

MEMORANDUM REPORT

AN EVALUATION OF TWO BRIDGE DECK OVERLAY
SYSTEMS ON THE RTE. 85 BRIDGES OVER THE ROANOKE RIVER

by

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Virginia Highway Research Council
(A Cooperative Organization Sponsored Jointly by the Virginia
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BACKGROUND

Because of exposed reinforcing steel in some areas of the decks, the interstate route 85 bridges over the Roanoke River were treated with overlays in August 1969. In order to evaluate two different materials on a comparative basis, the Department of Highways decided to apply a Guardkote 250 (epoxy) mortarmix overlay to the SBL deck, and a latex (DOW SM-100) modified portland cement overlay to the NBL deck. By memorandum to Mr. W. S. G. Britton dated August 1, 1969, the Maintenance Division requested that the Research Council review and evaluate the overlay treatments periodically. In accordance with this request, inspections have been conducted on a semiannual basis, and on other occasions, by the Structures Section of the Research Council.

GENERAL EVALUATION

Guardkote 250 Mortarmix

The Guardkote 250 material is an oil extended epoxy which, in this instance, was mixed with a sand aggregate to form an epoxy mortar. The preparation of the surface of the bridge deck, the materials requirements, and the application procedures used were in accordance with the recommendations and specifications¹ of the supplier.

After the first winter, the epoxy overlay performed satisfactorily; but by the fall of 1970 signs of impending failure were apparent. Failures in the bond between the deck and the overlay occurred at several locations during the latter part of 1970 — requiring patches of from less than one square foot to several square feet in area (Figure 1). Since all material necessary for repairs was to be supplied by the Shell Oil Company for a period of two years, a field inspection was held in April 1971. Additional patching, which was required at a half dozen locations, was installed several weeks after the field inspection. Subsequently, on

September 21, a new failure on one span was noted as shown in Figure 2. Several other spans have small areas where failure in bond has occurred but the unbonded area has not broken out from the overlay. It is apparent that the overlay will be a continuous maintenance problem.

In addition to the SBL of Rte. 85 over the Roanoke River, Guardkote 250 mortar overlays have been applied to two other bridge decks — one in the Bristol District and one in the Fredericksburg District. As reported earlier by McKeel² neither of these have performed satisfactorily due to bond failures such as that described above.

DOW SM-100 Latex Modified Portland Cement

Like the overlay on the SBL, the latex mortar overlay on the NBL bridge deck was applied in accordance with the specifications³ and procedures recommended by the product developer and supplier.

The DOW SM-100 is a film forming polymer emulsion which is designed to upgrade the physical properties of bonded portland cement overlays. Latex modified mortars are produced by adding 3.5 gallons of the SM-100 latex material for each bag of portland cement used in a mortar mix. Data developed by the Dow Company⁴ indicate that the modified composition is more flexible, more impermeable to water, less susceptible to chemical attack, and more resistant to abrasion than is a regular portland cement mortar. Microscopic studies by Isenburg, et al⁵, indicate that latex modified mortar overlays have greater bond to concrete than do mortar overlays without the latex additive.

After two years of service the DOW SM-100 overlay is performing satisfactorily. No failures in bond to the concrete deck have been observed to date and no maintenance repair work has been required. A network of hairline cracks, however, has developed throughout the overlay. As shown in Figure 3, the crack patterns can be easily detected as water evaporates from a wetted deck surface. The cracking is the most extensive in the transverse direction; but shorter length longitudinal cracking, propagating outward from the transverse cracks, is present also. The longitudinal cracking is more random and of shorter length than the transverse cracking, but often spans the distance between transverse cracks. While in some areas the cracking is beginning to resemble a fine pattern type cracking, it can best be described at this time as fine transverse cracking as defined and illustrated in the ACI guide for concrete condition surveys⁶.

On several DOW SM-100 overlays placed on bridge decks in Kentucky, Crace⁷ has reported that fine cracking had been observed when the overlays were wet and were in the process of drying. The cracking on the Kentucky bridge decks



Figure 1. Typical areas requiring patches after slightly more than a year's service. (Guardkote 250 epoxy mortar overlay, SBL Rte. 85 bridge over the Roanoke River.)



Figure 2. A failure (foreground) which developed three months after the repair shown in the background. (Guardkote 250 epoxy mortar overlay after two years' service, SBL, Rte. 85 bridge over the Roanoke River.)



Figure 3. Typical fine transverse cracking in the DOW SM-100 latex modified mortar overlay. (NBL Interstate Rte. 85 bridge over the Roanoke River.)

was not considered to be detrimental to the bond between the old concrete and the latex mortar, but an evaluation of the long-term durability of the overlays had not been made. While bond does not appear to be a problem on the Rte. 85 NBL study bridge at this time, the origin, degree, and effects of the cracking should be investigated further. Accordingly, sample cores will be taken from some randomly selected cracked and non-cracked areas of the deck and examined petrographically in the laboratory.

Since the long-term durability of the DOW SM-100 is still questionable, widespread use of the material for overlaying bridge decks should await more conclusive laboratory and field evaluations. Based on a comparison of the current results with earlier studies,² however, the modified latex mortar appears to be a better alternative than an epoxy mortar system for use where urgent repair of a deteriorated bridge deck is necessary.

CONCLUSIONS

After two years of service the following conclusions can be drawn from the comparison of the Guardkote 250 epoxy mortar overlay with the DOW SM-100 latex modified mortar overlay.

1. The performance of the Guardkote 250 epoxy mortar overlay on the SBL bridge deck has been unsatisfactory and will be a continuous maintenance problem due to failures in bond to the concrete deck. It can further be concluded that the poor performance of the Guardkote 250 overlay on the SBL of the Rte. 85 bridge over the Roanoke River is not an isolated case since similar distress has occurred on two additional bridge decks in Virginia.
2. The DOW SM-100 latex modified portland cement mortar has performed satisfactorily and no failures in bond to the concrete deck have occurred to date.
3. The performance of the DOW SM-100 latex modified overlay has been vastly superior to that of the Guardkote 250 epoxy mortar overlay.
4. The long-term durability of the SM-100 latex mortar is questionable at this time due to the development of extensive hairline cracking in the overlay. On the basis of its performance to date, however, the material shows promise and should be investigated further.

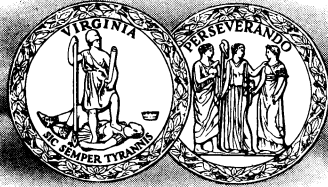
RECOMMENDATIONS

1. The Guardkote 250 epoxy mortar overlay as used for bridge deck repairs is a failure and no further use of the material is recommended.
2. While the performance of the SM-100 latex modified mortar has been satisfactory to date, it is recommended that widespread use of the material for repairing bridge decks await the outcome of a laboratory analysis of sample cores to be taken from the study overlay. In the interim, where urgent repairs of deteriorated bridge decks are necessary, a latex mortar overlay is a better alternative than a Guardkote 250 epoxy mortar overlay.

REFERENCES

1. "Highway Epoxy Information Series No. 1967-13 Job Analysis and Instructions Guardkote 250 Mortarmix Overlays," Shell Oil Company, May 1967.
2. McKeel, W. T., "Evaluation of Epoxy Compounds as a Material for Patching and Protecting Concrete," Virginia Highway Research Council, March 1971.
3. "Proposed Specifications for Repair of Portland Cement Concrete Bridge Decks with Latex Modified Portland Cement Compositions," The Dow Chemical Company, 1968.
4. "For Permanent Restoration of Concrete Bridge Deck Surfaces — Dow SM-100," The Dow Chemical Company, 1968.
5. Isenburg, J. E., E. J. Sutton, D. E. Rapp and J. W. Vanderhoff, "Micro-structure of the Bond Between Concrete and Dow SM-100 (Styrene-Butadiene Copolymer Latex) Modified Mortar. The Examination by Scanning Electron Microscopy Correlated with Physical Properties," The Dow Chemical Company, Midland, Michigan.
6. "Guide for Making a Condition Survey of Concrete in Service," Journal American Concrete Institute, No. 11, Proceedings V. 65, November 1968.
7. Crace, W. A., "Kentucky Bridge Decks Repaired with Latex Mortar Overlays," Better Roads, May 1969.

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IN REPLY PLEASE REFER TO FILE NO. 3-1

JACK H. DILLARD
STATE HIGHWAY RESEARCH ENGINEER

MEMORANDUM

TO : Mr. J. E. Harwood, Chairman, Research Council Administration Board

FROM : J. H. Dillard

SUBJECT: Report on An Evaluation of Two Overlay Materials on the Rte. 85
Bridges Over the Roanoke River

Attached is a report on "An Evaluation of Two Bridge Deck Overlay Systems On the Rte. 85 Bridges Over the Roanoke River" as prepared by M. H. Hilton of the Council's Structures Section. The Council was requested to review and evaluate the two overlays in August 1969 and a report was requested by Mr. J. V. Clarke by memorandum to Mr. Britton on September 10, 1971.

During two years of service the Guardkote 250 epoxy mortar overlay on the SBL deck has performed poorly. It is recommended that this material not be used further. The DOW SM-100 latex modified mortar overlay on the NBL deck has performed satisfactorily. No failures have occurred, but extensive hairline surface cracking has developed, and sample cores will be removed from the deck for laboratory analysis. While the performance of the overlay material has been impressive to date, it is recommended that widespread use of it for bridge deck overlays await the outcome of further evaluations.

Respectfully submitted,

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State Highway Research Engineer

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