COMMONWEALTH OF KENTUCKY
DEPARTMENT OF HIGHWAYS
FRANKFORT

HENRY WARD
COMMISSIONER OF HIGHWAYS

April 2, 1963

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

B.2.1.
D.1.7.

MEMO TO: A. O. Neiser
Assistant State Highway Engineer

Attached is a memorandum report on "Slurry Seal Maintenance and Test Applications of 1962." This work was mentioned at the March Meeting of the Research Committee and no plans were made to prepare a report for distribution then.

In view of the renewed interest in the Department for this type seal coat and the fact that the Specifications Committee is presently considering a Special Specification for Slurry Seal. We have reproduced the subject report for distribution to the Research Committee and other interested Department personnel.

I am of the opinion that this type of seal coat application has a place in the Department's program. Bituminous Interstate shoulders, medium traffic-volume roads, parking areas, rest areas, and service areas would be some of the facilities that this type maintenance could be most advantageously used. The new slurry seal coat has a pleasing appearance and should normally serve for a period of from two to five years. No structural increase in the pavement's load-carrying capacity should be attributed to this type surfacing.

Respectfully submitted

W. B. Drake
Director of Research

WBD:dl
Enc.
cc: Research Committee Members
Bureau of Public Roads (3)

April 4, 1963

B.2.1.

MEMORANDUM

TO: W. B. Drake
Director of Research

FROM: R. L. Florence RLF
Research Engineer

SUBJECT: Slurry Seal Maintenance and Test Applications of 1962

During the past year, slurry seals have been placed on the service areas of the Kentucky Turnpike, a section of South Third Street in Louisville, and a section of the Beuchel By-Pass (US 31-E). Several small demonstration or "test" applications of slurry seal have also been laid. All of the slurry applications were made by the Louisville Asphalt Company using a Young Slurry Machine. As The Department is presently writing a slurry seal specification, it will be beneficial to observe the performance of these slurries and of any that are placed in the future with local materials.

Slurry mixtures basically consist of graded fine aggregate (minus 3/8-in. material), mixing grade emulsified asphalt, and water. In general the emulsion content is determined by the fineness of the aggregate. The finer aggregates require higher emulsion contents for complete particle coating. Water is added to aid in mixing and to give the slurry a free-flowing consistency.

Fillers are often added to the slurries to maintain a homogeneous mixture. Without the proper amount of minus 200 sieve material, the sand-size particles and liquid will separate and not spread properly. Stone dust, portland cement, and hydrated lime are commonly used fillers. Active fillers such as portland cement or hydrated lime can affect the "setting time" of the slurry. These active fillers may also act as anti-stripping agents and aid in coating aggregates with hydrophilic qualities.

The "setting time" of the slurry is dependent upon several variables such as relative humidity, filler activity, type and quantity of emulsifying agents, aggregate, thickness of application, and the condition of the surface to be sealed. Thus, it may be prudent to lay a small trial area prior to attempting a large sealing project with untried materials. After sufficient experience has been gained with local materials, it should be possible to eliminate the use of a trial area.

A large proportion of slurry seal work is being done by various agencies with transit-mix trucks and "home-made" spreader-boxes. The materials are combined at a central batching plant by proportioning water, aggregate, and emulsion into transit-mix trucks. The transit-mix truck mixes the slurry and then deposits the slurry into the specially constructed spreader-box. The spreader-box is equipped with a strike-off squeegee made of heavy rubber belting. Normally, the spreader-box is one full lane in width and is towed by the transit-mix truck. Usually the surface is wetted just prior to laying the slurry. This aids in laying the slurry smoothly and promotes good adhesion to the surface. Often a tack coat is applied, prior to sealing, if the existing surface is badly weathered. The tack consists of one part emulsion in one to five parts water. The tack coats are applied at an approximate rate of 0.1 gal. per sq. yd.

The texture of the seal is primarily dependent upon the coarsest aggregate size. The greatest divergence in various slurry aggregate grading specifications appears to be the allowable top-size aggregate particle. If the top-size particle is too large, it is caught by the squeegee and streaks the seal. A smaller top-size particle results in less streaking, but the aggregate cost may be higher due to increased processing. Of course, the rate of application is determined primarily by the largest aggregate particle.

The slurry-mixtures were first developed by the Road Department of Los Angeles County, California (1). The mixtures have been applied to cracked and weathered surfaces of high traffic volume roads with reportedly good results. It is also claimed that slurry seal will provide a skid-resistant surface when proper aggregates and application techniques are used (2). In one season's program the City of Fresno, California, laid 195,000 sq. yds. of slurry seal at a total cost of 8.8 cents per sq. yd. using city crews. The life expectancy of the slurries have been reported at two to five years depending on seal thickness and traffic density.

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(1) Hokin, F., "Slurry", Rural Roads, June, 1960.

(2) Stenman, A., "Ten Steps for Successful Slurry Sealing," Public Works, Vol. 91, No. 5, May, 1960.

In August, 1962, the Maintenance Division in conjunction with the Louisville Asphalt Company sealed the Kentucky Turnpike service areas at Lebanon Junction and Shepherdsville. The Maintenance Division supplied the materials, cleaned the surface, and controlled traffic. The slurry was laid by the Louisville Asphalt Company, using the Young Slurry Machine.

The Young Slurry Machine is a permanently truck-mounted unit which basically consists of a large aggregate hopper, water and emulsion storage tanks, filler hopper, mixing unit, and a spreader-box (Fig. 1). The machine works on a continuous mix principle. Aggregate is metered to the mixer by a belt feed (volumetric control). Each time the belt makes one revolution, a pump delivers one gallon of emulsion to the mixer. Filler is fed continuously to the mixer from the filler hopper. The amount of filler delivered can be varied by interchangeable cogs. Water is added to the mixer at a rate to give the slurry the proper laying consistency. The slurry flows continuously through the mixer and into the spreader-box. The spreader-box is equipped with baffles to spread the slurry across its full width (Fig. 3). A spray-bar is mounted beneath the truck just in front of the spreader-box. The spray-bar wets the pavement with approximately 0.05 gal. per sq. yd.

To test various blends of the materials available for sealing the service areas, trial sections were laid on the Kentucky State Fairgrounds' parking lot. On August 7, a test strip was laid containing manufactured limestone sand from the Lambert Brothers Quarry at Okolona, and 16.6 percent SS-1h asphalt emulsion (Fig. 5). The following day a

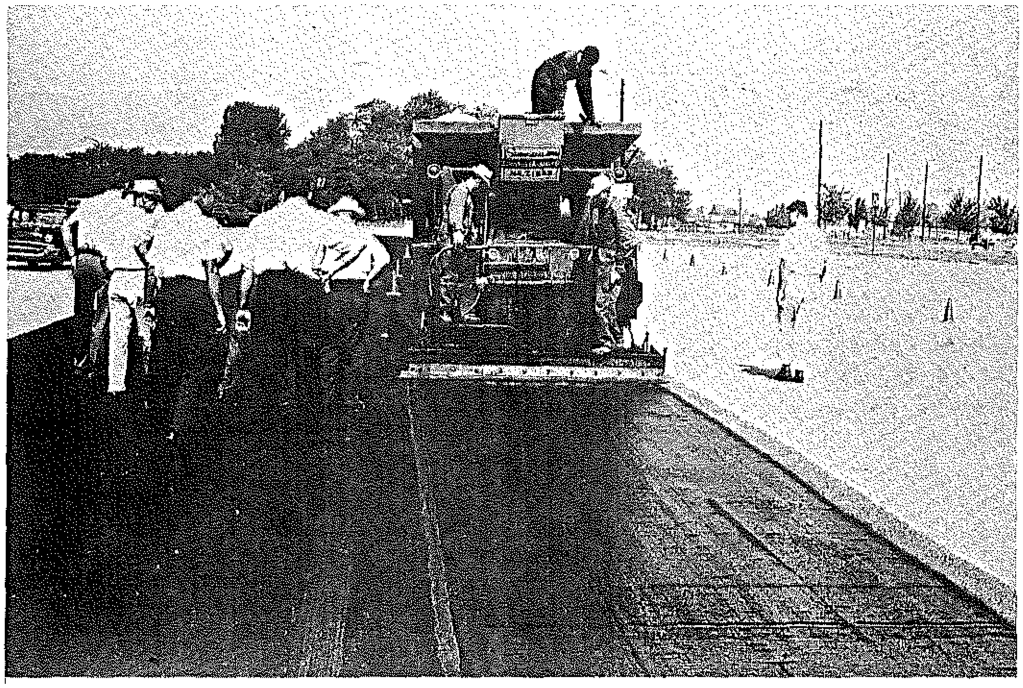

Fig. 2. Kentucky State Fairgrounds. The slurry being laid consists of blended sand, 14.0 percent SS-1h, and 1.25 percent portland cement. Note the streaks in the slurry which were caused by large aggregate particles caught by the squeegee.

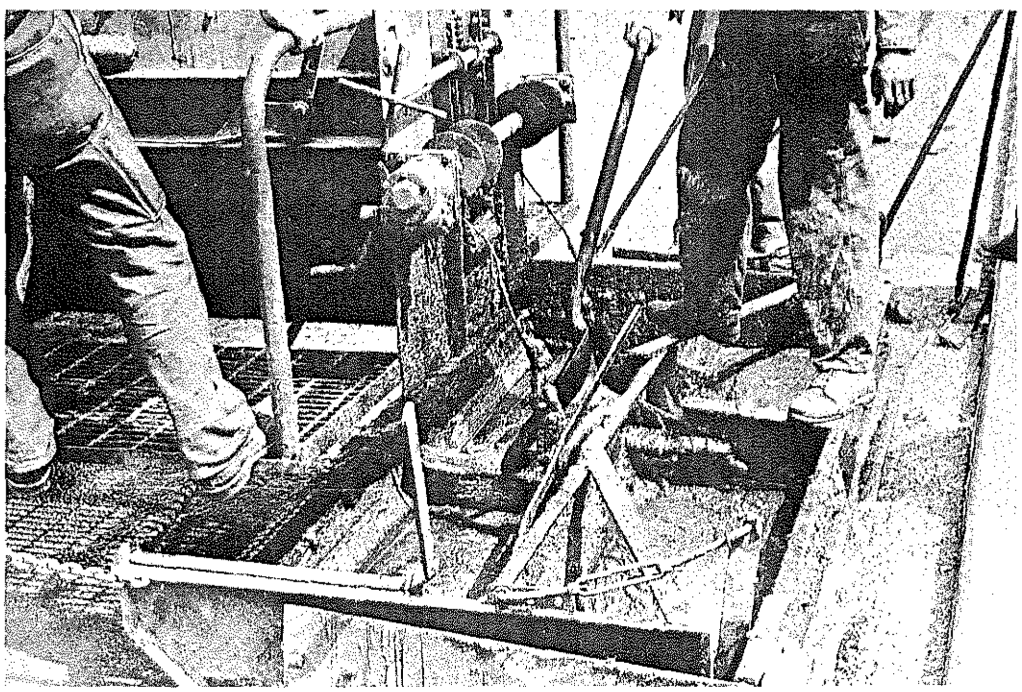

Fig. 3. Close-Up of Spreader-Box. Note the two-compartment construction to insure that the slurry will be spread across the full width of the squeegee.

Fig. 4. Kentucky State Fairgrounds. The laborer is smoothing a streak caused by an over-sized aggregate particle. The dark stripe next to the fresh slurry is water from the spray-bar beneath the slurry machine.

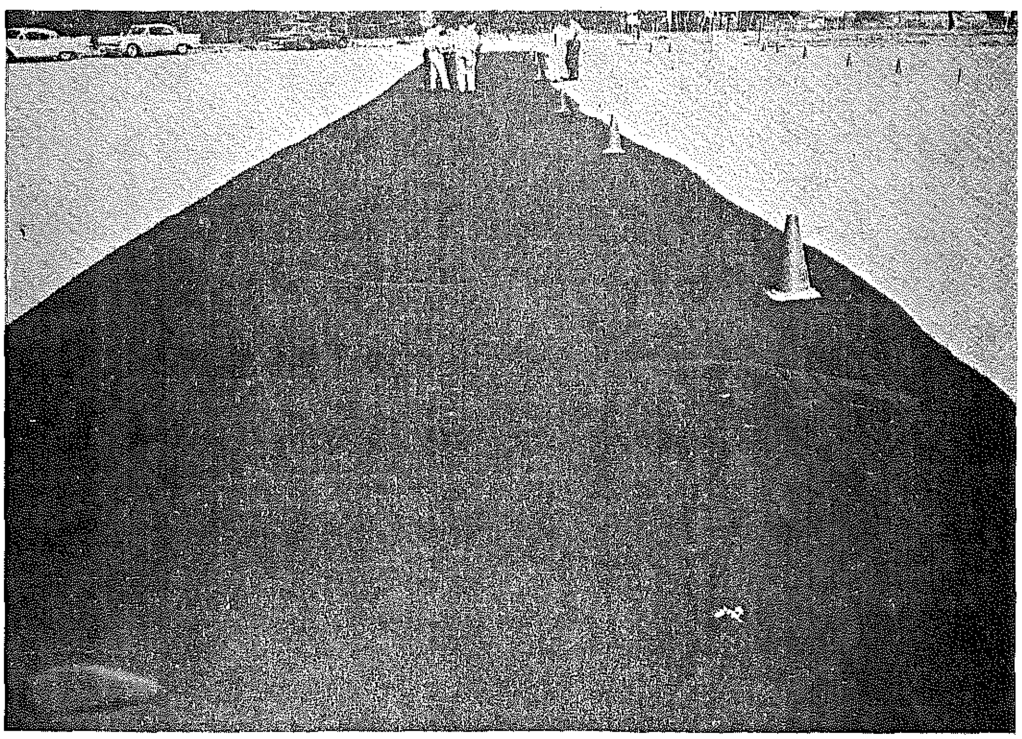

Fig. 5. Kentucky State Fairgrounds. This section is composed of limestone aggregate and 16.6 percent SS-1h. Note the tire track in the small depressed area where a greater thickness of slurry was laid.

slurry containing equal parts of the limestone sand and a medium Ohio River sand, 1.25 percent portland cement, and 14.0 percent SS-1h was laid. A strip was also laid containing equal parts of the sands, 2.5 percent portland cement, and 12.0 percent SS-1h. It was noted that paint stripes reflected through the fresh slurry, due to lower water absorption of the paint stripe surface (Fig. 7). Several times the fresh slurry was streaked by large aggregate particles caught by the squeegee. The slurry which fills deep depressions takes longer to cure or "set up" than the surrounding surface.

On the basis of the appearance of the trial sections, a mixture containing the blended sands, 1.25 percent portland cement, and 16.0 percent SS-1h was selected for sealing the service areas. The blended sand aggregate made a fine-textured surface; and, it was believed the natural sand would contribute to a skid-resistant surface.

On August 20, the Lebanon Junction Service Area was sealed with a slurry of the latter composition. The material laid well; but, it was noted that the slurry did not appear uniform in color and that over-all the seal appeared lean. The emulsion content was raised to 18.0 percent for the last area to be sealed at Lebanon Junction (Fig. 11).

At the Shepherdsville Service Area, the emulsion content was raised to 18.0 percent for the whole area. The aggregate blend and filler content were the same as used at Lebanon Junction. It was found that a more uniform appearing surface resulted when the slurry machine operated as continously as possible. When the machine is stopped and

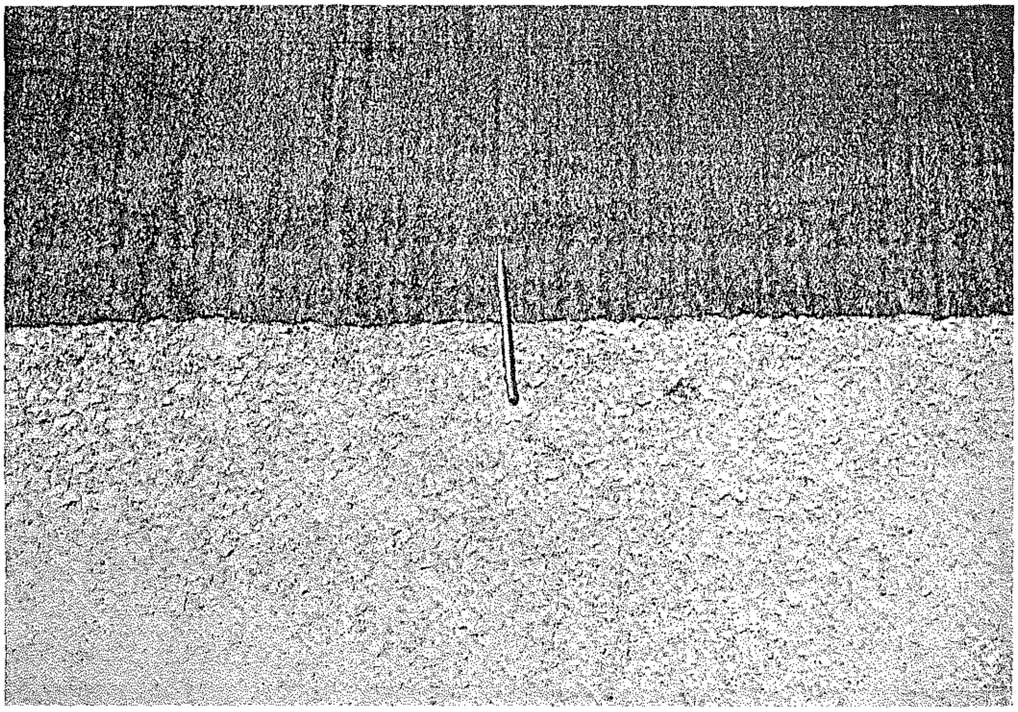

Fig. 6. Kentucky State Fairgrounds. The photograph shows the contrast of the sealed and un-sealed pavement.

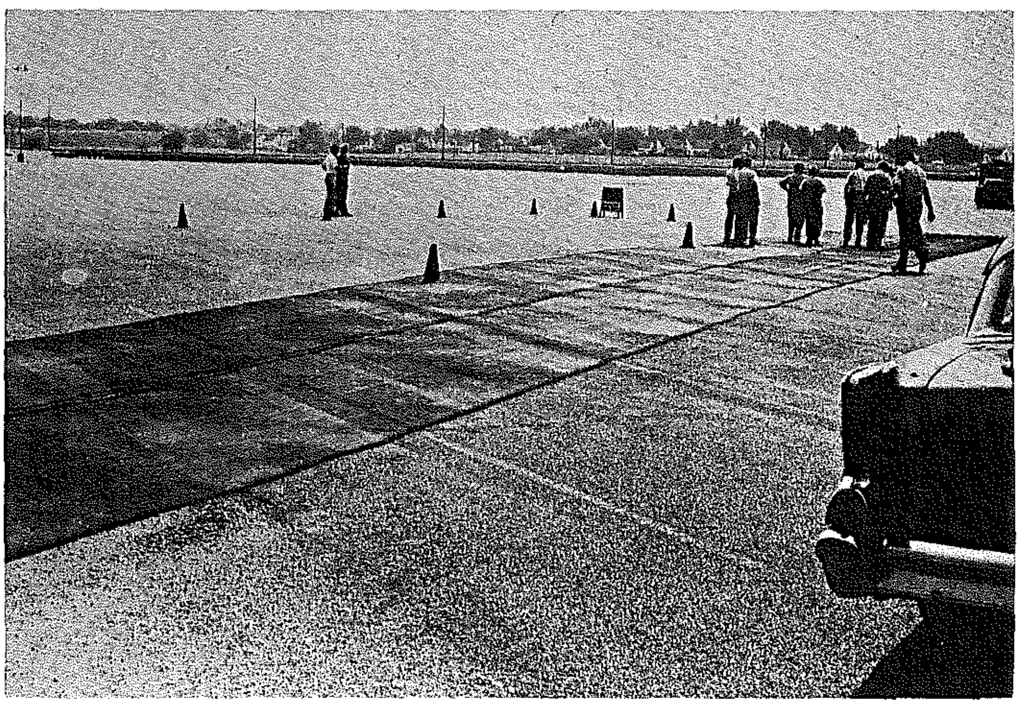

Fig. 7. Kentucky State Fairgrounds. Note that the paint stripes reflect through the cured slurry seal. This is due to lower absorption of the paint stripe surface.

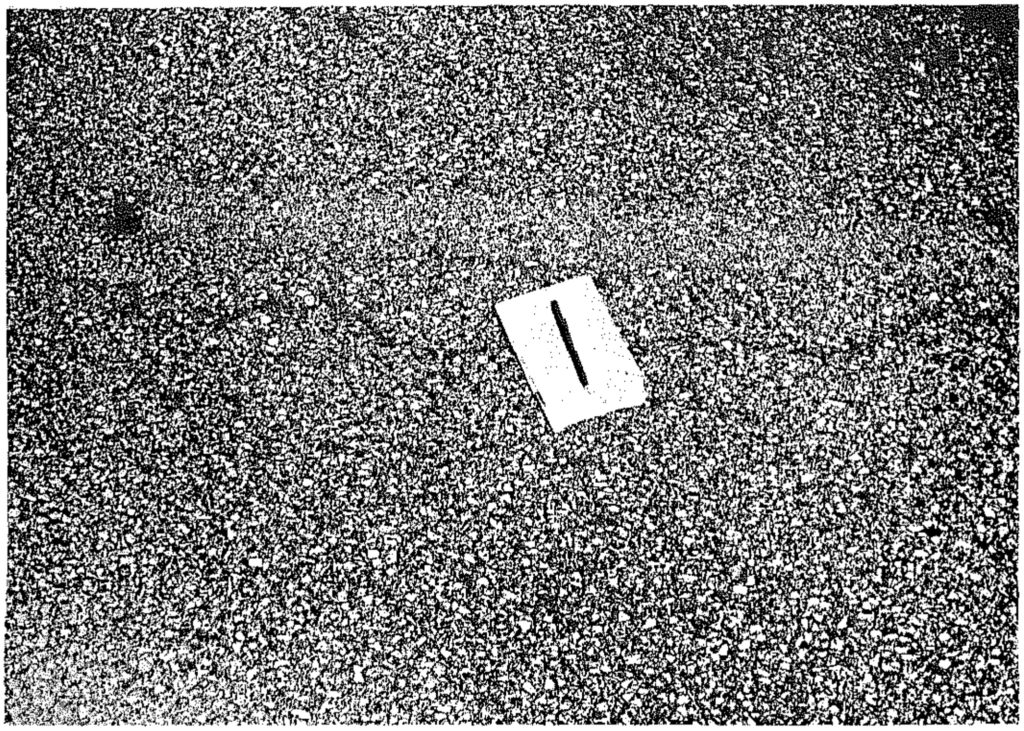

Fig. 8. Kentucky State Fairgrounds. Fine cracks were very apparent in the surface before sealing.

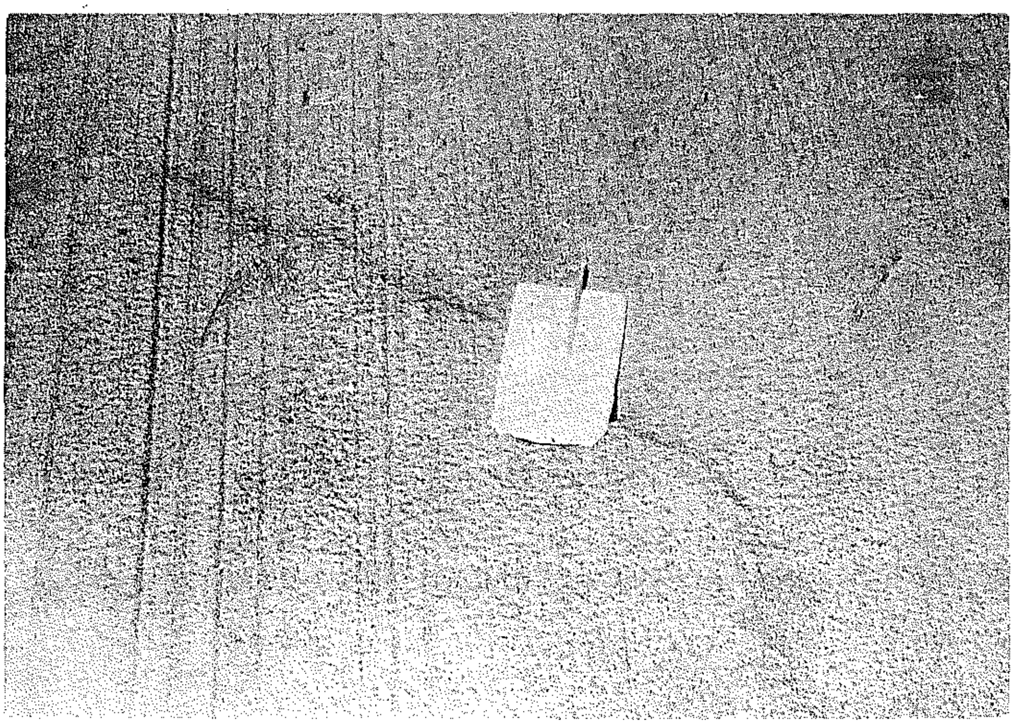

Fig. 9. Kentucky State Fairgrounds. The photograph shows the appearance of a fine crack immediately after sealing.

Fig. 10. Kentucky State Fairgrounds. The section containing all limestone aggregate and 16.6 percent SS-1h is on the left in the background. The section composed of blended sand, 1.25 percent portland cement, and 14.0 percent SS-1h is in the background between traffic hats. The section composed of blended sand, 12.0 percent SS-1h, and 2.5 percent portland cement is in the foreground.

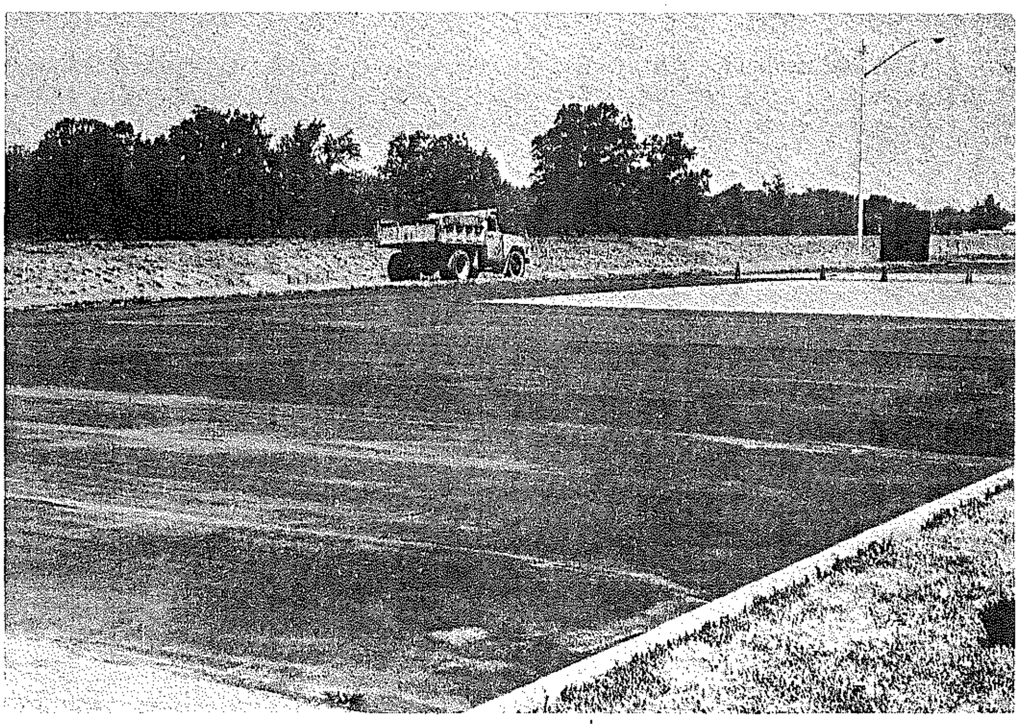

Fig. 11. Lebanon Junction Service Area. This section of the service area was laid at an emulsion content of 18.0 percent.

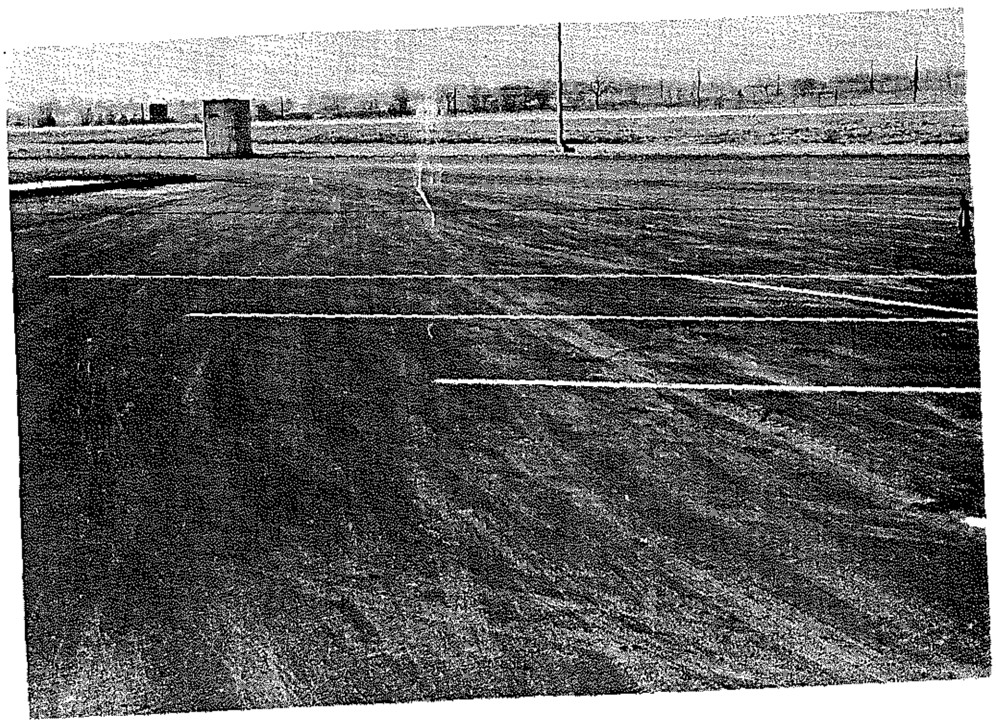

Fig. 12. Shepherdsville Service Area. The photograph was taken approximately four months after sealing. Fine cracks had reflected through the seal at the time the photograph was taken.

the spreader-box is being filled, there appears to be considerable variation in the slurry as it is discharged from the mixer.

Samples of the slurry were taken at both service areas for laboratory testing. The following test results were obtained:

Emulsion Content (% by Wt. of Aggregate)	
Lebanon Junction	Shepherdsville
Sample No. 1 - 18.4	Sample No. 1 - 27.8
	Sample No. 2 - 12.6

All samples were taken when the design emulsion content was 18.0 percent. The samples were taken while the machine was stationary and the spreader-box was being filled. This partially accounts for the large variation in emulsion content. Sieve analyses were not performed on the extracted aggregates as the samples were small; however, it was apparent that the aggregate grading was not uniform from sample to sample.

A sample of the stockpiled aggregate had the following gradation:

Sieve Size	Percent Passing
No. 4	100
No. 8	99.0
No. 16	84.4
No. 50	20.8
No. 100	12.1
No. 200	8.1

The cost of the slurry seal was estimated at $0.12 per sq. yd. by Fifth District Maintenance personnel. The Louisville Asphalt Company laid the slurry for $0.08 per sq. yd., and the materials were estimated to cost $0.04 per sq. yd.

On October 31, 1962, the Louisville Asphalt Company slurry sealed approximately one-half mile of the shoulder of the North-South Expressway in Louisville (Fig. 13). The sealed shoulder is on the south-bound lanes beside the Kentucky State Fairgrounds. The seal was laid as a test or demonstration of "Black Beauty Slag" as a slurry aggregate. The composition of the slurry was as follows:

SS-1h	17%
Type I Portland Cement...	2%
Black Beauty Slag........	98%

The slag was graded by the Black Beauty Company of Madison, Indiana, so that 100 percent passed the No. 4 screen. A sample was taken while the machine was in motion. The following laboratory test results were obtained:

Gradation: Extracted Aggregate

Sieve Size	Percent Passing
3/8 In.	100
No. 4	99.0
No. 8	80.9
No. 16	44.2
No. 50	18.2
No. 100	11.0
No. 200	6.2

Emulsion Content: 15.9% by wt. of agg.

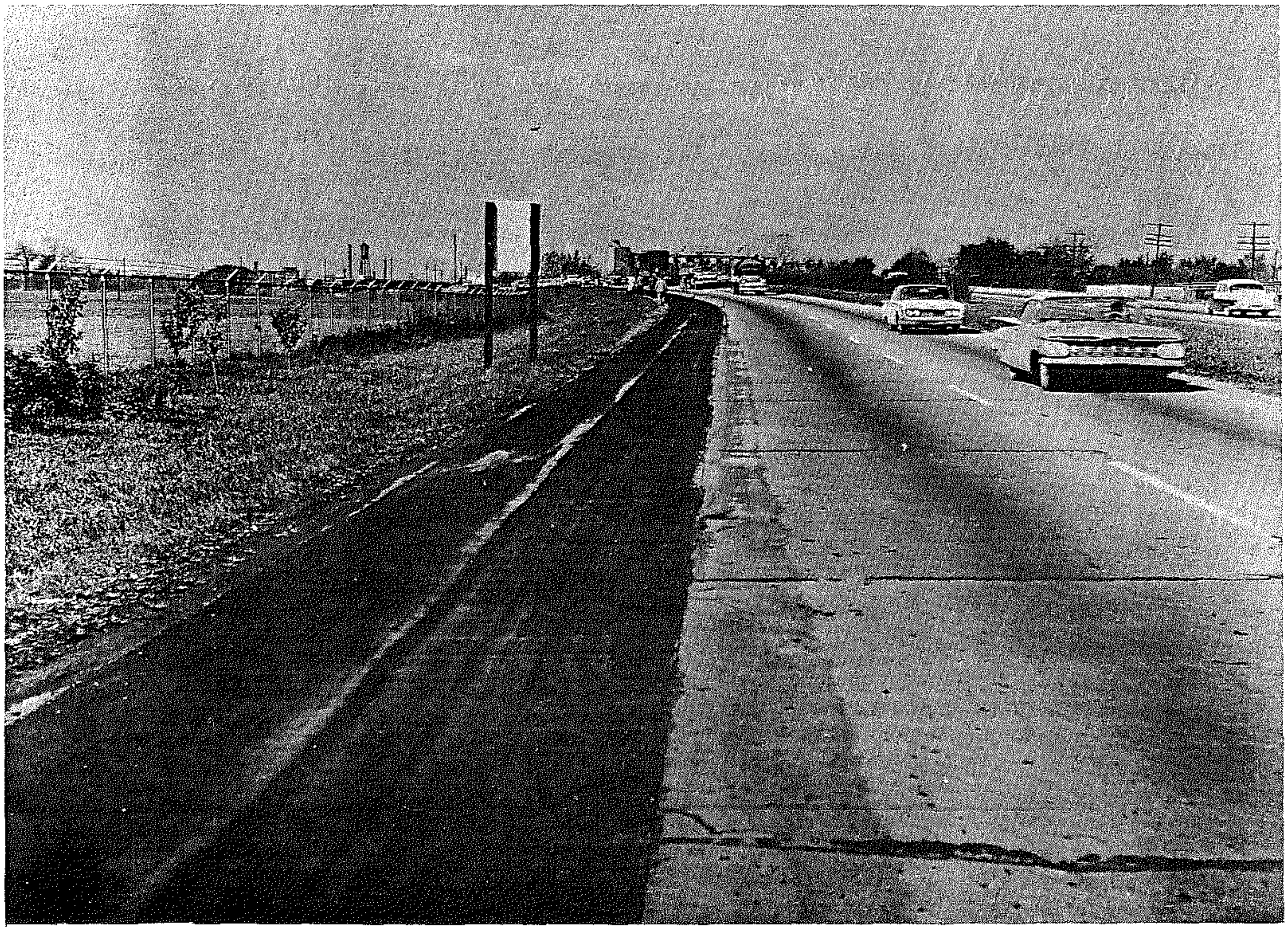

Fig. 13. North-South Expressway. The slurry contains "Black Beauty Slag" (minus No. 4 material), 17.0 percent SS-1h, and 2.0 percent portland cement. The photograph was taken immediately after sealing.

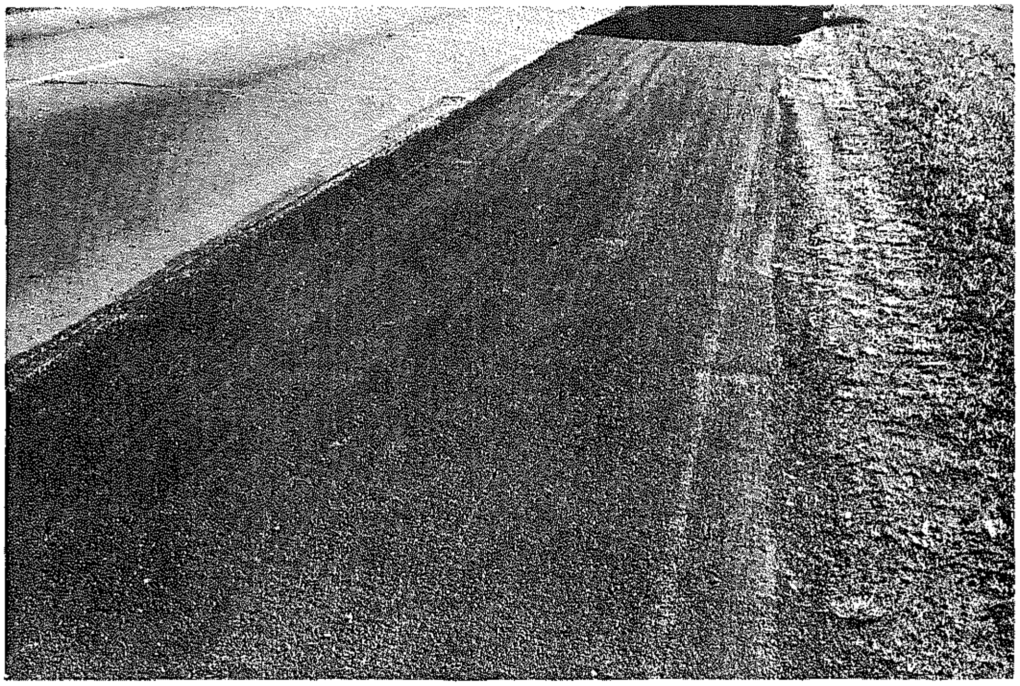

Fig. 14. North-South Expressway. The photograph was taken approximately two months after sealing. Note the streaks caused by coarse aggregate particles.

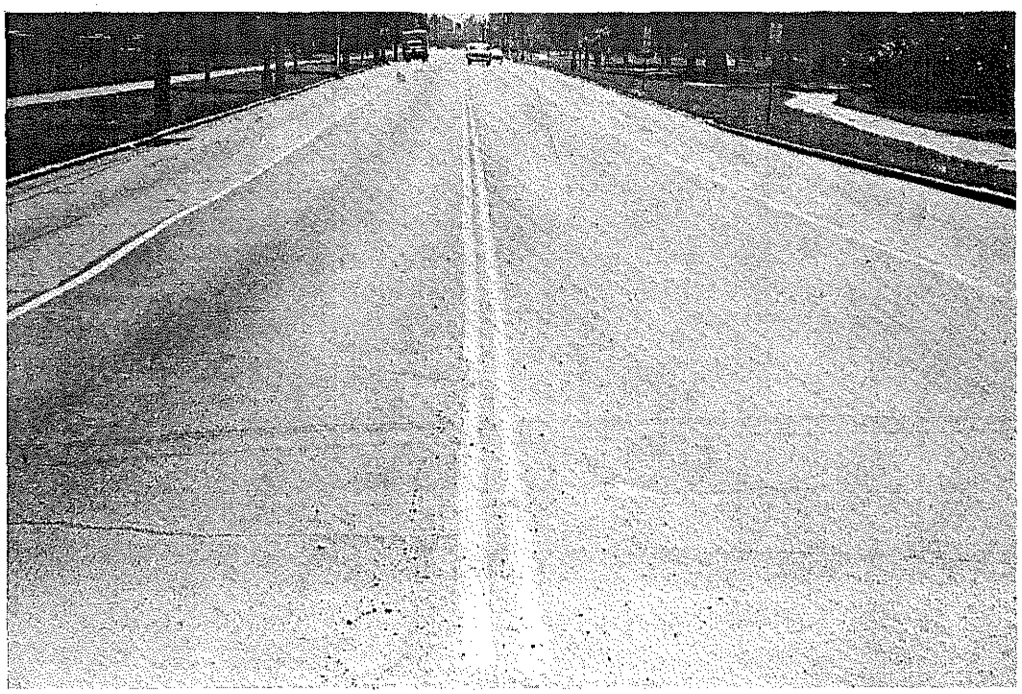

Fig. 15. South Third Street, Louisville. The seal contains silica sand from near Mt. Vernon. Only the two center lanes have been sealed. Note the shrinkage cracks in the old surface.

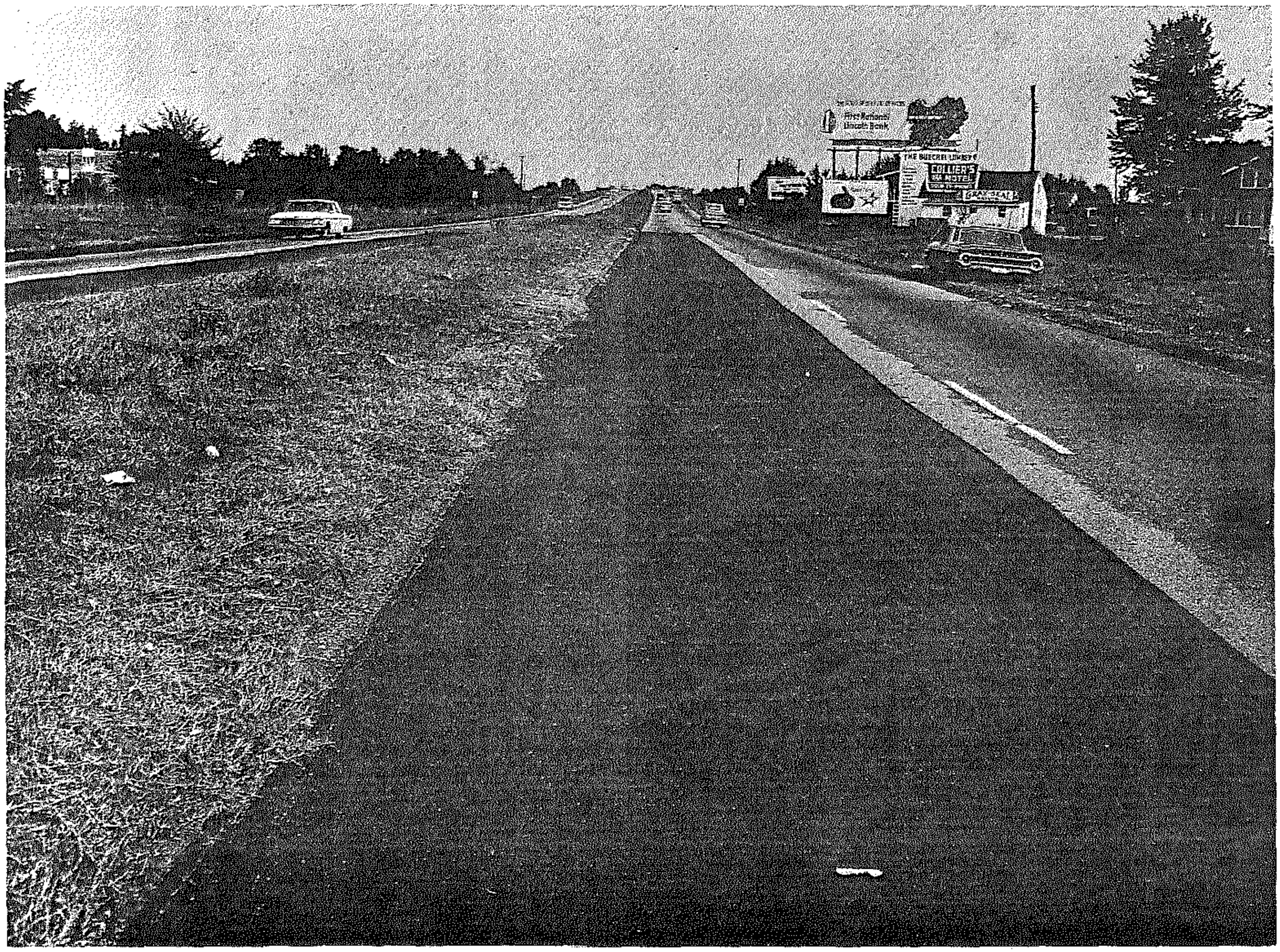

Fig. 16. Beuchel By-Pass (US 31-E). This section also contains silica sand from near Mt. Vernon. Only the inside lane was sealed. The surface was cracked due to deformation.

The slurry seal was streaked badly by the coarsest aggregate particles.

Prior to sealing the service areas, a section of the Beuchel By-Pass (US 31-E), and a section of South Third Street at the University of Louisville were slurry sealed by the Louisville Asphalt Company (Figs. 15 and 16). The aggregate used in these sections was silica sand from near Mt. Vernon in Rockcastle County. The emulsion was SS-1h. On the Beuchel By-Pass the pavement surface was cracked due to deformation. On South Third Street, the pavement was cracked due to age shrinkage. The total cost of these two sections was $300.00.

RLF:dl