Thin Overlay

Naches River Bridge 82/115S
Yakima River Bridge 82/114S

WA-RD 148.1

Post Construction Report
January 1989

Washington State Department of Transportation
Highway Division
Bridge and Structures
Transportation Building KF-01
Olympia, Washington 98504-5201

in cooperation with the
United States Department of Transportation
Federal Highway Administration

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

TECHNICAL REPORT STANDARD TITLE PAGE

1. REPORT NO.
WA-RD 148.1

2. GOVERNMENT ACCESSION NO.

3. RECIPIENT'S CATALOG NO.

4. TITLE AND SUBTITLE
Thin Overlay
Naches River Bridge 82/115S
Yakima River Bridge 82/114S

5. REPORT DATE
January 1989

6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)
Tom H. Roper and Edward H. Henley, Jr.

8. PERFORMING ORGANIZATION REPORT NO.

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Washington State Department of Transportation
Transportation Building
Olympia, WA 98504

10. WORK UNIT NO.

11. CONTRACT OR GRANT NO.
WA 86-04, WA 86-05

12. SPONSORING AGENCY NAME AND ADDRESS
Same

13. TYPE OF REPORT AN PERIOD COVERED
Post Construction
January 1989

14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES
The study was conducted in cooperation with the U.S. Department of Transportation, Federal Highway Administration

16. ABSTRACT

The Washington State Department of Transportation will be conducting experimental field testing of several selected polymer concrete thin (1/4 inch) overlays over a ten-year period. The polymer concrete material is manufactured by private industry firms and installed on selected bridge decks under standard WSDOT construction contracts. Approximately 21 bridges will be involved in the experiment; eight of these are included in federal participating projects as experimental features.

The polymer concrete thin overlays were applied to the decks of the Naches River Bridge 82/115S and the Yakima River Bridge 82/114S under Contract No. 3131, SR 90 and SR 82, Cle Elum Interchange to Terrace Heights. Both bridges are steel truss bridges located on SR 82 just outside Yakima, Washington.

Both the epoxy overlay and the methyl methacrylate overlays were versatile products to apply under difficult traffic control conditions. Starting and stopping the various pours to accommodate opening and closing of lanes for traffic proved satisfactory. To the extent possible, work was performed at night when traffic was light. All three lanes were then opened to traffic in the early morning to accommodate peak traffic conditions.

17. KEY WORDS
Thin overlay, polymer concrete, bridge deck repairs

18. DISTRIBUTION STATEMENT

19. SECURITY CLASSIF. (of this report)
Unclassified

20. SECURITY CLASSIF. (of this page)
Unclassified

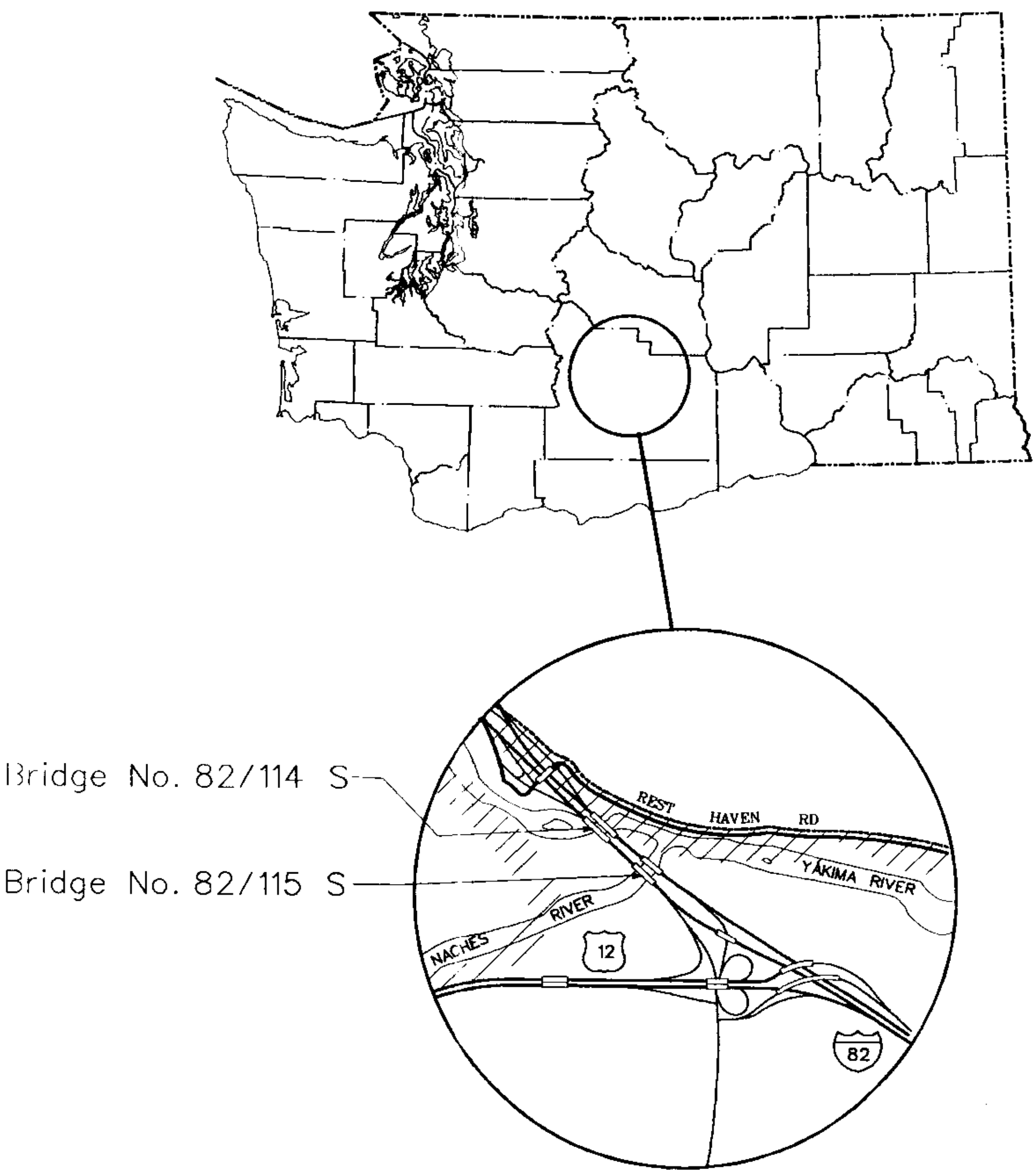
21. NO. OF PAGES
52

22. PRICE

DOT FORM 310 022 (11/86) 1216

TABLE OF CONTENTS

VICINITY MAP



PROJECT SITE

INTRODUCTION

These are the fifth and sixth bridges in a series of eight federal participating bridge deck overlay projects using thin polymer concretes. Each deck in the series will be constructed using a different commercially available polymer concrete system. Each deck will be monitored over a ten-year period to evaluate the long-term performance. A description of the total experimental project design can be found in Appendix A.

STUDY SITE

General

The polymer concrete thin overlays were applied to the decks of the Naches River Bridge 82/115S and the Yakima River Bridge 82/114S under Contract No. 3131, SR 90 and SR 82, Cle Elum Interchange to Terrace Heights. Both bridges are steel truss bridges located on SR 82 just outside Yakima, Washington.

The normal delamination and spall repairs were followed by the application of a thin PC overlay (¼-inch). The PC overlays were commercially available proprietary products. Contract documents specified the proprietary system each bridge was to receive, and the work was done under a standard WSDOT contract.

Naches River Bridge

There were many transverse and pattern cracks on the existing deck. Fifty-three percent (53%) of the chloride samples had values greater than 2.0 lbs. per cubic yard. Delaminations averaged 1.1 percent of the deck. Thirty-three percent (33%) of the half-cell tests had readings greater than 0.200 volts. Approximately 8 percent of the deck had concrete cover over the deck reinforcing of less than one inch. Approximate average rutting measurements were 3/16 inch. The deck is 40 feet wide and 284 feet 4 inches long for a deck area of 11,373 $feet^2$.

Yakima River Bridge

The existing deck of this bridge had many long, leaching, transverse, and pattern cracks. Sixty-six percent (66%) of the chloride samples had values greater than 2 lbs. per cubic yard. Delaminations averaged 1.4 percent of the deck area. Forty-eight percent (48%) of the half-cell tests had negative readings greater than 0.200 volts. Approximately 22 percent of the deck had concrete cover over the deck reinforcing of less than one inch. The average rutting measurements were 1/8 inch. The deck is 40 feet wide and 284 feet 4 inches long for a deck area of 11,373 $feet^2$.

CONSTRUCTION SUMMARY
NACHES RIVER BRIDGE 82/115S
EPOXY OVERLAY

Description of Installation Procedures

Friday, July 10, 1987; Saturday, July 11, 1987:

In order to minimize traffic disruption, work on both bridges was done at night over several weekends. The prime contractor for the project was Hamilton Construction Company, and the thin overlay subcontractor was David A. Mowat Company.

Work began on the Naches Bridge at 8:00 p.m. on Friday, July 10, 1987. The deck was cleaned with a shotblaster in the left lane from 10:00 p.m. Friday to 2:00 a.m. Saturday. The project engineer's inspector and two field representatives of Adhesive Engineering Company, the system supplier, agreed that the cleaning was satisfactory.

First, epoxy primer was put down the full length of a lane (14 feet wide by 280 feet long). The contractor waited until the primer became tacky and then immediately began the application of epoxy followed by broadcasting of the aggregate Epoxy, Concresive 3070, was mixed in 5-gallon buckets with a paddle on the electric drill, then poured on the deck and spread with squeegees. Workers began spreading aggregate with sand pot and air hose, but abandoned that program after approximately 60 L.F., and went to hand broadcast of aggregate The first lift was completed at approximately 4:30 a.m. Saturday. The contractor tried a power broom to remove excess aggregate, but there was too much pick of aggregate from the epoxy matrix. He tried a hand broom, but elected to give that up until the sun came up to give further cure. He resumed the hand broom at 7:00 a.m. Saturday and began the second lift of epoxy shortly thereafter. The second lift was completed at 9:10 a.m., and the contractor gave the okay to broom at 3:30 p.m. The roadway was opened to all three lanes of traffic at 4:30 p.m. Saturday.

Saturday, July 11, 1987; Sunday, July 12, 1987:

The middle lane was shotblasted clean from shortly before 8:00 p.m. until 11:00 p.m. Saturday. The contractor began the second epoxy overlay at 12:10 a.m. Sunday. Procedures were the same as those used for the first lift, except all aggregate was hand broadcast. When the second lift was completed. the contractor started brooming with a power broom, but not enough cure had occurred. Workers hand broomed the remainder of the deck, finishing at 5:30 a.m. The second lift of epoxy was completed at 7:30 a.m. All lanes (three) were opened to traffic at 1:15 p.m. Sunday, July 12, 1987.

Saturday, August 1, 1987; Sunday, August 2, 1987:

Shotblast cleaning was completed at 10:10 p.m. Saturday. The contractor began applying primer at 10:15 p.m. Saturday and completed the first lift of aggregate in the right lane at 11:30 p.m. Saturday. He began the second coat at 1:45 a.m. Sunday and completed at 3:00 a.m. Sunday. All lanes were opened to traffic at 9:15 a.m. Sunday.

All application procedures were the same as those used for the previous lifts Epoxy was squeegeed and aggregate was broadcast by hand.

By getting the first lift down sooner than the pours of July 10, 1987 through July 12, 1987, the contractor had the advantage of warmer cure temperature and consequently was able to get the second lift going sooner, thus reducing the overall construction time.

Construction Time for Installation

This bridge has a total of three traffic lanes in one direction. One lane was shotblasted and epoxy overlaid in one evening, and all lanes were opened to traffic the next morning. Work was accomplished on the weekends. Three evenings were necessary to complete the entire deck of the bridge. For one lane of approximately 3800 square feet, the application of the primer took approximately 30 minutes. The first lift epoxy and aggregate took about one hour to place, followed by two hours' cure time. The final lift of epoxy and aggregate took approximately 1¼ hours to cure. The entire system was left to cure for about six hours before opening to traffic. Air temperatures were around 60 degrees F.

Quality Control Performance of the Contractor

Contract special provisions required that a manufacturer's representative be present on the job during installation. Adhesive Engineering Company, the thin overlay system supplier, had two representatives on the job to advise on application procedures.

On the first lift of epoxy, after the initial broadcasting of aggregate, there were dark and shiny areas indicating insufficient aggregate. The contractor corrected this by broadcasting additional aggregate on these areas before the epoxy had begun to set. Aggregate arrived on the job in 2500-pound bags. Excess aggregate that was broomed off was recovered and reused.

Special Construction Procedures or Construction Problems and Any Remedial Actions Taken

One major problem was the contractor's inability to complete and open all three lanes to traffic at the time specified in the contract. To correct this, the contractor had to accelerate his program at the start of the evening when air and deck surface temperatures are warmer, to avoid the problem of poor cure temperatures typical of the pre-dawn hours.

Before proceeding with later pours, a pour schedule was requested to show work being completed within the contract time specification.

Upon completion of the overlay, the entire surface was chain dragged. Minor delamination areas were found. Upon removal of these areas, the delaminations were found to be in the existing deck and apparently were areas missed when the deck repair was performed.

Personal Observations

The shotblast machine was small, approximately 20 inches wide with 16 inches being effective, but did a very good job of cleaning. The key with these units is to go slow enough to get it right the first time.

Good uniformity of aggregate placement was obtained using the sand pot. The contractor abandoned this because it was too slow, but this could be solved using two larger pots. One could be charging while the other is discharging.

Epoxy placement could be started at one end of the deck while deck preparation and cleanup are still in progress on the far end. The contractor should take advantage of cure temperatures before the temperature drops at 4:00 or 5:00 in the morning.

The contractor estimated that cure time would be cut by 50 percent if the overlay were placed during warmer daylight temperatures.

CONSTRUCTION SUMMARY
YAKIMA RIVER BRIDGE 82/114S
METHYL METHACRYLATE OVERLAY

Description of Installation Procedures

Sunday, July 12, 1987; Monday, July 13, 1987:

The middle lane of the deck was cleaned with the shotblast machine from 8:00 p.m. to 10:00 p.m. Sunday, then blown clean with an air hose. The contractor began placing primer, Concresive 2042, at 10:00 p.m. Sunday. The primer is usually applied with a spray gun, but this was plugging, so a painter's type roller was used instead.

The contractor began placing concrete at 10:40 p.m. Sunday, batching out of two 4 cubic foot mortar mixers (paddle type), mixing 1.8 cubic feet/batch and transporting to the deck in wheelbarrows. The mix was composed of:

Concresive 2020 Part A (liquid)
Concresive 2021 Part B (bagged)
Concresive Activator Part C (powder)
Steilacoom sand

The lift was screeded 6 feet wide, using ¼" x 3" x 20' long steel plates for forms. The material was hand screeded with 2 x 4s in a saw action. The contractor's foreman explained that doing only a 6-foot pass at a time minimized overruns due to irregularity of the deck. At 3:30 a.m. Monday, the crew had completed the left 6 feet of the middle lane (6 feet x 280 feet) and approximately 200 linear feet of the right 6 feet of the middle lane. Shutdown occurred at 3:30 a.m. because the contractor had previously advised that the material required 2½ hours of cure time and the specs required a 6:00 a.m. opening to traffic. The partially complete overlay in the middle lane was sawcut at the terminal end of the pour, blown clean, and opened to traffic at 6:00 a.m. Monday.

Friday, July 31, 1987; Saturday, August 1, 1987:

Cleaning procedure was the same as that used on the previous day. Priming began at 10:10 p.m. on the remainder of the middle lane that was not completed July 13, 1987. The primer spraying was tried again, but was too slow, and roller priming was resumed at 10:25 p.m. Friday. The crew started placement of the remainder of the middle lane at 10:45 p.m. and were finished at 11:30 p.m. The contractor started placement of overlay on the left 6 feet of the right lane at 12:30 a.m. Saturday. The same mixing and delivery procedures were used.

The contractor tried a "clamp on" vibrator on a 2 x 4 screed, but it performed inconsistently and was soon discarded. He then went to a 2 x 4 straight pull strike off followed by a 2 x 4 saw action finish screed.

Two 6-foot passes of the right lane were completed in this manner at 4:55 a.m. Saturday. The far right 1 foot was then completed by hand trowel at 6:30 a.m., and the project was opened to three lanes of traffic at 7:30 a.m. Saturday.

Sunday, August 2, 1987; Monday, August 3, 1987:

The deck was cleaned by shotblast. Priming of the left lane began at 9:35 p.m. Sunday. The contractor began overlay of the right 6 feet of the left lane at 10:30 p.m. Sunday. The same screed procedure was used as previously. The same mixing and delivery procedures were used as for the previous overlays, except the mix was screened from the mortar mixer into wheelbarrows to get rid of lumps that had appeared in previous pours (approximately 3/8-inch screen). At the start of the pour, a finisher tried a float, but it was too sticky and was quickly abandoned. Another variation: throughout the pour the contractor very liberally sprayed Concresive 2020 immediately in front of the finish screed. The contractor finished the first 6-foot pass approximately at midnight, began the second 6-foot pass at 12:15 a.m. Monday, and completed the far left 1 foot at 2:45 a.m. All lanes were opened to traffic at 5:40 a.m. Monday.

Construction Time for Installation

Placement time averaged 575 square feet per hour. Cure and clean times averaged 2½ hours. Air temperatures ranged from 50 degrees to 72 degrees.

Quality Control Performance of the Contractor

The prime contractor and system supplier had representatives on the job at all times.

The first pour resulted in an irregular riding surface (a "choppy" ride). This was called to the attention of Adhesive Engineering Company during the pour and corrective action was requested. A "clamp on" vibrator was tried but did not accomplish much. A supplier representative felt the increased weight of a 2 x 6 screed board with the vibrator attached would give a better ride; however, the subcontractor's foreman elected to continue with his previous method.

The state inspector informed the supplier's representative that the specs give the representative control of mixing, placing, and finishing procedures, but he declined to provide direction to the contractor other than for mixing proportions.

Also, the state inspector questioned the supplier's representative about spraying compound on top of the overlay ahead of the screed. The suplier's representative indicated that this was not detrimental and that it improved workability and finish. The finish did improve as the job progressed.

Special Construction Procedures or Construction Problems and Any Remedial Actions Taken

Upon completion of the overlay, the entire surface was chain dragged. Minor delamination areas were found. Upon removal of these areas, the delaminations were found to be in the existing deck and apparently were areas missed when the deck repair was done.

During the winter of 1987, after the overlay had been in service, it was observed to have a number of worn spots. While the overlay did not appear to have worn down to the substrate deck, it had lost most of the aggregate in several wheel path areas and had a very slick appearance. It was quite apparent that the initial MMA overlay was not performing satisfactorily and needed to be repaired. Repairs were deferred to the following summer when weather conditions would be more favorable.

The contractor proposed the following repair procedure, which was accepted by the state:

Step 1) Sawcut the perimeter of all worn/bare/low spots on the deck. The cuts should be far enough away from the problem areas to ensure that the ¼ inch minimum thickness is being maintained.

Step 2) Prepare all areas within the sawcuts to provide a minimum of ¼-inch deep overlay and then sandblast the surfaces.

Step 3) Apply Concresive 2042 primer to the clean and prepared surfaces and allow it to cure 10 to 40 minutes (approximate).

Step 4) Apply the Concresive 2020 as originally used in the overlay to the proper grade and thickness.

Bridge 82/114S was repaired on September 13, 14, and 15, 1988, by David A. Mowat, subcontractor for Hamilton Construction Co., prime contractor.

The technical representative from Adhesive Engineering was on the job site throughout the repair.

<u>Repair Areas</u>

September 13, 1988	left lane	201 square feet
September 14, 1988	center lane	5.5 square feet
September 15, 1988	right lane	435 square feet

The technical representative stressed that the material should be placed at a depth of 3/8 inch.

The Concresive 2042 primer was cured 45 mintues before placing the Concresive 2020. The roadway was normally opened to traffic one hour after placement of the Concresive 2020 overlay.

Personal Observations

The Wheel-a-Brator cleaning machine did a good job.

Some delaminations were repaired. All were in underlying deck and none were larger than one square foot.

The technical representative advised that the ideal temperatures for placing this material are the 40s and 50s.

TEST RESULTS

Naches River Bridge

Bond test results met the minimum specifications of 300 psi or failure in the bridge deck Portland cement concrete.

Nine friction tests were conducted. The friction number ranges were 45 to 65, with the average being 53. Contract specifications require a minimum of 50 for the epoxy overlay. Friction was therefore considered satisfactory.

Only two resistivity values were below 100,000 ohms; 70 percent of the values were above 250,000 ohms. The resistivity values are therefore considered satisfactory.

Yakima River Bridge

Five of the ten bond pull-off tests broke in the methylmethacrylate overlay. Specifications required the average bond strength to be a minimum of 300 psi or failure in the bridge deck Portland cement concrete. Only one of the breaks in the methacrylate (PC) met the minimum 300 psi strength. The other five breaks occurred in the old concrete or the pipe cap adhesive.

Nine friction tests were conducted. The values obtained in October 1987 ranged from 28 to 39, with the average at 31. Contract specifications required a minimum of 45 for the methyl methacrylate. Subsequent friction tests in March 1988 indicated a range of 43 to 55 with the average at 49. This increase from the earlier tests suggests that as the polymer is worn away under the first few months of traffic, sufficient aggregate is exposed to produce acceptable skid resistance values.

Contract specifications required that 70 percent of resistivity test readings should be above 250,000 ohms, with no single reading less than 100,000 ohms. Only one reading was less than 100,000 ohms. The resistivity values are therefore considered satisfactory.

Good friction tests are necessary for vehicle traction on the overlaid surface. Good bond is necessary for the product to adhere to the existing surface. Adequate resistivity values indicate good resistance to the further intrusion of moisture and salts.

CONCLUSIONS AND RECOMMENDATIONS

General

Both the epoxy overlay and the methyl methacrylate overlays were versatile products to apply under difficult traffic control conditions. Starting and stopping the various pours to accommodate opening and closing of lanes for traffic proved satisfactory. To the extent possible, the work was performed at night when traffic was light All three lanes were then opened to traffic in the early morning to meet peak traffic conditions.

Naches River Bridge Epoxy Overlay

This overlay procedure uses squeegees to lay down the epoxy binder, followed by hand broadcast of the aggregate. Power mixing is not necessary. Application is labor intensive, but relatively simple. The construction process, degree of quality control necessary, and the versatility of the material to staging of construction to accommodate traffic all make this product satisfactory for deck overlays.

Yakima River Bridge Methyl Methacrylate Overlay

As specified by the manufacturer, this material must be laid by the screed process, rather than squeegee followed by hand broadcast of the aggregate. The construction process is versatile and the material cures quickly and is well adapted for stage construction to accommodate traffic control. The screed process has a quality control problem with smoothness of ride and skid resistance. The skid values were initially below required values but tended to increase to acceptable values as traffic wore some of the polymer away from the surface aggregate.

From rutting measurements and cores taken in the wheel path areas where very little aggregate was retained after several months of traffic, it was concluded that the slick "bare" areas resulted from the completed overlay being significantly less than the required minimum ¼-inch thickness in some areas. This suggests that selecting the location of the screed bars is critical for thin overlays and that a thorough check of the screeds by use of straight-edge measurements to ensure proper overlay thickness is essential to proper overlay placement and performance.

It is suggested that more control of the installation procedures be exercised prior to and during the actual construction. There seemed to be a lack of expertise on the part of the contractor concerning planning and execution of his activities.

4:BR-2

APPENDIX A

TOTAL EXPERIMENTAL

PROJECT DESIGN

TOTAL EXPERIMENTAL PROJECT DESIGN

General Background

Over time, the top few inches of a concrete structure can become contaminated with salt from a saltwater marine environment or from deicing agents used during the winter months. This condition destroys the passivity of the reinforcing steel and provides a favorable environment for the development of corrosive anode-cathode relationships on the surfaces of the reinforcing steel. The salt and moisture in the concrete serve as the electrolyte. A reinforcing bar will corrode at the anodes, with the rust expanding and cracking the concrete. Delaminations and spalls occur in the deck with resulting deterioration.

Latex modified concrete (LMC), low slump dense concrete (LSDC), and asphalt concrete with waterproofing membranes are the most common systems being used for bridge deck overlays to restore deteriorated decks and to help prevent further penetration of chloride into the deck concrete. These systems add extra weight to bridges. In addition, the latex modified and low slump concrete overlays require careful quality control during construction and generally require 96 hours of cure time before traffic can be restored to the structure.

In recent years, polymer concrete (PC) in the form of 1/4-inch thin bridge deck overlays has shown promise of providing a long-lasting, maintenance-free deck protection system. It is impervious to the penetration of salt, can be constructed with relative ease and with relatively simple construction equipment, allows traffic to be restored within 1 to 12 hours, and provides good skid resistance. During construction, no scarifying is necessary; therefore, there is less potential for debonding and damage to rebars. These polymer concretes have a cross-linked polymer which replaces Portland cement as a binder in a concrete mix. Epoxy resins are commonly used in polymer concretes, but much attention has also been focused on the use of vinyl monomers such as polyester-styrene, methyl methacrylate, high molecular weight methacrylate, furane derivative, and styrene. Since the polymer constitutes the continuous phase, behavior of the PC will be determined by the specific polymer used.

Purpose

The purpose of the experimental project is to gain knowledge about field installation techniques and procedures and to assess the performance and effectiveness of the PC thin overlays over time.

General Project Description

WSDOT has selected eight federal aid and 13 state-funded bridges needing deck rehabilitation and protection. The normal delamination and spall reapirs will be followed by the application of thin PC overlays (usually 1/4"). These PC overlays will be systems marketed by private industry. The work will be done under usual WSDOT contracts. It is anticipated that separate contracts will be necessary for each bridge. A number of different PC systems will be used on the bridges. Contract documents will specify what type of system each separate bridge will receive. A total of approximately 130,000 ft^2 of bridge deck will be involved in the FHWA experimental feature project portion of this study.

Installation of the PC overlay for the bridge deck will be per the manufacturer's recommendations. Contract documents require that a supplier's field representative be present during installation of the system. Complete records of field observations, testing, and subsequent monitoring will be maintained for each installation with emphasis on the cause and resolution of problems which may occur during any phase of the project. The district field office will be asked to submit an end of construction report on the installation.

Annual inspections and testing of the experimental feature projects will be made over a ten-year period. The WSDOT Materials Laboratory will have responsibility for all field testing and for reporting on all field activities. See Appendix B for scheduled testing and reporting.

Control Section

The final performance evaluation report for each thin overlay application will include a comparison of the installation techniques and procedures with those for the latex modified and low slump concrete overlays. Likewise, the effectiveness of the permeability for deck protection and length of service life will be compared to the LMC and LSC overlays in similar environments and service conditions.

The current "Bridge Deck Program Development" includes research for "Evaluation of Concrete Overlays for Bridge Applications." It is intended to utilize to the fullest extent possible the data collected and analyzed in that research as the basis for comparative evaluation of the overlays in this experimental feature project.

Tests

Annual inspections and testing of each bridge will be made over a ten-year period. The testing will include: 1) friction measurements for skid resistance of the overlay surface; 2) electrical resistivity for waterproofing effectiveness; 3) half-cell for corrosion activity; 4) chloride content for intrusion of corrosive chloride ions; 5) pachometer for rebar depth; 6) pulloff for bond strength; and 7) visual inspection for detection of surface deterioration such as cracks, spalls, or delaminations. The schedule upon which each of these tests will be performed is shown in Appendix B.

Reporting

A post-construction report will be issued within 90 days of the completion of the construction project. Annual Form 1461 reports will be submitted through the WSDOT Research Office to FHWA summarizing the performance of the overlay. The testing results for each year will be reported to the Research Office with a brief letter report summarizing any observations or conclusions that can be made at that point. A final report will be issued at the end of the evaluation period. This report will contain all of the observations, test results, and conclusions from the study along with any appropriate photographs.

APPENDIX B

PROJECT LIST AND TEST PLAN

EXPERIMENTAL BRIDGE DECK THIN OVERLAY PROJECTS

	FED. AID PROJECTS	DIST.	DECK AREA (FT.2)	DECK RATING	BID OPENING	CONT. NO.	SYSTEM TYPE	DOLLARS PER SQ. YARD
403/7	GRAYS R. ROSBURG	4	5,360	7	02/05/86	3090	DEGUSSA	35
12/915	SNAKE R. CLARKSTON	5	56,940	4	03/05/86	3107	FLEXOGRID	40
82/114S	YAKIMA R.	5	11,370	3	05/07/86	3131	CONCRESSIVE 2020	77
82/115S	NACHES R.	5	11,370	4	05/07/86	3131	CONCRESSIVE 3070	77
900/12W	SR 5 OC	1	13,950	5	08/27/86	3189	FLEXOLITH	60
900/13W	SR 5 OC	1	13,950	4	08/27/86	3189	SIKA PRONTO 19	55
5/316	CUSTER WAY UC	3	6,190	4	12/09/87	3361	EPI/FLEX 111	62.60
5/523E	S. 154TH ST. OC	1	7,300	6	12/02/87	3354	CONKRYL	100
	NON FED. AID PROJECTS							
167/102	THIRD AVE. SW OC	3	7,216	7	01/15/86	3078	FLEXOGR	UNK
167/104	ELLINGSTON RD. OC	3	7,172	7	01/15/86	3078	FLEXOGRID	UNK
167/106	FIRST AVE. N. OC	3	6,424	7	01/15/86	3078	FLEXOGRID	UNK
161/10	SR 512 OC	3	11,120	7	02/26/86	3100	EPI/FLEX 111	40
167/21	MILWAUKEE AVE. OC	3	6,864	7	07/23/86	3183	DEGUSSA	43
512/40	SR 167 OC	3	12,806	7	07/23/86	3183	DEGUSSA	43
529/20W	STEAMBOAT SL	1	20,472	5	(06/25/87)	XE 2625	FLEXOGRID	40
529/20E	STEAMBOAT SL	1	21,840	3	(06/25/87)	XE 2625	FLEXOGRID	40
104/5.2	HOOD CANAL E½	3	101,388	4	(07/08/87)	3316	FLEXOGRID	32
82/10S	THRALL RD. O-XING	5	18,992	5	N/A	2857	FLEXOLITH	82
101/115	CHEHALIS RIVER BR.	3	14,508	6	N/A	2643	FLEXOGRID	65
101/514	MOTTMAN ROAD O-XING	3	6,640	7	N/A	2945	DEGUSSA	45
16/120	OLYMPIC INTER UC	3	6,417	7	08/17/87	3336	---	42

19:BR10

THIN OVERLAY EXPERIMENTAL PROJECT + TESTING AND ANALYSIS COSTS PER AVERAGE 13,000 ft.^{2} BRIDGE

Responsible Unit	Work Item	Pre-Construct.	Post-Construct.	Year* 1	2	3	4	5	6	7	8	9	10	Totals
HQ ML	Friction Testing (x hrs) at $100/hr		(1 hr) $ 100	(1 hr) $ 100	(1 hr) $ 110	(1 hr) $ 121	(1 hr) $ 133	(1 hr) $ 146	(1 hr) $ 161	(1 hr) $ 177	(1 hr) $ 195	(1 hr) $ 215	(1 hr) $ 237	$ 1,695
HQ ML	Electrical Resistivity (x hrs) at $108/hr		(6 hrs) $ 648	(6 hrs) $ 648	(6 hrs) $ 713	(6 hrs) $ 784		(6 hrs) $ 948		(6 hrs) $1,147			(6 hrs) $1,527	$ 6,415
HQ ML	Half-Cell Testing (x hrs) at $108/hr	(8 hrs) $ 864				(1 hr) $ 131				(1 hr) $ 192			(1 hr) $ 255	$ 1,442
HQ ML	Chloride Testing (x hrs) at $108/hr	(2 hrs) $ 216				(1 hr) $ 131				(1 hr) $ 192			(1 hr) $ 255	$ 794
HQ ML	Rebar Depth (x hrs) at $108/hr	(2 hrs) $ 216												$ 216
HQ ML	Bond Testing (x hrs) at $108/hr		(2 hrs) $ 216	(2 hrs) $ 216		(2 hrs) $ 262							(2 hrs) $ 510	$ 1,204
HQ ML	Visual Observation (x hrs) at $108/hr		(2 hrs) $ 216	(2 hrs) $ 216	(2 hrs) $ 238	(2 hrs) $ 262		(2 hrs) $ 317		(2 hrs) $ 384			(2 hrs) $ 510	$ 2,143
**HQ Br. Branch & ML	Analysis & Report Writing (x hrs) at $27.50/hr		(40 hrs) $1,100	(8 hrs) $ 220	(8 hrs) $ 242	(8 hrs) $ 266	(4 hrs) $ 147	(8 hrs) $ 322	(4 hrs) $ 177	(8 hrs) $ 389	(4 hrs) $ 214	(4 hrs) $ 236	(40 hrs) $2,590	$ 5,903
	TOTALS	$1,296	$2,280	$1,400	$1,303	$1,957	$ 280	$1,733	$ 338	$2,481	$ 409	$ 451	$5,884	$19,812
	TOTAL CONTRACT FUNDING		$3,576											-3,576
								TOTAL EXPERIMENTAL PROJECT FUNDING						$16,236

* 10% Annual Inflation Rate Assumed.

** Field data reporting will be by Materials Lab (ML). Analysis of data and final report by Bridge Branch.

APPENDIX C

TEST RESULTS

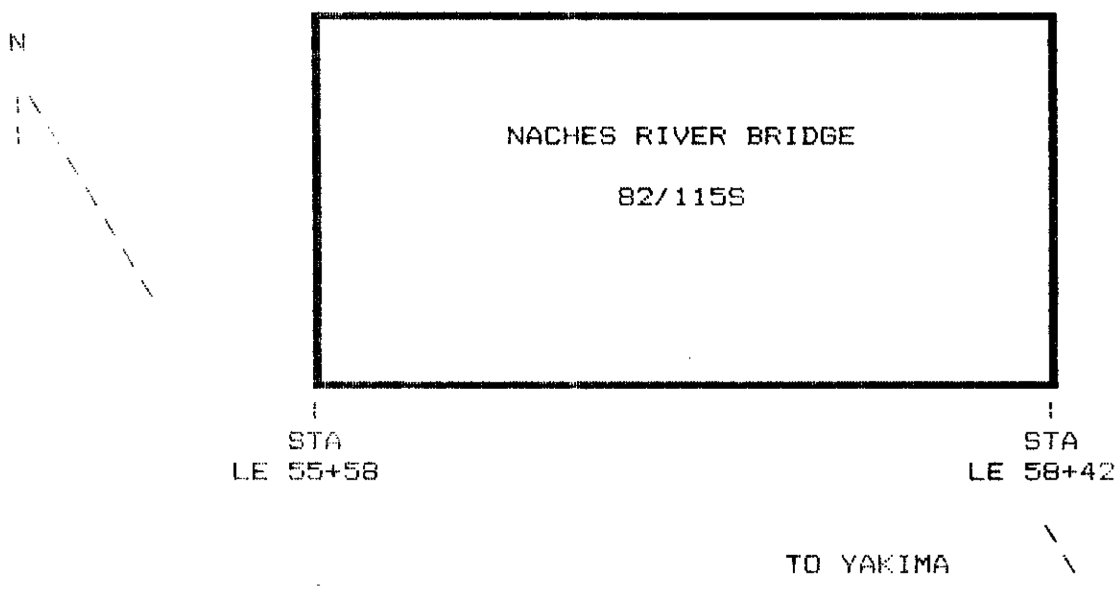
NACHES RIVER BRIDGE
82\115S
CONTRACT 3131

TESTING REQUIREMENTS

	Post Const 1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
FRICTION	10/87	3/88	x	x	x	x	x	x	x	x	x
RESISTIVITY	9/87	8/88	x	x		x		x			x
BOND	9/87	8/88		x							x
HALF-CELL				x				x			x
CHLORIDE				x				x			x

x = To Be Tested

Bridge
Orientation



BOND TEST RESULTS
NACHES RIVER BRIDGE 82/115S

Year	Station	Offset*	Depth	Load	PSI	Comments
1987	55+94	34	1/4"	1225	390	100% Break in old conc
	55+98	6	1/4"	1250	398	DITTO
	56+51	29	3/16"	1225	390	DITTO
	56+57	11	5/16"	1150	366	Break in pipe cap adhesive
	56+89	34	3/16"	1775	565	100% Break in old conc
	57+05	7	3/16"	1150	366	DITTO
	57+35	29	3/16"	****	***	No break - damaged by traffic
	57+54	11	1/4"	1000	318	Break in pipe cap adhesive
	57+85	35	1/8"	****	***	No break - damaged by traffic
	58+07	3.5	3/16"	1075	342	100% Break in old conc
1988	55+95	31	3/16"	1200	382	90% Break in old conc
	56+61	34	3/16"	1250	398	100% Break in old conc
	57+39	30	1/8"	1175	374	DITTO

*NOTE: Offset is feet right of left curb ahead on station.

FRICTION TEST RESULTS
NACHES RIVER BRIDGE 82/115S

DATE	DIR	FN	AVE	RANGE
10/87	S	48		
	S	45		
	S	60		
	S	53		
	S	47		
	S	59		
	S	51		
	S	49		
	S	65	53	45-65
03/88	S	40		
		40		
		39		
		48		
		46		
		50		
		59		
		57		
		59	49	39-59

DATE	DIR	FN	AVE	RANGE

WHEEL RUT MEASUREMENTS
NACHES RIVER BRIDGE 82/115S

DATE	STATION WHEELPATH	OUTSIDE LANE LEFT	OUTSIDE LANE RIGHT
08/88	55+60	3/16	3/16
	55+75	5/16	1/8
	56+00	3/16	1/8
	56+25	5/16	1/4
	56+50	5/16	1/8
	56+75	5/16	1/8
	57+00	5/16	3/16
	57+25	5/16	1/4
	57+50	3/8	1/4
	57+75	5/16	1/4
	58+00	3/8	1/4
	58+25	1/2	3/16

ELECTRICAL RESISTIVITY TEST RESULTS
NACHES RIVER BRIDGE 82/115S

SEPTEMBER, 1987

Sta LE 55+58	5	10	15	x	x	30	35
55+60	2.4M	4M	3M	x	x	2.8M	2.2M
55+65	1.1M	1.3M	400K	x	x	5M	1.7M
55+70	890K	3.6M	185K	x	x	10M	2.8M
55+75	3.6M	4M	84K	x	x	5.7M	2.4M
55+80	*	*	1.4M	x	x	5.3M	7.2M
55+85	*	3.8M	500K	x	x	3.7M	5.7M
55+90	9M	1.2M	750K	x	x	1.5M	1.3M
55+95	2.5M	*	830K	x	x	1.3M	1.3M
56+00	2.0M	970K	630K	x	x	4.0M	1.4M
56+05	&	2.6M	1.1M	x	x	970K	2.1M
56+10	13M	6M	2.3M	x	x	900K	1.4M
56+15	2.4M	480K	1.4M	x	x	3.1M	2.4M
56+20	3.2M	535K	970K	x	x	4.3M	7.6M
56+25	940K	*	1.1M	x	x	1.2M	2M
56+30	1.0M	3.3M	670K	x	x	1.7M	1.1M
56+35	5M	1.6M	920K	x	x	750K	1.0M
56+40	6M	1.1M	500K	x	x	700K	1.9M
56+45	440K	1.6M	870K	x	x	1.1M	8.4M
56+50	930K	2.2M	*	x	x	*	*
56+55	3M	410K	460K	x	x	32M	1.2M

& = Infinite Resistance

* = Bad reading - meter won't stabilize.

ELECTRICAL RESISTIVITY TEST RESULTS
NACHES RIVER BRIDGE 82/1155

SEPTEMBER, 1987
CONTINUED

56+55	5	10	15	x	x	30	35
56+60	4M	360K	640K	x	x	*	610K
56+65	1.0M	1.1M	470K	x	x	33K	2.7M
56+70	300K	1.6M	730K	x	x	3.1M	1.0M
56+75	580K	1.0M	780K	x	x	10M	5.5M
56+80	1.0M	1.6M	275K	x	x	2.2M	670K
56+85	2.4M	8M	280K	x	x	1.8M	600K
56+90	2.6M	1.5M	920K	x	x	1.3M	900K
56+95	1.0M	1.9M	610K	x	x	2.6M	3.0M
57+00	350K	920K	480K	x	x	870K	1.7M
57+05	315K	640K	390K	x	x	3.5M	2.6M
57+10	510K	2.7M	295K	x	x	2.8M	8.8M
57+15	2.7M	2.5M	910K	x	x	2.7M	750K
57+20	940K	2.8M	430K	x	x	460K	1.2M
57+25	330K	950K	200K	x	x	1.5M	545K
57+30	1.5M	2.1M	840K	x	x	1.2M	1.3M
57+35	1.1M	2.4M	550K	x	x	~104K	*
57+40	3.2M	2.2M	620K	x	x	750K	100K
57+45	2.6M	890K	480K	x	x	800K	100K
57+50	*	*	430K	x	x	530K	1.6M

& = Infinite Resistance

* = Bad reading - meter won't stabilize

~ = Leak to bond test drill hole

ELECTRICAL RESISTIVITY TEST RESULTS
NACHES RIVER BRIDGE 82/115S

SEPTEMBER, 1987
CONTINUED

	5	10	15	x	x	30	35
57+50							
57+55	3M	1.9M	1.2M	x	x	1.2M	750K
57+60	3M	1M	470K	x	x	780K	1.4M
57+65	3.7M	1.1M	620K	x	x	800K	2.5M
57+70	4M	2.2M	210K	x	x	1.4M	350K
57+75	4.6M	3.2M	3M	x	x	1.1M	1.5M
57+80	4.2M	3.8M	610K	x	x	2.0M	1.0M
57+85	3.5M	8M	2.7M	x	x	1.5M	900K
57+90	6M	3.5M	3.0M	x	x	1.1M	950K
57+95	8M	940K	2.9M	x	x	1.3M	700K
58+00	7M	3.6M	2.3M	x	x	1.6M	760K
58+05	3.4M	690K	1.2M	x	x	2.1M	750K
58+10	4.0M	6M	2.6M	x	x	5.4M	500K
58+15	1.9M	350K	520K	x	x	1.3M	1.2M
58+20	1.3M	260K	1.5M	x	x	1.0M	1.8M
58+25	1.0M	630K	560K	x	x	1.1M	*
58+30	1.2M	1.1M	670K	x	x	1.4M	2.3M
58+35	3.1M	2.6M	395K	x	x	2.0M	1.9M
58+40	2.3M	3.1M	4M	x	x	3.2M	2.5M
58+42							

& = Infinite Resistance

* = Bad reading - meter won't stabilize

ELECTRICAL RESISTIVITY TEST RESULTS
NACHES RIVER BRIDGE 82/115S

AUGUST, 1988

Sta LE 55+58	5	10	15	x	x	30	35
55+60	x	x	x	x	x	200K	284K
55+65	x	x	x	x	x	250K	210K
55+70	x	x	x	x	x	535K	295K
55+75	x	x	x	x	x	385K	500K
55+80	x	x	x	x	x	290K	360K
55+85	x	x	x	x	x	325K	450K
55+90	x	x	x	x	x	145K	1.6M
55+95	x	x	x	x	x	155K	772K
56+00	x	x	x	x	x	300K	640K
56+05	x	x	x	x	x	225K	620K
56+10	x	x	x	x	x	90K	445K
56+15	x	x	x	x	x	245K	37K
56+20	x	x	x	x	x	192K	290K
56+25	x	x	x	x	x	301K	470K
56+30	x	x	x	x	x	265K	584K
56+35	x	x	x	x	x	68K	570K
56+40	x	x	x	x	x	53K	340K
56+45	x	x	x	x	x	75K	750K
56+50	x	x	x	x	x	19K	185K
56+55	x	x	x	x	x	195K	189K

& = Infinite Resistance

Offset is feet right of left curb ahead on station

ELECTRICAL RESISTIVITY TEST RESULTS
NACHES RIVER BRIDGE 82/115S

AUGUST, 1988
CONTINUED

56+55	5	10	15	x	x	30	35
56+60	x	x	x	x	x	49K	325K
56+65	x	x	x	x	x	98K	130K
56+70	x	x	x	x	x	133K	162K
56+75	x	x	x	x	x	397K	175K
56+80	x	x	x	x	x	650K	155K
56+85	x	x	x	x	x	260K	310K
56+90	x	x	x	x	x	240K	185K
56+95	x	x	x	x	x	325K	320K
57+00	x	x	x	x	x	660K	1.4M
57+05	x	x	x	x	x	285K	465K
57+10	x	x	x	x	x	360K	300K
57+15	x	x	x	x	x	250K	180K
57+20	x	x	x	x	x	285K	470K
57+25	x	x	x	x	x	280K	140K
57+30	x	x	x	x	x	110K	155K
57+35	x	x	x	x	x	150K	240K
57+40	x	x	x	x	x	480K	120K
57+45	x	x	x	x	x	390K	130K
57+50	x	x	x	x	x	95K	185K

& = Infinite Resistance

ELECTRICAL RESISTIVITY TEST RESULTS
NACHES RIVER BRIDGE 82/1155

AUGUST, 1988
CONTINUED

	5	10	15	x	x	30	35
57+50							
57+55	x	x	x	x	x	327K	700K
57+60	x	x	x	x	x	85K	525K
57+65	x	x	x	x	x	120K	135K
57+70	x	x	x	x	x	180K	185K
57+75	x	x	x	x	x	375K	373K
57+80	x	x	x	x	x	1.4M	500K
57+85	x	x	x	x	x	625K	2.0M
57+90	x	x	x	x	x	665K	1.1M
57+95	x	x	x	x	x	965K	1.4M
58+00	x	x	x	x	x	506K	1.3M
58+05	x	x	x	x	x	1.5M	1.1M
58+10	x	x	x	x	x	2.2M	1.8M
58+15	x	x	x	x	x	210K	500K
58+20	x	x	x	x	x	300K	140K
58+25	x	x	x	x	x	310K	268K
58+30	x	x	x	x	x	210K	400K
58+35	x	x	x	x	x	470K	425K
58+40	x	x	x	x	x	1.4M	1.8M
58+42							

& = Infinite Resistance

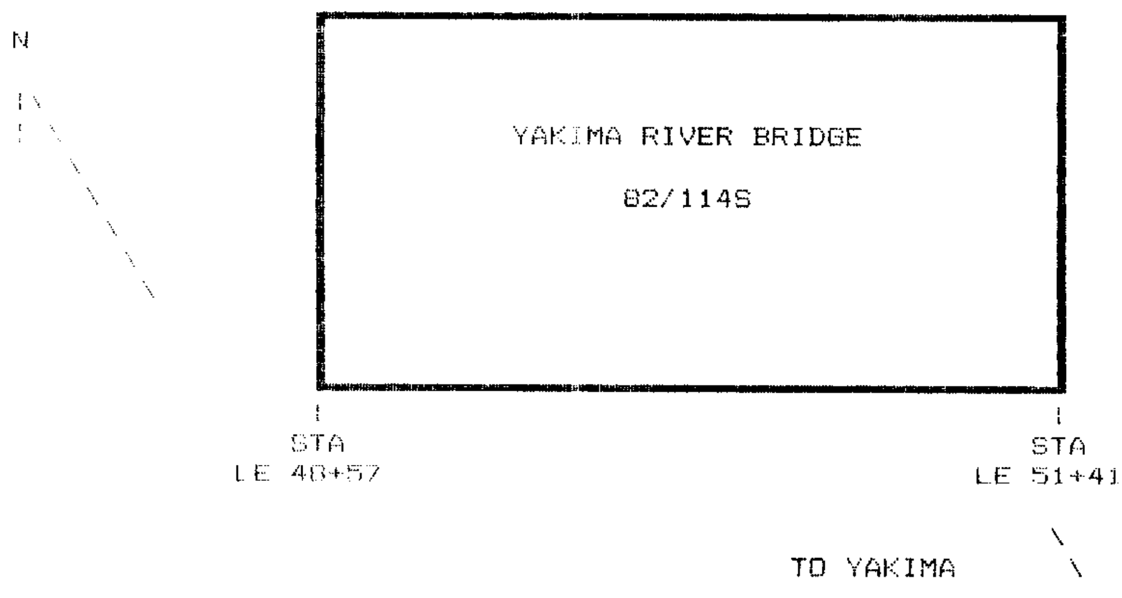
YAKIMA RIVER BRIDGE
82\114S
CONTRACT 3131

TESTING REQUIREMENTS

	Post Const 1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
FRICTION	10/87	3/88	x	x	x	x	x	x	x	x	x
RESISTIVITY	9/87	8/88	x	x		x		x			x
BOND	9/87	8/88		x							x
HALF-CELL				x				x			x
CHLORIDE				x				x			x

x = To Be Tested

Bridge
Orientation



BOND TEST RESULTS
YAKIMA RIVER BRIDGE 82/114S

Year	Station	Offset*	Depth	Load	PSI	Comments
1987	48+93	30	3/8"	1475	470	100% Break in old conc
	48+98	10.5	1/4"	675	215	100% Break in methyl
	49+41	34	5/16"	675	215	100% Break in old conc
	49+47	5	3/8"	835	266	100% Break in methyl
	49+92	31	1/8"	1050	334	Break in pipe cap adhesive
	49+94	10	3/16"	1025	326	100% Break in methyl
	50+35	35	5/16"	700	223	100% Break in old conc
	50+36	5	5/16"	700	223	100% Break in methyl
	50+86	29	3/16"	1250	398	Break in pipe cap adhesive
	51+01	9.5	1/8"	525	167	90% Break in methyl
1988	49+39	34.5	1/8"	1100	350	100% Break in old conc
	49+88	32	3/16"	1000	318	90% Break in old conc
	50+49	34	3/16"	1100	350	95% Break in old conc
	49+92	32	1/4"			Depth measurement only
	50+11	32	5/16"			DITTO
	50+73	32	1/4"			DITTO

*NOTE: Offset is feet right of left curb ahead on station.

FRICTION TEST RESULTS
YAKIMA RIVER BRIDGE 82/114S

DATE	DIR	FN	AVE	RANGE
10/87	S	29		
	S	28		
	S	36		
	S	29		
	S	29		
	S	32		
	S	31		
	S	29		
	S	39	31	28-39
03/90	S	48		
		50		
		52		
		43		
		44		
		47		
		53		
		55		
		52	49	43-55

DATE	DIR	FN	AVE	RANGE

WHEEL RUT MEASUREMENTS
YAKIMA RIVER BRIDGE 82/1145

DATE	STATION WHEELPATH	OUTSIDE LANE LEFT	OUTSIDE LANE RIGHT
08/88	48+60	1/16	1/8
	48+75	1/16	3/16
	49+00	1/16	1/8
	49+25	1/8	1/8
	49+50	1/16	1/8
	49+75	1/8	1/8
	50+00	1/16	1/8
	50+25	1/16	1/8
	50+50	1/16	1/8
	50+75	1/16	1/8
	51+00	1/16	1/16
	51+25	1/16	1/8

ELECTRICAL RESISTIVITY TEST RESULTS
YAKIMA RIVER BRIDGE 82/114S

SEPTEMBER, 1987

Sta LE 48+57		5	10	x	x	x	30	35
	48+60	&	&	x	x	x	3M	5M
	48+65	&	&	x	x	x	&	2.8M
	48+70	&	&	x	x	x	4.7M	3.0M
	48+75	&	&	x	x	x	2.7M	&
	48+80	&	&	x	x	x	1.6M	&
	48+85	&	&	x	x	x	3.6M	&
	48+90	&	11M	x	x	x	13M	11M
	48+95	&	&	x	x	x	&	530K
	49+00	9M	12M	x	x	x	&	750K
	49+05	&	&	x	x	x	&	5.8M
	49+10	&	&	x	x	x	&	800K
JOINT	49+15	57K	24M	x	x	x	4.1M	1.5M
	49+20	&	&	x	x	x	2.3M	2.1M
	49+25	27M	&	x	x	x	1.9M	1.4M
	49+30	13M	&	x	x	x	5.5M	1.5M
	49+35	&	&	x	x	x	4M	9M
	49+40	&	&	x	x	x	1.8M	2M
	49+45	460K	&	x	x	x	2.3M	1.6M
	49+50	&	&	x	x	x	1.7M	1.5M
	49+55	&	3.5M	x	x	x	2.3M	&

& = Infinite Resistance

ELECTRICAL RESISTIVITY TEST RESULTS
YAKIMA RIVER BRIDGE 82/114S

SEPTEMBER, 1987
CONTINUED

		5	10	x	x	x	30	35
	49+55							
	49+60	&	&	x	x	x	2.0M	&
	49+65	&	&	x	x	x	&	4.8M
JOINT	49+70	2.2M	2.0M	x	x	x	1.1M	2.0M
	49+75	&	19M	x	x	x	9M	&
	49+80	&	&	x	x	x	1.4M	600K
	49+85	16M	&	x	x	x	1.9M	1.3M
	49+90	&	&	x	x	x	1.5M	26M
	49+95	170K*	540K	x	x	x	1.9M	22M
	50+00	275K*	&	x	x	x	1.8M	950K
	50+05	&	&	x	x	x	3.1M	&
	50+10	&	&	x	x	x	&	900K
	50+15	&	8M	x	x	x	&	&
	50+20	1.3M	880K	x	x	x	29M	&
	50+25	&	17M	x	x	x	1.2M	&
	50+30	&	12M	x	x	x	2.6M	&
	50+35	350K	3M	x	x	x	&	&
	50+40	&	8M	x	x	x	1.6M	790K
	50+45	&	&	x	x	x	700K	370K
	50+50	&	&	x	x	x	1.2M	300K

& = Infinite Resistance

* Possiable leak to curb

ELECTRICAL RESISTIVITY TEST RESULTS
YAKIMA RIVER BRIDGE 82/114S

SEPTEMBER, 1987
CONTINUED

	5	10	x	x	x	30	35
50+50							
50+55	970K	860K	x	x	x	1.3M	1.1M
50+60	&	9M	x	x	x	2.1M	&
50+65	&	&	x	x	x	2.5M	&
50+70	&	&	x	x	x	3.4M	1.7M
50+75	&	4M	x	x	x	&	&
50+80	&	3M	x	x	x	&	400K
50+85	&	&	x	x	x	&	4.4M
50+90	&	420K	x	x	x	&	12M
50+95	&	390K	x	x	x	&	12M
51+00	&	390K	x	x	x	&	7.8M
51+05	1.5M	550K	x	x	x	4.4M	5.9M
51+10	620K	1.3M	x	x	x	1.1M	4.3M
51+15	&	16M	x	x	x	2.3M	&
51+20	&	22M	x	x	x	&	2.1M
51+25	&	&	x	x	x	2.3M	&
51+30	&	&	x	x	x	2.9M	&
51+35	&	&	x	x	x	2.1M	&
51+40	STEEL EXPANSION PLATE						
51+41							

& = Infinite Resistance

ELECTRICAL RESISTIVITY TEST RESULTS
YAKIMA RIVER BRIDGE 82/114S

AUGUST, 1988

Sta LE 48+57		5	10	x	x	x	30	35
	48+60	x	x	x	x	x	2.9M	2.3M
	48+65	x	x	x	x	x	2.2M	2.8M
	48+70	x	x	x	x	x	2.9M	1.0M
	48+75	x	x	x	x	x	1.8M	&
	48+80	x	x	x	x	x	840K	3.1M
	48+85	x	x	x	x	x	1.0M	1.9M
	48+90	x	x	x	x	x	740K	1.1M
	48+95	x	x	x	x	x	&	39K
	49+00	x	x	x	x	x	&	13K*
	49+05	x	x	x	x	x	2.2M	820K
	49+10	x	x	x	x	x	71K	640K
JOINT	49+15	x	x	x	x	x	1.5M	1.8M
	49+20	x	x	x	x	x	1.9M	1.9M
	49+25	x	x	x	x	x	1.3M	1.3M
	49+30	x	x	x	x	x	1.8M	960K*
	49+35	x	x	x	x	x	760K	1.0M
	49+40	x	x	x	x	x	1.1M	1.4M
	49+45	x	x	x	x	x	1.3M	760K
	49+50	x	x	x	x	x	870K	600K
	49+55	x	x	x	x	x	690K	640K

* = Bare Spot
& = Infinite Resistance
Offest is feet right of left curb ahead on station

ELECTRICAL RESISTIVITY TEST RESULTS
YAKIMA RIVER BRIDGE 82/114S

AUGUST, 1987
CONTINUED

	49+55	5	10	x	x	x	30	35
	49+60	x	x	x	x	x	800K	7.4M
	49+65	x	x	x	x	x	880K	1.0M
JOINT	49+70	x	x	x	x	x	1.5M	1.1M*
	49+75	x	x	x	x	x	2.0M	560K
	49+80	x	x	x	x	x	820K*	8.2M*
	49+85	x	x	x	x	x	710K	690K
	49+90	x	x	x	x	x	700K	760K
	49+95	x	x	x	x	x	1.2M	1.5M
	50+00	x	x	x	x	x	1.7M	3.7M
	50+05	x	x	x	x	x	580K	880K
	50+10	x	x	x	x	x	580K	13K*
	50+15	x	x	x	x	x	750K	590K
	50+20	x	x	x	x	x	440K	&
	50+25	x	x	x	x	x	650K	4.1M
	50+30	x	x	x	x	x	2.2M	&
	50+35	x	x	x	x	x	900K	&
	50+40	x	x	x	x	x	1.2M	&
	50+45	x	x	x	x	x	700K	2.0M
	50+50	x	x	x	x	x	1.1M	660K*

& = Infinite Resistance
* = Bare Spot

ELECTRICAL RESISTIVITY TEST RESULTS
YAKIMA RIVER BRIDGE 82/114S

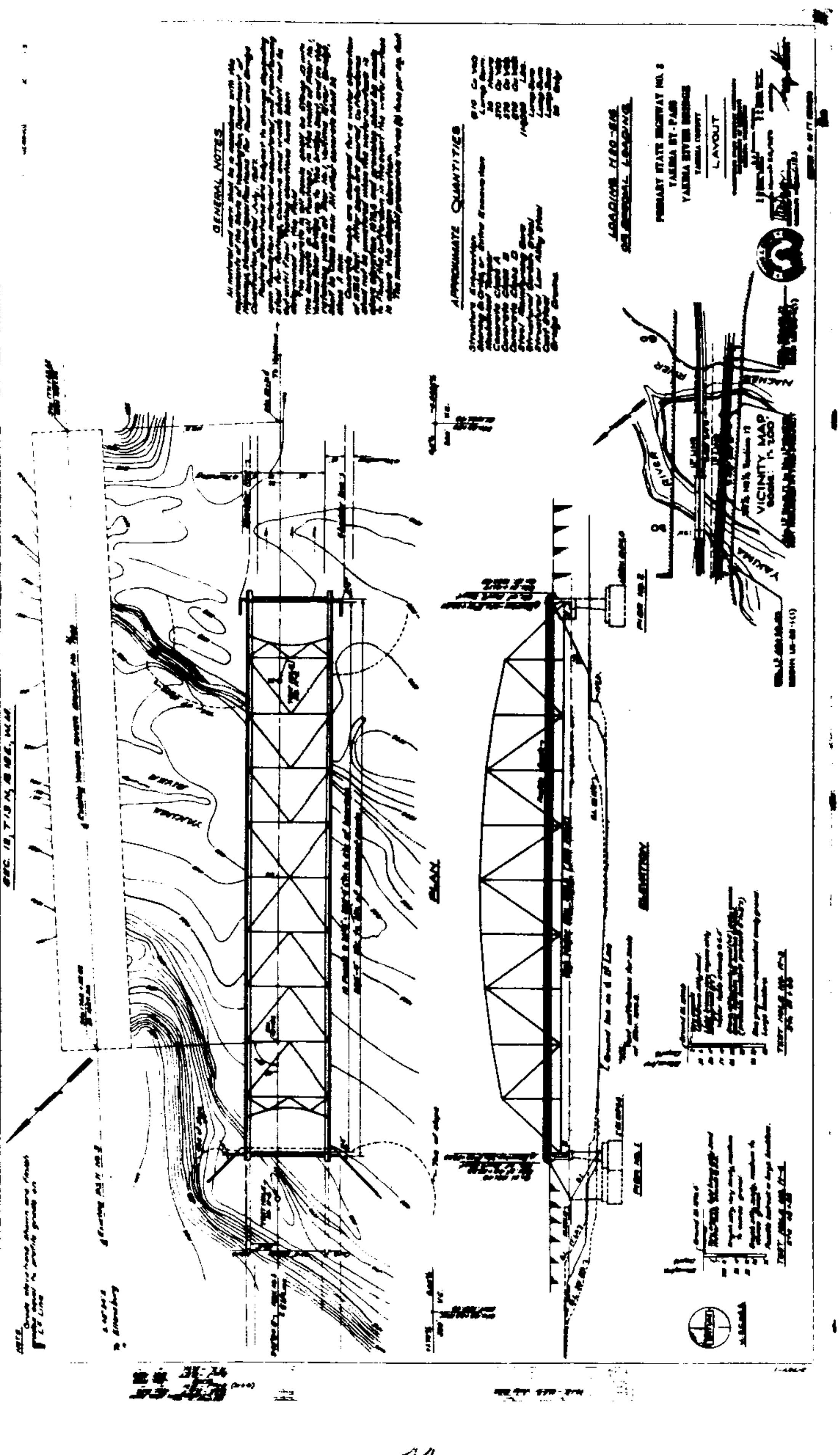
AUGUST, 1987
CONTINUED

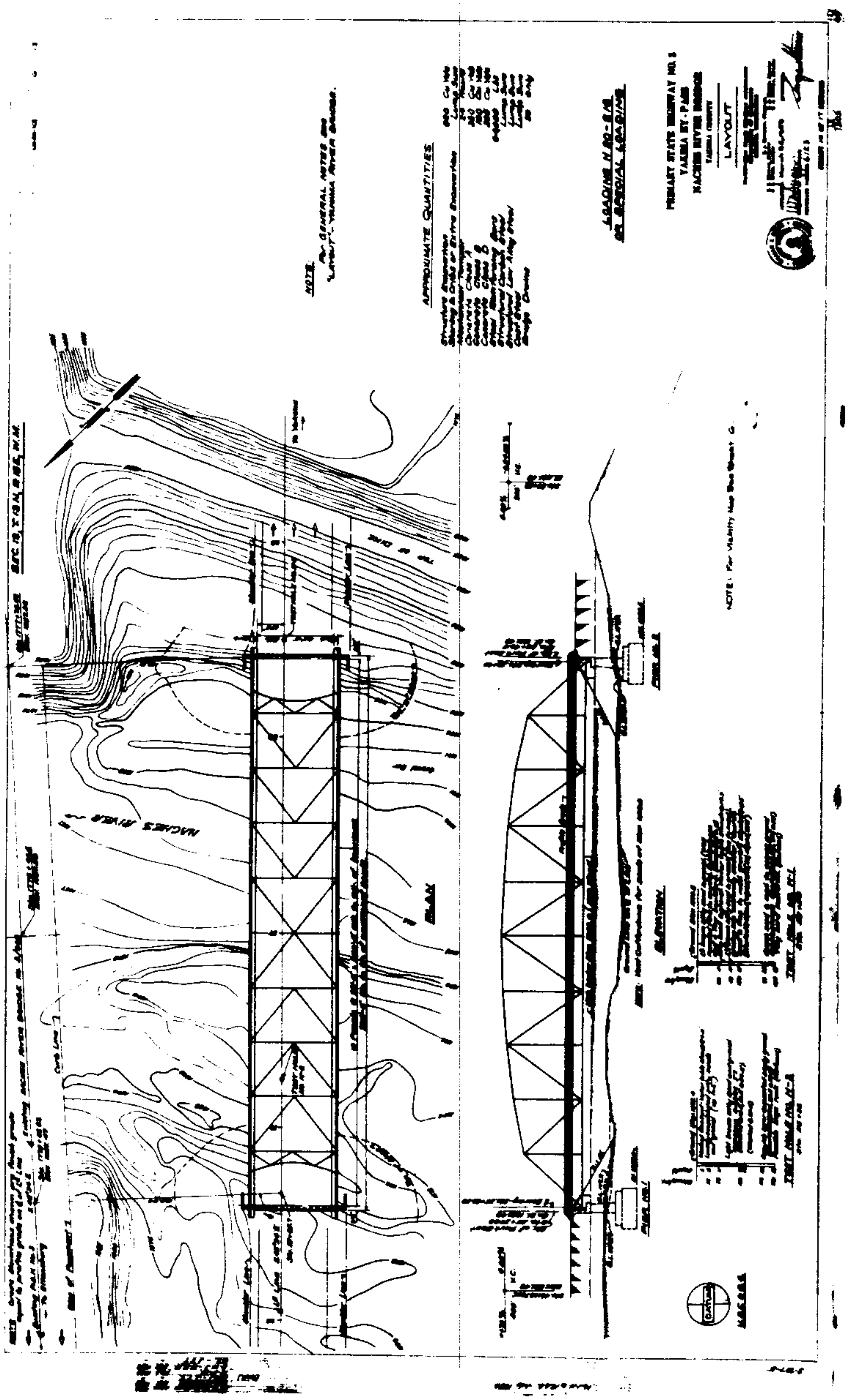
	5	10	x	x	x	30	35
50+50							
50+55	x	x	x	x	x	1.5M	610K
50+60	x	x	x	x	x	1.1M	&
50+65	x	x	x	x	x	1.0M	1.1M
50+70	x	x	x	x	x	910K	740K
50+75	x	x	x	x	x	1.1M	&
50+80	x	x	x	x	x	1.3M	20M
50+85	x	x	x	x	x	780K	460K
50+90	x	x	x	x	x	&	46K
50+95	x	x	x	x	x	450K	330K
51+00	x	x	x	x	x	780K	&
51+05	x	x	x	x	x	2.5M	14M
51+10	x	x	x	x	x	1.4M	370K
51+15	x	x	x	x	x	2.0M	&
51+20	x	x	x	x	x	680K	&
51+25	x	x	x	x	x	2.5M	3.9M
51+30	x	x	x	x	x	2.0M	&
51+35	x	x	x	x	x	1.9M	2.8M
51+40	STEEL EXPANSION PLATE						
51+41							

& = Infinite Resistance

APPENDIX D

GENERAL LAYOUTS


GENERAL NOTES
APPROXIMATE QUANTITIES
PLAN
ELEVATION
VICINITY MAP
LAYOUT

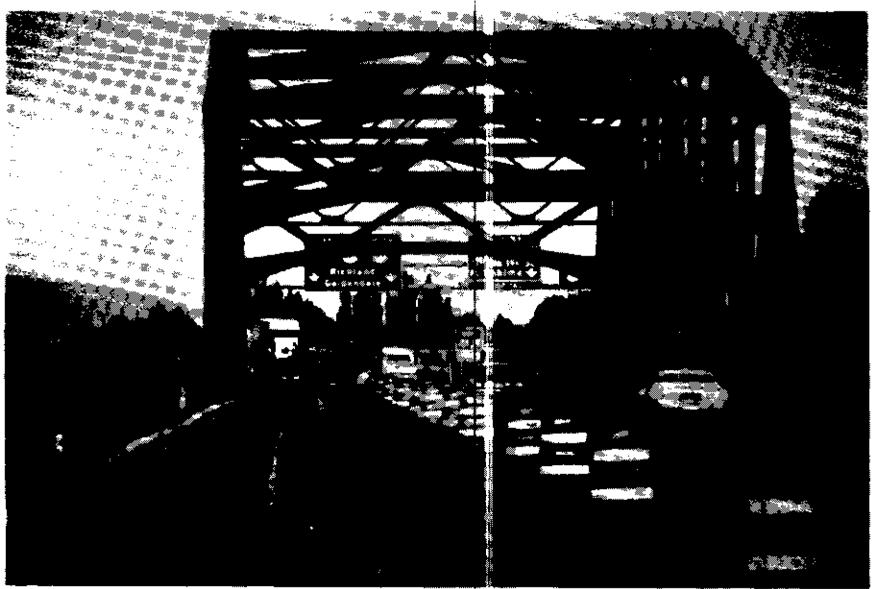


APPENDIX E

NACHES RIVER AND YAKIMA RIVER

PROJECT PHOTOGRAPHS

NACHES RIVER BRIDGE



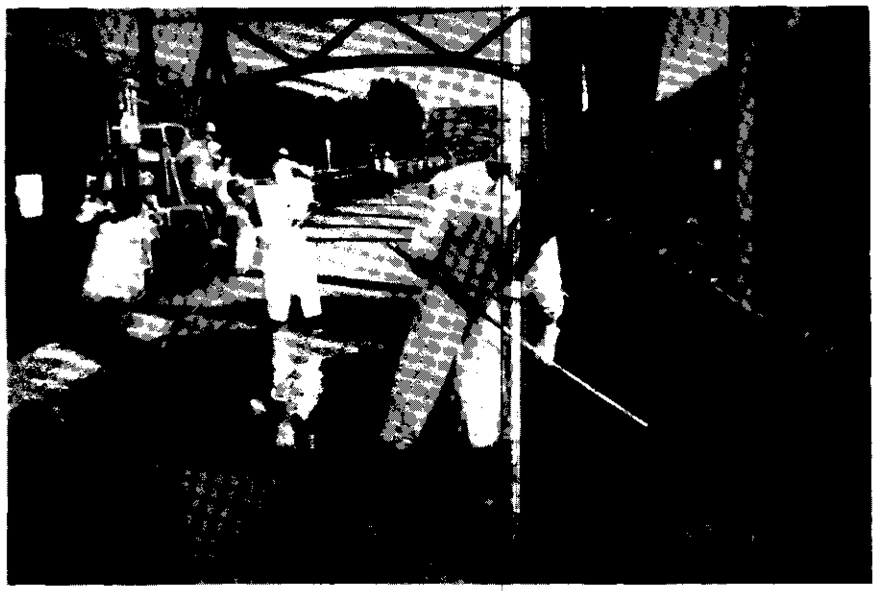
Lane closure.

Deck cleaning by shotblast.

Mixing epoxy resin component A and B.

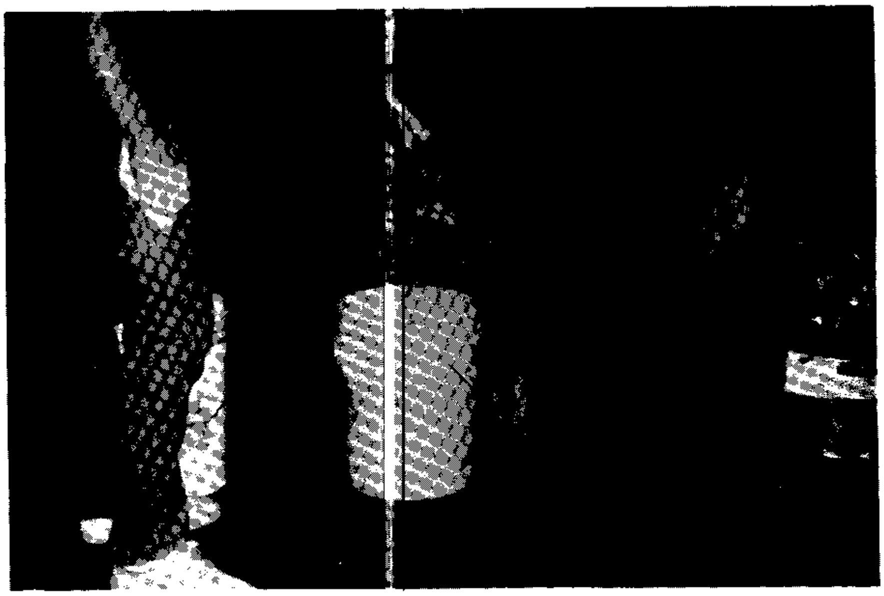
Pouring epoxy resin on deck.

NACHES RIVER BRIDGE

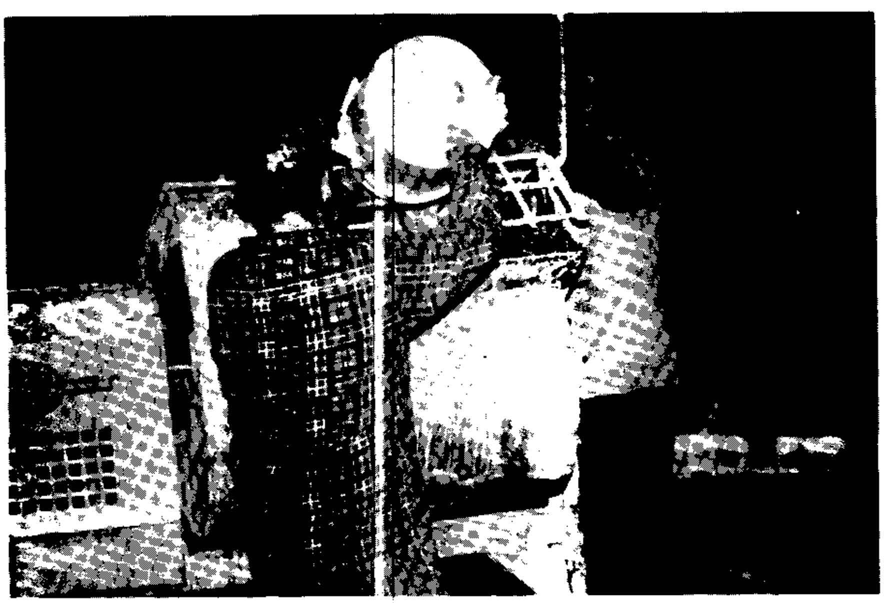


Spreading epoxy resin by squeegee.

Another view of spreading epoxy by squeegee.

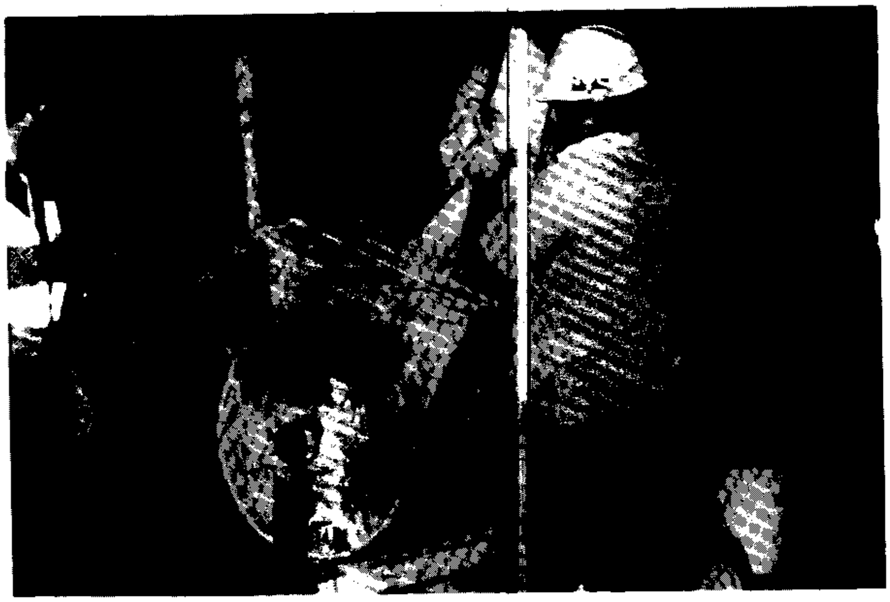


Pouring methacrylate resin components into bucket.

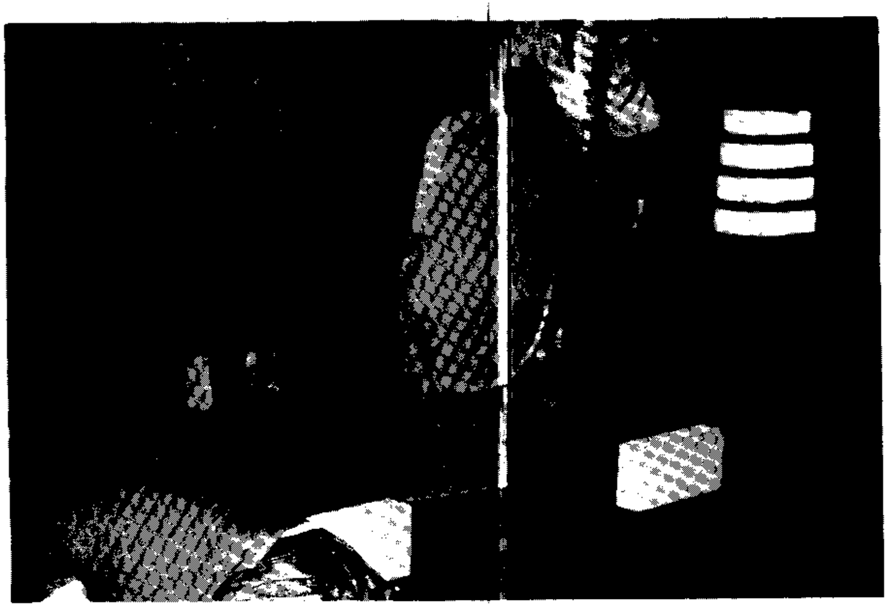


Mixing methacrylate components by paddle type mixer.

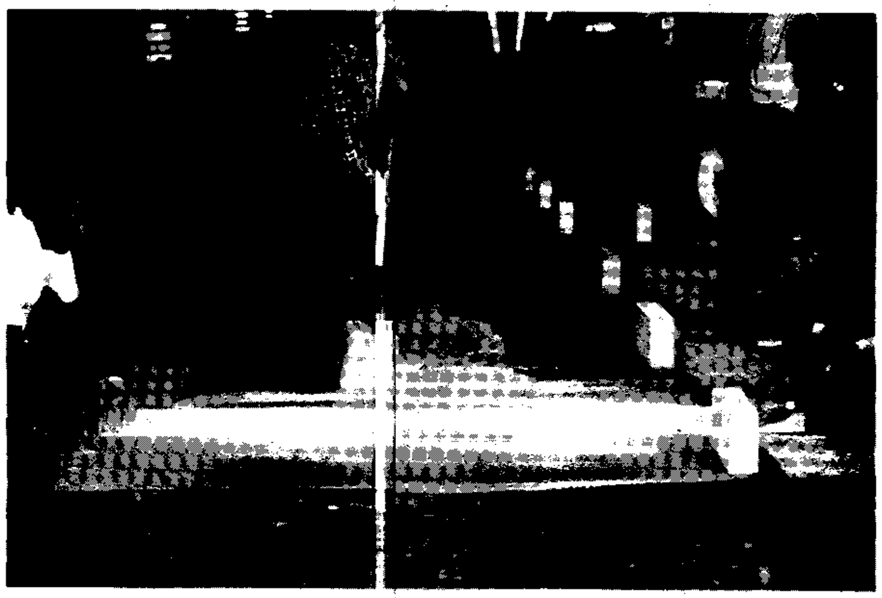
YAKIMA RIVER BRIDGE



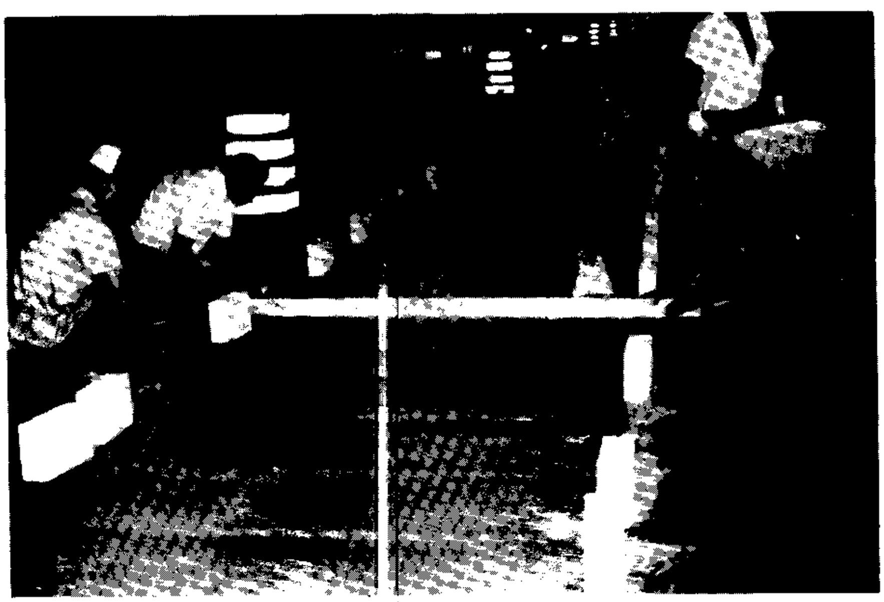
Another view of the mixer.



Wheelbarrow placement of MMA on deck.



Hand screeding MMA.



Another view of hand screeding. Note concrete blocks to hold down 1/4" steel forms.