



ROBERT HUMPHREYS  
COMMISSIONER OF HIGHWAYS

COMMONWEALTH OF KENTUCKY  
DEPARTMENT OF HIGHWAYS  
FRANKFORT

July 8, 1957

ADDRESS REPLY TO  
DEPARTMENT OF HIGHWAYS  
MATERIALS RESEARCH LABORATORY  
132 GRAHAM AVENUE  
LEXINGTON 29, KENTUCKY

B. 3. 4.

MEMO TO: A. O. Neiser  
Assistant State Highway Engineer

SUBJECT: Comparative Laboratory Evaluation of a Modified  
Class I Base Mixture.

At the March 22, 1957, meeting of the Research Committee, Loren Strunk gave an oral summary of some comparative tests on Class I Binder, Class I Base, and a modified base mixture composed of 65% No. 6 stone and 35% Class I sand. As you know, the new mixture was intended to provide a multiple purpose paving course which could serve as a high class base or binder course, but which might be left exposed for an indefinite period. At the time we were asked to make these comparisons, the Testing Laboratory had already made some trial mixes, using various proportions of No. 6 stone and Class I sand; and proportions of 65% and 35% had been fairly well established as the most favorable aggregate combination and gradation. However, in order to make a comparative evaluation of this mix with Class I base and binder, much larger specimens than those used in the usual laboratory tests would be required. We, then, undertook the job of making large scale triaxial tests on those mixes.

Our most concise interpretation of the results was that there were no significant differences in the angle of friction and cohesion values among the three mixes; and, insofar as the triaxial test is capable of reflecting essential properties of pavement courses, each mix should contribute adequate stability and supporting capacity to a pavement.

The modified base mixture is now being used, or has already been used, on the Providence-Princeton Road, Ky. 607, in Owen County, and Ky. 486 (Isonville-Webbville). We are making some observations on that field work and will probably submit a summary report on it late in the fall.

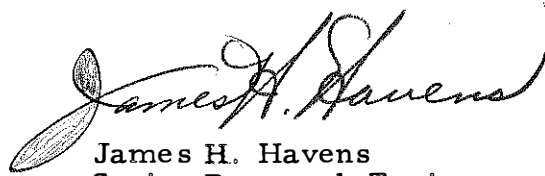
These memoranda are intended as a record of the laboratory testing and of Strunk's oral report to the Research Committee.

A.O. Neiser

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July 8, 1957

The minor changes in gradation for the modified mix, recommended at the end of Strunk's report, are simply adjustments to include the full limits of 65% No. 6 stone and 35% Class I sand combination. Since you might wish to bring these recommended changes in gradation to the attention of the Specifications Committee, Construction, Design, Materials, etc., several extra copies of these reports are being made for whatever circulation you feel might be necessary.

A handwritten signature in cursive script that reads "James H. Havens". The signature is written in dark ink and is positioned above the typed name and title.

James H. Havens  
Senior Research Engineer

For: W. B. Drake, Acting  
Assistant Director of Research

JHH:d1  
Encs.



ROBERT HUMPHREYS  
COMMISSIONER OF HIGHWAYS

COMMONWEALTH OF KENTUCKY  
DEPARTMENT OF HIGHWAYS  
FRANKFORT

July 5, 1957

ADDRESS REPLY TO  
DEPARTMENT OF HIGHWAYS  
MATERIALS RESEARCH LABORATORY  
132 GRAHAM AVENUE  
LEXINGTON 29, KENTUCKY

B. 3.4.

MEMO TO: J. H. Havens  
Senior Research Engineer

SUBJECT: Modified Class I Base Mixture

This report summarizes the tests made upon Class I Binder, Base, and Modified Base Mixtures. The work was done at the request of the Division of Materials.

Figure 1 is a plot of the specification limits for Class I Binder and Class I base gradations and limits achieved by combining 65% No. 6 stone and 35% Class I limestone sand. Top sizes of these aggregates are 1 inch for the binder, 2-1/2 inches for the base, and 1-1/2 inches for the modified base mixture. The large size of the particles prevented use of the Marshall Method, normally used for determining the stability of asphaltic mixtures, since a diameter of six inches was considered necessary for specimens made with these aggregates.

Specimens of the three gradations were molded with 6-inch diameters and 12-inch heights as shown in Fig. 2. These specimens were molded in four equal lifts of 3 inches each. Each lift received fifty blows of the Marshall hammer distributed over the surface; the specimens were then placed in the testing machine and a static load of 1000 psi was applied. This load was held for two minutes and then released. Specimens were allowed to cool, then were extruded and allowed to cure for two weeks at room temperature.

Since mixture properties contributed by the aggregates were of primary importance in these tests, a method of triaxial testing -- actually a modified Smith-type triaxial test -- was chosen. A pressure cell capable of testing specimens of the size used was designed and fabricated for this purpose (Fig. 3).

Half the specimens made were tested in unconfined compression and the remaining half were tested in the pressure cell under 20 psi lateral pressure. Angle of internal friction and cohesion were obtained from these two Mohr Circles. Specimens were deformed at a constant rate of .02 inches per minute; deformation and time were recorded for each 500-lb. increment of load. The rather slow rate of

deformation was used in an effort to minimize the effect of asphalt resistance to rapid deformation. Testing was done at room temperature. Most failures were of the diagonal plane (Fig. 4) or shear cone type.

Design curves for the three gradations are shown in Fig. 5. Unit weight curves indicate an increasing density to about 5% asphalt content for both the base and modified base mixtures. Results for the binder were somewhat erratic, with no indicated optimum. Maximum aggregate compaction, as shown by fewest voids in the compacted aggregate, occurred at about 4.75% asphalt for the modified base. Voids in the base gradation decreased only slightly past this point. Curves for unit stress at failure for specimens tested in unconfined compression indicate a somewhat lower optimum asphalt content than do those tested with 20 psi lateral pressure. Optimum asphalt content, considering both curves, would be about 4.7%. This value is verified by the density and void curves, especially the curves for voids in the compacted aggregate.

Stress-strain curves (Fig. 6) were also plotted for mixtures with 4.5 and 5.0% asphalt content. There were no differences between these curves that could be attributed to the aggregate gradation.

At optimum asphalt content, the angle of internal friction for the three gradations varied by only 2-1/2 deg. with an average value of about 41 deg. Values of cohesion were also quite similar, the average value being about 30 psi (Fig. 7).

Mixtures made with all of the gradations tested would be regarded as satisfactory according to the Smith Triaxial Method of Design. The data indicate that for all asphalt contents the modified base gradation has slightly greater stability, greater density, and fewer voids than the other gradations tested.

Following is a proposed gradation specification for modified Class I Base (Fig. 8). You will note certain minor changes from the tentative gradation previously given the Division of Materials.

<u>Sieve</u>	<u>% Passing</u>
1-1/2"	100
1"	85-97
1/2"	46-77
No. 4	28-44
No. 8	24-35
No. 16	14-30
No. 50	2-12
No. 100	0-5



L. H. Strunk  
Research Engineer

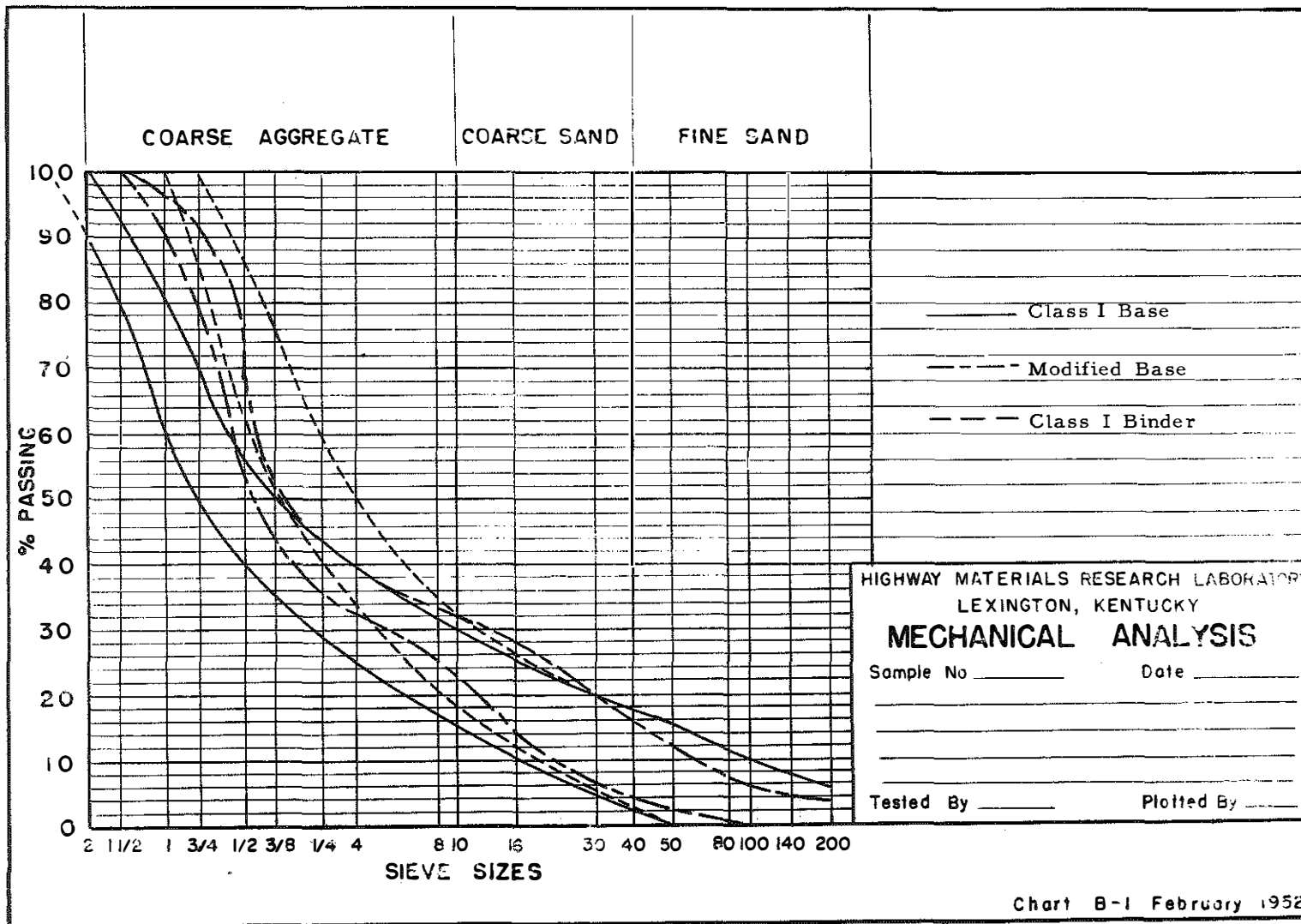


Fig. 1 - Curves Showing Gradation Limits for the three Aggregates Tested.

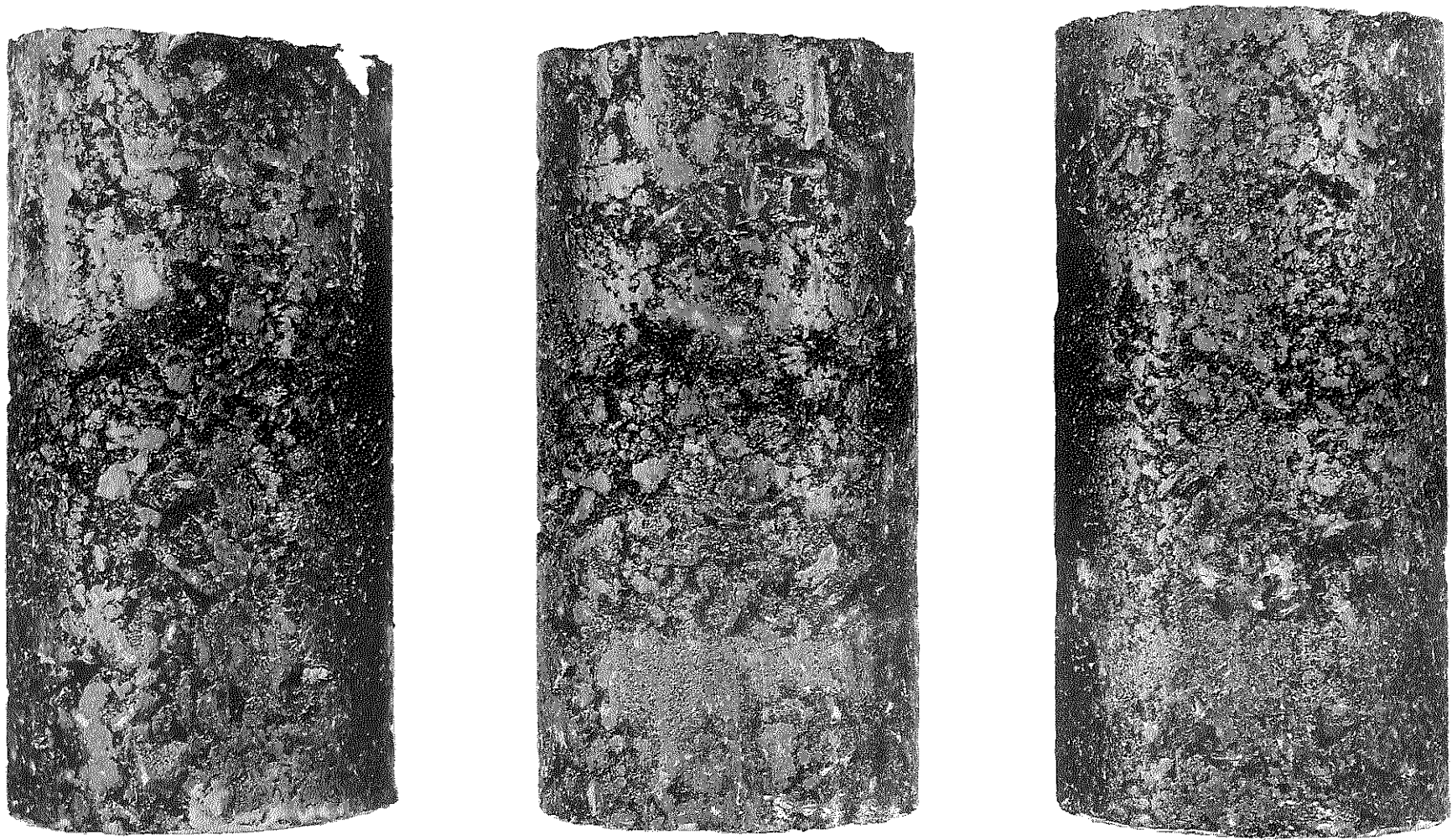


Fig. 2 - Specimens made with the three Gradations. Left to right;  
Base, Modified Base, and Binder.

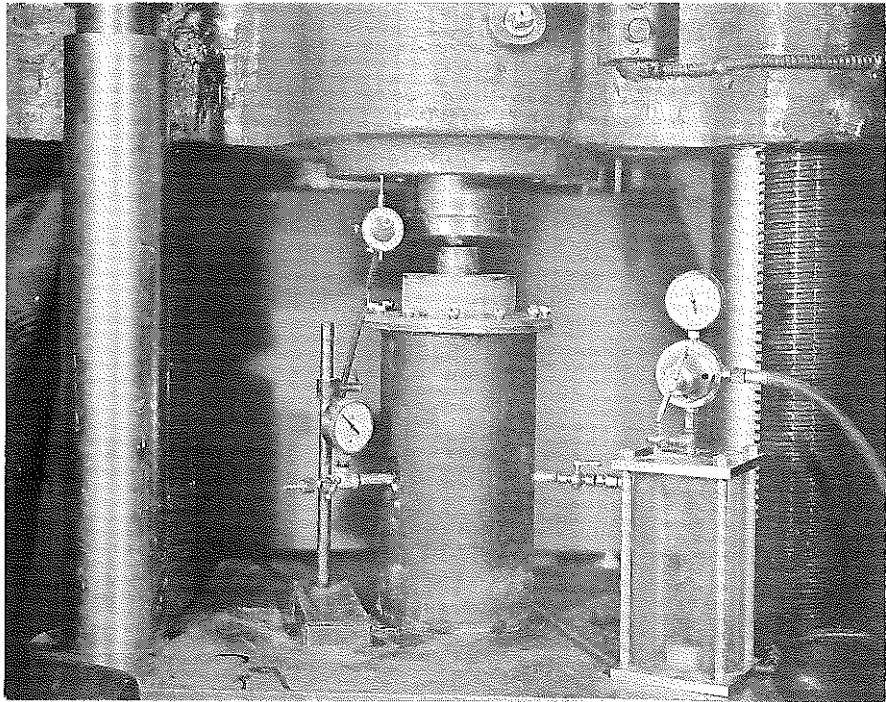


Fig. 3 - Pressure Cell Used in Testing under Lateral Pressure.

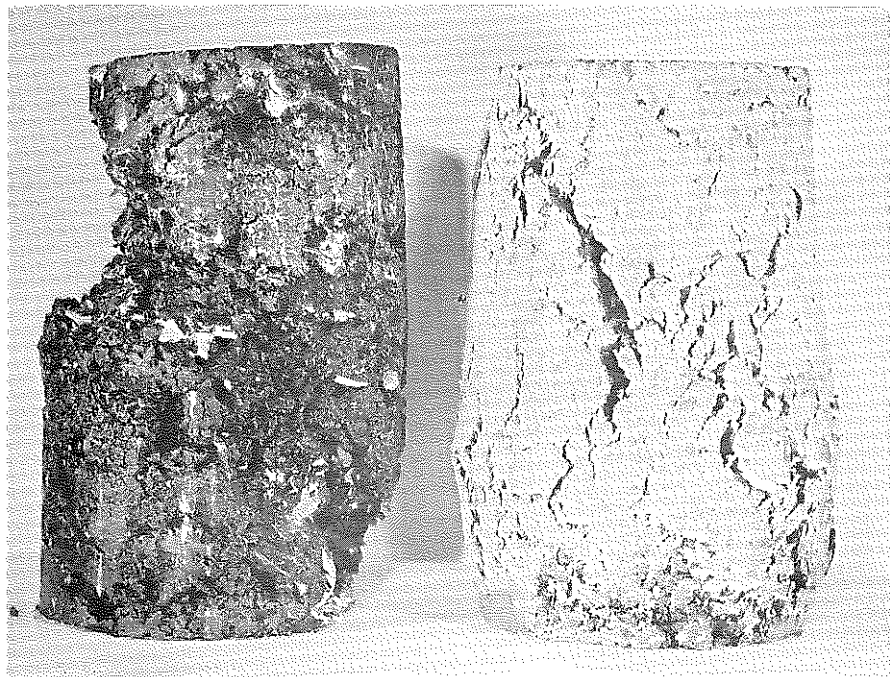


Fig. 4 - Typical Failures of Test Specimens.

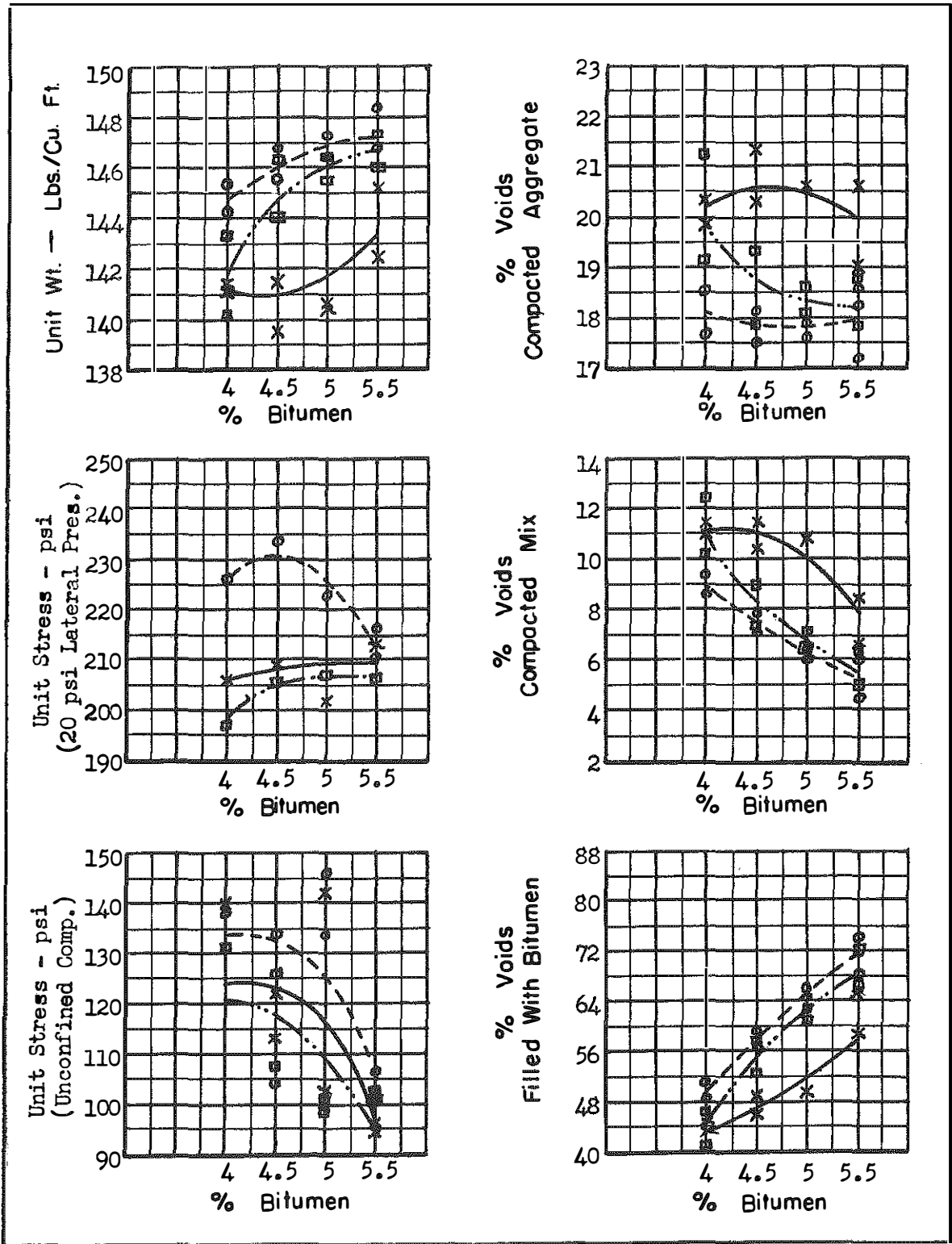


Fig. 5 - Curves Showing Results of Tests on Mixtures Made with the Three Gradations of Aggregate.



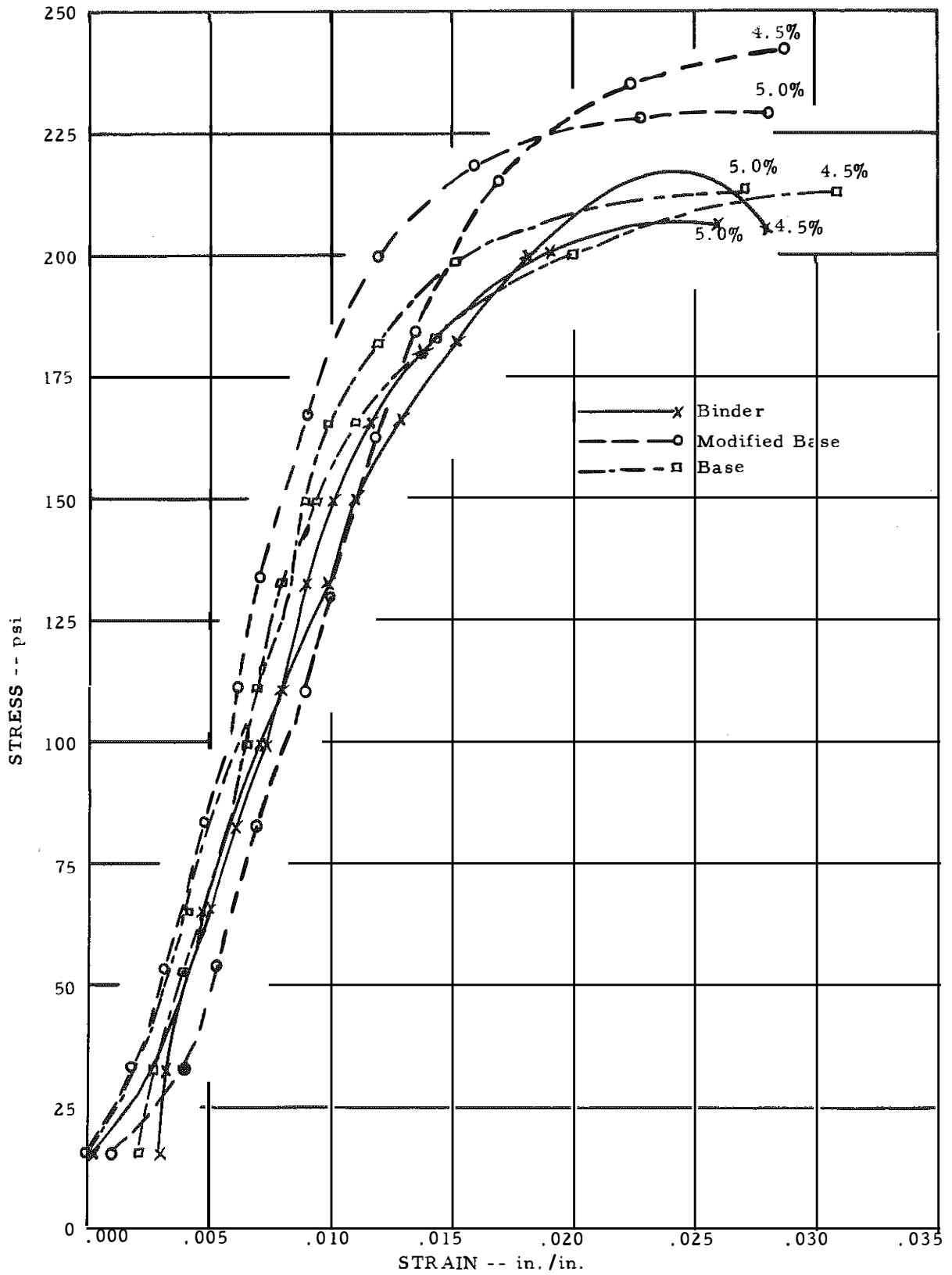


Fig. 6 - Stress-Strain Curves for Specimens Tested under 20 psi Lateral Pressure.

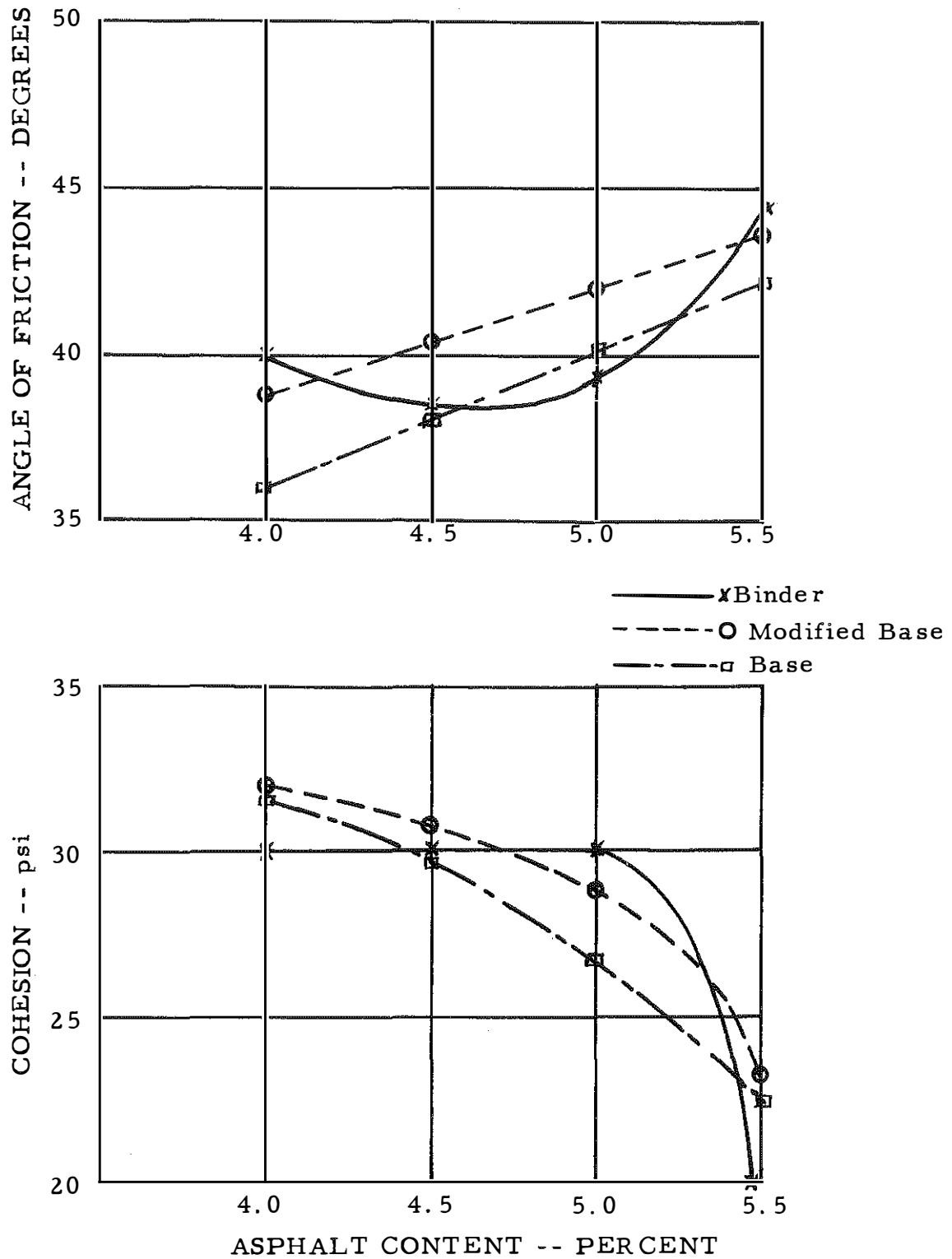


Fig. 7 - Angle of Internal Friction (above) and Cohesion (below) Plotted against Asphalt Content.

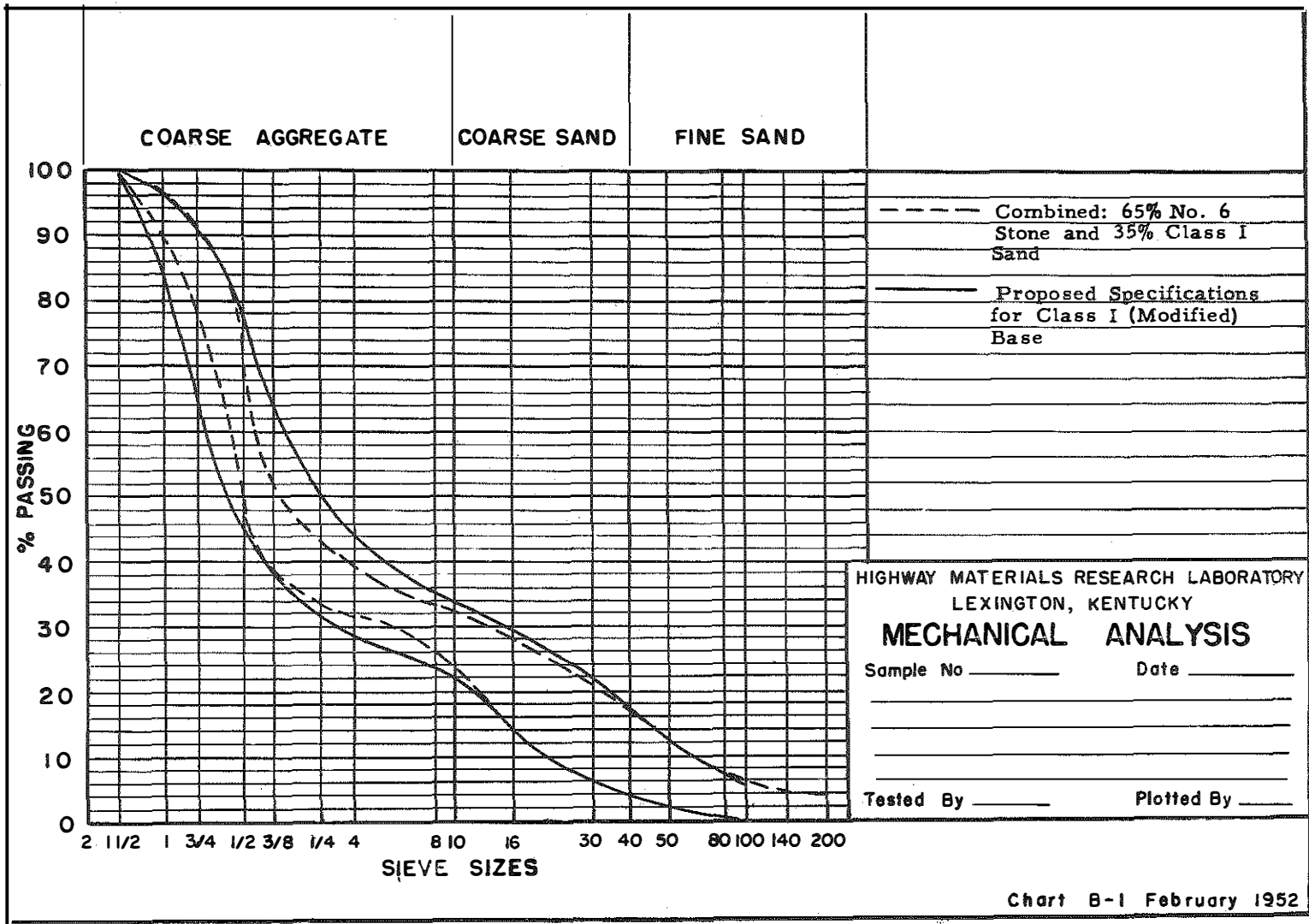


Fig. 8 - Proposed Gradation Specification Curves for Modified Class I Base Mixture.