RESULTS OF THE GEOLOGICAL SURVEY

DECEMBER 1994

JAPAN INTERNATIONAL COOPERATION AGENCY

ALSYR
Sistemas e Investigación Geotécnica

WASTEWATER TREATMENT PLANT, SOSA TEXCOCO, EDO. DE MÉXICO. SOIL MECHANICS SURVEYOR

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Av. División del Norte # 1228-105, Letrán Valle
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ALSYR
Sistemas e Investigación Geotécnica

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1.- INTRODUCTION

1.1.- Background

It's projected to build the waste water treatment plant that Sosa Texcoco, S. A. intends to install in a land inside the lake of Texcoco, at the northeast of Mexico City; reason why ALSYR, Sistemas e Investigación Geotécnica has been requested the elaboration of the soil mechanics study that may permit to know the stratigraphic conditions of the site, as well as determine the mechanical properties of the different materials composing it, same that are decisive in the foundation design.

This preliminary report included herein describes the activities makes in field and laboratory and include some conclusions related to the foundation design of the project structures.

1.2.- Location and description of the land

The land where the soil mechanics study was conducted has a rectangular shape of 1,000 m by 1,500 m aproximatly, in vicinity of the Gran Canal and railway México-Veracruz, fig. 1.

During the initial recognition of the land, the following general characteristics were established:

The present topography is flat, tipical of the bottom of the lake.

At the north of the site exist some mountains that may modify the stratigraphic conditions.

1.3.- Description of the project

The project comprise the construction of various tanks to water treatment, substations and buildings to process. The tanks are of 54 m by 80 m in view top and transmit at the ground level 6 Ton/m^2 and 10 Ton/m^2 in the case of the aeration tank.

2.- FIELD WORKS

With the purpose of anticipating the stratigraphic conditions that would be found during the exploration and in order to orientate the development of this activity, as well as to provide a general geological condition of the area, a regional recognition was performed to identify the different geological accidents established in the specialized literature.

2.1.- Geological conditions

The lowlands of the Valley are covered by Quaternary alluvial and lacustrine deposits. The volcanic basaltic series of Cerro Gordo, Chimalhuacán, Estrella, Chiconautla and the Sierra de Chichinautzin, which blocked the Valley to the south, also belong to the same geological era. The tuffs and breccia of the Tarango formation and the andesitic lavas of Iztaccihuatl and Ajusco in the highland parts to the south and east of the basin belong to the upper Terciary. Recalling that to the north in Apasco and to the south in Cuernavaca and Cuautla limestones of the upper Cretaceous reach the surface, it was assumed that this type of rock should be found beneath the Valley of México.

2.2.- Exploration and Sampling

With the purpose of accurately determining the stratigraphical conditions at the site as well as defining the soils mechanical properties which are essential for the design and behavior of the foundations, three mixed type borings were performed, down to 35.00 m depth, where the standar penetration test where alternately utilized, advance with conical drill and the recovery of undisturbed samples with Shelby thin-wall tube.

The standar penetration test is classified as a dynamic type by percussion test and consist of driving into the ground a somooth tube of 50.8 mm and 38.1 mm of external and

internal diameters respectively, with the utilization of a 64 kg weight pile driver which freely falls down through a guide from 76 cm height in order to assure its correct stroking. The standar penetration resistance is determined as the number of strokes necessary to drive the tool a 30 cm length. Due to the fact that the mentioned penetrometer has a 60 cm length, this measure corresponds to the central 30 cm, discarding the first and the last 15 cm readings. With this penetration resistance reading it is possible to use correlations established with the shear strength resistance of the different types of soils and define exactly the compaction and consistency of the sample materials. Upon removing the tube after the test, disturbed samples af the existing stratigraphical conditions are recovered, same that are protected against moisture loss during their transportation to the laboratory where they are submitted to classifciation tests.

The advance with conical drill is utilized to penetrate particularly hard strata without samples recovery.

To obtain undisturbed samples and determine the mechanical properties of the materials in the laboratory, a Shelby sampling was utilized.

The depths at which each one of these procedures was utilized, the standar penetration register and a macroscopic classification of the recovered materials, were recorded in the field logs, that later one were used to establish the stratigraphical conditions and the corresponding mechanical properties based on the results of the laboratory tests.

2.3.- Laboratory works

The samples recovered from borings were sent to the laboratory to be submitted to a series of tests in order to determine their classification in accordance to the USSC and determine the mechanical properties of the subsoil materials.

Initially, the total samples were macroscopically classified according to their color, texture, composition and odor.

Afterwards, previously selected specimens were determined their index properties of consistency limits (liquid and plastic), sieve analysis or smaller fines percentage of mesh N° 200 (0.074 mm), so that they were unmistakably classified and thus be able to make reliable stratigraphic profiles and apply the correlations offered by the specialized literature for the validation of the mechanical tests results later on described, as well as for the estimation of those same properties in the materials where the obtention of undisturbed samples was not possible.

The undisturbed samples recovered were determined their shear strength mechanical properties on undrained triaxial compression tests and compressibility on one-dimension consolidation tests in the clayey materials.

The stratigraphic profiles indicated in figures 2 to 4 include a summary of the tests performed on samples of the borings 1 to 3.

Figures 5 and 6 shows granulometric curves, figures 7 to 20 mention the triaxial compression tests and figures 21 to 27 the graphics of consolidation tests.

2.4.- Stratigraphics conditions

Considering the results available rigth now, was possible to establish the following stratigraphic general conditions, however the subsoil is very erratic below 15.0 m:

Depth [m]	Description
0.00	
	Clay gray to dark brown and reddish, very soft consistency with a strata of fine clayey sand (CH)
8.50	
	Fine silty sand, dark gray of medium dense
9.80	
	Inorganic clay gray greenish, very soft to medium stiff, with thin slices of fine sand
15.50	
	Silty fine sand gray greenish, very dense
19.20	
	High plasticity clay greenish gray, stiff with a slice of fine sand
24.00	
	Sandy silt dark gray, very soft
25.00	
	High plasticity clay gray greenish, stiff
28.30	
	Silty fine sand, dark gray greenish, very dense
30.60	
	Clay gray greenish, of consistency stiff to hard, with a thin slice of fine sand, light gray
35.20	

It is important annotate than the program of field works has ben formulated by the client and it's necesary enlarge the exploration campaign to at least 4 boring at each unit in project.

3.- SOIL MECHANICS ANALYSIS

3.1.- Selection of foundation

As it has been mentioned in the stratigraphic description, the subsoil is formed mainly by soft consistency clays in erratic thickness and the foundations in project transmit to ground subsoil moderate stress, however this pressure act in a extensive surface, inducing very important settlements; for this reason a shallow foundation is not permitted.

In the next we consider a pile analysis foundation, for to have a good behavior of the structure.

3.2.- Bearing capacity

In this order of ideas, was selected the Zeevaert's criteria to evaluate the bearing capacity of depth foundations, with negative friction because the region is in settlement process due to extraction of water.

Analizing the soil profile, was established a hard strata adequate to support the pile foundation among 16.00 m and 21.00 m, and selected a depth foundation in 18.00 m, under the ground surface.

Was calculate different values of bearing capacity in agreement with the author's method:

B [m]	Qult, point [Ton]	Qult, positive friction [Ton]	Negative friction [Ton]	Qallow at head [Ton]	Qult, at failure [Ton]	Security Factor
0.40	72	12	44	40	150	3.75
0.45	88	14	50	52	175	3.37
0.50	108	15	55	68	225	3.31

Where:

B:	wide pile	[m]
Qult, point	Ultimate bearing capacity of pile point	[Ton]
Qult, positive friction	Positive friction among 16.00 m and 18.00 m depth	[Ton]
Negative friction	Negative friction among 0.00 m and 16.00 m depth	[Ton]
Qallow at head	Qult. point+Qult. positive friction-Negative friction	[Ton]
Qult. at failure	Q at occur the failure of foundation	[Ton]
Security factor	Qult. at failure divide over Qult net at head	

In this calculus was made next considerations:

1. Exist regional settlement that induces negative friction in pile foundations.
2. The positive friction was limited to up boundary of support strata because if upper strata participe of this positive friction, very important settlements may be occur.
3. The support strata is reasonable continual to establish a uniform behaviour of the pile foundation
   (will be necessary verify this consideration with more exploration to confirm the soil profile)

Of this way, the settlements of pile foundation only will be by participation of the clay strata below the support strata, among 21.00 m and 29.00 m and results of order of 50 mm in 25 years, having the 50 % at the first year, without involve the regional settlement that need measure to found exactly the structural behaviour of the plant.

In other hand, was calculate the bearing capacity of shallow foundations that will be neccesary to support light structures outside the influence area of depth foundations and results, with the Skempton'criteria of:

$$q_{ad} = 2.124 + 1.166\ Df\ [T/m^2]\ Df\ [m]$$

To shallow foundations at depth foundations (Df) among 0.60 m to 2.00 m without calculate their settlements because requires the structural distribution and weight.

4.- CONCLUSIONS

The structures in project are the waste water treatment to Sosa Texcoco, S. A. inside the lake of Texcoco, at the northeast of Mexico City and consist in various concret tanks and buildings to process control and electrical unit.

The project manager found the exploration program in 3 mixed borings, amount inferior to a real necessity consider the subsoil condition and the project extention.

The stratigraphic profiles show the tipical subsoil conditions of lacustric valley of volcanic origin.

The bearing capacity of depth foundations was found with the Zeevaert's criteria involing negative friction to 16 m depth drive piles with the values show in the chapter 3.

It is important to consider that is necesary more exploration to found more precise the foundation depth to drive piles an to propose the distribution of piles and found its bearing capacity and performance.

We propose execute at least 4 borings in each unit of treatment and to install one piezometric station to find carefuly the hidraulic conditions in the subsoil and calculate the behaviour of foundations to long term.

ING.LUIS MORALES VIRGEN

Calculation of Consolidation Settlement Time at Boring Point SM-2 (Depth = 5 ~ 5.9m)

1. Coefficient of Consolidation (Cv)

$$Cv = \frac{Ti \cdot H^2}{t_i} \qquad \cdots\cdots(1)$$

Where

Cv = coefficient of consolidation (cm^2/s)
Ti = time factors for indicated pressure distribution (degree of consolidation : Uz = 90 %)
H = length of longest drainage path for a particle of water
t_i = time for *i* percent consolidation

From the laboratory test and Fig.28, Eq. (1) becomes

$$Cv = \frac{T_{90} \cdot H^2}{t_{90}}$$

$$= \frac{0.848 \times (\frac{1.894}{2})^2}{2.088}$$

$$= 0.00036(cm^2 / s)$$

2. Consolidation Settlement Time (t)

$$t = \frac{Ti \cdot H^2_f}{Cv} \qquad \cdots\cdots(2)$$

Where

t = consolidation settlement time
Ti = time factors for indicated pressure distribution (degree of consolidation : Uz = 90 %)
Hf = length of longest drainage
Cv = coefficient of consolidation (cm^2/s)

$$t = \frac{1}{0.00036} \times 0.848 \times (\frac{900}{2})^2$$

$$= 4.77 \times 10^8 \text{ sec.}$$

$$= 5{,}521 \textit{ days}$$

$$= 16 \textit{ years}$$

FIGURES

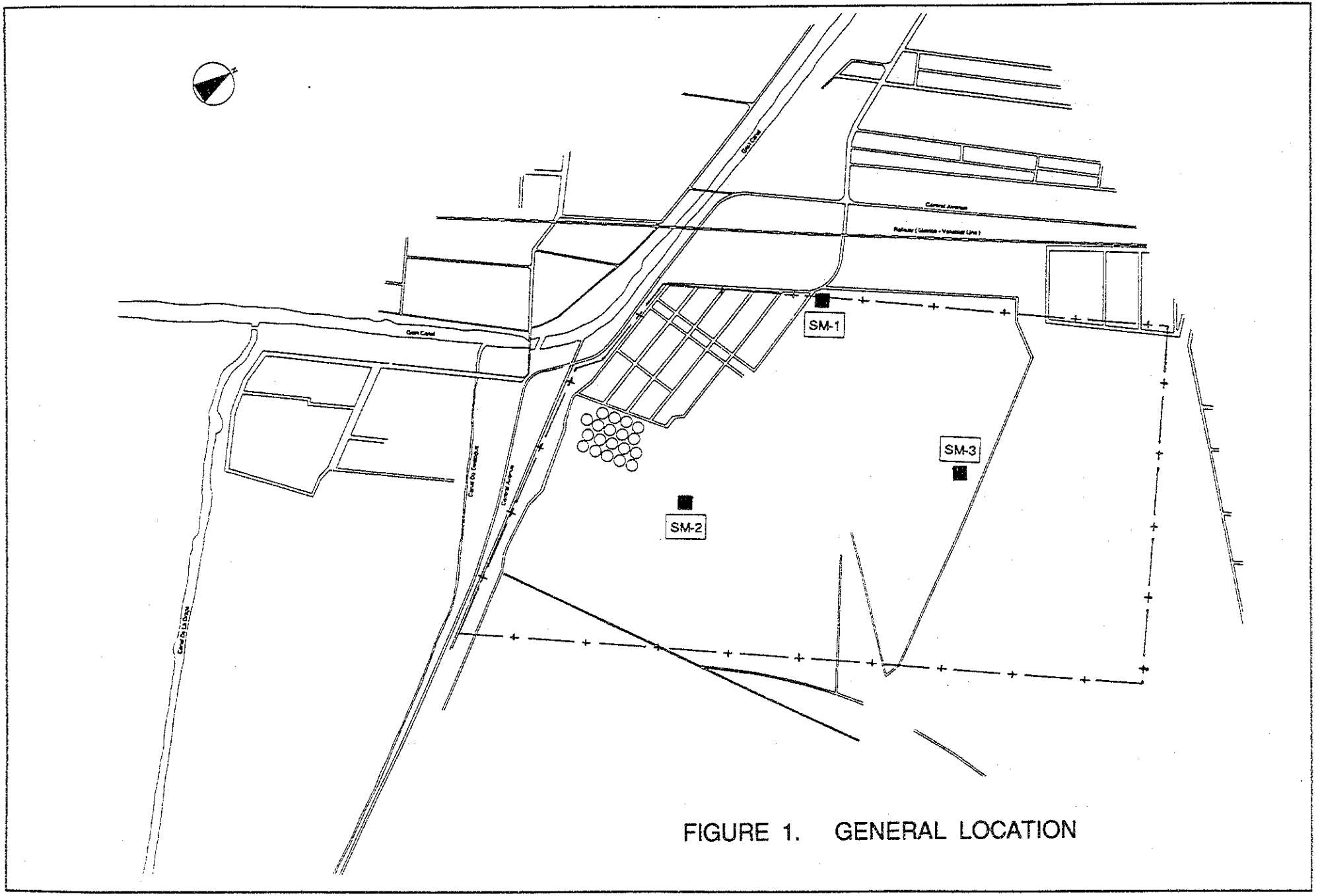
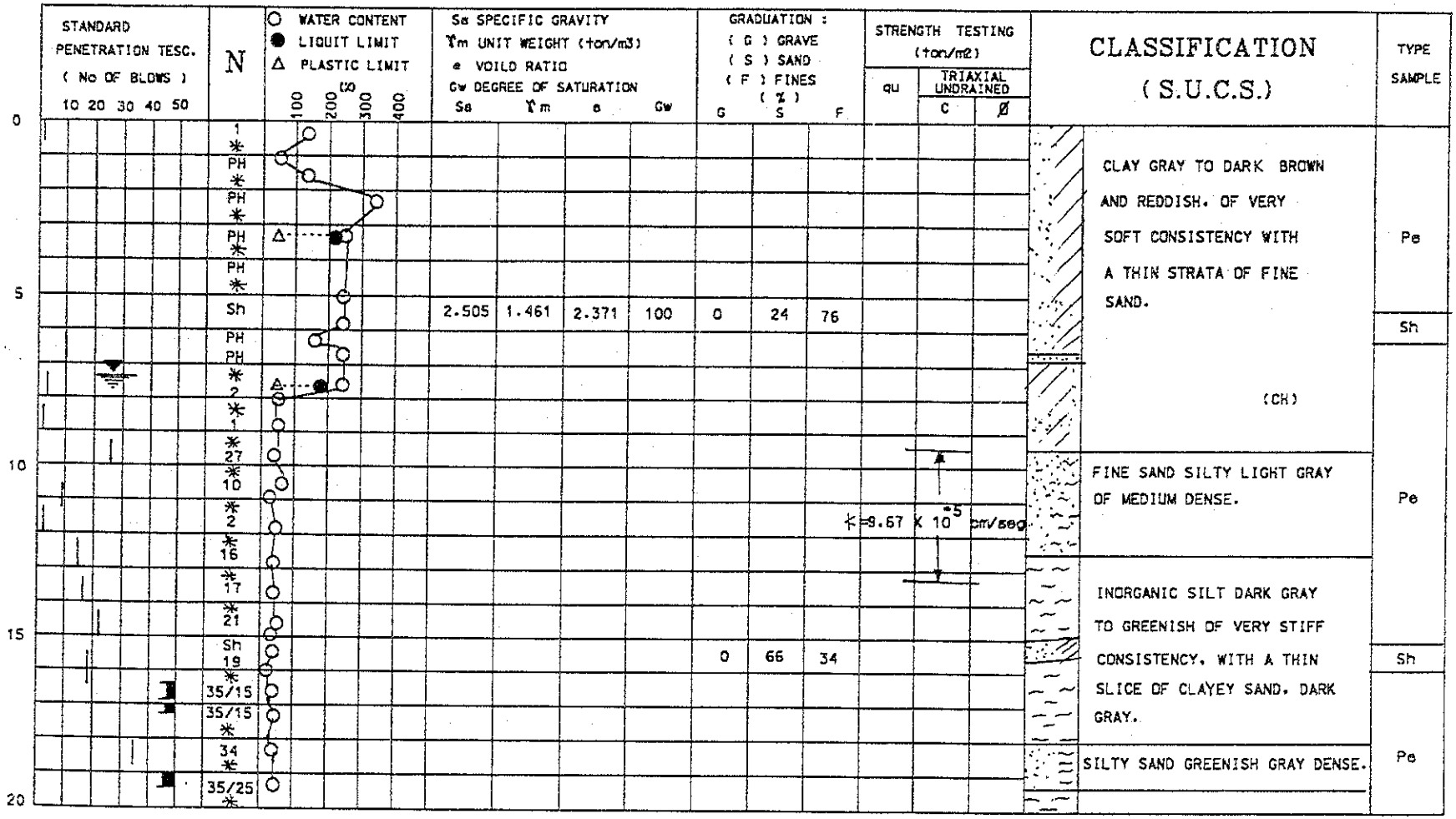


FIGURE 1. GENERAL LOCATION



C O N V E N T I O N A L S Y M B O L S

GRAVEL SAND SILT CLAY ORGANIC MAT. FILLER VOLCANIC GLASS

N= NUMBER OF BLOWS STANDARD PENETRATION TEST 30 cm

PH= OWN WEIGHT OF TOOL

NR= NO RECOVERED SAMPLE

Pe = STANDARD PENETRATION TEST

Sh = SAMPLE WITH SHELBY

BD= SAMPLE WITH DENISON

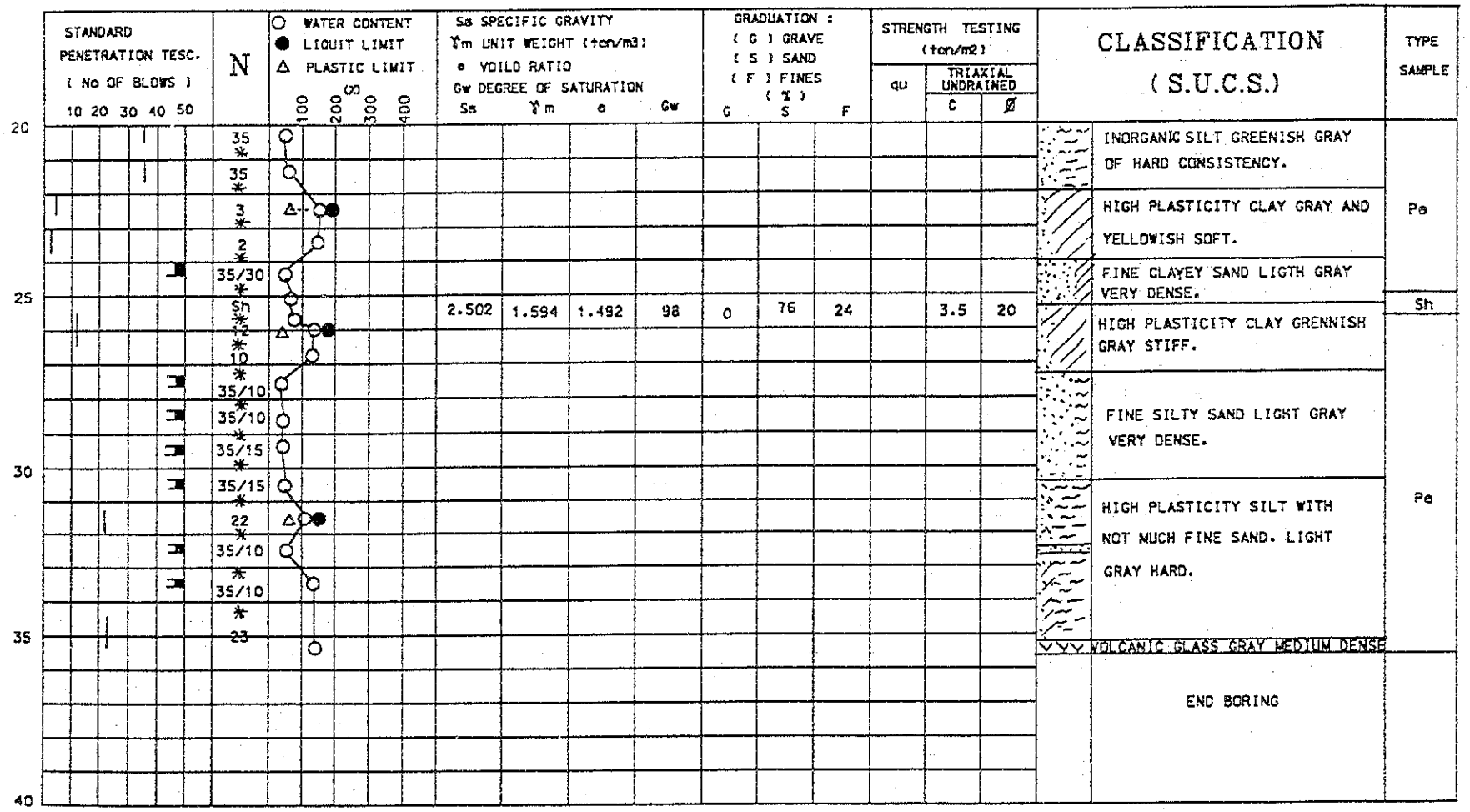
* = ROLLER BIT

MORE THAN 50 BLOWS

N.T. = SURFACE LEVEL

N.A.F. = WATER LEVEL

A L S Y R		
PROJECT : WASTE WATER TREATMENT SOSA TEXCOCO		
BORING : SM- 1	SURFACE LEVEL :	
WATER LEVEL : 7.40 m		FIG. 2 a



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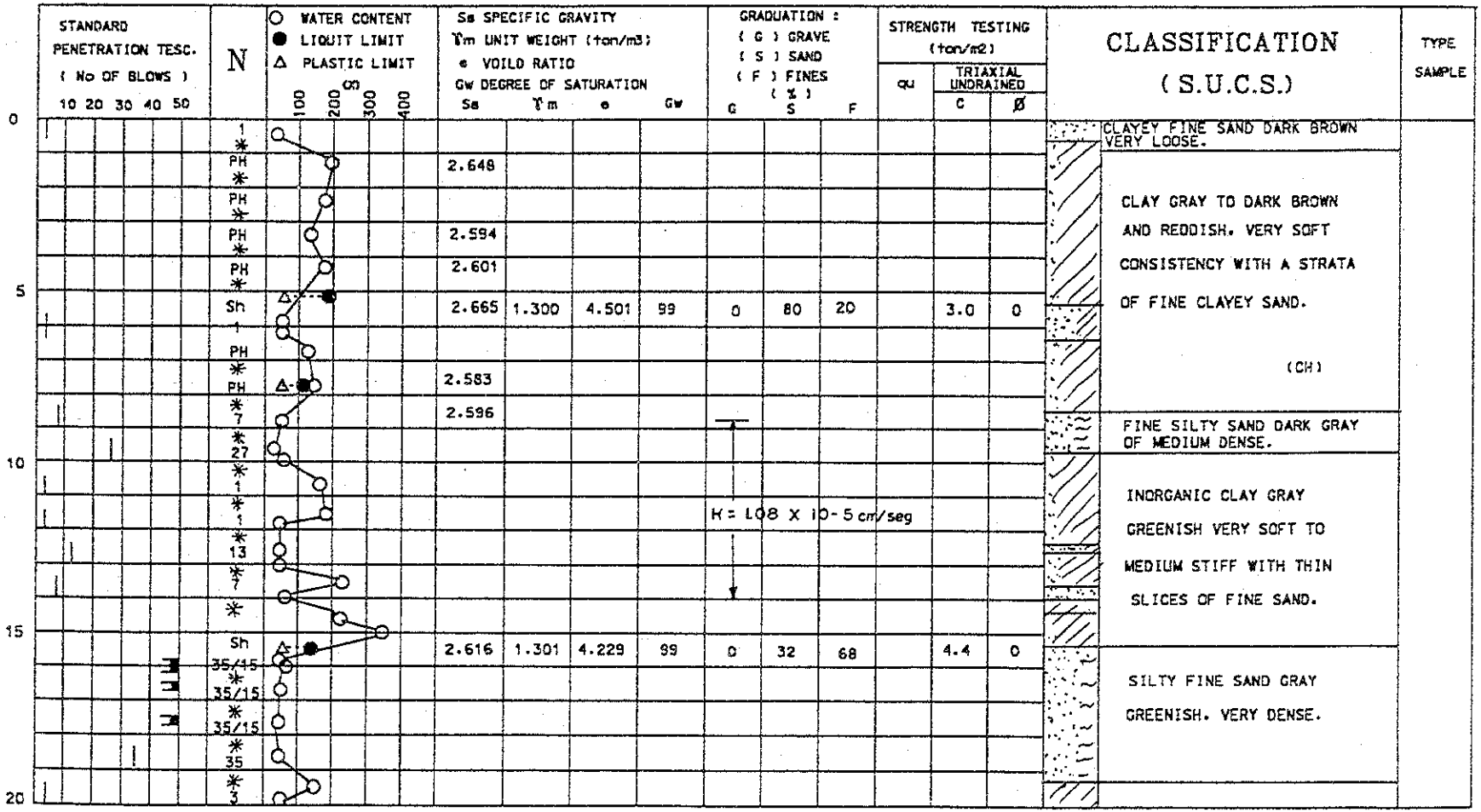
A L S Y R		
PROJECT : WASTE WATER TREATMENT SOSA TEXCOCO		
BORING : SM- 1	SURFACE LEVEL :	
WATER LEVEL : 7.40 m		FIG. 2 b



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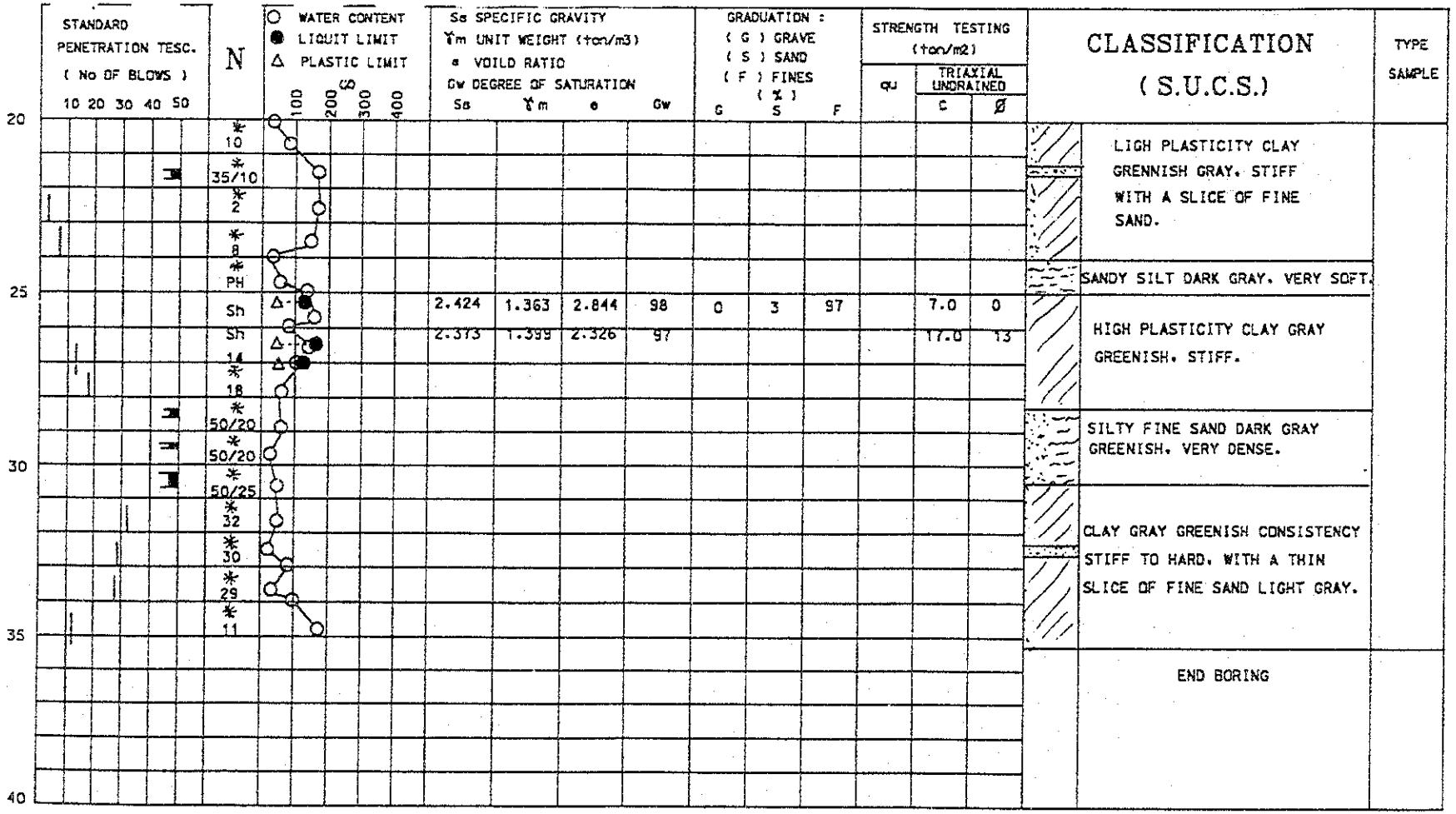
A L S Y R		
PROJECT : WASTE WATER TREATMENT SOSA TEXCOCO		
BORING : SM- 2	SURFACE LEVEL :	
WATER LEVEL : 7.21 m		FIG. 3 a



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A L S Y R		
PROJECT : WASTE WATER TREATMENT SOSA TEXCOCO		
BORING : SM- 2	SURFACE LEVEL :	
WATER LEVEL : 7.21 m		FIG. 3 b

STANDARD PENETRATION TESC. (No OF BLOWS) 10 20 30 40 50	N	WATER CONTENT (%) 100 200 300 400	Ss SPECIFIC GRAVITY	γm UNIT WEIGHT (ton/m3)	e VOID RATIO	Gw DEGREE OF SATURATION	GRADUATION : (G) GRAVE (S) SAND (F) FINES (%) G	S	F	STRENGTH TESTING (ton/m2) qu	TRIAXIAL UNDRAINED C	Ø	CLASSIFICATION (S.U.C.S.)	TYPE SAMPLE
0	2												FINE CLAYEY SAND. LIGHT BROWN VERY LOOSE.	
	3													
	Sh		2.465	1.088	6.700	86.8	0	29	71		0.95	14°		
	PH													
	Sh													
	PH		2.361	1.142	9.320	100	0	7	93		1.25	0°	HIGH PLASTICITY CLAY. GRAY TO DARK BROWN AND REDDISH VERY SOFT CONSISTENCY WITH TWO SLICES OF FINE SAND.	
5	Sh		2.333 2.434	1.258 1.128	4.713 9.116	100 99.5					1.0	3°		
	Sh		2.301	1.183	6.384	100	0	46	54		2.45	0°		
	Sh		2.529	1.165	9.526	100	0	18	82		1.6	6°		
	Sh		2.485	1.199	6.322	99.3					1.4	3°		
	1/60													
	9												FINE CLAYEY SAND DARK GRAY. LOOSE.	
	5													
10	1													
	1							K= 0.87 X 10-5 cm / seg						
	Sh		2.491	1.229	5.959	100	0	1	99		3.0	0°	INORGANIC HIGH PLASTICITY CLAY GRAY GREENISH. VERY SOFT TO STIFF CONSISTENCY WITH THIN SLICES OF SANDY SILT VERY STIFF.	
	35/20 *													
	12													
	35 *													
15	Sh		2.361	1.483	2.854	96.0	0	3	97		8.7	0°		
	1/45													
	1/45													
	55/10 *													
	35/15 *													
	35/10 *													
	35/15 *													
	35/10 *													
	35/20 *												CLAYEY FINE SAND WITH SOME GRAVEL AT THE TOP OF STRATA GRAY GREENISH. VERY DENSE.	
20	35/15 *						0	79	21					

C O N V E N T I O N A L S Y M B O L S

GRAVEL | SAND | SILT | CLAY | ORGANIC MAT. | FILLER | VOLCANIC GLASS

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MORE THAN 50 BLOWS

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A L S Y R

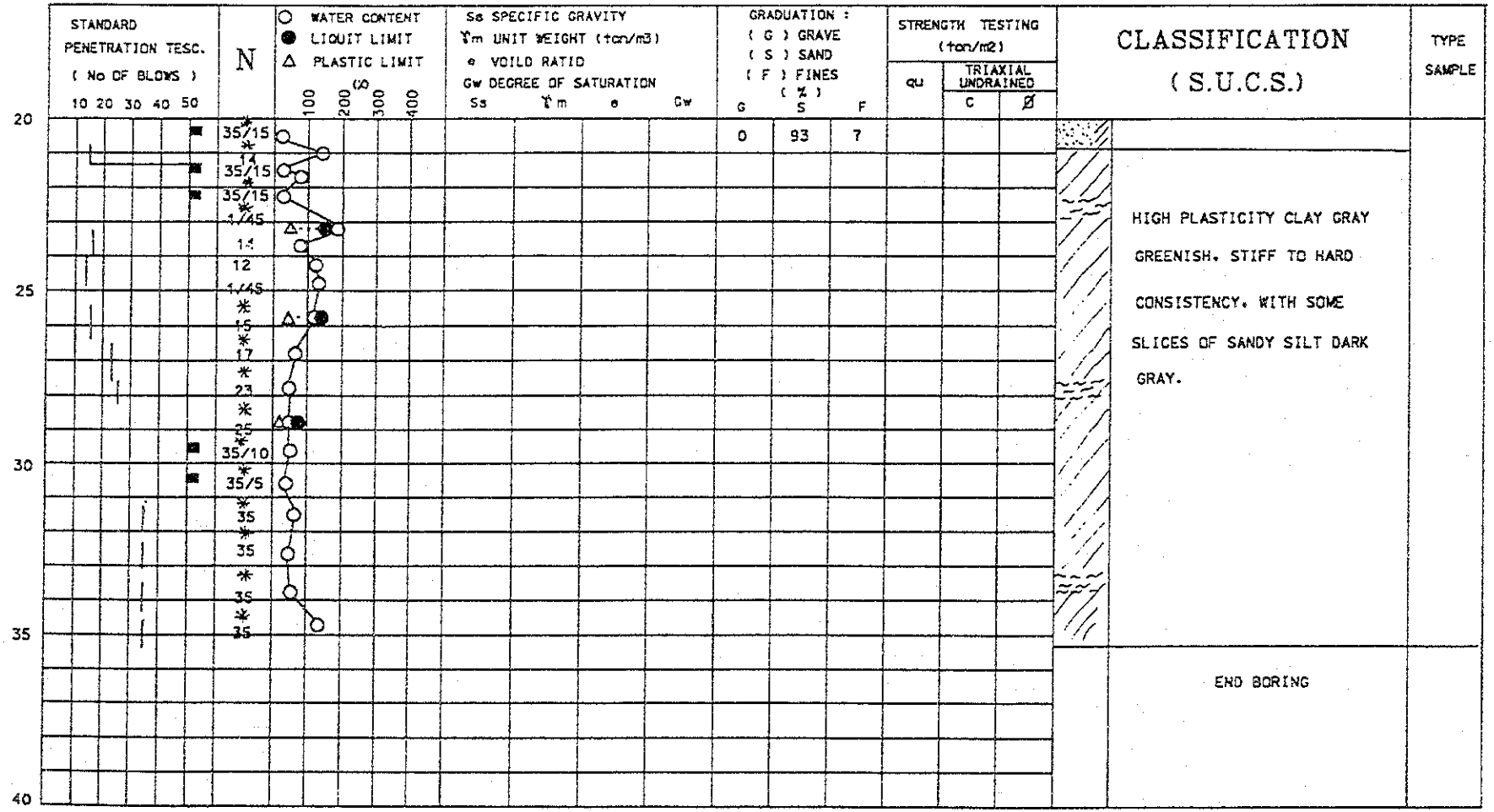
PROJECT : WASTE WATER TREATMENT
SOSA TEXCOCO

BORING : SM- 3

SURFACE LEVEL :

WATER LEVEL : 7.30 m

FIG. 4 a



C O N V E N T I O N A L S Y M B O L S

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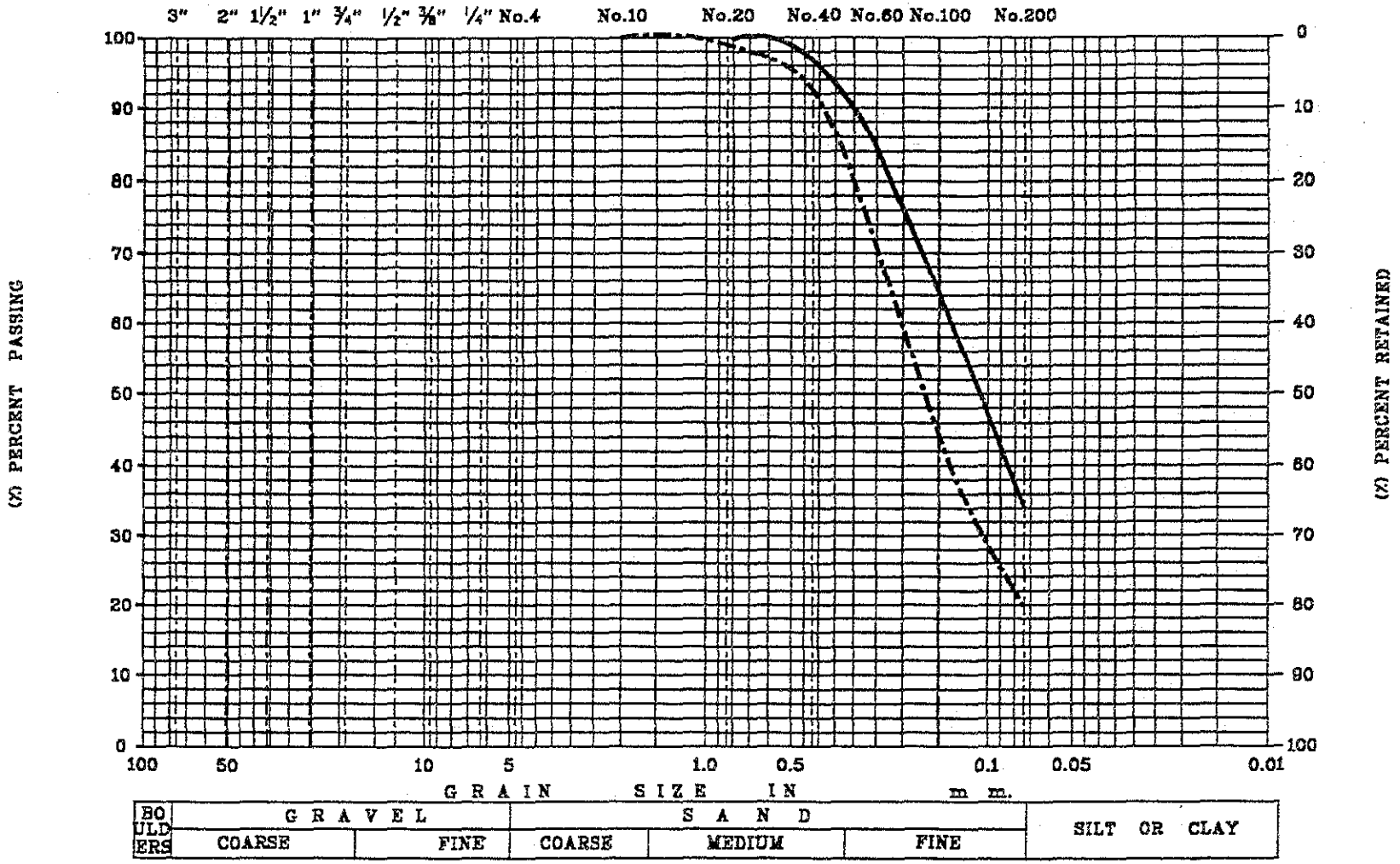
A L S Y R		
PROJECT : WASTE WATER TREATMENT SOSA TEXCOCO		
BORING : SM-- 3	SURFACE LEVEL :	
WATER LEVEL : 7.30 m		FIG. 4 d

S I E V E A N A L Y S I S



AVERAGE DEPTH	SAMPLE No	SYMBOL	D_{10}	D_{30}	D_{60}	$Cu = \frac{D_{60}}{D_{10}}$	$Cc = \frac{D_{30}^2}{D_{10} D_{60}}$	GRAVEL	SAND	FINE	GROUP SUCS
m	—		mm	mm	mm	—	—	(%)	(%)	(%)	
15.30	SM-1	———	-	-	0.13	-	-	0	66	34	SC
5.70	SM-2	—·—·—	-	0.10	0.20	-	-	0	80	20	SC

A L S Y R

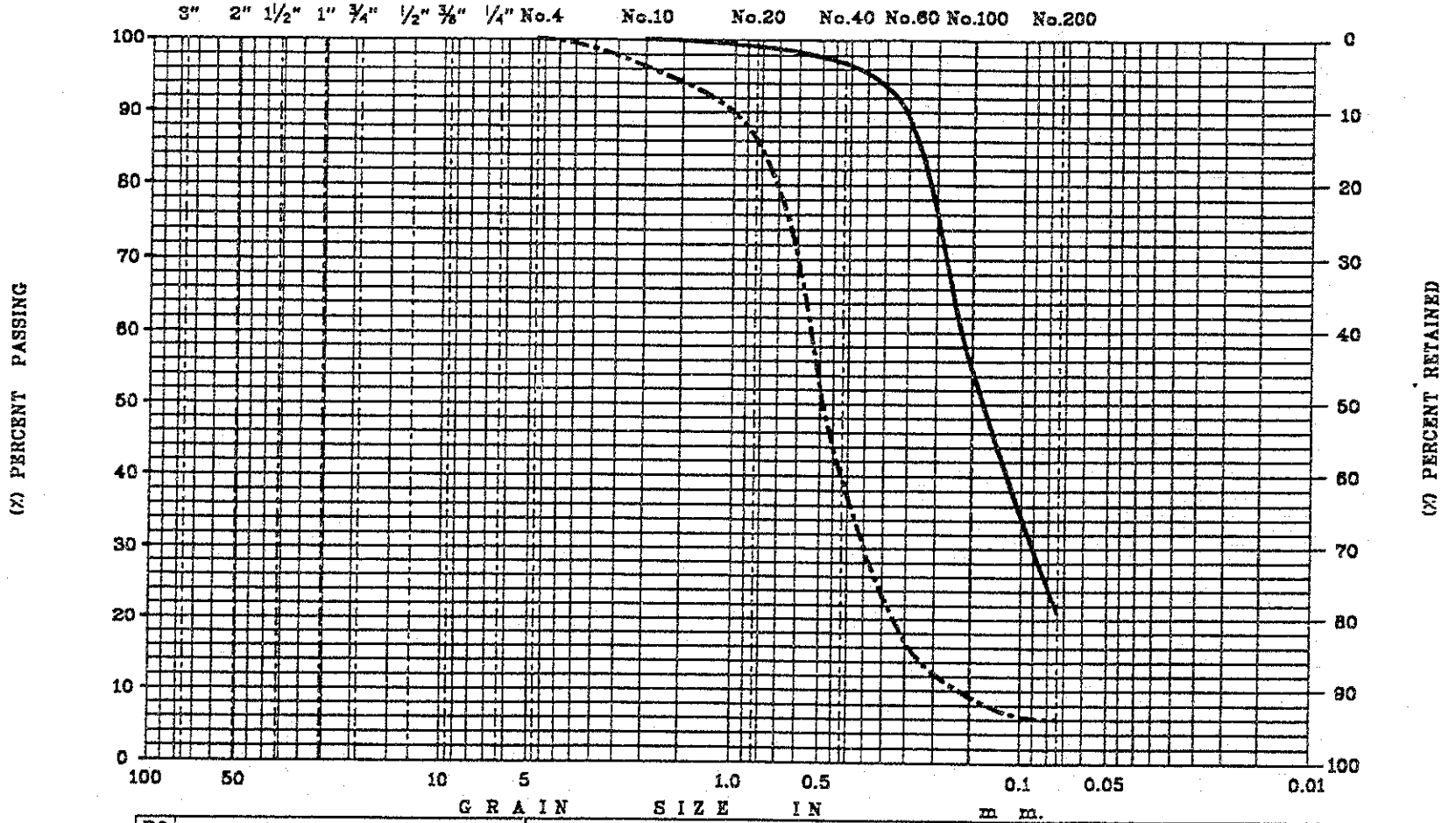
PROJECT WASTE WATER TREATMENT
SOSA TEXCOCO

LOCALIZATION : EDO. DE MEXICO

BORING : SM-1 and 2

FIG.: 5

S I E V E A N A L Y S I S

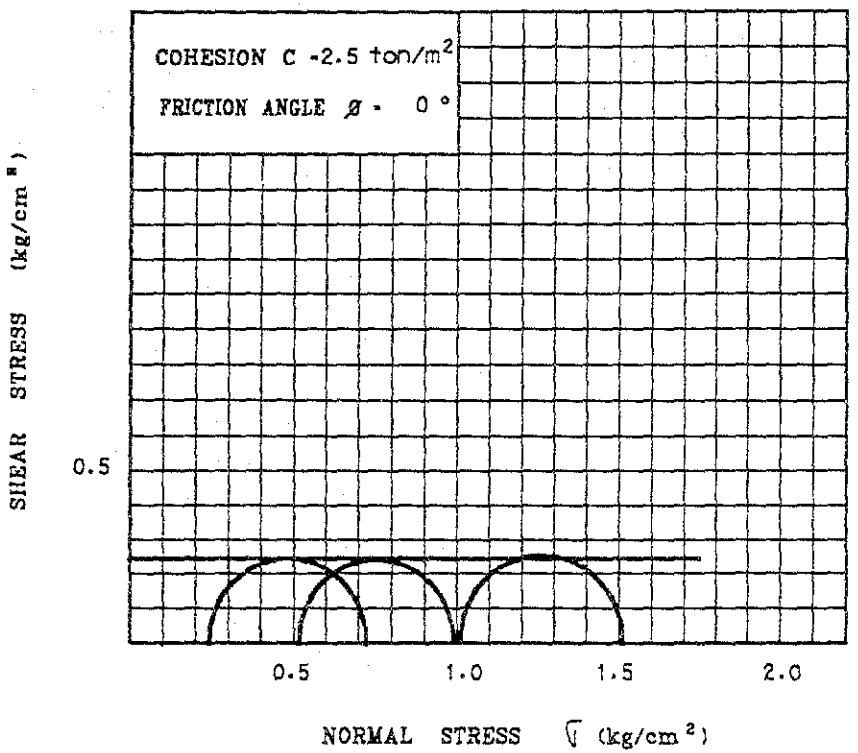


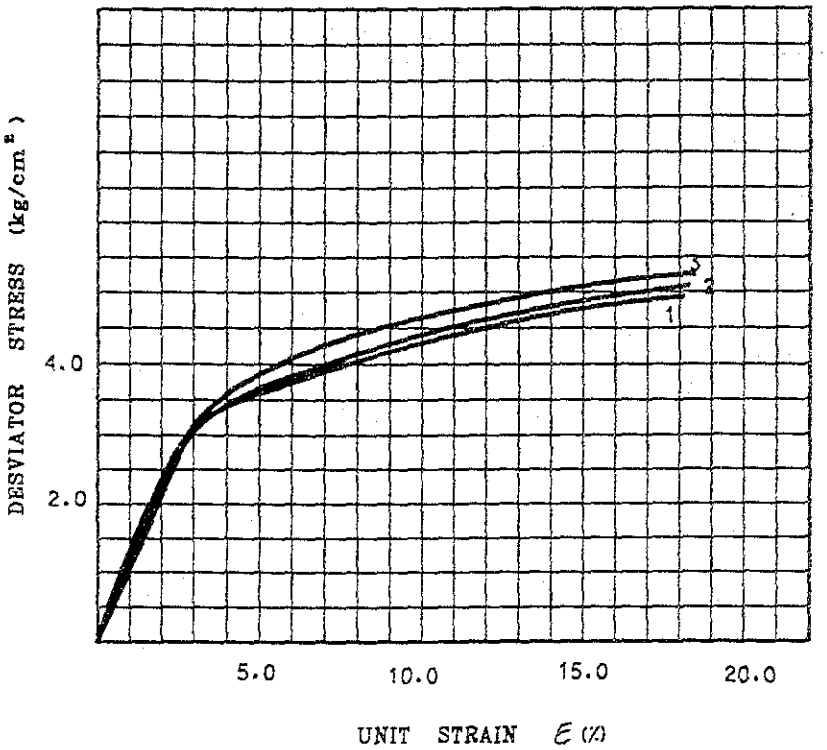
AVERAGE DEPTH	SAMPLE No	SYMBOL	D_{10}	D_{30}	D_{60}	$Cu=\frac{D_{60}}{D_{10}}$	$Cc=\frac{D_{30}^2}{D_{10}D_{60}}$	GRAVEL	SAND	FINE	GROUP SUCS
m	—		mm	mm	mm	—	—	(%)	(%)	(%)	
19.37	M-29	———	-	0.094	0.16	-	-	0	79	21	SC
20.47	M-31	——·—·—	0.16	0.35	0.60	3.75	1.276	0	93	7	SP-SC

A L S Y R	
PROJECT : WASTE WATER TREATMENT SOSA TEXCOCO	
LOCALIZATION : EDO. DE MEXICO	BORING : SM-3
	FIG.: 6

TRIAXIAL COMPRESSION TEST

UNDRAINED (UU) [X] CONSOLIDATED UNDRAINED (CU) [ ] CONSOLIDATED DRAINED (CD) [ ]



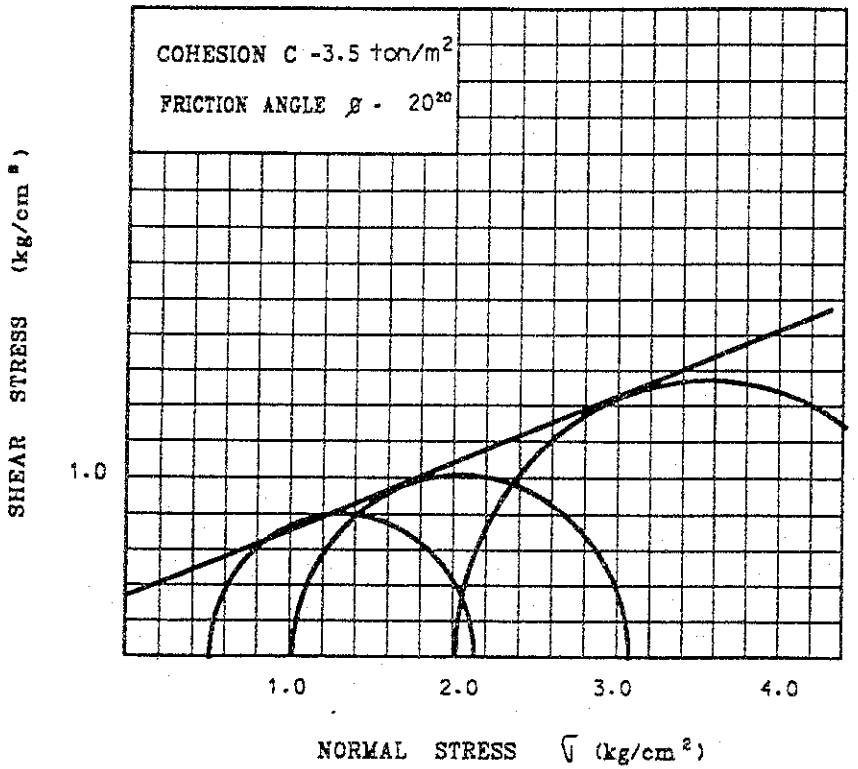


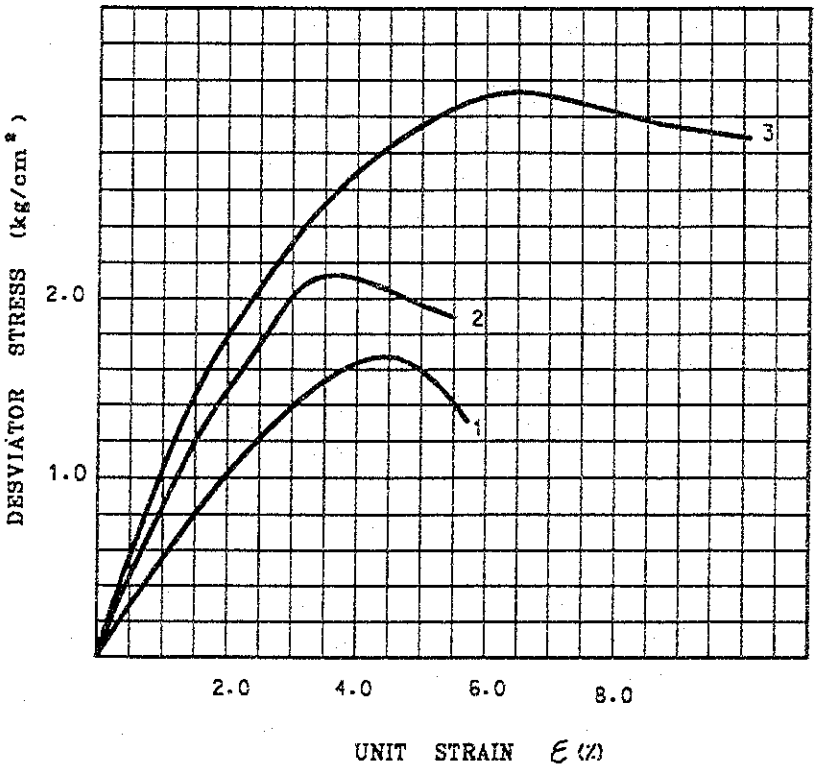
TEST NUMBER	Wi (%)	ei	Gwi (%)	γm ton/m³	σ3 kg/cm²	σi-σ3 kg/cm²
1	94.7	2.308	100	1.474	0.25	0.49
2	101.3	2.478	100	1.450	0.50	0.50
3	93.8	2.328	100	1.459	1.00	0.53

A L S Y R	
PROJECT : WASTE WATER TREATMENT SOSA TEXCOCO	
BORING : SM-1	DEPTH : 5.45 m
M-5 down	FIG.: 7

TRIAXIAL COMPRESSION TEST

UNDRAINED (UU) ☒ CONSOLIDATED UNDRAINED (CU) ☐ CONSOLIDATED DRAINED (CD) ☐



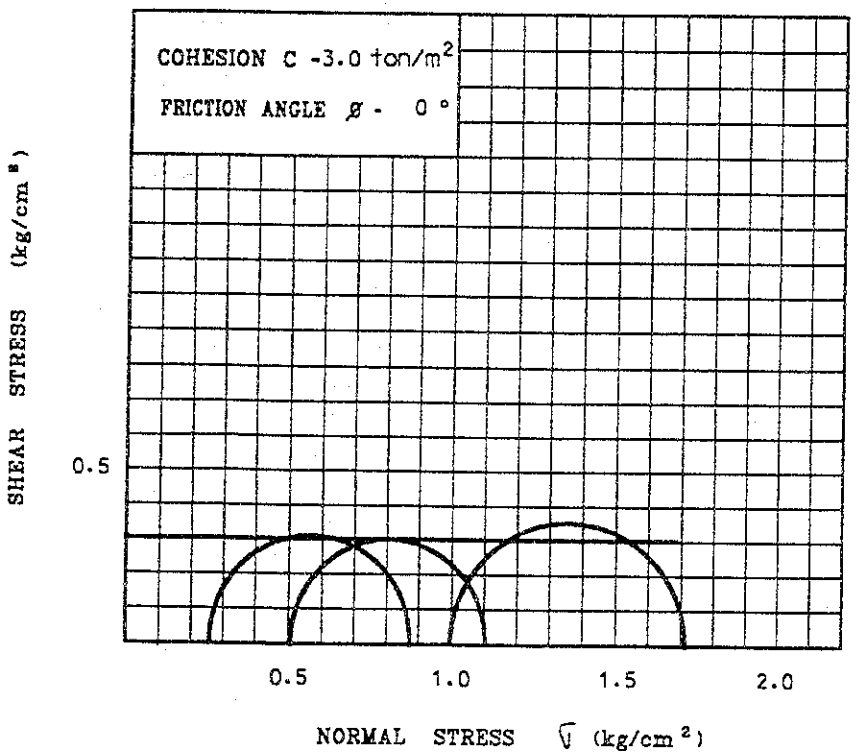


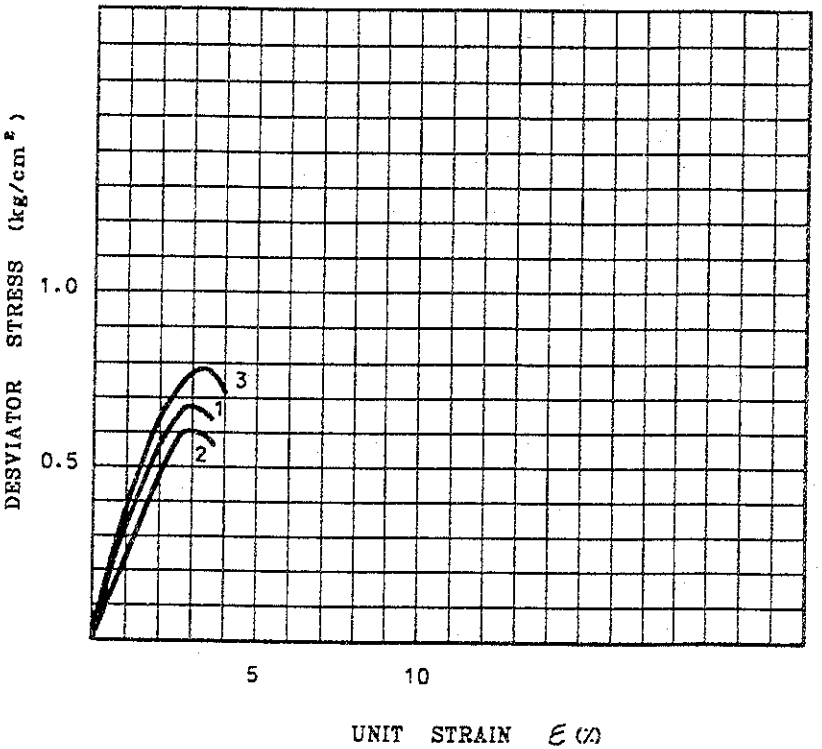
TEST NUMBER	Wi (%)	ei	Gwi (%)	γm ton/m³	σ3 kg/cm²	σi-σ3 kg/cm²
1	55.5	1.433	96.9	1.599	0.50	1.62
2	67.4	1.705	98.9	1.548	1.00	2.11
3	52.8	1.337	98.8	1.636	2.00	3.13

A L S Y R	
PROJECT : WASTE WATER TREATMENT SOSA TEXCOCO	
BORING : SM-1	DEPTH : 25.30 m
M-27 down	FIG.: 8

TRIAXIAL COMPRESSION TEST

UNDRAINED (UU) [X] CONSOLIDATED UNDRAINED (CU) [ ] CONSOLIDATED DRAINED (CD) [ ]



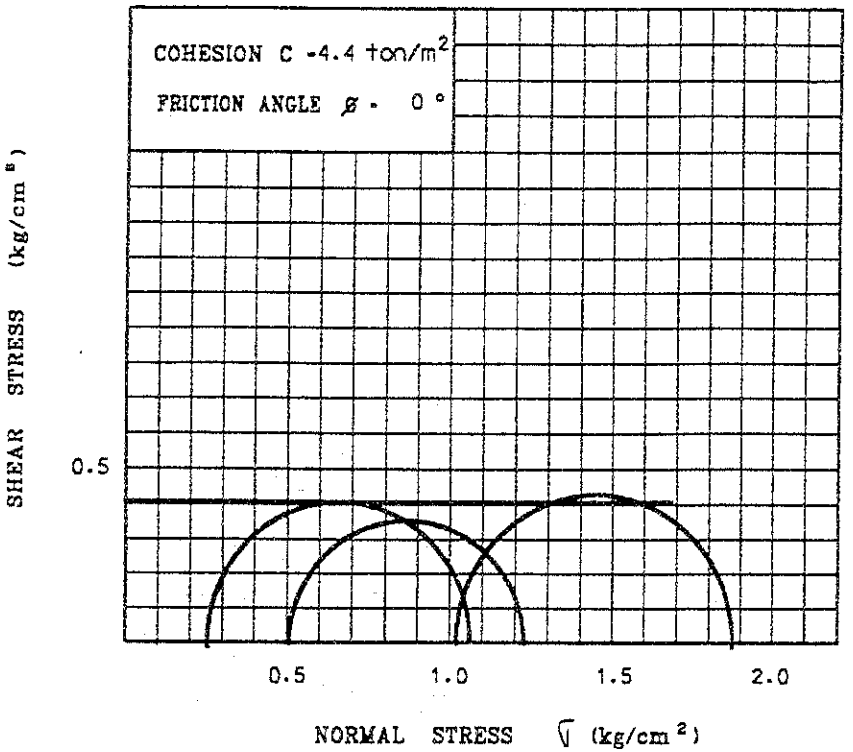


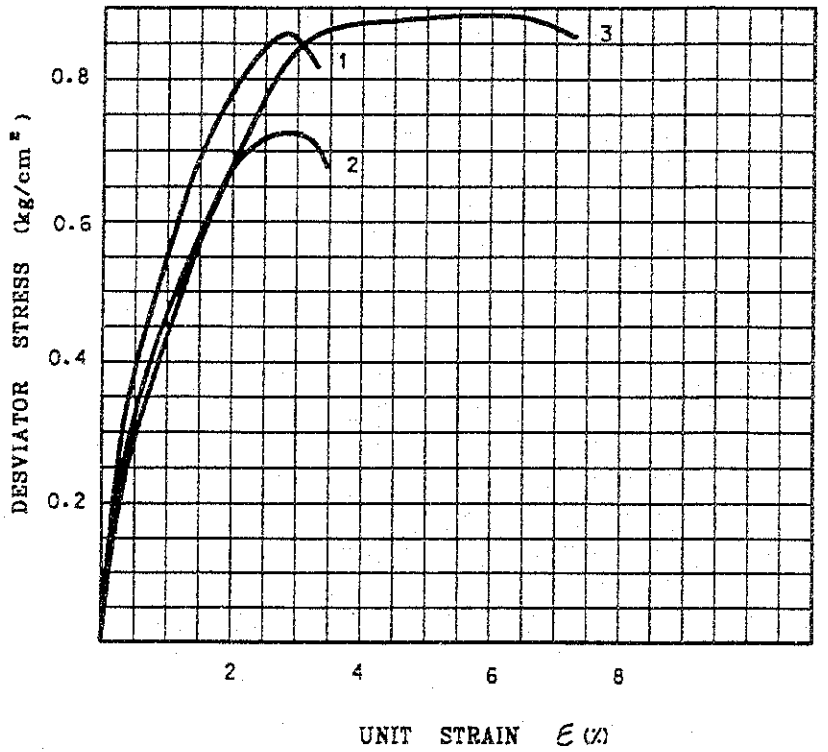
TEST NUMBER	Wi (%)	ei	Gwi (%)	γm ton/m³	σ3 kg/cm²	σi-σ3 kg/cm²
1	168.6	4.512	99.6	1.299	0.25	0.66
2	169.3	4.522	99.8	1.300	0.50	0.60
3	166.8	4.470	99.5	1.300	1.00	0.75

A L S Y R	
PROJECT : WASTE WATER TREATMENT SOSA TEXCOCO	
BORING : SM-2	DEPTH : 5.20 m
	FIG.: 9

TRIAXIAL COMPRESSION TEST

UNDRAINED (UU) ☒ CONSOLIDATED UNDRAINED (CU) ☐ CONSOLIDATED DRAINED (CD) ☐



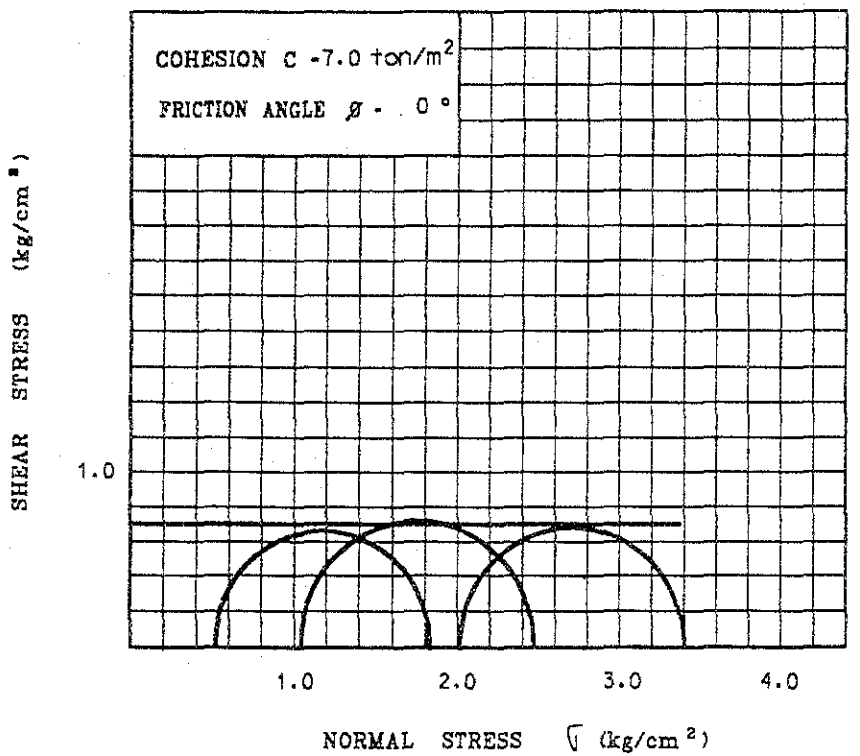


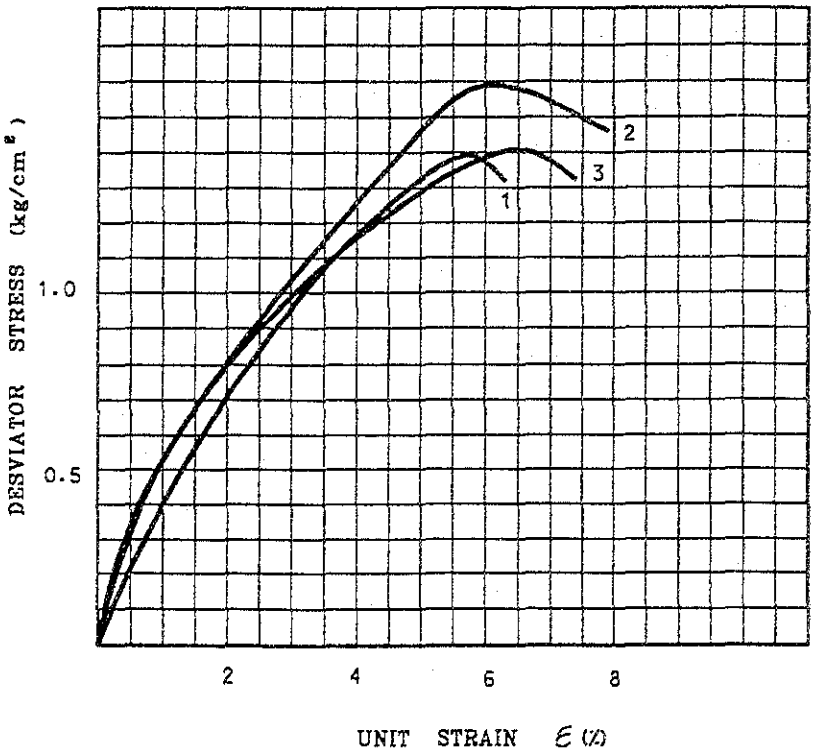
TEST NUMBER	Wi (%)	ei	Gwi (%)	γm ton/m³	σ3 kg/cm²	σi-σ3 kg/cm²
1	159.1	4.193	99.3	1.305	0.25	0.86
2	156.8	4.132	99.3	1.309	0.50	0.72
3	164.3	4.361	98.5	1.290	1.00	0.90

A L S Y R	
PROJECT : WASTE WATER TREATMENT SOSA TEXCOCO	
BORING : SM-2	DEPTH : 15.20 m
	FIG.: 10

TRIAXIAL COMPRESSION TEST

UNDRAINED (UU) [X] CONSOLIDATED UNDRAINED (CU) [ ] CONSOLIDATED DRAINED (CD) [ ]



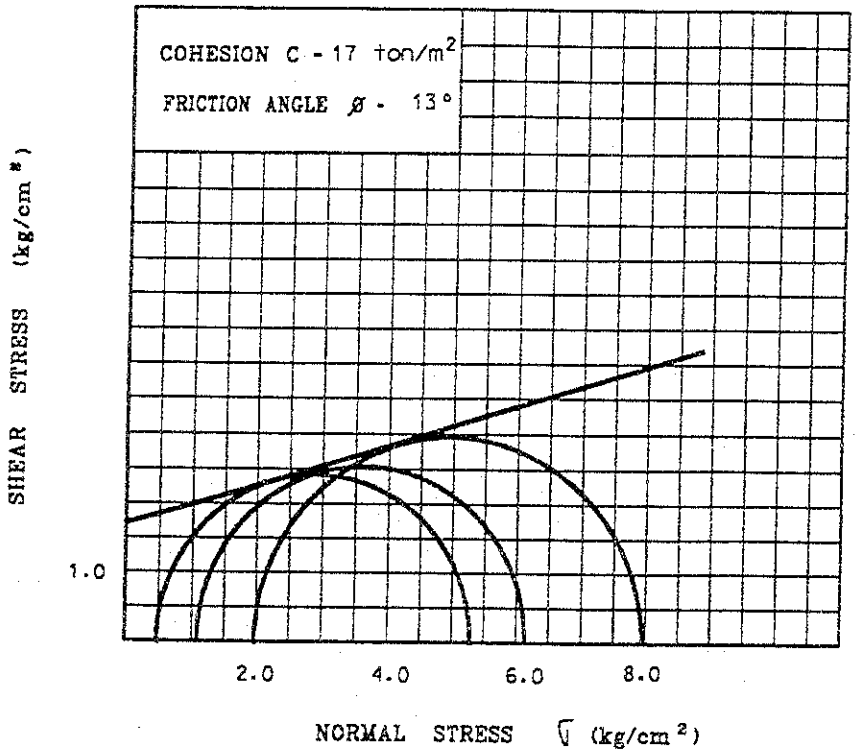


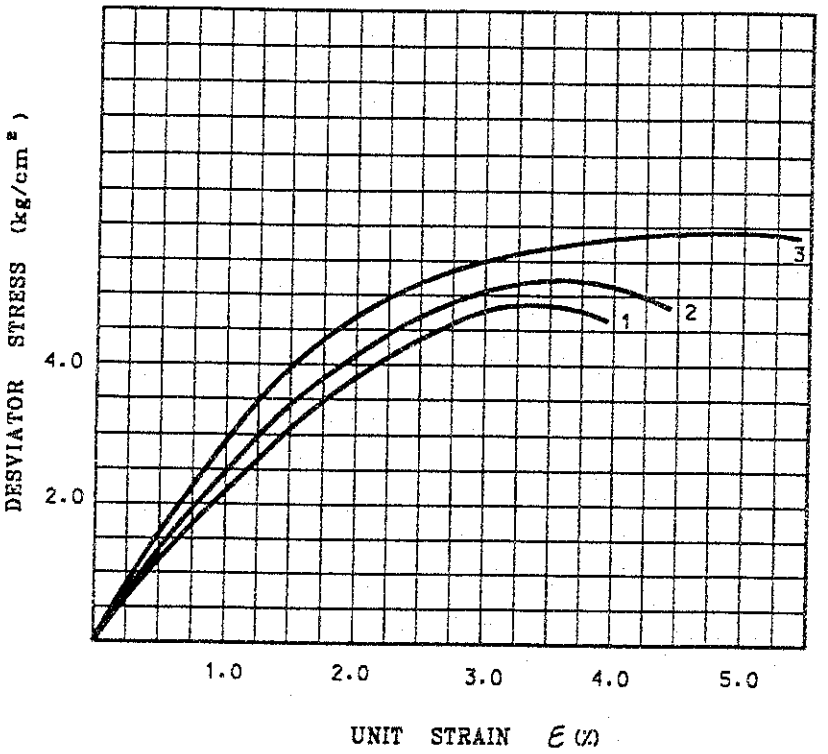
TEST NUMBER	Wi (%)	ei	Gwi (%)	γm ton/m³	σ3 kg/cm²	σi-σ3 kg/cm²
1	119.4	2.930	98.8	1.354	0.50	1.38
2	115.0	2.871	97.1	1.346	1.00	1.56
3	113.6	2.732	100	1.388	2.00	1.41

A L S Y R	
PROJECT : WASTE WATER TREATMENT SOSA TEXCOCO	
BORING : SM-2	DEPTH : 25.70 m
	FIG.: 11

TRIAXIAL COMPRESSION TEST

UNDRAINED (UU) [X] CONSOLIDATED UNDRAINED (CU) [ ] CONSOLIDATED DRAINED (CD) [ ]



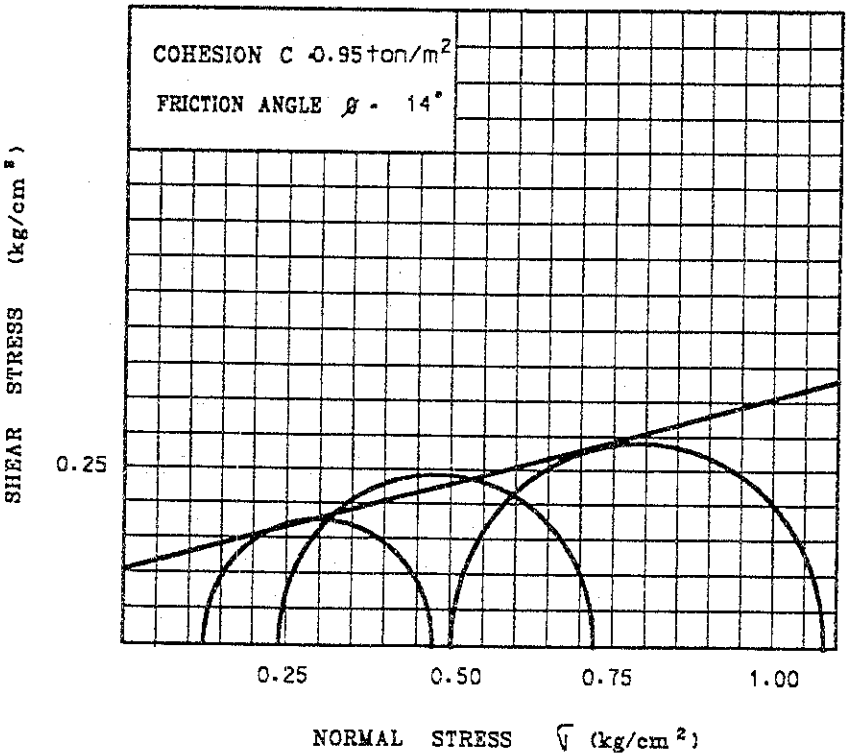


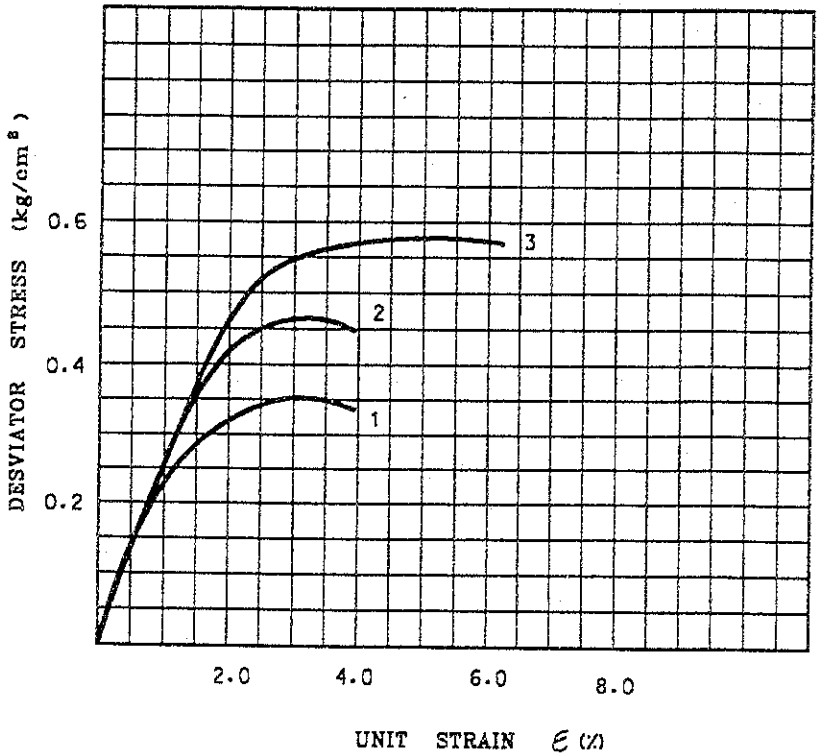
TEST NUMBER	Wi (%)	ei	Gwi (%)	γm ton/m³	σ3 kg/cm²	σi-σ3 kg/cm²
1	95.0	2.327	97.1	1.393	0.50	5.48
2	96.1	2.344	97.4	1.393	1.00	6.18
3	96.3	2.306	99.3	1.411	2.00	7.88

ALSYR	
PROJECT : WASTE WATER TREATMENT SOSA TEXCOCO	
BORING : SM-2	DEPTH : 26.40 m
	FIG.: 12

TRIAXIAL COMPRESSION TEST

UNDRAINED (UU) [X] CONSOLIDATED UNDRAINED (CU) [ ] CONSOLIDATED DRAINED (CD) [ ]



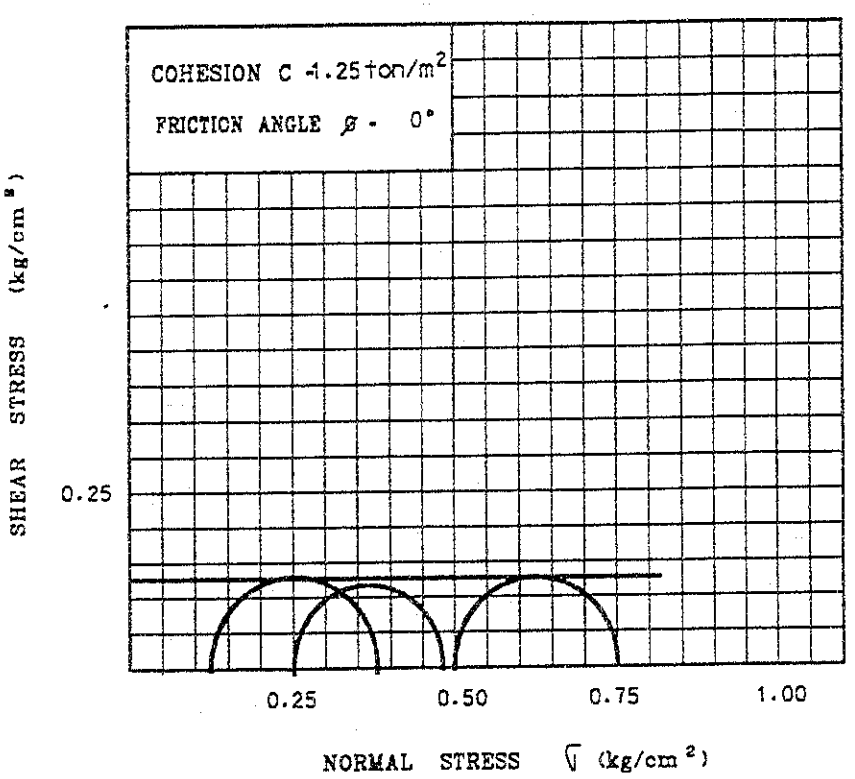


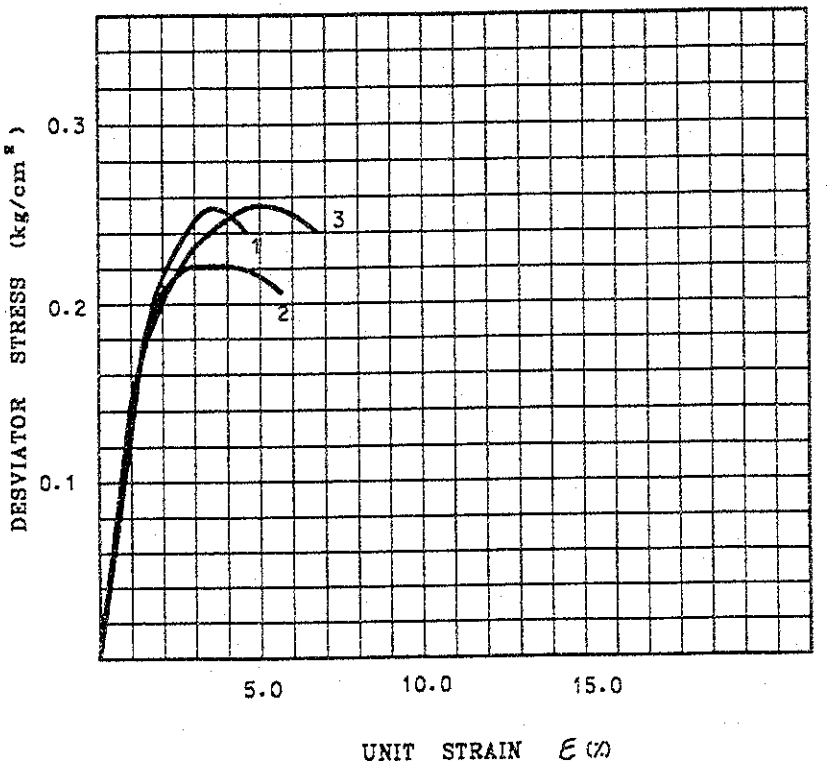
TEST NUMBER	Wi (%)	ei	Gwi (%)	γm ton/m³	σ3 kg/cm²	σi-σ3 kg/cm²
1	170.2	4.915	85.3	1.126	0.125	0.35
2	187.8	5.334	86.0	1.111	0.250	0.46
3	229.1	6.529	86.5	1.078	0.500	0.58

A L S Y R	
PROJECT : WASTE WATER TREATMENT SOSA TEXCOCO	
BORING : SM-3	DEPTH : 1.43 m
M-3 up	FIG.: 13

TRIAXIAL COMPRESSION TEST

UNDRAINED (UU) [X] CONSOLIDATED UNDRAINED (CU) [ ] CONSOLIDATED DRAINED (CD) [ ]



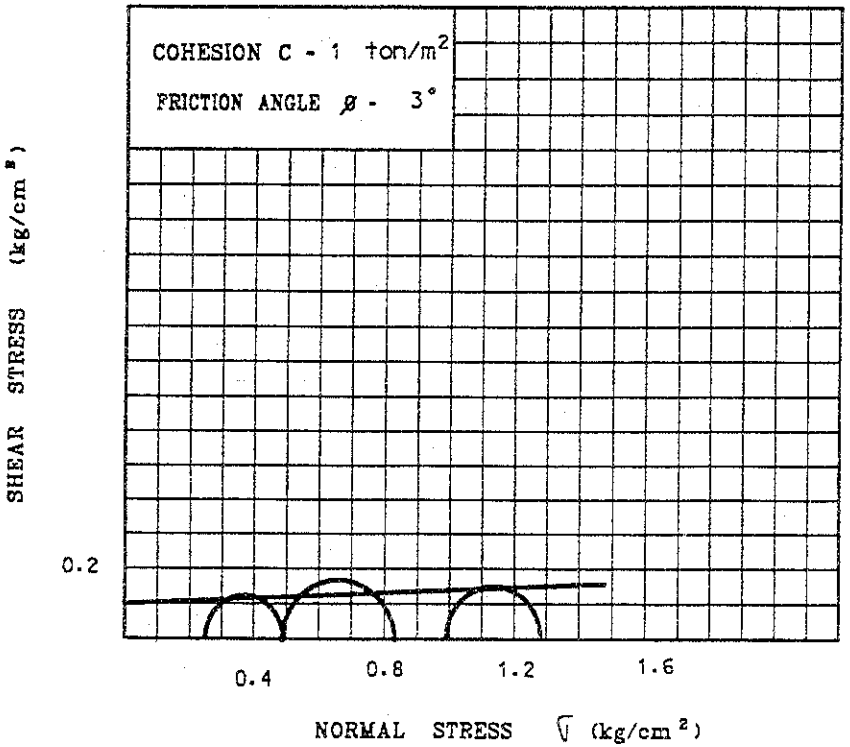


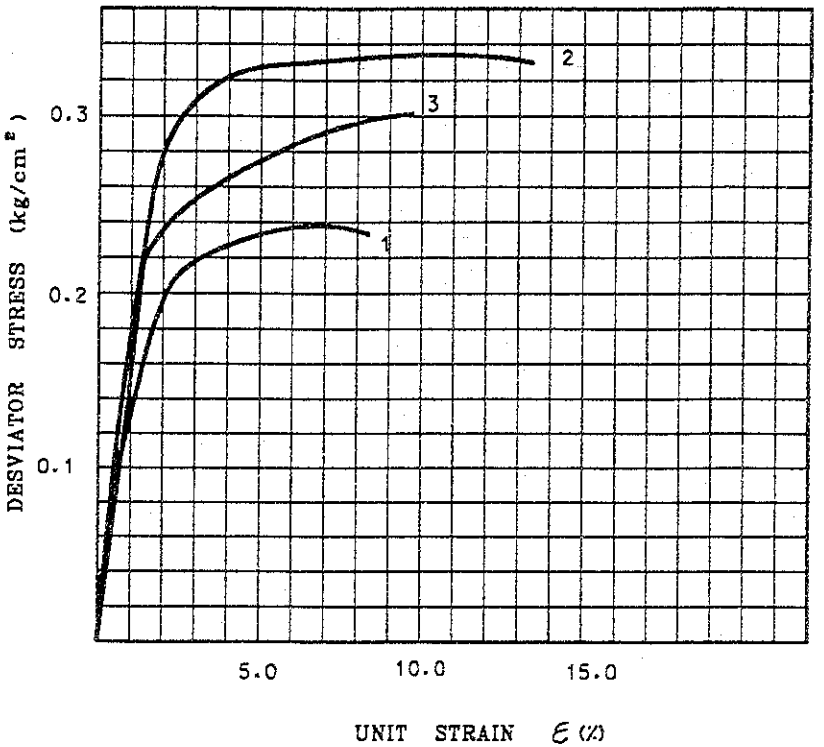
TEST NUMBER	Wi (%)	ei	Gwi (%)	γm ton/m³	σ3 kg/cm²	σi-σ3 kg/cm²
1	343.1	8.019	100	1.160	0.125	0.25
2	317.6	7.420	100	1.171	0.250	0.22
3	329.8	7.706	100	1.166	0.500	0.25

A L S Y R	
PROJECT : WASTE WATER TREATMENT SOSA TEXCOCO	
BORING : SM-3	DEPTH : 3.38 m
M-5 down	FIG.: 14

TRIAXIAL COMPRESSION TEST

UNDRAINED (UU) [X] CONSOLIDATED UNDRAINED (CU) [ ] CONSOLIDATED DRAINED (CD) [ ]



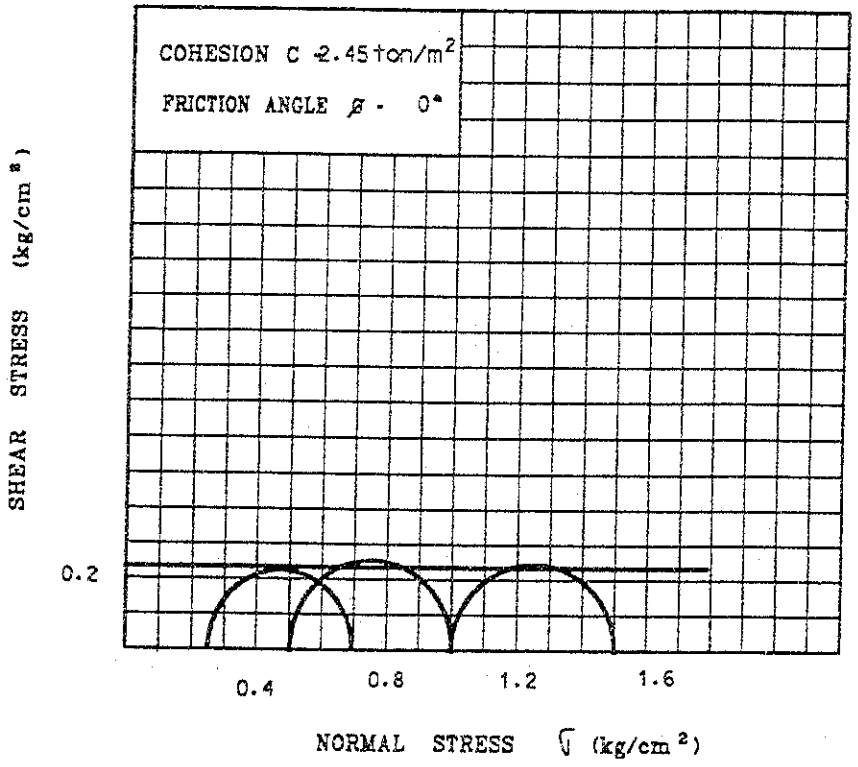


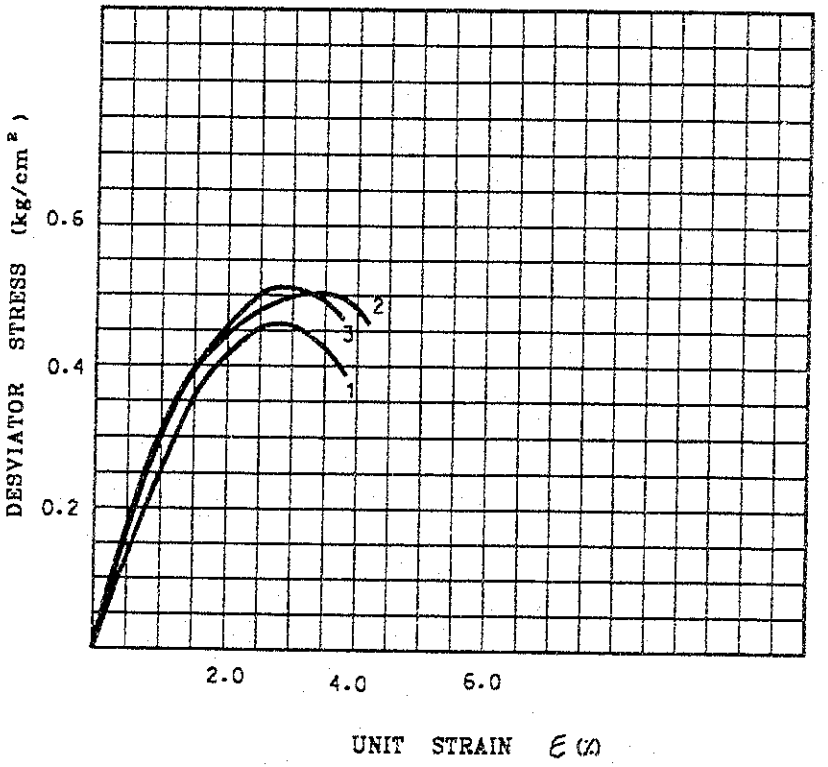
TEST NUMBER	Wi (%)	ei	Gwi (%)	γm ton/m³	∇3 kg/cm²	∇i-∇3 kg/cm²
1	190.8	4.637	100	1.256	0.250	0.24
2	195.8	4.685	100	1.266	0.500	0.33
3	199.7	4.817	100	1.254	1.000	0.30

A L S Y R	
PROJECT : WASTE WATER TREATMENT SOSA TEXCOCO	
BORING : SM-3	DEPTH : 4.88 m
M-7 down	FIG.: 15

TRIAXIAL COMPRESSION TEST

UNDRAINED (UU) [X] CONSOLIDATED UNDRAINED (CU) [ ] CONSOLIDATED DRAINED (CD) [ ]



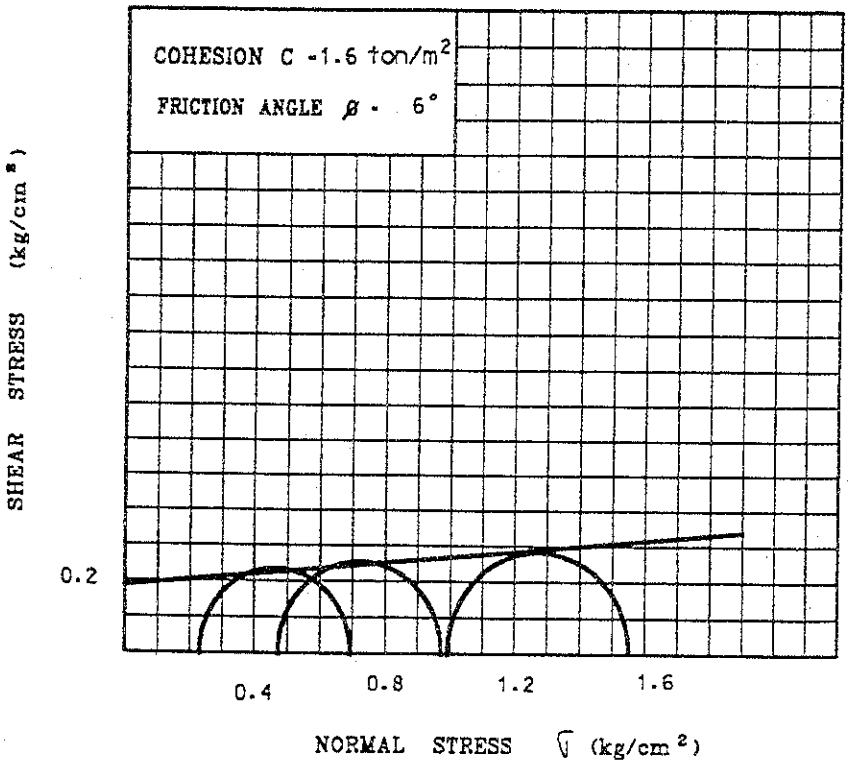


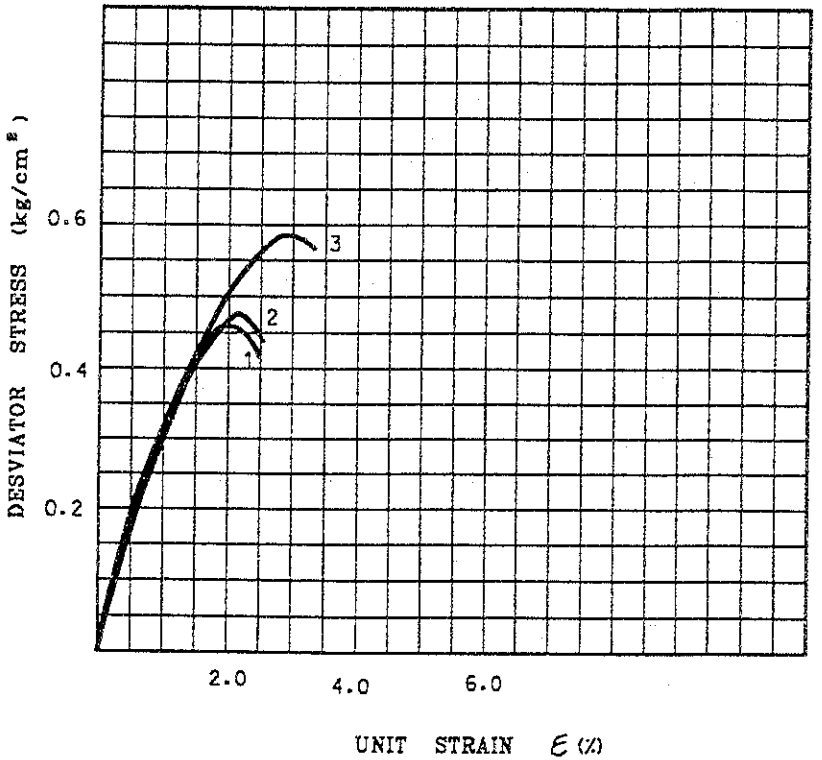
TEST NUMBER	Wi (%)	ei	Gwi (%)	γm ton/m³	σ3 kg/cm²	σi-σ3 kg/cm²
1	284.8	6.490	100	1.182	0.250	0.45
2	278.4	6.347	100	1.185	0.500	0.49
3	276.0	6.315	100	1.183	1.000	0.50

A L S Y R	
PROJECT : WASTE WATER TREATMENT SOSA TEXCOCO	
BORING : SM-3	DEPTH : 5.78 m
M-8 down	FIG.: 16

TRIAXIAL COMPRESSION TEST

UNDRAINED (UU) [X] CONSOLIDATED UNDRAINED (CU) [ ] CONSOLIDATED DRAINED (CD) [ ]



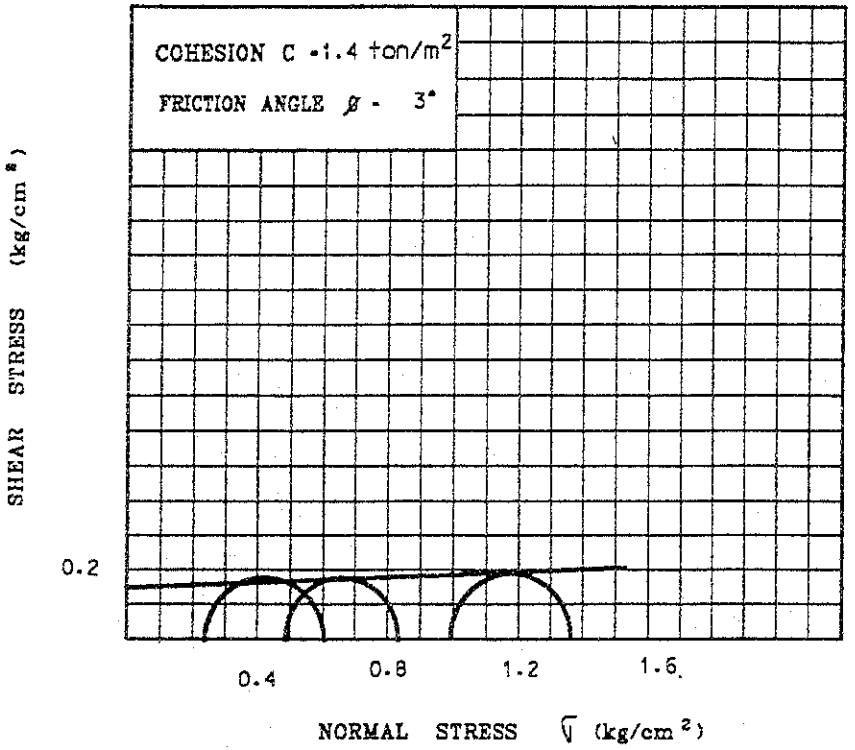


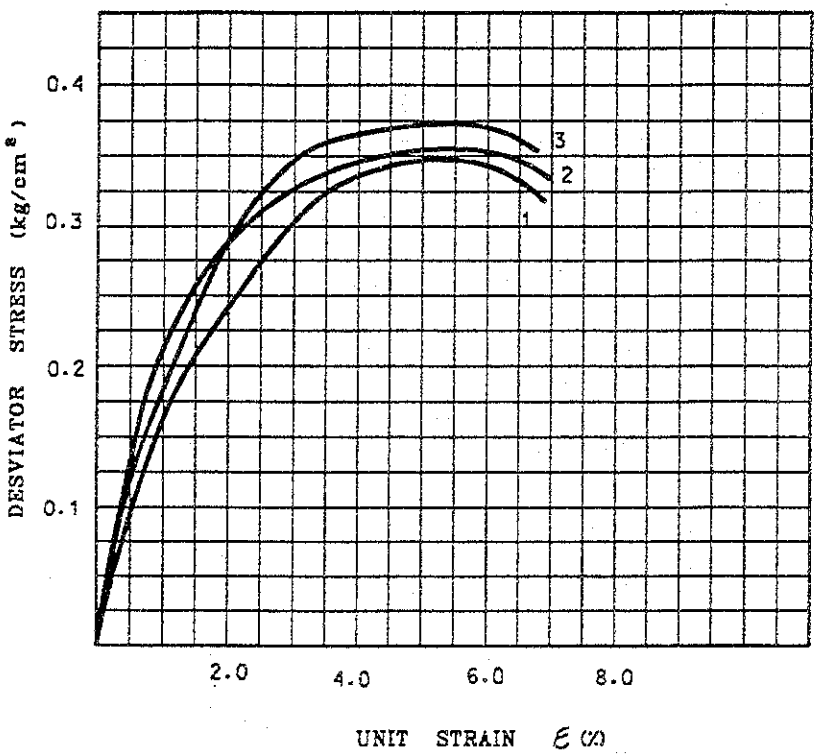
TEST NUMBER	Wi (%)	ei	Gwi (%)	γm ton/m³	σ3 kg/cm²	σi-σ3 kg/cm²
1	299.9	7.637	99.3	1.171	0.250	0.45
2	300.0	7.733	98.1	1.158	0.500	0.46
3	297.9	7.575	99.4	1.173	1.000	0.58

A L S Y R	
PROJECT : WASTE WATER TREATMENT SOSA TEXCOCO	
BORING : SM-3	DEPTH : 6.50 m
M-9 down	FIG.: 17

TRIAXIAL COMPRESSION TEST

UNDRAINED (UU) [X] CONSOLIDATED UNDRAINED (CU) [ ] CONSOLIDATED DRAINED (CD) [ ]



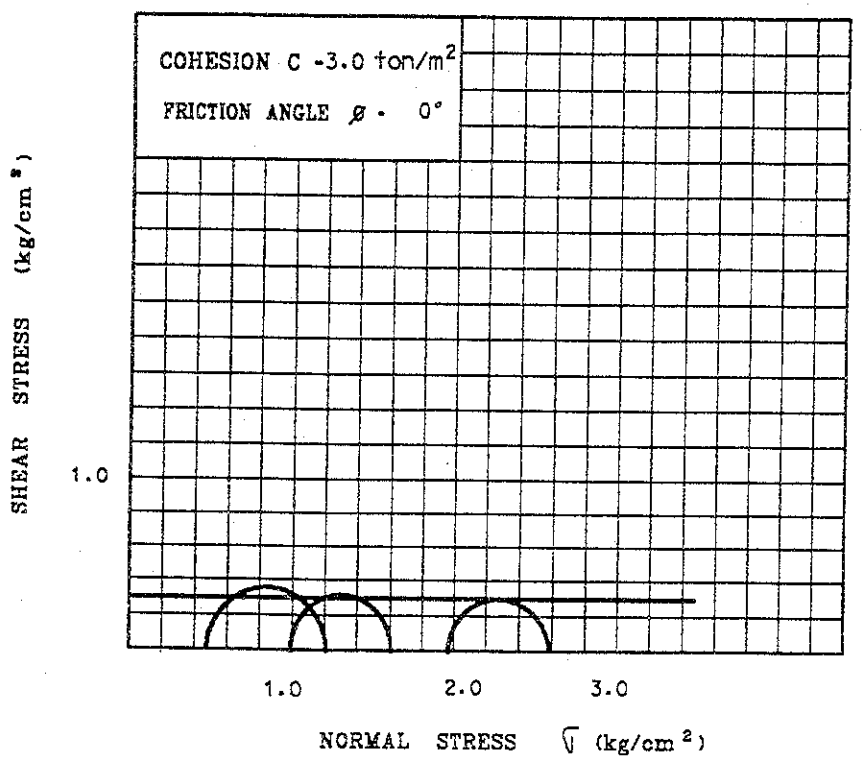


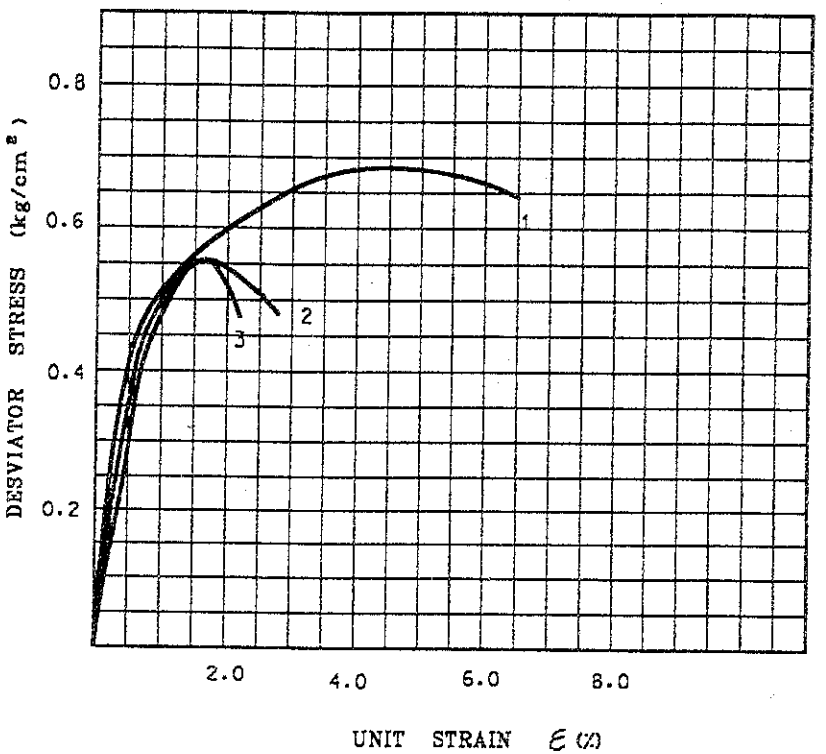
TEST NUMBER	Wi (%)	ei	Gwi (%)	γm ton/m³	σ3 kg/cm²	σi-σ3 kg/cm²
1	257.6	6.445	99.3	1.194	0.250	0.33
2	245.5	6.180	98.7	1.196	0.500	0.35
3	256.2	6.341	100	1.206	1.000	0.37

A L S Y R	
PROJECT : WASTE WATER TREATMENT SOSA TEXCOCO	
BORING : SM-3	DEPTH : 7.60 m
M-10 down	FIG.: 18

TRIAXIAL COMPRESSION TEST

UNDRAINED (UU) [X] CONSOLIDATED UNDRAINED (CU) [ ] CONSOLIDATED DRAINED (CD) [ ]



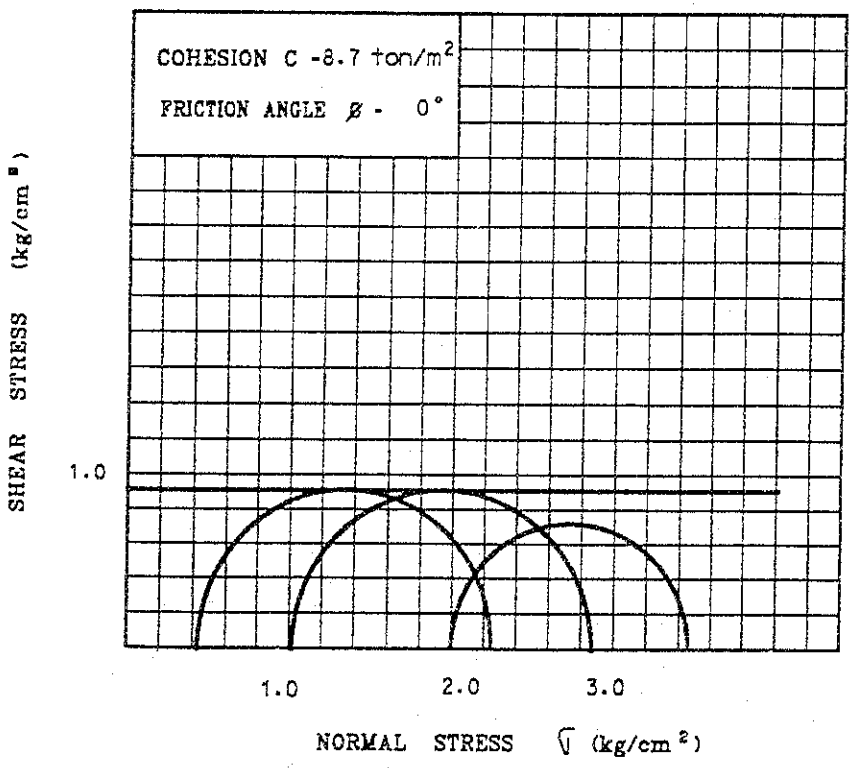


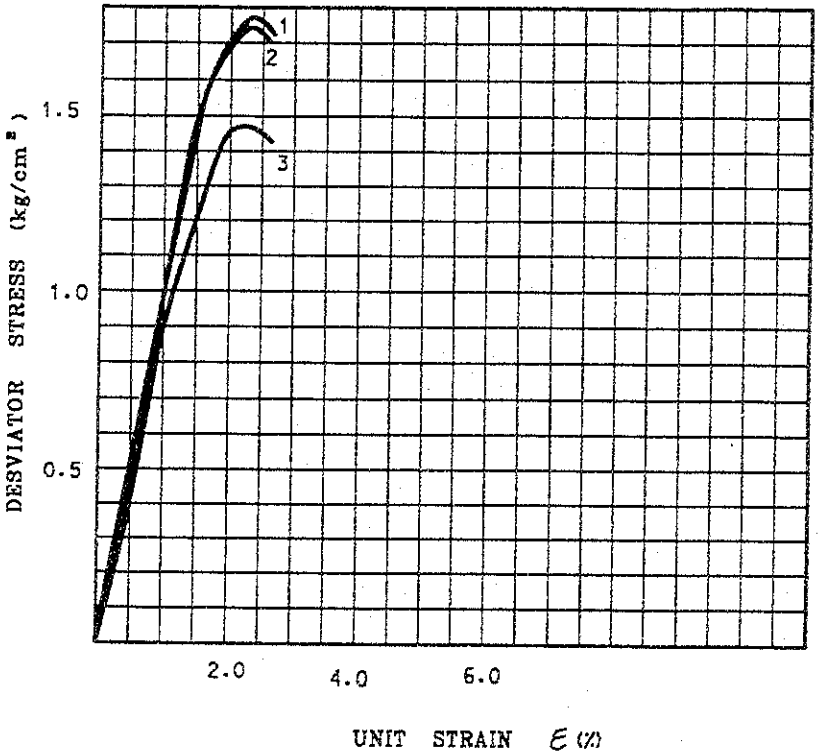
TEST NUMBER	Wi (%)	ei	Gwi (%)	γm ton/m³	σ3 kg/cm²	σi-σ3 kg/cm²
1	234.4	5.989	97.5	1.192	0.50	0.68
2	223.0	5.621	98.8	1.215	1.00	0.60
3	213.9	5.421	98.3	1.218	2.00	0.59

A L S Y R	
PROJECT : WASTE WATER TREATMENT SOSA TEXCOCO	
BORING : SM-3	DEPTH : 11.50 m
M-16 down	FIG.: 19

TRIAXIAL COMPRESSION TEST

UNDRAINED (UU) ☒ CONSOLIDATED UNDRAINED (CU) ☐ CONSOLIDATED DRAINED (CD) ☐





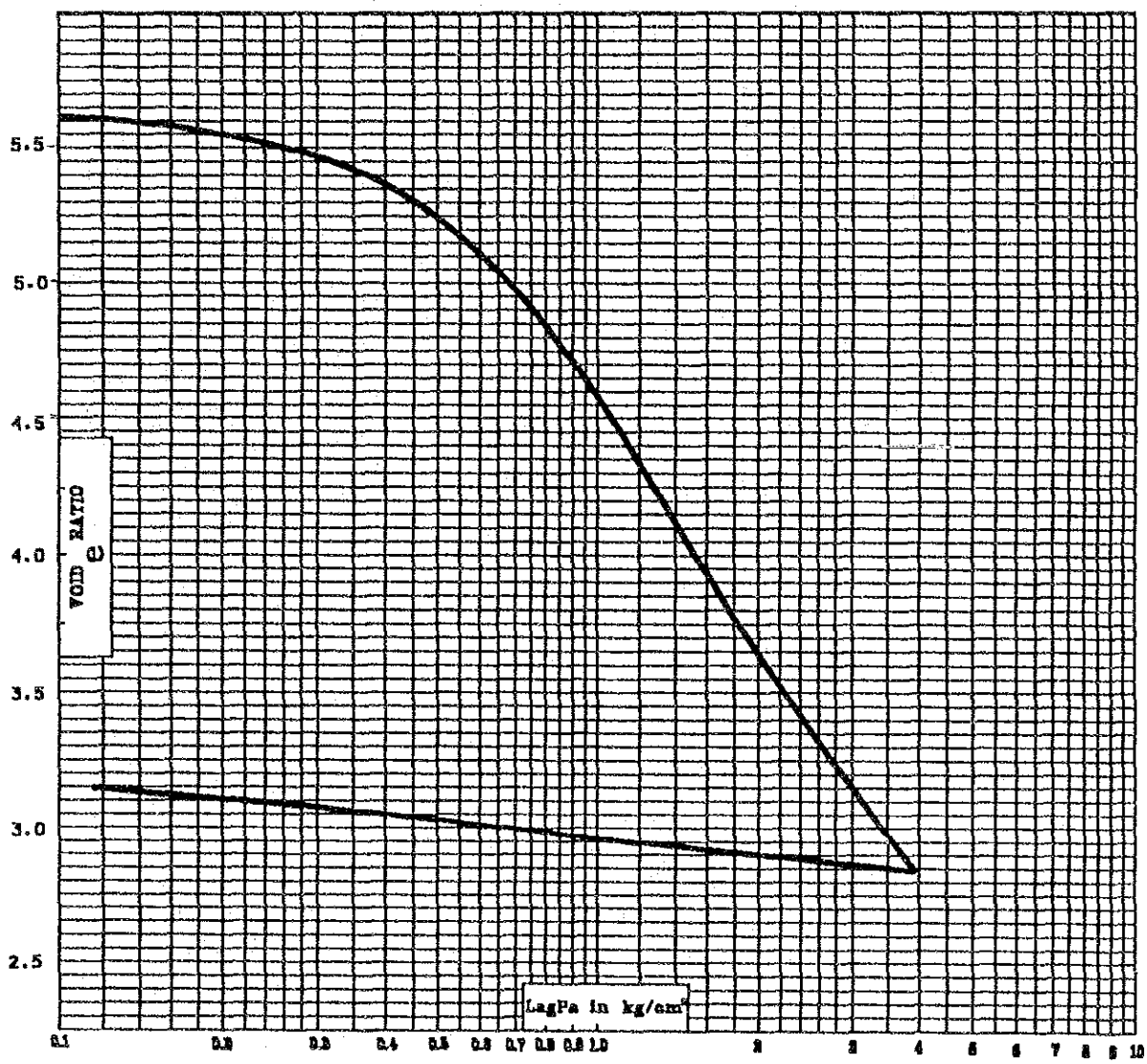
TEST NUMBER	Wi (%)	ei	Gwi (%)	γm ton/m³	σ3 kg/cm²	σi-σ3 kg/cm²
1	79.1	1.859	100	1.479	0.50	1.75
2	72.1	1.721	98.9	1.493	1.00	1.74
3	79.9	1.876	100	1.477	2.00	1.46

A L S Y R	
PROJECT : WASTE WATER TREATMENT SOSA TEXCOCO	
BORING : SM-3	DEPTH : 14.80 m
M-21 down	FIG.: 20

C O N S O L I D A T I O N

COMPRESSIBILITY CURVE

Pa- APPLY PRESSURE P- TOTAL PRESSURE P- EFFECTIVE PRESSURE Pc- PRECONSOLIDATION PRE



MEDIUM DEEP	SAMPLE No	SYMBOL	W	e	Gw	γm	Sw	P̄	Pc
(m)	-		(%)	-	(%)	T/m³	-	kg/cm²	kg/cm²
5.675	5 down	———	226.4	5.714	99.3	1.218	2.505		0.63

P̄ - EFFECTIVE PRESSURE

Pc - PRECONSOLIDATION PRESSURE

A L S Y R

PROJECT : WASTE WATER TREATMENT
SOSA TEXCOCO

LOCALIZATION : EDO. DE MEXICO

BORING: SM-1

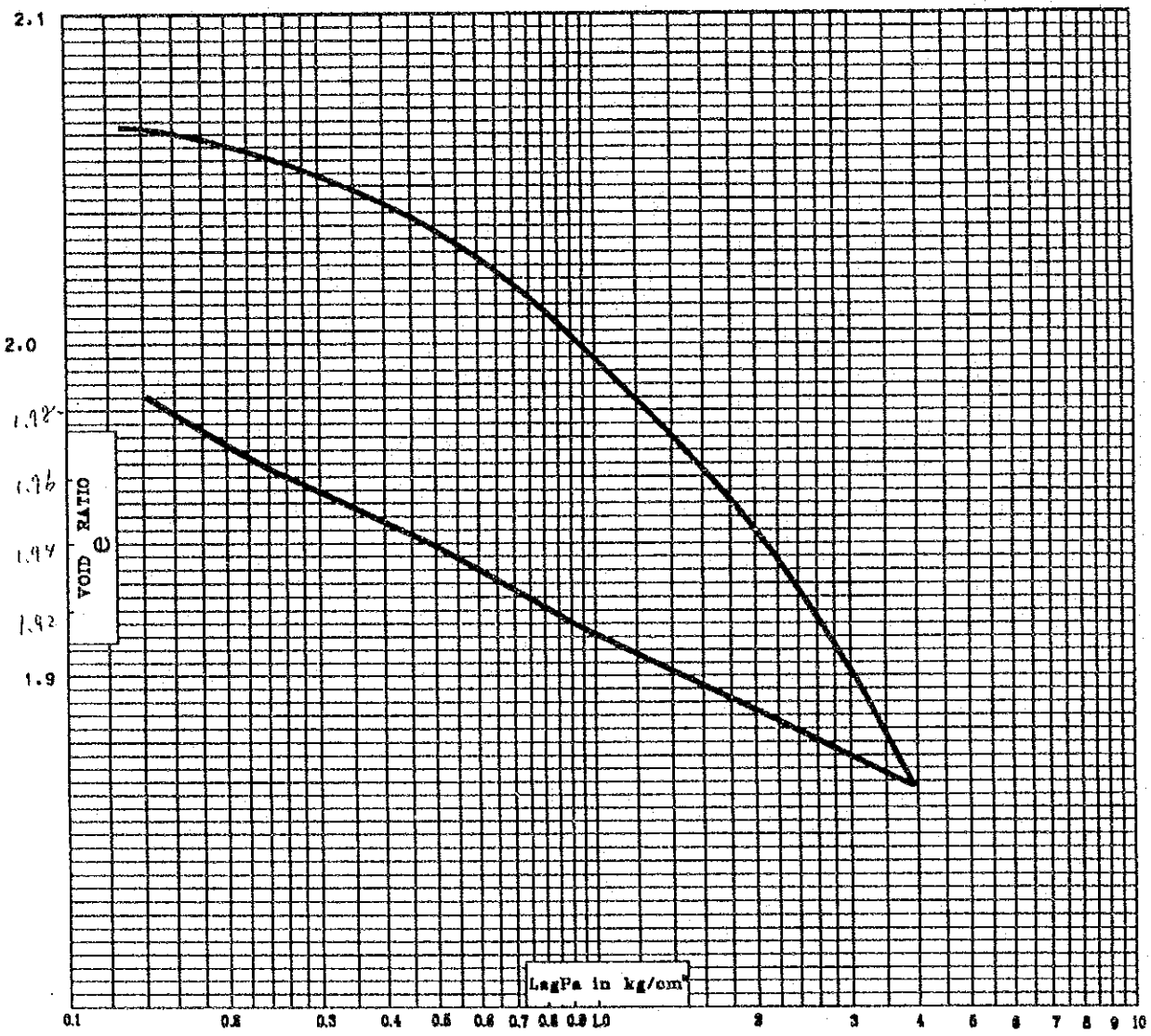
CLASSIFICATION

FIG : 21

C O N S O L I D A T I O N

COMPRESSIBILITY CURVE

Pa- APPLY PRESSURE P- TOTAL PRESSURE P- EFFECTIVE PRESSURE Pc- PRECONSOLIDATION PRE



MEDIUM DEEP	SAMPLE No	SYMBOL	W	e	Gw	ϒm	Ss	P̄	Pc
(m)	-		(%)	-	(%)	T/m³	-	kg/cm²	kg/cm²
25.15	27 up	———	79.3	2.085	95.2	1.454	2.504		1.50

P̄ - EFFECTIVE PRESSURE

Pc - PRECONSOLIDATION PRESSURE

A L S Y R

PROJECT : WASTE WATER TREATMENT
SOSA TEXCOCO

LOCALIZATION : EDO. DE MEXICO

BORING: SM-1

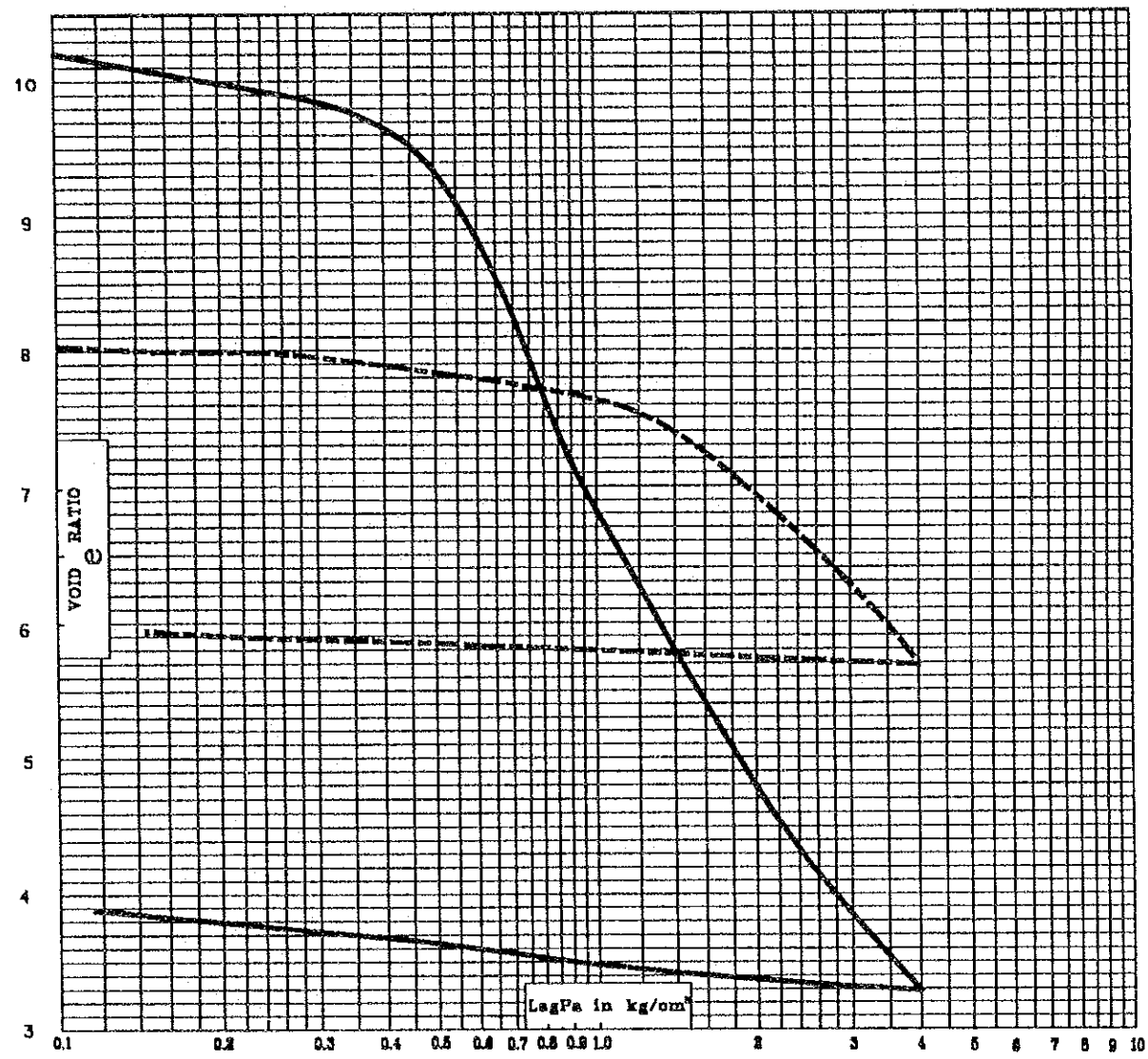
CLASSIFICATION

FIG : 22

C O N S O L I D A T I O N

COMPRESSIBILITY CURVE

Pa= APPLY PRESSURE P= TOTAL PRESSURE P= EFFECTIVE PRESSURE Pc= PRECONSOLIDATION PRE



MEDIUM DEEP	SAMPLE No	SYMBOL	W	e	Gw	γm	Ss	P̄	Pc
(m)	-		(%)	-	(%)	T/m³	-	kg/cm²	kg/cm²
5.23	6 up	———	432.9	10.229	100	1.265	2.665		0.555
15.23	17 up	- - - -	313.8	8.090	100	1.191	2.616		1.580

P̄ - EFFECTIVE PRESSURE

Pc - PRECONSOLIDATION PRESSURE

A L S Y R

PROJECT : WASTE WATER TREATMENT
SOSA TEXCOCO

LOCALIZATION : EDO. DE MEXICO

BORING: SM-2

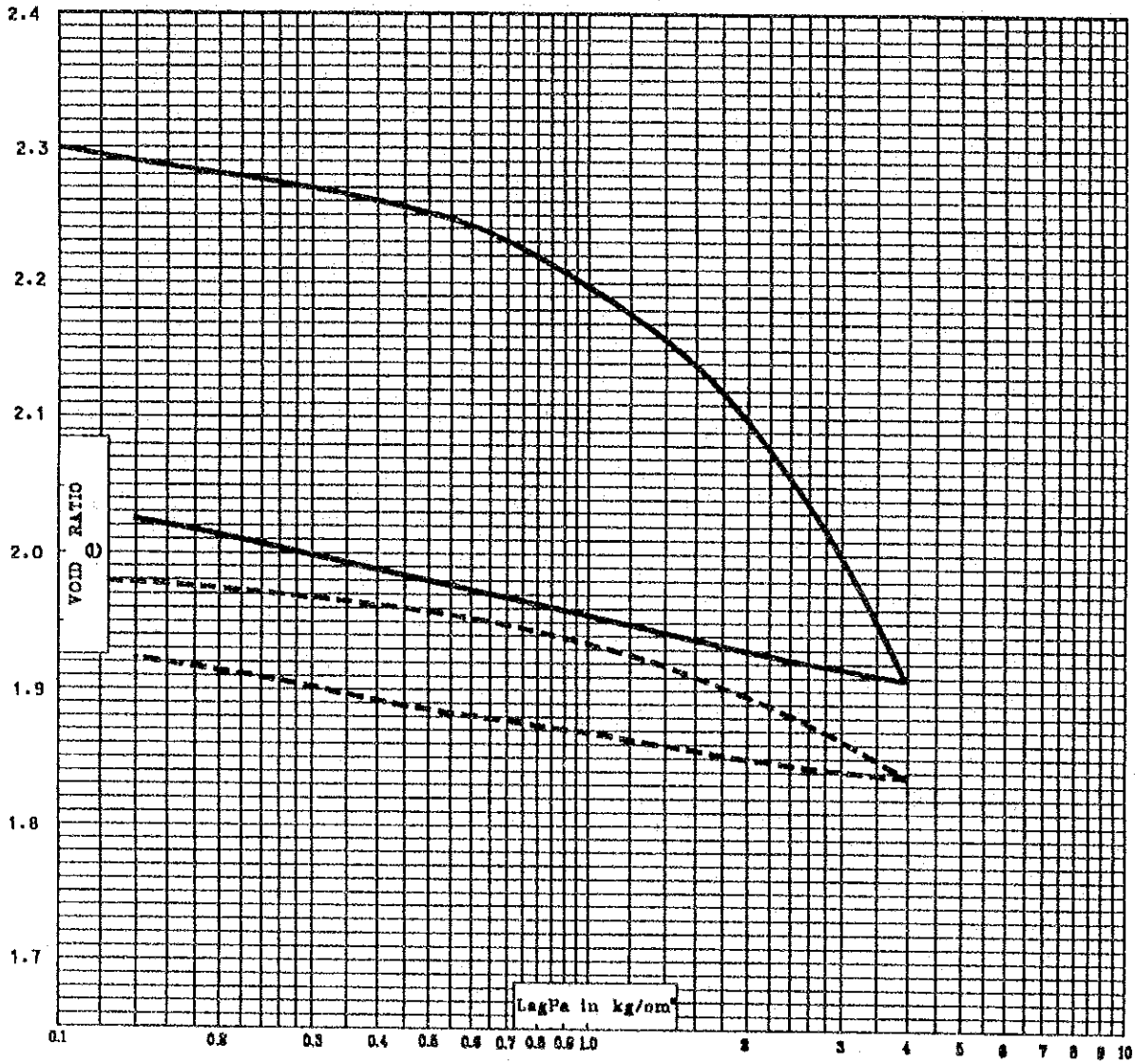
CLASSIFICATION

FIG : 23.

C O N S O L I D A T I O N

COMPRESSIBILITY CURVE

Pa- APPLY PRESSURE P- TOTAL PRESSURE P̄- EFFECTIVE PRESSURE Po- PRECONSOLIDATION PRE



MEDIUM DEEP	SAMPLE No	SYMBOL	W	e	Gw	γm	Ss	P̄	Pc
(m)	-		(%)	-	(%)	T/m³	-	kg/cm²	kg/cm²
25.45	28	———	95.4	2.305	100	1.433	2.424		1.75
26.43	29 down	- - - -	842	1.995	100	1.462	2.377		1.60

P̄ - EFFECTIVE PRESSURE

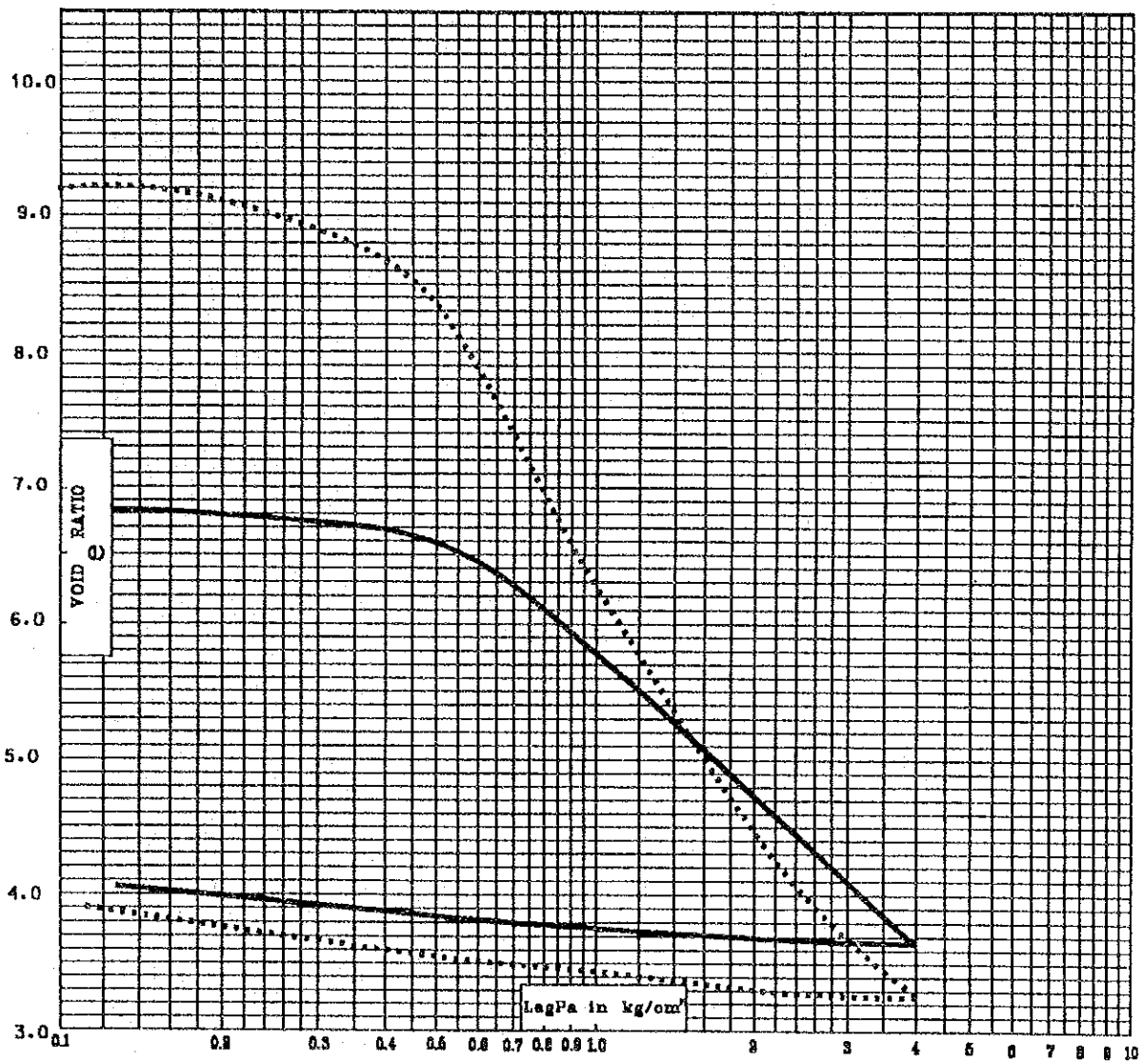
Pc - PRECONSOLIDATION PRESSURE

A L S Y R	
PROJECT : WASTE WATER TREATMENT SOSA TEXCOCO	
LOCALIZATION : EDO. DE MEXICO	BORING: SM-2
CLASSIFICATION	FIG : 24

C O N S O L I D A T I O N

COMPRESSIBILITY CURVE

Pa= APPLY PRESSURE P= TOTAL PRESSURE P̄= EFFECTIVE PRESSURE Pc= PRECONSOLIDATION PRE



MEDIUM DEEP	SAMPLE No	SYMBOL	W	e	Gw	γm	Ss	P̄	Pc
(m)	-		(%)	-	(%)	T/m³	-	kg/cm²	kg/cm²
1.425	3 up	———	207.3	6.872	86.8	1.088	2.455		0.70
3.375	5 down	.....	314.8	9.320	100	1.142	2.361		0.45

P̄ - EFFECTIVE PRESSURE

Pc - PRECONSOLIDATION PRESSURE

A L S Y R

PROJECT : WASTE WATER TREATMENT
SOSA TEXCOCO

LOCALIZATION : EDO. DE MEXICO

BORING: SM-3

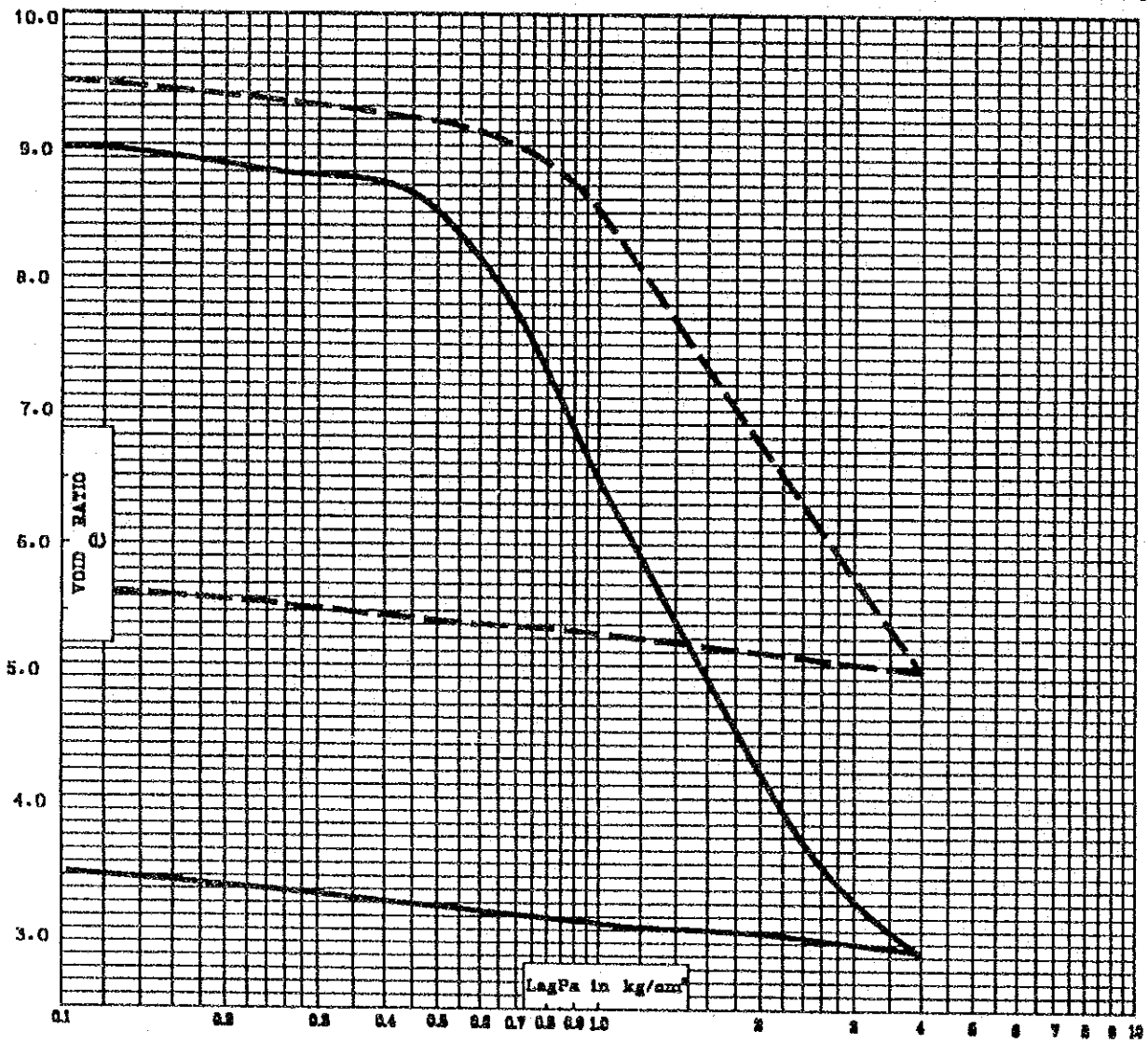
CLASSIFICATION

FIG : 25

C O N S O L I D A T I O N

COMPRESSIBILITY CURVE

Pa- APPLY PRESSURE P- TOTAL PRESSURE P- EFFECTIVE PRESSURE Pc- PRECONSOLIDATION PRE



MEDIUM DEEP	SAMPLE No	SYMBOL	W	e	Gw	γ_m	Ss	$\bar{P}$	Pc
(m)	-		(%)	-	(%)	T/m³	-	kg/cm²	kg/cm²
4.875	7 down	———	323.5	9.116	99.5	1.128	2.333		0.50
6.675	9 down	- - - -	312.3	9.526	100	1.165	2.529		1.00

$\bar{P}$ - EFFECTIVE PRESSURE

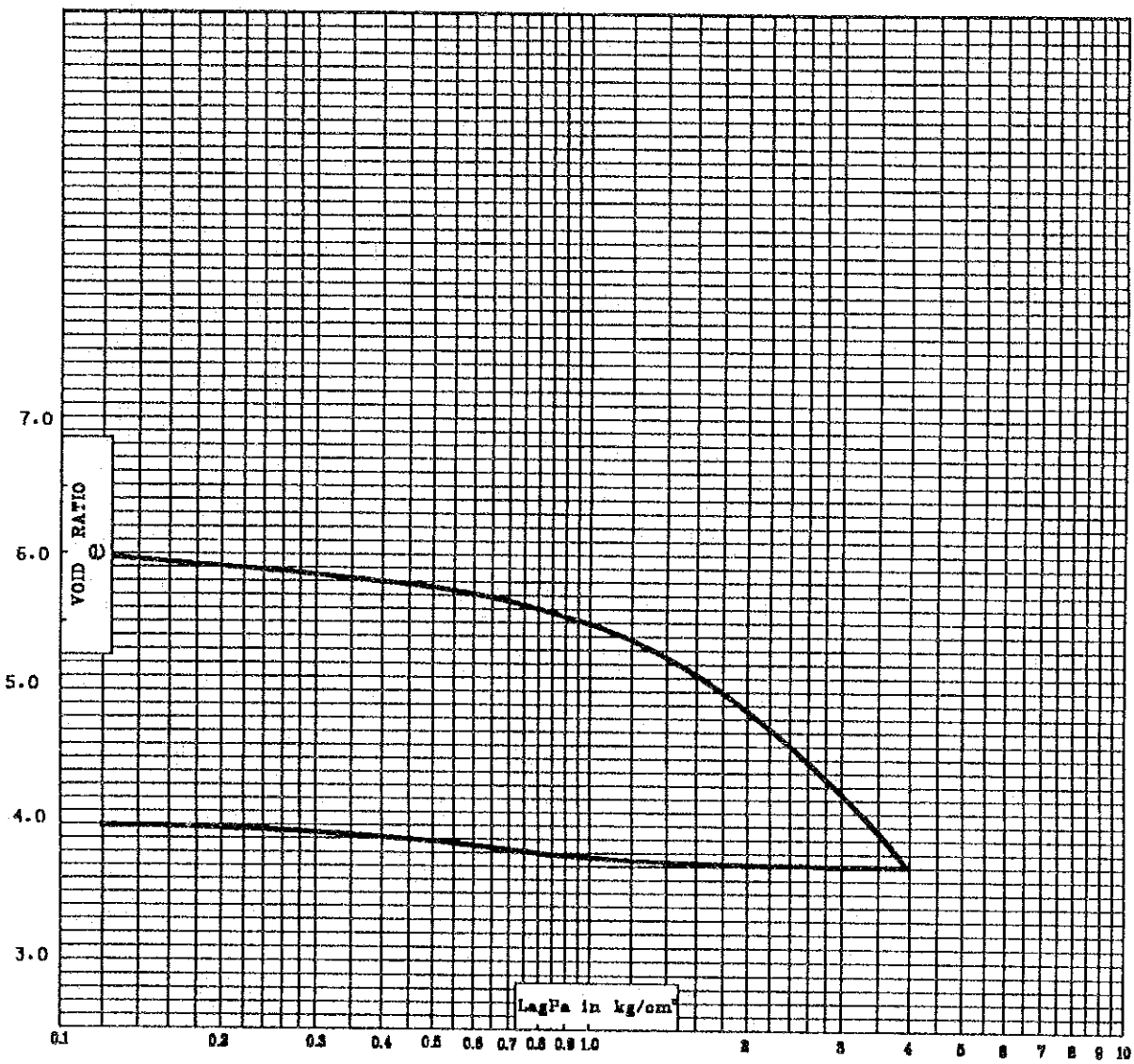
Pc - PRECONSOLIDATION PRESSURE

A L S Y R	
PROJECT : WASTE WATER TREATMENT SOSA TEXCOCO	
LOCALIZATION : EDO. DE MEXICO	BORING: SM-3
CLASSIFICATION	FIG : 26

C O N S O L I D A T I O N

COMPRESSIBILITY CURVE

Pa- APPLY PRESSURE P- TOTAL PRESSURE P̄- EFFECTIVE PRESSURE Po- PRECONSOLIDATION PRE



MEDIUM DEEP	SAMPLE No	SYMBOL	W	e	Gw	γm	Ss	P̄	Pc
(m)	-		(%)	-	(%)	T/m³	-	kg/cm²	kg/cm²
11.47	16down	———	219.8	5.959	100	1.229	2.491		1.60

P̄ - EFFECTIVE PRESSURE

Pc - PRECONSOLIDATION PRESSURE

A L S Y R

PROJECT : WASTE WATER TREATMENT
SOSA TEXCOCO

LOCALIZATION : EDO. DE MEXICO

BORING: SM-3

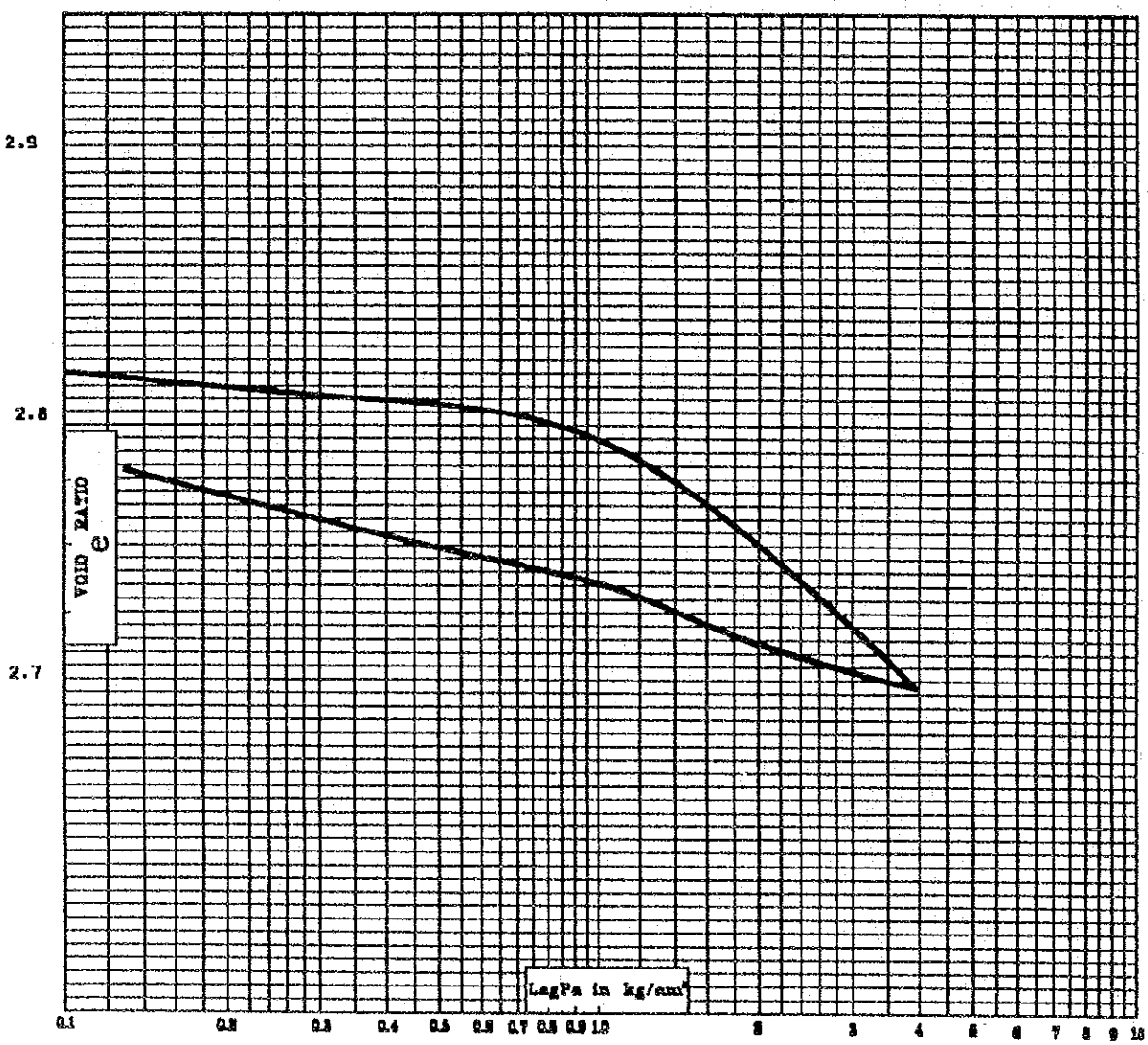
CLASSIFICATION

FIG : 27

C O N S O L I D A T I O N

COMPRESSIBILITY CURVE

Pa= APPLY PRESSURE P= TOTAL PRESSURE $\bar{P}$= EFFECTIVE PRESSURE Pc= PRECONSOLIDATION PRE

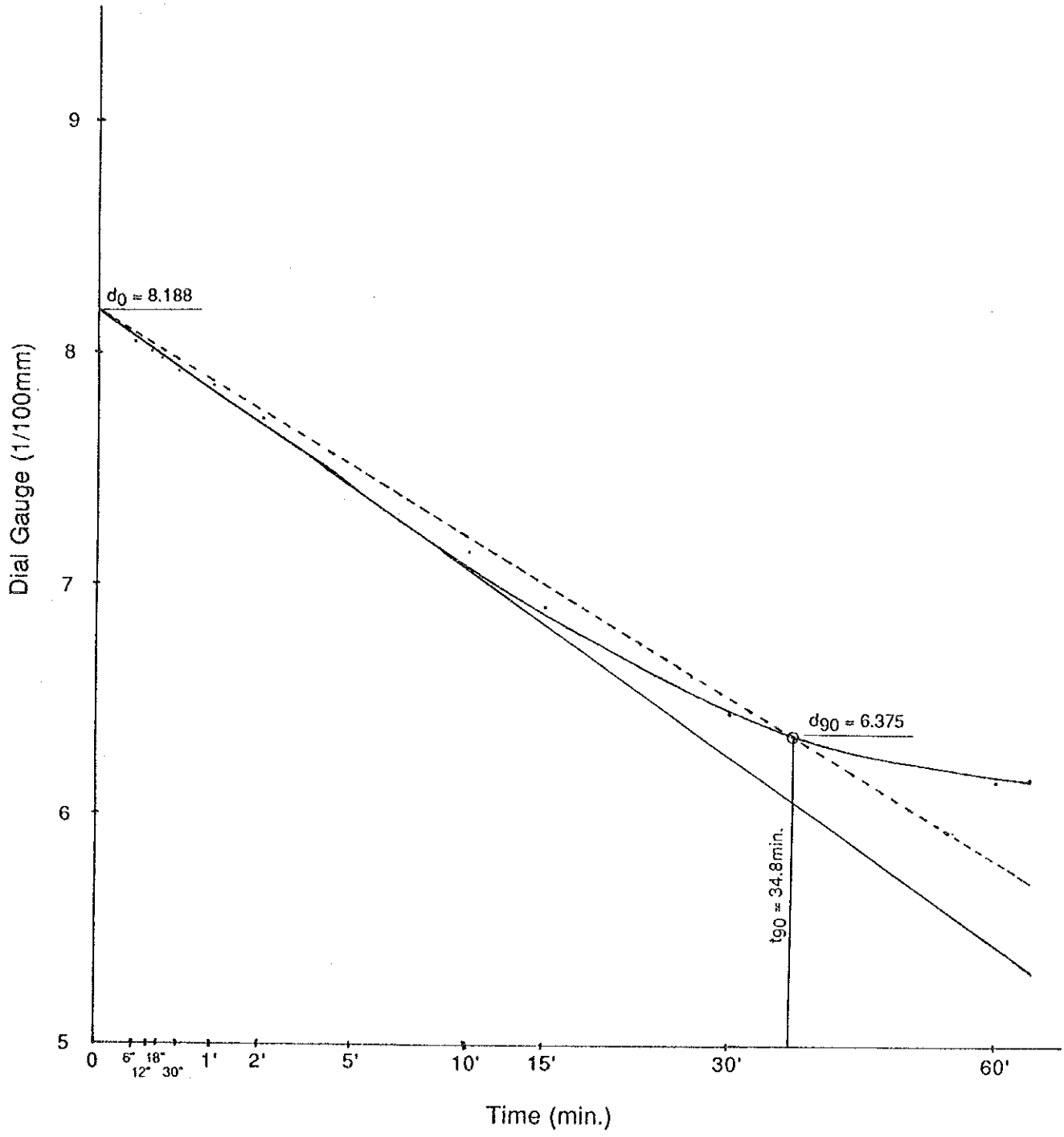


MEDIUM DEEP	SAMPLE No	SYMBOL	W	e	Gw	γ_m	Ss	$\bar{P}$	Pc
(m)	-		(%)	-	(%)	T/m³	-	kg/cm²	kg/cm²
14.77	21down	———	106.7	2.854	96.0	1.483	2.361		

$\bar{P}$ = EFFECTIVE PRESSURE

Pc = PRECONSOLIDATION PRESSURE

A L S Y R	
PROJECT : WASTE WATER TREATMENT SOSA TEXCOCO	
LOCALIZATION : EDO. DE MEXICO	BORING: SM-3
CLASSIFICATION	FIG : 27 a



$\sqrt{t}$ Method

WATER QUALITY DATA OF TERMOELECTRICA VALLE DE MEXICO TREATMENT PLANT AND GRAN CANAL

DECEMBER 1994

JAPAN INTERNATIONAL COOPERATION AGENCY

Table Water Quality Data of Termoelectrica Valle de Mexico treatment plant

(1) Monthly Average

1st unit (BOD)

	Primary Sed. Tank			Secondary Effluent	Total Removal Efficiency
	Influent	Effluent	Removal Efficiency		
APR.1993	266 mg/l	229	13.9 %	23	91.4 %
MAY.1993	250 mg/l	182	27.2 %	40	84.0 %
JUN.1993	255 mg/l	184	27.8 %	32	87.5 %
JUL.1993	260 mg/l	247	5.0 %	14	94.6 %
AUG.1993	_	_	####	_	###
SEP.1993	208 mg/l	178	14.4 %	24	88.5 %
OCT.1993	314 mg/l	288	8.3 %	38	87.9 %
NOV.1993	255 mg/l	184	27.8 %	33	87.1 %
DEC.1993	257 mg/l	187	27.2 %	34	86.8 %
JUN.1994	246 mg/l	_	####		###
Average			19.0 %		88.5 %

1st unit (SS)

	Primary Sed. Tank			Secondary Effluent	Total Removal Efficiency
	Influent	Effluent	Removal Efficiency		
APR.1993	228 mg/l	133	41.7 %	19	91.7 %
MAY.1993	375 mg/l	181	51.7 %	31	91.7 %
JUN.1993	258 mg/l	152	41.1 %	21	91.9 %
JUL.1993	306 mg/l	154	49.7 %	23	92.5 %
AUG.1993	314 mg/l	170	45.9 %	25	92.0 %
SEP.1993	198 mg/l	100	49.5 %	21	89.4 %
OCT.1993	266 mg/l	154	42.1 %	22	91.7 %
NOV.1993	238 mg/l	128	46.2 %	23	90.3 %
DEC.1993	255 mg/l	135	47.1 %	22	91.4 %
JUN.1994	246 mg/l	117	52.4 %	21	91.5 %
Average			46.7 %		91.4 %

2nd/3rd unit (BOD)

	Primary Sed. Tank			Secondary Effluent	Total Removal Efficiency
Influent	Influent	Effluent	Removal Efficiency		
APR.1993	266 mg/l	216	18.8 %	20	92.5 %
MAY.1993	250 mg/l	183	26.8 %	34	86.4 %
JUN.1993	255 mg/l	180	29.4 %	35	86.3 %
JUL.1993	260 mg/l	193	25.8 %	13	95.0 %
AUG.1993	_	_	####	_	###
SEP.1993	208 mg/l	172	17.3 %	22	89.4 %
OCT.1993	314 mg/l	283	9.9 %	30	90.4 %
NOV.1993	255 mg/l	180	29.4 %	35	86.3 %
DEC.1993	257 mg/l	182	29.2 %	37	85.6 %
JUN.1994	246 mg/l	_	####	23	90.7 %
Average			23.3 %		89.2 %

2nd/3rd unit (SS)

	Primary Sed. Tank			Secondary Effluent	Total Removal Efficiency
	Influent	Effluent	Removal Efficiency		
APR.1993	228 mg/l	120	47.4 %	18	92.1 %
MAY.1993	375 mg/l	183	51.2 %	34	90.9 %
JUN.1993	258 mg/l	154	40.3 %	20	92.2 %
JUL.1993	306 mg/l	170	44.4 %	23	92.5 %
AUG.1993	314 mg/l	160	49.0 %	24	92.4 %
SEP.1993	198 mg/l	90	54.5 %	15	92.4 %
OCT.1993	266 mg/l	146	45.1 %	18	93.2 %
NOV.1993	238 mg/l	122	48.7 %	20	91.6 %
DEC.1993	255 mg/l	132	48.2 %	20	92.2 %
JUN.1994	246 mg/l	126	48.8 %	22	91.1 %
Average			47.8 %		92.1 %

4th unit (BOD)

	Primary Sed. Tank			Secondary Effluent	Total Removal Efficiency
	Influent	Effluent	Removal Efficiency		
APR.1993	266 mg/l	210	21.1 %	20	92.5 %
MAY.1993	250 mg/l	192	23.2 %	24	90.4 %
JUN.1993	255 mg/l	185	27.5 %	25	90.2 %
JUL.1993	260 mg/l	224	13.8 %	16	93.8 %
AUG.1993	_	_	####	_	###
SEP.1993	208 mg/l	184	11.5 %	26	87.5 %
OCT.1993	314 mg/l	295	6.1 %	32	89.8 %
NOV.1993	255 mg/l	185	27.5 %	25	90.2 %
DEC.1993	257 mg/l	189	26.5 %	28	89.1 %
JUN.1994	246 mg/l	_	####	23	90.7 %
Average			19.6 %		90.5 %

4th unit (SS)

	Primary Sed. Tank			Secondary Effluent	Total Removal Efficiency
	Influent	Effluent	Removal Efficiency		
APR.1993	228 mg/l	130	43.0 %	18	92.1 %
MAY.1993	375 mg/l	197	47.5 %	27	92.8 %
JUN.1993	258 mg/l	152	41.1 %	20	92.2 %
JUL.1993	306 mg/l	150	51.0 %	22	92.8 %
AUG.1993	314 mg/l	160	49.0 %	21	93.3 %
SEP.1993	198 mg/l	88	55.6 %	17	91.4 %
OCT.1993	266 mg/l	152	42.9 %	20	92.5 %
NOV.1993	238 mg/l	127	46.6 %	19	92.0 %
DEC.1993	255 mg/l	133	47.8 %	20	92.2 %
JUN.1994	246 mg/l	128	48.0 %	23	90.7 %
Average			47.2 %		92.2 %

Table Water Quality Data of Termoelectrica Valle de Mexico treatment plant

(2) Minimum Value

1st unit (BOD)

	Primary Sed. Tank			Secondary	Total
	Influent	Effluent	Removal Efficiency	Effluent	Removal Efficiency
APR.1993	239 mg/l	192	19.7 %	11	95.4 %
MAY.1993	226 mg/l	173	23.5 %	30	86.7 %
JUN.1993	230 mg/l	170	26.1 %	23	90.0 %
JUL.1993	227 mg/l	213	6.2 %	12	94.7 %
AUG.1993	_	_	####	_	###
SEP.1993	125 mg/l	110	12.0 %	16	87.2 %
OCT.1993	223 mg/l	183	17.9 %	31	86.1 %
NOV.1993	230 mg/l	170	26.1 %	25	89.1 %
DEC.1993	232 mg/l	173	25.4 %	26	88.8 %
JUN.1994	183 mg/l				%
Average			19.6 %		89.8 %

1st unit (SS)

	Primary Sed. Tank			Secondary	Total
	Influent	Effluent	Removal Efficiency	Effluent	Removal Efficiency
APR.1993	196 mg/l	108	44.9 %	16	91.8 %
MAY.1993	200 mg/l	112	44.0 %	14	93.0 %
JUN.1993	200 mg/l	108	46.0 %	18	91.0 %
JUL.1993	196 mg/l	112	42.9 %	20	89.8 %
AUG.1993	260 mg/l	152	41.5 %	22	91.5 %
SEP.1993	152 mg/l	60	60.5 %	16	89.5 %
OCT.1993	212 mg/l	112	47.2 %	18	91.5 %
NOV.1993	200 mg/l	96	52.0 %	20	90.0 %
DEC.1993	224 mg/l	116	48.2 %	18	92.0 %
JUN.1994	216 mg/l	116	46.3 %	20	90.7 %
Average			47.4 %		91.1 %

2nd/3rd unit (BOD)

	Primary Sed. Tank			Secondary	Total
	Influent	Effluent	Removal Efficiency	Effluent	Removal Efficiency
APR.1993	239 mg/l	179	25.1 %	13	94.6 %
MAY.1993	226 mg/l	173	23.5 %	22	90.3 %
JUN.1993	230 mg/l	163	29.1 %	20	91.3 %
JUL.1993	227 mg/l	153	32.6 %	8	96.5 %
AUG.1993	_	_	####	_	###
SEP.1993	125 mg/l	105	16.0 %	18	85.6 %
OCT.1993	223 mg/l	173	22.4 %	26	88.3 %
NOV.1993	230 mg/l	163	29.1 %	20	91.3 %
DEC.1993	232 mg/l	165	28.9 %	22	90.5 %
JUN.1994	183 mg/l	168	8.2 %	10	94.5 %
Average			23.9 %		91.4 %

2nd/3rd unit (SS)

	Primary Sed. Tank			Secondary	Total
	Influent	Effluent	Removal Efficiency	Effluent	Removal Efficiency
APR.1993	196 mg/l	100	49.0 %	16	91.8 %
MAY.1993	200 mg/l	122	39.0 %	18	91.0 %
JUN.1993	200 mg/l	112	44.0 %	16	92.0 %
JUL.1993	196 mg/l	120	38.8 %	18	90.8 %
AUG.1993	260 mg/l	140	46.2 %	20	92.3 %
SEP.1993	152 mg/l	60	60.5 %	12	92.1 %
OCT.1993	212 mg/l	112	47.2 %	16	92.5 %
NOV.1993	200 mg/l	100	50.0 %	16	92.0 %
DEC.1993	224 mg/l	112	50.0 %	18	92.0 %
JUN.1994	216 mg/l	112	48.1 %	18	91.7 %
Average			47.3 %		91.8 %

4th unit (BOD)

	Primary Sed. Tank			Secondary	Total
	Influent	Effluent	Removal Efficiency	Effluent	Removal Efficiency
APR.1993	239 mg/l	179	25.1 %	11	95.4 %
MAY.1993	226 mg/l	173	23.5 %	16	92.9 %
JUN.1993	230 mg/l	170	26.1 %	15	93.5 %
JUL.1993	227 mg/l	180	20.7 %	10	95.6 %
AUG.1993	_	_	####	_	###
SEP.1993	125 mg/l	115	8.0 %	21	83.2 %
OCT.1993	223 mg/l	204	8.5 %	27	87.9 %
NOV.1993	230 mg/l	170	26.1 %	15	93.5 %
DEC.1993	232 mg/l	174	25.0 %	18	92.2 %
JUN.1994	183 mg/l	163	10.9 %	15	91.8 %
Average			19.3 %		91.8 %

4th unit (SS)

	Primary Sed. Tank			Secondary	Total
	Influent	Effluent	Removal Efficiency	Effluent	Removal Efficiency
APR.1993	196 mg/l	112	42.9 %	16	91.8 %
MAY.1993	200 mg/l	122	39.0 %	16	92.0 %
JUN.1993	200 mg/l	108	46.0 %	16	92.0 %
JUL.1993	196 mg/l	112	42.9 %	18	90.8 %
AUG.1993	260 mg/l	140	46.2 %	20	92.3 %
SEP.1993	152 mg/l	56	63.2 %	12	92.1 %
OCT.1993	212 mg/l	116	45.3 %	18	91.5 %
NOV.1993	200 mg/l	100	50.0 %	16	92.0 %
DEC.1993	224 mg/l	116	48.2 %	18	92.0 %
JUN.1994	216 mg/l	112	48.1 %	18	91.7 %
Average			47.2 %		91.8 %

Table Water Quality of Gran Canal (Dry Season)

Location	Month Year	Dry Season TSS	ISS	VSS	BOD	BOD Soluble	BOD Particle
Cerro Gordo	10/'91~3/'92	135	43	91	231 (100)	128 (55)	103 (45)
San Cristobal Num 1	12 /'92	203	49	154	271 (100)	175 (65)	96 (35)
San Cristobal Num 1	10/'91~3/'92	230	61	168	235 (100)	169 (72)	66 (28)
Lopez Portillo	10/'92	278	121	157	209 (100)	144 (69)	65 (31)
Lopez Portillo	10/'91~3/'92	235	97	138	251 (100)	182 (73)	69 (27)
Zumpango	10/'92	357	198	159	161 (100)	99 (61)	62 (39)
Zumpango	11/'92	244	106	139	165 (100)	124 (75)	41 (25)
Zumpango	12/'92	289	151	137	315 (100)	161 (51)	154 (49)
Zumpango	10/'91~3/'92	185	70	106	241 (100)	178 (74)	63 (26)
San Pedro	10/'91~3/'92	179	66	113	254 (100)	171 (67)	83 (33)
San Lazaro	10/'92	100	32	69	231 (100)	182 (79)	49 (21)
San Lazaro	11/'92	85	35	50	168 (100)	106 (63)	62 (37)
San Lazaro	12/'92	137	31	99	230 (100)	120 (52)	110 (48)
San Lazaro	10/'92~3/'92	120	25	95	185 (100)	111 (60)	74 (40)
San Juan de Aragon	9/'92	164	54	110	136 (100)	54 (40)	82 (60)
San Juan de Aragon	12/'92	148	34	100	203 (100)	145 (71)	58 (29)
San Juan de Aragon	10/'91~3/'92	166	43	123	244 (100)	131 (54)	113 (46)
San Juan de Aragon	10/'91~3/'92	74	34	41	27 (100)	7 (26)	20 (74)
Ejido	10/'92	240	143	96	110 (100)	72 (65)	38 (35)
Ejido	12/'92	129	51	78	215 (100)	136 (63)	79 (37)
Ejido	10/'91~3/'92	184	63	121	234 (100)	191 (82)	43 (18)
Avenida Central	10/'91~3/'92	180	70	110	249 (100)	129 (52)	120 (48)
Cerro Gordo	2/'93	133	33	105	217 (100)	147 (68)	70 (32)
Cerro Gordo	3/'93	153	46	107	233 (100)	119 (51)	114 (49)
Cerro Gordo	10/'92~3/'93	202	81	103	189 (100)	140 (74)	49 (26)
San Cristobal Num. 1	11/'93	179	105	71	199 (100)	164 (82)	35 (18)
San Cristobal Num. 1	12/'93	178	83	102	238 (100)	191 (80)	47 (20)
Lopez Portillo	3/'93	193	50	90	242 (100)	138 (57)	104 (43)
Lopez Portillo	10/'92~3/'93	233	100	130	226 (100)	139 (62)	87 (38)
Zumpango	11/'93	283	165	118	214 (100)	157 (73)	57 (27)
Zumpango	12/'93	443	165	278	228 (100)	120 (53)	108 (47)
San Pedro	2/'93	254	122	131	235 (100)	132 (56)	103 (44)
San Pedro	10/'92~3/'93	218	109	118	195 (100)	132 (68)	63 (32)
San Lazaro	1/'93	155	67	80	280 (100)	133 (48)	147 (53)
San Lazaro	2/'93	122	46	66	187 (100)	106 (57)	81 (43)
San Lazaro	3/'93	120	8	113	165 (100)	87 (53)	78 (47)
San Lazaro	11/'93	148	39	108	177 (100)	113 (64)	64 (36)
San Lazaro	12/'93	113	34	78	186 (100)	91 (49)	95 (51)
San Lazaro	10/'92~3/'93	123	31	80	212 (100)	111 (52)	101 (48)
San Juan de Aragon	1/'93	131	60	135	206 (100)	105 (51)	101 (49)
San Juan de Aragon	2/'93	125	30	67	153 (100)	105 (69)	48 (31)
San Juan de Aragon	12/'93	183	100	153	237 (100)	168 (71)	69 (29)
San Juan de Aragon	10/'92~3/'93	128	36	89	179 (100)	116 (65)	63 (35)
Ejido	1/'93	273	172	170	255 (100)	186 (73)	69 (27)
Ejido	2/'93	142	35	79	227 (100)	141 (62)	86 (38)
Ejido	3/'93	107	31	77	229 (100)	139 (61)	90 (39)
Ejido	10/'92~3/'93	171	75	88	198 (100)	139 (70)	59 (30)
Avenida Central	1/'93	167	76	91	256 (100)	156 (61)	100 (39)
Avenida Central	10/'92~3/'93	212	100	122	249 (100)	156 (63)	93 (37)

Ave. 38

Table Water Quality of Gran Canal (Rainny Season)

Rainny Season

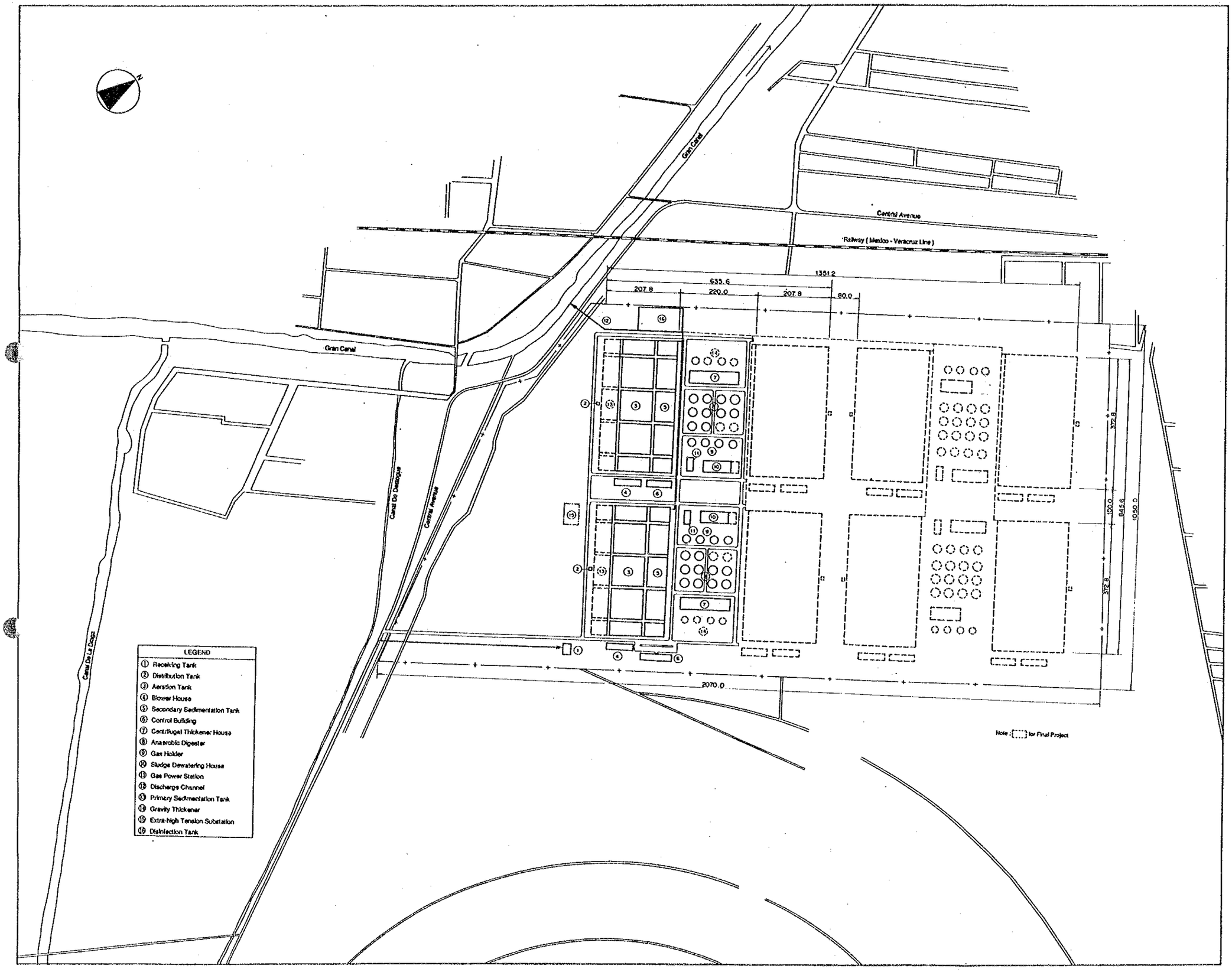
Location	Month Year	TSS	ISS	VSS	BOD	BOD Soluble	BOD Particle
ZUMPANGO	6 /'92	380	229	152	182 (100)	97 (53)	85 (47)
ZUMPANGO	8 /'92	458	256	201	131 (100)	55 (42)	76 (58)
ZUMPANGO	9 /'92	291	200	91	183 (100)	123 (67)	60 (33)
ZUMPANGO	4~9/'92	359	210	149	180 (100)	110 (61)	70 (39)
San Lazaro	6/'92	117	26	91	191 (100)	69 (36)	122 (64)
San Lazaro	8/'92	76	16	60	112 (100)	55 (49)	57 (51)
San Lazaro	9/'92	106	23	83	171 (100)	84 (49)	87 (51)
San Lazaro	4/'92~9/'92	113	25	88	165 (100)	77 (47)	88 (53)
San Juan de Aragon	6/'92	209	73	135	137 (100)	134 (98)	3 (2)
San Juan de Aragon	8/'92	105	31	85	103 (100)	46 (45)	57 (55)
San Juan de Aragon	4/'92~9/'92	19	10	12	30 (100)	5 (17)	25 (83)
San Juan de Aragon	4/'92~9/'92	173	55	129	185 (100)	78 (42)	107 (58)
Ejido	6/'92	240	103	137	142 (100)	136 (96)	6 (4)
Ejido	9/'92	271	217	85	185 (100)	57 (31)	128 (69)
Ejido	4/'92~9/'92	234	116	119	177 (100)	97 (55)	80 (45)
Cerro Gordo	7/'93	533	600	240	152 (100)	82 (54)	70 (46)
Cerro Gordo	4/'93~9/'93	268	325	220	228 (100)	82 (36)	146 (64)
Lopez Portillo	7/'93	301	73	66	149 (100)	69 (46)	80 (54)
Lopez Portillo	8/'93	278	174	130	167 (100)	115 (69)	52 (31)
Lopez Portillo	4/'93~9/'93	266	142	121	184 (100)	106 (58)	78 (42)
San Pedro	7/'93	432	200	140	146 (100)	69 (47)	77 (53)
San Pedro	4/'93~9/'93	199	200	140	153 (100)	69 (45)	84 (55)
San Lazaro	5/'93	106	10	102	161 (100)	83 (52)	78 (48)
San Lazaro	6/'93	92	23	69	119 (100)	51 (43)	68 (57)
San Lazaro	8/'93	128	34	94	114 (100)	78 (68)	36 (32)
San Lazaro	9/'93	132	22	109	111 (100)	72 (65)	39 (35)
San Lazaro	4/'93~9/'93	109	22	87	133 (100)	68 (51)	65 (49)
San Juan de Aragon	4/'93~9/'93	161	45	87	172 (100)	24 (14)	148 (86)
Ejido	4/'93	142	43	99	252 (100)	142 (56)	110 (44)
Ejido	5/'93	146	56	90	226 (100)	145 (64)	81 (36)
Ejido	6/'93	680	613	353	193 (100)	104 (54)	89 (46)
Ejido	8/'93	403	220	140	182 (100)	110 (60)	72 (40)
Avenida Central	7/'93	1168	625	268	170 (100)	77 (45)	93 (55)
Avenida Central	4/'93~9/'93	451	308	159	227 (100)	102 (45)	125 (55)
Obra de Toma	7/'93	2147	1882	265	165 (100)	59 (36)	106 (64)
Obra de Toma	4/'93~9/'93	788	1882	265	146 (100)	59 (40)	87 (60)
Zumpango	8/'92	458	256	201	131 (100)	55 (42)	76 (58)
San Lazaro	7/'93	70	11	59	99 (100)	38 (38)	61 (62)
San Juan de Aragon	7/'93	166	75	80	121 (100)	24 (20)	107 (58)
Ejido	7/'93	574	353	220	176 (100)	104 (59)	72 (41)
San Lazaro	4/'93	117	22	95	184 (100)	77 (42)	97 (80)
Ejido	9/'93	290	230	131	174 (100)	112 (64)	62 (36)
Ejido	4/'93~9/'93	378	231	166	202 (100)	121 (60)	81 (40)
Avenida Central	9/'93	359	220	140	141 (100)	128 (91)	13 (9)

Ave. 49

DRAWINGS

DECEMBER 1994

JAPAN INTERNATIONAL COOPERATION AGENCY



THE FEDERAL DISTRICT OF MEXICO

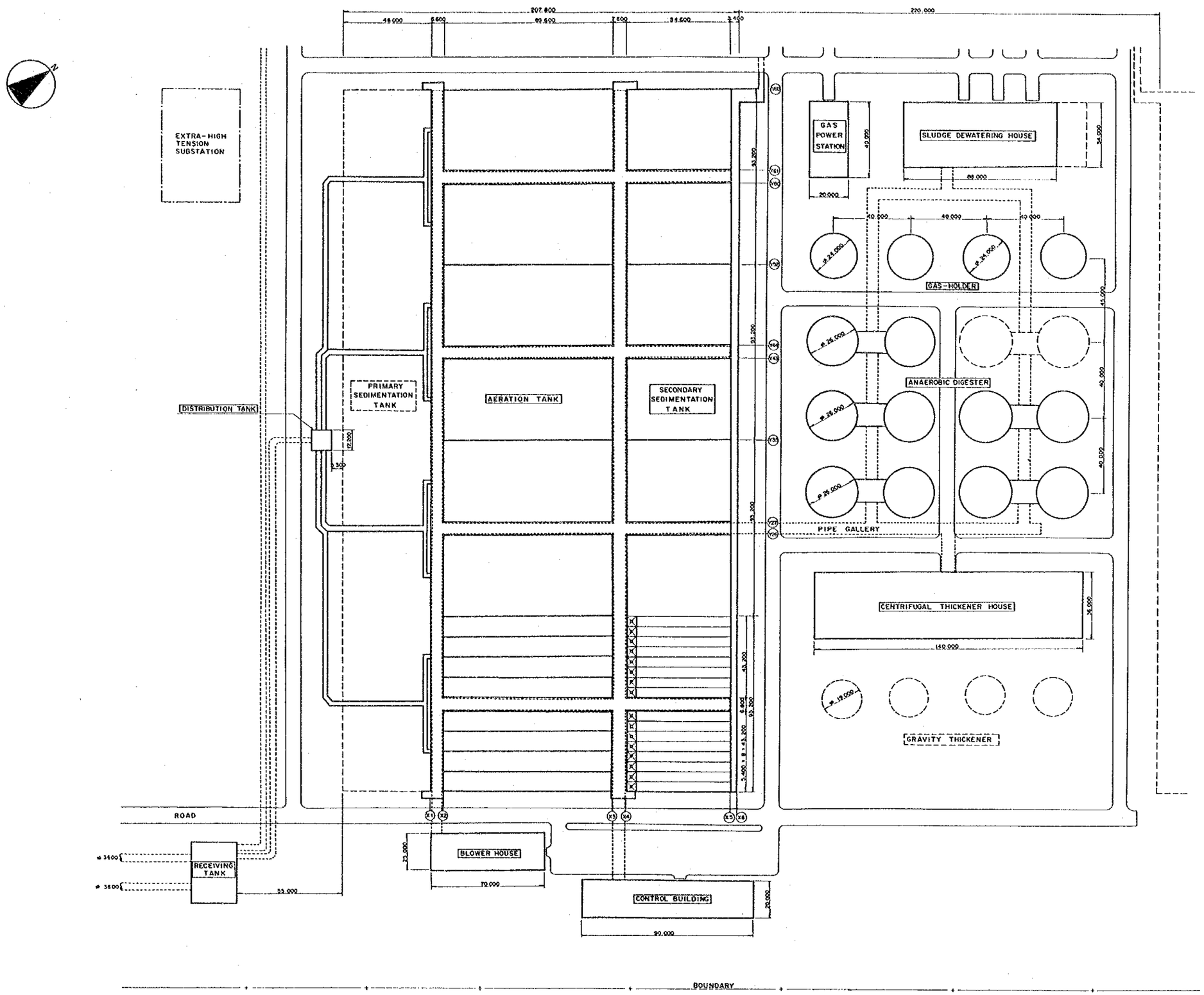
THE GENERAL DIRECTION OF CONSTRUCTION AND HYDRAULIC OPERATION (DGCOH)

THE FEASIBILITY STUDY ON WASTEWATER TREATMENT IN THE FEDERAL DISTRICT OF MEXICO

1. General Layout

SCALE	1 / 5000

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



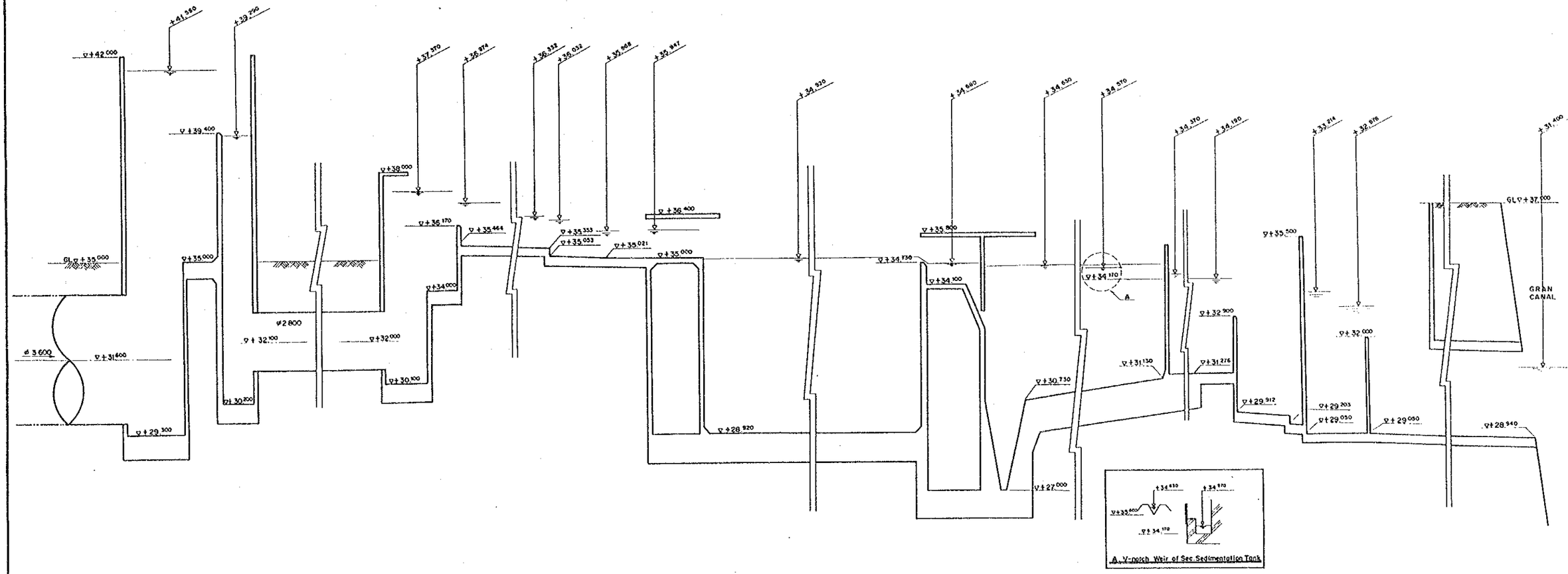
THE FEDERAL DISTRICT OF MEXICO
THE GENERAL DIRECTION OF CONSTRUCTION AND HYDRAULIC OPERATION (DGCOH)

THE FEASIBILITY STUDY ON WASTEWATER TREATMENT IN THE FEDERAL DISTRICT OF MEXICO

2. Layout of Wastewater Treatment Plant

SCALE 1/1000

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

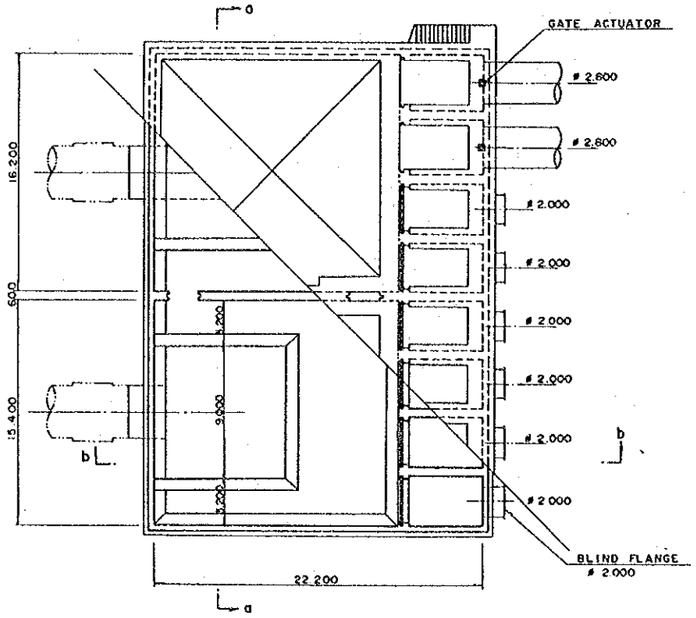


Receiving Tank | Distribution Tank | Aeration Tank | Sec. Sedimentation Tank | Effluent Flume | Disinfection Tank | Discharge Channel

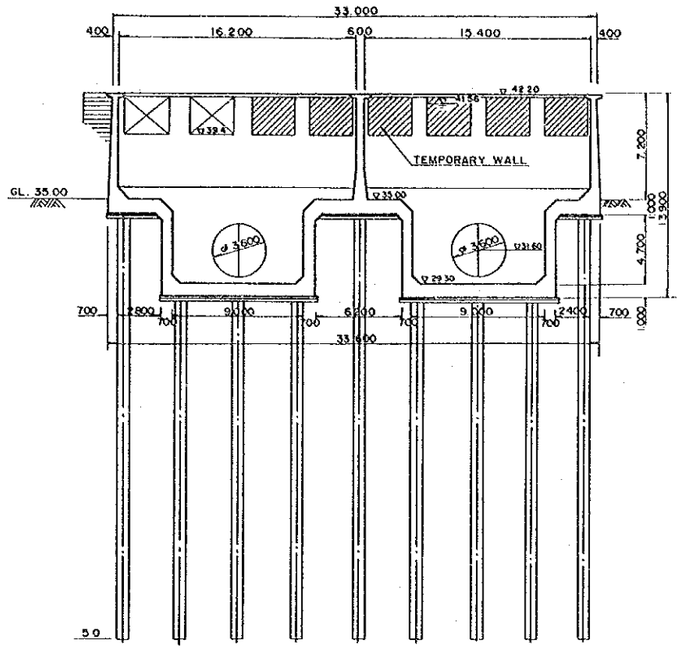
THE FEDERAL DISTRICT OF MEXICO THE GENERAL DIRECTION OF CONSTRUCTION AND HYDRAULIC OPERATION (DGCOH)	
THE FEASIBILITY STUDY ON WASTEWATER TREATMENT IN THE FEDERAL DISTRICT OF MEXICO	
3. Hydraulic Profile of Wastewater Treatment Plant	
SCALE	FREE
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

RECEIVING TANK

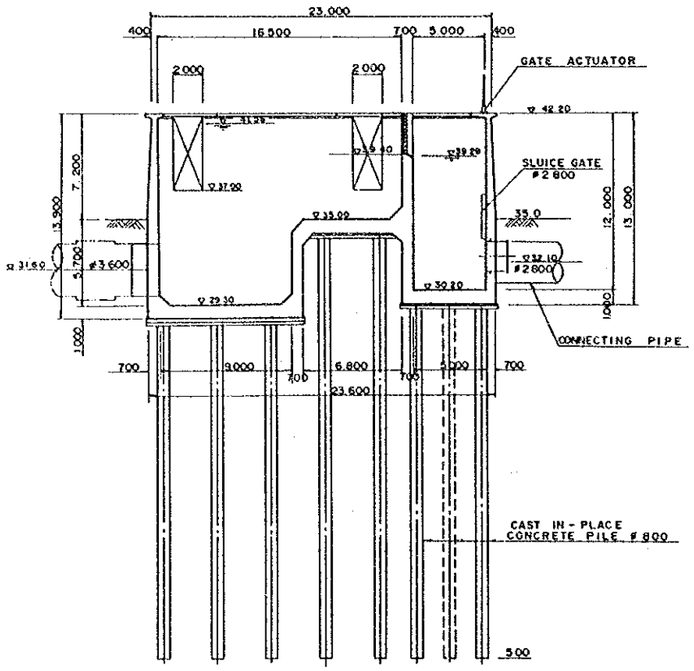
SCALE 1 : 200



PLAN



SECTION a - a

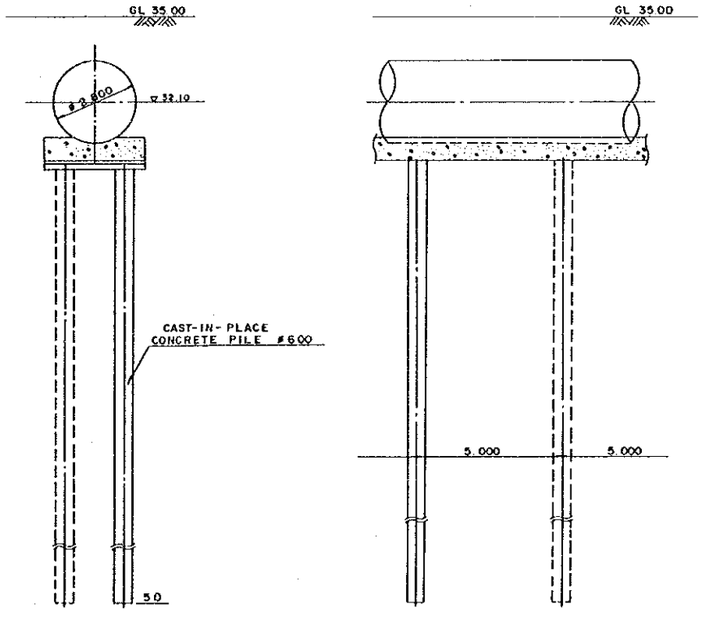


Unit : m

SECTION b - b

TYPICAL SECTION OF CONNECTING PIPE

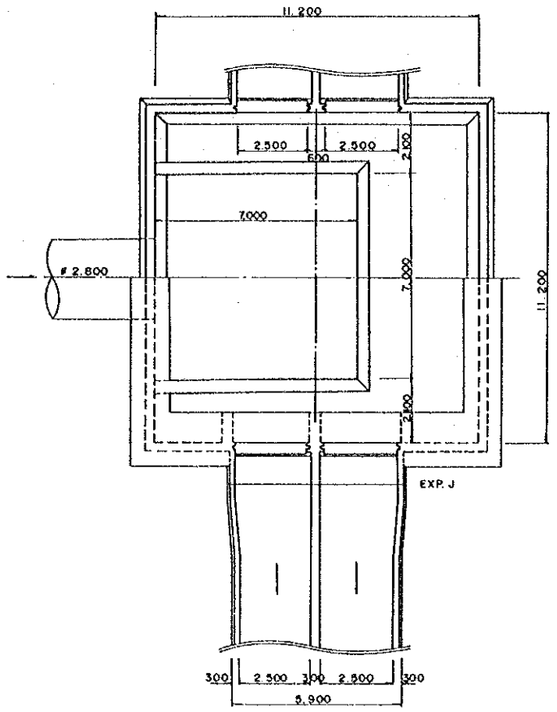
SCALE 1 : 100



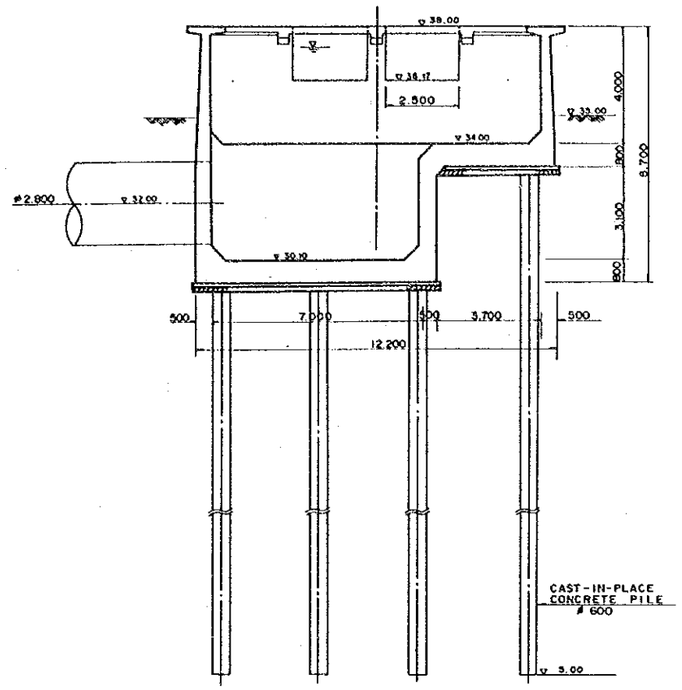
THE FEDERAL DISTRICT OF MEXICO THE GENERAL DIRECTION OF CONSTRUCTION AND HYDRAULIC OPERATION (DGCOH)	
THE FEASIBILITY STUDY ON WASTEWATER TREATMENT IN THE FEDERAL DISTRICT OF MEXICO	
4. Receiving Tank - Plan & Section	
SCALE	1/200
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

DISTRIBUTION TANK

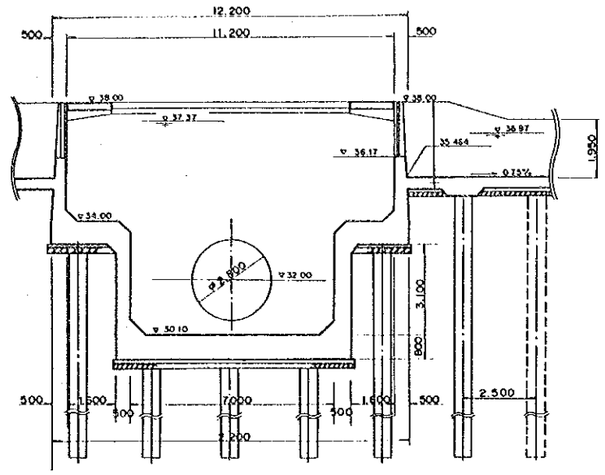
SCALE 1 : 100



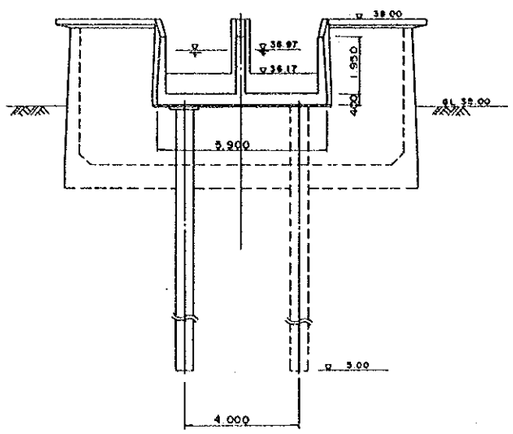
PLAN



SECTION a – a



SECTION b – b

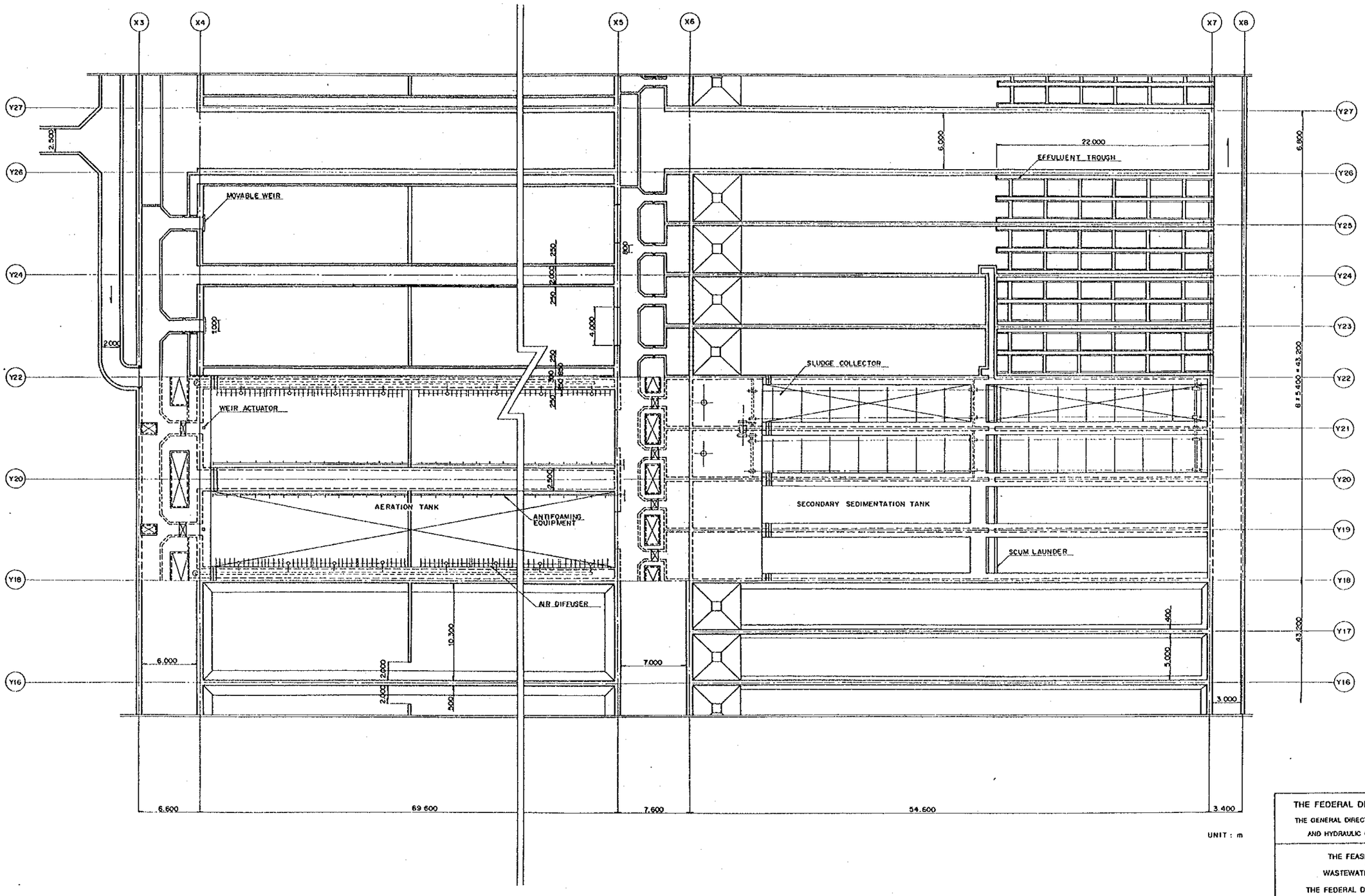


SECTION c – c

THE FEDERAL DISTRICT OF MEXICO THE GENERAL DIRECTION OF CONSTRUCTION AND HYDRAULIC OPERATION (DGCOH)	
THE FEASIBILITY STUDY ON WASTEWATER TREATMENT IN THE FEDERAL DISTRICT OF MEXICO	
5. Distribution Tank - Plan & Section	
SCALE	1/200
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

WASTEWATER TREATMENT FACILITY PLAN

SCALE 1 : 200



UNIT : m

THE FEDERAL DISTRICT OF MEXICO

THE GENERAL DIRECTION OF CONSTRUCTION AND HYDRAULIC OPERATION (DGCOH)

THE FEASIBILITY STUDY ON WASTEWATER TREATMENT IN THE FEDERAL DISTRICT OF MEXICO

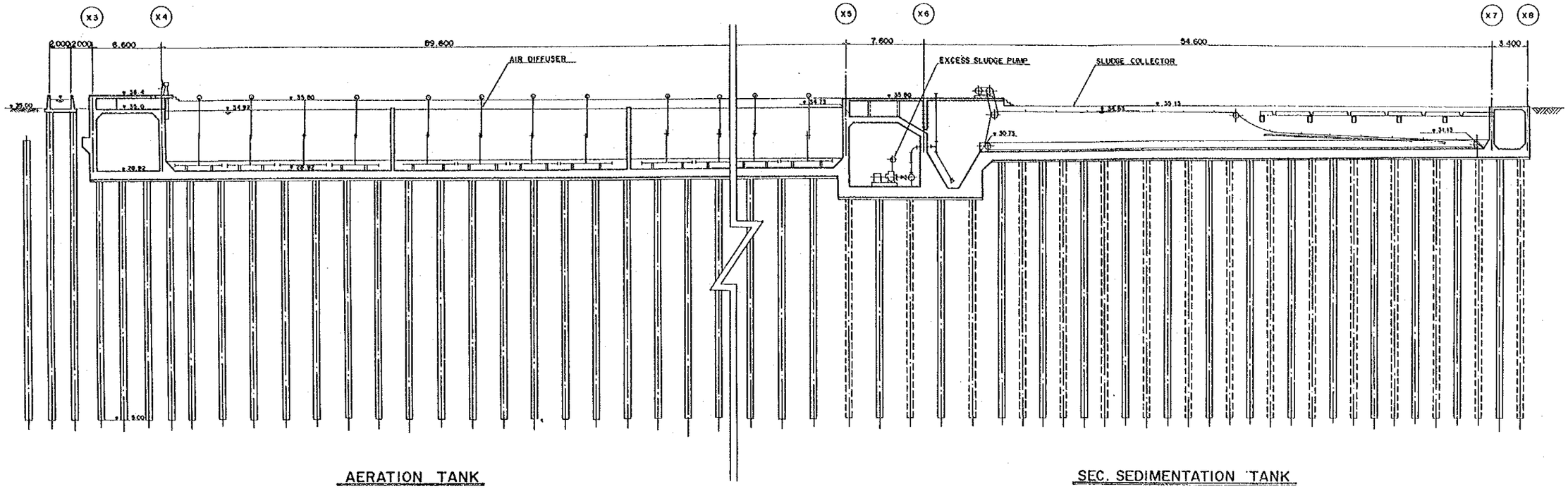
6. Aeration Tank & Secondary Sedimentation Tank - Plan

SCALE	1/200

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

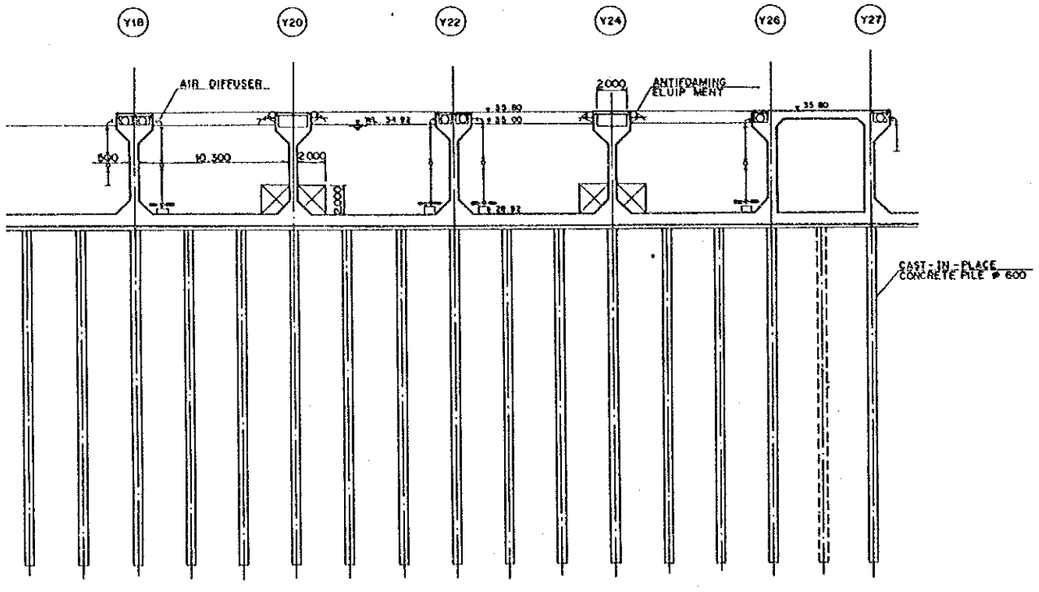
WASTEWATER TREATMENT FACILITY SECTION

SCALE 1 : 200

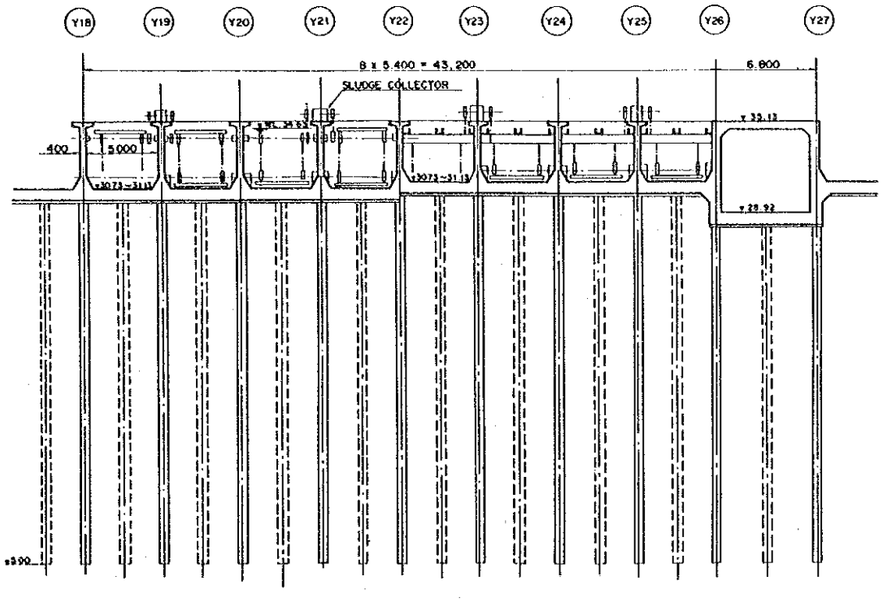


AERATION TANK

SEC. SEDIMENTATION TANK



SECTION (AERATION TANK)

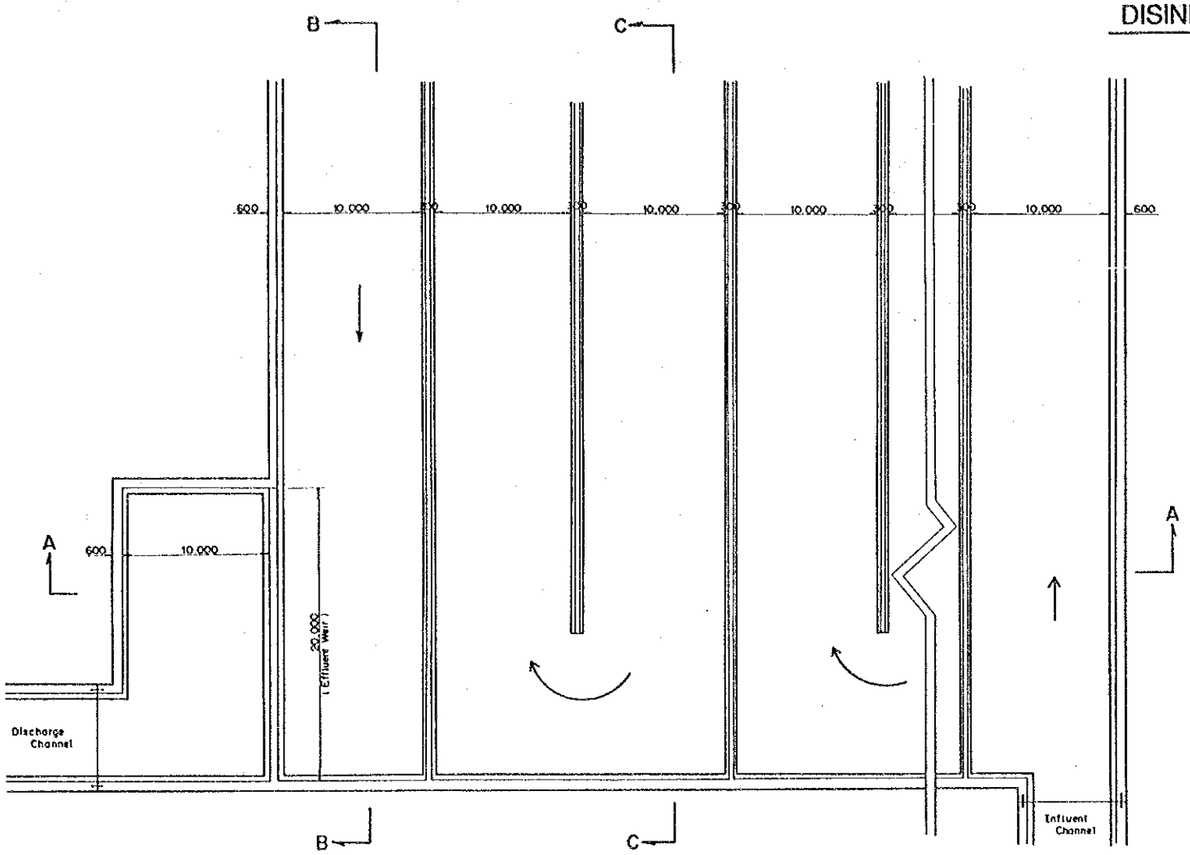


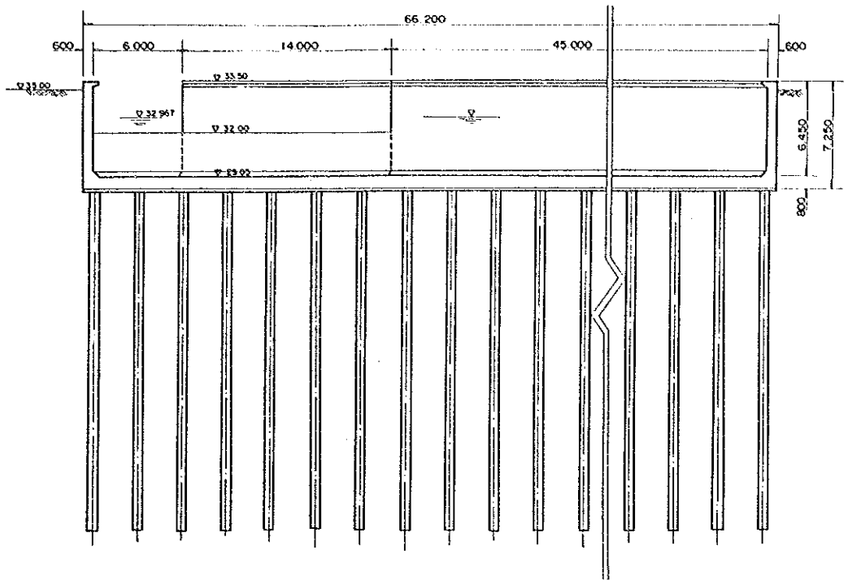
SECTION (SEC. SEDIMENTATION TANK)

THE FEDERAL DISTRICT OF MEXICO THE GENERAL DIRECTION OF CONSTRUCTION AND HYDRAULIC OPERATION (DGCOH)	
THE FEASIBILITY STUDY ON WASTEWATER TREATMENT IN THE FEDERAL DISTRICT OF MEXICO	
7. Aeration Tank & Secondary Sedimentation Tank - Section	
SCALE	1/200
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

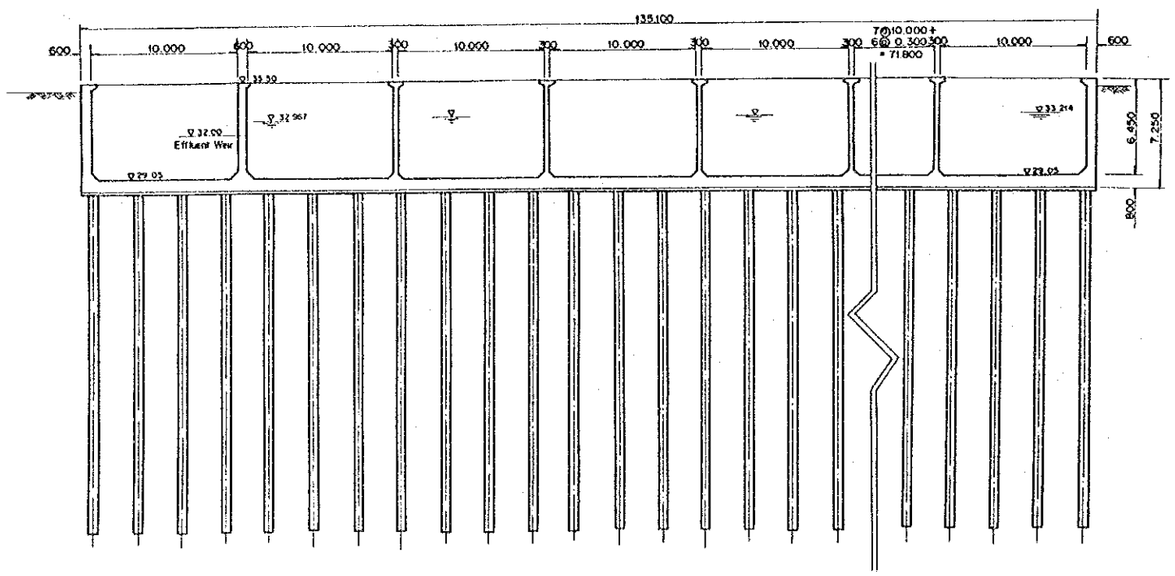
DISINFECTION TANK

SCALE 1 : 200

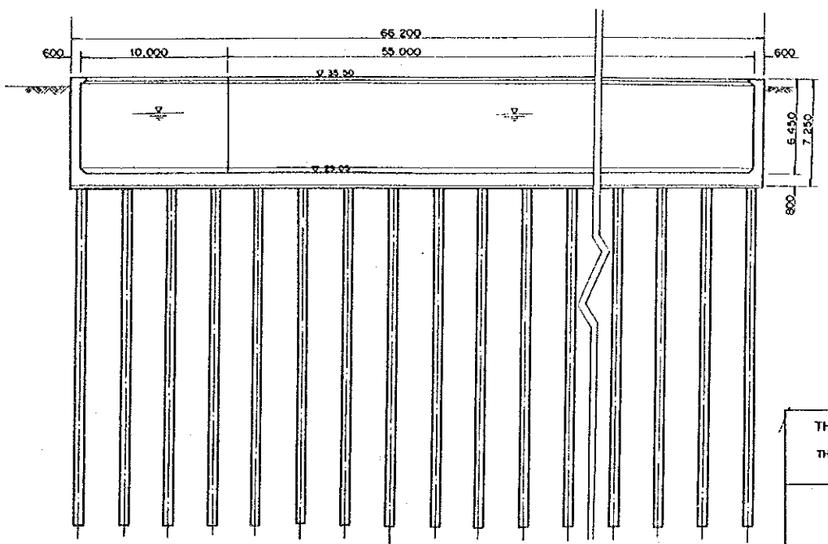




B — B

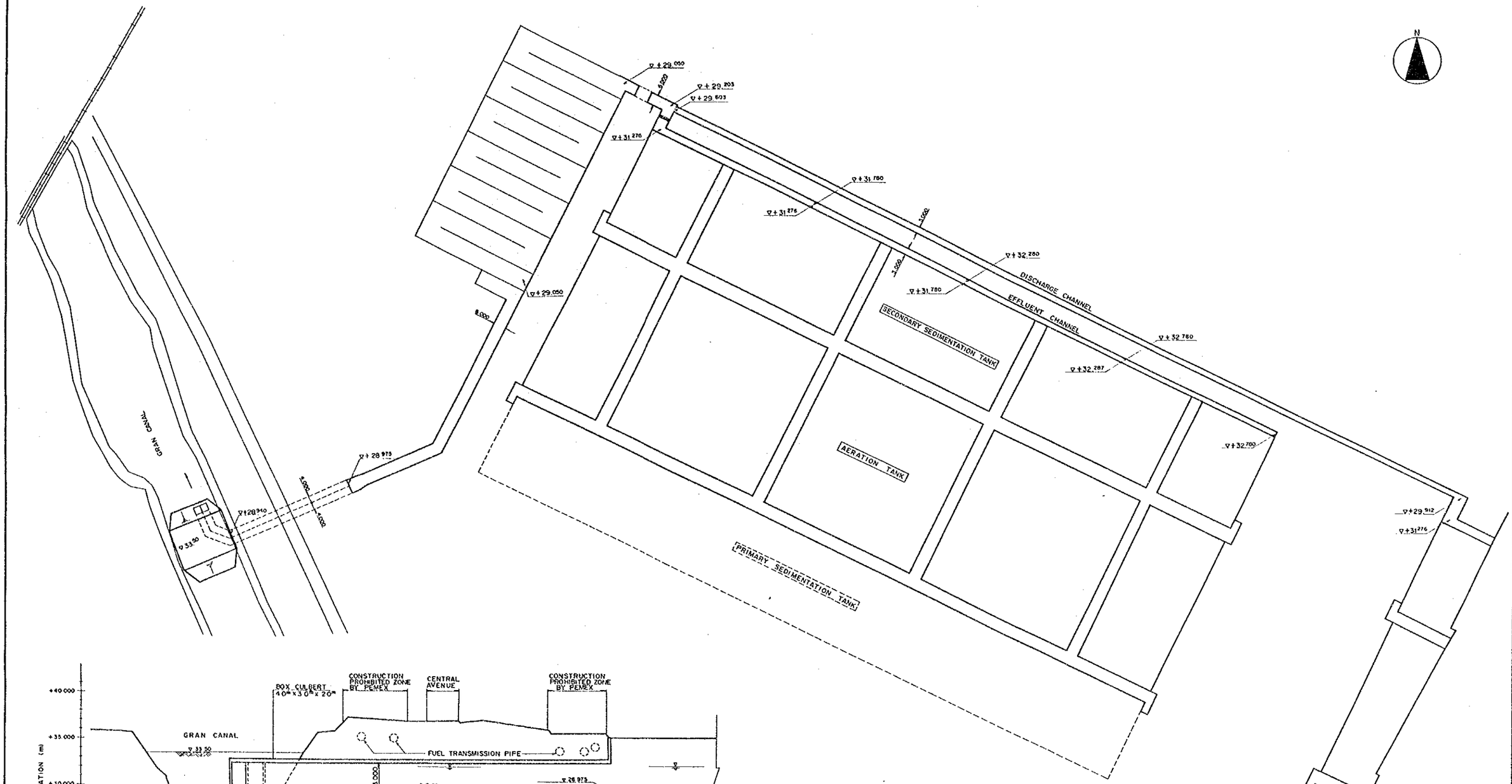


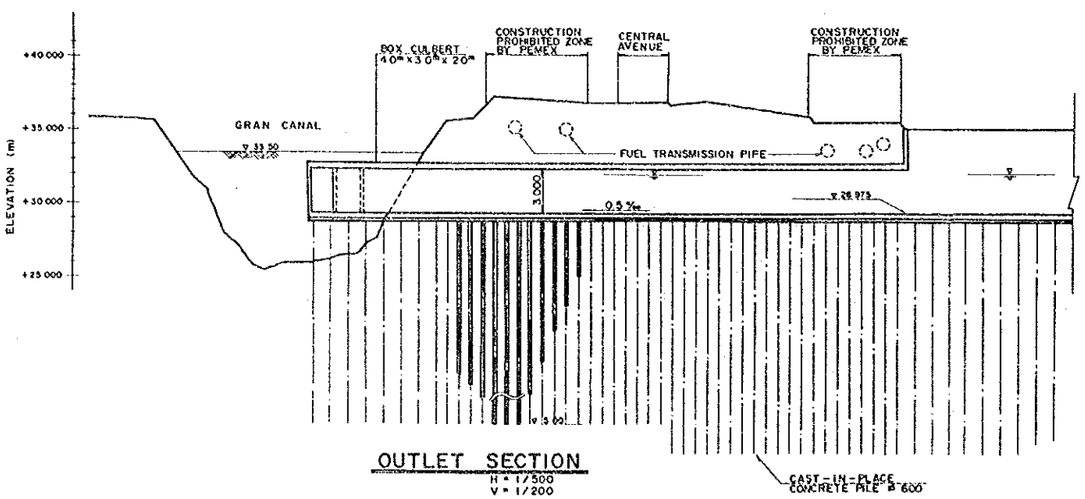
A — A



C — C

THE FEDERAL DISTRICT OF MEXICO	
THE GENERAL DIRECTION OF CONSTRUCTION AND HYDRAULIC OPERATION (DGCOH)	
THE FEASIBILITY STUDY ON WASTEWATER TREATMENT IN THE FEDERAL DISTRICT OF MEXICO	
8. Disinfection Tank	
SCALE	1/200
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	





OUTLET SECTION
H = 1/500
V = 1/200

THE FEDERAL DISTRICT OF MEXICO
THE GENERAL DIRECTION OF CONSTRUCTION AND HYDRAULIC OPERATION (DGCOH)

THE FEASIBILITY STUDY
ON
WASTEWATER TREATMENT
IN
THE FEDERAL DISTRICT OF MEXICO

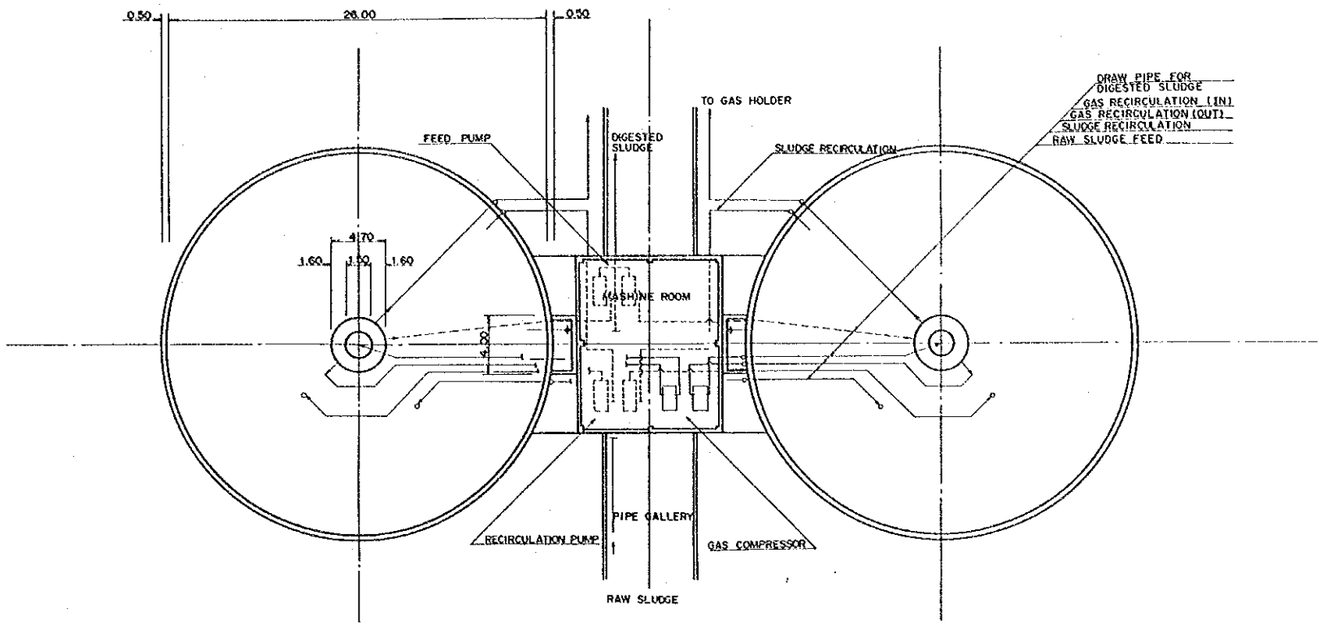
9. Discharge Channel

SCALE	1/1000

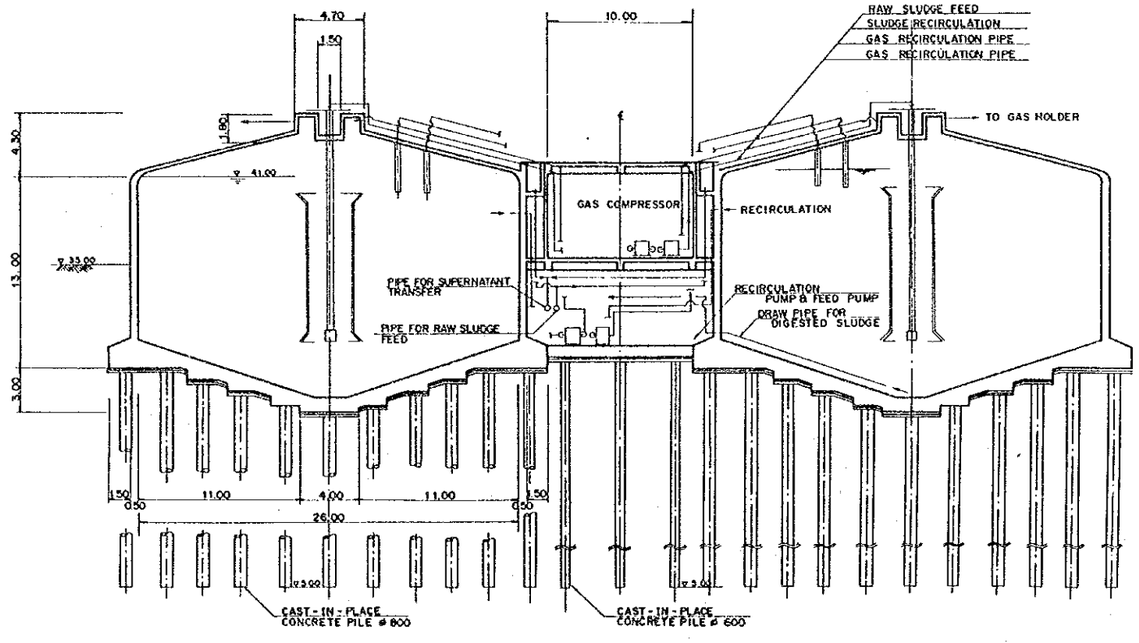
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

ANAEROBIC DIGESTION TANK

SCALE 1:200

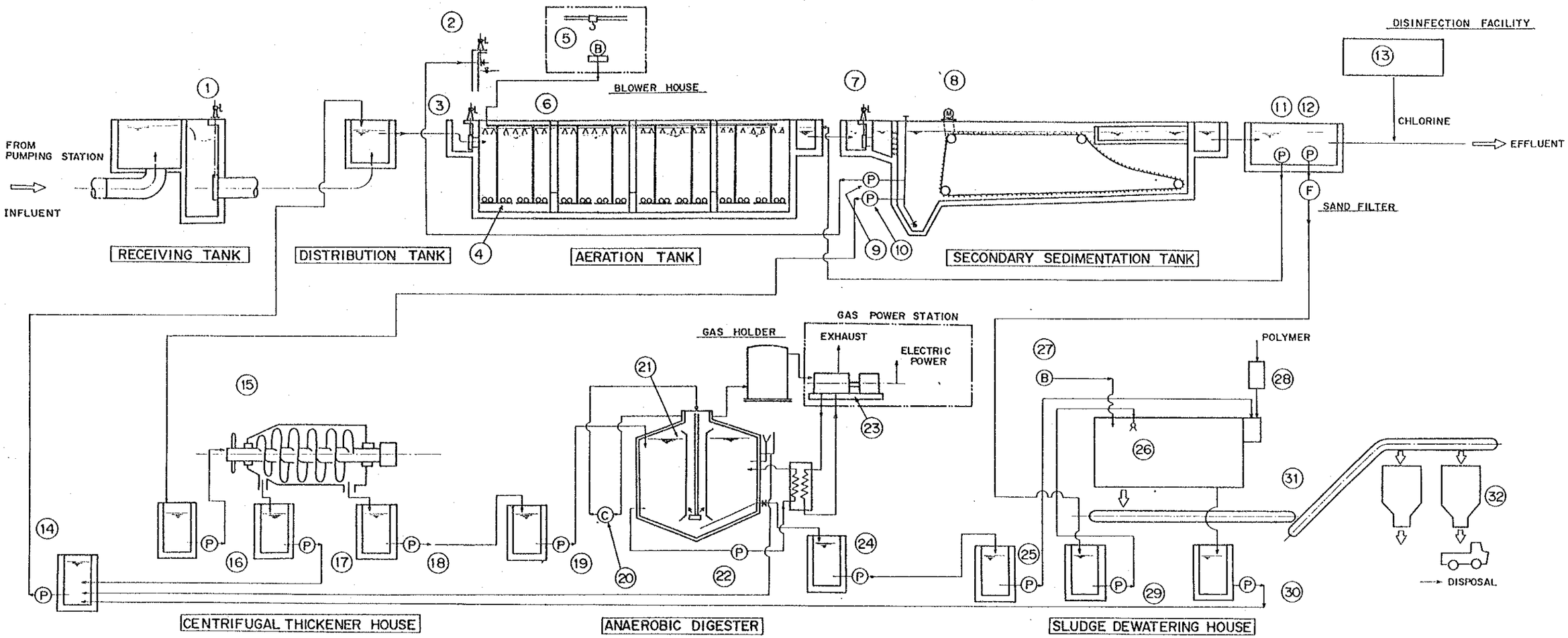


PLAN



SECTION

THE FEDERAL DISTRICT OF MEXICO THE GENERAL DIRECTION OF CONSTRUCTION AND HYDRAULIC OPERATION (DGCOH)	
THE FEASIBILITY STUDY ON WASTEWATER TREATMENT IN THE FEDERAL DISTRICT OF MEXICO	
10. Sludge Digestion Tank - Plan & Section	
SCALE	1/200
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	



Facility No.	1	2	3	4	5	6	7	8	9	10	11	12
Name	Outlet Gate	Sludge Inlet Gate	Inlet Gate	Air Diffuser	Blower	Antifoaming Equipment	Inlet Gate	Sludge Collector	Sludge Return Pump	Excess Sludge Pump	Pump for Antifoaming Spray	Pump for Sand Filter
Type	Sluice Gate (Manual)	Sluice Valve (Manual)	Movable Weir (Manual)	Diffuser Tube	Centrifugal Type	Water Spray	Sluice Gate (Manual)	Chain Flight Double Link Type	Centrifugal Type	Centrifugal Type	Vertical Centrifugal Type	Vertical Centrifugal Type
Power (Kw)	-	-	-	-	900	-	-	2.2	30	11	22	22
T. Quantity (Standby)	2	64	64	64	14	64	128	64	48	32	12 (6)	12 (6)

Facility No.	13	14	15	16	17	18	19	20	21	22	23	24
Name	Chlorinator	Sludge Pump	Centrifugal Thickener	Sludge Feed Pump	Sludge Pump for Distribution Tank	Sludge Pump for Anaerobic Digester	Sludge Feed Pump	Gas Compressor	Digestion Tank	Recirculation Pump	Generator	Transfer Pump for Belt Filter Press
Type	-	Centrifugal Type	Solid Bowl Type	Centrifugal Type	Centrifugal Type	Progressing Cavity Type	Progressing Cavity Type	-	Cylindrical Type	Progressing Cavity Pump	-	Progressing Cavity Pump
Power (Kw)	-	22	200	11	11	7.5	7.5	45	-	15	1400 KVA	7.5
T. Quantity (Standby)	2	14 (2)	22	32 (8)	32 (8)	32 (8)	20	20	20	20	8	20

Facility No.	25	26	27	28	29	30	31	32				
Name	Sludge Feed Pump	Belt Filter Press	Air Compressor	Polymer Mixing and Dosing System	Filter Cloth Washing Pump	Sludge Pump for Distribution Tank	Sludge Cake Conveyer	Sludge Cake Hopper				
Type	Progressing Cavity Pump	-	-	-	Centrifugal Type	Centrifugal Type	-	-				
Power (Kw)	7.5	5.5	3.7	4.85	11	5.5	2.2	1.5 x 2				
T. Quantity (Standby)	32	32	24 (8)	32	24 (8)	24 (8)	32	16				

THE FEDERAL DISTRICT OF MEXICO
THE GENERAL DIRECTION OF CONSTRUCTION AND HYDRAULIC OPERATION (DGCOH)

THE FEASIBILITY STUDY ON WASTEWATER TREATMENT IN THE FEDERAL DISTRICT OF MEXICO

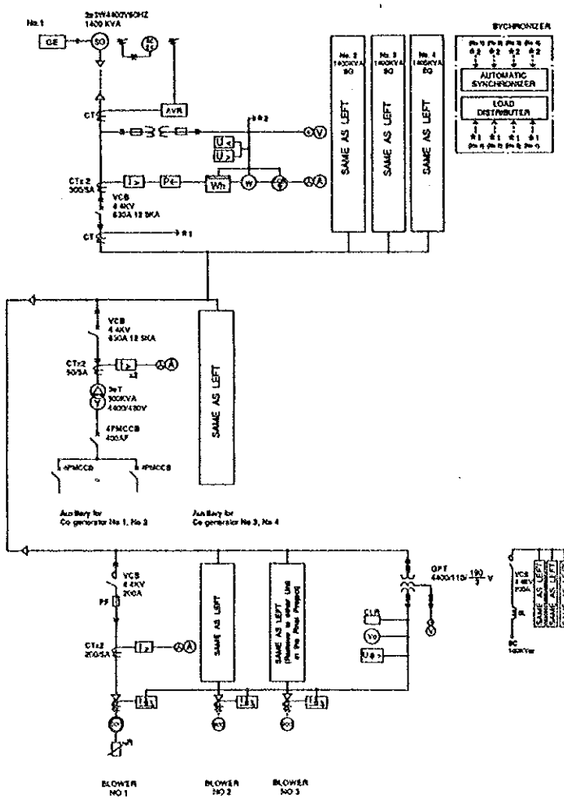
11. Process Diagram of Wastewater Treatment Plant

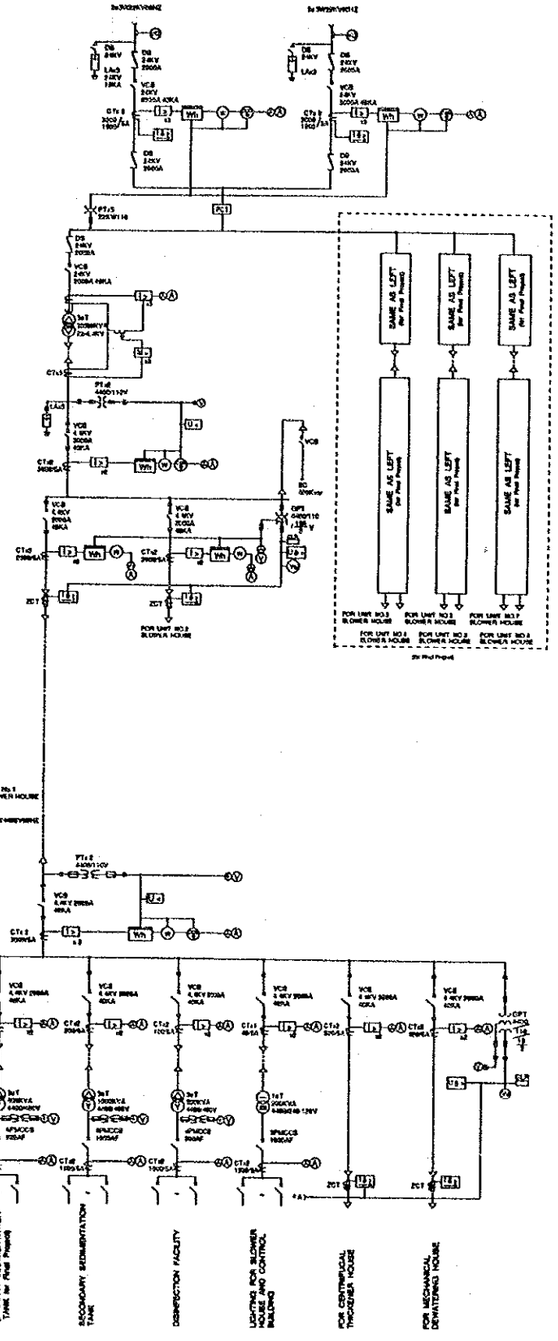
SCALE: FREE

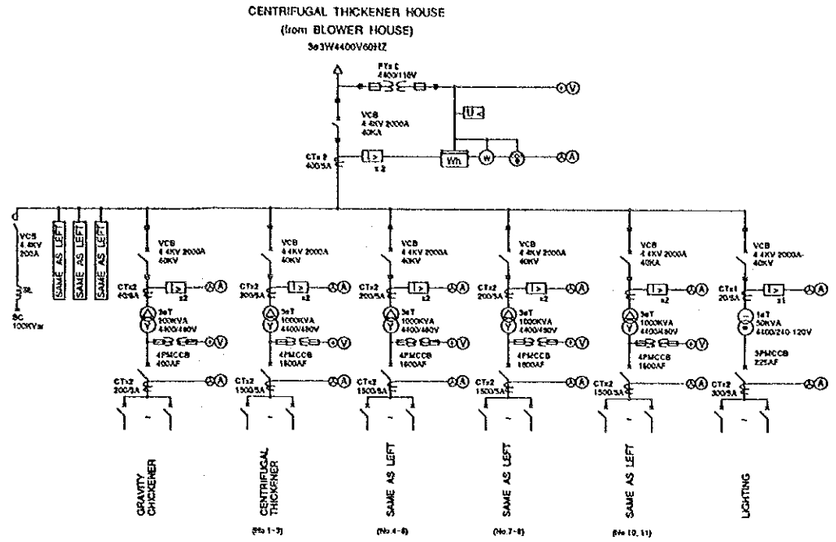
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

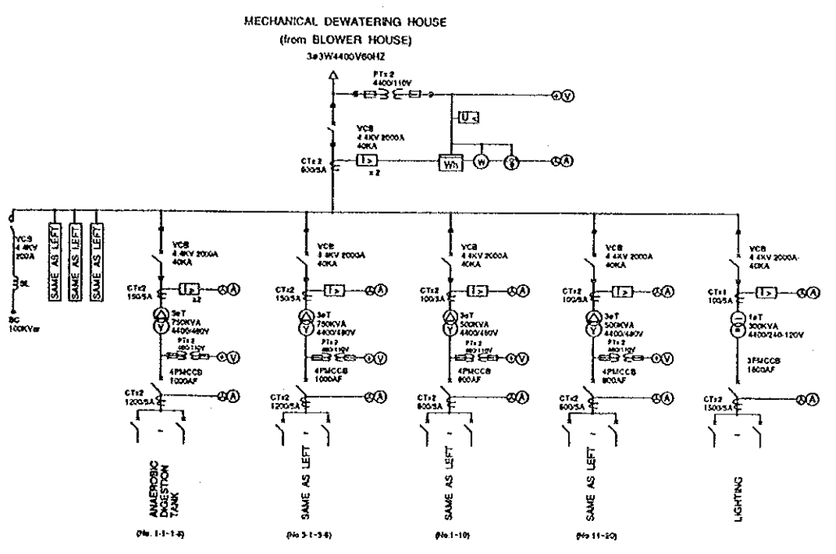
LEGEND

ITEM	DESCRIPTION	ITEM	DESCRIPTION
DB	Distributing Board	MC	Mode Controller
VCB	Vacuum Circuit Breaker	SL	Surge Diverter
LA	Lightning Arrester	S	Ammeter
CT	Current Transformer	V	Voltmeter
PT	Potential Transformer	WH	Watt hour meter
T	Transformer	W	Watt meter
MCCB	Molded Cased Circuit Breaker	COSΦ	Power factor meter
SG	Synchronous Generator		
GE	Gas Engine	51	Overcurrent Relay
VCB	Vacuum Contactor Switch	51G	Ground and Ground fault Current Relay
SV	Sealing Percolator	67	Directional Type Relay
PF	Power Fuse	U<	Undervoltage Relay
GPT	Ground Potential Transformer	64	Ground fault Voltage Relay
PCS	Potential and Current Transformer		









THE FEDERAL DISTRICT OF MEXICO

THE GENERAL DIRECTION OF CONSTRUCTION AND HYDRAULIC OPERATION (DGCOH)

THE FEASIBILITY STUDY
ON
WASTEWATER TREATMENT
IN
THE FEDERAL DISTRICT OF MEXICO

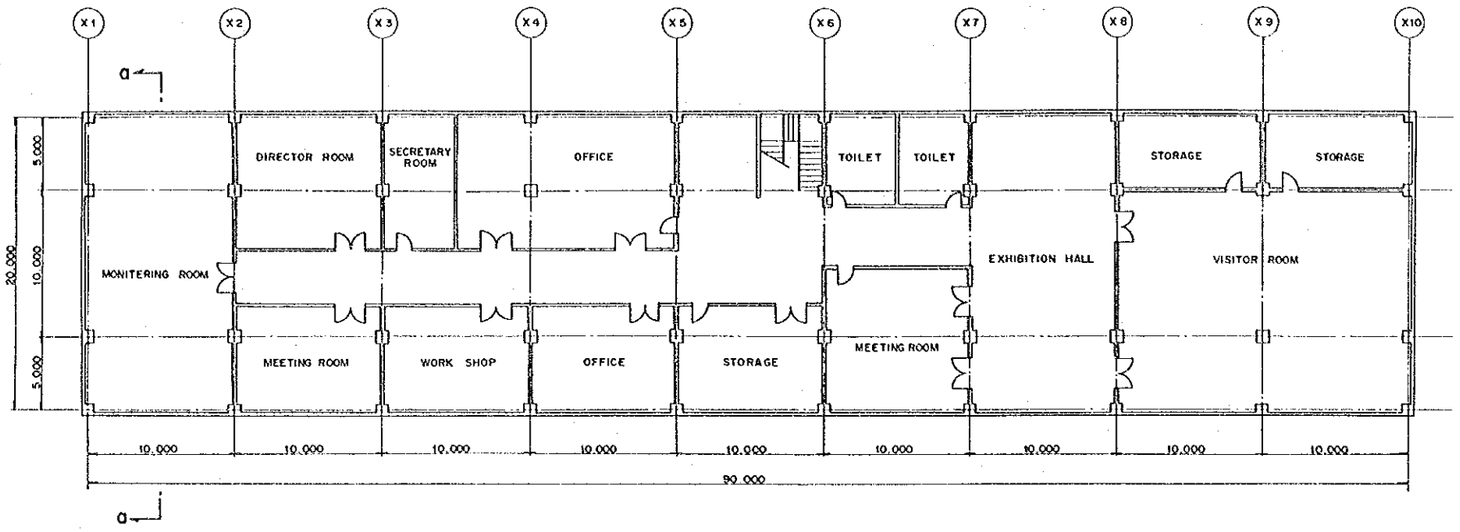
12. Single Line Diagram

SCALE	FREE

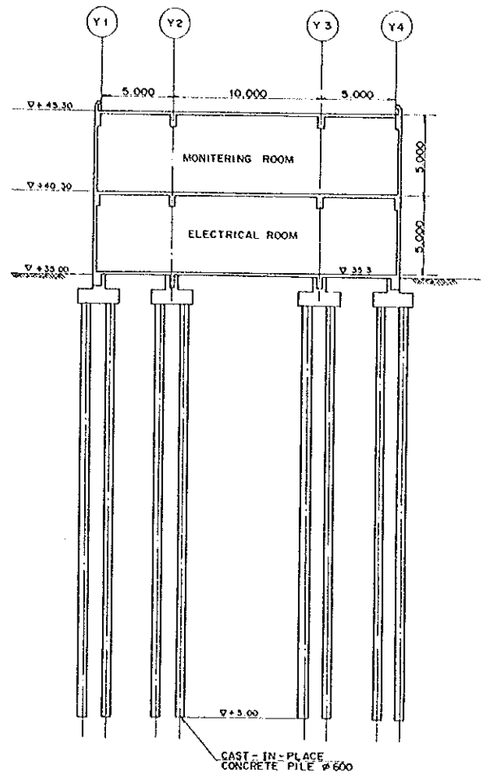
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

CONTROL BUILDING

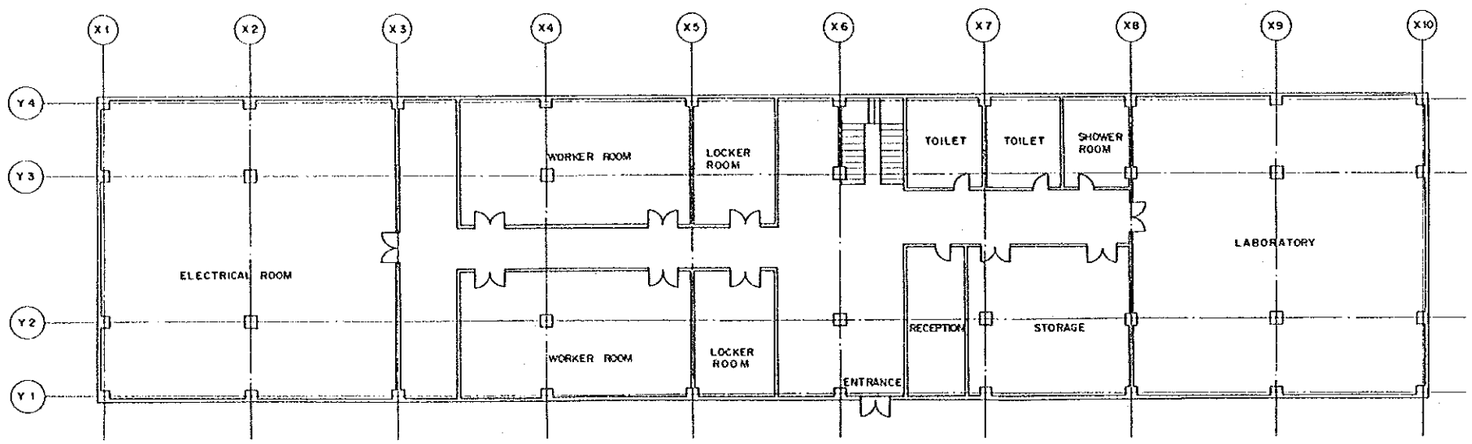
SCALE 1 : 200



1ST FLOOR PLAN



SECTION a – a

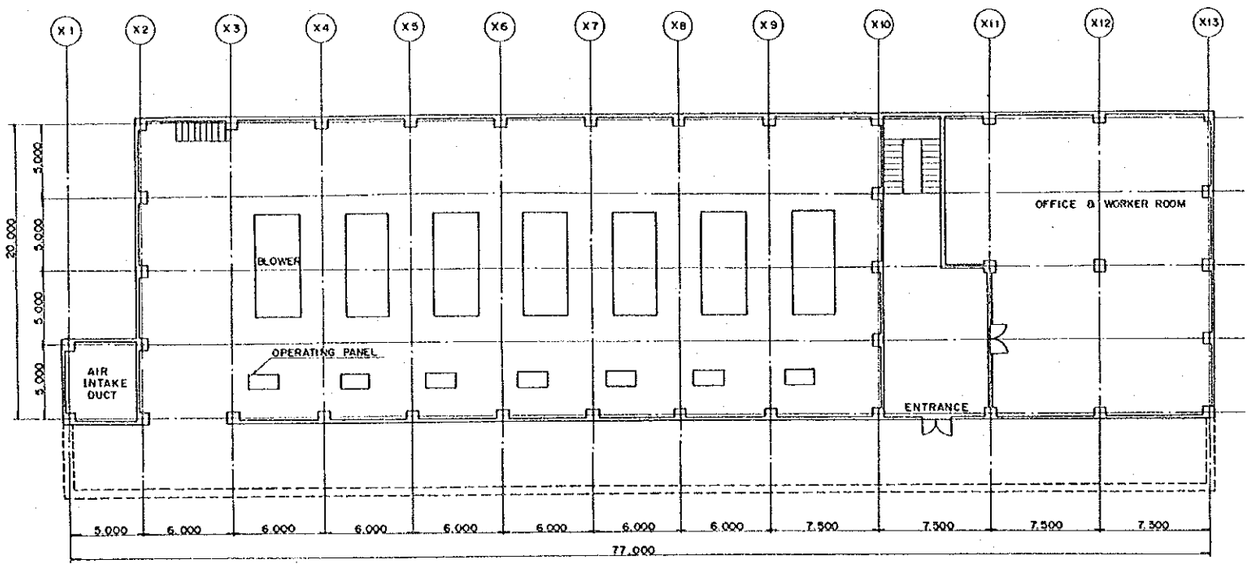


GROUND FLOOR PLAN

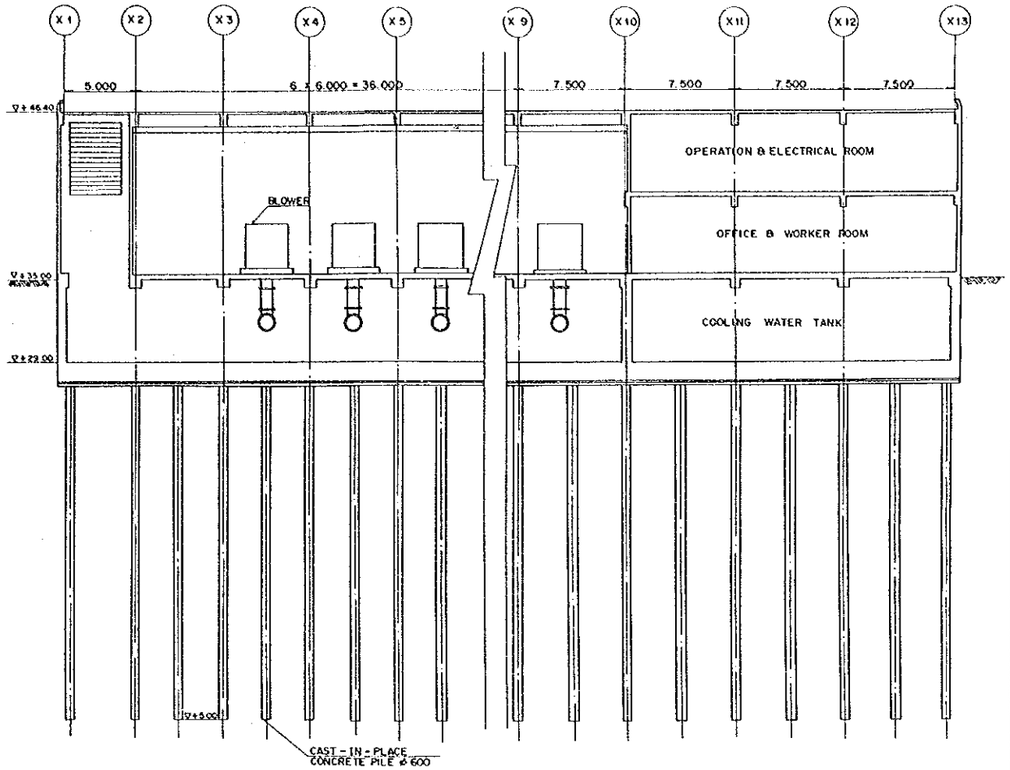
THE FEDERAL DISTRICT OF MEXICO THE GENERAL DIRECTION OF CONSTRUCTION AND HYDRAULIC OPERATION (DGCOH)	
THE FEASIBILITY STUDY ON WASTEWATER TREATMENT IN THE FEDERAL DISTRICT OF MEXICO	
13. Control Building	
SCALE	1/300
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

BLOWER HOUSE

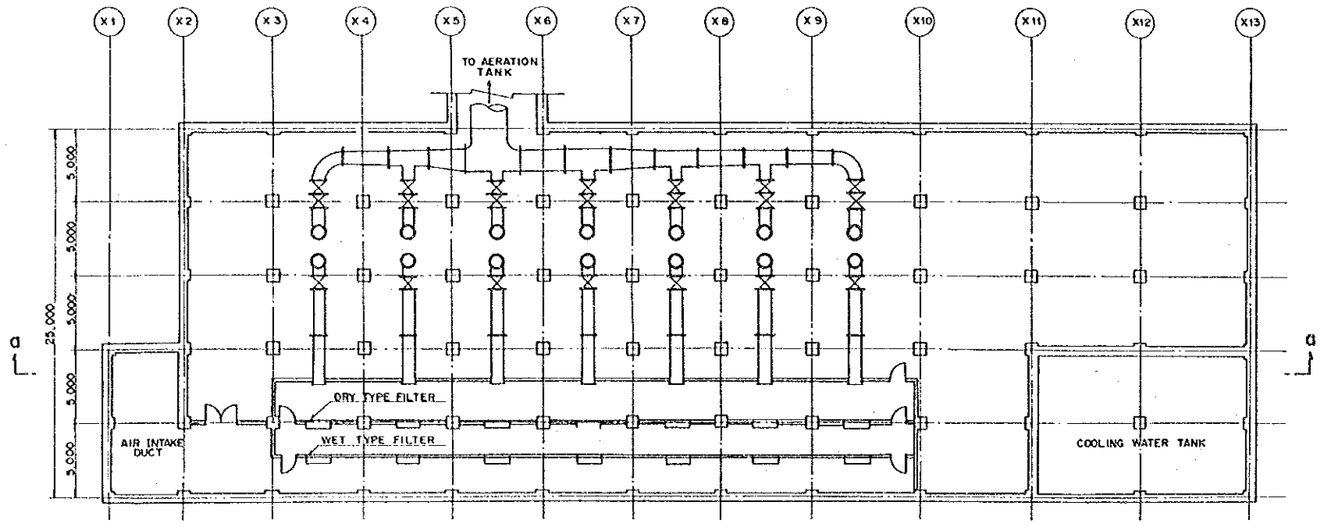
SCALE 1 : 200



GROUND FLOOR PLAN



SECTION a - a

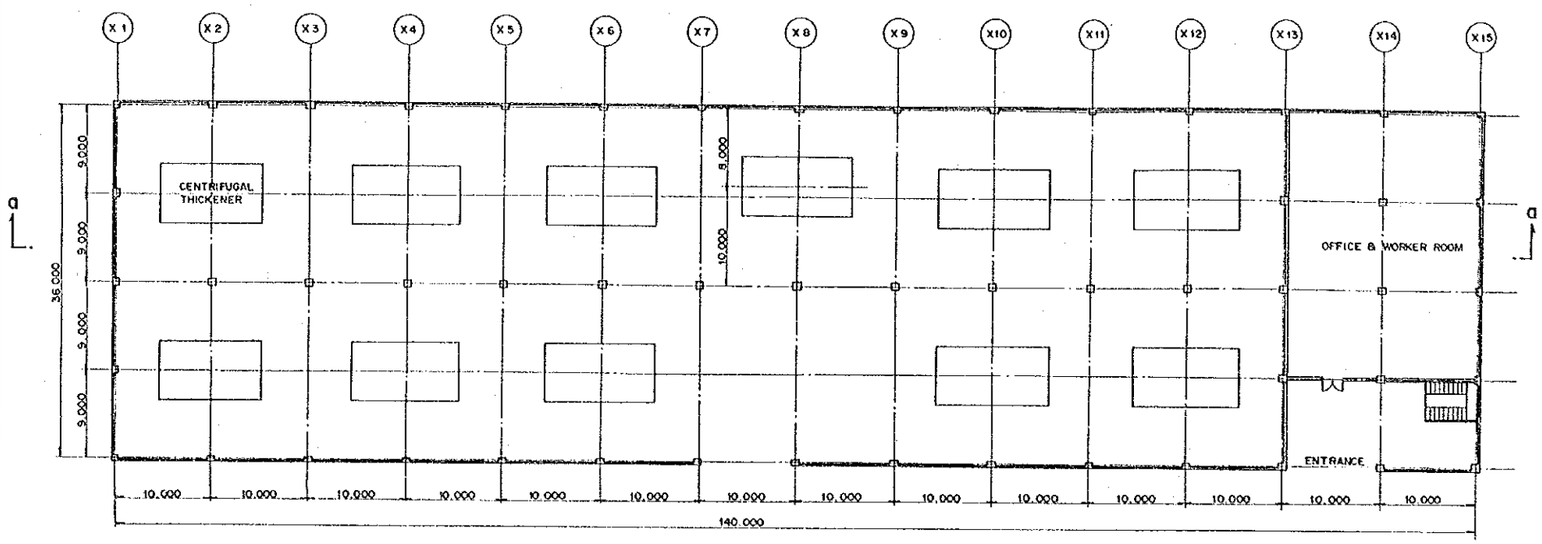


B1 FLOOR PLAN

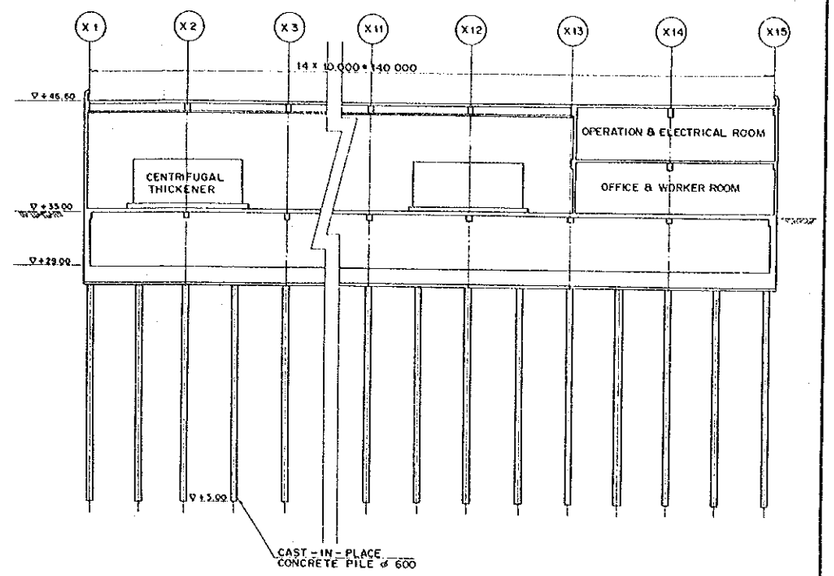
THE FEDERAL DISTRICT OF MEXICO THE GENERAL DIRECTION OF CONSTRUCTION AND HYDRAULIC OPERATION (DGCOH)	
THE FEASIBILITY STUDY ON WASTEWATER TREATMENT IN THE FEDERAL DISTRICT OF MEXICO	
14. Blower House	
SCALE	1/200
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

CENTRIFUGAL THICKENER HOUSE

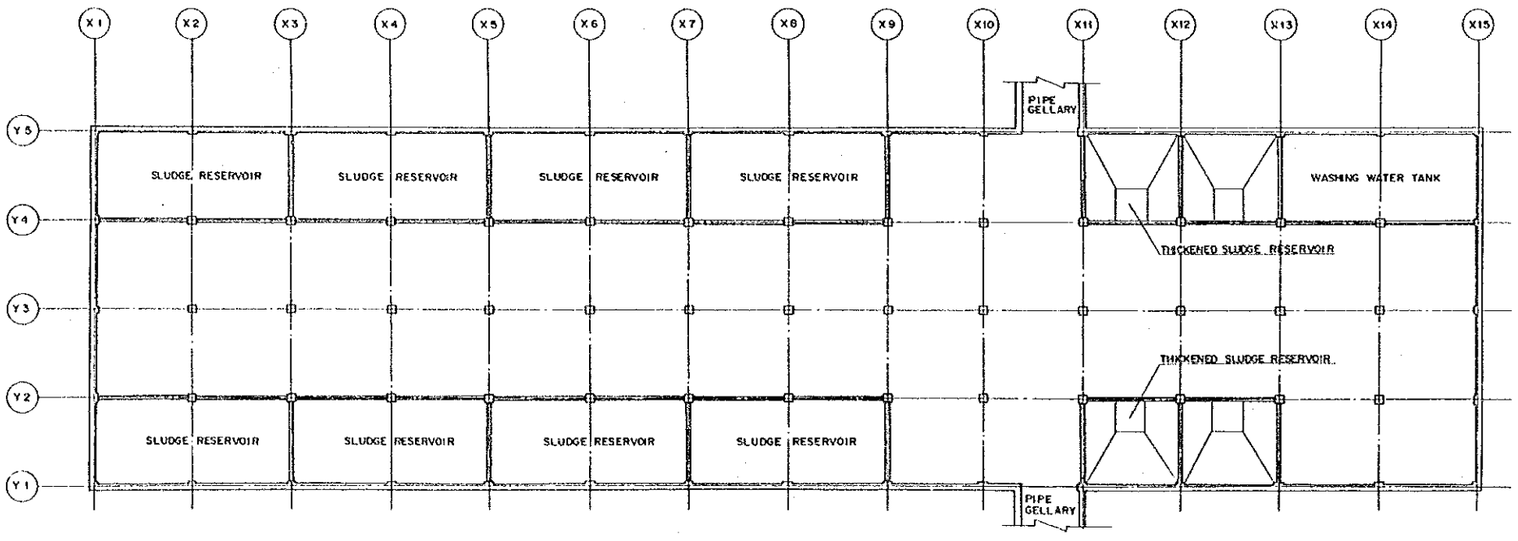
SCALE 1 : 300



GROUND FLOOR PLAN



SECTION a - a

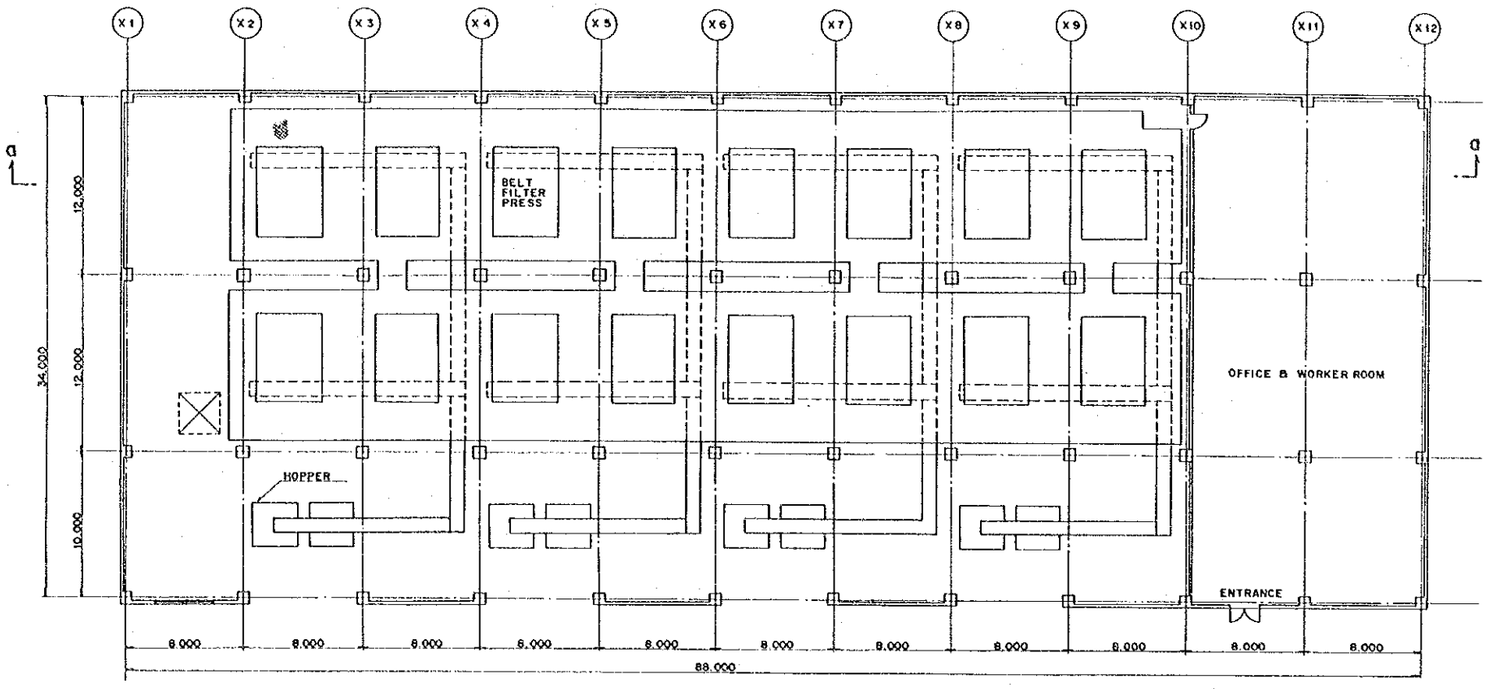


B1 FLOOR PLAN

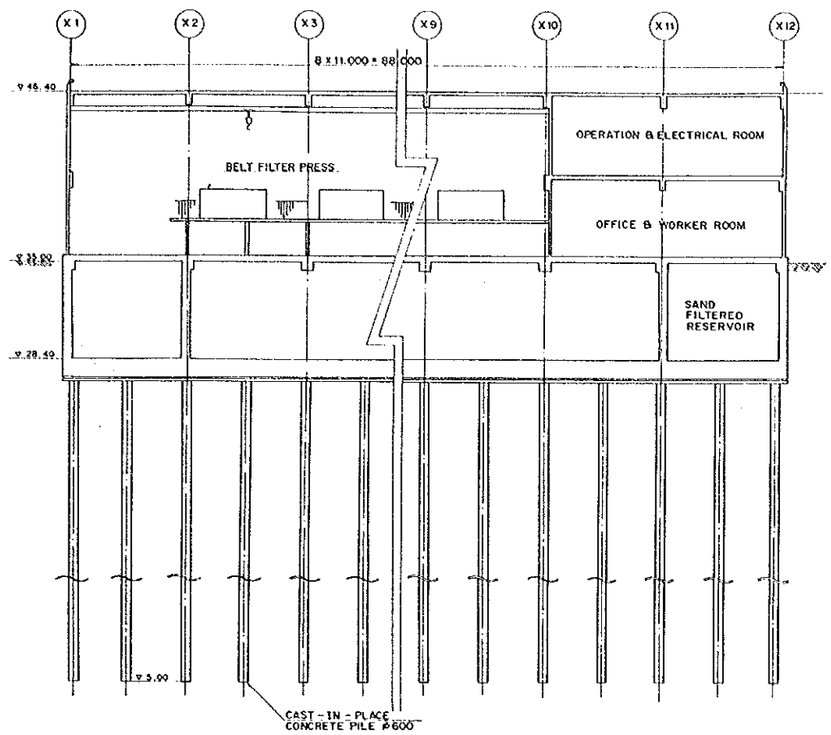
THE FEDERAL DISTRICT OF MEXICO	
THE GENERAL DIRECTION OF CONSTRUCTION AND HYDRAULIC OPERATION (DGCOH)	
THE FEASIBILITY STUDY ON WASTEWATER TREATMENT IN THE FEDERAL DISTRICT OF MEXICO	
15. Centrifugal Thickener House	
SCALE	1 / 200
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

SLUDGE DEWATERING HOUSE

SCALE 1 : 200



GROUND FLOOR PLAN



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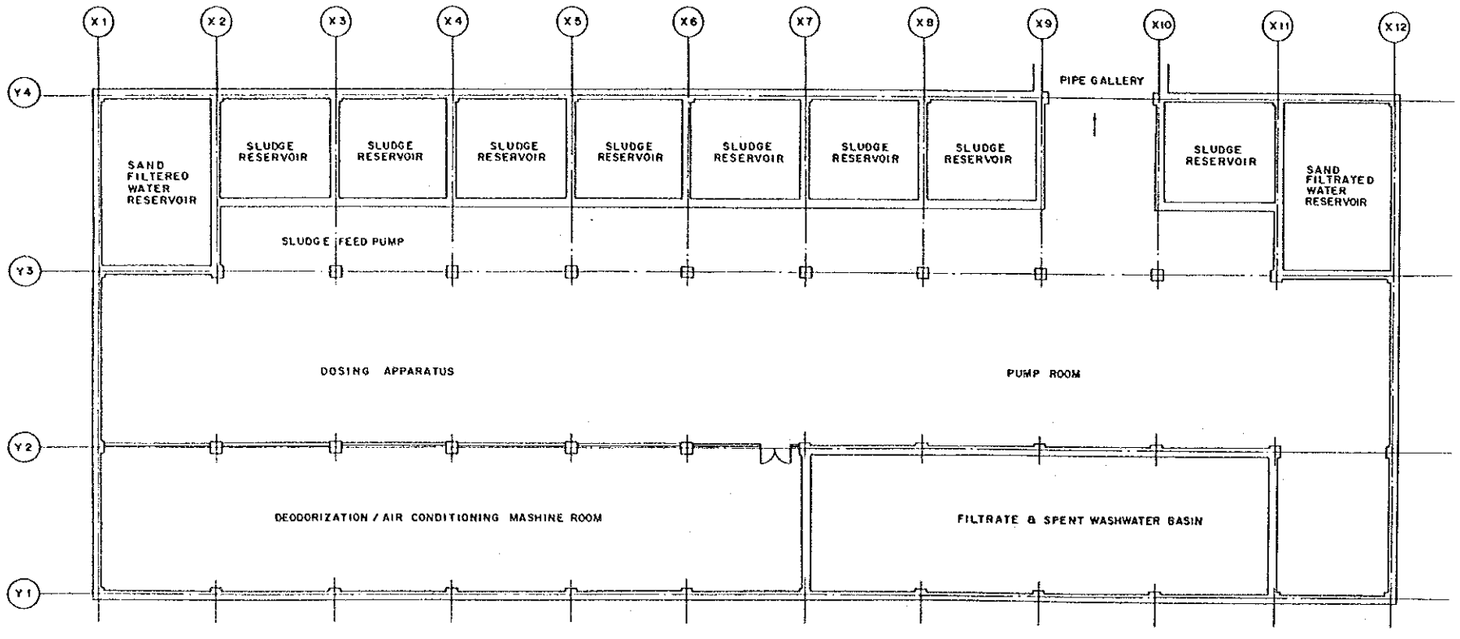

B1 FLOOR PLAN

THE FEDERAL DISTRICT OF MEXICO

THE GENERAL DIRECTION OF CONSTRUCTION AND HYDRAULIC OPERATION (DGCOH)

THE FEASIBILITY STUDY ON WASTEWATER TREATMENT IN THE FEDERAL DISTRICT OF MEXICO

16. Sludge Dewatering House

SCALE	1/200

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)