REPUBLIC OF THE PHILIPPINES

DESIGN REPORT
ON
EXPERIMENTAL FARM
FOR
BOHOL AGRICULTURAL PROMOTION CENTER PROJECT

(B.I.A.D.P.)

APPENDIX

MARCH 1983

JAPAN INTERNATIONAL COOPERATION AGENCY

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FOR
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APPENDIX

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JAPAN INTERNATIONAL COOPERATION AGENCY

APPENDIX

CONTENTS

LIST OF FIGURES AND TABLES

Appendix-1

1. Construction Costs of Buildings, Bilar

Since the Bilar district is more than 40 km away from Dao where Agricultural Promotion Center is proposed, field office, warehouse, and garage will be planned to facilitate the works by the Japanese experts. The following are the dimensions of major facilities:

1) Office and Quarter	52 m^2
2) Warehouse and Garage	60 m^2
3) Counterpart's Quarter	28 m^2
4) Water Supply and Drainage Facilities	1 unit
5) Electric Facilities	1 unit
6) Fence and Gate	1 unit
7) Land Levelling	600 m^2

The construction costs of these are estimated as follows:

Table-1. Construction Cost of Buildings

1. Direct Cost					
	1-1. Preparatory Works				₱ 18,500
	1-2. Office and Quarter				96,100
	1-3. Warehouse and Garage				40,400
	1-4. Counterpart's Quarter				37,100
	1-5. Water Supply and Drainage Facilities				53,500
	1-6. Land Leveling				10,000
	1-7. Fence and gate				8,400
	1-8. Electricity Works				6,000
	Sub-total				270,000
2.	Overhead Cost	(16%)	43,200	(40%)	108,100
3.	Contingency	(10%)	31,300		37,800
4.	Price Escalation(15%)		51,700		62,400
	Sub-total		126,200		208,300
	Total		₱396,200		₱478,300
₱ = ¥25.0			¥9,905,000		¥11,957,000

2. TECHNICAL SPECIFICATIONS FOR BUILDING WORKS

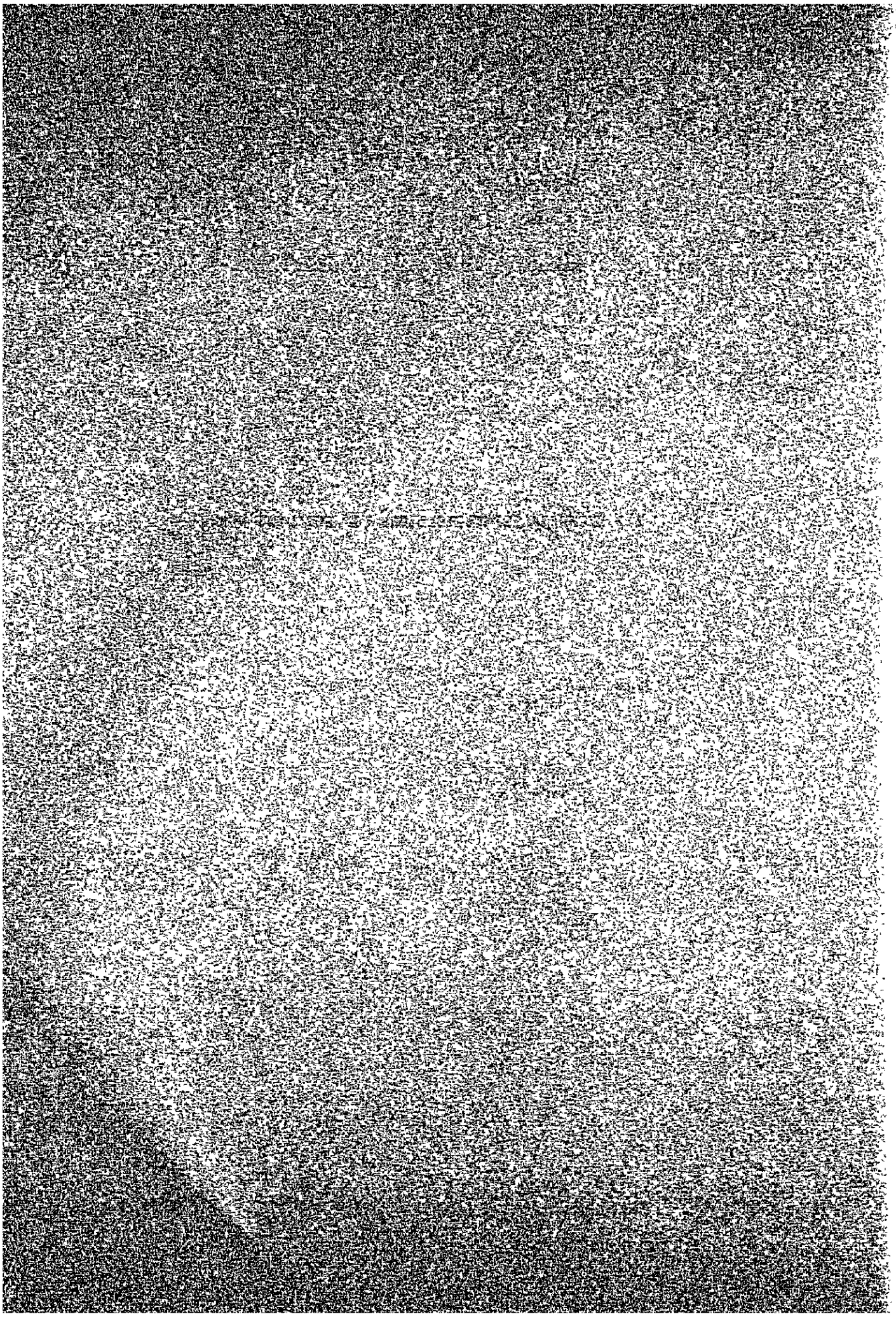


TABLE OF CONTENTS

SECTION I. BUILDING WORKS

101. Materials

All materials used in the building works shall be subject to the Engineer's approval. The Contractor shall submit to the Engineer, samples of the said materials prior to the commencement of relative works for the approval.

102. Earth works

(a) Leveling of grounds

The ground of the buildings shall be levelled before commencement of the works.

(b) Backfill

The portions around the foundations or other portions requiring backfill shall be filled with good materials and sufficiently compacted.

(c) Spoil bank

As a rule, the spoil bank shall be disposed within the site and the surface shall be levelled.

103. Concrete works

(a) Materials

The cement used shall be Portland cement conforming to the standard of ASTM C-150-TYPE I. The coarse aggregate of concrete shall be 25 mm in maximum.

(b) Proportioning and strength

The 28 days age strength of concrete shall be as given in the following table. The proportion of concrete mixes shall be in conformity with the Reinforced Concrete Works Specifications instituted by the Architectural Institute of Japan or with any equivalent standards.

Concrete	Design Strength kg/cm^2	Slump cm	Application
Plain concrete		Proportion 1:3:6	Lean 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

104. Form work

(a) Requirements

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 guaranteed in the finish of the surfaces.

(b) Allowable tolerance

The standard allowable tolerance of forms shall be given as below. The tolerance of sectional dimensions shall be within $\pm$ 2.0 mm in any directions.

Structure	Tolerance of deviation before concrete placing	Tolerance of deviation after concrete placing
Footing Beam	Vertical and Horizontal ± 4 mm	± 6 mm
Wall & Column	± 4 mm	± 6 mm
Beam & Slab	± 3 mm	± 5 mm

105. Reinforcing bars

(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 bars are placed, the rust, dirt, grease or other foreign substances 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 rahmen structures shall be more than 10 times of the steel bar diameter. The radius of 45° bend of the bar shall be more than five times of the diameters of bar.

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

106. Concrete block works

(a) Materials

The concrete blocks shall be in conformity with JIS A 5406 Hollow Concrete Blocks or other equivalent standards. The thickness of concrete blocks for walls shall be 10 cm.

107. Carpentry

(a) Materials

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

(b) Preservative treatment and insecticide treatment

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

Lauan not treated with insecticide shall not be used.

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

(c) Protection

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

(d) 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 drawings.

108. Roofing

(a) Materials

All the roof materials shall be No.26 corrugated galvanized iron sheets. The overlapped portions shall extend more than 1.1/2 crests in crosswise direction and more than 30 cm in lengthwise direction.

109. Tinsmith's works

(a) Eaves gutters and rain leader

The soffit covers of eaves gutters shall be made of 1.6 mm galvanized iron sheet, and the interior gutters shall be of No.26 galvanized iron sheet. The rain leaders shall be made of ϕ3" PVC pipes.

(b) Drip cap

Pent-roof and roof fitting portions shall be covered with No.26 galvanized iron sheet to hold good flashing.

110. Joiner's works

(a) Window

As a rule, windows shall be of glass and aluminium jalousize.

(b) Other openings

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

(c) Doors

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

(d) Fitting and manufacturing

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

(e) Hardwares

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.

Door locks	:	Cylinder locks with master keys Knobs to be made of stainless steel
Door closers	:	With floor hinge stops
Hinges	:	Stainless steel Hinges in office shall be pivot heinges

111. Glazing works

(a) Materials

The sheet glass shall be polished sheet glass.

(b) Fitting materials

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

112. Plastering

(a) 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.

(b) 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 matters 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 mixing ratio of cement and sand in bulk shall be as follows:

Backing	Coating place	First coat	Intermediate coat	Finish coat
Concrete	Floor	1:2	1:3	1:2
Concrete block	Inner wall	1:2	1:3	1:2

113. Painting

(a) General

All the facings of woods and steels in the buildings shall be painted in accordance with the Engineer's instruction. Cement plastered portions shall be painted with vinyl emulsion paint.

(b) Painting schedule

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

Alkyd resin paint

Ferrous portions		Wooden portions	
Painting schedule	No. of coats	Painting schedule	No. of coasts
Unticorrosive coat	1	Surface preparation	1
Intermediate coat	1	First coat	1
Finish coat	2	Intermediate coat	1
		Finish coat	2

Vinyl synthetic resin emulsion paint

Painting schedule	No. of coats
Surface preparation	1
First coat	1
Putty	1
Intermediate coat	1
Finish coat	2

114. Wiring works

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

115. Water supply, drainage, sanitary and water purification works

(a) Water supply

Drinking water shall be supplied from the well. The water quality shall be inspected, and if necessary, a water-purifier shall be installed.

(b) Drainage

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

(c) Sanitary appliances

All appliances shall be of first class quality. All sanitary fixture shall be white in color. The closet bowl shall be provided with plastic seat.

(d) Water-purifier

The water-purifier shall be installed in accordance with the standard in the Philippines. A water-purifier shall reduce BOD to the level less than 30 ppm, and the more than 85 percent of BOD shall be removed from the discharged water.

SECTION II. ELECTRICAL WORKS

201. Regulations and standards

The complete electrical works shall be carried out as per the Specifications and complying with Electric Power Act and other related Rules and Standards of the Republic of the Philippines and/or current Japanese Electrical Standards and Codes of Practices.

202. Materials

All materials used in the Project shall comply with the appropriate Standard Specification in the Philippines or Japan where such applies.

203. Power supply and incoming switch box

Power shall be taken from sources of 60 cycles, 220 volts, three phase system of public line. The connecting point of public line and the Project will be directed by the Engineer at the Site. An incoming switch box with watt-hour meter shall be installed at the connecting point.

204. Power control panel

A power control panel shall be designed and manufactured by the Contractor in accordance with following conditions.

205. Lighting fixtures

Lighting fixtures shall be of the high power factor rapid start type with ballast, porcelained base, housing assembly and

secured lamp holders. Lighting fixtures shall be included lamps and cords.

The exact locations and height of fixtures shall be determined by the structural and mechanical limitations of the building, and fixtures shall be installed in such manner as to avoid obstructions.

206. Inspection and test

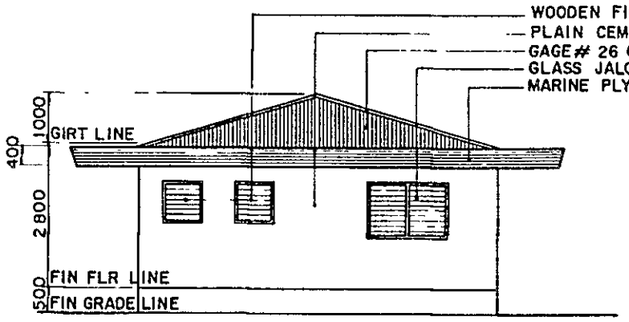
When all works are completed, the Contractor shall test the electrical installations for ground and/or short circuits in the presence of the Engineer, or his authorized representative.

LIST OF DRAWINGS (BUILDINGS)

(BILAR)

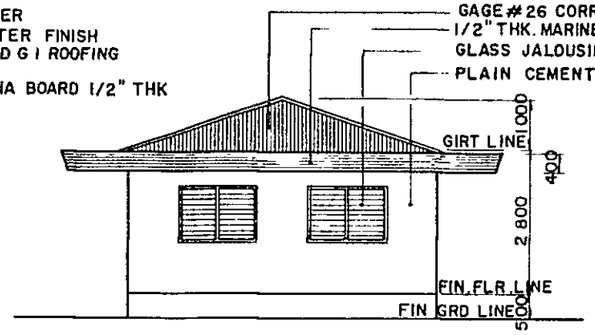
DWG. NO.	TITLE
B - 1 - 2	OFFICE (1/2 - 2/2)
B - 3	WAREHOUSE & GARAGE
B - 4	ACCESSORY OF BUILDING

(4)



REAR ELEVATION

SCALE 1 80



LEFT SIDE ELEVATION

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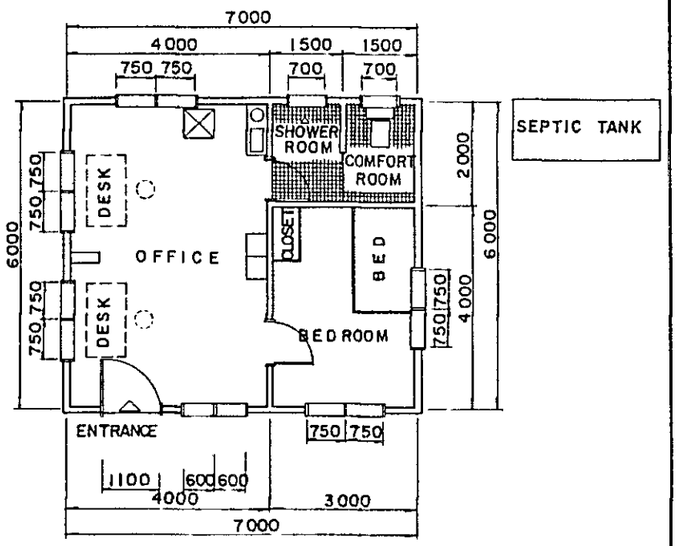
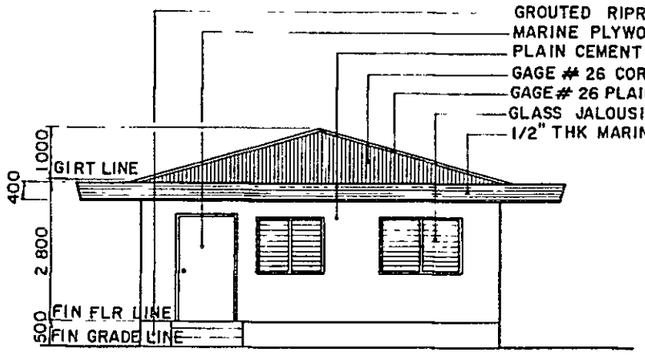


FLOOR PLAN

SCALE 1 80



FRONT ELEVATION

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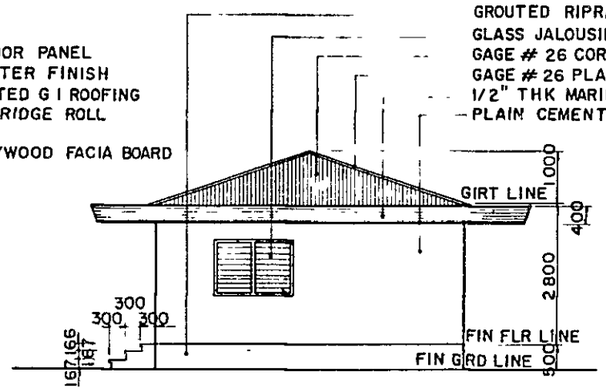

RIGHT SIDE ELEVATION

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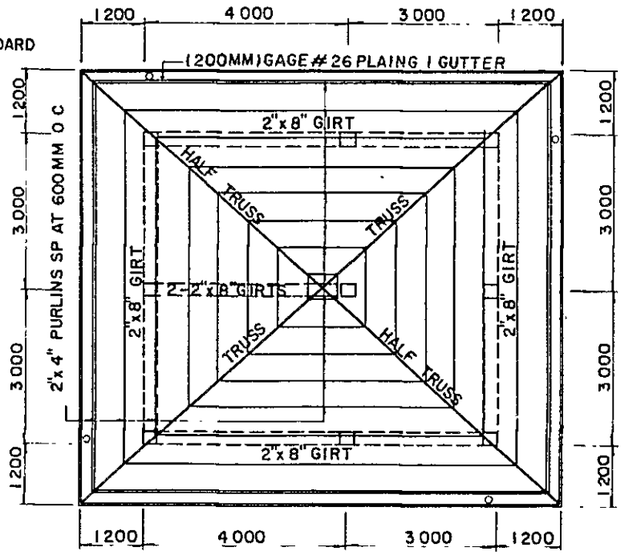

ROOF FRAMING PLAN

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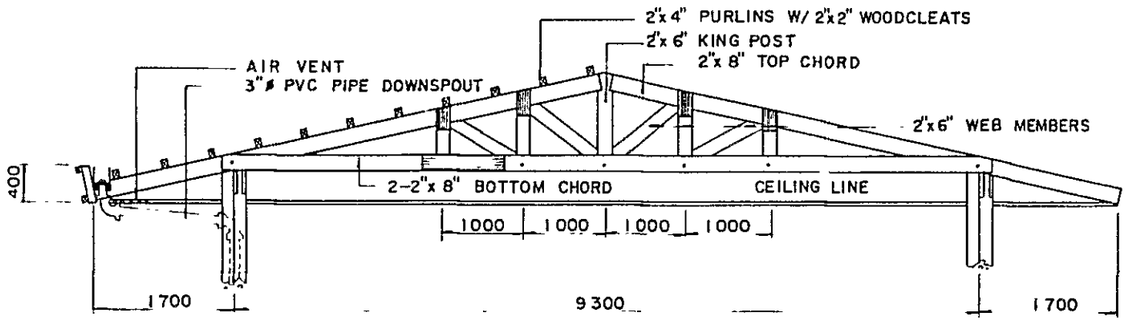


TRUSS DETAIL

SCALE 1 50

NOTES

ALL DIMENSIONS ARE GIVEN IN MILLIMETERS EXCEPT OTHERWISE SHOWN

0 05 1 2 3 4 5 M

SCALE 1 50

0 05 1 2 3 4 5 6 7 8 M

SCALE 1 80

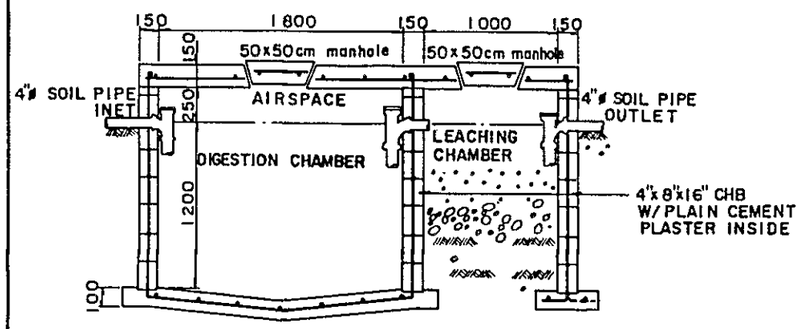
AGRICULTURAL PROMOTION CENTER PROJECT (A P C)

OFFICE (1/2)

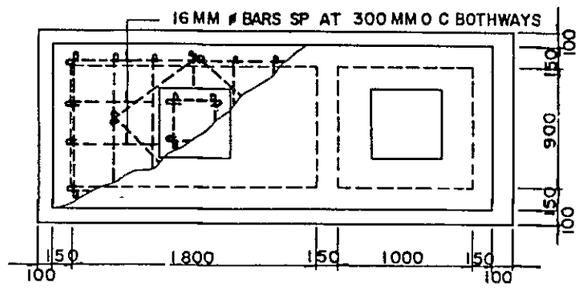
BILAR

DRAWING NO B - 1 | SCALE

JAPAN INTERNATIONAL COOPERATION AGENCY



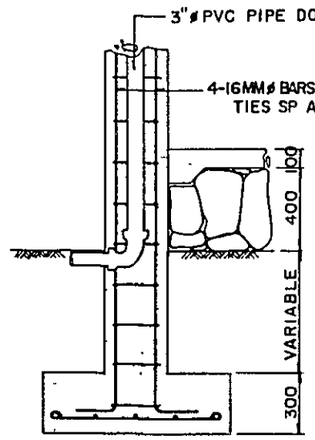
LONGITUDINAL SECTION



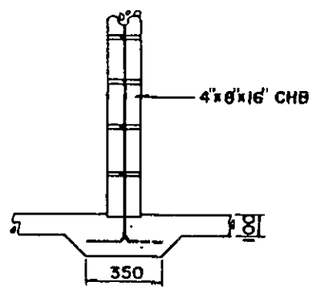
PLAN

SEPTIC TANK DETAIL

SCALE 1 30



SECTION



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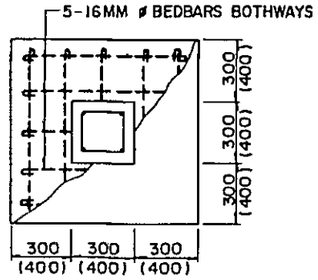

PLAN

F-1 COLUMN & FOOTING DETAIL

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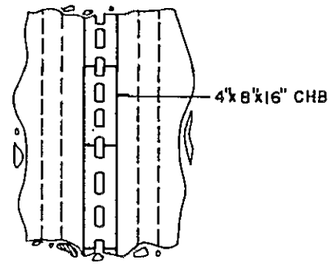

PLAN

WALL FOOTING DETAIL

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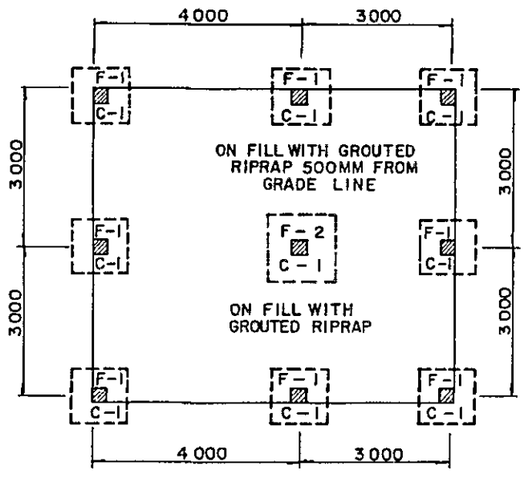


FOUNDATION PLAN

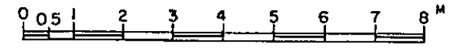
SCALE 1 80

NOTES

1 ALL DIMENSIONS ARE GIVEN IN MILLIMETERS EXCEPT OTHERWISE SHOWN.

2 DIMENSION IN ( ) IS SHOWN FOR F-2 FOOTING

SCALE 1 20



SCALE 1 80

AGRICULTURAL PROMOTION CENTER PROJECT (A P C)

OFFICE (2/2)

BILAR

DRAWING NO. B-2 | SCALE

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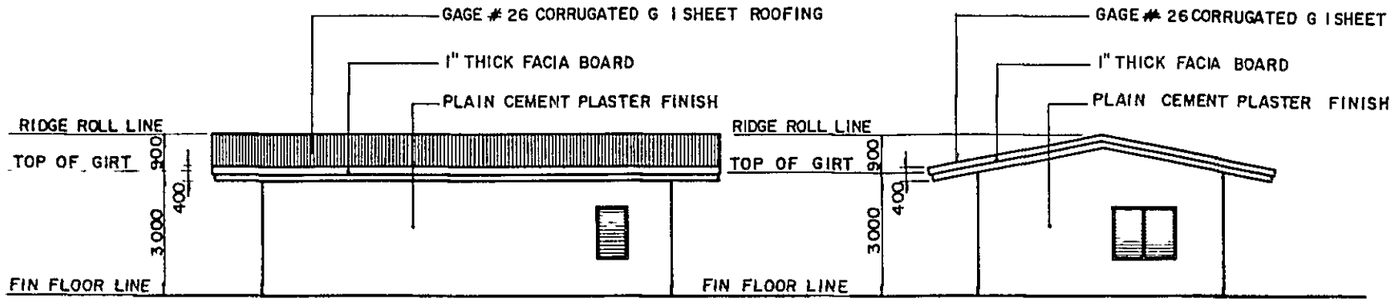
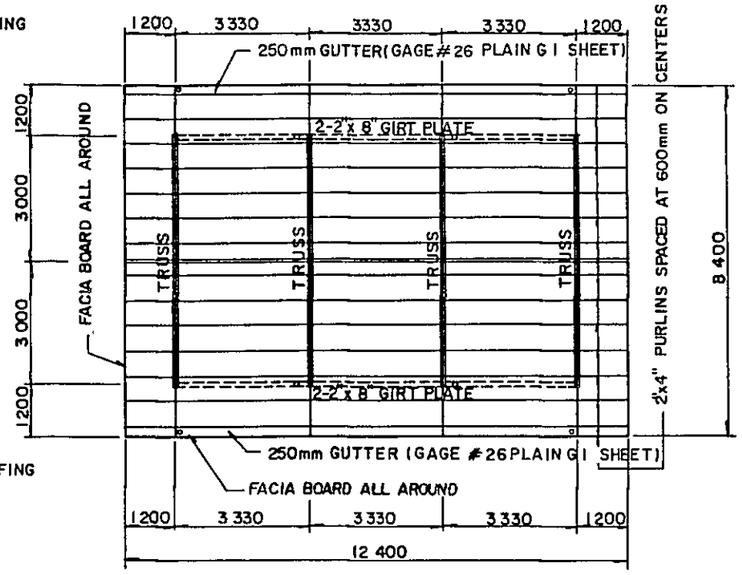
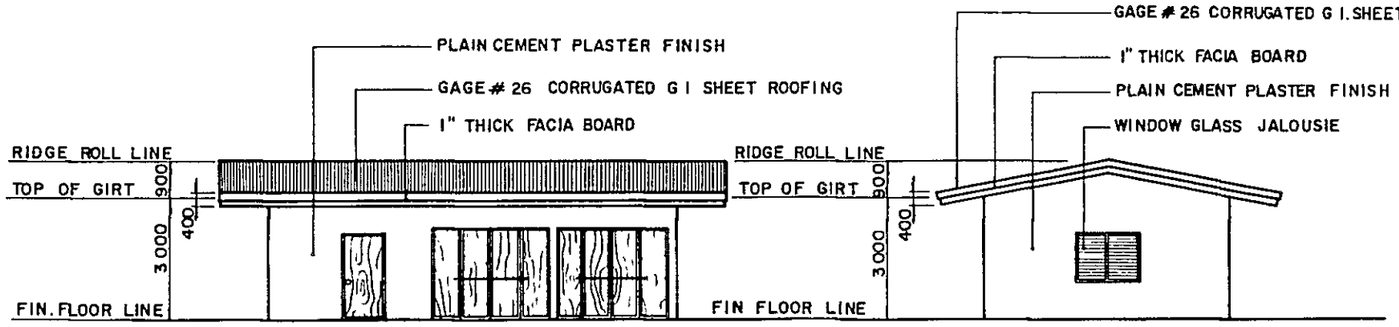


REAR ELEVATION
SCALE 1 100

LEFT SIDE ELEVATION
SCALE 1 100

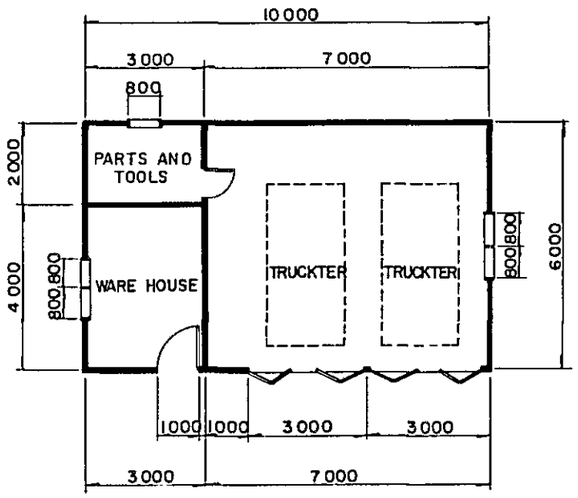


ROOF FRAMING PLAN
SCALE 1 100

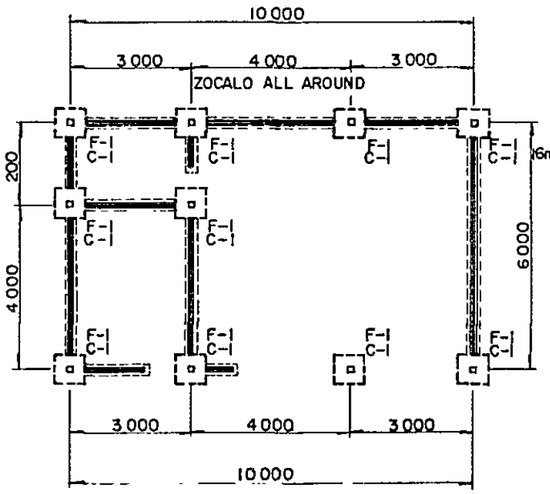


FRONT ELEVATION
SCALE 1:100

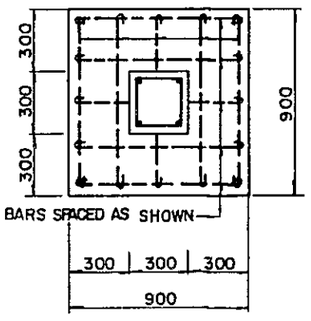
RIGHT SIDE ELEVATION
SCALE 1:100



FLOOR PLAN
SCALE 1:100



FOUNDATION PLAN
SCALE 1 100



PLAN

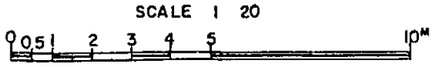
SECTION

FOOTING DETAIL
SCALE 1 20

NOTES

1 ALL DIMENSIONS ARE GIVEN IN MILLIMETERS EXCEPT OTHERWISE SHOWN

SCALE 1 20



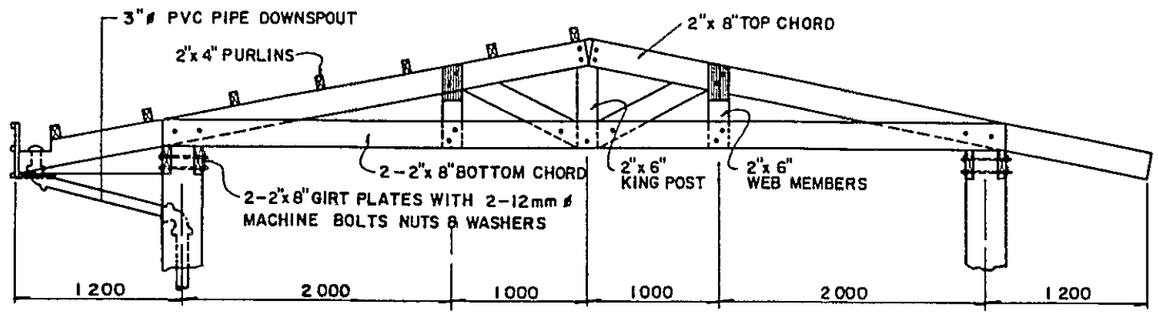
SCALE 1/100

AGRICULTURAL PROMOTION CENTER PROJECT
(A P C)

WAREHOUSE & GARAGE
BILAR

DRAWING NO B - 3	SCALE

JAPAN INTERNATIONAL COOPERATION AGENCY



TRUSS DETAIL

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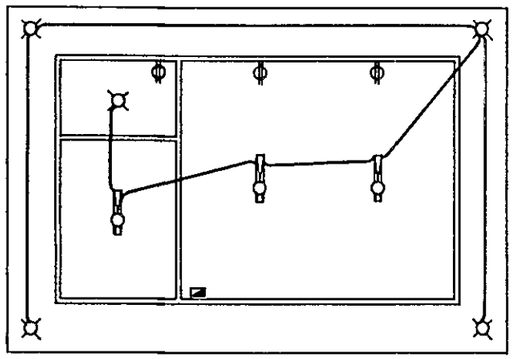


ELECTRICAL WIRING LAYOUT DIAGRAM

SCALE 1 100

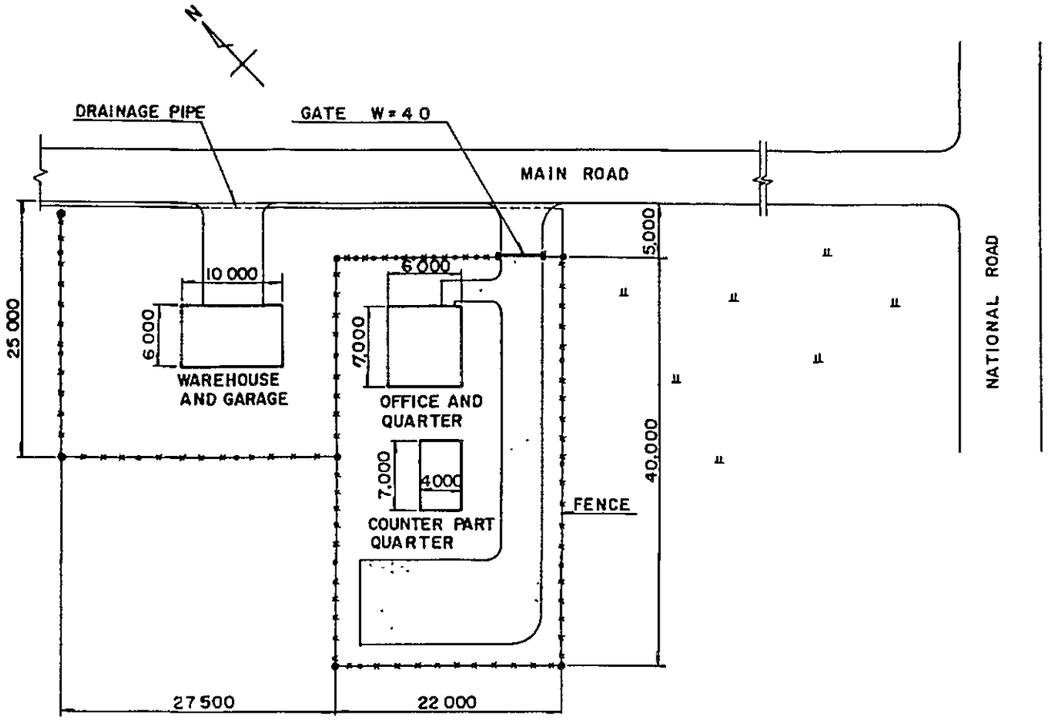
NOTES

1 THE CONNTER PART QUARTER IS PREFABRICATED HOUSE WHICH IS PROVIDED WITH A SHOWER ROOM , A COMFORT ROOM AND A BEDROOM

2 ALL DIMENSIONS ARE GIVEN IN MILLIMETERS EXCEPT OTHERWISE SHOWN

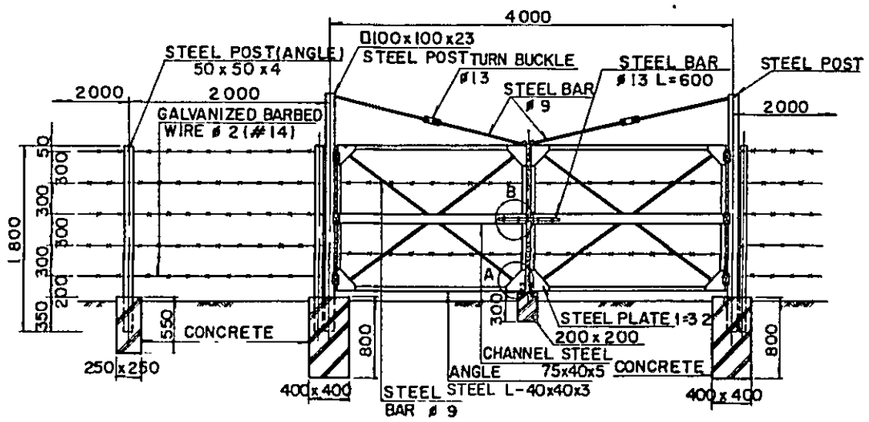
SCALE 1 30

SCALE 1 40



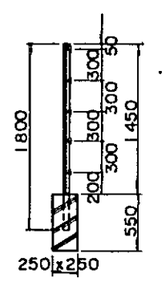
LOCATION MAP OF BUILDING

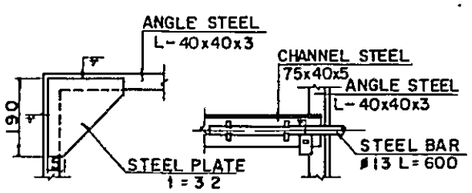
SCALE 1 40



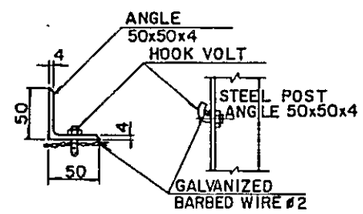
GATE AND FENCE

SCALE 1 20



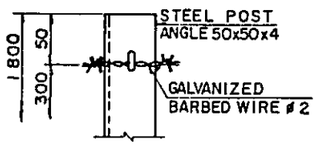


FENCE SCALE 1 20 DETAIL-A SCALE 1 5 DETAIL-B SCALE 1 5



DETAIL OF CONNECTION

SCALE 1 2



DETAIL OF CONNECTION

SCALE 1 2

AGRICULTURAL PROMOTION CENTER PROJECT (A P C)

ACCESSORY OF BUILDING

BILAR

DRAWING NO B - 4 | SCALE

JAPAN INTERNATIONAL COOPERATION AGENCY

Appendix-2

Survey Report on Groundwater
Bohol Agricultural Promotion Center Project
June 1982

1. Outline of the Survey

1-1. Objective

Through the pumping-out test at the production well of MPWH (Ministry of Public Works and Highway) located on the proposed site of Agricultural Promotion Center, Bohol, to verify the constant of the related acquifer, to determine an appropriate Pumpage, to roughly compute the radius of cone of influence by pumping-up of groundwater at the said production well, and to study the groundwater quality.

1-2. Survey Period

May 7th to June 5th, 1982

1-3. Location

Barangay Dao, Tagbilaran Municipality, Bohol Province, the Republic of the Philippines

1-4. Major Survey Items

1) Pumping-out tests and the data analyses
2) Water quality tests and studies
3) Preliminary survey on the existing water use at the experimental farm, Bohol Agricultural College, Bohol

2. Survey Schedule

May 7th	Tokyo - Manila
8th - 9th	Manila
10th	Manila - Tagbilaran(Bohol)
11th - 27th	Tagbilaran
28th	Tagbilaran - Manila
29th - June 4th	Manila
June 5th	Manila - Tokyo

3. Topography and Geological Conditions

The oval-shaped Bohol Island is about 77 km long from east to west and 55 km wide from north to south and is the tenth largest island in the Republic. The area totals about 4,100 km^2 and the population is about 800,000.

Municipality of Tagbilaran in Bohol Province is located in the southwestern most of the island and the southwestern part of the island is of the karstic topography and presents an extremely complicated topography peculiar to this type of topography.

The proposed site of 5 ha is 2.0 km north of the Municipality and situated on a relatively flat plateau of the ground elevation of 40 m. The difference of the ground elevation in the site ranges from 3 to 4 m and displays a flat topography without irregularity.

The geology in the neighborhood of the Municipality consist of Maribojoc Limestone of Tertiary Pliocene to Quaternary Diluvium as well as Sedimentary(Carmen Formation) of the middle to upper period of Tertiary Pliocene.

Maribojoc Limestone comprises tufa without fossils and it is very slightly stratified or has no stratification at all. This Limestone is of soft or marl nature and is not tightly layered.

Carmen Formations appear the base rock of the area and generally consist of shale, sandstone, plank or clastic limestones, conglomerate, siltstone, mudstone, and marlstone. In general, these formations incline very gently and are considered to have a characteristic of tuff.

4. Survey Results

4-1. Results of Pumping-out Test

4-1-1. Test Method

A casing pipe of five inches(125 mm) in diameter has been placed in the MPWH production well of six inches in diameter. However, the space between the outer surface of casing pipe and the well wall was not filled with sand and gravel, nor provided with grouting as of May 10, 1982. This required several days of filling and grouting for the completion of well. Soon after such works have been undertaken, the installation of a test pump was started. However, it took more than three days to complete the installation since no crane was available and instead a three-ton chain block had to be mobilized for the purpose.

On May 19, 1982, the first cleaning of the production well was conducted for 5.5 hours, but the recovery of groundwater table was abnormally late due probably to the insufficient number of cleaning hours. On May 21, 1982, therefore, consecutive pumping was made for 24 hours from 8:36 am, resulting in a smooth recovery of the table.

Consequently, step drawdown test and acquifer test were administered on May 24 and 26, 1982, respectively. The step drawdown test was conducted for five different pump discharges in four hours and in the acquifer test, consecutive observation was made for five hours. The measurement of recovery of the groundwater table was recorded for respective tests after the pumping was stopped.

4-1-2. Results of Step Drawdown Test

The sw-t curve in Figure 3 indicates the relationship between the drawdown(sw) and the time elapsed in pump operation for each pump discharge. Figure 4 shows the relationship between the amount of pumpage and the drawdown. Figure 4 gives no critical quantity of pumpage that causes a sudden sharp drawdown since the drawdown had to be kept within about 3.50 m(pumped-up water 160 m^3/day) for the following reasons:

° The pump has a maximum capacity of 50 GMP(0.19 m^3/min = 270 m^3/day)

° It was difficult to insert a water gauge into a space of 0.5 inches made between the inner wall of the casing pipe(inner diameter:5 inches) and the pump bowl(diameter: 4.5 inches)

Figure 5 illustrates the analysis of acquifer and well losses and the following formula shows the relationship between a surface drawdown(sw) and an amount of pumpage(Q):

$$sw = 5.3\ Q + 203\ Q^2$$

Assuming Q = 160m^3/day(0.111m^3/min),

Acquifer loss(BQ) = 0.60 m
Well loss(CQ^2) = 2.50 m
Drawdown(sw) = 3.10 m

Assuming Q = 200m^3/day(0.139m^3/min),

Acquifer loss(BQ) = 0.74 m
Well loss(CQ^2) = 3.92 m
Drawdown(sw) = 4.66 m

The well efficiency and the specific capacity in these cases are as follows:

	Case of $160m^3$/day	Case of $200m^3$/day
Well efficiency(BQ/sw)	19%	16%
Specific Capacity(Sc=Q/sw)	$51m^3$/day/m	$43m^3$/day/m

The above results indicate the well loss is high and the well efficiency is extremely low. This is due to the small density of drilled holes on the well screen which prevents the intrusion of groundwater from the acquifer. The density of drilled holes of this well is only 4 percent of the length of screen inserted and 1.7 percent of depth between the well bottom and the groundwater table.

In general, the specific capacity tends to become smaller as the drawdown increases. This well presents the similar tendency as illustrated below. Since the well loss accounts for a large portion of the drawdown, a well screen of better quality would have given a larger specific capacity. The limited density of drilled holes on the well screen has an adverse effect on the specific capacity.

Drawdown step	Pumpage (Q)	Drawdown (sw)	Specific capacity (Sc = Q/sw)
1	102 m^3/day	1.36	75 m^3/day/m
2	107	1.56	69
3	135	2.23	61
4	145	2.68	54
5	163	3.13	52

4-1-3. Results of Acquifer Test

Results of acquifer test are analyzed in Figure 6 using Theis's standard curve method. Analysis gives acquifer constants,i.e., transmissibility coefficient(T) and storage coefficient(S) to be as follows:

$$T = 4.84 \times 10^{-2}, \quad S = 2.40 \times 10^{-4}$$

The value of S for this well is considerably smaller than that of nonartesian acquifer which generally ranges from 0.01 to 0.35 whereas the value of T is reasonable for the type of limestone in the district. As mentioned in 4-1-2, in view of the extremely low well efficiency of 20 percent and also the sudden increase in a short period of the groundwater table after stopping the pumping, the above T and S are interpreted to have been influenced by the drag of screen section of the well.

Cone of influence(R) is generally known to have a positive relationship in qualitative terms with the drawdown, pumpage, pumpage time, and permiability coefficient, however, no explicit relationship has been recognized. Assuming that a site where the drawdown is less than 0.001 m is outside the cone of influence and using Theis's well theory, the substitution of the above T and S, 10 hours of pumpage time, and 110 lit/min of pumpage gives R = 1,500 m.

However, since the above T and S are not likely to be the right constants for the acquifer in the district, especially S will assume a much larger value, R is presumed to be the most commonly accepted value of 500 - 1,000 m.

4-1-4. Influence by Tide

The groundwater table of the well did not reveal any change and remained stable during the observation made twice a day(morning and

evening) for ten consecutive days before the pumping-out test was conducted. This may be interpreted that the table had not been influenced by the tidal change or the pumping of other wells in the neighborhood. The groundwater table of this well is recorded as GL.-39.45 m.

4-2. Results of Water Quality Test

4-2-1. Quality Analysis Test

Quality analysis test of the water for irrigation had been conducted by Bureau of Soil, MOA in Cebu city and the results were obtained through Provincial Development Staff of Tagbilaran. Table-2 presents the results of analysis. No abnormal characteristics has been recognized and the groundwater is judged to be a useful water resource as irrigation water. The results of analysis are shwon in Table-2.

The groundwater has been sampled during the pumping-out test and sent in plastic containers to the said Bureau for quality analysis test of the water as drinking water. Detailed analysis is yet to come, however, judging from the observation of the samples, the groundwater, being colorless and transparent without any particular taste or smell, appears to have no particular deficiency.

4-2-2. Results of Electric Conductivity Test

Water quality test by electric conductivity gauge gives in Table-1 different conductivities for different wells. For the pump stations 2,3, and 4 at the city's water source, the conductivity of 1,000 - 2,000μ℧/cm is two to four times higher than that of other pump stations. Water at wells 5,6, and 7 gave similar conductivity as the production well of MPWH. The water in the Loboc river was also tested and it was found that the river can be divided, in terms of the conductivity, into the upper and lower streams at the

hydropower plant. The upper stream showed a low conductivity of 400 μ℧ /cm whereas the lower stream an extremely high value of 50,000 μ℧ /cm.
This high value is attributable to the excessive sea water intrusion. Incidentally, the hydropower plant is located 30 km from Municipality of Tagbilaran.

4-3. Water Use at Experimental Farm of Bohol Agricultural College

Since Agricultural Promotion Center is proposed to use a part of the experimental farm of Bohol Agricultural College, the water use at the experimental farm has been surveyed. Bohol Agricultural College is located in Bilar district which is 40 km northeast of Municipality of Tagbilaran. The district has developed as an agricultural area in a valley surrounded by hillsides made of limestones. Small streams originating from the surrounding hillsides secure the irrigation water supply in the district. The earth canal without any lining meanders through the lower part of the district from east to west and runs the central part of experimental farm with a discharge of about 30,000 m^3/day and a high water quality of 275 μ℧/cm.

The College has an experimental paddy farm of 5 ha to the south of the College buildings and the farm is circumferenced by a road on the east side and hillsides on the south and west sides.

5. Conclusions

5-1. Construction of New Production Well

As mentioned in section 4-1, the pumping-out test did not seem to correctly identify the characteristics of the district's acquifer due to the deficiency of the well screen. Critical pumpage has not been measured either because of the limited capacity of the pump. This necessitates the construction of new production well with a

high quality screen. For the technical specifications of the new well, refer to Survey Report on Preliminary Design of Agricultural Promotion Complex in Bohol, Philippines submitted in September, 1981. The construction costs are estimated by the Ministry of Public Works and Highway(Bohol) as follows:

Materials	₱ 44,000.-	(without screen)
Labor cost	12,000.-	
Transportation	1,000.-	
Rent for machinery	14,000.-	
Miscellaneous	4,000.-	
Overhead cost	5,000.-	
Pumping-out test	5,000.-	
Sub-total	₱ 85,000.-	¥2,520,000.-
Johnson Screen(10 m) (Japan's market price)		¥ 300,000.-
Grand Total		¥ 2,820,000.-

No technical assistance is required during the construction period, but the groundwater experts have to be dispatched for electrical logging, casing planning, pumping-out test, etc. The pump to be mobilized must have a capacity of pump head of 60 m, pumpage of 500 lit/min, and diameter of 4 inches.

5-2. Usable Pumpage

The pumping-out test did not allow any quantitative estimate of usable pumpage, however, it would be probably 150 to 200 m^3/day. Assuming water requirement in depth to be 10 mm/day, the duty of water for a paddy field of 1 ha will be 100 m^3 /day, which implies that a paddy field of 2 ha will be irrigated with a pumpage of 200 m^3/day.

5-3. Cone of Influence of the Production Well of Bohol Agricultural Promotion Center

The constants of groundwater acquifer at the proposed site of Agricultural Promotion Center, as analyzed in the previous section, are not good estimates due to the limited density of drilled holes on the well screen installed. For the estimation of radius(R) of the cone of influence where a pumpage is 70 m^3/8 hrs, however, since there's no alternative but to use these estimates of constant, R is likely to be considerably large:

$$R = (4\ T\ t\ u/S)^{1/2}$$

$$W(u) = T\ s/0.0796Q$$

where $Q = 70m^3/8hrs = 0.146m^3/min$

$T = 4.84 \times 10^{-2}(m^2/min)$ Results of pumping-out test

$S = 2.40 \times 10^{-4}$

u : W(u) is read from the well relationship table

t = 8hrs = 480 min

s = 0.1(m)

Therefore, substituting $W(u) = 0.146$ gives $u = 6.4 \times 10^{-1}$ and

$$R = (4 \times 4.84 \times 10^{-2} \times 480 \times 6.4 \times 10^{-1}/2.4 \times 10^{-4})^{1/2}$$
$$= 247{,}808^{1/2} \fallingdotseq 500\ (m)$$

As noted previously, the following are proposed to be taken into account in the future:

1. Excavation of new production well(with a high quality screen)
2. Electrical logging(determination of acquifer depth)
3. Acquifer test(step drawdown and pumping-out) and analysis
4. Examination of the radius of cone of influence based on the above analysis
5. Dispatch of groundwater experts

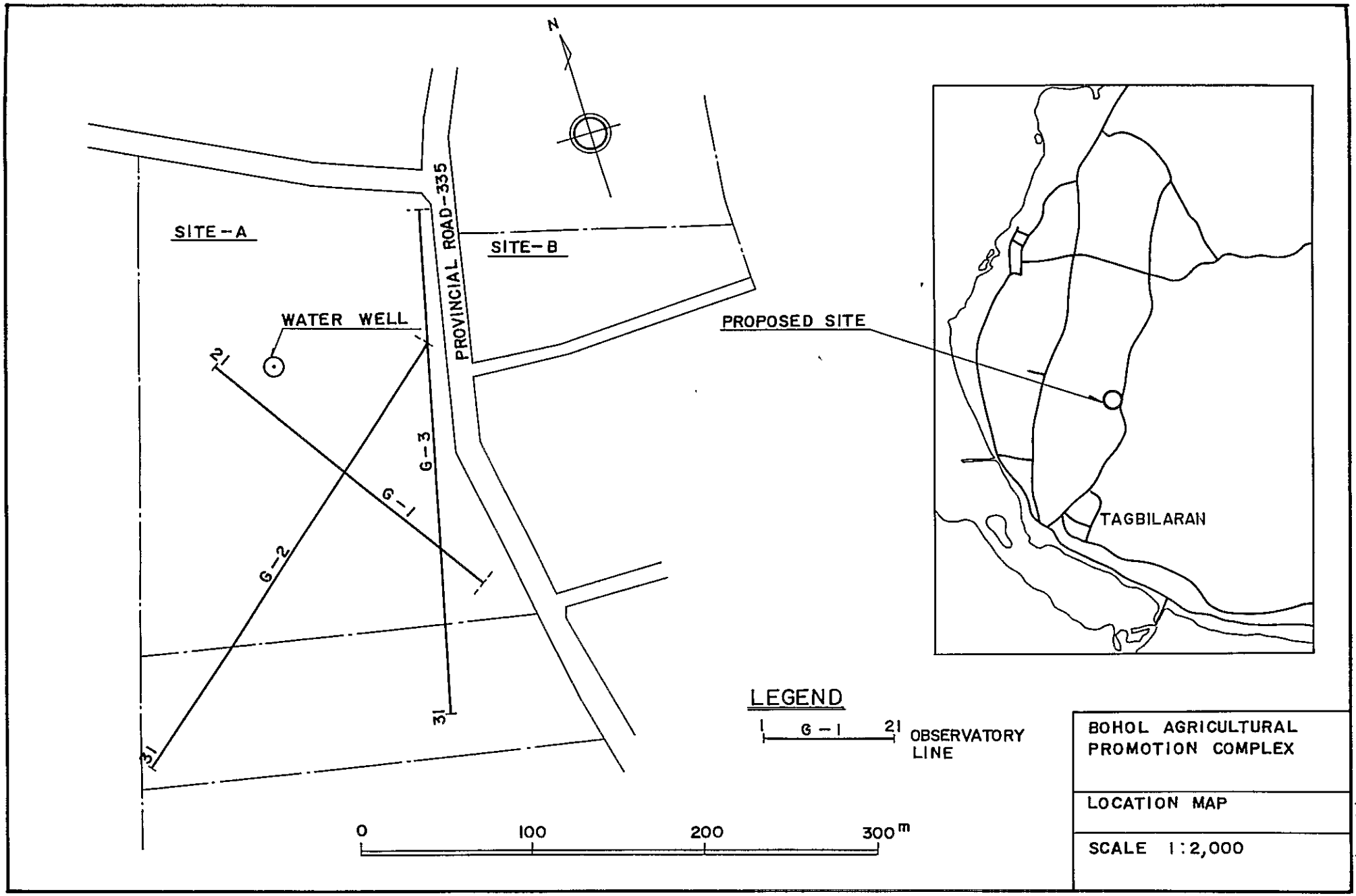
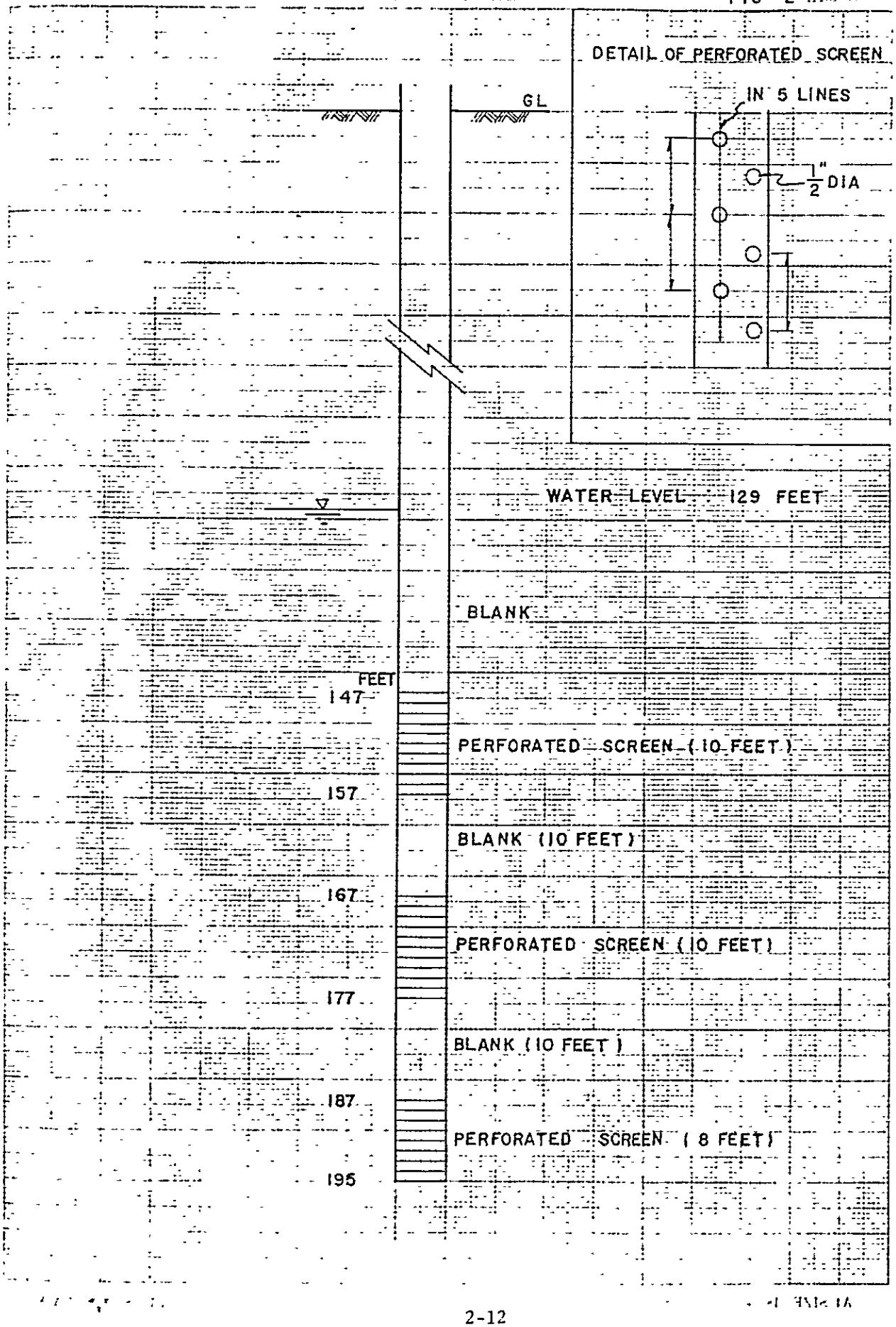

N
SITE-A
SITE-B
PROVINCIAL ROAD-335
WATER WELL
PROPOSED SITE
TAGBILARAN
G-1
G-2
G-3
1
21
31
31
LEGEND
1 G-1 21 OBSERVATORY LINE
0 100 200 300 m
BOHOL AGRICULTURAL PROMOTION COMPLEX
LOCATION MAP
SCALE 1:2,000

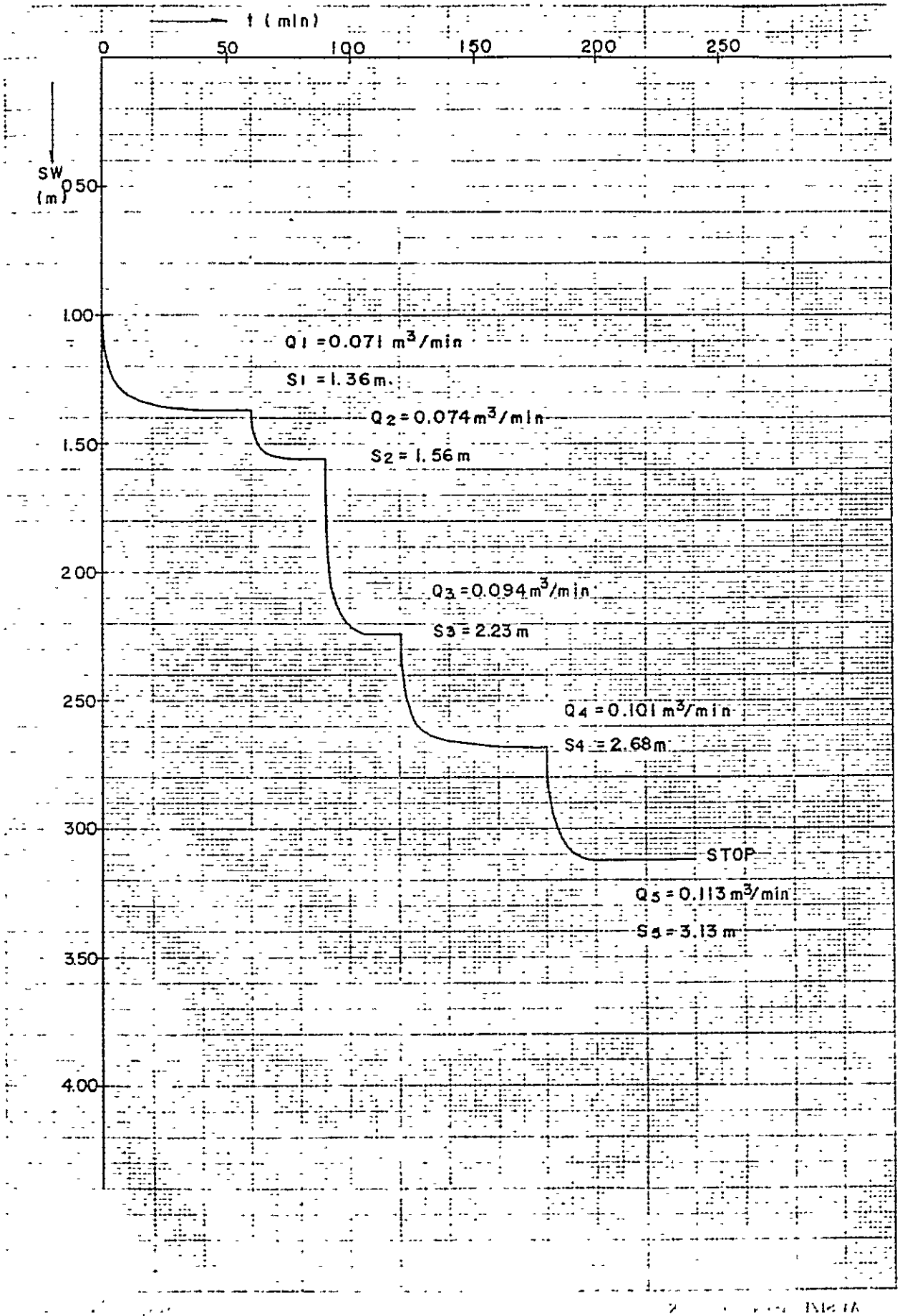
FIG-1

WELL STRUCTURE

FIG - 2

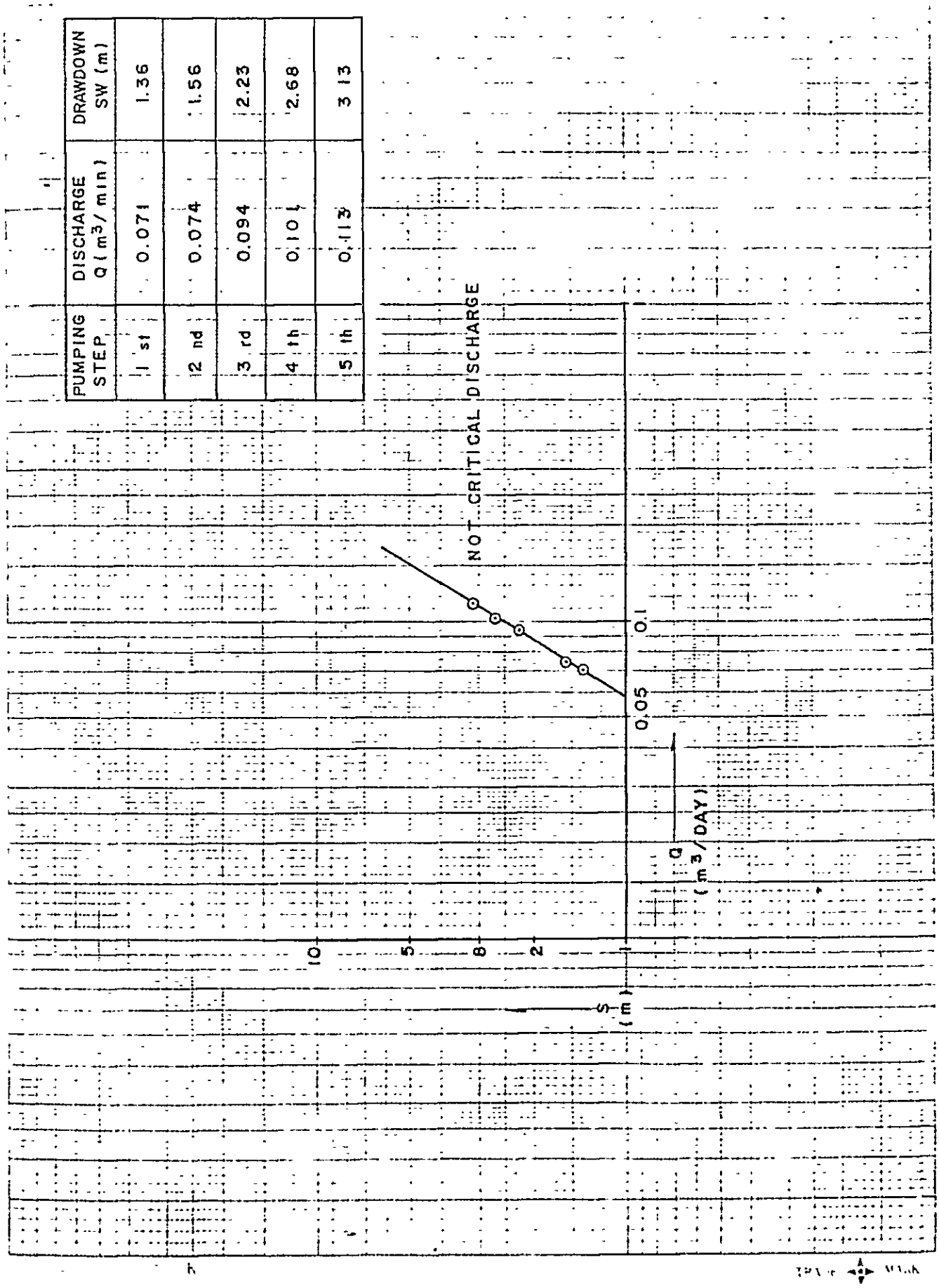


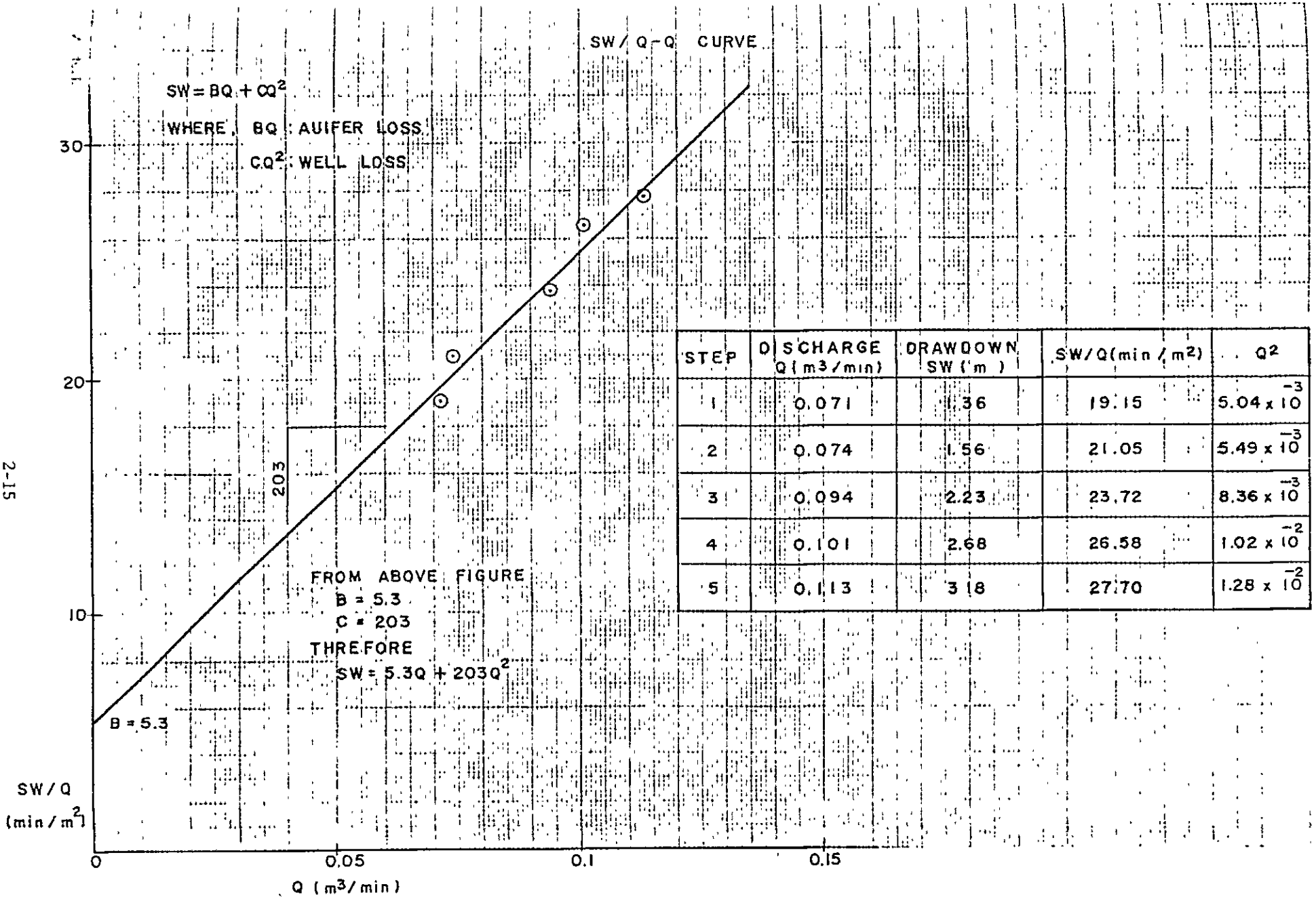
SW — t CURVE ON STEP DRAWDOWN TEST FIG. 3



Q — SW CURVE ON STEP DRAWDOWN TEST FIG — 4

PUMPING STEP	DISCHARGE Q (m^3/min)	DRAWDOWN SW (m)
1 st	0.071	1.36
2 nd	0.074	1.56
3 rd	0.094	2.23
4 th	0.104	2.68
5 th	0.113	3.13





STEP	DISCHARGE Q (m³/min)	DRAWDOWN SW (m)	SW/Q (min/m²)	Q²
1	0.071	1.36	19.15	5.04×10^{-3}
2	0.074	1.56	21.05	5.49×10^{-3}
3	0.094	2.23	23.72	8.36×10^{-3}
4	0.101	2.68	26.58	1.02×10^{-2}
5	0.113	3.18	27.70	1.28×10^{-2}

FIG-5

FIG - 6

s (m)
10.0
5.0
4.0
3.0
2.0
1.0
0.1
0.01
0.001
1/t (min⁻¹)
s - 1/t CURVE ON Q = 0.113 m³/min
MATCH POINT OF s - 1/t CURVE AND u - W(u) CURVE
AT THE MATCH POINT
W(u) = 14.2
u = 1 x 10⁻⁶
1/t = 0.20
s = 2.60
THE THEIS FORMULA
T = 0.0769W(u)Q / s
S = 4TU / r²/t
WHEN
T : TRANSMISSIBILITY
S : COEFFICIENT OF STORAGE
THEREFORE IF r = 0.0635 (m)
T = 4.84 x 10⁻²
S = 2.40 x 10⁻⁴

Table-1. Conductivity of Water Wells

Location	Temperature (C°)	Conductivity (/cm)	Note
APC - 1	28.0	650	A.P.C. Project area
W - 1	-	-	Abandoned
2	27.8	2,130	
3	28.2	1,670	
4	27.8	1,010	
5	29.0	640	
6	-	-	Abandoned
7	28.0	625	
8	-	-	Not operated
9	28.2	635	
10	-	-	Engine trouble
11	-	-	Under construction
Power Station	27.5	415	Loboc river
Loboc Town	27.2	50,000	Loboc river
Bilar Town	28.4	275	Canal

Table-2. Water Analysis Data

Republic of the Philippines
Ministry of Agriculture
Bureau of Soils
Cebu City

Date submitted
3/12/82
Date finished
4/28/82

Mauro de la Cruz
MOA - Soils Div., Bohol

Lab. No.	855
Field No./Source	
Determinations	
pH	7.4
E.C. mmhos/cm	0.261×10^3
Total Soluble Salts	
Na ppm	4.4
K ppm	0.7
Ca ppm	18.88
Mg ppm	1.26
Sum of Cations	0.73
Boron ppm	T
CO_3 ppm	86.65
HCO_3 ppm	212.46
SO_4 ppm	T
Cl ppm	6.20
Sum of Anions	
Exch. of Na %	0.21
SAR	6.11
Res. Na_2CO_3	

Analyzed by:

Sr. Soil Technologist

Submitted by :

Supv. Soil Technologist

JICA