OFFICE MEMORANDUM

MICHIGAN
DEPARTMENT OF STATE HIGHWAYS

March 31, 1967

To: E. A. Finney, Director
Research Laboratory Division

From: R. C. Mainfort and E. C. Novak

Subject: Laboratory Testing of Bituminous Base Course Samples: I 75 North of Wolverine (Construction Project EBI 16093, C3RN). Research Project 67 E-40. Research Report No. R-630.

At the request of P. J. Serafin, the Research Laboratory Division was authorized by R. L. Greenman to determine the salt content of the I 75 aggregate base course at locations selected by Mr. Serafin. In the resulting laboratory tests, the gradation and moisture content of the sampled areas were also determined. The field work was performed on March 15, 1967, with the help of A. P. Chritz of Mr. Serafin's office, who removed the asphaltic concrete surfaces at the test areas by coring. The pavement was constructed in 1962.

Six base course samples were obtained from near the center of a section of the northbound passing lane of I 75, starting near the Wolverine interchange and extending north for a distance of about six miles. All samples were taken at open cracks or adjoining them, as follows:

Station 3753+25	Cut Section
Station 3760+15	Cut Section
Station 3767+60	Fill Section
Station 3775+20	Fill Section
Station 3971+50	Fill Section
Station 3974+50	Fill Section

Laboratory testing included determination of grain size and moisture contents of each sample and the salt content of the top and bottom halves of the base. Results of these tests are summarized in Table 1 and the grain size distribution curve is shown in Figure 1.

The grain size distribution curve shows the base aggregate to be outside specification limits in certain areas, but not in an amount likely to cause inadequate support. Salt contents were low in all samples, being about one-fourth of the original specification amount of 6 lb per ton. The top and bottom halves of the base contained about the same quantity of salt, indicating no recent build-up of salt on top of the base due to infiltration from surface treatment. Moisture content of the base was quite high, averaging about 6.2 percent.

A review of the history of cracking in this area indicates that during the summer of 1964, only a few short longitudinal cracks were present. Now, however, numerous additional longitudinal cracks have appeared (Fig. 2). The shorter longitudinal cracks now seem to be linking up to form one continuous longitudinal crack. In addition, transverse cracking has also begun (Fig. 3). These and the longitudinal cracks extend all the way to the base, but not into it.

Figure 4 shows that the pavement surface in the immediate vicinity of the cracks has been abraded by snow removal equipment, indicating that the crack area has heaved at some time above the normal pavement surface level. Because the abraded area is quite narrow and follows the crack closely, it is probable that the heaving was due to frost action within and immediately below the crack, most likely caused by the entrance into the crack of moisture from rain or melting snow and ice. This moisture could be either water or a weak brine solution formed by ice-control chemicals. In either case, the pattern of frost action would be the same.

In spite of the increase in cracking, there is no sign of base course failure or inadequacy, and at the time of these tests the roadway was smooth-riding at all speeds.

Based on these studies and previous observations of I 75 asphalt pavement performance, the following conclusions appear warranted:

1. Although slightly out of specification limits in some areas, the aggregate base course appears to offer adequate support to the surface. There are no signs of rutting or other settlement to indicate a weak base condition.

2. Cracking of the asphalt surface has permitted entrance of water and salt solutions into the crack and adjoining base course. Subsequent freezing has caused heaving at the crack area, causing temporary rough spots in the surface along the cracks.

3. After thawing, the cracked area becomes smooth again and the cracks tend to close during the summer.

4. Measurement of selected cracks over a three-year period indicates that crack opening becomes progressively greater with each winter and that new areas of cracking are developing. The cracks extend to the base course.

5. Tests described in this report show the base course to have a high moisture content with a small quantity of salt present. The salt content averages less than 0.1 percent of the weight of the aggregate.

6. Whether the liquid entering the cracks is water or a salt solution, the resulting frost action should be the same when the temperature drops low enough for the solution to freeze. The volume of liquid present would depend, in either case, on how much had penetrated the crack prior to the temperature drop causing freezing.

OFFICE OF TESTING AND RESEARCH

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TABLE 1
PROPERTIES OF THE BASE COURSE AGGREGATE

Station No.	Percent Passing Indicated Sieve									Percent Moisture	Sodium Chloride, lb/ton	
	1-1/2-in.	1-in.	3/4-in.	1/2-in.	3/8-in.	#4	#10	#30	#200		Top	Bottom
3753+25	100.0	93.1	74.8	61.9	55.2	42.5	33.5	27.4	10.1	6.07	2.4	2.3
3760+15	100.0	100.0	91.7	71.9	63.9	47.6	36.2	29.3	10.3	6.78	1.5	1.2
3767+60	100.0	97.5	84.7	66.2	55.5	40.9	31.4	25.8	9.3	6.58	0.5	0.9
3775+20	100.0	100.0	85.9	67.0	59.2	44.9	34.1	27.5	9.5	6.33	0.8	0.8
3971+50	100.0	96.5	87.7	69.8	59.7	44.9	35.0	29.3	10.0	5.58	1.9	1.5
3974+50	100.0	87.1	72.6	57.8	50.8	47.8	29.5	24.3	8.7	5.82	1.7	1.8
Average	100.0	96.1	85.0	65.8	57.4	44.4	33.3	27.3	9.6	6.19	1.5	1.4

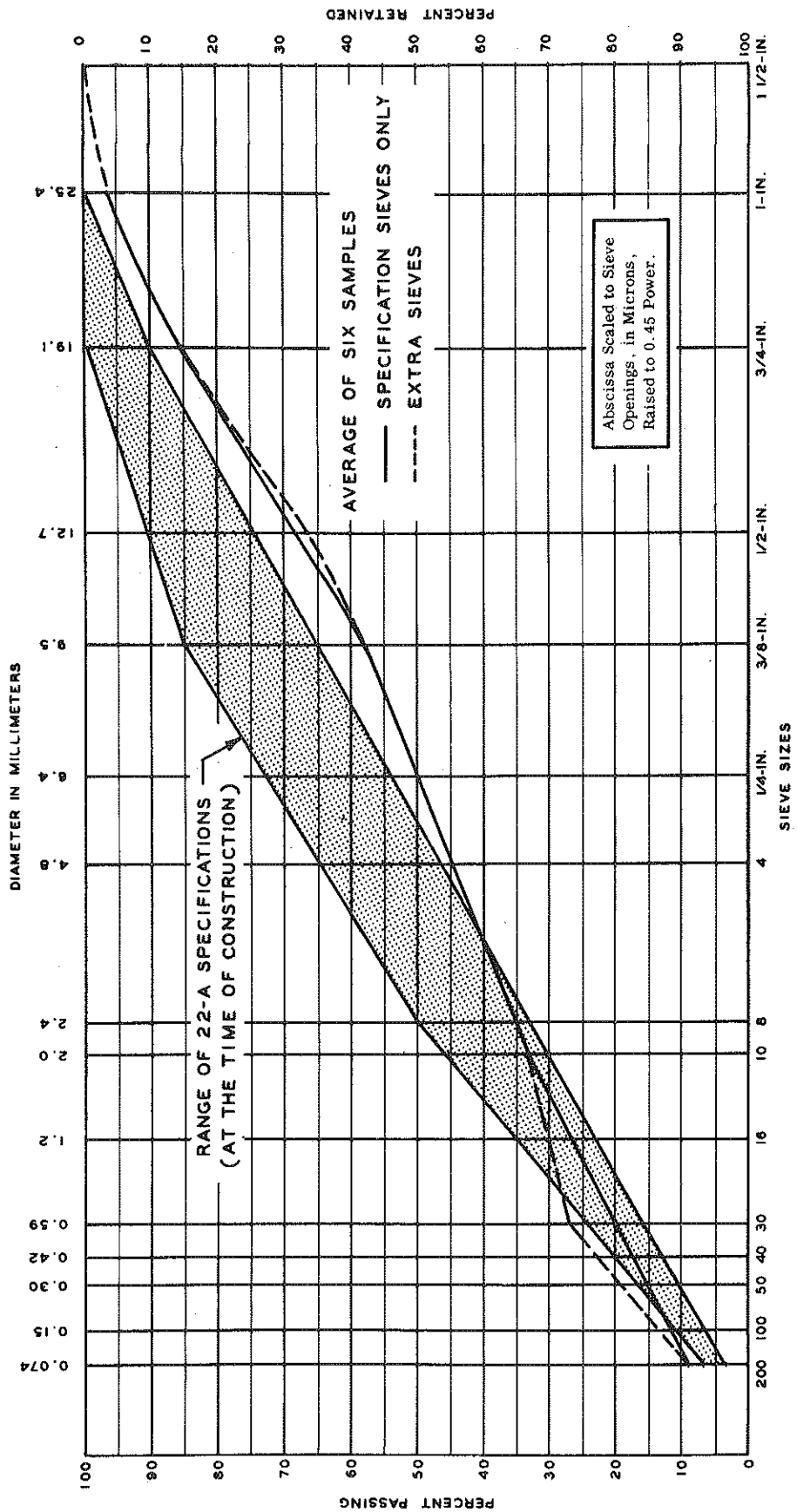

Figure 1. Grain size distribution of base course aggregate.

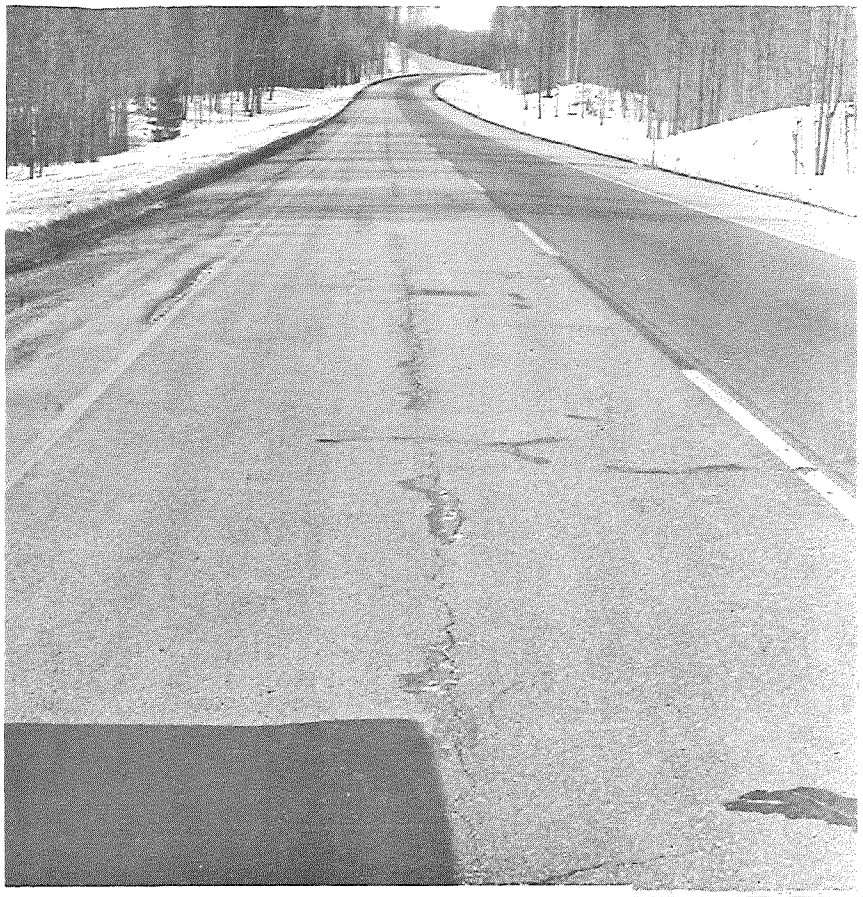

Figure 2. Typical longitudinal crack pattern.

Figure 3. Transverse cracking and sample hole.

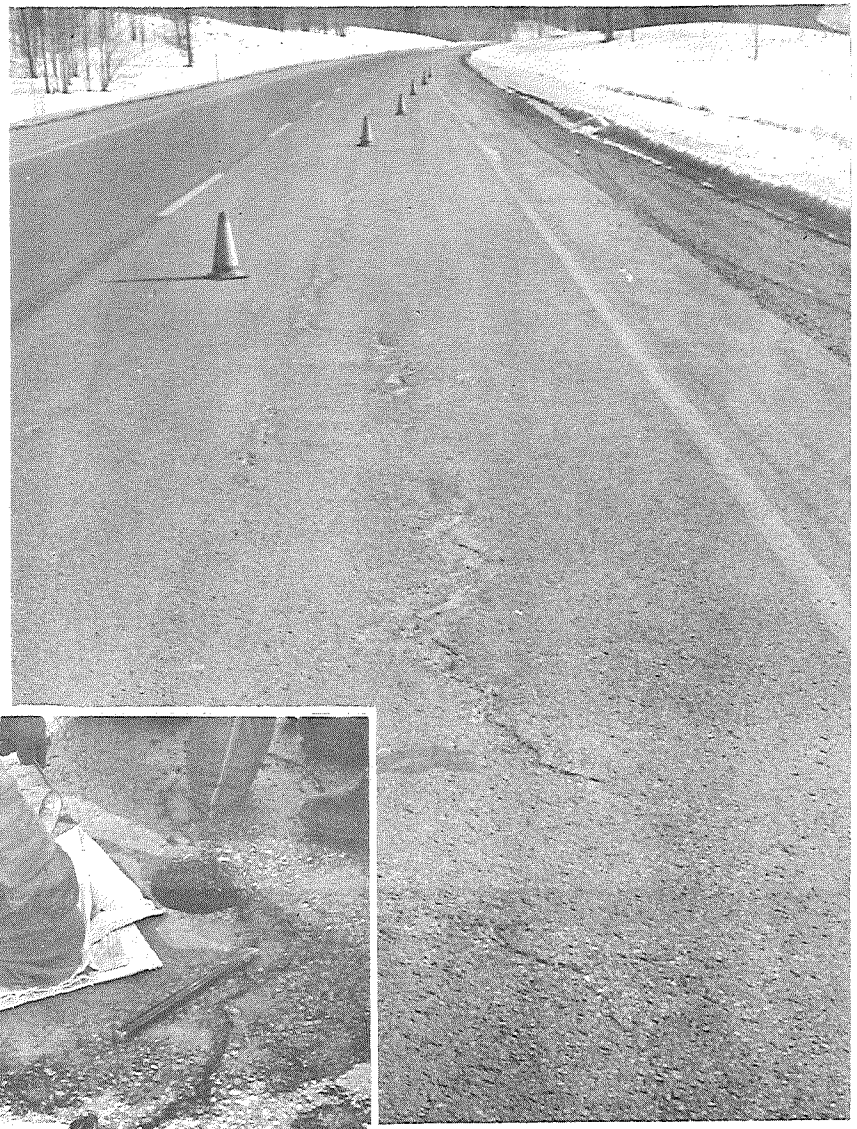

Figure 4. Abrasion along cracks due to snowplow blades.