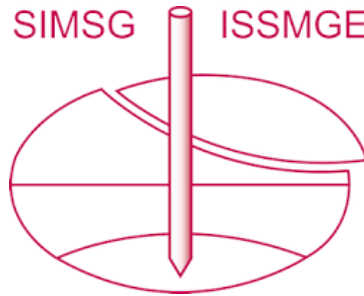


# INTERNATIONAL SOCIETY FOR SOIL MECHANICS AND GEOTECHNICAL ENGINEERING



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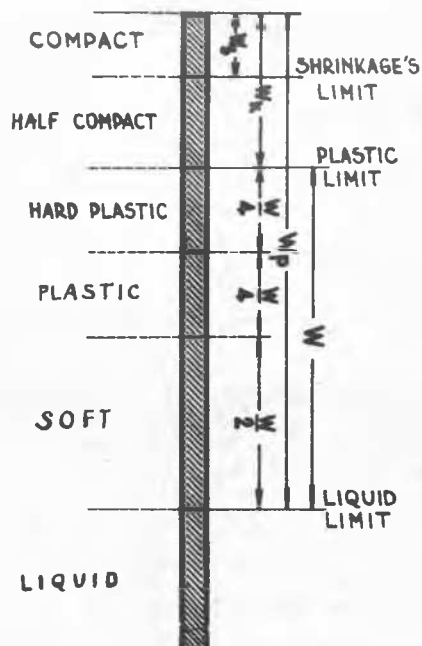


FIG. 2

The classification may seem to be somewhat to minute: the practice shall show that it is

virtually so, many contours can be possibly hereafter joined together; it is obvious now that to day a too wide classification would be reproachable.

It must be added that all designations of soils were adjusted to their commonly used names.

The second base of classification is the water - or voids - content of soils.

For the cohesive soils the Atterberg's consistency limits serve for a classification, as shown on fig. 2

For the cohesionless soils the compaction-in-

dex  $D = \frac{\epsilon - \epsilon_{\min}}{\epsilon_{\max} - \epsilon_{\min}}$  gives the second sign of value of a soil. In this figure the voids-in-

dexes  $\epsilon_{\max}$ ,  $\epsilon_{\min}$ , and  $\epsilon$  represent correspondingly the most loose, the most compact and the natural consistency of the same soil.

If  $0 < D \leq 0,33$  - soil is called loose

"  $0,33 < D \leq 0,66$  - " " " half

"  $0,66 < D \leq 1,00$  - " " " compact

It seems that in the present time it would be of high value to adopt an unified international classification and denomination of soils. This motion is here presented to the National Committees. In hope to serve to this aim this contribution is joined here.-

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## XII a 2 DEVELOPMENT OF A UNIFORM SYSTEM OF SOIL IDENTIFICATION AND CLASSIFICATION

MELBOURNE AND METROPOLITAN BOARD OF WORKS

Australia.

In view of the diversity of soil identification and classification systems, 1), it is suggested that this conference might consider initiating a uniform system.

The essential functions of a uniform system would be:

- To provide a standard of nomenclature for soil identification.
- To assist in condensing experience with soil behaviour.

A suitable system should be:

- Acceptable to all soil workers, e.g. engineers, agricultural scientists, and geologists.
- Simple and convenient in use.
- Capable of detailed expansion for special purposes without affecting the basic systems.

Any single system which met these basic requirements would probably be too complex for convenient use. An alternative would be a two-stage system providing:

- Simple system of field identification.
- Detailed functional classification for each major branch of soils work. These could each be developed by the appropriate professional association and its details exchanged with the other soil workers. Workers in any one field, e.g. civil engineering, would operate with that particular functional classification, but would have the other systems for

reference when exchanging data.

For the field identification, two systems are available: (a) The modified descriptive system adopted by the Division of Soils, C.S. I.R. Australia, or (b) the field section of the AC classification. 1).

The modified descriptive system uses standardized terminology, 2), but is essentially a field identification system. The ultimate test of the description of any soil is the majority verdict of experienced soil surveyors. To keep such opinions up to date and uniform, periodic conferences are held for interested parties, general descriptions are prepared, and comparisons are made between the classified types and their simple physical properties 2). All such descriptive terms and standards are subordinate to field usage and are periodically amended where necessary. This method has the advantage that it has been and still is, the most widely used identification system, it is very simple and convenient in use, and it is based on field observations and was developed solely for field use.

The AC classification field section is more complex and less flexible than the simpler system. In addition, its use is much more restricted and as such it would be harder to reach international agreement on its use.

For the engineering functional classification the alternative systems could be (a) PRA

system or (b) AC system.

The PRA system was developed for highways and is therefore limited in its general application. A further disadvantage is the periodic revisions which are being made to bring it more into line with the most modern practice.

The AC system is very widely adopted, following its use by the United States Army. It is simple, easily understood and follows logically from the modified descriptive classification of field identification. As such, it is suggested as the most suitable functional classification for civil engineers.

While considering uniformity in the classification, the grain-size scales should be studied. Reasonable acceptance of the International or a modified International scale would be simple if agreement could be reached on the clay-silt size boundaries. So far 0.02

and 0.05 or 0.06 m.m. have been suggested, but revision would probably meet with little objection from soil workers.

In conclusion, it is recommended that the field identification and classification system should consider as a field identification, the modified descriptive system, and as a classification, the AC system.

#### REFERENCES:

- 1) Dr. Arthur Casagrande "Classification and Identification of Soils" Proc. Amer. Soc. of Civil Eng. Vol. 73 No. 6, Part I, p. 783.
- 2) Dr. T.J. Marshall "Mechanical Composition of Soil In Relation to Field Descriptions of Texture" Bull. No. 224. Council for Scientific and Industrial Research, Commonwealth of Australia.

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## XII a 3

### A NEW CLASSIFICATION OF SOILS BASED ON THE PARTICLE SIZE DISTRIBUTION CURVE

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(i) The particle size distribution curve is thought to provide the ideal basis for a classification of soils for engineering purposes. It is, therefore, proposed to represent this curve by two components: namely, the maximum size of particle in the soil and the area enclosed by the curve from the largest down to the smallest particle present in the soil, which then supply the complete classification of the particular soil under consideration. This is believed to provide a fundamental characteristic of each soil with which other physical properties can be correlated.

1) A particle size distribution curve No. 1 is shown in Figure 1. It will be noted that each sieve opening has been plotted at 1.24 times the nominal opening of the sieve. The 200-mesh sieve with a nominal opening of 0.074 mm. is plotted at 0.092 mm., and so on. This is the diameter of a sphere having the same volume as a cubical particle just passing through the sieve; and brings the sieve analysis into line with the sedimentation analysis, which determines the diameter of a spherical particle having the same density and settling velocity in water as that of the nonspherical particle of the soil under test. The dimensions ascribed to the particles in the sedimentation test are thus equivalent diameters and not the true dimensions. With the exception of the 200-mesh sieve, it is not essential for the present purpose that this change should be made for all the sieves.

2) The spacing of these sieve sizes is  $\log 2$  ( $= 0.301$ ), and this spacing is then continued to the left of the location of the 200-mesh sieve at 0.092 mm., numbered 1 to 13 in Figure 1, to 0.0000112 mm.; which forms the origin for the determination of the area enclosed by the particle size distribution curve. This was chosen from consideration of the di-

mensions of the crystal lattice of clays (1), and was believed to represent the minimum size of particle which could be present in the soil. It has since been found that this is not so, but this fact introduces no complications even when, on rare occasions, an intercept is given by the grading curve of a very fine grained clay on the ordinate through the origin.

3) It has been shown in a companion paper (2) that the particle size distribution curve of every soil consists of a straight line from 0.001 mm. downwards. This straight line distribution usually extends upwards to a point between 0.005 mm. and 0.01 mm. or beyond. On this basis it is always possible to complete the particle size distribution curve from the maximum size down to the smallest particle existing in the soil, provided the curve is truly representative of the soil and the determinations have not been affected by flocculation during the test. Curves Nos. 6 and 7 in Figure 1 show the effects of two types of invisible flocculation, the dashed lines ending at a and b, respectively, at 0.001 mm. were obtained from the first sedimentation tests. A few notes on this subject have been made in the form of an Appendix to this paper.

4) The classifications of the soils, whose grading curves are shown in Figure 1, are given in Table I. The first component of the classification denotes the dimension of the largest particle contained in the soil, neglecting proportions of less than 7.5 per cent. coarser than any one size. The second component is the area above the curve enclosed between the 0 per cent. line and the ordinate through the origin for the abscissa scale at 0.0000112 mm. Thus in Figure 1, the area ACDGF of curve No. 2 is 2.948, and is determined as shown in Table II.

5) For soils composed of only one size of particle, that retained between