Technical Report No. CP-1

REPORT ON WATER MANAGEMENT EXPERIMENT CHAO PHYA PILOT PROJECT

MAMORU FUKUDA

IRRIGATION & DRAINAGE EXPERT

MARCH 1985

THAI IRRIGATED AGRICULTURE DEVELOPMENT PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

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Content

Preface

I have a pleasure to submit this brief report to conclude the activity during my assignment from Dec.3, 1982 to Mar.31, 1985 in the Chao Phya Pilot Project.

Since I had come to the Project, I have been concerned with not only Irrigation & Drainage but also other various kinds of jobs in the field of the agricultural engineering defined in broad sense in Japan. In this report, I mainly deal with the topics about irrigation. When I came here, the land consolidation had roughly finished in the whole of the Pilot area. As the predecessors had left only to point the problem about irrigation, besides someone pointed the problem qualitatively from his view point; I have been grasping the problem and trying to describe quantitatively the result derived from the activities in the area even though I got rough ones.

I believe that through cooperation activity the result from experiment, observation or calculation described numerically gives explanation impersonally and that anyone may compare the result with other reference easily. I compiled this owing to the counterparts' and technicians' labourious work.

I hope that the experience of the activities we have done in cooperation becomes any of use with regard to the idea, principle, method etc. in the future.

March 1985

Mamoru Fukuda
Irrigation & Drainage

Acknowledgement

I should like to express my thanks to the counterparts and technicians mentioned below for their cooperation activities of the field work in the Pilot area.

Mr. Wuthipong	Somanus	Counterpart	Dec.1982-Mar.1983
Mr. Thirawat	Witthayasin	Counterpart	Apr. - Sept. 1983
Mr. Prathuang	Noo-wanna	Technician	Apr. - Sept. 1983
Mr. Somsak	Nimitchitpakdee	Technician	Apr. - Sept. 1983
Mr. Udom	Wisetraksakul	Technician	Apr. - Sept. 1983
Mr. Chanchai	Atiwannapat	Counterpart	Jan.1984-continue
Mr. Sunthipong	Kongphao	Technician	Jan.1984-continue

I also express my thanks to the Thai staffs in the office at the Project site and other Japanese Experts concerned C.P.P.P. for their daily cooperation activities.

1. General description

1.1 Geological and geographical condition

The Chao Phya Pilot Project is located in the West Bank Tract of the Chao Phya River, about 70 Km north of Bangkok, in the middle of the central plain of Thailand.

Elevation	:	about El. 2.0 m
Gradient	:	gentle, 1/5,000-1/10,000
Soil	:	formed by alluvial action of the saline water river in the clayey acid sulphate soil contents much clay so that the soil hardness may vary to the large extent according to the soil moisture content
Climate	:	tropical savana
		Dry season ; May-October
		Wet season ; November-March
		Annual rainfall ; 1,200-1,300 mm

1.2 Scheme of the Pilot Project

As one of the land reform development program, the Project intended to embank the dike arround the Pilot area to protect the flood in the wet season operating drainage pump and lifting irrigation water in dry season so that the rice cultivation might carry out twice a year in the flood irrigation area in Amphoe Lad Bua Luang, Chanwat Ayuthaya.

The Pilot area was constructed applying the land consolidation work by the intensive method. As shown in Fig-1.1, 1.2, main facilities in the Pilot area were the polder dike, main canal, pumps and land consolidation work which represented irrigation, drainage and road net work. At the corner of the Project area, the trial farm was constructed to conduct the trials with improved agricultural techniques of rice cultivation (Fig-1.3).

(1) Polder dike :

Total length	;	9,100 m, width 6.0 m (crest)
Side slope	;	Outer 1:2.0, Inner 1:1.5
Pavement	;	Laterite pavement width 4.0 m thickness 15 cm
Crest elevation	;	El. 3.50 m

(2) Land consolidation :

Area	;	370 ha
Shape of plot	;	80 a (160 m * 50 m)
Unit farm land	;	1 unit 19.2 ha composed of 24 plots

(3) Drainage system :

Drainage canal	;	Rainfall 189 mm (Return Period 10 years 2 consective days), average inundation depth 25 cm, allowable duration 3 days, unit discharge 6.34 litre/(sec*ha)
Drainage pump	;	Rainfall 212 mm (Return Period 10 years 3 consective days), average inundation depth 25 cm, allowable duration 4 days, unit discharge 4 litre/(sec*ha)

(4) Main pump station :

Pump	;	Vertical mixed flow pump 700 VSM Total head 3.0 m Irrigation operation S.W.L El. 0.00 m D.W.L El. 1.10 m Drainage operation S.W.L El. 0.70 m D.W.L El. 3.10 m Speed 420 rpm Quantity 54.24 cu.m/min, 2 unit

Motor ; 3 phase induction motor
380 V, 50 Hz, 115 A,
45 kw, 2 unit

(5) Water intake system :

The irrigation water for the Pilot area is taken from the Nai Chat Canal.

Pump up quantity ; Q = 0.73 cu.m/s

Table-1.1 Gross water requirement

Crop	Area (ha)	Water requirement (mm/day)	Efficiency (%)	Unit water l/(s*ha)	Gross water (cu.m/s)
Paddy	433.8	9.6	72	1.54	0.67
Up-land	69.7	4.6	59	0.90	0.06
Total	503.5				0.73

(*) Source : Original design including the southern part

(6) Secondary pump station (4 stations) :

Pump ; Horizontal mixed flow pump 300 SZR
Total head 2.0 m (*1)
S.W.L El. 0.60 m
D.W.L El. 2.60 m
Speed 620 rpm (*1)
Quantity 10.2 cu.m/min (*1)

Motor ; 3 phase induction motor
380 V, 50 Hz, 11.8 A,
5.5 kw

(7) Irrigation pump (Trial farm) :

Pump	;	Vertical tubelar pump TDW-9W	(*2)
		diameter of tube 9 inch,	
		nominal diameter 100 mm	
		Total head 2.20 m	(*3)
		S.W.L El. 0.60 m	
		D.W.L El. 2.80 m	
		Speed 1100 rpm	(*4)
		Quantity 2.1 cu.m/min (Head 3.6 m)	
Motor	;	3 phase induction motor	
		380 V, 50 Hz, 11.8 A, 5.5 kw	

(8) Drainage pump (Trial farm) :

Pump	;	Vertical tubelar pump TDW-19W	(*2)
		diameter of tube 19 inch,	
		nominal diameter 300 mm	
		Total head 2.30 m	(*3)
		S.W.L El. 0.80 m	
		D.W.L El. 3.10 m	
		Speed 480 rpm	
		Quantity 10.5 cu.m/min (Head 3.6 m)	
Engine	;	YAMMAR 180 C-G	
		continuous 15 ps 2400 rpm	
		maximum 18 ps 2400 rpm	

(*1) These specifications were to be revised at No.1, 2, 4 stations.

(*2) These pumps were to be changed new ones.

(*3) For the vertical tubelar pumps in the trial farm, total head of those pumps coincided with the actual head of those.

(*4) This value was in original design.

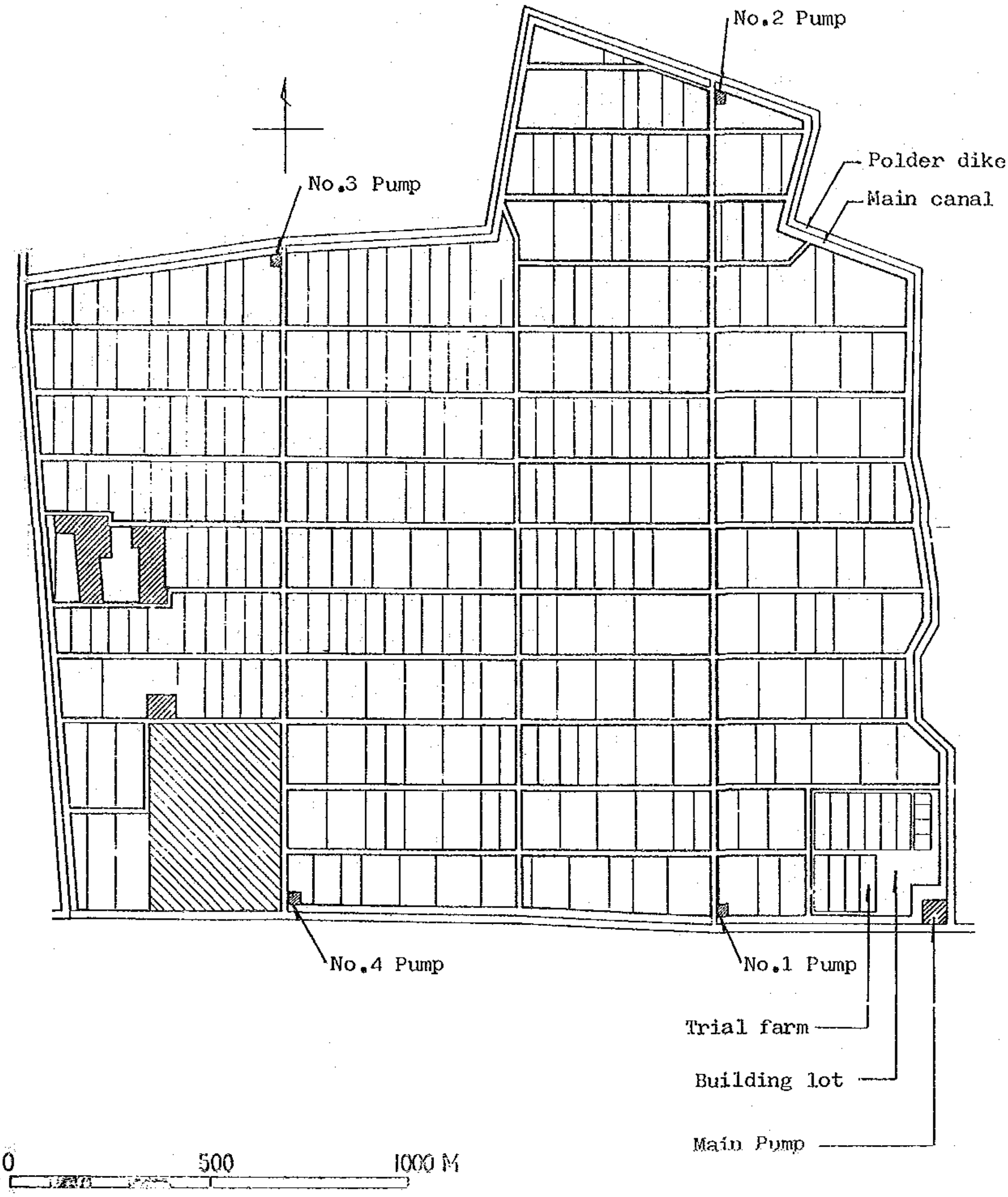


Fig - 1.1 Plan view of Chao Phya Pilot Project

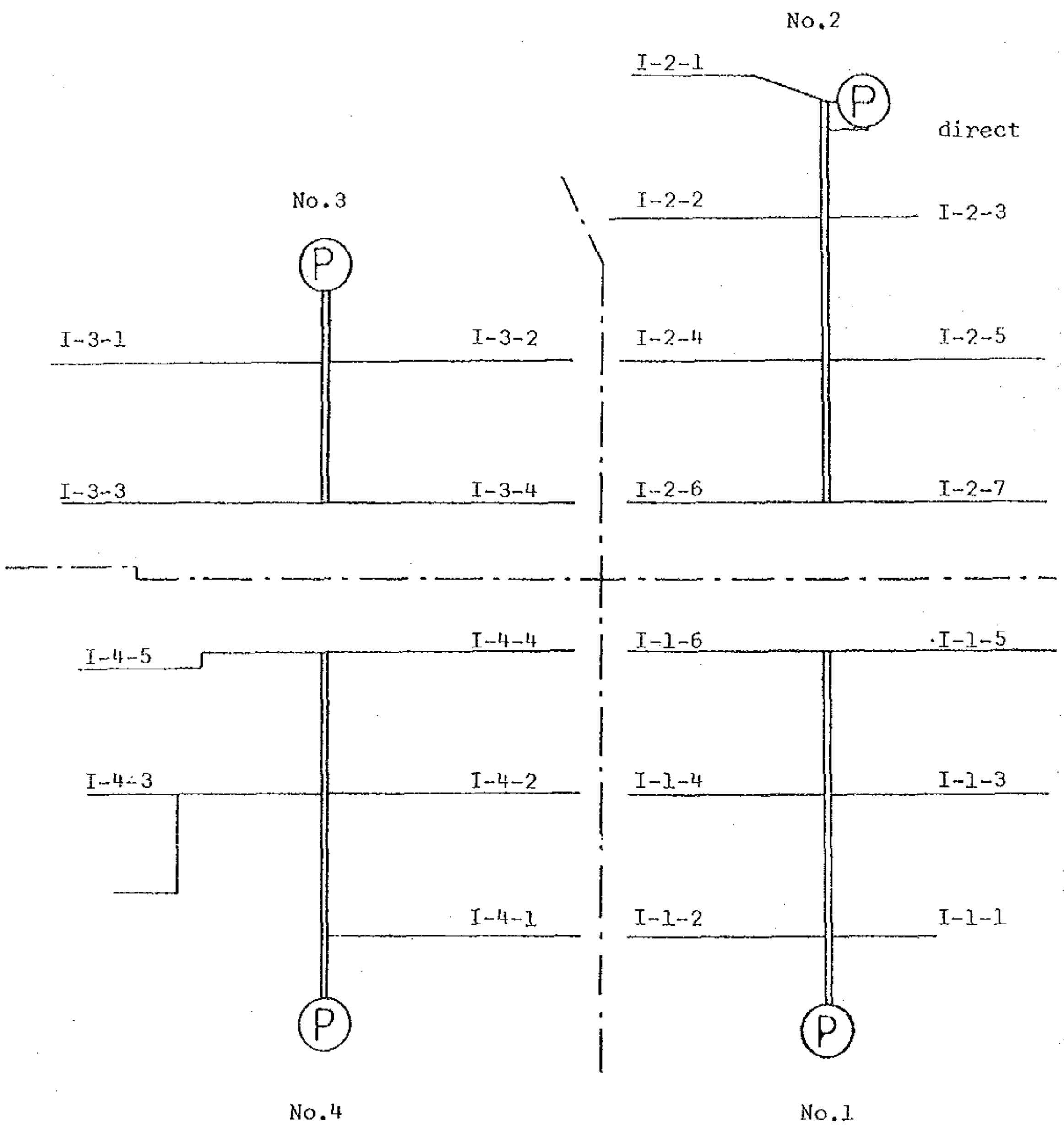


Fig-1.2 Irrigation diagram in Pilot area.

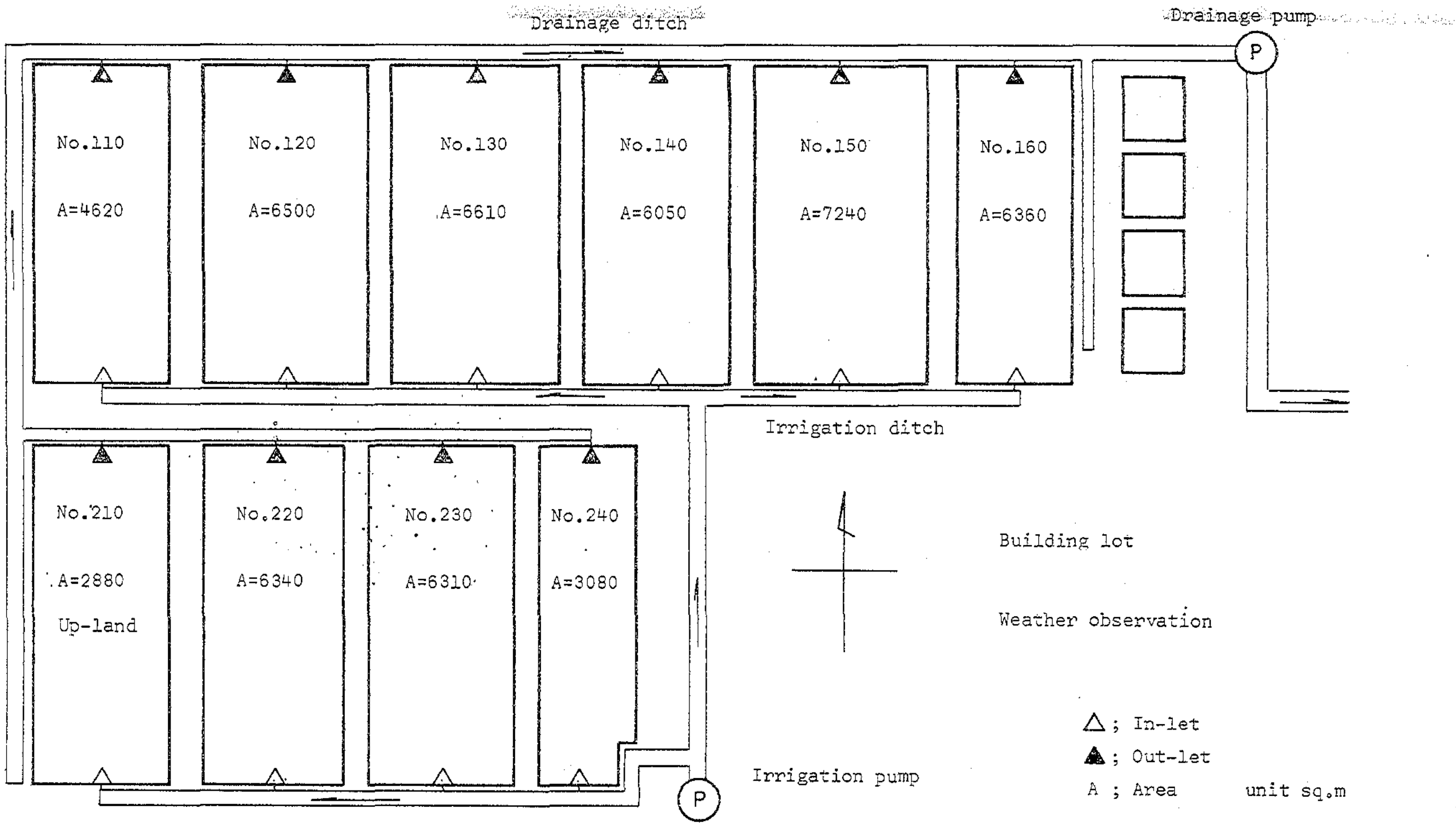


Fig-1.3 Plan view of trial farm

2. Discharge of secondary pump (part 1)

2.1 Objective

To check the quantity of the pump after installation.

2.2 Method

Indirect method using flow current meter

Instrument	:	(a) HIROI SANEI No. 8060
Calibration	:	October 27, 1981
		by the Resourve & Energy Agency of Japan
Measurement line	:	Horizontal 1 point
		40 % depth below the surface
Stop watch	:	SEIKO digital type

Since there were a few methods to estimate the partial discharge, I accepted the equation shown below and made the calculation form shown in Table-2.1

$$Q_{n,n+1} = \frac{1}{2}[B * (V_n + V_{n+1}) * H_n + \frac{1}{3}(V_n + 2 * V_{n+1}) * (H_{n+1} - H_n)]$$

where,

$Q_{n,n+1}$: Partial discharge between two measurement lines No. n and No. n+1.

B : Distance between two measurement lines No. n and No. n+1 .

V_n, V_{n+1} : Velocity on the measurement line No. n, No. n+1.

H_n, H_{n+1} : Depth on the measurement line No. n, No. n+1.

It was approximately assumed that the depth and the velocity would vary linearly in the cross section ; the equation gives the partial discharge between two measurement lines No. n and No. n+1 .

2.3 Result

Station	Quantity (litre/sec)	Date
No.1	180	Feb. 9, 1984
No.2	164	Aug. 23, 1983
No.3	167	Aug. 31, 1983
No.4	143 - 198	Aug. 18, 1983
	Average 171	Sept. 5, 1983

2.4 Summary

Pump discharge showed approximately specified value 170 litre/sec at each station.

2.5 Reference

(1) Specification of the pump & driver

1) Pump

Model	:	EBARA 300 SZR mixed flow pump
Capacity	:	10.2 cu.m/min (170 liter/sec)
Total head	:	2.0 m (*1)
Speed	:	620 rpm (*1)
Delivery Water Level	:	El. 2.60 m (*2)
Suction Water Level	:	El. 0.60 m

2) Driver

Model	:	TOSHIBA 3 phase induction motor
Output	:	5.5 Kw
Speed	:	1440 rpm
Pole	:	4

*1) A modification plan is considered in chapter 19.

*2) Mr. TSUJI had recommended before the construction of No.1 Pump station that the D.W.L. should be changed from El. 2.600 m to El. 2.700 m.

(2) Former result

Station	Quantity (liter/sec)	Date	Observer
No.1(temporary)	130		Mr. Hongo
No.2(temporary)	108		Mr. Hongo
No.3	129	Oct.28-29, 1981	Mr. Hongo Mr. Tierdikiet
No.4	135	Dec.23, 1981	Mr. Hongo Mr. Adesak

2.6 Comment

When I measured the depth and the velocity, I used the scaffolding not that I minded being drenched, but that I might not disturb the stream. The temperature of water in the canal was about 30°C.

Table - 2.1 QUANTITY OF FLOW

DATE : Feb. 9, 1984 TIME : 11.00~ PLACE : No.1 Pump NAME : FUKUDA, Arunee Chanchai, Sunthipong PAGE :

Number n	(1) Distance Dn m	(2) Depth Hn m	(3) Depth*0.4 m	(4) Revolution	(5) Time sec (5)-a	(5)-b	(5)-c	(5)-d	(5)-e	Average	(6) Revolution N 1/sec	(7) Velocity Vn m/sec
1	0	0										0
2	0.25	0.27	0.108	10 * 5	22.56	56.35	28.62	57.88		57.12	0.875	0.121
3	0.50	0.54	0.216	10	40.70	21.92	52.00			46.35	1.079	0.147
4	0.75	0.56	0.224	10	54.16	1.06.41	53.02			57.86	0.864	0.120
5	1.00	0.55	0.220	5	27.04	24.03	43.26			31.44	0.795	0.110
6	1.25	0.55	0.220	5	17.30	18.47	21.42			19.06	1.312	0.170
7	1.50	0.55	0.220	5	12.79	9.28	9.80			10.62	2.354	0.310
8	1.75	0.45	0.180	5	7.83	7.44	9.13			8.13	3.075	0.403
9	2.00	0.18	0.072	5	17.54	14.22	15.38			15.71	1.591	0.213
10	2.22	0										0

Number n	(8) Breadth Dn+1 -Dn m	(9) (Vn+Vn+1)/2	(10) (2)*(8)*(9)	(11) Vn+2*Vn+1	(12) Hn+1 -Hn m	(13) (8)*(11)*(12)/6	(14) (10)+(13)
1	0.25	0.061	0	0.242	0.27	0.003	0.003
2	0.25	0.134	0.009	0.415	0.27	0.005	0.014
3	0.25	0.134	0.018	0.387	0.02	0	0.018
4	0.25	0.115	0.016	0.340	-0.01	0	0.016
5	0.25	0.144	0.020	0.464	0	0	0.020
6	0.25	0.244	0.034	0.797	0	0	0.034
7	0.25	0.357	0.049	1.116	-0.10	-0.005	0.044
8	0.25	0.308	0.035	0.633	-0.27	-0.007	0.028
9	0.22	0.107	0.004	0.213	-0.18	-0.001	0.003
10							
			0.185			-0.005	0.180

Remarks

Instrument :

(A) HIROI SANEI No. 8060
V = 0.128*N + 0.009 m/sec

(B) NAKAASA J - 021 No. 5084
V = 0.658*N + 0.032 m/sec

(C) NAKAASA J - 021 No. 5189
V = 0.649*N + 0.036 m/sec

Result Q = 0.180 cu.m/sec

3. Discharge at several positions along the irrigation stream (part 1)

3.1 Objective

To grasp the water leakage or to estimate the irrigation efficiency.

3.2 Method

By using flow current meter, we measured the quantity of irrigation flow at several positions along the stream, such as lateral canal, turn-out and on-farm.

3.3 Result

Shown in Table-3.1

We consider that the difference of discharge between two sections at up-stream and down-stream is the lost water during conveyance. From this point of view, we estimated the proportion of actually lost water.

The result is shown in column (7) of Table-3.2.

The difference of discharge at two positions, in-coming and out-going at one turn-out flowed to other direction or leaked uselessly.

We could not measure the quantity practically by this method but it was beyond negligible quantity. Because the conveyance efficiency was not so good as the design value; what was worse, owing to the leakage water on the way, the effective water reached the farthest turn-out decreasing the quantity in proportion to the distance. The leakage was not avoidable owing to the precision of structure in process of manufacture.

We might point in the same manner the defect of structure or less estimation of leakage water at in-takes along the ditch.

3.4 Summary

Conveyance efficiency in lateral canal was less than 90%.

The loss water caused by the nature of the structure was beyond negligence.

It is essential to compact the border and to maintain canal and border timely.

3.5 Reference

Maximum water requirement of paddy	9.6	mm/day
the water requirement on the last day of land preparation 48 day rotation		
Area of the standard plot	8,000	sq.m
160 m * 50 m		
Application efficiency	80 %	
Operation hour of the secondary pump	22	hour
Quantity along an irrigation ditch (24 plots)	0.029	cu.m/sec
$\frac{0.0096 * 8,000 * 24}{60 * 60 * 22 * 0.80}$		
Conveyance efficiency in lateral	90 %	
Quantity along an irrigation block (48 plots)	0.065	cu.m/sec
$\frac{0.0096 * 8,000 * 48 * 1}{60 * 60 * 22 * 0.80 * 0.90}$		
Quantity at the up-stream of the lateral		
(2-irrigation blocks)	0.129	cu.m/sec
$\frac{0.0096 * 8,000 * 48 * 2}{60 * 60 * 22 * 0.80 * 0.90}$		
(3-irrigation blocks)	0.194	cu.m/sec
$\frac{0.0096 * 8,000 * 48 * 3}{60 * 60 * 22 * 0.80 * 0.90}$		

3.6 Comment

It is hoped to develop the pre-cast concrete structures manufactured in the factory such as turn-out box and in-take box. Those are well manfactured in size and have little allowable error.

Table-3.1 Discharge & Water level in the lateral canal I-1

		Discharge (liter/sec)						Supply Water Level (El.m)		Remarks
		Instrument (a)		Instrument (b)		Instrument (c)				
Section I L=179 m	Up-stream	180		179	loss ; 18 eff ;0.90 (*2)	188	loss ; 29 eff ;0.85	2.546	loss ; 0.016	*1)Date;Feb.9, 1984 *2)eff ; Conveyance efficiency *3)In the Main canal W.L = 1.230 *4)At up-stream of I-1-6 Q=96 (liter/sec) W.L = 2.347
	Down-stream			161		159		2.530		
Turn-out 1				loss ; 24		loss ; 19		loss ; 0.021		
Section II L=330 m	Up-stream	137	loss ; 9 eff ;0.93	137		140		2.509	loss ; 0.027	
	Down-stream	128						2.482		
Turn-out 2		loss ; 24						loss ; 0.022		
Section III L=330 m	Up-stream	106	loss ; 2 eff ;0.98					2.460	loss ; 0.084	
	Down-stream	104						2.376		

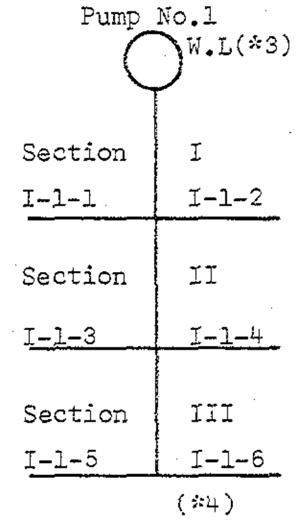


Table-3.2 Result of discharge measurement

Pump No.	Section			Discharge (liter/sec)			(7) Proportion (%)
	(1) Beginning Point Up-stream	(2) End Point Down-stream	(3) Distance (m)	(4) Up-stream	(5) Down-stream	(6) Difference	
2	T-1	T-2	292	164	137	27	16.5
	T-2	T-3	330	139	97	42	30.2
	T-2	T-3		131	110	21	16.0
	T-3	T-4	330	98	88	10	10.2
3	Pump	T-1	163	167	136	31	18.6
				155	126	29	18.7
4	Pump	T-2	452	143	106	37	25.9
				198	153	45	22.7
	T-2	T-3	320	137	115	22	16.1

*) T-1, T-2, T-3; Turn-out 1,2,3

4. Discharge at several positions along the irrigation stream (part 2; No.3 Pump area)

4.1 Objective

As the new counterpart and technician were assigned to the Project, succeeding to the duties; we tried the same activities in No.3 Pump area as I had done in No.2 Pump area in August and September 1983. The activities were as follows :

To check the quantity of the pump after installation.

To grasp the water leakage or to estimate the irrigation efficiency.

4.2 Method

By using flow current meter, we measured the quantity of irrigation flow at several positions along the stream.

4.3 Result

Shown in Table - 4.1

The pump discharge showed at most 161 liter/sec, which was less value than specified value 170 liter/sec.

Conveyance efficiency was estimated 86 % in the course of 163 m distance and 64 % in 493 m with normal maintenance of the lateral canal as to cut weed inside of it.

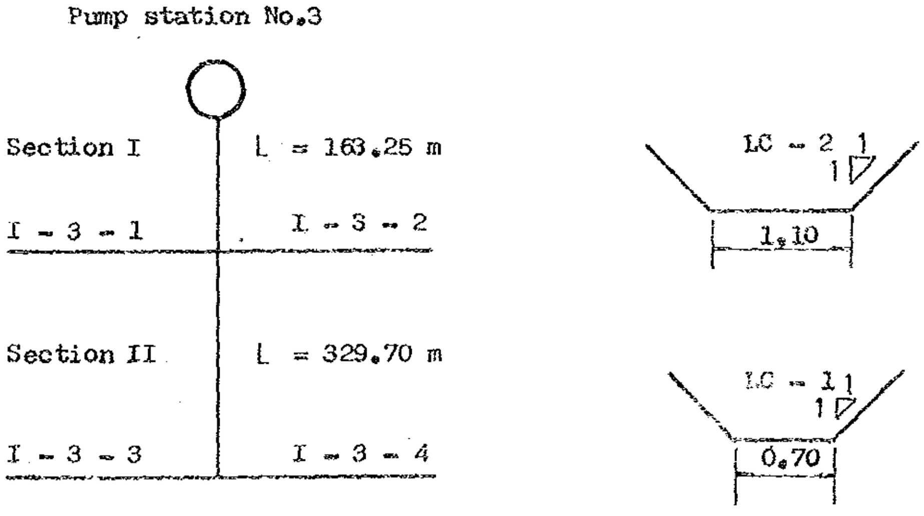
27 liter/sec, 17 % of the quantity lifted at up-stream flowed to another direction, owing to the poor structure of the diversion weir.

4.4 Comment

It seemed that there had been electrical problem about pump operation, but we could not measure the electrical items, because we had not enough instrument or tool at that time.

Table-4.1 Dicharge in the leteral canal

		Measurement		Remarks
		Discharge (liter/sec)	Supply Water Level (El.m)	
Section I LC - 2	Up-stream	161	2.620	Aug. 17,1984 Instrument (a) HIROI SANEI No. 8060
	Down-stream	138	2.603	Loss 23 liter/sec 161 - 138 = 23 23 / 161 = 14 %
Section II LC - 1	Up-stream	111	2.573	Loss 27 liter/sec 138 - 111 = 27 27 / 161 = 17 %
	Down-stream	103	2.366	Loss 8 liter/sec 111 - 103 = 8 8 / 111 = 7 % Conveyance efficiency 103/161 = 64 %



5. Profile survey along the stream (part 1; No.2 Pump area)

5.1 Objective

To check the height of irrigation facilities at several points along the stream after completion of the land consolidation.

5.2 Method

Survey by using auto level and observation two parties.

5.3 Result

Survey result was shown in Fig-5.1.

The lateral canal I-2 was completed a little higher than the height the drawing had specified.

Suppose that delivery water level, roughness, slope and cross section of canal are same as the design dimension, the uniform flow depth at Turn-out T-4 will be smaller than 0.40 m (E.L. 2.00 m - E.L. 1.80 m). In other words, the discharge at this point will be smaller than that of design value. But actually No.2 Pump was being operated higher suction water level than design value, which caused that delivery water levle rose higher than that of the design value.

5.4 Summary

Profile survey proved that the lateral canal I-2 was finished containing greater error or difference than that of generally allowable.

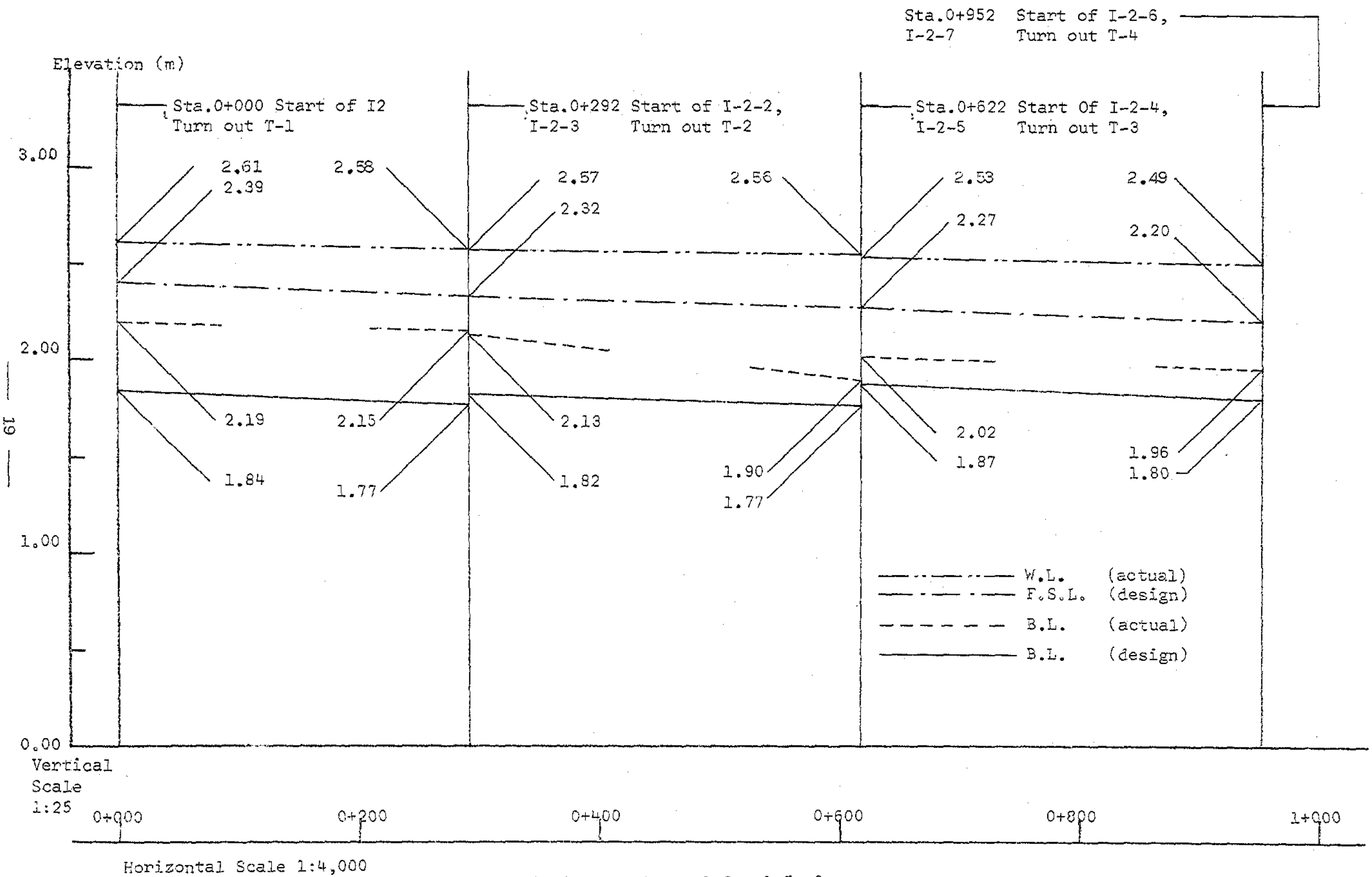


Fig-5.1, a Lateral Canal I — 2

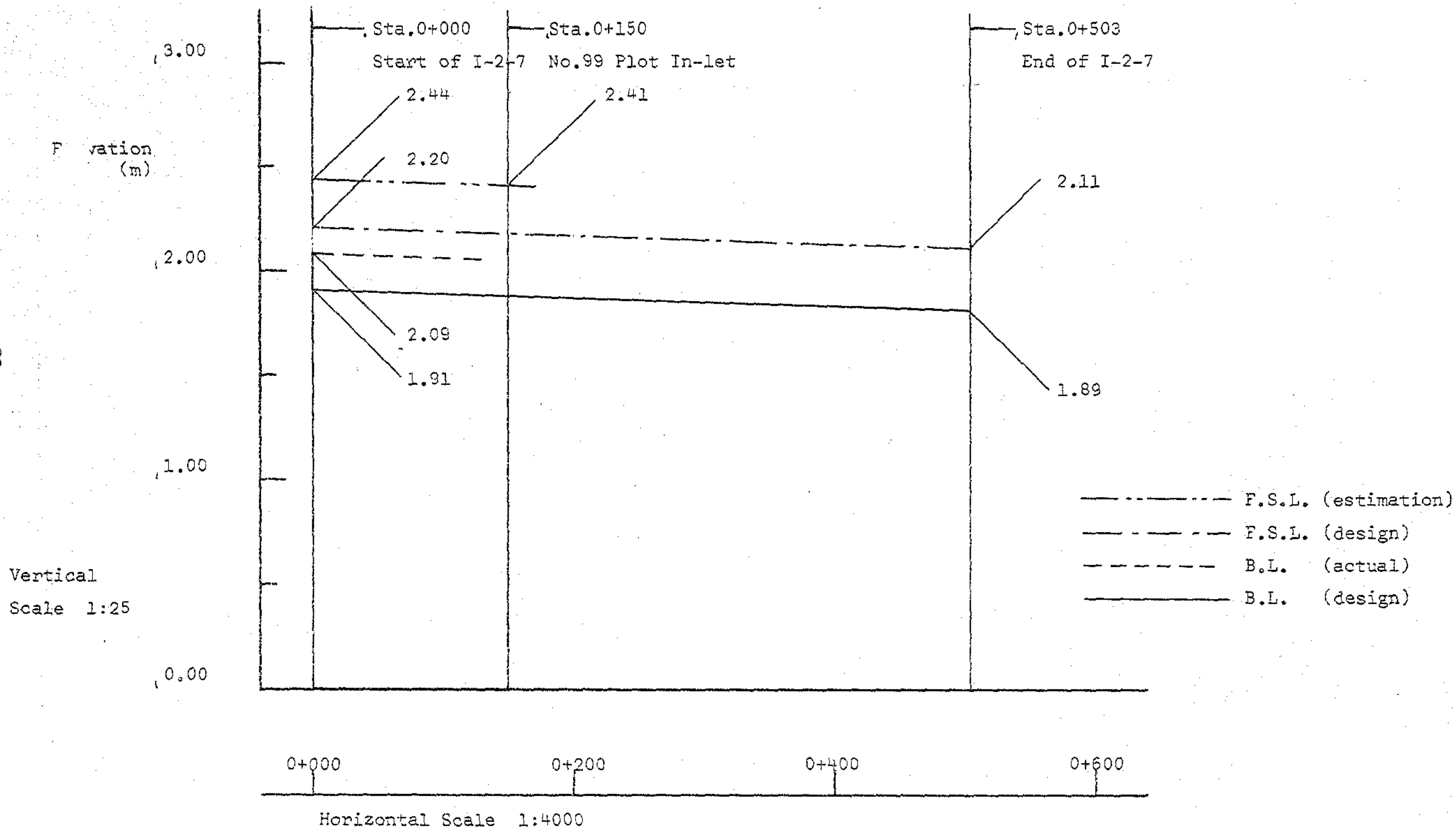


Fig 5-1, b Irrigation ditch I-2-7

6. Profile survey along the stream (part 2 ; No.3 Pump area)

6.1 Objective

The background was as same as described in 4.1.

To check the height of irrigation facilities at several points along the stream after completion of the land consolidation.

6.2 Method

Survey by using auto level and observation one party.

6.3 Result

Survey result was shown in Fig-6.1.

The figure proves; about B.L. of the canal, the idea of design and actual condition constructed in the area were different. According to the detail design, the design B.L. was set in uniform slope from up-stream of LC-2 to the end of LC-1. And F.S.L. was set adding normal depth to the B.L. in each section.

On the contrary, the actual B.L. was constructed applying the principle that F.S.L. should be set for the first almost in uniform slope, after that B.L. would be set subtracting the normal depth from F.S.L.

Though we might accept either of the method, the actual W.L. was about 20 cm higher than the design W.L.

The reason might be that the farmer dammed up the stream in I-3-3 or I-3-4 to lead the water into the plot. It seemed to effect to the up-stream.

6.4 Summary

About the design of the canal how to connect the canals which have different normal depth, there are some principles to connect B.L. or F.S.L. in series.

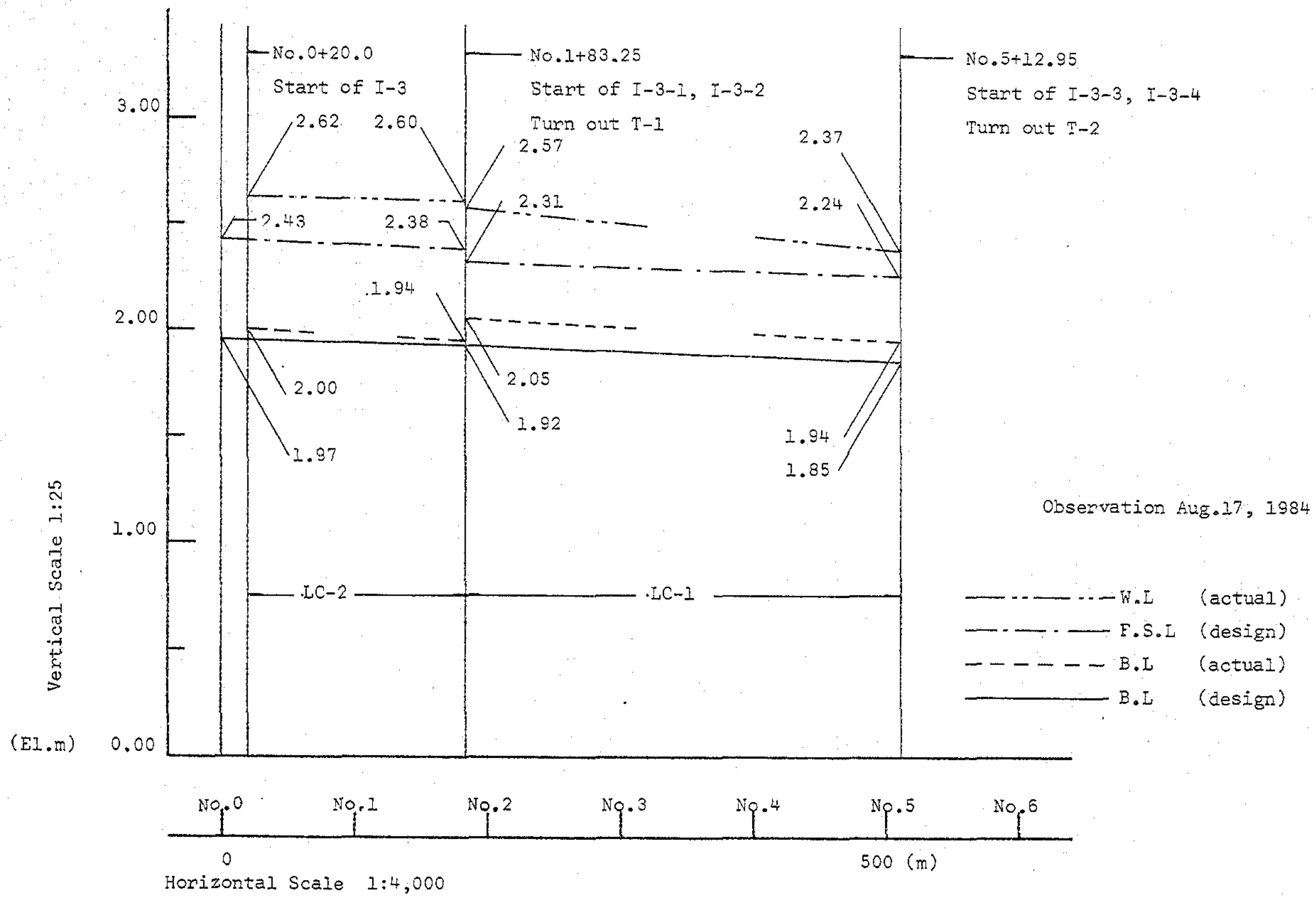


Fig-6.1 Lateral canal I-3

7. Profile survey along the stream (part 3)

7.1 Objective

To check the height of inlet pipe, weir crest and in plot near in-take along the ditch.

To grasp the standard allowance of land consolidation work in process of construction control.

7.2 Method

Survey using auto level, observation one party.

As the drawing did not mention the elevation of inlet pipe, weir and plot numerically; but showed them to be finished as shown in Fig-7.1 : I estimated the design elevation of works. After getting the survey result, I compared it with the design elevation. Then I processed those data statistically.

7.3 Result

Shown in Fig-7.2

1) Inlet pipe

Inlet pipe in No.1 area were properly installed in height.

Inlet pipe in No.2 and No.3 area were installed 7.5 cm–9.5 cm higher than design elevation in average respectively

Inlet pipes in No.4 area were 5.0 cm lower.

2) Weir crest

Weirs in No.2 and No.3 area were properly installed 4.5–6.5 cm higher than design elevation. On the contrary, weirs in No.4 area were 8.5 cm lower.

3) Elevation in plot near weir

When these were compared with those of weir crest in the whole area, the farmer was 5 - 8.5 cm higher than the latter. According to the popular drawings or criterion, weir crest should be installed 0 - 10 cm higher than the elevation in plot, but the relation of elevation between weir crest and plot might be thought abstructly to be opposite to the popular design.

7.4 Summary

Assuming that irrigation water reaches satisfactorily in discharge and energy in the lateral canal; it is necessary to improve the relation of elevation between weir crest and plot so that the water may be distributed properly to each plot along the ditch.

7.5 Reference

" The criteria for land improvement planning & design " book - land consolidation of the paddy - ; 1977 MAFF, Japan

INLET BOX

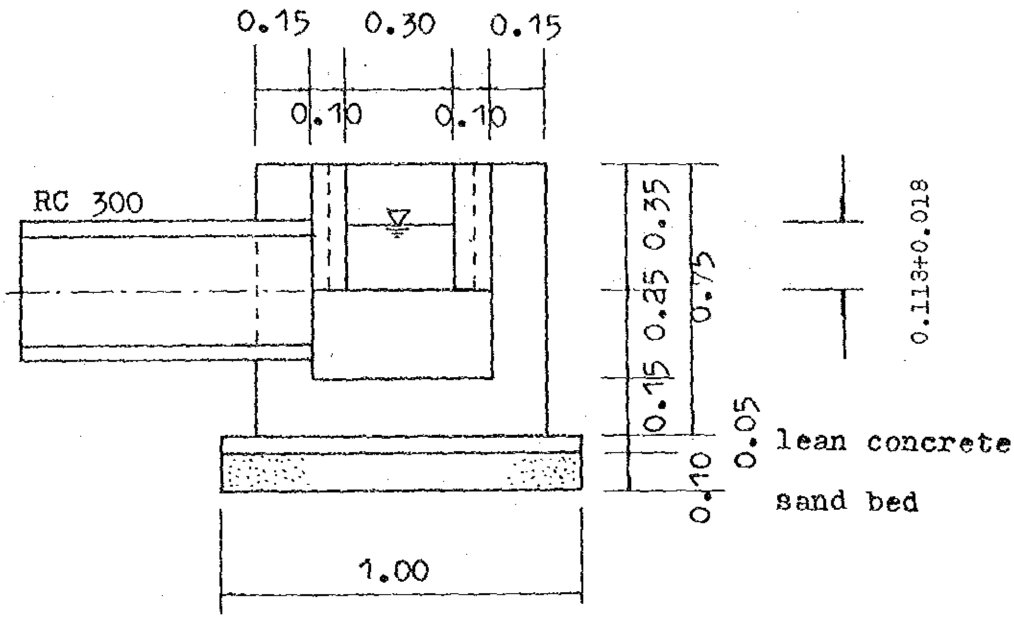


Fig.-7.1 a

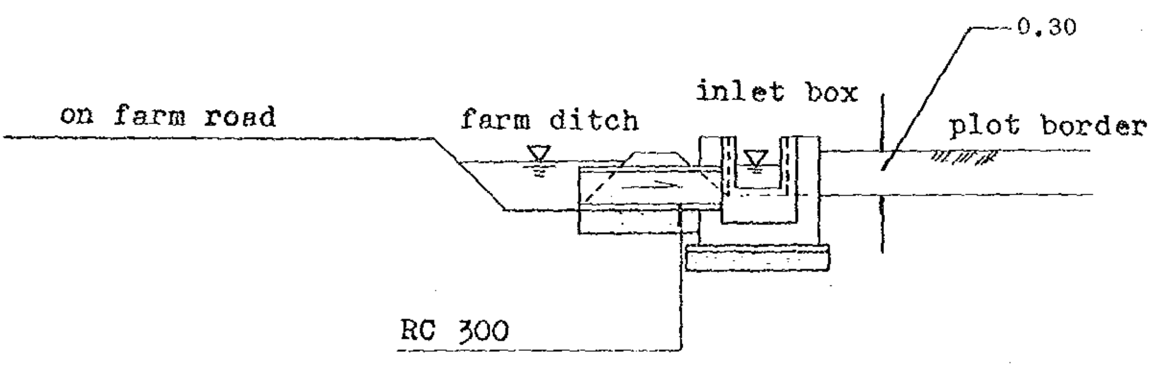


Fig.-7.1 b

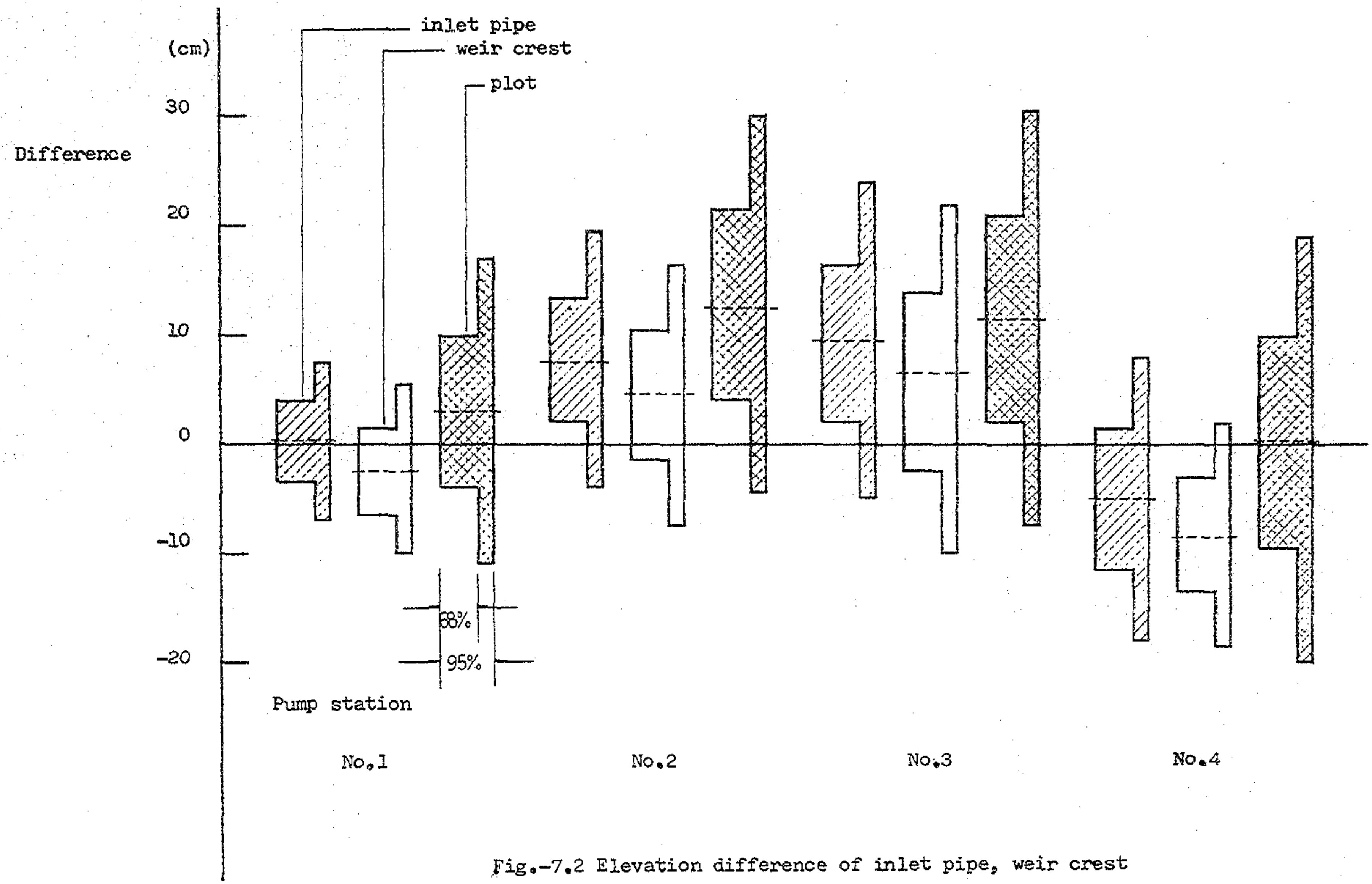


Fig.-7.2 Elevation difference of inlet pipe, weir crest and plot from design value

8. Comparison gross water requirement with pump capacity

8.1 Objective

To sum up the gross water requirement

To grasp the present condition of water distribution

To check the pump capacity

To examine the allowance of capacity

8.2 Method

I assumed that all pump command area were paddy; applied the design dimension for irrigation scheme : I summed up gross water requirement arithmetically with drawing irrigation diagram.

8.3 Result

Shown in Fig-8.1, Table-8.1

No.2 Pump area demands 169 litre/sec at maximum. The quantity is almost as equal as the specified value of the pump (170 litre/sec).

When the water requirement was compared among four pump command area, No.2 Pump area was the greatest of the four. No.2 Pump has less allowance of the capacity than other pumps have.

8.4 Summary

Being compared with another three pump command area, No.2 area is the greatest of the four. Then without suitable maintenance of canal and ditch, without order in distribution, shortage of water would frequently happen in the area.

Table - 8.1 Comparison Gross Water Requirement with Pump Capacity

Pump Station	(1) Command Area (ha)	(2) Gross Water Requirement Maximum (liter/sec)	(3) Pump Capacity (liter/sec)	(4) $\frac{(2)}{(3)}$ * 100 (%)
No.1	90.6	152	170	89
No.2	100.6	169	170	99
No.3	81.5	137	170	81
No.4	91.4	154	170	91

* 1) Unit water requirement per 38.4 ha ;

Maximum average field water requirement	9.6 mm/day
Conveyance efficiency	0.90
Application efficiency	0.80
Pump operation	22 hr.

* 2) Pump capacity ; Q = 10.2 cu.m/min
= 170 liter/sec

9. Water requirement experiment

(part 1; wet season - April 1983)

9.1 Objective

To grasp the water requirement for puddling and to compare the amount with that of the design value.

9.2 Method

Observation of the farmers' activity in the trial farm No.140

We measured the depth at four stakes installed at the corner of the plot.

We measured the discharge in the irrigation ditch using the flow current meter.

9.3 Result

Field condition

field	:	trial farm No.140
levelling	:	ploughed, well levelled
		σ = 0.023 m
soil moisture	:	depth 10 cm - 10 %
		depth 30 cm - 26 %
area	:	141 m * 43 m = 6063 sq.m

Water requirement for puddling

quantity	:	1,540 cu.m
		in depth 250 mm
		including standing water 80 mm

9.4 Reference

Field water requirement for nursery bed

acreage nursery bed	:	5% of the total acreage of related paddy fields
water requirements	:	300 mm
average water amount	:	300 * 0.05 ≈ 15 mm

Land preparation

Pre-irrigation water	15 mm
land preparation	160 mm
Total	190 mm

15 mm of water for land preparation will not be required in the wet season cropping in due consideration or maximum utilization of the effective rainfall.

10. Water requirement experiment

(part 2; dry season Dec. 1983 - Apr. 1984)

10.1 Objective

To grasp the water requirement for puddling and for growing; to compare the amount with that of the design value.

10.2 Method

Observation of the farmers' activity in the trial farm No.150.

We measured the depth at four stakes installed at the corner of the plot. About the water for puddling, we measured the discharge in the irrigation ditch using flow current meter at several points.

10.3 Result

Field condition

field	:	trial farm No.150
area	:	7,240 sq.m 51.4 m * 140.85 m
levelling	:	ploughed
soil analysis	:	

Specific gravity	;	Gs	= 2.62
Soil moisture contents	;	w	= 41.8 %
Void ratio	;	e	= 1.18
Porocity	;	n	= 54.1 %
Saturation degree	;	Sr	= 92.6 %
Wet dencity	;	Dwet	= 1.70 g/cu.cm

Water requirement for puddling

quantity ; Q = 1,498 cu.m

in depth 207 mm

including standing water 77 mm

10.4 Summary

(1) As it had rained more in wet season than usual, at the beginning in this dry season, soil in the paddy seemed to have rather more soil moisture than that of ever expected.

(2) Even after one month passed since flood water in the paddy had been drained out, the soil moisture kept about 40 % in 10 cm depth. The value was nearly equal to the condition before irrigation for puddling started.

(3) Soil in 30 cm depth did not seem to vary moisture ratio through season because of less permeability.

(4) To investigate the irrigation efficiency or the infiltration into cracks, it is worth while trying soil experiment in the field on a bigger scale than that in a laboratory.

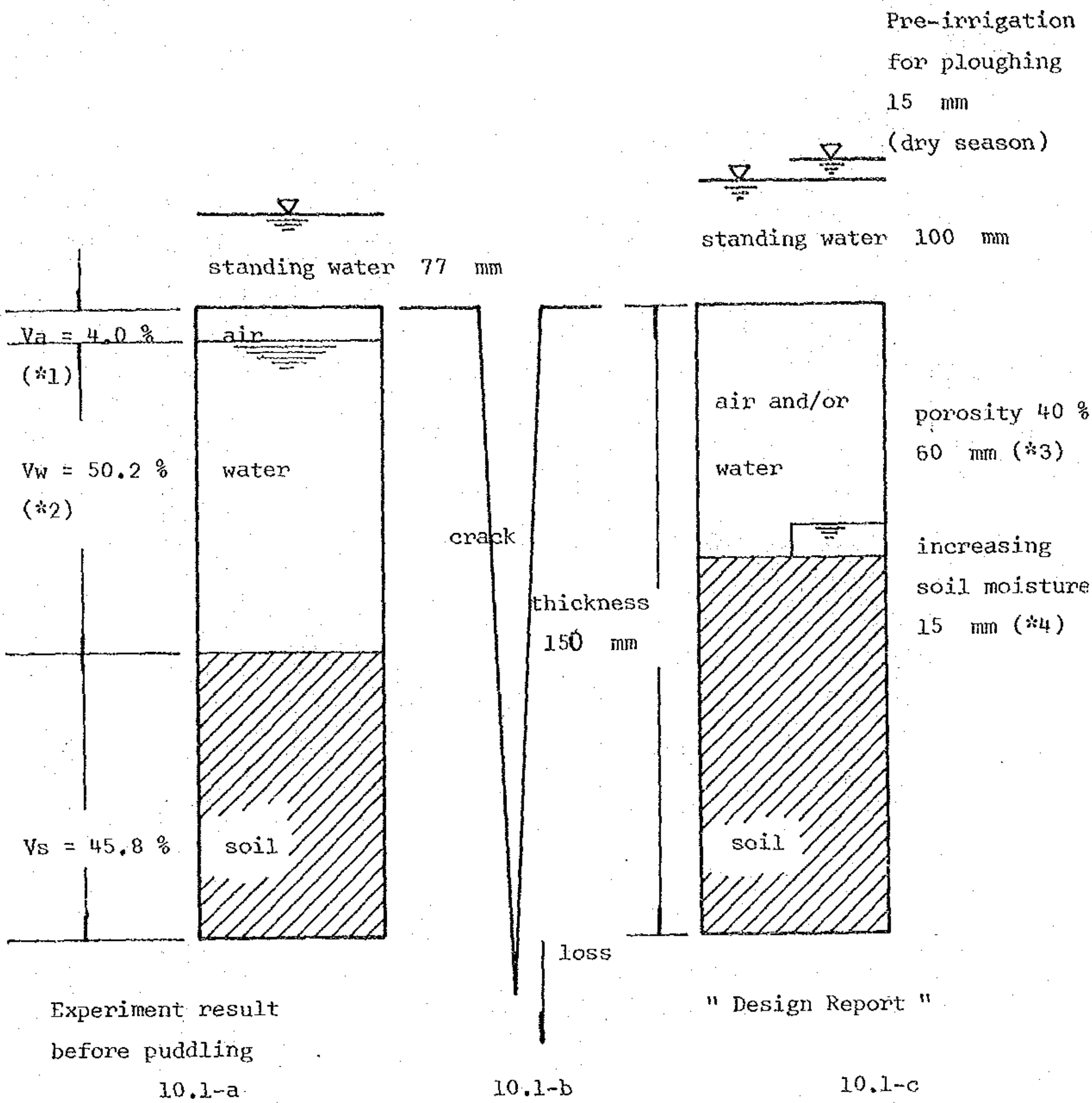


Fig.-10.1

(*1) Assuming that soil layer thickness is 150 mm, air phase is 6 mm

(*2) Assuming that soil layer thickness is 150 mm, liquid phase is 75.3 mm.

(*3) Saturation of surface soil layer : 60 mm
(ploughing depth 150 mm., with 40 % of soil porosity)

(*4) Pre-irrigation for ploughing 15 mm (ploughing depth 150 mm, increasing soil moisture from 10 % to 20 %

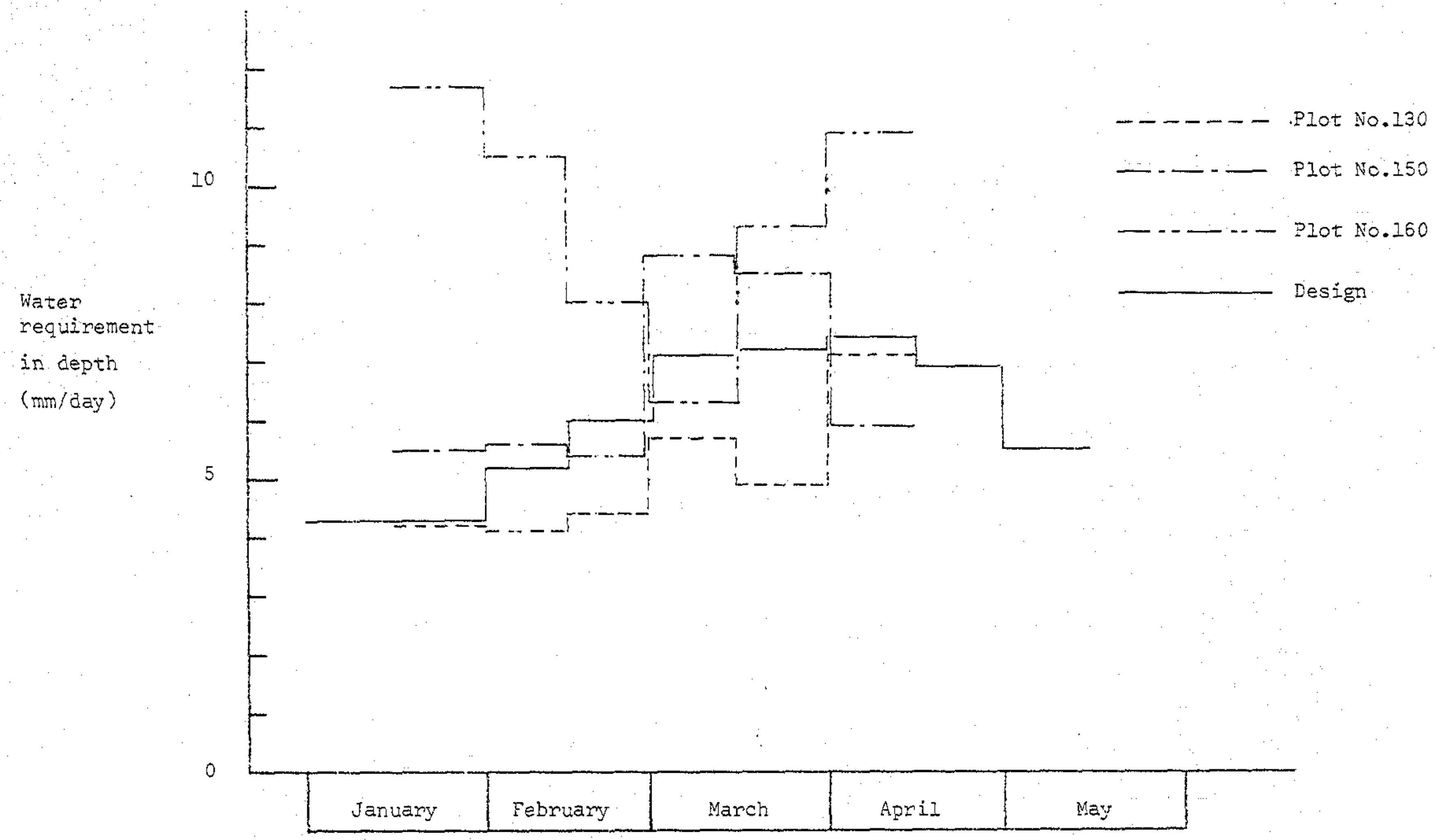


Fig.-10.2 Water requirement in depth
(dry season Dec.1983-Apr.1984)

Table-10.1 Schedule of cultivation

Plot No.	Planting Area (sq.m)	Date of Sowing	Date of Transplanting	Date of Havesting
130	6,610	Dec.1, 1983	Dec.22, 1983	Apr. 4, 1984
150	7,240	Dec.9, 1983	Dec.26, 1983	Apr. 11, 1984
160	6,360	Dec.9, 1983	Dec.27, 1983	Apr. 9, 1984

Table-10.2 Rainfall

Date	Depth (mm)
Dec. 31, 1983	15.0
Jan. 21, 1984	1.0
23	0.5
Feb. 14, 1984	2.5
15	0.5

*1) Station ; in the yard of C.P.P.P.

Table-10.3 Gauge Evaporation

Month	Evaporation (mm)
Dec. II 1983	3.2
Jan. I 1984	4.7
II	3.9
Feb. I	4.3
II	3.7
Mar. I	5.2
II	6.2

*1) Station ; in the yard of C.P.P.P.

*2) Evaporation ; average value

11. Water requirement experiment

(part 3; wet season Jun.-Oct., 1984)

11.1 Objective

To grasp the water requirement for growing; to compare the amount with that of the design value.

11.2 Method

(1) Water requirement in depth

Observation of the farmers' activity in the trial farm No.120, 130 and 140 (Table-11.1).

We measured daily the water level at four stakes installed at the corner of the each plot.

(2) Weather observation

Rainfall and gauge evaporation were observed in the yard of Chao Phya Pilot Project office.

11.3 Result

(1) Water requirement in depth

Shown in Fig-11.1

(2) Weather observation

Shown in Table-11.2,3

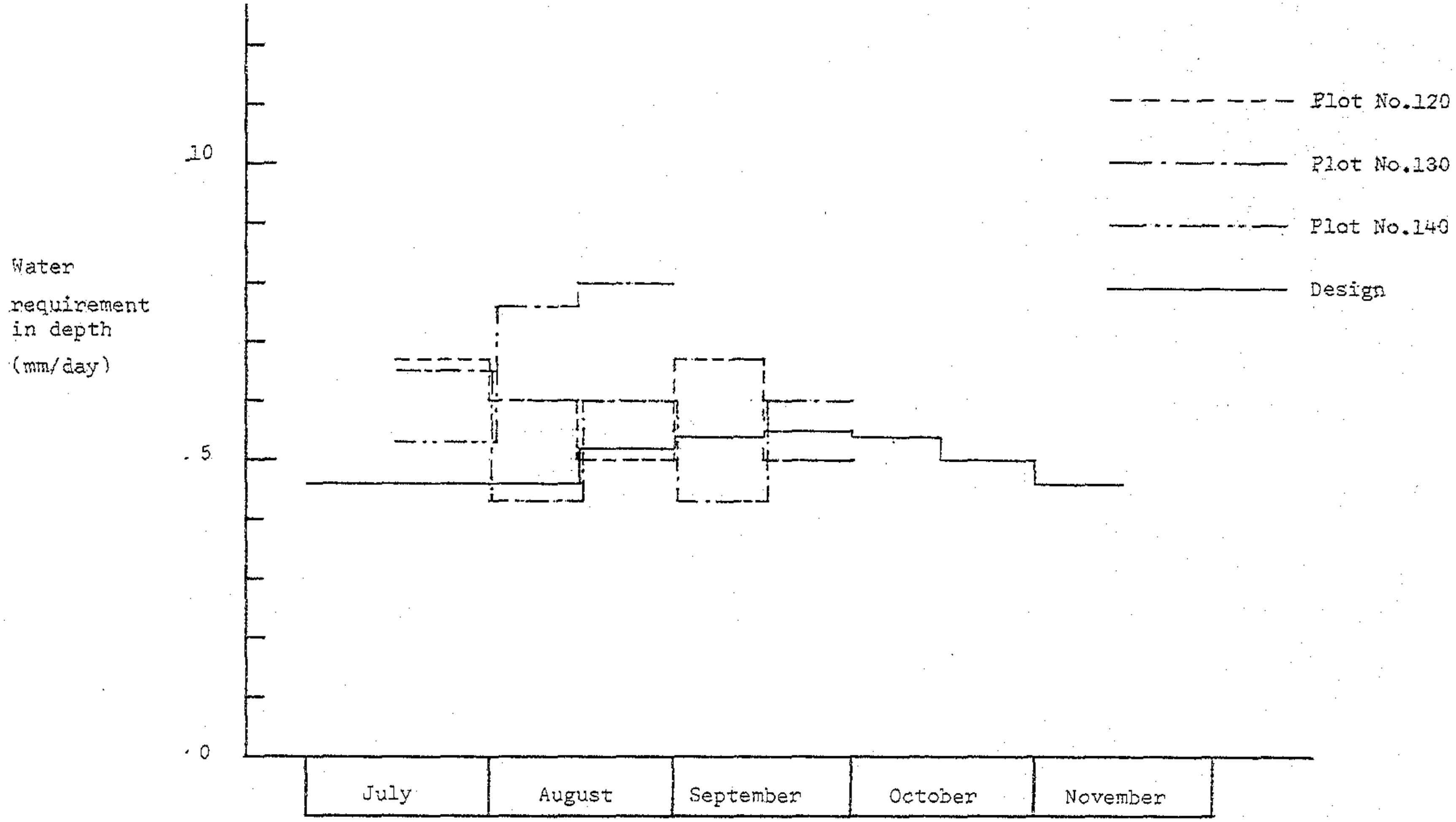


Fig.-11.1 Water requirement in depth
(wet season Jun.-Oct.1984)

Table-11.1 Schedule of cultivation

Plot No.	Planting Area (sq.m)	Date of Sowing	Date of Transplanting	Date of Havesting
120	6,500	Jun. 27, 1984	Jul.16-17,1984	Oct.29, 1984
130	6,610	Jul.5,6, 1984	(direct)	Oct.24, 1984
140	6,050	Jun. 20, 1984	Jul. 9-11,1984	Oct.19, 1984

Table-11.2 Rainfall

Month	Depth (mm)
Jul. I, 1984	136.5
II	1.0
Aug. I	42.0
II	33.0
Sept. I	96.5
II	218.0
Oct. I	112.0
II	31.0

*1) Station ; in the yard of C.P.P.P.

Table-11.3 Gauge Evaporation

Month	Evaporation (mm)
Jul. I, 1984	
II,	11
Aug. I	(*3)
II	8
Sept. I	5
II	6
Oct. I	(*3)

*1) Station ; in the yard of C.P.P.P.

*2) Evaporation ; average value

*3) no record

12. Water requirement experiment

(part 4; dry season Dec. 1984-continue)

12.1 Objective

To grasp the water requirement for puddling and to compare the amount with that of the design value.

12.2 Method

We observed the farmers' activity in the trial farm No.150. We measured the depth at stakes previously installed in the plot at several hours interval after irrigation had started. We measured the discharge in the irrigation ditch using flow current meter and checked the amount at the rectangular weir in the up-stream.

12.3 Result

Field condition

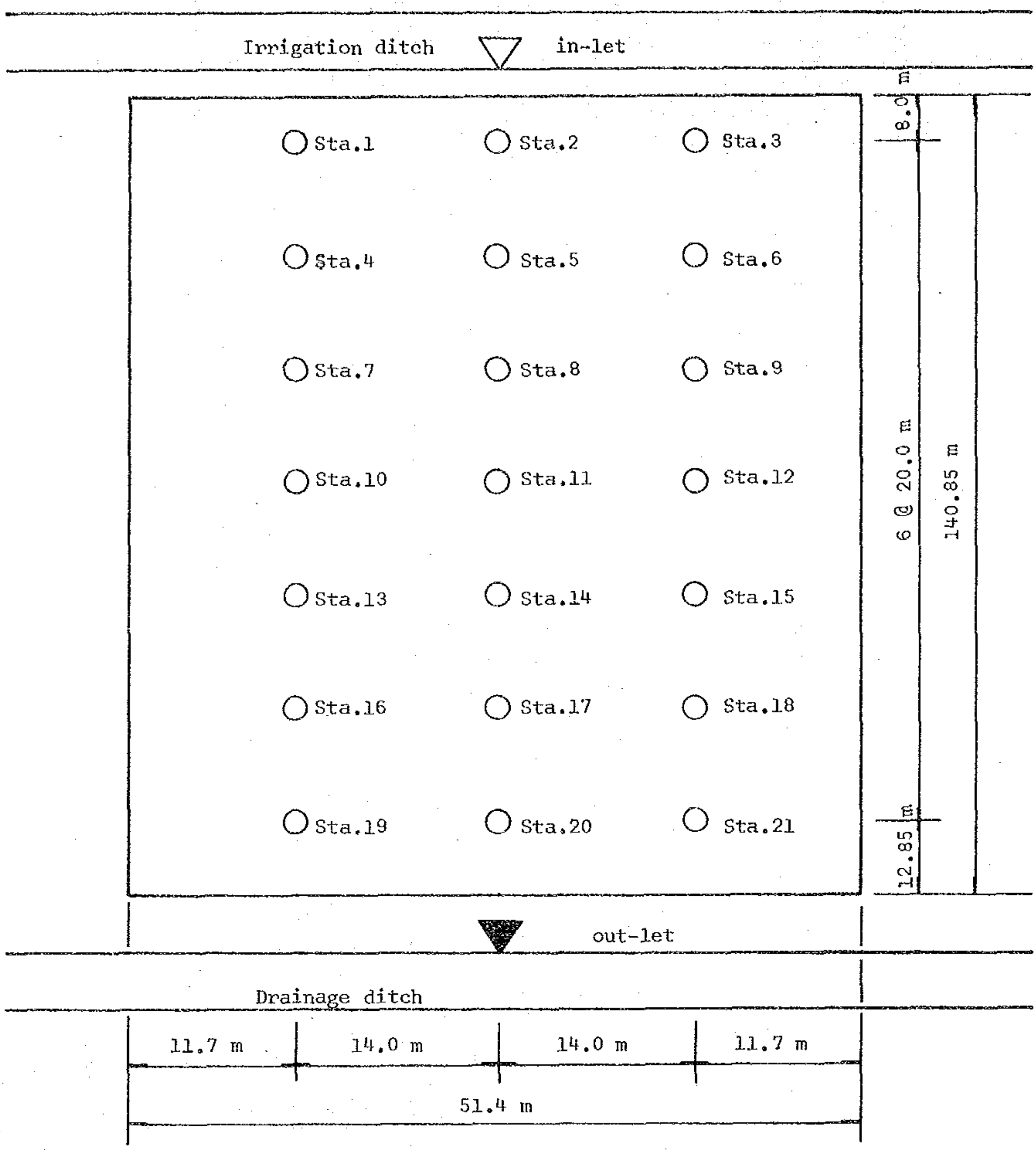
field	:	trial farm No.150
area	:	7240 sq.m 51.4 m * 140.85 m
levelling	:	ploughed, well levelled
		σ = 0.027 m

soil analysis:

Specific gravity	;	Gs = 2.62
Soil moisture content	;	w = 32.68 %
Void ratio	;	e = 0.900
Porocity	;	n = 47.39 %
Saturation degree	;	Sr = 95.00 %
Wet density	;	Dwet = 1.829 g/cu.m

Water requirement for puddling

quantity ; 864 cu.m
in depth 119 mm
including standing water 111 mm


Irrigation ditch
in-let
Sta.1
Sta.2
Sta.3
Sta.4
Sta.5
Sta.6
Sta.7
Sta.8
Sta.9
Sta.10
Sta.11
Sta.12
Sta.13
Sta.14
Sta.15
Sta.16
Sta.17
Sta.18
Sta.19
Sta.20
Sta.21
8.0 m
6 @ 20.0 m
140.85 m
12.85 m
out-let
Drainage ditch
11.7 m
14.0 m
14.0 m
11.7 m
51.4 m

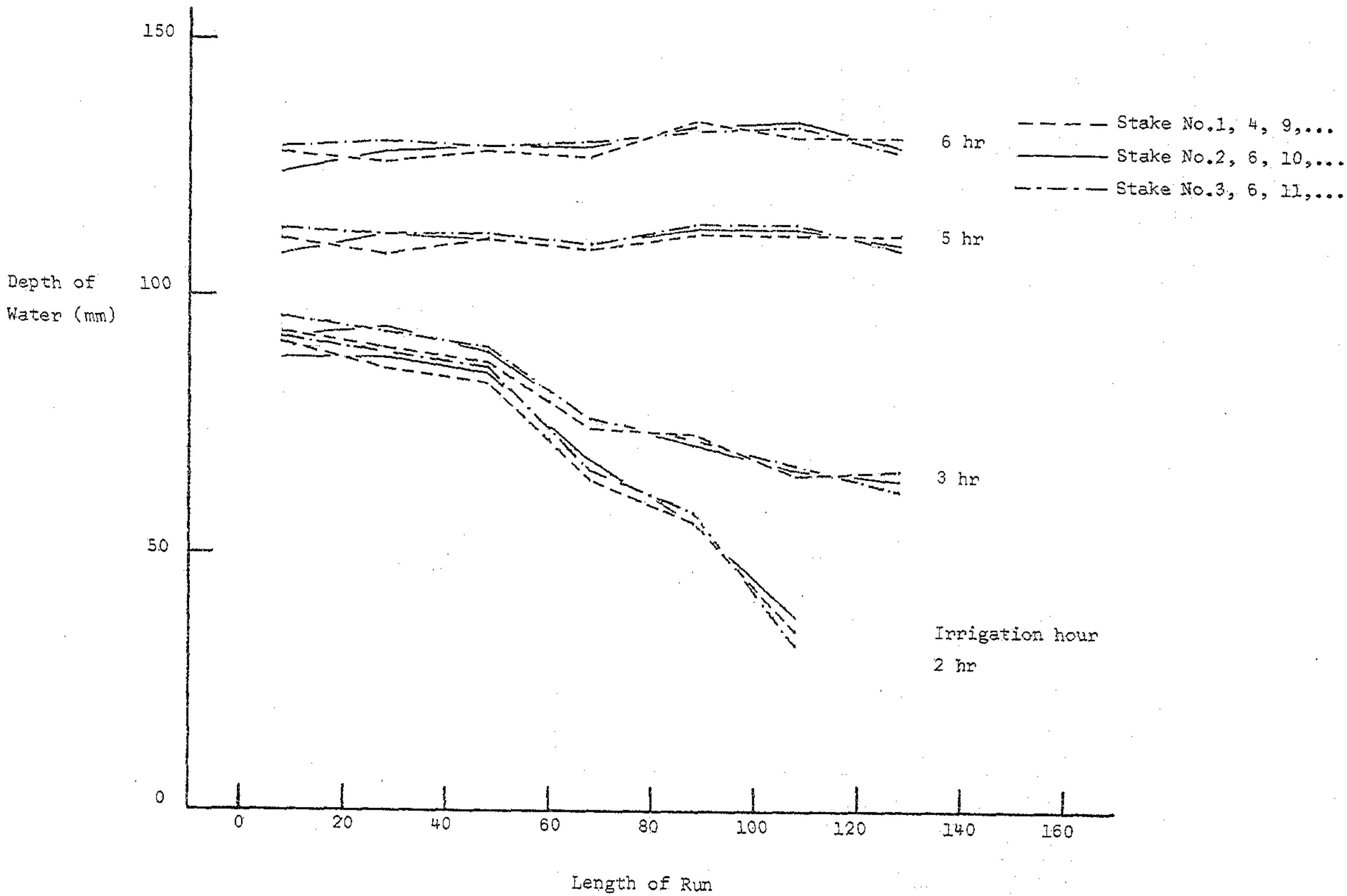
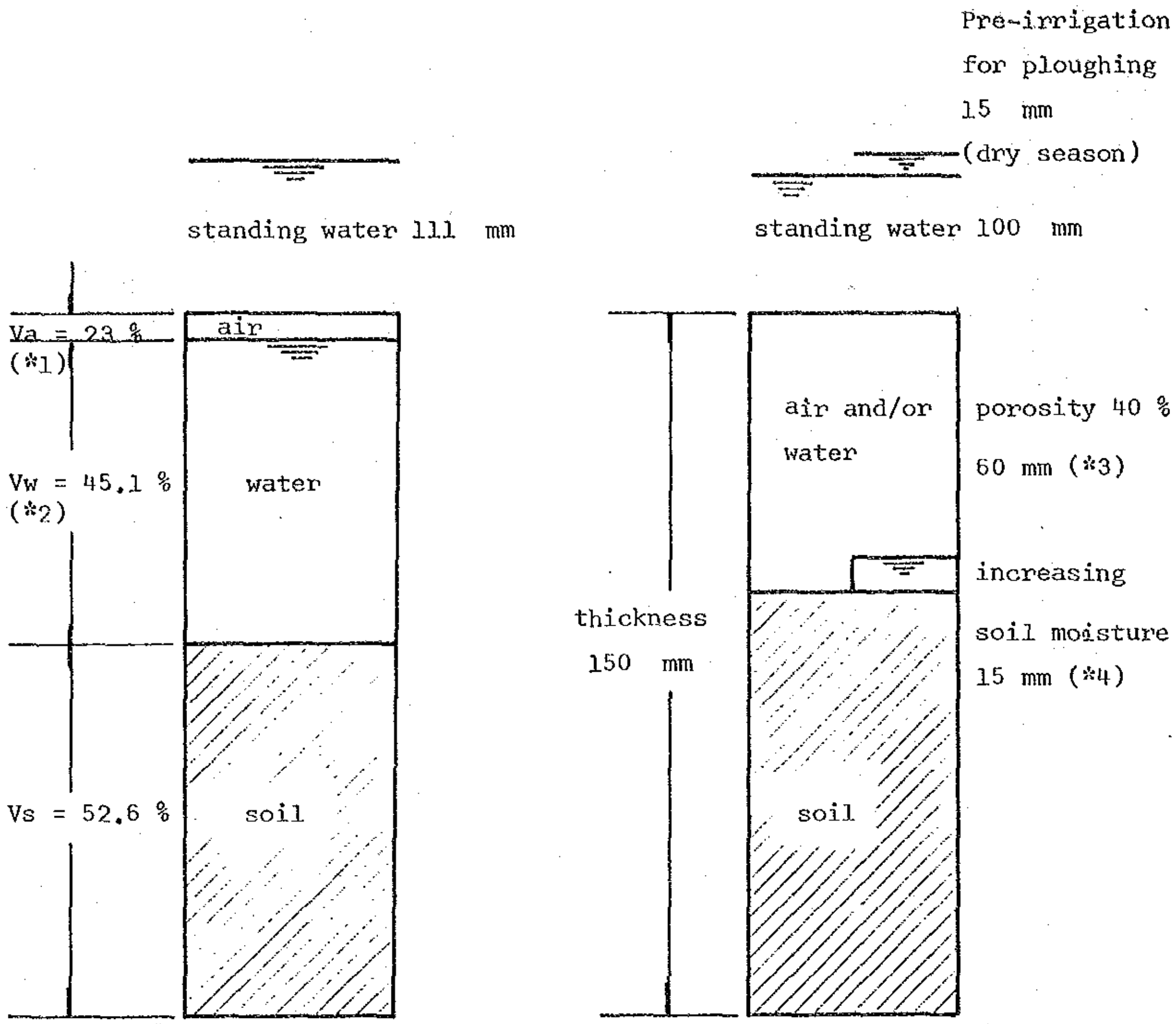


Fig-12.2 Depth of water vs. irrigation hour



Experiment result
before puddling
12.3,a

" Design Report "
12.3,b

Fig - 12.3

(*1) Assuming that soil layer thickness is 150 mm, air phase is 3.5 mm

(*2) Assuming that soil layer thickness is 150 mm, liquid phase is 67.7 mm .

(*3) Saturation of surface soil layer : 60 mm
(ploughing depth 150 mm, with 40 % of soil porosity)

(*4) Pre-irrigation for ploughing 15 mm (ploughing depth 150 mm, increasing soil moisture from 10 % to 20 %)

13. Spot height survey in the plots after re-levelling

13.1 Objective

To check the level in the plot after land re-levelling.

13.2 Method

Spot height survey with using auto level 16 spots/plot (50 m * 160 m)

13.3 Result

Shown in Table-13.1

The levelling in this term intended to cut the soil the former land consolidation work had left undone. By the farmers' request, the area to be improved became bigger than it had been estimated. As the result of this work, the irrigated area expanded than before in the Project area; but the flatness in the plots might not be sufficient owing to the limitted time and budget at that time.

13.4 Summary

It is necessary to define the standard of completion about the land levelling.

13.5 Reference

(1) Guide line

Range of allowable error;

100 mm more than 75% of total point shall be in the range of 75 mm.

Measure section;

Elevation at 16 points shall be measured in standard plot.

(2) Detail design

The margin of errors within ± 5 cm will be permissible. In the Project, the unit plot is so large by 160 m * 50 m that a great care should be excercised in levelling works. Partial uneveness in the Plots will be re-levelled when plowing and puddling are carried out after land consolidation completed.

Table-13.1 Spot height survey result

Plot number	Range (cm)	Number of spot	Plot number	Range (cm)	Number of spot
1,2,3	31.9	10	7	31.2	16
	41.0	10	8	25.2	16
	48.7	8	17,18,19	27.6	16
	20.0	7		31.8	16
	26.0	7	20	31.2	16
4,5	28.2	16	21	38.4	16
6	24.0	16			

No.2 Pump command area

14. Plot size at present in August 1984

14.1 Objective

To grasp the present condition of the plot size after a few years since the land consolidation finished.

14.2 Method

Field survey by measuring the distance between parallel borders.

Assuming that the plots in the area shown in Fig-14.1 were rectangle and that length of run was 160 m, I calculated the area of each plot; classified at 10 m interval.

14.3 Result

As shown Fig-14.2, we can find the many 160 are plot (100 m * 160 m) in the area shown in Fig-14.1. At present, standard plots (50 m * 160 m) exist nearly one-third in number: No.1 area 14 plots/36 plots, No.2 area 23/60, No.3 area 17/60, No.4 area 15/50.

14.4 Summary

The standard plots exist only one-third in number that may be designed in the area.

Survey area : Shown in Fig-14.1
the part surrounded by chain line

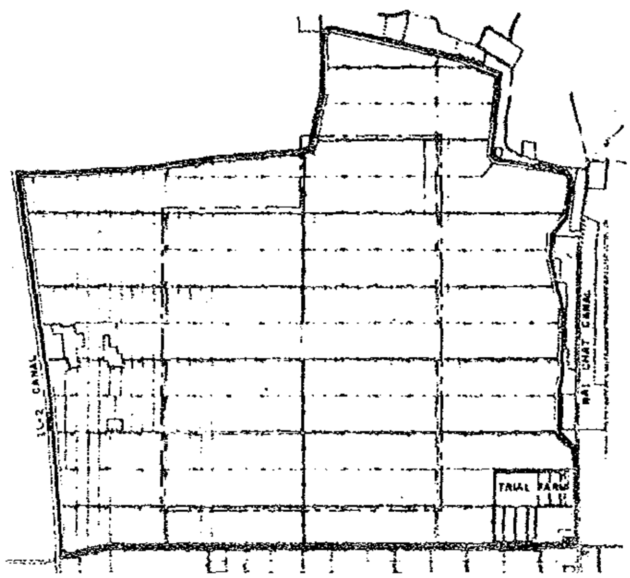


Fig-14.1

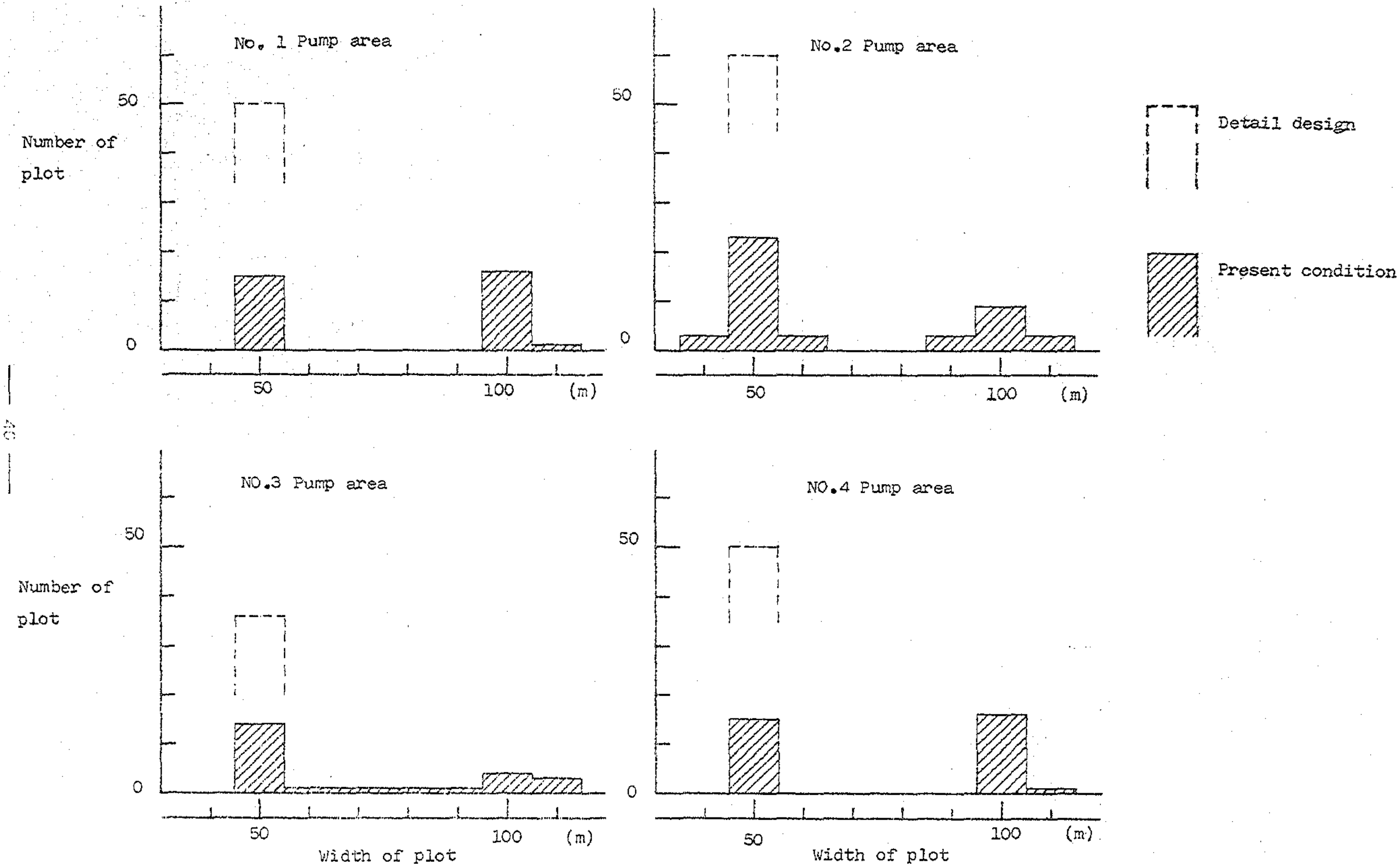


Fig.-14.2 Polt size in August,1984

15. Acreage of paddy classified according to the planting method

15.1 Objective

To grasp the present condition of the planting method applied in the Pilot area.

15.2 Method

I surveyed in the field and summed up the areage distributed to the farmers on the drawing.

15.3 Result

Shown in Table-15.1

Though " Detail design report " had suggested to adopt the transplanting after land consolidation, actually only 10 % of area of the paddy accepted transplanting, the rest did the direct sowing.

15.4 Reference

Refering to the " Detail design ", the condition of before land consolidation and proposed cropping pattern after land consolidation are shown in Fig-15.1 in comparison with the survey result.

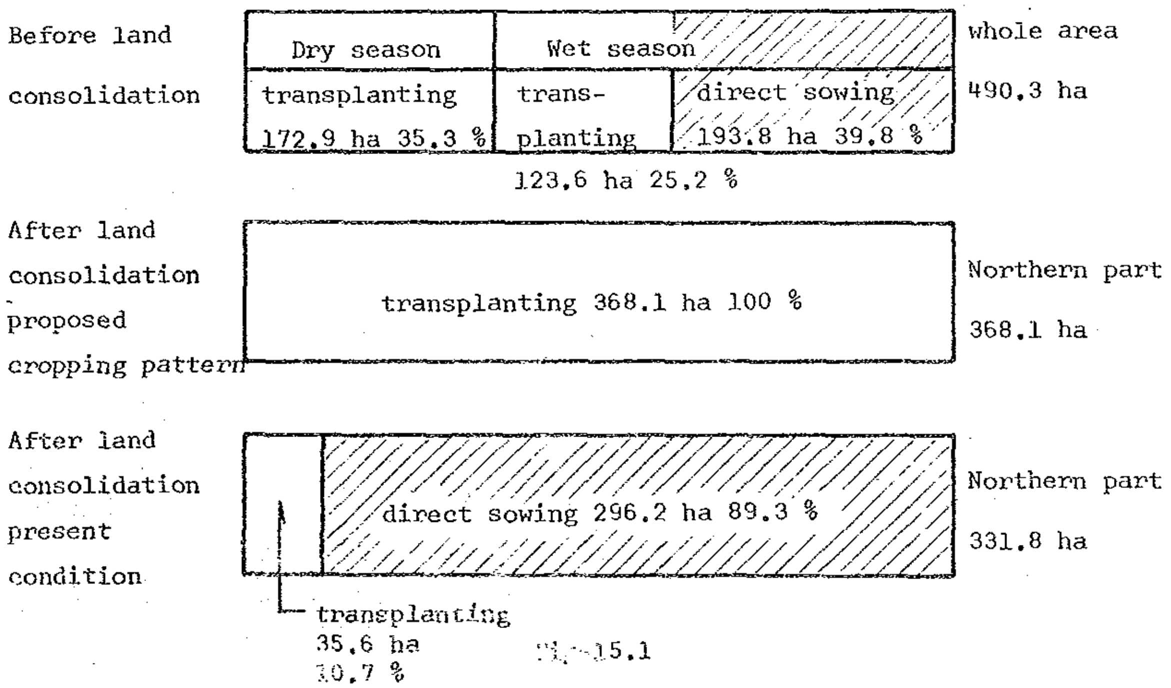
Table-15.1 Acreage VS. planting method

(Wet season, 1984)

unit : rai

Pump station	Transolanting	Direct sowing	Total
No.1	163.6	387.49	551.09
No.2	45.0	462.03	507.03
No.3	8.7	469.73	478.43
No.4	5.0	532.11	537.11
Total	222.3	1,851.36	2,073.66
	(10.7%)	(89.3 %)	(100 %)

*) 1 rai = 0.16 ha



[illegible]-15.1

16. Inspection of the diversion weir boxes in the Pilot area

16.1 Objective

To grasp the present condition of the diversion weir boxes in the Pilot area after the land consolidation finished.

16.2 Method

Inspection in sight

16.3 Result

As shown in Table-16.1, I checked 225 boxes in total. 180 boxes among these were active; 45 were dormant because the farmers put soil inside of boxes to stop the in-coming flow completely or the farmers gave up using boxes as these had not been installed at proper elevation.

With regard to the active 180 boxes, each box was to have 2 shuttering boards, then 360 pieces might exist. 122 pieces were available; but 73 pieces needed repairing because these had rotted to be short in heitht. What to worse, there were no boards at 165 positions.

I imagined the reason that the farmer dared not to repair the boards of his own plot or to make new ones. Because he did not feel the boards necessary when he would lead water into his plot. It was the time when the boards of his own plot became necessary that the irrigation rotation fell on the turn of the plot of another's own.

16.4 Summary

In the Pilot area, only one-third (122/360) of shuttering boards were available. It is necessary to prepare the all boards properly, so that the water management in the rotatio block may be performed.

Table-16.1 The Condition of Diversion Weir Box

Pump Station No.	Number of Box			Shuttering Flush Board			
	(1) active	(2) dormant	(3) total	(4) available	(5) need repair	(6) no exist	(7) Total
1	48	8	56	49	14	33	96
2	56	7	63	32	16	64	112
3	34	16	50	18	19	31	68
4	42	14	56	23	24	37	84
Total	180	45	225	122	73	165	360

17. Estimation of Manning's roughness n of the lateral canal

17.1 Objective

To estimate the roughness on hydraulics by the observation of the irrigation flow in the lateral canal and to compare the result with the design value.

17.2 Method

Since we might assume that the discharge, S.W.L. and D.W.L. of the secondary pump were nearly constant in a day operation, I considered that the stream flowed steadily but non-uniformly between two neibour turn-outs. Then I applied the equation shown below:

$$h_1 + \frac{\alpha Q_1^2}{2gA_1^2} = h_2 + il + \frac{\alpha Q_2^2}{2gA_2^2} - \frac{1}{2}\left(\frac{1}{R_1^{\frac{4}{3}} A_1^2} + \frac{1}{R_2^{\frac{4}{3}} A_2^2}\right) n^2 Q^2 l$$

where,

h_1 , h_2	;	depth of water
Q_1 , Q_2	;	discharge
A_1 , A_2	;	area of cross section
R_1 , R_2	;	hydraulic radius
i	;	slope of bed
l	,	distance
α	;	coefficient of energy
g	;	acceleration of energy
n	;	Manning's coefficient of roughness

(*) Suffix 1 and suffix 2 imply the value at down-stream and that at up-stream respectively.

We measured the discharge, using flow current meter.

(a) HIROI SANEI No.8060

(b) NAKAASA J-021 No.5084

(c) NAKAASA J-021 No.5189

I prepared the calculation form shown in Table-17.1. I got the result, using SHARP scientific calculator EL-5103 (pocket type).

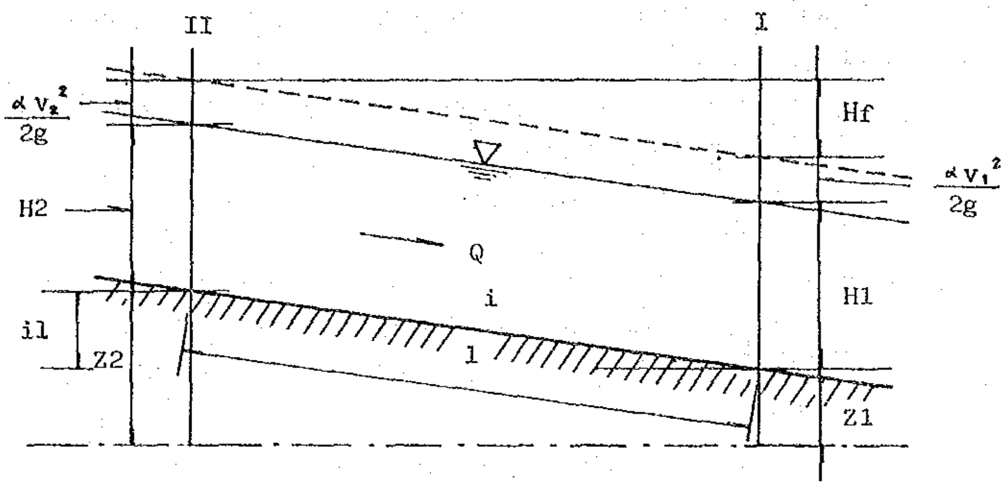


Fig-17.1

17.3 Result

Shown in Table-17.2

Soon after the periodical maintenance activity, such as cutting weed finished, the roughness was estimated to be n = 0.017-0.019 in the biggest canal LC-3.

Even with normal maintenance, the roughness was estimated to be n = 0.041 in the smallest canal LC-1.

17.4 Reference

Cross-section of canals

In hydraulic computation, the Manning's equation was adopted in taking roughness coefficient at 0.035. The canals shall provide the cross-section with the broader bottom for easy operation and maintenance, rather than that with hydraulical advantage. --" Detail design "--

Table-17.1 ESTIMATION OF ROUGHNESS

DATE : Feb. 9, 1984 PLACE : Pump Station No. 1 Lateral Canal NAME : Fukuda, Chanchai

ITEM	UP- STREAM	DOWN-STREAM	REMARKS
(1) Section	II Turn out 0	I Turn out 1	I : suffix 1 II : suffix 2
(2) Position	~~entrance~~ exit	entrance ~~exit~~	Instrument (b) NAKAASA J-021 No. 5084
(3) Time	14.00	15.15	
(4) Water level El.m	2.546	2.530	
(5) Depth m	0.55	0.52	
(6) Bottom level El.m	1.996	2.010	
(7) I : Bottom slope			I*L = -0.014
(8) L : Distance m	179		
(9) Q : Discharge cu.m/sec	0.179	0.161	Qave = 0.170
(10) Q ** 2	0.032041	0.025921	0.0289
(11) A : Cross section sq.m	0.9325	0.9495	
(12) A ** 2	0.869556	0.901550	
(13) P : Wetted perimeter m	2.680	2.816	
(14) R : Hydraulic radius m	0.347947	0.337180	(11) / (13)
(15) R ** (4/3)	0.244728	0.234683	
(16) R ** (4/3) * A ** 2	0.212805	0.211579	
(17) F(A,R) = 1 / (R**(4/3) * A**2)	4.699125	4.726363	I+II 9.425488
(18) 1 / (A ** 2)	1.150011	1.109200	II-I 0.040811

$$F(R,A) * n^2 * Q^2 * L = 2 * (H2 + i * L - H1) + \frac{Q^2}{g} \left(\frac{1}{A_2^2} - \frac{1}{A_1^2}\right)$$

$$9.425488 * n^2 * 0.0289 * 179 = 2 \left\{0.55 + (-0.014) - 0.52\right\} + \frac{0.0289}{9.8} * 0.040811$$

$$48.758 * n^2 = 0.032 + 0.00012$$

$$48.758 * n^2 = 0.03212$$

$$n^2 = 0.000658764$$

$$n = 0.0256$$

Table-17.2 Observation result of roughness co-efficient

Lateral Canal	Pump Station	Roughness Co-efficient n	Date	Instrument
LC - 3	1	0.0256	Feb. 9, 1984	b
		0.0251	Feb. 9, 1984	c
	1	0.0194	Dec.12, 1984	a
		0.0194	Dec.12, 1984	c
	2	0.0171	Dec.13, 1984	a
		0.0164	Dec.13, 1984	c
	3	0.0332	Aug.15, 1984	a
		0.0276	Aug.17, 1984	a
LC - 2	1	0.0255	Feb. 9, 1984	a
	3	0.0365	Aug.15, 1984	a
		0.0389	Aug.17, 1984	a
LC - 1	1	0.0411	Feb. 9, 1984	a

Instrument (a) ; HIROI SANEI No.8060
(b) ; NAKAASA J-021 No.5084
(c) ; NAKAASA J-021 No.5189

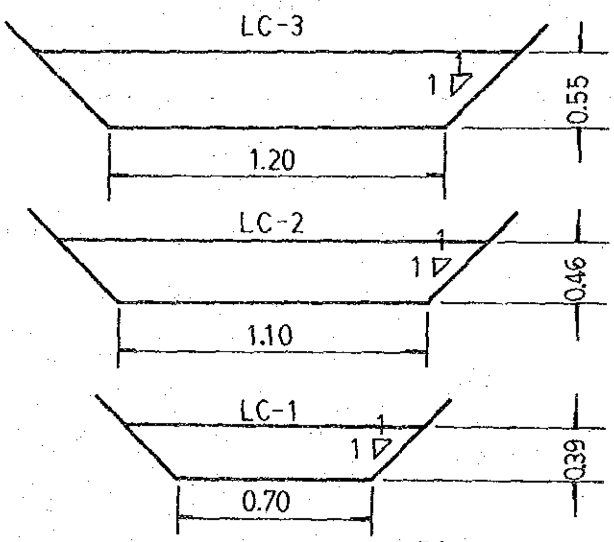


Fig.-17.2 Standard formation of the lateral cana

18. Irrigation diagram in No.2 Pump area

18.1 Objective

To revise the irrigation diagram applying the tentative design dimensions derived from the experiment in the Pilot area.

18.2 Method

I calculated the unit water requirement; summed up the gross requirement in No.2 Pump area considering the result of experiment and field observation as follows :

Unit water requirement	;	Water requirement for Puddling 230 mm (160 mm)
Irrigation efficiency	;	Application efficiency 0.80 (0.80) Conveyance efficiency 0.85 (0.90)
Pump operation hour of puddling stage	;	23 hr (22 hr)
Planting area	;	Observation result in August, 1984 paddy 83.0 ha up-land 17.4 ha total 100.4 ha

18.3 Result

Shown in Fig-18.1

The calculation in detail is shown appendix.

18.4 Summary

When we apply the dimensions derived from the experiment result in the Project, No.2 Pump requires quantity 10.8 cu.m/min (10.2 cu.m/min), speed 690 rpm (620 rpm) and drive power 7.5 Kw (5.5 Kw).

*) The value described in ( ) are derived from the detail design report or the final design.

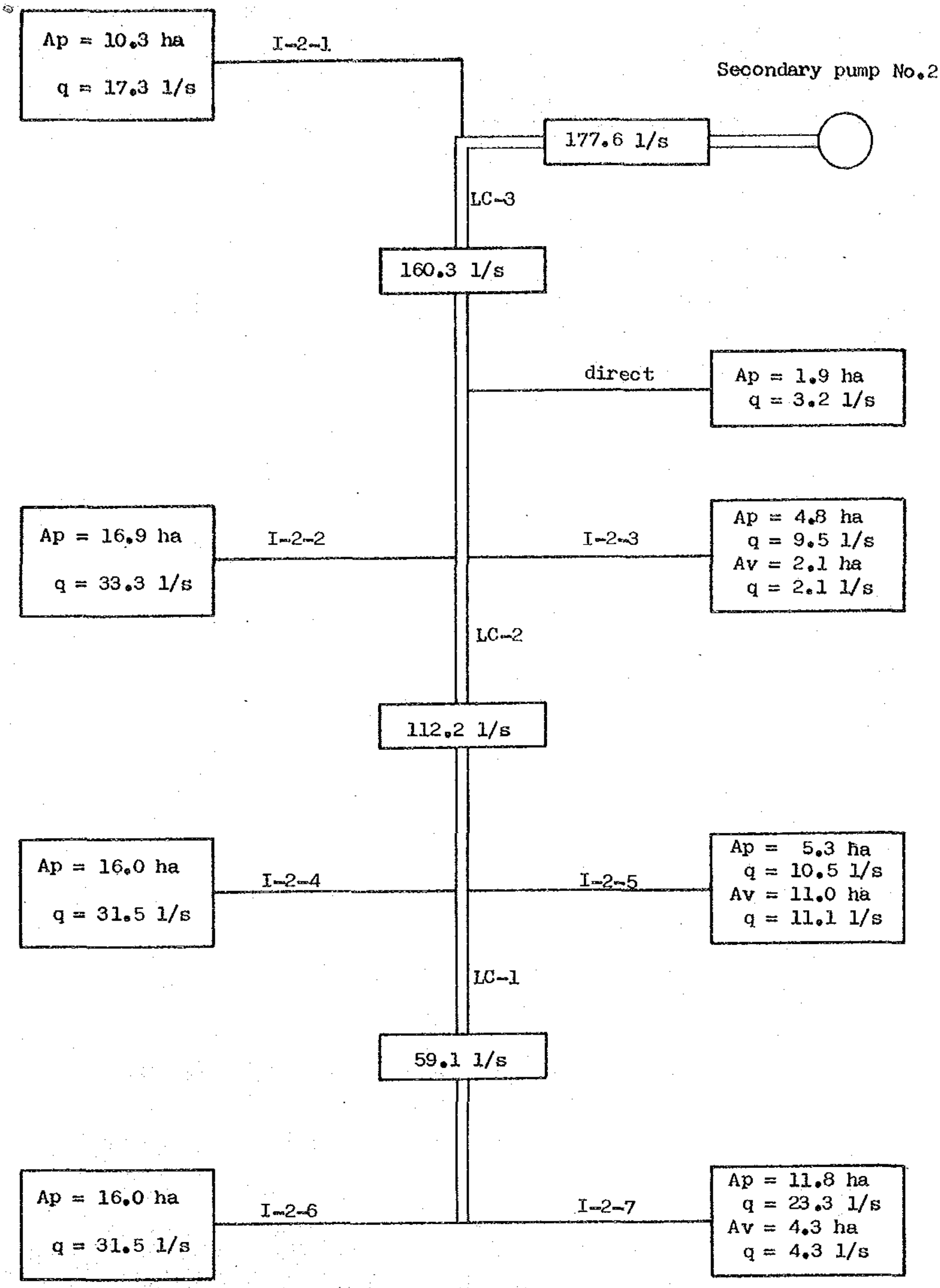


Fig.-18.1 Irrigation diagram in No.2 Pump area
(modification wet season 1984)

19. Consideration about hydro-dynamic dimensions of the secondary pump

19.1 Objective

To examine the capacity of the pump and the driver to improve the performance.

19.2 Method

I tried that the pump might discharge much quantity than that in the original condition with increasing the pump speed.

(1) Dynamic item

We changed the ratio of V-belt pulley in order to increase the pump speed.

(2) Hydraulic item

We measured the discharge indirect method using flow current meter HIROI SANEI No.8060.

(3) Electric item

We measured voltage using circuit tester SANWA MULTITESTER YX-360 TR. We checked amperage by the set position of the magnetic motor starter.

19.3 Result

Shown in Table-19.1

With the higher Suction Water Level, the motor was running 73 % load of the rated value.

19.4 Summary

In experimental operation, in the case that S.W.L. was higher than H.W.L. and head loss through the bar-screen was less than 0.20 m of the design value, the pump discharged 0.199 cu.m/sec at 738 rpm as the rated speed 620 rpm and 0.170 cu.m/sec.

Table-19.1 Dimensions of performance

Item		Rated value	Original condition	Modification in experiment
Pump discharge (cu.m/sec)		0.170	0.143	0.199
Pump speed (rpm)		620	620	738
Diameter of pipe (mm)		300	300	300
Velocity in pipe (m/sec)		2.40	2.02	2.82
Suction Water Level (El.m)		0.60	1.32	1.32
Delivery Water Level (El.m)		2.60	2.691	2.67
Head				
actual	(m)		1.371	1.35
loss	(m)		0.546	1.06
total	(m)	2.00	1.920	2.41
Water power	(Kw)	3.325	2.685	4.690
Shaft power	(Kw)	4.90	3.84	6.25
Drive power required	(kw)	5.5	4.22	6.88
Voltage	(V)	380	380	380
Amperage	(A)	11.8	8.0	11.2
Apparent power	(KVA)	7.767	5.265	7.371
Load efficiency	(%)	63	73	85

20. Discharge of secondary pump (part 2)

20.1 Objective

As we had grasped the necessity and possibility to improve the performance of the No.1 and No.2 Pump, we decided to replace the 5.5 Kw motor with 7.5 Kw motor to increase the discharge. The modification in detail is described in Table-20.1.

To check the discharge after the replacement and to confirm the performance.

20.2 Method

(1) Hydraulic item

We measured the discharge indirectly using flow current meter described below:

Instrument	;	(a) HIROI SANEI No.8060
		(c) NAKAASA J-021 NO.5189
Calibration	;	By the Resource & Energy Agency of Japan
Measurement line	;	Horizontal 1 point 40 % depth below surface

(2) Electrical item

We measured the voltage and ampere using circuit tester and clamp tester respectively described below:

Instrument	;	Circuit tester SANWA NULTITESTER YX-360 TR clamp meter KEW SNAP 9 MODEL 2904

20.3 Result

Shown in Table-20.2,3

20.4 Summary

No.1 Pump is successfully operating, increasing the discharge 33 liter/sec than before: No.2 Pump was not so successful as No.1 Pump owing to the bad electrical condition.

20.5 Reference

Selection chart of the mixed flow pump 300 SZ 50 Hz Vee-belt driven (Fig.-20.1).

20.6 Comment

At No.2 Pump station, we measured the amperage three times changing the combination of the electric wiring : the value of line-S were 7 A in each case. We asked the Provincial Electric Authority to investigate this matter.

Table-20.1 Comparison of the operation characteristic

Item		Final design	Modification *1)
Pump discharge	(cu.m/sec)	0.170	0.213 *2)
Pump speed	(rpm)	620	683
ratio		2.32	2.12
Diameter of pipe	(mm)	300	300
Velocity in pipe	(m/sec)	2.40	3.01
Suction Water Level	(El.m)	0.60	1.69
Delivery Water Level	(El.m)	2.60	2.617
Head			
actual	(m)		0.927
loss	(m)		1.229
total	(m)	2.00	2.156
Water power	(Kw)	3.325	4.491
Shaft power	(Kw)	4.90	6.173
Drive power required	(Kw)	5.145	6.79
		(5.5) *3)	(7.5) *3)
Voltage	(V)	380	390
Amperage	(A)	11.8	12.83
Apparent power	(KVA)	7.767	8.667
Load efficiency	(%)	63	71

*1) The value in column " Modification " were checked Dec. 12, 1984

*2) The value refers to the average discharge measured by instrument (a) and (c).

*3) The rated value is described in ( ).

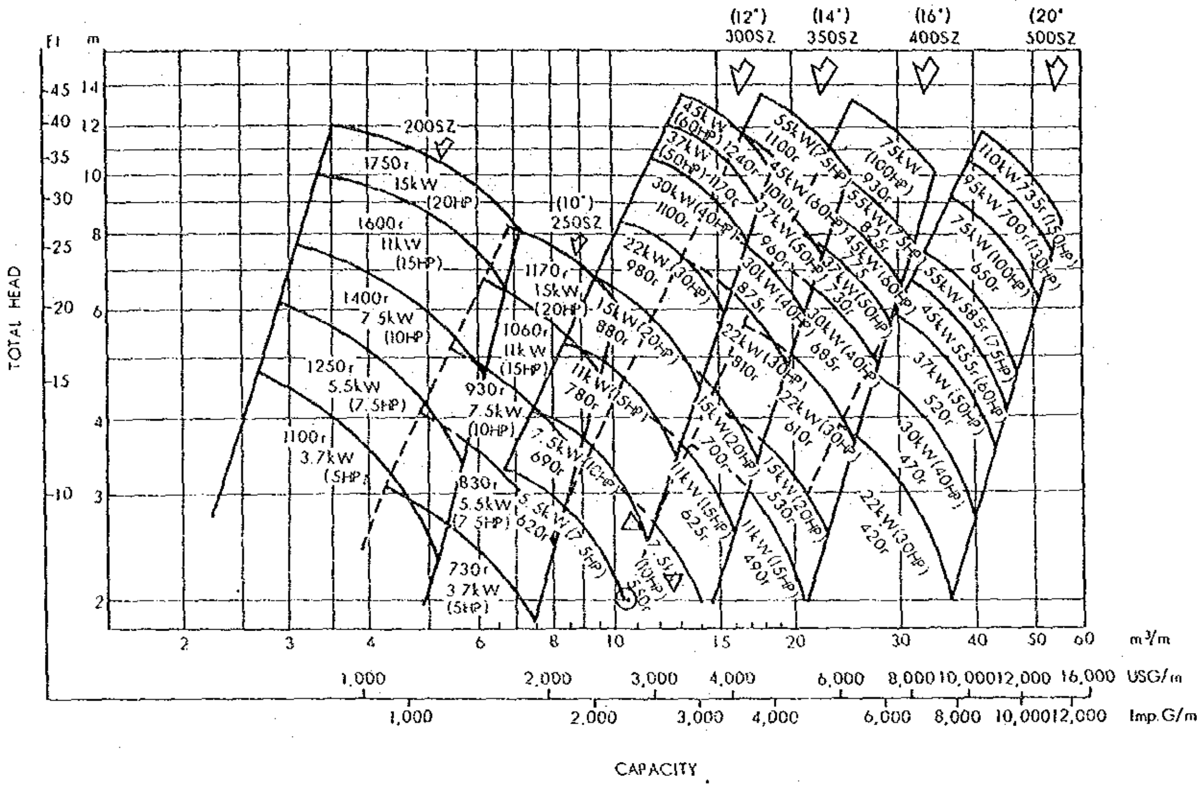
Table-20.2 Discharge after replacement

Pump Station	Discharge (liter/sec)		Suction Water Level (El.m)	Date
No.1	(a)	206	1.69	Dec. 12, 1984
	(c)	219		
No.2	(a)	181	1.80	Dec. 13, 1984
	(c)	182		

Table-20.3 Voltage and Amperage in operation

Pump Station	Line Voltage (V)			Line Amperage (A)			Apparent Power (KVA)
	U-V	V-W	U-W	R/U	S/V	T/W	
No.1	390	390	390	14	13	11.5	8.668
No.2	380	395	380	16.5	7	16.5	8.836

*) Voltage without load was 400 V



Symbol ○ ; the final design point

Symbol △ ; the proposed modification point

Symbol ▽ ; an operating point after modification

Fig. - 20.1 Selection chart of mixed flow pump

(Vee-belt driven 50 Hz)

APPENDIX

Acreage of the Chao Phya Pilot Project

October, 1984

unit : ha

Item / Area	Arable land (1) Paddy	(2) Vegetable	(3) Others	(4) Total (1) (3)	(5) Facility lot	(6) Road & canal	(7) Total (4) (6)
(a) Pump No.1	88.17	2.88	-	91.05	0.02	2.97	94.04
(b) Pump No.2	81.12	17.48	2.02	100.62	0.02	3.86	104.50
(c) Pump No.3	76.55	4.78	-	81.33	0.02	3.47	84.82
(d) Pump No.4	85.94	6.53	2.66	95.13	0.02	3.98	99.13
(e) Total (a) (d)	331.78	31.67	4.68	368.13	0.08	14.28	382.49
(f) Trial farm	5.62		0.85	6.47			6.47
(g) Main Pump Station					0.23		0.23
(h) Building lot					2.37		2.37
(i) Embank-ment						23.80	23.80
(j) Grand total							415.36

Water management groups and each coverage area Appendix-1.2

Wet season 1984

Unit : ha

Irrigation ditch	(1) Paddy	(2) Vegetable	(3) Others	(4) Total
Pump station No.1				
I-1-1	7.63	0.32		7.95
I-1-2	16.07			16.07
I-1-3	17.75			17.75
I-1-4	16.00			16.00
I-1-5	14.76	2.56		17.31
I-1-6	15.97			15.97
Total	88.17	2.88		91.05
Pump station No.2				
I-2-1	10.26		0.16	10.42
I-2-2	16.92			16.92
I-2-3	4.80	2.19		6.99
I-2-4	16.00			16.00
I-2-5	5.33	10.95		16.28
I-2-6	15.98			15.98
I-2-7	10.84	4.34		16.18
Direct			1.86	1.86
Total	81.12	17.48	2.02	100.62
Pump station No.3				
I-3-1	19.65			19.65
I-3-2	22.38			22.38
I-3-3	15.32	4.78		20.11
I-3-4	19.20			19.20
Total	76.55	4.78		81.33
Pump station No.4				
I-4-1	17.49			17.49
I-4-2	19.21			19.21
I-4-3	17.01	1.50	0.53	19.04
I-4-4	19.15			19.15
I-4-5	13.08	5.03	2.13	20.24
Total	85.94	6.53	2.66	95.13
Grand total	331.78	31.67	4.68	368.13

Dimension of the lateral canal in No.3 Pump area

1. Irrigation ditch and its coverage area

Ditch	Area (ha)
I-3-1	19.6
I-3-2	22.3
I-3-3	20.1
I-3-4	19.2
Total	81.2

* Area in Dec. 1981

2. Lateral canal and its coverage area

Lateral canal	Area (ha)
LC-2	81.2
LC-1	39.3

* Area in Dec. 1981

3. Design capacity

Lateral canal	Capacity (cu.m/sec)
LC-2	$\frac{0.0096 * 81.2 * 10,000}{60 * 60 * 22 * 0.80 * 0.90}$ = 0.137
LC-1	$\frac{0.0096 * 39.3 * 10,000}{60 * 60 * 22 * 0.80 * 0.90}$ = 0.066

4. Dimension of the lateral canal

Lateral canal	Capacity (cu.m/sec)	Bottom width (m)	Side slope	Bed slope	Roughness n	Normal depth(m)
LC-2	0.137	1.10	1:1	1/3265	0.035	0.421
LC-1	0.066	0.70	1:1	1/4710	0.035	0.385

Water requirement in depth of growing stage in wet season

Month		Design					Observation result		
		(1) Potential Evapo-transpiration (mm)	(2) Clop Co-efficiency	(3) Consumptive Use (mm)	(4) Percolation (mm)	(5) Water requirement (mm)	Plot No.130 (mm)	Plot No.150 (mm)	Plot No.160 (mm)
Jan.	I	3.9	0.85	3.3	1.0	4.3	nursery	nursery	nursery
	II	3.9	0.85	3.3	1.0	4.3	4.2	5.5	11.7
Feb.	I	4.7	0.90	4.2	1.0	5.2	4.1	5.6	10.5
	II	4.7	1.06	5.0	1.0	6.0	4.4	5.4	8.0
Mar.	I	5.2	1.17	6.1	1.0	7.1	5.7	8.8	6.3
	II	5.2	1.19	6.2	1.0	7.2	4.9	8.5	9.3
Apr.	I	5.7	1.13	6.4	1.0	7.4	7.1	5.9	10.9
	II	5.7	1.03	5.9	1.0	6.9			
May.	I	5.0	0.90	4.5	1.0	5.5			

Appendix-11.1

Water requirement in depth of growing stage in dry season

Month		Design Plant A					Observation result		
		(1) Potential Evapo-transpiration (mm)	(2) Crop Co-efficient	(3) = (1)+(2) Consumptive Use (mm)	(4) Percolation (mm)	(5) = (3)+(4) Water requirement (mm)	Plot No.120 (mm)	Plot No.130 (mm)	Plot Np.140 (mm)
Jul.	I	4.2	0.85	3.6	1.0	4.6	nursery	nursery	nursery
	II	4.2	0.85	3.6	1.0	4.6	6.7	6.5	5.3
Aug.	I	4.0	0.90	3.6	1.0	4.6	6.0	4.3	7.6
	II	4.0	1.06	4.2	1.0	5.2	5.0	6.0	8.0
Sept.	I	3.8	1.17	4.4	1.0	5.4	6.7	4.3	
	II	3.8	1.19	4.5	1.0	5.5	5.0	6.0	
Oct.	I	3.9	1.13	4.4	1.0	5.4	drain	drain	
	II	3.9	1.03	4.0	1.0	5.0			
Nov.	I	4.0	0.90	3.6	1.0	4.6			

Irrigation diagram in Pump No.2 area

1. Unit water requirement in depth

daily consumption (mm/day)		number of plot			plant	stage
7.1	*	15	=	106.5	A	growing
7.1	*	1	=	7.1	A	growing
6.5	*	15	=	97.5	B	growing
5.7	*	13	=	74.1	C	growing
5.4	*	2	=	10.8	C	growing
5.4	*	1	=	5.4	D	growing
230.0	*	1	=	230.0	D	growing
		48		531.4		
		531.4/48	=	11.1 mm/day		

2. Unit water requirement in the ditch per ha

1) paddy

$$\frac{0.0111 * 10,000}{60 * 60 * 23 * 0.80}$$

= 0.001675 cu.m/(sec . ha)

3. Unit water requirement in the lateral canal per ha

1) paddy

$$\frac{0.0111 * 10,000}{60 * 60 * 23 * 0.80 * 0.85}$$

= 0.001971 cu.m/(sec . ha)

2) up-land

$$\frac{0.0046 * 10,000}{60 * 60 * 23 * 0.65 * 0.85}$$

= 0.001005 cu.m/(sec . ha)

4. Ditch and its coverage area and discharge

ditch	Area (ha)		Discharge (l/sec)		
	paddy	up-land	paddy	up-land	Total
I - 2 - 1	10.3		17.3		17.3
direct	1.9		3.2		3.2
I - 2 - 2	16.9				
I - 2 - 3	4.8	2.1			
			42.8	2.1	44.9
I - 2 - 4	16.0				
I - 2 - 5	5.3	11.0			
			42.0	11.1	53.1
I - 2 - 6	16.0				
I - 2 - 7	11.8	4.3			
			54.8	4.3	59.1
Total	83.0	17.4	160.1	17.5	177.6