5	3.0	115.5
				5-24.5

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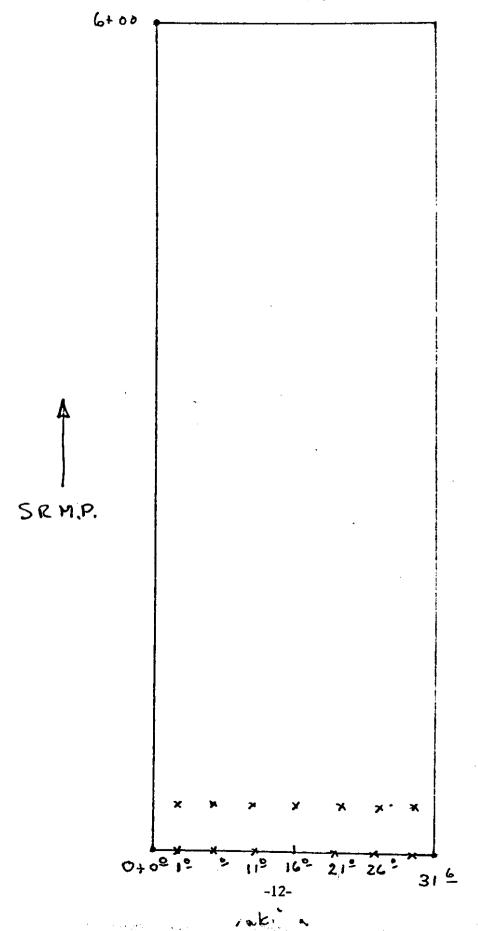
Yakıma River Bridge # 24/5

L-7774 Jan 13, 1984

0+00 = Westerly Pavement Seat. Cffsets measured left & right of existing &

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5+76	4.0 L+	2.0'		5.0
4 + 38	10.0 Lt	1.5	2.5	5.0
4+21	3.0 4	6.0	/. 5 ⁻	2.25
3 + 18	8.5 44	2.0	2.5	15.0
3 + 12	9.54	2.0	2.0	4.0
2+92	3.5 4		3.0	6.0
2+ 91	3.0 Lf	1.5T	1.5	2.25
2+70	3.0 Lt	1.5	1.5	2.25
2 + 68	10.0 24	4.0	2.5	10.0
2+64		2.5	3.0	7.5
1 + 85	3.0 Kf	2.0	2.0	4.0
1+85	8.5 4	1.5	1.5	2.25
•	2.0 4	2.0	1.0	2.0
1+72	3.5 4	2.0	2.0	4.0
1 + 68	3.0 4	3.0	2.0	6.0
1 + 63	3.0 44	2.5	2.5	6.25
1 + 59	9.0 At	1.5	1.5	2.25
0 + 56	3.5 4	3.5	2.0	7.0
0+46	3.04+	5.0	2.5	12.5
0 + 23	10.54	1.0	1.0	1.0
0 + 21	1.5 LF	42.0	3.0	126.0
0 + 18	10.0 Lt.	9.0	2.5	22.5
				255
3 +39	2.5 Pt	2.5	25	6.25
3 + 33	3.0 Rt	2.5	2.5	6.25
3 + 26	3.5 Rt	2.0	2.0	4.0
3 + 24	7.0 ist	1.0	1.0	1.0
3 +21	3.5 Rt	3.0	2.o	6.0
3+16	3.0 Rt	1.0	3.0	3.0
3+16	8.5 Rt.	1.0	2.5	25
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13+6,50	13+615-0-913-116-0-1/3-7-1/11-1/5-7-1/14-
13+7.0.1	3+7.0.11.6.19.8.15.5.1.7.9.99.2.2.1.0.95.01.
3+7.5-1	3+75-1,2,8-1,6,51,6,00,8,201,3,401,100
0 0 49 -1:	\$ 0.05.0.1.1.1.1.0.1.0.1.0.1.1.1.1.0.3.1.0.3.1.0.3.1.0.3.1.0.3.1.1.1.1
13+8,5.	13+8,51,0,51,0,11.1,2,4.1,5,3,0,4,1,3,9,1,4,4.
0.05+8	13+9.0.03.3.1.1.1.1.4.1.1.9.1.1.7.3.1.3.3.0.0.8.
13+9,5	13+9,5.05.6.0,8,3.11,6,2,3.6.1,1,9.2,1,51,1,2.
7-00+17	4+0,2.1,2,5.0,8,3.09.3,2,1.1.1,4,2.1,5,2.0,2,5.
2. 2. aty	
1.017+6	1,4+1.2.1,3,1.7,3,1,3,2.1,8,4.1,3,8.3,2,1.0,7,5.
1-14+1.5-1	144.51.613.1.618.1.518.218.21.5.71.1.55
1.0+2,0.1.	4+2,01,75,24,4,31,92,25,1,94 25,3.062.
1,42,5.1,	1.442,51,6,6,1,555.24,2,2,6,6.2,4,1.21,7.09.3.
17-512-1	1,4+3,0:10.9:1.8.5.26.4.4.4.4.20.2.24.2.
1 4+3 5.0	4+35.0.2.2.2.0.18.8 2.6.2.1.9.92.32 0.20
7.07.17	4442.1.23.1.5.8.2.1.7.1.7.02.02.1.0.1.
14/15/16	1,1+1,5.69.3.1,213.16.3.13.6.15.K.GO.30
1,03+/2	1450-1214-11-9-125-7-11-9-11-11-11-11-11-11-11-11-11-11-11-1
17+6 64	1546 5.1.1.01.13.3.1.4.71.3.1.3.6.1.9.4.2.8.31.

OCTIVE OF PRINKER ORDERED MATERIALS LABORATORY 96504 P. D. BOX 167 OLTEPIA, NA

HALF CELL POTENTIONETER TEST RESULTS

HURTES. LAB NO. SHEET

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ALL READINGS ARE ASSUMED MEGRIVE UNLESS CIRCLED

EXPANSION	OROUND OR										Gn1302¢											
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OFFSET FROM	E.	80	122 10-11.0-1.9.1 12.1.5 12.5.18 12.6.4 12.5.4 10.1.7	+ +5-1,2,3-1,9,5-2,4,7 .4.5-1 2.0,7 .4,4,0 .0,4,2.	12+70.09.0.24.5360 29.4.18.3.21.7.94.8	800	96,0	9171	21	4.6	25	. 115	24.7	4.4	5.2	34,15,02,4,13,0,1,6,2,2,1,0,1,5,0,3,0,0,7	2.3	10.8	. 9,90.	8.7	4.2.	3.7
OFFS	36 6	47 48	5.4.6	4.0.6	2.7.1	1,7,2,605	0, 29. 9, 26, 2	4.10.0.8.1	2.1.0.1.81	1.8.1.1.4.6	1 3+10 146 150 1123 21, 8.1, 3.2,0,5 025	13+12-1115-5-12-20-01-16,6,6,3200,511	3+ 10.1,0,2,3,5,3,1,3,8,2,2,9,1,9,2,3,0,1,94,7	13+ 5.091.21.0.1.7.8.022.1.62.2.35.14	193052	0,3,0	13+ 10.05.0.1.0,7.1.3.1.1.1.9.8.1.40.1.8.0.1.23	1.51	_ \	1,3,008,7	2.4.0.9.2	30037
	0	44 45	4 2	7.4.	3.	7.9		7.75	1.4.	5.7.6	3.20	6.3	3.2	7	2.7.0	0	217.0	4.1.	1.42,	7.1.5	20.12	1
	02/	142	.2.6	0	1.18	1.4	.7.5.	1,6,	.7.7.	.7.Z.	777	.7.6.	.67.	1917.	.7.7.	7.5	1.4	12	0.6	1.24	-97	1.00
	1.016.021	1 6	2.5.8	4.5.1	29.4	2.7.2	23.7	3,0,8	21.515	25.5	2,1.8	200	22.2	222	21.4	2778	1.9.8	1.9.0	1-5-19	1.6.1	1,6,8	19.7
	· ~1	38	5	4.7	6.0	95	6.4	170	1.91.	9.2.	7.3.	4 4	3.8	7.8	6.6	20	3.1	9.7.	5.2	6.4.	67	100 S
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STATION	- 1	2	24.6	*	07.42	12+15-12-12-12-19-5-12-12-1-46.	2+10.1311154164 237150	24 5.098 1.55 2.0,7 3.0,8 1.65.	12+10 1.3,1.1.8.3.21.9 3.5.5.1,7.1.	1,24,15,07,5,1,8,0,1,9,2,2,5,0,1,7,6,0	34.10	3+1,2	0+	34, 45	13+ 10 10.8.2.1.5.4.1.6.6.12.1.4.1.7.2.	÷	24.10	3+ 50,761,060,09,71,901,241	3+10.95.91.08.96.9.15.9.01.+8	3+15195711214.1614.11611.1126.	1.3+ 10.9.9.40.9.11.9.11.9.11.6.8.97.2.	13 2 3.95.0.1.5.3.1.6.51.9.1.1.0.2.1
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Offir. of inperportation in MATERIALS CROORDORY P. 0. BOX 167 OLYMPIA. HA 98504

HALF CELL POTENTIONETER TEST RESULTS

LAB NO.

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CONTROL FIELD

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COS 2.9 8.4 H.A.L.F

ALL READINOS ARE ASSUMED NEGATIVE UNLESS CIRCLED

EXPANSION	COLUNI OR						t															
UPI'SE LINE		47 48 60 51 53 54 66 57 59 60 62 63 65 66 68 69 71	3.2.1.6.0.2.86 0.1.3 0.1.1.0.1.9 0.2.0.	515115172150230160240151	23.1.9.1.1.8.7.03.2.0.1.5.0.2.7.0.1.2.	7.3.1.8.7.1.9.1.2.5.8.1.4.8.27.40.6.9.	5-1/29	7,1	1.2.1.4.2.1.8.5.2.0.9.1.0.7.1.5.1.1.7.0.	3.7.1.9.4.2.1.3.2.07.9.1.0.9.0.0.3.	11.2	18.47.4.4.1.200.4.6.4.20.7.00.8.	1,3-1,17-1,3,2,2,0,7-1,8,2-1,8,4-1,1,5-1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1	15.21,7.1.51.1.1.9.1.6.7.1.6.4.1.8.3.	10.1.35.1.3.1.1.1.1.2.1.5.21.90.6)	10.11.11.14.6.1.6.20.7.9.1.3.3 (60,2)	18.2.2.2.2.8.1.6.6.9.2.41.9.1.1.6.	12.1.4.4.2.1.7.1.75.0.5.8.1.1.4.0.0.0.	16 2022202200088172095.	17.20.2.30.8.23.4.1.0.7.1.6.1.0.2.1.	121/60.261812541401671671	2+1010210300236211.6238.21.3-6.73.1.
STATION	NUMBER 000	1	11/4.10.99.21/1	11-512-0-515-11	11-50103-7	1,1/+1,5,0,7,3.	2. 480.017/11	1.2.5.2.3.1.2	17.217.8.0:47	1+5-1,0,7.1,	12+ 10 . 1, 1.3 . 1.	17.8.52.51.8.1	13+ 10.0,43.	12+ 5 5 5 6 8 3	124 0.1.00.1.	12+ 5 640 1	2+ 0.66.8.2	124 5-110,2.11	12+ 10 1/12,6 12,6	12+ 12-11/2 21	14:01.42.16	24 101009151
	מאון פאפר אנות האיני אויים ביים ביים ביים ביים ביים ביים ביים	STRTTON	29 30 32 33 35 36 38 39 41 42 44 45 47 48 60 51 53 54 66 57 59 60 62 63 65 66 68 69 71	STRTTON NUMBER 29 30 32 33 35 36 38 39 41 42 44 45 47 48 60 51 53 54 66 57 69 60 62 63 65 66 68 69 71 1/4, 10, 69, 12, 1/4, 10, 2/8 6 0, 1/3 0, 1/1, 0, 1/9 0, 2, 0, , , , , , , , , , , , , , , ,	STRT TO! NUMBER 29 30 32 33 35 36 38 39 41 42 44 45 47 48 60 51 53 54 66 57 59 60 62 63 65 66 68 69 71 1/4, 10, 69, 2, 1/4, 0, 2, 8, 6, 0, 1/3, 0, 1/4, 0, 1/5, 0, 1/5, 0, 1/4, 0, 1/4, 0, 1/5, 0, 1/4, 0,	STRTTO!! NUMBER 29 30 32 33 35 36 38 39 41 42 4445 47 48 6051 53 54 66 57 69 60 62 63 65 66 68 69 71 1/4: 10: 059.2: 1/4: 0.2/8 60.1.3 0.1.1 0.1.9 0.2.0	STRTICUI NUMBER 29 30 32 33 35 36 38 39 41 42 4445 47 48 50 51 53 54 56 57 59 60 62 63 65 66 68 69 71 1/4:10:69:21/4:02/86 0.1/3 0.1/1:01/19 0.2.0: 1/4:15:02/3:1/3:1/3:1/3:02/3:01/5:02/3:01/5:02/3:01/5:02/3:01/5:02/3:01/5:02/3:02/3:02/3:02/3:02/3:02/3:02/3:02/3	STATION MUMBER 29 30 32 33 35 36 38 39 41 42 44 45 47 48 60 51 53 54 66 57 59 60 62 63 71	STATTON MURGER 29 30 32 33 35 36 38 39 41 12 44 46 47 48 60 51 53 54 66 57 59 60 62 63 65 66 68 69 71 1/4 C.	STRITULI NUMBER 29 30 32 33 36 38 316 62 62 63 65 66 67 69 67 10 10 10 10 10 10 10 10 10 10 10 10 10	STRITULI NUMBER 29 30 32 33 36 38 39 41 42 446 4716 51 51 51 56 57 59 60 62 63 65 66 68 67 71 14. 10. 0.99, 2. 1, 4. 10. 2, 8. 4. 10. 10. 19. 0. 2, 9. 1. 10. 19. 0. 2, 9. 1. 10. 10. 19. 0. 2, 9. 1. 10. 10. 10. 10. 10. 10. 10. 10. 10.	STATION WHITE A COL	STRITUTION STRITU	STRITULI	STRITULI CO 1 CO 6 CO 1 CO 1 CO 1 CO 1 CO 1 CO 1	STRATURE WINNER R OCT COCK COC	SIGNT (0)	SIGN (O) WINNER WINN	Windle	Windle	######################################	22.4 0.1.5 0.2.0 0.1.2 0

Contrate EXPANSION JOINT OR OROUND ENDING STR CO+CO Brk WAR Robert 古で · · · · · HALF CELL POTENTIOMETER TEST RESULTS BERLEO BATE ALL READINGS ARE ASSUMED NEGATIVE UNLESS CIRCLED LAB NO. HOGTRS. 0+0 62 63 Allison SECURESHINGTON STATE DEPARTMENT OF TRANSPORTATION STARTING STA 69/60 CURYE r.s. Rob 19193 Brida JOB NO. L7774 8.R. 24 BIRTIONING HEASURED FROM BEACK OF BAIDDE SEAT Sholts SKEW 19 63 OFFSET FROM BASE LINE **6**0|61 GATE BAPLED 8-29-84 CREH BON 01.99,61,8,81.1,7,81.0,21,191,21.01,71.00,2 21.00.6 16.4 19.1.000, 2015, 01.5.61 510. 1+0,0,0,5,8,1,5,8,1,7,5,0,2,5,0,1,3,0,1,8,0,0,7 2,00,020,10,10,18,20,17,41,18,21,10,21,10,21,1 200 5.01.2 1,7,010,1,810,1,210,1,510,1,2 1+10001711110116161022101121001710014 2,0,0,0,1,0,1,1,0,1,0,1,0,1,1,0,1,6,0,0,3 151062101010151011510110102010111 1/2: 20-90-4-69-21-14-81-92-31-91,21-02.41-90-3 +1012,012,012,140,1212,00,210,1250,12 1.1.016.1.0.19.00.91.0.1.21.10.21.1 10.7 0.3. PO-90 NETER USED 4.7140 CARO I.O. 7,19,51,130,238,01,7,01,2,01,7 0.2,6 ζ. - MIDTH 3/ 10.01.0151 1+12/0/1/0/0/1/3/2/0/2/3/2/0/0/0/0/ 00. MA 0,62,9 B,4 IH, DAY YEAR 0.2 17:018:018:01.7.8:21.8:01.8:01. SANPLE DATE LENGTH 600' **FEMPERATURE** 2 0 Ò BR 100E 1 ... " DISTRICT 36 39 13,01233 0 36 30 1002 11-12-199915121 000 CONTROL FIELD 25 30 32 33 DEPT. OF TRANSPORTATION 000 43,0,0,9,8 1+1,510,36 76615 MATERIALS LABORATORY 99504 P. O. 80X 167 OLYMPIA, MA + +

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A 38504 LENOTH 6000 KIDTH 31 6 SKEN O CURVE SEALED B	
STATIGNING HERBURED FROM Back of BRIDDE SEAT STARTING STA O + 00 ENDING STF 6+00	
DATE SAMPLED 8-29-84 CARH Rea Selutte But Allies Buck Wars, Pobet Aben	3
TEMPERATURE 80-50 HETER USED	
CONTROL FIELD NO. DAY YEAR CARD 1.0.	
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OFFBET FROM BASE LINE	
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1 +1006534533000256918.02.0.002.	
+1,511,25 2,8,9 3,1,6,0,1,9,0,1,5,0,2,0,0,0,7.	
+ 4 10 10, 8, 4 25 5 4, 8 5 10, 19 19 19 15 10 3 5 10, 0, 3 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,	
1, +2,51.09,1.2,7,3.3,2,0,0,2,5.0,1,0.03,0,0,2.	
+ + 10.084 2,7,1 258 0,2,2 91,0.0,15 90,10.10.10.10.10.10.10.10.10.10.10.10.10.1	
11 + 5 5 11 15 - 11 9 3 - 21 3 - 21 5 - 20 7 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	
+,0.1,2,1.1,8,63,8,0.0,2,0.0,5.0,0,15.0,0,1.	
4.5.973.21.6.36.20.0.0.4.91.0.0.0.1.	
11 + 2 26.6.8.25.23.1.0.23.0.1.0.91.4.0.05.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.	
+ 55.99.3.1.7.2.2.7.9.0.1.8.0.0.8.0.1.6.0.0.5	
1 + 4,0.0,3,6.7,6.2,3,9.0,1,2.0,0,8.0,1,6.0,0,4.	
1 4 5 963 121 1170 0, 115 0,09 121,3 0,00,7 1, 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
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AdAMC SEALED PEACE CONCERETE ENDING STR G+CO No. 2044 (S) BUCK WARE, RODUT HOOTRS. ETATIONING HEASURED FROM BACK OF BRIDGE SEAT STARTING STR OFO CURVE DATE SAMPLED 8-29-84 CREH PON STULTS, BOD AVISON, - SKEH 3. i.e. JOB NO. 47774 HETER USED PIVE O(LENOTH GOOD WITH 31 BAR 817E SO 90 #5 BRIDGE YAKSINIA DEPT. OF TARNSPORTATION MATERIALS LABORATORY 98504 P. 8. BOX 167 DLYRPIA, HS

REBAR COVER IN INCHES

SAMPLE DATE

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BANPLE DRTE	DAY YEAR	19	7,8		61	7	1750	2-1	か,て	かって	2318	7.4	2,12	かって	2, 12	7,3/4	/ /	/	/ '	/ '	/	/	/ '	
SAMPLE	30 'OH	15 17	08 29		36136	•	016	2,12	2,3 A		3-1	7-8	234	3-1	53H	/-'H	, /	/ '	/ '	/ '	/ '	/	/ 1	
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	CONTROL FIELD		-		3.0	3	001	2,2	7-2	11/1/1/1/1	12318	11,-1	123/1	カート	スイル	12-3/4	/	, /	/ '	/	/	/	, /	
			1	STRTION	NU" JER	١,	ן, ו	いらられ	160	+7.C	+7.5	+3°	+	0,64	£(+,	16+3C	+	+	4-	- 	+		+	
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MASHINGTON STATE DEPARTMENT OF TRANSPORTATION AND

, Bob All'Son, Buck WAR, ROBERT ACKMO SERIED BATE CONTRETE ENDING STR COTOCO HOGTRS. LAB NO. REBAR COVER IN INCHES STARTING STA DEC Mctel CURVE RINGT Bridge BRIDGE SEAT 24042 BRIDGE: YAKIMA RIJET BEI'D SKEH D GATE SAMPLED S-29-84 CAFEN POLD - HETER USED LENOTH GOO! HIDTH 31 & STATIONING NEASURED FROM BOKK BAR SIZE DEFT. OF IRANSPORTATION 36504 MATERIALS LABORATORY P. 6. BOX 167 OLYMPIR, HA

12,9 8,4 R,E,B,R CARO 1.0. DAY YEAR BAHPLE DATE 80 CONTROL FIELD

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MASS HASHINGTON STATE DEPONTHENT OF TRANSPORTATION A

GATE SAMPLES 8-29-84 CARENTSON SHULLS BOD ALLISON, BUCK WATE, ROBERT ACHAMO SEALED BATE CONCUEH STATIONING HEASURED FROM BACK OF BRIDGE SEAT STARTING STA CATOO HOGTRS. CURVE C.6. - JOB NO. 67774 8.8. 34 Bridge SKEH | BAR SIZE SECONDARY SHETER USED LENOTH ECOS HIOTH 31 & River BRIDDE: YAK MA district 3 DEPT. OF TRANSPORTATION 90504 MATERIALS LABORATORY P. O. BOX 167 OLYMPIR, NA

REBAR COVER IN INCHES

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ASSESSION STRIE DEPARTHENT OF TRANSFORTATION A

DEPT. OF TRANSPORTATION DISTRICT SHAFERINGS I ABORATORY
P. C. BOX 167
OLYMPIA, NA 98504
LENDTH 600 8

HOGTRS. CURVE STATIONING MEASURED FROM BACK OF BRIDGE SEAT 45 .N. L7774 8.R. 24 Bridge SKEN O LENOTH GCO & MIDTH 31 & BRIDDE, YAKIMA RIJET

m 2445:24/5

SERIED BATE CENSE-CHE PEKIT ADAMA - ENDING STR & +CC STARTING STA CHOC GATE SAMPLED 8-39-84 CAEN ROLD STULTS, BOD ALLISON

BAR SIZE SES 45 HETER USED

2 ols + R.E.B.R

CARD I.D.

DAY | YEAR

. 2

CONTROL FIELD

SAMPLE DATE

REBAR COVER IN INCHES

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CARLOS MASHINGTON STATE DEPARTMENT OF TRANSPORTATION AND AND STATE DEPARTMENT OF TRANSPORTATION AND ADDRESS OF TRANSPORTATION

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45 JULY 17774 8.8. - 34 LENOTH GOOS MIDTH 318 XAKiMA district 5 BRIDDE DEPT. OF TRANSPORTATION 98504 MATERIALS LABORATORY P . 0 . 80X 167 OLTHPIA, HA

DATE GAMPLES 8-29-84 CAFER ROW Shults, Bab Allison, Buck WATE, RODERT ADAM BERLED BATE CONCEPTE - ENDING STR GECO DI WHEN HOOTRS. LAB NO. BRIDGE SEAT STARTING STA CHCC CURVE SKEH O BAR BIZE SET SO#5 HETER USED JAME ETATIONING HEABURED FROM SACK CA

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A HASHINGTON STATE DEPARTMENT OF TRANSPORTATION, STATE

DEPT. OF TEANSPORTATION
MATERIALS LABORATORY
P. O. BOX, 167
DLYMPIA, MF 98504

ORTE GAMPLED 8-29-84 CAFERTZON SHOLLS (BOD BOCK WARG ROBCIT ADAMO SEALED BATE CONCRETE ENDING STR GT HOGTRS. STATIONING MEASURED FROM BACK OF BRIDGE SERT STARTING STR OFFO __ CURVE __ . S. Metel Bridge SKEW D 100 NO. 1-7774 8.R. -HETER USED _____ RIJRY LENOTH GODS' HIDTH 31 8 BAR SITE SES - 96-45 BRIDGE: YAKIMA dienkier S

REBAR COVER IN INCHES

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APPENDIX B CONTRACT SPECIAL PROVISIONS

the 96 hour curing period. Also, if, during the dry curing period, there is sufficient rain to wet the surface of the concrete for one hour or more, this number of hours will not be considered in the dry curing period.

C. Traffic is not permitted on the finished concrete until the specified curing time is satisfied and until the concrete has reached a minimum compressive strength of 2500 psi as verified by a 4 x 8 cylinder strength test. The cylinder strength test will be in accordance with WSDOT test method 801.

4.08 Checking for Bond

After the requirements for curing have been met, the entire overlaid surface shall be scunded by the Contractor, under the direction of the Engineer, to ensure total bond of the concrete to the bridge deck. Concrete in unbonded areas shall be removed and replaced by the Contractor at his own expense. All cracks, except those that are significant enough to require removal, shall be thoroughly sealed, to the satisfaction of the Engineer, with the latex modified grout. The grout shall be thinned as specified by the Engineer.

Part 5 Measurement

5.01 A. Measurement for this item of work, excluding the work required for "Bridge Deck repair" as described elsewhere in these special provisions, will be made by the square ward of overlay in place.

Part 6 Payment

6.01 A. Payment for this item of work, excluding the work required for "Bridge Deck Repair", as described elsewhere in these special provisions will be made at the unit contract price per square yard for "Latex Modified Concrete Overlay" which price shall be full compensation for all material, labor, tools and equipment necessary to complete the work specified in accordance with the plans, these special provisions and the standard specifications.

CATHODIC PROTECTION SYSTEM

The Contractor shall furnish a proposal document by the supplier of a non-embedded wire overlay cathodic protection system to be used on the deck of the Yakima River Bridge No. 24/5 to the Engineer for approval. The total length of the bridge is 600 feet. The width curb to curb is 28 feet. The scope of the work to be covered under this item shall include but not be limited to installing non-slotted anodes on the bridge deck, securing and protecting the anodes during the overlay installation, furnishing all electrical conduit, wiring, rectifiers,

SR 24 YAKIMA TO MOKEE CANAL

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connections, and hardware: energizing adjusting a complete cathodic protection system for the deck area. The anode shall be a pre-manufactured correr conductor, with an extrusion of semi-conductive polymeric matrix, and it shall be weaved into a mesh using polymeric clips to set the ancde spacing.

Electrical power source is available where shown in the plans. Conduit and pull wire will be provided from the service to a junction box in the vicinity of the bridge. The Contractor shall furnish and install conductors from the service to the junction box, in addition from the junction box to the bridge, to provide power to the cathodic protection system. Conduit installed from the junction box to the bridge and any conduit required on the bridge shall be PVC rigid wall, schedule 40.

Concrete fasteners for conduit shall be stainless steel or other approved corrosion resistant material. This system shall be installed after deck repair is complete as specified in the special provision. All electrical work shall comply with the requirements of the National Electrical Code.

The cathodic protection system shall include a minimum of five permanent reference cells (half-cells), five resistance type corrosion rate probes and five thermistors installed in the deck for monitoring the system.

The Contractor shall submit to the Engineer for approval all drawings, detail plans and calculations for this system. In general, six sets of prints shall be submitted to the Engineer for approval. Approval of drawings and details shall be understood to be an acceptance rather than a check on the system. No changes shall be made to any drawing after it has been approved, except by the consent or direction of the Engineer in writing. No material shall be purchased or fabricated and no work shall be done on preparation of the deck surface or installation of any part of the system until the plans have been approved by the Engineer and confirmation of such approval has been received in writing by the Contractor.

Prior to the completion of the project, the Contractor or his supplier shall furnish the original drawings of the as-built system to the Engineer. All drawings shall be on sheets conforming in size to the provisions of section 1-05.3 of the standard specifications. In addition, the Contractor shall furnish six complete sets of operating and maintenance instructions to the Engineer.

To aid in assuring proper installation, energizing and adjusting of the cathodic protection system, the Contractor shall have available during installation of the system the services of a qualified fulltime field representative in the employ of the system supplier. This representative shall be qualified in the field of cathodic protection of reinforced structures and shall be a registered Professional

SR 24 YAKIMA TO MOXEE CANAL

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Engineer certified by the National Association of Corrosion Engineers as a Corrosion Specialist or other Corrosion specialist approved by the Engineer. The representative shall provide instructions and training of State personnel in the operation and maintenance of the system.

Testing of this system shall be as recommended by the system supplier. Number and type of tests to be perfermed shall be approved by the Engineer prior to start of any testing. The results of this testing, the data collected and the findings of the whole study shall be documented and presented to the Engineer for his use.

The Contractor shall also submit to the State a proposal document by the supplier of the cathodic protection system indicating how to maintain, monitor and evaluate the system and prepare periodic performance reports. The proposal document shall cover a period of time of three years after the State has given final acceptance of all work under this contract. Such proposal document shall be furnished to the State before the State shall approve the source of supply for the system. The proposal document shall include an itemized list of activities and costs that describes the labor and materials anticipated to operate and maintain the system in a satisfactory manner. The State shall have the option of entering into an arrangement with the supplier to provide the services contained in the proposal without interference or obligation to the Contractor. Such an arrangement does not relieve the Contractor from providing instruction and training of State personnel in the operation and maintenance of the system before final acceptance of the work as described elsewhere in the contract provisions.

The cathodic protection system supplier shall be one of the following:

- 1. Norton Corrosion Limited, Inc. 22327 89th Avenue S.E. Woodinville, WA 98072 Tel. (206) 483-1616 TWX 910 449-2810
- 2. Harco Corporation Cathodic Protection Division 3411 Arden Road Hayward, California 94545 Tel. (415) 783-0924
- 3. Matcor, Inc. P.O. BOX 687 Doylestown, Penn. 18901 Tel. (215) 348-2974

SR 24 YAKIMA TO MOXEE CANAL

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4. Raychem corporation
300 Constitution Drive
Menlo Park, California 94025
Tel. (415) 361-5037

The Contractor is advised that the State may exclude this item of work from this contract in accordance with section 1-09.5 of the standard specifications.

The lump sum contract price for "Cathodic Protection System" shall be full compensation for all labor, materials, tools and equipment necessary to complete, furnish, install, energize, adjust, evaluate and test the system as specified and as shown in the plans. All concrete patches required for equipment installation, including repairs to damaged areas, if any, and the proposal documents to maintain this system are also included in this item.

BRIDGE DRAIN RISERS

All steel used in the construction of the risers for the drain modifications shall conform to ASTM designation A-36. The bridge drain risers shall be welded to the top of the existing bridge drains as detailed in the plans before installation of the latex modified overlay and they shall maintain uniform contact with the existing drain. The latex modified concrete overlay shall extend to the bottom of and all around the bridge drain riser.

After all the items of work on this project have been completed, the Contractor shall clean and flush all eight of the existing bridge drains.

All costs involved in the construction of the risers for the drain modifications, shall be incidental to and included in the unit contract price per square yard for "Latex Modified Concrete Overlay".

EXPANSION JOINT MODIFICATION

The Contractor shall remove portions of the existing expansion joint, furnish material for and install the new expansion joint and steel plates in accordance with the contract documents.

The expansion icint system(s) shall be installed in accordance with the manufacturer's written recommendations. The Contractor shall submit, with his working drawing submittal, the manufacturer's written installation procedure to the Engineer for his approval.

The Contractor shall submit working drawings of the expansion joint system(s) proposed for use in this project to the Engineer for approval. Submittal of working drawings shall be in accordance with provisions of section 1-05.3 cf the standard specifications. Six sets

SR 24 YAKIMA TO MOXEE CANAL

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APPENDIX C PROJECT CHANGE ORDERS



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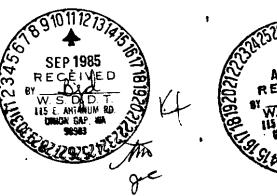
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Ordered by Engineer under terms of Section 1.04.4 of the Standard Specifications The Standard Specifications Endorsed by: Superior Asphalt & Concrete Concrete Concrete Firm Name Signature 8-26-85 Signature 8-26-85 Date Title Contract Representative Consent given by Surety: (when required) By: Attorney-in-fact Date	Centract No. To Superior Asphalt & Conc. P. O. Box 10268 Yakima, WA 98909 Sign Route SR 24 Federal Aid No. Project Title Yakima Ito Mox	rete Co.
The Special Provisions require sand blast latex modified concrete. Permission is granted to use high pressu in lieu of sand blasting. e to the sensitive nature of the cathod blasting (cleaning) is potentially a super-	re water blasting (acceptable this change order)	o the Engineer)

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This change will not effect contract time.



All work, materials and measurement to be in accordance with the provisions of the Standard Specifications and Special Provisions for the type of construction involved.

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Specialized Services:

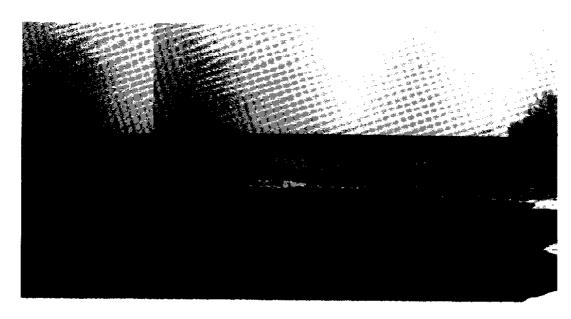
Under agreement by the Engineer and the Contractor, it may be determined that a certain item or service under force account work carnot be satisfactorily performed by the forces of the Contractor or his subcontractors, in which case such item or ervice may be performed by a specialist. Invoices for such tem or service on the basis of the current market price thereof may be accepted without complete itamization of labor, material and equipment cost when such itemization is impracticable or act customary under the circumstances. Where the force account work necessitates fabrication or machining work by the Contractor away from the job site, charges for such work may, by agreement, be accepted as a specialist tilling. The specialist invoices shall show credit for cash or trade discounts offered or available the same as applies to force account work, but shall not include a percentage or other markup. An amount equal to 15 percent of the total invoice from the specialist shall be added for overhead, profit, and all other costs incidental furnishing and providing such specialized work.

The State reserves the right to disallow invoice rayments based on rates higher than those customary for similar types of work. The Engineer may request a detailed breakdown of the invoice or further documentation which justifies the requested payment. In the event payment by invoice is disallowed, payment shall be made using the elements specified under subparagraphs 1, 2, and 3 of section 1-09.6 of the standard specifications.



C.O. # 6 Sheet 3 of 3

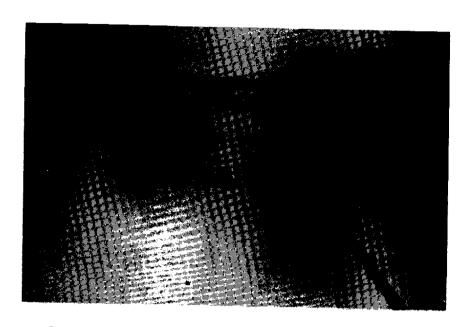
APPENDIX D PROJECT PHOTOGRAPHS



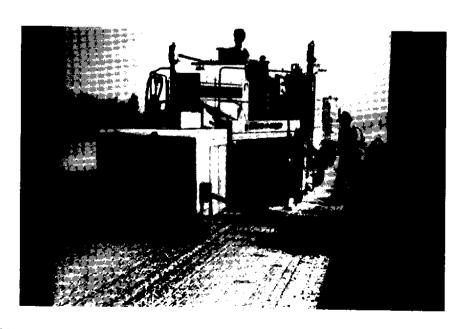
Yakima bridge elevation.



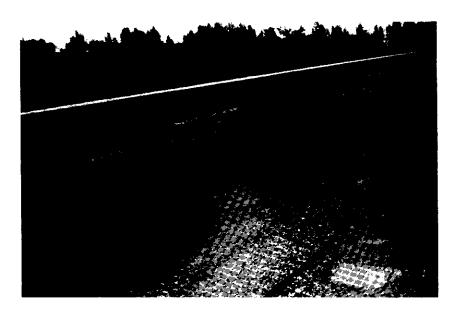
Yakima bridge deck.



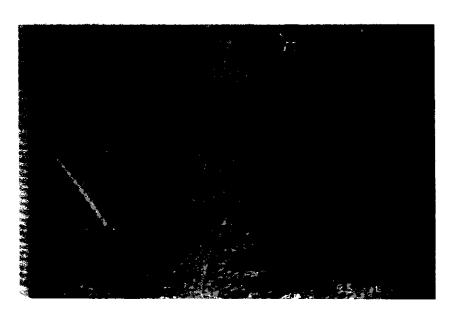
It was necessary during this project to keep one lane open to traffic at all times.



The first phase of the project was to scarify the deck 1/4" inch to remove surface contaminents such as oil and grease.



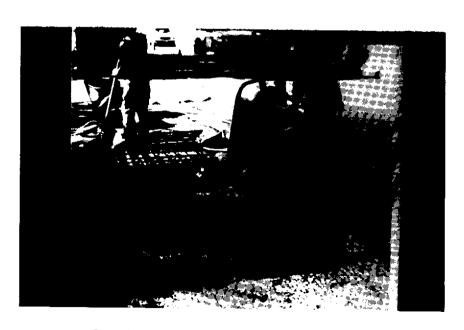
Locating delams by chain dragging and marking on the deck in red paint.



Pneumatic jackhammers are used to remove the delaminated areas.



Delam removal.



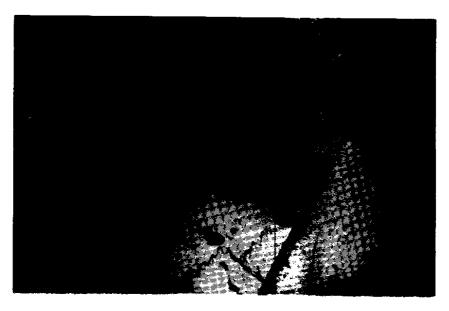
Premixed Fondu was used to repair the delaminated areas by hand.



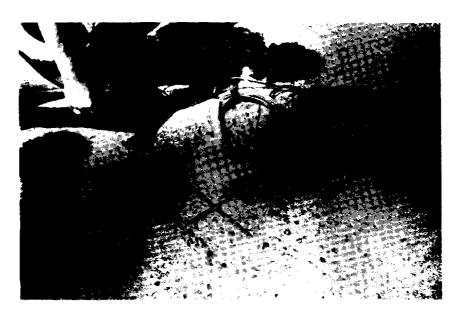
Expansion dams were found loose in some cases and were epoxy injected.



Cutouts are made in the deck to install the reference cells and rebar probes.



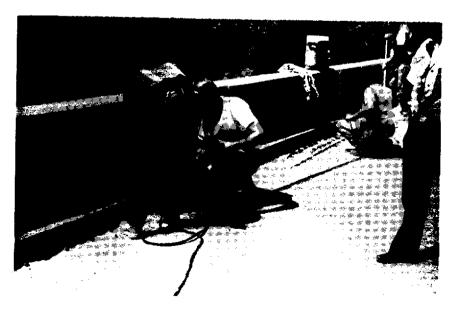
The small concrete block on the left is the rebar probe and the reference cell with cover is shown on the right.



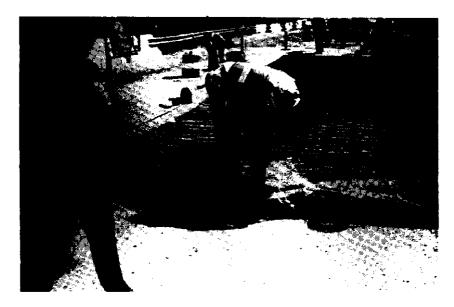
Rebar probe and reference cell being sized for the deck cutouts.



The deck is further prepared by sandblasting.



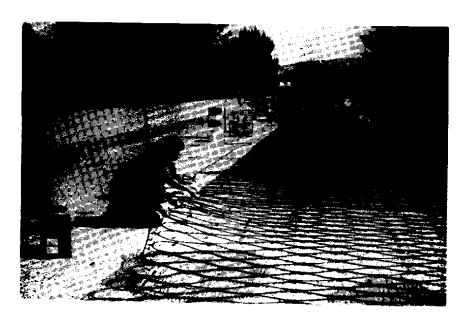
Fastening panel mounting rod to the deck near the curb line.



Ferex anode panels are rolled out on the deck.



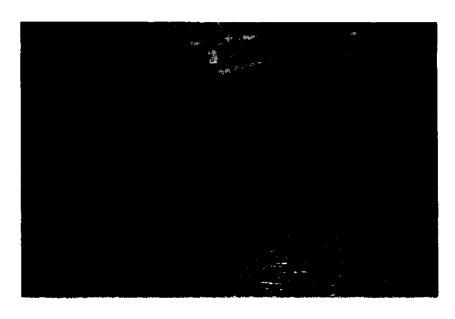
The Ferex anode is manufactured by the Raychem Company.



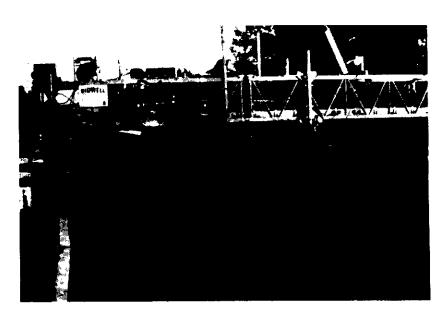
Stretching the anode panel to size. Drilling and installing plastic fasteners.



Anode strand panel loops meeting the panel mounting rods at the center of the bridge.



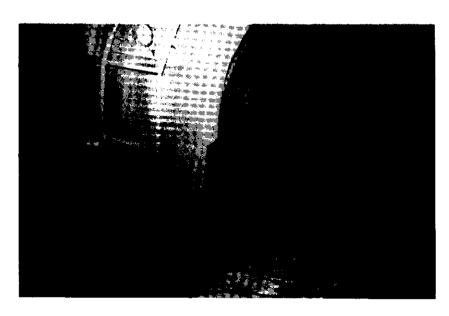
The deck is further cleaned by water blast just prior to pouring the latex modified concrete overlay.



The Bidwell paving machine is tested prior to the LMC pour.



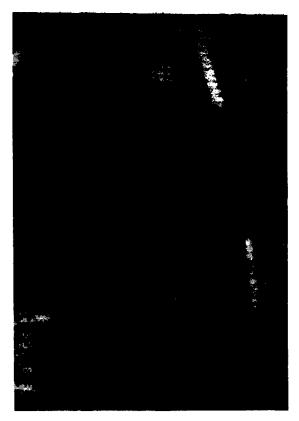
Night pour of the LMC.



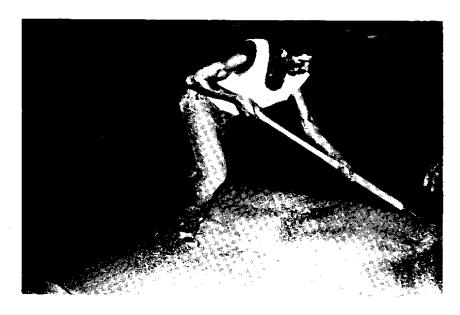
Plywood on the deck was used to distribute the weight of the LMC truck on the anode.



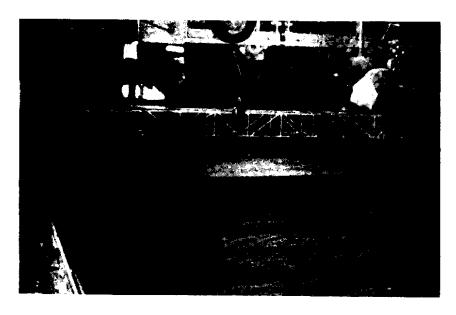
Slurry is brushed on the deck prior to placement of the LMC.



LMC deposited on deck by chute from truck.



Further spreading of LMC by hand in front of the paver.



 $\ensuremath{\mathsf{LMC}}$ covered behind the paver with wet burlap.