COMMONWEALTH OF KENTUCKY
DEPARTMENT OF HIGHWAYS
FRANKFORT

HENRY WARD
COMMISSIONER OF HIGHWAYS

ADDRESS REPLY TO
DEPARTMENT OF HIGHWAYS
MATERIALS RESEARCH LABORATORY
132 GRAHAM AVENUE
LEXINGTON 29, KENTUCKY

May 7, 1963

B.2.2.14.

MEMO TO: W. B. Drake
Assistant State Highway Engineer

SUBJECT: Performance Report, Class I, Type B, Initial Treatment, PAC-9; Butler County, Morgantown-Woodbury Road; RS 16-1516, RS 16-516, RS 16-326

Attached, hereto, is an up-to-date performance report on the above-named project. The report has been prepared by Robert L. Florence, Research Engineer; and, as you will note, it supplements his earlier report which pertains to the construction and early performance of the project. The combined reports, thus include the whole objectives and results from the project.

Your attention is particularly invited to the summary at the end of the performance report. The conclusions offered there are based upon our joint evaluation of performance. You will note that we question the use of large excesses of asphalt -- only from the standpoint of flushing or bleeding. One to 1-1/2 percent in excess of optimum seems to represent a more realistic limit for this particular mix. All of the mixes were more stable than we expected them to be, and it seems unlikely that the flexibility or deformability of the mix can be vastly increased by merely increasing the asphalt content alone. In other words, this mix will hold only a specific amount of asphalt. Perhaps a much higher proportion of fines and dust would extend its capacity to hold the bitumen and also increase its flexibility -- and to lower its stability.

I do not believe that we achieved all of the features which we were seeking in the mix; and I should make some mention of the fact that when the Type B mixes are used for initial treatment the job-mix formula would normally stipulate 5.8 to 6.0 percent asphalt anyhow. On this basis, I would surmise that little additional benefit is to be derived from this kind of mix unless it is modified in a way that will increase its capacity to hold the bitumen. Further speculation in this vein will inevitably lead us in the direction of highly sanded, mastic-type mixes.

Respectfully submitted,

Jas. H. Havens

Jas. H. Havens
Director of Research

JHH:dl
Encs.
cc: Research Committee Members
Bureau of Public Roads (3)

April 26, 1963

B.2.2.14.

MEMORANDUM

TO: Jas. H. Havens
Director of Research

FROM: R. L. Florence RLF
Research Engineer

SUBJECT: Inspection-Performance Report; Plant-Mix, Initial Treatment; Morgantown-Woodbury Road, Butler County

This report supplements my report of February 16, 1962*, which pertained to the construction and early performance of the above-named project -- a copy of which is attached, hereto, for your convenient reference.

The experimental pavement sections have now been in service through two winters -- during the second of which some of the lowest temperatures in the history of the State were recorded. Several inspections have been made during the past year. Only a small amount of damage occurred during the first winter and spring. In the spring of 1962, flood waters covered the road at two locations but caused no apparent damage. As anticipated, the bituminous binder flushed or bled to the surface to a varying

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* Florence, R. L., "Progress Report Class I, Type B, Plant-Mix Initial Treatment, PAC-9," Intra-Departmental Report, February, 1962.

degree in some of the sections during the summer months, and limestone sand was scattered over some portions in an effort to blot up the excess.

In addition to the gradation and extraction data and the stability data given in Tables I and II of the earlier report, a Marshall mix-design series has been performed on aggregates sampled from the project during its construction; and the normal criterion as applied thereto indicated an optimum asphalt content of 5.0 percent. (Note: PAC-5 asphalt was used in these tests rather than PAC-9 which was used on the job.) It may be noted from the graphs of these results, which are included here as Fig. 1, that all of the mixes used on the project were essentially at or above the zero air-voids condition. This was, in fact, the condition sought as the principal experimental feature of the project. However, inasmuch as all of the sections were similar in this respect, the only differences among the sections is in the amount of excess asphalt. Therefore, comparisons of performance are limited to that range of asphalt contents only.

In further regard to flushing and bleeding, the performance of the sections may be summarized as follows:

6.0% Asphalt - Flushing has been rather spotty (See Figs. 2 and 3)

6.5% Asphalt - Flushing has occurred in the wheel tracks (See Fig. 4)

7.0% Asphalt - Excess asphalt has bled to the surface throughout the entire section (See Figs. 3 and 5)

A detailed inspection was made of the project in September and October, 1962, and the locations of failures in the pavement are shown in

black in Fig. 6. All of the failed areas except one were small pot-holes; the one exception extended across the full width of the surface (Fig. 7). This failure was located in a cut-section near the center of the project. On 8,130 lane-feet of surface which was placed at an asphalt content of 6.0 percent, there were eight failures (pot-holes) which required patching; on 13,965 lane-feet which was laid at 6.5 percent asphalt, two pot-holes and one large failed area required patching; and, in 6,090 lane-feet of surface laid at 7.0 percent asphalt, only one rather large pot-hole needed patching. The project was inspected at the end of December, 1962, and it was noted that no additional failures had occurred.

An inspection was made of the pavement on April 8, 1963, and it was found that fairly extensive damage to the pavement had resulted from the severe weather in January and February. Failures had occurred in all of the test sections, and their locations and types are diagrammed, in red, in Fig. 6. No attempt has been made to show every crack in the pavement, but patches and their general location are shown.

Near the center of the project the road crosses a hill and is in a cut-section. Within this 0.3 mile stretch of roadway, there is considerable alligator-type cracking along the centerline and in the outside wheel-track of the southbound lane (Fig. 8). This cracking is located in a section of surface laid at 6.5 percent asphalt and continues into a section laid at 7.0 percent asphalt. Pieces of the pavement were beginning to ravel out. One failure within the cut-section extends across the full width of pavement and is approximately 30 ft. long (Fig. 9). The asphalt content of the surface was 7.0 percent. This failure is located close to

a similar one which occurred the previous winter in a section laid at 6.5 percent asphalt (Fig. 7). These failures, of course, are attributable to instability of the base and subgrade and are rather typical of performance in cut-sections where drainage is poor and where the subgrade is susceptible to frost damage.

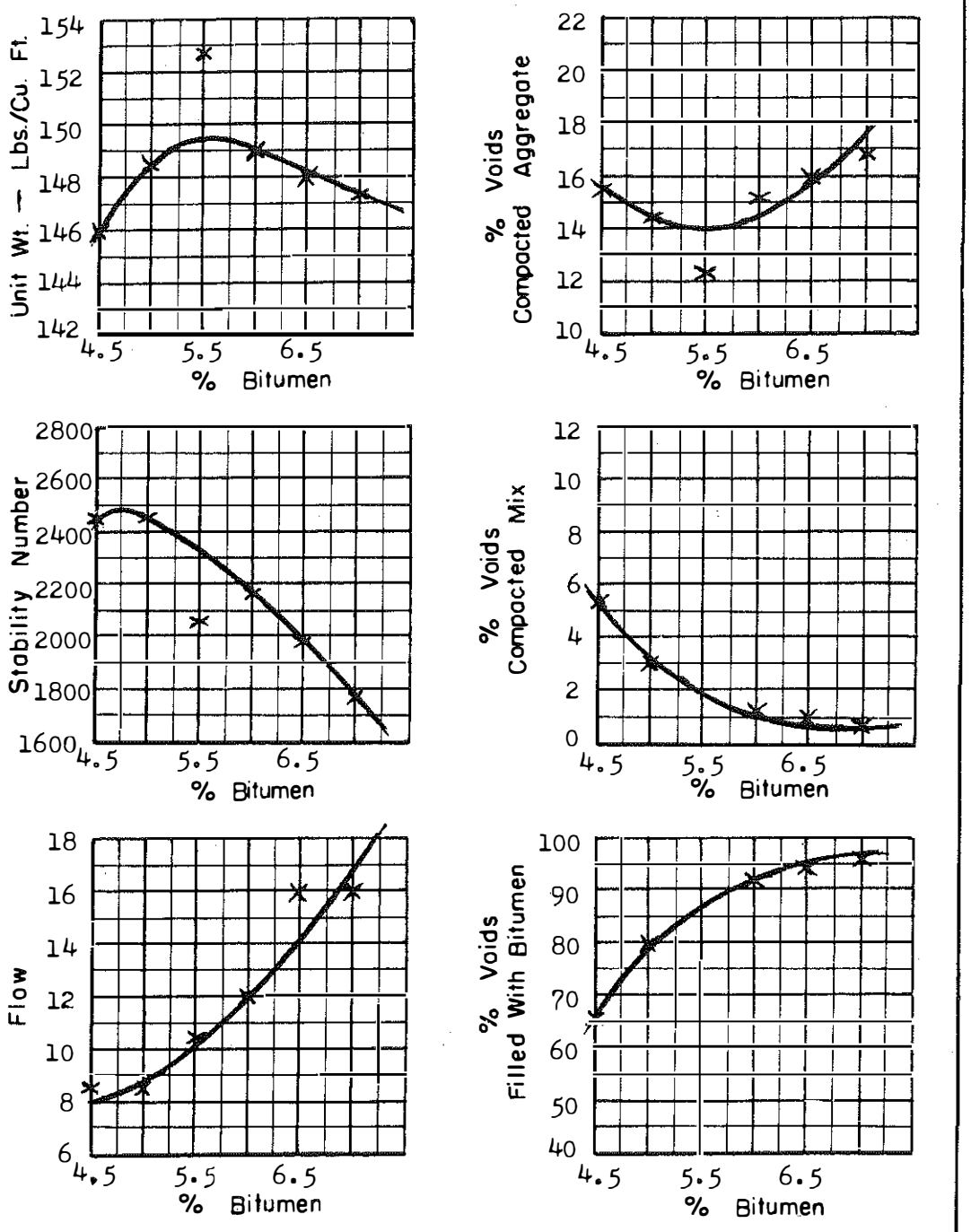
The only other section in which an extensive amount of cracking has occurred is located on a fill section which crosses bottom land approximately 1.1 miles from the southern terminus of the project. The surface there contains 6.5 percent asphalt. Fine, alligator cracking has occurred along the centerline for a distance of 0.2 miles; however, the surface was not raveling.

Pot-holes and cracking, of a limited extent, are very noticeable in a section of the surface near the city limits of Morgantown (Fig. 10). The failures there occurred mostly during the winter of 1961-62, and most of them are located over an outcrop of ledge rock. The surface at this location contains 6.0 percent asphalt.

In summary, the performance of the project thus far does not indicate any particular advantages from the use of 7.0 percent bitumen content; whereas, the bleeding which has resulted therefrom might be considered to be a distinct disadvantage from the standpoint of slipperiness. All of the mixes proved to have much higher stabilities than was anticipated -- understanding, of course, that greater deformability was sought in the mixes even at considerable sacrifice in stability. It seems that the performance of the sections is somewhat over-shadowed by the usual

quota of weak places in the road-bed; whereas, if the obvious weak places are discounted or reconciled in that way, the performances of the sections seem to be quite good. On this basis, asphalt contents above that required to fill the voids in the mixture do not seem to be justified. This is approximately one percent over optimum and represents about the maximum capacity of this particular mix.

JHH:dl
Encs.



TEST DATA	
Opt. % Bit. 5.0	Unit Wt. 148.4
Stability No. 2440	Flow 8.5
% Voids Comp. Agg. 14.4	
% Voids Comp. Mix. 2.9	
% Voids Filled With Bit. 79.9	
Chart B-3	February, 1955

HIGHWAY MATERIALS RESEARCH LABORATORY
LEXINGTON, KENTUCKY

MARSHALL STABILITY TEST

Mix No. _____ Date May 24,1962
Project Butler Co. Initial Treatment
Aggregate Gary Bros. -Limestone
Bitumen PAC-5, American Bitumals

Fig. 1. Marshall Test Property Curves.

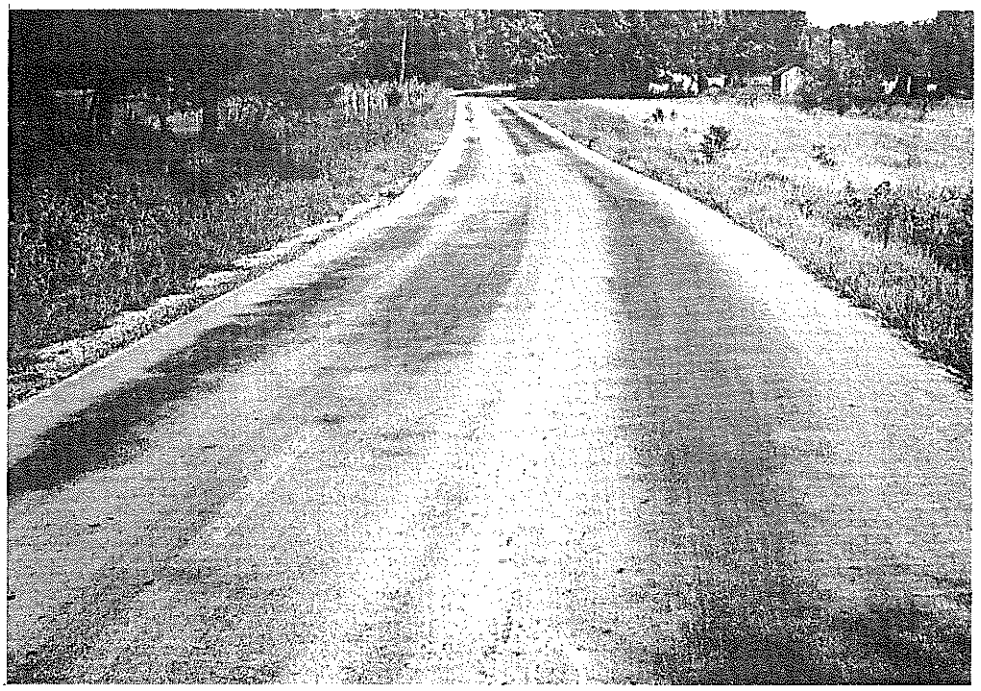


Fig. 4. Section of Surface Containing 6.5 Percent Asphalt (9-13-62).

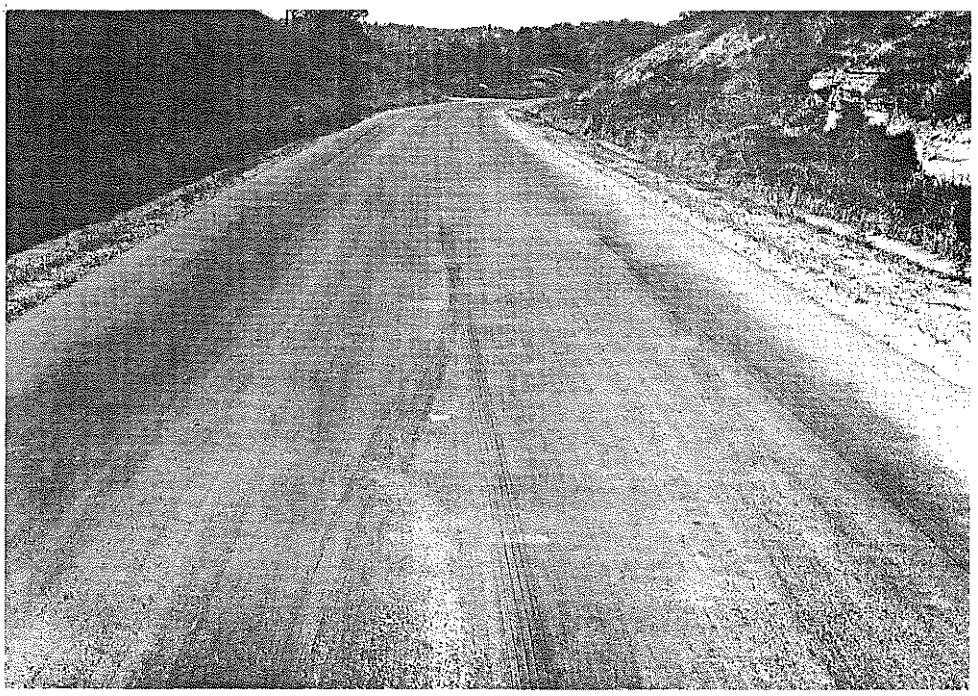


Fig. 5. Section of Surface Containing 7.0 Percent Asphalt (9-13-62).

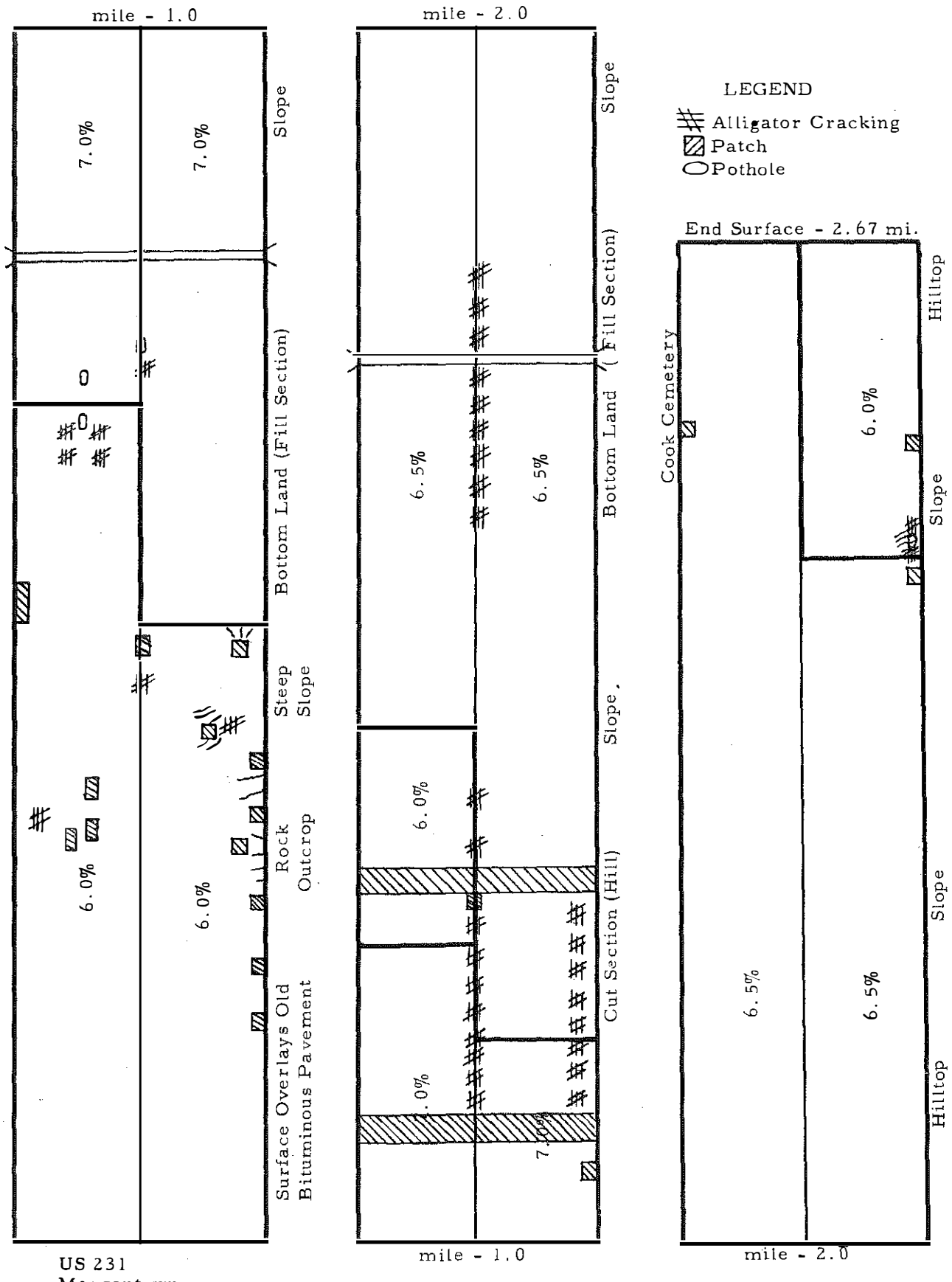


Fig. 6. Diagram Indicating Location of Failures. The failures which occurred prior to October, 1962, are shown in black. The failures indicated in red were noted on the inspection of April 8, 1963.

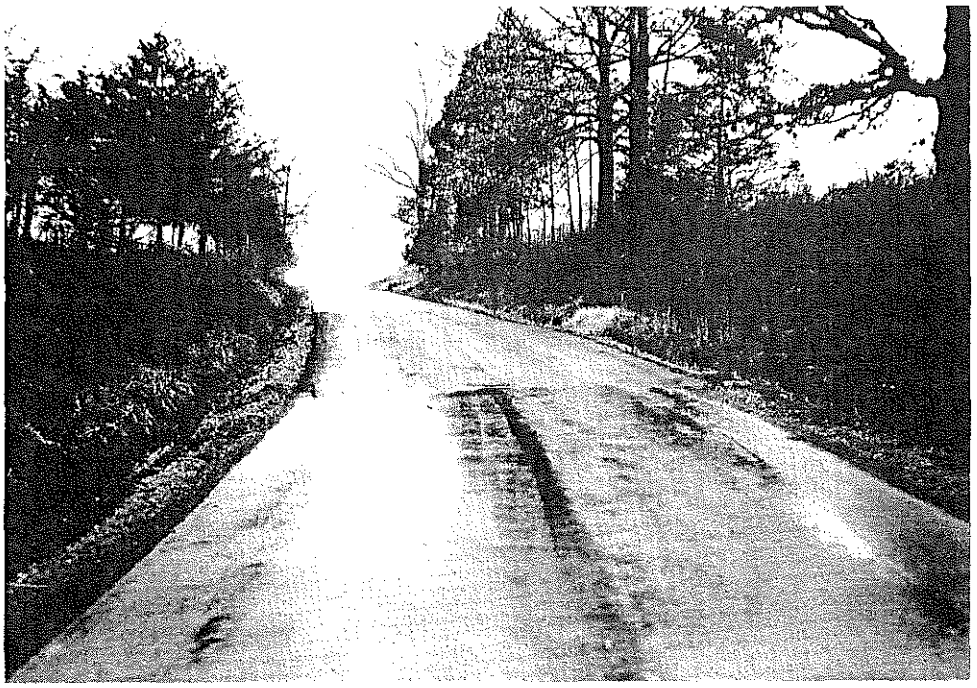


Fig. 7. Large Failed Area in a Cut-Section. The failure occurred during the winter of 1961-62. The surface contains 6.5 percent asphalt (1-7-63).

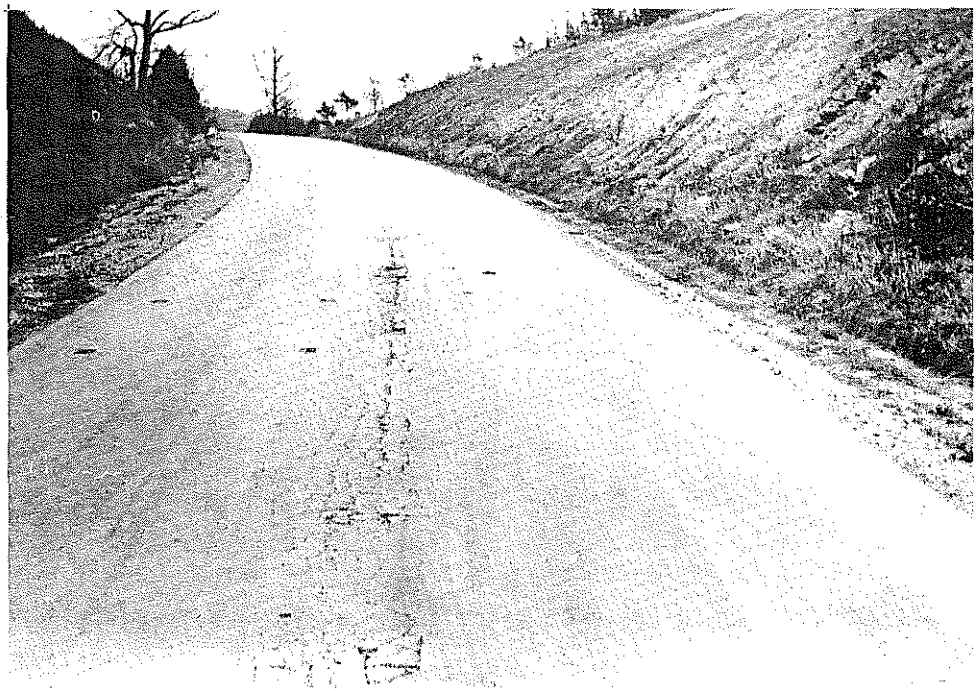


Fig. 8. Alligator Cracking Along the Centerline and Outside Wheel-Track of Southbound Lane. The surface contains 7.0 percent asphalt. Cracking, along the centerline joint, was the most extensive type of failure which occurred on the project (4-8-63).

Fig. 9. Large Failure in Cut-Section. The failure occurred during the winter of 1962-63, and is located near the failure shown in Fig. 7. The surface contains 7.0 percent asphalt (4-8-63).

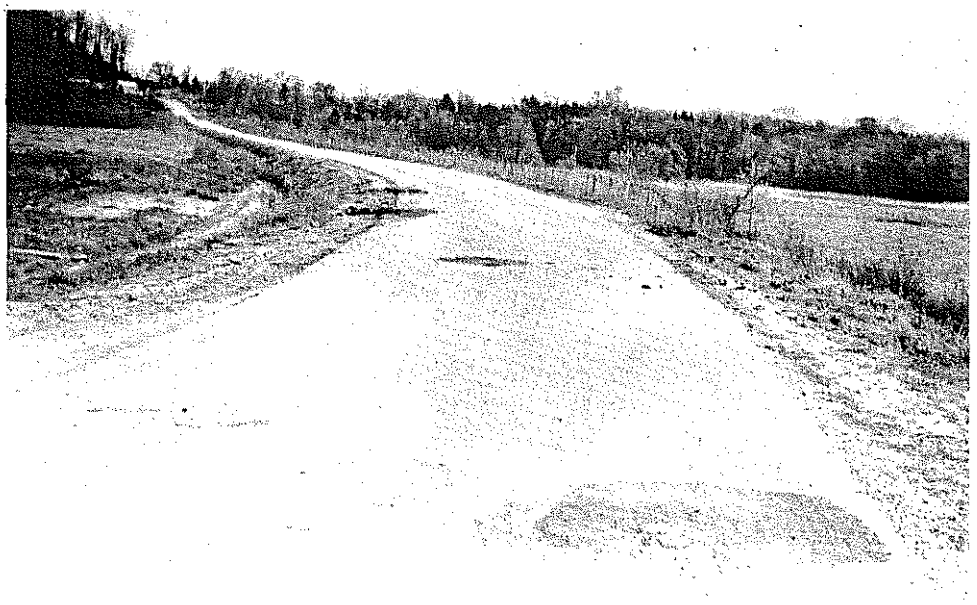


Fig. 10. Small Failures (Pot-Holes) in Surface Containing 6.0 Percent Asphalt. The right lane, in the background, contains 7.0 percent asphalt (4-8-63).