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SECONDARY COMPRESSION UNDER STRUCTURE LOAD FOR DIFFERENT PRELOADING DURATION AND INTENSITY

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Since Terzaghi's consolidation theory was published, secondary compression is still one of the most up to date topic in consolidation problems in general and in application of this theory for the preloading technique in particular. There are several approaches to the solution for Settlement analysis containing secondary compression. Considering the great efforts which was devoted to the research into secondary compression, no reliable method has yet been available for calculating the magnitude and the rate of such kind of settlement.

As an experimental approach to secondary compression, an attempt to formulate time – settlement observations in the laboratory and in the field into a practical relation were carried out by Buisman (1936), Koppejan (1948) and Zeeveart (1975). On the other hand, Taylor and Merchant (1940), Barden (1968) and Sekiguchi (1976) tried to explain secondary compression by numerical methods with the consideration of rheological properties of cohesive soils. Moreover, the recent experimental researches have given some important and valid information. In the present study, a series of tests were carried out in order to know the effect of preloading conditions concerning its duration and intensity on the secondary compression under structure load.

EXPERIMENTAL WORK

TESTED MATERIAL

The clay sample was a fraction passed through 75 μm of marine deposits and its physical properties are; specific gravity G_S = 2.689, LL = 74 % and PI = 36. The clay slurry was first preconsolidated under the pressure of 25 kPa to form a specimen of 150 mm diameter with an average height of about 95 mm and water content of about 56 %.

TEST PROCEDURE

Fig. 1 shows key sketch for loading sequence and corresponding strain. The test was started by the prepared clay sample and uniform drainage was allowed from both top and bottom. The preloading pressure Pp was applied step by step and removed in the same manner within the same period. After 16 hrs from removing the preload, the structure load Ps was applied and continued within the tested period Ts. The corresponding strain under both Pp and Ps are shown in Fig. 1 where $C_{\alpha S}$ indicate the coefficient of secondary compression under structure load. All the tests were performed in one dimensional conditions.

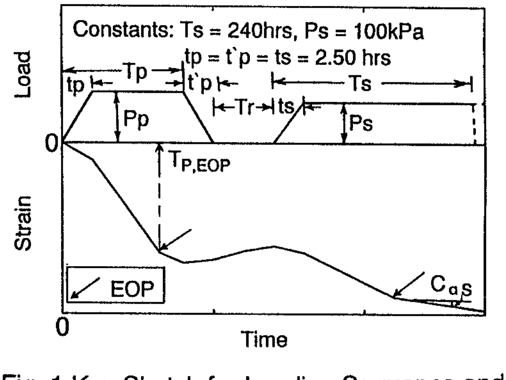

Fig. 1 Key Sketch for Loading Sequence and Corresponding Strain.

TEST RESULTS AND DISCUSSIONS

The settlement under structure load (Ps) is considered as an index factor which express the efficiency of the preloading technique. The primary consolidation part of this settlement occur in relatively short period where it could be monitored while the secondary compression part developed and continue for long period. For this reason, the values of the coefficient of secondary compression ($C_{\alpha S}$) under Ps is investigated. The results could be discussed as follows:

COEFFICIENT OF SECONDARY COMPRESSION UNDER STRUCTURE LOAD

Fig. 2 shows the effect of preloading duration ratio T_R (T_R = $Tp/T_{P,EOP}$) on the values of $C_{\alpha S}$ in case of small preloading intensity (P_R = Pp/Ps < 1) and large preloading intensity (P_R > 1). Based on the preloading duration ratio (T_R), $C_{\alpha S}$ values could be discussed in cases of short preloading period

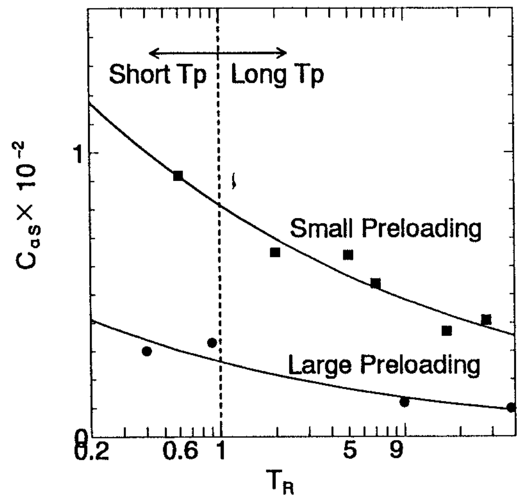

Fig. 2 $C_{\alpha s}$ With Different T_R.

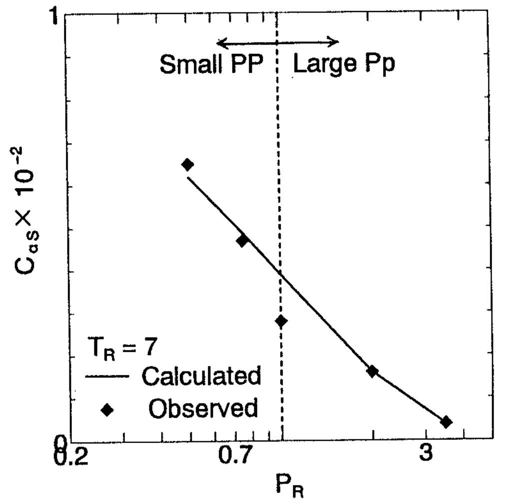

Fig. 3 $C_{\alpha s}$ With Different P_R.

(T_R <1) and long preloading period (T_R > 1) as follows:

Short Preloading Period :

In this period, the coefficient of secondary compression ($C_{\alpha S}$) generally records higher values in case of small preloading intensity as compared to that in case of large preloading. Also, it could be noticed that, $C_{\alpha S}$ values decreased in higher rate with respect to T_R ratio in case of small preloading intensity than that in case of large preloading.

Long Preloading Period :

In this period, $C_{\alpha S}$ values continue to record higher values in case of small preloading as compared to that in large preloading intensity (Fig. 2). Also, its rate of decrease with respect to T_R ratio still higher in case of small preloading than that for large intensity.

It could be concluded that, As the preloading intensity and duration is higher, both $C_{\alpha S}$ value and its rate of decrease with respect to T_R ratio are decreased. This behavior could be understood based on the fact that $C_{\alpha S}$ value reflect the condition of soil skeleton related to its ability to deform. Accordingly, for shorter preloading duration and smaller preloading intensity, the soil skeleton under Ps is expected to have a relatively high ability to deform and consequently higher $C_{\alpha S}$ values. In similar basis, lower $C_{\alpha S}$ values could be expected for longer preloading duration and larger preloading intensity.

ESTIMATION OF $C_{\alpha S}$ FOR DIFFERENT PRELOADING DURATION AND INTENSITY

$C_{\alpha S}$ is considered as an important factor affecting the settlement under Ps which express the efficiency of the preloading method to control that settlement. The following equation could be obtained from Fig. 2 by representing the results in a form of a power function:

$$C_{\alpha S} = 10^{-2}\ \mathrm{Exp}\ (0.484 - 0.912\ P_R - 0.6\ \mathrm{Log}\ T_R)$$

This equation is verified for another preloading conditions with different preloading intensity. The calculated and the observed values indicate good agreement as shown in Fig. 3. In the other hand, the results in Fig. 3 confirm the pervious conclusion concerning the decrease of $C_{\alpha S}$ values by the increase of preloading intensity.

CONCLUSIONS

1) Both the value of the coefficient of secondary compression ($C_{\alpha S}$)under structure load and its rate of decrease with respect to the preloading duration decreased by the increase of preloading intensity and duration.
2) $C_{\alpha S}$ could be estimated for different preloading intensity and duration using a simple equation. The calculated and the observed values indicate good agreement.

REFERENCES

KAZUYA YASUHARA, (1982)" A Practical Model for Secondary Compression ", Soils and Foundations, Vol. 22, No. 4, PP. 45 - 56.