III-125 EFFECT OF VARIATION OF THE FOLLOWED STRESS PATH ON MEASUREMENT OF SWELLING PRESSURE OF SOILS

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SYNOPSIS Due to the variation of swelling pressure definition, various devices and techniques have been suggested to predict the swelling pressure. The variation of the adopted techniques can be mainly attributed to the variation in the followed stress path. A theoretical analysis and its application to an experimental work showed a large variation of the swelling pressure value for the same soil. This study clearly emphasizes the requisite to standarize the apparatus and the adopted technique to measure a universal swelling characteristics.

INTRODUCTION Generally, the measurement of swelling pressure is mainly due to the following two aspects:

(a) Constant volume: in which the swelling pressure is defined as the maximum pressure required to hold the soil sample at its initial void ratio when it is in contact with water, as in constant volume method (Sing,1967) and different pressures method, or to bring the swollen sample (under light load) to its initial volume as in preswelled sample method.

(b) Allowed deformations: in which the swelling pressure is defined as the pressure which produces a certain compression deformations as in the USSR-method (0.2% comp.), or produces some compression deformations (depends upon the properties of soil) as in double oedometer method ($e_f < e_o$). Other methods allow some swelling deformations as in proving ring method (Palit,1953).

The question to be considered now is just "What is the reliable swelling pressure definition and what is the stress path which should be followed to achieve its measurement?". The followed stress path investigation may lead to the answer.

FOLLOWED STRESS PATH Five methods were applied and the results are discussed according to the swelling pressure definition and the followed stress path as follows:

(a) Constant volume methods: the swelling pressure value 1142 kPa measured by constant volume method (Fig.1) and the interpolated value 1470 kPa measured by different pressures method (Fig.2) theoretically, represent the pressure required to counteract the swelling energy exerted by the soil, and the difference between the two values

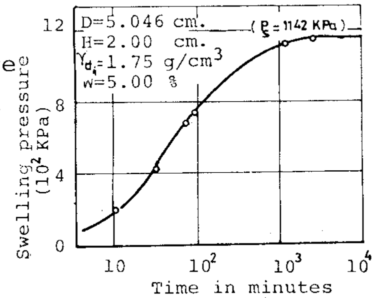

FIG.1 Constant volume method.

may be due to the variation of the followed stress path. Whereas the swelling pressure value 1960 kPa measured by preswelled sample method (Fig.3) represents the pressure required, to counteract the swelling energy, to remove the attracted lattice water and to overcome the resistance caused by the side friction, therefore this value may be over-estimated. An evaluation for these values showed that an identical sample under 1142 kPa compressed by 0.5%, and under 1470 kPa compressed by 5%.

(b) Allowed deformations methods: allowed compression deformations means more applied pressure than that exerted by the soil as it is clear from the result of 3332 kPa obtained by the double oedometer method (Fig.4). Whereas if swelling deformations are allowed a part of the stored swelling energy will vanish and the recorded value will be less than the actual value as shown in Fig.5.

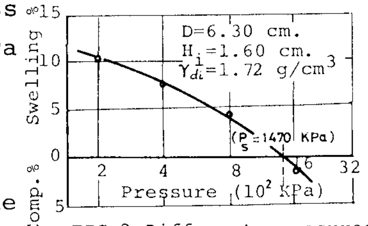

FIG.2 Different pressures method.

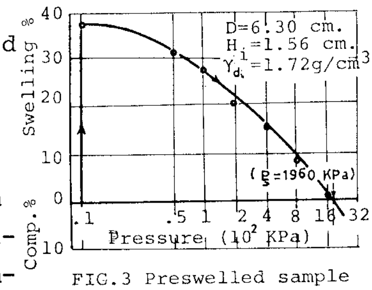

FIG.3 Preswelled sample method.

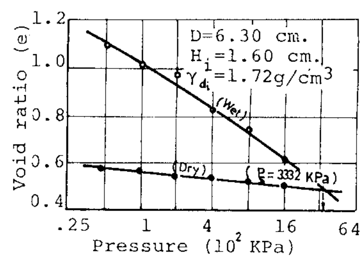

FIG.4 Double oedometer method.

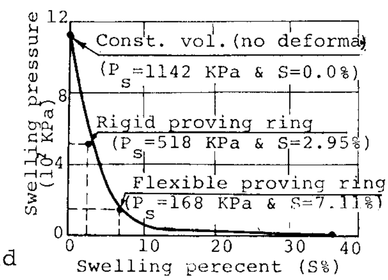

FIG.5 Effect of allowing deformations on measurement of swelling pressure

DISCUSSION AND CONCLUSION The analysis presented above indicates that the measurement of swelling pressure based on constant volume aspect reflects the actual energy exerted by the soil. The followed stress path based on keeping the soil sample at its initial void ratio without any deformation has the advantages that the soil structure is kept almost intact while water is penetrating the soil sample, and it is less affected by the side friction. Practically, the soil sample under the predetermined swelling pressure measured by the constant volume method may undergo some deformations which may be partially attributed to the reorientation of soil paricles, these deformations should be taken into consideration to evaluate the measured value, since the lesser the deformation is the more the actual swelling pressure value.

REFRENCES

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