ASPHALT OVERLAY OF BRIDGE DECKS

Final Report

April 1986

- Conducted by -

Arkansas State Highway and Transportation Department

Materials and Research Division

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TRC-96 FINAL REPORT

by

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BACKGROUND

In May of 1984 the Maintenance Division of the Arkansas Highway and Transportation Department began using its new Dynapac PL2000 Profiler. By July, 1984, it was working in District 9 and at the District's request, the first of many asphalt overlays were removed from bridge decks. Before the arrival of the machine, District 9 had decided to remove the asphalt overlays from some of their bridge decks because they were experiencing major problems with deck deterioration. These problems were often undetected because the asphalt overlay hid the true condition of the concrete deck. After a few months of removing overlays in other Districts a pattern of excessive deterioration was obvious. Consequently, a review of information and pictures collected by Maintenance Division personnel led to the initiation of this investigation.

CAUSE OF ACCELERATED DETERIORATION

The Investigating Committee's first objective was to determine if the detrimental effects on concrete decks are magnified or accelerated by salts and/or moisture being continuously trapped at the interface between the asphalt overlay and the concrete deck surface. Reports and information from

other states and from the Department's records indicate that the deterioration is taking place generally due to the mechanism as described below.

When a salt solution is placed on a concrete deck, it slowly and persistently permeates into the concrete. At a point which is not definitely determined, this permeation of salt water reaches equilibrium and a drying process follows. The salty melt-water that has penetrated the concrete rises toward the surface. The water evaporates, and the salt remains in place. Some of this salt can be leached from the concrete by flushing the surface with clean water using mechanical equipment or by relying on spring rains. The salt concentrated at the surface will be reduced somewhat by repeated flushing cycles, but it is never entirely eliminated.

This entire process will normally take place very near the surface and above the first mat of reinforcing steel. The concrete protects the steel, and normally will continue to do so for many years. However, if a deck is covered with an asphalt overlay, the process is interrupted. The salt water will continue to percolate through the asphalt and the concrete surface, but the evaporation and leaching process is effectively stopped. The salt water has no place to go but down, and higher concentrations of salt will reach the reinforcing steel sooner, causing severe deterioration of the deck.

An excellent example of how quickly this occurs was found on Highway 67 south of Newport. The end spans of five bridges were overlayed with asphalt in September, 1978. This was done to provide additional length for transition of overlays on the

approaches to the bridges. These 50-year old decks on all five bridges had a field condition rating of seven or above prior to having the asphalt removed from the end spans in January, 1985. After the asphalt was removed, The highest rating that could be given to any of the end spans was five. This reduction in rating is due entirely to deterioration. The interior spans, which had never been overlayed, still have a rating of seven or above. The deterioration of the end spans occurred in six years and four months after being overlayed. Concrete core samples taken from the ten end spans and from the adjacent spans were tested for chloride content. The results showed that the chloride content, at the level of the top mat of reinforcing steel, averaged nine times greater on the overlayed spans than on the adjacent spans.

A few state have reported some evidence that water alone, when trapped between an asphalt overlay and a concrete deck, will contribute to deterioration. This is believed to be due to the increased severity of the freeze-thaw cycles to which the saturated deck is subjected.

SEALERS FOR CONCRETE DECKS

The second objective was to determine if there are sealers or membranes which can be applied to a deck before overlaying with asphalt that will reduce the accelerated deterioration of the concrete. Many states have tried various liquid sealers and solid membranes, alone and in various combinations, but all have been found to be unreliable and/or not cost effective. Once a membrane has been placed and covered with an asphalt overlay, its performance cannot be monitored. It and the deck it is designed

to protect are hidden beneath the asphalt, and cannot be observed. Therefore, any flaws in the membrane will not be detected until the deterioration caused by the salt water has progressed to the point that the overlay begins to fail. There are some membranes which perform better and are more reliable than others, but these are not cost effective. It usually would be cheaper to clean and patch the deck and place a concrete overlay on it than to use one of the most effective membranes with an asphalt overlay. When the uncertainty of the effectiveness of the membrane (due to its being hidden) is considered, concrete overlays are even more favored.

The committee also planned, originally, to investigate processes and/or materials which could be used to seal a newly constructed deck prior to salt being applied; however, this subject is also being investigated by the committee for TRC-97, Concrete overlays of Bridge Decks, and was not considered for this project.

BRIDGE END TREATMENTS

Many of the existing asphalt overlays on bridge decks were placed to correct the abrupt profile grade change at bridge ends which was caused by a build-up of overlays on the approaches. This abrupt grade change resulted in poor rideability and subjected the bridge to increased impact loading. Overlaying the bridge with asphalt appeared to be a simple quick-fix to this problem. One of the objectives of this project was to determine appropriate bridge end treatments which would accommodate

resurfacing of the approaches without the abrupt grade change. One method found is to notch-in at the bridge end, using a cold milling machine, and revise the profile grade on the approach to provide a smooth transition. The Department has the equipment capable of handling any size project. In the past two seasons, this procedure has been done in several locations. This satisfactorily eliminated the abrupt grade changes at the bridge ends and there was no need to overlay the bridge decks.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of this study, the Committee recommends that no further attempt be made to find a feasible, effective method of using asphalt overlays on bridge decks. We further recommend that asphalt overlays of bridge decks be discontinued, except as a last resort.

Before approving as asphalt overlay careful consideration should be given to:

1. Whether deicing chemicals will be used on the deck.
2. The present condition of the concrete.
3. The rideability of the deck and the related impact loading.
4. The cost of repairing versus the cost of overlaying.
5. The expected life of the bridge - that is, when it is likely to be replaced.

If an asphalt overlay is then approved, the deck should be cleaned, then sealed with a rich chip seal. A chip seal would be inexpensive insurance and perhaps buy some time for the deck. Due to poor reliability and/or excessive cost, the Committee does not

recommend any membrane, either liquid or solid, as a protective measure for decks prior to asphalt overlays. A chip seal is probably the best and most cost effective measure to take if it is determined that an asphalt overlay must be used.

The question of sealers for newly constructed decks is being considered in TRC 97, Concrete Overlays of Bridge Decks; therefore, it was dropped from this investigation to eliminate duplication.

The Committee recommends that the cold milling notch-in procedure be used whenever the approaches are overlayed. Scheduling for the cold milling machine will have to be closely coordinated between the Districts and the Maintenance Division.