APPENDIX C

VERIFICATION OF SETTLEMENT BY ASAOKA'S METHOD

CONTENTS

APPENDIX C VERIFICATION OF SETTLEMENT BY ASAOKA'S METHOD

C.1 General

This appendix describes the method, namely Asaoka's graphical method, which can be used to verify the primary consolidation settlement using the field monitoring data of settlement.

C.2 Principle of Verification

If a function *s(t)* is given by

$$s(t) = a(1 - be^{-ct}) \qquad \text{where } a, b \text{ and } c \text{ are constant, and } c > 0 \tag{C1}$$

the discrete values of *s(t)* at equal time intervals of Δt can be characterised by the following recurrence equation:

$$s_i = \beta_0 + \beta_1 s_{i-1} \qquad [\ s_i \text{ means } s(t_i = i\Delta t)\ ] \tag{C2}$$

where

$$\beta_1 = e^{-c\Delta t} \tag{C3}$$

According to the solutions for both Terzaghi's one dimensional theory of consolidation and Barron's theory of radial consolidation, the primary consolidation settlement at time *t* and *s*(*t*) can be expressed in the form of Equation C1 as below:

Terzaghi: (C4)

$$s(t) = s_\infty \left(1 - \frac{8}{\pi^2} e^{-\frac{\pi^2 c_v t}{4H^2}}\right)$$

$$\text{Therefore,} \quad \beta_1 = e^{-\frac{\pi^2 c_v \Delta t}{4H^2}}$$

Barron: (C5)

$$s(t) = s_\infty \left(1 - e^{-\frac{8 c_h t}{D^2 F(n)}}\right)$$

$$\text{Therefore,} \quad \beta_1 = e^{-\frac{8 c_h \Delta t}{D^2 F(n)}}$$

The meanings of the constants *H*, *D* and *F*(*n*) are given in Appendix B.

The values of the ultimate primary consolidation settlement, s_∞ , can be readily obtained using the common methods of solving this type of equation. The graphical method suggested by Asaoka (1978) to find the ultimate primary consolidation settlement using field measurement data is illustrated in Figure C1. This is based on the linear relationship between s_{i-1} and s_i given in Equation C2. The intersection of the $s_{i-1} \sim s_i$ line ($s_i = \beta_0 + \beta_1 s_{i-1}$) with another line $s_{i-1} = s_i$ will give the ultimate primary consolidation settlement (s_∞).

In case of multi-stage loading, the line $s_i = \beta_0 + \beta_1 s_{i-1}$ will be moved up as shown in Figure C2. When the settlement is relatively small compared with the thickness of soil layer, the shifted line should be almost parallel to the initial line because β_1 should be independent of the applied load.

C.3 References

Asaoka, A (1978). Observational Procedure of Settlement Prediction. Soils and Foundations, Vol. 18, No. 4, Dec 1978, Japanese Society of Soil Mechanics and Foundation Engineering.

Kwong. J. S. M. (1996). A review of Some Drained Reclamation Works in Hong Kong. Geo. Report No. 63, Geotechnical Engineering Office, Hong Kong, 53p.

LIST OF FIGURES