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Among many other causes of the discrepancies I think that the viscous behaviour is not yet fully understood, but most of the researchers seem to believe that the viscosity is seated in the adsorbed layers.

If we now consider a clay fabric consisting of bladeshaped minerals mainly arranged edge-to-side as sketched in Fig. 65, there will at the beginning of the consolidation process be very small contact areas between the adsorbed layers. Gradually, as stresses are introduced, the contact areas will increase and consequently the resistance against deformation will increase. Because of the viscosity of these layers the resistance will be time dependent. This mechanism may be modelled by a ball of viscous material placed between two plates subjected to a load as shown in Fig. 65. To illustrate this an experimental result for a ball of bitumen in an oedometer is shown in Fig. 66. It has a marked similarity to a classical consolidation curve.

This very simple experiment demonstrates that if the viscous layer concept is correct one may get curves of this kind where only a minor part of the time dependent settlements originates from excess pore water pressure dissipation. Moreover, the time dependent resistance of viscous nature must be governed by factors other than drainage system and permeability. Consequently it should be expected that the time settlement parameters are dependent on whether they are derived from full scale observations in the field or from small tests. Also we should not be surprised that the discrepancies are most pronounced in highly plastic clays. Finally, it can be stated that in those cases where a major part of the time dependent settlements are due to other elements than excess pore water pressure dissipation, vertical drains cannot be very successful.

As a conclusion I think that very little improvements in time settlement calculations can be made until we are able to identify and separate better the different factors creating time dependent resistance in soils.

*1.34 V.P.B. DE MELLO (Brazil)**

Much of engineering relies on what are really just nominal considerations but this need not detract us from the creative aspects since what are sometimes quoted as dogmatic theories can always be controlled by a statistical approach - though this is not done as frequently as it should be.

For instance, with reference to the Plasticity Chart (prescription) how can any equation prevail associated merely with the PI without investigating the (statistical) importance of PI as a function of W_L, as against variation of PI at constant W_L? Should we not theorize somewhat, even if with nominal parameters, at least to determine (statistical) coefficients of adjustment of our mental models to reasoning and reality? Why should K_o be related to PI rather than W_L, or probably more comprehensibly to the ratio of C_e/C_c in consolidation and to ϕ'? If it might appear that these latter be physically comprehensible, can we still go back profitably to first-approximation prescriptions with PI and W_L through statistical correlations of C_e/C_c vs (PI, W_L)?

May I plead therefore on behalf of soil engineering that we make an effort to systematize engineering principles and let the individual cases establish the statistical dispersion which (temporarily) conditions our prescriptions and decisions. Thereupon, let us systematically work towards reducing the coefficients of adjustment theory-to-practice, as well as narrowing the band of the dispersions within suitable criteria of costs-benefits.

1.35 L. TRIPICIANO and V. VICENZETTO (Italy)+

The Geostudio Vicenzetto Co, Padova, have designed a hydraulic fixed-piston sampler instrumented with a pressure and a displacement transducer. Investigations have been made into the effect of driving velocity and the disturbance effects of using different diameter and thickness sampling tubes in different kinds of soils.

1.36 K.R. MASSARSCH (Sweden)

The many presentations to this Session indicate the interest in assessing design parameters for soft clay. The increasing use of analytical tools for geotechnical design requires improved understanding of fundamental soil behaviour. The reliability of any analysis depends, however, on the accuracy of the input parameters. It is possible today to study very complex geotechnical problems, provided that in situ stresses and stress-strain behaviour are correctly chosen. Today the analytical methods seem to have advanced ahead of the available geotechnical field and laboratory techniques.

For most seismic problems, the soil modulus has to be known. Hence, a variety of field and laboratory methods are today available which make it possible to measure the stress-strain behaviour. Traditionally, shear modulus obtained from seismic techniques have not been considered useful for "static" problems. However, at small shear strains (smaller than about 0.001 per cent), static and dynamic modulus are identical. Therefore the increasing knowledge concerning dynamic soil behaviour could be applied also to static problems.

Although the state of in situ stresses is considered to be of great importance for soil behaviour, contributions were not received for this discussion topic. This is unfortunate since various field methods are today available for the determination of lateral earth pressure such as the self boring pressuremeter and earth pressure cells. The practical application of new field methods and the evaluation of test results was only briefly discussed. It would also have been valuable for the practising engineer to learn more about the interpretation of field and laboratory tests, and about the critical evaluation of parameters used in existing design methods. At present there appears to be a gap between the advanced theoretical concepts and testing methods used in research and the simple empirical tools many times applied in practice.

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