



COMMONWEALTH OF KENTUCKY  
DEPARTMENT OF HIGHWAYS  
FRANKFORT

HENRY WARD  
COMMISSIONER OF HIGHWAYS

February 19, 1962

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

D. 1. 7.  
B. 2. 1.

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

The attached memorandum report on, "A Machine-Laid Surmountable Bituminous Concrete Median," by R. L. Florence, Head of the Bituminous Section, Division of Research, covers our observations of the Euclid Avenue Project placed last fall. The machine-laid bituminous concrete median appears to be performing its designed functions. As you may surmise from Fig. 7 of the report, it has a pleasing appearance.

In the report (page 4) we are recommending an aggregate gradation, bitumen content, and a paint coat for this type of bituminous concrete median. It is possible that one or more similar installations using this mix were placed late last fall.

In the interest of maintaining durability and performance, I am recommending that the mix specification for medians be incorporated into the Standard Specifications or designated on plans or proposals where applicable.

Respectfully submitted,

W. B. Drake  
Director of Research

WBD:dl  
Enc.

cc: Research Committee Members  
Bureau of Public Roads (3)

Commonwealth of Kentucky  
Department of Highways

Report

on

A MACHINE-LAID SURMOUNTABLE  
BITUMINOUS CONCRETE MEDIAN

by

Robert L. Florence  
Research Engineer Associate

Highway Materials Research Laboratory  
Lexington, Kentucky  
December, 1961

December 12, 1961

B.2.1.

MEMORANDUM

TO: W. B. Drake  
Director of Research

FROM: R. L. Florence *RLF*  
Research Engineer Associate

SUBJECT: A Machine-Laid Surmountable Bituminous  
Concrete Median

On August 28, 1961, personnel of the Research Division were requested to observe a demonstration of a newly developed Etnyre Median Paver. The demonstration was given at the Lehman-Roberts Company plant in Lexington, and was arranged primarily for the benefit of the paving contractor working on Euclid Avenue in Lexington. The paving contract called for the construction of a surmountable bituminous concrete median which, to our understanding, is the first instance for construction of that type to be machine-laid. Some doubts arose during the demonstration as to the ability of the machine to hold alignment and to give adequate compaction.

Following the demonstration, it seemed advisable to examine the finished median from the standpoint of density and stability. Representatives of the Division of Design, present at the demonstration, requested that the Research Division examine and evaluate a short trial-section of the median. The trial-section, approximately 25 ft. long, was laid that afternoon on the lot of the Thompson, King and Tate Ready-Mix Concrete Company in Lexington.

A sample of the mixture placed in the trial-section was taken to the laboratory in an insulated bucket and compacted into Marshall specimens. The following data were obtained:

|                           |                  |
|---------------------------|------------------|
| Density .....             | 141.6 lbs/cu.ft. |
| Stability(Marshall) ..... | 849 lbs.         |
| Flow .....                | 0.08 in.         |
| Voids, compacted mix ..   | 8.5%             |
| Voids, filled w/bitumen.  | 61.3%            |
| Voids, aggregate only..   | 21.9%            |

An extraction and sieve analysis of the material gave the following results:

| <u>Sieve</u>            | <u>Percent Passing</u> |
|-------------------------|------------------------|
| 1/2 .....               | 100.0                  |
| 3/8 .....               | 98.4                   |
| No. 4 .....             | 74.4                   |
| No. 8 .....             | 48.3                   |
| No. 16 .....            | 43.8                   |
| No. 50 .....            | 13.7                   |
| No. 100 .....           | 3.1                    |
| No. 200 .....           | 2.0                    |
| Bitumen Content (PAC-5) | 5.9%                   |

Density samples were cut from a cross-section of the trial-median after it had cured for several days. These samples were sawed into cubical blocks, weighed, and measured; and the densities were calculated. The densities varied across the section of the median as shown in Fig. 5. The average density and percent of laboratory density were as follows:

|                    |                                       |
|--------------------|---------------------------------------|
| Average Density    | 131.4 lb./cu.ft.                      |
| % Marshall Density | $\frac{131.4}{141.6} \times 100 = 93$ |

Similarly 4-in. diameter cores were taken from the center of the trial-median and tested for density and stability. The following data were obtained:

|                         |   |
|-------------------------|---|
| Stability (Marshall)    | 160 lbs.                                |
| Flow                    | 0.11 in.                                |
| Unit Wt.                | 135.2 lbs/cu.ft.                        |
| % Marshall Density      | $\frac{135.2}{141.6} \times 100 = 95.5$ |
|                         | 141.6                                   |
| Voids, compacted mix    | 15.1%                                   |
| Voids, Aggr. Only       | 27.7%                                   |
| Voids, filled w/bitumen | 44.7%                                   |

Construction of the machine-laid median on Euclid Avenue began September 26, 1961. The machine had been modified somewhat since the demonstration (Fig. 1). The hopper capacity had been

increased and levers had been added to guide the machine from the side. Hot-mix asphaltic concrete was loaded in the hopper by means of a front-end loader (Fig. 2), and four motorized screws pushed the mixture out through the mold-form (Fig. 3). The extrusion pressure compacted the mixture and propelled the machine forward at a speed of 5-1/2 ft. per min. The compactive effort, or pressure, is dependent upon the weight of the machine and its resistance to forward motion. Thus, the pressure exerted on the mixture is highest immediately behind the screws and when the hopper is full.

Alignment was held by keeping a pointer, on the machine, immediately over a line scribed on the existing pavement (Figs. 1 and 2). At first, the rear of the machine tended to swing around; but after skids were welded to the rear of the machine, good alignment was maintained. At intersections, the ends of the median were rounded off symmetrically with the aid of wooden forms.

The following laboratory test results were obtained from a sample of the mixture taken at the time of construction:

| <u>Marshall Test</u>    |                  |
|-------------------------|------------------|
| Stability               | 1491 lbs.        |
| Flow                    | 0.09 in.         |
| Unit Wt.                | 145.2 lbs/cu.ft. |
| Voids, compacted mix    | 5.5%             |
| Voids, aggr. only       | 19.8%            |
| Voids, filled w/bitumen | 72.6%            |

| <u>Composition by Extraction</u> |                |
|----------------------------------|----------------|
| <u>Sieve</u>                     | <u>Percent</u> |
| <u>Size</u>                      | <u>Passing</u> |
| 1/2                              | 100.0          |
| 3/8                              | 98.7           |
| No. 4                            | 62.2           |
| No. 8                            | 29.1           |
| No. 16                           | 23.4           |
| No. 50                           | 13.9           |
| No. 100                          | 3.3            |
| No. 200                          | 2.6            |
| Bitumen Content (PAC-5)          | 6.2%           |

River sand made up approximately 40 percent of the aggregate.

December 12, 1961

Subsequent to the construction of the extruded median on Euclid Avenue, the Research Division recommended\* the following composition

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\* Memorandum to T. H. Baker, Director of Construction, dated 10-22-61.

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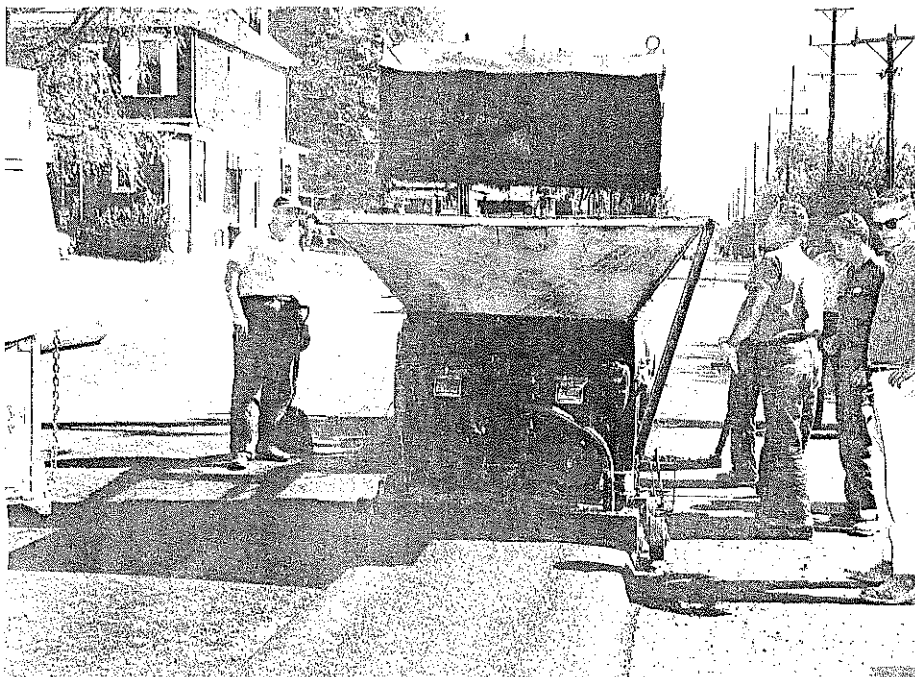
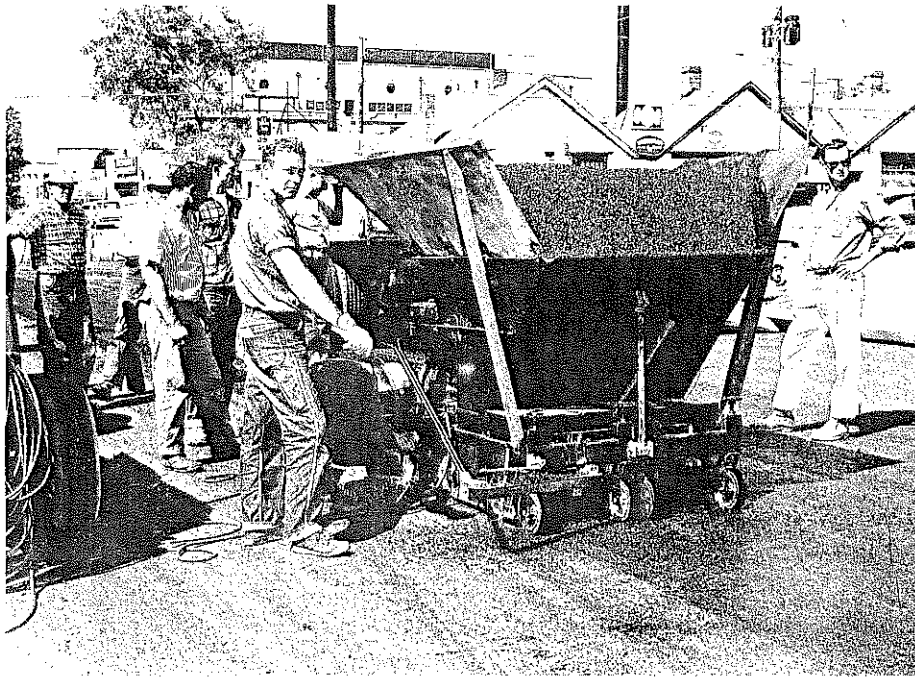
requirements for mixtures laid by extrusion-type pavers.

| <u>Sieve Size</u> | <u>Percent Passing</u>          |
|-------------------|---------------------------------|
| 1/2               | 100                             |
| 3/8               | 80-100                          |
| No. 4             | 60-80                           |
| No. 8             | 45-60                           |
| No. 50            | 18-30                           |
| No. 200           | 5-15                            |
| AC 85-100 Pen.    | 5.5-8.0% by wt.<br>of total mix |

It appears that this mixture can be produced with standard size aggregates (No. 9 stone and Class I sand), and mineral filler. The mixture is essentially a stone-filled sheet-asphalt which should produce a dense, stable mixture having a fine-textured surface. The recommended mixture is considerably finer than that used on Euclid Avenue and in the trial-section.

A paint coat of a 50-50 blend of water and emulsified asphalt (SS-1 or SS-1h) has also been recommended for future installations of this type. A slurry-seal of fine sand and diluted SS-1h is similarly recommended for sealing the mix if such seal is needed.

RLF:d1



Figs. 1 & 2: Etnyre Median Paving Machine. The hopper capacity was increased, and the guidance mechanism was moved to the side in order to load the machine from the front.

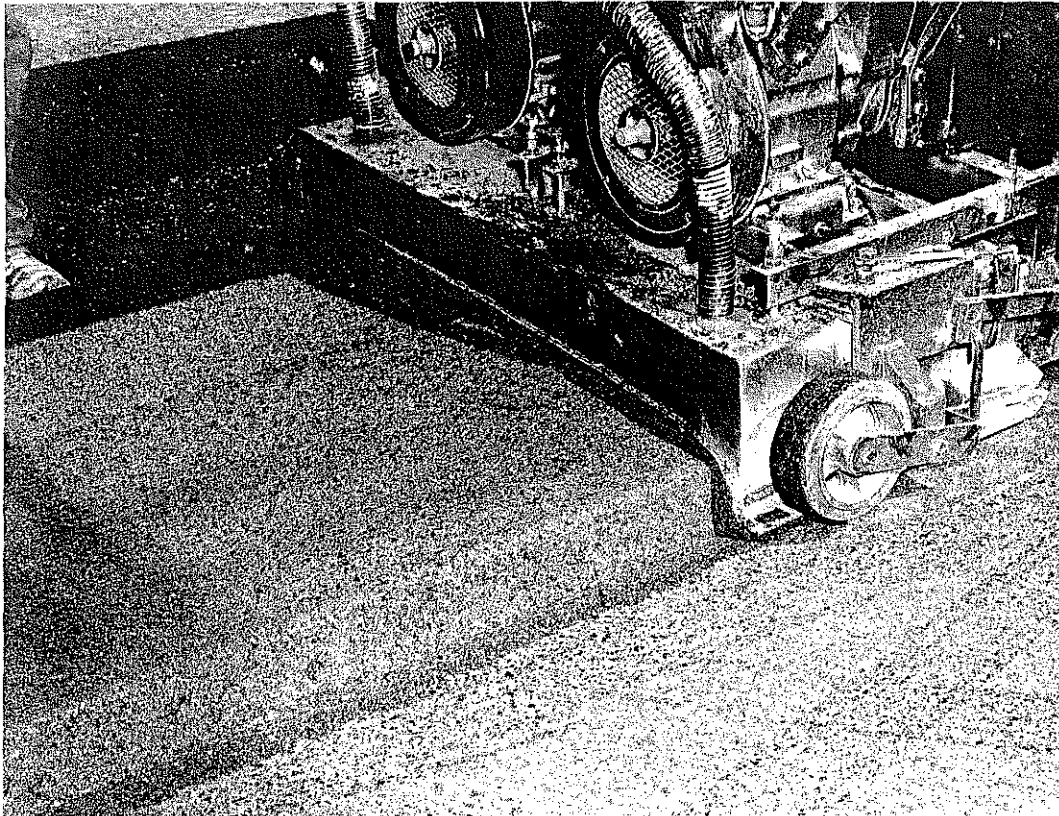


Fig. 3: Etnyre Median Paving Machine. A view of the mold form.



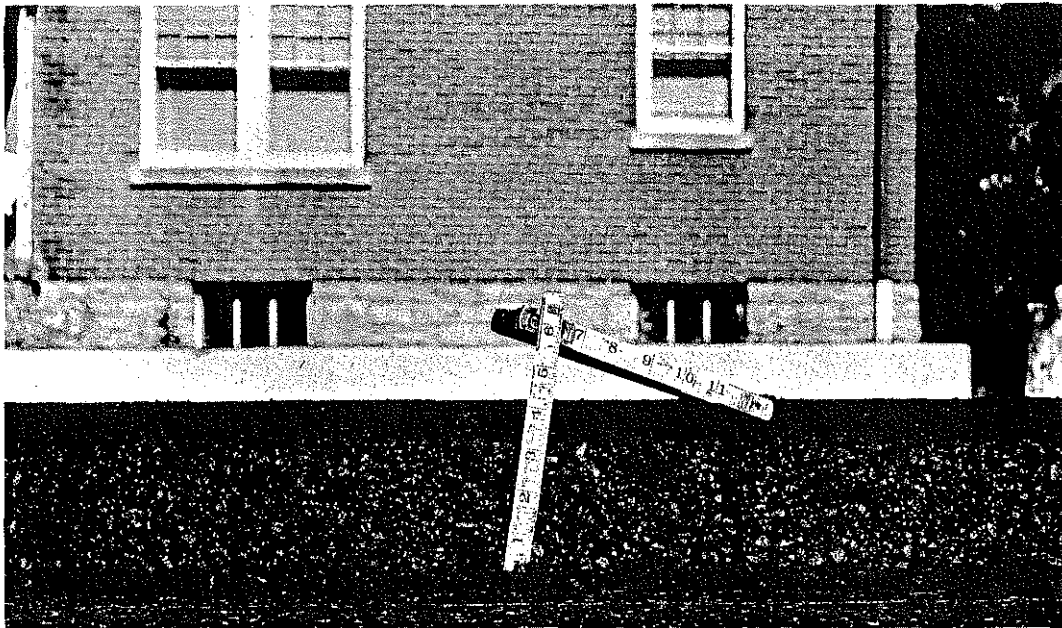


Fig. 4: Euclid Avenue Median. The depth of the median is approximately 4-3/4 inches at the center.

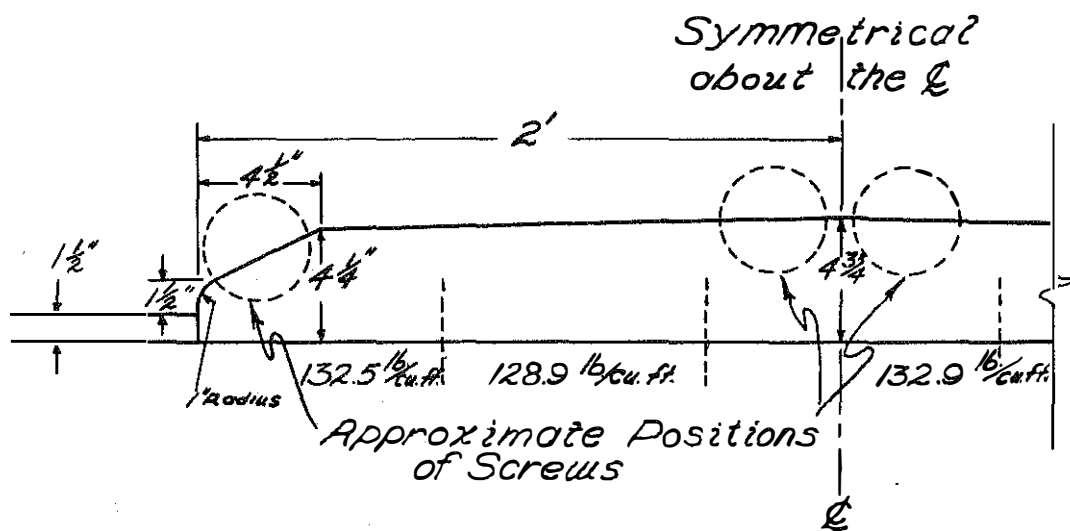


Fig. 5: Diagram Showing Cross-Section of Extruded Median as Constructed on Euclid Avenue.



Fig. 6: Euclid Avenue Median. Tests indicated a higher density along the path of the screws -- also evidenced by the finer texture. The surface course has not been placed.



Fig. 7: A View of the Completed Euclid Avenue Median.

PART III