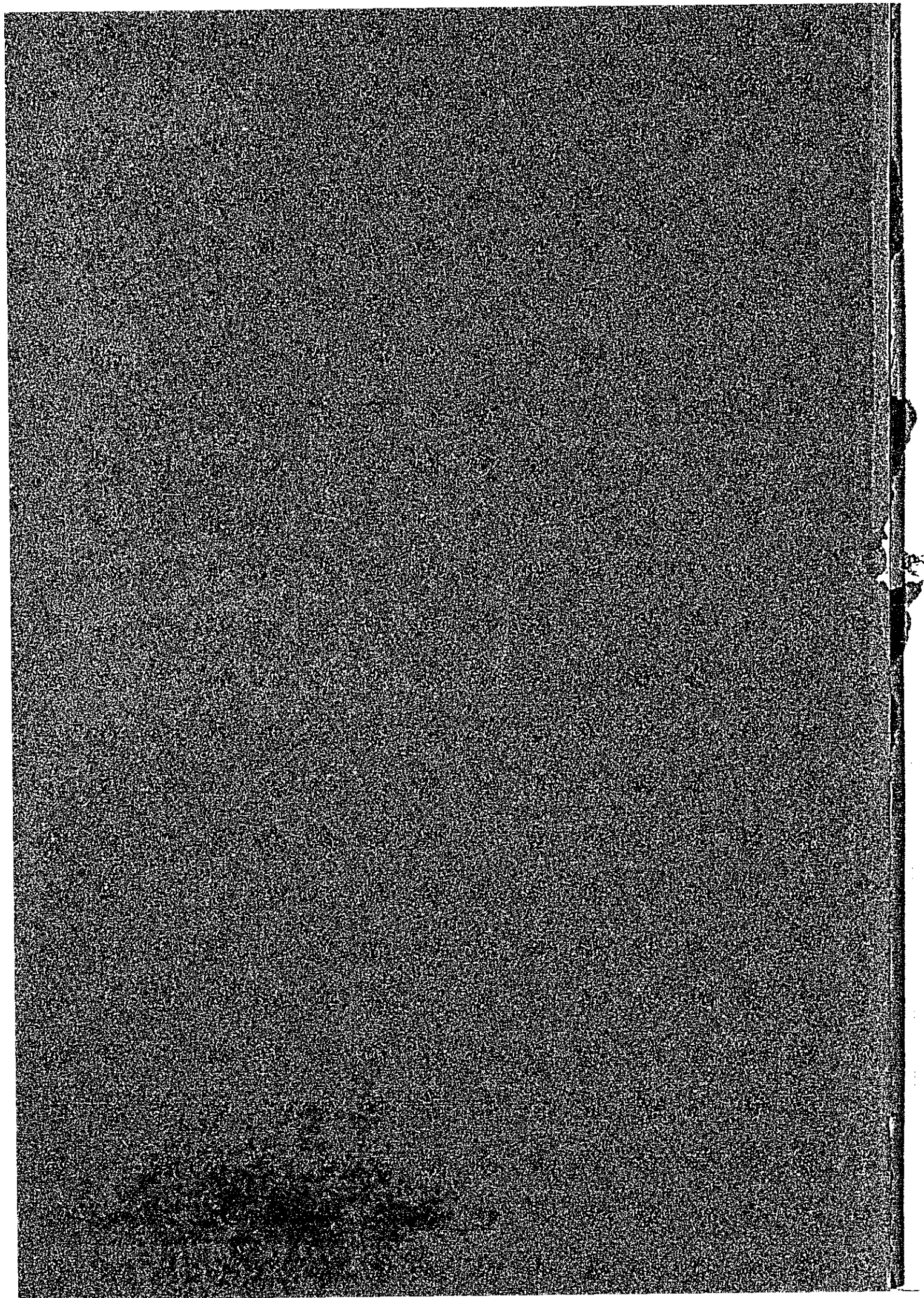


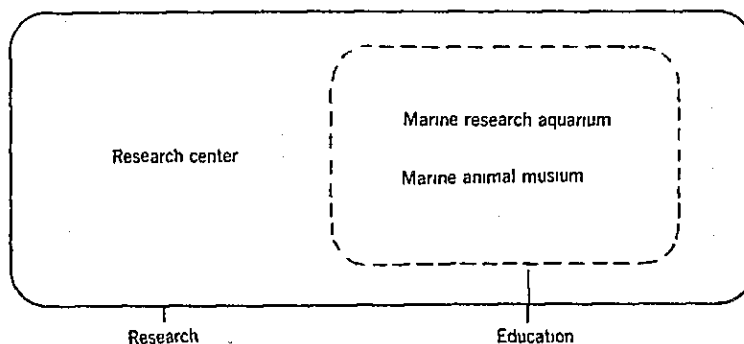
CHAPTER 3 BASIC DESIGN



CHAPTER 3 BASIC DESIGN

3.1 GENERAL DESCRIPTION

- (1) This basic design for the Bangsaen Marine Science Center is prepared on the basis of the following basic conditions agreed between the officials of the Government of the Kingdom of Thailand and the survey team of Japan International Cooperation Agency in February 1981.
- (2) The findings of the survey and the outcome of the deliberations between the two parties are well reflected in the basic design, so that the purposes of this project are realized.
- (3) Basic conditions:
 - a. The Center will be constructed in an area facing the main road and adjacent to the campus gate in Srinakarinwirot University.
 - b. The Center will be built for the University as research and educational facilities of marine science.
 - c. The Center will consist of research laboratories, marine research aquarium and marine animal museum. Both the aquarium and the museum will be open to the general public as well as to school children and students.



3.2 SUMMARY OF THE PROJECT

3.2.1 Location of the site

Bangsaen Campus, Srinakarinwirot University, The Kingdom of Thailand.

3.2.2 Scope of the project

(1) Buildings

- a. Center building; consists of four blocks as follows,
 - i. Marine animal museum and administration block
 - ii. Marine research aquarium block
 - iii. Laboratory block
 - iv. Auditorium block
- b. Ancillary building
 - i. Gate house
 - ii. Garage
 - iii. Service building

(2) Marine research aquarium installations

- a. Exhibition tanks
- b. Nursing tanks
- c. Rearing utilities
- d. Displays and signs

(3) Outdoor installations

- a. Gate
- b. Driveway, parking lot and service yard
- c. Seawater reservoir
- d. Waste water treatment facilities
- e. Outdoor utilities

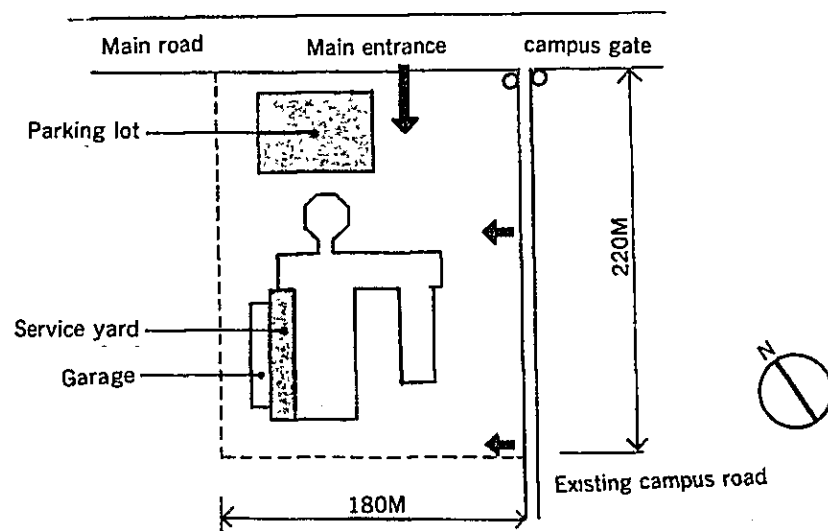
- (4) Supply of equipments
 - a. Laboratory equipments
 - b. Educational equipments
 - c. Rearing equipments

3.3 DESIGN PRINCIPLES

- (1) Emphasis is laid on clear and simple configuration where each one of the different functions of the Center is treated independently, and yet interrelated to each other.
- (2) Laboratory, being purely academic in nature, will be separated from Marine research aquarium and Marine animal museum which will be visited by the public, as they serve not only for research purposes but for educational purposes as well.
- (3) The Center building shall be able to accommodate a large number of visitors.
- (4) Design of the building will be the one suitable to the academic institution as well as the one attractive enough to the general public.
- (5) The building shall have flexibility for the future modification or extension.
- (6) In designing the building, local customs, meteorological conditions and other local conditions shall be taken into consideration.
- (7) Also, local construction techniques, materials and methods shall be given due consideration.

- (8) Easy maintenance and operation of the building and installations. Low running cost. For that purpose, natural ventilation and light will be utilized as much as possible to minimize mechanical installations.

3.4 SITE PLANNING



- (1) An area of approximately $39,600 \text{ m}^2$ indicated by broken lines in above figure will be used as a site for this project.
- (2) Swamps and basins in the site will be reclaimed to the level of the main road by the Government of Thailand.
- (3) To provide easy accessibility to the visitors, an entrance to the site will be located on the main road and close to the campus gate.
- (4) Auxiliary access will be provided from the campus road.

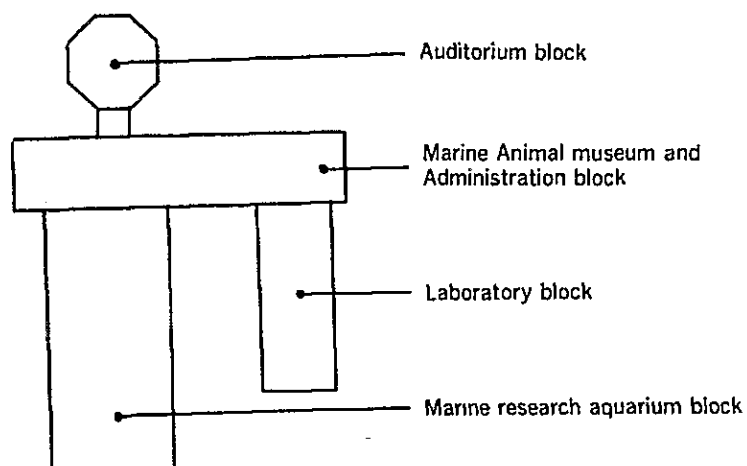
- (5) Sufficient space for parking will be provided in the site in front of the center building.
- (6) Services for the building will be provided from the west side of the center building as this side is less conspicuous. Garage and service building will be located on this side and a service yard will be provided between those and the center building.
- (7) Final position of the center building shall be defined so as not to remove the existing coconut trees as much as possible.

3.5 OUTLINE OF THE BUILDINGS

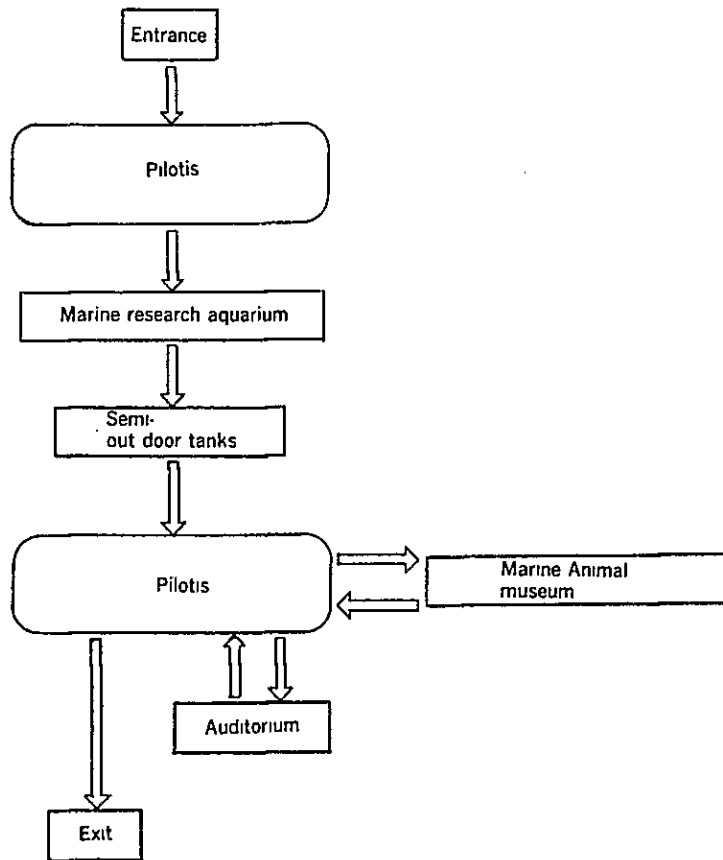
3.5.1 Center building

(1) Overall configuration

Center building will be arranged as a complex of four blocks divided by functions. The Marine animal Museum & administration block will be a key block which connects other blocks to each other.

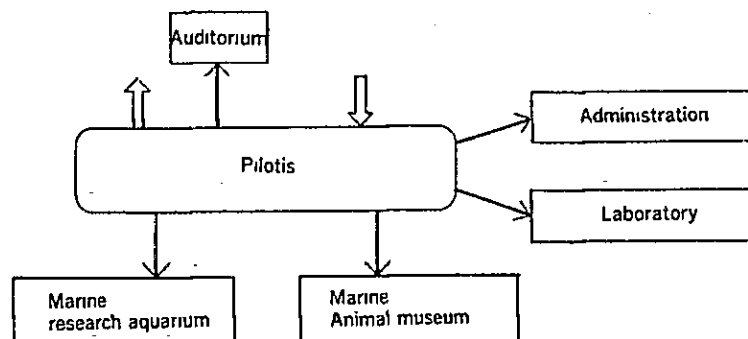


Typical flow of visitors will be as indicate below:



(2) Marine animal Museum & administration block

This block, a two-story reinforced concrete building, will be located at the center of the site facing the main road, representing the Center. Middle part of its first floor will be a large pilotis space. This semi-outdoor space will serve as an entrance hall to the Center and as lobbies for Marine research aquarium, Auditorium and marine animal museum, as well as a space for an exhibition of the collections. This versatile space will facilitate the operation of the Center.



On the east end of the pilotis hall, an administration office, staff canteen and a kitchen will be located. There will be a lecture room, storage and public toilets on the west end of pilotis hall.

The second floor will be used for marine animals museum where a collection of specimens and replicas of marine animals and their environments. Relevant rooms such as chief's office, scientist's offices, studio, storage and conference room will be provided on this floor. Two staircases connect the museum with the first floor pilotis hall to facilitate the circulation of visitors.

(3) Laboratory block

Laboratory block will be one story building of reinforced concrete structure, to be located behind the east end of the center building. This location will be suitable for laboratory block because this is the most visible side of the center building next to the front and also this is the nearest part of it to the rest of the campus building. Possibility for the future extension will be taken into consideration. Sixteen laboratories listed below and relevant facilities such as chief's office, library and scientist's office will be provided in this block

a. Wet laboratories (laboratories which require supply of sea water and compressed air)

- i. Pathology
- ii. Ecology I
- iii. Ecology II
- iv. Phytoplankton
- v. Zooplankton
- vi. Aquaculture I
- vii. Aquaculture II

b. Dry laboratories (laboratories which require supply of fresh water)

- i. Oceanography
- ii. Chemistry
- iii. Instrument room
- iv. Biochemistry
- v. Physiology
- vi. Taxonomy I
- vii. Taxonomy II
- viii. Electron microscope room
- ix. Microbiology

Special care will be taken to provide a good natural ventilation in wet laboratories.

Arranged of each laboratory is as show on drawings attached in Chapter 4.

(4) Marine research aquarium block

This is where the collection of sea animals are reared and exhibited for the purpose of research and education. There will be a space for rearing installation such as filtering and circulating system, air supply system and sea water supply system. Related offices, work rooms, storages and bait room will be located on the service yard side of the block. Roofed corridor will be provided on east side of the building as a return way to the pilotis hall. Outdoor pools will be located halfway on it.

(5) Auditorium block

Auditorium will be located in front of the Marine animals Museum & administration block and accessible from the pilotis hall of it. It will seat approximately 200 and be equipped with audio-visual system. Relevant spaces such as stage, ante-room, vestibule, projection room and mechanical room will be provided.

3.5.2 Ancillary buildings

The following ancillary buildings will be constructed:

- (1) Gate house at the entrance to the site.
- (2) Garage for four cars of the Center and a roofed parking for fifteen cars of the staff.
- (3) Service building comprising storage, work shop, mechanical and electrical equipment rooms and fresh water reservoir room facing the service yard.

3.5.3 Floor Area of the buildings

Approximate floor area of the basic design is indicated below.

Building		indoor	pilotis	total
Center bldg.	Museum & Admin.	2,160	865	3,025
	Aquarium	1,750	350	2,100
	Lab.	965	0	965
	Auditorium	490	120	610
	Sub total	5,365	1,335	6,700
Ancillary bldg.		300	-	300
Total		5,665	1,335	7,000

3.6 STRUCTURAL DESIGN

3.6.1 Basic policy

- (1) Suitable structural system for the size, configuration and the use of the building.

- (2) Due consideration for local conditions such as an availability of the materials, quality of materials and labour, construction methods and cost.

3.6.2 Design Principles

- (1) A structure of the buildings will be reinforced concrete rigid frames, as common structural system in Thailand. Most of the buildings in Bangsaen campus of the University are reinforced concrete structure.
- (2) Whether the type of the foundation be a spread type or a pile will depend upon the results of the soil tests.
- (3) Local products such as cement, fine and coarse aggregate and reinforcing bars will be used as much as possible.
- (4) The design loads will be determined conforming to "BY-LAWS OF THE BANGKOK METROPOLIS, RE: CONTROL OF THE CONSTRUCTION OF BUILDING 1979".
The structural calculation will be performed with the working stress design method according to the design standards of A.I.J. (Architectural Institute of Japan). The permissible stresses in structural materials will be determined with reference to the Thai and Japanese codes.
- (5) The bearing capacities of soil and pile will be determined after the soil tests of the site have been performed.
- (6) Since there has been no sensible earthquake in Thailand, a seismic force will not be taken into account for the structural design, however appropriate wind load will be considered.
- (7) Wind load will be taken into account in accordance with BY-LAWS OF THE BANGKOK METROPOLIS.

3.6.3 Design loads

Based on the foregoing principles, the design loads will be established as follows:

(1) Dead Loads

i. Reinforced Concrete:	2.4 t/m ³
ii. Structural Steel:.	7.85 t/m ³
iii. Brick:	1.9 t/m ³

(2) Live Load

The design loads will be determined conforming to "BY-LAWS OF THE BANGKOK METROPOLIS, RE: CONTROL OF THE CONSTRUCTION OF BUILDING 1979".

The following live loads will be used in the design.

a. Roof	50 Kg/m ²
b. Concrete canopy eaves of roof	100 "
c. Toilet, shower room	150 "
d. Office, conference, canteen, lecture room, dry laboratory	300 "
e. Hall, auditorium, corridor, stairs, kitchen	400 "
f. Museum, aquarium, library, storage, machine room	500 "
g. Wet laboratory	600 "

N.B. Other big loads such as big exhibition tanks, heavy machines etc. will be considered respectively.

(3) Wind Load

Height	Wind Pressure
below 10m high	50 kg/m ²
below 10m and 20m high	80 kg/m ²
between 20m and 40m high	120 kg/m ²

(4) Seismic Load

No seismic load need be considered.

3.6.4 Structural Materials

Principal structural materials to be used will be adopted as follows:

- i. Reinforcement Deformed bar SD30 (TIS Standard)
- ii. Concrete $F_c=210 \text{ kg/cm}^2$ (cylinder strength in 28 days)
- iii. Cement Ordinary Portland Cement (ASTM Standard)
- iv. Structural Steel SS41 (JIS Standard) or equivalent
- v. Pile Pre-stressed concrete or pre-cast concrete pile

3.7 UTILITY DESIGN

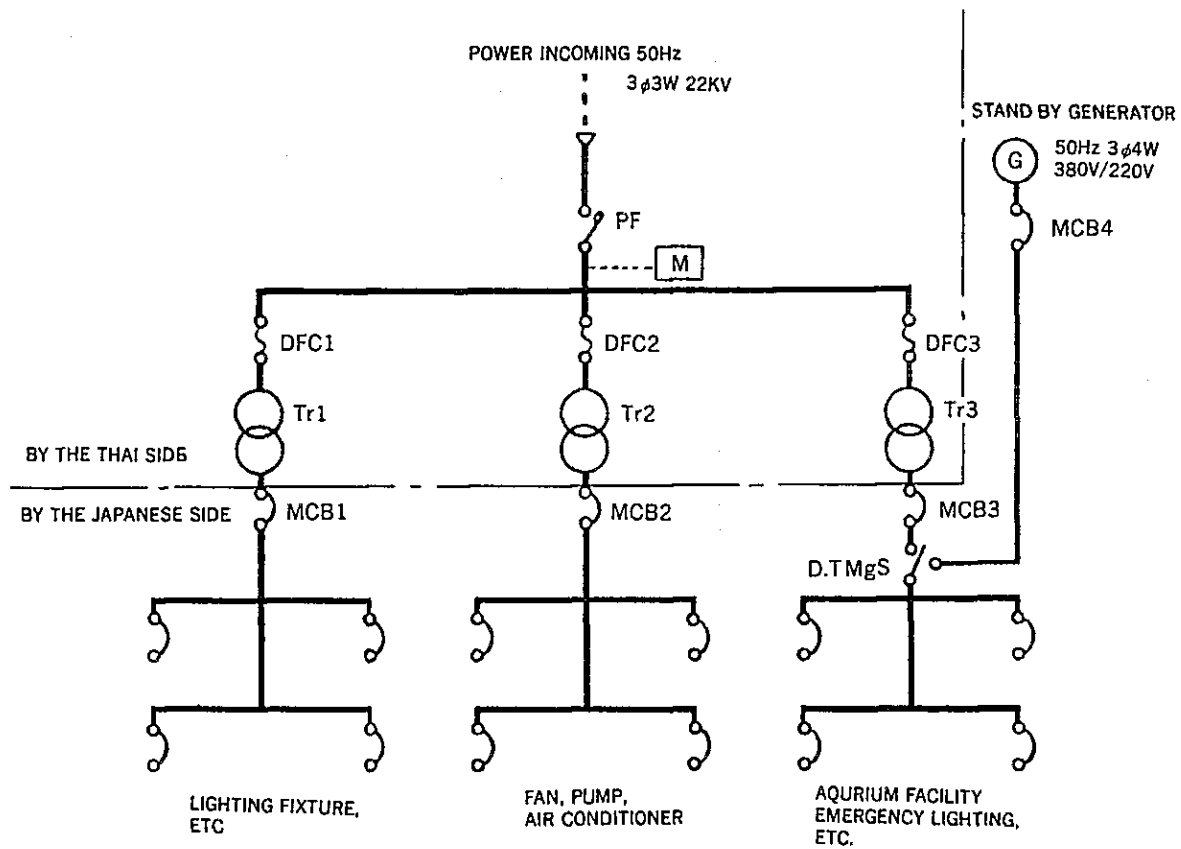
3.7.1 Design policy

- (1) Simple operation, easy maintenance and economical running cost shall be taken into consideration in designing an electrical and a mechanical system for this project to be suitable for local climate conditions and living habits and customs in Thailand.
- (2) Wherever possible, standerized equipments and fixtures will be selected to facilitate the future replacement and exchange.
- (3) The design of electrical and mechanical systems shall be in accordance with codes and regulations in Thailand. When these are not available, Japanese standards will be referred.
- (4) Equipments and materials to be imported from Japan will be comply with JIS (Japanese Industrial Standard) and those to be purchased in Thailand will be generally comply with TIS (Thai Industrial Standard).
- (5) Extensive consideration will be paid on corrosion protection for all the equipments relative to sea water.

3.7.2 Electrical system

(1) Power supply

Electric power of 50 HZ, 3 ϕ 380V and 1 ϕ 220V will be lead in to an electrical room in the service building by the University, then distributed to the power control panels and panel boards for lighting in the building.



POWER SUPPLY ONE LINE DIAGRAM

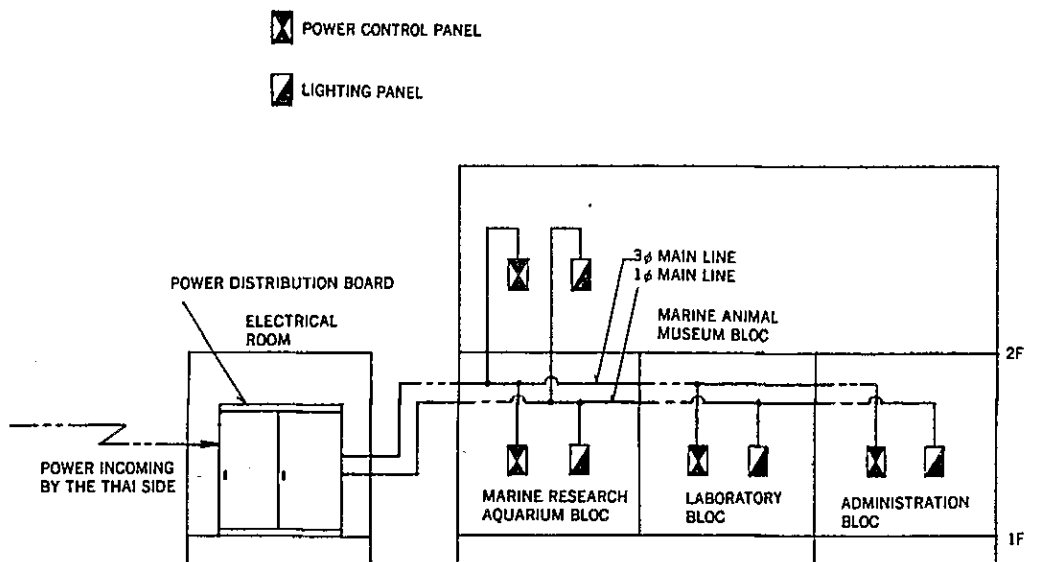
Estimated system design loads are as follows:

Lighting, service outlet	170 KVA
Airconditioning, ventilation	180 "
Plumbing	80 "
Rearing utilities	70 "
Laboratory equipments	70 "
<hr/>	
Total	570 KVA

A generator will be provided in the service building for the power supply for water treatment system for marine research aquarium, emergency lightings, fire-fighting system etc. in case of electric failure. A capacity of the generator is estimated as 150 KVA.

(2) Power mains

3 phase 380 volt and single phase 220 volt power mains will be installed from the distribution panels in the electrical room as far as the power control panels and lighting panel boards. Wiring will be generally installed in metal ducts, racks or conduit pipes.



POWER RISER DIAGRAM

(3) Lighting and service outlets

- a. Natural light will be utilized as much as possible throughout the building. Fluorescent lamps will be mainly used while incandescent lamps will be used for special rooms.
- b. The intensities of illumination for the main rooms will be as follows:

(Space)	(Average illuminance)
Laboratories	300 Luxe
Marine research aquarium	100 "
Marine animals museum	400 "
Auditorium	250 "
Administration offices	300 "
Conference rooms	300 "
Library	300 "
Staff canteen	250 "
Toilets & Corridors	100 "

- c. Service outlets comprise general outlets, kitchen outlets, laboratory equipment power supply outlets, rearing facilities outlets. Most outlets will be of single phase 220 volts.

(4) Power circuit

Wiring and conduiting will be provided to supply power to air-conditioning unit, ventilating fans, ceiling fans, pumps and blowers.

(5) Telephone

About four trunk lines will be provided to the main terminal board in the building by the University.

About twenty extension lines and a push button exchanger will be installed.

(6) Public address system

A public address system will be provided in marine research aquairum, marine animals museum and auditorium.

(7) Television and Radio system

TV and radio antenna will be installed on the top of the building and outlets for TV and radio sets will be provided in staff canteen and night keeper's room.

(8) Fire alarm system

A fire alarm system activated by heat detectors will be provided in the building. Indication panels will be located in the administration office and nightkeeper's room.

3.7.3 Ventilating and cooling system

(1) Ventilating system

Natural ventilation will be generally used by way of architectural treatment throughout the building. In addition, mechanical ventilating by ceiling fans or exhaust fans will be provided as shown below:

Room name	Mechanical ventilating	
	Ceiling fan	Exhaust fan
Marine research aquarium	<input type="radio"/>	<input type="radio"/> *
Marine animals museum	<input type="radio"/>	<input type="radio"/> *
Laboratories	<input type="radio"/> *	<input type="radio"/> *
Library	<input type="radio"/>	
Lecture room	<input type="radio"/>	
Conference rooms	<input type="radio"/>	<input type="radio"/> *
Offices	<input type="radio"/>	
Staff room	<input type="radio"/>	
Scientist's room	<input type="radio"/>	
Staff canteen	<input type="radio"/>	
Kitchen		<input type="radio"/>
Toilet		<input type="radio"/>
Generator room, Mechanical room		<input type="radio"/>

*: Depends on room conditions

(2) Cooling system

- a. Air-cooled split type room airconditioners will be installed in the following laboratories:
 - i. Instrument room
 - ii. Taxonomy II laboratory
 - iii. Electron microscope room
 - iv. Microbiology laboratory
 - v. Phytoplankton laboratory
- b. Air-cooled package type airconditioner will be installed in the auditorium. Noise level will be low enough for movie and lecture.
- c. Design temperature for cooling will be as follows:
 - i. Outdoor air temperature 35°C DB
 - ii. Room air temperature 27-29°C DB
- d. Dehumidifier will be installed in Taxonomy II.

3.7.4 Plumbing system

(1) Fresh water supply system

- a. Fresh water will be supplied to a reservoir tank in the utility block by the Thai Government, from which water will be pumped up to an elevated tank to be distributed to the rooms where water supply is required by way of gravity.
- b. Reservoir tank and elevated tank will have inside partitions to enable to drain half of their capacity for cleaning without disturbing the supply.

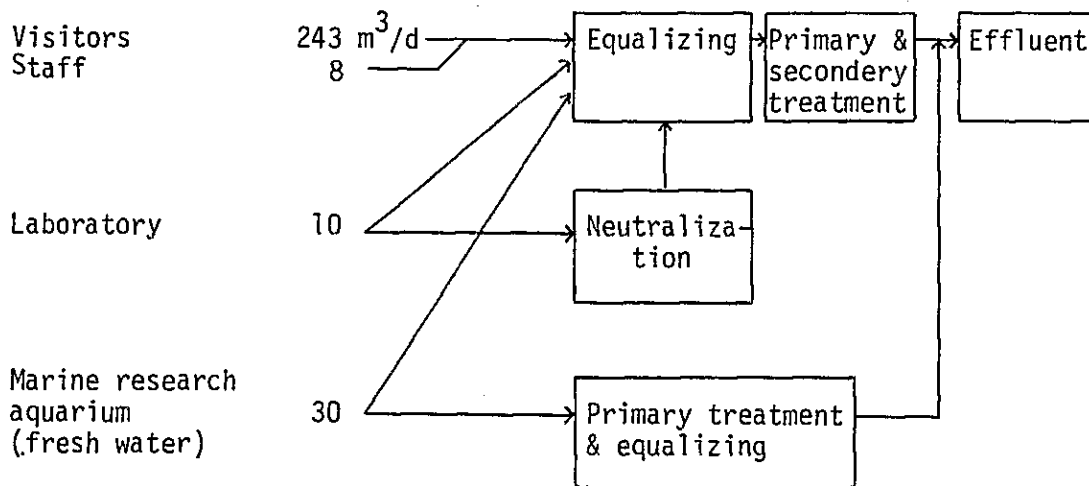
c. Water consumption is estimated as indicated below:

a. Visitors	Av. 2,700 ^C (Max. 8,100 ^C)	
	x 0.020 m ³ /c.d.	Av. 54m ³ /d (Max. 162m ³ /d)
b. Staff	Av. 50 ^C x 0.200m ³ /c.d.	" 10
c. Marine research aquarium		" 30
d. Laboratories		" 10
e. Miscellaneous		" 45

Total Av. 149

(2) Sewage and drainage system

a. There will be separate systems for sewage, drainage, laboratory waste water and sea water drain. Effluent water will be discharged to the pond adjacent to the Center which will be prepared by the University after being treated by the treatment facility. Toxic substances, radioactive substances, heavy metal substances, strong acid, strong base and solvent, if there are any, shall not to be discharged to these treatment facilities. They shall be recovered separately. Estimated volume of various waste water and treatment flow will be as indicated below:

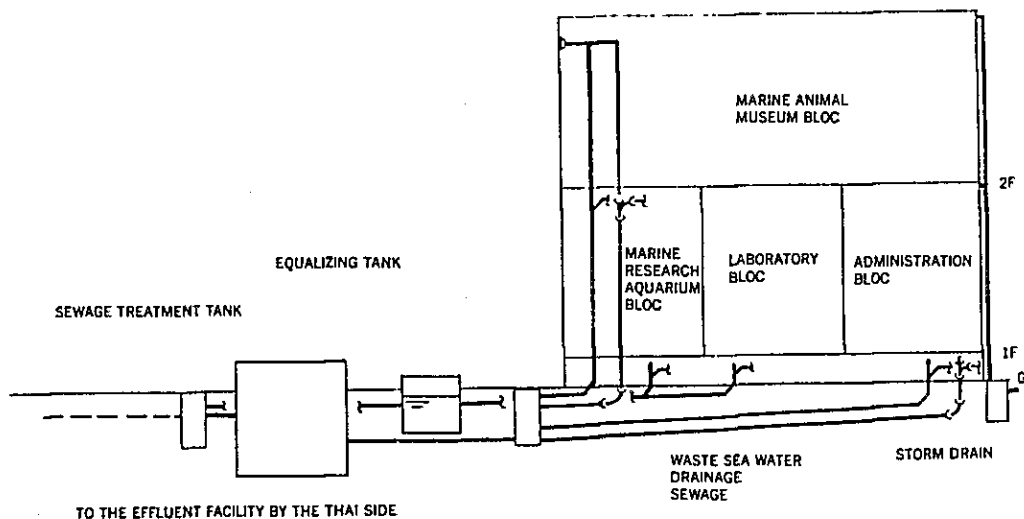


b. Capacity of sewage treatment is estimated as 90 m³/d. (average) and 200 m³/d. (max.). Influent and effluent water quality will be as follows:

Flow	BOD	SS
Influent	200 ppm	250 ppm
Effluent	120 ppm	

(3) Plumbing fixtures

Water closets, urinals, lavatories, mirrors and service sinks will be installed in the toilets. Local type fixtures will be used in the public toilets and western type ones for the staff toilets.



SEWAGE & DRAINAGE SYSTEM DIAGRAM

3.7.5 Kitchen equipment

Kitchen for staff canteen will facilitate a food and refreshment service for 50 persons.

3.7.6 Fire-fighting system

Fire extinguishers will be used.

3.7.7 Gas supply system

LPG will be supplied to the kitchen and laboratories. For other rooms where heat source is required for hot water supply, electricity will be utilized.

Gas cylinders will be installed outside of the rooms where gas is supplied.

3.8. MARINE RESEARCH AQUARIUM INSTALLATION

3.8.1 Design policy

- (1) Layout and display of the exhibition tanks shall be good enough to attract visitors' interest.
- (2) Description board for the exhibition tanks shall be academic in nature, but their presentation shall be easy to comprehend.
- (3) Good environment for fish and marine animals to ensure their longevity.
- (4) High durability of the tanks and utility systems.
- (5) Easy maintenance.
- (6) Low running cost.
- (7) Flexibility for the future modification.

3.8.2 Tanks

The following tanks are to be installed for the purpose of research and education:

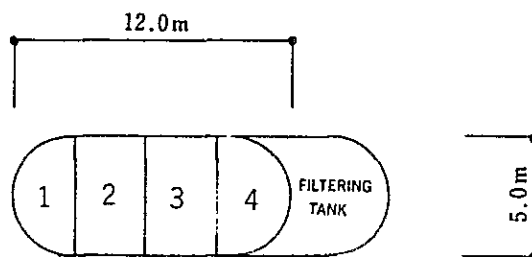
(1) Exhibition tanks

a. Indoor tanks

Type	Size of tank(m)			Volume of circulation water (m ³ /h)	Number	Total capacity (m ³)
	W	H	D			
A	2.0	0.5	1.0	1.0	4	4.0
B	1.0	1.0	1.0	1.0	10	10.0
C	2.0	1.0	1.0	2.0	8	16.0
D	2.7	1.3	1.5	5.3	4	21.2
E	5.4	1.3	1.5	10.6	2	21.2
F	8.0	2.5	10.0	200.0	1	200.0
Total					29	272.4

b. Semi-outdoor tanks

Four tanks will be arranged as indicated below
Total capacity of the tanks will be 72 m³.



(2) Nursing tanks

In addition to the exhibition tanks and pools, nursing tanks listed below will be installed.

Type	Size of tank (m)			Volume of circulation water (m ³ /h)	Number	Total capacity (m ³)
	W	D	H			
a	1.0	1.0	1.0	1.0	2	2.0
b	2.0	1.0	1.0	2.0	2	4.0
c	1.0	1.0	1.0	1.0	6	6.0
d	2.0	1.0	1.0	2.0	4	8.0
e	2.5	2.0	1.0	5.0	2	10.0
Total					16	30.0

3.8.3. Rearing installations

(1) Filtering and circulating system

Filtering and circulating system is of closed circulation system by open type balancing tank.

Exhibition tanks, nursing tanks and semi-outdoor tanks will be individually equipped with open type balancing tank. For circulating, air lift pumps will be used.

The turnover for exhibition tanks and nursing tanks will be about 24 turns a day.

This system has many advantages as follows:

- a. The opentype balancing tank system is good for bio-chemical filtering and is a very stable system.
- b. Maintenance work is easy because the level the balancing tanks are installed on is the same level the exhibition tanks are, and the water conditions can be visually inspected.
- c. The balancing tanks may be utilized as standby sea water tanks.
- d. By using air lift pumps , oxygen is easily supplied.
- e. Power loss for circulating is small.

(2) Sea water supply system

Sea water will be led into or carried into the sea water filtering tank attached to the sea water reservoir by the University.

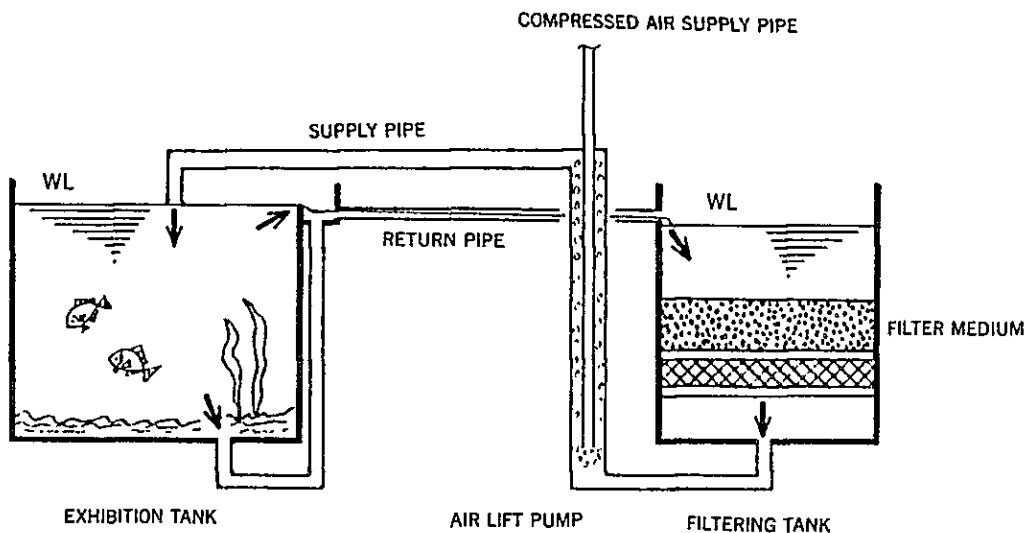
Then, sea water will be pumped up to the elevated sea water tank to be distributed to the marine research aquarium, the laboratories and the semi-outdoor tanks by gravity. The capacity of the sea water reservoir and that of the elevated sea water tank are as follows.

The sea water reservoir : 200 m^3

The elevated sea water tank: 10 m^3

(3) Compressed air supply system

Compressed air will be supplied to the air lift pumps and air ration devices in exhibition and nursing tanks in marine research aquarium and laboratories. In case of electricity failure, power will be supplied to those system from standby generator.



OPEN TYPE BALANCING TANK SYSTEM DIAGRAM

3.9 EQUIPMENT

The following equipment will be supplied and installed.

1. Laboratory Equipment

(1) Oceanography	<u>Quantity</u>
1. Echo sounder	1 set
2. Salinometer	1 "
3. Dissolved oxygen analyzer	1 "
4. Recording thermometer	1 "
5. Current meter	1 "
6. Inverting thermometer (3 pcs)	1 "
7. Mapping desk (with lighting)	1 "
8. Bench	1 "
9. Cupboard	1 "
10. Map cabinet	1 "
11. Water sampler	1 "
12. Grab	1 "
13. Cover	1 "
 (2) Chemistry	
1. Labo bench	2 sets
2. Water analyzing apparatus with spectrophotometer	1 set
3. Atomic absorption	1 "
4. IR (infrared spectroscope)	1 "
5. BOD Analyzing apparatus	2 sets
6. COD Analyzing apparatus	1 set

7.	Dissolved oxygen analyzer	1 set
8.	Balance (analytical)	1 "
9.	Fume cabinet	1 "
10.	Top-loading balance	1 "
11.	Deionizer	1 "
12.	Water bath	2 sets
13.	Drying oven	2 "
14.	Muffle furnace	1 set
15.	Magnetic stirrer	3 sets

(3) Instrument Room

(Common use equipments)

1.	Instrument table A	2 sets
	B	1 set
2.	Microscope binocular	4 sets
3.	Stereoscopic microscope binocular	4 "
4.	Microphotograph camera with accessories	1 set
5.	Electrophoresis	1 "
6.	Distillation equipment (pure water)	1 "
7.	Fluorescence microscope	1 "
8.	High speed centrifuge	1 "
9.	Oven	1 "
10.	PH meter	1 "
11.	Cart	3 sets
12.	Balance (analytical)	1 set

(4) Biochemistry

1. Labo bench	2 sets
2. Fume cabinet	1 set
3. Refrigerated centrifuge	1 "
4. Deep freezer	1 "
5. Refrigerated bath	1 "
6. Refrigerator	1 "

(5) Physiology

1. Labo bench	1 "
2. Physiological investigation apparatus for marine physiology	1 "
3. Refrigerator	1 "

(6) Pathology

1. Tank (see-through, 200L)	2 sets
2. Tank (see-through, 100L)	6 "

(7), (8) Ecology

1. Labo bench	2 "
2. Direct reading balance	1 set
3. Soil analysis apparatus	1 "
4. PH meter	1 "
5. Thermohygrometer	1 "
6. Soil sampler	1 "

(9), (10)	Taxonomy	
1.	Working table	2 sets
2.	Refrigerator	2 "
3.	Shelf	20 "
(11)	Electron Microscope	none
(12)	Microbiology	
1.	Labo bench	1 set
2.	UV sterilizer	1 "
3.	Autoclave	1 "
4.	Drying oven	1 "
5.	Balance (analytical)	1 "
6.	Refrigerator	1 "
7.	Bacterial counter	1 "
8.	Incubator	1 "
9.	Deep freezer	1 "
(13)	Phytoplankton	
1.	Growth chamber	1 "
2.	Refrigerator	1 "
3.	Phytopkankton net	2 sets
4.	Tank (FRP, 200L)	4 "
5.	Tank (FRP, 100L)	6 "
(14)	Zooplankton	
1.	Profile projector	1 set
2.	Refrigerator	1 "

- | | |
|-------------------------------|--------|
| 3. Water sampler (5-10L, 20m) | 1 set |
| 4. Zooplankton net | 1 " |
| 5. Tank (FRP, 500L) | 2 sets |
| 6. Tank (FRP, 200L) | 4 " |
| 7. Tank (FRP, 100L) | 6 " |

(15), (16) Aquaculture

- | | |
|-----------------------------|--------|
| 1. Aquarium set (60 - 100L) | 5 sets |
| 2. Tank (FRP, 500L) | 4 " |
| 3. Tank (FRP, 200L) | 3 " |
| 4. Refrigerator | 1 set |
| 5. Thermocontroller | 2 sets |

2. Educational Equipment

(1) Auditorium	<u>Quantity</u>
1. 16mm projector	1 set
2. Electric screen	1 "
3. Audio control console	1 "
4. Tape Recorder	2 sets
5. Speaker	10 "
6. Microphone with stand	4 "
7. Wireless microphone (complete set with two wireless mic.)	1 set
8. Cabinet for projection equipment	1 "
9. Slide projector (automatic type)	2 sets
10. Cassete tape recorder for above	2 "
11. Overhead projector	1 set
12. Screen (1.5 x 1.5m)	1 "
13. Video tape recorder (with accessories)	1 "
14. Wire and wiring materials	1 lot
15. Chair	200 pcs.

(2) Library

1. Bookshelf	10 sets
2. Catalog cabinet	2 "

<u>3. Rearing Equipment</u>	<u>Quantity</u>
1. Lux-meter in water	1 set
2. Air compressor with cart	2 sets
3. Portable pump in sea water	3 "
4. High pressure cleaner	1 set
5. Pump-up cleaner	1 "
6. Oxygen dispersion apparatus	30 sets
7. Tank	20 "
8. Working bench	2 "
9. Antifreezing bath	2 "
10. Platform scale (2 kg)	1 set
11. Platform scale (20 kg)	1 "
12. Platform scale (100 kg)	1 "
13. Tank (FRP with insulation)	2 sets
14. Container	2 "
15. Carrying cart	2 "
16. Oxygen gas cylinder	2 "
17. Sea water pump (handy type)	1 set
18. Truck	1 "
19. Aqualang set	2 sets
20. Aqualang, hose type	1 set
21. Air compressure	1 "
22. Air compressure, low pressure	1 "

3.10 Scope of the Works

3.10.1 The following buildings, facilities and equipments for the Center will be provided by the Government of Japan.

(1) Buildings

(Including utility services)

a. Center building, comprising

- i. Marine animals museum & administration block
- ii. Research aquarium block
- iii. Laboratory block
- iv. Auditorium block

b. Ancillary building

- i. Gate house
- ii. Garage
- iii. Service buildings

(2) Research aquarium installations

- a. Exhibition tanks
- b. Nursing tanks
- c. Rearing utility services
- d. Displays and sings

(3) Outdoor installations

- a. Gate
- b. Driveway, parking and service yard
- c. Seawater reservoir tank
- d. Waste water treatment facility
- e. Outdoor utility services

(4) Supply of equipments

- a. Laboratory equipments
- b. Educationalequipments
- c. Rearing equipments

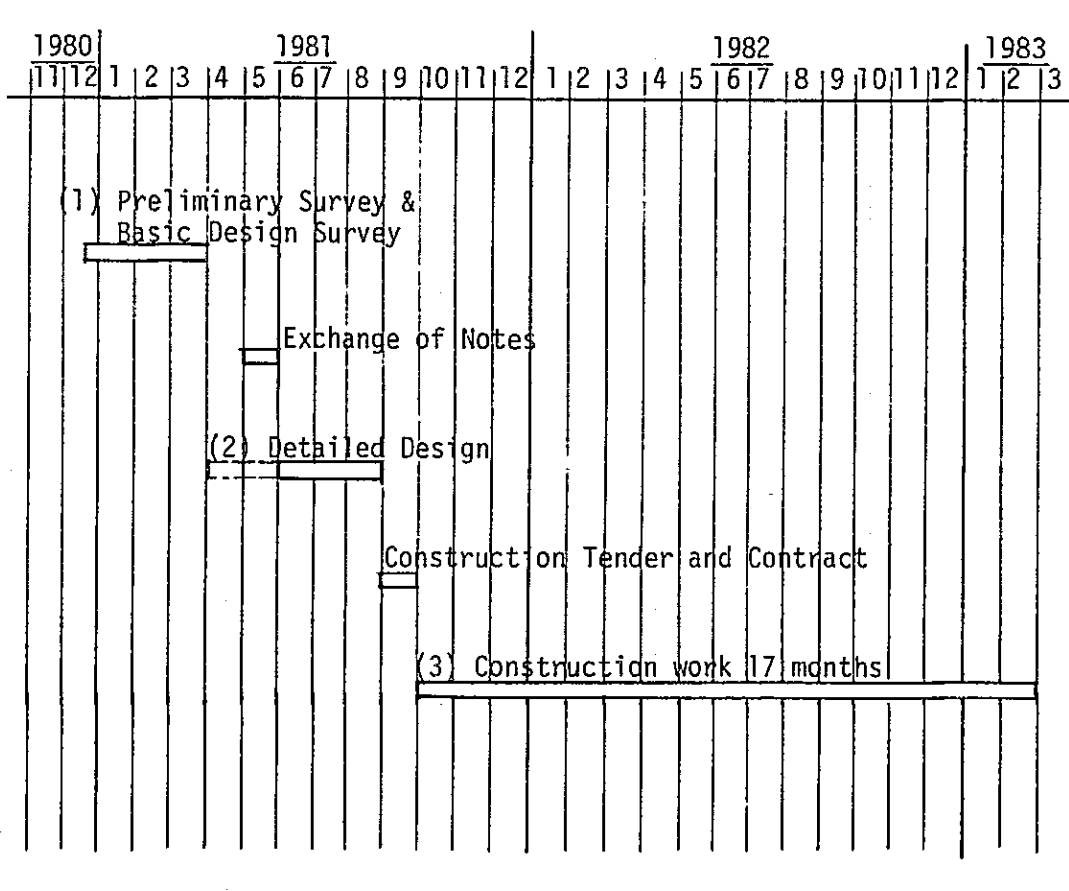
3.10.2 The Government of the Kingdom of Thailand will undertake the following items:

- (1) Reclamation of swamps and basins.
- (2) Clearance and leveling of the site.
- (3) Electric power supply and telephone line connection into the building.
- (4) Fresh water supply.
- (5) Sea water intake and supply to the reservoir in the building
Provision of facility for effluent water from the Center.
- (6) Office furniture, miscellaneous equipment, utensils etc.
- (7) Landscaping, reflection pools and fences.
- (8) Supply of marine animals for marine research aquarium.
- (9) Supply of specimens and exhibiting items for marine animals museum.
- (10) Provision of data and information necessary for the construction of the Center, including topographic survey, soil test and other geological data.

3-11 OVERALL PROJECT SCHEDULE (Tentative)

Since the project is to be implemented under the Grant Aid programme by the Japanese Government, the schedule is proposed as shown below. The schedule is divided into:

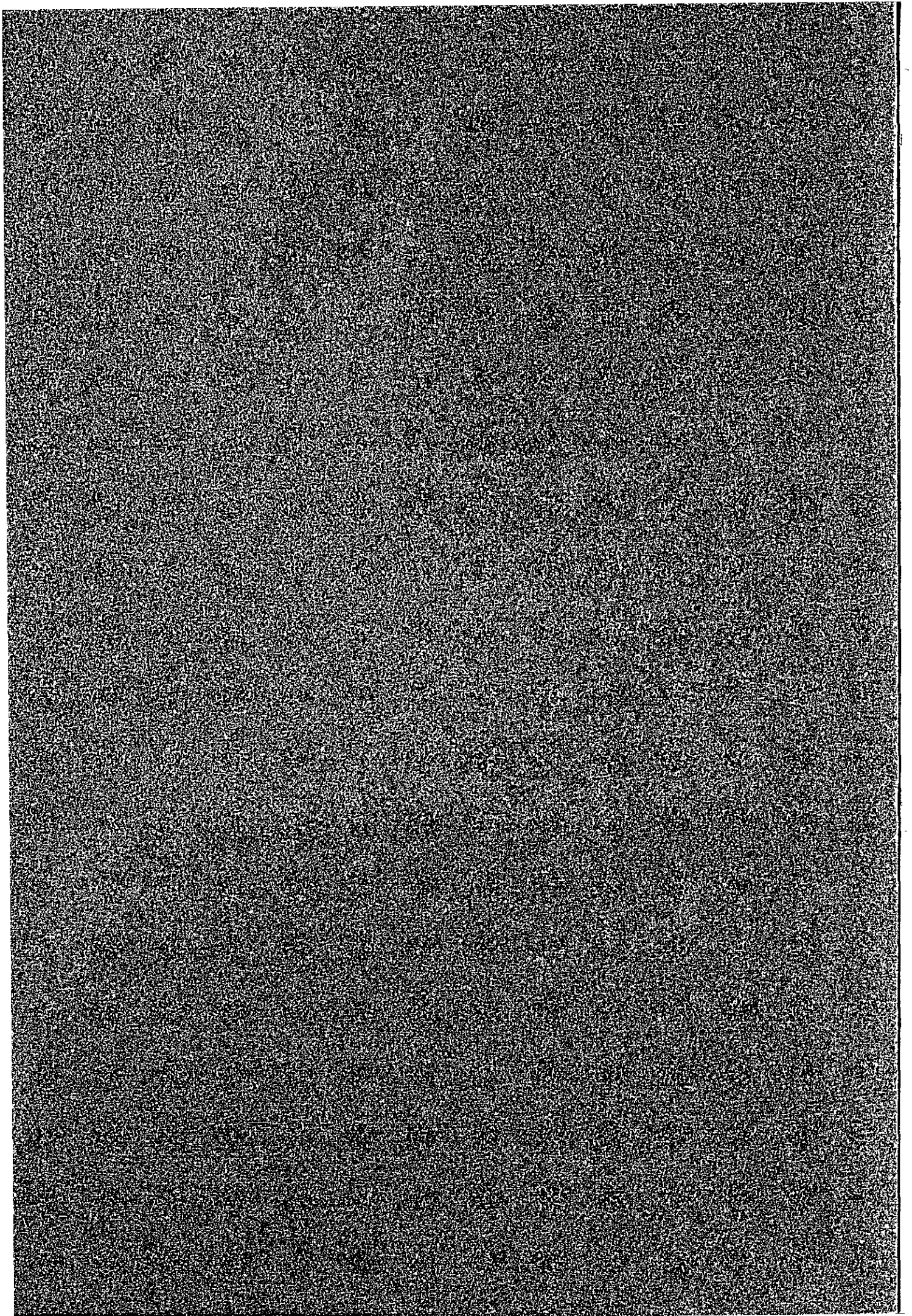
- (1) Basic Design Survey undertaken as part of the Japanese Technical Cooperation programme and
- (2) Detailed Design and (3) Construction work by the Grant Aid scheme.



Note in the above schedule

- 1. Exchange of Notes is assumed to be concluded by May 1981
- 2. Detailed Design work is consequently carried out up to August
- 3. Construction Tender and Contract are undertaken in September 1981
- 4. Construction schedule is conducted for a seventeen months period from October 1981 through February 1983

CHAPTER 4 DRAWINGS

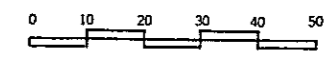
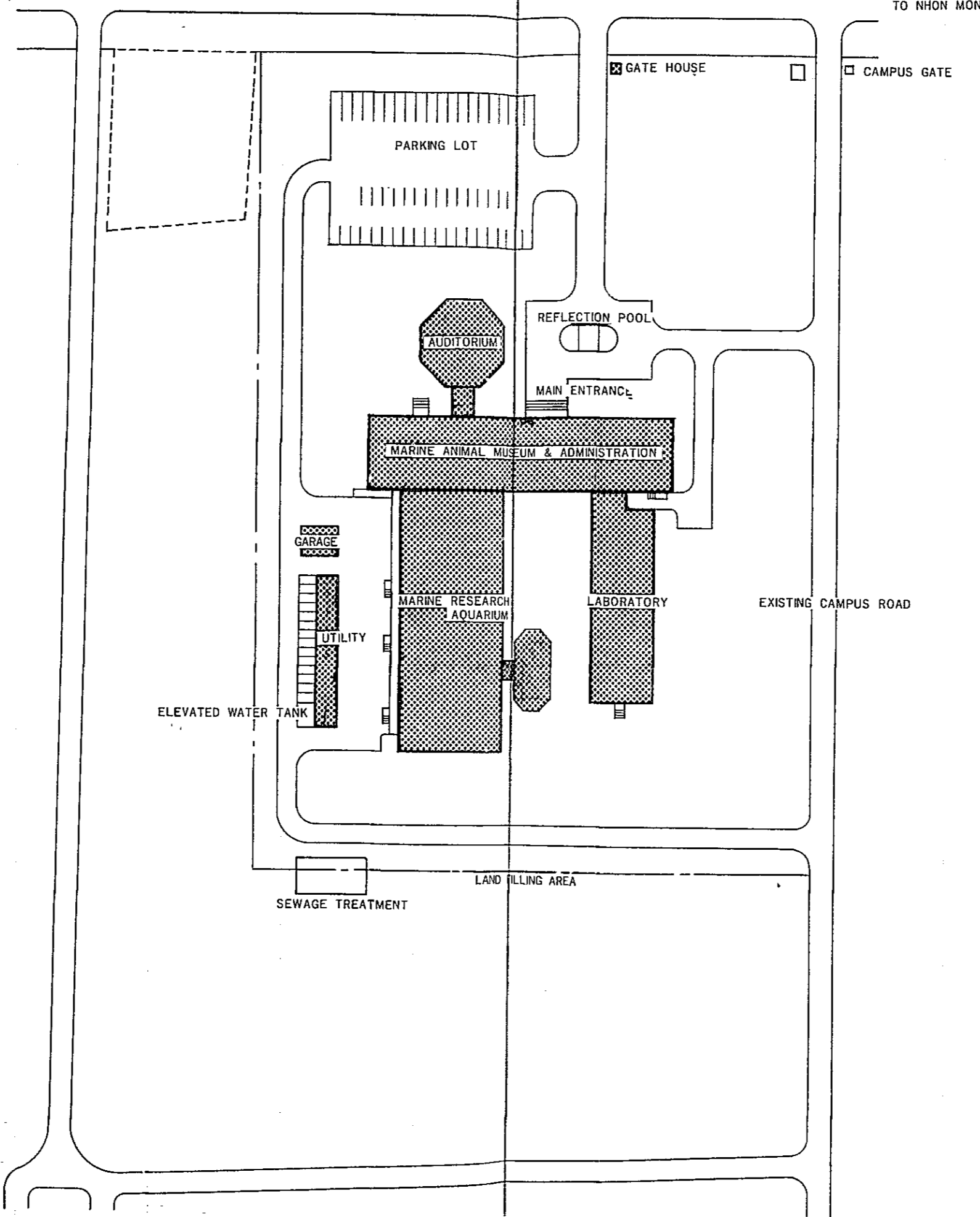


DRAWING LIST

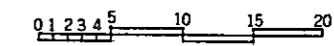
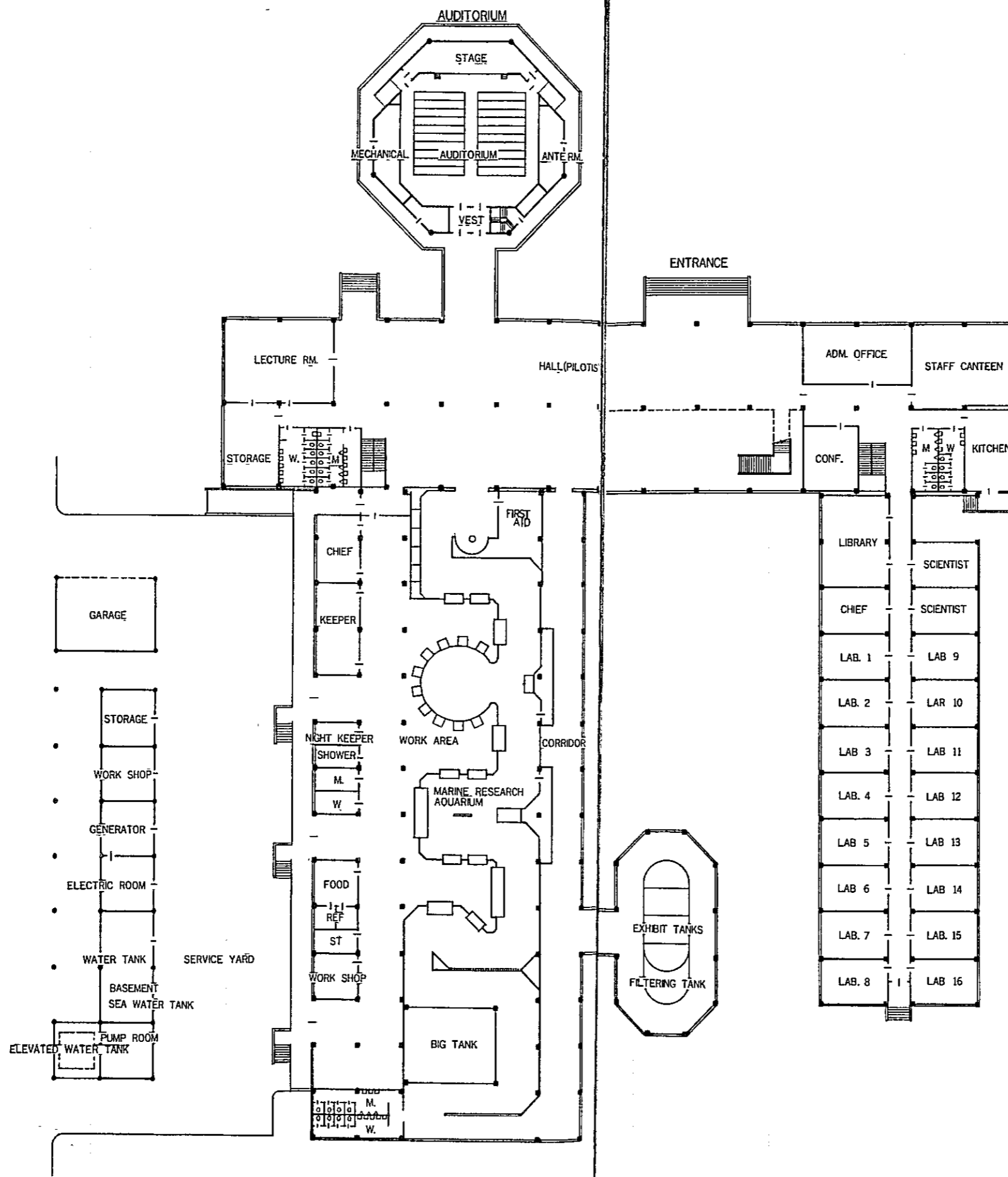
1. PLOT PLAN
2. 1ST FLOOR PLAN
3. 2ND FLOOR PLAN
4. ELEVATIONS & SECTIONS
5. LABORATORY PLANS
6. UTILITY SERVICES FOR LABORATORIES

TO BANGSAEN BEACH (APPROX 1KM)

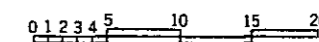
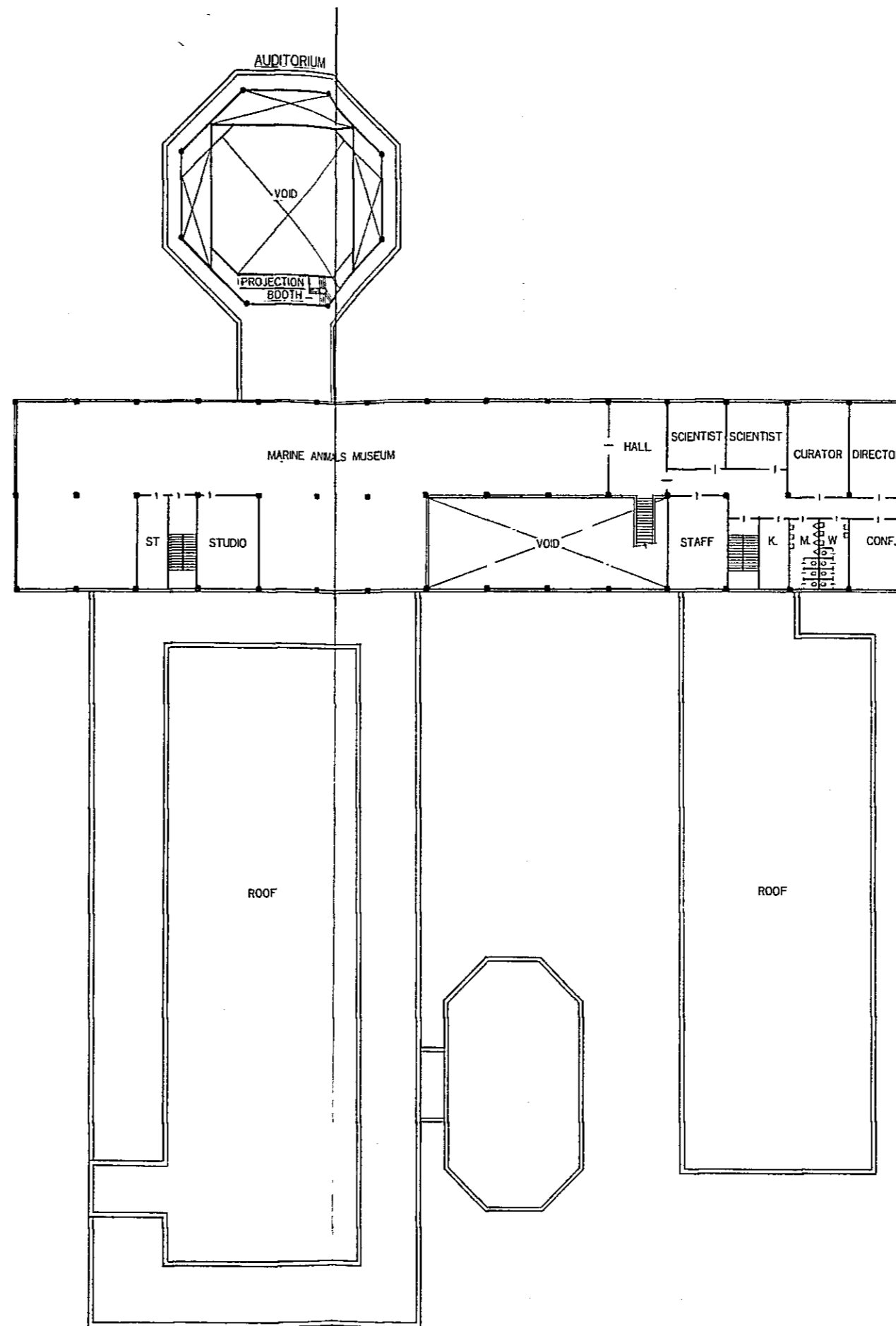
TO NHON MON



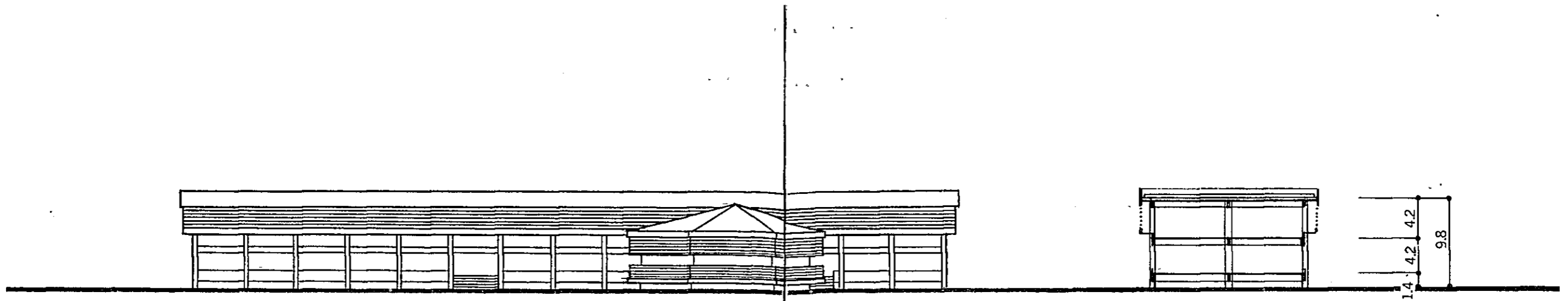
PLOT PLAN
BANGSAEN MARINE SCIENCE CENTER



1st FLOOR PLAN
 BANGSAEN MARINE SCIENCE CENTER

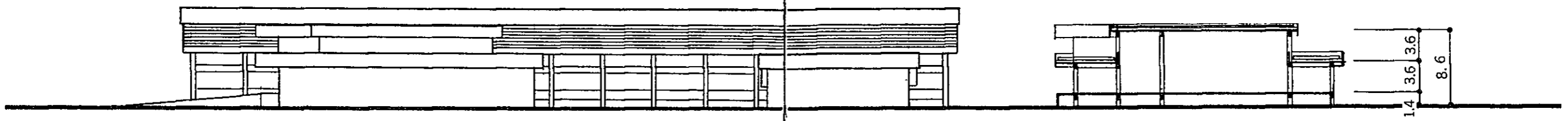


2ND FLOOR PLAN
 BANGSAEN MARINE SCIENCE CENTER



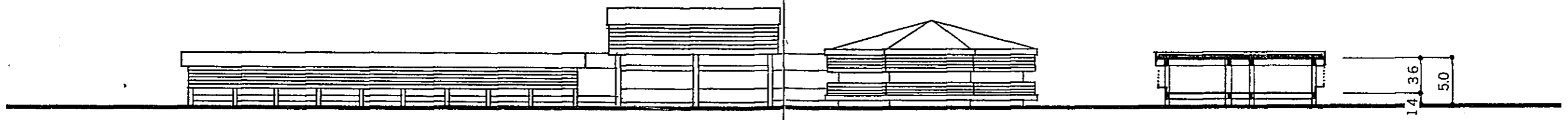
NORTH ELEVATION

SECTION (MARINE ANIMALS MUSEUM)



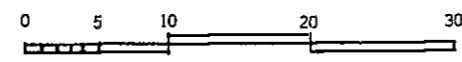
SOUTH ELEVATION

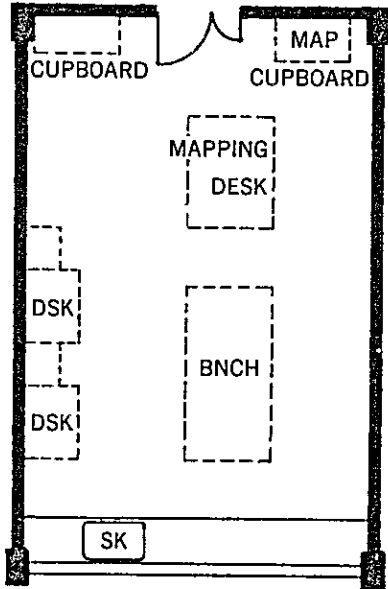
SECTION (RESEARCH AQUARIUM)



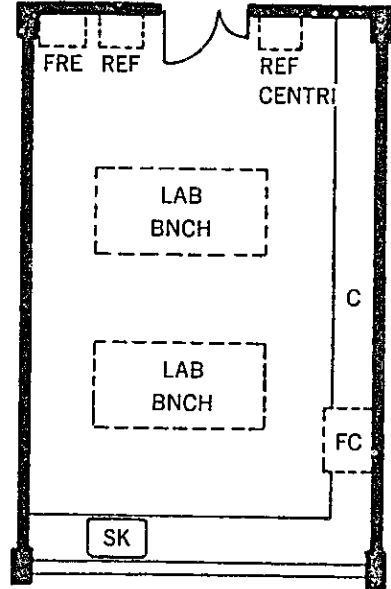
EAST ELEVATION

SECTION (LABORATORY)

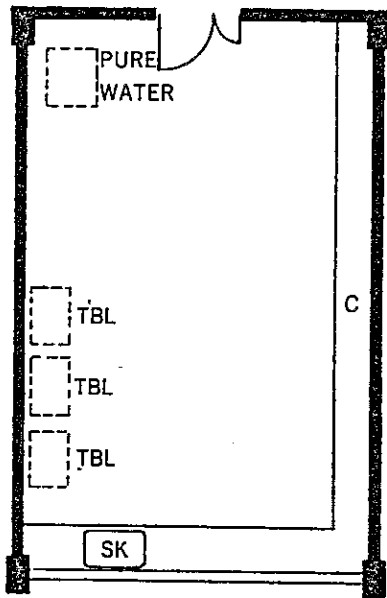




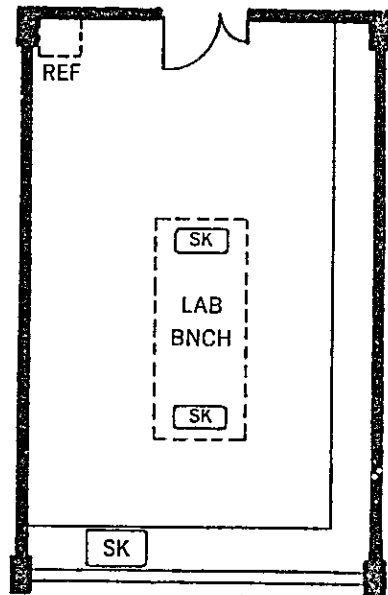
LAB. NO.1
OCEANOGRAPHY



LAB. NO.4 LAB. NO.2
BIOCHEMISTRY CHEMISTRY

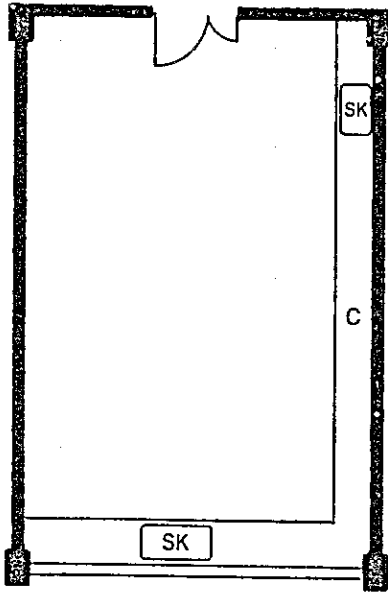


LAB. NO.3
INSTRUMENT

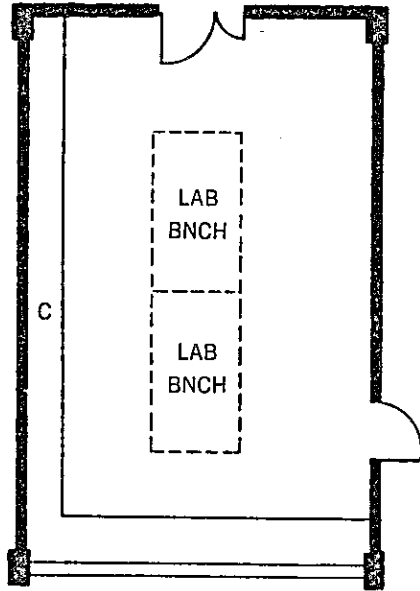


LAB. NO.5
PHYSIOLOGY

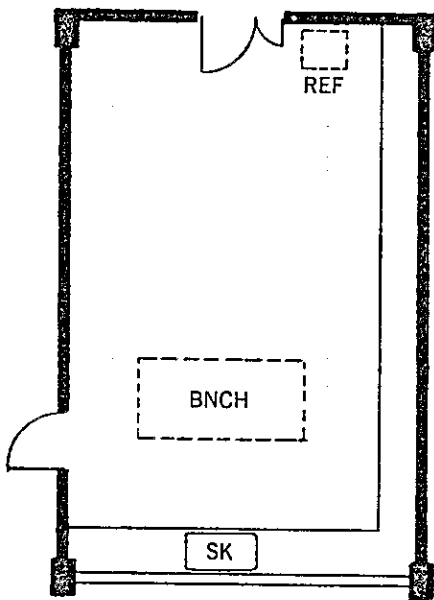
LABORATORY PLAN 1



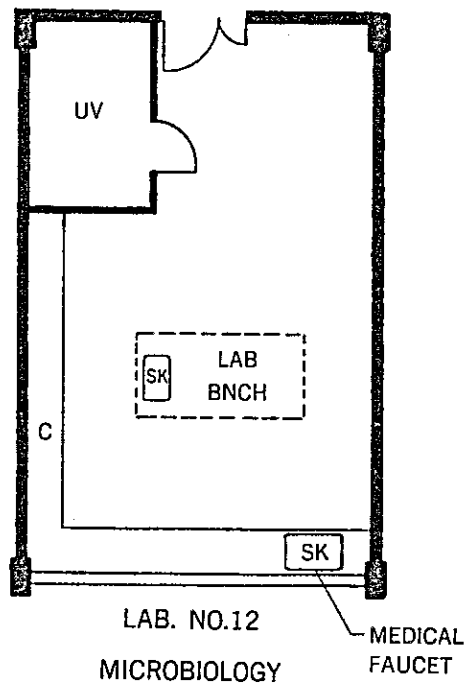
LAB. NO.6
PATHOLOGY



LAB. NO.7, 8
ECOLOGY I, II (SINK×2)

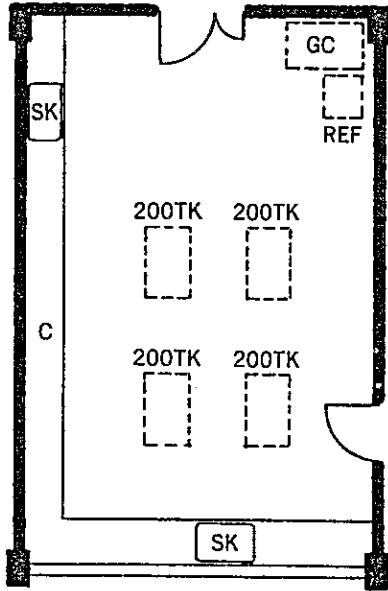


LAB. NO.9, 10
TAXONOMY I, II

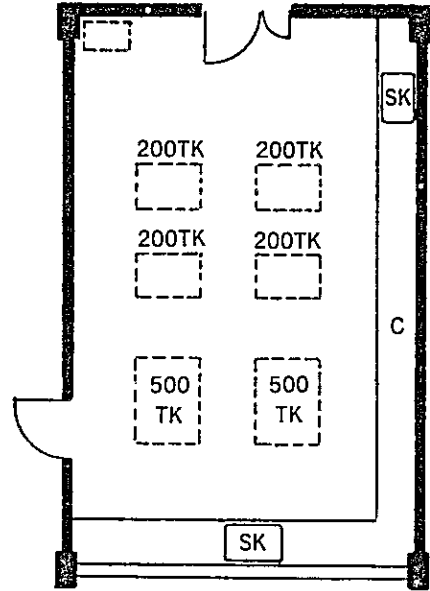


LAB. NO.12
MICROBIOLOGY
MEDICAL FAUCET

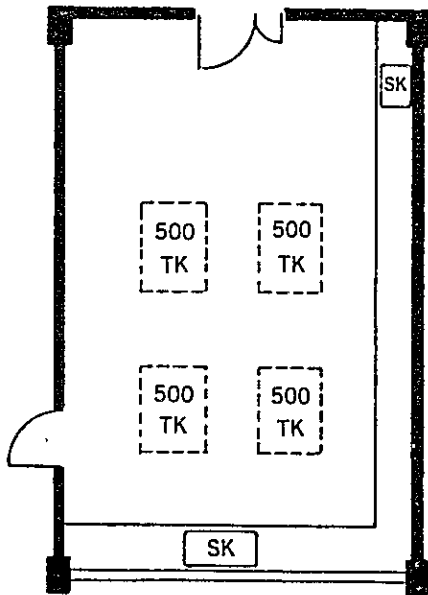
LABORATORY PLAN 2



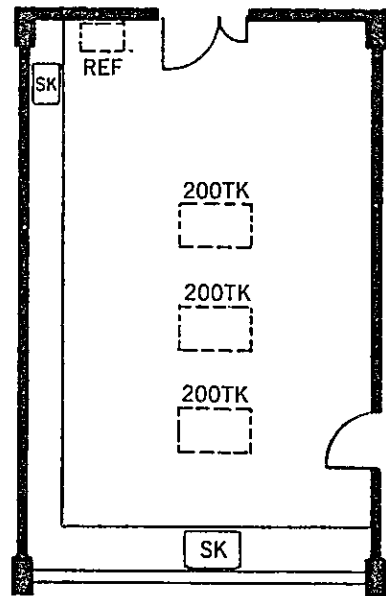
LAB. NO.13
PHYTO PLANKTON



LAB. NO.14
ZOO PLANKTON



LAB. NO.15
AQUACULTURE I



LAB. NO.16
AQUACULTURE II

UTILITY SERVICES FOR LABORATORIES

	FW	SW	D	LD	CA	AC	L/S
1. Oceanography	0		0	0			0
2. Chemistory	0		0	0			0
3. Instruments						0	0
4. Biochemistory	0		0	0			0
5. Physiology	0		0	0			0
6. Pathology	0	0	0		0		0
7. Ecology I	0	0	0		0		0
8. Ecology II	0	0	0		0		0
9. Taxonomy I	0		0				0
10. Taxonomy II	0		0			0	0
11. Electron Microscope						0	0
12. Microbiology	0		0			0	0
13. Phytoplankton	0	0	0		0	0	0
14. Zooplankton	0	0	0		0		0
15. Aquaculture I	0	0	0		0		0
16. Aquaculture II	0	0	0		0		0

FW : Fresh Water Supply

SW : Sea Water Supply

D : Drainage

LD : Laboratory Drainage

CA : Compressed Air Supply

AC : Air Conditioning

L/S : Lighting & Service Outlets

CHAPTER 5 EVALUATION OF THE PROJECT

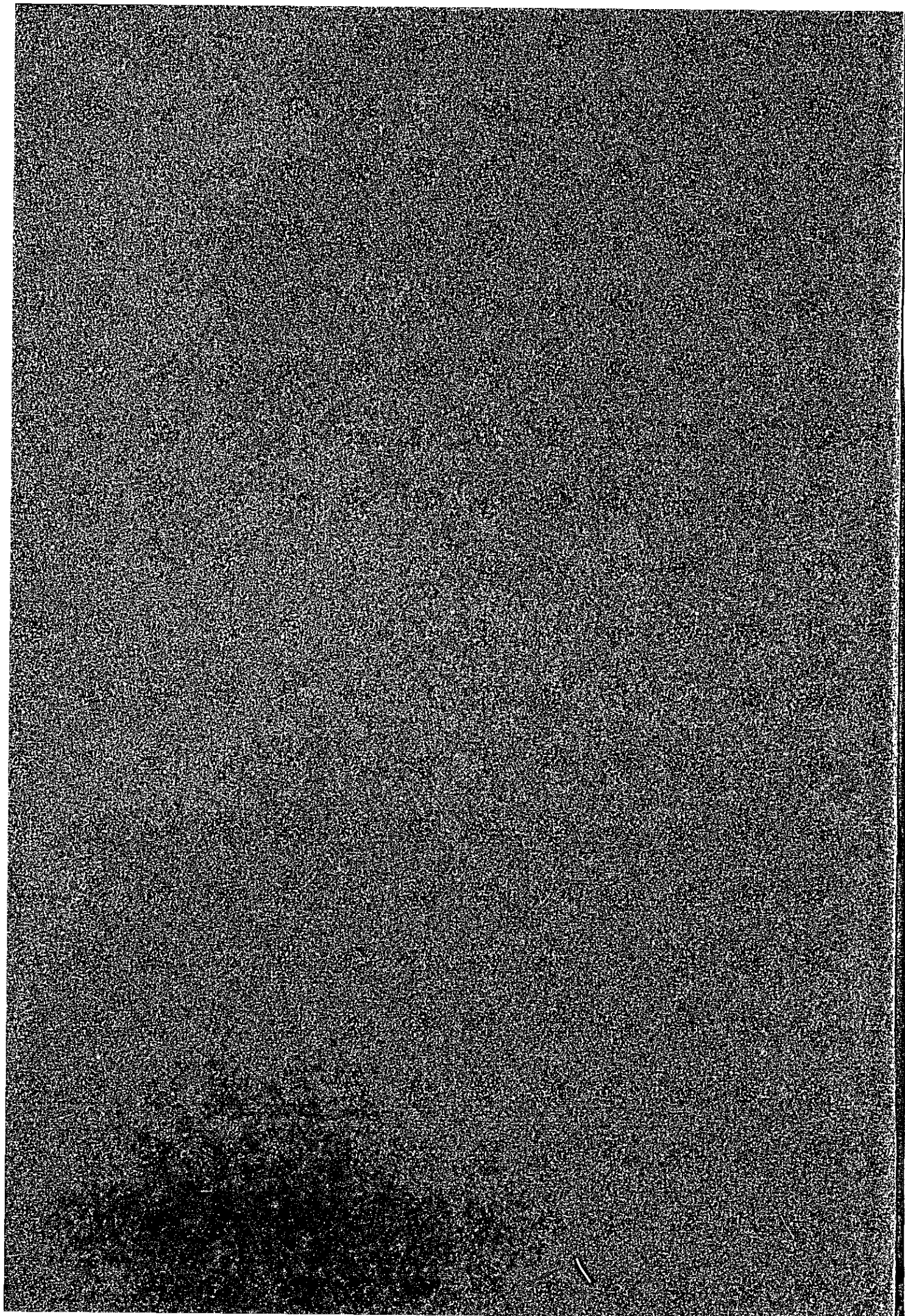


CHAPTER 5 CONSIDERATION

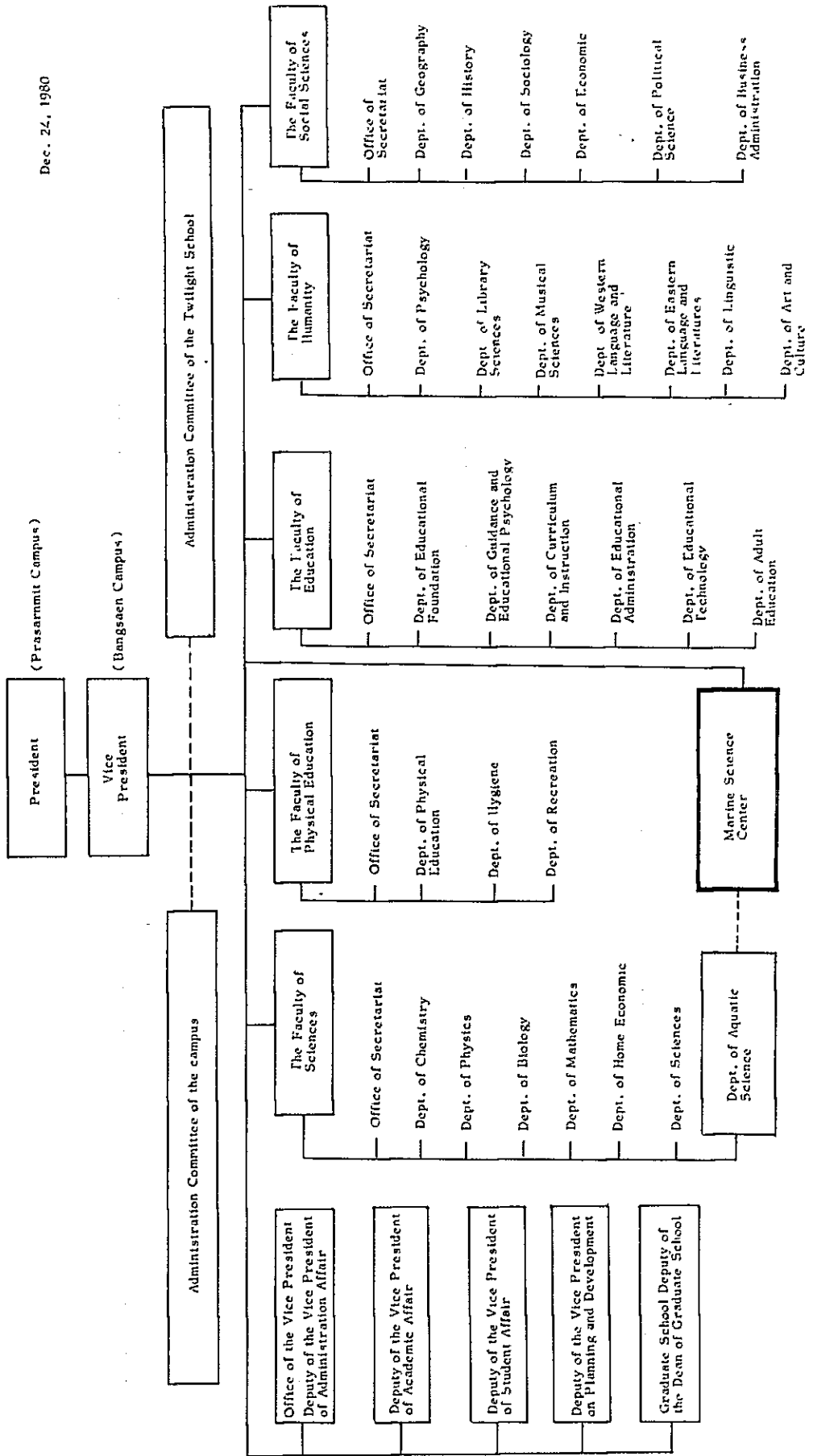
1. The planned Bangsaen Marine Science Center will, upon its completion, become the best of its kind not only in Thailand, but in Southeast Aisa, and to help promote research studies, development of marine resources and education.
2. It is planned that the Center will serve as a research facility specializing in marine animals in and around Thai Waters. Being unique in nature and high in quality, the Center will have good international contribution, as the outcome of their research will be shared with overseas research organizations including Japan.
3. The Unviarsity is highly interested in the improvement and acceleration of research works at the facility. They are eagerly pushing forward a plan not only to improve the quality and quantity of researchers at the University, but also to establish a network of cooperation and coordination of research activities with other universities and research organizations in Thailand. Therefore, we can expect good achievements from the facility.
4. The University has already accumulated experience in the management of the facility of this kind through the management of the existing facility. They will be capable to operate the new Center on the basis of this experience.
5. The facility will be open to the public and to the students of Thailand for education purpose. By visiting the facility, people will inevitably be aware of the cooperation of Japan with the facility which will, in a long run, contribute to promote friendship between Thailand and Japan.

APPENDIX- I

1. Organization chart of Srinakarinwirot University I - 1
2. Basic design survey diary I - 2
3. Thai governmental authorities concerned I - 4



1. Organization chart of Srinakariniwrot University



2. Summary of the Survey

- Feb. 4. Wed. The Team left Tokyo and arrived in Bangkok.
- Feb. 5. Thu. (a.m.) A call and briefing to JICA and DTEC were made.
(p.m.) First discussion with the University official was held at the University headquarter. A draft basic design report and a draft minutes of discussions prepared by the Team were produced to the University. Background and outline of these were explained by the Team.
- Feb. 6. Fri. The Team visited an existing aquarium and museum in Bangsaen Campus of the University and also surveyed the site for the Center. After that second discussion was held where the team explained the draft basic design to the univeristy officials.
- Feb. 7. Sat. Third discussion was held at the University head-quarters. Floor plans and aquarium installations were the main subjects.
- Feb. 8. Sun. Internal meeting of the Team was held.
- Feb. 9. Mon. Fourth discussion was held at the University head-quarters. An arrangement for semi-outdoor nursing tanks were examined followed by selecting of equipments. Also laboratory plans prepared by the University were examined.

- Feb. 10. Tue. (a.m.) The team reported the results of the discussions to the Embassy and JICA.
(p.m.) The Minutes of Discussion was signed by the representatives of the Team and the University at the University headquarters.
Fifth and final discussion was held to supplement the former discussion on the equipments and laboratory plan.
- Feb. 11. Wed. The Team prepared the Record of Discussions.
- Feb. 12. Thu. Final call by the Team to the Embassy, JICA and the University was paid to submit the Record of Discussions.
- Feb. 13. Fri. The Team left Bangkok for Tokyo.

3. Thai Governmental Authorities Concerned

(DTEC)

Mr. Apilas Osatananda

Director General

Mr. Pracha Chaowasilp

Director of Colombo Plan Div.

Mr. Sutin Susila

Div. of External Cooperation-Office 2

Mr. Jiroj Itharattana

Colombo Sub-Div.

(Srinakarinwirot Univ.)

Dr. Nibondh Sasidhorn

President

Dr. Prasert Witayarut

Vice President for Planning & Development

Dr. Twee Hormchong

Vice President, Bangsaen Campus

Asst. Prof. Smarn Srithunya

Director of Zoological Museum &
Marine Aquarium

Asst. Prof. Anan Bhumawarn

Deputy of Vice President

Dr. Sumeth Deoisres

Secretary to Vice President

Mr. Withaya Boonthanom

Chemistry Dept. Bangsaen Campus

Mr. Sithipan Siriratanachai

Marine Scientist, Zoological
Museum & Marine Aquarium

Mrs. Thanomsin Disathaporn

Bio-Chemist, Dept. of Chemistry,
Bangsaen Campus

Mr. Chukiat Nuansang

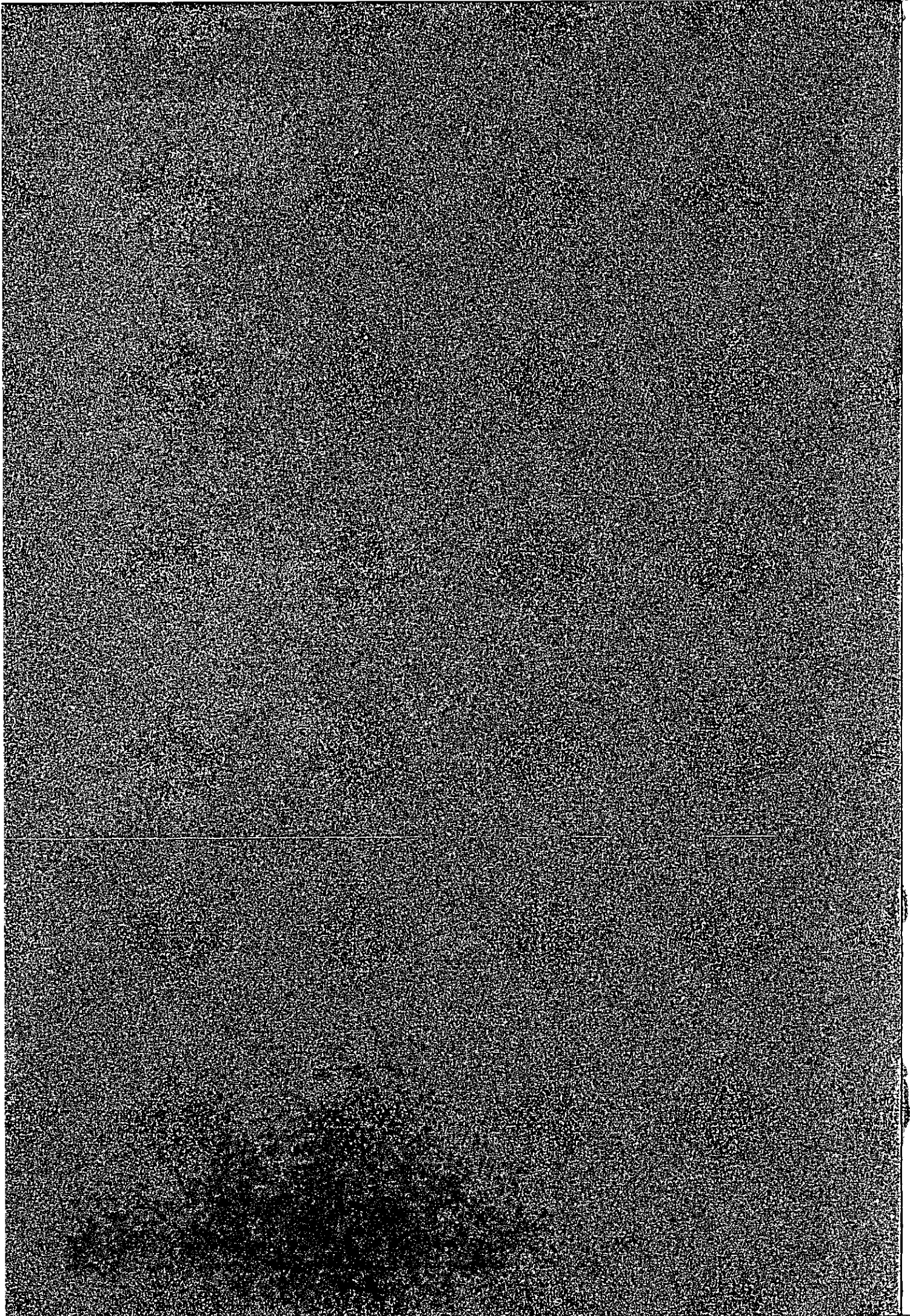
Engineer, Main Campus

Mr. Sittipun Sirirutanachai

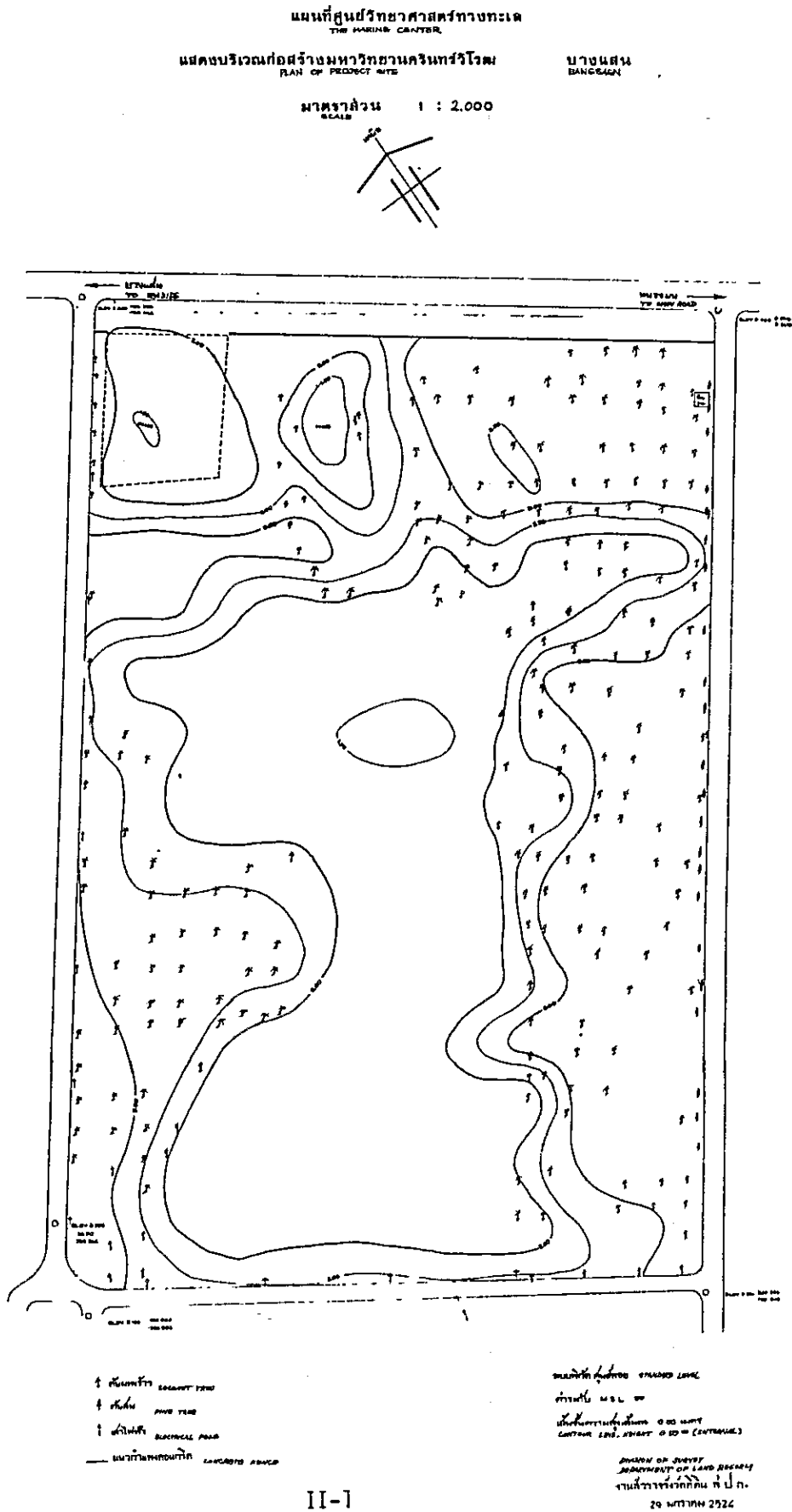
Physical & Chemical Oceanography,
Bangsaen Campus

APPENDIX-II

1. Topographic survey mapII- 1
2. Climatological dataII- 2
3. Plan of zoological museum and marine aquarium.....II- 3
4. Existing marine animal specimens and replicasII- 5
5. Existing marine animalsII- 6



1. Topographic survey map



2. Climatological data

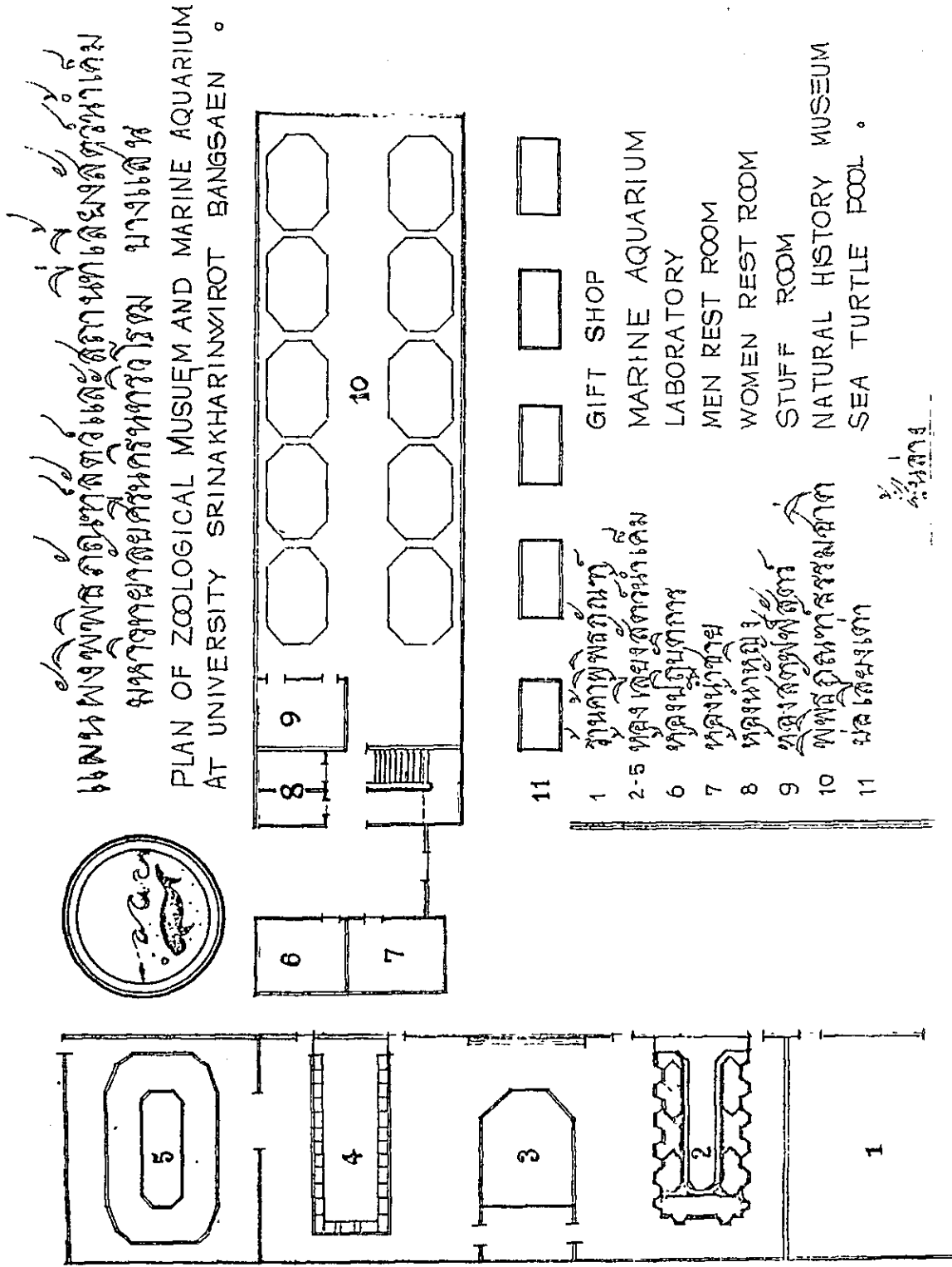
CLIMATOLOGICAL DATA FOR THE PERIOD 1951 - 1975

Station CHONBURI	Elevation of station above MSL.	3.00 meters
Index Station 48 459	Height of barometer above MSL.	4.22 meters
Latitude 13° 22' N.	Height of thermometer above ground	1.50 meters
Longitude 100° 59' E.	Height of wind vane above ground	12.00 meters
	Height of raingauge	0.56 meters

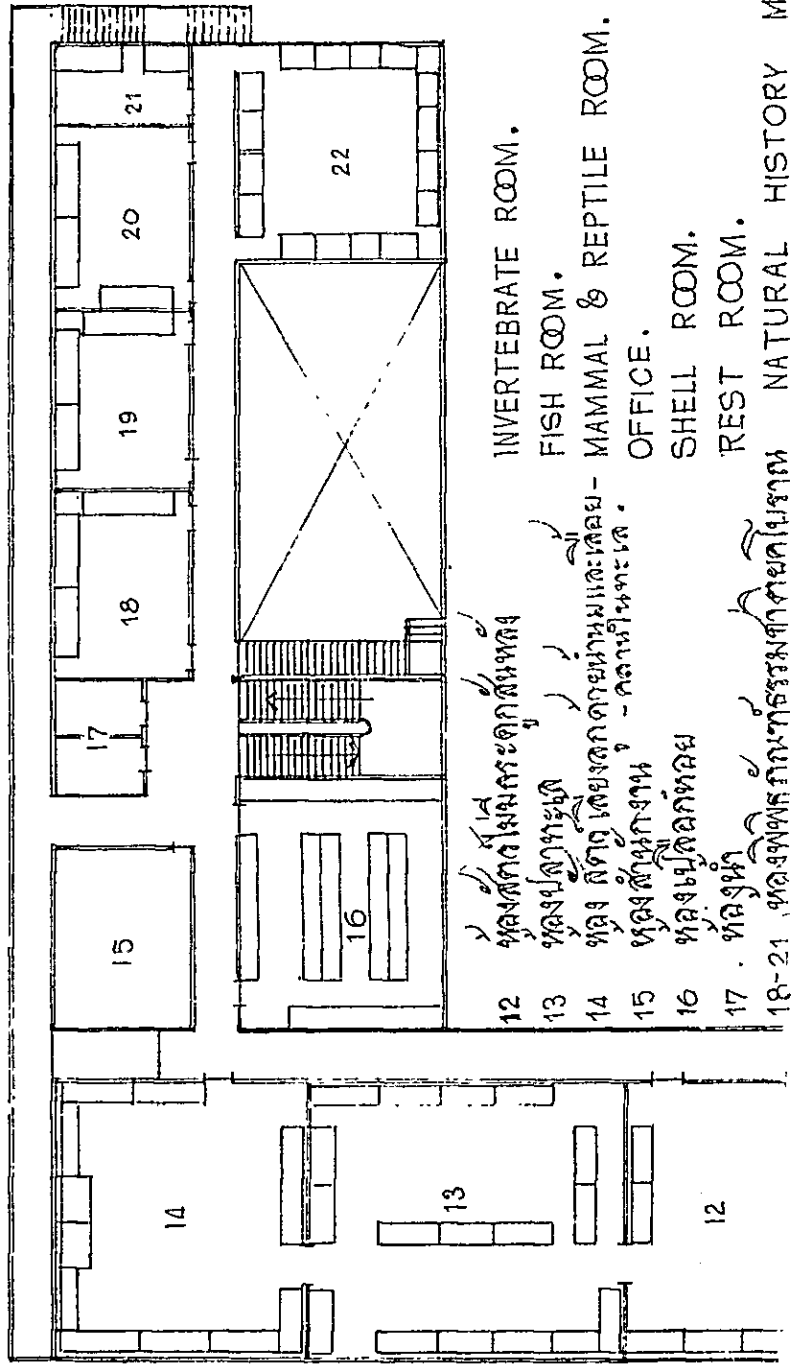
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Pressure (+1000 or 900 mbs)													
Mean	12.56	11.20	10.22	08.83	07.25	06.73	06.92	06.93	07.76	09.88	11.62	12.52	09.30
Ext. Max.	25.28	20.65	19.68	18.00	14.29	13.39	14.99	13.49	15.79	17.79	21.09	21.89	25.28
Ext. Min.	03.74	03.04	02.44	01.14	09.44	07.44	09.74	09.44	08.74	09.49	04.27	03.50	07.44
Mean daily range	4.57	4.66	4.69	4.61	4.27	3.65	3.48	3.76	4.22	4.41	4.29	4.43	4.25
Temperature (°C.)													
Mean	25.9	27.4	28.8	29.6	29.3	28.9	28.6	28.3	27.9	27.3	26.7	25.8	27.9
Mean Max.	31.3	32.1	33.2	34.1	33.3	32.5	31.9	31.6	31.2	31.3	31.1	31.0	32.0
Mean Min.	20.1	22.4	24.2	25.4	25.4	25.5	25.0	24.9	24.4	23.8	22.1	20.3	23.6
Ext. Max.	36.2	36.6	37.0	38.0	37.8	37.1	35.5	34.7	34.4	34.8	35.2	36.1	38.0
Ext. Min.	9.9	16.5	17.5	20.4	21.2	21.0	20.5	20.9	20.6	18.2	14.2	12.0	9.9
Relative Humidity (%)													
Mean	67.0	71.0	71.0	71.0	75.0	75.0	75.0	76.0	80.0	80.0	73.0	66.0	73.0
Mean Max.	85.0	88.2	87.8	87.6	88.8	87.6	88.5	90.0	92.3	93.0	89.5	85.1	88.6
Mean Min.	52.0	56.2	56.6	56.7	60.8	61.8	62.9	64.0	67.1	66.7	57.2	50.1	59.3
Ext. Min.	20.0	25.0	23.0	29.0	32.0	42.0	43.0	45.0	46.0	42.0	29.0	22.0	20.0
Dew Point (°C)													
Mean	18.6	21.2	22.6	23.8	24.2	23.8	23.5	23.6	23.8	23.4	21.0	18.6	22.3
Evaporation (mm.)													
Mean - Piche	109.4	91.3	101.6	96.2	79.6	83.3	79.7	73.6	54.2	59.5	87.2	111.6	1027.2
- Pan						No	Observation						
Cloudiness (0-8)													
Mean	3.9	3.8	4.0	4.7	6.1	6.5	6.7	6.9	6.7	5.8	4.5	3.6	5.2
Visibility (Km.)													
0700 L.S.T.	6.9	6.4	7.1	8.6	10.7	11.2	10.7	10.2	9.7	9.3	8.2	7.6	8.9
Mean	8.0	7.8	8.2	9.8	11.7	12.2	11.7	11.2	10.7	10.3	9.8	9.1	10.0
Wind (Knots)													
Prevailing wind	E	S	S	S	S	S	S	S	S	NE	NE	NE	-
Mean Wind Speed	6.4	7.0	7.1	6.4	5.9	7.1	6.6	6.5	5.3	5.0	6.2	6.6	-
Max. Wind Speed	40 NE	36 S, SW	37 NNE, SW	50 ENE	47 S, NW	55 SW, W	55 SW	55 SW	60 W	63 S	40 NE, S	37 NE	-
Rainfall (mm.)													
Mean	12.6	22.1	40.9	77.9	165.5	118.8	168.0	166.3	302.0	230.1	64.1	10.1	1379.4
Mean rainy days	1.7	3.4	4.8	8.2	15.2	15.0	16.9	19.6	20.0	17.6	6.7	1.6	130.7
Greatest in 24 hr.	37.7	92.1	103.4	74.7	126.2	65.4	110.6	131.0	124.2	145.4	91.8	37.7	145.4
Day/Year	18/75	25/58	13/54	23/47	11/54	23/72	22/51	27/71	26/63	14/52	4/75	1/70	14/52
Number of days with													
Haze	27.2	24.6	25.2	16.6	3.6	2.5	1.1	2.7	2.1	5.8	16.2	21.6	149.2
Fog	2.9	3.3	2.2	0.7	0.3	0.0	0.4	0.2	0.6	0.6	1.6	1.1	13.9
Hail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thunderstorm	0.7	3.2	6.6	15.4	15.9	7.7	7.7	7.9	11.0	11.0	3.8	0.7	91.6
Squall	0.0	0.0	0.0	0.4	0.1	0.4	0.0	0.0	0.0	0.1	0.0	0.2	1.2

Remark : 1. Pressure 1953 - 1975
2. Evaporation 1954 - 1975

3. Plan of zoological museum and marine aquarium



๒/๑๑/๕๕
UP STAIR.



- 12 INVERTEBRATE ROOM.
- 13 FISH ROOM.
- 14 MAMMAL & REPTILE ROOM.
- 15 OFFICE.
- 16 SHELL ROOM.
- 17 REST ROOM.
- 18-21 NATURAL HISTORY MUSEUM.

- 12 ห้องสัตว์ไม่มีกระดูกสันหลัง
- 13 ห้องปลาทะเล
- 14 ห้อง สัตว์ โดยจัดกักขังนมและเลื้อย - คลาสที่หะเด .
- 15 ห้องสำนักงาน
- 16 ห้องเปลือกหอย
- 17 ห้องพักผ่อน
- 18-21 ห้องจัดแสดงภาวภัณฑกรรมศาสตร์ตามชั้น

4. Existing marine animal specimens and replicas

Shell collection	Amphineura (Chiton)	8 species	
	Bivalvia (Clam)	Approx. 200	"
	Gastropod (Shail)	Approx. 800	"
	Scaphopod (Tusk shell)	4	"
	Cephalopod (Nautilus)	2	"
Mammal, ave & reptile	Mammal	Approx. 24	"
	Ave	40	"
	Reptile	5	"
Marine fish	Shark	10	"
	Skate and ray	14	"
	Bony fish	Approx. 130	"
Invertebrate	Sponge	12	"
	Coelenterate	120	"
	Worm	30	"
	Arthropod	Approx. 180	"
	Echinoderm	40	"
Replicas demonstrating sea animals in their natural environment	Coral reef		
	Nekton & benthod		
	Cartilage fish		
	Dolphine		
	Deep-sea animal		
	Shark		
	Fishing trap		
	Sea turtle		
	Rocky shore		
	Mangrore swamp		
	Life in Cambrian		

5. Existing marine animals

1st room	Damsel fish Filefish Soiny lobster etc.	Sea horse Porcupine fish	Grouper Corral trout
2nd room	Angelfish Soldierfish	Parrotfish Reefcord	Perch Batfish etc.
3rd room	Sea anemone Tube worm Spiny lobster Sea cucumber Damsel fish Sweetlip etc.	Coral Mantis shrimp Horse-shoe crab Feather star Wrasse	Sea fan Crab Sea star Butterfly fish Lion fish
4th room	Black-tipped sharks Golden sting ray etc.	Tiger-nurse shark	
Outdoor pool	Hawk's bill turtle Ridley turtle	Green turtle Loggerhead turtle	

JICA