DESIGN REPORT
ON
THE INFRASTRUCTURE IMPROVEMENT WORKS
FOR
THE FOOD CROP PROTECTION PROJECT (PHASE II)
IN
THE REPUBLIC OF INDONESIA

MARCH 1988

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

This project is to carry out studies and investigations on biological inhibiting factors against stable production of rice and palawija, mainly soybean providing designated experimental fields such as Jatisari Pests Forecasting Center in West Java as a core of its activities, Medan Field Laboratory in North Sumatra and Celuk Field Laboratory in Bali province, and five-year-cooperation with this project in establishing forecasting technique and controlling systems on insect pests has been started since April 1, 1987.

The team, headed by Mr. Takamichi Iwai, Chief Researcher, the Japanese Institute of Irrigation and Drainage, JIID was dispatched to Indonesia from December 18, 1987 to January 26, 1988 for the purpose of detailed design of infrastructure improvement works for rattus experimental farm of Jatisari Pests Forecasting Center, a base of the project activities, and for Tsungro disease experimental farm of Celuk Pests Forecasting Field Laboratory.

This report represents the results of the field survey and a subsequent study in Japan. We hope that this report will serve as a guideline for the infrastructure improvement works.

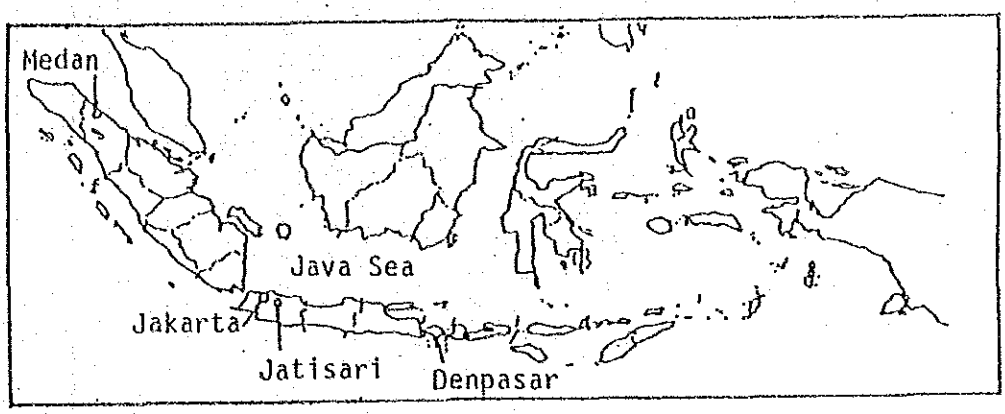
Lastly, we take this opportunity to express our deep gratitude to all those who were concerned with us for the close cooperation and assistance they extended to the Team throughout the survey period.

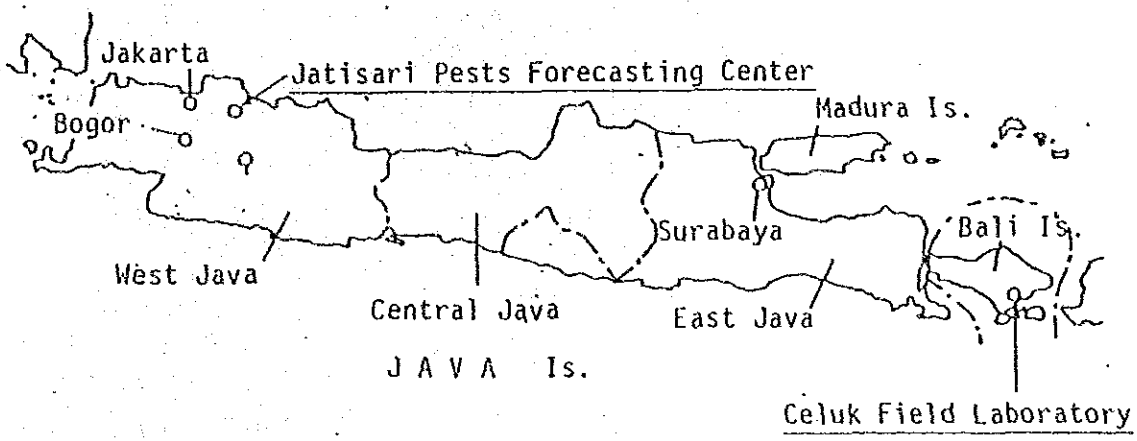
March 1988

Kazumi Miyamoto

Director
Agriculture Development
Cooperation Department,
Japan International Cooperation
Agency, JICA

LOCATION MAP OF PROJECT SITE





JATISARI PESTS FORECASTING CENTER

JAKARTA

BOGOR

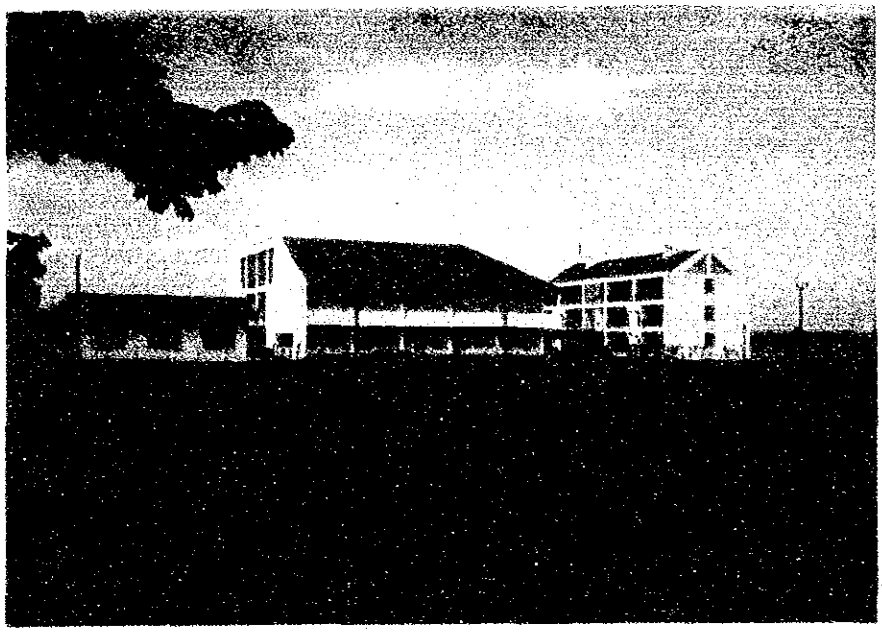
CELUK FIELD LABORATORY

DENPASAR

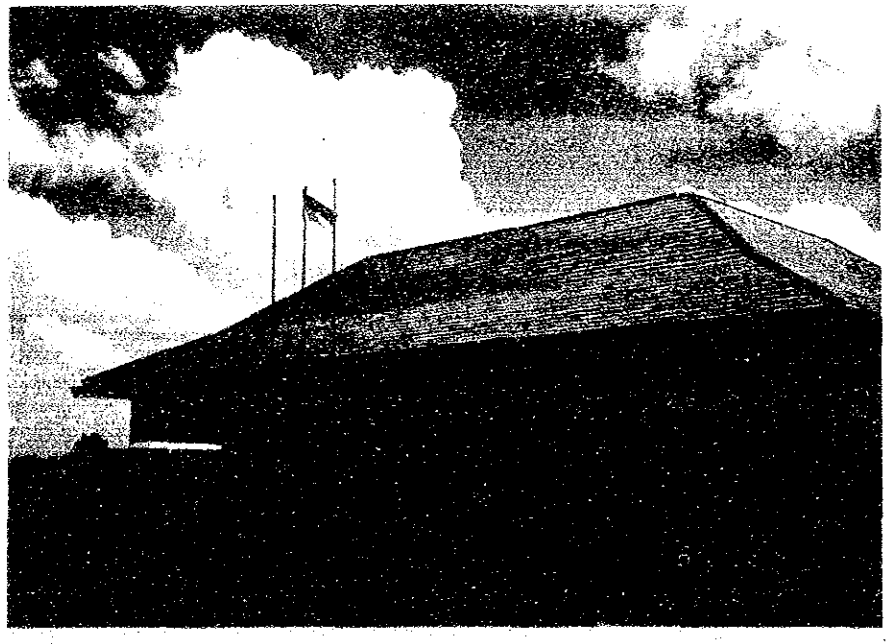
LOCATION MAP
OF
THE INFRASTRUCTURE IMPROVEMENT WORKS
FOR
THE FOOD CROP PROTECTION PROJECT
(PHASE II OF ATA-162)

SCALE 1 : 500,000

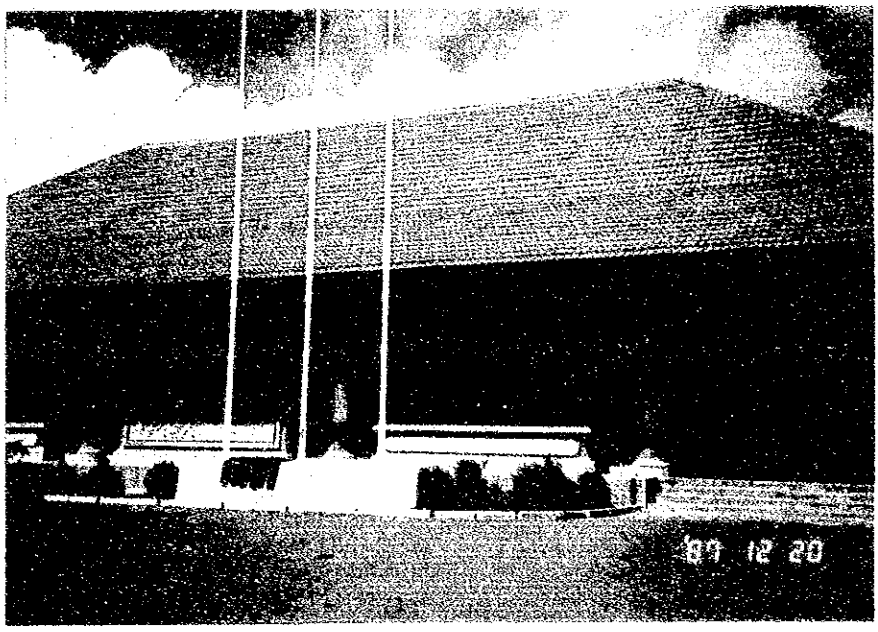
0 10 20 30 KM



No.1 Jatisari Pests Forecasting Center, West Java



No.2 Celuk Field Laboratory, Bali



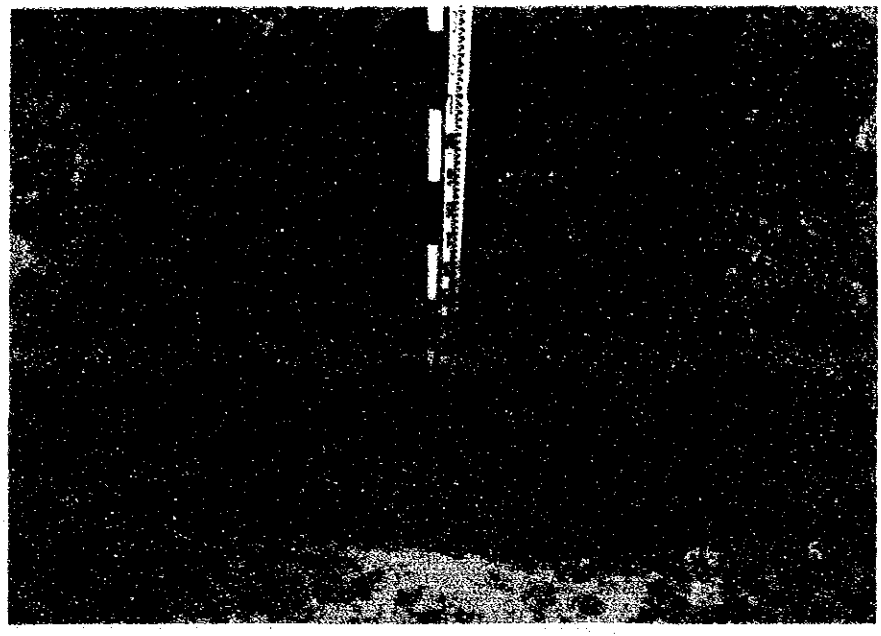
No.3 The 7 th Food Crop Protection Center, Denpasar Bali Province

No.4 Dormitory of Jatisari Center

(Reinforced Concrete, three-storied Building)

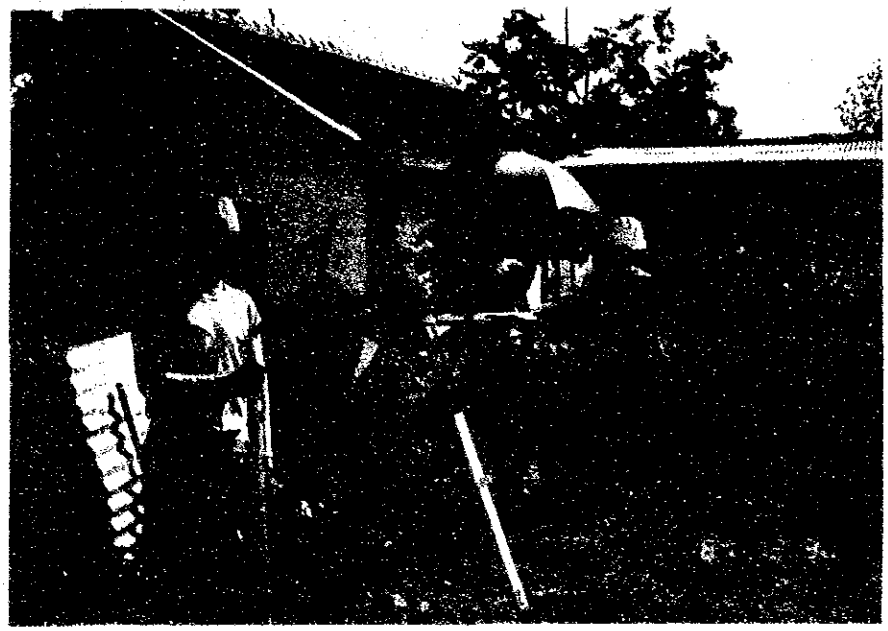
No.5 Experimental Farm of Jatisari
(Existing ; Left side, Planning ; Right side)

No.6 Planning Site of Vertebrate Laboratory, Net House and
Deep Well Pump (Embankment area just this side of photo)

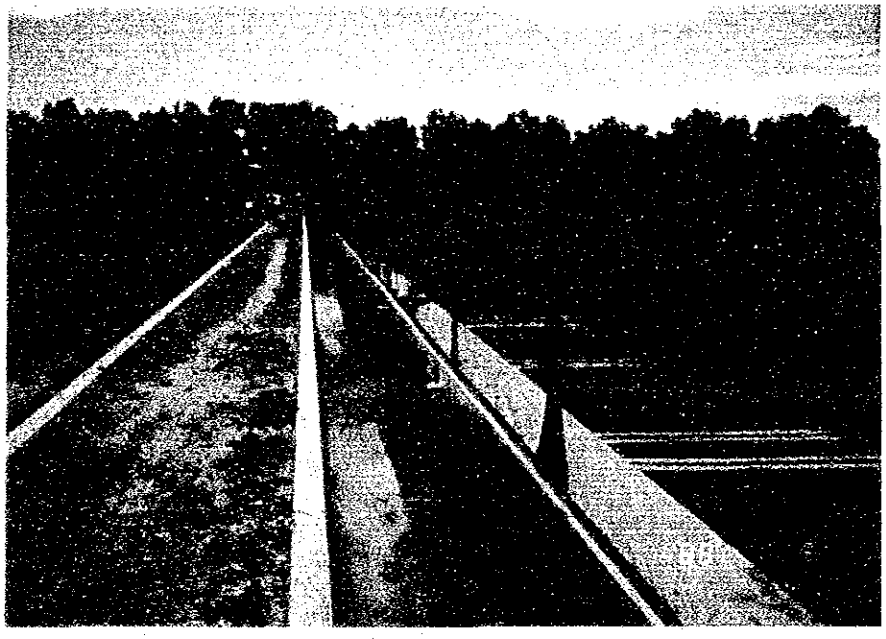


No.7 Excavation of Test Pit in the Present Paddy Field, Jatisari

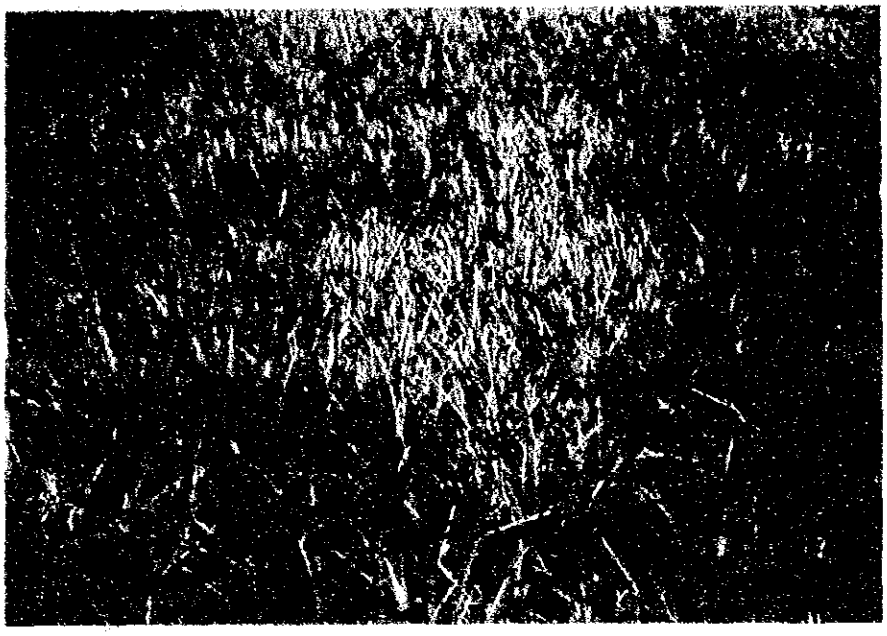
No.8 Planning Site of Intake Structure, Jatisari



No.9 Plane Table Survey, Jatisari



No.10 Rat Fence Structure in Ciba-Gaigi Research Center, Jatisari



No.11 Tungro Disease in Celuk, Bali

No.12 Planning Site of Experimental Farm, Celuk

No.13 Diversion Structure BLG.10 of Keduwatan Irrigation Project, Bali

No.14 Laboratory of the 7 th Food Crop Protection Center in Denpasar

OUTLINE OF MAIN WORK ITEMS

THE INFRASTRUCTURE IMPROVEMENT WORKS FOR
THE FOOD CROP PROTECTION PROJECT (PHASE - II of ATA-162)

I. JATISARI PESTS FORECASTING CENTER

1. LAND CONSOLIDATION WORK FOR PADDY FIELD

1)	Land shape adjustment & land levelling	2.8 ha
2)	Main drainage canal	238 m
3)	Main irrigation canal	447 m
4)	Lateral drainage canal	261 m
5)	Farm road	322 m
6)	Operation & maintenance road	246 m

2. CONSTRUCTION OF INTAKE FACILITIES & TERTIARY CANAL

1)	Intake & intake canal	1 L.S.
2)	Tertiary canal	178 m

3. CONSTRUCTION OF AUXILIARY WATER RESOURCES

1)	Deep well	40 m
2)	Submersible pump facilities	1 L.S.
3)	Generator house	1 house
4)	Regulating water tank	1 tank

4. INSTALLATION OF RAT FENCE

1)	Concrete foundation	430 m
2)	Installation of rat fence	640 m
3)	Automatic gate	1 pce

5. OTHER RELATED STRUCTURES

1)	Foundation of bertebrate laboratory	1 place
2)	Foundation of net house	2 places
3)	Improvement of existing operation road	157 m
4)	Improvement of access road & gate	1 L.S.
5)	Repairement of fence	1 L.S.

II. CELUK FIELD LABORATORY

1. LAND CONSOLIDATION WORK FOR PADDY FIELD

1)	Land shape adujustment & land levelling	0.5 ha
2)	Irrigation canal	130 m
3)	Drainage canal	230 m
4)	Farm road	200 m

2. CONSTRUCTION OF INTAKE & REGULATING WATER TANK

1) Intake canal & turn out	1 L.S.
2) Regulating water tank	1 tank

3. CONSTRUCTION OF RAT FENCE

1) Rat fence	275 m

4. OTHER RELATED STRUCTURES

1) Access road	1 L.S.
2) Masonry retaining wall	77 m_3
3) Mounding work	500 m^3
4) Repairement of fence	1 L.S.

GENERAL PLAN OF JATISARI CENTER

LOCATION MAP

THE INFRASTRUCTURE IMPROVEMENT WORKS FOR THE FOOD CROP PROTECTION PROJECT

1. LAND CONSOLIDATION WORK FOR PADDY FIELD
   1. Land shape adjustment & land levelling — A= 2.8 ha
   2. Irrigation canal — L= 447m
   3. Main drainage canal — L= 238m
   4. Drainage canal — L= 261m
   5. Farm ditch — L= 2126m
   6. Farm road / B=2.0, 3.5 m — L= 322m
   7. Operation road / B=3.5m — L= 208m

2. INTAKE AND IRRIGATION CANAL
   1. Intake / Qa= 2 l/sec — 1 place
   2. Tertiary canal / Q=50 l/sec — L= 176m
   3. Intake canal — L= 45m

3. AUXILIARY WATER RESOURCES
   1. Deep well / ø200 mm — H= 40m
   2. Deep well pump & operation panel/ 50mm — H= 40m
   3. Generator house — A= 3.75 x 4.4m
   4. Water Tank/masonry / 4 Nos. 5 m — V= 32.4m³

4. INSTALLATION OF RAT FENCE
   1. Concrete foundation / H= 0.8 m — L= 430m
   2. Rat Fence / L= 640m
   3. Automatic gate — 1 place

5. VERTEBRATE LABORATORY, NET HOUSES FOUNDATION WORKS
   1. Vertebrate Laboratory — A= 13.00 x 7.50
   2. Net houses — A= 14.54 x 7.24, 2 places

6. OTHER RELATED STRUCTURES
   1. Repairement of existing operation road/asphalt pavement / B=3.0 m — L= 157m
   2. Access road and gate — 2 places
   3. Repairement of existing fence — 1 L.S.

DIRECTORATE GENERAL OF FOOD CROP AGRICULTURE
THE INFRASTRUCTURE IMPROVEMENT WORKS FOR THE FOOD CROP PROTECTION PROJECT (2nd Phase of ATA-162)

JATISARI FISHS FORECASTING CENTER

GENERAL PLAN

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO

DWG. NO. J-1

GENERAL PLAN OF CELUK FIELD LABORATORY

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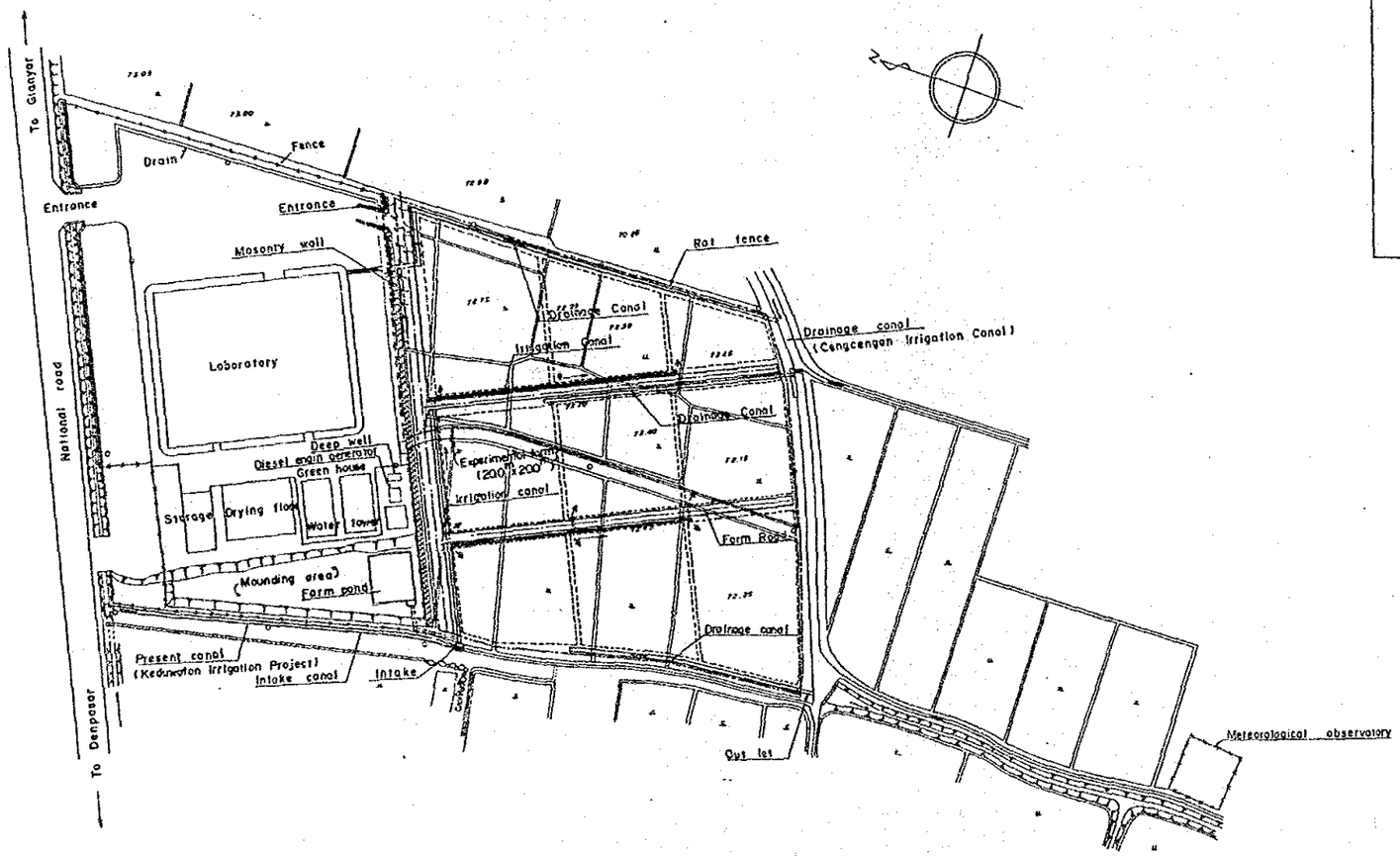
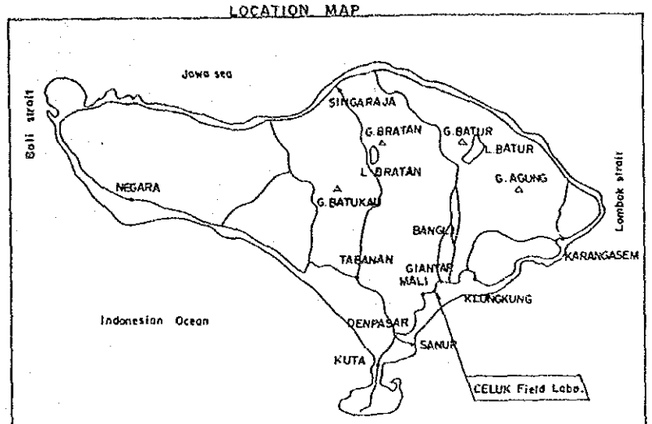
SCALE 1 : 500



LOCATION MAP



THE INFRASTRUCTURE IMPROVEMENT WORKS FOR THE FOOD CROP PROTECTION PROJECT

1. LAND CONSOLIDATION WORK FOR PADDY FIELD
   1. Land shape adjustment & land levelling — A=0.5 ha
   2. Irrigation canal/flume — L=130 m
   3. Drainage canal/masonry — L=230 m
   4. Farm road/gravel metaling
      - Type-A B=2.5 m — L= 75 m
      - Type-B B=1.5 m — L=125 m

2. INTAKE CANAL & FARM POND
   1. Intake canal/concrete lining — L= 60 m
   2. Turnout box/concrete — 1 place
   3. Farm pond/concrete 7.5x7.5x1.6 m — V= 80 m^3

3. INSTALLATION OF RAT FENCE WITH AUTOMATIC DOOR H=1.5 m — L=275 m

4. OTHER RELATED STRUCTURES
   1. Access road & entrance — 1 place
   2. Masonry wall H=1.8 m — L= 77 m
   3. Repairement of existing fence — 1 L.S.
   4. Mounding work — V=500 m^3

DIRECTORATE GENERAL OF FOOD CROP AGRICULTURE THE INFRASTRUCTURE IMPROVEMENT WORKS FOR THE FOOD CROP PROTECTION PROJECT (2nd Phase of ATA-162)	
CELUK FIELD LABORATORY GENERAL PLAN	
JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO	DWG. NO. C-1

C O N T E N T S

CHAPTER 1 BASIC PLAN

The objective of this survey is to conduct a detailed design survey for the infrastructure improvement works to construct an experimental farm and related facilities for the study on Rattus argentiventer at Jatisari Pests Forecasting Center in West Java and an experimental farm and related facilities for the study on the Green Leaf Hopper and Tungro Disease at Celuk Field Laboratory in Bali so that the technical cooperation of the Food Crop Protection Project (The Second Phase of ATA-162) started from April 1, 1987 will be proceeded smoothly and effectively.

After the reconnaissance survey and collecting related informations on two experimental farms, Jatisari in West Java and Celuk in Bali, the detailed design survey team dispatched by JICA submitted a report on Basic Plan mentioned below to the Directorate General of Food Crop Agriculture in December 26, 1987.

Basic Plan on the Infrastructure Improvement Works for the Food Crop Protection Project (the Second Phase of ATA-162)

INTRODUCTION

The Detailed Design Survery Team has decided the basic plan as follows based on field reconnaissance survey.

However, some of the items below may be changed after detailed survey.

JATISARI PESTS FORECASTING CENTER (EXPERIMENTAL FARM FOR RODENT)

1. Irrigation facilities

(1) An intake from existing irrigation canal will

be located at the nearest point from the new experimental farm. Surplus water will be conveyed to the adjacent existing experimental farm and surrounding paddy fields.

(2) As irrigation water above mentioned might be unstable, a new well will be dug to supply approximately 200 liters per minute. Suitable scale of a farm pond will also be installed.

2. Others

(1) Total area of the new experimental farm is 2 hectares (200m x 100m) and the area is surrounded by the rat fence.

(2) The farm road in the experimental farm has enough scale for the vehicle to carry such experimental equipment as a telemeter.

(3) Outline of approximate arrangement of farm road and canals is shown in the figure-1.

CELUK FIELD LABORATORY (EXPERIMENTAL FARM FOR GREEN LEAF HOPPER & TUNGRO DISEASE)

1. Irrigation facilities

An intake in the existing irrigation canal will be improved. A new farm pond (approximately 80 cubic meters) will be also installed to utilize the capacity of the existing deep well pump.

2. Others

(1) Total area is about 0.4 hectares, where the nine plots (20m x 20m) are made.

(2) The access road is designed for a tractor to enter the experimental farm. But, the farm roads along the plots can be lessened up to the one-wheel-car scale.

(3) The material and shape of the surrounding fence will be decided considering both rats proof and climatical conditions.

(4) Outline of approximate arrangement of farm road and canals is shown in the figure-2.

Fig - 1 Plan of Jatisari Pests Forecasting Center (Basic plan)

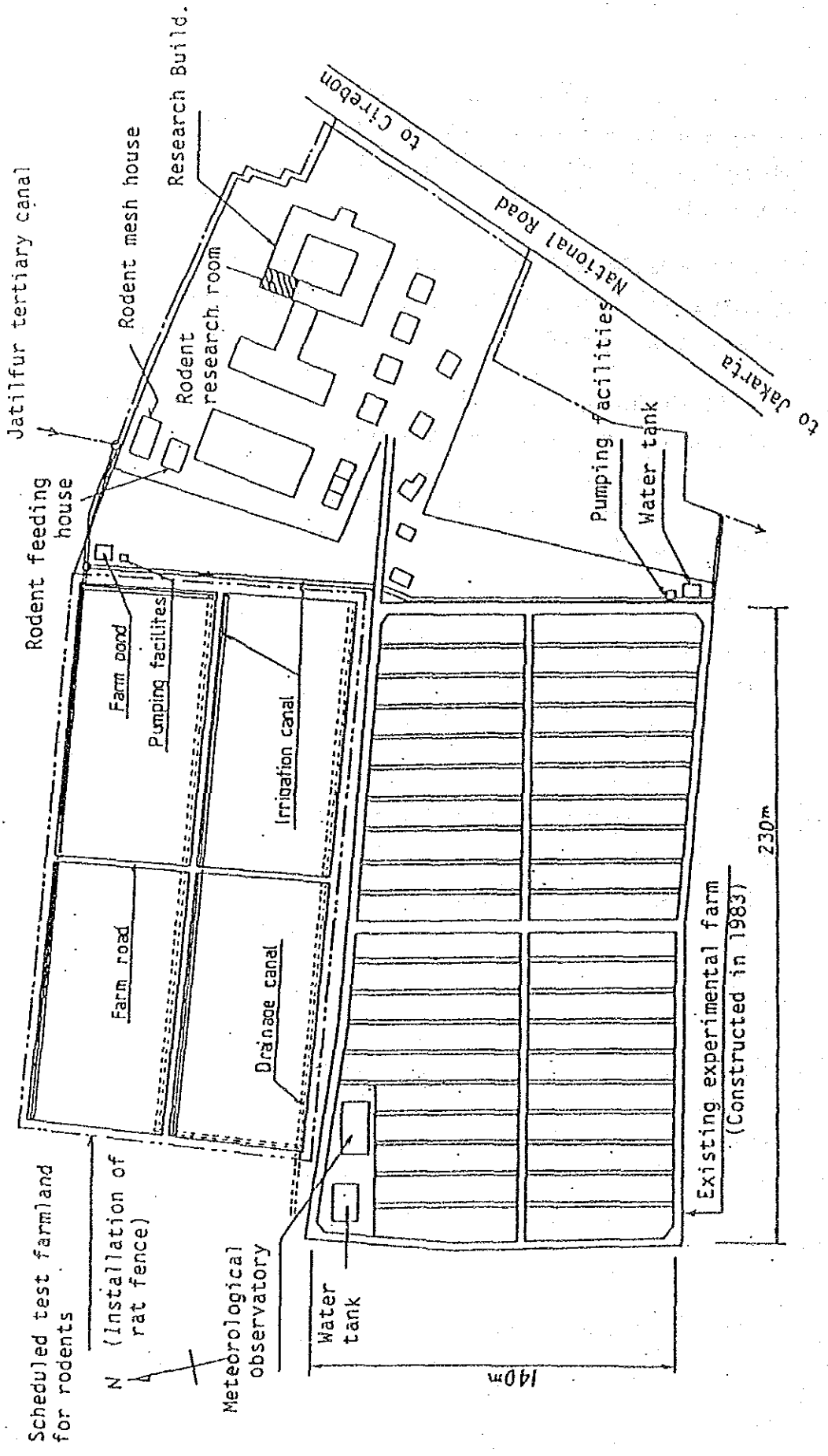
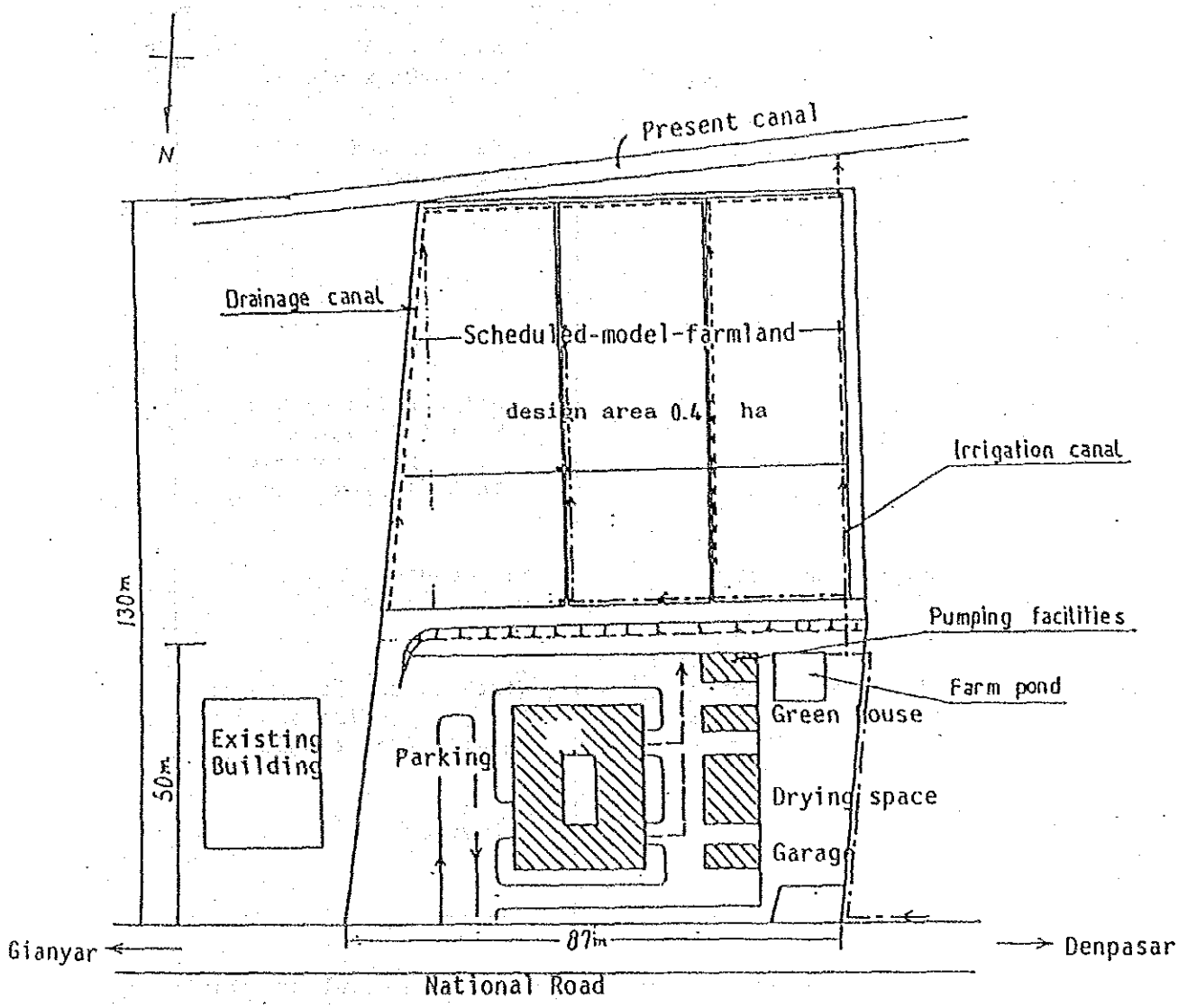


Fig. 2 Plan of Celuk Field Laboratory (Basic plan)



The following table shows major items to be improved for consolidating of Jatisari and Celuk determined in the above-mentioned Basic Plan.

Items to be Improved	Jatisari	Celuk
1) Experimental Farmland	About 2 ha (50m x 10m x 40 lots)	About 0.4 ha (20m x 20m x 9lots)
2) Water Source and intake facilities	Jatiluhur Tertiary Canal	Keduwatan Weir Tail Canal
3) Shifted Canal	Tertiary Canal	
4) Supplementary Water Source	· Using New Deep Well (Approx. 200ℓ/min) · New Regulating Water Tank (Approx. 36m^3)	· Using Existing Deep Well (40~50ℓ/min) · New Ragulating Water Tank (Approx. 80m^3)
5) Rat Fence	Surrounding Farm of about 2 ha	Surrounding Farm of about 0.4 ha
6) Farm Road	Width enough for a test-vehicle passing	Width enough for a farm tractor passing and a wheel barrow passing
7) Access Road to Farm	1 Lump Sun	1 Lump sum

The Detailed Design Survey was carried out based on the items for improvement works mentioned above.

CHAPTER 2. PRESENT CONDITION

Field survey, topo-survey and detailed design were carried out in the survey this time on two laboratories for insect pest and disease of rice located at Jatisari in the province of West Java and at Celuk in the province of Bali. General features of the both loboratories are as follows.

2-1 General Aspect of Jatisari Pests Forecasting Center

1) Originally the Jatisari Pests Forecasting Center was established as a pest forecasting laboratory in 1977, after that its facilities were improved by a grant aid cooperation of "The rice Pest and Disease Forecasting and Control Project" in 1987, and it became a National Center, the organization above the Food Crop Protection Center.

The Jatisari Center is located at Jatisari district, Karawang Regency, West Java Province about 100 km to the south east of Jakarta, at 6°23' south and 107°30' east. This area is in country of paddy field within the Jatiluhur Irrigation Project area, facing with the State road which connects Jakarta and Cirebon. The National Railways Jakarta - Surabaya line passes nearly Jatisari. The Jatisari Center is in the central part of paddy fields of 460,000ha in the northern region of the West Java province, about 20km down stream of the Jatiluhur Reservoir, about 20 km from the Java Sea with an elevation of 26 m.

Blessed with geographical conditions, the location of the Center has a suitable environment for the activty of insect pest forecasting and insect pest prevention.

The mean air temperature is 27.5°C and the annual rainfall is estimated at around 1,900 mm, however, the monthly rainfall in June, July, August and September is 30 ∿ 60 mm only, and once a year, Jatiluhur Irrigation Canal is cut off water supply in September for the maintenance.

As for geological feature of land in the vicinity of the Center originated in the Pleistocene era and indicates presently such structural phenomena as the volcanic facies comprised volcanic ashes and volcanic matters which is subject to the Quarternary era cover over the sedimentary facies consisted of clay materials and solid matters, which are formed in the Tertiary era.

The soil of the farmland mearly consists of association of yellow podzol and grey hydro-morph and the main materials formed the soil are sedimentation of clay and sand with a considerable thickness.

2) Summary of General Features of the Jatisari Center

Name of Center : Jatisari Pests Forecasting Center

Administrative District :

Desa : Pangulah Utara
Kecamatan : Jatisari
Kabupaten : Karawang
Propinsi : West Java

Location : About 100 km to the south east of Jakarta, located along the State road connecting Jakarta and Cirebon, adjacent to Cikampek and Sukamandi

Access : About 3.4 km length using national road from the crossing points of railways; Jakarta - Surabaya line at Cikampek district

Purpose of the Center

: Forecasting, surveillance of pests for food crops and the research

Operational Agency

: Directorate of Food Crop Protection, Directorate General of Food Crop Agriculture, Ministry of Agriculture

Topography

: Locating in paddy field area of 460,000 ha on a flat alluvial plain in West Java Province, 20 km from the Java Sea

Elevation: 26 - 28 m (Main office; EL 28.3 m, scheduled test field; EL26.0 - EL27.3 m)

Climate :

Mean temparature	:	27.5 °C
Max. temparature	:	35 °C
Min. temparature	:	19 °C
Mean Yearly rainfall	:	1970 mm
Mean Monthly rainfall	:	164 mm
Humidity	:	79%
Wind	:	1.6 m/sec

Geology and Soil

: Association Podsolic yellow and Hydromorph gray of Quaternary era

: Sedimentation of clay and sand, PH 6.5 - 6.8

Vegitation

: Rice (double cropping)

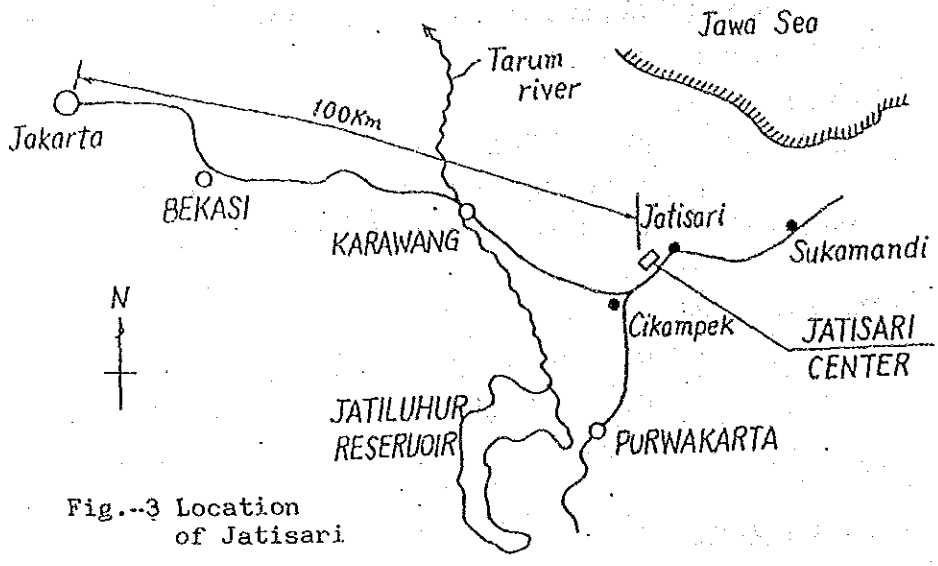


Fig.-3 Location of Jatisari

2-2 General Aspect of Celuk Field Laboratory

1) The buildings and facilities of this Laboratory were provided under the grant aid by Japanese Government and constructed on March 1987. The Laboratory has been functioned as a field laboratory (FL) for forecasting and prevention of insect pest on rice. The Celuk Field Laboratory is located in Celuk Village about 11 km to the north east of Denpasar, and its administrative location is Celuk Village, Sukawati district, Gianyar Regency, Bali Province, at 8°36' south and 115°15' east. Bali Island is a small island of 5,561 km^2, close to the east end of Jawa Island. Its population is as high as 444 man/km^2 similar to the population in Java Island, 690 man/km^2. Rice cropping and irrigation technology in Bali Island have been famous long, and there exist farmers water users association called Subak. The area of

this loboratory also belongs to Subak PEJAJAH.

The Celuk Field Laboratory is located along the State road from Denpasar to Gianyar City and its elevation is generally 72 ∿ 74.5 m. The mean air temperature is 27°C in Denpasar, and the annual rainfall in Celuk is about 1,500 mm. As for the geological properties around the laboratory, layers are composed of volcanic rocks and volcanic matters of the Quaternary era, and the substratum is made of basic (alkaline) rocks seemed to be covered over with deposits of acid andosols (volcanic ash soil), redusols and ferralsols.

2) Summary of General Features of Celuk Field Laboratory

Name of Center

: Celuk Pests Forecasting Field Laboratory

Adninistratie District

: Desa : Celuk
Kecamatan : Sukawati
Kabupaten : Gianyar
Propinsi : Bali

Access : About 11 km to the northeast of Denpasar. North of the area is facing the Denpasar - Gianyar, national road

Purpose of the Center

: Field laboratory for forecasting and surveillance of pests for food crops

Operational Agency

: Directorate of Food Crop Protection
: Denpasar 7th Food Crop Protection Center

Topography : Lower part between Ajung river and Oos river, mean land slope 1/60

Elevation : 72.0 - 74.5 m (Main office; EL 74.3 m, Experimental farm; EL72.0 - 72.6 m)

Climate :

Mean Temperature	:	27.0 C
Max. Temperature	:	31.4 C
Min. Temperature	:	22.4 C
Mean Yearly Rainfall	:	1473 mm
Humidity	:	80%
Mean Wind Velocity	:	2.6 m/sec

Gelogy/ and Soil

: Quarternary, Bujan-Bratan and Datur tuffs and lahar deposits

: Redusol, clay and sand, PH 5.5 - 6.2

Vegitation : Rice, double cropping (2.5 cropping partially)

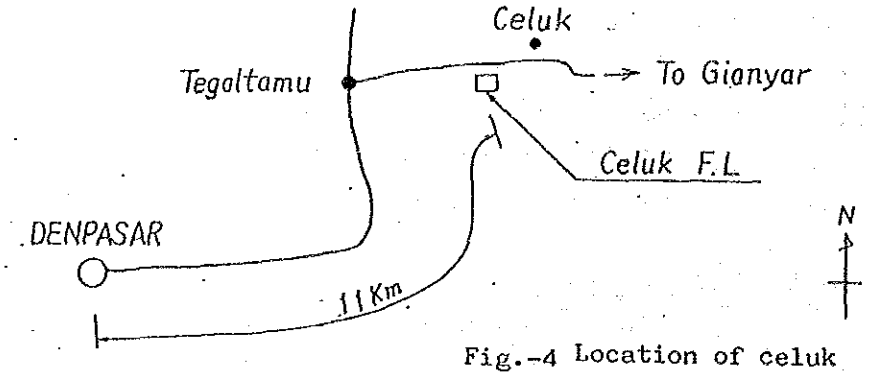


Fig.-4 Location of celuk

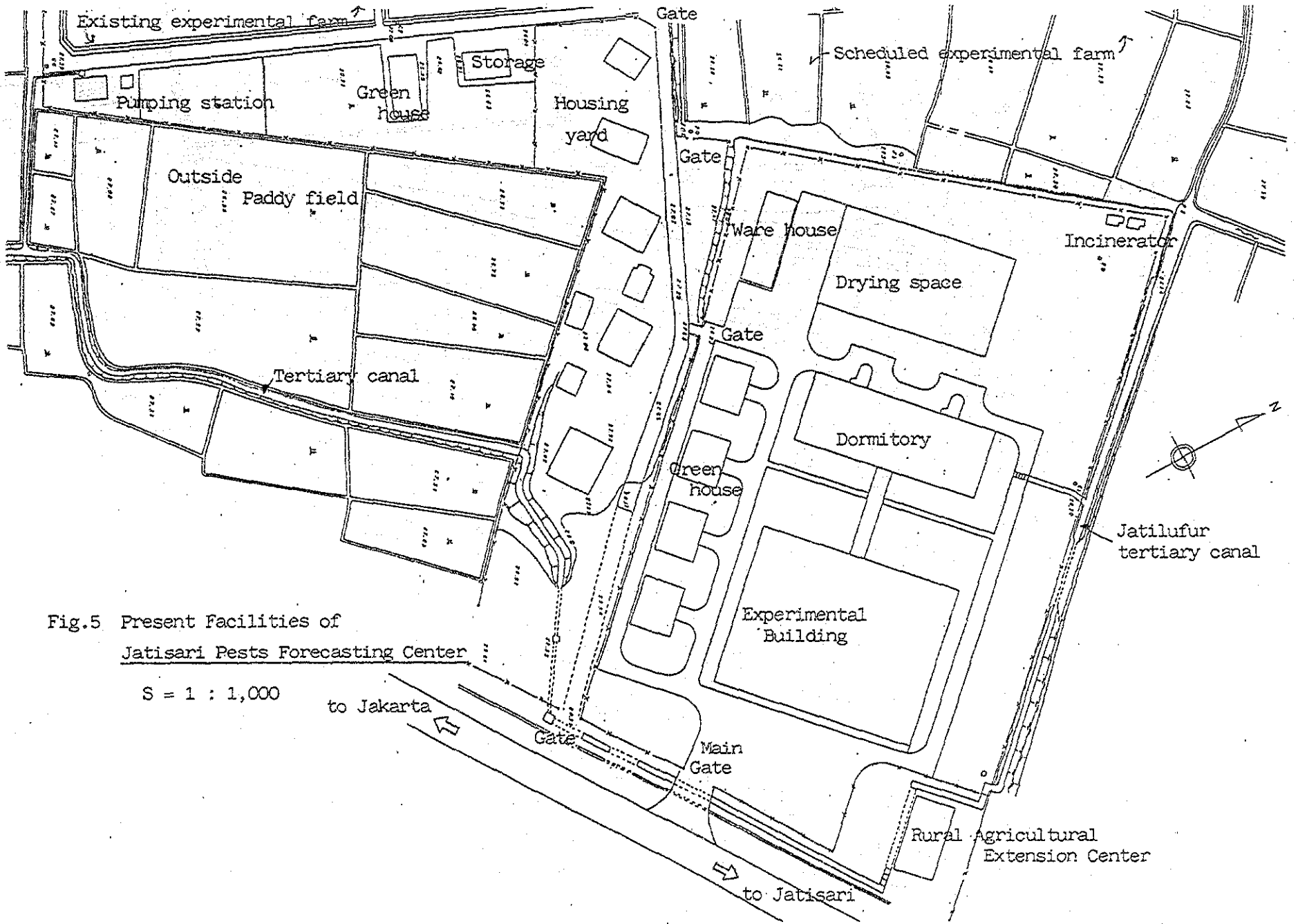
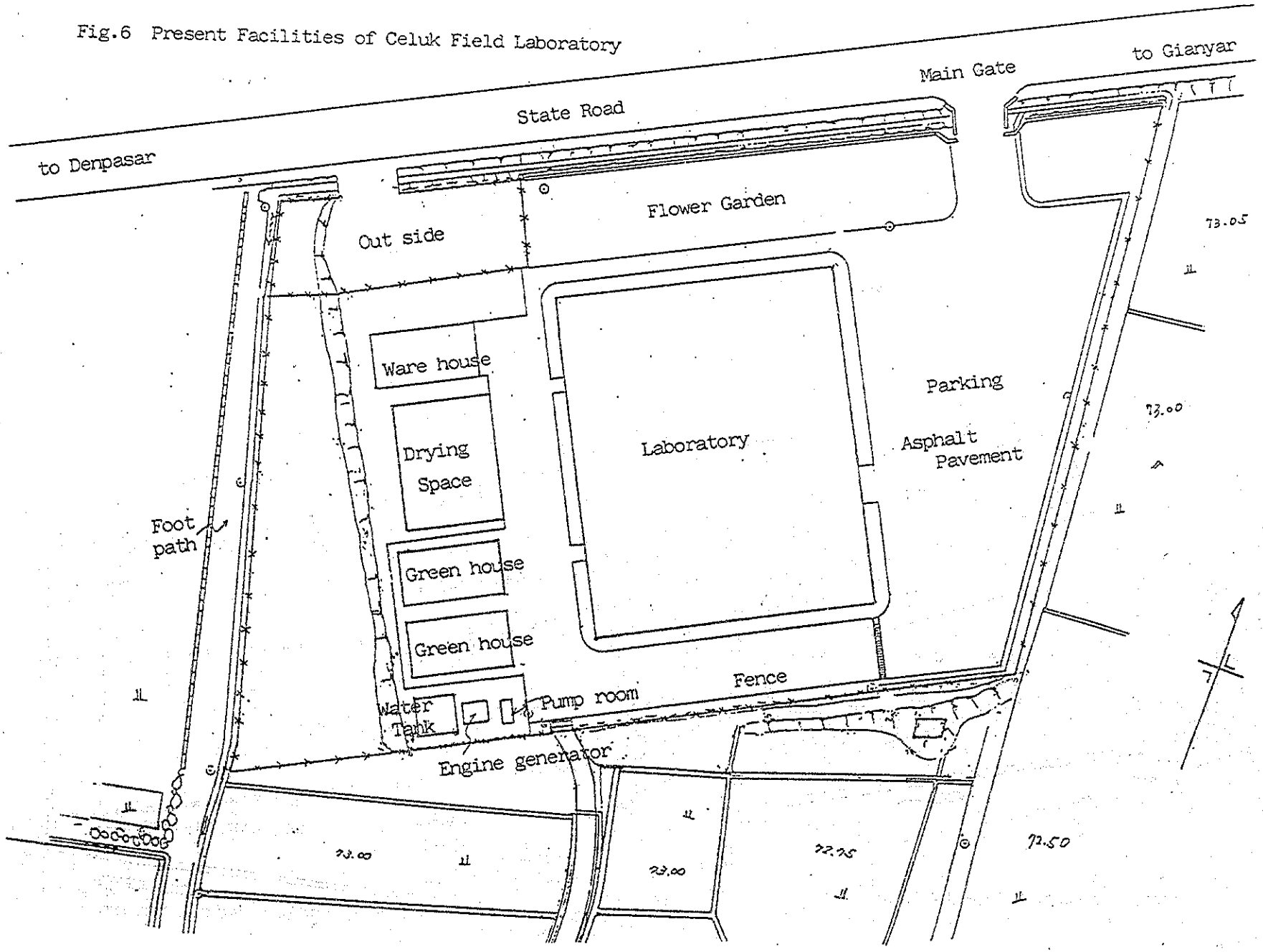


Fig.5 Present Facilities of
Jatisari Pests Forecasting Center

S = 1 : 1,000

Fig.6 Present Facilities of Celuk Field Laboratory



2-3 Present Condiitons of Jatisari Pests Forecasting Center

(1) Experimental Farm

The scheduled site for the experimental farm for rodent which became the object of this survey is located entirely in the midst of paddy field and adjacent to an existing experimental farm of 4.7 ha. The site belongs to Puruwakarta Regency and covers an area of 3.2 ha according to surveying.

The Agricultural division of Puruwakarta prefecture and the Forecasting Center have mutually agreed in writing that the prefecture rents the land for the site to the Center. According to this, the Center is to be entitled to use 2 ha of land for the experiment and additional land. The size of the land to be necessary for the experiment of rodent is scheduled to be 210 m x 110 m considering the arrangement of farm road and irrigation & drainage canal based on the standard pitch of levee of 10 m.

The shape of the scheduled site (3.2 ha) mentioned above is almost rectangular, and there are inspection road, drainage canal etc. at the boundary between the scheduled site and the existing experiment farm. The long side of the site shall be along those facilities.

The elevation of the new experimental field is 27.3 meters above the sea level in its highest part and 25.2 meters in its lowest one, that is, there are 2.3 m of difference. The field inclines from the northern corner of the laboratory to the lower portion of western boundary of the scheduled site with a slope of 1/120.

There are no fences in the paddy field area at

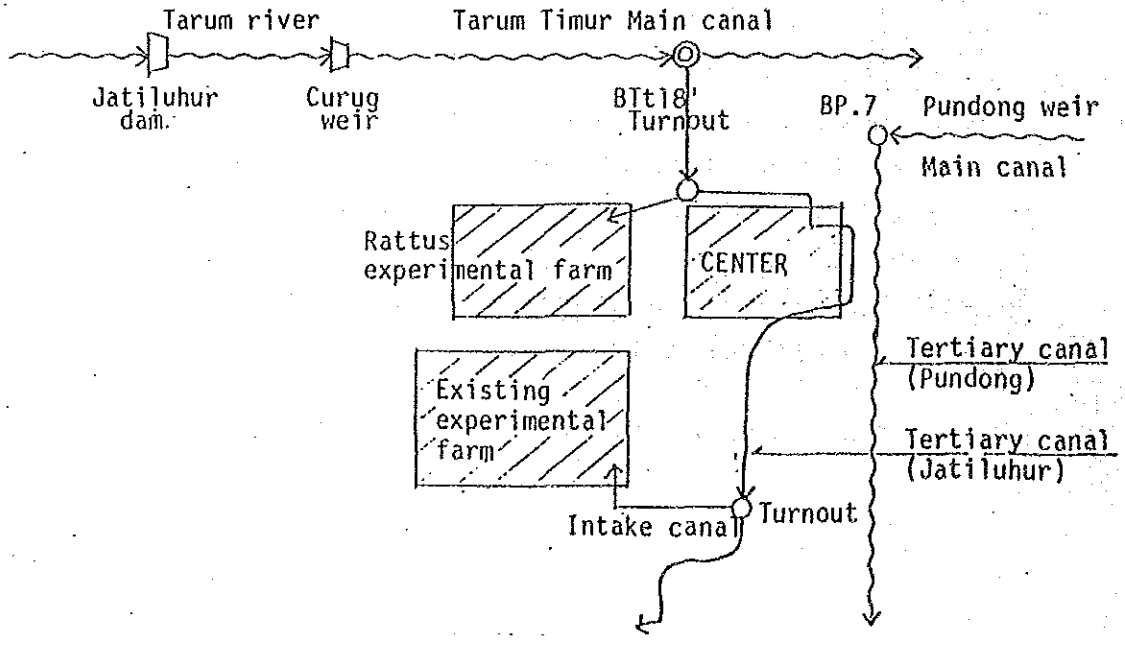
present, however, rat fences will be installed around the whole experimental farm of 2.4 ha with a length of about 640 m in order to prevent rodents coming into or go out of the experimental field strictly.

In addition to the above, the borrowing condition of the land was scheduled to be 2 ha in the beginning, but at present the necessary land is estimated as big as 2.4 ha, therefore the said condition shall be negotiated again by Indonesian authorities.

(2) Water Resources and Irrigation Canal

a. At present the irrigation water for the field has been taken from Jatiluhur Tertiary irrigation canal. The intake place is located 390 m down stream of the diversion of the main Canal, which is the northern edge of the Center, and at present the water is directly taken from the tertiary canal by opening a hole on the embankment.

The route of Jatiluhur Irrigation Canal is diagramed as follows.



The design specification of the turnout BTt 18' is as follows.

Check Water Level of Main Canal	C.W.S 27.66m
Irrigation Area	A = 75 ha
Intake Discharge	Q = 0.090 m^3/sec
Slope of Canal in the Downstream	I = 1/7,000

The existing experimental field also uses the water from this tertiary canal and backed up by a ground water from deep well by pumping (diameter 50 mm, pump head 40 m, capacity 100 - 200 ℓ/min., 2.2 kW) for an auxiliary irrigation water resources in case of shortage of water.

The Center has its own water resources for experiment and for drinking water from a deep well by pump (diameter 40 mm, capacity 150 ℓ/min., pump head 40 m).

As to the other water resources, there is an irrigation canal from Pundong weir running along the State road in front of the Center, however, the irrigation water from this canal is planned for other irrigation fields in higher elevation around the Center. Although this water source cannot be expected for the experiment field directly, drained water from these paddy fields irregularly flows into the Jatiluhur Tertiary Canal and is used in the lower fields.

The drained water from each plot is under different control and fluctuates its amount, moreover, the amount is small considering the irrigated area, so it is quite difficult to

get quantitative data in order to use the drained water as the water source for the experimental farm of the Center.

For the operation of a year around cropping, as an experimental farm, besides the water supply from the Jatiluhur Tertiary Canal for a main water source, it is necessary to utilize ground water as a supplementary water source as well as the existing experimental farm, particularly in July and August in the dry season and no water period of September.

As a new facility, a deep well is necessary to be constructed (pump diameter 50 mm, deep well 40 m, capacity 200 ℓ/min, 2.2 kW class, diesel generator 10 kVA, pump shed, regulating water tank etc.).

b. Owing to the construction of the Center, the canal route of the Jatiluhur Tertiary Canal was changed and detoured around the Centers building facilities. In connection with the detouring it is said that farmers in downstream of the Center are complaining that shortage of discharge became bigger than before and strongly requesting the Center to improve the detoured canal.

According to the head of the Rural Agricultural Extension Office who controls this area, the flowing capacity of the detoured canal has become lower than that of the former one, and the lowering of flow capacity is causing the low efficiency of intake water discharge of the existing exper-

imental farm of the Center as well as farmland of farmers in the downstream.

According to the result of the survey, actual conditions of the discharge of main canal, methods of water distribution by farmers etc. are considered to give big influence on the flowing capacity of the detoured canal, on the other hand, the following reasons are also considered from a structural point of view.

i The constructed canal bed doesn't have a smooth slope, that is, although a canal bed in the up stream is EL 27.05 m, that in the downstream is higher than it (EL 27.25 m) and is too low (EL 26.60 m) in the other place.

ii Consideration on hydraulic properties of canal on gently sloping land of 1/7,000 are basically lacking. The detoured canal have many sudden changing cross sections without smooth transitions. The structure of the canal is a combination of earth canal, rectangular masonry works, trapezoidal masonry works, pipes, culverts, boxes etc.

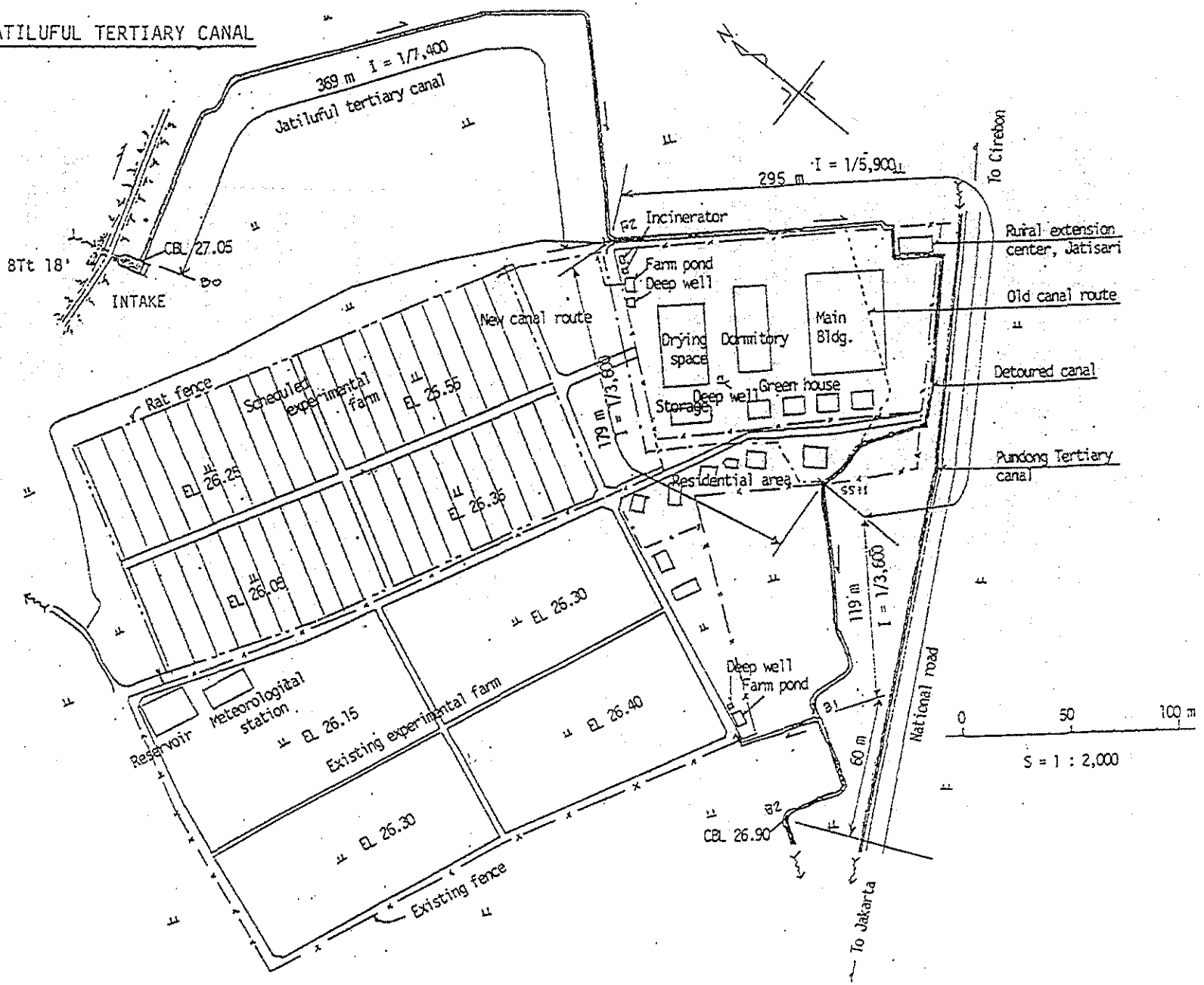
iii Check water level of Tarum Timur Jatiluhur main Canal is sometimes not kept as specified.

iv The detoured canal length (about 300 m) is longer than the former one (about 210 m), which suggest the increase of seepage water loss in proportion to the increase of canal length.

In order to regain the appropriate flow capacity it is necessary to study the hydraulic condition of the new canal route along the west boundary of the Center, and to construct a concrete lining canal (about 180 m).

Fig.-7

ROUTE MAP OF JATILUFUL TERTIARY CANAL



(3) Drainage Canal

In this rice field area, a plot to plot irrigation is a usual method for irrigation and drainage. Even the Jatiluhur Tertiary Irrigation Canal is used as the drainage canal for rice fields in the upstream. However, for the purpose of the experimental farm to carry out tests in each field at any time independent setting of irrigation and drainage canals shall be planned.

There is an existing drainage canal between the scheduled site and the existing experimental farm, and this drainage canal shall be improved to serve as a main drainage canal for whole the area (about 240 m).

(4) Discharge from Pumps

Discharges from pumps measured during the survey period are as follows.

Date of Measurement	Pump	Discharge
Dec. 23, 1987	For farm use	240 ℓ/min
Jan. 8, 1988	For farm use	239 ℓ/min
Jan. 8, 1988	For Building use	246 ℓ/min

(5) Test Pit Digging and Cone Penetration Test

The location of test pits, cone penetration test and the locations of former wells, borings etc., are shown in Fig. - 8.

a. Result of Cone Penetration Tests
(below paddy field)

Depth	Bearing Capacity
-10 (cm)	8 t/m^2
-100	11
-120	16
-130	21
-140	22
-150	27

b. Test Pits

No.1 : 1.2 x 1.2 x 1.5 m
(Foundation of Net House for Rodent)

No.2 : 1.2 x 1.2 x 1.3 m
(Paddy Field)

Soil of No.1 mainly consists of soil of carriage dressing (sandy clay) and is homogeneous. Its bearing capacity is almost the same as the result of (a).

Soil No.2 consists of clay up to 1 m deep from its surface and sandy clay below 1 m from the surface.

c. Boring

For the construction of buidings of the Center boring tests (30m x 4 pcs.) and standard penetration tests were carried out on November 1985. The results, soil sections and columnar sections, are attached in the last chapter.

Soil layers mainly consists of silty clay and the N value up to 3 m from the surface of the up to 3 m from the surface of the paddy field is 3 ∿ 9. Ground water was observed 0 ∿ 3 m under the surface.

(6) Others

The maximum daily rain fall in the past in the station No. 111 is 255 mm/day in March 1933. Maximum daily rain fall of the years from 1960 up to 1986 are shown in the Table - 2.

The cropping plan of the Jatiluhur Irrigation project is shown in Fig. - 9. The water requirement for Golongan - I is as follows.

Season	Month		Unit Water Requirement	Season	Month		Unit Water Requirement
Rainy Season	October	1st half	1.2 ℓ/s/ha	Dry Season	March	1st half	1.0 ℓ/s/ha
		2nd half	1.1			2nd hlf	1.0
	November	1st half	0.8		April	1st half	0.8
		2nd half	0.7			2nd half	0.8
	December	1st half	0.7		May	1st half	0.8
		2nd half	0.7			2nd half	0.8
	January	1st half	0.7		June	1st half	0.9
		2nd half	0.6			2nd half	0.9
	February	1st half	0.5		July	1st half	0.9
		2nd half	0.5			—	

Table-1 Monthly Rainfall at Jatisari

Unit in mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1960	522	378	215	275	183	54	54	0	91	151	425	182	2,530
1961	829	325	313	71	239	5	0	0	0	0	78	316	2,176
1962	644	818	282	226	67	112	110	17	7	126	109	428	2,946
1963	905	416	152	114	49	36	0	0	0	26	136	391	2,225
1964	26	184	210	95	206	59	42	38	53	228	300	315	1,756
1965	654	147	173	40	150	44	2	0	0	32	121	415	1,778
1966	188	462	189	204	102	105	0	0	9	201	356	-	-
1967	409	592	209	146	42	0	25	0	0	12	33	332	1,800
1968	190	449	232	414	275	150	152	176	17	79	31	274	2,439
1969	63	425	181	161	97	88	2	0	69	56	161	142	1,445
1970	274	297	374	252	237	98	9	1	14	52	380	163	2,151
1971	345	562	337	131	130	45	117	2	2	122	483	464	2,740
1972	476	186	414	101	108	0	0	4	0	1	85	120	1,495
1973	185	409	323	226	304	76	8	31	127	142	215	289	2,335
1974	556	289	128	199	70	66	109	138	73	183	104	131	2,046
1975	206	199	232	79	156	75	2	25	136	299	332	89	1,830
1976	640	97	332	101	85	0	0	4	25	63	128	80	1,555
1977	444	474	442	70	19	150	0	0	1	4	68	334	2,006
1978	386	234	148	91	91	100	-	144	129	-	-	244	-
1979	249	266	251	138	217	74	-	24	83	137	219	359	2,017
1980	368	253	163	181	57	14	97	87	16	181	227	182	1,826
1981	516	138	167	170	52	50	73	3	61	158	140	118	1,646

Table-1 (Con't) Monthly Rainfall at Jatisari

Unit in mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1982 ※	134	158	272	163	-	27	-	-	-	6	20	160	-
1983	164	186	113	132	182	9	61	0	0	188	179	195	1,429
1984	261	172	230	131	100	31	3	60	58	123	146	123	1,438
1985	271	159	209	184	115	53	226	5	86	163	94	139	1,704
1986	255	151	137	226	34	143	229	5	193	187	285	-	-
Total												n=23	45,313
Mean													1,970

Note : Data from 1982 is the records of Jatisari Center.

Table- 2 Maximum daily rainfall at Jatisari

Year	Month	Rainfall
		mm/day
1960	Jan.	114
1961	Jan.	166
1962	Jan.	136
1963	——	——
1964	Oct.	103
1965	——	——
1966	Nov.	93
1967	Feb.	125
1968	Apr.	114
1969	Feb.	105
1970	Nov.	94
1971	Dec.	114
1972	Jan.	87
1973	Apr.	110
1974	Jan.	86
1975	Mar.	71
1976	Jan.	95
1977		110
1978	Dec.	100
1979		70
1980		73
1981		83
1982	Feb.	96
1983	Nov.	76
1984	Nov.	73
1985	May.	72
1986	Jun.	90

Fig.8 Location of Soil Investigation (S= 1:2,000)

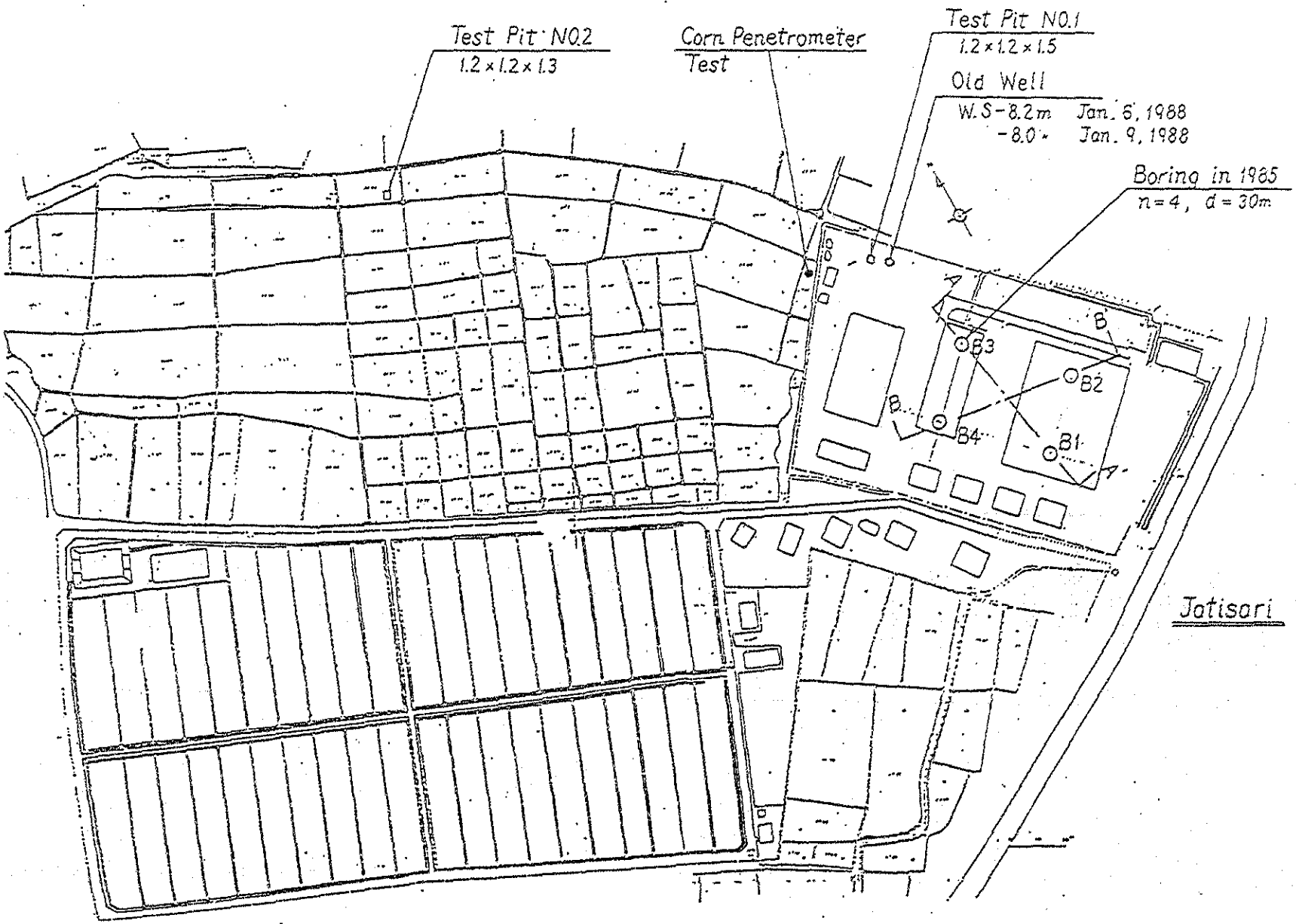
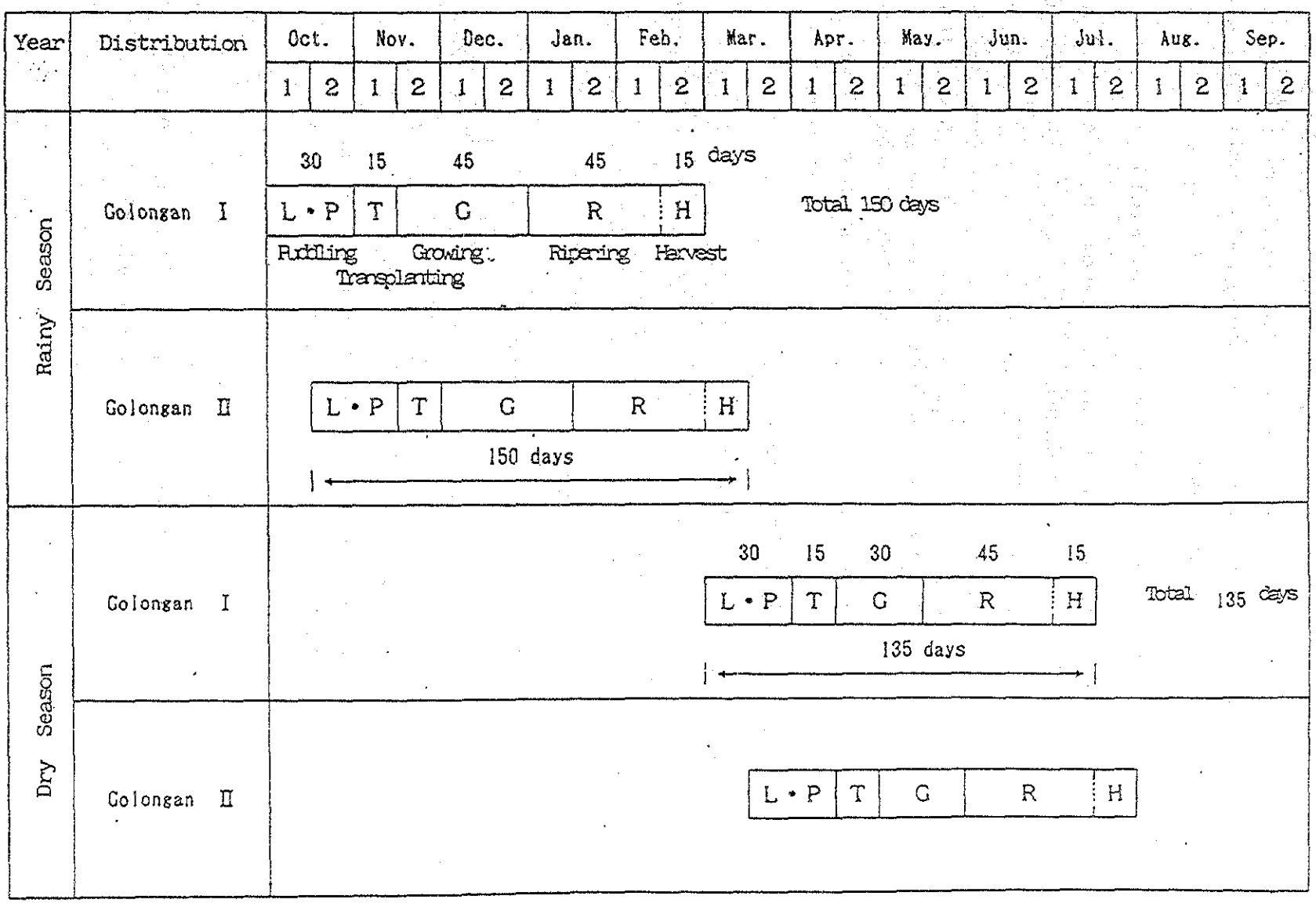


Fig.-9 Cropping Pattern of the Jatilufur Irrigation Project



2 - 4 Items of Improvement Works for the Jatisari Pests Forecasting Center

After the careful study on the result of the survey it was made clear that the following main facilities are necessary to be improved.

a. Land Consolidation Works for Paddy Field

1)	Land shape adjustment and levelling	(A = 2.8 ha)
2)	Main irrigation canal	(L = 450 m)
3)	Main drainage canal	(L = 240 m)
4)	Drainage canal	(L = 260 m)
5)	Irrigation and drainage canal in the farm (Farm ditch)	(L = 2,100 m)
6)	Farm road	(L = 320m, B = 3.5, 2.0 m)
7)	Operation road	(L = 250 m, B = 3.5 m)

b. Intake and Irrigation Canal

1)	Intake	(1 place, Q = 2 ℓ/sec)
2)	Tertiary canal	(L = 180 m, Q = 90 ℓ/sec)
3)	Intake canal	(L = 45 m)

c. Auxiliary Water Resources

1)	Deep well	(ø 200 mm, L = 40 m)
2)	Deep well pump and operation panel	(ø 50 mm, H = 40 m, Q = 200ℓ/min, 2.2 kW x 220V)
3)	Generator house	(A = 3.2 x 2.8 m)
4)	Diesel generator	(10 kVA)
5)	Farm pond/Masonry	(4 x 6 x 1.5 m)
6)	Water supply/drain pipes and valves	(ø 100, L = 40 m)

d. Installation of Rat Fence

1)	Concrete foundation	(L = 430 m, H = 0.8 m)
2)	Fence installation	(L = 640 m)
3)	Automatic gate	(1 place)

e. Foundation Works for Bertebrate Laboratory and Net House

1)	Bertebrate laboratory	(A = 7.5 x 13.0 m)
2)	Net house	(A = 7.2 x 14.3 m, 2 places)

f. Other Related Structures

1)	Repair of existing operation road	(Asphalt pavement works, L = 160 m, B = 3.0 m)
2)	Access road and gate	(2 places)
3)	Repair of existing fence	(1 L.S.)
4)	Miscellaneous construction works	(1 L.S.)

g. Temporary Works (1 L.S.)

Rat fence (L = 640 m) will be provided separately using the Procurement of Materials to be supplied by JICA, and a diesel engine generator is scheduled to be used as power source for a deep well pump for auxiliary water resources and will be provided as well. The specification of the generator is as follows.

Type	:	DCA - 14 LBM class 50 Hz, 200V/220V, 10 kVA	1 pc.
Engine	:	S2E 14 pS/1,500 rpm	
Attachment:		Duct and pipes	
Size	:	1.7 m^3, G/W 570 kg	
Price	:	Main Unit	¥1,200,000
		Duct & pipes	¥ 150,000
		Transportation cost	¥ 150,000
		Total price	¥1,500,000

2-5 Present Conditions of Celuk Field Laboratory

(1) Experimental Farm

a. Main office and other facilities of Celuk Field Laboratory were constructed in March 1987 by the Phase-I works of Pest and Disease Forecasting Control Project under the Grant Aid. Location of the scheduled experimental farm is planned to be the paddy field of about 0.5 ha adjacent to the southern border of the Field Laboratory.

The scheduled site belongs to Bali Province and it has been used as seed production field under the jurisdiction of the Bali Provincial Agriculture Division. The Bali Provincial Government approved on August 3, 1987 that the said site shall be used for Tungro Disease experimental field of the Celuk Field Laboratory by the Directorate of Food Crop Protection.

At present the improvement works have been kept waiting for the work for experimental farm for five (5) months without rice plant.

b. The shape of the site is a parralleogram with steep angles from 60° to 80° approximately, and the length of a side is about 60 to 75 m. The elevation of the field is 72 ∿ 73 m above the sea level.

c. Although survey for existing bench marks near by was carried out, bench marks could not be found in the neighboring land. They were considered to be weathered, therefore, a temporary bench mark (EL. 74.5m) was established in the laboratory based on a contour line adjacent to a bench mark on a topographic map of 1/50,000.

d. The experimental field is planned for paddy field because the object of the study is Tungro disease and green leaf hopper.

e. Present paddy field is divided into some dozen plots of various size by farm road and levees. In order to use the field as an experimental farm, a size of a standard plot will be about 20 x 20 m with farm road after land shape adjustment, land levelling and construction of irrigation and drainage canal, however, the majority of plots can not help being trapezoidal owing to the whole shape of the land.

(2) Water Resources and Intake Facilities

a. At present, the water resources for the present paddy field is dependent on the irrigation (quaternary) and drainage canal from Keduwatan weir which has been controlled by Gianyar prefectural D.P.U. office.

The Keduwatan weir is installed at the Ajung river about 12 Km upstream of the laboratory. The quaternary canal applies only to the scheduled experimental field of about 0.5 ha and existing neighboring paddy field in the west side.

An outline of Keduwatan weir;

Water Resources	Ajung River
Intake Method	Head work
Irrigation Area	3,745 ha
An outline of from weir up to diversion;	
Main Canal	3.96 km
Secondary Canal	8.75 km
Name of Diversion	BLG. 10
Name of Tertiary Canal	BLG, 10.ki

Irrigation Area	194.08 ha
Name of Subak	SB. PEJAJAH

b. As to the main irrigation water source, same as at present, the water from above Keduwatan weir is utilized for the experimental farm. But, it is afraid that the water may not be stable because of the plot-to-plot irrigation in upstream especially during dry season, therefore, an auxiliary water resource is necessary to be considered.

c. At the present time the necessary water for the Field Laboratory is dependent on a deep well (ø 250 mm, depth 80 m, pump ø40 mm, 1.5 kW) constructed at the south west corner of the laboratory. The water is pumped up and stored in an elevated tank (1.5 x 1.5 x 2.0 m, H = 12.5 m) then used. The power source is dependent on a diesel generator (15 kVA, 380 V, 50 Hz).

The ground water is used for both drinking and miscellaneous water of the laboratory, and the tank is filled up every three days, therefore, the water can be used for irrigation to some extent.

d. The measured discharge from the pump is shown as below.

1st.	December 21, 1987	Q = 39 ∿ 54 ℓ/min.
2nd.	January 16, 1988	Q = 53 ℓ/min.
3rd.	January 16, 1988	Q = 49 ℓ/min.

As an auxiliary water for irrigation it seems appropriate to utilize this ground water. In this case it is more economical to get water directly from the pipe at lower place, unnecessary through the tank. In addition to this a regulat-

ing reservoir (farm pond V = 80 m^3, water for about 2 days) will be constructed aiming at stable supplement to irrigation water.

(3) Irrigation Canal, Drainage Canal and Farm Road

a. All of irrigation and drainage canals at present are earth canal type having dualpurpose functions of irrigation and drainage as is usual in this area adopting plot-to-plot irrigation with masonry works at junction.

b. An independing setting of irrigation and drainage canals system should be applied in order to select arbitrarily the cultivation period at each plots from view points of experimental fields.

c. There is only one farm road with a width of 1.7 m in the center of the scheduled site at present. The step structure at the side of the pump shed is used as an access road from the laboratory to the farm at present. The farm road for the scheduled experimental farm being installed smoothly along the fence in the south, this step structure will be removed.

(4) Water Quality

Quality of drinking and miscellaneous water from the deep well was tested on April 1987 in Surabaya (See Table - 3). According to the test data, density of chemical substances higher than the water quality standard is as follows.

Item	Standard value	Result
Nitrite (NO_2)	0 ppm	0.013 ppm
Hydrosulfide (H_2S)	0	0.067

The above test allows an experimental error of ±0.75 ∿ 1.00 ppm, and evaluated the water that it is no problem of the water to be applied to drinking water. As a metter of fact chlorine is added to the water on its way from pump by an injecting instrument, then the water is used for drinking, etc.

(5) Geotechnical Investigation

There is a remain of hole of well for construction in the scheduled site for farm and according to this, the surface layer with thickness of 30 ∿ 50 cm is considered to be fertile soil and below this layer soil is solid sandy clay.

Top soil treatment will be necessary for surface layer when cutting and banking will be constructed for paddy field.

The results of cone penetration test on paddy field are shown in the tables as follows.

a. Foundation of Water Tank in Celuk (Present paddy field)

Used cone $A = 6.45\ cm^2$ $qa = 0.2 \times q$

Depth	Indication of Gauge	Penetration Resistance	Cone Bearing Capacity (q)	Allowable Soil Pressure (q^a)
m		kg	kg/cm^2	t/m^2
-0.35	50	23	3.6	7
-0.60	140	65	10.1	20

b. Paddy Field, Celuk

Used cone $A = 3.23\ cm^2$

Place	Indication of Gauge	Penetration Resistance	Cone Bearing Capacity (q)	Allowable Soil Pressure (q^a)
m		kg	kg/cm^2	t/m^2
Up-stream -50	130	60	18.6	37
Down-stream -80	50	23	7.1	14
Down-stream -120	100	45	13.9	28
Down-stream -160	120	55	17.0	34

(6) Rainfall

The rainfall gauge station of Celuk (440 f) has monthly rainfall data since January 1971. Although the station recorded the maximum daily rainfall in the past of 296 mm/day in January 1968, this figure seems to be the data in Gretek, a station adjacent.

Monthly rainfall and maximum daily rainfall in the past in Celuk are shown in Table - 4 and Table - 5.

(7) Cropping Pattern of Keduwatan Irrigation Project

Double cropping of wet paddy and three-months cultivation of soybean as Palawija are scheduled in the cropping plan over the field. Water for upland irrigation is required from April up to July, and water shortage is considered to occur is this period, so supplementary water seems necessary.

Abvoe cropping pattern is shown in Fig. - 10.

Table-3 Result of Water Quality Test

KOTAMADIA DATI II SURABAYA
(INSTALASI PENJERNIHAN II NGAGEL)
TILP.: 67745

Surabaya, 6 April 1987

1. Contoh : Deep Well
2. Tanggal : 3 April 1987
3. J a m : --
4. Lokasi : Celuk Gianyar Bali.-

Nomor :	Pemeriksaan atas		air sumur	Syarat-2Air Minum max. yg diperbolehkan.
	I UJI FISIKA :			
1.	Warna	(ppm PtCo)	1	50
2.	Rasa		tak berasa	Tidak berasa
3.	Bau		tak berbau	Tidak berbau
4.	Kekeruhan	(ppm SiO_2/mgr)	4,90	1,0
5.	Padatan terlarut.	(ppm)	228	
6.	Padatan jumlah	(ppm)	428	1500
7.				
	II UJI KIMIA :			
1.	Reaksi pH		6,5	6,5 - 9,2
2.	Alkalinitas	(ppm $CaCO_3$)	227,36	500
3.	Karbondioksida bebas	(ppm CO_2)	151,57	ta'disyaratkan
4.	Keadahan total	(ppm $CaCO_3$)	144	178
5.	Calsium	(ppm $CaCO_3$)	95,52	500
6.	Magnesium	(ppm Mg)	10,39	150
7.	Silikat	(ppm SiO_2)	51,30	
8.	Chlorida	(ppm Cl)	8,52	250
9.	Sulfat	(ppm SO_4)	6,5	200
10.	Nitrat	(ppm NO_3)	1,03	20
11.	Nitrit	(ppm NO_2)	0,013	0,0
12.	Oksigen terlarut	(ppm O_2)	7,10	diatas 5
13.	Besi	(ppm Fe)	0,019	1,0
14.	Mangan	(ppm Mn)	0,0	0,50
15.	Tembaga	(ppm Cu)	0,0	1,5
16.	Timbal	(ppm Pb)	0,003	0,10
17.	Seng	(ppm Zn)	0,35	15
18.	Bilangan $KMnO_4$	(ppm $KMnO_4$)	0,004	10
19.	Chroom	(ppm Cr^6)	0,0	0,05
20.	Ammonium	(ppm NH_3)	0,0	0,0
21.	Chlor bebas	(ppm Cl_2 aktif)	1,4	1,5
22.	Fluorida	(ppm F)	0,0	1,5 - 2,0
23.	Natrium	(ppm Na)		
24.	Phosphat	(ppm PO_4)	0,61	
25.	Sulfida	(ppm H_2S)	0,067	0,0
26.	Arsen	(ppm AS)	--	0,05
27.	C.O.D.	(ppm O_2)	19,67	50
28.	Hydrargyrum	(ppm Hg)		
29.				
30.				

Catatan : 1. Hasilpemeriksaan tab. diatas adalah kondisi air sumur setelah pembubuhan larutan kapurit ± 0,75 - 1,0 mgr/Lt., sehingga air tersebut telah memenui persyaratan sebagai air minum .

Mengetahui
Kepala
Instalasi Penjernihan II

(Soerarjono Dip.S.P.A.)

Kasi Laboratorium:

(... Soegianto)
Nip.: 510020101

Table-4 Monthly Rainfall at Celuk

Station No.440f

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1971	265	315	305	0	87	38	87	0	55	-	71	150	-
1972	111	56	225	0	99	150	0	0	0	0	28	78	747
1973	153	86	113	41	34	88	92	47	320	26	147	226	1.373
1974	194	182	193	0	0	0	11	-	104	393	225	153	-
1975	150	373	291	54	92	61	62	19	121	468	239	233	2.163
1976	181	143	103	0	8	59	0	0	0	62	93	19	668
1977													
1978	349	397	238	262	304	562	209	84	165	232	289	263	3.254
1979 ※	265	118	205	15	169	29	11	77	0	2	132	190	1.213
1980	622	147	81	33	5	0	48	0	0	0	0	0	936
1981	-	-	-	-	-	-	-	-	-	-	421	323	-
1982	342	193	21	20	19	3	0	13	0	0	65	53	729
1983	157	36	147	114	198	37	122	16	3	246	213	128	1.417
1984	286	206	303	121	138	54	48	33	373	15	39	363	1.919
1985	98	139	269	55	33	179	26	26	15	26	-	319	-
1986	423	339	78	194	19	193	44	34	0	27	191	161	1.703
1987	546	160	0	0	177	45	60	0	8	27	159	371	1.553
Total												n=12	17.675
Mean	276	193	171	61	92	100	55	25	78	103	154	189	1.473

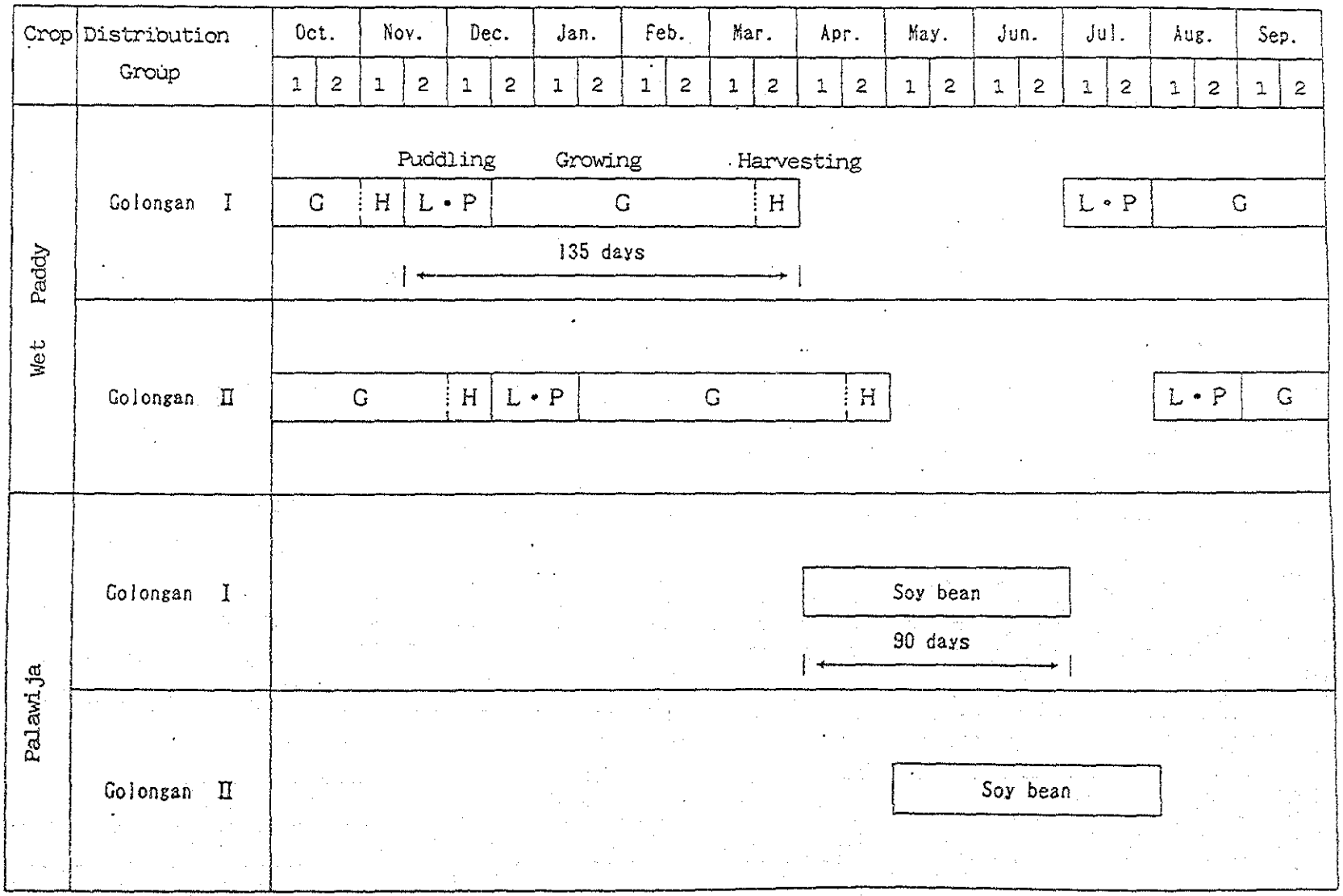
Note : Data since 1979 is the record of BALAI BENIH Celuk.

Maxinum daily rainfall was recorded in Jan. 1968. 296mm/day.

Table- 5 Maximum dairy rainfal at Celuk

Year	Month	Rainfall
		mm/day
1968	Jan.	296
1969	——	——
1970	——	——
1971	Mar.	77
1972	Jun.	150
1973	Nov.	80
1974	Mar.	112
1975	Oct.	195
1976	Jan.	89
1977	——	——
1978	Oct./ Dec.5	139
1979	Jun. 6	120
1980	Jan. 9	125
1981	Oct. 8	78
1982	Jan. 11	78
1983	Jun. 2	94
1984	Jan. 29	90
1985	Mar. 7	90
1986	Feb. 24	125
1987	Jan. 26	125

Fig.-10 Cropping Pattern of the Keduwatan Irrigation Project



Note : S.B PEJAJAH belongs in Golongan II.

2-6 Items of Improvement Works for the Celuk Field Laboratory

Items of improvement works in the Celuk Field Laboratory will be as follows.

a. Land Consolidation Work for Paddy Field

1)	Land shape adjustment and land levelling	(A = 0.5 ha)
2)	Irrigation canal/flume	(L = 130 m)
3)	Drainage canal/flume	(L = 230 m)
4)	Farm road/gravel pavement	
	Type - A	(L = 75m, B = 2.5m)
	Type - B	(L = 125m, B = 1.5m)
5)	Related structures	1 L.S.

b. Intake Canal, Irrigation Canal and Farm Pond

1)	Intake canal/concrete lining	(L = 60 m)
2)	Turnout box/concrete	(1 place)
3)	Farm pond/concrete	(7.5 x 7.5 x 1.6m, V = 80 m^3
4)	Pipe and valve/steel pipe	(1 place)

c. Rat Fence with gate (L = 275 m, H = 1.5 m)

d. Other Related Structures

1)	Access road to experimental farm and change of drain	(1 place)
2)	Masonry retaining wall/ masonry	(L = 77m, H = 1.8m)
3)	Repair of existing fence	(1 L.S.)
4)	Mounding work	(V = 500 m^3)
5)	Miscellaneous construction work	(1 L.S.)

e. Temporary Works (1 L.S.)

CHAPTER 3. DETAILED DESIGN

3-1 Plan of Improvement Works for the Facilities of the Jatisari Pests Forecasting Center

3-1-1 Farmland Consolidation

1) Land shape adjustment

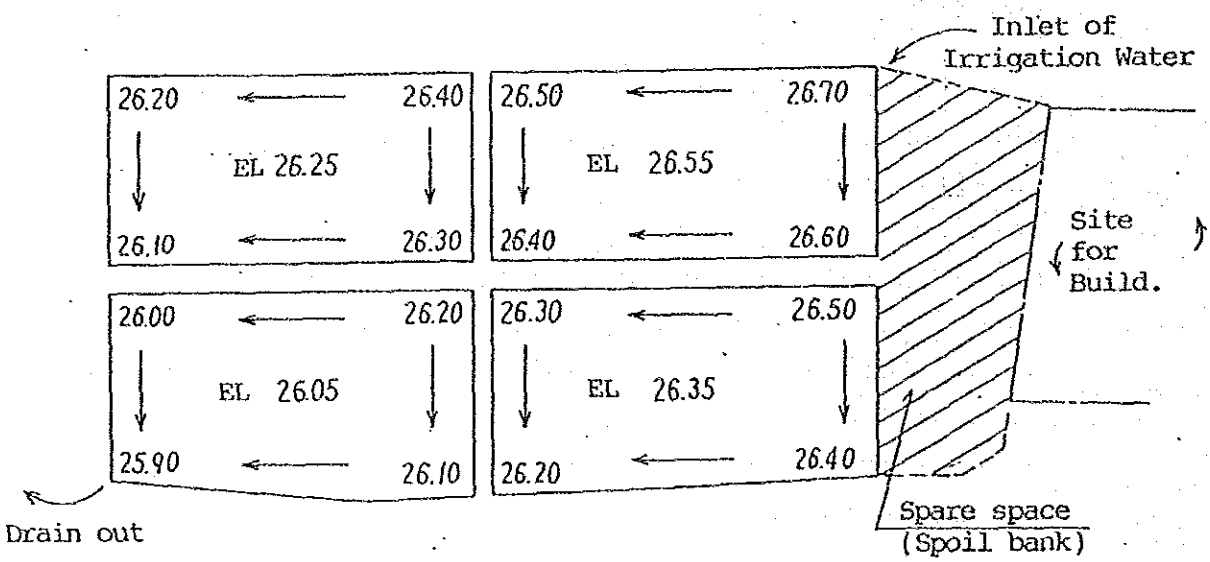
The experimental farm aims at studies and experiments on ecological aspect of rats and on methods for prevention of damages on crops caused by rats, and executes various investigations which can not be carried out in open field, that is, tracing the reproductive process of population of rat and testing methods of artificial control over the process on every different conditions prepared.

The experimental blcok of 200 m x 100 m is necessary for experiments considering the behavior (a sphere of action) of Rice field rat (Rattus argentiventer). Setting point of catching traps and releasing point for mark and release method will be prepared at fixed intervals of, for example, 10 m, 15 m or 20 m like a grid. Accordingly, the minimum unit of a test field will be 1 are (10 m x 10 m) mounding levees at intervals of 10 m making use of irrigation and drainage canals in the farm. The farm will be divided into four (4) blocks (one block: 50 m x 100 m) considering that 2 (two) samples under different cropping conditions (1 hectare for 1 sample) are necessary and that a road for observation of rats by biotelemetry is necessary. Such being the condition, the whole size will be 210 m x 110 m taking width of the road and the irrigation and drainage canal into consideration. In addition to the above, irrigation and drainage canals will be constructed so as to make individual water management on every five (5) test units (5 are, 10 m x 50 m) possible.

2) Land levelling

The slope of the farm at present is about 1/120 from the east to the west and about 1/125 from the north to the south. The biggest elevation difference among surface elevation of paddy field is 2.30 m. In order to lessen the soil movement, in and out, as far as possible, the existing paddy field will be divided into four (4) blocks like the above so as to make the land of farm even.

The land slope in each block shal be 1/500 considering slope of the surface of each paddy field. The surface elevation of each paddy field shall be as follows taking the balance of the amount of earth work for each plot in to account.



3) Land use

The Center covers a total area of 7.5 ha, 4.67 ha for existing facilities and 2.84 ha for the farm to be newly constructed, summarized as follows.

classification		Present	Plan	Remarks
Existing Experimental Farm	Paddy Field	ha 2.07	ha -	
	Drainage Canal	0.22	-	
	Irrigation Canal	0.16	-	
	Farm Road	0.35	-	
	Upland Field	0.23	-	
	Housing Area	0.21	-	
	Site for Buildings of the Center	1.12	-	
	Maintenance Road, etc.	0.31	-	
Sub-Total		4.67	4.67	
Farm to be newly Constructed	Paddy Field	ha 2.44	1.67	
	Drainage Canal		0.26	
	Irrigation Canal		0.26	
	Farm Road & Fence Site		0.25	
	Maintenance Road and Spare Space	0.40	0.40	Including Spoil Bank
Sub-Total		2.84	2.84	
Total		7.51	7.51	

4) Irrigation Canal

i) Water Resources

The existing paddy field is provided with water from Juliluhur Tarum Timur main Canal, and the same water resources will be applied to this new experimental farm as well. Every year in September the said main canal has its water shut off for the maintenance work of canals and facilities for one (1) month.

As to water distribution method, several Golongan methods (rotational irrigation) are applied, and the distributing period of water is sometimes changed by the conditions of each year.

In this area, Gologan Type I and Type II are applied and their water distributing periods are as follows.

Type of Cropping	Rainy Season Cropping	Dry Season Cropping
Golangan I	Oct. 1 ∿ Feb. 28	Mar. 1 ∿ Jul.15
Golangan II	Oct. 16 ∿ Mar. 15	Mar. 16 ∿ Jul.31

In case of Golongan Type I, therefore, water intake will come to be impossible for 2 months and a half from July 16 until September 30, so the ground water will be used as supplementary water resources as mentioned later.

ii) Water Requirement

The unit water requirement of the Jatiluhur Irrigation Project will be applied to the Center.

Peak unit water requirement Qmax = 1.2 ℓ/sec/ha

Minimum unit water requirement Qmin = 0.5 ℓ/sec/ha

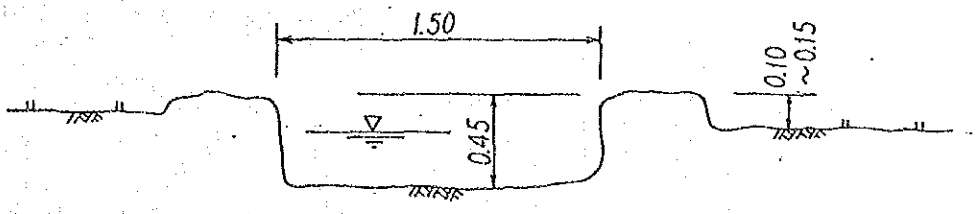
Consequently, the amount of intake water shall be as follows considering intake and conveyance loss.

$$Qmax = 1.67ha \times 1.2\ \ell/s/ha \times \frac{1}{0.65} = 3.1\ \ell/s$$

$$Qmin = 1.67ha \times 0.5\ \ell/s/ha \times \frac{1}{0.65} = 1.3\ \ell/s$$

iii) Intake water level

Diversion point to take water from the Jatiluhur Tertiary Canal will be at the north corner of the site for buildings of the Center, and the cross section of the tertiary canal at this point is as follows.

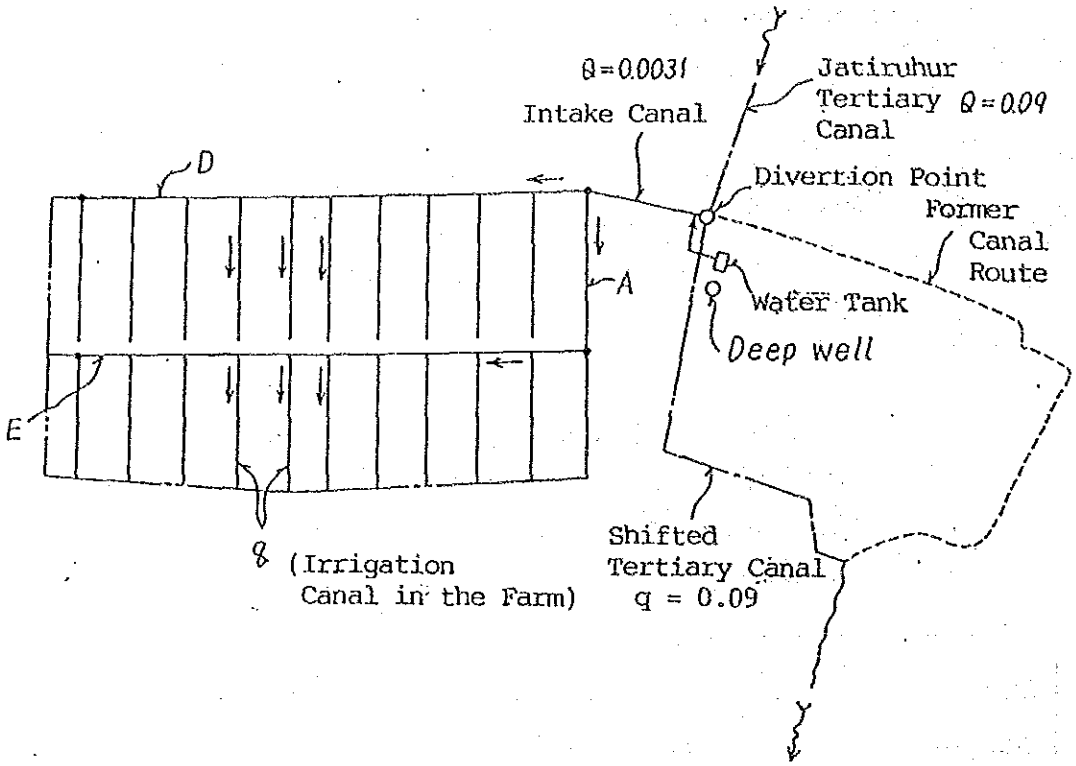


The tertiary canal is a downstream canal at the diversion works BTt 18' and its details are estimated from its covering area of 75 ha and its hydraulic features as follows.

Item		Max. Discharge	Min. Discharge
Design Area of Paddy Field	A	75 ha	75 ha
Unit Water Requirement	q	1.2 ℓ/s/ha	0.5 ℓ/s/ha
Design Discharge	Q	0.090 $m^3/3$	0.00375 m^3/s
Canal Slope	I	1/7,400	1/7,400
Depth of Water	d	0.385 m	0.214 m
Cross Section Area of Flow	A	0.5775 m^2	0.3210 m^2
Wetted Perimeter	P	2.270 m	1.928 m
Hydraulic Mean Depth	R	0.2544 m	0.1665 m
Velocity	V	0.156 m/s	0.117 m/s
Water Level	WS	27.385 m	27.214 m
Elevation of Canal Bed	EL	27.000 m	27.000 m

iv) Irrigation networks

The irrigation networks of the experimental farm will be as follows according to its land form.



Main Irrigation Canal	A-line	Q = 0.0016 m^3/s
Main Irrigation Canal	D-line	- ditto -
Main Irrigation Canal	E-line	- ditto -
Farm ditch		q = 0.0001 m^3/s

Table-6 Hydraulic Features of Irrigation Canal

Canal Name	Type	Design Discharge m^3/s	Water Surface at B.P. m	Canal Slope	Width x Height m	Water Depth m	Free Board m	Velocity m/s	Capacity m^3/s	Canal Length m	Irrigation Area ha
Tertiary Canal (Existing)	Earth Canal	0.090	WS27.44	1/7,400	1.50×0.45	0.385	0.065	0.156	0.090	—	75.0
Tertiary Canal (Shifted)	Reinforced Concrete	0.090	WS27.35	1/3,600	0.75×0.50	0.350	0.15	0.356	0.090	178	75.0
Intake Canal	Concrete	0.0031	WS27.18	1/1,000	0.20×0.20	0.064	0.10	0.242	0.0057	45	1.67
A-line	〃	0.0016	WS26.74	1/1,000	0.20×0.15	0.041	0.10	0.199	0.0022	57	0.84
D-line	〃	0.0016	WS26.74	1/1,000	0.20×0.15	0.041	0.10	0.199	0.0022	195	0.84
E-line	〃	0.0016	WS26.54	1/1,000	0.20×0.15	0.041	0.10	0.199	0.0022	195	0.84
Farm Ditch	Earth Canal	0.0002	—	1/1,000	Trapezoid 0.15×0.15	—	0.10	—	0.0012	1,062	0.10
Pipeline	P. V. C	0.0031	EL27.70	—	ϕ 100	0.100	—	0.395	0.0032	30	0.84

5) Drainage Canal

i) Daily Rainfall

The maximum daily rainfall in the past in Jatisari is 255 mm/day recorded in March 1933. Probabilities of daily rainfall obtained from the records of recent 25 years from 1960 until 1981 at the station No. 111 and from 1982 until 1986 at the experimental farm are as follows.

Probability	Daily Rainfall	Remarks
2 years	96 mm/day	· 1960 - 1986 · 25 data · Thomas Plot Method
5	116	
10	130	
20	143	

About the design of drainage, 10 years probability shall be used, therefore, the design rainfall for irrigation of 130 mm from the above table will be used.

ii) Design unit drainage discharge

On the drainage in the farm, a drainage of daily rainfall within 24 hours will be applied. The design unit drainage discharge will be obtained from the following equation.

$$Q = 10 \times f \times r \times A/(3,600 \times T)$$

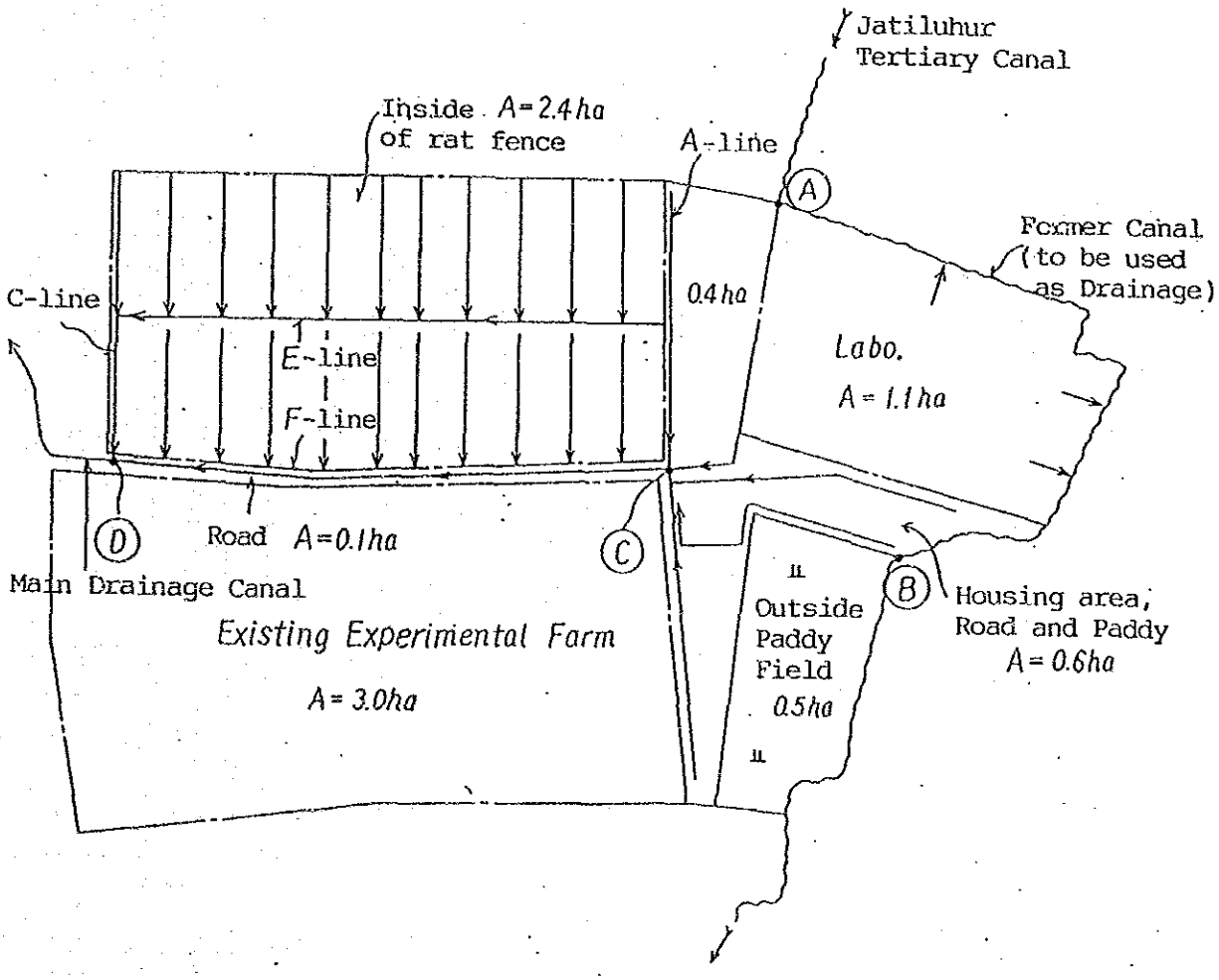
where,

Q	:	Design unit drainage discharge	
f	:	Runoff rate	0.8
r	:	Daily rainfall	130 mm/day
A	:	Unit area	1.0 ha
T	:	Time required of drainage	24 hrs.

$\therefore$ Q = 0.012 $m^3/s/ha$

iii) Drainage Networks

The drainage networks of the area will be as follows.



. The drainage water from the Laboratory will be drained into the Jatiluhur tertiary canal as smae as before, on condition that the former canal is closed on point A and an inverted siphon will be installed at point B along the back side of housing area, then drainage water is drained at point C.

. The final draining point will be point D.

. A PVC pipe with a mesh net at its end is burried for at the end of each drainage canal in the farm (10 lines) connected with the main drainage canal, F-line.

Table-7 Hydraulic Features of Drainage canal

Canal Name	Drainage Area	Type	Drainage Area ha	Drainage Discharge m^3/s	Slope	Width Height m	Water Depth m	Velocity m/s	Capacity m^3/s	Canal length m
Main Drainage Canal(F-line)	Whole area except for present farm	Reinforced concrete	5.0	0.060	1/400	0.60 0.60	0.15	0.718	0.328	228
ditto (end part)	Whole area	〃	8.0	0.096	1/400	0.60 0.60	0.20	0.811	0.328	10
A-line	Scheduled spoil bank	Concrete	0.4	0.005	1/500	0.20 0.20	0.07	0.356	0.008	215
E-line	A,C blocks	Masonry	1.2	0.014	1/500	0.30 0.30	0.12	0.321	0.032	204
C-line	ditto	〃	1.2	0.014	1/500	0.30 0.30	0.12	0.321	0.032	57
Farm ditch		Earth canal	0.1	0.001	1/500	0.15 0.30	0.04	0.156	0.025	1,064
Drainage canal in home yard	Laboratory, home yard & outside field	Concrete	2.2	0.026	1/1,000	0.30 0.30	0.21	0.416	0.026	131

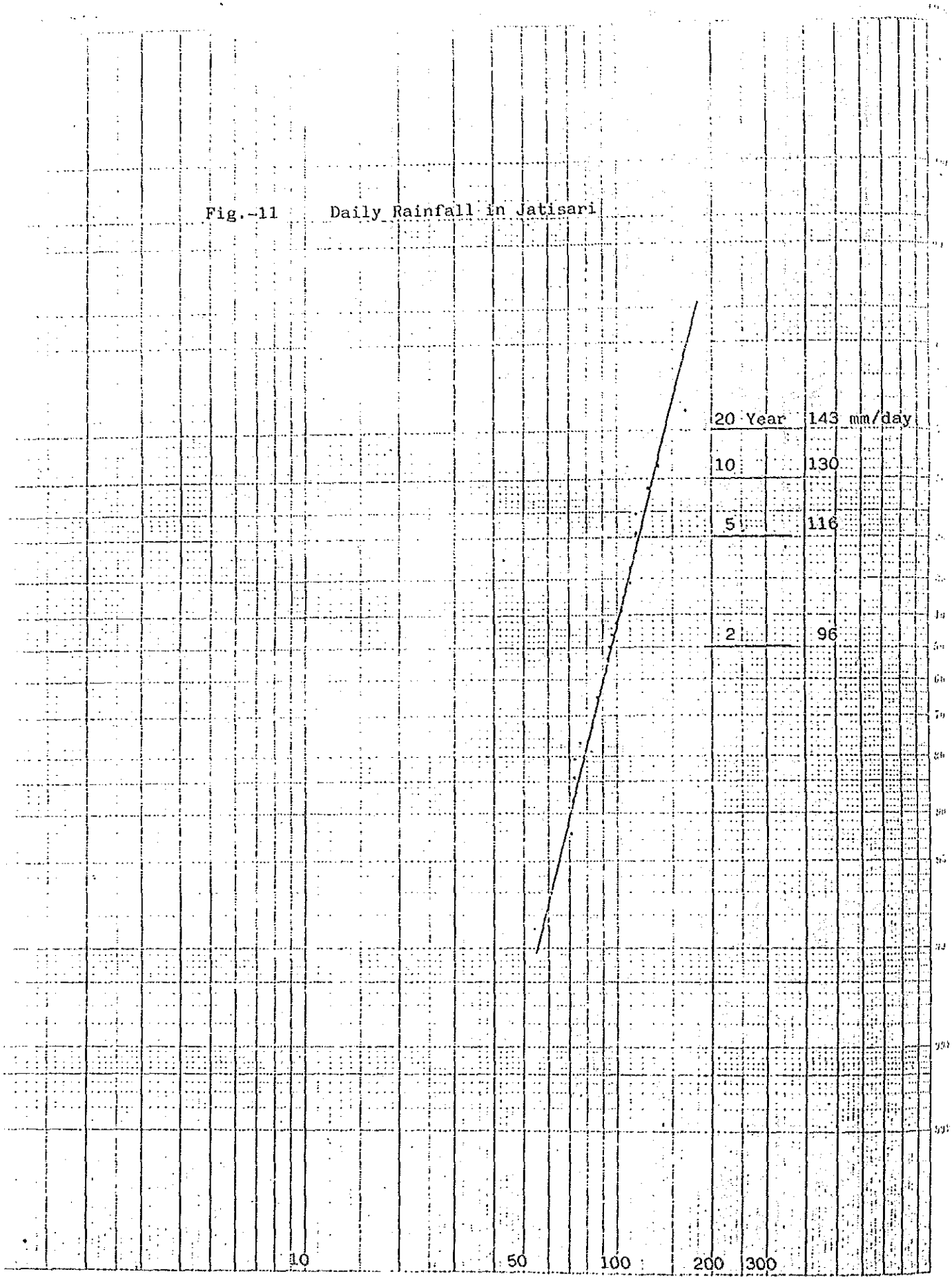
Roughness Coefficient : Reinforced concrete n = 0.015

Masonry n = 0.025

Earth canal n = 0.027

Present earth canal n = 0.030

Fig.-11 Daily Rainfall in Jatisari

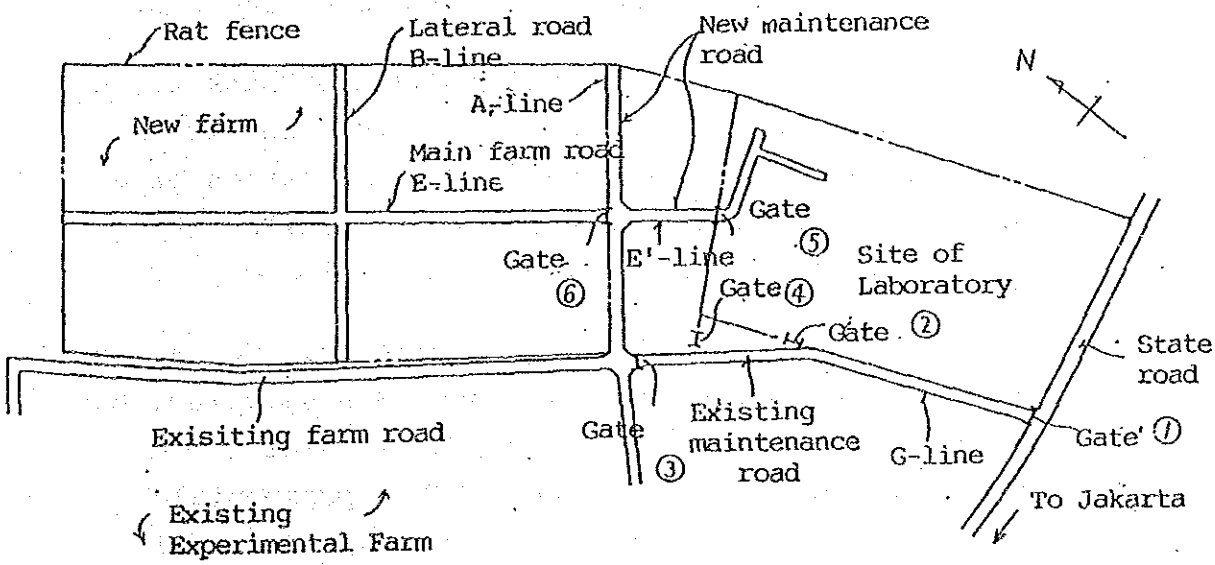


6) Farm Road and Maintenance Road

i) Road Networks

For the road networks of this experimental farm, the plan shall pay regard to the convenience for both the farming work and the method of experiment. The farm has a main road running along the center line of the farm which is parallel with the long side of the farm and a lateral road running across the main road parallel with the short side dividing the farm into two parts, the left part and the right part, about 1 ha respectively.

The maintenance road shall be established outside the rat fecne along the short side of the farm to the south-east of it's center, connected with the road of the existing farm. The main farm road mentioned above shall be extended to connect the farm with the present site of the laboratory as a connecting road. In addition, the existing maintenance road from the entrance gate of the State road to the entrance of the existing experimental farm shall be used as one of the facilities for the Center.



Details of Roads

Route	Length	Width	Pavement	Remarks
A line	113 m	3.5 m	Gravel	Outside the farm
B line	111	2.0	-	Lateral Road in the farm
E line	210	3.5	Gravel	Main Road in the farm
E' line	135	3.0	Gravel	Connecting Road
G line	152	3.0	Asphalt	Existing Maintenance Road
Total	721			

ii) Structure

The elevation of the road surface shall be 30 cm higher than that of the paddy field in principle for the maintenance and management of the road. Transported soil from borrow pit shall be applied to the road bed because the present paddy field has a weak foundation of clayee soil. Sandy soil shall be used for the above road bed.

The width, effective width and the thickness of gravel metalling shall be 3.5 m, 3.0 m and 10 cm respectively making allowances for operation of a tractor (30 ps class, B = 1.7 m), a trailer (B = 1.9 m), a vehicle for telemetry (B = 1.8 m), etc.

The laterial road shall be used only for a side-walk for farm work, observation, data sampling, etc. with a width of 2.0 m, effective width of 1.5 m. Rat fence is installed around the experimental farm, and the inside of the fence, a width of 1 m

is used as a sidewalk. The width of the embankment of irrigation and drainage canal which forms 10 m- lattice point in the farm shall be 40 cm for a sidewalk.

At present there are four gates attached to the maintenance road, and one of them is to be improved and two gates are to be newly installed.

Gate ① Existing, at along the state road (an exist and entrance of housing area)

Gate ② To be improved, at the west side of the laboratory (an exit and entrance of the laboratory), B = 3 m, H = 1.6 m

Gate ③ Existing, an exit and entrance of the experimental farm

Gate ④ Existing, an exit and entrance of the existing paddy field

Gate ⑤ New, an exist and entrance of the laboratory, B = 3 m, H = 1.3 m

Gate ⑥ New, an exit and entrance of the experimental field of rat B = 3 m, H = 1.6 m

The type of the door for the gate is double door made of steel especially for Gate ⑥, and door closers shall be installed as an automatic door.

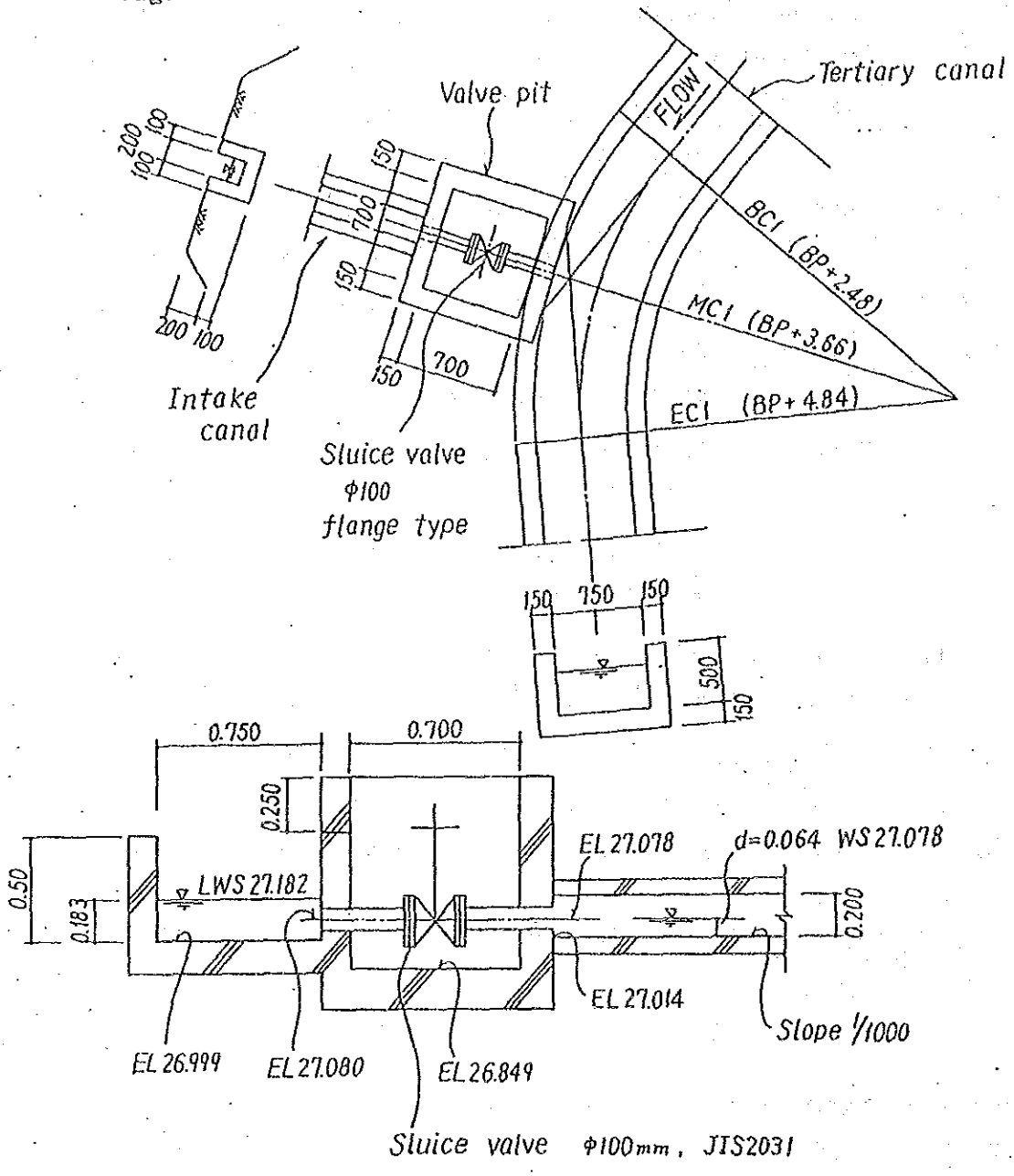
3-1-2 Intake Facilities and Improvement Works for Irrigation Canal

1) Intak Facilities

Water will be taken from the tertiary Canal made of reinforced concrete (B = 0.75 m, H = 0.50 m) with a steel pipe (ϕ 100 mm) and intake discharge will be controlled by a sluice valve. The pipe box will

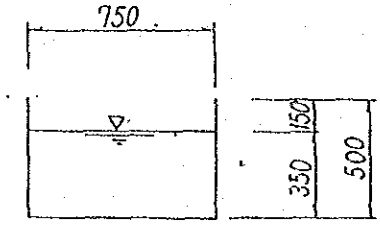
be installed at MC 1 (BP + 3.66) of the shifted tertiary canal.

Fig.11 Intake Str.



2) Shifted Tertiary Canal

The shifted tertiary canal shall be a canal made of reinforced concrete, 177.5 m long and have a following cross-sectional area of flow.



Hydraulic Features

$Q = 0.090 m^3/s$

$I = 1/3,600$, $I^{1/2} = 0.01667$

$d = 0.35$

$A = 0.2625 m^2$, $P = 1.45 m$, $R = 0.1810$

$R^{2/3} = 0.320$

$V = 1/n \times I^{1/2} \times R^{2/3} = 1/0.015 \times 0.01667 \times 0.320$

$= 0.356 m/s$

$\therefore$ $Q = A \cdot V = 0.093 \geqq 0.090 m^3/s$ OK

In case of minimum discharge (Q = 0.0375 m /s), the water depth and the flow velocity will be 0.183 m and 0.275 m/s respectively. The diversion water level into the experimental farm at the minimum discharge shall be applied. The structure of the shifted canal will be a conduit under the maintenance road and in the housing area ($\ell \doteqdot 80$ m).

3-1-3 Supplementary Water Resources

The Jatiluhur Tertiary Canal has a shut off period of water flow from July 15 until September 30, therefore a consecutive experiment through out a year can not be carried out. Such being the condition, ground water from a deep well is planned to be used as a supplementary water resources.

1) Deep well and Deep Well Pump

In this experimental farm there are two deep wells at present, and those details are as follows.

Items	In the Site for Buildings	In the Experimental Field
Purpose	Drinking Water, Miscellaneous water	Supplementary Water for Irrigation
Diameter of Bore Hole	ϕ250 mm	ϕ250 mm
Depth of Well	40 m	50 m
Submergible Motor Pump	ϕ40 mm	ϕ50 mm
Pump Head	40 m	40 m
Capacity of Pump	150 ℓ/min	100 - 200 ℓ/min
Casing	Steel pipe ϕ150	PVC ϕ150
Pump Output	2.2 kW Three phase-380V, 50 Hz.	2.2 kW Three phase-380V, 50 Hz.
Diesel Engine Generator	-	7.5 KVA

According to the results of the field pumping test, 200 ℓ/min of water can be expected, therefore, the features of the deep well shall be determined as follows.

Well Depth	40 m
Diameter of Bore Hole	ϕ200 mm
Submergible Motor Pump	ϕ50mm x 2.2 kW, 50BHS5-2.2 class
Total Head	40 m
Capacity of Pump	200 ℓ/min
Casing	ϕ150 mm, PVC pipe
Diesel Engine Generator	10 kVA, DCA 14 LBM class, 200/220 V
Input Method	Auto Transformer

One diesel engine generator of 10 KVA will be provided using a procurement method of JICA, therefore, the construction item of diesel engine generator will be an installation work and a running test only.

The water requirement for this project will be subject to utilization method of the experimental farm, however, water is limited in amount, therefore, the half of the whole farm might be irrigated from July upto September.

$$Q = 0.85 \text{ ha} \times 1.2 \text{ ℓ/sec/ha} \times \frac{1}{0.65} = 1.57 \text{ ℓ/sec}$$

In case of 12 hours' operation of the pump, the necessary water

Q' will be calculated as follows.

$$Q' = 1.57 \text{ ℓ/sec} \times \frac{24 \text{ hrs}}{12 \text{ hrs}} \times 60 \text{ min} = 188 \text{ ℓ/min} < 200 \text{ ℓ/min}$$

2) Size of Regulating Water Tank

The tank being used only for irrigation it is not necessary to store water so much, therefore direct

flow out can be applicable. Storing capacity will cover 1 ∿ 2 hrs' operation of the pump.

Storing Capacity of the regulating water tank:

$Q = 2 \text{ hrs} \times 0.2 \text{ ℓ/min} \times 60 \text{ min} = 24 \text{ m}^3$

Accordingly, the size of the regulating tank will be H = 1.5 m, B = 4.0 m and L = 6.0 m ($Q_{max} = 36 \text{ m}^3$) considering the free board.

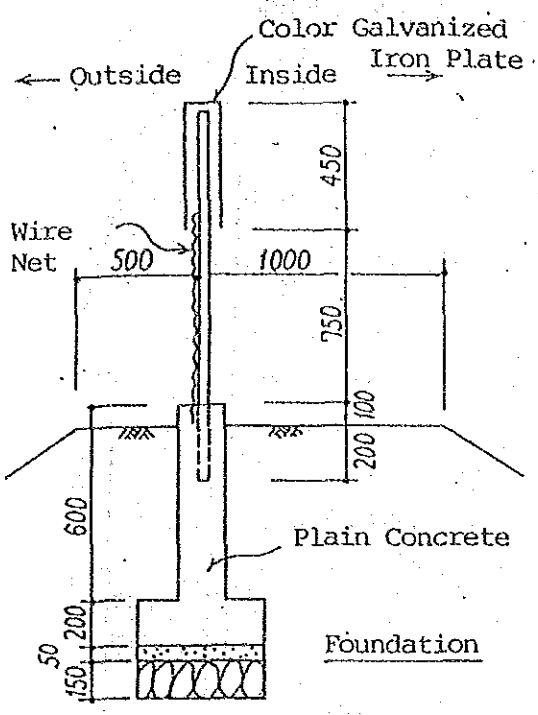
3-1-4 Construction of Rat Fence

The main subject of this infrastructure improvement works is to consolidate a experimental farm for the study on field rat, therefore, construction of a special fence is indispensable for partitioning the experimental farm completely of from the outside.

The foundation of a fence should be made of concrete with a depth of 70 cm below the ground surface taking habit of rice field rat into account, and on such foundation the fence should be installed. Installing length of the fence will be 640 m, surrounding the farm. Panels with meshes (the span of a panel: 2.0 m) are to be provided through JICA's on the site-procurement, so subjects of the construction will be foundation works and assembling works etc. The provided panels will be bolted each other then installed. Manufacturing of pannels at corners and installation of supporting materials at intervals of 10 m are included in the construction items.

In addition to above, the structure of the entrance shall be a double door type with a large size door closer.

2) Panel and Foundation



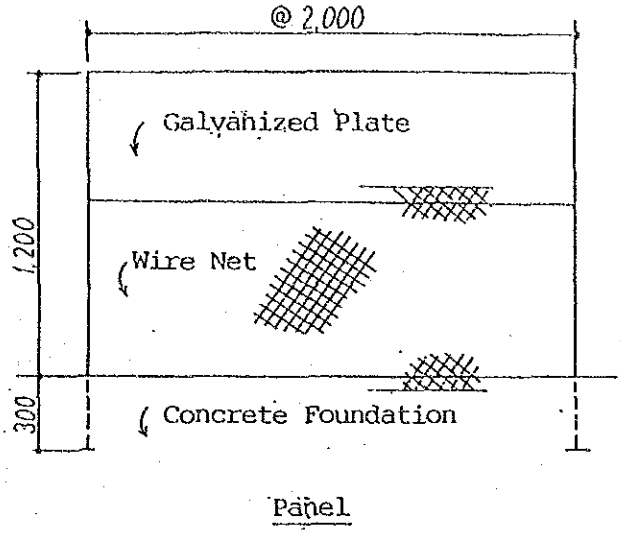
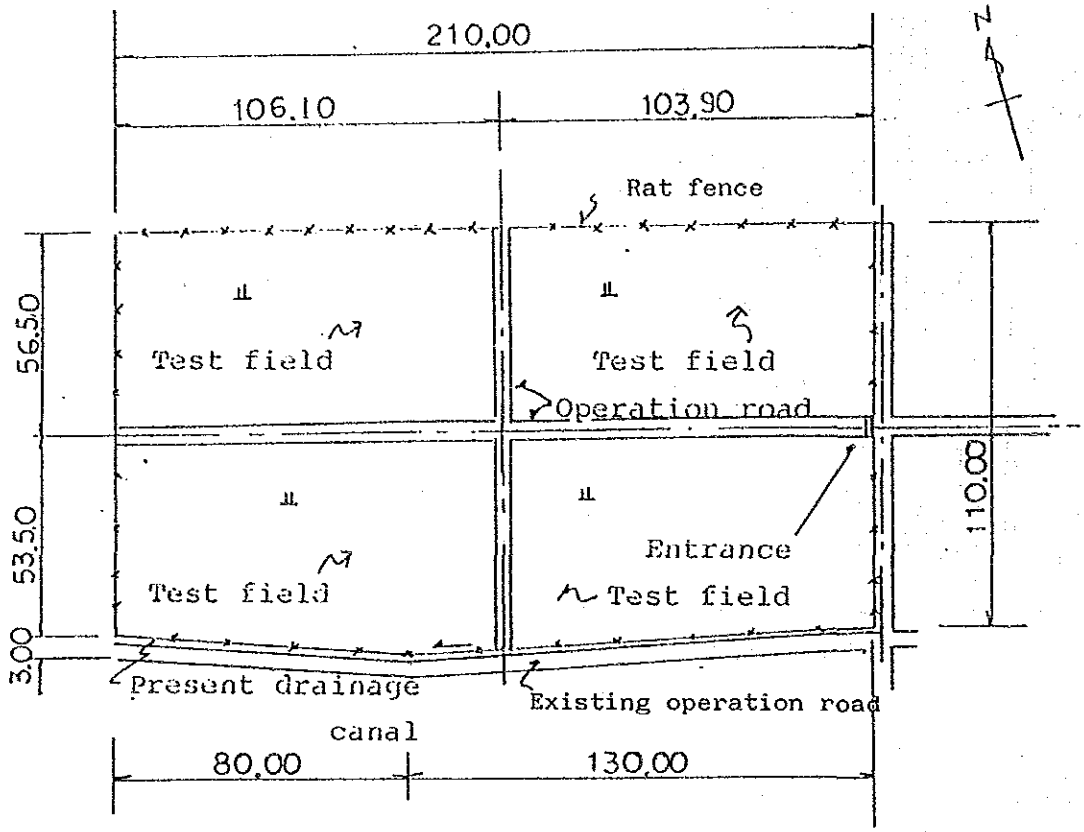


Fig.12 Rat fence

Fig.13 SHAPE OF EXPERIMENTAL FARM (PLAN)



3-1-5 Other Related Structures

1) Foundation works of bertebrate laboratory

Foundation works of a prefabricated house will be constructed for the DAIWA-HOUSE, Type YKA-3, 18-tsubo. As to the prefab materials, those have been provided and trnsported to the Jatisari Center as a procurement project of JICA.

The place of the house will be situated at the north corner of the center's building site. The size of the foundation will become to 11.00 x 5.54 meters and the type is a reverse T-shape foundation made of reinforced concrete. Further water supply pipes, PVC ϕ20 mm will be installed from the dormitory of the Center.

2) Foundation Works of Net Houses

There is a plan that two (2) net houses are constructed using the old materials of former's net houses. In accordance with this plan the foundation works itself will be carried out except for construction of house structure.

One net house will be constructed at the neighbour of the above-mentioned bertebrate laboratory and the other will be in the existing experimental farm. the size of foundation is 12.34 z 5.24 meters and a reverse T-shape type made of reinforced concrete will be adopted as a construction method of foundation works. The thickness of floor, made of plain concrete, is designed to be 10 cm.

As to the net house which is scheduled at the Center's building site, water supply pipes of PVC

ϕ20 mm will be installed as well as the bertebrate laboratory and a washing place will be added in the house.

3) Repair of the present operation & maintenance road

As shown in the clause 3-1-1, 6), the present operation and maintenance road will be repaired using asphalt pavement from the state road to existing experimental farm.

Length of repair	L = 157 m
Width of pavement	B = 3.0 m
Thickness of asphalt	T = 4 cm ($97.5\ kg/m^2$)

4) Repair of existing side gate for the Center

At present the side gate which connects with Center's laboratory and existing experimental farm cannot be used for passing of automobil owing to the narrow width, therefore the access road will be repaired and a steel gate will be also re-installed.

5) Repair of existing rat fence

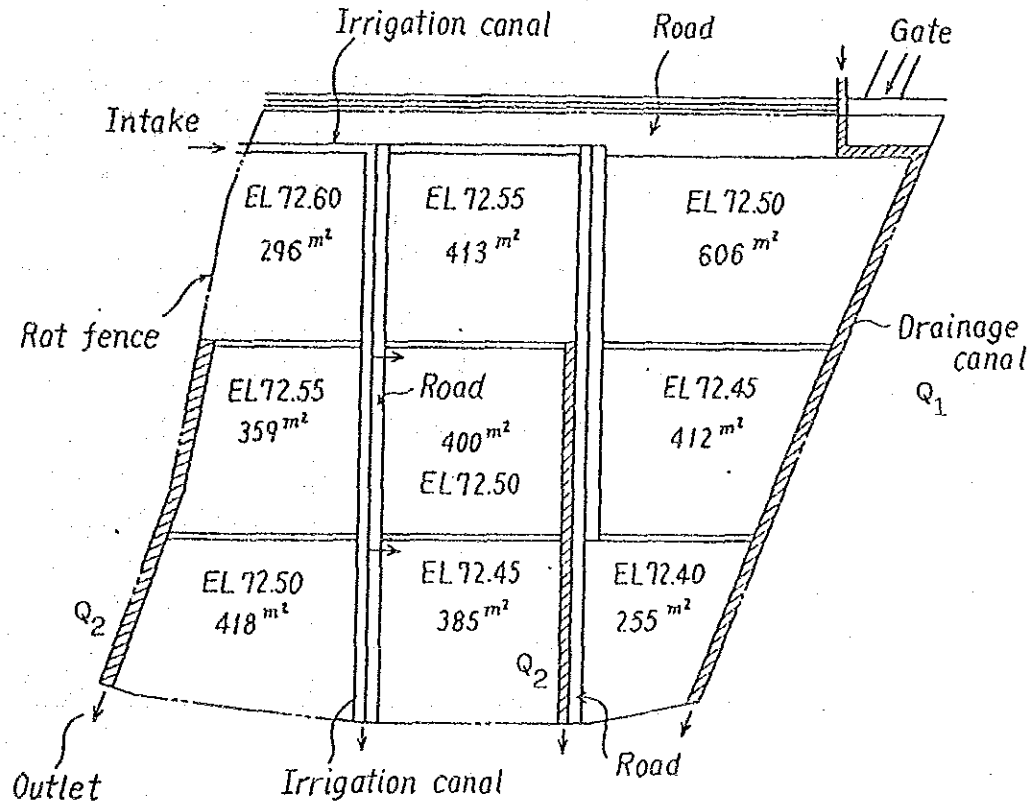
Present rat fence surrounding experimental farm will be repaired temporary using additional barbed wire of about one string and ordinary wire because that many tin plate of rat fence is now falling and peeling.

3-2 Plan of Improvement Works for the Celuk Field Laboratory

3-2-1 Farmland Consolidation

a. Land shape adjustment

The existing paddy field (A = 4,870m^2) shall be flattened, and irrigation canals, drainage canals and farm road will be constructed to consolidate the field into standard plots of 20 m x 20 m. The elevation of the existing paddy field varies from EL.72.15 m to 73.0 m. The elevation of the new paddy field after land granding shall be EL.72.60 m - EL 72.45 m considering the balance of the quantity of earth work for each plot. The land shape after the above work will be as follows.



b. Land levelling

The elevation of each plot of the paddy field shall be as above taking the amount of earth work for each plot into account. As for farm road, transported sandy soil from borrow pit shall be used.
The 530 m^2 of paddy field at present in the west side of the site for buildings shall be banked and leveled to EL. 74.4 m by the same transported soil as the farm roads.

c. Land use

The land use of the laboratory at the present condition and in the plan is as follows.

Item	Present	Plan	Remarks
Site for buildings of the laboratory	4,151m^2	4,151m^2	
Paddy field in the above site	(530)	–	Included in the site for building (4,151m^2
Mounding land in the above site	–	(530)	- ditto -
Paddy field	4,871	3,544	
Farm road and irrigation & drainage canel		1,067	
Space for fencing		260	
Total	9,022	9,022	

d. Irrigation canal

In principle a method of intake in conformity with the method at present shall be applied. The intake canal at present is one of the facilities under the control of the Public Works Division of Gianyar Prefecture and is the tail canal of the Keduwatan Irrigation Project. The water distribution system belongs to Golonga Type II.

Name of Subak	:	SB. PEJAJAH
Name of Diversion	:	BLG.10
Name of Tertiary Canal	:	BLG.10ki
Irrigation area	:	194.08ha

As for a unit water requirement, the unit water requirement of Dukun Sub-Project near to Gianyar (q = 2.2ℓ/sec/ha) can be applied. The irrigation canal will be made of plain concrete for economical utilization of water. The design water requirement for the connecting canal (ℓ = 63 m), therefore, shall be as follows:

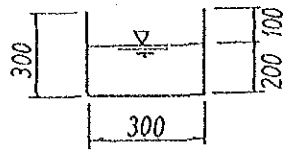
$$Q = 1.0 \text{ ha} \times 0.0022 = 0.0022 m^3/s$$

The details of the connecting canal shall be determined as follows considering the slope of present earth canal (1/80), the drainage capacity at present ($0.074 m^3$) and a design elevation of the suface of paddy field (EL.72.60m).

Connecting Canal	Elevation of Canal Bed at the beginning point	EL.73.65m
	Elevation of Canal Bed at the ending point	EL.72.86m

Canal slope 1/80

Cross Section of Canal (in case of drainage)



$B \times d = 0.30 \times 0.20$

$A = 0.06,\ P = 0.70,\ R = 0.0857,\ I = 1/80$

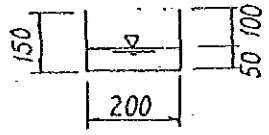
$V = 1.449,\ Q = 0.087 > 0.074\ m^3 / s$

In case of irrigation the design depth of water becoming too small as 2 cm, an intake depth of water shall be 10 cm taking application of stop-log into account.

On the other hand the design water requirement for the irrigation canal in the farm shall be calculated as below:

$Q = 0.4ha \times 0.0022 = 0.001 m^3 / s$

$I = 1/1,000,\ d = 0.05,\ A = 0.01,\ P = 0.30$



$R = 0.0333,\ n = 0.015,\ V = 0.218$

$Q = 0.002 > 0.001$

e. Drainage canal

The maximum daily rainfall in the past at Celuk is 296 mm/day recorded in January 1968. The probable rainfall estimated from the data of daily rainfall from from 1968 until 1987 is as follows:

Probability	Daily Rainfall	Remarks
2 years	115 mm	Data not obtained in 1969, 1970 and 1977 Total data: 17
5	165	
10	195	
20	235	

As for the design drainage discharge, the rainfall of 10 years' probability shall be used, so the design drainage discharge will be as follows.

$$Q_1 = 10 \times f \times r \times A / (3,600 \times T)$$

$$= 10 \times 0.8 \times 195 \times 0.6 / (3,600 \times 24)$$

$$= 0.011 m^3 / s$$

$$Q_2 = 10 \times 0.8 \times 195 \times 0.16 / (3,600 \times 24)$$

$$= 0.003 m^3 / s$$

Q1 includes drainage from the site of buildings of the laboratory.

Q2 shall cover one third (1/3) of the whole experimental farm.

All the drained water shall flow into Cengcengan dual purpose canal from each drainage outlet made of P.V.C. ø100 and ø150.

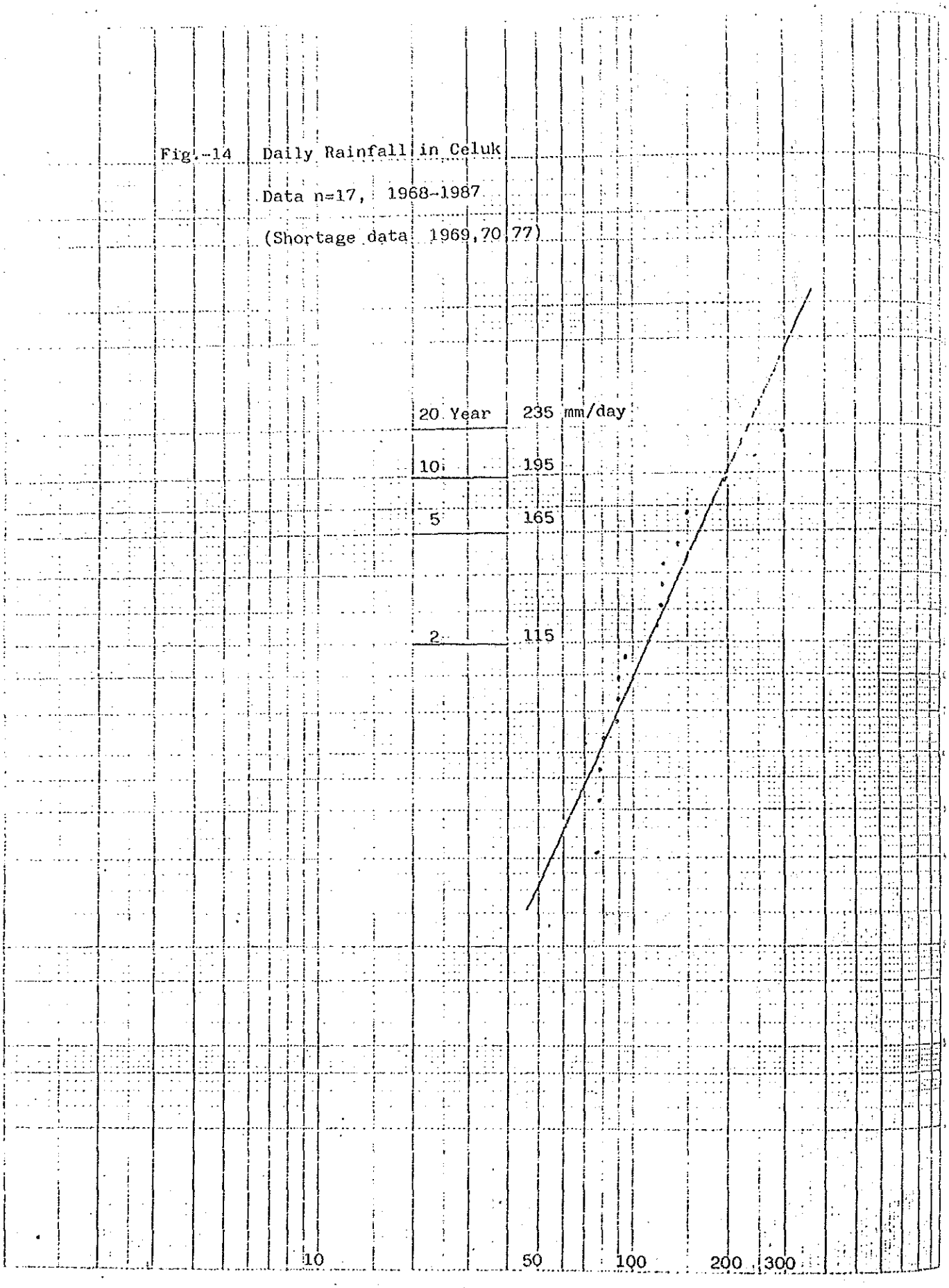


Fig.-14 Daily Rainfall in Celuk
Data n=17, 1968-1987
(Shortage data 1969,70,77)
20 Year 235 mm/day
10 195
5 165
2 115
10
50
100
200
300

f. Farm road

The following farm road shall be consturcted.

i. Access road; Width 2.5 m, effective width 2.0 m
(Tractor, 7.5Hp,B = 1.3 m will run over levees in the farm directly.)

ii. Road in the farm; Width 1.5 m, effective width 1.0 m
(Wheelbarrow passage).

Gravel metalling shall be done for the above roads.

An entrance from the site of the laboratory will be constructed at the east corner. 2 places of the irrigation canal where tractors run over, shall have conduit structures.

3-2-2 Regulating water tank

It is said that water flow of the said Keduwatan irrigation canal decreases especially during dry season, from July to September. For this period the deep well in the laboratory will be used to supply supplimentary water. At present the water tank is used once three days, therefore, the tank will be used 2 days (12 hrs × 2) for supplementary water for irrigation.

Accordingly, the capacity of the tank shall be calculated as follows provided that the capacity of the deep well is 50ℓ/min.

$V = 0.050 \times 60 \times 24 \text{ hrs} = 72m^3 \quad \therefore \quad V = 80m^3$

Irrigation area varies its size according to flow of existing irrigation canal and cropping conditions. The following cases are supposed by combinations of unit water requirement and flow in canal.

Unit Water Reuirement	Water Requir't	Rate of Canal Discharge	Canal Discharge	Supply of Pumping Water	Irrigable Area
	m^3/s	%	m^3/s	m^3/s	ha
100 % (2.2 ℓ/s/ha)	0.00088 (0.4ha)	100	0.00088	———	0.40
		75	0.00066	0.00022 ※	0.40
		50	0.00044	0.00028	0.33
		25	0.00022	0.00028	0.23
75 (1.65ℓ/s/ha)	0.00066 (0.4ha)	100	0.00066	———	0.40
		75	0.00050	0.00016	0.40
		50	0.00033	0.00028	0.37
		25	0.00017	0.00028	0.27
50 (1.1 ℓ/s/ha)	0.00044 (0.4ha)	100	0.00044	———	0.40
		75	0.00033	0.00011	0.40
		50	0.00022	0.00022	0.40
		25	0.00011	0.00028	0.35
25 (0.55ℓ/s/ha)	0.00022 (0.4ha)	100	0.00022	———	0.40
		75	0.00017	0.00005	0.40
		50	0.00011	0.00011	0.40
		25	0.00006	0.00016	0.40

(※ $Q = 72 \div (86,400 \times 3) = 0.00028 m^3/s$)

According to the above, about a half of the whole (0.23ha) can be irrigated when the maximum water requirement ($0.0088 m^3/s$) and flow rate of 25% are required for terminal canals.

3-2-3 Other Related Structures

a. Net fence

Net fences shall be installed surrounding the experimental farm.

Installation of net fences is indispensable for preventing rats from instruding into the farm where accurate data on damage intensity caused by Tunglo disease should be obtained.

The structure of net fences shall not change the natural meteorological conditions such as wind, sunshine etc. and have a function to shut rats out of the farm (L = 275 m, H = 1.5 m).

b. Access road to the farm

At present step work is used for access to the farm, but tractors and farming implements cannot enter into, therefore, an access road shall be constructed at the east side of the laboratory. The existing asphalt pavement, a brick work of drain ditches, fences etc. shall be repaired for the new access road.

The drain ditch shall be connected with drainage canals in the farm considering the elevations (B = 2.5m, L = 9.4m, slope 20%).

c. Masonny retaining wall

The elevation difference between the site of the laboratory and the scheduled experimental farm is estimated at 2.0 m. For effective land use, masonry work shall be done at the boundary between the site of the laboratory and the scheduled experimental farm (L = 77 m, H = 1.8 m).

d. Other miscellaneous works

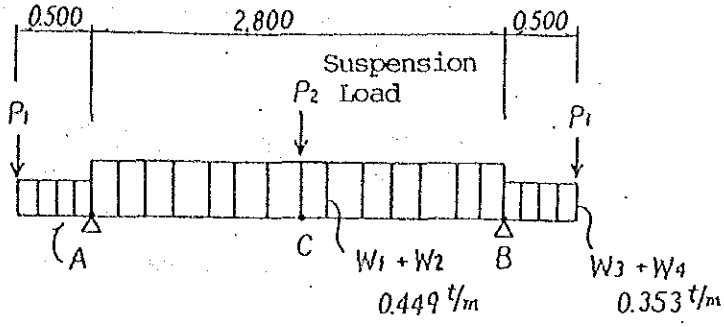
Works for cross culverts, switching of distributing pipes, repairing the existing fences etc. shall be carried out.

3 – 3 STRUCTURAL CALCULATION

3 – 3 – 1 Facilities in the Jatisari Center

1. Examination on generator housing

1) Roof



a. Load

Dead weight ; $W_1 = 0.12 \times 2.4 = 0.288 t/m$

Mortar ; $W_2 = (0.025 + 0.05) \times 2.15 = 0.161 t/m$

Dead weight ; $W_3 = 0.12 \times 2.4 = 0.288 t/m$

Mortar ; $W_4 = 0.03 \times 2.15 = 0.065 t/m$

Eaves ; $P_1 = 0.05 \times 0.10 \times 2.4 + 0.025 \times 0.2 \times 2.15 = 0.023 t$

Suspension load ; $P_2 = 0.3 t$

b. Moment and shearing force

Cantilever moment ; $$MA_1 = \left(\frac{0.353}{2} \times 0.5^2 + 0.023 \times 0.5\right)$$

$$= 0.056 t \cdot m$$

Cantilever shearing force ; $SA_1 = (0.353 \times 0.5 + 0.023) = 0.200 t$

Fixed end moment of beam ; $$MA_2 = -\left(\frac{0.449}{12} \times 2.8^2 + \frac{0.3}{8} \times 2.8\right)$$

$$= -0.398 t \cdot m$$

Shearing force of beam ; $$SA_2 = -\left(\frac{0.449}{2} \times 2.8 + \frac{0.3}{8}\right) = -0.779 t$$

Composite Moment ; $MA = MA_1 + MA_2 = 0.342 t \cdot m$

Composite Shearing Force ; $SA = SA_1 + SA_2 = 0.979 t$

C. Reinforcement bar

$$d = C_1\sqrt{\frac{M}{b}} = 5.5cm < 6.0cm$$

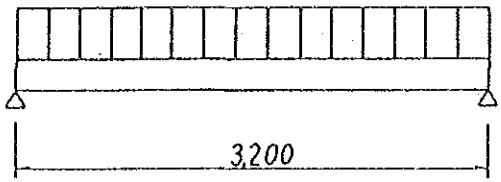
$$As = \frac{M}{\sigma_{sa} jd} = 3.61cm^2 < 8.47cm^2 \qquad D13 \ @150$$

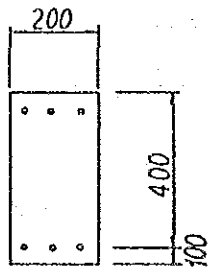
$$\sigma_{ca} = 6.18 \times \frac{M}{bd^2} = 58.7 < 70kg/cm^2$$

$$\tau_s = \frac{S}{bjd} = 1.9 < 4.25kg/cm^2$$

$$\tau_{oa} = \frac{S}{ujd} = \frac{979}{26.67 \times 0.877 \times 6} = 7.0 < 15.0kg/cm^2$$

2) Beam





Roof weight ; $W_1 = \frac{3.8 \times 4.2 \times 0.12 \times 2.4}{2 \times 3.2} = 0.718t/m$

Mortar ; $W_2 = (15.96 \times 0.05 \times 2.15 + 7.8 \times 0.025 \times 2.15) \div (2 \times 3.2) = 0.334t/m$

Beam weight ; $W_3 = 0.2 \times (0.5 - 0.12) \times 2.4 = 0.182t/m$

$W = W_1 + W_2 + W_3 = 1.234t/m$

Moment ; $M = \frac{W\ell^2}{8} = 1.58t \cdot m$

Shearing force; $S = \frac{W\ell}{2} = 1.97t$

C. Reinforcement bar

$$d = C_1\sqrt{\frac{M}{b}} = 26.4cm < 40cm$$

$$As = \frac{M}{\sigma_{sa} j d} = 2.5cm^2, \quad 3\text{-}D16 \quad As = 5.96cm^2$$

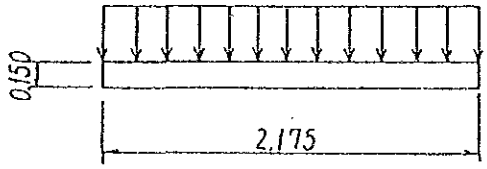
$$\sigma_{ca} = 6.18 \times \frac{M}{bd^2} = 30.5 < 70kg/cm^2$$

$$\tau_s = \frac{S}{bjd} = 2.8 < 4.25kg/cm^2$$

$$\tau_{oa} = \frac{S}{ujd} = \frac{1,970}{15 \times 0.877 \times 40} = 3.7 < 15kg/cm^2$$

2. Examination of Top Slab for Water Tank in Jatisari

a. Load condition



b. Load

Dead weight ; W_1 $0.15 \times 2.4 = 0.36t/m$

Load ; W_2 $0.50t/m$

Total ; $W = W_1 + W_2 = 0.86t/m$

c. Moment and shearing force at the center of the Slab

Center Moment ; $M = \frac{W\ell}{4} = \frac{0.86 \times 2.175}{4} = 0.468t \cdot m$

End point Shearing Force ; $S = \frac{W}{2} \times \ell = 0.935t$

d. Reinforcement bar

$$d = C_1\sqrt{\frac{M}{b}} = 6.4cm < 7.5cm \quad \text{(Slab center)}$$

$$As = \frac{M}{\sigma sajd} = 3.95cm^2 < 6.35cm^2 \quad D13 \ @200$$

$$\sigma ca = 6.18 \times \frac{M}{bd^2} = 51.4 < 70kg/cm^2$$

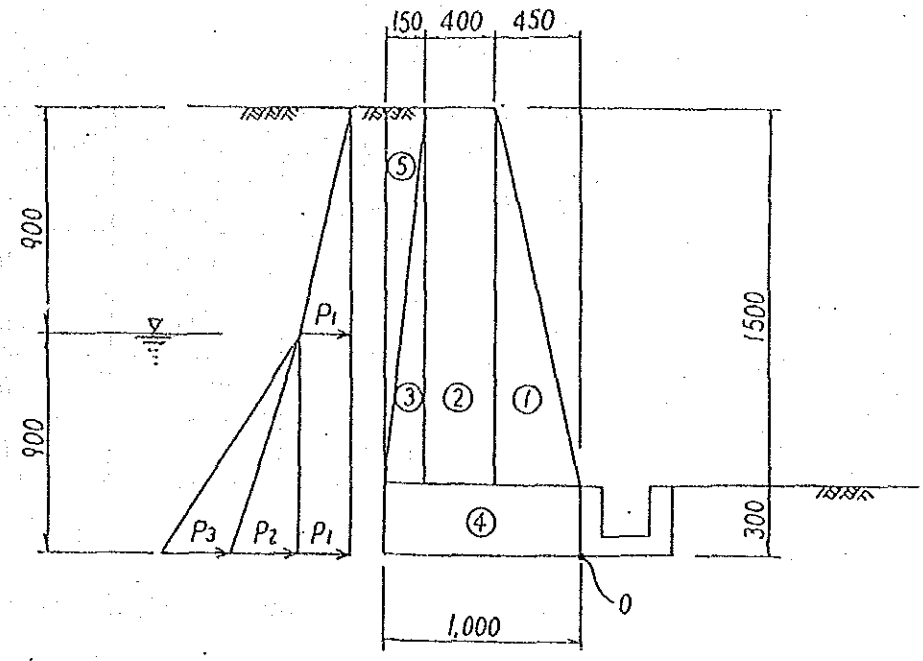
$$\tau s = \frac{S}{bjd} = 1.4 < 4.25kg/cm^2$$

$$\tau oa = \frac{S}{ujd} = \frac{935}{20 \times 0.877 \times 7.5} = 7.1 < 15kg/cm^2$$

3 - 3 - 2　Facilities in the Celuk Field Laboratory

1. Stability Analysis of Masonry Retaining Wall

1) Load conditions



Masonry weight ; $W_m = 2.2 t/m^3$

Wet soil ; $r_w = 1.8$ 〃

Saturated soil ; $r_s = 1.9$ 〃

Load No.	Vertical load(V)	Arm	Resisting Moment
①	0.74 t	0.30 m	0.22 t·m
②	1.32	0.65	0.86
③	0.25	0.90	0.23
④	0.66	0.50	0.33
⑤	0.20	0.95	0.19
Total	3.17		1.83 (Mr)

Horizontal Earth Pressure

$$P_1 = r_w \cdot Ka \cdot h_1 = 1.8 \times 0.333 \times 0.90 = 0.54 t/m^2$$

$$P_2 = (rs - 1) \cdot Ka \cdot h_2 = 0.9 \times 0.333 \times 0.90 = 0.27 t/m^2$$

Ground Water Pressure

$$P_3 = r \times h_2 = 1.0 \times 0.90 = 0.90 t/m^2$$

Load No.	Formula	Horizontal L.	Arm	Overturn Mom't
E_1	$1/2 \times h_1 \times P_1$	0.24 t	1.20 m	0.29 t·m
E_1'	$h_2 \times P_1$	0.49	0.45	0.22
E_2	$1/2 \times h_2 \times P_2$	0.12	0.30	0.04
E_3	$1/2 \times h_2 \times P_3$	0.41	0.30	0.12
Total		1.26		0.67

2) Stability calculation

- Examination on bearing capacity of foundation

$$\Sigma V = 3.17t$$

$$\Sigma H = 1.26t$$

$$\Sigma H = Mr - Mo = 1.16t \cdot m$$

The eccentricity,e, of resultant,R, from point O.,

$$d = \frac{\Sigma M}{\Sigma V} = 0.37m$$

$$e = \frac{B}{2} - d = 0.13m < \frac{B}{6} = 0.17m$$

$$\therefore \quad q = \frac{\Sigma V}{B}\left(1 \pm \frac{6 \times e}{B}\right) = \begin{cases} 5.6t/m^2 \leqq 20t/m^2 & OK \\ 0.7t/m^2 \end{cases}$$

- Examination on overturning

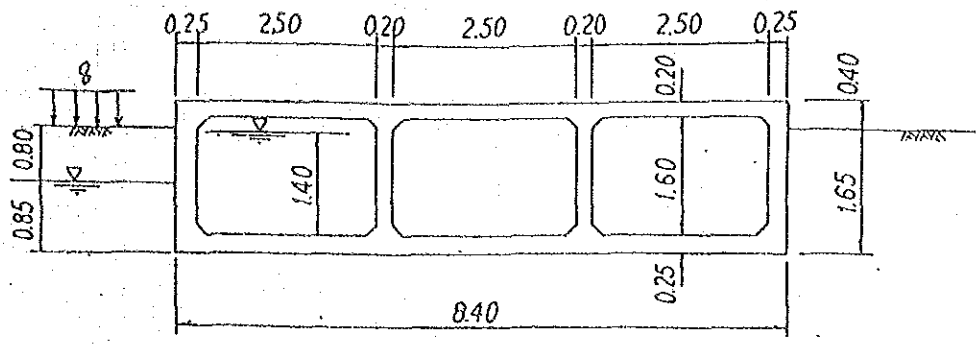
Safety Factor $\quad Fo = \dfrac{Mr}{Mo} = 2.7 \geqq 1.5 \qquad OK$

- Examination on sliding

Safety Factor $\quad Fs = \dfrac{0.5 \times \Sigma V}{\Sigma H} = 1.3 \geqq 1.2 \qquad OK$

2. Structural Calculation of Regulating water Tank

1) Load conditions



Truck load	;	$q = 1.0 t/m^2$
Dry soil	;	$r_d = 1.6 t/m^3$
Wet soil	;	$r_w = 1.8 t/m^3$
Saturated soil	;	$r_s = 1.9 t/m^3$
Reinforced concrete	;	$Wc = 2.4 t/m^3$
Coefficient of earth Pressure	;	$K = 0.333$
Compressive strength of concrete	;	$\sigma_{ca} = 70\ kg/cm^2$
Tensile strength of reinforcement bar	;	$\sigma_{sa} = 1,800 kg/cm^2$
Shearing stress of concrete (Beam/Slab)	;	$\sigma_s = 4.2/8.5 kg/cm^2$
Bond stress of deformed bar	;	$\tau_{oa} = 15\ kg/cm^2$

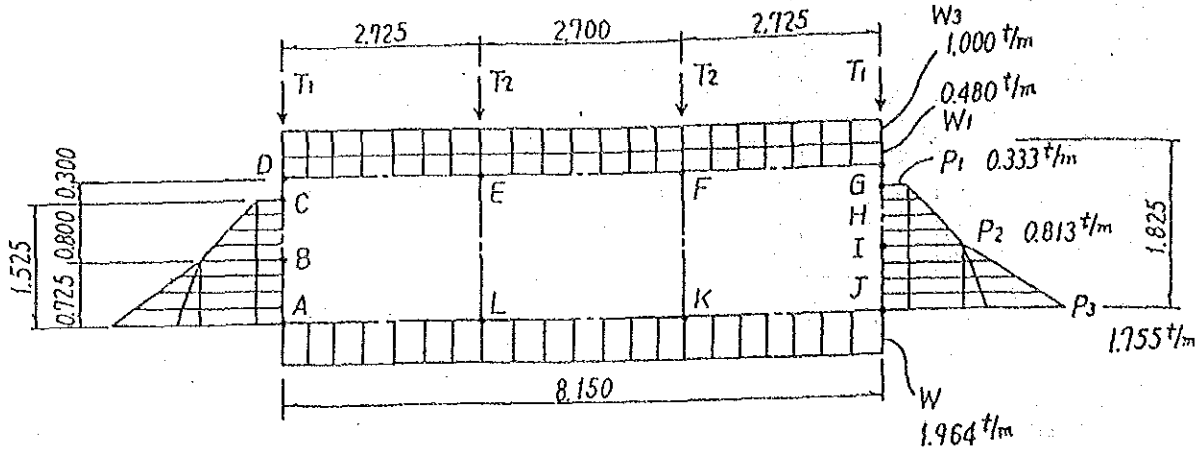
2) Examination on upland pressure

Uplift pressure ; $U = 0.85 \times 8.40 = 7.14 t/m^2$

Dead weight ; $W = 12.53 t$

$\therefore\ W > U$ OK

3) In case of empty (CASE-1)



Conversion load of truck load ; $h = \frac{q}{rd} = 0.625m$

Earth pressure ; $P_1 = K \cdot rd \cdot h = 0.333 \times 1.60 \times 0.625$

$= 0.333 t/m$

Earth pressure ; $P_2 = P_1 + K \cdot rw \cdot h$

$= 0.333 + 0.333 \times 1.80 \times 0.80$

$= 0.813 t/m$

Earth & water pressure ; $P_3 = P_2 + K \cdot (rs - 1.0) \times h + r \times h$

$= 0.813 + 0.333 \times 0.90 \times 0.725 + 1.0 \times 0.725$

$= 1.755 t/m$

Dead weight of top slab; $W_1 = 0.20 \times 2.4 = 0.480 t/m$

Uniform load ; $W_3 = 0.625 \times 1.6 = 1.000 t/m$

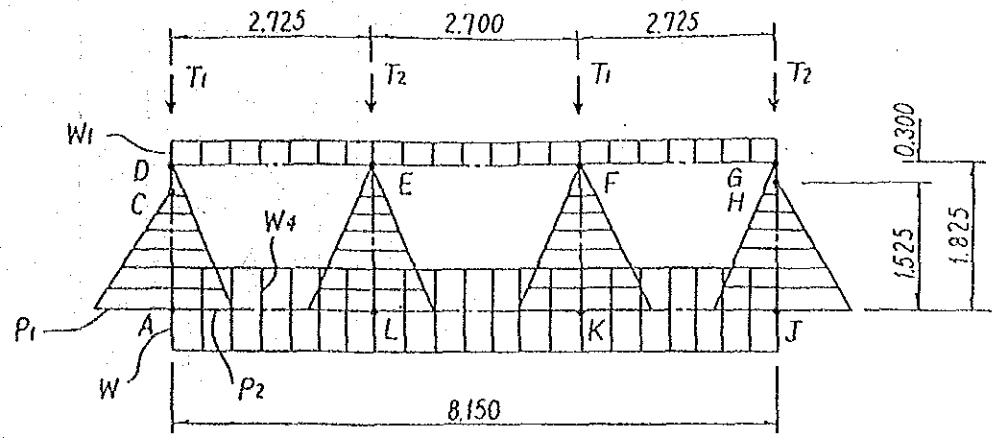
Outside wing wall ; $2T_1 = 1.095t \times 2 = 2.190t$

Inside wing wall ; $2T_2 = 0.876t \times 2 = 1.752t$

Reaction of dead weight; $W_2 = 0.48 + \frac{2.190 + 1.752}{8.150} = 0.964 t/m$

Reaction of bottom slab; $W = W_2 + W_3 = 1.964 t/m$

4) In case of full water (CASE-2)



Earth pressure ; $P_1 = K \times \gamma d \times h = 0.333 \times 1.60 \times 1.525$

$= 0.813 t/m$

Water pressure ; $P_2 = \gamma \times h$

$= 1.00 \times 1.825 = 1.825 t/m$

Dead weight of top slab ; $W_1 = 0.480 t/m$

Outside wall ; $2 \times T_1 = 2.190 t$

Inside wall ; $2 \times T_2 = 1.752 t$

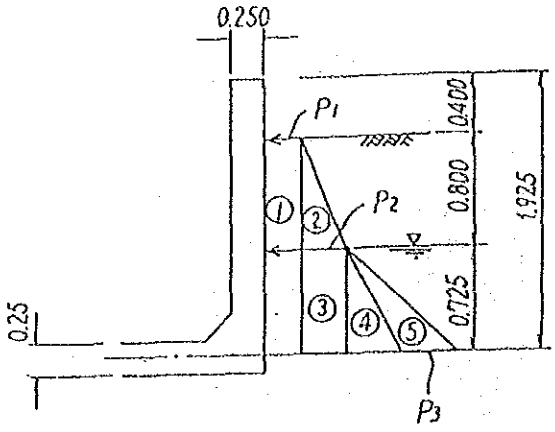
Reaction of dead weight ; $W_2 = 0.964 t/m$

Water pressure ; $W_4 = \gamma \times h = 1.825 t/m$

Reaction of bottom slab ; $W = W_2 + W_4 = 2.789 t/m$

5) Examination of side wall (empty inside)

a. Load condition



Earth pressure ; P_1 =0.333t/m

ditto〃 ; P_2 =0.813 〃

ditto〃 ; P_3 =1.755 〃

b. Moment (M) and shearing force (S) by earth pressure .

Load No.	Load (S)	Arm	Moment(M)
①	0.333×1.525 =0.508t	0.763 m	0.388 t·m
②	0.480×0.8、×1/2 =0.192t	0.992	0.190
③	0.480×0.725 =0.348t	0.363	0.126
④	0.217×0.725 ×1/2 =0.079t	0.242	0.019
⑤	0.725×0.725 ×1/2 =0.263t	0.242	0.064
Total	1.390t		0.787

c. Reinforcement bar at the base point

$$As = \frac{M}{\sigma sajd} = \frac{78,700}{1,800 \times 0.877 \times 19} = 2.62cm^2 \quad ,013 \quad @300$$

$$As = 4.23cm^2$$

$$\sigma ca = \frac{2M}{Kjbd^2} = 6.18 \times \frac{M}{bd^2} = 6.18 \times \frac{78,700}{100 \times 192}$$

$$= 13.4 \quad < \quad 70kg/cm^2 \qquad OK$$

$$\tau c = \frac{S}{bjd} = \frac{1,390}{100 \times 0.877 \times 19} = 0.8 \quad < \quad 4.25kg/cm^2 \qquad OK$$

$$\tau oa = \frac{S}{ujd} = \frac{1,390}{13.33 \times 0.877 \times 19} = 6.3 \quad < \quad 15kg/cm^2 \qquad OK$$

** CELUK FARM POND CASE1 **

*** STRUCTURE NO. 3 PLANE FRAME ***

*** STRUCTURE DATA ***

M	N	NJ	NR	NRJ	E
10	19	8	5	4	210000.0

*** CO-ORDINATES OF JOINTS ***

JOINT	X	Y
1	0.0	0.0
2	0.0	1.825
3	2.725	1.825
4	5.425	1.825
5	8.150	1.825
6	8.150	0.0
7	5.425	0.0
8	2.725	0.0

*** MEMBER INFORMATION ***

MEMBER	JJ	JK	AX	IZ	-L-
1	1	2	0.250	0.001	1.825
2	2	3	0.200	0.001	2.725
3	3	4	0.200	0.001	2.700
4	4	5	0.200	0.001	2.725
5	5	6	0.250	0.001	1.825
6	6	7	0.250	0.001	2.725
7	7	8	0.250	0.001	2.700
8	8	1	0.250	0.001	2.725
9	3	8	0.200	0.001	1.825
10	4	7	0.200	0.001	1.825

*** JOINT RESTRAINTS ***

JOINT	RL1	RL2	RL3
1	1	1	0
8	0	1	0
7	0	1	0
6	0	1	0

*** LOAD CASE NO. (1) ***

*** ACTIONS APPLIED AT JOINTS ***

JOINT	X-DIRECTION	Y-DIRECTION	Z-DIRECTION
1	0.0	0.96000	0.0
8	0.0	0.76800	0.0
7	0.0	0.76800	0.0
6	0.0	0.96000	0.0

*** ACTIONS APPLIED AT MEMBERS ***

NO.	K1	K2	-M-	-AS-	-PA-	-CS-	-PB-
1	1	2	1 0.0	0.174E+01	0.725E+00	0.813E+00	
2	1	2	1 0.725E+00	0.813E+00	0.800E+00	0.333E+00	
3	1	2	2 0.0	0.148E+01	0.273E+01	0.148E+01	
4	1	2	3 0.0	0.148E+01	0.270E+01	0.148E+01	
5	1	2	4 0.0	0.148E+01	0.273E+01	0.148E+01	
6	1	2	5 0.300E+00	0.333E+00	0.800E+00	0.813E+00	
7	1	2	5 0.110E+01	0.813E+00	0.725E+00	0.174E+01	
8	1	2	6 0.0	0.196E+01	0.273E+01	0.196E+01	
9	1	2	7 0.0	0.196E+01	0.270E+01	0.196E+01	
10	1	2	8 0.0	0.196E+01	0.273E+01	0.196E+01	

*** JOINT DISPLACEMENTS ***

JOINT	X-DIS	Y-DIS	ROTA.
1	0.0	0.0	-0.15293E-02
2	0.35470E-04	0.65785E-04	0.15485E-02
3	0.62931E-04	0.17983E-03	-0.37368E-03
4	0.89311E-04	0.17983E-03	0.37369E-03
5	0.11587E-03	0.65785E-04	-0.15485E-02
6	0.15135E-03	0.0	0.15293E-02
7	0.10049E-03	0.0	-0.42070E-03
8	0.50863E-04	0.0	0.42070E-03

*** MAXIMUM MOMENT ***

MEMBERS		DIST.	M-MAX	- S -	- N -
1	1 2	0.787	-0.354	0.0	1.892
2	2 3	1.279	0.562	0.0	0.409
3	3 4	1.350	0.411	0.0	0.424
4	4 5	1.446	0.562	0.0	0.409
5	5 6	1.038	-0.354	0.0	1.892
6	6 7	1.238	0.818	0.0	0.980
7	7 8	1.350	0.511	0.0	0.965
8	8 1	1.487	0.818	0.0	0.980
9	3 8	0.0	0.0	0.0	0.0
10	4 7	0.0	0.0	0.0	0.0

*** CALCULATION OF REINFORCEMENT ***

* ALLOWABLE STRESS

SSA = 1800.00
SCA = 70.00
TAUA = 3.60
TAUDA = 15.00
SSA' = 0.0

MD ... EFFECTIVE DEPTH DUE TO BENDING MOMENT
SD ... EFFECTIVE DEPTH DUE TO SHEARING FORCE
CD ... COMPRESSIVE STRESS DUE TO BENDING MOMENT
U ... CIRCUMFERENCE OF REINFORCEMENT

MEMBER	DIST	MS	N	S	TT	DD	MD	SD	CD	U	COMPRESSION S1	COMPRESSION S2	TENSION S1	TENSION S2
1	0.0	-0.810	1.892	0.980	25.00	6.00	8.45	3.10	13.90	3.92	1.65	0.0		
1	0.304	-0.587	1.892	0.506	25.00	6.00	7.19	1.60	10.07	2.03	0.91	0.0		
1	0.608	-0.490	1.892	0.153	25.00	6.00	6.57	0.48	8.41	0.61	0.58	0.0		
1	0.912	-0.482	1.892	-0.093	25.00	6.00	6.52	0.29	8.28	0.37	0.56	0.0		
1	1.217	-0.540	1.892	-0.278	25.00	6.00	6.90	0.88	9.28	1.11	0.75	0.0		
1	1.521	-0.646	1.892	-0.408	25.00	6.00	7.55	1.20	11.09	1.63	1.10	0.0		
1	1.825	-0.771	1.892	-0.409	25.00	6.00	8.24	1.30	13.23	1.64	1.52	0.0		
2	0.0	-0.664	0.409	1.892	20.00	6.00	7.65	5.99	20.99	10.28	2.78	0.0		
2	0.454	0.076	0.409	1.220	20.00	6.00	2.58	3.87	2.39	6.63	0.11	0.0		
2	0.908	0.477	0.409	0.548	20.00	6.00	6.49	1.74	15.09	2.98	1.93	0.0		
2	1.363	0.574	0.409	-0.124	20.00	6.00	7.11	0.39	18.13	0.67	2.37	0.0		
2	1.817	0.365	0.409	-0.796	20.00	6.00	5.67	2.52	11.53	4.32	1.42	0.0		
2	2.271	-0.182	0.409	-1.468	20.00	6.00	4.01	4.65	5.77	7.97	0.60	0.0		
2	2.725	-1.002	0.409	-2.141	20.00	6.00	9.40	6.78	31.48	11.62	4.31	0.0		
3	0.0	-0.955	0.424	1.998	20.00	6.00	9.18	6.33	30.20	10.85	4.09	0.0		
3	0.450	-0.206	0.424	1.332	20.00	6.00	4.26	4.22	6.51	7.23	0.70	0.0		
3	0.900	0.278	0.424	0.666	20.00	6.00	4.95	2.11	8.78	3.62	1.02	0.0		
3	1.350	0.428	0.424	-0.000	20.00	6.00	6.14	0.00	13.52	0.00	1.70	0.0		
3	1.800	0.278	0.424	-0.666	20.00	6.00	4.95	2.11	8.78	3.62	1.02	0.0		
3	2.250	-0.206	0.424	-1.332	20.00	6.00	4.26	4.22	6.51	7.23	0.70	0.0		
3	2.700	-0.955	0.424	-1.998	20.00	6.00	9.18	6.33	30.20	10.85	4.09	0.0		
4	0.0	-1.002	0.409	2.141	20.00	6.00	9.40	6.78	31.48	11.62	4.31	0.0		
4	0.454	-0.182	0.409	1.468	20.00	6.00	4.01	4.65	5.77	7.97	0.60	0.0		
4	0.908	0.365	0.409	0.796	20.00	6.00	5.67	2.52	11.53	4.32	1.42	0.0		
4	1.362	0.574	0.409	0.124	20.00	6.00	7.11	0.39	18.13	0.67	2.37	0.0		
4	1.817	0.477	0.409	-0.548	20.00	6.00	6.49	1.74	15.09	2.98	1.93	0.0		
4	2.271	0.076	0.409	-1.220	20.00	6.00	2.58	3.87	2.39	6.63	0.11	0.0		
4	2.725	-0.664	0.409	-1.892	20.00	6.00	7.65	5.99	20.99	10.28	2.78	0.0		
5	0.0	-0.771	1.892	0.409	25.00	6.00	8.24	1.30	13.23	1.64	1.52	0.0		
5	0.304	-0.646	1.892	0.408	25.00	6.00	7.55	1.20	11.09	1.63	1.10	0.0		
5	0.608	-0.540	1.892	0.278	25.00	6.00	6.90	0.88	9.28	1.11	0.75	0.0		
5	0.912	-0.482	1.892	0.093	25.00	6.00	6.52	0.29	8.28	0.37	0.56	0.0		
5	1.217	-0.490	1.892	-0.153	25.00	6.00	6.57	0.48	8.41	0.61	0.58	0.0		
5	1.521	-0.587	1.892	-0.506	25.00	6.00	7.19	1.60	10.07	2.03	0.91	0.0		
5	1.825	-0.810	1.892	-0.980	25.00	6.00	8.45	3.10	13.90	3.92	1.65	0.0		
6	0.0	-0.750	0.980	2.431	25.00	6.00	8.14	7.70	12.88	9.73	1.96	0.0		
6	0.454	0.279	0.980	1.559	25.00	6.00	4.96	4.88	4.78	6.16	0.38	0.0		
6	0.908	0.775	0.980	0.647	25.00	6.00	8.27	2.05	13.31	2.59	2.04	0.0		
6	1.362	0.867	0.980	-0.245	25.00	6.00	8.74	0.77	14.88	0.98	2.35	0.0		
6	1.817	0.553	0.980	-1.137	25.00	6.00	6.98	3.40	9.49	4.55	1.39	0.0		
6	2.271	-0.293	0.980	-2.029	25.00	6.00	5.08	6.43	5.03	8.12	0.43	0.0		
6	2.725	-1.417	0.980	-2.920	25.00	6.00	11.18	9.25	24.32	11.68	4.18	0.0		

MEMBER	DIST	- WS -	- N -	- S -	TT	DD	MD	SD	CD	U	COMPRESSION S1	COMPRESSION S2	TENSION S1	TENSION S2
7	0.0	-1.341	0.965	2.651	25.00	6.00	10.88	8.40	23.02	10.61	3.93	0.0		
7	0.450	-0.347	0.965	1.768	25.00	6.00	5.53	5.60	5.95	7.07	0.62	0.0		
7	0.900	0.375	0.965	0.884	25.00	6.00	5.75	2.80	6.44	3.54	0.72	0.0		
7	1.350	0.574	0.965	-0.000	25.00	6.00	7.12	0.00	9.86	0.00	1.38	0.0		
7	1.800	0.375	0.965	-0.884	25.00	6.00	5.75	2.80	6.44	3.54	0.72	0.0		
7	2.250	-0.347	0.965	-1.768	25.00	6.00	5.53	5.60	5.95	7.07	0.62	0.0		
7	2.700	-1.341	0.965	-2.651	25.00	6.00	10.88	8.40	23.02	10.61	3.93	0.0		
8	0.0	-1.417	0.980	2.920	25.00	6.00	11.18	9.25	24.32	11.68	4.18	0.0		
8	0.454	-0.293	0.980	2.029	25.00	6.00	5.08	6.42	5.03	8.12	0.43	0.0		
8	0.908	0.553	0.980	1.137	25.00	6.00	6.98	3.60	9.49	4.55	1.30	0.0		
8	1.363	0.867	0.980	0.245	25.00	6.00	8.74	0.77	14.88	0.98	2.35	0.0		
8	1.817	0.775	0.980	-0.647	25.00	6.00	8.27	2.05	13.31	2.59	2.04	0.0		
8	2.271	0.279	0.980	-1.539	25.00	6.00	4.96	4.88	4.78	6.16	0.38	0.0		
8	2.725	-0.750	0.980	-2.431	25.00	6.00	6.14	7.70	12.88	9.73	1.96	0.0		
9	0.0	-0.048	4.139	-0.015	20.00	6.00	2.05	0.05	1.50	0.08	0.0	0.0		
9	0.304	-0.052	4.139	-0.015	20.00	6.00	2.14	0.05	1.65	0.08	0.0	0.0		
9	0.608	-0.057	4.139	-0.015	20.00	6.00	2.24	0.05	1.79	0.08	0.0	0.0		
9	0.912	-0.061	4.139	-0.015	20.00	6.00	2.32	0.05	1.94	0.08	0.0	0.0		
9	1.217	-0.066	4.139	-0.015	20.00	6.00	2.41	0.05	2.08	0.08	0.0	0.0		
9	1.521	-0.070	4.139	-0.015	20.00	6.00	2.49	0.05	2.23	0.08	0.0	0.0		
9	1.825	-0.075	4.139	-0.015	20.00	6.00	2.57	0.05	2.37	0.08	0.0	0.0		
10	0.0	0.048	4.139	0.015	20.00	6.00	2.05	0.05	1.50	0.08	0.0	0.0		
10	0.304	0.052	4.139	0.015	20.00	6.00	2.14	0.05	1.65	0.08	0.0	0.0		
10	0.608	0.057	4.139	0.015	20.00	6.00	2.24	0.05	1.79	0.08	0.0	0.0		
10	0.912	0.061	4.139	0.015	20.00	6.00	2.32	0.05	1.94	0.08	0.0	0.0		
10	1.217	0.066	4.139	0.015	20.00	6.00	2.41	0.05	2.08	0.08	0.0	0.0		
10	1.521	0.070	4.139	0.015	20.00	6.00	2.49	0.05	2.23	0.08	0.0	0.0		
10	1.825	0.075	4.139	0.015	20.00	6.00	2.57	0.05	2.37	0.08	0.0	0.0		

** CELUK FARM POND CASE1 **

*** STRUCTURE NO. 3 PLANE FRAME ***

*** STRUCTURE DATA ***

M	N	NJ	NR	NRJ	E
12	19	8	5	6	210000.0

*** CO-ORDINATES OF JOINTS ***

JOINT	X	Y
1	0.0	0.0
2	0.0	1.825
3	2.725	1.825
4	5.425	1.825
5	8.150	1.825
6	8.150	0.0
7	5.425	0.0
8	2.725	0.0

*** MEMBER INFORMATION ***

MEMBER	JJ	JK	AX	IZ	-L-
1	1	2	0.250	0.001	1.825
2	2	3	0.200	0.001	2.725
3	3	4	0.200	0.001	2.700
4	4	5	0.200	0.001	2.725
5	5	6	0.250	0.001	1.825
6	6	7	0.250	0.001	2.725
7	7	8	0.250	0.001	2.700
8	8	1	0.250	0.001	2.725
9	3	8	0.200	0.001	1.825
10	4	7	0.200	0.001	1.825

*** JOINT RESTRAINTS ***

JOINT	RL1	RL2	RL3
1	1	1	0
8	0	1	0
7	0	1	0
6	0	1	0

*** LOAD CASE - (1) ***

*** ACTIONS APPLIED AT JOINTS ***

JOINT	X-DIRECTION	Y-DIRECTION	Z-DIRECTION
1	0.0	0.96000	0.0
8	0.0	0.76800	0.0
7	0.0	0.76800	0.0
6	0.0	0.96000	0.0

*** ACTIONS APPLIED AT MEMBERS ***

NO.	K1	K2	-M-	-AS-	-PA-	-CS-	-PB-
1	1	2	1 0.0	-0.101E+01	0.152E+01	-0.300E+00	
2	1	2	1 0.152E+01	-0.300E+00	0.300E+00	0.0	
3	1	2	2 0.0	0.480E+00	0.273E+01	0.480E+00	
4	1	2	3 0.0	0.480E+00	0.270E+01	0.480E+00	
5	1	2	4 0.0	0.480E+00	0.273E+01	0.480E+00	
6	1	2	5 0.0	0.0	0.300E+00	-0.300E+00	
7	1	2	5 0.300E+00	-0.300E+00	0.152E+01	-0.101E+01	
8	1	2	6 0.0	-0.861E+00	0.273E+01	-0.861E+00	
9	1	2	7 0.0	-0.861E+00	0.270E+01	-0.861E+00	
10	1	2	8 0.0	-0.861E+00	0.273E+01	-0.861E+00	

*** JOINT DISPLACEMENTS ***

JOINT	X-DIS	Y-DIS	ROTA.
1	0.0	0.0	0.24040E-03
2	-0.74404E-04	0.21091E-04	0.50904E-03
3	-0.76158E-04	0.58628E-04	-0.65795E-04
4	-0.80132E-04	0.58628E-04	0.65795E-04
5	-0.81887E-04	0.21091E-04	-0.50904E-03
6	-0.15630E-03	0.0	-0.24040E-03
7	-0.10344E-03	0.0	0.45917E-04
8	-0.52858E-04	0.0	-0.45918E-04

*** MAXIMUM MOMENT ***

MEMBERS		DIST.	M-MAX	- S -	- N -
1	1 2	1.592	-0.207	0.0	0.607
2	2 3	1.264	0.181	0.0	-0.027
3	3 4	1.350	0.139	0.0	-0.062
4	4 5	1.461	0.181	0.0	-0.027
5	5 6	0.233	-0.207	0.0	0.607
6	6 7	1.313	-0.296	0.0	-1.018
7	7 8	1.350	-0.252	0.0	-0.984
8	8 1	1.412	-0.296	0.0	-1.018
9	3 8	0.0	0.0	0.0	0.0
10	4 7	0.0	0.0	0.0	0.0

*** CALCULATION OF REINFORCEMENT ***

* ALLOWABLE STRESS

SSA = 1800.00
SCA = 70.00
TAUA = 7.60
TAUOA = 15.00
SSAT = 0.0

MD ... EFFECTIVE DEPTH DUE TO BENDING MOMENT
SD ... EFFECTIVE DEPTH DUE TO SHEARING FORCE
CD ... COMPRESSIVE STRESS DUE TO BENDING MOMENT
U ... CIRCUMFERENCE OF REINFORCEMENT

MEMBER	DIST	- MS -	- N -	- S -	TT	DD	MD	SD	CD	U	COMPRESSION S1	COMPRESSION S2	TENSION S1	TENSION S2
1	0.0	0.485	0.607	-1.018	25.00	6.00	6.54	3.23	8.33	4.07	1.28	0.0		
1	0.304	0.220	0.607	-0.732	25.00	6.00	4.40	2.32	3.78	2.93	0.40	0.0		
1	0.608	-0.004	0.607	-0.489	25.00	6.00	0.60	1.55	0.07	1.96	0.0	0.0		
1	0.912	-0.161	0.607	-0.289	25.00	6.00	3.77	0.92	2.76	1.16	0.20	0.0		
1	1.217	-0.224	0.607	-0.133	25.00	6.00	4.44	0.42	3.84	0.53	0.41	0.0		
1	1.521	-0.246	0.607	-0.019	25.00	6.00	4.66	0.06	4.22	0.08	0.48	0.0		
1	1.825	-0.242	0.607	0.027	25.00	6.00	4.62	0.09	4.16	0.11	0.47	0.0		
2	0.0	-0.202	-0.027	0.607	20.00	6.00	4.22	1.92	6.38	3.29			0.93	0.0
2	0.454	0.022	-0.027	0.389	20.00	6.00	1.39	1.23	0.70	2.11			0.11	0.0
2	0.908	0.149	-0.027	0.171	20.00	6.00	3.63	0.54	4.71	0.93			0.69	0.0
2	1.363	0.177	-0.027	-0.047	20.00	6.00	3.95	0.15	5.60	0.26			0.82	0.0
2	1.817	0.106	-0.027	-0.265	20.00	6.00	3.06	0.84	3.36	1.44			0.50	0.0
2	2.271	-0.062	-0.027	-0.483	20.00	6.00	2.33	1.53	1.95	2.62			0.29	0.0
2	2.725	-0.331	-0.027	-0.701	20.00	6.00	5.40	2.22	10.45	3.81			1.51	0.0
3	0.0	-0.296	-0.062	0.648	20.00	6.00	5.11	2.05	9.36	3.52			1.37	0.0
3	0.450	-0.053	-0.062	0.432	20.00	6.00	2.16	1.37	1.68	2.35			0.27	0.0
3	0.900	0.088	-0.062	0.216	20.00	6.00	2.78	0.68	2.78	1.17			0.43	0.0
3	1.350	0.136	-0.062	0.000	20.00	6.00	3.47	0.00	4.31	0.00			0.65	0.0
3	1.800	0.088	-0.062	-0.216	20.00	6.00	2.78	0.68	2.78	1.17			0.43	0.0
3	2.250	-0.053	-0.062	-0.432	20.00	6.00	2.16	1.37	1.68	2.35			0.27	0.0
3	2.700	-0.296	-0.062	-0.648	20.00	6.00	5.11	2.05	9.36	3.52			1.37	0.0
4	0.0	-0.331	-0.027	0.701	20.00	6.00	5.40	2.22	10.45	3.81			1.51	0.0
4	0.454	-0.062	-0.027	0.483	20.00	6.00	2.33	1.53	1.95	2.62			0.29	0.0
4	0.908	0.106	-0.027	0.265	20.00	6.00	3.06	0.84	3.36	1.44			0.50	0.0
4	1.362	0.177	-0.027	0.047	20.00	6.00	3.95	0.15	5.60	0.26			0.82	0.0
4	1.817	0.149	-0.027	-0.171	20.00	6.00	3.63	0.54	4.71	0.93			0.69	0.0
4	2.271	0.022	-0.027	-0.389	20.00	6.00	1.39	1.23	0.70	2.11			0.11	0.0
4	2.725	-0.202	-0.027	-0.607	20.00	6.00	4.22	1.92	6.38	3.29			0.93	0.0
5	0.0	-0.242	0.607	-0.027	25.00	6.00	4.62	0.09	4.16	0.11	0.47	0.0		
5	0.304	-0.246	0.607	0.019	25.00	6.00	4.66	0.06	4.22	0.08	0.48	0.0		
5	0.608	-0.224	0.607	0.133	25.00	6.00	4.44	0.42	3.84	0.53	0.41	0.0		
5	0.912	-0.161	0.607	0.289	25.00	6.00	3.77	0.92	2.76	1.16	0.20	0.0		
5	1.217	-0.004	0.607	0.489	25.00	6.00	0.60	1.55	0.07	1.96	0.0	0.0		
5	1.521	0.220	0.607	0.732	25.00	6.00	4.40	2.32	3.78	2.93	0.40	0.0		
5	1.825	0.485	0.607	1.018	25.00	6.00	6.54	3.23	8.33	4.07	1.28	0.0		
6	0.0	0.379	-1.018	-1.130	25.00	6.00	5.79	3.58	4.51	4.52			1.83	0.0
6	0.454	0.021	-1.018	-0.739	25.00	6.00	1.37	2.34	0.36	2.96			0.43	0.14
6	0.908	-0.160	-1.018	-0.348	25.00	6.00	3.75	1.10	2.74	1.39			1.10	0.0
6	1.362	-0.229	-1.018	0.043	25.00	6.00	4.49	0.14	3.93	0.17			1.33	0.0
6	1.817	-0.121	-1.018	0.434	25.00	6.00	3.26	1.37	2.07	1.74			0.97	0.0
6	2.271	0.033	-1.018	0.825	25.00	6.00	1.70	2.61	0.56	3.30			0.68	0.0
6	2.725	0.496	-1.018	1.216	25.00	6.00	6.62	3.85	8.52	4.87			2.22	0.0

MEMBER	DIST	- XS -	- Y -	- S -	TT	DD	MD	SD	CD	U	COMPRESSION S1	COMPRESSION S2	TENSION S1	TENSION S2
7	0.0	0.468	-0.984	-1.162	25.00	6.00	6.43	3.68	8.04	4.65			2.11	0.0
7	0.450	0.033	-0.984	-0.775	25.00	6.00	1.69	2.45	0.56	3.10			0.65	0.0
7	0.900	-0.101	-0.984	-0.387	25.00	6.00	2.99	1.23	1.74	1.55			0.88	0.0
7	1.350	-0.188	-0.984	0.000	25.00	6.00	4.08	0.00	3.23	0.00			1.17	0.0
7	1.800	-0.101	-0.984	0.387	25.00	6.00	2.99	1.23	1.74	1.55			0.88	0.0
7	2.250	0.033	-0.984	0.775	25.00	6.00	1.69	2.45	0.56	3.10			0.65	0.0
7	2.700	0.468	-0.984	1.162	25.00	6.00	6.43	3.68	8.04	4.65			2.11	0.0
8	0.0	0.496	-1.018	-1.216	25.00	6.00	6.62	3.85	8.52	4.87			2.22	0.0
8	0.454	0.033	-1.018	-0.825	25.00	6.00	1.70	2.61	0.56	3.30			0.68	0.0
8	0.908	-0.121	-1.018	-0.434	25.00	6.00	3.26	1.37	2.07	1.74			0.97	0.0
8	1.343	-0.229	-1.018	-0.043	25.00	6.00	4.49	0.14	3.93	0.17			1.33	0.0
8	1.817	-0.160	-1.018	0.348	25.00	6.00	3.75	1.10	2.74	1.39			1.10	0.0
8	2.271	0.021	-1.018	0.739	25.00	6.00	1.37	2.34	0.36	2.96			0.43	0.14
8	2.725	0.379	-1.018	1.130	25.00	6.00	5.79	3.58	4.51	4.52			1.83	0.0
9	0.0	-0.033	1.349	0.035	20.00	6.00	1.71	0.11	1.05	0.19	0.0	0.0		
9	0.304	-0.023	1.349	0.035	20.00	6.00	1.41	0.11	0.72	0.19	0.0	0.0		
9	0.608	-0.012	1.349	0.035	20.00	6.00	1.03	0.11	0.38	0.19	0.0	0.0		
9	0.912	-0.002	1.349	0.035	20.00	6.00	0.37	0.11	0.05	0.19	0.0	0.0		
9	1.217	0.009	1.349	0.035	20.00	6.00	0.89	0.11	0.29	0.19	0.0	0.0		
9	1.521	0.020	1.349	0.035	20.00	6.00	1.32	0.11	0.62	0.19	0.0	0.0		
9	1.825	0.030	1.349	0.035	20.00	6.00	1.63	0.11	0.96	0.19	0.0	0.0		
10	0.0	0.033	1.349	-0.035	20.00	6.00	1.71	0.11	1.05	0.19	0.0	0.0		
10	0.304	0.023	1.349	-0.035	20.00	6.00	1.41	0.11	0.72	0.19	0.0	0.0		
10	0.608	0.012	1.349	-0.035	20.00	6.00	1.03	0.11	0.38	0.19	0.0	0.0		
10	0.912	0.002	1.349	-0.035	20.00	6.00	0.37	0.11	0.05	0.19	0.0	0.0		
10	1.217	-0.009	1.349	-0.035	20.00	6.00	0.89	0.11	0.29	0.19	0.0	0.0		
10	1.521	-0.020	1.349	-0.035	20.00	6.00	1.32	0.11	0.62	0.19	0.0	0.0		
10	1.825	-0.030	1.349	-0.035	20.00	6.00	1.63	0.11	0.96	0.19	0.0	0.0		