JOINT REPAIR BY EPOXY INJECTION

MICHIGAN HIGHWAY RESEARCH LABORATORY SECTION

MICHIGAN DEPARTMENT OF STATE HIGHWAYS

JOINT REPAIR BY EPOXY INJECTION

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At its December 6, 1971 meeting the Pavement Selection Committee requested that a joint repair method consisting of grouting the existing joint and constructing a relief joint in the near vicinity of the grouted joint be investigated. The object of the study was to determine if the deteriorated concrete could be bonded together to make the slab continuous and sufficiently strong to withstand tensile forces during contraction of the slab. Compression forces in the pavement would be dissipated at the relief joint.

For some time, cracked concrete structures have been restored to near-original condition by injecting epoxy into the cracks. Although the pavement joints in need of repair consist not only of cracked areas but also contain deteriorated concrete as a result of salt solution entering the joints, the epoxy injection method appeared to be the only method available. Consequently, the Structural Bonding Company of Flint, who performs this type of work, was contacted concerning the grouting of pavement joints. In their opinion, joint repairs of this nature could possibly be successful. A contract between the Structural Bonding Company and the Department was negotiated in the amount of $1,800.00 for the grouting of three pavement joints. The relief joint installation and traffic control would be the responsibility of the Department.

The three joints selected for the experimental repair are located at Stations 639+58, 651+67, and 660+80 on the southbound roadway of US 127 just south of the Leslie exit. The pavement was constructed in 1957 and consists of two 11-ft lanes of 9-in. reinforced concrete. The joints are spaced 99 ft apart and contain 1-1/4-in. diameter steel dowels at 12-in. centers. Galvanized steel base plates and end plates were used on the slab bottom and edge, respectively, and the joint grooves were formed 1/2 in. wide by 2 in. deep. The joints were sealed with a hot-poured rubber-asphalt sealant. The pavement was constructed with expansion joints at 400-ft intervals. The surface condition of the selected joints is shown in Figure 1; the cores shown in Figure 2 were taken through the joint to check the deterioration at the bottom of the slab. Note that approximately 2 in. of concrete had deteriorated at the slab bottom.

The saw cuts for the relief joints were completed May 23, 1972. The cuts were made 6 ft away from the joints except at Sta 660+80 where only 2 ft separated the old and new joint. At this joint the compression in the slab crushed the 2 ft slab segment before grout could be injected into the old pavement joint or the relief joint could be installed. An agreement between the contractor and the Department deleted the failed joint from the contract. At the two locations where the relief joint was located 6 ft away, the compression in the slab did not damage the short slab between the joints.

Aside from preliminary work to determine the method to be used in cleaning the joints, the injection repair began June 2, 1972 and was completed June 7, 1972. Since this study was an attempt to evaluate the repair method, the time required to repair a joint was not considered to be of any consequence. The sequence followed in preparing the joint for injection of epoxy is as follows:

1. The existing seal was removed from the joint groove using hand tools. Figure 3 shows a cleaned-out joint groove.

2. The groove was sandblasted to remove dirt and sealant particles (Fig. 4).

3. Diluted hydrochloric acid was poured into the groove to dissolve any sealant that had seeped into the plane-of-weakness crack. The acid treatment lasted about 45 min. The groove was then washed out with soapy water followed by sandblasting and cleaning with compressed air. Figure 5 shows the cleaned groove.

4. The joint was filled to within about 1/2 in. of the surface with quartz sand (100 percent passing No. 4 sieve and 0-5 percent passing No. 16 sieve, Fig. 6).

5. An epoxy mortar consisting of No. 1173 concressive epoxy and sand was placed on top of the quartz sand as shown in Figure 7.

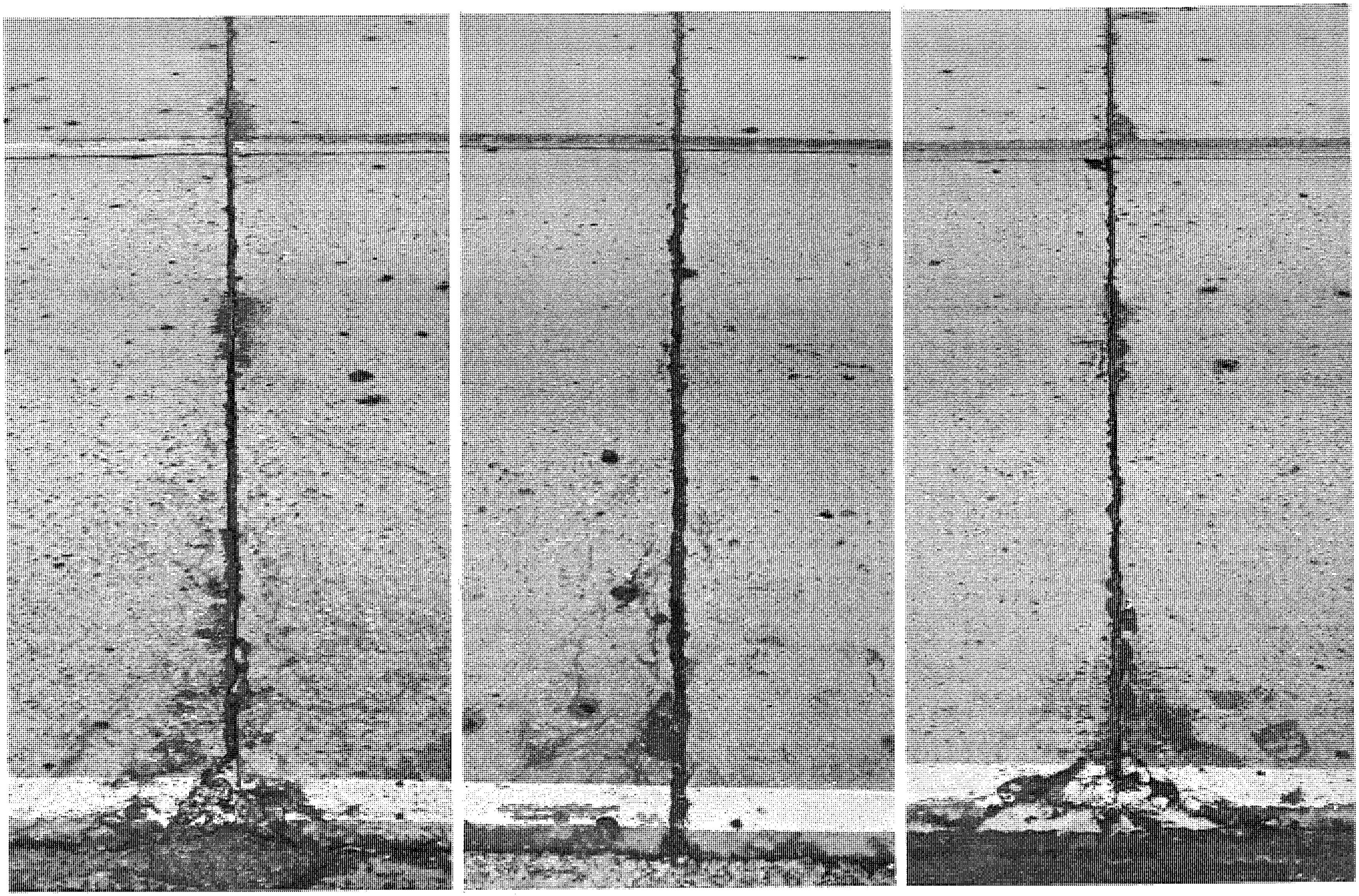
6. A thin layer of fast-setting No. 1192 epoxy was placed on top of the epoxy mortar to shorten the time until injection could begin (Fig. 8).

7. A No. 1050 concressive epoxy was injected into the joint through 1/4-in. holes spaced 2 ft apart. Figure 9 shows the injection pump and operator while Figure 10 is a close-up of the mixing nozzle and pressure gage. The pressure averaged 45 to 50 psi with a range of 15 to 100 psi. The injection began at the shoulder-edge hole and continued until epoxy was flowing up through the adjacent hole. The first hole was then plugged and injection begun in the second hole. This sequence was followed across the joint.

The relief joints were installed as soon as the grouting was completed.

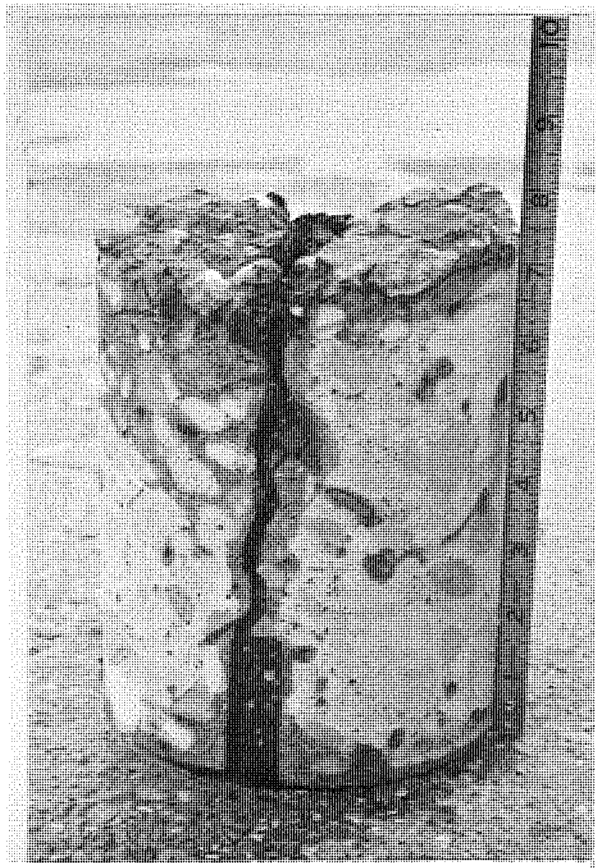
The success of the grouting was checked on September 18, 1972. First the joint surface was inspected and then 6-in. diameter cores were taken through the joint. The surface inspection revealed that the bond between the concrete and the epoxy had failed in some areas (Fig. 11), and at other locations the concrete adjacent to the groove had failed in tension (Fig. 12). A core taken through the bond failure area is shown in Figure 13 and one taken through the location of concrete failure is shown in Figure 14. Examination of both cores revealed that the epoxy had not penetrated through the plane-of-weakness crack and consequently the deteriorated concrete at the bottom of the joint was not bonded together.

On the basis of the results of this experiment it is concluded that grouting of pavement joints, coupled with the installation of a relief joint, is not feasible. The main reason for failure is attributed to the difficulty of removing the old sealant present in the plane-of-weakness crack in order to have clean surfaces to bond with. Even if bond of sufficient strength could be obtained in the plane-of-weakness crack it is apparent that the deteriorated concrete at the bottom of the joint cannot be successfully grouted because there is no way to clean the individual particles and the sound concrete surfaces in this area.

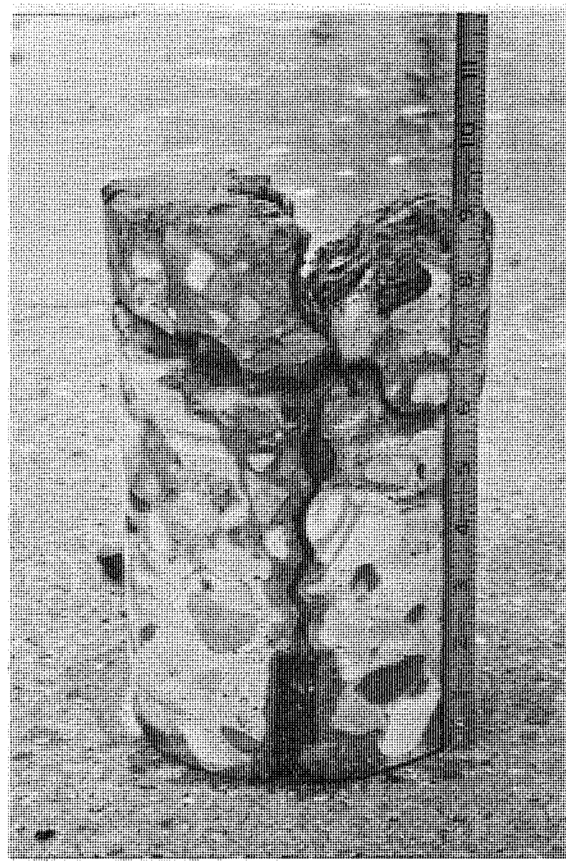


Sta. 660+80 Sta. 651+67 Sta. 639+59

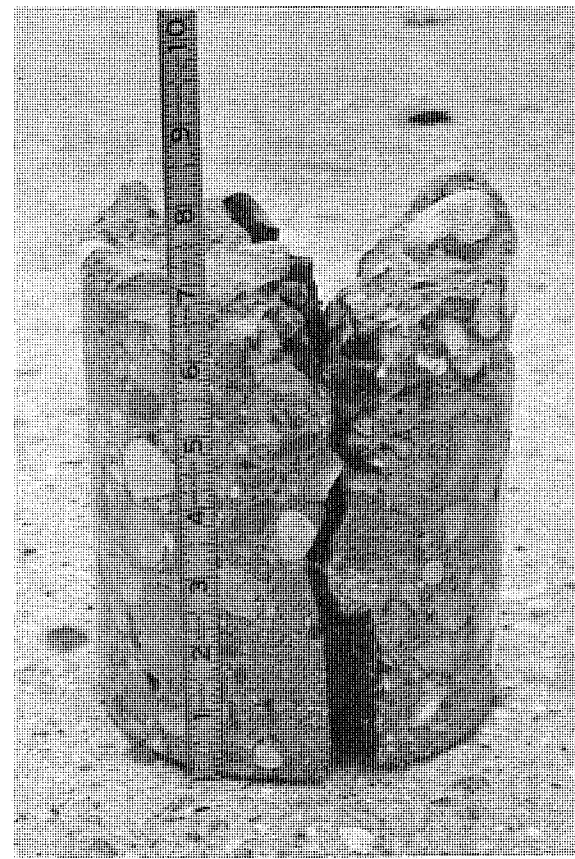
Figure 1. Surface condition of joints selected for grout injection.



Sta. 660+80



Sta. 651+67



Sta. 639+59

Figure 2. Cores taken through the joints selected for grouting.

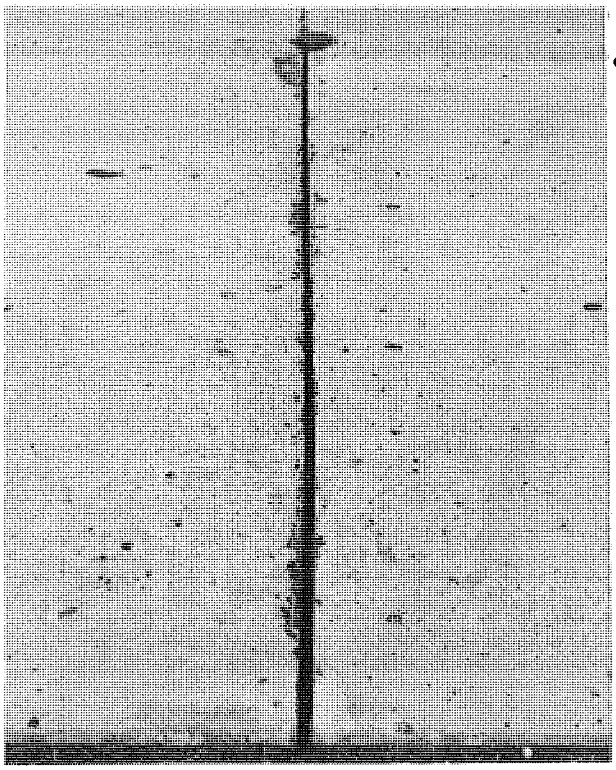


Figure 3. Condition of joint groove after removal of sealant.

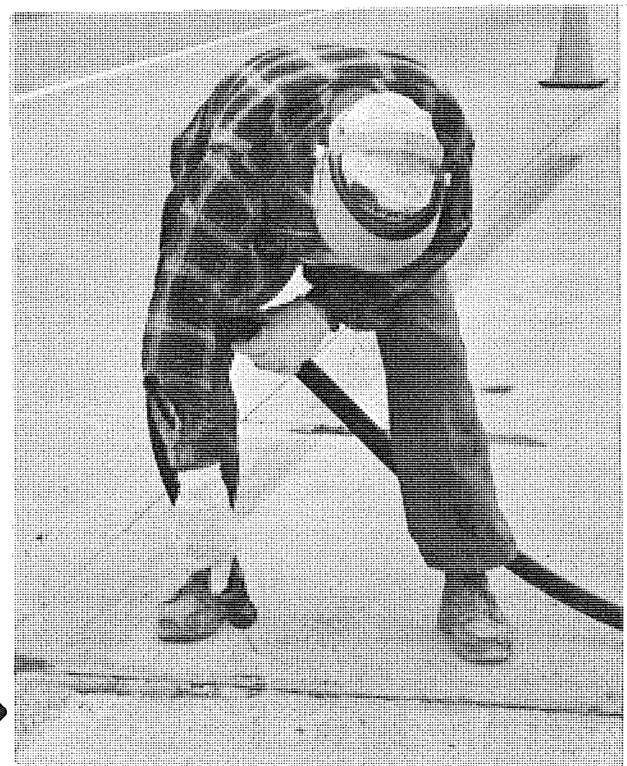


Figure 4. Sandblasting of joint groove.

Figure 5. Close-up of cleaned joint groove.

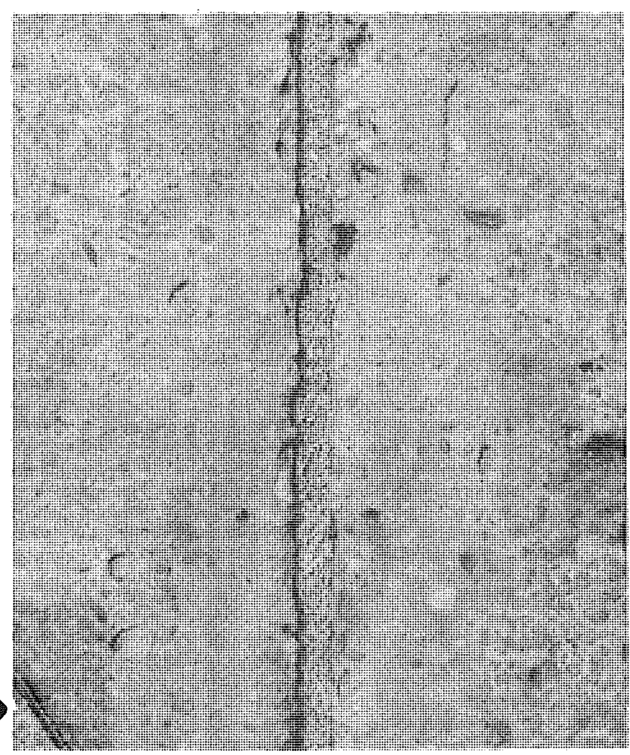


Figure 6. Close-up of groove nearly full of quartz sand.

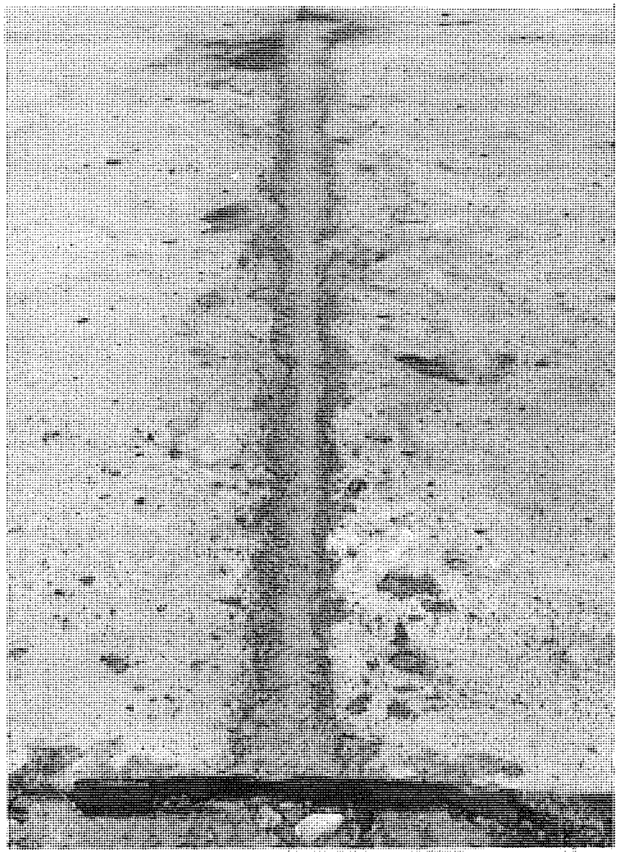


Figure 7. Condition of groove after applying epoxy mortar.

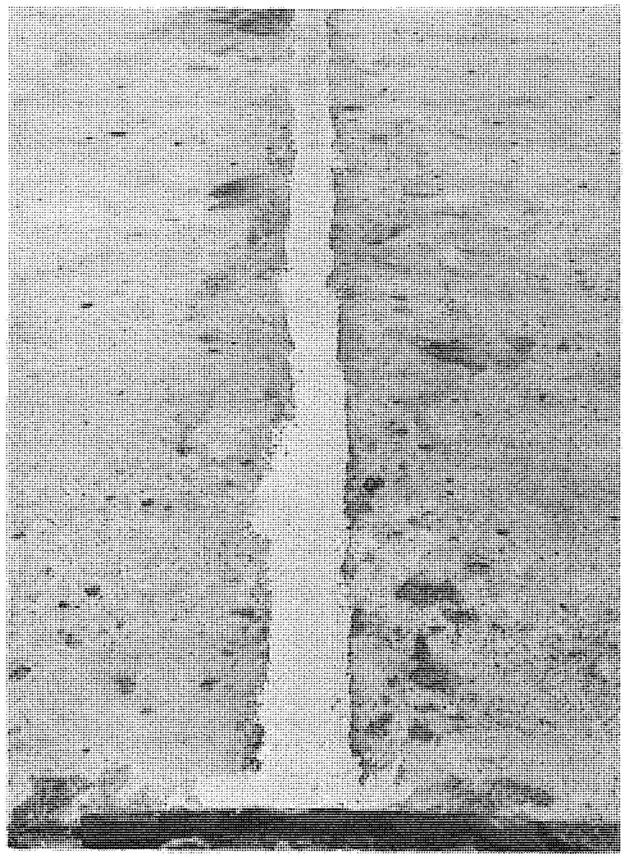


Figure 8. Condition of groove after thin layer of epoxy No. 1192 was placed on top of mortar.

Figure 9. Injection of No. 1050 concressive epoxy.

Figure 10. Close-up of mixing nozzle and pressure gage.

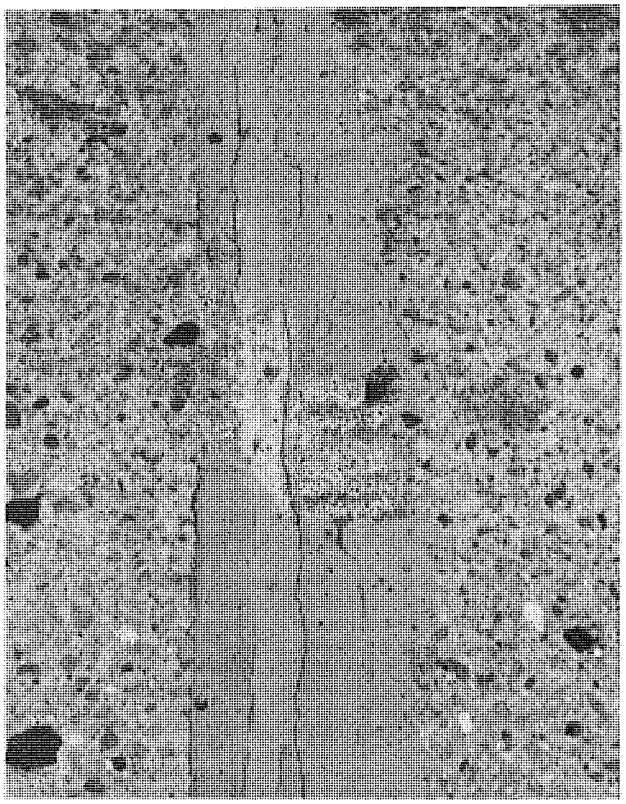


Figure 11. Bond failure between epoxy grouted groove and concrete surface.

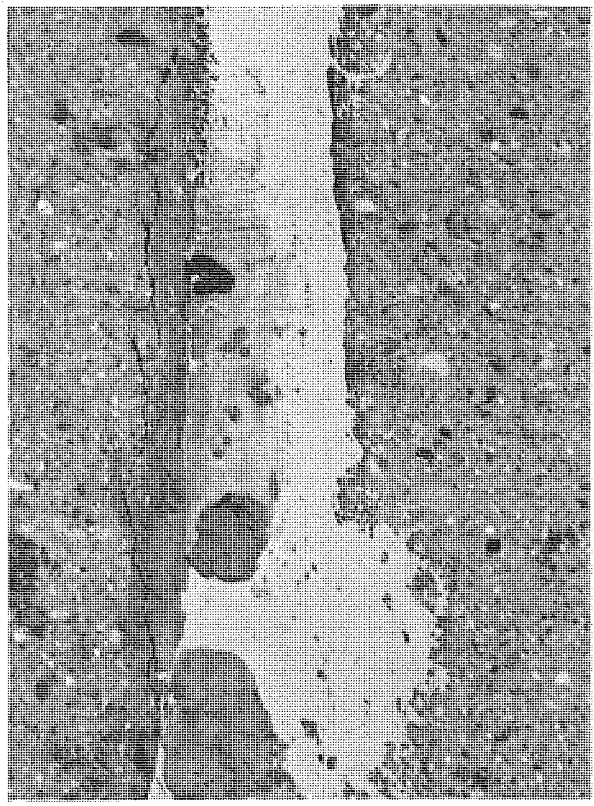


Figure 12. Failure in concrete adjacent to grouted groove.

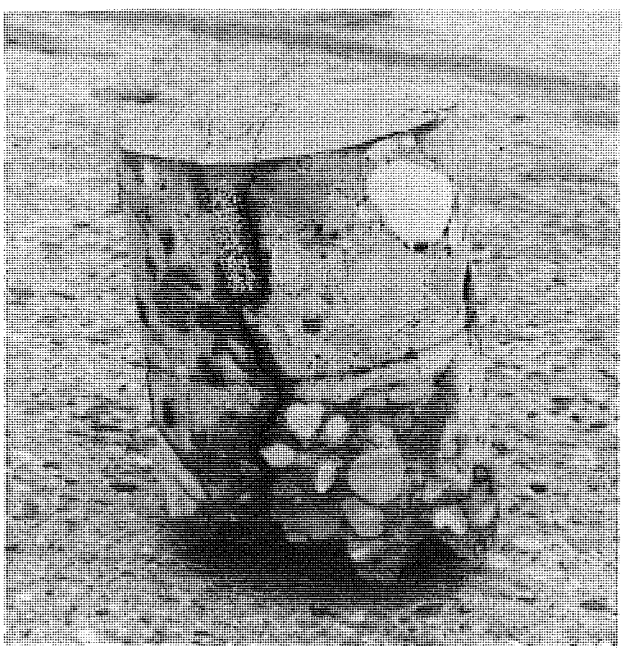


Figure 13. Core from area where bond failure between epoxy and concrete had occurred. No penetration of the epoxy into the plane-of-weakness crack was noted.

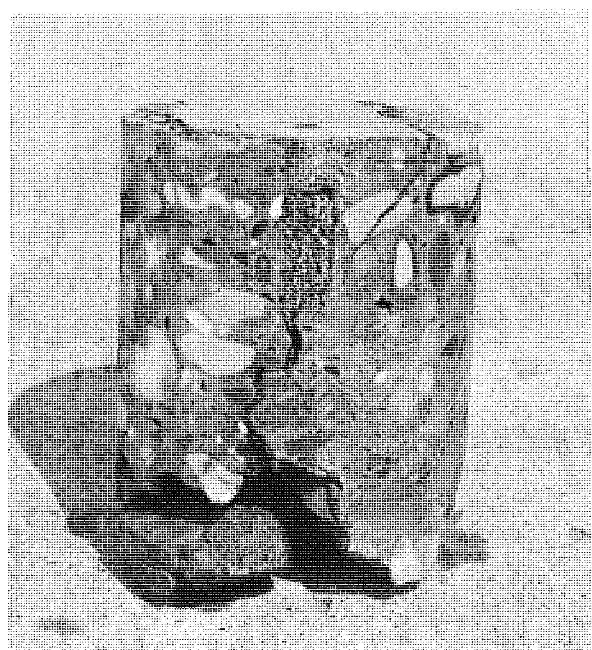


Figure 14. Core from area where the concrete had failed in tension. The epoxy had not entered the plane-of-weakness crack.