

STEEL-FIBER-REINFORCED CONCRETE OVERLAY

Progress Report

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MICHIGAN DEPARTMENT OF STATE HIGHWAYS

STEEL-FIBER-REINFORCED CONCRETE OVERLAY

Progress Report

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Research Laboratory Section
Testing and Research Division
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Michigan State Highway Commission
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Summary

Condition of the fibrous concrete overlay at the end of nine months has resulted in a decision to remove approximately 3/4 of the installation. Failures are not due to the fibrous concrete concept as such, but relate to thickness and curing.

Background Information

This project is a joint effort by the Michigan Department of State Highways, the Michigan Concrete Pavers Association, and the Federal Highway Administration. This report covers recent developments in the project, and is being issued for the information of all interested parties.

Construction and early performance of the experimental overlay have been reported previously in Research Report No. R-852 (April 1973). The installation has been observed periodically since construction, and has shown continuing, progressive failure. Reasons for the failure are covered in the previous report and will not be reiterated here, except to state that failures were due to insufficient thickness and incomplete curing, and are not failures of the fibrous concrete concept per se. Readers are referred to the original report for further details.

MDSH Construction and Research personnel met at the site on July 18, 1973, to review the condition of the overlay, and decide what action should be taken. Representatives of the Michigan Concrete Pavers Association and the Portland Cement Association were also present.

Discussion

After nine months, the largest deteriorated area is the area where the first failure occurred. Figure 1 shows the extent to which the failure has spread at that location. It is obvious that the extent of the failure is not related to pavement condition underneath the overlay, since much of the area has a sound concrete slab underneath. Fragments at this location show the thickness of the overlay to be only slightly more than 1 in. Figure 2 shows conditions at several other locations. The worst conditions were found in the western, or 120 lb/cu yd, section of the overlay. Similar failures in earlier stages of development were found in the outside lanes of the 200-lb/cu yd section as well.

Soundings with a hammer indicate that the overlay has lost its bond over nearly the entire area. Since no elaborate procedures to obtain bond were used at the time of construction, this probably could be anticipated; however, it was expected that a greater portion of the overlay would remain bonded for a longer period of time. Bond loss seems to be aided by extensive warping of the overlay. In many places the joint edges appear to be raised almost 1/8 in., and more at the corners (Fig. 3). Traffic over these joints causes pounding of the overlay against the underlying slab. The amount of warping is variable throughout the installation, and on July 18,

ranged from near zero, to an isolated maximum in excess of 1/4 in. at a slab corner on the north side where there is no traffic. This was on a hot day, when thermal stresses should have tended to warp the surface in the opposite direction.

We know that all concrete pavement slabs warp with temperature and moisture gradients. Such warping, under traffic, causes flexural stresses in the concrete and "rocking" of the slabs. Also, in the case of a rigid overlay, it causes open space between the slabs, at the joints, where dirt may infiltrate.

Our extensive system of concrete highways will need surface repairs and overlays at some future point in time. If rigid overlays are to be used in any case, they will require workable designs. Bonded overlays are not suitable for use over broken slabs and joints, so the remaining options are unbonded (or semi-bonded) jointed overlays, and continuously reinforced overlays. The former presents some problems with joints. The latter would require a considerable amount of steel, would have to be quite thick to provide adequate protection for the reinforcement, and also would present some construction problems. For these reasons, it was considered to be useful to keep a portion of the overlay in service for a longer period of time, to gain additional experience with performance of the joints in the overlay. The two inside lanes of the 200 lb/cu yd section were in far better condition than the remainder of the installation. Therefore, it was agreed that those two lanes of the 200 lb/cu yd section should be left in place for further observation. The remainder of the overlay is to be removed and replaced with a bituminous cap. This will be done in conjunction with scheduled paving operations on the adjacent roadway, probably during August or September of 1973. The sections to be removed are shown in Figure 4.

Conclusion

Approximately 3/4 of the experimental fibrous concrete overlay is to be removed, and the remaining portion retained for further observation. The original objectives of the project have not been met because of insufficient thickness, and incomplete curing of the overlay prior to opening to traffic.

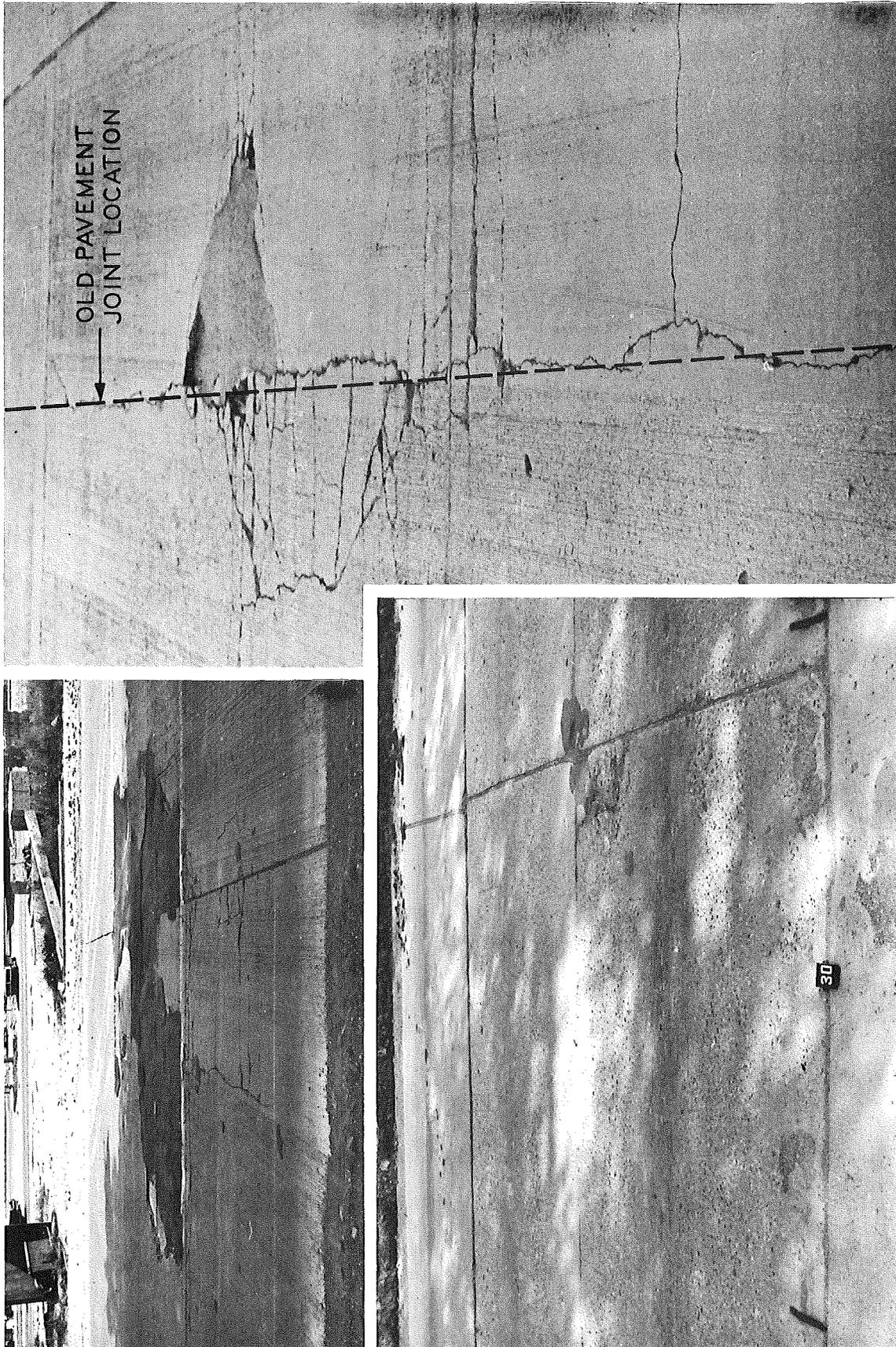


Figure 1. Extent of failure at the location where initial failure occurred. Photo at lower left shows original pavement; overlay at age 3 months (right); and, overlay at age 9 months (upper left).

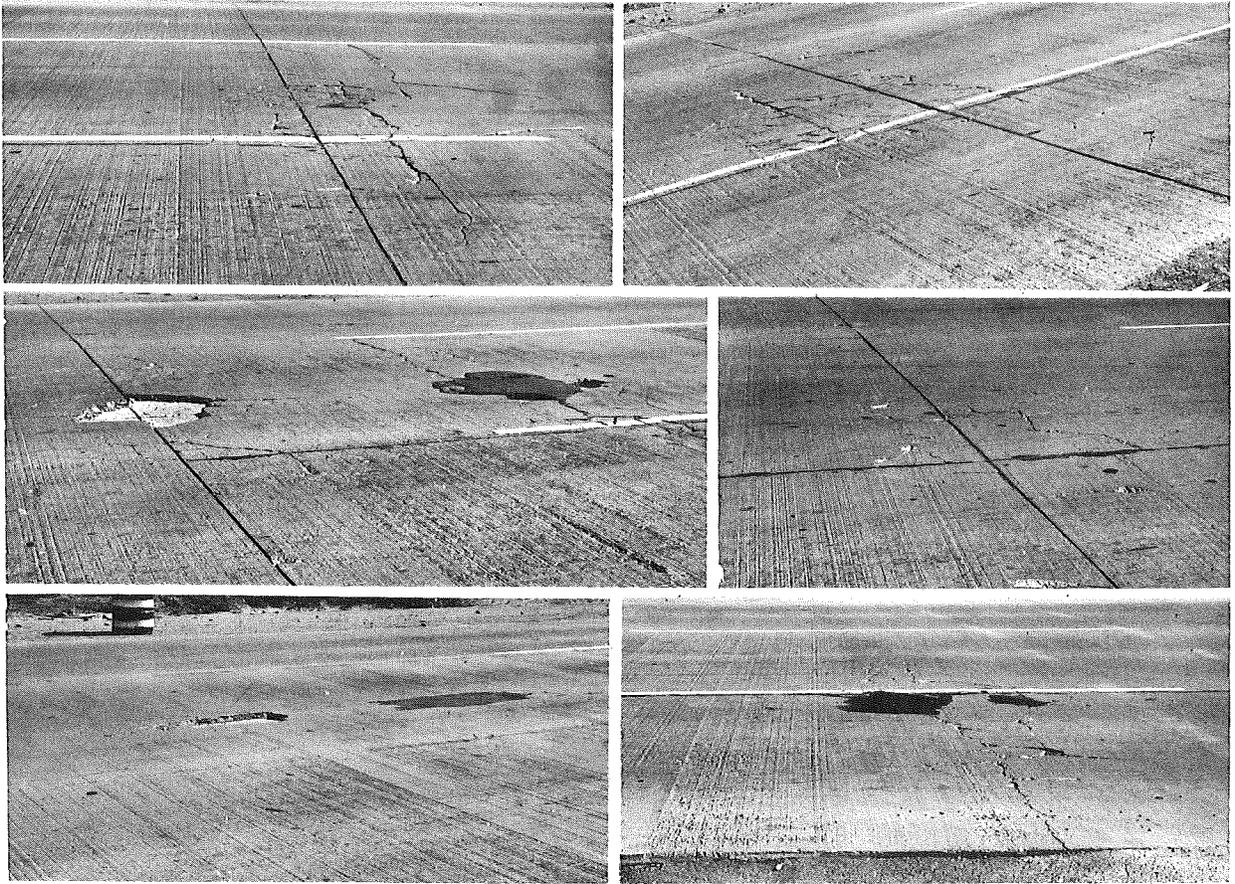


Figure 2. Examples of overlay failures, mainly within the western or 120 lb/cu yd section. However, similar failures in earlier stages of development, were noted in the outside two lanes of the 200 lb/cu yd section.

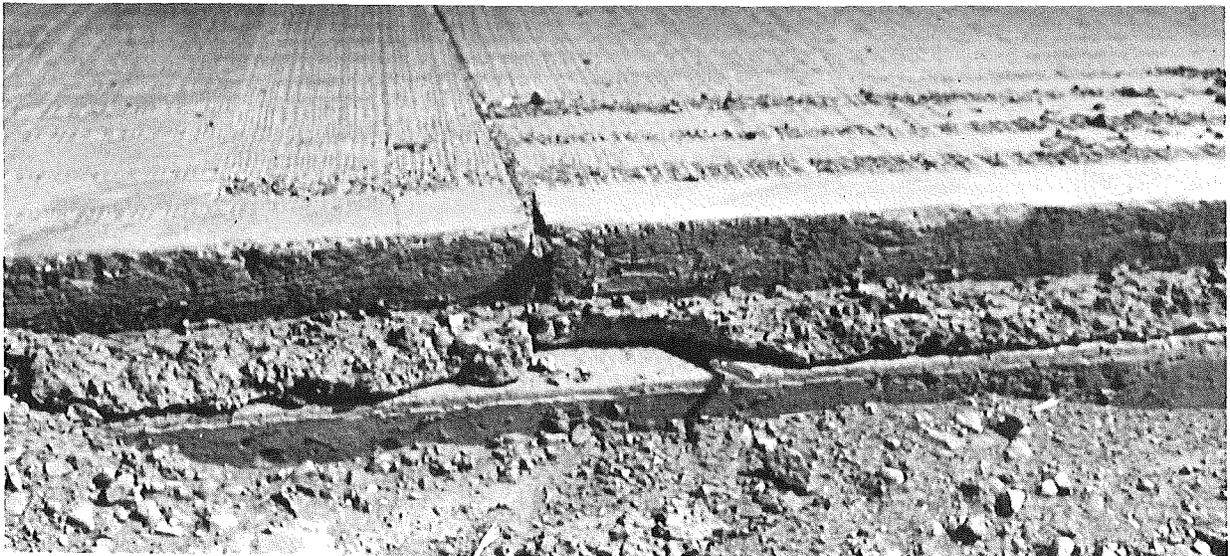


Figure 3. Warping lifts overlay away from underlying slab.

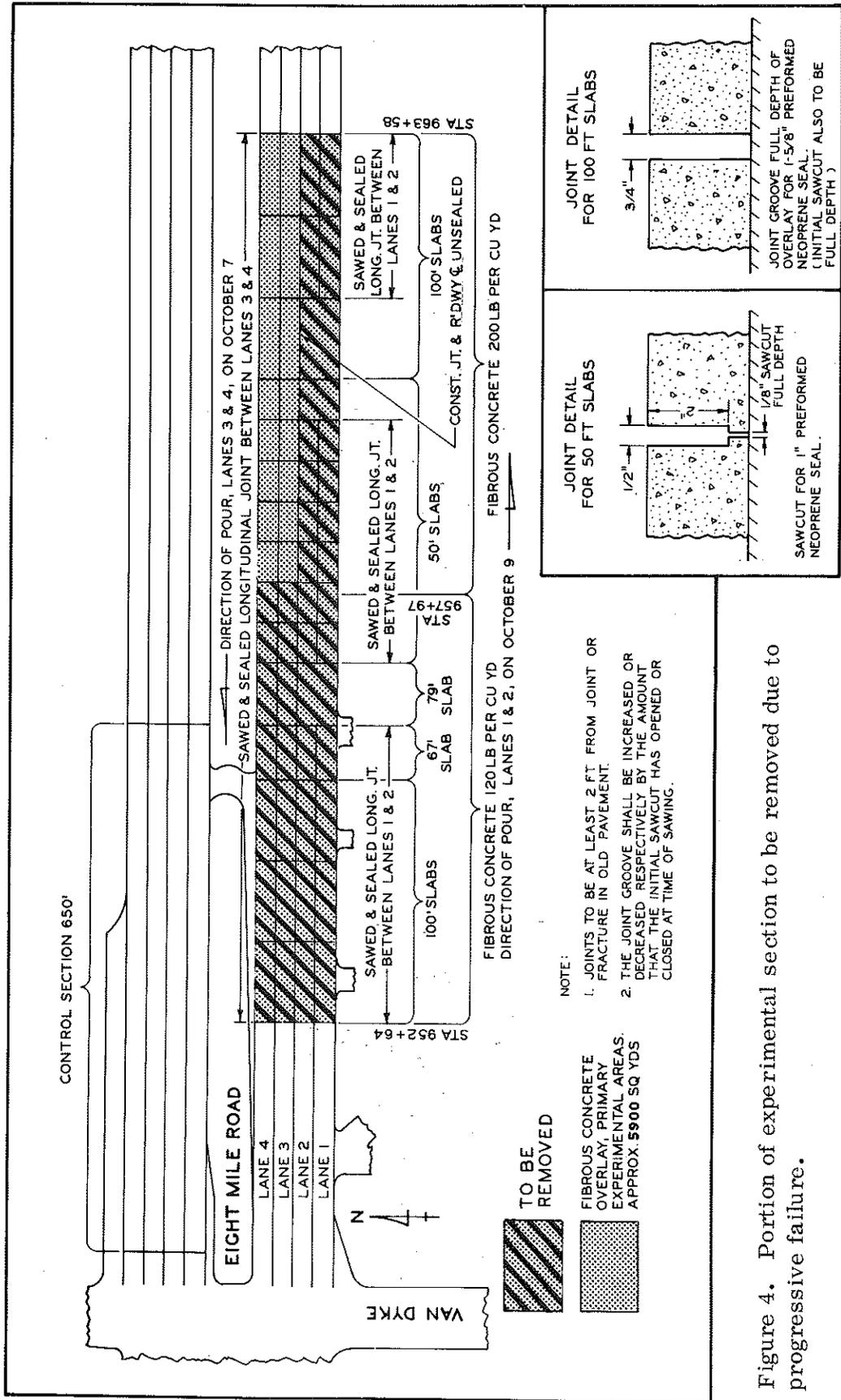


Figure 4. Portion of experimental section to be removed due to progressive failure.