# PROGRESS REPORT ON BRICK ROAD EXPERIMENTS IN OHIO

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## SYNOPSIS

After approximately one year's service the following condition of the fillers has been found on the Hocking County, Ohio, test road described at the 1935 meeting of the Highway Research Board

Four asphalt fillers, namely, the Ohio Department of Highways Filler F-1 (from a mid-continent crude), a similar asphalt of heavier consistency, and two asphalts similar to the above two but from a 100 per cent asphaltic base crude all exhibit considerable exuding

Two blended asphalts of the low temperature susceptibility type, one of which contains about 25 per cent added mineral matter, are in excellent condition and are practically free from exuding

A mastic filler, consisting of a mixture of Ohio Highway Filler F-1 and sand, is heavily exuded in spots due to lack of uniformity

Plasticized sulfur Type A, a semi-rigid filler, is in satisfactory condition except for the persistent undesirable odor of the plasticizer

Plasticized sulfur Type B, a mixture of asphalt and sulfur, is in very satisfactory condition and exhibits no exuding

The portland cement grout section is in satisfactory condition except for several areas in which the bond is broken between brick and filler

The butuminized grout section must be considered unsatisfactory due to several large areas in which the filler has been crushed and lost

Seven special pitch fillers exhibit various degrees of exuding with the exception of Filler #16, which is in satisfactory condition and practically free from exuding

The Natural Lake Asphalt, a pitch containing 5 per cent asbestos, and an asphalt containing about 38 per cent added mineral flour have receded in the joints and have flowed to the low side of the pavement These three fillers must be considered unsatisfactory

As a means of obtaining some definite information on temperatures (especially those of summer) existing in brick, filler, and concrete base of a brick pavement, seventeen thermocouples were permanently installed during the construction of this Hocking County filler test road Results of temperature readings have shown that while the temperature of the brick surface course may, under a bright sun, rise many degrees above the air temperature, the maximum temperature of the concrete base will not greatly exceed the maximum air temperature

A survey of the Carroll County Experimental Brick Road Project after three years of service has revealed some condition changes over the survey taken and reported last year Among the changes noted are some additional cases of longitudinal and transverse cracking

At the 1935 Annual Meeting of the Highway Research Board a description and outline was given of a newly constructed brick pavement in Hocking County, Ohio, devoted to the study of brick joint fillers[1] The 1 3 miles of pavement is 20 ft wide with two 9-in flush side curbs and one 6-in flush center curb The bedding course, with the exception of several short sections of sand, is mastic composed of 94 per cent sand and 6 per cent asphalt cutback by volume Bricks are of the 3-in wire-cut vertical fiber type with side and end lugs

[1] R R Litehiser, "Brick Road Experiments in Ohio" Proceedings Highway Research Board, Vol 15, p 170

The entire pavement is divided into sections allotted to the 22 trial fillers.

The weather during the one year this pavement has been in service has been exceptionally severe. During the winter, sustained periods of sub-zero weather were undergone. The past summer, being of exceptional warmth, was featured by one period during which on six consecutive days the temperature exceeded 100°F. This severity of weather and its resulting effect on some of the fillers indicates that an inspection at this time, while possibly not conclusive, has some value.

TABLE 1

TEMPERATURES—HOCKING COUNTY FILLER TEST ROAD

| | February 11, 1936 12:30 P.M. | July 13, 1936 4:00 P.M. |
|---|---|---|
| Air (shade) | 20°F. | 95°F. |
| Brick | 22 | 120 |
| Filler | 22 | 117 |
| Cushion | 18 | 113 |
| Base top | 18 | 102 |
| Base bottom | 18 | 97 |
| Subgrade 6 in. | 22 | 92 |
| Subgrade 12 in. | 24 | |
| Subgrade 18 in. | 24 | 87 |
| Subgrade 24 in. | 26 | |
| Subgrade 30 in. | 28 | 82 |
| | These temperatures represent the minimum recorded in subgrade | These temperatures represent the maximum recorded with the exception of Air and Brick |

## DESCRIPTION OF THE FILLERS AND THEIR PRESENT CONDITIONS, AFTER ONE YEAR'S SERVICE

1: Portland cement grout (one part cement and four parts sand by volume). While most of the section is in a very satisfactory condition, numerous small areas exist in which the bond of grout to brick is badly broken. Although at the present time the section is in serviceable condition, these broken areas are increasing in extent with the result that the test section as a whole is considered unsatisfactory. (Fig. 1)

2: Bituminized grout (one part portland cement, two parts asphalt emulsion and three parts sand by volume). In this section several large areas exist in which the filler has broken out and is entirely lost. In the remaining area, the filler top, due to loss, is $\frac{1}{8}$ to $\frac{1}{4}$ in. below the brick top. This filler must be considered unsatisfactory. (Fig. 2)

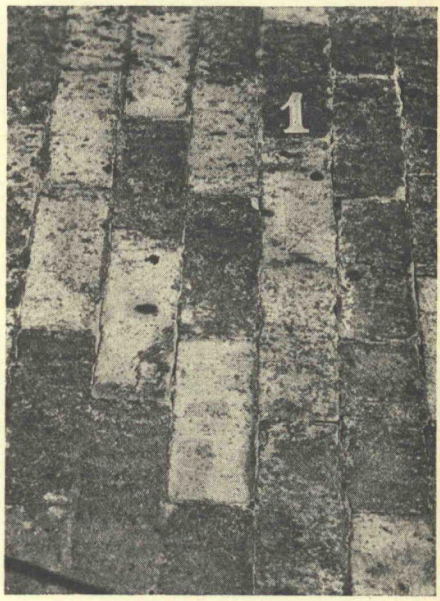


**Figure 1. Filler No. 1**

3: Plasticized sulfur Type A. This filler is composed of approximately 60 per cent sulfur, 30 per cent of a graded mineral aggregate and 10 per cent plasticizer (Thiokol), and the resulting filler joint resembles hard leather in consistency. With the exception of about 10 per cent of the total area, the section is in excellent condition and seems unchanged by one year's service. The excepted area contains filler which was damaged by overheating in the melting kettle.

Under summer temperatures the damaged filler exuded a small amount of oil


Figure 2. Filler No. 2


Figure 3. Filler No. 3

(a product of the breaking down of the Thiokol due to overheating) and the filler appears lifeless. While this filler must be considered very satisfactory, the success is somewhat limited by the continued presence of an obnoxious odor. (Fig. 3)

4: Plasticized sulfur Type B. This filler is a mixture of approximately 60 per cent asphalt and 40 per cent sulfur. In physical appearance it resembles a straight asphalt filler. The section shows no evidence of either exuding or receding and is considered very satisfactory. (Fig. 4)

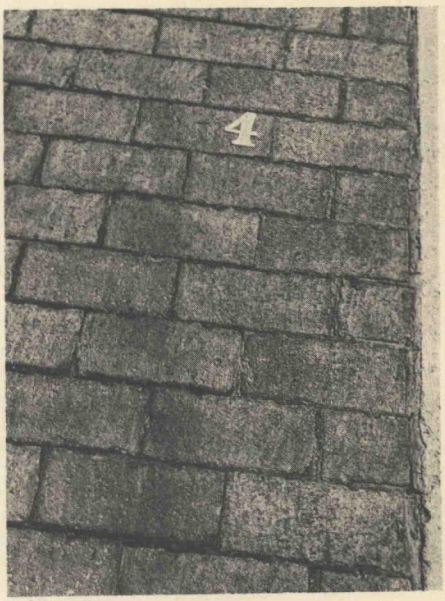


Figure 4. Filler No. 4

5: A mineral-filled blended asphalt of the low temperature susceptibility type, the asphalt being 65 per cent mid-continent base and 35 per cent asphaltic base to which is added about 25 per cent finely divided mineral matter. The filler shows no evidence of receding and little or no evidence of exuding, and the section is considered very satisfactory. (Fig. 5)

6: A blended asphalt very similar to No. 5 but with no added mineral matter. The condition of the section is identical

with that of Filler No. 5 and is very satisfactory. (Fig. 6)

7: A mastic filler consisting of 60 per cent Ohio Highway Asphalt Filler F-1 and 40 per cent of 30 to 100 mesh sand, by volume. During construction of this section it was possible to keep the constituents perfectly mixed. Further evidence of this lack of homogeneity is now shown by the spotty exuding. Exuding is heavy in areas in which the asphalt content is too large while no exuding has occurred in the high-sand areas. Unless some means can be devised to prevent segregation, this mastic must be considered unsatisfactory. (Fig. 7)

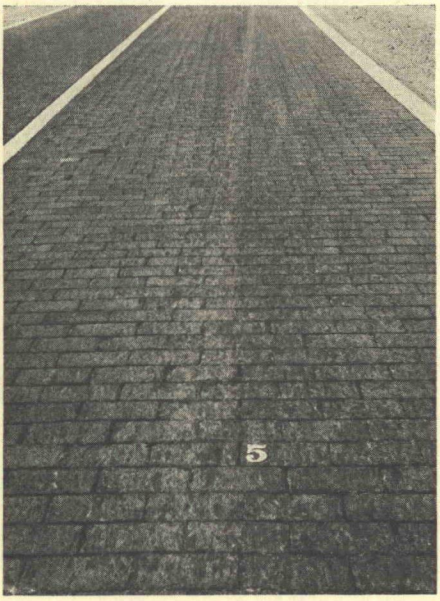


Figure 5. Filler No. 5

8A: Ohio Highway Asphalt Filler F-1 on sand cushion. This asphalt filler has a softening point of not less than 75°C and is from a mid-continent base crude. Over the entire section the filler has exuded heavily. (Fig. 8A)

8: Ohio Highway Asphalt Filler F-1, in this case with the brick laid on mastic cushion. In the areas between the base contraction joints the filler has exuded heavily but somewhat less than in Section 8A where the bricks are laid on sand cushion. Directly over the base con-

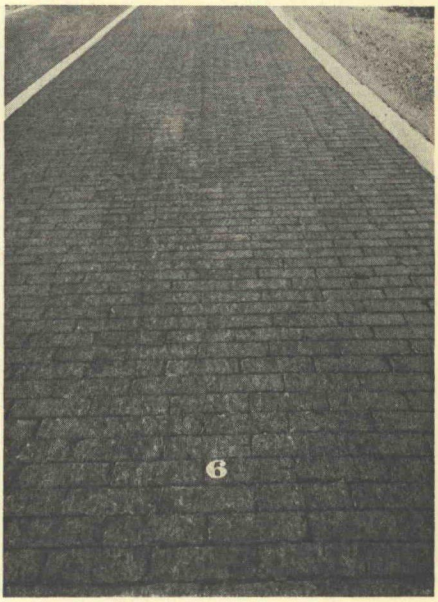


Figure 6. Filler No. 6

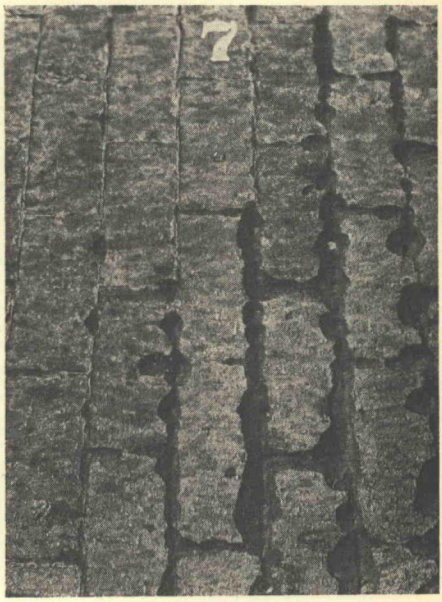


Figure 7. Filler No. 7

traction joints, however, the exuding is markedly greater. (Fig. 8)

Figure 8. Filler No. 8

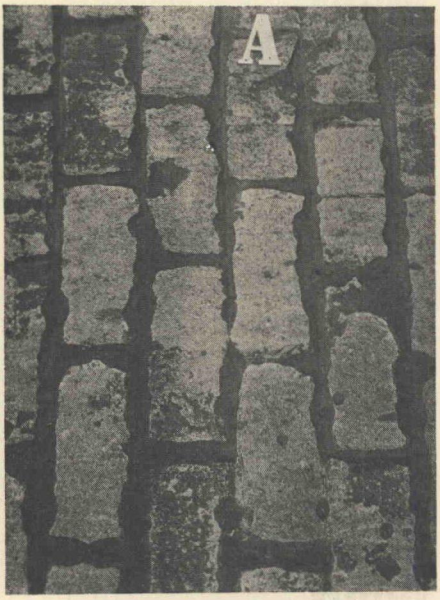


Figure 8A. Filler No. 8A

9: This asphalt filler meets the same specifications as Filler 8 but is from a 100 per cent asphaltic base crude. Exuding in this section might be designated as medium and is not equal to that exhibited by No. 8. (Fig. 9)

10: This asphalt has a softening point of 85° to 96°C and is from a mid-continent base crude. Exuding in this case might be designated as moderately heavy but not uniform. (Fig. 10)

11: This asphalt filler meets the same specifications as Filler No. 10 but is from a 100 per cent asphaltic base crude.


Figure 9. Filler No. 9

Exuding in this case might be designated as moderately heavy, being similar in amount to that of No. 10. (Fig. 11)

12: Natural Lake Asphalt. The filler is very soft at summer temperatures. On that part of the section which is superelevated, the filler has flowed from the high curb (leaving joints depressed $\frac{1}{2}$ to $1\frac{1}{2}$ in.) to the low curb which in extreme cases is covered with filler. On that part of the section which is level, the joints are uniformly depressed $\frac{1}{4}$ to $\frac{1}{2}$ in. This filler must be considered unsatisfactory. (Figs. 12 and 12A)

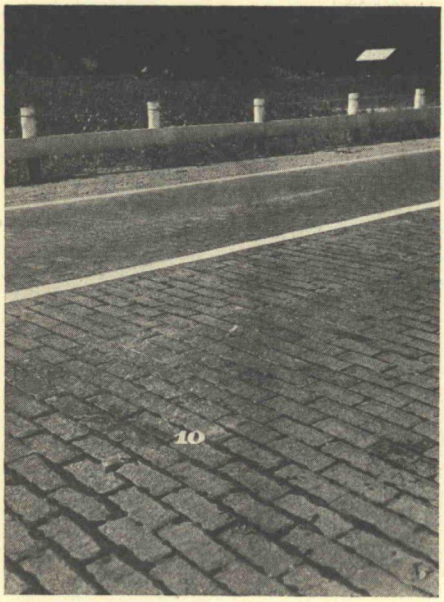


Figure 10. Filler No. 10

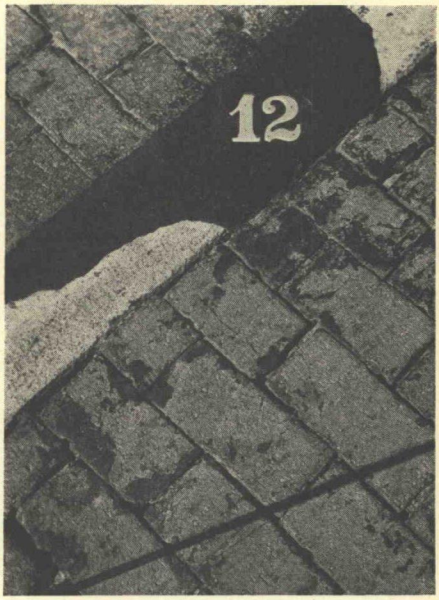


Figure 12. Filler No. 12

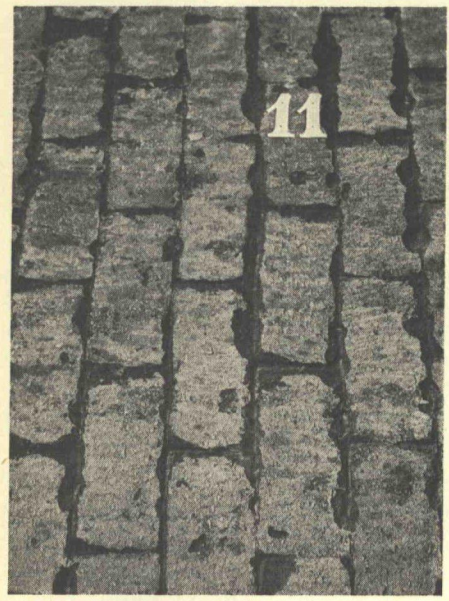


Figure 11. Filler No. 11

Figure 12A. Filler No. 12

13: A special pitch filler of softening point 45° to 50°C and containing 5 per


Figure 13. Filler No. 13

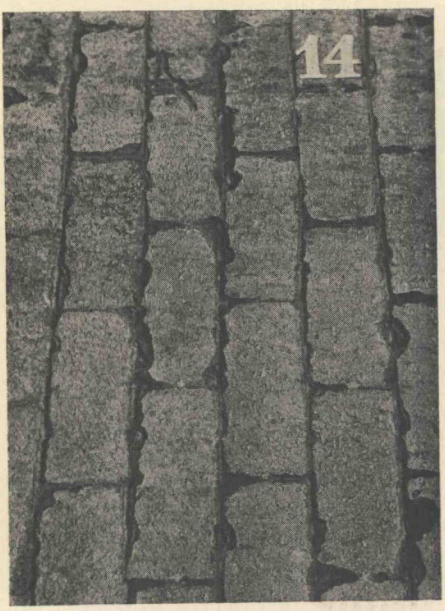


Figure 14. Filler No. 14

cent asbestos. During construction of this section, poor filling and removal were obtained due to softness of the filler. After one year's service the filler shows a tendency to creep onto the side curbs. Joints are uniformly depressed about ½ in. This filler must be considered unsatisfactory. (Fig. 13)

These 13 fillers constituted the original allotment for the filler study and are included in sections of 600 square yards and over. At the last minute the following eight fillers were added in sections somewhat smaller:


Figure 15. Filler No. 15

Numbers 14 and 15: Pitch fillers, one designated as a brick filler and one a crack and joint filler. Both exhibit exuding of medium to heavy degree. (Figs. 14 and 15)

17: A very hard pitch filler. Areas in which a slight movement of the brick is possible, such as that adjoining the first sponge rubber expansion joint of the cement grout section, have exuded heavily. There is also some slight evidence of filler breaking out probably due to brittleness in cold weather. In general, however, the filler has not exuded. (Fig. 17)

18: An asphalt filler containing about

38 per cent slate flour. The filler has receded in the joints and has some tendency to flow to the low side of the pavement. (Fig. 18)


Figure 16. Filler No. 16


Figure 17. Filler No. 17

Fillers 16, 19, 20 and 21: These are all pitch fillers and, while the last three named have exuded to a light or medium degree, No. 16 is practically free from exuding and its section is in excellent condition. (Figs. 16, 19, 20, 21)


Figure 18. Filler No. 18


Figure 19. Filler No. 19

No attempt has been made to draw definite conclusions and close comparisons


Figure 20. Filler No. 20


Figure 21. Filler No. 21

on all the fillers included in this test project. However, one year's service has been sufficient to show that, in their present form, the two grout fillers, the Natural Lake Asphalt and the asbestos filled pitch are not satisfactory, and they will be removed from the test road as a maintenance step. The Ohio State Highway Department, basing their selection on satisfactory behavior in the test road for one year, have designated Fillers 4, 5, 6 and 16 for more extended use and further trial in brick pavement projects.

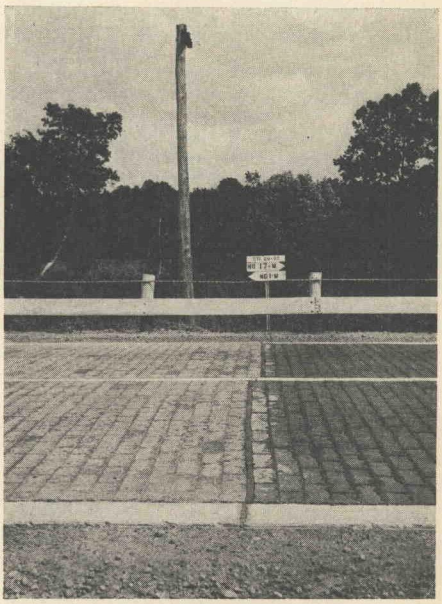

Figure 22. Fillers 1 and 17

During construction of this filler test road seventeen thermocouples were permanently installed in the sub-grade and over the pavement cross section (locations shown on Figure 23). Readings taken over the past year (see Figs. 24–27) revealed the following:

1. The brick surface course temperature was very sensitive to changes of air temperatures and to sun rays. In one instance (July 13), under the influence of bright sun, the brick temperature (121°F) exceeded the air temperature (97°F) by 24°F. This rather closely verified the previously estimated figure of 130°F

which was used as the maximum surface course temperature in laboratory tests of fillers

2 Temperature fluctuations of the brick surface course were transmitted to the concrete base slowly and in lesser degree

3 The temperature of the cushion was a mean of the brick and base temperatures

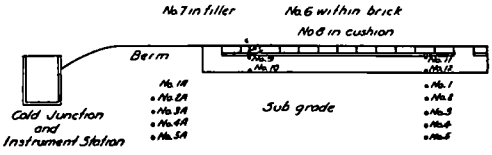


**Figure 23. Location of Thermocouples for Temperature Gradient Hocking County, Ohio**

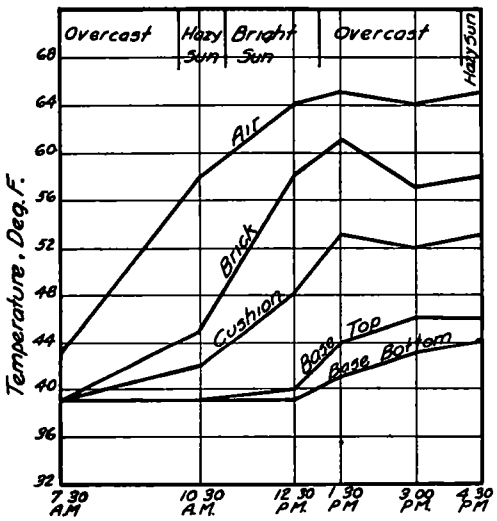


**Figure 24. Temperatures March 11, 1936**

4 Over the one-year period the range of the sub-grade 30 in below the pavement extended from a minimum temperature of 28°F to a maximum temperature of 82°F, this range being expanded for the lesser depths

Referring now to the Carroll County Experimental Brick Road, we find that there has been very little change in its condition since the last report made in 1935 This project was constructed by the Ohio Highway Department in 1933

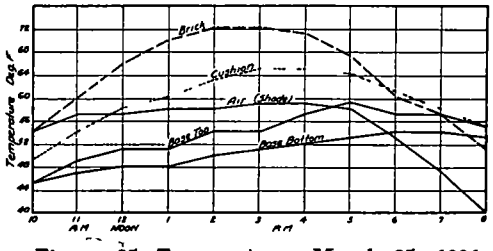


**Figure 25. Temperatures March 25, 1936 Bright Sun 10:30 A M. to Sunset (6:20 P.M.). Moderate West Wind Ceasing at Nightfall**

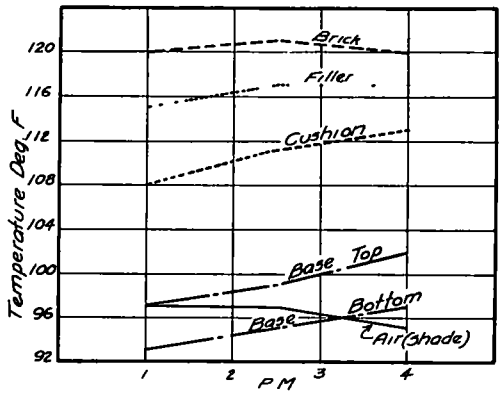


**Figure 26. Temperatures July 13, 1936 Sun, Gentle Varying Wind**

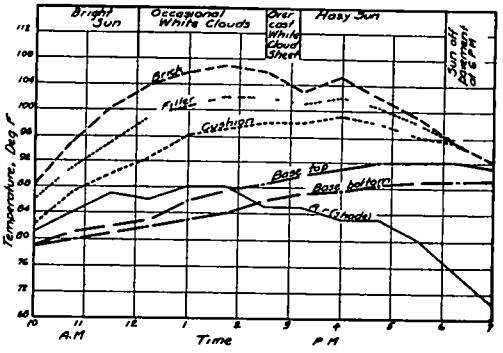


**Figure 27. Temperature September 9, 1936 Gentle Varying Wind**

for the purpose of comparing different types of brick road design rather than

experimental fillers as in the Hocking County road The following summarizes briefly the outstanding developments on the Carroll County road:

1 The monolithic sections are still in good condition showing only one failure in slabs and one in joints

2 Transverse cracking in the grout filled sections, previously reported to have consisted of one crack in each 100 foot slab, has increased to two cracks in some cases

3 Excessively exuded filler is still prevalent on all bituminous filled sections

4 Expansion joint failure is increasing in the grout filled sections This is due to poor alignment of the base joints with the brick joints

5. More evidence of cushion displacement was noted on sections with granulated slag

Some results of these brick road experiments have been very gratifying For example, in the filler study, it is felt that a definite step has been made in the past year Whereas, one year ago the experimental fillers were just emerging from the laboratory stage, four fillers, representing four classes, are now deemed worthy of use in whole projects and, in the case of at least one, at little extra cost