SOIL MECHANICS LABORATORY

COMPACTION TEST

Soil sample _____ Test No. 1.

Date. 30th OCTOBER 1985.

Tested by MR. SUTHER TAMOMGITNURUK

Location KONG. ; RACHASRIMA. Type Test Dry preparation and repetitive method

Boring No. 2. Mold : volume 956.44 cm^3

Sample No. _____ : weight 2027.20 gm.

Specific gravity. G_s = 2.60 RAMMER: WEIGHT 5.5 lbs

NUMBER OF LAYER : 3

DENSITY NUMBER OF TAMPING PER EACH LAYER 25.

Determination No.		1	2	3	4	5	6
Weight mold + compacted soil	g	3905.00	3895.00	3969	4007	3915	3895
Weight mold	g	2027.20	2027.20	2027.20	2027.20	2027.20	2027.20
Weight compacted soil	g	1677.80	1809.80	1941.80	1979.80	1887.80	1847.80
Wet density	g/cc	1.754	1.890	2.030	2.070	1.974	1.932
Dry density, γ_d	g/cc	1.653	1.438	1.812	1.993	1.623	1.560
Void ratio e		0.57	0.50	0.43	0.45	0.60	0.67
Porosity n	%	36	33	30	31	38	40

WATER CONTENT

Determination No.							
Container No.		NO_3-1	NO_3-2	NO_2-1	NO_4-1	NO_1-2	NO_4-2
Weight container + wet soil	g	85.64	81.25	73.01	62.09	94.10	130.00
Weight container + dry soil	g	81.65	75.99	66.80	55.30	80.00	109.00
Weight water, W_w	g	4.19	5.26	6.21	6.79	14.10	23.00
Weight container	g	14.59	15.68.	15.25	11.35	14.20	10.55
Weight dry soil, W_s	g	68.86	60.31	51.55	43.95	65.30	96.45
Water content, w	%	6.088	8.722	12.047	15.449	21.593	23.849

REMARKS:-

$$e = \frac{\gamma_w}{\gamma_d} G_s - 1 \quad , \quad \gamma_d = \frac{\gamma_w}{\frac{1}{G_s} + \frac{w}{S_r}}$$

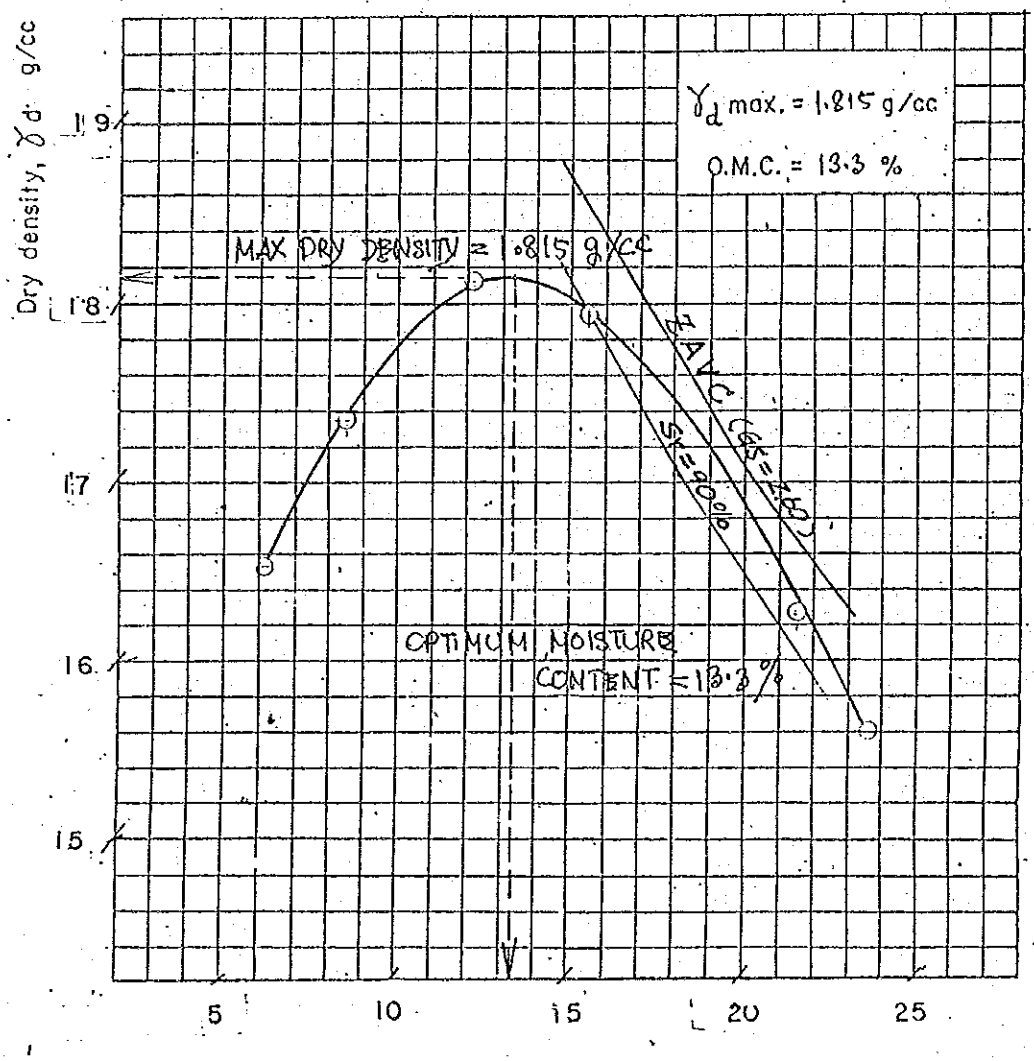
$$n = \frac{e}{1+e} \times 100 \quad (\%)$$

Table - 10-1 Compaction Test

Location KONG., RACHASRIMA. Date. 30th OCTOBER 1988

Boring No. 2. Test No. 1.

Type Test STANDARD COMPACTION Tested by MR. SUTHEP TANOMGITNURUK.



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SOIL MECHANICS LABORATORY

DEPARTMENT OF COOPERATIVE PROMOTION, ENGINEERING DIVISION.

COMPACTION TEST

Soil sample _____ Test No. 1.

Date. 1ST NOVEMBER 1985

Tested by นายสุเทพ ถนอมกิตติวรุฒ MR. SUTHEP TANOMGITTIVARUT.

Location _____ Type Test Dry preparation and repetitive method

Boring No. 1. Mold : volume 956.42 cm³

Sample No. _____ : weight 2024.29 gm.

Specific gravity, G_s = 2.59 Rammer : weight 5.5 lbs.

NUMBER OF LAYER : 3

DENSITY NUMBER OF TAMPING PER EACH LAYER : 25

Determination No.		1	2	3	4	5	6
Weight mold + compacted soil	g	3722.00	3826.00	3865	3968	3631	
Weight mold	g	2022.29	2022.29	2022.29	2022.29	2022.29	
Weight compacted soil W	g	1694.71	1798.71	1837.71	1740.71	1603.71	
Wet density γ_t	g/cc	1.772	1.881	1.922	1.820	1.677	
Dry density, γ_d	g/cc	1.593	1.634	1.603	1.470	1.306	
Void ratio e		0.63	0.57	0.62	0.76	0.98	
Porosity n		39.	37	38	43	49	
WATER CONTENT							
Determination No.							
Container No.		NO3-2	NO4-1	NO2-1	NO1-2	NO4-2	
Weight container + wet soil	g	65.31	79.61	87.92	66.00	60.80	
Weight container + dry soil	g	60.30	70.61	59.00	56.09	49.00	
Weight water, Ww	g	5.01	9.00	8.92	9.91	11.00	
Weight container	g	15.69	11.01	14.20	14.45	10.30	
Weight dry soil, Ws	g	44.61	59.60	44.80	41.64	38.70	
Water content, w	%	11.23	15.10	19.91	23.80	28.42	

REMARKS :-

$$e = \frac{\gamma_w}{\gamma_d} G_s - 1 \quad , \quad \gamma_d = \frac{\gamma_w}{\frac{1}{G_s} + \frac{w}{S_r}}$$

$$n = \frac{e}{1+e} \times 100\ (\%)$$

Table - 10-2 Compaction Test

Location _____ Date. 1ST NOVEMBER 1985.

Boring No. 1 Test No. 1.

Type Test STANDARD COMPACTION. Tested by MR. SUTHEP TANCHAITANURUK.

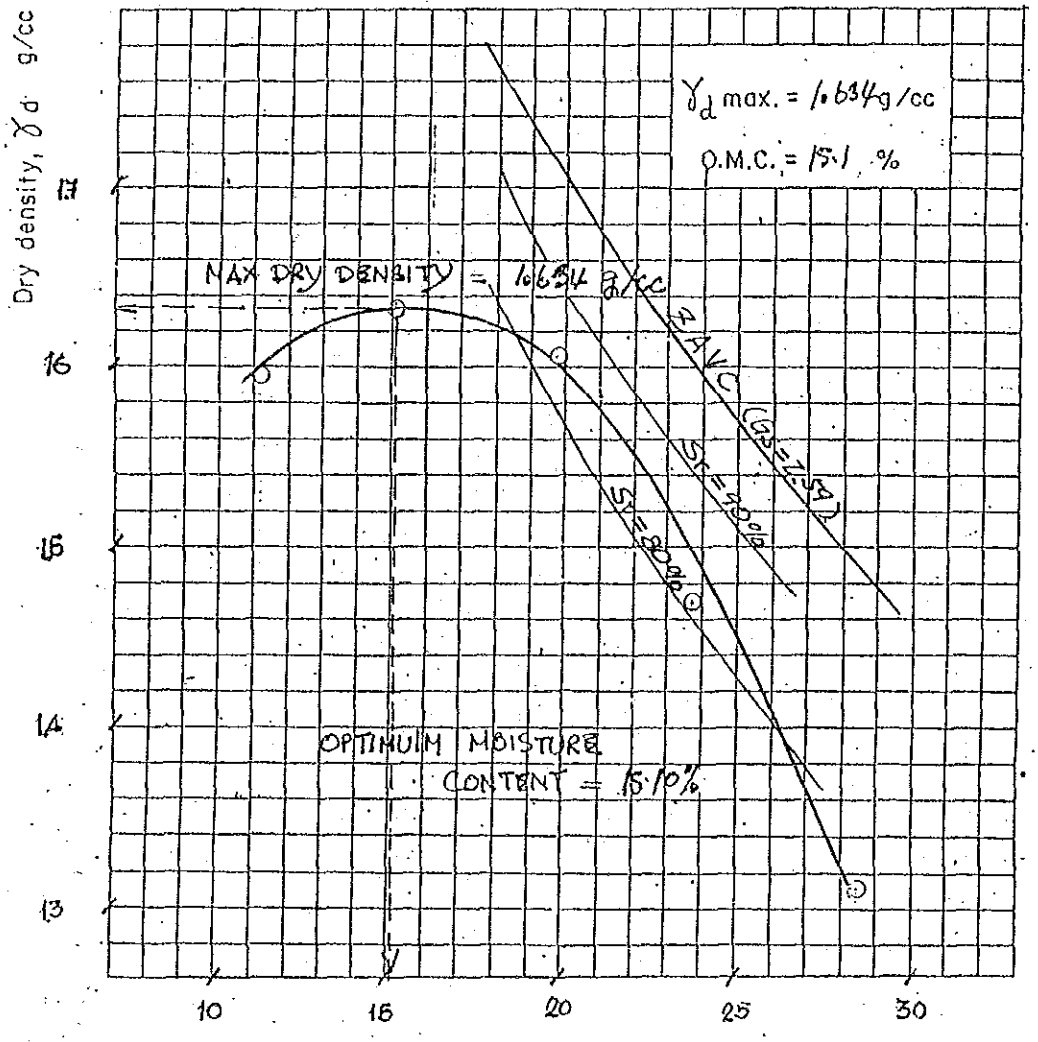

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Table -11-1 SIEVE ANALYSIS

Soil sample : _____

_____

_____

Location : KONG. RACHASRIMA.

Boring No. 1.

Sample No _____

Soil sample weight. _____

Container No. _____

Wt. Container + Dry soil in g. 1294.88 gm

Wt. Container in g 294.88 gm

Wt. Dry soil Ws, in g. 1000.00 gm

Specific Gravity, Gs, _____

Test No. 1.

_____

Date 31. OCTOBER 1985

_____

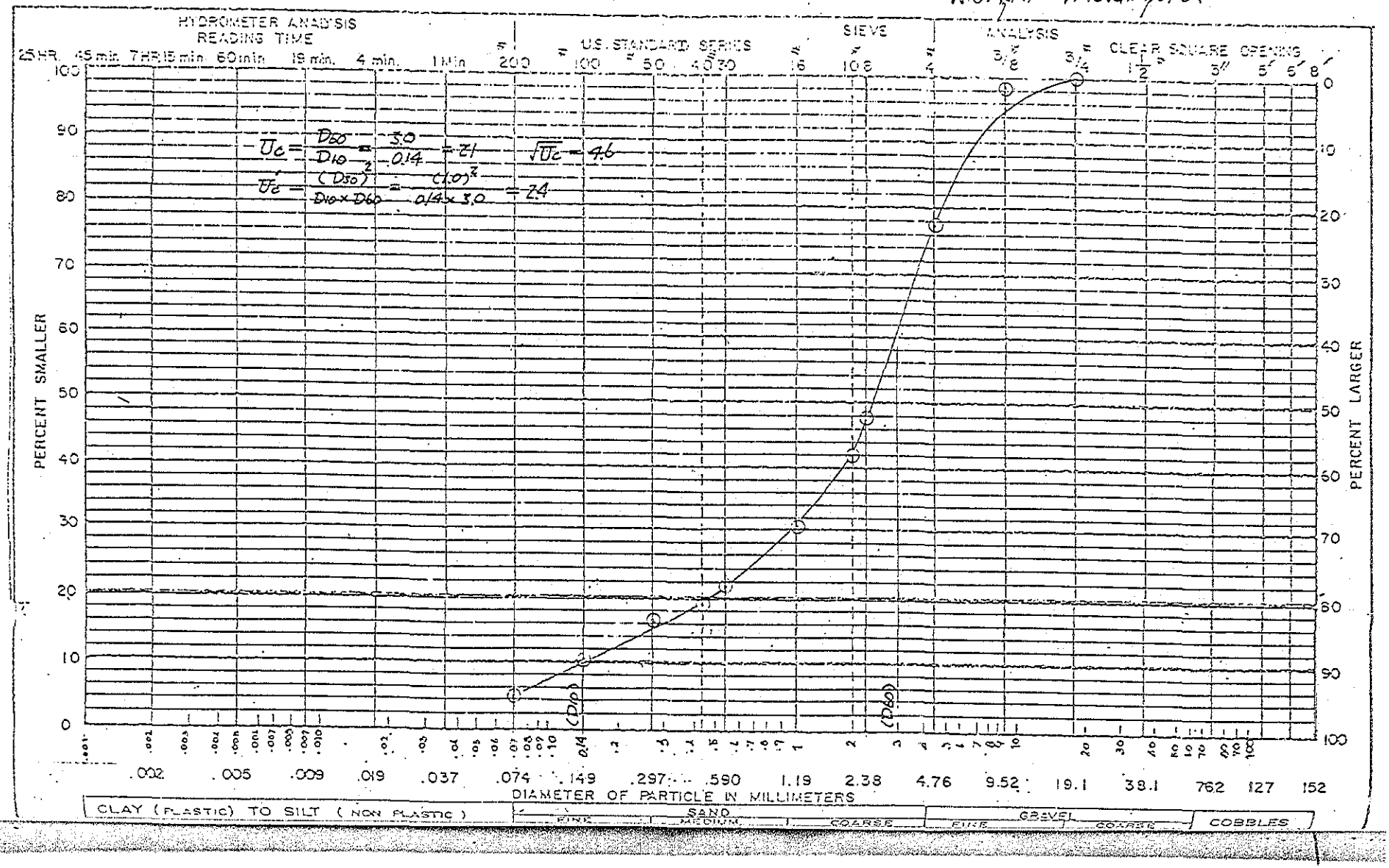
Tested by MR. SUTHEP TANOMGITNURUK.
MR. SOMW. BHOOTHONGSIRI

Sieve No.	Sieve opening in mm.	Wt. sieve in g.	Wt. sieve + soil in g.	Wt. soil returned in g	Percent Retained	Cumulative Percent Retained	Percent Finer
3/4"	19.00 m.m	502.45	502.45	—	—	—	100.00
3/8"	9.50 m.m	499.70	493.90	14.20	1.42	1.42	98.58
4	4.75 m.m	466.20	677.40	211.20	21.16	22.58	77.42
8	2.36	423.90	723.20	299.30	29.99	52.57	47.43
16	2.00	418.05	472.20	54.15	5.45	58.00	42.00
16	1.18	412.20	528.80	116.60	11.68	69.68	30.32
30	0.60	352.00	435.20	83.20	8.34	78.02	21.98
40	0.425	342.75	377.20	29.45	2.95	80.97	19.03
50	0.30	320.00	344.50	24.50	2.45	83.42	16.58
100	0.150	309.85	372.49	63.14	6.33	89.75	10.25
200	0.075	302.50	356.00	53.50	5.36	95.11	4.89
PAN.	—	294.88	343.70	48.82	4.89	100.00	0.00
				Σ 998.06			

ERROR = 1.94 gm

Boring No. 1. Date 31 OCTOBER 1985 Test No. 1.

Location : KONG., RACHASRIMA. Tested by MR SUTHEP TANOMGITMUBUK.



09

CLAY (PLASTIC) TO SILT (NON PLASTIC) | SAND: FINE, MEDIUM, COARSE | GRAVEL: FINE, COARSE | COBBLES

Table-11-2 SIEVE ANALYSIS

Soil sample : _____

Location : KONG., RACHASRIMA.

Boring No. 1.

Sample No _____

Soil sample weight. _____

Container No. _____

Wt. Container + Dry soil in g. 1294.75 gm

Wt. Container in g 294.75 gm.

Wt. Dry soil Ws, in g. 1000 gm.

Specific Gravity, Gs, _____

Test No. 2.

Date 1ST NOVEMBER 1985.

Tested by MR. SUTHEP TANOMGITNURUK. MR. SOMW. OHOANGSHO.

Sieve No.	Sieve opening in mm.	Wt. sieve in g.	Wt. sieve + soil in g.	Wt. soil returned in g	Percent Retained	Cumulative Percent Retained	Percent Finer
3/4"	19.00 m.m	507.45	—	—	—	—	100.00
3/8"	9.50 m.m	479.60	486.09	6.49	0.65	0.65	99.35
4	4.75	466.80	676.70	210.40	21.07	21.72	78.28
8.	2.36	423.80	699.69	275.89	27.63	49.35	50.65
10	2.00	418.00	471.88	53.88	5.40	54.75	45.25
16.	1.18	412.50	521.58	109.08	10.92	65.67	34.33
30	0.60	351.85	441.30	89.45	8.96	74.63	25.37
40	0.425	347.80	382.35	34.55	3.46	78.09	21.91
50	0.300	320.00	347.70	27.70	2.77	80.86	19.14
100	0.150	309.50	387.40	77.90	7.80	88.66	11.34
200	0.075	302.90.	358.45	55.55	5.56	94.22	5.78
PAN.	—	294.75	352.50	57.75	5.78	100.00	0.00

Σ 998.64 gm

ERROR 1.36 gm

Boring No. 1 Date 1st NOVEMBER 1985 Test No. 2.

Location : KONG., RACHASRIMA. Tested by NR SUTHEP. TANOMGITMURUK.

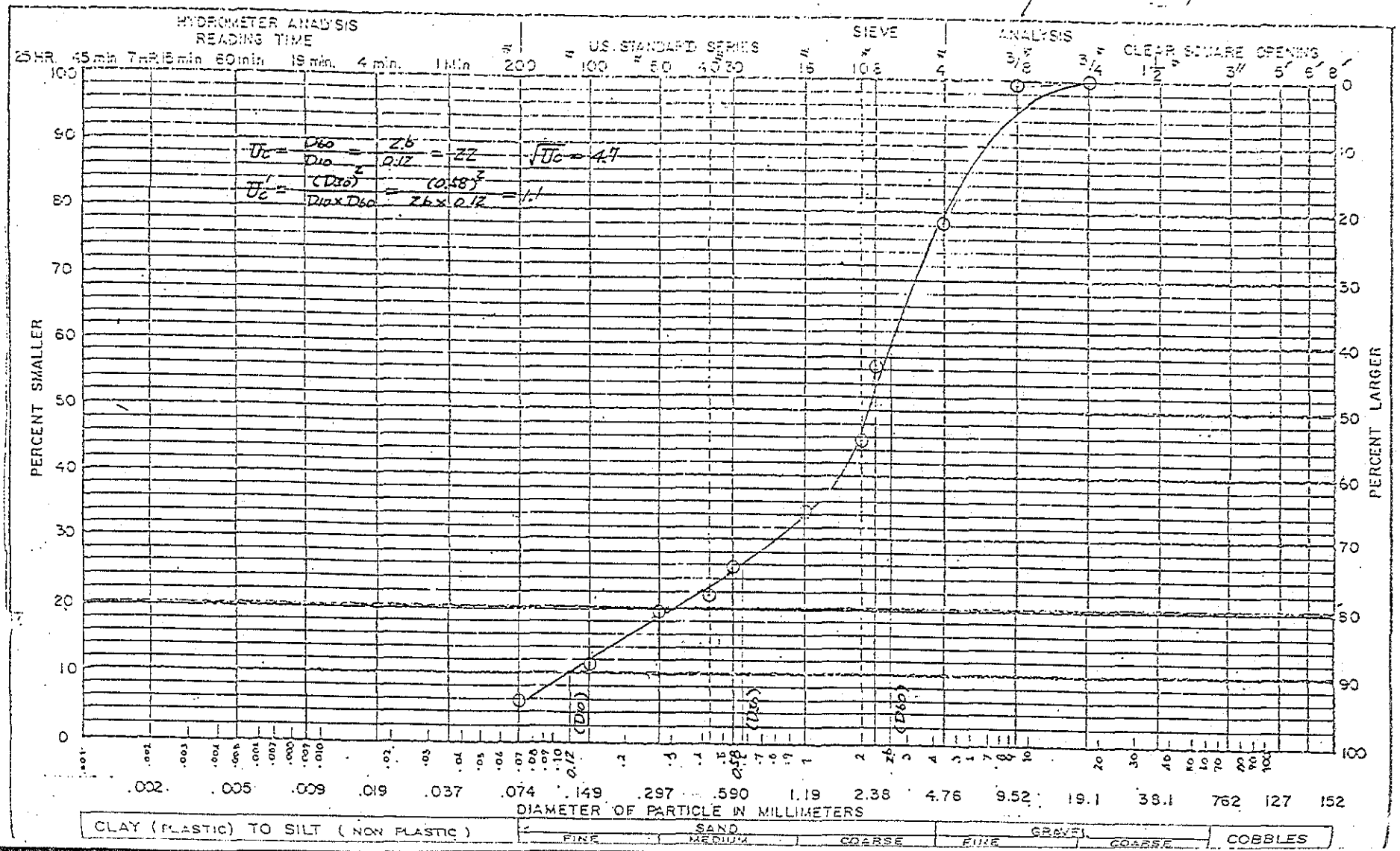


Table - 11-3 SIEVE ANALYSIS

Soil sample : _____

_____

_____

Location : KONG, RACHASRIMA.

Boring No. 2.

Sample No 2.

Soil sample weight. _____

Container No. _____

Wt. Container + Dry soil in g 1294.70 gm

Wt. Container, in g 294.70 gm

Wt. Dry soil Ws, in g. 1000 gm.

Specific Gravity, Gs, _____

Test No. 1.

Date 29TH. OCTOBER. 1985

Tested by MR. SUTHEP. TANONGJINGRUK
นาย สุเทพ. ทนงจิงรักษ์.
29.01.28.

Sieve No.	Sieve opening in mm.	Wt. sieve in g.	Wt. sieve + soil in g.	Wt. soil returned in g	Percent Retained	Cumulative Percent Retained	Percent Finer
3/4"	19.00 m.m	506.80	506.80	—	—	—	100.00
3/8"	9.50	479.30	565.35	86.05	8.61	8.61	91.39
4	4.75	466.15	763.20	297.05	29.72	38.33	69.00
8	2.36	423.70	684.52	260.82	26.10	64.43	35.57
10	2.00	414.90	466.70	48.80	4.88	69.31	30.69
16	1.18	412.20	511.89	99.69	9.98	79.29	20.71
30	0.60	359.40	420.15	68.75	6.88	86.17	13.83
40	0.425	347.60	370.82	23.22	2.32	88.49	11.51
50	0.30	319.90	336.30	16.40	1.64	90.13	9.87
100	0.15	309.20	348.35	39.15	3.92	94.05	5.95
200	0.075	302.70	330.70	28.00	2.80	96.85	3.15
PAN.	—	294.70	326.18	31.48	3.15	100.00	0.00

Σ 999.41

ERROR 0.59 gm

Boring No. 2. Date 19th OCTOBER 1985 Tested by MR. SUTHEP. TANONGITNUKUK

Test No. 1. Location : KONG - RACHASRIMA

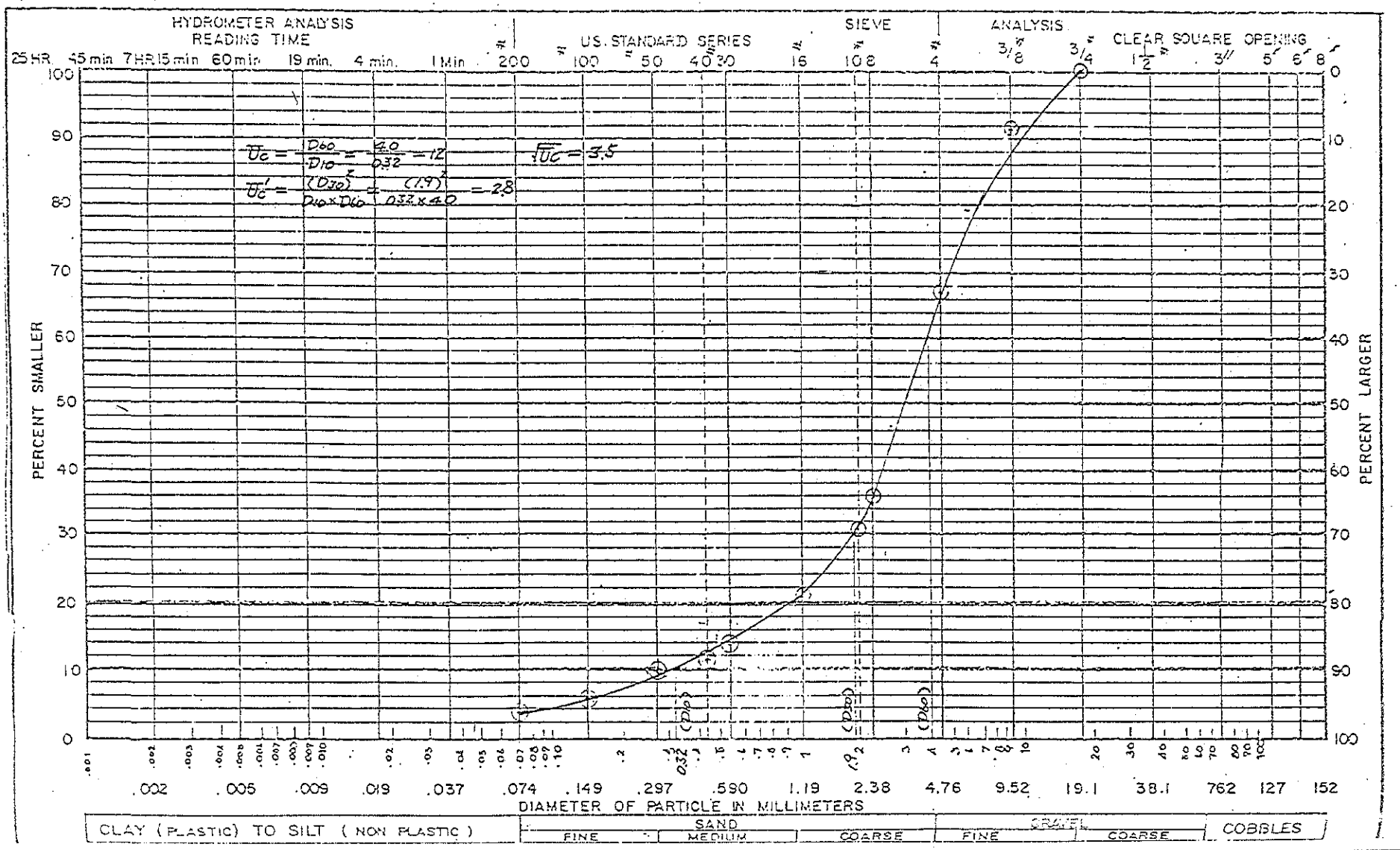


Table - 11-4 SIEVE ANALYSIS

Soil sample : _____

_____

_____

Location : KONG., RACHASRIMA.

Boring No. 2

Sample No 2

Soil sample weight. _____

Container No. _____

Wt. Container + Dry soil in g 1294.70 gm

Wt. Container in g 294.90 gm.

Wt. Dry soil Ws, in g. _____

Specific Gravity, Gs, _____

Test No. 2.

Date _____

Tested by MR. SUTHEP TANOMGITNURUK.
นาย สุเทพ ทนอมกิจนุรักษ์
28.01.28.

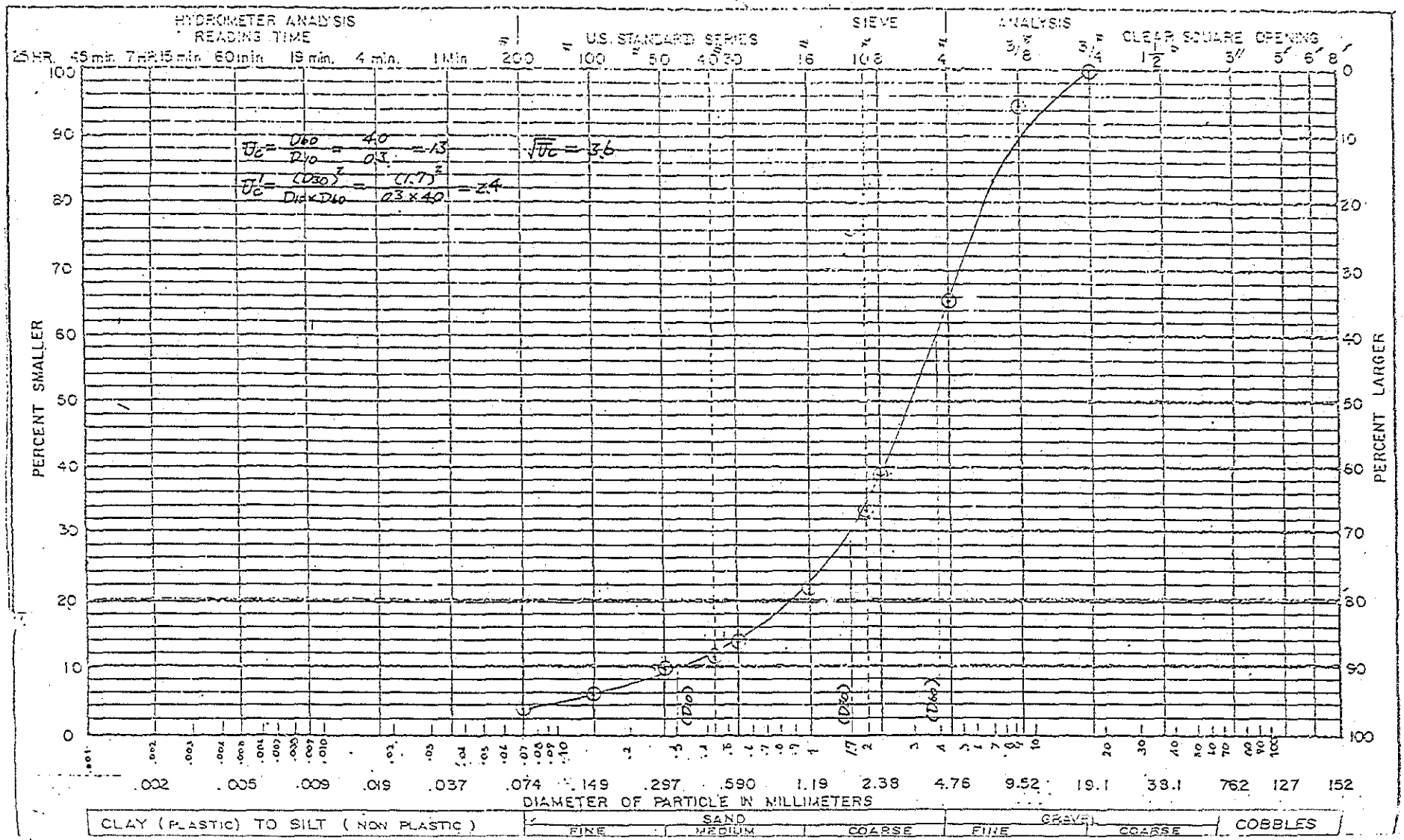
Sieve No.	Sieve opening in mm.	Wt. sieve in g.	Wt. sieve + soil in g.	Wt. soil returned in g	Percent Retained	Cumulative Percent Retained	Percent Finer
3/4"	19.00 m-m	507.10	—	—	—	—	100.00
3/8"	9.50	479.49	535.00	55.51	5.56	5.56	94.44
4	4.75	466.10	757.57	291.47	29.20	34.76	65.24
8	2.36	423.72	689.36	265.64	26.42	61.18	38.82
10	2.00	418.00	474.70	56.70	5.68	66.86	33.14
16	1.18	412.20	527.40	115.20	11.54	78.40	21.60
30	0.60	352.20	429.51	77.31	7.75	86.15	13.85
40	0.425	347.82	371.81	23.99	2.40	88.55	11.45
50	0.30	320.20	337.00	16.80	1.68	90.23	9.77
100	0.15	309.82	348.05	38.23	3.83	94.06	5.94
200	0.075	302.60	330.80	28.20	2.83	96.89	3.11
PAN.	—	294.20	325.75	31.05	3.11	100.00	0.00

Σ 998.10 gm

ERROR 1.9 gm

Boring No. 2. Date 28th. October. 1985 Test No. 2.

Location : KONG. RACHASRINA. Tested by NR. SUTHEP TANOMGITNURUK.



99

Determination		Test pit 1		Test pit 2	
		NO.1	NO.2	NO.3	NO.4
Specimen	Weight m ; Kg	1.580	1.500	3.010	2.930
	Volume V ; cm^3	816.2	703.7	1,436.5	1,447.3
Wet density ρt, m/V (g/cm^3)		1.936	2.132	2.095	2.024
Water contents (%)		14.67	17.20	15.99	15.09
Dry density ρd $\rho t/(1+w/100)$ (g/cm^3)		1.688	1.819	1.806	1.759
Specific gravity Gs		2.592	2.592	2.601	2.601
Void ratio e ($Gs \cdot \rho w/\rho d - 1$)		0.536	0.425	0.440	0.479
Degree of saturation Sr $Gs \cdot w/e$ (%)		70.94	100.00	94.52	81.94

Table 12-1 Field density test.

SOIL MECHANICS LABORATORY

DEPARTMENT OF COOPERATIVE PROMOTION, ENGINEERING DIVISION

WATER CONTENT OF SOIL

Soil sample _____ Test No. _____

Date. 25 October 1985.

Tested by MR. SUTHEP TANOMGITNUKUL.

Location KONG. 3, RACHASRINA.

Boring No. _____

Sample No. NO1, No2, NO3 - NO4.

Specific gravity, G_s _____

WATER CONTENT		NO1		NO2		NO3	
Determination No.		1	2	1	2	1	2
Container No.		A-1	A-2	B-1	B-2	C-1	C-2
Weight container + wet soil	g	68.40	100.27	85.90	100.00	99.00	102.39
Weight container + dry soil	g	61.05	89.40	75.40	87.90	87.00	90.59
Weight water, Ww	g	7.35	10.87	10.50	12.10	12.00	11.80
Weight container	g	11.30	14.75	15.30	16.40	12.80	15.99
Weight dry soil, Ws	g	49.95	74.65	60.10	71.50	74.20	74.60
Water content, W	%	14.72	14.56	17.47	16.92	16.17	15.81

WATER CONTENT		NO4					
Determination No.		1	2				
Container No.		D-1	D-2				
Weight container + wet soil	g	116.90	97.20				
Weight container + dry soil	g	103.40	85.60				
Weight water, Ww	g	13.50	11.60				
Weight container	g	11.40	10.80				
Weight dry soil, Ws	g	92.00	74.80				
Water content, W	%	14.67	15.50				

REMARKS :— NO.1, NO.2 : Test pit 1

$$\bar{w} = \frac{1}{4}(14.72 + 14.56 + 17.47 + 16.92) = 15.9 \ (\%)$$

NO.3, NO.4 : Test pit 2

$$\bar{w} = \frac{1}{4}(16.17 + 15.81 + 14.67 + 15.50) = 15.5 \ (\%)$$

Table 12-2 Water content of soil

Table 13 Suitability or soil for banking and foundation

Symbol	Suitability for banking	Compaction	Dry density (t/m^3)	Permeability cm/sec.	Suitability for foundation	Adjustment for permeability
GW	Very good used for pervious zone of bank or dam	Good by tractor, rubber tired roller, steel wheel roller	2.00 ∿ 2.16	$> 10^{-2}$	Good	Cut off wall required
GP	Good used for pervious zone of bank or dam	Good by tractor, rubber tired roller, steel wheel roller	1.84 ∿ 2.00	$> 10^{-2}$	Good	Cut off wall required
GM	Fair not so suitable as impervious zone, but used for impervious core or blanket	Good by close management, by rubber tired roller, sheeps food roller etc.	1.92 ∿ 2.16	10^{-3} ∿ 10^{-6}	Good	Toe trench required ∿ needless
GC	Barely fair used for impervious core	Fair by rubber tired roller, sheeps foot roller	1.84 ∿ 2.08	10^{-6} ∿ 10^{-8}	Good	Needless
SW	Very good used for pervious zone with slope protection	Good by tractor	1.76 ∿ 2.08	$> 10^{-3}$	Good	Upstream blanket, toe drain or drain well required
SP	Fair used for gentle slope banking	Good by tractor	1.60 ∿ 1.92	$> 10^{-3}$	Good-poor according their density	Upstream blanket, toe drain or drain well required
SM	Barely fair not so suitable for impervious zone, used for impervious core or bank	Good careful operation required. by rubber tired roller, sheeps foot roller	1.72 ∿ 2.00	10^{-3} ∿ 10^{-6}	Good-poor according their density	Upstream blanket, toe drain or drain well required
SC	Barely fair used for impervious core of flood protection bank	Fair by sheeps foot roller, rubber tired roller	1.68 ∿ 2.00	10^{-6} 10^{-8}	Good-poor	Needless
ML	Poor used on proper adjustment	Good - poor careful operation is important. by rubber tired roller, sheeps foot roller	1.52 ∿ 1.92	10^{-4} ∿ 10^{-6}	Very poor in danger of lique faction	Toe drain ∿ needless
CL	Barely fair used for impervious core or blanket	Fair - good by sheeps foot roller, rubber tired roller	1.52 ∿ 1.92	10^{-6} ∿ 10^{-8}	Good-poor	Needless
OL	Unsuitable for banking materials	Fair - poor by sheeps foot roller	1.28 ∿ 1.60	10^{-4} ∿ 10^{-6}	Fair-poor in danger large settlement	Needless
MH	Poor used for core in hydraulic fill but unsuitable for roll fill	Poor - unsuitable by sheeps foot roller	1.12 ∿ 1.52	10^{-4} ∿ 10^{-6}	Poor	Needless
CH	Fair for gentle slope, used for thin core, blanket	Fair - poor by sheeps foot roller	1.20 ∿ 1.68	10^{-6} ∿ 10^{-8}	Fair-poor	Needless
OH	Unsuitable for banking materials	Poor - unsuitable by sheeps foot roller	1.04 ∿ 1.60	10^{-6} ∿ 10^{-8}	Very poor	Needless
Pt	Can't use for construction materials	Practically impossible	-	-	Can't use for foundation	-

Table 14

Damage caused by salt on rice growth

Salt concentration and rice growth

Chlorine (ppm)	Height of rice (cm)	Tillering (number)	Weight ratio of unhulled rice (%)	Weight ratio of unhulled rice (%)	Weight of straw (g)
0	80.9	21.0	53.5	100	59.3
100	82.6	19.5	52.0	97	59.0
300	81.4	19.5	47.0	87	59.0
500	78.1	21.5	47.5	88	55.0
1,000	79.9	20.5	46.5	86	56.0
2,000	77.5	22.0	36.0	67	49.0
3,000	wither	-	-	-	-
5,000	wither	-	-	-	-

Table 15

Temporary salt injury in each growing period

Concentration of NaCl (ppm)	Nursery period		Yield ratio (%)		
	Germination ratio (%)	Height after 30 days (cm)	in trans-planting time	After setting	in booting period
0	100	13.0	100	100	100
1,000	100	13.0	54	109	112
2,500	100	13.0	34	79	100
5,000	100	12.0	0	9	106
7,500	80	9.5	0	0	67
10,000	50	8.0	0	0	57
15,000	0	-	0	0	27

ITEMS	A	B	C	D
1.PH Value	6	7	6	6
2.Electrical Conductivity	110	1,150	1,200	3,200
3.Total Hardness (as $CaCO_3$)	45	23	235	278
4.Mg^{++} ion	10.8	5.4	56.4	24
5.Ca^{++} ion	0	0	0	71.8
6.Na^{+} ion	2	24	86	218
7.SAR	0.85	14.6	16.2	31.5

ITEMS	E	F	G	H
1.PH Value	6	6	6	6
2.Electrical Conductivity	3,300	60	60	60
3.Total Hardness (as $CaCO_3$)	580	30	25	20
4.Mg^{++} ion	96	7.2	6	4.8
5.Ca^{++} ion	74.5	0	0	0
6.Na^{+} ion	206	1	1	2
7.SAR	22.4	0.53	0.58	0.63

Table 16 Report of water analysis

Table - 17 - 1

REPORT OF WATER ANALYSIS BY PHYSICAL AND CHEMICAL EXAMINATIONS

Sampling date	October 24, 1985
Sampling place	Existing Reservoir
Sample name	A

ANALYSIS RESULT (S)

Item \ Sample name		A
1. Appearance		Little White Mud
2. Colour		0'
3. Odour		-
4. Turbidity		40'
5. PH value		6
6. Electrical conductivity at 20°C, micromhos/cm		110
7. Total solids	(ppm)	213
8. Suspended solids	(ppm)	167
9. Dissolved solids	(ppm)	46
10. Total hardness	(ppm as $CaCo_3$)	45
11. Temporary hardness	(ppm as $CaCo_3$)	45
12. Permanent hardness	(ppm as $CaCo_3$)	0
13. M—Alkalinity	(ppm as $CaCo_3$)	62
14. P—Alkalinity	(ppm as $CaCo_3$)	0
15. Residual—Alkalinity	(ppm as $CaCo_3$)	0
16. Chlorides Ion	(ppm as Cl^-)	2
17. Sulfates Ion	(ppm as SO_4^{-2})	
18. Phosphates Ion	(ppm as PO_4^{-3})	
19. Nitrates Ion	(ppm as NO_3^-)	Detection
20. Nitrites Ion	(ppm as NO_2^-)	Detection
21. Ammonium Ion	(ppm as NH_4^+)	None
22. Silica	(ppm as Sio_2)	
23. Total Iron	(ppm)	3.5
24. Total Manganese	(ppm)	
25. Residual Chlorine	(ppm)	0
26. COD-Mn		4

REMARKS.

LABORATORY MANAGER

Table -17-2

REPORT OF WATER ANALYSIS BY PHYSICAL AND CHEMICAL EXAMINATIONS

Sampling date	October, 1985
Sampling place	NO.1 TEST PIT
Sample name	B

ANALYSIS RESULT (S)

Item \ Sample name		B
1. Appearance		Little White Mud
2. Colour		0
3. Odour		-
4. Turbidity		9
5. PH value		7
6. Electrical conductivity at 20°C, micrombos/cm		1,150
7. Total solids	(ppm)	1,685
8. Suspended solids	(ppm)	71
9. Dissolved solids	(ppm)	1,614
10. Total hardness	(ppm as $CaCo_3$)	23
11. Temporary hardness	(ppm as $CaCo_3$)	23
12. Permanent hardness	(ppm as $CaCo_3$)	0
13. M-Alkalinity	(ppm as $CaCo_3$)	1,300
14. P-Alkalinity	(ppm as $CaCo_3$)	0
15. Residual-Alkalinity	(ppm as $CaCo_3$)	0
16. Chlorides Ion	(ppm as Cl^-)	52
17. Sulfates Ion	(ppm as SO_4^{-2})	
18. Phosphates Ion	(ppm as PO_4^{-3})	
19. Nitrates Ion	(ppm as NO_3^-)	None
20. Nitrites Ion	(ppm as NO_2^-)	Detection
21. Ammonium Ion	(ppm as NH_4^+)	None
22. Silica	(ppm as Sio_2)	
23. Total Iron	(ppm)	.25
24. Total Manganese	(ppm)	
25. Residual Chlorine	(ppm)	0
26. COD-Mn		3

REMARKS.

LABORATORY MANAGER

REPORT OF WATER ANALYSIS

Table -17-3 BY PHYSICAL AND CHEMICAL EXAMINATIONS

Sampling date	October, 1985
Sampling place	NO. 2 TEST PIT
Sample name	C

ANALYSIS RESULT (S)

Item \ Sample name		C
1. Appearance		Little White Mud
2. Colour		0'
3. Odour		-
4. Turbidity		17'
5. PH value		6
6. Electrical conductivity at 20°C, micromhos/cm		1,200
7. Total solids	(ppm)	781
8. Suspended solids	(ppm)	135
9. Dissolved solids	(ppm)	646
10. Total hardness	(ppm as $CaCo_3$)	235
11. Temporary hardness	(ppm as $CaCo_3$)	235
12. Permanent hardness	(ppm as $CaCo_3$)	0
13. M-Alkalinity	(ppm as $CaCo_3$)	296
14. P-Alkalinity	(ppm as $CaCo_3$)	0
15. Residual-Alkalinity	(ppm as $CaCo_3$)	0
16. Chlorides Ion	(ppm as Cl^-)	162
17. Sulfates Ion	(ppm as SO_4^{-2})	
18. Phosphates Ion	(ppm as PO_4^{-3})	
19. Nitrates Ion	(ppm as NO_3^-)	None
20. Nitrites Ion	(ppm as NO_2^-)	None
21. Ammonium Ion	(ppm as NH_4^+)	None
22. Silica	(ppm as Slo_2)	
23. Total Iron	(ppm)	1
24. Total Manganese	(ppm)	
25. Residual Chlorine	(ppm)	0
26. COD-Mn		2

REMARKS.

LABORATORY MANAGER

REPORT OF WATER ANALYSIS

Table -17-4 BY PHYSICAL AND CHEMICAL EXAMINATIONS

Sampling date	October 24,1985
Sampling place	District public office
Sample name	D

ANALYSIS RESULT (S)

Item \ Sample name		D
1. Appearance		Little Brown Mud
2. Colour		0'
3. Odour		-
4. Turbidity		30'
5. PH value		6
6. Electrical conductivity at 20°C, micrombos/cm		3,200
7. Total solids	(ppm)	1,708
8. Suspended solids	(ppm)	211
9. Dissolved solids	(ppm)	1,497
10. Total hardness	(ppm as $CaCo_3$)	278
11. Temporary hardness	(ppm as $CaCo_3$)	278
12. Permanent hardness	(ppm as $CaCo_3$)	0
13. M-Alkalinity	(ppm as $CaCo_3$)	532
14. P-Alkalinity	(ppm as $CaCo_3$)	0
15. Residual-Alkalinity	(ppm as $CaCo_3$)	0
16. Chlorides Ion	(ppm as Cl^-)	661
17. Sulfates Ion	(ppm as SO_4^{-2})	
18. Phosphates Ion	(ppm as PO_4^{-3})	
19. Nitrates Ion	(ppm as NO_3^-)	None
20. Nitrites Ion	(ppm as NO_2^-)	None
21. Ammonium Ion	(ppm as NH_4^+)	None
22. Silica	(ppm as Slo_2)	
23. Total Iron	(ppm)	10.5
24. Total Manganese	(ppm)	
25. Residual Chlorine	(ppm)	0
26. COD-Mn		3

REMARKS.

LABORATORY MANAGER

REPORT OF WATER ANALYSIS

Table -17-5 BY PHYSICAL AND CHEMICAL EXAMINATIONS

Sampling date	October 24,1985
Sampling place	Deep Well of Un Samaki Hospital
Sample name	E

ANALYSIS RESULT (S)

Item \ Sample name		E
1. Appearance		Little White Mud
2. Colour		0'
3. Odour		-
4. Turbidity		3'
5. PH value		6
6. Electrical conductivity at 20°C, micromhos/cm		3,300
7. Total solids	(ppm)	2,072
8. Suspended solids	(ppm)	14
9. Dissolved solids	(ppm)	2,058
10. Total hardness	(ppm as $CaCo_3$)	580
11. Temporary hardness	(ppm as $CaCo_3$)	580
12. Permanent hardness	(ppm as $CaCo_3$)	0
13. M—Alkalinity	(ppm as $CaCo_3$)	374
14. P—Alkalinity	(ppm as $CaCo_3$)	0
15. Residual—Alkalinity	(ppm as $CaCo_3$)	0
16. Chlorides Ion	(ppm as Cl^-)	911
17. Sulfates Ion	(ppm as SO_4^{-2})	
18. Phosphates Ion	(ppm as PO_4^{-3})	
19. Nitrates Ion	(ppm as NO_3^-)	None
20. Nitrites Ion	(ppm as NO_2^-)	None
21. Ammonium Ion	(ppm as NH_4^+)	None
22. Silica	(ppm as Slo_2)	
23. Total Iron	(ppm)	1.25
24. Total Manganese	(ppm)	
25. Residual Chlorine	(ppm)	0
26. COD-Mn		

REMARKS.

LABORATORY MANAGER

REPORT OF WATER ANALYSIS

Table -17-6 BY PHYSICAL AND CHEMICAL EXAMINATIONS

Sampling date	October 30,1985
Sampling place	Chakaya River Point A
Sample name	F

ANALYSIS RESULT (S)

Item \ Sample name		F
1. Appearance		Little Brown Mud
2. Colour		0'
3. Odour		-
4. Turbidity		13'
5. PH value		6
6. Electrical conductivity at 20°C, micromhos/cm		60
7. Total solids	(ppm)	140
8. Suspended solids	(ppm)	69
9. Dissolved solids	(ppm)	71
10. Total hardness	(ppm as $CaCo_3$)	30
11. Temporary hardness	(ppm as $CaCo_3$)	30
12. Permanent hardness	(ppm as $CaCo_3$)	0
13. M—Alkalinity	(ppm as $CaCo_3$)	34
14. P—Alkalinity	(ppm as $CaCo_3$)	0
15. Residual—Alkalinity	(ppm as $CaCo_3$)	0
16. Chlorides Ion	(ppm as Cl^-)	4
17. Sulfates Ion	(ppm as SO_4^{-2})	
18. Phosphates Ion	(ppm as PO_4^{-3})	
19. Nitrates Ion	(ppm as NO_3^-)	None
20. Nitrites Ion	(ppm as NO_2^-)	None
21. Ammonium Ion	(ppm as NH_4^+)	None
22. Silica	(ppm as Slo_2)	
23. Total Iron	(ppm)	1.25
24. Total Manganese	(ppm)	
25. Residual Chlorine	(ppm)	0
26. COD-Mn		

REMARKS.

LABORATORY MANAGER

REPORT OF WATER ANALYSIS

Table -17-7 BY PHYSICAL AND CHEMICAL EXAMINATIONS

Sampling date	October 29,1985
Sampling place	Chakara River Point B
Sample name	G

ANALYSIS RESULT (S)

Item \ Sample name		G
1. Appearance		Little Brown Mud
2. Colour		0'
3. Odour		-
4. Turbidity		9'
5. PH value		6
6. Electrical conductivity at 20°C, micromhos/cm		60
7. Total solids	(ppm)	115
8. Suspended solids	(ppm)	57
9. Dissolved solids	(ppm)	58
10. Total hardness	(ppm as $CaCo_3$)	25
11. Temporary hardness	(ppm as $CaCo_3$)	25
12. Permanent hardness	(ppm as $CaCo_3$)	0
13. M—Alkalinity	(ppm as $CaCo_3$)	30
14. P—Alkalinity	(ppm as $CaCo_3$)	0
15. Residual—Alkalinity	(ppm as $CaCo_3$)	0
16. Chlorides Ion	(ppm as Cl^-)	4
17. Sulfates Ion	(ppm as SO_4^{-2})	
18. Phosphates Ion	(ppm as PO_4^{-3})	
19. Nitrates Ion	(ppm as NO_3^-)	None
20. Nitrites Ion	(ppm as NO_2^-)	None
21. Ammonium Ion	(ppm as NH_4^+)	None
22. Silica	(ppm as Sio_2)	
23. Total Iron	(ppm)	5
24. Total Manganese	(ppm)	
25. Residual Chlorine	(ppm)	
26. COD-Mn		3

REMARKS.

LABORATORY MANAGER

REPORT OF WATER ANALYSIS

Table -17-8 BY PHYSICAL AND CHEMICAL EXAMINATIONS

Sampling date	October 30, 1985
Sampling place	Chakara River under the Bridge
Sample name	H

ANALYSIS RESULT (S)

Item \ Sample name		H
1. Appearance		Little Brown Mud
2. Colour		0'
3. Odour		-
4. Turbidity		11'
5. PH value		6
6. Electrical conductivity at 20°C, micrombos/cm		60
7. Total solids	(ppm)	136
8. Suspended solids	(ppm)	58
9. Dissolved solids	(ppm)	78
10. Totul hardness	(ppm as $CaCo_3$)	20
11. Temporary hardness	(ppm as $CaCo_3$)	20
12. Permanent hardness	(ppm as $CaCo_3$)	0
13. M—Alkalinity	(ppm as $CaCo_3$)	32
14. P—Alkalinity	(ppm as $CaCo_3$)	0
15. Residual—Alkalinity	(ppm as $CaCo_3$)	0
16. Chlorides Ion	(ppm as Cl^-)	4
17. Sulfates Ion	(ppm as SO_4^{-2})	
18. Phosphates Ion	(ppm as PO_4^{-3})	
19. Nitrates Ion	(ppm as NO_3^-)	None
20. Nitrites Ion	(ppm as NO_2^-)	None
21. Ammonium Ion	(ppm as NH_4^+)	None
22. Silica	(ppm as Sio_2)	
23. Total Iron	(ppm)	1.25
24. Total Manganese	(ppm)	
25. Residual Chlorine	(ppm)	0
26. COD-Mn		3

REMARKS.

LABORATORY MANAGER

Table 18 CALCULATION OF EVAPOTRANSPIRATION

(1) Modified Penman Method ($ETo = C \{ W \cdot Rn + (1-W) \cdot f(u) \cdot (ea-ed) \}$)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Remarks
I. METEOROLOGICAL DATA													
Air Temperature (°c)	22.9	25.7	28.1	29.0	28.4	28.1	27.6	27.3	26.5	25.9	24.2	22.5	
Relative Humidity (%)	67.0	65.0	65.0	68.0	76.0	76.0	77.0	78.0	83.0	81.0	76.0	69.0	
Wind Velocity (m/s)	1.0	1.0	1.0	1.2	1.1	1.5	1.6	1.5	1.0	1.1	1.3	1.2	
Sun Shine Duration (n/N)	0.81	0.75	0.67	0.65	0.62	0.53	0.49	0.48	0.45	0.62	0.76	0.80	
II. CALCULATION													
ea (mbar)	27.9	33.0	38.0	40.1	38.7	38.0	37.0	36.3	34.7	33.4	30.2	27.3	
ed=eaxRHmean/100	18.7	21.5	24.7	27.3	29.4	28.9	28.5	28.3	28.8	27.1	23.0	18.8	
(ea-ed)	9.2	11.5	13.3	12.8	9.3	9.1	8.5	8.0	5.9	6.3	7.2	8.5	
u	86.4	86.4	86.4	103.4	95.0	129.6	138.2	129.6	86.4	95.0	112.3	103.7	
f(u)=0.27(1+u/100)	0.50	0.50	0.50	0.55	0.53	0.62	0.64	0.62	0.50	0.53	0.57	0.55	
(1-W)	0.28	0.25	0.23	0.23	0.23	0.23	0.23	0.24	0.25	0.25	0.27	0.29	
W	0.72	0.75	0.77	0.77	0.77	0.77	0.77	0.76	0.75	0.75	0.73	0.71	
Ra	12.2	13.5	14.8	15.7	15.9	15.8	15.8	15.7	15.1	14.0	12.6	11.8	
Rs=(0.25+0.50n/N)Ra	8.0	8.4	8.7	9.0	8.9	8.1	7.8	7.7	7.2	7.8	7.9	7.7	
Rns= (1-α)Rs	6.0	6.3	6.5	6.8	6.7	6.1	5.9	5.8	5.4	5.9	5.9	5.8	
Rnl=f(T)·f(ed)·F(n/N) f(T)	15.2	15.8	16.3	16.5	16.4	16.3	16.2	16.2	16.0	15.9	15.5	15.1	
Rnl=f(T)·f(ed)·F(n/N) f(ed)	0.13	0.12	0.11	0.11	0.11	0.11	0.11	0.11	0.12	0.12	0.12	0.13	
Rnl=f(T)·f(ed)·F(n/N) f(n/N)	0.83	0.78	0.70	0.69	0.66	0.58	0.54	0.53	0.51	0.66	0.78	0.82	
Rnl	1.6	1.5	1.3	1.3	1.2	1.0	1.0	0.9	1.0	1.3	1.5	1.6	
Rn=Rns-Rnl	4.4	4.8	5.2	5.5	5.5	5.1	4.9	4.9	4.4	4.6	4.4	4.2	
C	1.05	1.06	1.07	1.06	1.07	1.04	1.02	1.03	1.04	1.04	1.04	1.04	
ETo=C{W·Rn+(1-W)·f(u)·(ea-ed)}	4.7	5.3	5.9	6.2	5.7	5.4	5.1	5.1	4.2	4.5	4.5	4.5	

W : temperature-related weighting factor

Rn : net radiation in equivalent evaporation in mm/day

F(u) : wind-related function

(ea-ed) : difference between in saturation vapour pressure at mean air temperature and the mean actual vapour pressure of the air, both in mbar

C : adjustment factor to compensate for the effect of day and night weather conditions

- continue -

Temperature °C	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
ea mbar	6.1	6.6	7.1	7.6	8.1	8.7	9.3	10.0	10.7	11.5	12.3	13.1	14.0	15.0	16.1	17.0	18.2	19.4	20.6	22.0

Temperature °C	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
ea mbar	23.4	24.9	26.4	28.1	29.8	31.7	33.6	35.7	37.8	40.1	42.4	44.9	47.6	50.3	53.2	56.2	59.4	62.8	66.3	69.9

1/ Also actual vapour pressure (ed) can be obtained from this table using available Tdewpoint data.
(Example: Tdewpoint is 18°C; ed is 20.6 mbar)

Saturation Vapour Pressure (es) in mbar as Function of Mean Air Temperature (T) in °C 1/

Temperature °C	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
W at altitude m																				
0	0.43	.46	.49	.52	.55	.58	.61	.64	.66	.69	.71	.73	.75	.77	.78	.80	.82	.83	.84	.85
500	.44	.48	.51	.54	.57	.60	.62	.65	.67	.70	.72	.74	.76	.78	.79	.81	.82	.84	.85	.86
1 000	.46	.49	.52	.55	.58	.61	.64	.66	.69	.71	.73	.75	.77	.79	.80	.82	.83	.85	.86	.87
2 000	.49	.52	.55	.58	.61	.64	.66	.69	.71	.73	.75	.77	.79	.81	.82	.84	.85	.86	.87	.88
3 000	.52	.55	.58	.61	.64	.66	.69	.71	.73	.75	.77	.79	.81	.82	.84	.85	.86	.87	.88	.89
4 000	.54	.58	.61	.64	.66	.69	.71	.73	.75	.77	.79	.81	.82	.84	.85	.86	.87	.89	.90	.90

Values of Weighting Factor (W) for the Effect of Radiation on ETo at Different Temperatures and Altitudes

- continue -

$T^{\circ}C$	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36
$f(T) = \sigma T_k^4$	11.0	11.4	11.7	12.0	12.4	12.7	13.1	13.5	13.8	14.2	14.6	15.0	15.4	15.9	16.3	16.7	17.2	17.7	18.1

Effect of Temperature f(T) on Longwave Radiation (Rnl)

ed mbar	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
$f(ed) = 0.34 - 0.044\sqrt{ed}$	0.23	.22	.20	.19	.18	.16	.15	.14	.13	.12	.12	.11	.10	.09	.08	.08	.07	.06

Effect of Vapour Pressure f(ed) on Longwave Radiation (Rnl)

n/N	0	.05	.1	.15	.2	.25	.3	.35	.4	.45	.5	.55	.6	.65	.7	.75	.8	.85	.9	.95	1.0
$f(n/N) = 0.1 + 0.9\ n/N$	0.10	.15	.19	.24	.28	.33	.37	.42	.46	.51	.55	.60	.64	.69	.73	.78	.82	.87	.91	.96	1.0

Effect of the Ratio Actual and Maximum Bright Sunshine Hours f(n/N) on Longwave Radiation (Rnl)

– continue –

	RHmax = 30%				RHmax = 60%				RHmax = 90%			
Rs mm/day	3	6	9	12	3	6	9	12	3	6	9	12
Uday m/sec	Uday/Unight = 4.0											
0	.86	.90	1.00	1.00	.96	.98	1.05	1.05	1.02	1.06	1.10	1.10
3	.79	.84	.92	.97	.92	1.00	1.11	1.19	.99	1.10	1.27	1.32
6	.68	.77	.87	.93	.85	.96	1.11	1.19	.94	1.10	1.26	1.33
9	.55	.65	.78	.90	.76	.88	1.02	1.14	.88	1.01	1.16	1.27
	Uday/Unight = 3.0											
0	.86	.90	1.00	1.00	.96	.98	1.05	1.05	1.02	1.06	1.10	1.10
3	.76	.81	.88	.94	.87	.96	1.06	1.12	.94	1.04	1.18	1.28
6	.61	.68	.81	.88	.77	.88	1.02	1.10	.86	1.01	1.15	1.22
9	.46	.56	.72	.82	.67	.79	.88	1.05	.78	.92	1.06	1.18
	Uday/Unight = 2.0											
0	.86	.90	1.00	1.00	.96	.98	1.05	1.05	1.02	1.06	1.10	1.10
3	.69	.76	.85	.92	.83	.91	.99	1.05	.89	.98	1.10	1.14
6	.53	.61	.74	.84	.70	.80	.94	1.02	.79	.92	1.05	1.12
9	.37	.48	.65	.76	.59	.70	.84	.95	.71	.81	.96	1.06
	Uday/Unight = 1.0											
0	.86	.90	1.00	1.00	.96	.98	1.05	1.05	1.02	1.06	1.10	1.10
3	.64	.71	.82	.89	.78	.86	.94	.99	.85	.92	1.01	1.05
6	.43	.53	.68	.79	.62	.70	.84	.93	.72	.82	.95	1.00
9	.27	.41	.59	.70	.50	.60	.75	.87	.62	.72	.87	.96

Adjustment Factor (c) in Presented Penman Equation

- continue -

	month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CLIMATOLOGICAL DATA OF THAILAND [1951~1980]	Pan Evaporation mm/month	146.4	152.0	193.0	194.4	182.9	173.4	168.9	159.8	132.2	137.2	134.8	140.5
	Pan Evaporation mm/day	4.7	5.4	6.2	6.5	5.9	5.8	5.4	5.2	4.4	4.4	4.5	4.5
	*1 ETo mm/day	4.0	4.6	5.3	5.5	5.0	4.9	4.6	4.4	3.7	3.8	3.8	3.9
ESTIMATED POTENTIAL EVAPOTRANSPIRATION IN THE NORTHEAST [1965~1970]	Pan Evaporation ×0.6 mm/month	91.0	92.0	116.0	116.0	104.0	108.0	104.0	100.0	81.0	84.0	81.0	85.0
	Pan Evaporation mm/month	151.7	153.3	193.3	193.3	173.3	180.0	173.3	166.7	135.0	140.0	135.0	141.7
	Pan Evaporation mm/day	4.9	5.5	6.2	6.4	5.6	6.0	5.6	5.4	4.5	4.5	4.5	4.6
	*2 ETo mm/day	4.2	4.7	5.3	5.5	4.8	5.1	4.8	4.6	3.8	3.8	3.8	3.9
RAINFALL AND EVAPORATION ANALYSES OF THAILAND [17 years]	Pan Evaporation mm/month	146.0	153.0	191.0	192.0	185.0	179.0	167.0	159.0	135.0	135.0	131.0	143.0
	Pan Evaporation mm/day	4.7	5.5	6.2	6.4	6.0	6.0	5.4	5.1	4.5	4.4	4.4	4.6
	*3 ETo mm/day	4.0	4.6	5.2	5.4	5.1	5.1	4.6	4.4	3.8	3.7	3.7	3.9
ETo calculated by Penman method mm/day		4.7	5.3	5.9	6.2	5.7	5.4	5.1	5.1	4.2	4.5	4.5	4.5

(Pan evaporation data was observed in Nkhon Rachasima)

*1, *2, *3 ETo (Reference crop evapotranspiration) = kp · Epan

where Epan = pan evaporation in mm/day and represents the mean daily value of the period considered

kp = pan coefficient

= 0.85 (see FAO IRRIGATION AND DRAINAGE PAPER 24 Table 18 ; case A, RHmean high, Wind Light, Windward side distance of green crop 1000 m)

Table 19 Comparison of ETo Penman method - Pan evaporation method

(see fig 27)

Farm Pond No.	Area of paddy field	Total Area of paddy field	Volume of Irrigation	Volume of existing Farm·pond	Volume of planning Farm·pond	Total Volume of Farm·pond	The number of days for Irrigation possible
	ha	ha	cum/day	cum	cum	cum	days
	① 5.04						
	② 4.91			Ⓐ 1.000	Type C		
P1	③ 7.06	17.01	1,601	Ⓑ 2.280	5 380	8 660	5.4
					Type B		
P2	④ 6.20	6.20	584	Ⓒ 122	2 630	2 752	4.7
					Type A		
P3	⑤ 4.16	4.16	392		1 630	1 630	4.2
	⑥ 2.08				Type C		
P4	⑦ 7.31	9.39	884	Ⓓ 90	5 380	5 470	6.2
					Type B		
P5	⑧ 7.20	7.20	678		2 630	2 630	3.9
	⑨ 3.26						
	⑩ 5.02				Type C		
P6	⑪ 4.00	12.28	1,156		5 380	5 380	4.7
	⑫ 4.30				Type B		
P7	⑬ 3.86	8.16	768	Ⓔ 1,036	2 630	3 666	4.8
					Type B		
P8	⑭ 5.57	5.57	524		2 630	2 630	5.0
	⑮ 4.00						
	⑯ 5.57				Type C		
P9	⑰ 3.64	13.21	1,243		5 380	5 380	4.3
	⑱ 3.77				Type B		
P10	⑲ 4.00	7.77	731		2 630	2 630	3.6
					Type A		
P11	⑳ 4.07	4.07	383		1 630	1 630	4.3
					Type A		
P12	㉑ 4.49	4.49	423		1 630	1 630	3.9
Total		99.51	9.367	4528	39 560	44 088	(mean) 4.7

Table 20 Calculation of Farm Pond potential

Table-21-1

コンサマキ 地区　　数量集計表

工種	仕様		単位	数量
土工事 TypeA (3ヶ所)				
	表土掘削 (ブルドーザー)	480×3	m^3	1,440
	掘削 (ブルドーザー)	300×3	〃	900
	〃 (バックホー)	1,200×3	〃	3,600
	敷均し (ブルドーザー)	1,200×3	m^3	3,600
	表土敷均し (〃)	480×3	〃	1,440
	締固め (ブルドーザー)	1,980×3	m^3	5,940
	斜面整形	1,165×3	m^2	3,495
TypeB (5ヶ所)				
	表土掘削 (ブルドーザー)	720×5	m^3	3,600
	掘削 (ブルドーザー)	545×5	〃	2,725
	〃 (バックホー)	1,900×5	〃	9,500
	敷均し (ブルドーザー)	1,900×5	m^3	9,500
	表土敷均し (〃)	720×5	〃	3,600
	締固め (ブルドーザー)	3,165×5	m^3	15,825
	斜面整形	1,460×5	m^2	7,300
TypeC (4ヶ所)				
	表土掘削 (ブルドーザー)	1,125×4	m^3	4,500
	掘削 (ブルドーザー)	1,055×4	〃	4,220
	〃 (バックホー)	4,000×4	〃	16,000
	敷均し (ブルドーザー)	4,000×4	m^3	16,000
	表土敷均し (〃)	1,125×4	〃	4,500

工種	仕様		単位	数量
	締固め (ブルドーザー)	6.180×4	m^3	24.720
	斜面整形	2.416×4	m^2	9.664
流入口工事 TypeA (6ヵ所)	掘削	24×6	m^3	144
	掘削面整形	30×6	m^2	180
	コンクリート打設	(4.7+0.4)×6	m^3	30.6
	型枠	3.4×6	m^2	20.4
	斜面保護	36×6	〃	216
TypeB (10ヵ所)	掘削	30×10	m^3	300
	掘削面整形	38×10	〃	380
	コンクリート打設	(5.2+0.4)×10	〃	56
	型枠	3.4×10	m^2	34
	斜面保護	36×10	〃	360
TypeC (11ヵ所)	掘削	64×11	m^3	704
	掘削面整形	69×11	〃	759
	コンクリート打設	(7.2+0.4)×11	〃	83.6
	型枠	3.4×11	m^2	37.4
	斜面保護	36×11	〃	396

Table-21-2

チャカラ地区　　数量集計表

工種	仕様		単位	数量
放水工事				
土工事				
	掘削	110+50+190+610	m^3	960
	埋戻・盛土	340+100	〃	440
	斜面整形	240+350	m^2	590
コンクリート工事				
	コンクリート打設(鉄筋、無筋)	16.7+43.0	m^3	59.7
	型枠		m^2	30.1
給水工事				
土工事	掘削	180+200+90+140	m^3	610
	埋戻・盛土	200+160	〃	360
	斜面整形	480+120	m^2	600
コンクリート工事				
	コンクリート打設(鉄筋、無筋)	41.6+47.8	m^3	89.5
	型枠		m^2	90.5

Table 22　1日当りの作業能力表

作業	人員	計算	1日当り作業能力
掘削（人力）	10人	1.0m³÷0.4人/日×10人	25 m³/日
〃（ブル）	1台	11ton Bull-dozer	310.1 m³/日
〃（バックホー）	1台	0.55m³ Backhoe	311.9 m³/日
盛土（人力）	10人	10m³÷2.8人/日×10人	35 m³/日
締固め（ブル）	1台	11ton Bull-dozer	669.2 m³/日
敷均し（ブル）	1台	11ton Bull-dozer	499.8 m³/日
斜面整形	5人	10m²÷0.2人/日×5人	250 m²/日
コンクリート打設	—	——	1.5 m³/日

Table 23

甲

コンサマキ 地区　　工　程　算　出　表

工種	種目	施工量	能力	稼働率	日数	セット数	工程	備考
土工事								
	表土掘削	9,540	310.1	21/30	44	2	22	
	掘削	7,845	310.1	〃	37	2	19	ブル
	〃	29,100	311.9	〃	134	2	67	バックホー
	敷均し	29,100	499.8	21/30	84	2	42	ブル
	表土敷均し	9,540	499.8	〃	28	2	14	
	締固め	46,485	669.2	21/30	100	3	34	
	斜面整形	20,459	250.0	21/30	117	8	15	人力
流入工事								
	掘削	1,148	311.9	21/30	6	2	3	
	整形	1,319	250.0	〃	8	2	4	
	コンクリート打設	170.2	1.5	21/30	163	4	41	(型枠含む)
	斜面保護	972	25	21/30	39	4	10	人力

テャカラ 地区. 工 程 算 出 表

工 種	種 目	施工量	能 力	稼働率	日数	セット数	工程	備 考
放流工工事								
土工事	掘削	109	25	21/30	7	2	4	捨土.
	〃	48	〃	〃	3	2	2	流用
	埋戻.盛土	48	35	〃	2	1	2	
	掘削	190	25	〃	11	2	6	捨土
	〃	387	〃	〃	23	2	12	
	〃	221	〃	〃	13	2	7	捨土
	埋戻.盛土	288	35	〃	12	1	12	
	〃	99	〃	〃	5	1	5	
	斜面整形	590	250	〃	4	1	4	
コンクリート工事	コンクリート	59.7	1.5	21/30	57	2	29	
分水工工事								
土工事	掘削	178	25	21/30	11	2	6	捨土
	〃	72	〃	〃	5	2	3	〃
	〃	91	〃	〃	6	2	3	〃
	〃	197	〃	〃	12	2	6	
	〃	71	〃	〃	5	2	3	
	埋戻.盛土	197	35	〃	9	1	9	
	〃	71	〃	〃	3	1	3	
	斜面整形	600	250	〃	4	1	4	
コンクリート工事	コンクリート打設	89.5	1.5	〃	86	2	43	

Table 24　　工程表

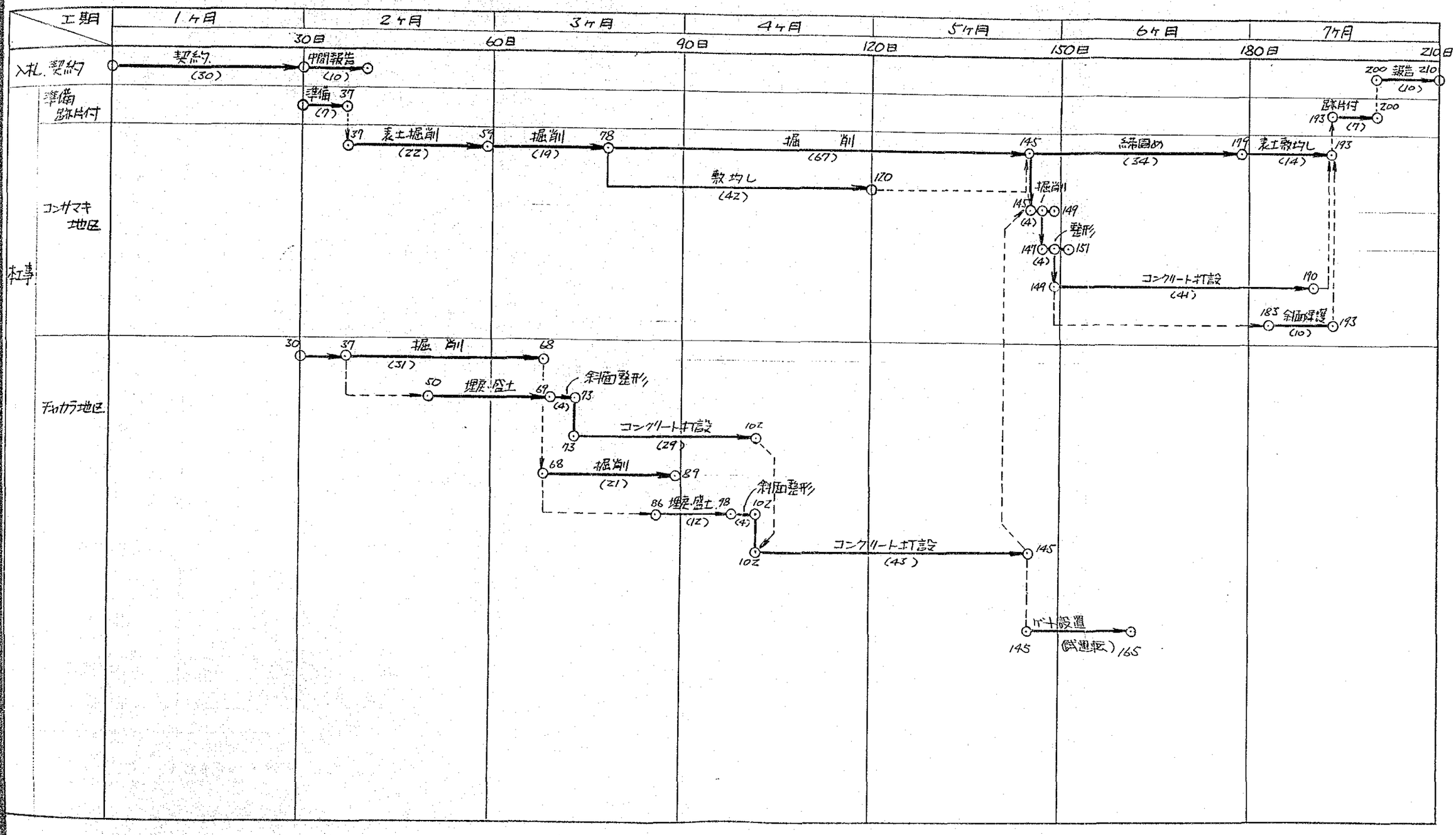

工期
1ヶ月
2ヶ月
3ヶ月
4ヶ月
5ヶ月
6ヶ月
7ヶ月
30日
60日
90日
120日
150日
180日
210日
入札.契約
契約 (30)
中間報告 (10)
準備 37 (7)
準備 跡片付
200 報告 210 (10)
跡片付 200 193 (7)
37 表土掘削 59 (22)
掘削 78 (19)
掘削 (67) 145
締固め 175 (34)
表土敷均し 193 (14)
敷均し (42) 120
本工事
コンクリート地区
掘削 145 149 (4)
整形 147 151 (4)
コンクリート打設 149 190 (41)
183 斜面保護 193 (10)
30 37 掘削 68 (31)
50 埋戻.盛土 69 (4) 73 斜面整形
コンクリート打設 73 102 (29)
68 掘削 89 (21)
86 埋戻.盛土 78 (12) 102 斜面整形 (4)
コンクリート打設 102 145 (43)
ゲート設置 145 (試運転) 165
チョカラ地区

Table 25　全体工事費

工種	数量	供与機材（バーツ）	工事費（バーツ）	備考
1. 工事費				
A. 直接工事費				
コンサマキ地区				
溜池工事	39,600㎥		1,706,000	12か所
付帯工事	1式		452,000	流入部工事 斜面保護工事
小計			(2,158,000)	
チャカラ地区				
放流工工事	1式		139,000	
付帯工事	1式	500,000	25,000	ゲート2門
分水工工事	1式		173,000	
付帯工事	1式	500,000	25,000	ゲート2門
小計		(1,000,000)	(362,000)	
計			(2,520,000)	(1)
B. 間接工事費			504,000	(2)＝(1)×20%
C. 予備費			211,000	((1)+(2)) × 7%
計			(715,000)	
合計			(3,235,000)	(3)
2. 工事諸費			305,000	(3)× 9%（±）
3. 工事費合計		(1,000,000)	(3,540,000)	
同上円換算		7,910,000 ≒ 8,000,000	28,001,400 ≒28,000,000	
総計	36,000,000円			

但し、換算レートは1B＝ 7.91 円（1985年10月現在）

Table 26 工事費明細書

第　　号

コンサマキ地区　溜池工事

金　1,706,000 Baht.

内　訳

種目	材料	形状	員数	単位	単価(B)	金額(B)	摘
1. タイプA (34ヶ所)		表土掘削	1,440	m^3	14.6	21,024	
		掘削	3,600	〃	32.3	116,280	4.
		掘削	900	〃	14.6	13,140	
		敷均し	1,440	〃	9.1	13,104	
		埋戻・盛土	5,940	〃	6.8	40,392	
		斜面整形	3,495	m^2	1.4	4,893	
		小計				208,833	
2. タイプB (5ヶ所)		表土掘削	3,600	m^3	14.6	52,560	
		掘削	9,500	〃	32.3	306,850	
		掘削	2,725	〃	14.6	39,785	
		敷均し	3,600	〃	9.1	32,760	
		埋戻・盛土	15,825	〃	6.8	107,610	
		斜面整形	7,300	m^2	1.4	10,220	
		小計				549,785	
3 タイプC (4ヶ所)		表土掘削	4,500	m^3	14.6	65,700	
		掘削	16,000	〃	32.3	516,800	
		掘削	4,220	〃	14.6	61,612	

種目	材料	形状	員数	単位	単価(円)	金額(円)	摘要
		敷均し	4,500	m³	9.1	40,948	
		埋戻・盛土	24,720	〃	6.8	168,096	
		斜面整形	9,664	m²	1.4	13,528	
		小計				866,684	
		計				1,625,302	
4. その他工事						81,265	上記計の5%
		合計				1,706,567	
					改め	1,706,000	

第　　号

コンサマキ地区　付帯構造物工事

金　452,000 Baht

内　訳

種目	材料	形状	員数	単位	単価(B)	金額(B)	摘要
1. 流入工							
i) タイプA		掘削	144	m^3	16.6	2,388	
		斜面整形	180	m^2	1.4	252	
		ライニングコンクリート	28.2	m^3	1,119.6	31,572	
		無筋コンクリート	2.4	〃	997.8	2,394	
		型枠	20.4	m^2	326.0	6,648	
		斜面保護	216	〃	196.6	42,462	
		小計				85,716	
ii) タイプB		掘削	300	m^3	16.6	4,980	
		斜面整形	380	m^2	1.4	530	
		ライニングコンクリート	52	m^3	1,119.6	58,210	
		無筋コンクリート	4	〃	997.8	3,990	
		型枠	34	m^2	326.0	11,080	
		斜面保護	360	〃	196.6	70,770	
		小計				149,560	
iii) タイプC		掘削	704	m^3	16.6	11,682	
		斜面整形	759	m^2	1.4	1,056	
		ライニングコンクリート	79.2	m^3	1,119.6	88,671	

種別	材料	形状	員数	単位	単価(円)	金額(円)	摘要
		無筋コンクリート	4.4	m^3	997.8	4,389	
		型枠	37.4	m^2	326	12,188	
		斜面保護	396	〃	196.6	77,847	
		小 計				195,833	
		計				431,109	
iv) その他工事						21,555	上記 計の5%
		合計				452,664	
					改め	452,000	

第　　号

テカカラ地区　放流工工事

金　139,000 Baht

内　訳

種目	材料	形状	員数	単位	単価(B)	金額(B)	摘要
1. 堤防工事.							
		掘削	110	m^3	28.0	3,080	
		〃	50	〃	28.0	1,400	
		運搬	110	〃	15.4	1,694	
		〃	50	〃	15.4	790	
		埋戻、盛土	340	〃	14.8	5,032	
		斜面整形	240	m^2	1.4	336	
		小計				12,312	
2. 放流工工事.							
		掘削	190	m^3	28.0	5,320	
		〃	610	〃	28.0	17,080	
		運搬	290	〃	28.0	8,120	
		〃	100	〃	15.4	1,540	
		〃	520	〃	15.4	8,008	
		埋戻、盛土	100	〃	14.8	1,480	
		斜面整形	350	m^2	1.4	490	
		鉄筋コンクリート	16.7	m^3	1,080.3	18,049	
		鉄筋	0.2	Ton	12,041.0	2,408	
		ライニングコンクリート	43.0	m^3	1,119.6	48,142	

種目	材料	形状	員数	単位	単価(B)	金額(B)	摘要
		型枠	30.1	㎡	326.0	9,812	
		小計				120,449	
		計				132,761	
3、その他工事			1	式		6,638	上記計の5%
		合計				139,399	
					2以下	139,000	

第　　号

チャカラ地区　合水工事

金　　173,000　Baht

内　　訳

種　目	材　料	形　状	員　数	単位	単価 (฿)	金額 (฿)	摘　要
1. 堤防工事							
		掘削	180	m^3	28.0	5,040	
		〃	200	〃	28.0	5,600	
		埋戻・盛土	200	〃	14.8	2,960	
		運搬	180	〃	15.4	2,772	
		〃	200	〃	15.4	3,080	
		斜面整形	480	m^2	1.4	672	
		小計				20,124	
2. 合水工事							
		掘削	90	m^3	28.0	2,520	
		〃	140	〃	28.0	3,920	
		埋戻・盛土	160	〃	14.8	2,368	
		運搬	70	〃	15.4	1,078	
		〃	160	〃	15.4	2,464	
		斜面整形	120	m^2	1.4	168	
		鉄筋コンクリート	41.6	m^3	1,080.8	44,961	
		ライニングコンクリート	47.8	〃	1,119.6	53,516	
		型枠	90.5	m^2	326	29,503	
		鉄筋	0.4	Ton	12,041.0	4,816	

種目	材料	形状	員数	単位	単価(B)	金額(B)	摘要
		小計				145,314	
		計				165,438	
5.	その他工事.		1	式		8,271	上記計の5%
		合計.				173,709	
					230	173,000	

Table 27 LIST OF LABOUR WAGES

(as Nokorn Ratchasima)

No.	I t e m	Pedium (฿/day)
1.	Commom labour	70
2.	Foreman, earth work	180
3.	Foreman, concrete work	215
4.	Foreman, other civil work	215
5.	Foreman, mechanical work	215
6.	Foreman, Electrical work	215
7.	Foreman, steel work	180
8.	Technician, capenter	180
9.	Technician, Electrician	180
10.	Technician, steel worker	180
11.	Techinician, form worker	180
12.	Technician, concrete worker	180
13.	Technician, mechanical	180
14.	Technician, mason	180
15.	Operator, bulldozer	180
16.	Operator, backhoe	180
17.	Operator, loader	180
18.	Operator, tamping roller	180
19.	Operator, other light equipment	145
20.	Drjver, dump truck	145
21.	Driver, truck	145
22.	Driver, light vehicles	120

Table 28 LIST OF MATERIAL COST

No.	I t e m	Unit	Unit Cost (₱)
1.	Portland cement	t	90
2.	Concrete admixture, AE & others	kg	45
3.	Reinforcing steel bar, deformed, SD 30	t	9,800
4.	Reinforcing steel bar, round, SR 24	t	9,800
5.	Wire for binding reinforcing steel bar, ϕ180mm	t	14,000
6.	Aggregate for concrete, coarse (gravel)	m^3	220
7.	Aggregate for concrete, fine (sand)	m^3	150
8.	Laterite	m^3	140
9.	Wooden material for wooden form, soft wood	m^3	7,000
10.	Wooden material for house, hard wood	m^3	13,500
11.	Metal form	m^2	460
12.	Reinforced concrete pipe ϕ150 mm (L=1.0m)	m	80
13.	Reinforced concrete pipe ϕ200 mm (")	m	95
14.	Reinforced concrete pipe ϕ300 mm (")	m	160
15.	Reinforced concrete pipe ϕ400 mm (")	m	245
16.	Reinforced concrete pipe ϕ500 mm (")	m	300
17.	Reinforced concrete pipe ϕ600 mm (")	m	350
18.	Reinforced concrete pipe ϕ800 mm (")	m	600
19.	Reinforced concrete pipe ϕ1,000 mm (")	m	840
20.	Reinforced concrete pipe ϕ1,200 mm (")	m	1,200
21.	Reinforced concrete pipe ϕ1,500 mm (")	m	2,200
22.	Structure steel	t	10,500
23.	Nail	t	12,500
24.	Water-stop, PVC, 230 x 6 mm	m	160
25.	Water-stop, PVC, 300 x 7 mm	m	225
26.	PVC pipe, ϕ20 mm x 4.0 m class 8.5 not for high pressior	pec.	36
27.	PVC pipe, ϕ25 mm	"	48
28.	PVC pipe, ϕ30 mm	"	60
29.	PVC pipe, ϕ40 mm	"	78
30.	PVC pipe, ϕ50 mm	"	125
31.	PVC pipe, ϕ75 mm	"	262
32.	PVC pipe, ϕ100 mm	"	430

LIST OF MATERIAL COST

No.	I t e m	Unit	Unit Cost (฿)
33.	PVC pipe, ϕ150 mm	pec.	920
34.	PVC pipe, ϕ200 mm	"	1,720
35.	PVC pipe, ϕ300 mm	"	3,360
36.	Sod	m^2	20
37.	Fence mech wire	m^2	58
38.	Fuel, diesel oil	lit	6.9
39.	Fuel, gasoline, regular	"	11.0
40.	Stone for masonry work	m^3	210
41.	Elastic filler 0.02 x 1.20 x 2.40 m	pc	1,730
42.	Elastic filler 0.01 x 1.20 x 2.40 m	"	920
43.	Steel pipe L=6.0m ϕ1/2" (BS-S)	"	45
44.	Steel pipe L=6.0m ϕ3/4" (")	"	70
45.	Steel pipe L=6.0m ϕ1" (")	"	100
46.	Steel pipe L=6.0m ϕ1 1/4(")	"	135
47.	Steel pipe L=6.0m ϕ1 1/2(")	"	160
48.	Steel pipe L=6.0m ϕ2" (")	"	194
49.	Steel pipe L=6.0m ϕ2 1/2 (")	"	262
50.	Steel pipe L=6.0m ϕ3" (")	"	386
51.	Steel pipe L=6.0m ϕ4" (")	"	540
52.	Steel pipe L=6.0m ϕ5" (")	"	1,025
53.	Steel pipe L=6.0m ϕ6" (")	"	1,160
54.	Welding bar ϕ2.6 mm	kg	23
55.	Welding bar ϕ3.2 mm	kg	23
56.	Welding bar ϕ4.0 mm	kg	23
57.	Electric power	kwH	2.8

Table 29 LIST OF UNIT COST BY MANPOWER

No.	I t e m	Unit	Unit Cost (Baht)
MP-1	Excavation by manpower		
	Sand	m^3	16.8
	Common soil	m^3	28.0
	Gravel	m^3	38.5
MP-2	Hauling by manpower		
	L = 20 m	m^3	15.4
	L = 40 m	m^3	20.3
	L = 60 m	m^3	23.8
	L = 80 m	m^3	28.0
	L = 100 m	m^3	29.4
	L = 120 m	m^3	30.1
MP-3	Compacting		
MP-3-1	Compacting by manpower	m^3	19.6
MP-3-2	Compacting by compactor	m^3	14.8
MP-4	Smoothing of face Excavated or filled up	m^2	1.4
MP-5	Concrete		
MP-5-1	Plain concrete	m^3	997.8
MP-5-2	Reinforced concrete	m^3	1,080.8
MP-5-3	Lean concrete	m^3	834.9
MP-5-4	Lining concrete	m^3	1,119.6
MP-6	Mortar (C:S = 1:3)	m^3	961.9
MP-7	Wooden form of concrete	m^2	326.0
MP-8	Processing and assembling of reinforcing steel bar	ton	12,041.0
MP-9	Sod facing	m^2	44.8
MP-10	Wooden scaffolding	m^3	140.1
MP-11	Drainage by pump	day	332.3

Table 30 LIST OF UNIT COST BY USING CONSTRUCTION EQUIPMENTS

No.	I t e m	Unit	Unit Cost (Baht)
EQ-1	Excavation by Bulldozer (11 ton)		
	Sand	m^3	14.6
	Common soil	m^3	17.1
	Gravel and weathered rock	m^3	20.5
EQ-2	Excavation by Bulldozer (21 ton)		
	Sand	m^3	13.3
	Common soil	m^3	15.5
	Gravel and weathered rock	m^3	17.0
EQ-3	Excavation by Backhoe Shovel(0.35 m^3)		
	Sand	m^3	16.6
	Common soil	m^3	17.7
	Gravel and weathered rock	m^3	22.1
EQ-4	Excavation by Backho Shovel (0.7 m^3)		
	Sand	m^3	14.2
	Common soil	m^3	15.2
	Gravel and weathered rock	m^3	19.0
EQ-5	Excavation by Backhoe shovel (1.2 m^3)		
	Sand	m^3	15.2
	Common soil	m^3	16.2
	Gravel and weathered rock	m^3	20.2
EQ-6	Loading by Tractor Shovel		
	Sand	m^3	13.9
	Common soil	m^3	15.2
	Gravel and weathered rock	m^3	16.7
EQ-7	Hauling by Dump Truck (8 ton)		
	Sand	m^3	0.0074L+15.5
	Common soil	m^3	0.0070L+14.6
	Gravel and weathered rock	m^3	0.0083L+17.3
EQ-8	Hauling by Dump Truck (11 ton)		
	Sand	m^3	0.0070L+14.8
	Common soil	m^3	0.0066L+13.9
	Gravel and weathered rock	m^3	0.0079L+16.5

LIST OF UNIT COST BY USING CONSTRUCTION EQUIPMENTS

No.	I t e m	Unit	Unit Cost (Baht)
EQ-9	Spreading by Bulldozer (11 ton)		
	Sand	m^3	9.1
	Common soil	m^3	9.1
	Gravel and weathered rock	m^3	9.1
EQ-10	Compaction by Tire Roller (11 - 20 t)	m^3	3.9
EQ-11	Compaction by Vibration Roller (3 - 5 t)	m^3	13.6
EQ-12	Compaction by Bulldozer (11 ton)	m^3	6.8

Table 31 供与機材一覧表

仕　　様	数量
Sluice gate （steel ） B×H ＝ 1,500× 1,500 スピンドル・巻上げ機等 付帯施設を含む。 現地輸送費込み。	4set

Table 32 施工業者一覧表

COMPANY NAME	THAI SUMICON CO., LTD.	THAI TAKENAKA INTERNATIONAL LTD.	THAI KONOIKE CONSTRUCTION CO., LTD.,	TODA CONSTRUCTION CO., LTD.	SAEREEPHAN S-PAC CO., LTD.	CHOKUCHAI CIVIL CO., LTD.
ADDRESS	26/21 Orakarn Office Condominium 7th Fl. Soi Chidlom, Ploenchit Road, Bangkok, 10500	5th Floor Boonmitr Building 138 Silom Road, Bangkok	10th Floor Silom Building, 197/1 Silom Road, Bangkok	48/9 Soi Korat-Pittayakom School Mittapab Road,Moo6 Tumbon Pru-Yai Amphoe Muang Nakorn Ratchasima 30000	7/17 Mitraphab Road, Muang, Korat Tel. 044241307	276 Chokuchai-Rajsima Road, T.Huathalae A.Muang Nakorn Ratchasima Tel. 044242125
CAPITAL	5,000,000.- Baht	10,000,000.- Baht	5,000,000.- Baht	-	-	-
ESTABLISHED DATE	21 August 2515 B. E.	18 March 1974	1 November 1982	-	-	-
REPRESENTATIVE	Mr. Tatsuhiko Tamaru, Managing Director	Mr. Taketsugu Nunose	Mr. Hikaru Ogawa, Managing Director	Mr. Bunshiro Ogata	Mr. Tanasak Chinkulkijniwat	Mr. Ong-Arj Tungsatidchai
NO. OF ENGINEER	90	90	40	-	2	2

F I G U R E S

FIGURES LIST

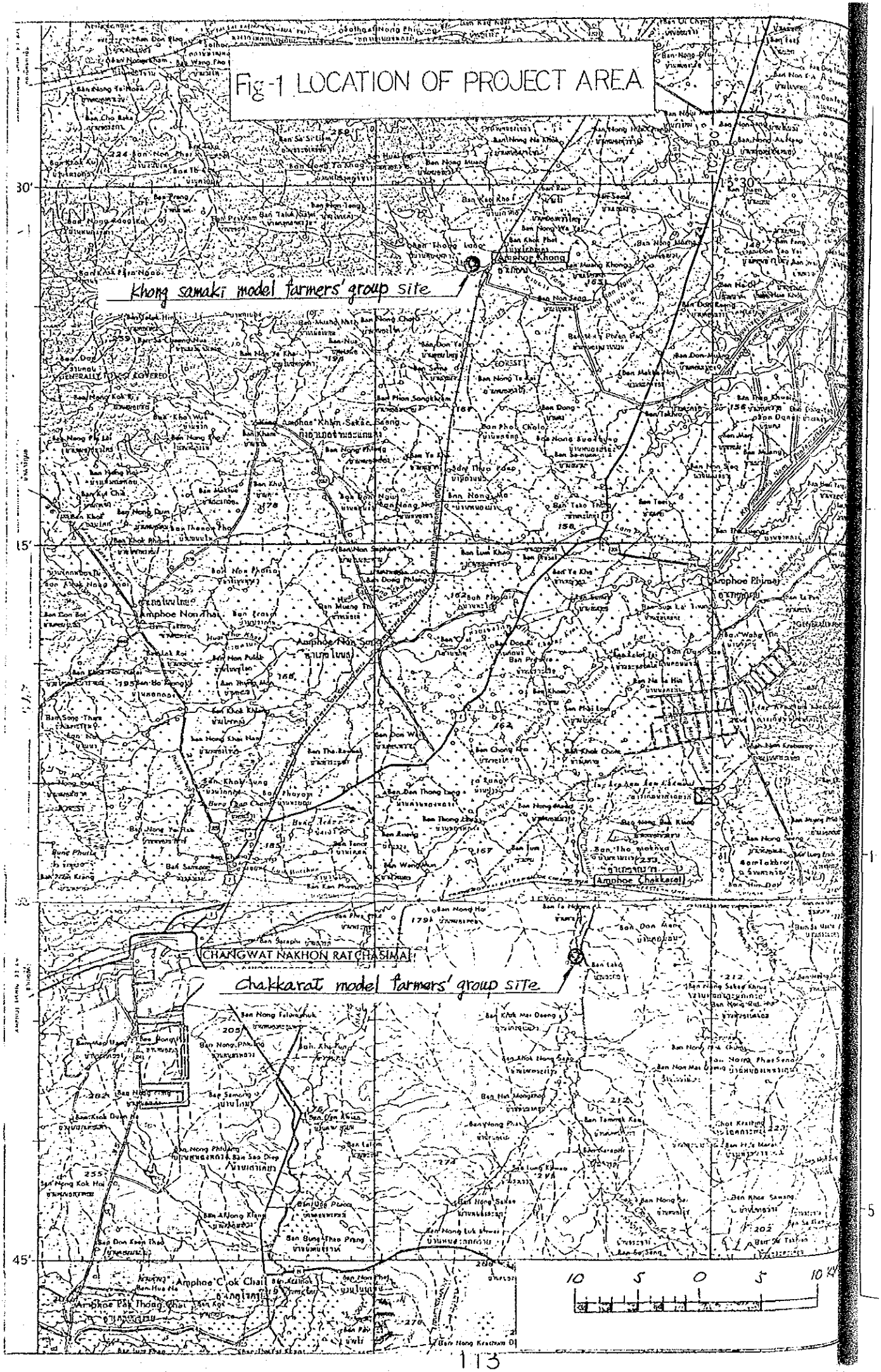


Fig-1 LOCATION OF PROJECT AREA
Khong samaki model farmers' group site
Chakkarat model farmers' group site
CHANGWAT NAKHON RATCHASIMA
Amphoe Khong
Amphoe Non Thai
Amphoe Non Sung
Amphoe Phimai
Amphoe Chakkarat
Amphoe Chok Chai
Amphoe Pak Thong Chai
10 5 0 5 10 KM

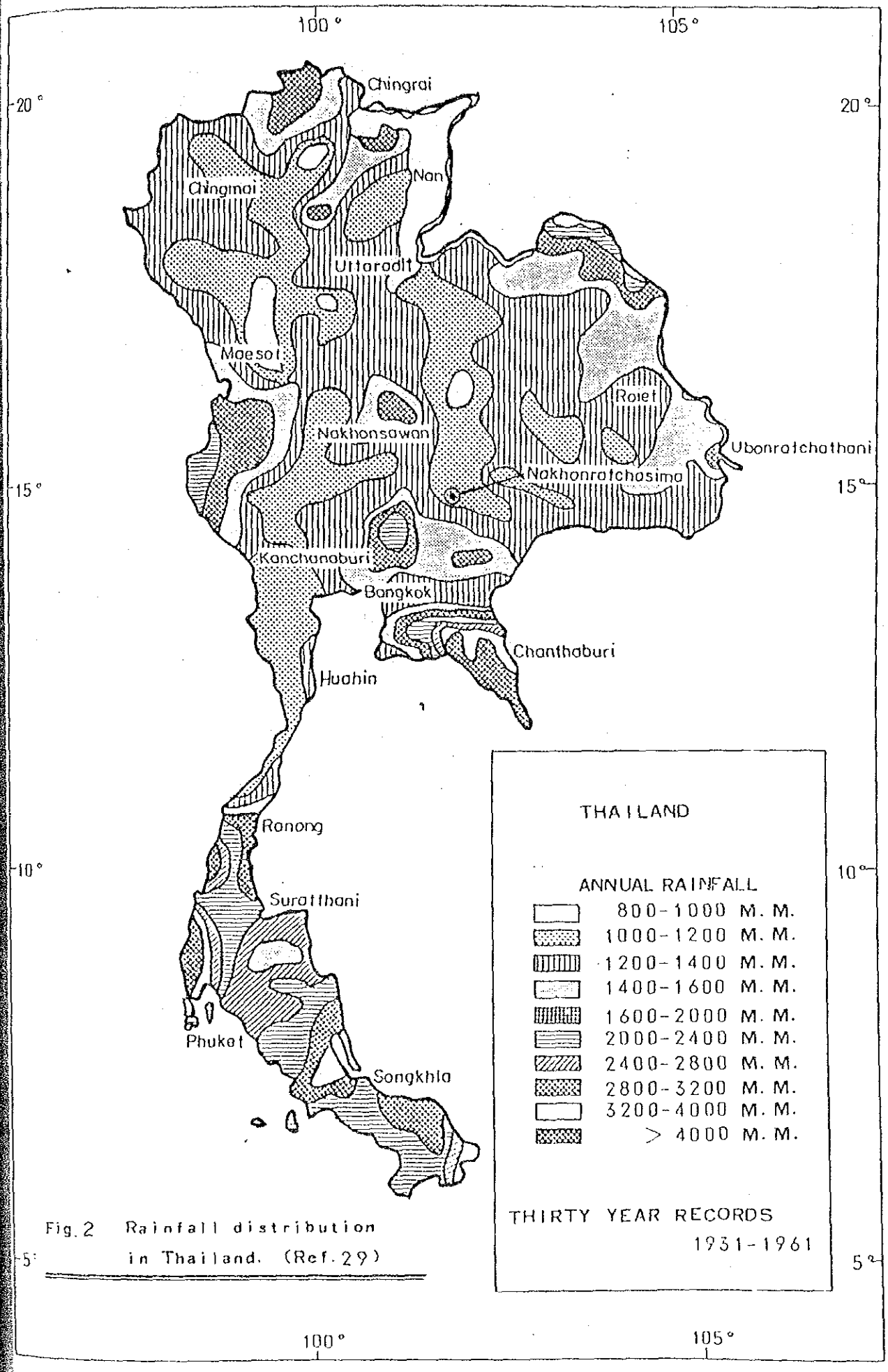


Fig. 2 Rainfall distribution in Thailand. (Ref. 29)

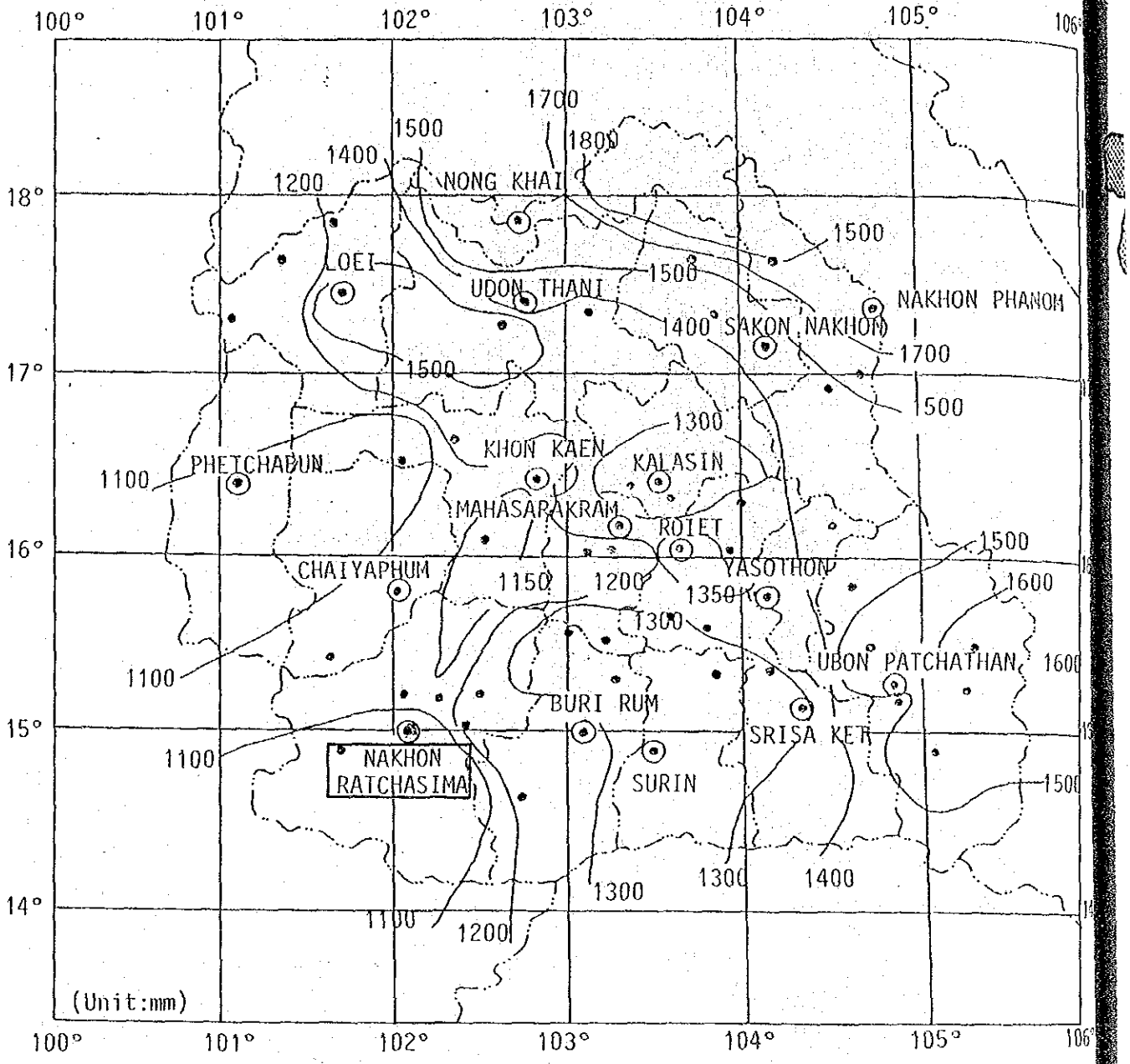


Fig. 3 Isohyets for Mean Annual Rainfall (Ref. 1)

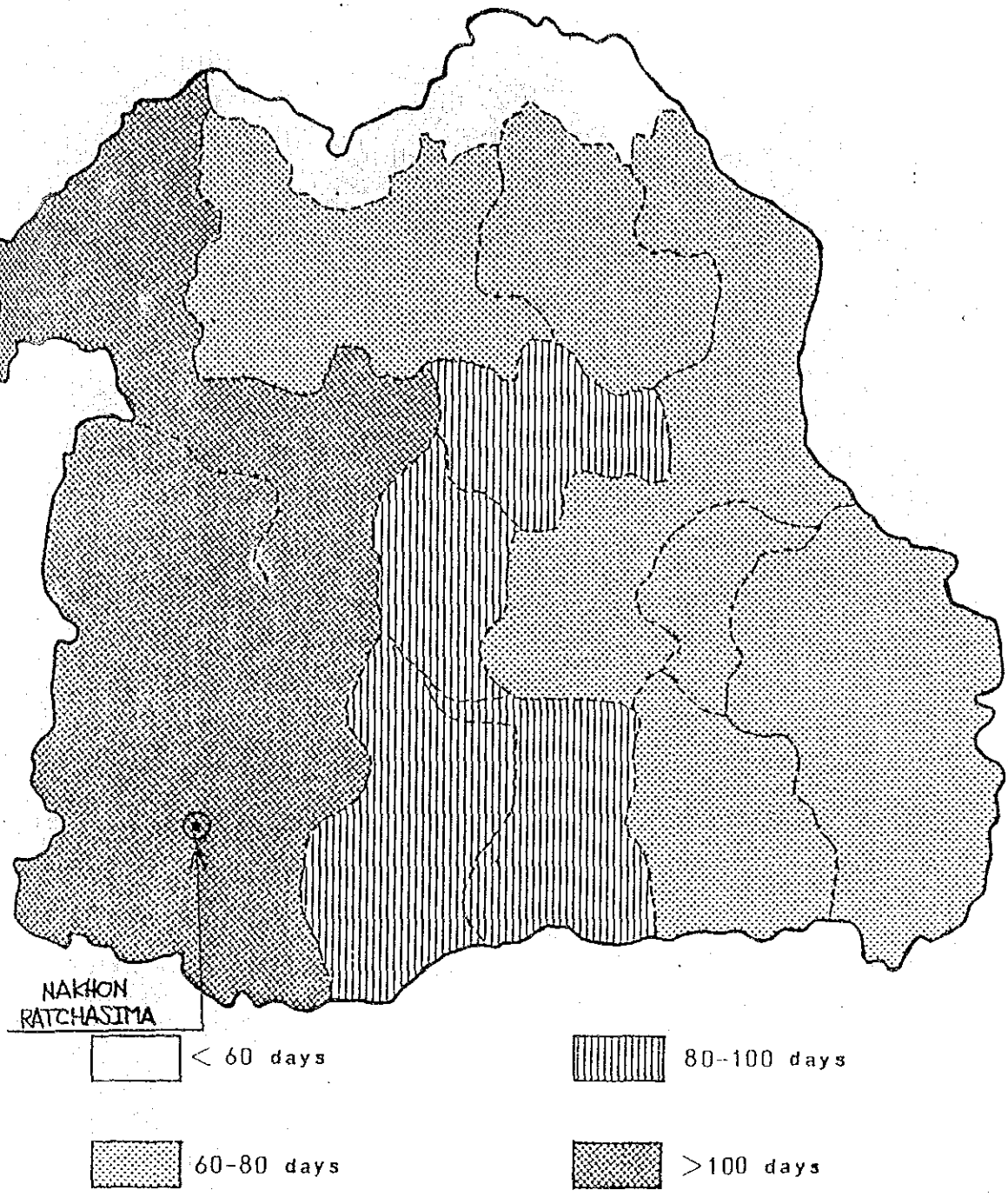


Fig. 4 Number of total drought days (calculated for paddy) for the period of May to October (Ref. 13, Original source: ESCAP 1974).

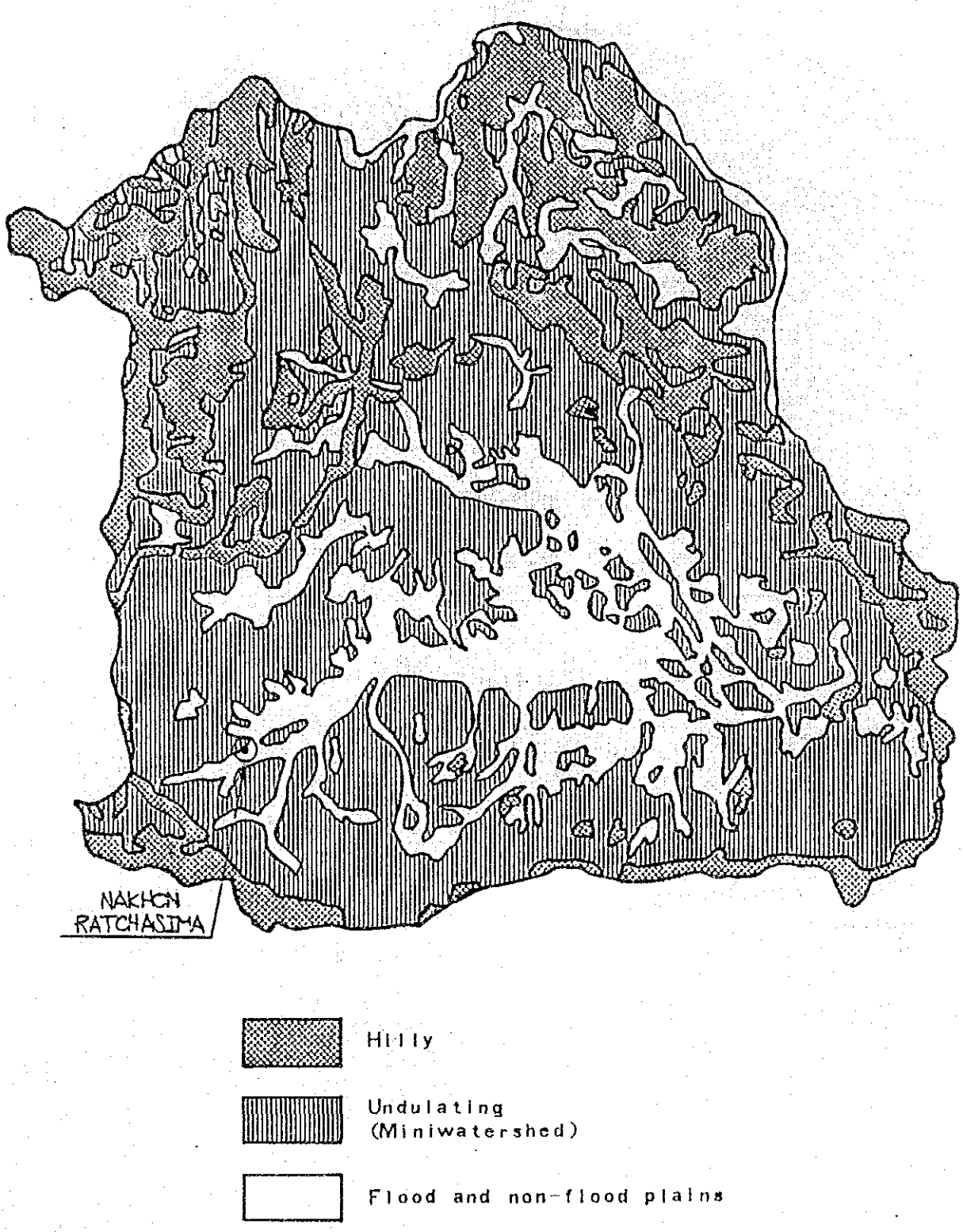


Fig - 5 Land form map of the Northeast (Ref. 13 Original source; Department of Land Development, 1972).

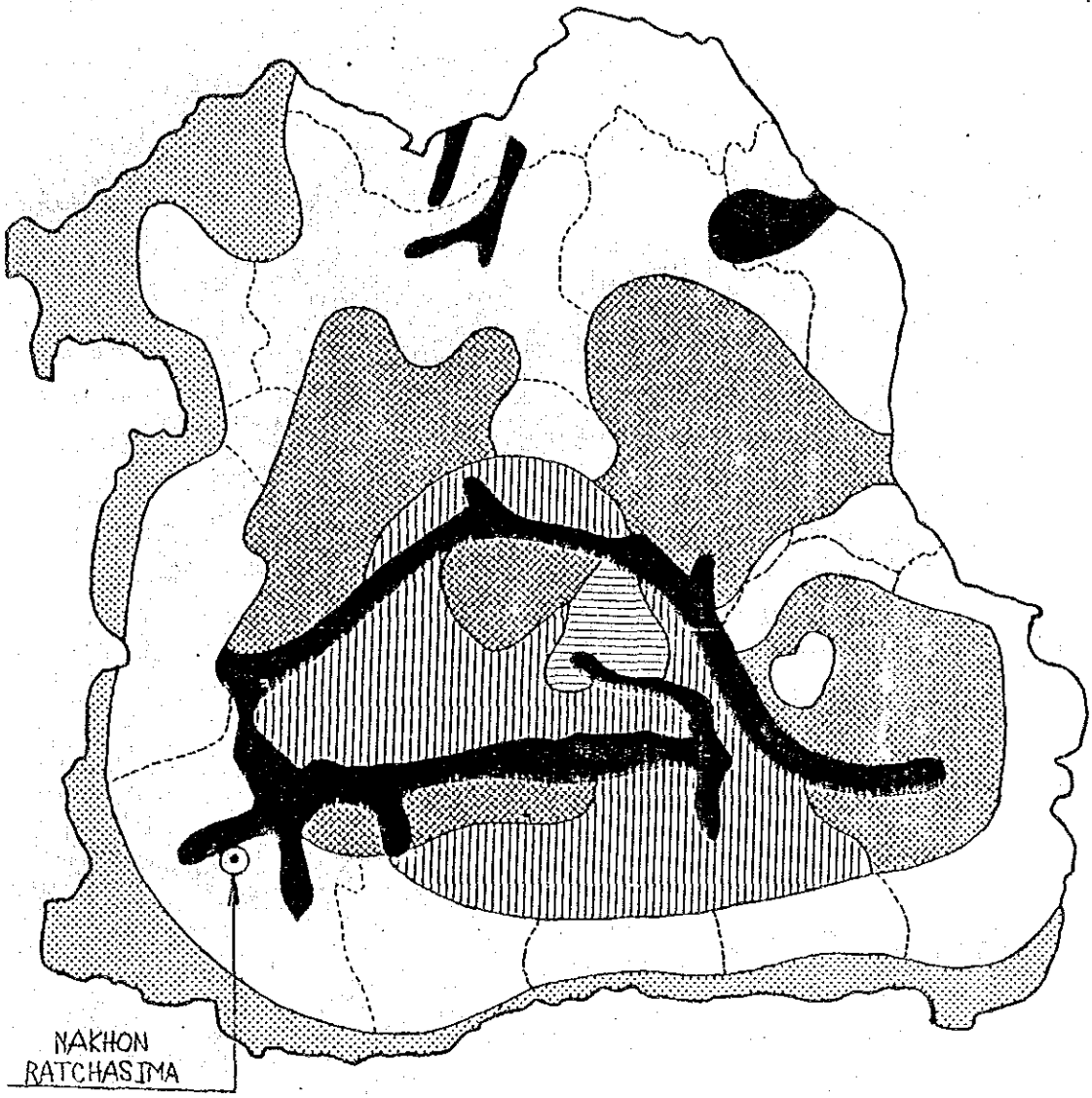


Fig-6 Simplified soil map of Northeast Thailand (Ref. 13)
Original source: Dept. of Land Development, 1979).

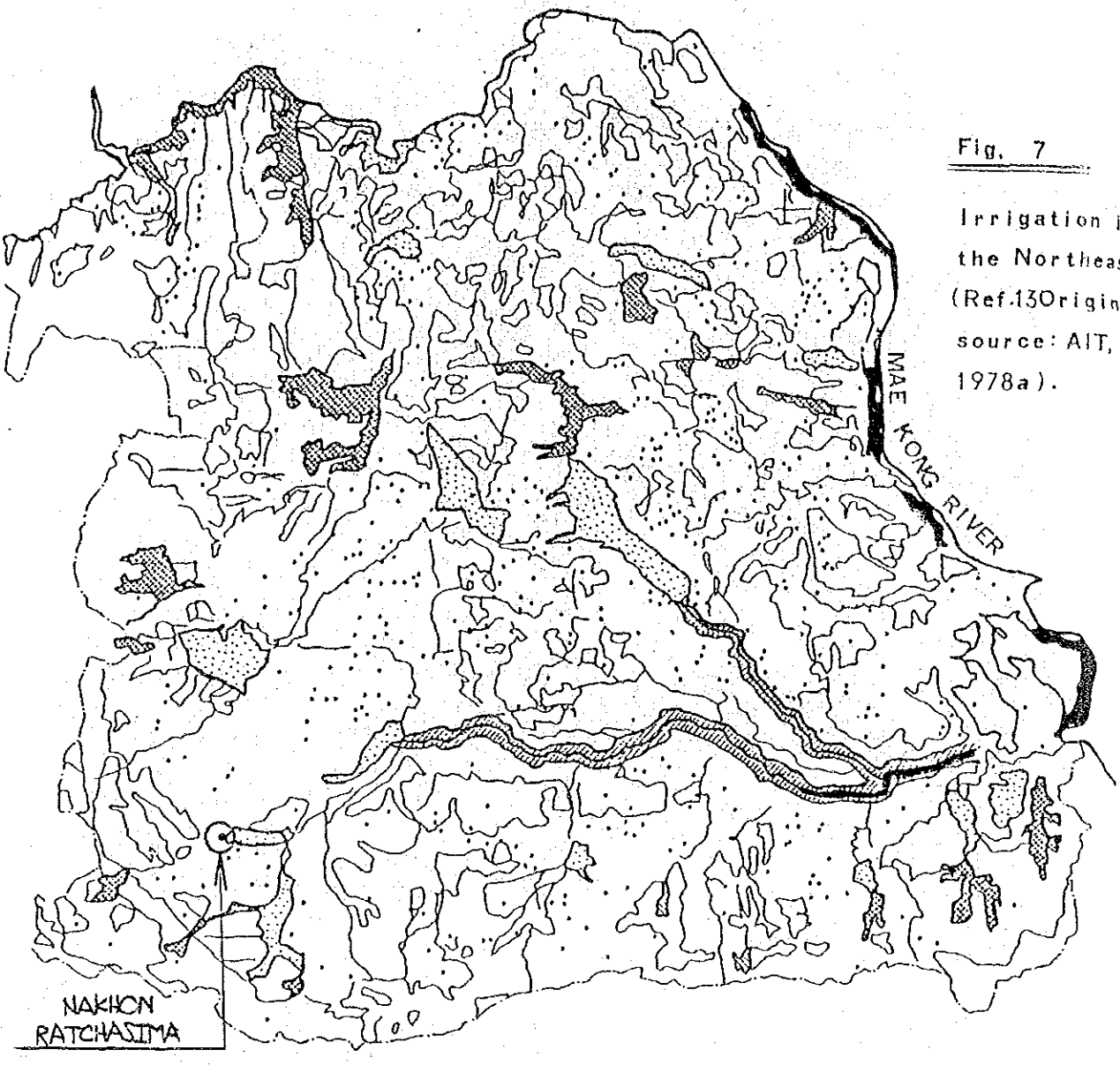


Fig. 7

Irrigation in the Northeast (Ref.13Original source: AIT, 1978a).

- Small tanks (completed and planned)
- Dry season, Wet season } Pump irrigation (existing and potential)
- Reservoir, Irrigated area } Irrigation from large reservoir (existing and potential)

FIG - 8

Soil Salinity Distribution in the Northeast

(Provided by : Land Development Department)

LEGEND

Mapping No	Description	Area Rai	Area %
1	Heavily salt-affected area	1,476,762	1.40
2	Moderately salt-affected area	3,690,349	3.50
3	Slightly salt-affected area	12,645,235	11.98
4	Potential salt source area	19,423,774	18.41
5	Non-salt-affected area	67,400,262	63.86
6	Reservoir	897,080	0.85
	Total	105,533,962	100.00

SCALE = 5,000,000

INDEX MAP

CONVENTIONAL SYMBOLS

- Changwat
- Amphoe
- Road
- Railroads
- International Boundary
- Changwat Boundary
- River, Khlong
- Water, Dam

SOIL SURVEY DIVISION BANGKOK, 1978