MICHIGAN
STATE HIGHWAY DEPARTMENT
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State Highway Commissioner

SUBGRADE EMBANKMENT SOIL

AASHO ROAD TEST

Results of Laboratory Tests
on Soil Samples from
Borrow Pits 1 and 2

by

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This report presents test data on samples of soil material taken from Borrow Pits 1 and 2 at the site of the AASHO Road Test in LaSalle County, Illinois. Both samples, designated BP-1 and BP-2, represent the soil material to be used in the construction of the 36-inch embankment under the test sections.

The soil material is from glacial till deposits of the Wisconsin glacial period. These deposits also are the parent materials of the Miami, Conover, Brookston catena. At the test road site this Wisconsin drift occurs between a thin mantle of loess and an underlying deposit of older or pre-Wisconsin drift.[1]

The samples were taken on October 31, 1956 by test road laboratory personnel as instructed by Mr. Walter McKendrick, Project Engineer, and brought to East Lansing Laboratory by Messrs. O. L. Stokstad and E. A. Finney.

The report has been prepared for Department information. Laboratory test data are presented in Tables 1 and 3 and represented graphically in Figures 1 to 4 inclusively.

Comments on Results

The properties of soil samples BP-1 and BP-2 were compared with the soil data in Table 1, pages 95-97, Green Book, AASHO Road Test Report of Working Committee. On the basis of mechanical analysis only, the following similarity is indicated:

Sample BP-1 to Test Hole No. 5, Ill. Lab. No. 52-3965 (5F)
Sample BP-2 to Test Hole No. 8, Ill. Lab. No. 52-3859 (8C)

On the basis of presented test data, it can be considered that the soil from Borrow Pits 1 and 2 are much alike in all characteristics.

Referring in particular to the qualitative and quantitative results, Table 3, we find again a very close relationship. Sample BP-1 did show some Illite and Vermiculite interstratafied. Other than this, the samples were so closely related that it could be said they are of the same Gray-Brown Podzolic Group.

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[1] Comment by O. L. Stokstad - letter 3-25-57.

TESTS PERFORMED AND THEIR DESIGNATIONS

1. Atterberg constants:

   a. Liquid Limit: This test conforms with the A. S. T. M. Designation: D 423-39. Table 1, Figure 2.

   b. Plastic Limit and Plasticity Index: This test conforms with the A. S. T. M. Designation: D 424-39. Table 1.

2. Sieve Analysis: This test conforms with the A. S. T. M. Designation: D 421-39. Table 1.

3. Hydrometer Analysis: This test conforms with the A. S. T. M. Designation: D 422-39 and A. A. S. H. O. T 88-49. Figure 1.

4. Field Moisture Equivalent: A. S. T. M. Designation: D 426-39 and A. A. S. H. O. T 99-49. Table 1.

5. Moisture Density Relations of Soils: This test was made to conform with A. A. S. H. O. T 99-49 and A. S. T. M. D 698-42T methods for determing moisture and density of soils. This compaction method was designed to give the same degree of compaction to a soil as would be secured if the soil was compacted at the same moisture content with a given roller under field conditions. Table 2, Figure 3.

6. Specific Gravity of Soils: This test conforms with the A. A. S. H. O. Designation: T 99-38 and A. S. T. M. Designation: D 698-42T. Table 1.

7. Triaxial Compression Test: Confined quick load method. The procedure was taken from the Laboratory Manual in Soil Mechanics, by Raymond F. Dawson, pp 157-167. The tests were performed in cooperation with the Michigan State University Department of Civil Engineering. Figure 4.

8. Qualitative and Quantitative Results of Clay Contents Based on the X-Ray Diffration Analysis of Particle Size Less Than Two Microns: These tests were performed by Max M. Mortland, PhD., Assoc. Professor of Soil Science, Michigan State University. Table 3.

TABLE 1

SOIL TEST DATA

Sample of	Subgrade Soil	Subgrade Soil
Research Lab. No.	56 AR-16	56 AR-17
AASHO Lab. No.	BP-1	BP-2
Identification	B-Horizon	B-Horizon
Color, Moist	Dark Brown	Light Brown
Soil Type	Silty Clay	Silty Clay
Sampled from	Borrow Pit 1	Borrow Pit 2
Location	AASHO Test Road	AASHO Test Road

TEST RESULTS

Percent passing 3/8	100	100
" " 4	92.93	98.77
" " 10	90.92	97.60
" " 20	90.54	96.50
" " 40	89.96	95.10
" " 60	89.04	92.50
" " 140	81.68	87.40
" " 200	77.86	85.60
Percent sand	17.10	12.40
" silt	46.10	44.90
" clay	17.40	18.50
" colloids	10.40	21.00
Field Moist. Equiv. %	17.60	18.27
Specific Gravity	2.72	2.71
Max. Dry Density #/ft.^{3}	118.5 @ 14.5% w	116.0 @ 16.1% w
Liquid Limit %	26.45	32.44
Plastic Limit %	14.21	15.19
Plastic Index %	12.24	17.25

TABLE 2

GAMMA-RAY GAGE DENSITY VERSUS VOLUME-WEIGHT DENSITY

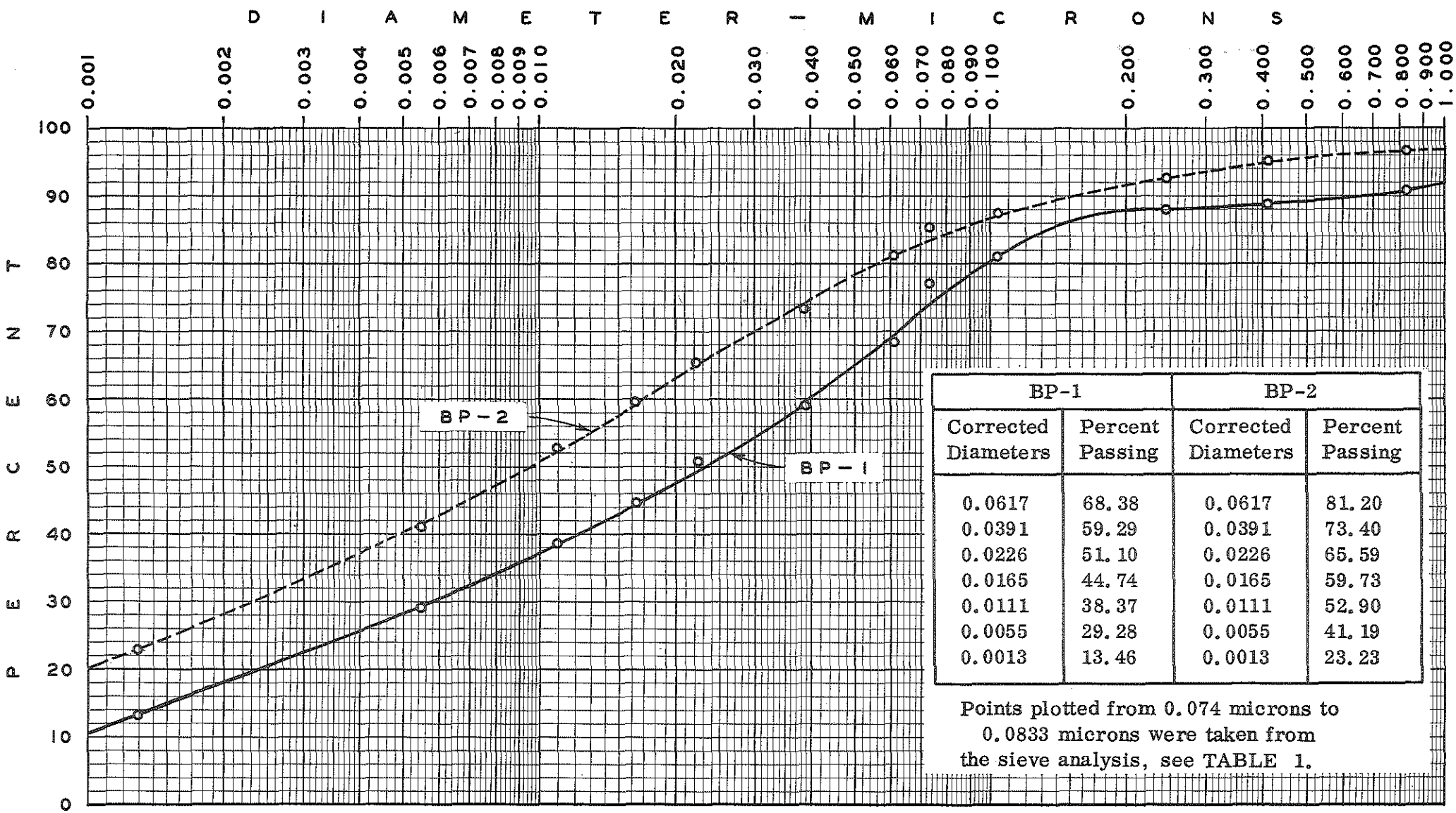
Sample No.	DENSITY Volume-Weight $lb/ft.^3$	DENSITY Gamma-Ray Gage Density $lb/ft.^3$	Percent Moisture	Count Rate for Gamma-Ray Density in C/M
BP-1	89.8	89.7	9.4	44,160
BP-2	84.0	84.2	5.8	45,500

The material used in these tests was placed in a tub having a volume of 2.02 cu. ft. The material was not compacted and was struck off level with the top of the tub. The weight of soil in the tub was obtained and the volume-weight density computed. The Gamma-ray Gage was then placed on the soil and a count rate taken. By entering this count rate on the calibration curve the Gamma-ray Gage density was determined.

TABLE 3

QUALITATIVE AND QUANTITATIVE RESULTS OF CLAY CONTENTS BASED ON THE X-RAY DIFFRACTION ANALYSIS OF PARTICLE SIZE LESS THAN TWO MICRON

Sample No.	Qualitative	Quantitative Percent
BP-1	Illite	70.59
	Kaolinite	29.41
BP-2	Illite	72.97
	Kaolinite	27.03



BP-1		BP-2	
Corrected Diameters	Percent Passing	Corrected Diameters	Percent Passing
0.0617	68.38	0.0617	81.20
0.0391	59.29	0.0391	73.40
0.0226	51.10	0.0226	65.59
0.0165	44.74	0.0165	59.73
0.0111	38.37	0.0111	52.90
0.0055	29.28	0.0055	41.19
0.0013	13.46	0.0013	23.23

Points plotted from 0.074 microns to 0.0833 microns were taken from the sieve analysis, see TABLE 1.

FIGURE 1. HYDROMETER ANALYSIS OF MATERIAL PASSING THE NO. 10 SIEVE. SPECIFIC GRAVITY CORRECTION A 2.65. WEIGHT OF SAMPLES USED WERE 50 GRAMS.

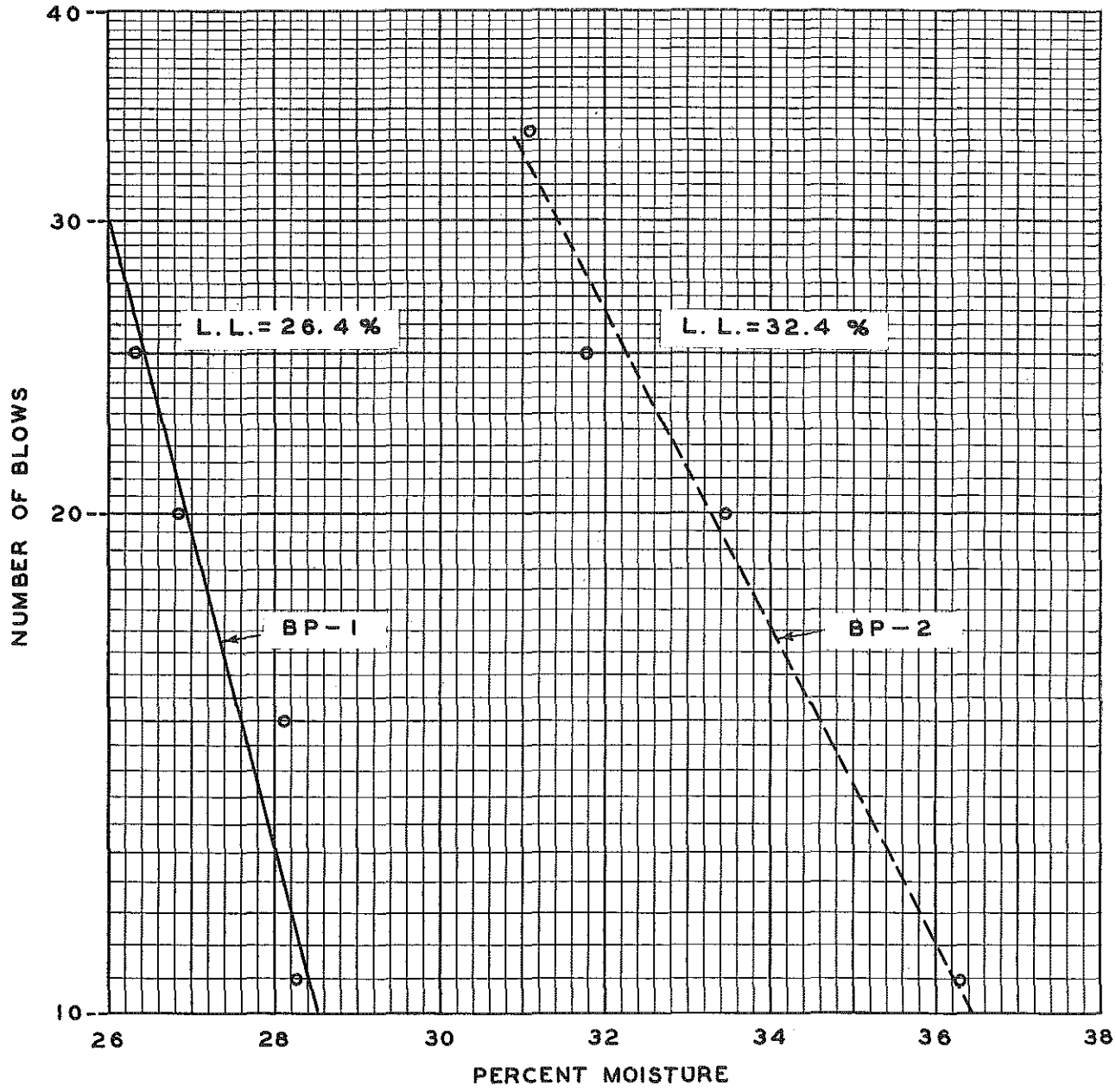


FIGURE 2. LIQUID LIMIT DETERMINATION

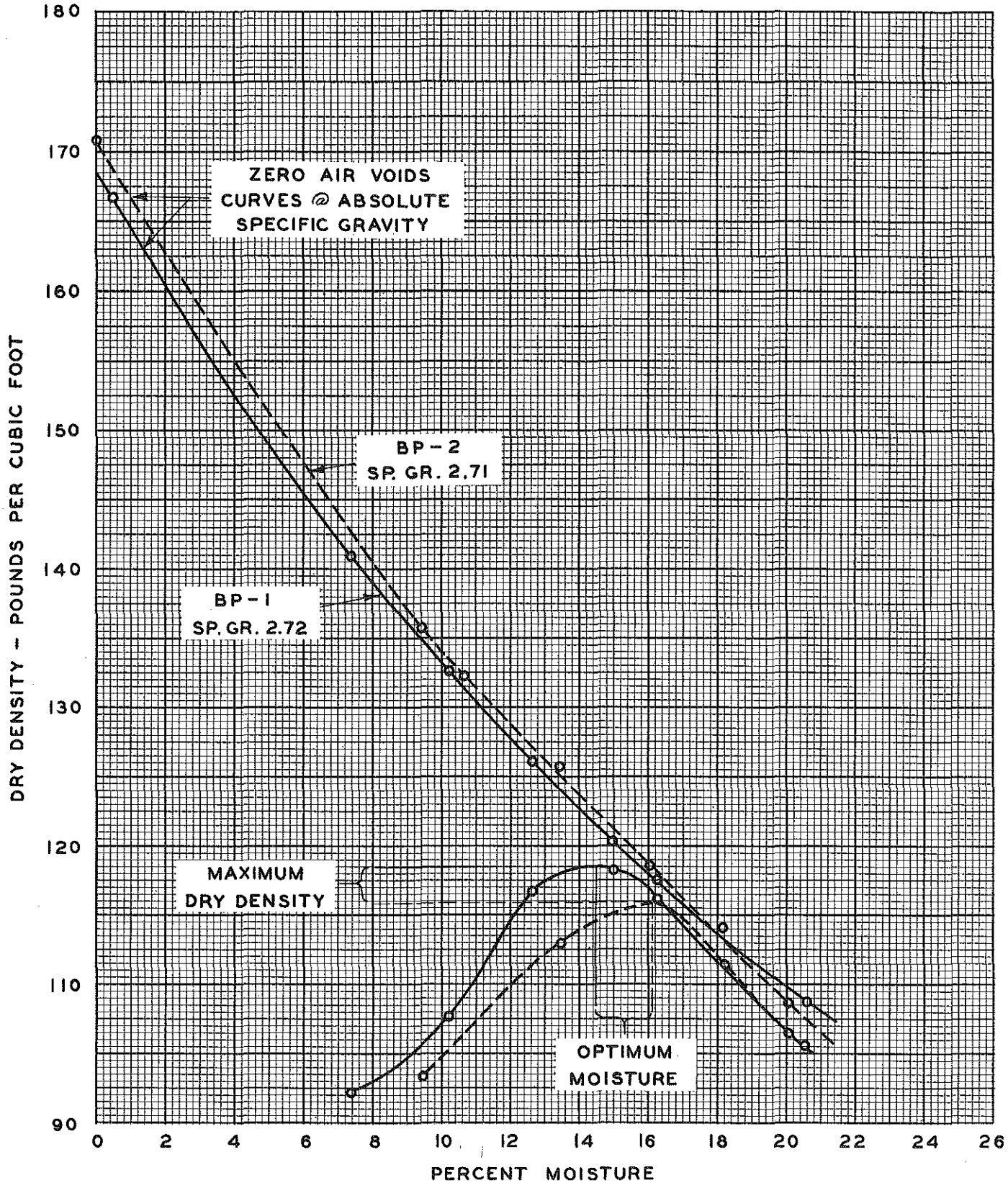
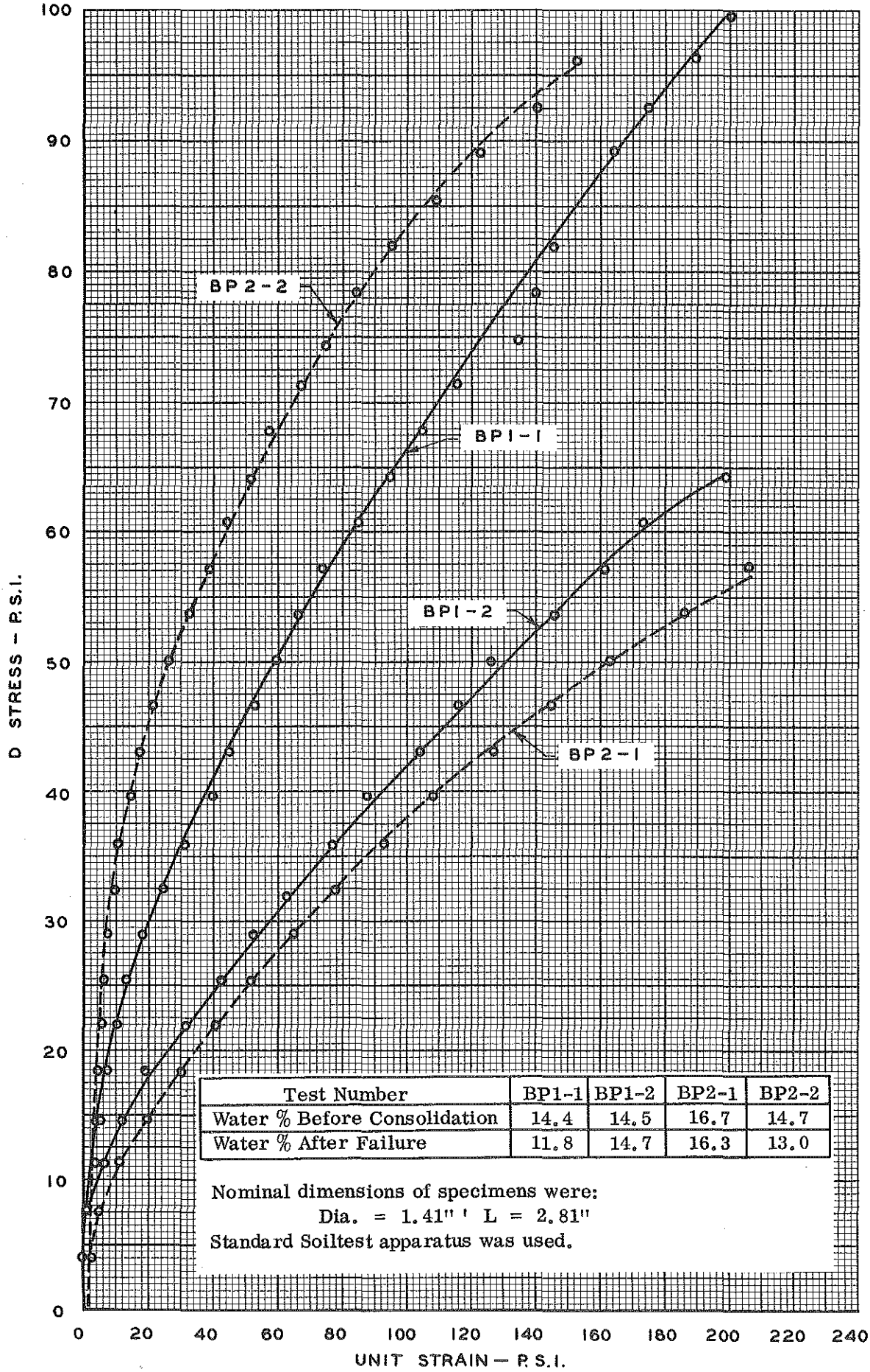


FIGURE 3. MOISTURE - DENSITY CURVES



Test Number	BP1-1	BP1-2	BP2-1	BP2-2
Water % Before Consolidation	14.4	14.5	16.7	14.7
Water % After Failure	11.8	14.7	16.3	13.0

Nominal dimensions of specimens were:
Dia. = 1.41" ' L = 2.81"
Standard Soiltest apparatus was used.

FIGURE 4. TRIAXIAL COMPRESSION TEST, CONSOLIDATED - QUICK