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A MEASURE OF THE BOND
BETWEEN ASPHALT AND CONCRETE

Thesis for the Degree of B. S.

Bruce B. Bolton

1928

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A Measure of the Bond Between
Asphalt and Concrete

A Thesis Submitted to
The Faculty of

Michigan State College
of
Agriculture and Applied Science

By

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THESIS

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The intention of the author was to measure the adhesive qualities of asphalt on concrete. As many different conditions as possible were used in the tests performed and graphic results were attainable. Concrete of different strengths was experimented with, comparison of Portland cement concrete with Lumnite cement concrete was made different kinds of asphalt being used. In addition, the asphalt was applied at varying temperatures, tests were made at varying temperatures and concrete both dry and moist was experimented upon.

The method of making the tests was similar to that of finding the tensile strength of concrete. Briquettes of concrete were molded first placing an insert at the exact center of the mold. This insert was of cardboard one-sixteenth of an inch thick and divided the concrete briquette into two equal sections each having a square face one square inch in cross section. When the concrete had taken an initial set the insert was removed. After the concrete had hardened and seasoned, the space between the half-briquettes was filled with asphalt. By pulling the half-briquettes apart and measuring the amount of pull, the bond in pounds per square inch was found.

The apparatus for measuring the bond consisted of a lever arm hinged at one end and supported at the other by a platform scale. The test piece was suspended at the quarter point from the hinged end and a pull exerted upon it. Multiplying the scale reading by four gave the amount

of pull in pounds per square inch. To make the results have a standard basis the stress was uniformly increased at the rate of twenty pounds per square inch per second.

The results of these experiments can be arranged in different orders and groups, to give comparison from several viewpoints. These arrangements are shown graphically in following pages.

Comparing first, the bond of asphalt on varying strengths of concrete, the bond was found to vary on some curve, with the strength of concrete for all of the different asphalts used. This result applies to Portland and Lun-nite cement concrete alike. From a consideration of temperature of application the bond increases with the application temperature, on some curve, for all asphalts at all temperatures of testing, on all concretes; with one exception. In the case of Blown asphalt on four-thousand pound Lunnite cement concrete, the bond was lowest at mid-range of application temperature and highest at the lowest temperature of application, with an exception. When the tests were made at 35°C. the bond varied with the temperature of application, on some curve.

Taking the temperature of the test as a basis for comparison the bond varied indirectly, on some curve, as the testing temperature; the bond being highest at the lowest temperature, for all the other conditions mentioned in the preceding paragraph.

A further comparison can be made of the asphalts used.

Stress Diagrams

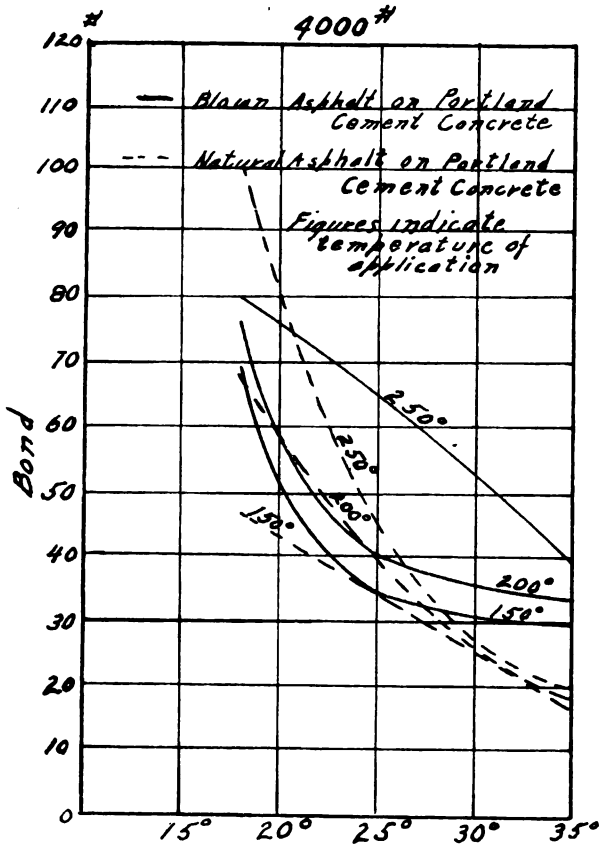


Fig. 1

Temperature of Test

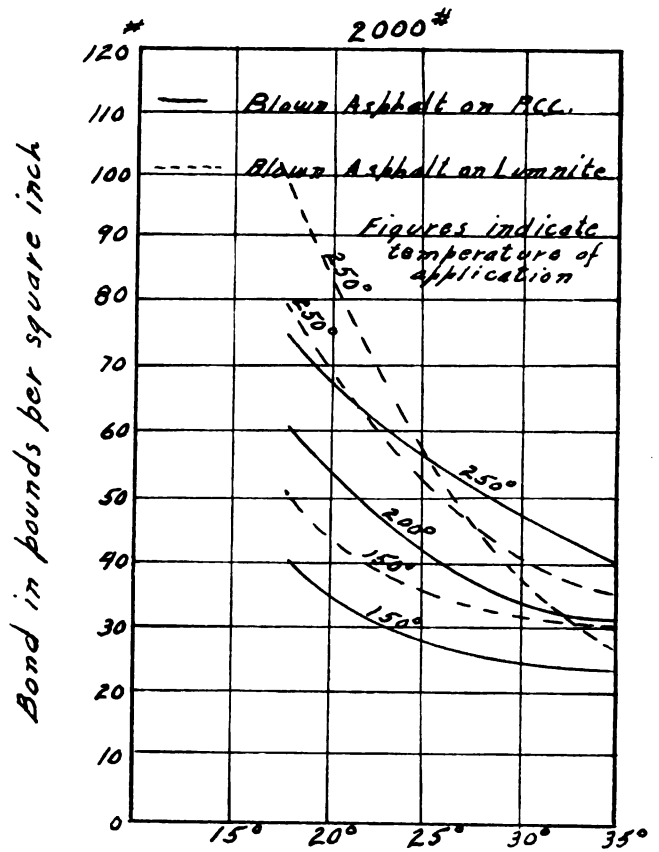


Fig. 2

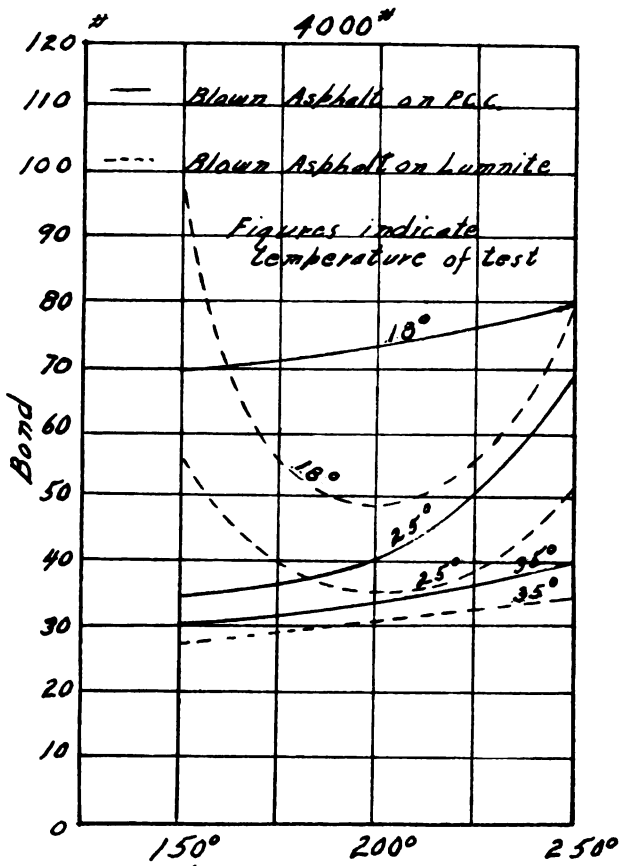


Fig. 3

Temperature of Application

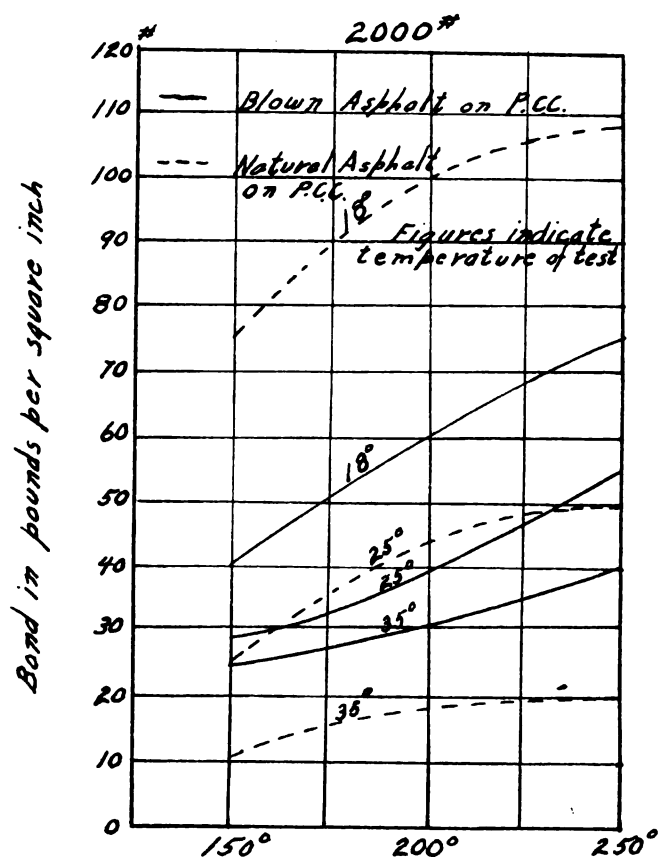


Fig. 4

Bond of Blown Asphalt

Portland 4000 $\frac{1}{2}$	Temperature of Test	Temperature of Application		
		150 $^{\circ}$	200 $^{\circ}$	250 $^{\circ}$
	18 $^{\circ}$	70 $\frac{1}{2}$	74 $\frac{1}{2}$	80 $\frac{1}{2}$
	25 $^{\circ}$	35	40	65
	35 $^{\circ}$	30	34	40
Portland 2000 $\frac{1}{2}$	18 $^{\circ}$	40	60	76
	25 $^{\circ}$	28	40	56
	35 $^{\circ}$	25	32	40
Lumnite 4000 $\frac{1}{2}$	18 $^{\circ}$	100	62	64
	25 $^{\circ}$	50	48	61
	35 $^{\circ}$	28	32	44
Lumnite 2000 $\frac{1}{2}$	18 $^{\circ}$	99	48	80
	25 $^{\circ}$	58	32	52
	35 $^{\circ}$	27	32	36

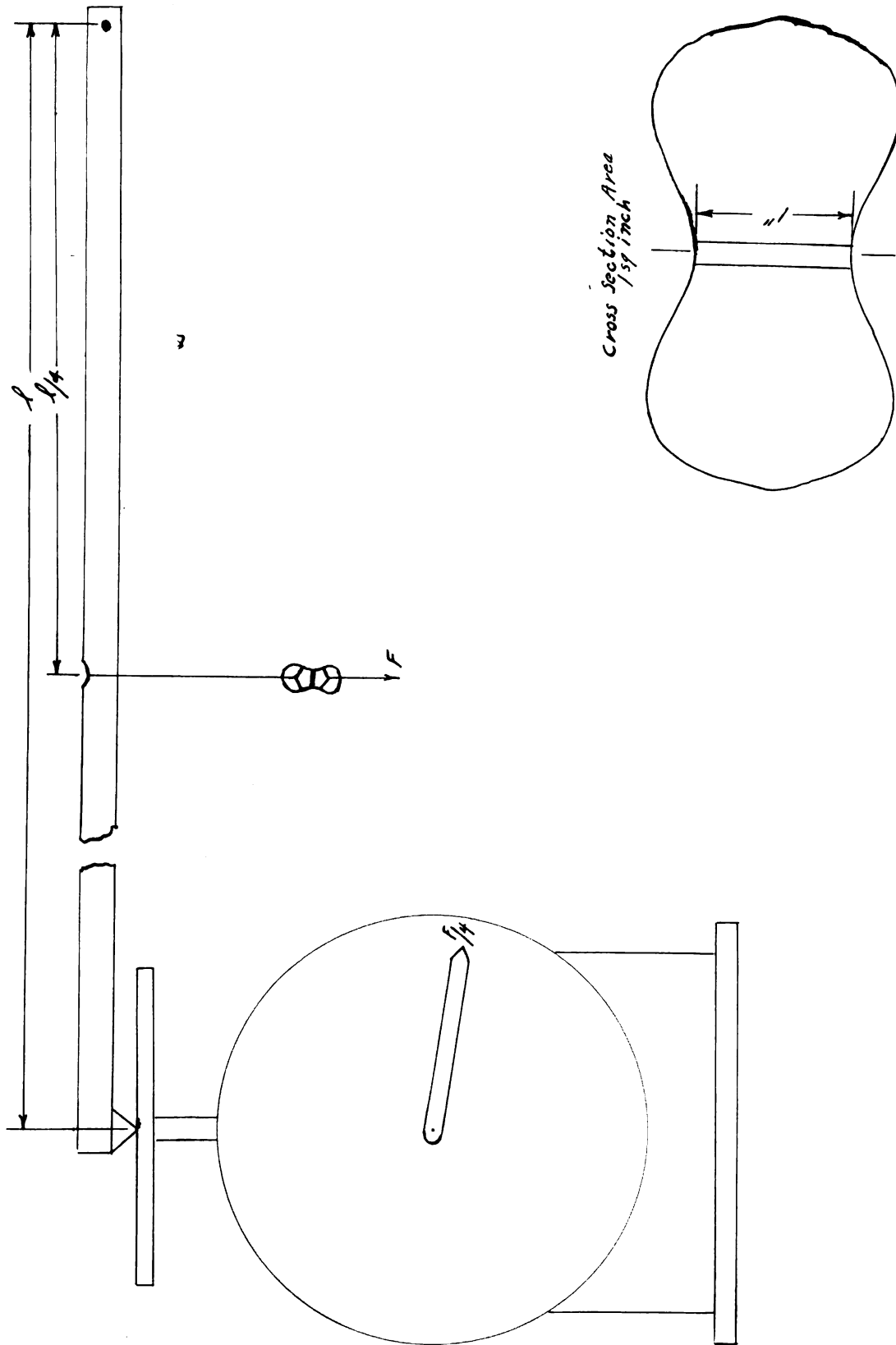
Above are some values for the bond of Blown asphalt on different kinds of concrete at varying temperatures, of application of asphalt and testing for bond. All values are in pounds per square inch.

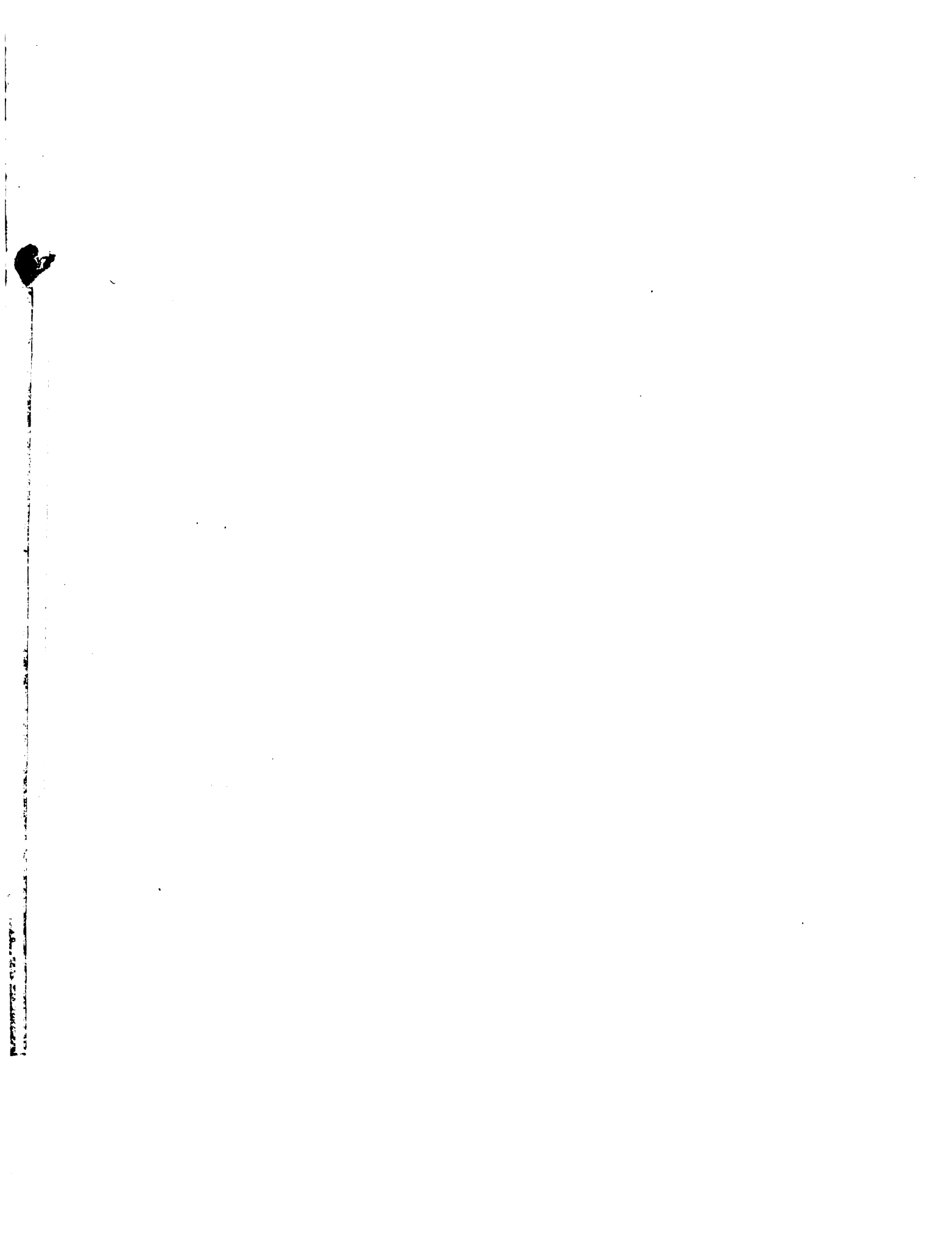
Blown asphalt seeming to have an average and the most consistent value, will be taken as an average. The bond of Blown asphalt on concrete varies, on some curve, as the application temperature and indirectly at the testing temperature. Natural asphalt has a bond varying in the same manner being higher than that of Blown asphalt at low temperatures and lower at high temperatures. The bond of Refined asphalt varies the same as that of Blown but differs from the bond of Natural asphalt in that at lower temperatures of testing the bond is lower than that of blown asphalt.

Another consideration is that of the bond of asphalt laid on moist or saturated concrete. In a number of tests it was found that asphalt laid on either moist or saturated concrete had a bond, ten to twenty percent for Blown and twenty to twenty-five percent for Refined and Natural asphalt, higher than bond for same asphalt under similar conditions of temperature, strength, etc, on a dry surface. Care was taken to thoroughly dry the test pieces after applying the asphalt as there is little or no bond while concrete surface is moist.

In the preceding graphs, Blown asphalt was taken as standard. In figures one and four, graphs for Natural asphalt were superimposed. Graphs of Blown asphalt on Lun-nite cement concrete were also superimposed on figures two and three.

Diagram of Apparatus





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