

MENT

Traffic Barrier Systems

Service Level 1 Bridge Rail

WA-RD 106.1

Initial Report
January 1987



Washington State Department of Transportation

Planning, Research and Public Transportation Division

in cooperation with the

United States Department of Transportation

Federal Highway Administration

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16. Abstract The Washington State Department of Transportation (WSDOT) designed and installed Service Level 1 (SL-1) bridge rails on three treated timber bridges in the state. To date there have been no accidents or maintenance problems reported at any of the modified bridges.			
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TRAFFIC BARRIER SYSTEMS
SERVICE LEVEL 1 (SL-1)
BRIDGE RAIL

by

Don Gripne
Project Development Office

Initial Report

FHWA Demonstration Project No. 64

Prepared for
Washington State Department of Transportation
and in Cooperation With
U. S. Department of Transportation
Federal Highway Administration

January 1987

DISCLAIMER

The contents of this report reflect the views of the author who is 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 Department of Transportation or the Federal Highway Administration. This report does not constitute a standard, specification or regulation.

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RAIL PERFORMANCE

To date there have been no accidents or maintenance problems reported at any of the modified bridges.

Maintenance personnel have expressed their liking for the SL-1 rail since it will cause little or no damage to the bridge when struck. The replacement of the wooden rail required extensive work when struck.

ADDITIONAL RESEARCH

Wood posts as an alternative to the G-2 posts for the approach rail needs to be investigated.

CONTACT PERSON

The principal investigator of the project is:

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STUDY SITE AND DESIGN

This demonstration project, consisting of the installation of a Service Level 1 (SL-1) railing system on timber bridges, has been completed on the three bridges that were selected for the study. The Middle Nemah River Bridge and the Jorgenson Slough Bridge are located on SR 101 and the Coulter Creek Bridge is located on SR 106, all in western Washington (see vicinity maps).

Below are data of these bridges:

Bridge Name	Middle Nemah River
Bridge No.	101/31 M.P. 33.8
Life Expectancy	1995
ADT	2250
Accident	None
Experience	
Width	Twenty-eight feet
Appr. Rdwy. Width	Twenty-four w/ two-foot asphalt shoulders
Bridge	Eighty-six feet/creosote treated
Length/Type	Timber trestle
Average Operating	
Speed	55 MPH
Vehicle Mix	13% Trucks
Completion Date of	
SL-1 Installation	Dec. 31, 1985

Bridge Name	Jorgenson Slough
Bridge No.	101/33 M.P. 34.3
Life Expectancy	1994
ADT	2250
Accident	None
Experience	
Width	Twenty-eight feet
Appr. Rdwy. Width	Twenty-four feet w/two-foot shoulders
Bridge	Seventy feet/timber treated
Length/Type	Longitudinal laminated deck
Average Operating	
Speed	55 MPH
Vehicle Mix	13% Trucks
Completion Date of	
SL-1 Installation	Dec. 31, 1985

PURPOSE

The Service Level-1 (SL-1) Bridge Rail was designed to function adequately and to be cost-effective when compared to conventional longitudinal barriers. The purpose of this demonstration project is to determine if these design goals can be achieved and to identify any modifications that could improve field performance.

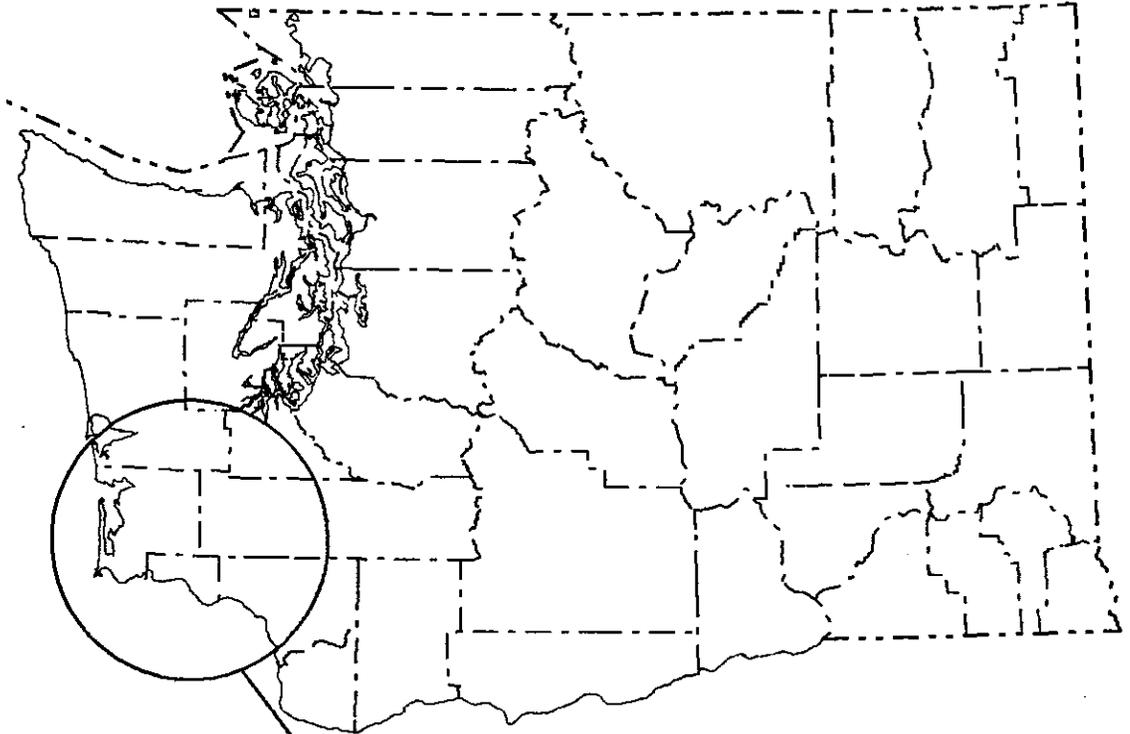
The SL-1 system was developed and tested for the FHWA by Southwest Research Institute. The Demonstration Projects Division of the FHWA wanted to verify the laboratory tests under actual field conditions and to obtain installation, performance, and maintenance data for this barrier system.

The purpose of this demonstration project is to show the feasibility and practicability of installing an SL-1 system on timber bridges and to perform an in-service evaluation to obtain maintenance costs and identify any design deficiencies.

The SL-1 systems were installed on low-volume state highways at sites suggested by the WSDOT and approved by the FHWA, Washington Division.

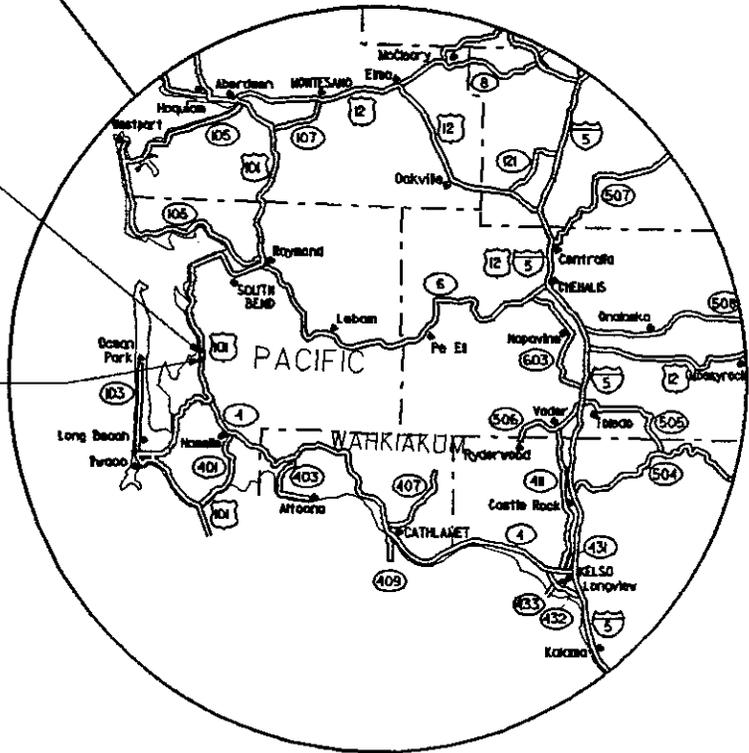
VICINITY MAP

Jorgenson Slough and Middle Nemah River Bridge



Jorgenson Slough

Middle Nemah River



Bridge Name	Coulter Creek
Bridge No.	302/3 M.P. 1.99
Life Expectancy	1997
ADT	1950
Accident	None
Experience	
Width	Twenty-eight feet
Appr. Rdwy. Width	Twenty-four feet w/two-foot shoulders
Bridge	One hundred sixteen feet/creosote
Length/Type	Treated timber trestle
Average Operating	
Speed	45 MPH
Vehicle Mix	6% Trucks
Completion Date of	
SL-1 Installation	Oct. 1, 1986

Plans were prepared by the Washington State Department of Transportation.

The design of the bridge rails followed the criteria in NCHRP Report 239, "Multiple-Service-Level Highway Bridge Railing Selection Procedures." The 239 report addressed the use of the SL-1 system on concrete bridges, so in order to use the system on wooden bridges, brackets were designed that could be bolted to the wooden deck. The rest of the system could then be connected to the bracket.

The mounting brackets for the rail posts were designed for use with the different timber bridge decks. All of our wooden deck bridges have an asphalt overlay on them. It was determined these brackets could be modified to accommodate an asphalt overlay depth of up to 9 inches. Asphalt depth greater than 9 inches will create a design that will cause construction problems in trying to install the system under traffic. Each bridge needs to be reviewed to see what modification needs to be made to the bracket to accommodate that bridge.

In all cases, the brackets need to be designed so that the posts are the same length and the top of the rail is 32 inches from roadway surface. The installed system will then be compatible with the system that was crash tested.

Most of our timber bridges have timber rub rails or curbs. This rail has to be removed to install the SL-1 system, thus requiring asphalt to fill in the void. To provide a nice finished surface at the edge of the bridge, a treated timber was bolted to the deck to provide a barrier to place the asphalt against.

CONSTRUCTION SUMMARY

This project consisted of replacing wood railing with SL-1 bridge rail on three bridges to upgrade the bridge rails for the three bridges.

The Middle Nemah River and Jorgenson Slough bridges were retrofitted by the bridge crews of District 4 based in Vancouver, Washington. The Coulter Creek bridge rail was rebuilt by the District 3 bridge crew based in Tumwater, Washington.

Typical crews included one Bridge Lead Tech, three Bridge Tech 2's, one Bridge Tech 3, and one Bridge Tech 1. Typical equipment for this project included one bridge tool truck, two bridge trucks, one carry-all, one three-quarter ton pickup, and one six-passenger pickup.

The actual total cost for these three bridges, including approach rail, is \$96,872.52. The cost breakdown is as follows:

Summary of Cost

Middle Nemah River Bridge

Bridge Rail Cost:

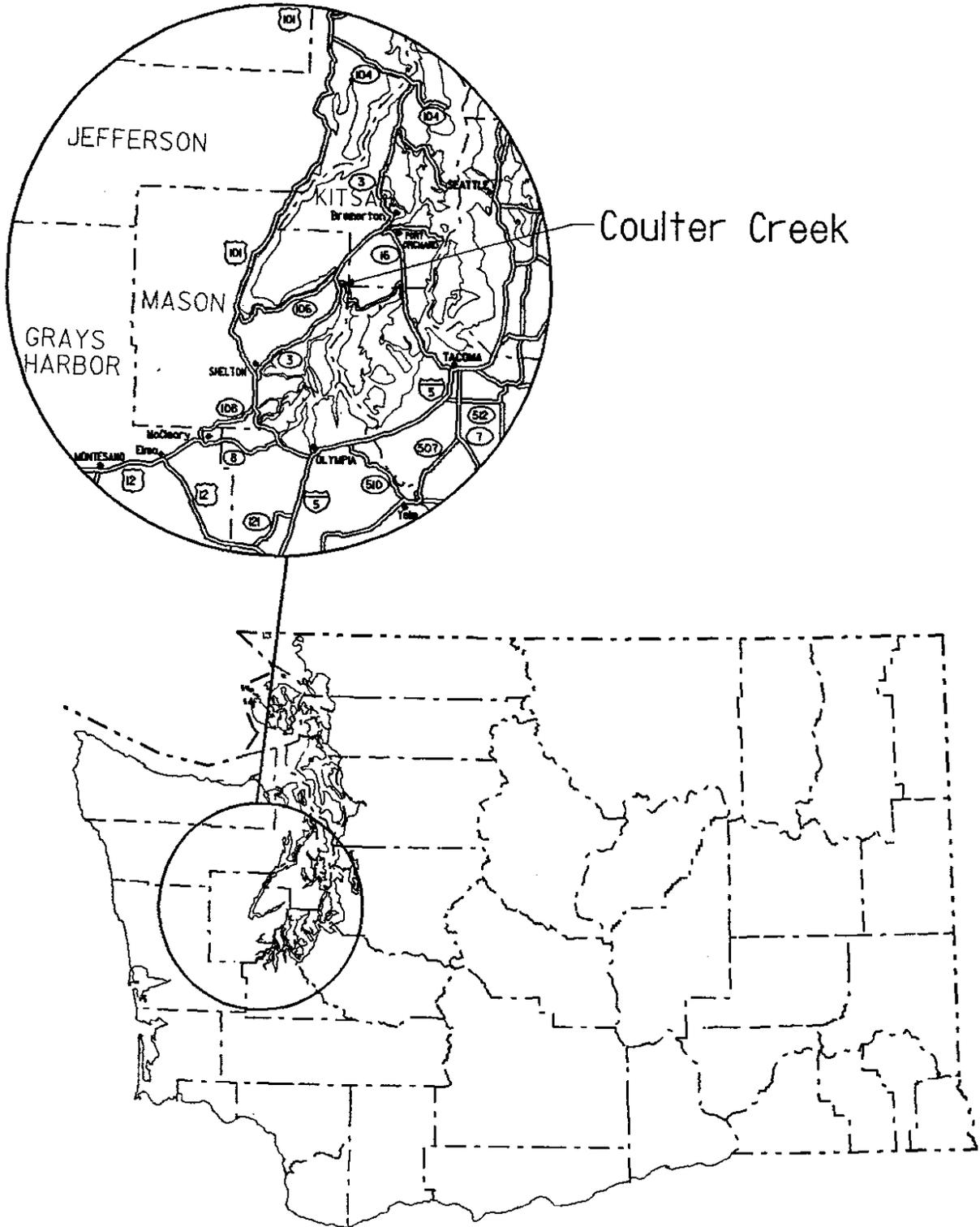
Labor	\$ 5,892.18
Equipment	3,180.15
Per Diem	1,585.65
Materials	<u>4,412.90</u>
	\$15,070.88

Approach Rail Cost:

Labor	\$ 5,633.00
Equipment	3,055.43
Per Diem	1,066.68
Materials	<u>3,963.44</u>
	\$13,718.55
Subtotal	\$28,789.43

VICINITY MAP

Coulter Creek Bridge



Equipment costs for the Coulter Creek rail replacement were higher because of unexpected soil conditions in the approaches. Large rocks were used in the fill at time of bridge construction and power auger was required for boring the holes for guardrail posts.

Included below are some of the problems which were encountered during construction of the Service Level 1 bridge rails.

Most of the bolt holes didn't have enough clearance for bolts to fit through after they were galvanized. The holes needed to be reamed in the field. All bolt threads needed to be chased prior to installation because of the galvanizing.

The deck for Middle Nemah Bridge was figured to be 3-1/2 to 4 inches thick, but was actually 6 inches. One-inch by 8-inch bolts were used to go through the mounting bracket, deck, and backing plate, as the 6-inch bolts which were ordered were not long enough.

Three-quarter inch by 10-inch lag screws on 3-foot centers were called out to secure the pressure treated timber two-by-two's and four-by-four paving rails to the deck. Galvanized spikes at 4-foot centers were used in place of the 10-inch lag screws.

All bridge work for Coulter Creek went smoothly. Except for the soil problem described above, all work went smoothly on the approaches.

Jorgenson Slough Bridge

Bridge Rail Cost:

Labor	\$ 5,539.22
Equipment	2,944.68
Per Diem	1,743.99
Materials	<u>5,686.45</u>
	\$15,914.34

Approach Rail Cost:

Labor	\$ 6,276.62
Equipment	3,320.59
Per Diem	1,406.49
Materials	<u>4,194.16</u>
	\$15,197.86

Subtotal \$31,112.20

Coulter Creek Bridge

Bridge Rail Cost:

Labor	\$ 3,889.30
Equipment	8,894.79
Per Diem	40.00
Materials	<u>6,732.51</u>
	\$19,556.60

Approach Rail Cost:

Labor	\$ 5,750.76
Equipment	6,557.40
Materials	<u>5,106.13</u>
	\$17,414.29

Subtotal \$36,970.89

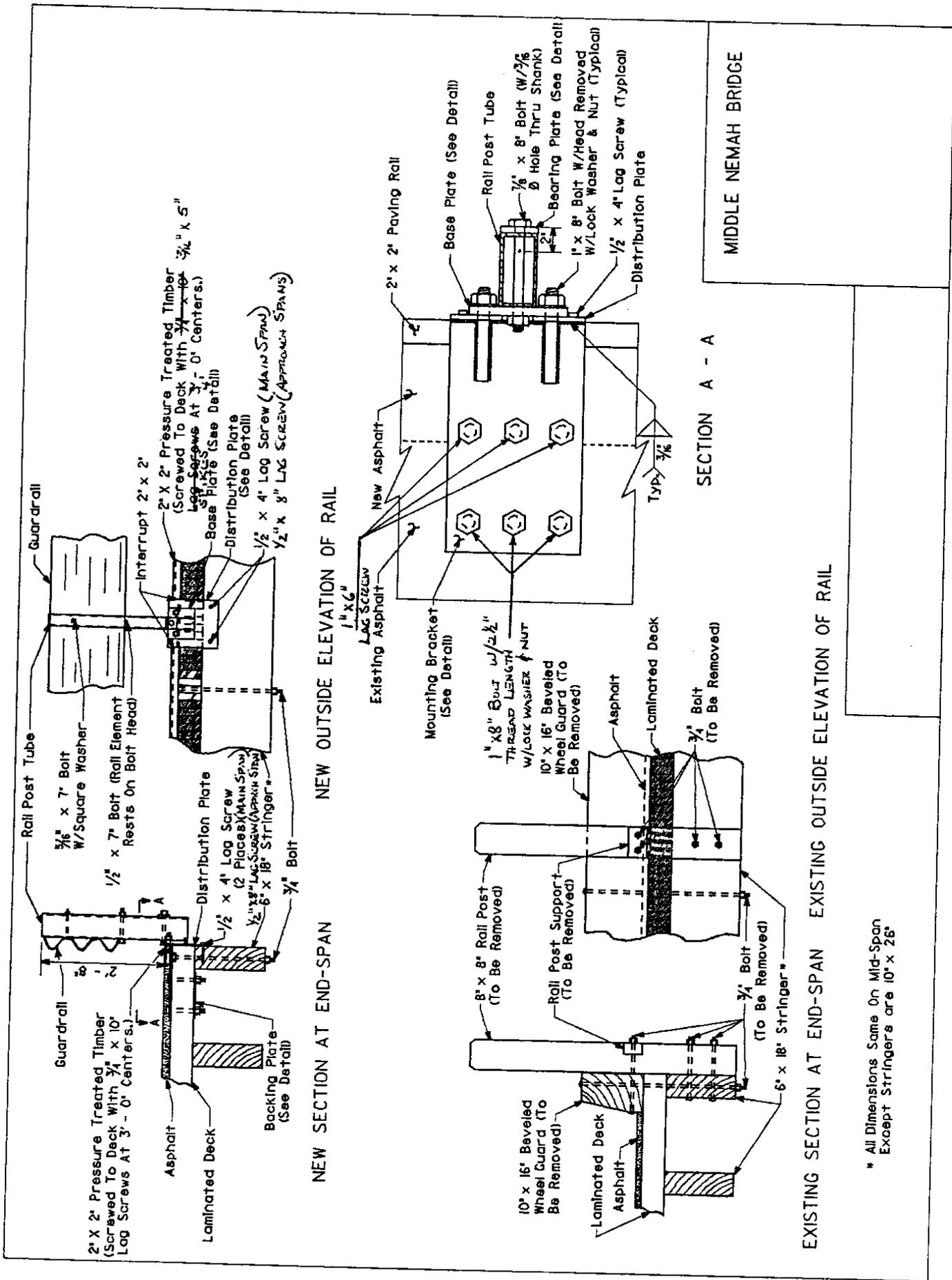
TOTAL \$96,872.52

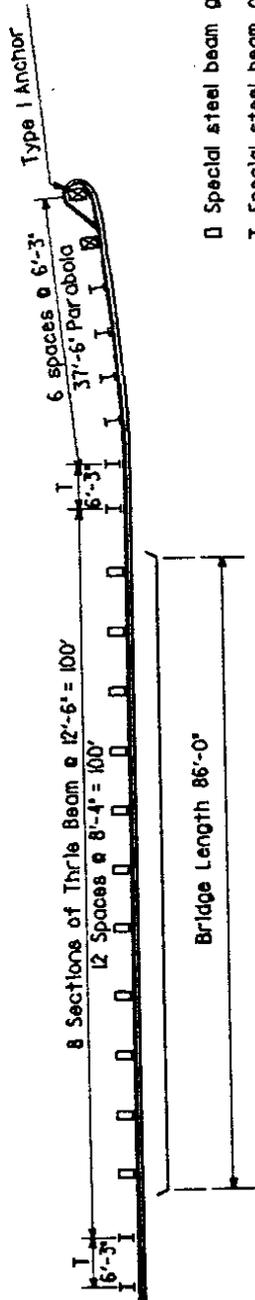
The cost of bridge rail was \$87.62 per foot for the Middle Nemah River Bridge, \$113.67 per foot for the Jorgenson Slough Bridge, and \$84.30 for the Coulter Creek Bridge. These costs can be compared with work done by a contractor to remove a wood rail and install an SL-1 system. The cost to do this work was \$91.34 per foot.

No cost comparison for installing the approach rails could be made. The approach rail installed under the contract was not compatible with an SL-1 system, and had to be redone by change order.

APPENDIX A
DESIGN SHEETS

APPENDIX B
PHOTOGRAPHS



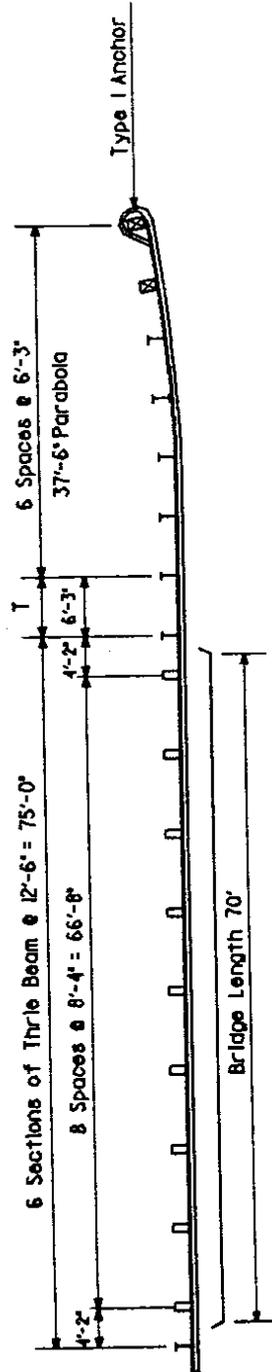


- Special steel beam guardrail post for attachment to structure.
- ▮ Special steel beam guardrail post 53x5.7.

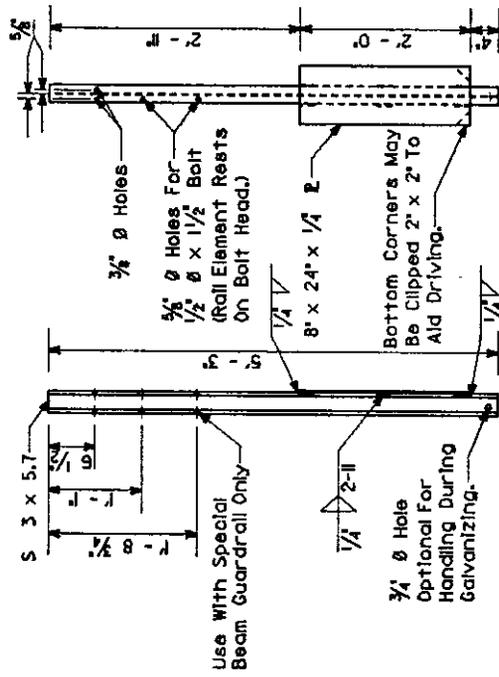
For Type I anchor and wood post details see Standard Plan sheet C-6.

For Triple Beam Guardrail details see Standard Plan sheet C-1a. T (Transition section) and BCT (3 - 12'-6" sections of W Beam at 6'-3" spacing) are typical for all Bridge ends.

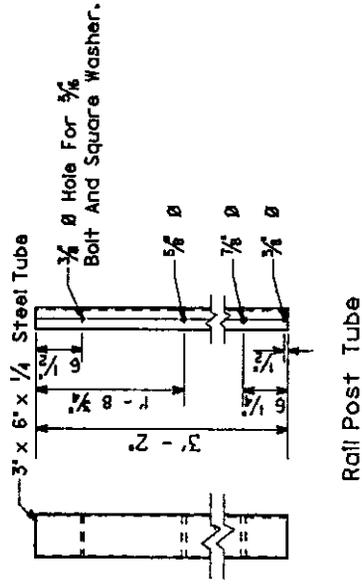
MIDDLE NEMAH RIVER BRIDGE 101/31



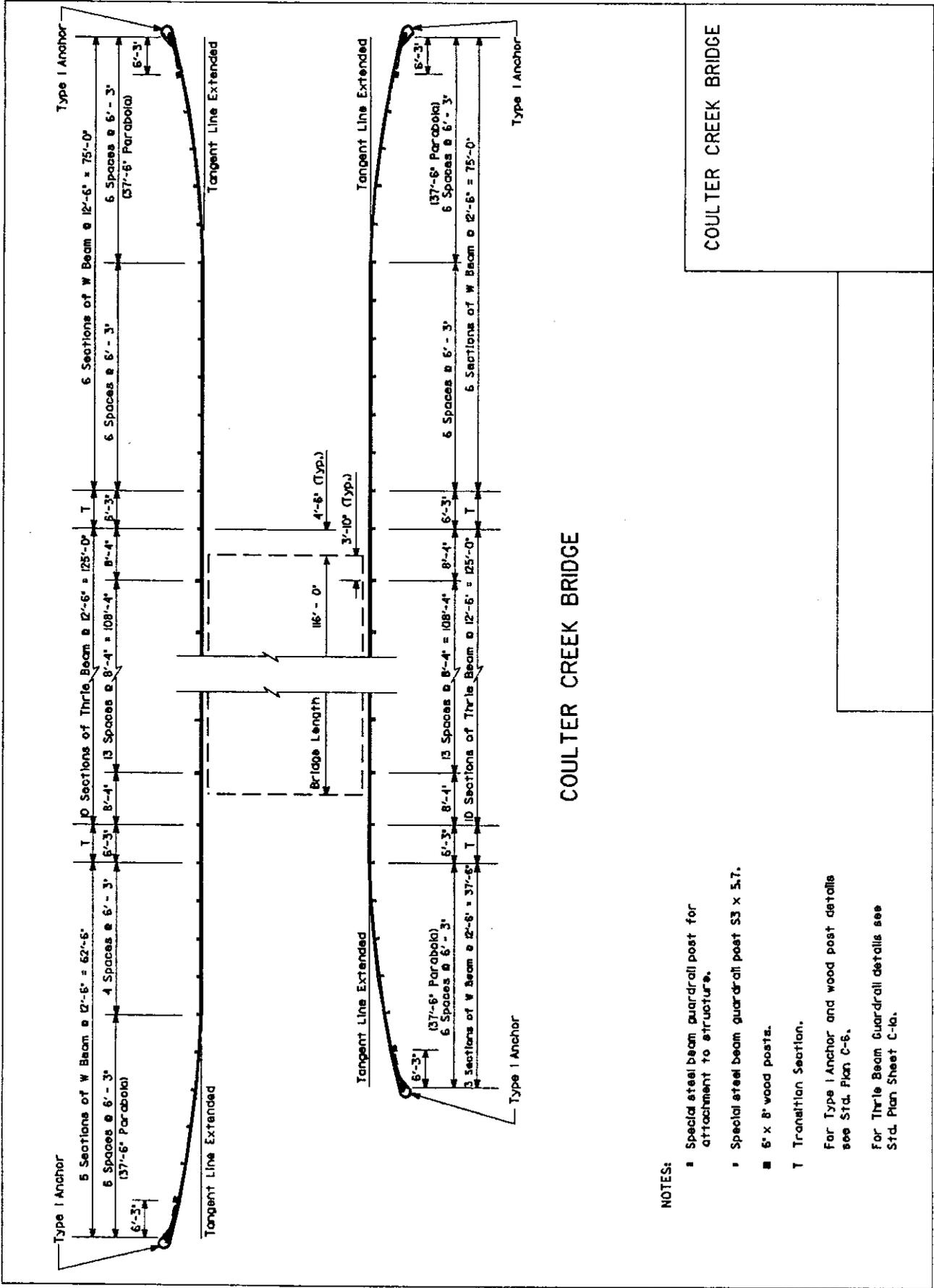
JORGENSON SLOUGH BRIDGE 101/33



G-2 Guardrail Post



MIDDLE NEMAH BRIDGE
STEEL POST DETAILS

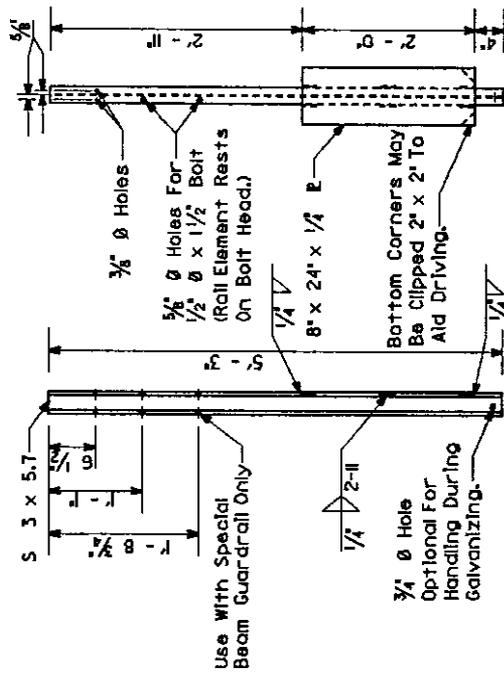


COULTER CREEK BRIDGE

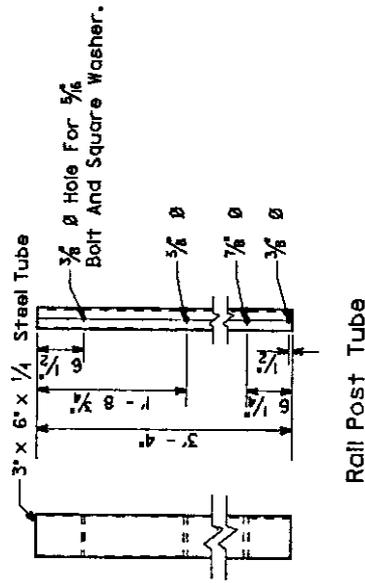
COULTER CREEK BRIDGE

NOTES:

- Special steel beam guardrail post for attachment to structure.
 - Special steel beam guardrail post S3 x 5.7.
 - 6' x 8' wood posts.
 - T Transition Section.
- For Type I Anchor and wood post details see Std. Plan C-6.
- For Thrift Beam Guardrail details see Std. Plan Sheet C-1a.

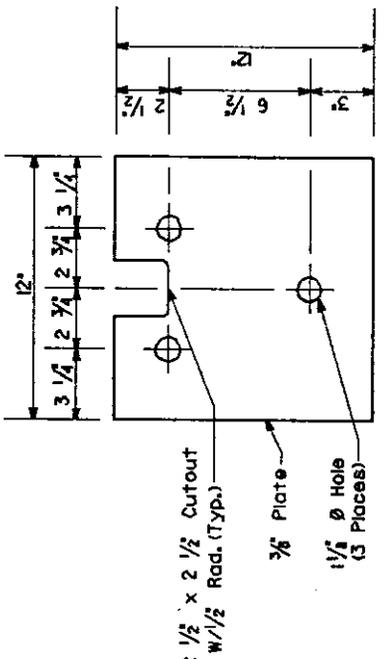


G-2 Guardrail Post



Rail Post Tube

JORGENSEN SLOUGH BRIDGE
STEEL POST DETAILS



DISTRIBUTION PLATE DETAIL

Notes:
 If unseasoned wood is encountered in mounting, it should be replaced.

To insure proper bearing for the mounting bracket the deck surface and side timbers must be sanded smooth & even under the plates and thoroughly dried.

Do not install under wet conditions.

Deck surface shall be square with side surface.

Galvanize all pieces, repair welded parts with galvanizing paint.

All plate material ASTM A36.

Horizontal threaded rods ASTM A325.

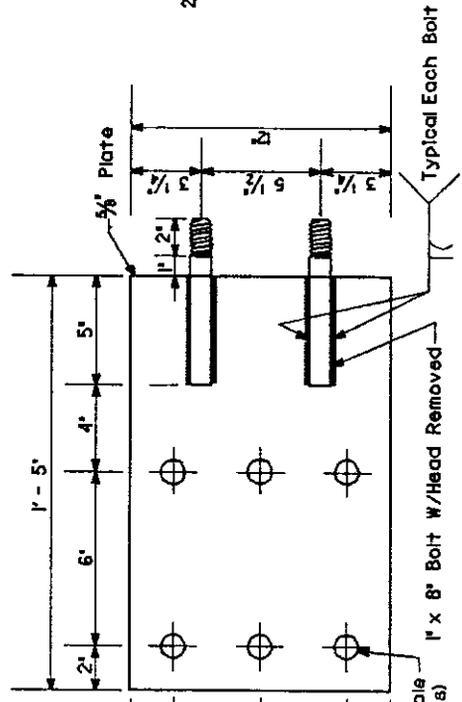
Vertical bolts thru deck ASTM A307.

Rail post tubes ASTM A501.

Bolt hole diameter thru deck 1/8."

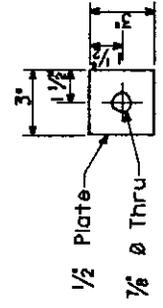
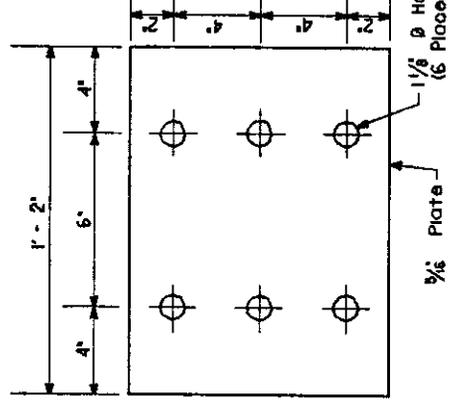
All Bolts to be UNC.

JORGENSEN SLOUGH BRIDGE

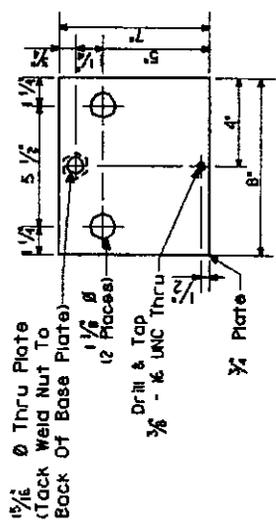


MOUNTING BRACKET DETAIL

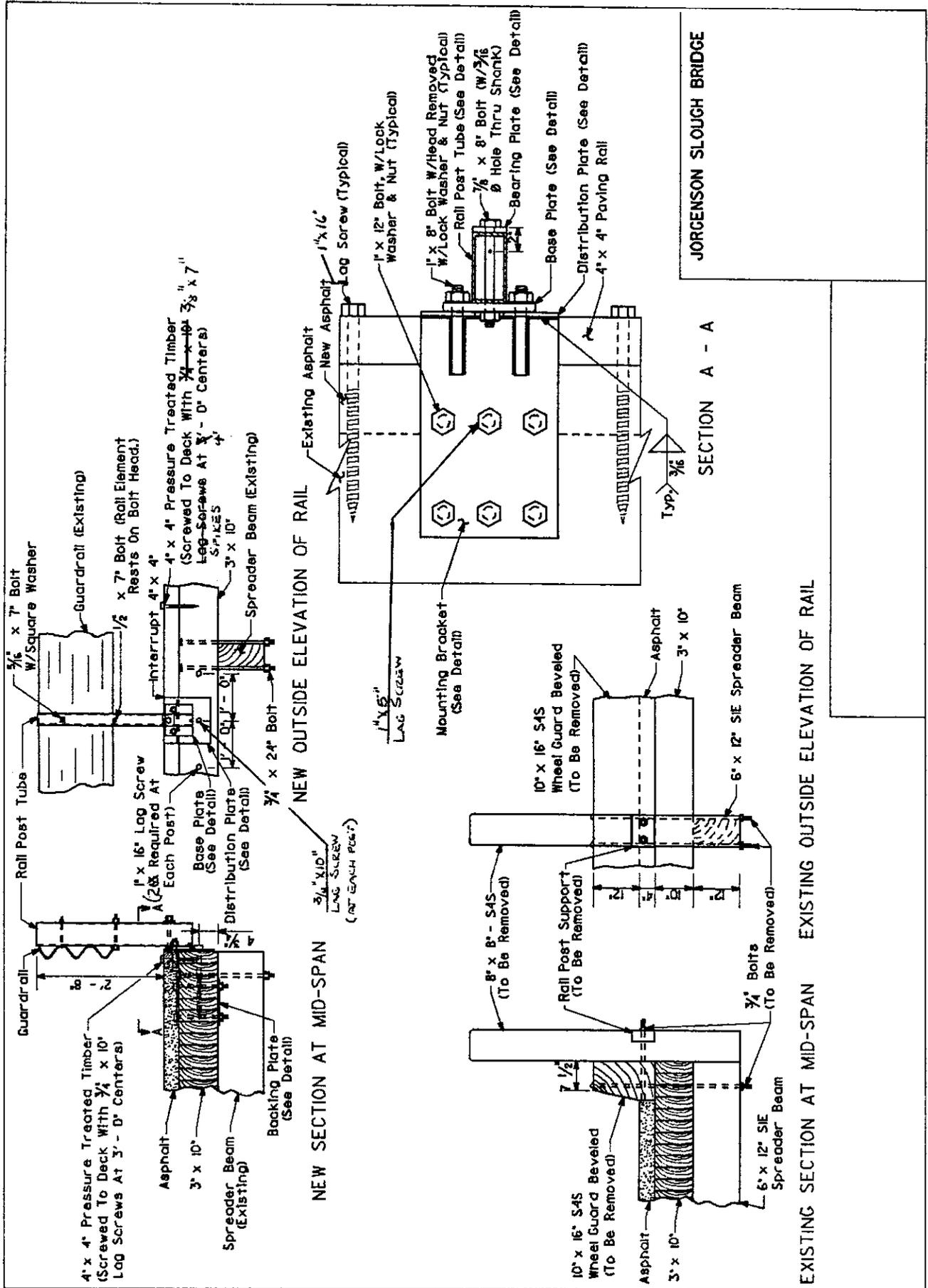
BACKING PLATE DETAIL

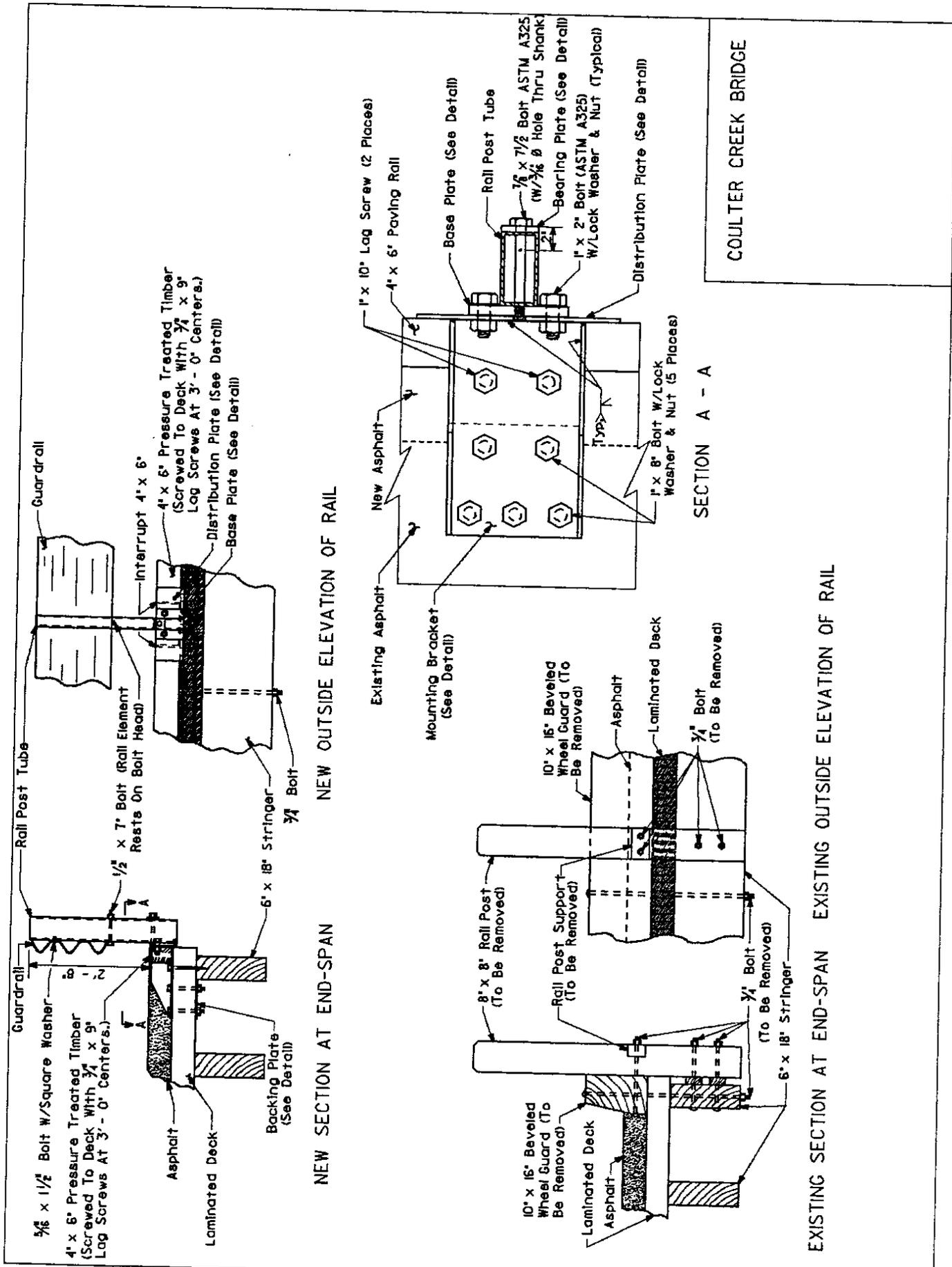


BEARING PLATE DETAIL



BASE PLATE DETAIL

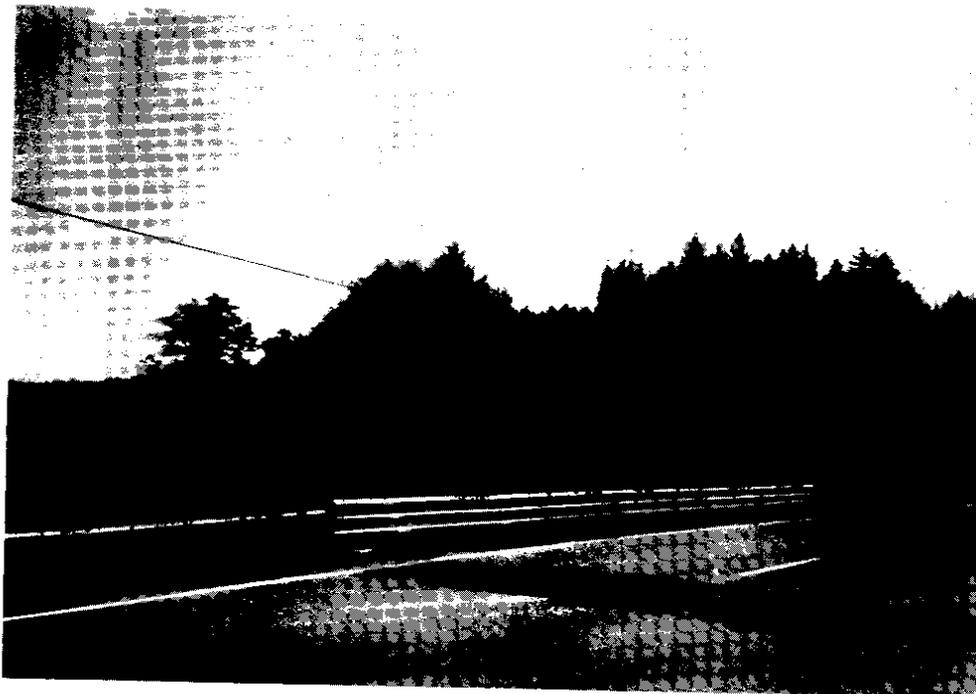




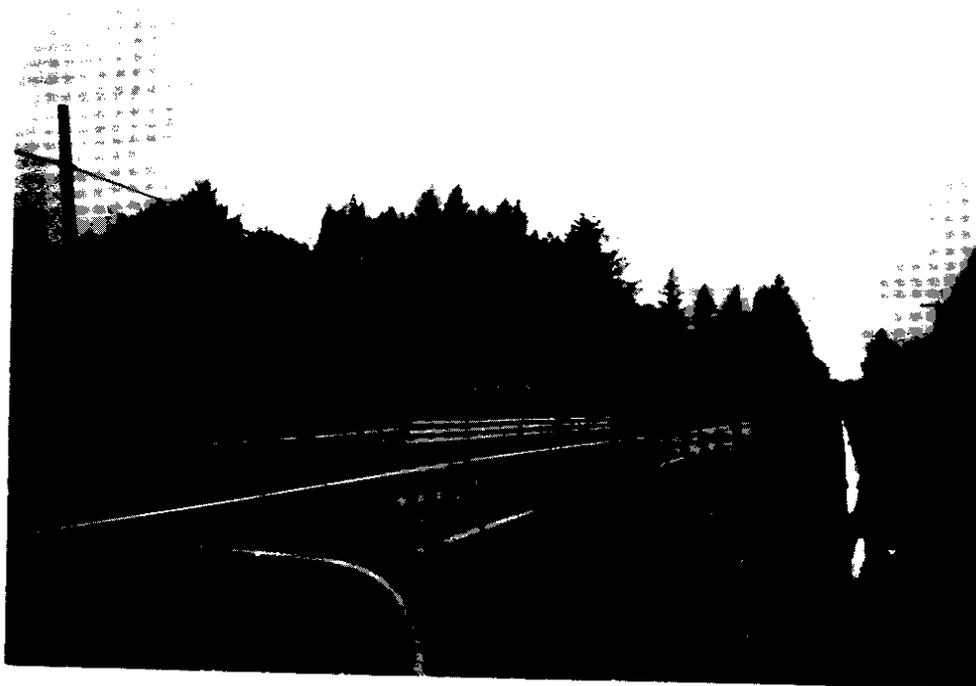
COULTER CREEK BRIDGE

SECTION A - A

DEMONSTRATION PROJECT 64
SERVICE LEVEL 1 BRIDGE RAIL



JORGENSEN SLOUGH: SERVICE LEVEL 1 BRIDGE RAIL NEAR
COMPLETION WEST SIDE OF BRIDGE.



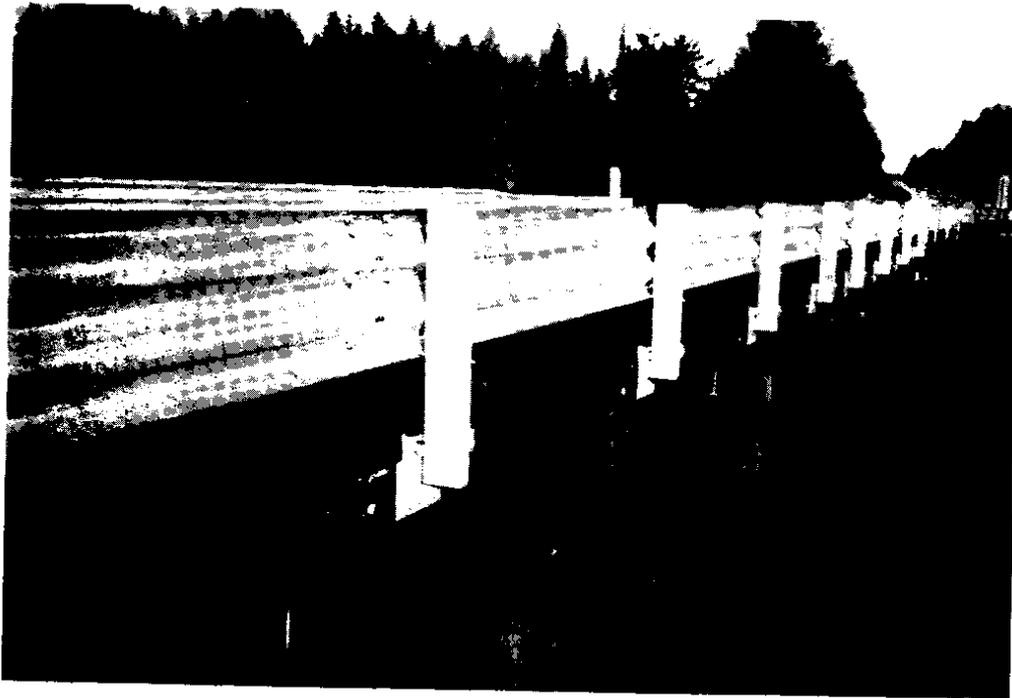
JOREGENSON SLOUGH: SERVICE LEVEL 1 BRIDGE RAIL
COMPLETE.

DEMONSTRATION PROJECT 64
SERVICE LEVEL 1 BRIDGE RAIL

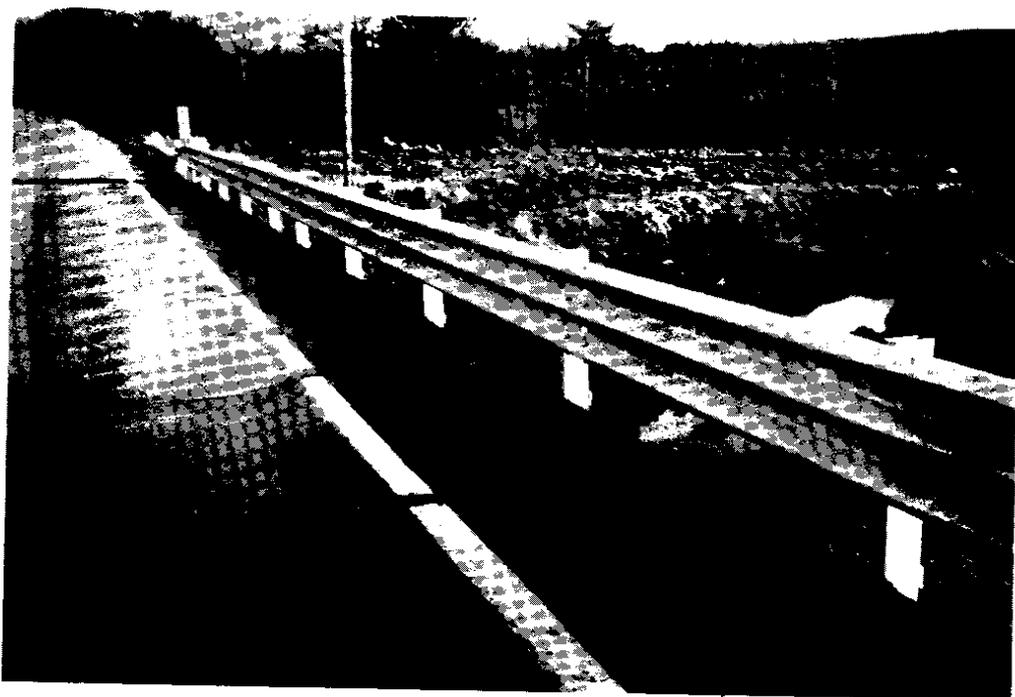


JORGENSON SLOUGH: BEFORE INSTALLATION OF
THE BRIDGE RAIL.

DEMONSTRATION PROJECT 64
SERVICE LEVEL 1 BRIDGE RAIL



JORGENSEN SLOUGH: RAIL POST TUBE INSTALLATION ON
EAST SIDE OF BRIDGE.

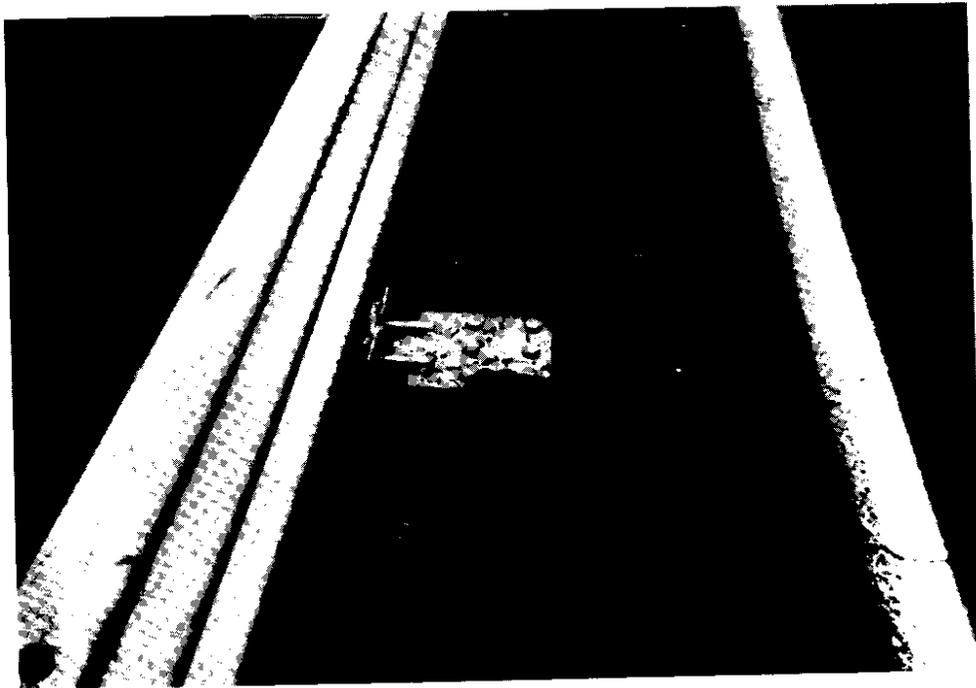


JOREGENSON SLOUGH: COMPLETED INSTALLATION OF SERVICE
LEVEL 1 BRIDGE RAIL

DEMONSTRATION PROJECT 64
SERVICE LEVEL 1 BRIDGE RAIL



JORGENSEN SLOUGH: RAIL POST TUBE INSTALLATION.

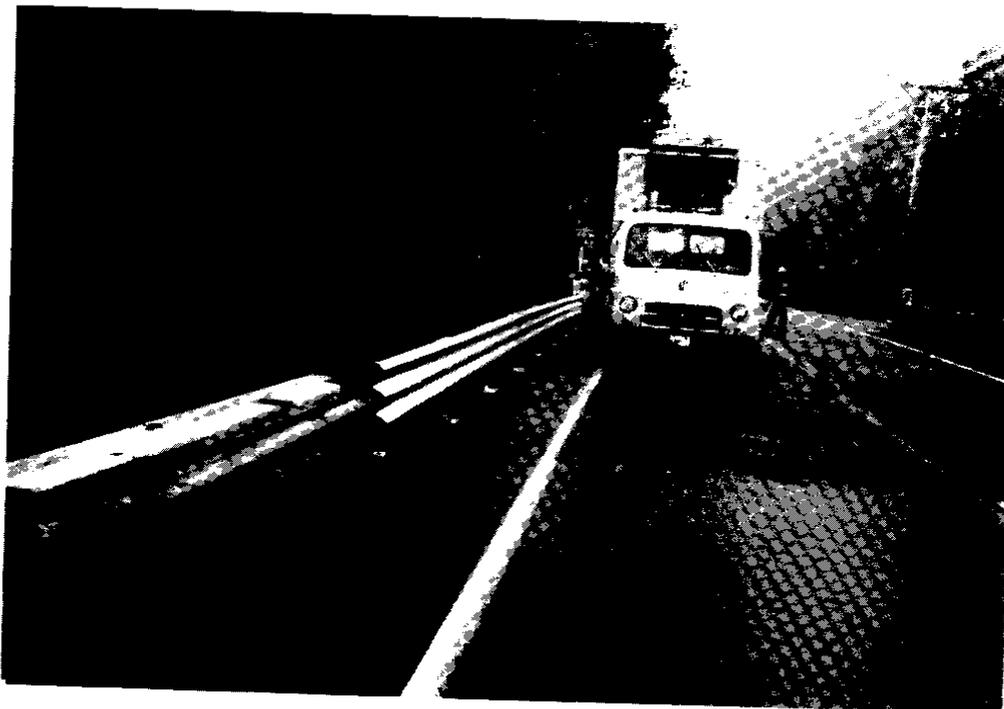


JOREGENSON SLOUGH: MOUNTING BRACKET INSTALATION
BEFORE ASPHALT IS PLACES.

DEMONSTRATION PROJECT 64
SERVICE LEVEL 1 BRIDGE RAIL



MIDDLE NEMAH RIVER: SERVICE LEVEL 1 BRIDGE RAIL NEAR
COMPLETION WEST SIDE OF BRIDGE.

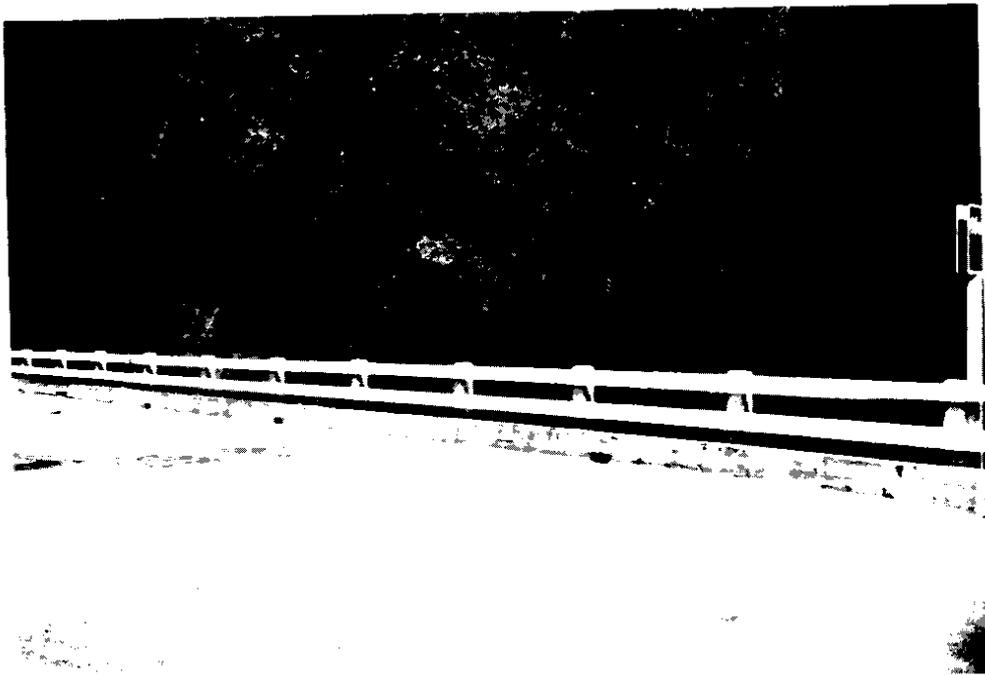


MIDDLE NEMAH RIVER: SPECIAL MAINTENANCE BRIDGE CREW
INSTALLING BRIDGE RAIL.

DEMONSTRATION PROJECT 64
SERVICE LEVEL 1 BRIDGE RAIL

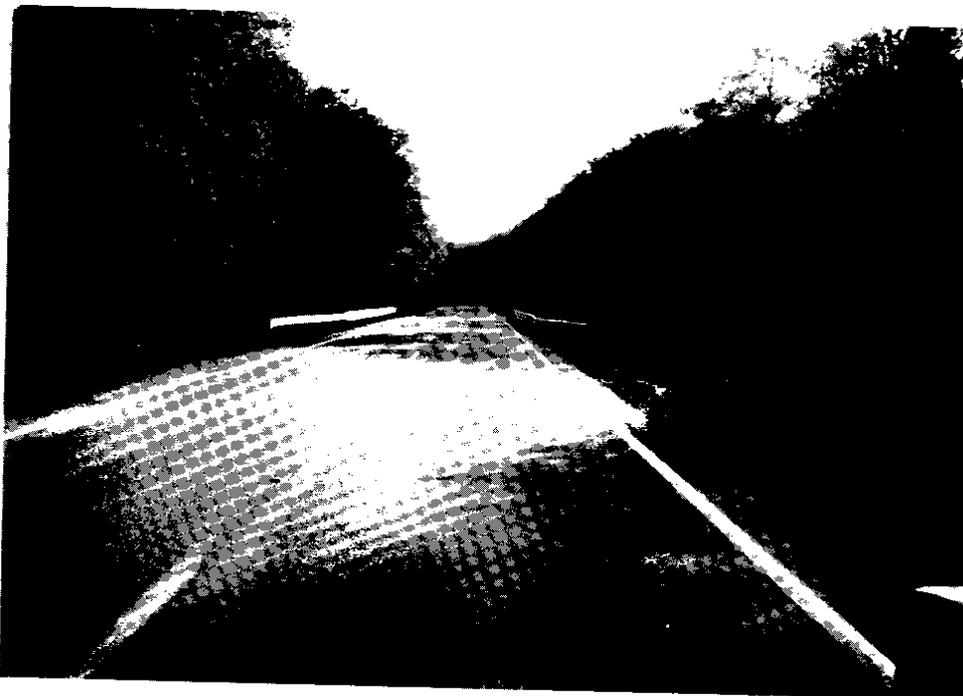


MIDDLE NEMAH RIVER: BEFORE INSTALLATION OF
BRIDGE RAIL.

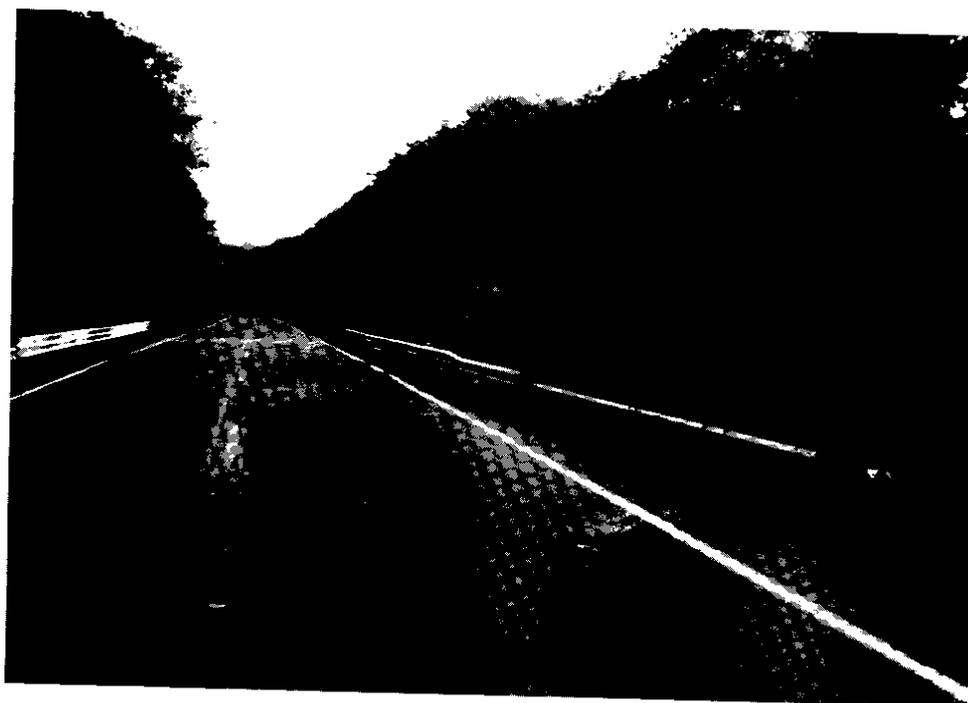


MIDDLE NEMAH RIVER: BEFORE INSTALLATION OF BRIDGE
RAIL.

DEMONSTRATION PROJECT 64
SERVICE LEVEL 1 BRIDGE RAIL

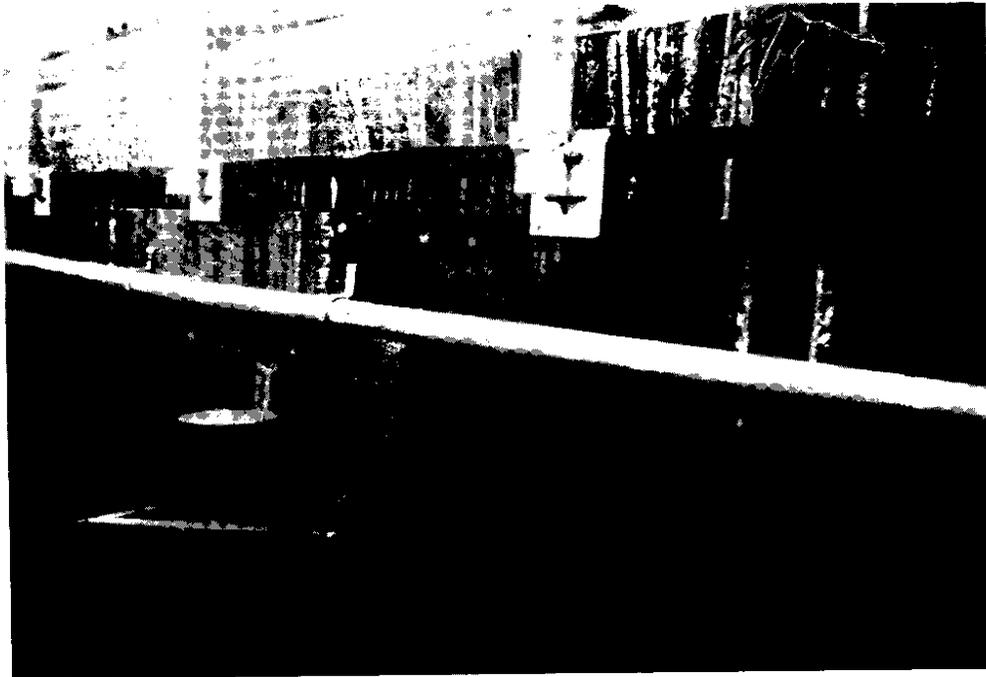


MIDDLE NEMAH RIVER: COMPLETED SERVICE LEVEL 1 BRIDGE
RAIL WITH COMPLETED APPROACH
GUARD RAIL.



MIDDLE NEMAH RIVER: COMPLETED SERVICE LEVEL 1 BRIDGE
RAIL WITH COMPLETED APPROACH
GUARD RAIL.

DEMONSTRATION PROJECT 64
SERVICE LEVEL 1 BRIDGE RAIL

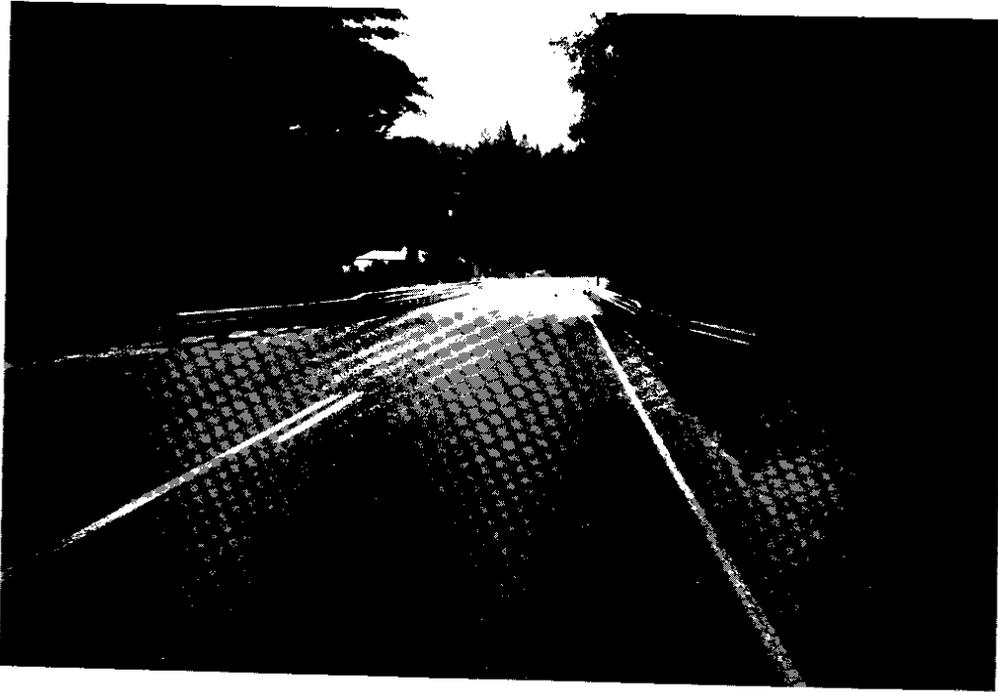


MIDDLE NEMAH RIVER: RAIL POST TUBE INSTALLATION
OF DISTRIBUTION PLATE.

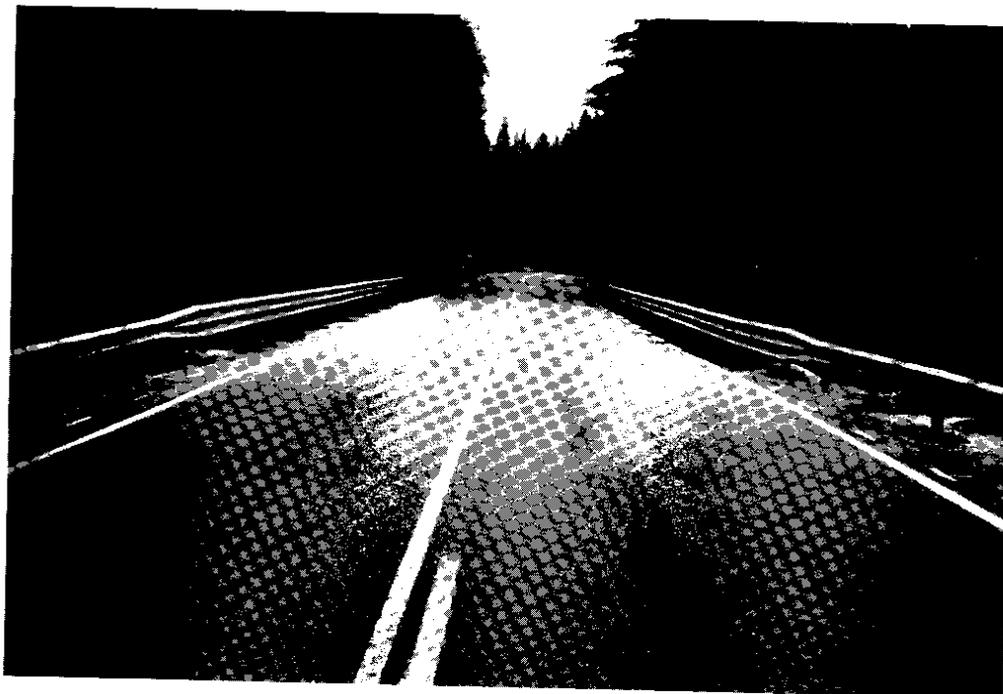


MIDDLE NEMAH RIVER: TRANSITION OF THRIE-BEAM TO
STANDARD W-BEAM GUARD RAIL.

DEMONSTRATION PROJECT 64
SERVICE LEVEL 1 BRIDGE RAIL



COULTER CREEK: COMPLETED SERVICE LEVEL 1 BRIDGE RAIL WITH
COMPLETED APPROACH GUARD RAIL.



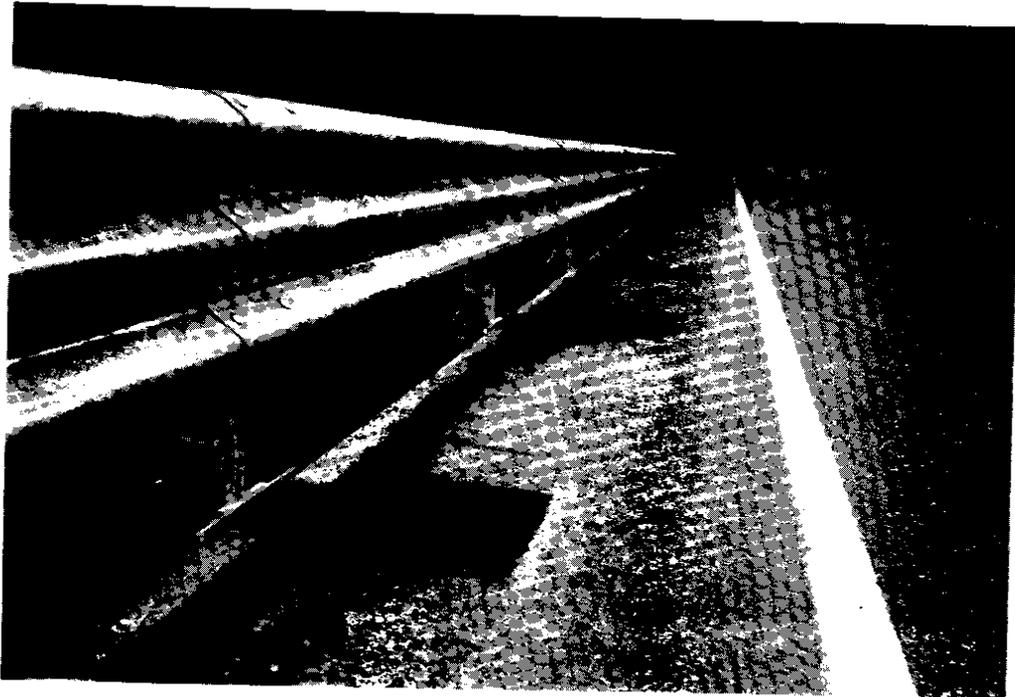
COULTER CREEK: COMPLETED SERVICE LEVEL 1 BRIDGE WITH
COMPLETED APPROACH GUARD RAIL.

DEMONSTRATION PROJECT 64
SERVICE LEVEL 1 BRIDGE RAIL



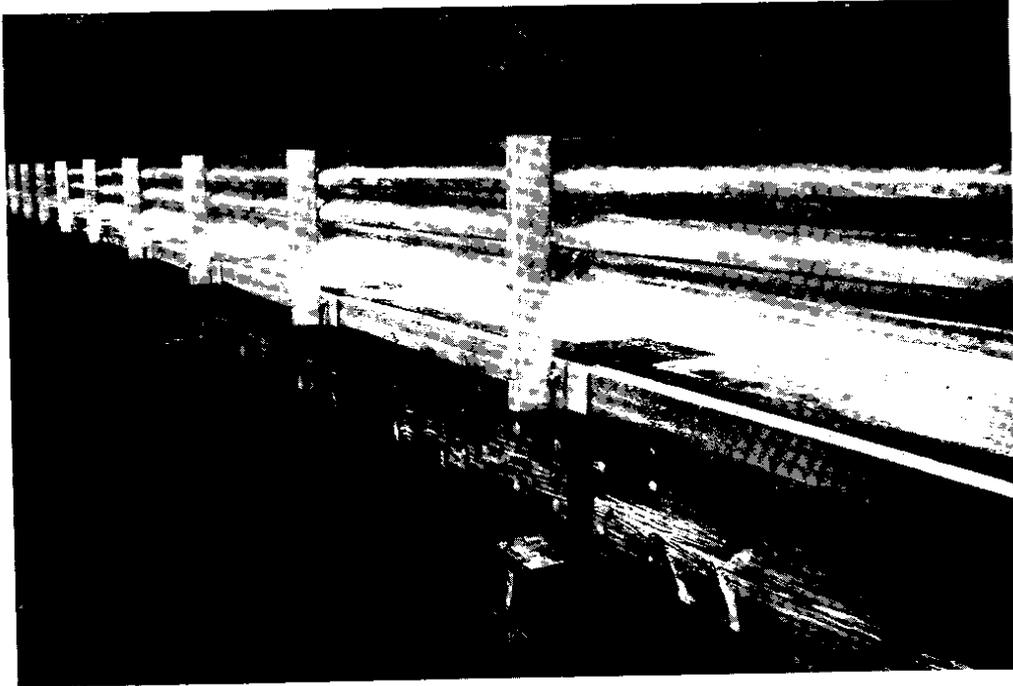
COULTER CREEK: BEFORE INSTALATION OF BRIDGE RAIL.

DEMONSTRATION PROJECT 64
SERVICE LEVEL 1 BRIDGE RAIL



COULTER CREEK: COMPLETED INSTALLATION OF SERVICE LEVEL 1
BRIDGE RAIL.

DEMONSTRATION PROJECT 64
SERVICE LEVEL 1 BRIDGE RAIL



COULTER CREEK: RAIL POST TUBE INSTALLATION OF DISTRIBUTION PLATE.



COULTER CREEK: TRANSITION OF THRIE-BEAM TO STANDARD W-BEAM
GUARD RAIL.