

No. 31

Highway Materials Research Laboratory  
132 Graham Avenue, Lexington 29, Kentucky

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Memorandum to Dean D. V. Terrell  
Director of Research

During the present construction season a considerable amount of paving was done by the Highway Department on streets which were parts of state and federal highways through Lexington. To the best of my knowledge all or most of this work was included in one contract designated as S.P. 34-6004-3SA, and among the several sections was one on west Third Street as well as Jefferson Street from Bolivar to Third. The existing pavement on both these streets was sheet asphalt which on Third Street, at least, was known to have been laid in 1912 and had failed distinctly through shoving.

Although removal of the sheet asphalt was not originally contemplated nor provided for in the contract, this was done on Third Street and for a distance of less than 100 feet on Jefferson Street southward from Third. Otherwise the new pavement was placed over the old. A Class I mix with PAC-5 was specified, but even so there was evidently some concern about the possibility of shoving of this pavement under heavy traffic on a relatively steep grade at the Jefferson Street approach to the traffic light.

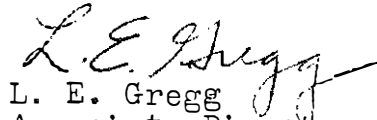
Apparently with this in mind, the contractor on the project (Lehman-Roberts Company) proposed an experiment with metal mats placed between the binder and surface courses, the objective being to integrate the pavement or join a large section of it into one mass in a manner such that displacement of any portion would necessitate displacement of all. Accordingly, Mr. W. E. Lehman obtained approval of the work through the Fifth District Office, and he then asked whether the Research Laboratory wished to make measurements, observations, and records on the job. The result at this stage is the attached initial report.

Installation of the mats, which were purchased at 20 cents per square foot, was not a part of the contract and consequently that expense was borne by the contractor. Extra time required for this special operation was negligible, so probably the entire additional cost in this case did not exceed \$75.00. Hence, such installations should be economically feasible provided, they do actually prevent failures at troublesome situations that are limited in extent. In the case of this experiment there remains the question as to whether failure would have occurred had the mats not been used, but even this may be shown eventually because of the area between the curb and the mats which should be subjected to severe forces of traffic.

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Observations and substantiating photographs will be made on this experiment periodically and reported in subsequent accounts of progress. For the present, this report was made as a matter of record and a means for bringing the project to the attention of the Research Board at its first meeting this fall.

Respectfully submitted,



L. E. Gregg  
Associate Director of Research

Copies to: Research Board members  
& District Engineers.

Commonwealth of Kentucky  
Department of Highways

Report No. 1  
on  
AN EXPERIMENT WITH EXPANDED-METAL INTEGRATING MATS  
IN  
BITUMINOUS CONCRETE PAVEMENT

Highway Materials Research Laboratory  
Lexington

September 30, 1947.

This is an initial report of an experiment dealing with the use of expanded metal mats placed between the binder and surface courses of a Class I bituminous pavement at a location where a bituminous pavement of different design had shoved under heavy traffic. The purpose of the mats, of course, was to integrate the pavement in both longitudinal and transverse directions; the theory being that a small portion of the pavement, when subjected to a force that would ordinarily cause shoving, could actually shove only if an entire section of the embedded mat could be moved by that force. The purpose of the experiment, then, is to determine whether a group of such mats of certain design and placed in a certain way will provide extraordinary stability and prevent displacement of the bituminous pavement.

Location

The location selected was a down-hill approach (about 4 per cent grade) to a traffic light on Jefferson Street at the intersection with Third Street in Lexington. (See Fig. 1) Through traffic on U.S. 25, as well as heavy urban traffic, is involved in the experiment since U.S. 25 traffic is carried on Jefferson Street as far as this intersection then west on Third.



Fig. 1. Looking north on Jefferson Street into the intersection with Third Street. Here the old sheet asphalt pavement has been removed down to the original brick in preparation for the new pavement and the metal mats.

Street. Paving at the particular location selected was part of a contract for removal of old bituminous pavement and replacement with Class I mix.

Actually, the removal of the old pavement and installation of mats were not portions of the contract. On Third Street the old pavement was sheet asphalt as described in Table I, this having been laid in 1912 and in bad condition throughout the distance of two blocks. On Jefferson Street, where the mats were placed, less than 100 feet of the existing sheet asphalt was removed, the remainder for a distance of about 0.25 miles being covered with the Class I mix. The sheet asphalt, particularly that portion removed, shodded presumably because of forces exerted under the braking of trucks and busses approaching the corner. From the standpoint of contrast, the approach to the light on Third Street is of significance also since it carries U.S. 25 traffic in the opposite direction and is down grade though not as steep as the approach on Jefferson Street. No mats were placed in the pavement on Third Street, and inasmuch as the bituminous mixes in both places were identical, the Third Street portion of the intersection will serve to some degree as a basis for evaluating the effect of mats. A layout of the intersection showing the position of the mats is contained in Fig. 2.

#### Materials and Construction

The Class I mix, described in Table III, was laid in two courses over the original brick base which in many places on Third Street had been patched by concrete (apparently over sewer openings) that usually protruded above the brick. However, as shown in Fig. 1 nothing of that type existed in the location where mats were placed on Jefferson Street. Design for the new pavement

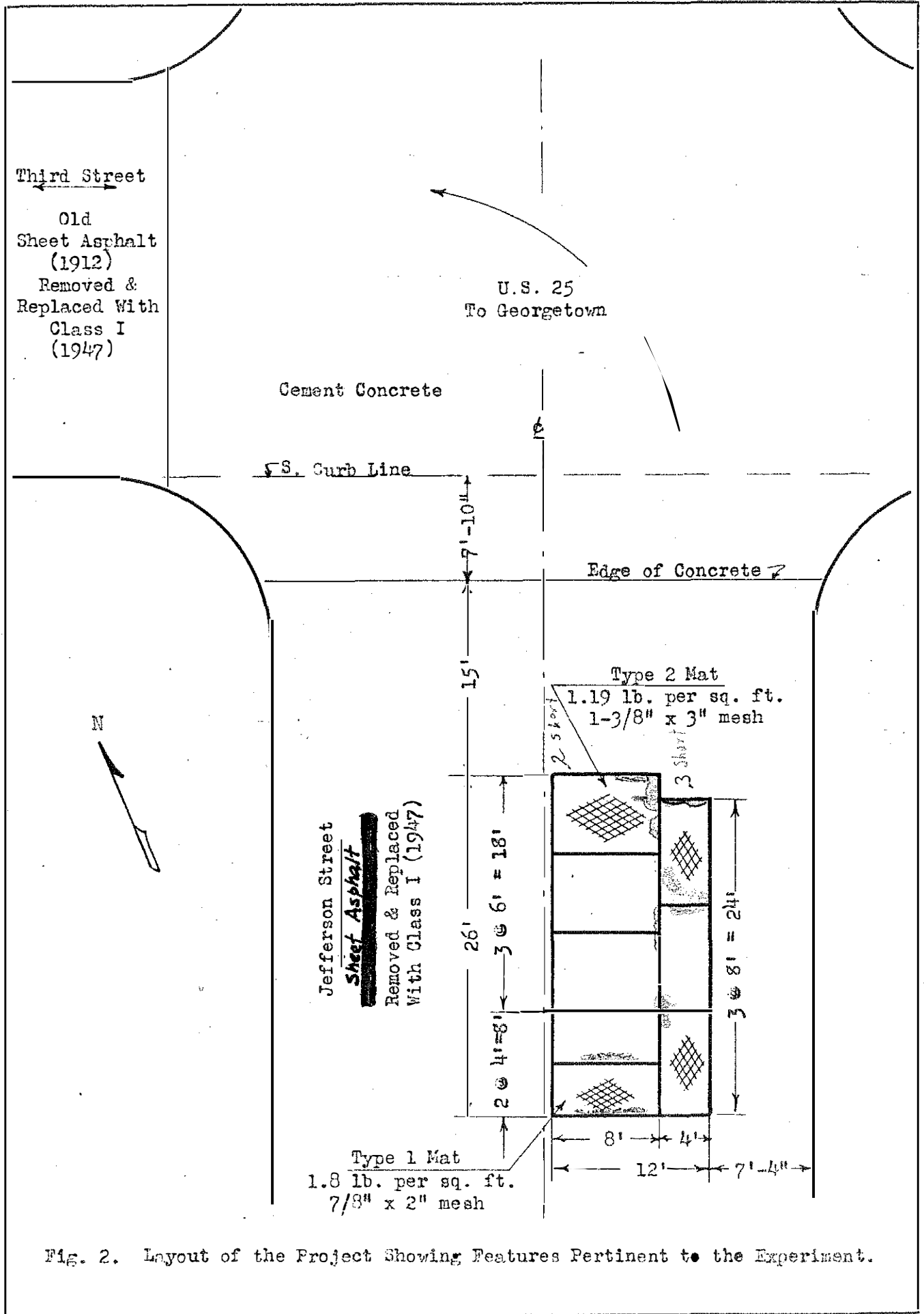


Fig. 2. Layout of the Project Showing Features Pertinent to the Experiment.

TABLE I. RESULTS OF EXTRACTION AND GRADATION TESTS ON SAMPLES OF SHEET ASPHALT CORED FROM WEST THIRD STREET, LEXINGTON

(Specimens Cored August 2, 1946)

Test	Results							Height of Cores (in.)
	Percentage of Aggregate Passing Sieves						Bitumen Content (pct.)	
	No.8	No.16	No.30	No.50	No.100	No.200		
Gradation	99.6	98.4	88.6	57.0	30.8	19.8	12.0 1 $\frac{1}{2}$ : 2-3/4; 2 $\frac{1}{2}$ : 3-3/8; 2-5/8	
Extraction								
Depth of Pvt.								

Note: Cores were cut from 5 locations. Long cores represent protruding pavement adjacent to depressions from which the sheet asphalt had been shoved; short cores were taken from the depressions. Pavement was laid in 1912.

TABLE II. GRADATION OF AGGREGATES AND PERCENTAGES OF BITUMEN IN CLASS I MIX PLACED ON JEFFERSON STREET, LEXINGTON, IN 1944

(Data from 1944 lab. reports on the project)

Section of Pvt.	Gradation									Bitumen Content (Pct.)
	Percentage of Aggregate Passing Sieves									
	3/4"	1/2"	3/8"	No. 4	No. 8	No.16	No.50	No.100	No.200	
Binder Course										
Surface Course		100	95.0	61.2	40.4	29.3	12.6	9.2	2.8	6.5(ave.)

TABLE III. RESULTS OF TESTS ON MATERIALS PLACED IN THE BINDER AND SURFACE COURSES ON JEFFERSON STREET, LEXINGTON, IN 1947

(Specimens taken or compacted on the job August 16 & 18, 1947)

Section of Pavement	Gradation										Bitumen Content (pct.)	Stability* (lb.)
	Percentage of Aggregate Passing Sieves											
	3/4"	1/2"	3/8"	No.4	No.8	No.16	No.30	No.50	No.100	No.200		
Binder Course	100	83.2	62.0	40.6	32.4	23.6	14.7	5.2	2.2	1.7	5.3	
Surface Course	100	92.6	62.8	42.4	30.2	18.6	5.7	2.4	1.9	6.3		
Sample No. 1												400
No. 2												425
No. 3												425
No. 4												395
Ave.												411

\*Radial Compression after 1 hr. in water at 140° F.

Note: Compaction under the tamper for stability specimens provided a unit weight of 133.3 lb. per cu. ft. or approximately 100 pounds per sq. yd. per inch of thickness in the surface course. This provided an average of 92.5 per cent of the theoretical unit weight of a solid volume of the materials as proportioned for the surface course. Sand was used for fine aggregate.



was for a 150 pound binder and a 150 pound surface course.

Eight separate mats of two different designs were used in forming an area essentially 26 feet in length and 12 feet in width, the longer dimension being in the direction of traffic. Both were 9 gauge metal, but the larger sheets (referred to as Type 2 mats in Fig. 2) 8 x 6 feet in size weighed 1.19 pounds per square foot and had diamond mesh  $1\frac{3}{8}$  x 3 inches, whereas the smaller 8 x 4 foot sheets weighed 1.8 pounds per square foot and had diamond mesh  $\frac{7}{8}$  x 2 inches. In addition, all the larger sheets were placed so that the mesh ran in the transverse direction, but the greater part of the small sheets had mesh running in the longitudinal direction. As shown in the layout of Fig. 2, combined large and small mats formed an inner row with mesh running transversely, and three sheets of the small mats formed an outer row with mesh running longitudinally. Arrangement of mesh in abutting sheets of the two rows is illustrated in Fig. 3.

In the construction where the mats were placed, the designated location beginning 15 feet from the edge of the cement concrete in the intersection and extending 26 feet southward was marked off. The initial set of mats for the entire 12 foot width was placed and loaded down with some of the mix at certain points, (See Fig. 4) then the paver was moved up onto the mats from which point it proceeded as usual. Thereafter, additional mats were placed as needed just prior to the time that the wheels of the paver passed off those mats that were in place. No longitudinal movement of the mats under the paver was noticed. As paving progressed, mix was placed by hand methods on those portions of the mats which extended beyond the width of the paver. A measurement



Fig. 3. Near view of abutting mats showing the 6 x 8 foot size on the right with mesh running transversely, and the 4 x 8 foot size on the left with mesh running longitudinally. Some of the smaller sheets were placed with the mesh running transversely (see Fig. 2). This view is toward the paver and away from the intersection.

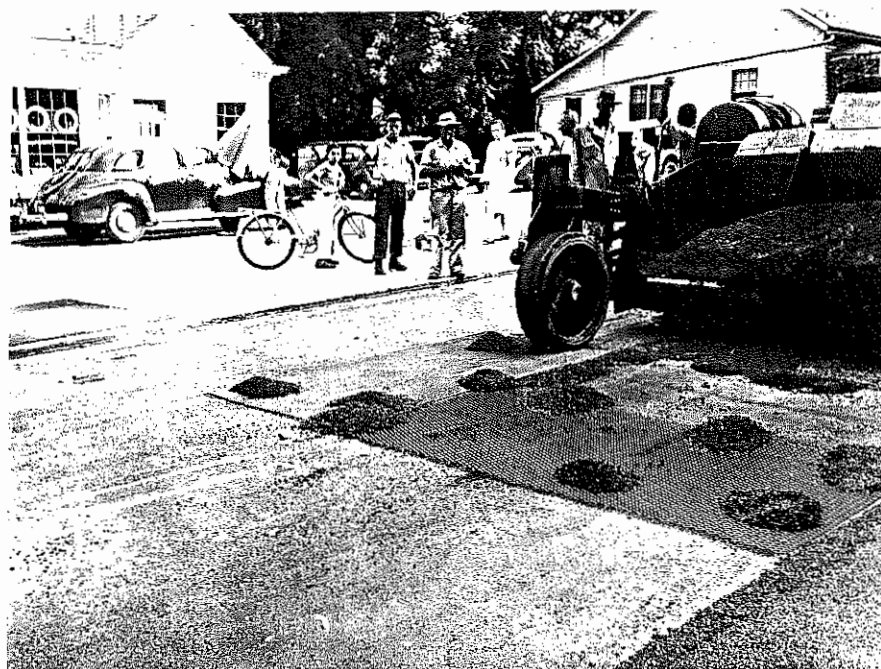


Fig. 4. Mats were placed in position and weighted down with some of the mix in order to prevent curling and consequent interference with the paver. The three mats shown were of the first group, and all were 4 x 8 feet in size.

made after the pavement had initial rolling showed that the depth of overlying surface material was 2 inches. The longitudinal extent of the mats is shown in Fig. 5 by the portion of paving material extending toward the observer.

The binder course on both streets was laid on Saturday, August 16, and the surface course was placed on August 18. The weather was clear and hot except for the early afternoon of August 18 when heavy rain stopped operations on the last few feet of the north side of Third Street at the west end of the project. After about two hours delay, operations were resumed and the Jefferson Street portion including the mats was completed by 5:30 p.m.

#### Observations

A few observations based on physical characteristics of the materials or dimensions involved in the experiment are pertinent at this stage even though results from the experiment cannot be evaluated for some length of time. First, the gap of more than 7 feet between the mats and the curb provides an opportunity in that area for shoving under trucks and especially city busses pulling near the curb to load or discharge passengers. This may prove to be a benefit rather than a detriment from the standpoint of research, because of the contrasting conditions. On the other hand, application of mats in practice could possibly require greater coverage.

Another factor of consequence is the depth of surface course overlying the mats. A two-inch depth of pavement may be too thick and allow shoving over the top of the mats, thus



Fig. 5. The extent of the mats longitudinally is illustrated by this view, in which the 26 foot length extends from the rear wheel of the bicycle almost to the left edge of the picture.



Fig. 6. Appearance of the finished pavement after about a month of use. This photograph was taken from approximately the same location as that in Fig. 1.

preventing the mats from functioning in the way intended. Also, the fact that the mats were not keyed into the binder course in some manner could detract from their ability to resist displacement. Probably this could be accomplished without making the cost prohibitive, by using dowel pins driven into the binder course and having hooked ends extending over the mesh of the steel mats. Finally, it is possible that mats having a different design would be satisfactory even if these fail in this experiment, or it may be that the cost could be reduced by use of mats of different design.