STRENGTHENING RESEARCH ACTIVITIES (PHASE II) PROJECT

AT

KASETSART UNIVERSITY

DETAIL DESIGN REPORT

ON

MODEL INFRASTRUCTURE IMPROVEMENT WORK

NOVEMBER 1988

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

In recognition of, and with reference to, the results of the two foregoing projects, being the Strengthening Research Activities Project at Kasetsart University and the Agricultural Extension and the Agricultural Mechanization Project at Kasetsart University, the Government of the Kingdom of Thailand has called upon Japan to provide technical cooperation in the Phase II project with a view to further upgrading and reinforcing the national research activities. Upon receipt of this request, the technical cooperation period of five years has been started since the Record of Discussions for the project was signed on April 16, 1987 between both Governments of the Kingdom of Thailand and Japan.

Despite of the base in research activities, the Kamphaengsaen Campus of the Kasetsart University has the incomplete preparation of the experimental fields to be used for the research of Breeding Programs and Variety Collection and for the testing of the agricultural machineries, and besides has lacked the installation of the screen houses necessary for the research of Tissue Cultures.

Therefore, in order to progress the technical cooperation, the urgent preparation of these facilities muse be required and hence the Short-Term Experts were made available for the period from August 8, 1988 through September 16, 1988 to execute designing and planning for these facilities.

The present report document sums up the findings of the site investigations and results of the study activities carried out in Japan, and it is hoped that this document will serve as a guide in the execution of the project activities designed to provide the facilities scheduled hereunder.

In conclusion, we wish to convey our sincere thanks to all who assisted us in the execution of the investigations under report.

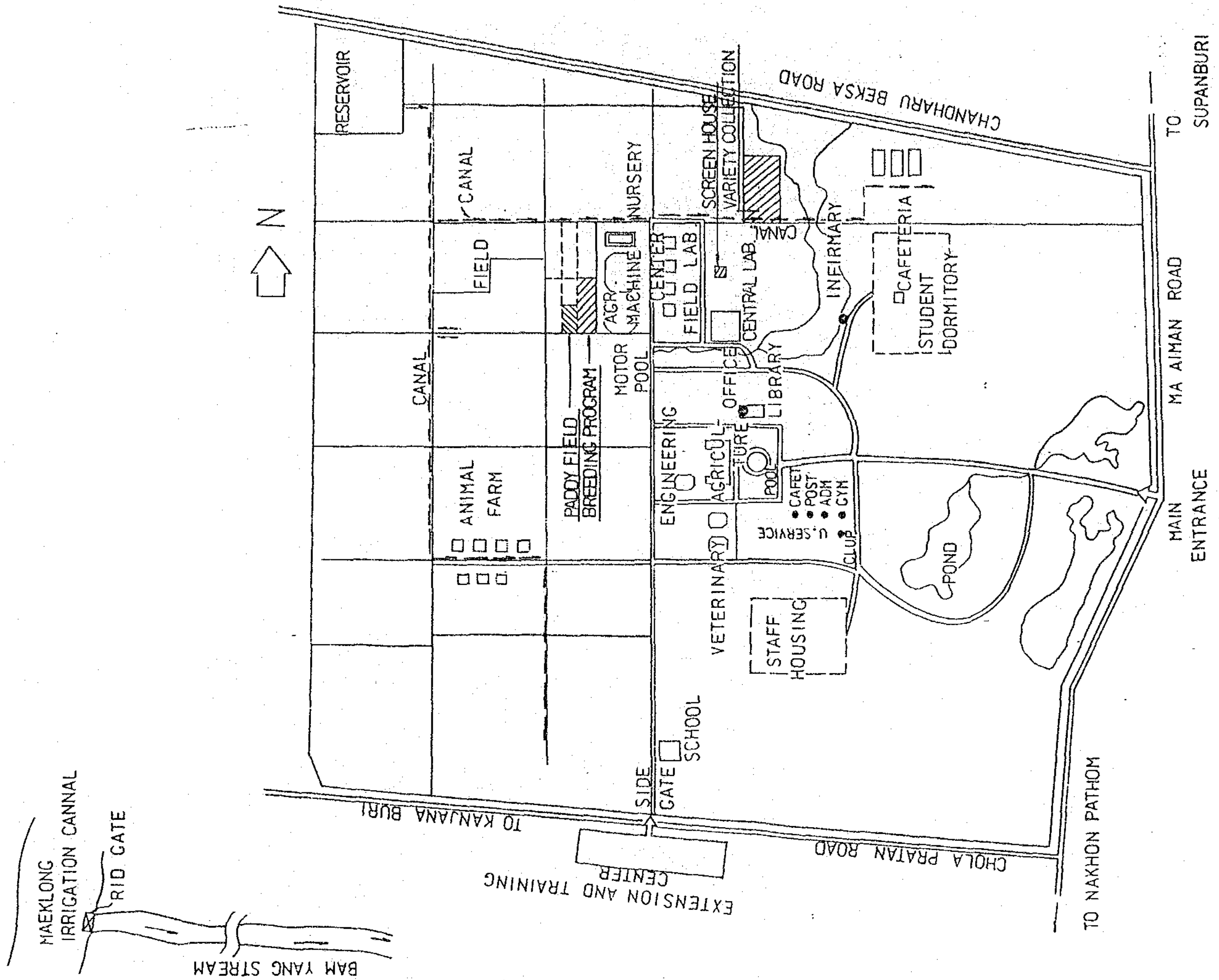
November, 1988

Kazumi MIYAMOTO

Director
Agricultural Development
Cooperation Department
Japan International Cooperation Agency

CONSTRUCTION OUTLINE

1. Experimental Farm of NAMC		
Land Leveling (Soil dressing)	A =	1.14ha
Concrete Ridge	L =	525 m
Irrigation Canal (Block Raising)	L =	490 m
Intake (φ400)		1 place
2. Breeding Program Plot of CLGC		
Land Leveling	A =	3.6 ha
Irrigation Canal (Concrete Lining)	L =	550 m
Intake (φ400)		1 place
Drainage Canal (Earth Lining)	L =	460 m
Farm Road	L =	390 m
3. Variety Collection Plot of CLGC		
Land Leveling	A =	6.5 ha
Irrigation Canal (Concrete Lining)	L =	830 m
Drainage Canal (Earth Lining)	L =	1,060 m
Farm Road	L =	950 m
4. Screen House in CLGC		
Screen House (10.0 m × 5.0 m)		10 ridges



JAPAN INTERNATIONAL COOPERATION AGENCY	
GENERAL PLAN	
PREPARED BY	DRAWING NO.
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Summary Report

CHAPTER 1 – INTRODUCTION

1-1 Background and Propose of the Activities

The Kasetsart University, of the one part, is the principal academic institution in Thailand responsible for agricultural research and the teaching of agricultural science.

Japan, of the other part, has already provided technical cooperation under a grant aid scheme implemented in 1978 and 1979 and involving the construction, on the Kamphaengsaen Campus of the Kasetsart University, of the Central Laboratory and Greenhouse Complex (CLGC), the National Agricultural Extension and Training Center (NAETC), and the National Agricultural Machinery Center (NAMC) and in two previous projects (under phase I), being the Strengthening Research Activities Project at Kasetsart University and the Agricultural Extension and the Agricultural Mechanization Project at Kasetsart University.

In recognition of, and with reference to, the results of these two foregoing projects,Thailand has called upon Japan to provide technical cooperation in the Phase II project with a view to further upgrading and reinforcing the research activities conducted at the Central Laboratory and Greenhouse Complex (CLGC) and the National Agricultural Machinery Center (NAMC).

Upon receipt of, and acting on, this request, in order to examine the proposal, Japan dispatched the Preliminary Investigation Team in October, 1986, and consequently has arrived at the conclusion that such technical cooperation would indeed greatly contribute to the upgrading and reinforcing of the research activities conducted at the Kasetsart University.

Having thus acknowledged the merit of said technical cooperation, in April, 1987, the Implementation Survey Team was dispatched and the discussions about the feasibility of the provision of technical cooperation in the implementation of the Phase II Project have been done between the Team and Thailand. Finally the two sides came to agreement and after setting their signatures on the Record of Discussions the technical cooperation of the Project has started.

In view of the felt need for the implementation, on the Kamphaengsaen Campus, of the preparation of the experimental fields or sites to be used for the research of breeding programs and variety collection and for the testing of the agricultural machinery concerned, and the erection and installation of screen houses to be used for tissue culture research, the project tasks hereunder entail the detailed design for the fields/sites and facilities required for the execution of these research activities.

The present report document is therefore comprised of the following information.

1. Cost estimate for the detailed design and construction work under the present project.

2. Preparation of the detailed design drawings.

3. Drawing up of the bid documentation.

1-2 Schedule of Detailed Design Survey and List of the Interviewer

Schedule of detailed design survey in Thailand

Aug. 8th	Arrived in Bangkok (TG.641)
9th	Movement to the project site (Bangkok-Kamphaengsaen) Courtesy call on NAMC,CLGC office and meeting with Japanese experts,Thai project staffs
10th ~11th	Meeting with Thai project staffs Field reconnaissance in the project site Preparation for survey
12th	Field survey (Water sampling,etc.) Movement to Bangkok
13th ~14ht	Discussion for preparation of the survey Data arrangement
15th	Courtesy call on JICA Bangkok office and meeting Preparation for topographic survey
16th	Movement to the Project site Discussion of the survey with Japanese experts
17th ~29th	Survey in the Project site Data collection and analysis Topographic survey in the Project site
30th~ Sep. 8th	Preparation of the Field Report and drawings Topographic survey in the Project site

9th	Submission of the Field Report to Japanese experts and discussion with the Project Implementation
10th	Movement to Bangkok
11th	Meeting and discussion concerning the Project Implementation
12th	—— ditto ——
13th ~14th	Data arrengement
15th	Visit the JICA office and meeting with submission the Field Report
16th	Leave Bangkok for Japan (TG.640)

LIST OF THE INTERVIEWERS

Kasetsart University	
1. Dr.Kamphol Adulavidhaya	Vice Rector for Research and Development Planning
2. Dr.Thira Sutabutra	Directer, KURDI
3. Dr.Thira Chaichanawongse	Deputy Director, KURDI
4. Mr.Kruik Naritoom	Vice Director, KURDI
5. Mr.Porn Rungchang	Assistant Vice Rector Kampaengsaen
6. Dr.Supat Attathom	Head, CLGC
7. Mr.Akradet Artachinda	Assistant Head, NAMC
8. Dr.Bundit Jarimopas	Head, NAMC
9. Dr.Kasem Sooksathan	Assistant Professor, CLGC
10. Mrs.Panie Temiesagdie	Head of Seed Technology Unit, CLGC
11. Miss Chuanpis Aronrungsikul	Deputy Head of Seed Technology Unit, CLGC
12. Miss Sirikul Wasee	Researcher
Regional Irrigation Office	
13. Mr.Supojana Rujirakul	Engineer (Vajiralongkorn Dam)
14. Mr.Dumrong Maungham	Engineer (Song Phinong Project)

LIST OF THE INTERVIEWERS

Embassy of Japan in Thailand	
Mr.Nobuyuki SAMEJIMA Mr.Kazuo HIRASHIMA	First Secretary First Secretary
Bangkok JICA	
Mr.Ben SAITO Mr.Koji ENDO Mr.Chisa HARA	Director Deputy Director Assistant Resident Representative
Japanese Experts	
Mr.Hiroshi HARADA Mr.Masahiro YONEYAMA Mr.Yoshiaki GOTO Mr.Toshio YAMAUCHI Mr.Tadashi NOBUCHI Mr.Hirobumi YAMAMOTO Mr.Shozo KUWATSUKA	Team Leader

CHAPTER 2 - SITE INVESTIGATION

2-1 Location

The Kamphaengsaen Campus of Kasetsart University occupies a ground area of 1,250ha and is located approximately 80km from Thailand's capital Bangkok (14 degr. 01' northern latitude and 99 degr. 58' eastern longitude) in the Province Nakhon Pathom (Fig.1).

The National Agricultural Machinery Center (NAMC) is located virtually in the center of the northern part of the campus along the west side of the main road, and its experimental fields are situated some 250m west of the Center.

The experimental farm for Breeding Programs between the NAMC and the field grounds belonging to the NAMC is located on the south side of the experimental fields which were established as the experimental site under phase I. The experimental fields for Variety Collection, however, are located approximately one kilometer east of the NAMC, along the main road that runs parallel to the RID canal extending in the east-west direction.

A topographic survey of the site has been performed and produced the following results.

a) Topographic data of the experimental farm of the NAMC

1) Survey area: 2.4 ha

2) Level survey

A standard line was fixed to establish a 20m×20m grid form this standard line, and the elevation above sea-level was determined at each grid intersection.

Number of measurement points: 91 points

3) The wall head of the existing concrete canal was taken as having an elevation of EL.10.00 to obtain the BM.

b) Topographic data of the Breeding Program Plot of CLGC

1) Survey area: 3.6 ha

2) Level survey

A standard line was fixed to establish a 20m×20m grid from this standard line, and the elevation above sea-level was determined at each grid intersection.

Number of measurement points: 117 points

3) The wall head of the existing concrete canal was taken as having an elevation of EL.10.00 to obtain the BM.

4) Number of vertical rows measured: 4

c) Topographic data of the Variety Collection Plot of CLGC

1) Survey area: 6.5 ha

2) Level survey

A standard line was fixed to establish a 20m×20m grid from this standard line, and the elevation above sea-level was determined at each grid intersection.

Number of measurement points: 176 points

3) The wall head of the existing concrete canal was taken as having an elevation of EL.10.00 to obtain the BM.

4) Number of vertical rows measured: 4

2-2 Topography and Geology

The western part of the central Plain of Thailand can be divided into four geologically different areas. These are 1) the ancient delta zone of the Chao Phraya River, 2) the recent delta zone of this river, 3) the calcareous zone, and 4) the fan-shaped zone sorrounding these three areas.

The surface layer of the ancient delta zone of the Chao Phraya River is constructed with slightly weathered soil.
Topographically this zone presents a little rugged terrain and has a gentle slope on the south. An elevation of the slope zone varys from 5m to 15m above sea-level and transition of the slope is found conspicuously along the borderline of the recent delta zone.

While in some parts, the recent delta zone of the Chao Phraya River has an elevation above sea-level of 3.5m or higher, it exhibits, for the most part, a very flat topography not rising above 2m elevation.

The calcareous zone, however, borders upon the open fields of the western plain, presenting a rugged terrain with steep eminences and depressions. This area may be considered a relic of a topographical formation pre-dating the diluvium. The original formations have undergone a repeated cycle of weathering, decomposition, and substitution in the quaternary under the action of many successive calcareous formations.

The fan-shaped area faces the center of plain and has some very steep slopes. Topographically, the area has formed as a result of an erosion process stretching over a long period of time in which the fan-shaped, terraced terrain was gradually shaped.

Fig.2 shows an overview diagram of the area (Southeaet Asian Studies, vol. 10, No. 2).

The Kamphaengsaen Campus is located at 185 in the diagram and is close to the recent delta zone of the Chao Phraya River within the fan-shaped zone.

Its elevation above sea-level lies between 6m and 7m.

2-3 Climate

2-3-1 Climatic Data

The climatic data required for the planing of the present project works have been taken from the results of earlier meteorological measurements performed at the Meteorological Observation Center located on the Kamphaengsaen Campus precincts of the Kasetsart University. These data, covering the period from 1973 through 1987 were used and analyzed. Tables 1 through 5 are a summary of the data which have been plotted in graphic from in Figs.3 through 8.

1. Atmospheric temperature by month (℃)
2. Humidity by month (%)
3. Wind velocity by month (m/sec) (Average)
4. Wind direction
5. Precipitation (rainfall) by month (mm)
6. Evaporation by month (mm)
7. Hours of sunshine by month (h)

2-3-2 Rainfall

Based on the above data for the monthly rainfall and average annual rainfall quantities and the annual pattern of rainfall, it has been established that the annual rainfall in the area under study amounts to 1,050-1,060mm. The rainy season covers the months from May through October and the dry season starts from November and ends in April. The project area is characterized by a seasonally concentrated pattern of rainfall, with 85% of the entire precipitation in a year (900mm) falling in the rainy season.

2-3-3 Wind Velocity and Prevailing Wind Direction

As can be seen from the wind velocity data (Table 8), the average wind velocity in the project area is around 2m/sec. Investigations of the prevailing directions of the wind have shown that at the beginning of the raining season in May, the wind blows predominantly in the S-SW direction and that this direction changes to a SW-W pattern as the rainy season goes in the months of June, July, August, and September. With the start of the dry season in October, the wind begins to reverse its direction, blowing in the NE direction. This pattern continues through November and December. In January and February, however, the wind direction makes another turn-about from the NE to the SE. In March and April the wind direction is prevalently SE-S.

2-4 Soil

A soil survey was conducted by drilling of a test pit and a hand auger. The drillings of the test pit were performed in two locations on the experimental farm site belonging to the NAMC and in one location of the variety collection plot of the CLGC, that is, in a total of three locations. These drilling locations are shown in Fig.9. The test pit has a double-stepped contour to drill to a depth of 0.80m. The drilling with the hand auger went to a greater depth of 1.5m.

Tht soil survey has demonstrated that the arable soil layer has a depth of 20-30cm and that the underlying strata down to a depth of 2.5m consist of sandy loam and silt loam. The survey drills have also shown evidence of fine and coarse sand at a depth of around 2m.

If the soil map according to the findings of a soil survey conducted by the Department of Soil Science of the Kasetsart University and presented in a report (Hydraulic Properties of Kamphaeng Saen Soil Series) is compared with the diagram giving the positions of the test pit locations for the present drill survey by superimposition, it is clear that the results of the present survey are in extremely good agreement with those obtained by the Department of Soil Science.

The test pits were left in the soil for about two or three days after the survey drill had been completed in order to observe whether or not the ground water would rise in the boreholes. The observations showed that there was no rising ground water and that the only rainwater was present. To measure the ground water conditions on a regular on-going basis, a 2.0m PVC pipe was prepared and lowered into the borehole produced with the hand auger. The water level in the pipe was measured with a float at regular intervals for six days. These measurements were carried at a fixed time each day. The results, presented in Table 6, show that the groundwater level in the auger holes remained constant in the region of 1.7-1.8m under the field surface.

2-5 Soil Properties

Soil tests were carried out to establish the following properties of the soil.

1. Specific gravity
2. Liquid Limit test
3. Plastic limit test
4. Grain size analysis
5. Permeability test

Samples of the sub-soil were taken to a depth of 0.80m below the surface by drilling of a test pit on the Experimental Farm of the NAMC.

Table 7 gives the test results.

From the results of the tests to determine the grain size distribution and the limit of plasticity, it is possible to classify the soil as being of class "CL-ML" in accordance with the Japanese Unified Soil Classification.

In view of the particular relationship between the coefficient of uniformity and the coefficient of curvature, it is clear that the soil of the project area has a grain size distribution characteristic of a poor-graded soil, and consequently it is considered that the soil has unfavorable characteristics about its mechanical properties. Since the soil has a small plasticity index, the slightest change in the soil's water content is liable to produce a dramatic change in soil condition. Since, however, the plasticity index IP is in the region of IP=6.5>4, it may be assumed that the soil presents no problem in terms of its use for as the upper sub-grade.

Permeability tests conducted on undistributed samples showed that the soil has a coefficient of water conductivity of $K = 4.1 \times 10^{-5}$cm/sec., a value indicating a somewhat high permeability of the soil to water. If the soil is thus flooded for paddy field cultivation, the soil structure in the plow layer will be identical to that of a sub-soil stratum. In view of this poor conservation ability, the soil can be expected to exhibit a very high permeability to water. By contrast, the structure of the soil in the Variety Collection Plot is felt to be identical to that of the NAMC, so that it may be concluded that its use as an upland field might give rise to a rather considerable permeation potential. This can also be interpreted as signifying, on the contrary, that this soil would not present any problems in terms of drainage.

2-6 Water Quality

Tests were performed on water samples taken from the locations detailed below viht a view to determining the suitability of the exsiting water resources in the project area for irrigation purposes. The sampling locations were as follows:

1. Seed project plot of the CLGC
2. RID canal
3. ditto
4. Regulating reservoir adjoining the RID canal
5. Household supply water at the Research Center
6. Existing reservoir in the University precincts
7. Water tower supplying general household water to the University complex
8. Existing reservoir in the University precincts

The water quality in terms of its suitability for irrigation purposes was estimated in accordance with the method laid down by the United States Department of Agriculture (USDA).

As shown in Fig.10, this method involves a classification of water resources into four different categories on the basis of their respective suitability as irrigation water by using the Sodium Adsorption Ratio (SAR) and the Electric Conductivity (EC) as the classification criteria.

SAR can be calculated by the following equation.

$$SAR = \frac{Na^{+}}{\sqrt{(Ca^{++}+Mg^{++})/2}} \qquad \text{(USDA)}$$

The water analysis results are given below.

Site	Title of Sample	E.C. MMHOS/CM 20°	pH	SAR	Sodium Hazard	Salinity Hazard
Deep well of Seed Project	1	2,050	6.3	30.6	S 4	C 3
RID canal	2	195	6.5	0.05	S 1	C 1
RID canal	3	190	6.6	0.90	S 1	C 1
Reservoir (RID)	4	195	6.6	0.75	S 1	C 1
CLGC Office	5	750	6.7	19.1	S 4	C 3
Existing farm pond	6	1,250	7.1	25.0	S 4	C 3
Feed tank	7	610	7.1	16.4	S 3	C 2
Existing farm pond	8	1,750	7.5	32.9	S 4	C 3

This water analysis table can be interpreted as follows.

i) The existing ground water and ponds have a high sodium and salinity hazard so that they cannot be considered suitable as water reserves for irrigation purposes. The ground water sampled from the water tower supplying the University complex with general household grade water (sample 7), however, does possess a relatively favorable quality as compared with the ground water samples taken from the other deep-wells (samples 1 and 5). The reason why these ground water samples manifest different water qualities can be attributed to the difference in sampling depth. Thus, ground water sampled from an aquifer at a depth of around 100m is found to have rather favorable properties suggesting that ground water of a suitable high-grade quality can be obtained from such depths. The other ground water, however, sampled from an aulfer at a depth of 30~40m has unfavorable properties.

It is therefore concluded that, in the absence of a different suitable irrigation water candidate, these water sources may be considered usable on condition that appropriate measures or methods are selected to prevent the accumulation of salt in the root zone through irrigation with large quantities of irrigation water and by "watering down " the salt levels with generous amounts of water of suitable quality. These measures come in addition to desalination for the rainy season and the development of local crop varieties that are tolerant to a high soil salinity.

ii) The water flowing through the RID canals are considered suitable for irrigation purposes.

2-7 General Irrigation Water Supply

The two field sites apart from the Experimental Farm of the NAMC are currently totally dependent on natural water for irrigation, with sweetcorn as partially the only crop grown on these fields which still have no proper top surface formation.

2-7-1 Irrigation Water Sources

The following water reserves may be considered as suitable irrigation water supply sources for the above field sites.

(1) Existing water-collecting ponds
(2) Use of water from the RID canals
(3) Utilization of underground water

Investigations of these three possibilities and the availability of these sources of irrigation water have shown the following results.

(1) Existing water-collecting ponds

There are several water-collecting ponds on the University precincts, but this water has so far not been used for irrigation purposes. They are considered to be unsuitable as an irrigation water source for a variety of reasons: In the dry season, these ponds dry out almost completely. They are not located near the fields requiring irrigation but at a distance of over 1 km. Nor is the quality of this pond water suitable for irrigation purposes.

(2) Use of water from the RID canal

The general supply water flowing in the canals adjoining the fields is a possible water source that may be used for the experimental fields in the Kasetsart University.

These canals feed irrigation water from the Vajiralongkorn Dam, built approximately 14km downstream of the Mae Klong River from Kanchanaburi City as part of the Great Mae Klong Project.

The general supply water schedule for the fields in the University complex is being drawn up by the University's Irrigation Department on this basis (Fig.11). The agricultural zoning of the fields and the irrigation water conduits as well as the regulating reservoirs have already been completed. The three experimental fields concerned are located in positions facing the canals whose water intake holes have been built in convenient locations to withdraw water. If these RID canals are to be contemplated as irrigation water sources, the question arises whether or not they can provide a stable water supply. To assess this question, we have conducted a survey by directly interviewing the appropriate executives at the Great Mae Klong Project Office which we visited for the purpose.

The RID canals are routed from the dam to the Kasetsart University through a stretch of approximately 50km.The Great Mae Klong Project is made up of a number of projects, each covering a small irrigated area. The Kasetsart University falls within the scope of the Banglien Project.

At present, the Banglien Project is lumped together, in budget terms, with the Son pi non Project whose area of benefit is located further upstream. Virtually the entire budget is spent on the Son pi non Project which is currently being executed, and the present progress status is that most of the project activities are yet in the design stage.

The water supply route to the Air Force Base (9L-2L) and the water supply route to KU (6R-2L, 1L-6R-2L), however, were completed in January, 1986, with the water coming "on-stream" in December, 1986.

The plan to supply water from the dam envisages the continuous flow of water, except for two regular stoppages of the water supply in a year to allow from repair and maintenance work on the water installation. The timing of these periodic maintenance stoppages has been fixed by taking into consideration the cropping patterns of the downstream areas irrigated under this project. (The stoppages take place as follows: Middle of June through middle of July, i.e., one month and end of December through beginning of February,i.e., one month.)

Except for these two months, when the water supply is stopped for regular maintenance, the University enjoys a stable supply of water from the RID. While the construction work on the canal as the water supply route from the RID was still not completed, the University took its own measures by installing a water pumping station of its own and operating it to secure its water needs. This water pumping station was located on the Ban Yan Canal (downstream of the Mae Klong River) some 1.5km west of the University precincts. The volute pump operated at this station was of 300mm dia. /110kw capacity, with a delivery rate of Q=10 cubic meter/minute.

The pumphouse was permanently manned by a pump attendant, and the pump was operated by him via remote radio control from the University. The machinery including the pump has now been removed and the pumping station abandoned.

Thus, the water supply from the RID canals must have been considered, by the University, as being a reliable and stable source so that it was felt that the pumping station could be scrapped.

This RID water is also considered suitable for irrigation purposes without posing any problem in terms of its quality.

(3) Utilization of Ground Water

The irrigation water supply within the University precinct is being met by relying on the RID canal, as has been described above. Yet, the household water requirement is currently being met almost entirely by using ground water. To pump up and store the ground water, there are several pumping stations and water tanks.

The only precedent of a ground water facility used exclusively for irrigation purposes is the deep-well, a well sunk as part of the neighboring Seed Project.

The data relating to the existing wells on the Campus are scanty, and the only data available are those referring to MD107 and ME1 well that are currently no longer in use, and the test data for the pump stations under the Seed Project. Table 8 presents these data.

Since the Seed Project data are the most recent figures and in view of the fact that the Seed Project borders on the present project, it may be safe to consider the evidence as reliable. These figures suggest that the supply rate of the experimental pumping station is given as 0.91 cubic meter/minute. Allowing for a certain safety factor, it may therefore be assumed that the pumping station could yield a constant supply of 0.7 cubic meter/minute.

As can be seen from the data in the Appendix, the water quality must be considered unsuitable for irrigation.

2-8 Current Drainage Facilities

The general topography of the University campus is characterized by a gradient, sloping from the north-west toward the south-east. Drainage culverts have been laid between the University campaus and the main road adjacent to the University on the south-east side.

The University campus has a large number of ponds of varying size, with four large ponds as shown in Fig.13.

The existing general service water supply routes as well as the household-grade water supply routes do ultimately all terminate in a pond.

These man-made ponds dry up completely in the dry season. In the rainy season, however, these ponds are flooded with excess water which could be utilized for irrigation of the surrounding areas.

During the rainy season, flooding does occur in the experimental fields and it is essential to ensure that adequate drainage is provided so that the experimental fields can be effectively utilized.

CHAPTER 3 - PLANNING AND DESIGN OF FACILITIES

3-1 General Plan

The field sites and screen house constructions under this projects shall be built on the following scale.

a) Experimental Farm of NAMC

The research objectives for the project fields are the development of farming and land preparation techniques to facilitate the use of agricultural equipment in fields.

Test have been conducted by varying the ponding depth between 0-150mm and determining the resulting effected on the operation of the seedling planting machines. In Thailand, the field plot area is normal 5,000-6,000m² so that the field size can be taken as 95m×60m. To enhance the efficiency of the experiments, two field plots should be planned for. Thus, the area to be considered is A =95m ×60m ×2 =11,400m².

b) Breeding Program Plot of CLGC

Research in the breeding program plots is designed to establish the breeding techniques for the main vegetable varieties currently cultivated in the area, i.e., sweetcorn, cucumber, tomato, and giant radish as well as the selection of varieties best suited for the region.

The field plot sizes are approximately 10 rais (1.6ha) for sweetcorn , and 10 rais (1.6ha) for cucumber, tomato, and giant radish. The total area is 3.6ha by allowing for the shape of the site.

c) Variety Collection Plot of CLGC

The purpose of research at the variety collection plot is to collect data on sugar cane varieties, agricultural productivity, irrigation requirement, fertilizer requirement, and infestation/insect/pest protection and to evaluate the agricultural productivity of the land for papaya. Considering the size of the present plot, the site should have a size of approximately 100 ×210m, consisting of three plot areas: 1 for papaya and 2 for sugar cane. The total is thus A=6.5ha.

d) Screen Houses in CLGC

Research in the screen houses tries to examine the possibilities of speeding up the growth of sugar cane and papaya seedlings, through the use of novel tissue cultivation technology with the purpose of enhancing the quality of the crops.

The screen houses are also to be used for the cultivation of improved varieties.

The size of the screen houses is to be 10.0 ×5.0m to allow for the need to facilitate indoor work and the need for indoor storage.
Five screen houses will be required for tissue cultivation and other five screen houses for vegetable breeding, so that a total of 10 screen houses will be required.

3-2 Land Re-adjustment

3-2-1 General

The general plan for the road, irrigation, and drainage systems (general irrigation and drainage system layout-Fig.11) has been proposed for the Kasetsart University farm and is currently being executed. This plan has been developed by the University.

For the experimental farm of the NAMC, the size of one block (farm plot) has already been defined as being 500m×500m. These have been sub-divided into eight sub-blocks of field plots of 125m×250m each.

An allocation plan for the land has been established by taking into consideration the fact that the Breeding Program plot of the CLGC is surrounded by the experimental vegetable farm of the Seed Project implemeneted in 1981 and the NAMC and the experimental fields of the NAMC. Similarly, the variety collection plot of the CLGC has also been divided into land plots in accordance with the overall plan established by the University as has been pointed out above.

The land re-adjustment plan is to be executed subject to the condition stated above, and what the plan entails will be a plan for dividing the land into farmland blocks and land leveling works.

3-2-2 Plan of Making Field Block

Under the land block plan, the eventual shape of the farm land is to be determined on the basis of the general irrigation and drainage system plan and the site survey results. The resulting shape of the farm plots will be arrived at by an equal division, into rectangular blocks, of the area falling within the scope of the plan, as can be seen in Fig.14.

In principle, the size of the field blocks will be 120m ×75m at the Breeding Program plot of the CLGC and 200m ×100m at the Variety Collection plot of the CLGC.

In view of considerations referring to the effectiveness of the irrigation and drainage plan and the work on agricultural machinery, these field blocks will be broken down even further. The arable plots obtained by this further subdivision will have a size of 40m ×100mm and rectangular shape. As can be seen from Fig.15, the efficiency that can be achieved in working of these arable field plots may be over 70% if a large tractor + 1.5m rotary loader is used. Thus, the size of the field plots is large enough to ensure the effective use of large-size agricultural machinery.

3-2-3 Land Leveling

The topographical site survey has shown that the site has an uneven contour with significant ups and downs so that due consideration has been given to the natural gradient of the terrain by allowing for the irrigation and drainage planning for the field blocks and the agricultural machinery work.

The present topography of the field plots requires some leveling. For this purpose, the present plan involves the reduction of the high parts of the terrain and filling the excavated soil onto the low-lying parts because the existing field as a whole is on rather gentle slope from the northwest toward the southeast. The elevation of the field blocks should thus be fixed so that a good balance is achieved between the earth removal works and the filling works. This should minimize the need for dumping soil on other sites.

The Breeding Program plot of the CLGC will have a 1/2,000 gradient in the south-north direction and a 1/500 gradient in the east-west direction to ensure the effective implementation of the irrigation and drainage plan. The Variety Collection plot of the CLGC is due to have a 1/500 gradient in the east-west direction and a 1/1,000 gradient in the south-north direction. But it will be necessary to level the terrain within the arable land so as to permit the use of the paddy field of NAMC.

3-3. Irrigation Plan

3-3-1. General

The irrigation plan for the University grounds provides for the irrigation water supply from the RID canal to be sent to regulating pond located on the University precincts first, with the water being subsequently pumped up for distribution through a pipe flow type system to the individual fields. Alternatively an open channel type system may be used instead of the pumped-up pipeflow system.

Three of the field sites under the present projects neighbor on the RID canal so that new water intake facilities may be installed on this open canal system or, alternatively, the existing water intake systems may be used to direct the fields.

The table below gives the cropping patterns and crop plantation surface areas for the different field sites.

Field Site	Type of Crop	Planting Area
1. Experimental Farm of NAMC	Rice	1.14 ha
2. Breeding Program plot of CLGC	Sweet corn Tomatoes	3.6 ha
3. Variety Collection plot of CLGC	Papaya Sugar cane	6.5 ha

3-3-2. Irrigation Plan

(1) Unit Water Requirement

The unit water requirement can be calculated by the following formula;

$$Dw = 0.116 \times Wn \times 100/E$$

where Dw : unit water requirement (ℓ/sec/ha)

E : irrigation efficiency (%)

Wn : net irrigation requirement (mm/day)

$$Wn = ET\ crop - (Pe + Ge + Wb)$$

where ET crop : crop evapotranspiration

$$ET\ crop = KC \times ETo$$

KC : crop coefficient

ETo : reference crop evapotranspiration

Pe : rainfall

Ge : groundwater contribution

Wb : stored soil water

The reference crop evapotranspiration (ETo) has been estimated by calculating it (by the Penman method) from the meterological data that are locally available.
Table 9 presents the calculation results.

For the present project, the reference crop evapotranspiration (ETo) has been calculated as being 6.8 mm/day. The crop coefficient (Kc) assumes the values given in the table below and the crop evapotranspiration (ETcrop) has been determined as shown in the following table.

Field Site	Type of Crop	ETomax (mm)	KCmax	ETcrop (mm)
1.Experimental Farm of NAMC	Rice	6.8	1.25	8.5
2.Breeding Program plot of CLGC	Sweet corn Tomatoes	6.8	1.05	7.1
3.Variety Collection plot of CLGC	Papaya	6.8	1.0	6.8
	Sugar cane	6.8	1.05	7.1

The effective rainfall data have been assessed on the basis of the rainfall records that are locally available. While some years bring rainfall even in the dry season, this must be regarded as off-season irregular rainfall that cannot be depended upon.
To allow for sufficient safety, this rainfall should therefore be disregarded.

The water losses likely to arise in transit, that is, while the irrigation water is being distributed to the farm plots, and the water losses encountered on the field plots, must be duly taken into consideration. To allow for these losses, the irrigation efficiency has been estimated at E = 60 (%).

Based on the results examined on the previous page, we can now determine the unit water requirement as shown in the following table.

Field Site	Type of Crop	Dw (ℓ/sec/ha)
1. Experimental Farm of NAMC	Rice	1.7
2. Breeding Program plot of CLGC	Sweet corn Tomatoes	1.4
3. Variety Collection plot of CLGC	Papaya Sugar cane	1.3 1.4

(2) Puddling Water

At the Experimental Farm of NAMC, the irrigation water requirement peaks in the puddling season.

The puddling water requirement can be determined from the following formula.

$$LP = (1/n) \times SS + KC\ ((n-1)/n \times PE) + SP$$

where LP : puddling water consumption

SS : puddling water requirement 150 mm/day

KC : crop coefficient in the puddling period KC = 0.7

n : number of puddling days n = 2 days

PE : crop evapotranspiration PE = 6.8 mm/day

SP : inundation volume SP = 75mm

Planting machines for the rice planting are used on the experimental fields under the present project so that one of the research themes addresses itself to the problems of soil preparation. One of the conditions stated for soil preparation is that the ponding depth should be changed to a maximum of around 150mm. We have here used a flooding or ponding depth of 75mm as an average value. If we substitute the corresponding numerical values in the above equation, we will obtain a value of 152.4mm for the puddling water demand.

Thus, the unit water requirement is 29.5ℓ/sec/ha.

(3) Designed Water Requirement

The designed water requirement levels are given in the table below.

Field Site	Planting Area	Design Water requirement
1. Experimental Farm of NAMC	1.14 ha	29.5ℓ/sec
2. Breeding Program plot of CLGC	3.6 ha	5.1ℓ/sec
3. Variety Collection plot of CLGC	6.5 ha	9.1ℓ/sec

3-3-3. Irrigation Canal Plan

(1) Design of Irrigation Canal

The irrigation water supply network has been designed by allowing for the shape of the field plots, the topographical gradient, the water intake points, and the drainage systems.
Fig.17 shows the canal network.

The cross-sectional shape of the irrigation water canal is trapezoidal for the open channel (concrete lining) type system.

The cross-section of the irrigation water canal has to be designed for canal section to ensure the supply of the designed water requirement with a generous margin. Another essential design requirements is that the system should not overflow in the peak discharge period when the maximum water flow is handled.
It is also necessary to take the elevation of the field plots and the topographic gradient of the terrain into account when determining the canal gradient. The irrigation interval should be taken as 10 days.

The calculations for the water requirements are performed by the Manning equation given below. The results are given in Table 12.

$$Q = A \cdot \frac{1}{n} R^{2/3} I^{1/2}$$

where Q : designed water requirement; (m^3/sec)
A : discharge section area; (m^2)
n : coefficient of roughness; n = 0.015 (assuming that the open canal has a concrete lining)
d : water depth; (m)
B : width of canal; (m)

R : hydraulic mean depth; (m)
P : wetted perimeter; (m)
I : canal slope
H : height of side wall; (m)
Fb: free board; (m) $Fb = 0.05 \times d + h\upsilon + 0.15$
hv: velocity head; (m)

(2) Design of Water Intake Facilities

The water-intake capacity from the water gates will vary depending on the variations of the water level in the main canal on the Campus precincts. Consequently, a system design should be selected so as to ensure necessary water requirement by maintaining the water level constant through suitably operating the check gate of the main canal.

In this section, we have calculated the water intake capacity with reference to the water level in the main canal.

The water flow rate through water intake gate can be calculated on the basis of formula (1) if the water intake takes the forms of a water pipe. If, however, the level in the main water supply canal falls and the water flows into the irrigation network in the form of an open channel, this flow rate must be seen from the diagram by using parameter which is calculated on the basis of formula (2) under consideration of a down-flow pattern with a water depth of uniform flow.

$$Q = K\sqrt{2gH} \quad \cdots\cdots\cdots\cdots (1)$$

where Q : water flow rate of water intake gate per hole(m^3/sec)
K : coefficient of head loss
g : $9.8 m/sec^2$
H : differance in water level

$$K = \frac{Q \times n}{I^{1/2} \cdot r^{8/3}} \quad \cdots\cdots\cdots\cdots\cdots \quad (2)$$

where k : parameter

n : coefficient of roughness

r : radius of pipe

The calculation results are given on Table 13 ~15. From these results it is clear that to take off water at the maximum intake capacity it will be necessary to control the water level in the main canal in such a manner as to raise the weir to a position corresponding to, or above, that given on the next page.

Position	Height to which weir must be raised to take off water at the maximum intake capacity (cm)
1.Experimental Farm of NAMC	0.67
2.Breeding Program plot of CLGC	0.59
3.Variety Collection plot of CLGC	0.15

3-4. Drainage Plan

3-4-1. General

The annual rainfall on the project site is given as 1,050 mm. This is a relatively small amount of rainfall. The annual rainfall pattern is marked by a clear seasonal pattern that can be broadly divided into a rainy and dry season. Since the project farm area has a seasonally concentrated rainfall pattern, the rainy season will create flooding problems throughout the site. These flooding conditions tend to make it impossible or difficult to use agricultural machinery.

3-4-2. Hydrological Analysis

The rainfall data required for hydrological analysis are given from the daily rainfall monitoring data (collected for 15 years) compiled by the hydrological observation department of the University. The analysis technique used is based on the Hazenplot method, and these analysis results are given in Fig.18.
Table 16 gives the probable rainfall levels by year.

3-4-3. Design Intensity of Rainfall

The probable rainfall levels used for the drainage plan in this project have been calculated for a probability incidence equal to once in a five-year period, by allowing for the fact that this has to be drained from agricultural land.

The probability incidence values on a five-year basis obtained by calculating the probability of rainfall of the given intensity occurring once in a five-year period on the basis of the above rainfall monitoring data give a rainfall intensity of around R24 = 100mm/day. This value should therefore be regarded as the design rainfall to be used as the basis for the drainage plan.

3-4-4. Unit Area Drainage Discharge

To ensure that no flooding occurs, the dry farm fields and the rotational paddy fields require a drainage capacity able to drainage of 4-hour rainfall within 4-hour. This drainage capacity can be calculated by the following formula.

$$Q = 10 \times f \times RA \times A / 3,600 \times T$$

where Q : design drainage capacity; m³/sec

f : runoff coefficient

;f = 0.6 (assuming a flat field)

RA: 4 hours rainfall

$$R^4 = \frac{R24}{24} \times \left(\frac{24^{2/3}}{T}\right) \times 4 = 55mm$$

R24 = 100mm/day

T : drainage time; T = 4 hours

A : drainage area; A = 1ha

$$Q = 10 \times 0.6 \times 55mm \times 1ha / 3,600 \times 4hrs$$

$$= 0.023\ m^3/sec/ha$$

3-4-5. The Drainage Canal Network

The drainage canal network shown in Fig. 19 has been planned on the basis of the topographic gradient of the project site and by giving consideration to the University's general supply water and drainage plans.

The cross-section of the drainage canals shall generally be equal to that of the earth lining canals. The cross-sectional shape can be determined by means of the Manning equation with a generous margin so as to ensure a safe discharge of drainage water at the design capacity. Fig.20 shows the cross-sectional shapes for each of the canals.

3-5. Farm Road Plan

3-5-1. General

The trunk roads are provided under the general water supply and drainage system plan of the University. For the lateralroads in the field plots, however, the current situation is far from being satisfactory since these roads do not permit the passage of large agricultural machines because of the narrow effective width.

3-5-2. Road Way Plan

The farm roads are to be planned along the terms of the farmland block division plan by using the existing trunk roads as the basis.

3-5-3. Types of Farm Roads

Depending on the purpose for which they are used, farm roads have different functions. Under the present project plans, the road system can be broadly divided into the following three types.

Trunk roads... Trunk roads are provided under the general water supply and drainage system plan of the University. One blook is circumscribed to form an area of 500m ×500m, and these trunk roads are formed for the link roads between the farm blocks.

Lateral roads...... These lateral roads off from the trunk roads to subdivide a farm block into sub-blocks, there by forming the link roads between individual field block.

Branch roads..... These branch roads are used for field work and in the harvest time, thus forming the boundaries between individual crop fields.

3-5-4. The Cross Section of Farm Roads

The cross section of farm roads consists of the roadway and the shoulders. Under the present project plan, the effective road width should be decided for each type of farm roads by taking into consideration of the effective width of the agricultural machines and equipment used by the NAMC and CLGC.

- Trunk roads

  Trunk roads have already been. They have an effective width of 6.0m. As shown in Fig. 21, this width is adequate for vehicles and trucks to pass each other on these roads.
  These roads also have side shoulders of 50cm on each side.

- Lateral roads

  Lateral roads currently have an effective width of 3.0-3.5m and are thus not wide enough to allow the pass-age of heavy agricultural machinery. As shown in Fig. 21, the width should therefore be increased to 5.0m so as to permit the passage of large agricultural equipment.

- Branch roads

  Branch roads have a width allowing people to walk in rows.
  Their width is 1.0m.

3-5-5. Height of Road Surface

The height of the road surface must be designed so that they are traffic worthy during rainfalls and permit access for agricultural machinery to and from the fields. The height is to bein the range from 20 to 30 cm.

3-5-6. Road Paving

For economic reasons, road paving should be carried out with laterite, a method widely and commonly used in the area. The paved surface thickness should be 15cm at center and 10cm at side.

3-5-7. Corner Cutting

Corner cutting for the roads should be a=2.0m under consideration of moving tractor being hitched trailer.

3-6. Ancillary Structures

3-6-1. Water Intake Facilities

a) Experimental Farm of NAMC

These water intake facilities have to be built new in the form of a water intake gate installed on the main canal (one steel sluice gate of 400mm diameter). After leaving the water intake gate, the water passes into the existing irrigation water canal.

b) Breeding Progran Plot of CLGC.

These water intake facilities have to be built new in the form of a water intake gate installed on the main canal (one steel sluice gate of 400mm diameter). After leaving the water intake gate, the water passes into the new-made irrigation water canal.

c) Variety Collection Plot of CLGC

These water intake facilities shall use the existing water intake gate already installed, by the University, on the main canal (one steel sluice gate of 400mm diameter). After leaving the water intake gate, the water is sent to the fields through a division box.

3-6-2. Water Gauge

Water gauges are mounted on the side walls of the main canal, having a water intake outlet. The water flow is ckecked by meanes of these water gauges by measuring the water depth.

3-6-3. Diversion Works

Water diversion points shall be erected to divert the irrigation water from the main canal toward the field plots.
These points shall be built at a rate of per 40 m. If the flowrate of the irrigation water should become very small so that water diversion is difficult to carry out, a weir with a stoplog should be provided to control the water level in the canals.

3-6-4. Culverts

Culverts shall be installed in the concrete structures at the intersection points between the irrigation/drainage canals and the farm road ways.

3-6-5. Tractor Passage

Tractor passage shall be provided to allow access for agricultural machines from the roads to the fields.
These tractors passages shall be built at a rate of per 40m.

3-7. Screen House

Five screen houses will be required for tissue cultivation and other five screen houses for vegetable breeding, so that a total screen houses will be constructed. The size of the screen houses is to be 10.0 m× 5.0m in floor area and 1.8m at height.

Double L-beam will be used for the colume and the roof in framework. Upper part of the wall and the roof will be covered with alumi-framed nylon screen. General structure of the screen house should be provided for protection from infestation of insect and pest.

Lower part of wall will be made of 2 layers of concrete block. All steel parts must be finished with enamel painting after rust preventive. At the part of interia slab will be covered with compacted sand and bricks will be spread there to have good ventilation.

CHAPTER 4 CONSTRUCTION PLANNING

4-1. Basic Assumptions

The following items should be considered prior to make a construction plan.

4-2. Basic Planning

4-2-1. Workable Days

Mean workable day is decided as 21 days per month, considering the suspension days caused by rainfall, Sunday, Saturday and national holidays.

4-2-2. Conversion Rate of Earth Volume

The conversion rate of earth volume for making the earth moving plan is dicided as 1 vs. 1.

4-2-3. Earth Moving Plan

In principle, the earth materials necessary for embankment are supplied by a excavated earth materials in the site.

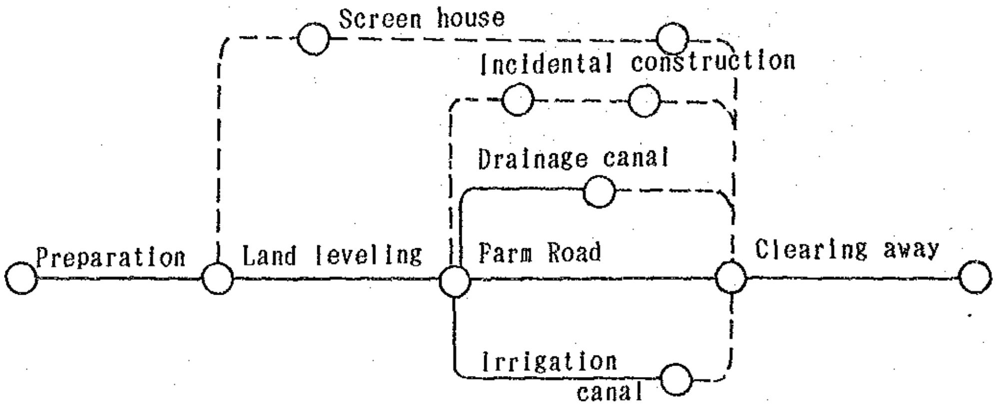
4-2-4. Application of Manpower and Construction Machinery

Manpower is applied for the work, because the work scale is the comparatively small and the employment opportunity for local labour can be increased. The construction equipment is selected as follows.

Dump Truck (8 ton)	transportation
Bull Dozer (11 ton)	excavation or spreading
Back-Hoe Shovel (0.35m³)	excavation
Tractor Shovel (1.2 m³)	loading
Vibration Roller (3 ton)	compaction
Portable Concrete Mixer	mixing of concrete

4-2-5. Work Routine

It is desirable to take the following work routine for implementation of the construction works, which is shown below by means of flow network.



Flow Network of the Construction

4-3. Construction Planning

4-3-1. Land Shape Adjustment and Land Levelling

The construction work for the land shape adjustment and land levelling would be executed by construction equipment, because the earth volume of cut and banking is very much. Excavation works of the farm are mainly made by Bull dozer, loading by Tractor shovel, and hauled by Dump truck. The construction of land shape adjustment would start after completion of the land levelling.

4-3-2. Irrigation and Drainage Canals

Irrigation canals are made of concrete lining. Drainage canals are made of earth lining. The excavation and filling work for these canals will be executed together with the work of farm road construction where the road and canals run parallel; earth works for canals will be done by man-power. Concrete for canal lining is to be mixed by portable concrete mixier of about 0.22m³ in capacity, placed by man-power, and compacted by vibrator.

4-3-3. Farm Road

Materials suitable for the embankment of farm road will be obtained from the site, and will be placed in layer by equipment and compacted by Vibration roller or hand operated mechanical tamper. The surface of the road is paved with bought laterite. Pavement will be executed after completion of embankment for the farm road.

4-4. Construction Schedule

The time required for construction of the project would be about 6 months including about one month of preparation of tender documents, tender calling and tender award and Final Inspection. The proposed construction schedule is shown in Table 18.

CHAPTER 5 CONSTRUCTION COST ESTIMATION

Construction cost of the project is estimated by ususing bill of quantities taken from the detail designs, drawings and reasonable unit costs. The construction cost is including tax, profit and overhead, and also including contingency for price escalation and physical measures of bill of quantities.

Cost for civil works is estimated taking account of various factors such as construction method, earth moving plan, workable days and so on.

Unit cost of each work items is estimated by using labour cost, material cost and construction equipment charge, which are current market prices surveyed on the beginning of Aug.1988.

5－1 Project Cost <u>Construction Cost</u>

Item	Quantity	Construction Cost (B)	Construction Cost (¥)	Remarks
I Construction Cost				
(A. Direct cost)				
1.Breeding program plot				
Land shape adjustment and land levering	3.6 ha	200,000		
Irrigation facilities	550m	530,000		
Drainage facilities	460m	90,000		
Farm road	390m	80,000		
Sub-total		900,000	4,763,000	1B=5.29
2.Variety collection plot				
Land shape adjustment and land levering	6.5 ha	150,000		
Irrigation facilities	800m	330,000		
Drainage facilities	1,030m	240,000		
Farm road	900m	130,000		
Sub-total		850,000	4,498,000	
3.Paddy field				
Land shape adjustment and land levering	11,400m²	480,000		
Concrete ridges	525m	360,000		
Irrigation facilities	490m	90,000		
Sub-total		930,000	4,922,000	
4.Screen house				
Structure work	10 Units	650,000		
Finish work	10 Units	180,000		
Sub-total		830,000	4,392,000	
Total		3,510,000	18,575,000	
(B. Indirect cost)			3,715,000	20%
Total			22,290,000	
(C. Physical contingency)			2,229,000	10%
II Others			1,181,000	5%
Ground Total			25,700,000	

Description	Unit	Quantity	U/C Cost	Currency	Currency	Remarks	Explanation
A) Breeding plot							
1) Land leneling							
Excavation	cum	5,100	14.4	73,440		Sand (EL. 9.30)	
Excavation	"	1,300	54.8	71,240		Spoil of Soils	
Trimming	"	400	7.5	3,000		spoil yard	
Spray water	day	20	2,000.0	40,000			
				187,680			
2) Irrigation canal							
· Open canal							
Excavation	cum	177	29.0	5,133		Manpower	
Banking	"	547	36.1	19,747		"	
Slope trimming	sqm	987.0	2.5	2,468			
Lining concrete	cum	44.7	1,152.5	51,517			
Wooden form	sqm	5.0	353.7	1,769			
				80,634			
· Cross siphon							
Excavation	cum	100	29.0	2,900		Manpower	
Banking	"	57	36.1	2,058		"	
Reinforced concrete	"	29.3	1,121.0	32,846			
Lean concrete	"	5.6	854.2	4,784			
Wooden form	sqm	124.0	353.7	43,859			
RC pipe	m	92.4	397.5	36,729		Φ400 265×1.5	
Iron Bar	t	0.879	17,536.2	15,415			
				138,591			

BILL OF QUANTITIES

NO. ______

Description	Unit	Quantity	U't Cost	Local Currency	Foreign Currency	Remarks	Explanation
Cross culvert							
Excavation	cum	22	29.0	638		Man power	
Banking	"	72	36.1	2,600		"	
Slope trimming	sqm	74.5	2.5	187			
Reinforced concrete	cum	11.4	1,121.0	12,780			
Lean concrete	"	2.3	854.2	1,965			
Wooden form	sqm	96.7	353.7	34,203			
Iron bar	ton	0.478	12,536.2	5,998			
				58,371			
Diversion							
Excavation	cum	254	29.0	7,366		Man power	
Banking	"	216	36.1	7,798		"	
Slope trimming	sqm	35.8	2.5	90			
Reinforced concrete	cum	35.3	1,121.0	39,572			
Lean concrete	"	4.2	854.2	3,588			
Wooden form	sqm	288.3	353.7	101,972			
Iron bar	ton	1.846	12,536.2	32,272			
				192,758			
Inlet							
Excavation	cum	3.4	29.0	99		Man power	
Banking	"	0.8	36.1	29		"	
Reinforced concrete	"	1.0	1,121.0	1,121			
Lean concrete	"	0.6	854.2	513			
Wooden form	sqm	24.0	353.7	8,489			
Iron bar	ton	0.089	12,536.2	1,561			
				11,812			

Description	Unit	Quantity	Unit Cost	Currency	Currency	Remarks	Explanation
3). Intake							
Excavation	cum	1.0	29.0	29		Man power	
Banking	"	0.3	36.1	11		"	
Reinforced concrete	"	1.1	1.121.0	1.234			
Lean concrete	"	0.04	854.2	35			
Wooden form	sqm	6.8	353.7	2.406			
RC pipe	m	1.6	397.5	636		Ø400 265×1.5	
Intake gate	LS	1	34.200.0	34.200		Ø400	
Remove concrete	cum	1.0	30.8	31		20.5×1.5 = 30.8	
Pump drainage	day	30	477.7	14.331			
Iron bar	ton	0.060	17.536.2	1.053			
				53.966			
4). Drainage canal							
· Open canal							
Excavation	cum	668	20.5	13.694			
Slope trimming	sqm	1.259.5	2.5	3.149			
				16.843			
· Cross culvert							
Excavation	cum	49	20.5	1005			
Banking	"	20	36.1	722			
Reinforced concrete	"	14.7	1.121.0	16.479			
Lean concrete	"	1.9	1.033.0	1.963			
Iron bar	Ton	0.899	17.536.2	15.766			
Wooden form	sqm	63.6	353.7	22.496			
RC pipe	m	18.0	1.012.5	18.225		Ø800 675×1.5	
				76.656			

BILL OF QUANTITIES

NO.

Description	Unit	Quantity	U't Cost	Local Currency	Foreign Currency	Remarks
5) Farm road						
Banking	cum	2615	19.9	52.039		
Slope trimming	sqm	803.5	2.5	2.009		
Laterite pavement	cum	219	110.0	24.090		
Banking	"	219	19.9	4.359		
				82.497		
6) Access road						
Banking	cum	32	19.9	637		
slope trimming	sqm	49.4	2.5	124		
				761		
Total				900.569		
				900.000		

Explanation

Description	Unit	Quantity	Unit Cost	Currency	Currency	Remarks	Explanation
B) Variety Collection Plot							
1) Land leveling							
Excavation	cum	4,600	14.4	66,240		Sand (EL 810)	
Excavation	"	600	54.8	32,880		Spoil of Soils	
Trimming	"	200	7.5	1,500		Spoil yard	
Spray water	day	20	2,000	40,000			
				140,620			
2) Irrigation canal							
· Open canal							
Excavation	cum	164	29.0	4,756		Manpower	
Banking	"	858	36.1	30,974		"	
Slope trimming	sqm	454	2.5	1,135			
Lining concrete	cum	62.2	1,152.5	71,686			
Wooden form	sqm	7.2	353.7	2,547			
				111,098			
· Cross culvert							
Excavation	cum	64	29.0	1,856			
Banking	"	31	36.1	1,120			
Slope trimming	sqm	—	2.5	—			
Reinforced concrete	cum	22.7	1,121.0	25,447			
Lean concrete	"	3.1	854.2	2,649			
Wooden form	sqm	130.9	353.7	46,300			
Iron bar	Ton	1.700	17,536.2	29,812			
				107,184			

BILL OF QUANTITIES

NO. ______

Description	Unit	Quantity	U't Cost	Local Currency	Foreign Currency	Remarks	Explanation
· Inlet							
Excavation	cum	2	29.0	58		Man power	
Banking	"	—	36.1	—		"	
Reinforced concrete	"	1.1	1,121.0	1,234			
Lean concrete	"	0.8	854.2	684			
Wooden form	sqm	21.1	353.7	7,464			
				9,440			
3). Drainage canal							
· Open canal							
Excavation	cum	1,549	20.5	31,755			
Slope trimming	sqm	2,920.4	2.5	7,301			
				39,056			
· Cross culvert							
Excavation	cum	140	20.5	2,870			
Banking	"	99	36.1	3,574		Man power	
Reinforced concrete	"	23.0	1,121.0	25,783			
Lean concrete	"	2.0	1,033.0	2,066			
Iron bar	Ton	1.181	17,536.2	20,711			
Wooden form	sqm	93.9	353.7	33,213			
RC pipe	m	9.5	1,012.5	9,619		ϕ800 625×1.5	
				97,836			

Description	Unit	Quantity	U.C Cost	Currency	Currency	Remarks	Explanation
4) Form road							
Banking	cum	3,200	19.9	63,680			
Slope trimming	sqm	1,944	2.5	4,860			
Laterite pavement	cum	507	110.0	55,770			
Banking	"	507	19.9	10,090			
				134,400			
5) Access road							
Banking	cum	86	19.9	1,712			
Slope trimming	sqm	42.0	2.5	105			
Reinforced concrete	cum	40.6	1121.0	45,513			
Lean concrete	"	3.7	1,033.0	3,823			
Iron bar	ton	2.658	17536.2	46,612			
Wooden form	sqm	259.5	353.7	91,786			
RC pipe	m	26	1,012.5	26,325		ϕ800 675×1.5	
				215,876			
Total				855,510			
				850,000			

NO.

BILL OF QUANTITIES

Description	Unit	Quantity	U't Cost	Local Currency	Foreign Currency	Remarks	Explanation
c) Paddy Field							
1). Land leveling (120×95 m²)							
Excavation	cum	2280	50.4	119.912		Top Soil 20cm	
Excavation	〃	1.710	48.8	83.448		Sand 15cm	
Excavation	〃	1.140	61.8	70.452		Clay 10cm	
Soil dressing (Clay)	〃	570	43.7	24.909			
〃 (Sand)	〃	570	41.9	23.883			
〃 (Clay)	〃	570	43.7	24.909			
〃 (Topsoil)	〃	570	41.8	23.826			
Back filling	〃	1.710	41.8	71.478		Top soil 15cm	
Trimming	〃	1.710	8.3	14.193		Stock yard	
Spray water	day	15	2000	30.000			
				482.010			
2) Concrete dike							
Excavation	cum	142.3	29.0	4.127		Man power	
Plain concrete	〃	52.5	1.033.0	54.233			
Wooden form	sqm	820	353.7	290.034			
Soil dressing (Clay)	cum	95	71.4	6.783			
Banking	〃	190	36.1	6.859		Sand. Manpower	
				362.036			
3). Intake.							
Excavation	cum	1.0	29.0	29			
Banking	〃	0.3	36.1	11			
Reinforced concrete	〃	1.1	1121.0	1.234			
Lean concrete	〃	0.04	859.2	35			
Wooden form	sqm	6.8	353.7	2.406			

Description	Unit	Quantity	U/C Cost	Currency	Currency	Remarks	Explanation
RC pipe	m	1.6	397.5	636		φ400 265×1.5	
Intake gate	LS	1	34,200	34,200		φ400	
Remove concrete	cum	1.0	30.8	31		20.5×1.5 = 30.8	
Pump drainage	day	30	477.7	14,331			
Iron bar	ton	0.06	17,536.2	1,053			
				53,966			
4) Irrigation canal							
· Open canal							
Concrete block	pc	2,433.6	2.5	6,084			
Iron bar	ton	0.860	17,536.2	15,082			
Martal	cum	3.3	1,304.2	4,304			
Banking	cum	46.1	36.1	1,665		Man power	
				27,135			
· Cross culvert							
Excavation	cum	9.8	29.0	285			
Banking	〃	5.0	36.1	181			
Reinforced concrete	〃	0.6	1,121.0	673			
Iron bar	ton	0.015	17,536.2	264			
Wooden form	sqm	10	353.7	3,537			
				4,940			
· Diversion							
Excavation	cum	—	29.0	—		Man power	
Banking	〃	0.5	36.1	19		〃	
Reinforced concrete	〃	0.2	1,121.0	225			

BILL OF QUANTITIES

NO.

Description	Unit	Quantity	U't Cost	Local Currency	Foreign Currency	Remarks	Explanation
Lean concrete	cum	—	854.2	—			
Wooden form	sqm	2.9	353.7	1,026			
Iron bar	Ton	0.006	17,536.2	100			
				1,376			
· Inlet							
Excavation	cum	0.4	29.0	12		Manpower	
Banking	〃	0.3	36.1	11			
Reinforced concrete	〃	0.8	1,121.0	897			
Lean concrete	〃	0.4	854.2	342			
Wooden form	sqm	11.7	353.7	4,139			
Iron bar	ton	0.011	17,536.2	193			
Remove concrete	cum	0.8	30.8	25			
				5,619			
5) Access road							
Banking	cum	6	19.9	120			
Slope trimming	sqm	26	2.5	65			
				185			
Total				937,261			
				930,000			

Description	Unit	Quantity	U't Cost	Local Currency	Foreign Currency	Remarks	Explanation
D). Screen House (1unit)							
I. Structure							
1. Excavation	cum	4.1		87.5		3.69 m³ × 20.5 % (Back Hoe) 0.41 " × 29.0 " (Man power)	
2. Sand Compact	"	0.5	87	43.5		Sand 65 ฿/m³ Compactor 22 ฿/m³	
3. Smothing of face	sqm	62.6	2.5	156.5			
4. Form Work	"	11.6	353.7	4,102.9			
5. Conc. Work	cum	3.5	1,114.0	3,899.0			
6. RC Bar	kg	83.0	17.536 2/4	1,455.5			
7. Block	sqm	11.5	134.3	1,549.5		152个 @ 7	
8. Brick	"	39.6	90	3,564.0		7182个 @ 0.4	
9. Paint Wall	"	23.0	52	1,196.0			
10. Steel Column Roof	kg	1,455.0	31	45,105.0		L-beam 12 ฿/kg	
11 Steel Column Roof Paint	"	60.0	65	3,900			
Sub tot				65,054.4			
II Finish Work							
1. Screen		1		17,200		net 1roll : 160 ฿ 0.9×18m	
2. Plumbing		1		898			
Sub tot				18,098			
Total				83,152			
			≒	83,000			

5 - 3 List of Unit Cost

UNIT COST OF LABOUR

Aug. 1988

No.	Item	Unit	Perdium
			(Baht)
1	Labour	md	85
2	Foreman	md	300
3	Carpenter	md	150
4	Head of Carpenter	md	300
5	Stone Worker	md	140
6	Head of Stone Worker	md	300
7	Steel Worker	md	140
8	Head of Steel Worker	md	350
9	Asphalt - Mix Worker	md	200
10	Driver	md	180
11	Operator (Heavy Equipment)	md	250
12	Mechanical	md	300
13	Electrical	md	300

List of Unit Cost

Aug. 1988

No.	ITEM	Unit	COST
			(Baht)
1.	Excavation by Manpower		
	Sand	m^3	29.0
	Normal Soil	m^3	50.6
2.	Hauling by Manpower		
	L = 100 m	m^3	39.3
3.	Compacting		
	Compacting by Manpower	m^3	36.1
	Compacting by Compactor	m^3	22.0
4.	Smoothing of Face excavated or filled up	m^2	2.5
5.	Concrete Mixed by Portable Mixer		
	Plain Concrete	m^3	1,033.0
	Reinforced Concrete	m^3	1,121.0
	Lean Concrete	m^3	854.2
	Lining Concrete	m^3	1,152.5
6.	Mortal	m^3	1,304.2
7.	Wooden Form of Concrete	m^2	353.7
8.	Processing and Assembling of Reinforced	t	
	Iron Bar		17,536.2
9.	Sod Facing	m^2	59.7
10.	Drainage by Pump	d	477.7
11.	Metal Form of Concrete	m^3	——
12.	Curing	m	——
	Curing	m^2	2

List of Unit Cost By Using Construction Equipments

Aug. 1988

No.	ITEM	U.	COST
			(Baht)
Eq 1	Excavation by Bull Dozer (11 ton)		
1-1	Sand	m^3	14.4
1-2	Normal Soil	m^3	16.9
Eq 2	Excavation by Bull Dozer (21 ton)		
2-1	Sand	m^3	13.1
2-2	Normal Soil	m^3	15.3
Eq 3	Excavation by Back-Hoe Shovel (0.35 m^3)		
3-1	Sand	m^3	20.5
3-2	Normal Soil	m^3	20.3
Eq 4	Loading by Tractor Shovel (1.2m^3)		
4-1	Sand	m^3	19.3
4-2	Normal Soil	m^3	19.3
Eq 5	Hauling by Dump Truck (8 ton)		
5-1	Sand	m^3	0.0068+14.3
5-2	Normal Soil	m^3	0.0064+13.4
5-3	Gravel and Weathered Rock	m^3	0.0076+15.9
Eq 6	Spreading by Bull Dozer (11 ton)		
6-1	Sand	m^3	7.5
6-2	Normal Soil	m^3	8.3
Eq 7	Compaction by Vibration Roller (3 ton)	m^3	12.4
Eq 8	Transportation by Truck (10 ton)		
8-1	1 way (L=80km)	way	380.1
8-2	1 ton (L=80km)	ton	38.0
Eq 9	Lifting by Truck W/h 2 ton Crane	d	1,789.7

Unit Cost of Materials (1)

Aug. 1988

No.	Item	Unit	Cost	Remarks
			(Baht)	
1	Aggregate			
	(a) Sand	m^3		65
	(b) Gravel	m^3		130
	(c) Boulder	m^3		120
2	Sod	m^2		18
3	Lumber			
	(a) Form Lumber	m^3		6,500
	(b) YANG 4 m/m and 4'X8'	SHEET		190
	(c) YANG 6 m/m and 4'X8'	SHEET		250
	(d) YANG 10 m/m and 4'X8'	SHEET		450
	(e) 1/2"X 4"X 4.5 - 2.0 M	pc		14,100/m^3
	(f) 1"X 6"X 4.5 - 3.0 M	pc		"
	(g) 2"X 3"X 1.5 M	pc		"
	(h) 2"X 4"X 3.0 - 2.0 M	pc		"
	(i) 2"X 6"X 4.5 - 3.0 M	pc		"
	(j) 4"X 4"X 3.0 - 2.5 M	pc		"
	(k) 4"X 6"X 2.5 M	pc		"
	(l) 7"X 4"X 5.5 M	pc		"
	(m) 1 1/2"X 4"X 5.0 - 3.0 M	pc		"
4	Reinforced Iron Bar	Kg		12.5
5	Nail, Bolt, Nut	Kg		20
6	Hardwares	Kg		
7	Cement (1 bag = 50 kg)			
	(a) Portland Cement (TYPE I)	bag		85
	(b) White Cement 40 kg/BAG	bag		170

Unit Cost of Materials (2)

No.	Item	Unit	Cost (Baht)	Remarks
8	Asphlt	Kg	1	Bitumen 7.5฿/kg
9	Tack Coat	m^2	9	
10	Fuel			
	(a) Gasoline	lit	8.9	Super BKK
	(b) Diesoline	lit	6.3	Hi-speed BKK
11	Laterite	m^3	110	
12	Brick	pc	0.5	Cholburi Brick
13	Concrete Block	pc	2.5	70×190×390
14	Tile	pc		
15	Roman Tile	pc		
16	RC pipe			
	(a) ø150 X 5,000	pc	560	ASBESTOS PIPE
	(b) ø250 X 5,000	pc	1,400	"
	(c) ø300 X 5,000	pc	2,050	
	(d) ø400 X 1,000 (EX FACTORY)	pc	265	CLASS II
	(e) ø500 X 1,000 "	pc	305	"
	(f) ø800 X 1,000 "	pc	675	"
	(g) ø1,000 X 1,000 "	pc	1,030	"
	(h) ø1,200 X 1,000 "	pc	1,435	"
	(i) ø1,500 X 1,000 "	pc	2,150	"
17	PVC PIPE (TIS 17-2523 CLASS 13.5) L=4m			
	(a) 1/2"	Stick	59	
	(b) 3/4"	Stick	72	
	(c) 1"	Stick	114	
	(d) 1 1/2"	Stick	191	
	(e) 2"	Stick	293	
	(f) 2 1/2"	Stick	482	

Unit Cost of Materials (3)

No.	Item	Unit	Cost	Remarks
			(Baht)	
	(g) 3"	Stick	673	
	(h) 4"	Stick	1,083	
18	Electricity	KWH	2	
19	Fence (H = 2.00 m)			
	(a) Mesh (H = 2 m)	m		
	(b) Concvele Block	m		
	(c) Dabe Wire	m		
20	Wire Mesh # 11 - 38 m/m	m^2	55	
21	H - Beam	Kg	14.5	
	(a) H - 100 X 100 X 8.5 (17.6)	m	260	
	(b) H - 125 X 125 X 9.5 (24.3)	m	350	
	(c) H - 150 X 150 X 10.5 (32.0)	m	470	
	(d) H - 175 X 175 X 13.5 (46.7)	m	680	
	(e) H - 300 X 200 X 12 (64.2)	m	950	
22	L - Beam	Kg	12	
	(a) L - 20 X 20 X 3 (0.885)	m	11	
	(b) L - 25 X 25 X 5 (1.76)	m	22	
	(c) L - 30 X 30 X 5 (2.16)	m	27	
	(d) L - 40 X 40 X 5 (2.95)	m	37	
	(e) L - 50 X 50 X 6 (4.43)	m	55	
	(f) L - 60 X 60 X 7 (6.21)	m	77	
	(g) L - 70 X 70 X 8 (8.29)	m	105	
23	Steel pipe (GSP , L = 6.00 m)			
	1/2" (BSM)	pc	140	Not including Transportation
	3/4"	pc	177	1 TRIP =
	1"	pc	258	2800 (13Ton)

Unit Cost of Materials (4)

No.	Item	Unit	Cost (Baht)	Remarks
	1 1/4"	pc	330	
	1 1/2"	pc	387	
	2"	pc	529	
	2 1/2"	pc	650	
	3"	pc	889	
	4"	pc	1,259	
	5"	pc	2,018	
	6"	pc	2,398	
24	Steel pipe (STPW)			
	300 m/m	m	1,250	Not including Transportation
	500	m	1,740	
	800	m	4,080	
	1,000	m	5,400	
	1,200	m	8,400	
25	ELBOW			

	1/2	3/4	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	4	5
45°	8.3	10.5	15.6	23.8	31.2	47.6	97.6	143.5	261	756
90°	7.8	9.1	16.5	26.5	32	48	85	131	228	653

No.	Item	Unit	Cost (Baht)	Remarks
26	VALVE			
	(1) GATE VALVE (150 LB.)			
	2"	pc	1,365	SCREW
	$1\frac{1}{2}$"	pc	860	"
	$1\frac{1}{4}$"	pc	640	"
	1"	pc	445	"

Unit Cost of Materials (5)

No.	Item	Unit	Cost (Baht)	Remarks
	3/4"	pc	325	SCREW
	1/2"	pc	225	"
	3/8"	pc	175	"
	6"	pc	9,000	FLANGE
	4"	pc	5,600	"
	(2) GATE VALVE (125 LB.)			
	6"	pc	8,700	FLANGE
	4"	pc	5,360	"
	3"	pc	3,660	"
	$2\frac{1}{2}$"	pc	3,100	"
	2"	pc	720	SCREW
	$1\frac{1}{2}$"	pc	490	"
	$1\frac{1}{4}$"	pc	375	"
	1"	pc	275	"
	3/4"	pc	195	"
	(3) CHECK VALVE (125 LB)			
	6"	pc	9,900	FLANGE
	3"	pc	3,280	"
	2"	pc	990	SCREW
	$1\frac{1}{2}$"	pc	640	"
	(4) CHECK VALVE (150 LB)			
	1"	pc	1,340	
	(5) GLOBE VALVE (150 LB)			
	2"	pc	1,150	
	3/4"	pc	245	

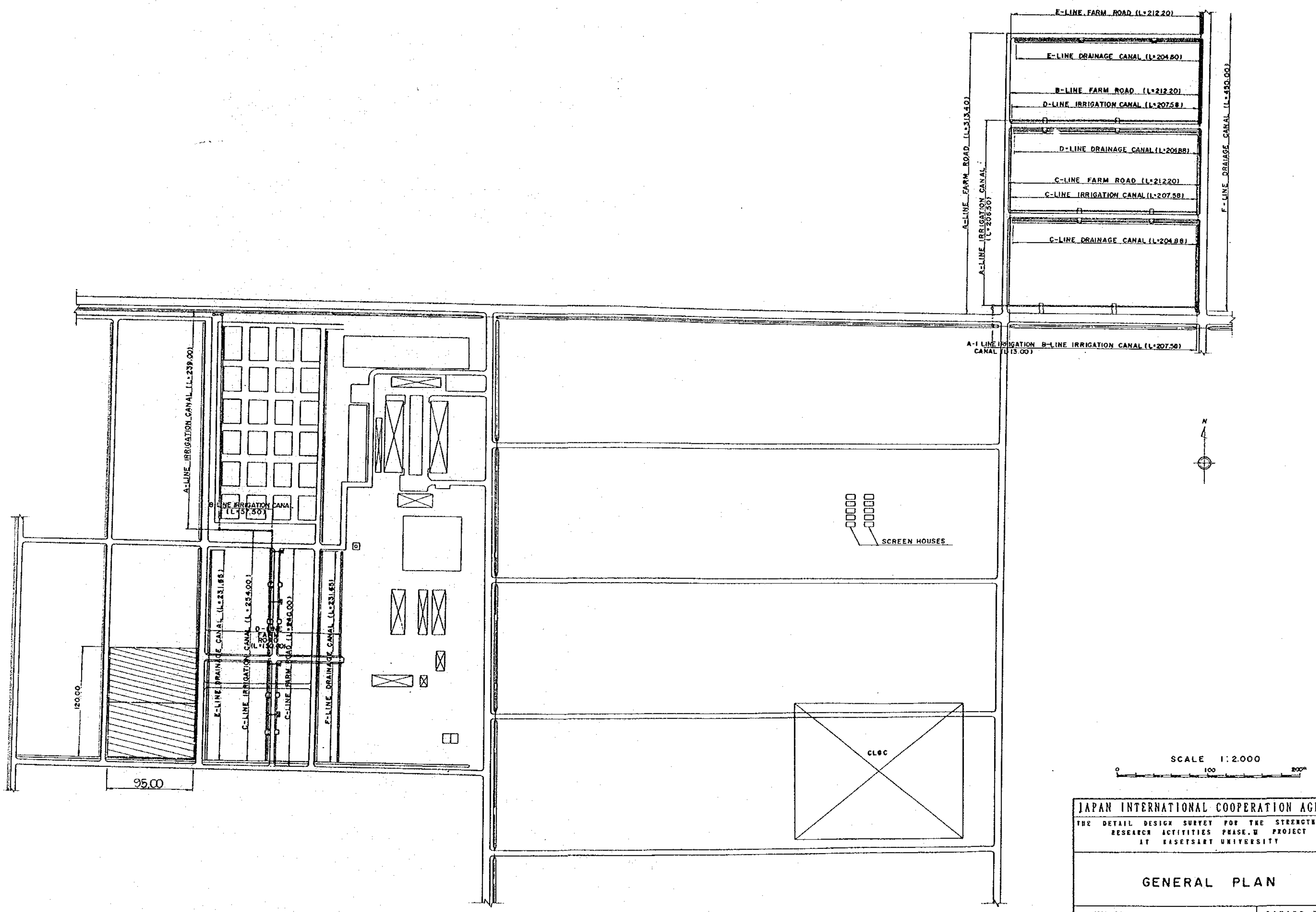
Unit Cost of Materials (6)

No.	Item	Unit	Cost	Remarks
			(Baht)	
	(6) GLOBE VALVE (125 LB)			
	$2\frac{1}{2}$"	pc	3,480	FLANGE
	2"	pc	1,450	SCREW
	$1\frac{1}{4}$"	pc	650	"
	1"	pc	450	"
	3/4"	pc	370	"
	(7) BUTTERFLY VALVE (125 LB)			
	6"	pc	7,990	
	4"	pc	4,080	
27	Water Tank	Ls	3,500	$1m^3$
28	Sluico gate ø500 m/m	Ls	55,000	
	ø1,000 m/m	Ls	195,000	
29	Nylon Net 20 mesh/inch	Roll	160	90m 18m(1Roll) 0.56m/m

CHAPTER 6 DRAWINGS

DRAWING LIST

No.	TITLE
1	GENERAL PLAN
2	-ditto - (PADDY FIELD, BREEDING PROGRAM PLOT)
3	-ditto - (VARIETY COLLECTION PLOT)
4	-ditto - (SCREEN HOUSE)
5	PADDY FIELD IRRIGATION CALAL (C-LINE)
6	-ditto - RELATED STRUCTURE (1)
7	-ditto - (2)
8	-ditto - (3)
9	BREEDING PROGRAM PLOT IRRIGATION CANAL
10	-ditto - DRAINAGE CANAL
11	-ditto - FARM ROAD
12	-ditto - RELATED STRUCTURE (1)
13	-ditto - (2)
14	-ditto - (3)
15	-ditto - (4)
16	VARIETY COLLECTION PLOT IRRIGATION CANAL (1)
17	-ditto - (2)
18	-ditto - DRAINAGE CANAL (1)
19	-ditto - (2)
20	-ditto - (3)
21	-ditto - FARM ROAD (1)
22	-ditto - (2)
23	-ditto - RELATED STRUCTURE (1)
24	〃 (2)
25	〃 (3)

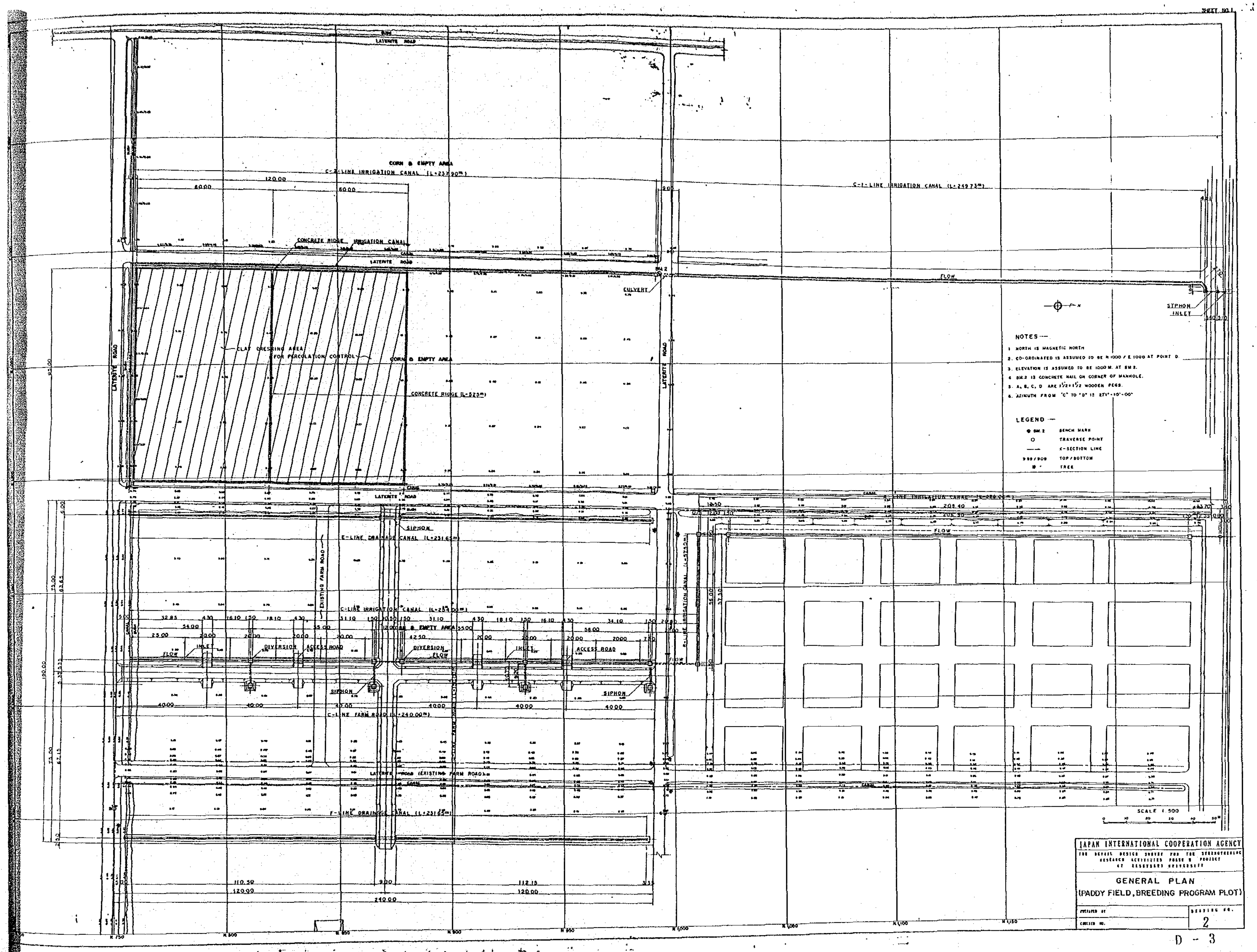


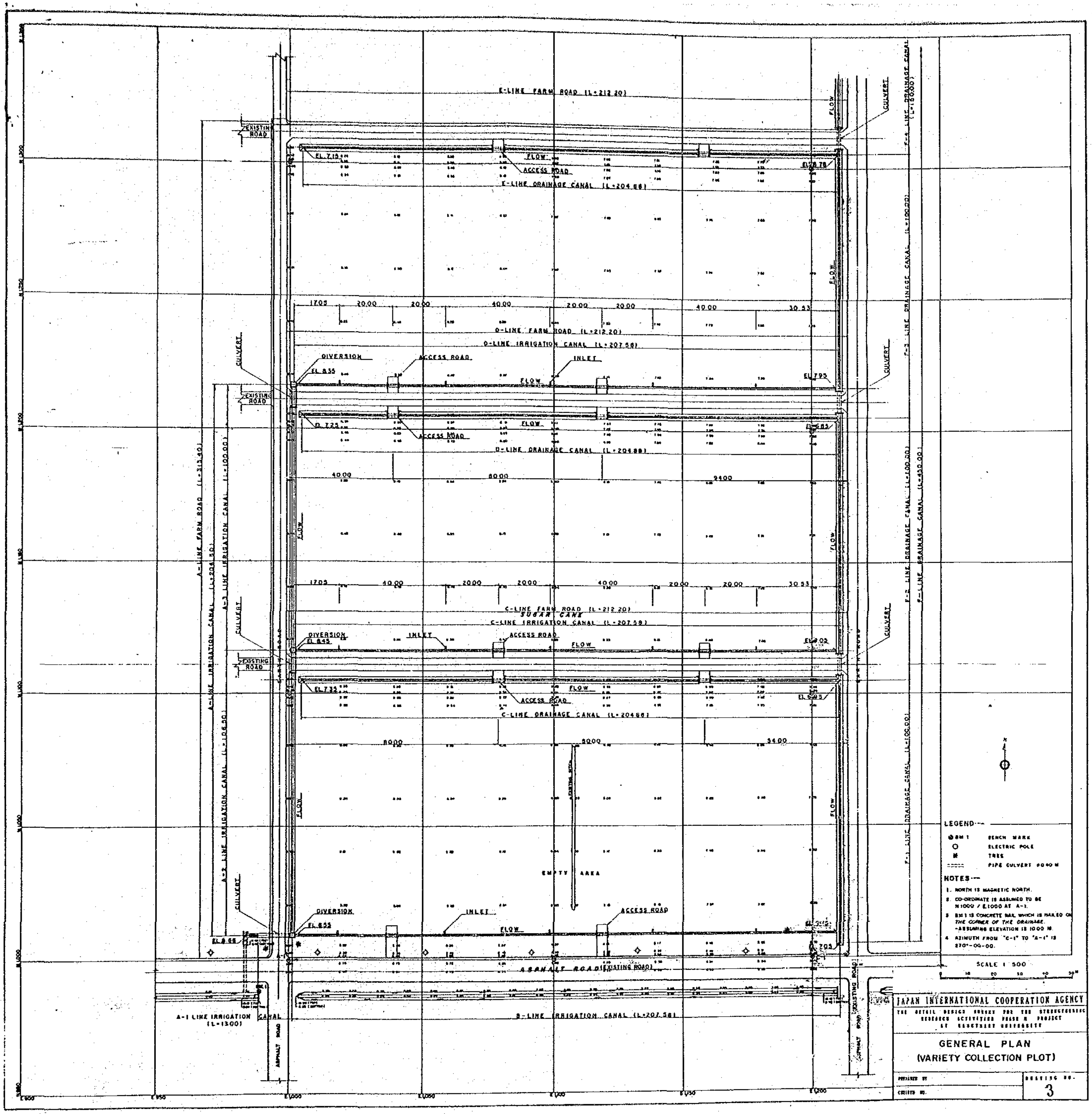
JAPAN INTERNATIONAL COOPERATION AGENCY

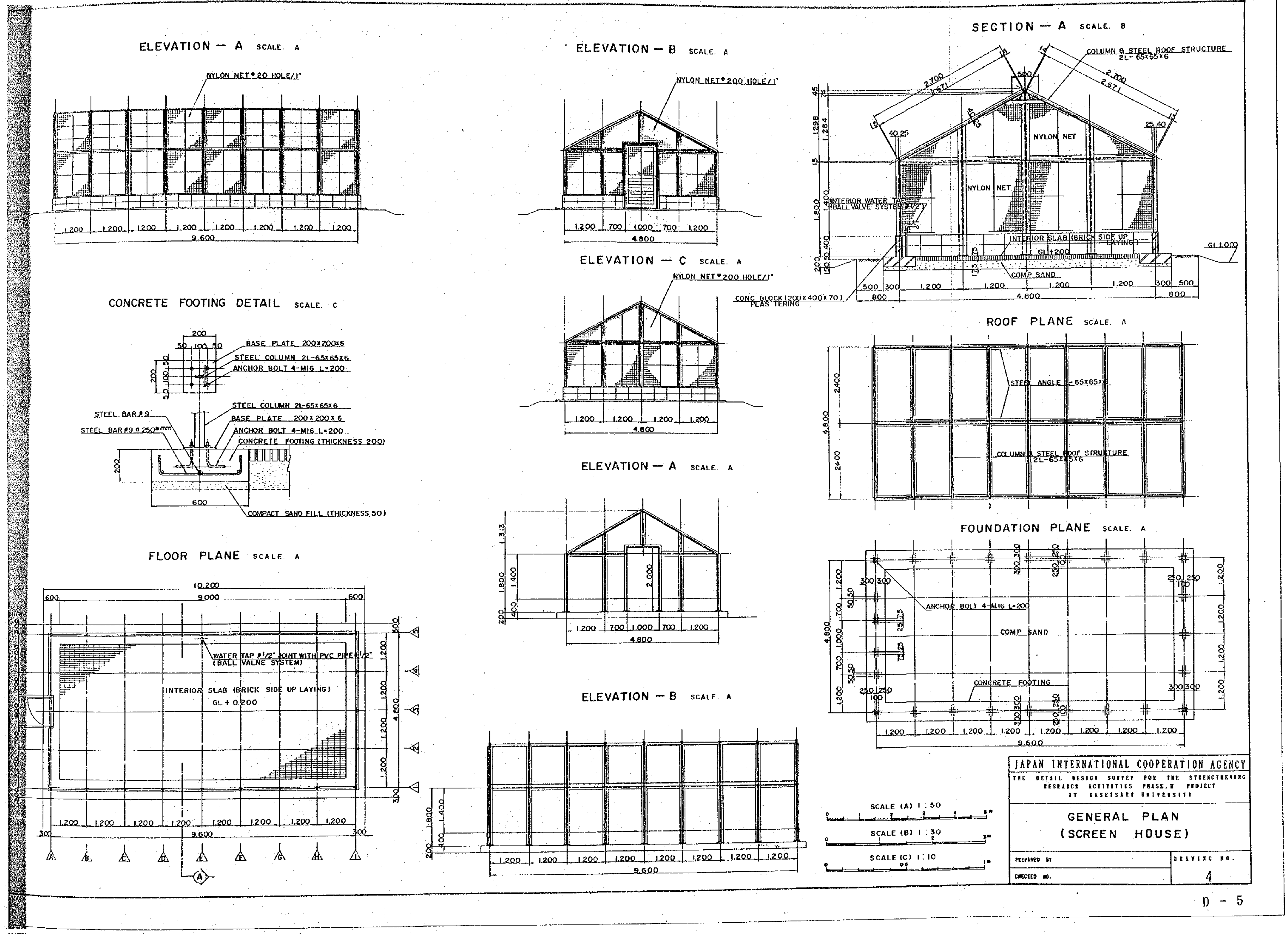
THE DETAIL DESIGN SURVEY FOR THE STRENGTHENING RESEARCH ACTIVITIES PHASE. II PROJECT AT KASETSART UNIVERSITY

GENERAL PLAN

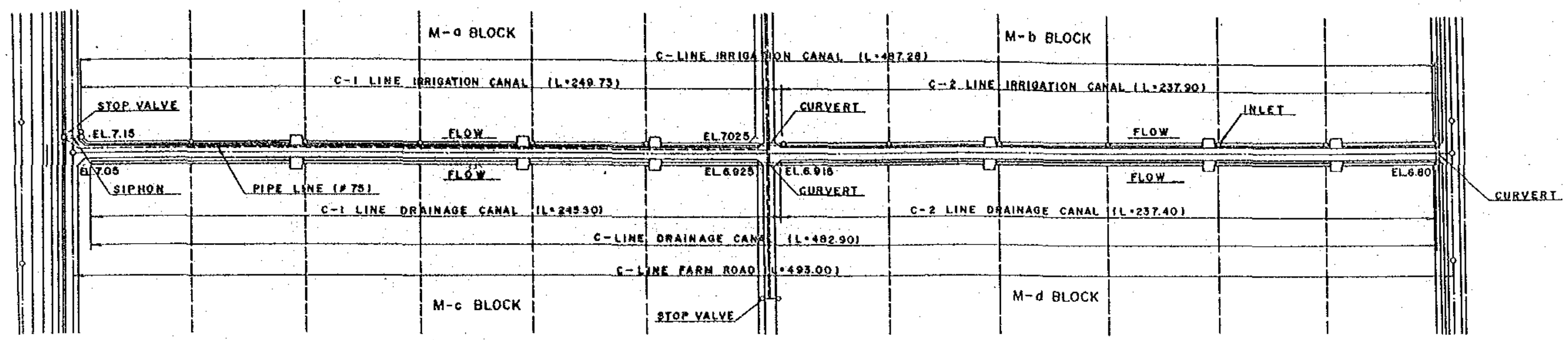
PREPARED BY	DRAWING NO.
CHECKED NO.	1

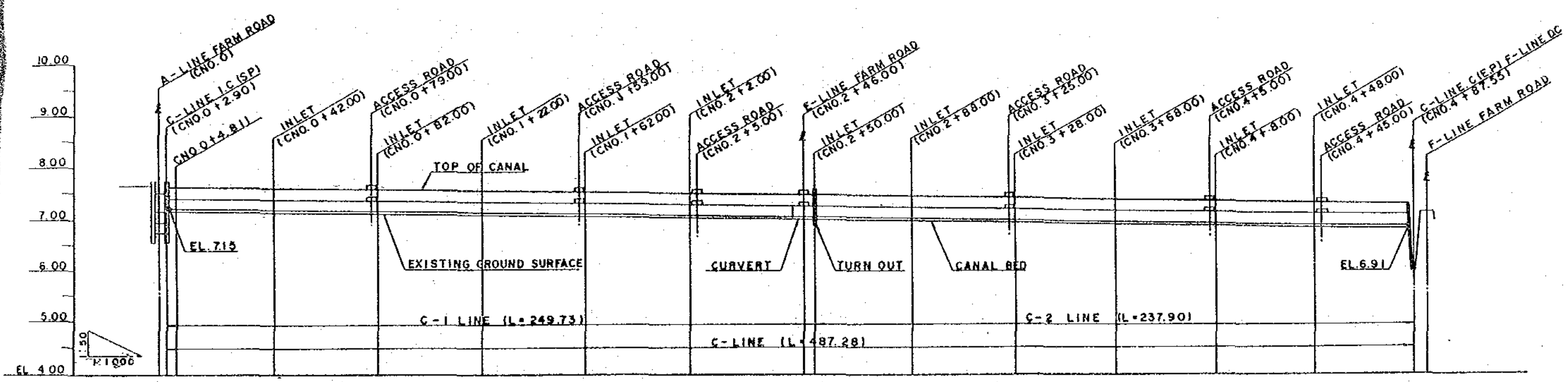

CORN & EMPTY AREA
C-2-LINE IRRIGATION CANAL (L=237.90m)
C-1-LINE IRRIGATION CANAL (L=249.73m)
CONCRETE RIDGE IRRIGATION CANAL
LATERITE ROAD
CULVERT
BM.2
FLOW
SIPHON
INLET
CLAY DRESSING AREA
FOR PERCOLATION CONTROL
CONCRETE RIDGE (L=523m)
NOTES ---
1. NORTH IS MAGNETIC NORTH
2. CO-ORDINATED IS ASSUMED TO BE N 1000 / E 1000 AT POINT D.
3. ELEVATION IS ASSUMED TO BE 1000 M. AT BM 2.
4. BM.2 IS CONCRETE NAIL ON CORNER OF MANHOLE.
5. A, B, C, D ARE 1 1/2 x 1 1/2 WOODEN PEGS.
6. AZIMUTH FROM "C" TO "D" IS 271°-10'-00"
LEGEND —
BM.2 BENCH MARK
TRAVERSE POINT
X-SECTION LINE
TOP / BOTTOM
TREE
E-LINE DRAINAGE CANAL (L=231.65m)
EXISTING FARM ROAD
C-LINE IRRIGATION CANAL
CORN & EMPTY AREA
DIVERSION
ACCESS ROAD
C-LINE FARM ROAD (L=240.00m)
LATERITE ROAD (EXISTING FARM ROAD)
F-LINE DRAINAGE CANAL (L=231.65m)
R-LINE IRRIGATION CANAL
SCALE 1:500
JAPAN INTERNATIONAL COOPERATION AGENCY
GENERAL PLAN
(PADDY FIELD, BREEDING PROGRAM PLOT)
2


E-LINE FARM ROAD (L=212.20)
E-LINE DRAINAGE CANAL (L=204.88)
D-LINE FARM ROAD (L=212.20)
D-LINE IRRIGATION CANAL (L=207.58)
D-LINE DRAINAGE CANAL (L=204.88)
C-LINE FARM ROAD (L=212.20)
SUGAR CANE
C-LINE IRRIGATION CANAL (L=207.58)
C-LINE DRAINAGE CANAL (L=204.88)
B-LINE IRRIGATION CANAL (L=207.58)
A-1 LINE IRRIGATION CANAL (L=13.00)
ASPHALT ROAD (EXISTING ROAD)
A-LINE FARM ROAD (L=313.40)
A-LINE IRRIGATION CANAL (L=204.50)
A-3 LINE IRRIGATION CANAL (L=100.00)
A-2 LINE IRRIGATION CANAL (L=106.50)
F-1 LINE DRAINAGE CANAL (L=100.00)
F-2 LINE DRAINAGE CANAL (L=100.00)
F-3 LINE DRAINAGE CANAL (L=100.00)
F-4 LINE DRAINAGE CANAL (L=100.00)
F LINE DRAINAGE CANAL (L=450.00)
EXISTING ROAD
DIVERSION
ACCESS ROAD
INLET
FLOW
CULVERT
EMPTY AREA
LEGEND
BM 1 BENCH MARK
ELECTRIC POLE
TREE
PIPE CULVERT
NOTES
1. NORTH IS MAGNETIC NORTH.
2. CO-ORDINATE IS ASSUMED TO BE N1000 / E1000 AT A-1.
3. BM 1 IS CONCRETE NAIL WHICH IS NAILED ON THE CORNER OF THE DRAINAGE. ASSUMING ELEVATION IS 10.00 M.
4. AZIMUTH FROM "C-1" TO "A-1" IS 270°-00-00.
SCALE 1:500
JAPAN INTERNATIONAL COOPERATION AGENCY
GENERAL PLAN
(VARIETY COLLECTION PLOT)
PREPARED BY
CHECKED BY
DRAWING NO.
3


ELEVATION — A SCALE. A
NYLON NET # 20 HOLE/1"
1.200 1.200 1.200 1.200 1.200 1.200 1.200 1.200
9.600
ELEVATION — B SCALE. A
NYLON NET # 200 HOLE/1"
1.200 700 1.000 700 1.200
4.800
ELEVATION — C SCALE. A
NYLON NET # 200 HOLE/1"
1.200 1.200 1.200 1.200
4.800
SECTION — A SCALE. B
COLUMN & STEEL ROOF STRUCTURE 2L- 65x65x6
2.700
2.671
500
NYLON NET
INTERIOR WATER TAP (BALL VALVE SYSTEM) 1/2"
INTERIOR SLAB (BRICK SIDE UP LAYING)
GL+200
GL±0.00
COMP SAND
CONC BLOCK (200x400x70) PLASTERING
500 300 1.200 1.200 1.200 1.200 300 500
800 4.800 800
CONCRETE FOOTING DETAIL SCALE. C
BASE PLATE 200x200x6
STEEL COLUMN 2L-65x65x6
ANCHOR BOLT 4-M16 L=200
STEEL BAR # 9
STEEL BAR # 9 @ 250 mm
CONCRETE FOOTING (THICKNESS 200)
COMPACT SAND FILL (THICKNESS 50)
600
ROOF PLANE SCALE. A
STEEL ANGLE L-65x65x6
COLUMN & STEEL ROOF STRUCTURE 2L-65x65x6
2400
4.800
ELEVATION — A SCALE. A
1.200 700 1.000 700 1.200
4.800
FOUNDATION PLANE SCALE. A
ANCHOR BOLT 4-M16 L=200
COMP SAND
CONCRETE FOOTING
1.200 1.200 1.200 1.200 1.200 1.200 1.200 1.200
9.600
FLOOR PLANE SCALE. A
10.200
600 9.000 600
WATER TAP # 1/2" JOINT WITH PVC PIPE 1/2" (BALL VALNE SYSTEM)
INTERIOR SLAB (BRICK SIDE UP LAYING)
GL + 0.200
1.200 1.200 1.200 1.200 1.200 1.200 1.200 1.200
300 9.600 300
A B C D E F G H I
ELEVATION — B SCALE. A
1.200 1.200 1.200 1.200 1.200 1.200 1.200 1.200
9.600
SCALE (A) 1 : 50
SCALE (B) 1 : 30
SCALE (C) 1 : 10
JAPAN INTERNATIONAL COOPERATION AGENCY
THE DETAIL DESIGN SURVEY FOR THE STRENGTHENING RESEARCH ACTIVITIES PHASE. II PROJECT AT KASETSART UNIVERSITY
GENERAL PLAN
(SCREEN HOUSE)
PREPARED BY
CHECKED BY
DRAWING NO.
4

PLANE (C-LINE IRRIGATION CANAL) SCALE. A.





SLOPE: 1/2000

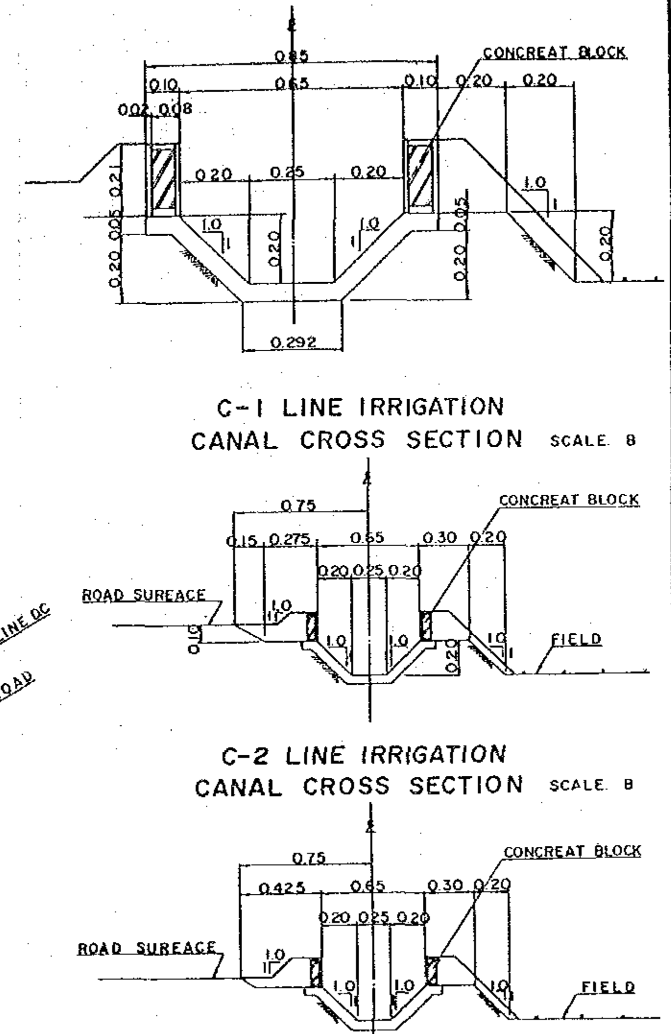
STATION	DISTANCE	ACCUMULATED DISTANCE	DESIGN DISCHARGE	GROUND ELEVATION	CANAL BED	WATER DEPTH	WATER SURFACE
CNO.0	0.00	-2.90		7.40			
+2.90	2.90	0.00	0.0065	7.20	7.15	0.09	7.44
+4.81	4.88	4.80	0.0065	7.00	7.15	0.09	7.44
+42.00	37.19	41.73	0.0065	6.82	7.13	0.09	7.42
+55.00	13.00	54.73	0.0065	6.80	7.12	0.09	7.41
+82.00	27.00	81.73	0.0065	6.76	7.11	0.09	7.40
CNO.1	18.00	99.73	0.0065	6.80	7.10	0.09	7.39
+10.00	10.00	109.73	0.0065	6.80	7.10	0.09	7.39
+22.00	12.00	121.73	0.0065	6.85	7.09	0.09	7.38
+44.00	22.00	143.73	0.0065	6.60	7.08	0.09	7.37
+62.00	18.00	161.73	0.0065	6.70	7.07	0.09	7.36
+85.00	23.00	184.73	0.0065	6.80	7.06	0.09	7.35
CNO.2 +2.00	17.00	202.00	0.0065	6.92	7.05	0.08	7.34
+42.00	40.00	241.73	0.0065	6.86	7.03	0.08	7.32
+46.00	4.00	245.73	0.0065	6.84	7.03	0.09	
+50.00	4.00	249.73	0.0041	6.82	7.03	0.07	7.30
+88.00	38.00	[illegible]	0.0041	7.00	7.01	0.07	7.28
CNO.3	12.00	[illegible]	0.0041	7.10	7.00	0.07	7.27
+17.00	17.00	316.73	0.0041	7.20	6.99	0.07	7.27
+28.00	11.00	377.73	0.0041	7.24	6.98	0.07	7.27
+41.00	13.00	340.73	0.0041	7.20	6.98	0.07	7.26
+68.00	27.00	367.73	0.0041	7.12	6.97	0.07	7.25
CNO.4 +8.00	40.00	407.73	0.0041	7.05	6.95	0.07	7.23
+22.00	14.00	421.73	0.0041	7.00	6.94	0.07	7.22
+48.00	26.00	447.73	0.0041	6.96	6.95	0.07	7.21
+87.55	39.55	487.28	—	7.00	—	—	—
+93.00	8.45	492.73	—	7.00	—	—	—

CURVE

C-LINE IRRIGATION CANAL STANDARD CROSS SECTION SCALE. D

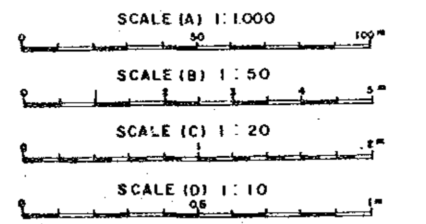
C-1 LINE IRRIGATION CANAL CROSS SECTION SCALE. B

C-2 LINE IRRIGATION CANAL CROSS SECTION SCALE. B



NOTE

1. ALL DIMENSIONS ARE SHOWN IN METERS UNLESS OTHERWISE INDICATED
2. ABBREVIATION AND SYMBOL
   ℄ : CENTER LINE
   EL : ELEVATION



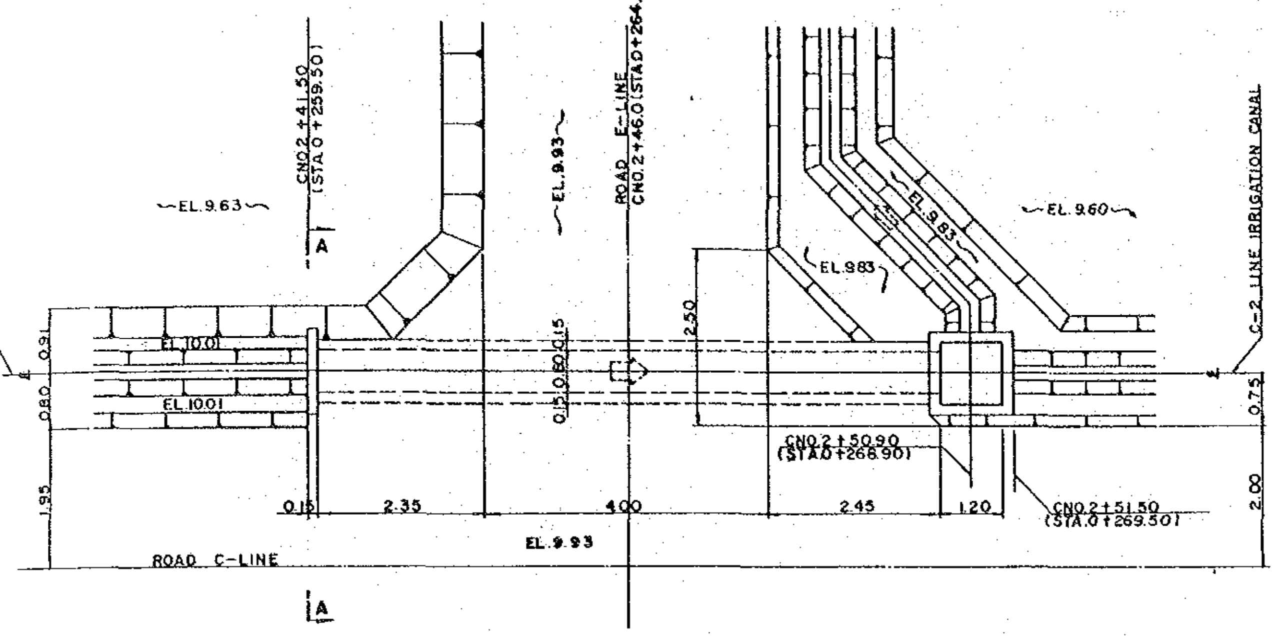
JAPAN INTERNATIONAL COOPERATION AGENCY

THE DETAIL DESIGN SURVEY FOR THE STRENGTHENING RESEARCH ACTIVITIES PHASE.II PROJECT AT KASETSART UNIVERSITY

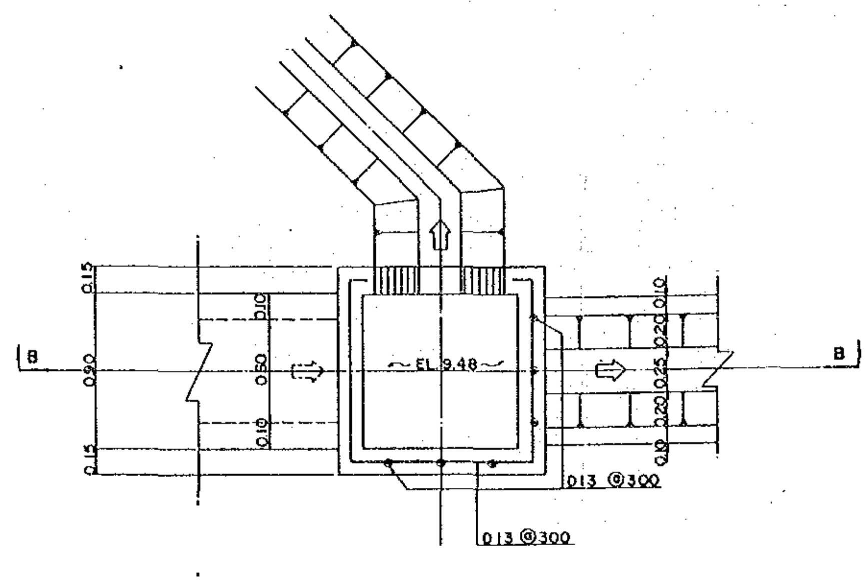
PADDY FILED IRRIGATION CANAL (C-LINE)

PREPARED BY	DRAWING NO.
CHECKED NO.	5

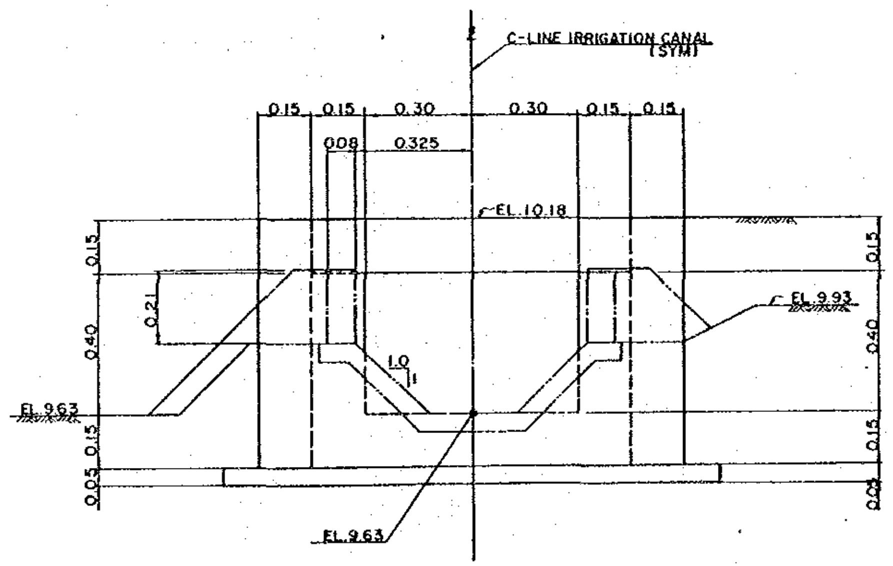
PLANE OF CULVERT SCALE. A



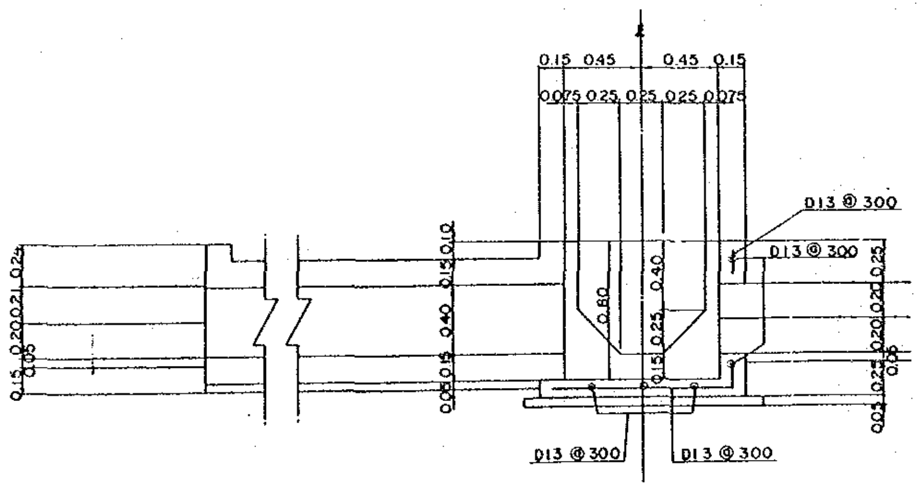
PLANE OF DIVERSION SCALE B



SECTION A – A SCALE. C



SECTION B – B SCALE. B



NOTE

1. ALL DIMENSIONS ARE SHOWN IN METERS UNLESS OTHERWISE INDICATED
2. ABBREVIATION AND SYMBOL
   ℄ : CENTER LINE
   EL : ELEVATION

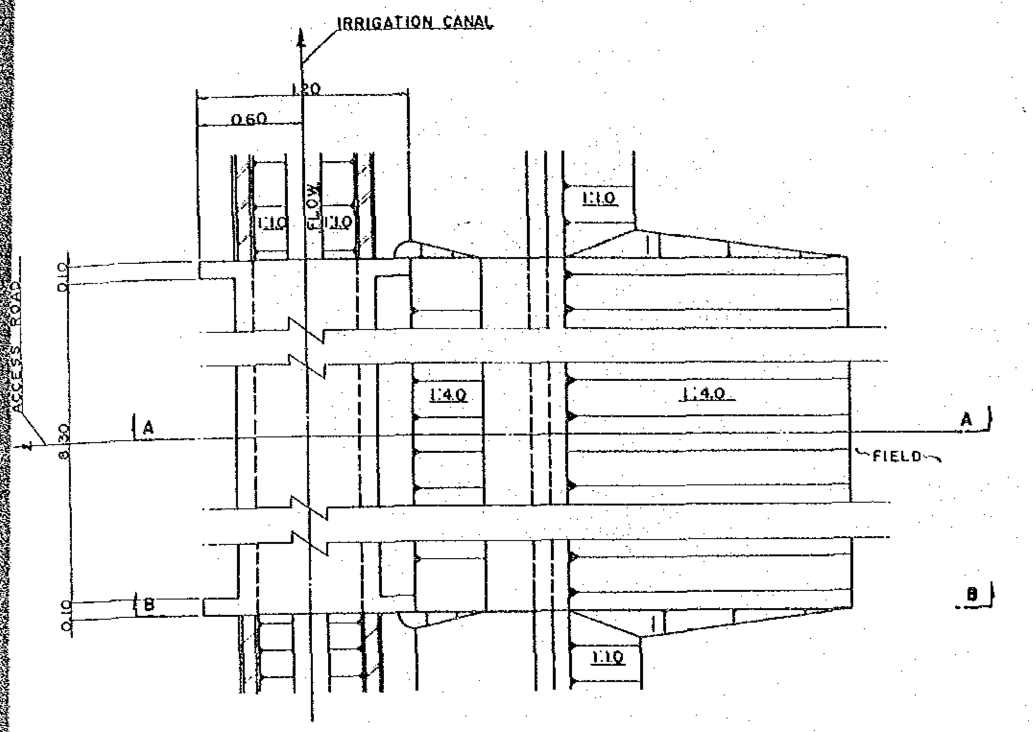
SCALE (A) 1 : 50

SCALE (B) 1 : 20

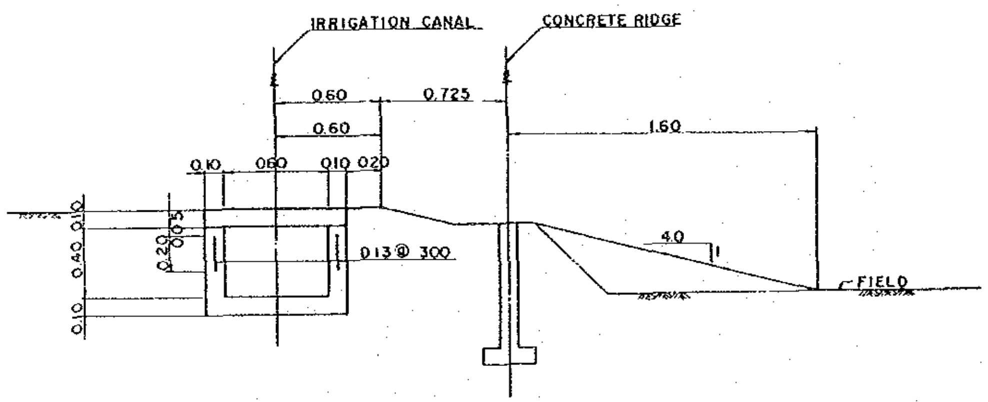
SCALE (C) 1 : 10

JAPAN INTERNATIONAL COOPERATION AGENCY	
THE DETAIL DESIGN SURVEY FOR THE STRENGTHENING RESEARCH ACTIVITIES PHASE. II PROJECT AT KASETSART UNIVERSITY	
PADDY FIELD RELATED STRUCTURE	
PREPARED BY	DRAWING NO.
CHECKED NO.	6

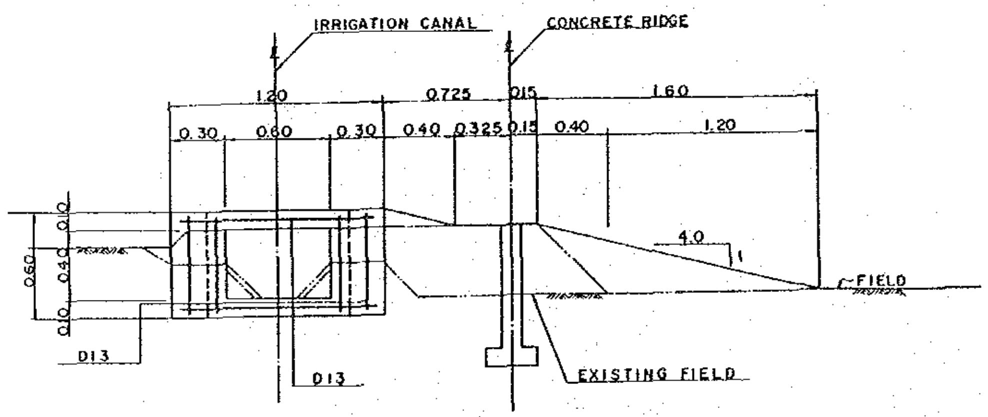
PLANE OF ACCESS ROAD SCALE. A



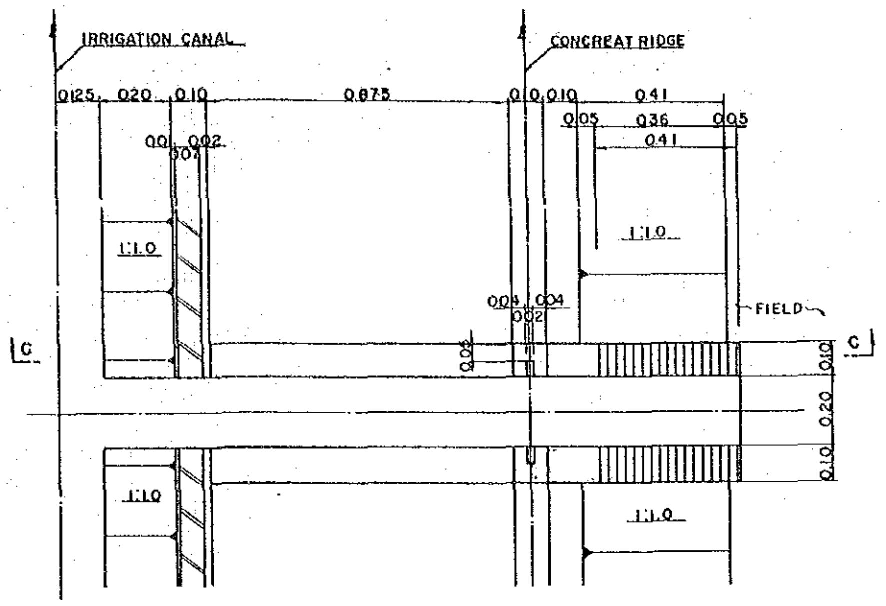
SECTION A — A SCALE. A



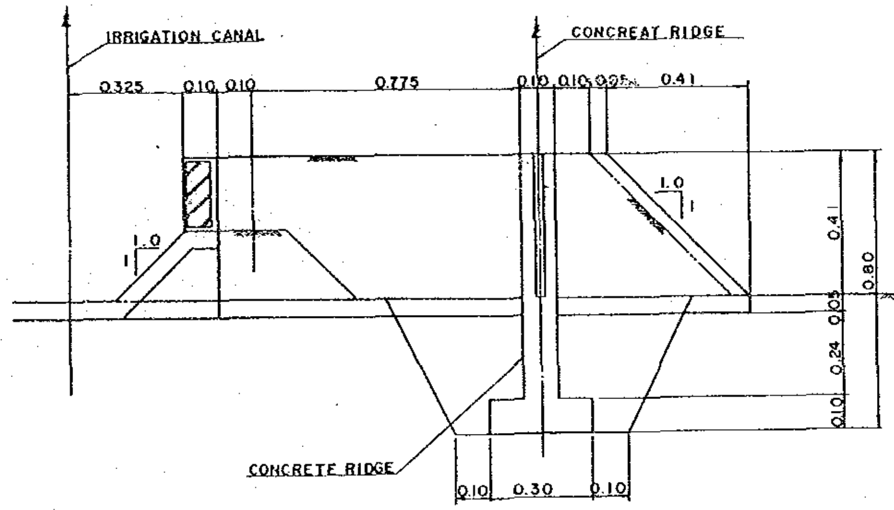
SECTION B — B SCALE. A



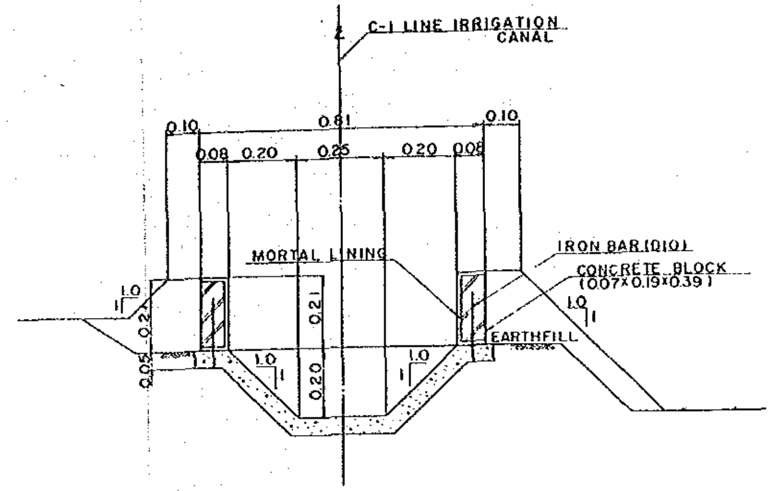
PLANE OF INLET SCALE. B



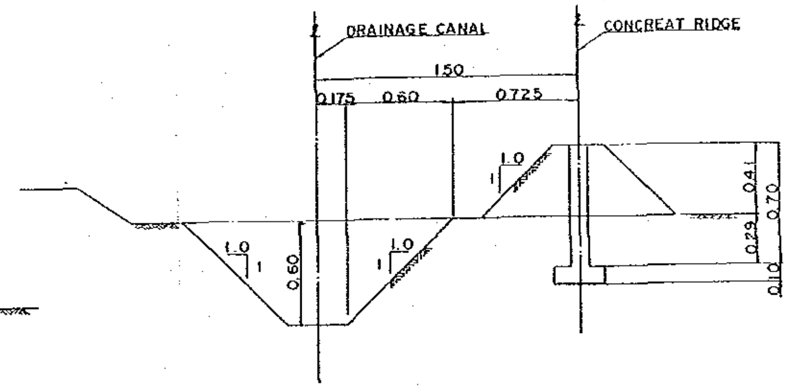
SECTION C — C SCALE. B



CROSS SECTION IRRIGATION CANAL SCALE. A



CROSS SECTION DRAINAGE CANAL SCALE. A



NOTE

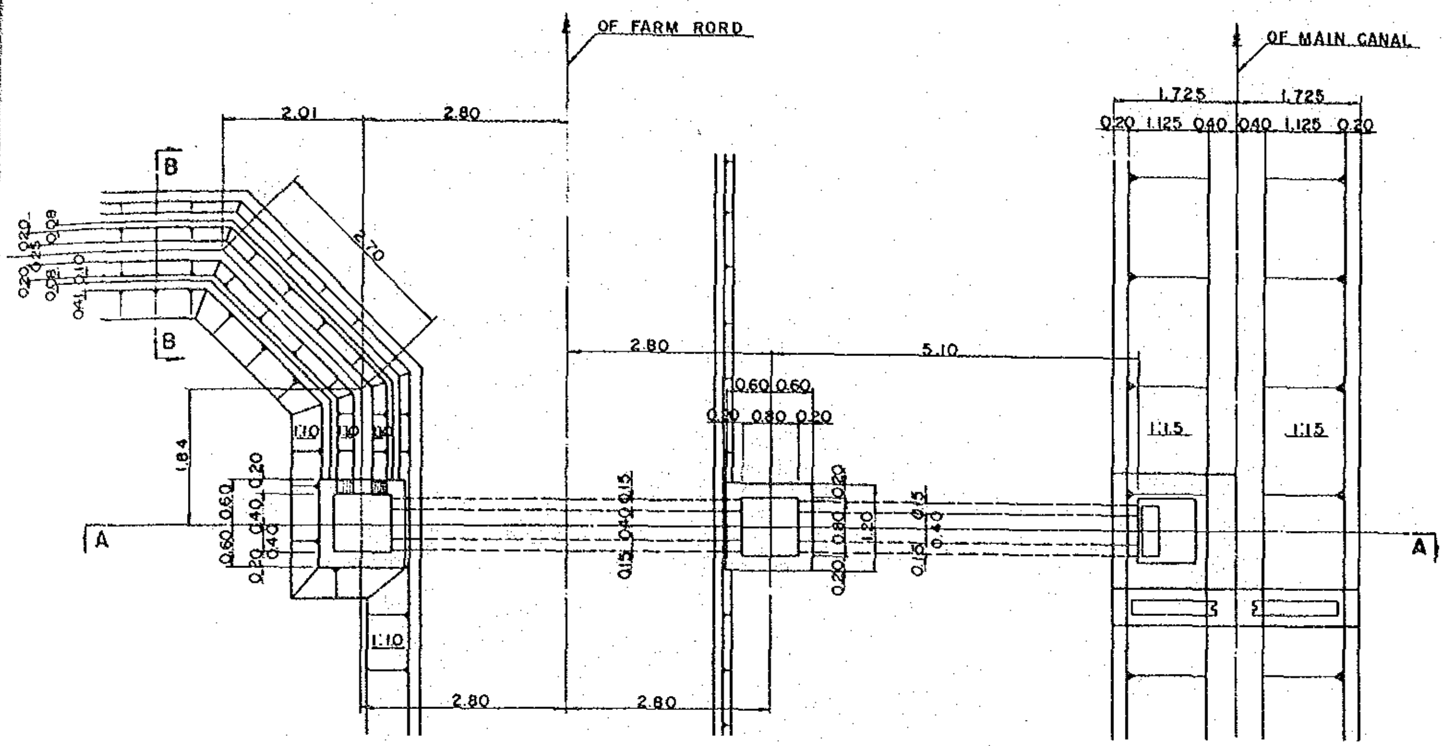
1. ALL DIMENSIONS ARE SHOWN IN METERS UNLESS OTHERWISE INDICATED
2. ABBREVIATION AND SYMBOL
   ℄ : CENTER LINE
   EL : ELEVATION

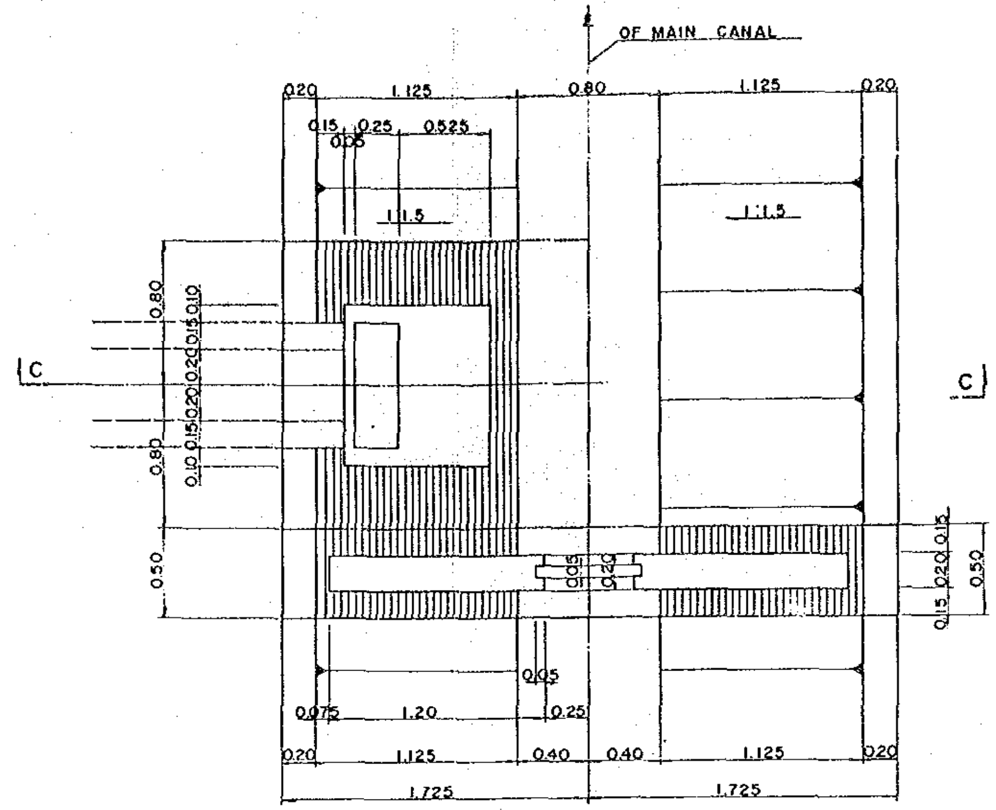
SCALE (A) 1 : 20

SCALE (B) 1 : 10

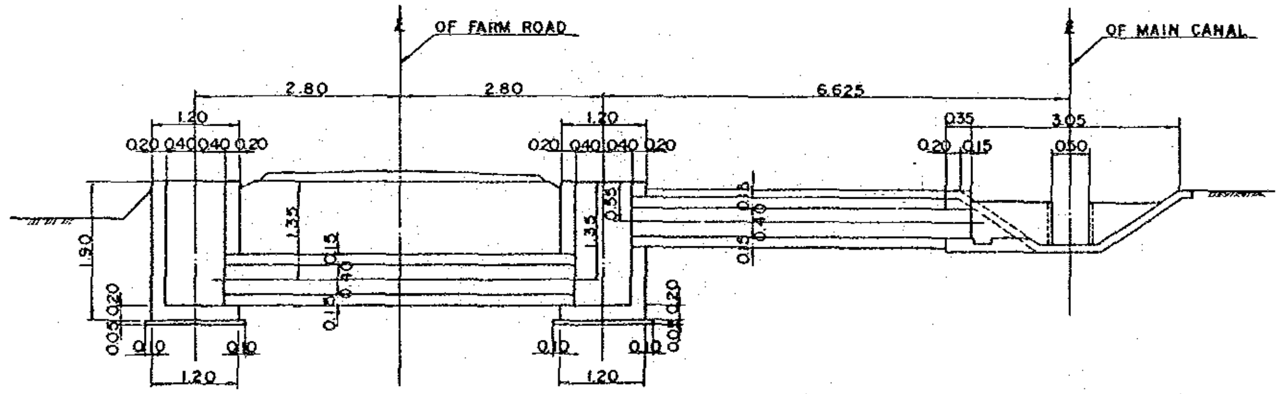
JAPAN INTERNATIONAL COOPERATION AGENCY	
THE DETAIL DESIGN SURVEY FOR THE STRENGTHENING RESEARCH ACTIVITIES PHASE II PROJECT AT KASETSART UNIVERSITY	
PADDY FIELD RELATED STRUCTURE	
PREPARED BY	DRAWING NO. 7
CHECKED NO.	

PLAN OF INTAKE SCALE. A

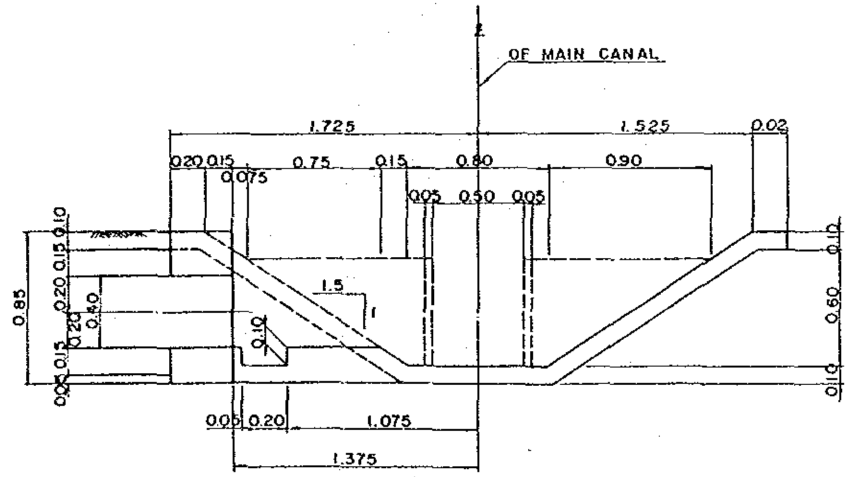




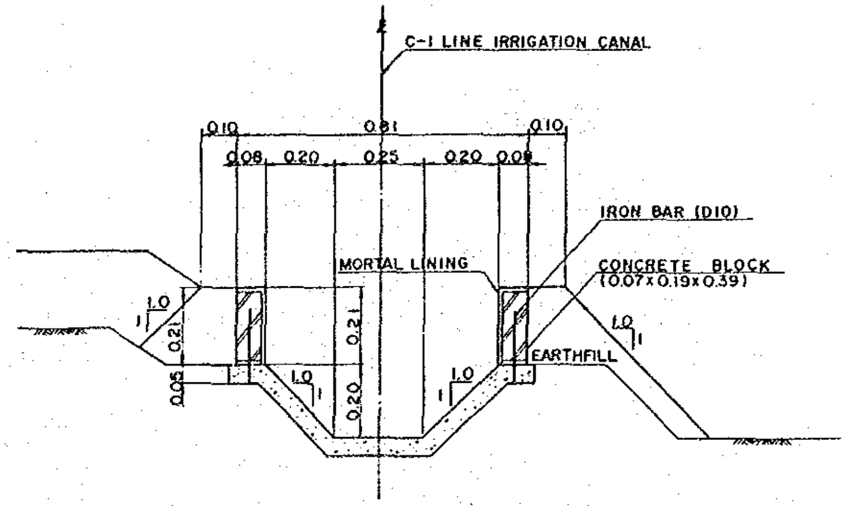
SECTION A — A SCALE. A



SECTION C — C SCALE. B



SECTION B — B SCALE. B



NOTE

1. ALL DIMENSIONS ARE SHOWN IN METERS UNLESS OTHERWISE INDICATED
2. ABBREVIATION AND SYMBOL
   ℄ : CENTER LINE
   EL : ELEVATION

SCALE (A) 1 : 50

SCALE (B) 1 : 20

JAPAN INTERNATIONAL COOPERATION AGENCY

THE DETAIL DESIGN SURVEY FOR THE STRENGTHENING RESEARCH ACTIVITIES PHASE.II PROJECT AT KASETSART UNIVERSITY

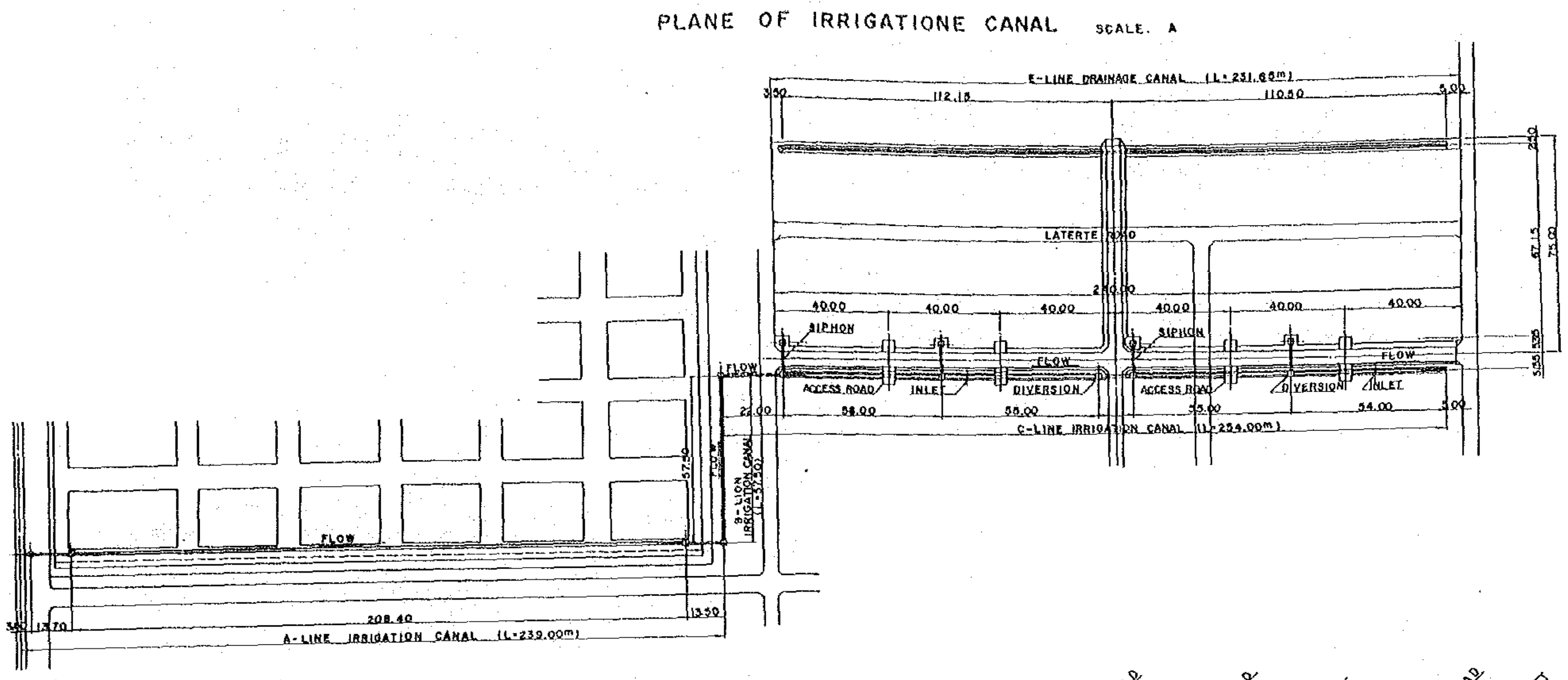
PADDY FIELD RELATED STRUCTURE

PREPARED BY

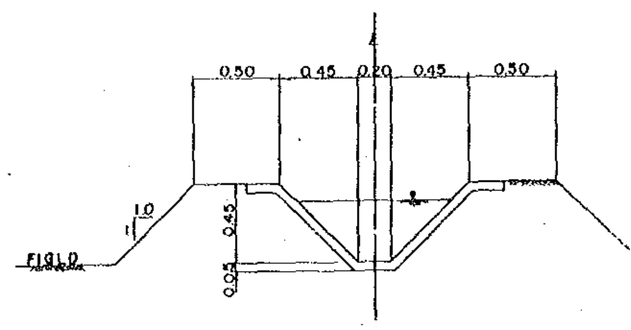
CHECKED NO.

DRAWING NO. 8

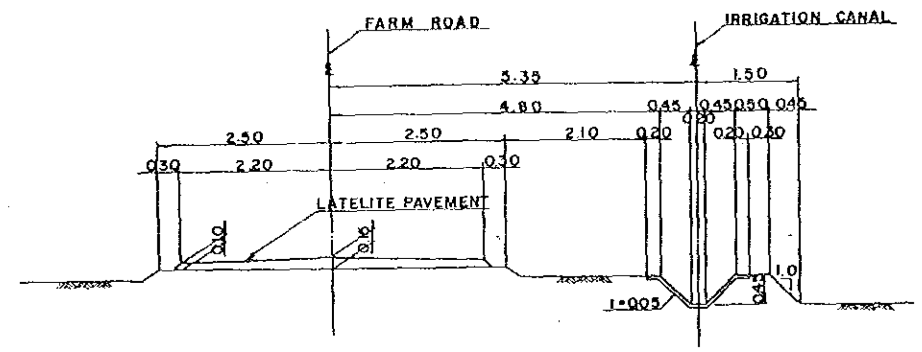
PLANE OF IRRIGATIONE CANAL SCALE. A

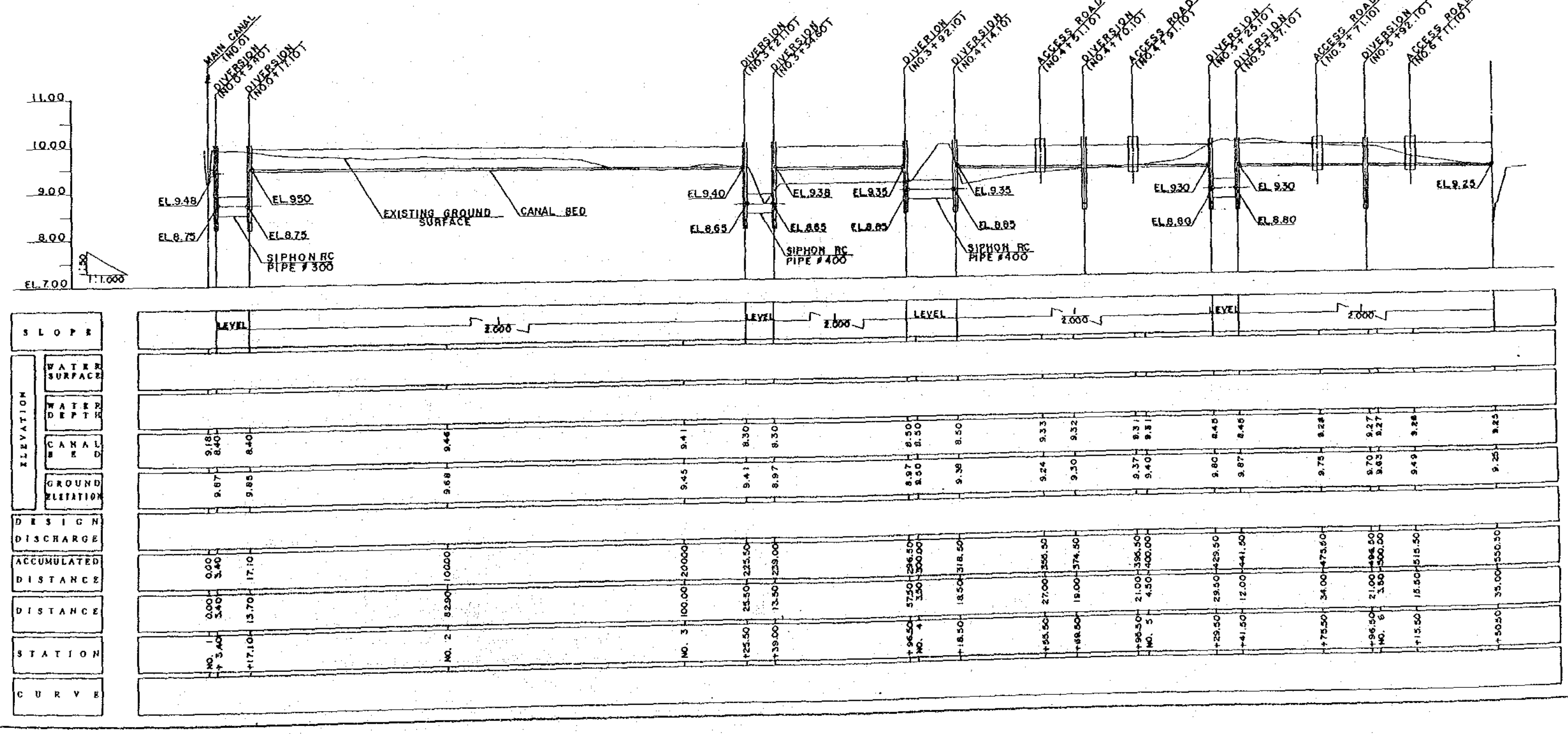


IRRIGATION CANAL STANDARD CROSS SECTION SCALE. C



IRRIGATION CANAL STANDARD CROSS SECTION SCALE. B





NOTE

1. ALL DIMENSIONS ARE SHOWN IN METERS UNLESS OTHERWISE INDICATED
2. ABBREVIATION AND SYMBOL
   ℄ : CENTER LINE
   EL : ELEVATION

SCALE(A) 1:1.000

SCALE(B) 1:50

SCALE(C) 1:20

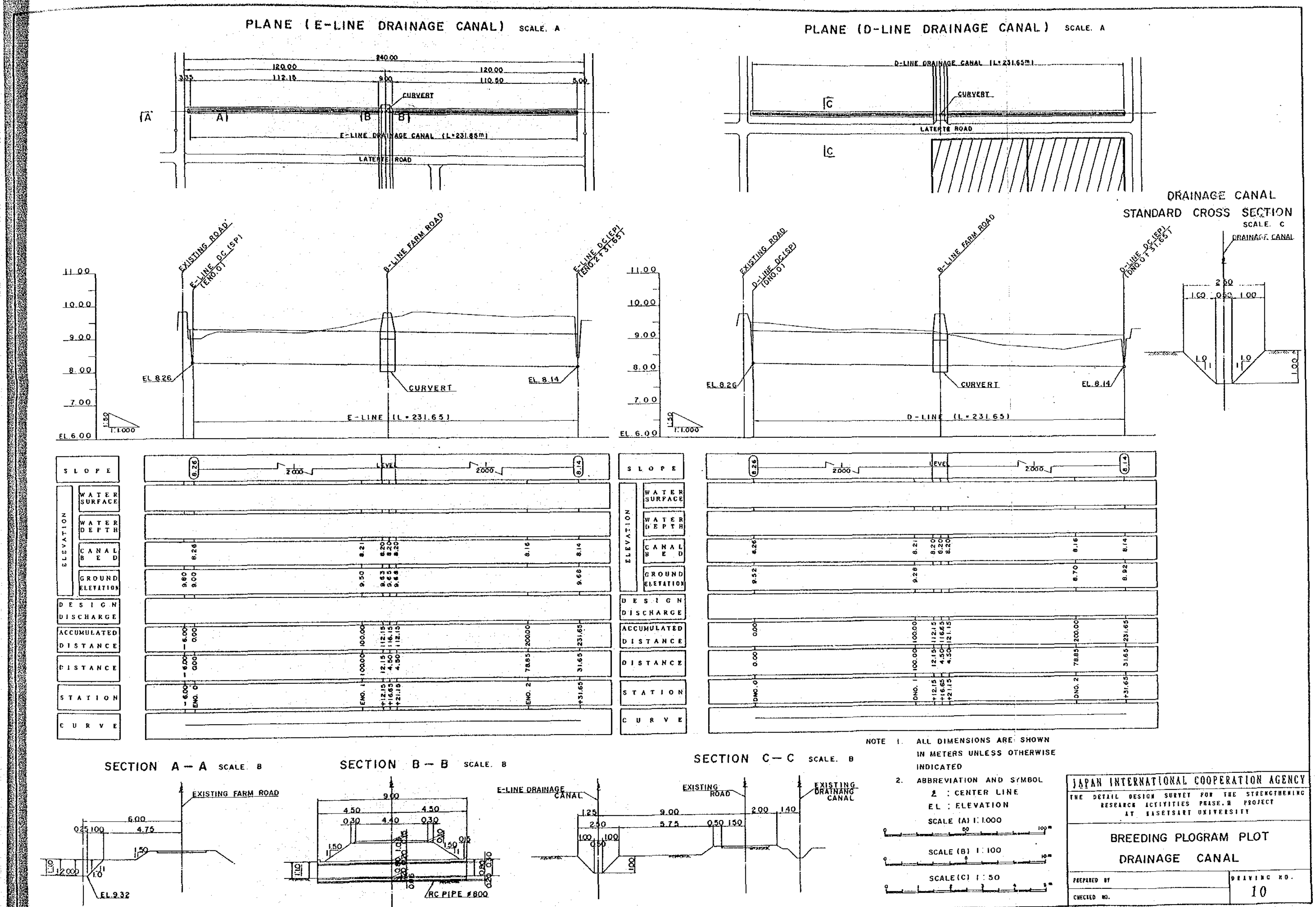
JAPAN INTERNATIONAL COOPERATION AGENCY

THE DETAIL DESIGN SURVEY FOR THE STRENGTHENING RESEARCH ACTIVITIES PHASE. II PROJECT AT KASETSART UNIVERSITY

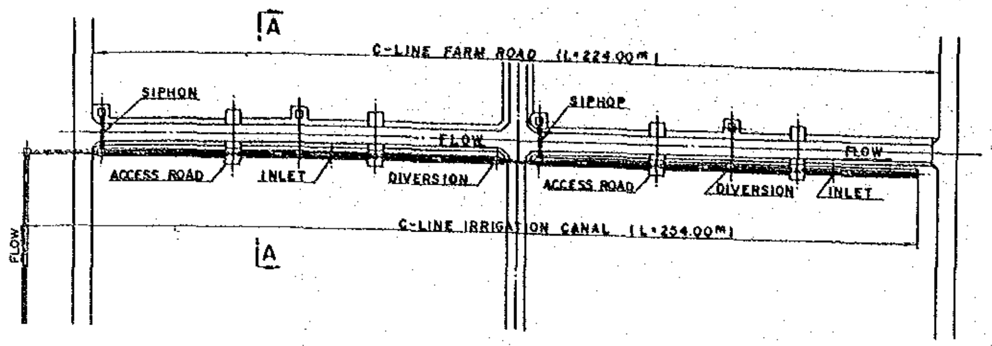
BREEDING PROGRAM PLOT

IRRIGATION CANAL

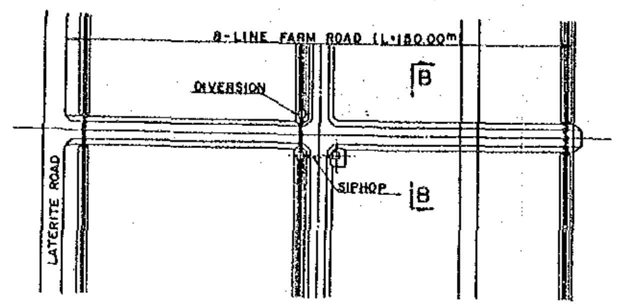
PREPARED BY	DRAWING NO.
CHECKED BY	9

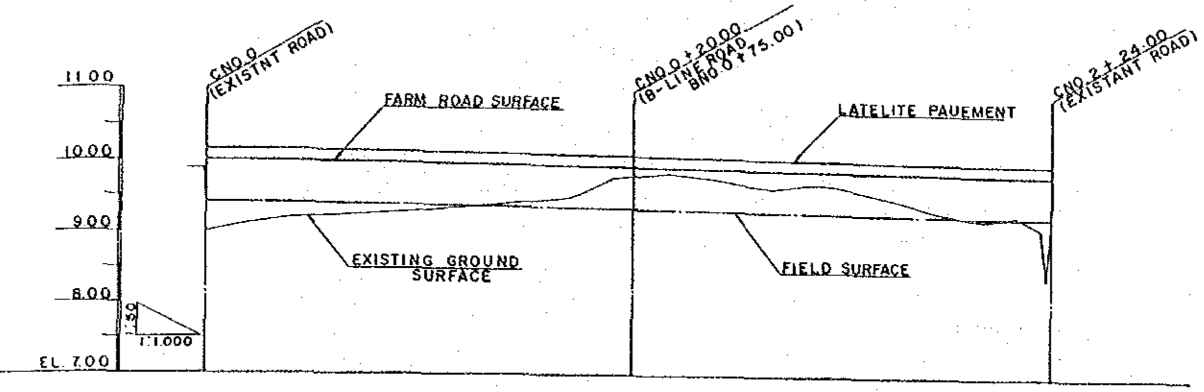

PLANE (E-LINE DRAINAGE CANAL) SCALE. A
PLANE (D-LINE DRAINAGE CANAL) SCALE. A
E-LINE DRAINAGE CANAL (L=231.65m)
D-LINE DRAINAGE CANAL (L=231.65m)
CURVERT
LATERITE ROAD
DRAINAGE CANAL
STANDARD CROSS SECTION
SCALE. C
EXISTING ROAD
B-LINE FARM ROAD
E-LINE (L=231.65)
D-LINE (L=231.65)
EL 8.26
EL 8.14
SLOPE
ELEVATION
WATER SURFACE
WATER DEPTH
CANAL BED
GROUND ELEVATION
DESIGN DISCHARGE
ACCUMULATED DISTANCE
DISTANCE
STATION
CURVE
SECTION A — A SCALE. B
EXISTING FARM ROAD
SECTION B — B SCALE. B
RC PIPE φ800
SECTION C — C SCALE. B
E-LINE DRAINAGE CANAL
EXISTING ROAD
EXISTING DRAINAGE CANAL
NOTE 1. ALL DIMENSIONS ARE SHOWN IN METERS UNLESS OTHERWISE INDICATED
2. ABBREVIATION AND SYMBOL
℄ : CENTER LINE
EL : ELEVATION
SCALE (A) 1:1,000
SCALE (B) 1:100
SCALE (C) 1:50
JAPAN INTERNATIONAL COOPERATION AGENCY
THE DETAIL DESIGN SURVEY FOR THE STRENGTHENING RESEARCH ACTIVITIES PHASE.II PROJECT AT KASETSART UNIVERSITY
BREEDING PLOGRAM PLOT
DRAINAGE CANAL
PREPARED BY
CHECKED NO.
DRAWING NO.
10

PLANE (C-LINE FARM ROAD) SCALE. A

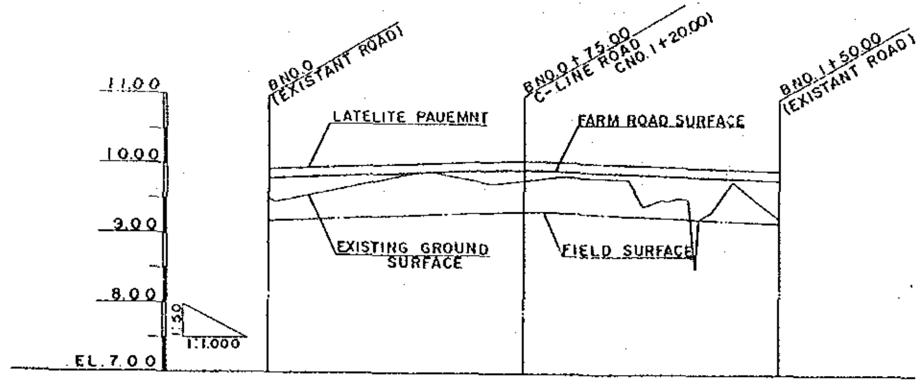


PLANE (B-LINE FARM ROAD) SCALE. A





SLOPE	10.01	1/2.000	LEVEL		1/2.000		9.89
EMBANKMENT	10.01	9.96	9.95	9.95	9.95	9.91	9.89
EXCAVATION							
GROUND ELEVATION	9.00	9.50	9.80	9.82	9.85	9.46	9.27
ACCUMULATED DISTANCE	0.00	100.00	115.50	120.00	124.50	200.00	224.00
DISTANCE	0.00	100.00	4.50	9.00	4.50	75.50	24.00
STATION	CNO. 0	CNO. 1	+15.50	+20.00	+24.50	CNO. 2	+24.00
CURVE							



SLOPE	9.80	1/500	LEVEL		1/500	9.80
EMBANKMENT	9.80	9.95	9.95	9.95	9.91	9.80
EXCAVATION						
GROUND ELEVATION	9.55	9.78	9.80	9.82	9.83	9.25
ACCUMULATED DISTANCE	0.00	70.50	75.00	79.50	100.00	150.00
DISTANCE	0.00	70.50	4.50	4.50	20.50	50.00
STATION	BNO. 0	+70.50	+75.00	+79.50	BNO. 1	+50.00
CURVE						

NOTE

1. ALL DIMENSIONS ARE SHOWN IN METERS UNLESS OTHERWISE INDICATED
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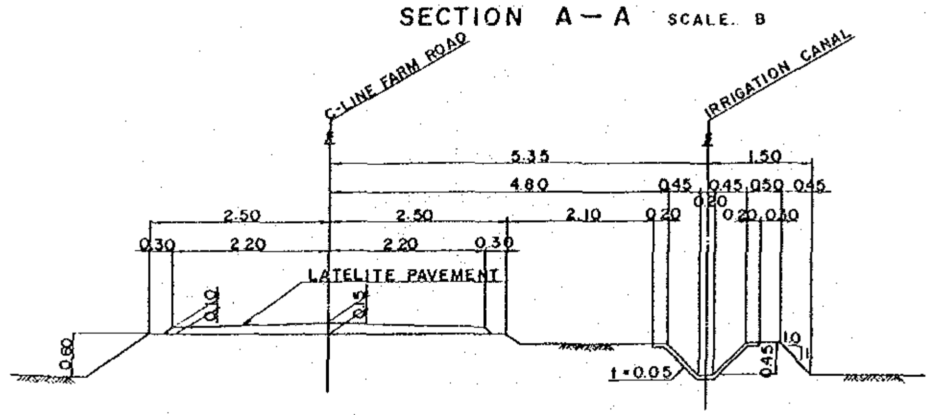
   ℄ : CENTER LINE
   EL : ELEVATION

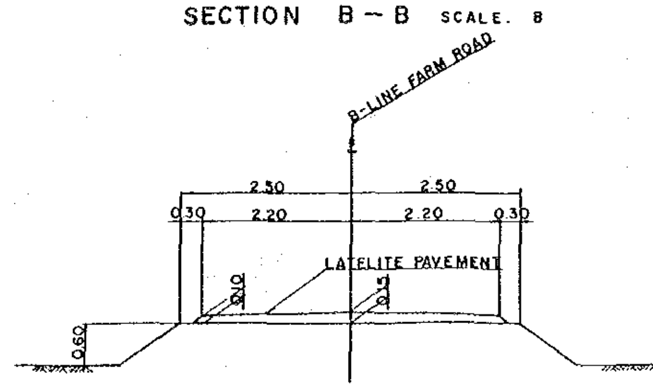
SCALE (A) 1:1.000 (0, 50, 100m)

SCALE (B) 1:50 (0, 1, 2, 3, 4, 5m)

SECTION A — A SCALE. B



SECTION B — B SCALE. B

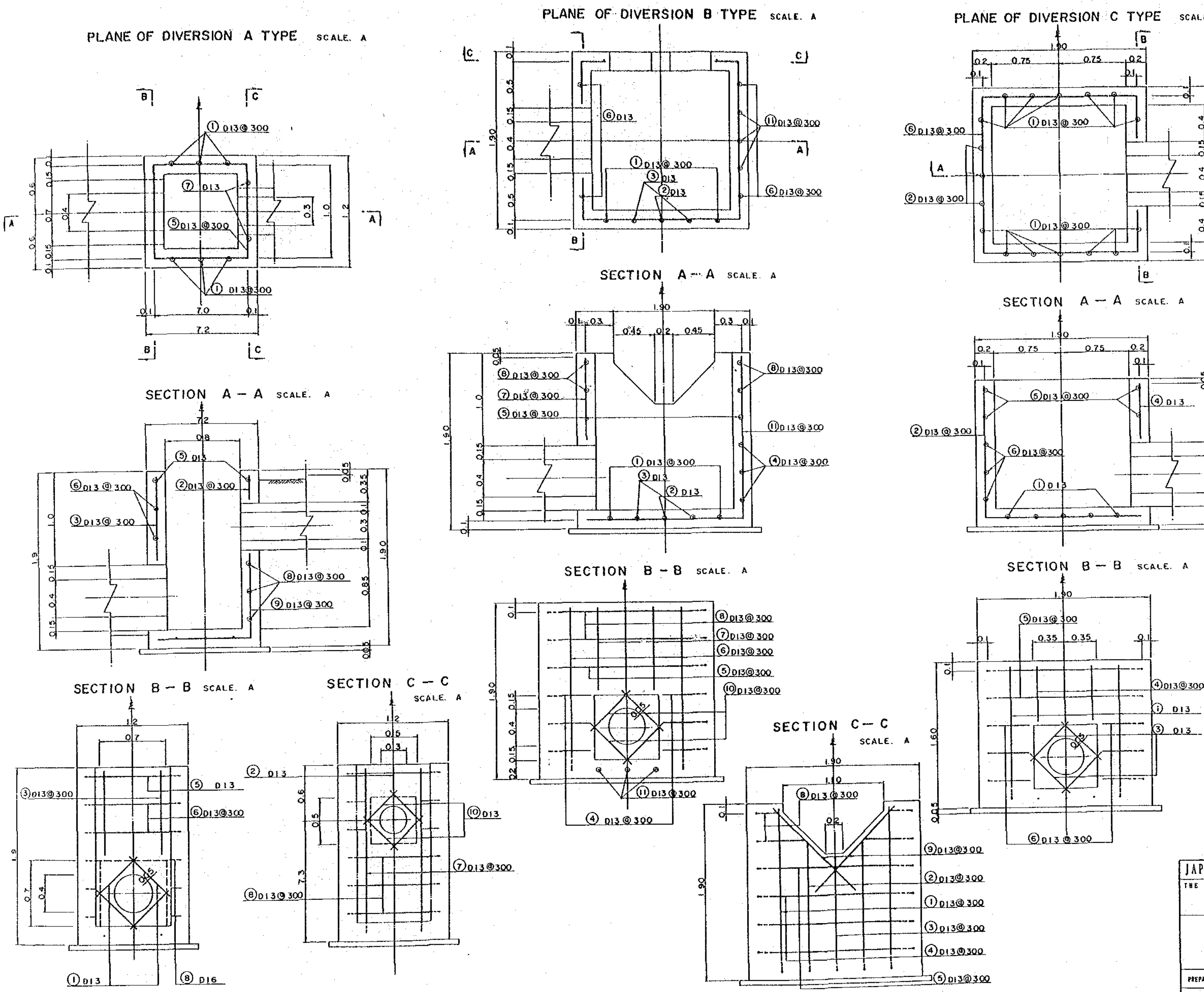


JAPAN INTERNATIONAL COOPERATION AGENCY

THE DETAIL DESIGN SURVEY FOR THE STRENGTHENING RESEARCH ACTIVITIES PHASE II PROJECT AT KASETSART UNIVERSITY

BREEDING PLOGRAM PLOT
FARM ROAD

PREPARED BY
CHECKED BY.
DRAWING NO. 11



NOTE

1. ALL DIMENSIONS ARE SHOWN IN METERS UNLESS OTHERWISE INDICATED
2. ABBREVIATION AND SYMBOL
   ℄ : CENTER LINE
   EL : ELEVATION

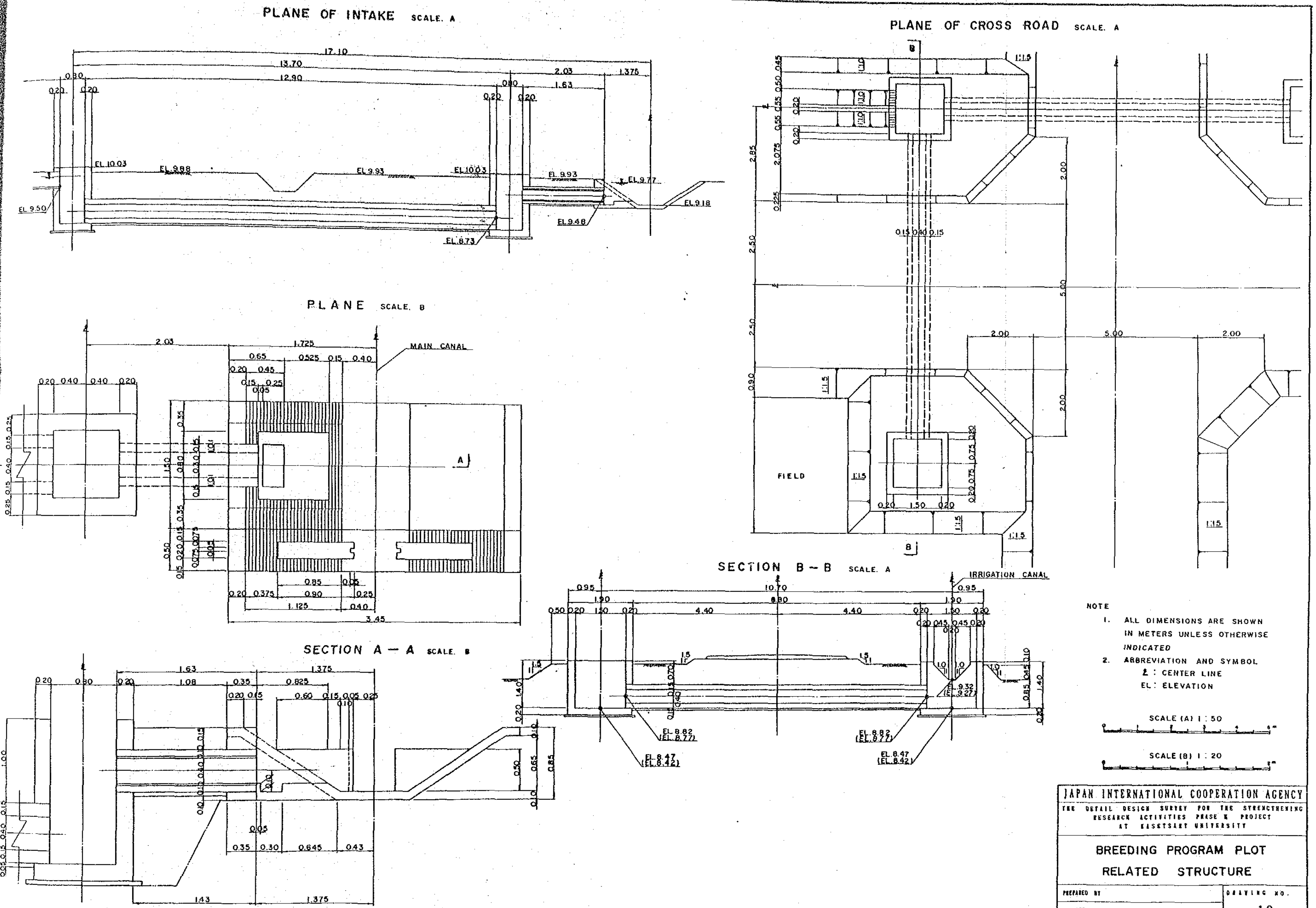
SCALE (A) 1 : 20

JAPAN INTERNATIONAL COOPERATION AGENCY

THE DETAIL DESIGN SURVEY FOR THE STRENGTHENING RESEARCH ACTIVITIES PHASE II PROJECT AT KASETSART UNIVERSITY

BREEDING PLOGRAM PLOT
RELATED STRUCTURE

PREPARED BY	DRAWING NO. 12
CHECKED NO.	



NOTE

1. ALL DIMENSIONS ARE SHOWN IN METERS UNLESS OTHERWISE INDICATED
2. ABBREVIATION AND SYMBOL
   ℄ : CENTER LINE
   EL : ELEVATION

SCALE (A) 1 : 50

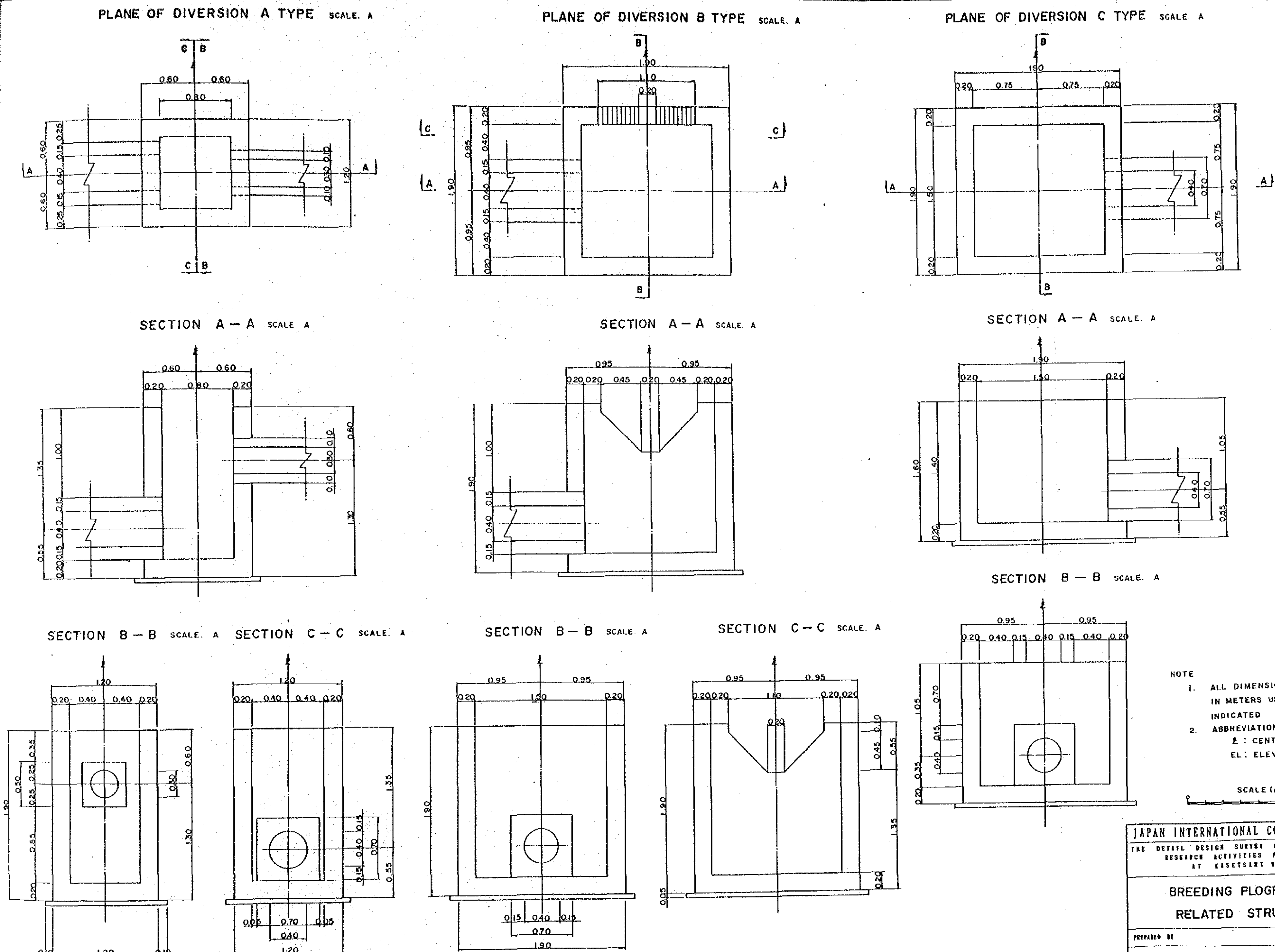
SCALE (B) 1 : 20

JAPAN INTERNATIONAL COOPERATION AGENCY

THE DETAIL DESIGN SURVEY FOR THE STRENGTHENING RESEARCH ACTIVITIES PHASE II PROJECT AT KASETSART UNIVERSITY

BREEDING PROGRAM PLOT
RELATED STRUCTURE

PREPARED BY	DRAWING NO.
CHECKED NO.	13



NOTE

1. ALL DIMENSIONS ARE SHOWN IN METERS UNLESS OTHERWISE INDICATED
2. ABBREVIATION AND SYMBOL
   ℄ : CENTER LINE
   EL : ELEVATION

SCALE (A) 1 : 20

JAPAN INTERNATIONAL COOPERATION AGENCY

THE DETAIL DESIGN SURVEY FOR THE STRENGTHENING RESEARCH ACTIVITIES PHASE II PROJECT AT KASETSART UNIVERSITY

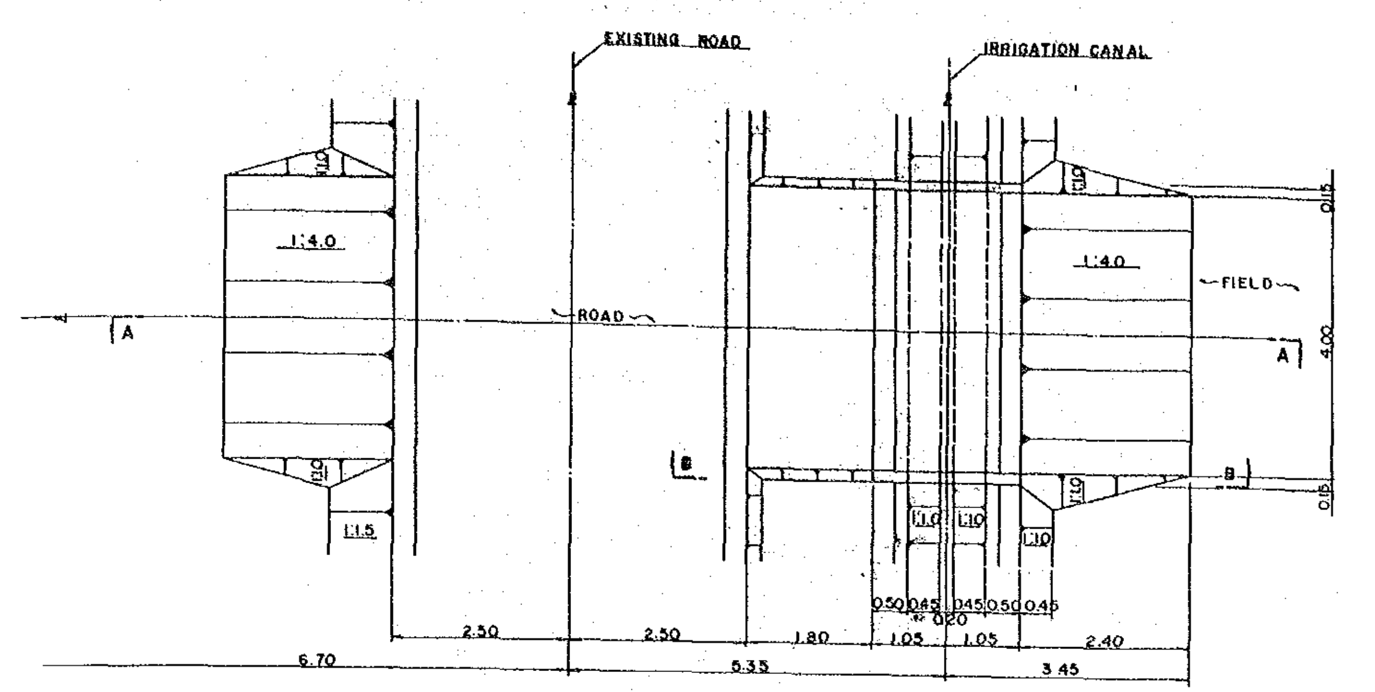
BREEDING PLOGRAM PLOT RELATED STRUCTURE

PREPARED BY

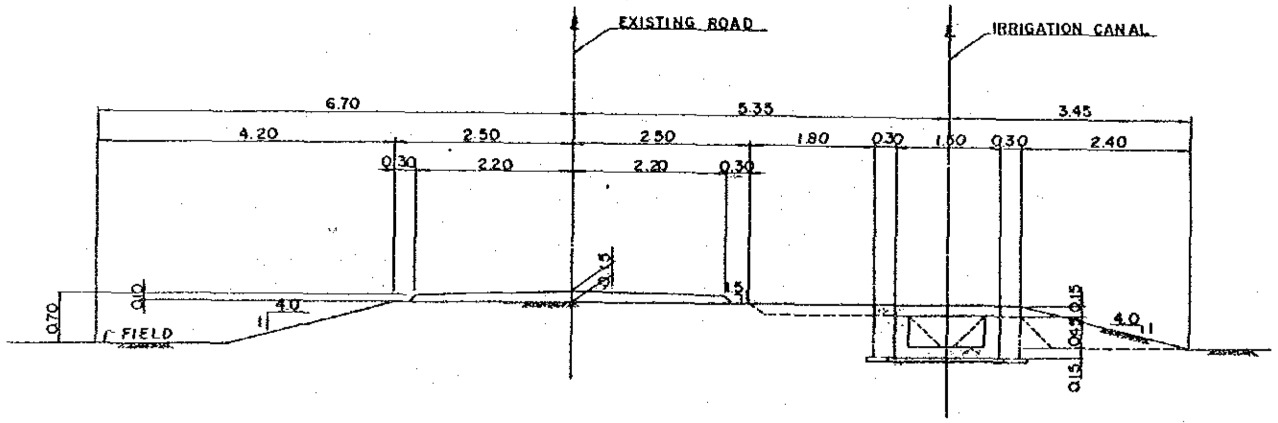
CHECKED NO.

DRAWING NO. 14

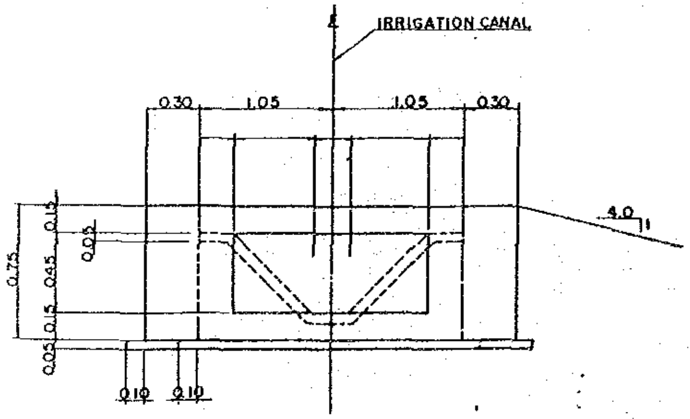
PLANE OF ACCESS ROAD SCALE. A



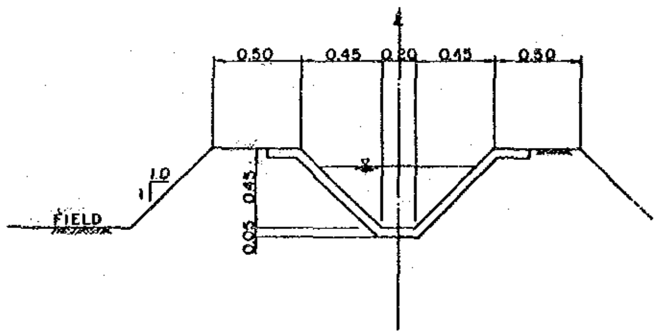
SECTION A — A SCALE. A



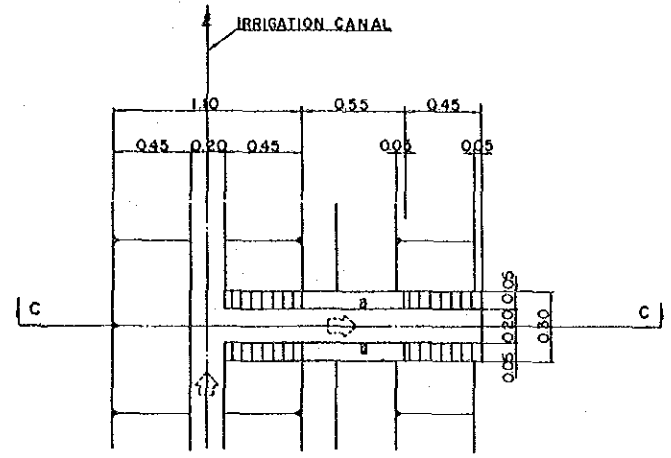
SECTION B — B SCALE. B



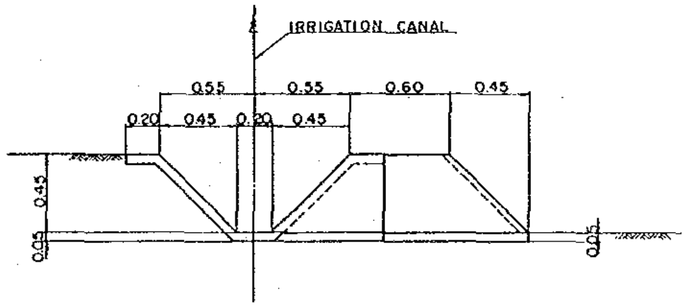
IRRIGATION CANAL SCALE. B



PLANE OF INLET SCALE. B



SECTION C — C SCALE. B



NOTE

1. ALL DIMENSIONS ARE SHOWN IN METERS UNLESS OTHERWISE INDICATED
2. ABBREVIATION AND SYMBOL
   ℄ : CENTER LINE
   EL : ELEVATION

SCALE (A) 1 : 50

SCALE (B) 1 : 20

JAPAN INTERNATIONAL COOPERATION AGENCY

THE DETAIL DESIGN SURVEY FOR THE STRENGTHENING RESEARCH ACTIVITIES PHASE II PROJECT AT KASETSART UNIVERSITY

BREEDING PROGRAM PLOT
RELATED STRUCTURE

PREPARED BY	DRAWING NO.
CHECKED NO.	15