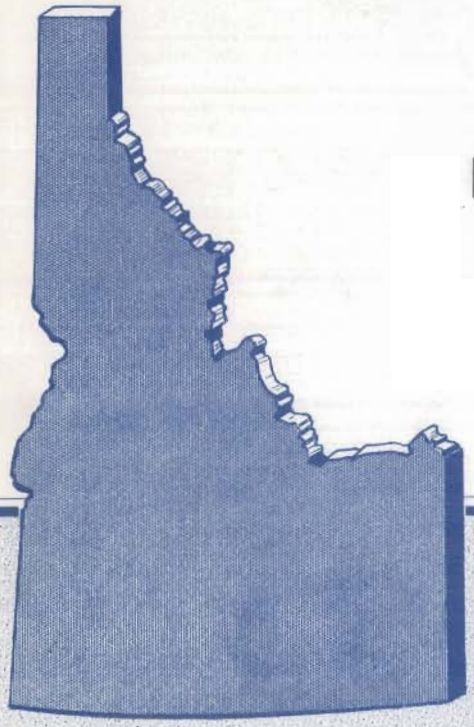
ASBESTOS FIBER AS A FILLER IN A PLANTMIX PAVEMENT



NOVEMBER 1969

RESEARCH PROJECT NO. 24

IDH-RP024(06)

STATE OF IDAHO DEPARTMENT OF HIGHWAYS

ASBESTOS FIBER

AS A

FILLER IN A PLANTMIX PAVEMENT

A Part of Research Project No. 24

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December 1969

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ACKNOWLEDGMENT

Field sampling during construction was done by the author and Marvin Derrick, Engineering Technician IV and were assisted by Kenny Vickers, Project Inspector. The Central Materials Lab tested the State's samples. Lab personnel also drilled the core samples.

Mr. William Riaski of Johns-Manville Products Company assisted in the experiment by giving technical advice. His company furnished the asbestos and performed laboratory testing on a portion of the samples taken during construction and all the core samples.

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SYNOPSIS

In its continuing search for products and/or processes which will improve asphalt pavements, the Department conducted an experiment using short fiber asbestos as a filler in a section of plantmix paving. On September 9, 1965, a section of pavement on Project ST-3021(525) was laid which had asbestos fiber mixed into it. The asbestos was furnished by the Johns-Manville Company.

Samples of the mix were taken and tested both in the Central Materials Laboratory and the Johns-Manville Company Laboratories, the results of which are contained in this report. Visual inspection of the performance of the pavement is being made at intervals.

INTRODUCTION

The use of asbestos fiber as an additive, or filler in plantmix pavement to improve pavement performance became recognized as a possibility when reports were received from Canada telling of its use in the asphaltic concrete pavement of an asbestos mine haul road. The pavement for this haul road performed excellently for 7 years, while the adjacent asphalt surfacing, with no asbestos, required replacement within 3 years.

In 1965 the Department undertook this study to compare the performance of a plantmix pavement containing asbestos fiber with that of an adjacent conventional plantmix pavement. The study was designed to determine if the addition of the asbestos fiber would increase the stability, durability and life of the pavement, and if the use of this product will help in reducing reflection cracking, as is claimed by the producers.

The test section is located in a high traffic volume section of US-30 between 11th Street and Capitol Boulevard on Front Street in Boise. The test section is 10 feet wide. Its location relative to the curb and roadway can be seen in Figure 1 which shows the paving operation in progress.

Figure 1 - Paving Operations

CONCLUSIONS

From the results of laboratory testing on the mix and cores from the roadway, and from the field observations of the test section no definite conclusions may be reached at this time. However, as will be noted in Figure 2, the severity of cracking has been reduced in the section containing asbestos.

The addition of asbestos to the mix required additional asphalt and thus decreased the air voids in the finished pavement. The finished pavement has shown no bleeding or flushing, giving what appears to be a good surface.

The addition of asbestos to the mix will increase the cost of plantmix approximately 30% making its use uneconomical for general use.

ASBESTOS EXPERIMENT

RESEARCH PROJECT No. 24

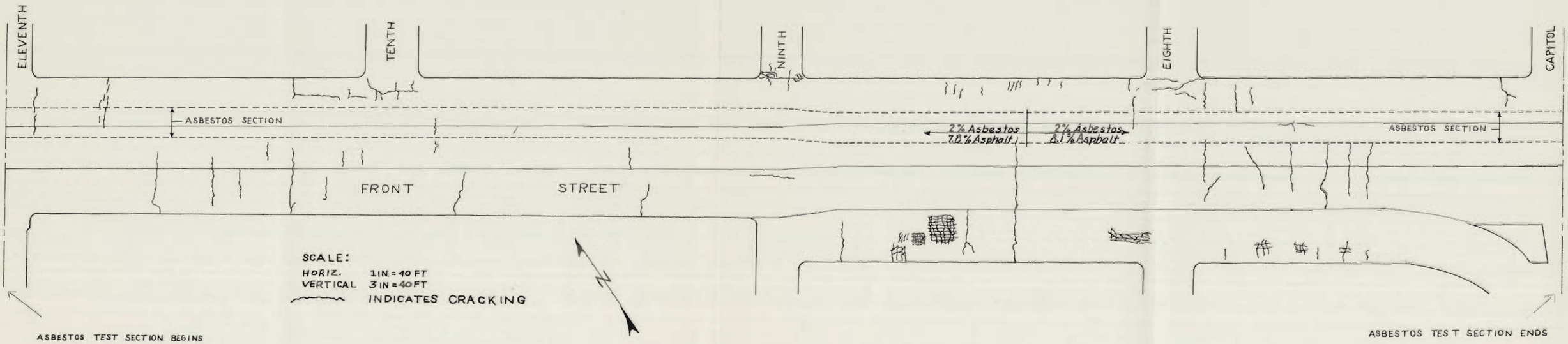

FIGURE 2

CRACK SURVEY
June 1969

RECOMMENDATIONS

It is recommended that surveillance of this section be continued in the years to come to see if it continues to perform well.

Cores should be extracted from both the test section and the adjacent control, or conventional, sections at given time intervals to compare stripping, asphalt hardening and any other characteristic signs of pavement deterioration.

IMPLEMENTATION

It is recommended that asbestos fiber be used in plantmix paving in an area known to have stripping aggregate as a test to see if the low air voids and higher densities obtainable will be effective in reducing stripping.

Asbestos fiber should be considered as a filler in overlays over badly cracked pavements, spalled bridge decks, surfaces where very low permeabilities are necessary, etc. It may reduce skid resistance and therefore its use must be carefully controlled.

DESIGN AND CONSTRUCTION

Asbestos fiber was used at a rate of 2% by weight of aggregate. For 11 stations 7.8% asphalt by weight of aggregate was used, and 8.1% asphalt was used for the remaining 494 feet. The standard mix required approximately 6% asphalt.

The test section was constructed exactly like the rest of the project in all details, except that in the mixing operations allowance had to be made for the introduction and mixing of the asbestos. At the mixing plant the asbestos was manually added to the dry aggregate in the pugmill from sacks. After a short dry mixing cycle the asphalt was introduced and mixed for 30 seconds. Figure 3 shows the asbestos being introduced into the pugmill.

SAMPLING AND TESTING

Samples were generally taken from the paver hopper at approximately 100 foot intervals, at locations shown in Table I. Duplicate samples were taken at each of the first five locations. One sample from each location was immediately taken to the Materials Lab in an insulated bag and tested, primarily for stability.

Four samples were shipped to Johns-Manville for testing.

Station	Station
106+23	114+50
107+23	115+50
108+23	116+00
109+23	117+00
110+23	118+00
113+18	Hot Mix Plant

TABLE I - Sampling Location

Figure 3 - Asbestos Mixing at Hotmix Plant

Core samples were taken in June 1966. Eighteen cores were drilled, 10 in the standard, or conventional, plantmix overlay section, 4 in the test section containing 7.8% asphalt, and 4 in the test section containing 8.1% asphalt. All the core samples where shipped to Johns-Manville for testing. Table II shows the location from which the core samples were taken. Results of the testing are shown in Table VI.

Core Number	Station	Distance in Ft. from the North Curb Line
1	103+50	21*
2	103+50	18*
3	103+45	15*
4	103+45	15*
5	103+40	18*
6	103+40	21*
7	108+30	11.5
8	108+35	11.5
9	108+30	15
10	108+35	15
11	108+30	5.5*
12	108+35	5.5*
13	119+10	16
14	119+15	16
15	119+10	13
16	110+15	13
17	110+10	11*
18	110+15	11*

*These cores were in the standard mix overlay.

TABLE II - Location of Core Samples

Station	% Asph. (Aggr.)	Stability	LB/CF	%Voids	% Passing 3/4"	1/2"	No. 4	No. 8	No. 40	No. 50	No. 200
*106+23	7.69	20	141.8	4.1	100	97	71	60	28	19	6
106+23	7.02	26	140.4	5.2	100	95	64	54	25	18	7
*107+23	7.36	18	142.2	3.1	100	93	66	54	24	18	6
107+23	7.25	26	140.3	4.4	100	97	66	54	24	17	6
*108+23	7.24	20	143.0	2.7	100	92	63	51	23	16	5
108+23	6.92	29	140.8	5.1	100	90	62	52	23	16	6
*109+23	7.06	23	143.9	2.6	100	91	64	52	28	16	6
109+23	7.22	24	142.2	4.2	100	93	63	51	23	16	6
*110+23	8.27	--	144.4	1.8	100	96	67	54	23	17	6
110+23	7.43	15	142.9	3.0	100	94	62	51	22	17	7
113+18	7.20	27	141.6	3.6	100	92	67	55	24	17	7
114+50	6.89	16	142.9	3.6	100	91	57	45	21	15	7
115+50	7.41	--	143.9	2.2	100	94	63	44	23	16	6
116+00	6.02	28	142.0	4.1	100	83	50	40	20	14	5
117+00	7.75	--	142.8	2.6	100	93	66	55	24	17	7
118+00	7.63	24	142.1	2.3	100	95	68	57	25	18	7

ASBESTOS SAMPLE DATA

No. 40	No. 50	No. 100	No. 200
100	99	64	26

LL = 62.3
PL = 49.7
PI = 12.6

*These samples were the "hot" samples for stability. The samples were taken to the Laboratory in insulated bags heated to proper temperature and tested immediately.

-- Too low to record.

TABLE III - Laboratory Results of Field Samples

RESULTS

In Table III are presented the data obtained from testing the samples collected from the hopper of the laydown machine at the time of construction. Besides the mix data the table also contains data for the asbestos, i.e., gradation, liquid limit, plastic limit and plasticity index.

Of the field samples sent to the Johns-Manville Asbestos Fiber Division, four were sent to the Chicago Testing Laboratories for testing. These test results are shown in Table IV.

Station No.	106+23	108+23	110+23	116+00
% Asphalt*	7.0	7.5	7.0	6.6
Gradation				
3/4"	100	100	100	100
1/2"	96	96	92	93
No. 4	63	66	58	54
No. 40	23	23	20	20
No.200	4	4	5	5
Asbestos Filler Present	No	Yes	Yes	Yes
Penetration				
77°F., 100/5	44	43	41	37
Ductility				
77°F, 5 cm/min., cm.	124	150*	150*	135
45°F, 1 cm/min., cm.	13.5	14.8	14.0	10.2
Ash Content, %	2.43	1.83	1.72	2.48

*Percent Asphalt by Weight of Mix

TABLE IV - Chicago Testing Laboratory, Inc., Results

The temperatures recorded during construction of the test sections are shown in Table V. It is of interest to note that the mean temperature after Final Rolling was only 17°F higher than the temperature of the existing pavement at 10:20 A.M. However, the mean intermediate rolling temperature was near the temperature required by the specifications.

	Range	Mean
Paver (laydown temp.)	290-360	320
Air	70-80	75
Before Breakdown	245-350	288
After Breakdown	185-305	248
Before Intermediate	140-160	150
After Intermediate	130-150	138
Before Final	101-120	109
After Final	92-104	98
Existing Pavement 10:20 A.M., 81°		

TABLE V - Construction Temperature, °F

Table VI shows the results obtained from the tests which were conducted by the Chicago Testing Laboratories on the 18 core samples shipped to Johns-Manville.

You will note the significant differences between the test results on cores from the test section and the conventional plantmix section. Due to the addition of fines to the mixture in the form of asbestos, the asphalt content was increased. This is evident in the testing. As a natural result of the increased asphalt content the percent of air voids in the cores was reduced when compared with the cores from the standard section. The Specific Gravities in the test sections were greater than those from the control section. It appears that the additional asphalt content with reduction of air voids helped the asphalt to retain a higher penetration level and to remain more ductile at 45°F.

A crack survey was made June 19, 1969. Figure 3 shows the location and trend of cracks that now exist in the test area.

Estimated Additional Cost for Adding Asbestos to Plantmix

The change order for adding the asbestos fiber to the plantmix shows that it cost approximately 19 cents per ton of hot mix for handling. Cost for the material, including shipping costs were $42.00 per ton or 84 cents per ton of mix, for a total of $1.03 per ton of mix for adding the asbestos fiber. This does not include all the costs associated with the experimental project.

In correspondence with the Johns-Manville Company we have found that the cost

of the asbestos today is approximately $61.60 per ton, FOB Boise, Idaho. Their estimate for the cost of handling to add the asbestos to the mix is 10 cents per ton of mix. Add to these two items, the increase of asphalt at about 1-1/2% or 30# @$50/ton, the additional cost for adding asbestos to plantmix amounts to approximately $2.10/ton.

Location	Core No.	Asbestos Present	% Asphalt (Mix)	Specific Gravity	% Air	3/4	1/2	#4	#10	#40	#200	Pen 77°F 1000 5 Sec.	Ductility 45°F 1 Cm/Min.
Sta. 103+45	1	No	4.8	2.233	8.4	100	92	61	48	28	6.5		
Standard Mix	2	No	5.0	2.239	8.1	100	95	63	51	31	7.4	31	10.0
No Asbestos	3	No	5.5	2.220	8.9	100	98	66	52	30	6.7		
5.8% Asphalt	4	No	6.1	2.206	9.5	100	99	69	54	32	7.2	32	10.5
(Agg)	5	No	5.3	2.221	8.9	100	100	66	52	25	7.3		
5.5% Asphalt	6	No	4.9	2.190	10.1	100	93	60	47	23	6.8	31	8.25
(Mix)	Avg.		5.3	2.218	9.0	100	96	64	51	28	7.0	31	9.6
Sta. 108+40	7	Yes	6.1	2.306	3.3	100	90	57	46	21	5.9		
2% Asbestos	8	Yes	6.7	2.276	4.6	100	92	61	49	23	6.6	40	13.5
7.8% Asphalt	9	Yes	6.4	2.244	5.9	100	93	62	49	23	6.6		
(Agg)	10	Yes	6.2	2.212	7.3	100	92	61	48	22	5.9	35	10.75
7.2% Asphalt	Avg.		6.4	2.259	5.3	100	92	60	48	22	6.3	37.5	12.1
(Mix)													
Sta. 119+15	13	Yes	6.8	2.320	2.5	100	95	64	53	24	7.1		
2% Asbestos	14	Yes	6.8	2.309	2.9	100	95	66	52	24	7.3	50	22.75
8.1% Asphalt	15	Yes	6.4	2.280	4.2	100	93	65	52	24	7.3		
(Agg)	16	Yes	6.9	2.293	3.6	100	95	63	51	24	7.2	37	13.0
7.5% Asphalt	Avg.		6.7	2.379	3.3	100	94	65	52	24	7.2	43.5	17.9
(Mix)													
Sta. 108+40	11	No	5.1	2.218	9.0	100	96	67	52	24	6.4		
(Core #11,12)	12	No	4.7	2.197	9.8	100	96	61	48	23	6.4	32	7.0
Sta. 119+15	17	No	5.6	2.237	8.2	100	96	63	50	23	6.8		
(Core #17,	18	No	5.4	2.258	7.3	100	98	65	51	24	7.0	33	8.0
and 18)	Ave.		5.2	2.227	8.6	100	97	64	50	23	6.7	32.5	7.5
5.8% Asphalt (Agg) 5.5% Asphalt (Mix)													

NOTE: Ductility test results @77°F., 5 cm/min. were 150+ for all samples tested.

TABLE VI - Asphalt Pavement Core Test Results from Chicago Testing Laboratory, Test Report 25756-A

OBSERVATIONS

Since the purpose of this project was to compare the performance of a plantmix pavement containing asbestos fiber with a standard plantmix overlay, most of the following observations will be based upon a visual inspection of performance. A few comments will be made concerning the results of the laboratory testing.

One of the hotmix samples sent to Johns-Manville showed no asbestos present, indicating incomplete mixing.

The stabilities were relatively low, ranging from very low to a high of 29, even though the asbestos producers claimed its use would give higher stability to the mix.

The percent asphalt recovered was always lower than the design amount. Air voids in the test section were understandably low, due to the increase in fines and high asphalt content. Air voids in the samples taken from the paver and compacted in the laboratory ranged from 1.8% to 5.2% with an average of 3.4% as shown in Table III.

On January 10, 1966, a visual inspection of the test section was conducted. The only evidence of distress was that a few popouts of aggregate had occurred. Otherwise, there was no significant difference between travel lanes. The left portion of the standard mix in the lane next to the north curb, is experiencing popouts and minor ravelling and definitely exhibits the poorest surface condition on the eastbound couplet at this location.

On June 7, 1967, Mr. William A. Riaski of the Johns-Manville Company, arrived in Boise to observe the condition of the experimental asphalt asbestos overlay on Front Street. With the Testing Engineer, Mr. Riaski inspected the roadway with the experimental overlay and noted that it was in good condition throughout. Three small cracks had reflected through and Mr. Riaski stated that cracks generally reflected through a one-inch overlay in about one year and a two-inch overlay in two years.

On August 14, 1968, the Associate Research Engineer took occasion to inspect the project. He observed only two cracks at this time. He reported the following: "It was quite obvious that the surface texture of the test section was much finer (smoother) than the adjacent sections. This could be the result of either the asbestos or the greater amount of asphalt in this section.

No distinction could be made as to serviceability as both the test section and the standard section showed no signs of failure except the small cracking mentioned earlier. It will undoubtedly be several years before any significant differences in the sections appear."

On June 17, 1969, the author and Larry Hippler, Engineering Technician VI, made a visual inspection of the test section. General appearance of the test section is good. The test section is darker in appearance than the adjacent sections due to its higher asphalt content. Some cracks have occurred in the test section but certainly less than in the adjacent roadway. Most of the cracks are transverse with only one longitudinal crack. It was noted that in some instances transverse cracks extending across the entire roadway died out or were masked in the asbestos section. A crack survey was not conducted prior to construction, therefore, it is difficult to determine the extent of reflective cracking.