3-8 RESEARCH EQUIPMENT PLANNING

3-8-1 Principles

a. The equipment to be provided in each laboratory is selected on the basis of the themes of research which are considered to be taken up as soon as the Center has been commissioned in operation.

b. Research equipment planning is made for the Bangkok Center. The Sakaerat Field Station is to be provided with laboratory tables only.

c. In view that some equipment will be supplied under the Japanese Technical Cooperation which is keeping abreast of the present grant aid, the preference in selection of items is given to those relevant to the buildings and utility services.

d. The research function is concentrated on the 3rd and 4th floors, which is utilized to take such advantages as the equipment can be used for experiment in several laboratories.

e. To assure easy operation and maintenance, preference in selection is given to those which can be easily handled and maintained.

3-8-2 Outline of Equipment

(1) Experimental Equipment

	Item	Quantity	Remarks
1.	Water distiller (glass type)	3	SOL, M-B, B-C
2.	High speed refrigerated centrifuge - special rotor for soil - 10 and 50 ml rotors	 1 1	 SOL B-C
3.	Automatic recording double beam spectrophotometer	1	ANA
4.	Atomic Absorption/flame emission spectrophotometer	1	ANA
5.	Calorimeter	1	ANA
6.	Carbon & Nitrogen analyser	1	ANA
7.	Germinators	3	TRS
8.	Soft X-ray apparatus	1	TRS
9.	Isozyme analyser (Major components; power supplier, small incubator, developer)	1	B-C
10.	Compressor	1	B-C
11.	Vacuum pump	1	B-C
12.	Laboratory washer	1	B-C
13.	Ultrasonic washer	1	B-C
14.	Autoclave	3	M-B, B-C
15.	Water bath w/cooling system	1	M-B
16.	Biological microscope w/photo attachment	1	M-B
17.	Operating microscope	1	M-B
18.	Growth chamber, walk-in type (Medium)	2	G-C
19.	Growth chamber (Small)	2	G-C
20.	Refrigerator	4	SOL, TRS, M-B, B-C

	Item	Quantity	Remarks
21.	Fume hood (special)	1	SOL
22.	Fume hood	3	SOL, M-B, B-C
23.	Sterile transfer hood	3	M-B, T-C
24.	Ice Machine	1	B-C
25.	Freezer	1	B-C
26.	Warburg apparatus	1	B-C
27.	Centrifuge	1	BAY
28.	Photosynthesis measurement set (Major Components: Infrared gas analyzer, gas sampling system, compressor, flow meter, recorder, etc.)	1	G-C
29.	Vaccum packing machine	1	S-P
30.	Kjeldahl digestor and hot plate	1	SOL
31.	Automatic printing thermometer, thermocouple type	1	G-C
32.	Temperature and humidity monitor	1	G-C
33.	Sterilizer, dry type	1	B-C
34.	Top loading balance, small capacity	1	ANA
35.	Cold room with shelves	1	
36.	Photo enlarger	1	PHL
37.	Small dryer	1	PHL
38.	Slide producer	1	PHL
39.	Shelves for sample storage & drying		S-P
40.	Shelves with light		T-C
41.	Specimen stock drawers		SMR
42.	Lab. bench (Center)		
43.	Lab. bench (Side)		
44.	Lab. cabinets		
45.	Work tables		

Item	Quantity	Remarks
46. Sinks		
47. Desks & chairs		
48. Ladder		
(2) Audio-Visual Equipment		
1. Power amplifier	2	
2. Main speaker	2	
3. Wall speaker (Auxiliary)	4	
4. Microphone with desk stand	4	
5. Cassette tape recorder	2	
6. Video tape recorder	2	
7. Monitor TV 20"	2	
8. Slide projector	2	
9. Casette recorder for syncronization of slide projector	1	
10. Movie projector 8mm film, stereo sound	1	
11. Overhead projector	1	
12. Screen 150cm x 150cm stand type	1	
(3) Auditorium		
1. Power amplifier	2	
2. Main speaker	2	
3. Wall speaker	8	
4. Monitor speaker	2	
5. Microphone with desk stand	2	

	Item	Quantity	Remarks
6.	Microphone with floor stand	2	
7.	Wireless microphone	2	
8.	Wireless antenna	2	
9.	Wireless receiver for 2 channels	1	
10.	Cassette tape recorder	2	
11.	Audio control mixer	1	
12.	Microphone receptacle	2	
13.	Speaker receptacle	2	
14.	Movie projector 16mm film, stereo sound	1	
15.	Slide projector	2	
16.	Overhead projector	1	
17.	Main screen, motor-driven type	1	

(4) Seminar Room

1.	Overhead projector	1	
2.	Screen	1	

The equipment listed above is to be further studied in detail to meet the requirements for research through the discussions with the officials concerned for this project at the implementation stage.

3-8-3 Service Systems Related to Research Equipment

a. Water for experimental use will be obtained at the laboratory sections locally with a water distiller or deionizer where required.

b. Cylinders of special gases for experimental use will be installed outside near the demand point.

c. Service outlets for research equipment will be provided in each laboratory. Service outlets and switch boxes with grounding for research equipment will also be provided where necessary.

CHAPTER 4: PROJECT IMPLEMENTATION

CHAPTER 4: PROJECT IMPLEMENTATION

It is anticipated that this Project will be implemented under the Japanese grant aid in accordance with the procedures set out by the Japanese Government. In that case, certain items of the work must be carried out by the Thai side in parallel with the work performed under the grant aid, and the former must be integrated with the latter. The work to be done by the Thai side is outlined in this report, but the details of such work must be determined through discussion as the implementation of the Construction makes progress.

4-1 SCOPE OF WORK

The Japanese Government will prepare the budget, in the way of grant aid, for the detailed design and supervisory services and the construction of the Central Forest Research Laboratory and Training Center in the Compound of the Royal Forest Department in Bangkok and the construction of the Sakaerat Field Station in Sakaerat whereas the Government of Thailand will prepare sites and provide necessary elements of infrastructure, furniture, etc. at both Bangkok and Sakaerat and will operate the Center and undertake maintenance of the facilities after completion. The items of the work assigned to each side are as indicated on Fig. 4-1-1.

4-2 TENTATIVE OVERALL SCHEDULE

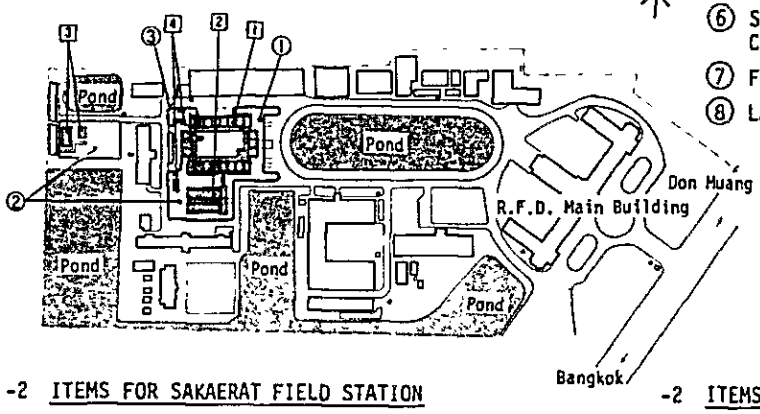
If it is assumed that the present Project is implemented according to the procedures normally followed in the Japanese Government's grant aid programs, the progress chart as indicated on Fig. 4-2-1 is considered. The works assigned to the Thai side should of course be implemented according to the schedule if this schedule is to be complied with.

ITEMS TO BE PROVIDED BY JAPANESE GOVERNMENT

-1 ITEMS FOR BANGKOK CENTER

1. CENTER BUILDING
2. AUDITORIUM
3. GLASSHOUSES
4. OUTDOOR FACILITIES
5. RESEARCH EQUIPMENT

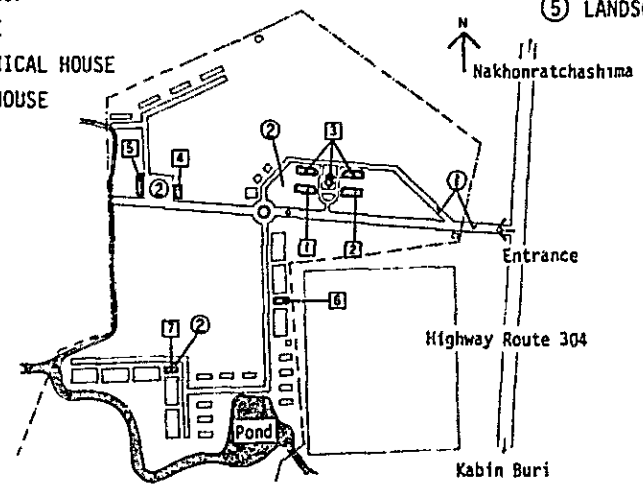
BANGKOK SITE



-2 ITEMS FOR SAKAERAT FIELD STATION

1. ADMINISTRATION AND TRAINING BLDG.
2. LABORATORY
3. DORMITORIES AND CAFETERIA
4. WORKSHOP
5. GARAGE
6. MECHANICAL HOUSE
7. GLASSHOUSE

SAKAERAT SITE



-3 PROJECT IMPLEMENTATION

1. DESIGN AND SUPERVISION
2. CONSTRUCTION

ITEMS TO BE PROVIDED BY THAI GOVERNMENT

-1 ITEMS FOR BANGKOK CENTER

① REMOVAL OF EXISTING SHED, UNDERGROUND OIL TANK AND OTHER OBSTACLES
② LANDFILL AND GRADING
③ REPLACEMENT OF EXISTING ROAD
④ SOIL TEST
⑤ UTILITY SERVICES ELECTRICITY, WATER, TELEPHONE, DRAINAGE AND SEWAGE
⑥ SPACE FOR TEMPORARY FACILITIES FOR CONSTRUCTION USE
⑦ FURNITURE (FOR ADMIN., ETC.)
⑧ LANDSCAPING

-2 ITEMS FOR SAKAERAT FIELD STATION

① ACCESS AND APPROACH ROAD CONSTRUCTION
② LAND FILLING, CUTTING AND GRADING
③ UTILITY SERVICE SUPPLY & CONNECTION
④ FURNITURE (FOR ADMIN., ETC.)
⑤ LANDSCAPING

-3 PROJECT IMPLEMENTATION

① NECESSARY PROCEDURAL MATTERS FOR CUSTOMS CLEARANCE, INTERNAL TRANSPORTATION, ETC.
② FORMATION OF PROJECT IMPLEMENTATION
③ MAINTENANCE OPERATION AND RUNNING COST FOR FACILITIES

Fig. 4-1-1 Scope of Works Provided by Both Governments

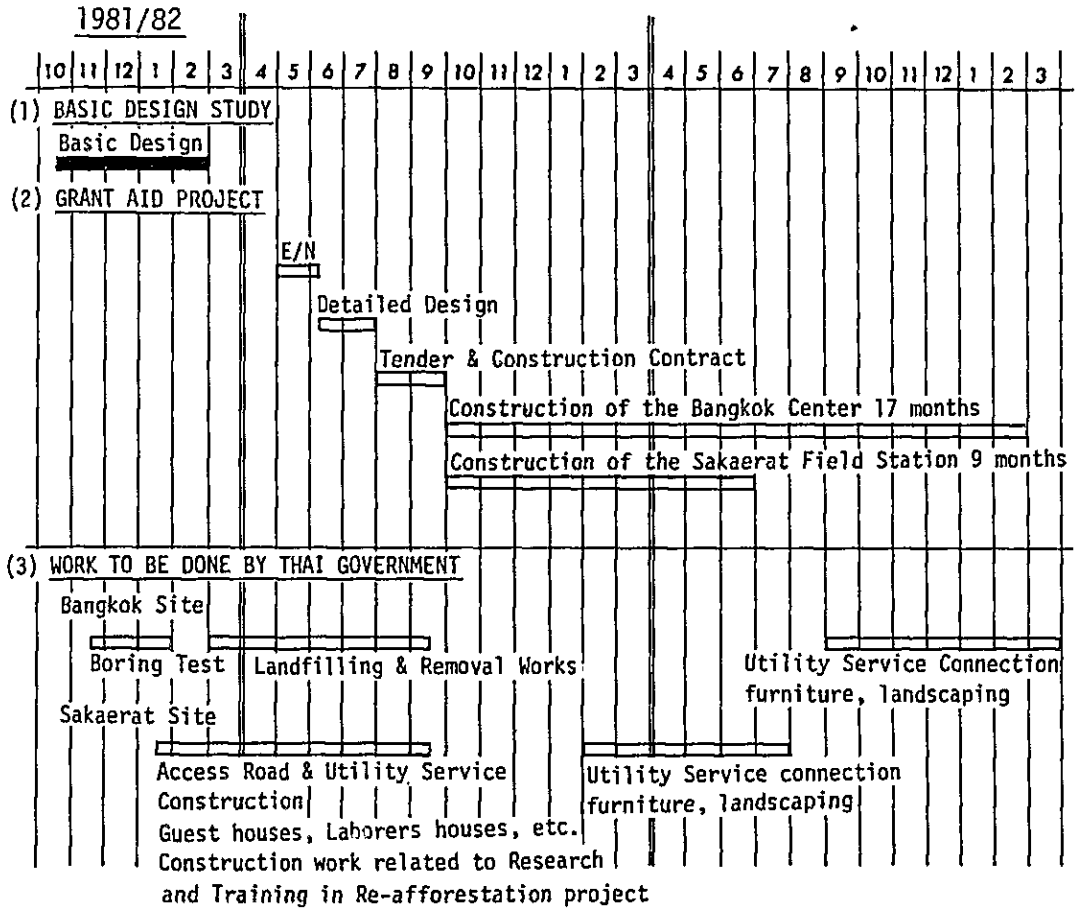


Fig. 4-2-1 Tentative Overall Schedule

Notes:

1) The Exchange of Notes was assumed to be concluded in middle of June.

2) The construction period is considered to be 17 months starting from October for the Bangkok Center and 9 months for the Sakaerat Field Station because of expectation for early utilization.

3) Further discussions will be needed with the Thai side on the arrangements as to the construction schedule of the work to be done by the Thai side as the Project progresses.

4-3 OPERATION AND MAINTENANCE

Upon the completion and taking-over to the Thai side, the completed facilities will be operated and maintained at the responsibilities of the Thai side. The following is the operation and maintenance scheme on which the present project program is predicated.

4-3-1 Running Cost

(1) Electricity : 1,692,180 Bahts/year

Demand charge : 700 KVA x 0.8 KW/KVA x 0.5 x 12 months x 98 Bahts/month = 329,280 Bahts/year

Energy charge : 1,362,900 Bahts/year

a. Plant Specimen 30 KW x 24 hr/day x 365 days/year x 1.54 Bahts/KWH = 404,712 Bahts/year

b. Growth chamber 50 KW x 24 hr/day x 365 days/year x 1/2 x 1.54 Bahts/KWM = 337,260 Bahts/year

c. Other loads 200KW x 8 hr/day x 21 days/month x 12 months x 1.54 Bahts/KWM = 620,928 Bahts/year

a + b + c = 1,362,900 Bahts/year

(2) Water : 22,680 Bahts/year

$20m^3$/day x 21 days/month x 12 months x 4.5 Bahts/m^3 = 22,680 Bahts/year

(3) Gas : 56,760 Bahts/year

10 pcs/month x 12 months x 473 Bahts/pcs = 56,760 Bahts/year

(4) Oil for Generator : 29,800 Bahts/year

2 hr/week x 4 times/month x 12 months x 150 KVA x 0.8 x 0.35ℓ/KWH x 7.39 Bahts/ℓ= 29,800 Bahts/year

(5) Telephone : α

(6) Special Gas : β

Net Running Cost : Approx. 1,800,000 Bahts/year

4-3-2 Maintenance of the Facilities and Equipment

(1) Buildings

For the effective service, buildings will inevitably involve routine clearning and other ways of maintenance, and, in addition, repairs of abrasions, breakages and deterioration occuring with the passage of time. In order, for the present project buildings, to keep the effective life for 30 years, such repairs and maintenance will relate mainly to the inside and outside finishes, including partial remodeling, but will not be required for the structural components themselves. Repairs and some replacement are predictable, in the outside, for the roofing, exterior wall, and doors/windows, and, in the inside, for the ceiling boards to be replaced, paint finish to be redone, floor vinyl tiles to be replaced, wood doors/windows to be adjusted or replaced, etc.

Remodeling will turn on changes in the usage of building facilities or modes of operation, such as increase in the staff number.

With respect to daily routine maintenance, the facilities should preferably be maintained with due care and frequently cleaned up. Minor repairs should be undertaken by a few workers being stationed there. The candidate workers may include at least one engineer, one carpenter, one painter or two, and five or so scrub workers.

(2) Utility Service Systems

Coverable scope includes the electrical, air-conditioning, plumbing, sanitary and elevator systems. For repairs as well as daily maintenance, about 4 engineers and 6 technicians, that is, about two to three times the number required in Japan, seem to be required.

Respective items of equipment have its own life cycle and accordingly need to be repaired or replaced. If the period is taken as 30 years compatibly with the building, replacement may be required one to a few times. For reference, such life cycles are listed below.

Electrical Equipment

Generator	15 - 20 years
Panel Board	20 - 30 "
Fluorescent Lamps	5,000 - 10,000 hours
Incandescent Lamps	1,000 - 1,500 "
Telephone Exchange	40 years
Public Address System Equipment	10 - 20 years
Elevator	20 years

Plumbing Equipment

Pump	15 - 20 years
Tank	"
Pipes & Valves	18 - 20 "
Plumbing Fixtures	25 years
Fire Extinguisher	20 "
Gas Equipment	6 "
Sewage Treatment Equipment	7 "

Air Conditioning Equipment

Pipes	10 - 20 years
Fans	15 - 18 "
Air Conditioners	10 - 15 "

(3) Research equipment

Generally, researchers, operators and maintenance engineers must be well-organized for the effective use of the research equipment. Though the researchers will be given an opportunity to acquaint themselves with the required techniques through the technical cooperation to be performed, keeping abreast of the present grant aid, there still remains a problem regarding the maintenance and repair of machines, that is, how the operators/maintenance engineers are secured. In the operation, simple types of equipment may be handled by the researchers themselves, but the equipment involving complicated mode of operation has to be handled by the expert operators exclusively assigned for it. These operators should fully master the operation techniques and be stationed in laboratories. For these reasons, the Thai side may be requested to establish the arrangement to provide for the operation training and staff assignment in a way to bring the project benefits to the best advantage.

Next come the maintenance engineers problems. According to the survey mission's review and findings at similar institutions, the maintenance practice commonly followed in Thailand is that a maintenance engineer is stationed and exclusively engaged in the maintenance together with a few technicians whose task includes the repair and maintenance of building facilities. In doing so, any insurmountable problem is referred to a sales agent of the equipment. It may be advisable to enter the maintenance agreement with the agent for periodic inspection of the equipment, though this way of maintenance seems unusual.

Where the project is implemented under the Japanese grant aid, most of the equipment items will be of Japanese make. In planning equipment supply, those which are easy to operate and maintain will be selected; however, growth chamber and other some items are inherently destined to fail to last for a long period of time unless sufficiently maintained. Then, the daily inspection by a maintenance engineer cannot be dispensed with. This is to mean that utmost efforts should be made to effect the regular inspection, keeping in mind the importance of preventive maintenance, without relying on the repair by an agent upon ultimate failure in operation. For this project, three engineers, one each of electric, electronic and mechanical engineering disciplines, and three technicians, one each subordinated to the former may be required. (At the same time, they can work for the maintenance of the utility service systems.)

4-3-3 Replacement of Service Systems and Equipment

Unavoidably, equipment and provisions will involve replacement because of becoming deteriorated with the passage of time, in case of research equipment, of advancement of research level, increased research items, improvement in equipment itself. Without regard to these considerations, it will be impossible to maintain the required function of the Center for a long time. In order to provide for such facts, it will be indispensable to make regular check and efforts to cope with newly emerging situation.

4-3-4 Budgeting of Running and Maintenance Costs

For a period of 30 years after completion of the project, the running, maintenance and repair costs both for building and equipment items are roughly predicted on an annual budget basis as follows.

Running Costs	1,800,000 Bahts/year
Maintenance Costs	756,000 Bahts/year
Repair Costs	1,450,000 Bahts/year
Total	4,006,000 Bahts/year

(Based on the current prices as of October 1981)

Data

1) The running costs are as in para. 4-3-1.

2) Maintenance costs are predicted, all taking as personnel expenses for maintenance staff.
(The personnel expenses are established by analogy.)

Engineer 5,000 Bahts/man. month x 5 personnel x 12 moths
= 300,000 Bahts/year

Technician 3,500 Bahts/man.month x 8 personnel x 12 months
= 336,000 Bahts/year

Scrub
Worker 2,000 Bahts/man.month x 5 personnel x 12 months
= 120,000 Bahts/year

3) The repair costs will be inconstant with the number of years. For instance, the repairs will cost yearly 2 Bahts/m^2 for the buildings and 10 Bahts/m^2 for the service systems, both until around the fifth year from the construction completion, but thereafter being on the sharp increase. Here, for the purpose of cost estimation, the yearly average repair costs are estimated at 50 Bahts/m^2 for the buildings and 100 Bahts/m^2 for the service systems constantly for the period of 30 years.

$$(50 + 100) \text{ Bahts/m}^2 \times 7{,}000 \text{ m}^2 = 1{,}050{,}000 \text{ Bahts/m}^2$$

Though variable depending upon the frequency of use, the equipment repairs are estimated to cost roughly 2 % of the initial costs.

Then, setting aside the management costs including the salary expenses for researchers, etc., about four million Bahts per year will be required for operating and maintaining the Center. In addition, if research equipment and utencils are wholly replaced once every ten years, another about 20 million Bahts may be required.

CHAPTER 5: PROJECT APPRAISAL

CHAPTER 5: PROJECT APPRAISAL

5-1 JUSTIFICATION AND EFFECTS OF THE PROJECT

The justification and effects of the establishment for the Central Forest Research Laboratory and Training Center under a Japanese grant aid will be assessed from the following angles.

1) The present Center Project is expected to secure the growing wood stock and increase the forest area, both of which are a key policy in the 5th National Social and Economic Development Plan now enforced by the Thai Government. Currently, the research on silviculture techniques for promoting afforestation is in progress at various fields in Thailand. Upon the completion, the Center will serve as a core institution for the nation-wide research activities so that the fundamental studies on silviculture techniques are deepened and expanded to provide researchers scattering across the country with an opportunity to avail themselves of effective means of study.

2) The Center has the bi-function as facilities for practical training related to desk training to be undertaken by the Bangkok Center and field training by the Sakaerat Field Station. Thus, it will provide those engaged in silviculture industry including inter alia, regional forestry officers with the field of practical study, thereby lending an impetus to the national afforestation.

3) By constructing the research center well-equipped with updated installations in the national capital, the Bangkok Center becomes more advantageous in recruiting talented researchers whereby insuring the bright prospect of the future afforestation activities.

4) The Sakaerat site is very satisfactory as a place for implementing research and training which are closely related with field practice.

Moreover, the site has a strategic advantage in that it provides chances to show through demonstration the real merits of afforestation efforts to the local inhabitants, particularly those who are engaged in burning agriculture, thereby helping to convince them of the importance of afforestation.

5) The realization of this Project will promote afforestation activities and thereby help achieve the annual target area in afforestation efforts. This in turn, will serve the purpose of national land protection and in consequence contribute not only to the happiness of local people but also to the national economic growth.

6) At this time, Japanese technical cooperation in connection with re-afforestation is being implemented. If the present grant aid project is implemented at the same time as such technical co-operation project, the effects of either project will be hightened and the achievements thus made will greatly contribute to the amity between Thailand and Japan.

5-2 PROPOSITION AS TO THE MANAGEMENT OF THE CENTER

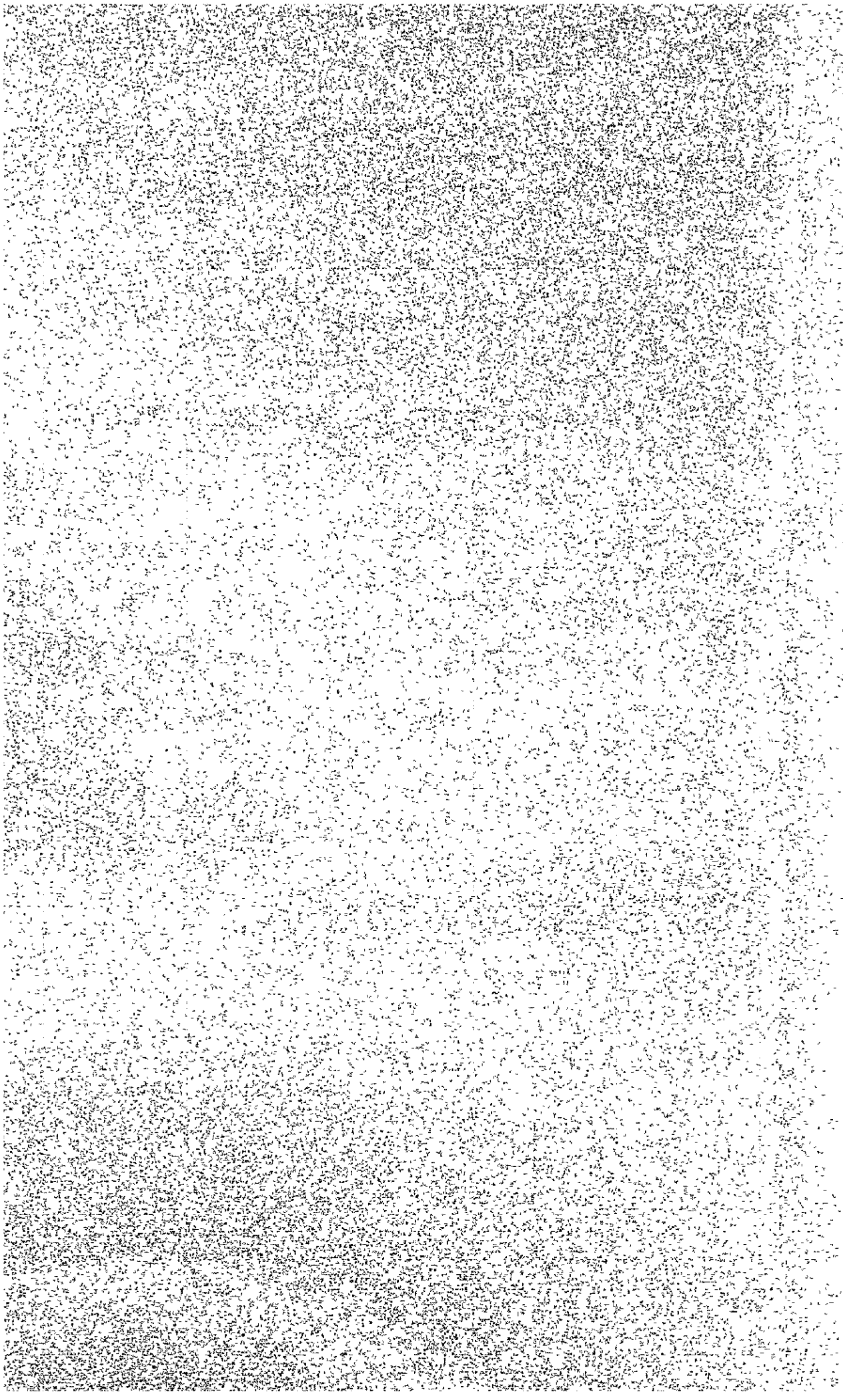
The management of this Center has been briefly discussed in Chapter 4 in connection with the maintenance. The subject will be discussed here again in some detail because great managerial responsibility must be fulfilled by the Thai side for satisfactory operation. The survey mission expects that the Thai side will observe the following:

1) According to the Thai side, the proposed Center is to serve as research institutions subordinated to Silviculture Division of R.F.D. at this moment. However, the authorities are now desirous that in the near future, these research institutions be the headquarters for research activities under direct command of the Director of R.F.D. This Center is anticipated to substantial annual budget continuously for the management, operation and maintenance after the completion of the Project. The strict budget control in Thailand, as the Thai side is worried, is liable to cause difficulties in securing reasonable budget if the Center remains the research facilities of Silviculture Division. In view of this, it is suggested that the management be shifted to the desired one at the earliest possible time.

2) While it is true that research in science and technology in these recent years has become increasingly dependent on mechanical equipment, it should basically be recognized that research in essence is governed by human capabilities. With this recognition in mind, the management should take constant care in promoting the qualitative level of the research staff and should provide technical and maintenance personnel with sufficient opportunities to undergo training and education, utilizing effectively the Japanese technical cooperation to advantage.

3) In view that the Center will maintain a number of expensive tools and equipment, special care needs to be exercised in facility administration to prevent thefts and losses.

CHAPTER 6: BASIC DESIGN DRAWINGS



CHAPTER 6: BASIC DESIGN DRAWINGS

CENTRAL FOREST RESEARCH LABORATORY AND TRAINING CENTER

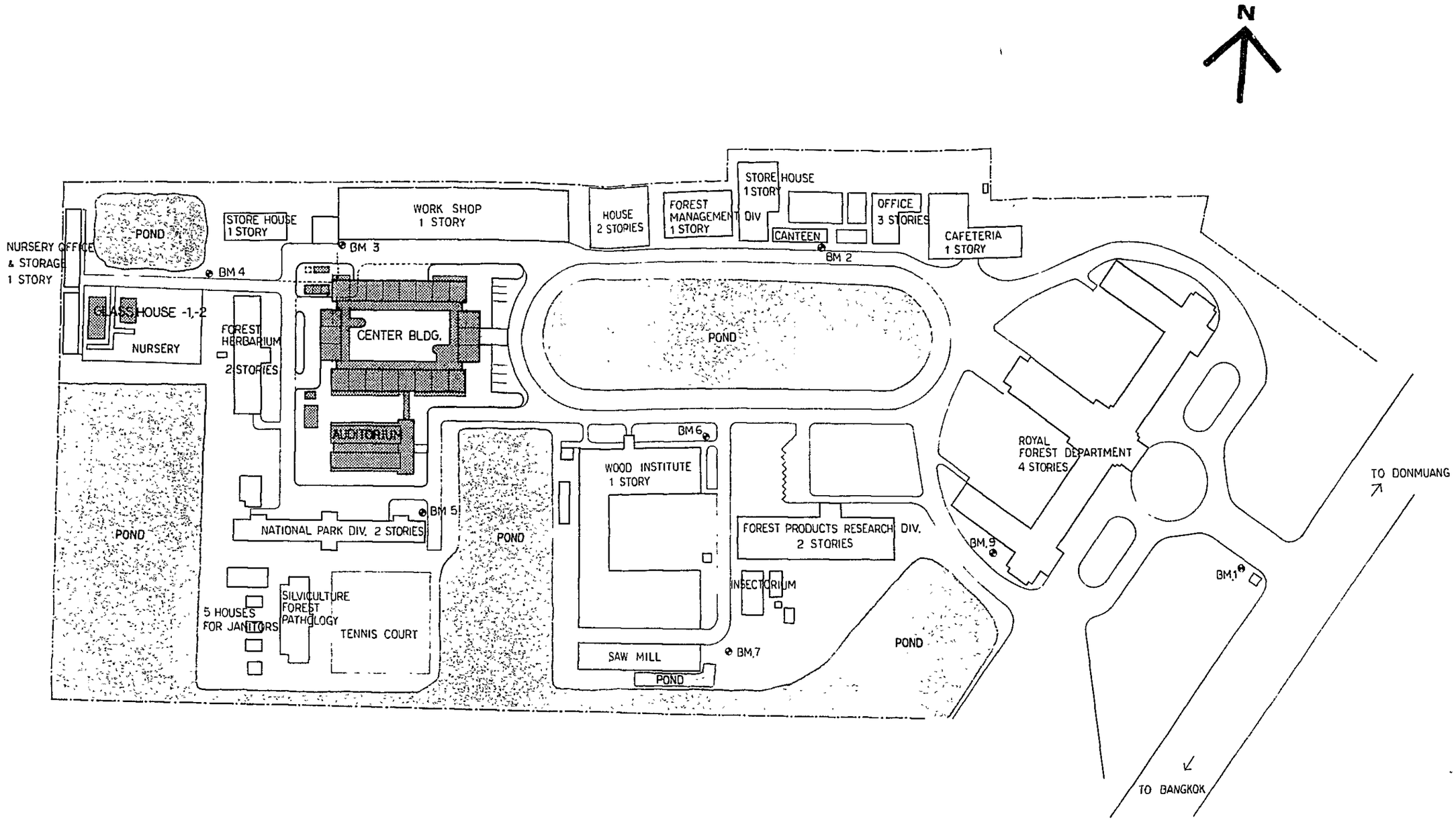
LIST OF BASIC DESIGN DRAWINGS

BANGKOK CENTER

1.	BANGKOK CENTER	LOCATION MAP
2.	BANGKOK CENTER	SITE PLAN
3.	CENTER BLDG.	1ST FLOOR PLAN
4.	CENTER BLDG.	2ND FLOOR PLAN
5.	CENTER BLDG.	3RD FLOOR PLAN
6.	CENT R BLDG.	4TH FLOOR PLAN
7.	CENTER BLDG.	ROOF AND PH. PLANS
8.	CENTER BLDG.	ELEVATIONS AND SECTIONS
9.	AUDITORIUM	PLANS, ELEVATIONS AND SECTIONS
10.	GLASSHOUSE -1, -2	PLANS, ELEVATIONS AND SECTIONS

SAKAERAT FIELD STATION

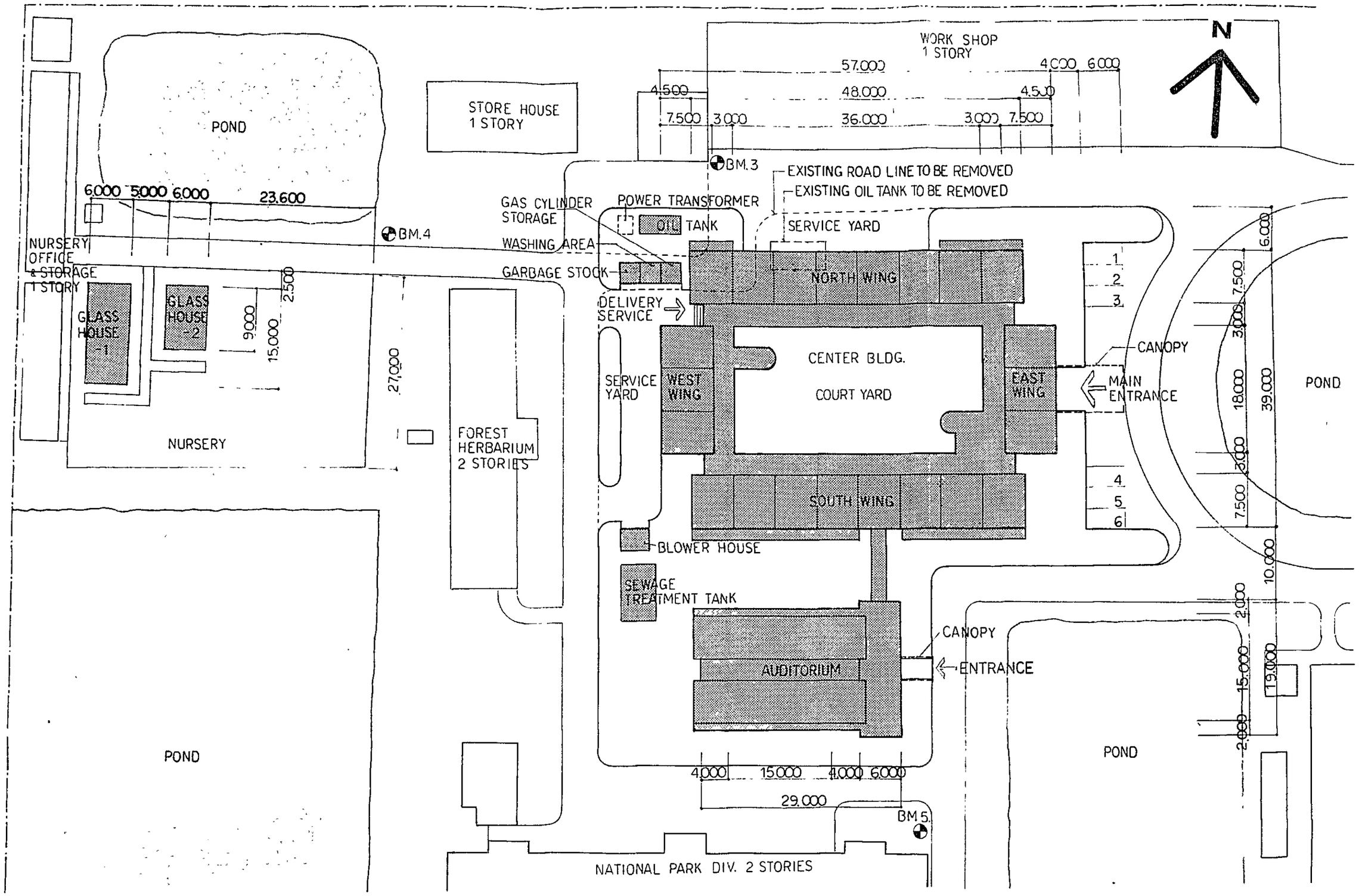
11.	SAKAERAT FIELD STATION	SITE PLAN
12.	ADMINISTRATION AND TRAINING BLDG., LABORATORY, DORMITORY -1, -2, CAFETERIA	1ST FLOOR PLANS
13.	ADMINISTRATION AND TRAINING BLDG., LABORATORY, DORMITORY -1, -2	2ND FLOOR PLANS
14.	ADMINISTRATION AND TRAINING BLDG., LABORATORY, DORMITORY -1, -2, C FETERIA	ELEVATIONS AND SECTIONS
15.	WORKSHOP, GARAGE, MECHANICAL HOUSE, GLASSHOUSE	PLANS, ELEVATIONS AND SECTIONS



LOCATION MAP 1 : 2000

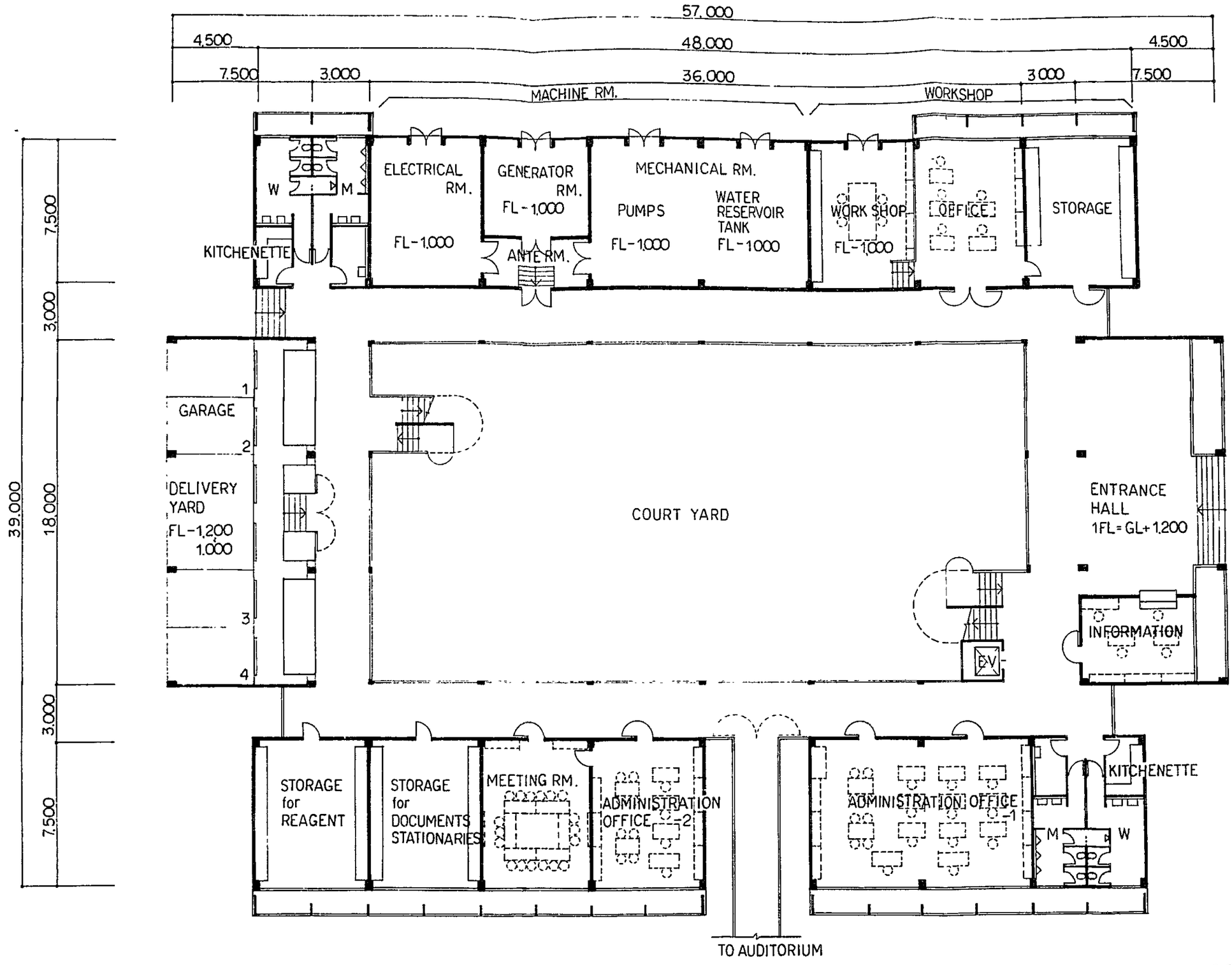
BANGKOK CENTER
LOCATION MAP

1



SITE PLAN 1 : 500

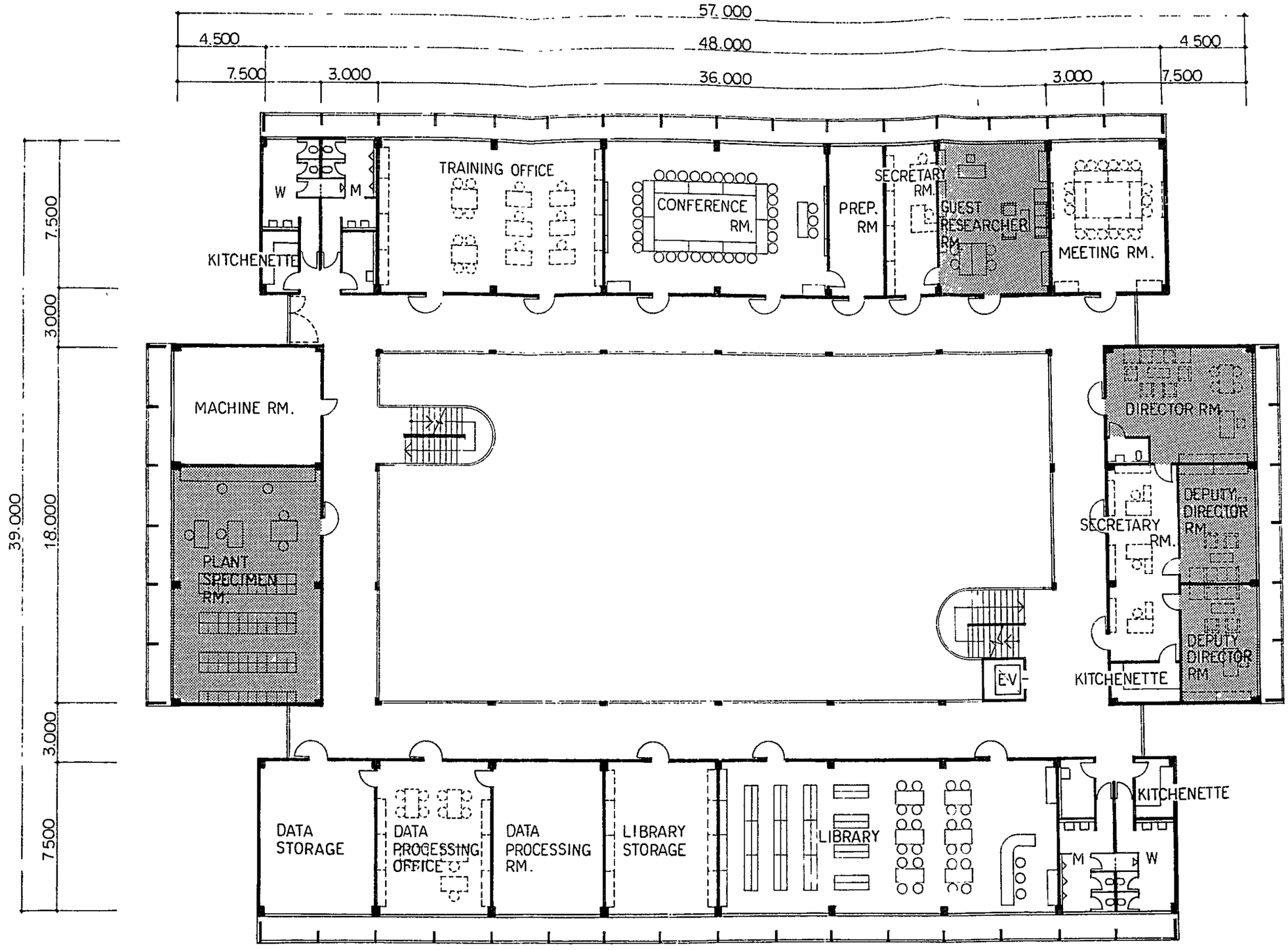
BANGKOK CENTER
SITE PLAN 2



1ST FLOOR PLAN 1 : 200

CENTER BLDG
1ST FLOOR PLAN

3

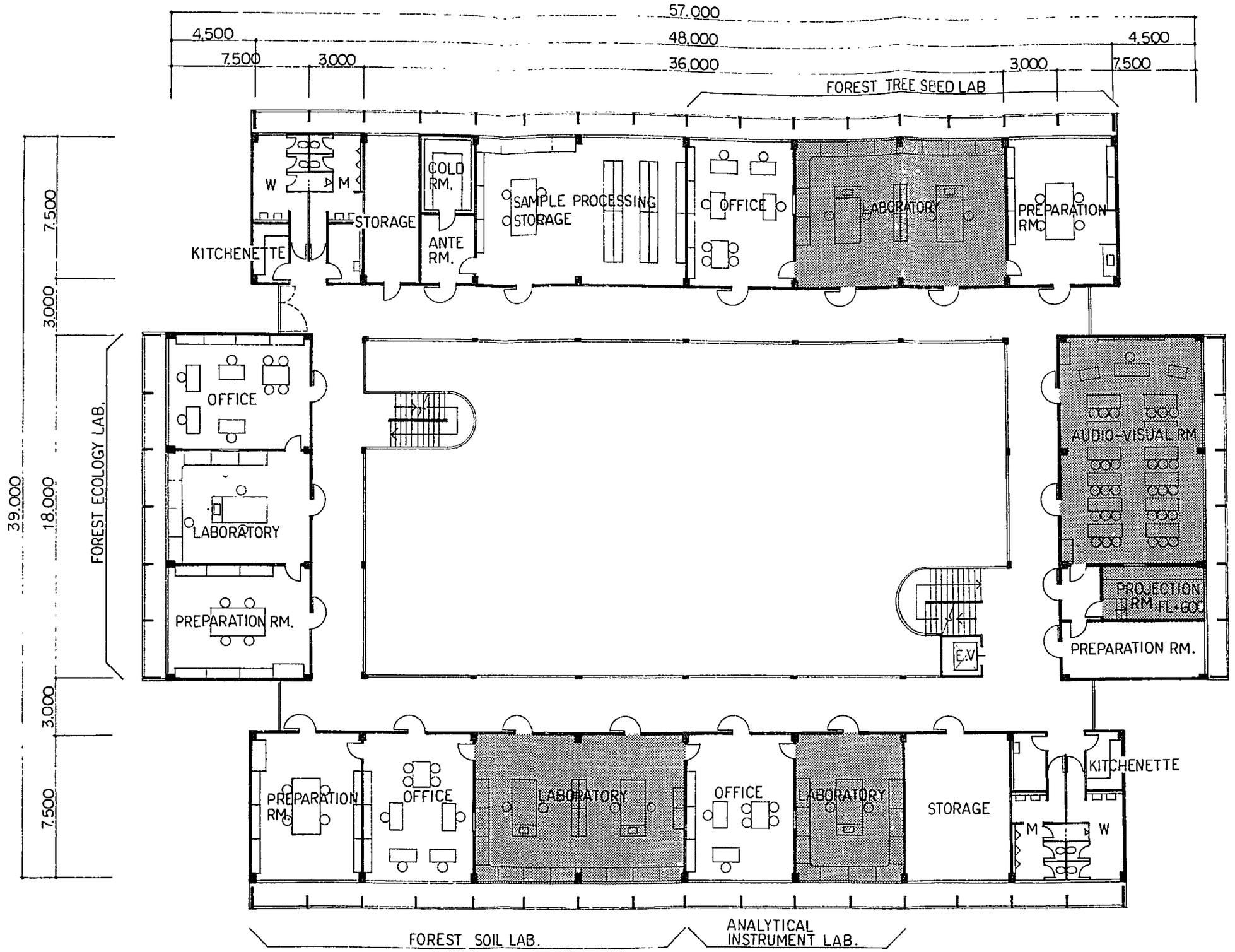


NOTES: ▒▒ ROOMS TO BE PROVIDED WITH AIR-CONDITIONING SYSTEM

2ND FLOOR PLAN 1 : 200

CENTER BLDG
2ND FLOOR PLAN

4

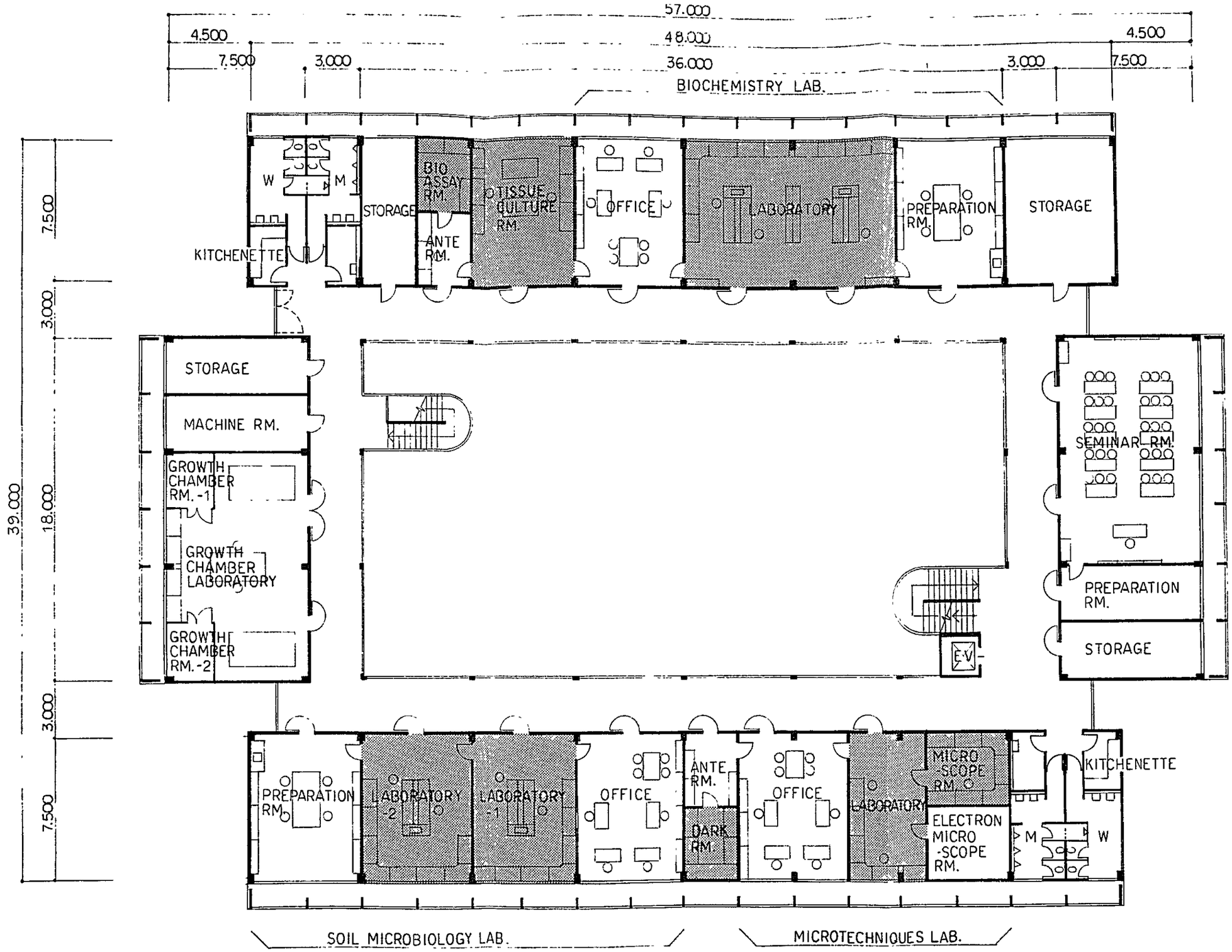


NOTES : ▒▒ ROOMS TO BE PROVIDED WITH AIR-CONDITIONING SYSTEM

3RD FLOOR PLAN 1 : 200

CENTER BLDG
3RD FLOOR PLAN

5



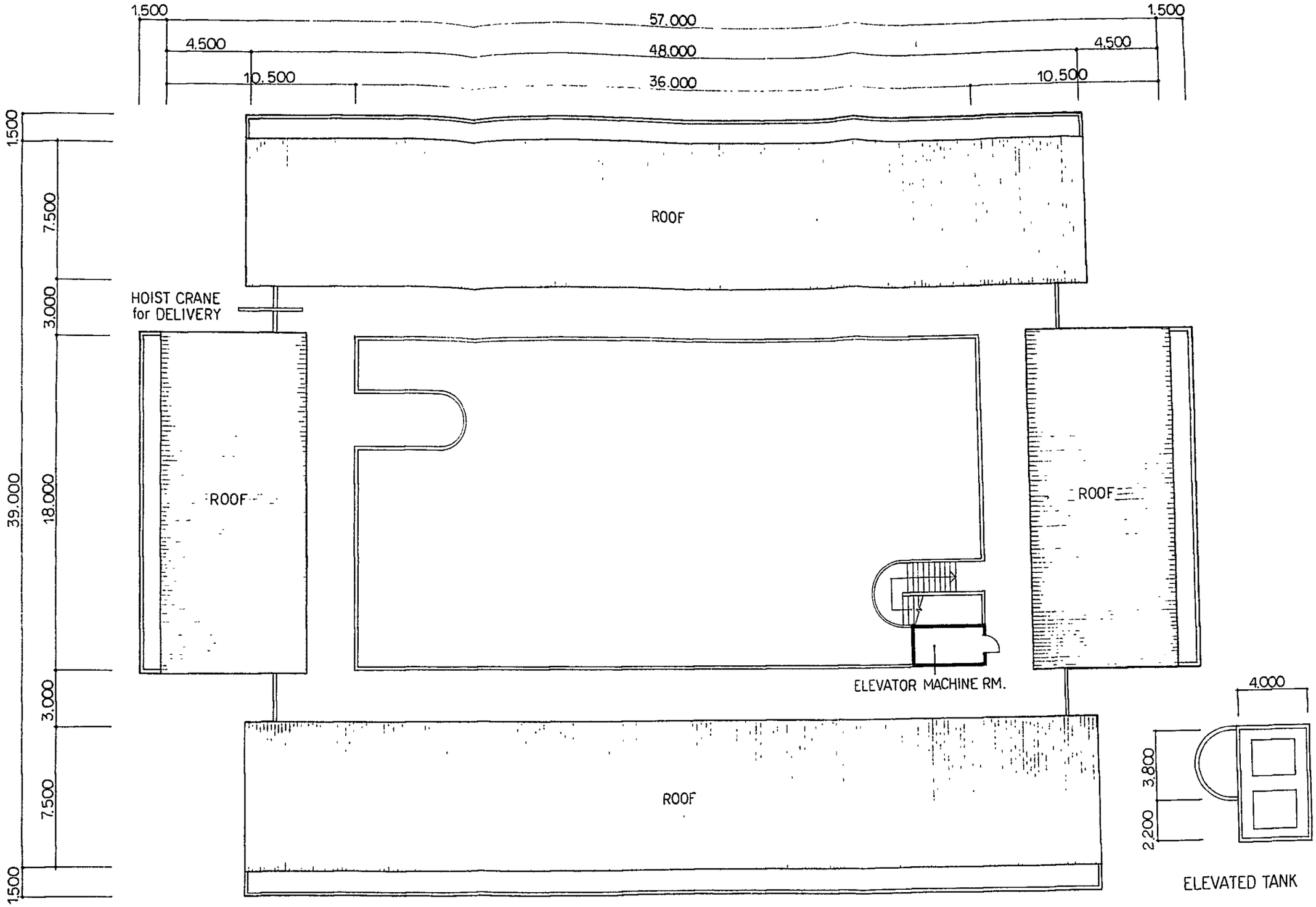
NOTES: ▒▒ ROOMS TO BE PROVIDED WITH AIR-CONDITIONING SYSTEM

4TH FLOOR PLAN 1 : 200

CENTER BLDG

4TH FLOOR PLAN

6

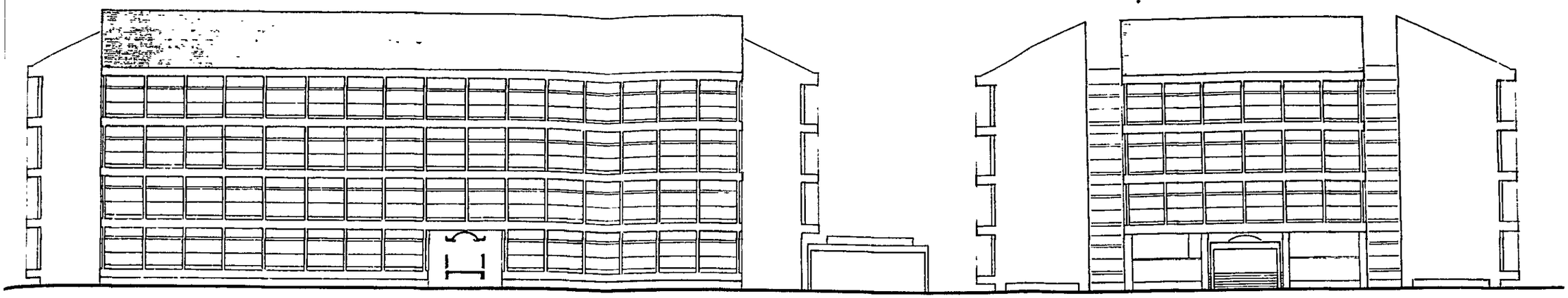


ROOF & PH. PLAN 1 : 200

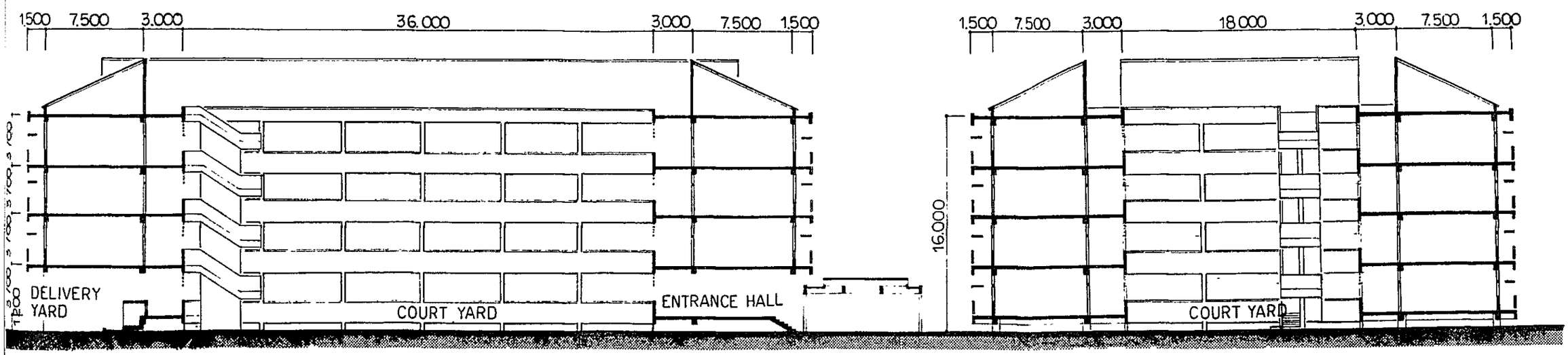
CENTER BLDG

ROOF AND PH PLAN

7



CENTER BLDG ELEVATIONS 1 : 300

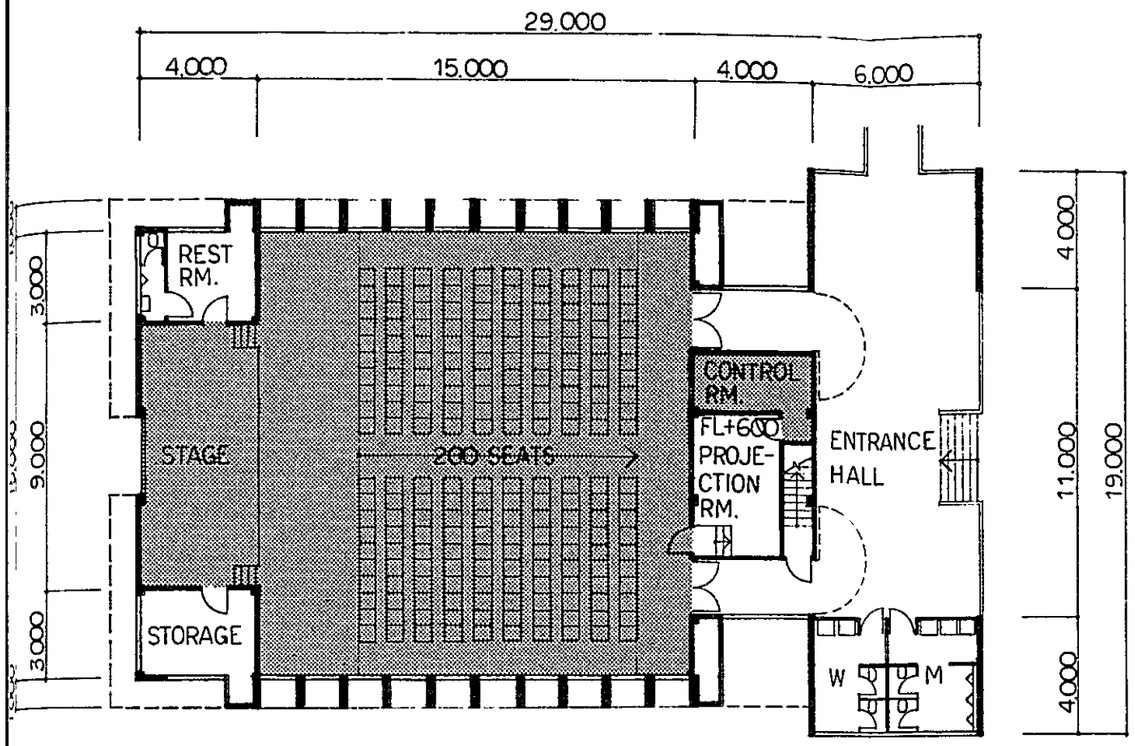


CENTER BLDG SECTIONS 1 : 300

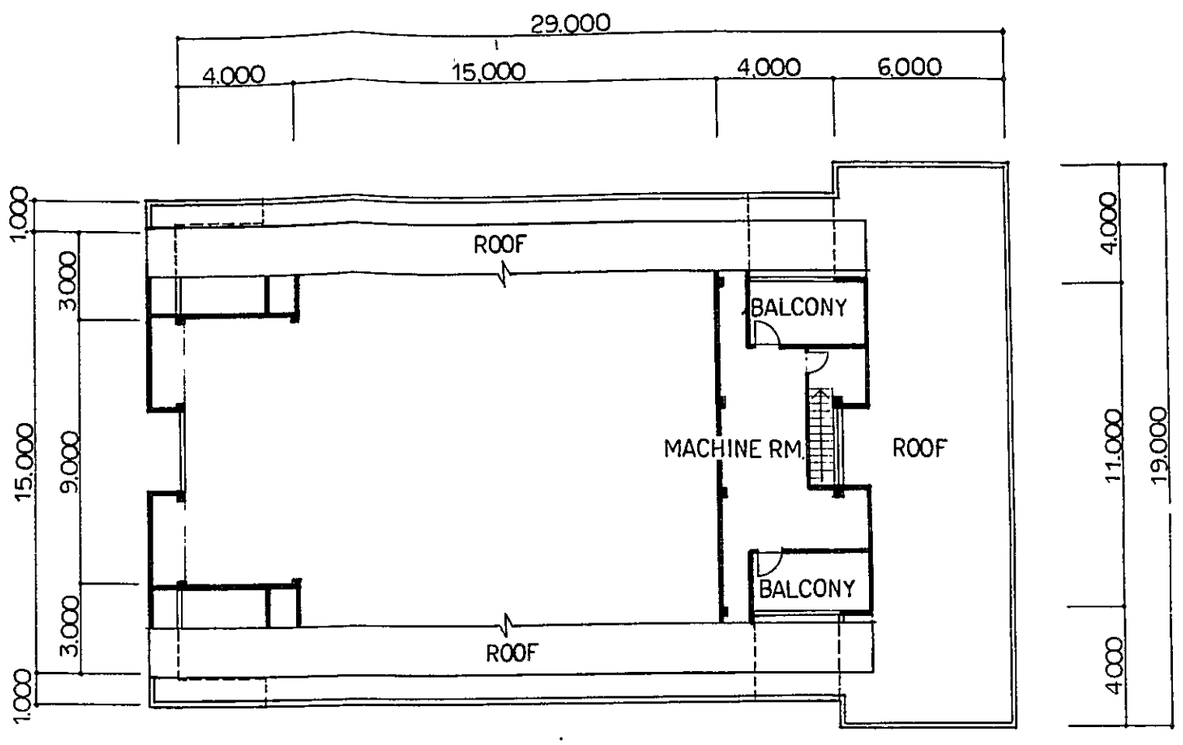
CENTER BLDG

ELEVATIONS AND SECTIONS

8

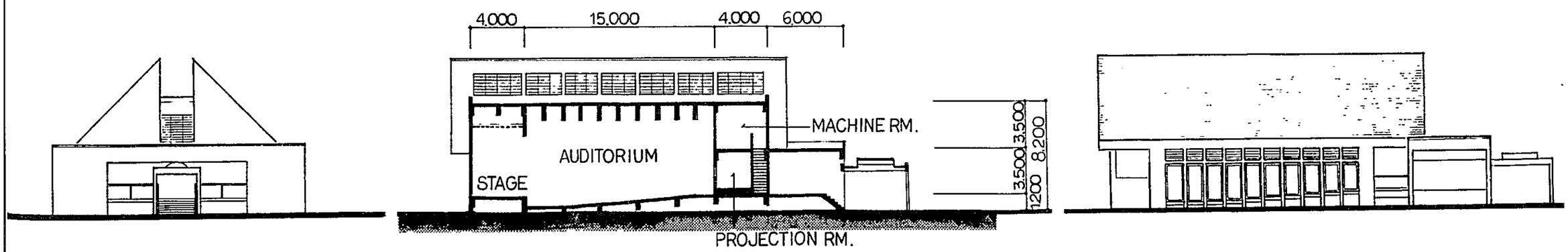


1ST FLOOR PLAN 1 : 200



2ND FLOOR PLAN 1 : 200

NOTES : ▒▒ ROOMS TO BE PROVIDED WITH AIR-CONDITIONING SYSTEM

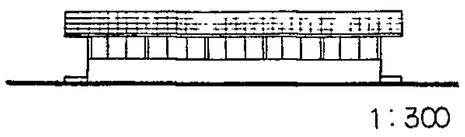


ELEVATIONS AND SECTION 1 : 300

AUDITORIUM

PLANS, ELEVATIONS AND SECTION

9



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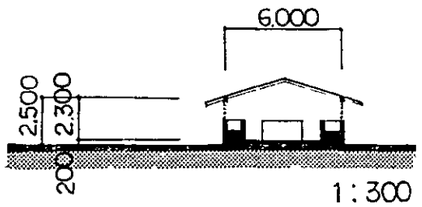

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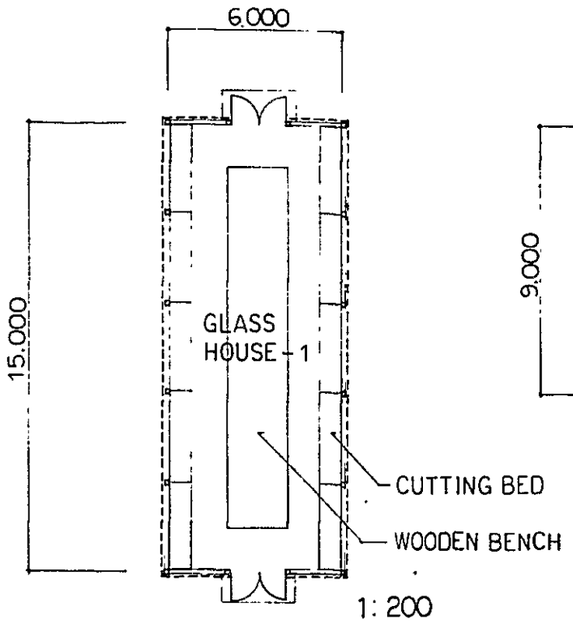

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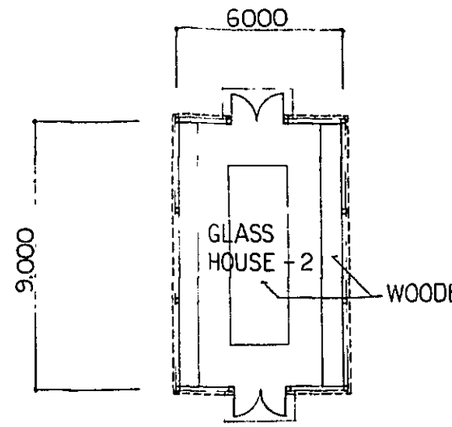
GLASSHOUSE-1
PLAN, ELEVATION & SECTION



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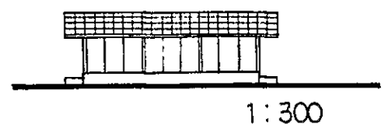

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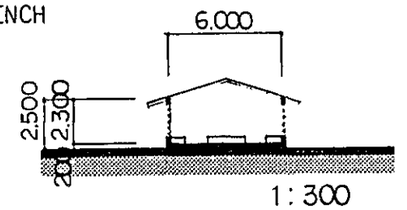

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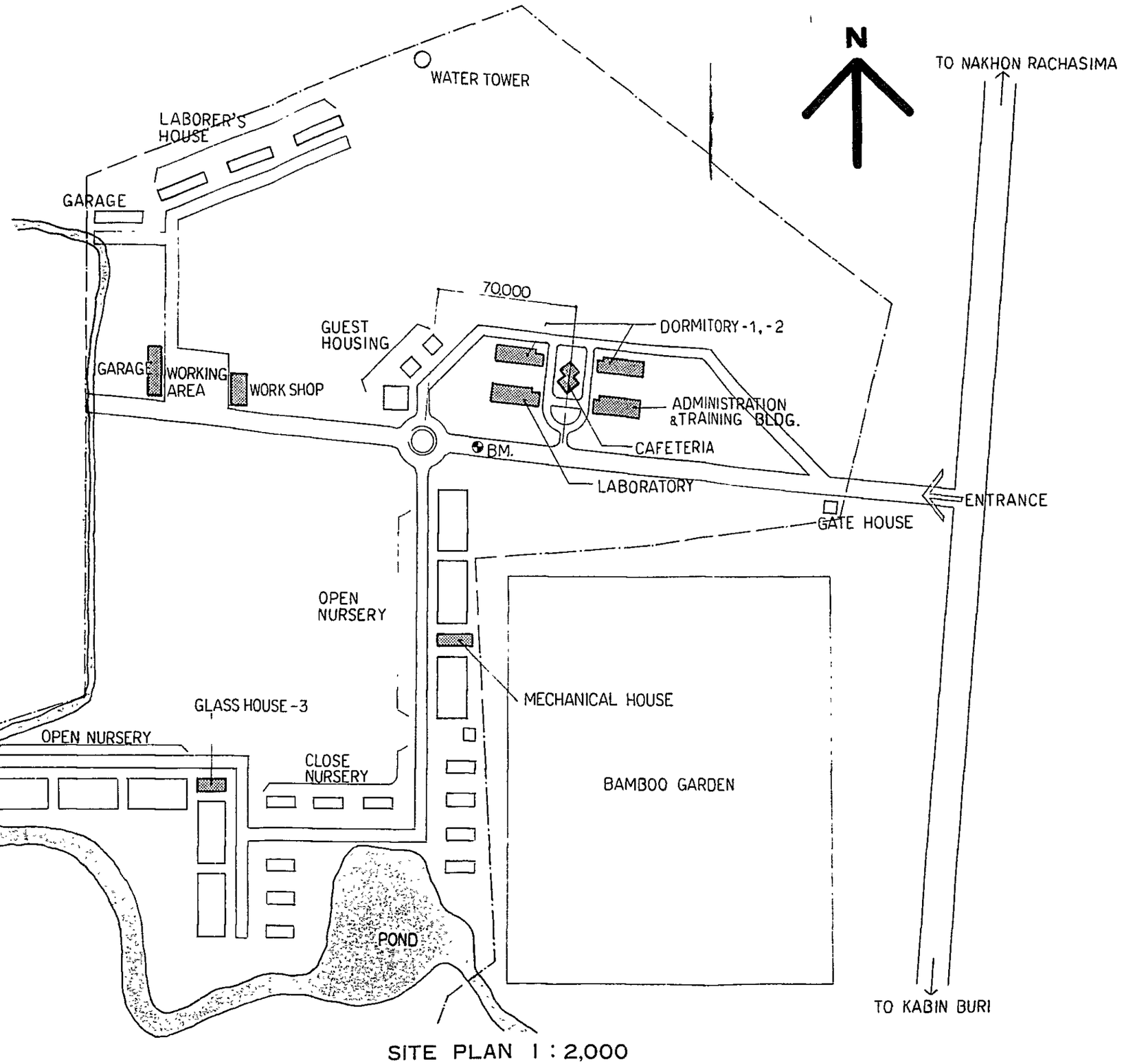
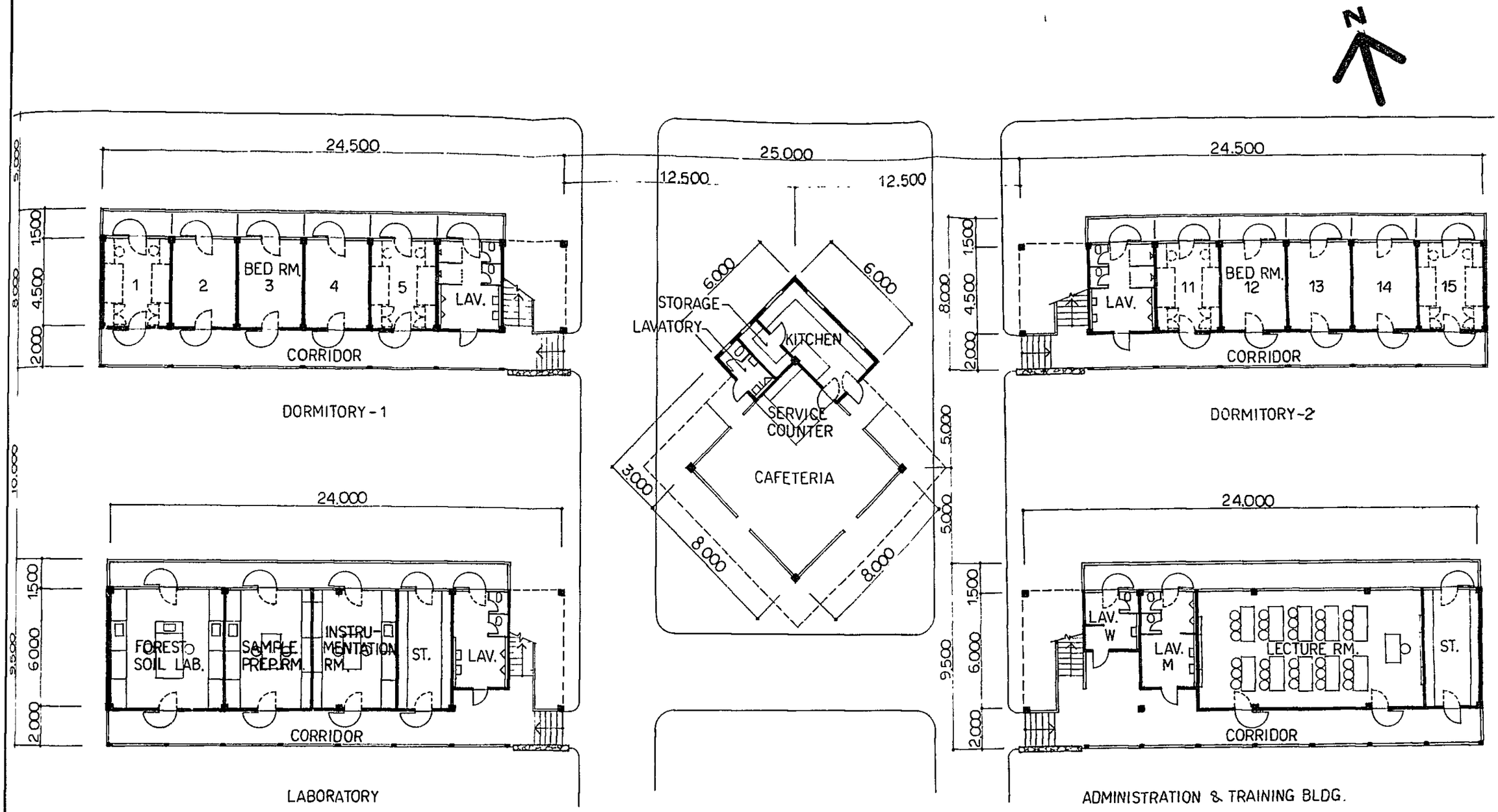
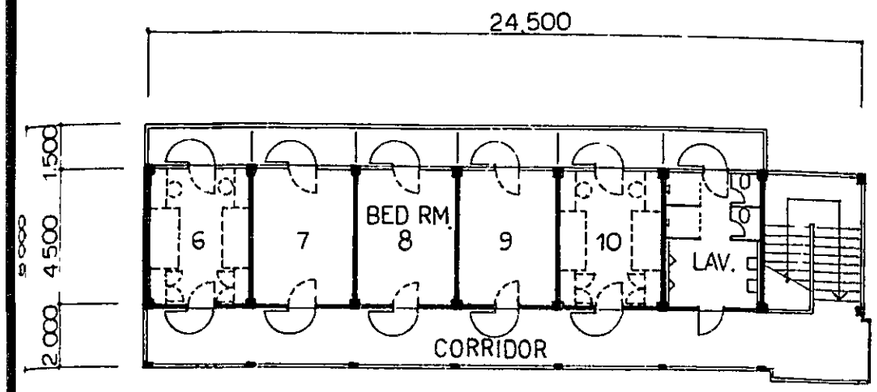
GLASSHOUSE-2
PLAN, ELEVATION & SECTION



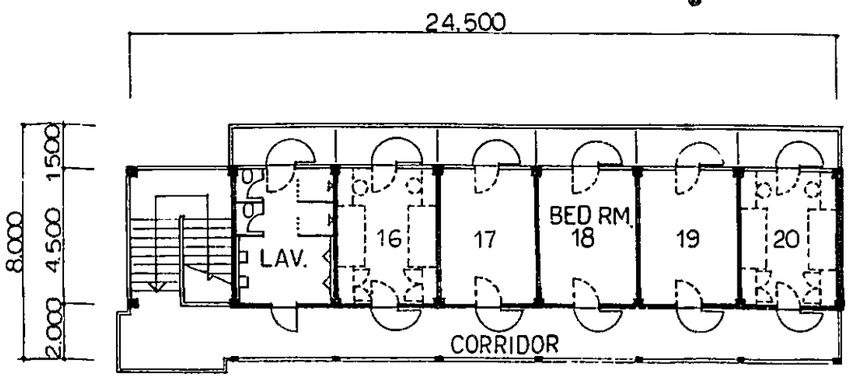
SITE PLAN 1 : 2,000



1ST FLOOR PLAN 1 : 200



DORMITORY - 1



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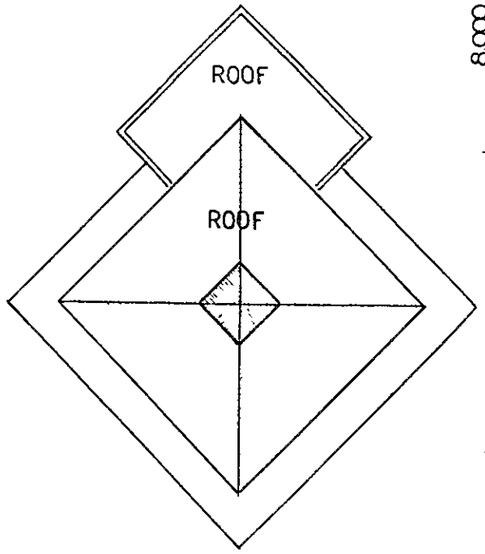
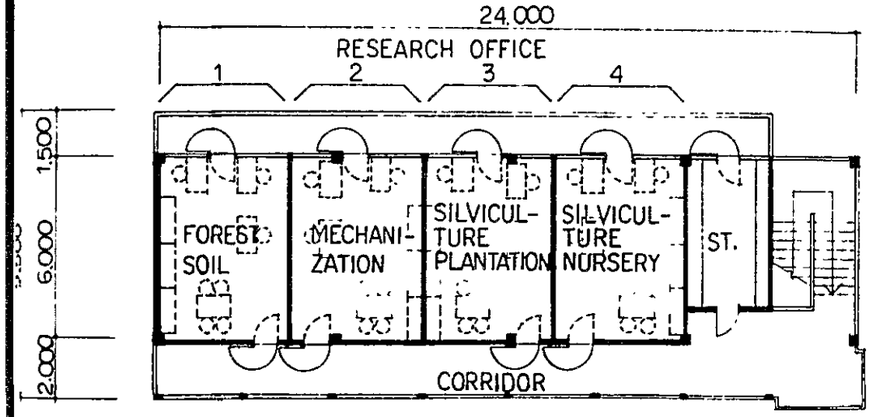
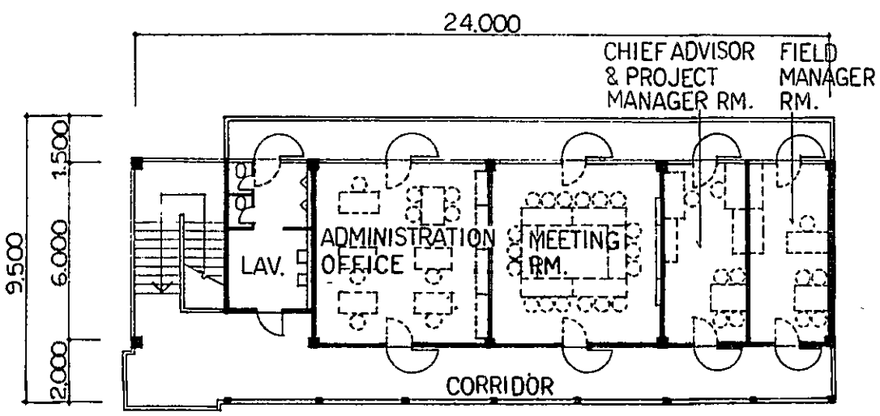


CAFETERIA



LABORATORY



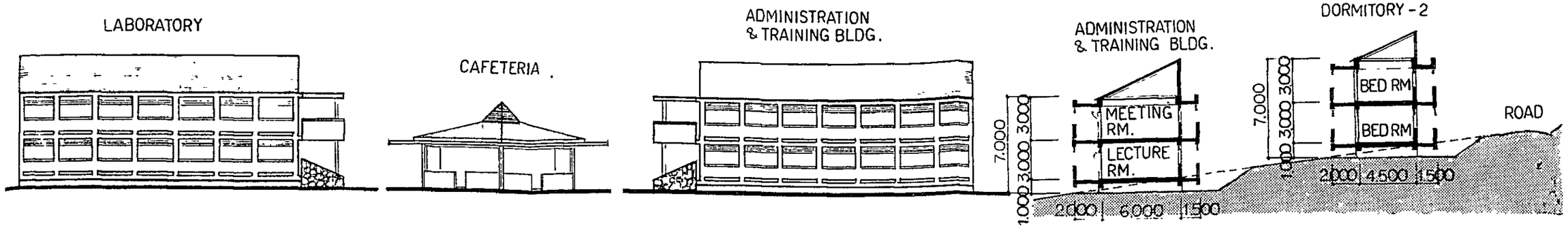
ADMINISTRATION & TRAINING BLDG.

2ND FLOOR PLAN 1 : 200

ADMINISTRATION AND TRAINING BLDG., LABORATORY, DORMITORY -1, -2

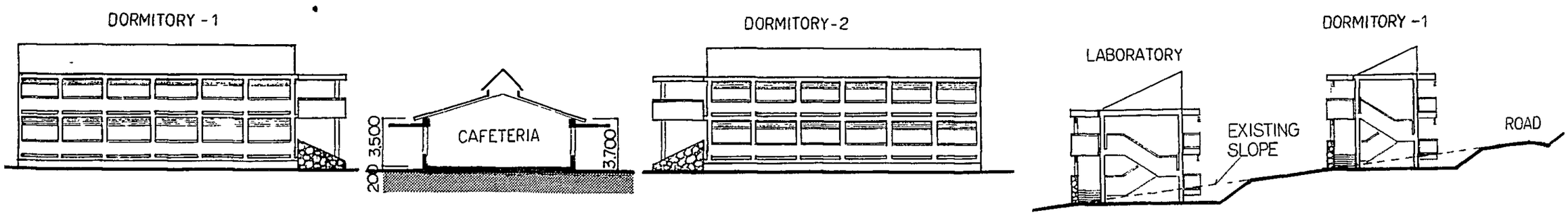
2ND FLOOR PLAN

13



ELEVATIONS 1 : 300

SECTIONS 1 : 300

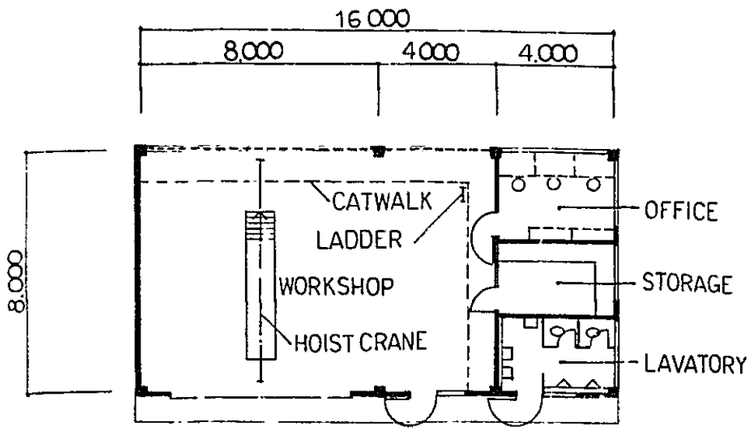


ELEVATIONS & SECTION 1 : 300

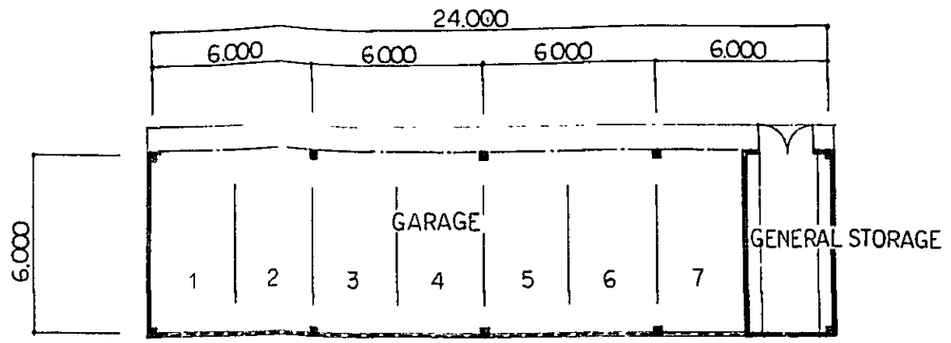
ELEVATIONS 1 : 300

ADMINISTRATION AND TRAINING BLDG., LABORATORY, DORMITORY - 1, - 2, CAFETERIA

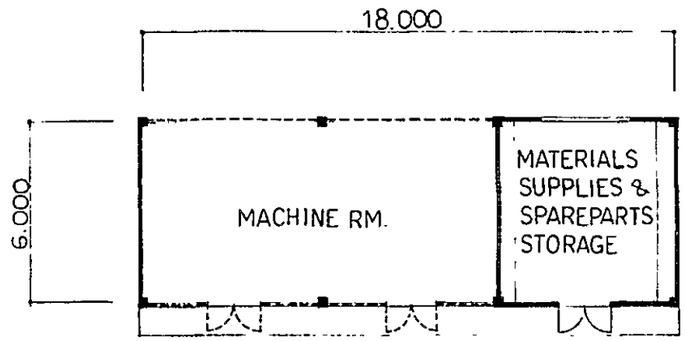
ELEVATIONS AND SECTIONS



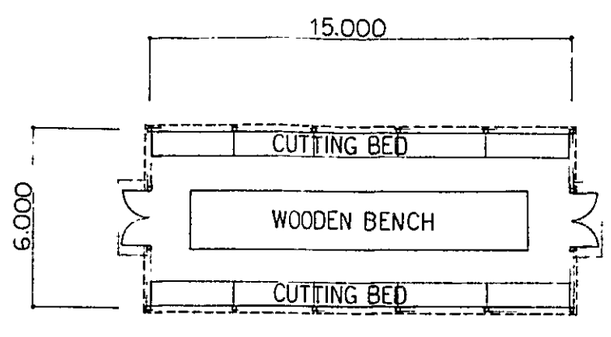
WORKSHOP PLAN 1 : 200



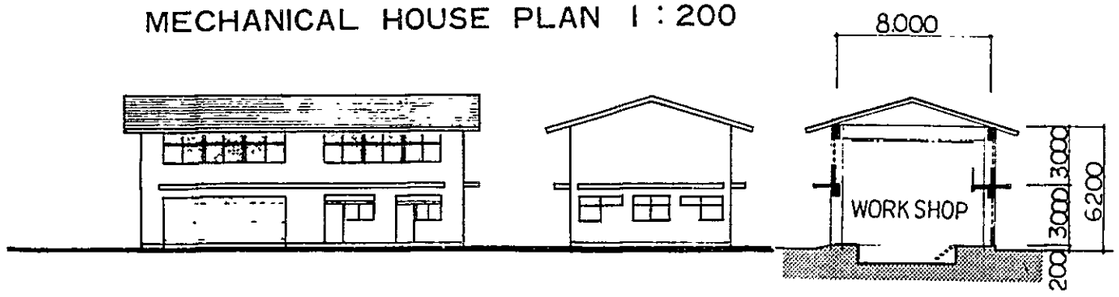
GARAGE PLAN 1 : 200



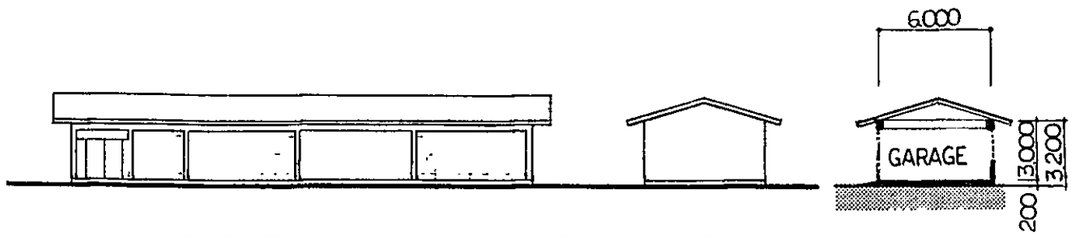
MECHANICAL HOUSE PLAN 1 : 200



GLASSHOUSE PLAN 1 : 200



WORKSHOP ELEVATIONS & SECTION 1 : 300



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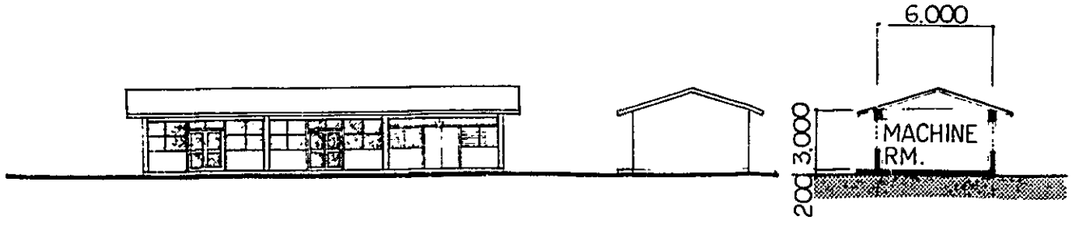
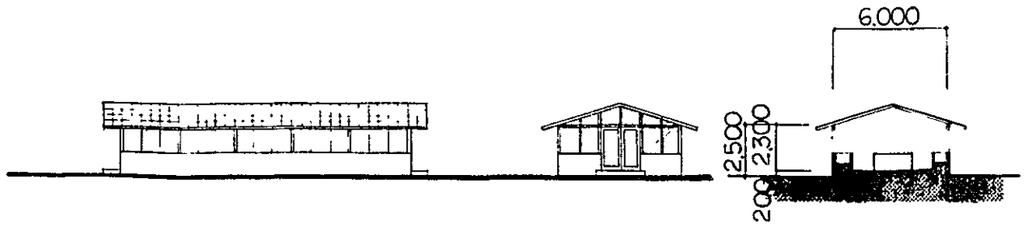
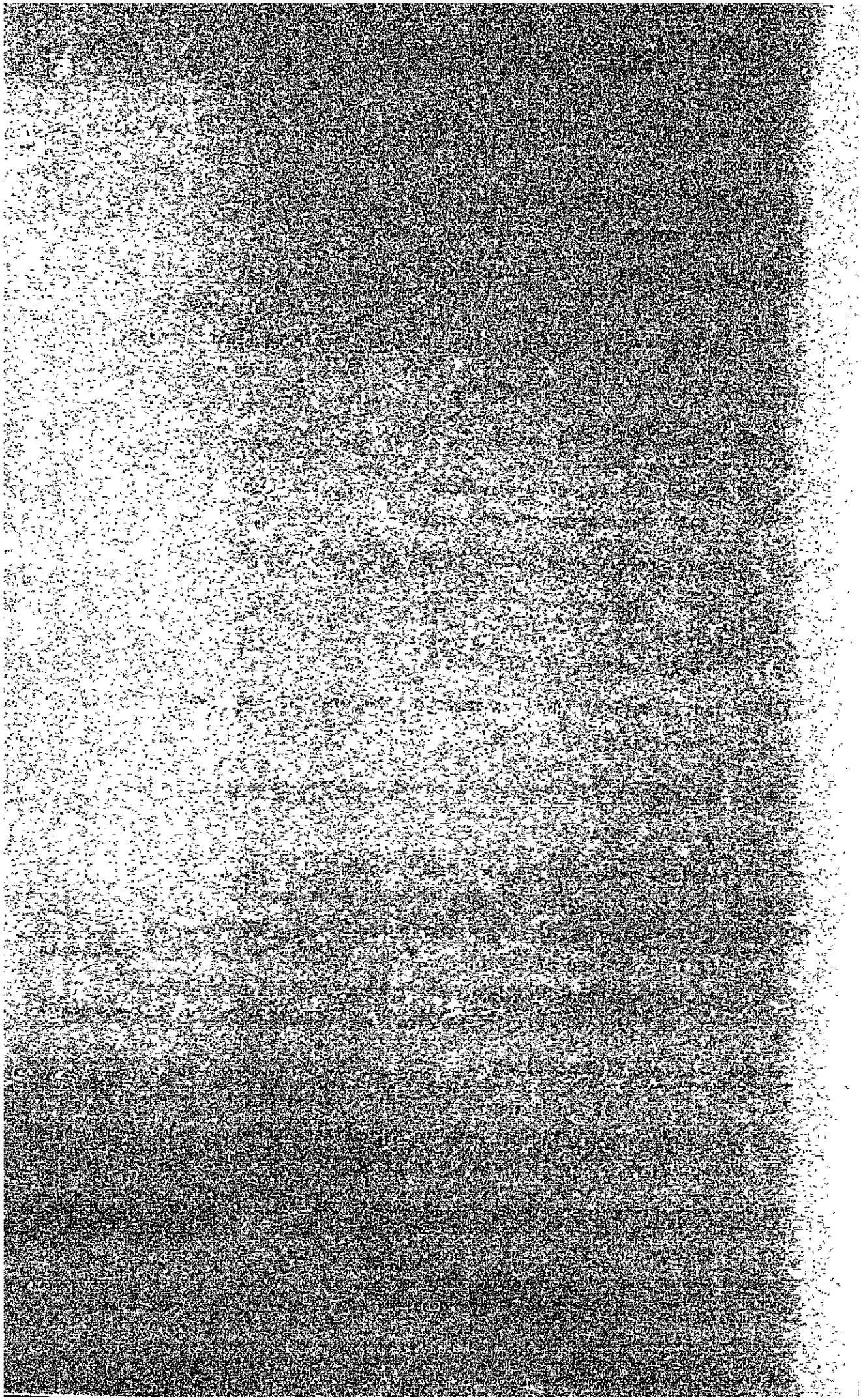


MECHANICAL HOUSE ELEVATIONS & SECTION 1 : 300



GLASSHOUSE ELEVATIONS & SECTION 1 : 300

APPENDICES



I-1 THAI GOVERNMENT OFFICIALS CONCERNED

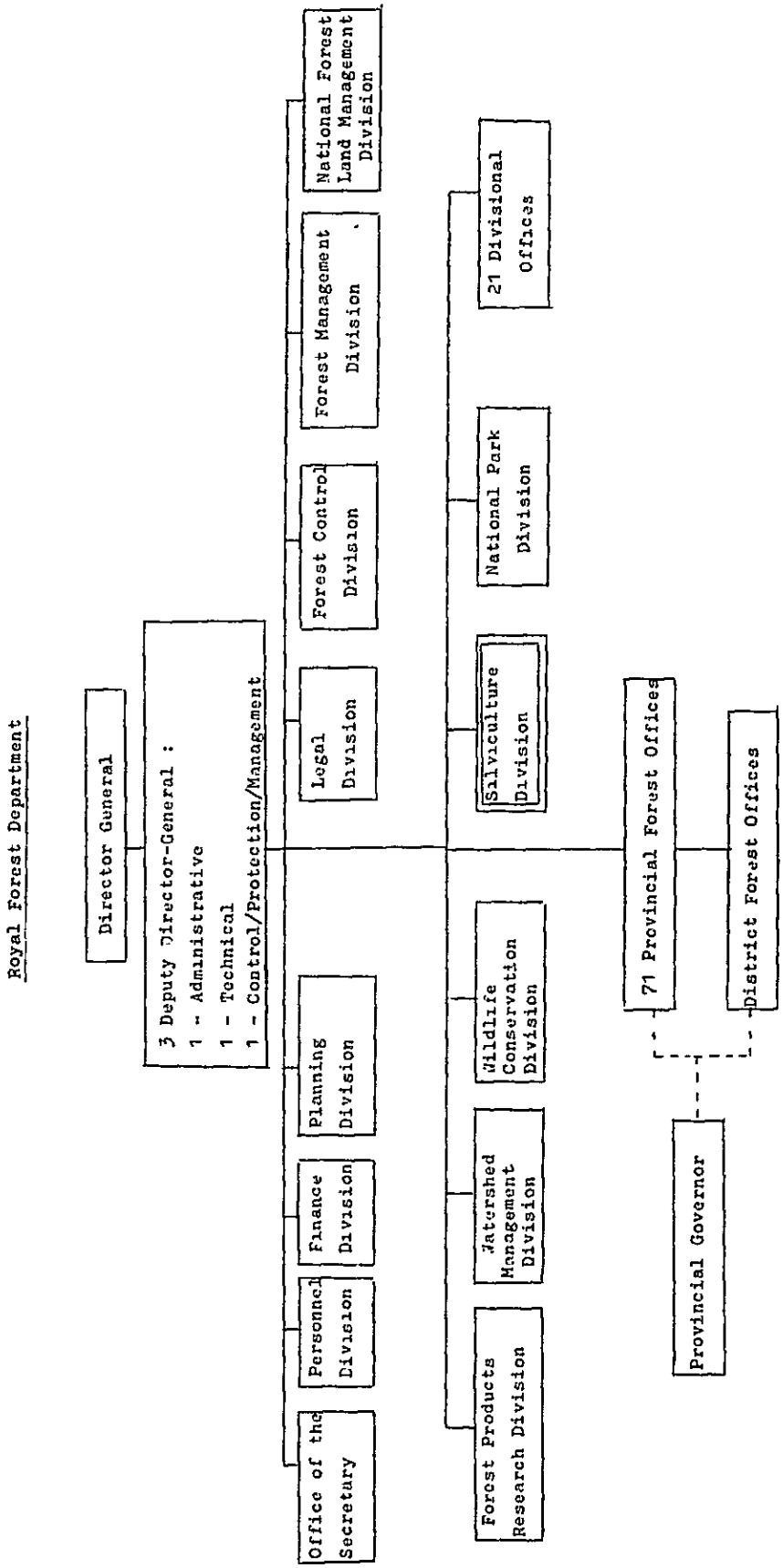
R.F.D.

Mr. Pong Sono	Director General
Mr. Sompherm Kittinanda	Deputy Director General
Mr. Sawat Nicharat	Director, Silviculture Division
Dr. Thanit Yingvanasiri	Chief, Forest Research Sub-division
Mr. Pravit Chittachamnonk	Chief, Physiological Research Section
Mr. Boonchoob Boontawee	Project Manager, Research and Training in Re-afforestation (RTR)
Mr. Pisal Wasuwanich	Director, ASEAN-Canada Forest Tree Seed Center
Mr. Paisal Kuwalairat	Field manager, RTR
Mr. Charin Itharat	Chief, Training Affairs Sub-division Personnel Division
Mr. Komon Pragthong	Chief, Survey & Planning Sub-division, National Forest Land Management Division (NFLMD)
Mr. Niwat Jatikanond	Chief, Design and Construction Sub-division NFLMD
Mr. Anon Na-Lampoon	Office of Secretary
Mr. Prachongget Liengprodit	Planning Division
Mr. Bunlur Emaruchi	Engineer, NFLMD
Mr. Chaiwat Phongsang	Architect, NFLMD

DTEC

Mr. Pracha Chaowasilp	Director of Colombo Plan Division
Mr. Sutin Susila	Div. of External Cooperation-Office 2
Mr. Jiroj Itharattana	Colombo Sub-division

I-2 ORGANIZATION OF THE ROYAL FOREST DEPARTMENT (R.F.D.)



I-3 MEMBERS OF THE IMPLEMENTATION TEAM FOR THE ESTABLISHMENT OF CENTRAL FOREST RESEARCH LABORATORY AND TRAINING CENTER PROJECT

Chairman	Mr. Sompherm Kittinanda	Deputy Director-General
Vice Chairman	Mr. Sawat Nicharat	Director, Silviculture Div.
Member	Miss Sumitra Chuatrakul	Chief, Finance Division
Member	Dr. Thanit Yingvanasiri	Chief, Forest Research Sub-div., Silviculture Division
Member	Mr. Charin Itharat	Chief, Training Affairs Sub-div., Personnel Division
Member	Mr. Niwat Jatikanond	Chief, Design and Construction Sub-div., National Forest Land Management Division
Member	Mr. Boonchoob Boontawee	Silviculture Division
Member	Mr. Pisal Wasuwanich	Silviculture Division
Member	Mr. Bunlur Emaruchi	National Forest Land Management Division
Member	Mr. Chaiwat Phongsang	National Forest Land Management Division
Member	Mr. Paisal Kuwalairat	Silviculture Division
Secretary	Mr. Pravit Chittachumnonk	Silviculture Division

I-4 BASIC DESIGN SURVEY MISSION

I-4-1 MEMBERS

Team leader	Shigeru KONDO	Special Technical Adviser to the President of JICA
Research planner	Tokunori MORI	Chief Researcher, Silviculture Division Forestry and Forest Products Research Institute
Project Coordinator	Shozo MATSUURA	Basic Design Section Japan International Cooperation Agency (JICA)
Acting Leader Planner	Kiyoshi HATA	Nikken Sekkei Ltd
Structural Engineer	Kyohei SAIMI	Nikken Sekkei Ltd
Elect. & Mech. Engineer	Koichi SUZUKI	Nikken Sekkei Ltd
Laboratory Equipment & Project Evaluation	Yasutaka INOUE	Nikken Sekkei Ltd
Architect	Yoshihisa TANAKA	Nikken Sekkei Ltd

I-4-2 DIARY

Date	Day	Description
Oct. 27	Tue.	Flight from Tokyo to Bangkok
28	Wed.	Courtesy call and briefing to the Japanese Embassy and JICA Office Courtesy call to R.F.D. and discussion on schedule and inception report
29	Thu.	Meeting in R.F.D.: discussion on inception report Presentation of the draft Minutes Investigation of the proposed Bangkok Center site
30	Fri.	From Bangkok to Sakaerat Visit to ASEAN-CANADA Tree Seed Laboratory and SERS
31	Sat.	Visit to Sakaerat Re-afforestation site and SERS Investigation of the Sakaerat Field Station site Return to Bangkok
Nov. 1	Sun.	Inter-term meeting
2	Mon.	Courtesy call to DTEC Meeting in R.F.D. Discussion on function of the proposed Center
3	Tue.	Meeting in R.F.D. Visit to Kasetsart University Kam Phaengsaen Campus
4	Wed.	Meeting in R.F.D. Discussion on the Minutes of Discussions
5	Thu.	Signing of the Minutes of Discussions
6	Fri.	Flight from Bangkok to Tokyo (Mr. Kondo, Mr. Mori, Mr. Matsuura and Mr. Saimi)
7	Sat.	Preparation of schematic design Collection of data
8	Sun.	Preparation of schematic design and necessary documents
9	Mon.	Meeting in R.F.D. Presentation of schematic design Visit to Kasetsart University Central Scientific Equipment Laboratory and R.F.D. Herbarium

Date	Day	Description
Nov. 10	Tue.	Meeting in R.F.D. Discussion on plans and room layouts
11	Wed.	Meeting in R.F.D. Discussion on technical aspects
12	Thu.	Meeting in R.F.D. Preparation of Memorandum
13	Fri.	Signing of Memorandum Briefing to the Japanese Embassy and JICA Office
14	Sat.	Flight from Bangkok to Tokyo

MINUTES OF DISCUSSIONS
ON
THE CONSTRUCTION PROJECT OF
THE CENTRAL FOREST RESEARCH
LABORATORY AND TRAINING CENTER
THE KINGDOM OF THAILAND

At the request of the Government of the Kingdom of Thailand for assistance in establishing the Central Forest Research Laboratory and Training Center (hereinafter refered to as "THE CENTER") in Bangkok and Sakaerat, the Government of Japan through Japan International Cooperation Agency (JICA) has sent a survey team headed by Mr. Shigeru Kondo (Special Technical Adviser to the president of JICA) to hold the Basic Design Survey on the project from October 27 to November 14, 1981.

The team held a series of discussions and exchanged views with the relevant Authorities of the Government of the Kingdom of Thailand on the establishment and construction of The Center.

Both parties have agreed to recommend to their respective Governments and the authorities concerned to examine the result of the survey attached herewith toward the realization of the Project.

November 5, 1981

SHIGERU KONDO
Leader, Japanese Survey Team

PONG SONO
Director General
Royal Forest Department

Attachments

1. The objective of the Project is to provide necessary buildings, facilities and equipment for upgrading forest research and training activities.

2. The proposed sites of the project are in the compound of the Royal Forest Department in Bangkok and in Re-afforestation Project area at Sakaerat in Nakhonratchasima.

3. The Japanese Survey Team will convey the desire of the Government of Thailand to the Government of Japan that the latter will provide the buildings and other items as listed in Annex I within the scope of Japanese economic cooperation in grant form.

4. The Government of Thailand will take necessary measures on condition that the grant assistance by the Government of Japan is extended to the Project :

   1). to provide data and information necessary for the design and the construction

   2). to secure land necessary for the construction

   3). to clear, fill and level the Project Site as needed before the start of the construction

   4). to construct and prepare the access road to the Project Site, as needed

   5). to provide other items listed in Annex II

6). to ensure prompt unloading and customs clearance in Thailand of imported materials and equipment for the construction and also to facilitate the internal transportation for them.

7). to exempt Japanese nationals concerned from customs duties, internal taxes and other fiscal levies which may be imposed in Thailand on the occasion of the supply of materials and services for construction.

8). to provide and accord necessary permissions, licences and other authorization required for carrying out the Project.

Annex I

Items requested by the Government of Thailand whose costs will be borne by the Government of Japan

1. Building and Facilities in Bangkok

    1. Administrative offices

    2. Library

    3. Data Processing and Storage Rooms

    4. Auditorium

    5. Audio-Visual Room

    6. Conference Room

    7. Seminar Room

    8. Soil Laboratory

    9. Tree Seed Laboratory

    10. Biochemistry Laboratory

    11. Microbiology Laboratory

    12. Microtechniques Laboratory

    13. Sample Storage and Processing Rooms

    14. Analytical Instrument Unit

15. Maintenance Unit

16. Offices for Research Scientists

17. Control Condition Unit

18. Glass Houses

2. Buildings and Facilities in Sakaerat

1. Field Office

2. Laboratories and Lecture Rooms

3. Sheds for Machinery and Equipment

4. Storehouse for Materials

5. Workshop and Garage

6. Mechanical Room

3. Equipments in Bangkok

1. Laboratory Equipments

2. Training Equipments

3. Other Research Equipments

Annex II

Items whose costs will be borne by the Government of Thailand

1. Water supply mains to the Center building.

2. External drainage from the Center building and sewage treatment facilities.

3. Electrical power main line to the Center building.

4. Telephone lines and equipment.

5. Exterior facilities and landscaping.

6. Provision of space necessary for such construction as temporary office, working area, stock yards, and others.

7. Furniture, carpet, curtains and other furnishings as necessary.

8. Maintenance and operating cost and expenses.

MEMORANDUM OF DISCUSSIONS

ON

THE BASIC DESIGN SURVEY

FOR

The Construction of the Central Forest Research Laboratory and Training Center, Kingdom of Thailand

November 13, 1981

Royal Forest Department

The Japanese Basic Design Survey Team

MEMORANDUM OF DISCUSSIONS

The Japanese Basic Design Survey Team and the Thai officials concerned held further discussions on technical matters in details after signing the Minutes of Discussions on November 5, 1981 and confirmed as follows :

1. Project Site Conditions in Bangkok and Sakaerat

Based on a series of land surveying in Bangkok and Sakaerat, a drawing was prepared by Thai side and delivered to the Japanese Team. However, a further survey was requested by the Japanese Team to be conducted by Thai side to verify the existing soil conditions in Bangkok site as per the attached specification and boring plot plan. (ATTACHMENT 1)

Thai side confirmed the soil test will be done as soon as possible and the test result should be given to the Japanese side by the end of February, 1982.

2. Block Plan of the Center

The Japanese Team prepared proposed block plans of the Center in Bangkok and Sakaerat and discussed them with Thai side. Both parties basically confirmed the block plans as per the attached sheets, although they may be slightly modified in the course of development of basic design. (ATTACHMENT 2)

3. Scope of Works in Detail

Based on the Minutes, both parties discussed the scope of works in detail and confirmed it each other as per the attached sheets. (ATTACHMENT 3). In addition, the works to be done by Thai side

were discussed in detail and confirmed as per the attached outline specifications. (ATTACHMENT 4).

4. Details of the Facilities

The Japanese Team prepared a sheet describing necessary facilities and equipment to be provided in each room to serve the purpose of the Center and discussed them with Thai side item by item. Both parties agreed that the facilities and equipment as mentioned in the said sheets with some pending items which will be settled after the Japanese Team's returning to Japan. The utilities and laboratory equipment in each room were summarized as per the attached sheets for confirmation. (ATTACHMENT 5). The sheets are also attached to this memorandum as a supplement.

November 13, 1981

KIYOSHI HATA	PONG SONO
Acting Leader	Director Gereral
Japanese Survey Team	Royal Forest Department

I-5 BASIC DESIGN CONFIRMATION SURVEY MISSION

I-5-1 Members

Team leader	Shigeru KONDO	Special Technical Adviser to the President of JICA
Project Coordinator	Shozo MATSUURA	Basic Design Section Japan International Cooperation Agency (JICA)
Acting Leader Planner	Kiyoshi HATA	Nikken Sekkei Ltd
Architect	Yoshihisa TANAKA	Nikken Sekkei Ltd

I-5-2 Diary

Date	Day	Description
Dec. 20	Sun.	Flight from Tokyo to Bangkok
21	Mon.	Courtesy call and briefing to JICA Office and DTEC Courtesy call to R.F.D. and presentation of the Basic Design Survey Report (Draft)
22	Tue.	Meeting in R.F.D.: Explanation and discussion on the Report
23	Wed.	Courtesy call to the Japanese Embassy Meeting in R.F.D.: Discussion on the Report
24	Thu.	Meeting in R.F.D.: Final discussion on the Report Signing of the Minutes Visit to NIFI
25	Fri.	Investigations of buildings in Bangkok Briefing to the Japanese Embassy and JICA Office
26	Sat.	Flight from Bangkok to Tokyo

MINUTES OF DISCUSSIONS
ON
THE DRAFT REPORT OF THE BASIC DESIGN STUDY
ON THE CONSTRUCTION PROJECT OF
CENTRAL FOREST RESEARCH LABORATORY AND TRAINING CENTER

The Government of Japan has sent, through Japan International Cooperation Agency (JICA), a Basic Design Study Team to Thailand from 20th to 26th, December 1981 for the purpose of submitting and explaining the Draft Final Report of the Basic Design Study (the Report) on the Construction Project of Central Forest Research Laboratory and Training Center (the Project).

The team held meetings with the staffs concerned of the Royal Forest Department, Ministry of Agriculture and Cooperatives to explain and to discuss on the Report. As a result of the discussions, both parties have agreed as follows :

1. The Report principally satisfied the Thai side and appropriate alterations in design agreed during the discussions will be incorporated in the Final Report.

2. The Final Report (10 copies in English) on the Project will be submitted to the Thai Government by the end of February 1982.

December 24, 1981
Bangkok Thailand.

Semphera Kittinanda
Acting Director General
Royal Forest Department

Shigeru KONDO
Leader Japanese Survey Team

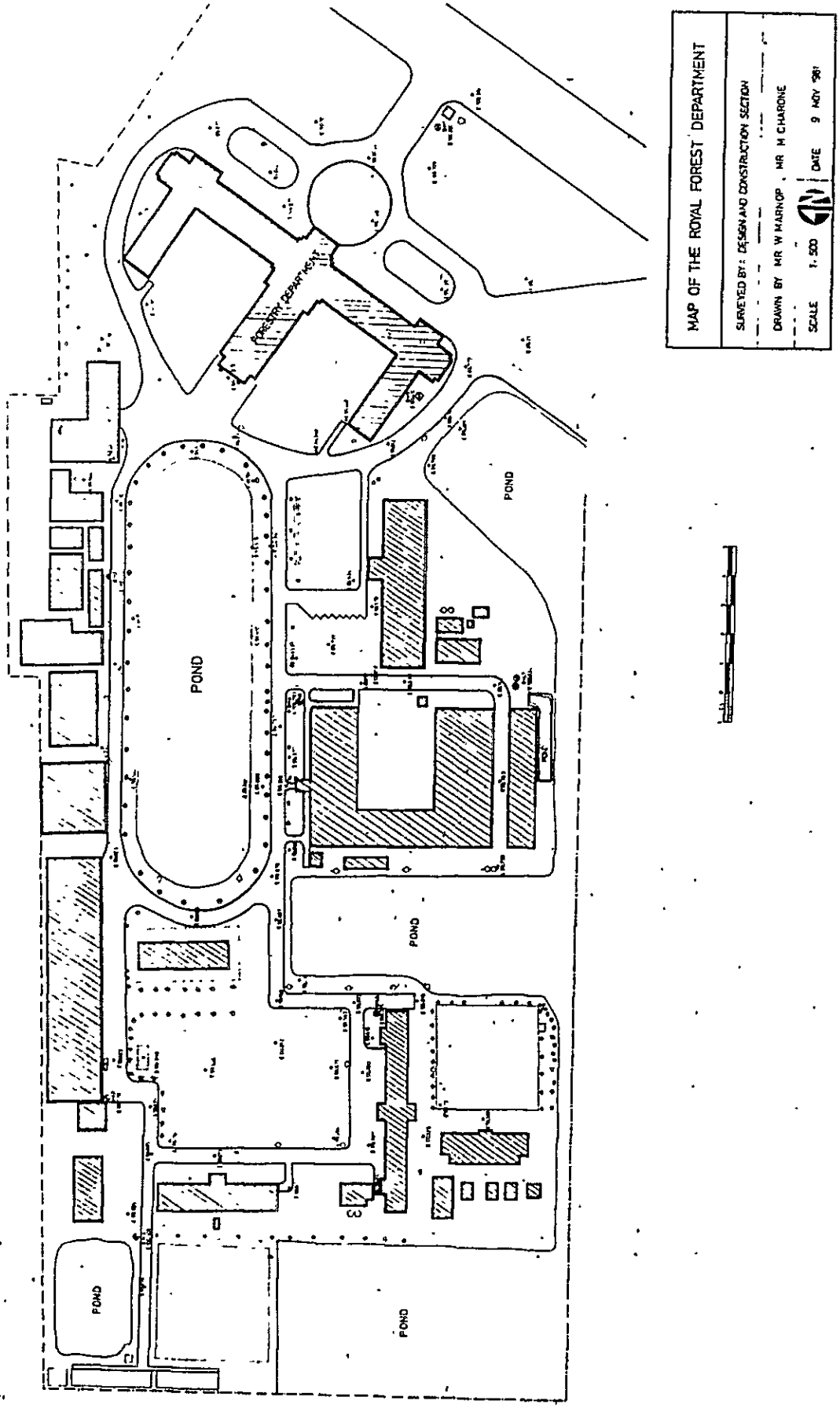
I-6 TENTATIVE TRAINING PROGRAMMES OF THE RESEARCH AND TRAINING IN RE-AFFORESTATION PROJECT

Tentative training programmes of the Research and Training in Re-afforestation Project

Type	Level	Qualification	Duration	Number	Remarks
I. Nursery practices	Foreman	Up to high School	2 Weeks	30 - 40	All levels of trainees will be selected from RFD nursery centres, FIO, Thai Plywood Company Ltd., private companies concerned, etc.
" ____ "	Ranger	School of Forestry or equivalent	2 Weeks	30 - 40	
" ____ "	Proffessional	B.Sc. (Forestry) or equivalent	1 Week	30 - 40	
II. Plantation practices	Foreman	Up to high School	2 Weeks	30 - 40	All levels of trainees will be selected from RFD forest plantation units, FIO, Thai Plywood Company Ltd., private companies concerned, etc.
" ____ "	Ranger	School of Forestry or equivalent	2 Weeks	30 - 40	
" ____ "	Proffessional	B.Sc. (Forestry) or equivalent	1 Week	30 - 40	
III. Mechanization	Tractor operator Machine operators Workers	Up to high School	2 Weeks	30 - 40	Trainees will be selected from the RFD forest plantations, FIO, Thai Plywood Company Ltd., and private companies concerned, etc.
" ____ "	Ranger	School of Forestry or equivalent	2 Weeks	30 - 40	
" ____ "	Proffessional	Chief of forest plantation	1 Week	30 - 40	

N.B. Each course should be organized and implemented under cooperation of all technical sections concerned.

II-1-1 SITE PLAN OF THE BANGKOK CENTER



CLIMATOLOGICAL DATA FOR THE PERIOD 1951 - 1975

Station BANGKOK METROPOLIS
Index Station 48 455
Latitude 13° 44' N.
Longitude 100° 30' E.

Elevation of station above MSL. 2.30 metres
Height of barometer above MSL. 16.37 metres
Height of thermometer above ground 1.50 metres
Height of wind vane above ground 23.38 metres
Height of raingauge 0.70 metres

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Pressure (+1000 or 900 mbs.)													
Mean	12.58	11.05	10.04	08.58	06 95	06.38	06.58	06 60	07.51	09.71	11 52	12.63	09.18
Ext. Max.	26.50	20.96	18.42	17.74	13.62	13.00	14.14	13 50	15.59	16.78	19.98	21.89	26.50
Ext. Min.	04.59	03.87	02.08	00.04	99.40	97.76	98.78	99.36	98.20	98.24	03 68	03.87	97.76
Mean daily range	4.75	4.85	4.87	4.91	4.50	3.81	3.74	3 97	4.38	4.43	4.25	4.46	4.41
Temperature (°C.)													
Mean	25.5	27.1	28.6	29.5	29.0	28.5	28.0	27.8	27.5	27.4	26.6	25.3	27.6
Mean Max.	31.8	32.7	33.8	34.8	34.0	32.9	32 4	32.1	31.7	31.5	31.1	31.1	32 5
Mean Min.	20.4	22.7	24.5	25.6	25.3	25 0	24 8	24.6	24.4	24.3	22.9	20.6	23.7
Ext. Max.	36.0	36.6	39.8	39.0	39 4	36.8	36.0	35.3	35.7	34.5	35.1	35.2	39.8
Ext. Min.	9.9	14.9	16.5	19.9	21.1	21.7	21 9	21.2	21.3	19.8	14.2	10.5	9.9
Relative Humidity (%)													
Mean	73.0	76.0	77.0	77.0	80.0	80.0	81 0	82.0	84.0	83.0	79.0	74.0	79.0
Mean Max.	91.8	93.4	93.0	91.9	93.8	92.9	92.9	94.4	95.7	95.7	94.3	92.2	93.5
Mean Min.	49.5	53.5	55.5	56 6	61.3	63.4	64.4	65.2	67.9	67.7	61.2	53.5	60.0
Ext. Min.	27.0	17.0	25.0	28.0	30 0	46.0	47.0	48.0	49.0	49.0	36 0	31.0	17.0
Dew Point (°C.)													
Mean	19.7	22.0	23.7	24 5	24 9	24 4	24.0	24 1	24.4	24.1	22.4	19 9	23.2
Evaporation (mm.)													
Mean – Piché	98.0	88.8	108.8	105.7	90 2	81.8	78.3	71.2	58.1	58.7	69.3	87.0	995.9
– Pan	132.8	139.2	179.8	182.6	162.6	145.8	141.6	140.3	126.2	120.7	118.8	123.9	1714.3
Cloudiness (0-8)													
Mean	4.6	5.0	5.2	5.8	6.6	7.0	7.1	7.2	7.2	6.6	5.4	4.7	6 0
Visibility (Km)													
0700 L.S.T.	5.8	5.0	5.8	7.8	8.8	8.7	8.2	7 8	7.8	7.9	8.0	7.6	7.4
Mean	10.5	10.0	9.9	11.5	12.9	13.0	12.5	12.2	12.0	12.2	12.5	12.2	11.8
Wind (Knots)													
Prevailing wind	NE	S	S	S	S	S	SW	S	SW	NE	N	NE	–
Mean Wind Speed	3 8	5.2	5.8	5.7	4.6	4.9	4.6	4 6	3.9	3 5	3.7	3.5	–
Max. Wind Speed	31 NNE	37 N	48 ENE	56 E	42 W	43 S,SW	43 SW,W	45 WNW	44 SSW	40 NE	45 ENE	31 NNE-SE	–
Rainfall (mm.)													
Mean	8.9	29.1	28.0	70 0	185.1	150.4	171.3	206.8	402 1	234.2	47.6	10.4	1543.9
Mean rainy days	1.8	2.8	3.6	6.4	15.8	16.5	18.4	20.8	21.6	17.4	6 0	1.6	132.7
Greatest in 24 hr.	39.3	73.0	52.8	133.5	124.2	82.9	108.8	97.8	153.7	123.2	81.2	32.0	153.7
Day/Year	31/61	11/64	24/73	23/51	15/66	6/59	30/55	26/71	23/68	5/60	2/69	8/72	23/68
Number of days with													
Haze	21.5	21.6	22.5	16.6	12.1	12.7	14.0	13.1	12.8	13.2	13.8	18.0	191.9
Fog	5.4	3.6	2.8	1.4	1 6	0.1	0.5	0.1	0.0	0.3	1.0	1.4	18.2
Hail	0.0	0 0	0.0	0.1	0.0	0.0	0 0	0.0	0.0	0 0	0 0	0.0	0.1
Thunderstorm	0.6	1.3	3.6	8.8	15.3	10.1	9.6	10 6	15.2	13.6	3.4	0.7	92.8
Squall	0.0	0.0	0 2	0.2	0.3	0.4	0.4	0.1	0.1	0.0	0.1	0.0	1.8

Remark : Evaporation – Pan 1961 – 1975

II-1-3 QUALITY OF CITY WATER IN THE R.F.D. COMPOUND

สถาบันวิจัยวิทยาศาสตร์และเทคโนโลยี
แห่งประเทศไทย
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THAILAND INSTITUTE OF SCIENTIFIC
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BANGKHEN, BANGKOK 9
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ที่ ทส. 0033/25 ที่ คม. 23/25

ห้องปฏิบัติการเคมีวิเคราะห์ สาขาทดสอบและมาตรวิทยา

ใบแจ้งผลการทดสอบและวิเคราะห์

น้ำ

ให้แก่

กรมป่าไม้

วิเคราะห์ด้วยวิธี Standard methods for the examination of water and wastewater.

ซึ่งผลการวิเคราะห์ปรากฏดังนี้ :-

1	Turbidity	=	0.5	F.T.U.
2	pH	=	7.4	
3	Total solids	=	360.3	mg/l
4	Suspended solids	=	2.2	"
5	Total hardness as $CaCO_3$	=	127.6	"
6	Non-carbonate hardness as $CaCO_3$	=	nil	"
7	Carbonate hardness as $CaCO_3$	=	127.6	"
8	Chloride as NaCl	=	16.2	"
9	Sulphate as Na_2SO_4	=	0.026	"
10	Calcium	=	36.5	"
11	Iron	=	0.076	"
12	Manganese	=	0.31	"
13	Magnesium	=	8.8	"

ผู้วิเคราะห์

ผู้รับรอง

(นายศิริ นันทศรี)
ผู้อำนวยการสาขาทดสอบและมาตรวิทยา

หัวหน้าห้องปฏิบัติการ

(นายจำนงค์ หัยกิจโกศล)

วันที่ 22 มกราคม 2525

ผลการวิเคราะห์นี้ รับรองผลเฉพาะตัวอย่างที่ได้ทำการตรวจวิเคราะห์เท่านั้น

II-1-4 OUTLINE OF EXISTING UTILITY SERVICES IN THE RFD COMPOUND

1. Electricity

a.	Total transformer capacity	1339.5KVA
b.	Primary voltage	12 KV
c.	Secondary voltage	3ø 380V, 1ø 220V
d.	Frequency	50 HZ

2. Telephone

a.	Direct call telephone	63
b.	Trunk line for exchanger	10
c.	Extension	87
d.	Main lines on the main road	300

3. Water supply

a.	Main pipe under the main road	50 cmø
b.	Branch pipe to the compound	10 & 7.5 cmø

4. Sewerage

a.	Sewerage under the main road	Covered drain made of concrete

5. Gas

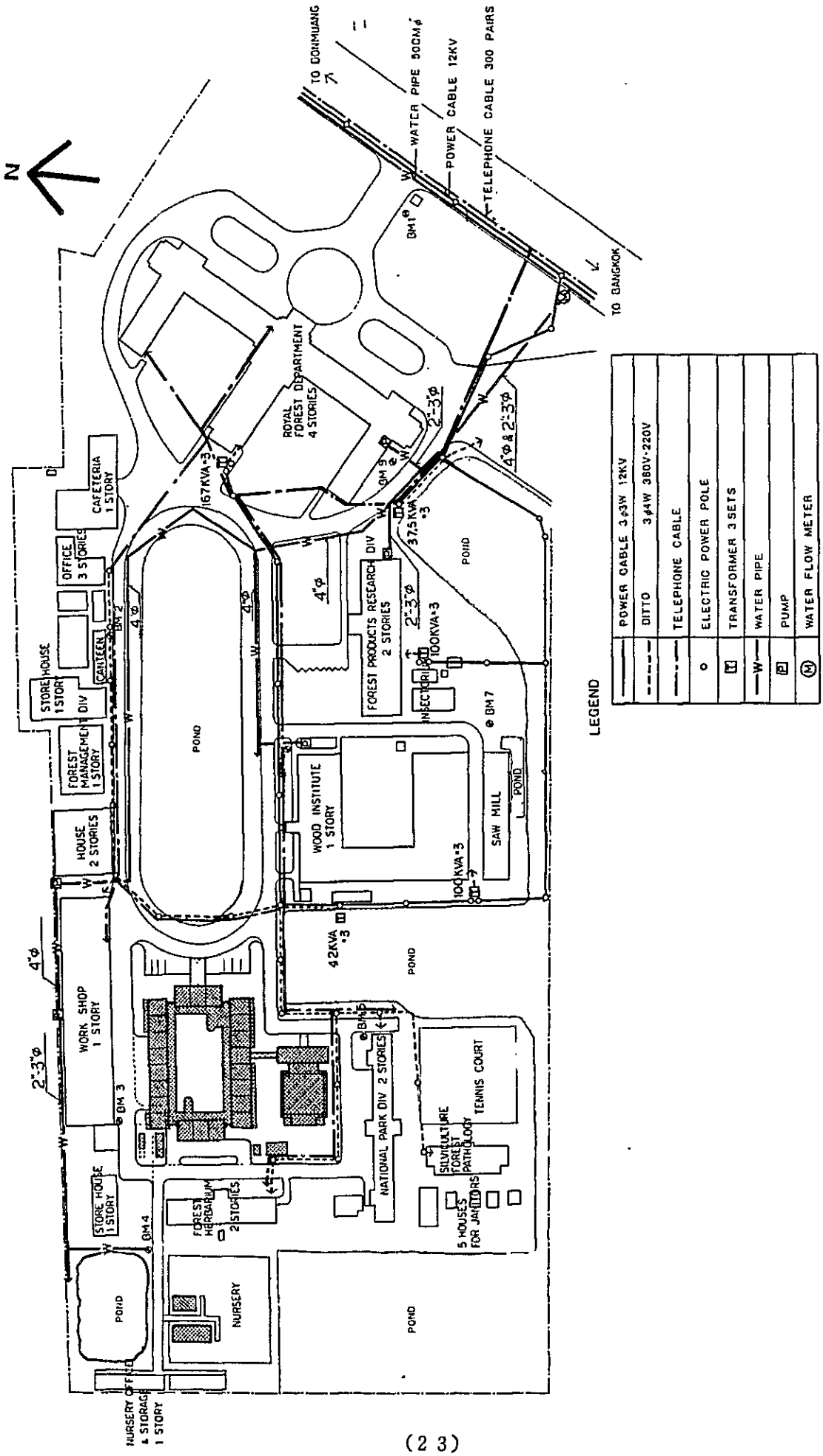
a.	Gas	Cylinder gas (C_3H_3+ C_4H_{10})

6. Gabage

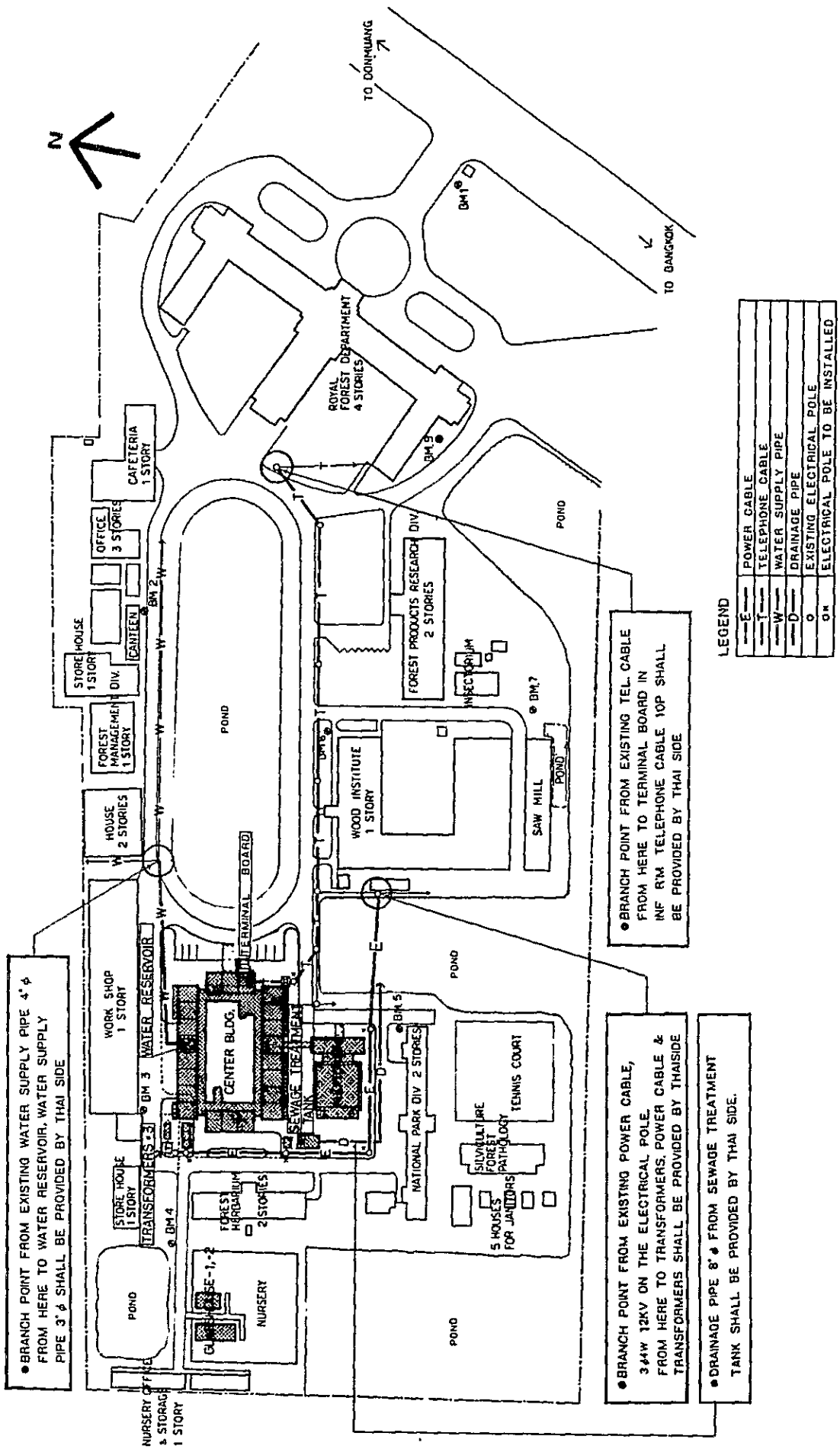
a.	Disposal	A Truck carries out every other day

7. Fuel oil

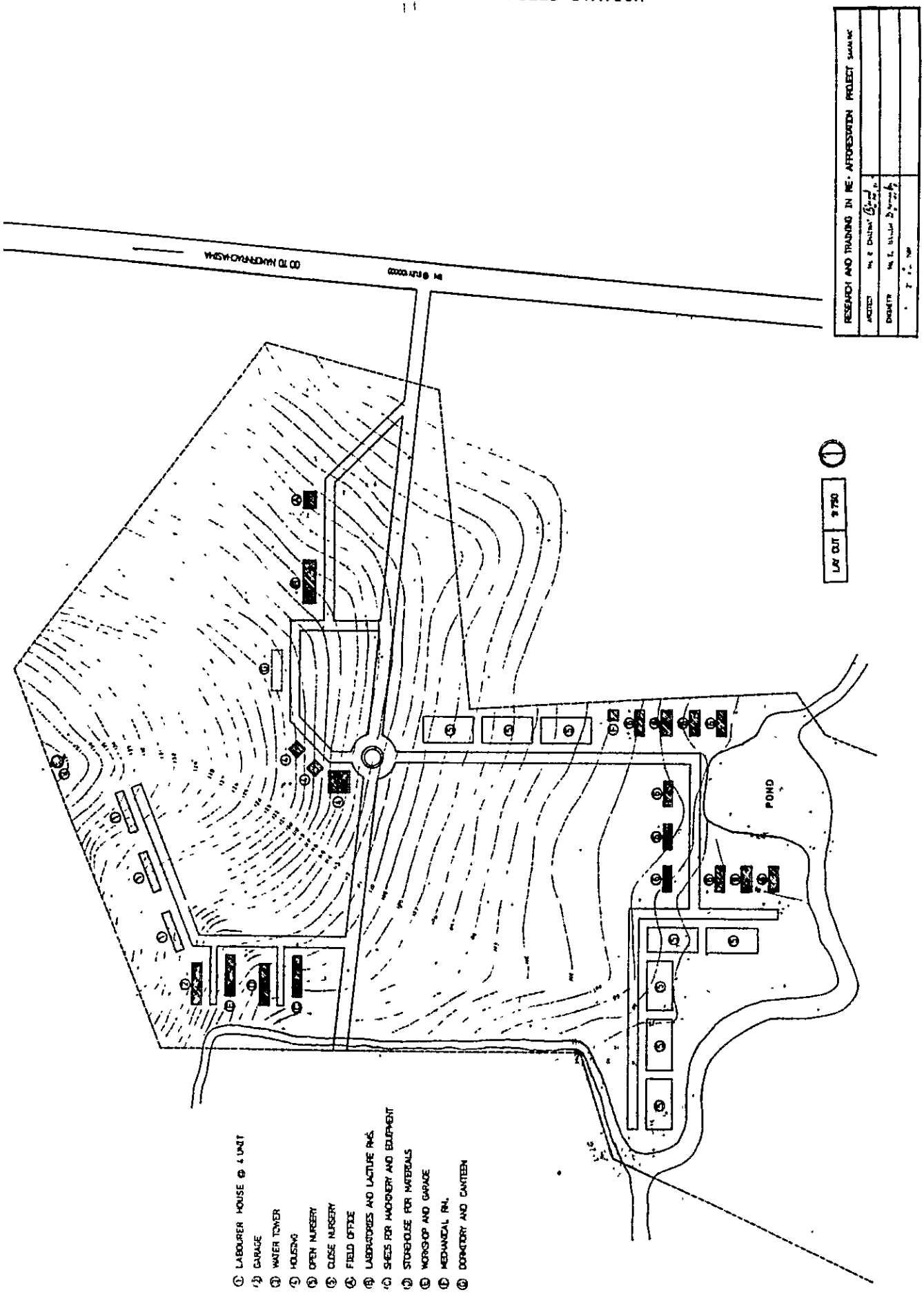
II-1-5 EXISTING UTILITY SERVICE PLAN IN THE R.F.D. COMPOUND



II-1-6 PROPOSED UTILITY SERVICE EXTENSION PLAN IN R.F.D. COMPOUND



II-2-1 SITE SURVEYING PLAN OF THE SAKAERAT FIELD STATION



CLIMATOLOGICAL DATA FOR THE PERIOD 1951 - 1975

Station NAKHON RATCHASIMA
Index Station 48 431
Latitude 14° 58' N.
Longitude 102° 05' E.

Elevation of station above MSL.	188.00	meters
Height of barometer above MSL.	189.50	meters
Height of thermometer above ground	1.50	meters
Height of wind vane above ground	12.20	meters
Height of raingauge	1.00	meters

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Pressure (+1000 or 900 mbs.)													
Mean	13.88	11.75	10.19	08.68	07.14	06 17	06.25	06.26	07 66	10.70	13 00	14.36	09.67
Ext. Max.	28.58	24.06	23.26	21.46	15.78	13 86	14.86	13.36	14.56	19.26	22.98	25 66	28.58
Ext. Min.	04.16	02.16	00 86	98.95	99.48	97.28	97.38	97.26	98.98	01.74	03 68	03.58	97 26
Mean daily range	5.78	6.14	5.93	5.44	4.82	4.31	4 26	4 46	4.66	4.78	4.83	5.30	5.06
Temperature (°C.)													
Mean	22.7	25.7	27 9	28.9	28.3	27.9	27.4	27 2	26 5	25.8	24.2	22 4	26.2
Mean Max.	30.8	33.5	35.6	36 4	35.0	33.8	33.3	32.7	31.9	30 7	30 0	29.5	32.8
Mean Min.	16 0	19.2	21.9	23.4	24 4	23 8	23.4	23 3	23 9	22 2	19.5	16.4	21.5
Ext. Max.	37.8	40.6	41.1	42 4	41.4	40.1	38.0	37.7	38.0	35 3	35.3	35 7	42.4
Ext. Min.	4.9	10.6	11 6	15.7	20 7	21.2	21.1	20.5	19 7	16.7	9.1	6 2	4.9
Relative Humidity (%)													
Mean	68.0	65.0	66 0	69.0	76.0	76.0	77.0	79.0	83.0	82 0	77.0	72 0	74.0
Mean Max.	89.2	87.1	86 6	87.9	91.6	91.4	91 6	92.5	95 2	94 5	92.4	90.7	90.9
Mean Min.	44.2	41.6	41.7	44 7	54.0	56.2	57.4	59 2	64.4	64 2	57.1	49.7	52.9
Ext. Min.	23 0	14 0	20 0	19.0	23 0	28.0	37.0	38.0	39.0	38.0	27.0	20 0	14.0
Dew Point (°C.)													
Mean	16.1	18 0	20.2	22.0	23.4	23.1	22 9	22 9	23 3	22 2	19.5	16.7	20 8
Evaporation (mm.)													
Mean – Piché	101.0	104 7	117.8	105.0	80.9	77.7	76.1	69.5	49.2	63.1	76.0	90.7	1011.7
– Pan	145.4	156.4	190.0	193.1	181.5	172.6	168.8	160.0	135.1	134.0	133.0	138.7	1908.6
Cloudiness (0–8)													
Mean	3.0	3.4	3.9	4 6	5.7	6.3	6.5	6.8	6.5	5.3	4.0	3.2	4.9
Visibility (Km.)													
0700 L.S.T.	3.9	3.6	4 0	5.3	7.8	9.3	9.3	9.1	7.9	6.7	5.3	4.3	6 4
Mean	7.1	6.2	6.1	7.4	9.5	10.2	10.0	9.9	9.3	9.4	8.9	8.2	8.5
Wind (Knots)													
Prevailing wind	NE	NE	NE	SW	SW	SW	W	W	W	NE	NE	NE	–
Mean Wind Speed	2.7	2.9	2.7	3.1	2.9	4.1	4 1	3.9	2.6	2.9	3.4	3 2	–
Max. Wind Speed	28 ENE	37 E	13 SSW	53 S	46 SE	35 W SF SW	41 W	35 SE	33 S	54 SE	44 NNE	40 NE	–
Rainfall (mm)													
Mean	4.1	24.1	57.4	75.1	165.5	119.3	137.2	122.9	271.4	166.2	33.5	3.3	1180.0
Mean rainy days	1.4	2 8	6 4	8.0	16.5	15.1	16.3	16.3	19.7	12 8	4.0	1.1	120.4
Greatest in 24 hr.	17.1	59.7	97.3	91.8	134.5	114.8	104.1	72.3	143.7	80.7	108 6	20 6	143.7
Day/Year	26/54	23/65	10/74	4/73	14/52	27/69	10/75	27/64	12/68	7/60	9/55	3/70	12/68
Number of days with													
Haze	27.0	26.6	28.8	21.0	5.5	0.5	0.7	1.3	2 5	9.0	16.4	23.1	162 4
Fog	3.8	3 7	3.0	3.5	1.5	0.3	0.3	0 2	1.2	2.8	2.6	2.9	25.8
Hail	0 0	0.0	0.1	0 0	0.0	0.0	0.0	0 0	0.0	0.0	0 0	0.0	0.1
Thunderstorm	0.4	2.0	7.4	12.8	16.6	7.4	7.3	6.2	10.4	6.5	0.7	0.0	77.7
Squall	0 0	0.0	0.1	0.1	0.1	0.1	0.0	0 0	0.0	0.1	0 0	0.0	0.5

Remark : Evaporation : Pan 1962 – 1975

II-2-3 QUALITY OF STEAM WATER AT SERS

1. Physical and Chemical Properties

pH	6.4 ∿ 6.9
Air temperature (°C)	22.0 ∿ 34.5
Water temperature (°C)	17.0 ∿ 29.0
Electric conductivity (m, mho/cm)	0.21 ∿ 0.70
Turbidity (J.T.U.)	4.2 ∿ 40.0
DO (mg/ℓ)	1.6 ∿ 7.5
BOD (mg/ℓ)	0.60 ∿ 2.8
Hg (PPb)	0.092
Cd (PPb)	0.228
Pb (PPb)	2.75
Dissolved solids (PPm)	95.87

II-3 AUTHORITIES CONCERNING UTILITY SERVICES

1. Electric Power Supply

a.	Bangkok Center	Metropolitan Electricity Authority (M.E.A.)
b.	Sakaerat	Provincial Electricity Authority (P.E.A.) in Nakhonrachashima

2. Telephone

Telephone Organization of Thailand (T.O.T.)

3. Water Supply

a.	Bangkok Center	Metropolitan Water Work Authority
b.	Sakaerat	Provincial Water Work Authority in Nakhonrachashima

4. Sewerage

5. Gabage Disposal

a.	Bangkok Center	Sanitary Work Division of Bangkok Metropolitan Administration

II-4 ENERGY CHARGE

1. Electrical Charge (For Large Businesses)

a. Demand charge (Bahts/KW)	98
b. Energy charge (Bahts/KWH)	1.54

2. Water Charge

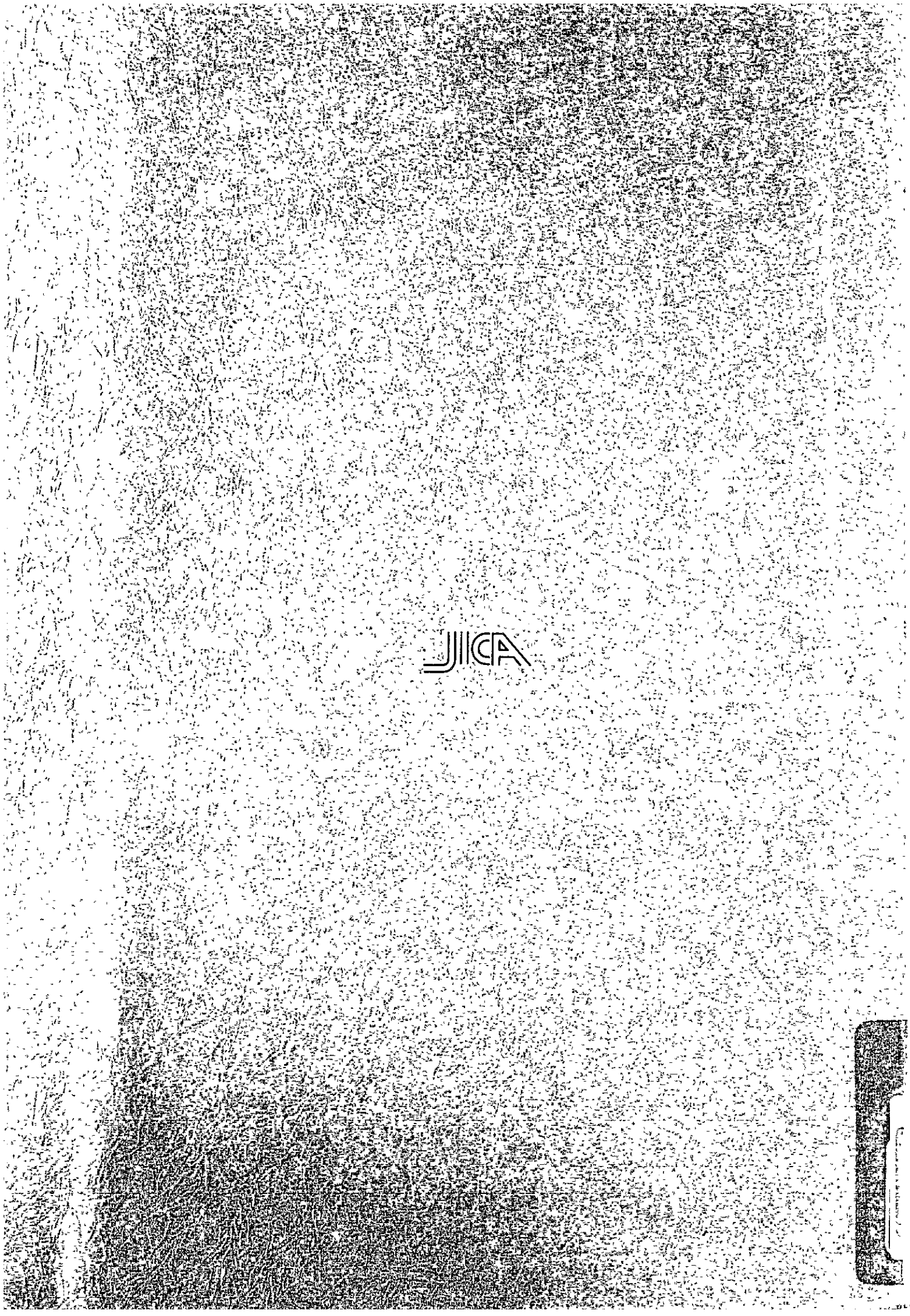
Amount used (m^3/month)	Charge
0 - 10 (minimum charge imposed)	30 Bahts
11 - 50	2 Bahts/m^3
51 - 100	3 Bahts/m^3
101 - 300	4 Bahts/m^3
301 and up	4.5 Bahts/m^3

3. Oil Charge

High speed diesel oil	7.39 Bahts/ℓ

4. Gas Charge

Size (kgs)	Charge (Bahts)
12.0	120
14.5	145
15	150
25	237
45	426
50	473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