EFFECT OF COMPACTION ON THE AGGREGATE FRACTURING OF ASPHALT CONCRETE.

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Study of Fracturing of Aggregates in Marshall Hammer Compacted A.C.C. Mixes.

PURPOSE

Other states have elected not to adopt the 75 Blow Marshall Mix Design for their heavy traffic roads. Their reasons are that the 75 blow design cracks the larger aggregates. Therefore, a limited study was done during December, 1985, to try to determine what amount of cracking took place, and in what condition the cracks are in the mix.

PROCEDURE

Thirty-five molded specimens from research project MLR-85-12 which had been compacted to 50 blow and 75 Blow Marshall Densities were used. The specimens were sawed diametrically. Some were sawed through the specimen near the middle at approximately 1.25" from the top or bottom surface. Others were sawed through at less than 1/4" of the top or bottom surfaces.

Each specimen was then observed for cracked or broken coarse aggregate. The number of fractured particles observed was recorded for each specimen. All specimens contained the same aggregate in the same proportions. The Mix Design aggregate was 1/2" crushed limestone from Martin-Marietta, Ames, mine at 60%. The sand from Hallett's Christiansen pit, Ames, at 40%. Asphalt cement varied from several sources and grades. No attempt was made to correlate the data as to the source or grade of asphalt. The data was correlated to % of A.C. and number of blows.

RESULTS

The 50 blow specimens averaged 6.2 fractures per specimen and the 75 blow specimens averaged 7.9 fractures. The range was 1 to 15 fractures per specimen.

% of A.C.	4.5	5.5	6.5
Ave. No. Fractures	6.0	8.1	6.8

No definite pattern was obvious from these results. As a follow-up, seven cores were selected and examined under a microscope. We estimated that 90% or more of the fractured particles had drawn asphalt into the crack and were still effectively sealed. Only a very small percentage of the fractured particles had not been sealed. It appeared that only a small percent of the highly absorptive, or soft, particles of the aggregate had been pulverized and did not seal itself. The non-absorptive particles of the aggregate showed

more fractures, but these were generally clean cracks that had not spread. All of these cracks were sealed when observed under the microscope.

CONCLUSIONS

From our observations, fracturing of the aggregate while the mix is still hot should not be a serious problem unless the stone is being pulverized. Any aggregates that appear pulverized are very soft and very few in number. Simple cracking into 2 to 3 pieces does not appear to expose uncoated aggregate surfaces. The amount of cracked aggregate in the 50 and 75 blow compacted specimens is essentially the same. The % of A.C. does not show any significant difference in the % of cracked particles.

The work that Lowell Zearley reported in June 1982, titled "Effect of Compaction of the Aggregate Gradation of Asphalt Concrete," addresses the breakdown of aggregate due to compaction. Table "B" of that report is attached. This information is based on 50 Blow Marshall only. 75 blow design was not being used at the time. The full report is available in the Materials Office.

RWM/esb
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Table B

Sample 1

	Percent Passing			
	Uncompacted Mix		Marshall Compacted Mix	
Sieve Size	Mean	Std. Dev.	Mean	Std. Dev.
1/2	99.5	0.6	99.0	0.8
3/8	90.0	1.4	90.5	0.6
4	71.5	1.3	72.3	0.5
8	57.0	0.8	57.8	1.0
16	44.3	1.0	44.0	0.8
30	30.5	0.6	32.0	0.8
50	17.3	1.0	19.5	0.6
100	9.4	0.2	10.5	0.6
200	7.3	0.2	8.5	0.4

Sample 2

	Percent Passing			
	Uncompacted Mix		Marshall Compacted Mix	
Sieve Size	Mean	Std. Dev.	Mean	Std. Dev.
1/2	100	0.0	100	0.0
3/8	99.3	0.5	99.5	0.6
4	85.8	2.6	86.5	2.4
8	68.3	2.8	69.3	2.1
16	53.3	2.1	54.0	1.8
30	35.5	1.3	37.3	1.0
50	21.0	0.8	22.8	1.9
100	13.3	0.5	14.3	0.5
200	11.3	0.5	12.5	0.6

Sample 3

	Percent Passing			
	Uncompacted Mix		Marshall Compacted Mix	
Sieve Size	Mean	Std. Dev.	Mean	Std. Dev.
1/2	99.5	0.6	99.8	0.5
3/8	90.5	0.6	91.5	1.3
4	69.8	1.0	70.8	2.1
8	53.0	0.8	54.5	1.7
16	41.0	0.8	42.5	1.0
30	26.0	0.8	27.8	0.5
50	13.3	1.0	14.0	1.1
100	6.0	0.6	7.0	0.4
200	5.0	0.6	5.8	0.4

Sample 4

Sieve Size	Percent Passing: Uncompacted Mix Mean	Uncompacted Mix Std. Dev.	Marshall Compacted Mix Mean	Marshall Compacted Mix Std. Dev.
3/4	100	0.0	99.8	0.5
1/2	93.5	3.3	92.0	3.7
3/8	86.0	5.9	84.3	4.9
4	72.3	5.9	70.8	6.3
8	61.0	5.9	60.0	5.9
16	49.5	5.4	48.8	5.1
30	32.3	3.1	32.8	3.4
50	12.8	0.5	14.5	0.6
100	5.1	0.1	6.3	0.3
200	4.0	0.2	5.0	0.2

Sample 5

Sieve Size	Percent Passing: Uncompacted Mix Mean	Uncompacted Mix Std. Dev.	Marshall Compacted Mix Mean	Marshall Compacted Mix Std. Dev.
1/2	99.0	0.0	99.3	0.5
3/8	93.5	0.6	93.5	1.0
4	76.5	1.0	77.0	1.4
8	62.5	1.0	63.0	1.4
16	50.8	1.0	51.3	1.0
30	31.5	0.6	32.8	0.5
50	15.0	1.6	15.8	0.5
100	5.4	0.6	6.1	0.5
200	4.8	0.7	5.4	0.4