I-7. Tests and specifications for fill materials.
I-8. Tests for adsorptive adhesion.

Department of Soil Investigations, Highway Research Board

1. Standardization of nomenclature and definitions.
2. What information is desired by a practicing engineer.
3. Methods of exploring, surveying and sampling soils for highway purposes.
4. Methods of determining in place the physical characteristics of foundation and subgrade soils.
5. Methods of testing disturbed soils and the application of the test results in practice.
6. Laboratory determinations of the properties of foundation soils in their natural state and the application of test data in practice.
7. Methods of compaction for control and construction and their effect upon the properties of soils for highway purposes.
8. Practical design of drainage for highways and airports exclusive of bridges and culverts.
9. The effect of disturbing the natural structure of a soil on its supporting power.
10. Committee on testing equipment and apparatus.
11. Stress distribution in earth masses
    a. Load due to own weight
    b. Load through pavements
    c. External loads on foundations.
12. Physico-chemical testing of soils and the application of the results in practice.
13. Stabilized soil road surfaces.

No. A-16 SOIL MECHANICS LABORATORY AT THE THAYER SCHOOL OF CIVIL ENGINEERING

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The Soil Mechanics laboratory at the Thayer School of Civil Engineering was established by the author in 1933, primarily for the purpose of instructing civil engineering students in the elements and fundamentals of soil characteristics and soil tests; secondarily, to enable the author to pursue such research as time might permit. The laboratory is contained in a single room having a floor area 20' x 22'. An adjoining room 6' x 10' in size is in the process of being converted into a humid room.

Equipment.

Grain size determination: Standard Tyler sieves and an Eimer and Amend hydrometer reading from 0.995 to 1.030.

Moisture Content Determination: Watch glasses and electric drying oven.

Organic matter is determined by heating the sample in a graphite crucible held over a "Pyrofax" gas Bunsen burner flame.

The specific gravity of the soil particles is determined with ordinary Pyrex 500 cc pycnometers calibrated for temperatures between 16°C and 30°C.

The plate used for immersing Shrinkage Limit test specimens in a dish of mercury has three nail heads, each about $\frac{1}{4}$" long attached to one side by means of liquid solder.

The Liquid Limit device (Fig. 1 and 2) is built in accordance with the specifications published in Public Roads, October, 1932. For economy, the cup consists of the bowl of a soup ladle which may be bought for ten cents at any five-and-ten cent store. The ladle happens to correspond almost identically with the specifications except that it is metal-plated and lighter in weight. The discrepancy in weight has been compensated for by fastening strip lead to the edges of the cup. The groover was made from steel and case hardened, the size and shape conforming to the specifications referred to.

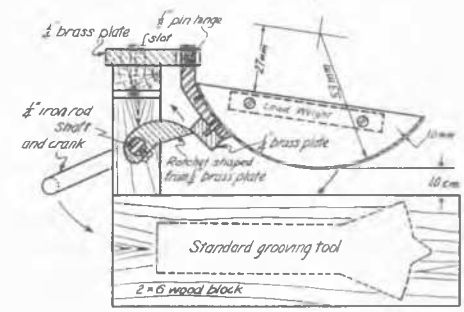
The consolidation device (Fig. 3 and 4) for $2\frac{1}{2}$ inch specimens, together with the special loading machine, (Fig. 5) accommodating four tests simultaneously, have been described in Engineering News-Record, February 27, 1936, page 324. Undisturbed specimens are introduced into the removable testing ring as described in the Proceedings of the American Society of Civil Engineers, August, 1933, page 1063. The form used for reporting test results is shown in Fig. 6.

Permeability tests are made with an ordinary 2" x 8" glass capillarity tube and a variable head permeameter, illustrated in Fig. 7. The capillarity tubes have been used also as variable-head permeameters.

The laboratory is equipped with a sampling tube similar to the one shown in Fig. 2 of the author's paper No. F-4, Vol. I. A special cap is used for driving the sampler with a mall when surface samples are to be taken for testing in the laboratory course. Samples 3" in diameter and about 18" long are obtained, immediately removed from the split liner tube, painted with paraffin and then immersed in paraffin which fills to overflowing the cardboard containers in which they are preserved. These cardboard containers are the standard one-quart ice-cream containers, $3\frac{1}{4}$" inside diameter, 7" long. The paraffin is melted in a pot over a "sterno" flame, and the only tools required are stillson wrenches or chain tongs for opening the sampling tube.

The lever loading device shown in Fig. 8 was built for experimental model tests. It has a capacity of 2000 lbs. and is equipped with an Ames dial for reading the deflection of the loading lever directly

Fig. 1. Liquid Limit Device



SECTIONAL VIEW
LIQUID LIMIT DEVICE
FIG. 2

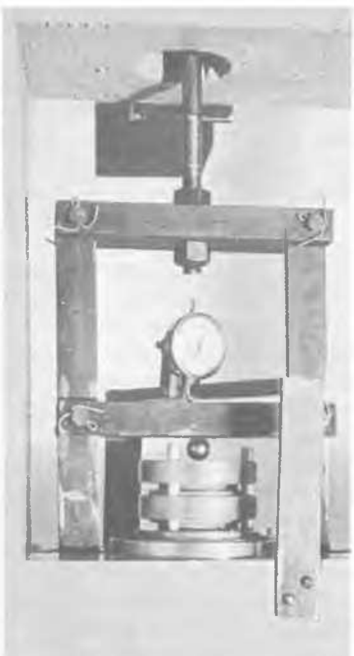


Fig.4 Consolidation Device mounted in loading machine with enclosing ring removed.

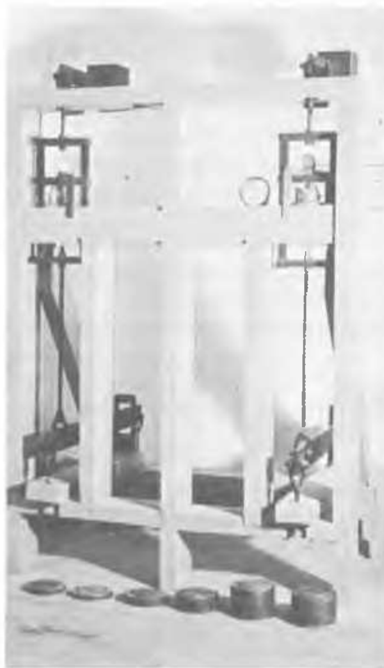
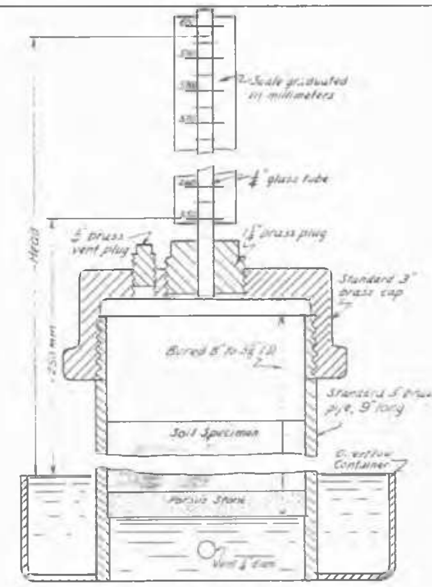


Fig.5. Special Loading Machine for Consolidation Tests.



VARIABLE HEAD PERMEAMETER
FIG. 7

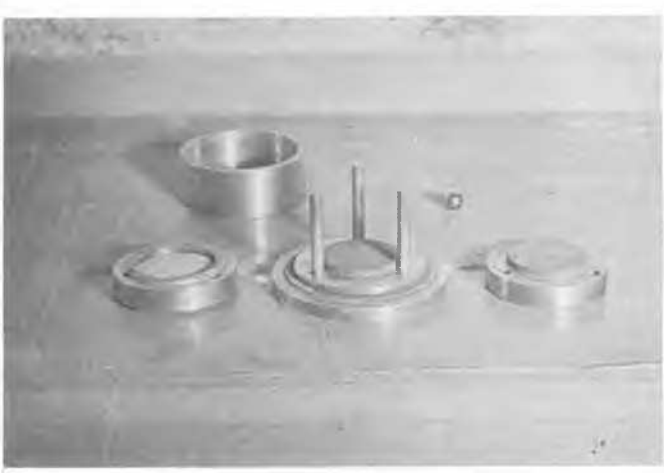


Fig.3. Consolidation Device Dismantled.

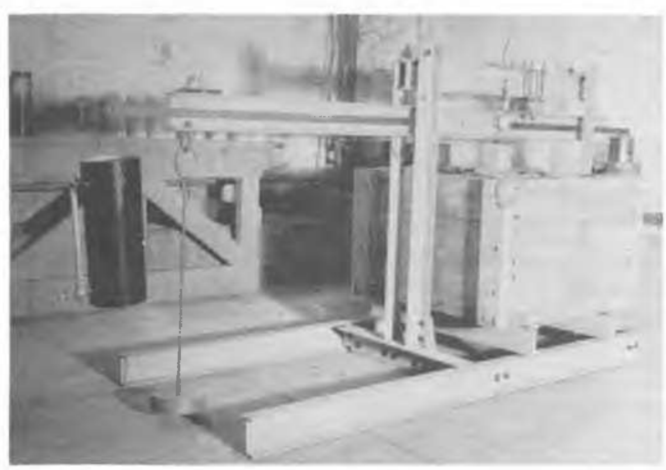


Fig.8. Experimental Model Loading Device.

over the point of application of load to 0.0001 inch. Total cost of equipment, to-date, $740.

Laboratory Instruction. The laboratory course, started in 1935, consists of the following experiments:

Experiment No. 1: Sampling. Using the 3" core sampling tube, each student obtains a sample from a clay bank in the vicinity, selects two portions suitable for testing, classifies the materials, seals them in paraffin-filled cardboard containers and marks them with conventional identification terms. These samples are used for all the laboratory tests required in the course.

Experiment No. 2: Determination of moisture content, specific weight, and plastic limit; preparation of undisturbed and remolded shrinkage limit specimens.

Experiment No. 3: Determination of undisturbed and remolded shrinkage limits and specific gravity of the soil grains.

Experiment No. 4: Determination of liquid limit. Preparation of trial suspensions for observance of flocculation preliminary to hydrometer tests.

Experiment No. 5: Determination of grain size by sieve and hydrometer analysis.

Experiment No. 6: Permeability test using variable-head permeameter.

Experiment No. 7: Permeability test using capillarity tube method; determination of constant F.

Experiment No. 8: Consolidation test on undisturbed sample, loading by increments to 8 tons per sq ft, and unloading by increments to zero load.

Experiment No. 9: Consolidation test on remolded sample using same procedure.

Experiments 1-7 inclusive require about three hour's time each. Experiments 8 and 9 require about six hours time each. Separate reports are required to cover experiments 2, 3, and 4. A special computation period is allowed after experiments 4, 5, 7, 8 and 9 respectively for the preparation of reports. The students work in pairs. Each student is required to perform and report on each of experiments 1-7 inclusive and on either experiment 8 or experiment 9. This schedule fits conveniently into a 15-week semester. The author believes that laboratory work of this nature is valuable for any engineering student who will be engaged in structural work. It affords an understanding of soil mechanics terminology and a familiarity with the properties of soils which should be of value in the interpretation of soil tests made by others, and in conjunction with a course in soil mechanics should form a sound basis for the actual making and evaluating of tests.

THAYER SCHOOL OF CIVIL ENGINEERING
FOUNDATIONS LABORATORY
REPORT OF SOIL CONSOLIDATION TEST

Sheet No. 1 of___sheets

Sample tested:______________________________
Consolidation device No.___; Loading device No.___; Dial No.___
Date test begun:____________; Date test ended:____________
Names of operators:______________________________
Report prepared by:____________; Date:____________
Note: Centimeter-gram-second or minute units used throughout.
Note: Fill in parentheses to show how values are obtained. Thus, parenthesis after item 3 should read: (1-2)

ITEM	VALUE	UNIT
1. Weight soil + H_2O at start		
2. Weight soil + H_2O at end		
3. Loss of H_2O during test ( )		
4. Diameter of testing ring		
5. Area of testing ring		
6. Depth of testing ring		
7. Weight of soil at end		
8. Weight of H_2O at end ( )		
9. w at end ( )		
10. Weight of H_2O at start ( )		
11. w at start ( )		
12. s of soil		
13. Volume of soil in testing ring ( )		
14. Volume of H_2O in testing ring at start ( )		
15. Volume of testing ring (capacity) [( ) ( )]		
16. Volume of soil + H_2O in ring at start ( )		
17. Volume of air in ring at start ( ) (+ or -)		
18. s_m of soil in ring at start ( )		
19. Dial reading at start		
20. Dial reading at end		
21. Total consolidation (start to end) ( )		
22. Loss in volume (start to end) (by dial) [( ) ( )]		
23. Loss in volume (start to end) (by w's) ( )		
24. Loss in volume (start to end) not shown by dial (+ or-) ( )		
25. Remarks:		

Fig. 6