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STATE OF ILLINOIS

DEPARTMENT OF PUBLIC WORKS AND BUILDINGS

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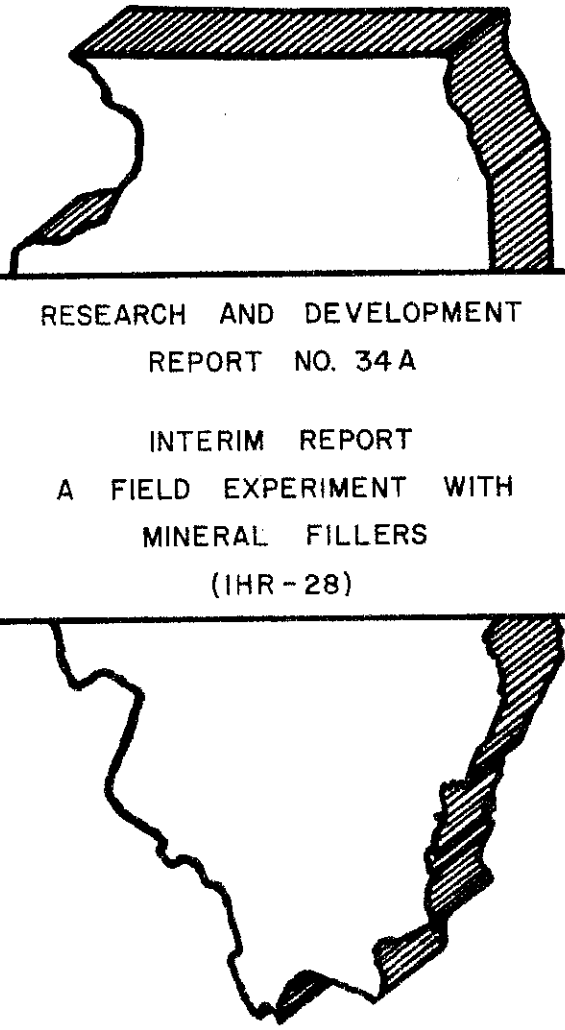

RESEARCH AND DEVELOPMENT REPORT NO. 34A

INTERIM REPORT

A FIELD EXPERIMENT WITH MINERAL FILLERS

(IHR-28)

RESEARCH & DEVELOPMENT

ILLINOIS DIVISION OF HIGHWAYS

State of Illinois
DEPARTMENT OF PUBLIC WORKS AND BUILDINGS
Division of Highways
Bureau of Research and Development

A FIELD EXPERIMENT WITH MINERAL FILLERS

Interim Report for Project IHR-28,
Rehabilitated AASHO Road Test

by

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A Research Study
by
Illinois Division of Highways
in cooperation with
U.S. Department of Transportation
Federal Highway Administration

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ABSTRACT

Eight years of service experience with four inert mineral filler types in dense-graded bituminous concrete (Class I) in an experimental project at the site of the former AASHO Road Test facility has shown no important behavioral differences attributable to individual characteristics of the mineral fillers. Laboratory tests of samples of the pavements recovered at age five years also showed no important differences. Mineral fillers included in the investigation were limestone dust, asbestos fiber, hydrated lime, and kaolin clay. The limestone dust, hydrated lime, and kaolin clay were used individually in the mixtures; the asbestos fiber was used in combination with limestone dust. All pavement of the experimental project is showing acceptable service at the age of eight years.

SUMMARY

Inert mineral fillers are often prescribed to raise the dust content (minus No. 200 sieve fraction) of bituminous concrete mixtures to levels above those normally imparted by the dust fractions of the aggregates that are used. Experience has shown that the additional fine material helps to improve the strength and water tightness of the mixtures by reducing void sizes. Mineral fillers are often described in specifications as "dry limestone dust or other materials approved by the Engineer."

At the time that the restoration of the AASHO Road Test facility was being planned in 1965, the possibility that materials other than the limestone dust then being used almost exclusively in Illinois might perform better as fillers was under discussion. A decision was made to include three filler types in addition to limestone dust for evaluation in the restoration.

Kaolin clay, hydrated lime, asbestos fiber, and the regularly used limestone dust were the four materials placed under observation. The limestone dust, hydrated lime, and kaolin clay were used individually in the mixtures; the asbestos fiber was used in combination with limestone dust. All were included in the standard Illinois dense-graded bituminous concrete mixture and placed in accordance with Illinois Standard Specifications.

Eight years of service experience with the four filler types has shown no important behavioral differences attributable to individual characteristics of the mineral fillers. Laboratory tests of samples of the pavements recovered at age five years also showed no important differences. All pavement of the experimental project is showing acceptable service at the age of eight years.

The results of the study provide a good indication that any of the four mineral fillers included in the experimentation can be expected to perform adequately in dense-graded bituminous concrete under environmental conditions such as exist at the site where the AASHO Road Test was conducted in Illinois.

A FIELD EXPERIMENT WITH MINERAL FILLERS

INTRODUCTION

The Illinois Standard Specifications for Road and Bridge Construction, as do many other highway specifications, prescribe the use of inert mineral fillers to raise the dust content (minus No. 200 sieve fraction) of bituminous concrete mixtures to levels above those normally imparted by the dust fractions of the aggregates that are used. Experience has shown that the additional fine material helps to improve the strengths and watertightness of the mixtures by reducing void sizes. The Illinois specifications describe mineral fillers as "dry limestone dust, or other materials approved by the Engineer," and require conformance with certain sieve size requirements.

At the time that the restoration of the AASHO Road Test facility was being planned in 1961, the possibility that materials other than the limestone dust then being used almost exclusively might perform better as fillers was under discussion. A decision was made to include three filler types in addition to limestone dust for evaluation in the restoration. The selection of the restored Road Test pavements for the study had no particular significance except that the observations could be added conveniently to other evaluative observations planned for the site.

The several fillers were included in the bituminous concrete mixtures that were used to resurface the flexible pavement test sections that had become badly rutted and sometimes otherwise damaged by the very heavy trucks used in the controlled traffic tests of 1958-61. Some of the fillers were used also in the surfacings in a few short sections of composite pavement that were newly established during the restoration. The restoration work took place in 1962, and the pavements were opened to regular traffic in December of that year.

Kaolin clay, hydrated lime, asbestos fiber, and the regularly used limestone dust were the four filler materials placed under evaluation. The limestone dust, hydrated lime, and kaolin clay were used individually in the mixtures; the asbestos fiber was used in combination with limestone dust. Eight years of observation of the service behavior of the pavements in which the four fillers were incorporated, together with laboratory tests of pavement samples recovered after five years of service, showed no important differences attributable to specific characteristics of the individual fillers. All of the pavements are continuing to give good service.

EXPERIMENTAL LAYOUT

All test sections for this study are in the westbound traffic lanes of Interstate 80 and within the limits of the original flexible pavement experiment of the AASHO Road Test (1958-61). When traffic tests were completed on the original facility, rutting and cracking in most of the flexible surfaces had progressed to the extent that general resurfacing was required to restore the pavements to a condition adequate for Interstate System service. The areas designated for this study contained sections from the original study that ranged from being completely rebuilt while testing was still in progress to near survival at the conclusion of testing.

In the restoration work that included the filler experiment, a leveling course was used to fill major depressions existing in the original surfacing. After the leveling course was applied where needed, a binder course and surface course were applied to the entire length of flexible pavement remaining after the Road Test. The mixes with various fillers were placed as overlays on portions of Loops 5 and 6 of the original Road Test. The sections with standard mineral filler and kaolin clay are in the Loop 5 area. The sections with hydrated lime and asbestos fiber are in the Loop 6 area. All fillers were included in surface course sections; only asbestos fiber and limestone dust were used in the binder course. Two new sections of "full strength" portland cement concrete base surfaced with asphaltic concrete were also included in the experimentation. This composite type construction was used where clearance requirements necessitated lowering the grade under existing structures. Asbestos fiber and limestone dust fillers were included at these locations. Pertinent information relating to the layout of the eight test sections of the study is included in Table 1.

For details regarding the environmental conditions and original construction at the test site, the reader is referred to AASHO Road Test Report 2 (Highway Research Board Special Report 61B), "Materials and Construction" (1962).

MATERIALS AND MIXTURES

Aggregates

The aggregates used in the bituminous concrete mixtures were a crushed dolomitic limestone coarse aggregate from Troy Grove, Illinois, a natural siliceous coarse sand from Ottawa, Illinois, and a natural siliceous fine blend sand from Utica, Illinois. Specified gradation limits for the coarse aggregate, and for the combination of coarse sand and blend sand, are presented in Table 2.

Mineral Fillers

The limestone dust representing the filler materials usually furnished by contractors under the Illinois standard specifications was obtained from a processor at Pontiac, Illinois. Typically, the dry material graded as follows:

Sieve Size	Passing (% by weight)
No. 30	100
No. 100	98
No. 200	92

The experimental asbestos fiber filler material, furnished by the Johns-Manville Company of Manville, New Jersey, was Canadian chrysotile fiber Grade 7M, Quebec Standard Test, Quebec Asbestos Manufacturers Association.

TABLE 1

TEST SECTION DATA

Section	Mineral Filler: Surface Course	Mineral Filler: Binder Course	Station	to Station	Length (ft)	Nominal Minimum Thickness: Binder Course (in.)	Nominal Minimum Thickness: Surface Course (in.)
			Flexible Pavement Overlays				
1	Asbestos fiber	Limestone dust	126+65	140+38	1373	2.0	1.5
2	Asbestos fiber	Asbestos fiber	140+38	154+00	1362	2.0	1.5
3	Hydrated lime	Limestone dust	162+00	194+41	3241	2.0	1.5
4	Limestone dust	Limestone dust	238+00	262+60	2460	3.0	1.5
5	Kaolin clay	Limestone dust	270+60	300+50	2990	3.0	1.5
			Composite Pavement				
6	Asbestos fiber	Asbestos fiber	154+00	158+00	400	1.5	1.5
7	Asbestos fiber	Limestone dust	158+00	162+00	400	1.5	1.5
8	Limestone dust	Limestone dust	262+60	270+60	800	1.5	1.5

TABLE 2

AGGREGATE GRADATION SPECIFICATIONS

Sieve Size Passing	Sieve Size Retained	Specification Limits (% by weight)
	Fine Aggregate	
No. 4		95-100
No. 4	No. 10	5-20
No. 10	No. 40	20-60
No. 40	No. 80	15-50
No. 80	No. 200	15-35
No. 200		0-5
	Coarse Aggregate	
	(a) Binder Course	
1 in.		100
3/4 in.		95-100
1/2 in.		50-75
No. 4		5-15
No. 10		0-5
	(b) Surface Course	
3/4 in.		100
1/2 in.		95-100
3/8 in.		70-85
No. 4		20-50
No. 200		0-5

The experimental hydrated lime filler conformed to the requirements of ASTM Designation: C207-49 Type N Mason's Lime.

The experimental kaolin clay filler was a pulverized natural material obtained from a supplier at Joliet, Illinois. It was essentially a nonplastic material, typically grading as follows in a dry, pulverized condition:

Sieve Size	Passing (% by weight)
No. 20	100
No. 100	77
No. 200	66

Asphalt

The paving asphalt used in the bituminous concrete mixtures was the standard grade PA-5 used by the Illinois Division of Highways for producing the general Class I, Subclass I-11 bituminous concretes. Specifications for this grade of asphalt, and typical test results for the asphalt used on the restoration project, are listed in Table 3.

Bituminous Concrete Mixtures

The bituminous concrete mixtures in which the experimental fillers were incorporated were composed of materials controlled, designed, and mixed under the requirements of the Illinois Standard Specifications for Road and Bridge Construction adopted January 2, 1958, covering bituminous concrete binder and surface courses of the fine dense-graded aggregate type (Class I, Subclass I-11). General gradation and bitumen-content specifications for these mixtures are shown in Table 4. The specific mixtures for this project were designed by the Illinois Division of Highways by the Marshall method using materials submitted by the contractor as representative of those he intended to use. Only the standard limestone dust filler was used in developing the mixture design. The mixing formulas and bitumen contents established for the project, the allowable tolerances, and typical compositions of mixtures furnished on

TABLE 3

ASPHALT SPECIFICATIONS AND TYPICAL TEST VALUES

Test	Specifications for PA-5	Typical Test Values
Flash point (Cleveland open cup), F	450+	625
Penetration at 77F, 100 g, 5 sec	85-100	91
Loss on heating at 325F, 50 g, 5 hrs, %	1.0-	---
Penetration at 77F, 100 g, 5 sec, of asphalt after heating at 325F, as compared with penetration of asphalt before heating, %	70.0+	---
Ductility at 77F, cm	100+	150
Bitumen soluble in carbon tetrachloride, %	99.5	99.88

TABLE 4

MIXTURE GRADATION SPECIFICATIONS

Sieve Size Passing	Sieve Size Retained	Specification Limits (% by weight)	
		Binder Course	
1 in.		95-100	
1 in.	1/2 in.	20-40	
1/2 in.	No. 4	10-30)	) 20-40
No. 4	No. 10	5-15)	
No. 10	No. 40	7-22)	
No. 40	No. 80	5-18)	) 20-35
No. 80	No. 200	3-10)	
No. 200		3-7	
Bitumen		3.5-7.0	
		Surface Course	
1/2 in.		95-100	
1/2 in.	No. 4	25-50	
No. 4	No. 10	10-30	
No. 10	No. 40	7-22	
No. 40	No. 80	5-18	
No. 80	No. 200	3-10	
No. 200		3-7	
Bitumen		4.0-7.0	

Note: Aggregate percentages based on total dry weight of aggregate; bitumen percentages based on total weight of mixture.

the project are shown in Table 5. The design asphalt contents were selected on the basis of the Marshall test results shown in Figures 1 and 2. The Marshall stability and flow values for the design mixtures were determined to be as follows:

Mixture	Marshall Stability, 140F (lbs)	Marshall Flow, 140F (0.01 in.)
Binder course	1900	8.2
Surface course	2100	8.3

Laboratory analysis indicated that the constituent aggregates, filler material, and asphalt combined in the following proportions could be expected to produce the design compositions of Table 5:

Material	Binder Course (%)	Surface Course (%)
Coarse aggregate	53.0	53.0
Fine aggregate, coarse fraction	25.7	25.6
Fine aggregate, blend sand	12.8	12.8
Mineral filler (limestone dust)	3.5	3.1
Bitumen	5.0	5.5

In the experimentation, the hydrated lime and the kaolin clay were used as fillers in place of limestone dust. The asbestos fiber was used in combination with limestone dust. For equivalent workability, it was necessary to increase the asphalt contents of the mixes containing asbestos fiber by 1.2 percent. Other portions of the mixes were adjusted accordingly to accommodate the asphalt content increase.

CONSTRUCTION

Procedures

Prior to placing asphaltic mix, the existing base was primed with a light application of a rapid-curing cutback asphalt (Grade RC-0). The mix was produced on the site in a batch type asphalt plant. Trucks delivered the mix to the paver

TABLE 5

MIXING FORMULAS AND TYPICAL MIXTURES

Passing	Retained	Mixing Formula (% by weight)		Mixture Tolerance (% by weight)	Typical Composition (% by weight)
		Binder Course			
1 in.	3/4 in.	9.0)	30.0	± 5.0	29.9
3/4 in.	1/2 in.	21.0)			
1/2 in.	No. 4	22.0)	30.0	± 5.0	23.7
No. 4	No. 10	8.0)			8.0
No. 10	No. 40	13.4)	)		10.2
No. 40	No. 80	11.2)	30.0)		14.5
No. 80	No. 200	5.4)	)	± 3.0	4.8
No. 200		5.0	)		4.1
Bitumen		5.0		± 0.3	4.8
		Surface Course			
1/2 in.	No. 4	35.0)	57.0	± 3.0	33.3
No. 4	No. 10	22.0)			25.7
No. 10	No. 40	14.5)			14.1
No. 40	No. 80	11.3)	32.0	± 3.0	9.6
No. 80	No. 200	6.2)			4.8
No. 200		5.5		± 1.5	7.0
Bitumen		5.5		± 0.3	5.5

Recommended asphalt content: 5.0 percent

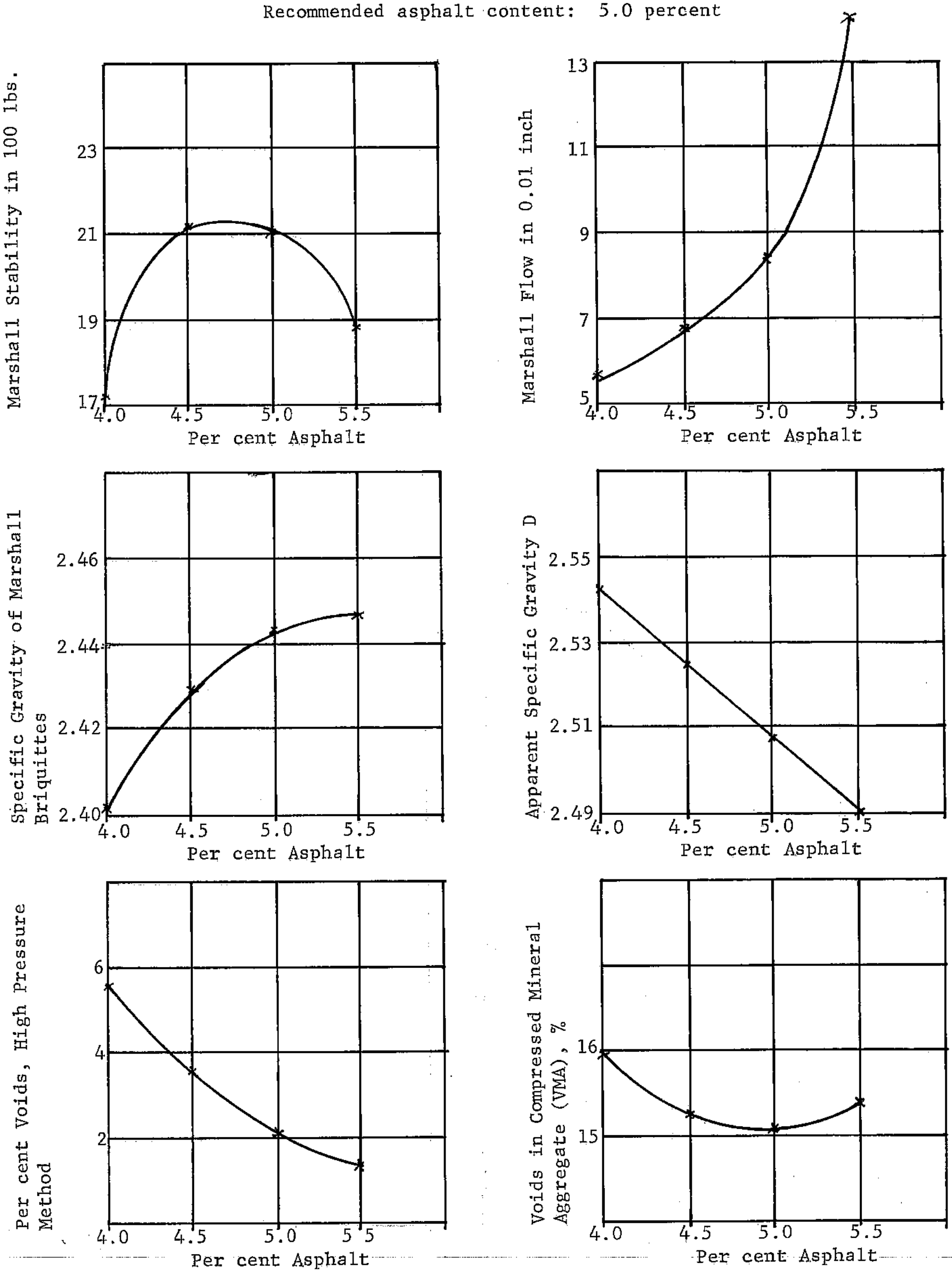

Figure 1. Marshall test results for binder course mixture design

for placement on the base course. All material was placed a lane at a time in thicknesses to produce 1 1/2- or 2-inch compacted lifts as required. Compaction was obtained by a three-wheel breakdown roller followed by a self-propelled pneumatic tired roller and a tandem roller. All work was conducted in accordance with the Illinois 1958 Standard Specifications for Road and Bridge Construction.

During construction, the proportions of the constituent aggregates and mineral fillers were changed slightly from those used in the original laboratory testing because of small variations from the original materials samples. The changes were made to meet the mixing formula. The mineral filler content was set at 2.5 percent for the limestone dust and for the hydrated lime fillers, as compared with 3.1 percent in the design mixture. The kaolin clay content was set at 3.0 percent. The asbestos fiber content was set at 2.0 percent, which was in addition to 2.5 percent limestone dust also included in the mixture. The asphalt content was raised from the 5.5 percent used in the other surface course mixtures to 6.7 percent for the mixture containing the asbestos fiber. An additional 1.2 percent of asphalt was also used in the binder course mixture containing asbestos fiber.

Density

The 1958 standard specifications required that the asphalt concrete be compacted to a minimum of 95 percent of theoretical density (maximum possible density of a voidless mixture of the same materials in like proportion). Samples cut from each day's pavement production showed that this requirement was met throughout the project. Routine samples taken from the surface course at locations within the experimental area showed the relative densities reported in Table 6.

Marshall Stability

Samples taken from regular plant production and tested by the Marshall procedure showed the test values presented in Table 7. It will be noted that, at least for

TABLE 6

RESULTS OF CONSTRUCTION DENSITY TESTS (1962)

Section	Mineral Filler	Relative Density[1] (% of theoretical)
1	Asbestos fiber	98.4
3	Hydrated lime	97.6
4	Limestone dust	96.4
5	Kaolin clay	96.8

(1) Compacted density as percent of theoretical voidless density

TABLE 7

RESULTS OF TESTS OF PLANT SAMPLES (1962)

		Surface Course Filler			Binder Course Filler	
	Asbestos Fiber	Hydrated Lime	Kaolin Clay	Limestone Dust	Asbestos Fiber	Limestone Dust
Stability, lbs	1310	1780	1640	1690	1620	1880
Flow, 0.01 in.	19.1	12.1	9.5	9.9	17.0	14.8
Sp. Gr. (d)	2.41	2.43	2.42	2.42	2.37	2.41
Sp. Gr. (D)	2.45	2.49	2.50	2.50	2.46	2.51
Filler, %	2.0	2.5	3.0	2.5	2.0	2.5
Asphalt, %	6.9	5.6	5.9	5.7	5.7	4.8

(d) bulk specific gravity
(D) theoretical specific gravity of voidless mixture

the single sample taken from the surface course mixture containing the asbestos fiber filler, the Marshall stability was appreciably lower and the flow higher than those test values for the other samples taken.

PERFORMANCE

With the opening of long segments of Interstate 80 both east and west of the test site since its construction in 1962, both passenger car and commercial traffic volumes have risen until traffic in the experimental area is among the highest for rural areas in Illinois. In 1970, the total average daily traffic was 13,400 vehicles, divided as follows: 9,600 passenger cars; 800 single-unit trucks and buses; 3,000 multiple-unit trucks.

Condition Evaluation

Pavement condition surveys were made at the experimental site annually through 1969. Roughness measurements were made at the completion of construction in 1962, and several times subsequently, most recently in 1971, with the Illinois BPR-type roughometer. Skid-resistance measurements were made in 1969 when Illinois acquired a skid trailer meeting the requirements of ASTM Designation E274-65T.

Structural condition.--The only defects that have been noted in the test pavements have been slight rutting in the wheelpaths of the traffic lane, and a small amount of cracking. No perceptible raveling has taken place. The photographs of Figures 3 and 4 show the present appearance (1971) of the traffic-lane wheelpath areas in the limestone dust and asbestos fiber filler sections. All sections present almost an identical appearance. Slight wear from studded tires has been noted in the last two years.

Rut depths have been measured periodically from the center of a 4-foot transverse straightedge placed over the wheelpaths. Averages of a large number of

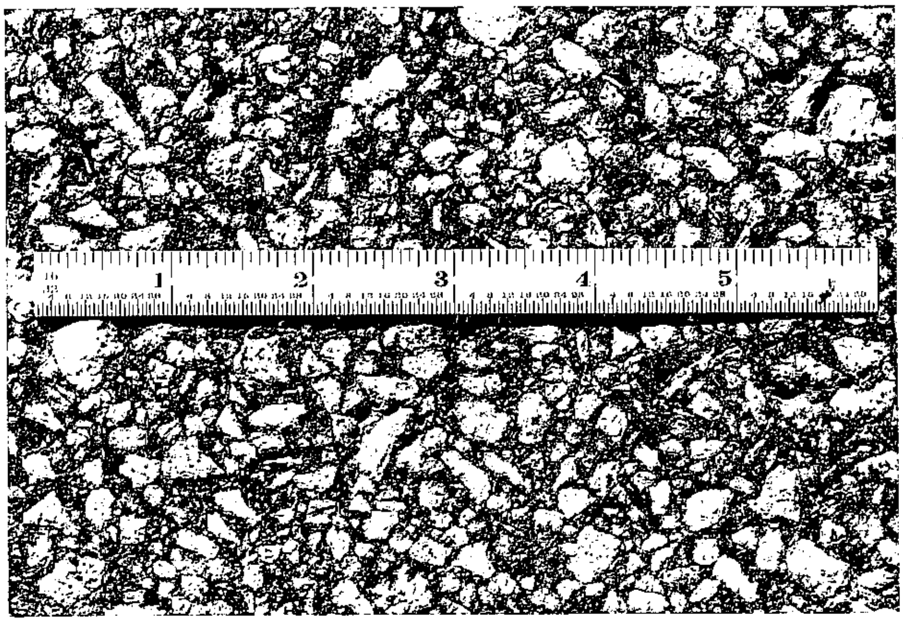

Figure 3. Limestone dust filler, outside wheelpath, traffic lane (1970)

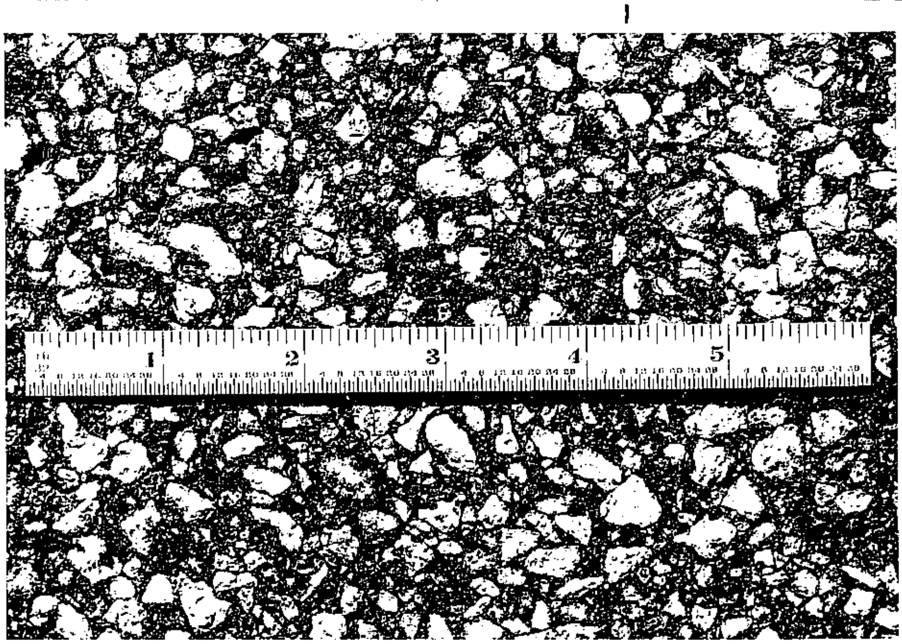

Figure 4. Asbestos fiber filler, outside wheelpath, traffic lane (1970)

measurements made in the wheelpaths of the main traffic lane for the years 1965, 1967, and 1970 are shown in Table 8. No perceptible rutting has been noted in the wheelpaths of the passing lane. It will be seen in the table that rutting, while showing an increase through the years, has not become severe. The asbestos fiber sections appear to be showing somewhat better resistance to rutting than the other sections, although the difference is not sufficiently pronounced to be a real factor in the selection of filler materials. The difference between rutting on the resurfaced sections and on the composite sections is more marked. The effect of the rigid bases of the composite sections in retarding rutting seems fairly obvious.

The small amount of cracking that has been observed in the test sections is mostly of a minor nature and not of consequence in weighing the overall performance of the pavements. It is also seemingly unrelated to filler type. Cracking details from the 1969 condition survey are presented in Table 9.

Surface roughness.--Roughness indexes determined with the Illinois BPR-type roughometer for the separate test sections not long after construction in 1962 and again in 1971 are shown in Table 10. The 1962 readings were taken in the traffic lane only, while the 1971 readings were taken in both the traffic lane and passing lane. While 1962 readings for the passing lane are not available, experience suggests that the roughness indexes for the passing lane may be presumed to be about the same as those for the traffic lane at this early stage following construction. With this presumption, it will be noted in the table that all sections were constructed with a reasonable degree of smoothness. It also will be noted that the wheelpaths in the main lane of travel have mostly become smoother through the years while those in the more lightly traveled passing lane have become somewhat rougher. While no serious roughness has developed anywhere, the composite sections have become appreciably rougher than the flexible pavement overlays. No relationship between filler type and surface roughness is apparent.

TABLE 8

AVERAGE RUT DEPTHS

Section	Mineral Filler: Surface Course	Mineral Filler: Binder Course	Average Rut Depth Both Wheelpaths of Traffic Lane: Sept. 1965 (in.)	Sept. 1967 (in.)	Oct. 1970 (in.)
		Flexible Pavement Overlays			
1	Asbestos fiber	Limestone dust	.17	.23	.27
2	Asbestos fiber	Asbestos fiber	.14	.18	.20
3	Hydrated lime	Limestone dust	.28	.36	.41
4	Limestone dust	Limestone dust	.28	.33	.36
5	Kaolin clay	Limestone dust	.22	.26	.32
		Composite Pavement			
6	Asbestos fiber	Asbestos fiber	.15	.12	.11
7	Asbestos fiber	Limestone dust	.07	.12	.13
8	Limestone dust	Limestone dust	.12	.18	.21

TABLE 9

CRACKING IN STUDY SECTIONS (1969)

Section	Mineral Filler: Surface Course	Mineral Filler: Binder Course	Section Length (ft)	Transverse Cracks (ft per 100 lineal ft of pavement)	Longitudinal Cracks (ft per 100 lineal ft of pavement)	Alligator Cracking (sq ft per 100 lineal ft of pavement)
			Flexible Pavement Overlays			
1	Asbestos fiber	Limestone dust	1373	13.1	5.9	21.4
2	Asbestos fiber	Asbestos fiber	1362	8.9	1.8	0.0
3	Hydrated lime	Limestone dust	3241	8.7	0.0	0.0
4	Limestone dust	Limestone dust	2460	9.8	0.0	9.8
5	Kaolin clay	Limestone dust	2990	19.6	0.0	10.2
			Composite Pavement			
6	Asbestos fiber	Asbestos fiber	400	12.0	0.0	0.0
7	Asbestos fiber	Limestone dust	400	18.0	0.0	0.0
8	Limestone dust	Limestone dust	800	17.9	0.0	0.0

Section	Mineral Filler: Surface Course	Mineral Filler: Binder Course	Roughness Index: October 1962 Traffic Lane (in. per mile)	Roughness Index: August 1971 Traffic Lane (in. per mile)	Roughness Index: August 1971 Passing Lane (in. per mile)
		Flexible Pavement Overlays			
1	Asbestos fiber	Limestone dust	82	61	94
2	Asbestos fiber	Asbestos fiber	64	54	91
3	Hydrated lime	Limestone dust	60	44	69
4	Limestone dust	Limestone dust	71	58	77
5	Kaolin clay	Limestone dust	68	49	76
		Composite Pavement			
6	Asbestos fiber	Asbestos fiber	76	100	98
7	Asbestos fiber	Limestone dust	86	78	112
8	Limestone dust	Limestone dust	66	79	109

Illinois adjective ratings
for Roughness Index readings:

Less than 60	Very smooth
60 to 75	Smooth
76 to 105	Slightly rough
106 to 145	Rough
146 to 190	Very rough
Over 190	Unsatisfactory

Skid resistance.--Measurements made in 1969 with the Illinois skid trailer in the inside wheelpaths at 40 mph in accordance with the procedures of E274-65T produced the results shown in Table 11. It will be noted that all of the skid numbers (SN's) are above the values lying somewhere in the 30's that are usually mentioned as minimum acceptable values. It will also be seen that, while the skid numbers for the asbestos fiber filler sections are the lowest, the range between the highest and lowest values within lanes is relatively small.

Coring Study

In 1967, five years after construction, 172 cores were taken from the eight study sections for a series of laboratory tests duplicating those made during construction. The effort was directed principally at evaluating whatever effects the fillers might have had in fostering or retarding undesirable changes in the pavement mixtures with time. Cores were taken from both within and outside the wheelpaths near the middle and ends of each of the longer sections, and at the third points of the three shortest sections.

Density changes.--The results of the core density tests are shown in Table 12. The results of density tests made during construction, as shown in Table 6, are repeated in Table 12 for convenience. Although some inconsistencies are apparent, a trend toward slight additional densification over the five-year period of traffic service since construction will be seen to exist. The trend is most obvious in the wheelpaths. No important influence of filler type on density change can be observed.

Changes in asphalt properties.--Certain physical properties determined for asphalt extracted from the cores taken in 1967 are shown in relation to core location and filler type in Table 13. Penetration test values for the asphalt cement prior to mixing averaged 94 at 77F, ranging from 91 to 101. Ductility test values for

TABLE 11

SKID NUMBERS FOR FILLER STUDY SECTIONS (1969)

Mineral Filler	Average Skid Number	
	Traffic Lane	Passing Lane
Asbestos fiber	40	51
Hydrated lime	41	53
Kaolin clay	44	54
Limestone dust	43	54

TABLE 12

RESULTS OF DENSITY TESTS OF CORES (1967)
(Surface Course Only)

Section	Mineral Filler	Relative Density: In Wheelpath (% of theoretical)	Relative Density: Out of Wheelpath (% of theoretical)	Relative Density: 1962 Tests
	Flexible Pavement Overlays			
1, 2	Asbestos fiber	98.7	96.7	98.4
3	Hydrated lime	98.2	98.4	97.6
4	Limestone dust	97.8	97.1	96.4
5	Kaolin clay	98.2	97.4	96.8
	Composite Pavement			
6, 7	Asbestos fiber	98.9	96.3	--
8	Limestone dust	98.6	96.8	--

TABLE 13

PHYSICAL PROPERTIES OF ASPHALT CEMENT
EXTRACTED FROM CORES TAKEN IN DECEMBER 1967

	Asbestos Fiber		Hydrated Lime		Kaolin Clay		Limestone Dust	
	W(1)	O(2)	W	O	W	O	W	O
Penetration at 77F, 100 g, 5 sec	46	37	36	47	47	29	45	36
Ductility at 77F, cm	150	107	150	150	150	83	150	150

(1) In wheelpath
(2) Outside of wheelpath

the asphalt cement in its original condition averaged 150 cm. without much variation between test values. It will be seen from the table that penetrations of the asphalt cement extracted in 1962 were not more than half of the original penetrations and sometimes substantially less than half. Ductilities remained about the same for most, but not all, of the samples. No relationship between test values and sample location, or filler type, is evident.

Changes in laboratory stability.--The results of Marshall tests conducted on the reworked materials taken from the cores were used in developing the graphs of Figure 5. Data from the 1962 tests of plant-produced mixtures were also used. It will be seen that, in general, Marshall stability values have increased somewhat and Marshall flow values have decreased slightly over the five-year service period. Some differences for cores taken in the wheelpaths and outside of the wheelpaths can be noted. No strong influence of filler type on changes in stability and flow values is observable.

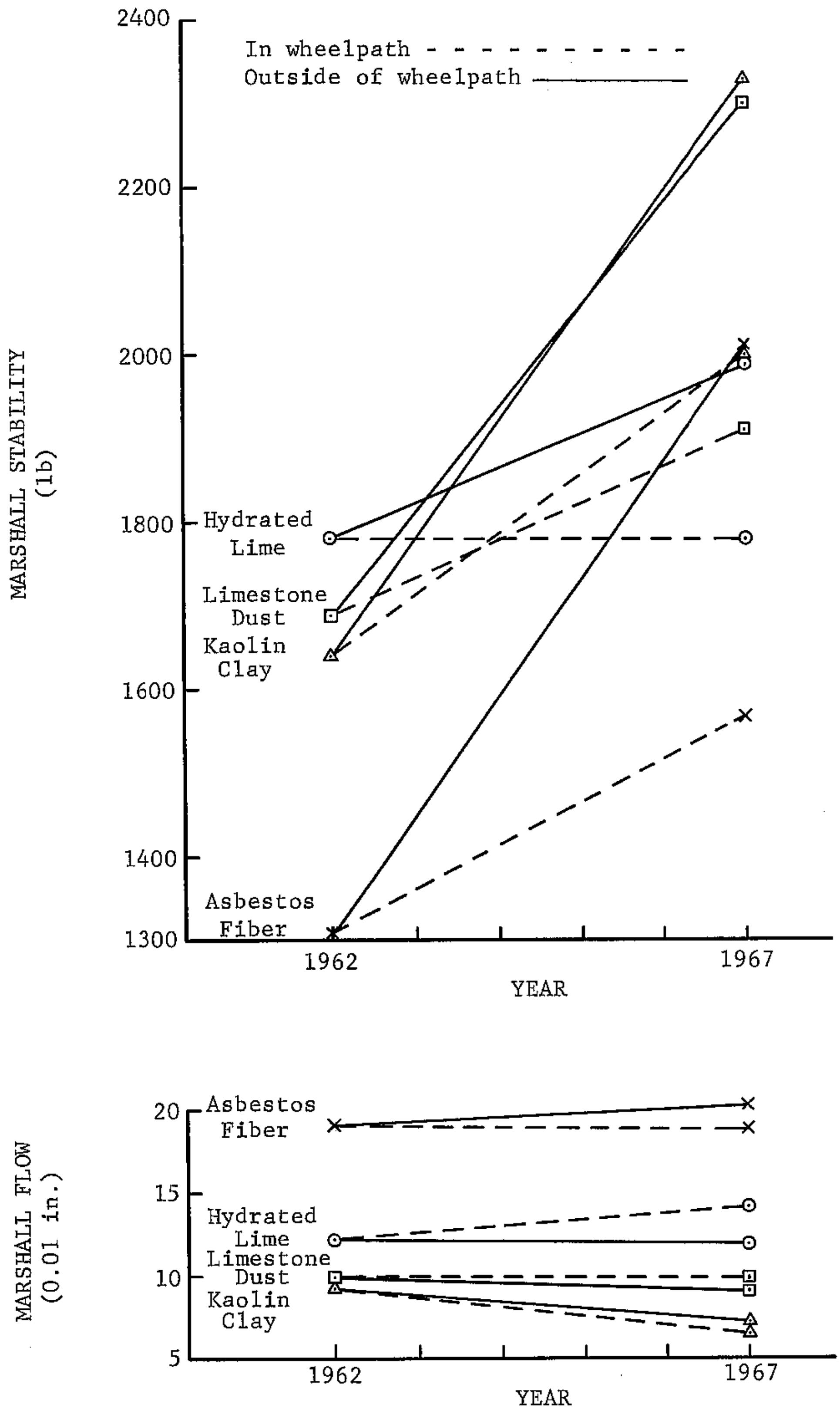

Figure 5. Changes in Marshall stability and flow values with time

CONCLUSIONS

Eight years of service experience with four inert mineral filler types in dense-graded bituminous concrete (Class I) has shown no important behavioral differences attributable to individual characteristics of the mineral fillers. Laboratory tests of samples of the pavements recovered at age five years also showed no important differences. Mineral fillers included in the investigation were limestone dust, asbestos fiber (Canadian chrysotile fiber Grade 7M, Quebec Standard Test, Quebec Asbestos Manufacturers Association), hydrated lime (ASTM C207-49 Type N Mason's Lime), and pulverized kaolin clay. The limestone dust, hydrated lime, and kaolin clay were used individually in the mixtures; the asbestos fiber was used in combination with limestone dust.

All pavement of the experimental project is showing acceptable service at the age of eight years.

IMPLEMENTATION

The results of the study provide a good indication that any of the four mineral fillers included in the experimentation can be expected to perform adequately in dense-graded bituminous concrete under environmental conditions such as exist at the site where the AASHO Road Test was conducted in Illinois. The type selected from among the four included in the experimentation can be left to the discretion of the contractor, and the selection that is made will be dependent on the cost of the delivered material, and on the cost of handling at the job-site.

REFERENCES

1. "The AASHO Road Test Report 5 Pavement Research," Highway Research Board, Special Report 61E.
2. "Mineral Fillers in Asphalt Paving Mixtures," Kallas, B. F., Puzinauskas, V. P., and Krieger, H. C., Highway Research Board Bulletin 329 (1962).
3. "Control of Asphalt Pavement Rutting with Asbestos Fiber," Speer, T. H., and Kietzman, J. H., Highway Research Board Bulletin 329 (1962).
4. "Effect of Fillers on the Marshall Stability of Bituminous Mixtures," Hudson, S. B., and Vokac, R., Highway Research Board Bulletin 329 (1962).