N

REPUBLIC OF THE PHILIPPINES

PILOT CENTER PROJECT

CAGAYAN INTEGRATED AGRICULTURAL DEVELOPMENT PROJECT

DESIGN REPORT FOR PILOT CENTER

JULY 1976

JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF THE PHILIPPINES

PILOT CENTER PROJECT

CAGAYAN INTEGRATED AGRICULTURAL DEVELOPMENT PROJECT

DESIGN REPORT FOR PILOT CENTER

JULY 1976

JAPAN INTERNATIONAL COOPERATION AGENCY

P R E F A C E

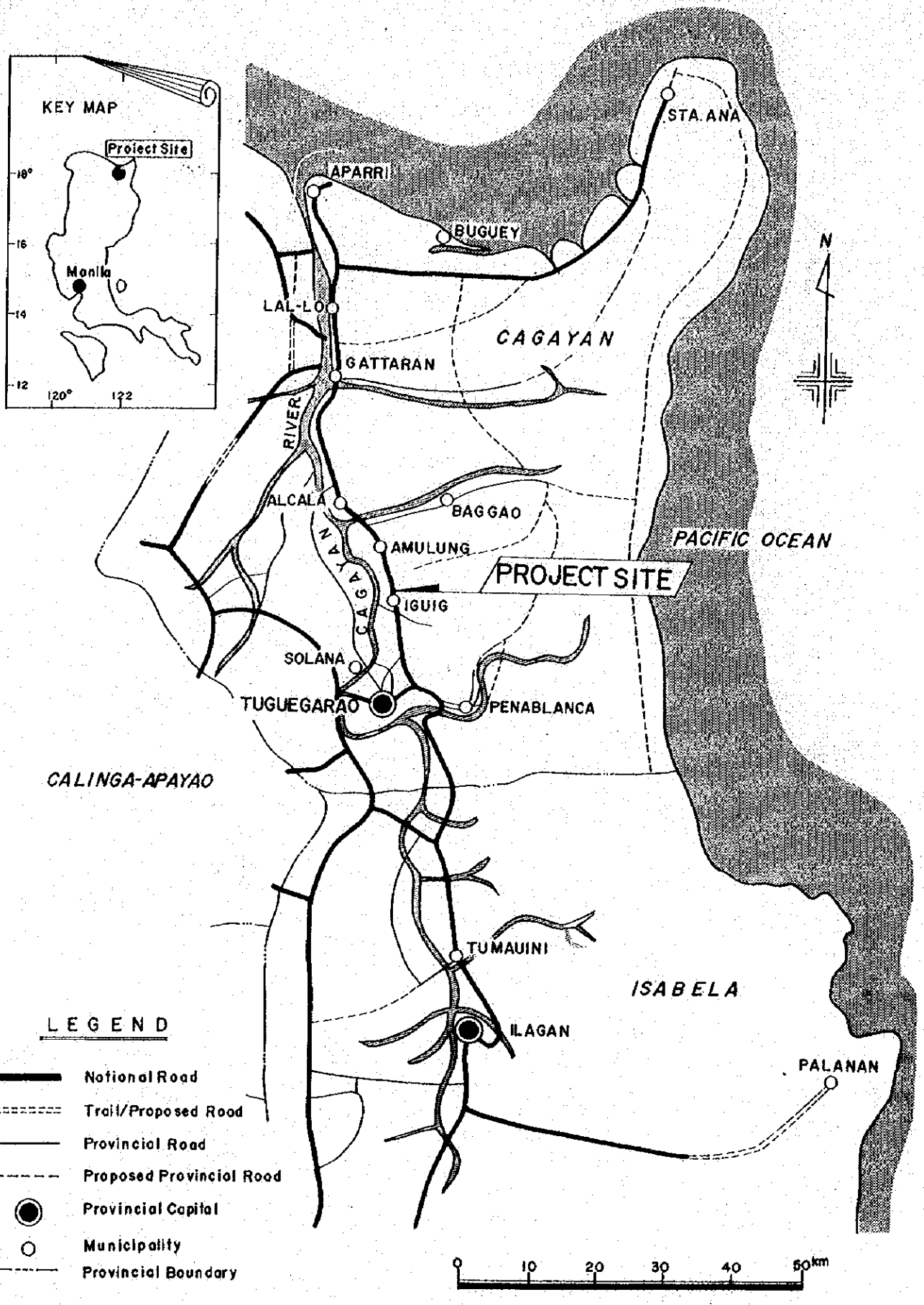
Since the year 1974, when the first survey team was sent to the Cagayan Valley, we have despatched several teams for identification and preparation of development project in the region. It is our pleasure to note that the Cagayan Integrated Agricultural Development Project (CIADP) has been formulated as initially envisaged and its feasibility has been confirmed. In addition, a technical cooperation project has also been prepared as an integral part of the CIADP. We owe, in this connection, very much to the collaboration rendered and efforts made by the Philippine authorities concerned and all the Japanese teams members.

This report is a joint-product of a four-men design team of the Pilot Center project and two experts. The team prepared the engineering design based on the concept of the feasibility survey team of October 1975. Two experts, Messrs. H. Iwasaki and S. Shiraishi cooperated with the design team by complementing the said feasibility survey.

It is expected that the detail design will later be finalized by the Philippine department concerned. We hope that this design report will fully be utilized as a guide and basic material for their work as well as for a general understanding of the underlying concept of the Pilot Center which will be the mainstay of our technical cooperation programs.

While this report was being prepared, it was reported to me that the Government of Japan pledged a loan for the construction of CIADP's infrastructure. It is my sincere hope that the both financial and technical cooperation scheme will proceed in parallel for the successful implementation of the Project.

Shinsaku HOGEN
President
Japan International Cooperation Agency


KEY MAP
Project Site
Manila
18°
16
14
12
120°
122
STA. ANA
APARRI
BUGUEY
LAL-LO
CAGAYAN
GATTARAN
RIVER
ALCALA
BAGGAO
AMULUNG
CAGAYAN
PACIFIC OCEAN
PROJECT SITE
IGUIG
SOLANA
TUGUEGARAO
PENABLANCA
CALINGA-APAYAO
TUMAUINI
ISABELA
ILAGAN
PALANAN
N
LEGEND
National Road
Trail/Proposed Road
Provincial Road
Proposed Provincial Road
Provincial Capital
Municipality
Provincial Boundary
0
10
20
30
40
50km

DESIGN

CONTENT

LIST OF DRAWINGS

CHAPTER 1. OUTLINE OF PILOT CENTER

1-1. General

Pilot Center as part of CIADP will be established at Iguig which is located about 18 km north of Tuguegarao, the provincial capital of the Cagayan Province. The site of the Pilot Center will be situated at the point where national highway and provincial road are intersected. Distance from this site to Cagayan River, the water source for irrigation, is approximately 700 m. The environs of the site is a flat paddy field area.

Areas in and around the site are not electrified at present. However, under the CAGELCO-II Project, the extension of a transmission line for 16,400V along the above mentioned national highway is scheduled to be completed by the end of August this year and all the electricity for this Pilot Center will be supplied from this transmission line. However the work to extend the distribution line from the Pilot Center to the pumping station is to be included in this project. As provision for an unexpected power failure, the auxiliary power generating unit is to be installed in the Pilot Center.

Total area, in which this Pilot Center was planned, is 11.3 ha and to be divided as follows:

Total Area	11.3 ha
(1) Farm	6.0 ha
Trial Field	2.9 ha
Training Field	1.1 ha
Seed Production & Demonstration Field	2.0 ha
(2) Building Site	2.7 ha
Block "A" (Main complex)	1.1 ha
Block "B" (Residential complex)	1.3 ha
Block "C" (Front yard)	0.3 ha
(3) Others (Roads, drainage canals, vacant lot, etc.)	2.6 ha

FIG. I-1 GENERAL PLAN

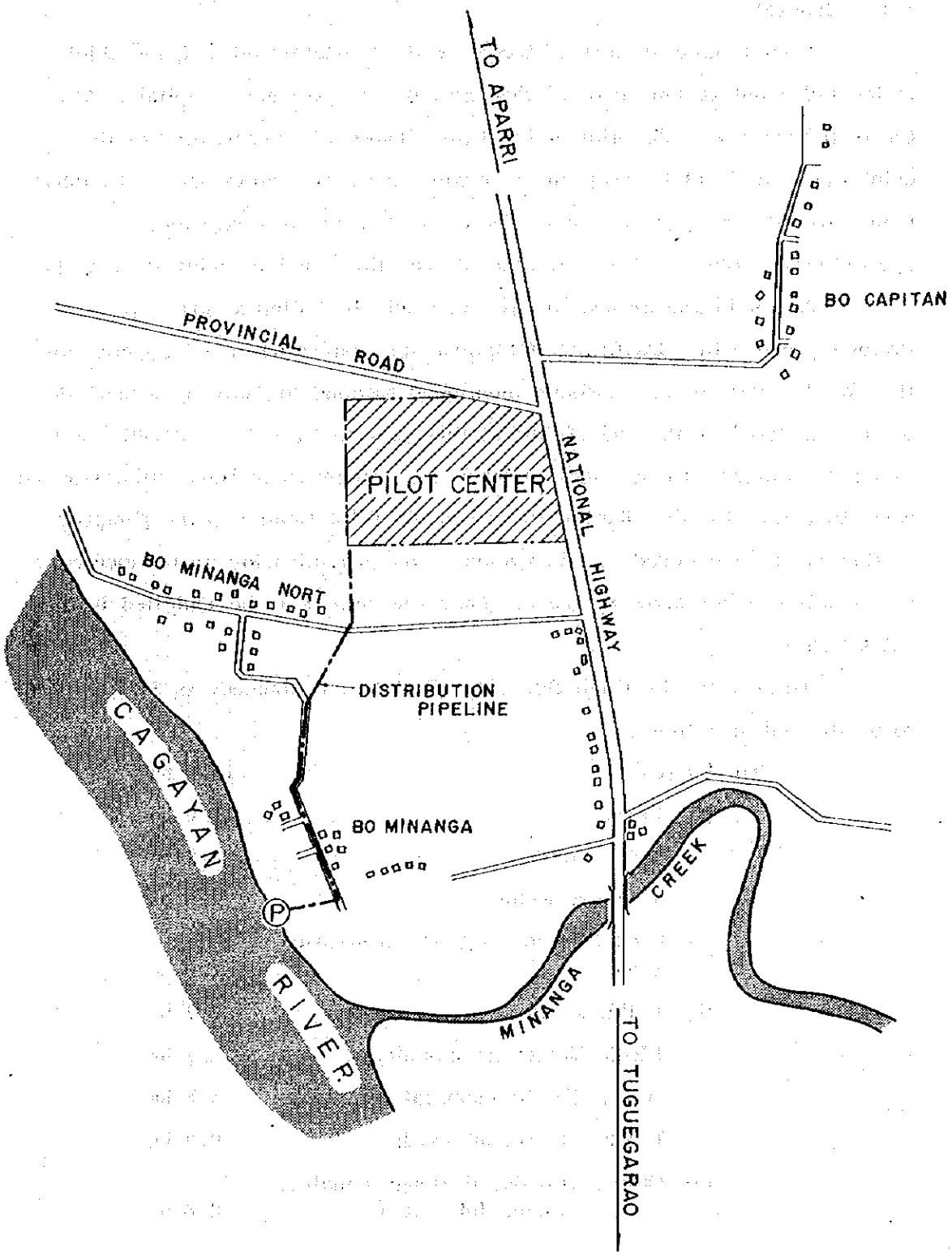
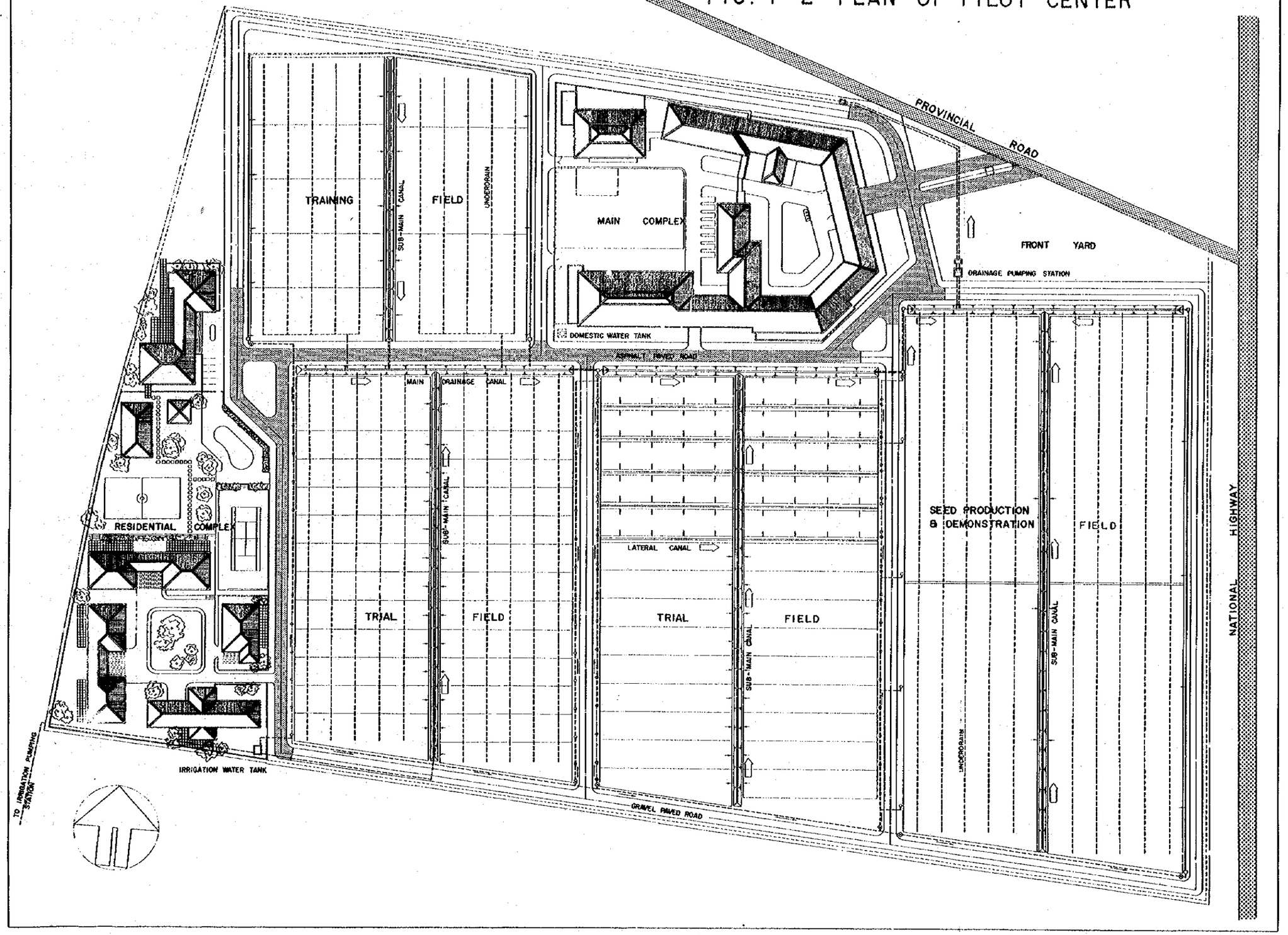


FIG. 1-2 PLAN OF PILOT CENTER



Cost of construction for this Pilot Center is estimated at about 6.7 million pesos not including the cost of materials to be provided by JICA.

1-2. Outline of Farm

1-2-1. Irrigation Facilities

For the supply of irrigation water from the main stream of the Cagayan River to the Pilot Center, two sets of submerged pump with ϕ125 mm are planned to be installed at Barrio Minanga, which is located at about 700 m south-west of the Pilot Center, to pump up the maximum duty of water of 46 lit/sec. These pumps will be automatically controlled by connecting the variation of water level in the distribution tank to an automatic operation device. Water distribution pipe will be P.V.C. pipe with ϕ200 mm. Method of conveyance of irrigation water from the tank will be a pipe line system for the Trial Field and a part of Seed Production and Demonstration Field and an open canal system for the Training Field and the remainder of Seed Production and Demonstration Field.

1-2-2. Drainage Facilities

For evacuating the design drainage discharge of 7.3 m^3/min, two sets of mixed flow pump with ϕ200 mm will be installed in the Pilot Center. Drainage canals will be lined for easy and economical maintenance. Main and sub-main canals will be lined with grouted ripraps while lateral canals will be of concrete flume type. Underdrainage with an average depth of 0.9 m and an interval of 9.0 m will be provided in all the fields of the Pilot Center with the exception of a part of the Trial Field.

1-2-3. Farm

Farm in the Pilot Center will be classified into Trial Field, Training Field and Seed Production and Demonstration Field according to their respective uses. Size of a block in each Field will be 50 m x 100 - 150 m. And standard size of farming plot in the Trial Field will be 50 m x 10 m.

1-2-4. Road

Road, which runs from the entrance of the Pilot Center along the main drainage canal on the south side of the Main Complex and leads to the Residential Complex, will be paved with asphalt and all other roads in the Pilot Center will be paved with gravel. Width of the pavement will be 4.5 m.

1-3. Outline of Architecture

1-3-1. Block Plan

Total area of building site is 2.7 ha and is divided into three blocks, namely Main Complex, Residential Complex and Front Yard.

So as to maintain best contact with the Fields and to be best viewed from the national highway, the Main Complex will be placed nearest to the entrance of the Center. Residential Complex will be placed on the west end of the site, and experts' houses and guest house are connected to the trainees' dormitory by the recreational facilities.

1-3-2. Architectural Facilities

(1) Main Complex

Main Complex is functionally divided into two sections, one for the office section and the other for the farming section. Buildings in each section are placed as surrounding the court yard according to their respective functions. Taking into account the wet season and the uniformity in the design, one continuous roofing was adopted to cover over the entire facilities.

(2) Residential Complex

Five independent experts' houses and one guest house are connected to the trainees' dormitory by the recreational facilities such as swimming pool, busket ball court, etc. A type of ordinary residential house is adopted for the design of trainees' dormitory instead of a conventional large room style dormitory. This is based on the CIADP office's idea of giving trainees an experience of new style living besides technical training.

(3) Structure and Materials

Designs given in this report for the architectural facilities are the basic design on the premises that the detail design for the same will be made by the Philippine side. Accordingly, all the materials and structures are planned out so as to conform to the Philippine standards.

1-4. List of Facilities

Main facilities to be provided or installed in the Pilot Center are as follows:

1-4-1. Farm Facilities

(1) Irrigation Facilities

Irrigation Pump	ϕ125 mm submerged pump	2 sets
Elevated Water Distribution Tank	20 m^3 capacity & 3.6 m height	
Irrigation Water Supply System	ϕ200 mm P.V.C. pipe	1,850 m
	ϕ200 mm steel pipe	40 m
	Concrete lined, 400 mm width x 300 mm height	530 m
Water Outlet	ϕ40 mm water valve	53 pcs
	ϕ75 mm water valve	4 pcs
	Water meter	14 pcs
	Flash board weir	12 sets

(2) Drainage Facilities

Main Drainage Canal	Grouted riprap, 0.5 m bottom width	350 m
Sub-main Drainage Canal	Grouted riprap, 0.3 m bottom width	630 m
Lateral Drainage Canal	Concrete Flume type	500 m
Drainage Pump	ϕ200 mm mixed flow pump	2 sets
Underdrainage	ϕ50 mm perforated P.V.C. pipe	4,550 m

(3) Road

Asphalt Paved Road	750 m
Gravel Paved Road	1,450 m

1-4-2. Buildings

(1) Main Complex

Total Floor Area	3,263.5 m^2
Rate of Building Occupancy	30 %
Main Office	469 m^2
Experts' Office	357 m^2
Laboratory	380 m^2
Lecture Room	177.5 m^2
Canteen	160 m^2
Field Trial Office	90 m^2
Workshop	325 m^2
Shed for Machinery	495 m^2
Milling & Drying House	425 m^2
Storage for Farming Materials	330 m^2
Generator House	40 m^2
Gas Station	15 m^2

(2) Residential Complex

Total Floor Area	1,928.5 m
Rate of Building Occupancy (Not including recreational buildings)	15 %
Trainees' Dormitory	465 m
Experts' Houses (five houses)	892.5 m
Guest House	571 m
Recreational Facilities (swimming pool, busket ball court, tennis court, pelota court)	

(3) Front Yard

Meteorological Station

Space for Green House

(4) Others

·Guard House

Fence

(5) Type of Structure

Foundation and Column	Reinforced Concrete
Truss	Wooden and partially steel
Wall	Concrete block
Story	Single

Note: Space for corridor, etc. is included in the above mentioned total floor area.

CHAPTER 2. DESIGN OF FARM

Through the field reconnaissances and studies on the collected data conducted by the First and Second Study Teams, 11.3 ha area in the Barrio of Minanga Norte was finally selected for the Pilot Center site. Of this 11.3 ha area, 6.0 ha area will be allocated for the farm and the rest will be used for the buildings and others.

In the course of site selection of the Pilot Center, Sta Maria, which was recommended by the Hon. Governor, was first studied. This Sta Maria, however, was found to be not suitable for the reasons that the demonstration effect of the Pilot Center cannot be much expected because of the houses located along the national highway and that the salinity problem of the Cagayan River in the area was remained unsolved. Then, the First Study Team has recommended Pared as suitable site for the Pilot Center. This Pared, however, was found to be not suitable either by the Second Study Team for the reasons that the area is attended with the problems of flood every year and that the area does not encourage the demonstration effect of the Pilot Center at all because of a small number of traffic (The Team counted only one jeep in half an hour traffic check) and passer-by.

Another proposed site was Barrio of Iguig and it was not considered suitable nor representative site for the Pilot Center by the First Study Team because of the problems with land ownership, high tenant fee and average farm size of the area. However, the Minanga Norte in the Barrio of Iguig was found to be differred in the conditions from that which were considered existing in the entire Iguig. The Second Study Team, therefore, has finally selected this Minanga Norte as the site for the Pilot Center, taking into consideration also its potentiality for the demonstration effect and its convenient location from the provincial capital.

2-1. Design of Irrigation Facilities

2-1-1. Determination of Design Discharge

(1) Design Discharge for Distribution Pipe Line from the Pumping Station to the Pilot Center.

Design discharge is calculated based on the following assumptions:

(a) Evapotranspiration Rate:

Monthly evaporation as recorded by the evaporation pan indicates that the maximum value is recorded for the month of April. Accordingly, mean daily evaporation of 7.8 mm for this month is multiplied by 1.3 and 10 mm/day as evapotranspiration rate is obtained. (See Table A-1 for evaporation recorded by the evaporation pan)

(b) Percoration Rate:

Soil in the farm is clayey and percoration rate of soil is assumed to be 1.5 - 2.0 mm/day. However, percoration rate will actually be increased by the installation of underdrainages in the farm and also by the mid-summer drainage which will cause cracks in the top soil. It is, therefore, assumed that percoration rate for the soils here would be 10 mm/day.

(c) Irrigation Efficiency: 80 %

(d) Conveyance Efficiency: 90 %

(e) Water Requirements for Surface Soil Puddling:

It is usually assumed that 100 mm - 150 mm/day of irrigation water is required for surface soil puddling. In the case of this Pilot Center Project, 150 mm/day is adopted.

Based on these assumptions the net irrigation requirement and diversion requirement per hectare are calculated as follows:

Net Irrigation Requirement:

$(10\text{mm} + 10\text{mm})/0.80 = 25$ mm/day

$\fallingdotseq 2.9$ lit/sec/ha

Diversion Requirement:

$2.9/0.90 = 3.2$ lit/sec/ha

When the period of surface soil puddling is 6 days, the diversion requirement at the end of the period will be as follows:

$$Q = (0.15\ m \times 10{,}000\ m^2/ha \times 6.0\ ha \times 1/6 \times 1{,}000\ lit/m^3 \div 86{,}400\ sec + 2.9\ lit/sec/ha \times 6.0\ ha \times 5/6) \div 0.90$$

$$\fallingdotseq 35\ lit/sec$$

When irrigation time during the normal period is 10 hr/day and that of during the period of surface soil puddling is 20 hr/day, the diversion requirement for the respective cases is calculated as follows:

Normal period:

$Q_1 = 3.2$ lit/sec/ha x 6 ha x 24/10 = 46 lit/sec

Period of surface soil puddling:

$Q_2 = 35$ lit/sec x 24/20 = 42 lit/sec

As a result of the above calculations, which indicates that the diversion requirement for the normal period is exceeding that of the period of surface soil puddling, the diversion requirement for the entire farm which is the design discharges for irrigation pump and distribution pipe lines to the Pilot Center will be determined to 46 lit/sec.

(2) Design Discharge for the Conveyance System in the Site of the Pilot Center

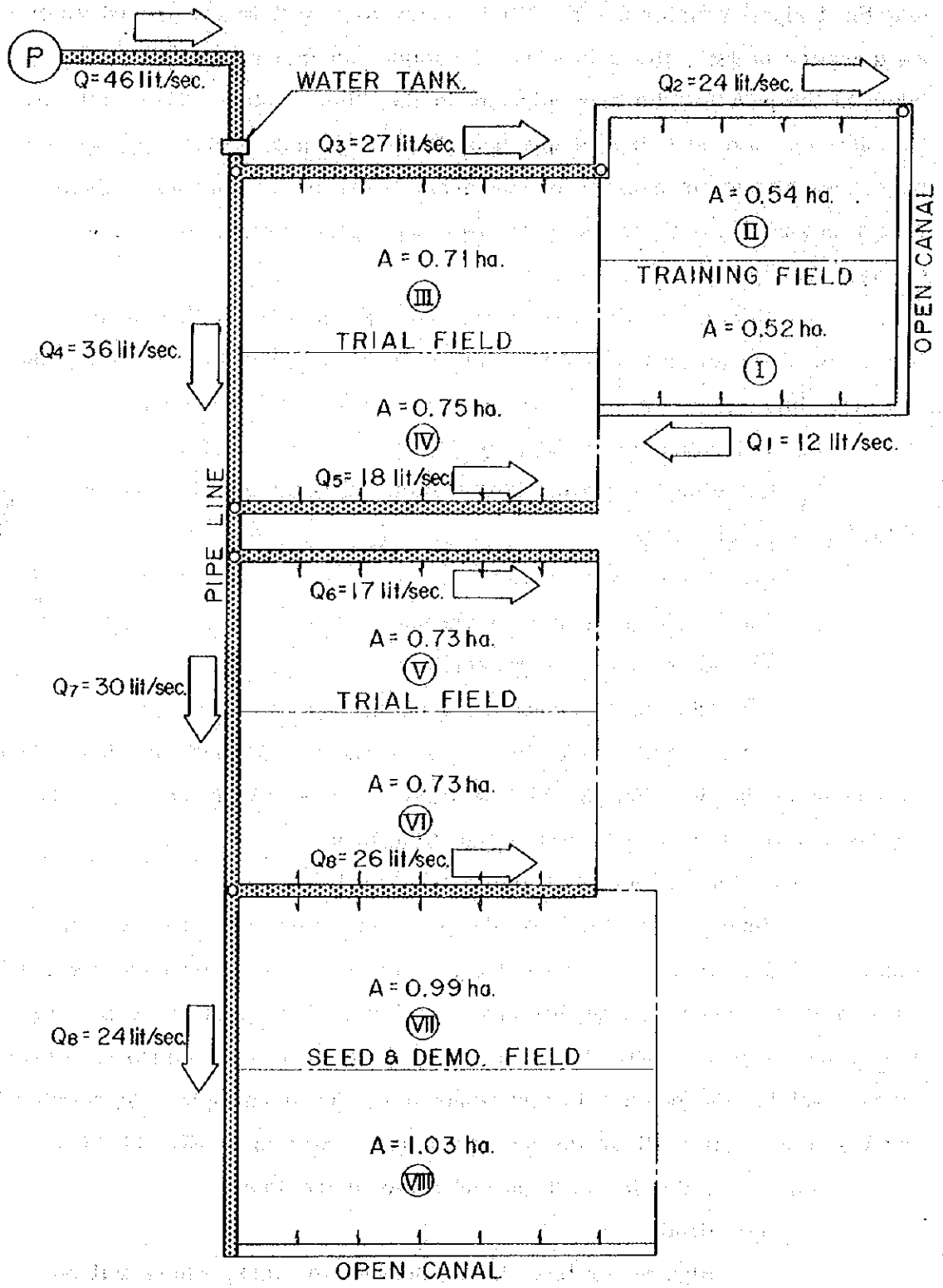
Design discharge for the conveyance system in the site of the Pilot Center is calculated by the same method as that of calculating the design discharge for irrigation pump and distribution pipe lines to the Pilot Center. Result of calculation is shown in Fig. 2-1 and the calculation itself is shown in the Table A-2.

2-1-2. Design of Pumping Station

(1) Water Source for Irrigation in the Project Area

Farmers in and around the Project area are getting the supply of their domestic water from the well and hand pumps. Wells are of pipe driven into the ground for the depth of 6 - 9 m. According to the

FIG. 2-1 FLOW CHART OF IRRIGATION SYSTEM



information from the farmers, stable supply of water can be obtained from these wells regardless of the seasons. Therefore, it may be possible that the irrigation water for the Pilot Center to resort to the ground water. As a matter of fact, there is a well by which the irrigation water was taken in the past for the area adjacent to the Pilot Center. This well with the pipe diameter of 6 inches was used for the irrigation of 12 ha and is not in use at present because of machinery breakdown. Further, USAID report is suggesting the possibility of ground water exploitation in the Cagayan Valley basin.

In spite of all these facts, the main stream of the Cagayan River was determined as irrigation water source because that the early and economic implementation of the Project will be ensured this way.

(2) Determination of Location for the Pumping Station

Location for the pumping station was determined based on the following considerations:

(a) Stable river course.

(b) Small quantity of sediment.

(c) Near to the Pilot Center.

(d) Easy to construct the pumping station.

As a result of the field reconnaissance, location was determined to a point in Barrio Minanga which is located, as shown in the Fig. 1-1, approximately 700 m south-west of the Pilot Center.

(3) Determination of Intake Water Level

Intake water level for the pump is determined based on the water level data gauged at Centro Iguig on the Cagayan River from the year 1968 to 1974. According to this data, the lowest low-water level of 1/10 year probability is at EL. 4.5 m and this elevation is determined as intake water level for the pump. In this connection, the mean highest high-water level on the Cagayan River for the recent five years is at EL. 17.20 m.

(4) Determination of Type and Scale of the Pump

(a) Head

High-water level in the distribution tank, which will be

provided in the Pilot Center, will be at EL. 22.60 m as determined in the next paragraph "2-1-3. Design of Conveyance System", while the intake water level for the pump is at EL. 4.5 m. Accordingly, actual head will be 18.1 m. Head loss from the pump to the distribution tank is 9.0 m. (See Table A-3 for the calculation of head loss). With an addition of this head loss 9.0 m to the actual head, the total head will be 27.1 m ≒ 28 m.

(b) Determination of Type of the Pump

The type of the pump is determined to a submerged pump based on the figures of the difference between the H.W.L. and L.W.L. of 12.7 m and the design intake discharge of 46 lit/sec. That is, in case of a centrifugal pump, the pumping station should be situated below H.W.L. because the suction head of the centrifugal pump is 6 to 7 m. Accordingly, the structure of the pumping station should be with a sufficient protection against the flood and would result in high construction cost, much higher than in the case of submerged pump. Submerged pump has enough capacity to pump up the design intake discharge of 46 lit/sec and yet requires no special protective structure against the flood.

(c) Determination of the Number of Pump

Judging from the design intake discharge, one set of submerged pump should be sufficient to meet the requirement of this pumping station. Besides, generally speaking, it will be more economical to have less number of the pump. However, it is determined, in this case, that the two sets of submerged pump with identical specifications will be installed for this pumping station with the intention of dispersing the risk of pump failure.

(d) Determination of Diameter of the Pump

Diameter of the pump is obtained by the following equation:

$$D = 90\sqrt{Q}$$

Where:

D: Diameter of the pump (mm)

Q: Design intake discharge (m^3/min) = 1.38 m^3/min

$$D = 90\sqrt{1.38} = 106 \fallingdotseq 125$$

(e) Power Requirement for the Motor

Power requirement for the motor is obtained by the following equation:

$$R_{HP} = \frac{0.163\ Q.\ H.\ (1+\alpha)}{n_T \cdot n_P}$$

Where:

R_{HP}: Power requirement for the motor (KW)

Q : Design intake discharge (m^3/min) = 1.38

H : Total head (m) = 28 m

α : Rate of allowance (%) = 15 %

n_T : Effficiency of Transmissibility (%) = 100%

n_P : Efficiency of pump (%) = 68 %

$$R_{HP} = \frac{0.163 \times 1.38 \times 28 \times (1 + 0.15)}{1.00 \times 0.68} = 10.7 \fallingdotseq 15 \text{ KW}$$

(5) Mode of Pump Operation

There are two modes of operation conceivable for the operation of the pump, one is automatic operation and the other is manual operation. In case of manual operation, so as to maintain the safety operation of the pump a regulating reservoir with a capacity of 1,500 m^3, which is 50 % of a day total duty of water, will be required within the site of the Pilot Center. This regulating reservoir will be required to have a base height of at least 3.6 m above the paddy level because, as described in detail later, the irrigation system to the Trial Field is to be of a pipe line system whose head loss will be fairly large. In other words, this regulating reservoir should be constructed on the fill of 3.6 m in height as the areas in and around the Pilot Center are entirely flat. A site required for

providing this regulating reservoir will be about 60 m x 60 m but it is considered quite difficult to secure such site within the Pilot Center site. Moreover, lining work of the surface of regulating reservoir against leakage is considered to be a large increment in the construction cost.

In case of the automatic operation, the construction cost of the required facilities will be less than that of the manual operation. Moreover, automatic operation will enable a reduction in manpower requirement and also enable such operations as are corresponding to the variable irrigation discharges to the farm.

Automatic operation as a mode of pump operation was thus adopted.

There are two methods for the automatic operation of the pump. One is to use pressure tank and the other is to use distribution tank. In comparison of these two methods, the method to use distribution tank is preferred for the reason that the former requires more complicated control system and higher degree of technique for its maintenance than that with distribution tank whose control system functions to start and stop the pump simply by sensing the water level in the tank and transmitting it to the control system. It is, therefore, determined to adopt the method to use distribution tank for the operation of these pumps of the Pilot Center. An operation system based on this method is shown in Fig. 2-2.

(6) Design of Inlet Suction Tank

Submerged pump is attended with a risk of getting the impellers damaged by a suction of solid materials such as sand, etc. Accordingly, the inlet structure of the submerged pump should be equipped with devices to avoid as much as possible the inflow of solid materials. Based on such thought, the inlet suction tank was designed to such shape as shown in the Fig. 2-3. Elevation of 8.5 m for the top of the inlet suction tank was determined from the mean water level of 7.8 m for the months from March to July in recent five years on the Cagayan River and an allowance of 0.7 m was added to it.

FIG. 2-2 OPERATION SYSTEM OF PUMP

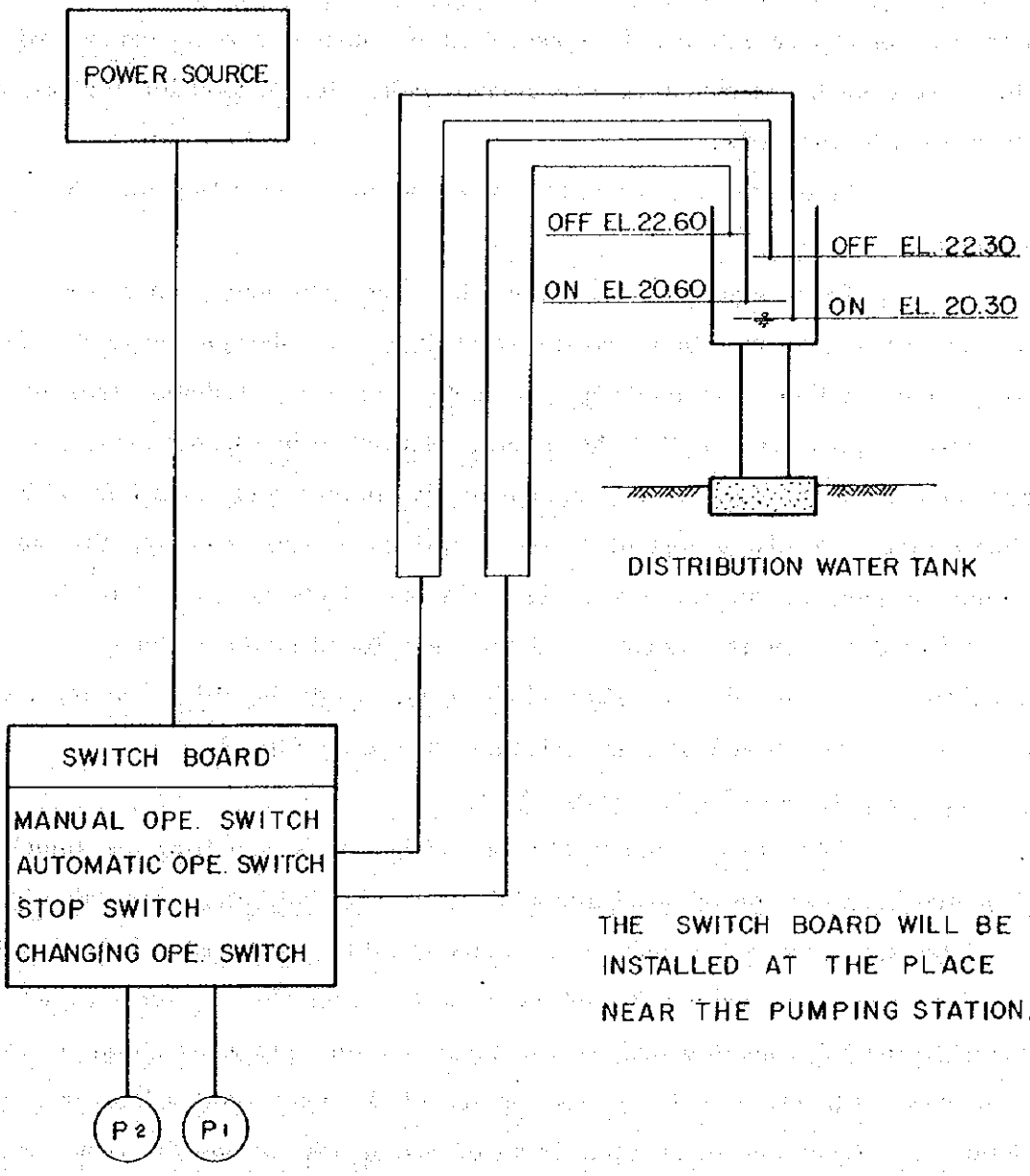
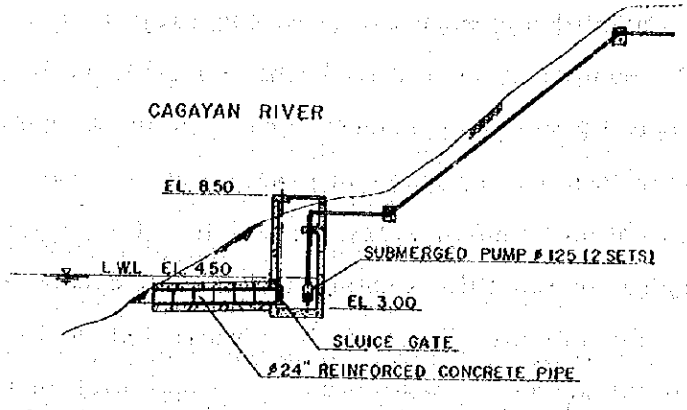


FIG. 2-3 INLET SUCTION TANK



As shown in the above Figure, a gate will be installed in preparation for any shut down of the pump for repair when water in the inlet suction tank is needed to be drained out.

(7) Supply of Irrigation Water at the Time of Pump Failure

Two sets of submerged pump with ø125 mm will be installed to the pumping station. If and when these two sets of submerged pump happen to have failure at the same, the supply of irrigation water to the farm will not be possible. If and when one of these pumps to fail, the required irrigation water can be still supplied by extending the operation time of the other pump from the planned 10 hr/day to 14 hr/day.

Day Maximum Total Duty of Water in Normal Period:

$$V = 0.046\ m^3/sec \times 10\ hr \times 3600\ sec$$
$$= 1656\ m^3/day \fallingdotseq 1,700\ m^3/day$$

Discharge per one unit of pump:

$$Q = \frac{n_T \cdot n_P \cdot R_{HP}}{0.163 \cdot H \cdot (1+\alpha)} = \frac{1.0 \times 0.68 \times 15}{0.163 \times 28 \times (1 + 0.15)}$$
$$= 1.94\ m^3/min \fallingdotseq 120\ m^3/hr$$

Operation time of pump:

$$T = 1,700\ m^3/day \div 120\ m^3/hr = 14.2 \fallingdotseq 14\ hr/day$$

Repair of pump will be done when water level of the Cagayan River goes down lower than the EL. 8.5 m which is the elevation on the top of the inlet suction tank. It is presumed quite difficult to get the

supply of spare parts for the pump locally that the sufficient kind and quantity of spare parts should be provided at the Project site. There is a possibility that the pump may be involved with a trouble or breakdown which can be repaired only by the pump manufacturer. It is, therefore, considered a good plan to provide auxiliary pump in preparation for such circumstance. After all, this irrigation pump in every respect is a temporary facility to meet the requirement of the Pilot Center until the permanent Iguig Pumping Station, as one of the inflastructures, to be constructed in the future. Considering the problems of the maintenance and operation of the pump and the cost of irrigation water to L.E.A. (Leading Extension Area) and the Pilot Center, it is believed that the early construction of the said Iguig Pumping Station, together with the construction of its connecting waterways, is of a vital importance. Furthermore, an early completion of the transmission line construction is a must in order to provide an electric power source for the above mentioned construction works.

(8) Electric Power Source for the Pumping Station

All the electric power required for the Pilot Center will be supplied from the transmission line of 16,400 V under the CAGELCO II Project, and the electricity of 30 KW needed for the pumping station is included in this project also. Construction of distribution lines from the Pilot Center to the pumping station, however, will be included in and undertaken by the Pilot Center Project.

2-1-3. Design of Irrigation Water Supply System

(1) Location of the Pipe Line Alignment

Alignment of the distribution pipeline was determined as shown in Fig. 1-1.

(2) Distribution Pipe Lines from the Pumping Station to the Distribution Tank

(a) Determination of Diameter of Pipe

In the design of pipe line, the velocity in the pipe is generally selected in the range of 0.7 - 1.6 m/sec in case of the pipe

diameter with the range of 75 - 400 mm. In case of this pipe line, a minimum pipe diameter whose velocity in the pipe still falls within that range was selected and it was ϕ200 mm.

$$D = \sqrt{0.046\ m^3/sec \div (0.7 \sim 1.6\ m/sec) \div \pi \times 2}$$
$$= 0.29 \sim 0.19\ m \fallingdotseq 0.20\ m$$

(b) Determination of a Kind of Pipe

Internal pressure is approximately 30 m. The pipes which will withstand such pressure and also considered economical are asbestos cement pipe and Polyvinyl Chloride (P.V.C.) pipe. Points of advantages and disadvantages for both pipes are enumerated as follows:

(i) Longitudinal strength of asbestos cement pipe with the diameter of 200 mm or less is comperatively low. Accordingly, the cautions handling is required in laying of such pipe under the unequal loading.

(ii) During the transportation and handling, asbestos cement pipe is attended with a risk of breakage.

(iii) P.V.C. pipe is light in weight, easy to cut and easy in jointing works.

(iv) P.V.C. pipe is slightly higher in price than that of the asbestos cement pipe.

Attaching more importance to the items (ii) and (iii) above, P.V.C. pipe was selected, with an exception that the pipes to be laid in the steep slope on the river bank will be a steel pipe.

(3) Distribution Tank

Capacity of the distribution tank is determined by the time needed to accomplish one cycle of pump operation from its start to stop and start again. This cycle time is considered longer the better it would be in view of the maintenance and operation of the pump but it would be limited to a certain length of time from the view point of the economy of the facilities. Generally speaking, the time of more than 20 min. is considered a desirable cycle time. In this case, it was determined to establish a cycle time of 30 min. and based on which an effective capacity of the distribution tank was

calculated by the following equation:

$$V = 1/4 \cdot Q_p \cdot t$$

Where:

V : Effective capacity of distribution tank (m^3)

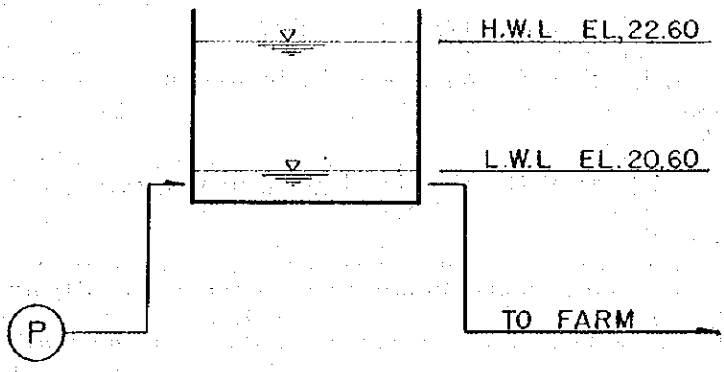
Q_p : Maximum discharge of pump (m^3/min)

t : Time required for one cycle of pump operation from start to stop and start (min)

$$V = 1/4 \times 0.046 \times 60 \times 30 = 20.7 \ m^3$$

Structure of distribution tank is designed to be a prefabricated panel construction of a rectangular shape with the dimensions of 3.0 m x 3.5 m x 3.0 m (height).

FIG. 2-4 DISTRIBUTION WATER TANK



L.W.L. of the distribution tank is obtained by the addition of a head loss from the distribution tank to the outlet and the required pressure of 0.1 kg/cm^2 at the outlet onto the EL. 17.55 m of the faucet at the outlet which is provided for the supply of irrigation water to the farm.

L.W.L. = EL. 17.55 m + 1.96 m + 1.0 m = EL. 20.51 m

$\fallingdotseq$ EL. 20.60 m

(4) Methods of Supplying Irrigation Water to the Farm

Methods of supplying irrigation water to the farm are as follows:

By pipe line ..... To Trial Field ..... Through ϕ40 mm faucet

By pipe line ..... To a part of Seed Production and Demonstration Field ..... Through ϕ75 mm faucet

By open canal..... To Training Field and Seed Production and Demonstration Field ..... Through flash board weir

Open canal will be of a concrete flume type with the dimensions of 0.4 m in width and 0.3 m in height and a gradient of 1/2000. Among those faucets to supply water to the Trial Field, 14 faucets will be equipped with water meters.

2-2. Design of Drainage Facilities

2-2-1. Design of Surface Drainage Facilities

(1) Calculation of Drainage Discharge

Design drainage discharge is calculated based on the maximum continuous rainfall for 3 days of the 1/10 year probability. Assuming that the time of draining excess water is 3 days and run-off coefficient is 80 % in average, the drainage discharge is calculated by the equation:

$$Q = \frac{A \cdot R \cdot F}{T}$$

Where:

Q: Drainage discharge m^3/sec

A: Drainage area 11.3 ha = 113,000 m^2

R: Rainfall 351.2 mm/3 days (See Table A-4)

F: Mean run-off coefficient 0.8

T: Time required to drain excess water 3 days = 259,200 sec

$$Q = \frac{113,000 \times 0.3512 \times 0.8}{259,200} = 0.122 \ m^3/sec = 7.3 \ m^3/min$$

(2) Design of Drainage Canal

As far as the cost is concerned, earth canal will be the most economical type for drainage. However, its maintenance is not easy because the canal will often be covered by weeds. Therefore the main drainage canals and sub-main drainage canals are designed to be grouted riprap canals while lateral canal is of concrete flume type. Base elevations of the drainage canals are designed to be at least 1.0 m lower from the paddy level for the main drainage canal and 0.7 m lower for the sub-main drainage canals and 0.3 m lower for the lateral drainage canals.

Hydraulic features for each of the drainage canals are as follows:

Table 2-1 Hydraulic Features for the Drainage Canals

	Main Drainage Canal	Sub-main Drainage Canal	Lateral Drainage Canal
Base width (m)	0.5	0.3	0.3
Gradient of slope	1:1	1:1	Vertical
Longitudinal gradient	1:2,000	1:2,000	1:1,000
Design discharge (m3/sec)	0.122	0.020	-
Depth (m)	0.45	0.20	-
Velocity (m/sec)	0.29	0.20	

(3) Design of Drainage Pumping Station

There is a natural drainage canal (creek) existing along the provincial road which runs adjacent to the Pilot Center. The bottom of this creek is located only 0.3 - 0.4 m lower than the elevations of surrounding paddy field. Because of this small difference in the elevations between the Pilot Center and the creek, a method for evacuating the excess water from the Pilot Center will be either to newly construct a drainage canal or pipe line of about 1.0 km from the Pilot Center to the Cagayan River or to install a pump to pump out the excess water into the creek.

For the reasons as enumerated below, the latter method was adopted.

(a) It is presumed that the securing of right-of-way for the drainage canal or pipe line would be difficult.

(b) In case of the drainage canal be constructed, the canal maintenance will be troublesome because of weeding and the capacity of the canal will be considerably large for the reason that the canal will be required to evacuate the excess water not only from the Pilot Center but also from the areas adjacent to the drainage canal.

(c) Drainage pipe line will cost high.

In case of the pump drainage, there is a possibility that the water once drained into the natural creek will be used as irrigation water to the paddy field in the adjacent area, specially in the dry season. Therefore sewage water from the residential houses and other facilities in the Pilot Center must be purified to the extent that it would not disturb the growing of rice. In this connection, a thorough explanation of the drainage system to the down stream villagers is considered essential.

(4) Location of the Drainage Pumping Station

Location of the drainage pumping station was determined to a space located in the Front Yard of the Pilot Center taking into consideration the following conditions.

(a) By this pump, main drainage canal and the creek must be linked with the shortest possible distance.

(b) Sufficient space for the pump can be secured.

(c) Pumping station should be located within the Government owned land.

(5) Determination of Scale of the Pump

(a) Head

Design drainage water level is EL. 16.12 m after deducting the head loss of 0.06 m of the 12 m pipe culvert, which is connecting the main drainage canal to the inlet suction tank, from the EL. 16.18 m of the drainage canal during the time of evacuating the design drainage discharge. Outer water level of the canal is unknown so it is assumed that the outer

water level will be at EL. 17.30 m which is 0.3 m above the designed paddy level in the Pilot Center. Accordingly, actual head will be Ha = 1.18 m. Total head will be H = 1.81 ≒ 2.0 m by an addition of a head loss of 0.63 m, for the section from the pump to discharge tank, to the actual head.

(b) Pump Diameter and the Number of Pump Required

Judging from the calculated drain discharge, one unit of pump should be sufficient. However, two units of pump with the same capacity will be installed in order to disperse the risk of pump failure.

Diameter of the pump will be determined as follows:

$$D = 90\sqrt{Q} = 90 \times \sqrt{3.65} = 172 \fallingdotseq 200 \text{ mm}$$

(c) Power Requirement for Motor

Power requirement for motor is obtained by the equation:

$$R_{HP} = \frac{0.163\ Q \cdot H \cdot (1 + \alpha)}{\eta_T \cdot \eta_P}$$

$$= \frac{0.163 \times 3.65 \times 2.0 \times (1 + 0.15)}{1.0 \times 0.68} = 2.1 \fallingdotseq 3 \text{ KW}$$

(6) Determination of Type of the Pump

Judging from the required head and the discharge for this pump, the kind of the pump is determined to a most economical mix flow pump.

(7) Mode of Pump Operation

Mode of pump operation will be a manual operation.

2-2-2. Underdrainage

Soils in and around the Pilot Center belong to the category of clayey soil. In order to increase the bearing capacity of the soil for the travel of farm machinery and to improve the aeration of the soil, the underdrainage was designed to be provided in the farm. Drainage discharge for the underdrainage is calculated by the following equation based on the concept that the percoration under the daily rainfall of 1/10 year probability is to be drained out in one week of time.

$$q = \frac{R \cdot P \cdot A}{N} = \frac{R \cdot P}{8.64N} \text{ (lit/sec/ha)}$$

Where:

q: Unit underdrainage discharge

R: Daily rainfall of 1/10 year probability 256.7 mm
(See Table A-4)

P: Percoration = 1-Coefficient of run-off = 0.3

N: Time required for drainage 7 days

$$q = \frac{256.7 \times 0.3}{8.64 \times 7} = 1.27 \text{ lit/sec/ha}$$

Largest block of the Field, in which the underdrainage will be provided, is 1.03 ha of Seed Production and Demonstration Field. When 5 rows of underdrainage is provided at an interval of 9 m, the drainage discharge per one row of underdrainage will be; Q = 1.27 lit/sec x 1.03 ha ÷ 5 ≒ 0.26 lit/sec. Perforated P.V.C. pipe with ϕ50 mm is designed to be used for this underdrainage and is designed to be laid at the gradient of 1/500 for the maximum discharge capacity of 0.4 lit/sec.

2-3. Design of Farm

2-3-1. Arrangement of Farm and Shape of Farm Plot

Farm to be constructed in the Pilot Center will be classified to Trial Field, Training Field and Seed Production and Demonstration Field according to their respective uses. Area of each Field is as follows:

Training Field	1.1 ha
Trial Field	2.9 ha
Seed Production and Demonstration Field	2.0 ha
Total	6.0 ha

Arrangement of farm is inevitably influenced by the block plan of the whole Pilot Center site and the arrangement of the buildings therein. However, the arrangement of farm was determined taking into account the following points primarily.

(1) In order to achieve the demonstration effects to the maximum, Seed Production and Demonstration Field will be located in the space along the national highway.

(2) In order to facilitate the going-in and out of the farm machinery, Training Field will be located in the corner block of the site. This field should also be near to the shed for machinery, workshop and the trainees' dormitory.

Taking into consideration the above mentioned points, the arrangement of farm was determined as shown in the Fig. 1-2. Further, considering the land ownership, the Training Field was located within the government's land. Size of a block in each Field will be 50 m x 100 - 150 m and standard size of farming plot in the Trial Field will be 50 m x 10 m.

2-3-2. Land Leveling Work

In the land leveling work for the farm, top soil will not be treated separately for the reasons described as follows:

(1) Area, in which the farm will be constructed, is a flat paddy field that the average thickness of cut and fill for the designed paddy is 5 cm for the Trial Field and 10 cm for the Training Field and Seed Production and Demonstration Field.

(2) It is not conceivable that there is much difference in the fertility of the top soil and that of the sub-soils.

(3) Soil layer is homogeneous from the surface to the bottom.

(4) Judging from the above mentioned reasons, the separate top soil treatment which brings an increase in the cost of land leveling work does not produce considerable effect to the farming.

2-3-3. Road Network

Standard width of the road base was designed to be 10.0 m and the width of pavement, either with asphalt or gravel, was designed to be 4.5 m. A road, which runs from the entrance of the Pilot Center along the main drainage canal on the south side of the Main Complex and leads to the Residential Complex, was designed to be asphalt paved and all other roads

to be paved with gravel of 15 cm thickness. Elevation of the paved surface of the road was designed to be EL. 17.50 m, minimum 50 cm above the designed paddy level.

CHAPTER 3. ARCHITECTURAL DESIGN

3-1. Premise for Design

3-1-1. Scope of Design

The designs given in this report are of basic design and do not exceed the scope to indicate an outline for the detail design.

3-1-2. Materials, Structure and Method of Construction

From the view point of economy, the structure and the method of construction which are commonly used in the Philippines were adopted. As to the construction materials also, the design enables to choose those which are easily procured locally.

3-1-3. Meteorology

Climatic condition in the Project area is of high temperature throughout the year, frequent strong wind and rainfall, and it is a considerably severe condition for any architectural facilities. It will be ideal to have the buildings with an elaborate design for the heat insulation and ventilation in addition to the normal air conditioning system. In this design, however, the priority was vested on the economy of the project that the specification just to provide a minimum living condition was adopted. It is hoped that a specification to provide a pleasant living condition will be adopted in the process of detail design by increasing the heat insulation effect, etc. so far as the budget permits.

3-1-4. Design

Buildings in the rural area are required to harmonize with the surroundings. The Pilot Center, especially in view of its nature, should be a kind of the building which will be harmonious with and well received by the residents in the neighborhood and by the trainees. In this design, due consideration as such was given to each building without damaging their function.

3-2. Arrangement of the Buildings

3-2-1. Site and Surroundings

The site of the Pilot Center is flat land of 11.3 ha bordering on the national highway on its east side and on the provincial road on its north side. 2.7 ha out of this land has been alloted for the establishment of the architectural facilities. The site is surrounded by the paddy fields and located in the spacious place which affords a fine view of the surroundings. There is no obstacle in and around the site that the good ventilation will be well expected. Further, the site can be easily identified by the passers-by on the national highway from the both south and north directions; the demonstration effect will also be promising.

3-2-2. Access to the Site

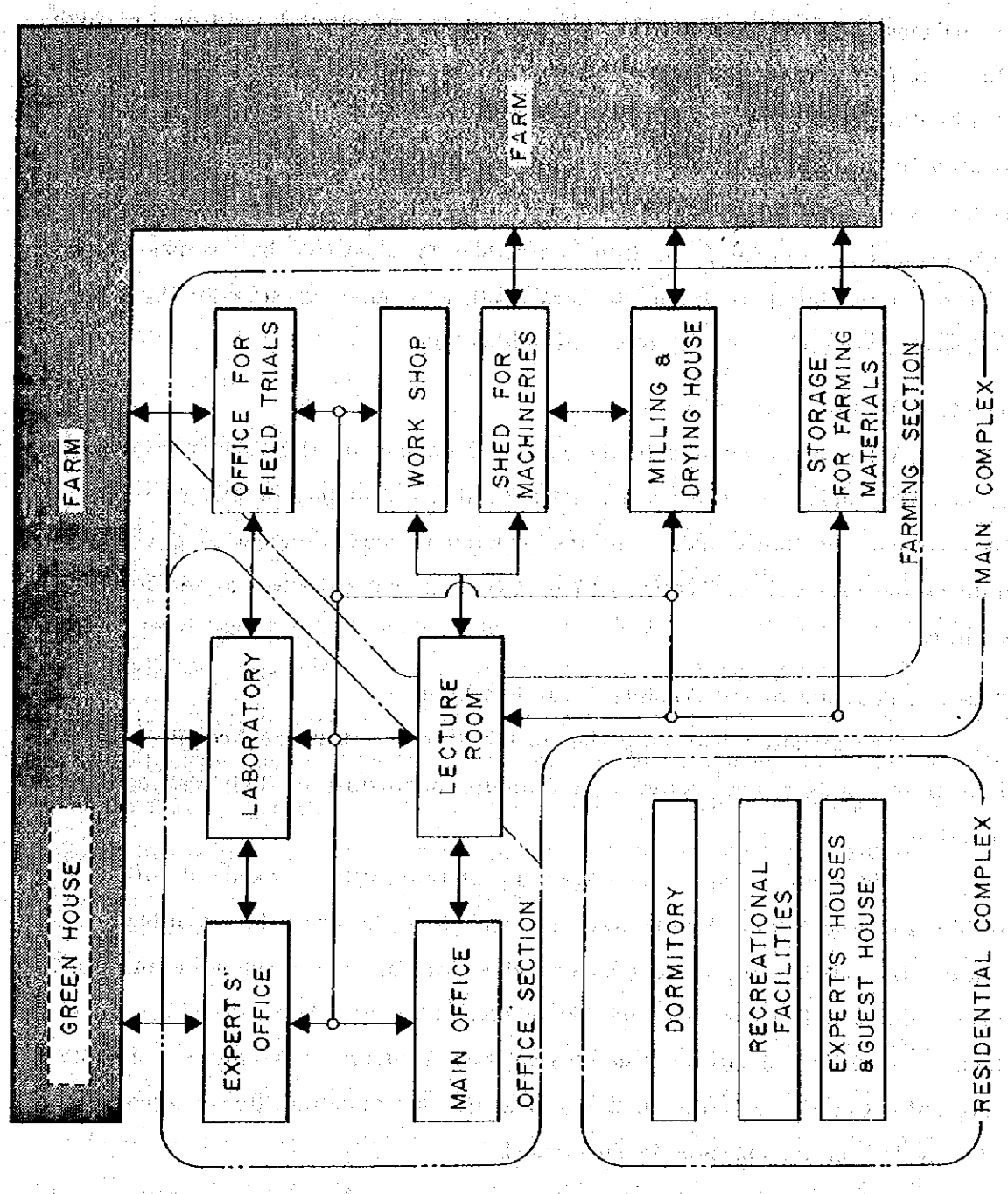
Most of the access to the site will depend on the national highway. Though the current traffic on the national highway is not so heavy, taking into account the future increase, the provincial road adjacent to the north side of the site was determined to be the main access road to the Pilot Center.

3-2-3. Function of the Architectural Facilities

The architectural facilities in the Pilot Center are broadly classified into Main Complex and Residential Complex according to their respective functions.

The Main Complex is consisting of main office, experts' office, office for field trials, laboratory, lecture room, storage for farming materials, milling and drying house, shed for farming machinery and work-shop while the Residential Complex is consisting of experts' houses, guest house, trainees' dormitory and recreational facilities. It can be said that this Pilot Center, in spite of a small scale, is substantially an agro-research city as far as its function is concerned.

FIG. 3-1


FARM
FARM
GREEN HOUSE
OFFICE FOR FIELD TRIALS
WORK SHOP
SHED FOR MACHINERIES
MILLING & DRYING HOUSE
STORAGE FOR FARMING MATERIALS
FARMING SECTION
MAIN COMPLEX
LABORATORY
LECTURE ROOM
EXPERT'S OFFICE
MAIN OFFICE
OFFICE SECTION
DORMITORY
RECREATIONAL FACILITIES
EXPERT'S HOUSES & GUEST HOUSE
RESIDENTIAL COMPLEX

3-2-4. Arrangement of the Buildings

In general, it is required to maintain an appropriate distance in between the working space and the living space. The Pilot Center is of no exception, therefore, that the separation of both spaces was considered as much as possible.

The location of the Main Complex is needed to be as near as possible to the farm in view of its functions and, at the same time, is desired to be in a place where it can exhibit the demonstration effect to its maximum. It was determined, as shown in the Fig. 1-2, that the Main Complex will be located in the site of 1.1 ha near the provincial road and in the center north of the Pilot Center.

The site for the Residential Complex is desired to be isolated from the noise and kept in a quietness. The site for this Residential Complex is not required to be a rectangular shape as is required for the farm. Accordingly, a site of 1.3 ha with a triangular shape, which was remained after securing the sites for the Main Complex and the farm, was selected for this Complex. This site is located farthest away from the national highway and is most quiet place in the Pilot Center.

Block "A"	Main Complex	1.1 ha
Block "B"	Residential Complex	1.3 ha
Block "C"	Front Yard	0.3 ha

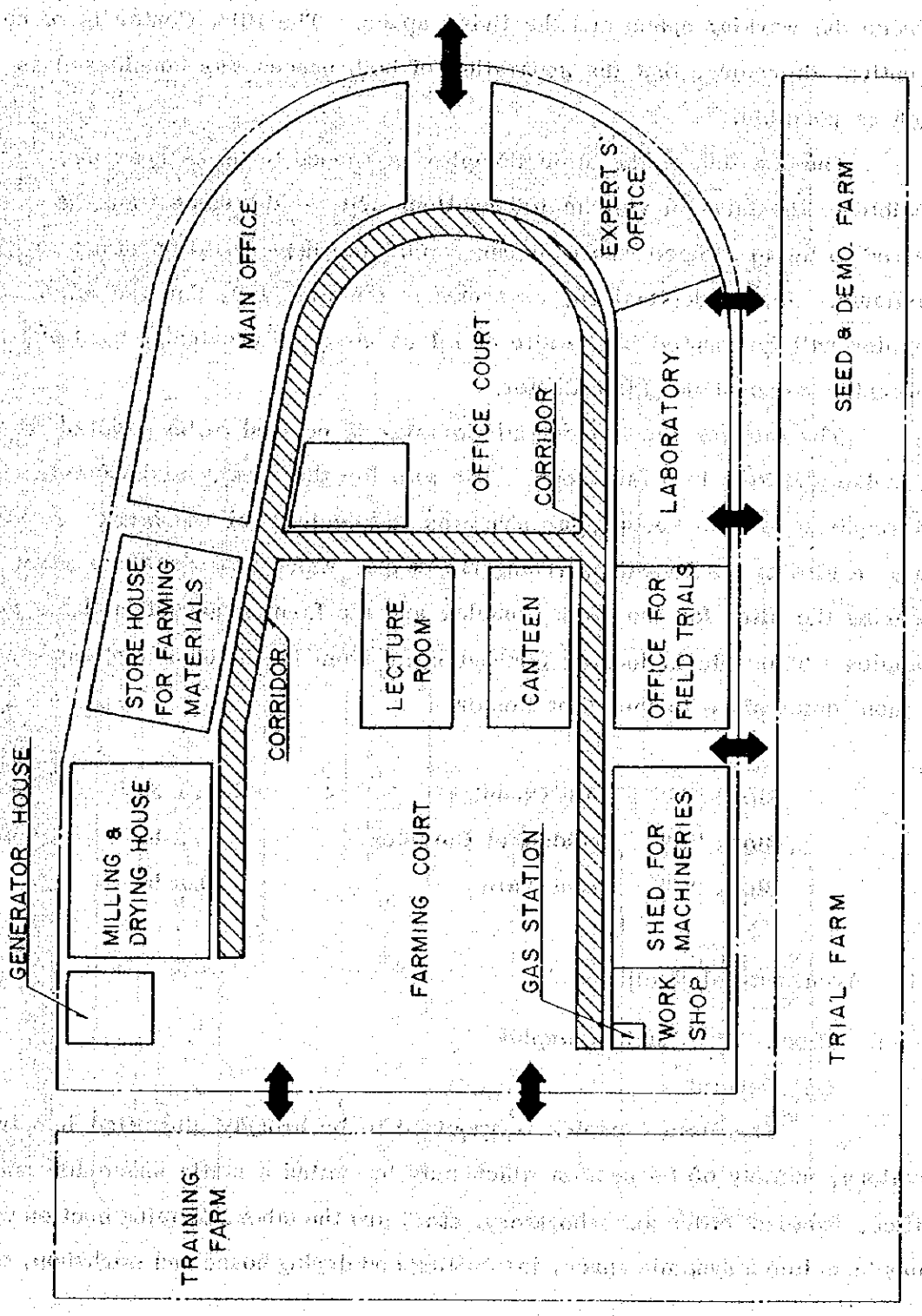
3-3. Architectural Facilities

3-3-1. Block "A" - Main Complex

(1) General

The Main Complex is required to be broadly classified into two sections, namely office section which may be called a static space for main office, experts' office and laboratory, etc., and the other, farming section which may be called a dynamic space, for milling and drying house and workshop, etc.

FIG. 3-2


MAIN OFFICE
EXPERT'S OFFICE
OFFICE COURT
CORRIDOR
LABORATORY
SEED & DEMO. FARM
STORE HOUSE FOR FARMING MATERIALS
CORRIDOR
LECTURE ROOM
CANTEEN
OFFICE FOR FIELD TRIALS
GENERATOR HOUSE
MILLING & DRYING HOUSE
FARMING COURT
GAS STATION
SHED FOR MACHINERIES
WORK SHOP
TRIAL FARM
TRAINING FARM

It is, therefore, determined that these two sections will be arranged separately in around the two court yards called the office court and farming court, and all the essential facilities therein will be arranged according to their respective functions.

In this office section, the main office and its appurtenances are arranged in the north side of the porch, and the experts' office, laboratory and the office for field trials in the south side of the porch nearer to the farm.

In the farming section, the milling and drying house and the storage for farming materials are arranged in its north wing, and both the shed for machinery and workshop are arranged in the wing nearer to the farm.

Generator house, because of its noise, will be located in the north-west corner of the Main Complex site.

For easy comings and goings in between each of the facilities during wet season, the entire facilities will be covered by one continuous roof. In this way, people will be able to go everywhere in the Main Complex without getting wet. Furthermore, the design of this long continuous roof line will offer aesthetic and harmonious effect to the surrounding horizontal landscape.

(2) Standard Structure

A method, which is quite common in the Philippines, of placing the wooden truss on the concrete column and roofing it over with corrugated sheet iron was determined to be used as standard structure for the Main Complex buildings, but is not satisfying the other aspects of the building such as durability, accuracy in the finish, and efficiency of the heat insulation. Advantage of this structure is low cost. Specially, considering the climate of the Philippines, a bad effect of heat insulation will be a critical defect for providing a pleasant living condition. In order to rectify this defect though little, the jalousie window was designed on the entire wall space, trying to take in as much wind as possible. Also, the

slope on the roof was designed to be a steep 1:4 gradient so as to provide a large space in the ceiling, trying to give more heat insulation effect to the building. The writer had made a recommendation while in the Philippines, upon considering of heat insulation in connection with a traditional design of Filipino architecture to thatch the roof with Nipa or Cogon over the corrugated sheet iron. This recommendation was denied by the CIADP for the reason that the building with such roofing would be appearing as recreational building. However, it is strongly recommended that the reconsideration to be given in the process of detail design to this type. Certainly, there will be a need for an added precaution in the design and construction of this type of roofing as it may be subject to receive more influence of the typhoons, etc. It is added that the writer could observe a number of buildings with the roofing of the same type and aged over 10 years.

(3) Outline of the Facilities

(a) Main Office 469 m^2

Main office will be used mainly for administration and shall include the Director's office where 13 to 15 persons could work effectively. It shall also include the radio room, conference room, rest room and reception hall, etc.

Porch	55 m^2
Reception hall and lobby	45 m^2
Director's office with secretaries' office and shower room	60 m^2
Conference room with waiting hall	50 m^2
Office	81 m^2
Radio room	10 m^2
Library	25 m^2
Locker room	25 m^2
Comfort room with shower	35 m^2
Kitchen	15 m^2

Corridor and others	68 m^2

(Space outside of center line will be included in the exterior of the building)

* Installation of air conditioning system is recommended.

(b) Experts' Office 357 m^2

This office will be for the use of Japanese experts and Filipino counterpart officials.

Porch	45 m^2
Entrance hall	20 m^2
Office	90 m^2
Meeting room (for 10 people)	42 m^2
Kitchen	12 m^2
Comfort room	22 m^2
Shower room	21 m^2
Corridor and others	105 m^2

* Installation of air conditioning system is recommended.

(c) Laboratory 380 m^2

Laboratory will face to the Trial Field and is in adjacent to the experts' office so that people can go in and out of farm directly from the laboratory. Providing for various experiment and research works, this room should be provided with the systems for water supply and sewage, gas service, electric wiring, etc. not to mention of the air conditioning system. Depend on the kind of researches and experiments to be conducted in the laboratory, a system of sewage treatment may be required separately from the other facilities. Pot yard is planned to be provided outside the laboratory. This yard may be covered around with wire net and made into the net room. The court yard in front of the south side of the laboratory may be used as storage yard of the laboratory.

Laboratory	294 m^2
Lecture room	45 m^2
Corridor and others	41 m^2

(d) Office for Field Trials 90 m^2

Office for field trials will be located in adjacent to the Laboratory and the Trial Field.

Office	70 m^2
Corridor and others	20 m^2

(e) Lecture Room 177.5 m^2

Lecture room will be used not only for the lectures but also for the conferences and other various purposes. A projection room, a screen and a blackout curtain are required in this room.

Lecture room	87.5 m^2
Projection room	14 m^2
Hall, Corridor and others	76 m^2

(f) Canteen 160 m^2

Canteen is located almost in the center of the Main Complex.

Canteen	75 m^2
Kitchen	15 m^2
Comfort room	25 m^2
Corridor and terrace	45 m^2

(g) Storage for Farming Materials 330 m^2

This storage will be used to store agricultural chemicals and seeds. Ventilation and heat insulation shall be given due consideration. In this building, air vents will be provided at both places near the eaves and floor, and wood wool cement board is used as roof sheathing material for heat insulation. Cold storage for the seed conservation are planned to be installed in the building.

(h) Workshop 325 m^2

The workshop will be used for the repairs, studies and researches of the farm machinery. The structure of this building should be reinforced in preparations for the installation of the hoist in the future. The workshop shall include among other things a concrete pit for vehicle

check and concrete tables for repairing equipment. Skylight will be provided on the roof for natural lighting.

	Workshop	160 m^2
	Chief's office	25 m^2
	Tools room	30 m^2
	Locker and shower room	45 m^2
	Storage for spare parts	65 m^2
(i)	Gas Station with Car Wash	15 m^2
(j)	Shed for Machinery	495 m^2
	Garage for the farm and construction machinery:	
	Shed for machinery	360 m^2
	Garage for official vehicles	90 m^2
	Passage	45 m^2
(k)	Milling and Drying House	425 m^2

This building shall have electric fans and rouver in addition to ceiling ventilation to ensure good ventilation. These electric fans and rouvers will be installed at the height of 1.0 - 1.5 m from the floor.

	Milling room	170 m^2
	Drying room	255 m^2
(l)	Generator House	40 m^2

3-3-2. Block "B" - Residential Complex

(1) General

The Residential Complex is consisting of Experts' houses, Guest house, Trainees' dormitory and Recreational Facilities. The experts' houses and guest house are connected to the trainees' dormitory by the recreational facilities. In this way, each section will be afforded with the needed privacy, and the recreational section shall also serve as a communication link between the two sections. To avoid the monotonous appearance of the complex, three different elevations were determined for ground elevation of each component as follows:

Experts' houses and guest house	EL. 18.5 m
Trainees' dormitory	EL. 18.0 m
Recreational Section	EL. 17.5 m

(2) Facilities

(a) Experts' houses Five units 892.5 m^2

The residence for experts and their families will be designed with an unified duplex type design and shall be furnished with living room, dining room, kitchen, 3 bedrooms, maid's room, garage and store room. The families of 4 to 5 persons are planned to be accommodated.

(b) Guest house 571 m^2

The guest house will be used for visitors and unmarried experts. Two twin rooms, four single rooms with all other essential rooms shall be provided. Bedrooms are arranged in two wings in consideration of a flexible use of the rooms like one wing to be used for male guests and the other for female guests or one wing to be used for residents and the other for visiting guests. Driver's room could be used not only by the driver but also by the resident manager.

(c) Trainees' Dormitory 465 m^2

For the trainees' dormitory, design of the duplex house style was adopted instead of the conventional dormitory type design. This was requested by the CIADP office who wished to give an opportunity for the trainees to experience the modern way of living at the same time they undergo new farming techniques training. One unit of dormitory house will be able to accommodate ten trainees making a total twenty trainees. By the use of extra beds, up to about forty trainees can be accommodated.

(d) Recreational Facilities

Swimming pool, basketball court, tennis court, pelota court, etc. are planned as recreational facilities. These are, however, only proposal for the moment, and reconsideration on the matter in the process of detail design is requested.

3-3-3. Block "C" - Front Yard

Front yard is an open space located at the entrance of the Pilot Center and is considered as a "face" of the Pilot Center, and so it should be carefully landscaped. The drainage pumping station and the meteorological station will be constructed in this site and also green house may be constructed in the future.

CHAPTER 4. CONSTRUCTION PROGRAM

4-1. Excavation

Land leveling work for the farm will be done by bulldozers of 11 ton class. Earth material moved by the land leveling works and the excavation of drainage canals will be used for the fills required for the construction of roads and building sites. The excavation of drainage canals, irrigation water supply system and underdrainages will be done by manpower.

4-2. Fill and Backfill

As above mentioned, the materials from the land leveling works and excavation of canals will be used for the fills required for road and building site construction. However, the quantity of such materials will not be enough that the additional materials from the borrow area will be needed. Bulldozer of 11 ton class will be used for the excavation of borrow area and 1.4 m^3 class tractor shovel for loading of the materials. Dump truck of 8 ton class will be used for hauling of materials.

For spreading and compaction of the materials, bulldozer of 11 ton class will be utilized and backfilling of the materials will be done by manpower.

Table 4-1. Capacity of Construction Equipment

Kind of works	Equipment	No. of Unit	Capacity	Remarks
Excavation of Borrow Area	11 ton Bulldozer	1 unit	190 m^3/day	
Loading of Borrow Materials	1.4 m^3 Tractor Shovel	1 unit	250 m^3/day	
Hauling from Borrow Area	8 ton Dump Truck	3 units	240 m^3/day/ 3 sets	Hauling distance = 2.5 km
Spreading & Compaction	11 ton Bulldozer	1 unit	210 m^3/day	

Total quantity of materials required for construction of roads and building sites is estimated at 32,000 m^3 of which 6,000 m^3 can be supplied by the excess materials from the excavation of drainage canals and land leveling works. The balance of materials required will be acquired from the borrow area located about 2.5 km away from the Project site.

When the rate of operation of construction equipment is assumed at 30/23, total number of days required for the filling works will be estimated as follows:

$$26,000 \div 190\ m^3/day \times 30/23 + 6,000\ m^3 \div 210\ m^3/day \times 30/23 \fallingdotseq 216\ days \fallingdotseq 7.2\ months$$

4-3. Concrete Work

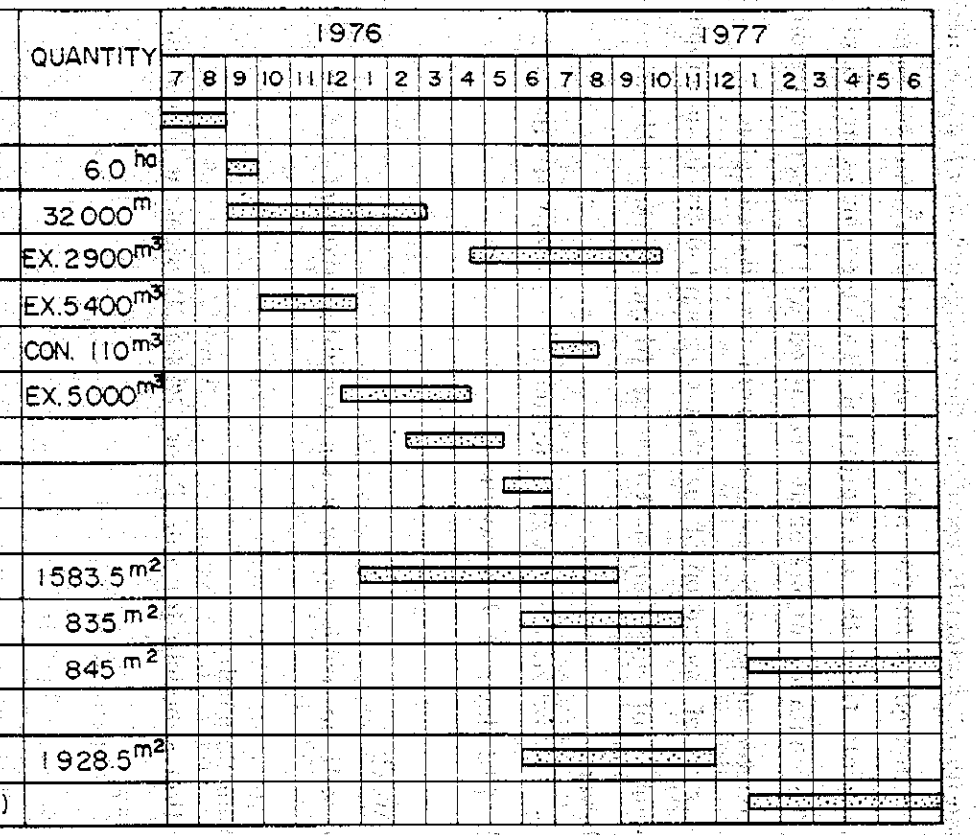
Concrete will be produced by using portable mixer of 0.3 m^3 class.

4-4. Construction Schedule

Construction schedule for this Pilot Center Project is shown in the following Table 4-2.

TABLE 4-2 CONSTRUCTION SCHEDULE

DESCRIPTION	QUANTITY
PREPARATION	
LAND LEVELING	6.0 ha
EMBANKMENT	32 000 m
IRRIGATION WATER SUPPLY SYSTEM	EX. 2900 m³
MAIN AND SUB-MAIN DRAINAGE	EX. 5400 m³
LATERAL CANAL	CON. 110 m³
UNDERDRAIN	EX. 5000 m³
IRRIGATION PUMPING STATION	
DRAINAGE PUMPING STATION	
MAIN COMPLEX	
1st Phase	1583.5 m²
2nd Phase	835 m²
3rd Phase	845 m²
RESIDENTIAL COMPLEX	
1st Phase (Buildings)	1928.5 m²
2nd Phase (Recreational Facilities)	



MAIN COMPLEX
- 1st Phase ------ Main Office, Experts' Office, Laboratory, Lecture Room, Canteen, Generator house, Deep Well, Elevated Water tank.
- 2nd Phase ------- Shed for Machineries, Work Shop, Gas Station.
- 3rd Phase ------- Office for Field Trials, Milling and Drying House, Storage for Farming Materials, Landscaping.

CHAPTER 5. COST ESTIMATION

5-1. Premise for Cost Estimation

The cost estimation is made under the following premises:

5-1-1. Scope of Cost Estimation

This cost estimation does not include the costs for land acquisition, compensation in connection with the land acquisition, and supervision of construction. Neither, the materials to be furnished to the contractor as shown in the paragraph 5-1-3. are not included.

5-1-2. Unit Price

Unit prices in the Bill of Quantities comprise all the cost components such as materials, labors, equipments and all others required to complete the construction.

5-1-3. Materials to be Furnished to the Contractor

Materials to be furnished to the contractor at the site of the Pilot Center are as follows:

- ø125 mm submerged pump with accessories	2 sets
- ø200 mm mixed flow pump with accessories	2 sets
- Elevated water distribution tank	1 set
- P.V.C. pipes, steel pipes, pipe fittings, sluice valves, water meters and air valves for irrigation water supply system	
- P.V.C. pipes with ø75 mm for drop structures on the paddy field	
- P.V.C. pipes with ø50 mm for weep holes	
- Perforated P.V.C. pipes with ø50 mm for underdrainages	
- Gate to be installed in the irrigation pumping station	

5-1-4. Scope of Construction Works

(1) The work under the section reading "Temporary work" in the Bill of Quantities includes mainly the followings:

- Sheet piling for making the construction of inlet suction tank of the irrigation pump to be an open work.
- Construction, maintenance and removal of contractor's camp for his staff and laborers and workshops, etc.
- Transportation, assembling and erection, and removal of the construction equipments and machinery.
- Preparation and restoration of borrow area.
- Surveying work.

(2) The work under the section reading "Irrigation water supply system to the Pilot Center" in the Bill of Quantities includes mainly the followings:

- Construction of inlet suction tank.
- Installation of ϕ125 mm submerged pumps (2 sets)
- Installation of distribution pipe with sluice valves and air valves from the pumps to the Pilot Center.
- Installation of underground cable from the pumps to the elevated water distribution tank for the operation of the pump.

(3) The work under the section reading "Land Consolidation" in the Bill of Quantities include the irrigation and drainage facilities, roads, farm, and building sites to be constructed within the Pilot Center.

(4) The work under the section reading "Building Work" in the Bill of Quantities includes mainly the followings:

- Buildings
- Indoor wiring, cabling and cable duct work including electrical equipment such as switches, convenience outlets, lighting equipment, etc.
- Indoor cable and cable duct work for telephone and interphone systems.
- Outdoor cabling and cable duct work from the distribution board to each building in the Pilot Center.

- Sanitary fixture work.
- Plumbing work for hot and cold water services, gas services and sewage.
- Fixed cabinets.
- Air conditioning for laboratory, guest house and experts' houses.
- Exterior and landscaping.
- Roads and walk in the building lots.
- Deep well and water tank.
- Fence around the area of the Pilot Center.
- Entrance gate and gate house
- Flag pole.

(5) The work under the section reading "Wiring work from Pilot Center to Irrigation Pump" in the Bill of Quantities is to be the construction of power distribution line for the submerged pumps for irrigation (15 KW x 2 units).

5-2. Construction Cost

The construction cost of the Pilot Center, under the premise mentioned above, is estimated at 6,739,000 pesos as shown below:

Table 5-1. Construction Cost

1.	Temporary Work	30,000
2.	Irrigation Water Supply System to the Pilot Center	77,000
3.	Land Consolidation	1,554,000
4.	Building Work	5,018,000
5.	Wiring work from Pilot Center to Irrigation Pump	60,000
	Total	₱ 6,739,000

Reference is made to Table 5-2. "Bill of Quantities" for the details of this cost estimation.

Tabel 5-2. Bill of Quantities

Item	Description	Unit	Quantity	Unit Price ₱	Amount ₱
1.	Temporary work	L.S.			30,000
2.	Irrigation Water Supply System to Pilot Center				
201	Excavation	m^3	2,300	7	16,100
202	Fill and backfill	"	1,800	5	9,000
203	Gravel	"	270	70	18,900
204	Sand Bed	"	110	30	3,300
205	Concrete class "A" w/forms	"	25	430	10,750
206	Concrete class "B" w/forms	"	10	350	3,500
207	Concrete class "D" w/forms	"	1	250	250
208	Reinforcing steel bar	ton	2	4,000	8,000
209	Miscellaneous steel w/painting	kg	110	5	550
211	ø24" R.C. pipe	m	9	150	1,350
212	Installation of ø125 mm submerged pump (2 sets), gate, distribution pipe, sluice valve, and cable for operation of pumps	L.S.			4,300
	Sub-total				77,000
3.	Land Consolidation				
301	Land leveling	ha	6	1,500	9,000
302	Excavation	m^3	12,000	5	60,000
303	Fill and backfill (incl. embankment of building sites)	"	40,000	15	600,000
304	Gravel	"	2,000	70	140,000
305	Aggregate for base course of asphalt paved road (incl. prime coat)	"	620	80	49,600
306	Aggregate for sub-base course of asphalt paved road"	"	1,000	40	40,000
307	Asphalt concrete 5 cm thickness (incl. seal coat)	m^2	3,000	70	210,000

Item	Description	Unit	Quantity	Unit Price ₱	Amount ₱
308	Sand bed	m^3	280	30	8,400
309	Concrete class "A" w/forms	"	280	430	120,400
310	Concrete class "B" w/forms	"	70	350	24,500
311	Concrete class "D" w/forms	"	50	250	12,500
312	Reinforcing steel bar	ton	18	4,000	72,000
313	Miscellaneous steel w/painting	kg	3,000	5	15,000
314	Grouted riprap w/expansion material	m^3	550	200	110,000
315	Expansion plate 1 cm thick	m^2	16	50	800
316	Turf	"	5,800	8	46,400
317	ø8" wooden pile (L=7.0m)	pcs.	25	100	2,500
318	ø24" R.C. pipe	m	150	150	22,500
319	ø18" R.C. pipe	"	28	80	2,240
320	ø12" R.C. pipe	"	30	60	1,800
321	Installation of ø 200 mm mix flow pump (2 sets), distribution pipe, service pipe, sluice valve, elevated water distribution tank, weep hole, drainage pipe and underdrainage pipe	L.S.			6,360
	Sub-total				1,554,000
4.	Building works (see table 5-3)	L.S.			5,018,000
5.	Wiring work from Pilot Center to to irrigation pump	L.S.			60,000
	T O T A L				6,739,000

Table 5-3. Bill of Quantities

Building Work

Item	Description	Unit	Quantity	Unit Price ₱	Amount ₱
	Main Complex				
501	Main office	m^2	469.0	850	398,650
502	Experts' office	m^2	357.0	850	303,450
503	Laboratory	m^2	380.0	850	323,000
504	Office for field trials	m^2	90.0	500	45,000
505	Lecture room & canteen	m^2	337.5	800	270,000
506	Storage for farming materials	m^2	330.0	350	115,500
507	Shed for machinery & workshop	m^2	820.0	350	287,000
508	Gas station	m^2	15.0	500	7,500
509	Milling & drying house	m^2	425.0	400	170,000
510	Generator house	m^2	40.0	350	14,000
511	Pavement	m^2	3000.0	120	360,000
512	Exterior work and landscaping	L.S.			100,000
	Sub-total				2,394,100
	Residential Complex				
513	Experts' house	m^2	892.5	850	758,625
514	Guest house	m^2	571.0	850	485,350
515	Trainees' dormitory	m^2	465.0	800	372,000
516	Recreational facilities, including swimming pool, basketball court, tennis court, pelota court, etc.	L.S.			200,000
517	Pavement	m^2	3400.0	120	408,000
518	Exterior work and landscaping	L.S.			50,000
	Sub-total				2,273,975

Item	Description	Unit	Quantity	Unit Price ₱	Amount ₱
	Front Yard				
519	Exterior work and landscaping	L.S.			50,000
	Sub-total				50,000
	Common Works				
520	Deep well, elevated water tank, plumbing work for water supply and sewage at the outside of the building sites	L.S.			200,000
521	Exterior work and landscaping, including entrance gate, guard house, fence around the area of pilot center, cabling and cable duct work for telephone and interphone system at the outside of the building sites, road separator, curb, shed for shade, flag pole etc.	L.S.			100,000
	Sub-total				300,000
	Total				5,018,075
					≒ 5,018,000

APPENDICES

Table A-1 Evaporation

Alimanao Reservoir, Tuguegarao Cagayan

Evaporation (Open, Rim)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1957	129.0	181.4	236.5	267.0	309.6	246.1	202.2	192.0	192.0	156.7	150.1	125.1	2,387.8
1958		161.5	224.3	266.7	277.1	163.6	184.9	157.5	173.5	120.6	129.3	125.7	2,111.7
1959		153.9	154.7	253.0	218.4	196.6	211.3	137.4	159.8	161.8	135.6	122.7	2,040.3
1960	148.0	132.6	217.4	178.3	236.2	175.0	156.5	168.2	149.1	168.1	155.7	156.0	2,041.1
1961	156.2	146.3	208.3	211.3	204.5	199.9	173.7	151.6	141.5	156.7	149.9	146.0	2,045.9
1962	149.0	156.2	216.7	245.9	217.7	211.3	157.7	177.5	204.0	189.7	147.8	154.9	2,229.3
1963	152.9	139.4	143.8	242.1	267.2	185.2	206.6	212.6	208.3	216.4	185.2	164.8	2,324.4
1964	148.0	132.8	201.9	241.6	266.4	183.9	229.6	200.4	169.2	162.9	69.9	132.8	2,139.1
1965	145.0	136.6	227.3	237.7	179.3	155.4	161.8	146.8	166.6	147.3	163.8	67.1	1,934.7
1966	153.4	196.1	228.6	232.9	164.8	185.7	190.0	170.4	190.5	193.3	127.8	169.9	2,203.4
1967	183.6	169.7	212.1	187.7	213.6	194.6	180.1	168.2	167.2	118.1	56.6	135.5	1,987.0
1968	128.5	172.5	225.0	250.0	208.5	174.0	107.4	135.6	85.1	163.6	148.0	160.0	1,958.2
1969	159.0	182.4	221.0	250.5	280.0	230.1	184.1	187.0	156.5	144.0	134.6	136.5	2,265.6
1970	121.0	152.0	191.4	218.0	228.0	168.5	180.1	168.2	161.5	162.5	120.0	121.4	1,992.0
Mean (month)	147.8	158.1	207.8	234.4	233.7	190.7	180.4	169.5	166.1	161.6	133.9	137.0	2,121.0
Mean (day)	4.8	5.6	6.7	7.8	7.5	6.4	5.8	5.5	5.5	5.2	4.5	4.4	5.8

Table A-2. Calculation of design discharge for irrigation water supply system in the Pilot Center

(1) Q_1 : Area served = Block I = 0.52 ha

Q_1 = (0.15 m x 10,000 m^2/ha x 0.52 ha x 1,000 lit/m^3 ÷ 86,400 sec) ÷ 0.9 x 24/20 = 12 lit/sec

(2) Q_2 : Area served = Block I + II = 1.06 ha

Q_2 = (0.15 m x 10,000 m^2/ha x 1.00 ha x 1,000 lit/m^3 ÷ 86,400 sec + 2.9 lit/sec/ha x 0.06 ha) ÷ 0.9 x 24/20 = 23.2 + 0.3 = 23.5 ≒ 24 lit/sec

(3) Q_3 : Area served = Block I + II + III = 1.77 ha

Q_3 = 23.2 lit/sec + 2.9 x 0.77 ÷ 0.9 x 24/20

= 23.2 + 3.0 = 26.2 ≒ 27 lit/sec

(4) Q_4 : Area served = Block IV + V + VI + VII + VIII = 4.23 ha

Q_4 = 23.2 + 2.9 x 3.23 ÷ 0.9 x 24/20 = 23.2 + 12.5

= 35.7 ≒ 36 lit/sec

(5) Q_5 : Area served = Block IV = 0.75 ha

Q_5 = 0.15 x 10,000 x 0.75 x 1,000 ÷ 86,400 ÷ 0.9 x 24/20

≒ 17.4 ≒ 18 lit/sec

(6) Q_6 : Area served = Block V = 0.73 ha

Q_6 = 0.15 x 10,000 x 0.73 x 1,000 ÷ 86,400 ÷ 0.9 x 24/20

= 16.9 ≒ 17 lit/sec

(7) Q_7 : Area served = Block VI + VII + VIII = 2.75 ha

Q_7 = 23.2 + 2.9 x 1.75 ÷ 0.9 x 24/20 = 23.2 + 6.8

= 30 lit/sec

(8) Q_8 : Area served = Block VI + VII = 1.72 ha

Q_8 = 23.2 + 2.9 x 0.72 ÷ 0.9 x 24/20 = 23.2 + 2.8

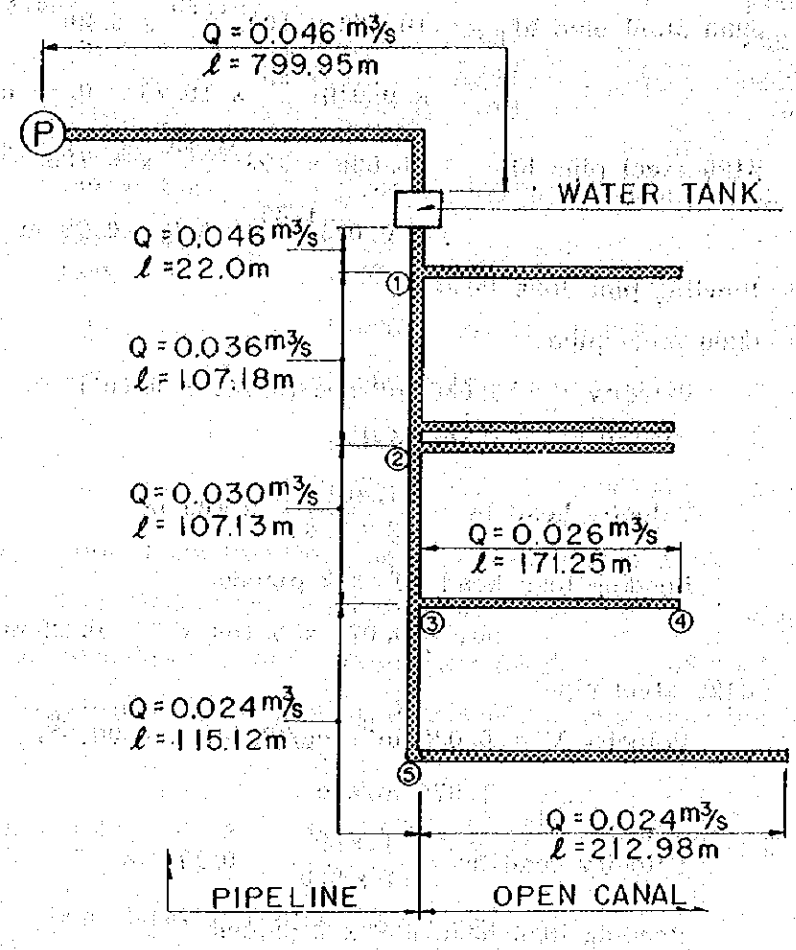
= 26 lit/sec

(9) Q_9 : Area served = Block VIII = 1.03 ha

Q_9 = 23.2 + 2.9 x 0.03 ÷ 0.9 x 24/20 = 23.2 + 0.1

= 23.2 ≒ 24 lit/sec

Table A-3. Hydraulic Computation for Irrigation Water Supply System



1. Hydraulic Computation for pipe line section

Williams-Hazen Formula will be used for hydraulic computation for the pipe line.

$$I = 10.666 . C^{-1.85} . D^{-4.87} . Q^{1.85}$$

Where:

I : Hydraulic gradient

C: Coefficient of discharge by pipe line material = 150

D: Diameter of pipe (m)

Q: Discharge (m^3/sec)

(1) Loss head around the pump

(a) Friction loss head

ϕ200 steel pipe $hf_1 = 10.666 \times 100^{-1.85} \times 0.20^{-4.87} \times 0.046^{1.85} \times 19.73 = 0.36$ m

ϕ125 steel pipe $hf_2 = 10.666 \times 100^{-1.85} \times 0.125^{-4.87} \times 0.023^{1.85} \times 5.5 = 0.28$ m

(b) Bending pipe loss head

ϕ200 steel pipe

Velocity $V = 0.046\ m^3/sec/(3.142 \times 0.10^2) = 1,464$ m/sec

Velocity head $hv = \frac{1.464^2}{2 \times 9.8} = 0.109$ m

Bending loss head 30^o x 2 places

$hb_1 = 0.073 \times 0.109 \times 2 = 0.02$ m

ϕ125 steel pipe

Velocity $V = 0.023\ m^3/sec/(3.142 \times 0.0625^2) = 1.874$ m/sec

Velocity head $hv = \frac{1.874^2}{2 \times 9.8} = 0.179$ m

Bending loss head 90^o x 2 places

$hb_2 = 0.99 \times 0.179 \times 2 = 0.35$ m

(c) Transition loss head (ϕ125 ----- ϕ200)

$hec = 0.46 \times 0.109 = 0.05$ m

(d) Valve loss head

ϕ200 sluice valve $hf_{v1} = 0.10 \times 0.109 = 0.01$ m

ϕ125 check valve $hf_{v2} = 1.50 \times 0.179 = 0.27$ m

Total loss head around the pump: $\Sigma h_p = 1.34$ m

(2) Friction Loss Head of pipe line

	Q (m^3/sec)	Pipe length (m)	I	Friction loss head (m)	Velocity (m/sec)
Pump - Distribution tank	0.046	799.95	0.008557	6.85	1.464
Distribution tank - 1	0.046	22.00	0.008557	0.19	1.464
1 - 2	0.036	107.18	0.005437	0.59	1.146
2 - 3	0.030	107.13	0.003881	0.42	0.955
3 - 4	0.026	171.25	0.002978	0.51	0.828
3 - 5	0.024	115.12	0.002568	0.30	0.764

(3) Total Loss Head of Pump to Distribution Tank

Total loss head is obtained by adding 10% of friction loss head and run-off loss head to the friction loss head. 10% of friction loss head is taken as corresponding to loss head around the pump and bending pipe loss head.

$$hf = 1.34 + 6.85 \times 1.1 + 1.0 \times \frac{1.464^2}{2 \times 9.8} = 8.99 \text{ m} \fallingdotseq 9.0 \text{ m}$$

(4) Loss head of Distribution Tank to 4

Total loss head is obtained by adding 10% of friction loss head and inflow. run-off loss head to the friction loss head. 10% of friction loss head is taken as corresponding to bending pipe loss head.

$$h_f = 1.71 \times 1.1 + 0.5 \times \frac{1.464^2}{2 \times 9.8} + 1.0 \times \frac{0.828^2}{2 \times 9.8} = 1.96 \text{ m}$$

2. Hydraulic Computation for Open Canal Section

When open canal is with the bottom width of 0.4 m and gradient of 1/2,000, hydraulic features of this canal will be as follows:

Discharge Q = 0.024 m^3/sec

Depth H = 0.20 m

Velocity V = 0.321 m/sec

Table A-4. Probable Rainfall

Year of Probability	Maximum Day Rainfall (mm)	Maximum 2 Day Continuous Rainfall (mm)	Maximum 3 Day Continuous Rainfall (mm)
2	146.5	198.7	205.3
5	211.6	284.0	292.6
10	256.7	341.1	351.2
20	301.2	396.2	407.7
50	360.6	468.3	481.8
100	406.7	523.2	538.2
200	454.1	578.9	595.4

Note: 1. Rainfall data used for the calculation of rainfall probability are the result of observations at Tuguegarao, Cagayan, from the year 1949 to 1973.

2. Calculation of probable rainfall was made by Iwai's method.

SPECIFICATIONS

This specification consists of the specification for the civil works and the one for the building construction.

The design of buildings described in this report is the basic design. The descriptions and the drawings were, therefore, made to give the basic idea to carry out the construction design. And the specification for the building construction shall be considered within the limit of this objectives.

THE SPECIFICATIONS FOR CIVIL WORKS

CONTENT

I. EARTH AND FOUNDATION WORKS

101 General

(a) The work site shall be maintained well drained and shall be kept free from the innundation caused by the rainfall or the spring during the construction.

(b) The woods and others which are produced by the clearing and the grubbing in the borrow area shall be treated in accordance with the direction of the Engineer. The materials for the embankment shall not be collected from the borrow area unless the Engineer approved to terminate the clearing and the grubbing works after the inspection of the works.

The Contractor shall readjust the land of the borrow area according to the direction of the Engineer after the completion of the construction.

(c) Before commencement of the construction, the Contractor shall study the program of the collection and the transportation of the materials and shall prepare and submit the report on the program to the Engineer to get the approval.

(d) The sediment deposited in the drainage, manhole and the pipe shall be removed at the Contractor's own expense.

102 Excavation

(a) If it occurred or expected to occur the spontaneous land slide of the slope, the Contractor shall inform it to the Engineer without delay and shall ask the Engineer how to deal with the land slide.

(b) The excavation slope shall be finished by tools to have the gradient indicated in the drawings or by the Engineer.

(c) If the slope and the foundation of the grouted riprap drainage canal or the foundation of the pipeline, manhole and the inlet suction tank of the pump are over excavated, the Contractor shall backfill with gravel or other materials approved by the Engineer at the Contractor's expense. And

the backfilled materials shall be compacted sufficiently.

(d) The excavated materials which were not judged to be suitable to the embankment shall be transported and be spoiled in the spoil bank.

(e) The accuracy of the land levelling of the paddy field surface is ±5 centimeters.

103 Embankment and Backfill

(a) The thickness of the spreding of the embanking materials shall be less than 30 centimeters. The density of the compacted embankment shall be more than 90 percent of the maximum dry density of the material.

(b) The embankment work shall be suspended without delay if it rains while working. After the rainfall, the embankment work shall not be restarted until the embankment filled before the rainfall dry to the appropriate moisture content.

(c) The earth hauling equipment shall not travel on the same course on the filled embankment. A rut on the embankment made by the travel of earth hauling equipment shall be erased and levelled promptly.

(d) The slope of the embankment shall be finished to the designed gradient by providing fixed ruler.

(e) Embankment or backfill contiguous to the structure shall be carried out in a manner not to bring the partial stress to the structure. Any damage on the structure caused by embankment or backfill work shall be restored by the Contractor at his own expense.

(f) Backfill for the construction of the pipeline shall be carried out in parallel with the joint work of the pipe. The excavated ditch for the pipe shall be backfilled until 60 cm above the top of the pipe soon after the inspection for the joint work is made. The heavy equipment including truck shall not be used for the spreading and the rolling compaction of the backfill until the backfill has reached an elevation of 60 cm above the top of the pipe.

104 Sand Bed and Gravel Foundation

Sand bed on which the pipes are laid and the gravel foundation for the concrete structure shall be compacted to have the uniform density in order not to cause the unequal settlement.

105 Sodding

(a) The Contractor shall submit the sample of the sod to be approved by the Engineer.

(b) Sodding shall not be made in the dry season. Water shall be sprinkled on the sod from time to time to keep the sod from withering.

(c) Sod shall be planted on the harrowed ground from which the trashes were removed. The sod shall be patted on the ground by wooden plate and fixed to the ground surface by the peg 20 cm in length. The planted sod shall be watered sufficiently after the clay loam was scattered lightly on them.

106 Wood Pile Work

(a) Log for wood pile shall be stripped its bark and shall be the good material which has no bent and no split and shall be approved by the Engineer. The diameter and the length of the log shall be as shown on the design drawings.

(b) The end of the pile is to be sharpened in the shape of pyramid and the standard height of the pyramid is one and a half of the diameter of the log.

(c) The top of the log shall be finished to have the circular section and be made adaptable to the steel ring or cap in order not to be broken down by driving into the ground. The piles which were broken by driving in or which were driven slantwise shall be disposed subject to the direction of the Engineer at the expense of the Contractor.

II. CONCRETE WORK

201 Application

This specification is applicable to the following concrete which are to be used in this construction, i.e. Reinforced concrete (Class A), Plain concrete (Class B) and Layer concrete (Class D).

202 Cement

(a) Cement used to concrete and mortar shall be Portland cement which conform to the standard described in ASTM C-150 TYPE I.

(b) The bagged cement shall be stored in the well damp-proofed warehouse of which the height of floor is more than 30 centimeters. The bagged cement which have been stored more than three month or which are suspected to be damped shall not be used unless otherwise approved by the Engineer.

203 Water

(a) Water used to concrete and mortar shall not contain harmful quantity of oil, acid, salt and so on which affect the quality of the concrete.

(b) Even if the quality of the water is questionable, the water may be used if the concrete to obtain 90% of the compressive strength at the age of 28 days of the concrete of which was made by using the city water.

204 Fine Aggregate

(a) Fine aggregate which is to be used in concrete and mortar shall be clean, sound and durable. It shall not contains the harmful quantities of organic impurities, salt and others.

(b) Fine aggregate shall be well distributed from large particle size to small one. Its grading shall conform to the standard shown in the following table unless otherwise approved by the Engineer.

Shieve Mesh	Percent by Weight Passing Individual Size
3/8"	100
No. 4	95 - 100
No. 8	65 - 95
No. 16	45 - 80
No. 40	25 - 85
No. 50	10 - 35
No. 100	2 - 10
No. 200	0 - 5

The fineness modulus shall be in the range from 2.3 to 3.00. The mix proportion shall be redesigned when the fineness modulus of the fine aggregate deviate more than 0.2 from the one which was originally designated as mix proportion of the concrete.

205 Coarse Aggregate

(a) Coarse aggregate which is to be used in concrete and mortar shall be clean, sound and durable. It shall not contain the harmfull quantities of thin or elongated shape gravel, organic impurities, salt and others. The coarse aggregate shall conform to ASTM C-33.

(b) Coarse aggregate shall have the proper distribution of the large and the small particle size. Its grading shall conform to the standard shown in the following table:

Shieve Mesh	Percent by Weight Passing Individual Size
1"	100
3/4"	90 - 100
3/8"	20 - 55
No. 4	0 - 10

206 Mix Proportion

(a) The Contractor shall design the mix proportion for every class of concrete before placing the concrete for the approval of the Engineer. The Contractor shall carry out the mix test in case being requested by the Engineer. The test is to be made at the expense of the Contractor.

(b) The compressive strength at the age of 28 days shall be as follows:

Class	Maximum size of coarse aggregate	Minimum 28 days compressive strength	Slump
A (Reinforced concrete)	3/4"	210 Kg/cm^2	7.5 $\pm$ 1.5
B (Plain concrete)	3/4"	180 Kg/cm^2	7.5 $\pm$ 1.5
D (Concrete layer)	3/4"	135 Kg/cm^2	15

207 Mixing

(a) Concrete shall be machine mixing unless otherwise approved by the Engineer in writing. The mixing machine shall be such that can produce uniform and homogeneous concrete and the type and the capacity of which is subject to the approval of the Engineer.

(b) The measurement of every ingredient of concrete shall be made in weight. Nevertheless, the measurement in volume is admitted subject to the approval of the Engineer.

(c) The mixing time of concrete shall be more than one and a half minute. Overmixing, requiring the introduction of additional water to preserve the required consistency, will not be permited. Overmixed concrete shall be wasted.

(d) The mixer shall be completely emptied before recieving the materials for the succeeding batch and shall be kept clean and washed out after stopping work at the end of each shift.

(e) On commencing work with a clean mixer, the first batch shall contain sufficient exess of cement, sand and water to coat the inside of the drum to avoid the reduction of the required mortar content of the mix.

208 Hauling and Placing

(a) Concrete shall be hauled speedily to the placing site by the method which does not cause the segregation of the ingredient.

The concrete shall be placed within 45 minutes after mixing. The concrete of which the ingredient being segregated shall be remixed.

(b) The Contractor shall prepare a plan for the method of hauling and placing of the concrete and shall submit such plan to the Engineer for his approval before commencement of the concrete work.

(c) Before placing the concrete, the surface of the foundation and the construction joint of concrete structure shall be cleaned and shall be covered with a layer of mortar at least 1.5 cm thick. The mortar shall have the same mix proportion of cement and sand as the concrete mix to be placed upon it.

(d) Before placing the concrete, the inside of the forms shall be cleaned in order to keep from mingling of impurities.

(e) The length of the chute to place the concrete shall be less than 1.5 meters and the distance between the lowest edge of the chute and the concrete surface shall be less than 1.5 m.

(f) Before placing the concrete, the Contractor shall obtain approval of the Engineer as to the arrangement of the reinforcing bars and the setting of the forms. All the concrete shall be placed only in the presence of the Engineer.

(g) The concrete shall be consolidated by internal vibrators. The form vibrator may be used together with the internal vibrator in such place as the thin wall in which the latter is difficult to use.

(h) The vibrator shall be inserted vertically and with the constant spacing into the concrete. The vibrator shall be drawn out slowly and

steadily in order to avoid remaining the void in the concrete.

(i) The interval and the duration of vibration shall be subject to the direction of the Engineer.

(j) The temperature of the concrete to be placed shall be under 32°C.

209 Form

(a) Forms shall have the sufficient strength to withstand the pressure resulting from placement and vibration of the concrete. In addition, the form is to conform to the shapes, lines and dimensions of the concrete shown on the drawings and shall be tight enough to prevent loss of mortar from the concrete.

(b) Form may be of steel, wood plane and plywood. The form surface in contact with the concrete shall be completely smooth.

(c) Unless otherwise instructed, the form shall be designed to enable beveling of 2 cm x 2 cm in the corner of the concrete.

(d) Bolts or steel bars may be used to tighten the forms. These clamps shall not be remained on the surface of the concrete after removal of the form.

(e) The surface of the form shall be coated with shutter oil to prevent adherence of the concrete to the form.

(f) The minimum period of time which shall be elapsed between the completion of concrete placing and the removal of the form shall be as follows:

Form	Minimum Time of removal after concrete placing
Vertical or near vertical faces of thick member	1 day
Vertical or near vertical faces of thin member	3 days
Slab	6 days

210 Finishing

(a) Unformed concrete surface shall not be finished until the water exuded from the surface of the concrete dissipate or be dewatered. Finishing shall be made by wood trowel. Nevertheless, the surface of the concrete which is required to be smooth and dense shall be finished by iron trowel with high pressure after placing of the concrete as late as practicable.

(b) The protrusion on the surface of the concrete shall be removed and shall be levelled. The honeycomb or faults in the concrete shall be wetted by water and shall be patched up by the concrete or mortar which are properly mixed and shall be finished after removing the incompleteness around them.

211 Curing

The placed concrete shall be covered by straw mat and kept continuously damp for a minimum of three days after placing.

212 Reinforcing Bar

(a) Unless otherwise shown on the drawings, the reinforcing bars shall be deformed bars and shall conform to ASTM-A15, A-305 and A-408.

(b) The equipment and tool which are to be used to cut, bend and manufacture the bar shall be to the Engineer's approval. Hot manufacturing of the reinforcing bar is not permitted.

(c) Before the bar is placed, the rust, dirt, grease or other foreign substance shall be removed from the surfaces of the reinforcing bars and the surfaces of any metal bar support and spacer.

(d) The minimum cover for all main reinforcing bars shall be 5 cm. The errors in the covering and in the distance between the center of bars shall be less than ± 1 cm.

(e) The radius of 90° bend of the bar in the members of the ramen structure shall be more than 10 times of the steel bar diameter. The radius of 45° bend of the bar shall be more than 5 times of the diameter of bar.

(f) Laps at joints of the reinforcing bar shall have a length at least thirty times of the diameter of bar and shall be bound by steel wire of which the diameter is bigger than 0.9 mm.

213 Expansion Material

(a) The expansion material shall conform to the specification of U.S.A. Federal Specification HH-F-341A and shall be 1 cm in thickness.

(b) The expansion material shall be fixed to the concrete which is placed precedingly by nail.

III. GROUTED RIPRAP

301 Material

(a) The stones used for grouted riprap shall be free from lenticels and cracks, have sufficient strength and durability against weathering and erosion by water and air, and have at least more than 15 cm diameter. The specific gravity of the stones shall be 2.6 or more.

(b) Gravel for back-filling shall have sufficient resistance against weathering and alteration and shall be in the range from 10 to 150 mm in diameter.

302 Construction Procedure

(a) Finishing stakes for construction of riprap shall be provided at the front and rear sides of the riprap and at the back of back-filling gravel.

(b) Procedure of grouted riprap shall be as follows;

(i) At first, stones shall be laid by hands on the back-filling gravel properly tamped and trimmed.

(ii) If any large space is formed between stones and the surface of back-filling gravel, the space shall be filled with stones or spalls of appropriate sizes.

(iii) All the spaces between the surface and bottom of the grouted riprap shown on the drawing shall be completely filled with grout.

(iv) The grouted riprap shall be covered with wet straw mats immediately after execution of work, and cured for at least 3 days.

303 Expansion Joint

The expansion joints of grouted riprap shall be provided at 10 m intervals. The material of expansion joints shall be 1 cm thick wooden plate with corrosion inhibitor coated.

304 Weep Hole

As weep holes, PVC pipe of 50 mm in diameter shall be provided in the grouted riprap at the intervals shown on the drawing. The PVC pipe shall be inserted into the back-filling gravel by at least 5 cm.

IV. ROAD WORK

401 Application

This chapter shall specify the subbase, base, and surface course of asphalt pavements, and gravel spreading of gravel roads, with regard to their materials and construction methods. For construction of subgrade, the specifications in Chapter 1 "Earth and foundation works" shall be applied.

402 Subbase

(a) The material of subbase shall be unscreened gravel with the maximum particle size of less than 50 mm and shall not contain more than 10% of the materials passing 0.074 mm sieve mesh.

(b) The subbase material shall be spread by a bulldozer or grader. One spread layer shall be less than 20 cm in finish thickness.

(c) Rolling shall be executed by using a 10 t or heavier macadam roller or 8 - 15 t tyre roller or vibrating roller with equivalent effect. The density of the subbase after compacting shall be more than 90% of the maximum dry density of the base material.

(d) When the subbase material becomes too dry during spreading or rolling, water shall be sprinkled appropriately to keep the moisture content of the rolled subbase material always in the vicinity of optimum.

403 Base

(a) The grading of base material shall be as follows;

Sieve Mesh	Percent by Weight Passing Individual Size
40 mm	95 - 100
30	80 - 100
25	70 - 95
13	50 - 80
2.5	20 - 50
0.074	2 - 10

(b) The base meaterial shall be spread by a grader or hands. One spread layer shall be less than 15 cm in finish thickness.

(c) Rolling shall be applied, with the moisture content of the base material always in the vicinity of optimum. The rolling machine shall be a vibrating roller, and tyre roller, or roller with equivalent effect. The density of the base after compacting shall be more than 95% of the maximum dry density of the base material.

(d) The spread material shall be invariably and completely compacted within that day.

404 Prime Coat

After the base is finished, primer shall be coated as soon as possible. The bituminous material used as the primer shall conform to AASHO TEST Designation M82-70, Grade MC-250. Unless otherwise specified by the Engineer, the amount of primer used shall be 1.2 $1/m^2$. For the prime coat, primer, as it is or as it is heated, shall be sprayed evenly on the base by a distributor or sprayer. If traffic is allowed to flow subject to the permission of the Engineer after the prime coat is sprayed, coarse sand shall be spreaded to prevent the adhesion of the primer to wheels. If the prime coating is exfoliated by traffic, primer shall be coated again for repaire as soon as possible.

405 Surface Course

(a) The aggregate used for asphalt concrete shall be clean, strong and durable, and shall not contain harmful amounts of stone strips, stone flakes, dust, mud, organic matter, etc. The grading of the aggregate shall be in the following ranges:

Sieve mesh	Percent by weight passing individual size
25 mm	100
20	95 - 100
13	80 - 100
5	50 - 70
2.5	35 - 50
0.6	14 - 26
0.3	8 - 18
0.15	3 - 11
0.074	0 - 5

The moisture content of aggregate when mixed shall be less than 4%.

(b) The asphalt emulsion used for asphalt concrete shall be to the approval of the Engineer. Unless otherwise specified by the Engineer, the amount of asphalt emulsion used shall be in the range from 8 to 9.5% against the weight of the aggregate.

(c) Asphalt concrete shall be mixed by a batch mixer or any method approved by the Engineer. For mixing by using a batch mixer, at first aggregate shall be put in for dry mixing, and then asphalt emulsion shall be added. The mixing time of aggregate and asphalt emulsion shall be about 20 seconds, and shall not exceed 30 seconds. The mixture made by the first batch and the mixture made with mixing time of more than 30 seconds shall not be used as pavement material.

(d) The mixture shall be transported by a dump truck or any method approved by the Engineer.

(e) The mixture shall be spread to be uniform in thickness by a finisher or spreader or hands.

(f) Initial rolling shall be carried out by using a 8t or heavier road roller. Second rolling shall be carried out sufficiently by using a 10t or heavier typre roller. The finish rolling shall be carried out, erasing

wheel tracks of the tyre roller by a road roller, after most of the moisture content in the mixture evaporates. If the mixture adheres to the road roller, a minimum amount of water or oil may be coated thinly on the wheels. The thickness of the surface course shall be 5 cm.

(g) Immediately after paving the surface course, seal coat shall be applied to provide water-proof and wear-proof properties to the surface course. Unless otherwise specified by the Engineer, the kinds and amounts of asphalt emulsion and aggregate used for the seal coat shall be as follows;

Asphalt emulsion: 80 - 100 l/100 m^2

Aggregate (particle size 5 - 2.5 mm): 0.5 m^3/100 m^2

406 Gravel Road

(a) The gravel to be spread on the gravel road shall be unscreened gravel, and the grading shall be as follows:

Sieve mesh	Percent by weight passing individual size
40 mm	95 - 100
20	50 - 80
2.5	5 - 25

(b) The spreading and rolling of gravel shall be the same as in the case of the base course of asphalt paved road. However, the density of gravel after compacting shall be more than 90% of the maximum dry density of the gravel.

V. PIPE WORK

501 Earth Work

For the earthwork required for piping, the specifications of Chapter 1 shall be applied.

502 Pipe Jointing

(a) The mortar caulking at the collar joint of reinforced concrete pipes shall be made after cleaning the inner face of the collar and the pipe surfaces for connection, and providing sufficient water. After the collar jointing work is completed, the jointed section shall be covered with straw mats, etc for at least 3 days. Furthermore, particular care shall be taken not to give impact to the collar connected section. When it is difficult to obtain or make collars, the Contractor shall prepare an alternative proposal concerning the jointing method and shall submit it to the Engineer.
All the expenses required for the jointing work executed based on the approval of the Engineer shall be borne by the Contractor.

(b) Flange joint

Rubber packing shall be first be cleaned sufficiently before pipe jointing. Diametrically opposite bolts shall be tightened in proper and regular sequence by small amounts at a time until all bolts are tight. The use of torque wrench is desiable for tightening to prevent irregular tightening which may cause leakage of water.

(c) Welded joint work shall be made by a welder with official qualification and approved by the Engineer. The details of welding method, sequence of welding, welding machine and process shall be to the approval of the Engineer.

The welding of steel pipes shall be by butt welding. Prior to welding, the groove shall be cleaned by using a wire brush, etc. to remove the materials adversely affecting the welding such as scale, rust, oils and fats, painting, etc. The Contractor shall control electrodes to be always in

dry. The standard reinforcement of weld on the outer surface shall be 2 mm.

(d) The PVC pipe used in this construction shall be of socket type. The pipe jointing shall be carried out in accordance with the pipe manufacturer's instructions but will be normally as follows:

(i) Before jointing pipes, the interior surface of the socket shall be throughly cleaned.

(ii) The presence of scratches, etc on the outer surface of the spigot of each pipe shall be confirmed. If there is a deep flaw in the portion, the portion shall be cut out.

(iii) The rubber ring shall be checked. If there are fine cracks on the surface of the rubber ring, the rubber is ageing, and the rubber ring shall not be used for pipe jointing.

(iv) The rubber ring shall be moistened by water, and fitted in the predetermined position in the socket.

(v) Lubricant shall be coated on the inner face of the rubber ring and on the spigot evenly over the entire circumference.

(vi) Connection shall be effected by hands or by using a lever. If abnormally large inserting force is required for the pipe jointing, it may be caused by inclusion of sand, dust, etc in the connected section, defective coating of lubricant, torsion of rubber ring, deviation of rubber ring, etc. Therefore, the pipe jointing work shall be suspended immediately, and the pipe shall be drawn out, for repeating from procedure (i).

(vii) After pipe jointing, it shall be confirmed over the entire circumference by using a check gauge, that the rubber ring is in normal state.

(viii) If the rubber ring is not normal, the pipe shall be drawn out immediately, for repeating from procedure (i).

VI PAINTING

601 General

(a) All metal surfaces shall be painted except the portions in contact with concrete. Unless otherwise specified, painting is not applied for galvanized surfaces.

(b) All oil, grease and dirt shall be removed by the use of clean solvent and clean wiping material. Following solvent cleaning, all loose rust, loose mill scale and other foreign substances shall be removed by wire brushing or other effective means. All defective or damaged areas shop-applied prime coat shall be sufficiently cleaned and painted again at the Contractor's expense.

(c) Each coat of painting shall be applied only after the previous painting has been sufficiently dried. As for the metal works which must be painted, the surface which cannot be painted after installation shall be painted before installation.

602 Metal Painting

Unless otherwise specified by the Engineer, the painting shall be carried out in accordance with the following table.

Portions	Paint	Number of Coat
Ferrous surfaces which will be submerged or intermittently submerged (trashrack, step, etc)	Self-curing inorganic zinc rich	1
	Coal tar epoxy paint	2
		1
Externally exposed surface (water tanks, man-hole cover)	Red lead	1
	Phenolic resin aluminium paint	2

THE SPECIFICATIONS FOR BUILDING WORKS

CONTENT

I. GENERAL

These specifications have been made mainly for the main complex. It is hoped that the specifications for the construction of residential complex are to be made based on these specifications.

II. SCOPE OF CONSTRUCTION

This construction shall include the following respective works:

- o Temporary works
- o Earthwork
- o Foundation work
- o Concrete work
- o Form work
- o Reinforcing bars and steel frame works
- o Concrete block work
- o Stone and terrazzo block works
- o Carpentry
- o Roofing
- o Tinsmith's work
- o Joiner's work
- o Glazing work
- o Plastering
- o Painting
- o Electricity and telephone works
- o Water supply, drainage, sanitary and water purification works
- o Outward appearance and landscape architecture works
- o Air conditioning work

III. OUTLINE OF DESIGN

301 Main Complex

Reinforced concrete construction and wooden construction partially with lightweight steel frame construction, single-storied building.

Total floor area: 3,263.5 m^2

Building height and floor height

First floor height: Office GL + 0.6 m

Other portions GL + 0.1 m

Eaves height: GL + 3 m

Milling and drying building: GL + 4.5 m

Foundation	:	Broken stone foundation
Footing	:	Reinforced concrete construction
Column	:	Reinforced concrete construction
Truss	:	Wooden construction partially with steel frame construction
Floor	:	Plain concrete placing on broken stone foundation
External wall	:	Sprayed stucco on the ground of concrete blocks. Partially No. 26 corrugated steel sheet
Roof	:	No. 26 corrugated steel sheet
Fitting	:	Window ... Aluminium jalousie window Vestibule ... Hard wood sash Door ... Wooden flush partially with steel flush
Gutter	:	1.6 mm thick steel sheet with oil paint
Painting	:	Ferrous and external surfaces ... Oil paint Internal surface ... Vinyl emulsion paint

302 Residential Complex

A. Experts' houses

Wooden construction, single-storied buildings

Total floor area: 178.5 m^2 (one building) x 5 = 892.5 m^2

Building height and floor height

First floor height: GL + 0.6 m

Eaves height: GL + 3 m

Foundation : Broken stone foundation

Footing : Reinforced concrete construction

Shed structure : Wooden construction

External walls : Sprayed stucco with cement plastering on the ground of lath sheet

Roofs : No. 26 corrugated steel sheet

Fittings : Wooden sash and door

B. Guest house

Reinforced concrete construction and wooden construction, two-storied building

Total floor area: 571 m^2

Building height and floor height

First floor height : GL + 0.45 m

Second floor height : GL + 3.35 m

Eaves height : GL + 5.75 m

Foundation : Broken stone foundation

Footing : Reinforced concrete construction

Shed structure : First floor ... Reinforced concrete construction
Second floor .. Wooden construction

External walls : Hollow concrete blocks

Roofs : No. 26 corrugated steel sheet

Fittings : Wooden

C. Trainees' dormitory

Wooden construction, one-storied building

Total floor area: 465 m^2

Building height and floor height

First floor height : GL + 0.60 m

Eaves height : GL + 3.00 m

Foundation	: Broken stone foundation
Footing	: Reinforced concrete construction
Shed structure	: Wooden construction
External walls	: Sprayed stucco with cement plastering on the ground of lath sheet
Roofs	: No. 26 corrugated steel sheet
Fittings	: Wooden

IV. TEMPORARY WORKS

401 Obstructions

All the obstructions for works in the site shall be removed.

402 Temporary Enclosures

Enclosures shall be provided in the necessary places during the works.

403 Staking Out

Positions shall be identified by staking out and shall be approved by the Engineer.

404 Leading Frame

The positions of buildings and the reference for level shall be clearly indicated and sometimes checked according to the surveying method specified by the Engineer.

405 Arrangement on the Premises

Arrangement on the premises shall be always proper not to disturb the progress of works.

V. EARTH WORK

501 Leveling of Grounds

The grounds on which buildings are built shall be leveled before commencement of the works.

502 Trench

Depth and width of trenches shall be as shown on the drawings.

503 Landslide Protection Wall

Where necessary, the walls shall be constructed for landslide protection.

504 Back Filling

The portions around the foundations or other portions requiring back filling shall be filled with good soil and sufficiently compacted.

505 Surplus Earth Disposal

As a rule, the surplus earth shall be disposed within the site and the surface shall be leveled.

VI. FOUNDATION WORK

601 Broken Stone Foundation

Hard and evenly sized broken stones shall be laid on end, being filled with gravel, and shall be sufficiently compacted. The broken stones under the first floor concrete also shall be treated similarly and rolled. However, the foundation for machine base and the portions under external walls shall be sufficiently compacted by a rammer according to the situations.

VII. CONCRETE WORK

701 Material

The cement used shall be Portland cement conforming to the standard of ASTM C-150-TYPE I. The coarse aggregate of concrete shall be nominal 25 mm or less. If the river sand used as fine aggregate is coarse and contains only a small amount of fine particles, fine sand shall be added by 10 to 30% to revise the grading.

702 Proportioning and Strength

The four week age strength of concrete shall be as given in the following table. The proportion of concrete shall be in conformance with the Reinforced Concrete Works Specifications instituted by the Architectural Institute of Japan or with any equivalent standard.

Concrete	Design Strength kg/m^2	Slump cm	Application
Plain Concrete		Proportion 1:3:6	Layer Concrete
Plain Concrete	150 or more	13 - 15	Floor
Reinforced Concrete	180 or more	15 - 18	Footing & Footing Beam
Reinforced Concrete	210 or more	18 - 21	Column & Second Floor

VIII. FORM WORK

801 Requirements of Form

The forms shall satisfy the requirements not to cause faults such as honeycomb and void in concrete and the forms for architectural concrete shall be able to guarantee the finish of the surfaces.

802 Allowable Tolerance of Form

The standard allowable tolerance of forms shall be as given below. The tolerance in sectional direction shall be within ±2 mm in any direction.

Structure		Tolerance allowable before concrete placing	Tolerance allowable after concrete placing
Footing Beam	Vertical and Horizontal	± 4 mm	± 6 mm
Wall & Column	Architectural	± 2 mm	± 4 mm
	Normal	± 4 mm	± 6 mm
Beam & Slab		± 3 mm (incl. chamber)	± 5 mm (incl. chamber)

IX. REINFORCING BARS AND STEEL FRAME WORKS

901 Erection and Inspection

o With regard to the spacers, trestles and hangers, etc used for erection of reinforcing bars, their samples shall be submitted for the Engineer's approval.

o The main reinforcements of beams and columns shall be invariably inspected as to the through arrangement by piano wires and the thickness of cover, intervals, etc shall be kept accurately.

o Joints and anchorage

The working drawings of reinforcing bars including the positions of joints shall be submitted before working, and approved by the Engineer.

902 Steel Frame

The steel frames shall be in accordance with JIS G 3350 Ordinary Structural Lightweight Shape Steel or another equivalent standard. Prior to manufacturing, full size drawings shall be submitted for the approval of the Engineer.

X. CONCRETE BLOCK WORK

1001 Material

The concrete blocks shall be in conforinance with JIS A 5406 Hollow Concrete Blocks or another equivalent standard. The concrete blocks for walls and external lower walls shall be 10 cm in thickness.

XI. STONE AND TERRAZZO BLOCK WORKS

1101 Places of Works

The places of works, kinds of stone and designation of finish for stone paving, masonry, etc shall be in accordance with the drawings and finishing table.

1102 Working Drawing

Drawings for courses in stone masonry work, full size drawings, and mounting work drawings shall be prepared based on the design drawing and shall be submitted for the Engineer's approval.

XII. CARPENTRY

1201 Material

The wood used shall be dried to the standard moisture contents as follows:

Structural wood	: 24% or less
Ceiling joist, furring strips	: 18% or less
Fixture	: 12% or less

1202 Preservative Treatment and Insecticide Treatment

o All the surfaces of wood in contact with concrete, mortar, etc shall be coated with phenol preservative twice.

o Lauan not treated with insecticide shall not be used.

o All metallic parts shall be coated with rust preventives, except the portions embedded in concrete.

1203 Protection

The portions which may be soiled or damaged during working shall be protected by the covering of paper or board, or any other suitable method.

1204 Material Designation

a. YACAL : Truss, door, window frame, etc.

b. APITONG : Joist, furring strips, ceiling finishing

c. NARRA : Wall, window frame and portions as indicated on the drawing.

XIII. ROOFING

1301 Material

All the roof material shall be No. 26 corrugated galvanized sheet iron. The overlapped portions shall extend more than 2 1/2 crests in crosswise direction and more than 30 cm in lengthwise direction.

XIV. TINSMITH'S WORK

1401 Eaves Gutters and Rain Leader

The soffit covers of eaves gutters shall be made on 1.6 mm galvanized sheet iron, and the interior gutters shall be of No. 28 galvanized sheet

iron. The rain leaders shall be made of 12 cm ϕ galvanized sheet iron.

1402 Drip Cap

Pent-roof and roof fitting portions shall be covered with No. 28 galvanized sheet iron to hold good flashing.

XV. JOINER'S WORK

1501 Window

As a rule, windows shall be aluminium jalousie windows.

1502 Other Opening

The other openings shall be of wooden sashes, unless otherwise specified on drawings.

1503 Door

The doors shall be wooden flush doors, unless otherwise specified on the drawings.

1504 Fitting and Manufacturing

For manufacturing, full size drawings shall be made and approved by the Engineer.

1505 Hardware

All the locks for fittings and other accessory hardwares shall be of first class quality, and their samples shall be submitted and approved by the Engineer.

a. Door locks : Cylinder locks with master keys
Knobs to be made of stainless steel

b. Door closers : With floor hinge stops

c. Lavatory hinges : Stainless steel

d. Hinges: Stainless steel

Hinges in office shall be pivot hinges.

XVI. GLAZING WORK

1601 Material

The sheet glass shall be polished sheet glass. Heat reflecting glass shall be used on the east, south and west sides of buildings.

1602 Fitting Material

For edge keeping portions, Thiokol sealing agent shall be used.

XVII. PLASTERING

1701 Backing

In backing of plastering for concrete, concrete blocks, etc., considerably uneven or strained portions shall be coated for filling or cut out, to obtain predetermined painting thickness. If plastering for filling is applied, a drying period of 14 days or more shall be taken before proceeding to the next step.

1702 Cement Mortar Plastering

As for the materials, Portland cement can be used for floors, and silica cement and Portland blast furnace cement can be used for walls. The sand shall be of good quality without containing harmful matter and the grading shall be in accordance with the following table.

For First and Intermediate Coats	Passing 5 mm sieve mesh	100%
	Passing 0.15 mm sieve mesh	less than 10%
For Finish Coat	Passing 2.5 mm sieve mesh	100%
	Passing 0.15 mm sieve mesh	less than 10%

In the case of mortar, the volume ratio between cement and sand shall be as follows:

Backing	Part to be Coated	First Coat	Intermediate Coat	Finish Coat
Concrete	Floor	1:2	1:3	1:2
Concrete Block	Inner Wall	1:2	1:3	1:2

XVIII. PAINTING

1801 Parts to be Painted

All the face sides of wood and iron inside and outside the buildings shall be painted with oil paint. Cement plastered portions shall be painted with vinyl emulsion paint.

1802 Painting Schedule

The painting schedule shall be as shown in the following tables.

a. Alkyd Resin Paint

Ferrous Portions		Wooden Portions	
Painting Schedule	No. of Coats or Cleaning	Painting Schedule	No. of Coats or Cleaning
Repair Coat	1	Surface Preparation	1
Grinding	1	Killing Knot	1
Intermediate Coat	1	First Coat	1
Grinding	1	Putty	1
Finish Coat	2	Grinding	1
		Intermediate Coat	1
		Grinding	1
		Finish Coat	2

b. Vinyl Synthetic Resin Emulsion Paint

Painting Schedule	No. of Coats or Cleaning
Surface Preparation	1
First Coat	1
Putty	1
Grinding	1
Intermediate Coat	1
Finish Coat	2

XIX. ELECTRICITY AND TELEPHONE WORKS

1901 Indoor Work

The works shall include indoor wirings, lighting fixtures, socket outlets, switches, interphones, telephones, etc. As for wireless apparatus, piping only shall be arranged. All the materials used shall be of first class quality.

1902 Outdoor Work

Telephone wirings on the premises and interphone cables shall be buried underground.

XX. WATER SUPPLY, DRAINAGE, SANITARY AND WATER PURIFICATION WORKS

2001 Water Source

Drinking water shall be supplied from a deep well. The water quality shall be inspected, and if necessary, a water-purifier shall be installed. Water shall be supplied to both blocks A and B from a single well through an elevated water tank.

2002 Drainage

The indoor drainage and outdoor drainage shall be provided until they are connected to the drainage canal in the farm.

2003 Appliances

All the appliances shall be of first class quality. All sanitary fixture shall be white in color. All closet bowls shall be provided with plastic seats.

2004 Water-Purifier

It shall be installed in accordance with the standard in the Philippines. A desirable water-purifier shall reduce BOD to less than 30 ppm, of the discharged water with more than 85 % BOD removed.

XXI. OUTWARD APPEARANCE AND LANDSCAPE ARCHITECTURE WORKS

2101 Pavement on the Premises

The office court of the main complex and the terraces and recreational sections of the residentail complex shall have the aggregate exposed finish by washing. Other portions shall be paved with asphalt or concrete.

2102 Landscape Architecture

Around the vestibules of block B, and main complex and the office court are desired to be carefully landscaped. For planting of trees for shade as illustrated in the plan, kinds of trees shall be selected. For landscape architecture designing, a method allowing easy maintenance shall be adopted.

XXII. AIR CONDITIONING WORK

The laboratory, guest house and experts' houses shall have air conditioning system. However, if the budget allows, it is desirable to install air conditioning system also in other facilities.