No.

MALAYSIA-JAPAN TECHNICAL COOPERATION

PROPOSED PLAN AND DESIGN FOR PILOT FARM NO. 2

TRAINING CENTRE, KOTA BHARU,
KELANTAN, MALAYSIA

JAPAN INTERNATIONAL COOPERATION AGENCY

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(1) Objectives of Pilot Farm

The main objectives of the Pilot Farm are to illustrate to the trainees and farmers on the practical aspect of water management.

This would enable them to realise the importance of improved field conditions and provision of on farm facilities for the practice of water management for rice cultivation.

Incidentally, the Record of Discussion on 3rd. September, 1977, mentioned concerning Pilot Farm as follows. "Training Center will set up four (4) Pilot Farms each of about 20 ha. nearby and will implement the following activities with the cooperation of authorities concerned:

(a) installation of irrigation, drainage, farm roads, and other facilities in the Pilot Farms;

(b) introduction of water management techniques and on-the-job training for technical staff;

(c) guidance and advice to farmers in Pilot Farms for introduction of improved paddy cultivation system with emphasis on water management techniques;

(d) guidance and advice on the formation of water management organizations."

Pilot Farm is hereinafter referred to as "P/F".

(2) Statistical Analysis

Based on the layout plan of the P/F, the geographical characteristics of the area should be studied and understood, wher by altitude and area analysis are very important aspects to be considered for planning and design of the water management facilities as well as for the agro-socio and other fundamental studies.

Accordingly, this paper gives an account of the altitude and area analysis using a statistical method.

1) Existing altitude analysis.

Each field lot is numbered and the altitudes of the lots are arranged so that the parameters such as frequency (f), mean ($\bar{x}$), sum of squares of deviation (Sx), variance ($\bar{v}$) and standerd deviation (σ) can be determined as follows.

2/-

Table-1: Statistical calculation of altitude

class	center of class (x)	frequency(f)	(u)= $\frac{x-30.75}{0.5}$	(f).(u)	(f).(u)^2
(Ft)	(Ft)				
28.5-29.0	28.75	2	-4	-8	32
29.0-29.5	29.25	6	-3	-18	54
29.5-30.0	29.75	2	-2	-4	8
30.0-30.5	30.25	3	-1	-3	3
30.5-31.0	30.75	8	0	0	0
31.0-31.5	31.25	43	1	43	43
31.5-32.0	31.75	26	2	52	104
32.0-32.5	32.25	16	3	48	144
32.5-33.0	32.75	0	4	0	0
total		106		110	388

i) means ($\bar{x}$).

$\bar{u} = f.u/\Sigma f$

$= 110/106 = 1.038$

$\bar{x} = 0.5 \times \bar{u} + 30.75$

$= 0.5 \times 1.038 + 30.75 = 31.269$ —— (1)

ii) sum of squares of deviation (Sx)

$Sx = h^2.Su = 0.5^2 \times 273.849 = 68.462$

$Su = \Sigma f.u^2 - \frac{(\Sigma f.u)^2}{\Sigma f}$

$= 388 - (110)^2/106 = 273.849$ —— (2)

iii) variance (v)

$v = \frac{Sx}{\Sigma f}$

$= 68.462 / 106 = 0.646$ —— (3)

iv) standard deviation (σ).

$\sigma = \sqrt{v}$

$= \sqrt{0.646} = 0.804$ —— (4)

v) limitage by 3σ

a) $\bar{x} - 3\sigma = 31.269 - 3 \times 0.804 = 28.857$ .... under limit

b) $x + 3\sigma = 31.269 + 3 \times 0.804 = 33.681$ .... upper limit

Table-2. shows the frequency concerning altitude,

Fig - 1. shows the classification of paddy field and

Fig - 2. shows it's histogram.

— notes —

1/-

Table-2: Frequency concerning altitude

1) Supposed area

Lot No.	E.L.	28.50-29.00	29.00-29.50	29.50-30.00	30.00-30.50	30.50-31.00	31.00-31.50	31.50-32.00	32.00-32.50	Area (10a)
1	32.28								1	0.405
2	32.26								1	0.179
3	32.16								1	1.152
4	32.35								1	0.869
5	32.38								1	0.975
6	32.38								1	0.661
7	32.13								1	1.146
8	32.30								1	1.455
9	32.12								1	1.579
10	31.29							1		0.522
11	31.65							1		0.274
12	31.44						1			0.632
13	32.06								1	0.539
14	32.15								1	0.731
15	32.04								1	1.167
16	31.78							1		1.558
17	32.10								1	1.518
18	31.40						1			1.405
19	31.48						1			0.982
20	31.69							1		1.441
21	31.48						1			2.266
22	32.00								1	0.979
23	32.08								1	0.994
24	31.71							1		2.012
25	31.78							1		0.417
26	31.44						1			0.678
27	31.59							1		0.869
28	31.56							1		0.928
29	31.66							1		1.693
30	31.94							1		1.054

31	31.33						1			1.453
32	31.41						1			1.110
33	31.38						1			1.471
34	31.70							1		1.152
35	31.23						1			0.903
36	31.74							1		0.662
37	31.62							1		0.712
38	31.33						1			1.146
39	31.62							1		0.993
40	31.73							1		1.107
41	31.59							1		1.372
42	31.64							1		1.344
43	31.20						1			1.764
44	31.27						1			1.322
45	31.16						1			1.526
46	31.40						1			2.055
47	31.36						1			0.474
48	31.05						1			0.527
49	31.21						1			0.960
50	31.38						1			1.993
51	31.28						1			2.022
52	31.52						1			1.186
53	31.48						1			1.146
54	31.27						1			1.566
55	30.90					1				1.273
56	31.14						1			1.671
57	30.96					1				1.859
58	31.29						1			1.008
59	31.24						1			0.863
60	31.52							1		1.919
61	31.30						1			1.169
62	31.50							1		0.897
63	31.65							1		0.948
64	31.47						1			1.310
65	31.64							1		0.948

66	31.68							1		1.206
67	30.86					1				1.149
68	30.75					1				0.572
69	30.76					1				0.560
70	31.10						1			0.867
71	31.15						1			0.800
72	31.02						1			1.490
73	29.79			1						1.031
74	31.24						1			2.249
75	31.36						1			0.587
76	31.32						1			0.448
77	29.17		1							1.280
78	29.75			1						2.375
79	30.25				1					1.269
80	31.00						1			0.928
81	30.96					1				1.761
82	31.00						1			0.933
83	31.07						1			0.946
84	31.31						1			0.813
85	31.45						1			0.329
86	31.31						1			0.540
87	31.63							1		0.461
88	31.67							1		0.220
89	30.39				1					0.267
total		0	1	2	2	6	39	24	15	97.990

7/-

2) Additional area

Lot No.	E.L	28.50-29.0	29.0-29.50	29.50-30.00	30.00-30.50	30.50-31.00	31.00-31.50	31.50-32.00	32.00-32.50	Area (10 a)
90	31.79							1		1.030
91	31.79							1		1.136
92	32.49								1	0.762
93	29.37		1							1.452
94	30.47				1					2.839
95	30.77					1				1.221
96	30.67					1				2.117
97	31.27						1			1.001
98	31.17						1			0.864
99	31.17						1			0.848
100	31.27						1			0.800
101	29.37		1							0.469
102	29.22		1							1.500
103	29.12		1							2.435
104	29.02		1							0.645
105	28.92	1								0.540
106	28.92	1								0.534
Total		2	5	0	1	2	4	2	1	20.243
Ground	Total	2	6	2	3	8	43	26	16	118.233

3) Kosong area

i) in a supposed area	6.728	(10 a)
ii) in a additional area	7.714	(10 a)
Total	14.442	(10 a)

TOTAL AREA OF P/F NO.2

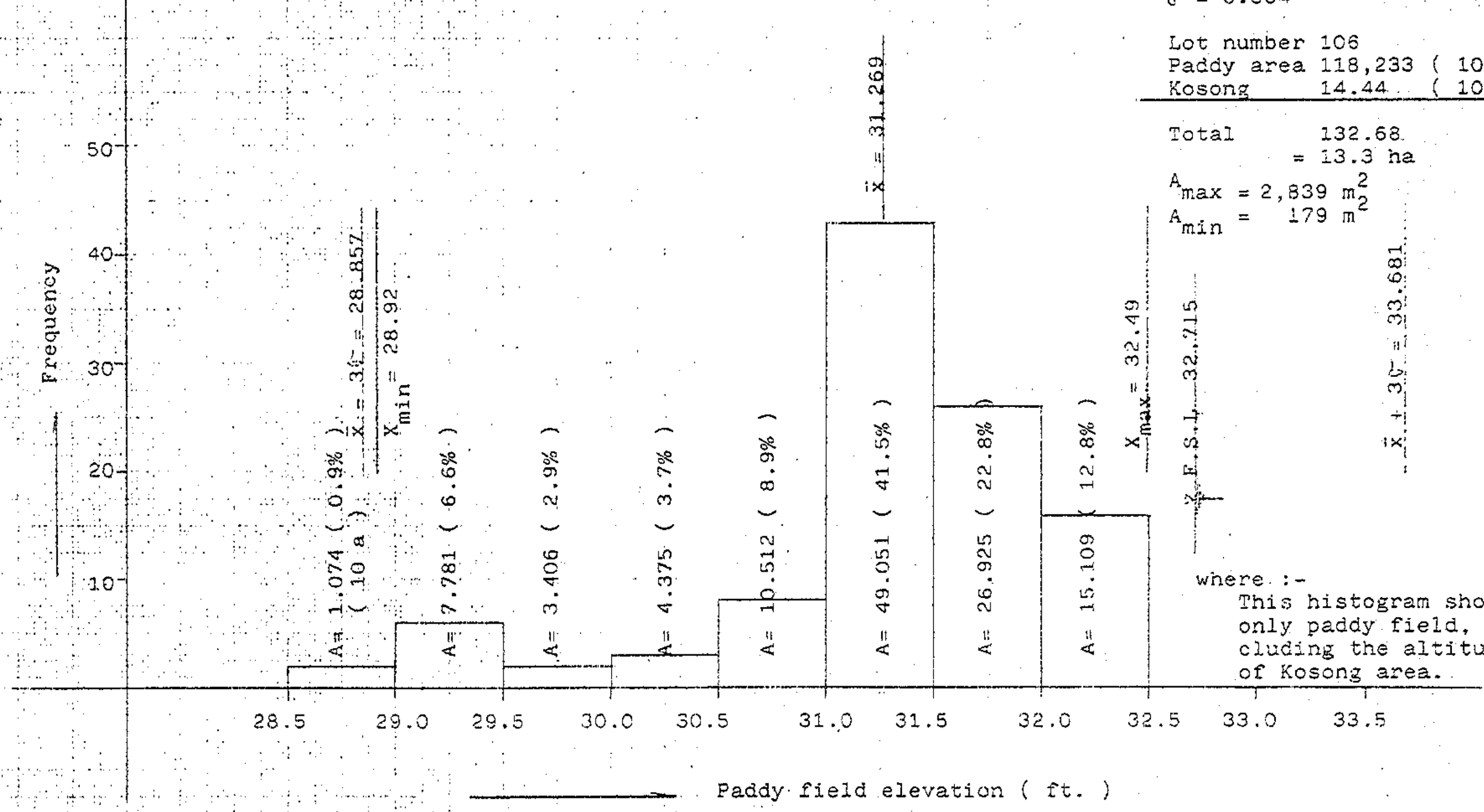
paddy field area + kosong area
= 118.233 + 14.442
= 132.68 (10 a)
= 13.268 (ha)
= 32.786 (acre)

Fig - 1. CLASSIFICATION OF PADDY FIELD

SCALE : 2 CHAINS TO AN INCH

-8-

Fig- 2. HISTOGRAM OF P/F NO.2 (ALTITUDE)



Remarks

$\bar{x}$ = 31.269
S_x = 68.462

v = 0.646
σ = 0.804

Lot number	106	
Paddy area	118,233	(10a)
Kosong	14.44	(10a)
Total	132.68	
	= 13.3 ha	

A_{max} = 2,839 m^2
A_{min} = 179 m^2

where :-
This histogram shows only paddy field, excluding the altitude of Kosong area.

2) Existing area analysis.

All of area of P/F No. 2 which is covered by offtake P4S3L should be calculated each one by one field lot using a triangle method, because of the scale of plan is normally used 2 chains to an inch (1 cm to 15.84 m), this scale is too small to measure each field lot using a planimeter. The analysis of area is shown as follows :-

Table-3. Statistical calculation of area

class	center of class (x)	frequency(f)	$(u) = \frac{x-1.50}{0.25}$	(f).(u)	$(f).(u)^2$
$(x1,000m^2)$	$(x1,000m^2)$				
0.0-0.25	0.125	2	- 5.5	- 11.0	60.5
0.25-0.50	0.375	9	- 4.5	- 40.5	182.25
0.50-0.75	0.625	16	- 3.5	- 56.0	196.00
0.25-1.00	0.875	24	- 2.5	- 60.0	150.00
1.00-1.25	1.125	19	- 1.5	- 28.5	42.75
1.25-1.50	1.375	14	- 0.5	- 7.0	3.50
1.50-1.75	1.625	8	0.5	4.0	2.00
1.75-2.00	1.875	5	1.5	7.5	11.25
2.00-2.25	2.125	5	2.5	12.5	31.25
2.25-2.50	2.375	3	3.5	10.5	36.75
2.50-2.75	2.625	0	4.5	0.0	0.0
2.75-3.00	2.875	1	5.5	5.5	30.25
Total		106		- 163.0	746.50

i) means ($\bar{x}$)

$\bar{u} = f.u/\Sigma f$

$= - 163.0 / 106 = - 1.54$

$\bar{x} = 0.25 \times \bar{u} + 1.50$

$= 0.25 \times - 1.54 + 1.50 = 1.120 \ (\times 1,000m^2)$ .... (1)

ii) sum of square of deviation (Sx).

$Sx = h^2 . Su$

$Su = \Sigma f.u^2 - \frac{(\Sigma f.u)^2}{\Sigma f}$

$= 746.50 - (- 163.0)^2/106 = 495.85$

$Sx = 0.25^2 \times 495.85$

$= 30.99$ .... (2)

4/-

iii) variance (v)

$$v = Sx/\sum f$$

$$= 30.99/106 = 0.29 \quad \text{....} \quad (3)$$

iv) standard deviation (σ)

$$\sigma = \sqrt{v}$$

$$= \sqrt{0.29} = 0.54 \quad \text{....} \quad (4)$$

v) limitage by 3

i) $\bar{x} - 3\sigma = 1.120 - 3 \times 0.54 = -0.50$

ii) $\bar{x} + 3\sigma = 1.120 + 3 \times 0.54 = 2.74$

Table-4. shows the frequency concerning area, Fig.-3. and table-5. show the triangle method and Fig-4. shows it's histograme.

—— notes ——

Table-4: Frequency concerning area

1) Supposed area

Lot No.	Area ($x1000m^2$)	0.0-0.25	0.25-0.50	0.50-0.75	0.75-1.0	1.0-1.25	1.25-1.50	1.50-1.75	1.75-2.0	2.0-2.25	2.25-2.50
1	0.405		1								
2	0.179	1									
3	0.152					1					
4	0.869				1						
5	0.975				1						
6	0.661			1							
7	1.146					1					
8	1.455						1				
9	1.578							1			
10	0.522			1							
11	0.274		1								
12	0.632			1							
13	0.539			1							
14	0.731			1							
15	1.167					1					
16	1.558							1			
17	1.518							1			
18	1.405						1				
19	0.982				1						
20	1.441						1				
21	2.266										1
22	0.979				1						
23	0.993				1						
24	2.012									1	
25	0.417		1								
26	0.678			1							
27	0.869				1						
28	0.928				1						
29	1.693							1			
30	1.054					1					
31	1.453						1				
32	1.110					1					
33	1.471						1				
34	1.152					1					
35	1.903				1						

36	0.662			1							
37	0.712			1							
38	1.146					1					
39	0.993				1						
40	1.107					1					
41	1.372						1				
42	1.344						1				
43	1.764								1		
44	1.322						1				
45	1.526							1			
46	2.055									1	
47	0.474		1								
48	0.527			1							
49	0.960				1						
50	1.993								1		
51	2.022									1	
52	1.186					1					
53	1.146					1					
54	1.566							1			
55	1.273						1				
56	1.671							1			
57	1.859								1		
58	1.008					1					
59	0.863				1						
60	1.919								1		
61	1.169					1					
62	0.897				1						
63	0.948				1						
64	1.310						1				
65	0.948				1						
66	1.206					1					
67	1.149					1					
68	0.572			1							
69	0.560			1							
70	0.867				1						
71	0.800				1						
72	1.490						1				
73	1.031					1					
74	2.249									1	
75	0.587			1							

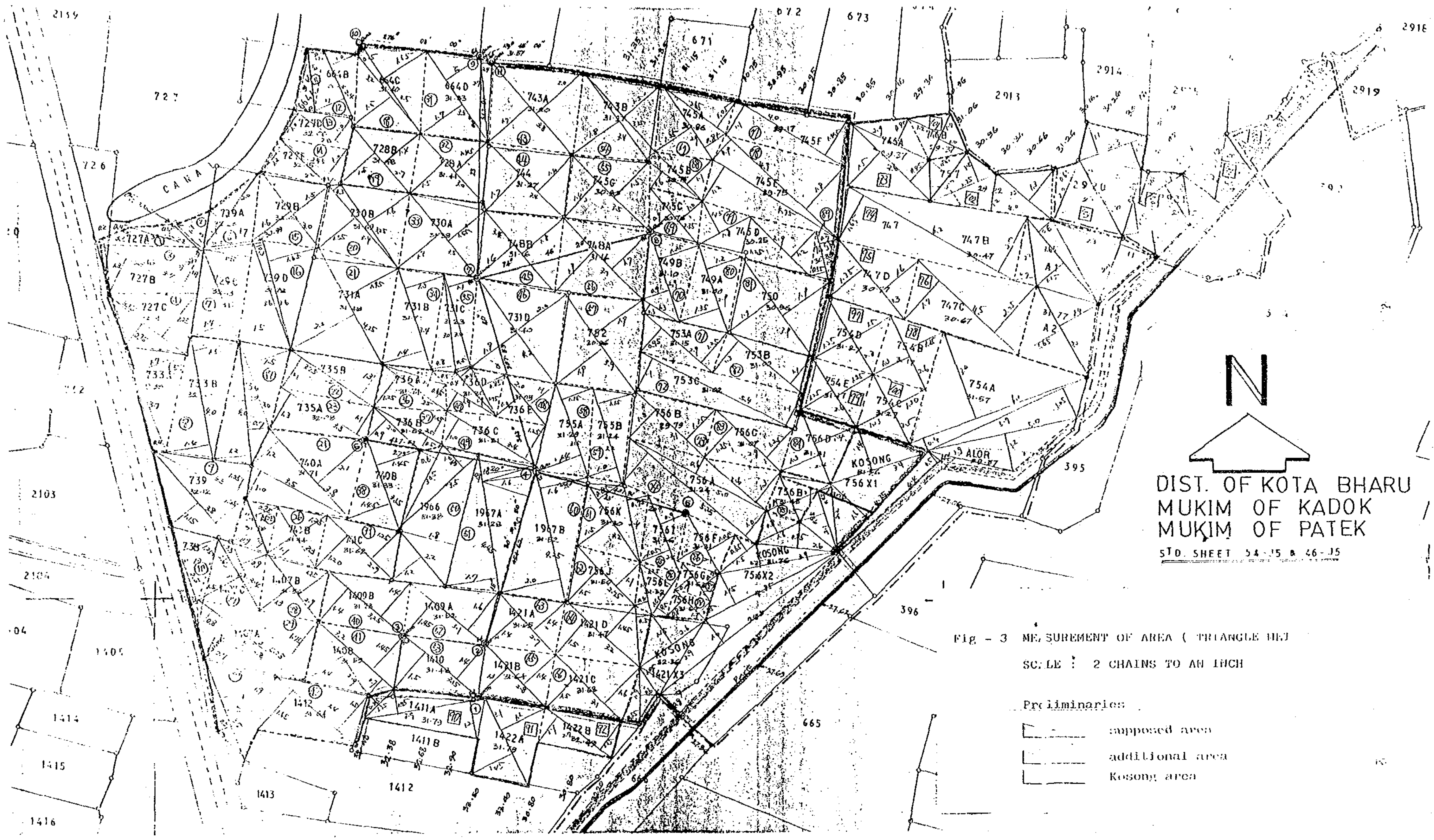


Fig - 3 MEASUREMENT OF AREA (TRIANGLE NET

SCALE : 2 CHAINS TO AN INCH

Preliminaries

supposed area

additional area

Kosong area

Table-5: Calculation of area in each field lot

1) Supposed area

Lot No.	items	b	h	b x h	$x\frac{1}{2}x15.84^2(m^2)$	total (m^2)
1	1-1	3.2	0.2	0.64	80.29	
	1-2	3.2	0.45	1.44	180.65	
	1-3	2.3	0.5	1.15	144.27	405.21
2	2-1	1.3	1.1	1.43	179.40	179.40
3	3-1	3.4	1.4	4.76	597.16	
	3-2	3.4	1.3	4.42	554.50	1,151.66
4	4-1	3.15	1.25	3.94	493.97	
	4-2	3.15	0.95	2.99	375.42	869.39
5	5-1	3.7	1.7	6.29	789.10	
	5-2	3.7	0.4	1.48	185.67	974.77
6	6-1	1.7	2.0	3.40	426.54	
	6-2	1.7	1.1	1.87	234.60	661.14
7	7-1	3.15	1.5	4.73	592.76	
	7-2	3.15	1.4	4.41	553.25	1,146.01
8	8-1	4.0	1.5	6.00	752.72	
	8-2	4.0	1.4	5.60	702.54	1,455.26
9	9-1	3.3	1.05	3.47	434.69	
	9-2	3.8	1.25	4.75	595.90	
	9-3	3.8	1.15	4.37	548.23	1,578.82
10	10-1	2.5	1.25	3.13	392.04	
	10-2	3.45	0.3	1.04	129.84	521.88
11	11-1	1.9	0.5	0.95	119.18	
	11-2	1.9	0.65	1.24	154.93	274.11
12	12-1	2.4	1.0	2.40	301.09	
	12-2	2.4	1.1	2.64	331.20	632.29
13	13-1	2.15	1.0	2.15	269.72	
	13-2	2.15	1.0	2.15	269.72	539.44
14	14-1	2.45	1.0	2.45	307.36	
	14-2	2.45	0.3	0.74	92.21	
	14-3	2.2	1.2	2.64	331.20	730.77
15	15-1	3.0	1.5	4.50	564.54	
	15-2	3.0	1.6	4.80	602.17	1,166.71
16	16-1	3.6	1.65	5.94	745.19	
	16-2	3.6	0.3	1.08	135.49	
	16-3	3.6	1.5	5.40	677.45	1,558.13

17/-

17	17-1	3.0	1.5	4.50	564.54	
	17-2	4.0	0.7	2.80	351.27	
	17-3	4.0	1.2	4.80	602.17	1,517.98
18	18-1	3.2	1.65	5.28	662.39	
	18-2	3.2	0.35	1.12	140.51	
	18-3	3.2	1.5	4.80	602.17	1,405.07
19	19-2	2.7	1.4	3.78	474.21	
	19-2	2.7	1.5	4.05	508.08	982.29
20	20-1	3.25	1.6	5.20	652.35	
	20-2	3.4	0.3	1.02	127.96	
	20-3	3.4	1.55	5.27	661.14	1,441.45
21	21-1	4.25	1.95	8.29	1,039.69	
	21-2	4.25	2.3	9.78	1,226.30	2,265.99
22	22-1	3.25	1.3	4.23	530.04	
	22-2	3.25	1.1	3.58	448.49	978.53
23	23-1	3.3	1.1	3.63	455.39	
	23-2	3.3	1.3	4.29	538.19	993.58
24	24-1	3.8	2.1	7.98	1,001.11	
	24-2	3.8	1.2	4.56	572.06	
	24-3	3.5	1.0	3.50	439.08	2,012.24
25	25-1	1.9	0.85	1.62	202.61	
	25-2	1.9	0.9	1.71	214.52	417.13
26	26-1	2.3	1.25	2.88	360.68	
	26-2	2.3	1.1	2.53	317.40	678.08
27	27-1	2.4	0.9	2.16	270.98	
	27-2	2.65	0.3	0.80	99.73	
	27-3	2.65	1.5	3.98	498.67	869.38
28	28-1	2.9	1.25	3.63	454.77	
	28-2	2.9	1.3	3.77	472.96	927.73
29	29-1	4.25	1.75	7.44	933.06	
	29-2	4.25	0.8	3.40	426.54	
	29-3	3.8	0.7	2.66	333.70	1,693.30
30	30-1	3.5	1.9	6.65	834.26	
	30-2	3.5	0.5	1.75	219.54	1,053.80
31	31-1	3.5	1.3	4.55	570.81	
	31-2	3.5	1.7	5.95	746.44	
	31-3	2.7	0.4	1.08	135.49	1,452.74

18/-

32	32-1	3.0	1.45	4.35	545.72	
	32-2	3.0	1.50	4.50	564.54	1,110.26
33	33-1	3.5	1.55	5.43	680.58	
	33-2	3.5	1.8	6.30	790.35	1,470.93
34	34-1	3.4	1.3	4.42	554.50	
	34-2	3.4	1.4	4.76	597.16	1,151.66
35	35-1	3.0	1.1	3.30	413.99	
	35-2	3.0	0.5	1.50	188.18	
	35-3	3.0	0.8	2.40	301.09	903.26
36	36-1	2.1	0.25	0.53	65.86	
	36-2	2.5	0.65	1.63	203.86	
	36-3	2.5	1.25	3.13	392.04	661.76
37	37-1	2.5	1.05	2.63	329.31	
	37-2	2.5	0.5	1.25	156.82	
	37-3	2.0	0.9	1.80	225.82	711.95
38	38-1	3.15	1.45	4.57	573.01	
	38-2	3.15	1.45	4.57	573.01	1,146.02
39	39-1	2.9	1.25	3.63	454.77	
	39-2	2.9	1.20	3.48	436.58	
	39-3	1.8	0.45	0.81	101.62	992.97
40	40-1	3.15	1.4	4.41	553.25	
	40-2	3.15	1.4	4.41	553.25	1,106.50
41	41-1	3.2	1.45	4.64	582.10	
	41-2	3.2	0.7	2.24	281.01	
	41-3	2.9	1.4	4.06	509.34	1,372.45
42	42-1	3.4	1.5	5.10	639.81	
	42-2	3.4	1.65	5.61	703.79	1,343.60
43-	43-1	3.8	2.0	7.60	953.44	
	43-2	3.8	1.7	6.46	810.43	1,763.87
44	44-1	3.4	1.4	4.76	597.16	
	44-2	3.4	1.7	5.78	725.12	1,322.28
45	45-1	3.8	1.8	6.84	858.10	
	45-2	3.8	1.4	5.32	667.41	1,525.51
46	46-1	4.2	2.0	8.40	1,053.80	
	46-2	4.2	1.9	7.98	1,001.11	2,054.91

19/-

47	47-1	1.75	0.85	1.49	186.61	
	47-2	1.9	0.4	0.76	95.34	
	47-3	0.4	0.5	0.20	25.09	
	47-4	1.9	0.7	1.33	166.85	473.89
48	48-1	2.0	1.1	2.20	276.00	
	48-2	2.0	1.0	2.00	250.91	526.91
49	49-1	3.4	1.25	4.25	533.17	
	49-2	3.4	1.0	3.40	426.54	959.71
50	50-1	3.05	0.6	1.83	229.58	
	50-2	3.5	1.0	3.50	439.08	
	50-3	4.4	1.8	7.92	993.59	
	50-4	2.2	1.2	2.64	331.20	1,993.45
51	51-1	4.45	1.7	7.57	949.05	
	51-2	4.05	1.6	6.48	812.93	
	51-3	1.8	0.25	0.45	56.45	
	51-4	0.9	1.8	1.62	203.23	2,021.66
52	52-1	3.1	1.6	4.96	622.25	
	52-2	3.1	1.45	4.50	563.91	1,186.16
53	53-1	3.15	1.4	4.41	553.25	
	53-2	3.15	1.5	4.73	592.76	1,146.01
54	54-1	3.35	1.5	5.03	630.40	
	54-2	3.35	0.4	1.34	168.11	
	54-3	3.4	1.8	6.12	767.77	1,566.28
55	55-1	3.5	1.5	5.25	658.63	
	55-2	3.5	1.4	4.90	614.72	1,273.35
56	56-1	3.7	1.7	6.29	789.10	
	56-2	3.7	1.9	7.03	881.93	1,671.03
57	57-1	3.9	1.9	7.41	929.61	
	57-2	3.9	1.9	7.41	929.61	1,859.22
58	58-1	3.15	1.15	3.62	454.45	
	58-2	3.15	1.4	4.41	553.25	1,007.70
59	59-1	3.2	1.15	3.68	461.67	
	59-2	3.2	1.0	3.20	401.45	863.12
60	60-1	4.25	1.6	6.80	853.08	
	60-2	4.25	2.0	8.50	1,066.35	1,919.43

61	61-1	2.4	0.75	1.80	225.82	
	61-2	3.2	0.85	2.72	341.23	
	61-3	3.2	1.5	4.80	602.17	1,169.22
62	62-1	2.75	1.1	3.03	379.49	
	62-2	2.75	1.5	4.13	517.49	896.98
63	63-1	2.7	1.4	3.78	474.21	
	63-2	2.7	1.4	3.78	474.21	948.42
64	64-1	3.2	1.45	4.64	582.10	
	64-2	2.0	0.5	1.00	125.45	
	64-3	3.2	1.5	4.80	602.17	1,309.72
65	65-1	2.8	1.4	3.92	491.77	
	65-2	2.8	1.3	3.64	456.65	948.42
66	66-1	3.1	1.6	4.96	622.25	
	66-2	3.1	1.5	4.65	583.36	1,205.61
67	67-1	2.65	1.05	2.78	349.07	
	67-2	2.9	0.85	2.47	309.24	
	67-3	2.9	1.35	3.92	491.15	1,149.46
68	68-1	2.2	1.1	2.42	303.60	
	68-2	2.2	0.4	0.88	110.40	
	68-3	2.1	0.6	1.26	158.07	572.07
69	69-1	2.35	1.0	2.35	294.81	
	69-2	2.35	0.9	2.12	265.33	560.14
70	70-1	2.9	1.35	3.92	491.15	
	70-2	2.9	0.9	2.61	327.43	
	70-3	1.3	0.3	0.39	48.93	867.51
71	71-1	2.9	1.25	3.63	454.77	
	71-2	2.9	0.95	2.76	345.62	800.39
72	72-1	5.4	1.1	5.94	745.19	
	72-2	5.4	1.1	5.94	745.19	1,490.38
73	73-1	3.1	1.35	4.19	525.02	
	73-2	3.1	1.3	4.03	505.57	1,030.59
74	74-1	5.0	0.6	3.00	376.36	
	74-2	2.6	1.3	3.38	424.03	
	74-3	5.25	1.0	5.25	658.63	
	74-4	5.25	1.2	6.30	790.35	2,249.37

21/-

75	75-1	2.4	0.9	2.16	270.98	
	75-2	2.4	1.05	2.52	316.14	587.12
76	76-1	1.7	0.4	0.68	85.31	
	76-2	1.65	1.25	2.06	258.75	
	76-3	1.65	0.5	0.83	103.50	447.56
77	77-1	4.0	1.45	5.80	727.63	
	77-2	4.0	1.1	4.40	551.99	1,279.62
78	78-1	4.9	1.8	8.82	1,106.49	
	78-2	4.9	0.9	4.41	553.25	
	78-3	4.75	1.2	5.70	715.08	2,374.82
79	79-1	1.8	1.15	2.07	259.69	
	79-2	3.65	1.25	4.56	572.38	
	79-3	2.9	1.2	3.48	436.58	1,268.65
80	80-1	2.9	1.2	3.48	436.58	
	80-2	2.9	1.35	3.92	419.15	927.73
81	81-1	3.9	1.9	7.41	929.61	
	81-2	3.9	1.7	6.63	831.75	1,761.36
82	82-1	3.1	1.1	3.41	427.79	
	82-2	3.1	1.3	4.03	505.57	933.36
83	83-1	2.9	1.25	3.63	454.77	
	83-2	2.9	1.35	3.92	491.15	945.92
84	84-1	2.4	1.4	3.36	421.52	
	84-2	2.4	1.3	3.12	391.41	812.93
85	85-1	1.5	0.9	1.35	169.36	
	85-2	1.5	0.85	1.28	159.95	329 31
86	86-1	2.1	1.05	2.21	276.62	
	86-2	2.1	1.0	2.10	263.45	540.07
87	87-1	1.5	1.75	2.63	329.31	
	87-2	1.5	0.7	1.05	131.73	461.04
88	88-1	1.3	0.55	0.72	89.70	
	88-2	1.3	0.8	1.04	130.47	220.17
89	89-1	1.7	0.7	1.19	149.29	
	89-2	1.7	0.55	0.94	117.30	266.59
Total				781.34		97,994.66

22/-

2) Additional area

	Area	b	h	b x h	x ½ x 15.84²	Total
90	90-1	3.9	1.2	4.68	587.12	
	90-2	3.9	0.75	2.93	366.95	
	90-3	1.35	0.45	0.61	76.21	1,030.28
91	91-1	3.1	1.60	4.96	622.25	
	91-2	3.1	1.45	4.50	563.91	1,186.16
92	92-1	2.7	1.1	2.97	372.59	
	92-2	2.7	1.15	3.11	389.53	762.12
93	93-1	3.6	1.5	5.4	677.45	
	93-2	3.6	0.95	3.42	429.05	
	93-3	2.9	0.95	2.76	345.62	1,452.12
94	94-1	6.2	1.65	10.23	1,283.38	
	94-2	6.2	2.0	12.40	1,555.61	2,838.99
95	95-1	3.3	1.35	4.46	558.89	
	95-2	3.3	1.6	5.28	662.39	1,221.28
96	96-1	4.5	1.7	7.65	959.71	
	96-2	4.5	2.05	9.23	1,157.30	2,117.01
97	97-1	2.8	1.35	3.78	474.21	
	97-2	2.8	1.5	4.20	526.90	1,001.11
98	98-1	2.6	1.3	3.38	424.03	
	98-2	2.6	1.35	3.51	440.34	864.37
99	99-1	2.6	1.25	3.25	407.72	
	99-2	2.6	1.35	3.51	440.34	848.06
100	100-1	2.5	1.25	3.13	392.04	
	100-2	2.5	1.30	3.25	407.72	799.76
101	101-1	1.7	1.0	1.7	213.27	
	101-2	1.7	1.2	2.04	255.92	469.19
102	102-1	2.0	0.85	1.70	213.27	
	102-2	2.35	1.05	2.47	309.55	
	102-3	4.0	1.2	4.80	602.17	
	102-4	2.3	1.3	2.99	375.10	1,500.09
103	103-1	2.3	1.1	2.53	317.40	
	103-2	2.3	0.9	2.07	259.69	
	103-3	2.0	0.65	1.30	163.09	
	103-4	3.15	1.2	3.78	474.21	

23/–

	103-5	3.15	1.6	5.04	632.28	
	103-6	2.2	1.05	2.31	289.80	
	103-7	2.2	0.9	1.98	248.40	
	103-8	1.0	0.2	0.20	25.09	
	103-9	1.0	0.2	0.20	25.09	2,435.05
104	104-1	1.7	0.65	1.11	138.63	
	104-2	1.7	1.5	2.55	319.90	
	104-3	1.65	0.9	1.49	186.30	644.83
105	105-1	2.1	1.2	2.52	316.14	
	105-2	2.1	0.85	1.79	223.93	540.07
106	106-1	1.8	0.9	1.62	203.23	
	106-2	3.9	0.3	1.17	146.78	
	106-3	2.3	0.55	1.27	158.70	
	106-4	0.8	0.25	0.20	25.09	533.8
					Total	20,244.29

Ground Total 97,994.66 + 20,244.29 = 118,238.95

24/-

3) Kosong area

KOSONG (supposed area)	1	1.9	0.55	1.05	131.10	
	2	1.9	0.6	1.14	143.02	
	3	2.6	1.15	2.99	375.10	
	4	2.9	1.05	3.05	382.00	
	5	7.45	0.8	5.96	747.70	
	6	7.45	1.0	7.45	934.62	
	7	4.85	1.15	5.58	699.71	
	8	3.9	1.75	6.83	856.22	
	9	1.5	0.65	0.98	122.32	
	10	2.6	0.85	2.21	277.25	
	11	1.6	0.8	1.28	160.58	
	12	2.1	0.85	1.79	223.93	
	13	2.2	0.45	0.99	124.20	
	14	4.35	1.6	6.96	873.15	
	15	3.4	1.4	4.76	597.16	
	16	1.6	0.25	0.40	50.18	
	17	1.6	0.15	0.24	30.11	
TOTAL				53.66	6,728.35	
KOSONG (additional area)	1	2.25	1.1	2.48	310.50	
	2	2.25	2.3	5.18	649.22	
	3	3.65	0.6	2.19	274.74	
	4	3.65	1.15	4.20	526.59	
	5	2.2	0.7	1.54	193.20	
	6	3.3	1.4	4.62	579.59	
	7	3.3	1.65	5.45	683.09	
	8	6.2	3.0	18.60	2333.42	
	9	6.2	0.4	2.48	311.12	
	10	5.7	1.05	5.99	750.84	
	11	5.0	1.2	6.00	752.72	
	12	2.9	0.2	0.58	72.76	
	13	4.4	0.5	2.20	276.00	
Total					7713.79	
Ground total					14,442.14	

TOTAL AREA OF P/F NO.2

paddy area + kosong area

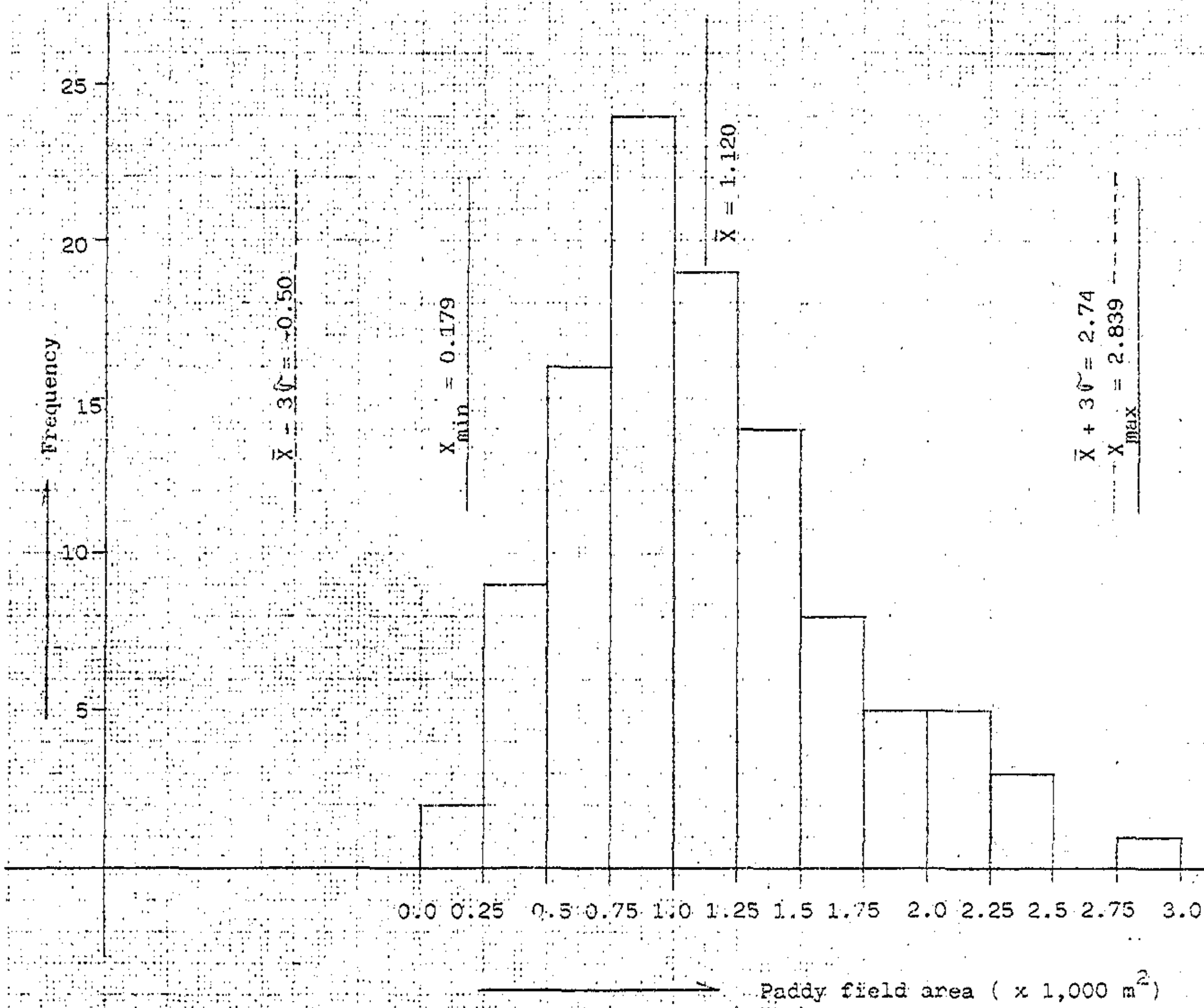
= 118,238.95 + 14,442.14

= 13.268 (ha)

= 32.786 (acre)

25/-

Fig.- 4 HISTOGRAM OF P/F NO.2 (AREA)



Remarks

$\bar{x} = 1.120$
$Sx = 30.99$
$v = 0.29$
$\sigma = 0.54$

Lot number 106

Area = 118.233 (10a)
Kosong =14.44 (10a)

132.58
= 13.3 Ha

$A_{max} = 2,839\ m^2$
$A_{min} = 179\ m^2$

Where :-
This histogram shows only paddy field, excluding the Kosong area.

3) Analysis

Statistical means ($\bar{\bar{x}}$) concerning altitude will be considered for the standard elevation of land consolidation planning, however it seems very difficult to promote the land consolidation system now in Malaysia due to the complication of the social and agricultural difficulties. In the case, it is better to construct at least minimum on farm facilities first in existing paddy field which has no facilities on water management, afterwards additional facilities should be rearranged gradually in each field block.

As above mentioned, this planning and design are not involved whole scale land levelling like a land consolidation, therefore if Government want to promote the land levelling later in this area the standard elevation should be decided within each one field block again.

After each field lot has been classified according to its altitude as in Fig.-1, the topography of the whole area in relation to its surrounding conditions can be studied for the purpose of planning and design.

To fully understand the altitude and area analysis, histogram are drawn as in Fig.-2 and Fig.-4.

Histogram shows the geographical conditions with an angle of view, in Fig.-2 64% of the lots lie between the range of 31.0 to 32.0 ft. and out of this 41.5% are between 31.0 to 31.5 ft. The difference between the Full Supply Water Level (F.S.L) and the means of P/F No. 2 is:-

$$F.S.L - \bar{\bar{x}} = 32.715 - 31.269$$
$$= 1.446 \text{ (ft)} \quad ... \quad 0.441 \text{ (m)}$$

Also the difference between the F.S.L and the highest paddy field elevation is:-

$$F.S.L - \dot{E}.L = 32.715 - 32.49$$
$$= 0.225 \text{ (ft)} \quad ... \quad 0.069 \text{ (m)}$$

If the water level in the canal couldn't be controlled the F.S.L to supply water to paddy field the difference in altitude means it is very difficult to get the water from the off-take, because of P/F No. 2 is located in the highest place of Kadok District. As a fact, actual presaturation period of 48 days for the area is found to be extremely delayed if compared to the KADA schedule whereby the presaturation period is 30 days.

Besides the above, the submerged off-take which is expected to draw 2 cusec of irrigation water was constructed without taking into consideration of the geographical conditions.

What is the solution of these problems?

So far, the major scheme has been constructed to deliver the water but not to supply the water to one irrigation district where has no water management facilities, therefore it is necessary to promote the on farm facilities to shorten the presaturation period and make well use of the water for rice cultivation. Regarding the area, 14,442 m^2 belongs to KOSONG. However, this KOSONG area has an ability for rice cultivation after getting the irrigation water and land levelling, so it is better to include this KOSONG area into the P/F No. 2 for the future plan.

The histogram of area (Fig. 4) shows the means of this area is 1.120 m^2, maximum is 2,839 m^2 and minimum is 179 m^2. This means the P/F No. 2 possess several kinds of field lots that are not good to use machinery for modern farming.

If the farmers want to promote an agricultural machinery they must group their own land with cooperation from their neighbours. This problem seems very difficult to solve immediately, however it shouldn't be abandoned for the future agriculture in Malaysia.

(3) Present Status

1) Name of off-take ; P4S3L

2) Area ; 13.27 ha.

- west side ; 250 m of public road and 140 m of secondary canal
- east side ; 480 m of upland and kampong road.
- south side ; 240 m of housing place
- north side ; 500 m of bound.

3) Altitude ; 29.0 - 32.5 ft

- mean ; 31.269 ft

4) Topographical slope ; West to East approximately 1/1000

5) Farm lot

- number of field lot ; 106 lots
- area/lot ; 0.02 - 0.28 ha
- mean; 0.11 ha

6) Field facilities

- irrigation channel ; 50 m
- drainage channel ; 30 m
- farm road ; none

28/-

7) Cultivating farmers : 26

8) Ill-irrigated area : 0.14 ha (lot 87,88,92) + kosong

9) Ill-drained area : 0.54 ha (lot 26,57,73,79,89)

10) Water supply for irrigation:

presaturation period ; 0.014 m^3/sec (11.82 ha x 1.18 l/sl/ha).

normal period ; 0.009 m^3/sec. (11.82 ha x 0.8 l/s/ha)

(4) Planning and Design

1) Determination of possible amount of intake water.

The off-take (P4S3L) is submerged one, so it must be careful to understand it's hydraulic feature.

i) Measurement of discharge

Expected discharge of P/F No. 2 due to KADA program is shown as follows.

area : 13.27 ha.

discharge : 1.18 l/s/ha (presaturation period)

13.27 x 1.18 =15.66 l/s

There was too little flow to measure the discharge using a current meter in the off-take so a pershall flume was applied.

One of the measurement of discharge using 6 inch type pershall flume is shown in Fig.-5. In this case the water level is still below the F.S.L by 1.1 cm, and afterwards there is no time to measure because the nursery period is due to be started by farmers soon.

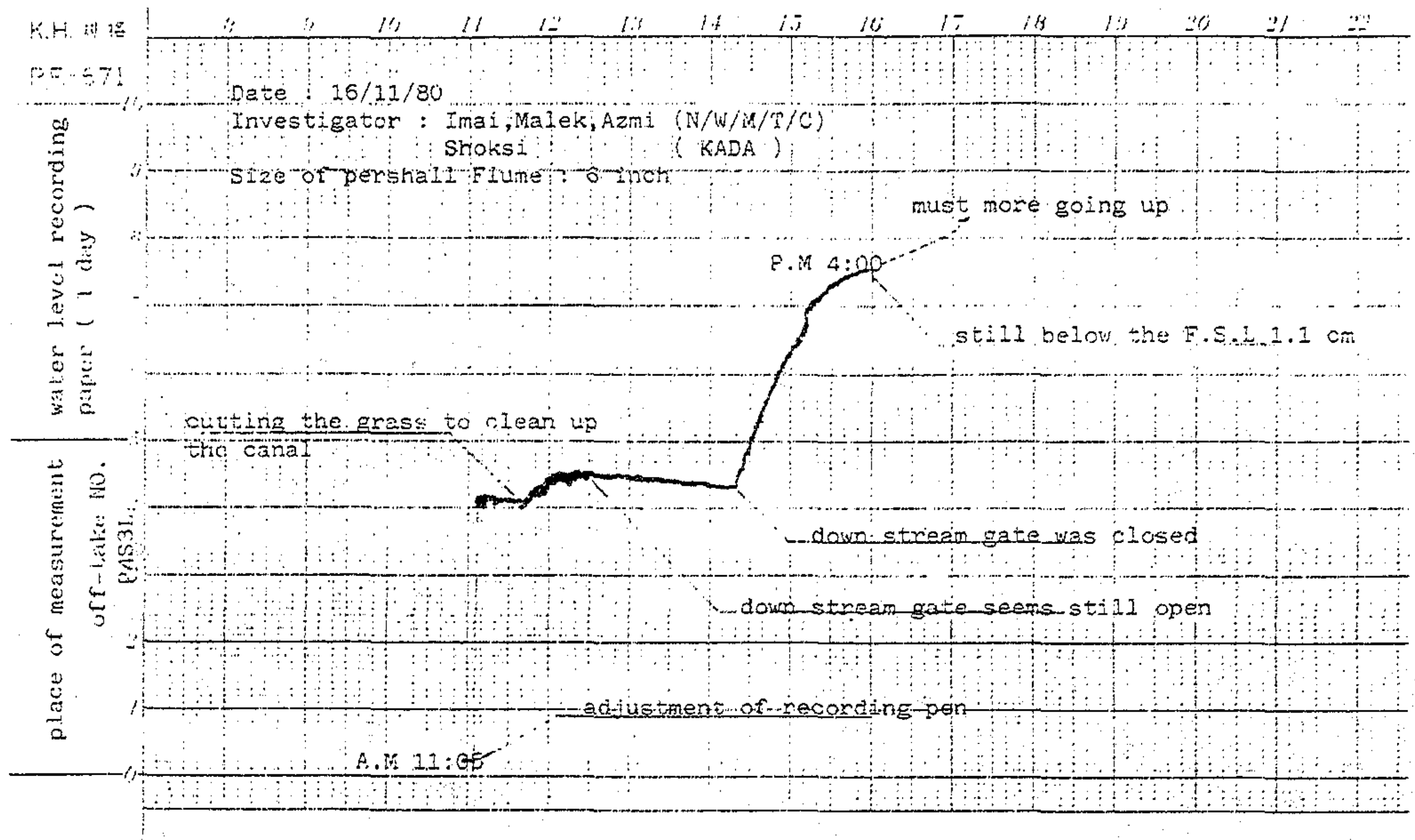
Hereinfafter the understanding of the characteristic of off-take is carried out by using the hydraulic equation.

ii) Understanding of off-take feature by hydraulic method.

The general view of off-take P4S3L is shown in Fig. 6, hereby the crest level is submerged and it is found out that these inlet, outlet frection and submerged orifice head loss will disturb the irrigation water to P/F No. 2.

29/-

Fig.- 5 Measurement of Discharge

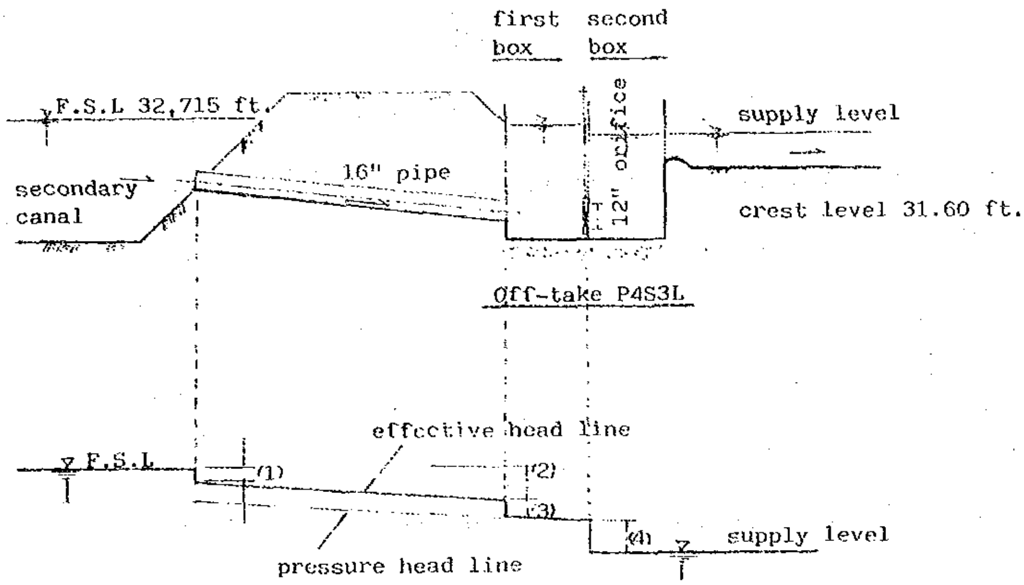


Where :-

$$Q = 0.264H^{1.58} \quad l/sec$$

H (cm)

Fig. 6. General view of off-take and its **head** loss



Where: (1) inlet head loss

(2) friction head loss

(3) outlet head loss

(4) submerged orifice head loss.

First of all, the hydraulic equation from secondary canal to first box can be given as follows:

a) velocity and quantity of water in the pipe

Manning's formula

$$V = \frac{1}{n} \cdot R^{2/3} \cdot I^{\frac{1}{2}}$$

$$= \frac{1}{n} \cdot R^{1/6} \cdot R^{\frac{1}{2}} \cdot I^{\frac{1}{2}}$$

$$= \frac{1}{n} \cdot R^{1/6} \cdot \sqrt{R \cdot I} \qquad \text{———— (1)}$$

Chigy's formula

$$V = C.\ \sqrt{R.I}$$

where, C: Coefficient of velocity

$$C = \sqrt{\frac{8.g}{f}}$$

f: Coefficient of friction losses

so that the coefficient of velocity can be given as follows.

$$\frac{1}{n}.\ R^{1/6} = C = \sqrt{\frac{8.g}{f}}$$

$$\therefore\ f = \frac{8.g.n^2}{R^{1/3}}$$

hereby n = 0.014

the cause of coefficient of friction losses is shown as follows.

$$R = \frac{16 \times 0.0254}{4} = 0.1016\ m$$

$$f = \frac{8.g.n^2}{R^{1/3}}$$

$$= \frac{8 \times 9.8 \times 0.014^2}{0.1016^{1/3}} = 0.0329$$

taking into consideration of inlet/outlet and friction losses the velocity in the pipe is shown as follows.

$$\therefore\ V = \sqrt{\frac{2.g.h}{1.5 + f.\frac{l}{D}}} \qquad \text{——— (1)}$$

where, h: difference of water head

f: coefficient of friction

l: length of pipe

D: diameter of pipe

32/

$$V = \sqrt{\frac{2 \times 9.8 \times h}{1.5 + 0.0329 \times \frac{6.15}{16 \times 0.0254}}}$$

$$= \sqrt{9.81 \times h}$$

$$\therefore \quad Q = A.V$$

$$= \frac{\pi \times (16 \times 0.0254)^2}{4} \times \sqrt{9.81 \times h}$$

$$= 0.130 \times \sqrt{9.81 \times h} \qquad \text{——————(4)}$$

Now the maximum difference of water head between the F.S.L and crest level of off-take is given as follows.

$$(32.715 - 31.60) \times 0.3048 = 0.34 \text{ m}$$

The discharge table from secondary canal to first box of offtake P4S3L is shown in table-6.

—notes —

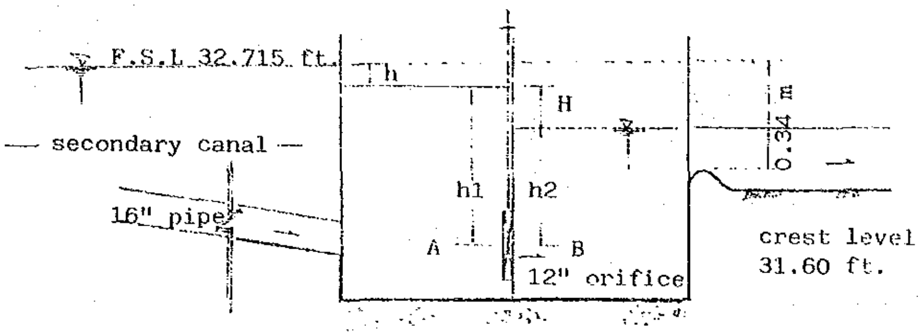
Table-6 Discharge table from secondary canal to first box of off-take

cm	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	Remarks
0	—	0.013	0.018	0.022	0.026	0.029	0.032	0.034	0.036	0.039	unit: m^3/sec
1	0.041	0.043	0.045	0.046	0.048	0.050	0.052	0.053	0.055	0.056	F.S.L= 32.715 ft
2	0.058	0.059	0.060	0.062	0.063	0.064	0.066	0.067	0.068	0.069	crest = 31.600 ft
3	0.071	0.072	0.073	0.074	0.075	0.076	0.077	0.078	0.079	0.080	
4	0.081	0.082	0.083	0.084	0.085	0.086	0.087	0.088	0.099	0.090	$Q = 0.130 \times \sqrt{9.81 \times h}$
5	0.091	0.092	0.093	0.094	0.095	0.095	0.096	0.097	0.098	0.039	
6	0.100	0.101	0.101	0.102	0.103	0.104	0.105	0.105	0.106	0.107	
7	0.108	0.108	0.109	0.110	0.111	0.112	0.112	0.113	0.114	0.114	
8	0.115	0.116	0.117	0.117	0.118	0.119	0.119	0.120	0.121	0.121	
9	0.122	0.123	0.124	0.124	0.125	0.125	0.126	0.127	0.127	0.128	
10	0.129	0.129	0.130	0.131	0.131	0.132	0.133	0.133	0.134	0.134	
11	0.135	0.136	0.136	0.137	0.137	0.138	0.139	0.139	0.140	0.140	
12	0.141	0.142	0.142	0.143	0.143	0.144	0.145	0.145	0.146	0.146	
13	0.147	0.147	0.148	0.148	0.149	0.150	0.150	0.151	0.151	0.152	
14	0.152	0.153	0.153	0.154	0.155	0.155	0.156	0.156	0.157	0.157	
15	0.158	0.158	0.159	0.159	0.160	0.160	0.161	0.161	0.162	0.162	
16	0.163	0.163	0.163	0.164	0.165	0.165	0.166	0.166	0.167	0.167	
17	0.168	0.168	0.169	0.169	0.170	0.170	0.171	0.171	0.172	0.172	
18	0.173	0.173	0.174	0.174	0.175	0.175	0.176	0.176	0.177	0.177	
19	0.177	0.178	0.178	0.179	0.179	0.180	0.180	0.181	0.181	0.182	
20	0.182	0.183	0.183	0.183	0.184	0.184	0.185	0.185	0.186	0.186	
21	0.187	0.187	0.187	0.188	0.188	0.189	0.189	0.190	0.190	0.191	
22	0.191	0.191	0.192	0.192	0.193	0.193	0.194	0.194	0.194	0.195	
23	0.195	0.196	0.196	0.197	0.197	0.197	0.198	0.198	0.199	0.199	
24	0.199	0.200	0.200	0.201	0.201	0.202	0.202	0.202	0.203	0.203	
25	0.204	0.204	0.204	0.205	0.205	0.206	0.206	0.206	0.207	0.207	
26	0.208	0.208	0.208	0.209	0.209	0.210	0.210	0.210	0.211	0.211	
27	0.212	0.212	0.212	0.213	0.213	0.214	0.214	0.214	0.215	0.215	
28	0.215	0.216	0.216	0.217	0.217	0.217	0.218	0.218	0.219	0.219	
29	0.219	0.220	0.220	0.220	0.221	0.221	0.222	0.222	0.222	0.223	
30	0.223	0.223	0.224	0.224	0.224	0.225	0.225	0.226	0.226	0.226	
31	0.227	0.227	0.227	0.228	0.228	0.229	0.229	0.229	0.230	0.230	
32	0.230	0.231	0.231	0.231	0.232	0.232	0.232	0.233	0.233	0.234	
33	0.234	0.234	0.235	0.235	0.235	0.236	0.236	0.236	0.237	0.237	
34	0.237	0.238	0.238	0.238	0.239	0.239	0.240	0.240	0.240	0.241	
35	0.241	0.241	0.242	0.242	0.242	0.243	0.243	0.243	0.244	0.244	

34/-

b) Submerged orifice head loss

Fig.-7. General view of submerged orifice head loss



where, h: inlet/outlet and friction head losses

H: submerged orifice head loss

h1: potential head of first box

h2: potential head of second box

At first, the water from the secondary canal is drawn into first box of off-take through 16 inch concrete pipe, afterwards the drawn water will go down to second box of the off-take through the submerged orifice.

In the case, the hydraulic equation can be given as follows.

Applying the Bernoulli's theorem on line A-B, the hydraulic connection is cleared as in table-7.

Table-7. Balance of head loss

point	P/W	$V^2/2g$	z	others
A	h1W/W	0	0	0
B	h2W/W	$V^2/2g$	0	0

where, PW/W: pressure head

$V^2/2g$: velocity head

z : potential head

There is no consideration about approaching velocity.

Bernoulli's theorem, that is, totel head of the pressure head (P/W), the velocity head ($V^2/2g$) and potential head (z) between A and B should be same.

$$A = B$$

$$\frac{h1.W}{W} = \frac{h2.W}{W} + \frac{V^2}{2.g}$$

$$V = \sqrt{2.g.(h1 - h2)}$$

hereby $H = h1 - h2$

$$V = \sqrt{2.g.H} \qquad \text{———} \quad (1)$$

$$Q = C.A.V$$

where, C: coefficient of discharge 0.60

A: area of orifice

V: velocity of water.

that is shown as follows

$$\therefore \; Q = C.A.V$$

$$= C.A.\sqrt{2.g.H} \qquad \text{———} \quad (2)$$

$$H = \frac{Q^2}{2.g.C^2.A^2}$$

$$= \frac{Q^2}{2x9.8x0.6^2x(12x0.0254)^4}$$

$$= \frac{Q^2}{0.0609}$$

the head losses through the orifice is given as follows.

$$\therefore \; H = \frac{Q^2}{0.0609} \qquad \text{———} \quad (3)$$

The discharge table from secondary canal to first box of off-take is shown in table-6, now the quantity of water through the submerged orifice from first box to second box is also given in table-6, at that time the head loss by submerged orifice is shown in table-8.

Table-8. Head loss by the submerged orifice

Q(m^3/sec) H(cm)	0.013 0.3	0.018 0.5	0.022 0.8	0.026 1.1	0.029 1.4	0.032 1.7	0.034 1.9	0.036 2.1	0.039 2.5
Q(") H(")	0.041 2.8	0.043 3.0	0.045 3.3	0.046 3.5	0.048 3.8	0.050 4.1	0.052 4.4	0.053 4.6	0.055 5.0
Q(") H(")	0.056 5.1	0.058 5.5	0.059 5.7	0.060 5.9	0.062 6.3	0.063 6.5	0.064 6.7	0.066 7.1	0.067 7.4
Q(") H(")	0.068 7.6	0.069 7.8	0.071 8.3	0.072 8.5	0.073 8.7	0.074 9.0	0.075 9.2	0.076 9.5	0.077 9.7
Q(") H(")	0.078 10.0	0.079 10.2	0.080 10.5	0.081 10.7	0.082 11.0	0.083 11.3	0.084 11.6	0.085 11.8	0.086 12.1
Q(") H(")	0.087 12.4	0.088 12.7	0.089 13.0	0.090 13.3	0.091 13.6	0.092 13.9	0.093 14.2	0.094 14.5	0.095 14.8
Q(") H(")	0.095 14.8	0.096 15.1	0.097 15.4	0.098 15.7	0.099 16.1	0.100 16.4	0.101 16.7	0.101 16.7	0.102 17.0
Q(") H(")	0.103 17.4	0.104 17.7	0.105 18.1	0.105 18.1	0.106 18.4	0.107 18.8	0.108 19.1	0.108 19.1	0.109 19.5
Q(") H(")	0.100 19.8	0.111 20.2	0.112 20.5	0.112 20.5	0.113 20.9	0.114 21.3	0.114 21.3	0.115 21.7	0.116 22.0
Q(") H(")	0.117 22.4	0.117 22.4	0.118 22.8	0.119 23.2	0.119 23.2	0.120 23.6	0.121 24.0	0.121 24.0	0.122 24.4
Q(") H(")	0.123 24.8	0.124 25.2	0.124 25.2	0.125 25.6	0.125 25.6	0.126 26.0	0.127 26.4	0.127 26.4	0.128 26.8

c) Total head loss

The total head losses from secondary canal to second box of off-take and it's discharge is shown in table-9.

Table-9. Total head loss and it's discharge

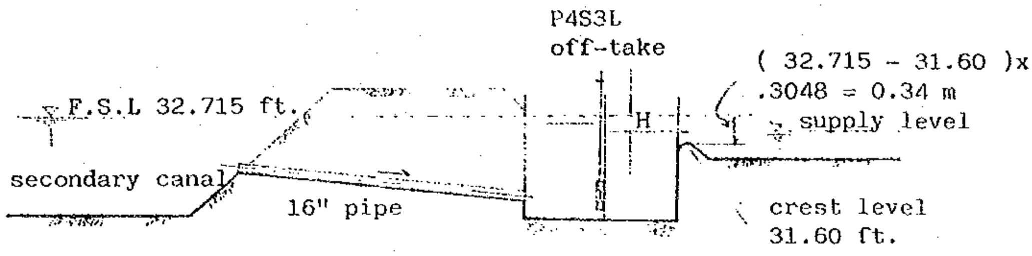
H (cm)	0.4	0.7	1.1	1.5	1.9	2.3	2.6	2.9	3.4
Q(m^3/sec)	0.013	0.018	0.022	0.026	0.029	0.032	0.034	0.036	0.039
H(")	3.8	4.1	4.5	4.8	5.2	5.6	6.0	6.3	6.8
Q(")	0.041	0.043	0.045	0.046	0.048	0.050	0.052	0.053	0.055
H(")	7.0	7.5	7.8	8.1	8.6	8.9	9.2	9.7	10.1
Q(")	0.056	0.058	0.059	0.060	0.062	0.063	0.064	0.066	0.067
H(")	10.4	10.7	11.3	11.6	11.9	12.3	12.6	13.0	13.3
Q(")	0.068	0.069	0.071	0.072	0.073	0.074	0.075	0.076	0.077
H(")	13.7	14.0	14.4	14.7	15.1	15.5	15.9	16.2	16.6
Q(")	0.078	0.079	0.080	0.081	0.082	0.083	0.084	0.085	0.086
H(")	17.0	17.4	17.8	18.2	18.6	19.0	19.4	19.8	20.2
Q(")	0.087	0.088	0.089	0.090	0.091	0.092	0.093	0.094	0.095
H(")	20.3	20.7	21.1	21.5	22.0	22.4	22.8	22.9	23.3
Q(")	0.095	0.096	0.097	0.098	0.099	0.100	0.101	0.101	0.102
H(")	23.8	24.2	24.7	24.8	25.2	25.7	26.1	26.2	26.7
Q(")	0.103	0.104	0.105	0.105	0.106	0.107	0.108	0.108	0.109
H(")	27.1	27.6	28.0	28.1	28.6	29.1	29.2	29.7	30.1
Q(")	0.110	0.111	0.112	0.112	0.113	0.114	0.114	0.115	0.116
H(")	30.6	30.7	31.2	31.7	31.8	32.3	32.8	32.9	33.4
Q(")	0.117	0.117	0.118	0.119	0.119	0.120	0.121	1.121	0.122
H(")	33.9	34.4	34.5	35.0					
Q(")	0.123	0.124	0.124	0.125					

where, $Q = 0.021.H^{\frac{1}{2}} + 1.916 \times 10^{-9} \times H^3$

38/—

The general view of total head losses of off-take P4S3L is shown as in fig.- 8

Fig.- 8. General view of total head losses of off-take



where, H : total head loss
(inlet + friction + outlet + orifice loss)

d) **Correlation between head loss and discharge.**

The total head loss and its discharge is shown in Fig. 9.

Hereby the positive optional numbers are given to a and b in the formula (1) as below, the correlation between head loss and it's discharge is shown as follows.

$$Q = c.H^{a} + d.H^{b} \qquad (1)$$

where, $a = 0.5$

$b = 3$

After using the program No. 1 for HP34C, the expression (1) is shown as below.

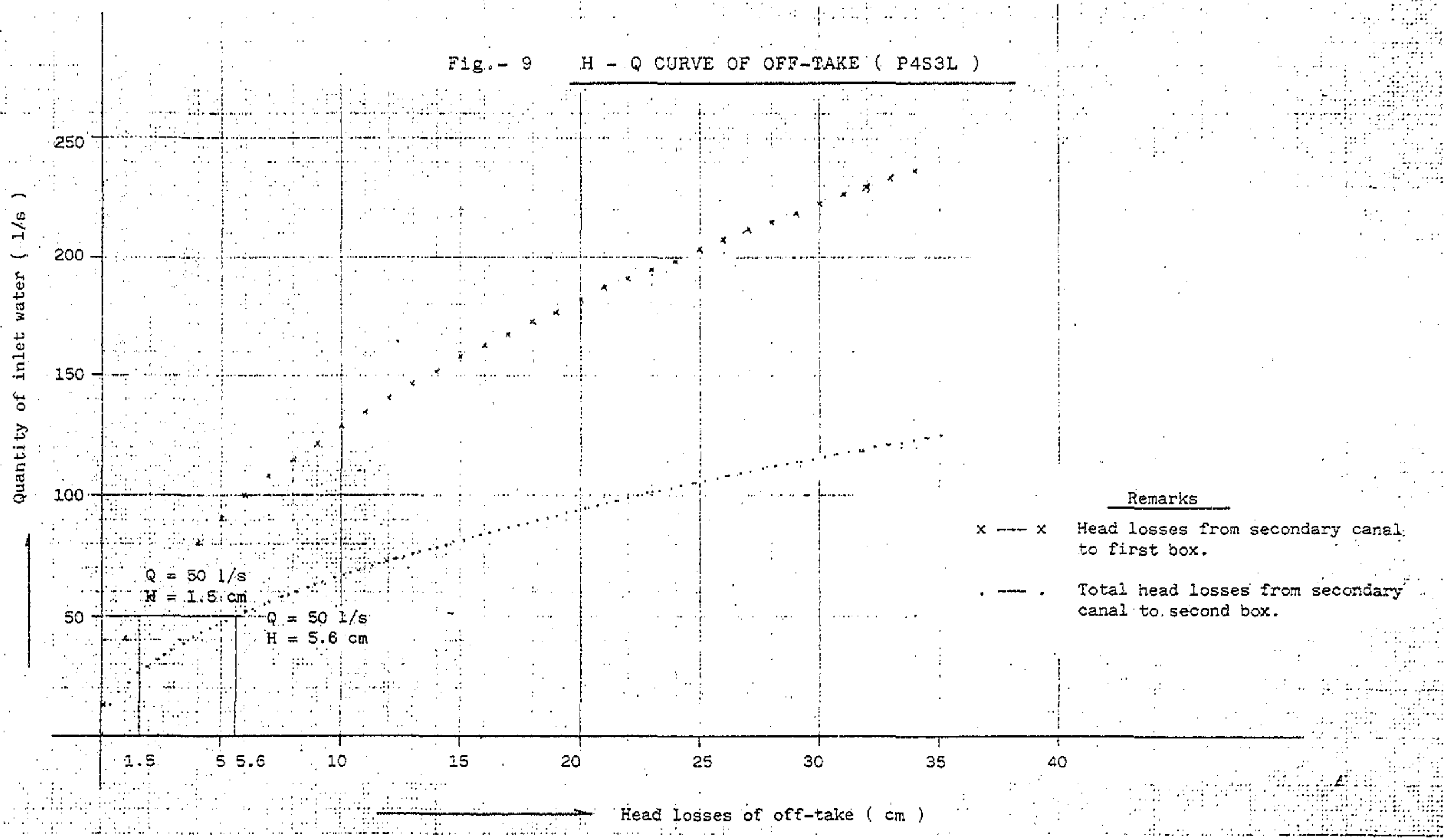
$$Q = 0.021.H^{\frac{1}{2}} + 1.916 \times 10^{-9} \times H^{3} \qquad (2)$$

where, dimension of H: cm,
Q: m^3/sec.

Fig.-9 shows the correlation of discharge and it's head losses, one is from secondary canal to first box of off-take and later is from secondary canal to secondary box i.e. it shows the total head losses of off-take P4S3L.

It is clear in Fig.-9, the submerged orifice cause big head loss for supply water level. If it is allowed to re-construct the off-take and assume the draw water $Q = 0.050\ m^3$/sec, the head loss will be able to decrease from 5.6 cm to 1.5 cm.

Fig.- 9 H - Q CURVE OF OFF-TAKE (P4S3L)



PROGRAM NAME Adoption of $Y = cX^a + dX^b$

PROGRAM NO 1
CODING DATE 02 . 12 .81

1) Schematic drawing

2) Purpose

This program is useful for finding the coefficient of c and d of the proposed formula as below.

$$Y = cX^a + dX^b$$

a and b can be given as positive optional numbe

3) Exercise

xi	1	4	9	16	a = 0.5
yi	9	-44	-699	-4056	b = 3

$$Y = 10X^{1/2} - X^3$$

4) Program list

Coded by : Shin IMAI

00	f.PRGM		16	g. ↓	15 22	32	$g.x^2$	15 03
01	h.LBL 0	25 13 00	17	X	61	33	STO+8	23 51 08
02	f.REG	14 33	18	STO+6	23 51 06	34	RCL 9	24 09
03	STO 2	23 02	19	CLx	34	35	$g.x^2$	15 03
04	x⇄y	21	20	h.LSTx	25 00	36	STO+7	23 51 07
05	STO 1	23 01	21	RCL 3	24 03	37	1	1
06	h.RTN	25 12	22	RCL 2	24 02	38	STO+0	23 51 00
07	h.LBL 1	25 13 01	23	$h.y^x$	25 03	39	RCL 0	24 00
08	x⇄y	21	24	STO 9	23 09	40	h.RTN	25 12
09	STo 3	23 03	25	X	61	41	h.LBL 2	25 13 02
10	RCL 1	24 01	26	STO+4	23 51 04	42	RCL 8	24 08
11	$h.y^x$	25 03	27	CLx	34	43	RCL 4	24 04
12	↑	31	28	RCL 9	24 09	44	X	61
13	↑	31	29	X	61	45	RCL 6	24 06
14	g. ↓	15 22	30	STO+5	23 51 05	46	RCL 5	24 05
15	g. ↓	15 22	31	g. ↓	15 22	47	X	61

5) Operation step

Step	Contents	Input	Operation	OUtput	Step	Contents	Input	Operation	Outpu
01	Program key-in				11				
02	key-in of a&b	0.5	↑		12				
03	"	3	GSB 0	0.50	13				
04	key-in of data	xi	↑		14				
05	"	yi	GSB 1	i	15				
06	coefficient c		GSB 2	10.00	16				
07	" d		R/S	- 1.00	17				
08					18				
09					19				
10					20				

41/-

PROGRAM NO. 1

48	−	41	78	RCL 3	24 03	108		
49	RCL 7	24 07	79	X	61	109		
50	RCL 8	24 08	80	+	51	110		
51	X	61	81	h.RTN	25 12	112		
52	RCL 5	24 05	82	R/S	74	113		
53	g.x^2	15 03	83			114		
54	−	41	84			115		
55	÷	71	85			116		
56	STO 3	23 03	86			117		
57	RCL 5	24 05	87			118		
58	X	61	88			119		
59	RCL 6	24 06	89			120		
60	x ⇄ y	21	90			121		
61	−	41	91			122		
62	RCL 8	24 08	92			123		
63	÷	71	93			124		
64	STO 9	23 09	94			125		
65	R/S	74	95			126		
66	RCL 3	24 03	96			127		
67	h.RTN	25 12	97			128		
68	h.LBL3	25 13 03	98			129		
69	↑	31	99			130		
70	↑	31	100			131		
71	RCL 1	24 01	101			132		
72	h.y^x	25 03	102			133		
73	RCL 9	24 09	103			134		
74	X	61	104			135		
75	x ⇆ y	21	105			136		
76	RCL 2	24 02	106			137		
77	h.y^x	25 03	107			138		

6) Register list

R0	counter	R1	a	R2	b	R3	x, d
R4	$\Sigma yi \cdot xi^b$	R5	Σxi^{a+b}	R6	$\Sigma xi^a \cdot yi$	R7	Σxi^{2b}
R8	Σxi^{2a}	R9	xi^b, c	R.0		R.1	
R.2		R.3		R.4		R.5	
R(16)		R(17)		R(18)		R(19)	
R(20)		R(21)		R(22)		R(23)	
R(24)		R(25)		R(26)		R(27)	
R(28)		R(29)					

42/-

2) Determination of planning

After understanding the existing altitude/area conditions the lay-out of P/F No. 2 is shown in Fig.-10. It goes without saying that the lay-out should be considered not only the shortsighted view for one of the extensive rice cultivation in Malaysia but for the future plan of the promotion like a land consolidation scheme.

Thus the expected future plan is shown in Fig.-11. The area of these field lots are planned approximately 3,000 m^2, the independent irrigation/drainage canal are arranged for each field lot, the farm roads are running across whole area of P/F No. 2 and connected to existing kampong road. This means the farmers can use the road for their farming and after harvesting when they can transfer their paddy so easily.

The independent irrigation/drainage system is so that the time when the water management is established.

From a point of view of existing system the complete planning is very difficult to promote in Malaysia now, so at least necessary farm facilities are shown in Fig.-10 though it is still remain the lot-to-lot irrigation that is unavoidable.

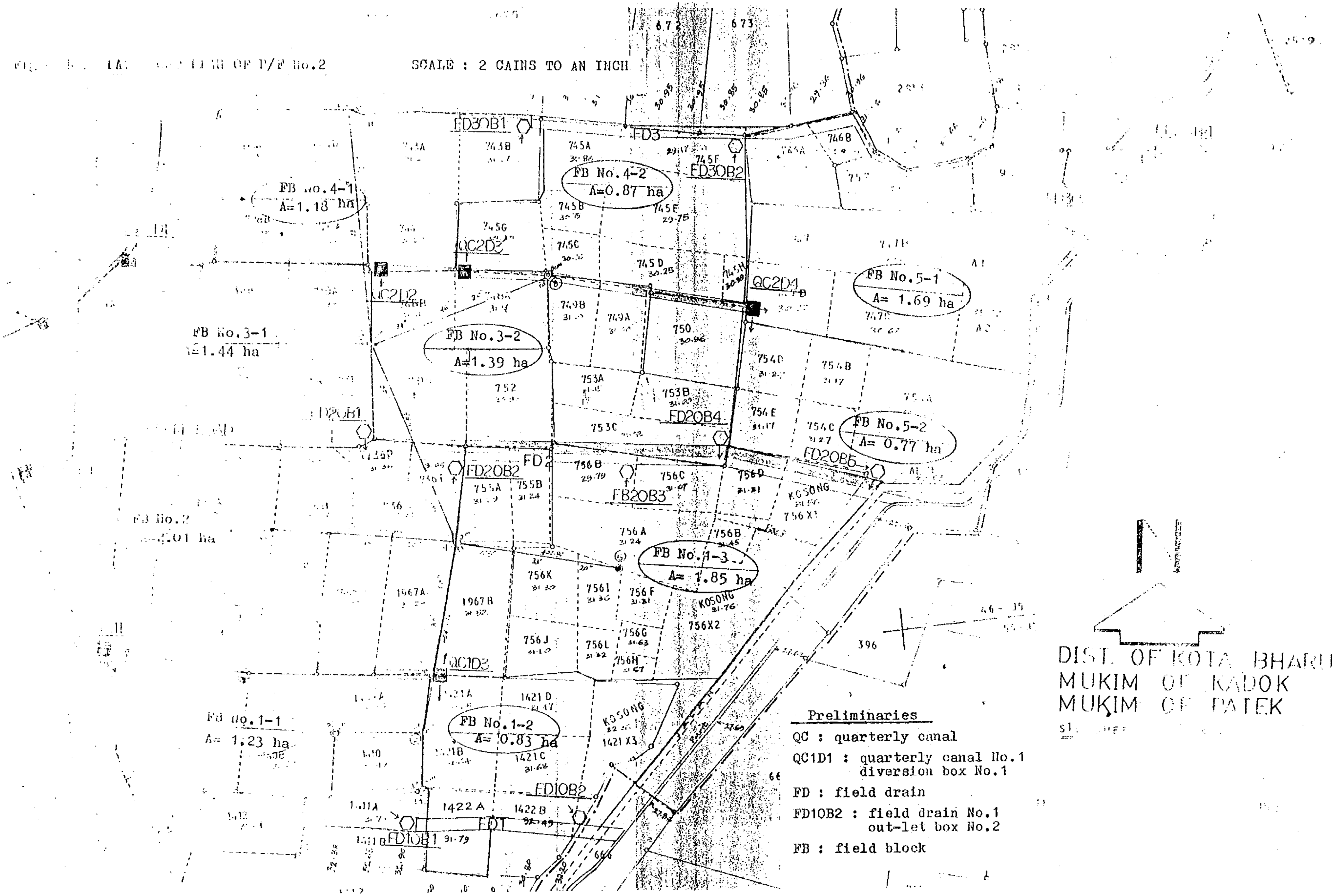
At any rate, the most important point is the facilities must be considered carefully because it is not allowed reconstruction so easily. Table-10, 11 shows the calculation of each field block area.

Table-10 Area of each field block

Field Block	Area (x 1,000 m^2)	Area (ha)	Area (acre)
1-1	12.251	1.23	3.03
1-2	8.325	0.833	2.06
1-3	18.518	1.852	4.58
2	20.094	2.01	4.97
3-1	14.370	1.44	3.55
3-2	13.890	1.39	3.43
4-1	11.778	1.18	2.91
4-2	8.745	0.87	2.13
5-1	16.970	1.697	4.19
5-2	7.733	0.773	1.91
Total	132.674	13.270	32.79

43/-

Fig. ... LAYOUT ... OF P/F No.2   SCALE : 2 CAINS TO AN INCH



Preliminaries

QC : quarterly canal
QC1D1 : quarterly canal No.1 diversion box No.1
FD : field drain
FD1OB2 : field drain No.1 out-let box No.2
FB : field block

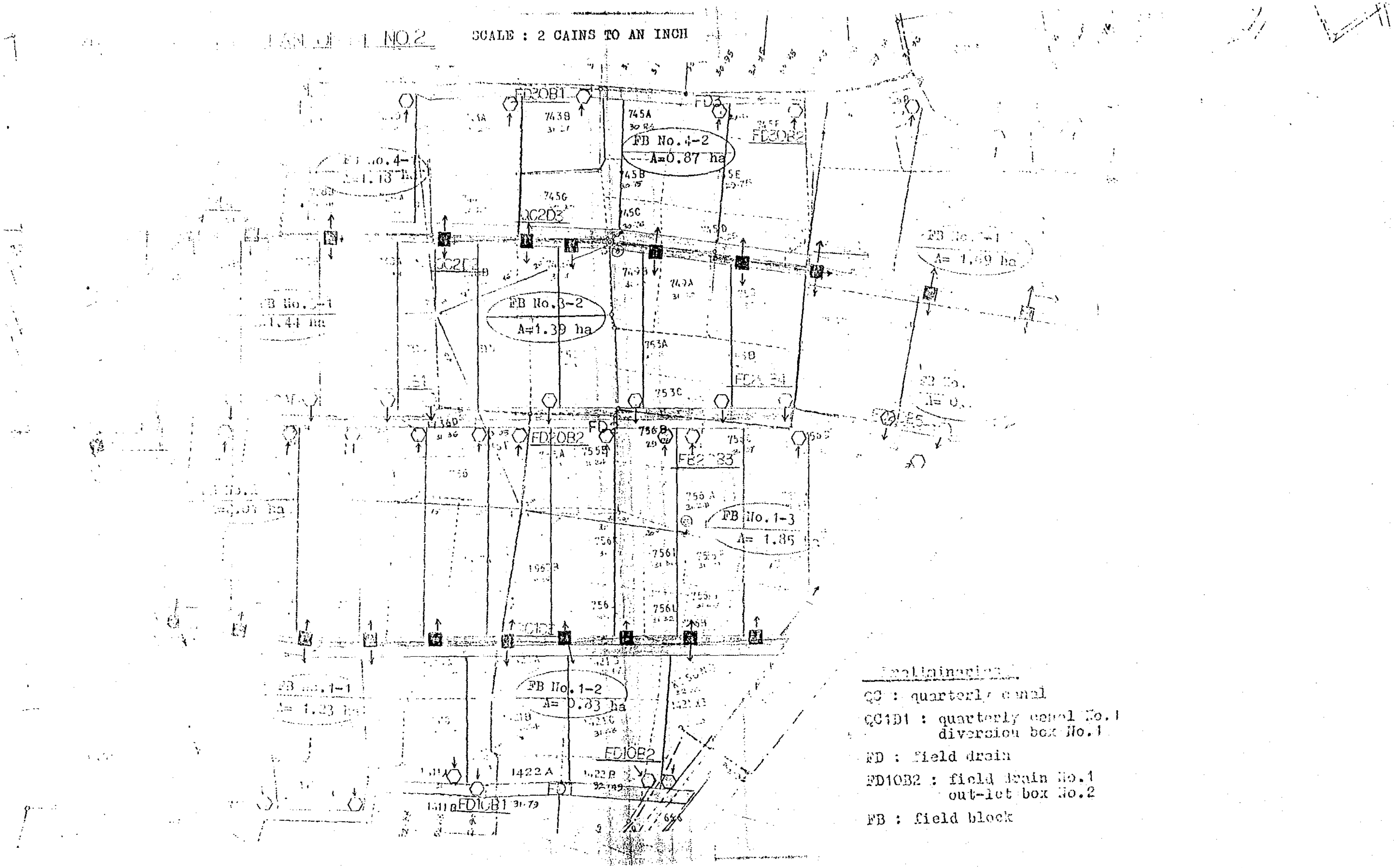

NO.2
SCALE : 2 CAINS TO AN INCH
FD2OB1
FD3
FD2OB2
FB No.4-2
A=0.87 ha
QC2D3
FB No.3-2
A=1.39 ha
FB No.1-3
A= 1.85
FB No. 1-2
A= 0.83 ha
FD10B2
FD1
FD1OB1
FB No. 1-1
A= 1.23
745A
745B
745C
745G
743B
749A
753A
753C
756B
756A
756
1422 A
quarterly canal
QC1D1 : quarterly canal No.1 diversion box No.1
FD : field drain
FD10B2 : field drain No.1 out-let box No.2
FB : field block

Table 11. Calculation of each field block area

Field Block	Lot No.	Area (x 1000m²)	Remarks
1-1 (11 lots)	10	0.522	
	27	0.869	
	28	0.928	
	30	1.054	higher than neighbour lots (+8.5 cm)
	40	1.107	
	41	1.372	
	42	1.344	
	52	1.186	
	53	1.146	
	90	1.030	
	total	12.251	
1-2 (6 lots + KOSONG)	63	0.948	
	91	1.186	
	92	0.762	
	64	1.310	
	65	0.948	
	66	1.206	
	KOSONG	1.965	
	total	8.325	
1-3 (15 lots + KOSONG)	58	1.008	
	59	0.863	
	60	1.919	
	61	1.169	
	62	0.897	
	73	1.031	lowest lot than neighbours (-39.0 cm)
	74	2.249	
	75	0.587	
	76	0.448	
	83	0.946	
	84	0.813	
	85	0.329	
	86	0.540	

	87	0.461	) higher than neighbour lots (+9.4 cm)
	88	0.220	) (+10.7 cm)
	KOSONG	5.038	4.762 + 0.276 = 5.038
	total	18.518	
2 (18 lots)	5	0.975	
	8	1.455	
	9	1.578	
	17	1.518	
	22	0.979	
	23	0.993	
	24	2.012	
	25	0.417	
	26	0.678	
	36	0.662	
	37	0.712	
	38	1.146	
	39	0.993	
	47	0.474	
	48	0.527	
	49	0.960	
	50	1.993	
	51	2.022	
	total	20.094	
3-1 (13 lots)	1	0.405	
	2	0.179	
	3	1.152	
	4	0.869	higher than neighbour lots (+ 5.8 cm)
	6	0.661	
	7	1.146	
	15	1.167	
	16	1.558	
	20	1.441	
	21	2.266	lower than neighbour lots (-6.7 cm)

47/-

	33	1.471	
	34	1.152	
	35	0.903	
	total	14.370	
3-2 (10 lots)	45	1.526	
	46	2.055	
	56	1.671	
	57	1.859	
	70	0.867	
	71	0.800	
	72	1.490	
	80	0.928	
	81	1.761	
	82	0.933	
	total	13.890	
4-1 (11 lots)	11	0.274	
	12	0.632	
	13	0.539	
	14	0.731	
	18	1.405	
	19	0.982	
	31	1.453	
	32	1.110	
	43	1.764	
	44	1.322	
	54	1.566	
	total	11.778	
4-2 (8 lots)	55	1.273	
	67	1.149	
	68	0.572	
	69	0.560	
	77	1.280	
	78	2.375	
	79	1.269	
	89	0.267	
	total	8.745	

5-1 (10 lot + kosong)	93	1.452	
	94	2.839	
	95	1.221	
	96	2.117	
	101	0.469	
	102	1.500	
	103	2.435	
	104	0.645	
	105	0.540	
	106	0.534	
	kosong	3.218	(0.331 + 0.649 + 0.275 + 0.527 + 0.193 + 0.580 + 0.683) = 3.218
	total	16.970	
5-2 (4 lot + kosong)	97	1.001	
	98	0.864	
	99	0.848	
	100	0.800	
	kosong	4.220	7.714 - (3.218 + 0.276) = 4.220
	total	7.733	
	TOTAL	132.674 = 13.3 ha	

3) Design of quarterly canal.

i) Present water supply plan in Kemubu Scheme

The water supply plan of each period in Off-Season/Main-Season is shown in Table-12.

Table-12: Present water supply plan in Kemubu Scheme.

	Period	Days in the Year	Height of water (in/Month)	Required Discharge	
				acre/cusec	l/s/ha
Off-Season	1. Presaturation Period	5	12	※1 60	※2 1.18
	2. Nursery Period Field Cultivation	25			
	3. Transplanting and Growing	95	8	89	0.8
	4. Water withdrawn	15	0		
	5. Harvesting and Fallow	40	0		
Main-Season	1. Presaturation Period	5	9	79	0.88
	2. Nursery Period Field Cultivation	25			
	3. Transplanting and Growing	95	8	89	0.8
	4. Water Withdrawn	15	0		
	5. Harvesting and Fallow	40	0		

This is clear from Table-12. that the peak water requirement of paddy field is during the Presaturation and Nursery/Field cultivation period i.e. 12 in/month.

The conversion of height of water into each dimension such as acre/cusec, l/s/ha is shown as follows.

※ 1 $$\frac{(12\text{ in}/12\text{ in}) \times A \times (4840^{\frac{1}{2}} \times 3)^2}{30\text{ days} \times 86400\text{ sec}} = 1\text{ cusec}$$

$A = 59.5 = 60$ acre

※ 2 $$\frac{0.3048^3}{59.5\text{ acre} \times 0.40469\text{ ha/acre}} = 0.00118\text{ m}^3/\text{sec/ha} = 1.18\text{ l/sec/ha}$$

$$\frac{12'' \times 0.0254\text{ m/in} \times 10000\text{m}^2}{30\text{ days} \times 86400\text{ sec}} = 0.00118 = 1.18\text{ l/sec/ha}$$

Table-13: Comparative table of Kemubu Scheme and others

	Period	Kemubu Scheme				DID MANUAL				MUDA (Tanah Merah)				DID information No.2
		Days/ Year	in/ Month	acre/ cusec	l/s/ha	Days/ Year	in/ Month	acre/ cusec	l/s/ha	Days/ Year	in/ Month	acre/ cusec	l/s/ha	
Off-Season	Presaturation Period	5	12	60	1.18	40	15	48	1.5	15	37.5	19	3.67	16-20 in
	Nursery Period	25												
	Field Cultivation													
	Transplanting and Growing	95	8	89	0.80		10	71	1.0		9.9	72	0.97	40-45 in
	Water Withdrawn	15	0											
	Harvesting & Fallow	40	0											
Main-Season	Presaturation Period	5	9	79	0.88	40	13	55	1.3					
	Nursery Period	25												
	Field Cultivation													
	Transplanting and Growing	95	8	89	0.80		9	79	0.9					
	Water Withdrawn	15	0											
	Harvesting & Fallow	40	0											

Accordingly, the total water requirement in Kemubu and DID information No. 2 are tabled below:-

Table-14: Total water requirement

Period	Kemubu Scheme	DID information No. 2
Presaturation Period	$12 \text{ in} \times \frac{5}{30} \times 0.0254 \times 100 = 5.1$ cm	16 in–20in =40.6–50.8cm
Nursery Period. Field Cultivation	$12 \text{ in} \times \frac{25}{30} \times 0.0254 \times 100 = 25.4$ cm	
Transplanting and Growing	$8 \text{ in} \times \frac{25}{30} \times 0.0254 \times 100 = 64.3$ cm	40in–45in=101.6–114.3cm
Total	94.8 cm	142.2–165.1

In this case, the water requirement in Kemubu Scheme is less than DID information No. 2 and others. There is no doubt that the water requirement will increase after improving the paddy field conditions as the promotion of independent irrigation and drainage system and shortening the presaturation period.

Therefore, it is better to look over again in the future through the water management practice in the Demonstration Farm and P/Fs which can give the actual data for double cropping rice cultivation.

ii) Supposition of the presaturation period and water requirement

Hereinafter, the presaturation period means the total days of the presaturation period, nursery period and field cultivation period.

This P/F No. 2 has an ability to get enough water due to the secondary canal which is located nearby, and the acreage is the smallest among the four P/Fs, therefore the presaturation period of P/F No. 2 is supposed to be within 9 days, that is, the shortest duration for the presaturation if compared with the other three P/Fs.

a) Determination of the water requirement

The assumed maximum water requirement for the rotational irrigation is shown as follows.

(1) according to the Kemubu schedule (No. 1)

$$Q_{max} = \frac{q \times 0.001 \times A \times 30}{T}$$

where, q: water requirement (l/s/ha) 1.18

A: presaturation area (ha) 13.27

T: presaturation period (days) 9

$$Q_{max} = \frac{1.18 \times 0.001 \times 13.27 \times 30}{9} = 0.052 \ m^3/sec$$

(2) also due to the Kemubu schedule (No. 2)

$$Q_{max} = \frac{H \times 0.0254 \times A \times 10^4}{T \times 86,400}$$

where, H: water requirement (in/month) 12

A: presaturation area (ha) 13.27

T: presaturation period (days) 9

$$Q_{max} = \frac{12 \times 0.0254 \times 13.27 \times 10^4}{9 \times 86400} = 0.052 \ m^3/sec$$

(3) water for puddling and supplementary water

$$Q_{max} = Q1 + Q2$$

$$Q1 = \frac{(S + H + E \times T) \times A \times 10^4}{86400 \times T}$$

$$Q2 = \frac{E \times L \times A1 \times 10^4 \times T}{86400 \times T}$$

where, Q1: water requirement for pudlling (m^3/sec)

Q2: water requirement for supplementary water (m^3/sec)

S: water requirement for saturation (m) 0.15

H: standing water layer (m) 0.10

E: evaporation (m) 0.004

T: presaturation period (days) 9

L: field losses (%) 20

A: presaturation area (ha) 13.27

A1: supplement area (ha) $13.27 - \frac{13.27}{9} = 11.80$

$$Q1 = \frac{(0.15 + 0.10 + 0.004 \times 9) \times 13.27 \times 10^4}{86400 \times 9} = 0.049 \ m^3/sec$$

$$Q2 = \frac{0.004 \times 11.80 \times 10^4 \times 9}{86,400 \times 9 \times 0.8} = 0.007 \ m^3/sec$$

$$Q_{max} = Q1 + Q2$$

$$= 0.049 + 0.007 = 0.056 \ m^3/sec.$$

These three formula show the mostly the same water requirement for presaturation, however the presaturation period of each rotational field block will be rounded to one day unit therefore these maximum water requirement seem too big.

Hereinafter the maximum water requirement is assumed as below:-

$$Qmax = 0.050\ m^3/sec$$

Consequently, the presaturation period will be finished within 9 days in accordance with approximately Qmax = 0.050 m^3/sec of the water requirement.

iii) Determination of supply water level.

Now, the water level control in the secondary canal is supervised by KADA, however it is not always kept up to the F.S.L. whenever the farmers want the water for the presaturation. As the result of the water level investigation using the water level recorder, normally the water level is below the F.S.L. by 5.0 cm. Therefore it is better to consider the reasonable water level is 5.0 cm below the F.S.L, that is, normal supply water level is shown below:-

the F.S.L.	32.715 (ft)
below	0.005/0.3048 = 0.164 (ft)

$\therefore$ 32.715-0.164 = 32.551 (ft)

Ordinally supply water level is hereinafter referred to as "O.S.L".

When the water for the presaturation, that is Q=0.050 m^3/sec, the supply water level in the second box of off-take will decrease by 5.6 cm which is shown in table-9. This means the actual supply water level is shown below:-

O.S.L.	32.551 (ft)
below	0.056/0.3048 = 0.184 (ft)

$\therefore$ 32.551-0.184 = 32.367 (ft)

Actual supply water level is hereinafter referred to as "A.S.L".

(Arrangement)

the F.S.L.	32.715 (ft)	
the O.S.L	32.551 (ft)	below the F.S.L by 5.0 cm
the A.S.L	32.367 (ft)	below the O.S.L by 5.6 cm

4/-

The A.S.L is situated like this, however sometimes it will be happened that the water for presaturation is impossible to be drawn from the A.S.L due to the topographical conditions. In this case, it is necessary to provide dam up weir or otherwise change the O.S.L to the F.S.L or to reconstruct the offtake to solve the problems of head losses. Using like this trial, the rational design will be carried out.

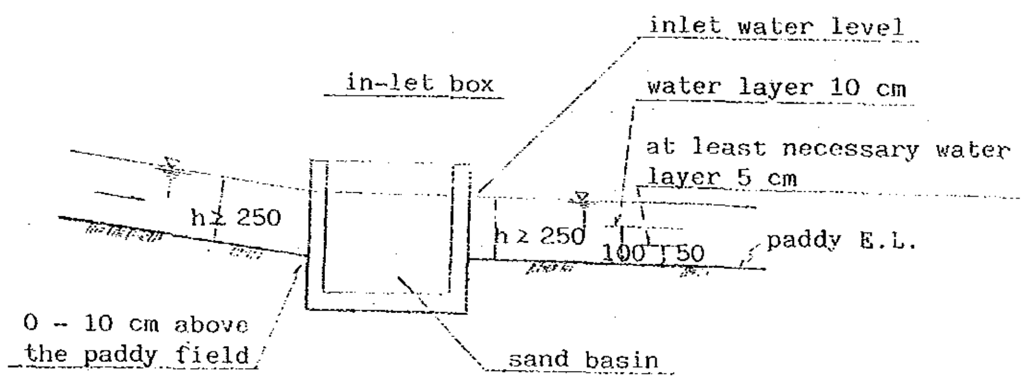
4) Design of QC1

i) Foundation height right near the inlet box.

It is said that the foundation height which is right near the inlet box should be situated 0–10 cm above the paddy ground, and the reasonable conveyed water depth is expected approximately 25 cm above the paddy ground.

Now, looking around the topographical conditions the water layer in the paddy field is decided at 10 cm, though the supposed water layer is expected to be 5 cm. And also, if the assumed conveied water depth is given in 25 cm from the paddy ground, the general view of QC1 which is right near the inlet box is shown in Fig.-12.

Fig-12. General view of QC1 which is situated right near the inlet box.



Adapting this criteria to present conditions the highest position of water elevation is shown below:-

the A.S.L	32.37 (ft)	below the O.S.L by 5.6 cm
paddy field elevation	31.65 (ft)	end of QC1
conveied water depth	0.82 (ft)	0.25/0.3048
water level in paddy field	32.47 (ft)	31.65 + 0.82 (ft)

In this case, the water level in paddy field is higher then the A.S.L, that is, it is impossible to get the water from QC1.

Regarding this fact, if the upper limit of the water level in paddy field is assumed to 32.365 (ft), that is, almost same water level to the A.S.L, the water slope is given as follows.

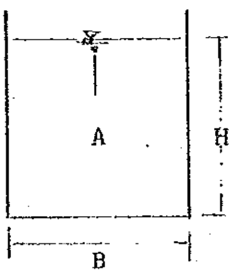
$$(32.37 - 32.365) \times 0.3048/361.9 = \frac{1}{237\,467}$$

where, The distance of QC 1 is assumed
L = 361.9 m

ii) Calculation of the most effective cross-section (case 1)

In this conditions the most effective cross-section of QC1 is given as follows.

Now, the function f(H) regards H, that is, the water depth in the QC1 is shown below:-



$$A = B.H$$

$$P = 2.H + B$$

$$R = B.H/(2.H + B)$$

$$Q = A.V$$

$$= B.H.\frac{1}{n}.\left(\frac{B.H}{2.H+B}\right)^{2/3}.I^{\frac{1}{2}}$$

$$Q^3 = (B.H)^3.\left(\frac{1}{n}\right)^3.\left(\frac{B.H}{2.H+B}\right)^2.I^{3/2}$$

$$\frac{Q^3}{\left(\frac{1}{n}\right)^3.I^{3/2}} = \frac{(B.H)^5}{(2.H + B)^2}$$

$$(4.H^2+4.B.H+B^2).Q^3 = B^5.H^5.\left(\frac{1}{n}\right)^3.I^{3/2}$$

$$f(H) = H^5 - \frac{4.Q^3}{B^5.\frac{1}{n^3}.I^{3/2}}.H^2 - \frac{4.B.Q^3}{B^5.\frac{1}{n^3}.I^{3/2}}.H - \frac{B^2.Q^3}{B^5.\frac{1}{n^3}.I^{3/2}} = 0 \quad ...(1)$$

Now, replace the (1) expression to Horner's method the f(H) is shown below:–

$$f(H) = ((((H-0)H-0)H- \frac{4.Q^3}{B^5.\frac{1}{n^3}.I^{3/2}})H- \frac{4.B.Q^3}{B^5.\frac{1}{n^3}.I^{3/2}})H-$$

$$\frac{B^2.Q^3}{B^5.\frac{1}{n^3}.I^{3/2}} = 0 \quad \ldots \quad (2)$$

The program No. 2 is shown the analysis to get the coefficient in the expression (2) for HP34C. Each water depth in the QC1 is given by the program No. 3 that follows the program No. 2.

The result of the calculation using program No. 2 and No. 3 is shown in Table-15. This is clear from table-15, the most effective cross-section is given when the width of QC1 is 1.25 m.

On the other hand, if it is necessary to adjust the foundation height to paddy field elevation therefore, the width of QC1 becomes 4.9 m.

However, both of them are not fit in with the reality because of the land for the facilities must be prepared wider width of land has to be provided. The longitudinal section in case of the width of QC1 by 1.25 m is shown in Fig.-13 and the cross-section is also shown in Fig-14. Fig-15 shows the cross-section that is given 4.9 m width to the QC1. Fig-16 shows the most effective cross-section in relation to width/wetted perimeter/depth.

Hereinafter, the each coefficient in the expression (2) is given as follows;-

$$A = 4.Q^3/(B^5.\frac{1}{n^3}.I^{½})$$

$$B = 4.B.Q^3/(B^5.\frac{1}{n^3}.I^{½})$$

$$C = B^2.Q^3/(B^5.\frac{1}{n^3}. I^{½})$$

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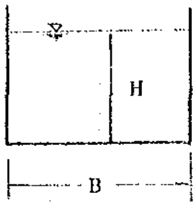
PROGRAM NAME	Calculation of uniform flow in the rectangular canal (NO.1)	PROGRAM NO	2
		CODING DATE	16 ,12 ,80

1) Schematic drawing



$f(H)=((((H-O)H-O)H-A)H-B)H-C=O$

2) Purpose

At first time, following number is given, that is, the quantity (Q), width (B), water slope (I)and coefficient of roughness (n), afterwards each coefficient of A,B and C is calculated every 0.05 m width continuously.

3) Exercise

$Q = 0.050\ m^3/s,\ n = 0.015,\ I^* = 237{,}467$

B = 1.25, A = 0.06399, B = 0.07999, C = 0.02500
B = 1.30, A = 0.05259, B = 0.06837, C = 0.02222
. . . .
. . . .

4) Program list Coded by : Shin IMAI

00	f.PRGM		16	RCL 1	24 01	32	$h.y^x$	25 03
01	h.LBL.A	25 13 11	17	3	03	33	f.√x	14 03
02	f.FIX.5	14 11 05	18	$h.y^x$	25 03	34	X	61
03	RCL 2	24 02	19	STO 5	23 05	35	X	61
04	.	73	20	RCL 2	24 02	36	STO 6	23 06
05	0	0	21	5	05	37	RCL 5	24 05
06	5	05	22	h,y^x	25 03	38	4	04
07	STO-2	23 41 02	23	↑	31	39	X	61
08	h.LBL 0	25 13 00	24	RCL 3	24 03	40	STO 7	23 07
09	.	73	25	3	03	41	RCL 5	24 05
10	0	0	26	$h.y^x$	25 03	42	RCL 2	24 02
11	5	05	27	h.1/x	25 02	43	X	61
12	STO+2	23 51 02	28	↑	31	44	4	04
13	RCL 2	24 02	29	RCL 4	24 04	45	X	61
14	h.PSE	25 74	30	h.1/x	25 02	46	STO 8	23 08
15	h.PSE	25 74	31	3	03	47	RCL 5	24 05

5) Operation step

Step	Contents	Input	Operation	OUtput	Step	Contents	Input	Operation	Outp
01	Program key-in				11	indicate next B			1.30
02	Q STO 1	0.050	STO 1		12	coefficient next A			0.05259
03	B STO 2	1.25	STO 2		13	" B			0.06837
04	n STO 3	0.015	STO 3		14	" C			0.02222
05	I STO 4	237,467	STO 4		15	continue			
06	calculation of A,B,C		A		16				
07	indicate B			1.25	17				
08	coefficient A			0.06399	18				
09	" B			0.07999	19				
10	" C			0.02500	20				

18/-

PROGRAM NO. 2

48	RCL 2	24 02	78			108	
49	2	02	79			109	
50	h.y^x	25 03	80			110	
51	X	61	81			112	
52	STO 9	23 09	82			113	
53	RCL 7	24 07	83			114	
54	RCL 6	24 06	84			115	
55	÷	71	85			116	
56	h.PSE	25 74	86			117	
57	h.PSE	25 74	87			118	
58	h.PSE	25 74	88			119	
59	h.PSE	25 74	89			120	
60	RCL 8	24 08	90			121	
61	RCL 6	24 06	91			122	
62	÷	71	92			123	
63	h.PSE	25 74	93			124	
64	h.PSE	25 74	94			125	
65	h.PSE	25 74	95			126	
66	h.PSE	25 74	96			127	
67	RCL 9	24 09	97			128	
68	RCL 6	24 06	98			129	
69	÷	71	99			130	
70	h.PSE	25 74	100			131	
71	h.PSE	25 74	101			132	
72	h.PSE	25 74	102			133	
73	h.PSE	25 74	103			134	
74	GTO 0	22 00	104			135	
75	h.RTN	25 12	105			136	
76			106			137	
77			107			138	

6) Register list

R0		R1	Q	R2	B	R3	n
R4	$\frac{I}{4.B.Q^3}$	R5	Q^3	R6	$B^5 \cdot \frac{1}{n^3} \cdot I^{\frac{3}{2}}$	R7	$4Q^3$
R8		R9	$B^2.Q^2$	R.0		R.1	
R.2		R.3		R.4		R.5	
R(16)		R(17)		R(18)		R(19)	
R(20)		R(21)		R(22)		R(23)	
R(24)		R(25)		R(26)		R(27)	
R(28)		R(29)					

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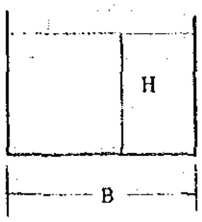
PROGRAM NAME	Caluculation of uniform flow in the rectangular canal (NO.2)	PROGRAM NO 3 CODING DATE 16 '12 '80

1) Schematic drawing



$f(H) = ((((H-0)H-0)H-A)H-B)H-C = 0$

2) Purpose

Using the coefficient of A,B and C which are calculated by program NO.2, the water depth (H) is able to get by this program.

3) Exercise

A = 0.06399
B = 0.07999 H = 0.632 m
C = 0.02500

4) Program list Coded by : Shin IMAI

00	f.PRGM		16	.	73	32		
01	h.LBLO	25 13 00	17	0	0	33		
02	0	0	18	7	07	34		
03	−	41	19	9	09	35		
04	X	61	20	9	09	36		
05	0	0	21	9	09	37		
06	−	41	22	−	41	38		
07	X	61	23	X	61	39		
08	.	73	24	.	73	40		
09	0	0	25	0	0	41		
10	6	06	26	2	02	42		
11	3	03	27	5	05	43		
12	9	09	28	−	41	44		
13	9	09	29	h.RTN	25 12	45		
14	−	41	30			46		
15	X	61	31			47		

5) Operation step

Step	Contents	Input	Operation	OUtput	Step	Contents	Input	Operation	Outp:
01	Program key-in				11				
02	assumed water depth	0.6	0.6		12				
03	"		↑		13				
04	"		↑		14				
05	"		↑		15				
06	calculation of H		f.SOLVE 0	0.632	16				
07					17				
08					18				
09					19				
10					20				

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Table-15: The most effective cross-section of QC1 (Case 1)

B (m)	A	B	C	H(m)	F(m)	F(ft)
0.60	2.51126	1.50676	0.22601	1.531	3.662	32.342
0.65	1.68299	1.09394	0.17777	1.371	3.392	27.867
0.70	1.16187	0.81331	0.14233	1.323	3.346	28.024
0.75	0.82289	0.61717	0.11572	1.134	3.018	28.645
0.80	0.59593	0.47675	0.09535	1.045	2.890	28.937
0.85	0.44010	0.37409	0.07949	0.969	2.788	29.186
0.90	0.33070	0.29763	0.06697	0.905	2.710	29.396
0.95	0.25237	0.23975	0.05694	0.802	2.554	29.734
1.00	0.19528	0.19528	0.04882	0.802	2.604	29.734
1.05	0.15300	0.16065	0.04217	0.759	2.568	29.875
1.10	0.12125	0.13338	0.03668	0.722	2.544	29.996
1.15	0.09709	0.11165	0.3210	0.689	2.528	30.105
1.20	0.07848	0.09417	0.02825	0.657	2.518	30.203
1.25	0.06399	0.07999	0.02500	0.632	2.514	30.292
1.30	0.05259	0.06837	0.02222	0.608	2.516	30.370
1.35	0.04355	0.05879	0.01984	0.586	2.522	30.442
1.40	0.03631	0.05083	0.01779	0.566	2.532	30.508
1.45	0.03047	0.04418	0.01601	0.548	2.546	30.567
1.50	0.02572	0.03857	0.01446	0.531	2.562	30.623
1.55	0.02183	0.03383	0.1311	0.515	2.581	30.675
1.60	0.01862	0.02980	0.01192	0.501	2.602	30.721
1.65	0.01597	0.02635	0.01087	0.487	2.624	30.767
1.70	0.01375	0.02338	0.00994	0.487	2.674	30.767
1.75	0.01190	0.02082	0.00911	0.463	2.676	30.846
1.80	0.01033	0.01860	0.00837	0.452	2.704	30.882
1.85	0.00901	0.01667	0.00771	0.442	2.734	30.915
1.90	0.00789	0.01498	0.00712	0.432	2.764	30.948
1.95	0.00693	0.01351	0.00658	0.423	2.796	30.977
2.00	0.00610	0.01220	0.00610	0.414	2.829	31.007
2.05	0.00539	0.01106	0.00567	0.406	2.862	31.033
2.10	0.00478	0.01004	0.00527	0.398	2.896	31.059
2.15	0.00425	0.00914	0.00491	0.391	2.932	31.082

2.20	0.00379	0.00834	0.00458	0.384	2.965	31.105
2.25	0.00339	0.00762	0.00429	0.377	3.005	31.128
2.30	0.00303	0.00698	0.00401	0.371	3.042	31.148
2.35	0.00272	0.00640	0.00376	0.365	3.080	31.167
2.40	0.00245	0.00589	0.00353	0.359	3.118	31.187
2.45	0.00221	0.00542	0.00332	0.353	3.157	31.207
2.50	0.00200	0.00500	0.00312	0.348	3.196	31.223
2.55	0.00181	0.00462	0.00294	0.343	3.236	31.240
2.60	0.00164	0.00427	0.00278	0.338	3.276	31.256
2.65	0.00149	0.00396	0.00262	0.333	3.316	31.272
2.70	0.00136	0.00367	0.00248	0.329	3.357	31.286
2.75	0.00124	0.00341	0.00235	0.329	3.497	31.286
2.80	0.00113	0.00318	0.00222	0.320	3.440	31.315
2.85	0.00104	0.00296	0.00211	0.316	3.481	31.328
2.90	0.00095	0.00276	0.00200	0.312	3.524	31.341
2.95	0.00087	0.00258	0.00190	0.308	3.566	31.355
3.00	0.00080	0.00241	0.00181	0.305	3.609	31.364
3.05	0.00074	0.00226	0.00172	0.301	3.652	31.377
3.10	0.00068	0.00211	0.00164	0.297	3.695	31.391
3.15	0.00063	0.00198	0.00156	0.294	3.738	31.400
3.20	0.00058	0.00186	0.00149	0.291	3.782	31.410
3.25	0.00054	0.00175	0.00142	0.288	3.826	31.420
3.30	0.00050	0.00165	0.00136	0.285	3.870	31.430
3.35	0.00046	0.00155	0.00130	0.282	3.914	31.440
3.40	0.00043	0.00146	0.00124	0.279	3.958	31.450
3.45	0.00040	0.00138	0.00119	0.276	4.002	31.459
3.50	0.00037	0.00130	0.00114	0.273	4.046	31.469
3.55	0.00035	0.00123	0.00109	0.271	4.092	31.476
3.60	0.00032	0.00116	0.00105	0.268	4.136	31.486
3.65	0.00030	0.00110	0.00100	0.265	4.180	31.496
3.70	0.00028	0.00104	0.00096	0.263	4.226	31.502
3.75	0.00026	0.00099	0.00093	0.261	4.272	31.509
3.80	0.00025	0.00094	0.00089	0.258	4.316	31.519
3.85	0.00023	0.00089	0.00086	0.256	4.362	31.525
3.90	0.00022	0.00084	0.00082	0.254	4.408	31.532

67/-

3.95	0.00020	0.00080	0.00079	0.251	4.452	31.542
4.00	0.00019	0.00076	0.00076	0.249	4.498	31.548
4.05	0.00018	0.00073	0.00073	0.247	4.544	31.555
4.10	0.00017	0.00069	0.00071	0.245	4.590	31.561
4.15	0.00016	0.00066	0.00068	0.243	4.636	31.568
4.20	0.00015	0.00063	0.00066	0.241	4.682	31.574
4.25	0.00014	0.00060	0.00064	0.240	4.730	31.578
4.30	0.00013	0.00057	0.00061	0.237	4.775	31.587
4.35	0.00013	0.00055	0.00059	0.236	4.822	31.591
4.40	0.00012	0.00052	0.00057	0.277	4.953	31.456
4.45	0.00011	0.00050	0.00055	0.232	4.914	31.604
4.50	0.00011	0.00048	0.00054	0.231	4.962	31.607
4.55	0.00010	0.00046	0.00052	0.229	5.008	31.614
4.60	0.00009	0.00044	0.00050	0.227	5.054	31.620
4.65	0.00009	0.00042	0.00049	0.226	5.102	31.624
4.70	0.00009	0.00040	0.00047	0.224	5.148	31.630
4.75	0.00008	0.00038	0.00046	0.223	5.196	31.633
4.80	0.00008	0.00037	0.00044	0.221	5.242	31.640
4.85	0.00007	0.00035	0.00043	0.220	5.289	31.643
4.90	0.00007	0.00034	0.00041	0.218	5.335	31.650
4.95	0.00007	0.00033	0.00040	0.216	5.383	31.656
5.00	0.00006	0.00031	0.00039	0.215	5.430	31.650
5.05	0.00006	0.00030	0.00038	0.214	5.478	31.663
5.10	0.00006	0.00029	0.00037	0.213	5.525	31.666
5.15	0.00005	0.00028	0.00036	0.211	5.573	31.673
5.20	0.00005	0.00027	0.00035	0.210	5.620	31.676
5.25	0.00005	0.00026	0.00034	0.209	5.668	31.679
5.30	0.00005	0.00025	0.00033	0.207	5.715	31.686

where, B: width of QC1
H: depth of QC1
P: wetted perimeter
F: foundation height
A, B, C: Coefficient

Fig-13: Longitudinal section by 1.25 m width of QC 1

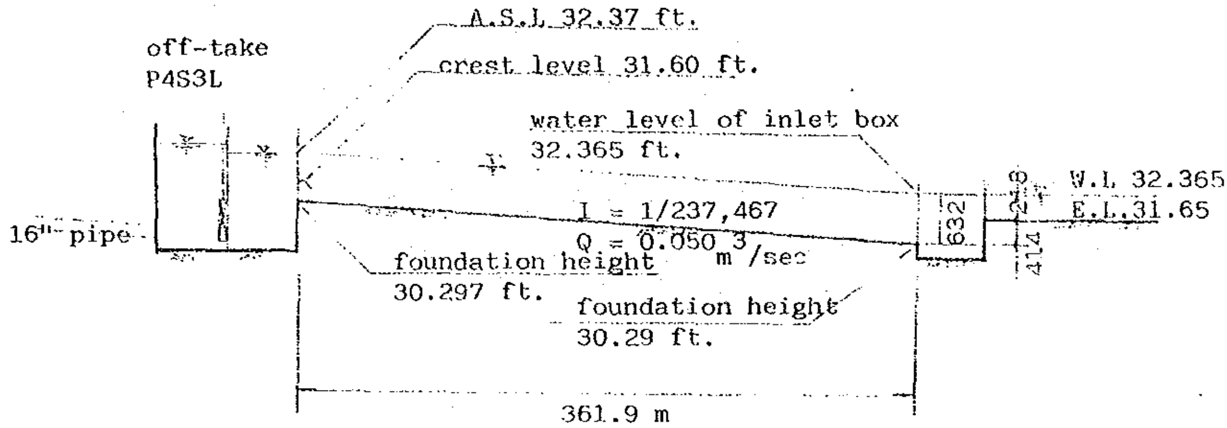
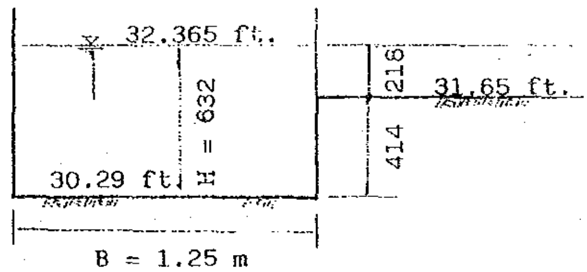


Fig-14: The most effective cross-section by 1.25 m width of QC 1



(Check accounts)

$A = 1.25 \times 0.632 = 0.790\ m^2$

$P = 1.25 + 0.632 \times 2 = 2.514\ m$

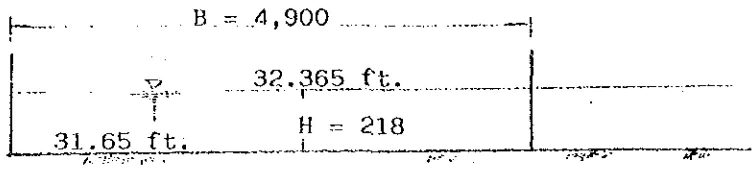
$R = 0.790/2.514 = 0.314\ m$

$R^{2/3} = 0.462$

$$V = \frac{1}{0.015} \times 0.462 \times \left(\frac{1}{237,467}\right)^{\frac{1}{2}} = 0.063\ m/sec$$

$Q = 0.790 \times 0.063 = 0.050\ m^3/sec$ .....O.K

Fig-15: Cross-section by 4.9 m width of QC 1



iii) Calculation of the most effective corss-section (case 2)

thus, in this design the water slope should be given more steep than before up to the limitage by 10 cm above the paddy ground, that is, the water slope is given as below:-

the A.S.L	32.37 (ft)	below the O.S.L by 5.6 cm
paddy field elevation	31.65 (ft)	end of QC 1
conveied water depth	0.33 (ft)	0.10/0.3048
water level in paddy field	31.98 (ft)	31.65 + 0.33

$$I = \frac{(32.37 - 31.98) \times 0.3048}{361.9} = \frac{1}{3050}$$

the most effective cross-section on this conditions is shown as follows.

Table-16 : The most effective cross section of QC 1 (case 2)

B (m)	A	B	C	H (m)	P (m)	F (ft)
0.45	0.01540	0.00693	0.00078	0.347	1.144	30.842
0.50	0.00910	0.00455	0.00057	0.310	1.120	30.963
0.55	0.00565	0.00311	0.00043	0.281	1.112	31.058
0.60	0.00366	0.00219	0.00033	0.258	1.116	31.134
0.65	0.00245	0.00159	0.00026	0.239	1.128	31.196

the most effective cross-section is clear in Tab-16, that is, the wetted perimeter is given the smallest number when the width of QC1 is given 0.55 m.

Fig.- 16 Graph of The Most Effective Cross-section in Relation to Width/Wetted Perimeter and Depth

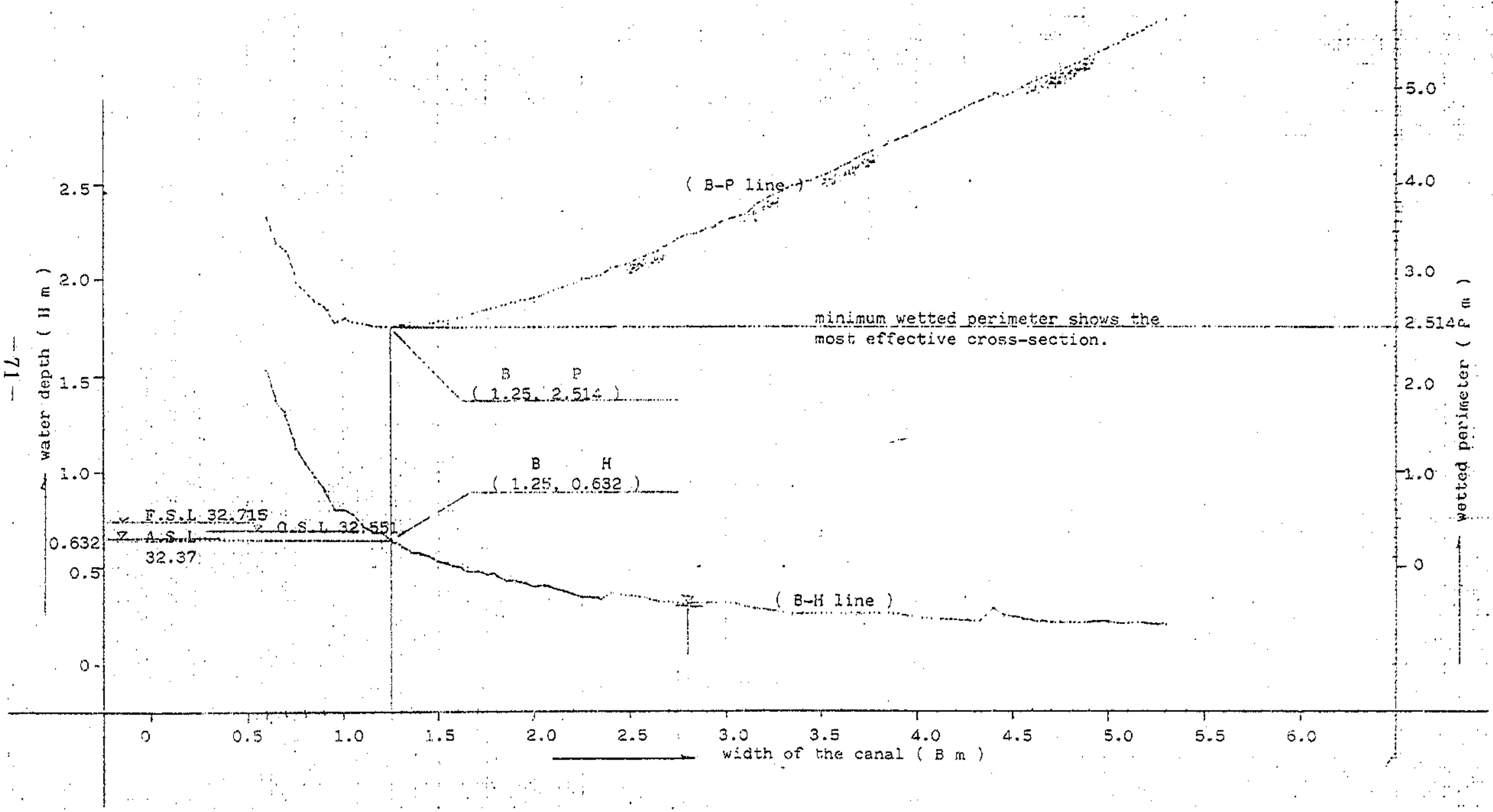


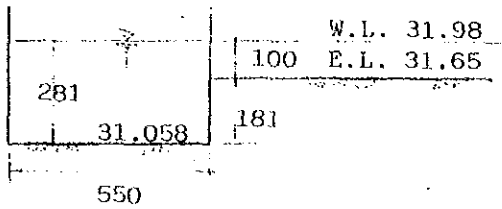
Fig-17. shows the cross-section by 0.55 m width of QC 1

(check accounts)

$A = 0.55 \times 0.281 = 0.155 \ m^2$

$P = 0.281 \times 2 + 0.55 = 1.112 \ m$

$R = 0.155/1.112 = 0.139 \ m$



$R^{2/3} = 0.269$

$V = \frac{1}{0.015} \times 0.269 \times \left(\frac{1}{3,050}\right)^{\frac{1}{2}} = 0.325 \ m/sec.$

$Q = 0.155 \times 0.325 = 0.050 \ m^3/sec$ ...... o.k

the comparative table between the first conditions ($I = \frac{1}{237,467}$) and second conditions ($I = \frac{1}{3,050}$) is shown in table-17.

Table-17 Comparative table between case 1 and 2

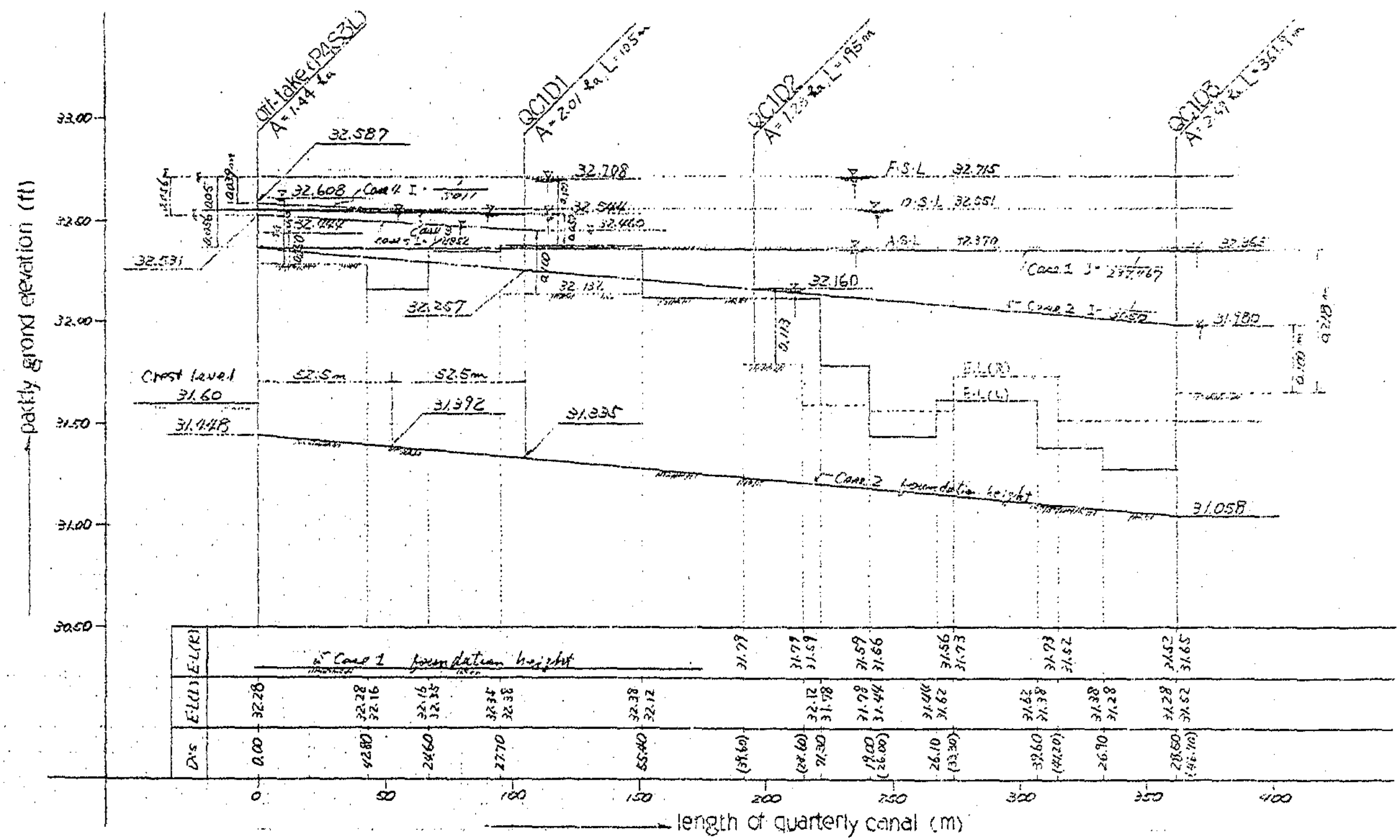
Conditions	Qmax (m^3/sec)	V (m/sec)	I	A.S.L	Water level of inlet (ft)
Case 1	0.050	0.063	$\frac{1}{237,467}$	32.37	32.365
Case 2	0.050	0.325	$\frac{1}{3,050}$	32.37	31.978

Conditions	paddy E.L (ft)	water layer (m)	under the paddy (m)	Area of canal(m^2)	secondary canal
Case 1	31.65	0.218	0.414	0.790	O.S.L
Case 2	31.65	0.100	0.181	0.155	O.S.L

iv) Calculation of the most effective cross-section (case 3 and 4) Fig-18 shows that QC1D2 and QC1D3 are satisfied to supply the water requirement, that is 0.050 m^3/sec.

However, at the point of QC1D1, it is impossible to get the water due to the topographical conditions, therefore the dam up weir should be considered.

Fig-18 : LONGITUDINAL SECTION AND DESIGN OF QC1



In this case if the water layer is given 10 cm, the water level in paddy field become 32.708 (ft.), that is, the level is almost same the F.S.L 32.715 (ft.).

Accordingly the water layer in the paddy field is supposed to be 5 cm which is the least necessary water depth for rice cultivation.

Now, assumed water quantity from the F.S.L and the O.S.L is shown below:-

the F.S.L	32.715 (ft)		Case 4
the O.S.L	32.551 (ft)	Case 3	Case 4
supply level to paddy field	32.544 (ft)	Case 3	Case 4

(Case 3)

$$(32.551-32.544) \times 0.3048 = 0.002 \text{ m.}$$

the assumed water quantity can get in table-9 that is:-

$$Q_{max} = 0.010 \text{ m}^3/\text{sec.}$$

(Case 4)

$$(32.715-32.544) \times 0.3048 = 0.052 \text{ m.}$$

the assumed water quantity can get equally:-

$$Q_{max} = 0.048 \text{ m}^3/\text{sec.}$$

So far, the A.S.L. is given 5.6 cm below the O.S.L which is considered the risk of water level control of secondary canal. however case 3 is too small to supply, therefore case 3 is rejected for the exception. Though the case 4 is from the F.S.L, in this case it is unavoidable and also the water level control of secondary canal to keep the F.S.L should be done during presaturation period, or otherwise it is difficult to supply water.

Now the foundation height is fixed by the 1/3050 water slope, however in this case the water slope is not the same. therefore the actual water quantity is calculated as follows.

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The longitudinal section from off-take (P4S3L) to QC1D1 is shown in Fig.- 19.

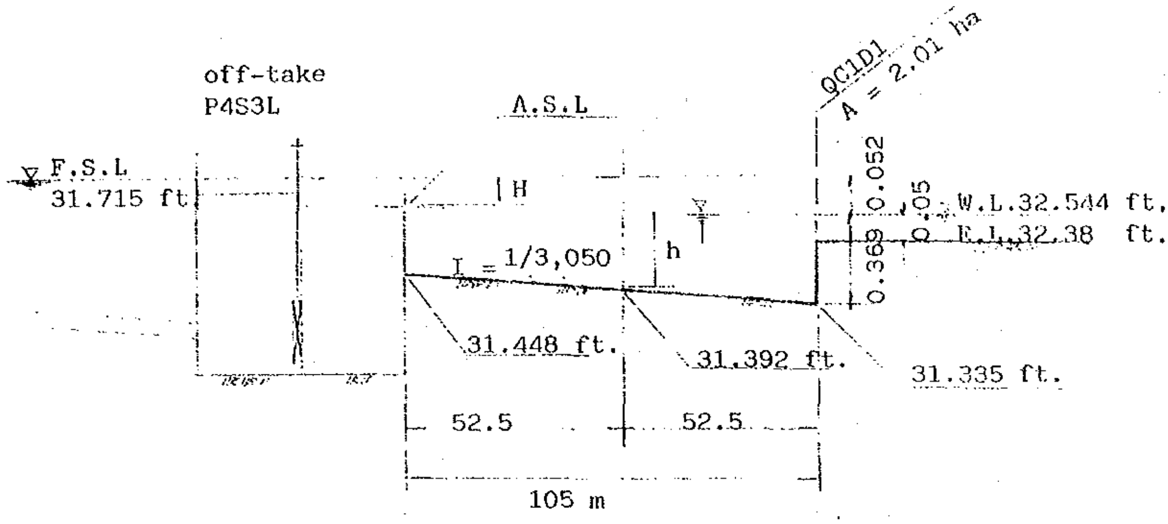


Table-18 shows the trial calculation to get the actual water quantity from the off-take (p4S3L).

--- note ---

79/-

Table-18 Trial calculation for dam up wair of QC1D1

assumed H (m)	A.S.L (ft)	water level in Paddy field (ft)	assumed Q (m^3/sec)	I	h(m)
0.050	32.551	32.544	0.047	1/49213	0.352
0.045	32.567	"	0.045	1/14978	0.355
0.040	32.584	"	0.042	1/8612	0.357
0.039	32.587	"	0.041	1/8011	0.358

assumed H (m)	A(m^2) 0.55 x h	P (m)	$R^{2/3}$	V(m/sec)	Q (m^2/sec)	Remarks
0.050	0.194	1.254	0.288	0.087	0.017	less
0.045	0.195	1.260	0.288	0.157	0.031	"
0.040	0.196	1.264	0.289	0.208	0.041	"
0.039	0.197	1.266	0.289	0.215	0.042	over

the actual water quantity is decided as below:-

Q = 0.042 m^3/sec < 0.050 m^3/sec.

On the other hand, this quantity shows less than the expected water requirement, that is 0.050 m^3/sec, however it is unavoidable due to the topographical conditions.

v) Regarding to the Field Block No. 3-1

Field Block No. 3-1 is situated to the direct supply area through the existing canal.

If the water layer in paddy field is given 10 cm, it is impossible to supply water from the O.S.L. thus, the water is taken from the F.S.L and the supply level to paddy field is shown below:-

paddy field elevation	32.28 (ft)	
water layer	0.164(ft)	0.05/0.3048
supply level	32.444(ft)	

the assumed water quantity from the F.S.L is shown below:-

the F.S.L.	32.715 (ft)	
supply level	32.444 (ft)	
difference	0.083 (m)	(32.715-32.444) x 0.3048

the assumed water can get in table-9, that is:-

$Q = 0.061\ m^3/sec.$

this means the water quantity is enough than expected one, that is, 0.050 m^3/sec, that seems suitable water requirement for the water management.

It seems good enough, only improve the existing intake facilities which is mole hole to P.V.C. pipe. The decision of the diameter of P.V.C pipe is carry on as follows.

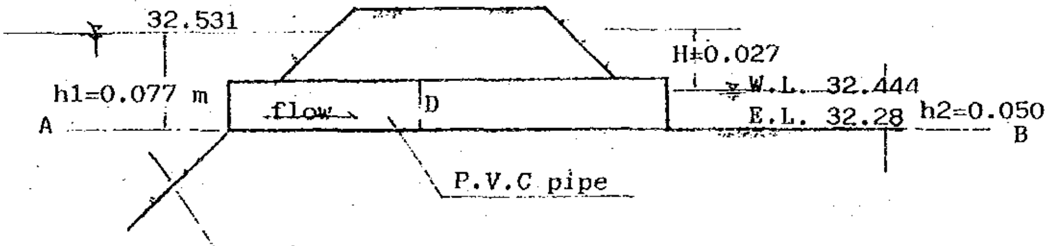
expected water quantity	$Q=0.050\ m^3/sec$	
it's head loss	H=0.056 m.	
the A.S.L	32.531 (ft)	32.715-0.056/0.3048
paddy field elevation	32.28 (ft)	
water layer	0.050 m	
water level in paddy field	32.444 (ft)	32.28+0.050/0.3048

the difference of head losses between the A.S.L and the water level in paddy field is:-

$H = (32.531 - 32.444) \times 0.3048 = 0.0265$ m

Fig-20 shows the cross-section of inlet facilities at Field Block NO. 3-1.

Fig-20: Cross-section of inlet facilities of Field Block No.3-1



The Bernoulli's theorem is applied to the line A-B and the balance is shown below:-

point	P/W	$V^2/2.g$	Z
A	$\frac{h1.W}{W}$	0	0
B	$\frac{h2.W}{W}$	$V^2/2.g$	0

$$h1 = h2 + \frac{V^2}{2.g}$$

$$V = \sqrt{2.g.(h1-h2)}$$

where, H = h1-h2

$$V = \sqrt{2.g.H}$$

thus velocity in the P.V.C. pipe is shown below:-

$$V = 2 \times 9.8 \times 0.027$$

$$= 0.727 \text{ m/sec}$$

there are five inlet facilities along the existing quartary canal therefore the average water quantity is expected $0.010 m^3/sec$. the diameter of the P.V.C. pipe is given as below.

$$Q = A.V$$

$$0.010 = A \times 0.727$$

$$D = \left(\frac{4 \times 0.010}{\pi \times 0.727} \right)^{\frac{1}{2}} = 0.132 \text{ m}$$

Accordingly the P.V.C. pipe diameter is decided to 6 inches.

vi) Arrangement of QCl

So far the most effective cross-section is decided in spite of the A.S.L is related to the F.S.L on the O.S.L, these facilities are arranged in table-19.

Table-19: Arrangement of QC1

name	Qmax (m^3/sec)	V(m/sec)	I	Conditions of Secondary Canal	Remarks
off-take direct	0.050	0.490	-	F.S.L	(32.531-31.60) x 0.3048 x 0.36 = 0.102m^2
QC1D1	0.042	0.215	1/8011	F.S.L	0.050/0.102 = 0.490 m/sec. (at crest)
QC1D2	0.050	0.325	1/3050	O.S.L	
QC1D3	0.050	0.325	1/3050	O.S.L	

It is clear in table-19, only the water quantity of QC1D1 is less than the expected discharge, that is 0.050 m^3/sec.

In this case, there are three considerations to correspond with this problem, that is:-

a) To decrease the paddy field elevation.

this means that only two field lots i.e. field number five and eight are higher than others in Field Block No. 2, therefore these two field lots elevation might be decreased to get the more steep water slope as case 5 in Fig-18.

At the same time, the expected water height in the in-let box should be kept 10 cm above the paddy elevation instead of the unavoidable height, that is 5 cm, in order to take the irrigation water as well as QC1D2 and QC1D3.

Table-20 shows the expected water slope as case 5 and its longitudinal section is shown in Fig-21.

Table-20: Expected water slope as Case 5.

A.S.L (ft)	X(ft)	I	H(m)	A(m^2)	P(m)	$R^{2/3}$	V(m/sec)	Q(m^3/sec)	Remarks
32.531	32.40	1/2630	0.327	0.180	1.204	0.282	0.367	0.066	0.050 m^3/sec
"	32.45	1/4253	0.335	0.184	1.220	0.283	0.289	0.053	0.050
"	32.46	1/4852	0.336	0.185	1.222	0.284	0.272	0.050	O.K
"	32.47	1/5647	0.338	0.186	1.226	0.284	0.252	0.047	0.050

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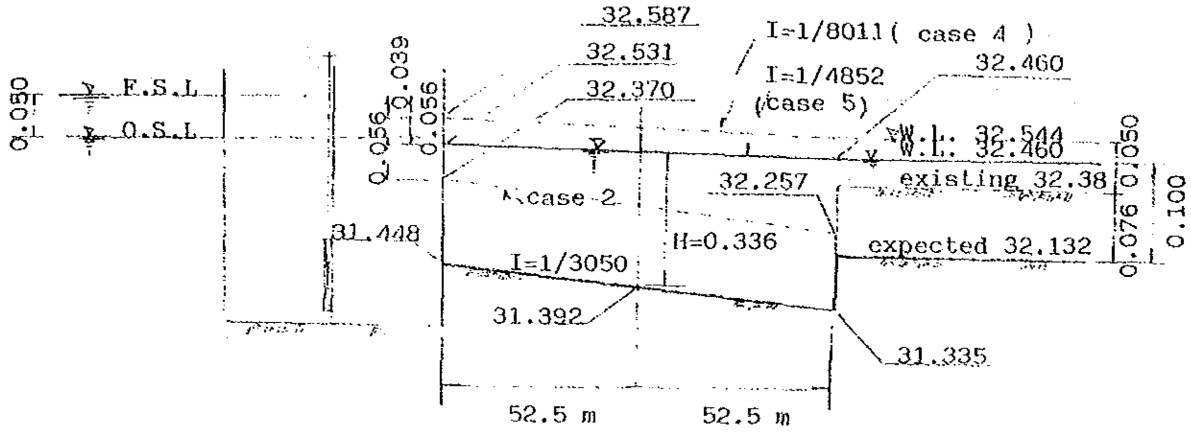
Fig-2': Expected longitudinal section as Case 5.



b) To postpone the duration of the presaturation period.

the maximum water discharge of QC1D1 is less than others, therefore one of the correspond with this problem is to postpone the presaturation period, that is, it will take more longer period to supply total water requirement into Field Block No. 3-1 due to the shortage of maximum discharge.

However, with a view to good water management like this system is not good as a rule, that is, Field Block No. 3-1 has an ability to take the expected water discharge as 0.050 m^3/sec after land levelling and the way of the water management should be under taken as well as same conditions for the farmers except from the unavoidable design due to the topographical conditions.

c) To re-construct the off-take in order to solve big head losses.

the off-take P4S3L has been constructed at the highest place of the Kadok district, therefore this off-take is always submerged as a result. The general longitudinal section between the Regulator R1S3L and R2S3L is shown in Fig-22.

It is clear that the design of secondary canal has constructed like a pond, that is, the water slope shows 1:51,017, on the other hand the topographical slope of existing paddy field is steeper than water slope.

Accordingly, the higher paddy field is always situated no good conditions to take the irrigation water due to the off-take has constructed standardized.

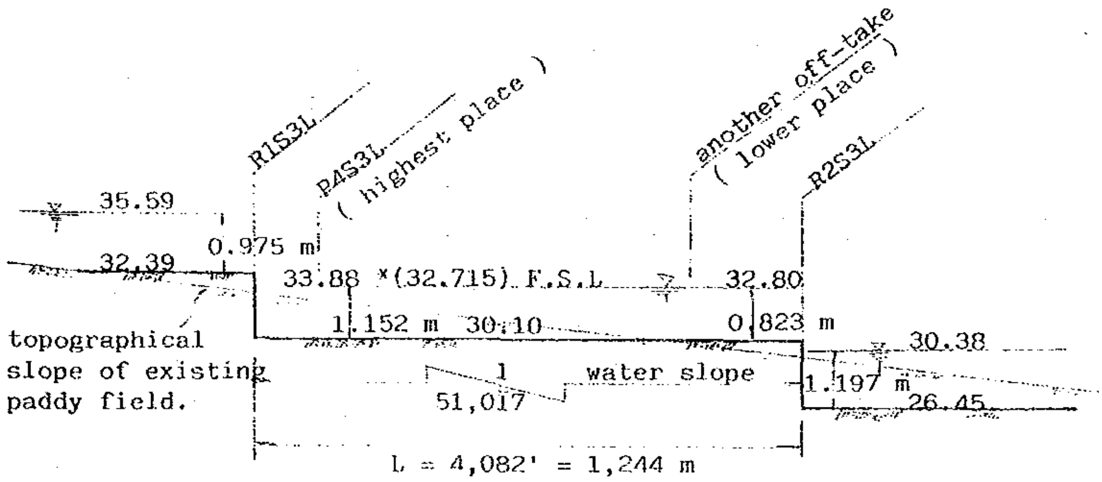
However, the existing scheme has counter measured against this problem to give smaller benefited land, that is the Kadok area where is covered by the off-take P4S3L is smaller than 60 acre/cusec which is the standard water requirement of Kemubu schedule in table-12.

As above-mentioned, if the presaturation period of P/F No. 2 is followed as well as the existing Kemubu schedule, that is 30 days, in this case it is not necessary to re-construct the off-take at all, however the P/F No. 2 is expected to improve the on farm facilities in order to demonstrate the well achieved water management systems to the farmers.

Consequently, the presaturation period of P/F No. 2 is expected around within 9 days and the assumed water requirement is supposed 0.050 m^3/sec.

The compared head losses between the design of P/F No. 2 and existing one is shown in table-21.

Fig-22. Longitudinal section between R1S3L and R2S3L



* actual F.S.L

Table-21: Comparative table of the head losses between the design of P/F No. 2 and existing one.

area	period 30 days	head losses	period 9 days	head losses
13.27 ha	1.18 x 13.27 ≒15.66 l/sec ↓ assumed requirement 15 l/sec	0.5 cm	1.18x 13.27x30/9 = 52.20 l/sec ↓ assumed requirement 50 l/sec	5.6 cm

The head losses of the presaturation period on 30 days is a very little, that is 0.5 cm , but after improved design the head losses shows as 5.6 cm which is especially caused by the submerged orifice of the off-take P4S3L.

So far, the most effective cross-section is calculated as case 1 to 5, however these calculation doesn't give the best solution against the problem of QC1D1, that is, the supply water level is still below and also the water layer in the paddy field is not deep enough to supply irrigation water from in-let box.

After re-construction of the off-take if submerged orifice is taken out, the head losses will decrease by 1.5 cm which is shown in table-6.

Hereby the most important thing is to recover the head losses eventhough 1 cm and things like that to lift up the A.S.L.

In addition, when looking around the off-take it is anticipated that the diversion box will be occupied the farmers own land too much if it will be constructed without re-construction of the off-take.

Accordingly, the re-construction of the off-take is expected to carry out the foundemental solution of these problems.

vii) Calculation of the most effective cross-section (case 6 and 7)

Now, the most effective cross-section which is after re-construct the off-take, is carried out as follows.

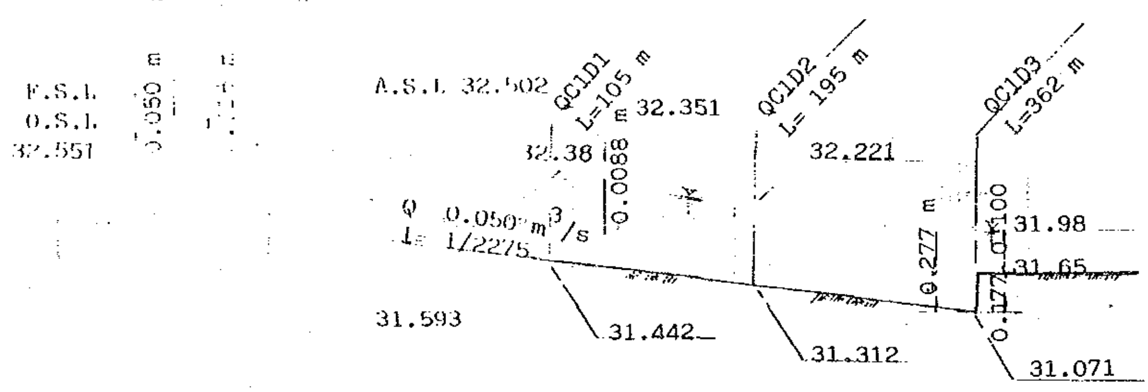
Hereby the case 6 and 7 is thought as below:-

Case 6: the most effective cross-section when the A.S.L is given 1.5 cm below the O.S.L and the supply level of in-let box is 10 cm above the paddy elevation.

Case 7: the most effective cross-section when the water slope is sifted up 4.1 cm parallel to the water slope of case ...

the longitudinal section of case 6 is shown in Fig-23, and case 7 is in Fig-25.

Fig-23: longitudinal section of case 6.



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The water slope of case 6 is given as below:-

$$\frac{(32.502-31.98) \times 0.3048}{362} = \frac{1}{2,275}$$

The most effective cross-section is calculated using the program No. 2 and No. 3 and the result is tabled as below.

Table-22: The most effective cross-section of Case 6.

B(m)	A	B	C	H(m)	P(m)	F (ft)
0.30	0.07535	0.02261	0.00170	0.503	1.306	30.330
0.35	0.03486	0.01220	0.00107	0.413	1.176	30.625
0.40	0.01788	0.00715	0.00072	0.353	1.106	30.822
0.45	0.00992	0.00447	0.00050	0.309	1.068	30.966
0.50	0.00586	0.00293	0.00037	0.277	1.054	31.071
0.55	0.00364	0.00200	0.00028	0.252	1.054	31.153
0.60	0.00235	0.00141	0.00021	0.231	1.062	31.222
0.65	0.00158	0.00103	0.00017	0.216	1.082	31.271

where,
- B: width of QCl
- H: depth of QCl
- P: wetted perimeter
- F: foundation height
- A, B, C: coefficient

Consequently, the most effective cross-section is given to 0.5 m width of QCl and Fig-24 shows its cross-section.

Fig-24: Cross-section by 0.50 width of QCl