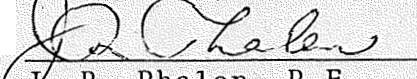



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Page 1 Of 2

R E S E A R C H    U P D A T E

**Performance Of Waterproofing Membranes  
On Chloride Contaminated Bridge Decks**

**Reference** - Work Plan 86-R-10, Bridge Deck Performance Following Rehabilitation, also Update No. U87-4, January 29, 1987.

**Research Problem Statement** - At this time, there is no concensus Nationwide on the extent of rehabilitation required to restore and extend the service life of salt contaminated bridge decks. Specific areas in question include how much Chloride ( $Cl^-$ ) contaminated concrete must be removed, can areas with rebar voltage potentials over -0.35 volts be left untreated and will the placement of a waterproofing membrane stop or significantly retard ongoing rebar corrosion activity? The latter item is the subject of this Update.

**History** - In 1976, Bridge #131 over the Black River in Coventry on Vermont Route 14 was rehabilitated by District Maintenance Forces. The three span structure, which had been constructed in 1959, had received a light application of RC-MC 100 on the PC concrete deck and two one inch courses of bituminous pavement. Removal of the pavement in 1976 revealed severe scaling of the concrete along the curb lines and corrosion stains and concrete delamination on all three spans.

A condition survey of the stripped deck made by Materials & Research personnel on April 29, 1976 included photographs and a corrosion survey made at five foot intervals at 1', 5', and 15' offsets from the southerly curb line. The survey revealed 34% corrosion activity (-0.35 volts or greater) at the 1' offset, 34% at the 5' offset and 98% at the 15' offset. Concrete samples taken at the 2" to 3" depth revealed  $Cl^-$  levels ranging from 0.4 to 6.1 lbs/cy of concrete with an average of 2.7 lbs.

The rehabilitation treatment included removal of some but not all of the delaminated areas and removal of concrete along the curb lines to an average 1 inch depth. Following curing of the patch concrete, a five foot strip of preformed sheet membrane was placed along each curb line and tar emulsion was placed on the remainder of the deck prior to repaving.

In 1984 a series of potholes began to develop at various locations along the center of the structure requiring bituminous patching in the following years. The distress resulted in the structure being programmed for rehabilitation in 1987 (Coventry RS-Deck (13)).



**Status** - Following removal of the pavement in late April of 1987, observations and testing revealed the following conditions:

- 1) The curb line areas, which had been patched with a thin course of PC concrete and then received the membrane application, were free of any delamination.
- 2) Virtually all of the patches placed on the middle portion of the deck had delaminated and reinforcing steel was visible on 5% of the deck surface prior to beginning the concrete removal process.
- 3) A corrosion survey taken at the 1' offset where 34% of the readings had been active in 1976 now revealed only a single reading over -0.35 volts with that occurring at the downhill end of the deck.
- 4) Corrosion activity at the 5' offset, which coincided with the edge of the preformed membrane was down slightly from 34% in 1976 to 29%.
- 5) Corrosion values at the 15' offset, which had only received tar emulsion averaged -0.53 volts as compared to -0.48 volts in 1976.

**Summary** - The corrosion survey taken one foot off the curb line eleven years after the membrane was placed revealed a reduction in corrosion activity from 34% of the readings in 1976 to a single active reading in 1987 despite the fact that the concrete contained an average of 2.9 lbs of Cl<sup>-</sup> per cy of concrete at the 2" to 3" depth at the same locations.

The findings compliment the information recorded in Update U87-4 where corrosion activity dropped from 84% to 7% of the area on a Cl<sup>-</sup> contaminated deck which had been treated with a liquid membrane 13 years earlier.

It is assumed that the reduction or elimination of corrosion activity is due to the reduction of moisture and oxygen available at both the anode and cathode sites on the reinforcing steel. If that assumption is true, it is possible that deck rehabilitation procedures may not require the removal of Cl<sup>-</sup> contaminated concrete from areas with high corrosion values (>-.35 volts) when a waterproofing membrane system is to be placed. Exceptions would include locations where the corrosion activity has already resulted in delamination of the concrete surface.

**Follow-up** - Monitoring of additional field test sites is underway to substantiate the findings reported here.