4-8 Technical Note on Consolidation Characteristics of the Land Reclaimed with Tampico Clay, (March, 1981)

4-8-1 Introduction

This paper describes the use of the CRS-test to clarify the consolidation characteristics of the reclaimed land at Tampico.

Land reclaimed with very soft dredged clayey soil has a high water content, ranging from 100% to 300%, and is a unconsolidated slurry immediately after the completion of reclamation, unlike natural ground. Reclaimed land is usually left undisturbed for long periods after reclamation, until capable of supporting traffic for construction work. During these long periods consolidation of the reclaimed land and surface drying occur, causing the water content to decrease slightly. However, the filled soil still holds a very high water content -- even after drying and completion of consolidation by self-weight. For this reason, the reclaimed land cannot adequately support construction loads. If it is necessary to make good use of the reclaimed land as soon as possible, soil stabilization should be applied. In order to properly estimate and design profitable soil stabilization, clarification of the consolidation characteristics of the filled soil is essential.

Up to the present time, the test method to investigate consolidation characteristics of clay in the laboratory has been the conventional oedometer test based upon Terzaghi's consolidation theory. However, it is not applicable to very soft clayey soil with high water content, such as Tampico clay. When the soil is consolidated from a very soft state, the change of thickness of specimen becomes too significant to be neglected. Also, it is quite difficult to prevent the sample from squeezing out along the inner surface of a consolidation ring, especially at the instant of loading, and tends to cause significant scatters in consolidation constants.

In order to overcome these difficulties, as an alternative method, the constant rate of strain consolidation test (refered to the CRS-test) has been developed to obtain the consolidation constants of clay slurry, such as coefficient of consolidation and f - logp' curves.

Thus, the CRS-test was applied to Tampico clay to investigate the clay's consolidation constants in the laboratory.

The settlement and the consolidation period of the reclaimed land was analyzed by the computer program "CONSOLID" which takes account of the self-weight of soil and the change of layer thickness.

The following soil properties were determined in this investigation:

1) CRS-test
   - f -- log p' curve (f = 1 + e)
   - Coefficient of consolidation, Cv
2) Consolidation analysis of the reclaimed land:
   - Settlement, S
   - Consolidation period, t
   - Degree of consolidation, U
   - Pore water pressure, u_w
   - Void ratio, e
3) Estimation of the strength of the ground
   - Cohesion, c

Among above mentioned items, 2) and 3) are performed using some assumptions.

4-8-2 General Aspects of Reclaimed Land

A land reclaimed with dredged clay has a very high water content and properties similar to slurry. The settlement of ground during the first stage is proceeded mainly by sedimentation of clay particles until the water content of the ground becomes about 200% to 300%. Near the completion of sedimentation, the settlement is caused mainly by consolidation due to the weight of the clay particles.

Fig. 4-8-1 and Fig. 4-8-2 show a sedimentation test on Honmoku clay. In these figures, the marks ↑ and ⊗ indicate the starting point of consolidation, when the settlement is conventionally divided into two factors – sedimentation and consolidation. Fig. 4-8-3 indicates the initial water content, Wo (%) vs. sedimentation/initial thickness of layer, S/Ho. As shown in Fig. 4-8-3, little sedimentation is observed when the initial water content is low. The critical initial water content at which the settlement due to sedimentation appears is approximately 200% to 300%. Thus, if the initial water content of the reclaimed land is less than 200% to 300%, the settlement is predicted by taking into account only the consolidation phenomenon. On the other hand, if the initial water content is greater than 200% to 300%, the settlement by both sedimentation and consolidation should be considered.

On the surface of the reclaimed land the water content decreases due to evaporation and drying. However, the reduction of the water content is reported to occur to a depth no greater than 50 to 60cm, for the dried surface interrupts the capillary drying of the deeper soil. If the water level in the ground is near the surface, the water content is said to remain about 140% to 160%, even 4 months after reclamation. As the effect of evaporation and drying to the settlement is a minor factor when estimating the settlement of the reclaimed land, only the settlement due to sedimentation and consolidation is considered in this paper.

Fig. 4-8-1 Sedimentation Test on Honmoku Clay

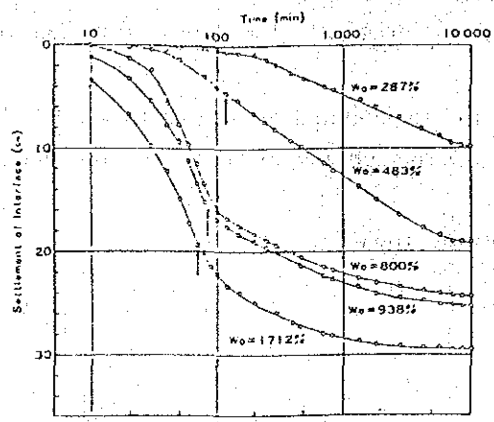


Fig. 4-8-3 Sedimentation Test on Honmoku Clay

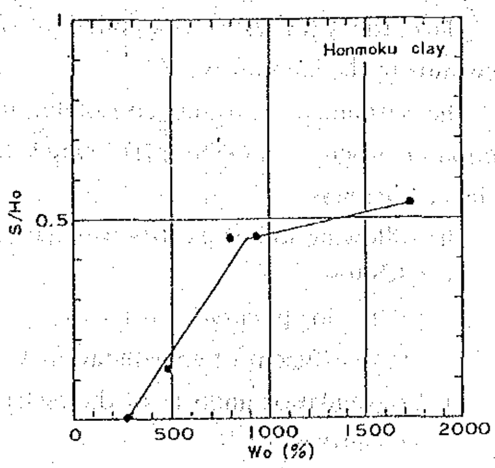
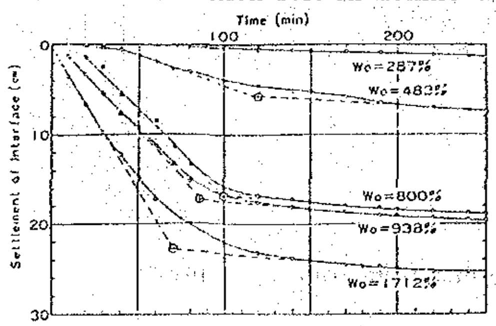


Fig. 4-8-2 Sedimentation Test on Honmoku CLay



4-8-3 Constant Rate of Strain Consolidation Test

(1) Theoretical Background

The conventional oedometer test is not applicable to very soft slurry. The main reasons are as follows:

a) Terzaghis' theory does not take into account the change of the layer thickness due to the consolidation settlement.
b) Terzaghis' theory neglects the effect of the self-weight of soils.
c) The conventional oedometer test is not suitable for the test of slurry-like soils with high water content, because the leakage of soil sample from the gap of the ring significantly affects test results such as the e - log p' curves.
d) The conventional oedometer test is difficult to apply to consolidation pressures less than 0.05 Kg/cm^2, and includes excessive errors at the low level of consolidation pressure which is necessary for the analysis of the consolidation of reclaimed land.

As an alternative, the CRS-test was proposed to determine the consolidation constants. The details are described in the paper "Constant rate of strain consolidation for very soft clayer soils", Soils and Foundations, Vol. 20, No. 2, June 1980 (References 4)).

(2) Test Equipment and Procedure

The sample was mixed with water to a slurry consistency with a water content greater than 300%. Photo 4-8-1 shows the Tampico clay after preparation for the CRS-test.

Photo 4-8-1 Tampico Clay for the CRS Test

Photo 4-8-2 shows the CRS-test equipment. The maximum capacities of the transducers for the vertical pressure and the pore water pressure are 2.0 Kg/cm^2; the pressure was measured at the bottom of specimen. A pre-consolidation pressure of about 0.03 Kg/cm^2 was applied in advance, after pouring the sample into the ring, to complete the pre-consolidation. The constant strain was added to the sample after completion of pre-consolidation. The vertical pressure and the pore water pressure were measured at the bottom of the sample.

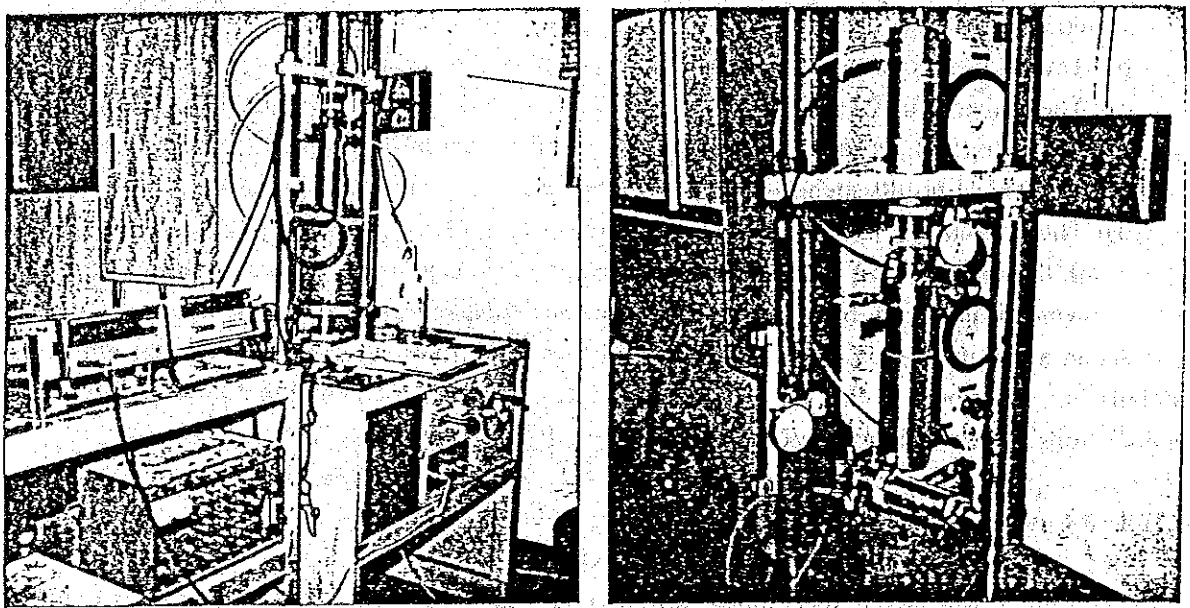


Photo 4-8-2 CRS-Test Equipment

(3) Consolidation Constants

Fig. 4-8-4 and Fig. 4-8-5 show the f - log p' curve and coefficient of consolidation Cv for the Tampico clay. The f - log p' curve is fitted by the following equation:

$$\left.\begin{aligned} f &= f_1 - Cc \log p' \\ \text{where} & \\ f_1 &= 2.885 \\ Cc &= 0.95 \end{aligned}\right\} \cdots\cdots\cdots\cdots (3.1)$$

The coefficients of consolidation Cv for the appropriate range of consolidation pressures are:

$$Cv = 2.5 \times 10^{-2} \quad cm^2/min \quad \cdots\cdots\cdots\cdots (3.2)$$

The above consolidation constants are adapted to the analysis of the reclaimed land in the section 4-8-5.

Fig. 4-8-4 f-log p' Curve for the Tampico Clay

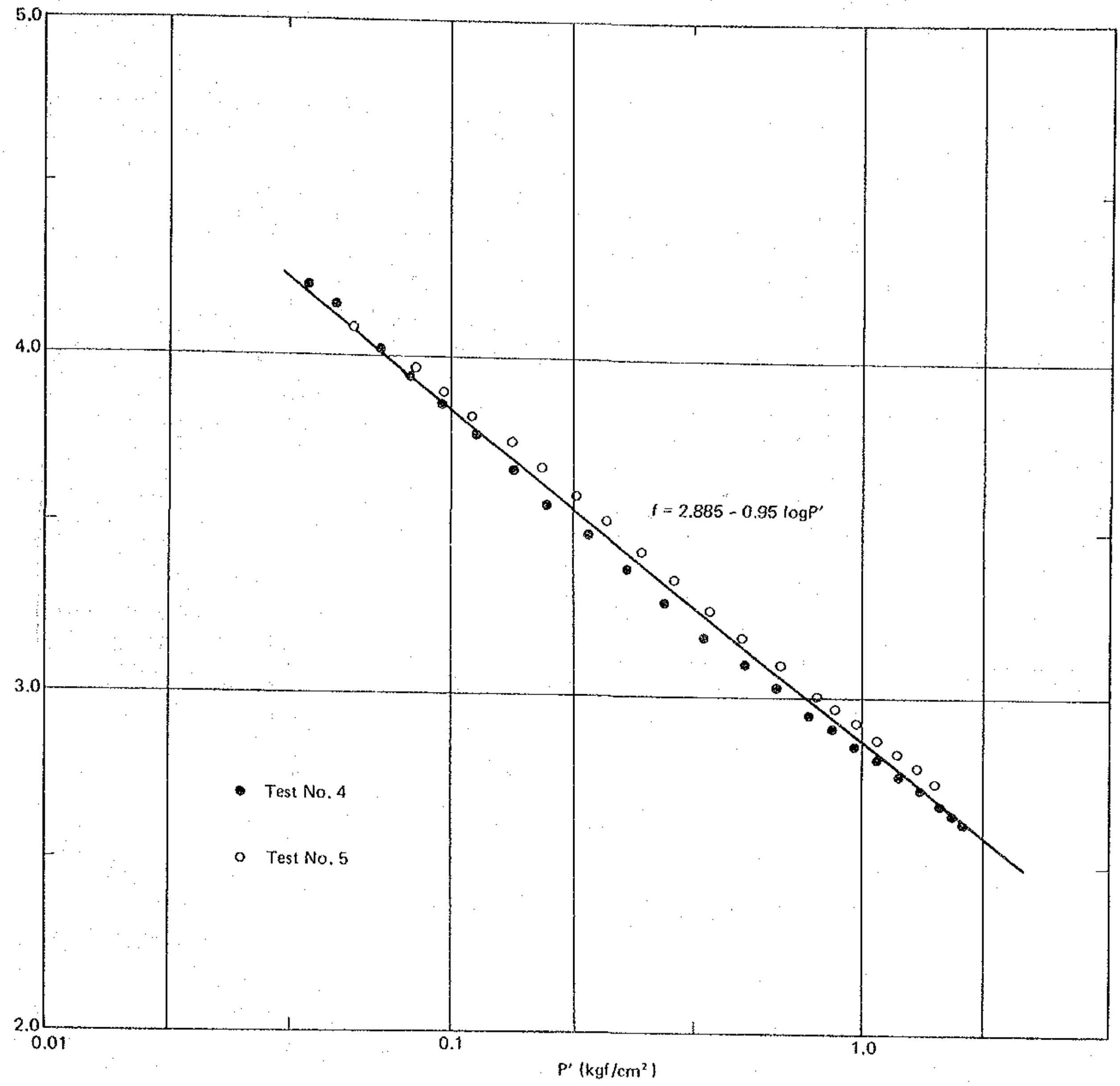
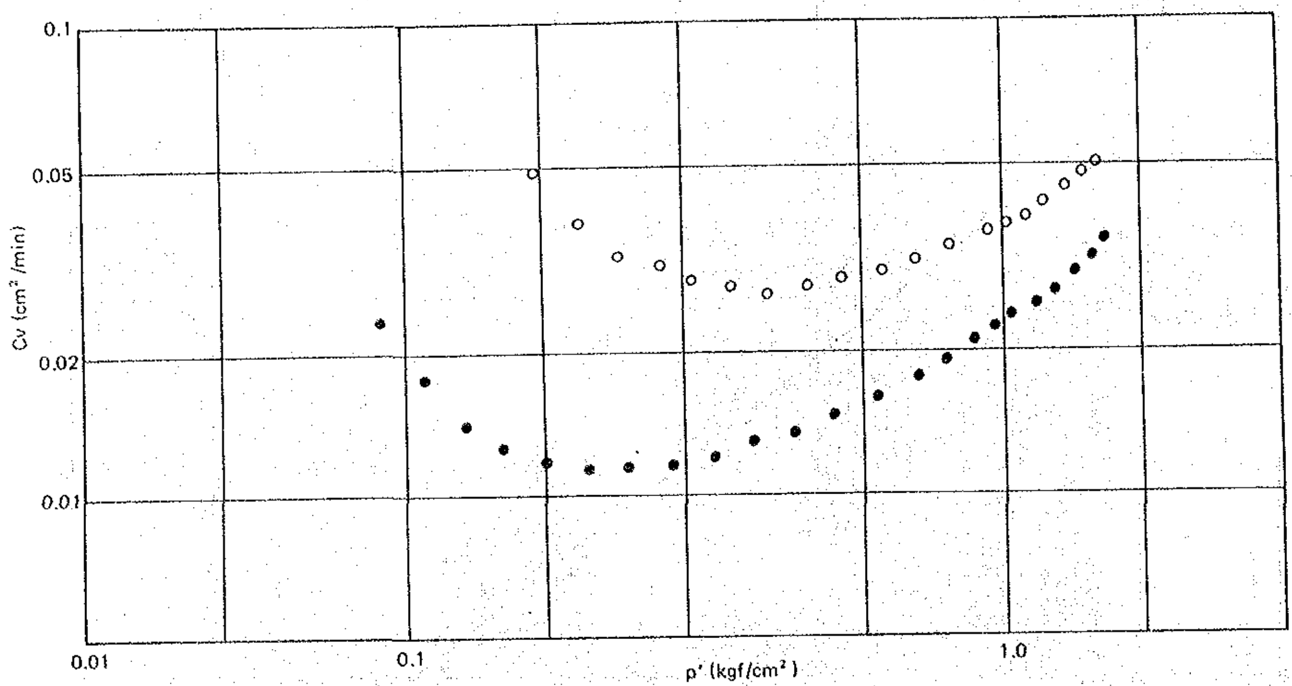


Fig. 4-8-5 Coefficient of Consolidation (Cv) for the Tampico Clay



4-8-4 Consolidation Analysis of Reclaimed Land

(1) Available Information for Analysis

There is little available data to analyze the consolidation phenomena of the reclaimed land at Tampico. The following information is given in the minutes of discussion;

a) Soil at the planned channel area is silt, which varies in N-value from 0 to 5 from the surface of seabed to -12m in depth.

b) The silt will be dumped to reclaim the land area being planned for use in the Phase II and Phase III Projects, because it takes much time to complete consolidation and to make good use of the reclaimed land.

c) The soils dredged from the depth of -12m to -18m are to be used for raising the land embankment.

d) The dredged sands are to be mixed with coastal sands for the land embankment.

(2) Some Analysis Assumptions

The following assumptions are applied to analyze the consolidation phenomena of the reclaimed land:

a) Initial Conditions

· Water content	W_o	= 100%, 200%
Void ratio	e_o	= 2.773, 5.546
Volume ratio	f_o	$= 1 + e_o = 3.773, 6.546$
· Degree of saturation	S_r	= 100%
· Thickness of layer	H_o	= 5m, 10m

b) Boundary Condition

The boundary is perminable at the surface and bottom of the clay layer.

c) Load Condition

· Surcharge $q = 0,\ 20\ t/m^2$

Instantaneously loaded

· Unit weight of embankment	γ	= 1.8 t/m^3
Height of embankment	h	= 0m, 11m

(3) Consolidation Analysis

a) Basic Consolidation Theory

Mikasa proposed the consolidation theory in terms of compression strain, in which the change in the thickness of the layer and the self-weight of soil are taken into account. Assuming the coefficient of consolidation is constant, the following basic consolidation theory is obtained:

$$\frac{\delta \xi}{\delta t} = \xi^2 \cdot Cv \left\{ \frac{\delta^2 \xi}{\delta Zo^2} = \frac{d}{d\xi}(Mv\,\gamma')\frac{\delta \xi}{\delta Zo} \right\} \quad \cdots\cdots\cdots\cdots \quad (4.1)$$

After the completion of consolidation, if the velocity of the pore water is zero, the following equations are given:

$$\frac{\delta \zeta}{\delta Zo} = Mv\,\gamma' \qquad \cdots\cdots\cdots\cdots \quad (4.2)$$

or

$$\frac{\delta p'}{\delta Zo} = \gamma'_0 \qquad \cdots\cdots\cdots\cdots \quad (4.3)$$

where,

t : Time

Zo : Depth

ζ : Consolidation ratio fo/f

fo : Initial volume ratio

f : Volume ratio $\quad f = 1+e$

e : Void ratio

Cv : Coefficient of consolidation

Mv : Coefficient of volume change, $\quad Mv = \frac{0.4343Cc}{f} \cdot \frac{1}{p'}$

$$\frac{d}{dS}(Mv\gamma') = -\left(1 - \frac{0.8686Cc}{fo} \cdot \zeta\right)\frac{\gamma'_0}{p'} = \frac{-1}{L\zeta}$$

γ'_0 : Unit weight of soil

p' : Effective stress

Cc : Compression index

b) Differential Equation

Equation (4.1) is transfered into equation (4.4) shown below:

$$\frac{\zeta_{Zo,\,t+\Delta t} - \zeta_{Zo,\,t}}{\Delta t} = Cv\,\bar{\zeta}^2 \left\{ \frac{\zeta_{Zo+\Delta Zo,\,t} - 2\zeta_{Zo,\,t} + \zeta_{Zo-\Delta Zo,\,t}}{(Zo^2)^2} + \frac{1}{L\zeta}\,\frac{\zeta_{Zo+\Delta Zo,\,t} - \zeta_{Zo-\Delta Zo,\,t}}{2\,Zo} \right\} \cdots\cdots \quad (4.4)$$

Therefore,

$$\zeta_{Zo,\,t+\Delta t} = \zeta_{Zo,\,t} + \frac{Cv\Delta t\bar{\zeta}^2}{(\Delta Zo)^2} \left\{ (\zeta_{Zo+\Delta Zo,\,t} - 2\zeta_{Zo,\,t} + \zeta_{Zo-Zo,\,t}) + \frac{\Delta Zo}{2L_{\zeta}}(\zeta_{Zo+\Delta Zo,\,t} - \zeta_{Zo-\Delta Zo,\,t}) \right\}$$

$\cdots\cdots\cdots \quad (4.5)$

where,

$\bar{\zeta}$: $\frac{1}{2}$ $(\zeta_{Zo,\,t} + \zeta_{Zo,\,t+\Delta t})$

$L_{\bar{\zeta}}$: $\frac{1}{2}$ $(L_{\zeta_{Zo,t}} + L_{\zeta_{Zo,t+\Delta t}})$

Average value between time t and t+Δt.

Fig. 4-8-6 Space Mesh

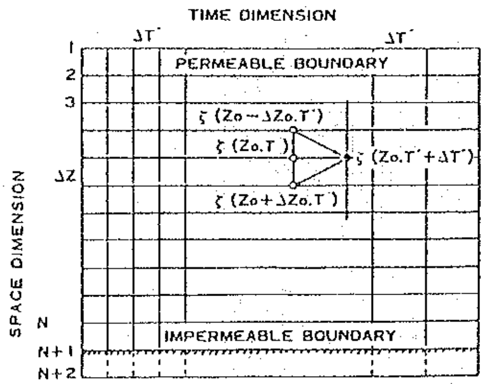


Fig. 4-8-6 shows the space mesh used for the finite difference method.

c) Results of Analysis

The settlement and consolidation period of the reclaimed land are examined with the computer program "CONSOLID" which takes account of the self-weight of the filled soil and the change of the layer thickness.

The computation was made under the conditions stated in section 4-8-3-(3) and 4-8-4-(2). The void ratio and volume ratio of the reclaimed land were assumed uniform after completion of reclamation. The conditions for analysis are tabulated in Table 4-8-1, together with the respective settlements and consolidation periods at a consolidation of 70%, 80%, 90% and 100%.

Fig. 4-8-7 shows the settlement vs. time curves for Case 1 to case 4.

The state of the reclaimed land, such as strain, volume ratio, effective stress and pore water pressure during consolidation, are shown in Table 4-8-2.

Table 4-8-1 Respective Settlement and Consolidation Periods of Tampico Clay

Case	Initial Conditions					Degree of Consolidation (%)						
						70*		80*		90*		100
	Water content W_0 (%)	Void ratio e_0	Volume ratio f_0	Thickness of layer H_0 (m)	Pre-loading q_0 (t/m^2)	Settle-ment (m)	Time (day)	Settle-ment (m)	Time (day)	Settle-ment (m)	Time (day)	Settle-ment (m)
1	200	5.546	6.546	5.00	0	1.28	72.0 (68.7)	1.46	123.2 (78.7)	1.68	276.8 (90.9)	1.84
2				10.00		2.95	249.6 (71.3)	3.36	454.4 (81.3)	3.72	864.0 (90.2)	4.12
3	100	2.773	3.773	5.00	20**	1.09	403.2 (68.6)	1.25	556.8 (78.9)	1.42	812.8 (89.6)	1.59
4					20***	1.10	435.1 (67.0)	1.26	588.7 (79.2)	1.42	844.7 (89.7)	1.59

Note: * Approximate degree of consolidation, ( ) : Degree of consolidation
** Instantaneously loaded
*** Gradually loaded as below:

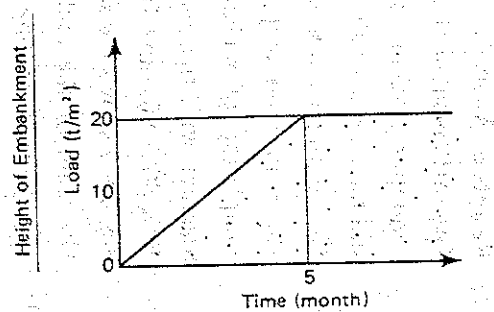


Fig. 4-8-7 (a) Time Curve of Settlement (Tampico Clay: Case 1)

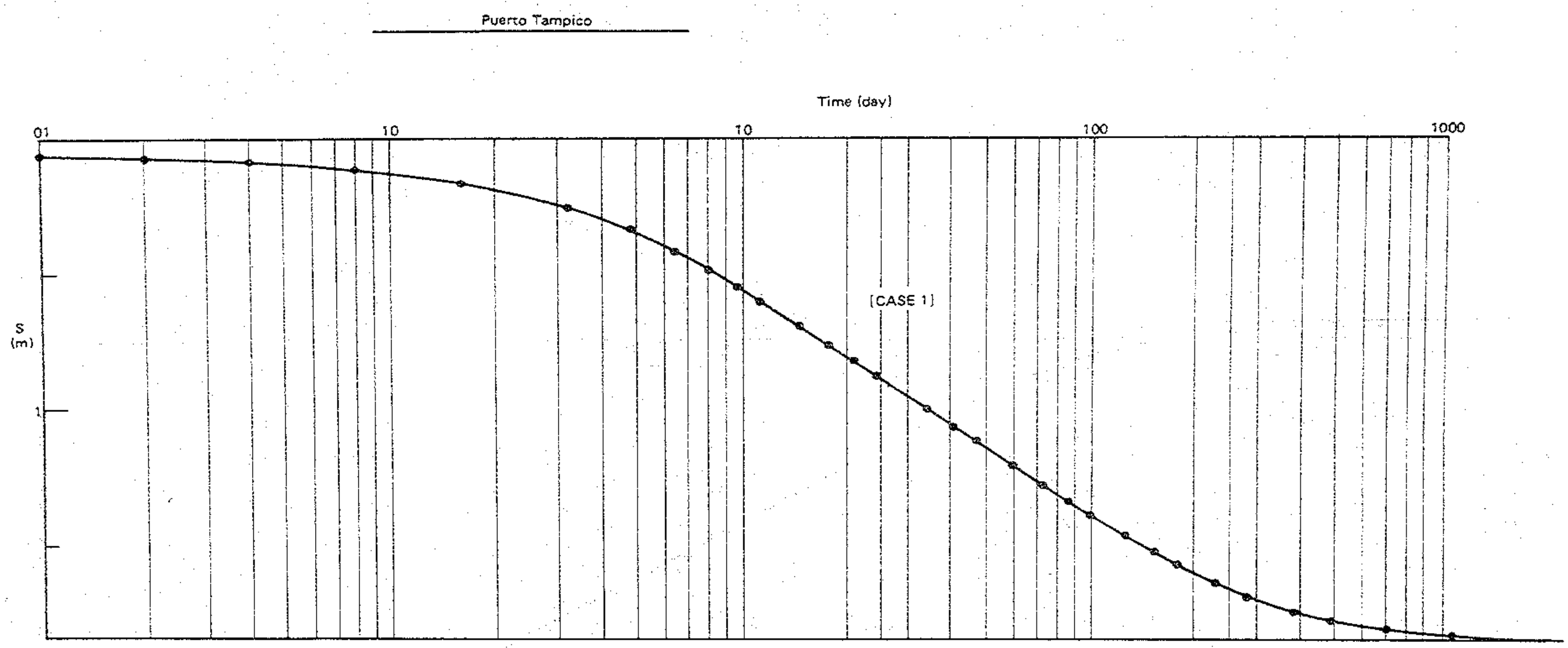


Fig. 4-8-7 (b) Time Curve of Settlement (Tampico Clay: Case 2)

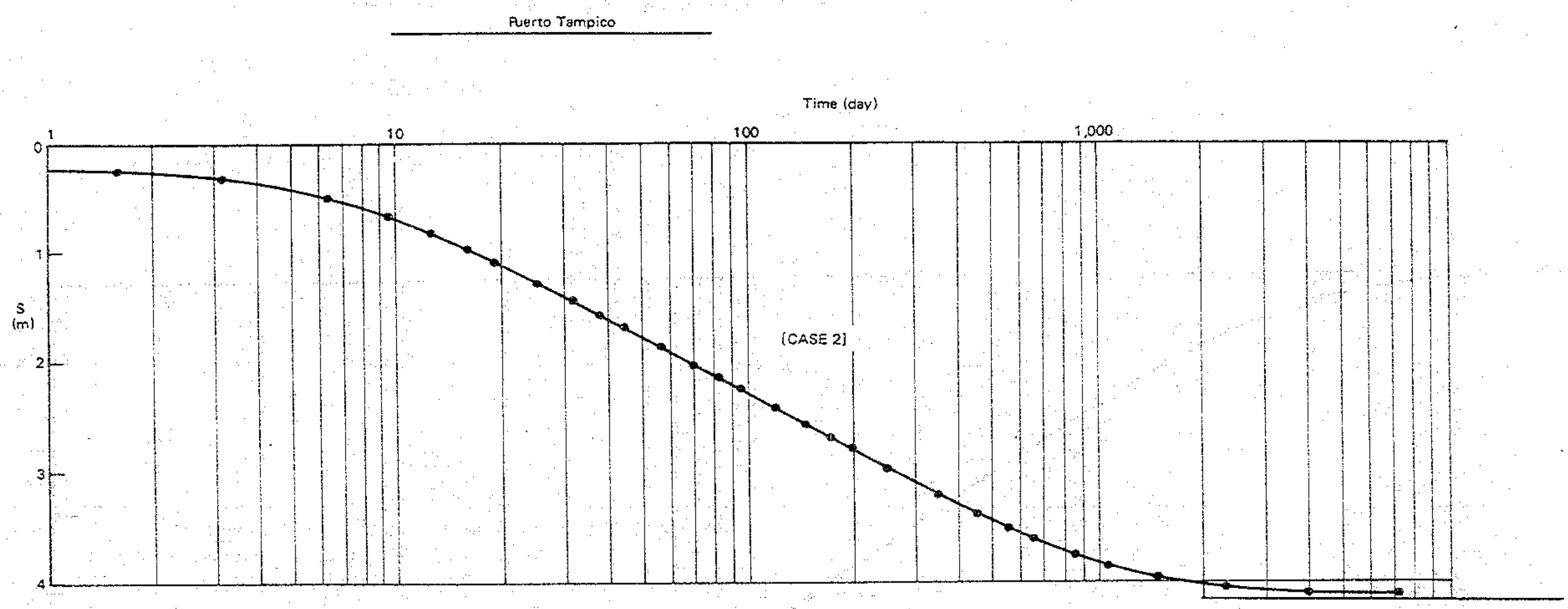


Fig. 4-8-7 (c) Time Curve of Settlement (Tampico Clay: Case 3)

Puerto Tampico

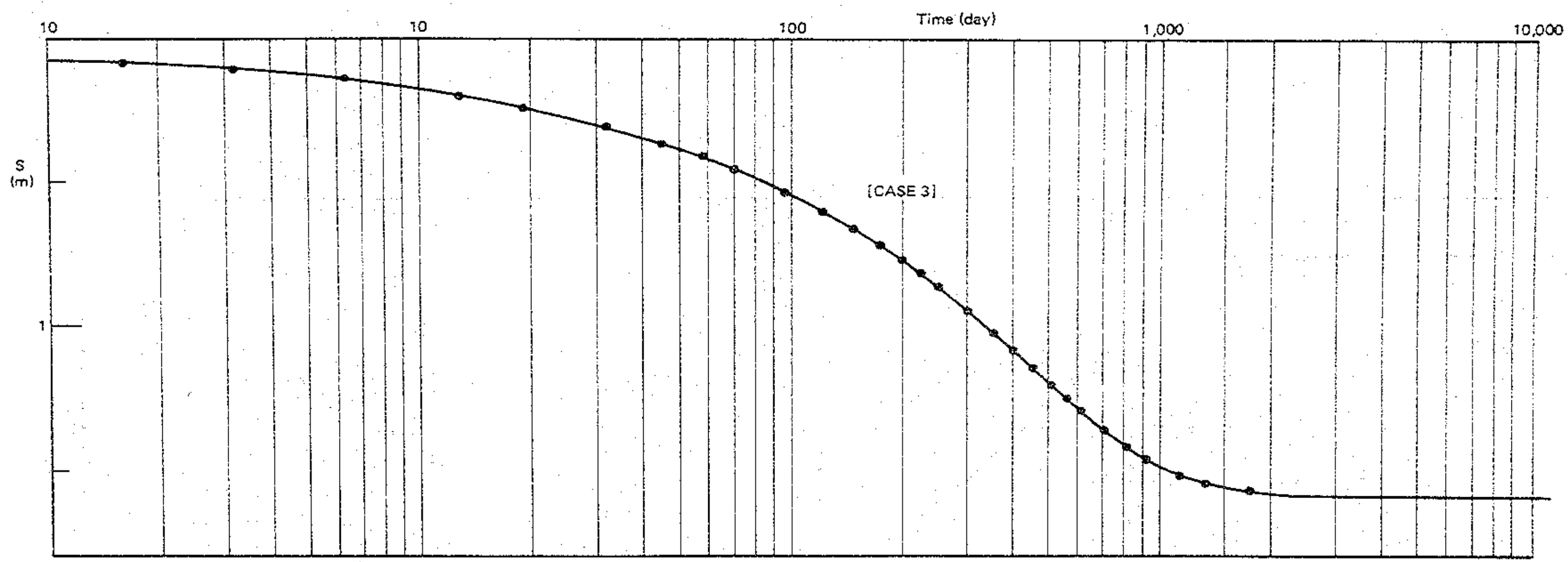


Fig. 4-8-7 (d) Time Curve of Settlement (Tampico Clay: Case 4)

Puerto Tampico

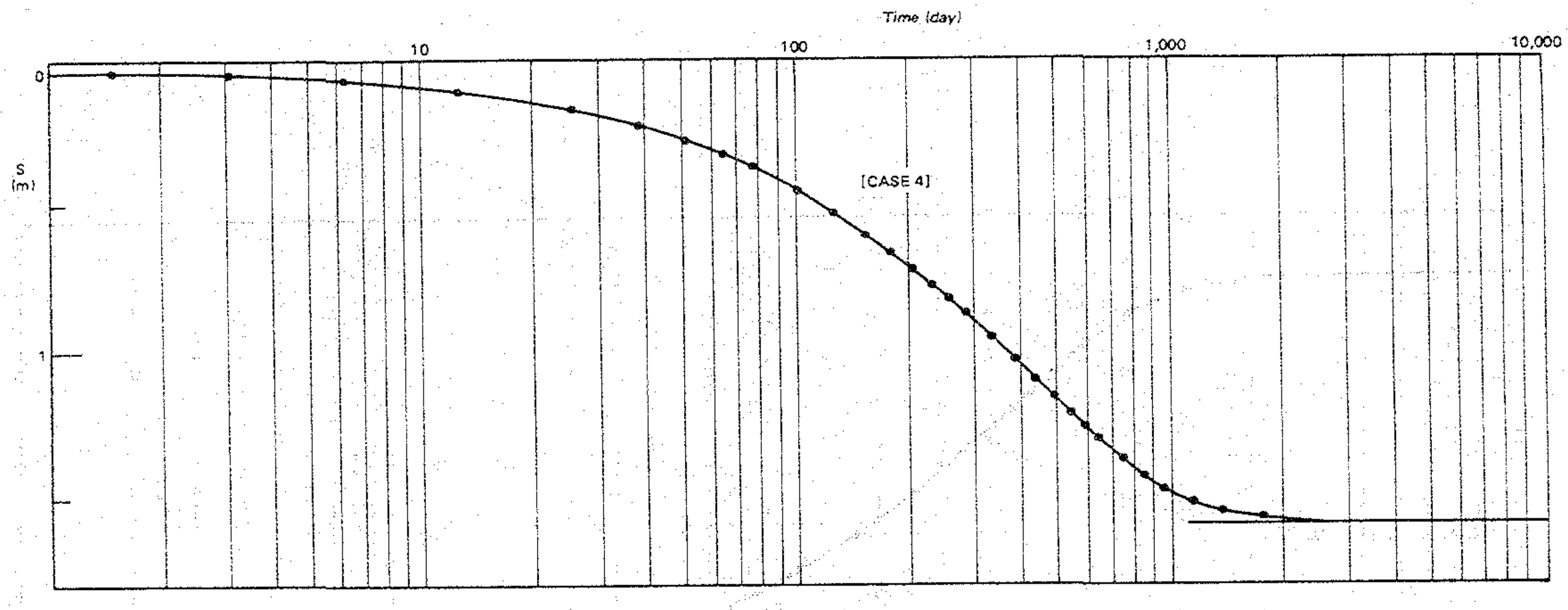


Table 4-8-2 State of the Reclaimed Land during Consolidation

**** OUTPUT OF CALCULATED VALUE ****

---- STEADY STATE ----

[CASE I]

SETTLEMENT AT FOLLOWING DEPTH

DEPTH	SETTLEMENT
0.1000000E 03	0.1582364E 03
0.2000000E 03	0.1226199E 03
0.3000000E 03	0.8370523E 02
0.4000000E 03	0.4264888E 02

FINAL SETTLEMENT = 0.1844083E 03

ZO/HO	EF	FF	PF	ZETAF
0.	0.	0.6546000E 01	0.	0.1000000E 01
0.5000000E-01	0.2444453E 00	0.4945861E 01	0.6771311E-02	0.1323531E 01
0.1000000E 00	0.2881329E 00	0.4659882E 01	0.1354262E-01	0.1404756E 01
0.1500000E 00	0.3136884E 00	0.4492596E 01	0.2031393E-01	0.1457064E 01
0.2000000E 00	0.3318204E 00	0.4373904E 01	0.2708524E-01	0.1496604E 01
0.2500000E 00	0.3458846E 00	0.4281839E 01	0.3385655E-01	0.1528782E 01
0.3000000E 00	0.3573759E 00	0.4206617E 01	0.4062786E-01	0.1556120E 01
0.3500000E 00	0.3670917E 00	0.4143018E 01	0.4739918E-01	0.1580008E 01
0.4000000E 00	0.3755079E 00	0.4087925E 01	0.5417049E-01	0.1601301E 01
0.4500000E 00	0.3829315E 00	0.4039330E 01	0.6094180E-01	0.1620566E 01
0.5000000E 00	0.3895721E 00	0.3995861E 01	0.6771311E-01	0.1638195E 01
0.5500000E 00	0.3955793E 00	0.3956538E 01	0.7448442E-01	0.1654477E 01
0.6000000E 00	0.4010634E 00	0.3920639E 01	0.8125573E-01	0.1669626E 01
0.6500000E 00	0.4061084E 00	0.3887615E 01	0.8802704E-01	0.1683809E 01
0.7000000E 00	0.4107792E 00	0.3857039E 01	0.9479835E-01	0.1697157E 01
0.7500000E 00	0.4151277E 00	0.3828574E 01	0.1015697E 00	0.1709775E 01
0.8000000E 00	0.4191954E 00	0.3801947E 01	0.1083410E 00	0.1721749E 01
0.8500000E 00	0.4230164E 00	0.3776934E 01	0.1151123E 00	0.1733152E 01
0.9000000E 00	0.4266190E 00	0.3753352E 01	0.1218836E 00	0.1744041E 01
0.9500000E 00	0.4300267E 00	0.3731045E 01	0.1286549E 00	0.1754468E 01
0.1000000E 01	0.4332596E 00	0.3709882E 01	0.1354262E 00	0.1764476E 01

```
TIME                    = 0.1036791E 06MIN.        0.1727985E 04HR.        0.7199936E 02DAY

TIME FACTOR             = 0.4147163E-01

SETTLEMENT              = 0.1275002E 03CM          0.1275002E 01M.

DEGREE OF CONSOLIDATION = 0.6874673E 00

SETTLEMENT AT FOLLOWING DEPTH
```

DEPTH	SETTLEMENT
0.1000000E 03	0.1112649E 03
0.2000000E 03	0.9146624E 02
0.3000000E 03	0.6805984E 02
0.4000000E 03	0.3857582E 02

ZO/HO	UZO	E	F	P	ZETA	UW
0.	0.1000000E 01	0.	0.6546000E 01	0.	0.1000000E 01	0.
0.5000000E-01	0.7139487E 00	0.1745214E 00	0.5403583E 01	0.2232853E-02	0.1211418E 01	0.4538457E-02
0.1000000E 00	0.6076280E 00	0.1750776E 00	0.5399942E 01	0.2252644E-02	0.1212235E 01	0.1128998E-01
0.1500000E 00	0.5700740E 00	0.1788256E 00	0.5375408E 01	0.2390663E-02	0.1217768E 01	0.1792327E-01
0.2000000E 00	0.5566197E 00	0.1846977E 00	0.5336969E 01	0.2624101E-02	0.1226539E 01	0.2446114E-01
0.2500000E 00	0.5516207E 00	0.1907971E 00	0.5297042E 01	0.2890735E-02	0.1235784E 01	0.3096582E-01
0.3000000E 00	0.5526671E 00	0.1975099E 00	0.5253100E 01	0.3215609E-02	0.1246121E 01	0.3741226E-01
0.3500000E 00	0.5582575E 00	0.2049317E 00	0.5204517E 01	0.3617453E-02	0.1257754E 01	0.4378172E-01
0.4000000E 00	0.5677751E 00	0.2132040E 00	0.5150366E 01	0.4124809E-02	0.1270978E 01	0.5004568E-01
0.4500000E 00	0.5810575E 00	0.2225052E 00	0.5089481E 01	0.4780725E-02	0.1286182E 01	0.5616107E-01
0.5000000E 00	0.5982314E 00	0.2330543E 00	0.5020427E 01	0.5651744E-02	0.1303873E 01	0.6206136E-01
0.5500000E 00	0.6196323E 00	0.2451137E 00	0.4941486E 01	0.6843502E-02	0.1324703E 01	0.6764092E-01
0.6000000E 00	0.6457336E 00	0.2589802E 00	0.4850716E 01	0.8527571E-02	0.1349492E 01	0.7272816E-01
0.6500000E 00	0.6770438E 00	0.2749531E 00	0.4746157E 01	0.1098721E-01	0.1379221E 01	0.7703983E-01
0.7000000E 00	0.7139284E 00	0.2932669E 00	0.4626275E 01	0.1469195E-01	0.1414961E 01	0.8010641E-01
0.7500000E 00	0.7563432E 00	0.3139790E 00	0.4490694E 01	0.2040780E-01	0.1457681E 01	0.8116186E-01
0.8000000E 00	0.8035376E 00	0.3368393E 00	0.4341050E 01	0.2933024E-01	0.1507930E 01	0.7901073E-01
0.8500000E 00	0.8538938E 00	0.3612111E 00	0.4181512E 01	0.4317680E-01	0.1565462E 01	0.7193549E-01
0.9000000E 00	0.9050825E 00	0.3861254E 00	0.4018423E 01	0.6410960E-01	0.1628997E 01	0.5777400E-01
0.9500000E 00	0.9545362E 00	0.4104761E 00	0.3859023E 01	0.9434353E-01	0.1696284E 01	0.3431138E-01
0.1000000E 01	0.1000000E 01	0.4332596E 00	0.3709882E 01	0.1354262E 00	0.1764476E 01	0.1862645E-08

TIME = 0.1774067E 06MIN. 0.2956778E 04HR. 0.1231991E 03DAY

TIME FACTOR = 0.7096267E-01

SETTLEMENT = 0.1457169E 03CM 0.1457169E 01M.

DEGREE OF CONSOLIDATION = 0.7873938E 00

SETTLEMENT AT FOLLOWING DEPTH

DEPTH	SETTLEMENT
0.1000000E 03	0.1261628E 03
0.2000000E 03	0.1018092E 03
0.3000000E 03	0.7368810E 02
0.4000000E 03	0.4013425E 02

ZO/HO	UZO	E	F	P	ZETA	UW
0.	0.1000000E 01	0.	0.6546000E 01	0.	0.1000000E 01	0.
0.5000000E-01	0.8141667E 00	0.1990192E 00	0.5243220E 01	0.3293541E-02	0.1248469E 01	0.3477769E-02
0.1000000E 00	0.7475776E 00	0.2154017E 00	0.5135981E 01	0.4271169E-02	0.1274538E 01	0.9271453E-02
0.1500000E 00	0.7097665E 00	0.2226455E 00	0.5088562E 01	0.4791380E-02	0.1286414E 01	0.1552255E-01
0.2000000E 00	0.6902155E 00	0.2290276E 00	0.5046786E 01	0.5301958E-02	0.1297063E 01	0.2178329E-01
0.2500000E 00	0.6815837E 00	0.2357493E 00	0.5002785E 01	0.5898651E-02	0.1308471E 01	0.2795790E-01
0.3000000E 00	0.6801338E 00	0.2430634E 00	0.4954907E 01	0.6624464E-02	0.1321115E 01	0.3400340E-01
0.3500000E 00	0.6839917E 00	0.2510877E 00	0.4902380E 01	0.7523884E-02	0.1335270E 01	0.3987529E-01
0.4000000E 00	0.6922001E 00	0.2599266E 00	0.4844521E 01	0.8656589E-02	0.1351217E 01	0.4551390E-01
0.4500000E 00	0.7042690E 00	0.2696868E 00	0.4780630E 01	0.1010647E-01	0.1369275E 01	0.5083532E-01
0.5000000E 00	0.7199485E 00	0.2804719E 00	0.4710031E 01	0.1199264E-01	0.1389800E 01	0.5572047E-01
0.5500000E 00	0.7390935E 00	0.2923701E 00	0.4632145E 01	0.1448437E-01	0.1413168E 01	0.6000005E-01
0.6000000E 00	0.7615622E 00	0.3054348E 00	0.4546624E 01	0.1782059E-01	0.1439750E 01	0.6343514E-01
0.6500000E 00	0.7871309E 00	0.3196604E 00	0.4453503E 01	0.2233287E-01	0.1469854E 01	0.6569417E-01
0.7000000E 00	0.8154215E 00	0.3349582E 00	0.4353364E 01	0.2846782E-01	0.1503665E 01	0.6633055E-01
0.7500000E 00	0.8458576E 00	0.3511389E 00	0.4247445E 01	0.3679999E-01	0.1541162E 01	0.6476967E-01
0.8000000E 00	0.8776644E 00	0.3679129E 00	0.4137642E 01	0.4602077E-01	0.1582060E 01	0.6032020E-01
0.8500000E 00	0.9099207E 00	0.3849114E 00	0.4026370E 01	0.6288660E-01	0.1625782E 01	0.5222569E-01
0.9000000E 00	0.9416525E 00	0.4017269E 00	0.3916296E 01	0.8211553E-01	0.1671477E 01	0.3976807E-01
0.9500000E 00	0.9719387E 00	0.4179596E 00	0.3810036E 01	0.1062374E 00	0.1718094E 01	0.2241747E-01
0.1000000E 01	0.1000000E 01	0.4332596E 00	0.3709682E 01	0.1354262E 00	0.1764476E 01	0.1862645E-08

```
TIME                        =  0.3985873E 06MIN.      0.6643122E 04HR.      0.2767967E 03DAY

TIME FACTOR                 =  0.1594349E 00

SETTLEMENT                  =  0.1680106E 03CM        0.1680106E 01M.

DEGREE OF CONSOLIDATION  =  0.9091299E 00

SETTLEMENT AT FOLLOWING DEPTH
```

DEPTH	SETTLEMENT
0.1000000E 03	0.1448500E 03
0.2000000E 03	0.1139761E 03
0.3000000E 03	0.7963062E 02
0.4000000E 03	0.4163549E 02

ZO/HO	UZO	E	F	P	ZETA	UW
0.	0.1000000E 01	0.	0.6546000E 01	0.	0.1000000E 01	0.
0.5000000E-01	0.8892426E 00	0.2173712E 00	0.5123088E 01	0.4406744E-02	0.1277745E 01	0.2364567E-02
0.1000000E 00	0.8913303E 00	0.2568215E 00	0.4864846E 01	0.8240459E-02	0.1345572E 01	0.5302162E-02
0.1500000E 00	0.8817647E 00	0.2765994E 00	0.4735380E 01	0.1127797E-01	0.1382360E 01	0.9035959E-02
0.2000000E 00	0.8731913E 00	0.2897427E 00	0.4649345E 01	0.1389297E-01	0.1407940E 01	0.1319227E-01
0.2500000E 00	0.8674958E 00	0.3000534E 00	0.4581850E 01	0.1636221E-01	0.1428680E 01	0.1749435E-01
0.3000000E 00	0.8649278E 00	0.3091044E 00	0.4522603E 01	0.1888894E-01	0.1447397E 01	0.2173893E-01
0.3500000E 00	0.8653245E 00	0.3176534E 00	0.4466641E 01	0.2163292E-01	0.1465531E 01	0.2576625E-01
0.4000000E 00	0.8683978E 00	0.3260902E 00	0.4411413E 01	0.2473142E-01	0.1483878E 01	0.2943906E-01
0.4500000E 00	0.8738236E 00	0.3346146E 00	0.4355613E 01	0.2831303E-01	0.1502888E 01	0.3262877E-01
0.5000000E 00	0.8812734E 00	0.3433195E 00	0.4298630E 01	0.3250635E-01	0.1522811E 01	0.3520676E-01
0.5500000E 00	0.8904234E 00	0.3522331E 00	0.4240282E 01	0.3744442E-01	0.1543765E 01	0.3704000E-01
0.6000000E 00	0.9009568E 00	0.3613408E 00	0.4180663E 01	0.4326575E-01	0.1565780E 01	0.3798998E-01
0.6500000E 00	0.9125629E 00	0.3705994E 00	0.4120056E 01	0.5011189E-01	0.1588813E 01	0.3791515E-01
0.7000000E 00	0.9249378E 00	0.3799452E 00	0.4058879E 01	0.5812170E-01	0.1612761E 01	0.3667665E-01
0.7500000E 00	0.9377866E 00	0.3893012E 00	0.3997634E 01	0.6742265E-01	0.1637468E 01	0.3414701E-01
0.8000000E 00	0.9508274E 00	0.3985825E 00	0.3936879E 01	0.7811939E-01	0.1662738E 01	0.3022158E-01
0.8500000E 00	0.9637961E 00	0.4077016E 00	0.3877185E 01	0.9028060E-01	0.1688338E 01	0.2483169E-01
0.9000000E 00	0.9764517E 00	0.4165729E 00	0.3819114E 01	0.1039255E 00	0.1714010E 01	0.1795813E-01
0.9500000E 00	0.9885806E 00	0.4251161E 00	0.3763190E 01	0.1190117E 00	0.1739482E 01	0.9643244E-02
0.1000000E 01	0.1000000E 01	0.4332596E 00	0.3709882E 01	0.1354262E 00	0.1764476E 01	0.1862645E-08

**** OUTPUT OF CALCULATED VALUE ****

---- STEADY STATE ----

[CASE II]

SETTLEMENT AT FOLLOWING DEPTH

DEPTH	SETTLEMENT
0.2000000E 03	0.3514229E 03
0.4000000E 03	0.2714523E 03
0.6000000E 03	0.1848855E 03
0.8000000E 03	0.9403527E 02

FINAL SETTLEMENT = 0.4117759E 03

ZO/HO	EF	FF	PF	ZETAF
0.	0.	0.6546000E 01	0.	0.1000000E 01
0.5000000E-01	0.2881329E 00	0.4659882E 01	0.1354262E-01	0.1404756E 01
0.1000000E 00	0.3318204E 00	0.4373904E 01	0.2708524E-01	0.1496604E 01
0.1500000E 00	0.3573759E 00	0.4206617E 01	0.4062786E-01	0.1556120E 01
0.2000000E 00	0.3755079E 00	0.4087925E 01	0.5417049E-01	0.1601301E 01
0.2500000E 00	0.3895721E 00	0.3995861E 01	0.6771311E-01	0.1638195E 01
0.3000000E 00	0.4010634E 00	0.3920639E 01	0.8125573E-01	0.1669626E 01
0.3500000E 00	0.4107792E 00	0.3857039E 01	0.9479835E-01	0.1697157E 01
0.4000000E 00	0.4191954E 00	0.3801947E 01	0.1083410E 00	0.1721749E 01
0.4500000E 00	0.4266190E 00	0.3753352E 01	0.1218836E 00	0.1744041E 01
0.5000000E 00	0.4332596E 00	0.3709882E 01	0.1354262E 00	0.1764476E 01
0.5500000E 00	0.4392668E 00	0.3670559E 01	0.1489688E 00	0.1783379E 01
0.6000000E 00	0.4447510E 00	0.3634660E 01	0.1625115E 00	0.1800994E 01
0.6500000E 00	0.4497959E 00	0.3601636E 01	0.1760541E 00	0.1817507E 01
0.7000000E 00	0.4544667E 00	0.3571061E 01	0.1895967E 00	0.1833069E 01
0.7500000E 00	0.4588152E 00	0.3542596E 01	0.2031393E 00	0.1847798E 01
0.8000000E 00	0.4628829E 00	0.3515968E 01	0.2166819E 00	0.1861791E 01
0.8500000E 00	0.4667040E 00	0.3490956E 01	0.2302246E 00	0.1875131E 01
0.9000000E 00	0.4703065E 00	0.3467373E 01	0.2437672E 00	0.1887884E 01
0.9500000E 00	0.4737143E 00	0.3445066E 01	0.2573098E 00	0.1900108E 01
0.1000000E 01	0.4769472E 00	0.3423904E 01	0.2708524E 00	0.1911853E 01

TIME = 0.3594210E 06MIN. 0.5990350E 04HR. 0.2495979E 03DAY

TIME FACTOR = 0.3594210E-01

SETTLEMENT = 0.2947009E 03CM 0.2947009E 01M.

DEGREE OF CONSOLIDATION = 0.7132383E 00

SETTLEMENT AT FOLLOWING DEPTH

DEPTH	SETTLEMENT
0.2000000E 03	0.2550187E 03
0.4000000E 03	0.2075604E 03
0.6000000E 03	0.1528338E 03
0.8000000E 03	0.8572697E 02

ZO/HO	UZO	E	F	P	ZETA	UW
0.	0.1000000E 01	0.	0.6546000E 01	0.	0.1000000E 01	0.
0.5000000E-01	0.7412583E 00	0.2135809E 00	0.5147900E 01	0.4149545E-02	0.1271587E 01	0.9393077E-02
0.1000000E 00	0.6473860E 00	0.2148159E 00	0.5139815E 01	0.4231653E-02	0.1273587E 01	0.2285359E-01
0.1500000E 00	0.6107369E 00	0.2182627E 00	0.5117252E 01	0.4469517E-02	0.1279202E 01	0.3615835E-01
0.2000000E 00	0.5963147E 00	0.2239209E 00	0.5080214E 01	0.4889318E-02	0.1288528E 01	0.4928117E-01
0.2500000E 00	0.5906000E 00	0.2300813E 00	0.5039888E 01	0.5391343E-02	0.1298838E 01	0.6232177E-01
0.3000000E 00	0.5904588E 00	0.2368114E 00	0.4995832E 01	0.5998894E-02	0.1310292E 01	0.7525684E-01
0.3500000E 00	0.5946331E 00	0.2442629E 00	0.4947055E 01	0.6751740E-02	0.1323211E 01	0.8804661E-01
0.4000000E 00	0.6025320E 00	0.2525786E 00	0.4892620E 01	0.7703985E-02	0.1337933E 01	0.1006370E 00
0.4500000E 00	0.6140014E 00	0.2619447E 00	0.4831310E 01	0.8938247E-02	0.1354912E 01	0.1129453E 00
0.5000000E 00	0.6291632E 00	0.2725910E 00	0.4761619E 01	0.1058306E-01	0.1374742E 01	0.1248432E 00
0.5500000E 00	0.6483434E 00	0.2847958E 00	0.4681727E 01	0.1284424E-01	0.1398202E 01	0.1361246E 00
0.6000000E 00	0.6720080E 00	0.2988762E 00	0.4589556E 01	0.1605944E-01	0.1426282E 01	0.1464520E 00
0.6500000E 00	0.7006638E 00	0.3151557E 00	0.4482991E 01	0.2079239E-01	0.1460186E 01	0.1552617E 00
0.7000000E 00	0.7346805E 00	0.3338879E 00	0.4360370E 01	0.2798845E-01	0.1501249E 01	0.1616083E 00
0.7500000E 00	0.7740195E 00	0.3551319E 00	0.4221306E 01	0.3920683E-01	0.1550705E 01	0.1639325E 00
0.8000000E 00	0.8179311E 00	0.3786063E 00	0.4067643E 01	0.5690005E-01	0.1609286E 01	0.1597819E 00
0.8500000E 00	0.8648027E 00	0.4036068E 00	0.3903990E 01	0.8460173E-01	0.1676746E 01	0.1456228E 00
0.9000000E 00	0.9123466E 00	0.4290825E 00	0.3737226E 01	0.1267419E 00	0.1751567E 01	0.1170253E 00
0.9500000E 00	0.9581053E 00	0.4538681E 00	0.3574979E 01	0.1878046E 00	0.1831060E 01	0.6950526E-01
0.1000000E 01	0.1000000E 01	0.4769472E 00	0.3423904E 01	0.2708524E 00	0.1911853E 01	0.3725290E-08

```
TIME                     =  0.6543285E 06MIN.     0.1090547E 05HR.     0.4543948E 03DAY

TIME FACTOR              =  0.6543285E-01

SETTLEMENT               =  0.3355164E 03CM       0.3355164E 01M.

DEGREE OF CONSOLIDATION  =  0.8129873E 00

SETTLEMENT AT FOLLOWING DEPTH
```

DEPTH	SETTLEMENT
0.2000000E 03	0.2884396E 03
0.4000000E 03	0.2307477E 03
0.6000000E 03	0.1654117E 03
0.8000000E 03	0.8917777E 02

ZO/HO	UZO	E	F	P	ZETA	UW
0.	0.1000000E 01	0.	0.6546000E 01	0.	0.1000000E 01	0.
0.5000000E-01	0.8362793E 00	0.2409595E 00	0.4968679E 01	0.6406987E-02	0.1317453E 01	0.7135634E-02
0.1000000E 00	0.7815118E 00	0.2593215E 00	0.4848481E 01	0.8573885E-02	0.1350114E 01	0.1851136E-01
0.1500000E 00	0.7474176E 00	0.2671091E 00	0.4797504E 01	0.9701476E-02	0.1364459E 01	0.3092639E-01
0.2000000E 00	0.7288610E 00	0.2736931E 00	0.4754405E 01	0.1076974E-01	0.1376828E 01	0.4340075E-01
0.2500000E 00	0.7201355E 00	0.2805447E 00	0.4709554E 01	0.1200651E-01	0.1389940E 01	0.5570660E-01
0.3000000E 00	0.7180474E 00	0.2879826E 00	0.4660866E 01	0.1351037E-01	0.1404460E 01	0.6774536E-01
0.3500000E 00	0.7209190E 00	0.2961385E 00	0.4607477E 01	0.1537681E-01	0.1420734E 01	0.7942154E-01
0.4000000E 00	0.7278663E 00	0.3051182E 00	0.4548696E 01	0.1773131E-01	0.1439094E 01	0.9060966E-01
0.4500000E 00	0.7384204E 00	0.3150242E 00	0.4483852E 01	0.2074904E-01	0.1459906E 01	0.1011346E 00
0.5000000E 00	0.7523248E 00	0.3259520F 00	0.4412318E 01	0.2467724E-01	0.1483574E 01	0.1107490E 00
0.5500000E 00	0.7694116E 00	0.3379770E 00	0.4333603E 01	0.2986449E-01	0.1510522E 01	0.1191043E 00
0.6000000E 00	0.7895082E 00	0.3511345E 00	0.4247473E 01	0.3679743E-01	0.1541151E 01	0.1257140E 00
0.6500000E 00	0.8123620E 00	0.3653971E 00	0.4154111E 01	0.4614174E-01	0.1575789E 01	0.1299123E 00
0.7000000E 00	0.8375818E 00	0.3806530E 00	0.4054245E 01	0.5877811E-01	0.1614604E 01	0.1308186E 00
0.7500000E 00	0.8646081E 00	0.3966954E 00	0.3949232E 01	0.7581507E-01	0.1657537E 01	0.1273243E 00
0.8000000E 00	0.8927256E 00	0.4132274E 00	0.3841013E 01	0.9855309E-01	0.1704238E 01	0.1181289E 00
0.8500000E 00	0.9211171E 00	0.4298890E 00	0.3731947E 01	0.1283740E 00	0.1754044E 01	0.1018505E 00
0.9000000E 00	0.9489479E 00	0.4462964E 00	0.3624544E 01	0.1665455E 00	0.1806020E 01	0.7722173E-01
0.9500000E 00	0.9754522E 00	0.4620856E 00	0.3521187E 01	0.2139582E 00	0.1859032E 01	0.4335158E-01
0.1000000E 01	0.1000000E 01	0.4769472E 00	0.3423904E 01	0.2708524E 00	0.1911853E 01	0.3725290E-08

TIME = 0.1244144E 07MIN. 0.2073573E 05HR. 0.8639885E 03DAY

TIME FACTOR = 0.1244143E 00

SETTLEMENT = 0.3719118E 03CM 0.3719118E 01M.

DEGREE OF CONSOLIDATION = 0.9015808E 00

SETTLEMENT AT FOLLOWING DEPTH

DEPTH	SETTLEMENT
0.2000000E 03	0.3189763E 03
0.4000000E 03	0.2506182E 03
0.6000000E 03	0.1751067E 03
0.8000000E 03	0.9161331E 02

ZO/HO	UZO	E	F	P	ZETA	UW
0.	0.1000000E 01	0.	0.6546000E 01	0.	0.1000000E 01	0.
0.5000000E-01	0.8850730E 00	0.2550186E 00	0.4876648E 01	0.8008075E-02	0.1342315E 01	0.5534546E-02
0.1000000E 00	0.8836172E 00	0.2932022E 00	0.4626698E 01	0.1467686E-01	0.1414832E 01	0.1240838E-01
0.1500000E 00	0.8716774E 00	0.3115165E 00	0.4506813E 01	0.1962586E-01	0.1452468E 01	0.2100201E-01
0.2000000E 00	0.8617288E 00	0.3235860E 00	0.4427806E 01	0.2376805E-01	0.1478384E 01	0.3040244E-01
0.2500000E 00	0.8553717E 00	0.3332290E 00	0.4364683E 01	0.2769739E-01	0.1499765E 01	0.4001572E-01
0.3000000E 00	0.8526398E 00	0.3419627E 00	0.4307512E 01	0.3181402E-01	0.1519671E 01	0.4944171E-01
0.3500000E 00	0.8532149E 00	0.3504830E 00	0.4251739E 01	0.3641899E-01	0.1539605E 01	0.5837937E-01
0.4000000E 00	0.8567050E 00	0.3591268E 00	0.4195156E 01	0.4177231E-01	0.1560371E 01	0.6656867E-01
0.4500000E 00	0.8627226E 00	0.3680539E 00	0.4136719E 01	0.4812832E-01	0.1582413E 01	0.7375528E-01
0.5000000E 00	0.8709030E 00	0.3773271E 00	0.4076017E 01	0.5575685E-01	0.1605980E 01	0.7966936E-01
0.5500000E 00	0.8809014E 00	0.3869508E 00	0.4013020E 01	0.6495464E-01	0.1631190E 01	0.8401420E-01
0.6000000E 00	0.8923850E 00	0.3968891E 00	0.3947964E 01	0.7604845E-01	0.1658070E 01	0.8646301E-01
0.6500000E 00	0.9050261E 00	0.4070770E 00	0.3881274E 01	0.8939036E-01	0.1686560E 01	0.8666373E-01
0.7000000E 00	0.9184997E 00	0.4174276E 00	0.3813519E 01	0.1053444E 00	0.1716525E 01	0.8425229E-01
0.7500000E 00	0.9324851E 00	0.4278384E 00	0.3745370E 01	0.1242646E 00	0.1747758E 01	0.7887476E-01
0.8000000E 00	0.9466717E 00	0.4381982E 00	0.3677555E 01	0.1464643E 00	0.1779987E 01	0.7021761E-01
0.8500000E 00	0.9607667E 00	0.4483936E 00	0.3610815E 01	0.1721804E 00	0.1812887E 01	0.5804416E-01
0.9000000E 00	0.9745030E 00	0.4583151E 00	0.3545869E 01	0.2015339E 00	0.1846092E 01	0.4223330E-01
0.9500000E 00	0.9876464E 00	0.4678622E 00	0.3483374E 01	0.2344944E 00	0.1879212E 01	0.2281539E-01
0.1000000E 01	0.1000000E 01	0.4769472E 00	0.3423904E 01	0.2708524E 00	0.1911853E 01	0.3725290E-08

**** OUTPUT OF CALCULATED VALUE ****

---- STEADY STATE ----

SETTLEMENT AT FOLLOWING DEPTH

[CASEIII]

DEPTH	SETTLEMENT
0.1000000E 03	0.1274263E 03
0.2000000E 03	0.9593252E 02
0.3000000E 03	0.6419533E 02
0.4000000E 03	0.3221410E 02

FINAL SETTLEMENT = 0.1586690E 03

ZO/HO	EF	FF	PF	ZETAF
0.	0.3111525E 00	0.2599021E 01	0.2000000E 01	0.1451700E 01
0.5000000E-01	0.3117930E 00	0.2596605E 01	0.2011748E 01	0.1453051E 01
0.1000000E 00	0.3124297E 00	0.2594203E 01	0.2023496E 01	0.1454397E 01
0.1500000E 00	0.3130627E 00	0.2591814E 01	0.2035244E 01	0.1455737E 01
0.2000000E 00	0.3136921E 00	0.2589440E 01	0.2046992E 01	0.1457072E 01
0.2500000E 00	0.3143179E 00	0.2587079E 01	0.2058740E 01	0.1458402E 01
0.3000000E 00	0.3149401E 00	0.2584731E 01	0.2070488E 01	0.1459726E 01
0.3500000E 00	0.3155588E 00	0.2582397E 01	0.2082236E 01	0.1461046E 01
0.4000000E 00	0.3161740E 00	0.2580075E 01	0.2093984E 01	0.1462360E 01
0.4500000E 00	0.3167858E 00	0.2577767E 01	0.2105732E 01	0.1463670E 01
0.5000000E 00	0.3173942E 00	0.2575472E 01	0.2117480E 01	0.1464974E 01
0.5500000E 00	0.3179992E 00	0.2573189E 01	0.2129228E 01	0.1466274E 01
0.6000000E 00	0.3186009E 00	0.2570919E 01	0.2140975E 01	0.1467569E 01
0.6500000E 00	0.3191993E 00	0.2568661E 01	0.2152723E 01	0.1468859E 01
0.7000000E 00	0.3197944E 00	0.2566416E 01	0.2164471E 01	0.1470144E 01
0.7500000E 00	0.3203863E 00	0.2564182E 01	0.2176219E 01	0.1471424E 01
0.8000000E 00	0.3209750E 00	0.2561961E 01	0.2187967E 01	0.1472700E 01
0.8500000E 00	0.3215606E 00	0.2559752E 01	0.2199715E 01	0.1473971E 01
0.9000000E 00	0.3221431E 00	0.2557554E 01	0.2211463E 01	0.1475238E 01
0.9500000E 00	0.3227224E 00	0.2555368E 01	0.2223211E 01	0.1476499E 01
0.1000000E 01	0.3232987E 00	0.2553194E 01	0.2234959E 01	0.1477757E 01

TIME = 0.5806112E 06MIN. 0.9676854E 04HR. 0.4032022E 03DAY

TIME FACTOR = 0.2322445E 00

SETTLEMENT = 0.1088430E 03CM 0.1088430E 01M.

DEGREE OF CONSOLIDATION = 0.6858834E 00

SETTLEMENT AT FOLLOWING DEPTH

DEPTH	SETTLEMENT
0.1000000E 03	0.8213390E 02
0.2000000E 03	0.6363115E 02
0.3000000E 03	0.4817453E 02
0.4000000E 03	0.2819439E 02

ZO/HO	UZO	E	F	P	ZETA	UW
0.	0.1000000E 01	0.3111525E 00	0.2599021E 01	0.2000000E 01	0.1451700E 01	0.
0.5000000E-01	0.9289456E 00	0.2896387E 00	0.2680193E 01	0.1642806E 01	0.1407734E 01	0.3689422E 00
0.1000000E 00	0.8555035E 00	0.2672847E 00	0.2764535E 01	0.1339077E 01	0.1364787E 01	0.6844194E 00
0.1500000E 00	0.7813668E 00	0.2446168E 00	0.2850061E 01	0.1088374E 01	0.1323831E 01	0.9468699E 00
0.2000000E 00	0.7088120E 00	0.2223487E 00	0.2934078E 01	0.8878482E 00	0.1285923E 01	0.1159144E 01
0.2500000E 00	0.6406874E 00	0.2013795E 00	0.3013195E 01	0.7329219E 00	0.1252159E 01	0.1325818E 01
0.3000000E 00	0.5802703E 00	0.1827504E 00	0.3083483E 01	0.6181171E 00	0.1223616E 01	0.1452371E 01
0.3500000E 00	0.5309598E 00	0.1675491E 00	0.3140837E 01	0.5378949E 00	0.1201272E 01	0.1544341E 01
0.4000000E 00	0.4958205E 00	0.1567656E 00	0.3181524E 01	0.4873825E 00	0.1185910E 01	0.1606601E 01
0.4500000E 00	0.4770796E 00	0.1511321E 00	0.3202779E 01	0.4629094E 00	0.1178040E 01	0.1642822E 01
0.5000000E 00	0.4757336E 00	0.1509951E 00	0.3203296E 01	0.4623299E 00	0.1177849E 01	0.1655150E 01
0.5500000E 00	0.4913992E 00	0.1562646E 00	0.3183414E 01	0.4851547E 00	0.1185206E 01	0.1644073E 01
0.6000000E 00	0.5224465E 00	0.1664526E 00	0.3144974E 01	0.5325282E 00	0.1199692E 01	0.1608447E 01
0.6500000E 00	0.5663529E 00	0.1807794E 00	0.3090919E 01	0.6070759E 00	0.1220672E 01	0.1545648E 01
0.7000000E 00	0.6201109E 00	0.1983080E 00	0.3024784E 01	0.7126216E 00	0.1247362E 01	0.1451850E 01
0.7500000E 00	0.6806430E 00	0.2180687E 00	0.2950227E 01	0.8537687E 00	0.1278885E 01	0.1322451E 01
0.8000000E 00	0.7450903E 00	0.2391554E 00	0.2870667E 01	0.1035351E 01	0.1314329E 01	0.1152616E 01
0.8500000E 00	0.8109952E 00	0.2607841E 00	0.2789062E 01	0.1261792E 01	0.1352785E 01	0.9379231E 00
0.9000000E 00	0.8763765E 00	0.2823193E 00	0.2707809E 01	0.1536443E 01	0.1393377E 01	0.6750205E 00
0.9500000E 00	0.9397378E 00	0.3032745E 00	0.2628745E 01	0.1860980E 01	0.1435285E 01	0.3622315E 00
0.1000000E 01	0.1000000E 01	0.3232987E 00	0.2553194E 01	0.2234959E 01	0.1477757E 01	0.5960464E-07

```
TIME                       =  0.8018087E 06MIN.      0.1336348E 05HR.      0.5568116E 03DAY

TIME FACTOR                =  0.3207235E 00

SETTLEMENT                 =  0.1251602E 03CM        0.1251602E 01M.

DEGREE OF CONSOLIDATION    =  0.7887626E 00

SETTLEMENT AT FOLLOWING DEPTH
```

DEPTH	SETTLEMENT
0.1000000E 03	0.9704073E 02
0.2000000E 03	0.7420620E 02
0.3000000E 03	0.5322892E 02
0.4000000E 03	0.2938881E 02

ZO/HO	UZO	E	F	P	ZETA	UW
0.	0.1000000E 01	0.3111525E 00	0.2599021E 01	0.2000000E 01	0.1451700E 01	0.
0.5000000E-01	0.9501707E 00	0.2962565E 00	0.2655224E 01	0.1745297E 01	0.1420972E 01	0.2664508E 00
0.1000000E 00	0.8997220E 00	0.2810999E 00	0.2712410E 01	0.1519405E 01	0.1391014E 01	0.5040910E 00
0.1500000E 00	0.8499131E 00	0.2660761E 00	0.2769095E 01	0.1324358E 01	0.1362539E 01	0.7108859E 00
0.2000000E 00	0.8022467E 00	0.2516584E 00	0.2823493E 01	0.1160766E 01	0.1336288E 01	0.8862262E 00
0.2500000E 00	0.7584224E 00	0.2383857E 00	0.2873571E 01	0.1028089E 01	0.1313001E 01	0.1030650E 01
0.3000000E 00	0.7202370E 00	0.2268315E 00	0.2917165E 01	0.9250014E 00	0.1293379E 01	0.1145486E 01
0.3500000E 00	0.6894337E 00	0.2175569E 00	0.2952158E 01	0.8497820E 00	0.1278048E 01	0.1232454E 01
0.4000000E 00	0.6675163E 00	0.2110513E 00	0.2976703E 01	0.8007005E 00	0.1267510E 01	0.1293283E 01
0.4500000E 00	0.6555613E 00	0.2076725E 00	0.2989452E 01	0.7763381E 00	0.1262104E 01	0.1329393E 01
0.5000000E 00	0.6540747E 00	0.2075995E 00	0.2989727E 01	0.7758200E 00	0.1261988E 01	0.1341660E 01
0.5500000E 00	0.6629277E 00	0.2108105E 00	0.2977612E 01	0.7989391E 00	0.1267123E 01	0.1330288E 01
0.6000000E 00	0.6813894E 00	0.2170913E 00	0.2953915E 01	0.8461712E 00	0.1277288E 01	0.1294804E 01
0.6500000E 00	0.7082423E 00	0.2260704E 00	0.2920036E 01	0.9185857E 00	0.1292107E 01	0.1234138E 01
0.7000000E 00	0.7419491E 00	0.2372712E 00	0.2877776E 01	0.1017664E 01	0.1311082E 01	0.1146803E 01
0.7500000E 00	0.7808287E 00	0.2501668E 00	0.2829121E 01	0.1145039E 01	0.1333630E 01	0.1031180E 01
0.8000000E 00	0.8232116E 00	0.2642304E 00	0.2776059E 01	0.1302192E 01	0.1359121E 01	0.8857755E 00
0.8500000E 00	0.8675545E 00	0.2789713E 00	0.2720441E 01	0.1490115E 01	0.1386907E 01	0.7096002E 00
0.9000000E 00	0.9125098E 00	0.2939587E 00	0.2663894E 01	0.1709005E 01	0.1416348E 01	0.5024582E 00
0.9500000E 00	0.9569566E 00	0.3088313E 00	0.2607779E 01	0.1957993E 01	0.1446825E 01	0.2652180E 00
0.1000000E 01	0.1000000E 01	0.3232987E 00	0.2553194E 01	0.2234959E 01	0.1477757E 01	0.5960464E-07

TIME = 0.1170458E 07MIN. 0.1950763E 05HR. 0.8128181E 03DAY

TIME FACTOR = 0.4681832E 00

SETTLEMENT = 0.1421267E 03CM 0.1421267E 01M.

DEGREE OF CONSOLIDATION = 0.8957248E 00

SETTLEMENT AT FOLLOWING DEPTH

DEPTH	SETTLEMENT
0.1000000E 03	0.1124644E 03
0.2000000E 03	0.8520117E 02
0.3000000E 03	0.5867212E 02
0.4000000E 03	0.3074695E 02

ZO/HO	UZO	E	F	P	ZETA	UW
0.	0.1000000E 01	0.3111525E 00	0.2599021E 01	0.2000000E 01	0.1451700E 01	0.
0.5000000E-01	0.9742840E 00	0.3037749E 00	0.2626857E 01	0.1869516E 01	0.1436317E 01	0.1422318E 00
0.1000000E 00	0.9488552E 00	0.2964505E 00	0.2654492E 01	0.1748396E 01	0.1421364E 01	0.2750999E 00
0.1500000E 00	0.9243613E 00	0.2893831E 00	0.2681158E 01	0.1638969E 01	0.1407228E 01	0.3962747E 00
0.2000000E 00	0.9014864E 00	0.2827392E 00	0.2706037E 01	0.1543059E 01	0.1394290E 01	0.5039325E 00
0.2500000E 00	0.8809232E 00	0.2768899E 00	0.2728294E 01	0.1462020E 01	0.1382915E 01	0.5967198E 00
0.3000000E 00	0.8633373E 00	0.2718996E 00	0.2747123E 01	0.1396798E 01	0.1373437E 01	0.6736894E 00
0.3500000E 00	0.8493262E 00	0.2680124E 00	0.2761789E 01	0.1348017E 01	0.1366143E 01	0.7342137E 00
0.4000000E 00	0.8393765E 00	0.2653890E 00	0.2771687E 01	0.1316063E 01	0.1361265E 01	0.7779211E 00
0.4500000E 00	0.8338256E 00	0.2641441E 00	0.2776384E 01	0.1301165E 01	0.1358962E 01	0.8045667E 00
0.5000000E 00	0.8328354E 00	0.2643371E 00	0.2775656E 01	0.1303463E 01	0.1359318E 01	0.8140162E 00
0.5500000E 00	0.8363783E 00	0.2659676E 00	0.2769504E 01	0.1323045E 01	0.1362338E 01	0.8061827E 00
0.6000000E 00	0.8442423E 00	0.2689763E 00	0.2758152E 01	0.1359953E 01	0.1367945E 01	0.7810226E 00
0.6500000E 00	0.8560512E 00	0.2732509E 00	0.2742024E 01	0.1414167E 01	0.1375991E 01	0.7385563E 00
0.7000000E 00	0.8712982E 00	0.2786363E 00	0.2721705E 01	0.1485556E 01	0.1386263E 01	0.6789150E 00
0.7500000E 00	0.8893852E 00	0.2849468E 00	0.2697896E 01	0.1573809E 01	0.1398497E 01	0.6024103E 00
0.8000000E 00	0.9096653E 00	0.2919798E 00	0.2671360E 01	0.1678356E 01	0.1412389E 01	0.5096110E 00
0.8500000E 00	0.9314804E 00	0.2995274E 00	0.2642883E 01	0.1798291E 01	0.1427608E 01	0.4014245E 00
0.9000000E 00	0.9541935E 00	0.3073868E 00	0.2613230E 01	0.1932298E 01	0.1443807E 01	0.2791650E 00
0.9500000E 00	0.9772114E 00	0.3153680E 00	0.2583116E 01	0.2078606E 01	0.1460639E 01	0.1446051E 00
0.1000000E 01	0.1000000E 01	0.3232987E 00	0.2553194E 01	0.2234959E 01	0.1477757E 01	0.5960464E-07

**** OUTPUT OF CALCULATED VALUE ****

---- STEADY STATE ----

[CASEIV]

SETTLEMENT AT FOLLOWING DEPTH

DEPTH	SETTLEMENT
0.1000000E 03	0.1274263E 03
0.2000000E 03	0.9593252E 02
0.3000000E 03	0.6419333E 02
0.4000000E 03	0.3221410E 02

FINAL SETTLEMENT = 0.1586690E 03

ZO/HO	FF	FF	PF	ZETAF
0.	0.3111525E 00	0.2599021E 01	0.2000000E 01	0.1451700E 01
0.5000000E-01	0.3117930E 00	0.2596605E 01	0.2011748E 01	0.1453051E 01
0.1000000E 00	0.3124297E 00	0.2594203E 01	0.2023496E 01	0.1454397E 01
0.1500000E 00	0.3130627E 00	0.2591814E 01	0.2035244E 01	0.1455737E 01
0.2000000E 00	0.3136721E 00	0.2589440E 01	0.2046992E 01	0.1457072E 01
0.2500000E 00	0.3143179E 00	0.2587079E 01	0.2058740E 01	0.1458402E 01
0.3000000E 00	0.3149401E 00	0.2584731E 01	0.2070488E 01	0.1459726E 01
0.3500000E 00	0.3155588E 00	0.2582397E 01	0.2082236E 01	0.1461046E 01
0.4000000E 00	0.3161740E 00	0.2580075E 01	0.2093984E 01	0.1462360E 01
0.4500000E 00	0.3167858E 00	0.2577767E 01	0.2105732E 01	0.1463670E 01
0.5000000E 00	0.3173942E 00	0.2575472E 01	0.2117480E 01	0.1464974E 01
0.5500000E 00	0.3179992E 00	0.2573189E 01	0.2129228E 01	0.1466274E 01
0.6000000E 00	0.3186009E 00	0.2570919E 01	0.2140975E 01	0.1467569E 01
0.6500000E 00	0.3191993E 00	0.2568661E 01	0.2152723E 01	0.1468859E 01
0.7000000E 00	0.3197944E 00	0.2566416E 01	0.2164471E 01	0.1470144E 01
0.7500000E 00	0.3203863E 00	0.2564182E 01	0.2176219E 01	0.1471424E 01
0.8000000E 00	0.3209750E 00	0.2561961E 01	0.2187967E 01	0.1472700E 01
0.8500000E 00	0.3215606E 00	0.2559752E 01	0.2199715E 01	0.1473971E 01
0.9000000E 00	0.3221431E 00	0.2557554E 01	0.2211463E 01	0.1475238E 01
0.9500000E 00	0.3227224E 00	0.2555368E 01	0.2223211E 01	0.1476499E 01
0.1000000E 01	0.3232987E 00	0.2553194E 01	0.2234959E 01	0.1477757E 01

TIME = 0.6265537E 06MIN. 0.1044256E 05HR. 0.4351068E 03DAY

TIME FACTOR = 0.2506215E 00

SETTLEMENT = 0.1095007E 03CM 0.1095007E 01M.

DEGREE OF CONSOLIDATION = 0.6899904E 00

SETTLEMENT AT FOLLOWING DEPTH

DEPTH	SETTLEMENT
0.1000000E 03	0.8284702E 02
0.2000000E 03	0.6438059E 02
0.3000000E 03	0.4867443E 02
0.4000000E 03	0.2833379E 02

ZO/HO	UZO	E	F	P	ZETA	UW
0.	0.1000000E 01	0.3111525E 00	0.2599021E 01	0.2000000E 01	0.1451700E 01	0.
0.5000000E-01	0.9279815E 00	0.2893381E 00	0.2681327E 01	0.1638296E 01	0.1407139E 01	0.3734520E 00
0.1000000E 00	0.8535976E 00	0.2666892E 00	0.2766781E 01	0.1331805E 01	0.1363678E 01	0.6916912E 00
0.1500000E 00	0.7787160E 00	0.2437869E 00	0.2853192E 01	0.1080145E 01	0.1322379E 01	0.9550984E 00
0.2000000E 00	0.7058218E 00	0.2214107E 00	0.2937617E 01	0.8802649E 00	0.1284374E 01	0.1166727E 01
0.2500000E 00	0.6379726E 00	0.2005262E 00	0.3016415E 01	0.7272251E 00	0.1250823E 01	0.1331515E 01
0.3000000E 00	0.5785983E 00	0.1822238E 00	0.3085470E 01	0.6151478E 00	0.1222828E 01	0.1455340E 01
0.3500000E 00	0.5311251E 00	0.1676012E 00	0.3140641E 01	0.5381516E 00	0.1201347E 01	0.1544084E 01
0.4000000E 00	0.4984705E 00	0.1576034E 00	0.3178362E 01	0.4911313E 00	0.1187089E 01	0.1602852E 01
0.4500000E 00	0.4825430E 00	0.1528623E 00	0.3196249E 01	0.4702943E 00	0.1180446E 01	0.1635437E 01
0.5000000E 00	0.4839180E 00	0.1535928E 00	0.3193495E 01	0.4734443E 00	0.1181464E 01	0.1644035E 01
0.5500000E 00	0.5017985E 00	0.1595715E 00	0.3170937E 01	0.5000506E 00	0.1189869E 01	0.1629177E 01
0.6000000E 00	0.5342520E 00	0.1702131E 00	0.3130786E 01	0.5511605E 00	0.1205129E 01	0.1589815E 01
0.6500000E 00	0.5786109E 00	0.1846922E 00	0.3076156E 01	0.6291913E 00	0.1226531E 01	0.1523532E 01
0.7000000E 00	0.6318984E 00	0.2020776E 00	0.3010561E 01	0.7376157E 00	0.1253255E 01	0.1426856E 01
0.7500000E 00	0.6911827E 00	0.2214455E 00	0.2937486E 01	0.8805447E 00	0.1284432E 01	0.1295675E 01
0.8000000E 00	0.7538192E 00	0.2419571E 00	0.2860096E 01	0.1062221E 01	0.1319187E 01	0.1125746E 01
0.8500000E 00	0.8175789E 00	0.2629012E 00	0.2781074E 01	0.1286459E 01	0.1356670E 01	0.9132565E 00
0.9000000E 00	0.8806896E 00	0.2837080E 00	0.2702570E 01	0.1556080E 01	0.1396079E 01	0.6553829E 00
0.9500000E 00	0.9418145E 00	0.3039447E 00	0.2626217E 01	0.1872420E 01	0.1436667E 01	0.3507909E 00
0.1000000E 01	0.1000000E 01	0.3232987E 00	0.2553194E 01	0.2234959E 01	0.1477757E 01	0.5960464E-07

```
TIME                        =  0.8477512E 06MIN.      0.1412919E 05HR.      0.5887161E 03DAY
TIME FACTOR                 =  0.3391005E 00
SETTLEMENT                  =  0.1256424E 03CM        0.1256424E 01M.
DEGREE OF CONSOLIDATION     =  0.7917933E 00
SETTLEMENT AT FOLLOWING DEPTH
```

DEPTH	SETTLEMENT
0.1000000E 03	0.9750628E 02
0.2000000E 03	0.7459230E 02
0.3000000E 03	0.5345129E 02
0.4000000E 03	0.2944908E 02

ZO/HO	UZO	E	F	P	ZETA	UW
0.	0.1000000E 01	0.3111525E 00	0.2599021E 01	0.2000000E 01	0.1451700E 01	0.
0.5000000E-01	0.9503902E 00	0.2963250E 00	0.2654966E 01	0.1746390E 01	0.1421111E 01	0.2653577E 00
0.1000000E 00	0.9002052E 00	0.2812508E 00	0.2711841E 01	0.1521504E 01	0.1391306E 01	0.5019923E 00
0.1500000E 00	0.8507330E 00	0.2663328E 00	0.2768126E 01	0.1327470E 01	0.1363016E 01	0.7077737E 00
0.2000000E 00	0.8035027E 00	0.2520524E 00	0.2822006E 01	0.1164955E 01	0.1336992E 01	0.8820364E 00
0.2500000E 00	0.7602290E 00	0.2389536E 00	0.2871428E 01	0.1033442E 01	0.1313980E 01	0.1025298E 01
0.3000000E 00	0.7227051E 00	0.2276088E 00	0.2914232E 01	0.9316002E 00	0.1294681E 01	0.1138888E 01
0.3500000E 00	0.6926457E 00	0.2185704E 00	0.2948334E 01	0.8576951E 00	0.1279706E 01	0.1224541E 01
0.4000000E 00	0.6714989E 00	0.2123105E 00	0.2971952E 01	0.8099741E 00	0.1269536E 01	0.1284010E 01
0.4500000E 00	0.6602659E 00	0.2091629E 00	0.2983828E 01	0.7869915E 00	0.1264483E 01	0.1318740E 01
0.5000000E 00	0.6593688E 00	0.2092798E 00	0.2983387E 01	0.7878336E 00	0.1264670E 01	0.1329646E 01
0.5500000E 00	0.6686032E 00	0.2126153E 00	0.2970803E 01	0.8122347E 00	0.1270027E 01	0.1316993E 01
0.6000000E 00	0.6871871E 00	0.2189334E 00	0.2946945E 01	0.8605861E 00	0.1280309E 01	0.1280389E 01
0.6500000E 00	0.7138833E 00	0.2278710E 00	0.2913243E 01	0.9338368E 00	0.1295120E 01	0.1218887E 01
0.7000000E 00	0.7471682E 00	0.2389402E 00	0.2871479E 01	0.1033316E 01	0.1313957E 01	0.1131156E 01
0.7500000E 00	0.7854007E 00	0.2516316E 00	0.2823594E 01	0.1160481E 01	0.1336240E 01	0.1015738E 01
0.8000000E 00	0.8269681E 00	0.2654361E 00	0.2771510E 01	0.1316630E 01	0.1361552E 01	0.8713377E 00
0.8500000E 00	0.8703898E 00	0.2798831E 00	0.2717001E 01	0.1502591E 01	0.1388663E 01	0.6971238E 00
0.9000000E 00	0.9143792E 00	0.2945609E 00	0.2661622E 01	0.1718443E 01	0.1417557E 01	0.4930205E 00
0.9500000E 00	0.9578668E 00	0.3091251E 00	0.2606671E 01	0.1963260E 01	0.1447440E 01	0.2599510E 00
0.1000000E 01	0.1000000E 01	0.3232987E 00	0.2553194E 01	0.2234959E 01	0.1477757E 01	0.5960464E-07

TIME = 0.1216404E 07MIN. 0.2027340E 05HR. 0.8447250E 03DAY

TIME FACTOR = 0.4865616E 00

SETTLEMENT = 0.1423826E 03CM 0.1423826E 01M.

DEGREE OF CONSOLIDATION = 0.8973373E 00

SETTLEMENT AT FOLLOWING DEPTH

DEPTH	SETTLEMENT
0.1000000E 03	0.1126983E 03
0.2000000E 03	0.8537220E 02
0.3000000E 03	0.5876090E 02
0.4000000E 03	0.3077030E 02

ZO/HO	UZO	F	F	P	ZETA	UW
0.	0.1000000E 01	0.3111525E 00	0.2599021E 01	0.2000000E 01	0.1451700E 01	0.
0.5000000E-01	0.9746319E 00	0.3038834E 00	0.2626448E 01	0.1871372E 01	0.1436541E 01	0.1403764E 00
0.1000000E 00	0.9495578E 00	0.2966701E 00	0.2653664E 01	0.1751910E 01	0.1421808E 01	0.2715863E 00
0.1500000E 00	0.9254189E 00	0.2897142E 00	0.2679908E 01	0.1643939E 01	0.1407884E 01	0.3913045E 00
0.2000000E 00	0.9028903E 00	0.2832296E 00	0.2704375E 01	0.1549286E 01	0.1395147E 01	0.4977055E 00
0.2500000E 00	0.8826540E 00	0.2774339E 00	0.2726242E 01	0.1469312E 01	0.1383956E 01	0.5894281E 00
0.3000000E 00	0.8653631E 00	0.2725376E 00	0.2744716E 01	0.1404972E 01	0.1374641E 01	0.6655161E 00
0.3500000E 00	0.8516022E 00	0.2687306E 00	0.2759080E 01	0.1356900E 01	0.1367485E 01	0.7253357E 00
0.4000000E 00	0.8418453E 00	0.2661696E 00	0.2768742E 01	0.1325491E 01	0.1362713E 01	0.7684923E 00
0.4500000E 00	0.8364196E 00	0.2649659E 00	0.2773284E 01	0.1310980E 01	0.1360481E 01	0.7947517E 00
0.5000000E 00	0.8354789E 00	0.2651761E 00	0.2772490E 01	0.1313503E 01	0.1360870E 01	0.8039764E 00
0.5500000E 00	0.8389920E 00	0.2667938E 00	0.2766368E 01	0.1333140E 01	0.1363882E 01	0.7960880E 00
0.6000000E 00	0.8467480E 00	0.2697747E 00	0.2755140E 01	0.1369918E 01	0.1369440E 01	0.7710576E 00
0.6500000E 00	0.8583763E 00	0.2739931E 00	0.2739224E 01	0.1423798E 01	0.1377397E 01	0.7289255E 00
0.7000000E 00	0.8733792E 00	0.2793018E 00	0.2719194E 01	0.1494625E 01	0.1387543E 01	0.6698467E 00
0.7500000E 00	0.8911706E 00	0.2855189E 00	0.2695737E 01	0.1582063E 01	0.1399617E 01	0.5941561E 00
0.8000000E 00	0.9111171E 00	0.2924459E 00	0.2669602E 01	0.1685524E 01	0.1413319E 01	0.5024433E 00
0.8500000E 00	0.9325746E 00	0.2998793E 00	0.2641556E 01	0.1804096E 01	0.1428325E 01	0.3956290E 00
0.9000000E 00	0.9549191E 00	0.3076206E 00	0.2612348E 01	0.1936433E 01	0.1444295E 01	0.2750303E 00
0.9500000E 00	0.9775689E 00	0.3154834E 00	0.2582681E 01	0.2080801E 01	0.1460885E 01	0.1424106E 00
0.1000000E 01	0.1000000E 01	0.3232987E 00	0.2553194E 01	0.2234959E 01	0.1477757E 01	0.5960464E-07

4-8-5 Discussions

(1) Consolidation Constants

The consolidation constants for the Tampico clay are expressed by the equation (3.1) and (3.2). They are drawn in Fig. 4-8-8 together with the consolidation constants for several clays sampled at the harbour areas in Japan. The compression index and the coefficient of consolidation for the Tampico clay are likely to be somewhat smaller than those for some other clays. The Tampico clay sample tested in the laboratory was taken from a limited area of the reclaimed land, so it may not indicate the typical properties of the whole reclaimed area. However, the water content of the filled soil is so high that the reclaimed land should be very uniform, assuming that the land fill has been completed within a short period compared with the total consolidation period. Thus, the consolidation constants expressed by equation (3.1) and (3.2) are considered to be the typical ones for the Tampico clay.

Fig. 4-8-8 Consolidation Constants and Coefficient of Consolidation

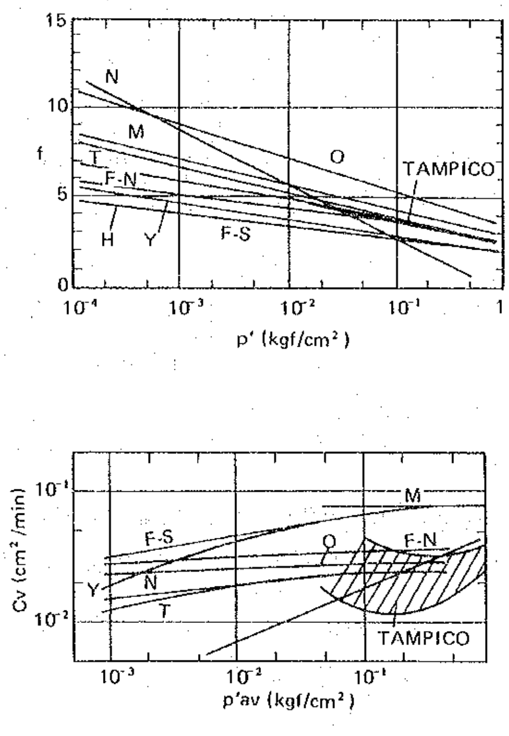


Table 4-8-3 is a list of mechanical properties of the Tampico clay and Fig. 4-8-9 shows the grain size accumulation curve. A plasticity chart and trianguler diagram are included in the Appendex. From these results, the consolidation constants of the Tampico clay are plotted onto Fig. 4-8-10 and Fig. 4-8-11 together with those of clayer soils sampled at harbour areas in Japan. The consolidation constants of the Tampico clay are at the lower boundary in Fig. 4-8-10 and 4-8-11.

Table 4-8-3 Result of Soil Testing

Site Port of TAMPICO No. 3002-C Date 4/80

Sample number			
Unit weight		γ_t (t/m^3)	
Water content		w (%)	
Void ratio		e	
Degree of saturation		S_r (%)	
Specific gravity		G_s	2.774
Consistency	Liquid limit	w_L (%)	95.2
	Plastic limit	w_p (%)	27.7
	Plasticity index	I_p	67.5
	Classification	Plasticity Chart	*CH
Textur	Gravel	Gravel (%)	8.9 (Seashell)
	Sand	Sand (%)	12.9
	Silt	Silt (%)	20.4
	Clay	Clay (%)	57.8
	Classification		*F (Fine grain size)** Clay

Note: * Classification by Japanese Unified Soil Classification system

** Classification by Mississippi River Commission

Fig. 4-8-9 Grain Size

	MECHANICAL ANALYSIS OF SOILS	

Name of Survey Port of TAMPICO Date 1980 y 4 m 25 day

Tested by

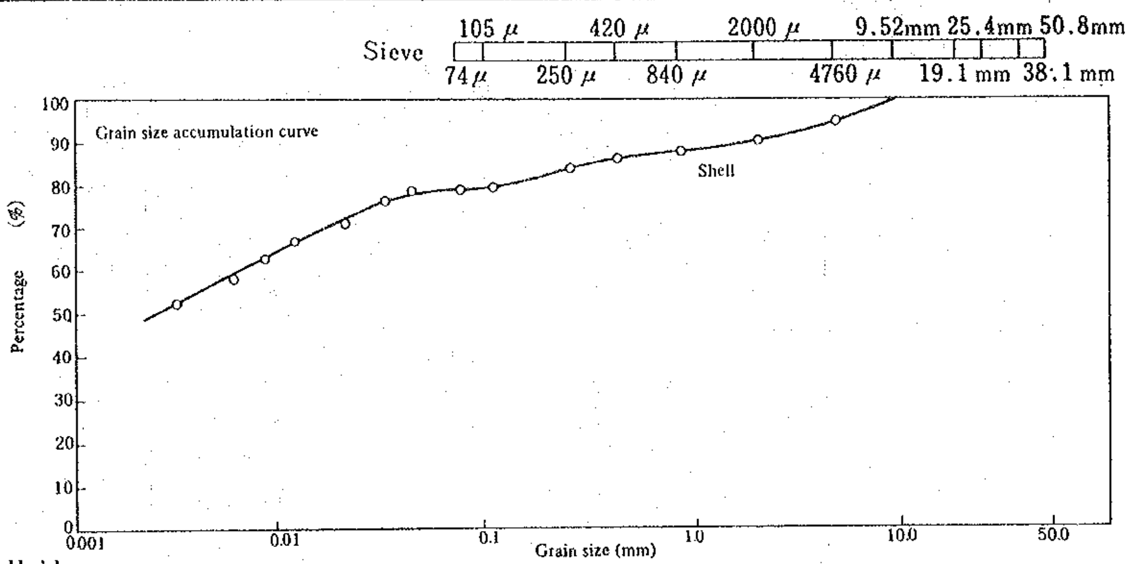
Relation between grain size and percentage finer by weight

Sample No. Depth: No. 3002-C (m - m) Specific Gravity 2.774

Sieve	Size mm	50.8	38.1	25.4	19.1	9.52	4.76	2.00	0.84	0.42	0.25	0.105	0.074
Sieve	% finer						95.2	91.1	87.7	86.1	84.3	79.5	78.2
Hydro meter	Size mm	0.0443	0.0316	0.0203	0.0119	0.0085	0.0060	0.0031					
Hydro meter	% finer	78.8	76.3	70.9	66.4	63.0	58.2	53.4					

Sample No. Depth: No. (m - m) Specific Gravity

Sieve	Size mm	50.8	38.1	25.4	19.1	9.52	4.76	2.00	0.84	0.42	0.25	0.105	0.074
Sieve	% finer												
Hydro meter	Size mm												
Hydro meter	% finer												



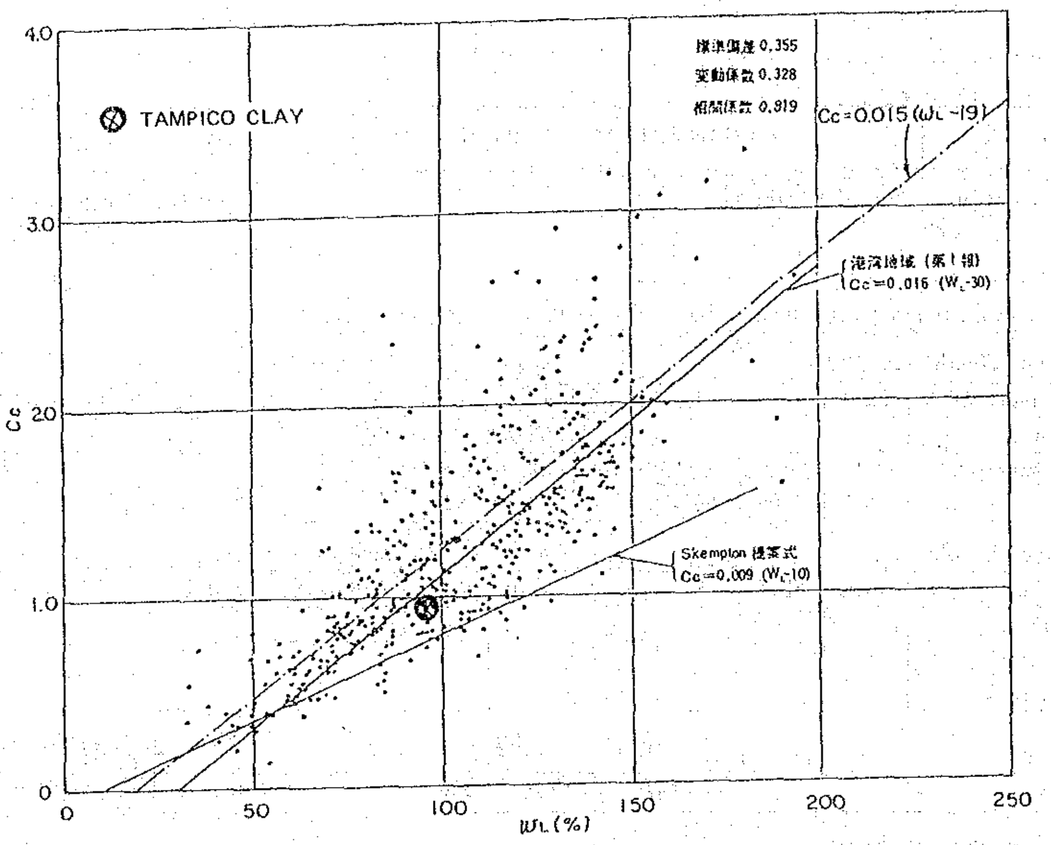
colloid

clay	silt	sand	gravel

0.001 0.005 0.074 2.0

Sample No. Depth	No. 3002-C m m	No. m m	Sample No. Dapth	No. m m	No. m m
Grain > 4.76 mm	4.8 % Shell	%	Maximum grain	mm	mm
4.76-2 mm	4.1 %	%	D_{60}	mm	mm
2-0.42 mm	5.0 %	%	D_{30}	mm	mm
0.42-0.074 mm	7.9 %	%	D_{10}	mm	mm
0.074-0.005 mm	20.4 %	%	Coef. Uniformity		
Clay < 0.005 mm	57.8 %	%	U_c'		
Colloid < 0.001 mm	%	%			
Passing 2000 μ	91.1 %	%			
Passing 420 μ	86.1 %	%			
Passing 74 μ	78.2 %	%			

Fig. 4-8-10 Compression Index C_C vs. Liquid Limit W_L and Plastisity Index I_P



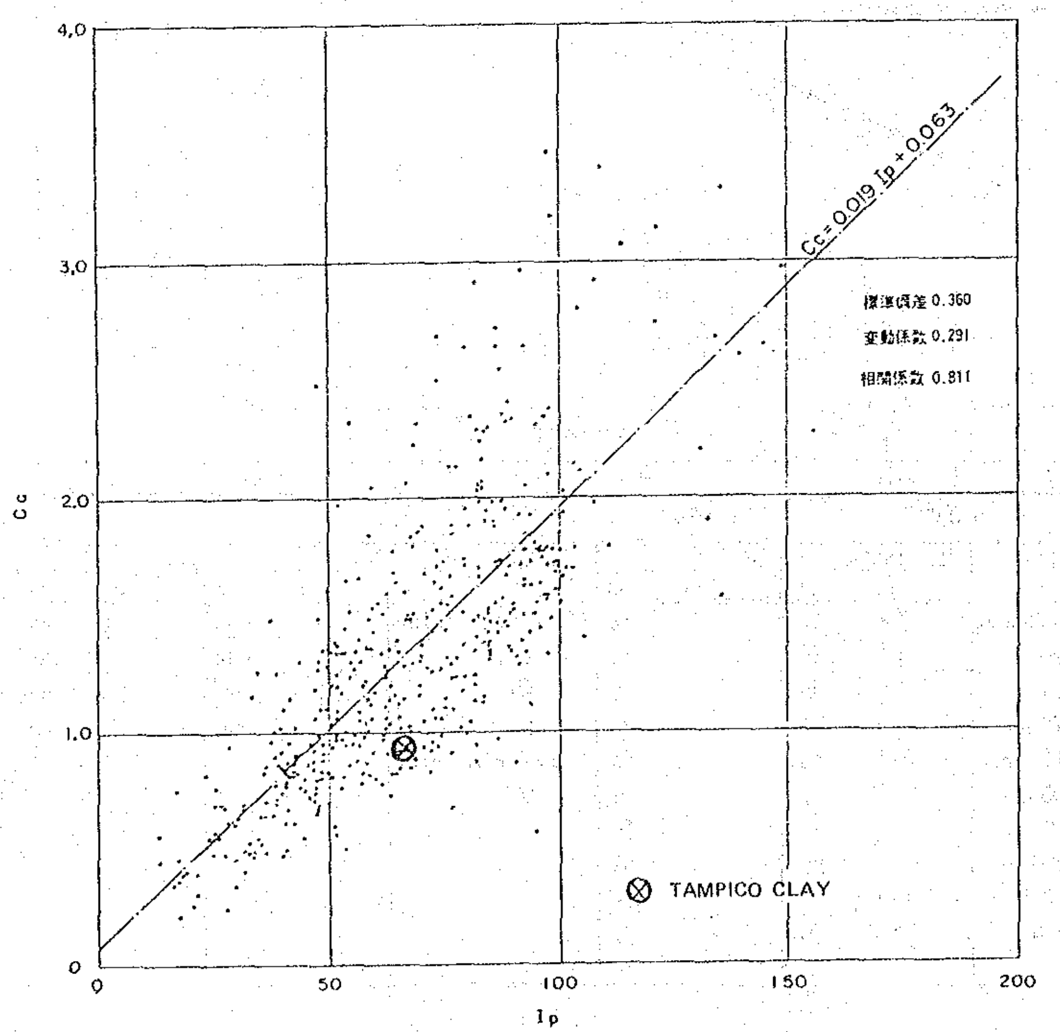


Fig. 4-8-11 (a) Coefficient of Consolidation C_V vs. Liquid Limit W_L

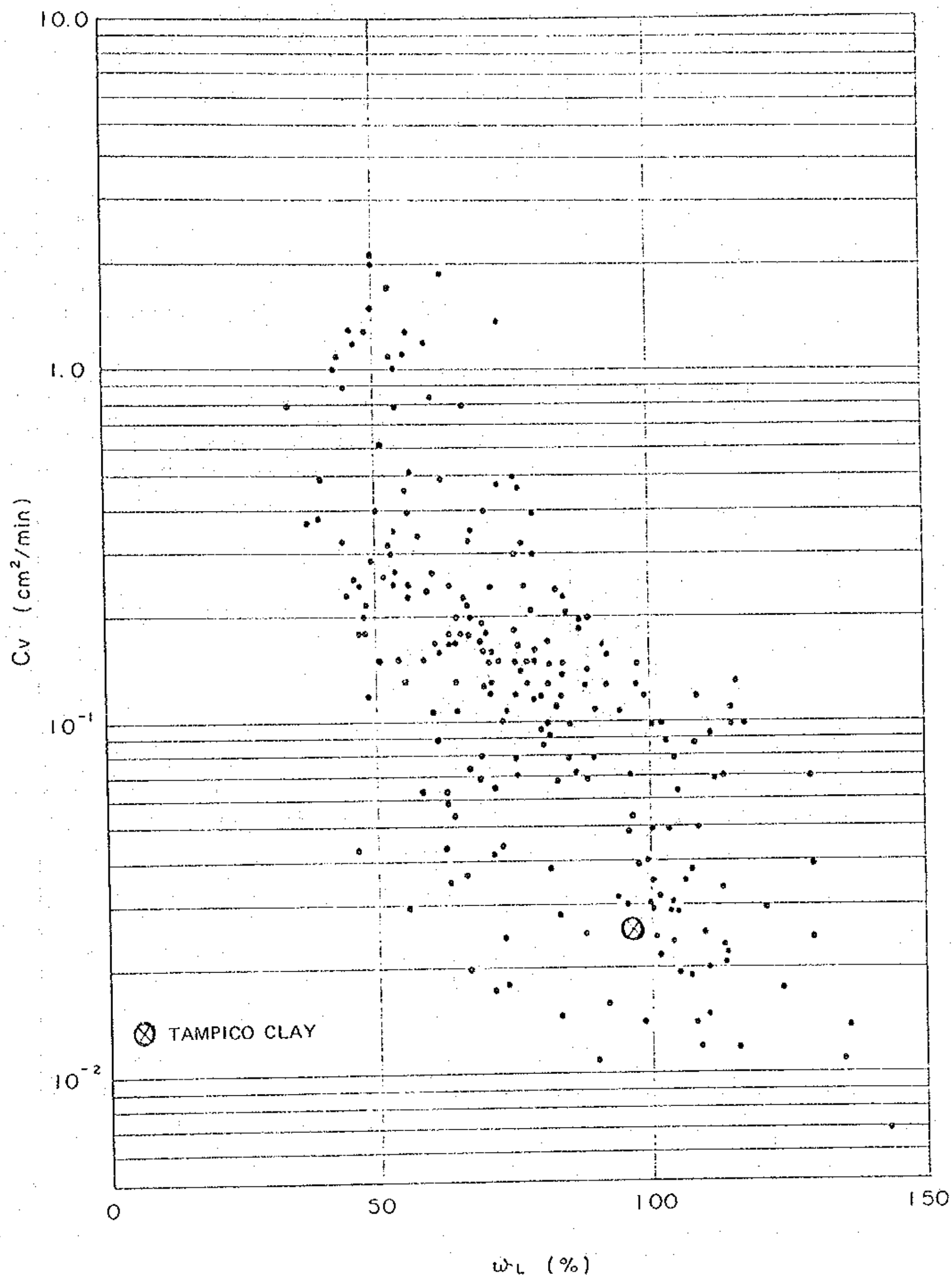
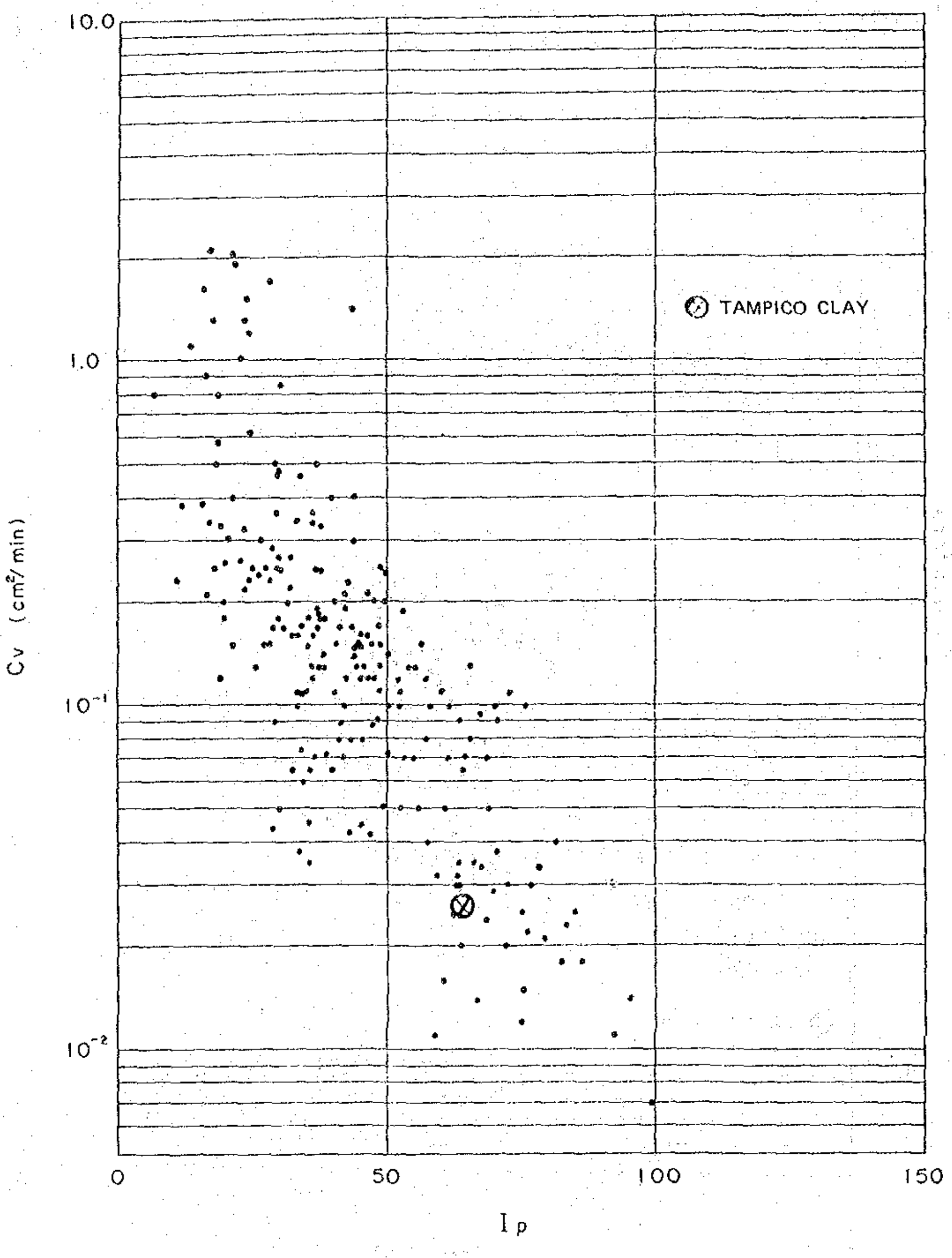


Fig. 4-8-11 (b) Coefficient of Consolidation C_V vs. Plastisity Index I_P



(2) Consolidation Period, Settlement and Strength

From the results of four case studies described in Section 4-8-4-(3)-a), consolidation periods, settlements and the strength of the reclaimed land at a consolidation of 80% are discussed.

The strength of the reclaimed land increases due to the progress of consolidation. The increase of the strength is represented by the $(\Delta c/\Delta p')$ ratio. If the ratio is known, the increase of the strength τ is obtained as follow:

$$\tau = c_0 + (\Delta c/\Delta p')\,\Delta p' \quad \cdots\cdots\cdots (5.1)$$

where,

c_0 : the initial cohesion

$\Delta p'$: the increase of effective stress

As the $(\Delta c/\Delta p')$ ratio is generally given by the values of 0.367 to 0.410 as shown in Table 4-8-4, and c_0 is nearly zero for the reclaimed land, equation (5.1) will be as follow:

$$\tau = (0.367 - 0.410)\,\Delta p' \quad \cdots\cdots\cdots (5.2)$$

On the other hand, Skempton proposed the following equation on the $(\Delta c/\Delta p')$ ratio:

$$\Delta c/\Delta p' = 0.11 + 0.0037 I_p \quad \cdots\cdots\cdots (5.3)$$

Where,

I_p : Plastic Index (%)
67.5% for the Tampico clay

Therefore,

$$\tau = 0.36\,p' \quad \cdots\cdots\cdots (5.4)$$

In this paper, equation, (5.4) is applied to the Tampico clay

Table 4-8-4 $\Delta C/\Delta P'$ Ratio

Sample	NAGOYA	CHIBA	AMAGASAKI	YOKOSUKA
CIU	0.456	0.412	0.403	0.450
CKoU	0.394	0.368	0.367	0.410

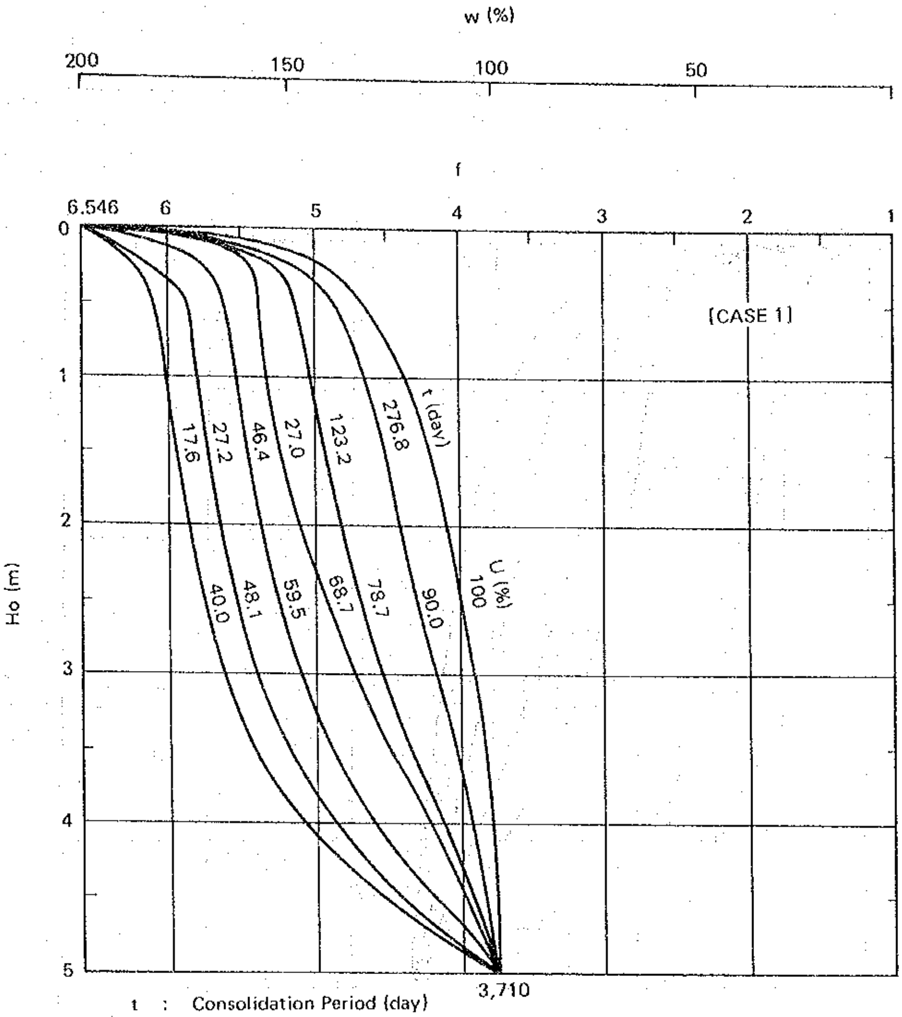
Case 1 and Case 2 in Table 4-8-1 correspond to the state of reclaimed land having a water content of 200% and left without any loading after completion of reclamation. In these cases, the land is consolidated only by its self-weight. The settlements are estimated to be 1.46m for Case 1 and 3.36m for Case 2 at the respective consolidation periods of 123 and 454 days. The settlement and consolidation period for Case 2 is larger by 1.9m and longer by 331 days than that for Case 1. The variations of volume ratio and water content during consolidation is shown in Fig. 4-8-12. The strength is calculated from the effective stresses at the inner part of the layer by the equation (5.4) and it is shown in Fig. 4-8-13. At these strengths, the land seems too weak to support the construction equipment. Even if the effect of surface drying is considered, the strength of the lower part of the land is still very weak.

Case 3 corresponds the state that the embankment with the height of 11m is loaded instantaneously to the land having a water content of 100% and layer thickness of 5m. This embankment may be regarded as pre-loading to the land. The settlement is 1.25m for a consolidation period of 557 days. The variations of volume ratio and water content are shown in Fig. 4-8-14. The strength of the land is shown in Fig. 4-8-15.

In Case 3, the embankment is assumed to be instantaneously loaded. However, this is not practical because the embankment is gradually mounded in construction works. Thus, in Case 4, the loading of 2.0 kg/cm^2 is done with the same conditions as Case 3. The linear increase of loading are assumed as shown in the drawing of Table 4-8-1. When the embankment work is completed within 5 months, the effect of gradual loading to the settlement is very slight at the degree of consolidation of 80%. However, the variations of volume ratio, water content and the strength shown in Fig. 4-8-16 and Fig. 4-8-17 are little different from those of Case 3 at a consolidation period of less than 5 months. Anyway, in the both cases, the strengths of the center part of the layer are approximately 1.3 kgf/cm^2 to a consolidation of 90%. Confirmation on whether the land could support the embankment shall be made based on the distribution of strength, as shown in Fig. 4-8-17. Bearing capacity and circular failure are not discussed in this paper.

Detailed analysis shall be performed, based on an engineering survey of the reclaimed land, and taking into account future land utilization.

Fig. 4-8-12 (a) Variations of Volume Ratio and Water Content during Consolidation (Case I)



t : Consolidation Period (day)

U : Degree of Consolidation (%)

w : Water Content (%), f : Volume Ratio, H_0 : Depth (m)

Fig. 4-8-12 (b) Variations of Volume Ratio and Water Content during Consolidation (Case 2)

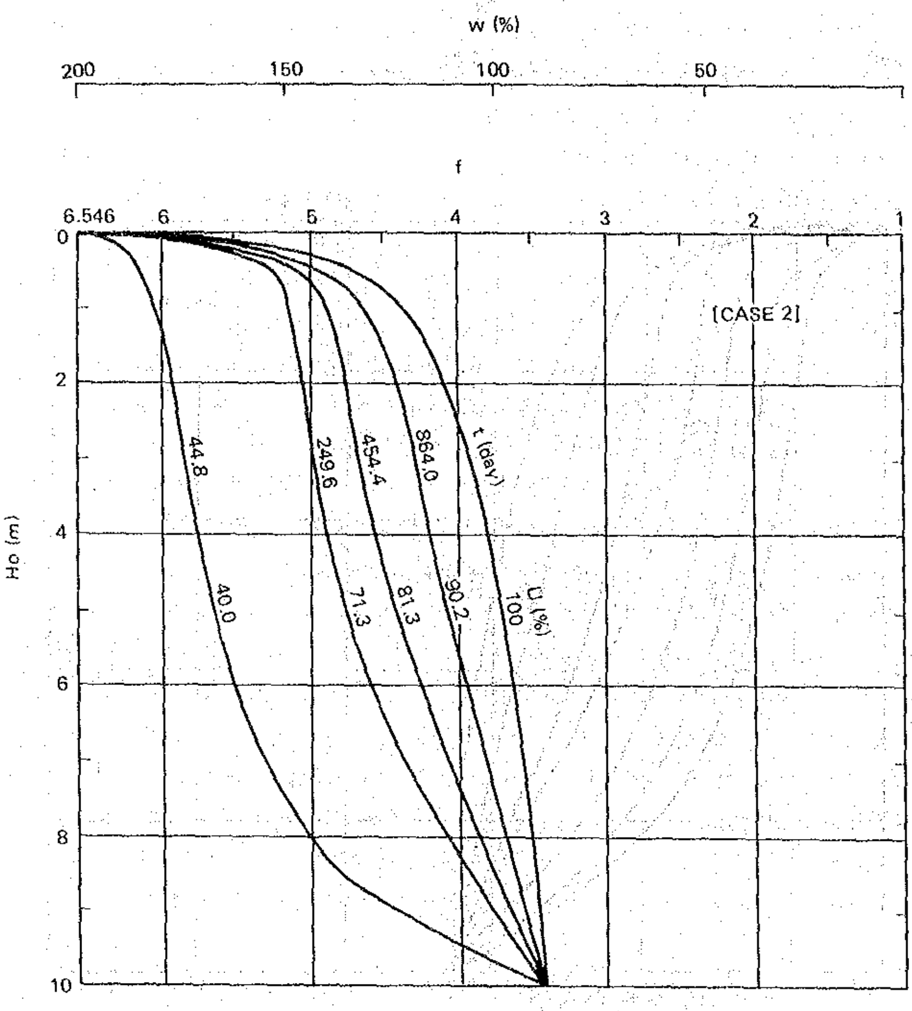
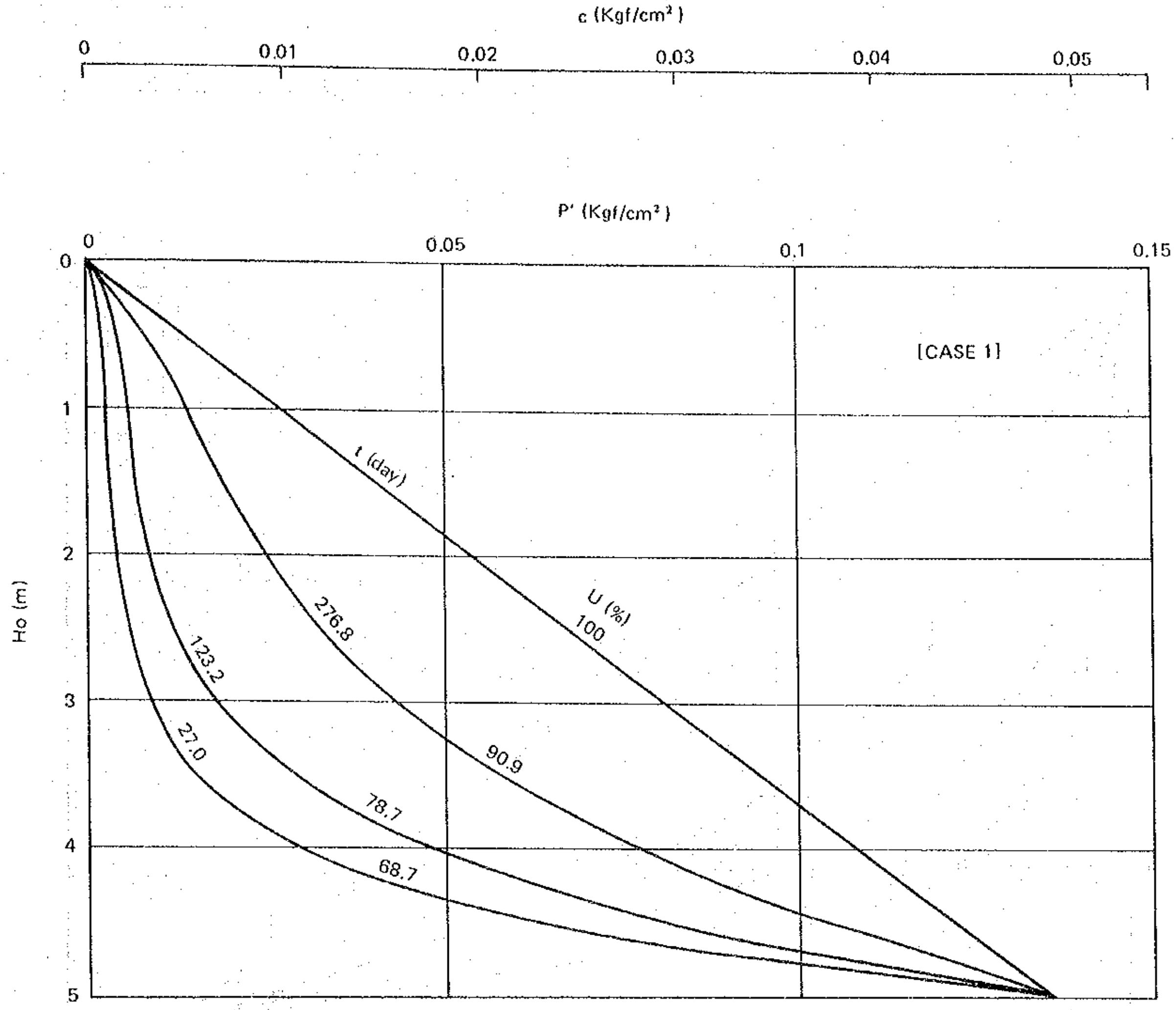


Fig. 4-8-13 (a) The Strength of the Land (Case 1)



t : Consolidation Period (day)

U : Degree of Consolidation (%)

P' : Effective Stress (Kgf/cm²), Ho : Depth (m)

Fig. 4-8-13 (b) The Strength of the Land (Case 2)

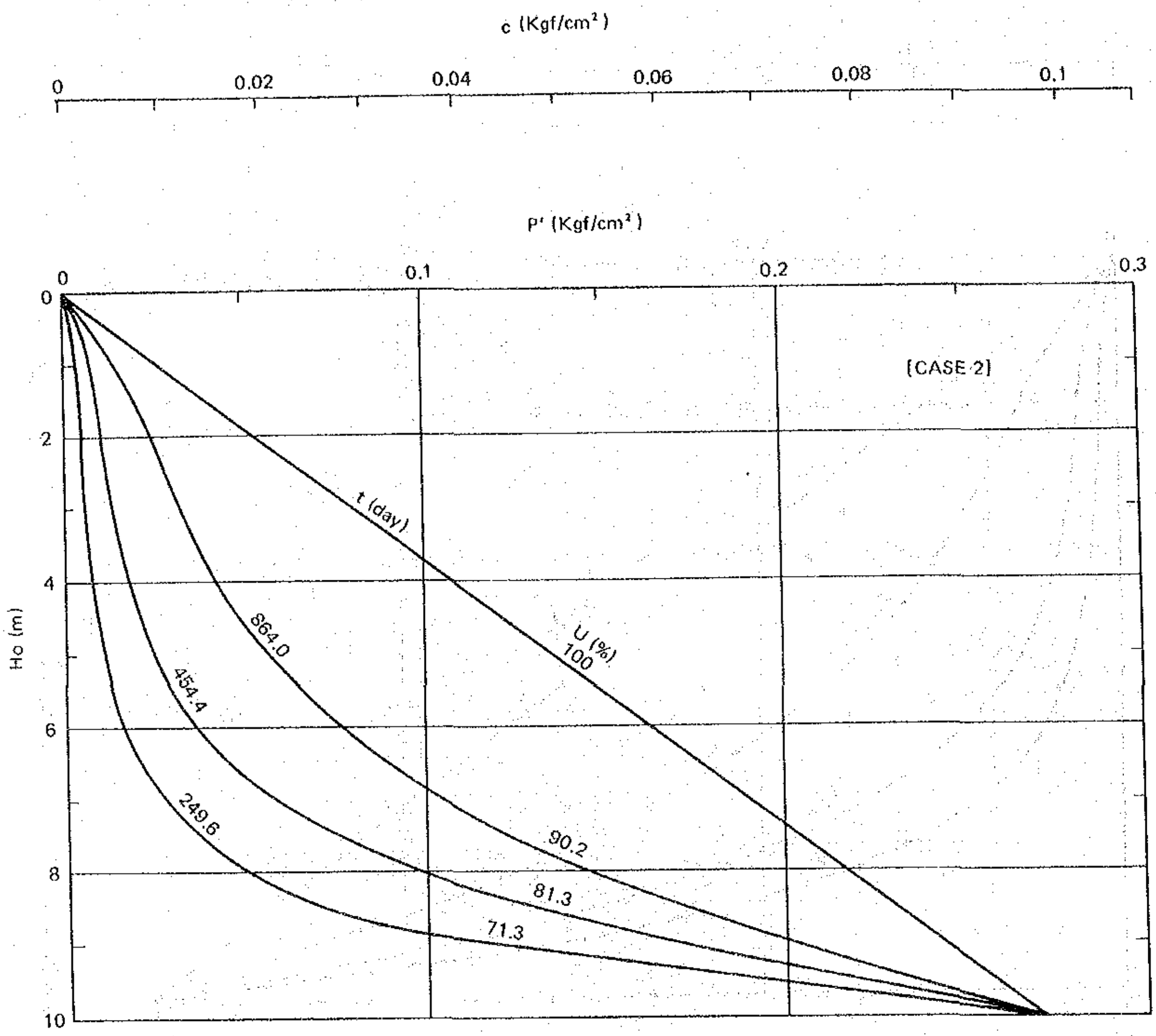


Fig. 4-8-14 Variations of Volume Ratio and Water Content during Consolidation (Case 3)

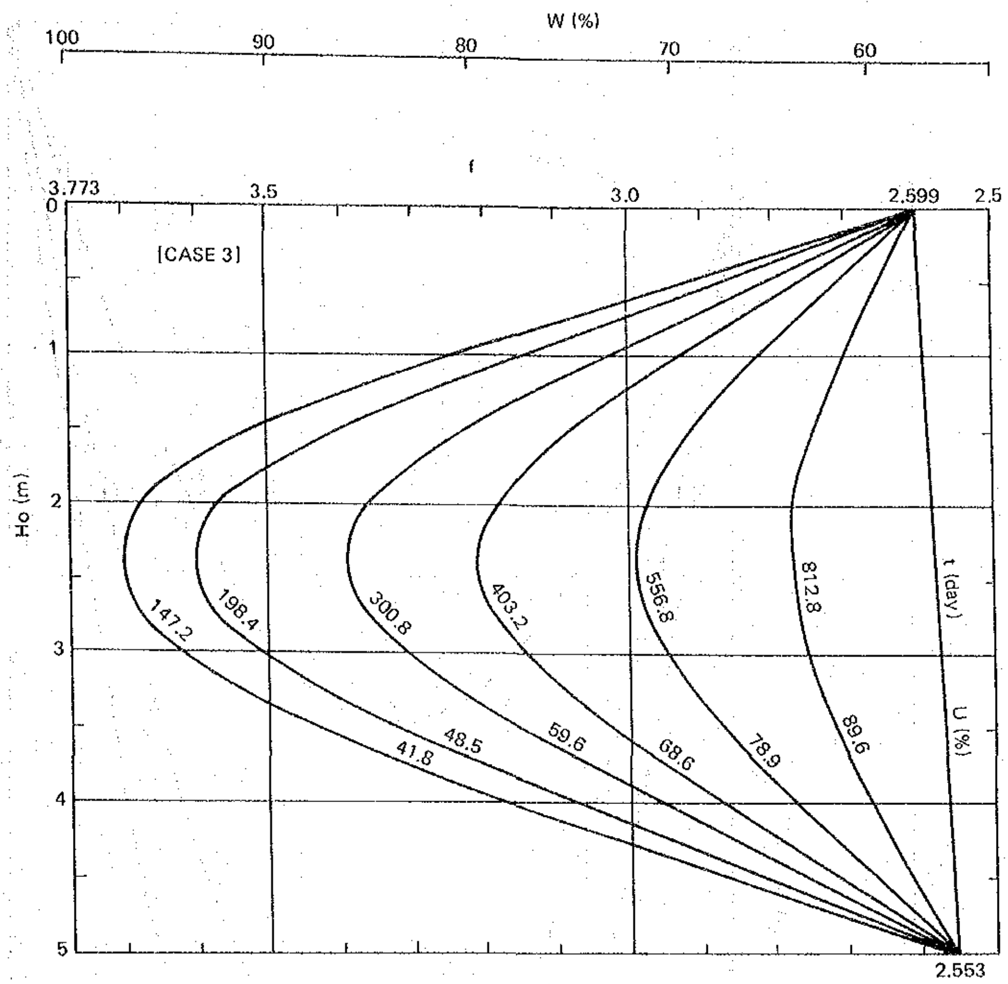


Fig. 4-8-15 Strength of the Land (Case 3)

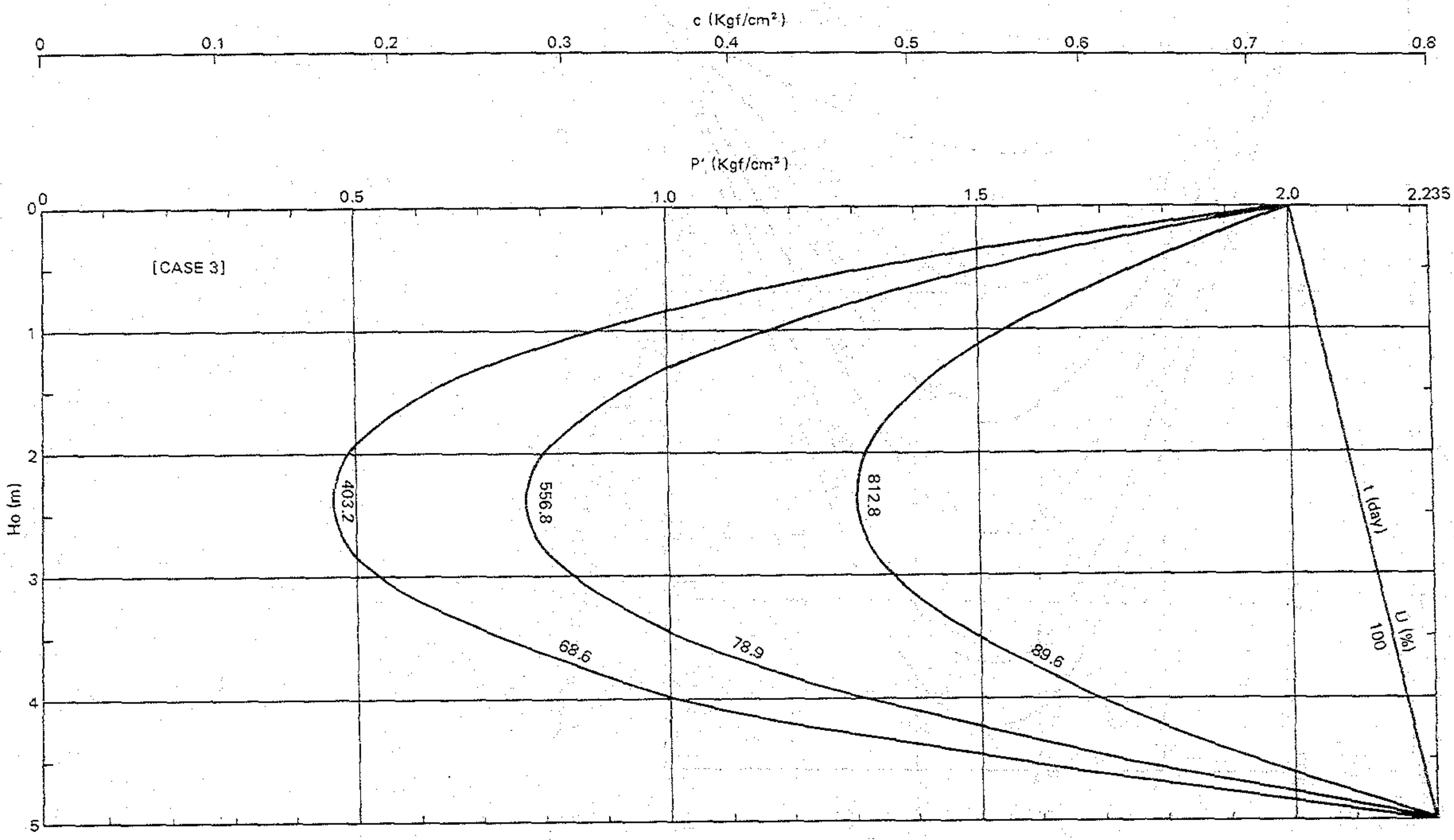


Fig. 4-8-16 Variations of Volume Ratio and Water Content during Consolidation (Case 4)

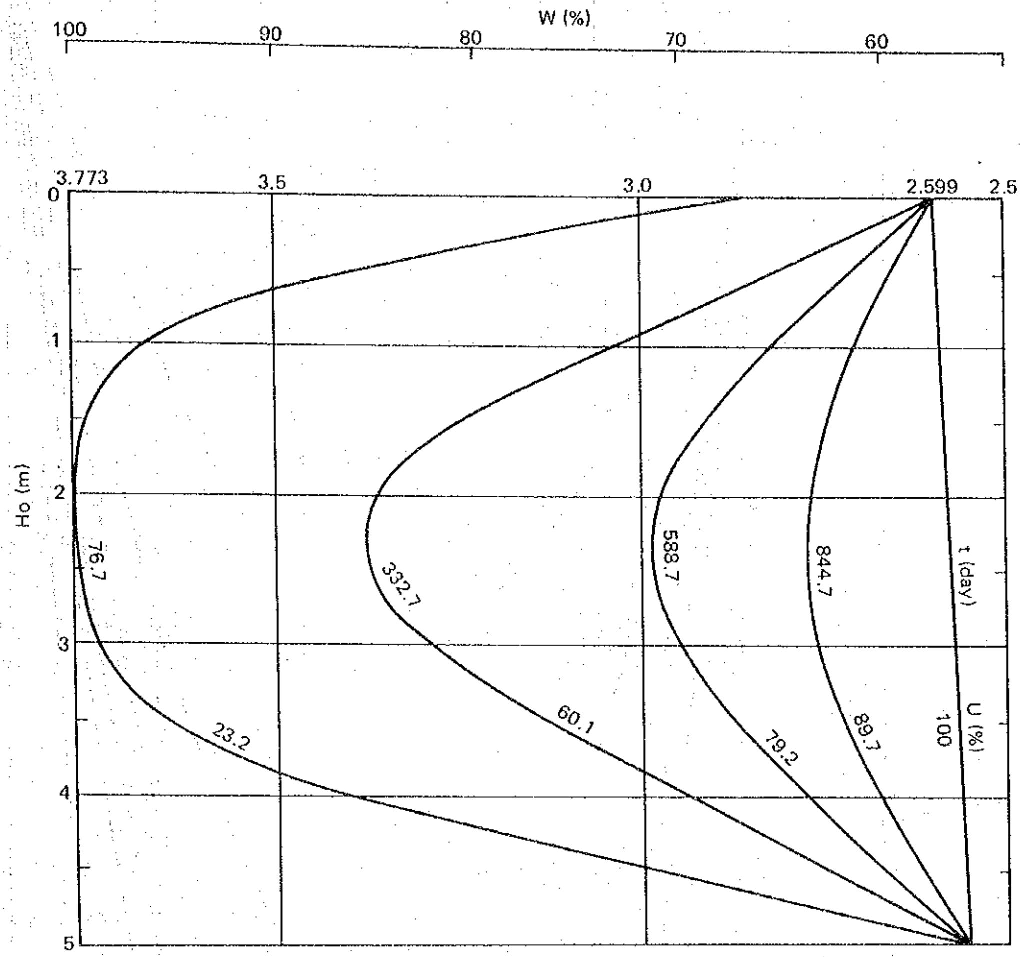
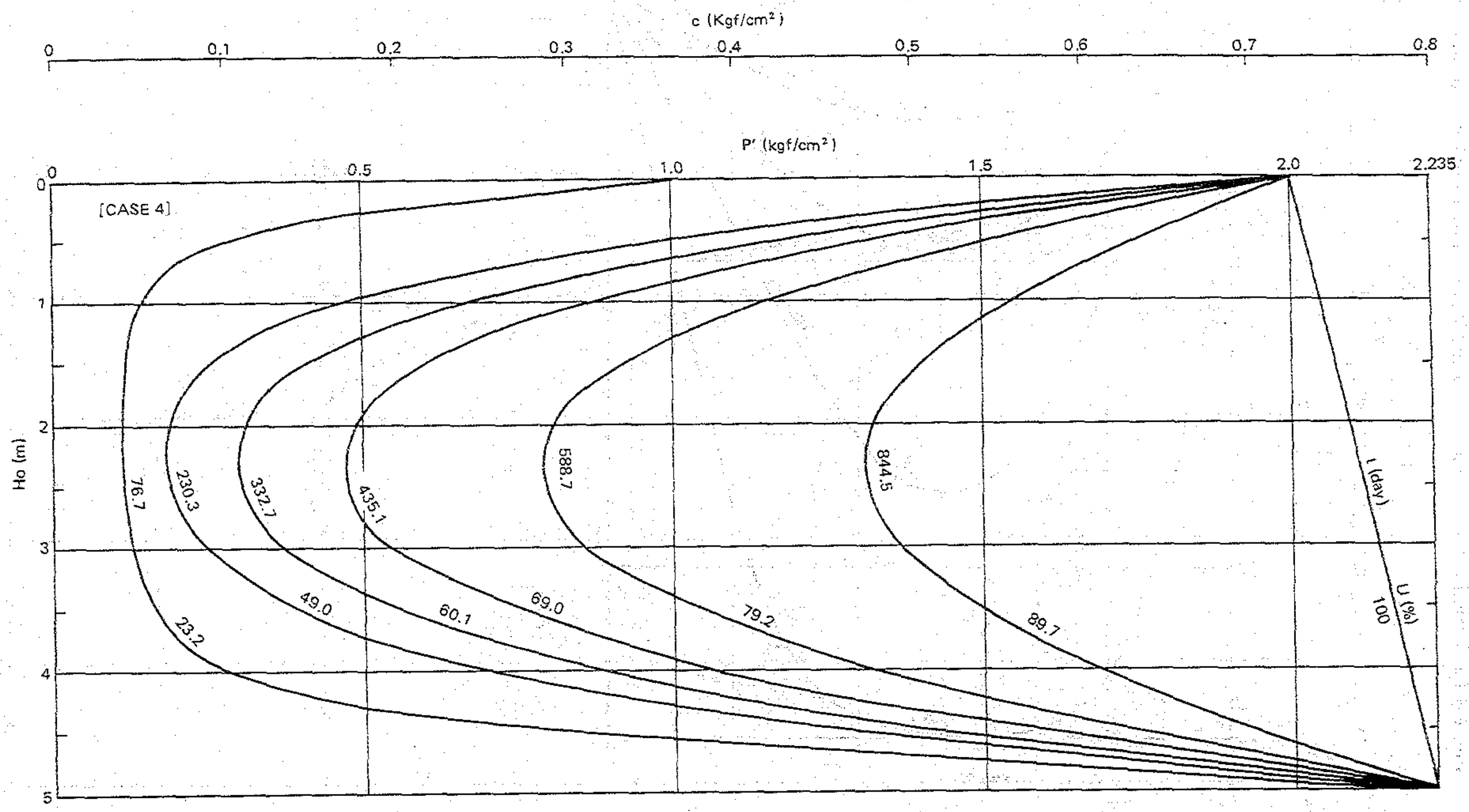


Fig. 4-8-17 Strength of the Land (Case 4)



(3) Soil Stabilization

In order to make good use of the reclaimed land, some soil stabilizations will be necessary. The purposes of soil stabilizations are two, (1) ensuring trafficability for construction equipment, (2) support of embankment and structures to be constructed on the reclaimed land.

For item (1), the following surface soil stabilization are usually applied:

a) Natural evaporation and drying

b) Gradual mounding of embankment

c) Laying polyethylene net or cloth on the surface of the reclaimed land

d) Mixing chemicals such as cement milk or lime

For item (2), the following three methods are effective for clayey soil:

a) Pre-loading method

b) Sand drain method

c) Chemical mixing method

The most efficient and cost effective soil stabilization method is decided by taking into account the opening date of the reclaimed land, construction schedule and period, the types of structures to be constructed and cost of stabilization. From the viewpoint of engineering, the pre-loading method is suitable when a long time period is available. On the other hand, if only a short time is available, the chemical mixing method is useful.

4-8-6 Conclusions

The consolidation characteristics of the Tampico clay was investigated by the CRS-test in the laboratory and the results were applied to analysis on the consolidation of the reclaimed land. The following conclusions are obtained:

(1) Tampico clay is not a good fill material, because it induces large settlement and requires long time to complete consolidation.

(2) If a reclaimed land with a water content of 200% is left without any loading, the land will remain very weak even after completion of consolidation by self-weight. It is impossible to make good use of the reclaimed land without soil stabilization.

(3) A large settlement of 1.26m will occur for a consolidation period of 588.7 days, which corresponds to a consolidation of 80%, when a loading of 2.0 kgf/cm^2 is applied to the land with a water content of 100% and layer thickness of 5m.

(4) If the reclaimed land is to be used as the ground for structures within a short time, some soil stabilization is necessary. Further study shall be carried out to determine what kind of soil stabilization is best.

(5) When pre-loading is to be applied to the land, some surface soil stabilization shall be inevitablely required for supporting embankment and construction equipment. The bearing capacity and circular failure of the reclaimed land should be determined.

(6) Above mentioned conclusions are based on some assumptions, if a more detailed analysis is needed, an detail engineering survey should be executed.

Appendix

CRS

PORT AND HARBOUR RESEARCH INSTITUTE

SAMPLE ; PUERTO TAMPICO TEST No. 4 DATE 4/19/1980

H_i	3.067 (cm)	G_S	2.773	K_{load}	0.87322
ΔH_i	1.428 (cm)	H_S	0.3815 (cm)	$K_{p.w.p.}$	0.48738
H_0	1.639 (cm)	f_0	4.296	R	0.00160 (cm/min)
W_d	29.90 (gf)	σ_0	0.031 (kgf/cm^2)	u_s	(kgf/cm^2)

No.	TIME (min)	DISPLACE D.G. (1/100mm)	DISPLACE ΔH (cm)	LOAD (V)	LOAD σ_B (kgf/cm^2)	PORE WATER PRESSURE (V)	PORE WATER PRESSURE u (kgf/cm^2)	PORE WATER PRESSURE $u-u_s$ (kgf/cm^2)
0	0.0	1579.2	0.0	0.035	0.031	0.000	0.000	
1	2.0	1582.7	0.0035	0.063	0.055	0.035	0.017	
2	5.0	1587.2	0.0080	0.073	0.064	0.055	0.027	
3	10.0	1595.0	0.0158	0.084	0.073	0.072	0.035	
4	20.0	1611.2	0.0320	0.104	0.091	0.102	0.050	
5	30.0	1627.1	0.0479	0.119	0.104	0.128	0.062	
6	40.0	1642.5	0.0633	0.135	0.118	0.150	0.073	
7	60.0	1674.7	0.0955	0.169	0.148	0.197	0.096	
8	80.0	1706.7	0.1275	0.199	0.174	0.237	0.116	
9	100.0	1738.4	0.1592	0.229	0.200	0.273	0.133	
10	120.0	1770.7	0.1915	0.260	0.227	0.304	0.148	
11	140.0	1802.9	0.2237	0.298	0.260	0.338	0.165	
12	160.0	1835.1	0.2559	0.338	0.295	0.368	0.179	
13	180.0	1867.7	0.2885	0.382	0.334	0.395	0.193	
14	200.0	1899.8	0.3206	0.431	0.376	0.419	0.204	
15	220.0	1932.7	0.3535	0.495	0.432	0.442	0.215	
16	240.0	1965.2	0.3860	0.573	0.500	0.471	0.230	
17	260.0	1997.6	0.4184	0.664	0.580	0.495	0.241	
18	280.0	2029.9	0.4507	0.774	0.676	0.519	0.253	
19	300.0	2061.7	0.4825	0.907	0.792	0.540	0.263	
20	315.0	2085.5	0.5063	1.036	0.905	0.559	0.272	
21	330.0	2109.2	0.5300	1.183	1.033	0.575	0.280	
22	340.0	2125.0	0.5458	1.309	1.143	0.588	0.287	
23	350.0	2140.3	0.5611	1.436	1.254	0.595	0.290	
24	360.0	2156.0	0.5768	1.585	1.384	0.608	0.296	
25	370.0	2171.8	0.5926	1.757	1.534	0.617	0.301	
26	380.0	2187.2	0.6080	1.928	1.684	0.624	0.304	
27	390.0	2202.8	0.6236	2.151	1.878	0.636	0.310	
28	395.0	2210.7	0.6315	2.262	1.975	0.639	0.311	
29	400.0	2218.6	0.6394	2.381	2.079	0.642	0.313	
30								
31								
32								
33								
34								

CRS-TEST SAMPLE; PUERTO TAMPICO TEST No. 4

σ'_0 = 0.031 kgf/cm² ; f_0 = 4.296

H_0 = 1.639 cm ; R = 0.00160 cm/min

No.	$\Delta h/H_0$	$\sigma - u$ (kgf/cm²)	$\sigma - u_s$ (kgf/cm²)	F	C_v/RH_0	C_v (cm²/min) $\times 10^{-2}$	f_0/f_b	f_b	f_0/f_t	f_t	f_{ave}	σ'_{ave} (kgf/cm²)
1	0.002	0.038	0.055	0.355								
2	0.005	0.037	0.064	0.244								
3	0.010	0.038	0.073	0.238								
4	0.020	0.041	0.091	0.260								
5	0.029	0.042	0.104	0.251								
6	0.039	0.045	0.118	0.279	9.0	2.36	1.021	4.21	1.077	3.99	4.13	0.045
7	0.058	0.052	0.148	0.331	6.8	1.78	1.035	4.15	1.117	3.85	4.05	0.055
8	0.078	0.058	0.174	0.363	5.4	1.41	1.050	4.09	1.150	3.74	3.96	0.068
9	0.097	0.067	0.200	0.413	4.8	1.26	1.068	4.02	1.182	3.63	3.88	0.082
10	0.117	0.079	0.227	0.470	4.5	1.18	1.091	3.94	1.213	3.54	3.79	0.102
11	0.136	0.095	0.260	0.527	4.3	1.13	1.113	3.86	1.245	3.45	3.71	0.124
12	0.156	0.116	0.295	0.586	4.3	1.13	1.141	3.77	1.274	3.37	3.63	0.151
13	0.176	0.141	0.334	0.637	4.3	1.13	1.170	3.67	1.300	3.30	3.54	0.188
14	0.196	0.172	0.376	0.687	4.6	1.21	1.202	3.57	1.324	3.24	3.45	0.234
15	0.216	0.217	0.432	0.739	4.9	1.28	1.236	3.48	1.350	3.18	3.37	0.284
16	0.236	0.270	0.500	0.778	5.1	1.34	1.272	3.38	1.378	3.12	3.28	0.353
17	0.255	0.339	0.580	0.817	5.6	1.47	1.309	3.28	1.407	3.05	3.20	0.428
18	0.275	0.423	0.676	0.848	6.1	1.60	1.350	3.18	1.442	2.98	3.11	0.532
19	0.294	0.529	0.792	0.875	6.7	1.76	1.388	3.10	1.472	2.92	3.03	0.646
20	0.309	0.633	0.905	0.894	7.3	1.01	1.420	3.03	1.500	2.86	2.97	0.748
21	0.323	0.753	1.033	0.910	8.0	2.10	1.454	2.95	1.520	2.83	2.91	0.865
22	0.333	0.856	1.143	0.920	8.5	2.23	1.478	2.91	1.540	2.79	2.87	0.953
23	0.342	0.964	1.254	0.929	9.0	2.36	1.500	2.86	1.560	2.75	2.83	1.050
24	0.352	1.088	1.384	0.937	9.5	2.49	1.523	2.82	1.580	2.72	2.78	1.185
25	0.362	1.233	1.534	0.944	10.0	2.62	1.550	2.77	1.604	2.68	2.74	1.306
26	0.371	1.380	1.684	0.950	11.0	2.88	1.575	2.73	1.625	2.64	2.70	1.438
27	0.380	1.568	1.878	0.956	12.0	3.11	1.605	2.68	1.645	2.61	2.66	1.585
28	0.385	1.664	1.975	0.959	13.0	3.41	1.620	2.65	1.655	2.60	2.64	1.664
29	0.390	1.766	2.079	0.961	13.0	3.41	1.630	2.64	1.670	2.57	2.62	1.746
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31												

CRS

PORT AND HARBOUR RESEARCH INSTITUTE

SAMPLE ; PUERTO TAMPICO TEST No. 5 DATE

H_i	3.110 (cm)	G_S	2.773	K_{load}	0.87322
ΔH_i	1.423 (cm)	H_S	0.4100 (cm)	$K_{p.w.p.}$	0.48738
H_0	1.687 (cm)	f_0	4.115	R	0.00319 (cm/min)
W_d	32.13 (gf)	σ_0'	0.031 (kgf/cm²)	u_s	(kgf/cm²)

No.	TIME (min)	DISPLACE D.G. (1/100mm)	DISPLACE ΔH (cm)	LOAD (V)	LOAD σ_B (kgf/cm²)	PORE WATER PRESSURE (V)	PORE WATER PRESSURE u (kgf/cm²)	PORE WATER PRESSURE $u - u_s$ (kgf/cm²)
0	0.0	1499.7	0.0000	0.036	0.031	0.000	0.000	
1	2.0	1505.9	0.0062	0.110	0.096	0.109	0.053	
2	5.0	1515.6	0.0159	0.141	0.123	0.156	0.076	
3	10.0	1531.7	0.0320	0.182	0.159	0.215	0.105	
4	15.0	1547.9	0.0482	0.224	0.196	0.278	0.135	
5	20.0	1564.9	0.0652	0.265	0.231	0.336	0.164	
6	30.0	1597.3	0.0972	0.338	0.295	0.439	0.214	
7	40.0	1631.4	0.1317	0.407	0.355	0.533	0.260	
8	50.0	1664.0	0.1643	0.471	0.411	0.612	0.298	
9	60.0	1696.3	0.1966	0.543	0.474	0.690	0.336	
10	70.0	1728.6	0.2289	0.611	0.534	0.758	0.369	
11	80.0	1760.3	0.2606	0.680	0.594	0.809	0.394	
12	90.0	1791.8	0.2921	0.740	0.646	0.836	0.407	
13	100.0	1823.5	0.3238	0.828	0.723	0.886	0.432	
14	110.0	1854.1	0.3544	0.926	0.809	0.930	0.453	
15	120.0	1885.2	0.3855	1.031	0.900	0.965	0.470	
16	130.0	1914.3	0.4146	1.142	0.997	0.984	0.480	
17	140.0	1944.7	0.4450	1.300	1.135	1.011	0.493	
18	150.0	1976.1	0.4764	1.483	1.295	1.043	0.508	
19	155.0	1992.9	0.4932	1.579	1.379	1.049	0.511	
20	160.0	2009.7	0.5100	1.702	1.486	1.063	0.518	
21	165.0	2025.6	0.5259	1.839	1.606	1.064	0.519	
22	170.0	2041.7	0.5420	1.991	1.739	1.062	0.518	
23	175.0	2057.5	0.5578	2.170	1.895	1.078	0.525	
24	180.0	2073.0	0.5733	2.327	2.032	1.072	0.522	
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CRS-TEST SAMPLE; PUERTO TAMPICO TEST No. 5

σ'_0 = 0.031 kgf/cm² ; f_0 = 4.115

H_0 = 1.687 cm ; R= 0.00319 cm/min

No.	$\Delta h/H_0$	$\sigma - u$ (kgf/cm²)	$\sigma - u_s$ (kgf/cm²)	F	C_v/RH_0	C_v (cm²/min)	f_0/f_b	f_b	f_0/f_t	f_t	f_{ave}	σ'_{ave} (kgf/cm²)
1	0.004	0.037	0.096	0.157								
2	0.009	0.047	0.123	0.302								
3	0.019	0.054	0.159	0.339		$\times 10^{-2}$						
4	0.029	0.061	0.196	0.367	16.0	8.61						
5	0.039	0.067	0.231	0.384	13.0	7.00						
6	0.058	0.081	0.295	0.426	9.0	4.84	1.040	3.96	1.106	3.72	3.88	0.098
7	0.078	0.095	0.355	0.459	7.05	3.79	1.057	3.89	1.142	3.60	3.79	0.121
8	0.097	0.113	0.411	0.500	6.00	3.23	1.078	3.82	1.173	3.51	3.72	0.144
9	0.117	0.138	0.474	0.548	5.65	3.04	1.098	3.75	1.197	3.44	3.63	0.179
10	0.136	0.165	0.534	0.587	5.25	2.83	1.121	3.67	1.223	3.34	3.56	0.212
11	0.155	0.200	0.594	0.631	5.10	2.74	1.145	3.59	1.252	3.29	3.48	0.257
12	0.173	0.239	0.646	0.673	4.90	2.64	1.170	3.52	1.283	3.21	3.40	0.312
13	0.192	0.291	0.723	0.711	5.13	2.76	1.201	3.43	1.308	3.15	3.32	0.379
14	0.210	0.356	0.809	0.748	5.28	2.84	1.230	3.35	1.335	3.08	3.25	0.449
15	0.229	0.430	0.900	0.781	5.50	2.96	1.261	3.26	1.362	3.02	3.17	0.546
16	0.246	0.517	0.997	0.811	5.80	3.12	1.295	3.18	1.387	2.97	3.10	0.646
17	0.264	0.642	1.135	0.842	6.26	3.37	1.328	3.10	1.420	2.90	3.03	0.766
18	0.282	0.787	1.295	0.867	6.65	3.58	1.365	3.01	1.452	2.83	2.95	0.930
19	0.292	0.868	1.379	0.878	6.85	3.69	1.385	2.97	1.470	2.80	2.91	1.025
20	0.302	0.968	1.486	0.889	7.05	3.79	1.406	2.93	1.488	2.77	2.87	1.129
21	0.312	1.087	1.606	0.901	7.60	4.09	1.428	2.88	1.503	2.74	2.83	1.244
22	0.321	1.221	1.739	0.912	8.20	4.41	1.450	2.84	1.514	2.72	2.79	1.370
23	0.331	1.370	1.895	0.921	8.70	4.68	1.471	2.80	1.542	2.67	2.75	1.510
24	0.340	1.510	2.032	0.929	9.20	4.95	1.474	2.75	1.554	2.65	2.72	1.624
25												
26												
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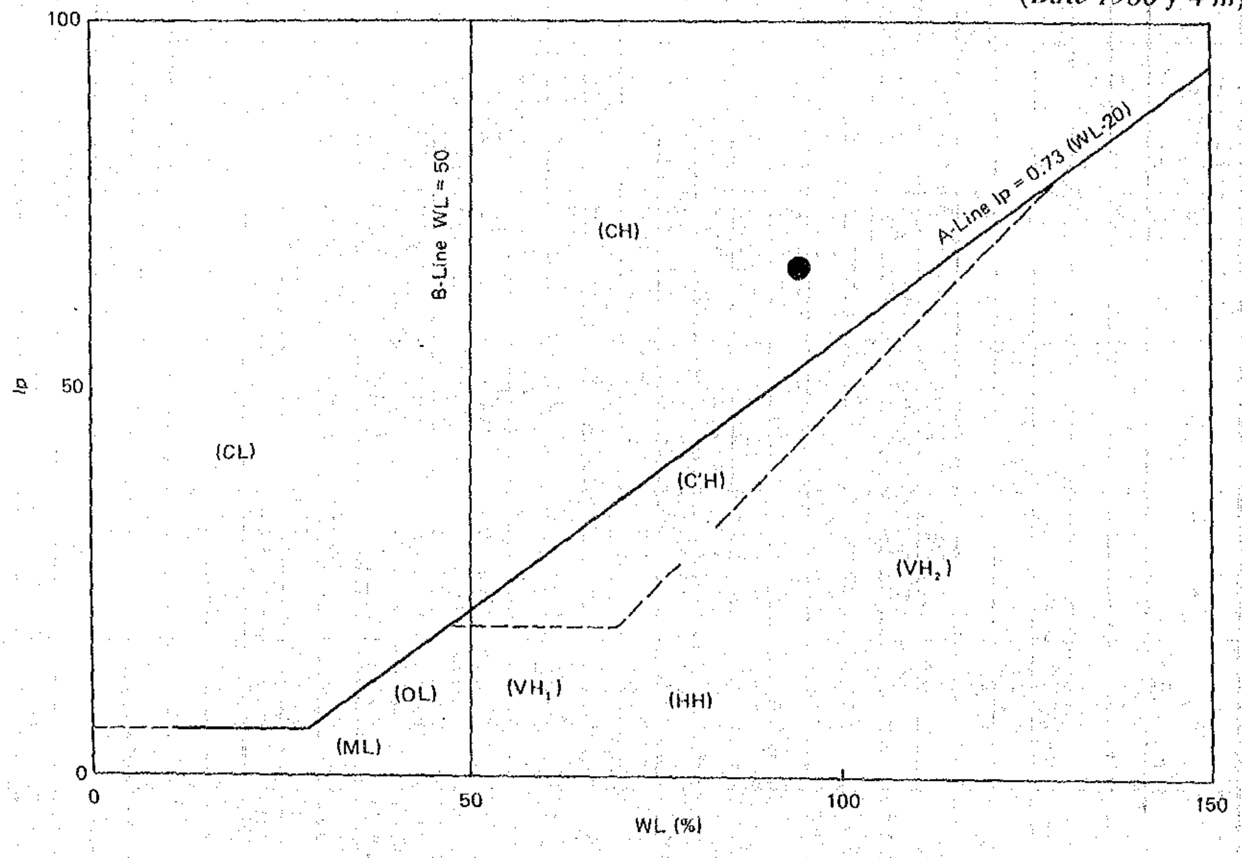
Prasticity Chart (Japanese Unified Soil Classification System)

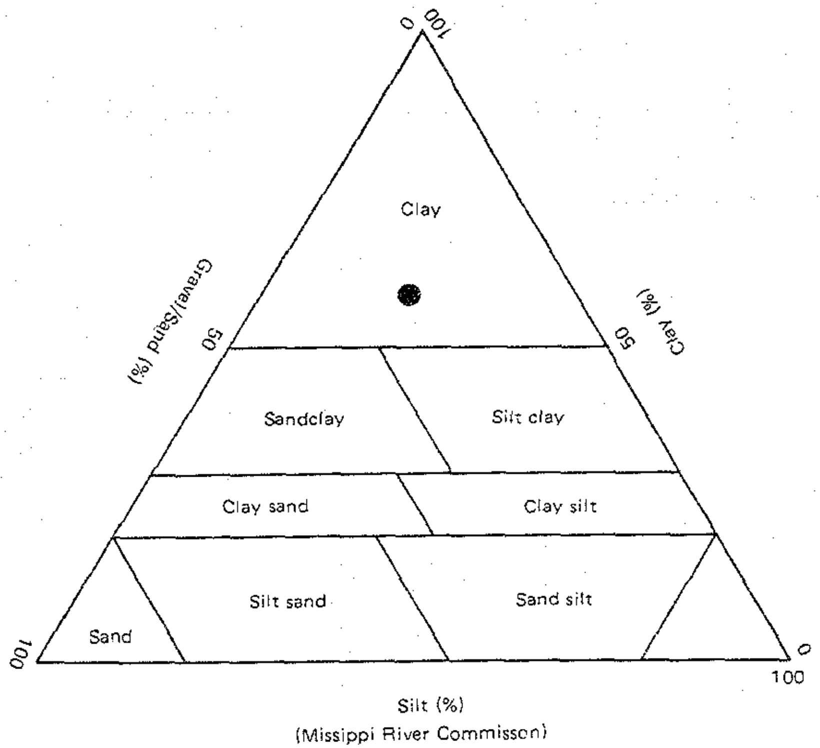
Sample No. Part of TAMPICO
No. 3002 C

(Date 1980 y 4 m)



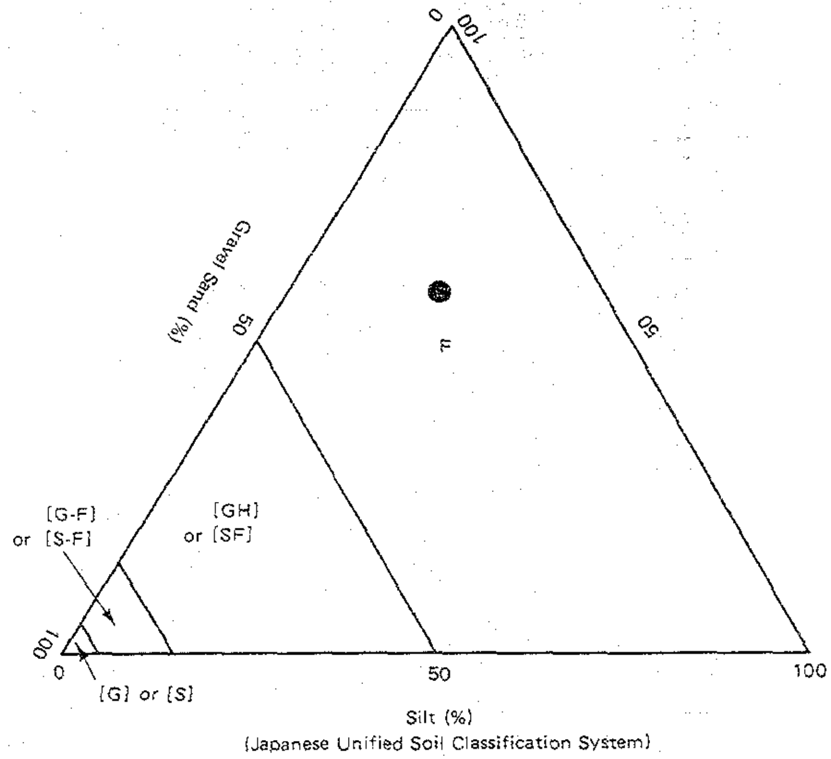
Triangler diagram
Sample No. Port of TAMPICO
No. 3002-C

Date 1980 y 4 m



Triangler diagram
Sample No. Port of TAMPICO
No. 3002-C

Date 1980 y 4 m



PLASTIC LIMIT AND LIQUID LIMIT TESTS

Name of Survey Port of Tampico

Date 1980 y 4 m day

Tested by

Sample No. Depth | No. (m – m)

LL-test			PL-test	
No.	No. of blows	W/C (%)	No.	W/C (%)
1	44	91.18	1	27,740
2	44	90.73	2	27,447
3	25	95.10	3	27,543
4	22	96.40		
5	19	97.56		
6	18	97.87	Mean	27,694

w_L (%)	w_P (%)	I_P	

Sample No. Depth | No. (m – m)

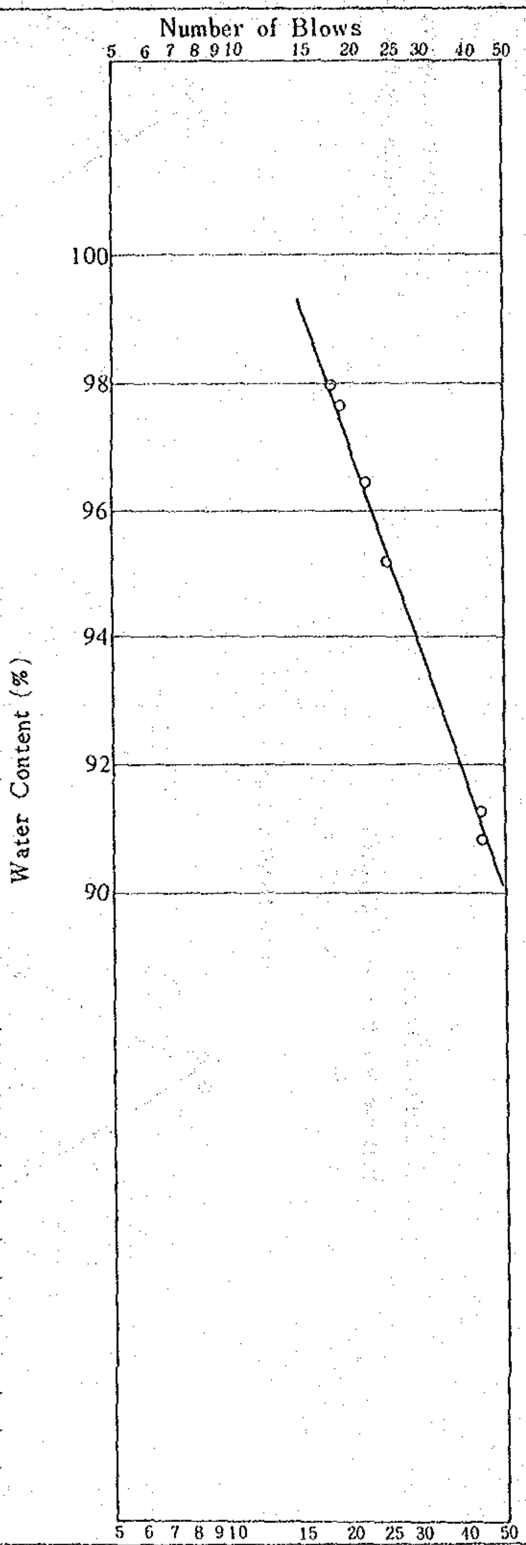
LL-test			PL-test	
No.	No. of blows	W/C (%)	No.	W/C (%)
1			1	
2			2	
3			3	
4				
5				
6			Mean	

w_L (%)	w_P (%)	I_P	

Sample No. Depth | No. (m – m)

LL-test			PL-test	
No.	No. of blows	W/C (%)	No.	W/C (%)
1			1	
2			2	
3			3	
4				
5				
6			Mean	

w_L (%)	w_P (%)	I_P	



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1) Mikasa, M. (1963), "The consolidation of soft clay-A new consolidation theory and its application", Kajima Institution Publishing Co., Ltd. (in Japanese)
2) Umehara, Y. and Zen, K. (1976), "Determination of consolidation constants for very soft clays", Report of the Port and Harbour Research Institute, Ministry of Transport, Vol. 14, No. 4 (in Japanese)
3) Umehara, Y. and Zen, K. (1979), "Consolidation test method of very soft clays and its application", Report of the Port and Harbour Research Institute, Ministry of Transport, Vol. 18, No. 1 (in Japanese)
4) Umehara, Y. and Zen, K. (1980), "Constant rate of strain consolidation for very soft clayey soils", Soils and Foundations, the Japanese Society of soil mechanics and Foundation engineering
5) Ogawa, F. and Matsumoto, K. (1978), "Correlation of the mechanical and index properties of soils in harbour districts", Report of the Port and Harbour Research Institute, Ministry of Transport, Vol. 17, No. 3 (in Japanese)

4-9 Offered References

1). LAWS AND REGULATIONS ON PORTS AND HARBOURS OF JAPAN PORTS AND HARBOURS BUREAU, MINISTRY OFTRANSPORT

2). Regional Development and Ports Preface – TEXTBOOK FORUM 80
Special Lecture

1. Present Situation of Ports in Japan.
2. History of Port Development.
3. Direction of Port Development in Future.
4. Factors Having Influenced the Promotion of Port-Based Regional Development.

Appendix Development of Kashima Industrial Area

1. Background and Concept.
2. Agriculture-Industry Joint Development Plan and 60-40 Land Policy.
3. City Plan for a Population of 300,000.
4. Unpoluted Industrial Complex.
5. Social Changes with Project Development.
6. Kashima Port Project.

Takashi HAZAMA

Executive Director
The Overseas Coastal Area Development Institute
of
Japan

3). Port Structure upon Soft Ground – TEXTBOOK FORUM 80

LECTURE-1 **METHOD OF IMPROVEMENT FOR SOFT SUB-SOIL AND ADEQUATE PORT STRUCTURE**

Kazuhiro KOSHIRO

Registered Consulting Engineer (Construction)
General Manager, Overseas Division
Toa Harbor Works Co., Ltd.

LECTURE- II **DESIGN AND CONSTRUCTION OF STEEL STRUCTURES SUITED FOR SOFT GROUND**

Motoo SHIRAISHI

Manager
Waterfront Engineering Technical Service Section
Structurals Sales Dept, Nippon Steel Corporation

LECTURE-III

SOIL MECHANICS AND SOIL STABILIZATION METHOD

Dr. Shoichi KITAJIMA

Director Chif Engineer

Mitsui Consultants Co.,Ltd.

LECTURE-Ⅳ

THE CHARACTERISTICS OF PORT ENGINEERING AND SOFT GROUND TECHNOLOGY

Akio OGO

Director Engineering Division

Overseas Coastal Area Development Institute of Japan

JICA