LAMPUNG AGRICULTURAL DEVELOPMENT PROJECT IN LAMPUNG INDONESIA

DESIGN REPORT

FEBRUARY 1973

OVERSEAS TECHNICAL COOPERATION AGENCY
JAPAN

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Preface

The Overseas Technical Cooperation Agency, being entrusted by the Government of Japan, sent a Survey Team (the third Survey Team) for the detail design of Lampung Agriculture Development headed by Mr. Motoo Tanaka, Directer General of Extension Department, Agricultural Administration Bureau, Ministry of Agriculture and Forestry for a period of 45 days from September 1, 1972.

The current detail design survey, basing on the Record of Discussion signed April 1972 between the head of the second survey team which was dispatched March 1972 and the Indonesian authority concerned, is aimed at executing the detail design on the equipments for the agricultural extention center and the land improvement works in the center which form parts of Lampung agriculture development project as well as on the land consolidation for the large and small demonstration farm.

The report, now ready for presentation, is summarized as to the result and findings of the detail design and of the survey. I sincerely extend my gratitude to the efforts exerted by the members of the team, which enabled the survey successful, and am convinced that the guideline for the promotion of Lampung Agriculture Development Project is given by the report.

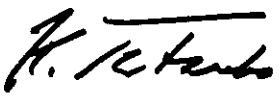
As is well-known, the Government of the Republic of Indonesia decided to explore such remote areas as Sumatra, Karimamtan and Sulawesi in order to cope with the high population density in the Java island. The Lampung province located at the south tip of the Sumatra island receives the tip priority of the development due to the facts that it is included in Jakarta economic zone and that it has vast uncultivated land. The province is also favored with the advantageous conditions for various plants growing and for the agriucltural development such as topography and soil.

The Government of Japan, in view of the above mentioned situation in Indonesia and in Lampung, decided to render an aid to the wide-range Lampung Agriculture Development Project. We will not hesitate to overcome the difficulties which are supposed to emerge with the increasingly big project, by means of treating them as the problems attached to the project aid.

The Japanese, both official and private, are deeply interested in this project with much expectation for the development. I wish the further support extended by those authorities concerned to this project.

Lastly I take this opportunity to express my heart felt thanks to Directorate General of Agriculture, Ministry of Agriculture and the Agriculture Extension Bureau, Lampung Provinse, offices concerned in Indonesia

December 1972



Keiichi Tatsuke
Director General
Overseas Technical Cooperation Agency

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CHAPTER 1 INTRODUCTION

1-1 Historical Background

1. The agricultural development of middle Lampung and its consecutive project have been adopted in the negotiation between the Government of Indonesia and the Government of Japan in June, 1971 from the necessity of improving the outer islands and the establishment of a food supply base for the counterplan of improvement of the Indonesia economy as a result of the increasing population of Java Island.

2. The foundation survey was executed by the 1st Survey Mission in August, 1972 to accept the above requirement for studying the basic concept of the cooperation of agricultural development at Lampung area. It being found that this area is favoured with natural conditions and suitable as the area for comprehensive cooperation which has the greatest feasibility of development, after discussion with all authorities concerned, the following plan has been proposed.

a. Agricultural Development Center

This center will be the base for developing agriculture in Lampung province.

b. Program for the Improvement of Farm Villages in Paddy Field Zones.

The improvement of paddy field zones in the middle Lampung area will be executed.

c. Program for the Improvement of Upland Fields

The improvement of upland fields in the middle Lampung area will be planned.

3. The second survey conducted by the Government of Japan was implemented in March, 1972 for examination of the details of the cooperation program. This survey was discussed with the Government of Indonesia after field survey. The necessity of establishing the detailed final design of buildings and farms for Agricultural Extension Center and Demonstration Farms which will be the Center of this cooperation program was confirmed.

1-2 Purpose of the Survey Mission

In accordance with the Tani Makmur project which will be implemented by the Government of Indonesia and the result of the second survey. Various technical tests on paddy crops, upland crops and the training of extension service personnel and key farmers will be performed. A large scale demonstration farm will be provided at Totokaton, a small scale demonstration farm will be provided at another village. Detailed final design of land improvement works will be executed for better living in agriculture in the surrounding area to plan the stability of agri-

culture management and the increased income to cooperate such as extension and guidance of new agricultural management technics and organization of farmers.

1. Agricultural Extension Center

   a. Program of Facility Arrangement

   (Classification, scale, quantity, arrangement of facilities, building structure, construction of site.)

   b. Design of Reservoir

   (Catchment area, hydrology, reservoir, coffer dam and attached facilities.)

   c. Design of Farm

   (Scale of paddy field and upland field arrangement, construction plan, pump, farm pond, irrigation and drainage, farm road.)

   d. Estimation of Construction Costs and Construction Program

   e. Investigation, Survey and Design for the above.

2. Large Demonstration Farm (L.D. Farm)

   a. Land Readjustment Program

   (Facilities in present condition, land category, block condition, design farm road, irrigation water, construction of block allotment.)

   b. Construction of Elements of Main Work

   (Irrigation water, analysis of hydraulics, section structure, water intake, water-diversion, scale of structure, arrangement of farm roads.)

   c. Estimation of Construction Cost and Construction Program.

   d. Investigation, Survey and Design for the above.

3. Small Demonstration Farm (S.D. Farm)

Investigation and examination regarding land improvement in seven blocks.

1-3 Organization of the Survey Team and Respective Assignment:

Motoo Tankaka	Leader	Chief of Extension Department, Agricultural Administration Bureau, Ministry of Agriculture & Forestry.
Yuji Hirano	Sub. Leader General Planning	Designing Officer, Design Section Kanto Agricultural Administration Bureau

Takashi Tauchi	Planning of Irrigation & Drainage	Agricultural Cooperation Department O. T. C. A (Overseas Technical Cooperation Agency)
Tadashi Nishioka	Land Consolidation	Chief of Engineering Department JIRCO (Japan Irrigation and Reclamation Consultants)
Satoshi Hirai	Structural Designer	Design Section JIRCO
Takeshi Sato	Canal Designer	Design Section JIRCO
Shigeru Takeishi	Road Designer	Design Section JIRCO
Junji Konda	Hydrology	Design Section JIRCO
Tose Watanabe	Liaison	Agricultural Cooperation Department O. T. C. A.
Hideo Sugita	Estimation of Construction Costs	Design Section JIRCO

1-4 Names of The Indonesian Government Officials and Local Co-operators Concerned

1. Counterparts Personnel:

a.	Ir. Nusjirwan Zen	Chief of Dinas Pertanian, Lampung
b.	Thamrih Bastari	Secondary of Dinas Pertanian, Lampung
c.	Ir. Mattjik Gani	Staff of Dinas Pertanian, Lampung
d.	Ir. Achmad Sjarnadi, h. m.	Staff of Dinas Pertanian, Lampung
e.	Ir. Kamaludin Sipajung	Staff of Dinas Pertanian, Lampung
f.	Ir. Muzakir Noor	Staff of Dinas Pertanian, Lampung
g.	Ir. Sukirno	Chief of Tegineneng Center
h.	Ir. Sachruddin	Staff of Tegineneng Center
i.	S. Sochadies B. I. E.	Chief of Irrigation Section D. P. U. Lampung
j.	Ir. Rubini Jusuf	Staff of Irrigation Section D. P. U. Lampung

k. Mr. A. Hafied Gani B.I.E. — Staff of D. P. U. Lampung Tengah

2. Cooperators:

a. Dr. Nojima, (Expert from Japan)

b. Mr. Ohata, (Expert from Japan)

c. Solrman Simin — Kapara Desa Totokaton Extension Worker, Kajamatan Punggur

d. Mathan Charman — Extension Worker, Kajamatan Punggur

1-5 Survey Schedule

Date	Contents of Works	Counterparts
Fri. Sept. 1	Left Tokyo; Haneda Air Port by JAL No. 711 at 9:50 A.M., arrived at Djakarta at 7:30 P.M.	
Sat. Sept. 2	Paid a courtesy visit to Mr. Sugiyama, Chief of O.T.C.A. Paid a courtesy visit to the Embassy of Japan and met with Mr. Sugimoto, First Secretary. Greeting to the Directorate General of Agriculture, the Central Government and spoke with Mr. Soekendro and Mr. Smantory.	
Sun. Sept. 3	Attended a briefing conducted by Mr. Sugo, Project Leader, and others pertaining to the Tjihea project and other areas.	
Mon. Sept. 4	Discussed with Mr. Soekendro and Mr. Smantory of the Directorate General of Agriculture and along with Mr. Nojima, Mr. Sugimoto and paid a courtsey visit to Mr. Uthman, Chief of the Department of Irrigation, the Directorate General of River, the D. P. U.	
Tue. Sept. 5	Attended a briefing conducted by Mr. Kawamata and Mr. Kanai pertaining to Tadjum Project. Left Djakarta at 2:20 P.M., arriving at Tanjung Karang, Branti Airport at 4:00 P.M. and discussed with Mr. Nojima and Mr. Ohata.	
Wed. Sept. 6	Greeting to the Department of Agricultural Extension of Lampung province and discussed with Mr. Thamrih, sub-Chief. Greeting to the D. P. U. and discussed with Mr. Skadis, Head of Irrigation Section.	

Date	Contents of Works	Counterparts
Thu. Sept. 7	Left Tanjung Karang for Metro. Greeting and discussion on Lampung Tengah, Kabpaten. Mr. Sjachrum, of the Directorate General of Agriculture, of the Central Government followed. Greeting to Mr. Mathan Charman, Chief of Kajamatan Punggur. Greeting to Chief of Totokaton Desa and held a discussion. Greeting and discussion with Mr. Skirno Sjarif, Chief of the Tegineneng Center. Implementation of preliminary reconnaissance of Large Demonstration Farm and Center.	Sjachrum Mattjikgam
Fri. Sept. 8	At the Center: The establishment of base line, border, and the reconnaissance of leveling area.	Sjachrum Sukirno Sjarif
Sat. Sept. 9	At the Center: A plane table survey and others were conducted by Mr. Sugita and Mr. Takeishi.	Sukirno Sjarif
	At L.D.F: The establishment of borders, and the installation of stakes for traverse surveying and minor control were conducted by the survey team excluding Mr. Sugita and Mr. Takeishi.	Sjachrum Kamaluddin
Sun. Sept. 10	At the Center: Profile leveling and cross sectional leveling of coffer dam was conducted by Mr. Sugita and Mr. Takeishi.	Sjarif Sjachrum
	At the L.D.F: The traverse survey and the survey of establishment of the stakes for minor control were conducted by the survey team excluding Mr. Sugita and Mr. Takeishi.	
Mon. Sept. 11	At the Center: The plane table survey of farm areas was conducted by Mr. Sugita and Mr. Takeishi.	Sjarif Sjachrum
	At the L.D.F: The traverse survey, leveling, and survey of installing the stakes for minor control. Due consideration was paid on the center program to conform with the conception of D.P.U. with Mr. Sjachrum, Mattjik Gani, Kamaluddin.	Kamaluddin
Tue. Sept. 12	At the Center: The plot of buildings was surveyed by Mr. Sugita and Mr. Takeishi.	
	At the L.D.F: The traverse survey and leveling were carried out by the survey team excluding Mr. Sugita and Mr. Takeishi.	Sjarif, Sjachrum Kamaluddin Sjarnadi

Date	Contents of Works	Counterparts
Wed. Sept. 13	Rearrangement and computation of the results of surveying, minor control lines and plots.	
Thu. Sept. 14	At the Center: Establishment of the center of reservior basin was made by Mr. Sugita and Mr. Takeishi.	Sjarif Kamaluddin Sjarnadi
	At the L.D.F: Traverse survey and leveling survey were conducted in the southern portion.	
Fri. Sept. 15	At the Center: The survey of reservior basin, measurement of full water basin and the reconnaissance of establishing a catchment area was made.	
	At the L.D.F: A survey of each plot was executed.	Kamaluddin
Sat. Sept. 16	At the Center: The investigation of elements on the permeability of reservoir basin, soil property, ground layer, vertical permeability in the farm and soil stratum, etc. were made.	
	At the L.D.F: A survey of each plot was excuted.	Kamaluddin
Sun. Sept. 17	At the Center: The rearrangement of profile leveling and cross sectional leveling of swamp was conducted.	
	At the L.D.F: The computation of traverse survey and others.	
Mon. Sept. 18	At the Center: The plane table survey, investigation of soil texture, and additional bore holes of reservoir basin were executed.	
	At the L.D.F: A plane table survey and investigation of each plot were made.	Sjarnadi
Tue. Sept. 19	At the Center: The plane table survey was conducted.	
	At the L.D.F: Investigation of soil texture and vertical permeability was performed at three separate locations of proposed fields. Observation of the discharge of torrent and the installation of a N-type water requirement in depth were executed. A plane table survey of each plot was also carried out.	Sjarnadi

Date	Contents of Works	Counterparts
Wed. Sept. 20	At the Center: The survey of leveling and the drilling of additional bore holes in weak foundation of the reservoir basin were executed.	
	At the L.D.F: The plane table survey of each plot, the investigation of intake system and the cross section of the canal were performed.	Sjarnadi
Thu. Sept. 21	At the Center: Leveling and investigation of bore holes of reservoir basin were performed.	
	At the L.D.F: The plane table survey of each plot, the investigation of existing block, border diversion and farms were performed.	Sjarnadi.
Fri. Sept. 22	At the Center: Leveling and investigation of farm earth work was performed.	
	At the L.D.F: A plane table survey of each plot was conducted.	Sjarnadi
Sat. Sept. 23	At the Center: The installation of a water level staff in the reservoir basin.	
	At the L.D.F: The Plane table survey of each plot. The investigation of intake level, the cross section, the gradient of the canal and intake facilities were conducted.	Sjarnadi
Sun. Sept. 24	At the Center: The rearrangement of survey results.	
	At the L.D.F: The rearrangement of survey and investigation.	
Mon. Sept. 25	At the Center: The study of elements of the reservoir.	
	At the L.D.F: The plane table survey and investigation of each plot. Discussion with the Directorate General of Agriculture, Lampung province, D.P.U.	Kamaluddin
Tue. Sept. 26	At the Center: Rough design of the reservoir and attached facilities.	
	At the L.D.F: The plane table survey of each plot. Discussion with Kapara desa on summarized rearrangement plan.	

Date	Contents of Works	Counterparts
Wed. Sept. 27	At the Center: The design and drafting of farms.	
	At the L.D.F: The plane table survey and leveling of each plot. Preparation of the master plan of farm rearrangement was conducted.	Kamaluddin
Thu. Sept. 28	At the Center: The study of rearrangement of reservoir capacity and rough design of water distribution system was conducted.	
	At the L.D.F: The leveling of each plot, and the field check of designed irrigation water system were performed.	Kamaluddin
Fri. Sept. 29	At the Center: The computation of soil required to construct earth works, and to utilize surplus soil from canal and reservoir excavation was performed.	
	At the L.D.F: The leveling survey of each plot and investigation of road program. The discussion on the whole plan with Kapara desa.	Kamaluddin
Sat. Sept. 30	At the Center: The design of upland irrigation facilities was conducted.	
	At the L.D.F: The surveying of design route of main works. Rearrangement of elements of irrigation water and data.	Kamaluddin
Sun. Oct. 1	At the Center: The rearrangement of survey and investigation data.	
	At the L.D.F: Ditto.	
Mon. Oct. 2	At the Center: A rough reconnaissance survey of added uplaned farms was performed.	
	At the L.D.F: The survey of design route of main works and the establishment of block allotment were conducted.	
	At the L.D.F: The survey of design route of main works and the establishment of block allotment were conducted.	
Tue. Oct. 3	Removed from Metro to Tandjung Karang.	
	At the Center: Establishment of borders of added farms.	Kamaluddin
Wed. Oct. 4	At the Center and L.D.F: Discussion on the project and study of summarized plan.	
	At the S.D.F: Plane table survey (Trimurdjo).	Kamaluddin

Date	Contents of Works	Counterparts
Thu. Oct. 5	At the Center and L.D.F: Detailed design.	
	At the S.D.F: Plane table survey (Trimurdijo).	Kamaluddin
Fri. Oct. 6	At the S.D.F: Plane table survey (Punggur).	Kamaluddin
	Arrangement with Mr. Rubini, Irrigation Section, D.P.U. Lampung Provinsi on Center Dam.	
Sat. Oct. 7	At the S.D.F: Plane table survey (Punggur). Went to Prefecture Office in Metro for the arrangement of the Interim Report, the Governor was not present.	Mattjik Jani Kamaluddin
Sun. Oct. 8	Team leader arrived in Djakarta.	
Mon. Oct. 9	Survey team leader arrived in Lampung province. A meeting was not held with Mr. Nusjirwan as he did not return from Djakarta as scheduled.	
Tue. Oct. 10	The Interim Report was accepted by the Governor of the province and authorities concerned in Metro. The Leader of Mission conducted a field investigation survey. (Totokaton, Tegineneng and others.) After meeting with Mr. Nusjirwan Inspector and others, a dinner party was held.	
Wed. Oct. 11	Discussed with Mr. Nusjurwan, Inspector, Lampung Provinsi concerning the arrangement and scale of buildings. The Leader of Mission left Lampung Provinsi for Djakarta and made a report to the Embassy of Japan and a party was held for the minister.	
Thu. Oct. 12	A meeting was held at the Embassy in the morning. A report was made to Mr. Sadikin, Director of the Directorate General of Agriculture and was accepted.	
Fri. Oct. 13	The annual project program and detailed project schedule was explained by Mr. Soekendro, Head of Liaison Section, the Directorate General of Agriculture and Officers concerned and was understood after discussion.	
Sat. Oct. 14	Arranged for return and shipment of equipments.	
Sun. Oct. 15	Left Djakarta by Cathey Pacific Cx-550 at 7:00 A.M., arriving at Tokyo at 10:30 P.M.	

CHAPTER 2 OUTLINE OF PROJECT

2-1 Project Area

2-1-1 Location

The Agricultural Extension Center together with the Extension Farm, which is the agricultural development center of Lampung, is located at Tegineneng, 36 km north of Jandjun Karang, the provincial capital of Lampung Province in the southernmost extremity of Sumatra Island. This farm is being used at present as the Government Seed Growing Farm of Lampung Province. The full-scale Demonstration Farm is situated at Totokaton village, Punggur County, 15 km to the north-east of the above mentioned Agricultural Extension Center. Totokaton village is located in the region of the Punggur Utara Irrigation Project which is administered under the auspices of the Department of Water Sources of the Ministry of Public Works; the area, comprising 108 hectars, is irrigated by Tertiary Canal diverted at BPU 10 of the Main Canal of the above project.

2-2 Agricultural Extension Center

The matters necessary for the agricultural development of Lampung province (e.g. tests and experiments required for selection of suitable crops, introduction of superior varieties and agricultural machinery; agricultural exhibition; technical instruction of extension workers and key farmers; propagation and distribution of seeds) will be carried out at this center, and the following facilities will be installed:

Total building area:	5,490 m^2
Irrigation facility :	Reservoir
Pilot farm :	15 ha
Paddy field irrigation farm	5 ha
Upland irrigation farm	10 ha

2-2-1 Design of Building Arrangement

The contents and scale of the facilities included in the following chart should be considered in utilization of the effective existing facilities for the above purpose, and the arrangement has been planned as per attached Fig. 2-2.

2-2-2 Design of Reservoir

Outline:

The farms for tests and experimental purposes, as well as for training and exhibition, will be provided with 5 ha. of paddy and 10 ha. of upland fields (mainly for upland irrigation) on the plateau to the east of the area. In view of the shortage of water in the dry season and some parts of the rainy season, the water

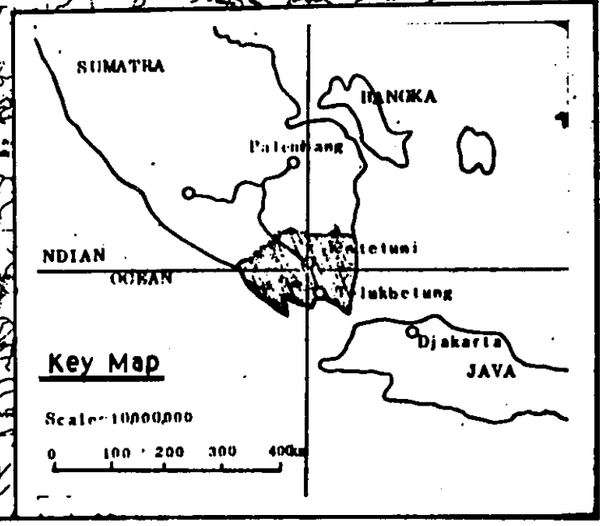
PETA
TATA PENGEMBANGAN
WILAYAH PROPINSI LAMPUNG
SKALA 1:100.000

LAMPUNG TENGAH

PROJEK GULA

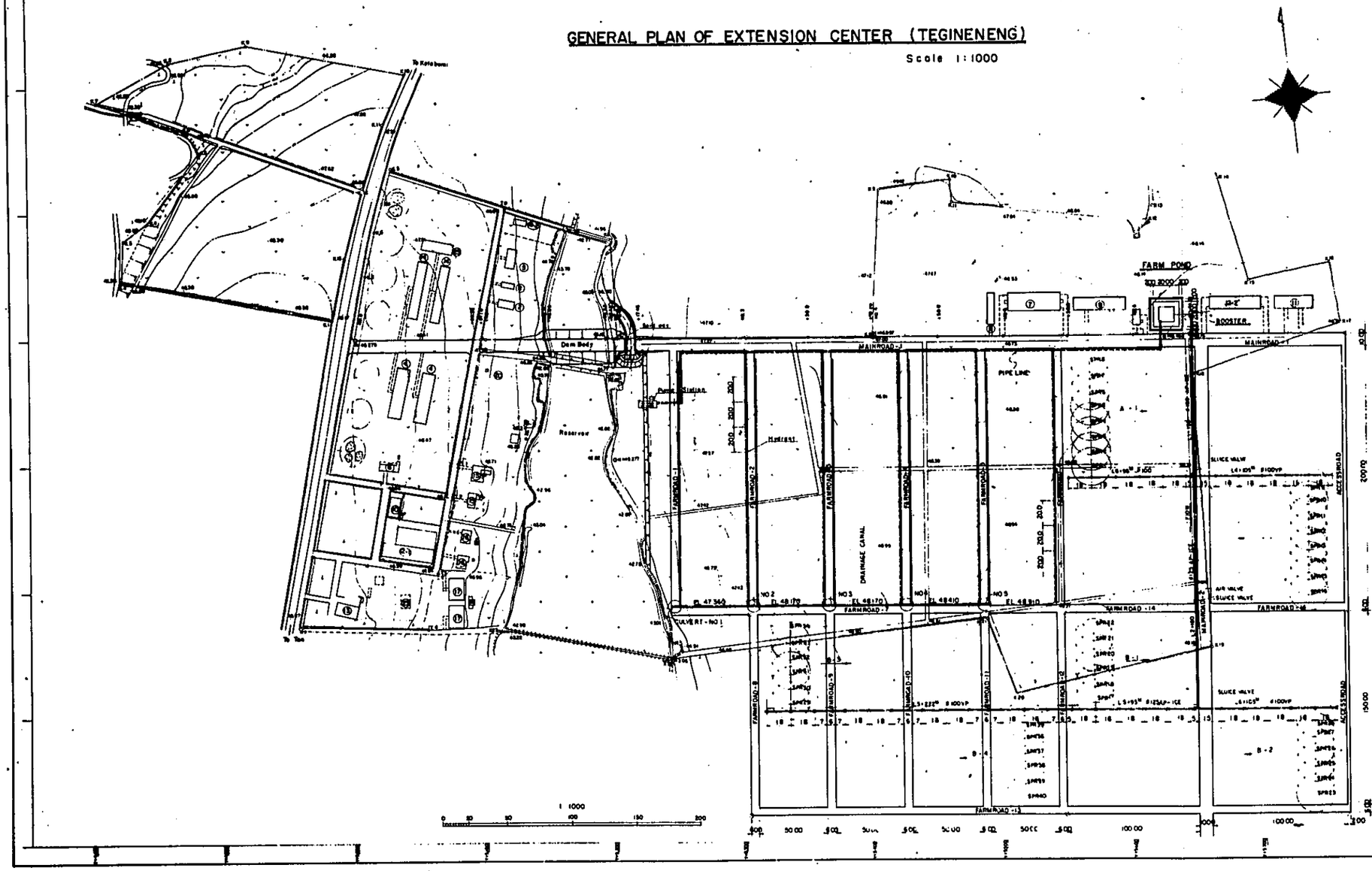
LAMPUNG SELATAN

TELUK LAMPUNG



GENERAL PLAN OF EXTENSION CENTER (TEGINENENG)

Scale 1:1000



NO	Name of Buildings and Other Structures	Size
1	Gasoline filling Stand	18 x 9 = 72
2	Hot house (cage)	6.5x6.5 = 42
4	Office and laboratory	40+10+12=900
5	Installation and weed processing house	10+6.5=65
7	Tractor workshop and shed	40+12=480
8	Washing shop(house) storehouse	40+10=400
9	Work room	20+6.5=130
11	Fertilizer and chemicals storehouse	30+10=300
2-2	Storage and tiger	40+10=400
14	Dormitory (40 person)	48+12=576
16	Cattle shed	20+6 = 60
19-2	Generator room	10 x 8 = 80
20	Elevated tank with piping device and Pump room	18P x 17 4 x 4 = 16
23	Dining hall	24+8=192

PADDY FIELD
- WATER-DELIVERY PIPE
- WATER-SUPPLY PIPE
- OPEN DITCHES

FIELD
- WATER-DELIVERY PIPE
- WATER-SUPPLY PIPE

LAMPUNG AGRICULTURAL PEVELOPMENT PROJECT
(TEGINENENG) LAMPUNG INDONESIA

General plan of Extension Center

OVERSEAS TECHNICAL COOPERATION AGENCY
TOKYO JAPAN

DESIGNED | JAPAN IRRIGATION AND RECLAMATION CONSULTANTS
SUBMITTED | DATE
APPROVED | DRAWING No.

requirement will be met by building a dam (total storage capacity: 210,000 m^3) at the narrowest part of the valley. The basic requirements of the dam facilities will be in accordance with the following table.

Elements of Dam Design

Location	:	Teginneng
Name of River	:	Swamp
Dam Type	:	Homogeneity
Name of Dam	:	Reservoir
Ground Foundation	:	Sandy Clay

Hydrology	Catchment Area	$A = 2.73\ km^2$
	Spillway Basic Rainfall	r_t = 185 mm/day x 1.2 = 222 mm/day
	Total Storage Capacity	$V = 210,000\ m^3$
	Amount of Sand Accumulation	$V_{nr} = 6,320\ m^3$
	Effective storage	$V_n = 164,000\ m^3$
Reservoir	Capacity	
	Full Water Area	$A = 0.095\ km^3$
	Storage Level	HWL = 45.75 m FWL = 45.00 m DWL = 43.00 m
	Available Depth	H = 2.00 m
	Dam Height	$H_o = 6.100$ m
	Dam Length	$L_o = 124.00$ m
	Crest Width	$B_o = 10.000$ m
Dam Body	Gradient of Slope	Upstream Side: 1:2.0 Downstream Side: 1:1.8
	Volume of Dam Body Embankment	$6520.00\ m^3$
	Spillway Type	Flowover Weir Type Sillway

Spillway	Design Flood Discharge	Q_s = 18.9 m^3/sec
	Length of Flowover Weir	B_s = 20.00 m
	Overflow Depth	H_s = 0.75 m
Water Intake Installation	Intake Type	Pump (Single Suction Centrifugal Pump)
	Maximum Amount of Intake Water	0.015 m^3/sec/set x 2 sets x 10 HP
Division	Type	Existing Pump & Existing Pipe
Channel	Diversion Drainage	By Existing Drainage Canal

2-2-3 Design of Pilot Farm

1. Scale and Arrangement of Farms

The function of pilot farms will be to suitably organize the permanent paddy plot and the changeable farmland to have it conform to the present requirements, in addition to the tests and experiments, and also to any alterations in the future, as indicated in Fig. 2-2.

2. Water Requirement

Cropping patterns will be prepared as Fig. 2-3 from the view point of the efficiency ratio of facilities for the cropping of paddy fields. The water requirement in depth and water requirement of upland irrigation was considered and added to measured values.

Paddy Field

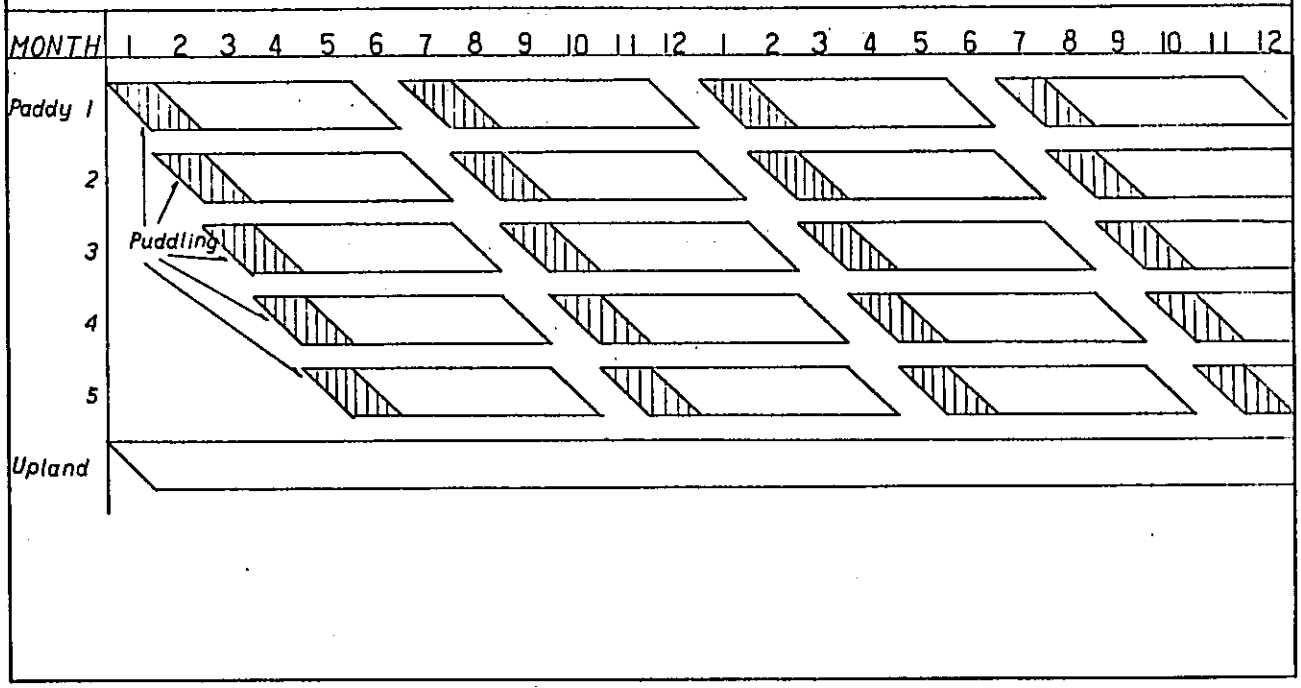
Qmax	= 24.61 l/s (24 hr/day)	32.81 l/s (18 hr/day)
Qmean	= 10.96 l/s (24 hr/day)	14.61 l/s (18 hr/day)

Upland

Qmax	= 11.43 l/s (24 hr/day)	15.24 l/s (18 hr/day) 18.29 l/s (15 hr/day)
Qmean	= 8.47 l/s (24 hr/day)	11.28 l/s (18 hr/day) 13.55 l/s (15 hr/day)

Facility Capacity: The capacity of water pipe and pumps will be 18 hr, each irrigation hour will be 24 hr in surface soil puddling, 18 hr in the normal for paddy fields, and 15 hr for the farm operation of upland irrigation. The facility capacity will be roughly estimated by the water requirement for preparation of paddy fields. Surplus water will be stored in the farm pond and may be used for upland irrigation when desired.

Fig.2-3 Operation Plan of Fields



Facility Schedule of Pilot Farm

Name of Facility	Kind	Quantity	Unit	Remark
	Pilot Farm	15.0	ha	Paddy irrigation farm 5 ha Upland irrigation farm 10 ha
Farm Consolidation	Main Farm Road	545	m	Width of road 10 m
	Lateral Farm Road	2,866	m	Width of road 6 m
	Small Drainage Ditch	1,000	m	Bottom width 0.3 m, depth 0.5 Side slope 1:1
	Drainage Canal	280	m	Bottom width 0.5 m, depth 0.5 Side slope 1:1
Paddy Irrigation Facility	Pump	2	No.	Diameter: 100 m Discharge: 0.9 m^3/m Total head: 18 m Prime mover: Diesel engine 10 PS Kind: Single suction Centrifugal pump Driver by Diesel engine
	Pump House	28	m^2	Structure: Constructed of brick
	Water Pipe	382		Kind: Vinyle chloride pipe for domestic use Diameter: 150 mm
	Water-Supply Pipe	1,000	m	Kind: Vinyle chloride pipe for domestic use.
	Water Application Apparatus	50	Piece	Hydrant (50 ϕ)

Facility Schedule of Pilot Farm (Continued)

Name of Facility	Kind	Quantity	Unit	Remark
	Farm Pond	1	Place	Storage capacity: $330m^3$ Structure: Plan 26 m x 26 m
Upland Irrigation Facility	Booster Pump	1	No.	Diameter: 125 mm Discharge: 1.32 m^3/m Total head: 53 m Driver: Diesel engine 40 PS Kind: Horizontal shaft Multistage centrifuged Direct engine
	Water Pipe	305	m	Kind: Asbestos cement pipe Diameter, length 150 ϕ l_1 = 125 mm 125 ϕ l_2 = 180 mm
	Water-Supply Pipe	622	m	Kind: Solid vinyle chloride pipe for domestic use Diameter, length: ϕ100 $l_3+l_4+l_5+l_6$ = 527
Upland Irrigation Facility				Kind: Asbetos-Cement pipe Diameter, length: 125 ϕ l_5 = 95
	Sprinkler	6	Set	Kind: T_5 = 30 type and the like Nozzle size: 3/16" x 3/32" 8 stands (dist) 2 sets 6 stands (dist) 4 sets

2-2-4 Approximate Work Costs and Scheme of Execution

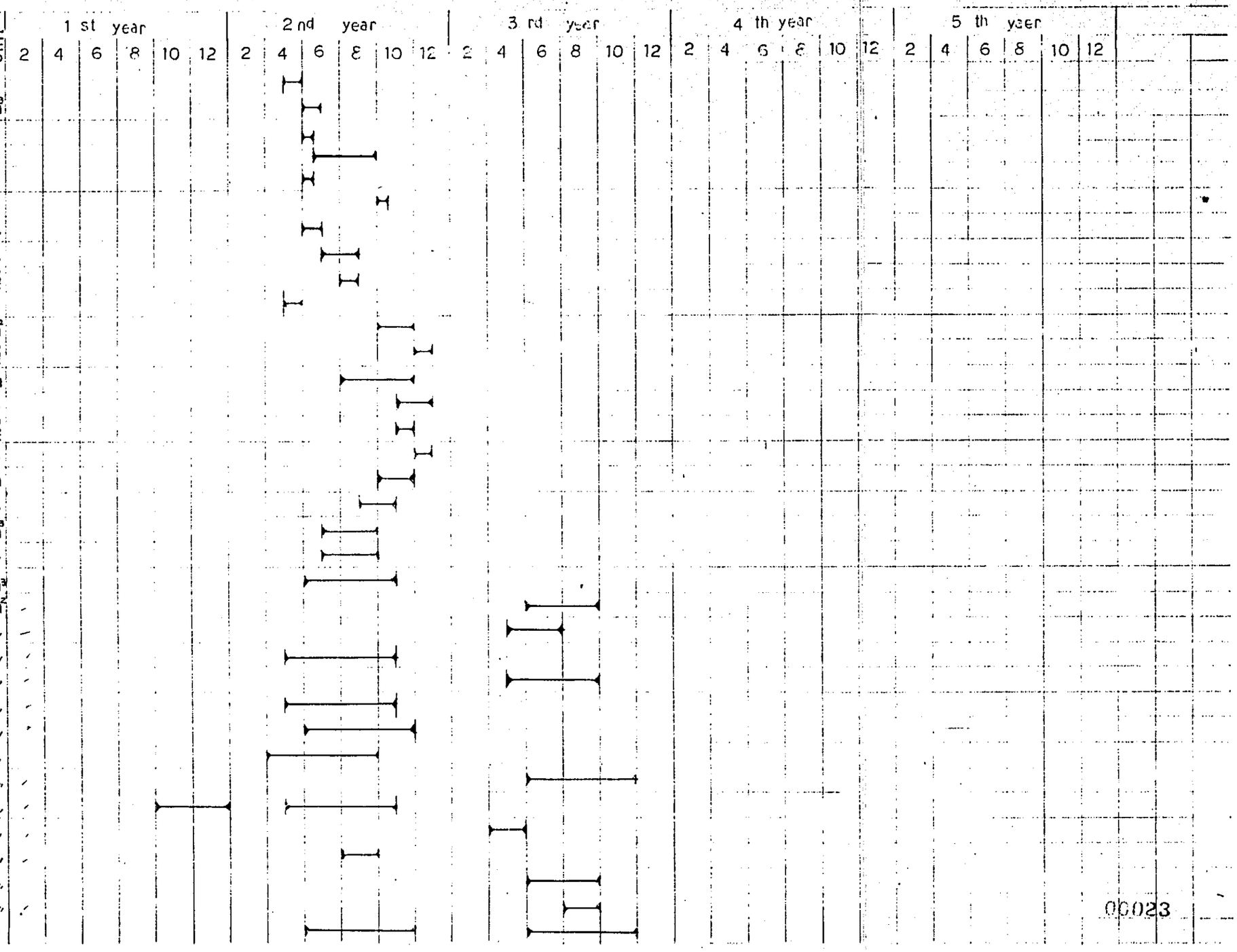
Work costs necessary for each facility will be as follows:

(Unit : Yen)

	Item	Quantity	Unit	Local Currency	Foreign Currency	Total
1.	Dam			1,698,000	2,137,000	3,835,000
	a. Dam Body	6,600	m^3	452,000	878,000	1,330,000
	b. Spillway	1	Place	1,092,000	1,259,000	2,351,000
	c. General Temporary Construction			154,000	-	154,000
2.	Pilot Farm			2,137,000	11,979,000	14,116,000
	a. Farm Consolidation	5.0	ha	735,000	2,443,000	3,178,000
	b. Foundation of Pump Station	1	Place	483,000	241,000	724,000
	c. Pump	1	Place	5,000	829,000	834,000
	d. Water Pipe Work	440	m	783,000	3,660,000	4,443,000
	e. Booster Pump	1	Place	6,000	1,628,000	1,634,000
	f. Water-Supply Pipe	930	m	125,000	1,967,000	2,092,000
	g. Sprinkler	6	Set	-	1,211,000	1,211,000
3.	Building	5,490	m^2	39,152,000	7,073,000	46,225,000
	TOTAL			42,987,000	21,189,000	64,176,000

Fig 2-4 Construction Schedule Agricultural Development Center

	Item	Amount	Unit
Dam and Reservoir	Preparatory works		
	Surface soil removing	1586	m³
	Excavation	600	"
	Embankment	6417	"
	Spillway Excavation	1080	"
	Embankment	170	"
	Stone pitching	147	"
	Masonry	134	"
	Bridge	1	nos.
	Intake	1	"
	Pump House	28	m²
	Pump	2	nos.
	Delivery Pipe	442	m
	Pipe line for low land	900	"
	Farm pond	1	nos.
	Booster Pump	1	"
	Pipe line for up land	927	m
	Drainage canal	1280	"
	Access road embankment	545	m³
	Farm road	2866	"
	Land leveling	10570	m²
Building and Facilities	Net house	68	m²
	Dry floor	72	"
	Office and Laboratory	800	"
	Inoculation house	95	"
	Workshop and roof	600	"
	Machine storage	400	"
	Fertilizer storehouse	300	"
	Storage and floor	600	"
	Dormitory	630	"
	Cattle Shed	40	"
	Generator room	50	"
	Work room	150	"
	Gasoline stand	68	"
	Pump room	16	"



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2-3 Large Demonstration Farm

2-3-1 Land Consolidation Plan

The purpose of this project deals with land improvement, mainly for rice production which is the center of food production of the Tani-Makmur Project. The Government of Indonesia plans to introduce the second cropping and to extend the scope of management to include the development of alang-alang grass.

Outline of Land Consolidation Plan

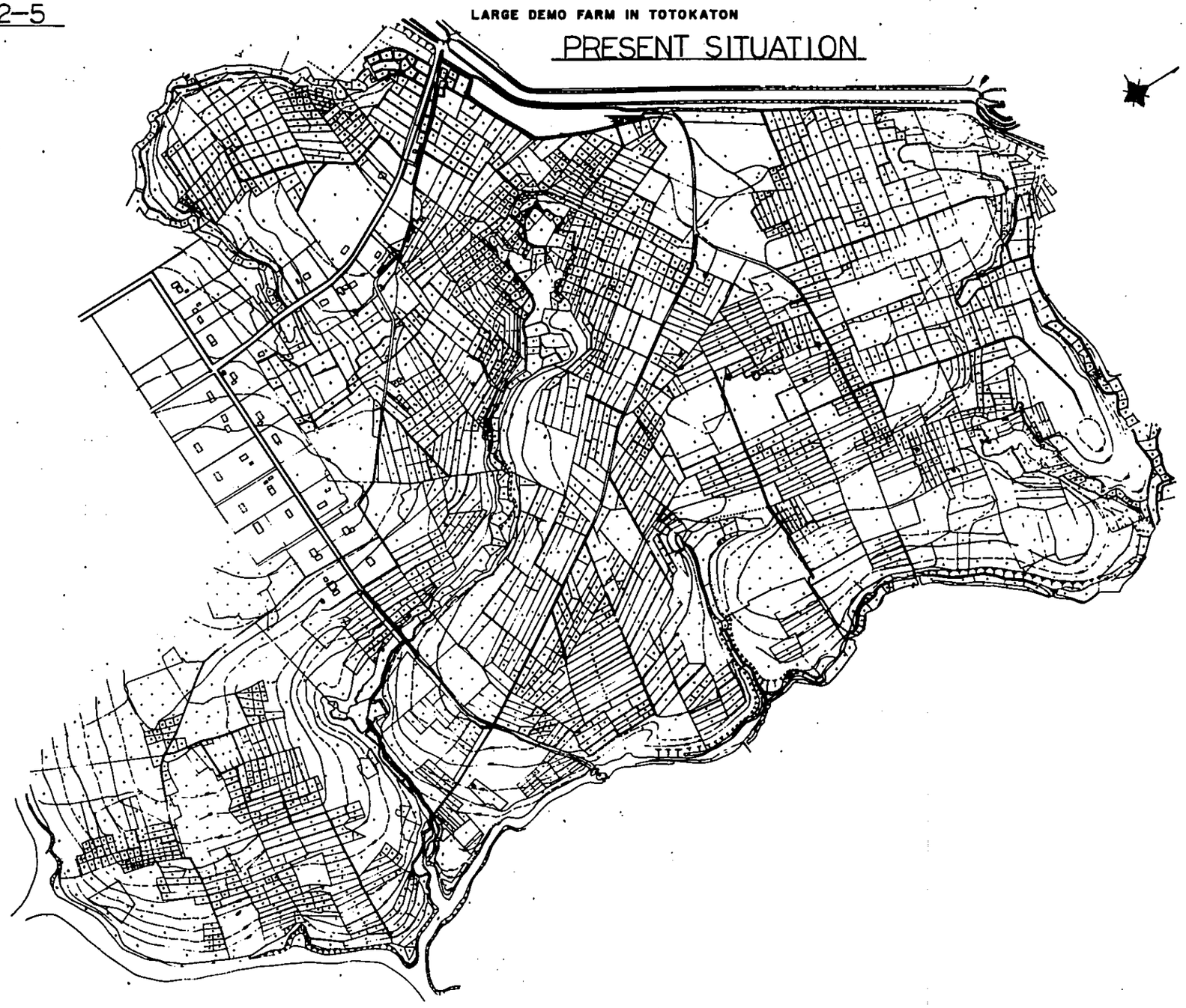
In compliance with the completion of main canal under the D.P.U., the tertiary canal, which was constructed by Goton Royon due to mutual aid of farmers five years ago, runs on the high land in the direction of east west at the north side of the area, the other one having been traversed along a group of villages in the southern direction as shown in the following diagram. Though the fourth canal is being extended to conform with the degree of reclamation to make the tertiary canal as base, due to shortage of the planning capacity regarding the location and section, circulating irrigation has been adopted occasionally wherever met with shortage of water. Further these are such conditions that regarding water diversion, continuous irrigation has been done after had cut plot borders of field water as may be required and satisfied water control has not been implemented by the reasons of water shortage and ununiformity of cropping. Concerning the drainage canal, there is no drainage system in this area. Although continuous irrigation has been carried out, it is in such a condition that surplus water floods the low paddy fields. As the arable areas are the lands which have been reclaimed by the mutual aid of farmers, the paddy fields are small in area and irregular in shape, the average ploted area is 0.15 ha. Many small ploted areas are located on reclaimed land in swamp areas, average width of each plot is 6-7 m and the difference in height between plots is 30-40 cm. Access roads are not found in paddy fields, farm workers are using the embankment of the tertiary canal and borders of paddy fields as foot paths. Farmers using water buffalo also use the same paddy borders and slowly destroy them in the process.

To rectify the above situation, the land consolidation plan of Fig. 2-5 has been employed. Namely, concerning the irrigation canal, two lines will be installed in the south east direction to follow the present water system and to the utmost will be bank type so as to be able to carry out a complete water management program. The fourth canal will be installed so as to extend water management over an additional 21 plots. Water management in each plot will benefit from the continuous irrigation water provided by the fourth canal. Maximum control area of each turnout will be limited to 3 ha. for controlling the tendency that upstream paddy fields are profitable but not downstream fields, the continuous irrigation reduces the unbalance of arrival time of irrigation water.

Fg 2-5

LARGE DEMO FARM IN TOTOKATON

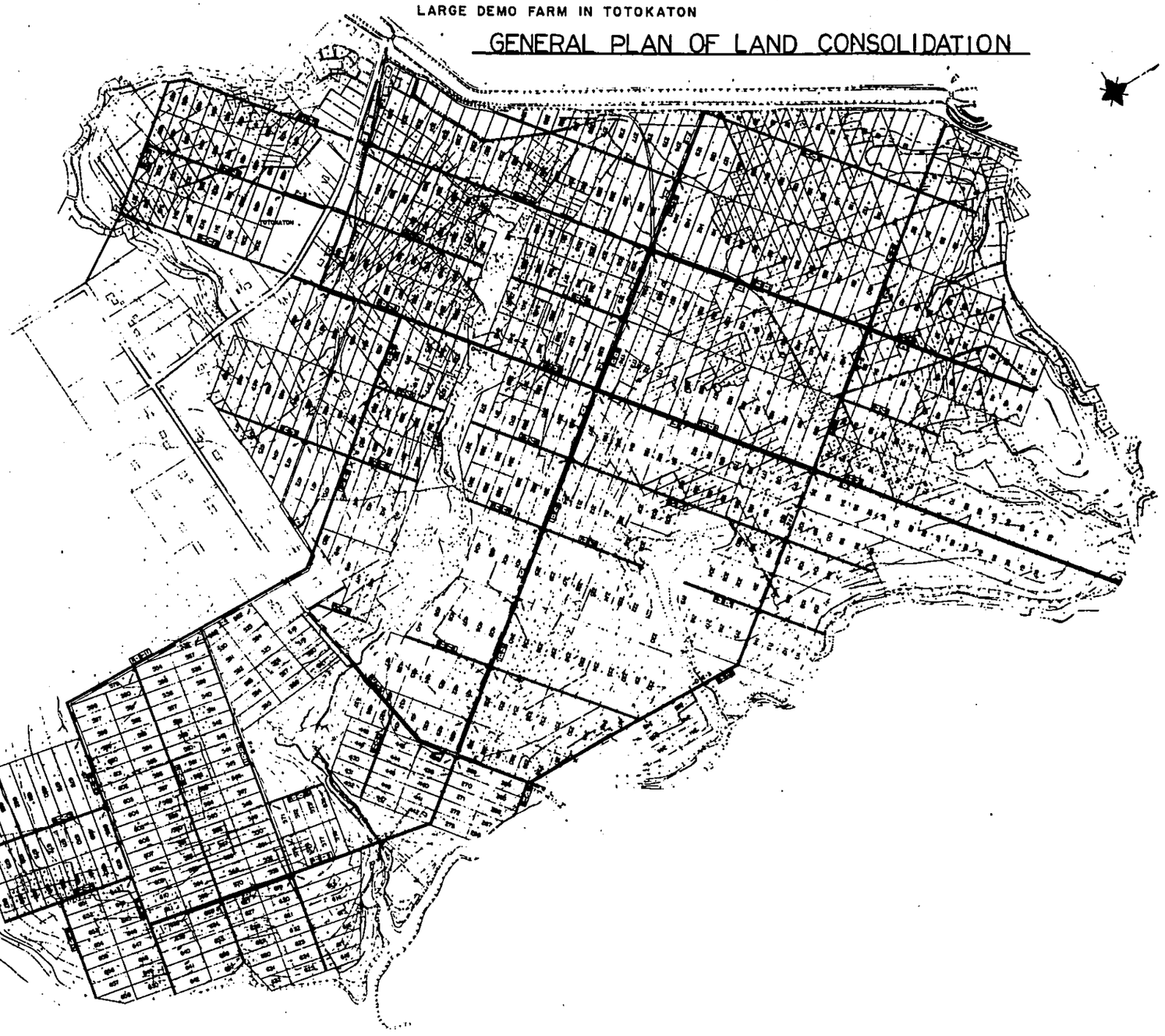
PRESENT SITUATION



Fg 2-6

LARGE DEMO FARM IN TOTOKATON

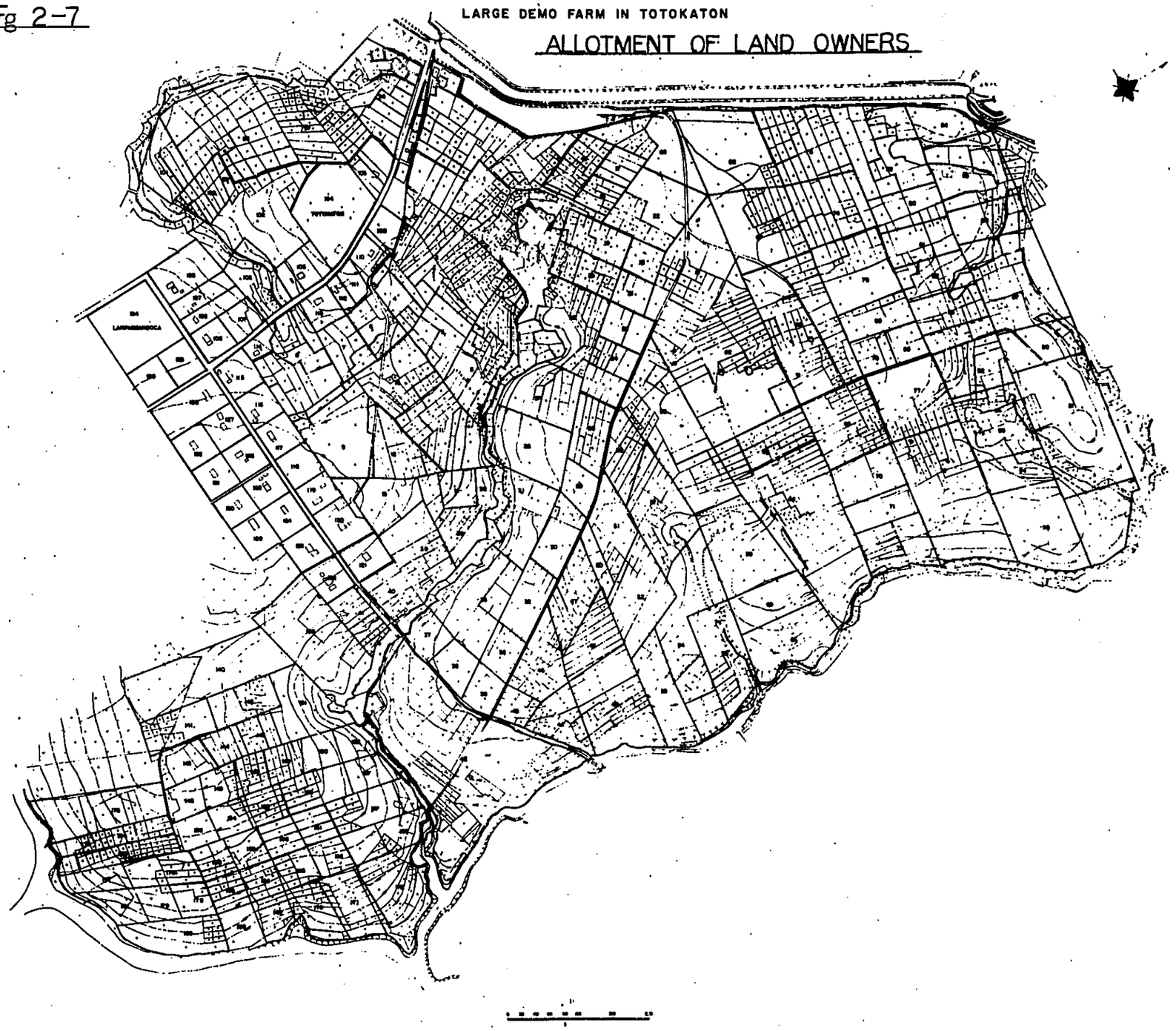
GENERAL PLAN OF LAND CONSOLIDATION



Fg 2-7

LARGE DEMO FARM IN TOTOKATON

ALLOTMENT OF LAND OWNERS



Concerning the size of the paddy fields, it is considered that as a tentative measure, tillage, weeding and other maintenance and operation tasks will be performed by man and animal powers. Power cultivators in small type will be used in the future, due to the farm management system, progression and improvement of cultivation technics. In view of the present topographic condition, the size of plots will be 20 m x 100 m = 2,000 m^2 and be 20 m x 50 m = 1,000 m^2 in less 1/100 of the gradient of topography.

Density and Arrangement of Farm Road

Main Farm Road

Concerning roads in the areas which will become the farming center, two lines of roads will be constructed as shown in Fig. 2-5 to conform with farmers' desires. Roads will be 2.5 m wide and 0.5 m high.

Lateral Farm Road

Lateral farm roads of 1.5 m width, spaced 200 m apart will be constructed to provide easy access to all areas and equipment of each paddy field.

Small Farm Road

Smaller farm road, 1.0 m in width, will be installed in the spacing of 100-200 m in connection with main and lateral farm roads to allow the smaller farm road to connect with one side of each farm area.

2-3-2 Elements of Main Works

General Table of Land Improvement Planning Facilities

	Item	Quantity	Unit	Remark
1.	Irrigation Area	108.0	ha	
	a. Net Irrigation Area	89.2	ha	Only paddy field, no upland
	b. Number of Block	21.0	Block	
	c. Number of Paddy Field (A)	450.0	No.	Size 50 m x 20 m = 1,000 m^2
	d. Number of Paddy Field (B)	221.0	No.	Size 100 m x 20 m = 2,000 m^2

2. Irrigation Facilities

	Item	Quantity	Unit	Remark
a.	Irrigation Method			Continuous flowing irrigation
b.	Design Unit Water Requirement	1.84	1/s/ha	Due to design standard of Ministry of Public works, Indonesia
c.	Lateral	4,600	m	Trapezoidal earth canal
	Tertiary Canal	1,413	m	b = 0.5-1.0 m H = 0.7 m n = 1:1
	Fourth Canal	3,187	m	b = 0.3 m H = 0.5 m n = 1:1
d.	Diversion Devices	41		Overflow weir type, built of Pasangan
	Turnout (A)	6	Place	B = 1.0 m
	Turnout (B)	7	"	B = 0.5 m
	Turnout (C)	28	"	B = 0.3 m
e.	Culvert	54	"	Built of Pasangan, cover built of Pasangan
	Culvert (A)	4	"	
	Culvert (B)	10	"	
	Culvert (C)	40	"	
f.	Cross Drainage Culvert	3	"	Corrugated pipe
	Culvert D-C-1 D-C-3	2	"	ϕ = 600 l = 5.0 - 8.0 m
	Culvert D-C-2	1	"	ϕ = 800 l = 5.0 m
g.	Border	50,715	m	u = 1:1 D = 0.3 m H = 0.3 m

3.	Roads	11,077	m	
	a. Main Farm Road	1,900	m	B = 2.5 m height of fill 0.5 m
	b. Lateral Farm Road	5,563	m	B = 1.5 m height of fill 0.5 m
	c. Farming Road	3,614	m	B = 1.0 m height of fill 0.5 m
4.	Facility Buildings	2.0	Each	Brick made, roofing with galvanized steel plate
	a. Storage House	1.0	"	
	b. Granary House	1.0	"	24 m x 7.5 m = 180 m^2

2-3-3 Approximate - Estimation of Construction Cost and Construction Program

Construction Costs for Land Improvement will be as following Table

(Unit - Yen)

	Item	Quantity	Unit	Currency (Domestic)	Currency (Foreign)	Total Cost
1.	Road	11,077	m	478,491	322,762	801,253
2.	Irrigation Channel	4,600	m	147,100	-	147,100
3.	Culvert	54	Place	398,534	9,558	408,092
4.	Turnout Cross Drainage	41	"	162,763	-	162,763
5.	Culvert	3	"	96,378	93,625	190,003
6.	Border	50,715	m	365,120	-	365,120
7.	Land Leveling	74,017	m^3	222,051	2,294,527	2,516,578
SUB TOTAL				1,870,437	2,720,472	4,590,909
Project Cost per ha			Rp	28,438	41,363	69,709 Rp/ha
			Yen	20,969	30,499	51,400 Yen/ha
			Dollar	70	100	170 $/ha
8.	Facility Building	2	Ridge	3,812,000	-	3,812,000
SUB TOTAL				3,812,000		3,812,000
TOTAL				5,682,000	2,720,000	8,402,000

Construction Schedule (L.D.F in Totokaton)

Item	Amount		3 nd year 1	2	3	4	5	6	7	8	9	10	11	12	4 rd year 1	2	3	4	5	6	7	8	9	10	11	12	Remark
Farm Roads	1900	m					28(5)											11(3)									W = 2.5 m
" "	5563	"					32(10)												16(5)								" = 1.5 "
" "	3614	"					16(5)												8(3)								" = 1.0 "
Canal TYPE A	1413	"					12												6								
" " B	3187	"					17												9								
Culverts	54	Nos								10												5					
" " For Drainage	3	"							7											3							
Turf-cut	41	"									18												7				*
Leveling	89.2 74017	Ha m^3				180 (130)												100 (65)									( )---Machine
Border	50,715	m					70												30								25 workers/day
Storage and Sterility	180 180	m^2				100												100									Total =
Preparatory Works					13												7										786(241) days

* 25 workers/day
( )---Machine
Total = 786(241) days

CHAPTER 3. REARRANGEMENT PLAN OF AGRICULTURAL EXTENSION CENTER

3-1 Farm Planning

3-1-1 Scale and Arrangement of Farm

The function of farms will be organized into permanent farm plots and changeable paddy blocks to correspond to various matters such as tests, studies, and exhibitions of agricultural technics. Function of the pilot farm is shown in the purpose paragraph of the second Report of The Agricultural Development Center. Namely, concerning paddy block, it will be the facility to correspond to future conditions. The formation of farm plots will be as reflected in Fig. 2-2. The pilot field will consist of about 5 ha of fields of J-O blocks in the existing seeds growing farm. An upland irrigation pilot farm of 10 ha will be formed with tobacco fields of P.N.P. (State owned farms) located at south side and farmer's upland fields of 7 ha to be purchased at a future date.

3-1-2 Computation of Facility Capacity

Cropping of paddy fields will eliminate fallow land and place for all available land in effective use. The cropping pattern will be established by Fig. 2-3. The water requirement in depth and water requirement of upland irrigation was considered and added to measured values.

1. Water Requirement

As May is the beginning of the dry season, it will become the maximum used period to conform with Fig. 3-1.

Paddy Field Section:

$$Q_{max} = \frac{1}{8.64}\{\underbrace{130\text{mm} \times 1\text{ ha}}_{\text{Paddling Water 1 ha}} + \underbrace{18\text{mm} \times 4\text{ ha}}_{\text{Curing Water Growing Water}}\} \times \frac{1}{\underset{(0.95)}{\eta}}$$

$$\underset{24\text{ hr/day}}{} \quad \underset{18\text{ hr/day}}{}$$

$$= 24.61\ \ell/s \rightarrow 32.81\ \ell/s$$

$$Q_{mean} = \frac{1}{8.64}\{18\text{mm} \times 5\text{ ha}\} \times \frac{1}{\underset{(0.95)}{\eta}} = 10.96\ \ell/s \rightarrow 14.61\ \ell/s$$

So in the puddling end, operation capacity will be 24 hr and stationary capacity will be 10.7 ℓ/s.

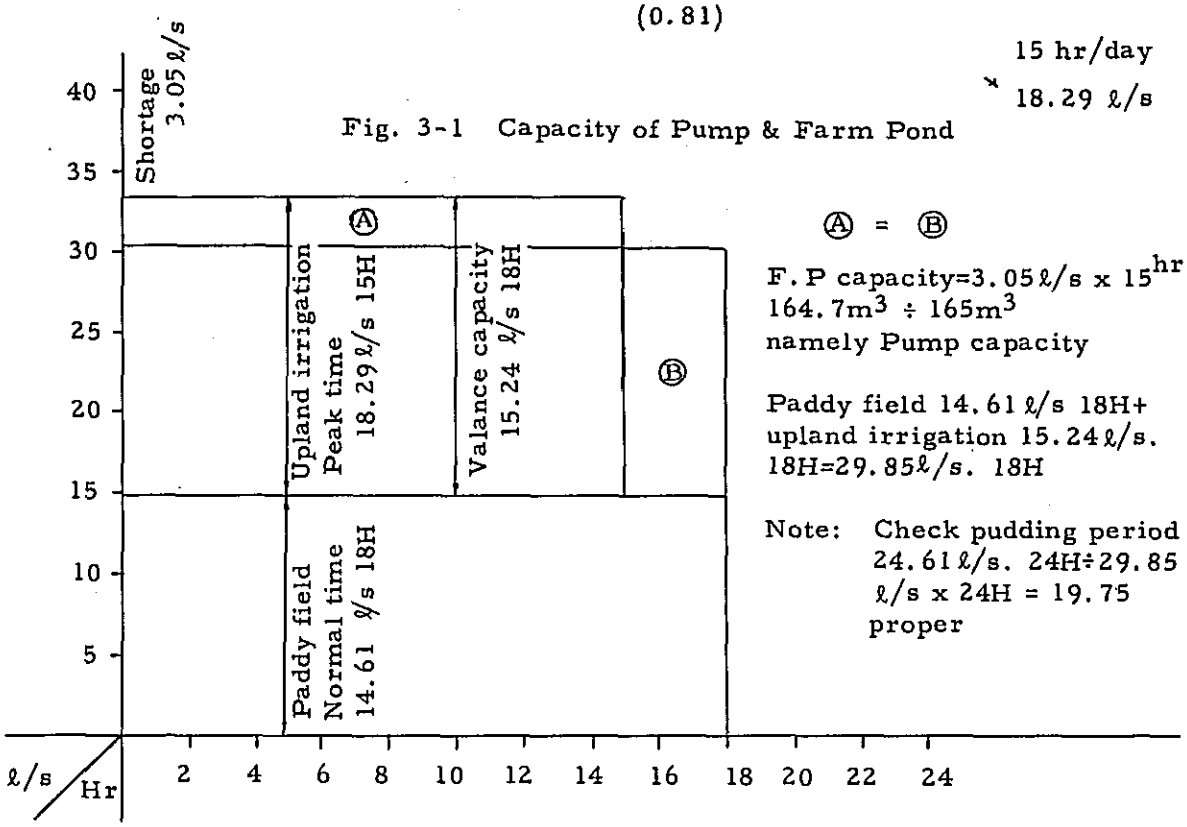
Upland Irrigation Section:

$$Q_{max} = \frac{1}{8.64}\{8mm \times 10\ ha\} \times \frac{1}{\eta\ (0.81)} = 11.43\ \ell/s$$

24 hr/day → 18 hr/day → 15 hr/day

15 hr/day → 18.29 ℓ/s

Fig. 3-1 Capacity of Pump & Farm Pond



Ⓐ = Ⓑ

F.P capacity=3.05ℓ/s x 15^{hr}= $164.7m^3 \div 165m^3$ namely Pump capacity

Paddy field 14.61 ℓ/s 18H+ upland irrigation 15.24 ℓ/s. 18H=29.85ℓ/s. 18H

Note: Check pudding period 24.61 ℓ/s. 24H÷29.85 ℓ/s x 24H = 19.75 proper

2. Water Supply System

A pump Station will be provided on the right bank of dam site for water supply method and will supply the water to the farm pond by pipe line (L = 640m). Water will be provided to the pilot farm of 5 ha by means of a branch pipe from the main pipe line. A booster pump for upland irrigation will be installed on the farm pond and uplands of 10 ha will be irrigated to use sprinklers. The farm pond will be established by the following reasons:

a. In case of installing booster pump for upland irrigation, the total head will be about 80 m at the pump station of paddy fields. Piping cost of water pipes will be extremely high as two pieces of steel water pipes will be utilized in parallel.

b. The head of pumps for paddy fields and the booster pumps for upland irrigation will be extremely different, so no same pump size will be used. Consequently the available ratio of paddy field pumps is low and uneconomical.

c. Installation of farm pond will provide necessary water for daily living in support of several facilities being constructed at the proposed farm land.

3. Pump Capacity

The capacity of water pipes and pumps will be 18 hr, each irrigation hour will be 24 hr in surface soil puddling, 18 hr in normal for paddy fields, and 15 hr for the farm operation of upland irrigation. The facility capacity will be roughly estimated by the water requirement for preparation of paddy fields. Surplus water will be stored in the farm pond and may be used for upland irrigation when desired.

In this case, for adequate operation of pumps to be 18 hr by Fig. 3-1, A = B will be necessary. The pump capacity will be as shown below. (See Fig. 3-1.)

$$\text{Pump Capacity} = \underset{\text{Paddy Field}}{14.61\ \ell/s\ (18\ hr/day)} + \underset{\text{Upland Irrigation}}{15.24\ \ell/s\ (18\ hr/day)}$$

$$= 29.85\ \ell/s\ (18\ hr/day) \div 30\ \ell/s$$

4. Farm Pond Capacity

$18.29\ \ell/s\ (15\ hr/day) - 15.29\ \ell/s\ (18\ hr/day) \times (18\ hr - 15\ hr)$
$= 165\ m^3$

To estimate the above amount of shortage of upland irrigation water and the same amount required for daily living and the amount of percolation and evaporation, the storage capacity will be $165 \times 2 = 330\ m^3$.

3-1-3 Paddy Irrigation Pilot Farm

1. 5 ha of pilot paddy farms will be blocked to 1 ha (200 m x 50 m) as Fig. 2-2. Farm roads 6 m wide will be provided along the long side of each block. A main road 10 m wide will be provided along the short side of each block.

2. Hydrants will be provided in every 20 m along the upper portion of the long side of the block. Earth canal of side slope, 1:0.5 and bottom width 0.3 m will be provided as a drainage canal on the low level side. The water pipe and water supply pipe leading from the pump to the dam to provide drainage in the south side road in the short side direction, will be vinyl chloride pipe (JISK 6742). Regulating valves will be fitted to the approach of water supply pipes.

3-1-4 Determination of Size of Pump

1. Elements of Pump

a.	Design pump lift capacity	0.03 m^3/s
b.	Number of pumps	2 units
	Pump lift capacity per unit	0.015 m^3/s
c.	Type of pump	Single suction volute pump
d.	Design intake level	EL 43.00
e.	Design discharge level	EL 49.50
f.	Actual head	6.50 m
g.	Suction pipe	100 m/m
h.	Water supply pipe (solid vinyle chloride pipe)	ϕ 150 L = 462 m

2. Head Loss

Velocity of flow in pipe $V_1 = \frac{Q/2}{4} \times D^2 = \frac{\frac{0.015}{3.14}}{4} \times 0.10^2 = 1.91 m/s$

Velocity head $V_1 2/2\ g = 0.186$

a. Inlet loss $h_1 = f_1 \frac{V_1^2}{2g} = 0.2 \times 0.186 = 0.037$

b. Friction loss

In case of obtaining the loss per m as C = 100 by William Hazen formula:

Length of suction = 12.3 m

$h_2 = 0.065 \times 12.3 = 0.80$ m

c. Bend loss

$h_3 = f_3 \frac{V^2 3}{2g} = 0.13 \times 0.186 = 0.024$ m

d. Valve loss

Foot valve and sluice valve $f_4 = 1.50 + 0.14 = 1.64$

Discharge pipe (ϕ 60 mm) velocity of flow V = 2.98 m/s

Velocity head in discharge pipe $\frac{V^2}{2g} = 0.453$ m

$h_4 = 0.186 \times 1.5 + 0.453 \times 0.14 = 0.342$ m

e. Transition loss

ϕ 80 - ϕ 100 $f_5 = 0.35$

$h_5 = 0.35\ (0.453 - 0.186) = 0.093$ m

f. Confluence loss

ϕ 150 mm velocity of flow in pipe 1.70 m/s

ϕ 150 mm velocity head in pipe $\frac{V^2}{2g} = 0.147$ m

$f_6 = 0.46$

$h_6 = 0.46 \times 0.147 = 0.068$ m

g. Friction loss of water pipe

Solid vinyl chloride pipe of 150 mm in diameter will be used. In case of obtaining the loss by the Chart of William Hazen formula as C = 140, the loss will be 1.4 m/100 m. Therefore, total length of water pipe = 462 m.

$h_7 = 1.8 \times 4.62 = 8.316$ m

h. Bend loss of water pipe

$f_8 = 0.15 \times 4$ places $= 0.6$ ..... R/D = 2.0 (90° Bend)

$h_8 = 0.6 \times 0.147 = 0.088$

i. Outlet loss

$f_9 = 1.0$

$f_9 = 1.0 \times 0.147 = 0.147$

From the above, the total head loss will be:

$h = 0.037 + 0.800 + 0.024 + 0.342 + 0.093 + 0.068 + 8.316 + 0.088 + 0.147 = 9.915$ m

Accordingly, the total head loss will be:

T. Head = 6.50 + 9.915 = 16.415 m

Estimate about 10 % surplus, 16.415 x 1.1 ÷ 18.0 m

Determination output of Prime Mover (Diesel engine)

(1) Water horsepower $Pw = 0.222 \times r \times Q \times H$

$= 0.222 \times 1.0 \times 0.90 m^3/m \times 18.0$

$= 3.6$ (PS)

(2) Shaft power $Pm = \frac{Pw(1 +)}{q_p \times q_t}$

Where, = Surplus 20 %

q_p = Pump efficiency 59 %

q_t = Drive efficiency 95 %

$$P_m = \frac{3.6\,(1 + 0.2)}{0.59 \times 0.95} = 7.7\ (PS)$$

The prime mover will be 10 (PS) of Diesel engine of 1,800 R.P.M.

3. Study on Water Hammer

L	= Length of Pipe	382 m
K	= Volve elastic modulus of water	$2.07 \times 10^8 kg/m^2$
E	= Longitudinal elastic modulus of pipe	$2.5 \times 10^8 kg/m^2$
D	= Inner diameter of pipe	0.148 m (V.P.)
t	= Thickness of pipe	0.0085m (V.P.)
a	= Pressure Propagation Velocity	(m/sec)

(1) Pressure Propagation Velocity

$$a = \frac{1420}{1 + \frac{K}{E}\frac{D}{t}} = \frac{1420}{1 + \frac{2.07}{2.5} \times \frac{10^8}{10^8} \times \frac{0.148}{0.0085}} = 324 \text{ m/sec}$$

(2) Velocity of Flow in Pipe

$$= \frac{Q}{60 \times \frac{W}{4} \times D^2} \qquad Q = 1.8\ m^3/min$$

$$= \frac{1.8}{60 \times \frac{W}{4} \times (0.148)^2} = 1.744 \text{ m/sec}$$

(3) Constant of Pipeline: P

$2P = \frac{a.\ to}{g.h.}$ Where, g: Gravity acceleration 9.8 m/sec

H_o: Total head 18 m

(4) Up-Surging

(a) In case of rapid valve closing

Valve closing time To

$$To = \frac{2L}{a} = \frac{2 \times 382}{324} - 2.36 \text{ sec}$$

$$H_{max} = \frac{a.v_o}{g} = \frac{324 \times 1.744}{9.8} = 57.66$$

Therefore, as the water pressure proof of V.P. will be 6.0 kg/cm^2 (normal pressure), 5.77 kg/cm^2 < 6.0 kg/cm^2 will be sufficient.

3-1-5 Pilot Farm of Upland Irrigation

1. Topography and Climate Condition of Irrigation Area.

2. Determination of Amount of Irrigation Water Required.

a. Crops for irrigation and determination of its consumption of water (See 3-1-2 & 3-2-5A).

b. Irrigation area Au = 10 ha

c. Determination of amount of irrigation water for one time irrigation. In case of water requirement in depth in use. (Wd = 50mm)

Layer	Depth of Root Zone	Crop Water Consumption Ratio	F.C. 24	D.F. 3.0	Assumed Specific Gravity	A.M.	Limitted layer	T.R.A.M.	Amount Irrigation Water/ Time
						mm			
1	10am	40%				22.4	1st layer	55.8mm	55.8mm
2	10	30							x 0.85
3	10	20	30%	10%	1.12	"			÷ 50 mm
4	10	10				"			
Total	40					89.6			

d. Irrigation interval - Days necessary for covering irrigation area, 6 days.

T.R.A.M. x 0.35	Daily Maximum Consumption Water for Irrigation Crops	Irrigation Interval
50 mm	8 mm/day	$\frac{50}{8} = 6.22 \div 6$

e. Daily operation's time T = 15 hrs

f. Water requirement

Net water requirement 8.0 mm/day
Gross water requirement 8.0 ÷ 0.81 = 9.9 mm/day
= 1.14 ℓ/s/ha.

However, irrigation efficiency will be:

E = Ec x Ea = 0.95 x 0.85 = 0.81
Ec = Water movement efficiency
Ea = Water application efficiency

3. Elements of Sprinkler

a. From of irrigation area. (See Fig. 2-2)

Rectangular 200 m x 100 m block ---- 2 blocks
150 m x 100 m block ---- 2 blocks
150 m x 50 m block ---- 4 blocks

b. Length of sprinkler lateral (See Fig. 3-2)

Length of one side of blocks
In case of 100 m 92 m
In case of 75 m 68 m

c. Type and capacity of sprinkler

Intermediate pressure type, Rain Bird
No. 30B equivalent, Nozzler size 3/16" x 3/32" 7°
Working Pressure 3.16 kg/cm^2
Precipitation amount 32.4 1/min
Precipitation diameter D-29.9 m

d. Distance of sprinklers (S_1) and of laterals (S_2)

S_1 = 12 m, S_2 = 18 m

e. Number of sprinklers

Length of laterals, in case of 92 m 8 (See Fig. 3-2)
in case of 68 m 6 (See Fig. 3-2)

4. Sprinkling Strength and Set Number

a. Sprinkling Strength

$$1\ (mm/hr) = \frac{60 \times q}{S_1 \times S_2} = \frac{60 \times 324}{12 \times 18} = \frac{1940}{216} \div 9.0\ mm/hr$$

b. Irrigation hour requirement

$$t_1 = \frac{Wd \times 1/Ea}{1} = \frac{50 \times 1/85}{9.0} = 6.55\ hrs$$

c. Moving and setting hours t_2 = 0.5 hrs

d. Lateral hour requirement $t_1 + t_2 = 6.55 + 0.5 = 7.05$ hrs

Number of moving per day 7.05 hr x 2 times = 14.1 hrs

moving, 2 times

e. Determination of set number required.

A type = sprinkler 8 numbers, length of lateral 92 m

q6 = 32.4 1/min x 8 = 259.2 1/min

Covering area (ha) of 1 set per day.

Covering area of 1 set 100 m x 18 m = 1,800 m^2

Two time movement per day 1,800m^2x2=3,600m^2/day

In 6 day irrigation interval.

Covering area 3,600m^2/day x 6 day = 2,600m^2 = 2.16ha

In case of B type sprinkler 6 sets

Length of lateral 68 m

q_6 = 32.4 l/min x 6 sets = 194.4 l/min

Covering area (ha) of 1 set 75 m x 18 m = 1,350 m^2

Two time movement per day 1,350 m^2 x 2 = 2,700 m^2/day

Covering area 2,700 m^2 x 6 days = 16,200 m^2 = 1.62 ha

In case of A type 2 sets, areas supplied in 6 days will be:

2.16 ha x 2 = 4.32 ha 4.0 ha proper

In case of B type 3 sets, areas supplied in 6 days will be:

1.62 ha x 3 = 4.86 ha 6.0 ha improper

In case of B type 4 sets, areas supplied in 6 days will be:

1.62 ha x 4 = 6.48 ha 6.0 ha proper

5. Determination of System Capacity

a. Field stream $Q_f = \frac{9.9 \times 10}{8.64} \times \frac{24}{15}$ = 18.29 l/sec/10 ha

= 1,097.4 l/min/10 ha

b. Rotation block area $A = \frac{18.29}{0.185 \times 9.9} \div 10$ ha

c. But A type sprinkler set

259.2 l/min x 2 set = 518.4 l/min/set

B type sprinkler set

194.4 l/min x 4 set = 777.6 l/min/set

Total 1,296 l/min/6 set/10.8

For running 6 sets at the same time, it will become 1,296 l/min 1,097.4 l/min. Therefore, it will be regulated by farm pond.

In case of 1,097.4 l/min of field stream, 10 ha will be supplied in 6 days and in 1,296 l/min of field stream, 10.8 ha will be supplied in 6 days.

d. In this pilot farm, the system capacity will be the capacity of 6 sets which will be operated at the same time.

6. Determination of Size of Main and Lateral Pipes

a. Arrangement of main pipe (see attached diagram). The structure of water pipe and hydrant will be useful in maintenance and operation. Pipes will be classified with regulating valve from water supply pipe. An underground hydrant system will be installed to prevent damage to farm area.

b. Size of Main pipe: The diameter of pipes was decided in the scope of the velocity of flow in pipes, v = 1.0 1.5 m/s from the computation of friction head loss (see paragraph 3-1-4, 2). Asbestos cement pipe and solid vinyl chloride pipe (JISK 6742), were selected.

c. Arrangement and Size of Lateral Pipe: The lateral pipe will be portable type, the arrangement will be that of A-1, A-2, B-1, B-2, B-3 and B-4 in Fig. 3-2. The size of laterals will be decided so as to be 20 % or less difference between the first and the end of each lateral.

A-type (8 piece stand q = 259.2 l/min = 4.32 ℓ/s)

ϕ 50 mm Almi $H_f \fallingdotseq \frac{140}{1000}$ $V \fallingdotseq 2.3$ m/s

$0.4 \times H_f = 0.4 \times 92 \times \frac{140}{1000} = 5.16$ 6.3 ... proper

* 3.16 kg/cm^2 x 0.2 $\fallingdotseq$ 0.63 kg/cm^2 6.3 m

B-type (6 piece stand) q = 194.4 ℓ/s = 3.24 ℓ/s

ϕ 50 mm Almi $H_f = \frac{63}{1000}$ v = 1.55 m/s

$0.4 \times H_f = 0.4 \times 68 \times \frac{63}{1000} = 4.28$

$\fallingdotseq 4.3$ m 6.3 .... proper

7. Determination of Required Power

a. Determination of Head Required

(1) Loss of the structure of main pipe and supply hydrant. Design condition will be the structure of hydrant at the end of water supply pipe, L_5.

$l = l_1 + l_2 + l_3 = 125 + 180 + 317 = 622$ m

$H_s = H_{f1} + H_{f2} + H_{f5} = 1.5 + 1.8 + 7.6 = 10.9$ m

Loss of stand pipe with Machino's type, angle pipe, ϕ 2" = 2.5 m

$H = 10.9 + 2.5 = 13.4$ m

(2) Loss of Lateral Pipe

In case of applying water pressure of 3.16 kg/cm^2 by the sprinkler at the end of B- 3 set, $0.4 \times H_f = 4.3$ m

(3) Pressure of Sprinkler ---- 3.16 kg/cm^2

(4) Loss of Pump 3.60 m

Required head 13.7 + 4.3 + 31.6 + 3.6 = 53.0 m
Estimate about 10% surplus 53.0 x 1.1 = 58.3 m ≒ 59.0 m
Output of motive power $P_w = 0.222 \times r \times Q \times H$
$= 0.222 \times 1.0 \times 1.32 \times 59.0$
$= 17.3$ (PS)

$$\text{Shaft power } P_m = \frac{Pw\,(1+\ )}{q_p \times q_t} = \frac{17.3\,(1+0.20)}{0.59 \times 0.95} = 37.0 \text{ PS}$$

: Surplus 20 %
q_p : Pump efficiency 59 %
q_t : Transmission efficiency 95 %

The prime mover will be 40 PS of Diesel engine of 1,800 R.P.M.

8. Elements of Booster Pump

a. Design pump lift capacity: 0.022 m^3/s = 1.32 m^3/min

b. Type: Horizontal multistage suction volute pump: 125 mm aperture - 1

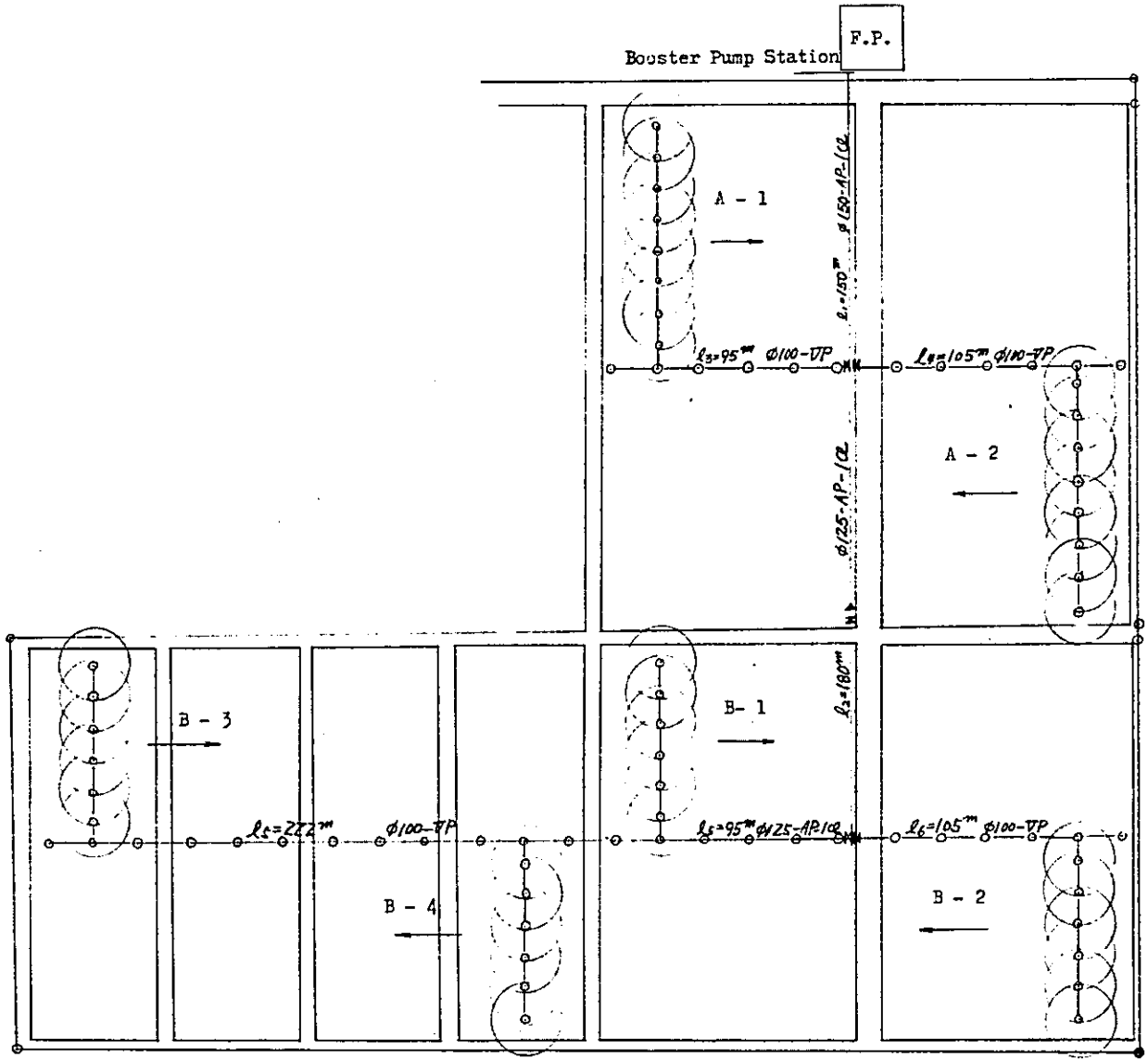
c. Design intake level: EL 46.50 m

d. Center height of pump shaft: 49.50 m

e. Intake pipe: 125 mm steel pipe

f. Water pipe: 125 mm steel pipe

FIG 3-2 SPRINKLER IRRIGATION LAYOUT (PLANE)



F.P Farm pond

Main pipe

Supply pipe

Hydrant

Air vent

Sluice gate work

8 stand 2 sets, A-Type, 6 stand 4 sets, B-Type, of sprinklers will be provided.

Movement will be made in 12m of sprinkler's space and in 18m of lateral's space.

Main pipes & supply pipes will be buried. Sprinkler laterals will be movable pipes.

S = 1/2000

3-2 Facility of Water Source

3-2-1 Topography and Geology

1. Topography

The Agricultural Development Center is located on the plateau of a small hill, low paddy fields are located between small hills. The difference in elevation between plateau and low paddy fields will be about 4-8 m. Topographical gradient at the neck part of the low paddy field upstream of the proposed dam site is less than 1/100, and here low paddy fields branch into three directions at a point 560 m from the dam site. The largest area is about 1,400 m in length, and about 70 m in average width from the junction. Catchment area (2.73 km^2) was determined by the result of the survey.

2. Geology

The Tegineneng Center consists of high land and low lands formed by torrents of water during past rain seasons. On the whole, soil is gray brown in color and of Laterite type, which is a characteristic of tropical zones and covers the entire surface. This layer will be 15-20 cm in thickness and changed into cohesive soil containing soil in gray white color to the lower layer and a layer containing weathered iron of gray brown is mixed with cohesive soil of gray white at over 1.00 m in depth and the lower layer will become fine sand and silt layer containing coarse sand and gravel at 170-200 cm in depth. In the excavation of test pit, the test hole has been excavated vertically and no failure of walls could be found. The revealed water level of ground water has been different in each hole.

3-2-2 Survey and Test Result

1. Foundation Survey and Test Result

Concerning the foundation of the dam site, the observation with the naked eye of the substratum under surface soil, the measurement of the thickness of course, the analysis of structural component, the estimation of underground water level have been made to excavate four test pits of 1.5 m in depth at the distance of about 14 m on the proposed dam axis line. (The locations of test pit, see Fig. 1, Dam Lateral-Profile), and the specific gravity, natural moisture percentage and analysis of grain size have been carried out to collect sample, from representative layers of test pit 1 and 2.

a. Geology Survey

The foundation of dam site consists of cohesive soil containing silt at the substratum of surface soil and sandy soil containing gravel, sandy silt and clay at the lower part. A summary of the investigation and results are as follows:

Table of Soil Strata at Dam Site

	Test Pit				Total Thick-ness Strata	Average Strata Thick-ness	Remarks
	No. 1 (m)	No. 2 (m)	No. 3 (m)	No. 4 (m)			
Surface Soil	0.20	0.12	0.20	0.10	0.72	0.18	0.18
Sanday Silt	0.20	0.18	0.10	-	0.48	0.16	0.34
Silt	0.50	0.60	0.70	0.50	2.30	0.575	0.915
Cohesive Soil Containing Silt	0.70	0.40	0.80	1.00	2.90	0.725	1.640
Sanday Silt Containing Gravel	0.70	1.00	0.80	0.60	3.10	0.775	2.415
TOTAL	2.30	2.30	2.60	2.30	-	-	

b. Rest Result

(i) Coefficient of Permeability

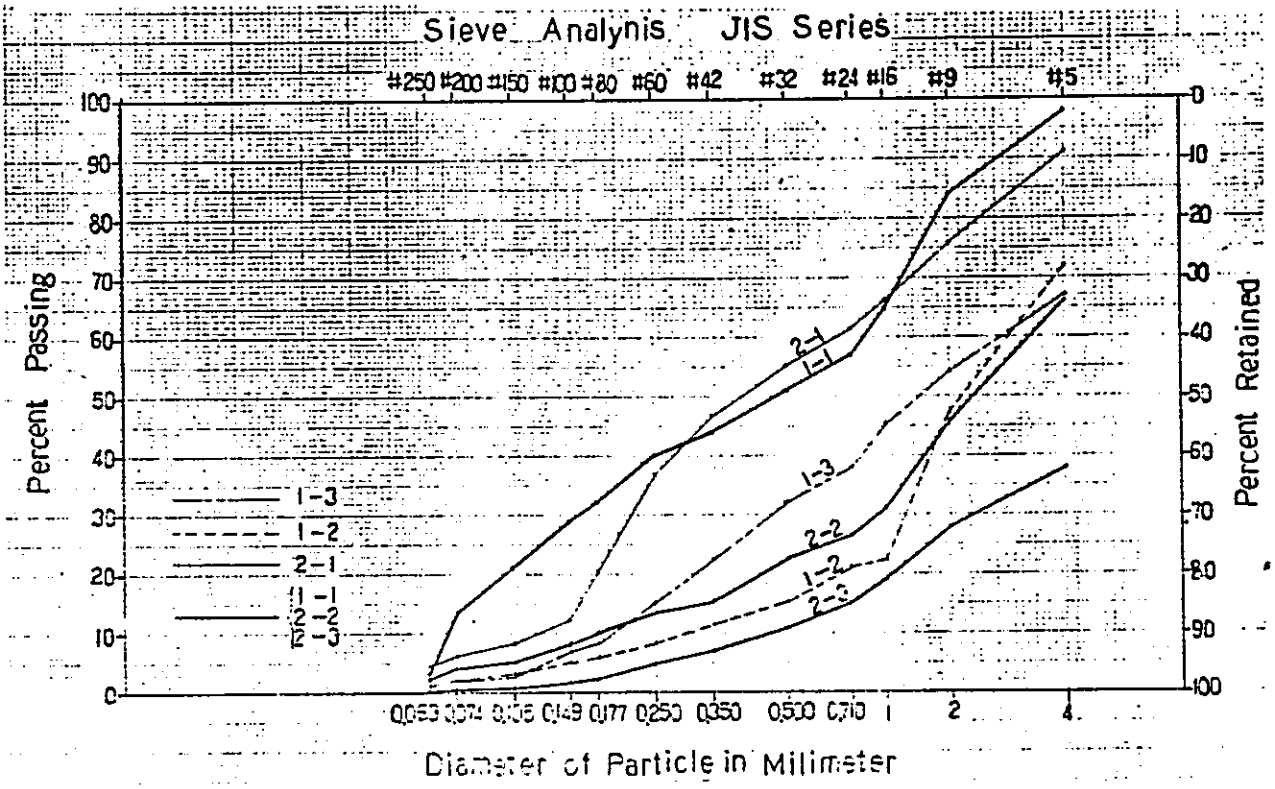
Table

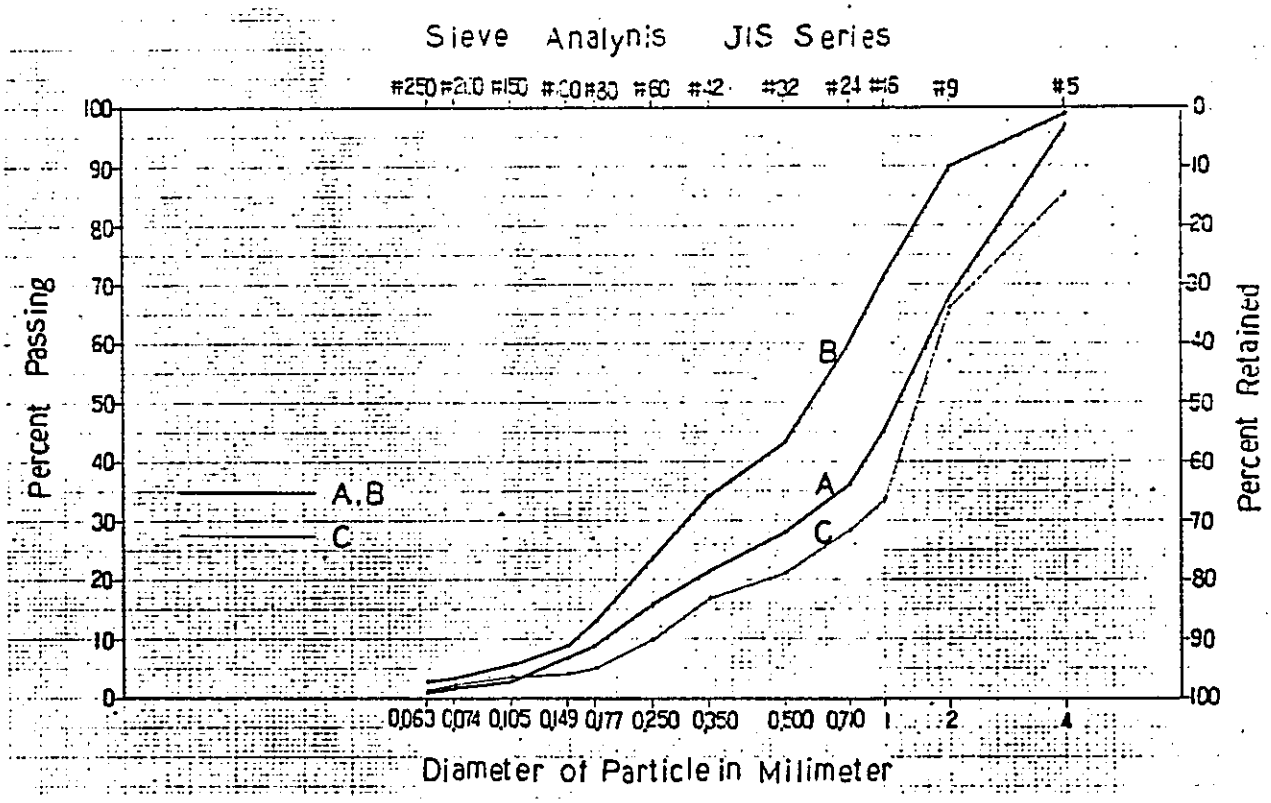
Coefficient of Permeab. / Soil Texture	K (cm/sec)	Remarks
Sandy Silt and Clay	5.5×10^{-4}	
Sandy Silt and Gravel	4.5×10^{-3}	

(ii) Soil Constant

Table

Sample No.	Sample	Sampling Depth D(m)	Gravity GS	Natural Moisture Content WF (%)	Particle D60	Particle D30	Particle D10	Mean Factor Cu	Curva-ture Factor Cc	Classifi-cation	Remarks
1-1	0.5D	0.50	2.513	10.11	0.668	0.200	0.123	5.43	0.49	SW-SM	Pin hole
1-2	100C 1.00	1.00	2.390	31.80	3.000	1.300	0.310	9.68	10.41	SP	
1-3	2.00B	2.00	2.616	24.76	3.00	0.455	0.200	15.00	0.35	SP	
2-1	0.70	0.70	2.617	15.23	0.830	0.155	0.071	11.69	0.40	SW-SM	
2-2	1.20	1.20	2.225	7.15	3.400	0.942	0.177	19.21	1.47	SP	Pin hole
2-3	230A	2.30	2.520	9.67	-	2.200	0.440	-	-	-	

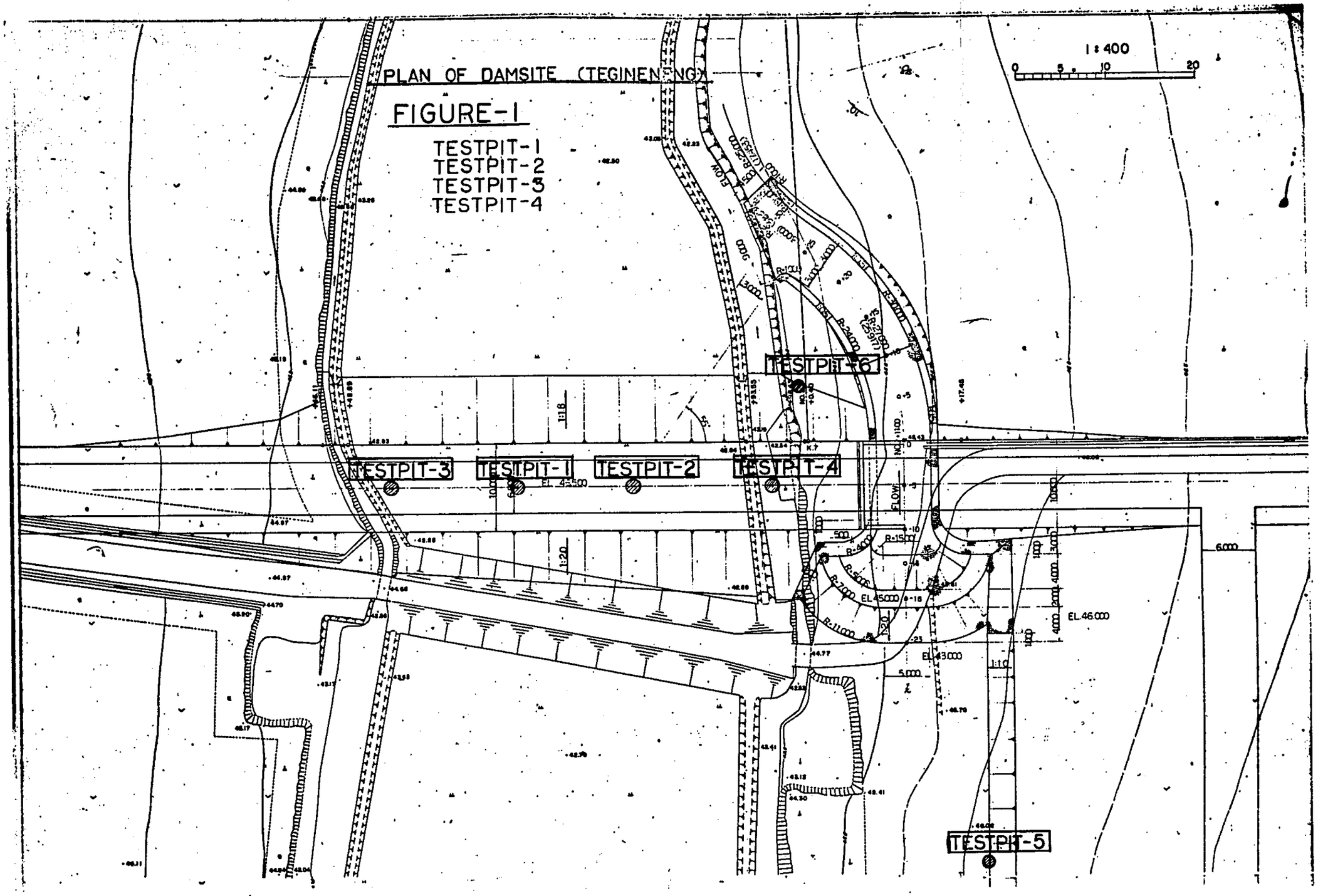

Sieve Analynis JIS Series
#250 #200 #150 #100 #80 #60 #42 #32 #24 #16 #9 #5
Percent Passing
Percent Retained
1-3
1-2
2-1
1-1
2-2
2-3
0.063 0.074 0.105 0.149 0.177 0.250 0.350 0.500 0.710 1 2 4
Diameter of Particle in Milimeter


Sieve Analynis JIS Series
#250 #200 #150 #100 #80 #60 #42 #32 #24 #16 #9 #5
Percent Passing
Percent Retained
A,B
C
B
A
C
0.063 0.074 0.105 0.149 0.177 0.250 0.350 0.500 0.710 1 2 4
Diameter of Particle in Milimeter

PLAN OF DAMSITE (TEGINENANG)

FIGURE-1

TESTPIT-1
TESTPIT-2
TESTPIT-3
TESTPIT-4



Test Pit - 1

Elev. (m)	Depth (m)	Mark	Soil Texture	Remarks
	0.00			
			Surface Soil	
	0.20			
			Silt with Fine Sand	Ash-colored
	0.40			
			← (Sample No.1-1)	
			Silt	Yellowish Brown and Ash-colored
	0.90			
			← (Sample No.1-2)	
			Silt and Clay	Brown and Ash-colored
	1.60			
			Fine Sand and Silt with Gravel and	
			← (Sample No.1-3)	
	2.00			
			Fine Sand and Silt with Gravel	Brown
	2.30			

Test Pit - 2

Elev. (m)	Depth (m)	Mark	Soil Texture	Remarks
	0.00			
			Surface Soil	
	0.12			
			Silt with Fine Sand	Ash-colored
	0.30			
			Silt	Yellowish Brown and Ash-colored
			← (Sample No.2-1)	
	0.90			
			Silt and Clay	Brown and Ash-colored
			← (Sample No.2-2)	
	1.30			
			Fine Sand and Silt with Gravel	
	1.90			
			Fine Sand and Silt with Gravel	Brown
	2.30		← (Sample No.2-3)	

Test Pit - 3

Elev. (m)	Depth (cm)	Mark	Soil Texture	Remarks
	0.00		Surface soil	
	0.20		Silt with Fine Sand	Ash-colored
	0.60		Silt	Yellowish Brown and Ash colored
	1.00		Silt & Clay	Brown and Ash colored
	1.80		Fine Sand and Silt with Gravel	and G.T.
	1.90		Fine Sand and Silt with Gravel	Brown
	2.30			

Test Pit - 4

Elev (m)	Depth	Mark	Soil Texture	Remarks
	0.00		Surface Soil	
	0.20		Silt	Ash-colored
	0.70		Silt and Clay	Brown and Ash-colored
	1.70		Gravel and Coarse Sand	
	2.30			

2. Investigation of Banking Materials and Test Results

a. Proposed banking materials will be collected from the plateau on the right bank immediately upstream of the dam site. The reasons for deciding on the plateau as borrow pit are that the average distance of transporting the earth to the proposed place of banking is quite close (70 m) and that works such as surface soil removal and excavation from the reservoir basin will be easy and economical.

b. The test of soil analysis has been executed to collect soil samples from the proposed place of borrow pit for judging the suitability as banking material. Its results will be summarized according to the following table.

(1) Survey of Amount of Assessment

Borrowing area of the proposed borrow pit of dam materials will be A = 3,300 m^2, borrowing mean depth, D = 2.0 m.

Therefore, the amount of assessment, V will be:

V = 3,300 m^2 x 2.0 m = 6,600 m^2

(Concerning its shortage, the amount of the excavated soil of spillway, 1,080 m^3 will be used.)

(2) Test of Dam Materials

The test has been made for the estimation of suitability for banking material. Concerning the borrowing location, test pit - 5, test pit - 6 are shown in the general plan (1:200).

Sample No.	Sample	Sampling Depth D (m)	Gravity Gs	Moisture Content W (%)	Practicle			Mean Factor Cu	Curvature Factor Cc	Classification	Remarks
					D60	D30	D10				
A	F.A.	0.7	2.51	-	1.600	0.598	0.192	8.33	2.16	SP	Farm
B	F.B	0.8	2.53	33.8	0.710	0.310	0.157	4.52	0.86	SP	Borrow pit
C	DamR	0.0	2.51	-	1.800	0.797	0.257	7.20	1.41	SP	Spillway

3-2-3 Dam Axis and Dam Type

1. Determination of Dam Axis

The dam axis will agree with the center line of the main road of 10 m in the farm as shown in the general plan.

2. Determination of Dam Type

According to the result of geological survey in the borrow-pit and spillway area, it was concluded that both soil was nearly the same. A homogeneous type dam was adopted by considering the scale of Dam and the execution of the work.

3-2-4 Determination of Design Flood Discharge

1. Probable Rainfall

a. Rainfall Data (Period 1952-1970, in Metro)

Date	Daily Rainfall
1952 November	131 mm/day
1953 May	144 "
1954 May	81 "
1955 March	130 "
1956 August	144 "
1957 January	87 "
1958 January	103 "
1959 May	68 "
1960 December	90 "
1961 February	115 "
1962 September	134 "
1963 February	105 "
1964 January	120 "
1965 November	75 "
1966 April	80 "
1967 January	56 "
1968 July	96 "
1969 April	95 "
1970 January	109 "

	/n	Daily Rainfall	Date
1	0.053	144 mm/day	1953 May
2	0.105	144 "	1956 August
3	0.158	134 "	1962 September
4	0.211	131 "	1952 November
5	0.263	130 "	1955 March
6	0.316	120 "	1964 January
7	0.368	115 "	1961 February
8	0.421	109 "	1970 January
9	0.474	105 "	1963 February
10	0.526	103 "	1958 January
11	0.579	96 "	1968 January
12	0.632	95 "	1969 April
13	0.684	90 "	1960 December
14	0.737	87 "	1957 January
15	0.789	81 "	1954 May
16	0.842	80 "	1966 April
17	0.895	75 "	1965 November
18	0.947	68 "	1959 May
19	1.000	56 "	1967 January

b. Computation of Probable Rainfall and Results

(1) Computation

The computation was performed by computer.

***** PROBABILITY RAINFALL IN METRO *****

TABLE OF PROBABILITY RAINFALL (1)

NO	XI	LOG(XI)	XI+B	LOG(XI+B)	AA	AA*AA
1	144.0	2.1584	144.00	2.1584	0.1580	0.0250
2	144.0	2.1584	144.00	2.1584	0.1580	0.0250
3	134.0	2.1271	134.00	2.1271	0.1267	0.0161
4	131.0	2.1173	131.00	2.1173	0.1169	0.0137
5	130.0	2.1139	130.00	2.1139	0.1136	0.0129
6	120.0	2.0792	120.00	2.0792	0.0788	0.0062
7	115.0	2.0607	115.00	2.0607	0.0603	0.0036
8	109.0	2.0374	109.00	2.0374	0.0370	0.0014
9	108.0	2.0212	108.00	2.0212	0.0208	0.0004
10	103.0	2.0128	103.00	2.0128	0.0124	0.0002
11	96.0	1.9823	96.00	1.9823	-0.0181	0.0003
12	95.0	1.9777	95.00	1.9777	-0.0227	0.0005
13	90.0	1.9542	90.00	1.9542	-0.0461	0.0021
14	87.0	1.9395	87.00	1.9395	-0.0609	0.0037
15	81.0	1.9085	81.00	1.9085	-0.0919	0.0084
16	80.0	1.9031	80.00	1.9031	-0.0973	0.0095
17	75.0	1.8751	75.00	1.8751	-0.1253	0.0157
18	68.0	1.8325	68.00	1.8325	-0.1679	0.0282
19	56.0	1.7482	56.00	1.7482	-0.2522	0.0636

***** PROBABILITY RAINFALL IN METRO *****

TABLE OF PROBABILITY RAINFALL (2)

W	KSI	C	CC	D	CC+D	E	B	XI
2	0.0	8.7257	0.0	2.0004	2.0004	100.09	0.0	100.09
5	0.5951	8.7257	0.0965	2.0004	2.0968	124.98	0.0	124.98
10	0.9062	8.7257	0.1469	2.0004	2.1473	140.37	0.0	140.37
50	1.4522	8.7257	0.2354	2.0004	2.2358	172.09	0.0	172.09
100	1.6450	8.7257	0.2666	2.0004	2.2670	184.93	0.0	184.93

(2) Results

Results of Computation of Probable Daily Rainfall

2 year	100.09 mm/day
5 "	124.98 "
10 "	140.37 "
50 "	172.09 "
100 "	184.93 "

2. Design Flood Discharge of Spillway

a. Determination of Design Flood Discharge

(1) Determination of Design Rainfall Intensity

The design rainfall intensity will be calculated by the following formula:

$$r_t = \frac{r24}{24} \left(\frac{24}{t} \right)^n$$

Where, r_t: Design hourly rainfall intensity (mm/hour)

r24: Probable daily rainfall of 100 years
184.93 (mm/day)

t : Arrival time of flood 1.0 hour

n : Precipitation index 0.5

$$r_t = \frac{184.93}{24} \left(\frac{24}{1}\right) 0.5 = 37.75 \text{ mm/hour}$$

$$37.75 \times 1.2 = 45.3 \text{ mm/hour}$$

(2) Determination Design Flood Discharge

The design flood discharge will be calculated by the following formula:

$$Q = \frac{1}{3.6} \cdot f \cdot r_t \cdot A$$

Where, Q: Design flood discharge m^3/sec

f : Rounoff ratio 0.55

r_t: Design rainfall instensity 45.3 mm/hour

A = Catchment area 2.73 km^3

$$A = \frac{1}{3.6} \times 0.55 \times 45.3 \times 2.73 = 18.89 \text{ } m^3/sec$$

Therefore, the design flood discharge will be 18.9 m^3/sec.

3-2-5 Determination of Scale of Dam Body

1. Design of Reservoir

The scale of reservoir will be decided by field investigation survey and data concerned.

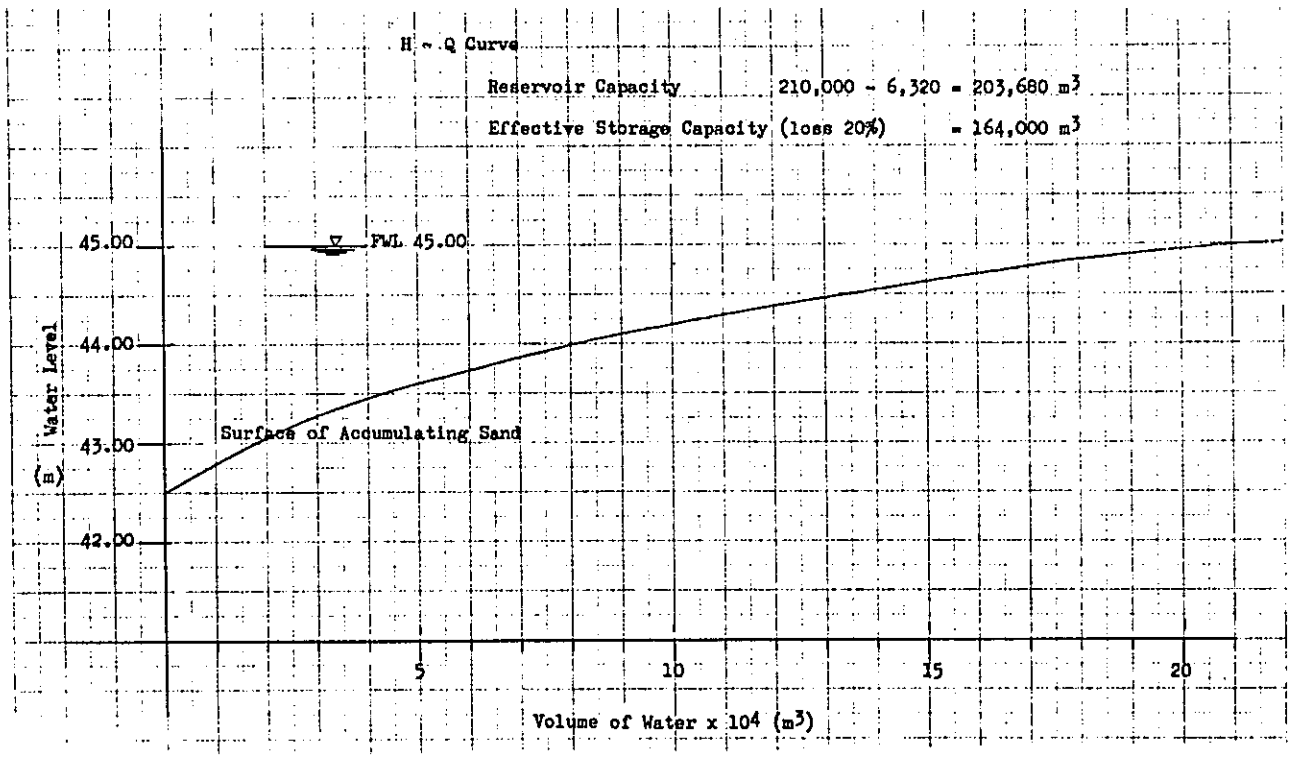
a. Reservoir Water Level and Reservoir Height-Capacity Curve.

The reservoir capacity has shown the relation with the resorvoir water level due to the topography survey. (See Reservoir Height-Capacity Curve.)

b. Reservoir Capacity

(1) Determination of Net Reservoir Capacity

(a) Designed Basic Year: The designed basic year will be probable rainfall of 10 years and be computed with the rainfall in dry season which is a definite factor and the year of 1966 has been adopted.



(b) Water Requirement in Area: 16-18 mm in the rain season and 12-13 mm in the dry season will be employed to conform with measured values of water requirement in depth (vertical percolation + evapotranspiration) in the growing season respectively at two places in the area. Concerning puddling water, 130 mm/ha/day will be used. (See attached Table 3-1). Time lag in each month will be established for paddy fields 6-8 mm being for water requirement for uplands. (See attached Table 3-2.)

(c) Inflow: After established runoff in each rainfall instensity respectively in designed basic year and investigation of the catchment area, 2.73 km^2 will be adopted. (See attachment Table 3-3.)

(2) Determination of Total Reservoir Capacity

(a) Net Reservoir Capacity: 158,877 m^3

(b) Reservoir Percolation:

Allowable maximum percolation	0.05 %/day
Mean percolation	0.025 %/day
Period (May-October)	184 days

$\therefore$ 158.877 x 0.025 %/day x 184 days = 7,300 m^3

(c) Lake Evapo-Transpiration:

May	June	July	August	September	October
6 mm/day	6	6	6	6	3

Total 6 mm/day x 153 days + 3 mm/day x 31 days = 1,011 mm

Lake Area 9.54 ha x mean lake area 1/3 = 3.18 ha

$\therefore$ Evaporation 3.18 ha x 1,011 mm = 32.150 m^3

(d) Assumed Amount of Accumulated Sand:

Compacted volcanic sand; therefor, 30 m^3/year km^2 will be adopted.

Mean durable year will be 80 years.

$\therefore$ Among of accumulated sand

= (2.73 km^2 - 9.54 ha) x 30 m^3/year km^2 x 80 year

= 6,323 m^3

(e) Daily Living Water Requirement and Other Water Required:

Daily living water requirement 250 l/day man x 100 mm/day x 184 days

$= 4,600\ m^3$

Other water required $= 742\ m^3$

(f) Total Reservoir Capacity:

Net reservoir capacity	$158,877\ mm^3$
Reservoir percolation	7,308
Lake evapo-transpiration	32,150
Amount of accumulated sand	6,323
Daily living water requirement	5,842
And other water required.	
TOTAL	=210,000

The total reservoir capacity will be $210,000\ m^3$.

The stationary full water level (F.W.L) will be F.W.L. = EL. 45.00 m from H-Q curve.

c. Summary of Design of Reservoir

(1)	Catchment Area	$A = 2.73\ km^2$
(2)	Total Reservoir Capacity	$V = 210,000\ m^3$
(3)	Amount of Accumulated Sand	$V_{wn} = 6,320\ m^3$
(4)	Effective Reservoir Capacity	$V_w = 164,290\ m^3$ ($\fallingdotseq 164,000\ m^3$)
(5)	Full Water Area	$A_w = 95,400\ m^2 = 0.095\ km^2$
(6)	Reservoir Water Level	H.W.L. = 45.75 m F.W.L. = 45.00 m D.W.L. = 43.00 m
(7)	Available Depth	$H_w = 2.00$ m

d. Attached Table

Attached Table 3-1. Water Requirement in Depth.

Puddling Water: Field capacity 100 mm + depth of flooding water, 30 mm = 130 mm

Vertical Percolation: Field constant head injection test

$$K = \frac{2.30 \times Q}{2h^2} \quad 10g_{10} \frac{h}{r_o} + 1 + \left(\frac{h}{r_o}\right)^2 - 1$$

$Q = 1.18\ cm^3/s$

$h = 53\ cm$

$r_o = 6\ cm$

$= 0.5\ cm$

$K = 9.4 \times 10^{-5}$

Water requirement in depth 8.1 mm/day ≒ 8 mm/day

Evapotranspiration

Month	Atomometer Amount of Evaporation	*2 Evapo-Transpiration	*3 Lake Evaporation	Water Requirement in Depth
JAN	4 mm	4 mm	2 mm	12 mm
FEB	4	4	2	12
MAR	6	5	3	13
APR	7	8	5	16
MAY	9	10	6	18
JUN	9	10	6	18
JUL	9	10	6	18
AUG	9	10	6	18
SEP	*1 9	10	6	18
OCT	6	5	3	13
NOV	4	4	2	12
DEC	4	4	2	12

* 1 The amount of evaporation in September was observed at the Metrological Observatory, Tegineneng Center, Bogor, and others. This data was considered and is annually alocated.

* 2 Concerning evapo-transpiration, 1.1 will be adopted for the dry season, 0.9 for the raining season.

* 3 Lake evaporation will be 0.7 in the dry season, and 0.5 in the rainy season.

Attached Table 3-2

Paddy field

		P1	P2	P3	P4	P5	Sub Total	Upland irrigation
Rainy season	Jan.	Nursery bed 1/20 130mm×12mm×14B =14.9 Surface soil puddling 130 Normal 12mm×15B=180 324.9	Preparation	Normal 12mm×31B=372	Normal 12mm×31B=372	Normal 12mm×31B=372	1,440.9	6mm×31B×10ha=1,860
	Feb.	Normal 12mm×28B=336	Nursery bed 1/20 130mm+12mm×14B =14.9 Surface soil puddling 130 Normal 12×12B=144 288.9	Preparation	12 × 28 =336	12 × 28 =336	1,296.9	" × 28 × " =1,680
	Mar.	Normal 13mm×31B=403	13mm×31B=403	Nursery bed 1/20 130 + 13 × 14 =15.6 Surface soil puddling 130 Normal 13 × 15B=195 340.6	Preparation	13 × 31 =403	1,549.6	" × 31 × " =1,860
	Apr.	Normal 16mm×30B=480	16 × 30 =480	16 × 30 =480	Nursery bed 1/20 130 + 18 × 14 =17.7 Surface soil puddling 130 Normal 16 × 14 =224 371.7	Preparation	1,811.7	8 × 30 × " =2,400
	May	Normal 18mm×31B=558	18 × 31 =558	18 × 31 =558	18 × 31 =558	Nursery bed 1/20 130 + 16 × 14 =19.1 Surface soil puddling 130 Normal 18 × 15 =270 419.1	2,651.1	" × 31 × " =2,480
Dry season	June	Preparation	18 × 30 =540	18 × 30 =540	18 × 30 =540	18 × 30 =540	2,160.0	" × 30 × " =2,400
	July	Nursery bed 1/20 130 + 18 x 14 =19.1 Surface soil puddling 130 Normal 18 × 15 =270 419.1	Preparation	18 × 31 =558	18 × 31 =558	18 × 31 =558	2,093.1	" × 31 × " =2,480
	Aug.	Normal 18 × 31 =558	Nursery bed 1/20 130 + 18 × 14 =19.1 Surface soil puddling 130 18 × 15 =270 419.1	Preparation	18 × 31 =558	18 × 31 =558	2,093.1	" × 31 × " =2,480
	Sept.	Normal 18 x 30 =540	Normal 18 × 30=540	Nursery bed 1/20 130 + 18 × 14 =19.1 Surface soil puddling 130 Normal 18 × 14 =270 419.1	Preparation	18 × 30 =540	2,031.1	" × 30 × " =2,400
Rainy season	Oct.	Normal 13 × 31 =403	13 × 31 =403	13 × 31 =403	Nursery bed 1/20 130 + 13 × 14 =15.6 Surface soil puddling 130 Normal 13 × 15 =195 340.6	Preparation	1,549.6	6 × 31 × " =1,860
	Nov.	Normal 12 × 30 =360	12 × 30=360	12 × 30 =360	12 × 30 =360	Nursery bed 1/20 130 + 12 × 14 =14.9 Surface soil puddling 130 Normal 12 × 14=168 312.9	1,752.9	" × 30 × " =2,400
	Dec.	Preparation	12 × 31 =372	12 × 31 =372	12 × 31 =372	12 × 31 =372	1,488.0	" × 31 × " =2,480

Attached Table 3-3 Reservoir Capacity

Amount of Inflow

	Month	Amount of rainfall	Items of calculation of water requirement								Amount of Inflow	
			Paddy field (5 ha)				Upland field (10 ha)				Height of run-off Amount of rainfall x f	Amount of inflow Height of runoff x catchment area (2.73 km^2)
			Net water requirement	Effective rainfall	Remainder	Gross water requirement	Net water requirement	Effective rainfall	Remainder	Gross water requirement		
				x 5 ha		/0.95		x 10 ha		/0.81	x 85 %	
		mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	m^3
Rainy season	Jan.	319	1,440.9	425.0	1,015.3	1,068.7	1,860	1,312	548	676.5	271.0	740,376
	Feb.	79	1,296.9	0	1,296.9	1,365.2	1,680	0	1,680	2,074.1	x 70 % 55.3	150,969
	Mar.	139	1,549.6	0	1,549.6	1,631.2	1,860	0	1,860	2,296.3	x 85 % 118.2	322,686
Dry season	Apr.	199	1,811.7	696	1,115.7	1,174.4	2,400	1,392	1,008	1,244.4	x 55 % 109.5	273,110
	May	12	2,651.1	0	2,651.1	2,790.6	2,480	0	2,480	3,061.7	x 20 % 2.4	6,552
	June	26	2,160.0	0	2,160.0	2,273.7	2,400	8	2,392	2,953.1	x 30 % 7.8	21,294
	July	32	2,093.1	0	2,093.1	2,203.3	2,480	256	2,224	2,745.7	x 30 % 9.6	26,208
	Aug.	1	2,093.1	0	2,093.1	2,203.3	2,480	0	2,480	3,061.7	0	0
	Sep.	28	2,031.1	0	2,031.1	2,138.0	2,400	0	2,400	2,963.0	x 30 % 8.4	22,932
Rainy season	Oct.	39	1,549.6	0	2,549.6	1,631.2	1,860	0	1,860	2,296.3	x 55 % 21.5	58,695
	Nov.	149	1,752.9	0	1,752.9	1,845.2	2,400	0	2,400	2,963.0	x 80 % 119.2	325,416
	Dec.	131	1,488.0	0	1,488.0	1,566.3	2,480	0	2,480	3,061.7	x 80 % 104.8	286,104
	Total	1,154										

Attached Table 3-4 Amount of Reliance on Reservoir

Month	Amount of rainfall	Needed gross water requirement of farm land				Amount of reliance on reservoir		
		Paddy field	Upland field	Sub Total	Volume x 10^4	Amount of inflow	Remainder	Amount of reliance
	mm	mm	mm	mm	m^3	m^3	m^3	m^3
Jan.	319	1,068.7	676.5	1,745.2	17.452	740,376	+722,924	0
Feb.	79	1,365.2	2,074.1	3,439.3	34.393	150,969	+116,576	0
Mar.	139	1,631.2	2,296.3	3,927.5	39.275	322,686	+283.411	0
Apr.	199	1,174.4	1,244.4	2,418.8	24.188	273,110	+248,922	0
May	12	2,790.6	3,061.7	5,852.3	58.523	6,522	- 61,971	-51,971
June	26	2,273.7	2,953.1	5,226.8	52.268	21,294	-30,974	-82,945
July	32	2,203.3	2,745.7	4,949.0	49,490	26,208	-23,282	-106,227
Aug.	1	2,203.3	3,061.7	5,265.0	52.650	0	-52,650	-158,877
Sept.	28	2,138.0	2,963.0	5,101.0	51.010	22,932	+17,831	-141,046
Oct.	39	1,631.2	2,296.3	3,927.5	39.275	58,695	+19,420	-121,626
Nov.	149	1,845.2	2,963.0	4,808.2	48.082	325,416	+277,334	0
Dec.	131	1,566.3	3,061.7	4,628.0	46.280	286,104	+239,224	0
Total	1154							

2. Determination of Scale of Dam Body

a. Determination of Free Board

The free board of low dam will be computed by the following formula.

$$H_f = 0.05\,H + 1.0$$

Where, H_f : free board (m)

H : Height from foundation to the maximum proposed water level (m)

HWL = 45.75 m, GH = 42.40 m

$\therefore$ H = HWL - GH = 3.35 m

$\therefore H_f = 0.05 \times 3.35 + 1.0 = 1.168$ m

Free board, H_f will become 1.168 m

(1) The Scale of Reservoir is small, but full water area A = 95,400 m^2 is large to total storage capacity V = 210,000 m^3. That is, due to V/A ≒ 2.2, the efficiency of storage will be high.

(2) This area is an area of no typhoon, strong wind and earthquake.

(3) The crest of dam will be proposed to use as main canal connecting road to the model farm. The width of the crest of dam will be 10.0 m, being 3 times wider than the normal width of low dam.

(4) Non-regulating type will be adopted for the spillway. A consideration has been paid to the reduction of the rising of water level to the runoff.

(5) The free board of 1.5 m from EL. 45.00 m at the normal water level till EL. 46.50 m at the dam crest will have a big portion to 2.00 m of normal water depth.

Considering the above, 100 % of 0.75 m of the overflow depth will be adopted for the free board. The free board over the normal full water level will be 1.5 m and the free board over the flood level will be 0.75 m.

b. Determination of Dam Height

(1) Determination of Elevation of Dam Crest

Elevation of Crest = Normal full water level + overflow water depth + free board

= 45.00 + 0.75 + 0.75

= 46.50 m

(2) Determination of Dam Height

According to the topographical profile, the elevation of the lowest foundation will be EL 40.40 m and will be considered as the elevation of the lowest excavation line.

Dam Height = Elevation of Dam crest - lowest elevation of ground

H_D = EL 46.50 - EL 40.40 = 6.10 m

c. Determination of Width of Dam Crest

(1) The width of crest of the low dam will be computed by the following formula.

$B_p = 0.2\,H + 2.0$ m 3.0 m

Where, B_p : Width of crest (m)

H : Height of dam: $H_D = H = 6.10$ m

$B_p = 0.2 \times 6.1 + 2.0 = 3.22$ m 10 m

(2) The crest of dam will be utilized as main canal connecting road, the width being the same as that of model farm.

B_D = 10.0 m

d. Definit Map of Scale of Dam Body.

Dafinite Map of Scale of Dam Body

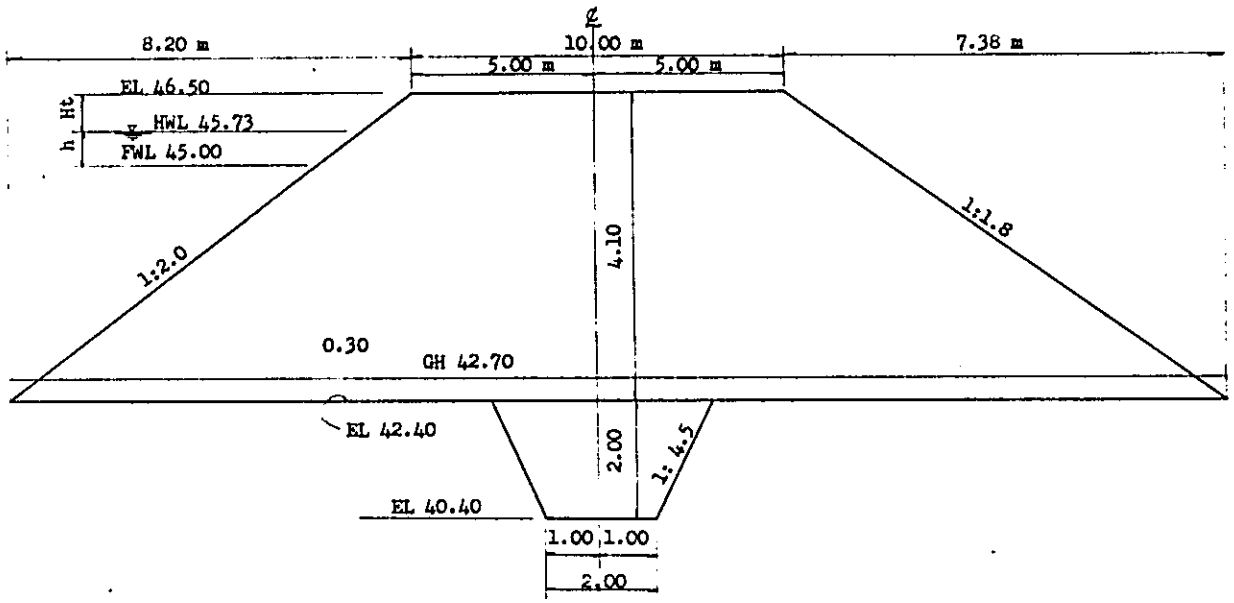


FIG 3-1 PLAN OF DAMSITE (TEGINENENG)

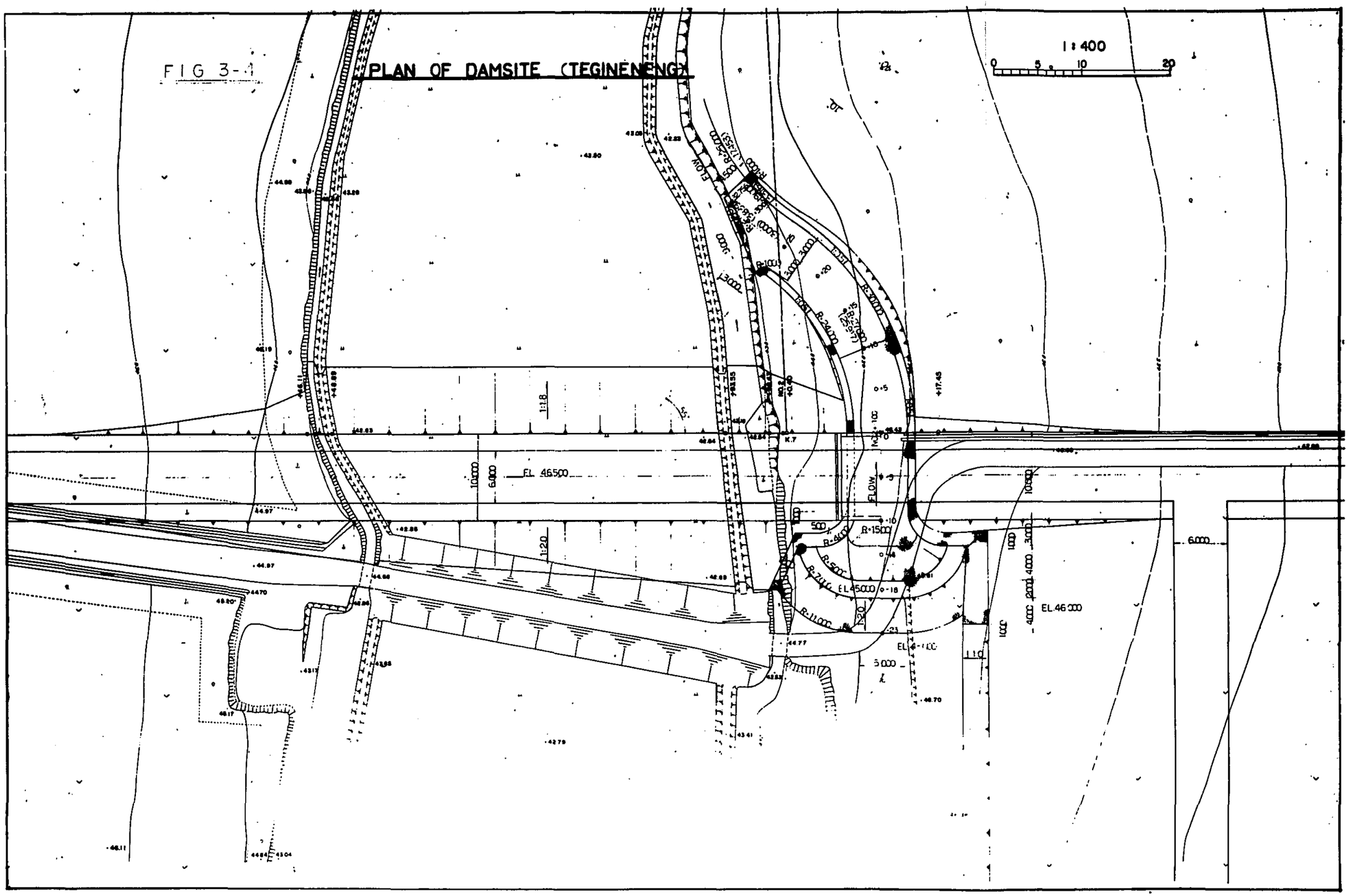
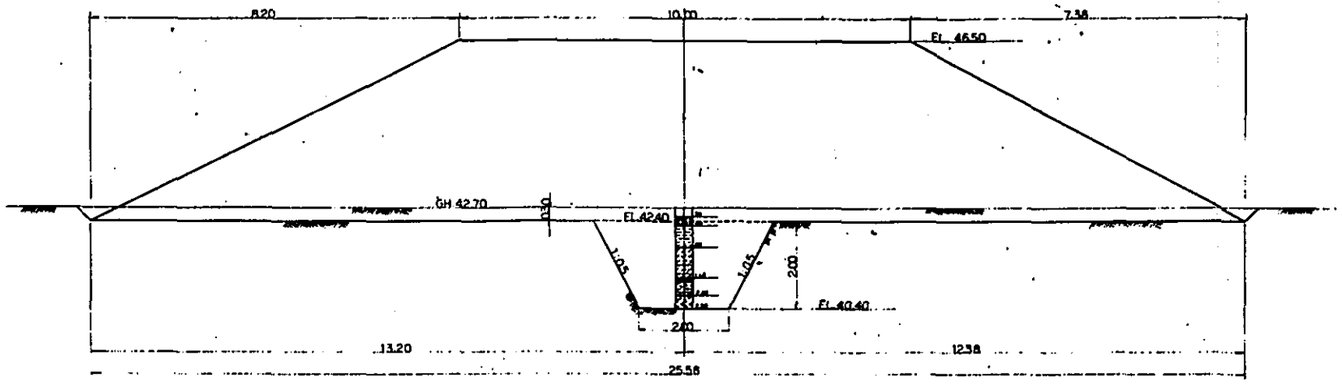
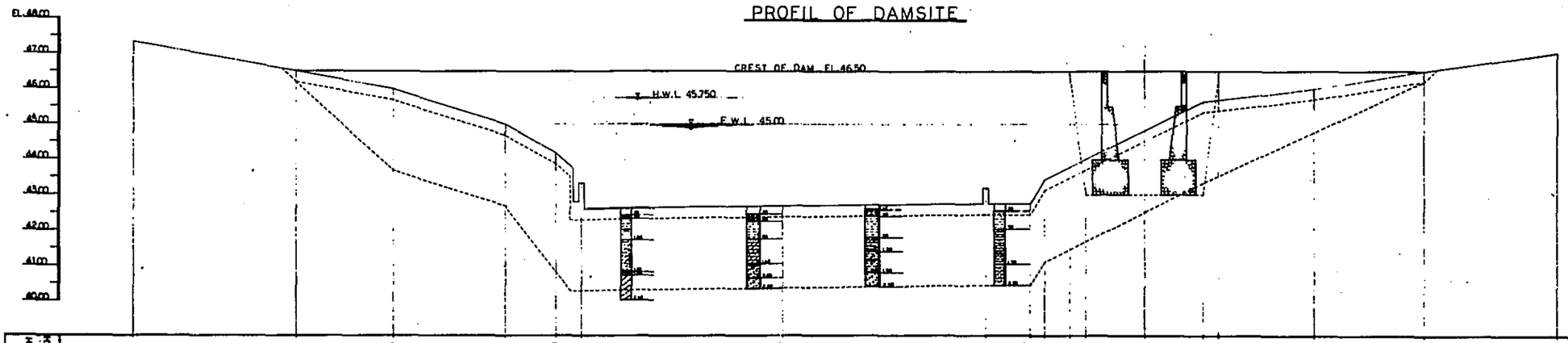


FIG 3-5 CROSS SECTION OF DAM



PROFIL OF DAMSITE



STA.	DIST.	ACCUM DIST.	EXIST GROUND ELEV	DEPTH OF SURFACE SOIL REMOV	DEPTH OF TRENCH
NO. 1	0	0	49.31		
+17.45	17.45	17.45	46.69	0.30	0
+29.30	10.45	28.20	46.00	0.30	2.00
+48.00	12.20	48.50	45.00	0.30	2.00
+46.11	5.41	46.11	44.17	0.30	2.00
+48.89	2.78	48.89	43.33	0.30	2.00
+71.22	22.33	71.22	42.90	0.30	2.00
+93.55	22.33	93.55	43.19	0.30	2.00
+98.43	4.88	98.43	42.74	0.30	2.00
NO 2	1.57	100.00	43.44	0.30	2.00
+102.75	2.75	102.75	43.19	0.30	2.00
+104.50	1.75	104.50			
+111.00	6.50	111.00		0.30	2.00
+117.45	6.45	117.45	45.64	0.30	2.00
+119.20	1.75	119.20	45.70	0.30	1.26
+129.45	10.25	129.45	46.00	0.30	0.99
+141.45	12.00	141.45	46.00	0.30	0
+154.90	13.45	154.90	47.00		

EXPLANATORY NOTES

- SURFACE SOIL
- SILT WITH FINE SAND
- SILT
- SILT AND CLAY
- FINE SAND AND SILT WITH GRAVEL AND G.T.
- FINE SAND AND SILT WITH GRAVEL
- GRAVEL AND COARSE SAND

LAMPUNG AGRICULTURAL DEVELOPMENT PROJECT
LAMPUNG INDONESIA

CROSS SECTION OF DAM
PROFIL OF DAMSITE

OVERSEAS TECHNICAL COOPERATION AGENCY
TOKYO, JAPAN

DESIGNED	JAPAN IRRIGATION AND RECLAMTION CONSULTANTS		
SUBMITTED		DATE	
APPROVED		DRAWING No.	

3-2-6 Design of Dam Body

1. Design Value of Embankment Materials

Though embankment materials of this project are deemed to be "SP" materials as a result of the mechanical analysis, almost all soil near the dam site consists of clay containing silt in Latosol system and is considered that these are different in quality from "SP" materials which are shown in the information of (Earth and Earth-Rock Dams). It is decided to conform with informations reflected in (ICHTISAR HASIL^2 PENIELIOIKAN LABORATORIUM MEKANIKA TANAN L, P, M, A, UNTUK, TJONTOH^2 DARI). (See p. 83. Table of Soil Test Results)

a. Standard Value

(1) Specific Gravity of Soil Particle (G_{SM})

$$G_{SM} = \sum^{n} \frac{1\ GSi}{n} = \frac{2.51 + 2.53 + 2.51}{3} = 2.517 \fallingdotseq 2.52$$

(2) Natural moisture content (WFM)

$$WFM = 33.8 \fallingdotseq 34.0\ \%$$

(3) Optimum moisture content (WoptM)

$$WoptM = \frac{\sum^{n} Li = 1\ Wopti}{n} = \frac{171.30}{4} = 42.825 \fallingdotseq 42.8\ \%$$

(4) Maximum dry density (T dmax M)

$$T dmaxM = \frac{\sum^{n} Li = 1\ \ TdmaxM}{n} = \frac{4.85}{4} = 1.213 \fallingdotseq 1.21\ tm^3$$

2. Unit Weight

a. Dry density (Td)

(1) Max. dry density (T dmaxM)

Mean value

$$T\ dmaxM = 1.21\ t/m^3$$

Standard deviation

$$Trd = \sqrt{\frac{1}{n-1}\left(Tdmax_1 - TdmaxM\right)^2 + \ldots . (Tdmax - TdmaxM)^2}$$

$$= \sqrt{\frac{1}{4-1} \times 0.0019} = 0.025 \fallingdotseq 0.03$$

Table of Soil Test Results

Sample Number	Depth of Sampling	Specific Gravity	Tamping Test			Direct Shear		Permeability Test	Remark
			Max. Moisture Content Wopt (%)	Max. Dry Density Dmax (t/m^2)	Moisture Density (t/m^2)	Cohesion C(t/m^2)	Angle of Interval Friction (Degree)	Permeability Coefficient (cm/sec)	
No.	D(m)								
ST-A1	0.50 1.50	2.67	39.2	1.21	1.68	1.50	28°30'	8.1×10^{-9}	
ST-A2	0.50 1.50	2.67	42.1	1.24	1.76	1.10	37°30'	5.7×10^{-9}	
ST-B	2.00 3.00	2.66	46.5	1.18	1.73	1.90	14°30'	5.0×10^{-9}	
S II	0.50 1.50	2.61	43.5	1.22	1.75	2.30	28°15'	8.5×10^{-9}	
Mean Value		2.65	42.8	1.21	(1.73)	1.70	27°11'	6.8×10^{-9}	

Note 1) : $Tt = (1 + \frac{W}{100}) T\,dmax$

Dry density

$$T\,dmaxM' = T\,dmaxM - \frac{1}{2}\,\delta\,rd$$

$$= 1.21 - \frac{1}{2}\,0.03 = 1.195 \fallingdotseq 1.19\ t/m^3$$

(2) Dry density 90 %

$$Td95 = T\,dmaxM \times 0.9$$

$$= 1.21 \times 0.9 = 1.089 \fallingdotseq 1.00\ t/m^3$$

Therefore, as that will become $T\,d90 < T\,dmaxM$, $T\,d90$ will be adopted to consider construction condition.

$\therefore Td = Td90 = 1.0\ t/m^3$

b. Moisture Content (W)

i) Natural moisture content (WFM)

WFM = 34.0 %

ii) Optimum moisture content (WoptM)

Mean value

WoptM = 42.8 %

Standard deviation

$$\delta \text{ Wopt} = \sqrt{\frac{1}{4-1}} \times 27.63 = 3.0347 \fallingdotseq 3.03$$

Moisture content

$$\text{WoptM}' = \text{WoptM} \pm \delta \text{ Wopt}$$

$$= 42.8 \pm 3.03 = \begin{cases} 45.83 \fallingdotseq 45.8\ \% \\ 39.77 \fallingdotseq 39.8\ \% \end{cases}$$

Therefore, WFM will be adopted for moisture content to consider i), ii) and safety of dam body, term of construction & etc.

$$\therefore W = WFM = 34.0\ \%$$

c. Moisture density (T_t)

$$T_t = T_d (1 + W)$$

$$\therefore T_t = 1.0 (1 + 0.34) = 1.34\ t/m^3$$

d. Porosity (ℓ)

$$\ell = \frac{Gs}{Td} - 1$$

$$\therefore \ell = \frac{2.52}{1.34} = 1.88$$

e. Saturated Weight (T_{sat})

$$T_{sat} = \frac{G + \ell}{1 + \ell} T_w$$

$$\therefore T_{sat} = \frac{2.52 + 1.88}{1 + 1.88} \times -1.0 = 1.527 \fallingdotseq 1.53\ t/m^3$$

f. Weight in Water

$$T_{sub} = T_{sub} - T_w$$

$$\therefore T_{sub} = 1.53 - 1.0 = 0.53\ t/m^3$$

3. Shearing Strength

a. Angle of internal friction (ϕ)

$$\phi_m = \frac{\sum_{i=1}^{n} \phi i}{n} = \frac{108.75}{4} = 27,1875 \fallingdotseq 27°11'$$

$$\rho\phi = \sqrt{\frac{1}{n-1} (\phi - \phi m)^2 + (\phi_2 - \phi m)^2 + \ldots . (\phi n - \phi m)^2}$$

$$= \sqrt{\frac{1}{4-1} \times 271,482} = 9.5128 \fallingdotseq 9°30'$$

$$\phi = \phi m - \rho\phi$$

$$= 27.1875 - 9.5128 = 17,6747$$

$$\therefore \quad \phi = 17,6747 \fallingdotseq 17°40'$$

$$\therefore \tan\phi = 0.3185$$

b. Cohesion (C)

$$Cm = \frac{\sum_{i=1}^{n} Ci}{n} = \frac{6.8}{4} = 1.7 \text{ t/m}^2$$

$$C = \sqrt{\frac{1}{4-1}} \times 0.8 = 0.5163$$

$$C = Cm - \delta C$$

$$\therefore C = 1.7 - 0.5163 \fallingdotseq 1.2 \text{ t/m}^2$$

c. Coefficient of Permeability

The mean value of coefficiency of permeability will be km - 6.8×10^{-9} cm/sec, the design density being dmax x 90 %.

The value of coefficiency of design permeability will be as follows.

$$k = 5.0 \times 10^{-6} \text{ cm/sec}$$

d. Summary of Design values

The summary of design values in dam body will be as follows.

General Table of Design Values

Moisture Content W(%)	Unit Weight				Shearing Strength			Coefficiency of Permeability k	Remark
	rd	rt	r sat	r sub	C	ϕ	tanϕ		
	t/m^3	t/m^3	t/m^3	t/m^3	t/m^2	(degree)		(cm/sec)	
34.0	1.0	1.34	1.53	0.53	1.2	17°40'	0.3185	5.0×10^{-6}	

2. Water Seepage Examination

a. Wetted Line of Dam Body

In case of stationary full water level (FWL 45.00), the wetted line will be obtained to use Casagrande Method.

(1) Basic Values

$1 = 5.20$ m

$2 = 0.3\ 1 = 1.56$ m

$d = 0.3\ 1 + 2 = 21.94$ m

$h = 2.60$ m

(2) Basic Parabola

$$Y\,o = \sqrt{h^2 + d^2} - d = \sqrt{2.60^2 + 21.94^2} - 21.94 = 0.15\text{m}$$

$$\therefore\ X = \frac{y^2 - yo2}{2yo} = \frac{y^2 - 0.154^2}{2 \times 0.154} = \frac{y^2 - 0.024}{0.308}$$

Scheme Table of Basic Parabola (Wetted Line)

Y	0	0.5	1.0	1.5	2.0	2.5
X	0.077	0.734	3.169	7.227	12.909	20.021

(3) Revision of Basic Parabola

$$\tan d = \frac{4.10}{7.38} = 0.555$$

$\therefore\ d \doteqdot 29°03'$

Percolated sheet (a) is:

$$a + \Delta a = \frac{yo}{1 - \cos\alpha}$$

$\cos\alpha = 0.8742$

$yo = 0.154$ m

$$a + \Delta a = \frac{0.154}{1 - 0.8742} = 1.224\text{ m}$$

$$a = \frac{d}{\cos\alpha} - \sqrt{\left(\frac{d}{\cos\alpha}\right)^2 - \left(\frac{h}{\sin\alpha}\right)^2}$$

where, $d = 21.94$ m

$h = 2.60$ m

$\cos\alpha = 0.8742$

$\sin\alpha = 0.4855$

$$\therefore a = \frac{21.94}{0.8742} - \sqrt{\left(\frac{21.94}{0.8742}\right)^2 - \left(\frac{2.60}{0.4855}\right)^2} = 0.478 \text{ m}$$

$$\therefore \Delta a = 1.224 - 0.478 = 0.737 \text{ m}$$

Also vertical constituent of a and (a + Δa) is:

$$\therefore a = a \sin\alpha = 0.478 \times 0.4855 = 0.232 \text{ m}$$

$$\therefore a + \Delta a = (a + \Delta a^*) \sin\alpha = 1.224 \times 0.4855 = 0.594 \text{ m}$$

3. Amount of Percolation of Dam Body

a. Amount of Percolation per unit width of Dam Body

$$qD = k,\ yo$$

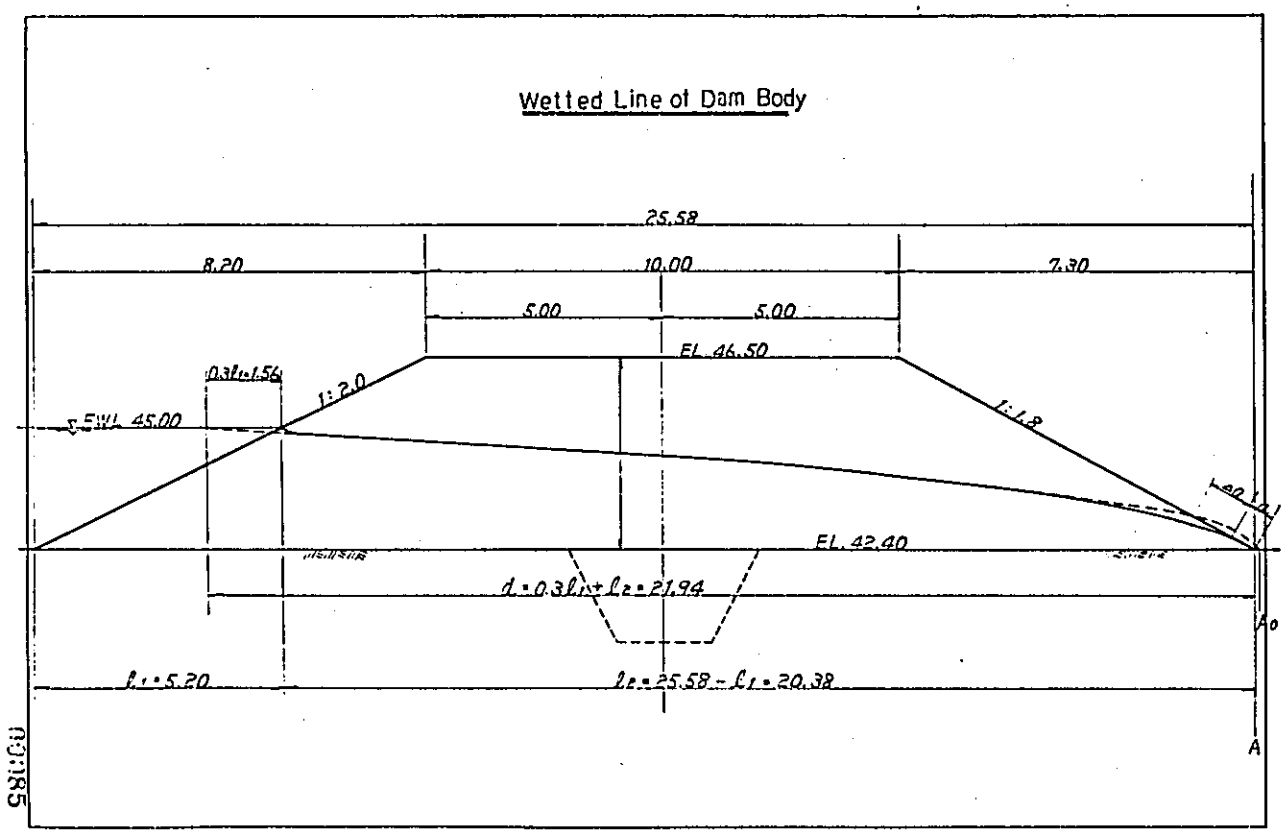
where, K : Percolation factor = 5.0×10^{-6} cm/sec

$$\therefore K = 5.0 \times 10^{-8} \text{m/sec}$$

yo : Height of percolated sheet

(See 6-2-1 2) = 0.154 m

$$\therefore q_D = 5.0 \times 10^{-8} \times 0.154 = 7.7 \times 10^{-9} \text{ m}^3/\text{sec/m}$$



b. Total Amount of Percolation from Dam Body (Qo)

$$Qo = q_o \ell$$

where, ℓ: Average width of percolation of dam body = 66.0 m

ℓ_1 = 80.0 m (FWL 45.00)

ℓ_2 = 52.0 m (width of dam bottom)

$$\therefore \ell = \frac{\ell_1 + \ell_2}{2} = \frac{80.0 + 52.0}{2} = 66.0 \text{ m}$$

$$\therefore Qo = 7.7 \times 10^{-9} \times 66.0 = 5.082 \times 10^{-7} \text{ m}^3/\text{sec}$$

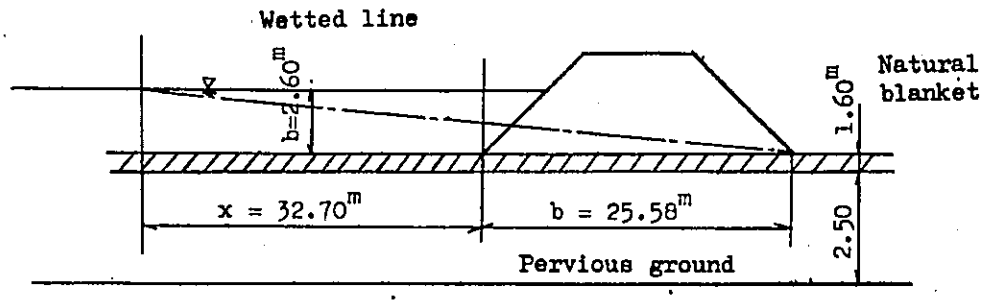
$$\therefore Qday = 5.082 \times 10^{-7} \times 86.400 = 4.4 \times 10^{-2}/\text{day} = 0.044 \text{m}^2/\text{day}$$

c. Proportion of Amount of Leakage

Total amount of storage : V = 210,000 m^3

$$\Delta W = \frac{Qday}{V} \times 100$$

$$\therefore \Delta W = \frac{0.044}{210,000} \times 100 = 2.0952 \times 10^{-5}\%/\text{day}$$



4. Amount of Percolation from Dam Body and Foundation

It is considered that the foundation of dam site consists of accumulating clay on semipervious ground (k = 4.5 x 10^{-3}cm/sec) and forms a natural blanket. Therefore, the amount of percolation from the ground of foundation will be approximately obtained as natural blanket.

a. Length of Effective Percolation

$$X = \sqrt{\frac{t, d, k}{k}}$$

where, x : Length of effective percolation (m)

t : Thickness of natural blanket = 1.640 m ≒ 1.60 m

d : Depth of foundation = 2.5 m (assumed)

k_1 : Percolation factor of natural blanket

$\therefore$ 5.5×10^{-4} cm/sec = 5.5×10^{-6} m/sec

k : Base of permeability factor

$\therefore$ 4.5×10^{-3} cm/sec = 4.5×10^{-5} m/sec

$$X = \sqrt{\frac{1.60 \times 2.50 \times 4.5 \times 10^{-5}}{5.5 \times 10^{-6}}} = 32.727 \fallingdotseq 32.7 \text{ m}$$

b. Amount of Percolation from Foundation

i) Amount of Percolation per unit width (q)

$$q = \frac{k,\ d,\ h}{0.62x\ +\ D}$$

$$\therefore\ q = \frac{4.5 \times 10^{-5} \times 2.5 \times 2.6}{0.62 \times 32.7 \times 25.58} = 6.38 \times 10^{-6} \text{m}^3/\text{sec/m}$$

ii) Total Amount of Percolation (Q)

$Q = q,\ \ell$ where, $\ell = 66.0$ m

$\therefore$ $Q = 6.38 \times 10^{-6} \times 66.0 = 4.21 \times 10^{-4} \text{m}^3/\text{sec}$

$\therefore$ $Qday = 4.21 \times 10^{-4} \times 86.400 = 36.374 \text{ m}^3/\text{day}$

c. Proportion of Amount of Leakage

Total amount of storage : $V = 210.000 \text{ m}^3$

$$\Delta W = \frac{Qday}{V} \times 100$$

$$\therefore\ \Delta W = \frac{36.374}{210.000} \times 100 = 0.0173\ \%$$

d. Summary of Amount of Percolation

The mount of percolation from the dam body & its foundation will be as follows.

General Table of Amount of Percolation

Specification	Total amount of storage V (m^3)	Effective amount of storage VW (m^3)	Amount of leakage Q (m^3/day)	$W = \frac{Q}{V} \times 100$ (%)	$W' = \frac{Q}{W} \times 100$ (%)	Remark
Dam body			0.044	0.000021	0.0000268	OK
Foundation	210.000	164.000	36.374	0.017321	0.0221779	OK
			36.418	0.017342	0.02220	OK

The amount of leakage is $Q = 36.418 \text{ m}^3$/day as specified in the above table. The proportion of effective amount of storage, $Vw = 164,000 \text{ m}^3$ is $W' = 0.0222$ %.

The amount of leakage is Q = 36.418 m^3/day as specified in the above table. The proportion of effective amount of storage, Vw = 164,000 m^3 is $\Delta W' = 0.0222$ %.

5. Computation of Stability of Dam Body

a. Condition of stability computation

Stability computation of the slope of dam body will be made to use Taylor's stability computation chart.

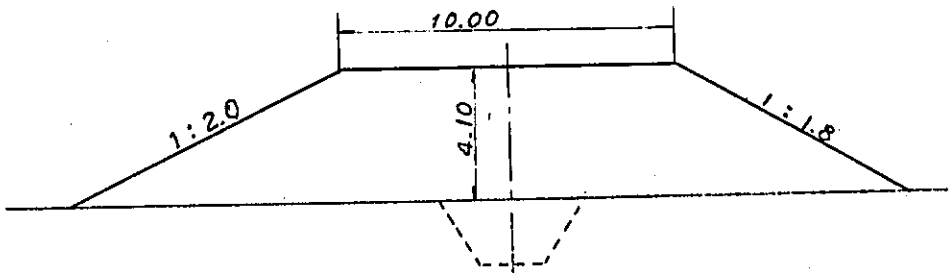
(1) Embankment Materials

Table of Design Values

Unit weight		Shearing strength			Remark
Drying Td_{t/m^3}	Wetting Tt_{t/m^3}	Cohesion C_{t/m^2}	Angle of interval friction ϕ (degree)	tan ϕ	
1.000	1.34	1.2	17"-40	0.3185	

(2) Dam Body Structure

Standard Section



Dam type : Homogeneity type earth dam

Dam height : $H_D' = 4.10$ m

Unit weight : $TtH_D' = 1.34 \times 4.10 = 5.494 = 5.5$ t/m^2

Gradient of slope: Upstream side : 1 : 20 (26°34')

Downstream side: 1 : 1.8 (29°03')

b. Stability Computation

(1) Upstream Side

Stability Computation Table of Slope at Upstream Side

Assumed angle of internal friction	Stability factor	Necessary cohesion	Safety factor for cohesion	tan ϕa	Safety factor for angle of internal friction
ϕa	$\frac{1}{Ns}$	$Ca = \gamma tH\frac{1}{Ns}$	$Fc = \frac{C}{Ca}$		$F\phi = \frac{\tan\phi}{\tan\phi a}$
0	0.154	0.847	1.417	0	0
5	0.102	0.561	2.139	0.0875	3.640
10	0.062	0.341	3.519	0.1763	1.806
15	0.034	0.187	6.417	0.2679	1.189
20	0.015	0.083	14.458	0.3639	0.875

(2) Downstream Side

Stability Computation Table of Slope at Downstream Side

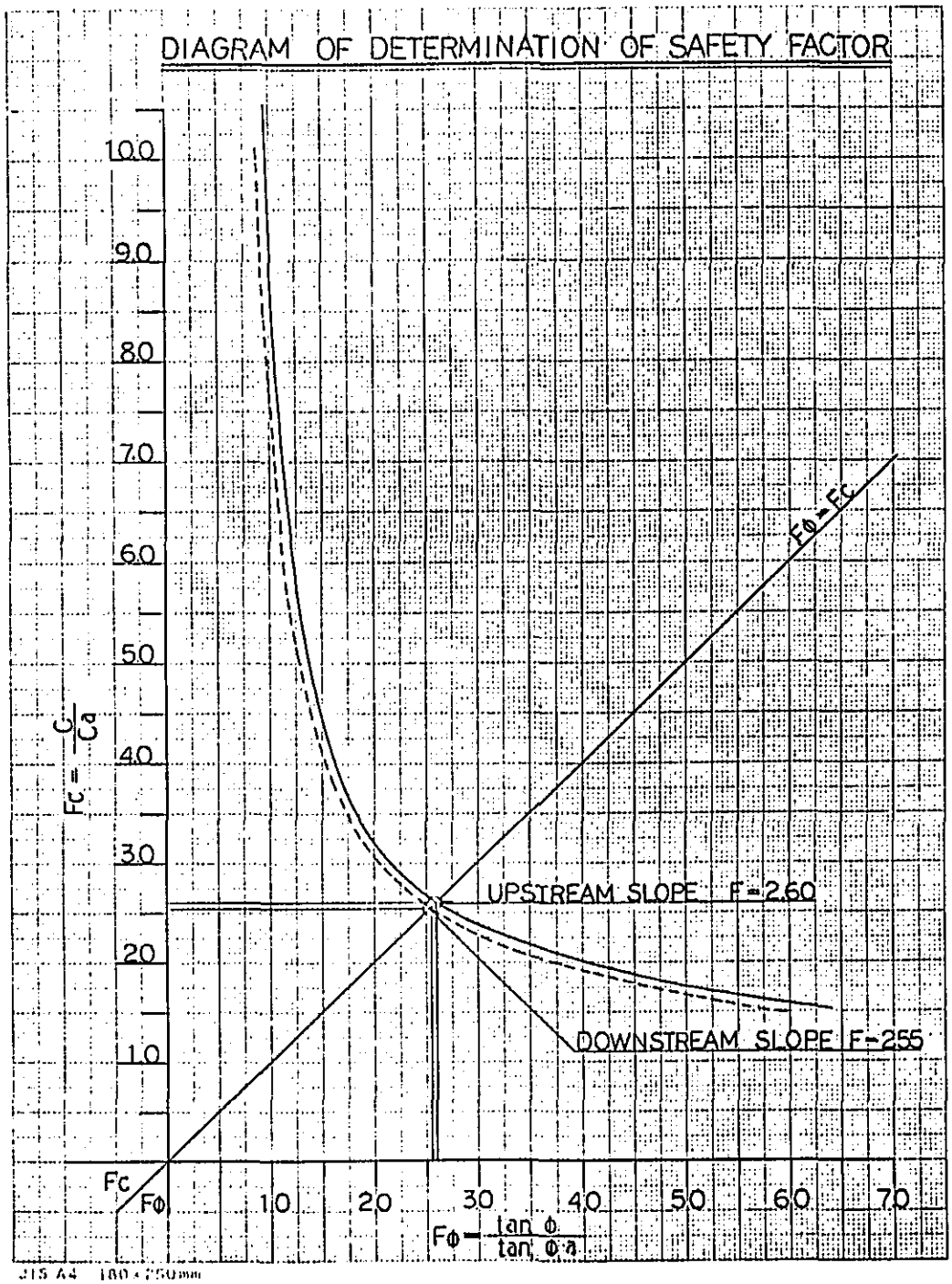
ϕa	$\frac{1}{Ns}$	$Ca = \gamma tH\frac{1}{Ns}$	$Fc = \frac{C}{Ca}$	tan ϕ_a	$Fa = \frac{\tan\phi}{\tan\phi a}$
0	0.155	0.852	1.408	0	0
5	0.107	0.588	2.040	0.0875	3.640
10	0.064	0.352	3.409	0.1763	1.806
15	0.040	0.220	5.454	0.2679	1.189
20	0.024	0.132	9.090	0.3639	0.875
25	0.008	0.044	27.272	0.4663	0.683

c. Summary of Stability Factor

The results which the safety factor of dam body was obtained to plot safety factor for cohesion, Fc and safety factor for angle of internal friction into coordinate of Fc, Fb (see definite chart of safety factor), will be as follows:

General Table of Safety Factor

Slope	Gradient of slope	Safety factor Fs	Remark
Upstream side	1 : 2.0	2.60	C = 1.2 t/m^2 ϕ = 17°-40'
Downstream side	1 : 1.8	2.55	C = " ϕ = "



Element of Dam Design

Location	:	Teginneng
Name of River	:	Swamp
Dam Type	:	Homogeneity
Name of Dam	:	Reservoir
Ground Foundation:		Sandy Clay

Hydrology	Catchment Area	$A = 2.73\ km^2$
	Spillway Basic Rainfall	$r_t = 185\ mm/day \times 1.2 = 222\ mm/day$
Reservoir	Total Storage Capacity	$V = 210,000\ m^3$
	Amount of Sand Accumulation	$V_{nr} = 6,320\ m^3$
	Effective Storage Capacity	$V_n = 164,000\ m^3$
	Full Water Area	$A = 0.095\ km^3$
	Storage Level	HWL = 45.75 m FWL = 45.00 m DWL = 43.00 m
	Available Depth	H = 2.00 m
Dam Body	Dam Height	$H_o = 6.100$ m
	Dam Length	$L_o = 124.00$ m
	Crest Width	$B_o = 10.000$
	Gradient of Slope	Upstream Side : 1:2.0 Downstream Side: 1:1.8
	Volume of Dam Body Embankment	$6520.00\ m^3$
Spillway	Spillway Type	Flowover Weir Type Sillway
	Design Flood Discharge	$Q_s = 18.9\ m^3/sec$
	Length of Flowover Weir	$B_s = 20.00$ m
	Overflow Depth	$H_s = 0.75$ m
Water Intake Installation	Intake Type	Pump (Single Suction Centrifugal Pump)
	Maximum Amount of Intake Water	$0.015\ m^3/sec/set \times 2$ sets x 10HP
Division Channel	Type	Existing Pump & Existing Pipe
	Diversion Drainage	By Existing Drainage Canal

3-2-7 Design of Spillway

1. Determination of Location, Type and Route

a. Location of Spillway

(1) Concerning the determination of the location of spillway, the location shall be selected on the basis of safety and economy considering various points such as the topography, geology and possibility of utilizing excavation materials of surroundings of the dam site, the purpose of the reservoir and on the management.

(2) In the dam site of this program, two open canal exist, both having been used as drainage canals in past rainy seasons. Subject canals are located on both sides of low paddy fields, which will be submerged as reservoir basin as stated before. The spillway of this program will be provided on either the right bank or the left bank of the reservoir to refer to the location of this open canal.

(3) In case of providing the spillway on the right bank, the spillway will fully be able to intrude into the natural ground with less excavation in proper utilization of the slope of the natural ground and the short length of canal of the spillway will result in lower construction costs than that on the left bank. (This is due to that in case of installing the spillway on the left bank, the spillway shall be provided to close the side of the natural ground.) Borders of low paddy fields exist withing 90 m of down stream side of the coffer dam (see general plan). In case of installing the spillway on the left bank, there is danger in the down stream area to damage these barders by the flood which will be excluded.

(4) Also a net house, a cattle shed and an insect rearing room will be proposed on the upland of the left bank side to conform with the development program. The spillway of this program will be installed on the right bank in conformance with the above.

b. Type of Spillway

In reference to the regulating section of the spillway in this program, non-regulating type will be adopted as complete maintenance and control is impossible. And the spillway shall be that which can sufficiently correspond with the flood proposed than design flood discharge as the catchment area can not be cleared due to little hydrological date on this area. Therefore, the spillway will be desirable to be good in hydraulic coefficiency and to be able to ensure excess unexpected water capacity to flow. The overflow spillway which is best suited to the topography has been selected.

c. Determination of Route

The center line of spillway will be short from the view point of the stability of Dam-Body, spillway and the topographical limitations. Then, the center line will cross the dam axis and will be curved at a sufficient distance from the down-stream toe of the dam body and to prevent scoring.

2. Hydraulic Computation

a. Design Condition:

(1)	Design flood discharge	$Q = 18.9\ m^3/3$
(2)	Coefficient of roughness	$n = 0.025$
(3)	Overflow depth	$H = 0.75$ m
(4)	Stationary full water level	F.W.L. = EL 45.00 m
(5)	Design flood level	H.W.L. = EL 45.75 m
(6)	Elevation of crest	EL = 45.00 m
(7)	Elevation of intake skill	EL = 43.00 m

b. Overflow Section

(1) Affection of Depth of Approaching Canal

$$W \geq \frac{1}{5}H \quad \ldots\ldots\ldots\ldots\ldots (1)$$

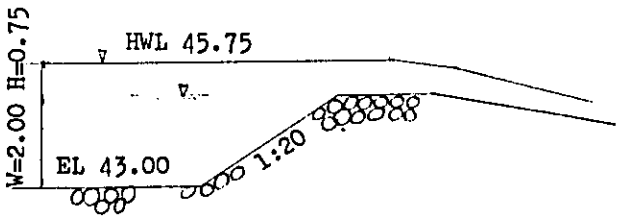
$(H = 0.75)\ (W = 2.00)$

$$2.00 > \frac{1}{5} \times 0.75$$

Then, the condition of (1) will be satisfied.

(2) Affection of Upstream Face Gradient of Dam

Considering the most advantage grade to conform with $w/H \div 2.7$, a right angle wall would be good, but a 20 % gradient will be adopted to consider the safety of overflow dam which will be constructed with Pasangan.



(3) Coefficient of Overflow (Discharge)

The coefficient of overflow will be C = 1.7 to consider the condition of the previous items (1) & (2).

(4) Determination of Overflow Crest Width of Spillway

$Q = CBH\ 3/2$ $\qquad Q = 18.9\ m^3/s$

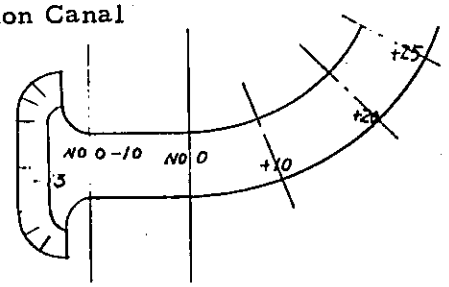
$H = 0.75$ cm

$C = 1.7$

$$B = \frac{Q}{CH^{3/2}} = \frac{18.9}{1.7 \times (0.75)^{3/2}} = 17.12$$

Then, this spillway will be non-regulating type, the effective crest width will be 20.00 m to allow for surplus.

c. Transition Canal

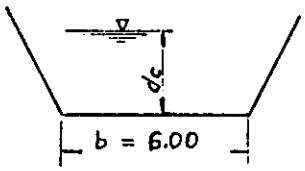


(1) Terminal of Transition Canal (control point)

When the design flood discharge, $Q = 18.9\ m^3/s$ is flooded on the trapezoidal section of base width of 6.00 m and grade of slope of side wall is 1:0.5, the critical water depth (dc) will be:

$$\frac{Q}{b^{2.5}} = \sqrt{g}\,(\frac{d_c}{b})\,3/2 \times [(1 + Z\frac{d_c}{b})3/2 \Big/ (1 + 2Z\frac{d_c}{b})\,1/2\,]$$

$$= k''$$



$Q = 18.9\ m^3/s$

$b = 6.00$ m

$Z = 0.5$

$$\therefore k'' = \frac{18.9}{6^{2.5}} = 0.2143 \quad \frac{d_c}{b} \rightarrow = 0.163$$

$$\therefore d_c = (\frac{d_c}{b}) \times b = 0.163 \times 6 = 0.978\ m$$

In this case, the hydraulic elements will be as follows:

$d_c = 0.978$ m

$AC = d_c\,(b + Zdc) = 0.978\,(6.000 + 0.5 \times 0.978) = 6.346\ m^2$

$P_c = b + \sqrt{d_c 2 + (Zd_c)^2} = b + d_c \times \sqrt{1.25} = 7.093$ m

$R_c = A_c/P_c = 6.346/7.093 = 0.895$

$R_c 2/3 = 0.9287$

$v_c = Q/A_c = 18.9/5.346 = 2.978$ m/s

$$I_c = \left(\frac{n.\ V_c}{R_c 2/3}\right)^2 = \left(\frac{0.025 \times 2.978}{0.9287}\right)^2 = 0.006426 \doteqdot \frac{1}{156}$$

Then, the ordinary flow slope of 1/500 will be adopted from the terminal of transition canal to - 13.00 m point and the jet flow slope of 1/5 till + 10.00 m point.

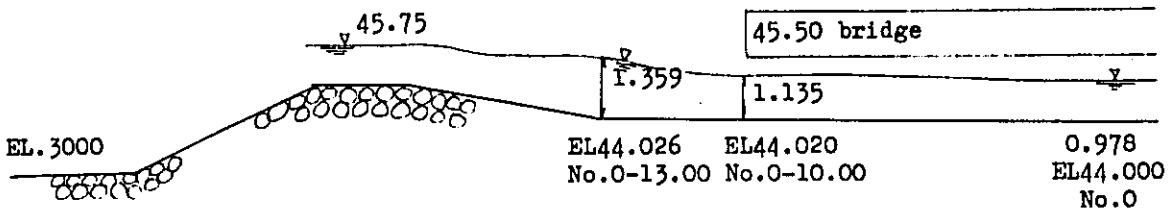
(2) Computation of Water level of Upstream Side Canal from Control Point. (See computation of attached Table 1.)

NO. 0 = 10.00 (Starting point of bridge sub-structure work)

d = 1.135 m v = 2.536 m/s

NO. 0 = 13.00 (Toe of overflow weir.)

d = 1.359 m v = 1.437 m/s



Due to the above, the water level at NO. O - 13.00 m will be EL 45.385 < EL 45.000 + $\frac{2}{3}$ x 0.75 and the bridge clearance will be 45.500 - (45.155) = 0.345 m. There will be no problem on submerged overflow and bridge clearance.

d. Chute Section

(Computation is stated in Table 1)

NO. O + 10.000 point d = 0.436 m v = 6.972 m

(Head loss due to bend and vortex will be ignored)

e. Computation of Stilling Basin as Stated in d. above the terminal of the chute section is as follows:

d_1 = 0.436 m v_1 = 6.972 m/s

Q = 18.9 m^3/s

From the above, natural stilling basin (I type) will be suitable.

(1) Froude Number (F_1)

$$F_1 = \frac{v_1}{\sqrt{gxd_1}} = \frac{6.972}{9.8 \times 0.436} = 3.373$$

Where, v_1: velocity of flow before hydraulic jump 6.972 m/s

d_1: water depth before hydraulic jump 0.436 m

(2) Depth of Hydraulic Jump (d_2)

$$\therefore \frac{d_2}{d_.} = \frac{1}{2} \quad (\sqrt{1 + 8F_1^2} = p)$$

$$\therefore d_2 = \frac{d_1}{2} \quad (\sqrt{1 + 8F_1^2} - 1)$$

$$= 0.436/2 \times (\sqrt{1 + 8 \times 3.373^2} - 1) = 1.873 \text{ m}$$

From the above, the wall height of stilling basin will be 2.000 m and the length of stilling basin will be over 12.000 m.

3-3 Facility of Center

3-3-1 Arrangement and Outline of Buildings

1. The following scale of facilities will be arranged in order to satisfy this function as stated above as well as to utlize existing facilities effectively. The arrangement will be planned as attached Fig. 2-2. Namely, farm operation buildings will be installed near the farm, such as tractor garage, work shop and vehicle floor (NO. 7), machine attachment storehouse (NO. 8), work room (NO. 9), fertilizer and chemical storehouse (NO. 11), storehouse with concrete floor for drying crops (NO. 12-2) and etc.

2. The other buildings will be arranged to consider the systematic utilization of existing buildings.

(Table -3-5)

No.	l	b	d	A	V	$V^2/2g$	P	R	R4/3	$n^2v^2/R\,4/3$	$\bar{S}f$	Sf./ + re	EL	EL+d		Error	C.K.
Computation of Water Level of Upstream Side Canal from Control Point																	
No. 0		6.000	0.978	6.346	2.978	0.453	7.093	0.894	0.861	0.00644	-	-	44.000	45.431			
No. 0--10	10.000	6.000	1.135	7.454	2.536	0.328	7.269	1.025	1.034	0.00389	0.00516	0.052	44.020	45.483	45.431	0	OK
No. 0--13	3.000	9.000	1.359	13.154	1.437	0.105	10.519	1.250	1.347	0.00096	0.00243	0.007	44.026	45.490	45.483	0	OK
Computation of Water Level of Downstream Side Canal from Control Point																	
No. 0	-	6.000	0.978	6.346	2.978	0.453	7.093	0.894	0.861	0.00444	-	-	44.000	45.431			
No. 0-+10	10.000	6.000	0.436	2.711	6.972	2.480	6.487	0.418	0.313	0.0971	0.0518	0.518	42.000	44.916	45.343	0.003	OK

3. Floor space and construction materials of each building will be as the following table.

Table of Buildings and Other Structures

No.	Name of Buildings	Existing or New	Size	
1	Gasoline Filling Stand	New	72m^2	12mx6m
2	Net House (Cage)	"	68	12.5x5.4
3	Drying Room with Plastic Roof	"	72	12x6
4	Office and Laboratory	"	800	40x10x2
5	Inoculator and Insect Rearing House	"	94.5	15x6.3
6	Exhibition Room and Library	Existing	120	-
7	Tractor Workshop and Floor	New	600	40x15
8	Machine Attachment Storehouse	"	400	40x10
9	Work Room	"	150	25x6
10	Tractor Warehouse	Existing	120	-
11	Fertilizer and Chemicals Storehouse	New	300	30x10
12-1	Storage and Floor	Existing	400	-
12-2	Storage and Floor	New	600	40x15
13	House of the Head of Center	Existing	120	-
14	Domitory (40 persons)	New	624	48x6.5x2
15	House of Permanent Officers	Existing	240	-
16	House of Semipermanent Officers	"	240	-
17	House of Laborers	"	430	
18	Cattle Shed	New	40	10x4
19-1	Pump Room	Existing		
19-2	Generator Room	New	50	10x5
20	Elevated Tank and Pump Room	"	16	4x4
21	Meteorological Observatory	"		
22	Insect Trapping Light	"		
23	Generator Room	Existing		
24	Street Light	New		
25	Dining Hall	"	192	24x8
	TOTAL		5,749m^2	

No.	Name of Buildings	Outline of Buildings	Building Area(m^2)	Floor Space(m^2)
1	Gasoline, Filling Stand	Made of Brick, One-storied, Wooden Support Roof (steep-plate roof slope 1:4)	72	18
2	Net House		68	68
3	Drying Room	Made of Brick, One-storied, Wooden Support Roof (plastic corrugated plate roof slope 1:4)	72	72
4	Office and Laboratory	Made of Brick, One-storied, Wooden Support Roof (color steelplate roof slope 1:4)	300 x 2 units	304 x 2 units
5	Inoculator and Insect Rearing House		95	95
7	Tractor Workshop	Made of Brick, One-storied, Wooden Support Roof (steel-plate roof slope 1:4)	600	600
8	Machine Attachment Storehouse	Made of Brick, One-storied, Wooden Support Roof (steel-plate roof slope 1:4)	400	400
9	Work Room	Made of Brick, One-storied, Wooden Support Roof (color steelplate slope 1:4)	150	150
11	Chemical Storehouse	Made of Brick, One-storied, Wooden Support Roof (steel-plate roof slope 1:4)	300	300
12-2	Storage and Floor	Made of Brick, One-storied, Wooden Support Roof (steel-plate roof slope 1:4)	400	400
14	Domitory	Made of Brick, One-storied, Wooden Support Roof (color steelplate roof slope 1:4)	318 x 2 units	216
18	Cattle Shed	Made of Brick, One-storied, Wooden Support Roof (color steelplate roof slope 1:4)	40	40
19-2	Generator Room	Made of Brick, One-storied, Wooden Support Roof (steel-plate roof slope 1:4)	50	50
20	Pump Room	Made of Brick, One-storied, Wooden Support Roof (color steelplate roof slope 1:2)	16	16
25	Dining Hall	Made of Brick, One-storied, Wooden Support Roof (color steelplate · roof slope 1:2)	192	192

No.	Name of Buildings	Outside Wall	Roof	Floor	Plinth	Inner Wall	Ceiling	Remark
1	Office	Plaster Painting	Steelplate	Tiling	Lauan O.P.	Plaster V.P.	Asbestos Plate	
2	Net House	----	----	----	----	----	----	
3	Drying Room	"	"	Concrete by trowel	----	Brick	----	
4	Office and Laboratory	"	Color Steelplate	Tiling	"	Plaster V.P.	Sound-Absorbent-Tex	
	Toilet and Material Room	----	----	Morter by trowel	----	"	Asbestos Plate	
5	Inoculator and Insect House	----	----	----	----	----	----	
7	Tractor Workshop	"	Steelplate	Concrete by trowel	----	Brick	----	
8	Machine Attachment Storehouse	"	"	"	----	"	----	
9	Work Room	"	Color Steelplate	Tiling	"	Plaster V.P.	Sound Absorbent Tex	
11	Fertilizer and Chemicals Storehouse	"	Steelplate	Concrete by trowel	----	Brick	----	
12-2	Storage and Floor	"	"	"	----	"	----	
14	Domitory	"	Color Steelplate	Tiling	"	Plaster V.P.	"	
	Toilet and Shower Room	----	"	Morter by trowel	----	"	Asbestos Plate	
	Bath Room	----	"	Tiling	----	"	"	
18	Cattle Shed	"	"	Concrete by trowel	----	Brick	----	
19-2	Generator Room	"	"	"	----	"	----	
20	Pump Room	"	"	"	----	"	----	
25	Dining Hall	"	"	Tiling	"	Plaster	Sound Absorbent Tex	
	Cocking Room	"	"	"	Tile	"	Asbestos Plate	

3-3-2 Estimation of Generator Capacity

No.	Name of Buildings and Other Structures	Existing or New	Size		Load of Electricity (W)	Connection Method	Remark
1	Gasoline Pilling Stand	New	72 m^2	12m x 6m	240	U.O.	
2	Net House (Cage)	"	68	12.5 x 5.4	240	U.O.	
3	Drying Room with Plastic Roof	"	72	12 x 6			
4	Office and Laboratory	"	800	40 x 10 x 2	8,000	U.O.	
5	Inoculator and Insect Rearing House	"	94.5	15 x 6.3	3,800	U.O.	
6	Exhibition Room and Library	Existing	120	-	1,400	U.O.	
7	Tractor Workshop and Floor	New	600	40 x 15	2,400	U.O.	* Explanation of Connection Method
8	Machine Attachment Storehouse	"	400	40 x 10	4,000	V.O.	
9	Work Room	"	150	25 x 6	3,000	U.O.	
10	Tractor Warehouse	Existing	120	-	480	V.O.	
11	Fertilizer and Chemicals Storehouse	New	300	30 x 10	1,440	V.O.	
12-1	Storage and Floor	Existing	400	-	720	U.O.	
12-2	Storage and Floor	New	600	40 x 15	720	V.O.	
13	House of the Head of Center	Existing	120	-	1,200	U.O.	
14	Domitory	New	624	48 x 6.5 x 2	12,600	V.O.	
15	House of Permanent Officers	Existing	240	-	1,000	V.O.	
16	House of Semipermanent Officers	"	240	-	4,800	U.O.	
17	House of Laborers	"	430	-	6,450	V.O.	
18	Cattle Shed	New	40	10 x 4	400	V.O.	
19-1	Pump Room	Existing		-			
19-2	Generator Room	New	50	10 x 5	720	U.O.	
20	Elevated Tank and Pump Room	"	16	4 x 4	3,700	U.O.	
21	Meteorological Observatory	"					
22	Insect Trapping Light	"					
23	Generator Room	Existing					
24	Street Light	New					
25	Dining Hall	"	192	24 x 8			

3-3-3 Quality-of-Water Test

A quality-of-water test was performed on a sample of ground water in the area of the dam site. Water test was performed to judge the quality of well water in the pilot farm and to determine the adaptability. The result of quality-of-water test will be in accordance with the following table. In case of comparing the test result with that in Japan, the following will be specified:

1. PH is low.

2. A small amount of nitrogen is contained in nitrous acidity.

3. The amount of residual chlorine is small.

4. Coloring degree is a little high.

It is understood that the well water in the pilot farm can be distributed for use as drinking water from the view point that at present, the same well water is being consumed by local people and no indisposition has been found among them, as they are boiling the water prior to drinking. Future tests are planned to ensure well water is safe after testing for city and living water.

Result of Quality-of-Water Test

Item \ No. of Sampling	No.	Reference
Water Sampling Place	Proposed Site of Dam (Test Pit)	
Water Sampling Date	Sept. 29, 1972	
Climate in Water Sampling	Fine	Japan Quality of Water Standard
Temperature °C	31°C	
Coloring Degree	7.5	5 and less
Odor	None	None
PH Value	5.6	5.8-8.6
Residual Chlorine (ppm)	0.05 and less	0.8 and less
Ammoniacal Nitrogen (ppm)	No Detection	No Detection
Nitrous Acidity Nitrogen (ppm)	0.002 and less	"
Nitric Acidity Nitrogen (ppm)	10 and less	10 and less
Chloric Ion	2.5 and less	200 and less
Consumption Amount of Potassium Permanganate (ppm)	10 and less	10 and less
Hardness (ppm)	No Measurement	300 and less
Test Date	October, 1972	
Test Method	Simple Water Quality Inspection Apparatus (Shibata Chemical Machine Co.)	

CHAPTER 4 LARGE DEMONSTRATION FARM

4-1 Purpose of Land Consolidation Plan and It's Present Condition

4-1-1 Purpose of Project

Concerning the agricultural development of Lampung province, the Government of Indonesia intends this development as the future base of farm provisions to Java island, it also intends to adopt a policy of immigrating farmers of Java island into this area and planning the increment of agricultural products due to this as a means of settlement for Java farmers and the shortage of provisions. In order to increase production and promote the management systematically, the obtaining of irrigation water and the rational and suitable distribution of such water will be needed. The hauling of materials and rational farm management will be attained by the improvement of farm roads. Systematization of agricultural works such as harvest, plowing and farm management will be performed easily by enlargement of farm fields. This project shall not be a civil engineering work restricted in the project area but shall also serve as a center for the improvement of agricultural technics including the establishment of fertilization standards, water management, guidance on maintenance of facilities, introduction of mechanization, storage and processing of agricultural products and the guidance on marketing technics. This project will be gradually extended by this activity to systematically connect with the neighbouring villages.

4-1-2 Present Conditions in The Project Area

1. River system - River system in this area as shown in table 4-1, figure 2-1 is a part of Punggur-Utara district, one of the large scale irrigation areas of 4 river systems at the middle part of Sekampung. That is, water intake will be made by the diversion weir which has been constructed at Argogurch located at the middle stream of the river Sekampung. After being trained for about 9 km, the water is divided into the river Sekampung in 32.19 m^3/s and Punggur Utra in 26.09 m^3/s respectively at a point of Trimurdjo (Diversion facility No. KH_2). The training to this area has been performed for about 13 Km, the object have being attained for 118 ha to make the tertiary canal as starting point from BPU 10 turnout.

2. Land Utilization

Being under reclamation as shown in the following table, the percentage of utilized land is low (64%), being 12 % of the overall arable lands of the second crapping. As the arable areas are the lands which have been reclaimed by the mutual aid of farmers, the paddy fields are small in area and irregullar in shape, its average plated area is 0.02 ha. In recent years reclaimed fields were constructed on high lands, but these fields

consist of soil accumulated at an average of 7-12 cm in depth. At deeply sloped parts, the difference in height of fields will be 30-40 cm, lands have been reclaimed till where the short edge will be 6-7m. Most of the borders are small plots of a width of 20-30 cm and a height of 20-30 cm.

Area	Related Farm House	Farm Fields First Paddy	Second Paddy	Up land	Sub Total
Present Condition	181	50.38	(10.20)	18.36	69.04
Planing Condition	181	89.20	(50.00)	39.20	89.20

Alang-Alan	Building Lot	Canal	Others	Total	No. of Paddy Block	No. of Block
29.66	9.79	1.86	2.84	123.19	1	5,000
5.13	9.79	3.67	15.40	123.19	21	684

3. Farm Roads in Project Area

Present roads in project area are standardized at 7-8 m in width. Access roads are not found in paddy fields, farm workers are using the embankment of the tertiary canal and borders of paddy fields as foot paths. Farmers using water buffalo also use the same paddy borders and slowly destroy them in the process.

4. Irrigation Water

In compliance with the completion of main canal, Tertiary which was constructed by Gotong Rojong 5 years ago has ran as one line in the direction of east west at the north side of the area, the other one having been traversed along in the groupe of villages in the south direction as shown in the following map. Though laterals are being extended to conform with degree of reclamation to make Teritrary as base, due to shortage of the panning capacity regarding the location and section, alternative irrigation has been adopted occasionally wherever met with shortage of irrigation water. Only some ten hectares of areas have been recognized which will be able to cultivate the second paddy to use reduction water along swamps. Irrigation has been done after cutting plot borders of field water as may be required.Satistactory water control has not been implemented by the reasons of water shortage and ununiformity of cropping.

5. Drainage Canal

As there is no designed drainage canal and irrigation has been carried out, the surplus water has flowed into low paddy fields in natural field areas. It seems that in the rainy season, considerable deep submerging water will be expected. In the dry season, it will be possible for the second paddy cultivation to use remaining water and seepage water.

Table 4-1 Large Irrigation Design in the Basin of Way Sekampung

Items \ Location	SEKAMPUNG	RAMAN UTARA	BATANGAARI UTARA	PUNGGUR UTARA	SEPUTIH I
Area	35,000 ha	9,100 ha	10,000 ha	40,000 ha	
Irrigation Area	21,000 ha	6,300 ha	7,300 ha	30,000 ha	25,000 ha
Construction Period	1935 - 1956	1956 - 1967	1953 - 1967	1969 - 1972	1958 - 1974
Irrigation Water Supply River	Way Sekampung	Way Raman	Dam Garongan	Dam Argoguruh	
Intake Point	Dam Argoguruh	Dam Remen	Dam Garongan	Dam Argoguruh	
Design Amount of Water Intake	32.19 m^3/sec	5.24 m^3/sec	10.00 m^3/sec	26.09 m^3/sec	25.00 m^3/sec
Structure for water Utilization					
(1) Intake Dam					
Design Elevation of Water Intake	EL. + 58.90 m	EL. + 42.40 m	EL. + 28.20 m	EL. + 58.90 m	
Length of Crest	80.8 m	15.0 m	15.0 m	80.8 m	
Crest of Dam	EL. + 59.00 m	EL. + 40.60 m	EL.	EL. + 59.00 m	
Height of Dam	7.70 m	3.90 m	2.80 m	7.70 m	
Dam Body	Wet Stone Pitching	Wet Stone Pitching	Wet Stone Pitching	Wet Stone Pitching	
Scouring Sluice	Width 6.00 m	Width 2.00 m Height 1.70 m	Width 2.00 m Height 2.60 m	Width 6.00 m	
Intake	Left bank intake 2.55 x 2.50 x 5	Right-bank intake 1.60 x 1.70 x 2	Right-bank intake 1.50x 1.50 x 3	Left-bank intake 2.55 x 2.50 x 5	
(2) Canal					
Main Canal					
Total Length	70.9 km	27.7 km	35.1 km	36.3 km	42 km
Structure	Trapezoidal Earth Canal	Trapezoidal Earth Canal	Trapezoidal Earth Canal	Trapezoidal Earth Canal	
Total Length	42.9 km	22.6 km	24.0 km	98.2 km	
Structure	Trapezoidal Earth Canal	Trapezoidal Earth Canal	Trapezoidal Earth Canal	Trapezoidal Earth Canal	
Accessory Structures					
Diversion Works	54 Places	41 Places	33 Places	134 Places	
Intake	133 Places	88 Places	74 Places	119 Places	

6. Repeating Irrigation Water

Water remaining in low land area will be almost dried out except tourent running in the east section of the area and a small amount of 9 ℓ/s following down (in the dry season) from the culvert under village roads which flows into the tourent in the middle part of the area. Concerning the utilization of this, it is considered that the natural flowing down method will be unsuitable for use. Under various circumstances so as to manage the villages in agriculture as a group changes will be necessary in the future in accordance with the alternation of future cropping and its marketing, pump irrigation and other technical studies will be further required.

4-2 Land Consolidation Plan

Outline - The main purpose will be irrigation water improvement and farm road rearrangement. The extention of paddy blocks has been decided to execute from the part of small volume of earthwork in the latitude of farmers' liability.

Namely, concerning the irrigation water, a complete arrangement of water diversion and water distribution will be planned to keep the canal line straight to maintain the function of passing water for easy irrigation into the irrigation area.

As regards to the farm road, the main farm roads have been provided at a base of the groups of villages and lateral farm roads have been provided in minimum in connection with the formation of paddy blocks.

Farming roads will be prepared in the paddy block as much as possible, being installed every 200 m distance, generally. The general plan will be shown at Figure 2-6.

4-2-1 Form and Size of Paddy Field Plots

With regard to the form and size of paddy field plots, it is considered that as a tentative measure, tillage, weeding and other maintenance and operation work will mainly be executed by man power and animal power, and partially by the small power-cultivators at present in use. But in determining size and form of paddy plots, future developments in farm management systems, and future progress and improvement in agricultural techniques should be taken into account. The plotting of fields will therefore be governed by the following conditions:

1. Technical Process in Farming Operations

In the execution of manual transplantation, the efficiency of the operation will be reduced if the size of plots is too big, so it is desirable that each plot be of such a size that it can be finished in one day by a group of 4-5 men, that is to say with a standard area of 20-30 areas.

With regard to the size of fields, the proportion of long to short field sides is economical when it is 3:1, as far as running cultivators are concerned. In the use of spreaders, on the other hand, efficiency of operation will drop owing to the long sides of the fields being too long.

2. Condition of Topography in Paddy Block

Though the topography of the area seems flat, the gradient has become 1/30 - 1/280 owing to a swamp of 3-4 metres depth having spread into this area.

The long side of the paddy field will be designed to run parallel to the contour line. Where the controur line is straight and there is no topographical restriction the long side of the field will be 100 m; and where the contour is not straight the long side of the field will be 50 m. The short side in either case will be 20 m due to the fact that if the length of the short side is extended, the amount of earth moving will be increased, because the short sides of the fields are at right angles to the contour line and, where the difference between the field surface and the adjacent plots becomes greater than 30 cm., stronger slope fortification at the borders is legally required, and efficiency of farming will be reduced.

3. Area of Land Possessed by Farmers: Possibility of Grouping Farms and Management Areas.

The average area of lands possessed by the farmers concerned will be twice the unit of 0.25 hectares per house (50 m x 50 m) as in Figure 2-7, Table 7-2.

The farmers concerned have already agreed to grouping of land.

4. Design Standard of Agricultural Land Bureau (Japan)

In addition to the above various conditions it is also necessary to consider the following Design Standards of the Japan Agricultural Land Bureau.

Gradient of topography	1/200 -	1/100-1/200	1/50-1/100	1/10-1/50
Size of plot	30 a -	15 a-30 a	7.5 a-15 a	5.0 a-7.5 a
Short side-Long side	30 m-100 m	15 m-100 m	10 m-15 m 75 m-100m	10 m-50 m-75 m

The size of plots will be 20 m x 100 m = 0.2 ha. in gradients of more than 1/100, and be 20 m x 50 m = 0.1 ha. in gradients of less than 1/100.

4-4-2 Design of Road

Arrangement of roads will be determined after consideration of the mutual relationship of hamlets, farm lands and markets.

Access Farm Roads

Existing access farm roads are in comparatively good condition. The gradient at the junction of the Main Canal Inspection Road and the road to the hamlets will be adjusted from its present steep gradient of 1/6 - 1/7 to a gentler gradient of less than 1/10. The existing width is 6.0 m.

Main Road

This is the road which links the farming areas with the villages and serves traffic coming to and leaving each block; 2 lines of roads will be installed as in attached figure and in conformity with the farmers' wishes.

Side Roads

Side roads will generally be constructed every 200 m. with a view to facilitating water control and giving easy access to each farm plot in the farming area.

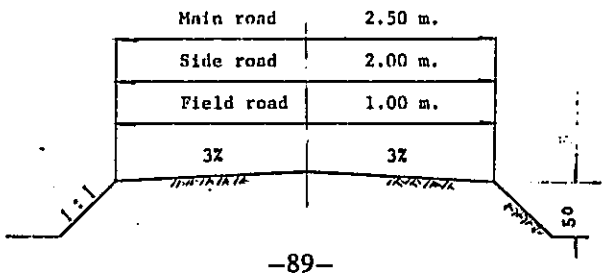
It is considered that cultivators will be used for farming operations and gathering of harvests will be made by cultivators or ox-carts for the foreseeable future. These vehicles have a width of 1.0 m - 1.4 m, so the width of main farm roads shall be 2.5 m, and side roads 2.0 m.

Field Roads

Field roads will be placed every 100 - 200 m, depending on the arrangement of main and side roads, in such a way that each field is served by a field road on one side. The width of field roads will be 1.0 m, since they will mainly be used by men and animals.

The elevation of roads will be 50 cm at road shoulder with a cross gradient of 3 %.

Foundations must be laid for roads across the existing paddy fields. Most of the paddy fields were developed 2 or 3 years ago. The arable soil is in a thin layer of 7 - 13 cm and is silty in quality and the subsoil has been well compacted. There is no fear that ox-carts or cultivators will cause the roads to break or settle. Filling materials will be obtained from adjacent field areas. The standard section will be as follows:



4-2-3 Ground Leveling Work

The construction cost of ground leveling will be reduced by arranging paddy plots and fields as far as possible along contour lines, and ground leveling work will be most satisfactorily carried out by moving earth within respective field areas and will be designed so as to incorporate complete irrigation water drainage. To avoid poor drainage the paddy fields should be terraced with steps of 5 cm.

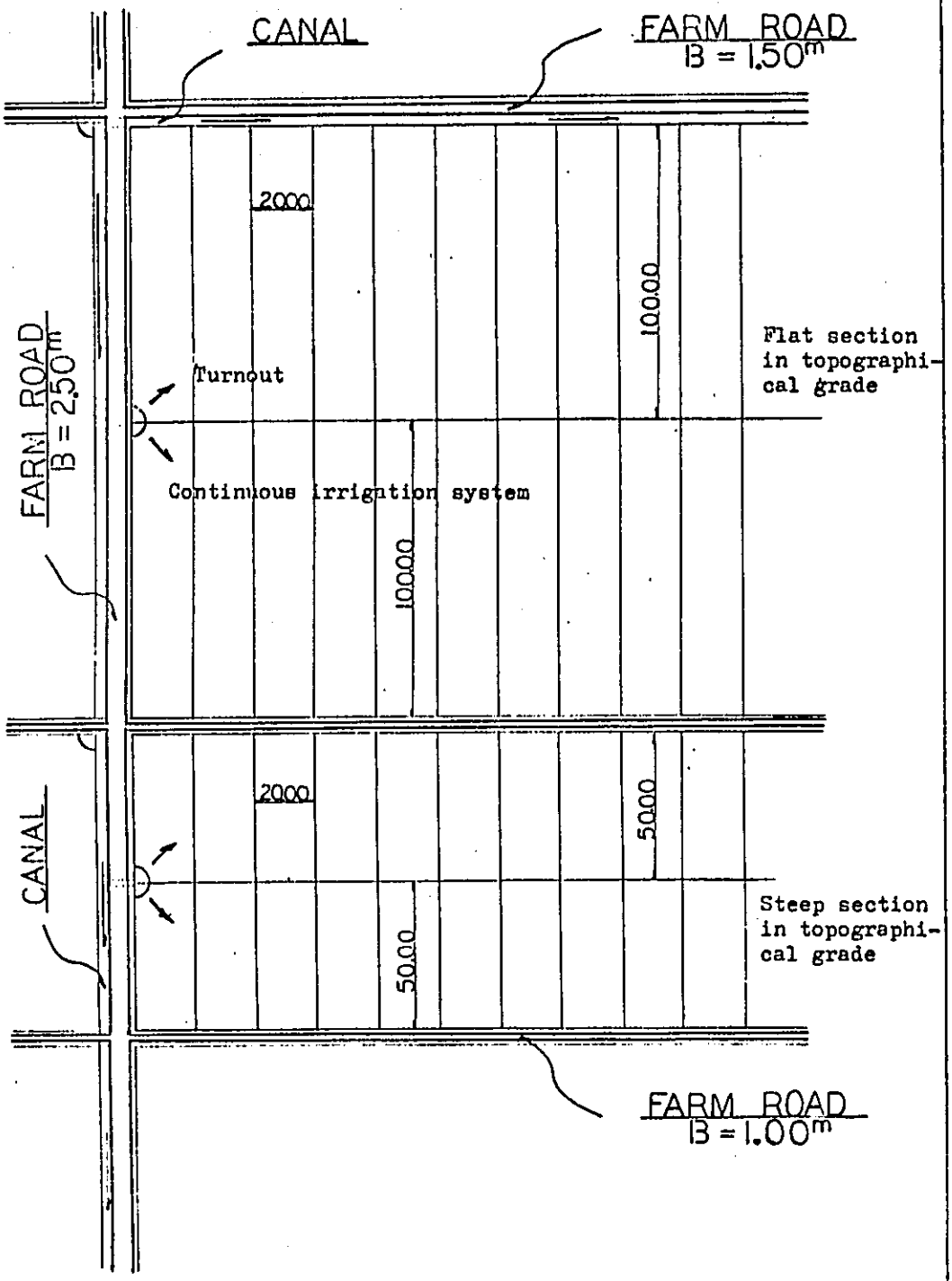
With regard to arable soil: considering that most of the arable soils contain humus of 7 - 13 cm in a thin layer with a little organic humus, and that these are fields which were developed 2-3 years ago, or were waste lands of Alang Alang, treatment of surface soil will not be undertaken.

Table of Roads

R-A Type		R-B Type		R-C Type	
No.	L	No.	L	No.	L
R-A-1	943	R-B-1	972	R-C-1	221
R-A-2	767	R-B-2	444	R-C-2	163
R-A-3	190	R-B-3	295	R-C-3	393
		R-B-4	250	R-C-4	142
		R-B-5	204	R-C-5	100
		R-B-6	334	R-C-6	143
		R-B-7	788	R-C-7	328
		R-B-8	330	R-C-8	84
		R-B-9	510	R-C-9	48
		R-B-10	430	R-C-10	125
		R-B-11	285	R-C-11	498
		R-B-12	461	R-C-12	433
		R-B-13	260	R-C-13	141
				R-C-14	181
				R-C-15	181
				R-C-16	240
				R-C-17	197
				R-C-18	267
Sub Total	1,900		5,563		3,614
Total	11,077 m ..... Road density 124 m/ha				

Main road .. R-A Type Side road .... R-B Type
Field road .. R-C Type

Fig 4-1 STANDARD FARMLAND BLOCK S=1:2,000



The plan for each field area, the elevation of field surfaces and the amount of earth moving in each field area will be shown in Annex. For instance, where the amount of earth in one field area is not sufficient, where the planned water level can not be attained, or where the effluent side is higher than the affluent side, earth-moving should be planned within the respective field areas so as to involve minimum amounts of earth and minimum earth-removal distances. Operations involving computation of areas from design plans, computation of amounts of earch and earth-removal distances will be made by use of electronic computers. The computation will be made after establishing a program of land-levelling calculations based on the following chart.

Outline of Operation Schedule
(For Computation of Earthworks from Design Plan)

Operation schedule for planning and design	Planning and design	Planning, design and reference numbering of field plots and field sections, roads, and irrigation and drainage canals.
Operation schedule of computation of area	Establishment of coordinates; computation of area	Measuring borders of each existing plot and attribution coordinates. Coordinate values will be punched on papers by use of automatic recording devices, or be obtained by print electronic computer (including adjustment of computation).
Operation schedule of soil computation	1st computation of present mean amount of soil	By electronic computor, as may be required, taking into account the amount of soil in the border dikes.
	1st planning and design of field rearrangement	Determing planned amount of soil.
Operation schedule of soil computation	2nd computation of present mean amount of soil	Taking into account the amount of soil required for general ground leveling, specific ground leveling and new installation of irrigation and drainage systems, and roads, etc.
	2nd planning and design of field rearrangement	Determining the final planned amount.
	Computation of final planned amount	Including amount of soil to be moved between field sections.
	Computation of soil cut and banked on existing plots	Computed from final planned amount of soil.
Computation schedule of hauling distances and amounts of soil to be hauled	Computation of amounts of soil to be hauled and hauling distances	Computation of amounts of soil to be hauled between plots and hauling distances.

4-2-4 Irrigation Canal

1. Irrigation Requirement

Generally the irrigation requirement will be determined by analizing practical example of such variable factors as increasing improvement of plots and deep plowing; increasing amount of percolation due to distance of terminal plot and reduction of the amount of percolation due to tramping pressure of mechanical construction methods. However, as satisfactory data was in short supply irrigation requirement was surveyed to conform with practical examples among areas. Except the gray white soil area south east of the villages, the land is generally covered with surface layers of Latosol soil in brown red color.

The water requirement in depth is comparatively less even in submerged fields due to poor permeability and durability of soil measured by Conepenetrometer is larger than qa=5.0 t/m^2, execution of mechanical construction will be easy.

Concerning the water requirement in depth, a measurement and observation test, using a vertical angle measurement was performed at 3 locations in the south east area and also tried to install N type measuing device at one place where is considered as a representative field in the future due to less affection of ground water, arable soil being thick (see Appendix Figure 7-1). In the results of comparing with the values of Design Standard of the D. P. U., those were found to be of approximate value. It will depend upon the following table to determine unification of water management and water diversion in areas under D. P. U. hereafter.

(* 100 Bau = 141 ha)

Maximum Water Requirement		Bau	ha	$q^1/s/ha$
a.	Due to D. P. U. Computation Standard.	0-5	3.5	4.00
		5-10	7.0	3.35
		10-25	17.5	2.80
		25-30	35.0	2.30
		50-100	70.0	1.84
b.	In Case of Field Measurement Water for Puddling.	130 mm	10 days	
	Water Requirement in depth	Rainy Season	13mm	Dry Season 18mm
	Canal Loss	20 %		

Irrigation Requirement

$$Q\max \text{ (rainy season)} = \frac{1}{8.64}\left(\frac{1}{10} \times 130 \text{ mm} + \frac{9}{10} \times 13 \frac{1}{0.8}\right)$$

$$= 3.57 \ \ell/s/ha$$

$$(\text{dry season}) = \frac{1}{8.64}\left(\frac{1}{10} \times 130 \text{ mm} + \frac{9}{10} \times 18\right) \times \frac{1}{0.8}$$

$$= 4.22 \text{ ℓ/s/ha}$$

2. Irrigation Canal

The irrigation canal will start at the turnout of the tertiary canal where water has been taken from D.P.U. 10 and 2 lines will be installed in a south east direction to follow the present water system and to the utmost will be bank type so as to be able to carry out complete water management program, cropping of each farm lot is not an urgent program and continuous irrigation will be employed. Though this type will be limitted in free degree of water management in each farm plot and in the view of irrigation, there is a tendency that upstream paddy fields are profitable, but not in downstream fields. On the other hand, irrigation canals in a longitudinal direction become unnecessary and such canals will be reduced, small farm roads will be constructed in place of longitudinal canals thereby ma making hauling easy. In take structure and labors of water management will be reduced under management of one unit plot and as circulating irrigation in some extent can be executed in the same area, this farm will be adaptable for this area which is short irrigation water.

In the future, in case of causing necessity of paddy field draining and drainage due to such as program and alteration of cultivation technics, drainage after sprouting, mid-summer drainage for flooding direct-sowing, free operation of irrigation and drainage for spraying chemicals and fertilizing liquid fertilizer or giving proper permeability to the soil, the designing will be made to instal a drainage at the middle part of plots and some additional intake facilities for this equivalent and regarding water application block, it will be settled as Figure 2-6 in accordance with the above ideas for topography and system of water requirement.

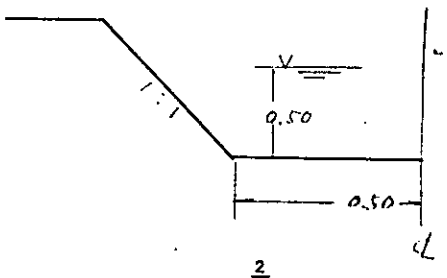
3. Design of Canal Section

The design discharge of canals will be the section which can flow the discharge to multiply the maximum irrigation water.

In this case, the discharge of each canal will be changed due to continuous irrigation. Though shortage of the section shall be considered for that identical section will be adopted to give a function of drainage. Having a drainage function, the canal bottom section is 20 cm lower than the height of field surface.

The water level intake of each paddy field will be 20 cm higher than the field surface. In case of minimum discharge, the water intake will be made to raise the weir at diversion weir. The type of canal section will be the following 3 types, S.B.C. to conform with the gradient of canal discharge.

T - A Type



$A = \frac{1}{2}(1.00 + 2.00)$

$\times 0.50 = 0.75\ m^2$

$P = 1.00 + 2\sqrt{2} \times 0.5$

$= 2.414\ m$

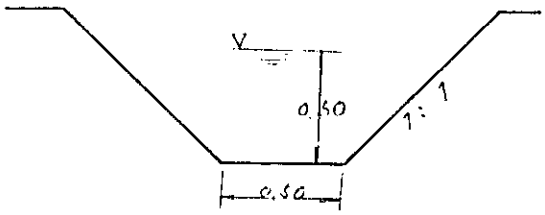
$R = A/P = 0.3107$ $\qquad R^{\frac{2}{3}} = 0.439$

$I = \frac{1}{10,000}$, $n = 0.035$

$V = \frac{1}{n} \cdot R^{\frac{2}{3}} \cdot I^{\frac{1}{2}} = 0.131\ m/s$

$Q = 0.75 \times 0.131 = 0.098\ m^3/s$ $\qquad > 0.096\ m^3/s$ .... ok

T - B Type



$A = 0.50\ m^2$

$P = 1.914\ m$

$R = 0.261\ m$

$I = 1/100 \sim 1/1000$

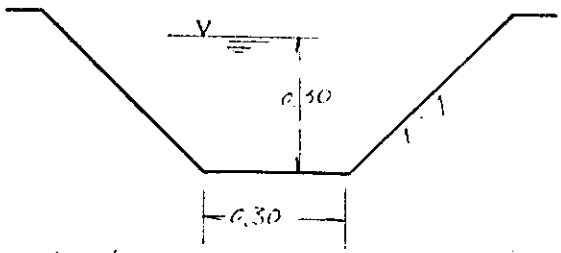
$Q = 0.683\ m^3/s \sim 0.215\ m^3/s$

F - A Type

$A = 0.18\ m^2$ $\qquad P = 1.148\ m$ $\qquad R = 0.157$

$I = 1/100 \sim 1/1000$

$Q = 0.174 \sim 0.055\ m^3/s$



F - 3 - C

$I = \frac{1}{2000}$ $\qquad n = 0.035$

$V = \frac{1}{0.035} \cdot 0.157^{\frac{2}{3}} \cdot \left(\frac{1}{2000}\right)^{\frac{1}{2}} = 0.186\ m/s$

$Q = 0.18 \times 0.186 = 0.033\ m^3/s$ $\quad > 0.006\ m^3/s$ ..... ok

F - 2 - B

$I = \frac{1}{3000}$ $\qquad n = 0.035$

$V = \frac{1}{0.035} \cdot 0.261^{\frac{2}{3}} \cdot \left(\frac{1}{3000}\right)^{\frac{1}{2}} = 0.212\ m/s$

$Q = 0.50 \times 0.212 = 0.106\ m^3/s$ $\quad > 0.028\ m^3/s$ ..... ok

Table of Tertiary, Fourth Canal Length

	Type	Canal Length	Irrigation Area	Discharge
Tertiary Canal	T- -1	735.0	54.3	0.096 m^2/s
" "	T- -2	538.0	19.1	0.053 "
" "	T- -3	813.7	33.6	0.077 "
" "	T- -4	593.0	17.6	0.049 "
Fourth Canal	F- -1	552.0	5.4	0.018 "
" "	F- -2	753.0	8.3	0.028 "
" "	F- -3	203.5	1.5	0.006 "
" "	F- -4	"	4.4	0.018 "
" "	F- -5	90.0	4.0	0.016 "
" "	F- -6	361.0	1.8	0.007 "
" "	F- -7	153.0	2.3	0.009 "
" "	F- -8	100.0	1.8	0.007 "

	TYPE	B	h	F-b	H	B_c	$1-_m$	I	Q^1/s
A	T - 1	1.00	0.50	0.20	0.70		635	1/4000	98
B	T - 1	0.50	"	"	"		100	1/1000	215
B	T - 2	"	"	"	"		200	1/1000	"
C	T - 2	0.30	0.30	0.20	0.50		338	1/250	110
A	T - 3	100	0.50	0.20	0.70		330	1/4000	98
B	T - 3	0.50	"	"	"		483	1/1000	215
C	T - 4	0.30	0.30	"	0.50		338	1/4000	87
C	T -	"	"	"	"		255	1/150	142
C	F - 1	"	"	"	"		307	1/500	78
C	F - 1	"	"	"	"		245	1/150	142
C	F - 2	"	"	"	"		307	1/3000	
C	F - 2	"					445	1/200	123

4-2-5 Drainage

Concerning drainage, it is necessary to examine the surface drainage and under-ground discharge. However, regarding surface drainage, the necessity of non-submerged condition is less due to high utilization of paddy fields such as second crop introduction, rotation of fields and uplands, direct sowing on dry paddy fields. On the contrary, it will fully be able to correspond to high borders, installation of the outlet of irrigation water, and providing canal bottoms to below field surface. The designing of under ground water drainage will not be considered as stated above as a tentative measure. Therefore, only under-drainage in the area, where drainage will be disturbed to comply with installation of farm roads, will be newly provided.

1. Determination of Section of Under Rainage

a. Design probable daily rainfall of 10 years (140 mm), will be adopted as drainage standard rainfall in this project.

The rainfall condition will be continued for a few hours each day. Assuming daily rainfall for average 3 hours, it will be r = 47mm.

b. Design drainage discharge

$Q = 0.2778\ f\ r\ A$
where $Q \doteqdot$ drainage discharge $m3/3$
f = runoff ratio 0.8
r = rainfall intensity 47m/m
A = area 0.2 km^2
$\therefore\ Q = 0.2778 \times 0.8 \times 47 \times 0.2 = 2.09\ m^3/3$

4-2-6 Canal Structure

1. Irrigation Culvert

As canal section is small in scale at the crossing point of canals and farm roads, a cover type flume or pipe culvert is generally used. A type, which is a cover set on a flume and covered with pasangan, easily obtained at the site, will be employed. The kind and place of culverts will be as shown on following table.

2. Turnout

Irrigation water of this area will be supplied from D. P. U. 10 turnout of main canal and delivered a distance of 4,600 m, the total length of the tertiary and fourth canal. 120 ha will be irrigated with 41 turnouts.

The maximum control area in one turnout will be controlled in less 3 ha as possible to control the disturbance of being profitable at upstream, not at downstream in continuous irrigation and to reduce unbalance of driving hours of irrigation water in each plot.

In turnouts of small scale, the measurement of diversion in precision is difficult; therefore, the overflow weir type, a simple structure which can be made for fluctuation of water intake level in the canal will be adopted.

3. Drainage Culvert

Due to thickness of over-burdon and culvert section, pipe culvert is easy in construction execution and profitable in economy. Therefore corrugated pipe culverts of 600 ϕ and 800 ϕ will be installed at 3 locations except one which has a drainage culvert.

Culvert

Type	Size (B H L)	Q'ty	Remark
CAA	1.20 x 0.60 x 2.50 (Pasangan Batukali) (Concrete Cover)	1	Across A Type Farm Road of A Type Canal
CAB	1.20 x 0.60 x 1.50 (Pasangan Batukali) (Concrete Cover)	2	Across B Type Farm Road of A Type Canal
CAC	1.20 x 0.60 x 1.00 (Pasangan Batukali) (Concrete Cover)	1	Across C Type Farm Road of A Type Canal
CBA	0.70 x 0.60 x 2.50 (Pasangan Batukali) (Concrete Cover)	6	Across A Type Farm Road of B Type Canal
CBB	0.70 x 0.60 x 1.50 (Pasangan Batukali) (Concrete Cover)	2	Across B Type Farm Road of B Type Canal
CBC	0.70 x 0.60 x 1.00 (Pasangan Batukali) (Concrete Cover)	2	Across C Type Farm Road of B Type Canal
CCA	0.50 x 0.40 x 2.50 (Pasangan Batukali) (Concrete Cover)	6	Across A Type Farm Road of C Type Canal
CCB	0.50 x 0.40 x 1.50 (Pasangan Batukali) (Concrete Cover)	24	Across B Type Farm Road of C Type Canal
CCC	0.50 x 0.40 x 1.00 (Pasangan Batukali) (Concrete Cover)	8	Across C Type Farm Road of C Type Canal
CCD	1.20 x 0.60 x 5.60 (Pasangan Batukali) (Concrete Cover)	1	Across D Type Farm Road of C Type Canal
CCE	1.20 x 0.60 x 8.60 (Pasangan Batukali) (Concrete Cover)	1	Across E Type Farm Road of C Type Canal
TOTAL		54	

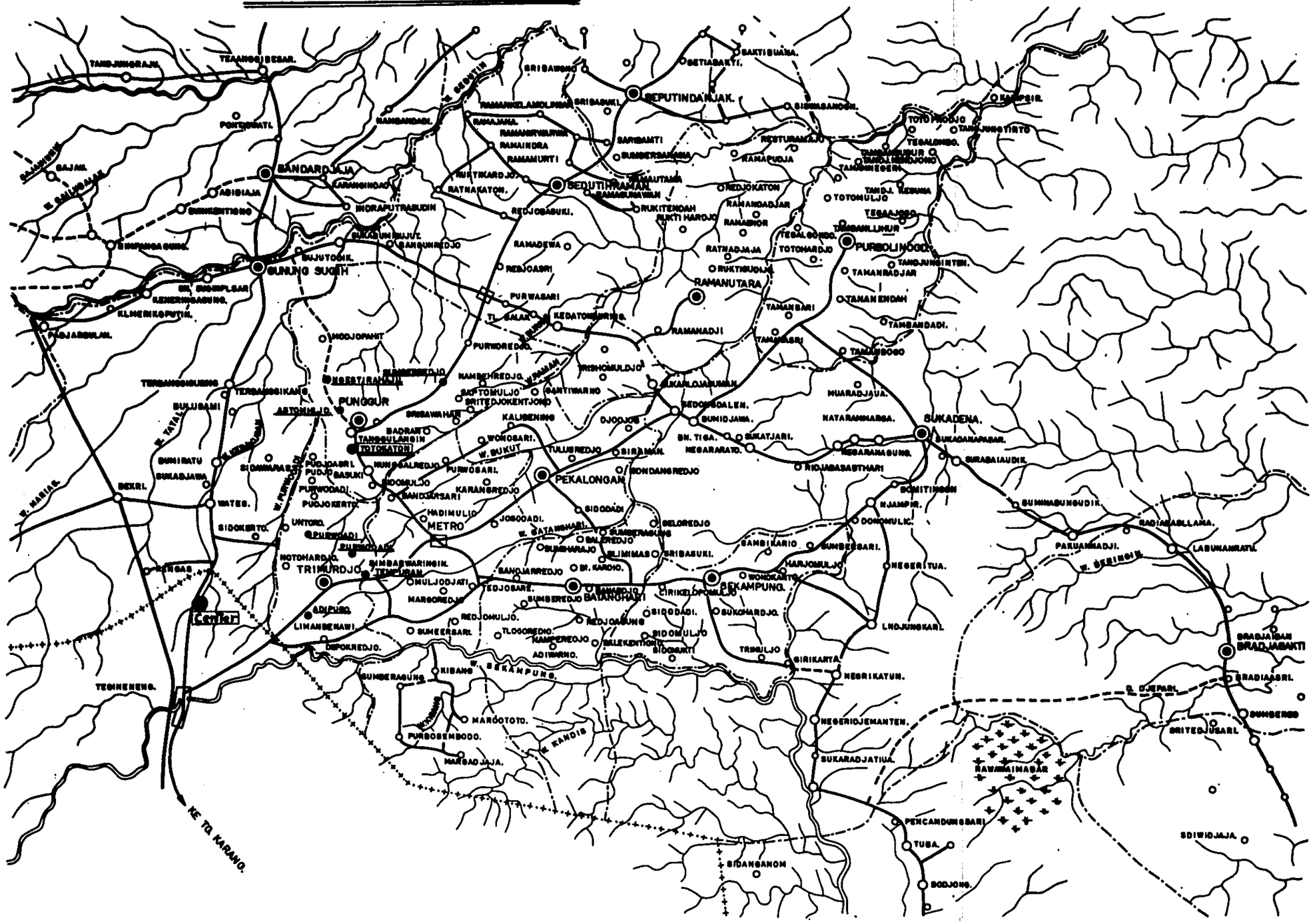
Diversion Works

Type	Size (B H)	Q'ty	Remark
WA	1.00 x 0.55 (Pasangan Batukali)	6	Attached to A-Type Canal
WB	0.60 x 0.55 (Pasangan Batukali)	7	Attached to B-Type Canal
WC	0.40 x 0.35 (Pasangan Batukali)	28	Attached to C-Type Canal
TOTAL		41	

Culvert for Drainage

Type	Size	Q'ty	Remark
D-C-1	600 ϕ x 5.00 ℓ (Corrugate Pipe)	1	
D-C-2	600 ϕ x 5.00 ℓ (Corrugate Pipe)	1	
D-C-3	800 ϕ x 8.00 ℓ (Corrugate Pipe)	1	

FIG 5-1 Location of S.D.F



CHAPTER 5 SMALL DEMONSTRATION FARM

5-1 Purpose and Plan of Investigation

The purpose will be to provide a model farm for farm lands and lands to be developed in the future to execute the rational development of rice culture technics.

Namely, by implementation of land improvement work, the rationalization of irrigation and drainage, reduction of labour and increased farm production will be promoted, and with improvement of upland crops in dry season, development of the productivity of lands, the rationalization of currency system, the introduction of new technics and training of farmers organization will be promoted. Therefore, in the land consolidation, the investigation and consideration were comprehensively carried out to conform with the following matters under such back ground.

As various values in planning and designing haven't been detailed due to the term of survey of the mission being limitted, it will be desired to make measuring and analyzing by expects hereinafter.

1. Demonstration farm will be essential as standard of industrialization for adjacent areas to conform with social, natural and various technical conditions of the areas.

2. In regards to land readjustment, some improvement of the present management process concerning man and animal power (in the scope of tiller at present); and to improve the practical conditions such as form and area of plots, land possession, distribution of arable lands, the improvement of productivity has been anticipated by the extention, rearrangement and grouping of plots.

3. Concerning farm roads, investigation and consideration have been made on necessity of the improvement of various functions such as arrangement, density, width, height of road function, access structures to traffic conditions (including farming operation) based on form of villages or farming system as improvement of plots.

4. Concerning irrigation and drainage, main canals will be controlled under D. P. U. Comprehensive management is required in connection with its improvement scheme and a special consideration has been paid on quality of the function of irrigation and drainage, specially on the function of water distribution, water diversion and proper arrangement of canal lines.

5. Various plans of land improvement work has been determined also to consider the improvement of soil layers, preservation of farm lands and other infrastructures.

5-2 Present Condition

This design area will include Kabupatan Trimurdjo, a nine other Katjamatan in Lampung province, and Kabupatan Lampung, Tengah.

Lampung province is situated in about 2 % of the area of Indonesia and also contains 2 % of the total population of Indonesia. The population of Kabupatan L. T. is 959,220 as of 1970, recently this area experienced a population increase of 8.5 %.

In the promotion of the development of outer islands, this area is extremely favoured in natural and various economical factors. However, the ultimate population policy and the core of BIMAS, which is mainly promoted by the Government, will be development and improvement in this area. Realization of this goal is an urgent problem.

Therefore, small demonstration farms will be installed at 40 separate locations in this area. An investigation has been performed to consolidate 7 areas of land into two separate locations, one location consists of 3 areas around Trimurdjo and the other consists of 4 areas around Punggur quickly.

The objective area is located upstream comparatively and its intake facility has been completed, being proposed area in the first year of proposed project. Namely, Dam Argoguruh was constructed at Way Sekampung in 1935 and those areas are that which the construction of paddy fields has comparatively performed consequently to comply with the completion of each turnout facility at Trimurdjo and KH point downstream.

But it is considered that the discharge of water resource will be extremely reduced in dry season (in the plan of water intake of head work: A = 30.483 ha and Q = 26.09 m^3/s at Punggur Utar, A = 22.00 ha Q = 32.19 m^3 at Sekempang, being A = 52.483 ha Q = 58.28 m^3/in total. As of the 8th of September 1972, the discharge of water resource is 12 m^3/s in the total amount of intake water except some partial leakage on the 8th of September 1972 being 8 m^3/s on the 9th of October) and the water demand will be considerably increased to conform with development of downstream area and improvement of Teriary canal. So another counter plan of water resource will be needed. Also, the implementation of the project on irrigation and water management will be as follows.

KatJamatan	SDF No.	Objective No.
Trimurdjo	4	4
Punggur	3	3
Metro	5	
Peklongan	4	
Batnhari	5	
Sekampung	3	
Septih Raman	4	
Raman Utra	4	
Purbolingo	4	
Sukadava	4	
TOTAL	40	7

The operation of sluice at Mondor, Wokkor can not be done as water gauges are short or have not been provided and gate flash boards

Classification	D. P. U.	Gotong Rojong or Each Farmera
Control of Canal	Main Canal → Secondary Canal →	Tertiary canal Branch ditches (till approach 15 m by D. P. U.)
Control of Water Supply	Irrigation District Resort → Mondor → Wakker → Pekerdjo	Each Kabupatan P. M. D. → ili-ili

are rotten, the operation of this sluice is not easy. For example, no gate in design has been provided at some places and even in the weir operation, square timber for sluice gate has remained. Therefore, in order to reduce the damage, circulating irrigation is excuted as a temporary measure in Desa at the end.

Existing paddy fields belong to Latsole or Podosole system, most of these consist of red brown soil. But gray white soil has penetrated into some parts of the south area. Every substratum of subsoil under arable lands is in solid condition (at over 40 in Penetrometer value A = 3.23 cm^2), the effective soil layer is some 10 cm except partial rawa paddy, being quite thin and contains little humus.

Concerning the average amount of rainfall for the period 1950-1967 (Metro observation EL +57 m), 1,973 mm/year was served. Rainfall in the dry season will be light due to alternating east seasonal wind, monthly rainfall will be 5-6 days. It seems that every 6 to 7 years a drought occurs during the dry season at this time the cassava plant becomes withered and loose their drought resistance.

Farmers of this area mostly consist of immigrants from Java except for a number of Lampung people. Immigration to this area was started about 1930 but was not prosperous to this area until after independance. As a result, the government adopted a policy of developing promising areas and encouraged immigration to control problems such as drought, flood, wild mice, and noxious insects.

Ordinally, in case of immigration, its allocation will be 20 ha in total of 1.0 ha of paddy fields, 0.5 ha of uplands, 0.25 ha for permanent cropping and 0.25 ha for building lots. The mean scale of obstraction will be 1.65 ha in total of allocating 1.2 ha of paddy fields, 0.2 ha of uplands and 0.25 ha of building lots. Although field reclamation has been promoted to accorde with extension of irrigation facilities in recent years, past local customs coupled with an increasing population is having an adverse affect on the farm reclamation program. With each men generation farms are reduced in size as they are divided among new family members. Small farms in this area lack proper farm management technics and equipment, relying almost entirely on ancient farm instruments such as Ani Ani (pinching heads), Todjok (soil scraper) and tugol (seeding hole stick), etc. Only 30-40 % of puddling and cultivation are carried out by the use of cattle.

technics to such land conditions, with an ultimate plan to extend arable land into the Alang-Alang plain.

Outline of Small Demonstration Farm

Katjamatan	Desa	No. of Farmhouse Concerned	S.D.F. (Paddy Field)				Another District	
			Cadaster		Actual Survey		Paddy	Upland Ordinary
			No. of Fields	Area	No. of Fields	Area		
				ha		ha	ha	
Trimurdjo	Limonlienawa	8	54	3.125	90	4.115	6.165	-
	Tempuran	5	39	3.140	52	3.470	5.420	-
	Purwoadi	7	33	3.725	36	5.583	7.725	0.525
	Purwodadi	4	59	3.150	58	2.429	7.200	0.800
Punggur	Sumberredjo	7	51	3.125	57	2.984	1.375	2.000
	Ngestirapaju	7	35	3.080	38	2.737	2.245	1.000
	Astomhljo	7	41	3.000	42	2.737	1.750	-
Total		45	312	22.345	373	24.055	31.880	4.325
Average (per Hours)			6.63	0.497	8.29 (per field)	0.535 0.065	0.708	0.096

Notice: See Figure 5-2.

Concerning transplantation of rice seedling, normal planting methods will prevail. Most farmers adopt careful farming technics such as spacing in the row is quite close and depth of root is 6-7 cm. They hope the paddy field will be pooled as soon as possible in order to prevent noxious insects from appearing.

The condition of arable lands has comperatively been possessed in grouping, being such a small area as less 1a/plot due to these having been reclaimed in case of utilizing a small amount of natural and surplus water. Lack of farm roads and improper utilization of farm borders as roads are caused for low production (2 TON/ha).

Accordingly, it is necessary to promote the consolidation of land foundation to improve irrigation facilities, not only to expect an increase in production but also to introduce modern new agricultural

5-3 Guidance of Land Consolidation

Eventhough proposed small demonstration farm which have comparatively affluent irrigation water, excluding Simbarwaringun, Purwoadi, only 20-30 % of paddy fields were planted in the dry season of 1972. It will be necessary to expect effective management of investment not only to introduce upland cops such as maize, cassava, soybean and peanut but also to consider high utility of lands. Concerning irrigation facilities and structure of farm road (for instance, the height or road surface), it is necessary to divide into permanent and temporary structure in accordance with the demand, the condition and frequency of use. It will also be necessary to consider the effectiveness of investment.

In regards to the plot and form of arable lands, the implementation will as much as possible respect the existing facilities and habitual water use to agree with the topography and gradient as may be required, but it will be essential to reduce the amount of soil as much as possible and not to consolidate areas uniformly. The present arable area consists of small plots of less than 1 ha each as stated before and the possessed plots consist of 10 or less plots. Rational water management is needed to extend and to improve farm areas to group and reduce farm labor, and improve irrigation facilities.

Concerning farm roads, lateral class, it has been comperatively rearranged but main farm roads almost haven't been rearranged. Therefore, farm roads will be necessary to install along the short side of paddy block in each farm plot.

Important points of the result of investigation and consideration of each place will be summarized as follows.

Name of Place	Items of Rearrangement	Guidance and Summary of Rearrangement
Limanbenawi	Paddy Block	The direction of long side of plots will be from north east to south east, (generally the central part in present situation has been generally in this direction), and the short side will be some 20m at generous slope zone, being 10 m at north side and along Tertiary canal at south side. This is unavoidable due to topography gradient.
	Drainage Canal	One line of drainage canal will be installed in the direction from south east to north east at the central region of this area so as to be able to control submerging and drainage treatment in the area. In this case, it will be necessary to investigate in detail on various hydraulic functions as catchment area,

		amount of collecting water, crossing structure of roads (the surface of road base has been lowered), canal bottom, water level at the upstream and drawing feasibility of connection with the end of downstream.
	Road	The existing road located in the west of the area (above and less 5 m in width) will be adopted as main line, lateral roads being provided along drainage canal. Farming works will become easy to construct a farm road in the direction from north east to south east to cross at the near middle point.
	Irrigation Water	Water intakes will be provided at 6 locations in total, 3 locations of both sides of Tertiary canal. Continuous irrigation will be adopted.
	Structure	Dimensions of the 2 conduits that cross the main road are 0.6 m in bottom width and 0.55 m in height. However, in case of the reconstruction in the future due to considerable amount of sedimentation at the canal bottom, its structure will be needed to keep the velocity of flow required (including survey of the position). or to have the possibility of silt removal.
Tempuran	Paddy Block	Concerning arable area of the south east part, which occupies most of the area, the establishment of farm plots will be made at right angles to Djalan Raja re Metro and at a high place along Saluran, the paddy block will parallel to the Teriary canal and the block will become large in size. In this case, as the gradient between both areas is somewhat steep, it is necessary to adjust at the short side of paddy blocks along the tertiary canal so as not to become different in the height of fall.
	Irrigation Water	There is a fall of 10-20 cm between canal bottom and arable lands west of the site. Concerning the water level, complete water intake is easy, complete installation of the intake will be necessary at the lowest point of the south east parts of the area and at two places of the tertiary canal in the west direction.

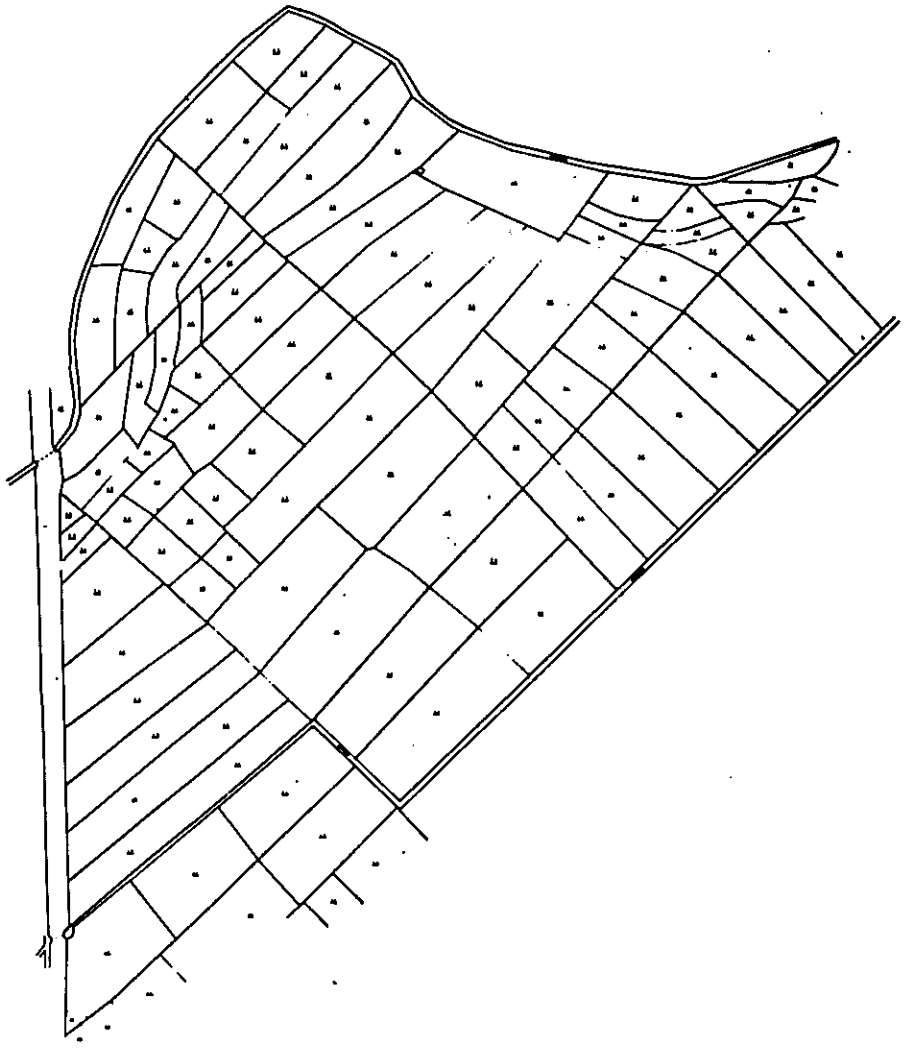
	Road	This area is cut by 2 lines of tertiary canals at south and east sides. One line of farm road will be necessary to construct from Djalan Desa to the borders of both farm plots at the low part in south direction and high part in north direction.
Purwoadi	Arable Land	The area will be expected high productivity and intensive agricultural management at an early stage following the introduction of fertilizing and agronomical technics due to the topographical condition is favoured through constant improvement. In the connection with small irrigation canal which is running through the center of this area to the east west, paddy blocks will be established at right angles to the irrigation canal.
	Road	It is necessary to install one line of lateral road in an east west direction along the existing canal to make Kantor Lurah as the starting point.
	Structure	Although the intake of water diversion weir was designed to be made of logs, etc., at turnout from tertiary canal in east direction of the area, the construction of water diversion weir will be made from Pasangan from the viewpoint of the operation, maintenance, and distribution of water.
Purwodadi	Paddy Block	The operation ration of cultivations will be reduced to provide the long side of paddy blocks along Djalan Desa in south direction of the area. But as there is a gradient even in the direction of design long side of this area, it is profitable that its fall will be settled to 20-30 cm and the short canals, it is desirable to make a comparison to the habitual water use and the gradient of topography of connecting lands.
	Road	One line of farm road will be constructed in a east-west direction from the main road along Pungur Utara and along the existing canal. In this case, it is necessary to make a comparison with the line running up to the north along the east direction of the area from Djalan Desa.
	Irrigation Canal	The field surface of farm plots in the south direction of tertiary canal is high at about 10-20 cm from canal bottom.

		Due to this, easy water intake can not be constructed side will be provided till alternation of gradient along Rawa. Also paddy blocks along Rawa will be obliged to settle small plot allocation to respect the present plot allocation not to conform to the topography.
	Structure	The installation of entering roads will be needed at 3 locations to cross the existing canal by the use of simple conduits after improvement of entering roads along the border of both paddy blocks.
Sumberredjo	Paddy Block	The long side of paddy blocks will be provided to cross the tertiary canal at a right angle where water intake has been directly made from B. P. U. 15. Concerning blocks in west direction of opposite the farm plot, accordingly it will be necessary to construct a simple water intake at the head part of the area.
Ngestirahaju	Arable Block	Paddy block ownership will basically conform to the present system. It is desirable that regarding Mr. Sahiti and Mr. Bissis' possession, their land consolidation will be made from two blocks each in total and for Mr. Djarto and Mr. Suarno's, the short side of blocks will be at least above 20 cm to exclude borders. Regarding Mr. Amat Danuris in the south east section of the plot, such comprehensive improvements as 2 paddy blocks will be desirable.
	Road	Farming operations will be made easy after installation of farm roads on every other farm border.
	Irrigation	It will be rational to install irrigation canal to alter irrigation water at the borders of Mr. Djanto and Mr. Suarnos'.
Astomhljo	Paddy Block	It is necessary to extend plots to establish the long side of the paddy block to cross in a right angle to the present Djalan Desa. Therefore, the long side will become block border at 100 m and the water intake will be freely settled for each paddy block.
	Structure	Entering roads will be constructed at two locations in the north and three locations in the south of farm plots.

LIMANBENAWI

Scale

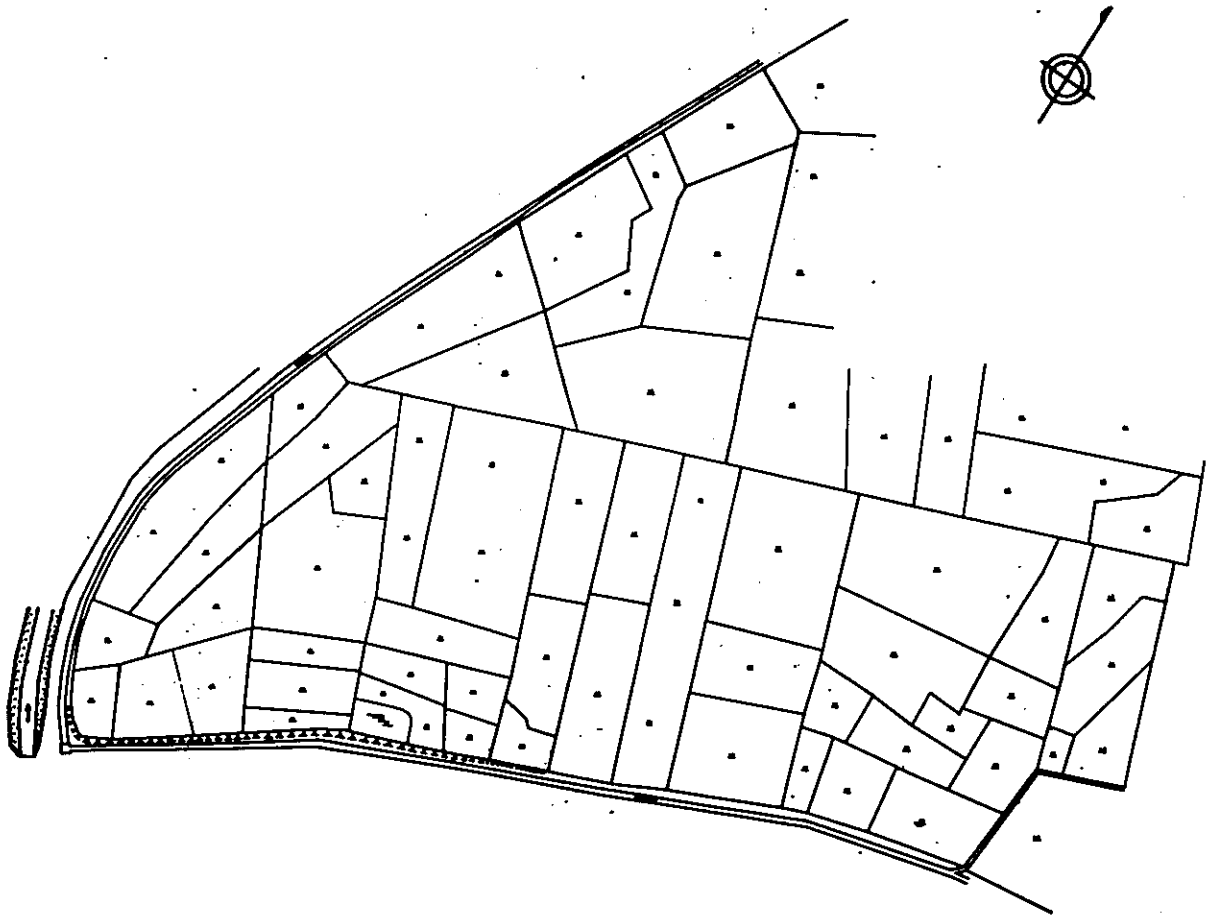
A = 41.153 m^2

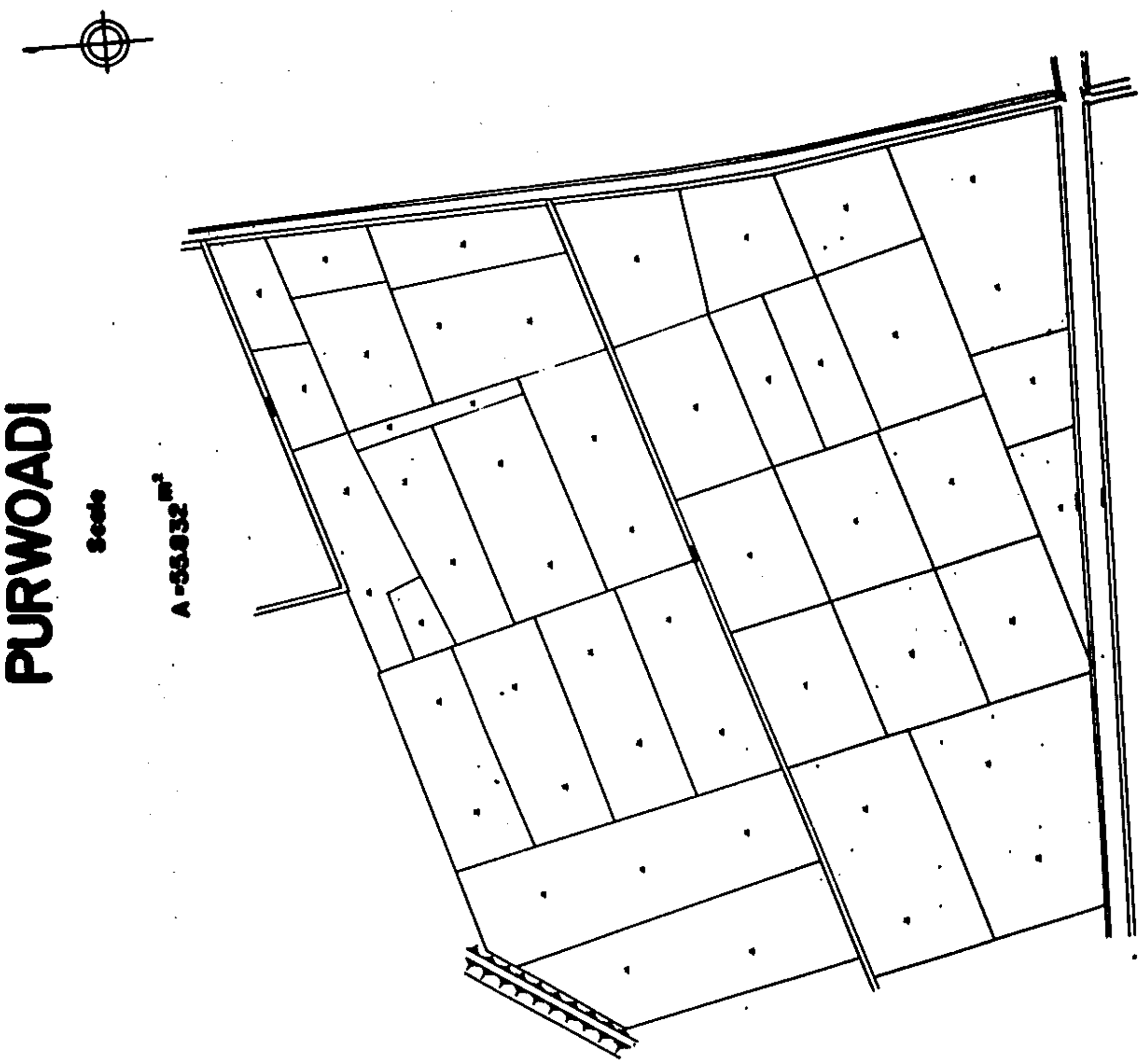


TEMPURAN

Desa

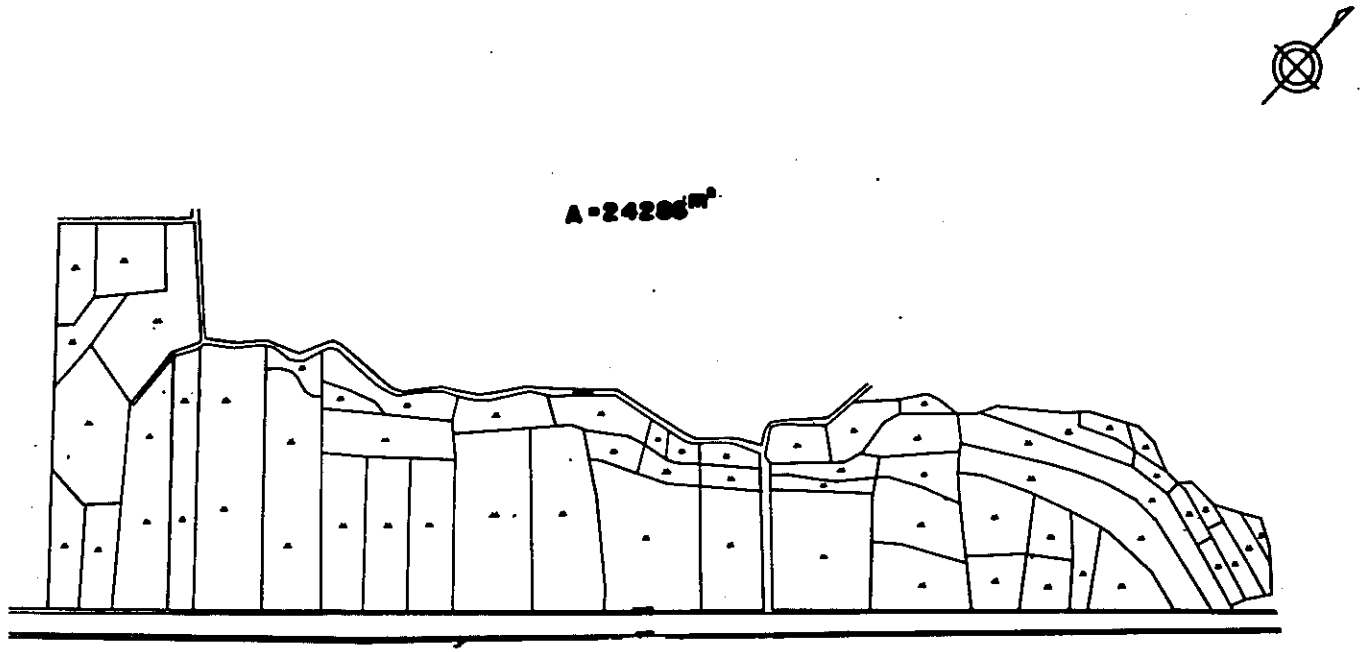
A=34.702 m^2




PURWOADI
Scale
A =55.832 m²

PURWODADI

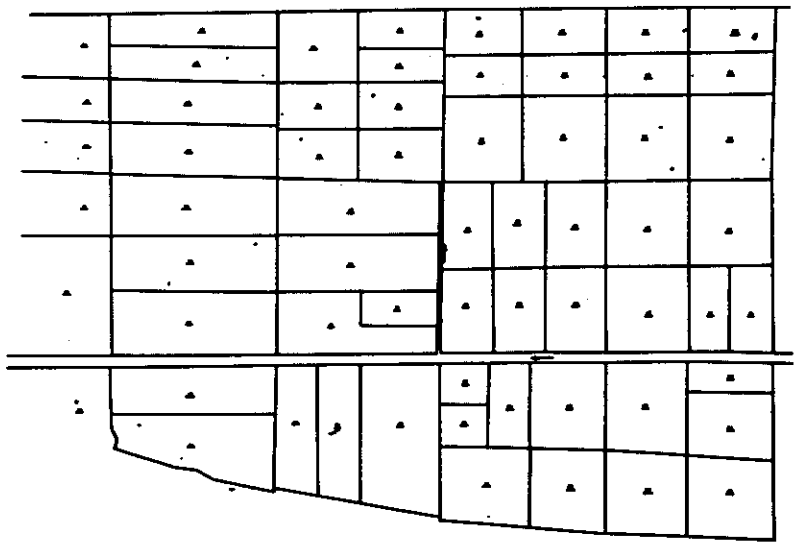
Scale



SUMBERREDJO

Scale

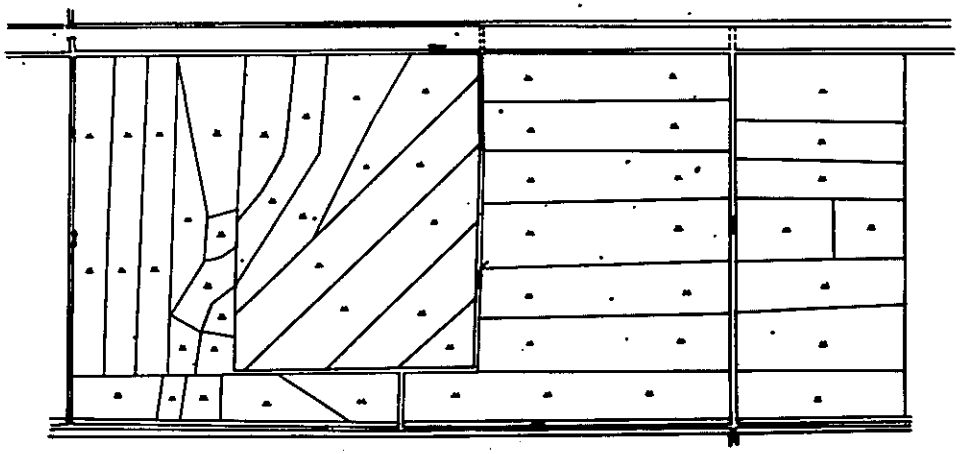
A-23.844 m^2



NGESTIRAHAJU

Skala

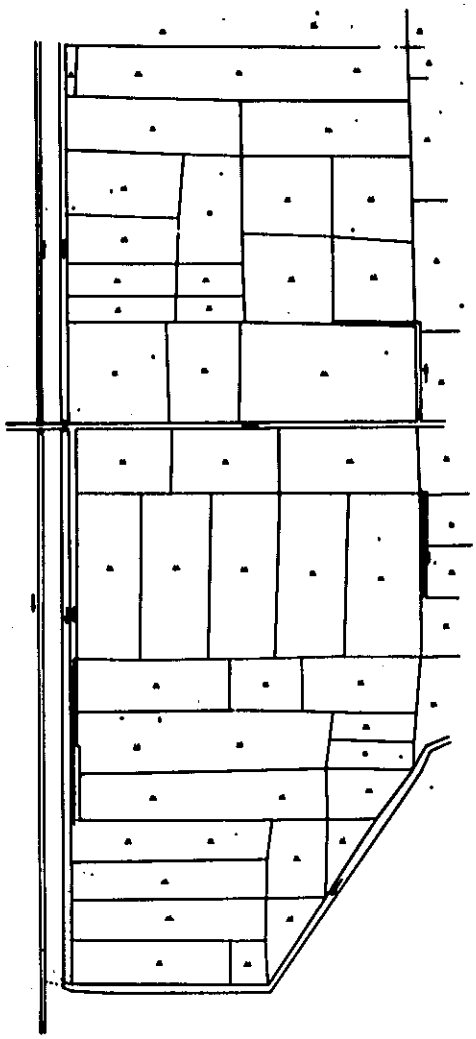
A=2Z458 m²



ASTOMHLJO

Scale

A=27.368$^{m^2}$



CHAPTER 6 CONSTRUCTION PROGRAM

6-1 Construction Program

6-1-1 Construction Program of Facilities of Water Source

1. Outline

a. Farms of 5 ha and uplands of 10 ha will be constructed for test as well as training and exhibition on the east plateau in this area. Judging from discharge and annual rainfall in the proposed water source site, irrigation water will be in short supply during a portion of rainy season and dry season. So, in order to ensure the water required (Total reservoir capacity 210,000 m^3), low paddy fields will be used as a reservoir . Irrigation water will be supplied to the farms on the plateau by pump from the reservoir.

b. Concerning the scale of dam, the length of the dam is long, but the height is extremely low. Main works will be composed of the excavation for dam materials at the borrow pit, the embankment of the dam, the excavation of the spillway site and the masonry of Pasangan Batukali. The construction program of each work is as follows.

2. Order of Execution

Starting with the construction of a road leading to the work and then proceeding on to the completion of dam construction, all work will be carried out in an orderly marner.

(1) Vehicles will be allowed to pass the dam basin freely by making a road from the present connection road in the basin. 11 ton buildozer will be used for this work.

(2) After the completion of work of (1), an open canal, which runs at the left edge of low paddy field in the dam basin, will be utilized as a temporary diversion channel, and this canal will be excavated by man power, and the cross section will be enlarged.

(3) Surface soil removal will be carried out by diverting from 11 ton bulldozer for temporary road works in parallel with the works of (2).

After the completion of this work, the excavation of spillway site will be performed by using the bulldozer. Concerning the spillway, the construction of bridge abutment made of Pasangan will begin immediately. The trench excavation will be started with a backhoe-shovel (0.35 m^3) in the dam basin area when surface soil removal is completed.

(4) The 11 ton bulldozer which completed the surface soil removal and the excavation of spillway site will be transfered to the borrow-pit on the right bank of the reservoir basin, being used for cutting trees and stumping.

(5) After the completion on works of (4), the excavation of embankment material and temporary deposit of soil will be performed with the same bulldozer.

When there is the possibility that the moisture ration of the embankment material will become high due to rain, suitable treatment of drainage such as providing trenches will be needed.

(6) After completion of the bridge abutment of the spillway, masonry of Pasangan Batukali will be performed at the overflow section and floodway.

(7) After the bridge abutment will be cured for 28 days, the embankment will be implemented by carrying the earth of the borrow pit along the center-line of proposed embankment in accordance with specification.

(8) The dam creat will be paved by asphalt with thickness in 8 cm, width in 6 m and length in 124 m so that the dam crest will be utilized as a connection road after completing the embankment.

3. Execution of Each Work

Each work will be proceeded as stated in (2) Order of Execution. In this paragraph, the construction machine and disposal of soil will be stated definetly.

(1) Construction of Temporary Boad

The embankment of temporary road will be carried out by using 11 ton bulldozer so that the vehicles can pass freely in the dam basin from the present connection road. After removing the border of the low paddy field on the right bank in the dam basin, this soil will be applied to the embankment.

(2) Temporary Drainage Canal

An old connection road will be used as a cofferdam and existing canal will be used as a temporary canal so that drainage during construction period will not be obstructed.

After excavating the existing canal by manpower, it will be arranged in shape, and the necessary section of temporary drainage canal will be provided.

(3) Surface Soil Removal and Excavation of Spillway Site

The work will be performed with 11 ton bulldozer and removed humus soil will be abandoned to the place where it will not disturb the work.

Excavated earth of the spillway site will be temporarily deposited in the dam basin of the downstream dam body, being applied for embankment of the dam.

(4) Trench Excavation

Trench will be excavated with 0.35 m^3 backhoe-shovel and the excavated earth will be temporarily deposited in the dam basin of downstream dam body, being applied to the embankment of the dam.

(5) Excavation of Borrow-Pit

Excavation will be made with 11 ton bulldozer and the excavated earth will be deposited temporarily in the dam basin, being prepared for embankment.

(6) Disposal of Old Bank (Existing Connection Road)

Old bank will be used as a cofferdam. Concerning the old bank in the design line of new dam, the surface soil removal will be carried out.

After that, compaction required for the dam body will be made, and old bank will be used as a part of the dam body. However, the execution should be done so as to unite the new enbankment and old bank in a body.

(7) Embankment

Excavated soil from the borrow-pit and spillway site will be used as embankment materials. 11 ton bulldozer will be employed for compaction and compression. 80 kg rammer will be used at around the bridge abutment of spillway and old embankment section. In this case, an attention should be paid to construction so that the embankment part may not separate easily. After the work proceeds till the elevation of new embankment will be nearly the same as the elevation of cofferdam, the temporary drainage will be changed to drainage by using the existing pump of 1 set and new type pump of 2 sets (total capacity 3 m^3/min), which have been installed on the left bank of the dam basin. After that, the embankment of the temporary drainage section will be started and the embankment of the whole dam body will be advanced.

(8) Transport of Embankment Material

Embankment materials, which are excavated and temporarily deposited with 11 ton bulldozer at the borrow-pit, will be loaded with 0.4 m^3 tractor-shovel and transported to the proposed site of the embankment with 4 ton dump truck (average hauling distance 70 m).

(9) Pasangan Batukali

Pasangan Batukali, which is used at the bridge abutment, overflow weir section and floodway of the spillway, is Indonesian special masonry. These materials will be transported to each execution place, its mixing and placing being carried out by manpower.

(10) Mold

The mold will be used at placing place of Pasangan Batukali, and materials which can be obtained in the place will be used after prefabrication at the appointed place.

(11) Asphalt Pavement

After the completion of embankment, dam crest will be paved with asphalt in 124.00 m of length, 6.00 m of width and 0.08 m of depth.

4. Scheduling

Construction machines necessary for various works as stated above will be bulldozer, backhoe, tractor-shovel, etc. The required number and workable days will be estimated as follows to examine the amount of works and work efficiency of machines so that these construction machines may be smoothly and effectively used.

(1) Construction Period

The work which workable day per month will be 25 days will be implemented for 6 months of the dry season from May to October.

Mean daily earthwork = total earthwork/25 day x 6 month
Daily maximum earthwork = mean daily earthwork x 1.2

(2) Amount of Work and Execution Efficiency of Construction Machinery and Required Number

Amount of Work and Execution Efficiency of Construction Machine and Required Number

Structure	Work	Quantity	Mean Daily Earthwork	Daily Maximum Earthwork	Work Efficiency per Hour	Work Efficiency per Day	Number Required	Kind of Machine
	Surface Soil Removal	$740m^3$	$59.22m^3$	$71.06m^3$	$53.33m^3$/ hr	$.266m^3$/ day	1	11 ton Bull-dozer
Dam Body	Trench Excava-tion	645	51.58	61.89	16.9	84.5	1	$0.35m^3$ Backhoe shovel
	Embank-ment	52.5	41.99	50.39	47.9	239.4	1	11 ton Bull.
Borrow-Pit	Surface Soil Disposal	600	59.22	71.06	53.3	266	1	"
	Excava-tion	6600	43.12	51.75	18.3	91.7	1	"
Spillway	Excava-tion	1080	43.12	51.75	18.3	91.7	1	"

Surface Soil Removal

11 ton bulldozer	
Daily work hour	5 hours
Daily work efficiency	53.3 m^3/ha x 5 = 266 m^3/ha
Required number	$\frac{71.06}{266.00} \fallingdotseq 1$

Trench Excavation

0.35^3 backhoe	
Daily work hour	5.0 hours
Daily work efficiency	16.9 m^3/ha x 5.0 = 84.5 m^3/day
Required number	$\frac{61.89}{84.5} \fallingdotseq 1$

Embankment

11 ton bulldozer	Excavation transport of earth
Daily work hour	5 hours
Daily work efficiency	53.3 m^3/ha x 5 x 0.9 = 239.4 m^3/day
Required number	$\frac{50.39}{239.4} \fallingdotseq 1$

Excavation

11 ton bulldorzer	
Daily work hour	5 hours
Daily work efficiency	18.33 m^3/hr x 5 = 91.7 m^3/day
Required number	$\frac{51.75}{91.7} \fallingdotseq 1$

(3) Work Days of Each Construction Machine

Construction Machine	Kind of Work	Amount of Work	Amount of Work per day	Day	Remark
11 ton Bulldozer	Preparatory Work	200 m^3	266.0 m^3	1	
1	Dam Body Surface Soil Disposal	740 m^3	266.0 m^3	3	
	Spillway Excavation	1,080 m^3	91.7	12	
	Old Levee Disposal	54	266.0	1	Old levee Surface Soil disposal 180 m x 0.3 m = 54 m^3
	Borrow-Pit Surface Soil Disposal	600	266.0	3	
	Borrow-Pit Excavation	6,600	91.7	72	
	Dam Body Embankment	5,250	145.5	36	
0.4 m^3 Tractor Shovel	Borrow-Pit Loading	6,600	116.0	57	
4 ton Dump 2	Transport	6,600	86.4	77	
0.35 m^3 Backhoe	Dam Body Trench Excavation	645	84.5	8	

11 TON BULLDOZER

1. Preparatory work — $\frac{200\ m^3}{266\ m^3/day} = 0.75 \doteqdot 1$ (day)
2. Dam Body Surface Soil Disposal — $\frac{740\ m^3}{266\ m^3/day} = 2.78 \doteqdot 3$ (day)
3. Spillway Excavation — $\frac{1080\ m^3}{91.7\ m^3/day} = 11.78 \doteqdot 12$ (day)
4. Old Levee Disposal — $\frac{54\ m^3}{266\ m^3/day} = 0.20 \doteqdot 1$ (day)
5. Borrow-Pit surface Soil Disposal — $\frac{600\ m^3}{266\ m^3/day} = 2.26 \doteqdot 3$ (day)
6. Borrow-Pit Excavation — $\frac{6600\ m^3}{91.7\ m^3/day} = 71.97 \doteqdot 72$ (day)
7. Dam Embankment — $\frac{5250\ m^3}{145.5\ m^3/day} = 36.08 \doteqdot 36$ (day)

0.43 m^3 TRACTOR - SHOVEL

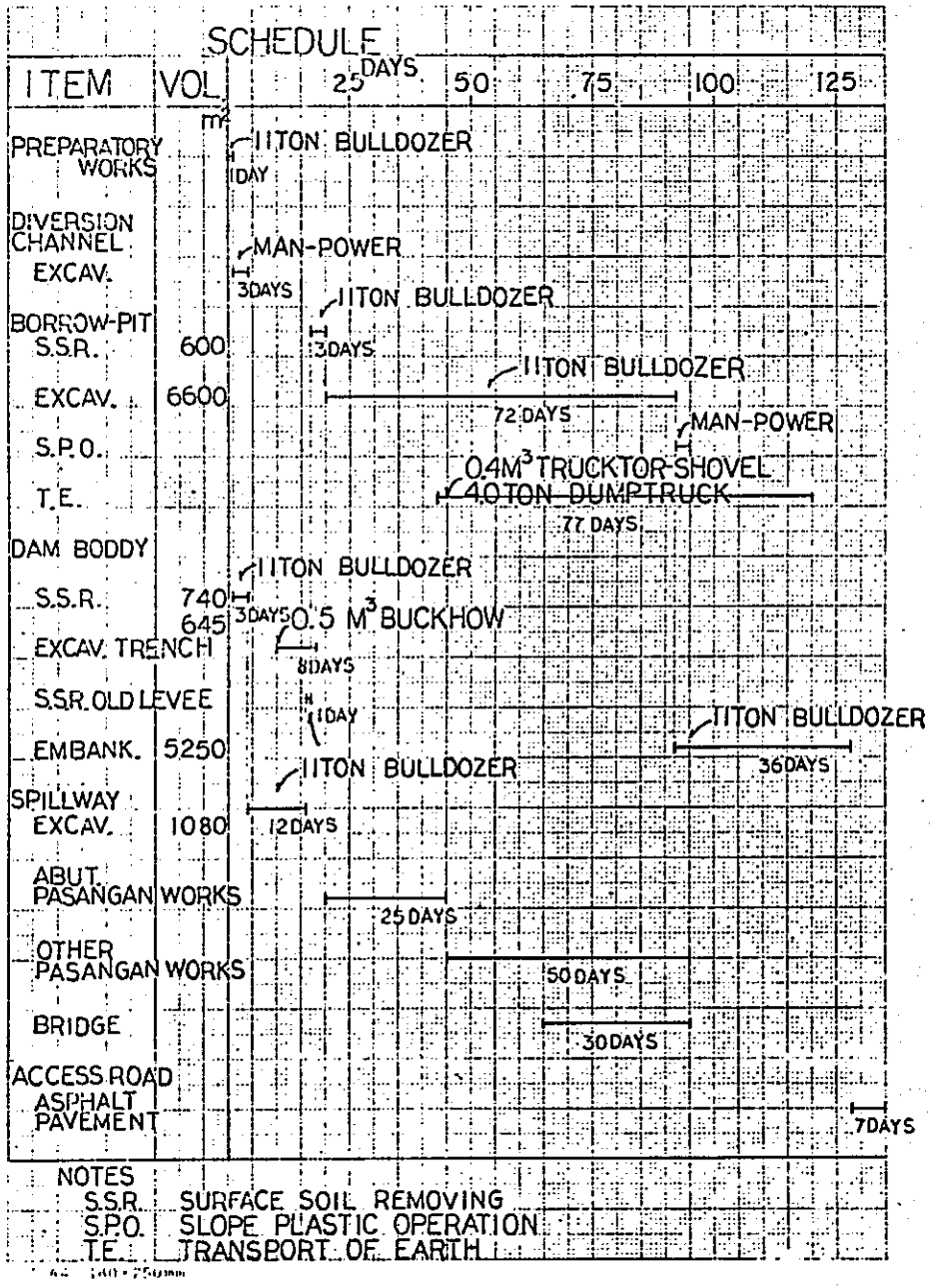
1. Borrow-Pit Transport — $\frac{6600\ m^3}{116.0\ m^3/day} = 56.90 \doteqdot 57$ (day)

4.0 TON DUMP TRUCK

1. Borrow-Pit Transport — $\frac{6600\ m^3}{86.4\ m^3/day} = 76.39 \doteqdot 77$ (day)

0.35 m^3 BACKHOE

1. Dam Body Truck Excavation — $\frac{64.5\ m^3}{84.5\ m^3/day} = 7.63 \doteqdot 8$ (day)



6-1-2 Construction Program of Pilot Farm and Facility Buildings

The pilot farm reclamation will start at the same time as dam work. The paddy field reclamation of 5 ha will be carried out by using bulldozer due to the volume of earthwork in ground leveling being considerably large as 10,500 m^3. The farm road work will be completed to bury water pipes after completion of the paddy field reclamation. The construction execution will be finished in all in the second year and will be managed with the cropping of the third year. Regarding the construction of facility buildings, these will be constructed to divide the term into 5 in accordance with the necessity from the first year to the fifth year.

6-1-3 Construction Program of Large Demonstration Farm

The construction will be carried out in May-October of dry season in order to minimize the reduction of agricultural products, to increase efficiency of work and to reduce the construction cost. About 85,600 m^3 of the soil will be treated in the ground leveling work and the embankment of the road. But it is not economical to carry out these works for 6 months because many labour and construction machine will be needed. Therefore, 60 ha of the north east part at the D.P.U. 10 turnout will be constructed in the third year and 30 ha of the remainder in the fourth year.

Scheme of Execution

(1) Construction Period

Workable days per month will be 25 day and 7 months in the year (from May to October in the dry season).

Mean daily earthwork = total amount/25 days
Daily maximum earthwork = mean daily earthwork x 1.2
2.3 of the amount of work will be executed in the third year and the 1/3 remaining in the fourth year.

(2) Amount of work and number requirement of main machines

( ) shows the total amount of works.

Item	Amount	Mean Daily Earthwork	Daily Maximum Earthwork	Working Capacity Per Hour	Working Capacity Per Day	No. Required	Kind of Machine
Main Road	1,900m^3 (2,850)	10.8m^3	13.0m^3	75.8m^3/hr	37.9m^3 /day	1	11 ton Bull.
Lateral Road	3,709 (5,563)	21.2	25.4	"	"	1	"
Farm Road	1,807 (2,710)	10.3	12.4	"	"	1	"
Land Leveling	49,345 (7,017)	282.0	338.0	"	"	1	"

Lateral Road: 14 ton Bulldozer daily working hour 5.0 hr
Working capacity per day = 75.8 x 5.0 = 379 m^3/day
Number requirement n $\frac{25.4}{379} \fallingdotseq$ number 1

Land Leveling: 14 ton Bulldozer daily working hour 5.0 hr
Working capacity per day = 75.8 x 5.0 = 379 m^3/day
Number requirement n $\frac{338}{379} \fallingdotseq 1.0$

(3) Calculation of Working Hour per Number

$$\text{Working day per number} = \frac{\text{Amount}}{\text{Working Capacity}} \text{ hr/number} \times \text{number}$$

Kind of Works	Item	Amount	Total Capacity per Hour			Working Hr/Number	Working Hour	Day Required
			Working Capacity/Hr	Number	Total Capacity/Hr			
Connecting Road	Excavation & Push Soil	1,900 (2,850)	75.8 m^3/hr	1	75.8m^3/hr	25hr/Number (37)	50 hr	5.0 day (7.5)
Lateral Farm Road	"	3,709 (5,563)	"	1	"	45 (74)	"	10.0 (14.7)
Land Leveling	"	49,345 (74,017)	"	1	"	650 (076)	"	130 (195.3)
Farm Land	"	1,807 (2,710)	"	1	"	23 (35)	"	5.0 (7.1)
TOTAL								150.0 (224.6)

6-2 Specifications

6-2-1 Working Specifications

1. Type of Works: Scope of Works .... These specifications provide general conditions for the execution of the following works.

a. Dam Body
b. Spillway
c. Access Road

2. Excavation: Clearance and Surface Soil Removal

a. For the removal of surface soil and corrosive substances as weed, wood scraps, stumps, roots, etc. and organic matters shall be removed completely.

b. The removed surface soil, the corrosive substances and the organic matters shall be disposed of by means approved by the supervisor. Filling excavation or borrowing shall be started after the inspection and approval of the supervisor.

c. These works are to be executed with the use of 11 ton bulldozer.

Excavation at the Borrow-Pit and the Spillway

a. Excavation shall be finished to the required side slope with 11 ton bulldozer comforming to the standard cross sectional drawing. (Required side slope = 1:1.0)

b. Where the removal of exposed stumps or rocks is difficult or unappropriate for management reason, appropriate steps must be taken under the direction of the supervisor.

c. When encounted with unexpected inferior soils, buried materials or wood, they must be disposed of as ordered by the supervisor.

Excavation Trench

a. This work is to be done by 0.5 m^3 Backhoe shovel.

b. The excavated earth is to be kept in the reservoir basing of Damdownstream site for future use as banking material.

Old Levee Treatment

a. Old levee is to be executed surface soil removing with the use of 11 ton bulldozer.

b. After surface soil removal at old levee is finished, compaction of old levee is to be done in 5 times of passage of 2 ton Rolley.

Embankment

a. All the obstructions of embankment bed shall be cleared prior to the commencement of the works.

b. When there is spring water or impounded water in embankment bed or when embankment has to be provided on soft foundations or foundations of high groundwater level, effort shall be made to dry the embankment bed through such means as drainage or replacements of soil.

c. Materials for embankment at borrow-pit and spillway must be used priority to ones in reservoir basin.

d. Banking layer thickness and compaction density will be as follows;
The banking layer thickness will be less than 20 cm when compaction is provided by machineries or rollers, and less than 10 cm when compaction is provided by rammer or other light weight compaction equipments. The standard compaction dencity will be obtained after about five passages of 2 ton roller.

e. Excavation of embankment materials and embankment layer work will be done in such a manner as to provide sufficient mixture to obtain optimum compaction and stability when materials are compacted.

Stone Masonry

Materials

a. Stone materials will be of uniform quality and with hardness, and be free from weathering and defects such as cracks, etc.

b. Shapes of boulders and quary stones will not be flat or such that is not suitable for masonry works. The boulder will be of the natural shape with diameters of 10-30 cm crosswise and 15-40 cm lengthwise.

Miscellaneous stones have the same finish as the boulders mentioned above.

c. Mixing of concrete and materials used for Pasangan Batukali will be as per Indonesian Standard.

Works

a. The foundation for direct laying of rubbles (including Pasangan Batukali) will be thoroughly compacted and will be finished at right angle to the masonry surface.

b. Bulders, rubbles and miscellaneous crushed stones used for masonry except for Pasangan Batukali will not be less than 15 cm in diameter.

c. Pasangan Batukali to be used will have a diameter of over 10 cm crosswise and the surface of masonry will be finished uniform with the use of miscellaneous crushed stones.

d. Pasangan Batukali used at the place in contact with water (for example; Spillway, Abutment of the bridge, etc.) will be filled with concrete or mortar at least 3 cm above the surface.

e. Though the laying method and the corsswise diameter of Pasangan Batukali are not specified, the diameter will not be less than 10 cm.

f. Pasangan Batukali and stones used for wet masonry will be clean and free from mud, dust, etc. Such foreign matters will be cleaned thoroughly with water.

g. Pasangan Batukali will be provided with levee concrete of more than 5 cm even when not specified.

Asphalt Paving on Access Road

a. After embankment is all finished, dam crest is to be used as an access road.

b. It is necessary to pave with asphalt on access road.

Length of asphalt paving = 124 m

Wide of asphalt paving = 6 m

Thickness of asphalt paving = 8 cm

6.2.2 Machine Specifications

1 D60A - Bulldozer

a.	Type	Crawler
b.	Engine Type	Water-cooled, 4-cycle, Overhead valve, direct-injection type diesel
c.	Starting Method	By electric starting motor
d.	Flywheel Horsepower	140 hp/1600 rpm
e.	Max. Draw Bar Pull	15620 kg
f.	Angledozer Equipment	
	Operating Weight	15250 kg
	Overall Length	5305 mm
	Overall Width	3970 mm
	Overall Height	3015 mm

g.	Ground Pressure	0.62 kg/cm^2
h.	Blade Equipment	
	Type	Angling and titlting blade, hydraulically controlled
	Length	3970 mm
	Height	1050 mm
	Max. Lift Above Ground	1110 mm
	Max. Drop Below-Ground	520 mm
2	D50A - Bulldozer	
a.	Type	Crawler
b.	Engine Type	Water-cooled, 4-cycle, overhead valve, pre-combustion chamber type diesel
c.	Starting Method	By electric starting motor
d.	Flywheel Horsepower	90 hp/1750 rpm
e.	Max, Draw Bar Pull	10340 kg
f.	Angledozer Equipment	
	Operating weight	11000 kg
	Overall Length	4700 mm
	Overall Width	3350 mm
	Overall Height	2690 mm
g.	Ground Pressure	0.66 kg/cm^2
h.	Blade Equipment	
	Control Type	Hydraulic
	Blade Length	3350 mm
	Blade Height	855 mm
	Max. Lift above Ground	1050 mm
	Max. Drop Below Ground	380 mm
3	D30S - Dozer Shovel	
a.	Type	Crawler
b.	Engine Type	Water-cooled, 4-cycle, overhead valve, direct-injection type diesel
c.	Starting Method	By electric starting motor
d.	Flywheel Horsewheel	55 hp/2000 rpm

e.	Max. Draw Sar Pull	6170 kg
f.	Operating Weight	6800 kg
	Overall Length	4385 mm
	Overall Width	1685 mm
	Overall Height	2570 mm
g.	Ground Pressure	0.55 kg/cm^2
h.	Bucket Capacity	0.80 m^3
	Max. Loading Capacity	1600 kg
i.	Max. Tilt-Back Angle, at Ground	40°
	Max. Dumping Angle, Fully Raised	50°

4 Backhoe (as a attachment of Dozer-Shovel)

a.	Angle of Swing	95°
b.	Range of Offset	560 mm
c.	Bucket Capacity	0.2 m^3
d.	Digging Width	580 mm
e.	Digging Depth	3150 mm

5 4 ton Dump-Truck

a.	Max. Loading Capacity	4000 kg
b.	Right-side Handle	
c.	Speed	Forward 5 stages Backward 1 stage
d.	Engine	Water-cooling diesel engine
e.	Starting Method	Battery System or electric starting motor
f.	Front-wheel	2
	Back-wheel	4
g.	Hydraulic Control	Packing System

6.	Tamper		
a.	Weight	80 kg	
b.	Percussion Number	550-700 times/min	
c.	Impact Stroke	30-60 mm	
d.	Impact Plate	330 x 330 mm	
e.	Horsepower	3 ps	1600 rpm
7	Concrete Mixer		
a.	Capacity	0.09 m^3	
b.	Drum Revolution Number	25 times	
c.	Drum Dimension	Bore Inlet	700 mm 450 mm
d.	With Gasoline Engine Engine Horsepower	3.0 ps	
8	Concrete Vibrator		
a.	Type	Vibration system	
b.	Bar Diameter	27 mm	
c.	Generator	Gasoline Engine	
d.	Horsepower	4.0 ps	
e.	Vibrator Frequency Vibrator Amplitude Vibrator Length	8000 VPM 10 mm 360 mm	
f.	Tool for Disjointing		
9	Portable Pump		
a.	Type	Gasoline Engine	
b.	Diameter	70 mm	
c.	Total Head	5.00 m	
d.	Engine Horsepower	3.0 ps	

e. Note: It is important that pump and engine is unit structure and easy to transport.

f. Notes of Attached Hose

(1) It is necessary that hose consist of either synthetic fibre rubber and vinyle or compound products, that products can make resistance to the pressure of above 1.0 kg/cm^2.

(2) It's also necessary that the products are light in weight and easy to handle.

(3) The size of it will be 50-80 mm.

(4) The length of a piece of hose will be about 20 m.

(5) Quantity of hose 60 m

g. Tool set

10 I. Pump Installation (for Paddy Irrigation)

1. Item of Pump

Type	Horizontal shaft, single suction, two stages, centrifugal pump
Suction Size	100 mm
Discharge Size	100 mm
Capacity	0.9 m^3/m
Total Head	18 m
Speed	1800 rpm
Efficiency	59 %
Engine Output	10 ps

Driving System Directly Driven by Engine

Quantity	2 nos.

Operation System Field Independent Operation

2. Materials

Main materials of this pump shall be as follows:

a.	Pump Casing	Cast iron (FC)
b.	Impeller	Bronze cast (BC)
c.	Liner Ring	Leaded Bronze (LBC)
d.	Shaft	Carbon steel (S 35C)

3. Structure

Casing	This pump shall be multistage, centrifugal pump. Rotary part shall be detachable for inspection to remove the suction cover of the from. A vortex part, which the velocity head of the water having been released from the impeller is changed into the pressure head, is provided in the drum. The inside of vortex part has a smooth casting body to reduce the friction.
Impeller	Impeller is monobloc casting. The characteristic of the water quantity and total head shall be downward curve and safety driving will be able to expect to the fluctuation of parallel operation.
Main Shaft	Main shaft will be well considered on power transmission, critical speed and deflection, making a high accuracy work.

4. Accessories

Accessories for one pump shall be as follows:

Foot Valve	1 piece	Cock for air vant	1 piece
Drain Cock	1 piece	Priming water funnel	1 set
Foundation Bolts	1 set	Companion flange	2 sheets
Flexible Coupling	1 set	Drain pipe for bearing	1 set
Disassembling Tool	1 set	Compound gauge	1 piece

II. Installation of Attachment Machine

1. Manual Sluice Valve for Discharge

Opening Size	100 mm
Type	Manual Sluice valve (inner screw type)
Material	Cast iron (FC)
Quantity	2 nos.

2. Check Valve

Opening Size	100 mm
Type	Spring internal type rofid choking check valve.
Materials	Cast iron (FC) This valve is a check valve which keeps self-closing power high by spring and will have a high efficiency

for reducing the rising of pressure of water-hammer.

3. Piping of Suction and Discharge

These piping materials shall be used at suction and discharge sides and shall be of SGP.

III. Operation System

1. Close Discharge Valve
2. Sufficient priming shall be conducted.
3. Drain Air Completely.
4. Engine Starting
5. Open Discharge Valve

IV. Engine for Driving Pump

1.	Type	4 cycle horizontal Diesel Engine	
2.	Number	2 nos.	
3.	Continuous Rating	12 OPS/22000 rpm	
4.	Maximum Output	13.5 PS/2200 rpm	
5.	Starting System	Manual operation	
6.	Accessory	Fuel Tank	1 piece
		Air Cleaner	"
		Sound Exhauster	"
		Fitting Volts	1 set
		Maintenance Equipment	1 set
		Fan Velt	1 piece

I. Pump Installation (for Field Irrigation)

1. Item of Pump

Type	Horizontal shaft, single suction, two stages, centrifugal pump
Suction size	125 mm
Discharge size	125 mm
Capacity	1.32 m^2/m
Total Heal	55 m
Speed	1800 rpm
Efficiency	61 %
Engine Output	30 ps
Driving System	Directly driven by engine
Quantity	1 nos.
Operation System	Field independent operation

2. Materials

Main materials of this pump shall be as follows:

a.	Pump Casing	Cast iron (FC)
b.	Impeller	Bronze (BC)
c.	Liner Ring	Leaded bronze (LBC)
d.	Shaft	Carbon Steel (S35C)
e.	Shaft Sleeve	Bronze (BC)

3. Structure

Casing	This pump shall be horizontal shaft, multistage, centrifugal pump, consisting of suction, intermediate and discharge casings, and side suction, top discharge. Guide Vane shall not be used in the pump casing. It shall be keep a high efficiency at any capacity.
Impeller	Impeller is monobloc casting. The characteristics of the water quantity and total head shall be downward curve and safety driving will be able to expect to the fluctuation of parallel operation.
Main Shaft	Main shaft shall be well considered on power, transmission, critical speed and deflection, making a high accuracy work.

4. Accessories

Accessories for one pump shall be as follows:

Foot Valve	1 piece	Cock for air vent 1 piece
Drain Cock	1 piece	Pumping Water funnel 1 set
Foundation Bolts	1 set	Companion flange 2 sheets
Flexible Coupling	1 set	Drain pipe for bearing 1 set
Disassembling tool	1 set	Compound gauge 1 piece

II. Installation of Attachment Machine

1. Manual Sluice Valve for Discharge

Opening Size	125 mm
Type	Manual sluice valve
Quality	Cast iron (FC)
Quantity	1 nos.

2. Check Valve

Opening Size	125 mm
Type	Spring internal type, rofid choking check valve
Materials	Cast iron (FC) This valve is a check valve which keeps self closing power high by spring and will have a high efficiency for reducing the rising of pressure of water hammer.

3. Piping of Suction and Discharge

These piping materials shall be used at suction and discharge sides and shall be of SGP.

III. Operation System

1. Close Discharge Valve.
2. Sufficient Priming shall be conducted.
3. Drain Air Completely.
4. Engine Starting.
5. Open Discharge Valve.

IV. Engine for Driving Pump

1.	Type	4 cycle vertical Diesel Engine	
2.	Continuous Rating	30 ps/1800 rpm	
3.	Starting System	Electric motor	1 piece
4.	Accessories	Tachometer	1 piece
		Pressure gauge for lubricating oil	1 piece
		Thermometer for lubricating oil	1 piece
		Thermometer for cooling water	1 piece
		Air Cleaner	1 piece
		Fitting Volts	1 set
		Radiator Cooling Fan	1 piece
		Vatery Charger	1 set
		Tools	1 set

Chapter 7 Appendix

MEASUREMENT OF EVAPO-TRANSPIRATION
(BY EVAPORIMETER)

TEGINENENG EXTENSION CENTER

(A) EVAPORIMETER: DEPTH 70 mm
DIAMETER 120mm

DATE		POTENTIAL EVAPORTRANSPIRATION (mm)
SEPT	17	11
	18	9
	19	8
	20	9
	21	9
	22	7
	23	11
	24	10
	25	9
	26	10
	27	9
	28	19
	29	12
	30	10
OCT	1	11
	2	12
	3	8
	4	10
	5	11
	6	9
	7	10
	8	11
	9	13
	10	11

Tab 7-2 (1)

No. Urut	nama pemilik	Tempat tinggal	luas tonah Ha	No. Kav.	
1.	Sulaiman Simin	Kp. Totokaton	4	1	
2.	Parto Wirono	"	1,75	2	
3.	Njono	"	0,75	5	
4.	Djakimin	"	0,50	4	
5.	Minto Sudarmo	"	1,25	5	
6.	Parto wirono	"	0,25	6	
7.	Rabin	"	0,50	7	
8.	Kartosemito	"	1,50	8	
9.	Pirut	"	0,75	9	
10.	Mbok reken	"	0,75	10	
11.	Samiran	"	0,75	11	
12.	Raban	"	0,25	12	
13.	Dulah Subarl	"	0,25	13	
14.	K a r m a n	"	0,25	14	
15.	Rahman	"	0,50	15	
16.	Mukiman	"	0,25	16	
17.	Baidi	"	0,25	17	
18.	Ponidjo	"	1,25	18	
19.	Dikin	"	0,50	19	
20.	mbok Kartoredjo	"	0,50	20	
21.	Wagimin	"	0,25	21	
22.	Ansjori	"	1	22	
23.	Suradi	"	0,25	23	
24.	Samsudin	"	0,25	24	
25.	Rusdi	"	1	25	
26.	T u p a n	"	0,25	26	
27.	Kamidin	"	0,75	27	
28.	Miswati	"	0,75	28	
29.	Tarno	"	0,25	29	
30.	Panggih	"	0,50	30	
31.	S i t a r	"	1,75	31	
32.	Samiran	"	0,50	32	
33.	Kasanredjo	"	0,75	33	
34.	Kartoredjo	"	0,25	34	
35.	Dulah Muin	"	0,25	35	
36.	Djoreno	"	0,25	36	
37.	Djoreso	"	0,25	37	
38.	S u s a h	"	0,50	38	
39.	Adbullah	"	0,75	39	
40.	Suradi	Totokaton	0,29	40	
41.	Suradi	"	0,50	41	
42.	Bustami	"	4	42	
43.	Bustami	"	0,25	43	
44.	Saimin	"	0,25	44	Kav.
45.	Keni	"	0,50	45	no. 5
46.	Saimin	"	0,25	46	da
47.	K a r n e n	"	0,25	47	djadi
48.	Kasmiri	"	0,75	48	satu
49.	S i t a r	"	1	49	
50.	Dulah Subari	"	0,25	50	

51.	Nadenan	"	0,25	51	
52.	Ponidjo	"	1.	52	
53.	Samiran Rt	"	0,50	53	
54.	Pawirodimedjo	"	1,50	54	
55.	K a s n o	"	1	55	
56.	K a s t a m	"	0,50	56	
57.	S u j u t	"	1,50	57	
58.	Muzamman Ali	"	2	58	
59.	Karijotiko	"	1	59	
60.	M u h a r t o	"	0,50	60	
61.	B u r z a	"	2	61	
62.	Zuhdi	"	0,50	62	
63.	Kardido	"	0,50	63	
64.	Supardi	"	2,50	64	
65.	Dulah Subari	"	0,50	65	
66.	Suwardi	"	1	66	
67.	Sukarno	"	1	67	
68.	S a r n i	"	2	68	
69.	Pawiro	"	1	69	
70.	Djaimin	"	0,50	70	
71.	Tukiman	"	0,50	71	
72.	Djarimin	"	0,50	72	
73.	D j a j u s	"	1	73	
74.	Djureni	"	1	74	
75.	Anwar	"	1	75	
76.	Dul Djalal	"	0,25	76	
77.	Adenan Zen	M e t r o	1	77	
78.	Usup Alam	Tanjungkorang	2	78	
79.	Ramelan	Totokaton	1,50	79	
80.	Salimi	"	0,50	80	
81.	Ramelan	"	0,50	81	
82.	Sjamsudin	"	0,50	82	
83.	Sungkono	"	0,50	83	
84.	Ramelan	Totokaton	0,25	84	
85.	S i r a d	"	1,50	85	
86.	Mudjahit	"	0,50	86	
87.	Mursidi	"	1,50	87	
88.	D a w a n	"	0,25	88	
89.	Sutarno	"	0,50	89	
90.	Ramelan	"	0,50	90	
91.	Mangun Parwito	"	2	91	
92.	Hasan Manap	Tanjungkarang	1	92	
93.	Abuhasan	M e t r o	1	93	
94.	Ibrahim	Totokaton	0,50	94	
95.	Supriono	"	1	95	
96.	Sarwono	"	1,50	96	
97.	H. Parid	"	1,50	97	
98.	T a r n o	"	2	98	
99.	Djuari	"	0,125	99	
100.	Akad	"	0,375	100	
101.	Maidi	"	0,50	101	
102.	Sppian	"	1	102	
103.	Dulah subari	"	0,25	103	tanah
104.	Sulaiman Simin	"	1	104	pekarangan
105.	Maidi	"	0,25	105	"
106.	mbok Kunah	"	0,50	106	"

107.	mbok Reken	"	0,25	107	"
108.	Samiran	"	0,25	108	"
109.	Partowirono	"	0,25	109	"
110.	Kasanwijono	"	0,25	110	"
111.	Njono	"	0,125	111	"
112.	Partowirono	"	0,125	112	"
113.	R o b i n	"	0,25	113	"
114.	Kartosemito	"	0,25	114	"
115.	Suradi	"	0,25	115	"
116.	Tupan	"	0,25	116	"
117.	R a b a n	"	0,25	117	"
118.	Suradi	"	0,25	118	"
119.	Mintosudarmo	"	0.25	119	"
120.	N g a d i	"	0,25	120	"
121.	Ngadinan	"	0,25	121	"
122.	mbok tuninah	"	0,25	122	"
123.	Kasanredjo	"	0,25	123	"
124.	Abdulah	"	0,25	124	"
125.	Susah	"	0,25	125	"
126.	Djuari	"	0,25	126	"
127.	Kamidin	"	0,25	127	"
128.	K e n i	Totokaton	0,50	128	Tanah pe /
129.	Saimin	"	0,25	129	"
130.	Panggih	"	0,25	130	"
131.	Sitar	"	0,25	131	"
132.	Dulah subari	"	0,25	132	"
133.	Miswadi	"	0,25	133	"
134.	Lapangan	"	1	134	"
135.	Likin	"	0,25	135	"
136.	Karmin	"	0,25	136	"
137.	Pawiro	"	0,125	137	"
138.	Karnen	"	0,50	138	"
139.	Darmawan A	"	1	139	"
140.	Darmawan B	"	1	140	
141.	Bakir	"	0,50	141	
142.	Tarmidi	"	0,50	142	
143.	Busrowi	"	0,375	143	
144.	Ngadi	"	0,25	144	
145.	Djuari	"	0,25	145	
146.	Misri	"	0,25	146	
147.	Darkup.	"	0,25	147	
148.	Sopian	"	0,25	148	
149.	Pirut	"	0,25	149	
150.	Somosuratin	"	0,25	150	
151.	Dulhalim	"	0,50	151	
152.	Paimin	"	0,25	152	
153.	Setra	"	0,25	153	
154.	Tukiem	"	0,25	154	
155.	Redjo	"	0,25	155	
156.	Dirno	"	0,50	156	
157.	Rebo	"	0,25	157	
158.	S a g i	"	0,25	158	
159.	Ardjo	"	0,25	159	
160.	Situr	"	0,25	160	

161.	: Daiman	: "	: 0,25	: 161 :
162.	: Saimin	: "	: 0,50	: 162 :
163.	: Muhari	: "	: 0,25	: 163 :
164.	: Paidjo	: "	: 0,25	: 164 :
165.	: Atmo	: "	: 0,25	: 165 :
166.	: S i k a t	: "	: 0,50	: 166 :
167.	: Sumpono	: "	: 0,25	: 167 :
168.	: Sandari	: "	: 0,25	: 168 :
169.	: Pardi	: "	: 0,25	: 169 :
170.	: U s u p	: "	: 0,25	: 170 :
171.	: Darmi	: "	: 0,25	: 171 :
172.	: Katidjo	: "	: 0,50	: 172 :
173.	: Buhari	: Totokaton	: 1	: 173 :
174.	: Rusdi	: "	: 0,25	: 174 :
175.	: Sujut	: "	: 0,25	: 175 :
176.	: Noerdin	: "	: 0,25	: 176 :
177.	: Sak Dulah Pati	: Metro	: 0,25	: 177 :
178.	: Mudijat	: Totokaton	: 0,25	: 178 :
179.	: Sudin	: "	: 0,25	: 179 :
180.	: Sahri	: "	: 0,50	: 180 :
181.	: Karijopawiro	: "	: 0,25	: 181 :
	D j u m l a h		: 103	: :

Metro, 3 Oktober 1972

Potugas Kasubdit Agraria Kab.
Lampung Tengah
ttd.
(ACH AR BASRI)

LARGE DEMO FARM IN TOTOKATON

Tab 7-3

A TABULATION OF EARTH-VOLUME (1)

(DOBOKU SHUKEIHYO)

JOB 2511

EMBA/EXCAV. = 0.900

KOKU NO.	BANGOSU	EARTH VOLUME (DORYO) KIRIDO EXCAVATION	MORIDO EMBANK.	HITSUYODORYO DORO ROAD	SUIRO CANAL	KEIHAN BORDER	DENKUKAN	EXCAV. (0 -10)	AREA (11-)	EMBANK. (0 -10)	AREA (11-)	AREA(M2)
1	28	3235,	2632,	-306,	0,	0,	-32,	7024,00	11890,00	9047,00	7527,00	35586,00
2	36	4181,	3257,	-552,	0,	0,	-106,	12239,00	13560,00	8000,00	9201,00	43000,00
3	35	3862,	2976,	-558,	0,	0,	-43,	8262,00	13927,00	8271,00	7160,00	37640,00
4	43	7339,	5730,	-979,	0,	0,	-278,	23245,00	23506,00	13241,00	19609,00	79601,00
5	30	6004,	4432,	-1047,	0,	0,	-299,	14174,00	20151,00	14193,00	13552,00	62060,00
6	45	5768,	4544,	-737,	0,	0,	-108,	18502,00	14958,00	12394,00	14515,00	60429,00
7	27	3606,	2556,	-725,	0,	0,	-19,	12116,00	12751,00	11480,00	9070,00	45417,00
8	31	6798,	4626,	-610,	0,	0,	-1321,	9221,00	21765,00	8227,00	13662,00	52895,00
9	28	2662,	2056,	-409,	0,	0,	0,	7211,00	9341,00	9164,00	6264,00	32000,00
10	30	3355,	2771,	-262,	0,	0,	0,	7042,00	12111,00	7748,00	9749,00	36650,00
11	38	4011,	3174,	-483,	0,	0,	-27,	13534,00	12977,00	11688,00	8104,00	46303,00
12	20	2674,	2194,	-230,	0,	0,	-8,	6362,00	11994,00	9981,00	7162,00	35469,00
13	27	3106,	2305,	-542,	0,	0,	-7,	6169,00	11046,00	4410,00	7494,00	29139,00
14	25	5413,	4270,	-675,	0,	0,	-261,	6317,00	19516,00	7843,00	13248,00	46926,00
15	40	3358,	2089,	-694,	0,	0,	-13,	12650,00	11909,00	7597,00	7734,00	39890,00
16	26	2812,	2313,	-236,	0,	0,	0,	4304,00	9644,00	2764,00	8581,00	25353,00
17	35	4131,	3241,	-525,	0,	0,	-145,	6696,00	11530,00	5293,00	11100,00	34619,00
18	33	3013,	2241,	-529,	0,	0,	-122,	11432,00	9736,00	4662,00	6079,00	31929,00
19	31	3216,	2674,	-233,	0,	0,	0,	6311,00	12862,00	5321,00	7325,00	33839,00
20	42	4274,	3223,	-686,	0,	0,	0,	12106,00	14167,00	11053,00	12346,00	49672,00
131	32	2747,	1983,	-543,	0,	0,	0,	11358,00	6863,00	6301,00	5022,00	33004,00
GOKEI	684	85611,	65621,	-11594,	0,	0,	-2769,	218435,00	288226,00	180748,00	204614,00	892026,00

A TABULATION OF EARTH-VOLUME (2)

DORYO SHUKEIHYO

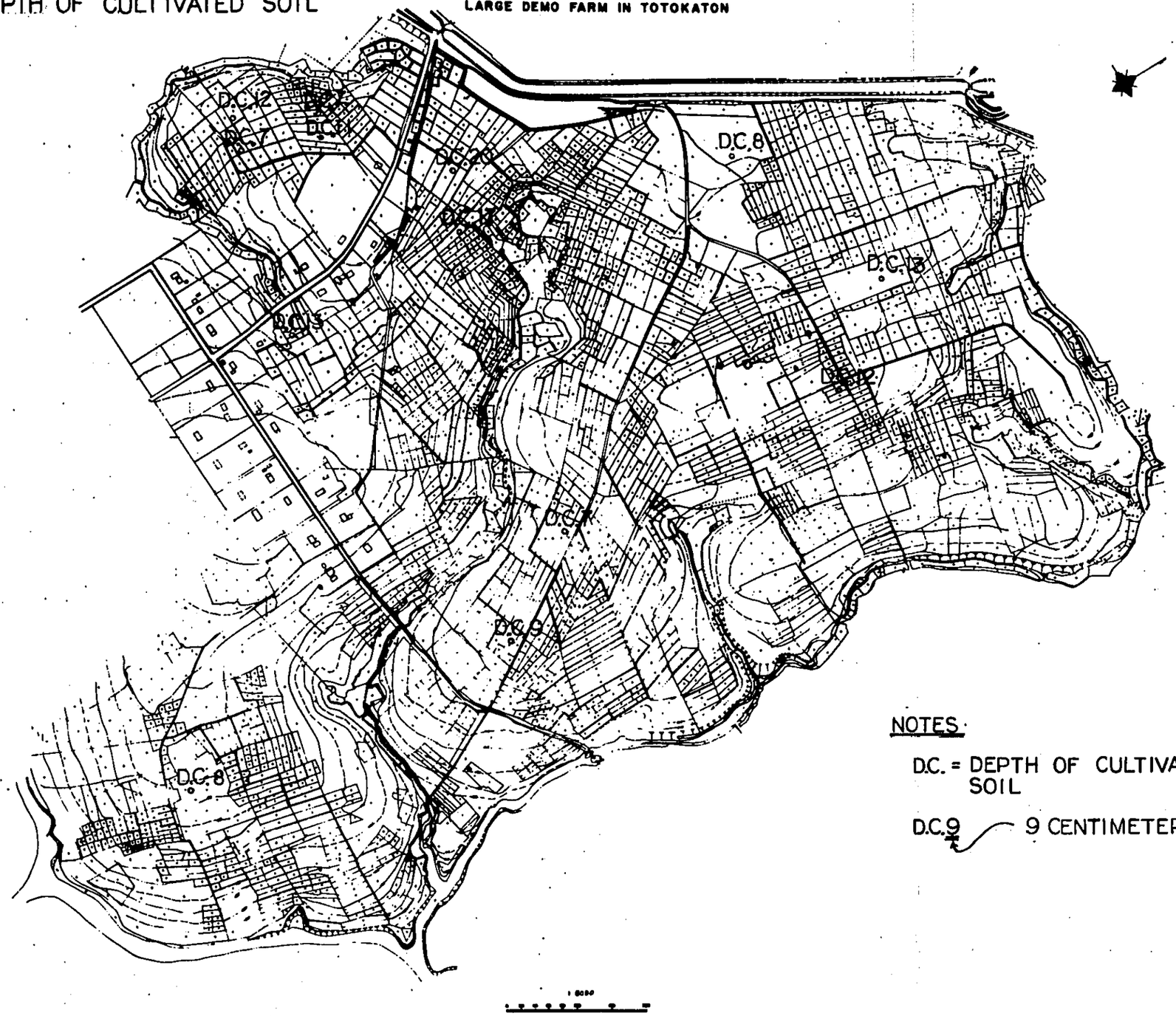
JOB 2511

MORI/KIRI = 0,900

KOKU NO.	BANGOSU	DORYO KIRIDO	MORIDO	HITSUYODORYO (DORO	SUIRO	KEIHAN	DENKUKAN)	KIRIDO MENSEKI (0 -10)	KIRIDO MENSEKI (11-)	MORIDO MENSEKI (0 -10)	MORIDO MENSEKI (11-)	MENSEKI
1	21	85611,	65621,	-11594,	0,	0,	-2769,	218435,00	288226,00	180748,00	204614,00	892026,00
GOKEI	21	85611,	65621,	-11594,	0,	0,	-2769,	218435,00	288226,00	180748,00	204614,00	892026,00

FIG 7-1 DEPTH OF CULTIVATED SOIL

LARGE DEMO FARM IN TOTOKATON



NOTES:

D.C. = DEPTH OF CULTIVATED SOIL

D.C.9 ~ 9 CENTIMETERS

Chapter 8 Project Cost

INDEX

AMOUNT IN CONSTRUCTION COST SPECIFICATION

¥72,578,000 Yen

* Upper Part: Domestic Currency (D.C)
Under Part: Forein Currency (F.C)

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
(I) Cost of extension center						42,987,000 D.C 21,189,000 F.C		64,176,000 yen
(II) Cost of large demo farm						5,682,000 D.C 2,720,000 F.C		8,402,000
Grand total						48,669,000 D.C 23,909,000 F.C		72,578,000

(I) COST OF EXTENSION CENTER SPECIFICATION

¥64,176,000 yen

42,987,000 D.C
21,189,000 F.C

* Upper Part: Domestic Currency (D.C)
Under Part: Forein Currency (F.C)

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
(1) Dam						1,698,000 2,137,000		3,835,000
(2) Farm Consolidation						2,137,000 11,979,000		14,116,000
(3) Building						39,152,000 7,073,000		46,225,000
Total						42,987,000 21,189,000		64,176,000

(1) CONSTRUCTION COST OF DAM SPECIFICATION

¥3,835,000 yen

1,698,000 D.C
2,137,000 F.C

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. Dam body					1,330,000	452,000 878,000		
2. Spillway					2,351,000	1,092,000 1,259,000		
3. Common temporary cost						154,000		10% of above amount but except ripairing cost
Total					3,835,000	1,698,000 2,137,000		D.C F.C
						3,835,000		

1 CONSTRUCTION COST OF DAM BODY SPECIFICATION

¥1,330,000 yen

452,000
878,000

* Upper Part: Domestic Currency (D.C)
Under Part: Foreign Currency (F.C)

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
Surface soil removing			1,220	m3	4 33 120	4,880 40,260 43,920		By man power 1,220 x 0.3 = 366 m3
Do			366	m3	8	3,600		By machine 644 x 0.7 = 450
Excavation trench			450	m3	102 245	45,900 47,530		By man power 644 x 0.3 = 194
Do			194	m3	6	34,638		net loss
Excavation and transport of earth			5,773	m3	39 4	225,147 23,092		5,248 x (1.+0.1)=5,773
Excavation and Loading			"	m3	85 10	490,705 57,730		
Carring			"	m3	65 7	375,245 40,411		
Leveling and compaction			"	m3	60 15	346,380 17,325		By rammer
Soil compaction			1,155	m3	22	25,410		5,773 x 0.2 = 1,155
Asphalt-pavement		t=8cm	744	m2	237	176,328		124m x 6m = 744 m2
Removal of surplus soil			644	m3	4 33	2,576 21,252		
Total						452,030 877,539		D.C F.C
						1,329,569		
						≒ 1,330,000		

2 CONSTRUCTION COST OF SPILLWAY SPECIFICATION

¥2,351,000 yen

1,092,000
1,259,000

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
Excavation			755	m3	6 39 120	4,530 29,445 38,760		By machinery 1,078 x 0.7 = 755 By man power
Excavation			323	m3	40	6,800		1,078 x 0.3 = 323
Embankment			170	m3	4,415	649,005		
Pasangan-batukali			147	m3				588m2 x 0.25m = 147m3
Bridge								
Substructure	Pasangan batukali		134 25	m3	4,415	592,713		
Super structure	Steel		6 754	ton	138,000	932,052		120,000 x 1.15 = 138,000
	Guard-rail		17 0	m	4,105	69,785		3,570 Y/m x 1.15 =
	Concrete		19 8	m3	6,350	125,730		
	Rein. forcement		4 950	ton	44,454 46,000	220,047 227,700		40,000 yen/ton x 1.15 = 46,000
	Wooden form		106 5	m2	991	105,541		
	Total					1,092,121 1,258,982		
						2,351,103		
						≒ 2,351,000		

(2) FARM CONSOLIDATION SPECIFICATION

¥14,116,000 yen

2,137,000 D.C
11,979,000 F.C

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. Cost of farm consolidation						735,000 2,443,000		3,178,000
2. Cost of pump-station works						483,000 241,000		724,000
3. Cost of pump						5,000 829,000		834,000
4. Cost of delivery and supply pipe lying						783,000 3,660,000		4,443,000
5. Cost of booster pump						6,000 1,628,000		1,634,000
6. Cost of supply pipe for sprinkler						125,000 1,967,000		2,092,000
7. Cost of sprinkler head						1,211,000		1,211,000
Total						2,137,000 11,979,000		14,116,000

1 COST OF FARM CONSOLIDATION SPECIFICATION

¥3,178,000 yen

735,000 D.C
2,443,000 F.C

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. Land-leveling								
Excavation and transport of soil			10,570	m3	13 115	137,410 1,215,550		
Leveling			10,570	m3	2	21,140		
2. Main road		B = 10 m ℓ = 545m						
Excavation			67 7	m3	120	8,124		
Embankment			3,944 1	m3	53 115	209,037 453,571		
3. Farm road								
Excavation			1,145 0	m3	13 115	14,885 131,675		
Embankment			5,389 5	m3	53 115	285,643 619,792		
4. Drainage-culvert			5	pcs				
Concreat			1 45	m3	7,110	10,309		
Mortal			0 50	m3	6,350	3,175		
Pasangan-batukal			15 16	m3	4,415	66,931		
Total						735,514 2,442,728 3,178,242 ≒ 3,178,000		D.C F.C

2 COST OF PUMP-STATION WORKS SPECIFICATION

¥724,000 yen

483,000 D.C
241,000 F.C

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
							21,22	
Filter			37 68	m3	895	33,723		
Currugated pipe		3000 ϕ m/m t = 3.2	6 40	m	46,700	298,880		
Base concrete			7 74	m3	7,110	55,031		
Wooden form			12 89	m2	991	12,773		
Steel			0 10	ton	46,000	4,600		
Pasangan - batukali			90 5	m3	4,415	399,557		
Excavation			62 8	m3	245	15,386		V=2.5π x3.2=62.8m3
Bolt			62	nos	70	4,340		56pc x (1.+0.1) ≒ 62
						482,747		D.C
						241,620		F.C
Total						724,367		
					≒	724,000		

3 COST OF PUMP SPECIFICATION
(FOR PADDY FIELD)

¥834,000

5,000 D.C
829,000 F.C

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. Pump		Suction bove 100 mm Capacity 0.9 m3/min Total head 18 m Speed 1800 rpm Engine lating 10 ps	2 0	set	47,000	94,000		Horizontal single suction volute pumps directly driven by diesel engine
Accessories								
Foot valve			2 0	pc				
Drain cock			2 0	pc				
Air cock			2 0	pc				
Priming funnel cock			2 0	pc				
Foundation bolt			2 0	set				
Drain pipe			2 0	set				
Companion flange			4 0	pcs				
2. Manual sluice valve	100	100 ϕ	2 0	set	13,500	27,000		
3. Self closing chech valve		100 ϕ	2 0	set	15,000	30,000		
4. Suction and discharge pipe with flange			1 0	set	105,500	105,500		
		100ϕx2,900 ℓ	2 0	pc				Suction side
		100ϕx1,800 ℓ	2 0	pc				"

	100φx4,100ℓ	2 0	pc			"
	100φx1,500ℓ	2 0	pc			"
	100φx1,600ℓ	2 0	pc			Discharge
	100φx1,550ℓ	2 0	pc			"
	100φx 900ℓ	2 0	pcs			
	100φx1,240ℓ	1 0	pcs			
	100φx 400φ	1 0	pcs			
Bend pipe	φ100 90° elbow φ100	10 0	pcs			
	45° elbow	4 0	pcs			
	100φx 150φ	1 0	pcs			
Cheese	100φx 100φ	1 0	pcs			
TS flange		1 0	pcs			
Pipe	100φx 500ℓ	1 0	pcs			
5. Diesel engine	Continuous latin 12ps/2200rpm	2 0	set	270,000	540,000	
Accessories						
Fuel tank		2 0	pc			
Air cleaner		2 0	pc			
Muffler		2 0	pc			
Bolt		2 0	pc			
Tools		2 0	pc			
Fan velt		2 0	pc			
6. Package and shipping		1 0	set	33,000	33,000	
7. Pump setting						
Labor		15 0	man	110	1,650	
Super intendent		8 0	man	400	3,200	
					4,850	
Total					4,850 829,500	F.C
					834,350	

¥4,443,000 yen

783,000 D.C
3,660,000 F.C

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
Material cost								
VW pipe (delivery)		150ϕx5,000	(444 5)	m) nos				GF JIS K 6742 - 6743 unplasticized polyviniyl chloride pipe for water works service
VW pipe (supply)		150ϕx5,000	(900	m) nos	8,485	2,545,500		
TS socket		150ϕ	30	"	800	24,000		
90° bend pipe		150ϕ - 90°	3	"	6,500	19,500		
Cheese		150 x 150	5	"	4,485	22,425		
Flexible flange		150	5	"	3,680	18,400		
Sluice valve		150ϕ	5	"	34,800	174,000		
Dresser joint		150ϕ	13	"	3,670	47,710		
Caps			5	"	1,590	7,950		
TS flange		150ϕ	10	pc	1,500	15,000		
Cheese		150 x 50	50	nos	7,500	375,000		
VW pipe		50ϕ x 0.50	50	pc	480	24,000		
Hydrant		50ϕ	50	pc	3,220	161,000		
Sub Total						3,434,820		
Pipe laying		150ϕ	1,344 5	m	50	67,225		
Hydrant setting			50	plc	1,028	51,400		
Sub Total						118,625		
Farm-pond								
Excavation			742 7	m3	120	89,124		702+28.8+11.9=742.7
Embankment			134 3	m3	40	5,372		108+26.3=134.3
Pasangan-batukali			126 6	m3	4,415	558,939		506.3m2 x 0.25m = 126.6m3
Currugated pipe		600ϕx2.7t	9 5	m	6,440	61,180		
		2000ϕx3.2t	4 8	m	32,700	156,960		
Bolt			41	nos	70	2,870		loss 37 x (1+0.1) = 41
Steel		Angle 50x50x6 - 4	0 1	ton	46,000	4,600		
Base concrete			1 8	m3	6,350	11,430		
						664,865		
Sub Total						225,610		
						890,475		
Total						783,490	D.C	
						3,660,095	F.C	
						4,443,585		
						= 4,443,000		

5 COST OF BOOSTER PUMPS SPECIFICATION

¥1,634,000 yen

6,000 D.C
1,628,000 F.C

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. Pump		Suction bove 125 mm Capacity 1.32m3/min Total head 53m Speed 1800 rpm Engine rating 40 ps	1 0	set	210,000	210,000		Multistage centrifugal pump directly driven by diesel engine
Accessories								
Foot valve		125φ	1 0	pc				
Drain cock			1 0	pc				
Air cock			1 0	pc				
Priming funnel cock			1 0	pc				
Foundation bolt			1 0	set				
Drain pipe			1 0	set				
Companion flange			2 0	pcs				
2. Manual sluice valve		125φ	1 0	pc	18,000	18,000		
3. Self closing check valve		125φ	1 0	pc	17,000	17,000		
4. Suction and discharge pipe with flange						60,820		
		125φx2,600x1	39 0	kg				SGK
		" x1,000x2	30	kg				
		" x400x1	6 0	kg				
		" x1,450x1	21 0	kg				
		" x600x1	9 0	kg				
		" x170x1	25 0	kg				
		125φ90° elbow	4 0	pc				
		125φ 45°	2 0	pc				
		125φ x 150φ	1 0	pc				
5. Diesel Engine			1 0	set	1,300,000	1,300,000		Continuous lating 40 ps/1800 rpm
		Sel-motor	1 0	pc				
Accessories								
Speed meter			1 0	pc				
Press gage for lubrication oil			1 0	pc				
Thermometer for lubrication oil			1 0	pc				
Thermometer for cooling water			1 0	pc				
Air cleaner			1 0	pc				
Bolt			1 0	pc				
Radiator fan			1 0	pc				
Battery			1 0	pc				
Tools			1 0	pc				

6. Package and shipping	1 0	set	22,000	22,000		
7. Pump setting						
Labor	20 0	man	110	2,200	D.C	
Super-intendent	10 0	man	400	4,000	D.C	
				6,200	D.C	
Total				1,627,820	F.C	
				1,634,020		
				≒ 1,634,000		

6 COST OF SUPPLY PIPE SPECIFICATION (FOR SPRINKLER)

¥2,092,000 yen

125,000 D.C
1,967,000 F.C

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. Delivery pipe-L1								
Asbestos cement pipe	Class-A	ϕ150 x 4000 m/m	(125 35 0	m) pc	4,700	164,500		
Collar joint	" "	ϕ150	35 0	pc	900	31,500		
Cross-pipe	FC.20 "	ϕ150x100	1 0	pc	6,700	6,700		24.4 kg/pc
Givolt joint	FC.20	For ϕ150	8 0	set	1,650	13,200		
2. Delivery pipe-L2								
Asbestos cement pipe	Class-A "	ϕ125 x 4000 m/m	(180 50 0	m) pc	4,000	200,000		With collar joint
Reducer pipe	FC.20	ϕ150 x 125	1 0	pc	4,320	4,320		17.2 kg/pc
Saddle of ferrle	Class A	ϕ125	1 0	pc	1,100	1,100		17.2 kg/pc
Cross-pipe	FC.20	ϕ125 x 125	1 0	pc	2,020	2,020		17.2 kg/pc
Regulating valve work		ϕ125	1 0	place	38,420	38,420		Short pipe (B) ϕ125 x 2 pc x 12.5 kg/pc Regulation valve for water supply JIS B2062 ϕ125 x 1 pc
Exhaust valve work		ϕ20	1 0	place	6,860	16,860		Single air valve Socket 20ϕx1 pc Long nipple 20ϕx200ℓ
Givolt joint		ϕ125 G.J	13 0	pc	1,360	17,680		8.14 kg/pc (JISA 5520)
3. Supply Pipe-L3								
VW pipe		ϕ100 x 5000	(95 21 0	m) pc	4,350	91,350		With sleeve joint A type JIS K 6742
Regulating valve work		ϕ100	1 0	place	27,650	27,650		Short pipe (B) ϕ100 x 2 pc x 10.1 kg/pc Regulation valve
Dressor joint		ϕ100	6 0	place	1,530	9,180		for water supply (JIS B 2062)
Asbestos cement pipe	Class-A	ϕ100 x 3000ℓ	1 0	place	1,500	1,500		ϕ100 x 1 pc Regulating valve
Hydrant (B)			6 0	place	8,400	50,400		50ϕ x 1 pc Long nipple
VA socket		ϕ100	1 0	pc	1,730	1,730		50ϕ x 300ℓ x 1 pc Iron cheese 100ϕ x 50ϕ x 1 pc Valve socket 100ϕ x 2 pc
Plug	FC.20	for plain Cheese ϕ100	1 0	pc	600	600		JIS B-2301
Givolt joint		ϕ100 GJ	3 0	pc	1,180	3,540		JIS A5520 6.93 kg/pc

4.	Supply pipe -L4			(105 m)			
	VW pipe		ϕ100 x 5000	21 0	pc	4,350	91,350
	Regulating valve work		ϕ100	1 0	place	27,650	27,650
	Hydrant (B)			6 0	place	8,400	50,400
	VA socket		ϕ100	1 0	pc	1,730	1,730
	Plug	FC.20		1 0	pc	600	600
	Givolt joint		GJ ϕ100	3 0	pc	1,180	3,540
	Asbestos cement pipe	Class-A	100ϕ x 3000	1 0	pc	1,500	1,500
5.	Water supply canal-L5						
	Asbestos cement pipe	Class-A	ϕ125 x 4000	(95 m) 27 0	pc	4,000	108,000
	Regulating valve work		ϕ125	1 0	place	38,420	38,420
	Hydrant (A)			6 0	place	9,200	55,200
	Hydrant (B)			12 0	place	8,400	100,800
	Reducer pipe	Class-A	ϕ125 x 100	1 0	pc	4,030	4,030
	VW pipe		ϕ100 x 5000	(222 m) 45 0	pc	4,350	217,500
	VA socket	"	ϕ100 VP	1 0	pc	1,730	1,730
	Plug	FC.20		1 0	pc	600	600
			ϕ125 GJ	9 0	pc	1,360	12,240
	Givolt joint		ϕ100 GJ	1 0	pc	1,180	1,180
	Dressor joint		ϕ100	12 0	pc	1,530	18,360
6.	Water supply canal-L6						
	VW pipe	VP	ϕ100 x 5000	(105 m) 23	pc	4,350	100,050
	Regulating valve work		ϕ100	1 0	place	27,650	27,650
	Hydrant (B)			6 0	place		
	Reducer pipe	Class A FC.20	ϕ125 x 100	1 0	pc	4,030	4,030
			ϕ100 JP	1 0	pc	1,730	1,730
	Givolt joint		ϕ100 GJ	4	pc	1,180	4,720
	Plug	FC.20		1 0	pc	600	600
	Dressor joint		100ϕ	7 0	pc	1,530	10,710
	Flexible flage		100ϕ	1 0	pc	2,140	2,140
	Sub Total						1,619,560

With sleeve joint (A type) Short pipe (B) 100ϕ x 2 pc x 10.1 kg Regulating valve 100ϕ x 1 pc Regulating valve 50ϕ x 1 pc Iron cheese 100ϕ x 50ϕ x 1 pc Long nipple 50ϕ x 300 x 1 pc Valve socket 100ϕ x 2 pc
For plain cheese ϕ100
With collar joint Regulating valve 125ϕ x 1 pc Short pipe (B) 100ϕ x 2 pc x 10.1 kg Regulating valve 50ϕ x 1 pc Long nipple 50ϕ x 300 x 1 pc Givolt cheese 125ϕ x 50ϕ x 1 pc Regulating valve 50ϕ x 1 pc Long nipple 50ϕ x 300 x 1 pc Iron cheese 100ϕ x 50ϕ x 1 pc Valve socket 100ϕ x 2 pc
With sleeve joint A type JIS K 6742
For plain cheese ϕ100
With sleeve joint A type Regulating valve 100ϕ x 1 pc Flexible flange 100ϕ x 1 pc Short pipe (B) 100ϕ x 2 pc x 10.1 kg Regulating valve 50ϕ x 1 pc Long nipple 50ϕ x 300 x 1 pc Iron cheese 100ϕ x 50ϕ x 1 pc Valve socket 100ϕ x 2 pc
For plain cheese ϕ100

7. Pipe lying							
Pipe lying	150ϕ	125	m	50	6,250		
Pipe lying	125ϕ	275	m	45	17,375		
Pipe lying	100ϕ	527	m	45	23,715		
Hydrant (A)		6	pcs	1,721	10,326		
Do (B)		30	pcs	1,721	51,630		
Regulating valve work		5	pcs	3,130	15,650		
Tools					105,000		Cutter, monkey wrench bond for pipe etc.
Sub Total					229,946		
Shipping and Transport		1,619 560 x 0.15			242,934		
					124,946	D.C	
Total					1,967,494	F.C	
					2,092,440		
					≒ 2,092,000		

7 COST OF SPRINKLER HEAD SPECIFICATION

¥1,211,000 (F.C)

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
Sprinkler		8 stands set	2 0	set	217,910	435,820		
Sprinkler		6 stands set	4 0	set	158,820	635,280		
Ames valve S type		50ϕ	35 0	pc	4,000	140,000		
Total						1,211,100		
						≒ 1,211,000		

SPRINKLER (8 stands set) SPECIFICATION

¥217,910

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
Sprinkler		3/16x3/32"	8 0	pcs	2,350	18,800		3.16 kg/cm2, 324ℓ/min, 29.9m
Riser pipe		20ϕ x 1 m	8 0	pcs	2,300	18,400		With 3 leg sockets
Riser pipe		20ϕ x 2 m	8 0	pcs	4,500	36,000		With sockets of nylon lope 3 leg
Plug for spigot socket			15 0	pcs	450	6,750		
Aluminium pipe with ames		50ϕ x 4 m	8 0	pcs	4,500	36,000		With riser
Aluminium pipe with ames		50ϕ x 4 m	17 0	pcs	4,400	74,800		No riser
JET hose			1 0	pcs	3,400	3,400		With joint
Ames plug			1 0	pcs	1,800	1,800		
Ames elbow			1 0	pcs	3,500	3,500		For hydrant with 1/4" rimover
Water gage		7 kg/cm2	1 0	pcs	1,800	1,800		With cock
Pipe foot			25 0		500	12,500		

* Spares				
Ames plug	1 0	1,800	1,800	
Seal for ames	8 0	140	1,120	
Spring for ames	8 0	120	960	
U ling for spigot socket	4 0	70	280	
Total			217,910	

SPRINKLER (6 stands set) SPECIFICATION

¥158,820

Description of items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
Sprinkler		3/16x3/32"	6 0		2,350	14,100		3.16 kg/cm2, 32.4 ℓ/mm 29.9 m
Riser pipe		20φ x 1 m	6 0		2,300	13,800		With 3 log sockets
Riser pipe		20φ x 2 m	6 0		4,500	27,000		With sockets of nylon lope 3 log
Plug for spigot socket			11 0		450	4,950		
Aluminium pipe with ames		50φ x 4 m	6 0		4,500	27,000		With riser
Aluminium pipe with ames		50φ x 4 m	11 0		4,400	48,400		No riser
Jet hose		50φ x 1 m	1 0		3,400	3,400		With joint
Ames plug			1 0		1,800	1,800		
Ames elbow			1 0		3,500	3,500		For hydrant with 1/4" rimover
Water gage		7 kg/cm2	1 0		1,800	1,800		With cock
Pipe foot			19 0		500	9,500		
* Spares								
Ames plug			1 0		1,800	1,800		
Seal for ames			6 0		140	840		
Spring for ames			6 0		120	720		
U ring for spigot socket			3 0		70	210		
Total						158,820		

(3) COST OF BUILDINGS SPECIFICATION

¥46,225,000 yen

39,152,000 D.C
7,073,000 F.C

Description of items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
						Rp.		
1. Gasoline filling stand	(No. 1)					509,423		(¥ 375,623)
2. Net house (cage)	(No. 2)					4,445,656		(¥3,278,000)
3. Office and laboratory	(No. 4-1-2)					10,613,820		(¥7,826,094)
4. Inoculator and insect rearing house	(No. 5)					3,747,208		(¥2,763,000)

5.	Tractor work-shop and floor	(No. 7)	4,500,514	(¥3,318,451)
6.	Machine attachment store house	(No. 8)	3,199,032	(¥2,358,804)
7.	Work room	(No. 9)	2,154,539	(¥1,588,648)
8.	Fertilizer and chemicals storehouse	(No. 11)	2,584,924	(¥1,905,992)
9.	Storage and floor	(No. 12-2)	1,448,154	(¥1,067,795)
10.	Domitory	(No. 14-1-2)	9,854,814	(¥7,266,442)
11.	Cattle shed	(No. 18)	306,475	(¥ 225,980)
12.	Generator room	(No. 19-2)	528,150	(¥ 389,430)
13.	Pump room for paddy field		302,718	(¥ 223,209)
14.	Dining hall	(No. 25)	2,885,641	(¥2,127,726)
15.	Drying shop	(No. 3)	691,071	(¥ 509,561)
16.	Pumping room for buildings	(No. 20)	241,576	(¥ 178,125)
17.	Pumping room for booster pump		241,576	(¥ 178,125)
18.	Cost of installation work 1		10,515,000	(¥7,753,230)
	" work 2		3,921,000	(¥2,891,147)
	Total		62,691,291	(¥46,225,382)
			= 62,691,000	= 46,225,000

1 GASOLINE FILLING STAND SPECIFICATION
(NO. 1)

Rp. 509,423 (¥375,623)

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
						Rp.		
1. Temporary work			1	set		33,500		
2. Earth work			1	set		14,482		
3. Concrete work			1	set		148,996		
4. Wood work			1	set		163,605		
5. Roofing work			1	set		122,720		
6. Painting work			1	set		26,120		1 US$= 415 Rp. 306 yen
Total						Rp. 509,423		
						(¥ 375,623)		(5217 Yen/m2)
1. Temporary work								
Land consolidation			1	set		3,500		
Leveling batter board			1	set		1,000		
Scaffolding			120	m2	150	18,000		
Curing			1	set		1,000		
Transportation			1	set		5,000		
Temporary building			1	set		5,000		
Total						33,500		

2. Earth work				
Root excavation	24	m3	160	3,840
Rubble foundation	3 2	m3	1,450	4,640
Sand leveling	3 6		1,020	3,670
Back filling	13		120	1,560
Waste treatment	11		70	770
Total				14,482
3. Concrete work				
Foundation	7 8	m3	5,810	45,318
Brick masonry	4 2	m3	5,740	24,108
Parquet concrete	3 4	m3	9,200	31,280
Plaster painting	93	m2	280	26,040
Floor tile	13 5	m2	1,200	16,200
Floor mortar	4 5	m2	500	2,250
Lavatory	1	nos		2,000
Fixtures mortar	1	set		1,800
Total				148,996
4. Wood work				
Wood materials (including roof, ceiling bed etc.)	3 9	m3	15,000	58,500
Carpenter labors	1	set		14,700
Nail etc.	1	set		5,000
Glass window	45	m2		19,215
Louver window	10	m2		46,100
Door screen	4 7	m2		17,390
Plinth	15	m		2,700
Total				163,605
5. Roofing work				
Iron plate flat seam roofing	112	m2	1,060	118,720
Iron plate ridge	8	m	500	4,000
Total				112,720
6. Painting work				
Painting	70	m2	260	18,200
Ceiling	18	m2	440	7,920
Total				26,120

Rp. (¥3,278,000)

97,000 D.C
3,190,000 F.C

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No,	Remark
1. Net house (No corrosive type of alminum alldy and other submaterials)			1	ridge		1,472,424		
2. Doors (Entrance door)			1	ridge		153,000		
3. Glass roofvent (3mm clear glass roof)			1	ridge		127,250		
4. Wire net (Screen Stainless #30-20 mesh)			1	ridge		577,500		
5. Roofvent electric Automatic Thermometrical operator and automatic voltage controller			1	ridge		206,100		
6. Basement (*Reinforced concrete*, mold)			1	set		149,000		
7. Tools						165,000		
8. Package and shipping						427,500		1 US$ = 415 Rp. 306 yen
9. Setting						9,500		
						97,500	D.C	
Total						3,190,274	F.C	
						3,287,774		
1. Net house								
Alumi extruded material			1,006	kg	508	728,344		
Post, pafter, barcap, ventprocess fee						357,000		
Alumite process fee			1,006		80			
Plates			1	set				
Volt, nut (stainless, alumi)			1	set				
Seal, calking material			1	set				
Collar with plate			1	set				
Gutter with fittings			1	set				
Total								
2. Doors								
Entrance door with lock		1,820x1,770	2	set				
3. Glass								
3 m/m Clear plate		36 x 24	75	box	4,700			
" curved		30 x 24	75	box	37,000			
Total								
4. Wire net (*Screen #30-20 mesh*)								
Side wall screen with almi flame		3,000 m x 0.830 m	30	sheet				
Gable wall with almi flame		1,700 m x 0.830 m	8	sheet				
"		2,800 m x 0.830 m	12	sheet				
Roofvent with almi flame		2,500 m x 0.800 m	18	sheet				
"		1,250 m x 0.800 m	4	sheet				
Clip for stopping almi flame screen			1	set				
Total								

5. Roofvent electric automatic thermometrical operator						
Automatic control a and reduction device		2	nos		9,800	
Fitting pipe, hanger, arm joint		1	set			
Ditto electric wiring (cord)		1	set			
Automatic voltage control		1	nos			
Total						
6. Basement material						
Cement		200	bag	350	70,000	
Temporary form	Plywood	20	sheet	900	18,000	
	Sashbar	30	piece	250	7,500	
	Nail Separator (60 mm) annealedwire				7,000	
Reinforcement	9 mm					
	For uditch	775	kg	60	46,500	
Total					149,000	
7. Tools						
		1	set		16,500	
Total					16,500	
8. Package and shipping					427,500	15% of amount of above
9. *Setting*	*Labor*	50 0	men	110	5,500	
	Super intendent	10 0	men	400	4,000	
Total					9,500	

3-1 OFFICE AND LABORATORY (NO. 4-1) SPECIFICATION

Rp. 5,306,910 (¥3,913,047)

Description of Items	*Material*	*Size*	*Quantity*	*Unit*	*Unit Price*	*Cost*	*No.*	*Remark*
						Rp.		
1. Temporary work			1	set		159,000		
2. Earth work			1	set		180,590		
3. Concrete work			1	set		1,839,960		
4. Wood work			1	set		1,516,780		
5. Roofing work			1	set		1,045,400		
6. Painting work			1	set		565,180		1 US$ = 415 Rp. 306 yen
Total						Rp. 5,306,910		
						(¥3,913,047)		(9783 yen/m2)
1. Temporary work								
Land consolidation			1	set		20,000		
Leveling batter board			1	set		20,000		
Scaffolding			380	m2	150	57,000		
Curing			1	set		12,000		

Transportation	1	set		40,000
Temporary building	1	set		10,000
Total				159,000
2. Earth work				
Root excavation	216	m3	160	34,560
Rubble foundation	25	m3	1,450	36,250
Sand leveling	88	m3	1,020	89,760
Back filling	98	m3	120	11,760
Waste treatment	118	m3	70	8,260
Total				180,590
3. Concrete work				
Foundation	82	m3	5,810	476,420
Parquef concrete	44	m3	9,200	404,800
Brick masonry	41	m3	5,740	235,340
Plaster painting	900	m2	280	252,000
Floor tile	352	m2	1,200	422,400
Floor mortar	52		500	26,000
Lavatory	4	nos.	2,000	8,000
Arch	10	nos.	500	5,000
Fixtures mortar	1	set		10,000
Total				1,839,960
4. Wood work				
Wood materials	46 8	m3	18,000	842,400
Carpenter labors	1	set		127,000
Nail, metalic materials	1	set		89,000
Glass window	40	m2	4,270	170,800
Louver window	40	m2	4,610	184,400
Door screen	22	m2	3,700	81,400
Plinth	121	m	180	21,780
Total				1,516,780
5. Roofing work				
Iron plate flat seam roofing	550	m2	1,800	990,000
Ditto ridge	56	m	700	39,200
Eaves gutter	108	m	120	12,960
Vertical gutter	36	m	90	3,240
Total				1,045,400
6. Painting work				
Painting	643	m2	260	167,180
Ceiling (including back of eaues)	200	m2	450	90,000
" (indoor)	280	m2	1,100	308,000
Total				565,180

Rp. 5,306,910 (¥3,913,047)

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. Temporary work			1	set		159,000		
2. Earth work			1	set		180,590		
3. Concrete work			1	set		1,839,960		
4. Wood work			1	set		1,516,780		
5. Roofing work			1	set		1,045,400		
6. Painting work			1	set		565,180		
								1 US$ = 415 Rp. 306 yen
Total						Rp. 5,306,910		
						(¥3,913,047)		(9783 yen/m2)
1. Temporary work								
Land consolidation			1	set		20,000		
Leveling batter board			1	set		20,000		
Scaffolding			380	m2	150	57,000		
Curing			1	set		12,000		
Transportation			1	set		40,000		
Temporary building			1	set		10,000		
Total						159,000		
2. Earth work								
Root excavation			216	m3	160	34,560		
Rubble foundation			25	m3	1,450	36,250		
Sand leveling			88	m3	1,020	89,760		
Back filling			98	m3	120	11,760		
Waste treatment			118	m3	70	8,260		
Total						180,590		
3. Concrete work								
Foundation			82	m3	5,810	476,420		
Parquet concrete			44	m3	9,200	404,800		
Brick masonry			41	m3	57,400	235,340		
Plaster painting			900	m2	280	252,000		
Floor tile			352	m2	1,200	422,400		
Floor mortar			52	m2	500	26,000		
Lavatory			4	nos	2,000	8,000		
Arch			10	nos	500	5,000		
Fixtures mortar			1	set		10,000		
Total						1,839,960		
4. Wood work								
Wood materials			46 8	m3	18,000	842,400		
Carpenter, labors			1	set		127,000		
Nail, metalic materials			1	set		89,000		

Glass window	40	m2	4,270	170,800
Louver window	40	m2	4,610	184,400
Door screen	22	m2	3,700	81,400
Plinth	121	m	180	21,780
Total				1,516,780
5. Roofing work				
Iron plate flat seam roofing	550	m2	1,800	990,000
Ditto ridge	56	m	700	39,200
Eaves gutter	108	m	120	12,960
Vertical gutter	36	m	90	3,240
Total				1,045,400
6. Painting work				
Painting Ceiling (including back of eaues)	643	m2	260	167,180
	200	m2	450	90,000
" (indoor)	280	m2	1,100	308,000
Total				565,180

4 INOCULATOR AND INSECT REARINGHOUSE (NO.5) SPECIFICATION

¥2,763,000 yen

148,000 D.C
2,615,000 F.C

Description of Items Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. Green house (Insect rearing room, germ culture room)		1	set		1,472,680		
2. Door (Entrance door)		1	set		80,000		
3. Glass (3mm clean flat, curve)		1	set		274,900		
4. Roof vent electric thermometrical Operator and voltage controler		1	set		206,100		
5. Basement work material (Cement, rein for cement, flame)		1	set		196,000		
6. Tools					165,000		
7. Package and shipping					359,000		
8. Setting					9,500		Labor 50 man x 110 = 5,500 Super intendent 10 man x 400 = 4,000
Total					2,614,687 F.C 148,500 D.C		
					2,763,187		
1. Green house (Insect rearing room, germ culture room)							
Alumi extruded type material		1,320	kg	724	955,680		

Post, raften, bar cap vent process fee					184,000
Alumite process fee		1,320	kg	80	105,600
Plates		1	set		40,000
Volt and nut (stainless alumi)		1	set		68,000
Seal calking materials					89,000
Coller with plate					30,400
Total					1,472,680
2. Doors					
Entrance door (with lock)		2	set	4,000	80,000
Total					80,000
3. Glass					
3mm clean flat	36 x 24	27	box	4,700	126,900
" curve	30 x 24	4	box	37,000	148,000
Total					274,900
4. Roof vent electric thermometrical operator and voltage controler					
Automatic controler and reduction device		2	set		98,000
Fitting pipe, arm, hanger joint (each galvaniged set)		1	set		43,100
Ditto electric wiring cord, pipe		1	set		20,000
Automatic voltage control		1	set		45,000
Total					206,100
5. Basement work materials					
Cement		250	bag	350	87,500
Temporary form	(Ply wood, sash, etc.)	1	set		51,500
Reinforcement	(for 9mm U-ditch)	950	kg	60	57,000
Total					196,000
6. Tools		1	set		165,000
Total					165,000

5 TRACTOR WORK SHOP AND FLOOR (NO. 7) SPECIFICATION

Rp. 4,500,514 (¥3,318,451)

Description of Items Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. Temporary work		1	set		189,000		
2. Earth work		1	set		263,080		
3. Concrete work		1	set		1,712,814		
4. Wood work		1	set		1,383,440		
5. Roofing work		1	set		840,380		
6. Painting work		1	set		111,800		
Total					Rp. 4,500,514		1 US$ = 415 Rp. 306 yen
					(¥3,318,451)		(5531 yen/m2)
1. Temporary work							
Land consolidation		1	set		30,000		
Leveling batter board		1	set		30,000		
Curing		1	set		15,000		
Transportation		1	set		50,000		
Temporary building		1	set		10,000		
Scaffolding		366	m2	150	54,000		
Total					189,000		
2. Earth work							
Root excavation		360	m2	160	58,560		
Rubble foundation		119	m2	1,450	172,550		
Back filling		127	m2	120	15,240		
Waste treatment		239	m2	70	16,730		
Total					263,080		
3. Concrete work							
Foundation		95	m3	5,810	551,950		
Parquet concrete		95	m3	9,200	874,000		
Brick masdnry		33 6	m3	5,740	192,864		
Plaster painting			m2	280	84,000		
Fixtures mortar		1	set		10,000		140+36+24 = 200
Total					1,712,814		
4. Wood work							
Wood materials		44 7	m3	15,000	670,500		
Carpenter labors		1	set		100,000		
Glass window		40	m2		170,800		
Louver window		54	m2		248,940		
Door		36	m2		133,200		
Nail, metalic materials		1	set		60,000		
Total					1,383,440		

5. Roofing work				
Iron plate flat seam roofing	773	m2	1,060	819,380
Ditto ridge	42	m	500	21,000
Total				840,380
6. Painting work				
Painting	430	m2	260	111,800
Total				111,800

6 MACHINE ATTACHMENT STOREHOUSE (NO. 8) SPECIFICATION

Rp. 3,199,032 (¥2,358,804)

Description of Items Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. Temporary work		1	set		146,000		
2. Earth work		1	set		172,160		
3. Concrete work		1	set		1,051,222		
4. Wood work		1	set		1,146,610		
5. Roofing work		1	set		604,000		
6. Painting work		1	set		79,040		1 US$ = 415 Rp. 306 yen
Total					Rp. 3,199,032		
					(¥2,358,804)		(5897 yen/m2)
1. Temporary work							
Land consolidation		1	set		20,000		
Leveling batter board		1	set		20,000		
Scaffolding		340	m2	150	51,000		
Curing		1	m2		10,000		
Transportation		1	set		35,000		
Temporary		1	set		10,000		
Total					146,000		
2. Earth work							
Root excavation		197	m3	160	31,520		
Rubble foundation		85	m3	1,450	123,250		
Back filling		72	m3	120	8,640		
Waste treatment		125	m3	70	8,750		
Total					172,160		
3. Concrete work							
Foundation		77	m3	5,810	447,370		
Parquet concrete		37	m3	9,200	340,400		
Brick masonry		29 8	m3	5,740	171,052		
Plaster painting		330	m2	280	92,400		
Total					1,051,222		

4. Wood work				
Wood materials	42 5	m3	15,000	637,500
Carpenter labors	1	set		95,000
Glass window	16	set	4,270	68,320
Louver window	39	m2	4,610	179,790
Door	30	m2	3,700	111,000
Nail, metallic materials				55,000
Total				1,146,610
5. Roofing work				
Iron plate roof	550	m2	1,060	583,000
Iron plate ridge	42	m	500	21,000
Total				604,000
6. Painting work				
Painting	304	m2	260	79,040
Total				79,040

7 WORK ROOM (NO. 9) SPECIFICATION

Rp. 2,154,539 (¥1,588,648)

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. Temporary work			1	set		71,000		
2. Earth work			1	set		61,014		
3. Concrete work			1	set		623,635		
4. Wood work			1	set		650,440		
5. Roofing work			1	set		476,200		
6. Painting work			1	set		272,250		
								1 US$ = 415 Rp. 306 yen
Total						Rp. 2,154,539		
						(¥1,588,648)		(10591 yen/m2)
1. Temporary work								
Land consolidation			1	set		7,500		
Leveling batter board			1	set		7,500		
Curing			1	set		4,500		
Transportation			1	set		12,000		
Temporary building			1	set		8,000		
Scaffolding			210	m2	150	31,500		
Total						71,000		
2. Earth work								
Root excavation			69	m3	160	11,040		
Rubble foundation			8 4	m3	1,450	12,180		
Sand leveling			30 7	m3	1,020	31,314		
Back filling			33	m3	120	3,960		
Waste treatment			36	m3	70	2,520		
Total						61,014		

3. Concrete work				
Foundation	27 3	m3	5,810	158,613
Parquet concrete	15 7	m3	9,200	144,440
Brick masonry	11 3	m3	5,740	64,862
Plaster painting	249	m2	280	69,720
Floor tile	150	m2	1,200	180,000
Fixtures mortar	1	set		6,000
Total				623,635
4. Wood work				
Wood materials	15 7	m3	18,000	282,600
Carpenter labors	1	set		41,100
Glass window	38	m2	4,270	162,260
Louver window	18	m2	4,610	82,980
Door	11	m2	3,700	40,700
Nail, metalic materials	1	set		30,000
Plinte	60	m	180	10,800
Total				650,440
5. Roofing work				
Iron plate flat seam roofing	243	m2	1,800	437,400
Ditto ridge	40	m	700	28,000
Eaves gutter	72	m	120	8,600
Vertical gutter	24	m	90	2,140
Total				476,200
6. Painting work				
Painting	300	m2	260	78,000
Ceiling (indoor)	150	m2	1,100	165,000
" (back of eaves)	65	m2	450	29,250
Total				272,250

Rp. 2,584,924 (¥1,905,992)

Description of Items Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. Temporary work		1	set		119,500		
2. Earth work		1	set		147,070		
3. Concrete work		1	set		989,114		
4. Wood work		1	set		759,220		
5. Roofing work		1	set		460,820		
6. Painting work		1	set		109,200		1 US$ = 415 Rp. 306 yen
Total					Rp. 2,584,924		
					(¥ 1,905,992)		(6353 yen/m2)
1. Temporary work							
Land consolidation		1	set		15,000		
Leveling batter board		1	set		15,000		
Curing		1	set		9,000		
Transportation		1	set		30,000		
Temporary building		1	set		10,000		
Scaffolding		270	m2	150	40,500		
Total					119,500		
2. Earth work							
Root excavation		209	m3	160	33,440		
Rubble foundation		65	m3	1,450	94,250		
Back filling		95	m3	120	11,400		
Waste treatment		114	m3	70	7,980		
Total					147,070		
3. Concrete work							
Foundation		87	m3	5,810	505,470		
Parquet concrete		33	m3	9,200	303,600		
Brick masonry		20 6	m3	5,740	118,244		
Plaster painting		185	m2	280	51,800		
Fixtures mortar		1	set		5,000		
Arch		8	nos		5,000		
Total					989,114		
4. Earth work							
Wood materials		17 9	m3	15,000	268,500		
Carpenter labors		1	set		45,000		
Louver window		72	m2	4,610	331,920		
Door		24	m2	3,700	88,800		
Nail, metalic materials		1	set		25,000		
Total					759,220		

5. Roofing work				
Iron plate flat seam roofing	377	m2	1,160	437,320
Ditto ridge	47	m	500	23,500
Total				460,820
6. Painting work				
Painting	420	m2	260	109,200
Total				109,200

9 STORAGE AND FLOOR (NO. 12-2) SPECIFICATION

Rp. 1,488,154 (¥1,067,795)

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. Temporary work			1	set		80,000		
2. Earth work			1	set		74,540		
3. Concrete work			1	set		503,394		
4. Wood work			1	set		443,020		
5. Roofing work			1	set		293,900		
6. Painting work			1	set		53,300		1 US$ = 415 Rp. 306 yen
Total						Rp. 1,448,154		
						(¥1,067,795)		(2669 yen/m2)
1. Temporary work								
Land consolidation			1	set		9,000		
Leveling batter board			1	set		9,000		
Curing			1	set		6,000		
Transportation			1	set		15,000		
Temporary building			1	set		8,000		
Scaffolding			220	m2		33,000		
Total						80,000		
2. Earth work								
Root excavation			83	m3	160	13,280		
Rubble foundation			37	m3	1,450	53,650		
Back filling			36	m3	120	4,320		
Waste treatment			47	m3	70	3,290		
Total						74,540		
3. Concrete work								
Foundation			30	m3	5,810	174,300		
Parquet concrete			18	m3	9,200	165,600		
Brick masonry			18 1	m3	5,740	103,894		
Plaster painting			195	m2	280	54,600		
Mortar			1	set		5,000		
Total						503,394		

4. Wood work				
Wood materials	13	m3	15,000	195,000
Carpenter labors	1	set		30,000
Louver	32	m2	4,610	147,520
Door	15	m2	3,700	55,500
Mortar	1	set		15,000
Total				443,020
5. Roofing work				
Iron plate flat seam roofing		m2	1,060	280,900
Ditto ridge		m	500	13,000
Total				293,900
6. Painting work				
Painting	205	m2	260	53,300
Total				53,300

10 DOMITORY (NO. 14-1) SPECIFICATION

Rp. 4,927,407 (¥3,633,221)

Description of Items Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. Temporary work		1	set		142,000		
2. Earth work		1	set		164,087		
3. Concrete work		1	set		1,831,040		
4. Wood work		1	set		1,159,300		
5. Roofing work		1	set		917,480		
6. Painting work		1	set		713,500		1 US$ = 415 Rp. 306 yen
Total					Rp. 4,927,407		
					(¥3,633,221)		(11534 yen/m2)
1. Temporary work							
Land consolidation		1	set		15,000		
Leveling batter board		1	set		15,000		
Scaffolding		400	m2	150	60,000		
Curing		1	set		12,000		
Transportation		1	set		30,000		
Temporary building		1	set		10,000		
Total					142,000		
2. Earth work							
Root excavation		220	m3	160	35,200		
Rubble foundation		30 7	m3	1,450	44,515		
Sand filling		63 6	m3	1,020	64,872		
Back filling		82	m3	120	9,840		
Waste treatment		138	m3	70	9,660		
Total					164,087		

3. Concrete work				
Foundation	100	m3	5,810	581,000
Parquen concrete	32 2	m3	9,200	296,240
Brick masonry	47	m3	5,740	269,780
Plaster painting	1,034	m2	280	289,520
Tile (terrace)	280	m2	1,200	336,000
Tile (bathroom)	9	m2	1,500	13,500
Floor mortar	30	m2	500	15,000
Lavatory	4	nos	2,000	8,000
Bath-tub	2	nos	3,500	7,000
Fixtures mortar	1	set		15,000
Total				1,831,040
4. Wood work				
Wood materials	30 2	m3	1,500	453,000
Carpenter labors	1	set		79,500
Glass window	22	m2		93,940
Louver window	56	m2		258,160
Door screen	51	m2		188,700
Nail, metalic materials	1	set		50,000
Plinth	200	m	180	36,000
Total				1,159,300
5. Roofing work				
Iron plate flat seam roofing	476	m2	1,800	856,800
Ditto ridge	62	m	700	43,400
Eaves gutter	117	m	120	14,040
Vertical gutter	36	m	90	3,240
Total				917,480
6. Painting work				
Painting	1,500	m2	260	390,000
Ceiling (back of eaves etc.)	230	m2	450	103,500
" (bed room)	200	m2	1,100	220,000
Total				713,500

10 DOMITORY (NO. 14-2) SPECIFICATION

Rp. 4,927,407 (¥3,633,221)

Description of Items Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. Temporary work		1	set		142,000		
2. Earth work		1	set		164,087		
3. Concrete work		1	set		1,831,040		
4. Wood work		1	set		1,159,300		
5. Roofing work		1	set		917,480		
6. Painting work		1	set		713,500		
						1 US$ =	415 Rp. 306 yen
Total					Rp. 4,927,407		
					(¥3,633,221)		(11534 yen/m2)
1. Temporary work							
Land consolidation		1	set		15,000		
Leveling batter board		1	set		15,000		
Scaffolding		400	m2	150	60,000		
Curing		1	set		12,000		
Transportation		1	set		30,000		
Temporary building		1	set		10,000		
Total					142,000		
2. Earth work							
Root excavation		220	m3	160	35,200		
Rubble foundation		30 7	m3	1,450	44,515		
Sand filling		63 6	m3	1,020	64,872		
Back filling		82	m3	120	9,840		
Waste treatment		138	m3	70	9,660		
Total					164,087		
3. Concrete work							
Foundation		100	m3	5,810	581,000		
Parquet concrete		32 2	m3	9,200	296,240		
Brick masonry		47	m3	5,740	269,780		
Plaster painting		1,034	m2	280	289,520		
Tile (terrace)		280	m2	1,200	336,000		
Tile (bathroom)		9	m2	1,500	13,500		
Floor mortar		30	m2	1,500	15,000		
Lavatory		4	nos	2,000	8,000		
Bath-tory		2	nos	3,500	7,000		
Fixtures mortar		1	set		15,000		
Total					1,831,040		
4. Wood work							
Wood materials		30 2	m3	15,000	453,000		
Carpenter labors		1	set		79,500		

Glass window	22	m2		93,940		
Louver window	56	m2		258,160		
Door screen	51	m2		188,700		
Nail, metalic materials	1	set		50,000		
Plinth	200	m	180	36,000		
Total				1,159,300		
5. Roofing work						
Iron plate flat seam roofing	476	m2	1,800	856,800		
Ditto ridge	62	m	700	43,400		
Eaves gutter	117	m	120	14,040		
Vertical gutter	36	m	90	3,240		
Total				917,480		
6. Painting work						
Painting	1,500	m2	260	390,000		
Ceiling (back of eaves etc.)	230	m2	450	103,500		
" (bed room)	200	m2	1,100	220,000		
Total				713,500		

11 CATTLE SHED (NO. 18) SPECIFICATION

Rp. 306,475 (¥225,980)

Description of Items Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
					Rp.		
1. Temporary work		1	set		22,300		
2. Earth work		1	set		21,720		
3. Concrete work		1	set		113,155		
4. Wood work		1	set		58,500		
5. Roofing work		1	set		90,800		
							1 US$ = 415 Rp. 306 yen
Total				Rp.	306,475		
					(¥225,980)		(5650 yen/m2)
1. Temporary work							
Land consolidation		1	set		1,000		
Leveling batter board		1	set		1,000		
Scaffolding		90	m2	150	13,500		
Curing		1	set		800		
Transportation		1	set		3,000		
Temporary building		1	set		3,000		
Total					22,300		
2. Earth work							
Root excavation		29	m3	160	4,640		
Rubble foundation		10	m3	1,450	14,500		

Back filling	11	m3	120	1,320
Waste treatment	18	m3	70	1,260
Total				21,720
3. Concrete work				
Foundation	8 9	m3	5,810	51,709
Brick masonry	3 5		5,740	20,090
Parquet concrete	4 5		9,200	41,400
Total				113,155
4. Wood work				
Wood materials	3 3	m3	1,500	49,500
Carpenter labors	1	set		6,000
Nail, metalic materials	1	set		3,000
Total				58,500
5. Roofing work				
Iron plate flat seam roofing	80	m2	1,060	84,800
Ditto ridge	12	m2	500	6,000
Total				90,800

12 GENERATOR ROOM (NO. 19-2) SPECIFICATION

Rp. 528,150 (¥389,430)

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. Temporary work			1	set		23,300		
2. Earth work			1	set		24,270		
3. Concrete work			1	set		223,800		
4. Wood work			1	set		131,340		
5. Roofing work			1	set		111,400		
6. Painting work			1	set		14,040		1 US$ = 415 Rp, 306 yen
Total						Rp. 528,150		
						(¥389,430)		(7,788 yen/m2)
1. Temporary work								
Land consolidation			1	set		1,500		
Leveling batter board			1	set		1,500		
Scaffolding			76	m2	150	1,400		
Curing			1	set		900		
Transportation			1	set		3,000		
Temporary building			1	set		5,000		
Total						23,300		

2. Earth work				
Root excavation	34	m3	160	5,440
Rubble foundation	11	m3	450	15,950
Back filling	10	m3	120	1,200
Waste treatment	24	m3	70	1,680
Total				24,270
3. Concrete work				
Foundation	15 0	m3	5,810	87,150
Parquet concrete	5 5	m3	9,200	50,600
Brick masonry	7 5	m3	5,740	43,050
Plaster painting	150	m2	280	42,000
Mortar	1	set		1,000
Total				223,800
4. Wood work				
Wood materials	3 5	m3	15,000	52,500
Carpenter labors	1	set		10,200
Louver window	12	m2	4,610	55,320
Door	3 6	m2	3,700	13,320
Total				131,340
5. Roofing work				
Iron plate flat seam roofing	90	m2	1,060	95,400
Ditto ridge	12	m	500	6,000
Total				111,400
6. Painting work	54	m2	260	14,040
Painting	54	m2	260	14,040
Total				14,040

13

PUMPING ROOM FOR PADDY FIELD

Rp. 302,718 (¥223,209)

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. TEMPORARY	WORK		1	SET		23,900		
2. EARTH	WORK		1	"		8,410		
3. CONCRETE	WORK		1	"		135,953		
4. WOOD	WORK		1	"		73,935		
5. POOFING	WORK		1	"		52,200		
6. PAINTING	WORK		1	"		8,320		
TOTAL						Rp. 302,718		1US$= 415 Rp. 306 YEN
						(¥ 223,209)		(4464 YEN/M^2)

1. TEMPORARY WORK				
LAND CONSOLIDATION	1	SET		1,500
LEVELING BATTER BOARD	1	"		1,500
SCAFFOLDING	80	M^2	150	12,000
CURING	1	SET		900
TRANSPORTATION	1	"		3,000
TEMPORARY BUILDING	1	"		5,000
TOTAL				23,900
2. EARTH WORK				
ROOT EXCAVATION	22	M^2	160	3,520
RUBBLE FOUNDATION	2	"	1,450	2,900
BACK FILLING	9	"	120	1,080
WASTE TREATMENT	13	"	70	910
TOTAL				8,410
3. CONCRETE WORK				
FOUNDATION	5.3	M^3	5,810	30,793
PARQUET CONCRETE	5.6	M^3	5,740	34,440
PLASTER PAINTING	65	M^2	280	18,200
MORTAR	1	SET		1,000
TOTAL				135,953
4. WOOD WORK				
WOOD MATERIALS	2.3	M^3	15,000	34,500
CARPENTER LABORS	1	SET		4,800
LOUVER WINDOW	3.5	M^2	4,610	16,135
DOOR	5	"	3,700	18,500
TOTAL				73,935
5. ROOFING WORK				
IRON PLATE FLAT SEAM ROOFING	45	M^2	1,060	47,700
DITTO RIDGE	9	M	500	4,500
TOTAL				52,200
6. PAINTING WORK				
PAINTING	32	M^2	260	8,320
TOTAL				8,320

DINING HALL (NO. 25) SPECIFICATION

Rp. 2,885,641 (¥2,127,726)

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. TEMPORARY	WORK		1	SET		96,000		
2. EARTH	WORK		1	"		92,315		
3. CONCRETE	WORK		1	"		944,610		
4. WOOD	WORK		1	"		820,100		
5. ROOFING	WORK		1	"		551,800		
6. PAINTING	WORK		1	"		372,496		
								1US$ = 415 Rp. 306 YEN
TOTAL						Rp. 2,885,641		
						(¥2,127,726)		(11082 YEN/M^2)
1. TEMPORARY	WORK							
LAND CONSOLIDATION			1	SET		10,000		
LEVELING BATTER BOARD			1	"		10,000		
SCAFFOLDING			220	M^2	150	33,000		
CURING			1	SET		8,000		
TRANSPORTATION			1	"		25,000		
TEMPORARY BUILDING			1	"		10,000		
TOTAL						96,000		
2. EARTH WORK								
ROOT EXCAVATION			127	M^3	160	20,320		
RUBBLE FOUNDATION			14.5	"	1,450	21,025		
SAND FILLING			39	"	1,020	39,780		
BACK FILLING			46	"	120	5,520		
WASTE TREATMENT			81	"	70	5,670		
TOTAL						92,315		
3. CONCRETE WORK								
LOUVER WINDOW			35	M^2	4,610	161,350		
DOOR, SCREEN			20	"	3,700	74,000		
COUNTER			1	SET		5,000		
PLINTH			1	"		6,000		
TOTAL						820,100		
5. ROOFING WORK								
IRON PLATE FIAT SEAM ROOFING			285	M^2	1,800	513,000		
DITTO RIDGE			40	M	700	28,000		
EAVES GUTTER			72	"	120	8,640		
VERTICAL GUTTER			24	"	90	2,160		
TOTAL						551,800		

6. PAINTING WORK				
PAINTING	750	M^2	260	195,000
CEILING (BACK OF EAVES etc.)	52	M^2	450	23,400
" (DININGROOM, BEDROOM)	140	"	1,100	154,000
TOTAL				372,400
FOUNDATION	47	M^3	5,810	273,070
PARQUET CONCRETE	19.2	"	9,200	176,640
BRICK MASONRY	21	"	5,740	120,540
PLASTER PAINTING	462	M^2	280	129,360
FLOOR MORTAR	3	"	500	1,500
FLOOR TILE	185	"	1,200	222,000
" (BATHROOM)	5	"	1,500	7,500
LAVATORY	1	NOS		2,000
BATHROOM	1	"		3,000
MORTAR	1	SET		9,000
TOTAL				944,610
4. WOOD WORK				
WOOD MATERIALS	21.7	M^3	15,000	325,500
CARPENTER LABORS	1	SET		58,800
NAIL, METALIC MATERIALS	1	"		40,000
GLASS WINDOW	35	M^2	4,270	149,450

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DRYING SHOP (NO. 3) SPECIFICATION

Rp. 691,071 (¥509,561)

Description of Items Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. TEMPORARY WORK		1	SET		40,500		
2. EARTH WORK		1	"		33,645		
3. CONCRETE WORK		1	"		231,614		
4. WOOD WORK		1	"		200,958		
5. ROOFING WORK		1	"		162,150		
6. PAINTING WORK		1	"		22,204		
							1US$= 415 Rp. 306 YEN
TOTAL					Rp. 691,071 (¥509,561)		(7,077 YEN/M^2)
1. TEMPORARY WORK							
LAND CONSOLIDATION		1	SET		3,500		
LEVELING BATTER BOARD		1	"		3,500		
SCAFFOLDING		130	M^2	150	19,500		
CURING		1	SET		2,000		
TRANSPORTATION		1	"		7,000		
TEMPORARY BUILDING		1	"		5,000		
TOTAL					40,500		

2. EARTH WORK				
ROOT EXCAVATION	36	M^3	160	5,760
RUBBLE FOUNDATION	17	"	1,450	24,650
BACK FILLING	14.3	"	120	1,716
WASTE TREATMENT	21.7	"	70	1,519
TOTAL				33,745
3. CONCRETE WORK				
FOUNDATION	12.6	M^3	5,810	73,206
BRICK MASONRY	9.2	M^3	5,810	52,808
PARQUET CONCRETE	8	"	5,740	73,600
PLASTER PAINTING	100	M^2	9,200	28,000
MORTAR			280	4,000
TOTAL				231,614
4. EARTH WORK				
WOOD MATERIALS	4.4	M^3	15,000	66,000
CARPENTER LABORS	1	SET		10,000
NAIL AND METALIC METERIALS	1	"		6,000
GLASS WINDOW	12	M^2	4,270	51,240
LOUVER WINDOW	11.8	"	4,610	54,398
DOOR	3.6	"	3,700	13,320
TOTAL				200,958
5. ROOFING WORK				
POLYVINYL CHLORIDE ROOF	123	M^2	1,250	153,750
DITTO RIDGE	14	M	600	8,400
TOTAL				162,150
6. PAINTING WORK				
PAINTING	85.4	M^2	260	22,204
TOTAL				22,204

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PUMPING ROOM SPECIFICATION
(FOR BOOSTER PUMP AND FOR BUILDINGS)

Rp. 241,576 (¥178,125)

NO. 20

Description of Items Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. TEMPORARY WORK		1	SET		19,100		
2. EARTH WORK		1	"		8,760		
3. CONCRETE WORK		1	"		108,666		
4. WOOD WORK		1	"		54,750		
5. ROOFING WORK		1	"		43,280		
6. PAINTING WORK		1	"		7,020		
						1US$=	415 Rp. 306 YEN
TOTAL					Rp. 241,576		
					(¥178,125)		
1. TEMPORARY WORK							
LAND CONSOLIDATION		1	SET		1,500		
LEVEING BATTER BOARD		1	"		1,500		
SCAFFOLDING		48	M^2	150	7,200		
CURING		1	SET		900		
TRANSPORTATION		1	"		3,000		
TEMPORARY BUILDING		1	"		5,000		
TOTAL					19,100		
2. EARTH WORK							
ROOT EXCAVATION		13	M^3	160	2,080		
RUBBLE FOUNDATION		4	"	1,450	5,800		
BACK FILLING		5	"	120	600		
WASTE TREATMENT		4	"	70	280		
TOTAL					8,760		
3. CONCRETE WORK							
FOUNDATION		3.9	M^3	5,810	22,659		
PARQUET CONCRETE		1.6	M^3	9,200	14,720		
BRICK MASONRY		4.2	"	5,740	24,108		
PLASTER PAINTING		84	M^2	280	23,520		
MORTAR		1	SET		1,000		
TOTAL					108,666		
4. WOOD WORK							
WOOD MATERIALS		1.6	M^3	15,000	24,000		
CARPENTER LABORS		1	SET		3,600		
LOUVER WINDOW		3	M^2	4,610	13,820		
DOOR		3.6	"	3,700	13,320		
TOTAL					54,750		
5. ROOFING WORK							

IRON PLATE FLAT SEAM ROOFING	38	M^2	1,060	40,280	
DITTO RIDGE	6	M	500	3,000	
TOTAL				43,280	
6. PAINTING WORK					
PAINTING	27	M^2	260	7,020	
TOTAL				7,020	

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COST OF INSTALLATION WORK SPECIFICATION

Rp. 9,703,000 (¥7,155,000)

7,983,000 DC (5,887,000)
1,720,000 FC (1,268,000)

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. ELECTRIC INSTALLATION WORK								
LIGHTING EQUIPMENT			34	LIGHT	6,960	236,640		
(FL20W PREVENTION OF CRIMES LIGHT, AUTOMATIC SWITCH)								
ELECTRIC WIRE	150		3,240	M	1,315	4,260,600		
"	100		720	"	850	612,000		
"	38		170	"	315	53,550		
"	22		120	"	185	22,200		
"	14		1,560	"	123	191,880		
ELECTRIC POLE								
		12M x 19	35	POLE	24,660	863,100		
ELECTRIC POLE BASE (CONCRETE PRODUCT)			1	SET		232,900		
TRANSFORMER	75 kVA	SCOT TRANS $200^V/200^V/100^V$	1	PIECE		616,500		
GROUNDING			1	SET		41,100		
SUPPLIES MISCELLANEOUS MATERIALS			1	"		94,268		
TRANSPORTATION FEE			1	"		933,941		
LABOR COST			1	"		150,000		400Rp/man x 375 man
						1,219,679 7,089,000	D.C. F.C.	1US$= 415 Rp. 306 YEN
TOTAL						8,308,679		
2. WATER-SUPPLY INSTALLATION WORK								
V.W. PIPE		20A	505	M	69	34,845		
		25A	522	"	96	50,112		
		32A	198	"	123	24,354		
		40A	260	"	178	46,280		
		95A	12	M	521	6,252		
GALVANIZED STEEL PIPE JOINTS			1	SET		72,810		
GATE VALVE		($10kg/cm^2$ 20GV BOX)	16	PIECE	3,014	48,214		
		(25GV ")	6	"	7,534	45,270		

	(32GV ")	1	"		9,453	
	(75GV ")	1	"		21,920	
SUPPLIES MISCELLANEOUS MATERIALS		1	SET		10,900	
TRANSPORTATION FEE (TRANSPORTATION IN THE FARM)		1	"		10,800	
SUB-TOTAL					381,210	F.C.
PIPING COST						
ROOT EXCAVATION BACK FILLING		1,497	M	60	89,820	
TOWER WATER TANK	3 ton	1	PIECE		315,100	
DITTO SILL	10 M	1	"		698,700	
DITTO PROCESSING COST		1	SET		411,000	
(Including installation of water tank)						
TOTAL					1,514,620 500,820 1,395,010	1US$= 415 Rp. 306 YEN

(1) COST OF FARM CONSOLIDATION SPECIFICATION

¥4,590,000

1,870,000 D.C.
2,720,000 F.C.

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. ROAD								
MAIN ROAD		w=2.5m	1,900	M	64.5 43.5	122,550 82,650	1	
LATERAL ROAD		w=1.5m	5,563	"	43.0 29.0	239,209 161,327	2	
FARM ROAD		w=1.0m	3,614	"	32.3 21.8	116,732 78,785	3	
SUB-TOTAL						478,491 322,762		
						801,253		
2. CANAL								
TYPE A			1,413	"	60.8	85,910	4	
TYPE B			3,187	"	19.2	61,170	5	
SUB-TOTAL						147,100		
3. CULVERT								
CAA TYPE			1	PLS	14,950 1,140	14,950 1,140	6	
CAB TYPE			2	"	9,967 644	19,934 1,288	7	
CAC TYPE			1	"	8,014 506	8,014 506	8	
CBA TYPE			6	"	10,186 46	61,116 276	9	
CBB TYPE			2	"	7,394 92	14,788 184	10	
CBC TYPE			2	"	6,162 92	12,324 184	11	
CCA TYPE			6	"	8,124 184	48,744 1,104	12	
CCB TYPE			24	"	5,887 92	141,288 2,208	13	
CCC TYPE			8	"	4,632 46	37,056 368	14	
CCD TYPE			1	"	25,261 920	25,261 920	15	
CCE TYPE			1	"	29,995 1,380	29,995 1,380	16	
SUB-TOTAL						398,534 9,558 408,092		

4. FLASH BOAD WEIR						
WA TYPE	6	PLS	5,006	30,036	17	
WB TYPE	7	"	4,629	32,403	18	
WC TYPE	28	"	3,583	100,324	19	
SUB-TOTAL				162,763		
5. DRAINAGE CULVERT						
D-C-1 TYPE	1	"		49,837	20	
D-C-2 TYPE	1	"		69,765	21	
D-C-3 TYPE	1	"		70,401	22	
SUB-TOTAL				96,378 93,625		
				190,003		
6. BORDER						
EMBANKMENT	9,128	M^3	40	365,120		50,715m x 0.18m^3=
SUB-TOTAL				365,120		
7. LAND LEVELING						
EXCAVATION AND TRANSPORT	74,017	M^3	3 29	222,051 2,146,493		
LEVELING	74,017	"	0 2	148,034		
SUB-TOTAL				222,051 2,294,527		
				2,516,578		
TOTAL				1,870,437 2,720,472		
				4,590,909		
				=4,590,000		
PER 1.0 Ha				51,457	Yen	
				(169,8	$)	
				÷ 170,0	$	

(II)

COST OF LARGE-DEMOFARM SPECIFICATION

¥8,402,000 Yen

5,682,000 D.C.
2,720,000 F.C.

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
(1) COST OF FARM CONSOLIDATION						1,870,000 D.C. 2,720,000 F.C.		4,590,000
(2) COST OF BUILDINGS						3,812,000 D.C.		3,812,000
TOTAL						5,682,000 2,720,000		8,402,000
(1) MAIN ROAD		Per 10.0m						
EXCAVATION AND TRANSPORT			15.0	M^3	3 29	45 435		
EMBANKMENT			15.0	"	40	600		
TOTAL						1,080 645 435		
(2) LATERAL ROAD		Per 10.0m						
EXCAVATION AND TRANSPORT			10.0	"	3 29	30 290		
EMBANKMENT			10.0	"	40	400		
TOTAL						720 430 290		
(3) FARM ROAD		Per 10.0m						
EXCAVATION AND TRANSPORT			7.5	"	3 29	23 218		
EMBANKMENT			7.5	"	40	300		
TOTAL						541 323 218		
(4) CANAL A		Per 10.0m						
EXCAVATION			2.4	M^3	120	288		
EMBANKMENT			8.0	"	40	320		
TOTAL						608		
(5) CANAL B		Per 10.0m						
EXCAVATION			1.0	"	120	120		
EMBANKMENT			1.8	"	40	72		
TOTAL						192		
(6) CULVERT(CAA)								
PASANGAN BATUKALI			1.51	"	4,415	6,666		
REINFORCED CONCRETE			0.488	"	7,110	3,470		
FORM			2.3	M^2	991	2,279		
REINFORCEMENT			0.022	TON	44,454 46,000	978 1,012		
EXCAVATION			9.5	M^3	120	1,140		

BACKFILLING	5.3	M^3	40	212
REMOVAL OF SURPLUS SOIL	4.1	"	50	205
TOTAL				14,950 1,140 16,090

(7) CULVERT(CAB)

PASANGAN BATUKALI	1.06	"	4,415	4,680
REINFORCED CONCRETE	0.28	"	7,110	1,990
FORM	1.5	M^2	991	1,486
REINFORCEMENT	0.014	TON	44,454 46,000	622 644
EXCAVATION	7.2	M^3	120	864
BACKFILLING	4.1	"	40	164
REMOVAL OF SURPLUS SOIL	3.2	"	50	160
TOTAL				9,967 644 10,611

(8) CULVERT(CAC)

PASANGAN BATUKALI	0.85	M^3	4,415	3,752
REINFORCED CONRETE	0.22	"	7,110	1,564
FORM	1.2	M^2	991	1,189
REINFORCEMENT	0.011	TON	44,454 46,000	489 506
EXCAVATION	6.2	M^3	120	744
BACKFILLING	3.5	"	40	140
REMOVAL OF SURPLUS SOIL	2.7	"	50	135
TOTAL				8,014 506 8,520

(9) CULVERT(CBA)

PASANGAN BATUKALI	1.53	"	4,415	6,755
REINFORCED CONCRETE	0.20	"	7,110	1,422
FORM	0.8	M^2	991	793
REINFORCEMENT	0.003	TON	44,454 46,000	44 46
EXCAVATION	7.1	M^3	120	852
BACKFILLING	3.3	"	40	132
REMOVAL OF SURPLUS SOIL	3.8	"	50	190
TOTAL				10,186 46 10,232

(10) CULVERT(CBB)

PASANGAN BATUKALI	1.13	"	4,415	4,989
REINFORCED CONCRETE	0.13	"	7,110	924
FORM	0.5	M^2	991	495
REINFORCEMENT	0.002	TON	44,454 46,000	89 92
EXCAVATION	5.4	M^3	120	648
BACKFILLING	2.6	"	40	104
REMOVAL OF SURPLUS SOIL	2.9	"	50	145
TOTAL				7,394 92 7,486

(11) CULVERT(CBC)				
PASANGAN BATUKALI	0.93	M^3	4,415	4,106
REINFORCED CONCRETE	0.10	"	7,110	711
FORM	0.5	M^2	991	495
REINFORCEMENT	0.002	TON	44,454 46,000	89
EXCAVATION	4.6	M^3	120	552
BACKFILLING	2.1	"	40	84
REMOVAL OF SURPLUS SOIL	2.5	"	50	125
TOTAL				6,162 92 6,254
(12) CULVERT(CCA)				
PASANGAN BATUKALI	1.26	"	4,415	5,562
REINFORCED CONCRETE	0.15	"	7,110	1,065
FORM	0.6	M^2	991	594
REINFORCEMENT	0.004	TON	44,454 46,000	177 184
EXCAVATION	4.4	M^3	120	528
BACKFILLING	2.5	"	40	100
REMOVAL OF SURPLUS SOIL	1.9	"	50	95
TOTAL				8,124 184 8,308
(13) COLVERT(CCB)				
PASANGAN BATUKALI	0.92	"	4,415	4,061
REINFORCED CONCRETE	0.10	"	7,110	711
FORM	0.5	M^2	991	495
REINFORCEMENT	0.002	TON	44,454 46,000	90 92
EXCAVATION	3.2	M^3	120	384
BACKFILLING	1.4	"	40	56
REMOVAL OF SURPLUS SOIL	1.8	"	50	90
TOTAL				5,887 92 5,979
(14) CULVERT(CCC)				
PASANGAN BATUKALI	0.75	M^3	4,415	3,311
REINFORCED CONCRETE	0.08	"	7,110	568
FORM	0.3	M^2	991	297
REINFORCEMENT	0.001	TON	44,454 46,000	44 46
EXCAVATION	2.5	M^3	120	300
BACKFILLING	1.4	"	40	56
REMOVAL OF SURPLUS SOIL	1.1	"	50	55
TOTAL				4,632 46 4,678
(15) CULVERT(CCD)				
PASANGAN BATUKALI	2.95	M^3	4,415	13,024
REINFORCED CONCRETE	0.43	"	7,110	3,057
FORM	1.9	M^2	991	1,883
REINFORCEMENT	0.020	TON	44,454 46,000	889 920

EXCAVATION	10.5	M^3	120	1,260
BACKFILLING	6.1	"	40	244
REMOVAL OF SURPLUS SOIL	4.5	"	50	225
TOTAL				25,261 920 26,181
(16) CULVERT(CCE)				
PASANGAN BATUKALI	4.23	"	4,415	18,675
REINFORCED CONCRETE	0.64	"	7,110	4,550
FORM	3.0	M^2	991	2,973
REINFORCEMENT	0.030	TON	44,454 46,000	1,333 1,380
EXCAVATION	15.0	M^3	120	1,800
BACKFILLING	8.7	"	40	348
REMOVAL OF SURPLUS SOIL	6.3	"	50	315
TOTAL				29,995 1,380 31,375
(17) FLASH BOAD WEA (A)				
PASANGAN BATUKALI	0.57	M^3	4,415	2,516
FORM	2.0	M^2	991	1,982
RIP RAP	0.28	M^3	1,215	340
SHUTTERING BOAD	1.0	UNIT	500	500
EXCAVATION	1.4	M^3	120	168
BACKFILLING	1.0	"	40	40
REMOVAL OF SURPLUS SOIL	0.4	"	50	20
TOTAL				5,006
(18) FLASH BOAD WEA (B)				
PASANGAN BATUKALI	0.50	"	4,415	2,207
FORM	2.0	M^2	991	1,982
RIP RAP	0.2	M^3	1,215	243
SHUTTERING BOAD	1.0	UNIT	500	500
EXCAVATION	1.1	M^3	120	132
BACKFILLING	0.9	M^3	40	36
REMOVAL OF SURPLUS SOIL	0.3	"	50	15
TOTAL				4,629
(19) FLASH BOAD WEA (C)				
PASANGAN BATUKALI	0.21	M^3	4,415	927
FORM	2.0	M^2	991	1,982
RIP RAP	0.09	M^3	1,215	109
SHUTTERING BOAD	1.0	UNIT	500	500
EXCAVATION	0.4	M^3	120	48
BACKFILLING	0.3	"	40	12
REMOVAL OF SURPLUS SOIL	0.1	"	50	5
TOTAL				3,583
(20) DRAINAGE CULVER(D-C-1)				
EXCAVATION	10.4	"	120	1,248

EMBANKMENT		32.6	M^3	40	1,304	
PASANGAN BATUKALI		5.00	"	4,415	22,075	
SAND BED		1.9	"	500	950	
CORRUGATED-PIPE	600ϕ t=2mm	5.0	M	4,830	24,150	F.C.
PIPE LAYING LABOR		1.0	MAN	110	110	
SUB-TOTAL					25,687 24,150	
					49,837	
(21) DRAINAGE CULVERT(D-C-2)						
EXCAVATION		14.7	M^3	120	1,764	
EMBANKMENT		36.6	"	40	1,464	
PASANGAN BATUKALI		7.74	"	4,415	34,172	
SAND BED		2.4	"	500	1,200	
PIPE LAYING LABOR		1.5	MAN	110	165	
CORRUGATED-PIPE	800ϕ t=2mm	5.0	M	6,200	31,000	F.C.
SUB-TOTAL					38,765 31,000	
					69,765	
(22) DRAINAGE CULVER(D-C-3)						
EXCAVATION		10.3	M^3	120	1,236	
EMBANKMENT		97.6	"	40	3,904	
PASANGAN BATUKALI		5.63	"	4,415	24,856	
SAND BED		3.2		500	1,600	
CURRUGATED-PIPE	600ϕ t-2mm	8.0	M	4,830	38,640	
CURRUGATED PIPE LYING		1.5	MAN	110	165	
SUB-TOTAL					31,926 38,640	
					70,401	

(2)

COST OF BUILDINGS SPECIFICATION

¥3,812,000

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. STORAGE HOUSE						1,906,000		
2. GRANARY						1,906,000		
TOTAL						3,812,000		

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STORAGE HOUSE SPECIFICATION

Rp. 2,585,446 (¥1,906,375)

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. TEMPORARY WORK			1	SET		85,200		
2. EARTH WORK			1	"		76,139		
3. CONCRETE WORK			1	"		748,013		
4. WOOD WORK			1	"		779,808		
5. ROOFING WORK			1	"		571,440		
6. PAINTING WORK			1	"		326,700		
TOTAL						2,587,400	1US$= 415 Rp. 306 YEN	
						(1,906,375)	(10,590 YEN/M^2)	
1. TEMPORARY WORK								
LAND CONSOLIDATION			1	SET		9,000		
LEVELING BATTER BOARD			1	"		9,000		
CURING			1	"		5,400		
TRANSPORTATION			1	"		14,400		
TEMPORARY BUILDING			1	"		9,600		
SCAFFOLDING			252	M^2	150	37,800		
TOTAL						85,200		
2. EARTH WORK								
ROOT EXCAVATION			82.8	M^3	160	13,248		
RUBBLE FOUNDATION			12.1	"	1,450	17,539		
SAND LEVELING			36.84	"	1,020	37,576		
BACK FILLING			39.6	"	120	4,752		
WASTE TREATMENT			43.2	"	70	3,024		
TOTAL						76,139		

3. CONCRETE WORK				
FOUNDATION	32.7	M^3	5,810	189,987
PARQUET CONCRETE	18.84	"	9,200	173,328
BRICK MASONRY	13.56	"	5,740	77,834
PLASTER PAINTING	298.8	M^2	280	83,664
FLOOR TILE	180.0	"	1,200	216,000
FIXTURES MORTAR		SET		7,200
TOTAL				748,013
4. WOOD WORK				
WOOD MATERIALS	18.8	M^3	18,000	338,400
CARPENTER LABORS	1	SET		49,320
GLASS WINDOW	45.6	M^2	4,270	194,712
LOUVER WINDOW	21.6	"	4,610	99,576
DOOR	13.2	"	3,700	48,840
NAIL, METALIC MATERIALS	1	SET		36,000
PLINTE	72.0	M	180	12,960
TOTAL				779,808
5. ROOFING WORK				
IRON PLATE FLAT SEAM ROOFING	291.6	M^2	1,800	524,880
DITTO RIDGE	48.0	M	700	33,600
EAVES GUTTER	86.4	"	120	10,368
VERTICAL GUTTER	28.8	"	90	2,592
TOTAL				571,440
6. PAINTING WORK				
PAINTING	360	M^2	260	93,600
CEILING(INDOOR)	180	"	1,100	198,000
" (BACK OF EAVES)	78	"	450	35,100
TOTAL				326,700

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GRANARY SPECIFICATION

Rp. 2,585,446 (¥1,906,375)

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. TEMPORARY WORK			1	SET		85,200		
2. EARTH WORK			1	"		76,139		
3. CONCRETE WORK			1	"		748,013		
4. WOOD WORK			1	"		779,808		
5. ROOFING WORK			1	"		571,440		
6. PAINTING WORK			1	"		326,700		
TOTAL						2,587,400	1US$= 415 Rp.. 306 YEN	
						(1,906,375)	(10,590 YEN/M^2)	

1. TEMPORARY WORK				
LAND CONSOLIDATION	1	SET		9,000
LEVELING BATTER BOARD	1	"		9,000
CURING	1	"		5,400
TRANSPORTATION	1	"		14,400
TEMPORARY BUILDING	1	"		9,600
SCAFFOLDING	252	M^2	150	37,800
TOTAL				85,200
2. EARTH WORK				
ROOT EXCAVATION	82.8	M^3	160	13,248
RUBBLE FOUNDATION	12.1	"	1,450	17,539
SAND LEVELING	36.84	"	1,020	37,576
BACK FILLING	39.6	"	120	4,752
WASTE TREATMENT	43.2	"	70	3,024
TOTAL				76,139
3. CONCRETE WORK				
FOUNDATION	32.7	M^3	5,810	189,987
PARQUET CONCRETE	18.84	"	9,200	173,328
BRICK MASONRY	13.56	"	5,740	77,834
PLASTER PAINTING	29.88	M^2	280	83,664
FLOOR TILE	180.0	"	1,200	216,000
FIXTURES MORTAR		SET		7,200
TOTAL				748,013
4. WOOD WORK				
WOOD MATERIALS	18.8	M^3	18,000	338,400
CARPENTER LABORS	1	SET		49,320
GLASS WINDOW	45.6	M^2	4,270	194,712
LOUVER WINDOW	21.6	"	4,610	99,576
DOOR	13.2	"	3,700	48,840
NAIL, METALIC MATERIALS	1	SET		36,000
PLINTE	72.0	M	180	12,960
TOTAL				779,808
5. ROOFING WORK				
IRON PLATE FLAT SEAM ROOFING	291.6	M^2	1,800	524,880
DITTO RIDGE	48.0	M	700	33,600
EAVES GUTTER	86.4	"	120	10,368
VERTICAL GUTTER	28.8	"	90	2,592
TOTAL				571,440
6. PAINTING WORK				
PAINTING	360	M^2	260	93,600
CEILING(INDOOR)	180	"	1,100	198,000
" (BACK OF EAVES)	78	"	450	35,100
TOTAL				326,700

(III) UNIT COST

Description of Items	Material	Size	Quantity	Unit	Unit Price	Cost	No.	Remark
1. EXCAVATION (NORMAL SOIL)								
EARTH WORK			0.75	MAN	120	90		
SUPERINTENDENT			0.025	"	150	3		
GENERAL EXPENSES						27		30% OF ABOVE AMOUNT
TOTAL						120		
2. EXCAVATION (SOLID SOIL)								
EARTH WORK			1.0	MAN	120	120		
SUPERINTENDENT			0.33	"	150	4		
GENERAL EXPENSES						36		30% OF ABOVE AMOUNT
TOTAL						160		
3. EXCAVATION(SILTY MUD, DEPTH 1.0m)								
EARTH WORK			1.50	MAN	120	180		
SUPERINTENDENT			0.05	"	150	7		
GENERAL EXPENSES						58		30% OF ABOVE AMOUNT
TOTAL						245		
4. SOIL HAULING(DISTANCE 30m)								
EARTH WORK			0.33	"	120	39		
SUPERINTENDENT			0.01	"	150	1		
GENERAL EXPENSES						10		30% OF ABOVE AMOUNT
TOTAL						50		
5. SOIL HAULING (DISTANCE 75m)								
K						65		K=120/275x(L+75)
GENERAL EXPENSES						20		30% OF ABOVE AMOUNT
TOTAL						85		
6. EXCAVATION (DEPTH 1.0m MORE)			0.15	MAN	120	18		
EARTH WORK			0.0075	"	150	1		
SUPERINTENDENT						6		30% OF ABOVE AMOUNT
GENERAL EXEPNSES						25		
TOTAL						50		
7. FILLING (INCLUDING CONPACTION)								
EARTH WORK			0.25	"	120	30		
SUPERINTENDENT			0.01	"	150	1		
GENERAL EXPENSES						9		30% OF ABOVE AMOUNT
TOTAL						40		

8. SODDING				
EARTH WORK	0.15	MAN	120	18	
SUPERINTENDENT	0.01	"	150	1	
GENERAL EXPENSES				6	30% OF ABOVE AMOUNT
TOTAL				25	
9. SOD HAULING				5	
10. MASONRY (FOR ROAD)					
QUARRY STONE	1.20	M^3	950	1,140	
EARTH WORK	0.30	MAN	120	36	
SUPERINTENDENT	0.15	"	150	22	
GENERAL EXPENSES				17	30% OF ABOVE AMOUNT
TOTAL				1,215	
11. PASANGAN (1:4)					
RUBBLE STONE	1.20	M^3	950	1,140	
P.C.	0.958	DRUM	2,190	2,098	
SAND	0.522	M^3	510	266	
MASON	1.20	MAN	180	216	
SUPERINTENDENT	0.12	"	220	26	
EARTH WORK	3.60	"	120	432	
SUPERINTENDENT	0.18	"	150	27	
GENERAL EXPENSES				210	30% OF ABOVE AMOUNT
TOTAL				4,415	
12. PLASTER (1:3)					
P.C.	0.048	DRUM	2,190	105	
SAND	0.0194	M^3	510	9	
MASON	0.20	MAN	180	36	
SUPERINTENDENT	0.02	"	220	4	
ASSISTANT OF DRIVER	0.40	MAN	120	48	
SUPERINTENDENT	0.02	"	150	3	
GENERAL EXPENSES				25	30% OF ABOVE AMOUNT
TOTAL				230	
13. FOUNDATION CONCRETE (1:2$\frac{1}{2}$)					
P.C.	0.031	DRUM	2,190	67	
SAND	0.0085	M^2	510	4	
MASON	0.12	MAN	180	21	
EARTH WORK	0.35	"	120	42	
SUPERINTENDENT	0.01	"	220	2	
SUPERINTENDENT	0.02	"	150	3	
GENERAL EXPENSES				21	30% OF ABOVE AMOUNT
TOTAL				160	

14. CONCRETE (1:2:3)					
RUBBLE STONE	0.32	M^3	1,460	467	
SAND	0.54	"	510	275	
P.C.	2.00	DRUM	2,190	4,380	
EARTH WORK	6.00	MAN	120	720	
SUPERINTENDENT	0.30	"	150	45	
MASON	1.00	"	180	180	
GENERAL EXPENSES				283	30% OF ABOVE AMOUNT
TOTAL				6,350	
15. MASONRY (1:3)					
RUBBLE STONE	1.20	M^3	950	1,140	
P.C.	1.191	DRUM	2,190	2,608	
SAND	0.186	M^3	510	94	
LAVORS		MAN		913	C.F. NO.11
TOTAL				4,755	
16. PITCHING (1:4)					
RUBBLE STONE	1.50	M^3	950	1,425	
P.C.	0.950	DRUM	2,190	2,098	
SAND	0.522	M^3	510	266	
MASON	1.20	MAN	180	216	
SUPERINTENDENT	0.12	"	220	26	
EARTH WORK	3.60	"	120	432	
SUPERINTENDENT	0.18	"	150	27	
GENERAL EXPENSES				211	30% OF ABOVE AMOUNT
TOTAL				4,235	
17. REINFORCED CONCRETE				24,765	(NO. 18+19+20)
18. CONCRETE					
CRUSHED STONE	0.82	M^3	1,460	1,197	
SAND	0.54	"	510	275	
P.C.	2.00	DRUM	2,190	4,380	
EARTH WORK	6.00	MAN	120	720	
SUPERINTENDENT	0.30	"	150	45	
MASON	1.00	"	180	180	
SUPERINTENDENT	0.10	"	220	22	
GENERAL EXPENSES				29	30% OF ABOVE AMOUNT
TOTAL				7,110	
19. REINFORCING BAR					
REINFORCEMENT	110.0	Kg	80	8,800	
TIE-REINFORCEMENT	2.00	"	260	520	
REINFORCEMENT WORKS	9.00	MAN	180	1,620	
SUPERINTENDENT	3.00	"	220	660	
EARTH WORK	9.00	"	120	1,080	
GENERAL EXPENSES				1,010	30% OF ABOVE AMOUNT
TOTAL				13,690	

20. FORM					
CARPENTER	5.00	MAN	180	900	
SUPERINTENDENT	0.50	"	220	110	
EARTH WORK	2.00	"	120	240	
SUPERINTENDENT	0.10	"	150	15	
LUMBER	0.40	M^3	4,750	1,900	
NAIL	4.00	Kg	80	320	
EARTH WORK	4.00	MAN	120	480	
TOTAL				3,965	
21. FOUNDATION OF FINE AGGREGATE (INCLUDING SMALL HAULING)					
SAND	1.20	M^3	400	480	
EARTH WORK	0.375	MAN	120	45	
SUPERINTENDENT	0.199	"	150	29	
GENERAL EXPENSES				26	30% OF ABOVE AMOUNT
TOTAL				580	
22. GRAVEL FILLING					
CRUSHED STONE	1.20	M^3	950	1,140	
EARTH WORK	0.30	MAN	120	36	
SUPERINTENDENT	0.15	"	150	22	
GENERAL EXPENSES				17	30% OF ABOVE AMOUNT
TOTAL				1,215	
23. ASPHALT (DEPTH 3m 100m^2)					
BALLAST	4.0	M^3	1,900	7,600	
SAND	2.0	"	400	800	
ASPHALT	1000.00	Kg	20	20,000	
ASPHALT EMULSION	20.0	L	40	800	
EARTH WORK	6.0	DRUM	80	480	
EARTH WORK	20.0	MAN	120	2,400	
SUPERINTENDENT	1.00	"	150	150	
DRIVER	1.00	"	150	150	
LABOR	1.00	MAN	120	120	
EARTH WORK	1.00	"	120	120	
GENERAL EXPENSES				880	30% OF ABOVE AMOUNT
TOTAL				33,500	
* ASPHALT (DEPTH 8cm Per m^2)				237	
24. PITCHING Per m^2, DEPTH 15cm)					
CRUSHED STONE	0.20	M^3	1,170	234	
SAND	0.05	M^3	400	20	
EARTH WORK	0.375	MAN	120	45	
SUPERINTENDENT	0.019	"	290	5	
GENERAL EXPENSES				16	30% OF ABOVE AMOUNT
TOTAL				320	

* PITCHING (Per m^2, DEPTH 20cm)				425	
25. FILLING OF SMALL CRUSHED STONE (DEPTH 6cm, Per 100m^2)					
CRUSHED STONE	8.00	M^3	1,460	11,680	
SAND	2.00	"	400	800	
EARTH WORK	7.50	MAN	120	900	
SUPERINTENDENT	0.375	"	150	56	
GENERAL EXPENSES				1,964	2/75 x NO.26
TOTAL				15,400	
26.					
OPERATOR	30.00	MAN	150	4,500	
OPERATOR ASSISTANT	30.00	"	110	3,300	
WATER HAULING WORK	30.00	MAN	110	3,300	
EARTH WORK	150.00	"	110	16,500	
SPRAY WORK	60.00	"	110	6,600	
GASOLINE	1200.00	L	20	24,000	
ENGINE OIL	20.00	L	130	2,600	
SUPERINTENDENT	8.00	MAN	150	1,200	
GREASE	5.00	Kg	220	1,100	
GENERAL EXPENSES				10,620	30% OF ABOVE AMOUNT
TOTAL				73,720	
27. SURFACE SOIL REMOVING WITH BULLDOZER (11 TON CLASS)					
WORKING LENGTH L=30M					
Q=QxfxE=64 x 0.9 x 0.926 = 53.3 M^3/Hr					E=E1 x E2 x E3 x E4 = 10x10x0.85x1.09=0.926
PER DAY 5 Hr. x 53.3 = 266M^3/DAY					
COST OF FUEL	10.5	ℓ	11	116	
OTHER MATERIAL	1			35	x 0.3 =
DRIVER	0.168	MAN	220	37	
DRIVER ASSISTANT	0.168	"	110	18	
SUB-TOTAL				206	F.C.
REPAIRING COST				1,755	
SUB-TOTAL				1,755	
TOTAL				1,961	
PER 1M^3	206/53.3			4	D.C.
"	1,755/53.3			33	F.C.

28. EXCAVATION AND TRANSPORT OF EARTH WITH BULLDOZER (11 TON CLASS)

WORKING LENGTH L=95M

Q=QxfxE= 22 x 0.9 x 0.926 = 18.3M^3/Hr.

E=E1 x E2 x E3 x E4
=1.0x1.0x0.85x1.09=0.926

PER DAY 5 Hr. x 15.3 = 91.7M^3/DAY

COST OF FUEL	10.5	ℓ	11	116	
OTHER MATERIALS	1.0			35	116 x 0.3 =
DRIVER	0.168		220	37	$\frac{25\ DAY}{30\ DAY \times 5\ Hr.} = 0.168$
DRIVER ASSISTANT	0.168		110	18	"
SUB-TOTAL				206	F.C.
REPAIRING COST				1,755	
SUB-TOTAL				1,755	
TOTAL				1,961	
PER 1M^3	206/15.3			13	D.C.
"	1,755/15.3			115	F.C.

29. LAND LEVELING WITH BULLDOZER (11 TON CLASS)

S = So x E So = 520.2 x W W = B-0.30

W = 3.35-0.30 = 3.05m

So = 520.2 x 3.05 = 1,586.6 E = 0.8

S = 1,586.6 x 0.8 = 1,269.3

TOTAL					
PER 1.0m^3	206/1,269.3	0.16	≒	0	D.C.
"	1,755/1,269.3	1.38	≒	2	F.C.

30. EXCAVATION TRENCH WITH BUCKHOW (0.35M^3 CLASS)

$$Q = \frac{3600 \times q \times f \times E}{Cm} = \frac{3600 \times 0.31 \times 1.0 \times 0.5}{33} = 16.9m^3/Hr.$$

q = qo x K = 0.35 x 0.88 = 0.31

f = 1.0 E = 0.5 Cm = 0.067ϕ + 24 ϕ = 135°

= 33 SEC.

COST OF FUEL	6.0	ℓ	11	66	
OTHER MATERIALS	1			20	x 0.3 =
DRIVER	0.168	MAN	220	37	
DRIVER ASSISTANT	0.168	"	110	18	
SUB-TOTAL				141	
REPAIRING COST				1,729	
TOTAL				1,870	
PER 1.0M^3	141/16.9			8	D.C.
"	1,729/16.9			102	F.C.

31. LOADING WITH TRUCKTOR SHOVEL ($0.4m^3$ CLASS)

$$Q = \frac{3600 \times q \times f \times E}{Cm} = \frac{3600 \times 0.30 \times 0.9 \times 0.5}{42} = 23.2m^3/Hr.$$

$qo = 0.4m^3$ $K = 0.75$ $q = qo \times K = 0.30$

$Cm = 42$ SEC. $f = 0.9$ $E = 0.5$

COST OF FUEL	2.5		11	28	
OTHER MATERIAL	1			8	30% OF ABOVE
DRIVER	0.167	MAN	220	37	
DRIVER ASSISTANT	0.167	"	110	18	
SUB-TOTAL				91	
REPAIRING COST				1,972	
TOTAL				2,063	
PER $1.0m^3$	91/23.2			4	
"	1,972/23.2			85	

32. CARRING WITH 4.0 TON DUMPTRUCK

WORKING LENGTH $L = 500m$

$$Q = \frac{60 \times q \times f \times E}{Cm} = \frac{60 \times 2.2 \times 0.9}{11} = 8.64m^3/Hr.$$

$q = T/W = 4/1.8 = 2.2$ $f = 0.9$ $E = 0.8$

$Cm = 11.0$ ($L = 500m$)

COST OF FUEL	4.0	ℓ	11	44	
OTHER MATERIALS	1.0			13	30% OF ABOVE
DRIVER	0.139	MAN	220	31	$t = \frac{200 \times 7}{235} = 6.0$ $0.833/6 = 0.139$
SUB-TOTAL				88	
REPAIRING COST	1.0	Hr.		560	
TOTAL				648	
PER $1.0m^3$	88/8.64			10	D.C.
"	560/8.64			65	F.C.

33.1 LEVERING AND SOIL COMPACTION WITH BULLDOZER

$$Q1 = \frac{60 \times V \times W \times D \times E}{N} = \frac{60 \times 67 \times 0.7 \times 0.15 \times 0.7}{6} = 49.2m^3/Hr.$$

$V = 67m/min.$ $W = 0.7$ $D = 0.15$ $E = 0.7$ $N = 6$

$Q2 = 10E(10D+8) = 10 \times 0.75 \times (10 \times 0.15 + 8) = 71.3m^3/Hr.$

$$Q = \frac{Q1 \times Q2}{Q1 + Q2} = \frac{49.2 \times 71.3}{49.2 + 71.3} = 29.1m^3/Hr.$$

33.2 PER $1.0m^3$	206/29.1			7	
"	1,755/29.1			60	

SOIL COMPACTION WITH RAMMER

GASOLINE	0.55	ℓ	26	14	
OTHER MATERIALS	1.0			4	30% OF ABOVE AMOUNT
DRIVER	0.143	MAN	200	28	1.0 man/7 Hr. = 0.143
SUB-TOTAL				46	

REPAIRING COST		1.0	Hr.	70	70	495/7 = 70
TOTAL					116	

$$V = \frac{60 \times A \times D \times f \times E}{N} = \frac{60 \times 1.8 \times 0.15 \times 0.9 \times 0.86}{4} = 3.14 m^3/Hr.$$

nd = 60 time/min. $A = nd \times a = 60 \times 0.03 m^2 = 1.8$

D = 0.15cm f = 0.90 $E = E1 \times E2 = 0.9 \times 0.95$

N = 4 $= 0.86$

PER $1.0m^3$		46/3.14			15	D.C.
"		70/3.14			22	F.C.

34. PIPE LYING	(150ϕ)					
EXCAVATION		13.5	M^3	120	1,620	0.6 x 0.45 x 50 = 13.5
BACK FILLING		12.5	"	40	500	
LAYING	LABOR	1.0	MAN	110	110	
	TECHNICIAN	1.6	"	180	288	
TOTAL					2,518	
PER	1.0m	2,518/50			50	

35. PIPE LYING	(125ϕ)					
EXCAVATION		12.3	M^3	120	1,476	0.57 x 0.43 x 50 = 12.3
BACK FILLING		12.0	"	40	480	
LAYING	LABOR	0.6	MAN	110	66	
	TECHNICIAN	1.2	"	180	216	
TOTAL					2,238	
PER	1.0m	2,238/50			45	

36. SLUICE VALVE BOX PER 1.0 PLACE					
PASANGAN BATUKALI	0.55	M^3	4,415	2,428	
CONCRETE	0.013	"	6,350	83	
FORM	0.35	M^2	991	346	
EXCAVATION	1.86	M^3	120	223	
BACK FILLING	1.25	"	40	50	
TOTAL				3,130	

37. HYDRANT (FOR PADDY FIELD)						
CONCRETE		0.016	"	4,415	20	
FORM		0.16	M^2	991	158	
POLY VINYL CHLORIDE PIPE	ϕ300 L=0.35	1.0	PC	800	800	
TOTAL					1,028	

HYDRANT (FOR UPLAND FIELD)

CONCRETE	0.084	M^3	4,415	371
FORM	1.3	M^2	991	1,288
EXCAVATION	0.36	M^3	120	43
BACK FILLING	0.24	"	40	10
TOTAL				1,712

38. EXCAVATION AND TRANSPORT OF EARTH WITH BULLDOZER (15 TON CLASS)

WORKING LENGTH L = 30M

$Q = Q' \times f \times E = 91 \times 0.9 \times 0.926 = 75.8 M^3/Hr.$

PER DAY 5 Hr. x 75.8 = $379 M^3/Hr.$

THIS IS BLADE RATIO
101 x 0.9 = 91
E = E1 x E2 x E3 x E4
= 1.0x1.0x0.85x1.09=0.926

COST OF FUEL	12.0 ℓ	11	132	
OTHER MATERIALS	1.0		40	132 x 0.3 =
DRIVER	0.168	220	37	25 day/30 day = 0.833 0.833/5 Hr. = 0.168
DRIVER ASSISTANT	0.168	110	18	" "
SUB-TOTAL			227	F.C.
PREPAIRING COST			2,211	
SUB-TOTAL			2,211	
TOTAL			2,438	

PER	$1M^3$	227/75.8	3	D.C.
"	"	2,211/75.8	29	F.C.

39. LAND LEVELING WITH BULLDOZER (15 TON CLASS)

$S = So \times E$ $So = 520.2 \times W$ $W = B - 0.30$

$W = 3.24 - 0.30 = 29.4m$

$So = 520.2 \times 2.94 = 1,529.4 m^3$ $E = 0.8$

$S = 1,529.4 \times 0.8 = 1,223.5 m^3$

TOTAL

PER	$1.0M^3$	227/1,223.5	0.18	≒ 0	D.C.
"	"	2211/1,223.5	1.82	≒ 2	F.C.

(IV) CALCULATION OF MATERIALS

DAM BODY

Station	Distance	Excavation			Embankment			Surface Soil Removing		
		Section	Average Section	Volume	Section	Average Section	Volume	Section	Average Section	Volume
	(m)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)
No. 1										
+17.65		0.00			3.17			3.43		
+28.30	10.65	6.00	3.00	31.95	15.22	9.20	97.98	4.00	3.72	39.62
+40.50	12.20	6.00	6.00	73.20	30.16	22.69	276.82	5.14	4.57	55.75
+46.11	5.61	6.00	6.00	33.60	45.45	37.81	212.11	6.09	5.62	31.58
+71.22	53.89	6.00	6.00	323.34	78.94	78.94	425408	7.76	7.76	418.19
No.2		6.00			59.69			6.85		
+ 2.75	2.75	6.00	6.00	16.50	53.32	56.51	155.40	6.52	6.69	18.40
+19.20	16.45	6.00	6.00	98.70	19.30	-	-	4.34	5.43	89.32
+41.65	22.45	0.00	3.00	67.35	3.17	11.24	252.23	3.43	3.89	87.33
Total				644.70			5248.62			740.19

SURFACE SOIL REMOVING OF BORROW-PIT

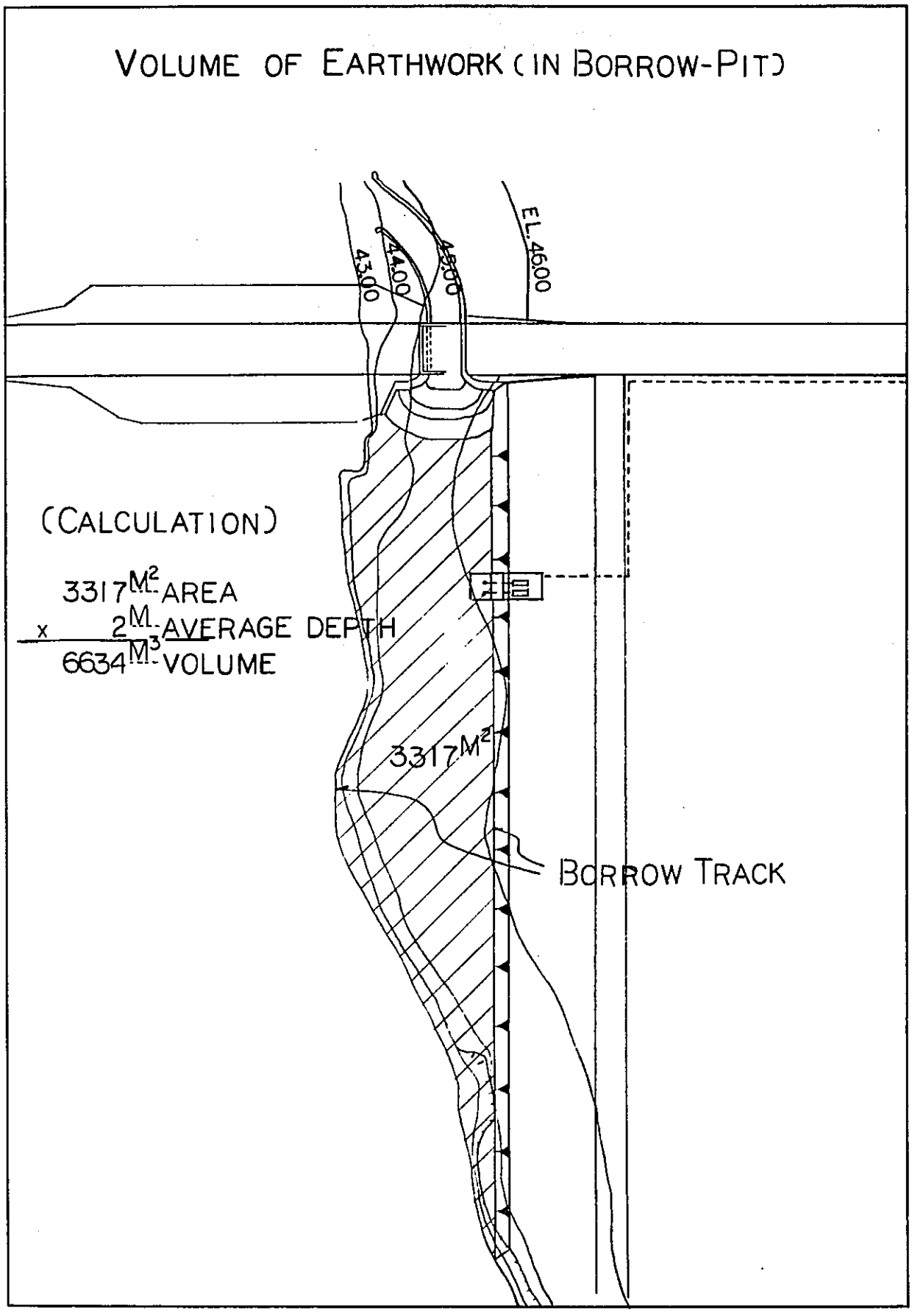
$2,400^{m^2} \times 0.2 = 480^{m^3}$

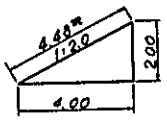
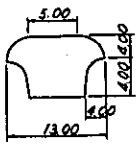
TOTAL OF SURFACE SOIL REMOVING

$740 + 480 = 1,220\ m^3$

SPILL WAY

Station	Distance	Excavation			Embankment			Surface Soil Removing		
		Section	Average Section	Volume	Section	Average Section	Volume	Section	Average Section	Volume
	(m)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)
+30.00		7.64			0.00					
+20.00	10.00	17.48	12.56	125.60	0.00					
+10.00	10.00	20.68	19.08	190.80	0.00					
No.0	10.00	9.60	15.14	151.40	0.00					
-10.00	10.00	31.50	31.50	315.00	13.75	13.75	13.75			
-13.00	3.00	18.34	24.92	74.76	2.46	8.11	24.33			
-17.00	4.00	11.99	15.17	60.68	1.28	1.87	7.48			
-19.00	2.00	18.28	15.14	30.28	0.00	0.64	1.28			
-23.00	4.00	46.50	32.39	129.56	0.00					
Total				1,078.08			170.59			

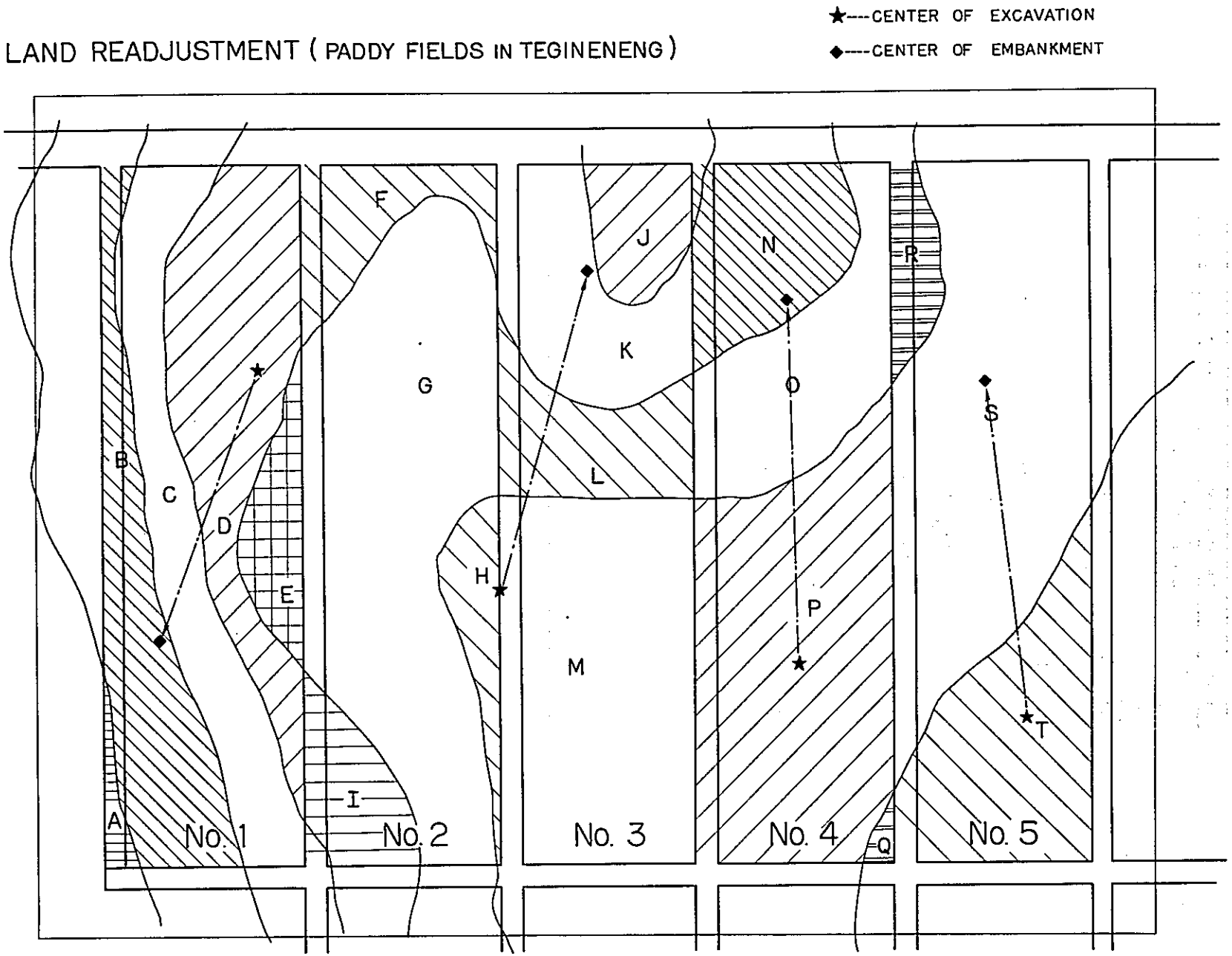

VOLUME OF EARTHWORK (IN BORROW-PIT)
EL. 46.00
45.00
44.00
43.00
(CALCULATION)
3317 M² AREA
x 2 M. AVERAGE DEPTH
6634 M³ VOLUME
3317 M²
BORROW TRACK

Kinds	Calculated Process	Unit Quantities width (m)	Unit Quantities length (m)	Total	Remarks
STONE PITCHING AREA					
(i) INLET					
a. SLOPE OF UPSTEAM SIDE		m 4.48	m 25.00	112.00	
b. DAMSITE		3.20	10.00	32.00	
	$\frac{4.00 + 2.40}{2} = 3.2$				
c. CREST		2.00	21.85	44.00	
d. BED OF APPROACH					
	A = 13.00 x 8.00 -4.00^{2}x2			72.00	
e. TRANSITION OF DAM		1.00	7.83	8.00	
f. SLOPE OF APPROACH		2.23	12.57	28.00	
			SUBTOTAL	296.00	
(ii) CANAL					
a. BED OF CANAL	6.00 x 25.9 + 4.00 x 8.00 x 1/2 + (4.50 + 3.00) x 1/2 x 6.50			195.00	
b. SLOPE OF CANAL	1.50 x $\frac{\sqrt{5}}{2}$ x (25.9 x 2 + 6.30)			97.00	
			SUBTOTAL	292.00	
	TOTAL			588.00 m^2	

Kinds	Calculated Process	Unit Quantities	Total	Remarks
CORSSING BRIGE (H-BEAM)				
1. H-BEAM	H-596 x 199 x 10 x 15 L = 9.00^{M} N=5			
	9.00x(5x94.6 kg/m =		4,257 kg	
SS-41H.	90 x 9 x 556 N=30			
	3.61^{kg} x 30 =		108 kg	
SS-41 B.N	M22 x 60 N=120	(H-BEAM)	63 kg	
SS41- C	300 x 90 x 9 L=26.388^{M}			
	26.388 x 34.6 kg =		9,130 kg	
SS41- E.	170 x 9 x 230 N=16			
	3,964^{kg} x 16 =		63 kg	
SLAB PLATE	570 x 3.2 L=10.00^{M} N=16			
	20.8^{kg} x 10 x 16 =		3,328 kg	
SS41-B.N	M25 x 460 N-20			ANCHOR BDLT
	1.88 x 20 =		38 kg	
SS41-B.N	ϕ 19 x 55 N=160			
	0.231^{kg}x 160 =		37 kg	
SS41-B.N	ϕ 19x45 N-495			
	0.290^{kg} x 495 =		144 kg	
FORM PLATE	455 x 3.2 x 2.250 N=8			(SS41)
	25.72 ^{kg} x 8 =		206 kg	
SS41-H.	100 x 3.2 x 350 N =6			
	088 x 6 =		5 kg	
SS41-B.N	ϕ 16 x 30 N=64			
	0.16 ^{kg} x 64 =		10 kg	
SS41-B.N	ϕ 16 x 30 N=36			(FOR JOINT)
	0.16^{kg}x 36 =		6 kg	
FORM PLATE (WOOD FORM)				
	{0.58 x (9.3 + 0.7)-(0.58x			
	5 x 0.199)}+ (0.2 x 9) x2 =		14.04 $^{m^2}$	
SPACER	ϕ 90 x 15 N=60			
GUARD RAIL	L = 9.00^{M} N=2			
REINFORCE-MENT	1 D16 L=9.8^{M} ℓ=0.44^{M} N=12			
	W = 12 x 10.24 x 1.56		192 kg	
	2 D10 L=0.86^{M} N=82			
	W = 0.86 x 82 x 0.56=		40 kg	
	3 D13 L=880^{M} ℓ=0.35^{M} N=10			
	W = 9.15x10x0.995		91 kg	

Kinds	Calculated Process	Unit Quantities	Total	Remarks
	4 D10 L=1.22M N=72			
	W=1.22x72x0.56=		49kg	
REINFORCE-MENT NET	ϕ 6 x 150 x 150			
	10.0 x 9.0 =		90 mc	
CONCRETE				
CONCRETE FOR PAVING	V = 0.05 x 9.30 x 9.0 =		4.20 m^3	
	V_1= 0.162x 9.3 x (9.0-1.0) = 12.05			
	V_2= 9.3x0.5x(0.162+0.06) x 2 = 2.06			
	V_2 = 0.014 x 9.3 = 0.13			
	V_4 = 0.35x0.30x9.0=0.95		15.19 m^3	
JOINT FILLER	t = 20 m/m			
	0.15x10.0x2=		2.30 m^2	
DRAINAGE OUTLET(VP)	ϕ 75 x 700 N=4			
	4 x 0.7 =		2.80 m	
RUBBER SHOE	250 x 200 x 46 N-10			
	3.2 kg x 10 =		32 kg	
PASANGAN BATUKALI	(2 ABUTMENT)			
	{ (3.87x1.00)+(3.87+1.10)x 1/2 x 1.70 + (0.80x0.600)} 10.00x2 =		171.40 m^3	

LAND READJUSTMENT (PADDY FIELDS IN TEGINENENG)



PADDY FIELD	EARTH WORK	AVERAGE DISTANCE
	m^3	m
No. 1	2,650	83.00
No. 2, No. 3	3,970	96.00
No. 4	2,360	105.00
No. 5	1,590	97.00
TOTAL	10,570	

NO. 1 PADDY FIELD

	Exist			Prop	Excavation (-)			Embankment (+)		
No.	Area (A)	Elev.(B)	(A)x(B)	Elev.	Area	Height	Vol.(m^3)	Area	Height	Vol.
	m^2	m	m^3	m	m^2	m	m^3	m^2	m	m^3
E	1,107.00	48.25	53,412.75	47.36	407.00	0.89	985.23			
D	4,257.00	47.75	203,771.75	47.36	4,257.00	0.39	1,660.23			
C	3,487.00	47.25	164,760.75	47.36				3,487.00	0.11	383.57
B	3,210,00	46.77	150,131.70	47.36				3,210.00	0.59	1,893.90
A	273,00	46.00	12,558,00	47.36				273.00	1.36	371.28
	m^2		m^3				m^3			m^3
Total	12,334.00		584,134.95				2,645.46			2,648.75

EL. PROPOSAL = $\frac{584,134.95}{12,344.00} = 47.36^{m}$

NO.2 PADDY FIELD

	Exist			Prop	Excavation (-)			Embankment (+)		
No.	Area (A)	Elev.(B)	(A)x(B)	Elev.	Area	Height	Vol.(m^3)	Area	Height	Vol.
	m^2	m	m^3	m	m^2	m	m^3	m^2	m	m^3
H	940.00	48.50	45,590.00	48.17	940.00	0.33	310.20			
G	8,253.00	48.25	398,707.25	48.17	8,253.00	0.08	660.24			
F	1,483.00	48.00	71,184.00	48.17				1,483.00	0.17	252.11
I	1,283.00	47.75	61,263.25	48.17				1,283.00	0.42	538.86
	m^2		m^3				m^3			m^3
Total	11,959.00		576,244.50				970.44			790.97

EL. AVE = $\frac{576,244.50}{11,959.00} = 48.185^{m}$ EL. PROPOSAL = $\frac{48.185+48.155}{2} = 48.17^{m}$

NO. 3 PADDY FIELD

No.	Exist Area (A) m^2	Elev.(B) m	(A)x(B) m^3	Prop Elev. m	Excavation (-) Area m^2	Height m	Vol (m^3)	Embankment (+) Area m^2	Height m	Vol m^3
M	6,195.00	48.63	301,262.85	48.17	6,195.00	0.46	2,849.70			
L	1,870.00	48.25	90,227.50	48.17	1,870.00	0.08	149.60			
K	2,723.00	47.50	129,342.50	48.17				2,723.00	0.67	1,824.41
J	1,160.00	47.00	54,520.00	48.17				1,160.00	1.17	1,357.20
Total	m^2 11,948.00		m^3 575,352.85				m^3 2,999.30			m^3 3,181.61

EL. AVE = $\frac{575,352.85}{11,948.00}$ = 48,155^m EL. PROPOSAL = $\frac{48,185 + 48,155}{2}$ = 48.170^m

NO. 4 PADDY FIELD

No.	Exist Area (A) m^2	Elev.(B) m	(A)x(B) m^3	Prop Elev. m	Excavation (-) Area m^2	Height m	Vol.(m^3)	Embankment (+) Area m^2	Height m	Vol. m^3
Q	100.00	49.00	4,900.00	48.41	100.00	0.59	59.00			
P	6,737.00	48.75	328,428.75	48.41	6,737.00	0.34	2,290.58			
O	2,973.00	48.25	143,447.25	48.41				2,973.00	0.16	475.68
N	2,727.00	47.72	130,132.44	48.41				2,727.00	0.69	1,881.63
Total	m^2 12,537.00		m^3 606,908.44				m^3 2,349.58			m^3 2,357.31

EL. PROPOSAL = $\frac{606,908.44}{12,537.00}$ = 48,409^m

NO. 5 PADDY FIELD

No.	Exist Area (A) m^2	Elev.(B) m	(A)x(B) m^3	Prop Elev. m	Excavation (-) Area m^2	Height m	Vol.(m^3)	Embankment (+) Area m^2	Height m	Vol. m^3
T	3,706.00	49.33	182,816.98	48.91	3,706.00	0.42	1,556.52			
S	7,558.00	48.75	368,452.50	48.91				7,558.00	0.16	1,209.28
R	713.00	48.38	34,494.94					713.00	0.53	377.89
Total	m^2 11,977.00		m^3 585,764.42				m^3 1,556.52			m^3 1,587.17

EL. PROPOSAL = $\frac{585,764.42}{11,977.00}$ = 48,907^m

Station	Distance	Excavation			Embankment			Surface Soil Removing		
		Section	Average Section	Volume	Section	Average Section	Volume	Section	Average Section	Volume
	(m)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)
1. MAIN ROAD-1 (B=10.00m)										
No. 2 +17.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
+41.65	24.20	-	-	-	14.48	12.24	296.21			
+55.00	13.35	-	-	-	8.76	11.62	155.13			
+81.00	26.00	-	-	-	7.50	8.13	211.38			
No. 3	19.00	-	-	-	8.65	8.08	153.52			
+50.00	50.00	-	-	-	11.78	10.22	511.00			
No. 4	50.00	-	-	-	23.19	17.49	874.50			
+25.00	25.00	-	-	-	20.97	22.08	552.00			
+50.00	25.00	-	-	-	12.68	16.83	420.75			
+89.00	39.00	-	-	-	7.83	10.26	400.14			
No. 5	11.00	-	-	-	5.81	6.82	75.02			
+50.00	50.00	-	-	-	2.98	4.40	220.00			
No. 6	50.00	0.36	0.18	9.00	0.00	1.49	74.50			
No. 7 +63.00	16300	0.36	0.36	58.68	0.00	-	0.00			
Total	545.55			67.68			3,944.15			

Station	Distance	Excavation			Embankment			Surface Soil Removing		
		Section	Average Section	Volume	Section	Average Section	Volume	Section	Average Section	Volume
	(m)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)
2. FARM ROAD-7 (B=6.00M)										
No.0	0.00	0.50	0.25	0.00	20.06	10.03	0.00			
+12.50	12.50	0.50	0.50	6.25	12.86	16.46	205.75			
+43.00	30.50	0.50	0.50	15.25	8.60	10.73	327.27			
+69.00	26.00	0.50	0.50	13.00	6.88	7.74	201.24			
+95.00	26.00	0.50	0.50	13.00	4.06	5.47	142.22			
No. 1 +17.00	22.00	0.50	0.50	11.00	1.34	2.70	59.40			
No. 2 +27.00	11000	0.50	0.50	55.00	1.04	1.19	130.90			
No. 3 + 5.00	78.00	1.17	0.84	65.52	0.18	0.61	97.58			
Total				179.02			1,114.36			
3. FARM ROAD-1 (B=6.00m)										
No.00	0.00	0.10	0.05	0.00	2.89	1.45	0.00			
+34.00	34.00	0.10	0.10	3.40	2.64	2.79	94.86			
+97.00	63.00	0.10	0.10	6.30	2.89	2.77	174.51			
+16400	67.00	0.10	0.10	6.70	3.84	3.37	225.79			
+20300	39.00	0.10	0.10	3.90	4.79	4.32	168.48			
Total				20.30			663.64			

Station	Distance	Excavation			Embankment			Surface Soil Removing		
		Section	Average Section	Volume	Section	Average Section	Volume	Section	Average Section	Volume
	(m)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)

4. FARM ROAD-2 (B=6.00^m L=203.00^m)

	203.00		0.10	20.30		3.18	645.54

5. FARM ROAD-3 (B=6.00^m L=203.00^m)

	203.00		0.10	20.30		3.96	803.88

6. FARM ROAD-4 (B=6.00^m L=203.00^m)

	203.00		0.10	20.30		3.77	765.31

7. FARM ROAD-5 (B=6.00^m L=203.00^m)

	203.00		0.10	20.30		2.53	513.59

8. FARM ROAD-6 (B=6.00^m)

No.0	0.00	0.18	0.09	0.00	1.89	0.95	0.00
+93.00	93.00	0.18	0.18	16.74	1.27	1.58	146.94
+20300	11000	0.78	0.48	52.80	0.05	0.66	72.60
Total				69.54			219.54

9. MAIN ROAD (B=10.00^m L=362.00^m)

	362.00		0.36	130.32		0.00	0.00

10. MAIN ROAD-8 ~ 14 (B=6.00^m L=1,428.00^m)

	142.80		0.36	514.08		0.00	0.00

11. ACCESS ROAD (B=200^m L=362.00^m)

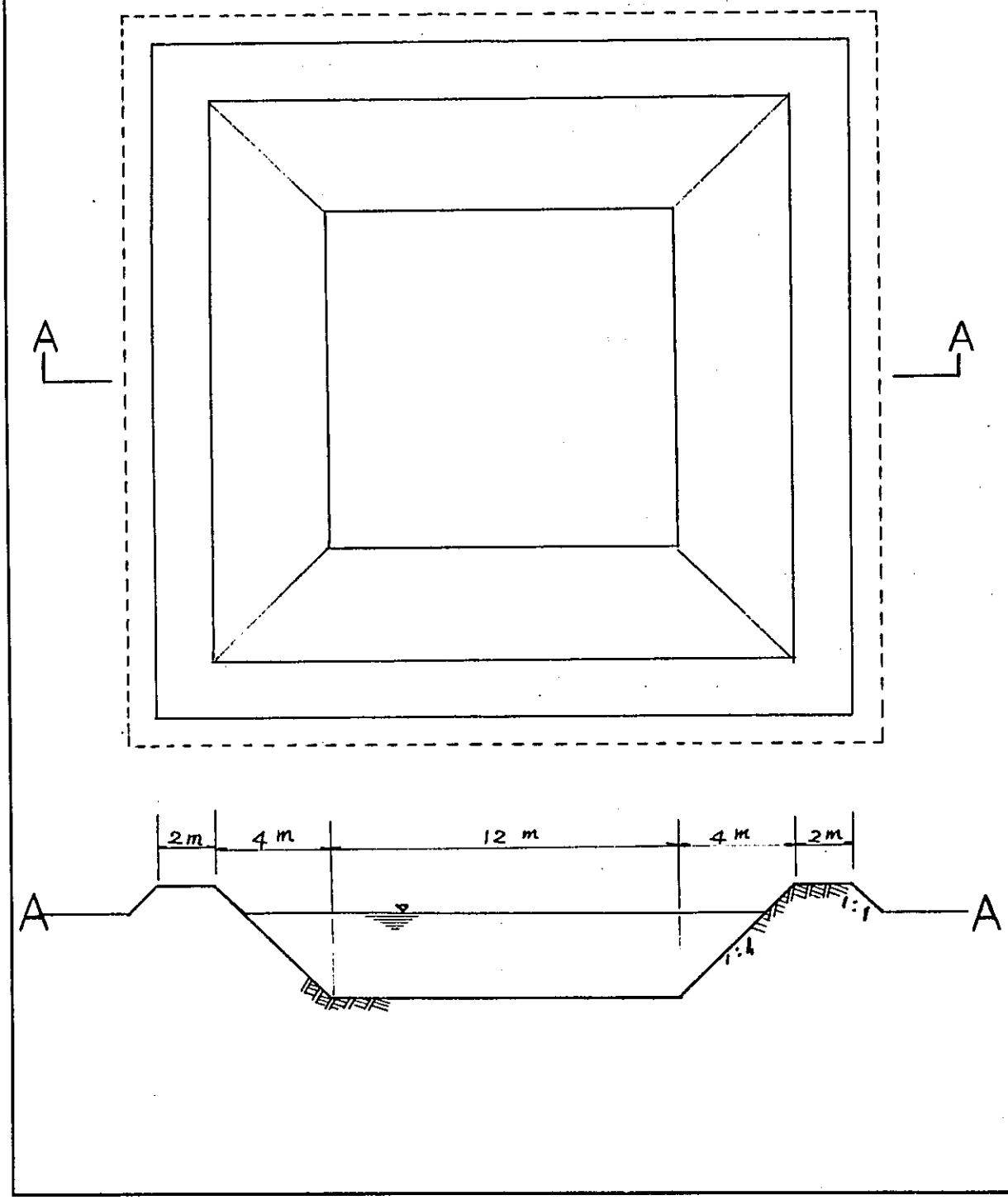
	362.00		0.36	130.32		0.00	0.00

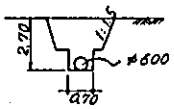
Kinds	Calculated Process	Unit Quantities	Total	Remarks
1. SLUICE VALVE BOX (PER 10 PIECE)				
PASANGAN BATUKALI	0.2 x (0.8 + 0.4) x 0.95 x 2 + 0.2 x 0.8 x 0.8 = 0.56			
	⊖ 0.05 x (0.5+0.4)x0.05x2 +(0.15²x3.14x1/4)x0.4 = 0.01		0.55 m^3	
CONCRETE	0.5 x 0.5 x 0.05 =		0.0125m^3	
FORM	0.5x0.5+0.05x0.5x4 =		0.350 m^2	
EXCAVATION	B=1.40 L=1.40 H=0.95 1.4 x p.4 x 0.95 =		1,862 m^3	
BACK FILLING	(1.4²x0.95)-0.8x0.8x0.95=		1,254 m^3	
2. HYDRANT (FOR PADDY FIELD)				
CONCRETE	0.4 x 0.4 x 0.1 =		0.016 m^3	
FORM	10.4 x 0.4 x 4 =		0.160 m^2	
ROLYVINYL CHORIDEPIPE	+300mm ±=0.35m			
3. HYDRANT (FOR UPLAND FIELD)				
CONCRETE	0.1x(0.5+0.4)x0.3x2 +0.5x0.6x0.1=		0.084 m^3	
FORM	0.3x(0.3+0.4)x2+0.4 x (0.5+0.6)x2=		1.300 m^2	
EXCAVA-TION	B=0.8 L=0.9 H=0.4 0.8x0.9x0.4=		0.360 m^3	
BACK FILLING	(0.8x0.9x0.4)-(0.5x6x0.4)=		0.240 m^3	

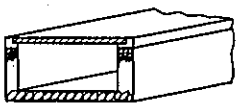
Fig 7

FARM POND

1 : 200



Kinds	Calculated Process	Unit Quantities	Total	Remarks
	FARM- POND			
EXCAVATION	12.0x12.0x3.0=432.00			
	(3.0x3.0x0.5x15.0)x4=270.00		702.00 m^3	
EMBANKMENT	(2.00 x 1.00 x 20) x4-1600			
	(1.00x1.00x0.5x21.0)x4=42.00			
	(1.00x1.00x0.50x25.0)x4=50.00		108.00 m^3	
PASANGAN BATUKALI	($\sqrt{\text{piece}}$ x 4.00x16.0)x4=362.30			
	12.00x12.00=144.00		506.30 m^2	
EXCAVATION (PIPING)				
	(AREA)			
	(1.30+2.80)x1.5x1/2=3.075			
	0.70x1.20=0.84	3.915m^2		
	3.915x6.0=23.49			
	x.915x2.70x1/2=5.29		28.78 m^3	
BACK FILLING	28.78$^{m^3}$-(0.6^{2}x3.14x1/4			
	8.7)=		26.32 m^3	
EXCAVATION (SUMP WELL)	2.0x2.0x3.14x1/4x3.8=		119.30 m^3	
	PUMP STATION (FOR PADDY FIELD)			
CORRUGATE PIPE	ϕ 3000$^{m/m}$ L=6.40^m			
	t=3.2$^{m/m}$			
FILTER				
	(5.00^2-3.00^2)x1/4x3.14x3.0=		37.68 m^3	
CONCRETE (SUMP WELL)				
	3.70^2 x3.14x1/4x0.8=8.60			
	3.00^2 x3.14x1/4x0.20=- 1.41		7.19 m^3	
(PUMP BASE)				
	(0.30x0.65+0.50x0.85)x0.24			
	x 2 = 0.30			
	(0.60x0.30x0.70)x2 =0.25		0.55 m^3	
FORM				
	3.70 x 3.14 x 0.8 = 9.29			
	(1.5+1.5+0.5+0.5)x0.24x2 =			
	1.92			
	(0.3+0.3+0.6)x0.70x2 =1.68		12.89$^{m^2}$	
PASANGAN BATUKALI				
	$\sqrt{2}$ x 3.2 x 20.0 =		90.50 m^2	
STEEL(ANGLE)				
	50x50x6 mm L=500 N=8			
	50x50x6 mm L=470 N=8			
	50x50x4 mm L=3000 N=2			
BOLT AND UNIT				
	ϕ 10mm x 32 N=50			
ANCHOR BOLT	ϕ 15 mm x 300 N=8			
PLATE (STEEL)	50x6mm x 358mm			
	50x4mx716mm			

Kinds	Calculated Process	Unit Quantities	Total	Remarks
	BOOSTER PUMP			
CORRUGATE PIPE	$\phi 600^{m/m}$ L=9.50^{m} t=2.7$^{m/m}$			
	$\phi 2000^{m/m}$ L=4.80^{m} t=3.2$^{m/m}$			
CONCRETE	2.50^{2}x3.14x1/4x0.30=1.47			
	0.90x2.0x0.2=0.36		1.83 m^2	
STEEL (PLATE)	50x6^{mm} L=440^{mm}			
	50x5^{mm} L=440^{mm}			
FORM	2.5x3.14x0.3=2.34			
	(40+1.8)x0.2=1.16		3.50 m^2	
STEEL (ANGLE)	50x50x6$^{m/m}$ N=4 L=470^{mm}			
	50x50x6$^{m/m}$ N=4 L=500^{mm}			
	50x50x4$^{m/m}$ N=4 L=930^{mm}			
ANCHOR BOLT	ϕ150^{mm}x210 N=4			
BOLT AND NUT	ϕ 10^{mm}x 32 N=36			
	CULVERT			
NO. 1 PASANGAN BATUKALI				
	{ 0.25x1.00+(0.15+0.25) x0.44 } x 6.0=2.56			
	(0.25+1.05)x0.25x0.90=0.29			
	{ 0.20x0.20x0.80+(0.80x0.80x0.5 x0.2)} x2=0.19		3.04 m^3	
CONCRETE	0.70x0.07x6.00=		0.29 m^3	
MORTAL	{ (0.10x0.15-0.07x0.1) } x2 x6.0=		0.10 m^3	
FORM			2.00 m^2	
REINFORCE-MENT	ϕ6 L=656.^{m} 0.222$^{mg/m}$		14.54 kg	
NO. 2				
PASANGAN TATUKALI	{ 0.25x1.0+(0.15+0.25)x0.43 } x 6 = 2.53			
	(0.56+1.19)x0.25x0.9=0.40			
	(0.2x0.5x0.94+0.94x0.94x 0.94x0.5x0.2)x2=0.25		3.18 m^3	
CONCRETE	0.70x0.07x6.00=		0.29 m^3	
MORTAR	{ 0.10x0.15-0.07x0.1 } x2x6.0=		0.10 m^3	

Kinds	Calculated Process	Unit Quantities	Total	Remarks
FORM			2.00 m^2	
REINFORCE-MENT	ϕ 6 L=65.5^{m} 0.222$^{kg/m}$		14.54 kg	
No. 3 PASANGAN BATUKALI	{0.25x1.00+(0.15+0.25)x 0.63} x6.0=3.10 0.25x0.9x0.53=0.12 {(0.2x0.2x0.53)+0.53x0.53 x0.5x0.2} x2==0.10		3.32 m^3	
CONCRETE	0.70x0.07x6.00=		0.29m^3	
MORTAL	(0.10x0.15x0.07x0.10)x2x6.0		0.10 m^3	
FORM			2.00 m^2	
REINFORCEMENT	ϕ 6mm L=65.5mm 0.222kg/m		14.54 kg	
NO.4 PASANGAN BATUKALI	0.25x1.00+9(0.25+0.15)x0.59 x6.0= 2.92 0.25x0.90x0.53=0.12 (0.2x0.2x0.53+0.53x0.53x0.5x0.2) x2=0.10		3.14 m^3	
CONCRETE	0.70x0.07x6.00=		0.29 m^3	
MORTAL	10.10x0.15+0.07x0.10)x2x6		0.10m^3	
FORM			2.00 m^2	
REINFORCEMENT	ϕ6mm L=65.5m 0.222kg/m		14.54 kg	
NO. 5 PASSANGAN BATUKALI	{0.25x1.00+(0.15-0.25)x 0.29}x6.0=2.20 (0.25+0.84)x0.25x0.90=0.25 {0.2x0.2x0.59+0.59x0.59x 0.5x0.2}x2=0.12		2.57 m^3	
CONCRETE	0.70x0.07x6.00=		0.29m^3	
MORTAL	{(0.10x0.15+0.07x0.10)} x2x6.0		0.10 m^3	
FORM			2.00 m^2	
REINFORCEMENT	ϕ6mm L=65.5m 0.222kg/m		14.45 m	

ITEM	MATERIAL	DIMENSION	Q'TY	UNIT	
WATER-SUPPLY CANAL					
ASBESTOS CEMENT PIPE	A CLASS	ϕ125x4000	(95 m) 24	Piece	
REGULATING VALVE WORK		ϕ125	1	Place	
HYDRANT (A)		MACHINO TYPE WITH ANGLE PIPE OF ϕ2 x45"	6	"	A-TYPE
HYDRANT (B)		"	12	"	B-TYPE
REDNCER PIPE	A CLASS FC 20	ϕ125x100	1	Piece	12.6kg/piece
SOLID VINYL CHLORIDE PIPE	VP	ϕ100x5000	(222 m) 45	Piece	JISK 6742
SOCKET FOR GIVOLT JOINT	"	ϕ 100 VP	1	"	
PLUG	FC 20	FOR PLAIN CHEESE ϕ100	1	"	
GIVOLT JOINT		ϕ 100 G.J.	1	"	
WATER-SUPPLY CANAL					
SOLID VINYL CHLORDIDE PIPE	VP	ϕ100 x 5000	(105 m) 21	Piece	
REGULATING VALVE WORK		ϕ100	1	Place	
HYDRANT (B)		MACHINO TYPE ANGLE VALVE OF ϕ2"x45°	6	"	
REDNCER PIPE	ACLASS FC 20	ϕ 125 x 100	1	Piece	
SOCKET FOR GIVOLT JOINT		ϕ 100 VP	1	"	
GIVOLT JOINT		ϕ 100 GJ	3	"	
PLUG	FC 20	FOR PLAIN CHEESE ϕ 100	1	"	

ITEM	QUANTITY	UNIT WEIGHT	WEIGHT
90° VENT PIPE FOR ϕ150	1	23.1	23.1
CROSS-PIPE	1	24.4	24.4
REDNCER PIPE	1	17.2	17.2
IF CROSS-PIPE FOR ϕ125	1	17.2	17.2
CROSS- PIPE	1	17.0	17.0
SHORT PIPE (B)	4	12.5	50.0

ITEM	QUANTITY	UNIT WEIGHT	WEIGHT
CROSS-PIPE FOR GAS PIPE	6	(13.7)	82.2
REDNCER PIPE	2	12.6	25.2
SHORT PIPE FOR ϕ100(B)	6	10.1	60.6
TOTAL			kg 316.9
G.J. ϕ150	4 SET	9.93 kg	39.72 kg
" ϕ125	8	8.14	65.12
" ϕ100	10	6.93	69.30
TOTAL			kg 174.14
PLUG	4		
SOCKET FOR G J ϕ100	4		

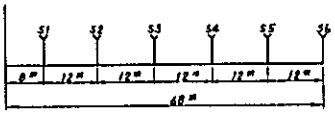
ITEM	MATERIAL	DIMENSION	Q'TY	UNIT		
DELIVERY PIPE						
ASBESTOS CEMENT PIPE	CLASS A	ϕ150x4000	(125 M) 32	Piece		
BEND PIPE	FC 20	ϕ150	1	PC	23.1	KG/piece
CROSS-PIPE	"	ϕ150 x 100	1	P	24.4	KG/piece
GIVOLT JOINT	"	FOR ϕ150	4	SET		
SELIVERY PIPE						
ASBESTOS CEMENT PIPE	A CLASS	ϕ 125 x 4000	(180 M) 45	Piece		
REELUCER PIPE	FC 20	ϕ 150 x 125	1	"	17.2	KG/piece
FLANZE CROSS-PIPE	"	ϕ 125 x 75	1	"	17.2	
CROSS-PIPE	"	ϕ 125 x 125	1	"	17.0	
REGULATING VALVE WORK		ϕ 125	1	Place	SHORT PIPE ϕ125x2 piece x12.5 KG/piece REGULATION VALVE FOR WATER SUPPLY JIS B 2062 ϕ125 x 1	

ITEM	MATERIAL	DIMENSION	Q'TY	UNIT	
EXHAUST VALVE WORK		SINGLEAIR VALVE A TYPE	1	Piece	
GIVOLT JOINT		ϕ 125 G.J.	8	Piece	8.14 KG/piece JIS A5520
SUPPLY PIPE					
SOLID VINYL CHLORIDE PIPE	VP	ϕ100 x 5000	(95 M) 19	Piece	JISK 6742
REGULATING VALVE WORK		ϕ 100	1	Place	SHORT PIPE (B) ϕ100x2 piece x 10. 1KG/piece REGULATING VALVE WATER SUPPLY JIS B2062 ϕ100 x 1 piece
HYDRANT		MACHINE TYPE WITH ANGLE PIPE OF ϕ2"x 45°	6	"	
SOCKET FOR GIVOLT JOINT		ϕ100 - VP	1	Piece	
PLUG	FC 20	FOR PLAIN CHEESE ϕ100	1		JIS B-2301
GIVOLT JOINT		G. J ϕ 100	3	"	JIS A-5520 693 KG/piece
SUPPLY PIPE					
SOLID VINYL CHLORIDE PIPE	VP	ϕ 100x 5000	(105 M) 21	Piece	
REGULATING VALVE WORK		ϕ 100	1	Place	
WATER SUPPLY WORK		MACHINO TYPE ANGLE PIPE OF ϕ 2"x45°	6	"	
SOCKET FOR GIVOLT JOINT		ϕ 100-VP	1	Piece	
PLUG	FC 20	FOR PLAIN CHEESE ϕ100	1	"	
GIVOLT JOINT		G J ϕ 100	3	"	

Kinds	Calculated Process	Unit Quantities	Total	Remarks
A-TYPE	SPRINKLER-8STAND (LATERAL LENGTH 92^{m})			
PER SET				
SPRINKLER	*EQUIVALENT TO RAINBIRD* No. 30B 3/16"x3/32" 70	8 Pieces EACH	2 SETS	
RISER	ϕ25 mm x 10m AND 2.0m	8 Pieces	2 "	
RISER HOLDER	0.85^{m} TRIPOD 1.70^{m} TRIPOD	Each 8 Pieces	2"	
RISER PLUG	ϕ 3/4 "	15 Pieces 23-8= 15 Pieces	2"	
ALUMINUM PORTABLE PIPE	ϕ50^{mm}x 4.0^{m}	Pieces 23	2"	
PIPE FOOT	FOR ϕ 50 ^{mm}	23	2"	
JET HOSE	FOR " (LENGTH 1.0^{m}) MACHINES TYPE, METAL FITTINGS	Set 1	2"	
END PLUG	FOR ϕ 50 ^{mm}	Piece 1	2"	
HYDRAULIC PRESSURE GOUGE (FOR MEASUREMENTS OF NOZZLE PRESSURE) 2 SETS PREPARED				
* [NOTE] SPRINKLEREQUIVALENT TO RAINBIRD NO. 30B NOZZLE SIZE 3/16" x 3/32" 70 WARKING PRESSURE 3.16kg/cm^{2} SPRAY AMOUNT 32.4 ℓ/min SPRAY DIAMETER 29.9 m				
B-TYPE	SPRINKLER-6 STAND, (LATERAL LENGTH 68m)			
PER SET				
SPRINKLER	EQUIVALENT TO RAINBIRD NO. 30B	Pieces 6	Sets 4	
RISER	ϕ25^{mm}x 1.0^{m}	6"	4"	
	ϕ25^{mm}x 2.0^{m}	6"	4"	
RISER HOLDER	0.85^{m} TRIPOD	6"	4"	
	1.70^{m} TRIPOD	6"	4"	
RIZER PLUG	ϕ 3/4"	11"	4"	
ALUMINUM PORTABLE PIPE	ϕ 50^{mm}x 4.0^{m}	17"	4"	
PIPE FOOT	(FOR ϕ 50^{mm})	17"	4"	
JET NOSE	(FOR ϕ 50^{mm}) LENGTH 1.0^{m} MACHINO-TYPE METAL FITTINGS	SET 1	4"	

Kinds	Calculated Process	Unit	Quantities	Total	Remarks
		PIECE	SET		
END PLUG	(FOR ϕ 50^{mm})	1	4		
HYDRAULIC PRESSURE GOUGE (FOR MEASUREMENT OF NOZZLE PRESSURE)		1"	4"		

4 SET PREPARED



PEUVERY PIPE SCOBEY'S FORMULA WILL BE USED FOR COMPUTATION OF FRICTION LOSS.

*Q_1=22 ℓ/s ℓ_1=125^m ϕ150-AP-1 cℓ $H_f = \frac{12}{1000}$, V_1=1.25 m/s, ΣH_{f1}=125^m $\times \frac{12}{1000}$ = 1.5^m

*Q_2 = 13 ℓ/s, ℓ_2 = 180^m ϕ125-AP-1 c ℓ $H_{f2} = \frac{10}{1000}$, V_2=1.10 m/s, ΣH_{f2} = 180^m $\times \frac{10}{1000}$ = 1.8^m

$\Sigma \ell$ = 330^m ΣH_f = 3.3^m

ZUFFLY PIPE

* Q_3=9 ℓ/s, ℓ_3=95^m, ϕ100-VP $H_{f3} = \frac{15}{1000}$, V_3 = 1.10 m/s ΣH_{f3} =95^m $\times \frac{15}{1000}$

= 1.425 ≒ 1.5^m

* Q_4 = 9 ℓ/s, ℓ_4=105^m ϕ 100-VP $H_{f4} = \frac{15}{1000}$, V_4 = 1.10 m/s ΣH_{f4}=105^m $\times \frac{15}{1000}$

= 1,575 ≒ 1.6^m

*Q_5 = 13 ℓ/s

- ℓ_5=95^m ϕ125-AP-1 $\Sigma H_{f5} = \frac{10}{1000}$, V_5 = 1.00 m/s ΣH_{f5}= 95^m $\times \frac{10}{1000}$ = 0.95^m
- ℓ_5 = 222^m ϕ 100-VP $H_{f5} = \frac{30}{1000}$, V_5' = 1.60 m/s ΣH_{f5}= 222^m $\times \frac{30}{1000}$ = 6.66^m

ΣH_{f5} = 7.6^m

*Q_6 = 13 ℓ/s, ℓ_6=105^m, ϕ 100-VP $H_{f6} = \frac{30}{1000}$, V_6 = 1.60 m/s ΣH_{f6} = 10.5^m

$\times \frac{30}{1000}$ = 3.15^m

DESIGN CONDITION WILL BE THE END OF 5,

$\Sigma H_f = \Sigma H_{f1} + \Sigma H_{f2} + \Sigma H_{f5}$=1.5^m+1.8^m+7.6^m=10.9^m → DESIGN FRICTION LOSE 10.9m

$\Sigma \ell = \ell_1 + \ell_2 + \ell_3$ = 125^m + 180^m + 317^m = 622^m

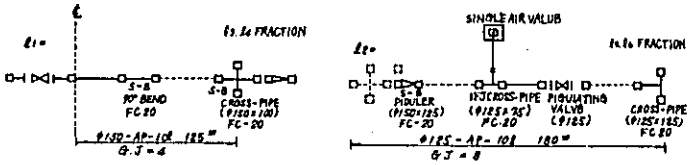
Kinds	Calculated Process	Unit	Quantities	Total	Remarks

PUMP H_f = HYDRANT LOSS + LATERAL LOSS + PUMP SURROUNDINGS + OTHER VALVE VEND LOSS ETC.

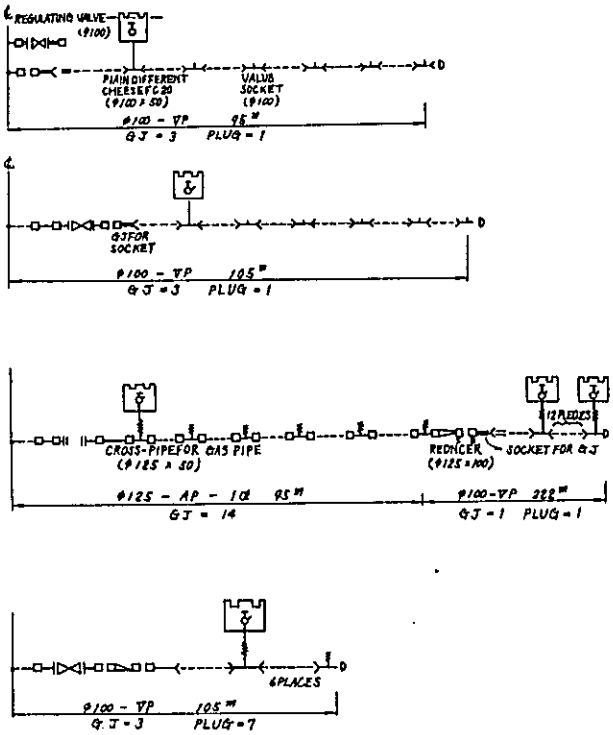
= 10.9 + 2.5 + 4.3 + 31.6 + 3.6

= 53^{m}

DELIVERY PIPE



ZUPPLY PIPE



BULLDOZERWORKING DISTANCE (TOTOKATON)

FIELD NO.	V	L x V	L
1	2,910	80,014	27
2	3,117	77,472	25
3	3,429	99,253	29
4	4,550	208,462	46
5	3,006	136,158	45
6	4,685	131,045	28
7	3,409	125,444	37
8	2,942	121,868	41
9	2,675	71,649	27
10	3,324	110,134	33
11	3,724	108,602	29
12	2,584	104,454	40
13	3,031	98,507	32
14	2,798	104,663	37
15	3,202	79,983	25
16	2,802	47,414	17
17	2,665	59,950	22
18	1,746	28,472	16
19	3,178	65,874	21
20	4,244	96,894	23
131	4,737	65,101	24
Σ	66,758	2,021,413	30 M
	ΣV	ΣL x V	$\Sigma L = \frac{\Sigma L \times V}{\Sigma V}$

V : VOLUME OF EARTH WORK
L : AVERAGE DISTANCE OF EARTH WORK

Kinds	Calculated Process	Unit Quantities	Total	Remarks
PROPOSAL PADDY FIELD NO.	(LENGTH OF BORDER)		m	
NO. 1 ~ NO. 8	90+92.5+94+95.5+81.5		453.5	
NO. 9 ~ NO. 21	107+98.5+92+84+74+69.5 +63+54+47+40+29.5+22		780.5	
NO. 22 ~ NO. 41	200x4+100x4+50x4 +160+161.5		1,721.5	
NO. 42 ~ NO. 55	100x7+50x5+140		1,090.0	
NO. 56 ~ NO. 79	100x7+50x10+340		1,540	
NO. 80 ~ NO. 102	100x6+50x11+340		1,490	
NO. 103 ~ NO. 110	100x4+80		480	
NO. 111 ~ NO. 114	80x4+80		400	
NO. 115 ~ NO. 144	200x14+303		3,103	
NO. 145 ~ NO. 174	202x14+307		3,135	
NO. 175 ~ NO. 190	100x8+165		965	
NO. 191 ~ NO. 197	100x6+100		700	
NO. 198 ~ NO. 204	100x3+50+85		435	

Kinds	Calculated Process	Unit Quantities	Total	Remarks
PROPOSAL PADDY FIELD NO.	(LENGTH OF BORDER)		m	
NO.205 ~ NO.209	50+102.5x3+60		417.5	
NO.210 ~ NO.214	102.5x4		410	
NO.205 ~ NO.219	80x2+76+49+24+60.5+7+65		441.5	
NO.220 ~ NO.240	87+110.5+140+170.5+201 x7+220+108		2,243	
NO.241 ~ NO.246	100x3+60x3		480	
NO.247 ~ NO.263	34.5+59.5+80+107+130x5 +141		1,072	
NO.264~ NO.273	100x2+89+79+56+100 +30+22.5+16		592.5	
NO.274~ NO.284	85+78+71.5+64.5+56+51.5 +42+37+31.5+23.5		540.5	
NO.285~ NO.304	100x13+97+94+97.5+103 +108+109+112.5		2,021	
NO.305 ~ NO.320	100x8+160		960	
NO.321 ~ NO.334	56+100x9+120		1,070	
NO.335 ~ NO.346	100x8+80		880	
NO.347 ~ NO.362	100x10+120		1,120	
NO.363 ~ NO.372	100x6+43.5+28+60		731.5	
NO.373 ~ NO.380	100x5+60		560	
NO.381 ~ NO.390	100x5+82+46.5+60		688.5	
NO.391 ~ NO.400	100x5+100		600	
NO.401 ~ NO.410	200x4+61+65+45+80		1,051	
NO.411 ~ NO.420	204x3+155+140+100+75		1,082	
NO.421 ~ NO.433	130x2+120+109+97 +77x2+140+20		900	
NO.(434)435 ~ NO.437	60+37.5+48+59		204.5	
NO.438 ~ NO.447	100+100x4+47+92		639	
NO.448 ~ NO.452	80+42+12+50x4		334	
NO.453 ~ NO.469	204x6+102x2+94+200+13		1,735	

Kinds	Calculated Process	Unit Quantities	Total	Remarks
PROPOSAL PADDY FIELD NO.	(LENGTH OF BORDER)		m	
NO.470 ~ NO.477	123+108+75.5+60+45+32+155		598.5	
NO.478 ~ NO.497	29+100x9+200		1,129	
NO.498 ~ NO.517	50+100x9+200		1,150	
NO.518 ~ NO.535	80.5+87+139+146+153.5 +160+168+140+134.5+80		1,288.5	
NO.536 ~ NO.570	85+100x160+340		2,025	
NO.571 ~ NO.578	100x4+80		480	
NO.579 ~ NO.611	97x16+320		1,872	
NO.612 ~ NO.618	92.5+85+77.5+70+62.5 +55+47.5+150		640	
NO.619 ~ NO.632	100x4+96.5+87+79+140+53.5		856	
NO.633 ~ NO.642	100x4+85+17.5+100		602.5	
NO.643 ~ NO.658	100x7+66+40+160		966	
NO.659 ~ NO.676	100x9+180		1,080	
NO.677 ~ NO.684	100x8+160		960	
			Σ 50,714.5 m	

Kinds	Calculated Process	Unit Quantities	Total	Remarks
CULVERT				
CAA			1	
CAB			2	
CAC			1	
CBA			6	
CBB			2	
CBC			2	
CCA			6	
CCB			24	
CCC			8	
CCD			1	
CCE			1	
				(54)
FLASH BOARD WEIR				
W.A			6	
WB			7	
WC			28	
				(41)
DRAINAGE CULVERT				
D-C-1			1	
D-C-2			1	
D-C-3			1	
				(3)

CCA TYPE

Kinds	Calculated Process	Unit	Quantities	Total	Remarks
Pasangan Batukali	(0.20x0.60+0.10x0.10x1/2 +0.20x0.40)x2x3.20+(0.60 x0.60x1/2x0.20x4)+(0.10 x0.10x1/2x0.60x4) +($\frac{0.30+0.40}{2}$ x 0.20x0.60 x4)	m^3	1,510		
Reinforced concrete plate	1.40x0.60x0.10x5 +1.40x0.20x0.10	m^3	0.448		
Form	Pasangan 2x(0.80+0.50+0.14+ 0.20)x3.20+4x(0.20x0.60) +(0.14x0.60x4)+ ($\frac{0.60x0.60}{2}$ + $\frac{0.50x0.50}{2}$)x4 +0.30x0.20x4	m^2	12.77		
	concrete 0.10x(0.60+1.40)x2x5+ 0.10x(0.20+1.40)x2	m^2	2.32		
		m^2		15.09	
Reinforcement	ϕ6 L=0.74 .... 0.74x(14x5) x0.222 kg/m	kg	11.50		
	L=1.54 .... 1.54x(5x5+ 2)x0.222	kg	9.231		
	L=0.34 .... 0.34x14x 0.222	"	1.057		
		kg		21.788	
Excavation	2.00x1.10x4.30	m^3	9.46		
Backfilling	9.46-(1.60x0.60x4.30)	m^3	5.33		
Residual soil		m^3	4.13		

CAB TYPE

Kinds	Calculated Process	Unit	Quantities	Total	Remarks
Pasangan Batukali	(0.20x0.60+0.10x0.10x1/2 +0.20x0.40)x2x2.10+(0.60x 0.60x1/2x0.20x4)+(0.10x 0.10x1/2x0.60x4)+($\frac{0.30+0.40}{2}$ x0.20x0.60x4)	m^3	1.059		
Reinforced Concrete plate	1.40x0.60x0.10x3+ 1.40x0.30x0.10	m^3	0.28		
Form	Pasangan. 2x(0.80+0.50+0.14+ 0.20)x2.10+4x(0.20x0.60) +(0.14x0.60x4)+($\frac{0.60x0.60}{2}$ + $\frac{0.50x0.50}{2}$)x4+0.30x0.20 x4	m^2	9.16		
	Concrete 0.10x(0.60+1.40)x2 x3+0.10x(0.30+1.40)x2	m^2	1.54		
		m^2		10.70	
Reinforcement	ϕ6 L=0.74x(14x3)x0.222 kg/m	kg	6.90		
	L=1.54x(5x3+3)x0.222	"	6.15		
	L=0.44x14x0.222	"	1.368		
		kg		14.418	
Excavation	2.00x1.10x3.30	m^3	7.26		

Backfilling	7.26-(1.60x0.60x3.30)	m^3	4.09		
Residual soil	7.26-4.09	m^3	3.17		

C B A TYPE

Kinds	Calculated Process	Unit	Quantities	Total	Remarks
Pasangan Batukali	(0.20x0.60+0.20x0.40)x 2x3.10+(0.60x0.60x1/2 x0.20x4)+($\frac{0.40+0.20}{2}$x0.20 x0.60x4)	m^3	1.528		
Concrete plate	1.00x0.90x0.07x2 +1.10x0.90x0.07	m^3	0.195		
Form	pasangan (0.80+0.60+0.20)x2x3.10 +(0.20x0.60x4)+$\frac{0.6x0.6}{2}$ x4	m^2	11.12		
	Concrete 0.07x(0.90+1.00)x2x2 +0.07x(0.90+1.10)x2	m^2	0.812		
		m^2		11.93	
Iron wire	ϕ4 0.097$^{kg/m}$x(0.90x7x3 +0.80x7x3)	kg	3.46		
Excavation	1.50x1.10x4.30	m^3	7.10		
Backfilling	7.10-(0.80x1.10x4.30)	m^3	3.32		
Residual soil	7.10-3.32	m^3	3.78		

C B B TYPE

Kinds	Calculated Process	Unit	Quantities	Total	Remarks
Pasangan Batukali	(0.20x0.60+0.20x0.40)x2 x2.10+(0.60x0.60x1/2x0.20 x4)+($\frac{0.40+0.20}{2}$x0.20x0.60 x4)	m^3	1.128		
Concrete plate	1.00x0.90x0.07 + 1.10x0.90x0.07	m^3	0.132		
Form	Pasangan. (0.80+0.60+0.20)x2x2.10+ (0.20x0.60x4)+$\frac{0.60x0.60}{2}$ x4	m^2	7.92		
	concrete 0.07x(0.90+1.00)x2+ 0.07x(0.90+1.10)x2	m^3	0.546		
		m^2		8.47	
Iron wire	ϕ4 0.097$^{kg/m}$x(0.90x7 x2+0.80x7x2)	kg	2.309		
Excavation	L50x1.10x3.30	m^3	5.45		
Backfilling	5.45-(0.80x1.10x3.30)	m^3	2.55		
Residual soil	5.45-2.55	m^3	2.90		

C B C TYPE

Kinds	Calculated Process	Unit	Quantities	Total	Remarks
Pasangan Batukali	(0.20x0.60+0.20x0.40)x 2x1.60+(0.60x0.60x1/2x 0.20x4)+($\frac{0.40+0.20}{2}$ x0.20 x0.60x4)	m^3	0.928		
Concrete Plate	1.00x0.90x0.07+0.60x0.90 x0.07	m^3	0.101		
Form	Pasangan. (0.80+0.60+0.20)x2x1.60+ (0.20x0.60x4)+$\frac{0.60x0.60}{2}$ x4	m^2	6.32		
	concrete 0.07x(0.90+1.00)x2+ 0.07x(0.90+0.60)x2	m^2	0.476		
		m^2		6.80	
Iron wire	ϕ4 0.097 kg/m x (0.90 x7+0.80x7+0.80x4+ 0.50x7)	kg	1.853		
Excavation	1.50x1.10x2.80	m^3	4.62		
Backfilling	4.62-(0.80x1.10x2.80)	m^3	2.16		
Residual soil	4.62 - 2.16	m^3	2.46		

C C A TYPE

Kinds	Calculated Process	Unit	Quantities	Total	Remarks
Pasangan Batukali	(0.20x0.40x2+0.20x 0.90)x3.10+(0.20x 0.90x0.40)x2+ (0.40x0.40x1/2x0.20x 4)	m^3	1.262		
Concrete(Plate)	0.70x1.50x0.07	m^3	0.074		
	0.70x1.60x0.07	"	0.078		
		"	0.152		
Form	Pasanga. outside (0.60x3.10x2)+(0.40 x0.20+$\frac{0.40x0.40}{2}$)x4 +(0.20x0.90x2)	m^2	4.72		
	Inside (0.40x3.10x2)+(0.40x0.40 x1/2x4)	m^2	2.80		
	concrete form				
	0.07x(0.70+1.50)x2	m^2	0.308		
	0.07x(0.70+1.60)x2		0.322		
		m^2		8.15	
Iron wire	ϕ4mm (0.097$^{kg/m}$x1.^{L}40x5^{N}) (0.097x1.^{L}50x5^{N})+(0.097x 0.60x51)	kg	4.37		
Excavation	1.40x0.90x3.50	m^3	4.41		
Backfilling	4.41-(0.90x0.60x3.50)	"	2.52		
Residual soil	4.41-2.52	"	1.89		

C A C TYPE

Kinds	Calculated Process	Unit	Quantities	Total	Remarks
Pasangan Batukali	(0.20x0.60+0.10x0.10x1/2+ 0.20x0.40)x2x1.60+ (0.60x0.60x1/2x0.20x4) +(0.10x0.10x1/2x0.60x4) + ($\frac{0.30+0.40}{2}$ x0.20x0.60x4)	m^3	0.854		
Reinforced Concrete Plate	1.40x0.60x0.10x2+ 1.40x0.40x0.10 Pasangan. 2x(0.80+0.50+0.14+0.20) x1.60+4x(0.20x0.60)+(0.14 x0.60x4)+($\frac{0.60x0.60}{2}$ + $\frac{0.50x0.50}{2}$)x4+0.30x0.20x4 concrete	m^3	0.224		
	0.10x(0.60+1.40)x2x2+ 0.10x(0.40+1.40)x2	m^2	12.77		
		m^2	1.20		
		m^2		13.97	
Reinforcement	ϕ6 L=0.74m 0.74x(14x2) x0.222	kg	4.60		
	L=1.54 1.54x(5x2+4) x0.222	"	4.786		
	L=0.54 0.54x14x0.222	"	1.678		
		kg		11.064	
Excavation	2.00x1.10x2.80	m^3	6.16		
Backfilling	6.16-(1.60x0.60x2.80)	m^3	3.47		
Residual Soil	6.16-3.47	m^3	2.69		

C C B TYPE

Kinds	Calculated Process	Unit	Quantities	Total	Remarks
Pasangan Batukali	(0.20x0.40x2+0.20x0.90) x2.10+(0.20x0.90x0.40) x2+(0.40x0.40x1/2x0.20x4)	m^3	0.922		
Concrete plate	0.70x1.50x0.07	m^3	0.074		
	0.70x0.60x0.07	"	0.029		
		"		0.103	
Form	Pasangan Aut side (0.60x2.10x2)+(0.40 x0.20+$\frac{0.40x0.40}{2}$ x4+(0.20 x0.90x2)	m^2	3.52		
	Inside (0.40x2.10x2)+(0.40x 0.40x1/2x4)	m^2	2.00		
	Concrete 0.07x (0.70+1.50)x2	m^2	0.308		
	0.07x(0.70+0.60)x2	"	0.182		
		m^2		6.01	
Iron wire	ϕ4mm(0.097kg/m x1.40x5)m N +(0.097x0.50x5)+(0.097x 0.60x14)	kg	1.736		

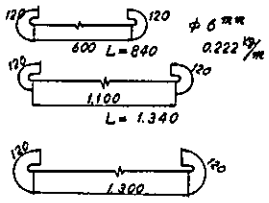
Excavation	1.40x0.90x2.50	m^3	3.15		
Backfilling	3.15-(0.90x0.60x2.50)	m^3	1.35		
Residual soil		m^3	1.80		

C C C TYPE

Kinds	Calculated Process	Unit	Quantities	Total	Remarks
Pasangan Batukali	(0.20x0.40x2+0.20x0.90) x1.60+(0.20x0.90x0.40) x2+0.40x0.40x1/2x0.20x4)	m3	0.752		
Concrete plate	0.70x1.60x0.07	m^3	0.078		
Form	Passangan Aut side (0.60x1.60x2)+(0.40x0.20 $+\frac{0.40x0.40}{2}$)x4 +(0.20x0.90 x2)	m^2	2.92		
	Inside (0.40x1.60x2)+(0.40x0.40 x1/2x4)	"	1.60		
	Concrete 0.07x(0.70+1.60)x2	"	0.322		
		m^2		4.84	
Iron wire	ϕ4mm $0.097^{kg/m}$x1.50x5 +(0.097x0.60x11)	kg	1.37		
Excavation	1.40x0.90x2.00	m^3	2.52		
Backfilling	2.52-(0,90x0.60x2.00)	"	1.44		
Residual soil		"	1.08		

C C D TYPE

Kinds	Calculated Process	Unit	Quantities	Total	Remarks
	$L=0.84^{m} \times (13^{N}x4+15)$ x $0.222^{kg/m}$	kg	12.494		
	L=1.34x(5x4)x0.222	"	5.950		
	L=1.54 x 5 x 0.222			1.709	
		kg		20.153	
Excavation	1.50x1.00x7.00	m^3	10.50		
Backfilling	10.50-(0.90x0.70x7.00)	m^3	6.09		
Residual soil		m^3	4.49		
Pasangan Batukali	(0.20x0.40x2+0.30x0.90) x6.20+(0.30x0.90x0.40x2) +(0.40x0.40x1/2x0.20x4)	m^3	2.946		

Reinforced concrete (plate)	(0.70x1.20x0.10x4)			
	+(0.70x1.40x0.10)	m^3	0.434	
Form	Pasangan. Aut side			
	(0.70x6.20x2)+(0.40x			
	0.30+0.40x0.40x1/2)x4			
	+(0.30x0.90x2)	m^3	10.98	
	Inside (0.40x6.20x2)+			
	(0.40x0.40x1/2x4)	m^2	5.28	
	Concrete			
	0.10x(0.70+1.20)x2x4			
	+0.10x(0.70+1.40)x2	m^2	1.94	
		m^2		18.20
Reinforcement				

W A TYPE

Kinds	Calculated Process	Unit	Quantities	Total	Remarks
Cobble stone concrete	{(2.40 x 1.05)-(1.10x0.55)				
	+(0.05x0.05x1/2x2) }				
	x 0.30-(0.06x0.06x0.55)x2	m^3	0.571		
Form	(2.40x1.05-1.10x0.55				
	+0.55x0.05x1/2x2)				
	x2+(1.05x0.30x2)				
	+ {0.30x0.55+(0.06+				
	0.06)x0.55 } x2	m^2	4.928		
Rip rap *	$(\frac{1.00+1.20}{2}$ x0.20+				
	$\frac{0.30+0.35}{2}$ x0.20x2)x0.80	m^3	0.28		
Shuttering board	W H t				
	1200 x 500 x 50		1		
Excavation	Mean. WL $\frac{3.10+2.60}{2}$ x 0.50 x 0.75				
	+ *0.28	m^3	1.35		
Backfilling	1.35-(0.50x2.40x0.30)	"	0.99		
Residual soil	1.35 = 0.99	"	0.36		

C C E TYPE

Kinds	Calculated Process	Unit	Quantities	Total	Remarks
Pasangan Batukali	(0.20x0.40x2+0.30x0.90) x920+(0.30x0.90x0.40 x2)+(0.40x0.40x1/2x0.20 x4)	m^3	4.236		
Reinforced concrete plate	(0.70x1.20x0.10x7)+ (0.70x0.80x0.10)	m^3	0.644		
Form	Pasangan. Autside (0.70x9.20x2)+(0.40x 0.30+0.40x0.40x1/2)x4 +(0.30x0.90x2)	m^2	15.18		
	Inside (0.40x9.20x2)+ (0.40x0.40x1/2x4)	m^2	7.68		
	Concrete 0.10x(0.70+1.20)x2x7+ 0.10x(0.70+0.80)x2	m^2	2.96		
		m^2		25.82	
Reinforcement	L=0.84m...0.84x(13x7+9) x0.222kg/m	kg	18.648		
	L=1.34m...1.34x(5x7)x0.222	"	10.412		
	L=0.94m...0.94x5x0.222	"	1.043		
		kg		30.103	
Excavation	1.50x1.00x10.00	m^3	15.00		
Backfilling	15.00-(0.90x0.70x10.00)	m^3	8.70		
Residual soil		m^3	6.30		

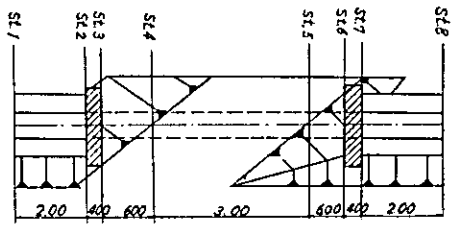
W C TYPE

Kinds	Calculated Process	Unit	Quantities	Total	Remarks
Cobble stone concrete	{(1.30x0.65)-(0.40x0.35) +(0.05x0.05x1/2x2)} x0.30 -(0.06x0.06x0.35x2)	m^3	0.210		
Form	(1.30x0.65-0.40x0.35+ 0.05x0.05x1/2x2)2+ (0.65x0.30x2)+{(0.30 x0.35+(0.06+0.06)x0.35 }x2	m^2	2.10		
RIP rap *	$(\frac{0.30+0.50}{2} \times 0.20+ \frac{0.20+0.25}{2} \times 0.20 \times 2)$ x0.50	m^3	0.085		
Shuttering board	W H t 500x300x50		1		
Excavation	$\frac{1.50+1.80}{2}$ x0.30x Mean Wt 0.65+0.085	m^3	0.41		
Backfilling	0.41-(0.30x1.30x0.30)	m^3	0.29		
Residual Soil	0.41-0.29	m^3	0.12		

WB TYPE

Kinds	Calculated Process	Unit	Quantities	Total	Remarks
Cobble stone concrete	{(1.90x1.05)-(0.60x0.55) +(0.05x0.05x1/2x2)} x0.30-(0.06x0.06x0.55 x2)	m^3	0.496		
Form	(1.90x1.05-0.60x0.55+ 0.05x0.05x1/2x2)x2 +(1.05x0.30x2)+{(0.30 x0.55+(0.06+0.06)x0.55} x2	m^2	4.427		
Rip rap	* $(\frac{0.50+0.70}{2}$ x0.20+ $\frac{0.30+0.35}{2}$ x0.20x2)x0.80	m^3	0.20		
Shuttering board	W 700 λ H_{500} x t_{50}		1		
Excavation	$\frac{2.80+2.10}{2}$ x 0.50x0.75 (Mean WL) + *0.20	m^3	1.14		
Backfilling	1.14-(0.50x1.90x0.30)	"	0.86		
Residual soil	1.14 - 0.86	"	0.28		

D-C-1



PLAN

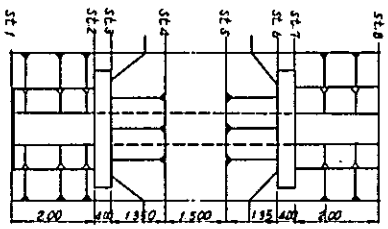
1	0.00	1.04	-				
2	2.00	1.04	1.04	2.08			
2	0.00	1.46	-				
3	0.40	1.46	1.46	0.58			
3	0.00	1.20	-		6.40	-	
4	0.60	1.20	1.20	0.72	8.00	7.20	4.32
5	3.00	1.20	1.20	3.60	8.00	8.00	24.00
6	0.60	1.20	1.20	0.72	6.40	7.20	4.32
6	0.00	1.46	-				
7	0.40	1.46	1.46	0.58			
7	0.00	1.04	-				
8	2.00	1.04	1.04	2.08			

			Sodding Slope
Total	m^3 10.36	m^3 32.64	m^2 10.00

D-C-1

Kinds	Calculated Process	Unit	Quantities	Total	Remarks
Pasangan Batukali	$(\frac{0.90+2.00}{2} \times 1.20 - \frac{0.60+1.60}{2} \times 100) \times 2.00 \times 2$	m^3	2.660		
	$\{(\frac{0.20+0.40}{2} \times 1.40 + 0.40 \times 0.60) \times 2.00 - (0.30^2 \times 3.14 \times 0.35)\} \times 2$	m^3	2.442		
		m^3		5.002	
Form	$(1.118 + 1.342) \times 2 \times 2.00 \times 2 + 0.64^{m^2} \times 2$	m^2	20.96		 A = 0.64 m²
	$\{2.00 \times 2.00 - (0.64^{m^2} + 0.30^2\pi) + (2.00 \times 2.00 - 0.30^2\pi) + (\frac{0.20+0.40}{2} \times 1.40 + 0.40 \times 0.60) \times 2\} \times 2$	m^2	16.228		
		m^2		37.188	
Sand bed	$(1.20+1.80) \times 1/2 \times 0.30 \times 4.20$	m^3		1.890	
Corrugated metal pipe	$\phi\ 600^{m/m}{}_{t\ 2}{}^{mm}$	m		5.000	

D-C-2



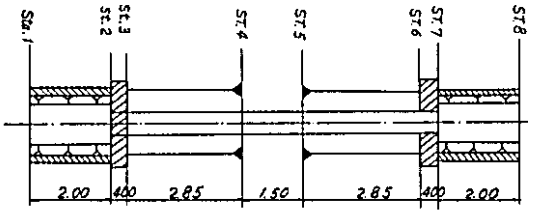
PLAN

1	0.00	1.88	-		-				
2	2.00	1.88	1.88	3.76	-				
2	0.00	3.75	-		-				
3	0.40	3.75	3.75	1.50	-				
3	0.00	1.00	-		6.00				
4	1.35	1.00	1.00	1.35	10.00	8.00	10.80		w=4,000
5	1.50	1.00	1.00	1.50	10.00	10.00	15.00		"
6	1.35	1.00	1.00	1.35	6.00	8.00	10.80		"
6	0.00	3.75	-		-				
7	0.40	3.75	3.75	1.50	-				
7	0.00	1.88	-		-				
8	2.00	1.88	1.88	3.76	-				
Total			m^3 14.72			m^3 36.60		Sodding Slope $3.6^{m} \times 4.0^{m} = 14.40^{m^2}$	

D-C-2

Kinds	Calculated Process	Unit	Quantities	Total	Remarks
Pasangan Batukali	$(\frac{2.50 + 1.15}{2} \times 1.55 - \frac{2.10 + 0.80}{2} \times 1.30) \times 2.00$				
	$\times 2$	m^3	3.776		
	$(\frac{0.20 + 0.40}{2} \times 1.60 + 0.40 \times 0.60) \times 3.00 - 0.40^2\pi \times 0.35) \times 2$	m^3	3.968		
		m^3		7.744	
Form	$(1.456 + 1.733) \times 2 \times 2.00 \times 2 + (0.944 \times 2)$	m^2	27.40		
	$[3.00 \times 2.20 - (\frac{0.944}{2} + 0.40\pi) + 3.00 \times 2.20 - (0.40^2\pi) + (\frac{0.20+0.40}{2} \times 1.60 + 0.40 \times 0.60) \times 2]$				
	$\times 2$	m^2	25.382		
		m^2		52.782	
Sand bed	$(1.60 \times 2.20) \times 1/2 \times 0.30 \times 4.20$	m^3		2.394	
Corrugated metal pipe	ϕ 750 $^{m/m}t$ 2 mm	m		5.000	

D-C-3



PLAN

1	0.00	0.28	-		0.29	-			
2	2.00	0.28	0.28	0.56	0.29	0.29	0.58		
2	0.00	1.32	-	-	6.75	-	-		
3	0.40	1.32	1.32	0.53	6.75	6.75	2.70		w=5,000
4	2.85	1.00	1.16	3.31	16.50	11.63	33.15		w=5,000
5	1.50	1.00	1.00	1.50	16.50	16.50	24.75		"
6	2.85	1.32	1.16	3.31	6.75	11.63	33.15		"
7	0.40	1.32	1.32	0.53	6.75	6.75	2.70		"
7	0.00	0.28	-	-	0.29	-	-		
8	2.00	0.28	0.28	0.56	0.29	0.29	0.58		
				m^3			m^3	Sodding Slope S.L m	m^w m^2
Total				10.30			97.61	7.20 x5.00	=36.00

D-C-3

Kinds	Calculated Process	Unit	Quantities	Total	Remarks
Pasangan Batukali	$\left(\frac{1.90+1.40}{2} \times 1.20 - \frac{1.50+1.00}{2} \times 1.00\right) \times 2.00 \times 2$	m^3	2.92		
	$\left\{\left(\frac{0.20+0.40}{2} \times 1.40 + 0.60 \times 0.40\right) \times 2.20 - 0.30^2 \pi \times 0.35\right\} \times 2$	m^3	2.706		
		m^3		5.626	
Form	$(1.118 + 1.342) \times 2 \times 2.00 \times 2 + 0.73^{m^2} \times 2$	m^2	21.14		
	$\{2.20 \times 2.00 - (0.73 + 0.30^{m^2} \pi) + (2.20 \times 2.00 - 0.30^2) + (\frac{0.20 + 0.40}{2} \times 1.40 + 0.40 \times 0.60) \times 2\} \times 2$	m^2	17.65		
		m^2		38.79	
Sand bed	$(1.20 + 1.80) \times 1/2 \times 0.30 \times 7.20$	m^3		3.24	
Corrugated metal pipe	$\phi 600^{mm}$ t 2^{mm}	m		8.000