MEMORANDUM

TO: W. B. Drake, Assistant State Highway Engineer
Chairman, Kentucky Highway Research Committee

RE: Research Report, "Kentucky Rock Asphalt,
Traffic-Bound Bases"; KYHPR-64-10, HPS-HPR-1(25)

The above-entitled report, attached hereto,
supplements an earlier one which was entitled: "...Experimental Use of Natural, Bituminous, Quartz Sandstone
(Kentucky Rock Asphalt) as a Traffic-Bound Aggregate",
and which was submitted in December, 1962. Whereas the
earlier report pertained solely to the original experimental application, the current report includes five
additional case studies and records the construction and
performance features observed. Even so, it is principally an interim report of progress and is issued at
this time for review and for guidance of the Department's
further activities in this area. I am referring, of
course, to the scheduling of additional experimental
work during the current season and to the types of
experimental treatments now adjudged to merit attention
and consideration.

You will recall that considerable forethought
was given to the potential binding characteristics of
the materials containing appreciable quantities of the
bitumen. Originally, two levels of bitumen content were
sought; but sorting material on that basis proved to be
somewhat impractical - mindful, of course, that bitumen-rich material was preferred. As was somewhat foreseen,
a dilemma has evolved from the tendency of the material
richer in bitumen to bind together when it is applied
during the summer season. In some instances, the result-
ing surface was sealed in an attempt to preserve its pave-
ment-like features; but, because of structural inade-
quacies—attributable to deficiencies in thickness—
some sustained extensive breakup during the winter season
and could not be easily reworked with a patrol grader.
Elsewhere, the roads could be maintained as typical
traffic-bound roads.

The dilemma mentioned above emanates largely
from the tendency of the material to bind together under
certain conditions and the desire to fully utilize the
apparent potentialities of the material. Whereas the
aggregate minimizes the dust problem normally associated
with traffic-bound roads and can be used at will as
supplemental aggregate on unsurfaced roads, the question
remains as to whether or not this material, if applied
in sufficient quantities and thicknesses and sealed,
would be capable of rendering service as a pavement and
whether or not such usage would be economically feasible
in comparison to regular traffic-bound roads or traffic-
bound roads receiving initial surfacing. Test Section
No. 6 demonstrated thus far a favorable likelihood from
the standpoint of structural adequacy. However, the
answer to the other question posed cannot be resolved
at this time.

On the basis of the experience gained thus far,
I can confidently recommend continued use of the material
as a traffic-bound aggregate and especially so as supple-
mental aggregate for this series of test sections when
the need arises. Additional sections constructed will be
included in the study for surveillance. It is suggested
that consideration be given to further experimentation
involving base and surface courses in lieu of conventional
types of initial surfacing. This suggestion is made with
the understanding that the experimental work would be
confined to the immediate area surrounding the source of
supply and, thereby, not require excessive transportation
costs.

Respectfully submitted,

Jas. H. Havens
Director of Research
Secretary, Kentucky Highway
Research Committee

Attachment

cc: Research Committee
    R. O. Beauchamp
    R. L. Campbell
    T. J. Hopgood
    A. O. Neiser
    D. V. Terrell
Research Report

KENTUCKY ROCK ASPHALT, TRAFFIC-BOUND BASES

AN INTERIM REPORT
Project KYHPR-64-10; HPS-HPR-1(25)

by

George R. Laughlin
Research Engineer
DEPARTMENT OF HIGHWAYS
Commonwealth of Kentucky

in cooperation with the
BUREAU OF PUBLIC ROADS
U. S. Department of Commerce

132 Graham Avenue
Lexington, Kentucky

June, 1964
INTRODUCTION

Kentucky rock asphalt (a medium-grained quartz sandstone impregnated with natural bitumen) occurs as major deposits in Edmonson, Grayson, Hardin, Breckinridge, Logan and Warren Counties. Physiographically these deposits occur along the southeastern margin of the Western Coal Field. Geologically the Caseyville formation (particularly the Bee Spring member) of the Pottsville series of the Pennsylvania strata and the Hardinsburg and Cypress sandstones of the Middle Chester series of the Mississippian strata are of interest. The areal geology of Kentucky is shown in Figure 1 and the locations of rock asphalt deposits are depicted in Figure 2.

Locally the deposits are erratic and lenticular. The amount of bitumen varies, ranging from a trace to saturation. Rock having less than four percent bitumen generally appears brown in color. Rock having bitumen in excess of four percent usually appears dull black, while rock having higher contents of bitumen appears shiny black. The properties of the bitumen varies with each deposit. Volatilization of lighter hydrocarbons and oxidation, controlled by the amount of overburden and percolating ground waters, have brought about these differences.

Kentucky rock asphalt has been used primarily as a road surfacing material. The properties that have led to its extensive use are: surface texture, non-glaring surface, and anti-skid properties. During the era before rubber tires, rock asphalt was much desired for use in city streets and residential areas for deadening sound and shock of traffic. The surface texture of rock asphalt has always
Fig. 1 Areal Geology of Kentucky
given a pleasing, smooth appearance to roads. Most important is the skid resistance of the material. The anti-skid characteristics of rock asphalt is attributed to the grading and angularity of the quartz grains of which the material is composed.

The rock asphalt industry in Kentucky began in the 1880's. A report by Edward Orton in 1891 describes the rock asphalt deposits and covers the early history of its use as a road surfacing material. With the road building era of the 1920's and 1930's, production of rock asphalt was at its peak. In 1927, 340,000 tons, having an estimated worth of $3,000,000, were produced. From the beginning of the industry to its collapse in 1957, more than fifteen companies were engaged in quarrying and processing rock asphalt. The leading and last producer was the Kentucky Rock Asphalt Company which marketed the material under the trade name of "Kyrock". Production was revived and then declined in the post war period; and, with the close of the Kentucky Rock Asphalt Company in 1957, the industry in Kentucky was at an end.

As a road-surfacing material, rock asphalt was a highly processed material. Selective quarrying and blending was used to meet specification requirements of a material having a bitumen content of 6.2 percent to 10.5 percent. The material was milled to pass a No. 4 sieve. In preparation for laying, the rock asphalt was heated with steam to make the material workable.

The collapse of the industry may be attributed to the inability

Orton, Edward, Occurrence of Petroleum, Natural Gas, and Asphalt Rock in Western Kentucky, Geological Survey of Kentucky, 1891.
of the slow curing rock asphalt to perform under present-day traffic and to the growth of the plant-mix asphalt industry. The inability of rock asphalt to perform satisfactorily was attributed to the softness of the bitumen. Where performance was unsatisfactory, deterioration occurred immediately after placement -- that is, in the form of scaling, striping, and sanding. Where allowed to cure (time for bitumen to harden), the rock asphalt has given satisfactory performance; and many miles of highway yet remain as evidence of the preferred performance of the material.

Paving mixtures produced from refinery asphalts are not only more economical than the highly processed rock asphalt but also give more reliable performance. Hot-mix material may be subjected to traffic shortly after placing, without detrimental effects. However, rock asphalt is still one of the best anti-skid materials known. A report by J. H. Havens and E. G. Williams covers past methods of using rock asphalt as a surfacing material.

Because of a desire to use available local materials in highway construction and maintenance, a program was initiated recently to study the feasibility of using this material as a dust-free, traffic-bound base and surface and as a material for stage construction of bases on rural roads. Five traffic-bound macadam roads in Edmonson and Grayson Counties have been treated with rock asphalt. Of these test sections, two have been treated with a No.-610 gradation applied approximately two inches thick and sealed with an asphaltic emul-

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The three remaining sections were resurfaced with a crusher-run gradation which was applied approximately two inches thick. A sixth test section is composed of a five-inch compacted base of rock asphalt which was sealed with asphaltic emulsion. A detailed report covering the construction phase of Test Section No. 1 was prepared by the Division of Research in December, 1962.

Although a thorough evaluation cannot be fully developed at the present, several conclusions are evident:

1. The use of rock asphalt as an aggregate in base construction is economically feasible.

2. The bases constructed thus far have given satisfactory service.

3. In contrast to traffic-bound limestone bases, there is less attrition of the aggregate and less dusting of the road surface.

4. When constructed during the summer months, rock asphalt bases become compacted, firm, and dustless (the aggregate becomes knitted and cemented together).

5. When constructed during cool weather, and especially in the fall, the material remains in a loose condition (the bitumen does not bind the aggregate together until the following summer).

6. When proper construction methods are employed and adequate thickness is provided, rock asphalt will serve as an excellent, economical, dust-free, base and surface on rural roads.

7. Where bases are constructed with full thickness, seal coating will render the surface more impervious to surface water and minimize softening of the subgrade.

8. The use of spreader boxes in placing the rock asphalt en-

hances the smoothness of the road surface.

Quantities and costs of construction of rock asphalt bases and seal coats for the test sections are tabulated in Table 1. Although the cost of producing a crusher-run gradation of rock asphalt is relatively cheap, the cost in place, as with any aggregate, depends upon the length of haul. Figure 2 depicts the areas of rock asphalt occurrence and may serve as an aid in determining where rock asphalt may be utilized as a base material. The average cost of maintaining Test Sections 1 and 2 was $70.23 per mile for the first year.
### Table I

**QUANTITIES AND COSTS OF BASE AND SEAL COAT-CONSTRUCTION**

<table>
<thead>
<tr>
<th>Test Section No.</th>
<th>Length (miles)</th>
<th>Width of Base (feet)</th>
<th>Area of Base (sq. yds.)</th>
<th>Rock Asphalt Applied (total tons)</th>
<th>Rock Asphalt Applied (lbs. per sq. yd.)</th>
<th><em>Cost, Rock Asphalt Base (per mile)</em></th>
<th><em>Cost, Rock Asphalt Base (per sq. yd.)</em></th>
<th>Emulsion Application Rate (gals. per sq. yd.)</th>
<th>Sand-Size Rock Asphalt Overlay Application Rate (lbs. per sq. yd.)</th>
<th>Seal Coat Cost (per sq. yd.)</th>
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<tbody>
<tr>
<td>No. 1</td>
<td>3.27</td>
<td>16</td>
<td>30,675</td>
<td>3,500</td>
<td>228</td>
<td>$2,836.00</td>
<td>$0.34</td>
<td>0.056</td>
<td>4.5</td>
<td>$0.065</td>
</tr>
<tr>
<td>No. 2</td>
<td>2.70</td>
<td>14</td>
<td>22,275</td>
<td>2,410</td>
<td>216</td>
<td>$2,640.00</td>
<td>$0.32</td>
<td>0.15</td>
<td>10</td>
<td>$0.08</td>
</tr>
<tr>
<td>No. 3</td>
<td>2.30</td>
<td>18</td>
<td>24,288</td>
<td>1,725</td>
<td>142</td>
<td>$3,300.00</td>
<td>$0.31</td>
<td>--</td>
<td>--</td>
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</tr>
<tr>
<td>No. 4</td>
<td>2.00</td>
<td>18</td>
<td>21,120</td>
<td>1,500</td>
<td>142</td>
<td>$3,315.00</td>
<td>$0.31</td>
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<td>--</td>
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<tr>
<td>No. 5</td>
<td>6.15</td>
<td>18</td>
<td>64,964</td>
<td>4,615</td>
<td>142</td>
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<td>--</td>
<td>$0.10</td>
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<td>No. 6</td>
<td>0.03</td>
<td>20</td>
<td>367</td>
<td>96</td>
<td>523</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Based on 10,550 sq. yds. per mile*
TEST SECTION NO. 1

County: Edmonson
Road: Ky 238, Sunfish-Independence School Road
Project: MP 31-298-B
Length: 3.27 miles
Width: 16 feet
Initial Condition: Traffic-bound limestone base, 0 in. to 3 in. thick, 1 1/2 in. average thickness (Fig. 4)
Treatment: Base: 225 lbs/sq yd of a No.-610 gradation of rock asphalt,
1500 ft. at the eastern end of test section - Primed with 0.3 gal/sq yd of RT-2 before placement of rock asphalt base.
Seal: 500 ft. located one mile from western end of test section - 0.05 gal/sq yd of RS-2 overlain with 4.5 lbs/sq yd of a sand-size rock asphalt.
Procedure: Shaping existing roadway.
Spreading rock asphalt on roadway with dumptrucks (Fig. 5).
Shaping to line and grade with a patrol grader (Fig. 6).
Compacting of rock asphalt base with pneumatic roller.
Sealing operation.
Date: Rock asphalt base - August, September, 1962.
Seal - October, 1962.
Condition Surveys: The rock asphalt base placed on the western portion of the project during dry, warm weather compacted readily under traffic, forming a firm, dense base. Because of thinness of the base, "map" cracking and chuckholes developed during the spring when the subgrade was in the weakest condition. Maintenance of this portion has consisted of patching chuckholes. The 500-ft. section that was sealed has given much better performance. The only deterioration is adjacent to a culvert where flexure of the subgrade has produced "map" cracking of the rock asphalt base. The sub-section constructed during cool, wet weather has performed still differently. The rock asphalt base remained in a loose state until the following summer when the aggregate in some areas knitted together. Maintenance of this subsection has consisted of regular bladings with a patrol grader.

Figures 5 through 22 illustrate the construction and performance of the section.
Fig. 5 Test Section No. 1. Placing Rock Asphalt Base. August, 1962

Fig. 6 Test Section No. 1. Shaping Rock-Asphalt Base. August, 1962
Fig. 7 Test Section No. 1, Completed Portion of Rock Asphalt Base. August, 1962

Fig. 8 Test Section No. 1, Condition of Rock Asphalt Base on Eastern Portion of Road. October, 1962
Fig. 9 Test Section No. 1. Condition of Rock Asphalt Base on Western Portion of Road. October, 1962

Fig. 10 Test Section No. 1. Condition of Rock Asphalt Base. November, 1962. Portion in background was constructed during dry, warm weather. Portion in foreground was constructed during cool, wet weather.
Fig. 12 Test Section No. 1. Condition of Rock Asphalt Base, May, 1963. This portion was constructed during cool, wet weather.

Fig. 13 Test Section No. 1. Condition of Rock Asphalt Base, May, 1963. This portion was constructed during dry, warm weather. The area in the background was sealed in October, 1962.
Fig. 14 Test Section No. 1. Condition of Rock Asphalt Base on Western Portion of Road, June, 1963

Fig. 15 Test Section No. 1. Close-Up of Surface Depicted in Fig. 14, June, 1963
Fig. 16 Test Section No. 1. Condition of Sealed Rock Asphalt Base on Western Portion of Road, October, 1963

Fig. 17 Test Section No. 1. Condition of Rock Asphalt Base on Eastern Portion of Road, October, 1963
Fig. 18 Test Section No. 1. Condition of Rock Asphalt Base on Eastern Portion of Road, January, 1964

Fig. 19 Test Section No. 1. Close-Up of Rock Asphalt Base Depicted in Fig. 18. January, 1964
Fig. 20 Test Section No. 1. Condition of Sealed Rock Asphalt Base. January, 1964

Fig. 21 Test Section No. 1. Condition of Rock Asphalt Base on Western Portion of Road. January, 1964
Fig. 22 Test Section No. 1. Condition of Rock Asphalt Base on Western Portion of Road. April, 1964
Fig. 23 Test Section No. 2, Edmonson County
TEST SECTION NO. 2

County
Road
Project
Length
Width
Initial Condition
Northern portion: Unstable metal averaging 1/2 in thick.
Southern portion: Stable metal averaging 1 in. thick (Fig. 24).

Condition
Northern portion: Unstable metal averaging 1/2 in thick.
Southern portion: Stable metal averaging 1 in. thick (Fig. 24).

Treatment
Base: 216 lbs/sq yd of a No.-610 gradation of rock asphalt.
Seal: 0.15 gal/sq yd of RS-2 covered by 10 lbs/sq yd of sand-size rock asphalt.

Procedure
Shaping existing roadway. Spreading aggregate on roadway with dump trucks. Shaping to line and grade with a patrol grader. Sealing operation.

Date
Seal - October, 1963.

Condition Survey
This test section gave satisfactory service until the spring thaw. Prior to sealing, maintenance consisted of patching chuckholes. After sealing and before the spring thaw, this section required no maintenance. Because of the thinness of the base, chuckholes have developed over approximately 20 percent of the roadway (Fig. 36 and 37).

The traffic-bound limestone portion of this test section has given satisfactory service. There is a contrast between the performance of the two materials, however. The rock asphalt has resulted in a dustless, compact, all-weather surface. There is no evidence of loss of material from the road. The sealed, rock asphalt base has performed as a bituminous concrete pavement. The aggregate of traffic-bound limestone has remained in a loose condition, particularly the coarser aggregate. The road is dusty in dry weather and muddy in wet weather.
Figures 24 through 37 depict the condition of the rock asphalt project and the traffic-bound limestone section before and after construction.
Fig. 24 Test Section No. 2. Initial Condition of Road. May, 1963. After Reshaping but prior to Placement of Rock Asphalt Base

Fig. 25 Test Section No. 2. Initial Condition of Traffic-Bound Limestone Portion of Road. May, 1963. After Supplemental Application of 610's
Fig. 26 Test Section No. 2. Condition of Rock Asphalt Base.
July, 1963

Fig. 27 Test Section No. 2. Condition of Rock Asphalt Base.
July, 1963
Fig. 28 Test Section No. 2. Condition of Traffic-Bound Limestone Portion, October, 1963

Fig. 29 Test Section No. 2. Condition of Traffic-Bound Limestone Portion. October, 1963. Rock Asphalt Section Appears in Background
Fig. 30 Test Section No. 2. Condition of Rock Asphalt Base. October, 1963. Prior to Sealing

Fig. 31 Test Section No. 2. Condition of Rock Asphalt Base. October, 1963. Depicting Chuckhole Patched with Rock Asphalt and Sealed with Emulsion Prior to Application of Over-all Seal
Fig. 32 Test Section No. 2. Applying Sand-Size Rock Asphalt on Emulsion Seal. October, 1963

Fig. 33 Test Section No. 2. Sealed Rock Asphalt Base. October, 1963
Fig. 34 Test Section No. 2. Condition of Traffic-Bound Limestone Portion. January, 1964. After a Rain

Fig. 35 Test Section No. 2. Condition of Sealed Rock Asphalt Base. January, 1964
Fig. 36 Test Section No. 2. Typical Chuckholes. April, 1964. Logging Trucks Were Observed on This Road in March.

Fig. 37 Test Section No. 2. Close-up View of Chuckhole. April, 1964. Note the thinness of the pavement section - 1" of rock asphalt and 1/2" of agricultural limestone underlain by soft subgrade.
Fig. 38  Test Section No. 3. Grayson County
TEST SECTION NO. 3

County          Grayson
Road            Clarkson - Thomas School Road
Project         RSR 43-205-351
Length          2.30 miles
Width           18 feet
Initial Condition
Traffic-bound limestone base averaging 3 1/2 in. thick (Fig. 39).
Binder-size material constitutes approximately one-third of the base.

Treatment       142 lbs/sq yd of crusher-run (passing 1-in. sieve) rock asphalt.

Procedure       Shaping existing roadway.
                Spreading rock asphalt to line and grade with an adjustable spreader box.

Date            October, 1963.

Condition Survey
Since placement of the rock asphalt, the material has remained in a loose condition. The roadway is maintained by regularly blading the surface. Immediately after blading, the surface is smooth, but numerous, shallow chuckholes soon develop and the surface becomes extremely rough.

Figures 39 through 42 show the original condition of the road and the condition of the rock asphalt base since placement.
Fig. 39 Test Section No. 3. Initial Condition of Road. October, 1963

Fig. 40 Test Section No. 3. Condition of Rock Asphalt Base. January, 1964. This section was constructed in October; photo was taken following a rain.
Fig. 41 Test Section No. 3, Condition of Rock-Asphalt Base. January, 1964. Mottled appearance is due to water on the surface.

Fig. 42 Test Section No. 3. Numerous, Shallow Chuckholes and Rough Surface. April, 1964. This section of road has been maintained with a patrol grader.
Fig. 43 Test Section No. 4, Grayson County
TEST SECTION NO. 4

County: Grayson
Road: McGrew School Road
Project: RH 1140-AML
Length: 2.00 miles
Width: 18 feet
Initial Condition: Traffic-bound base, 2 in. average thickness (Fig. 44).
Treatment: 142 lbs/sq yd of crusher-run (passing 1-in. sieve) rock asphalt.
Procedure: Shaping existing roadway. Spreading rock asphalt to line and grade with an adjustable spreader box (Fig. 45).
Date: October, 1963.
Condition Survey: This test road has given satisfactory service. The material, however, has not knitted together since the base was placed in cool weather. Periodic grading is required to keep the surface smooth. As a result of grading, subgrade material has been mixed with the base, resulting in a rather dusty road during dry weather.

Figures 45 through 48 depict the construction of the Test Section and its condition since construction.
Fig. 46 Test Section No. 4. Condition of Rock Asphalt Base.
October, 1963

Fig. 47 Test Section No. 4. Condition of Rock Asphalt Base.
January, 1964
Fig. 48 Test Section No. 4. Smooth Surface Immediately After Blading. April, 1964
TEST SECTION NO. 5

County: Grayson
Road: Shrewsbury - Ready Road
Project: RSR 43-175-2S1
Length: 6.152 miles
Width: 18 feet
Initial Condition: Traffic-bound base, 1/2 in., average thickness (Fig. 50).
Treatment: 142 lbs/sq yd of crusher-run (passing 1-in. sieve) rock asphalt.
Procedure: Shaping existing roadway.
Spreading rock asphalt to line and grade with an adjustable spreader box.
Date: October, 1963.
Condition Survey: Because of the thinness of the rock asphalt base and thinness of the existing base material, several areas developed rutting during wet weather. However, where the base was of sufficient thickness and drainage adequate, the rock asphalt base has given satisfactory service. Since the rock asphalt base was placed during cool weather, the material has remained in a loose condition and periodic grading has been required to keep the surface in a smooth condition. The surface is relatively dusty during dry weather because of subgrade material mixed into the base during grading operations.

Figures 50 through 56 depict the condition of the project prior to application of rock asphalt and afterwards.
Fig. 50 Test Section No. 5. Initial Condition of Road.
October, 1963
Fig. 51 Test Section No. 5. Condition of Rock Asphalt Base. January, 1964. Small potholes may be noted in the foreground.

Fig. 52 Test Section No. 5. Condition of Rock Asphalt Base. January, 1964. Failures here are due to rich clay in subsoil.
Fig. 53 Test Section No. 5. Condition of Rock Asphalt Base. January, 1964. Failure here was due to an outcrop of clay. Snow whitened the landscape.

Fig. 54 Test Section No. 5. Condition of Rock Asphalt Base. January, 1964. Note the three wheel paths. Snow covers the landscape.
Fig. 55 Test Section No. 5, Condition of Rock Asphalt Base. January, 1964. This portion of the road has given excellent performance.

Fig. 56 Test Section No. 5, Close-Up of Surface of Rock Asphalt Base. January, 1964.
Fig. 57 Test Section No. 6, Edmonson County
<table>
<thead>
<tr>
<th>County</th>
<th>Grayson</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road</td>
<td>Entrance to plant site in Brownsville</td>
</tr>
<tr>
<td>Project</td>
<td>Special</td>
</tr>
<tr>
<td>Length</td>
<td>165 feet</td>
</tr>
<tr>
<td>Width</td>
<td>20 feet</td>
</tr>
<tr>
<td>Initial Condition</td>
<td>New fill, soft shoulders.</td>
</tr>
</tbody>
</table>

**Treatment**

- Base: 5 in-of compacted crusher-run (passing 1-in. sieve) rock asphalt.
- Seal: 0.34 gal/sq yd of SS-1H covered with 10 lbs/sq yd of sand-size rock asphalt.

**Procedure**

- Placing of rock asphalt on subgrade in two lifts with an adjustable spreader box (Fig. 58).
- Compacting each lift with a pneumatic roller and a three-wheeled roller (Fig. 59 and 60).
- Sealing Operation (Fig. 62 through 64).

**Date**


**Condition Survey**

This test section has given excellent service. Being five inches thick, the sealed base has supported heavy construction equipment exceptionally well. Where the base was thinned on each end of the road some chuckholes have developed. No maintenance has been required on this section.

Figures 58 through 64 show the construction of the test section. Figure 65 shows the condition after five months.
Fig. 58 Test Section No. 6. Placing Rock Asphalt Base. November, 1963

Fig. 59 Test Section No. 6. Compacting Rock Asphalt Base with a Pneumatic Roller. November, 1963
Fig. 60 Test Section No. 6. Compacting Rock Asphalt with Pneumatic and Three-Wheeled Roller. November, 1963
Fig. 61 Test Section No. 6. Effects of Rollers Depicted in Fig. 60
View on left shows result of three-wheeled roller. View
on right shows results of Pneumatic roller
Fig. 62 Test Section No. 6. Application of SS-1h Emulsion on Rock-Asphalt Base. November, 1963

Fig. 63 Test Section No. 6. Applying Sand-Size Rock-Asphalt on Emulsion Seal. November, 1963
Fig. 64 Test Section No. 6. Compacting Rock-Asphalt Emulsion Seal-Coat. November, 1963

Fig. 65 Test Section No. 6. Condition of Road Surface. April, 1964