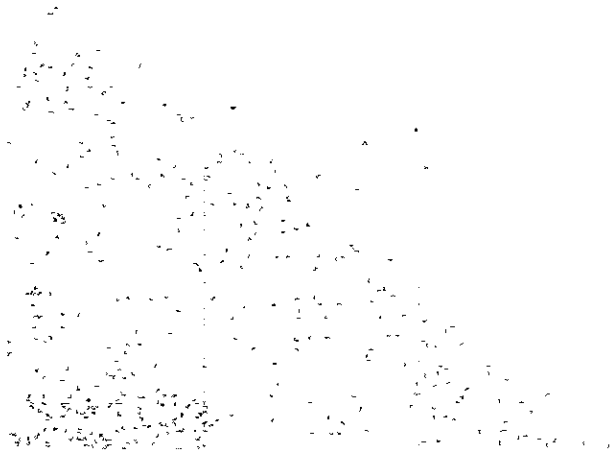
BASIC DESIGN STUDY
ON
THE ESTABLISHMENT PROJECT OF THE THREE INLAND FISHERIES CENTERS
IN
THE KINGDOM OF THAILAND

JULY 1982

JAPAN INTERNATIONAL COOPERATION AGENCY



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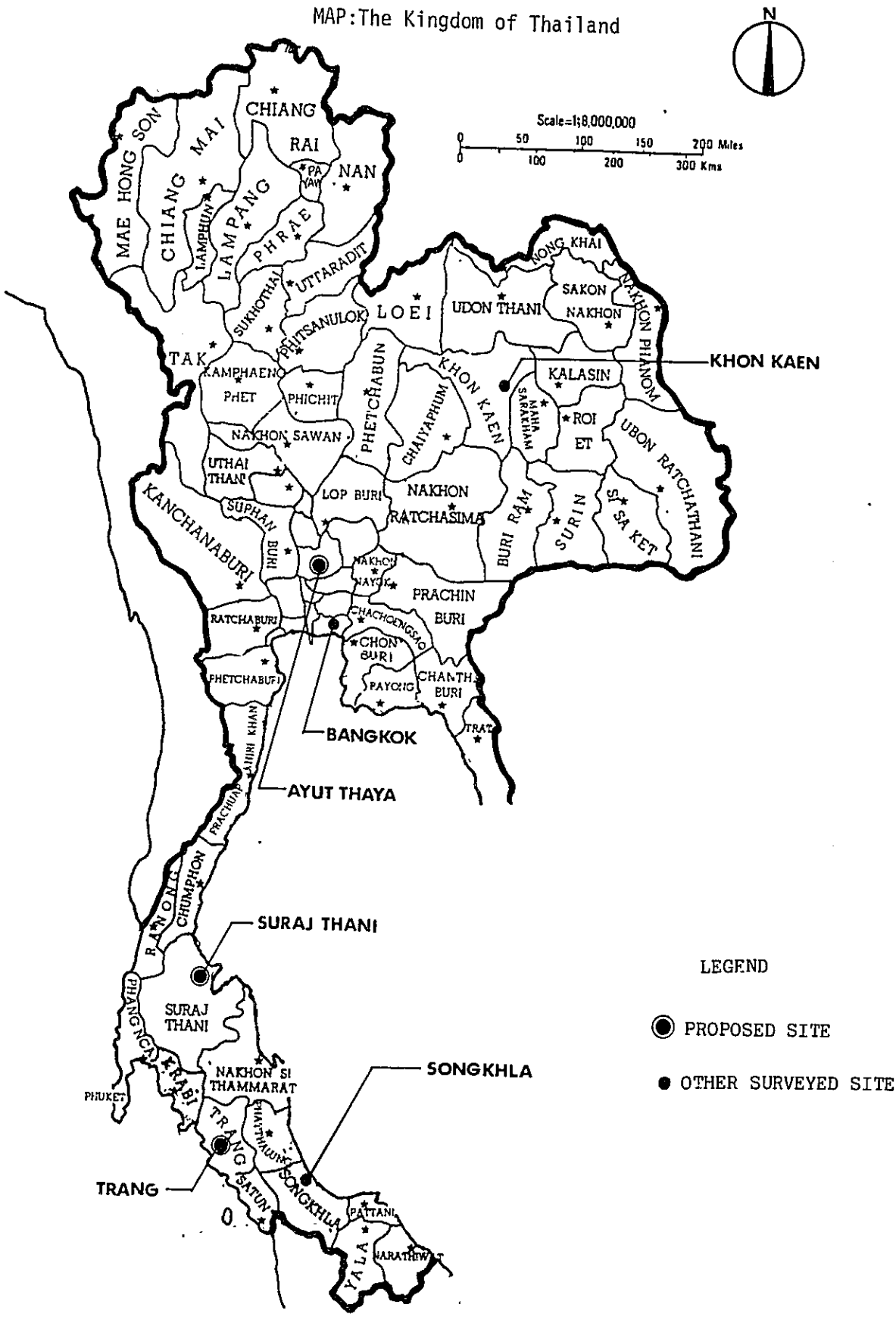
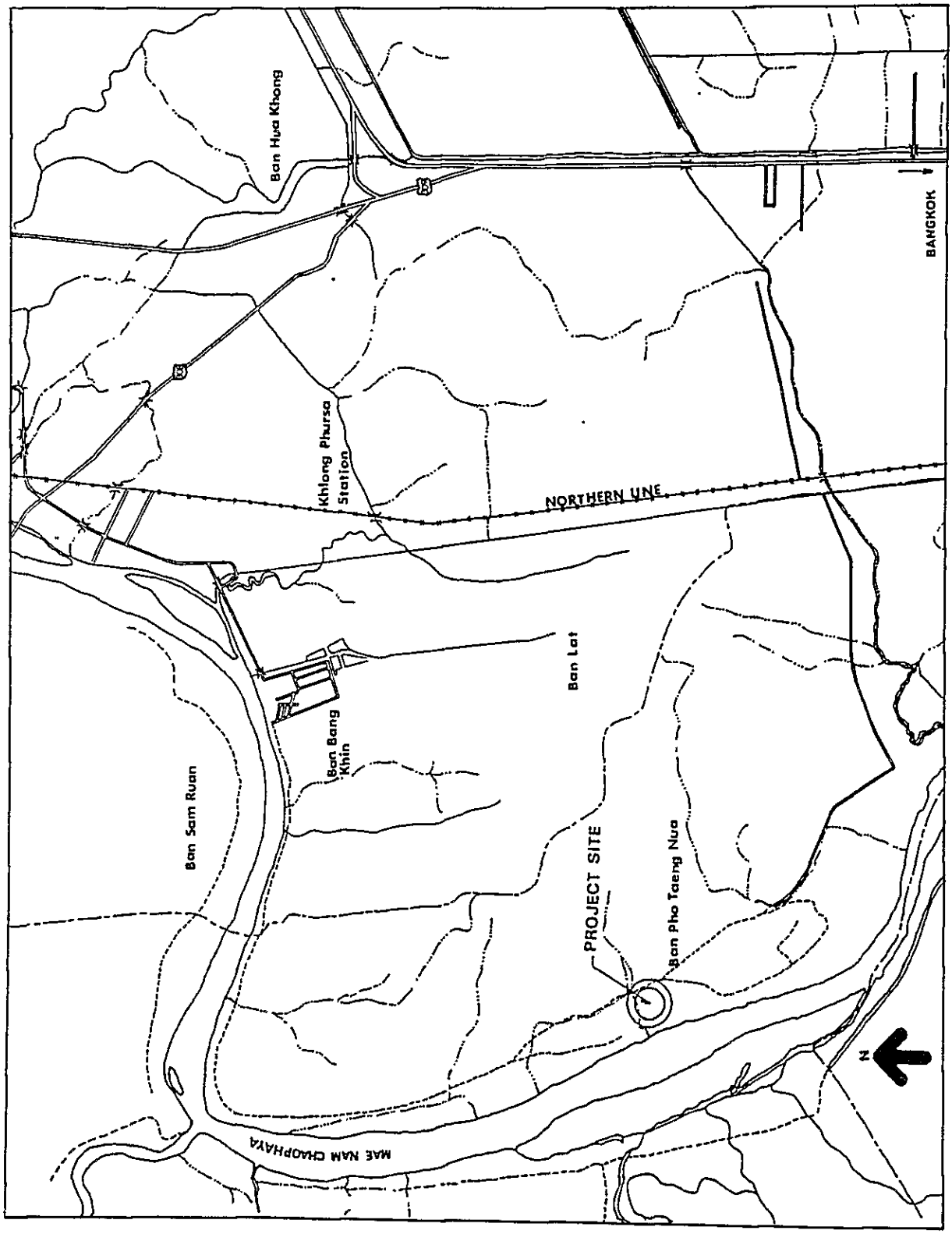
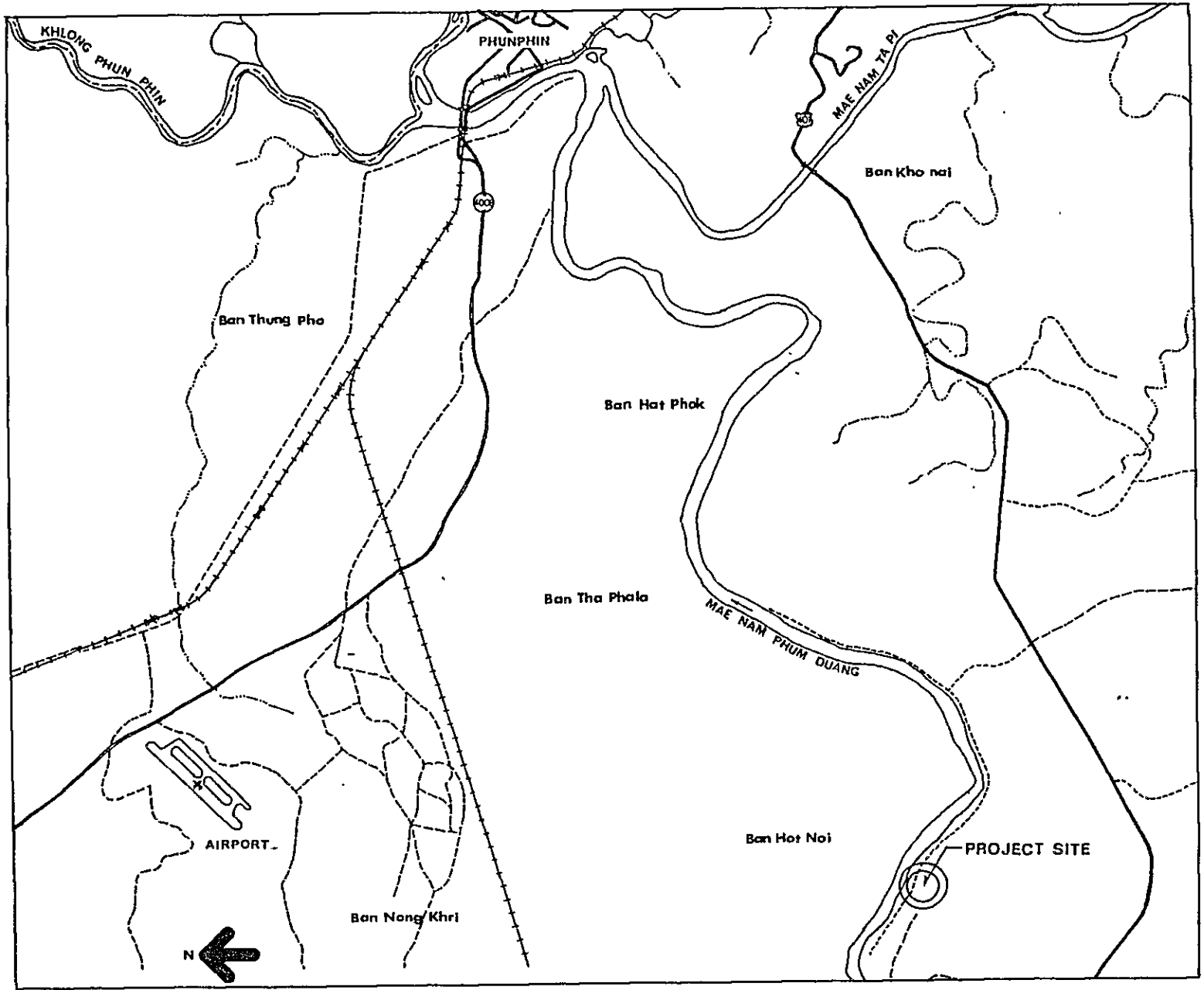
MAP:The Kingdom of Thailand





SITE LOCATION — AYUTTHAYA — S = 1:70,000



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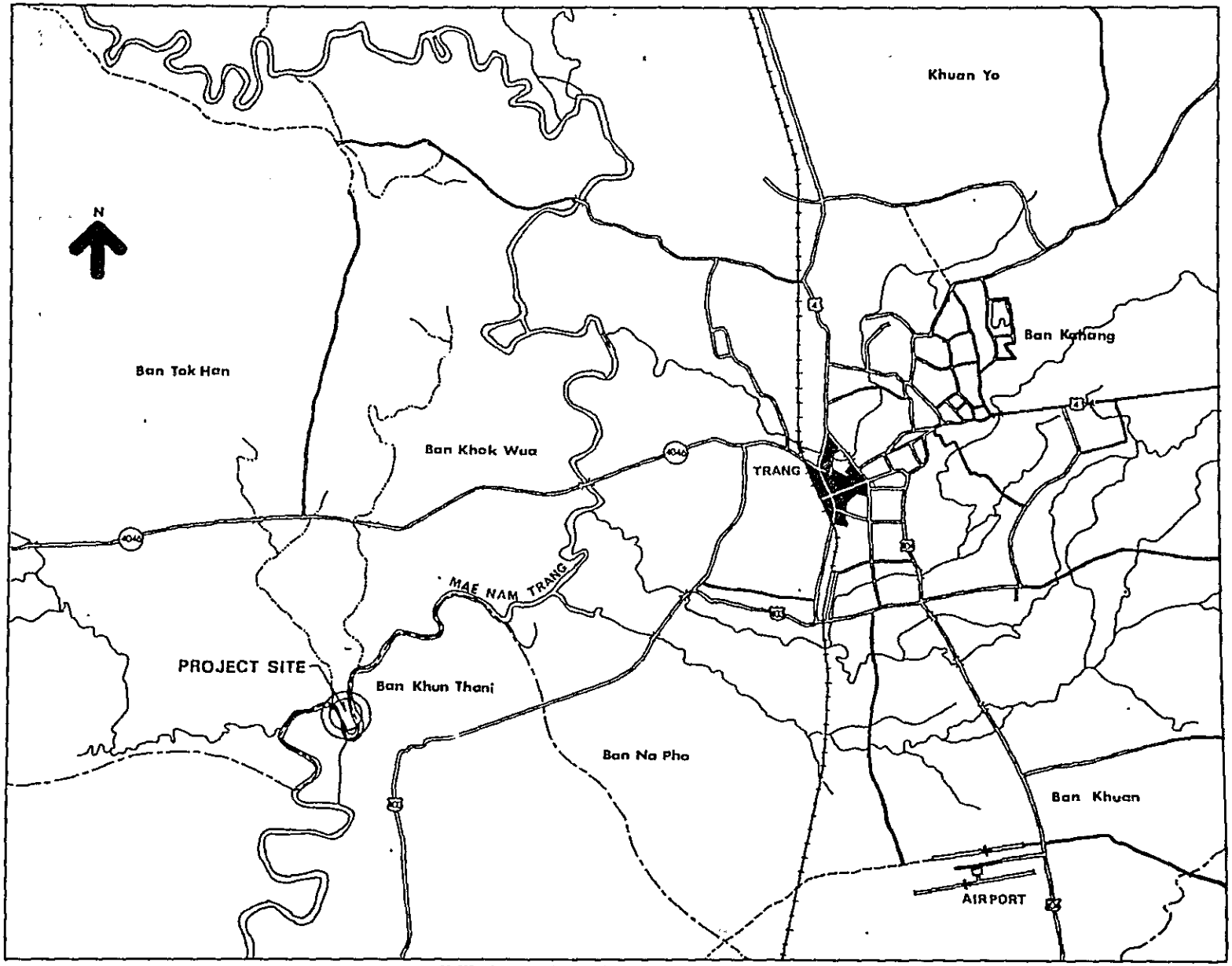

SITE LOCATION — TRANG —

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PREFACE

In response to the request of the Government of the Kingdom of Thailand, the Government of Japan decided to conduct a study on the Establishment project of Inland Fisheries Centers and entrusted the study to the Japan International Cooperation Agency (JICA). The JICA sent to Thailand a survey team headed by Mr. Tamezo Maruyama, First Laboratory, the Environment Control Devision, National Research Institute Aquaculture, Fisheries Agency from April 10 to April 30, 1982.

The team had discussions with the officials concerned of the Government of The Kingdom of Thailand and conducted a field survey (in Ayutthaya, Surajthni, and Tnang). After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Kingdom of Thailand for their close cooperation extended to the team.

July, 1982

Keisuke Arita
President
Japan International Cooperation Agency.

SUMMARY

The Fifth National Economic and Social Development Plan (the 5th NESDP) aims at stabilizing the national economy of Thailand. The Government of Thailand regards the reduction of unemployment and poverty as major policy goals of the 5th NESDP. The development of the forestry and fishery industries, in line with these goals, will play an important role in stabilizing the economic progress in Thailand.

As regards the aspect of the fishery, the amount of fish hauled by trawling declined steadily, after the peak in 1977, due to the dwindling fish resources in the Gulf of Thailand, the rise in fuel prices, and the reduction of fishery area by the imposition of the 200 mile exclusive economic zone. Under the condition of increasing population, the declining haul has had an especially serious effect on the food supply to the Thai people, since fish is consumed as their main source of animal protein.

Consequently, the Government of Thailand intends to develop urgently the inland fishery in order to provide animal protein to regional population at a reasonable price, and in order to provide work opportunities; thus, it aids in reducing the unemployment rate.

The Government of Thailand is planning to establish four inland fisheries centers and fifty stations as its inland fisheries development program under the 5th NESDP, in order to produce and distribute seed fish and to conduct research, technical training, as well as to provide extension service for farmers and fishermen.

This project will be implemented in three high priority regions: Ayutthaya, Surajthani, and Trang. The specific objectives of the three inland fisheries centers aim at the stable production and distribution of the seed fish in the three areas. The objectives of this plan also include carrying out a program for training farmers and fishermen in cultivation techniques and also a seed fish distribution program to increase the stock of fish in the waters of the three areas involved. Hence, the cultivation industry can be developed rapidly.

The objectives of the three fisheries centers and the number of staff are shown as follows.

Ayuttaya Fishery Center:

1) Production of seed fish.

2) Aquaculture research and genetic study on fresh water fish.

3) Training of the fishery officers and farmers, in the Central Region of Thailand.

4) Total number of staff 45

- Lab. staff 13
- Officers 12
- Support staff 20

Surajthani Fishery Center:

1) Production of seed fish

2) Applied aquaculture research on fresh water fish.

3) Training of the fishery officers and farmers, and developing of fishery resources in the Southern Region of Thailand.

4) Total number of staff 60

- Lab. staff 16
- Officers 19
- Support staff 25

Trang Fishery Center:

1) Production of seed fish.

2) Teaching farmers techniques for effective cultivation and management of fresh water fish.

3) Total number of staff 28

- Lab. staff 5
- Officers 8
- Support staff 15

The accomplishment of the centers' objectives can only be reached through the cooperation of the Governments of the Kingdom of Thailand and Japan. The portion of the project to be completed by each country is shown below.

Japanese portion of the project cost is estimated 1,185,000,000yen. The duration of construction will be approximately 20 months, including the detailed design stage.

JAPAN:

CENTER / FACILITIES	AFC	SFC	TFC	TOTAL
1. CEMENT POND 50m²	20	20	10	50
2. EARTHEN POND 400m²	60	-	-	60
3. EARTHEN POND 1,600m²	26	48	14	88
4. EARTHEN POND 3,200m²	14	18	6	38
5. RESERVOIR	2.9ha	2.0ha	2.0ha	6.9ha
6. CENTER BLDG.	500m²	830m²	150m²	1,480m²
7. HATCHERY	420m²	500m²	250m²	1,170m²
8. DORMITORY	530m²	530m²	-	1,060m²
9. EQUIPMENT	1 SET	1 SET	1 SET	3 SETS

THAILAND:

Access Roads	Main Roads
Dikes	Wells
Ground Leveling	The Infrastructure Exterior to the Project Sites
Residences	

As for the project organization, the central governmental office of the Inland Fishery Development and Operation Center is in direct charge of the project. The principal officers in charge have already been assigned and temporary managers of the centers have already been nominated.

The budget for this project has also already been appropriated for the years to come to insure the operation. The amount of the seed fish production will be in accord with the water area in a fit condition for release. The species of the seed fish that have been selected are suitable to the project because these fish species are all those whose cultivation technology has been developed in Thailand.

The project target production of seed fish in the initial stage will not be large enough to supply the large population in Thailand, but through

training and promotion of seed fish culture in these sites, it is expected the cultivation fishery in the future.

At the initial stage, training and promotion programs will be limited mainly to the governmental officers. In the later stage, they will be opened to the farmers and fishermen. Thus, the fisheries project may contribute to the Thai economy.

The species of fish in the Ayutthaya Fishery Center program were selected for a high reproductive potential and a strong constitution.

As a result of economic evaluation, the EIRR (Economic Internal Rate of Return) was calculated at 9.4% overall, and this value is by no means poor for a project including planning, research, training and popularization, that can not be directly expressed in figures. But it is definitely valuable for the development of the inland fishery industry.

It can be concluded that the project will contribute in the three provinces to the improvement of food supply to the farmers and fishermen. As a result of increased production of fresh water fish there will be an accompanying rise in the income of the local population, as well as more employment chances and the ability to aquire foreign currency. This leads us to believe that this project is well suited for the subject of Japanese grant aid.

In order to manage the project more effectively, new aquaculture engineers must be trained and techniques for the prevention of fish disease must be mastered. As for the cultivation of seed fish strict staff supervision of the cultivation process, training programs and extension services should be important to operate the centers efficiently.

CONTENTS

1. Introduction

1-1 Project Background

Based on the request by the Kingdom of Thailand for assistance in the implementation of their project to establish Inland Fisheries Centers, the Government of Japan despatched an advance investigation team from February 9 to February 18, 1982 so that the fundamental roles of the centers, contents of the project, organization for management and control, etc., could be fully discussed with the Thai Government officers in charge of the project.

Based on the results of the advance investigation, the Government of Japan despatched a basic design survey team from April 10 to April 30, 1982 to discuss the matter with the officers in the Government of Thailand and to collect data necessary for the basic design.

1-2 Basic Design Study and Discussed Items

The items of investigation and discussion by the basic design study team are as follows.

(1) Confirmation of the project was given by the Ministry of Agriculture and Cooperatives Fishery Department and by the provincial governments of the sites concerned.

(2) Confirmation of the project scale and project organization was given by officials in both the fishery Department and Fresh Water Fishery Development and Control Centers.

(3) Investigation of the project sites and of the organization and arrangement of the infrastructure was completed.

(4) Investigation of the circumstances concerning construction work within Thailand, including laws, regulations and engineering standards was carried out. The construction standards for engineering projects were found to be high. Based on the material prices in Bangkok, data was collected on the costs of materials in the provinces concerned.

(5) Plans for the execution and management of the project construction, as well as plans for the running and maintenance of the centers after construction were confirmed.

(6) The contents of the request made by the Government of Thailand including the reasons for developing the fisheries centers and the level of priority for the project were evaluated.

(7) The scale, site plan, architectural design and the types and amounts of equipment needed were decided on.

(8) The contents and system of the grant to be given by the Government of Japan was explained and the scope of work to be completed by each country was clarified.

1-3 The Results of The Basic Design Study

The results of the basic design study were prepared and, in the meeting of April 27, 1982 the contents of the proposal were discussed, including sites of construction, activities of each of the centers, the scope of construction work to be taken charge of by each government, and the basic design plan of the centers.

Consequently, on the bases of the "Minutes of Discussion," the report on the basic design study was generated with an analysis and development of the data. More specifically, this report, after analyzing and evaluating the feasibility and the priority level of Thailand's request, proposes what the basic design of the project will be. The basic design, responding to the requests of the Government of Thailand, also is designed to meet the climatic and geographical conditions of Thailand. In addition, the report proposes the time and labor schedule for the maintenance and operation of the centers. The total project cost in EIRR is also included in the report.

2. Project Necessity and Role

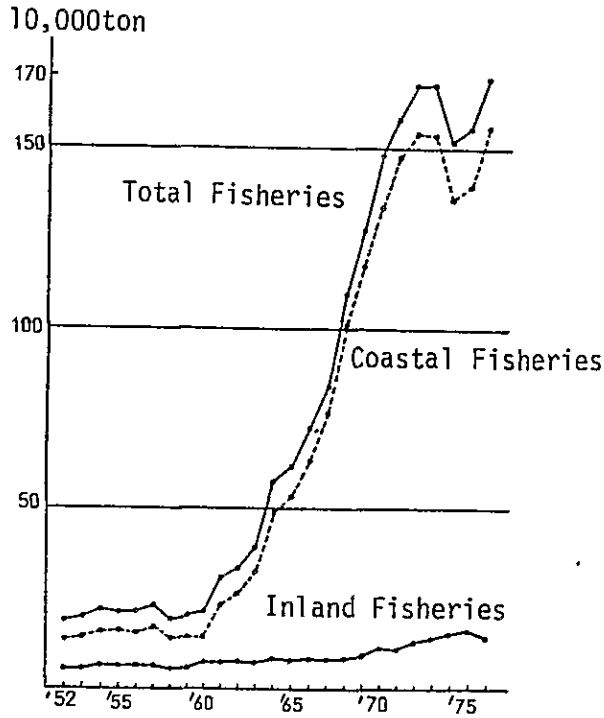
2-1 The Necessity for Developing Inland Fisheries

As regards the fishery industry, the amount of fish hauled by trawling increased rapidly in the 1960's and reached a peak in 1977. After this time, the average yearly catch has declined steadily owing to the dwindling fish resources in the Gulf of Thailand, the rise in fuel prices, and the reduction of fishing ground by the imposition of the 200 mile exclusive economic zone.

The declining haul has had an especially negative effect on the diet of the Thai people since their main source of protein is in the form of relatively inexpensive fish. Consequently, the Government of Thailand considers that the development of inland fisheries is an improvement plan that will provide animal protein to regional populations at a reasonable price and will also aid in reducing the unemployment rate.

Under the circumstances, the development of inland fisheries is a matter of necessity for the Thai people.

Fig. 2-1 Changes in Fishery Production



QUOTED: "Fishery in Thailand in 1979" Toshibumi Sakurai, published by Japan Fishing Resources Association

2-2 The Role of the Project

The project is carried out with the objective to increase the supply

of fishery resources in accordance with the 5th NSEDP.

This program is being implemented in the hope of developing inland water fishing along with improving common cultivation ponds and establishing fishery Department facilities in necessary areas. The project will play an important role in the realization of the 5th NSEP's goal to develop inland fisheries.

2-3 Fishery Projects Constructed by Foreign Organizations

The Canada International Development Agency (CIDA) and the United States Agency for International Development (USAID) provid the projects which are quite similar to the project.

The CIDA assisted the Thai Fishery Department from 1975 to 1980 and also helped to establish the National Inland Fisheries Institute (NIFI). The principal activities of the NIFI are to research various aspects of fresh water fish and to provide a training program for fishery studies at the national level.

The USAID provided training programs and scientific instruments to the fishery department from 1968 to 1972, and sponsored many biological researchers from the department to study abroad. These foreign trained researchers are expected to be able to help execute a project similar to the program directed by the CIDA.

The USAID sponsored the Village Fish Pond Program (1980-1981) which is located in the Northeastern district of Thailand. In Bangkok, the International Development Research Center (IDRS) had been assisting in the breeding of fish with NIFI equipment since 1981. This program will continue until 1983 and strongly resembles the proposed fish breeding project in Ayutthaya now under consideration.

Table 2-1 Inland Fisheries of Thailand:
Foreign Aid For Fresh Water Fish Culture Programs

Item / Year	Nation	Budget Unit:$Mil.	Project
1973 - 1978	Canada	3	Establishment of the National Inland Fisheries Institute, Bangkok
1980 - 1981	The U.S.A.	0.5	Village Fish Pond Project Northeast Region
1981 - 1983	Canada	0.5	Fish Genetic Improvement Project, Bangkok

In addition, a Pilot Freshwater Fish Farm Project in Lan Pao, located in northeastern Thailand, is under construction through aid received from Holland. A production capacity of 80 tons of fresh water fish, research and training programs are planned at this center, while in Thaland the investigations team had a opportunity to inspect this site. This program aims at developing fish cultivation which is adapted to the environmental conditions present in northeastern Tahiland. In an effort to demonstrate the usefulness of this project, the most recent fish cultivation technology is being employed.

3. Site Conditions

3-1 Proposed Sites

3-1-1 Ayutthaya

(1) Location: About 50 km north of Bangkok along the River Chaophaya.

(2) Total area: 32 ha, utilized area: 25.5 ha,
unutilized area: 6.5 ha

(3) Present State:
- o Most of the land is paddy fields, with low relief.
- o Embankments are necessary against floods in the rainy season.
- o This construction work is now proceeding.

(4) The Access Road is almost completed except for paving. The dike under construction around the site is 6 m in width and can be used as a road.

(5) Access River: The River Chaophaya used to be abundant in fish resourses, and fresh water fishing is still being continued at present, although the resources are dwindling. This river can be utilized as a water source for the site.

3-1-2 Surajthani

(1) Location: Along the river side, 20 km upstream from the rivermouth of the River Tapee, about 500 km to the south of Bangkok and 12 km from Punpin.

(2) Total area: 89 ha,
utilized area: 89 ha
unutilized area: 0 ha

(3) Present State:
- o The land is grassland, withlow relief.
- o A large scale dike is necessary around the site.
  The Government of Thailand has appropriated a budget for the construction of the dike for the period lasting from October, 1981 to September, 1982.

(4) Access Road: A 4 m wide farming road extends for 2 km from National Highway 401 to the site. It is sufficient for the construction work, but it must be widened during the rainy season, so that it may be used.

(5) Access River: The River Tapee. A multi-purpose dam is being planned about 50 km upstream from the site, and a stable supply of water can

be expected in the future.

3-1-3 Trang

(1) Location: About 200 km to the south of Surajthani along the River Gunttang, located about 7 km from Trang and 15 km from the mouth of the River Trang.

(2) Total Area: 88 ha,
utilized area 21 ha,
unutilized area 67 ha.

(3) Present State: The land is undulating grassland and forest.

(4) Access Road: An access road 2 km in length has been built from the National Highway 4046 to the site, but the road is narrow, only 2 m wide; thus, the road should be widened and elevated before the construction work starts.

(5) Access River: The River Gunttang. Of all the sites, the center at trang has the smallest supply of water, but it is of good quality and will be sufficient for the project.

3-2 Infrastructure

The infrasturcutre for the sites is sufficient as far as the roads and power supply are concerned, but other matters must be improved for the project.

3-2-1 Electric Power Supply

No trouble is anticipated as far as the installation of the electrical power supply is concerned, although there are some apprehensions about the cost of the electricity due to rising fuel prices. The installation of an independent power plant is advisable in case of an emergency.

3-2-2 Telegram and Telephone

Telephone wire can only be led into the Ayutthaya Fishery Center. Wireless facilities are needed in other centers.

3-2-3 Water Supply

Water supply and drainage are not available in any of the sites, and wells must be excavated. The construction work will be taken care of by Thai workers. For the amount and quality of water, see 3-2-4.

3-2-4 Drainage

Drainage from ponds is especially large and this problem must be examined in detail. During heavy rains the water must be discharged into an adjacent canal or river by pumps.

3-2-5 Fuel

As for the fuel for research and training facilities, along with that for dormitories, propane gas should be used, as no city gas is available.

3-2-6 Infrastructure Construction by the Government of Thailand

In addition to some necessary earthwork on the sites, the following work is to be completed by the Government of Thailand:

Table 3-1 Infrastructure Construction by the Government of Thailand at the Present Stage

Construction Item \ Center	AFC	SFC	TFC
1. Dike	Proceeding	Start Construction After Exchange of note	Start Construction
2. Access Road	Almost Completed	Improvement After Exchange of Note	Proceeding Construction After Exchange of Note
3. Main Road	Start Construction After Exchange of Note	Start Construction	Start Construction
4. Electricity Inlet	Start Construction Existing Close to the Site	Start Construction	Start Construction
5. Well	Start Construction After Exchange of Note	Start Construction	Start Construction
6. Drainage	Start Construction After Exchange of Note		
7. Telegram	Start Construction Existing Close to the Site		

Note: Drinage systems and Telegraph service within the Infrastructure are not planned at this stage in Surajthani and Trang.

4. Contents of the Project

4-1 Purpose and Contents

4-1-1 Purpose

About half of the fishing boats in Thailand are suspending their operations due to the reduction in fishing ground due to the imposition of the 200-mile exclusive economic zone and also due to the rise in fuel prices. Because the haul of marine fish is steadily decreasing, the Government of Thailand is putting emphasis on the increased haul of fresh water fish.

The project, as its main purpose, will aid in the supply of animal protein to poor farmers, and secondly, will increase the income of people living in the areas involved. In the subject districts, a further objective is to stock all inland waters capable of utilization with seed fish.

The seed fish will be distributed, possibly free of charge, to farmers in the said districts who have land capable of irrigation. At the same time, the fish cultivation industry in inland waters will be promoted through the project's training program.

4-1-2 Roles of the three Fisheries Centers

(1) Ayutthaya Fishery Center

1) Production of seed fish.
2) Aquaculture research and genetic study of fresh water fish.
3) Training of the fishery officers and farmers, in the Central Region of Thailand.

(2) Surajthani Fishery Center:

1) Production of seed fish
2) Applied aquaculture research on fresh water fish.
3) Training of the fishery officers and farmers, and developing of fishery resources in the Southern Region of Thailand.

(3) Trang Fishery Center:

1) Production of seed fish.
2) Teaching farmers techniques for effective cultivation and management of fresh water fish.

4-1-3 Programs

(1) Target Areas of the three Centers

1) Target Areas of Seed Fish Supply and Extension Service

The Center's range of seed fish supply and extension service are shown in the Table 4-1.

Table 4-1 Seedfish Supply and Extension Service

Center / Terget Region	AFC	SFC	TFC
Central Plain	Yes	No	No
Gulf West Coast	No	Yes	Little
Undaman Coast	No	Some	Yes

2) Target Area of Research and Training

Research and training programs are conducted in the respective centers for the target which are shown in the Table 4-2.

Table 4-2 Research and Training

Center / Target Region	AFC	SFC	TFC
Center Plain	Yes	Very Little	No
Gulf West Coast	Little (Genetic)	Yes	No
Undaman Coast	Little (Genetic)	Yes	Some

(2) Contents of Research and Study

Table 4-3 shows the contents of the research and study programs in the respective centers.

Table 4-3 Research and Study Programs

Programs \ Center	AFC	SFC	TFC
Extensive Fish Culture	Yes	Yes	Some
Intensive Fish Culture	Yes	Yes	No
Fish Propagation	Yes	Yes	No
Fish Feed	Yes	Yes	No
Fish Diseases	Yes	Yes	No
Fish Genetics	Yes	No	No
Integrated Farming	Yes	No	No
Cage Culture	Yes	No	No
River Fishery	Yes	Yes	Some
Resevoir Fishery	No	Yes	Some
Ecology	Yes	Yes	No
Hydrobiology	Yes	Yes	No
Pollution	Yes	No	No
Taxonomy	Yes	Yes	Yes

(3) Contents of Training Program

The contents of the training activities are shown in Table 4-4 and 4-5.

1) Training Program

*Approxmately 25 persons are trained for 3 to 15 days at a time.

Table 4-4 Training Program

Training Subject \ Center	AFC	SFC	The Number of Courses per year
General Fish Culture	Yes	Yes	3
Intensive Fish Culture	Yes	Yes	2
Fish Propagation in Different Species	Yes	Yes	2
Fish Feed And Feeding	Yes	Yes	1
Fish Disease	Yes	Yes	1
Fish Genetics	Yes	No	1
Integrated Farming	Yes	No	2
Fishing Management	Yes	Yes	3

2) Target Training Group

Table 4-5 shows the target training groups and courses per year.

Table 4-5 Target Training Groups

Center / Target Groups	AFC	SFC	The Number of Courses Per Year
National (Fishery Staff)	Yes	No	1
Regional (Fishery Staff)	Yes	Yes	2
Related Government Officer	Yes	Yes	2
Local Farmers and Fishermen	Yes	Yes	10

(4) Extension Service

Table 4-6 Extension Service

Staff / Activities	Service Days In Month			Officers
	Directors	Senior Biologists	Biologists	
Fish Culture	2	4	5	7
Stoking Program	2	4	5	8
Fishery Management	2	4	5	5

The staff have the responsibility to promote the fishery activities as shown in Table 4-6.

4-1-4 Production Plan for Seed Fish

The Production output of different fish species are shown in Table 4-7.

Table 4-7 Production Plan For Seed Fish

(Units: Mil.)

Fish Name	Common Name	Production Output (in mil.)			
		AFC	SFC	TFC	Total
Trichogaster pectoralis	Sepat siam	-	20	4	24
Puntius gonionotus	Thai carp	10	50	10	70
Tilapia nilotica	Nile tilapia	10	8	4	22
Cyprinus carpio	Common carp	10	2	2	14
Pangasius sutchi	Catfish	18	20	5	43
Oxyleotris marmoratus	Sand goby	1	-	-	1
Ophicephalus striatus	Snake head	0.5	-	-	0.5
Clarias batrachus	Walking catfish	0.5	-	-	0.5
Labeo rohita	Rohu	10	20	5	35
	Total	60	120	30	210

4-1-5 Distribution of Produced Seed Fish

The seed fish produced in the three fisheries centers are to be distributed in the respective areas as shown in Table 4-8.

Table 4-8 Distribution of Seed Fish

Center	Target provinces	Number of seed fish (mil.)
AFC	Ayutthaya	15
	Bangkok	15
	Thonburi	10
	Samutprakarn	10
	Pratumthani	10
Total		60
SFC	Surajthani	40
	Choompon	30
	Ranong	10
	Nakhonsrithamarat	30
	Pang-nga	10
Total		120
TFS	Trang	10
	Krabi	4
	Phuget	3
	Pathalung	10
	Satul	3
Total		30
Grand Total		210

4-1-6 Project Demand and Appropriate Technical Methods

(1) Project Demand

Promotion of inland fisheries is a sound measure to take in response to the threat posed by the continuing decline in the catch of marine fish.

It is important that the seed fish should be supplied constantly and in large amounts in order that fish production be increased in fresh water. The three regtons in question should have the opportunity to extend production if waranted by increases in future fish consumption rates and by the availability of suitable water resources. The demand for the fish is large enough, and the level of technology in the Fishery Department of Thailand is high enough for the project to be rated suitable for the establishment of the centers.

(2) Fish species included in the production plan

The target amount of seed fish production is not too large, in any of the three centers. Six kinds of herbivorous and omnivorous fish (see table 4-7) have been selected in Surajthani and in Trang, five of the six species being native to the waters in areas surrounding these two provinces, Rohu is the only fish being utilized which is not native to these regions, but the culturing technique for breeding Rohu are sufficiently advanced as to not pose a problem. The use of native species in the southern regions is an ecologically sound more as the collective culturing techniques are not yet fully developed in these sites: thus, the introduction of new species could pose breeding problems. In Ayutthaya, three kinds of carnivorous fish, Channa striatus, Clarias batrachus, and Oxyeleotris marmoratus are being used in addition to the 5 kinds of herbivorous and omnivorous fish mentioned previously. These species are suitable for extensive and intensive culturing with already developed culturing techniques. Therefore, these species are considered appropriate for distribution from Ayutthaya to other regions where a stable supply of seed fish is required.

(3) Training and Promotion Activities

In addition to the production of seed fish, training and promotion activities, geared towards local farmers and fishermen rather than government officers, is deemed to be an essential component for the

successful operation of all the centers. Consequently, the project will begin under government direction, but emphasis is being laid on the promotion of private peoples participation in the program.

(4) Research Activities

Research and study will be carried out in many phases of freshwater fishery reserch (See Table 4-3). The breeding included in the activities at Ayutthaya aims at the increased production of fish through propagation and culturing.

As a short term program, the productivity of each species will be recorded carefully and this contribute to the selection of better fish streams to be used in production. Reduction in production as a result of breeding within the same variety will be avoided by cross breeding between different species and strains. As a long term program, it is intended that species with high productivity and strong resistance will be singled out by means of selected breeding and crossing. These programs are in the initial stages, and substantial results cannot expected in such a short period; but in the longrun they will prove to be the fisheries program.

4-2 Pond and Reservoir Area

4-2-1 Pond Type and Area

The following table was compiled which shows the number of ponds and their areas, as calculated according to the system of seed fish breeding developed for the 9 kinds of fish after discussion with officers of the Government of Thailand.

Table 4-9 Statistics Supplied by the Government of Thailand

Item / Fish Name	Size of Adult Fish (cm)	No. of Fecundity	Hatching Rate %	Seed Size (cm)	Survival Rate from Hatching Till Seed Size	Density of seed Fish per Unit Square
1. Trichogaster Pectoralis	15	30,000	60 (18,000)	3	40 (7,200)	1,000
2. Puntius Gonionotus	20	200,000	75 (150,000)	3	(45,000)	2,000
3. Tilapia Nilotica	15	1,000	80 (800)	3	80 (640)	1,000
4. Cyprinus Carpio	25	40,000	60 (24,000)	3	50 (12,000)	1,000
5. Pangasius Sutchi	50	400,000	75 (300,000)	5	40 (120,000)	1,500
6. Oxyeleotris Marmoratus	20	20,000	60 (12,000)	10	15 ((1,800)	300 *
7. Channa Striatus	45	10,000	75 (7,500)	3	60 (4,500)	500
8. Clarias Batrachus	25	8,000	75 (6,000)	5	60 (3,600)	500
9. Labeo Rohita	35	100,000	60 (60,000)	5	50 (30,000)	1,000

* The big seed size of this species is related to a successful rearing method, "cage culture".

Table 4-10 Ayutthaya Fishery Center: Required Numbers of Ponds and Water Area

Item / Fish Name	Fish Seed No./ Year Unit: Million	Required Water Area			Required Pond Site as related to hatching method		
		Adult Fish	Nursing	Haching	Adult Fish (3,200 m^2)	Nursing (1,600 m^2)	Hatching
1. Trichogaster Pectoralis	———	———	———	———	———	———	Natural
2. Pntius Gonionatus	10	0.11 (0.66)	0.42 (2.604)	Indoor	0.33	2.6	Induced
3. Tilapia Nilotica	10	2 (12.50)	1 (6.25)	Outdoor	6.25	6.25	Natural
4. Cyprinus Carpio	10	0.8 (5.00)	0.36 (2.25)	Outdoor	2.5	2.25	Natural
5. Pangasius Sutchi	18	0.58 (3.60)	1.00 (6.246)	Indoor	1.81	6.25	Induced
6. Oxyeleotris Marmoratus	1	0.16 (1.0)	0.57 (3.57)	Indoor	0.5	3.57	Induced
7. Channa Striatus	0.5	0.16 (1.0)	0.13 (0.82)	Outdoor	0.5	0.82	Natural
8. Clarias Batrachus	0.5	0.08 (0.50)	0.04 (0.25)	Indoor	0.25	0.25	Induced
9. Labeo Rohita	10	0.53 (3.34)	0.5 (3.13)	Indoor	1.66	3.13	Induced
Total	60	4.42 (27.6)	4.02 (25.12)		13.8	25.12	

Table 4-11 Surajthani Fishery Center: Required Number of Ponds and Water Area

Item / Fish Name	Fish Seed No./ Year Unit: Million	Required Water Area			Required Pond Size as Related to Hatching Method		
		Adult Fish	Nursing	Hatching	Adult Fish (3,200 m²)	Nursing (1,600 m²)	Hatching
1. Trichogaster Pectoralis	20	1.44 (9.0)	2.50 (15.6)	Outdoor	4.5	15.6	Natural
2. Puntius Gonionotus	50	0.53 (3.3)	2.08 (13.3)	Indoor	1.65	13	Induced
3. Tilapia Nilotica	8	1.6 (10.0)	0.8 (5.0)	Outdoor	5	5	Natural
4. Cyprinus Carpio	2	0.16 (1.0)	0.2 (1.25)	Outdoor	0.5	1.25	Natural
5. Pangasius Sutchi	20	0.54 (4.0)	1.14 (6.94)	Indoor	2	7	Induced
6. Oxyeleotris Marmoratus	———	———	———	———	—	—	———
7. Channa Striatus	———	———	———	———	—	—	———
8. Clarias Batrachus	———	———	———	———	—	—	———
9. Labeo Rohita	20	1.07 (6.67)	1 (6.25)	Indoor	3.335	6.25	Induced
Total	120	5.44 (33.97)	7.69 (48.04)		16.985	48.1	

Table 4-12 Trang Fishery Center: Required Number of Ponds and Water Area

Item / Fish Name	Fish Seed No./ Year Unit: Million	Required Water Area			Required Pond Area as Related to hatching method		
		Adult Fish	Nursing	Haching	Adult Fish (3,200 m)	Nursing (1,600 m)	Hatching
1. Trichogaster Pectoralis	4	0.29 (1.80)	0.5 (3.13)	Outdoor	1.8	3.13	Natural
2. Puntius Gonionotus	10	0.11 (0.66)	0.42 (2.604)	Indoor	0.66	2.604	Induced
3. Tilapia Nilotica	4	0.8 (5.00)	0.4 (2.50)	Outdoor	5.00	2.50	Natural
4. Cyprinus Carpio	2	0.16 (1.00)	0.2 (1.25)	Outdoor	1.00	1.25	Natural
5. Pangasius Sutchi	5	0.16 (1.00)	0.28 (1.74)	Indoor	1.00	1.74	Induced
6. Oxyeleotris Marmoratus	———	——	——	——	——	——	Induced
7. Channa Striatus	———	——	——	——	——	——	Natural
8. Clarias Batrachus	———	——	——	——	——	——	Induced
9. Labeo Rohita	5	0.27 (1.64)	0.25 (1.56)	Indoor	3.34 (1.67)	1.56 (1.56)	Natural
Total	30	1.79 (11.13)	2.05 (12.784)		5,565	12.784	

4-2-2 Reservoir Area

In order to estimate the evaporation rates of the reservoirs in Surajthani and Trang, evaporation rates were measured in Chumphon, Chumphon Province, located to the north of these sites. This was the nearest data source available. In Chumphon, 5.2 mm/day*, was highest value in the last 13 years, while in Chainat, Chainat Province, 7.8 mm/day was the highest ev. rate in the last a years, (located directly to the north of Ayutthaya)

* from "The Asian Institute of Technology, 1980, Rainfall and Evaporation Analysis of Thailand"

Table 4-13

Item \ Location	AFC	SFC	TFC
Total Water Surface Area (m^2)	111,900	135,900	42,300
Maximum Evaporation (mm/day)	7.8	5.2	5.2
Total Maximum Evaporation/Day Ⓐ (m^3/day)	872.8	706.7	220.0
Required Minutes By 3m³/min. Power Pump (min)	290.9	235.6	73.3
Required Minutes By 3m/min. Power Pump (hr.)	4.85	3.93	1.22
Electricity Power of the Pump/Day (kwH/day)	26.68	21.62	6.71

The size of reservoir is calculated based on the two factors. One is that the reservoir sedimentation ponds which keep the water for one week. The other is that it needs pump operation at least once every few days for the maintenance.

Ayutthaya (29 ha) (Durable filtering system shall be employed because the river water becomes somewhat poor in quality during dry season.)
Surajthani 2 ha
Trang 2 ha (Future expansion anticipated.)

Table 4-14

Item \ Center		AFC	SFC	TFC
Reservoir	Effective Water Level (m)	1.8	2.0	2.0
	Water Surface Area (m²)	29,000	20,000	20,000
	Stored Volume of Water (m³)	51,630	40,000	40,000
Total Maximum Evaporation/Day Ⓑ (m³/day)		226.2	104.0	104.0
Ⓐ + Ⓑ (m³/day)		1,099	810.7	324.0
Required hours for Supplying Water (hr.)		6.11	4.51	1.80
Days when the Water can be Supplied by One Stock of Reservoir (day)		47.0	49.3	123.5

4-3 Basic Design

4-3-1 Direction of Basic Design

(1) Basic design policies

The following items are considered important as basic design policy in the project as disscussed with the Government of Thailand.

1) Each center must be designed for each center's respective role to be fulfilled within the districts concerned.

2) Civil engineering work, especially for the ponds, which occupies a major part in construction; hence, it operational method, fine allotment, and cost shall be fully analyzed. The road situation and river conditions in the vicinity must be considered, and other arrangements are decided.

3) The structure of buildings are designed in consideration of the climate, natural features, and life-style, in Thailand.

4) The part of engineering and skill in the districts, and the local construction system shall be adopted as far as possible so that the construction cost be lowered.

5) Since the sites are separated by wide distances, it is important

to arrange in order to promote efficient working coodination.

6) The facilities should be designed for easy maintenance after being completed, so that the running costs be saved. At all the centers the electric power consumption rate must be examined most carefully.

(2) Japanese Construction of Respective Facilities

The area of the respective facilities are determined based on the results between Thailand Government and Japanese Government.

Table 4-15

Facility \ Center	AFC	SFC	TFC	Remarks
Pond				
1. Cement Pond 50 m^2	x20 1,000 m^2	x20 1,000 m^2	x10 500 m^2	
2. Earthen Pond 400 m^2	x60 2,400 m^2			
3. Earthen Pond 1,600 m^2	x26 41,600 m^2	x48 76,800 m^2	x14 22,400 m^2	
4. Earthen Pond 3,200 m^2	x14 44,800 m^2	x18 57,680 m^2	x6 19,200 m^2	
5. Reservoir	29,000 m^2	20,200 m^2	20,000 m^2	
Total Pond Area	11.9ha	15.5ha	6.2ha	
Building				
6. Center Bldg.	500 m^2	830 m^2	150 m^2	
7. Dormitory	530 m^2	530 m^2		
8. Hatchery	420 m^2	500 m^2	250 m^2	
Total Floor Area	1,450 m^2	1,860m^2	400 m^2	
Others				
9. Road	Follows the meeting			
10. Pump Station				
11. Equipments for Training and				

(3) Design Standards and Codes

In the case of a Cooperative project of grant aid by the Japanese Government, application to the government office of Thailand is not necessary if the design drawings are approved by the bureau in charge of the project (Fishery Department). Actually, however, there are laws and regulations in Thailand concerning construction, many of which have been enacted with reference to those in Japan and the U.S.A. Therefore, the following design standards, and codes in Japan, Thailand, and the U.S.A. have been partially adopted for the present project. Among them, city regulation termed, Control of Construction of Buildings, is well arranged and is a good reference.

Design Standards and Codes

1) JASS (Japan Architectural Standard Specification)
2) AIJ (Architectural Institute of Japan)
3) ACI (American Concrete Institute)
4) AISC (American Iron And Steel Institute)
5) ASTM (American Society of Testing Materials)
6) TIS (Thai Industrial Standard)
7) JIS (Japanese Industrial Standard)
8) HASS (Heating, Air-Conditioning and Sanitary Standard)
9) JSWAS (Japan Sewage Works Association Standard)
10) JEM (The Standard of Japan Electrical Manufacturers' Association)
11) JEAC (Japan Electric Association Code)
12) CCB (Control of Construction of Buildings)

4-3-2 Master Planning

(1) Functional Relationship Diagrams for the Four Main Blocks

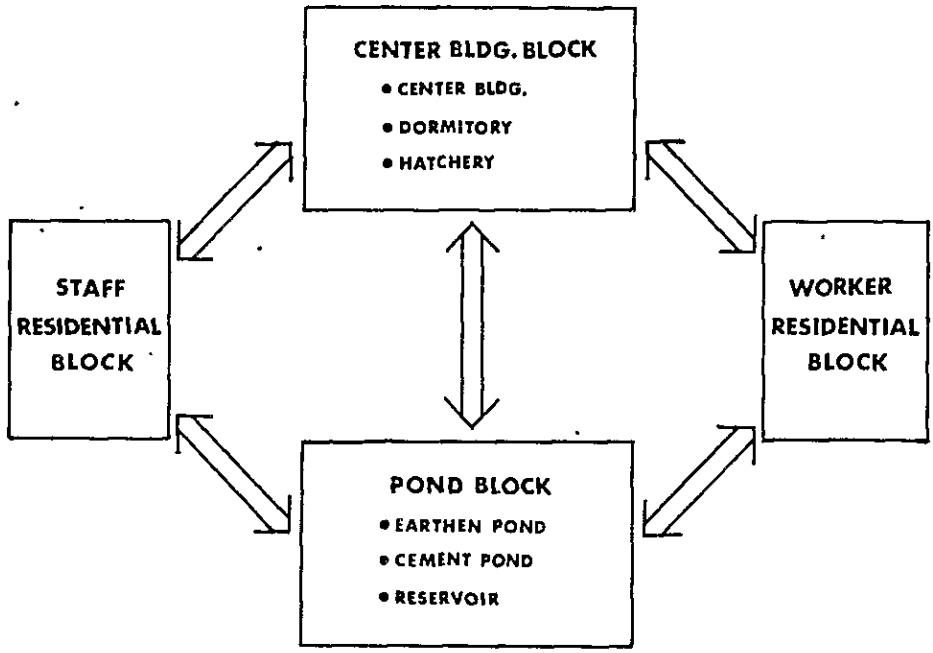
Each Fishery Center consists of following four blocks.

1) Center Bldg. Block (Center Bldg. Dormitory, Hatchery)
2) Pond Block (Pond, Reservoir)
3) Staff Residential Block
4) Worker Residential Block

The main function of the center consists of the center building block and pond block, which are supported by the staff residential block and the worker residential block.

The functional relationship between the blocks is shown in Figure 4-1.

Fig. 4-1 Functional Relationships of the Four Blocks



(2) Master Planning Principles

The main policy for the arrangement plan is as follows:

1) The center building block shall be arranged in a position that has the easiest access from the road and is highly visible, for it is the most frequently visited part of the center.

2) The ponds and related facilities shall be arranged so that differences in height levels within the site may be fully utilized in order to save the running costs of the water systems for feeding and draining.

3) The residential blocks for the staff and workers shall be separated from the central block in order to provide a change of environment from the work area duty.

4) The residential block for the staff shall be set back from the access road for the safety.

5) The residential block for the workers shall be separated into several sections if the configuration of the land permits so that the security of the facilities may be enhanced.

6) If the expansion area is reserved, the master plan of the facilities should be designed to meet the future expansion.

(3) Master Plan: Ayutthaya

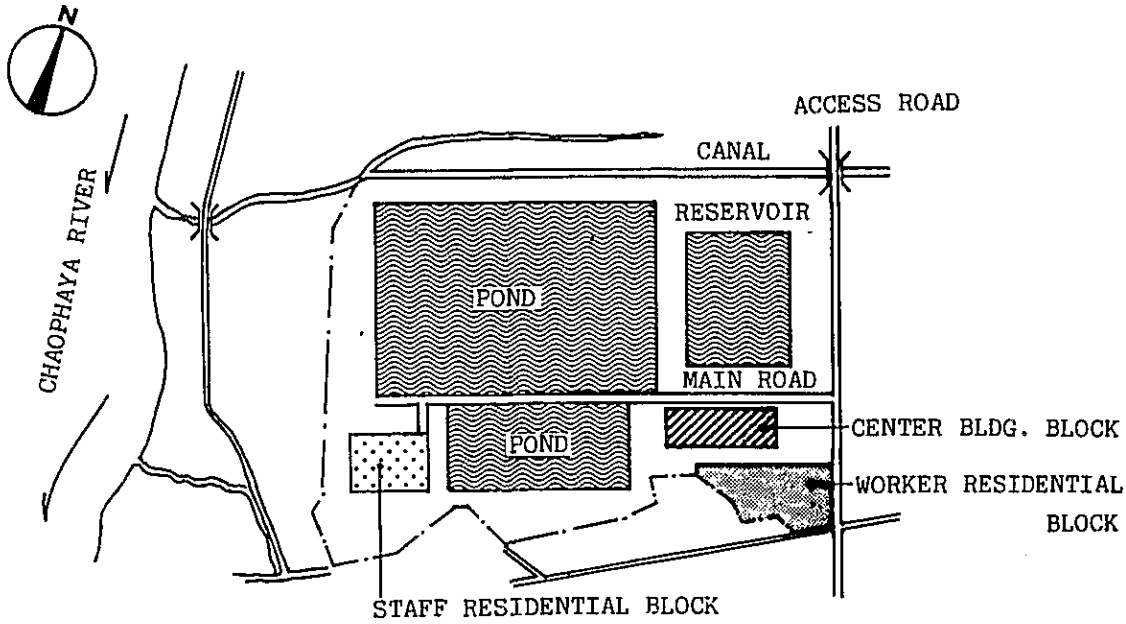


Fig. 4-2 SCALE 1:10000

1) Due to the large area needed for the ponds, the portion of required area to effective area is large; and arrangement of the blocks is needed so that an efficient utilization of the land is achieved.

2) Ponds and reservoirs were arranged on the side of a canal, so that the efficiency of the water systems for feeding and drainage is high.

3) The residential blocks were arranged on the southern side where the shape of land is complicated so that the land can be utilized efficiently.

4) The center building block was arranged in the center of the lot along the main road so that it is easily approached from the access road.

5) The residential blocks were separated into those for the staff and those for the workers, the two being divided by one of the ponds.

(4) Master Plan: Surejthari

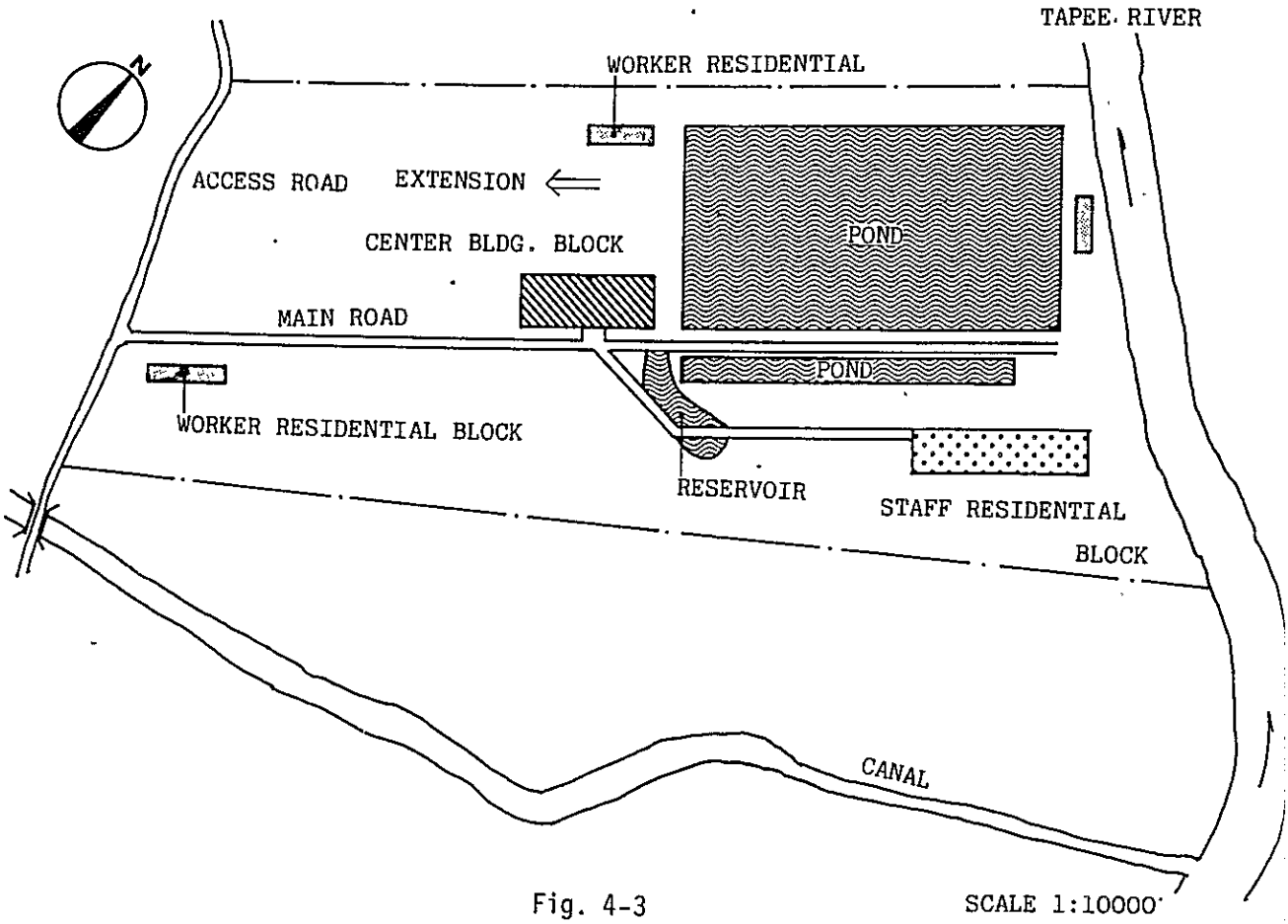


Fig. 4-3 SCALE 1:10000

1) The area of the site is large, and there is plenty of room for future expansion. Therefore, arrangement was decided with consideration of possible expansion in mind.

2) The level of the land is low, during the flood season, the level of the water service is higher than the land. Thus the embankment must be of large scale and the water intake and drainage systems must be carefully planned.

3) Ponds shall be arranged next to the access river and the water system be constructed to assure an efficient supply of water.

4) The worker's residential blocks should be separated to keep the security of the large site.

(5) Master Plan: Trang

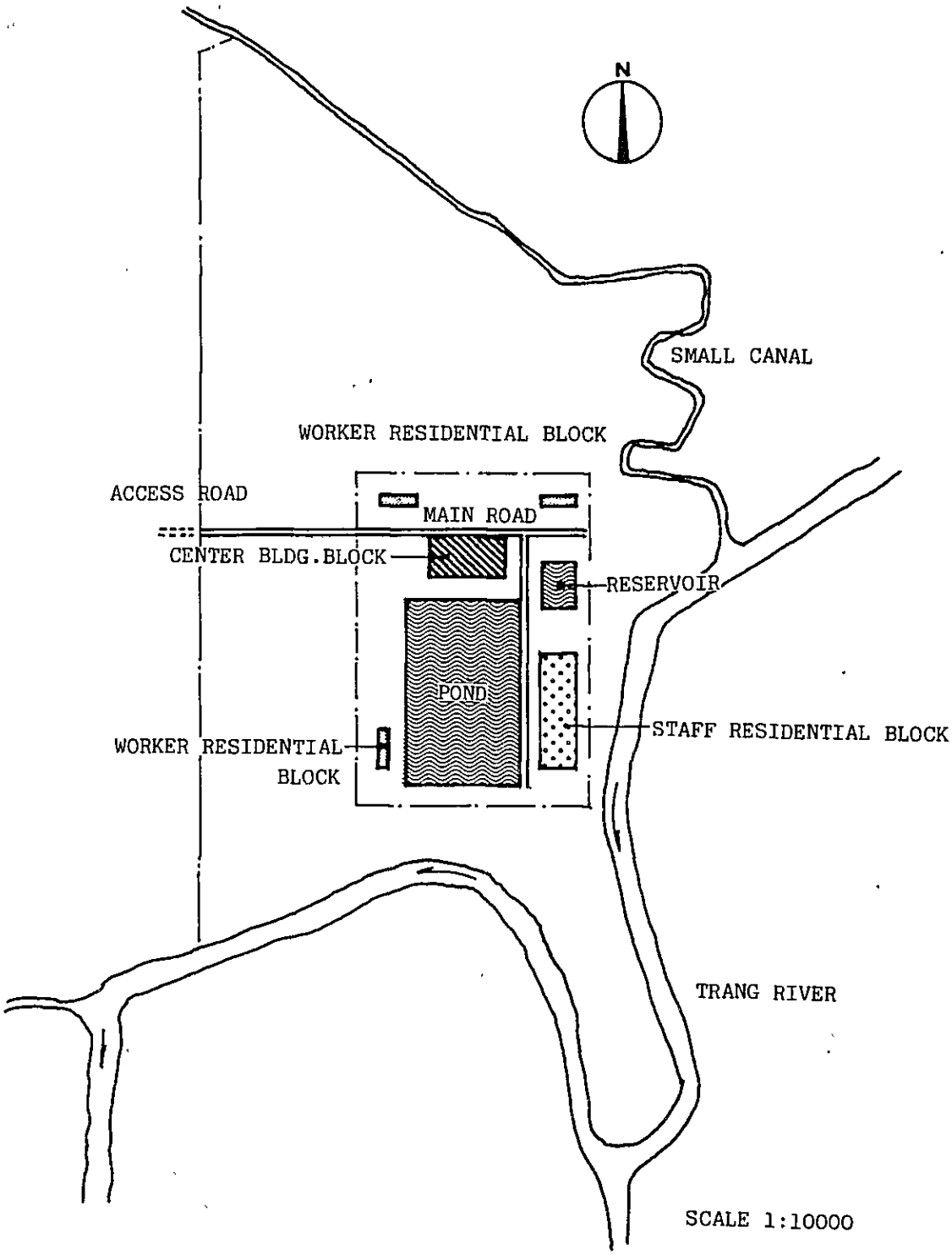


Fig. 4-4

1) The area of the site is large, and there is plenty of room for expansion; the land is low in relief with differences in the height in some areas, this each of the blocks shall be arranged for

the most efficient use of land.

2) The access road runs through the central part of the site, and arrangements made based on this road as the center.

3) The area surrounded by dike should be minimized to reduce the drained water during rainy season.

4-3-3 Architectural Planning

(1) Concept of the plan

The basic design will be based on a functional relationship between the rooms and with the climate, natural features, living styles, and etc, present in Thailand.

1) Functional correlation between rooms.

The principal buildings of each of the centers include center buildings, dormitory, and hatchery but here explanation is given for the center buildings, which have a complex functional correlation, and for the dormitories.

a) Center Bldg.

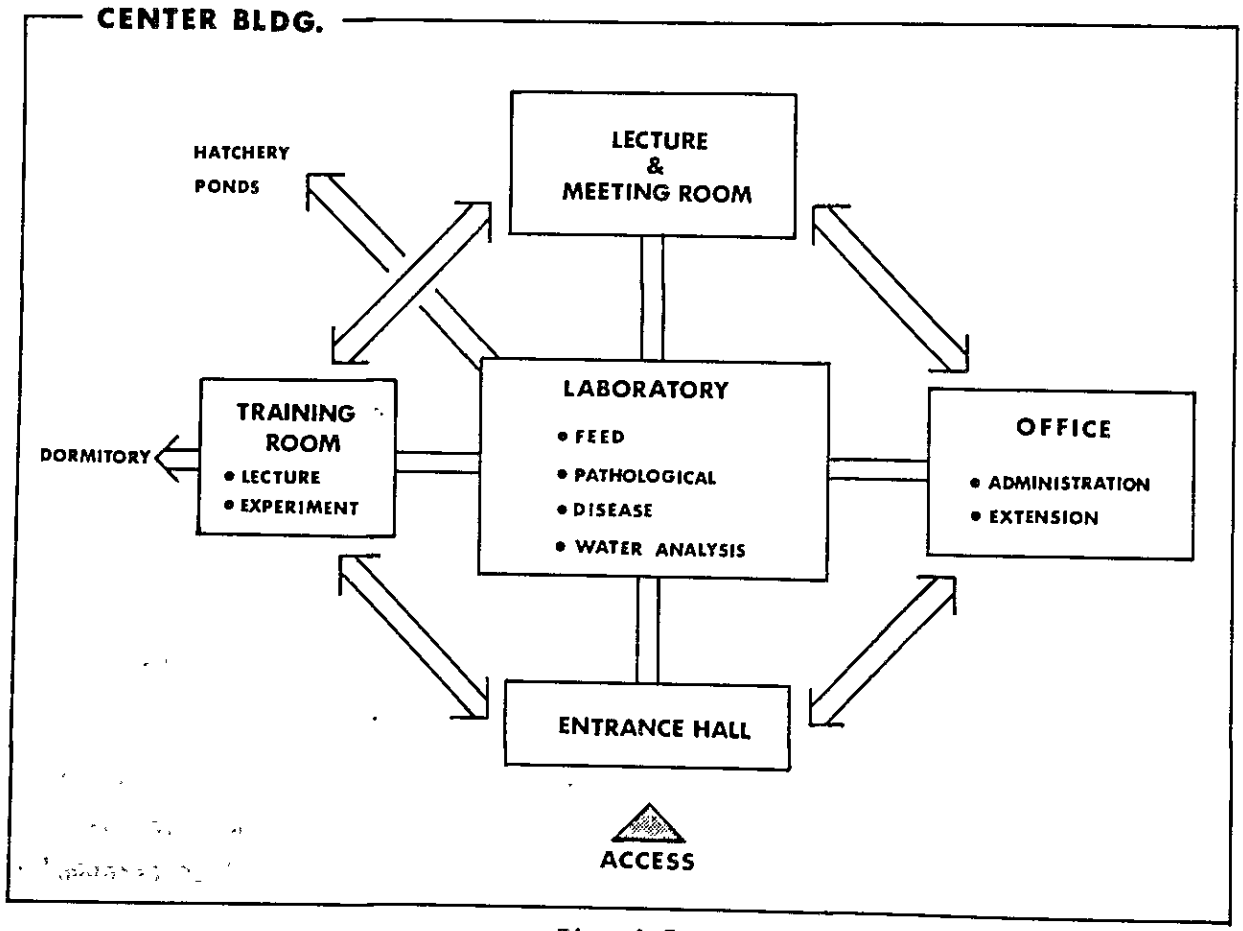


Fig. 4-5

The main functions of the Centers are to be carried out in the laboratories with secondary activities to be conducted in the office, training room, and meeting room. By arranging the laboratory at the center, efficient utilization of the training room can be accomplished; consequently, more efficient research work by the staff is facilitated. A part of the office shall be located near the entrance hall on the ground floor for the convenience of application by new trainees and promotions work. The lecture room can be used, as required lectures, or other large group gathering. As for Trang Fishery Center, the facilities consist of a simple laboratory and office.

b) Dormitory

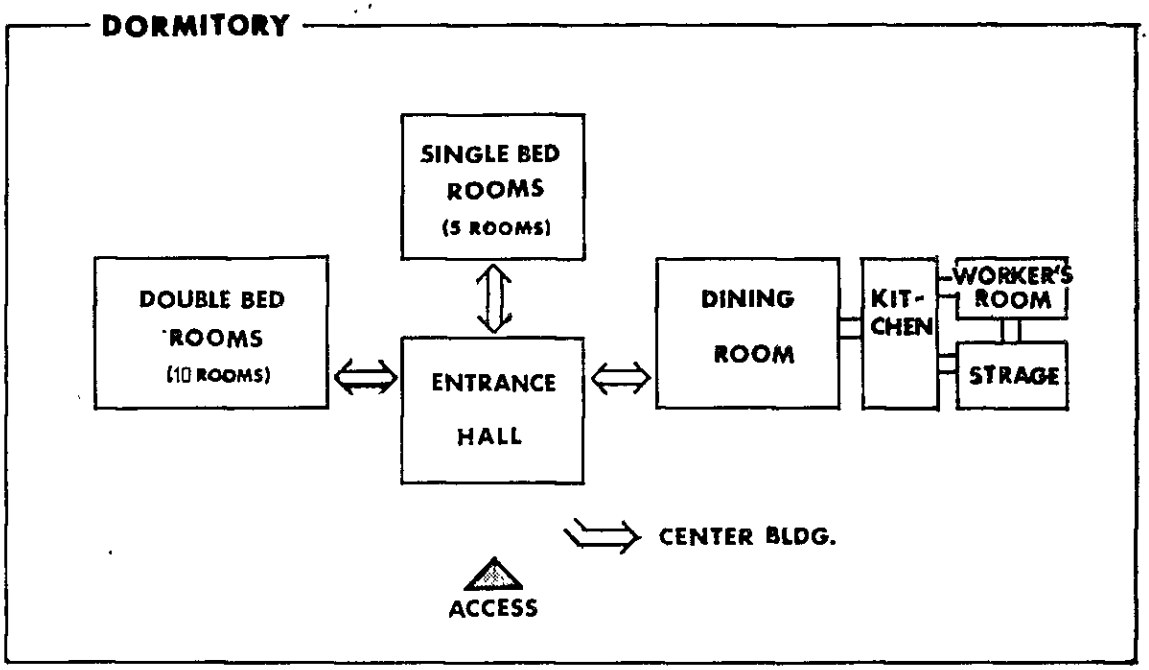


Fig. 4-6

Practical promotion activities are to be developed in the center with the goal of educating nearby farmers and fishermen and as a part of the activities, leading people in the villages shall be called together in units of 25 people or so that short training on propagation and culture of fish and their management can be given. The dormitory is used for the purpose. The entrance of the dormitory should be connected with the Center Bldg.

c) Hatchery

The hatchery will consist of a hatchery, pellet plant, and

storage. In the hatchery, studies on seed fish of various species and their production are to be carried out by a flexible use of two different sized FRP tanks, which can be differentially utilized to suit, seed fish species under investigation.

The pellet plant will produce fish feed to be given in the hatchery and ponds.

The storage is used for the storing of materials used in training, and equipments used in the ponds, weighing machines, fishing net, and etc.

2) Floor system and ventilation analysis in view of climate and natural features

a) High-floor system: The high-floor system shall be adopted so that ventilation under the floor can be secured. The floor level shall be higher than the ground level of the buildings (level of nearby road) by 60 cm (min.), so that inundation by floods and that excessive humidity under floor be avoided.

b) Ventilation: All rooms shall be constructed for a sufficient natural ventilation.

c) Ceiling Height: The ceiling height should be placed in a relatively high position in order to prevent excessive heat from collecting in the room.

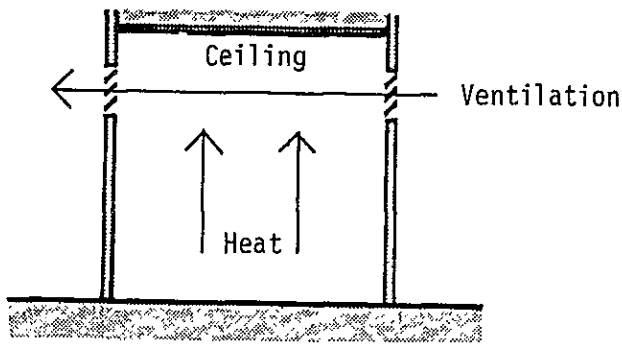


Fig. 4-7

d) Sunshade: To prevent direct sun from entering the rooms an overhang will be built to shield the sun.

e) The direction of the each facilities: Buildings shall be arranged with east-west axis line, with lighting and gallery faces on the south and north.

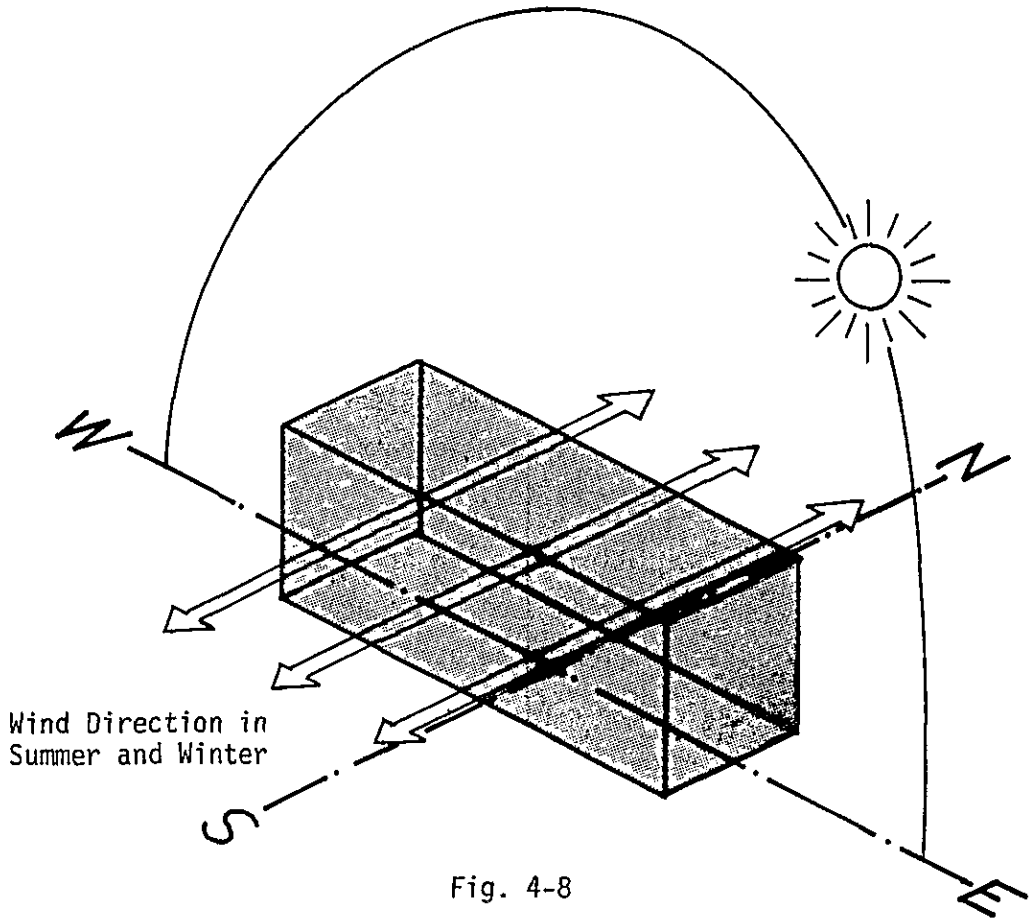


Fig. 4-8

1) Basic of Calculation

The following dimensions were presented by the department of Fisheries.

Table 4-16 (Unit: m^2)

Room	Area
1. Director's Room	25 m^2 /Person
2. Senior Officer's Room	16 m^2 /Person
3. Officer's Room	9 m^2 /Person
4. Staff Room	6 m^2 /Person
5. Lecture Room	44 m^2 /25 Persons
6. Laboratory	3.5 m^2 /Person
7. Biology Study Room	10 m^2 /Person
8. Dormitory (Single Room)	22 m^2 /Person
9. Dormitory (Double Room)	30 m^2 /2 Persons
10. Dining Room	2.5 m^2 /Person

Based on these dimensions, the following rooms are examined in order to determine areas suitable for the actual working and living conditions.

a) Office: In view of the fact that the present project is emphasizing experimental and training programs, the area of office management rooms are designed smaller than the given dimensions, and departments for research and training are enlarged.

b) Laboratory: The necessary laboratory area must be determined according to the layout of equipment for research work.

c) Training Room: Training is to be carried out with 25 trainees per class, and 65 m^2/25 persons was adopted for training room area with consideration for the space occupied by laboratory tables, etc.

d) Lecuture and Meeting Room: An area somewhat larger than originally planned was appropriated for the lecture room which will also be used as a meeting room.

2) Estimated Area of the center building

a) Ayutthaya

Ayutthaya Fishery Center also plays the role of a liaison center with the NIFI in addition to its main function of carrying out research activity. Because the laboratories will be used frequently, their area was designed larger and the office area designed correspondingly smaller than the standards.

Table 4-17

Room	Area per Person (m^2) x the Number	Necessary Area (m^2)	Remarks
1. Director Room	20 x 1	20	· Director also is a scientist who works in the laboratory
2. Extension Officer Room	9 x 8	72	· Scientists and Biologists usually study in the laboratory.
3. Technician (Staff Room)	6 x 4	24	
Total Office Area		116	
4. Biological Laboratory		30	Laboratory areas which are based on the layout of the experiment table, but they will be fixed.
5. Pathological Laboratory		15	
6. Feed Laboratory		15	
7. Water Analysis Laboratory		25	
8. Genetic Room		15	
9. Dark Room		6	
10. Lecture & Meeting Room		50	44 m^2/25 persons
11. Training Room		6.5	Including experiment table 44 m^2 x 1.5 = 66 m^2 66 m^2/25 persons
12. Others Including Corridors, Halls, Toilets and etc.		130	27.8%
Total Area		467	

b) Surajthani

In the Surajthani Fishery Center, production of seed fish and extension service programs will be the major activities; thus, the center will be the headquarters for the three centers in those fields of activity.

A larger office area was appropriated to accomodate the several

scientists to be stationed there as the senior officers.

Table 4-18

Room	Area per Person (m^2) x the Number	Necessary Area (m^2)	Remarks
1. Director Room	20 x 1	20	Five Senior Officers are selected from the five scientists and ten biologists.
2. Senior Officer Room	16 x 5	80	
3. Extension Officer Room	9 x 5	135	
4. Technician (Staff Room)	6 x 3	18	
Office Area		253	
5. Biological Laboratory		50	Laboratory areas which are based on the layout of the experiment table, but they will be.
6. Pathological Laboratory		50	
7. Feed Laboratory		50	
8. Water Analysis Laboratory		50	
9. Disease Laboratory		25	
10. Dark Room		35	
11. Lecture & Meeting Room		50	44 m^2/25 persons
12. Training Room		65	Including experiment table. 44 m^2 x 1.5 = 66 m^2 66 m^2 x 25 persons
13. Others Including Corridors, Halls, Toilets and etc.		200	24.2%
Total Area		828	

c) Trang

In the Trang Fishery Center, production of seed fish and their release are the main activities and no room for training is necessary.

Table 4-19

Item / Room	Area per Person (m^2) x the Number	Necessary Area (m^2)	Remarks
1. Senior Officer Room	16 x 1	16	
2. Extension Officer Room	9 x 4	36	
3. Technician	6 x 4	24	
Office Area		76	
4. Biological Laboratory		30	Simple experiment can be operated with a exteriment table
5. Others Including Corridors, Halls, Toilets and etc.		40	27.4%
Total Area		146	

3) Dormitory Area REquirements

Dormitories are to be built in Ayutthaya and Surajthani Fishery Centers for the lodging of trainees. The trainees will be comprised groups of 25 people and single and twin bed rooms will be constructed to accomodate them during their residence at the center.

Table 4-20

Item / Room	Area (m^2)	Remarks
1. Single Bed Room	75	The Layout of the Room is to be based on a Later Meeting
2. Double Bed Room	216	
3. Dining Room	35	
4. Kitchen	15	
5. Worker's Room	10	
6. Storage	10	
7. Others Including Corridors, Toilet, Hall and Etc.	160	30.7%
Total	521	

4) Estimated Area of the Hatchery

The hatchery area is calculated based on the number of tanks. The hatchery in Surajthani will be increased according to the large pond area available to it. The hatchery in Trang has additional space to the calculated area and the possibility of extending the pond area is expected in the future.

Table 4-21 (Unit: m^2)

Center / Room	AFC	SFC	TFC	Remarks
1. Hatchery	250	335	160	Equipment for ponds and Training Programs.
2. Storage	100	100	80	
3. Pellet Plant Room	30	30		Mainly for Research
4. Material Room	15	15		
5. Feed Room	15	15		Ayutthaya for future Purpose
Total	410	495	240	

4-3-4 Structural Planning

(1) Foundation Subsystem

Each site is located in, flat, paddy field, or woody field. Judging by the reports on soil boring data at or near the site, the surface soil cannot adequately support a building without improving the ground.

The soil, being composed of soft clay, is too weak for the project requirements.

By transfering the weight load, (by use of piles), to the strata lying below that of the surface level, it will be possible to support the buildings safely.

The adoption of an adequate supporting system is one of the more important elements in terms of the project cost and construction time required; therefore, geological surveys and new boring tests are required before a final decision on the support system is made.

(2) Structural System

These buildings will be built by common strucutral methods employed in Thailand. In this way, procurement for the labor and materials can be made easily. Moreover, reducing the cost of material and shortening the period of construction, will be facilitated.

Structure;

Items	:	Contents
Main Frame	:	Rigid joint frame made of reinforced concrete
Slab	:	Reinforced concrete
Exterior Wall	:	Concrete blocks or bricks
Roof	:	Steel beams and light gage steel purlins

(3) Materials

Materials shall meet the requirements of the following Japan Industrial Standards (JIS)

1) Piles : Precast Concrete piles
JIS A 5310, JIS A 5335

2) Reinforcing Bars : JIS G 3112, Plain Bar (SR24)
Deformed Bar (SD30)

3) Concrete : JIS A 5308

4) Steel : JIS G 3101, SS41, JIS G 3350 SSC 41

5) High Strength Bolt: JIS B 1186 F 10T

6) Bolt : JIS B1180

7) Weldings : JIS Z 3210, JIS Z 3211, JIS Z 3212, JIS Z 3311
(Submerged Arc Welding)

(4) Loads

Table 4-22

Dead Loads	
Reinforced concrete	2,400 kg/m^3
Concrete	2,300 kg/m^3
Steel	7,850 kg/m^3
Live Loads	
Offices	300 kg/m^2
Training Room	400 kg/m^2
Lecture & Meeting Room	400 kg/m^2

Dormitory	200 kg/m^2
Dining Room	400 kg/m^2
Storage	500 kg/m^2
Hatchery	1,000 kg/m^2

(5) Wind Load

The wind load for buildings shall be as follows:

Table 4- 23

Height Zones (in meter)	Velocity Pressure (kg/m^2)
less than 15	50
15 and over	100

Depending on the slope of the roof to the horizontal, the recommended allowable wind force shall be calculated in accordance with the coefficient table of AIJ.

Note: The respective loads shall be determined in the detailed design stage.

4-3-5 Mechanical and Electrical Planning

(1) Mechanical Planning

1) Water-supply planning

a) Calculation of necessary water supply

Assuming that water is used for 8 hours a day in the center building and dormitory, the amount of water required per hour was determined by utilizing the following parameters:

$Qd = N \times qe$ Qd: Amount of water feed per day

N : Number of persons

Qe: Amount of water per day per person
For the office and dormitory a qe of 120 ℓ/day.person was calculated.

$Q = Qd \div T$ Q : Supply water per hour

T : Hours of supplying water

Larger values for the amount of supply water per hour are adopted and this value is decided at Qu (liter/hour).
The peak amount is determined by assuming a peak load factor of 2.0.

The results of the calculations for each site is shown in Table 4-24.

Table 4-24 Water Supply

Item \ Center	AFC	SFC	TFC
Center Bldg.			
N (Person)	45	60	28
Qd(Liter/day)	5,400	7,200	3,360
Q (Liter/hour)	675	900	420
Dormitory			
N (Person)	25	25	-
Qd(Liter/day)	3,000	3,000	-
Q (Liter/hour)	375	375	-
Qu(Liter/hour)	675	900	420
Qp(Liter/hour)	1,350	1,800	840

b) Reservoir Tank

The well water supplied by the Government of Thailand is received in the tanks, hoisted to the head tank, and distributed to the taps.

The capacity of the receiving tank is only adequate for one day's consumption or less, but owing to the unstable supply of well water, a one day amount was adopted.

Assuming at 8 hours use per day, V=Qu x 8 (V: Capacity of receiving tank)

This equation gives 5.4 liters, 7.2 liters, and 3.3 liters respectively for Ayutthaya, Surajthani, and Trang; and the capacities of reservoir tanks were decided at 6 tons, 8 tons and 4 tons respectively.

c) Elevated Water

Considering the stability of power source, the capacity of the elevated tank was decided at twice as much as that of the demand of peak consumption.

The capacity of the elevated tank is given by the equation

$V_H = Qp \times 2$

If calculated, the equation gives 2.7 liters, 3.6 liters, and 1.68 liters respectively for Ayutthaya, Surajthani, and Trang, and the capacities of elevated tanks were decided at 3 tons, 4 tons and 2 tons respectively.

Two lifting pumps shall be installed so that lifting can be continued even if one is out of order.

2) Hot Water Supply

In each of the centers, hot water for drinking and washing will be supplied in the center buildings and dormitories by means of a storage type gas boiler. For cooking a larger boilder will be installed. Hot water for showers will be supplied at only three taps max. due to the limited capacity of boiler.

3) Gas Supply

The gas (LPG) for hot water, cooking, and laboratory experiments will be supplied central pressure bottles where it is gasified by the generator and distributed to various outlets through pipes.

Calculation of the amount of gas required (assuming the lowest) ambient temperature at 20 - 25°C)

The number of pressure tanks shall be adequate for at least five days worth of consumption, and the pressure tanks shall be equipped with switching devices in order to conserve gas and insure a stable supply of gas.

Table 4-25 Gas Consumption Amount (Unit: kg/h)

Item \ Center	AFC	SFC	TFC
Center Bldg.			
Experiment Table	0.16	0.16	0.04
Potable Water Boiler	0.12	0.12	0.12
Dormitory			
Kitchen	1.8	1.8	-
Potable Water Boiler	0.36	0.36	-
Shower Water Boiler	1.25	1.25	-
Total	3.69	3.69	0.16

4) Drainage

Waste water shall be discharged separately. The human waste will be introduced into the purifying tank (independent treatment, 90 ppm BOD) and then mixed with other waste water after treatment, to be discharged.

Table 4-26 Calculation of Septic Tank size Based on Number of Persons
Coeficiency rate = 0.5 (JIS A 3302)

Item / Center	Building	Format		
AFC	Center Bldg.	45 persons x 1/2	= 22.5 persons	,50 persons capacity
	Dormitory		25 persons	
SFC	Center Bldg.	60 persons x 1/2	= 30 persons	60 persons capacity
	Dormitory		25 persons	
TFC	Center Bldg.	28 persons x 1/2	= 14 persons	15 persons capacity

5) Ventilation

Kitchens and loboratories shall be prepared mechanical ventilations and general rooms shall utilize natural ventilation.

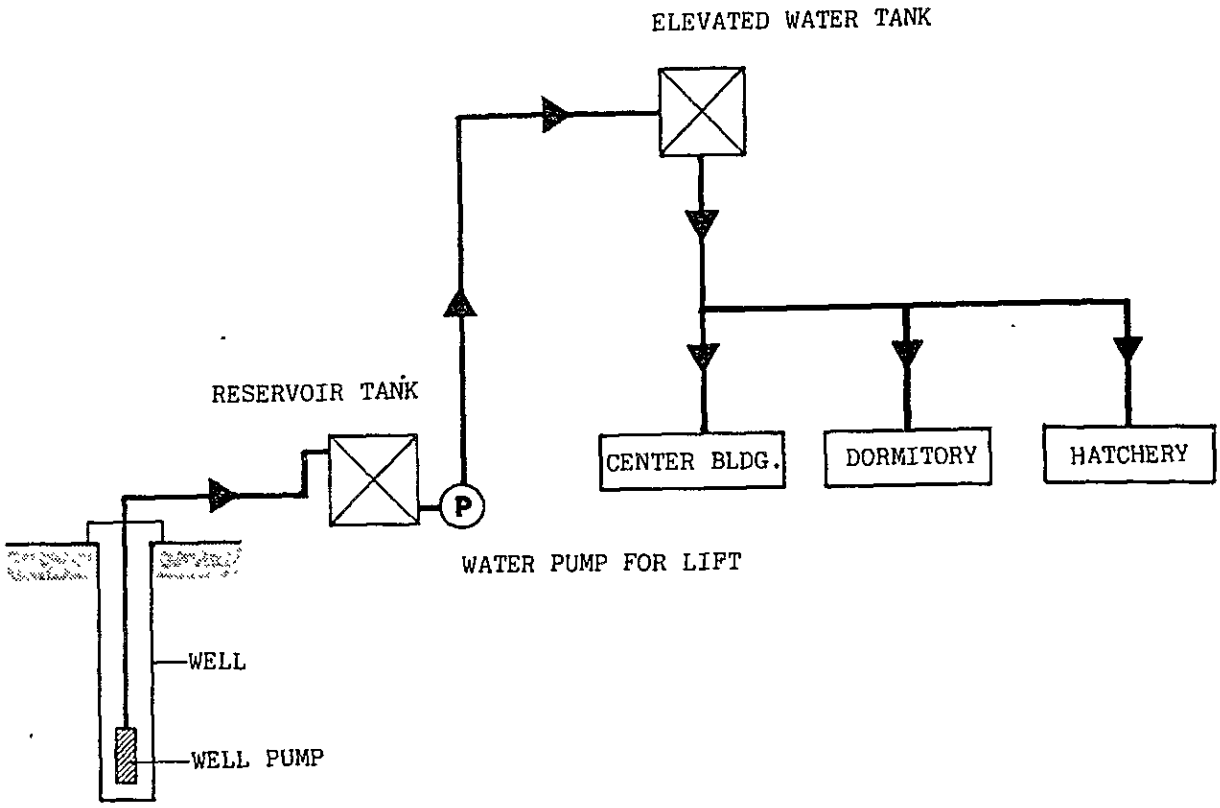


Fig. 4-9 Water Supply System

◎ ガス設備フローシート

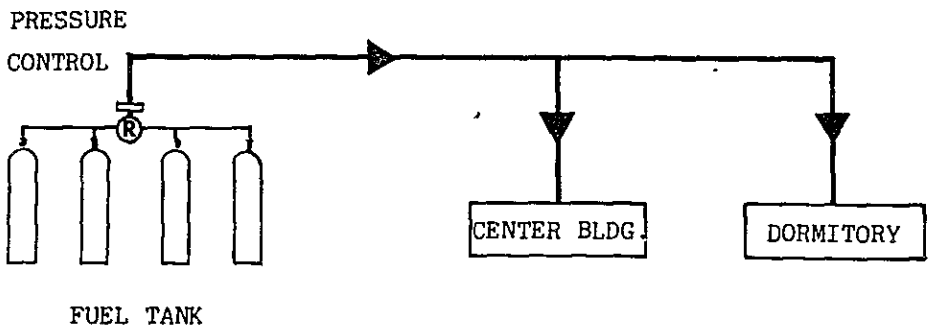


Fig. 4-10 Gas Distribution System

(2) Electrical system

1) Principals of the Electrical System

a) Required Electricity

Receiving Electric Power	3ø4 W	380/220 V
Distributing Electric Power	3ø4 W	380/220 V

b) Light Levels

Table 4-27 Light Levels

(Unit: Lx)

Room	Light Level
Office Room	300
Training Room	300
Laboratory	400
Lecture & Meeting Room	300
Dining Room	300
Hall	150
Bed Room	100
Storage	50
Hatchery	50

c) Voltage drop in the main electric line

The maximum permissible voltage drop in the main line shall be as follows:

less than 5% in the less than 200 m of length
less than 6% in the more than 200 m of length

d) Maximum permissible current of cable

The maximum permissible current of through the cable shall be determined based on the ambient temperature at 35°C and maximum permissible temperature of the cable at 60°C.

e) Generator Capacity

The capacity of the power generator shall be determined based on an ambient temperature of 35°C, a cooling water temperature of 30°C, and a short time overloading rate of 120%.

f) Capacity of transformer

The capacity of transformer shall be determined based on an ambient temperature of 35°C, an interior temperature of +60°C, and a load rate of 80% max.

g) Pipe size

The diameters of conduits for wiring shall be determined, so that the total of the wires' cross section inside the conduit shall be a maximum of 40% of the pipe's diameter.

h) Lightning Conductor

A lightning conductor shall be installed on each of the main buildings so that the structure of the buildings is used at the conductor. The grounding resistance shall be 1 ohm max.

2) Electrical Loud Requirements

a) Load Capacity

The load capacity for the equipments is estimated as follows.

Table 4-28 Calculation conditions

Item / Equipment Item	Calculation Conditions	
Light & Socket Outlet	Center Bldg. & Dormitory Hatchery	30 W/ m^2 5 W/ m^2
Experimental Equipment & Socket Outlet	Center Bldg.	15 W/ m^2
Pumps for Water Supply and Drainage	Estimated as In Equipment Planning	
Air-Conditioning Equipment	For Future Use	
Pumps for Pond Water	Estimated as In Civil Planning	

Format:

Load Capacity = Equipment Capacity x 1/Factor x 1/Efficiency Rate x Demand Rate

on the basic of Table 4-28 the load capacity of the respective center are calculated as follows:

Table 4-29 Load Capacity - Ayutthaya

Item / Equipment	Capacity (Unit: kw)	Factor	Efficiency Rate	Demend Rate	Load Capacity (Unit: kVA)
Light & Socket Outlet	33 kw	0.9	1	0.8	29
Experimental Equipment & Socket Outlet	7.5	1	1	0.2	1.5
Pumps For Water Supply and Drainage	2.6	0.8	0.8	0.4	1.6
Air-Conditioning Equipment	13.5	0.8	0.8	0.8	17
Pumps for Pond Water	11	0.8	0.8	0.5	8.6
Total					57.7 KVA

Table 4-30 Load Capacity - Surajthani

Item / Equipment	Capacity (Unit: kw)	Factor	Efficiency Rate	Demend Rate	Load Capacity (Unit: kVA)
Light & Socket Outlet	42.5	0.9	1	0.8	37.8
Experimental Equipment & Socket Outlet	12.5	1	1	0.2	2.5
Pumps for Water Supply and Drainage	2.6	0.8	0.8	0.4	1.6
Air-Conditioning Equipment	13.5	0.8	0.8	0.8	17
Pumps for Pond Water	15	0.8	0.8	0.5	11.7
Total					70.6 KVA

Table 4-31 Load Capacity - Trang

Item / Equipment	Capacity (Unit: kw)	Factor	Efficiency Rate	Demend Rate	Load Capacity (Unit: kVA)
Light & Socket Outlet	5.7	0.9	1	0.8	5
Experimental Equipment & Socket OUtlet	2.2	1	1	0.2	0.4
Pumps for Water Supply and Drainage	2.1	0.8	0.8	0.4	2.6
Air-Conditioning Equipment	3.0	0.8	0.8	0.8	3.7
Pumps for Pond Water	11.0	0.8	0.8	0.5	8.6
Total					20.3 KVA

b) Power Intake and Distribution Plan

The power shall be received at 3ø4W, 220 V, and the power for a part of the experimental instruments shall be transformed to 100V. On the main line for distribution, 600 V PVC wire shall be used with 20% min. margin for future extensions.

c) Electric Lamps

Light fixtures shall be installed mostly with 40 W fluorescent lamps according to Table 4-27. The current of a circuit shall be 12 A max., and the lamps shall be placed with switches in each of the rooms.

d) Receptacle

All rooms shall be equipped with a receptacle for cleaning, etc. with additional ones in laboratories for experiments and instruments.

e) Power Wiring

Pumps for water supply and drainage and ventilation machines shall be operated automatically and controlled at one place as far as possible.

Pumps for intake and discharge of water for the ponds are to be

located far from the center building. Therefore, the controlling panel shall be equipped with an alarm panel for automatic operation within the center building.

f) Electric Generator

Electric power generation shall be carried out by 3ø 4W 380/220 V generators, the capacity of which is to be decided based on an ambient temperature of 35°C. It is to be driven by a light oil diesel engine for not more than a maximum of 9 hours, continuously.

The fuel tank shall have a running capacity of 3 days, and its use will be limited by the following conditions.

- o The generator will be of the load controlling type, where air conditioners and pumps for water intake and drainage for the ponds shall be stopped automatically under event of a power failure.
- o In case the pumps for ponds must be operated, they shall be closed manually after limiting other loads.

Capacities of the generators in the centers are shown in the following talbe.

$Q_G = Q_T - (Q_P + Q_A)$

Q_G : load capacity of generator
Q_T : total load capacity
Q_P : load capacity of pumps for ponds
Q_A : load capacity of air conditioners

$Q = Q_G \div 0.8$ (Capacity correction at 35°C)

Q : load capacity of generator

Table 4-30 Generator Capacity

(Unit: kVA)

Item \ Center	AFC	SFC	TFC
Required Load Capacity for Generator Qg = Qt-(Qp+Qa)	57.7-25.6=32.1	70.6-28.7=41.9	20.3-12.3=8
Maximum Load Capacity of Generator Q = Qg ÷ 0.8	32.1÷0.8 =40	41.9÷0.8 =52	8 ÷ 0.8=10...(1) 25.8* .....(2)

* Trang

Generator capacity by the equation above = 10 kVA ..... (1)

Required capacity for starting the generator by independent maximum load, starting 5.5 kw pump = 25.8 kVA .... (2)

Capacity for the larger value among (1) and (2)

g) Lightning Conductors

Lightning conductors shall be fitted on each of the main buildings, reinforcing bars to be used while in center buildings and dormitories and tailing copper wire will be used in the hatcheries.

Grounding shall be separate for each of the buildings.

h) Antenna for Wireless Communication

Antenna (UHF/FM) shall be fitted in Surajthani and Trang for the wireless telephone.

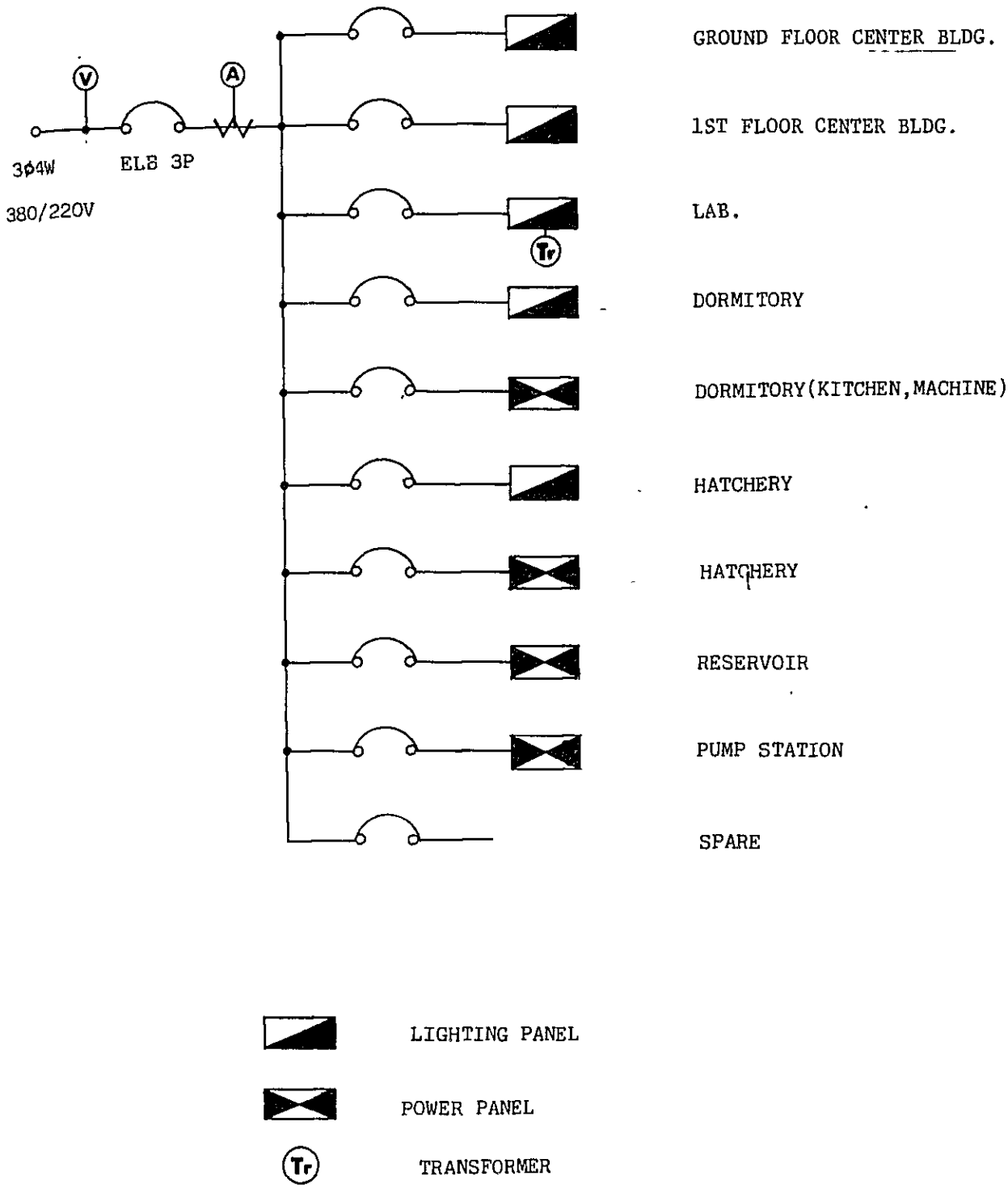


Fig. 4-10 Electricity Distribution Diagram

4-3-6 Civil Engineering Planning

(1) Earthwork

1) The ground plan will be determined by consideration of the water feed and drainage plan, the height of dike around the site, cross sectional plan of the ponds and locations of the ponds.

2) In order to reduce the amount of rain water in the site, the area to be surrounded by the embankment is limited to the minimum required.

3) Discharge of water from the site shall be drained to flow naturelly as far as possible in order to save running costs; and for this reason, the inclination of drainage in the site was decided at 2.5‰.

4) The height of the ground for the buildings such as the center building, dormitory, and residential houses shall be large enough to cope with a flood caused by the heavy rain.

The planned cross sections of the ground in the sites were determined as shown in the following figures. (Figs. 4-11, 4-12, 4-13)

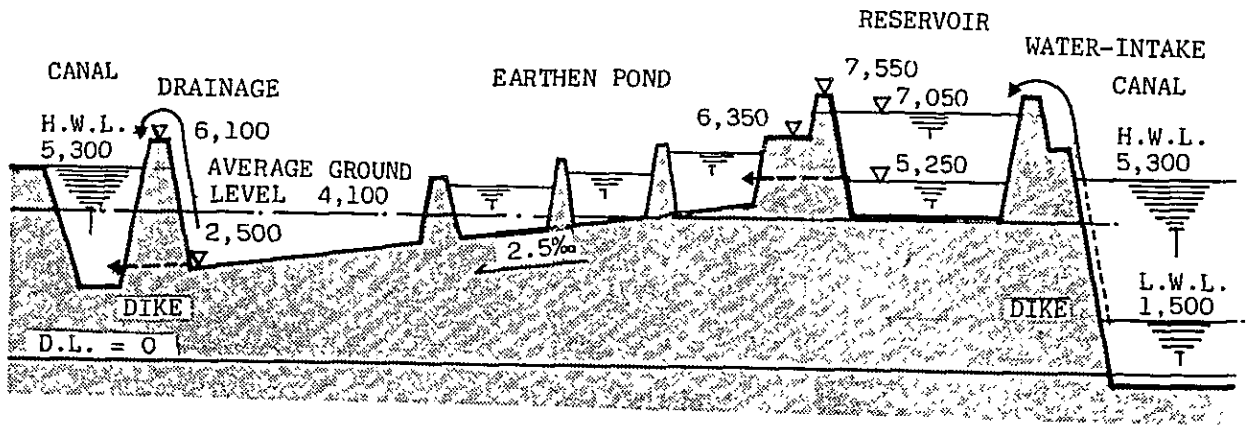


Fig. 4-11 Cross Section: Ayutthaya

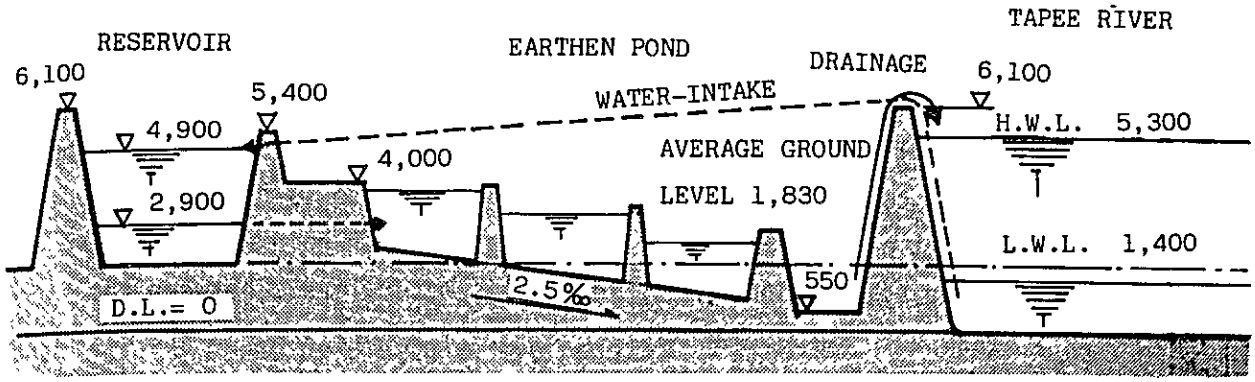


Fig. 4-12 Cross Section: Surajthani

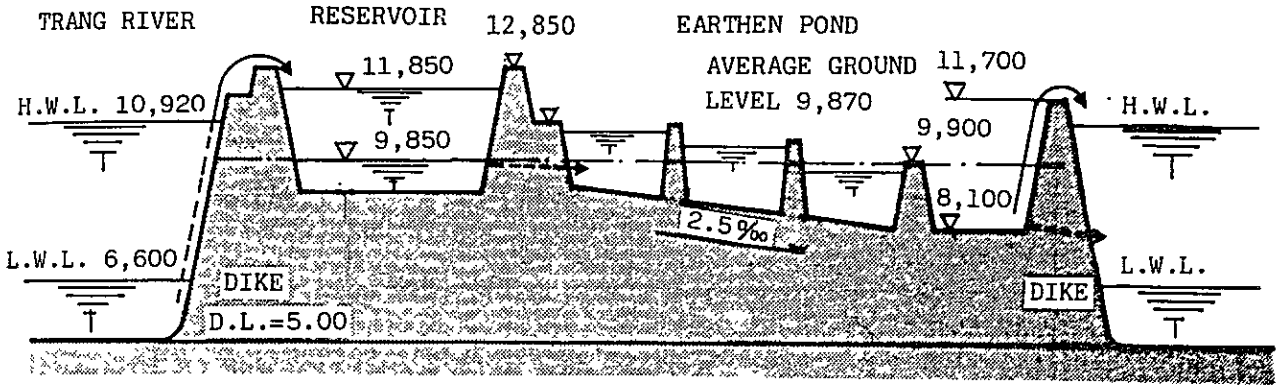


Fig. 4-13 Cross Section: Trang

The amount of earth fill required shall be reduced to a minimum, but it is somewhat large in Surajthani, compared with that in other sites. Also in Surajthani, because a stratum of sandy loam is present at the site, the depth of excavation must be made deeper than the geological cross section to insave watertightness.

(2) Water intake, Water supply, and Drainage System

The system of water circulation in the sites is shown as follows:

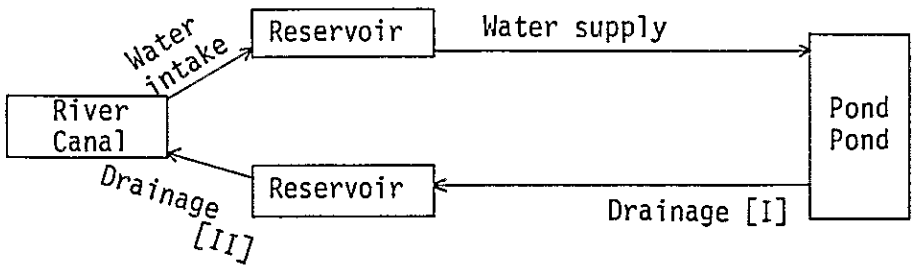


Fig 4-14

1) Water Intake (Rivers → Reservoirs)

River water of comparatively good quality shall be selected and taken into the reservoir by means of pump, and a transistor controller is installed on the power board in order to save the power consumption. The capacity of the pump is determined by the amount of water intake, in consideration of rain water in the rainy season, and the difference in water levels between the reservoir surface and low level of river surface, as the maximum lift.

Table 4-33 Capacity Circulation of Water intake Pumps in the Respective Centers

Item \ Area	Ayutthata	Surajthani	Trang
Rainy Season	May-Oct. (180 days)	May-Dec. (240 days)	May-Dec. (240 days)
Total Precipitation During Rainy Season (mm)	927.2	1,487.0	1,863.8
Daily Average Precipitation During Rainy Season (mm/day)	6.1	6.2	7.8
Daily Average Evaporation During A Year (mm/day)	7.8	5.2	5.2

Table 4-33 shows that water intake is necessary in the case of Ayutthaya for 6 months of dry season. The maximu lift of pump is given by the low river level at 1.50 m and the maximum height in the reservoir at 7.55 m, and two pumps of 7.0 m maximum lift and a capacity of 3 m^3/min. will be installed.

In the case of Surajthani, water intake is necessary for 4 months in the dry season. From the low level of river water at 1.40 m and the top of dike at 6.10 m, the maximum lift will be 6.0 m for the two pumps with a capacity of 3 m^3/min.

In the case of Trang, water intake is necessary also for 4 months in the dry season. From the low level of river water at 6.6 m and

the top of reservoir at 12.85 m, two pumps with a lift of 7.5 m maximum and 3 m^3/min. capacity will be installed.

2) Water Supply (Reservoir → Ponds)

Water will be supplied from the reservoir to each of the ponds through piping, and contamination of the pipes shall be avoided by due construction for the maintenance of the system. In order to facilitate operation, valves shall be installed at the discharge end of piping to the pond.

Pipes of 150 mm diameter are used in view of the amount of water.

3) Drainage (I) (Ponds → Regulating Reservoir)

Drainage from a pond to regulating Reservoir shall be constructed of concrete pipes for natural flow down. The inclination of the piping shall be 2.5‰, and pressure pipes of 600 mm diameter are used for crossing under the main road with a manhole every 70 m. Monk shall be arranged so that the flowrate of water can be regulated with a wooden board.

4) Drainage (II) (Regulating Reservoir → Pond)

Drainage from the regulation pond to the river shall be made by pump as a mechanical Drainage, but in the dry season at Ayutthaya the water level of River Trang is low enough to allow natural discharge.

The capacity of pumps is determined by the difference between the levels of the regulating pond and the top of dike.

Table 4-34 Calculated Capacity of Drainage Pumps for the Respective Centers.

Item \ Area	Ayutthaya	Surajthani	Trang
Maximum Monthly Precipitation from 1952 (mm/day) [A]	526.4 (Sep.1963)	488.0 (Nov.1975)	496.2 (Aug.1961)
Daily Precipitation [B=A/30] (mm/day)	17.5	16.3	16.5
Total Recipitation Per Day (m^3/day) [C=B x Site Area/1000]	5,390	8,232	3,465
Precipitation Per Minute (m^3/minute) [D=C/1440]	3.74	5.72	2.41

As shown in Table 4-34' at least 3.74 m^3/min.of water must be drained in Ayutthaya, and two pumps with a capacity of 3 m^3/min and 5 m lift will be installed.

In Surajthani 5.72 m^3/min.or more amount of water must be discharged with a lift of 7 m, and two pumps of capacity 4.5 m^3/min are installed.

In Trang 2.41 m^3/min.or more at 4 m lift is required, and two pumps with 3 m^3/min.are installed.

In all of the sites the remainder of the area can be used as a regulating pond for the rainfall exceeding the capacity of pumps, the capacities for holding water being 68,000 m^3 in Ayutthaya, 140,500 m^3 in Surajthani, and 41,000 m^3 in Trang. This will correspond to the amount of rainfall for 12.6 days, 17.1 days, and 11.8 days in the month of largest rainfall respectively; and the regulating capacities are evaluated as sufficient.

The number of pumps and their capacity are shown in Table 4-25.

Table 4-35 Proposed Types of Pumps for Water intake and Water supply

Item / Center	Water-Intake Pump			Water-Supply Pump		
	Amount (m^3/min)	Max.Lift Height (m)	Number of Pumps	Amount (m^3/min)	Max.Lift Height (m)	Number of Pumps
AFC	3.0	7.0	2	3.0	5.0	2
SFC	3.0	6.0	2	4.5	7.0	2
TFC	3.0	7.5	2	3.0	4.0	2

(4) Size and Design Principals of the Ponds

The required area of ponds are determined based on the results of the discussion the number of ponds.

Table 4-36 The number of Required Ponds

Pond Category / Center	Cement Pond	Earth Pond		
	50 m^2	400 m^2	1,600 m^2	3,200 m^2
AFC	20	60	26	14
SFC	20	0	48	18
TFC	10	0	14	6

o Design principles

1) Large frontage-to-depth ratio increases the length of circumference with due increase in the amount of work and cost, and the ratio is kept near 1 as far as possible.

2) The length of shorter side shall be 30 m max. for the efficiency in collecting operation of fish with net.

3) Arrangement of ponds, their shape and others must be fully considered in Ayutthaya where the area of site is small, although this is not very important in other two centers.

The pond's dimensions are determined based on the area requirement and shown in table 4-37

Table 4-37 Pond Dimensions

Item / Type of Pond	Width (m)	Length (m)	Area (m^2)	Ratio of Width to Length
50m^2 POND	5.0	10.0	50.0	1:2.0
400m^2 POND	10.0	40.0	400.0	1:4.0
1,600m^2 POND	16.0	100.0	1,600.0	1:6.3
3,200m^2 POND	30.0	107.0	3,210.0	1:3.6

(5) Section of Ponds

1) Bottom level of pond

Bottom level of ponds shall be designed in view of drainage plan and earth moving plan, but it is set at 150 cm as water depth of 120 cm min. is necessary for culture of fish. Considering the function for regulation in heavy rainfall, 30 cm is added and the height from the bottom to the top of dike shall be 180 cm. For the ease of drainage, 1.0 to 2.0‰ of inclination shall be given to the bottom.

2) Dike for pond

The earth from excavation of pond is used for the dike, and the slope of dike shall be 1:1.5 as the earth is clay.

3) Others

Fish collecting box shall be arranged in each of the ponds by simple excavation for the case of total drainage of pond once a

year. The discharge pump for the box shall be a light weight engine pump in view of avoiding electric shock, saving cost, and others.

(6) Water Intake System

1) Selective Water intake

The water from the muddy river should be refined to a certain degree; thus, the water intake is from the surface which is relatively clearer than the other portion of the water level. The methods which is used for the Hitotsuse dam in Japan is applied to this project.

Responding to the elevation changes of the water, removable intake boards are used at the intake point. The structure is simple enough to ease the maintenance.

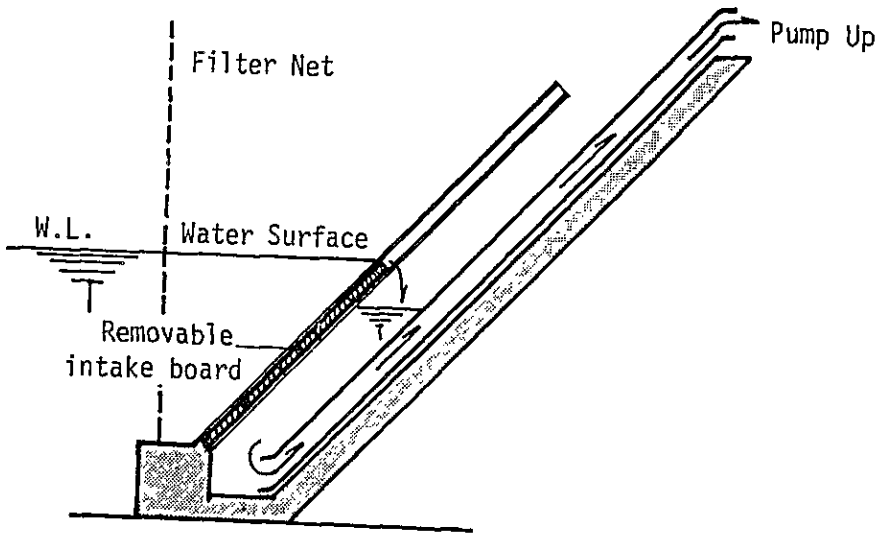


Fig. 4-14

2) Water Quality in Ayutthaya

In the case of Ayutthaya, the water quality is relatively low, since an alcohol refinary factory exhausts wasted water in the upstream. Therefore, the filtering structure should be facilitated.

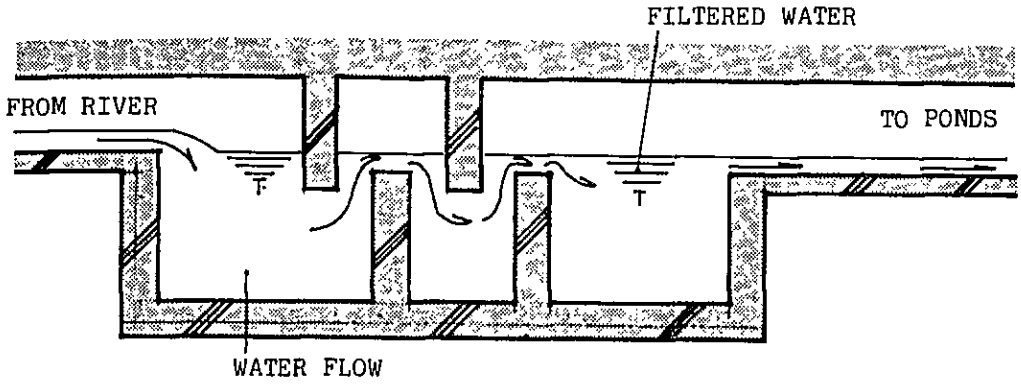


Fig. 4-15

4-3-7 Equipment

(1) General Equipment: Roneo machine and photo Copy machine are necessary for training and promotion activities. Also a telecommunication radio is used for the exchanging information among centers.

(2) Transportation: As vehicles for transportation, trucks for carrying seed fish produced, microbus for the connection with other center and carrying trainees, and cars for promotion activity are necessary.

Boats are used in the ponds and access river for collection and observation of fish and plankton.

(3) Pellet plant: Pellet plants used for production of feed are constructed in Surajthani and Trang. In Ayutthaya the feed is carried from NIFI in Bangkok; hence, the pellet plant would be not equiped. A plant of small scale is sufficient, for processed raw materials are used.

(4) Hatchery: Hatchery is used for study of hatching and production, FRP tanks are utilized for this purpose. In addition, nets for use in the ponds, portable pumps, and measuring devices are stored in the storage.

(5) Experimental Equipment: Those equipment suitable for Japanese grant aid shall be selected, while supplies and those available from the existing centers are utilized as far as possible.

(6) Equipments for Extension Service: Slide set and movie set are equiped, so that films for promotion shall be arranged; hence, they can be shown in nearby schools and elsewhere.

Table 4-38 List of Equipment

Item \ Center	AFC	SFC	TFC	Remarks
General				
1. Telecommunication Radio	-ea.	1ea.	1ea.	UHF/FM
2. Roneo Machine	1	1	1	W/Elec. Scanner
3. Photo Copy Machine	1	1	1	
Transportation				
4. 4WD Car	1	1	1	
5. Truck 4.5	1	1	1	Fish Transportation
6. Micro Bus	1	1	-	
7. Speed Boat	1	2	1	Out Board Engine
8. Research Boat	1	1	-	
Pellet Plant				
9. Mixer	-	1	1	
10. Pelleting Machine	-	1	-	
11. Extruder	-	1	1	W/Dryer
Hatchery				
12. Airation System	2	2	2	Small for Hatchery & Cement Pond
13. Aquarium	50	50	30	900 mm x 450 mm x 450 mm
14. Water Pump 100 mmø	3	3	2	Portable
15. Water Pump 200 mmø	3	3	2	Portable
16. Suction Pump 50 mmø	3	3	2	Under Water Portable
17. Trawl Net 50 m	4	4	2	20 mm Mesh
18. Trawl Net 25 m	4	4	2	5 mm Mesh
19. FRP Tank 7 m^3	10	10	5	
20. FRP Tank 0.85 m^3	10	10	5	
21. Grag Cart	5	5	2	
22. Weighting Scale Set	2	2	1	Set (30 kg, 70 kg, 100 kg)
Laboratory				
23. Microscope	2	2	1	
24. Stereo Microscope	2	2	1	
25. Electronic Balance	1	1	1	
26. Portable Water Analyses Kit	1	1	1	
27. Portable PH Meter	1	1	1	
28. Portable Do Meter	1	1	1	
29. Refrigerator	2	2	1	Stocker Type -25°C
30. Incubator	1	1	1	

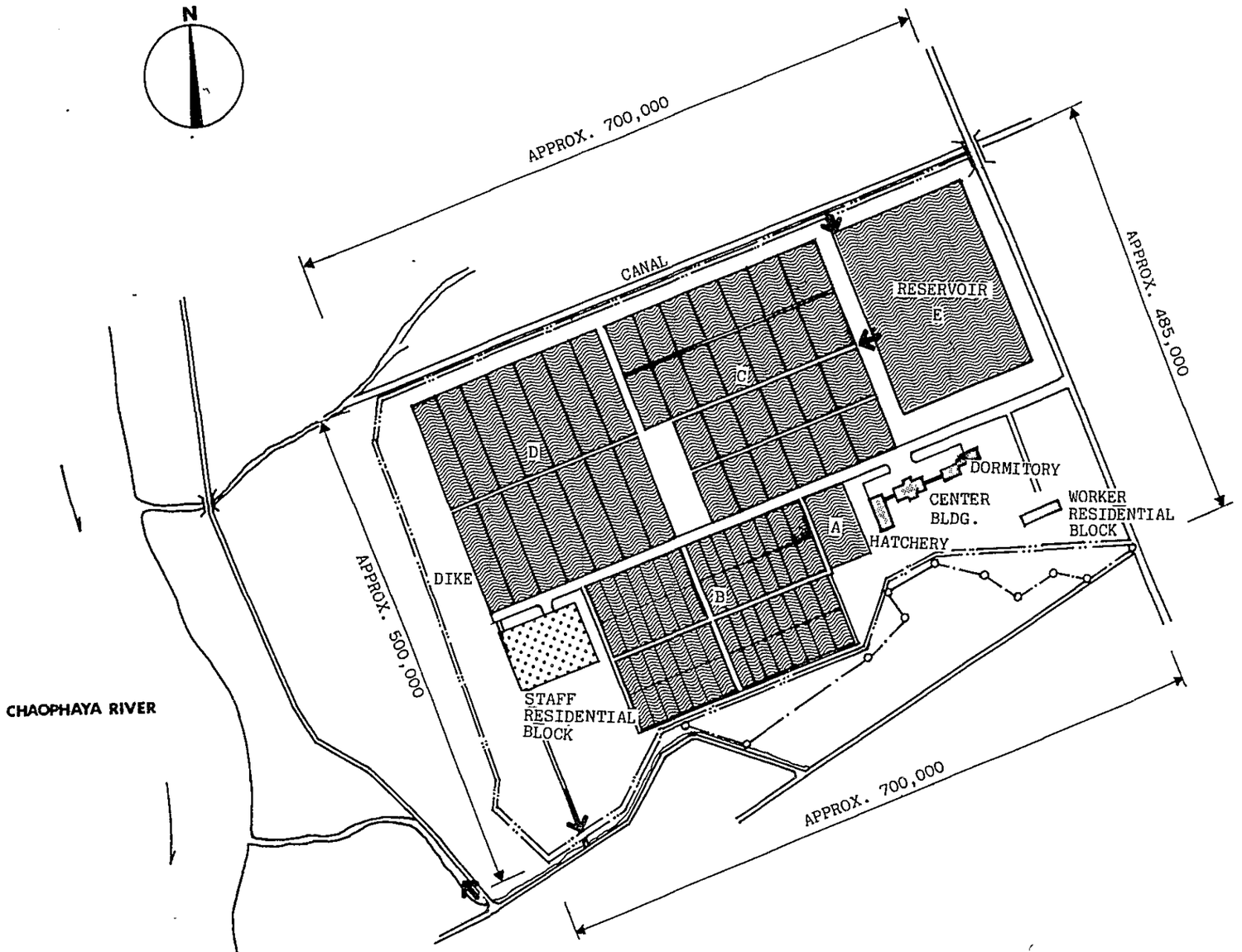
Item \ Location	AFC	SFC	TFC	Remarks
31. Electrophoresis	1	-	-	
32. Distiller	1	1	1	
33. Plankton Net	2	2	2	
34. Centrifugal Machine 300 mm	1	1	1	
35. Test Stand				
Training				
36. Slide Set	1	1	1	Projector & Camera
37. Amplifier Set 200 Watt	AMP1,MIC6 Speaker 4	AMP1,MIC6 Speaker 4	AMP1,MIC3 Speaker 2	Amp Microphone & Loud Speaker
38. Portable Speaker	2	2	1	
39. Overhead Projector	1	1	1	
40. Movie Set 8 mm	1	1	1	Projector & Camera
41. Opaque Projector	1	1	1	
42. Daylight Screen (Big)	1	1	1	
43. Daylight Screen (Small)	1	1	1	
44. Training Stand	Depend on Layout			

4-4 Basic Design Drawings

List of Drawings

4-5 Project Cost

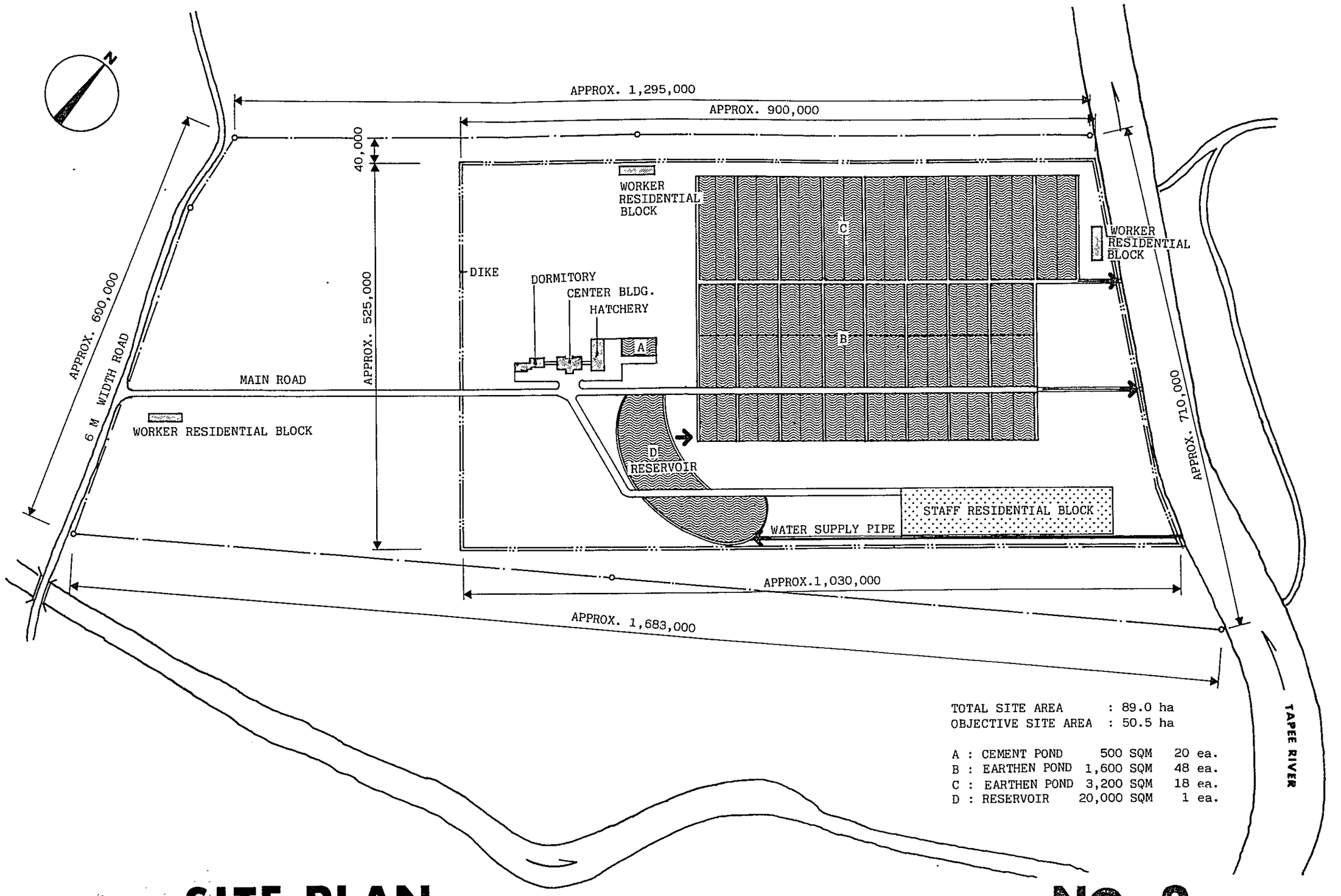
The Japanese Portion of the project cost is estimated 1,185,000,000 yen.



TOTAL SITE AREA : 32.0 ha
OBJECTIVE SITE AREA : 30.8 ha

A : CEMENT POND	50 SQM	20 ea.
B : EARTHEN POND	400 SQM	60.ea.
C : EARTHEN POND	1,600 SQM	26 ea.
D : EARTHEN POND	3,200 SQM.	14 ea.
E : RESERVOIR	29,000 SQM	1 ea.

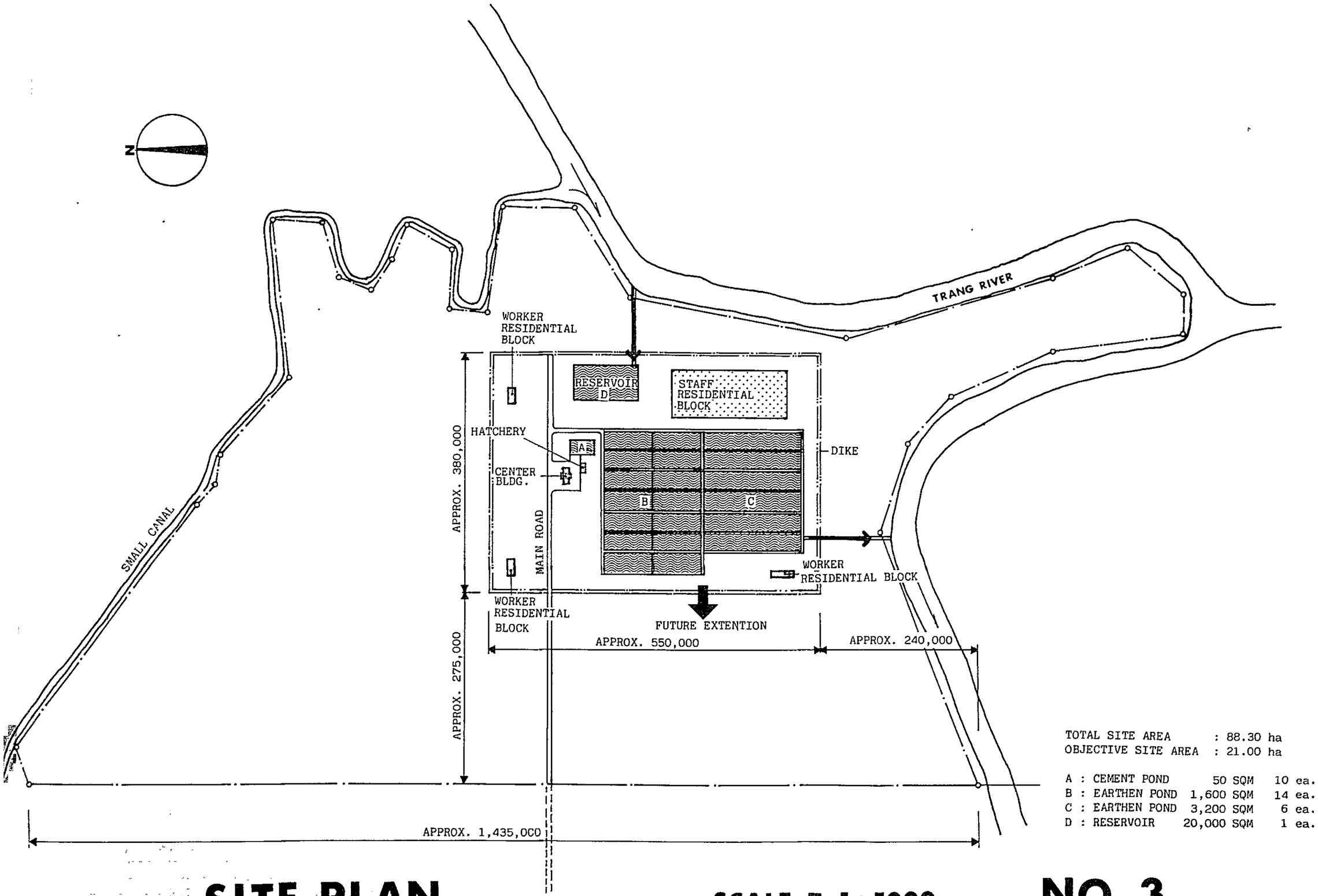
SITE PLAN SCALE = 1:5000 NO. 1



TOTAL SITE AREA : 89.0 ha
OBJECTIVE SITE AREA : 50.5 ha

A : CEMENT POND	500 SQM	20 ea.
B : EARTHEN POND	1,600 SQM	48 ea.
C : EARTHEN POND	3,200 SQM	18 ea.
D : RESERVOIR	20,000 SQM	1 ea.

SITE PLAN SCALE = 1:5000 NO. 2



TOTAL SITE AREA : 88.30 ha
OBJECTIVE SITE AREA : 21.00 ha

A : CEMENT POND	50 SQM	10	ea.
B : EARTHEN POND	1,600 SQM	14	ea.
C : EARTHEN POND	3,200 SQM	6	ea.
D : RESERVOIR	20,000 SQM	1	ea.

SITE PLAN — SCALE = 1:5000 — NO. 3

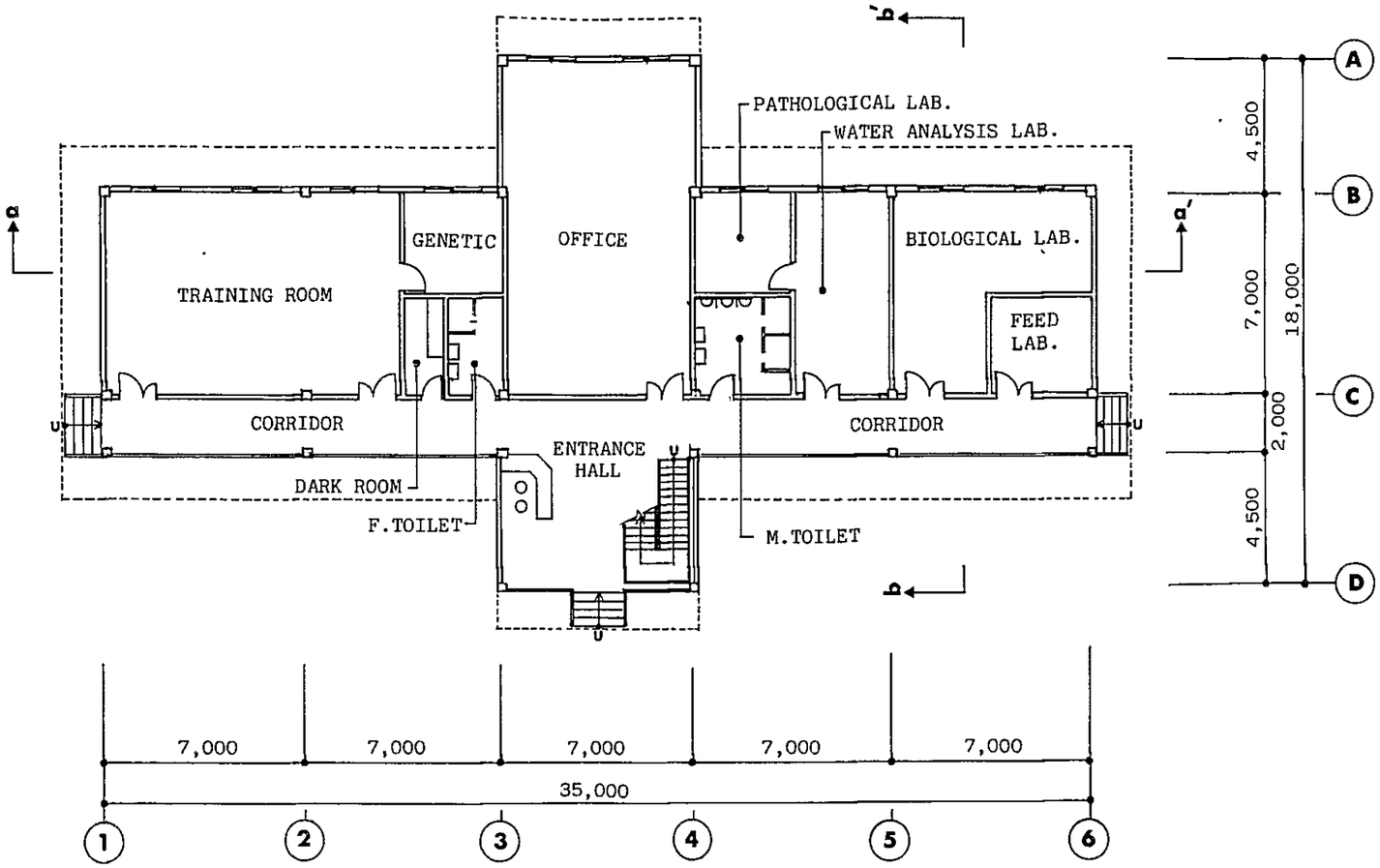
EXTERIOR FINISH SCHEDULE

LOCATION \ FINISH	EXTERIOR WALL		ROOF			METAL (HANDRAIL ETC.)		REMARKS
	SPRAYED ACRYLIC RESIN ON CEMENT MORTAR		CPAC MONIA	CORRUGATED ASBESTOS CEMENT SHEET		STEEL O.P		
CENTER BLDG.	○		○			○		
DORMITORY	○		○			○		
HATCHERY	○			○		○		

INTERIOR FINISH SCHEDULE

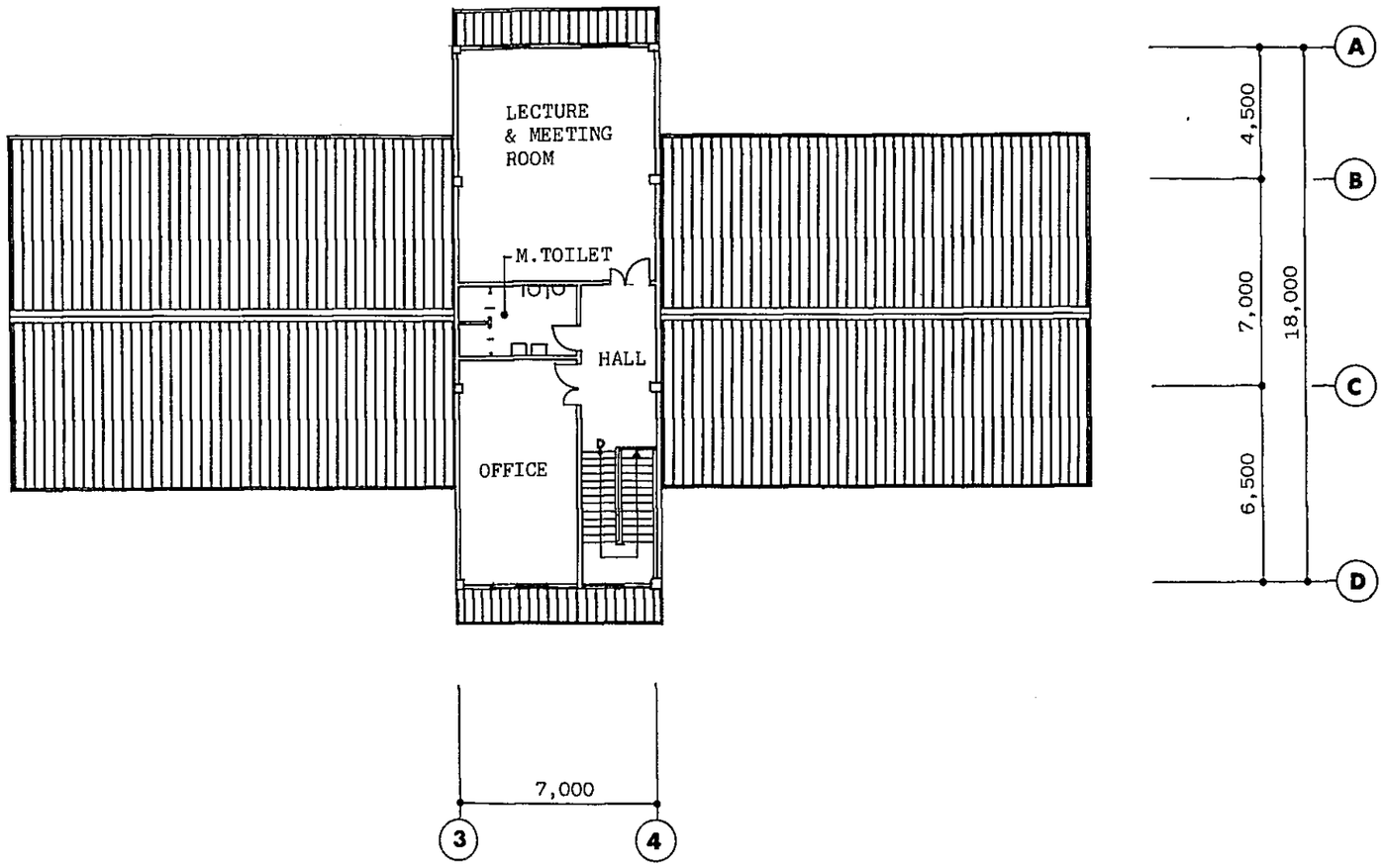
LOCATION \ FINISH	FLOOR					BASE				WALL				CEILING				REMARKS
	VINYL TILE	CEMENT MORTAR STEEL TROWEL FINISH	CLINKER TILE	TERRAZZO TILE		HARDWOOD H=100 O.P	MORTAR V.P	SEMI-VITREOUS TILE		MORTAR V.P	SEMI-VITREOUS TILE	CONCRETE BLOCK		GYPSUM PLASTER BOARD V.P	ASBESTOS CEMENT BOARD V.P			
OFFICE	○					○				○				○				
LABORATORY TRAINING ROOM		○					○			○				○				
DINING ROOM	○					○				○								
KITCHEN			○					○		○	○				○			
BED ROOM	○					○				○				○				
TOILET				○				○			○				○			
HATCHERY		○					○			○								

FINISH SCHEDULE NO. 4



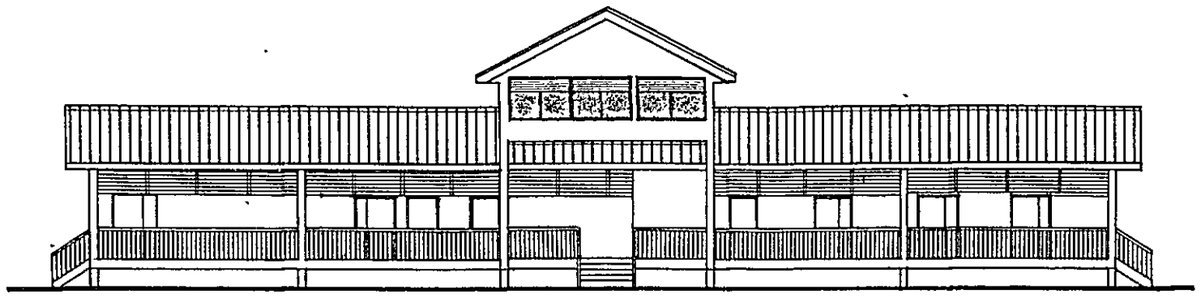
GF PLAN

CENTER BLDG. SCALE = 1:200 NO. 5

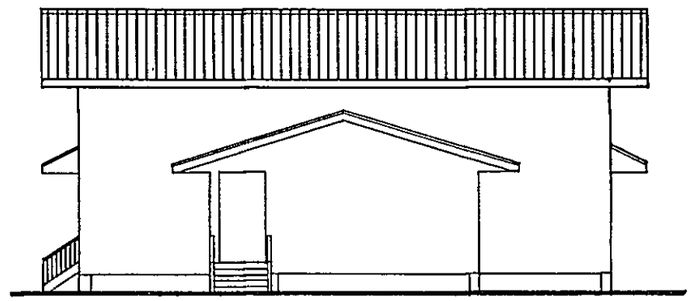


1F PLAN

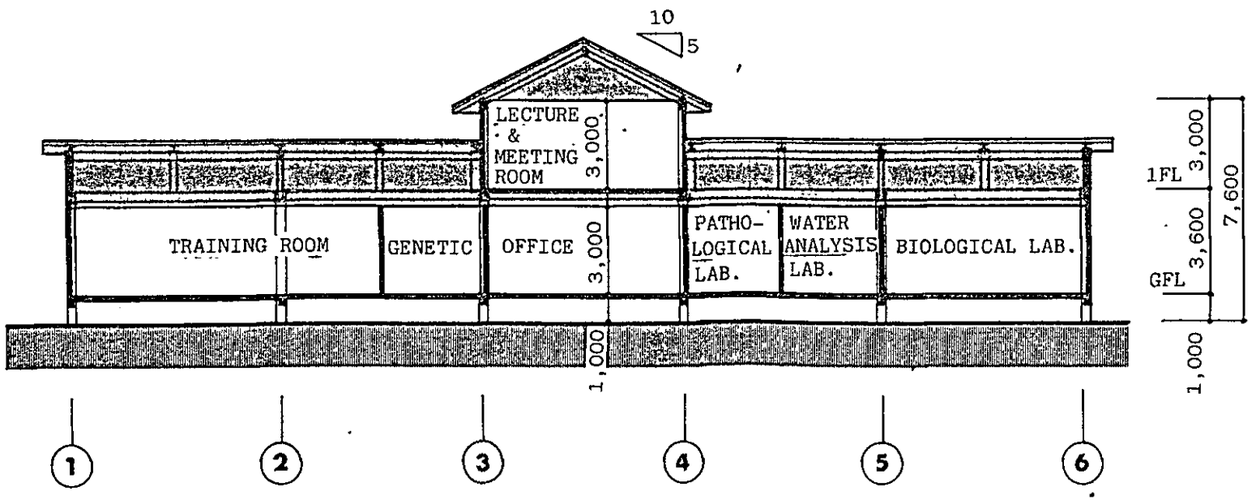
CENTER BLDG. SCALE = 1:200 NO. 6



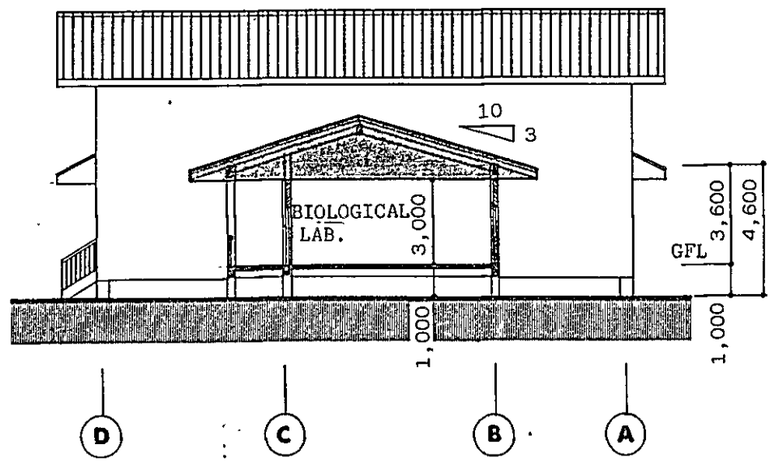
ELEVATION – ⓒ



ELEVATION – ⑥

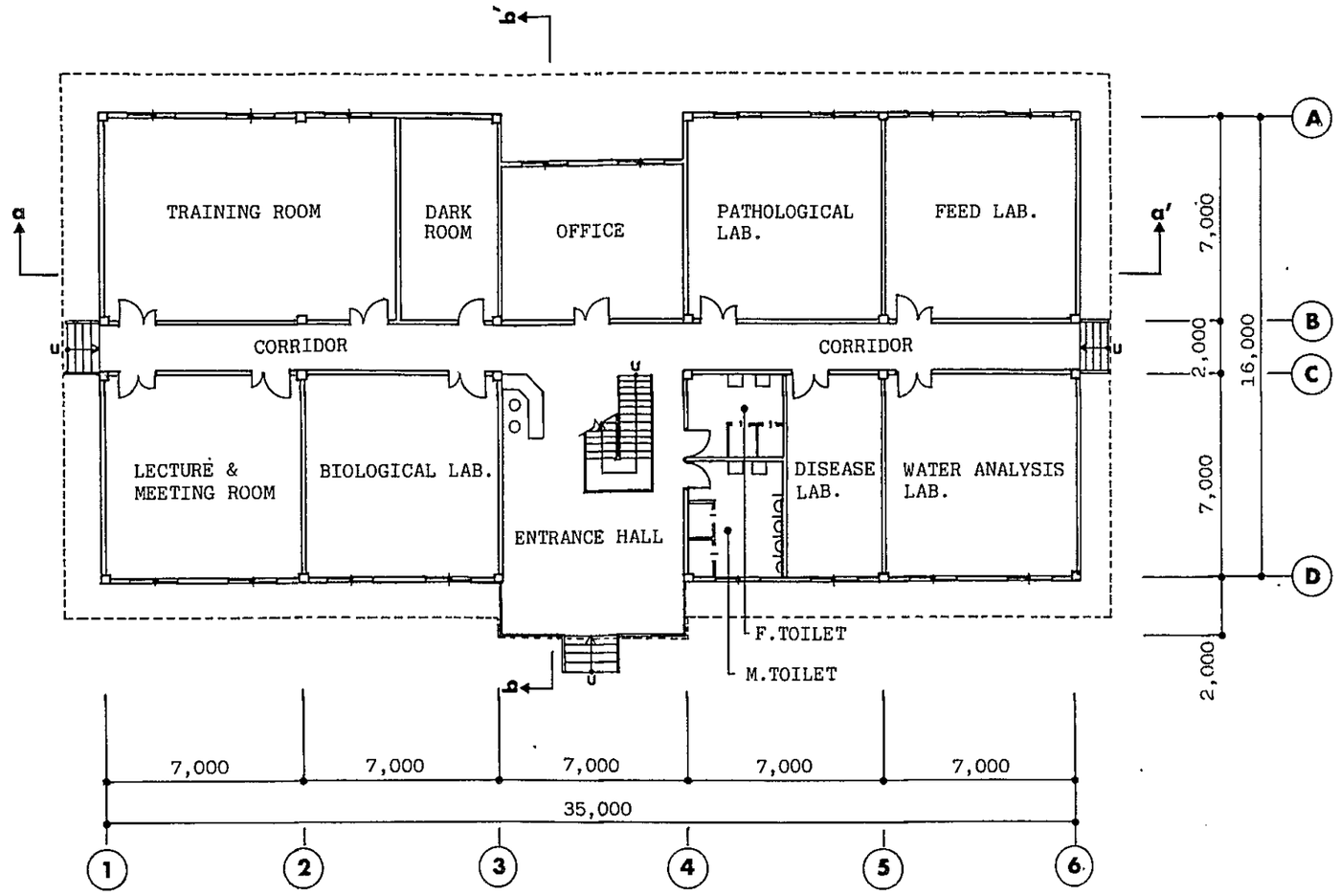


SECTION a – a′



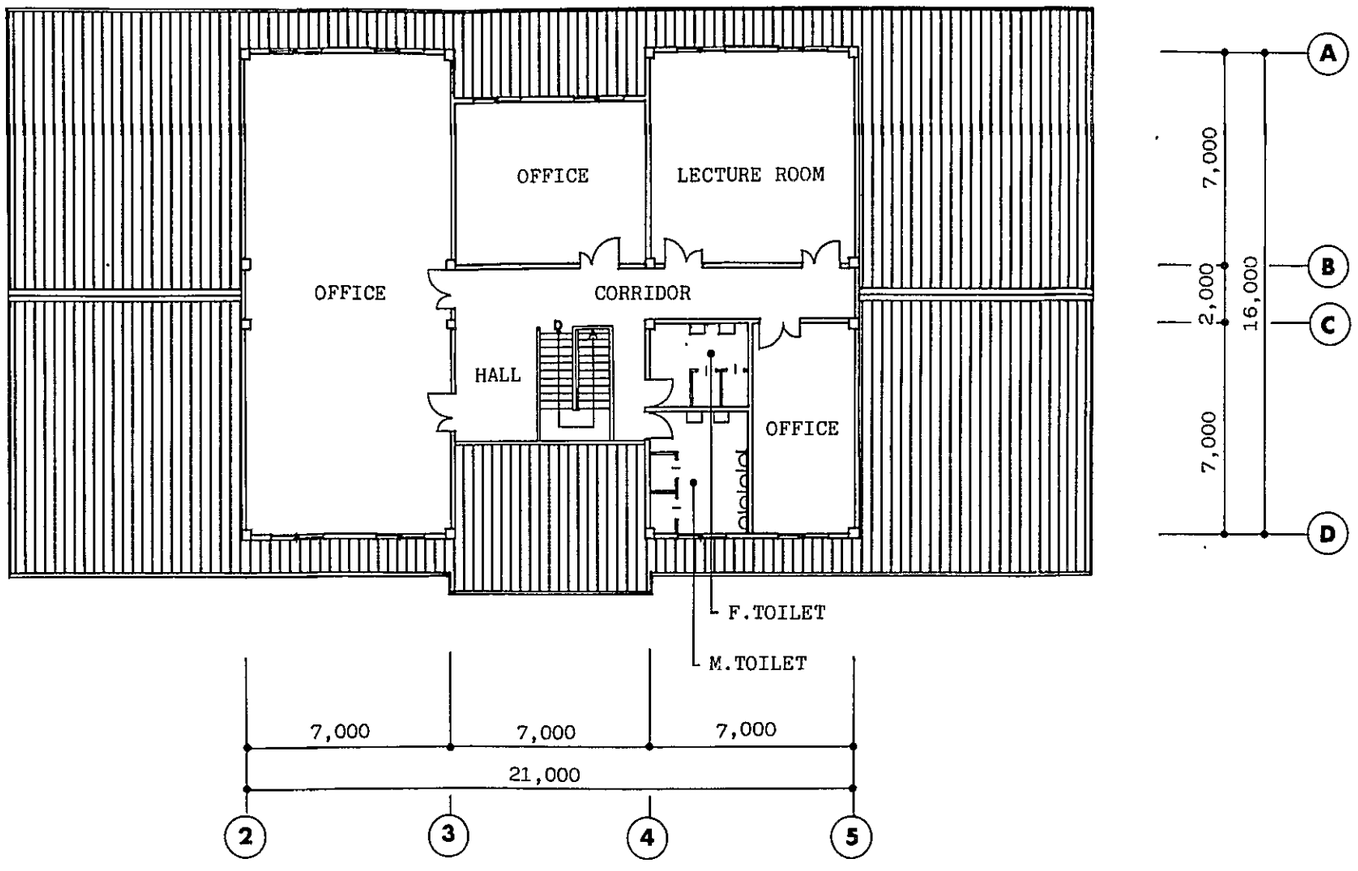
SECTION b – b′

CENTER BLDG. SCALE = 1 : 200 NO. 7



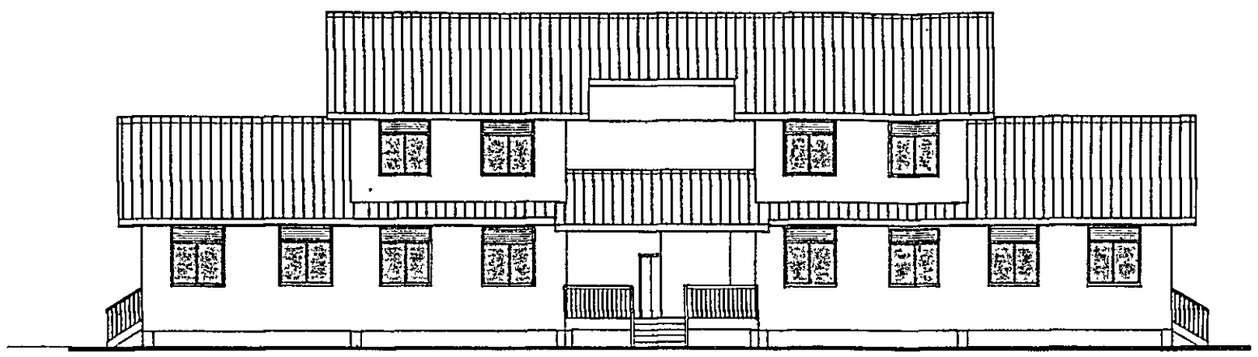
GF PLAN

CENTER BLDG. SCALE = 1:200 NO. 8

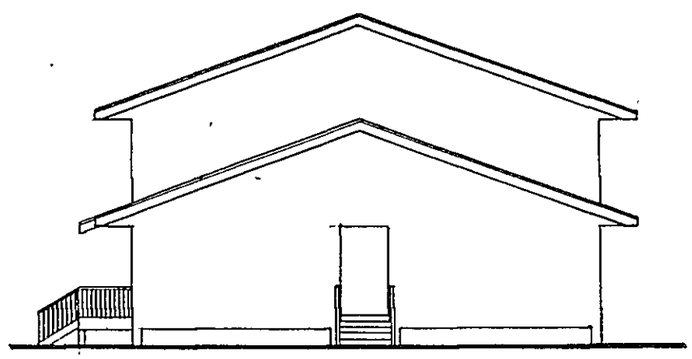


1F PLAN

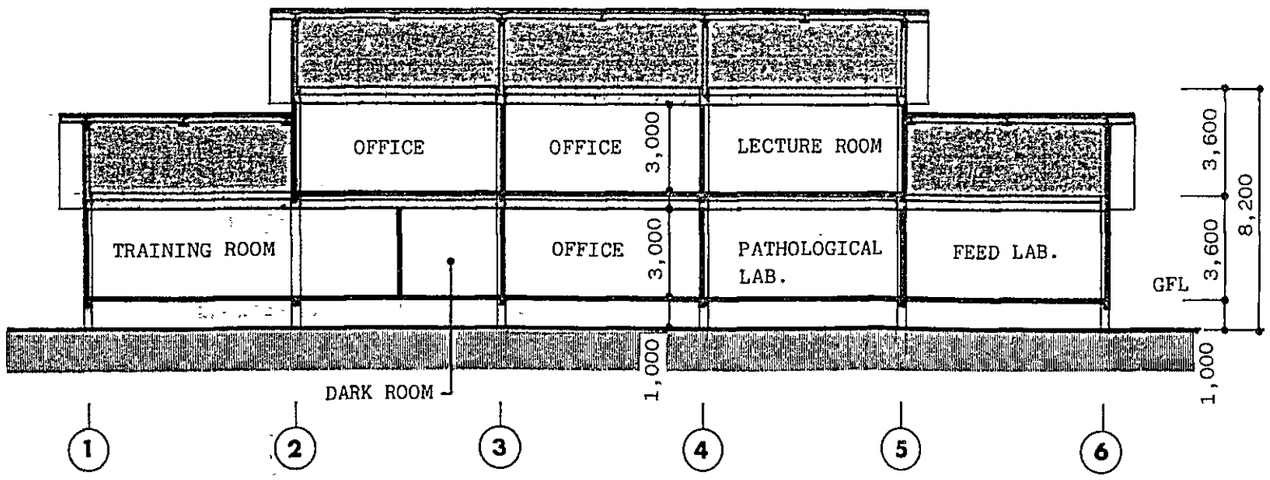
CENTER BLDG. SCALE = 1:200 NO. 9



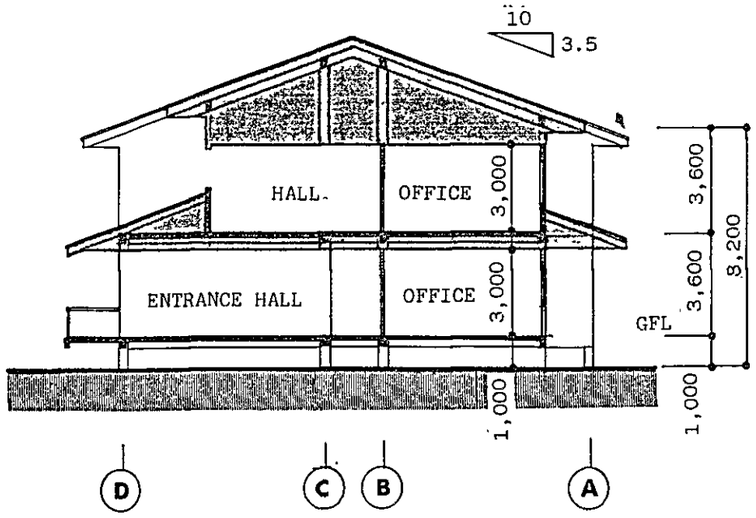
ELEVATION-(D)



ELEVATION-(6)



SECTION a-a'



SECTION b-b'

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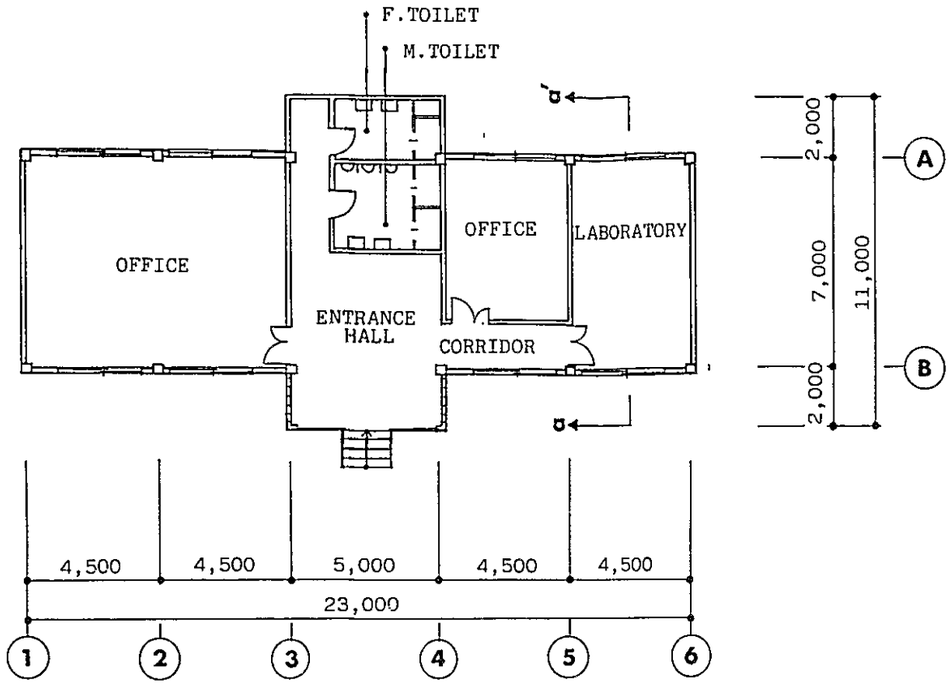
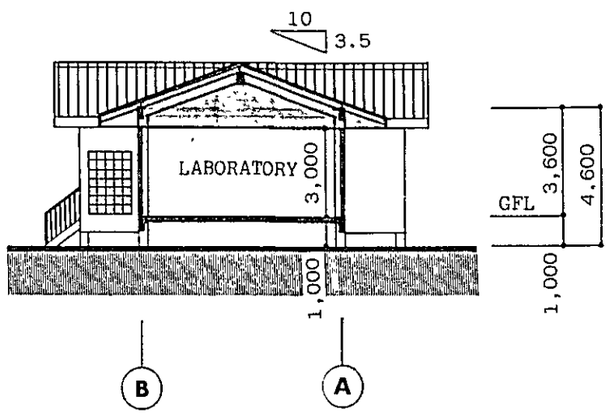
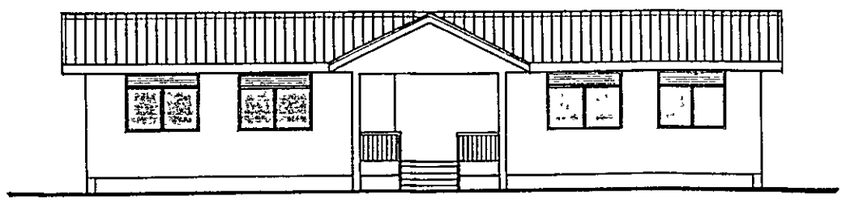


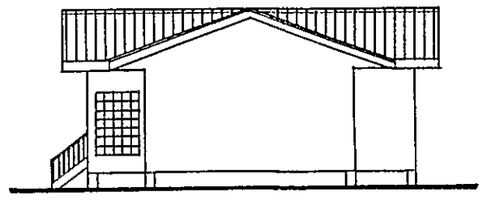
PLAN



SECTION a-a'

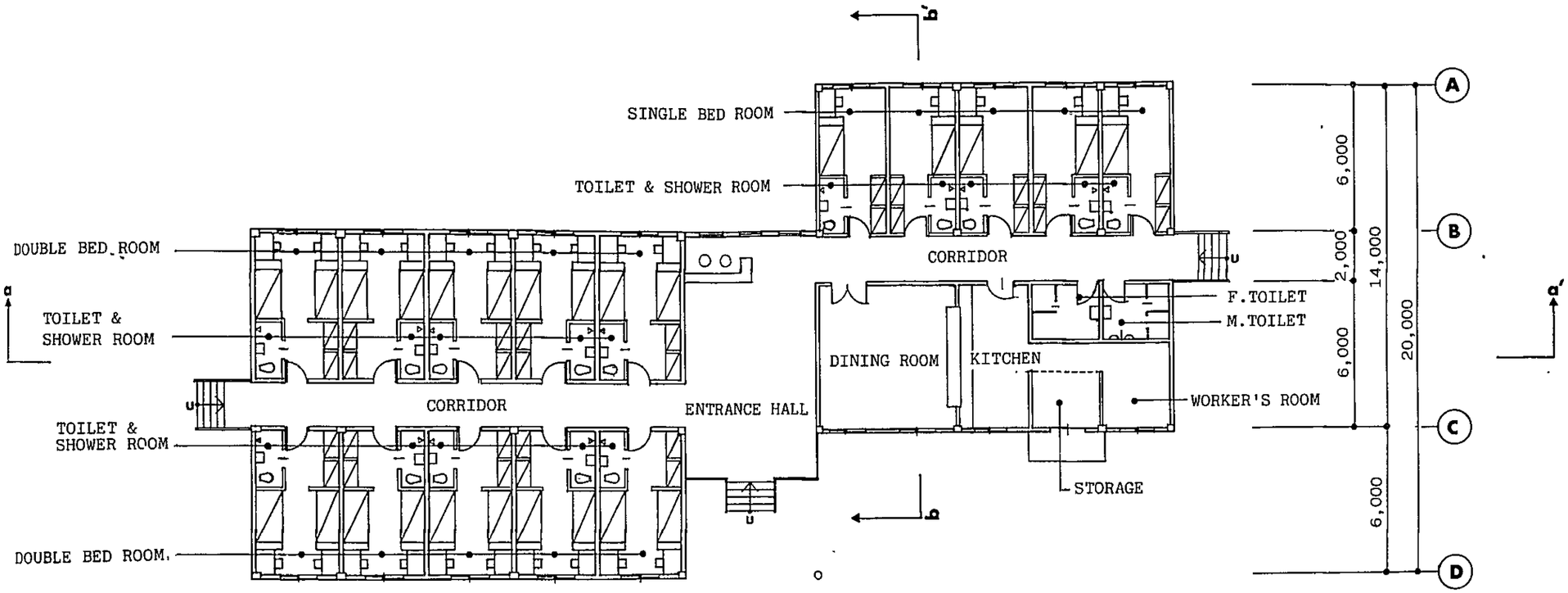


ELEVATION-(B)



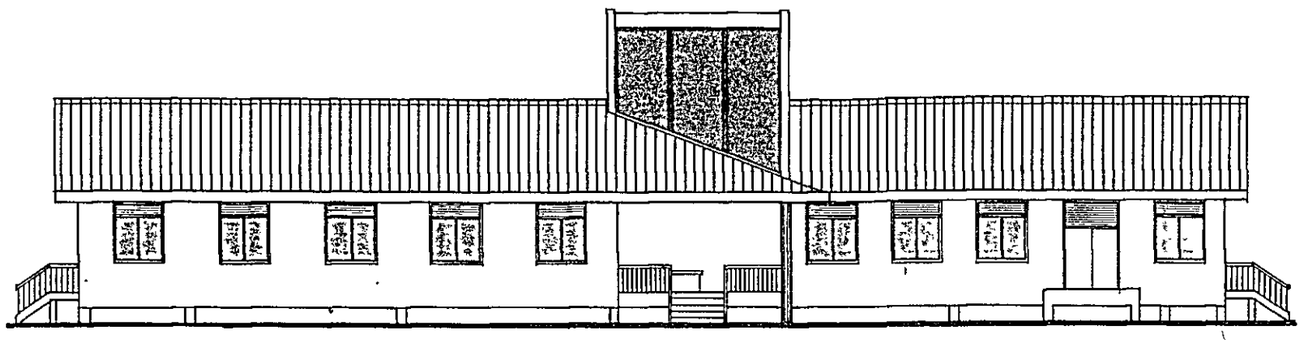
ELEVATION-(6)

CENTER BLDG. SCALE = 1:200 NO. 11

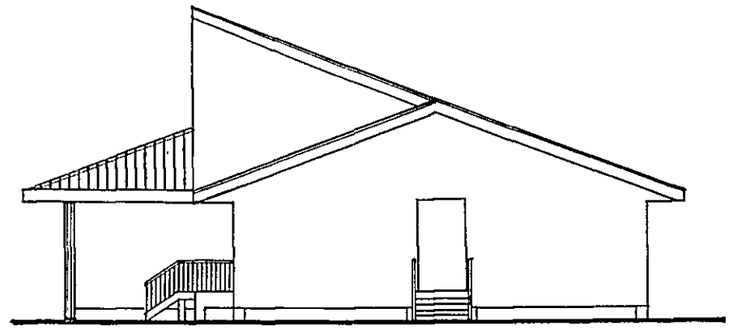


PLAN

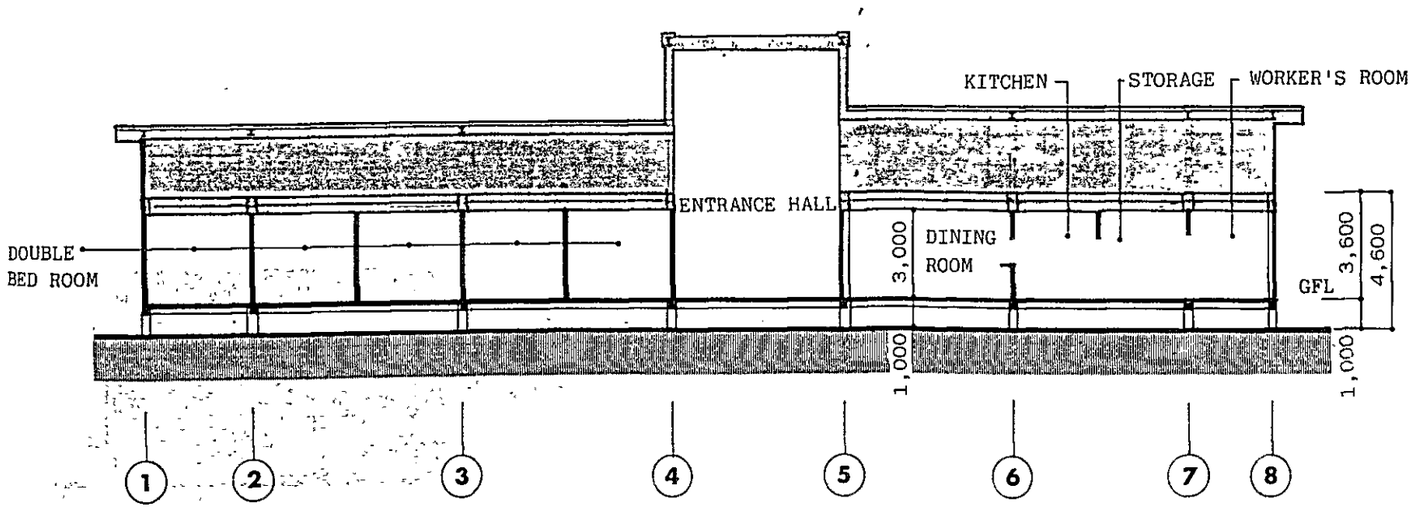
DORMITORY — SCALE = 1:200 — NO.12



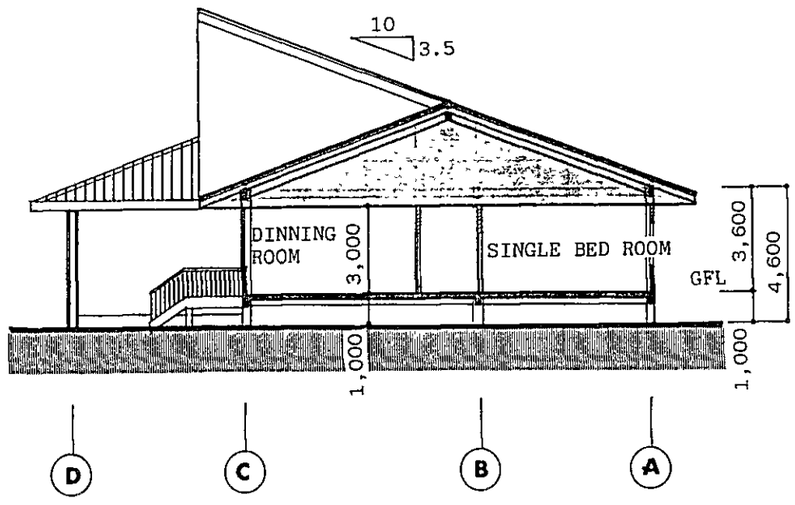
ELEVATION-Ⓒ



ELEVATION-⑧



SECTION a-a'

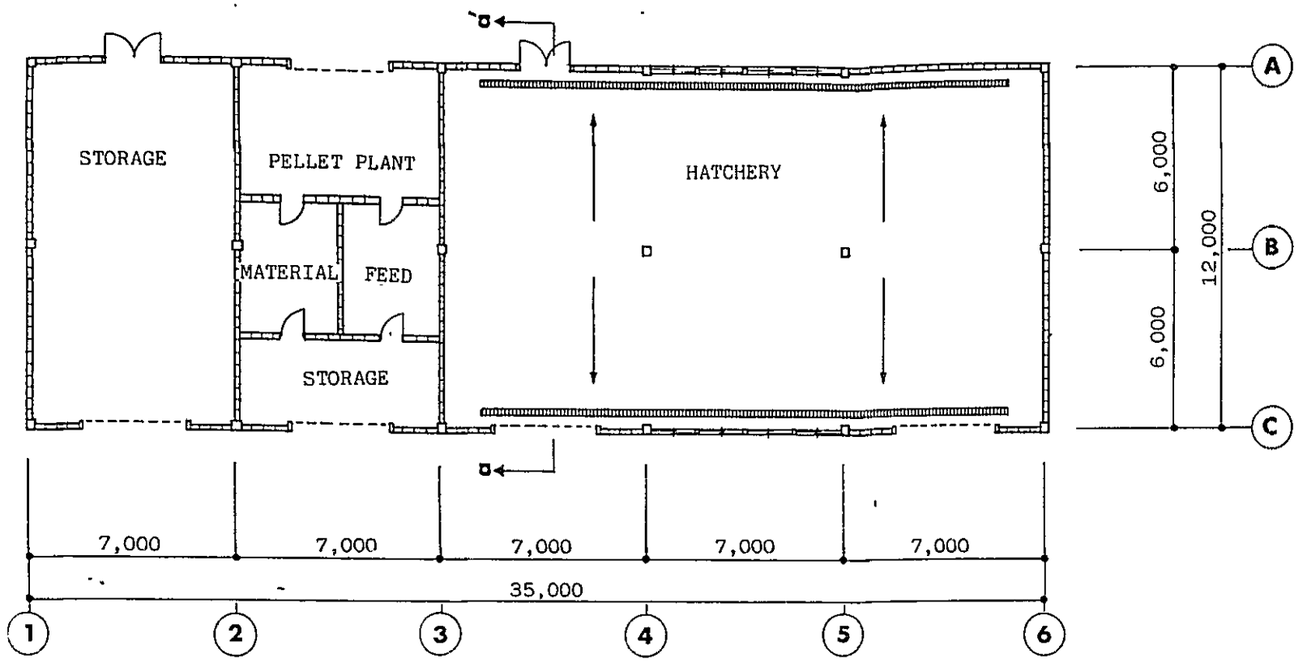


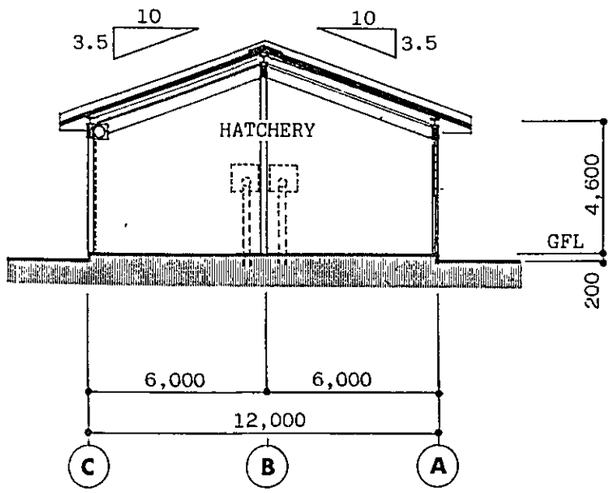
SECTION b-b'

DORMITORY

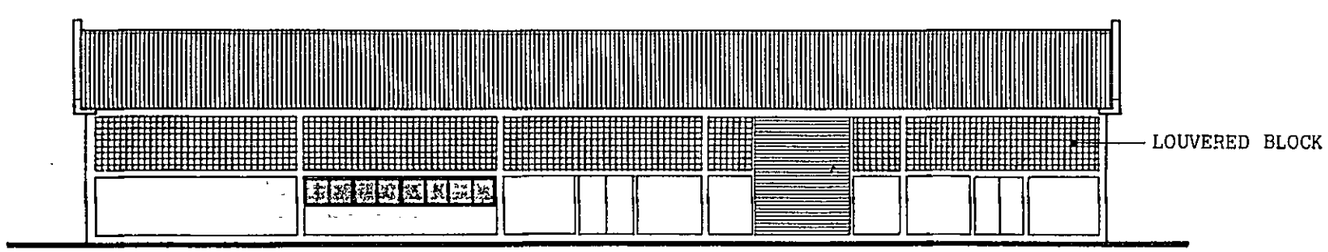
SCALE = 1:200

NO. 13

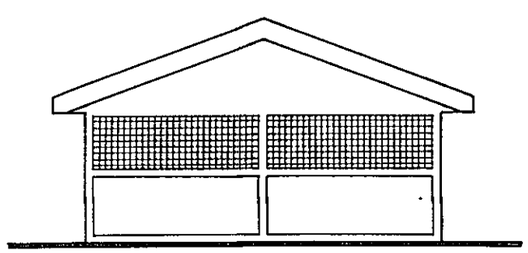




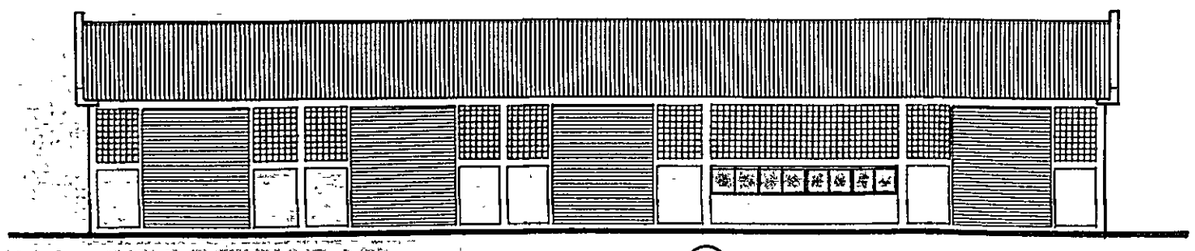
SECTION a - a'



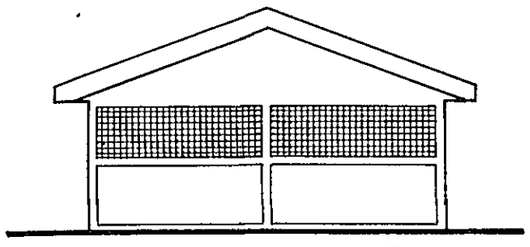
ELEVATION - (A)



ELEVATION - (1)



ELEVATION - (C)

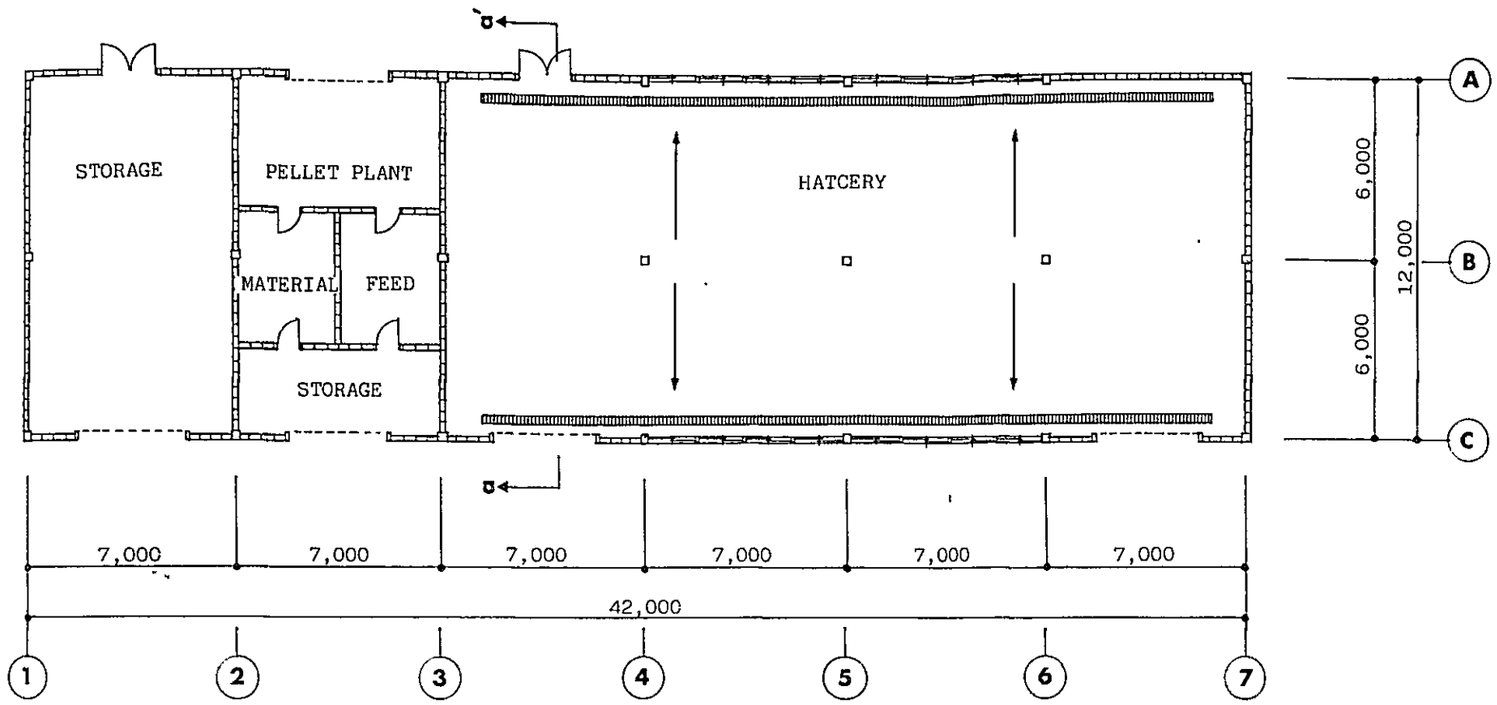


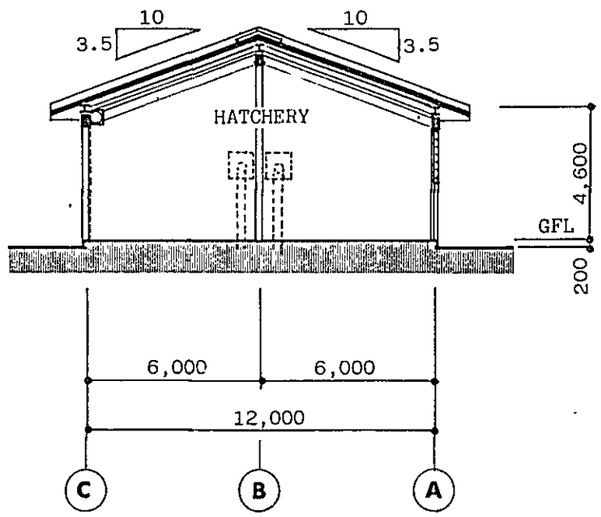
ELEVATION - (6)

HATCHERY

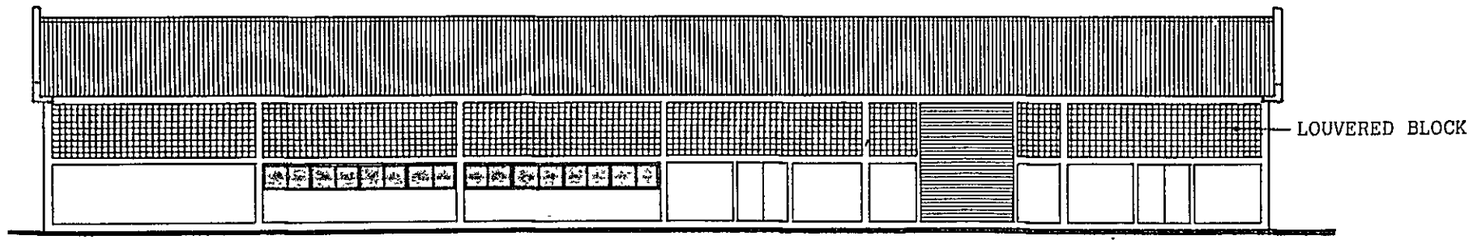
SCALE = 1:200

NO. 14

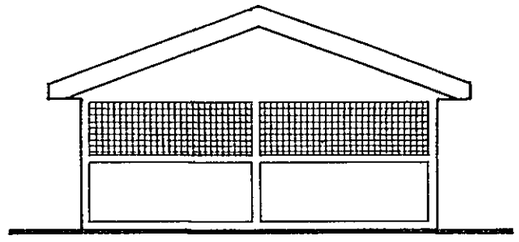




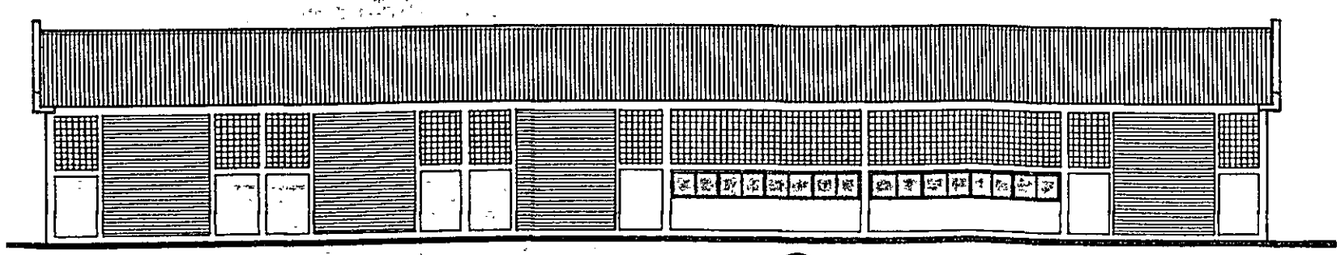
SECTION a - a'



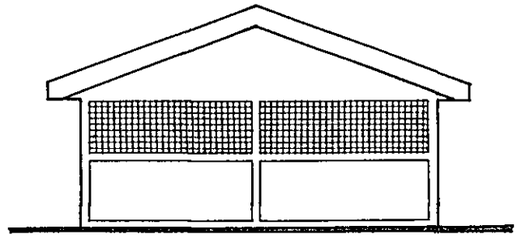
ELEVATION- (A)



ELEVATION- (1)



ELEVATION- (C)

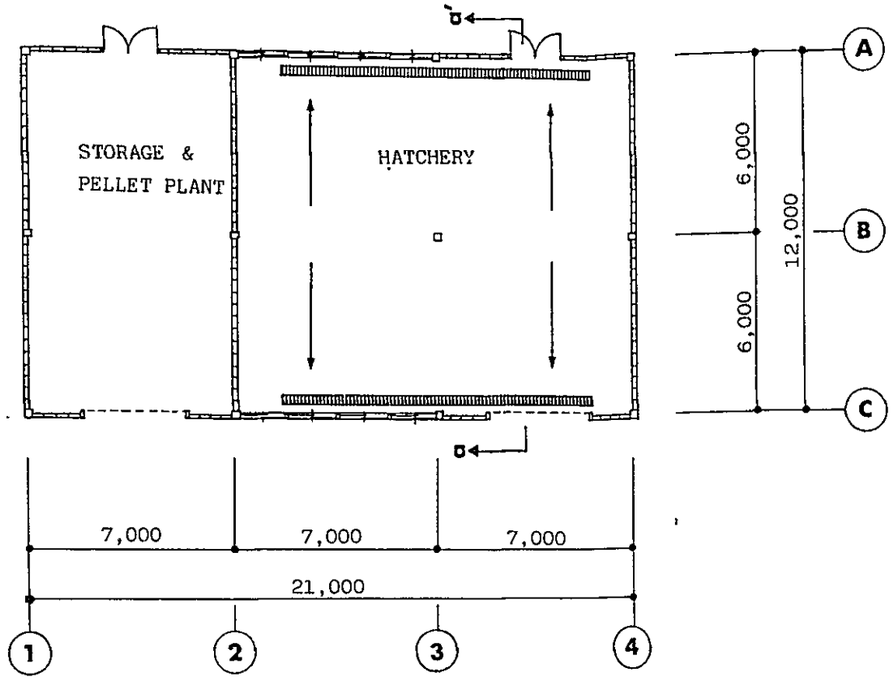


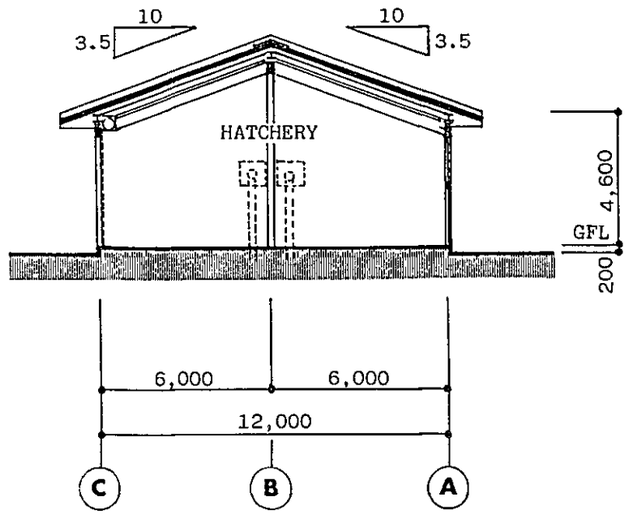
ELEVATION- (6)

HATCHERY

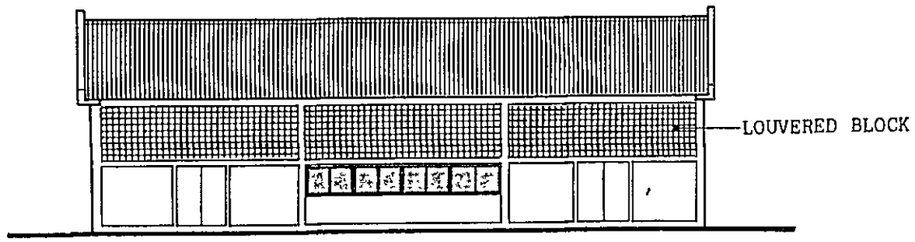
SCALE = 1:200

NO. 15

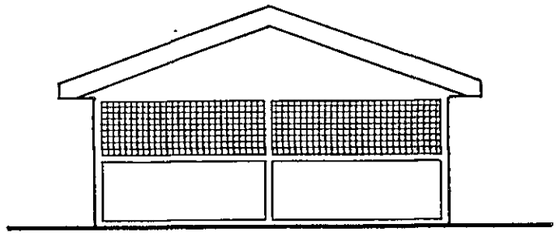




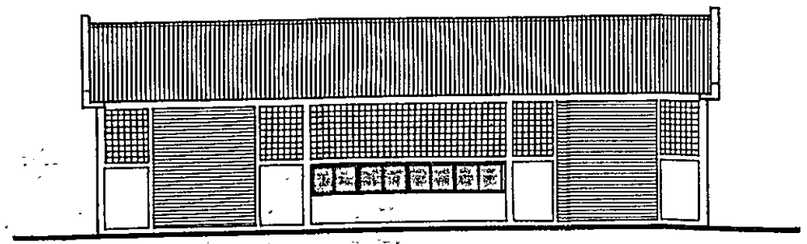
SECTION a - a'



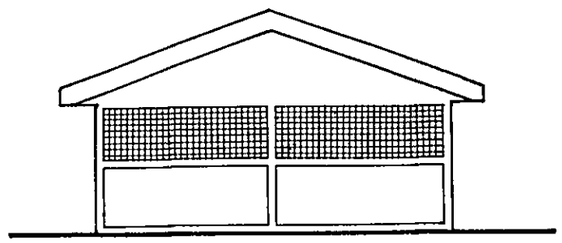
ELEVATION-(A)



ELEVATION-(1)



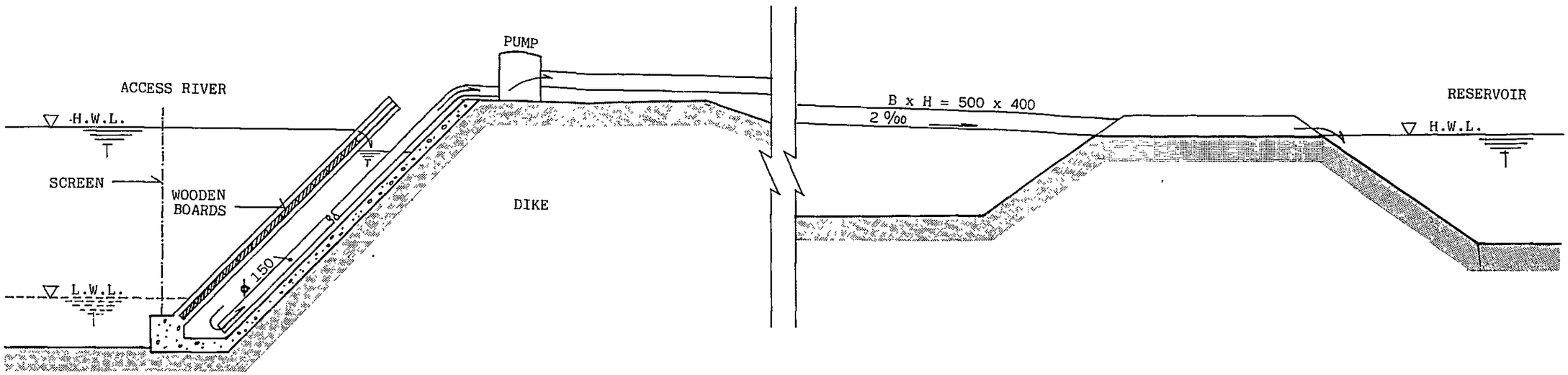
ELEVATION-(C)



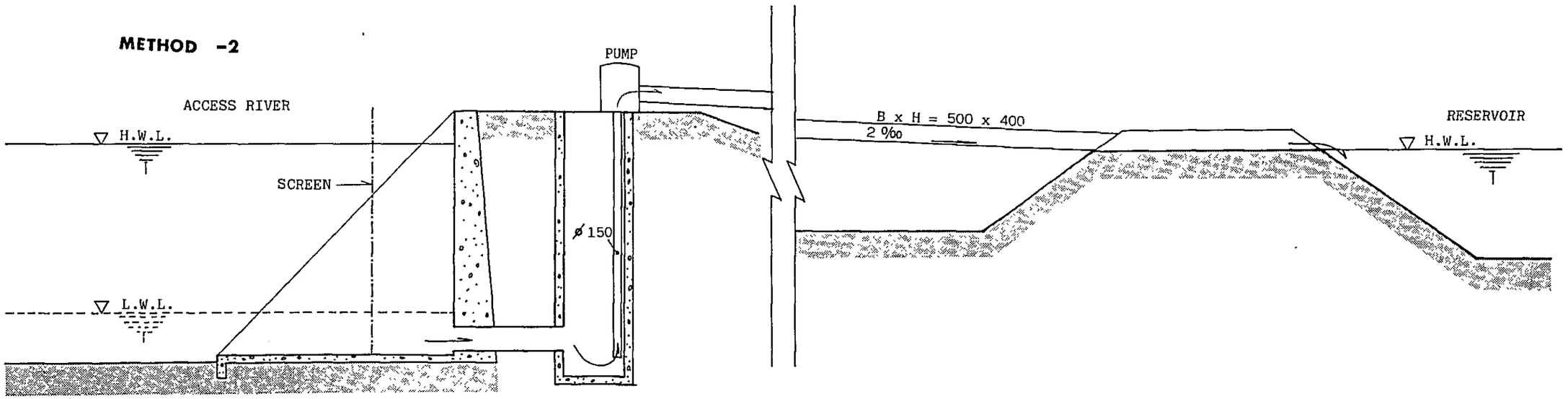
ELEVATION-(6)

HATCHERY — SCALE = 1:200 — NO. 16

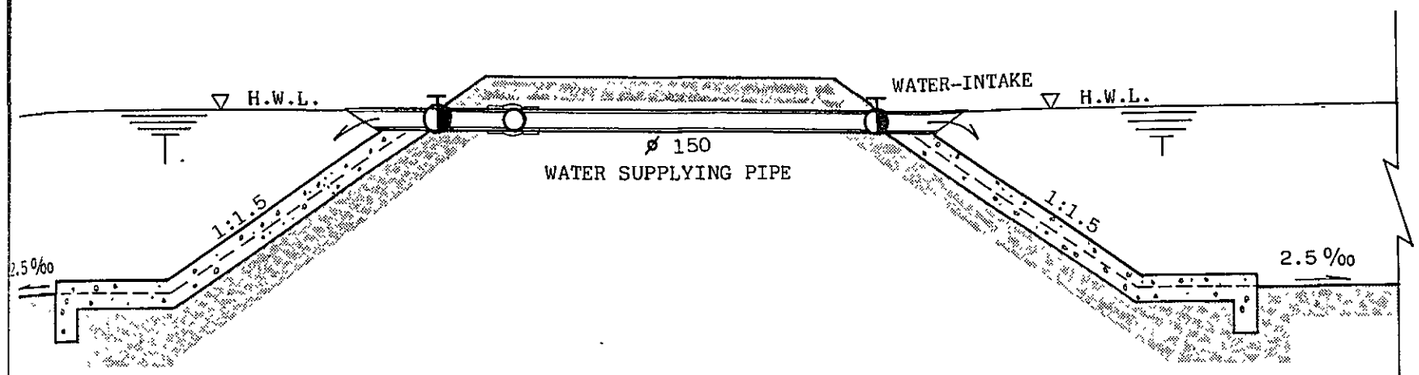
METHOD -1



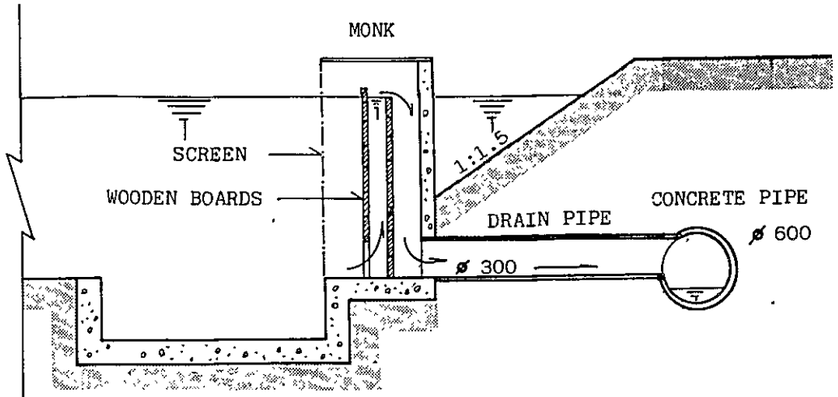
METHOD -2

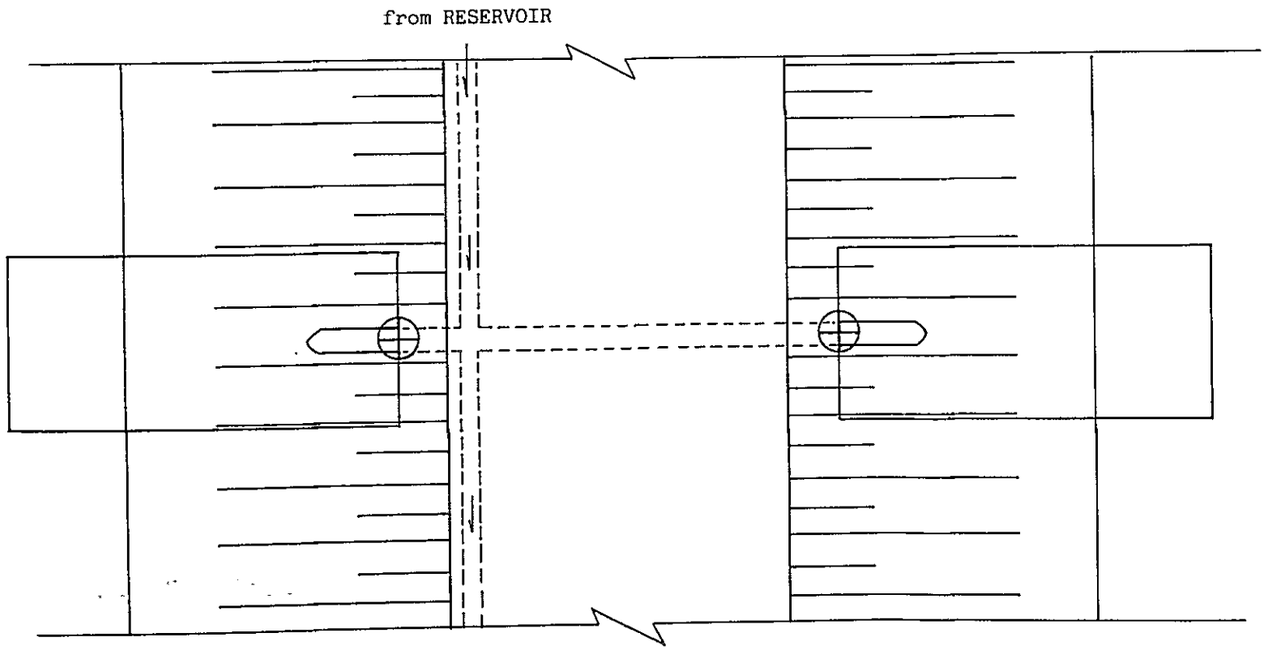


WATER-INTAKE SYSTEM NO. 17

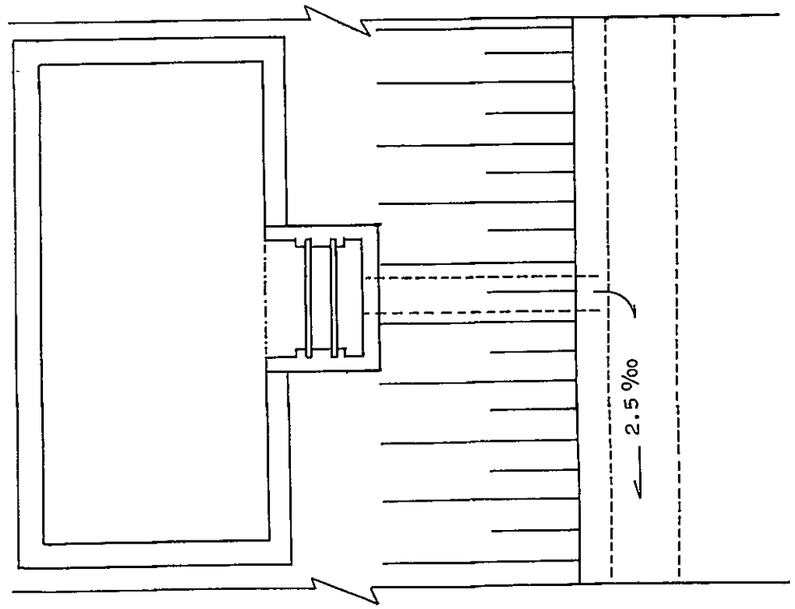


SECTION





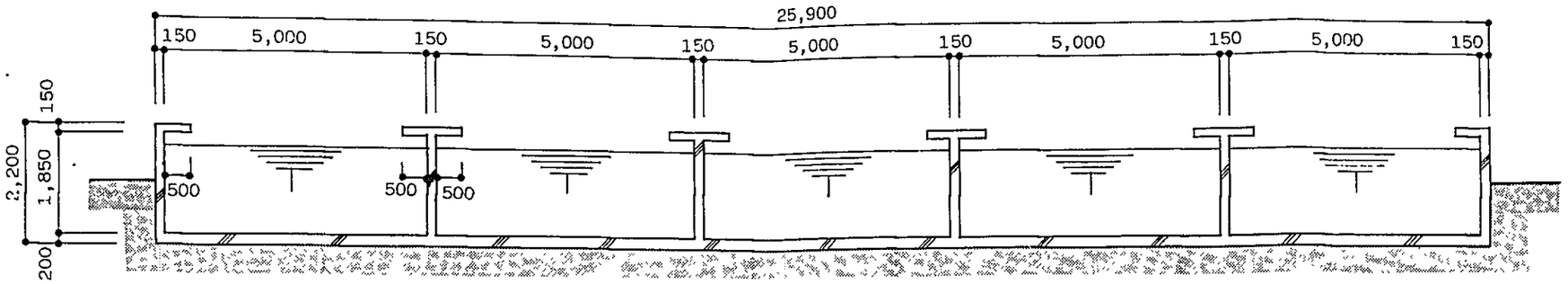
PLAN



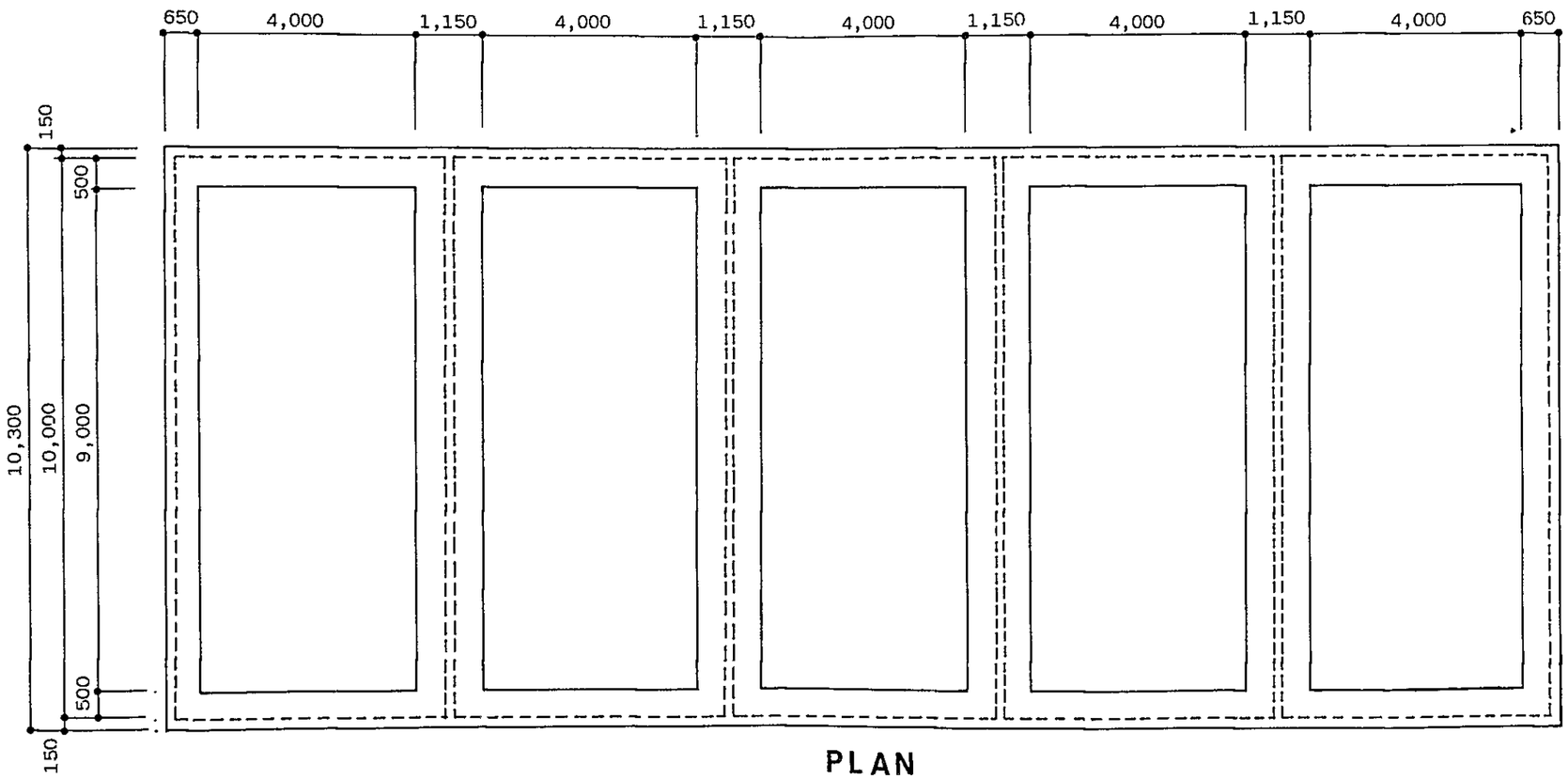
EARTHEN POND

SCALE = 1 : 50

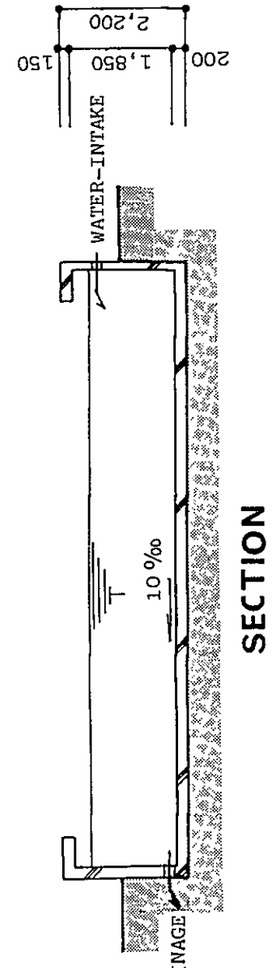
NO.18



SECTION

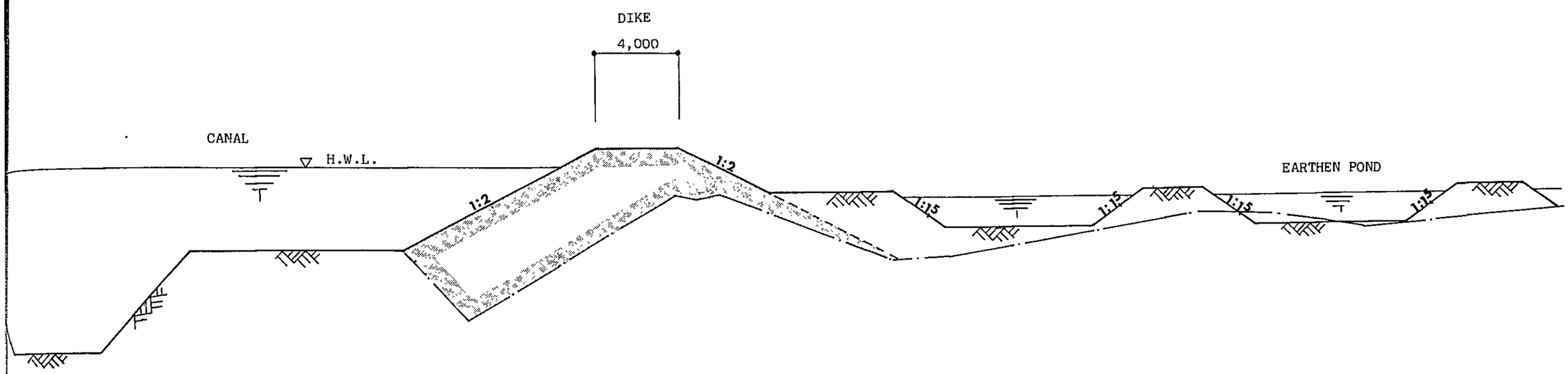


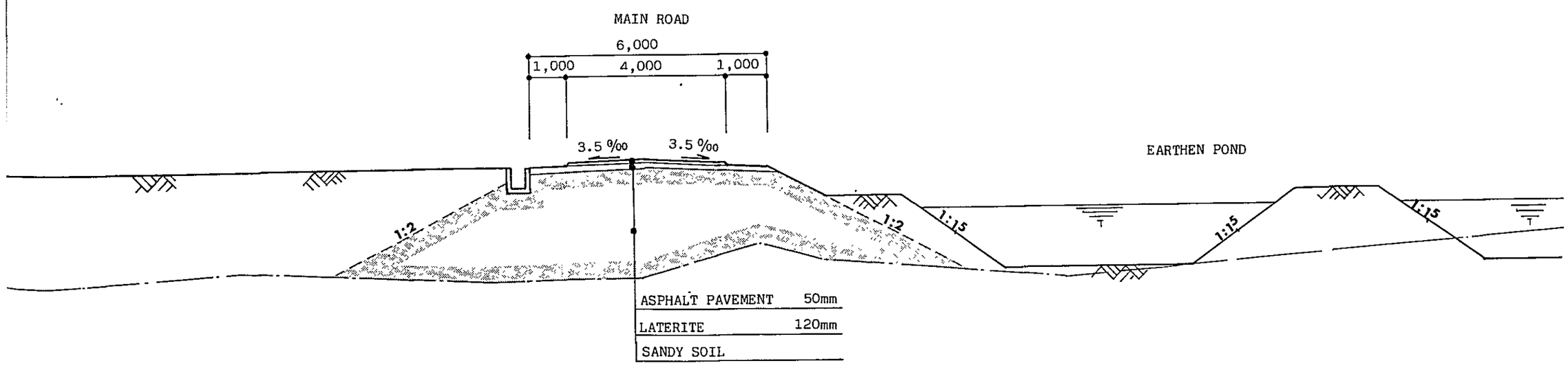
PLAN



SECTION

CEMENT POND — SCALE = 1:100 — NO.19





DIKE & MAIN ROAD — SCALE = 1:100 — NO. 20