4-2-2 Facility Sizes

Facility sizes have been chosen after defining the functions of the respective rooms and in accordance with the personnel allocation plan for the respective rooms based on the Indonesian request.

- Office rooms

  Office rooms for the respective departments should be designed to be of a one-room type which can be partitioned into smaller areas by considering Indonesian customs and normal utilization of the existing facilities. Office room areas have been calculated by referring to the planned areas of the respective rooms based on personnel plans, allocating $8m^2$ to a manager and $6m^2$ to staff members and taking into account the local style of furniture arrangement (namely, each piece of furniture is laid out with sufficient space left between it and adjacent ones). Divided sections of the office room should be partitioned, not with walls, but by means of furniture sets, leaving flexibility to meet increases or decreases in personnel in the future. The division chief room is a booth type room with an area of 18 m^2 which is based on the customary space allocated to that position.

- Laboratories

  Laboratories are composed of large and special laboratories. Each large laboratory is applied to the principal experimentation activities of each of the three divisions of Reference Laboratory division. Those equipment which are to be commonly employed among the departments, those which require high measuring accuracy, and those which require installation conditions substantially different from those in the large laboratory will be housed in special laboratories which are divided by types of equipment to be housed. The dimensions of the respective laboratories will be determined depending upon the layout of the experiment tables and equipment needed in these rooms. Preparatory rooms which are built adjacent to the large laboratories should have space enough to contain instruments, materials, and expendables even if some of them may be added in the future.

- Researchers' rooms

  Researchers are often studying in laboratories. However, they should not stay there when engaged in routine desk work, because constant presence in an atmosphere with chemicals and harmful gases may have unfavorable

influences upon their health. Researchers' rooms are secured adjacent to the laboratories with an area of 6.0 m^2 per capita.

- Data-processing room and data base room

  These rooms are to be used i) for building data base of experiment results in the Reference Laboratory Divi. and data to be collected from sources throughout the country and from related international agencies and ii) for computerizing central processing, analyses, simulation, and graphic conversion of the Environmental Information Divi. It aims at forming an information network with related agencies in Jakarta in the future by means of LAN (local area network) as the repository of environmental information and data in the country. For the time being, however, this project aims at establishing a simplified form of LAN applicable to this facility alone. Formation of a data base and central processing will be effected in the processing room for the time being while the data base is used for arranging and storing data by sources. When the necessity occurs as the EMC's activities are expanded, a data base will be formed in the data base room so that the room may be used only for that purpose. The needed areas are 108m^2 for the processing room and 90m^2 for the data base room judging from the layout of the computer systems and ancillary items.

- Library and document service room

  The library will supply researchers, trainees, lecturers, and the general public with data and information and will publicize results of the Center's activities, and it will also function to allow them to read and borrow books and documents and offer space for off-time study. Data to be stored in the library include books and magazines, environmental data floppy discs and video tapes to be prepared by the Information Divi., publications for PR, and training textbooks. The library area will be large enough to contain about 15,000 books where open racks are arranged to contain 150 books /m^2, judging from the present situation at similar facilities (P4L, etc.). The number of desks should be 30, this being calculated based on 20 desks for a class of trainees and 10 for researchers; the required space is secured by adopting 10 carrels and a large table for the remaining 20 persons. As a result, the library area is 180m^2, or 100m^2 for book racks, 60m^2 for reading and studying space, and 20m^2 for a reception counter. To reinforce the functions of the library, a document service room is to be established adjacent to it, while the corridor facing the library should be

designed so that display panels may be installed there as part of the PR activities of the library.

- Lecture rooms

  They are to be used for room lecture courses in technical training and all courses in administrative training. Numbers and sizes of rooms have been determined by considering the contents of training curriculums and possible changes in numbers of trainees in the future. The area of a training room is calculated based on an area of $2m^2$ per trainee when using a two-seat desk of 1.5m x 0.4m.

  Training rooms No. 1 to 4: Small room for 15 trainees, $39m^2$

  Training rooms No. 5 to 6: Medium room for 25 trainees, $58m^2$

  Training room No. 7: AV room for 40 trainees, 108 m2, capable of containing two classes at a time

- Laboratories for practice

  According to the training schedules, experiments and practical training are planned for small groups of 10 to 15 trainees. This plan is based on a reference value of $7m^2$/trainee as standard space, but the most appropriate space will be determined after adjusting layouts.

- Auditorium

  An auditorium is provided for holding events for the whole Center (such as orientation and lectures), training a large group of trainees (40 or more), and holding short-term special seminars for which people interested in them may gather. Since the number of special seminars in which 200 to 400 people will take part occupies more than 50% of the events in the auditorium, the number of seats needed is assumed to be 300 when using desks and chairs (400 in case of chairs only), with the floor area being about $350m^2$ for containing these desks and chairs. Foldable desks and chairs are employed to allow the auditorium to be used for a variety of purposes.

- Canteen

  The dining hall aims to serve lunch for a total of about 160 people, or 63 Center staff members and trainees (about 70 on an average) and lecturers and experts (27 persons on an average). It is designed to have a space of about $140m^2$ (including kitchen space) for 80 seats in two shifts. If the number of users is

increased temporarily as a result of, for example, holding a seminar at the auditorium, chairs will be placed on the adjacent terrace to meet the demand.

- Dormitory

According to the training schedules, trainees living in Jakarta as well as those coming from local cities cannot attend courses from their own homes because of traffic conditions. Lectures will be given on the assumption that almost all the trainees and a certain number of the outside lecturers stay in the Center during the whole training period. The Project adopts the number of 56 persons to be accommodated in the dormitory, assuming that about 80% of the course participants (including lecturers) among a planned number of 70 trainees a month will utilize the facility. The dormitory is composed of 4 two-person rooms (containing 8 persons in total) and 16 three-person rooms (containing 48 persons in total), considering efficiency and ideal styles of utilization; floor areas being $27m^2$ and $36m^2$, respectively, accommodating furniture sets and a shower room.

Sizes of the above-mentioned rooms are indicated in subsequent pages.

<Research and Training Bldg.>

Room	No. of Staff	Calculation Basis and Remarks	Planned Floor Area (m^2)
<Administrative Block>			
Director's Room	1	Including reception space	30
Deputy Director's Room	2	$20m^2 \times 2$	40
Secretaries Room		3 Secretaries, Waiting space	38
Technical Expert Room		Leader's room, Coordinator's room, Technical experts' room for 8 persons	97
Administrative Office	4	Chief room $18m^2$ $6m^2 \times 3$ persons $= 18m^2$ Reception area $20m^2$ Facility control space $20m^2$	81
Training Division Office	18	Chief room $18m^2$ $6m^2 \times 17$ persons $= 102m^2$	135
Lecturers' Room	12	Working space for 12 persons $6m^2 \times 12$ persons $= 72m^2$	80
Meeting Room		$2m^2$/person $\times 25$ persons $\times 2$ room, separated by a movable partition	108
Reception Room		$15m^2 \times 2$	30
Hall, Corridor			486
Lavatory, Stairs, Storage, Pantry, etc.			
Sub-Total (1)			1,125
<Library Block>			
Library		15,000 books 30 seats	180
Document Service Room		Production of research materials, training materials, located near library	40
Corridor, Lavatory, Stairs, etc.			436
Sub-Total (2)			656

Room	No. of Staff	Calculation Basis and Remarks	Planned Floor Area (m^2)
<Research Block>			
Water Quality Soil Laboratory	8	Depends on equipment layout (including prefabricated refrigerator $18m^2$, storage)	202
Air Quality Laboratory	9	Depends on equipment layout	162
Noise Laboratory		Depends on equipment layout (including storage)	54
Toxic Substance Laboratory	7	Depends on equipment layout (including Weighing room, Blender room, storage)	176
Gas Chromatograph Room		Depends on equipment layout	54
GC-MS Room		Depends on equipment layout	19
Semi-Clean Room		as above (including ante room)	19
Constant Temperature Room		Prefabricated Refrigerator installed for 20°C and 0°C	54
Weighing Room		Depends on equipment layout	19
X-ray Fluorescence Room		as above (including treatment room)	39
Scanning Electron Microscope Room		as above (including dark room)	39
Atomic Absorption Room		as above	31
Washing and Drying Room		as above	54
IR Spectrophotometer Room		as above	19
Supply Room		Storage and supply of consumable laboratory material	54
Division Office (Reference Laboratory Division)	24	Chief room $18m^2$ Water quality soil section $6m^2 \times 8$ p. $= 48m^2$ Air quality noise section $6m^2 \times 9$ p. $= 54m^2$ Toxic substance section $6m^2 \times 7$ p. $= 42m^2$ Total $162m^2$	162
Data Processing Room		Depends on equipment layout	108
Data Base Room		Storage and production of material	90
Division Office (Environmental Information Division)		Chief room $18m^2$ $6m^2 \times 13$ persons (total of 3 sections) $= 78m^2$	108
Meeting Room		$2m^2$/person $\times 25$ persons $= 50m^2$	54
Work Shop		Repair and maintenance of laboratory equipment	81
Electrical Machinery Room		Depends on machine layout	108
Maintenance Staff Room		Including guard room	24
Hall, Corridor, Lavatory, Stairs, Storage, Pantry, etc.			1,048
Sub-Total (3)			2,778

Room	No. of Staff	Calculation Basis and Remarks	Planned Floor Area (m^2)
<Training Block>			
Lecture Room		2.0m^2/person × 25 persons × 2rooms = 100m^2 2.0m^2/person × 15 persons × 4rooms = 120m^2	273
Practice Room			
Water Quality		Depends on equipment layout (including preparation room)	162
Air Quality		as above	121
Noise and Vibration		as above (including noise laboratory)	54
Solid Waste (Soil)		as above (including blender room)	81
Toxic Substances		as above	121
Atomic Absorption Room		Depends on equipment layout	44
Gas Chromatograph Room		as above	44
Weighing Room		as above	12
Computer Room		3.5m^2/person × 20 persons = 70m^2 Personal computer × 10 pcs.	81
Audio Visual Room		2.5m^2/person × 40 persons = 100m^2	108
A/V Preparation Room		Storage of A/V equipment and computer production of training materials	39
Drafting Room		Production of large size training materials 4.0m^2/person × 15 persons = 60m^2	54
Hall, Corridor, Lavatory, Stairs, Storage, Pantry, etc.			494
Sub-Total (4)			1,688
Auditorium			1,688
Large Seminar Room (Auditorium)		1.0m^2/person × 300 persons = 300m^2 Stage and control room	350
Hall, Corridor, Lavatory, Stairs, Storage, etc.			259
Sub-Total (5)			609
Canteen		1.2m^2 × 80 seats = 96m^2	100
Kitchen		40% of dining space	40
Sub-Total (6)			140
Coverd Way			296

Total Area (1) + (2) + (3) + (4) + (5) + (6) + (7) = 7,292m^2

Outdoor Facilities

Garage	space for 6 cars including storage and PLN machine room, etc.
Parking	40 cars
Organic Solvent (ether etc.) Distillation Room	20 m^2
Solid Waste Pretreatment Room	40 m^2
Solid Waste Stockyard	40 m^2

Room	No. of Staff	Calculation Basis and Remarks	Planned Floor Area (m^2)
<Dormitory>			
Bedroom A type		For ordinary trainees with shower room $36m^2 \times 16$ rooms (triple bed rooms) $= 576m^2$	576
Bedroom B type		For lecturer and expert with shower room $27m^2 \times 4$ rooms (twin bed rooms) $= 108m^2$	108
Dormitory office		Reception, bed space	27
Dining Room		40 persons (70% of total number of residents) to be used as a common room outside of mealtimes	60
Kitchen		40% of floor area of canteen	30
Laundry Room		For Basic laundry excluding bed clothes	24
Linen Storage			18
Meeting Room		$2m^2$/person $\times$ 30 seats	54
Counselling Room		Individual counselling for trainee	27
Hall, Corridor, Lavatory, Stairs, Storage, etc.			516
Total			1,440

Parking 20 cars

Total Floor Area

Room	Research and Training Bldg.	Dormitory	Total (m^2)
Total	7,292	1,440	8,732

4-3 Basic Plan

4-3-1 Site and Facility Layout Plan

Since the project site is located in the Complex of the National Center for Research, Science, and Technology (PUSPIPTEK Complex), the Project should meet the requirements of the Complex's master plan. Since the research and the residential zones are clearly separated from each other in PUSPIPTEK's requirements, the laboratory and dormitory buildings are to be constructed on separate sites.

(1) Research and training building

1) Site zoning

According to PUSPIPTEK's requirements on wall surface lines in the research zone the building should be 40m or more apart from the nearest road in regard to the southern and western roads which are already existing, and 30 m or more apart from the nearest road in regard to the northern and eastern service roads which are to be completed in FY 1992. This means that the central approximately 2.5 ha out of the project site area of 5 ha is the area where buildings can be laid out, including any buildings to be added in the future. The project site has relatively flat portions at the center, with the northern and eastern sides sloping downward gently. Taking these factors into consideration, the buildings should be constructed at the center of the site so that cutting and banking may be avoided as far as possible.

2) Approaches

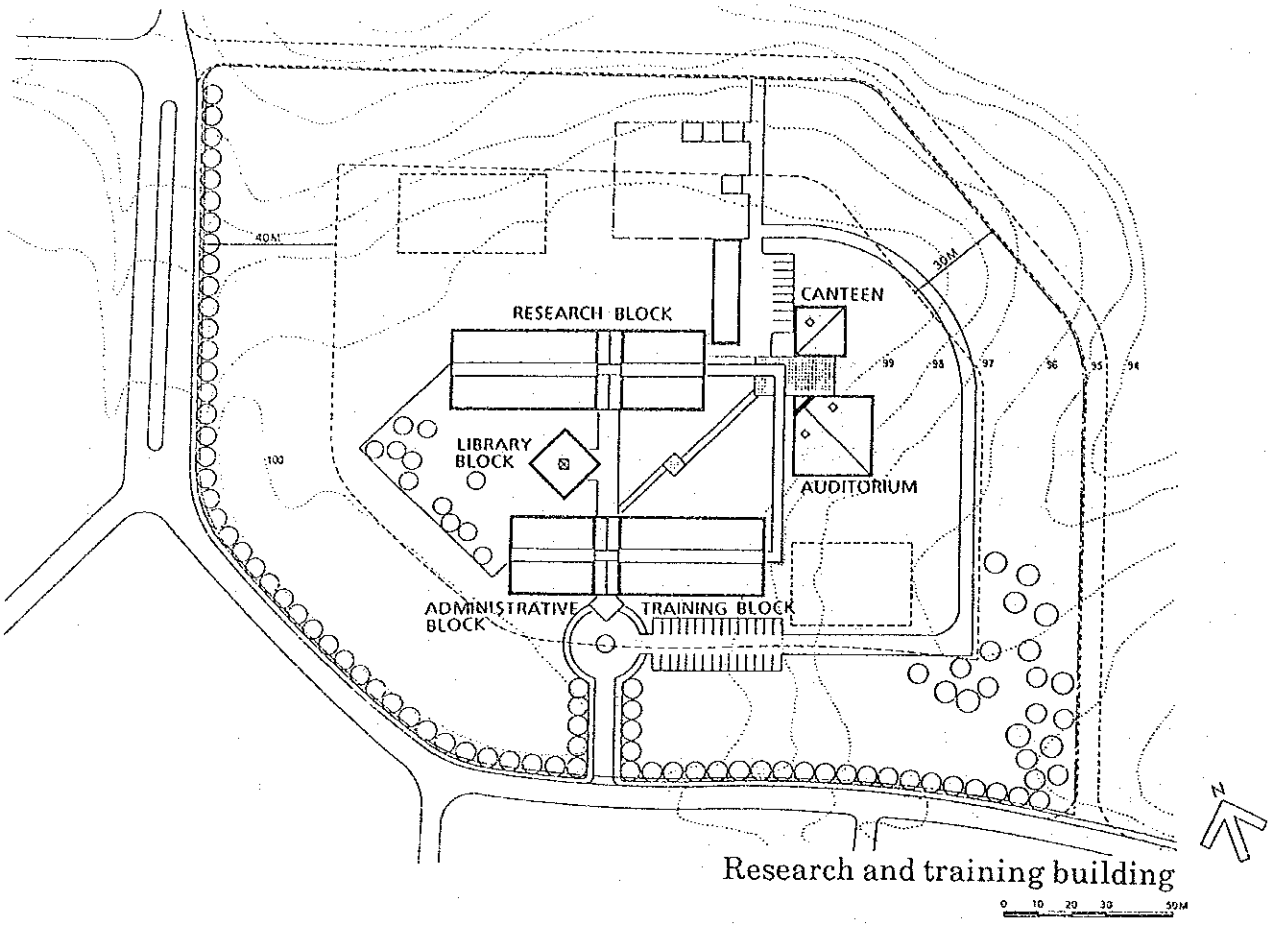
The project site adjoins a seven-meter-wide road on both the southern and the western sides. Since the southern side is nearer to the entrance of the PUSPIPTEK research zone, the front approach of the buildings will be provided on this side. At the northern side where a service road is to be constructed, a service approach will be constructed to deliver commodities to the laboratories and canteen. Both approaches are to be connected with a road to enhance traffic convenience within the EMC site. Parking lots are to be prepared along the roads near the front and the service approaches.

3) Layout of facilities

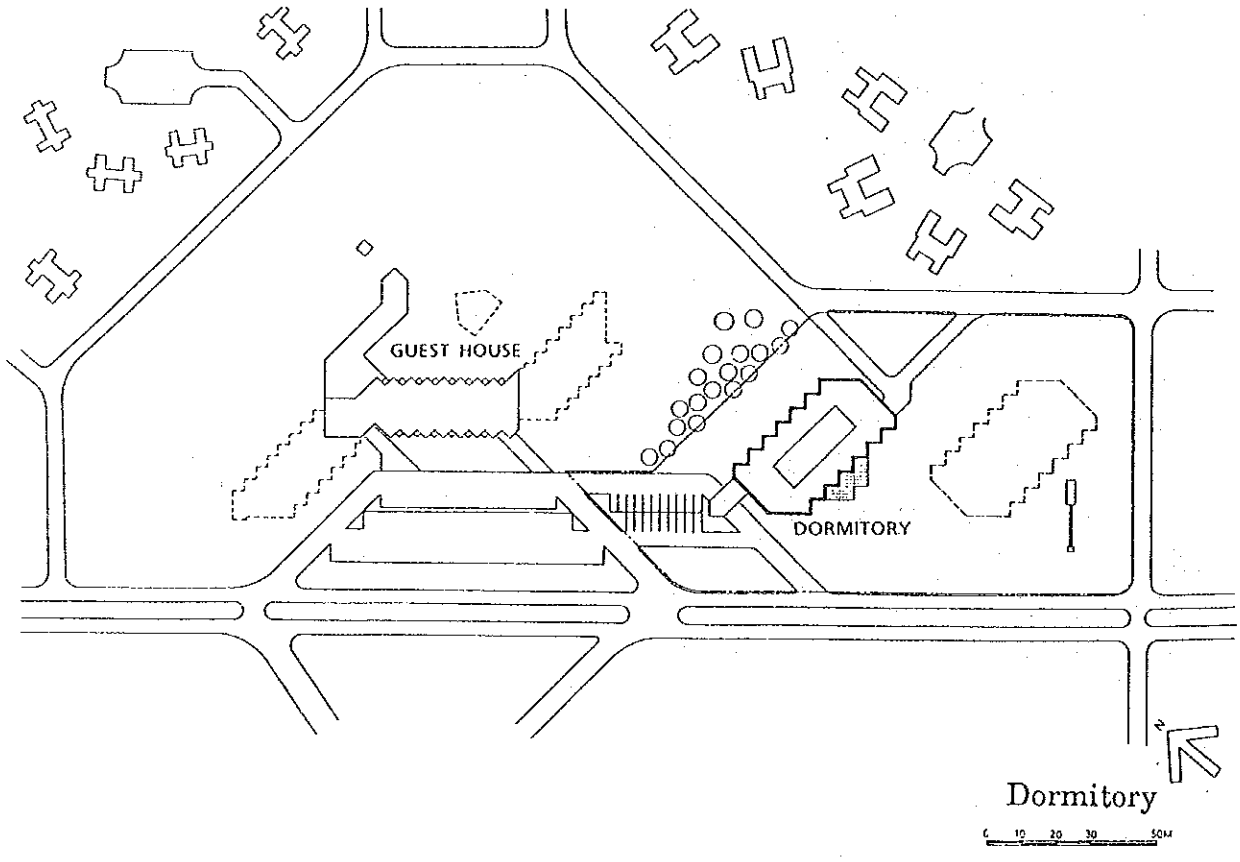
The buildings should ideally be located along the east-west axis of the site to minimize wall surfaces facing the east and west, since this layout is effective in reducing exposure to strong sunlight in the tropical district and thereby alleviating the air-conditioning load. This plan arranges the principal blocks of the administrative, research, and training rooms along the east-west axis to minimize reception of solar heat in the morning and afternoon. The construction standards applied to the PUSPIPTEK research zone, however, require all the buildings to be constructed along the south-north axis or at an angle of 65 degrees northeast or southwest to that axis of each construction site. However, this project follows the exceptional instruction by PUSPIPTEK, from the view point of affording a balance between the buildings and the site, the buildings is arranged in parallel with the southern road.

Near the front approach will be arranged the administrative and training block, with the research block located to its north-east. Separation between these blocks will secure a quiet environment for the research facilities. The library block is to be arranged between these two blocks so that it is easily accessible from both blocks. Both canteen and the auditorium will be arranged at the east of the main blocks to command a view of the natural landscape spreading from the eastern to the northern part of the site. All of these blocks are independently arranged in a scattered way, and they are connected with corridors to assure a comfortable and functional facility configuration. Spaces in which buildings can be added in the future are secured at the northern part of the research block and the eastern part of the training block. An area is prepared along the service approach in the northern part of the site for constructing outdoor experimental facilities such as experimental farms, which may be required as the Center's activities are expanded in the future. This dispersed arrangement aims at offering to researchers and trainees an open atmosphere which is one of the characteristics of a suburban research facility constructed in a spacious area with well-arranged surrounding conditions.

Layout of facilities



Research and training building



Dormitory

(2) Dormitory

1) Site zoning

The site consists of two flat areas, the lower one and the higher one with 1m level difference. The building will be constructed on the center of the lower west area next to the existing guest house site, and the higher east area is for the future extension building.

2) Approaches

Extending existing parking lot for the guest house, the front approach of the building will be provided there. A service approach and service yard to deliver commodities will be constructed at the back side of the building.

3) Layout of facilities

The building is arranged along the east-west axis, facing the same axis of the future extension block of the guest house to harmonize each other in layout. Distance of 15m will be kept between the building and the site boundary line of the guest house side to preserve the existing trees along the line.

4-3-2 Building Plan

(1) Plan

The PUSPIPTEK standards require all the buildings in its site to be, in principle, three-storied or lower. Two-storied buildings have been chosen for the laboratory/training and dormitory buildings in this project i) because the area is spacious, ii) because close linkage will be assured among the rooms if upward and downward movements are minimized, and iii) no piling work is needed which will substantially reduce the construction period and costs. The administrative and training block and the research block are to be composed of single-storied buildings with connecting corridors, because this layout minimizes traffic lines and assures efficient movement among rooms. Rooms more closely related are arranged nearer to each other. Being a living space, the dormitory building gives priority to natural draft and ventilation and is of a style in which rooms are connected through a corridor along a court.

Each building is composed of the following elements:

1) Research and training building

① Administrative block

Administrative offices and lecturers' rooms are arranged on the first floor. Rooms for the director, deputy directors, and experts to be dispatched for carrying out technical cooperation are located on the second floor, securing private spaces.

② Research block

Large laboratories, workshop, and a supply room for experiment equipment are arranged on the first floor, in consideration of the functions and characteristics of the respective research sections. An electron microscope room, gas chromatograph room, atomic absorption room, and other special laboratories are provided on the second floor, together with computer rooms and researchers' rooms. A cargo elevator is to be installed to load and unload data, articles, and equipment.

③ Library block

A library is arranged on the second floor, while a document service room and an machine room are provided on the first floor.

④ Training block

Experiment and practical training rooms are arranged on the first floor to facilitate delivery of experiment instruments and materials and to secure convenient conditions for water supply and discharge. Lecture rooms, AV room, and computer training room are arranged on the second floor for giving lectures through books and audio-visual equipment.

⑤ Auditorium

This two-storied building contains an auditorium, foyer, lavatory, and stock spaces on the first floor and a control room and an air conditioner room on the second floor. A section ranging from the foyer to the canteen forms a single space with a plaza covered with a pergola at the center. It will play the role of a rest site when holding a special seminar with many participants.

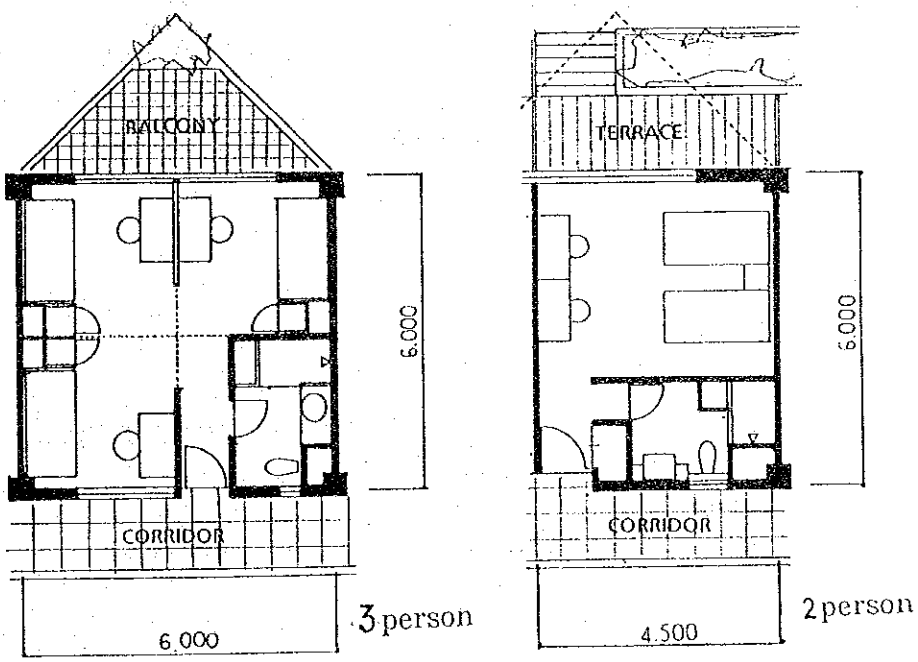
⑥ Canteen

This is a single-storied building containing an eating space with 80 seats, a kitchen, and a terrace.

2) Dormitory

This building contains 16 three-person bed rooms for trainees on the second floor and 4 two-person bed rooms, one dining room, meeting rooms, a consultation room, and a keepers' room on the first floor.

Unit plan of dormitory rooms



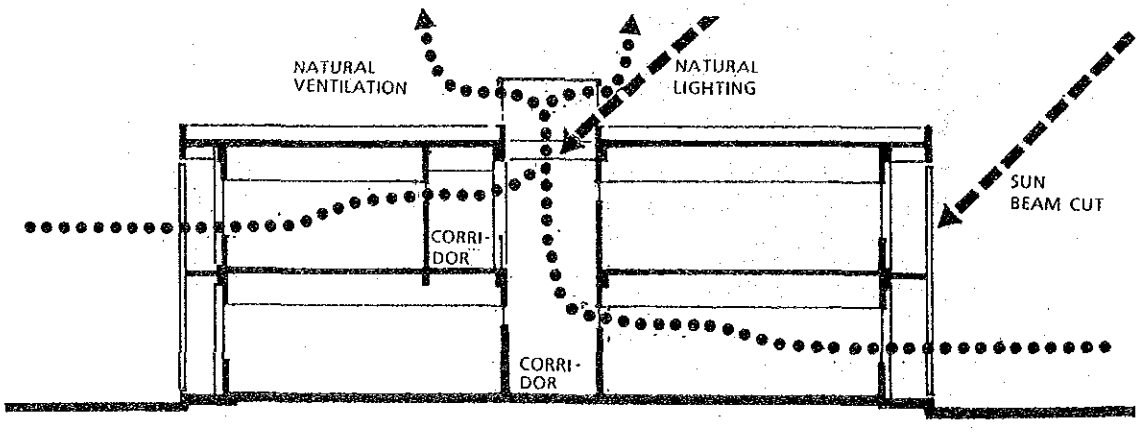
(2) Elevation and Section Planning

Roofs of the buildings, except for those for the auditorium and the canteen, are of a deck type which is most popular for buildings containing laboratories. The main rooms have a double-decked ceiling. Heights of each story of the buildings are set to the following values in accordance with the ceiling heights of the main rooms, dimensions of the facilities above the ceilings, dimensions of structural beam sections and the thickness of the finish materials.

	Laboratory building		Dormitory building	
	1st flr.	2nd flr.	1st flr.	2nd flr.
Ceiling height	2.7 m	2.7 m	2.7 m	2.7 m
Height of story	4.0 m	4.0 m	3.5 m	3.5 m

The administrative, training, and research blocks have a corridor inside the buildings. The ceiling of the corridor on the first floor is as high as that of the second floor, by dislocating the corridor on the second floor from that on the first floor. The ceiling of the first-floor corridor, which is as high as that of the second-floor corridor, is provided with louvers and top lights to facilitate natural ventilation and illumination. Almost all the rooms are air-conditioned. They are provided with windows and transoms on both the external wall side and the corridor side to allow external air to circulate in the building in case of power failures and for reducing operating hours of the air conditioners. Gratings and balconies are installed on the external side of the building to prevent direct sunbeams from entering the rooms or reaching the external walls. These elements act as external features of the building, giving it an effect suitable for a tropical climate.

Sectional view of the research and training block.



A clay-tiled inclined roof is adopted for the auditorium and the canteen to give the facilities as a whole some variety in appearance and to display their symbolic characteristics. Since these buildings contain a large room where many people may gather, the ceiling has a similar shape to the external appearance, providing extensive space with effective heights of 3m to 7m and 2.5m to 5m, respectively. A canopy is installed at the upper part of the patio of the dormitory building to prevent rainwater from entering it.

(3) Structural Design

1) Basic Policy for Structural Design Work.

To pursuit the structural design of the buildings theses items will be set up as follows.

① Structural Form

Building Name	No. of Stories	Structural Form
Administrative, Training, Research blocks	2 Stories above ground	RC rigid Rahmen frame
Library block	2 Stories above ground	RC rigid Rahmen frame
Auditorium	2 Stories above ground	RC rigid Rahmen frame (Steel Structure for Roof supporting)
Canteen	1 Stories above ground	RC rigid Rahmen frame (Steel Structure for Roof supporting)
Dormitory	2 Stories above ground	RC rigid Rahmen frame

② Ground Conditions around Site, and Foundation design principle

Cutting & buck-filling of the Site has not been done. The soil properties at the site are clay and silt layer, partly mixed with sand layer. Direct foundation system will be adopted for all buildings. Because most buildings are 1, 2 stories above ground and supporting layer (GL-1.5m beneath) will be clay or silt which can be expected bearing capacity of 10t/m^2 in long term.

③ Structural Materials

Most structural materials shall be locally produced ones.

- Concrete (Strength : K 225kg/cm2)
  Cement : River gravel, Crushed stone
  Coarse aggregate : River gravel, Crushed stone
  Fine aggregate : River sand
- Reinforcing bar
  Deformed Steel bar : BJT D30 - D10, D13
  BJT D40 - D16, D19, D22, D25
- Steel frame
  H-shaped Steel, Equal angle : SS400

2) Principal standards

Design standards for this project will be pursuant to the Indonesian Standards for design loading and structural design of the R.C. members although the design standards of ACI (American building code requirements for reinforced concrete) and Standards of Japan will also be referred to whenever necessary.

① Load and External Force Regulation NI18-1983
Peraturan Dembebanan Indonesia Untuk Gedung 1983

② Reinforced Concrete Structure Design Standards NI2-1971
Perturan Beton Bertulang Indonesia

③ Design Standard for steel structures (The architectural institute of Japan)

3) Design conditions on loads and external forces

Design conditions on loads and external forces are as summarized below for the buildings.

① Dead Load
Structural materials, Finishing and Things which is fixed to the buildings are properly estimated.

② Live Load

Room	kg/m2
Roof (Not walk)	75
Roof (Walk)	100
Lecture Rm., Practice Rm. Office, Dormitory Rm. (Live Load of Practice Rm. should be adjusted by estimating the weight of Instruments)	250
Library	400
Auditorium	500

③ Wind Load

Mainly Wind load (P) will be considered to the design of Roof Supporting Steel.

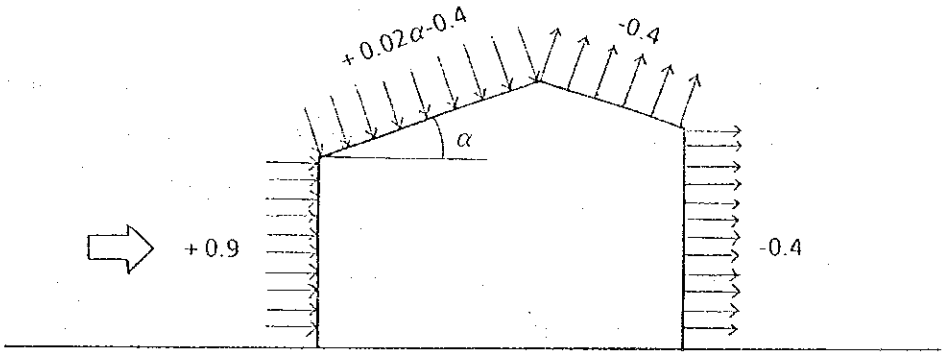
$P = C \times q \times A$

where, C : Pressure coefficients

q : dynamic pressure of wind 25kg/m²

A : Surface Area m²

Pressure Coefficients are shown below



$\alpha \leqq 65°$

④ Seismic Force

The proposed site is located in Zone 4 on the Seismic Zoning Map shown below.

Basic seismic coefficient will be 0.05 (It will be 0.2 in Japan). The buildings are RC structure and 2 Stories above ground level, thus Seismic force will be shown as below.

$V = C_2^* \times I \times Wt$

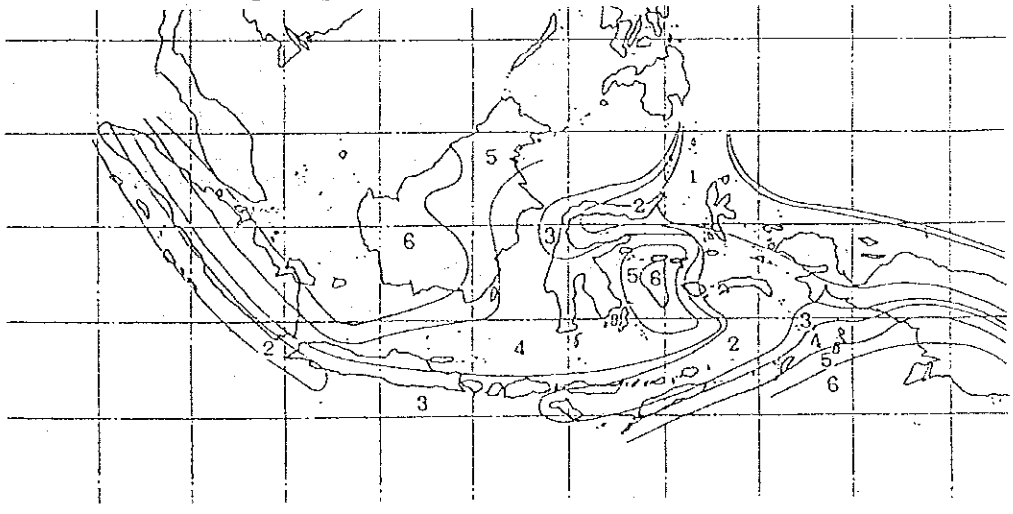
where, V : Base shear

C_2 : Basic seismic coefficient

I : Importance factor of the building

Wt : Weight of the building

Seismic Zoning Map



(4) Building Utilities planning

1) Air-conditioning and ventilation installation plan

An appropriate air-conditioning and ventilation installation plan is adopted to afford a comfortable working and living en-vironment for promoting smooth activities in the EMC.

Considering air-conditioning types and maintenance and costs of air-conditioners in Indonesia, the air-conditioning and ventilation installation plan should be based on the following basic policy.

- Energy should be saved by making effective use of natural energy so that the buildings may be ventilated while air- conditioners are not in use.

- Energy needs of the air-conditioning and ventilation facilities in Indonesia are taken to be 0.05 to 0.07 kw/m^2 in terms of electric power. To minimize operation and maintenance costs, a system which allows the facilities to be individually operated should be adopted while high-efficiency equipment should be introduced.

- Complicated systems whose operation and maintenance are difficult should not be adopted so as to simplify operation and maintenance of the air-conditioning system and to minimize costs.

- An ideal air-conditioning system should be adopted under the above-mentioned conditions to maintain an ideal atmosphere in the laboratories for the people and precision instruments there.

① Design conditions of indoor and outdoor temperature/humidity

- Design indoor conditions
  - D.B. 25°C ± 2°C and R.H. 55% ± 10% in general - D.B. 24°C± 1°C and R.H. 50%±10% for special rooms (although design conditions for cooling a room stipulate D.B. 26°C in Japan, they have been set to D.B. 25° in Indonesia by considering outdoor conditions.)
- Design outdoor conditions
  D.B. 32.2°C and R.H. 65% for outdoor conditions

② Air-conditioning system

- Air-conditioning system for the laboratory and training building
  a. Air conditioners should be installed in the following rooms: General office rooms, meeting room, research and training rooms, laboratories, library, auditorium and canteen
  b. Air-conditioning system for ordinary rooms
     A separate-type air conditioner is installed to assure easy operation and to save maintenance costs. Auditorium, the library, and other rooms with large floor areas should be provided with an air-conditioning package with ducts, and a ceiling hanging-type separate multiple air conditioner is used for other rooms.
  c. Air-conditioning system for special laboratories
     In principle, a whole air single-duct type should be used, preferably a system with high maintainability for both heat and air-conditioning sources. An air-conditioning package should be used, if applicable.
- Air-conditioning system for the dormitory building
  Air-cooling separate-type air-conditioners should be installed in this building.

③ Ventilation system

Natural ventilation should be adopted in principle. However, mechanical ventilation should be used, if functions require it. A special gas exhaust system for the laboratories should use a draft chamber with a scrubber so that it may act as a model for pollution control.

2) Water supply, sewerage, and sanitation installation plan

The water supply, sewerage, and sanitation installation plan in the EMC should be provided with means to control pollution by the waste water to be produced in the buildings, so as to assure a stable water supply, simplify operation and maintenance, save energy, and make the EMC a model of environmental conservation facilities.

① Water supply and sewerage installation plan

- Water supply source

Water is to be supplied to the research training and dormitory buildings (for sanitation water, experiment water, and so on) from the central water supply tower which treats and supplies river water to the whole PUSPIPTEK district. Water which has been boiled and cooled and is available in the market should be used for drinking purposes.

- Water supply system
  a. Research training building
     Total water to be supplied to the EMC is assumed to be, at most, 70m^3 a day. The water supply plant of the central water supply source under the Project is not equipped with an emergency generator. A water reservoir tank containing water for one-day use should be provided in consideration of power failures. Water is to be supplied to the tank through a pipe (100A in diameter) connected to a water supply pipe (150A in diameter) from the water supply tower constructed in the project site. Water in the reservoir tank is to be lifted to an elevated tank (about 10 m3) by means of a lifting pump and then supplied in a gravity-feed system. A chlorinator is to be equipped to supply cleaning water to the kitchen.
  b. Dormitory building
     About 15m^3 of water is estimated to be supplied daily to the building. A water reservoir tank is also equipped in this building, and water is to be supplied to respective faucets by means of a pressurizing pump.
  c. Water supply pipes
     Galvanized steel pipe covered by anti-corrosion tape should be used for water pipes from the tower and pipes to assure durability, and galvanized steel pipe should be used for ordinary supply pipes.

② Hot water supply installation plan

- Research training building
  Hot water supply installation are to be installed in the kitchen of this building by using a gas instant water heater.

- Dormitory building

  Hot water is to be supplied to shower facilities in this building in a centralized heating system. The main heat source for the hot water utilizes solar energy by installing solar heat collectors at the upper part of a patio. A small-capacity electric boiler is to be used as an auxiliary heat source. A stainless steel pipe is to be used for supplying hot water.

③ Water discharge and ventilation installation plan

- Water discharge system

  a. Research training building

  The water discharge system is composed of three systems, one each for rainwater, sanitary sewage and waste water, and experimental waste water.

  Rainwater system ... Rainwater is to be discharged in a gravity-feed system into street gutters along the western and southern sides of the project site.

  Sanitary sewage and waste water ... Sewage and waste water are delivered through separate channels indoors and a combined channel outdoors, and are treated in a purifying tank before being discharged into the street gutters.

  Experimental waste water ... Heavy metals contained in the experimental waste water are collected and treated in a treating facility provided with the instruments. Acids and alkalis are introduced into a neutralizing tank and discharged into the street gutters.

  b. Dormitory building

  The water-discharge system in this building employs a method similar to that used in existing facilities in PUSPIPTEK. It is composed of three systems, one each for rainwater, sanitary sewage, and waste water.

Rainwater ... Rainwater is to be discharged in a gravity-feed system into street gutters along the western side of the project site. An emergency discharging pump is to be installed to dispose of any large volume of rainwater.

Waste water ... Waste water is to be discharged through the same channel as the rainwater above in the gravity-feed system.

Sanitary sewage ... Sanitary sewage is to be introduced into a separate treating vessel before it is sent into a sub-leaching system.

- Ventilation system
  The ventilation system is a channel ventilation system and a stack vent system.

- Waste water treating system
  a. Research training building
     Purifying vessel ... The vessel employs a combined treatment system for sewage and waste water through extended aeration. A standard requirement for effluence should be B.O.D. 20 ppm or less. Activated sludge is to be treated on a drying bed.
     Neutralization ... A pH control agent is to be used for treating acidic and alkaline wastes.
  b. Dormitory building
     Purifying vessel ... The vessel employs a separate local treatment of sewage and sends it to a subleaching system.

④ Sanitary facilities installation plan
Sanitary facilities are to be installed in a manner to assure comfortable utilization by local residents by taking local customs into consideration.

Closet bowl ··· Western types are to be employed in principle, and some local types are also to be adopted. A water faucet is to be installed in each booth.

Urinal stall ... A wall-type stall provided with a special nozzle is to be employed.

Washing vessel ... To be installed in lavatories and the kitchen.

Scrub-up sink ... To be made of terrazzo or stainless steel.

Shower ... A manual mixing type is to be used.

⑤ Gas installation plan

LPG cylinders are to be installed to supply LPG to the kitchen and experiment rooms.

⑥ Special gas facilities

Piping is to be installed in the research training building to supply oxygen, hydrogen, nitrogen, helium, and acetylene gases as well as compressed air to laboratories. The suppl system should be a separate one. A simplified system is to be formulated so that researchers and trainees may handle and maintain these special gases with ease.

⑦ Emergency shower facilities

A shower facility is to be installed at laboratories, if necessary, to help rinse away chemicals in case of unexpected troubles.

⑧ Fire-extinguishing facilities

Indoor and outdoor fire hydrants are to be installed in both the research training and the dormitory buildings. A large-sized ABC fire extinguisher is to be provided in each laboratory. A fixed nonflammable gas extinguisher which is generally employed in Japan to protect instruments from fire will not be installed in these buildings, since it cannot be correctly handled and maintained in local facilities.

3) Power installation plan

In Indonesia, power supply capacity has not kept up with the speed of economic development. New applications for power supply service have rarely been accepted by the power corporation (PLN), especially in Jakarta. However, no problems are expected in the matter of power

supply to the EMC in this Project, because the Center is to be constructed in PUSPIPTEK to which priority has been given in the power supply plan to help promote economic activities there. The basic policy in the power installation plan in the EMC is described as follows.

- Facility system plan which assures reduction of running costs
  (It is expected that power rates will be raised in the future and that they will occupy 80% to 90% of the total running costs. Reduction in power costs will substantially affect operation and maintenance costs of the facilities.)
- Selection of instruments which can be easily operated, managed and maintained
- Assurance of a stable power supply to protect study and training from being interrupted by power failures.

① Trunk facilities

- Power facilities

  A secondary substation of PLN is located in PUSPIPTEK to supply power to the surrounding facilities. Underground cables have been embedded along trunk roads to the project site and form a power loop distribution system. The Project intends to utilize a PLN switchboard room already built in the EMC.

  The PLN switchboard room is provided with high-voltage switches, measuring meters, and other necessary instruments. Power is to be distributed to a power room of the EMC laboratory building through the underground cable (with a circuit of three-phase, three-wire, 50 Hz, 20 KV).

  Facility capacity is estimated to be 865 KVA for the laboratory building and 200 KVA or less for the dormitory building.

  Power supply work is divided into two portions; the Japanese side Project work covers connection between the power room of the research building and a switchboard in the PLN switchboard room while the Indonesian side covers connection of cables to a low-voltage power distribution board in the dormitory building.

- Telephone facilities

  A centralized PABX system has been installed in PUSPIPTEK and the telephone exchanges capacities are presently 1,000 circuits for existing facilities in the research zone and 200 circuits for those in the residential zone, respectively.

  400 telephone circuits are connected from the Serpong Office of the telephone company (PERUMTEL) to a centralized PABX-MDF board. The EMC is to be connected with 30 circuits from the centralized PABX board and with one or two direct circuits.

  Private telephone lines are installed along trunk roads by means of underground cables and are connected to an outdoor-type branch terminal installed within the EMC site. A proximity outdoor-type branch terminal is used for the dormitory building.

  Cable connections in the buildings are covered by the Project and apparatus connections, by the Indonesian side.

- Auxiliary power supply

  An independent power facility as an auxiliary power supply is to be installed to ensure that minimum load for research and training instruments and EMC activities is not suspended and to supply power to emergency lighting facilities and air-conditioning loads in case of power failures. The facility capacity is approximately 400 KVA. No auxiliary power supply is provided for the dormitory building.

② Ordinary power facilities

- Power supply to illumination facilities

  a) Illumination facilities

  Illuminance is determined under IES (Illuminating Engi neering Society Lighting Handbook) according to the PUSPIPTEK design standards. An illumination plan is to be adopted to reduce running costs by securing suitable illumination by means of natural lighting during daytime. Illumination apparatuses should be those which can be locally repaired.

Proposed illuminance is as follows:

- Office, training, and research rooms 350 to 400 lx
- Library (reading room) 500 lx
- Auditorium 250 to 300 lx
- Corridor and lavatory 50 to 100 lx
- Dormitory rooms 200 lx

b) Power outlets

Power outlets are to be provided in office and training rooms by considering degrees of utilization and ease of maintenance. Power distribution boards are to be provided to training and research rooms as exclusive power sources for instruments, so that power may be supplied in accordance with the layout of the instruments. Grounding facilities are to be prepared for research instruments which require special grounding.

- Trunk line power facilities

Low-voltage trunk lines are divided into applications in each building, and power supply from commercial generators is to be prepared, if necessary.A power control board for starting and stopping motor operation is to be installed in each machine room of air conditioners, ventilators, air blowers, water supply and discharge pumps, and other machines. Alarms to warn mechanical operation, water level, and other abnormal conditions are to be installed in an administrative office.

Power supply for the trunk lines and load facilities is shown as follows:

- Trunk lines for lighting and driving power :
  Three-phase, 4-wire, 380/220V
- Illumination and power outlets :
  Single-phase, 2-wire, 220V
- Power for driving fans and pumps :
  Three-phase, 3-wire, 380V

- Lightning rod

  Lightning frequencies at the project area in the EMC arenormal, since the degree of danger is about 12 according to available data and calculations based on the Indonesian standard for lightning facilities (PUIPP). However, light-ning conductors are to be installed to protect facilities from lightning.

- Outdoor lamps

  Outdoor lamps which are fluorescent mercury garden lights are to be installed in the EMC premise as safety lamps at night. Since street lamps have already been installed along the trunk roads in PUSPIPTEK, however, the safety lamps will be installed only where necessary to assure safety. The PUSPIPTEK design standard is available as to street lamps.

③ Low-voltage power facilities

- PA facilities

  Speakers are to be installed in principal rooms and PA units are to be installed in the administrative office for paging and information service in the research training building. Simplified audio equipment is to be installed in the auditorium and is to be used, in principle, at a stage. Individual broadcasting units are to be provided in the AV room.

  No PA facilities are to be installed in the dormitory building.

- Community TV antenna facilities

  Community TV antenna outlets are to be installed in the AV and lecture rooms, auditorium, and other rooms where they are needed. The antenna is to be mounted on the roof of the buildings.

  The outlets are also to be installed in the meeting room and dining room in the dormitory building.

- Automatic fire alarm

  The fire alarm is composed of a fire detector and an emergency push-button bell and is installed to detect fire at an early stage

to assure human safety. An alarm indicator panel is to be installed in the EMC administrative office of the laboratory building and in the administrator's room of the dormitory building.

- Spare piping for ETHERNET facilities
  Spare piping for personal computer Ethernetwork for the purpose of establishment of the information management system is to be installed between research block and training block as the internal connection inside the EMC.

④ Elevator facilities
An elevator is to be installed in the laboratory building to load and unload heavy instruments, gas cylinders for research uses, etc.

- Capacity : 13 persons, 750 kg
- Speed : 30/45 m/min.
- System : Hydraulic

(5) Construction Materials Planning

Construction materials for the EMC are selected by giving priority to those materials and construction methods which are best suited to the local climate and have been locally adopted.
The following materials are to be used in consideration of economical merits, durability, and maintainability suited to the applications of the respective facilities:

1) External finishing materials
External walls will be finished with coated tiles which are suited to the local climate, are excellent in durability, and produce a suitable atmosphere for research and training facilities. Brick tiles are partially employed to maintai harmony with other buildings in PUSPIPTEK. Except for the auditorium and the canteen, the roofs of the buildings are to be a reinforced concrete deck roof to which heat-insulating and waterproofing treatment is given together with installation of highly durable urethane waterproof concrete retainers.

The roofs of the auditorium and the canteen are clay-tiled and gently inclined to give variety to the buildings. Window sashes are made of aluminum since they are easy to maintain and excellent in airtightness, and since their quality has been locally improved to a great extent. It is our understanding that no mosquito screens are needed except in the dormitory building, because almost all the rooms are air-conditioned and are rarely employed during nighttime.

2) Interior Finishing Materials

The suitable interior finishing materials have been selected based on the individual requirements of each room. The finishing materials for main rooms is as below.

Room name	Floor	Wall	Ceiling	Selection points
Office, Lab., Lecture Rm etc.	Floor tile	Paint	Rockwool board	Durability, Cleanliness
Conputer rooms	OA Floor Tilecarpet	Paint	Rockwool board	Special usage
Director Rm Meeting Rm, etc	Carpet	Wood, Vinyl cloth	Rockwool board	Executive staff & Guest use
Auditorium	Local stone	Wood, Vinyl cloth	Rockwool board	Durability, Acoustics
Entrance Hall, Canteen	Local Stone	Exposed brick	Wood	Suitable atmosphere
Toilet, Pantry, etc.	Ceramic tile	Ceramic tile	Gypsum board, Paint	Easy cleaning
Bed Rm	Terrazzo block	Paint	Gypsum board, Paint	Residential comfort
Machine Rm	Mortar	Glass wool board	Glass wool board	Noise abrorption
Corridor, etc.	Terrazzo block	Spray tile	Gypsum board Paint	Durability, Easy maintenace

4-3-3 Equipment Plan

The following points should be taken into consideration when selecting the equipment to be granted to and installed in the EMC.

(1) Selection of environmental of appropriate technological levels Equipment should be selected by fully considering i) handling ease for the lecturers and staff members of the EMC, ii) contents of curriculums specified in the project plan and iii) technological levels suited to local conditions which may be determined by referring to similar facilities at the PUSPIPTEK site. It is necessary to select equipment and instruments that will reinforce the effects of the environmental monitoring research activities and environmental training and that will contribute to environmental conservation activities through their being adopted by other agencies concerned.

(2) Compatibility between effective operation and technical cooperationQuantities and layout of equipment and instruments should be decided in a manner so as to contribute to the technical cooperation activities which are to be undertaken by reviewing the project implementation systems and contents of curriculums. The equipment and instruments should be effectively employed by their common use among different sections as far as possible.

(3) Consideration of maintenance and aftercareEach of the equipment and instruments will be continuously employed over a long period and most are precision and advanced types. When selecting their types and models, priority should be given to the availability of aftercare, namely, easy procurement of spare parts and expendables and availability of local maintenance service.

(4) Consistency with the activities in the EMC
The EMC plays the role of the standard measuring institution (reference laboratory) through its research and monitoring activities, and plays a leading role in monitoring planning, in addition to accuracy management of data obtained form environment-related institutions. Consequently the activities in the EMC require equipment which ensures as much accuracy as possible. In training activities, familiar equipment easy to handle is to be primarily chosen, because training for participants from environment-related

institutions needs to be effective and useful after they return to their respective offices.

The equipment and instruments to be used in the EMC are clas-sified as follows (respective lists of the equipment are given in the subsequent pages).

1) Commonly analytical equipment
2) General laboratory equipment
3) Water quality monitoring equipment
4) Air quality monitoring equipment
5) Noise and vibration level monitoring equipment
6) Waste and toxic substance analytical equipment
7) Information system equipment
8) Other training equipment
9) Workshop equipment
10) Research and training fittings

Proposed Equipment List for Basic Design

1. Common Analytical Equipment

Code No.	Equipment	Purpose		Total
		Research	Training	
C01a	FID/FTD Gas Chromatograph (Research)	2	0	2
C01b	FID/FTD Gas Chromatograph (Training)	0	1	1
C01c	FID/FPD Gas Chromatograph (Research)	2	0	2
C01d	FID/FPD Gas Chromatograph (Training)	0	2	2
C01e	ECD Gas Chromatograph (Research)	2	0	2
C01f	ECD Gas Chromatograph (Training)	0	2	2
C01g	Capillary Gas Chromatograph	1	0	1
C02	UV/FL High Performance Liquid Chromatograph	2	2	4
C03	Ion Chromatograph	2	0	2
C04	Polarograph	0	1	1
C05a	Single Beam UV/VIS Spectrophotometer	0	3	3
C05b	Double Beam UV/VIS Spectrophotometer	2	3	5
C06a	IR Spectrophotometer (Research)	1	0	1
C06b	IR Spectrophotometer (Training)	0	1	1
C07	FTIR Spectrophotometer	1	0	1
C08	Fluorescence Spectrophotometer	2	0	2
C09a	Flame Type Atomic Absorption Spectrophotometer	2	3	5
C09b	Flameless Type Atomic Absorption Spectrophotometer	1	1	2
C10	GC-Quadruple Pole Mass Spectrometer	1	0	1
C11	Scanning Electron Microscope	1	0	1
C12	X-ray Fluorescence Analyzer	1	0	1
C13a	High Accuracy Type pH Meter	1	0	1
C13b	Laboratory Type pH Meter	3	3	6
C13c	Portable Type pH Meter	2	3	5
C14	Ion Meter	1	2	3
C15	Ion Selective Electrode (F, CN, NH_4, etc)	1set	2sets	3sets
C16	Mercury Analyzer	1	1	2
C17	Metallurgical Microscope	1	0	1
C18a	Biological Microscope (incl. Camera)	1	1	2
C18b	Stereomicroscope	1	3	4
C19	Cylinder Rack	2	2	4
C20	Gas Regulator (Brass)	3	2	5
C21	Gas Regulator (Stainless)	3	2	5
C22	Glass Apparatus	1lot	1lot	2lots
C23	Chemicals	1lot	1lot	2lots

2. General Laboratory Equipment (1)

Code No.	Equipment	Purpose		Total
		Research	Training	
G01a	Semi-Micro Chemical Balance	2	2	4
G01b	Micro Chemical Balance	2	2	4
G01c	Indicated Chemical Balance (3kg)	1	2	3
G02a	Balance (5kg)	1	1	2
G02b	Balance (10kg)	1	1	2
G03a	Table Top Type Centrifuge	2	1	3
G03b	High Speed Type Centrifuge	1	0	1
G04	Automatic Muffle Furnace	2	2	4
G05	Electric Oven	3	2	5
G06	Vacuum Drying Oven	2	0	2
G07	Incubator	1	1	2
G08	BOD Incubator	1	1	2
G09a	Rotary Evaporator (Water Cooling)	1	1	2
G09b	Rotary Evaporator (Ice Cooling)	1	1	2
G10	Low Temperature Water Circulation Bath	1	1	2
G11	Standard Water Bath	2	2	4
G12	Thermistor Water Bath	1	1	2
G13	Fraction Collector	1	0	1
G14	Rotary Culti-Shaker	1	1	2
G15	Multi Labo Shaker	1	1	2
G16	Homogemizer	1	1	2
G17	Magnetic Stirrer	5	5	10
G18a	Ultra Sonic Cleaner	2	2	4
G18b	Ultra Sonic Cleaner (Large)	1	0	1
G19	Water Distilling Apparatus	1	2	3
G20	Ice Cube Maker	1	1	2
G21	Refrigerator/Freezer	2	2	4
G22	Ultra Sonic Cleaner for Pipette	2	2	4
G23	Soxlet Extraction Apparatus	2	2	4
G24	Automatic Dispenser	1	0	1
G25	Flow Meter	2	2	4
G26a	Automatic Pure Water System	2	2	4
G26b	Automatic Ultra Pure Water System	1	0	1
G27	Peristaltic Pump	4	6	10
G28	Aspirator	3	4	7
G29	Cold Storage Chamber	1	0	1
G30	Freeze Storage Chamber	1	1	2
G31	V Type Blender	1	0	1

2. General Laboratory Equipment (2)

Code No.	Equipment	Purpose		Total
		Research	Training	
G32	AC Stabilizer	0	11	11
G33	Mixer	2	2	4
G34	Reagent Locker	3	2	5
G35	Hot Plate (Small)	2	2	4
G36	Hot Plate (Large)	1	1	2
G37	Syphon Type Pipette Cleaner	3	2	5
G38	Stop Watch	2	3	5
G39	White Board	3	2	5
G40	Rack	18	12	30
G41	Bottle Cabinet	3	2	5
G42	Mantle Heater (Small)	5	5	10
G43	Mantle Heater (Large)	5	5	10
G44	Steel Cabinet	25	13	38
G45	Mini Pump	3	2	5
G46	Laboratory Table (Wall Side)	22	16	38
G47	Laboratory Table (Central)	11	16	27
G48	Sink	10	5	15
G49	Balance Table	4	4	8
G50	Working Table	3	1	4
G51	Draft Chamber	4	3	7
G52	Clean Bench	2	0	2
G53	Heavy Metal Waste Treatment Apparatus	1	1	2

3. Water Quality Monitoring Equipment

Code No.	Equipment	Purpose		Total
		Research	Training	
W01a	Laboratory Type DO Meter	2	3	5
W01b	Portable Type DO Meter	2	3	5
W02a	Laboratory Type Conductivity Meter	1	2	3
W02b	Portable Type Conductivity Meter	2	2	4
W03	Salinity Meter	1	1	2
W04	TOC Analyzer	1	0	1
W05	Portable Oil Analyzer	1	0	1
W06	Portable Residual Chlorine Meter	1	1	2
	Portable Water Quality Analyzer :			
W07a	* Turbidity Meter	1	0	1
W07b	* Portable Water Quality Analyzer System	1	0	1
W07c	* Portable Mercury Analyzer	1	0	1
W08	Water Test Kit for General Use	2	2	4
W09	Bacteria Test Paper	2	3	5
W10	Refractometer	1	1	2
W11	Plankton Net	2	3	5
W12	Hyrout Water Sampler	2	2	4
W13	Van Dorn Water Sampler	2	2	4
W14	Eckman-Berge Dredge	2	2	4
W15	Core Sampler	1	1	2
W16	Price's Electric Current Meter	1	1	2
W17	Jar Tester	1	1	2
W18	Digital Colony Counter	2	2	4
W19	UV lamp	2	2	4
W20	Steam Sterilizer	1	1	2
W21	Blowing Type Contact Temporary Oven	1	1	2
W22	Autoclave	1	1	2

4. Air Quality Monitoring Equipment (1)

Code No.	Equipment	Purpose		Total
		Research	Training	
A01	Portable SO_2 Analyzer	1	1	2
A02	Portable NO_X Analyzer	1	1	2
A03	Portable CO Analyzer	1	1	2
A04	Portable HC Analyzer	1	1	2
A05a	Container for Air Conditioner	3	0	3
A05b	Data Logger	3	0	3
A05c	Automatic SO_2 Analyzer	3	0	3
A05d	Automatic NO_X Analyzer	3	0	3
A05e	Automatic CO Analyzer	3	0	3
A05f	Automatic Hydrocarbon Analyzer	3	0	3
A05g	Automatic Particulate Matter Analyzer	3	0	3
A05h	Automatic Oxidant Analyzer	3	0	3
A05i	Weather Observation Instruments	3	0	3
A06	Vehicle Emission Gas Analyzer (HC/CO)	1	1	2
A07	Automatic Gas Burner Exhaust Gas Analyzer	1	1	2
A08	High Volume Air Sampler	3	2	5
A09	Low Volume Air Sampler	3	2	5
A10	Andersen Particle Fractioning Sampler	2	0	2
A11	Deposit Gauge	3	2	5
A12	Dust Jar	3	2	5
A13	Portable Wind System	2	3	5
A14	Thermo-Hygrograph	3	2	5
A15	Syphon Type Recording Rain Gauge	2	0	2
A16	Precision Gas Detector	2	4	6
A17	Solar Radiation Meter	1	0	1
A18	Portable Black Fume Meter	1	1	2
A19	Kitagawa Type Gas Sampler	2	4	6
A20	Orzat Analyzer	2	3	5
A21	Stack Sampler	2	3	5
A22	Gas Phase Diluter	2	0	2
A23	Zero Gas Generator	2	0	2
A24	Standard Gas Generator	2	0	2
A25	Vacuum Sampler/Vacuum Pump Set	2	2	4
A26	Standard Gas Cylinder	1lot	0	1lot
A27	Oil Pump	3	2	5

4. Air Quality Monitoring Equipment (2)

Code No.	Equipment	Purpose		Total
		Research	Training	
A28	Rotary Pump	2	1	3
A29	Dry Type Gas Meter	2	0	2
A30	Wet Type Gas Meter	3	3	6
A31	Standard Voltage Generator	1	0	1
A32	Handy Sampler for Gas Sampling	3	3	6
A33	Standard Ozone Gas Generator	1	0	1
A34	Hydrogen Gas Generator	3	0	3
A35	Osciloscope	1	0	1
A36	Air Purifier for Lab Atmosphere	3	1	4
A37	Electric Desicator	3	2	5
A38	Sequential Timer	1	2	3

5. Noise and Vibration Level Monitoring Equipment

Code No.	Equipment	Purpose		Total
		Research	Training	
N01	Sound level Meter	2	3	5
N02	Level Recorder	2	3	5
N03	Tape Recorder	2	3	5
N04	Precision Integrating Sound Level Meter	2	3	5
N05	Piston Phone	1	1	2
N06	Octave Band Filter	1	1	2
N07	1/3 Octave Band Real-Time Analyzer	1	1	2
N08	Vibration Meter	1	2	3
N09	Tunable Filter	1	2	3
N10	Calibration Exciter	1	1	2
N11	Data Processing Unit	1	1	2
N12	Tripod	4	6	10
N13	Extension Code (10m)	5	8	13
N14	Extension Code (30m)	5	8	13
N15	Transceiver	3	0	3

6. Equipment for Waste and Toxic Substance Analytical Equipment

Code No.	Equipment	Purpose		Total
		Research	Training	
T01	Milling Machine	1	1	2
T02	Sieve Shaker	1	1	2
T03	Compact Balance	1	1	2
T04	Platform Scale	1	1	2
T05	Hot Air Drying Oven	1	1	2
T06	Automatic Tag Closed Cup Flash Point Tester	2	1	3
T07	Copper Corrision Tester	2	1	3
T08	Elemental Analysis Instrument (CHN)	1	1	2
T09	Calorie Meter	1	1	2
T10	KD Evaporator	1	1	2
T11	Micro Kjeldahl Distiller	1	1	2
T12	Kjeldahl Nitrogen Digestion and Distilling Apparatus	2	2	4
T13	Blender	1	1	2

7. Information System Equipment

Code No.	Equipment	Purpose		Total
		Research	Training	
I01	Central Processor	1	0	1
I02	Reel to Reel Magnetic Tape Device	1	0	1
I03	Image Processor	1	0	1
I04	Dot Matrix Printer	5	0	5
I05	Laser Printer	1	0	1
I06	Plotter	1	0	1
I07	Digitizer	1	0	1
I08	Personal Computer	7	0	7
I09	Soft Ware	1set	0	1set

8. Other Training Equipment

Code No.	Equipment	Purpose		Total
		Research	Training	
O01	Computer and Desk for Training	0	11	11
O02	Slide Projector	1	4	5
O03	OHP Projector	1	4	5
O04	VTR, Camera, Video TV Editing Set	0	1	1
O05	Video Projector	0	1	1
O06	TV Set (Multi System)	0	1	1
O07	TV Set	0	2	2
O08	Screen (Including Tripod)	1	2	3
O09	Electric Typewriter	6	2	8
O10	Photo Copy Machine	2	1	3
O11	Facsimile	1	0	1
O12	Calculator	50	25	75
O13	High Class Photo Copy Machine and Building Machine	1	0	1
O14	Camera, Lens and Accessory	2	2	4
O15	Under Water Camera	1	1	2
O16	Desk Lamp	0	58	58
O17	Washing Machine and Laundry Machine	0	2	2
O18	4 Wheel Drive and Cruiser Type Vehicle, Air Conditioned	2	0	2
O19	Microbus, Air Conditioned	0	1	1
O20	Utility Van/-Light Truck	1	0	1

9. Workshop Equipment

Code No.	Equipment	Purpose		Total
		Research	Training	
S01	Precision Engine Lathe	1	0	1
S02	Horizontal Milling Machine	1	0	1
S03	Vertical Milling Machine	1	0	1
S04	Upright Drilling Machine	1	0	1
S05	AC Arc Welder	1	0	1
S06	Glass Work Set	1	0	1
S07	Precision Universal Cutter	1	0	1
S08	Tool Set	2	0	2
S09	Hand Drill	1	0	1
S10	Clamp	1	0	1
S11	Work Bench	1	0	1
S12	Parts Container	1	0	1
S13	Lab Cart for Gas Cylinder	3	3	6

10. Research & Training Fittings

No.	Item	Q'ty (Pcs./Nos.)
1	Desk (Director Rm., Expert's Rm., etc.)	14
2	Chair (Director Rm., Expert's R., etc.)	14
3	Book Cabinet (Director rm., Expert's Rm., etc.)	6
4	Meeting Table (Director Rm., Expert's Rm., etc.)	10
5	Meeting Chair (Director Rm., Expert's Rm., Guest Rm., etc.)	50
6	Meeting Table (Meeting Rm.)	3
7	Meeting Chair (Meeting Rm.)	75
8	Desk (Office, Lecturer's Rm.)	80
9	Chair (Office, Lecturer's Rm.)	80
10	Partition (Expert's Rm., Lecturer's Rm.)	20sets
11	Office Cabinet (Office Lecturer's Rm.)	80
12	Book Shelves (Library)	30
13	Reading Table (Library)	10
14	Reading Chair (Library)	30
15	Library Counter (Library)	1
16	File Cabinet (Library)	4
17	Microfilm Cabinet (Library)	2
18	Magazine Rack (Library)	2
19	Newspaper Rack (Library)	1
20	Card Catalogue Cabinet (Library)	30
21	Work Table (Workshop, Drafting Rm., etc.)	8
22	Stool (Workshop , Drafting Rm., etc.)	32
23	Storage Rack (Preparation Rm., Data Base Rm., etc.)	60
24	Storage Cabinet (Preparation Rm., Data Base Rm., etc.)	60
25	Stool (Laboratory)	120

No.	Item	Q'ty (Pcs./Nos.)
26	Computer Rack (Data Processing Rm.)	6
27	Desk Cabinet (Data Base Rm.)	4
28	Movable White Board (Meeting Rm.)	6
29	Lobby set (Lounge, Waiting, etc.)	8
30	Seminar Desk (Lecture Rm., AV Rm.)	100
31	Lecture's Desk (Seminar Rm.)	7
32	Seminar Chair (Lecture Rm.)	200
33	Lecturer's Chair (Lecture Rm.)	7
34	Computer Desk (CPU Practice Rm.)	6
35	Computer Chair (CPU Practice Rm.)	12
36	Folding Desk (Auditorium)	60
37	Folding Chair (Auditorium)	120
38	Dining Table (Canteen)	20
39	Dining Chair (Canteen)	80
40	Dining Table (Dormitory)	10
41	Dining Chair (Dormitory)	40
42	Bed (Superint. Rm., Bed Rm.)	58
43	Study Desk (Superint. Rm., Bed Rm.)	58
44	Study Chair (Superint. Rm., Bed Rm.)	58
45	Locker (Superint. Rm., Bed Rm.)	58
46	Conference Table (Bed Rm.-B, Counceling Rm.)	6
47	Conference Chair (Bed Rm.-B, Counceling Rm.)	18
48	Meeting Table (Meeting Rm.)	1set
49	Meeting Chair (Meeting Rm.)	40
50	Lobby set (Lounge)	2set
51	Linen Cabinet (Storage)	4

(Reference) Equipment for Training at P4L (Excluding from This Grant Aid Programme)

Code No.	Equipment	Purpose		Total
		Research	Training	
P01	FID/FTD Gas Chromatograph	0	1	1
P02	ECD Gas Chromatograph	0	1	1
P03	UV/FL High Performance Liquid Chromatograph	0	1	1
P04	Double Beam UV/VIS Spectrophotometer	0	1	1
P05	Mercury Analyzer	0	1	1
P06	Flame Type Atomic Absorption Spectrophotometer	0	1	1
P07	Automatic SO_2 Analyzer	0	1	1
P08	Automatic NO_X Analyzer	0	1	1
P09	Automatic CO Analyzer	0	1	1
P10	Weather Observation Instrument	0	1	1
P11	Gas Phase Diluter	0	1	1
P12	Zero Gas Generator	0	1	1
P13	Standard Gas Generator	0	1	1
P14	Standard Gas Cylinder	0	1lot	1lot

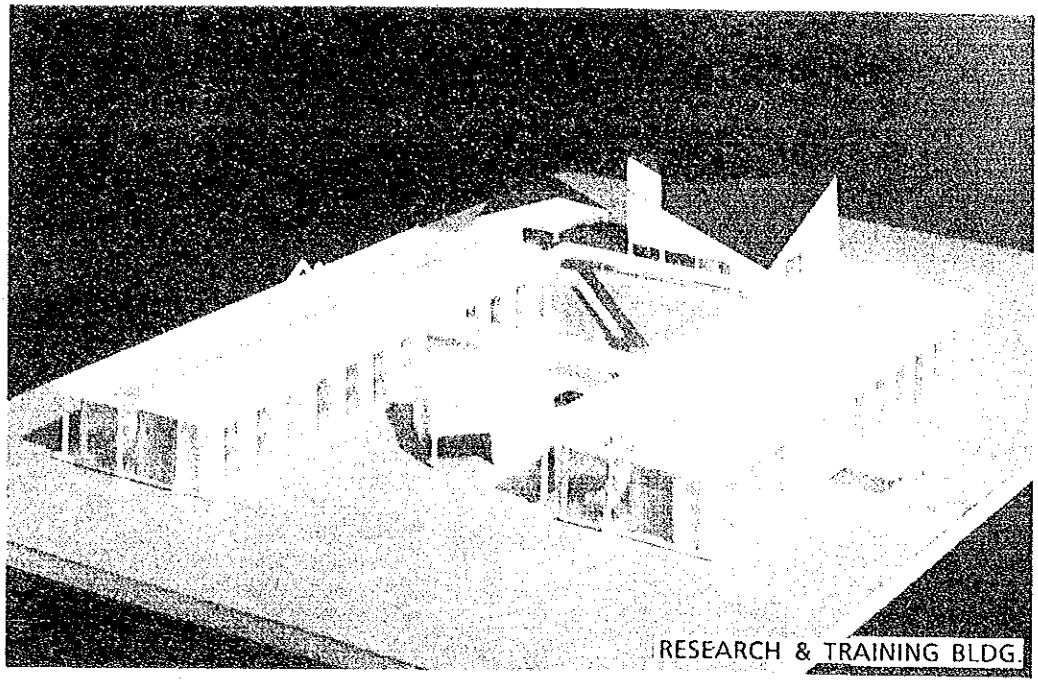
4-3-4 Basic design Drawings

(1) Drawing List

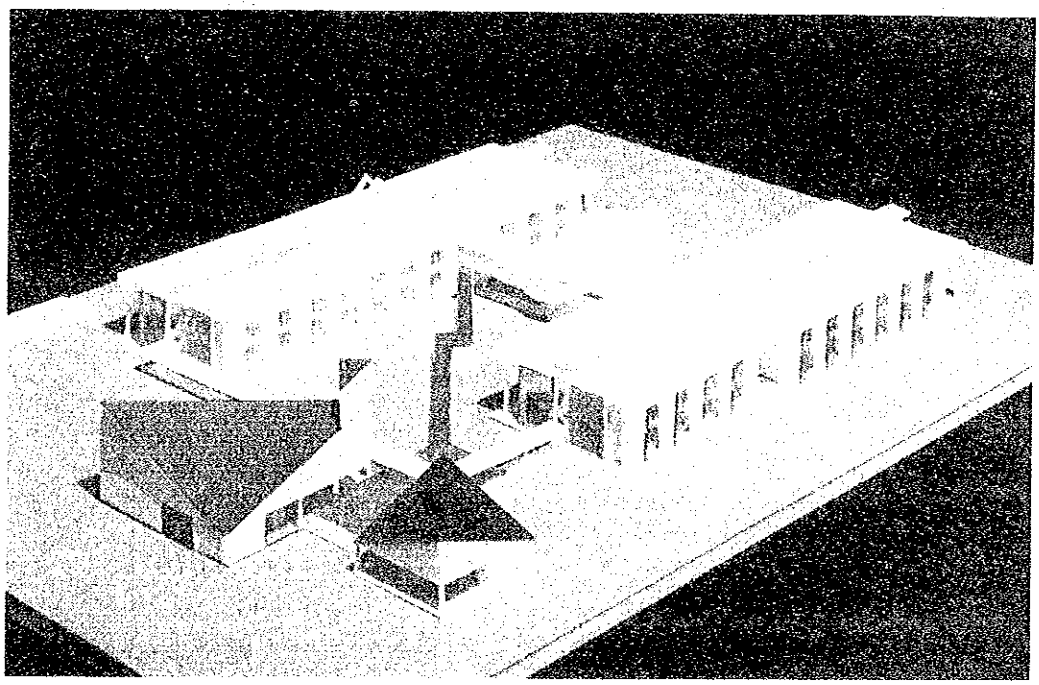
01	Research and Training Bldg.	Block Plan
02	〃	1st Floor Plan
03	〃	2nd Floor Plan
04	〃	Elevation-1
05	〃	Elevation-2
06	〃	Section
07	〃	Elec, Tel, Plumb, Suppling Plan
08	Dormitory	Block Plan
09	〃	Plan, Elevation, Section
10	〃	Elec, Tel, Plumb, Suppling Plan
11	Equipment Layout Plan-1	
12	Equipment Layout Plan-2	
13	Equipment Layout Plan-3	
14	Equipment Layout Plan-4	
15	Equipment Layout Plan-5	
16	Equipment Layout Plan-6	

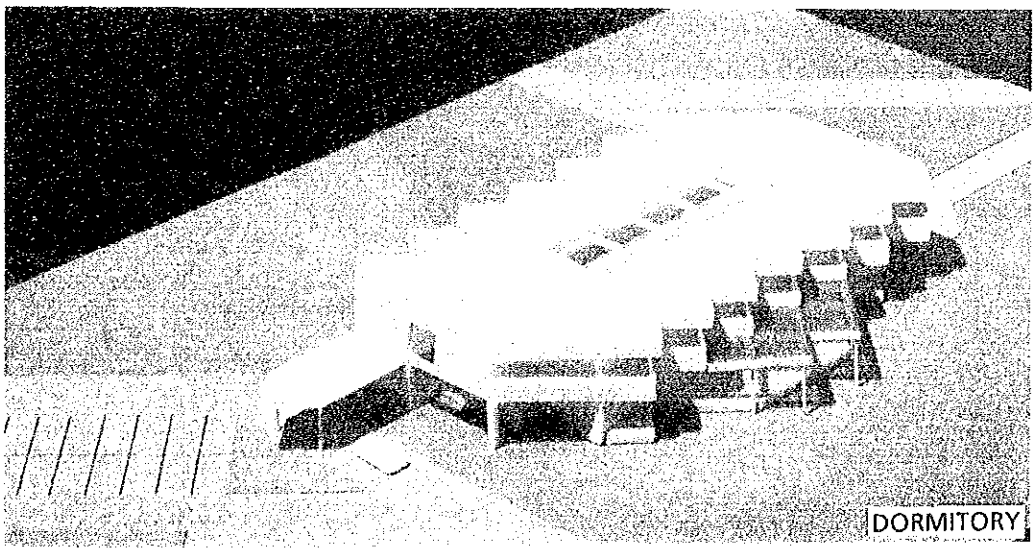
(2) Floor Area Tabulation

Building	Research & Training Building								Dormitory
Block	Admini.	Library	Research	Training	Auditorium	Canteen	Covered Way	Total (m^2)	
1F	647	270	1,440	874	576	140	296	4,250	652
2F	478	380	1,302	778	33	-	-	2,970	774
PH	-	-	36	36		-	-	72	14
Sub Total (m^2)	1,125	656	2,778	1,688	609	140	296	7,292	1,440
Phasing(m^2)	1st Phase			4,559	2nd Phase				4,173
Total									8,732

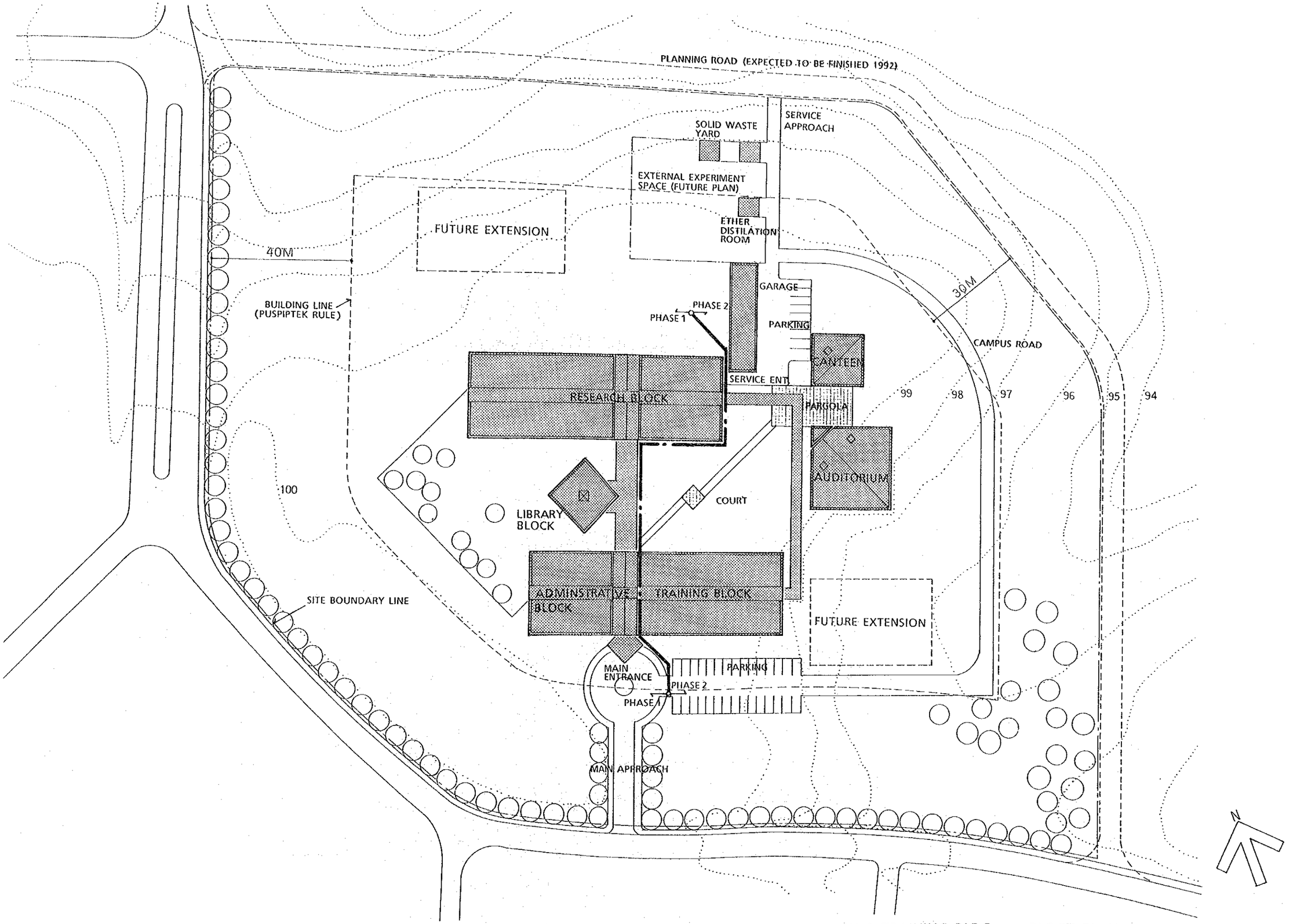


RESEARCH & TRAINING BLDG.





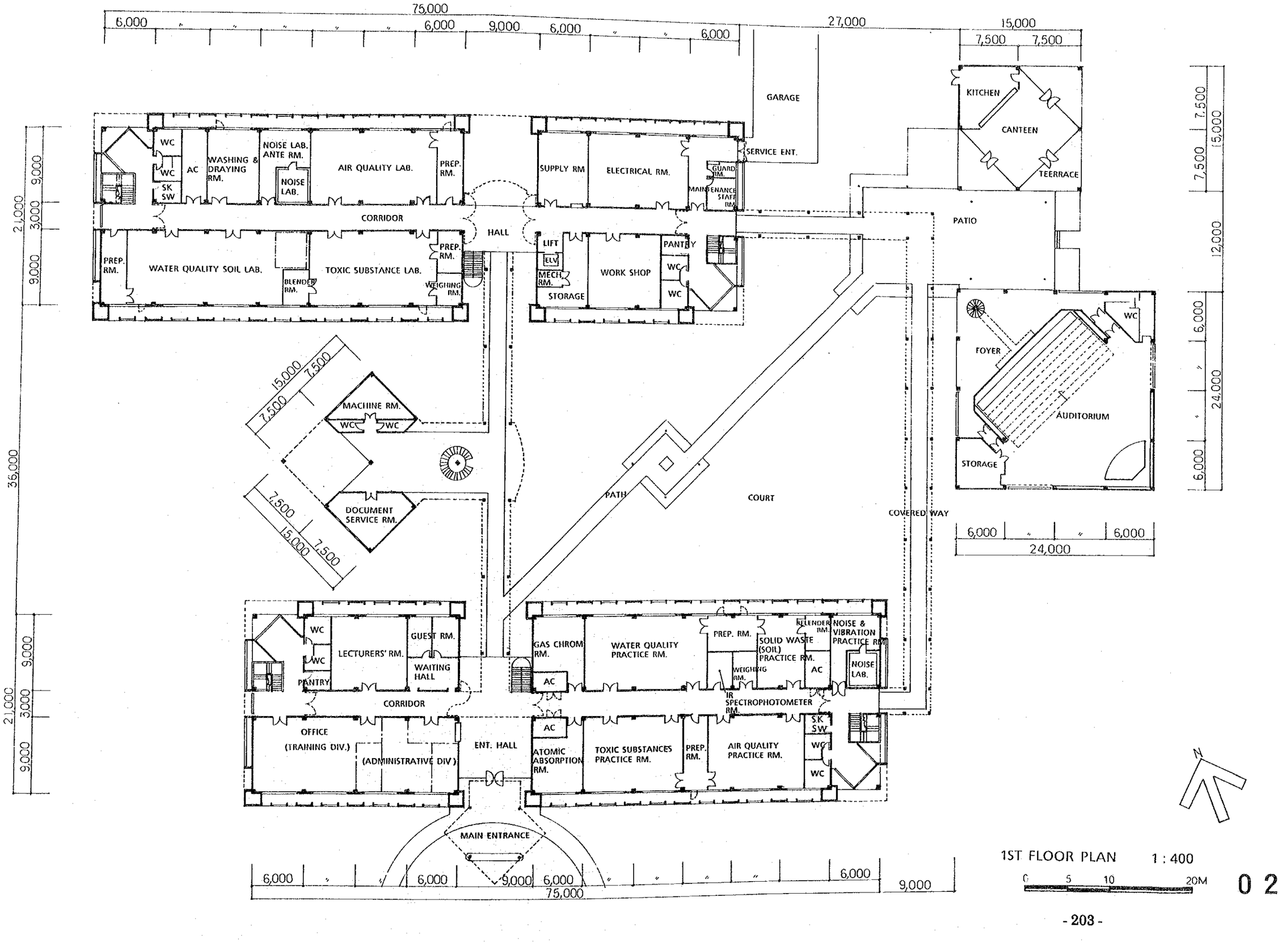
DORMITORY



RESEARCH & TRAINING BLDG. BLOCK PLAN 1 : 1,000

0 10 20 30 50M

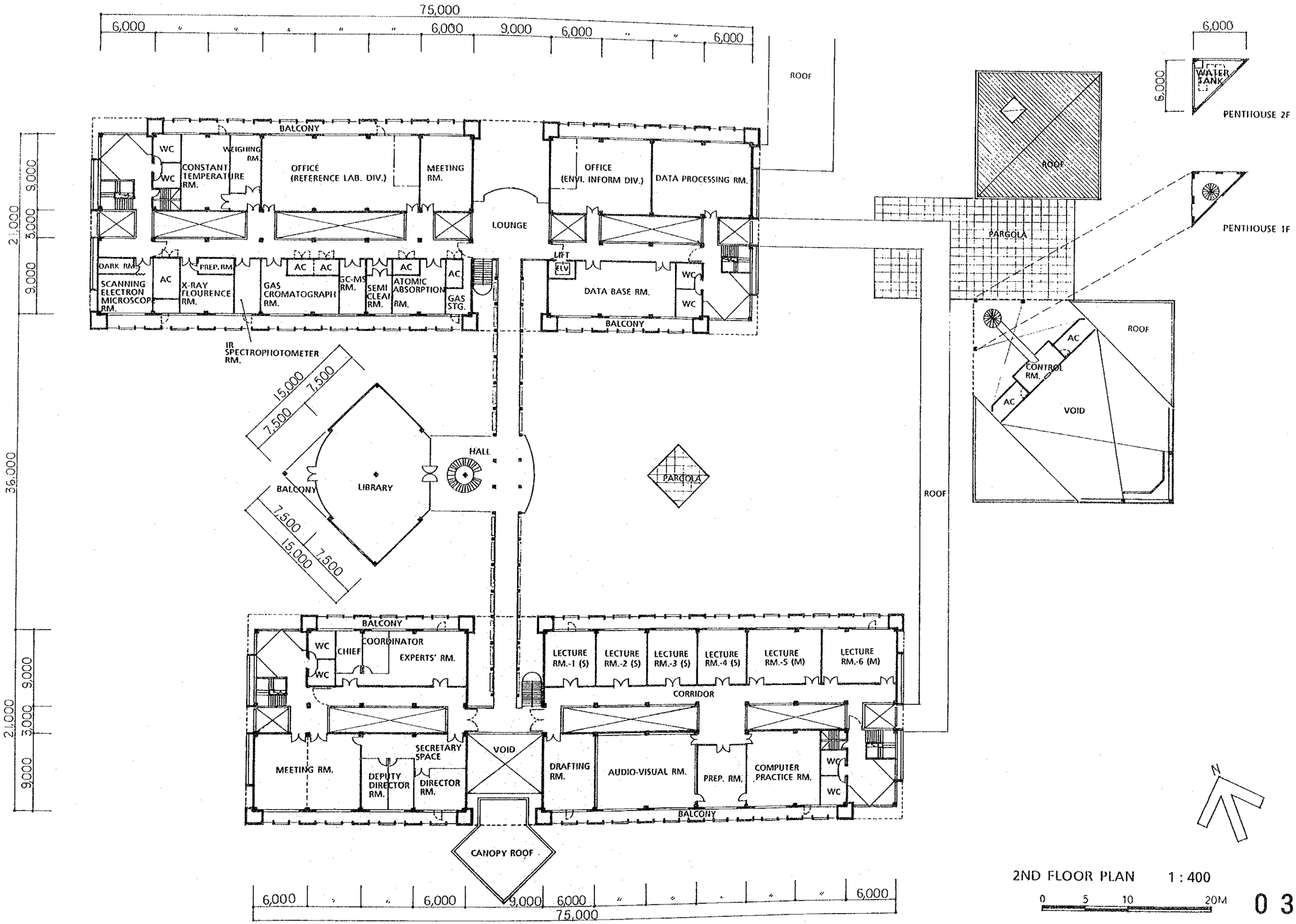
01



1ST FLOOR PLAN 1 : 400

0 5 10 20M

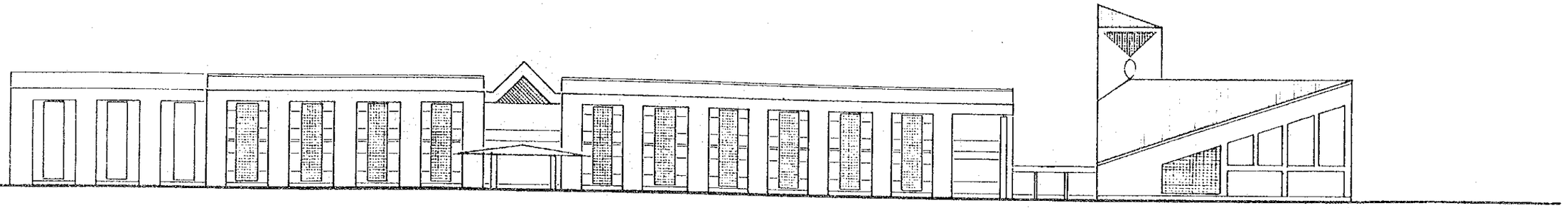
02



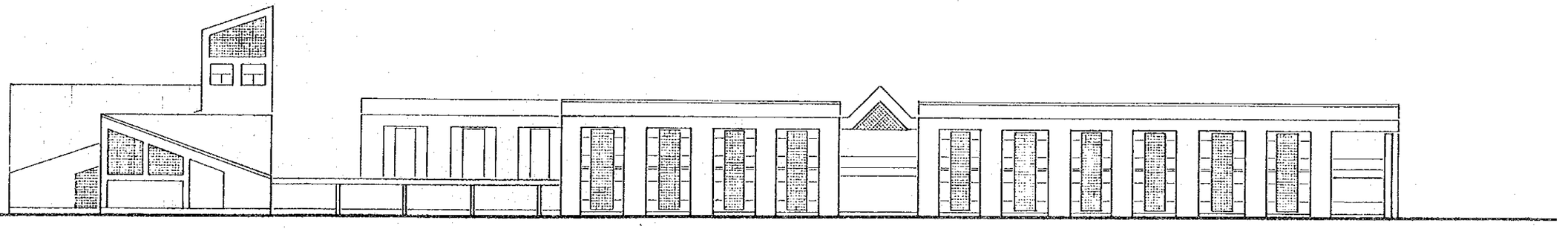
2ND FLOOR PLAN 1 : 400

0 5 10 20M

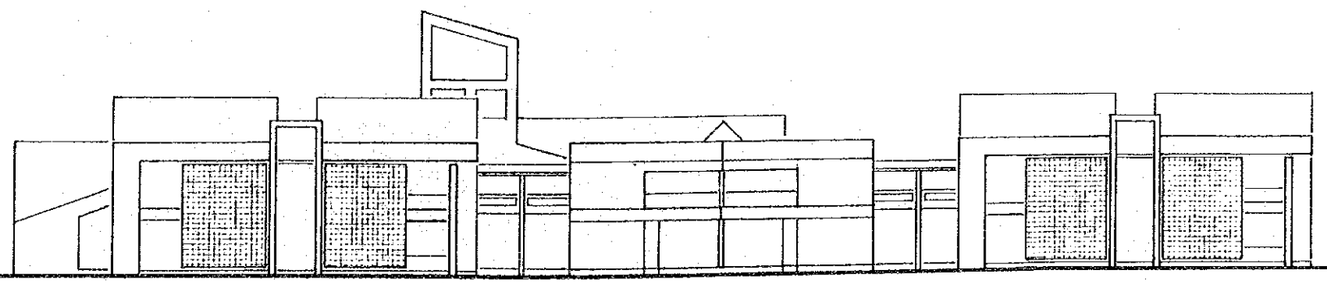
03



SOUTH SIDE



NORTH SIDE

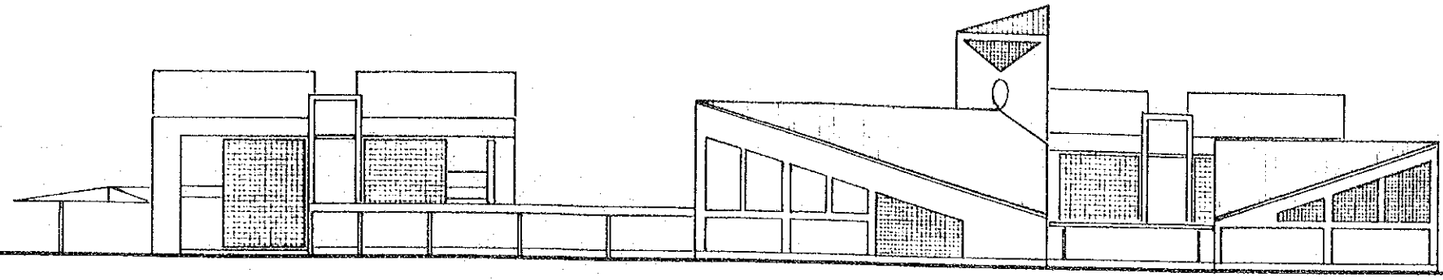


WEST SIDE

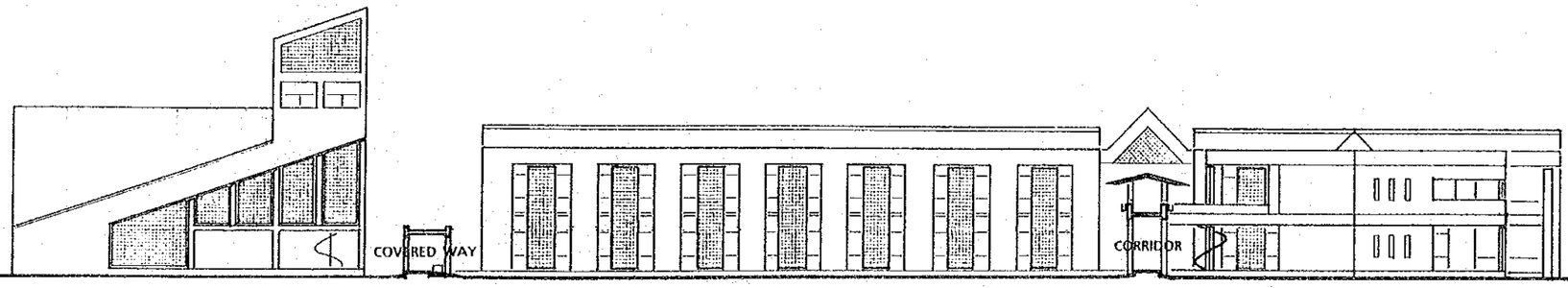
ELEVATION - 1 1 : 400

0 5 10 20M

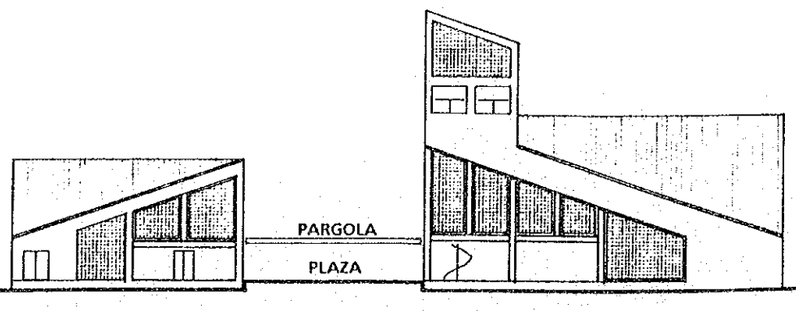
04



EAST SIDE



AUDITORIUM TRAINING BLOCK LIBRARY BLOCK NORTH SIDE



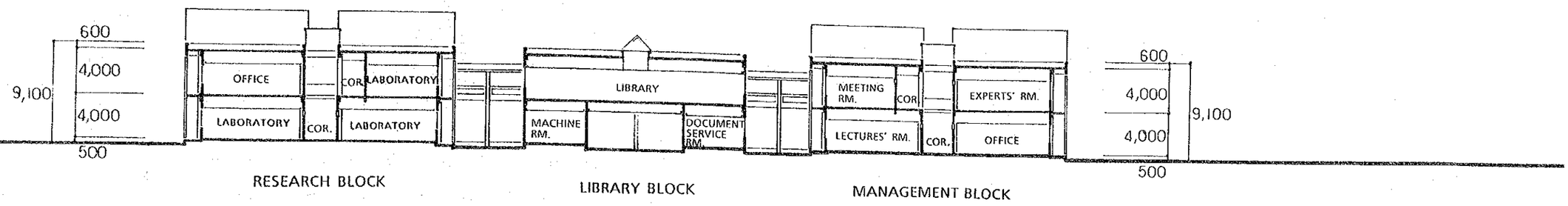
CANTEEN AUDITORIUM

WEST SIDE

ELEVATION - 2 1 : 400

0 5 10 20M

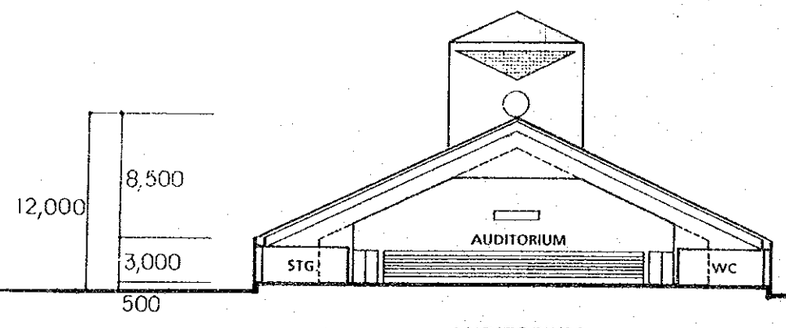
05



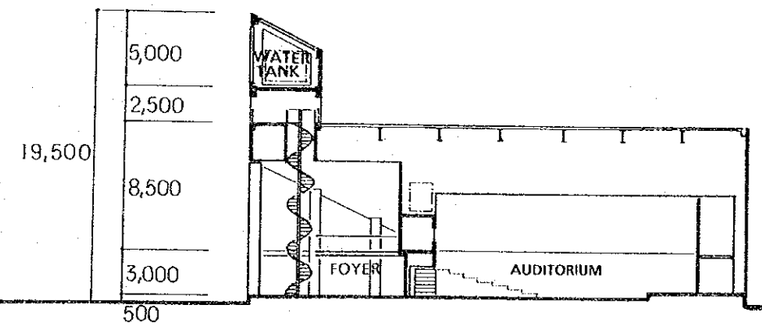
RESEARCH BLOCK

LIBRARY BLOCK

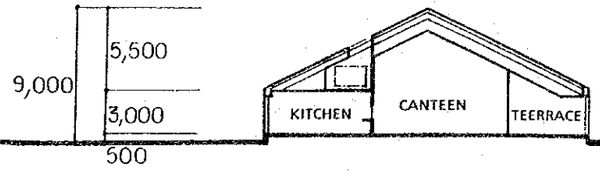
MANAGEMENT BLOCK



AUDITORIUM



AUDITORIUM

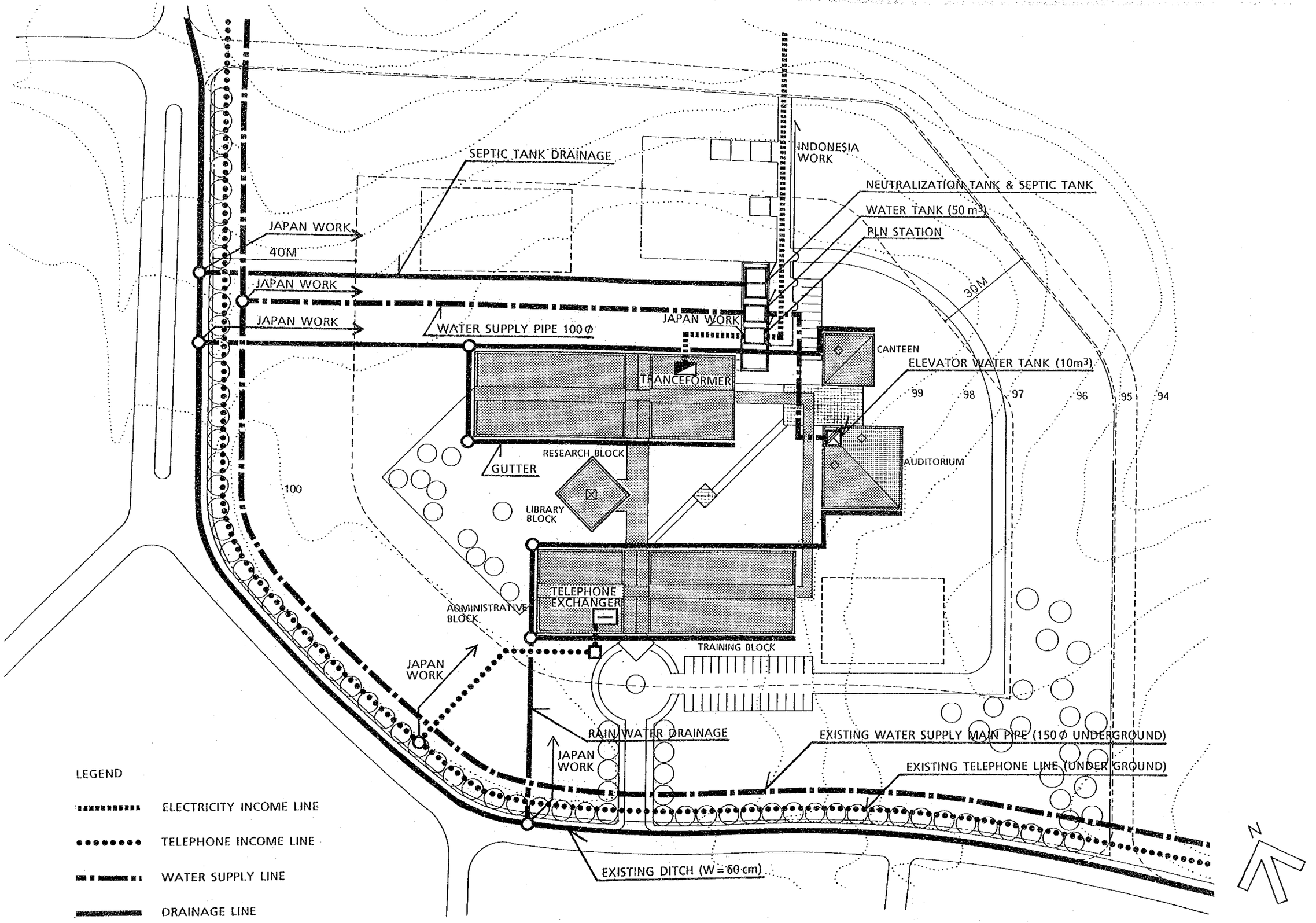


CANTEEN

SECTION 1 : 400

0 5 10 20M

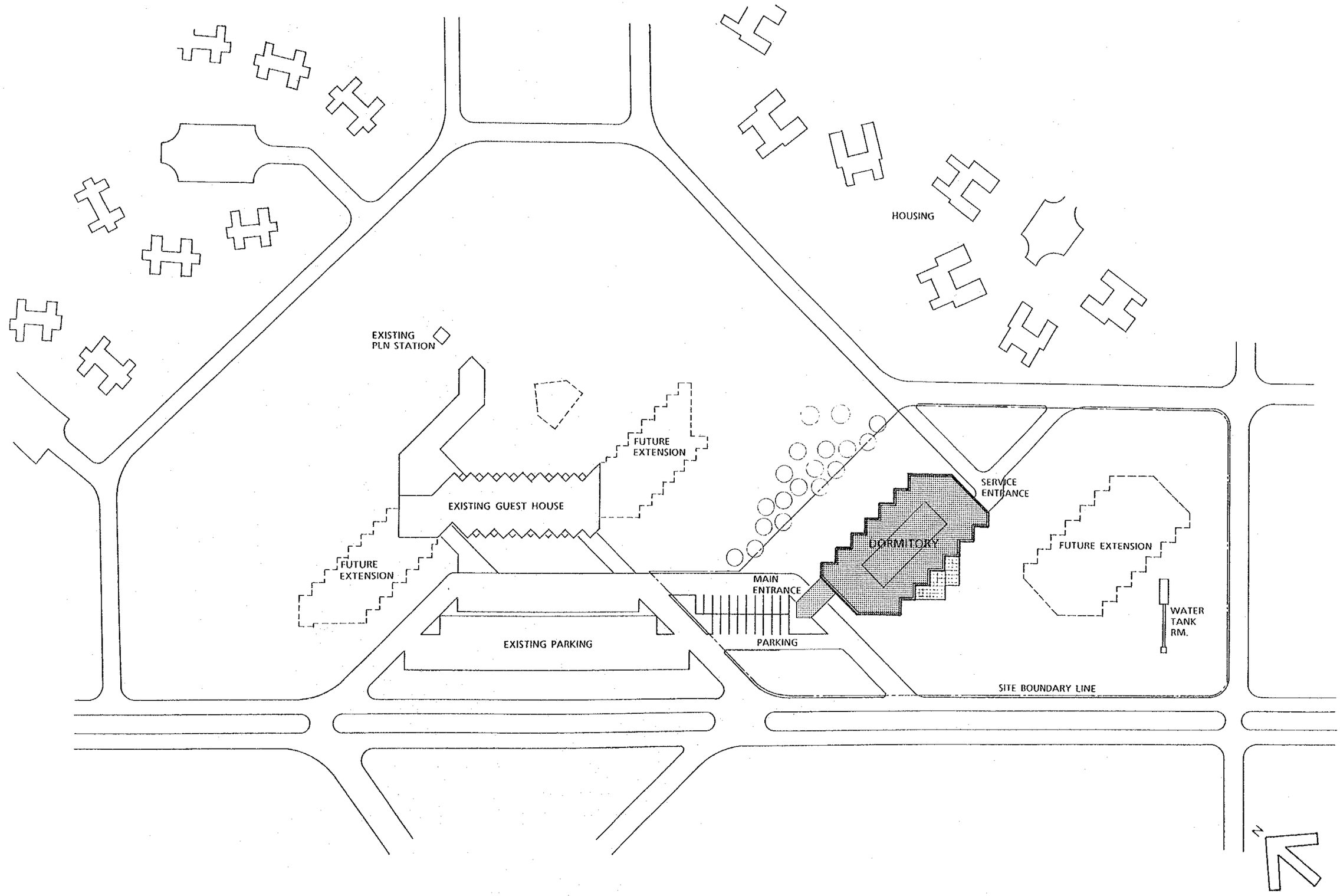
06



ELECTRICITY · TELEPHONE · WATER SUPPLY · DRAINAGE PLAN 1 : 1,000

0 10 20 30 50M

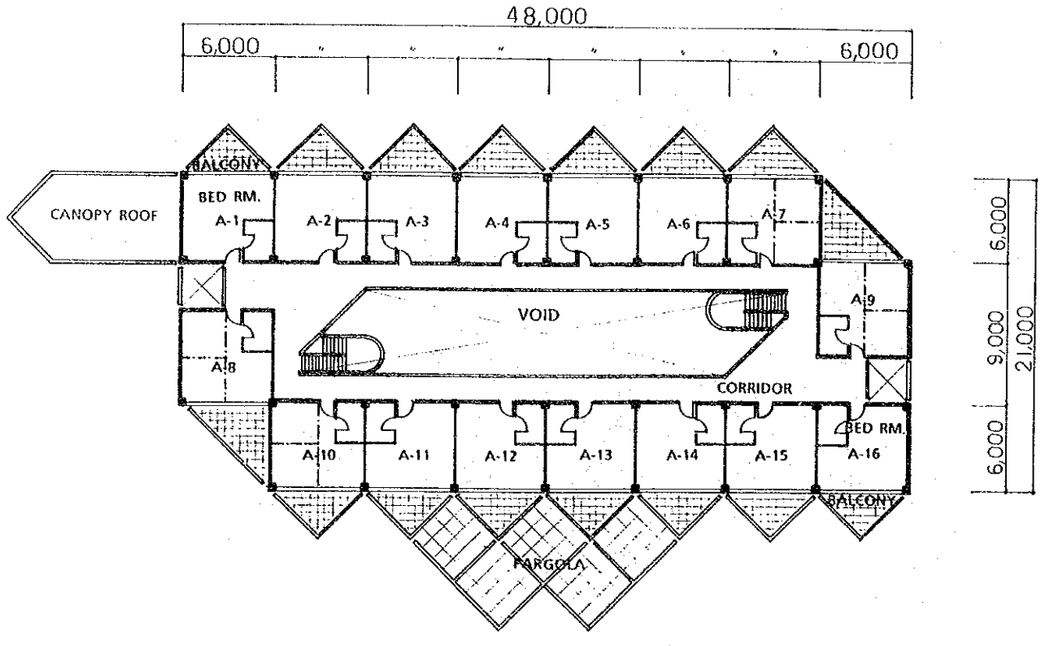
0 7



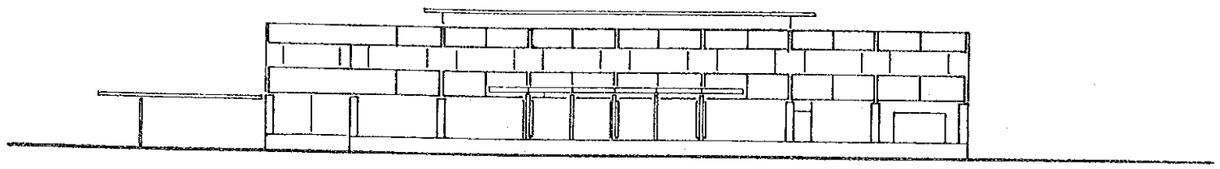
DORMITORY BLOCK PLAN 1 : 1,000

0 10 20 30 50M

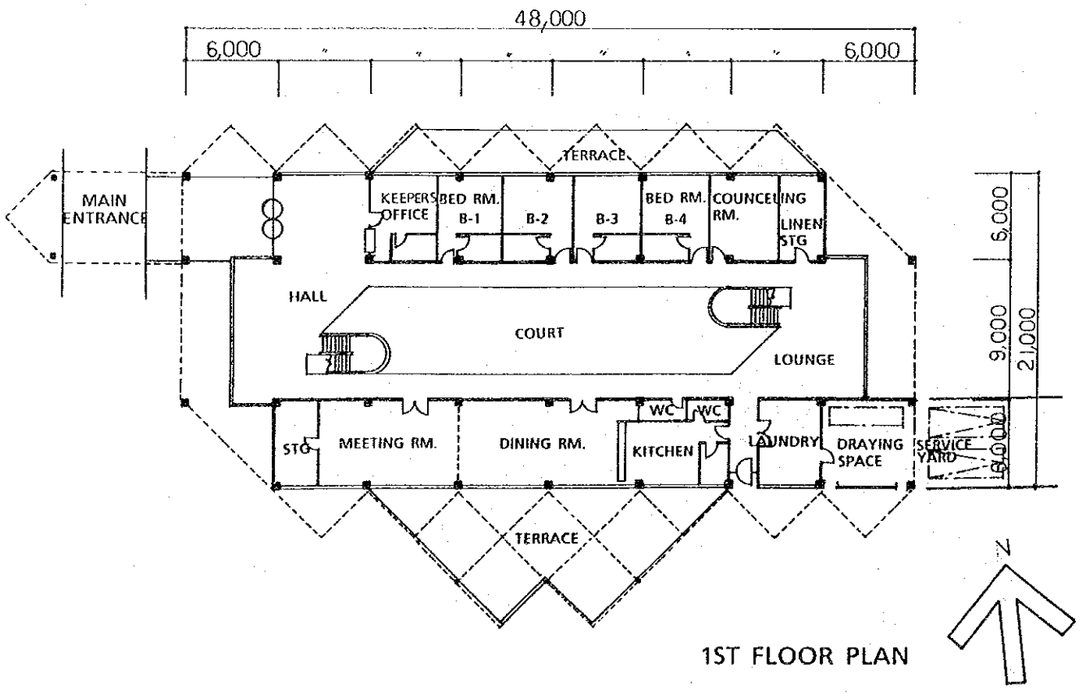
08



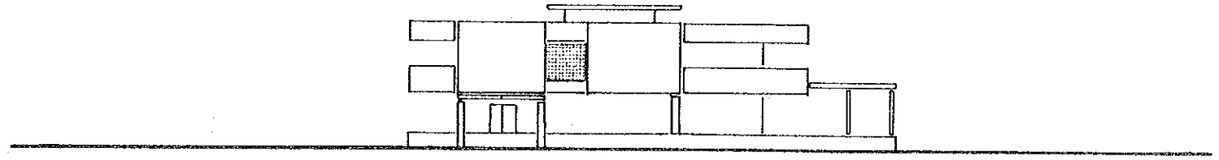
2ND FLOOR PLAN



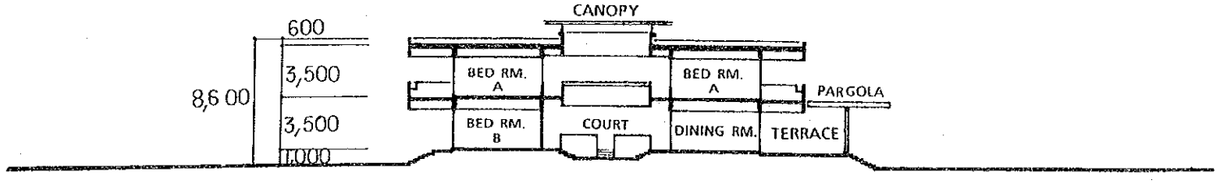
SOUTH SIDE ELEVATION



1ST FLOOR PLAN



WEST SIDE ELEVATION

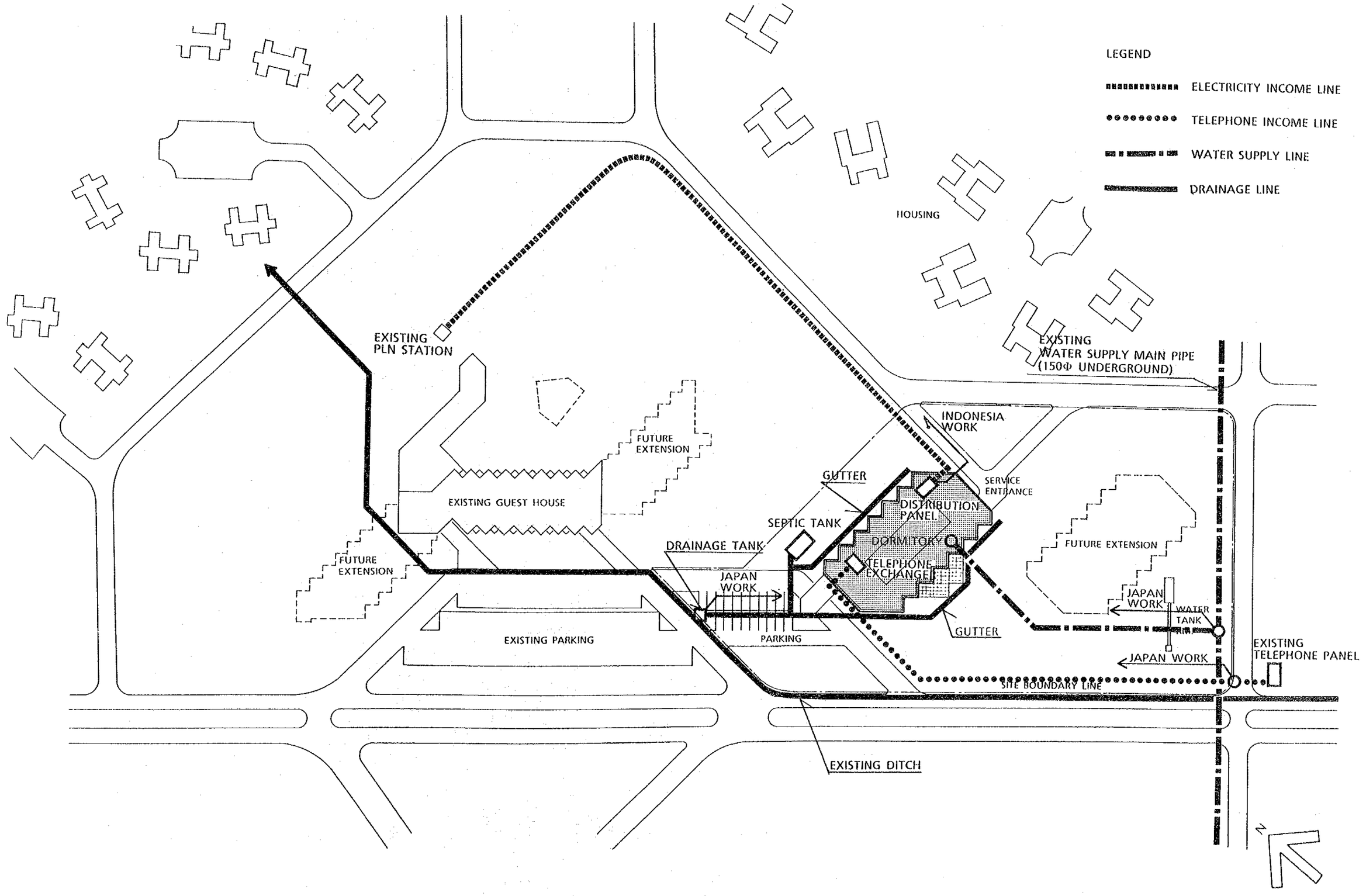


SECTION

PLAN • ELEVATION • SECTION 1 : 400

0 5 10 20M

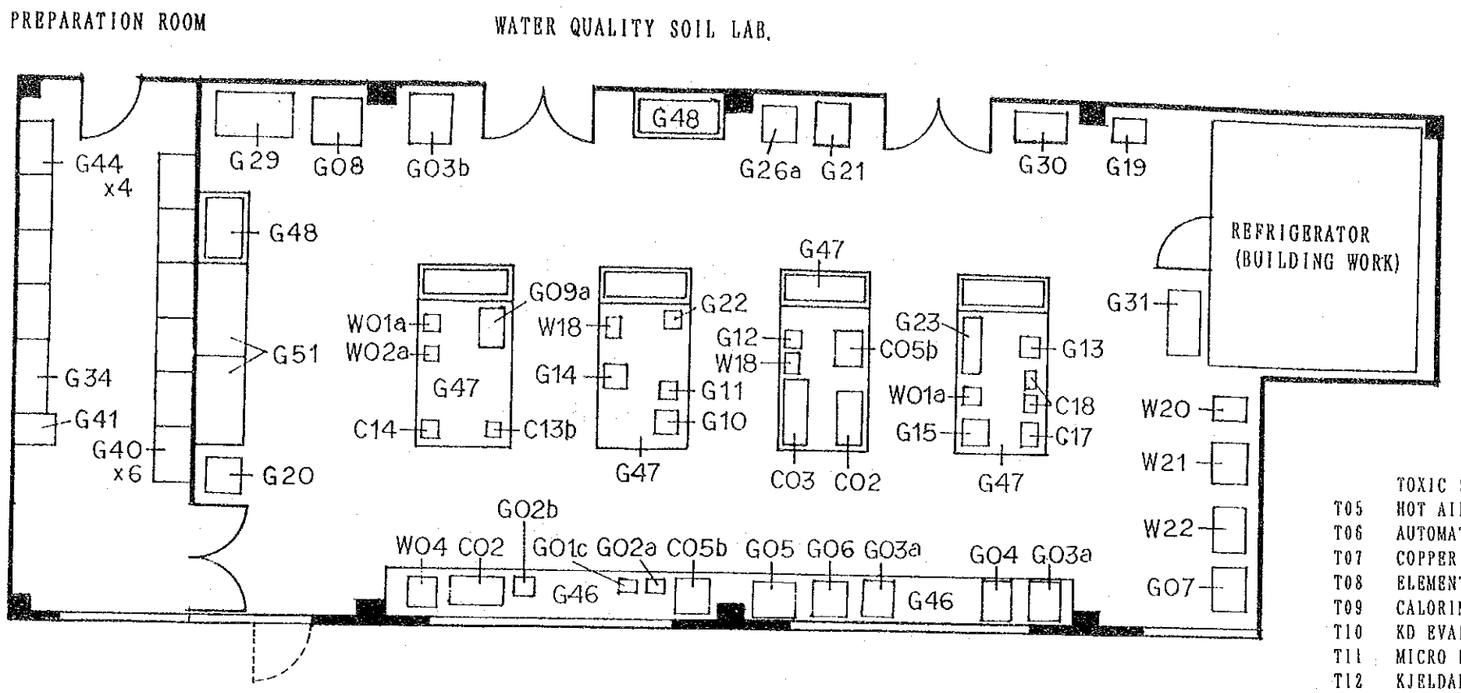
09



ELECTRICITY · TELEPHONE · WATER SUPPLY · DRAINAGE PLAN 1 : 1,000

0 10 20 30 50M

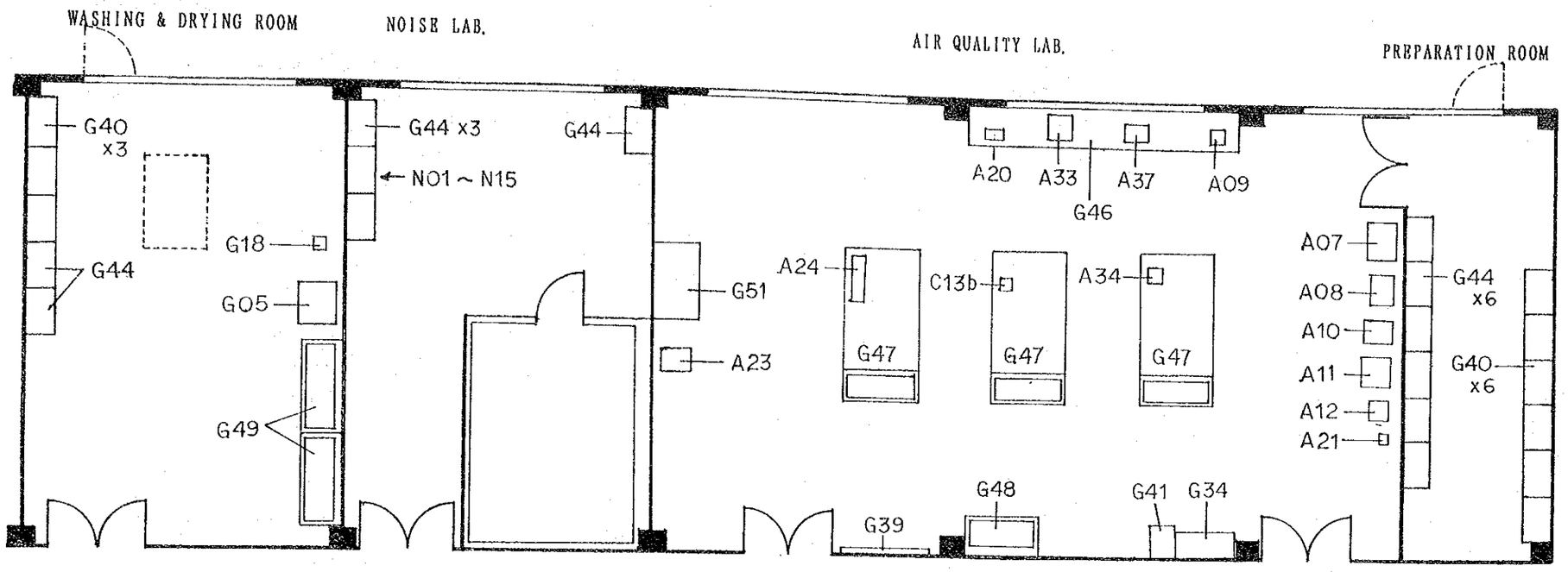
10



	WATER QUALITY SOIL LAB.
W01a	DO METER LABORATORY TYPE
W02a	CONDUCTIVITY METER LAB. TYPE
W04	TOC ANALYZER
W18	DIGITAL COLONY COUNTER
W20	STEAM STERILIZER
W21	DRY STERILIZER
W22	AUTOCLAVE
C13b	pH METER LABORATORY TYPE
C14	ION METER
C17	METALLURGICAL MICROSCOPE
C18a	BIOLOGICAL MICROSCOPE
G01c	INDICATED BALANCE (3Kg)
G02a	BALANCE (5Kg)
G02b	BALANCE (10Kg)
G03a	CENTRIFUGE TABLE TOP TYPE
G03b	CENTRIFUGE HIGH SPEED
G04	AUTOMATIC MUFFLE FURNACE
G05	ELECTRIC OVEN
G06	VACUUM DRYING OVEN
G07	INCUBATOR
G08	AUTOMATIC BOD INCUBATOR
G09a	ROTARY EVAPORATOR
G10	LOW TEMP. WATER CIRCULAT' N BATH
G11	STANDARD WATER BATH
G12	THERMISTOR WATER BATH
G13	FRACTION COLLECTOR
G14	RATARY CULTI-SHAKER
G15	MULTI LABO SHAKER
G19	WATER DISTILLING APPARATUS
G20	ICE CUBE MAKER
G21	REFRIGERATOR/FREEZER
G22	ULTRASONIC CLEANER FOR PIPETTE
G23	SOXLET EXTRACTION APPARATUS
G26a	AUTOMATIC PURE WATER SYSTEM
G29	FREEZE STORAGE CHAMBER
G30	COLD STORAGE CHAMBER
G31	V TYPE BLENDER
G34	REAGENT LOCKER
G40	RACK
G41	BOTTLE CABINET
G44	CABINET
C02	HP LIQUID CHROMATOGRAPH (UV/FL)
C03	ION CHROMATOGRAPH
C05b	UV/VIS SPECTROPHOTOMETER (W)
G51	DRAFT CHAMBER
G47	LABORATORY TABLE (CENTRAL)
G46	LABORATORY TABLE (WALL SIDE)
G48	SINK

	TOXIC SUBSTANCE LAB.
T05	HOT AIR DRYING OVEN
T06	AUTOMATIC TAG CLOSED CUP F. P. T
T07	COPPER CORROSION TESTER
T08	ELEMENTAL ANALYSIS INST. (CHN)
T09	CALORIMETER
T10	KD EVAPORATOR
T11	MICRO KJELDAHL DISTILLER
T12	KJELDAHL INTROGEN DIG/DIST APP
C13b	pH METER LABORATORY TYPE
G04	AUTOMATIC MUFFLE FURNACE
G05	ELECTRIC OVEN
G06	VACUUM DRYING OVEN
G09b	ROTARY EVAPORATOR
G11	STANDARD WATER BATH
G21	REFRIGERATOR/FREEZER
G22	ULTRA SONIC CLEANER FOR PIPETT
G23	SOXLET EXTRACTION APPARATUS
G26a	AUTOMATIC PURE WATER SYSTEM
G26b	ULTRA PURE WATER SYSTEM
G34	REAGENT LOCKER
G39	WHITE BOARD
G40	RACK
G41	BOTTLE CABINET
G44	CABINET
G51	DRAFT CHAMBER
G47	LABORATORY TABLE (CENTRAL)
G46	LABORATORY TABLE (WALL SIDE)
G48	SINK
	BLENDER ROOM
T01	MILLING MACHINE
T02	SIEVE SHAKER
T13	BLENDER
	WEIGHING ROOM
T03	COMPACT BALANCE
T04	PLATFORM SCALE

EQUIPMENT LAYOUT PLAN-1 1:100 11



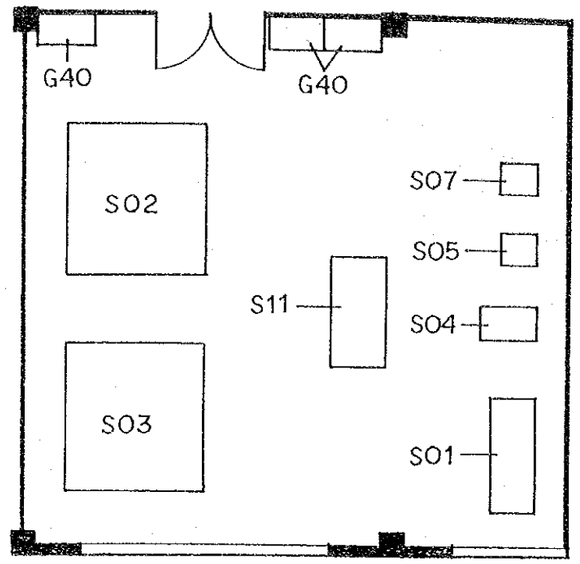
	WASHING & DRYING ROOM
G18	ULTRA SONIC CLEANER
G05	HOT AIR DRYING OVEN
G40	RACK
G44	CABINET
G49	SINK

	NOISE LAB.
N01	SOUND LEVEL METER
N02	LEVEL RECORDER
N03	TAPE RECORDER
N04	PRECIS' N INTEGRAT' G SOUND L. M.
N05	PISTON PHONE
N06	OCTAVE BAND FILTER
N07	1/3 OCTAVE BAND REAL-TIME ANAL
N08	VIBRATION MATER
N09	TUNABLE FILTER
N10	CALIBRATION EXCITER
N11	DATA PROCESSING UNIT
N12	TRIPOD
N13	EXTENSION CODE (10M)
N14	EXTENSION CODE (30M)
N15	TRANCEIVER
G44	CABINET

	AIR QUALITY LAB.
A06	VEHICLE EMISSION GAS ANALYZER
A07	AUTO. GAS BURNER EXH. GAS ANALYZ
A08	HIGH VOLUME AIR SAMPLER
A09	LOW VOLUME AIR SAMPLER
A10	ANDERSEN PARTICLE FRACT. SAMPL
A11	DEPOSIT GAUGE
A12	DUST JAR
A20	ORZAT ANALYZER
A21	STACK SAMPLER
A23	ZERO GAS GENERATOR
A24	STANDARD GAS GENERATOR
A33	STANDARD OZONE GAS GENERATOR
A34	HYDROGEN GENERATOR
A37	ELECTRIC DESICATOR
C13b	pH METER LABORATORY TYPE
G34	REAGENT LOCKER
G39	WHITE BOARD
G40	STORAGE RACK
G41	BOTTLE CABINET
G44	CABINET
G51	DRAFT CHAMBER
G47	LABORATORY TABLE (CENTRAL)
G46	LABORATORY TABLE (WALL SIDE)
G48	SINK

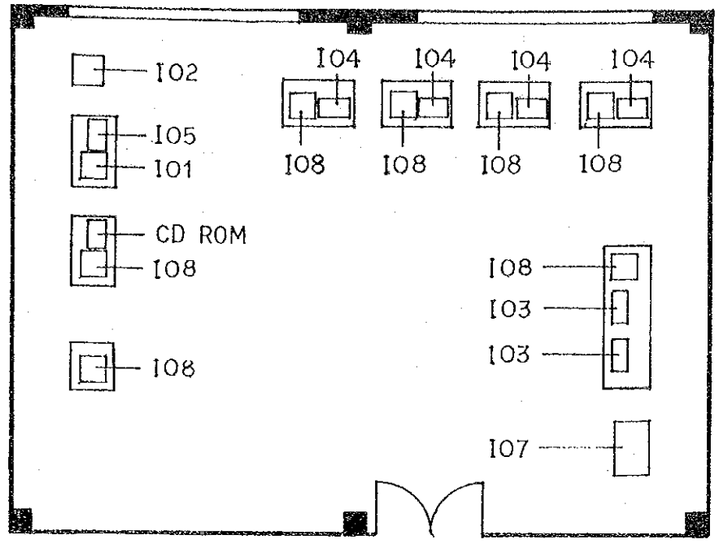
EQUIPMENT LAYOUT PLAN-2 1:100 12

WORKSHOP

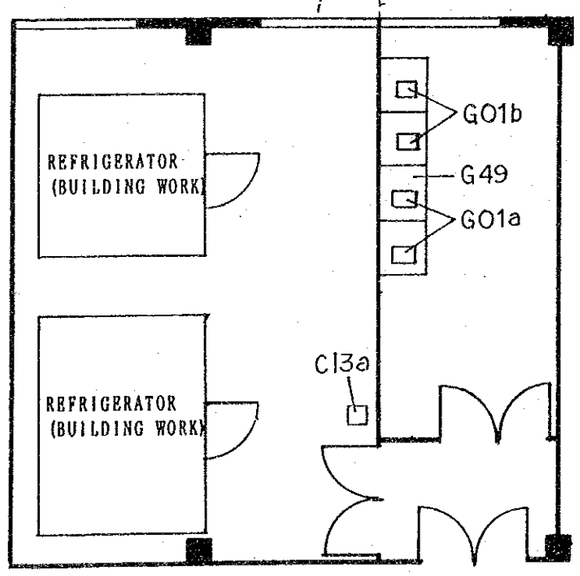


WORKSHOP
S01 PRECISION ENGINE LATHE
S02 HORIZONTAL MILLING MACHINE
S03 VERTICAL MILLING MACHINE
S04 UPRIGHT DRILLING MACHINE
S05 AC ARC WELDER
S07 PRECISION UNIVERSAL CUTTER
S11 WORK BENCH
G40 STORAGE RACK

DATA PROCESSING ROOM



CONSTANT TEMPERATURE ROOM WEIGHING ROOM

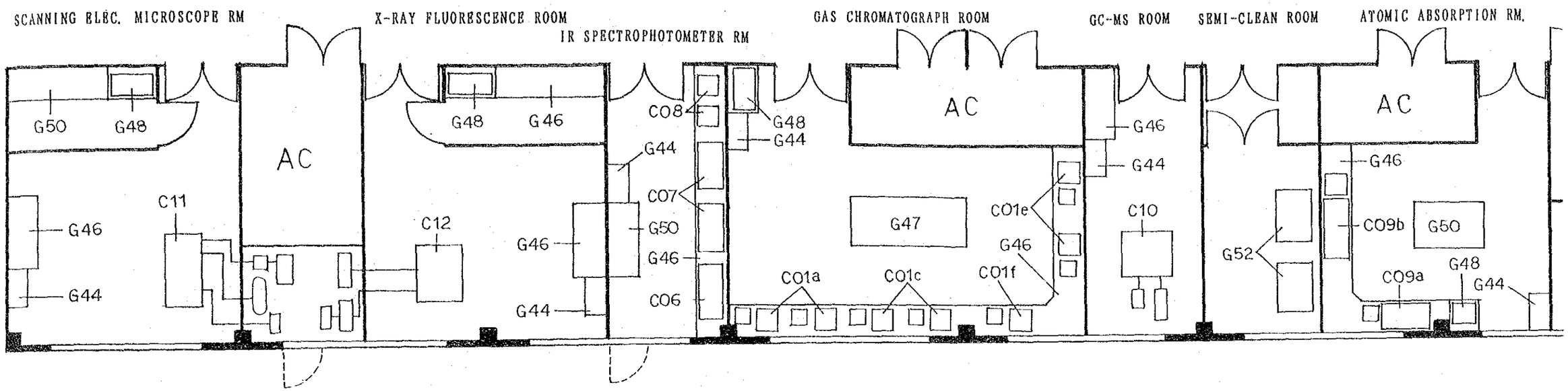


CONSTANT TEMPERATURE ROOM
C13a pH METER HIGH ACCURACY TYPE

WEIGHING ROOM
G01a SEMI-MICRO BALANCE
G01b MICRO BALANCE
G49 BALANCE TABLE

DATA PROCESSING ROOM
I01 CENTRAL PROCESSOR
I03 REEL TO REEL MAGNETIC TAPE DEV
I04 IMAGE PROCESSOR
I05 DOT MATRIX PRINTER
I06 LASER PRINTER
I07 PLOTTER
I08 DIGITIZER
I09 PERSONAL COMPUTER

EQUIPMENT LAYOUT PLAN-3 1:100 13



	SCANNING ELEC. MICROSCOPE RM
C11	SCANNING ELECTRON MICROSCOPE
G44	CABINET
G50	WORK BENCH
G46	LABORATORY TABLE (WALL SIDE)
G48	SINK

	X-RAY FLUORESCENCE ROOM
C12	X-RAY FLUORESCENCE ANALYZER
G44	CABINET
G46	LABORATORY TABLE (WALL SIDE)
G48	SINK

	IR SPECTROPHOTOMETER RM
C06a	IR SPECTROPHOTOMETER
C07	FTIR SPECTROPHOTOMETER
C08	FLUORESCENCE SPECTROPHOTOMETER
G44	CABINET
G50	WORK BENCH
G46	LABORATORY TABLE (WALL SIDE)

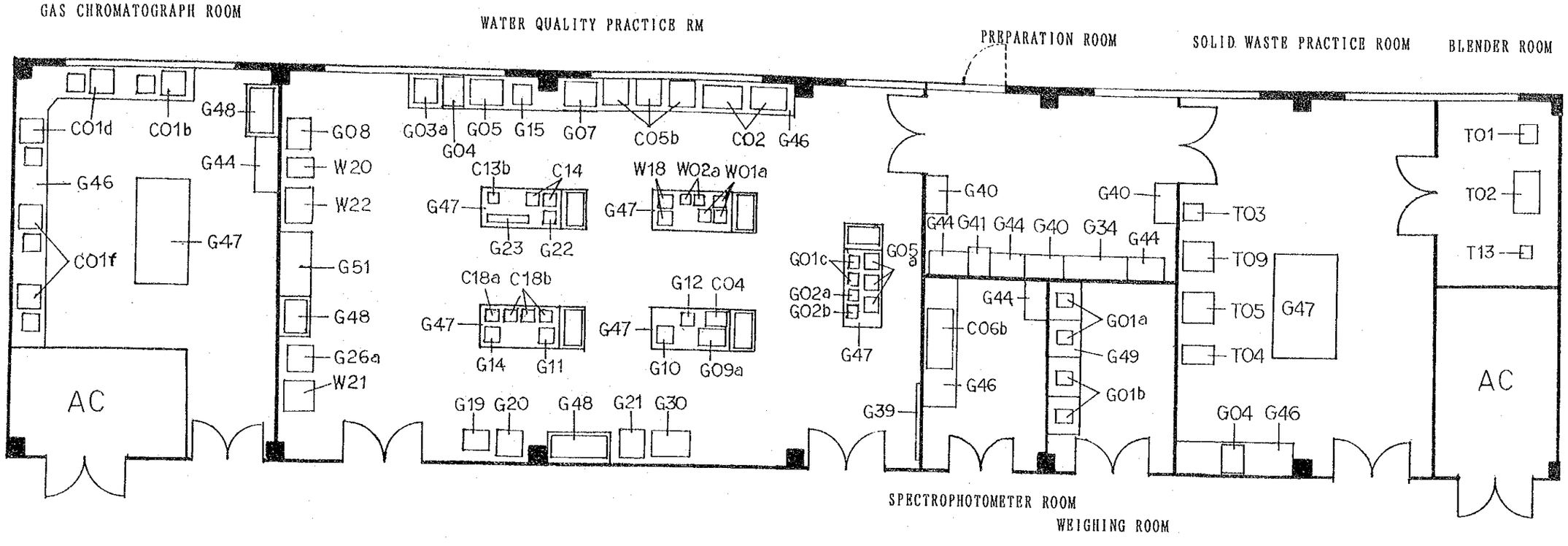
	GAS CHROMATOGRAPH ROOM
C01a	GAS CHROMATOGRAPH FID/FTD
C01c	GAS CHROMATOGRAPH FID/FPD
C01e	GAS CHROMATOGRAPH ECD
C01g	GAS CHROMATOGRAPH CAPILLARY
G44	CABINET
G47	LABORATORY TABLE (CENTRAL)
G46	LABORATORY TABLE (WALL SIDE)
G48	SINK

	GC-MS ROOM
C10	GC-MS QUADRUPLE POLE SPECTRO.
G44	CABINET
G46	LABORATORY TABLE (WALL SIDE)

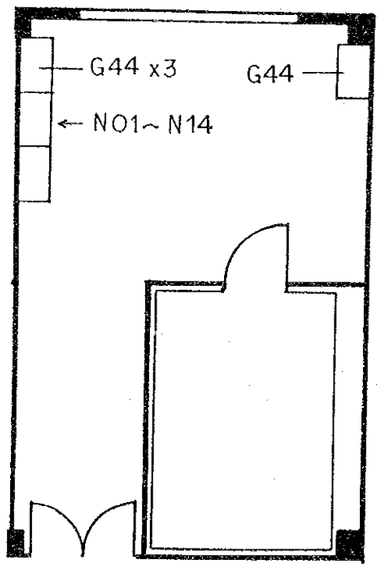
	SEMI-CLEAN ROOM
G52	CLEAN BENCH

	ATOMIC ABSORPTION RM.
C09a	ATOMIC ABSORP. SPECTRO. (FLAME)
C09b	A. A. S. (FLAMELESS)
G44	CABINET
G50	WORK BENCH
G46	LABORATORY TABLE (WALL SIDE)
G48	SINK

EQUIPMENT LAYOUT PLAN-4 1:100 14



NOISE & VIBRATION PRACTICE RM



GAS CHROMATOGRAPH ROOM

C01b	GAS CHROMATOGRAPH FID/FTD
C01d	GAS CHROMATOGRAPH FID/FPD
C01f	GAS CHROMATOGRAPH ECD
G44	CABINET
G47	LABORATORY TABLE (CENTRAL)
G46	LABORATORY TABLE (WALL SIDE)
G48	SINK

WATER QUALITY PRACTICE RM

W01a	DO METER LABORATORY TYPE
W02a	CONDUCTIVITY METER LAB. TYPE
W18	DIGITAL COLONY COUNTER
W20	STEAM STERILIZER
W21	DRY STERILIZER
W22	AUTOCLAVE
C13b	pH METER LABORATORY TYPE
C14	ION METER
C18a	BIOLOGICAL MICROSCOPE
C18b	MICROSCOPE
G01c	INDICATED BALANCE (3Kg)
G02a	BALANCE (5Kg)
G02b	BALANCE (10Kg)
G03a	CENTRIFUGE TABLE TOP TYPE
G04	AUTOMATIC MUFFLE FURNACE
G05	ELECTRIC OVEN
G07	INCUBATOR
G08	AUTOMATIC BOD INCUBATOR
G09a	ROTARY EVAPORATOR
G10	LOW TEMP. WATER CIRCULAT' N BATH
G11	STANDARD WATER BATH
G12	THERMISTOR WATER BATH
G14	RATARY CULTI-SHAKER
G15	MULTI LABO SHAKER
G19	WATER DISTILLING APPARATUS
G20	ICE CUBE MAKER
G21	REFRIGERATOR/FREEZER
G22	ULTRASONIC CLEANER FOR PIPETTE
G23	SOXLET EXTRACTION APPARATUS
G26a	AUTOMATIC PURE WATER SYSTEM
G30	COLD STORAGE CHAMBER
G34	REAGENT LOCKER
G39	WHITE BOARD
G40	RACK
G41	BOTTLE CABINET
G44	CABINET
C02	HP LIQUID CHROMATOGRAPH (UV/FL)
C04	PORALOGRAPH
C05a	UV/VIS SPECTROPHOTOMETER (S)
C05b	UV/VIS SPECTROPHOTOMETER (W)
G51	DRAFT CHAMBER
G47	LABORATORY TABLE (CENTRAL)
G46	LABORATORY TABLE (WALL SIDE)
G48	SINK

WEIGHING ROOM

G01a	SEMI-MICRO BALANCE
G01b	MICRO BALANCE
G49	BALANCE TABLE

SPECTROPHOTOMETER ROOM

C06b	IR SPECTROPHOTOMETER
G44	CABINET
G46	LABORATORY TABLE (WALL SIDE)

SOLID WASTE PRACTICE ROOM

T03	COMPACT BALANCE
T04	PLATFORM SCALE
T05	HOT AIR DRYING OVEN
T09	CALORIMETER
G04	AUTOMATIC MUFFLE FURNACE
G47	LABORATORY TABLE (CENTRAL)
G46	LABORATORY TABLE (WALL SIDE)

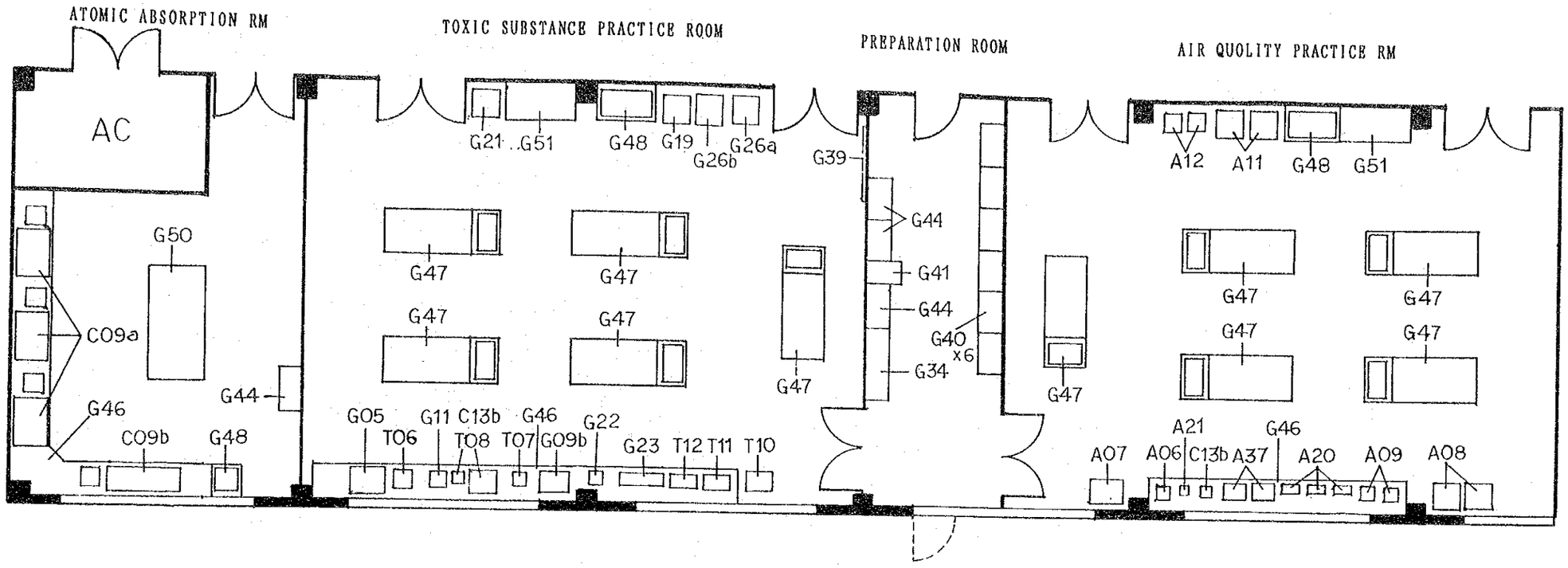
BLENDER ROOM

T01	MILLING MACHINE
T02	SIEVE SHAKER
T13	BLENDER

NOISE & VIBRATION PRACTICE RM

N01	SOUND LEVEL METER
N02	LEVEL RECORDER
N03	TAPE RECORDER
N04	PRECIS' N INTEGRAT' G SOUND L. M.
N05	PISTON PHONE
N06	OCTAVE BAND FILTER
N07	1/3 OCTAVE BAND REAL-TIME ANAL
N08	VIBRATION MATER
N09	TUNABLE FILTER
N10	CALIBRATION EXCITER
N11	DATA PROCESSING UNIT
N12	TRIPOD
N13	EXTENSION CODE (10M)
N14	EXTENSION CODE (30M)
G44	CABINET

EQUIPMENT LAYOUT PLAN-5 1:100 15



	ATOMIC ABSORPTION RM
C09a	ATOMIC ABSORP. SPECTRO. (FLAME)
C09b	A. A. S. (FLAMELESS)
G44	CABINET
G50	WORK BENCH
G46	LABORATORY TABLE (WALL SIDE)
G48	SINK

	TOXIC SUBSTANCE PRACTICE ROOM
T06	AUTOMATIC TAG CLOSED CUP F.P.T
T07	COPPER CORROSION TESTER
T08	ELEMENTAL ANALYSIS INST. (CHN)
T10	KD EVAPORATOR
T11	MICRO KJELDAHL DISTILLER
T12	KJELDAHL INTROGEN DIG/DIST APP
C13b	pH METER LABORATORY TYPE
G05	ELECTRIC OVEN
G09b	ROTARY EVAPORATOR
G11	STANDARD WATER BATH
G19	WATER DISTILLING APPARATUS
G21	REFRIGERATOR/FREEZER
G22	ULTRA SONIC CLEANER FOR PIPETT
G23	SOXLET EXTRACTION APPARATUS
G26a	AUTOMATIC PURE WATER SYSTEM
G26b	ULTRA PURE WATER SYSTEM
G34	REAGENT LOCKER
G39	WHITE BOARD
G40	RACK
G41	BOTTLE CABINET
G44	CABINET
G51	DRAFT CHAMBER
G47	LABORATORY TABLE (CENTRAL)
G46	LABORATORY TABLE (WALL SIDE)
G48	SINK

	AIR QUOLITY PRACTICE RM
A06	VEHICLE EMISSION GAS ANALYZER
A07	AUTO. GAS BURNER EXH. GAS ANALYZ
A08	HIGH VOLUME AIR SAMPLER
A09	LOW VOLUME AIR SAMPLER
A11	DEPOSIT GAUGE
A12	DUST JAR
A20	ORZAT ANALYZER
A21	STACK SAMPLER
A37	ELECTRIC DESICATOR
C13b	pH METER LABORATORY TYPE
G40	STORAGE RACK
G44	CABINET
G51	DRAFT CHAMBER
G47	LABORATORY TABLE (CENTRAL)
G46	LABORATORY TABLE (WALL SIDE)
G48	SINK

EQUIPMENT LAYOUT PLAN-6 1:100 16

4-4 Construction Plan

4-4-1 General

The project to construct the EMC will be implemented in accordance with the guidelines of Japan's grant-aid system. Its implementation will be officially started when and after it is approved by the Japanese and Indonesian governments and the E/N is concluded. Then, the Indonesian government will select a Japanese corporation to act as a consultant for the stage of preparing detailed designs for the facilities and equipment. After completing documentation of the detailed designs, a Japanese construction engineering company and an equipment supply company, which will be selected by tender, will carry out the construction of buildings and the supply and installation of facilities and equipment. Contracts on the consultancy service, building construction and equipment supply and installation will only become effective after being verified by the Government of Japan.

4-4-2 Construction Supervision Plan

Supervision of and construction under the Project will involve the project implementation agency, the Consultant, the Contractor and the Equipment Supplier under the control of the related ministries of both governments. The work assignments of each body are as follows.

(1) Project-implementing agency

The Indonesian agency which is in charge of the implementation of this project is BAPEDAL, and BAPEDAL will act as the contracting party of the Indonesian government for the Project. The agency has already set up a working group headed by Mr. Coutrier, Deputy Director for Development and architects (staff members of BAPEDAL) who have taken part in discussion of the basic concepts of the facilities at the stage of the basic design study, will contribute to the construction of such facilities.

(2) Consultant

From the many Japanese consulting companies capable of handling the Project, BAPEDAL of the Indonesian government will select the Consultant to conduct the detail design work for the facilities and equipment and to prepare the tender documents through consultations with BAPEDAL taking the contents of the Basic Design into consideration. The Consultant will dispatch a full-time supervisor to the project site at the construction and equipment installation stage to supervise the Contractors and to report on the work progress to the implementation agency and other related organizations. The Consultant will also dispatch engineers to inspect the work in accordance with the work progress. The Consultant will have the following work assignments.

- Detail Design
  preparation of tender documents for construction and equipment work (detail design drawings, specifications, cost estimate, etc.)
- Assistance for Tender and Contracts
  decisions on contract procedures, preparation of draft contracts, examination of detail breakdowns and selection of Contractor (preliminary qualification examination, announcement of tender, evaluation of bids, contract negotiations and witness to contracts)
- Inspection and Confirmation of Working Drawing
  inspection and confirmation of working drawings, construction plans, samples of materials and finishings and building serviced and other equipment offered by the Contractors.
- Construction Supervision
  examination of work plans and schedules and provision of instructions to Contractor
- Work Progress Report
  report of work progress to implementation agency and other related organizations
- Assistance for Payment Procedure
  examination of requisition notes payable interim and completion offered by the Contractors
- Inspection of Completed Work
  inspection of work at various stages throughout the construction period

(3) Construction Contractor

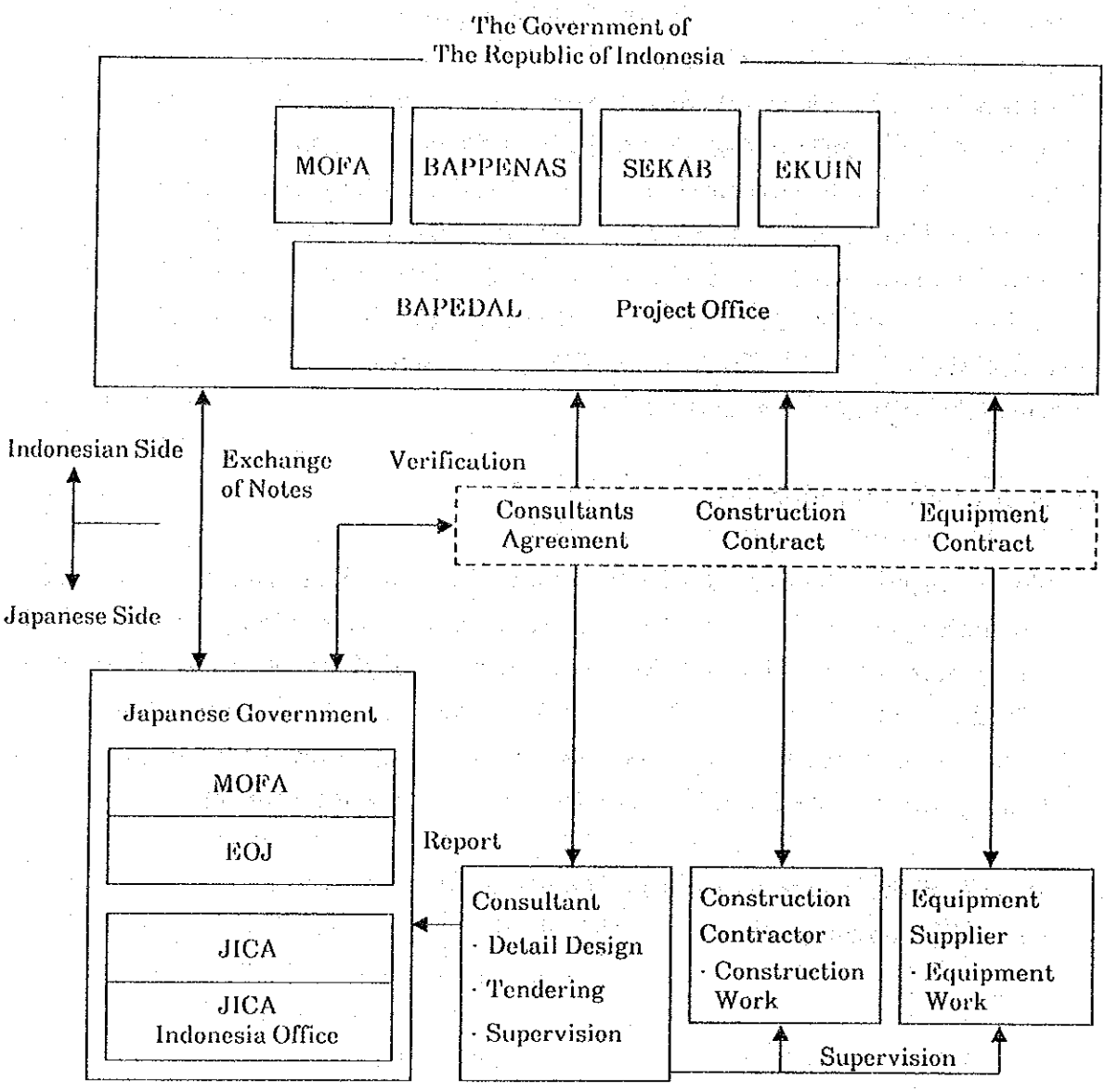
The Contractor will be a qualified Japanese construction firm selected through open tender. The Contractor will complete the construction of the planned buildings on schedule based on the detail design drawings prepared by the Consultant and will hand the buildings over to the Indonesian side.
The construction work for which the Contractor is responsible will mainly consist of buildings, air-conditioning and ventilation, plumbing, electrical and exterior work and the Contractor will sub-contract the work to Indonesian or Japanese sub-contractors, technicians and workers as required. Some field staffs for full-time on-site construction work will be required in view of the project size and contents.

(4) Equipment Supplier

The Equipment Supplier will be a qualified Japanese trading firm selected through open tender. The Equipment Supplier will procure and install the equipment which will satisfy the specifications given by the Consultant on schedule. The Equipment Supplier will also dispatch expert engineers to the project site to assist in the installation of the equipment and to provide the Indonesian side with explanations on the equipment handling methods.

Based on the above work assignment division, the construction supervision system is shown below.

Supervision Plan



4-4-3 Condition of Local Construction Industry and Points of Note in Construction Work

(1) Construction environment

The construction environment in Jakarta and surrounding districts are outlined as follows.

1) Although the project site is located in an area where local construction companies with high capabilities and skilled workers have commonly been operating, it has been rather difficult in recent years to secure the services of these companies and such workers as a result of the construction boom caused by the considerable commercial activities of Japanese firms in this country.
2) Carpentry, plastering, steel bar reinforcing, and finishing have been treated as professions, and organizations covering the respective types of work have been formed under a foreman. Ordinary workers other than those mentioned above are not specialized and are often employed as part-timers. On an average, it will take about 2.5 to 3 times the construction man power common in Japan for each work item.
3) Construction materials have recently been mass-produced at factories. For the principal construction materials not including those used in facilities and electric work, more factory prefabricated products have been utilized than locally produced or assembled ones which have been commonly used in the area.
4) There are no particular problems in the local supply of construction materials. However, since the construction boom has substantially raised prices and wages, prices of such main materials as concrete and steel bars have been hiked by 15 to 20% in the past year. It is feared that increases of oil prices by 22% effective on and after July 10, 1991 and of electricity by 20% in August had a great influence upon the upward movement of prices of cement and other construction materials. Wages have increased by 6 to 10% during the past year.

(2) Points to be taken note of implementation of construction

The facilities under this project are two-storied, reinforced concrete buildings (with single-storied ones in some blocks), and local construction companies are considered to have full capabilities to construct them. Most of

construction materials can be locally procured, and some special materials to be imported from Japan will be handled well by local skilled engineers. Hence, no dispatch of special engineers will be required except for during the equipment installation work. As to the equipment installation work, local agents have able engineers and fully cope with maintenance after completion. However, manufacturers' engineers should be dispatched to give technical instructions to local engineers since the installation work is specific and precise, and requires personal explanations as to how to operate the equipment.

It is expected that the construction boom will continue for a few more years in Indonesia, and that attention should be paid to securing locally available construction materials and skilled workers during the course of the construction work.

(3) Points to be taken note of in formulating construction schedule

1) Appropriate construction schedules with no excessive working conditions and processes involved should be set up.
2) Timing to start and complete work should be carefully considered so that construction processes are convenient for both countries.
3) A minimum number of staff and specialized technicians should be dispatched from Japan. An appropriate number, timing, and periods of stay should be chosen carefully in accordance with the progress of the work.
4) As many local materials as possible should be employed. Procurement of Japanese materials should be minimized, and conditions which facilitate local installation should be prepared.
5) Each work item should be subdivided into its basic elements to simplify the construction process.
6) The rainy season continues from December to May in Serpong.
Squalls occur for about one hour almost every day during this season, but no particular interference will be caused to implementation of the construction work. Localized torrential downpours may submerge a part of the public roads leading to the construction site due to insufficient water drainage capability. However, the construction site will not be submerged, because it is higher in elevation than the roads.

(4) Construction schedule

The construction schedule should be fully discussed item by item in advance between the consultant and the working group to assure smooth implementation of the Project; starting periods and construction methods should be confirmed as to the work which is to be carried out by both countries.

Among the work to be conducted by the Indonesian side as described in Section 4.4.6 below, infrastructures (land formation of the project site, improvement of site conditions by filling, supply of power, water, and telephone service) which should be completed before starting the construction of the EMC facilities have been already completed, there being no particular obstacles to commencing the construction. In addition, ordinary office furniture sets necessary for the operation of the EMC should be installed before the facilities are completed. The construction schedule should be established by reviewing arrangement for the delivery of materials to be procured in Japan to the project site and the progress of construction activities using locally procured materials, without allowing such materials to be stocked for an excessively long period or to run short, thereby causing the construction process to be hindered as a result of any delayed delivery of materials.

(5) Contractor's field representative(s)

Smooth completion of the facility construction in accordance with the design documents within the specified period requires a contractor's field representatives ability to assure smooth operation of joint work with local construction companies in Indonesia and to afford appropriate technical instructions to them. It is desirable, in addition, to appoint a construction contractor's field representative(s) with sufficient experience in the construction of research and training facilities to fully understand the characteristics of the EMC and securing a high level of quality for it.

1) Judging from the scale and contents of the EMC facilities, the number and types of construction engineers who are required to continually stay at the site are as follows.