LATEX MODIFIED FIBER REINFORCED CONCRETE BRIDGE DECK OVERLAY

Final Report

Experimental Features
Project No. OR 90-01
Hayden Bridge in Lane County, Oregon

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16. Abstract

In an attempt to increase the tensile strength of LMC and reduce cracking, steel fibers were added to a LMC mix. The results are what is termed as "latex- modified, fiber-reinforced concrete" (LMFRC). LMFRC was placed on Hayden Bridge as an experimental overlay.

The LMFRC overlay has performed well and has not yet developed any visible cracks. The overlay has not delaminated or rutted. The skid resistance is comparable to a standard PCC deck.

Recommendations for improved construction practices can be found in the Construction/ Interim Report that was prepared in June 1993. Finally, because of it's improved performance, a LMFRC overlay may be considered as a permitted alternative to LMC.

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DISCLAIMER

Latex Modified Fiber Reinforced Concrete Bridge Deck Overlay

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1.0 INTRODUCTION

1.1 BACKGROUND

Latex-modified concrete (LMC) is portland cement concrete (PCC) with a latex based admixture. LMC mix designs call for more cement, less water, less entrained air, and a higher slump than conventional PCC. The result is a concrete with increased durability, ductility, strength and toughness. The latex also decreases the permeability of the concrete, making LMC an effective chloride barrier. LMC has been used to overlay bridge decks for over 30 years and has largely replaced conventional PCC for that purpose in Oregon.

Unfortunately, some LMC bridge deck overlays have shown a tendency to crack. When this happens, water is trapped in the cracks and, if freezing temperatures are experienced, the water freezes and expands. This creates an internal pressure on the overlay that, after multiple cycles of freezing and thawing, degrades the bond of the overlay to the deck. As the bond degrades, water begins to enter the area between the overlay and the deck. With subsequent freeze-thaw cycles the overlay begins to delaminate, which results in increased maintenance costs.

If the water entering the cracks carries contaminates, these contaminates may eventually cause rebar corrosion. Rebar corrosion will eventually cause additional cracking and delamination in the deck.

In an attempt to increase the tensile strength and reduce cracking of LMC, steel fibers were added to a LMC mix. The results are what is termed " latex-modified, fiber-reinforced concrete" (LMFRC).

1.2 OBJECTIVES AND SCOPE

The objective of this study was to evaluate LMFRC as an alternative bridge deck overlay.

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2.0 LOCATION, ENVIRONMENT AND TRAFFIC

2.1 LOCATION AND LAYOUT

Hayden Bridge is located in Lane County, about eight kilometers east of Eugene, Oregon. It spans east-west over the McKenzie River on Marcola Road (FAS A464) and begins at milepoint 1.67 and ends at milepoint 2.12. Figures 2.1 (a) and (b) show the location of the bridge.

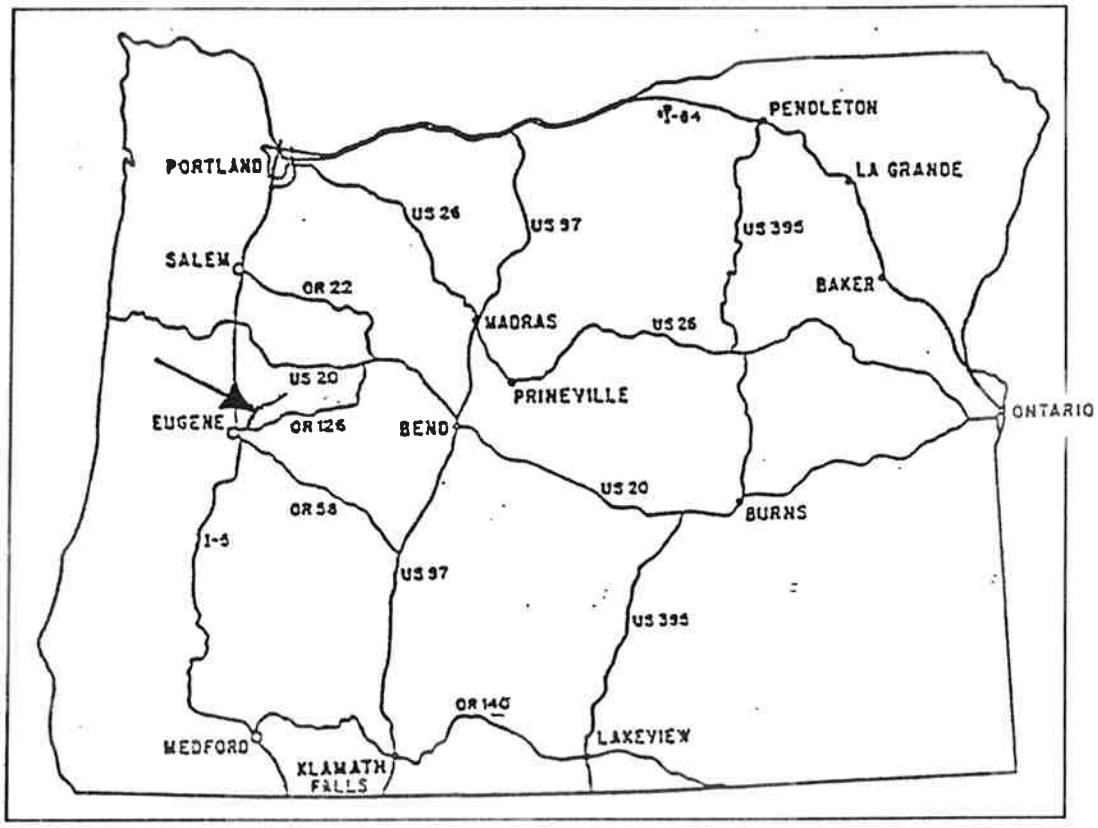
The original bridge, built in 1969, is approximately 11 meters wide by 81 meters long. It carried eastbound and westbound traffic, but now it is all eastbound traffic. A new bridge was built beside the old one, which carries the westbound traffic; the new bridge deck was constructed with conventional PCC.

2.2 ENVIRONMENT AND TRAFFIC

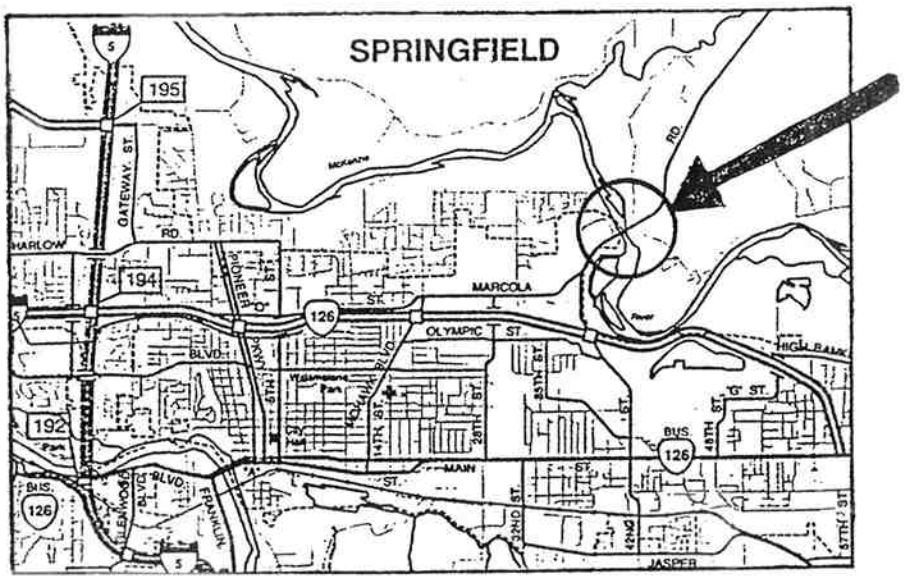
Table 2.1 summarizes environmental and traffic data. Winter maintenance includes snow plowing and sanding during freezing weather.

Table 2.1: Environmental and Traffic Data

Elevation (Bridge deck, above sea level)	146 m
Average Daily Temperature of coldest month	5° C
Average Daily Temperature of Hottest Month	19° C
Average Annual Precipitation	1 m
Average Annual Daily Traffic (AADT)	6500 VPD
Heavy Trucks, Percent of AADT	6.0%



(a) General Location



(b) Close-Up of Project Site

Figure 2.1: Project Location

3.0 RESULTS

3.1 END OF CONSTRUCTION INSPECTION AND TESTING

In 1991, OBEC Engineering Consultants performed the end of construction inspection of the deck and found no cracks or delamination.

In 1991, the ODOT Pavements Unit ran friction tests on the outer lanes of the Hayden Bridges. The skid resistance tests indicated that there was no significant difference between the two bridges. Both bridges had friction numbers typical of newly constructed pavements in Oregon.

To test the bond between the LMFRC overlay and the existing deck, four cores were drilled through the LMFRC overlay and into about 25.4 mm of the existing concrete. A device was attached to the top of the core, and a tensile load was applied until failure occurred. The bond strengths were above the specified minimum of 690 kPa.

3.2 INTERIM INSPECTION

An inspection of the overlay two years after construction revealed no visible cracks in the LMFRC.

Due to construction problems, tining throughout the overlay was shallow. Some of the tining had worn off in an area about 0.9 meters in diameter. That area was within the section of overlay poured first, when many construction problems occurred. The shallow tining has not affected the skid resistance.

Steel fibers were visible throughout the surface of the overlay but they did not present a problem.

3.3 FINAL INSPECTION

The final inspection was conducted four years after construction. No cracks or delamination were found. The steel fibers that were visible were not rusty and do not present a problem.

The 1994 friction tests indicated that the skid resistance on both structures is satisfactory.

No rutting was apparent at this inspection.

To date there has been no maintenance required for this overlay.

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4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 INTERIM CONCLUSIONS

- LMFRC is difficult to construct due to the clumping of fibers. The clumping leads to a slow work pace, tining difficulties, and overall poor workability.

- Although is was not evidenced by this project, LMFRC overlays could be a costly overlay alternative, due to the extra labor needed.

4.2 FINAL CONCLUSIONS

- The LMFRC overlay has performed well and has not yet developed any visible cracks.

- The overlay has not delaminated or rutted.

- The skid resistance is comparable to a standard PCC deck.

4.3 INTERIM RECOMMENDATIONS

Recommendations for improved construction practices can be found in the Construction/ Interim Report available from the Oregon Department of Transportation Research Unit. This report was prepared in June 1993.

4.4 FINAL RECOMMENDATIONS

A LMFRC overlay may be considered as a permitted alternative to an LMC overlay.