CHAPTER 4
BASIC DESIGN

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4-1 Design Principle

1) This Centre, being positioned as the central institution for research and conservation of plant genetic resources shall be designed to have such facilities and functions as befitting its position. It shall be designed so that the facilities can be smoothly and effectively utilized jointly with the Central Agricultural Research Institute and, at the same time, designed to be self-contained and independent from the existing facilities so that it can function as the centre to administer its organizational setup for management of plant genetic resources and promote joint and cooperative activities with other relevant institutions on a nationwide basis.

2) As Japan's project type technical cooperation is being considered for this Centre in the future, it shall be designed to have facilities and functions which can adequately accommodate such a project.

3) The facilities shall be designed to be suitable to the climate of Sri Lanka and to harmonize with its former capital, Kandy, and with the group of academic institutions in Peradeniya area.

4) In the light of the fact that this Centre, in nature, is to be the facility for conserving plant genetic resources, its facilities shall be designed so that the Sri Lankan side can administer, operate and maintain them by itself for a very long period of time even after termination of Japan's technical cooperation.

5) Facilities to be constructed should be capable of maintaining their functions with the lowest possible operating and maintenance costs.

The largest running expense in the administration and maintenance costs is the electric power charge. Expense items which grow with the years are maintenance and repairs of buildings and structures, facilities and equipment and also the recurrent replacement costs of equipment and

apparatus which become necessary at each expiration of their service life. With due regard to these matters, the plan shall embody the following considerations.

(1) Regarding utilities, the installation of powered equipment shall be avoided as much as possible. Instead, every room shall be designed to assure a comfortable environment with natural ventilation and natural lighting, and for this purpose, the corridor, as a rule, shall be placed on one side of the building rather than at the centre and the rooms shall be designed to be not too deep but large enough with a high ceiling.

(2) An architectural design with adequate consideration to heat insulation and damp proofing shall be adopted for rooms that require air-conditioning because of their intended functions in order to lessen the electric load.

(3) As for the style of building, it shall be designed to have deep eaves to keep out the strong rays of the tropical sun, driving rain, heat and high humidity. To secure good ventilation adjacent buildings shall be spaced wide apart and the rooms shall be surrounded by a corridor. Also, the outer walls shall have as many openings as possible.

(4) The buildings shall be built solid and stout to minimize repair and maintenance expenditures and also in a way that they shall be easy to clean. The use of materials and building methods which will pose no problem, when the need to locally perform repair and maintenance work arises, shall be emphasized.

(5) In planning the equipment and apparatus, they shall be limited as much as possible in the number of models; and the models shall be interchangeable in order to minimize the varieties of spare parts required. The system to be adopted shall also be easy to operate.

Furthermore, in planning the equipment and apparatus, those which are highly reliable in terms of useful service life shall be given priority, and the manufacturer of those products who have local agents shall be given full consideration.

(6) With due regard to the future growth potential of the Centre as a research institution, the buildings and equipment systems shall be designed so that they can be easily expanded without major remodeling or rework.

4-2 Determination of the Scale of Facilities

As the basic design criteria, the functions and scales of this Centre's facilities shall be determined on the basis of the research programme and the staff assignment plan. As for the number of persons estimated to use the facilities, the figures for the last year (1991) of the annual manpower expansion programme produced by the Sri Lankan side shall be adopted being 84 of RO and RA, 11 of administration staffs.

Laboratory building $3,553m^2$

Room name	Scale determination criteria and basis	Planned area
1. Laboratory for seed storage (9 researchers, 6 assistants)		
Short term storage	Stored volume: 10,000 items x 500g, 180 items per storage shelf (900W x 450D x 1800 H, 60 tiers), 10,000 items ÷ 180 items = 56 shelves, 20 shelves per room x 3 rooms. Aisles between shelves 1.0 - 1.2m 7.5m x 4.0m = $30m^2$/room	30m x 3 rooms = $90m^2$
Medium term storage	Stored volume: 25,000 items x 300g, 1,000 items per storage shelf (3400W x 450D x 1,800H), 25,000 items ÷ 1,000 items x 2 shelves/storage rooms = 12 rooms. Inside dimensions of a prefabricated type cold storage: 1.8mW x 3.45m D x 2.6m H. Outside dimensions: 2m x 4m = $8m^2$	$8m^2$ x 12 rooms = $96m^2$
Long term storage	Stored volume: 25,000 items x 90g, shelves same as above, 3,000 items per shelf, 25,000 items/ 3,000 items x 2 shelves/storage room = 4.2 → 4 rooms. Inside dimensions of a prefabricated type cold storage: same as above.	$8m^2$ x 4 rooms = $32m^2$

Room name	Scale determination criteria and basis	Planned area
Passage within storage facilities	Middle corridor to be 3.0m wide for the total length of storage facilities	3m x 30m = $90m^2$
Machine room for storage	Width to install machine 1.2m + width of aisle for inspection 1.2m = 2.4m	$133m^2$
Seed drying & packing room	3 seed dryers, 1 packing machine, and 1 testing bench to be installed.	$40m^2$
Seed inspection room	2 germination test cabinets to be installed Average length of work bench per worker: 4.5m - 8m/ capita, Average room space per 1m of work bench: $2.4m^{2*1}$ Hence 10.8 - $19.3m^2$/capita, Assuming 6 workers at all times, 60.4 - $115.2m^2$ Determined to be $90m^2$ by comparing to $84m^2$ for CARI's existing laboratory.	7.5m x 3m x 4 spans = $90m^2$
Researcher's room	For desk work that require no experiments. Standard $5.2m^2$/ capita^{*2} x 9 researchers = $46.8m^2$	7.5m x 3m x 2 spans = $45m^2$
Senior researcher's office	1 person	7.5m x 3m = $22.5m^2$
Preparation room cum storage	Around 1/4 the space of a standard laboratory	7.5m x 3m = $22.5m^2$

Room name	Scale determination criteria and basis	Planned area
2. Laboratory for propagation and preservation of vegetatively propagated plants (7 researchers, 5 assistants)		
1 laboratory room	Culture medium preparation, clean bench, etc. Depends on layout of laboratory equipment. Standard*1: Length of testing bench/capita: 4.5 - 8m Area per 1 m length of testing bench: 2.1-2.7m^2 9.5-21.6m^2/capita x (5+7/2) persons = 81-184m^2 Determined to be 90m^2 by comparing to 84m^2 for CARI's existing laboratory.	7.5m x 3.0m x 4 spans = 90m^2
1 sterilizing room	According to the layout of sterilizer to be installed.	7.5m x 3.0m = 22.5m^2
1 incubation room	According to the layout of 2 low temperature thermostats, 1 hygrostat and 2 incubators	6.0m x 5.0m = 30m^2
1 clonal preservation storage	According to the layout of 20 shelves for 1,000 plants	7.5m x 6.0m = 45m^2
1 researchers, room	Standard: 5.2m^2/capita*2 x 7 researchers= 36.4m^2	7.5m x 3.0m x 2 spans= 45m^2
1 senior researcher's room	1 person	7.5m x 3.0m = 22.5m^2

Room name	Scale determination criteria and basis	Planned area
3. Laboratory for data management (4 researchers, 5 assistants)		
1 computer room	2 personal computers to be used	7.5m x 3.0m x 2 spans = $45m^2$
1 data storage-room	According to the layout of 26 data file cabinets	7.5m x 3.0m x 2 spans = $45m^2$
1 researchers'room	Standard: $5.2m^{2*2}$ x 4 researchers = $20.8m^2$	7.5m x 3.0m = $22.5m^2$
4. Laboratory for exploration & collection (9 researchers, 8 assistants)		
1 laboratory room	Proportionate to the size of laboratories of other research units	7.5m x 3.0m x 4 spans = $90m^2$
1 preparation room cum storage	Around 1/4 the space of laboratory room	7.5m x 3.0m = $22.5m^2$
1 researchers' room	Standard: $5.2m^{2*2}$/capita x 9 researchers = $46.8m^2$	7.5m x 3.0m x 2 spans = $45m^2$
1 senior researcher's room	1 person	7.5m x 3.0m = $22.5m^2$
5. Laboratory for evaluation (19 researchers, 12 assistants)		
1 laboratory room	Proportionate to the size of laboratories of other research units	7.5m x 3m x 4 spans = $90m^2$
1 preparation room cum storage	Around 1/4 the space of experiment laboratory	7.5m x 3m = $22.5m^2$

Room name	Scale determination criteria and basis	Planned area
1 researchers' room	Standard 5.2m^2/capita*2 x 19 persons = 98.8m^2 x 1/2 Half the staff of the evaluation laboratory are assumed to be assigned to the laboratory for visiting scientists	7.5m x 3m x 2 spans = 45m^2
1 senior researcher's office	One person	7.5m x 3m = 22.5m^2
6. Laboratory for visiting scientists		
1 experiment laboratory	Proportionate to the size of laboratories of other research units	7.5m x 3m x 4 spans = 90m^2
1 preparation room cum storage	Around 1/4 the space of experiment laboratory	7.5m x 3m = 22.5m^2
1 researchers' room	10 staff from the evaluation laboratory are assumed to stay here at all times. Standard: 5.2m^2/capita*2 x 10 persons = 52m^2	7.5m x 3m x 4 spans = 90m^2
7. Common testing facilities		
1 dark room		4m x 3m = 12m^2
1 room for balances	Around 5 measuring instruments, work bench per instrument 1.8m long x 5 sets = 9m, floor area per 1m of work bench: 2.1 - 2.7m^2/m x 9m = 18.9 - 24.3m^2	7.5m x 3m = 22.5m^2

Room name	Scale determination criteria and basis	Planned area
1 specimen preparation room	1 work bench fixed to the wall, 3 specimen and instrument cabinets	7.5m x 3m = 22.5m^2
1 room for microscopes	According to the layout of 5 microscopes and a work bench	4.5m x 6m = 22.5m^2
8. Night duty room	12 - 16m^2/capita x 6 persons (one each for every research unit)	7.5m x 3m x 3 spans = 67.5m^2
9. 2 seminar rooms	Standard 1.0 - 1.3m^2/capita	7.5m x 3m x 2 spans = 67.5m^2
	a) Researchers' conference: 15 - 20 participants x 1.6m^2/capita = 24 - 32 m^2	A: 30m^2
	b) Weekly work planning conference: 50 persons x 1.5m^2/capita = 75m^2	B: 37.5m^2
	c) Academic lecture meeting, etc: 80 persons x 0.8m^2/capita = 64m^2 shall be 2 rooms each with a space for case (a)*. * The partition between 2 rooms will be removed in the event of use as one room for cases (b) and (c).	
10. 1 library	Around 2,000 books (including magazines), 3 bookshelves, 1,800W x 240D x 1.900H each. Reading space 10 seats x 2.0m^2/ seat = 20m^2	7.5m x 5m = 37.5m^2

Room name	Scale determination criteria and basis	Planned area
11. Common equipment storage	As each laboratory is attached with a $22.5m^2$ of preparation room cum storage, common storage shall be sized about half of the total of these, $22.5m^2 \times 6 \times 1/2 = 67.5m^2$	$7.5m \times 9.0m = 67.5m^2$
Corridor and other common space	Covered way connecting buildings: $288m^2$ All portions under eaves are included in the area.	$1,687.5m^2$

*1 In accordance with the collection of date on laboratory facilities, buildings and fixtures.
*2 In accordance with the collection of architectural design data compiled by Architecture Institutes of Japan.

Administration building $1,741m^2$

	Room name	Scale determination criteria and basis	Planned area
1.	1 Director's room	Includes space for work desk, reception and prearrangement meetings	7.5m x 4.5m = $33.8m^2$
2.	1 Reception room	Chairs for 6 - 8 guests	7.5m x 3m = $22.5m^2$
3.	1 conference room	Senior researchers, chief administrator, etc. 16 seats x $2.0m^2$/seat	7.5m x 4.5m = $33.8m^2$
4.	Administration office	3 clerks, 2 typists, 2 janitors, Standard: $5.2m^2$/capita x 7 persons = $36.4m^2$, includes space for telephone exchange, copying corner	7.5m x 3m x 2 spans = $45m^2$
5.	Visiting scientist's rooms	For 3 long term experts, equivalent to 3 senior researcher's rooms	7.5m x 3m x 3 rooms = $67.5m^2$
6.	1 conference hall	(a) National conference on research programme 150 conferees (table and chair) x $1.5m^2$/capita = $225m^2$ (b) National convention of agricultural extension technologists, etc. 300 participants (chair only) 300 persons x $0.8m^2$/capita = $240m^2$ Stage 3m x 8m = $24m^2$ Sound control room 3m x 6m = $18m^2$	18m x 15m = $270m^2$
7.	Exhibition Corner	According to the layout of 5 display cases (wall faced type) and 2 display cases (table type)	6m x 9m = $54m^2$
8.	1 Lounge	$1.5m^2$/capita x 300 persons x 1/5 = $90m^2$	$67.5m^2$

Room name	Scale determination criteria and basis	Planned area
	Centre's staff 96 persons x 1/3 x 1.5m^2/capita = 48m^2 Sized somewhere between the above two.	
9. 1 Pantry	For serving only refreshments and snacks, around 1/5 the size of the lounge	7.5m x 3m = 22.5m^2
10. General storage	2 storages for office supplies, 1 storage for conference hall furnishings and supplies	112.5m^2
Corridor and other common space	Covered way connecting buildings: 207m^2 All portions under eaves are included in the area	1,012m^2

Facilities related to outdoor field

1. Screen houses		90m^2 x 5 = 450m^2
Entomological studies - 1 Pathological studies - 1 Physiological studies - 1 Tissue culture studies - 1 Germplasm studies - 1	Internally partitioned type (3 compartments/house) for entomological studies and germplasm studies Sidewalks of each compartment: 600 - 800 W Plant beds in the centre 2m W x 3m Plant beds on each side 1.1m w x 6m 6m x 6m = 36m^2/compartment x 3 ..... 108m^2/house One compartment/house type: centre passage 1.2m W Plant beds on each side: 6-8 beds/house 1.6m/bed + passage width 0.8 ..... 2.4m	6m x 15m = 90m^2 6m x 15m = 90m^2 6m x 15m = 90m^2 6m x 15m = 90m^2 6m x 15m^2 = 90m^2

Room name	Scale determination Criteria and basis	Planned area
	Length of house 2.4m/bed x 6-8 beds/2 = 7-10m ..... 43 - 58m^2 Earth floor about the same size .....40m^2 83 $\frac{-}{2}$ 98m^2/house 90m^2 system of the same construction shall be adopted for both (a) and (b)	
2. Workshop building		441m^2
1 indoor drying yard	30m^2 per 1 rice variety 6-10 varieties: 180 - 300m^2	12m x 15m = 180m^2
1 working space	30m^2 for seed cleaning, threshing, fumigation, 10m^2 potting of plants	6m x 15m = 90m^2
1 field equipment storage		4.5m x 3m = 13.5m^2
1 sterilized soil yard	Around 4m^2 per type, passage width 2m	7.5m x 6m = 45m^2
1 agro-chemicals storage		7.5m x 6m = 45m^2
1 garage for tractors, etc.	2.5m x 6m x 2 vehicles: 30m^2 Space for repair work: 30m^2	7.5m x 6m = 45.0m^2
3. Field management building		135m^2
1 Management office	Farm manager, assistant farm manager, 3 technical officers 5.2m^2/capita x 5 = 26m^2 + reception space 20m^2	7.5m x 6m = 45m^2

Room name	Scale determination Criteria and basis	Planned area
2 field workers' rooms	30 males and 30 females, space for changing clothes $0.6m^2$/ capita x 60 persons = $36m^2$ space for lunching on rainy days to be taken into account	7.5m x 6m = $45m^2$
Lavatory cum shower room	60 persons x 1/8 x $3m^2$ = $22.5m^2$	7.5m x 6m = $45m^2$
		$202.5m^2$
Utilities buildings		
1. Electrical equipment room	Transformer capacity 250 KVA x 2 sets Generator 100 KVA x 2 sets	7.5m x 15m = $112.5m^2$
2. Pump room	Staff room, repair shop, parts storage	6m x 15m = $90m^2$

4-3 Master Plan

4-3-1 Site planning

The proposed site shall be utilized for the construction of the aforementioned facilities and the reserved experimental field.

From the standpoint of overall utilization of the site, it is considered desirable to arrange these buildings toward the arterial road and have them face the Central Agricultural Research Institute as this would not only afford better access from the road but enhance the effectiveness of mutual utilization by either facilities; and also because by being grouped together they would constitute an integrated group of research facilities.

As the conditions for determining the distance from the arterial road to the building, the legally required distance from the high tension distribution line which crosses over the site (construction of structures is prohibited on the 18m wide strip of land directly below the aerial line) shall be reserved and an appropriate open space shall be secured in front of the building such as by an approach road, a driveway or a parking lot.

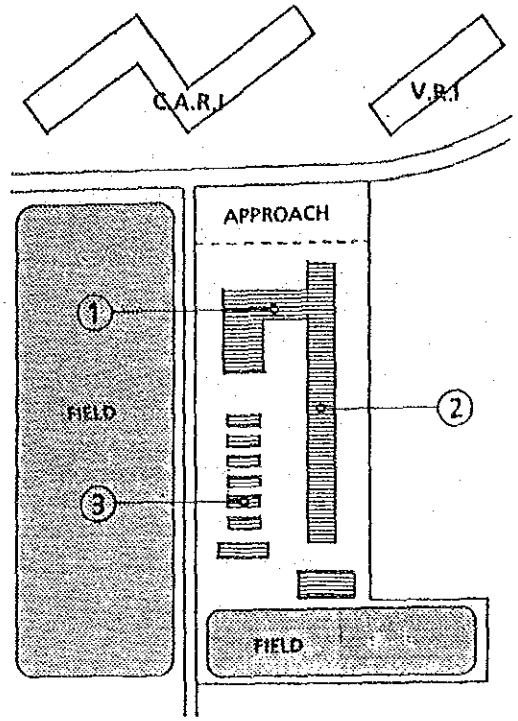
As for the reserved experimental field, southern part of the site shall be utilized.

4-3-1-1 Facilities layout planning

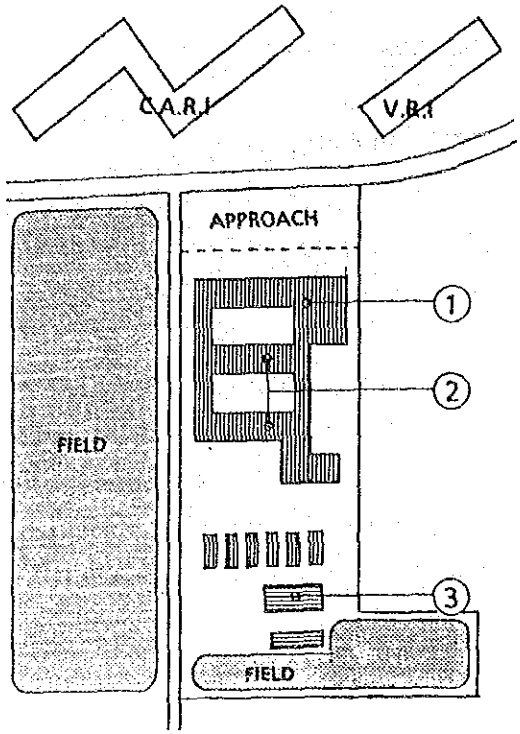
The facilities of this project shall consist of three functional segments: (1) administration segment, (2) research and experiment segment and (3) field and related facilities segment.

As for buildings, (1) the administration segment and (2) the research and experiment segment including storage facilities and shall be lumped together and (3) the field related facilities laid out separately from the former in the light of the combination of traffic lines. Of the

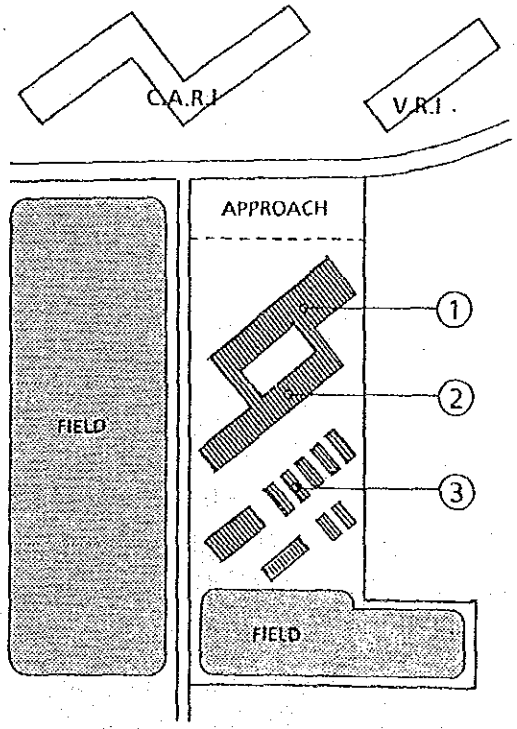
Fig. 4-1 Comparison of Facility Placement Alternative



PLAN-A 2 STORIES



PLAN-B 2 STORIES



PLAN-C 4 STORIES

PLAN-A :

In case of Laboratory facilities put in one building, this building shall be a long building on a straight line, because of restrictions arising from the shape of the site.

It is not suitable for natural conditions which direct sunray enter into the room in the morning and evening, and for walking distance is too long when staffs move.

PLAN-B :

In case of planning 2 buildings for laboratory which is paralleled to the site boundary, it is still effected by the sunray enter into the room in the morning and evening, because building axis is 40° against east-west.

It is not harmonize with the existing building facade.

PLAN-C :

In case of harmonizing the axis of whole facilities with the existing buildings facade, it is effective for protecting the sunray and browing rain. It leaves useless space around the building because building axis is diagonal to the site boundary, but it can be used for parking lot.

①— ADMINISTRATION ②— RESEARCH EXPERIMENTAL LAB ③— FIELD MANAGEMENT FACILITIES

former, (1) the administration segment shall be located on the entrance side near the arterial road and (2) the research and experiment segment including storage facilities shall be located on the side facing (3) the field related facilities segment in view of their respective functions.

In accordance with the above principles, facilities layout alternatives were studied as shown in Fig. 4-1.

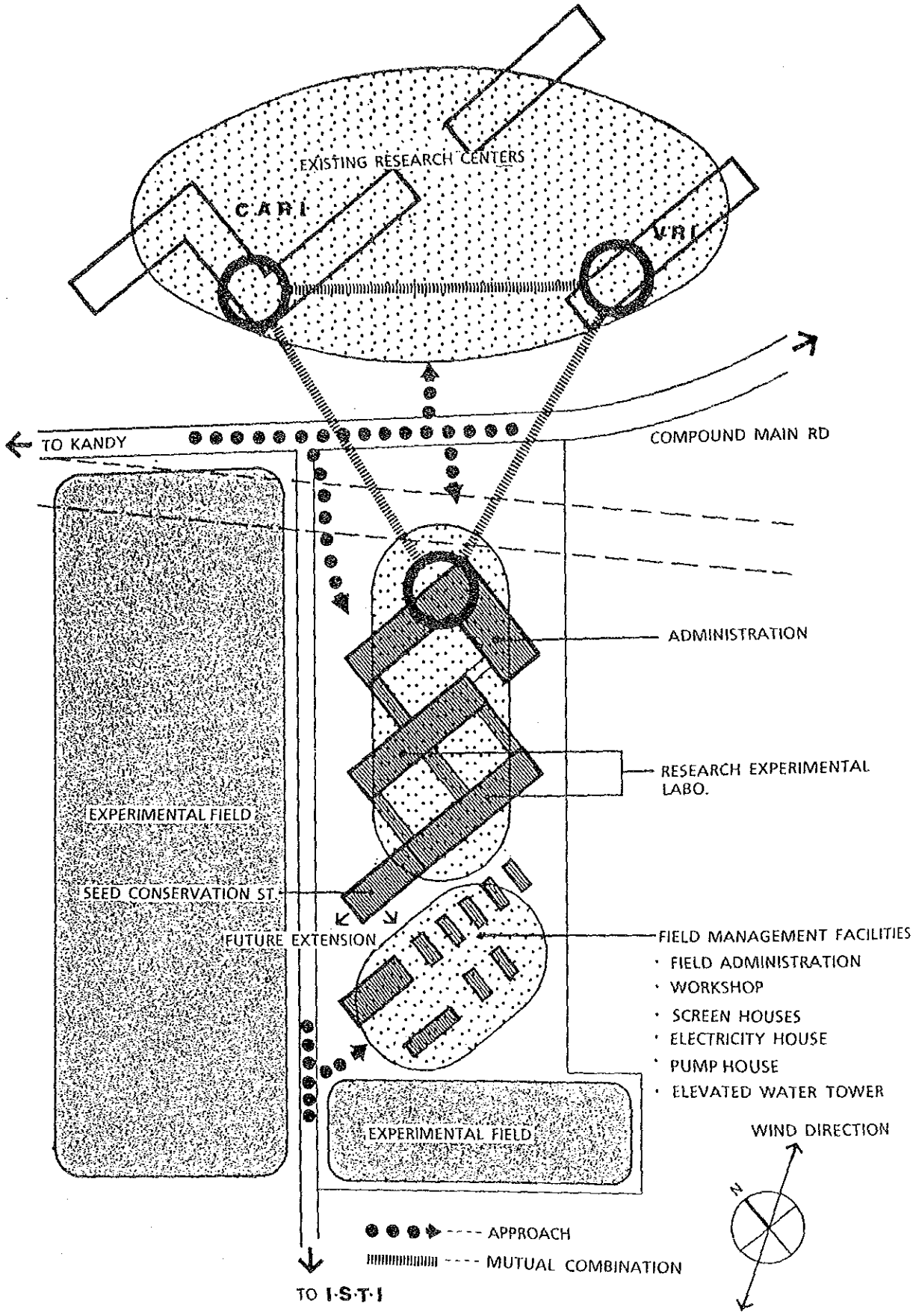
The plan C is considered to be the best output for the utilization of the site, harmonizing with the surroundings and suitable to the climate.

As all of the existing facilities located nearby, including the Central Agricultural Research Institute and the Veterinary Science Research Institute, are two stories high and built longitudinally along the east-west axis in view of the climatic conditions, the facilities of this Centre shall also be planned to be built in the same direction and in the same number of stories so that they harmonize with the rest of the research facilities complex.

The configuration of the site is rectangular, but the fact that it deviates from the east-west direction by about 45° constitutes a major obstacle to effective utilization of the site when the buildings are arranged parallel to the east-west axis. Nonetheless, the said layout being the most suitable to the natural conditions in Sri Lanka where buildings must be constructed to shield the strong rays of the sun and with due regard to the direction of the wind, the buildings shall be laid out diagonally to the site.

In case of the facilities are to be built two stories high, it would be impossible to house all of the laboratories in one building due to the limited width of the site. The laboratories, therefore, shall be divided into two buildings. Also, in view of their nature as research facilities, it is considered effective to secure a quiet environment and adequate natural ventilation by planning a courtyard to be surrounded by a corridor. (Refer to Fig. 4-2)

Fig. 4-2 Facilities Layout Plan

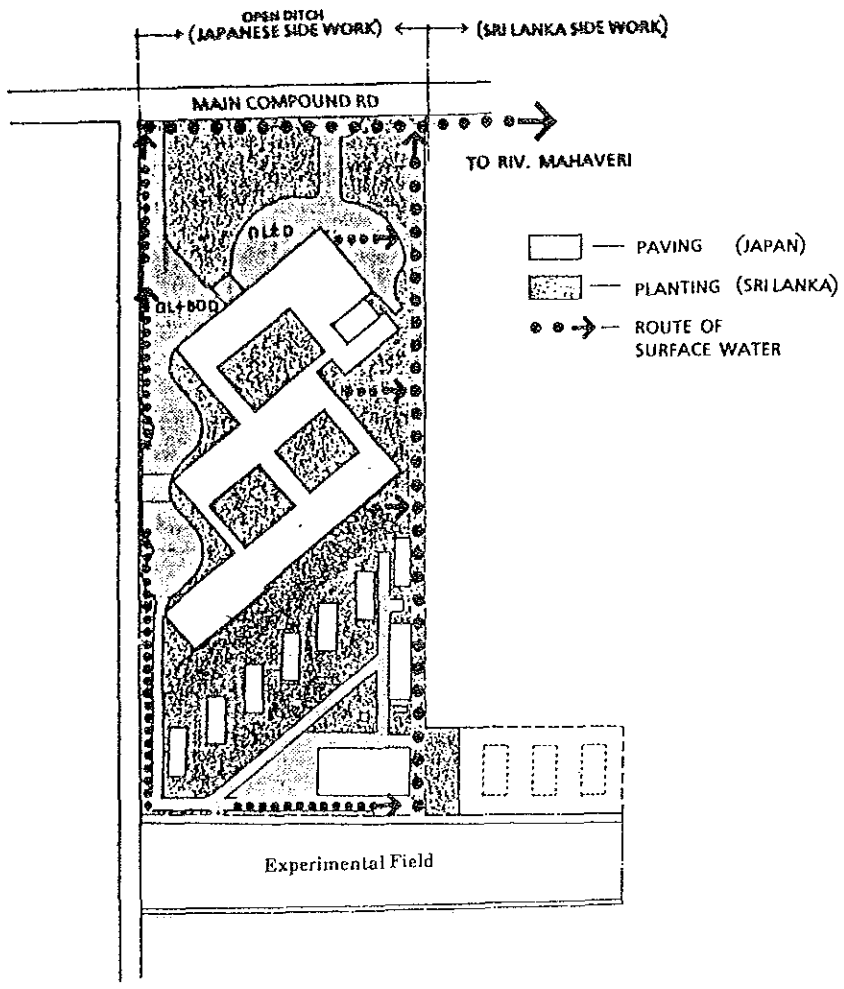


4-3-1-2 External work planning

What requires particular attention in planning the outdoor facilities of this Centre is how to cope with the site which is a few feet lower than the road surface. This means that it requires special planning efforts in the method of approaching the building from the road and in the drainage method of the site.

At least the part of the building near the main entrance must be built on the same level as the road to enable smooth access from the arterial road. Also, drainage ditches must be provided along the boundaries of the site to prevent the inflow of rainwater into the site from the surrounding areas; and a culvert must be laid up to a distance where the water gathered in the foregoing side ditches can be discharged into the Mahaweli River by natural gradient.

Fig. 4-3 External Work Planning



4-3-2 Building design

4-3-2-1 Composition of each building and floor planning

1. Laboratory building

The laboratory unit for seed preservation is closely linked with the laboratory unit for exploration and collection and, from the standpoint of effective genetic resources management, should preferably be located adjacent to the research unit for information management.

The laboratory unit for vegetatively propagated plants, insofar as its research activities are concerned, has no direct bearing upon other laboratories but should preferably be located close to the common facilities such as the microscope, balance and culturing rooms and the dark room as well as to the evaluation laboratory in the light of research activity traffic lines. The visiting scientists' laboratory unit is linked with every laboratory unit, such as seed storage, exploration and collection, and information management, in the fields where technical cooperation will be extended by the long term and short term experts dispatched from Japan, but as the contents of its experimental work have much in common with the fields of evaluation and classification it should be placed close to the evaluation laboratory unit.

As examined in the layout planning for each building, the laboratory division will have to be housed in two, two-storied buildings. As for floor planning, the three laboratory units, namely for seed preservation, exploration and collection and information management, and the storage facilities, the seminar rooms and the library reading room shall be placed on the ground floor in view of the mutual linkages that exist among these units. The other three laboratory units, namely for vegetatively propagated plants, evaluation and visiting scientists' and the other rooms for common use shall be placed on the first floor.

Fig. 4-4 Concept Model of the Facilities

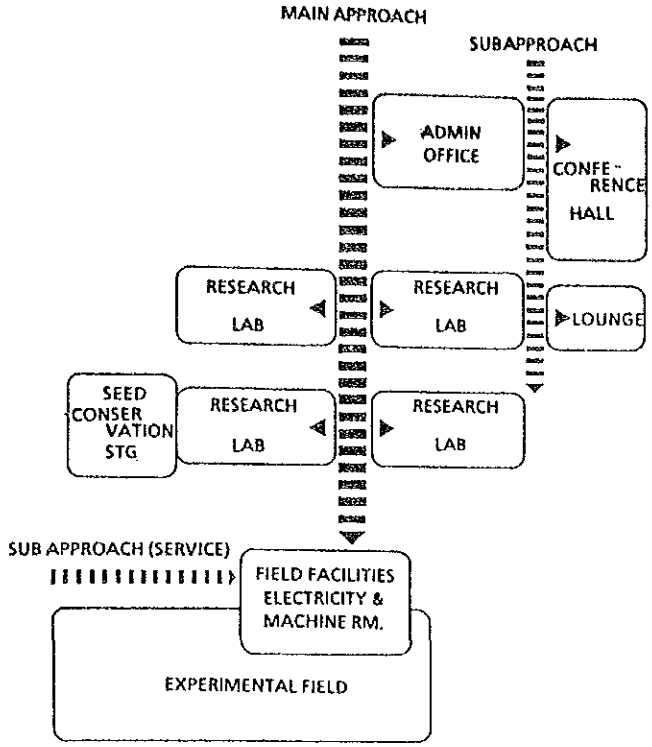
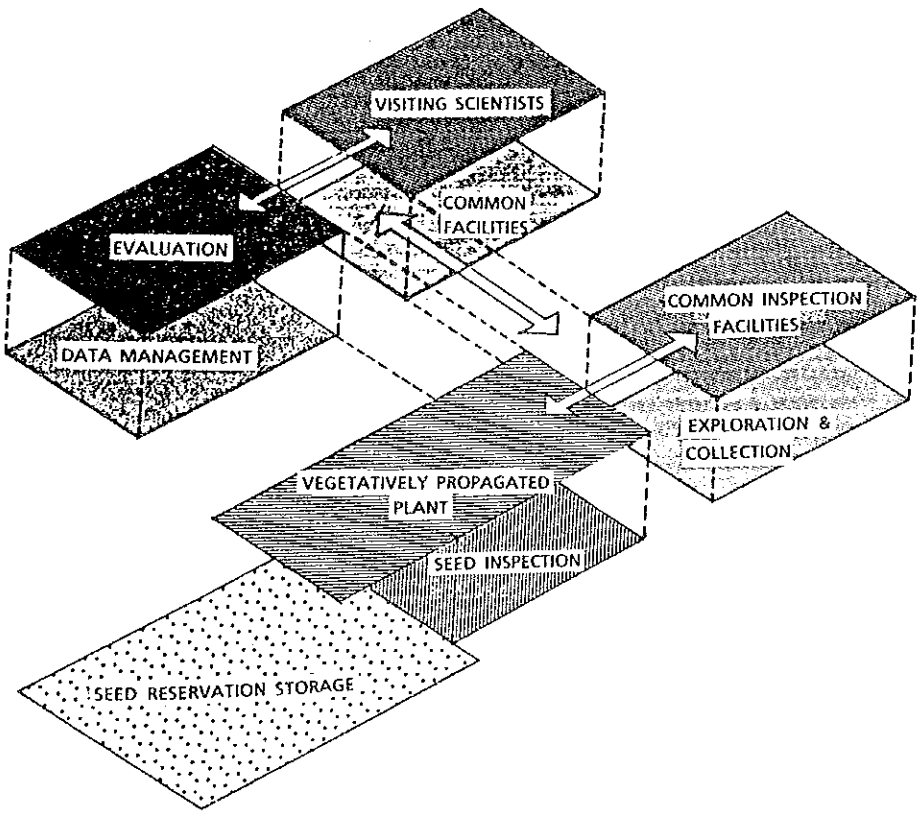


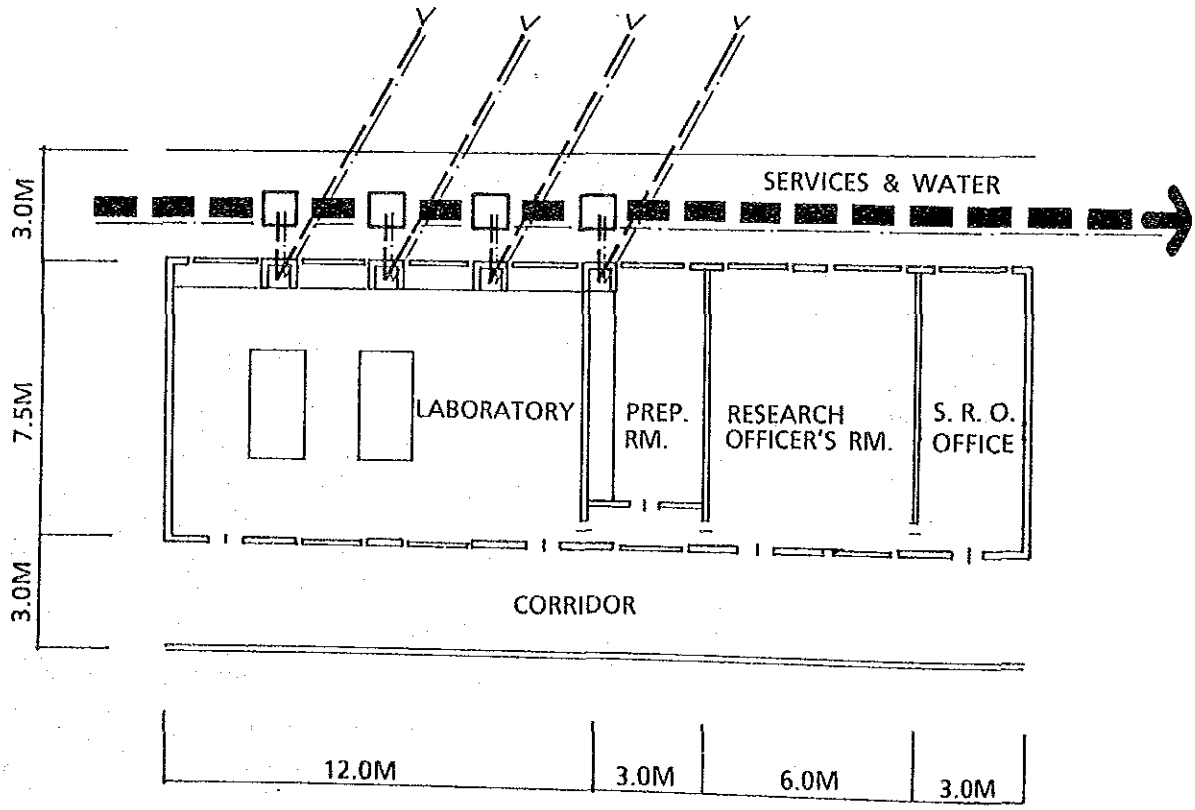
Fig. 4-5 Allocation of Laboratory Units



2. Laboratory unit planning

Although there may be some difference among the laboratory units in terms of conveniences depending on their respective field of research and layout of laboratory equipment, each laboratory unit shall basically be composed of four rooms: an experiment laboratory, a preparation room, a researcher's room and a senior researcher's room. Laboratories shall be provided with water supply and drainage facilities, gas, power source and other conveniences as necessary, and if the buildings are to be two stories high the floor plans shall be designed to place the experiment laboratories of both the upper and lower floors at the same location so that utilities amy be rationally arranged. Also, to facilitate making future changes in these conveniences with the development of the research programme, the experiment laboratories shall be provided with connections for water supply and drainage, electricity, etc. at regular intervals.

Fig. 4-6 Type of Laboratory

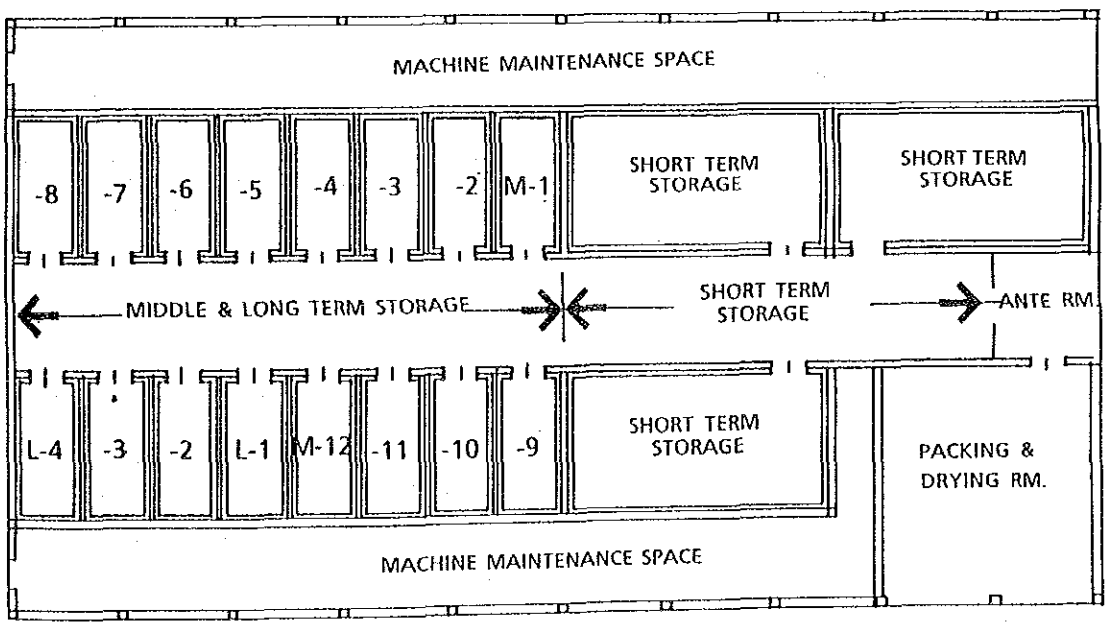


3. Seed preservation and storage facilities

In order to minimize the types of spare parts and to make future maintenance easier, both medium and long term storages for storing seeds shall be based on the same specifications so that they can be used interchangeably either as a long term storage (at 1°C) or as a medium term storage (at 10°C) simply by changing the operating mode. The medium term and long term storages will be the prefabricated type modular units which shall be assembled and erected locally. The short term storages shall be locally constructed rooms. The short term storages and the medium and long term storages shall be placed on each side of the dividing middle corridor. Condensers and radiators for air conditioning system shall be lined up outside of these storages to demarcate the space to be used exclusively for maintenance and also serve to enhance the heat insulating effect of the storages.

The seed drying and packing rooms shall be planned in the same compartment as they must be air-conditioned, and the drying machines shall be arranged so that they face the maintenance space.

Fig. 4-7 Speed Preservation Unit



4. Administration building

The administration building shall be connected to the laboratory buildings with a connecting corridor to clearly separate the two differing functions. The ground floor shall accommodate the private office of the Director of the Centre, offices and the conference hall, and a part of the first floor shall accommodate rooms for visiting researchers. The main entrance shall be provided at a place where it can be most easily approached from the arterial road. The conference hall shall have an independent sub-entrance so that even if it were to be used at a considerable frequency by a large number of people from the outside it would be completely separated from the laboratory buildings and not disturb their activities. The administration offices on the ground floor, therefore, shall be arranged between the main and the sub-entrances so that they can both be controlled without trouble.

For the display of dried plant specimens, an exhibition gallery, which shall be an open space in the lobby attached to the conference hall instead of a separate room, shall be provided. Also, a place where the Centre's personnel can sit and chat shall be provided near the conference hall. This space shall be conveniently located and large enough to accommodate even outsiders participating in conferences, training or other programs.

5. Field related facilities

The farm manager's room field management office, locker room cum waiting room for field workers, lavatories and shower room shall be housed together in the field management building separate from the workshop building.

The workshop building shall accommodate a space for drying, a work space for threshing, seed cleaning, fumigation and potting, storages for field implements, soil, agro-chemicals and a garage for tractors and other vehicles. Five screen houses shall be constructed near the laboratory buildings to secure close linkage with each relevant units. Besides the foregoing, an infrastructure facilities building shall be constructed to

house the power receiving and transforming equipment, pumps, water supply tank, etc., and a maintenance workshop shall be attached to same.

4-3-2-2 Facade design

In modelling the elevation of each building and configuration of all buildings, an architectural expression adapted to the climatic condition of Sri Lanka and which harmonizes with the cultural environment of Kandy, the country's old capital and also with Sri Lanka's traditional style as seen in the Peradeniya University's group of facilities shall be attempted as stated in the basic design principle.

Functionally, the building elevation shall be composed of deep eaves to shield sunshine and to keep out rain and also open corridors around the outer walls to make the rooms well ventilated.

The form that meets the foregoing functions would inevitably constitute the elements of Sri Lanka's traditional style of building, and some modern expressions that shall express the function of this Centre as an academic research institute also be induced to harmonize with it.

4-3-2-3 Planning of the building section

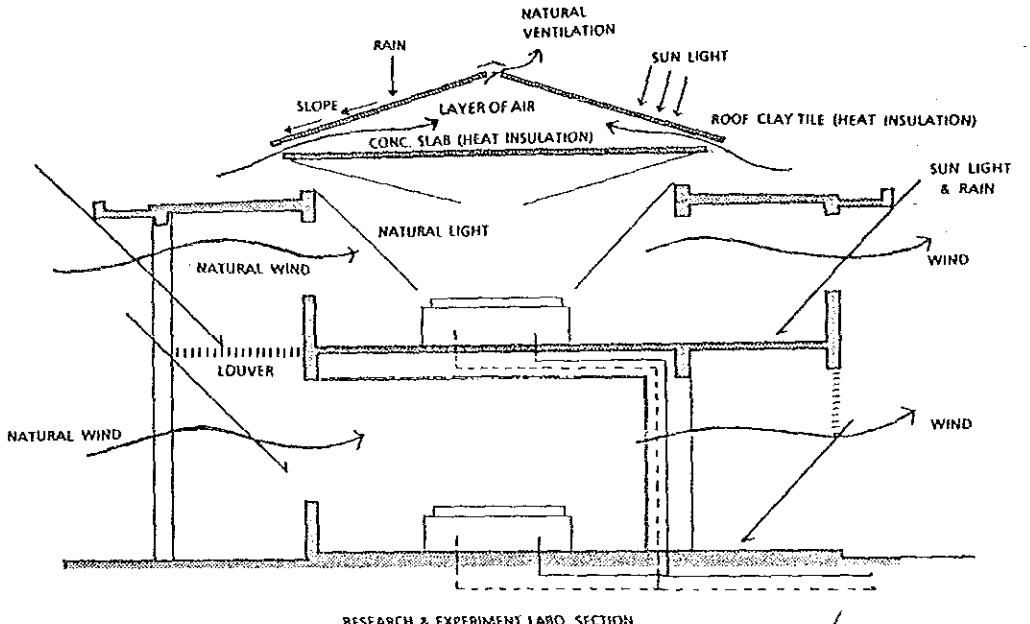
As stated in the design principle, the section of the buildings shall be designed to prevent sunshine and rain and to ensure good ventilation. In other words, corridors with deep eaves shall be provided along the outer periphery of each building, and transoms shall be provided in the upper part of every room.

The roof shall be slabs made of concrete covered by a pitched roof to quickly drain rainwater and to adequately ventilate the loft over the roof truss to enhance the heat insulation effect of every room on the first floor. The storey height shall be above 4m for the ground floor and above 3.7m for the first floor so that, basically, a comfortable environment can be secured by resorting to natural draft and ventilation

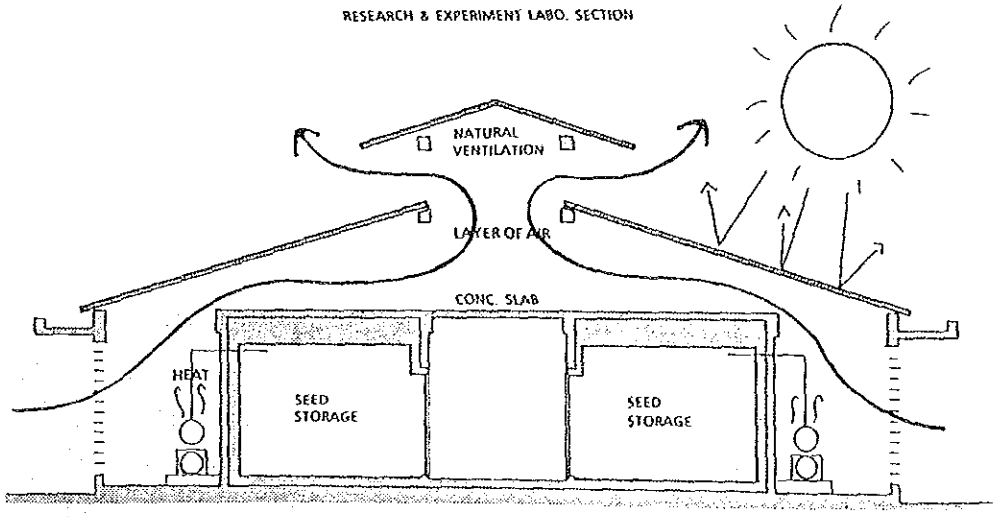
instead of mechanical air-conditioning. The height of the rooms that will be used by a large number of people such as the conference hall and the lobby shall be made as high as to secure the largest possible void space as possible.

Plumbing work for equipment, electric power, etc. of the experiment laboratory rooms and the like shall be designed to be adequately flexible to accommodate future changes, and the sectional space provided for these shall be large enough to facilitate maintenance and upkeep.

Fig. 4-8 Building Section Plan



RESEARCH & EXPERIMENT LABO. SECTION



SEED CONSERVATION STORAGE SECTION

4-3-2-4 Building materials planning

The building materials to be used for construction of this Centre shall be suitable to the local natural conditions and to the functions of the Centre and make the buildings strong and easy to maintain. As a policy, locally available materials shall be used as much as possible.

(1) Principal structural members

Columns, beams, and floor slabs ····· Reinforced concrete
Walls ····· Concrete blocks and bricks
Roof truss ····· Steel work and light-weight steel work

(2) External finishing materials

Pitched roof ···· Tile-roofing over corrugated slate (The grand roof of the conference hall shall be covered with copper plates. The screen houses shall be roofed with corrugated poly-carbonate sheets.)

Flat roof ····· Clay tiles over asphalt water proofing.

External wall ··· Acrylic resin based coating over mortar undercoat (Walls of conference hall to be of local stone masonry)

Fittings ····· Wooden and aluminum

(3) Interior finishing materials

Floor..... Mortar undercoat overlaid with terrazzo tile. Shall permit local mending and replacement.
Wall..... Mortar undercoat and vinyl paint finish. Shall permit local mending and repainting.
Ceiling..... Mortar undercoat and emulsion paint finish. Shall permit local mending and repainting.

(4) Internal finishing materials

Room name	Floor	Wall	Ceiling
Laboratory Building:			
Researchers' room	Terrazzo tile	Mortar Vinyl paint finish	Mortar, emulsion paint finish
Laboratory room	"	"	"
Preparation room	"	Skirting: semi-ceramic tile Upper wall: mortar, vinyl paint finish	"
Short term storage	Mortar	steel panel (lined with heat insulating and damp proofing materials)	steel panel (lined with heat insulating and damp proofing materials)
Medium & long term storages	Long vinyl sheet	"	"
Aisles within storage	Mortar	Mortar finished with vinyl paint	Asbestos heat insulating panel
Seed drying & packing room	Terrazzo tile	Mortar, vinyl paint finish	Mortar, emulsion paint finish
Germination test & seed inspection room	"	"	"
Clonal preservation room	"	"	Asbestos heat insulating panel
Room for balances	"	"	Mortar, emulsion paint finish

Room name	Floor	Wall	Ceiling
Room for microscopes	Terrazzo tile	Mortar, vinyl paint finish	Mortar, emulsion paint finish
Room for incubators	"	"	"
Dark room	"	Skirting: semi-ceramic tile	"
		Upper wall: Mortar, vinyl paint finish	"
Seminar room	"	"	"
Library reading	"	Mortar, vinyl paint finish	"
Machine storage	"	"	"
General storage	Mortar	"	"
Administration Building:			
Director's room	Terrazzo tile	"	"
Administration office	"	"	"
Conference hall	"	"	Rockwool acoustic board
Lounge	"	"	"
Corridor	"	"	Mortar, emulsion paint finish
Stairway	Stone	"	"
Lavatory	Ceramic tile	Semi-ceramic tile	Cement asbestos, E.P.

Room name	Floor	Wall	Ceiling
Field-Related Facilities:			
Rooms in the workshop building	Mortar	Mortar, vinyl paint finish	Corrugated slate, emulsion paint finish
Field management office	"	"	Sarking, oil stain finish
Field workers' room	"	"	"
Lavatory	Ceramic tile	Semi-ceramic tile	"
Simple green house	Mortar and Soil	Skirting: mortar, concrete paint, stainless steel net	Corrugated glass plate
Utilities buildings			
Electrical equipment room	Mortar	Mortar	Cement asbestos, E.P.
Pump room	"	"	"

4-3-2-5 Structural planning

In planning the structure of buildings under this project the cast-in-place reinforced concrete structure, which is popular in Sri Lanka as being the most rational and economical construction method for buildings of the scale being planned, shall be adopted; and in designing the external force and selecting the design standards, the general approaches practiced locally shall be respected.

1) Ground conditions

Geologically, the ground of the site is composed of lateritic clay layers, the top soil of 1.5m to 2.0m in thickness being comprised of somewhat soft clay layer mixed with sand having N-values of 4 to 6 and the layers underneath it being hard silty clay having N-values ranging between 9 and 25.

Spread footing, which is the type of foundation for buildings generally adopted in the neighborhood of this site is considered sufficient for the buildings to be constructed under this project, in which case an estimated design bearing capacity of around 10 t/m^2 shall be assumed to support it above the layer around GL -1.5m.

2) Structural design

The buildings shall be of reinforced concrete rigid frame structure with external walls and partitioning walls built by brick masonry.

Ordinary roof trusses and roofs with long span of the conference hall, for instance, shall adopt the steel framed, trussed beam construction.

Sri Lanka, normally employs the British Standards, for which reason the following standards were likewise based on the British Standards.

* Dead load, live load - BS 6399, Part 1 (1984)
* Wind load - BS CP3, Chapter V (1972)
* Reinforced concrete construction - Bs CP110 (1972)
* Steel framed structure - JASS

Table 1 shows the principal live loads to be employed in designing the buildings under this project. The design wind velocity of 35 m/second (about 75 miles/hour) shall be adopted in calculating the wind load. Seismic load is not considered here as there is no record of an earthquake in Sri Lanka.

Table 1 Live Load for Principal Rooms

Room name	Live load (kg/m^2)
Administration office	225
Researcher's room	306
Laboratory room	306
Seminar room	306
Conference hall	510
Seed storage	510
Corridor, balcony	306

3) Materials to be used

Local materials shall be used as much as possible. Materials made in Japan shall be used only when the local supply capacity is insufficient or where the quality of local products is inferior.

Cement:	Normal Portland cement (Japanese product for framework, local product for finishing)
Coarse aggregate:	Locally produced crushed stone
Fine aggregate:	Locally produced river sand
Reinforcement:	Deformed steel bar made in Japan, SD 30, SD 35
Steel frame:	H - beam and light-weight shaped steel made in Japan, SS41, SSC 41

4-3-2-6 Utilities planning

Basic policies in utilities planning

The equipment and systems shall be planned to conform with the purpose of this Centre by giving adequate consideration to maintenance and operating costs and to repairs and maintenance of mechanical systems necessary for preserving the seeds safely for a long period of time, and also by emphasizing economy by energy saving and manpower reduction efforts and the reliability and interchangeability of equipment and apparatus in renewing them.

Zoning, air-conditioning, public hygiene and electrical systems shall be determined by considering the purpose, operating hours, usage time and indoor environmental condition of each building in order that reliable facilities may be planned for long term preservation of seeds.

(1) Measures for maintenance, upkeep and renewal of equipment and apparatus in Sri Lanka

It is necessary that the utilities system be always kept in a safe, manpower saving and satisfactory condition in order that the buildings and facilities as a whole may adequately perform their intended functions and thereby contribute to research and experiment.

For the various equipment and apparatus to be normally operated they shall be selected carefully by considering them from every angle. Especially in the case of the dehumidifying equipment for this Centre, the one that performs mechanical cooling and dehumidifying and is most suitable for this area was selected, because even though the chemical method and the mechanical method are available, the chemical method involves such problems as water quality control after installation, control on the concentration and make up of the liquid and the maintenance costs being higher.

In planning, the method of repair in the event of machine breakdown, the replenishment of spare parts, the method for maintenance of the machine

and economy of maintenance costs as well as the interchangeability of equipment and apparatus shall be considered.

(2) Economical mechanical systems by energy saving and manpower reduction

In order to save energy and manpower, architectural and mechanical energy saving methods shall be employed to construct buildings that are well balanced in terms of energy conservation, effective utilization and manpower reduction.

Particular emphasis shall be given to heat insulation and damp proofing in storage rooms that perennially need to be kept at a constant temperature and constant humidity, and the infiltration of heat and moisture shall be prevented architecturally to reduce the load of the mechanical system as much as possible.

Also, the mechanical systems for the medium and long term storages shall be of the same model to be interchangeable, and at least the long term storages shall be made semi-permanently usable interchangeably for medium and long term storage.

Laboratory rooms and workshops shall be planned with due consideration to ventilation and sunshine and to be suitable to the natural conditions to reduce the installed capacity of the mechanical systems as much as possible.

As concrete measures for energy saving, the following shall be considered.

1) Storage facilities and the like shall be architecturally heat insulated and damp proofed adequately.

2) Air conditioning shall be planned separately by operating hours, by purpose and by system to match each different mode of use in order to reduce power costs.

3) Waste gas shall be utilized for the air conditioners of the storage facilities for heating the air for defrosting in order to reduce the maintenance cost and labor cost.

4) There shall be at least two or more cooling equipment (condensers) so that the number of equipment operated may be changed in accordance with the change in load to reduce the power cost and to extend the life cycle of the equipment. particularly the medium term and long term storages shall be based on common specifications and have two condensers each, which shall be used interchangeably at 1°c (for long term storage) when operating both condensers and at 10°c (for medium term storage) when operating only one condenser. Four numbers of stand-by condenser shall be provided for long term storages.

5) The condensers shall be of the outdoor type to prevent generation of heat inside the room.

6) The laboratory equipment for each laboratory shall be those that are suitable to their respective purpose (viz. oven, bench, chamber, etc.) and shall be planned to be flexible to allow future changes instead of being fixed as to instrumentalize the whole laboratory.

(1) Air conditioning and ventilation equipment

With a view to save maintenance and operating costs of the facilities and with due consideration to the climatic conditions of Kandy, natural ventilation shall be effectively utilized instead of resorting to cooling equipment or mechanical ventilation, except in the following rooms.

1) Rooms with cooling equipment

Room name	Design temperature	Design humidity	Type of air-conditioning system
Short term storage	15°- 20°C	40 - 50%	Air cooled, direct blowing, separated type package cooler for low temperature, 2 sets / room Dry portable dehumidifier, 2 sets / room
Medium term storage	10°C (1°C - 10°C)	No dew condensation	Air-cooled direct blowing separated type, 2 sets/ storage Off-cycle defrosting system
Long term storage	1°C (1°- 10°C)	No dew condensation	Refrigerating unit 2Hp (1Hp x 2)
Seed drying & packing room	15°- 20°C	40 - 50%	Air-cooled direct blowing type package cooler for low temperature: 2 sets Dry portable dehumidifier: 2 sets
Anteroom for above	25°C - 27°C	40 - 50%	"

Room name	Design temperature	Design humidity	Type of air-conditioning system
Clonal preservation storage	25°- 27°C	40 - 50%	Air-cooled separated type package cooler Dry portable dehumidifier
Room for incubators		40 - 50%	
Clonal preservation laboratory	25°C - 27°C	Natural	Air-cooled separated type package cooler
Clean bench room	25°C - 27°C	Natural	"
Computer room	25°C - 27°C	Natural	"
Room for balances	25°C - 27°C	Natural	"
Room for microscope	25°C - 27°C	Natural	"
Dark room		Natural	"

2) Rooms with mechanical ventilation

A ventilating fan suitable for each respective purpose shall be provided for each laboratory, pantry and lavatory.

(2) Plumbing and sanitary facilities planning

1) Water supply facilities

An 80m deep well shall be drilled on the proposed construction site. Pumped water, after being lifted to the elevated tank from the receiving tank, shall be divided into two lines of piping, one for supplying water for in-house use and the other for farming. The water requirements for household use, experiment, and cleaning shall be estimated by assuming the manpower plan for this Centre to be 95 persons housed within the facilities and 60 persons working outdoors, totalling 155 persons. Daily mean water consumption is estimated to be:

Water for domestic consumption

155 persons x 120 l/capita/day* = 18,600 l/day

300 persons x 120 l/capita/day x 1/2 = 18,000 l/day

Total 36,000l/day .... 40,000l day

Hourly mean(8h/day) = 5,000 l/day .....(A)

Water for farming

Screen house 450m^2 x 3 cm/day = 13,500 l/day

Hourly mean (3 h/day) = 4,500 l/h .....(B)

(a) = (B) = 9,500 l/h

The reservoir tank capacity shall be large enough to store one day's (8 hours) supply of water; viz.,

9,600 l/h x 8 h = 76,000 l ..... 80m^3 shall be secured.

The reservoir tank shall be of the type partitioned inside for the convenience of cleaning and maintenance.

* Determined on the basis of 100-120 l/day for offices and 100-200/day for laboratories according to the handbook of the Japan Air-Conditioning and Sanitary Engineering Institute and with due regard to the actual status in Sri Lanka.

The capacity of elevated tank shall be 10 m^3 which stores one hour supply of water. Two separate piping shall be adopted after the elevated tank, one for domestic water with chlorination system and the other for screen house without chlorination

2) Hot water supply facilities

To supply hot water for serving tea at this Centre, an individual hot water storing type heater shall be adopted.

3) Sanitary fixtures

Specified sanitary fixtures shall be provided wherever necessary within this Centre according to the architectural design.

4) Drainage facilities

For planning purpose, drainage discharged from this Centre shall be classified into the three catagories of household type drainage, effluent from laboratories, and rainwater. For each type of waste water, installation of the necessary waste water treatment tank and laboratory effluent neutralization tank shall be planned. Treated waste water shall be disposed of by evaporation. Rainwater collected within the site shall be discharged into the side ditch, the terminal end of which shall be led into the Mahaweli River.

5) Fire fighting facilities

A fire fighting pump shall be installed in the pump room of this Centre, and hydrants shall be provided inside and outside of each building to serve in the event of fire.

6) Gas facilities

Considering the cost advantage, gas to be used within this Centre shall be supplied through localized piping from the LPG cylinders installed in each block close to the places where gas is used.

7) Other facilities

A small scale cooking facility shall be planned in the pantry of the tea parlor attached to the conference hall.

Fig. 4-9 Water Supply System

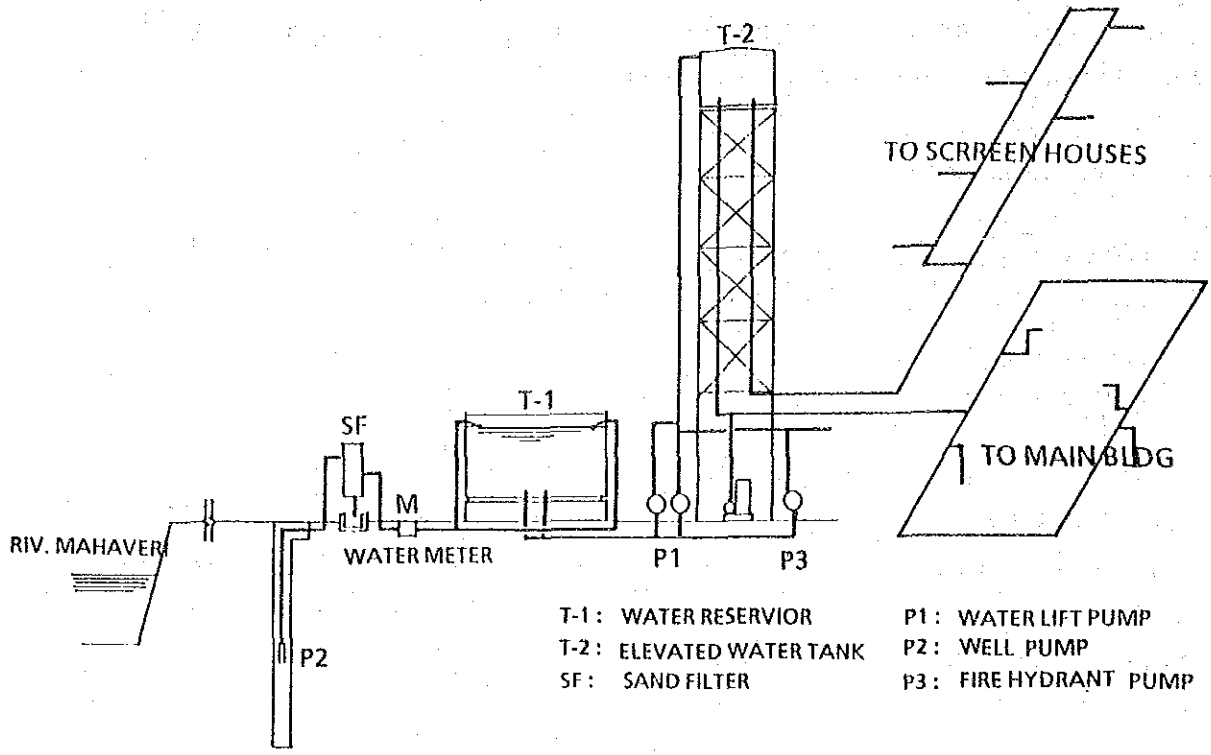
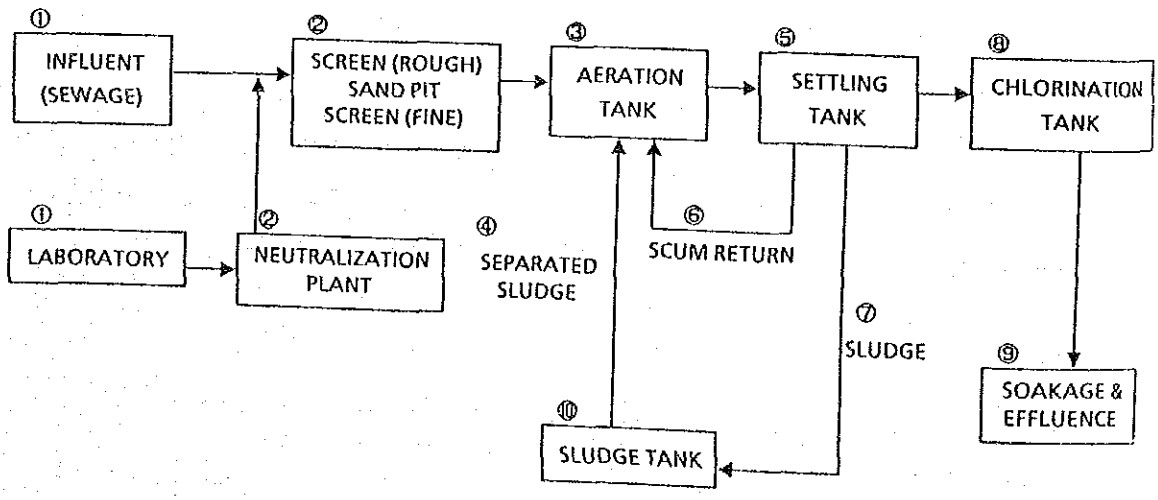


Fig. 4-10 Waste Water Treatment Flowchart



(3) Electrical system planning

An electrical system highly reliable and easy to maintain shall be planned with due regard to energy saving and safety. Particularly when considering the functions of this Center, such as long term preservation of seeds, it is necessary that each building be provided with a stable and reliable power source. Accordingly, substation facilities and emergency power source facilities are the most crucial electrical systems to which particular attention shall be given in planning.

1) Power receiving and transforming facilities

* Voltage and frequency

As a three phase, three wire, 33 KV, 50 Hz high tension aerial distribution cable of the Ceilon Electricity Board (C.E.B.) is laid on the proposed construction site, a lead-in wire shall be branched from this cable to receive power into the primary lead-in pole.

From this pole, power shall be led into the electrical room via the underground distribution line.

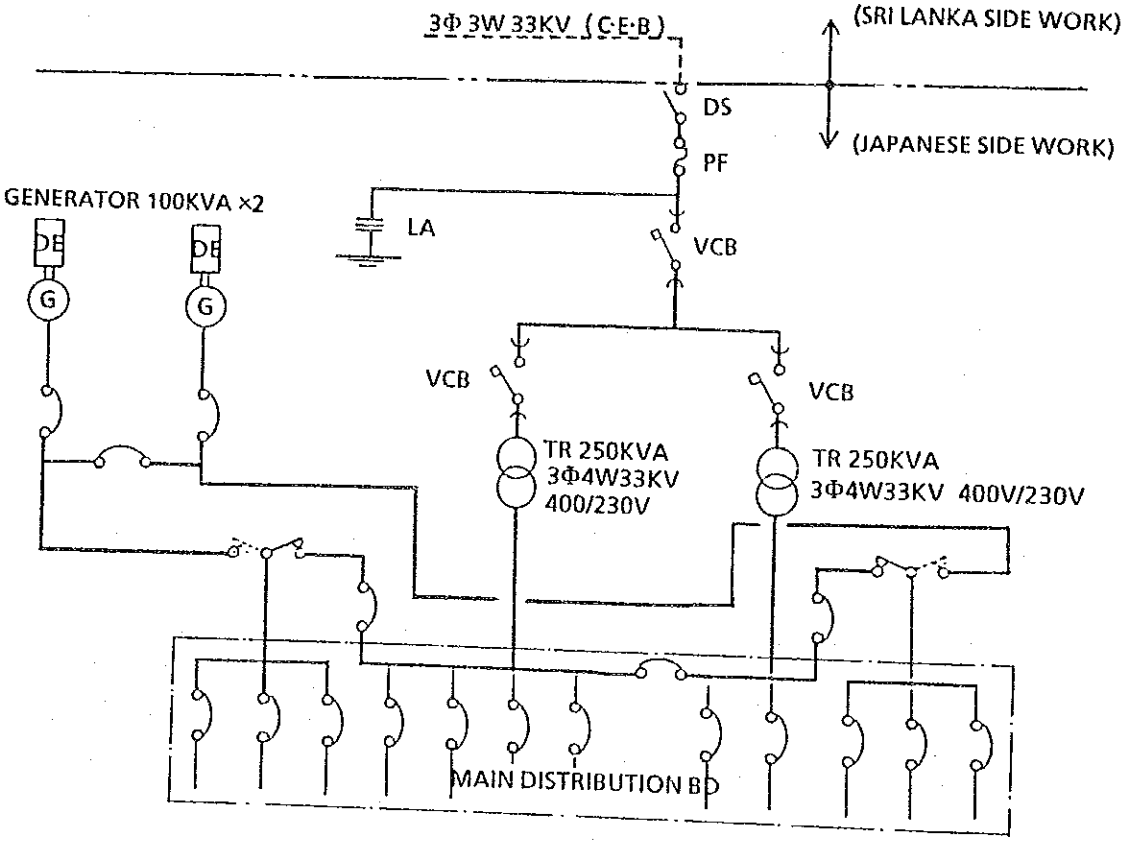
* Transformer facilities

Transformer facilities of the cubicle switchgear type shall be installed inside the electrical room. The 53KV high tension power led into the electrical room shall be stepped down to 400V/230V low tension power by means of transformer and supplied to the distribution board or power panel installed in each building. The required transformer capacity shall be 250 KVA x 2 sets.

* Division of work

The Sri Lankan side shall be responsible for leading in the high tension power onto the proposed construction site up to the high tension switch on the primary lead-in pole and the secondary terminal of the power fuse. The Japanese side shall be responsible for the work beyond the said high tension switch.

Fig. 4-11 Power Supply Diagram



2) Emergency power source facilities

2 sets of diesel engine generator, each having a capacity of around 100 KVA, shall be installed as the power source for the operating display status of transformers and driving power, the alarm system, seed storages, the storage for vegetatively propagated plants and the incubator room.

3) Main line facilities

Power which has been transformed by the transformer is distributed to the lighting cabinet panel and power control panel of each building via MCB of the low voltage switchboard in the electrical room.

The electrical systems of the main line and the loads are as follows.

(1) Lighting and power main lines: three phase, four wire system, 400/230V
(2) Illumination, plug socket: single-phase, two wire system, 230V
(3) Power for fan, pump, etc.: three phase, three wire system, 400V

4) Lighting facilities

* Illumination facilities

The power source for illumination shall be primarily fluorescent lamps with a view to reduce the running cost. The switches shall be divided into sections so that the lights can be turned on and off in small blocks and also thinned-out on corridors and similar places with a view to reduce the running cost.

The intensity of illumination shall be roughly as follows:

(1) Office rooms, conference hall, research officers' rooms, laboratory rooms: 300 - 350 lux
(2) Lobby, storage rooms: 150 - 200 lux
(3) Corridors, lavatories, warehouses, rooms in the

workshop building: 50 - 100 lux

* Plug socket facilities

Besides the general purpose plug sockets to be provided in office rooms and the conference hall, suitable plug sockets shall also be designed for rooms such as the research officers' rooms and laboratory rooms wherein many electrical equipment and apparatus are likely to be used, to be adaptable to the types and capacities of each respective equipment and apparatus.

* Ceiling fans

Ceiling fans shall be installed in office rooms, conference hall and research officers' rooms.

5) Power facilities

A power control panel shall be installed in each machine room to start and stop the fans and pumps and other motors. The alarm panel in the administration division shall display (any anomaly in power load or water level) and issue an alarm.

6) Telephone facilities

As an aerial telephone line is installed over the road in front of the proposed construction site, an aerial service line shall be dropped from said line up to the leading-in pole, from where a conduit shall be laid up to the service terminal board to be installed in the administration office. The work on the telephone drop up to the service terminal board shall be the responsibility of the Sri Lankan side.

A telephone conduit laying work shall be executed from the service terminal board to the relay terminal board in each building and to the telephone outlets in each principal room.

* Telephone exchange facilities

For communicating with the inside and outside parties, a digital private automatic branch exchange capable of accommodating up to 50 extension lines shall be installed in the administration office, and altogether 30 extension telephone sets shall be installed in necessary rooms within the Centre.

7) Public address system

* P.A. system for the entire building

For transmitting messages, paging, and time chimes, speakers shall be provided in each of the major rooms, and an amplifier and a mike installed in the administration office for broadcasting. An independent broadcasting line shall be provided for each building.

* Independent broadcasting system

An independent broadcasting system shall be installed in the conference hall.

8) Interphone system

An interphone system shall be connect the administration office, electrical room and machine room for operation and maintenance purpose.

9) TV joint receiving system

Outlets for the TV joint receiving system shall be equipped in the conference hall and the library reading room as audiovisual aid.

10) Fire alarm system

A fire alarm system which shall sound an emergency bell by depression of the push button to help people evacuate safely or notify the outbreak of a fire or other emergency at an early stage shall be installed. The display panel shall be installed in the administration office and shall indicate the building in which the push button was depressed.

11) Lightening arrester system

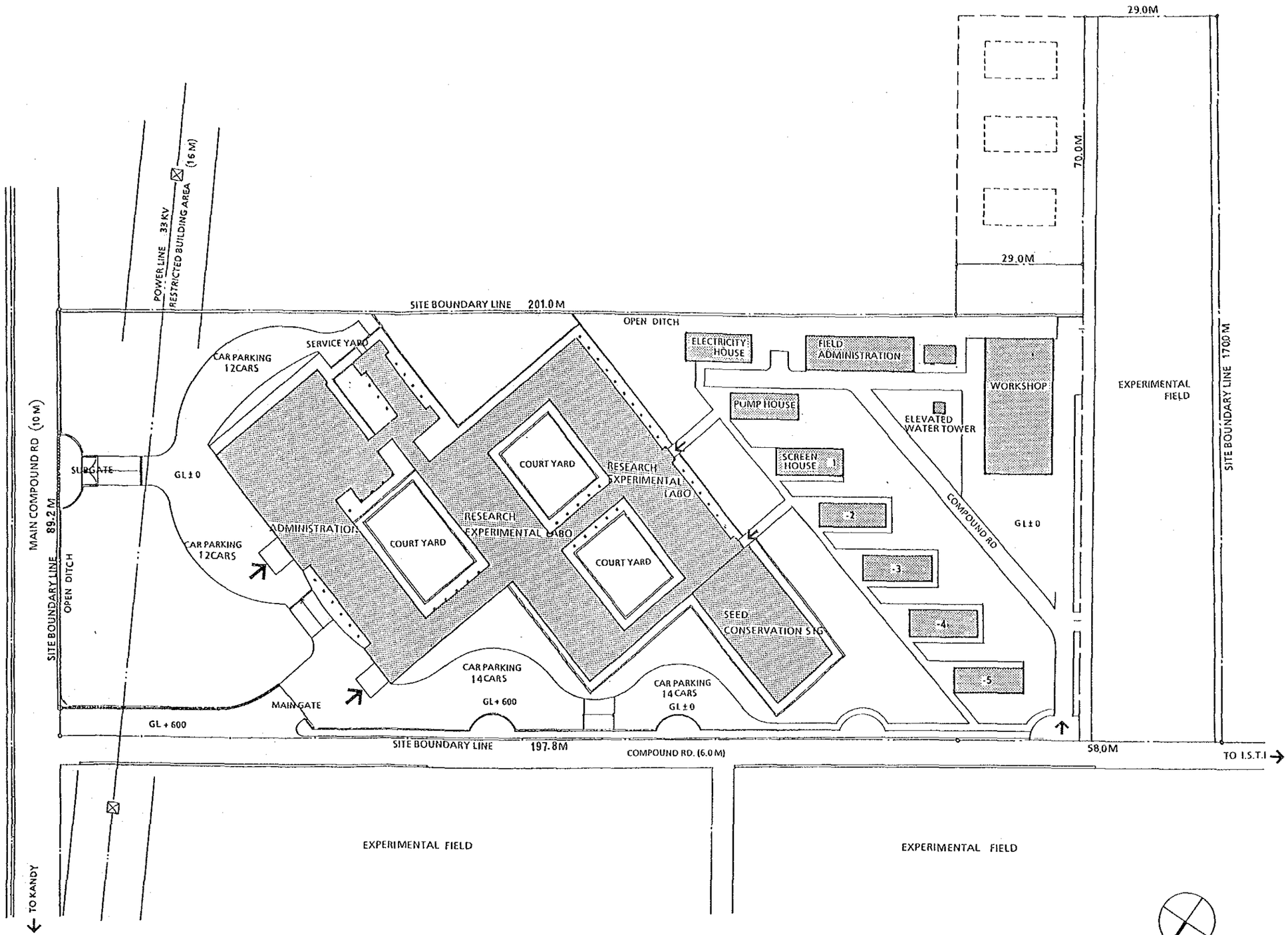
A lightening arrester system shall be installed to protect the people and the buildings on the site from damages by thunderbolts.

12) Exterior lighting facilities

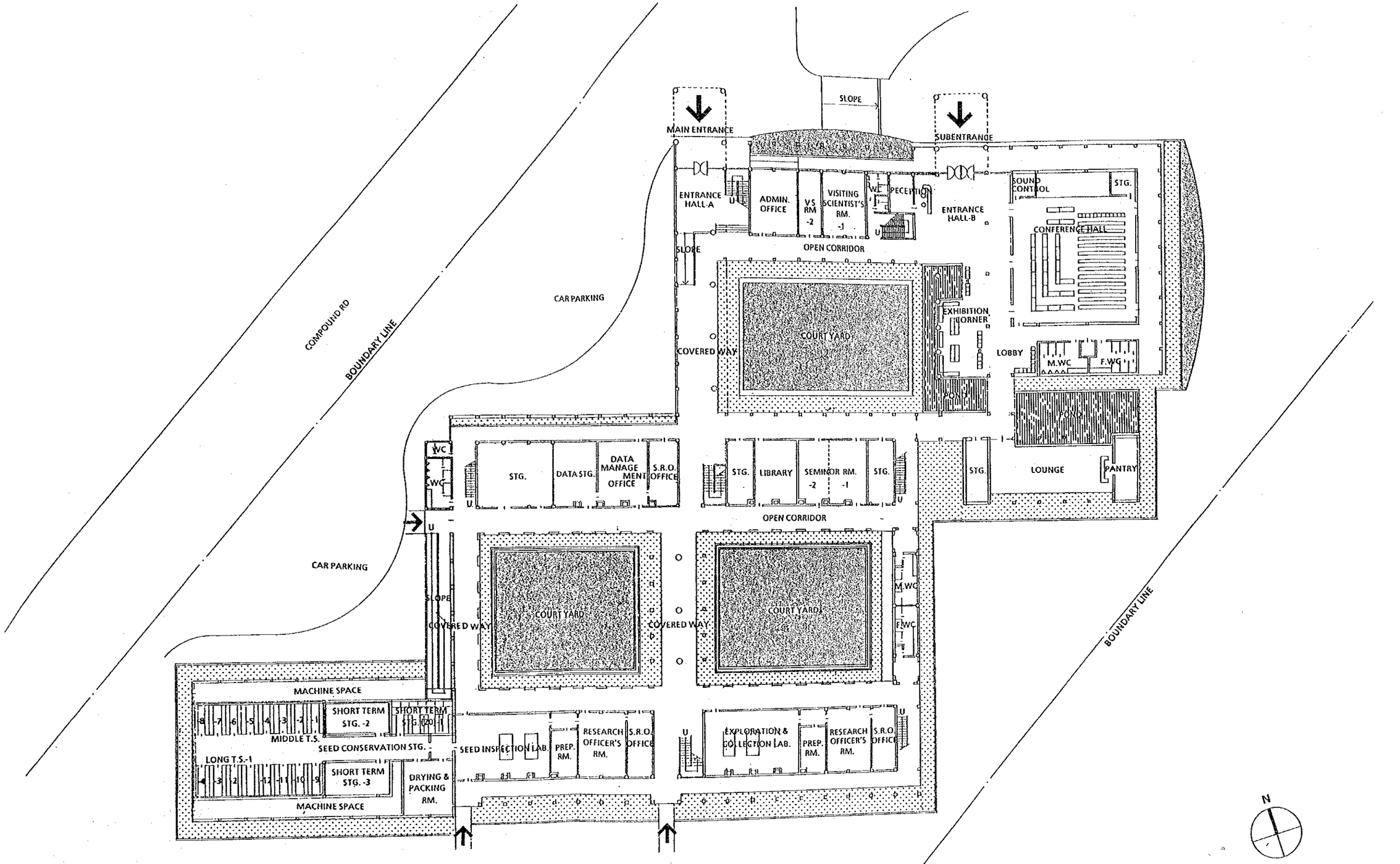
Exterior lighting lamps shall be installed on the premises for reasons of safety and for prevention of crimes during night.

4-3-3 Basic design drawings

1. SITE PLAN
2. GROUND FLOOR PLAN
3. 1ST FLOOR PLAN
4. ROOF PLAN
5. ELEVATION - 1
6. ELEVATION - 2
7. SECTION
8. PLAN FOR FIELD FACILITIES
9. ELEVATION AND SECTION FOR FIELD FACILITIES
10. WATER SUPPLY LINE
11. DRAINAGE SYSTEM
12. ELECTRICAL AND TELEPHONE SYSTEM



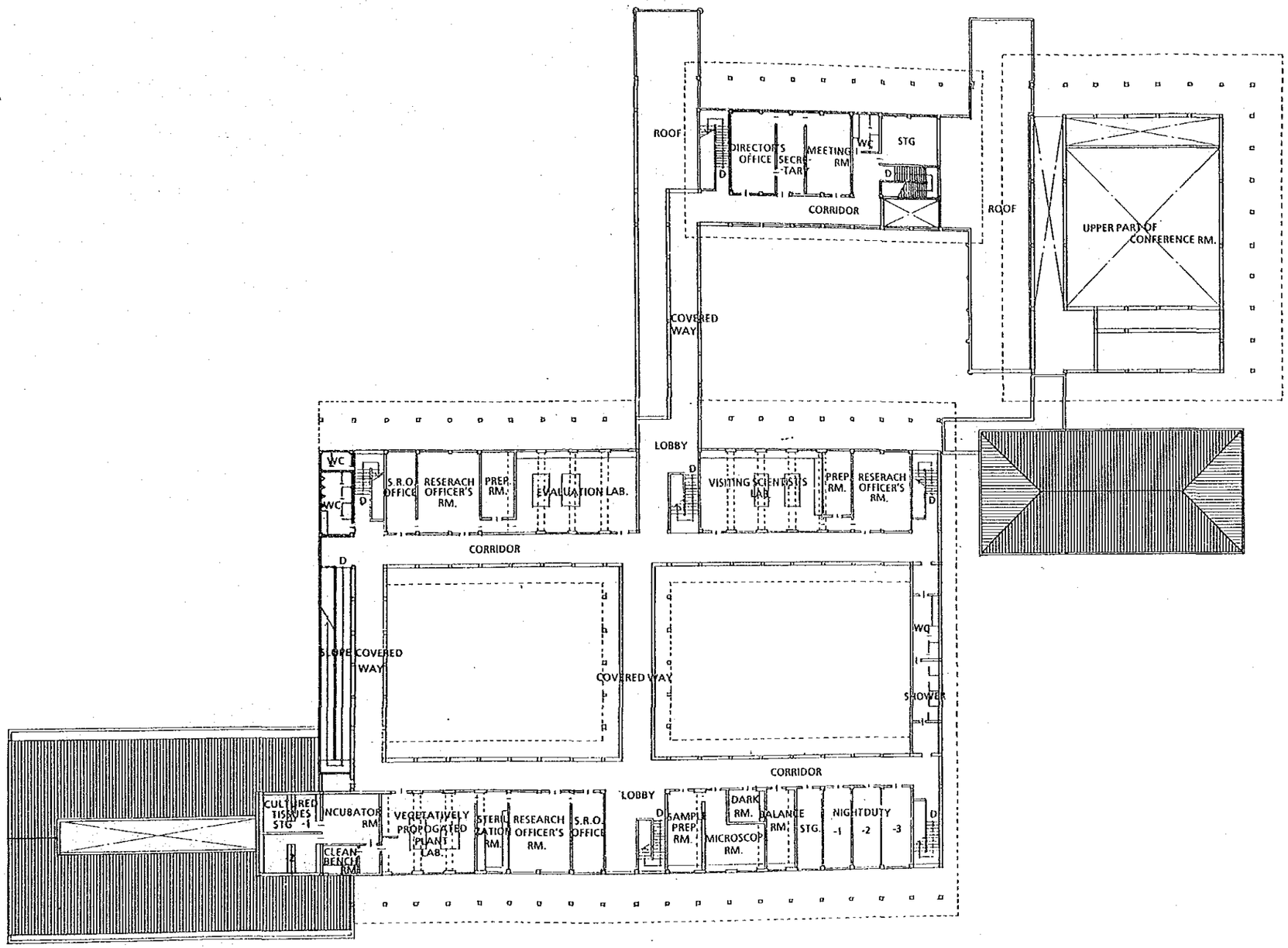
SITE PLAN 0 10 20 30M 1



GROUND FLOOR PLAN

0 5 10 20M

2



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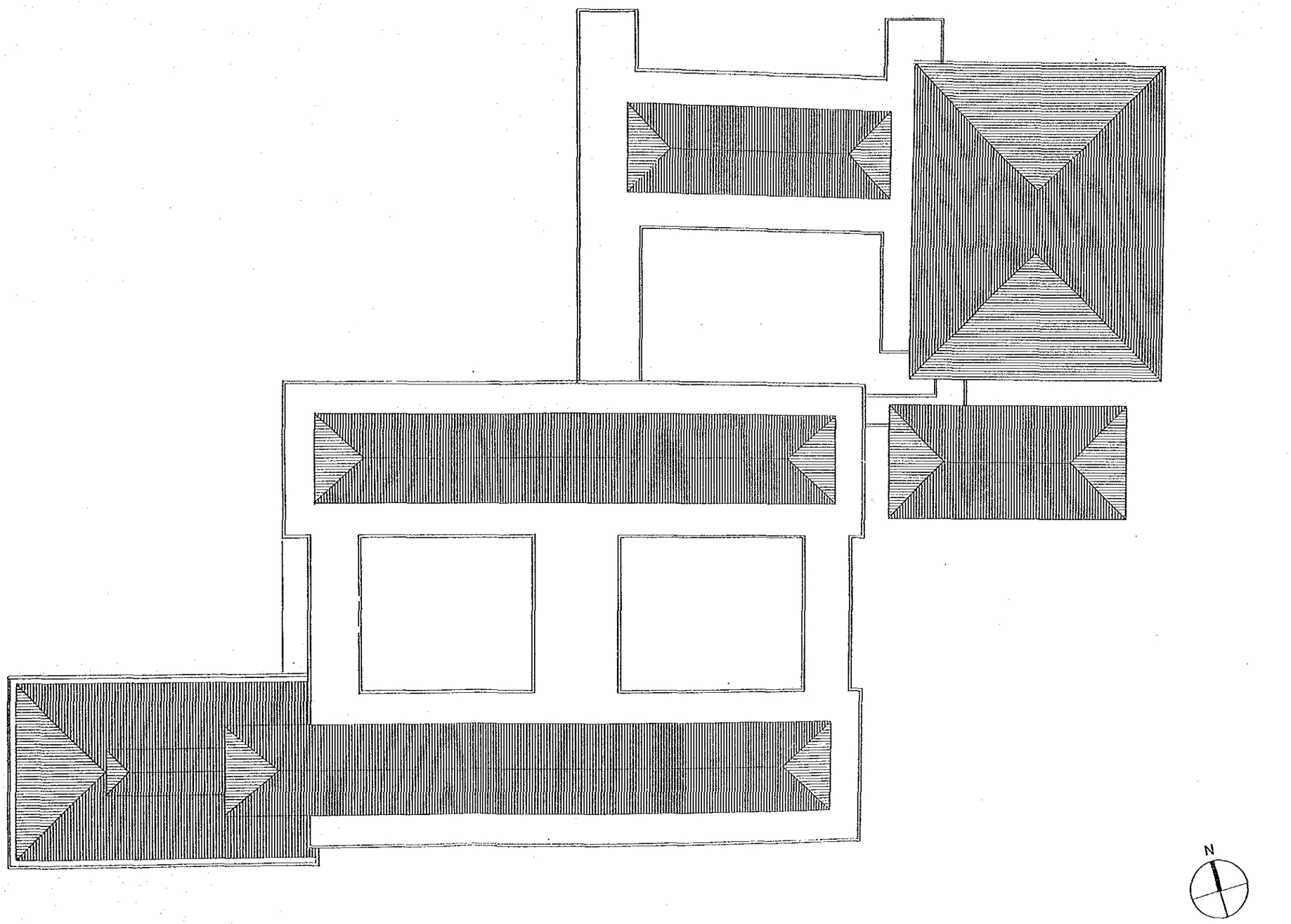
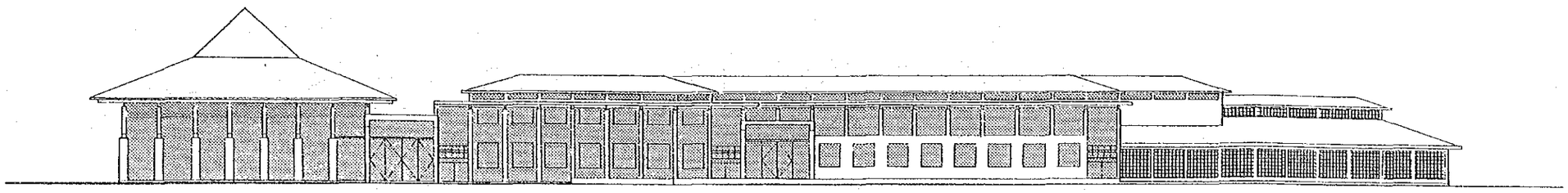
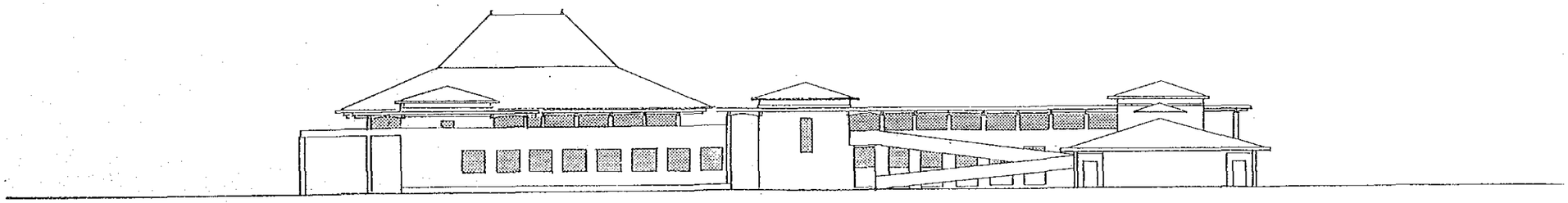
1ST FLOOR PLAN 0 5 10 20M 3



ROOF PLAN 0 5 10 20M 4

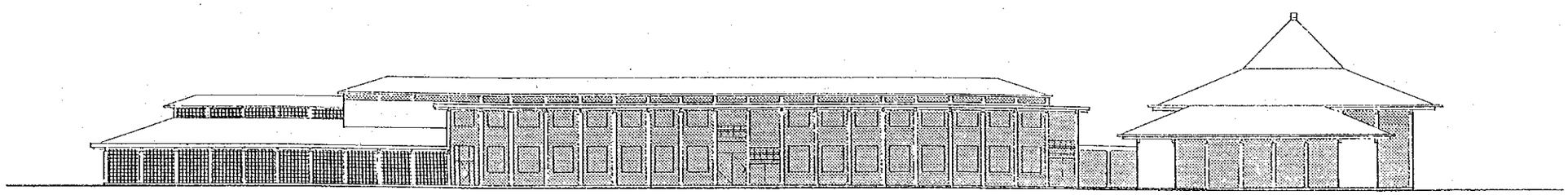


NORTH ELEVATION

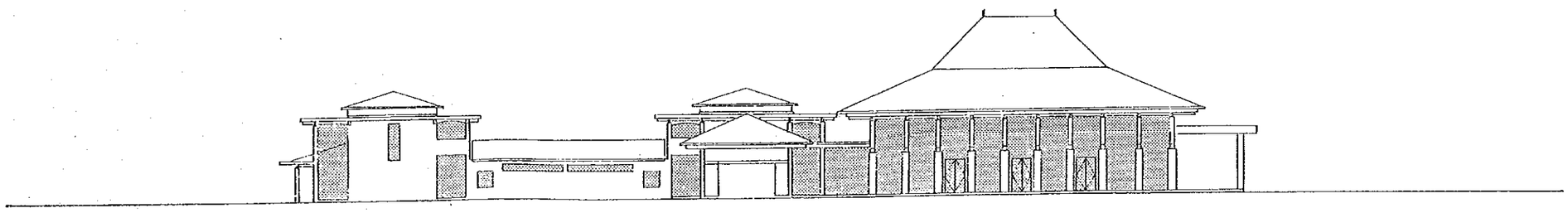


WEST ELEVATION

ELEVATION 0 5 10 20M **5**

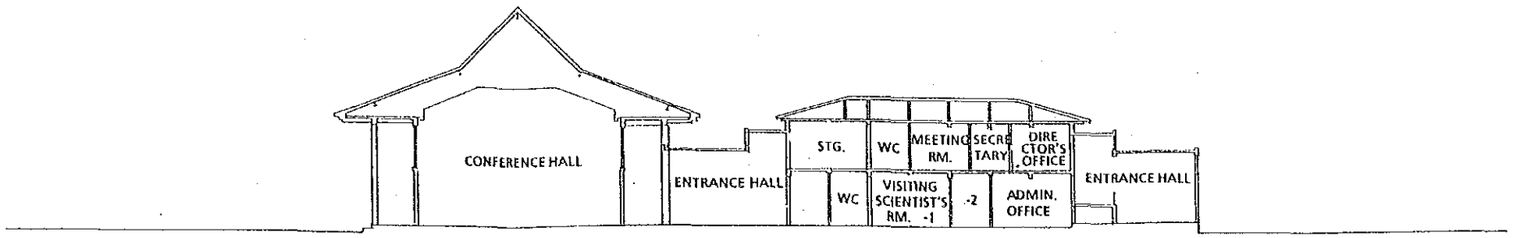


SOUTH ELEVATION

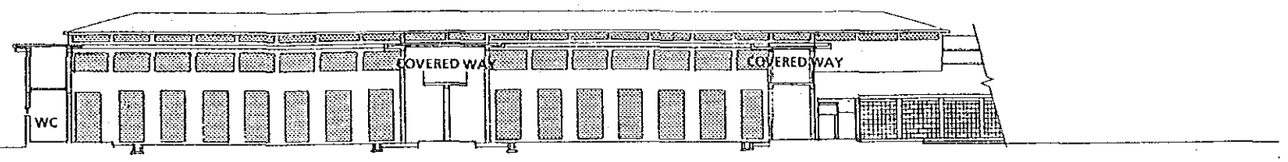


EAST ELEVATION

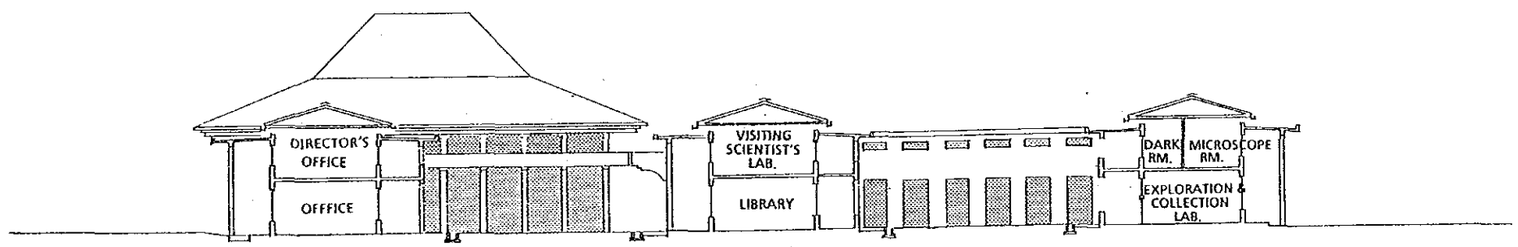
ELEVATION 0 5 10 20M **6**



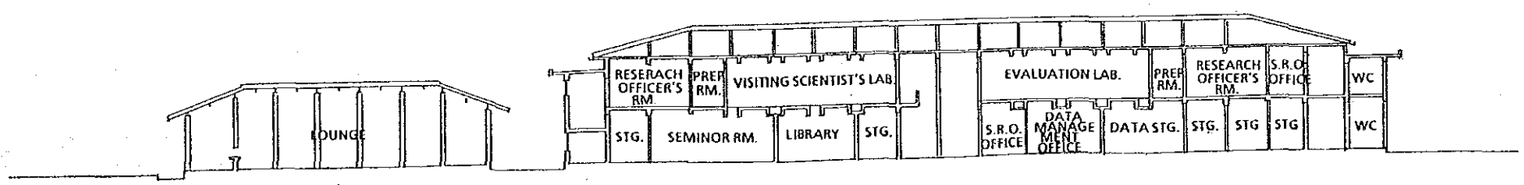
SECTION 1



SECTION 2

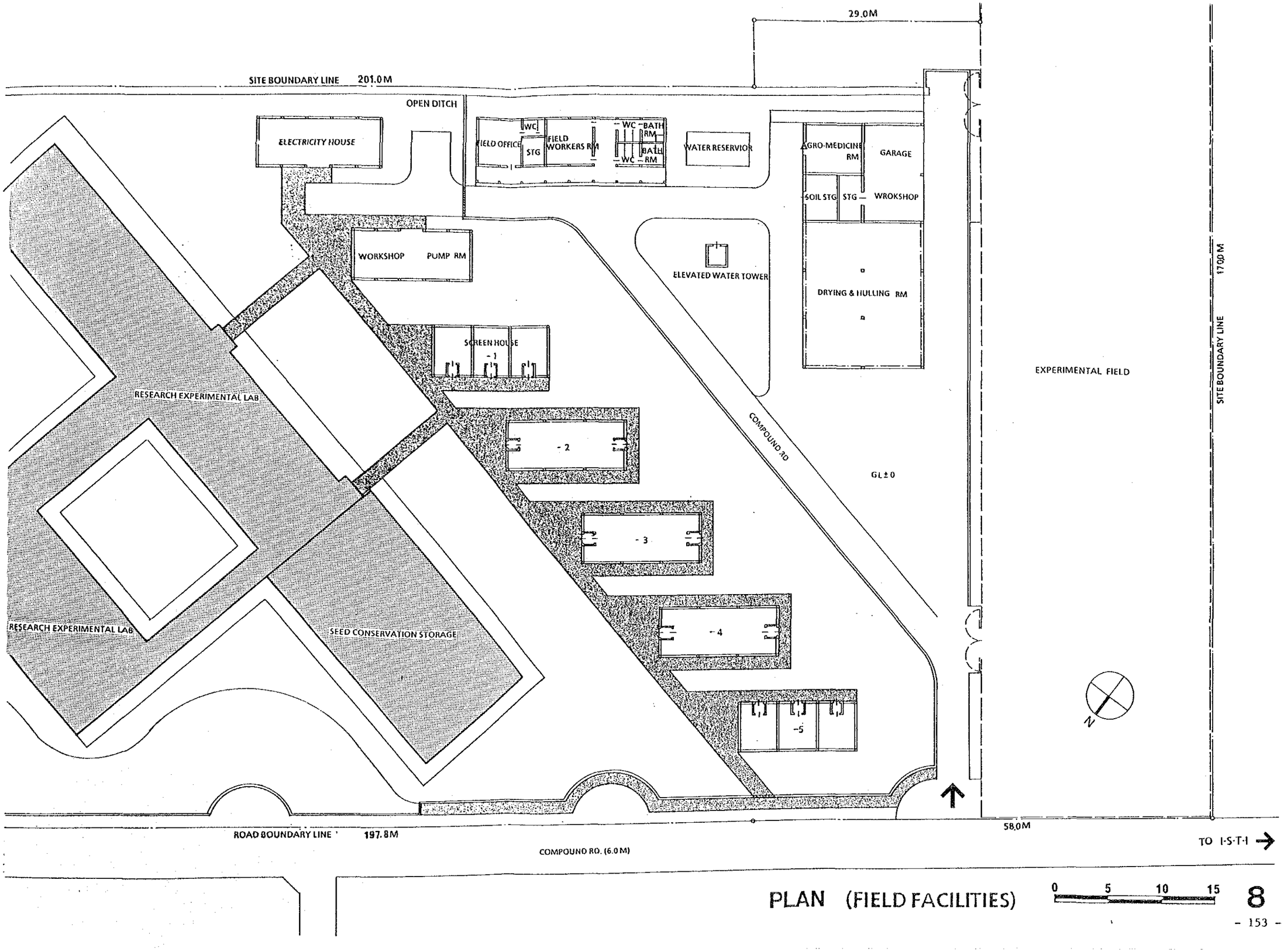


SECTION 3



SECTION 4

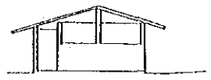
SECTION 0 5 10 20M **7**

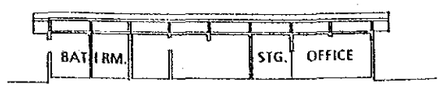


PLAN (FIELD FACILITIES) 0 5 10 15 8

FIELD ADMINISTRATION

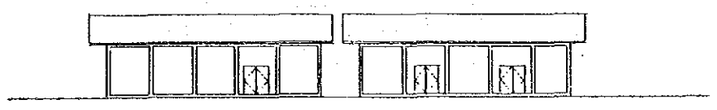
ELEVATION





SECTION

ELECTRICITY HOUSE PUMP HOUSE



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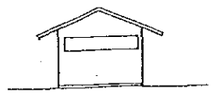
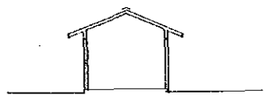
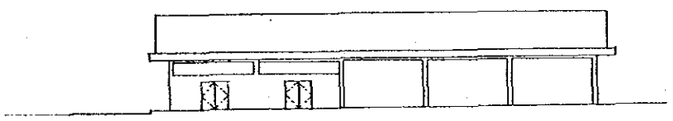




SECTION

WORK SHOP



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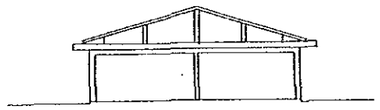
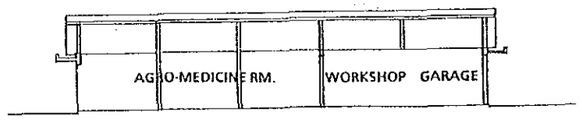
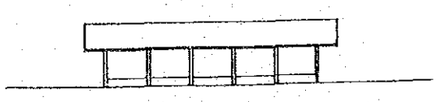




SECTION

SCREEN HOUSE



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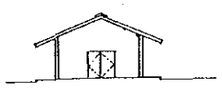

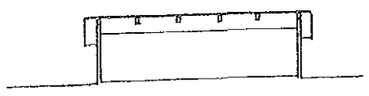

SECTION

ELEVATION AND SECTION (FIELD FACILITIES)

0 5 10 20

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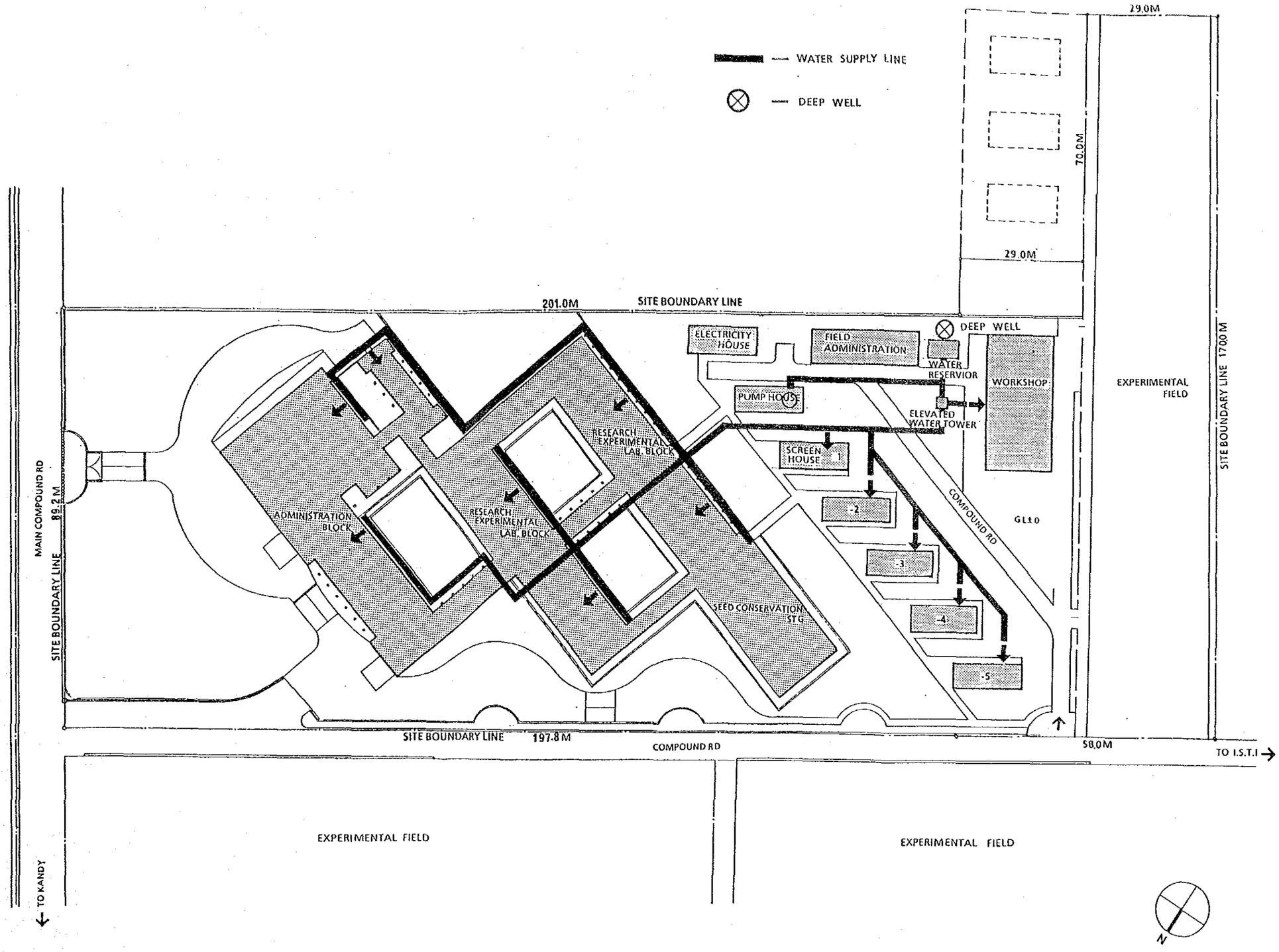

WATER SUPPLY LINE

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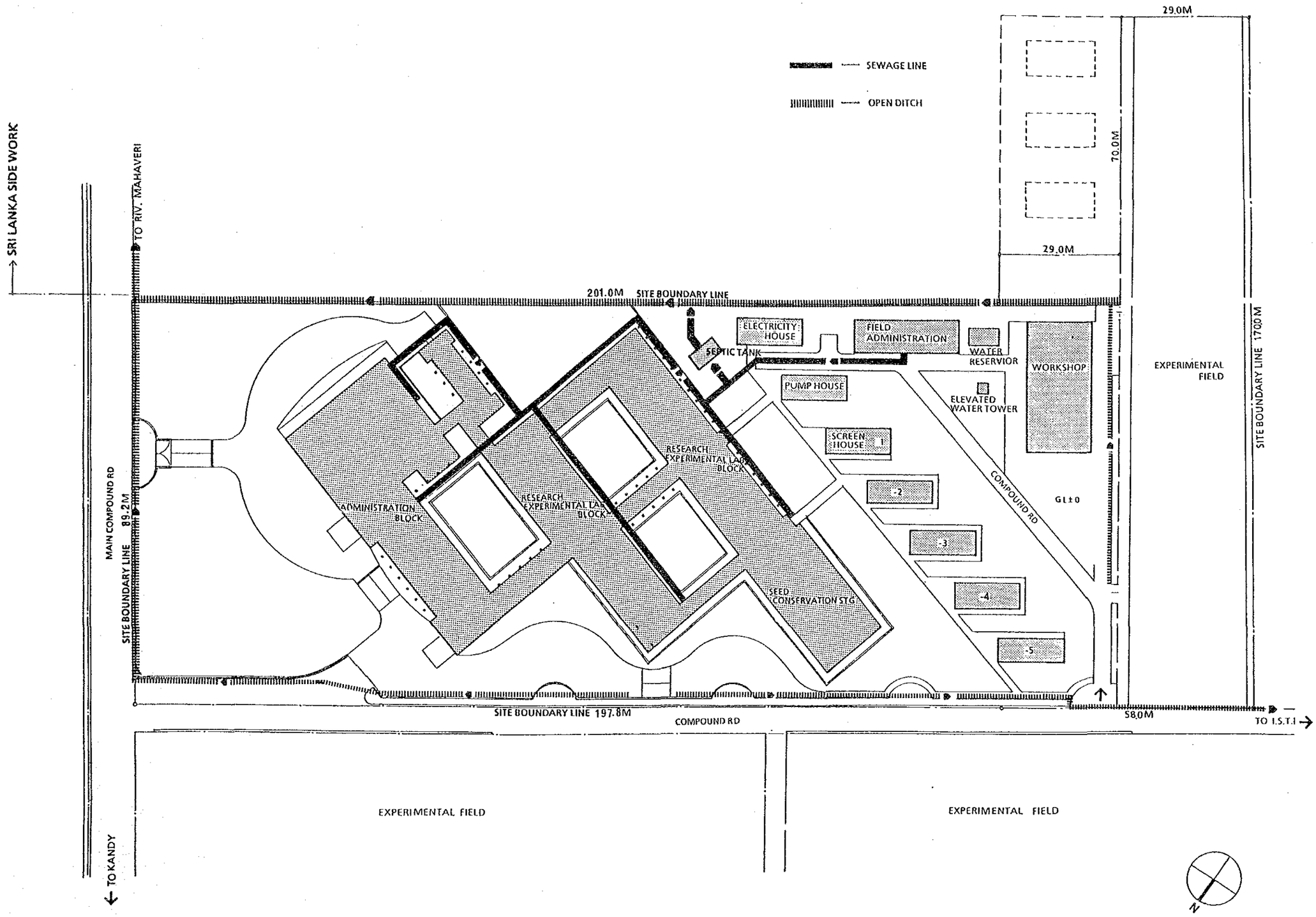

DRAINAGE SYSTEM

0 10 20 30M

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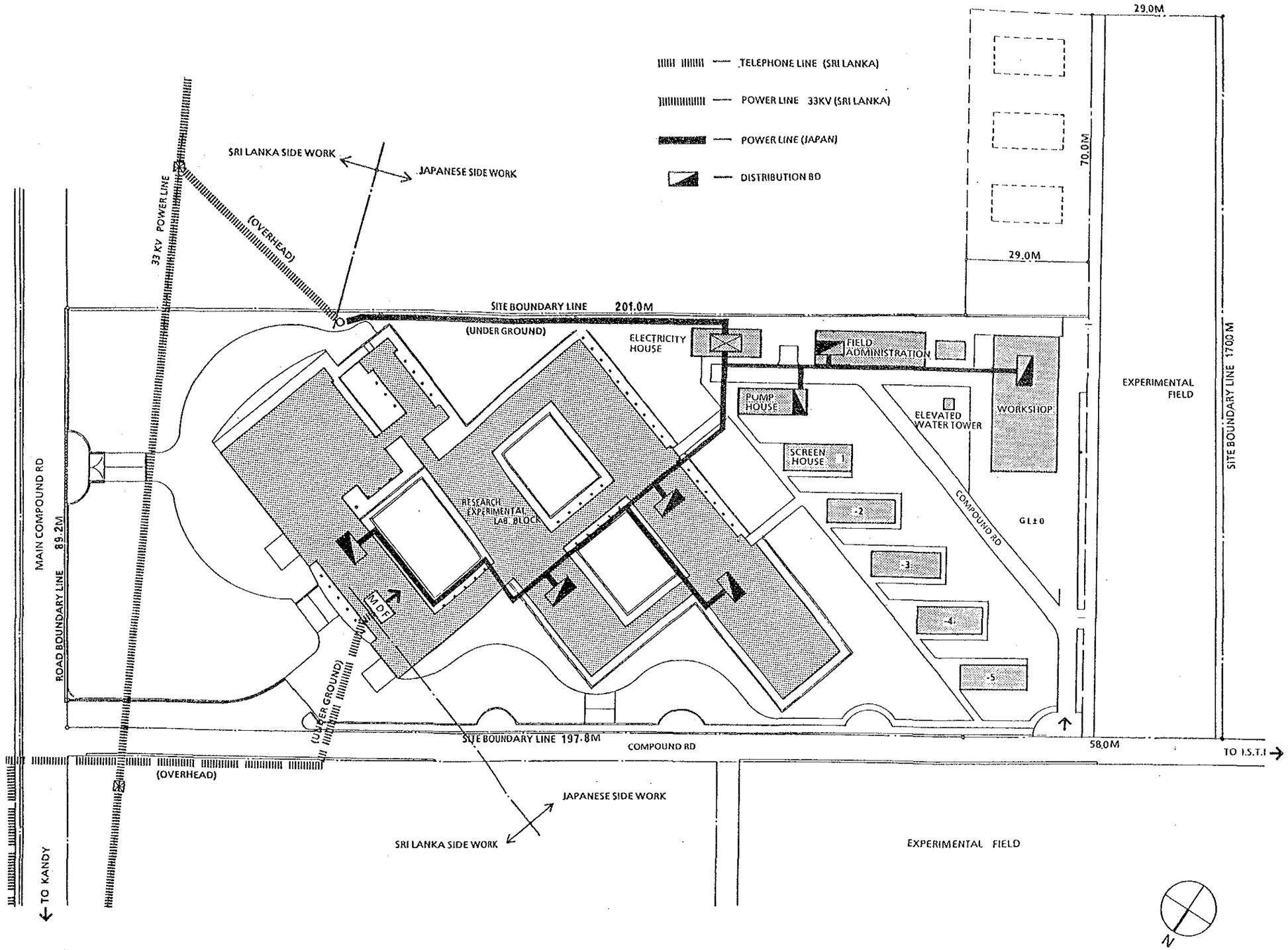

ELECTRICAL AND TELEPHONE SYSTEM

0 10 20 30M

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4-3-4 Equipment planning

Equipment selection was carried out under the following basic policies upon a full understanding of the function and role of each equipment and upon consultation with the officers concerned of the executing agency of the Government of the Democratic Socialist Republic of Sri Lanka.

(1) Since the scope of research activities of this Centre is the preservation of plant genetic resources and basic studies relevant thereto , the equipment to be provided shall be suitable for said research objectives.

(2) For the preservation of plant genetic resources, not only seed preservation but biotechnology such as tissue culture for clonal preservation but biotechnology such as tissue culture for clonal preservation must be effectively utilized, and the equipment shall be selected with due consideration to such future advances in research capabilities of this field.

(3) To minimize maintenance and operating costs, equipment of the energy saving type and of simple mechanism shall be selected. Also, joint utilization of laboratory equipment shall be considered so long as their joint use will not hamper research activities.

(4) The equipment and apparatus and their specifications shall be of the level which can be fully utilized and thoroughly maintained by the Sri Lankan researchers.

Equipment List

1. Laboratory for Seed Storage

Description		Q'ty	Spec. & Remarks
1.1 Storage			
(1) Long-term Storage			
1) Seed Containing Can	o	75,000	50ϕ X 40mm Seeds of one variety divided into 3 sub-lots, bagged, and stored 25,000 X 3 = 75,000 Extra 25,000 cans in reserve.
2) Can Container	*	25,000	60ϕ X 150mm, plastic 1 container (for three aluminium cans) per 1 variety
3) Case	*	750	300 X 450 X 500mm SUS 35 containers per case.
4) Trestle	*	1	25,000/35 = 714 Extra 36 containers in reserve.
(2) Medium-term Storage			
1) Seed Container (Small)	o	25,000	100 X 100 X 150mm, poly-ethylene plastic 1 for each variety
2) Seed Envelope (Small)		75,000	25 X 75 X 120mm Aluminum Seeds of one variety divided into 3 sub-lots and bagged. 25,000 X 3 = 75,000 Twice as many provided in view of replacement needs due to germination test, etc.
3) Case	*	21,000	300 X 450 X 50mm SUS 12 containers/case 25,000/12 = 2,083 Extra 17 in reserve.
4) Silica Gel	o	2,500 litre	0.1ℓ container 25,000 X 0.1 = 2,500
5) Trestle	*	1	1.5 m
(3) Short-term Storage			
1) Seed Container (Large)	o	1,500	240 X 240 X 400mm poly-ethylene plastic 10 varieties (20 bags) stored in one container. 15,000/10 = 1,500
2) Seed Envelope (Large)	o	30,000	40 X 75 X 200mm Aluminum Seeds of 1 variety divided into 2 sub-lots and bagged. 15,000 X 2 = 30,000 Three times as many provided in view of replacement needs due to germination tests, etc.
3) Silica Gel	o	750 litre	0.5ℓ/container 15,000 X 0.5 = 750
4) Storage Shelf	*	60	900W X 450D X 1,800H Steel Six Section
5) Trestle	*	1	1.5m

Description		Q'ty	Spec. & Remarks
1.2 & 1.3 Seed Inspection & Germination Test Room			
1) Germinator (Large)	o	2	400ℓ
2) Germinator (Small)	o	1	200ℓ
3) Tray for Germination Test	o	1,000	150 X 75 X 30mm, Plastic 100 samples tested for germination per day. 10 days necessary for one test.
4) Sieve Set (Medium)	o	2	ϕ200mm
5) Mirror Plate	*	2	
6) Enlarger Scope	*	1	
7) Infra-red Grain Moisture Meter	o	2	
8) Grain Moisture Meter (Portable Type)	o	2	
9) Grain Moisture Meter (Labo.Type)	o	1	
10) Grain Volume Measurer	*	1	
11) Seed Pan, Plastic	o	100	Handles 100 samples or so per day.
Steel	o	100	
12) Grain Micrometer	*	2	
13) Drying Oven	o	1	150ℓ
14) Stereo Microscope	o	1	7 X 30 X
15) Aluminium Can with Cover (Weighing Can)	*	50	
16) Seed Counter	o	1	
17) Grain Sample Divider	*	1	
18) Double Beam Balance	o	1	2,000g/0.1g
19) Table Balance	o	2	200g/200mg
20) Drying Rack	o	1	
21) Labo Cart	o	1	
22) Experiment worktable	*	2	with outlet 3,000L x 1,500W
23) Chair for Experiment	*	6	Stool type
24) Equipment shelf	*	2	Steel Upper shelf plate: 2 tiers. Lower shelf plate: 1 tier, plus 1 tier of drawers. 1,200W x 400/500D x 1,800H 1,800W x 400/500D x 1,800H

Description		Q'ty	Spec. & Remarks
1.4 & 1.5 Seed Drying & Packing Room			
1) Seed Finishing Dryer (Large)	o	2	for 200 ℓ Installation work necessary
2) Seed Finishing Dryer (Small)	o	1	for 500 ℓ Installation work necessary
3) Vacuum Canning Machine	o	1	
4) Vacuum Sealer for Aluminum Evaporated Envelope	o	2	
5) Moisture Meter (Labo. type)	o	2	
6) Seed Pan, Plastic	o	500	Assume 200 lines or so being dried per day. Stand-by unit to be con-
Steel	o	500	sidered as a few days may be necessary for drying.
7) Seed Cloth Bag	*	5,000	2ℓ Temporary storage in cloth bags to prevent mixing up different seeds. To preserve 25,000 sample seeds, seeds of about 5,000 lines would have to be handled every year.
8) Labeling Set	o	2	
9) Top-pan Balance (Small)	o	2	2,000g/5g
10) Table Balance	o	2	200g/200mg
11) Labo Cart	o	1	with lift
12) Working table	*	1	with outlet
13) Chair	*	3	Stool type
14) Equipment Shelf	*	2	Upper shelf plate: 2 tiers, lower shelf plate: 1 tier, plus 1 tier of drawers.

2. Vegetatively Propagated Plants Labo.

Description		Q'ty	Spec. & Remarks
2.1 Sterilizing Room			
1) Drying Sterilizer (Small)	o	1	100ℓ
2) " (Large)	o	1	300ℓ
3) Autoclave (Large)	o	1	50ℓ
4) Water Bath	o	1	30ℓ
5) Water Bath with Shaker	o	1	20ℓ
6) Electronic Oven	o	1	
7) Auto Still (Large)	o	1	10ℓ/hr
8) Sterilization Can	o	5	ϕ150 X 200mm, SUS
2.2 Medium Preparation & Experiment Room			
1) Clean Bench	o	2	Class 10, Horizontal Installation work necessary.
2) Draft Chamber	o	1	2,000mm width Installation work necessary.
3) Analytical Precision Balance with Table	o	1	200g/0.1mg
4) Electrical Top-pan Balance	o	2	3,000g/10mg
5) Tube Mixer	*	1	
6) Magnetic Stirrer with Hot Plate	o	1	Max 300°C
7) Magnetic Stirrer with Cold Plate	o	1	0 - 60°C
8) Auto Dispensor	o	1	5 - 100mℓ
9) Filter Holder	o	2	
10) PH Meter (Labo. Type)	o	1	
11) Salinity Meter	o	1	
12) Drying Rack	o	1	
13) Drying Rack for Beaker	*	1	
14) Ultra Sonic Cleaner	o	1	
15) Culture Flask Shaking Incubator (Rotating Type)	o	1	40 x 250mℓ flasks
16) " (Reciprocating Type)	o	1	
17) Sieve Set (Small)	o	1	ϕ200mm
18) Labeling Set	o	1	

Description		Q'ty	Spec. & Remarks
19) Freezer for Chemicals	o	1	500ℓ
20) Inverted Microscope with Photomicrographic Attachment	o	1	
21) Stereo Microscope	o	1	7X - 30X
22) Loop Cinerator	*	2	800°C
23) Haemacytometer	o	1	
24) Colony Counter	o	1	
25) Shelf for Chemicals	o	1	
26) Labo Cart	o	2	w/plug socket, gas, water, sink
27) Experiment work table	*	2	w/shelf in the centre 3,000L x 1,500W
2.3 Storage for Cultured Tissue			
1) Shelf with Fluoresence Light	*	20	1 unit capable of preserving 50 lines or so. Preservation of 1,000 lines aimed for in the immediate future.

3. Laboratory for Data Management

Description		Q'ty	Spec. & Remarks
1) Personal Computer with Display & Printer	o	1	20MB
2) Software for Data Processing & Analysis with Graphic Function	o	2	
3) Data Card Filing Cabinet	*	1 set	1 large cabinet can store 1,300 A-4 files. 1 small cabinet can store 650 A-4 files.
4) Data Filing Cabinet (Large)	o	12	
5) Data Filing Cabinet (Small)	o	14	1,300 x 12 + 650 x 12 = 24,700 About 25,000 files can be stored.
6) Desk for computer	*	2	Steel, with Printer Desk
7) Chair	*	2	

4. Laboratory for Exploration and Collection

Description		Q'ty	Spec. & Remarks
1) Camping Set	o	1	
2) Altimeter	o	2	
3) PH Meter (Portable Type)	o	2	
4) Clinometer	o	2	
5) Seed Pan, Plastic	o	100	Handles 100 samples or so per day.
6) Seive Set (Steel Medium)	o o	100 2	ϕ200mm
7) Mirror Plate	*	2	
8) Grain Micrometer	*	2	
9) Grain Moisture Meter (Portable Type)	o	2	
10) Portable Weather Instrument Set	*	1	
11) Standard Soil Color Charts	o	2	
12) Ice Box	*	2	40ℓ
13) Camera	o	1	w/single, close-up phographing lens
14) Double Beam Balance	o	1	2,000g/0.1g
15) Table Balance	o	2	200g/200mg
16) Rack for Herbarium	*	5	
17) Rack for Seed Speciment	*	1 set	for 10,000 Containers
18) Measuring Tape	*	2	
19) Refrigerater for Sample Seed	o	1	450ℓ
20) Labo Cart	o	1	
21) Station wagon for Exploration & Collection	o	2	4WD
22) Experiment Worktable	*	2	with plug socket, gas, sink
23) Chair	*	6	Stool Type
24) Equipment Shelf	*	2	Upper shelf plate: 2 tiers, Lower shelf plate: 1 tier, plus 1 tier of drawers

5. Laboratory for Evaluation

Description		Q'ty	Spec. & Remarks
1) Salinity Meter	o	1	
2) Tension Meter	*	2	
3) Soil Moisture Meter	o	1	
4) Straw Fracture Tester	*	1	
5) Lux Meter	o	1	
6) Chlorophyll Meter	*	1	
7) Leaf Area Meter	o	1	
8) Planimeter	o	1	
9) Porometer	o	1	
10) PH Meter (Portable Type)	o	2	
11) Grain Moisture Meter(Portable)	o	1	
12) Insect Reading Box	*	5	
13) Hand Sprayer	*	5	
14) Soil Colour Chart	o	2	
15) Digital Hygrometer	o	1	
16) Infra-red Thermometer	o	1	
17) Test Rice Husker	*	1	Rubber-roll type
18) Test Rice Mill	*	1	
19) Seed Pan, Plastic	o	50	
20) Vacuum Emasculator	o	1	
21) Magnetic Stirrer (Small)	o	1	5ℓ.
22) Centrifuge (Handle type)	o	1	
23) Oven	o	1	150ℓ
24) Table Balance	o	2	500g/200mg
25) Shelf for Chemicals	*	1	500ℓ
26) Refrigerater for Chemicals	o	1	
27) Drying Rack	o	1	
28) Labo Cart	o	1	
29) Experiment Worktable	*	2	with plug socket, gas, sink 3,000L x 1,500W

Description		Q'ty	Spec. & Remarks
30) Chair	*	6	Stool Type
31) Equipment Shelf	*	2	Upper shelf plate: 2 tiers, Lower shelf plate: 1 tier, plus 1 tier of drawers

6. Laboratory for Visiting Scientists

Description		Q'ty	Spec. & Remarks
1) Deep Freezer	o	1	300ℓ
2) Auto Mortar Grindar	o	1	
3) Magnetic Stirrer (Large)	o	1	10ℓ
4) Centrifuge	o	1	
5) PH Meter (Labo. Type)	o	1	
6) Micro Hammer Cutter Mill	o	1	6,000 rpm
7) Hot Plate	o	1	250°C
8) Rotary Evaporator	o	1	
9) Oven	o	2	150 ℓ
10) Vacuum Oven	*	1	10 ℓ
11) Vacuum Pump	o	1	
12) Autoclave (Small)	o	1	20 ℓ
13) Draft Chamber	o	1	2,000m width
14) Kjeldahl Apparatus Set	o	1	
15) Soxhelt's Apparatus Set	*	1	
16) Electrophoresis Apparatus Set for isozyme with Power Supply	o	2	Cooled, multi-purpose type
17) Amino Acid Hydrolysis Tube with Vacuum Apparatus	*	1	
18) Amino Acid Analyzer	o	1	
19) Ultra Sonic Cleaner	o	1	10 ℓ
20) Table Balance	o	2	200g/200mg
21) Centrifuge Tube Balance	*	1	
22) Freezer	o	1	300 ℓ
23) Auto Still (Small)	o	1	5ℓ/hr
24) Shelf for chemicals	o	1	
25) Drying Rack	o	1	
26) Drying Rack for Beaker	*	1	
27) Labo Cart	o	1	
28) Experiment Worktable	*	2	with plug socket, gas, sink w/centre shelf 3,000L x 1,500W

Description		Q'ty	Spec. & Remarks
29) Chair	*	6	Stool Type
30) Equipment Shelf	*	2	Upper shelf plate: 2 tiers, Lower shelf plate: 1 tier, plus 1 tier of drawers

7. Common Facilities

Description		Q'ty	Spec. & Remarks
7.1 Room for Balance			
1) Analytical Presicion Balance with Table	o	1	200g/0.1mg
2) Electrical Top-pan Balance with Table	o	2	300g/0.01g
3) Electrical Top-pan Balance	o	2	300g/0.1g
4) Chair	*	5	Stool Type 1,800L x 400/500D x 1,800H
5) Equipment Shelf	*	3	1,800L x 400/500D x 1,800H
7.2 Room for Microscope			
1) Stereo Microscope	o	2	7X - 30X
2) Student Microscope	o	2	4X - 1,000X
3) Bio-microscope with Photo-micrographic Attachment	o	1	40X - 1,500X
4) Table for Microscope	o	1	
5) Chair	*	5	1,800L x 400/500D x 1,800H
6) Equipment Shelf	*	3	1,800L x 400/500D x 1,800H
7.3 Room for Microscopic Sample Preparation			
1) Microtome	o	1	Sliding-type
2) Automatic Tissue Processor	*	1	Rotating-type
3) Paraffin Oven	*	1	
4) Paraffin Warming Plate	o	1	
5) "L" Mould with Plate	o	1	
6) Staining Vessel	*	10	
7) Fume Hood	*	1	
8) Experiment Worktable	*	1	with plug socket, gas, sink
9) Chair	*	2	Stool Type
10) Equipment Shelf	*	3	1,800L x 500/500D x 1,800H
7.4 Room for Incubator			
1) Low Temp. Incubator	o	2	250 ℓ
2) Growth Chamber	o	1	$1m^2$ X 1.5m

Description		Q'ty	Spec. & Remarks
3) Rotary Incubator	*	2	for 400 test tubes
7.5 Dark Room			
1) Development & Printing Set for Black & White Film	o	1	30ℓ
2) Equipment Shelf	*	3	1,800L x 400/500D x 1,800H
7.6 Meteorology			
1) Weather Instrument Screen	o	1	
2) Hygro-Thermograph	o	1	
3) Combination Anemometer	o	1	
4) Recording Raingauge	o	1	
5) Sunshine Gauge	o	1	
6) Actinograph	o	1	
7.7 Laboratory Glassware and Miscellaneous 1 unit			

8. Facilities for Administration

Description		Q'ty	Spec. & Remarks
8.1 Administrative Office			
1) Copying Machine	o	1	B6 - A3
2) Printing Machine	o	1	
3) Type-writer	o	2	English
4) Word Processor	o	1	English
5) Book Binding Apparatus	*	1	
8.2 Seminar Rooms			
1) Slide Projector (Large)	o	1	
2) Overhead Projector	o	1	
3) Stand for Projector	o	2	
4) Video Camera Set	o	1	
5) Video Television Set	o	1	
6) Slide Projector (Small)	*	1	
7) Stereo Cassette Recorder	o	1	
8.3 Conference Room			
1) Projector (16mm)	o	1	
2) Slide Projector	o	1	
3) OHP	o	1	
4) Casset Tape Recorder	o	1	
5) Amplifier for Speaker	o	1	
6) Speaker	o	2	
7) Microphone	o	2	
8) Stand for Microphone	o	1	Desk Type
9) Stand for Microphone	o	1	Floor Type
10) Wireless Amplifier	o	1	
11) Wireless Anntena	o	1	
12) Wireless Microphone	o	1	

Description		Q'ty	Spec. & Remarks
8.4 Library			
1) Book Shelf	*	3	1,800L x 400/500D x 1,800H
2) Reading Desk	*	2	1,800L x 1,200W
3) Chair	*	12	
8.5 Exposition			
1) Display Case	o	7	Wall hang type 5, table type 2

9. Work Shop

Description		Q'ty	Spec. & Remarks
9.1 Seed Processing			
1) Seed Dryer	o	1	for 36 samples
2) Miniture Thresher for paddy	*	2	
3) Hand Maize Thresher	*	2	
4) Dockage Tester	o	1	
5) Aspirator for Seed Selection	o	2	1.2ℓ
6) Awn Remover	*	1	500 kg/hr
7) Sieve Set (Large)	*	2	∅400mm
8) Seed Drying Tray (Large)	*	50	Vinyl chloride For preliminary drying prior to finish drying.
9) " (Small)	*	100	Vinyl chloride Assume 100 lines per day
10) Grain Moisture Meter (Portable Type)	o	2	
11) Grain Moisture Meter (Labo. Type)	o	1	
12) Seed Collecting Thresher	*	1	500 rpm
13) Top Pan Balance (Large)	o	2	20kg/100g
14) Platform Scale	o	1	100kg/200g
15) Seed Cloth Bag	*	5,000	2ℓ Temporary storage in cloth bag to prevent mixing up different seeds. To preserve 25,000 seed samples, seeds of about 5,000 lines would have to be handled every year.
9.2 Agri. Machinery for Field Work			
1) Tractor	o	1	25HP
2) Attachments for Tractor	o	1 set	Plow, Harrow, Chiesel, Trailor
3) Hand Tractor	o	1	10HP
4) Attachment for Hand Tractor	o	1 set	Rorary plow, Plow Trailor
5) Maintenance Tools Set	o	1	
6) Woodwork Tools Set	o	1	
7) Handsprayer (Large)	o	2	12ℓ
8) Sprinkler Set	o	1	Movable, Installation work necessary Main pipe 250m
9) Work bench for workshop	o	3	3,000L x 1,500W

Description		Q'ty	Spec. & Remarks
9.3 Fumigation			
1) Gas Detector (A)	*	1	Kitagawa-type
2) Gas Detector (B)	*	1	Mackinly-type
3) Gas Inspector	*	1	
4) Fumigation Chamber	*	1	$1m^3$
5) Gas Mask	*	3	All face covering
9.4 Net Houses			
1) Culture Pot for Paddy Large	*	500	100 pots per green house
Small	*	500	100 pots per green house
2) Culture Pot for Upland Crop Large	*	500	100 pots per green house
Medium	*	500	100 pots per green house
Small	*	500	100 pots per green house
3) Hand Sprayer (Small)	o	5	10ℓ
4) Hydro-Thermograph	o	5	
5) Hydro-Thermometer	o	5	
6) Cart for Culture Pot	*	5	50ℓ
7) Soil Mixer	*	1	
8) Insect Screen	*	10	16μ mesh 910mm x 30m

4-4 Project Implementation Plan

4-4-1 Arrangements for project implementation

1) Project executing body

The competent agency responsible for the execution of this project on the part of the Government of the Democratic Socialist Republic of Sri Lanka is the Department of Agriculture.

The Department of External Resources of the Ministry of Finance and Planning, handles the matters related to bilateral agreements.

2) Consultant

The Japanese consultant shall perform the following duties.

a. Detailed design

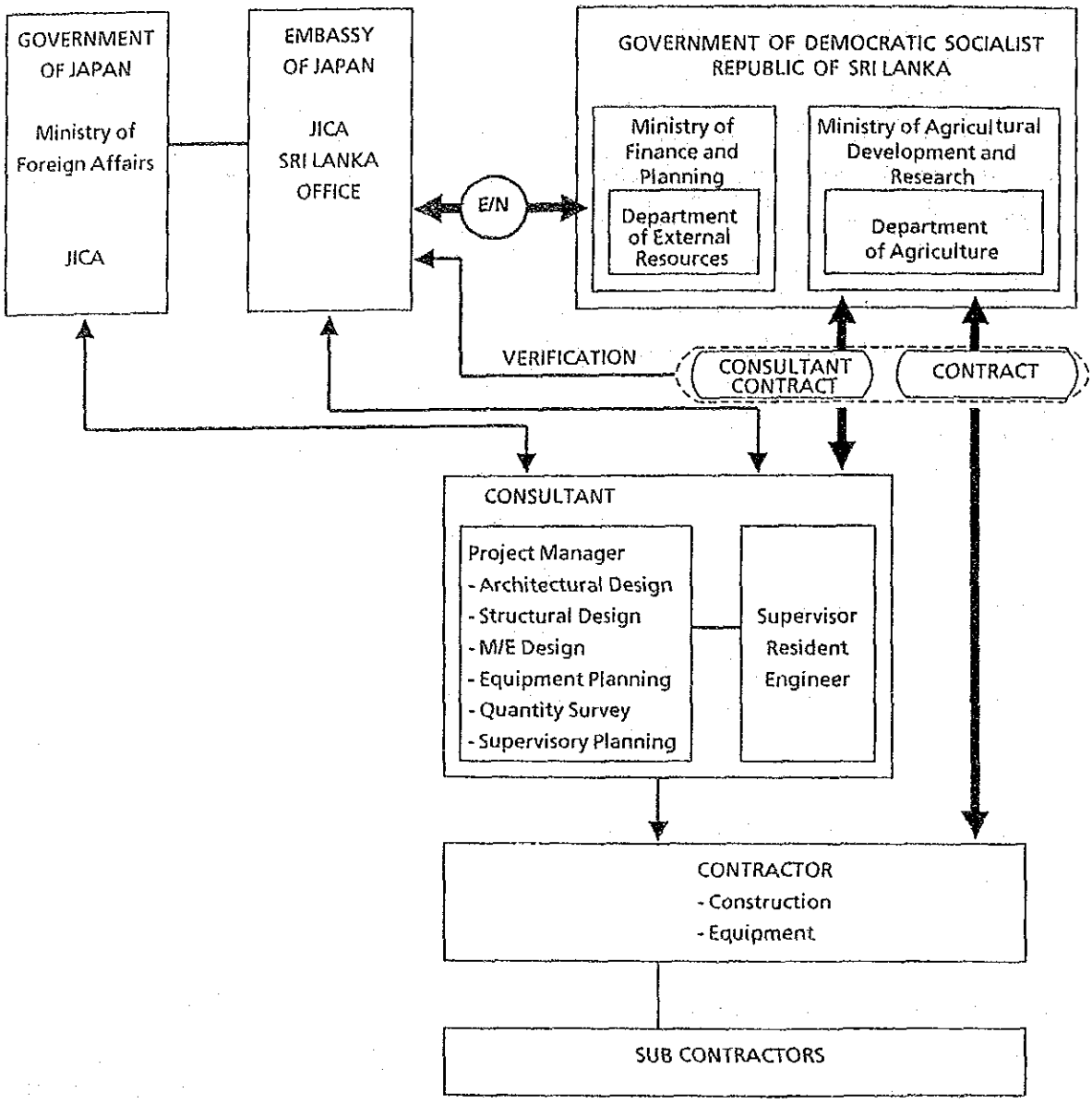
b. Execution of tendering and contracting procedures on behalf of the Sri Lankan Government

c. Construction supervision and management

3) Contractor

In accordance with the grant aid system of the Government of Japan, the Japanese contractor selected by open tender shall execute the construction work of facilities and supply the equipment. The constructor shall fully understand the mechanisms of the grant-in-aid cooperation system and shall be particularly careful to complete the work within the predetermined period.

Fig. 4-12 Project Executing Organization



4-4-2 Scope of work

The scope of work to be undertaken by the Government of Japan as grant-in-aid cooperation and by the Government of the Democratic Socialist Republic of Sri Lanka shall be considered as follows in so far as the establishment of this Centre is concerned.

1. Portions to be undertaken by the Government of Japan

-1 Provision of buildings

1) Laboratory Buildings
2) Administration Building
3) Screen Houses
4) Workshop Building
5) Field Management Building
6) Utilities Building

-2 Infrastructure facilities work

1) Water supply facilities (onsite)
2) Drainage and aseptic tank facilities
3) Power receiving and transforming facilities (onsite)
4) Telephone exchange facilities

-3 Exterior works

1) Onsite road
2) Exterior lamps

-4 Provision of research and experiment equipment and apparatus

-5 Others

1) Transportation of construction materials and equipment from Japan to the construction site in Sri Lanka
2) Consultancy services

2. Portions to be undertaken by the Government of Sri Lanka

1) In relation to site and exterior works:
   1. Securing of land and its clearing
   2. Land scaping work (Turfing and planting)
   3. Relocation of telephone wiring
   4. Construction of gate and fence
   5. Relocation of bus stop

2) In relation to infrastructure facilities

Leading-in work of electricity and telephone:

Securing of a drainage canal leading out of the site

3) In relation to fixtures and furnishings:

Fixtures, furnishings and furnitures outside the scope of work to be undertaken by the Japanese side

4) Formalities and procedural matters.

a) Bearing of various expenses

* Expenses associated with bank arrangements
* Expenses for import tax to be imposed upon the construction equipment, materials and experimental equipment which shall be brought into Sri Lanka

b) Prompt action concerning customs clearance

c) Arrangements for exemption of customs duty, domestic taxes and other public charges on the Japanese nationals who shall be involved in the implementation of the project based on the verified contract

d) Provision of conveniences to said Japanese nationals concerning their entry and stay in Sri Lanka for the purpose of performing their duties

e) Assignment of staff necessary for the operation and administration of this Project to be based on an elaborate staff assignment plan.

4-4-3 Work execution and supervision planning

4-4-3-1 General circumstances surrounding the construction industry

Construction sites of foreign construction companies, equipped with steel scaffold, steel support and even tower crane can be seen in Colombo and its vicinity where many large scale construction works are in progress lately, but mere generally, the traditional external scaffold made of bamboo and wooden support are used.

There are companies which lease heavy construction equipment of all sorts but most of the equipment are old and tend to frequently break down so that their operating rate is quite unsatisfactory.

The levels of technology and materials for the whole range of work from structural work to finishing are still underdeveloped. In concrete placement work, for example, concrete mixing cars are sometimes seen lately, but the more common method is to mix concrete on a batch mixer by the volumetric measurement method, hand deliver the mixed concrete and place it manually.

In form work, the condition is such that if work is to be done by using plywood form, the plywood would have to be procured first from overseas.

1) Execution system

Sri Lanka's system is based on the principle of democratic socialism, and government ministries has public corporations and agencies to execute the works under its respective jurisdiction such as Buildings Department, State Engineering Corporation etc. Therefore, the big public works had been monopolized by the public corporations and agencies, with most of them carrying out all work from project development to design supervision, equipment procurement to construction execution. Because of this, the fostering of private construction contractors, as a result, has not made much progress. The actual situation so far has been that most of the private construction

contractors were handled like the subcontractors who supplied the laborers.

Subcontractors in the construction industry are not specialized like the subcontractors in Japan. Each subcontractor executes all sorts of work. However, since the capability of these contractors cannot be claimed to be sufficient, every kind of work has to be split and subcontracted to a number of subcontractors if the scale of construction work is large.

2) Construction laborers

Local laborers are abundant but there is no subcontractor who has on hand technical workers in various specialized fields. The situation is such that the one who has worked as a reinforcement man yesterday may be working as a form carpenter today. their level of technical competence is therefore low.

Also, the local engineers and laborers who have been trained at the construction sites of foreign construction companies and who have thereby acquired the new technical knowhow almost always, upon completion of work at these sites, leave the country in search of higher paying new jobs in Singapore, the Middle East and other places. This vicious cycle has been repeated through the years.

(1) Ability to manage materials and labor

The method of subletting the necessary quantity of tools for pit excavation and plastering to the subcontractor and of letting that subcontractor control them is often employed, but the ratio of loss and damage is extremely high. The subcontractors should be given detailed guidance and the tools should be checked more closely. The subcontractors exercise their own control over the labors so that there is no particular problem as far as labor control is concerned.

(2) Ability to control quality and working steps

The subcontractors' managerial ability cannot be trusted sufficiently so that guidance by Japanese staff is indispensable. With proper guidance and systematic assignment, however, they should be able to control the quality of work and the work schedule sufficiently.

(3) Other technical ability

On the whole, the number of skilled technical workers is small, and the number of skilled technical workers with a complete set of working tools and implements is very few. Considerable improvement in the required skill would be attainable with proper guidance by Japanese supervisors and other means, but because it is difficult for the subcontractors to retain them after completion of work, their skill acquired with much trouble is seldom utililzed in the next work, and it is difficult to sound them up when they are needed.

3) Matters that require considerations

(1) Unseasonable weather

Normally, July through September and December through February are the dry seasons, but unseasonable weather frequently prevails lately, which must be taken into full consideration in scheduling the working steps.

(2) Shortage of skilled workers

As the number of skilled workers available locally is small, it would be necessary to dispatch supervisors from Japan to provide the local workers with adequate technical guidance and also to split each type of work among a multiple number of companies to alleviate the burden on each company.

(3) Unstable supply of locally procured materials

In order to secure a stable supply of sand and crushed stone, plants shall be preferrably owned by the executing company.

4-4-3-2 Execution planning

As the construction contractor must, upon a full grasp of the significance and mechanisms of the grant-in-aid cooperation project of the Government of Japan, complete the work within a single fiscal year, in principle, the consultant and the contractor shall closely examine the sequential steps of work execution prior to launching on construction and work out a detailed work sequencing plan and the scheme of execution particularly with due regard to:

1) natural conditions,
2) labor conditions and technical competence,
3) scope of work to be undertaken by each country,
4) timing for conjoining infrastructure facilities,
5) schedule for procurement of construction materials and equipment Japan, delivery to construction site, execution of construction and installation works, and
6) test operation of equipment and apparatus.

At the same time the Sri Lankan side shall see that, prior to executing the construction work under this project, the aforementioned in 4-4-2 works and procedural matters will be carried out without fail by them smoothly and shall prepare a detailed implementation plan to the aforesaid effect.

4-4-3-3 Execution supervision and management plan

In accordance with the policy of the Government of Japan with respect to the grant-in-aid cooperation, the consultant shall organize a project execution team to be responsible for the detailed design work and execution supervision throughout the project period in line with the intent of the parties concerned and aim for successful completion of the facilities.

In the stage of execution supervision and management, the consultant shall appoint a resident field supervisor with proper technical competence from among the members of said execution team and dispatch him to the construction site of this project, who shall provide guidance on the

construction work and act as a liaison man. In addition, the consultant shall dispatch specialized engineers for a short period as required in keeping with the progress of work, for inspection, eye-witnessing, and provision of guidance on the method of execution.

1) Policies for execution supervision and management

The consultant shall:

* aim for the successful completion of the facilities according to the construction schedule without delay by maintaining close contact with and reporting to the officers in charge of related government authorities of both countries,
* give preference to the employment of local construction methods using the locally available construction materials and equipment as much as possible with a view to develop the local construction materials and equipment industries of Sri Lanka,
* provide pertinent advice and guidance on maintenance and upkeep of the facilities so that the recipient upon completion and delivery of the facilities, shall be able to smoothly operate the facilities.

2) Execution supervision and management duties

(1) Cooperation with respect to the construction contract:
Determination of the form of construction contract, preparation of the draft construction contract, investigation of the details of itemized work specifications, selection of the construction contractor (pre-screening of the qualifications of tenders, announcement of tender, tendering and evaluation of tenders, contract negotiation, witnessing of the signing of contract)

(2) Inspection and approval of working diagrams and the like:
Inspection and approval of working diagrams, execution schemes, samples of materials and finishing, materials and apparatus for utilities submitted by the contractor.

(3) Guidance on construction work:
Review of and instructing the contractor on the work plan and work schedule.

(4) Progress reporting:
Reporting on the progress of construction work to the orderer.

(5) Cooperation in the processing of approval for payment:
Cooperation in reviewing the details of bills etc. to be paid as remuneration during and after the completion of work, and processing of same.

(6) Presence at time of inspection
Inspection of each interim form of the facilities during their construction since commencement to completion.

The consultant shall witness the delivery of the object of contract upon verifying the completion of work and the fulfillment of the terms and conditions of the contract, and with the issuance of the certificate of acceptance by the order, his supervisory work shall have been completed. The consultant shall report the necessary matters concerning the status of progress during construction of this Centre, payment procedure, completion of work and delivery to the concerned authorities of the Government of Japan.

4-4-4 Procurement of construction materials and equipment

In principle, procurement of locally available construction materials and equipment shall be given preference as much as possible. Also, adequate considerations shall be given to the construction period, supply capacity, durability, quality, workability, cost, and ease of maintenance. Based on the results of the survey of local construction materials conducted at the time of the basic design survey, procurement of construction materials and equipment to be used in the construction of this Centre shall be planned as follows.

Material or equipment	Procurement in		Remark
	Sri Lanka	Japan and the third countries	
For building construction:			Periodic supply is questionable, because of that the cement mill in Twincomaly has stopped operating, the use of locally produced cement for structure poses some difficulty in shortening the construction period because it is slow in manifesting the initial strength.
Cement:			
for framework	-	o	
for finishing	o	-	

Material or equipment	Procurement in		Remark
	Sri Lanka	Japan and the third countries	
Sand	o	-	River sand in the catchment basin of the Mahaweli River will be used. It runs short of supply, however, at time of flooding during the rainy season.
Gravel	o	-	Crushed mountain rock will be used.
Reinforcing bar	-	o	As Sri Lanka depends on imports, bars made in Japan will be used.
Steel frame	-	o	Same as above
Forms & panels	-	o	Plywood forms and panels not produced locally
Concrete block	o	-	Light-weight block is unavailable but no particular problem is seen. Will be used for partitioning walls.

Material or equipment	Procurement in		Remark
	Sri Lanka	Japan and the third countries	
Brick	o	-	Sun-dried bricks mainly. Unusable for face finishing. Some problem in procurement during rainy season. Will be used for partitioning walls.
Stone	o	-	Supply capacity somewhat limited but considered important as the best raw material available.
Terrazzo tile	o	-	Few in variety and small in tip stone size but popular as flooring material locally. Durability and workability considered good.
Ceramic tile	o	-	Manufactured by a public corporation. Few in number and type of products.

Material or equipment	Procurement in		Remark
	Sri Lanka	Japan and the third countries	
Plywood	-	o	Questionable quality. Local product is expensive.
Asbestos slate	-	o	Same as above
Lumber	-	*	Supply availability questionable as felling is restricted at present. Difficult to obtain well seasoned and dried lumber.
Metal sashes	-	o	Not manufactured locally
Wooden sashes	-	*	In terms of process, procurement of wood and manufacturing are difficult.
Metal fixtures/ Hardware	-	o	Problems in quality and available varieties
Glass	o	o	Depend on size and thickness
Paints	o	-	High priced but local products must be used

Material or equipment	Procurement in		Remark
	Sri Lanka	Japan and the third countries	
			because of future maintenance needs.
Asphalt water proofing	-	o	Working experience inadequate as only simple water proofing has been done.
Corrugated asbesstoss slate	o	-	No problem both in quality and available quantity
Roof tile	o	-	Brittle as the baking temperature is low, but it is the traditional roofing material in Sri Lanka
Furniture	o	o	Depend on quality, usage and manufacturing term.

Material or equipment	Procurement in		Remark
	Sri Lanka	Japan and the third countries	
For utilities work & plumbing:			
Vinyl pipe	-	o	Not manufactured locally. Locally available pipes too thin in wall thickness and not strong.
Steel pipe	-	o	Cast iron pipe questionable in accuracy
Valve, pipe fittings Pump	- o	o -	Large dispersion in quality and accuracy. Procurement and maintenance is available.
Sanitary fixture (China)	-	o	Pose problems in maintenance as pipe jointing section being inaccurate.
Air conditioner	-	o	Not manufactured locally.

Material or equipment	Procurement in		Remark
	Sri Lanka	Japan and the third countries	
For electrical work:			
Transformer	-	o	Not manufactured locally.
Power board	-	o	"
Telephone exchange	-	o	"
Wires and cables	-	o	"
Lighting fixture	-	o	"
Electric appliances	-	o	"

*: indicate the materials from the third country.

2) Laboratory equipment

Laboratory equipment shall be procured from Japan as a rule.

However, it is considered preferable to procure the following equipment in Sri Lanka depending on the supply of expendables, maintenance service and other conditions.

* Copying machine
* Computer
* Word processor

Procurement from third countries is not planned.

Since many of the equipment are weak against impact, humidity and high temperature, adequate cars is needed in packing and transporting them. Particularly, a mode of packing which is highly resistant to moisture is planned for some equipment in order to cope with transport in hot and humid tropical zone.

4-4-5 Project implementation schedule

In the event that establishment of this Centre is to be effected under the grant-in-aid cooperation of the Government of Japan, after signing of the official notes to be exchanged between the two governments (E/N) and conclusion of the consultancy agreement, the construction of the facilities and the installation of equipment shall be carried out in three stages of totalling 24 months, namely, 4 months for preparation of detailed design documents, 2 months for tendering and construction contracting procedures, and 18 months for the execution of construction work and equipment work.

1) Detailed design work

The contract documents shall be prepared on the basis of the basic design. The documents consist of detailed design drawings, specifications, calculation sheets, and cost estimation, in which the margin of error by comparison to the basic design shall be held within 10%. At each necessary time during the detail designing stage, the consultant shall discuss details with the authorities concerned of the Sri Lankan side, and shall proceed to the next stage, tendering, only after obtaining the approval of the Sri Lankan side on the final contract documents. The period of time required for the detailed design work is estimated to be four months.

2) Tendering

Upon completion of detailed design, prequalification (P/Q) of eligible tenderers through public announcement shall be carried out in Japan, according to which results the executing agency of the Sri Lankan side shall invite the eligible contractors to participate in the tender, and the tenders submitted shall be opened in Japan. At the time of opening the tenders, the officer in charge of executing this project on the Sri Lankan side is anticipated to be present as the witness.

The contractor who submits the lowest quotation in the public competitive tender shall conclude the contract with the executing agency of the

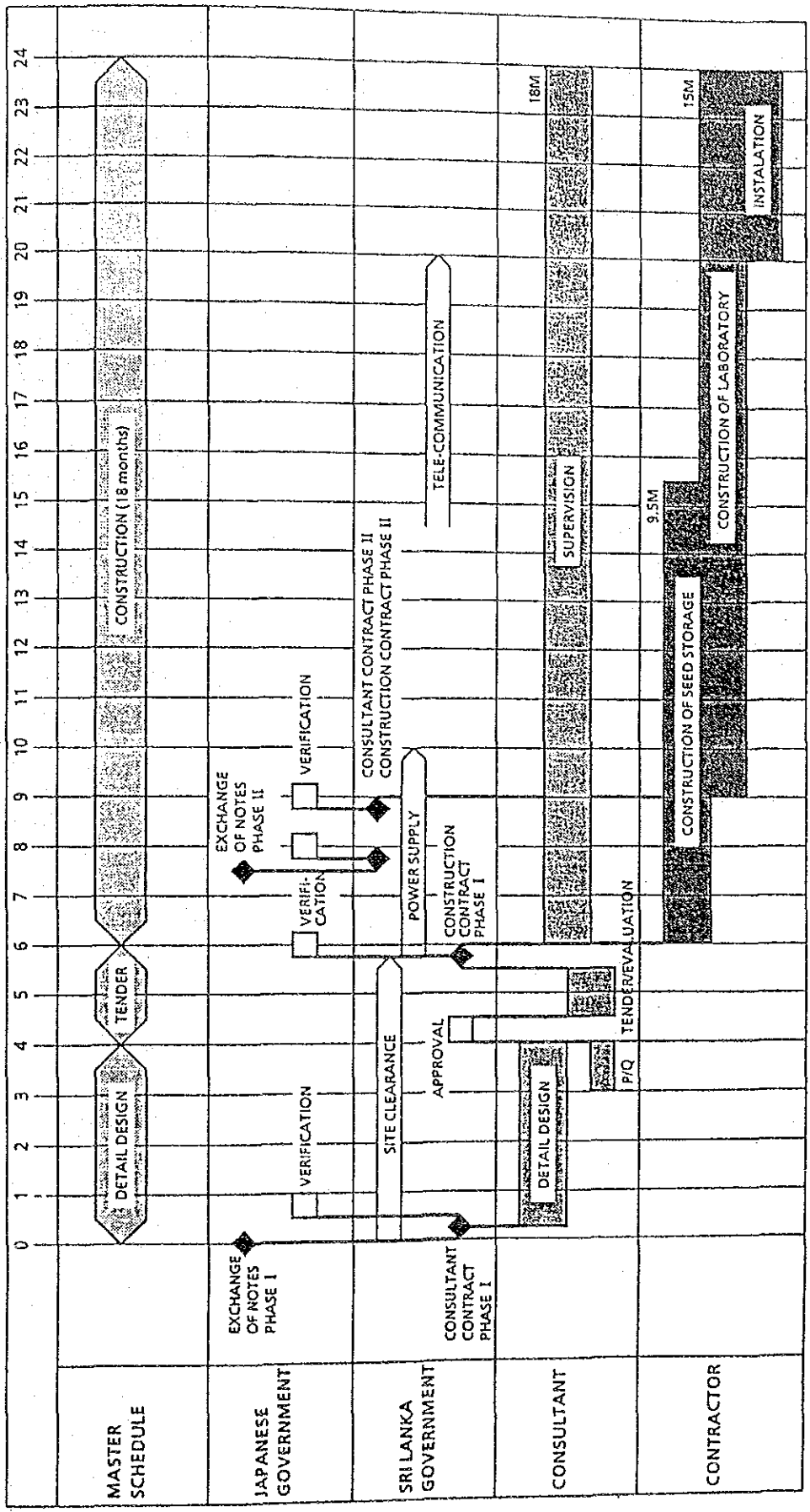
Sri Lankan side. the period of time required for tendering and contracting procedures is estimated to be two months.

3) Construction and equipment work

The construction work shall be started after the signing of the contract and verification thereof by the Government of Japan.

Judging from the scale and description of the facilities of this Centre, the period required for the construction of this Centre is estimated to be approximately 18 months, provided that procurement of the construction materials and equipment will proceed smoothly and the works to be undertaken by the Government of the Democratic Socialist Republic of Sri Lanka will be executed satisfactorily.

Executing Schedule



4-5 Probable Construction Cost for the Sri Lankan Side Work

Construction of the centre consists of the work to be undertaken by the Government of Sri Lanka and the one to be undertaken by the Government of Japan.

Probable construction cost for the Sri Lankan side work as classified in Chapter 4 is estimated as follows; (expenditure for the item 4-4-2 2.4) are excluded.)

1.	Site clearance	Rs. 10,000.-
2.	Electricity-supply wiring 33 KV line, Aerial 50 metre	Rs. 100,000.-
3.	Telephone cable laying Wiring underground 3 lines	Rs. 60,000.-
4.	Relocation of telephone line	Rs. 150,000.-
5.	Relocation of Bus stop	Rs. 50,000.-
6.	Gate and fence work length of fence 500 metre	Rs. 250,000.-
7.	Drainage pipe laying from the site to Mahaweli River 350ϕ x 70 metre	Rs. 70,000.-
8.	Landscaping turfing 720m^2 and planting	Rs. 1,010,000.-
9.	Furniture and utensile	Rs. 1,200,000.-
1-9 Total		Rs. 2,900,000.-

CHAPTER 5
MAINTENANCE PLAN

CHAPTER 5 MAINTENANCE PLAN

5-1 Arrangement for Maintenance of Facilities and Equipment

As the purpose of facilities to be constructed under this project is to preserve plant genetic resources semipermanently and safely, it must be guaranteed that utilities, mechanical systems and equipment to maintain the function of said facilities will be kept in good working conditions without any trouble.

Along with the provision of facilities and equipment under this project, the Government of Japan is also considering to extend technical cooperation, but a plan and a system which will enable the Sri Lankan side to maintain the facilities and equipment by themselves even after the termination of technical cooperation must be established.

In principle, the Administrations Division of this Centre shall be responsible for maintenance of all facilities, except for maintenance of power supply facilities which shall be the responsibility of the Kandy Branch of the Ceylon Electricity Board, and that of the telephone system, of the Kandy Branch of Telecommunication Department.

So far, repair and maintenance services for public installations have been provided by the Government Factory and the Department of Buildings besides the above named offices, but these services are gradually being consigned to private enterprises in view of the promptness and quality of their services.

In the maintenance system of this Centre, existing CARI has the manpower and the workshop for maintenance and repair of equipment so that their cooperation in this regard can be counted on; but for repairs and maintenance of utilities and mechanical systems of each buildings, it is necessary that full time technician and operators of electrical facilities be stationed within the Centre at all times.

Utilities and mechanical systems technically too advanced or difficult to maintain and repair locally will not be installed, but in order that

the maintenance staff of this Centre may acquire a better understanding of the utilities and mechanical systems of this Centre and be able to maintain them even after they have been entrusted in their care, it is advisable that they be present during their installation work at the time of constructing this Centre.

For maintenance and upkeep of equipment which will be installed at this Centre, each staff assigned according to the staff assignment plan described in Paragraph 3-3-1-4, shall undertake his share of work under his respective supervisor who shall be responsible for the maintenance of each equipment assigned under his care.

5-1-1 Local circumstances relevant to maintenance

The following describes the technical level and contents of services of the maintenance function of the Central Agricultural Research Institute (CARI) and of the private workshops related to utilities, mechanical systems and equipment located mostly in Kandy.

(1) Maintenance workshop of CARI

Carries out repair and mending of refrigerator, air conditioner, simple laboratory equipment, motor, etc. Capable of repairing electronic circuits of precision instruments with simple transistors. However, it has difficulty in repairing circuits of I.C., L.S.I. and the like.

There is no problem with the knowledge and technical skill of the technical staff to repair various basic mechanical systems but because of the difficulty in acquiring spare parts, they are frequently precluded from putting their skill to use. Particularly because most of the laboratory equipment are made by manufacturers who have no local agent, acquisition of the necessary parts is practically impossible.

(2) Colombo Commercial Co., Ltd., Kandy Branch

Kandy Branch is mainly engaged in repair and fabrication of machinery for black tea factories. It has such machinery as lathe, grinder, milling machine, drilling machine, and employs about 15 mechanics. It is capable of manufacturing such generator parts as piston ring, iron ring and iron bar from iron and steel materials and also repairing them. Electrical machinery and appliances are sent to its main office in Colombo for repair.

(3) Walker Sons and Co., Ltd., Kandy Branch

Its main business lines are: (1) repair and mending of refrigerator, freezer, small air conditioning unit, (2) repair and mending of motor, (3) repair, mending and fabrication of machinery for black tea factories, (4) sale of electrical appliances (radio, refrigerator, plug socket for lamp, etc.) and sanitary ware (made in Italy). Its workshop has casting machine, lathe, grinder, milling machine, coil winder for motor, foundry for press machine and other equipment.

It can repair almost any kind of ordinary refrigerators and freezers for the home, including repair of refrigerant piping and injection of gas. Just for reference, it can repair a 22 kW motor in about a week at 3,000 rupees.

(4) Browns Co., Ltd., Kandy Branch

It mainly handles sale and repair of power control panel, electrical machinery and appliance, and steel products. Like Colombo Commercial, it is mainly engaged in repair of machinery for black tea factories.

(5) UAHA Agent Co., Ltd.

It is a shop specialized in sale and repair of refrigerators and freezers. The shop has three employees. The level of its repairing skill is high. It is even capable of replacing and repairing locally made radiators and expansion valves made in Denmark.

(6) On physical and chemical apparatus

TECAP(PVT) Ltd. is an agent representing several Japanese makers but it is actually only a sales shop which can be counted on for spare parts supply services, but not for equipment repair.

(7) On copying machine and computer

Every Japanese manufacturer of copying machine is making aggressive efforts to sell its products. In Colombo, the Metropolitan Agencies Co., Ltd. is the influential representative. The company has branch offices at numerous places including Kandy and undertakes repair and maintenance.

A few American and European computer manufacturers have local subsidiaries and agents in Colombo and are training operators and engineers, but computers have to be sent to Colombo for repair.

Based on the conditions described above, it is concluded that technically, there will be no problem in maintaining the project facilities in Sri Lanka except some special ones as long as the necessary spare parts and expendables for the mechanical systems and equipment can be supplied locally.

Accordingly, it is considered necessary to select the equipment and apparatus for which the necessary parts can be locally procured and to design the utilities and mechanical systems by giving preferential considerations to the manufacturers who have local agents. In the event that equipment and apparatus which cannot meet for these requirements must be selected, it would be necessary to the provision of spare parts in advance in accordance with the serviceable life of each equipment, apparatus or their component.

It is needless to say that the maintenance and administration expenses to renew these equipment and apparatus and purchase parts as necessary must be secured on a priority basis.

5-1-2 Maintenance work on facilities

For maintenance of utilities and mechanical systems of buildings, the following items must be checked routinely by the stationing technicians and staff.

Utilities and mechanical systems of buildings		Matters to be checked	Interval
Substation facilities	Equipment	1. Condition of fixing 2. Crack, damage, rust, heating, abnormal sound or condition of wiring connection 3. Damage or wear of operating mechanism, lubricants, working conditions 4. Overall working test	Within one year
		5. Withstand voltage test of insulating oil	Within 6 years
	Accessory meters	Set values and working of alarm contact point	Within one year
	Protective relays	Characteristic test	Within one year
Stand-by generator facilities	Equipment and accessories	1. Working condition	Within one month (at all times if considered to be a power plant)

Utilities and mechanical systems of buildings		Matters to be checked	Interval
Stand-by generator facilities	Equipment and accessories	2. Condition of fixing	Within 6 months
		3. Crack, damage, wear, rust, abnormal heat, abnormal noise, abnormal vibration, condition or wiring connection	Within 6 months
		4. Leakage of oil, water and air 5. Confirmation of the quality and quantity of lubricating oil 6. Adhesion of dust or deposite on radiator	
		7. Overall operating test	Within one year
	Accessory meters	Approprietenes of set values	Within 6 months
	Protective device and alarm system	1. Working conditions	Within 6 months

Utilities and mechanical systems of buildings		Matters to be checked	Interval
Stand-by generator facilities	Protective device and alarm system	2. Working condition of alarm contacts when equipment and accessories are in operation 3. Characteristic test	Within one year
Lighting and power supply facilities	Apparatus for lighting and power supply	1. Damage in rust, heating or abnormal noise inside the panel and condition of wiring connection	Within one year
		2. Working condition	
		3. Performance test of protective devices	
		4. Damage, rust or heating of exterior lighting fixtures and wiring	
	Main line	1. Damage, rust or heating	Within one year
		2. Damage, rust and mounting condition of supporting structures	

Utilities and mechanical systems of buildings		Matters to be checked	Interval
Monitoring and controlling system	Supervisory control device	1. Damage, rust, heating, and abnormal noise condition of wiring connections 2. Action of control section, display section and measuring section	Within one year Within one year
		3. Measuring of transmitting and receiving signal level and transmission characteristic test	
	Automatic recording device and terminal device	1. Acceptability of recorded values 2. Performance test of input-output device	Within one year
Direct current power supply facilities		1. Confirmation of the volume of electrolyte in the battery 2. Deformation or damage of electrode plates of battery	Within 6 months

Utilities and mechanical systems of buildings	Matters to be checked	Interval
Direct current power supply facilities	3. Acceptability of charging voltage or need for uniform charging 4. Acceptability of specific gravity and temperature of electrolyte 5. Performance test of charging device and control circuit 6. Rust, corrosion or loosening of supporting stand and fixtures	Within 6 months
	7. Test of storage battery capacity	Within one year
Onsite distribution line	1. Damage, corrosion, fitting condition, connection, separation of wiring and apparatus 2. Deformation, damage, corrosion and fitting condition of wiring supports and protective devices	Within 6 months
	3. Crack, damage or sinking of hand holes and manholes	Within one year

Utilities and mechanical systems of buildings		Matters to be checked	Interval
Onsite distribution line		4. Deformation or damage and fitting condition or metal fittings in manholes	Within one year
		5. Performance test of apparatus	
Refrige-rating system	Refrigerator proper	1. Crack, damage, wear, rust or corrosion	Within one year
		2. Inspection or refrigerant	
		3. Air tightness test	
		4. Action or combustion device and safety device	
	Control	1. Damage, rust, abnormal sound or vibration, condition of wiring connection	Within one year
		2. Overall performance test	
	Attachments	1. Damage, wear, rust, abnormal sound or vib-ration, action and performance	Within one year

Utilities and mechanical systems of buildings		Matters to be checked	Interval
	Attachments	2. Confirmation of the quantity of lubricating oil 3. Crack, damage, rust or loosening of mounting frame and fixtures	Within one year
Air conditioning system	Air conditioning and venting device	1. Damage, rust, corrosion, abnormal sound or vibration, burning condition, fitting condition, action & performance	Within one year
	Blower	1. Damage, wear, rust, heating, abnormal sound or vibration	Within one year
		2. Loosening of bearings and gearings	
	Controlling device	1. Damage, rust, heating, abnormal sound or vibration, condition of wiring connection	Within one year
		2. Action of automatic control device and protective device	

Utilities and mechanical systems of buildings		Matters to be checked	Interval
Air conditioning system	Pump	1. Damage, wear, rust, abnormal sound or vibration	Within one year
		2. Confirmation of the quanity of lubricating oil in bearings	
	Air duct accessories	1. Damage, rust, abnormal sound or vibration, fitting condition	Within one year
		2. Action of damper	
	Pipe, valve and trap	1. Damage, rust or corrosion	Within one year
		2. Action of valves and traps	
		3. Clogging of traps	
Water supply, drainage & sanitary facilities	Water supply, hot water supply, and drainage systems	1. Damage, rust, corrosion, abnormal sound or vibration	Within one year
		2. Confirmation of the quantity of lubricating oil in bearings	
		3. Performance of equipment and apparatus	

Utilities and mechanical systems of buildings		Matters to be checked	Interval
Water supply, drainage & sanitary facilities	Pipe and valve	1. Damage, rust or corrosion	Within one year
		2. Action of valves	

The periodical inspection and maintenance works for major equipment are as follows:

(Every three months)

* Replacement of filter in the pure water manufacturing system

(Every six months)

* Replacement of ion exchange resin in the pure water manufacturing system
* Changing of grease in the rotary incubator for shake culture
* Changing of grease in the reciprocating incubator for shake culture
* Making up of grease in the rotating parts of agricultural machine and implement

(Every year)

* Changing of oil in the vacuum pump
* Inspection of the light source and fuse of the measuring instruments that use light source

Besides the above, equipment that use thermostat shall be inspected at intervals of two or three years.

Note The inspection intervals indicated above are just the guidelines. Inspection intervals for the equipment which are used frequently shall be shortened according to the frequency of their use.