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OFERECE
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TABLE I. TYPES OF ELUVIAL SOILS

Soils	Distinguishing characteristics
	Rocky soils
1. broken-up structure rock, including shales	Bedding in the form of displaced structures like dry laying. Temporary compression strength in a water saturated state is more than 50 kg/sq. cm. Softening ratio $K_s > 0.75$.
2. rotten rock	Temporary compression strength in a saturated state is less than 50 kg/sq. cm. but more than 10 kg/sq. cm. Softening ratio $K_s \leqslant 0.75$.
including a rotten broken-up structure rock	Bedding in the form of undisplaced structures.
rubble-gruss rotten rock	Bedding in the form of accumulations of debris of different sizes with some remaining cohesion.
clayey rotten material	Bedding in the form of massive deposits.
	Coarse debris
1. grussy, grubbly, rubble-grussy, with solid debris	Debris is not crushed and reduced in size by hand and does not soften in water. Weathering ratio $K_w < 0.5$.
2. grussy, rubbly, rubble-grussy with rotten debris	Debris may be crushed, but not reduced in size by hand and partly softens in water. Weathering ratio $0.5 \leqslant K_w \leqslant 0.75$.
	Clayey soils
1. weak soils-clays, loams, sandy loams.	Specific shear strength from uni-axial compression $\tau_0 \leqslant 1$ kg/sq.cm. The coefficient of structural strength $K_{sst} \leqslant 1.25$.
2. solid soils—clayey, loamy sandy loamy suprolite	Specific shear strength from uni-axial compression $\tau_0 \leqslant 1$ kg/sq.cm. The coefficient of structural strength $K_{sst} \leqslant 1.25$. Debris may be reduced in size by hand and softens in water.
3. gruss-rubbly with suprolites debris	Debris may be reduced in size by hand and softens in water. Weathering ratio $K_w > 0.75$.

these soils is that a rotten material is a weakened rocky soil in which some of the less stable minerals are transformed into clayey products under the action of slight chemical decomposition, whereas suprolite is a product of more profound chemical transformation in which a considerable quantity of minerals is displaced by clayey materials, but where some crystal binding agents of chemically stable minerals have partly remained among separate grains. The presence of such braces in suprolites, forming a peculiar rigid honeycomb structure, makes them different from the usual clayey soil with a similar characteristic composition. The quantitative difference between a rotten material and suprolite is determined according to the nomenclature characteristics.

The nomenclature developed does not include sandy eluvial soils as they are relatively scarce. Designations of all types of eluvial soils must be supplemented by mentioning the type of parent rocky material; for coarse debris soils it is necessary to include a description of particle shape as well.

The weathering ratio K_w and the coefficient of structural strength K_{sst}, are determined according to special procedures and by special apparatus (Korzhenko, 1963; Shwets, 1964; *Specifications*, 1964). On the basis of common terminology this nomenclature presents an opportunity for creating a better understanding among surveyors, designers, and builders in establishing the necessary investigations to evaluate correctly the natural properties of eluvial soils in designing, building, and working, and to make fuller use of their bearing capacity for structure foundations.

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V. F. B. DE MELLO (Brazil)

The ingenious development of the Dutch cone penetration method put forward by *Begemann (1/4)* uses a comparison of cone penetration resistances with local friction measurements made by means of a friction sleeve. Begemann purports to furnish an approximate identification of soil layers penetrated on the strength of a demonstration that the higher the angle of friction ϕ', presumed directly and intimately correlated with the soil texture, the greater will be the ratio between the two values. Indeed such a method would appear to fill a deeply felt deficiency inherent in the use of the cone penetrometer for subsoil exploration, and therefore runs the risk of coming into much wider and undiscriminating use than really intended or warranted. Hence I cannot help but deplore a concept which may come to cloak a practice, inherently unsound and unacceptable, whereby preliminary subsoil explorations may once again be used in place of close and careful inspection and identification of truly representative soil samples. The long and difficult struggle is still vividly remembered, a struggle during which wash-sampling techniques were rejected by the pioneers of modern soil mechanics, while searching for a subsoil exploration procedure which would yield adequate samples for identification of the soil type, and also permit an empirical measure of density and consistency. The procedure arrived at was the use of dry-sample boring combined with the measurement of dynamic penetration resistances.

The reader should realize that whereas the author suggests the present method for *preliminary* identification of soil layers, the limitations in principle and practice involved would merely allow us to accept its possible applicability for the *approximate* identification of soil layers in simple subsoil profiles that are already well-known in a preliminary fashion and where only the location of the main soil types remains to be established. One must guard against extending the intention of the author to encompass tacit acceptance of the use of the proposed method for the preliminary reconnaissance of a subsoil at a given site. The principle of basing any subsoil reconnaissance on methods that dispense with the visual and tactile identification of representative soil samples is totally unacceptable and must never be condoned. In the cases that served as a background for the author's interesting development, the indispensable preliminary subsoil reconnaissance is tacitly covered by the well-known upper subsoil profile that prevails in Holland which has been extensively investigated and described, and is geologically extremely simple.

The correct use of the Dutch penetrometer, whether or not it is improved with the local friction sleeve, continues to be as a complement to preliminary subsoil reconnaissance, at sites where the subsoil profile is comprised of relatively simple soil types, and more detail is required of *in-situ* strength and bearing capacity parameters. Since it is always annoying to interpret such parameters without recourse to any real knowledge of the strata tested, the author's proposal may be hailed as an interesting advance, reducing the uncertainties in the formulation of the probable soil type involved at each point. Hitherto the probable soil types were assumed on the basis of interpolation between dry-sample reconnaissance borings. Henceforth such assumptions may be less subject to statistical error, by using the indirect method proposed by the author.

Considering the strictly empirical nature of the correlations established by the author, it is rather unfortunate that he has not seen fit to analyse and present his data in a statistical fashion, so that average values and confidence limits may be established and evaluated. The data represented in Fig. 1, which are intended to furnish satisfactory evidence of a good correlation between the three methods of evaluating apparent cohesion in saturated clay layers ($\phi' = 0$), may stand closer scrutiny, especially if the number of cases and range of consistencies covered is extended, and if submitted to statistical correlation. At present, the correlations are only fair. To begin with, since the derivation of Eq (d) in the paper, $c_u = S/_{14}$, is recognizedly somewhat loose, a statistical correlation might well suggest a correction factor for a better fit on an average; for instance $c_u = S/_{17}$ appears to give a better fit of the data listed. Moreover, since the data are rather scanty, the scatter of approximately ± 40 to 60 per cent around the average values may indicate too broad a confidence limit to stir immediate enthusiasm.

In short, even if the experimental data available to the author do warrant the presentation of a graph such as that of Fig. 2, none of the straight lines relating cone resistance, local friction, and percentage of soil particles $<16\mu$, could be proposed or interpreted as furnishing any more than an average relationship. Such average empirical relationships should always be accompanied, in my opinion, by graphs clearly indicating the plotted points and the statistically computed confidence limits that apply to each correlation. Presumably the data summarized in Fig. 5 constitute one of the approximately 250 points scattered over the Netherlands, collected by the author as field and laboratory evidence in support of Figs. 2, 3, and 4. Since there are nine sets of data for the desired correlations on grain size in the borings represented in Fig. 5, it is presumed that sufficient sets of data are available for interesting statistical correlations.

It is hoped that the author may see fit to furnish such data, and that the profession will be very cautious in employing the method proposed, with due regard not only to the limitations emphasized within the paper itself, but also to the objections in principle and to the empirical confidence limits as discussed briefly herein.

Y. Nishida (Japan)

Arnold (1/3) presents interesting data for the permeability of clay with a high void ratio. He shows the relationship of $\log_{10} k \propto \log_{10} e$, referring to its liquidity index. However, the better relationship expressed by $e = a + b \log_{10} k$ is found generally in many clays in the ordinal void ratio, where a and b are coefficients. I would like to point out that the coefficients a and b in the above expression have a linear relationship with the plastic index of each clay. According to my experiments (Nishida, 1961), $a \doteqdot 0.085\ (I_p) + 2.0$; $b = a/_{10}$; $I_p = \%$, where I_p is the plastic index. This expression is valid for a wide range of I_p from 5 per cent to 60 per cent.

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E. Paszyc-Stępkowska (Poland)

The phenomenological description of clay behaviour does not seem to be satisfactory any more, and attempts are being made to explain this behaviour in terms of physico-chemical theories. The paper by *Arnold* (1/3) is an example.

Forces are presented below that may be calculated according to physico-chemical theories. Some conclusions are in agreement with Arnold's considerations.

It was assumed that:

1. The main reason for swelling of clay and for the swelling pressure is the double-layer repulsion (Bolt and Miller, 1955; Norrish and Rausell-Colom, 1961). This repulsion p_R may be calculated from:

$$p_R = 2nkT\ (\cosh Y_d - 1) \qquad (1)$$

where n = concentration expressed as number of ions per cu. cm. of the solution away from the particle surface where the electric potential is zero; $k = 1.38 \times 10^{-16}$ erg/molec. °K; T = temperature in °K; and Y_d is a dimensionless parameter of the electric potential in the middle between two parallel clay particles, and is an exponential function of the distance $2d$ between the particles.

2. Above a certain water content, the distance between clay particles is a linear function of the water content. Norrish (1954) proved this for Na-montmorillonite. During the shearing process the average effective distance, d, between clay particles may be calculated from:

$$\bar{d} = (W - W_s)/\bar{S}, \qquad (2)$$

where W = water content, W_s = water content when the entire theoretical surface of the clay is covered by monomolecular water layer, $\bar{S}$ = specific surface effective in the shearing process.

3. Remembering Lambe's reasoning (1960) in somewhat changed form, assume that any effective stress $\bar{\sigma} = \sigma - u$ in saturated clays is divided into two components. One part of it $k\bar{\sigma}$ (where $k < 1$ and positive) is carried by the swelling pressure p_s, that is caused mainly by double-layer repulsion p_R. The other part $(1 - k)\,\bar{\sigma}$ is carried at mineral to mineral contact as $\bar{\sigma}_m$.

$$\bar{\sigma} = |p_s| + \bar{\sigma}_m = k\bar{\sigma} + (1 - k)\bar{\sigma}. \qquad (3)$$