EVALUATION OF A SACRIFICIAL TYPE CATHODIC PROTECTION SYSTEM FOR BRIDGE DECK REINFORCEMENT

Category II Experimental

Project 76-02-13

Final Report

I-80N-1(69)35 - Nampa Boulevard Interchange

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INTRODUCTION

Cathodic protection, using externally supplied electrical power, has been used with some success for protecting bridge deck reinforcing steel against corrosion. Unfortunately, the coke breeze layer used to obtain uniform current distribution represents considerable dead weight, which is structurally undesirable.

A properly designed sacrificial anode protective system would eliminate the need for the coke breeze layer and the external power supply with its associated hardware. A thin grid form of sacrificial anode network, placed directly on the concrete deck, would produce a uniform current distribution. A wearing course of conventional plant mix would be needed, such as in the externally powered system.

DISCUSSION

The objective of this research project was to evaluate, under service conditions, the concept of cathodic protection on an existing bridge in the State of Idaho.

Project I-80N-1(69)35, Nampa Boulevard Interchange, consisted of replacing bridge rail and curbing with new curbing and aluminum handrail, and installation of the cathodic protection system on two 37' x 150' structures. The work on this project was performed between September 1978 and September 1979. Alexander Construction Company was the contractor.

There were no particular problems associated with the removal and replacement of the curbing and bridge rail, other than delivery time required for the aluminum handrail.

The threaded insert connections, for anchoring the aluminum grid for the cathodic protection system, were driven into holes drilled into the rebar, as shown in the first alternate in the specifications. The aluminum grid was then attached to the connectors. Adjacent sheets of aluminum grid were tack welded together, approximately every three inches on each side. Due to the thermal expansion and contraction of the aluminum grid during different times of the day, the adjacent sheets of aluminum that had been tack welded were cut apart to prevent buckling, and the remainder were not welded.

The steel joint angles were to be held in place by 5/8 inch bolts anchored into the concrete deck. It was very difficult to drill some of the holes for the anchor bolts due to the existing reinforcing steel location at the joint. The anchor bolt spacings had to be adjusted at various locations due to this conflict with the reinforcing steel. Also, some of the anchor bolts would not tighten down correctly, which required installation of additional anchors.

The first major problem with the cathodic protection system developed when the plant mix overlay was placed over the secured aluminum grid. The temperature of the plant mix caused the aluminum grid to expand and buckle above the deck. This caused waves in the plant mix. The grid moved up and down as the plant mix was being rolled and prevented bond between the plant mix and the concrete deck. This also lifted the plant mix off the deck, which caused excessive cracking in the plant mix during and after rolling. Also, this resulted in a thin layer of plant mix over the aluminum grid. Some of the aluminum grid system had to be cut and removed to allow room for expansion and proper deck repair.

During the winter months of 1978-79, water penetrated the overlay, destroying the bond between the concrete deck and plant mix overlay. This caused breakup, potholes, and raveling of the plant mix, resulting in requiring extensive patching the following spring.

Also, during the winter months of 1978-79, the traffic over the structures loosened the expansion anchor studs and the steel joint angles had to be removed. Installation of 2" x 4" steel plates and joint repair work under the steel joint angles had to be done by change order the following spring.

In the fall of 1980, State maintenance forces cold milled the plant mix pavement from the travel lanes of both EBL and WBL bridge decks, and removed the aluminum grid. However, the aluminum grid was left intact in the shoulder areas. This would allow the research project to continue.

In July 1987, two sets of test bars were removed from the WBL structure for evaluation. These test bars were stamped "2" (from the center span) and "3" (from the easternmost span).

These test bars were to have been weighed and the weights recorded prior to installation, and then re-weighed upon removal. However, no record of the initial weights can be found, and the reinforcing test bars now have been slightly damaged by removal, so only visual observations can be made.

From the visual observations, both test bars in both sets looked very good. There is no deterioration evident on any of the test bars. The 3-1/2 inch square cut steel washers, used to fasten the aluminum grid to the reinforcing steel and the aluminum grid in direct contact with the steel washers, is highly corroded however. These test bars are on file at the District Three Materials section office.

CONCLUSIONS

It is difficult to judge whether this project was successful. Construction difficulties, along with inadequate initial data, severely limits our abilities to draw accurate conclusions. The only basis for judging this system is visual inspections of two test bars recovered.