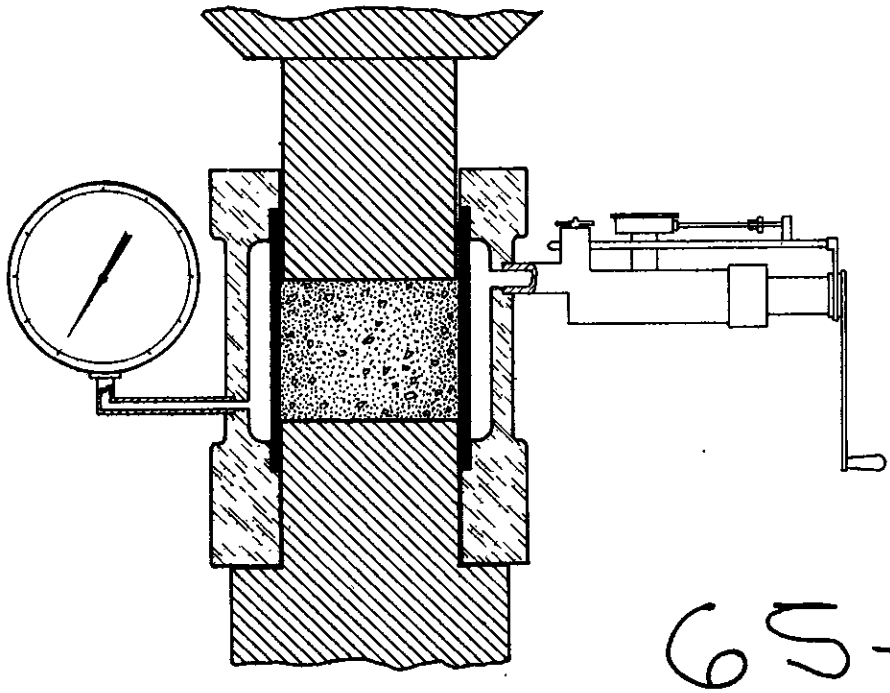
INVESTIGATION of METHODS for REDUCING the TIME REQUIRED to DETERMINE the R-VALUE of SOILS and AGGREGATES



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MATERIALS AND RESEARCH DEPARTMENT

RESEARCH REPORT

NO. M & R 231698

Prepared in Cooperation with The U.S. Department of Commerce, Bureau of Public Roads November, 1965

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State of California
Department of Public Works
Division of Highways
Materials and Research Department

November 10, 1965

HPR 1(1) F-5-1
Exp. Auth. 231698

Mr. J. C. Womack
State Highway Engineer
Division of Highways
Sacramento, California

Dear Sir:

Submitted for your consideration is:

REPORT ON

INVESTIGATION OF METHODS

FOR REDUCING THE TIME REQUIRED

TO DETERMINE

THE R-VALUE OF SOILS AND AGGREGATES.

Study made by . . . . . Pavement Section
Under general direction of . . . . . E. Zube
Work supervised by . . . . . Clyde Gates
Report prepared by . . . . . Mas Hatano

Very truly yours,

JOHN L. BEATON
Materials and Research Engineer

Attach.

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INTRODUCTION

The R-value test normally requires from three to four days time before test results are available. For construction control purposes, this was not desirable. The purpose of this project was to investigate the possibility of modifying the R-value test method so that test data could be available shortly after the material was received in the laboratory.

SUMMARY AND CONCLUSIONS

A modification in the R-value method, Test Method No. Calif. 301-F, was adopted on September 14, 1964 and transmitted to the districts. The new method permits tests on aggregate base materials to be performed in one day. The unit R-value will be the same whether tested by old Test Method No. Calif. 301-E or by new Test Method No. Calif. 301-F within limits of reproducibility of the test.

Basically, the new procedure will eliminate the overnight soak phase of the test and permit the stabilometer test to be performed if the test specimens drain water during the expansion pressure test and do not show any expansion pressure at the end of a two hour period. In addition, the sample must conform to the aggregate base grading requirement of the standard specifications in order to test by this new method.

The test data indicates that subbase materials may not be tested using the same shortened procedure adapted for the base materials.

DISCUSSION

The routine R-value test, Test Method No. Calif. 301-E, requires the overnight expansion pressure (EP) test for soil samples as well as an overnight soak moisture.

Figure 1 shows a plot of R-values with no overnight soak moisture and R-values with 1/2 to 2/3 overnight soak moisture. For base material, (78 or higher R-value) there is no significant difference in R-values.

The following Table A shows a tabulation of R-value tests performed at the Materials and Research Laboratory during the period July 1, 1962 to July 1, 1963.

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TABLE A

	Total Tests	All test specimens drained freely and /or had Zero EP		Tests showing some EP and/or did not drain freely.		Tests showing EP control.	
		No.of Tests	% of Tests	No.of Tests	% of Tests	No.of Tests	% of Tests
Bases	917	881	96%	36	4%	1*	0.1%
Subbase	1166	896	77%	270	23%	21	1.8%
Other types of material	253	131	52%	122	48%	10	4.0%
	2336	1908	82%	428	18%	32	1.4%

* R-value by Exud. = 81
R-value by Expan.Pr.= 80

Table A indicates that only 4% of the base samples showed some expansion. There were 23% of the subbase and 48% of materials other than base or subbase which had some expansion, however there was a smaller percentage of these samples where R-value by expansion pressure controlled. The aggregate base material showed only 0.1% controlled by expansion pressure R-value.

Figure 2 shows R-value tests performed on aggregate base samples, eliminating the overnight soak and with only 2 hours on the EP devices (this will be known as the short method) as compared to the routine method of performing the overnight soak and overnight expansion pressure test. Our experience indicated that expansion pressure develops quite rapidly in the expansion pressure devices. Therefore, if no expansion pressure develops within 2 hours, it is safe to proceed with the stabilometer test. The test data bears this out by indicating good correlation with the small differences between the tests for the individual samples, due to normal variations in the test itself.

Based on the data from Figures 1, 2, and Table A, a test procedure for aggregate bases was adopted eliminating the overnight soak moisture and permitting the stabilometer test to be performed on those samples that show three specimens draining freely and having no expansion at the end of two hours. In addition, the sample must conform to the aggregate base grading requirements.

Figure 3 shows R-value tests performed on Class 1 aggregate subbase material by the routine and short methods. The correla-

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tion appears satisfactory when the R-value is 77 or higher. However, the correlation is poor for materials having R-values less than 77.

Figure 4 shows R-value tests performed on Class 2 and 3 aggregate subbase materials by the routine and short methods. There is a definite trend which indicates the tests performed with the short method will give higher R-values in most cases.

Figure 5 shows a composite plot of tests performed on Class 1, 2, and 3 aggregate subbase samples. The test data indicates that the short method cannot be applied to subbase materials in general. Rather than establish limiting controls for certain subbase materials in order to permit testing by the short method, it is recommended that all subbase material be tested for R-value using the routine method.

No experiments were performed on materials other than base or subbase material since experience and test data indicates that many of the fine grained soils develop expansion pressure and are affected by overnight soak moisture.

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FIGURE I

GRAPH SHOWING COMPARISONS BETWEEN R-VALUE WITH PRESCRIBED OVERNIGHT SOAK AND R-VALUE WITH ZERO OVERNIGHT SOAK

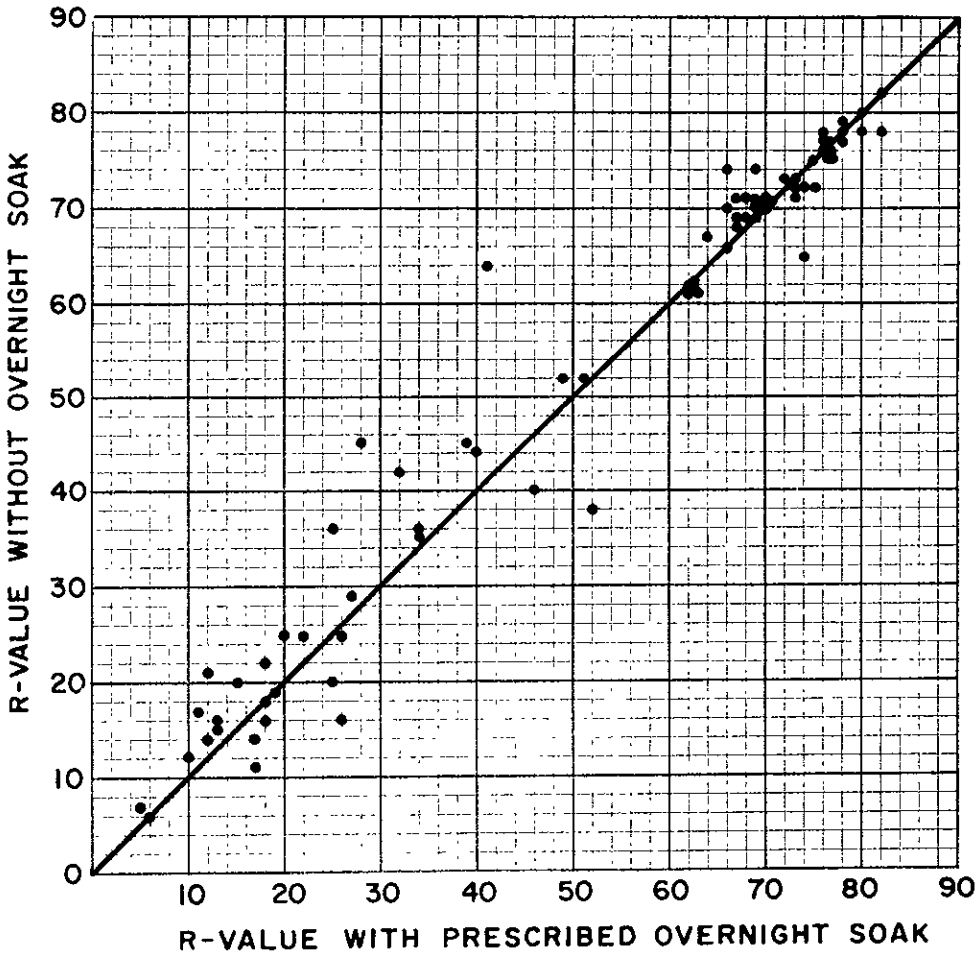

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FIGURE 2

GRAPH SHOWING R-VALUES DETERMINED WITH OVERNIGHT SOAK WATER AND OVERNIGHT ON THE EXPANSION PRESSURE DEVICE AS COMPARED TO NO OVERNIGHT SOAK AND 2 HOURS ON THE EXPANSION PRESSURE DEVICE

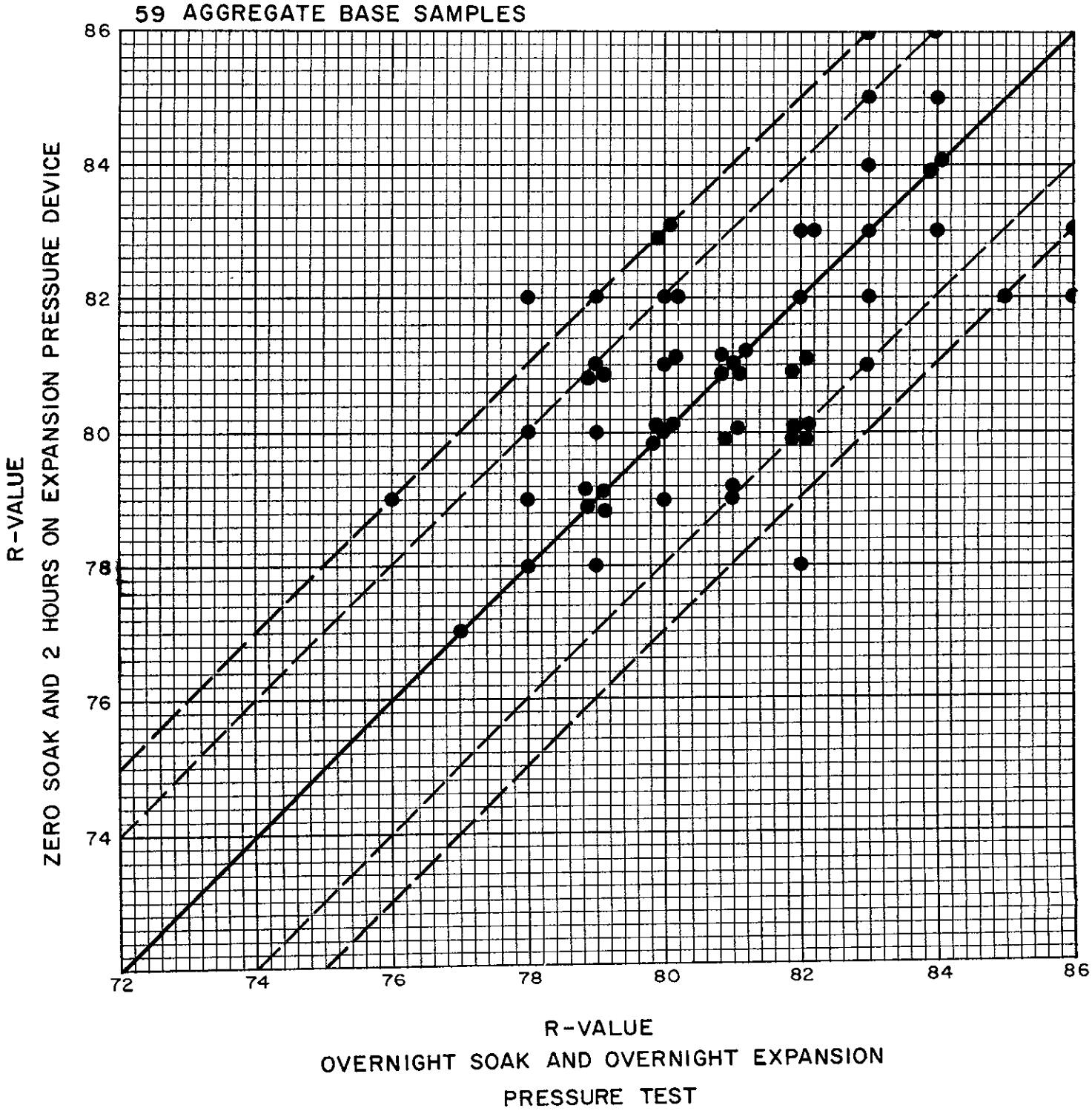

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FIGURE 3

GRAPH SHOWING R-VALUES DETERMINED WITH OVERNIGHT SOAK AND OVERNIGHT ON THE EXPANSION PRESSURE DEVICE AS COMPARED TO NO OVERNIGHT SOAK

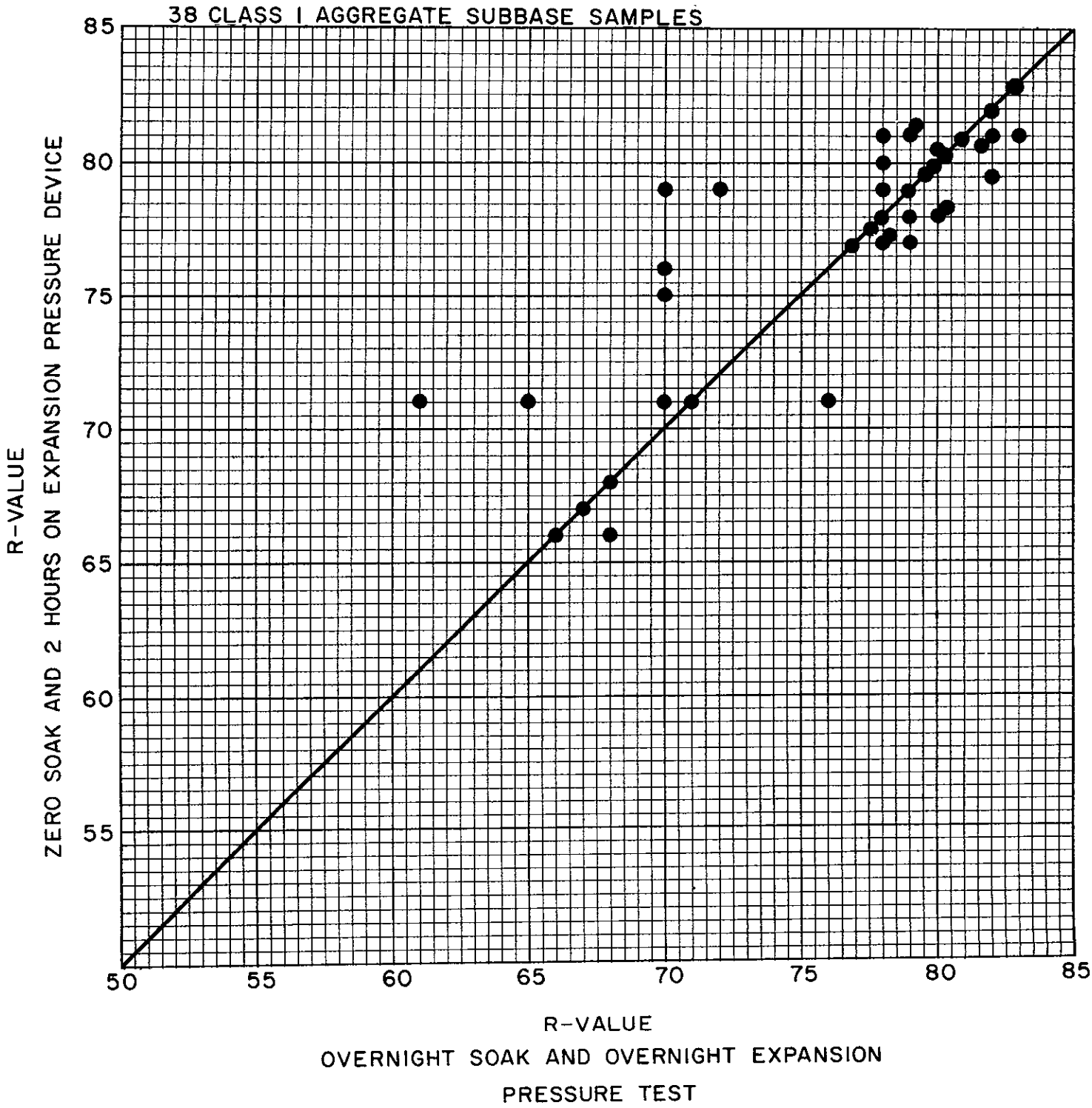

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FIGURE 4

GRAPH SHOWING R-VALUES DETERMINED WITH OVERNIGHT SOAK WATER AND OVERNIGHT ON THE EXPANSION PRESSURE DEVICE AS COMPARED TO NO OVERNIGHT SOAK AND 2 HOURS ON THE EXPANSION PRESSURE DEVICE

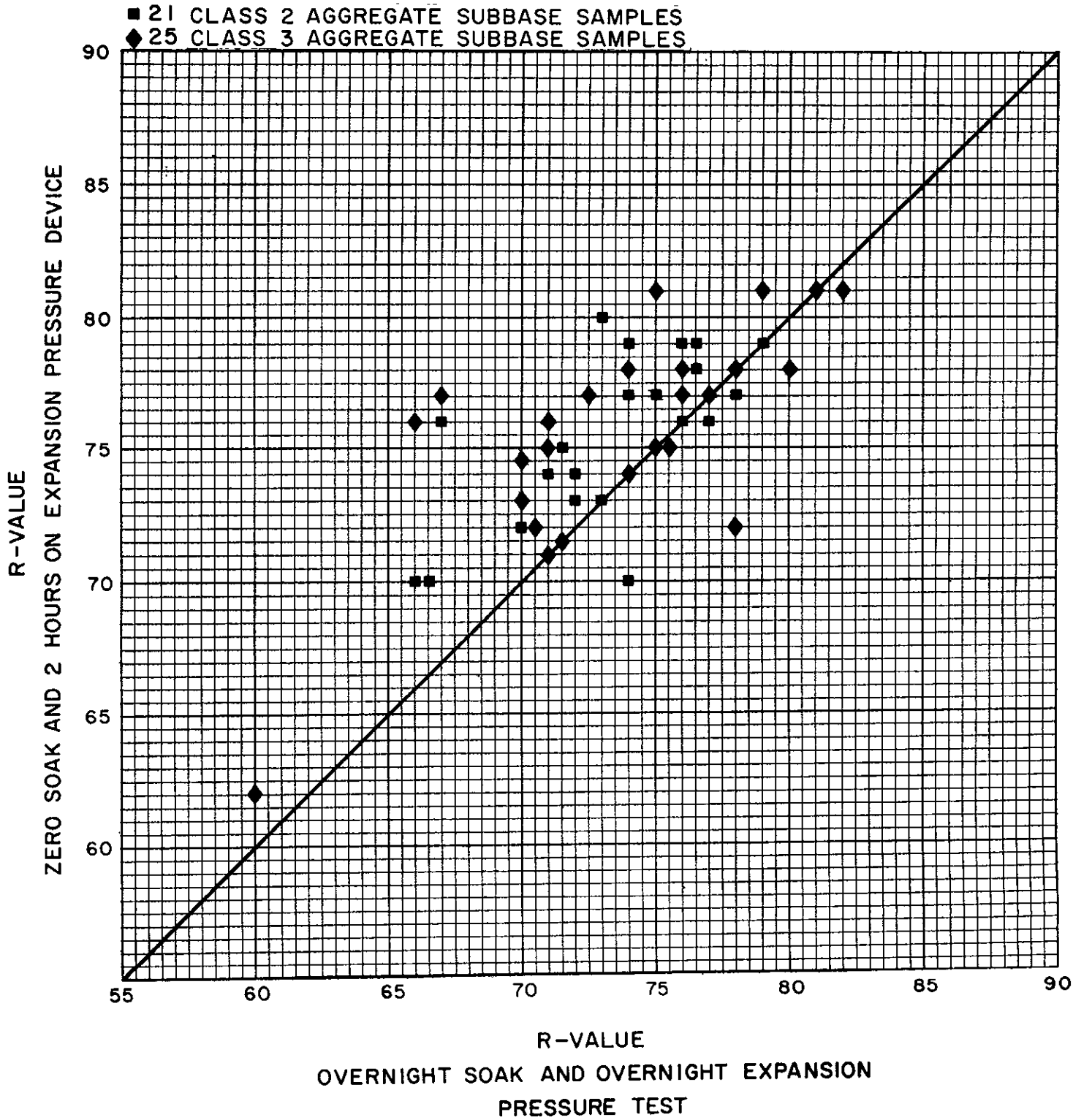

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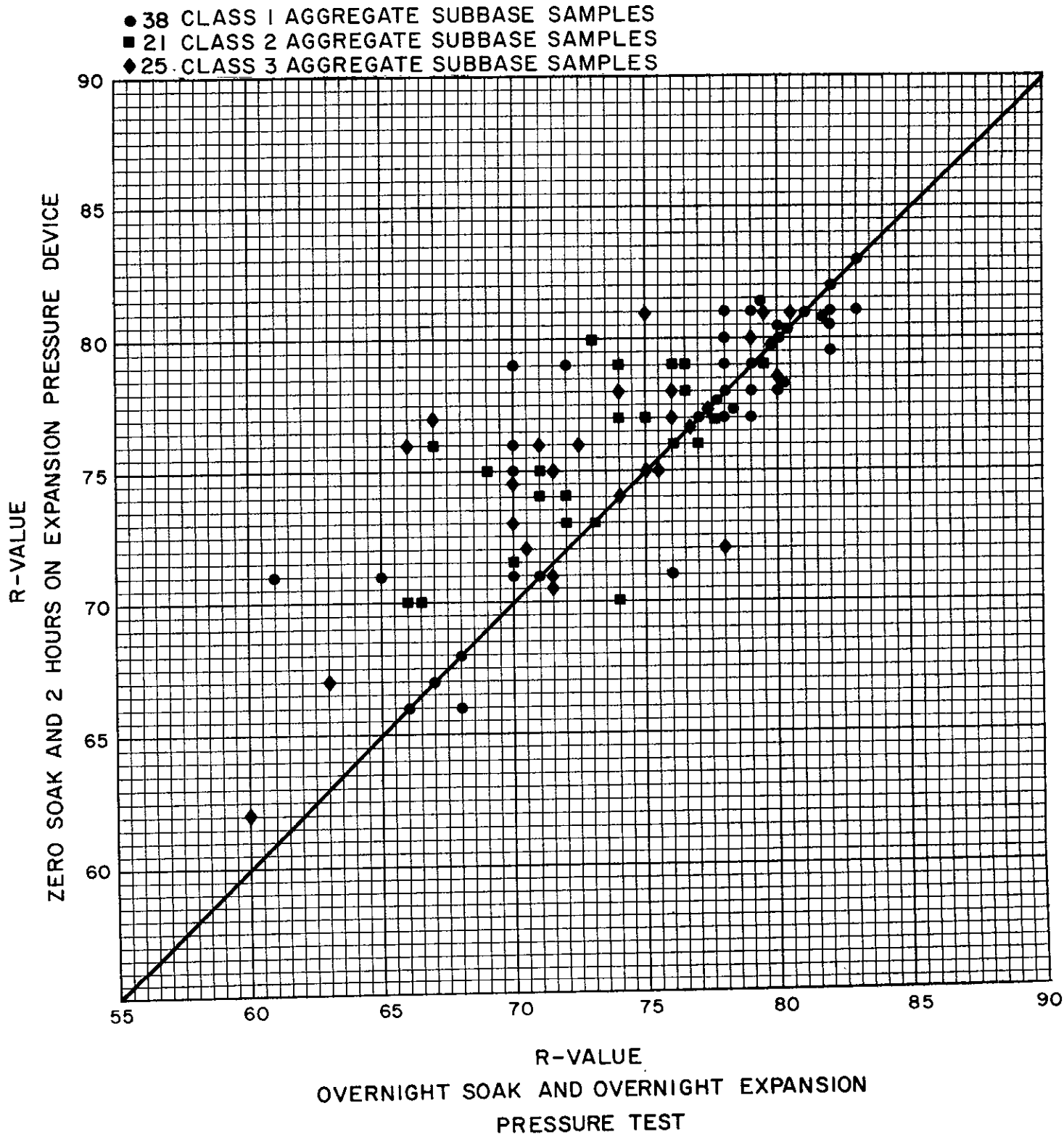
FIGURE 5

GRAPH SHOWING R-VALUES DETERMINED WITH OVERNIGHT SOAK WATER AND OVERNIGHT ON THE EXPANSION PRESSURE DEVICE AS COMPARED TO NO OVERNIGHT SOAK AND 2 HOURS ON THE EXPANSION PRESSURE DEVICE



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