No. A-1 GENERAL REPORT FROM THE LABORATORY OF THE EGYPTIAN UNIVERSITY IN CAIRO

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Organisation of laboratory. The Foundation Soils Research Laboratory is an Egyptian Government Institution of the Faculty of Engineering, Egyptian University, Cairo.

The creation of the laboratory was deoided in December 1933. Sinoe that date, Dr. William Selim Hanna, Researoh Engineer of the Faoulty, is in charge of the laboratory, assisted by Dipl. Ing. G. Tsohebotareff, who was engaged for its organisation and for further work.

The laboratory began working in the spring, 1934. Kamal Khalifa Eff., Dipl. R.S.E., Cairo, was joined to the staff of the laboratory in Ootober, 1935. The staff of the laboratory is oomposed of the three above named persons.

In dealing with more complioated mathematical problems, the staff benefits of the oooperation of Dr. F. E. Relton, Professor of Mathematics and Mechanics.

No temporary employees or students take part in researoh for the time being.

Purpose and policy of the laboratory. The main purpose of the laboratory is investigation of all problems connected with settlements of buildings. Several cases of foundation diffioulties had oocurred looally, oaused by laok of data oonoerning faotors governing settlements of struotures. A systematio oentralised investigation of these factors appeared neoessary.

The laboratory equipment was ohosen with this aim in view. It was however considered that laboratory work alone oould not be developed in a manner allowing it to become of praotioal importanoe, unless it was oheoked by and oorrelated to results of observations on aotual struotures.

Therefore the main work of the laboratory oonsists in systematio observations of structures and olassification of the settlement data obtained, its comparison to results of laboratory tests and theoretical investigations and the development of latter, on the basis of suoh comparisons, to allow future direct foreoasts.

Considerable diffioulties were experienoed at first in obtaining struotures to observe. There was a general reluotanoe to allow suoh observations, largely beoause of the erroneous idea that a good foundation should not settle at all.

With the aim of helping to overoome suoh hesitations and of getting experience in the interpretation of test results and in making foreoasts, adapted to peouliarities of local soil formations, it was deoided to oonsider the work of the laboratory during the first years of its existenoe as one of publio service only. Therefore the laboratory oarries out gratuitously borings, extraotion of soil samples, laboratory tests; fixes speoial benoh-marks and makes settlement and other observations on any building, governmental or private, given to it for investigation, with any type of foundation or soil formation. When consulting servioes only are required in connection with investigations not representing further soientifio interest, suoh servioes are oharged for.

In spite of these facilities and the guarantee offered that all results would be treated confidentially and not made publio, in a manner allowing to reoognise the building, without the written agreement of the institution or person which had given it to the laboratory for investigation, oases have ooourred of refusal of permission to observe struotures of partioular soientific interest.

Conditions are now gradually beginning to ohange. A number of governmental departments, private architeots, oonsulting engineers and firms are oooperating at present with the laboratory.

Laboratory equipment. The laboratory oocupies a floor area of 95 sq. metres. The humid room has humidity kept up at 85% by constant watering. No constant temperature room is yet available, but is foreseen in a new building.

The equipment oonsists of the following apparatus for determination of:

(1)	Water oontent.	Balanoes, preoision 0, lmgr. Watch glasses or Petri dishes. Drying at 105° C in eleotrio oven with automatio regulation. Dessioators.
(2)	Specific gravity of mineral matter.	Weighing of dispersed matter in 500 oom measuring flasks.
(3)	Grain size.	A. Sieving in machine of oonorete laboratory. B. Sedimentation by Casagrande-Boyouoos method.
(4)	Atterberg limits.	A. Liquid limit by Casagrande oup devioe. B. Plastio limit by hand rolling. C. Shrinkage limit in conneotion with volume determination by immersion in meroury.
(5)	Shearing strength.	Apparatus system Casagrande. 6 shearing boxes with porous idented stones, 10 x 10 om., fixed to one stand. Vertioal foroe applied by levers 1:5. Horizontal foroe applied by lever moving on stand from box to box, with rolling weight. Inset shear boxes 6 x 6 om used for smaller undisturbed samples.
(6)	Compressive strength.	Soil oylinders tested of 2.5 om diameter, and 3.7 om high. Load applied by lever with rolling weight.
(7)	Consolidation and permeability	Combined tests. 6 oedometers system Terzaghi. 5 have sample diameter 70 mms and 1 has 44 mms. Sample height 12 mms. Load applied by lever to piston moving within oylinder in whioh sample is fitted. Smaller oedometer modified to fit sample into separate ring adjustable to oylinder.

(8)	Cone penetration.	2 apparatus. First with standardized light cones for disturbed and weak soils. Second with cone weights of 1; 2; 3; 4; & 5 kgs for stiff soils.
(9)	Soil exploration.	A. Complete outfit for boring down to 30 m. Adjustable 6 to 9 m high steel tubular shear logs with winch. 6" diameter lining tubes, hand operated augers, valves, etc. B. Light hand operated 5" borer, without lining tubes, for boring down to 5.5 m depth. C. Devices for extraction of undisturbed soil samples, described in Paper No. B-4, Vol. I, driven down by 50 kg drop hammer and 2" pipe driving stem.
(10)	Settlement of structures.	A. Watt's optical precision level. B. Several hundred levelling bench marks, system Terzaghi, having brass heads with unscrewable lids to screw in levelling bolts. C. Precision hangers with millimetre scale for preceding levelling bolts. D. Water level, system Terzaghi. Two glass cylinders, connected by 20 m long rubber tube, to fix on levelling bolts under B. With needle points, to touch water surface, with micrometer screw and vernier scale.
(11)	Variations in width of cracks on buildings.	Transportable deformeter, system Huggenberger reading to 1/10000". Corresponding precision plugs with unscrewable covers.
(12)	Variations in inclination of structures.	Transportable clinometer, system Huggenberger, reading variations of angles to 1". Corresponding plates, with unscrewable covers, to be fixed to structures.

14 Zeiss dial gauges, reading to 0.01 mm, are used with preceding apparatus.

Apparatus for lime content determination and direct permeability tests have been ordered. Other developments and improvements in the equipment are considered.

The apparatus under 3B; 4A; 5; 8; 10C; 10D; 3 oedometers under 7; and device "c" under 9C were supplied by Dr. Terzaghi's Laboratory, Technische Hochschule, Vienna. Device "e" under 9C by Laboratory of the "Degebo", Technische Hochschule, Berlin.

The remaining oedometers and modification under 7; the other extraction devices under 9C; benchmarks under 10B and various fittings were made by the Workshops of the Faculty.

Buildings under observation by the laboratory. Fourteen buildings are at present under settlement observation by the laboratory; (5 on raft and 9 on pile foundations of different types, in different localities and soil formations.) Over 400 special permanent bench marks are fixed in these buildings and are regularly levelled. Their number generally varies from 8 to 52 per building.

Observations will be started shortly on five more buildings (3 raft and 2 pile foundations), as soon as their superstructure is begun.

The usual procedure of laboratory for settlement observation in Cairo is that two or three laboratory bench marks are fixed on old buildings, etc., in vicinity. These bench marks, as well as those on facade of new building, are then periodically levelled by the Survey Department and joined up to the network of their accurately controlled bench marks. Remaining points on new building, as well as intermediate general levellings, and, in some cases, the entire observation, are done by the laboratory staff.

This cooperation of the Survey Department is greatly appreciated. For buildings situated in the provinces the entire levellings are done by laboratory staff.

Main subjects of research and conclusions.

A. Classification of and data about soils contributing to settlement of buildings.

Conclusions:
1. The classification of soils for engineering purposes by laboratory methods affords accuracy not given by other procedures.
2. Coefficients relating to the behaviour of local clays under stress have been established. Some values have been determined fairly accurately. Others within limit values, the range becoming narrower with further information from continued direct observations.

B. Accuracy of direct settlement forecasts, (based upon oedometer compressibility and permeability tests).

Conclusions:
1. Usual method of testing always gives too high values of settlements for local soils. The change in the technique of testing developed seems to decrease this difference.
2. The order of dimension of the observed rate of settlements seems to agree with theoretical values based on permeability tests.

C. Data obtained from observations on structures.

Conclusions:
1. Both raft and pile foundations can settle appreciably when resting on clay soils. Load tests on limited areas in the case of rafts, or on single piles, give no idea about the eventual settlement which takes place later.
2. Buildings resting on piles, reaching sand under certain precautions, seem to settle much less than those resting on clay soils under same loading.
3. Continued collection of data promises to give reliable information for future forecasts of settlements of structures in Egypt.

D. Correlation between theoretical stress distribution in the soil and observed inequalities of settlements.

Conclusions: 1. The observed inequalities of settlement appear to be governed in the majority of cases by stress distribution in the soil derived from Boussinesq equation.

E. Effects of remoulding on clays.

Conclusions: 1. From results of compressive strength tests two types of clays have been found. The first unaffected by remoulding and the second decidedly affected by it. The influence of the remoulding on the bearing capacity of piles resting on the second clay is under study.

The papers No. B-4, C-1, D-1, E-1, E-2, F-1, Vol. I, give details about the investigations made.

Most of these investigations are in the initial stage and it will take some years before they are entirely completed. Results and preliminary deductions are nevertheless presented as tentative conclusions, subject to possible revision later, when more ample information will be accumulated.

No. A-2 REPORT ON TESTING APPARATUS, TECHNIQUE OF TESTING AND INVESTIGATIONS IN PROGRESS

Submitted by the Laboratory of Soil Mechanics, Delft

1. Name of institution, organization or firm supporting the laboratory; its location and year established.
"Laboratorium voor Grondmechanica" part of the foundation "Het Waterbouwkundig Laboratorium", Raam 61, Delft, Netherlands, established 15 February 1934, formerly a division of the Technical University; for scientific problems collaborating with the Technical University Delft, Department of Soil Mechanics (prof. ir. A. S. Keverling Buisman).

2. Name and title of person in charge of laboratory; number of persons on regular staff and average number of temporary employees or students engaged in research.
Managing Director ir. T. K. Huizinga; at this moment on staff:

5 engineers (for consulting and research work)	6 workmen (for field work)
4 assistants (for consulting and research work)	1 bookkeeper
2 draftsmen	2 workmen (construction and maintenance of app.)
1 engineer (for field work)	1 office boy
1 assistant (for field work)	

During the period of the existence of the laboratory 7 students of the technical college of civil Engineers at the "Technische Hoogeschool" Delft, worked on research problems.

3. Principal purpose for which laboratory is equipped (research, instruction or consulting service).
Principally for consulting service, sustained by research work the latter serving as scientific studies for instruction in Soil Mechanics of the Technical University.

4. Description of equipment:
   a. Total floor area, deducting office space. Humid room and constant temperature room; type of equipment for humidification and temperature control.
   A plan of the laboratory is given in Fig. 1. The place and the room occupied by the apparatus are indicated by rectangles; the numbers referring to the legenda. Behind the indication the figure-numbers refer to the drawings in this same report. The humid-room is part of a cellar: it has no openings in the walls, besides the door. Humifidication is caused by blankets, which are constantly kept saturated with water.
   b. Apparatus for the classification of soils according to grain size distribution, grain shape, porosity, relative density, water content, air content, lime content, content of organic matter, specific gravity of mineral matter, Atterberg limit tests, consistency.
   Grain-size distribution.
      Sieves. A set of sieves from 25.4 mm to 0.075 mm.
      Atterberg method. A set of cylinders and beakers, Fig. 2.
      Hydrometer method. A set of cylinders, an areometer, Fig. 3, a watertank for constant temperature, a movable needlegauge for measuring difference in height between top of areometer and surface of fluid, Fig. 4, an electric drink-mixer.
   Grain shape. A geological microscope
   Water content, etc. An electric stove with thermostatic control. Small glass containers (for disturbed samples) A balance.
   Organic matter-content and lime content. Boiling with H_2O_2 and HCl.
      Lime content only. Apparatus according to Passon.
   Specific gravity of mineral matter. A simple specific-gravity-meter.
   Atterberg limit tests. Apparatus for lower liquid limit (acc. to Casagrande) Fig. 5.
      Apparatus for lower plastic limit, Fig. 6. Simple apparatus for measuring lineal shrinkage (result of an investigation on different soils) Fig. 7.
   Consistency. Measured by penetration-test, (cone-test) Fig. 10, 11, 27, 28.
   c. Apparatus for shearing tests.
   Normal shearing apparatus, Fig. 8,9. Litt. prof. ir. A. S. Buisman "de Ingenieur" 1928 No. 21. Cell-apparatus, Fig. 31, 32. Litt. prof. ir. A. S. Buisman "de Ingenieur" 1934 No. 26.