

MICHIGAN
STATE HIGHWAY DEPARTMENT
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EXPERIMENTAL COLD-APPLIED JOINT SEAL INSTALLATION
ON US-31, HOLLAND BY-PASS
PROJECT FI 3-38, C2R; FI 70-46, C2R

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For several years the sawing of both longitudinal and transverse joints in concrete pavements has been under investigation by the Department in an attempt to eliminate the deterioration which so often resulted at the formed type of joint. The first experiment in sawing was carried out in 1951 on US-27 between Lansing and St. Johns where 3,760 feet of longitudinal joint and four 22-foot transverse joints were sawed and sealed with cold-applied joint sealer. The joints were $5/32$ in. wide and sawed to a depth of 2 inches.

Three projects were constructed during the 1953 season with sawed longitudinal joints, one of them an experiment at Jackson in varying the sawcut depth. In that same year, proposed supplemental specifications for the construction of sawed longitudinal joints in concrete pavements were drawn up by the Research Laboratory. These specifications were revised the following year and adopted on July 21, 1954 by the Department as standard. At the same time proposed supplemental specifications were also adopted as standard for cold-applied joint sealing compounds and their use in filling and sealing longitudinal joints in concrete pavements. This was necessary since it had been found exceedingly difficult, if not impossible, to penetrate a narrow $1/8$ -inch sawcut with hot-poured rubber type compound by pouring.

After the adoption of these specifications, the Department on Aug. 6, 1954 required all longitudinal joints in concrete pavements to be formed by cutting with a concrete saw and the groove filled with hot-poured or cold-applied joint sealer in accordance with the supplemental specifications.

During the 1954 season the entire longitudinal joint was sawed in both the north and southbound roadways of the US-31 Holland By-Pass. Variations in depth of sawing were tried in order to verify in a full-scale operation the results of the Jackson experiment in which only relatively short sections were sawed. Under Construction Project FI 3-38, C2R, Authorized Extra 2004 called for a total of 20,437 feet of 1/8-inch longitudinal joint sawed to a depth of 2 inches from station 13+00 to station 117+20 in the northbound roadway, and from station 15+10 to station 116+83 in the southbound roadway. In addition, under Construction Project FI 70-46, C2R, Authorized Extras 2005 and 2013 called for a total of 21,769 feet of 1/8 -in. longitudinal joint sawed to a depth of 1-1/2 inches from station 117+20 to station 222+70 in the northbound roadway, and from station 116+83 to station 228+78 in the southbound roadway. These joints, as in the previous sawed joint tests, were sealed with the cold-applied type joint sealer. As an additional test of the cold-applied sealer, the transverse joints, 1/2" x 2" contraction joints spaced 99 feet apart, were also sealed with the same material.

This cold-applied joint seal placed last fall was examined in some detail on February 9, 1955 by the Research Laboratory.

The joint seal in the sawed longitudinal joint appeared to be in good condition, adequately filling the joint groove and adhering to both faces, Figures 1 and 2. The exposed surface of the joint seal was slightly concave, the lowest point of the surface being about 1/16 inch below pavement level.

In the transverse joints the entire surface of the joint seal in each joint had become covered with a coarse sand or fine gravel, Figure 3. After this foreign material was removed with a whisk broom, a V-shaped groove or

crevice of variable depth was exposed in the joint seal, Figures 4 and 5. Probing into the joint seal with a screwdriver revealed that even the deepest crevice did not penetrate to the bottom of the joint groove, but that a layer of joint seal still existed between the bottom of the crevice and the contraction crack at the bottom of the joint groove, Figure 6. These crevices appeared to range from 0 to 1-1/4 inches in depth. Figure 7 indicates the cross-sectional appearance of typical sections of joint seal in transverse joints. The variations in crevice depths occurred within each individual joint and each joint had some sections where crevices appeared in the joint seal.

Joint seal removed from the joints was fresh and sticky and still smelled strongly of solvent. It appeared to be fairly well adhered to the joint faces, maintaining an effective seal against moisture. In view of the fact that the sealing material had not undergone any appreciable drying out, it is the opinion of the writer that the crevices found in this material were not caused by shrinkage.

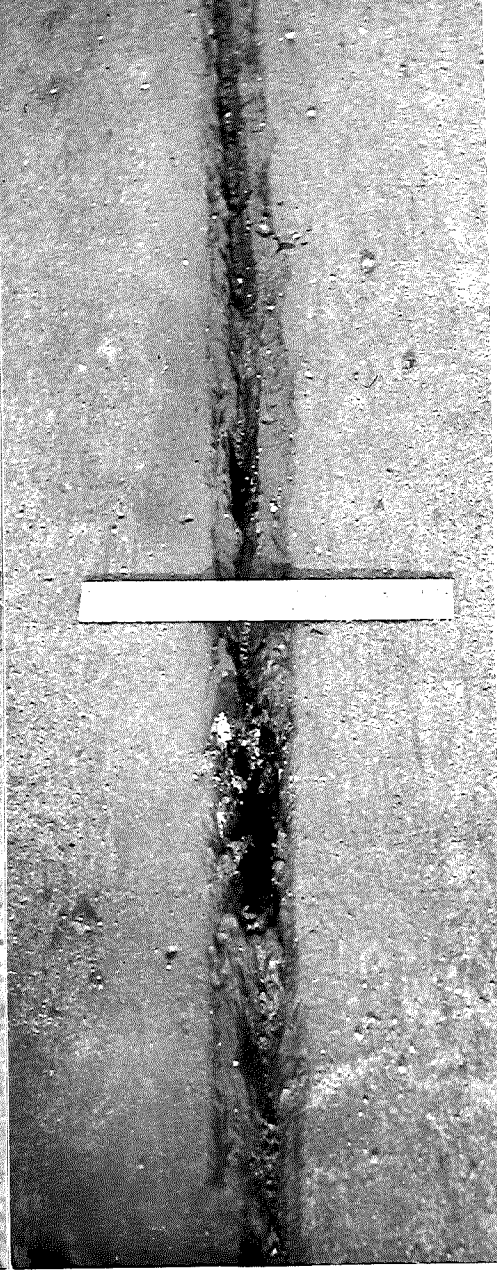
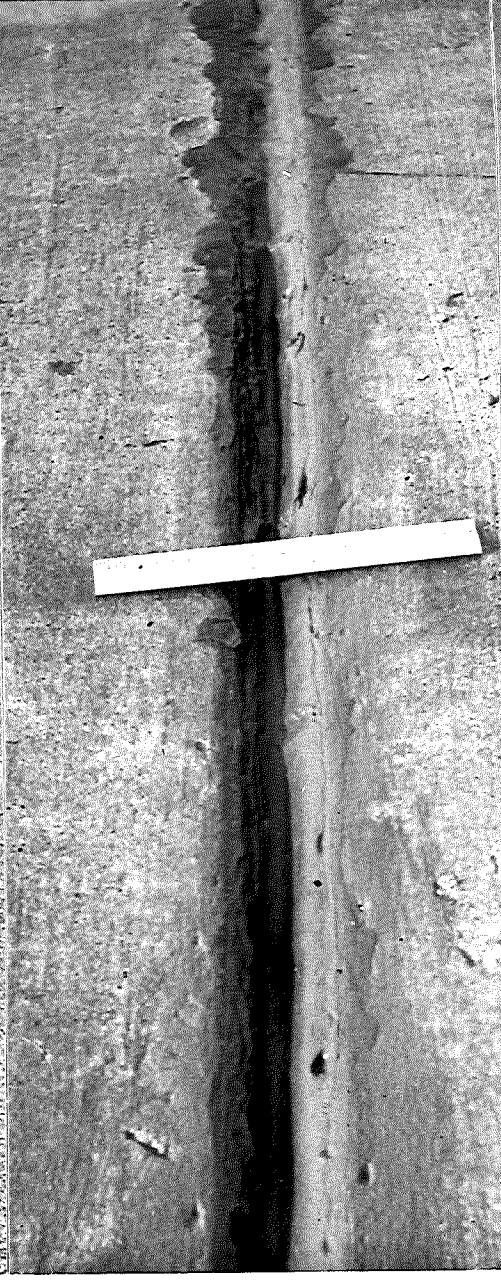
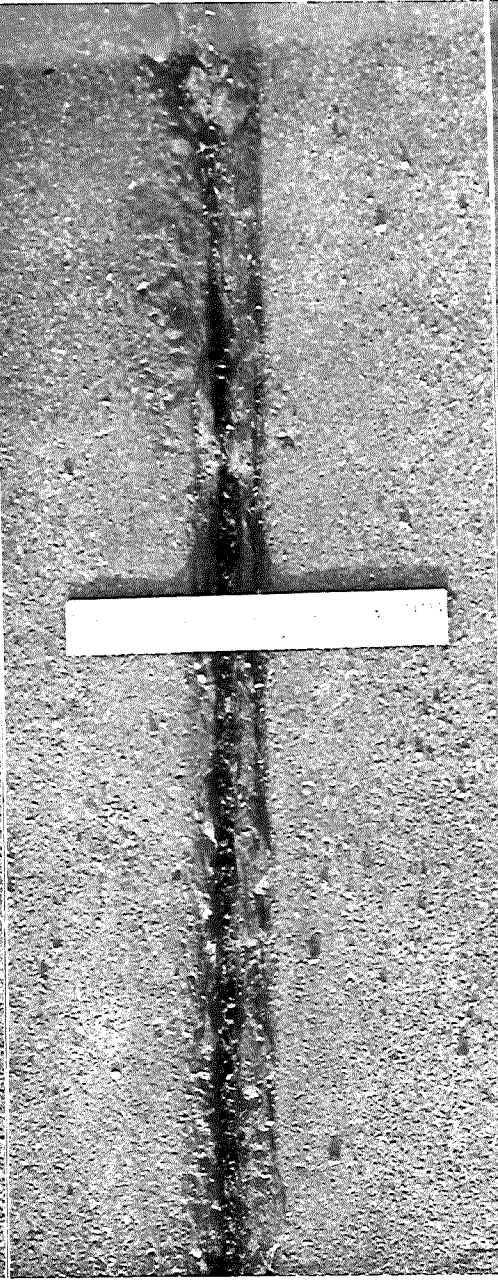
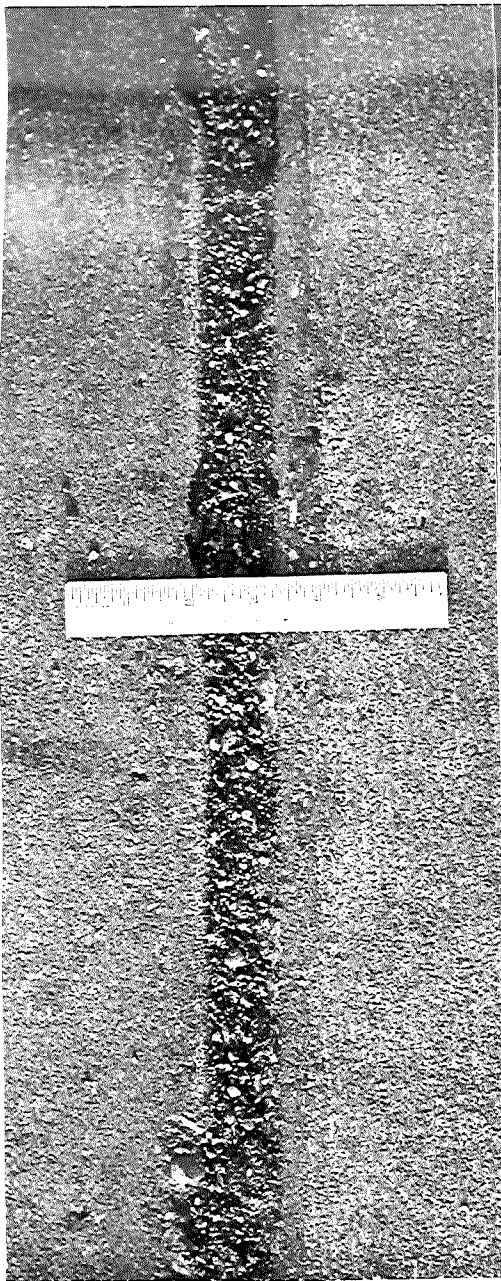
Since the viscosity of the sealer was very high, it is also inconceivable that the crevices were formed by loss of sealer through the contraction cracks under the joint groove. These cracks appeared to be a maximum of about 1/8-inch wide, and previous experience in this laboratory has indicated that a relatively low viscosity sealer is required to penetrate a 1/8 in. crack.

It is also unlikely that the crevices in the joint seal were formed through volume increase of the joint groove due to slab contraction, since the depth of the crevices was so irregular. In addition, the volume of the crevice in most cases seemed greater than the volume change which occurred in the joint groove.

As a result of these observations, it is suggested that a void was formed in the joint seal at the time it was applied and, as the air was later excluded from this void through settling and consolidation of the joint seal, a crevice was formed in the top of the seal. The void could have formed around the nozzle with which the joint seal was applied as the nozzle was dragged along through the joint groove. Since the material was applied by hand rather than mechanically, a variation in the speed with which the nozzle was moved along in the groove and the pulsations of the pump could have caused the variations in crevice depth that was observed. A mechanical device moving along the joint at a constant optimum speed might insure the complete filling of each joint.



▲ FIGURE 1. SAWED LONGITUDINAL JOINT AT WHITE PAINT STRIPE ▲ FIGURE 2. SAWED LONGITUDINAL JOINT AT BLACK PAINT STRIPE
US-31 HOLLAND BY-PASS. STATION 212 + 50 S.B.



▲ FIGURE 3. TRANSVERSE JOINT SEAL COVERED WITH COARSE SAND US-31 HOLLAND BY-PASS. STATION 17 + 60 N.B.

▲ FIGURE 4. JOINT SHOWN IN FIGURE 3 AFTER REMOVING SAND AND EXPOSING CREVICE IN JOINT SEAL. STATION 17 + 60 N.B.

▲ FIGURE 5. TRANSVERSE JOINT WITH SAND REMOVED EXPOSING SHALLOWER CREVICE THAN IN FIGURE 4. STATION 212 + 50 S.B.

▲ FIGURE 6. JOINT SHOWN IN FIGURE 4 AND 5 AFTER REMOVING SOME OF JOINT SEAL. NOTE CONTINUITY OF JOINT SEAL UNDER CREVICE. STATION 17 + 60 N.B.

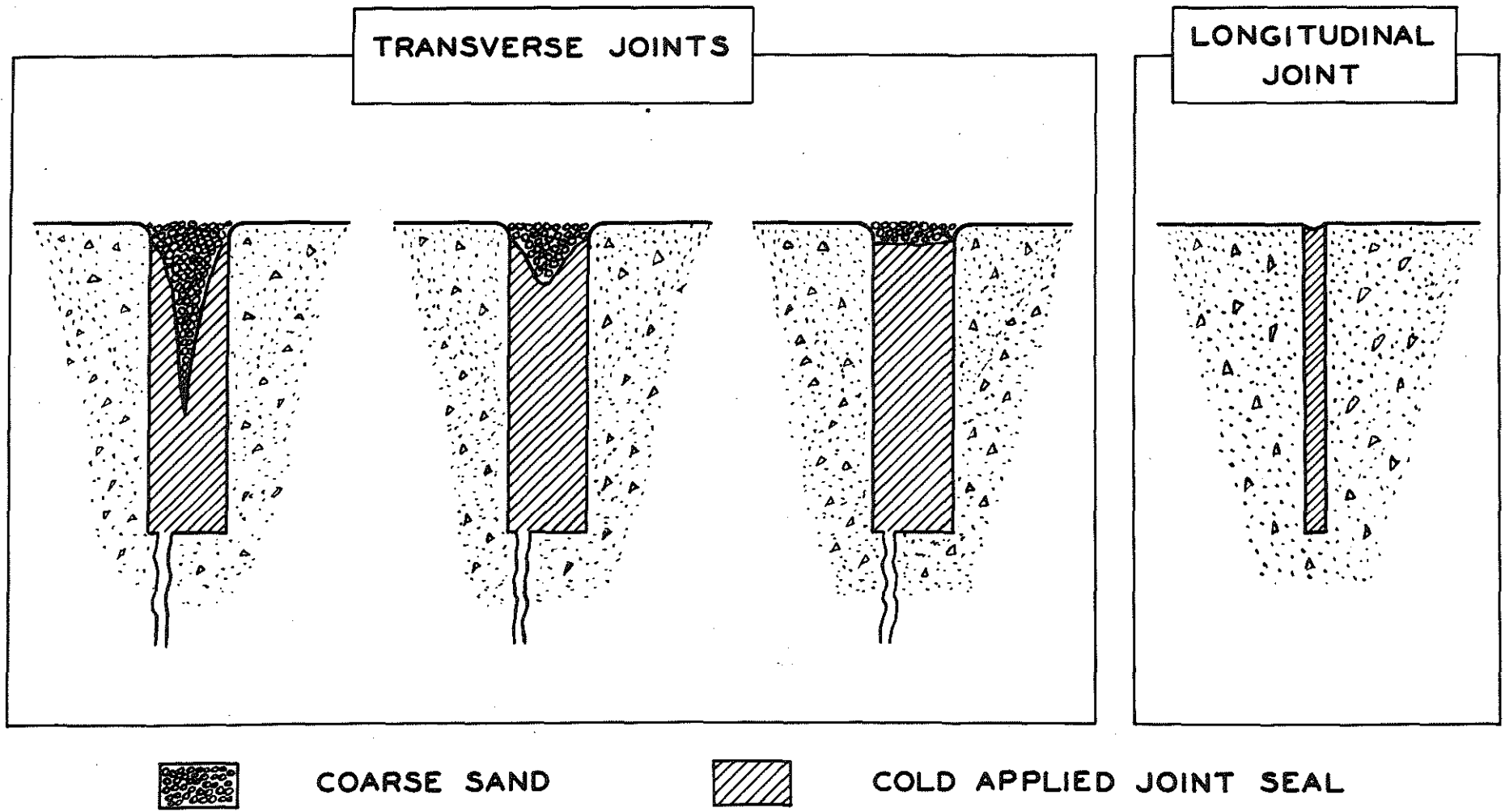


FIGURE 7. US-31 HOLLAND BY PASS. LEFT, CROSS SECTIONAL SKETCH OF VARIOUS CONDITIONS OF JOINT SEAL IN TRANSVERSE JOINTS. RIGHT, CROSS SECTIONAL SKETCH SHOWING APPROXIMATE APPEARANCE OF JOINT SEAL SURFACE IN LONGITUDINAL JOINT.

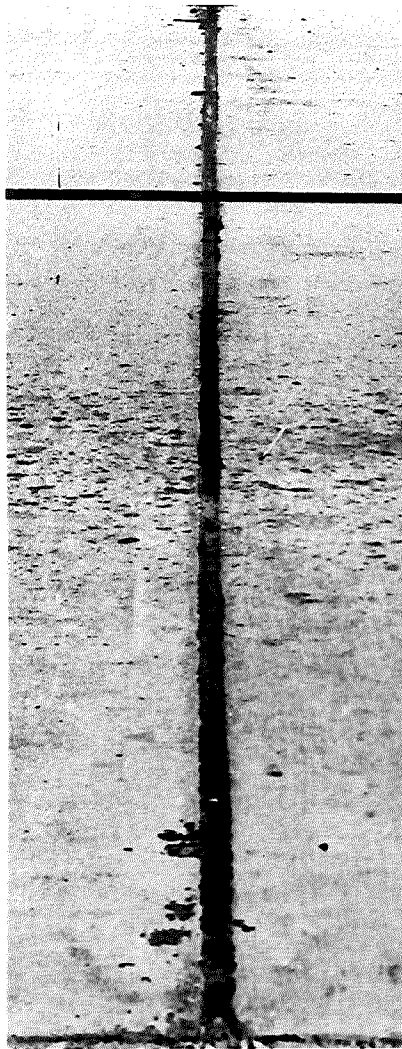
Supplement to Report No. 226
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At the request of Mr. W.W. McLaughlin, a second inspection of the cold-applied joint seal installation was made on May 5, 1955 to determine the overall general condition of the joints on the two projects and, if necessary, decide what steps should be taken to put the joints in first-class condition. The survey was made by E. A. Finney, C. C. Rhodes, and L. A. Fickes.

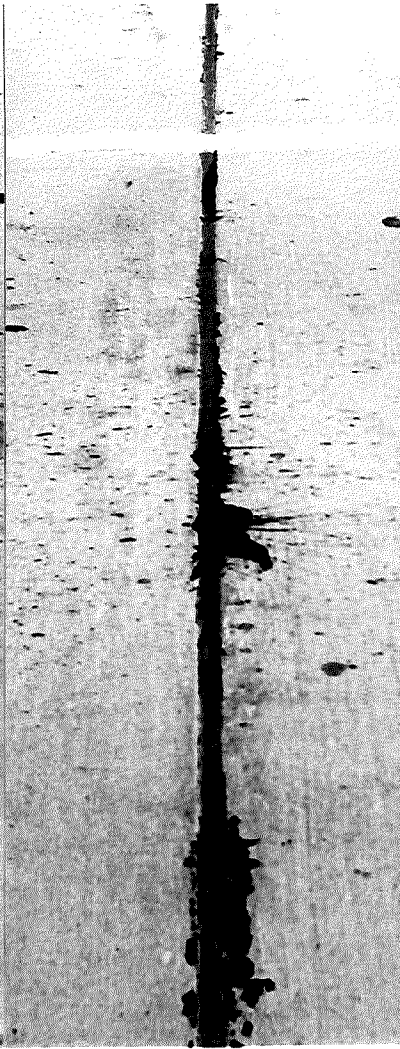
With reference to Figures 1 to 5 inclusive, it was observed that, in general, all joints could be classified into three categories - for instance, those which were apparently in excellent condition as illustrated in Figures 1 and 2; those which had intermittently good and poor areas as shown in Figure 3; and finally, those which were in poor condition throughout their entire length as shown in Figure 4. In a few instances, the joint seal was observed to be exuding from the joints, as may be seen in Figure 5.

Examination of the apparently poorly sealed joints revealed that they were sealed underneath and it was the considered opinion of the observers that the joints should be left as they are for the present in order that they may be observed from time to time to determine additional information as to the life expectancy and behavior of this type of joint sealing material. This factual information will be very helpful in relation to the Research Laboratory's current research program on joint sealing materials.

Further, it is the recommendation that cold-applied sealing material should not be used for sealing transverse joints on future pavements.



▲ FIGURE 1. JOINT SEAL IN GOOD CONDITION. STATION 217 + 30 SOUTH-BOUND.



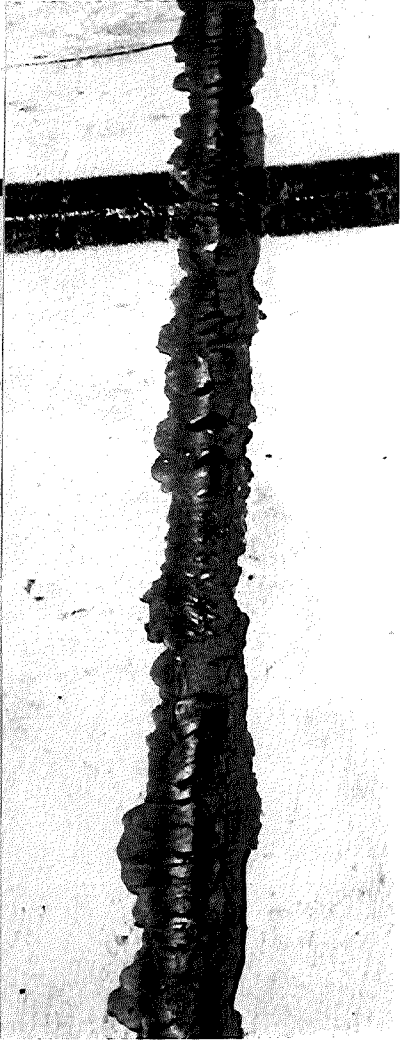
▲ FIGURE 2. JOINT SEAL IN GOOD CONDITION. NOTE MATERIAL STARTING TO TRACK UNDER TRAFFIC. STATION 144 + 05 SOUTHBOUND.



▲ FIGURE 3. JOINT SEAL IN FAIR CONDITION. NOTE ALTERNATE GOOD AND BAD AREAS. STONES IN JOINT. STATION 29 + 60 NORTHBOUND.



▲ FIGURE 4. JOINT SEAL IN GENERALLY POOR CONDITION ALONG ENTIRE LENGTH OF JOINT. STATION 53 + 25 NORTHBOUND.



▲ FIGURE 5. JOINT SEAL MATERIAL STARTING TO EXUDE FROM JOINT. NOTE TIRE MARKS INDICATING HEIGHT OF EXTRUDED MATERIAL. STATION 215 + 40 SOUTHBOUND.