EVALUATION OF SYNTHETIC FABRICS
FOR THE REDUCTION OF REFLECTIVE CRACKING

FINAL REPORT

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FEDERAL HIGHWAY ADMINISTRATION

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April 1975

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INTRODUCTION

Over the years, the use of asphaltic concrete as an overlay material for existing concrete pavements has been generally accepted. This practice has restored to the original pavement a new degree of surface smoothness, an acceptable structural strength, and--in recent years--an effective skid resistant surface.

Perhaps the most widespread fault attributed to such overlays has been the reflection of cracks to the overlay surface. These cracks not only widen and deepen with the passage of time, thereby detracting from the appearance and riding surface of the new overlay, but also shorten the life of the entire pavement structure due to seepage of foreign material into the underlying lifts (incompressibles into the joints and water into the subgrade).

Two basic approaches have been taken to combat this cracking problem: Treat the effect by crack sealing; or treat the supposed cause, which is the concentration of stress due to movement within the old concrete pavement.

PURPOSE OF STUDY

This research was undertaken to evaluate the effectiveness of two synthetic fabrics in relieving stress and reducing or eliminating reflection cracking in the asphaltic concrete overlay of existing distressed concrete pavements.

SCOPE

The polypropylene fabric was placed in strips over the cracks and joints of an existing concrete pavement, followed by a 3-1/2 inch (88.9 mm) asphaltic concrete overlay. The nylon fabric was placed "full width" over one lane of another concrete pavement, followed by a 3-inch (76.2 mm) asphaltic concrete overlay. Visual observations were made periodically at both locations after construction to determine the degree of reflection cracking.

FIELD APPLICATION

Polypropylene Fabric

In March of 1971, the Research and Development Section of the Louisiana Department of Highways installed a nonwoven polyproplyene fabric over the joints and cracks in an existing concrete highway. The site selected for this application was the north-bound lanes of U. S. 61 just south of Sorrento, Louisiana. Control and test sections were selected and aerial photographs were taken prior to the application and subsequent overlay. The joints and cracks were noted on these photographs (Figure 1) so that visual observation at a later date could be used to evaluate the effectiveness of the fabric in eliminating or reducing reflection cracking.

Approximately 600 feet (182.9 m) of the highway was used as a test section; an additional 600 feet (182.9 m), immediately adjacent, was used as a control section. Before the fabric was laid, all the joints and cracks were swept clean. All cracks and joints in excess of 1/4 inch (6.35 mm) were filled with sand and then cemented with an RS-2K type emulsion. The polypropylene fabric was then placed over these prepared surfaces using a special applicator (Figure 2) which saturated the fabric with RS-2K emulsion as it was being unrolled (Figure 3). The fabric was then "broomed" to squeeze out the excess emulsion and to help it lie flat on the roadway. The fabric was next blotted with a broadcasting of fine sand (Figure 4). The roadway was opened to traffic within 2 hours. Due to plant problems, the asphaltic concrete overlay (3-1/2 inches, or 88.9 mm, of a dense graded mix, LDH designation Type 3) was not laid for two days. Prior to overlay (Figure 5), an RC-250 tack coat was applied at approximately 0.3 gals/yd^2 over the entire pavement width. Following construction, observation was made periodically of both test and control sections.

Nylon Fabric

In May of 1973, a second fabric installation was made on the northbound lane of La. 19 between Baker and Zachary, Louisiana. This fabric was a continuous filament, spun-bonded nylon. The test section consisted of a 100-foot (30.48 m) length of full coverage; the control section was the southbound lane immediately adjacent. As was the case with the previous installation, aerial photographs of the sections were taken prior to application and the subsequent overlay. The joints and cracks were noted as before (Figure 6).

Prior to the fabric installation, the test section was swept clean and all cracks and joints were filled. An RS-2K emulsion was spread at 160°F (71.1°C) over the 100-by-10-foot (30.48-by-3.05-meter) surface at a rate of 0.2 gal/yd^2. Following the emulsion break, the nylon fabric was hand laid the length of the section in seven longitudinal strips, with 3-1/2 inch (88.9 mm) overlaps*. A portable, 500-pound (226.8 kg), gas driven steel wheel roller was used to seat the fabric, then three passes were made by a pneumatic roller. At this point, no gross asphalt was noticed seeping through the fabric. Approximately 30 minutes after the fabric lay-down, the first mix truck was backed over the fabric to meet the spreader at the beginning test section joint. No problem of fabric pickup was observed. However, with the first movement of the spreader over the section, the fabric began to wind around the small rubber wheels. A 3-foot (0.91-m) longitudinal section of the fabric closest to the centerline had to be cut away due to its mangled condition. Apparently, a light tack coat of RC-250 cutback covered these spreader wheels; RC-250 being the tack used throughout the job with the exception of this test section. To prevent further occurances, hot mix from the spreader was lightly shoveled on the fabric in the wheel paths of the spreader. No similar problem was encountered.

Immediately after the spreader had passed any given point within the test section, slight separations or tares were noticed in the 1-1/2-inch (38.1-mm) binder course overlay. These separations were transverse in nature and were randomly distributed along the 100-foot (30.48-m) test section length. Hot mix was shoveled over these tares and after three passes of a three-wheel roller, no sign of these separations was noticed. Following nine passes with the pneumatic roller and subsequent cool rolling with the tandem, the finished surface was comparable to the rest of the job.

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*It was the Department's original intent that this fabric, delivered 60 inches (1.52 m) in width, be used in a manner similar to the polypropylene fabric; that is, strip coverage of joints and cracks. Subsequent to cutting the fabric into 20-inch (0.51-m) strips, the decision was made to apply the fabric "full width."

It is believed that these separations were the result of fabric movement, prompted by an excess of high penetration residual emulsion which was softening from the heat of the overlay. To ascertain if such movement seriously affected the degree of compaction of the test section, field densities were taken with a nuclear gage five days after initial compaction of the binder course. Fifteen readings were taken--five immediately south of the test section, five within the test section, and five immediately north of the test section. The results did indicate an apparent loss of initial compaction within the test section--141 lb/ft^3 (2258.6 kg/m^3) versus 143 lb/ft^3 (2290.6 kg/m^3)--although such a slight difference may not be statistically significant considering all the variables. However, some movement or shoving of the overlay was visually apparent (Figures 7 and 8). This is probably the result of outer wheel path loads shoving the highly tacked overlay outward to the unconfined shoulder edge.

VISUAL OBSERVATIONS

At random intervals of time, observations were made on both fabric installation sites. The polypropylene fabric on U. S. 61 was overlaid with 3-1/2 inches (88.9 mm) of asphaltic concrete and was subject to an ADT per lane of 6500; the nylon fabric on La. 19 was overlaid with 3 inches (76.2 mm) of asphaltic concrete and was subject to an ADT per lane of 3600.

Polypropylene Fabric

In the case of the polypropylene fabric, there was no evidence of any reflection cracking in either the test or the control section after the first six months. After one year, slight hairline cracks appeared in both test and control sections; there was no appreciable difference between the sections. This trend of similarity between test and control sections continued throughout the remaining months of observation. Photographs taken 3-1/2 years after construction confirm surface cracking consistent with the joint separation of the original concrete pavement. This is true to the same extent for both the control and test sections (Figures 9 and 10). There was also evidence of non-joint distress cracks reflecting through (Figures 11 and 12). At the present time, no further significant changes have taken place in either the test or control sections; both sections are performing equally well.

Nylon Fabric

The sections with the nylon fabric under observation were quite similar to those with the polypropylene, in that joint cracks reflected through the overlay both in the control and test sections to the same extent (Figure 13). However, unlike the previously examined U. S. 61 location, the reflection of cracks on La. 19 occurred within the first 4 months (Figures 14-17). Photographs of these and similar transverse cracks were taken to record their growth at 7 months and 15 months after fabric installation and overlay (Figures 18-20). It is apparent from the observations made on these test and control sections that surface cracking of the overlay is consistent with the transverse joint separations of the original concrete. It has been observed, and can be seen in the above designated figures, that the longitudinal joint separation has not been reflected. At the present time, with the exception of reflection cracks, both the control and test sections of La. 19 are performing well.

CONCLUSIONS AND RECOMMENDATIONS

The observations made at the time of application and subsequent performance evaluations for both test fabrics warrant the following conclusions, with the stipulation that they are based upon the application procedures previously cited. No claim is made that these procedures were optimums, although every effort was made to follow the manufacturers' recommendations whenever equipment and/or personnel made this possible.

(1) Both fabrics have neither eliminated reflection cracks nor, when compared to the control sections, reduced the degree of cracking up to this point in time.

(2) Both fabric test sections are performing in a structural manner similar to their control sections.

(3) All control and test sections are still considered to be quite acceptable from a structural standpoint; the presence of cracks in the overlay surfaces, although believed to be a prelude to pavement distress, are as yet nothing more than surface blemishes.

(4) A special fabric applicator not only facilitates the laydown process, but eliminates the danger of over tacking.

(5) A light broadcasting of sand serves to blot any excess tack, thereby allowing traffic on the fabric prior to the overlay; likewise, shoveling of hot mix over the fabric in the wheel paths of the spreader prevents fabric pick-ups.

IT IS RECOMMENDED THAT THE DEPARTMENT CONTINUE TO OBSERVE BOTH FABRIC INSTALLATION SITES TO DETERMINE WHETHER EITHER FABRIC TEST SECTION WILL STRUCTURALLY OUT PERFORM ITS RESPECTIVE CONTROL SECTION WITH THE PASSAGE OF TIME. IT MAY BE IN THIS MODE, RATHER THAN IN THE TOTAL ELIMINATION OF REFLECTION CRACKS, THAT THESE AND SIMILAR FABRICS WILL PROVE BENEFICIAL.

APPENDIX

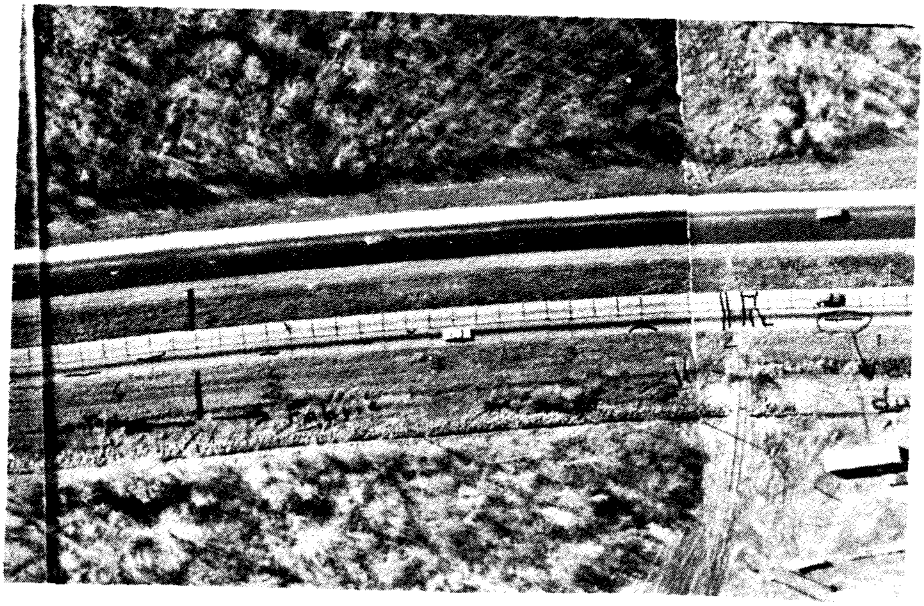

FIGURE I
AERIAL PHOTOGRAPH OF ORIGINAL CONCRETE PAVEMENT - U. S. 6I

FIGURE 2
SPECIAL APPLICATOR USED TO SPREAD POLYPROPYLENE FABRIC

FIGURE 3
UNROLLING OF PRE-SOAKED POLYPROPYLENE FABRIC

FIGURE 4
BLOTTING OF TACKED POLYPROPYLENE FABRIC

FIGURE 5
POLYPROPYLENE TEST SECTION PRIOR TO OVERLAY

FIGURE 6
AERIAL PHOTOGRAPH OF ORIGINAL CONCRETE PAVEMENT - LA. I9

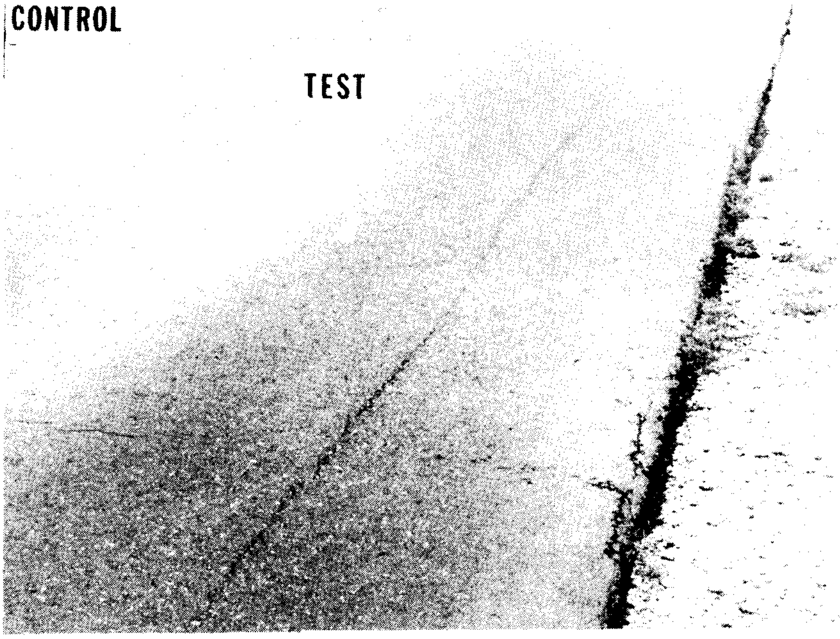

FIGURE 7
LONGITUDINAL CRACK IN OUTER WHEEL PATH - LA. I9

FIGURE 8
SHOVING OF OVERLAY TOWARD SHOULDER EDGE - LA. I9

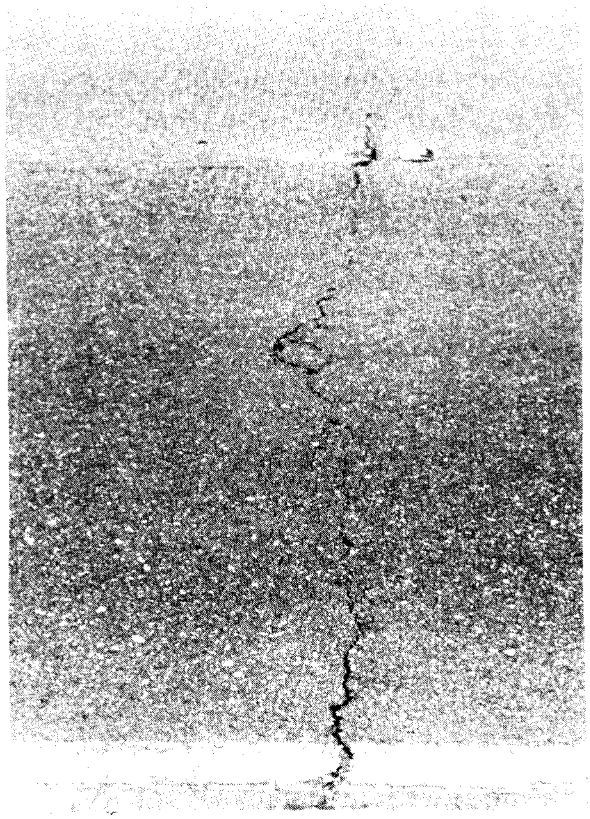

FIGURE 9
REFLECTION OF TRANSVERSE JOINT IN CONTROL SECTION - U. S. 6I

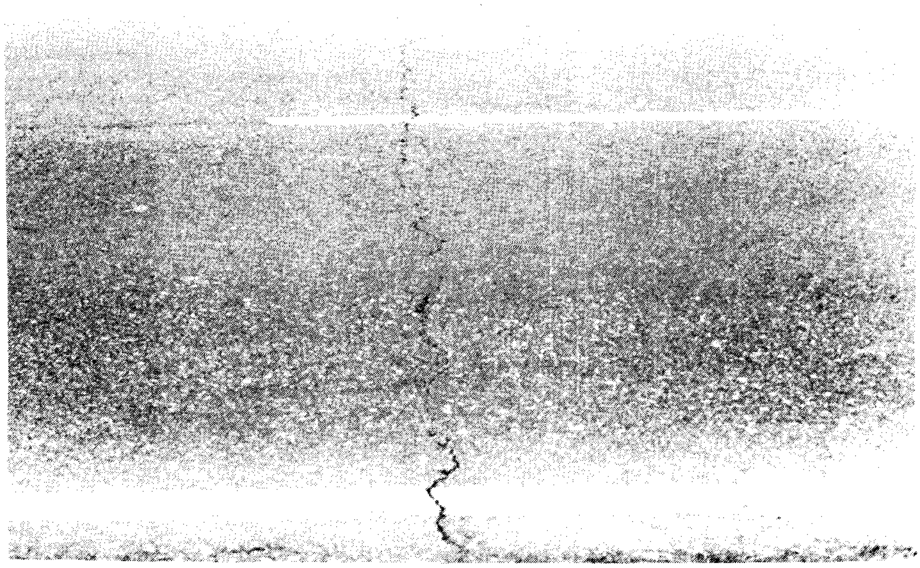

FIGURE 10
REFLECTION OF TRANSVERSE JOINT IN TEST SECTION - U. S. 6I

FIGURE 11
DISTRESSED CONCRETE PAVEMENT IN TEST SECTION - U. S. 61

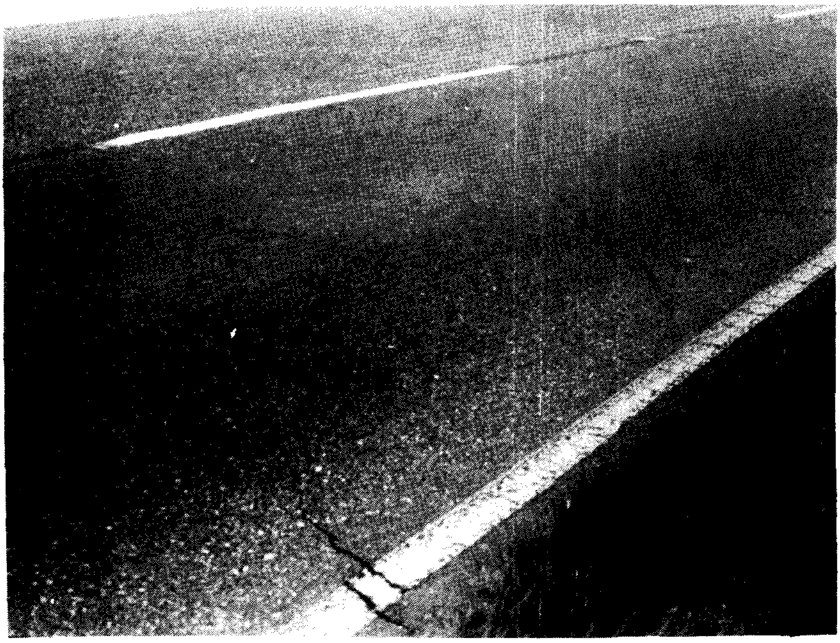

FIGURE 12
REFLECTION OF ORIGINAL CRACK SHOWN ABOVE

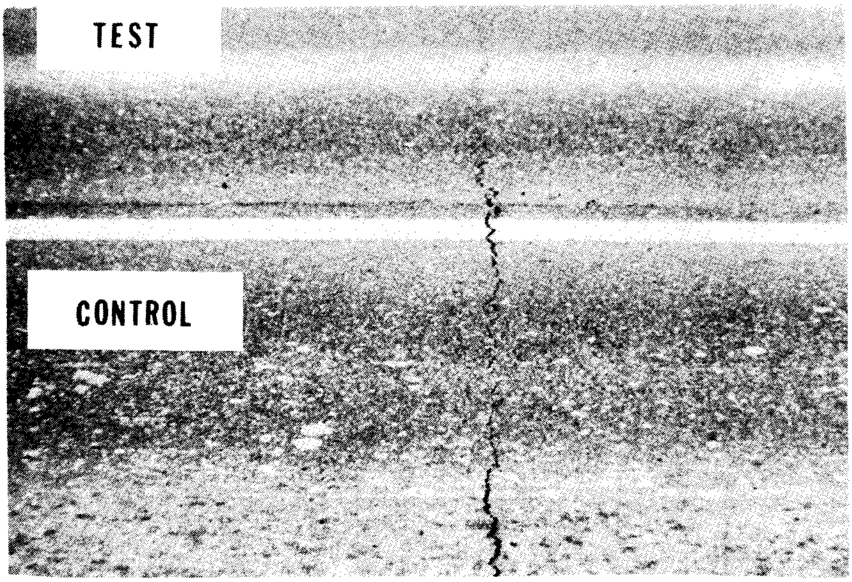

FIGURE I3
REFLECTION OF TRANSVERSE JOINT IN BOTH CONTROL AND TEST SECTION - LA. I9

FIGURE I4
ORIGINAL CRACK PATTERN OF CONTROL AND TEST SECTION - LA. I9

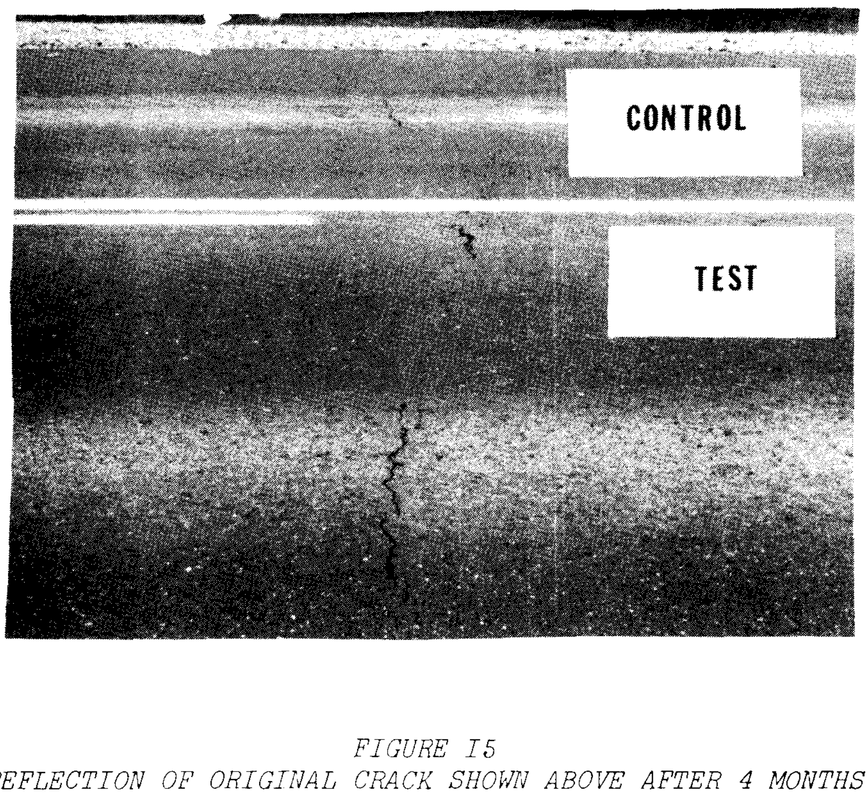

FIGURE I5
REFLECTION OF ORIGINAL CRACK SHOWN ABOVE AFTER 4 MONTHS

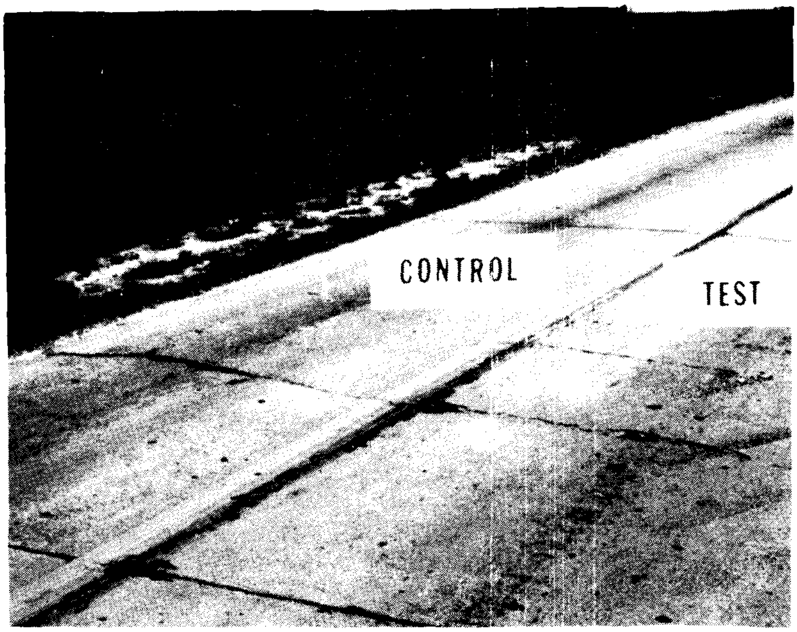

FIGURE I6

ORIGINAL CRACK PATTERN OF CONTROL AND TEST SECTION - LA. I9

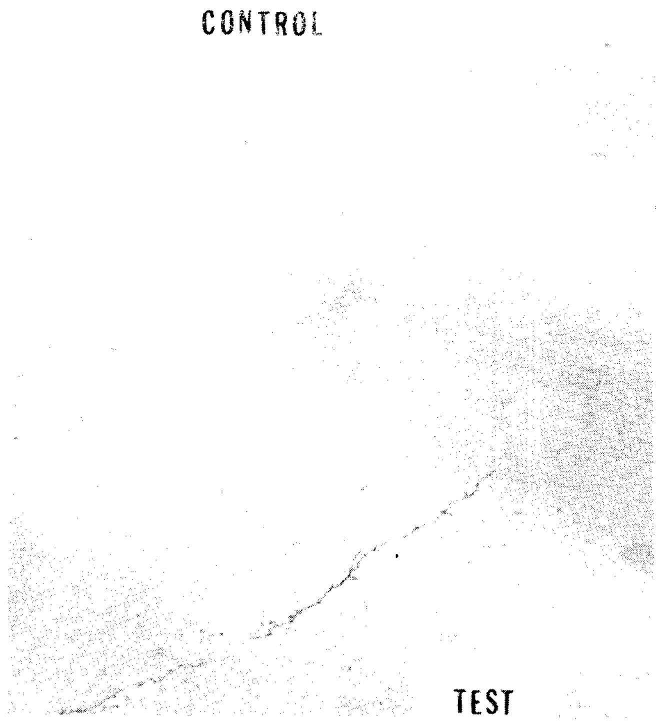

FIGURE I7

REFLECTION OF ORIGINAL CRACK SHOWN ABOVE AFTER 4 MONTHS

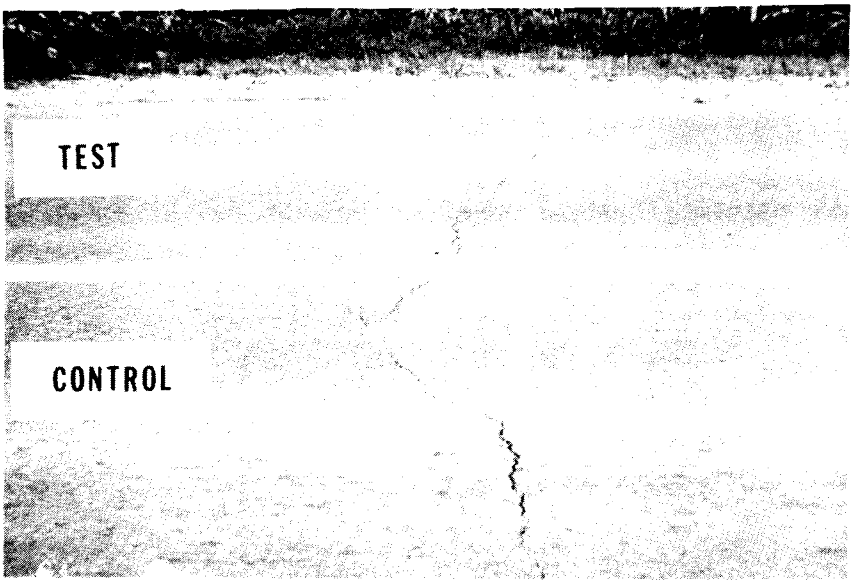

FIGURE I8
REFLECTION OF FIGURE I4 AND I5 CRACK AFTER I5 MONTHS - LA. I9

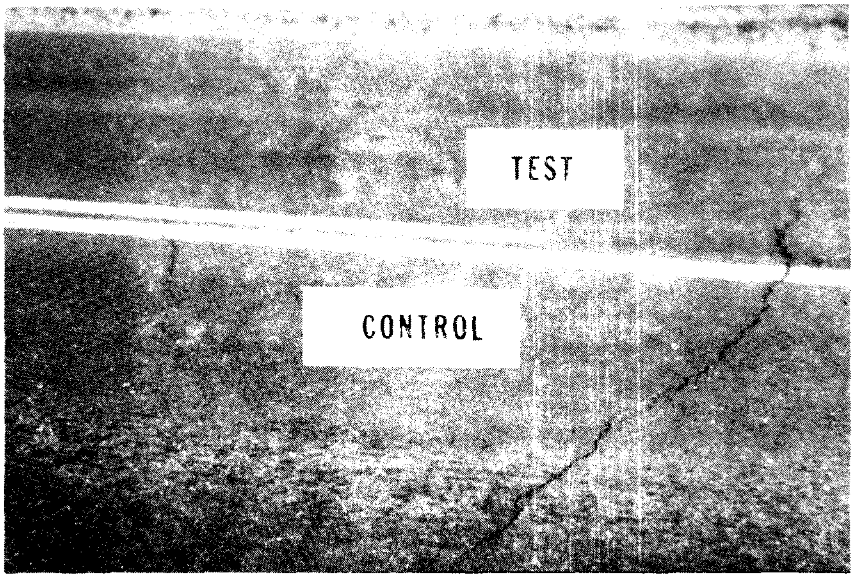

FIGURE I9
REFLECTION OF FIGURE I6 AND I7 CRACK AFTER 7 MONTHS - LA. I9

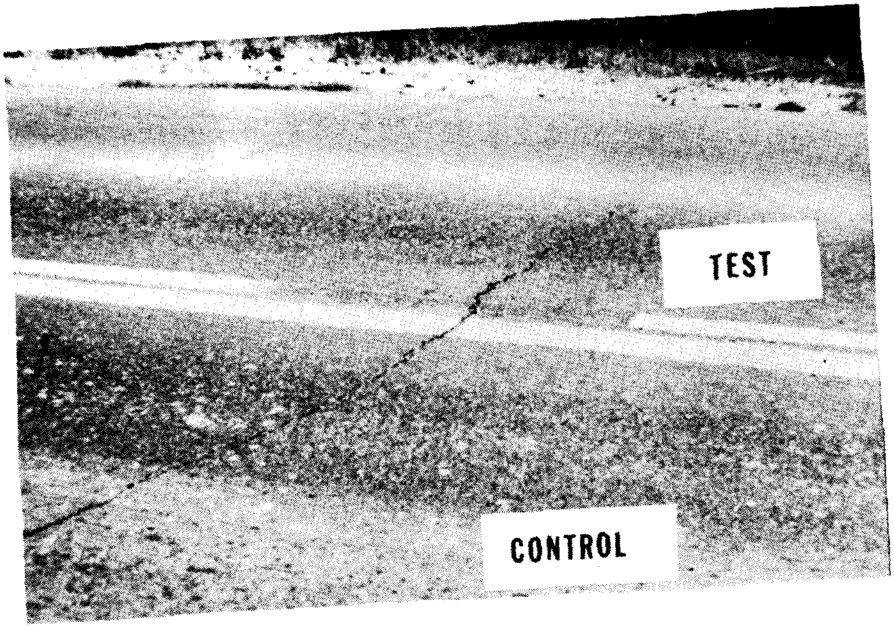

FIGURE 20
REFLECTION OF FIGURE I6 AND I7 CRACK AFTER I5 MONTHS - LA. I9