Table 3.2.2: Ordinary Budget of the Fisheries Division of the Ministry of Agriculture, Fisheries and Natural Resources (prior to Reorganization in November, 1993)

Category	Fiscal 1993/94	Fiscal 1992/93 (1st July - 30th June)
Personnel	30,000,000	22,600,000
Travel Expenses	2,500,010	1,500,000
Procurement	3,790,990	4,945,000
Disbursements for Fishermen's Insurance	850,000	850,000
Total (Recurrent budget)	37,141,000	29,895,000
Total Capital Budget (Fisheries Development)	9,900,000	7,000,000

As will be discussed in detail in Section 3.4, the estimated operating budget for the subject Plan will be in the order of Rs 900,000. While maintenance of the Plan facilities and equipment are to be covered out of the regular budget, routine maintenance can probably be funded from the procurement budget.

3.2.4 Related Plans:

The countries or international agencies which are implementing or planning cooperation with Mauritius in the fishery section include the World Bank, France, Canada, and Japan. The FAO/UNDP has undertaken a baseline survey on the Mauritius fishing industry but no specific projects have as yet been implemented or planned. France has dispatch expert, through ORSTOM, to provide technical cooperation in research on regional tuna resources.

The World Bank has prepared an environmental monitoring and development plan for Mauritius (on the national level), and the Mauritius Government has, in turn, drafted an Environmental Investment Plan (EIP), based on the World Bank plan. This EIP covers six fields:

1) Government institutional reinforcement
2) Effective land use and harmonization with tourism
3) Disposal of sewage, drainage, and industrial waste
4) Prevention of environmental pollution from agricultural chemicals and fertilizers
5) Marine conservation

6) Conservation of land-based life forms

Based on the EIP, the Mauritius Government has established a National Environmental Research Center to purchase various types of analytical equipment and make a start toward improving the environmental monitoring structure. However, the analytical targets at this Center are related to water and air pollution as well as agricultural chemicals and so the plan is not designed to conduct monitoring activities related to seawater and other aspects of the marine environment.

The marine conservation phase of the EIP, however, is concerned with management of the marine environment and the creation of marine parks, but the World Bank has no plans for providing direct financial assistance for their projects. However, Canada's CIDA has shown interest in both these plans and has gone so far as to conduct a survey thereon, with details of a possible cooperation.

Japan has carried out developmental cooperation programs through the dispatch of a JICA expert for aquaculture since 1989 and experts for the bank fishery through OFCF from 1991 through 1994.

3.2.5 Component of the Plan:

The subject Plan embodies two basic elements: facility construction and equipment procurement. The main items included in the facility construction phase are an Administration/Research building to provide needed space to the research and administration divisions including laboratories,offices, and a conference hall and an Annex building to house a workshop, generator room, and other auxiliary functions in support of research programs.

The equipment will comprise items required for the Marine Conservation and Aquaculture Divisions. Items for the Marine Conservation Division will include equipment for ecosystem research, chemical analysis, test equipment for bacteriology, marine observation equipment, and supporting equipment for the preceding functions, such as data processing, educational and training equipment, boats and vehicles.

The main items related to the Aquaculture Division comprise nets cages, water pumps, filtration equipment, and other equipment that is either newly required for the expanded research work at the Center or whose performance is no longer adequate to the tasks involved.

Provision of sufficient research space and supply of the requisite equipment will permit AFRC to continue effective research performance under the subject Plan. It is essential then that two phases of the plan be simultaneously implemented to insure that these project components function smoothly.

3.2.6 Consideration of the Request Items:

3.2.6.1 Building:

(1) Utilization Plan:

The original plan for the maine bldg. of AFRC envisaged sufficient space to accommodate about 11 researchers. However, the objectives were later change, and a portion of the administration areas -- the Principal Fisheries Officer (P.F.O.) room, administration office, conference room, guard room, dining room, and garage-- were diverted to research use as a data analysis room, technical staff room, and library. In this way, space was obtained to accommodate the programs of two research divisions, with a staff of 20 researcher, and the Plan is to continue the Artisanal Banks and Offshore Fishing Divisions in their present locations, since they have had a string of outstanding accomplishments since the very inception of the Center. The present Plan also calls for continuing use of the Marine Shrimp Culture Experimental Station, since this station was already fully equipped with a hatching lab, wet lab, and facilities for the supply and drainage of seawater.

Totally new facilities are planned for the Administration and Marine Conservation Divisions.

The expansion plan for the AFRC facility, including the use plan for existing facilities, is intended to eliminate the research space bottleneck which is seriously hampering the progress of research programs and to improve the research environment so as to achieve greater efficiency in the Center's research activities.

(2) Required Facility Functions:

The necessary functions include researchers' rooms for the Marine Conservation Division(MCD), which was established in 1989, administrative space included in the Administrative Division(AD), machine room, workshop and other auxiliary rooms. The primary objective of the new facilities is to strengthen R&D operations throughout the MCD. At the present time, this Division is composed of 4 research laboratories for marine ecology, marine chemistry, marine bacteria, and marine physics. It is therefore, appropriate to continue these 4 areas in their existing form. The main research themes being pursued in these sections are as follows:

1) Marine Ecological Lab (MEL):
   --- research on coral reef ecosystems, biological classification, and specimen preservation.
2) Marine Chemical Lab (MCL):
   --- chemical analysis of marine contaminants.
3) Marine Bacteriological Lab (MBL):
   --- analysis of marine pollutants, based on bacteria indices
4) Marine Physical Lab (MPL):
   --- analysis of oceanographic conditions, such ascurrents, temperature distribution, and topography

With the planned expansion of monitoring locations via the establishment in mangrove areas, it may be presumed that the research themes will also have to be broadened to include classification of plankton, plants, and spawning and growing areas. In addition, there is a major need to add socio-environmental factors to the monitoring system, and so there is a distinct trend toward a broadening of both research scope and themes.

Based on accumulation and analysis of information gathered through these studies, it is expected that this work will help to develop administrative policy guidelines from a long-term perspective, for dealing with environmental conservation and effective resource utilization in Mauritius. It is also anticipated that the AFRC will be responsible for educational programs on environmental conservation for fishermen and the general public.

(3) Room Composition:

The main rooms required for the MCD will comprise: research areas (researchers' rooms and laboratories), administrative areas (PFO's room, offices, conference hall) included in the

Administration Division; auxiliary facilities (machine room, workshop, storage areas), and common areas (entrance hall, rest rooms, utility rooms, corridors, and storage rooms). Let us now consider the rooms shown in the Request.

1) Researchers' Rooms

7 researcher rooms have been requested. In the case of the MCD, private rooms are required for 8 researchers : the Divisional Scientific Officer,Scientific Officers (4), and technical officers (3). The plan also calls for a data room, which will be used as a researcher room as being practiced in the existing facility. Thus, the number (7) shown in the Request can be considered appropriate.

Since outside researchers are often invited to reside at the facility for extended periods of time to collaborate on particular projects or provide research guidance, it will be necessary to provide rooms for these guest researchers.

With respect to laboratory areas, we have determined that individual rooms will be required for: a Marine Physical Lab, for analysis of data from natural environmental studies and for drafting work; a Marine Bacteriological Lab for bacteria culture and tests on water quality, plus a sterilization room and storage area; a Marine Ecological Lab and ecology wet lab for storage and analysis of specimens from the coral reef ecosystem; and an experimental lab, comprising a Chemical lab and a storage rooms for reagents, for testing chemical substances from water pollution studies.

2) Administration Areas

These rooms will accommodate a PFO, executive secretary, and
5 general personnel, including a receptionist. The request calls for a PFO's room, executive secretary's office, administration office, reception area, and a small conference room, which appear reasonable in terms of their functions and the staff composition. Since audio-visual equipment has also been requested for information and education purposes, we have decided that rooms will also be required for storing this equipment, editing operations, and storage of material and data.

A conference hall has also been requested. Many visitors can be expected as the Center steadily develops its educational programs for conservation of the natural environment, directed

at fishermen, the general public, and elementary and junior high school students. In addition, the AFRC hosts a number of international conferences, at which research finding are presented and opinions exchanged. But, owing to space shortages at the present facilities, these conferences have to be held at hotels. It has, therefore, been decided that space should be provided in the research center for educational and information lectures and meetings as well as gatherings of researchers from the Center .

At present, more than half of the Center employees lunch outside the facility but, since the Center is quite far from the city center, there are few appropriate eating places in the immediate vicinity. And, with transportation limited, much time is lost traveling to and from outside restaurants, while dining facilities are also required for night workers. For the above seasons, a dining room and kitchen have been included in the request.

The Team has, therefore, determined that a small dining room and kitchen should be furnished under this Plan as a welfare facility to insure adequate rest time, provide meals to night staff, and to serve coffee and light snacks during the day to researchers and visitors.

3) Auxiliary Rooms

As back-up facilities for Center programs, the Request includes a workshop, a room for diving equipment, a machinery room, and a storage room.

The workshop would perform light maintenance work and repairs on research facilities, equipment, vehicles, and machinery. We confirm that these areas are justified by the scope of activity at the Center.

The room for diving equipment would be used for compressed air operations for divers as well as for equipment storage. We agree that this room will be indispensable as a supporting facility for field surveys on coral reefs.

The request also calls for a machinery room for housing a generator to provide emergency power during power failures, a distribution board and other equipment, a storage room for materials, and rest rooms. All of these have been deemed essential as support facilities.

4) Common Areas

As common areas, the request includes an entrance hall, rest rooms, utility rooms, corridors, and a storage area. All these have been deemed essential as research support facilities.

3.2.6.2 Equipment:

The equipment items contained in the request may be classified into research equipment to expedite ecosystem and environmental research studies in the MCD and aquaculture equipment for use in the Aquaculture Division.

(1) Research equipment:

The MCD runs a continuing program of research studies on ecosystems in coral reef areas and water quality, using 8 monitoring sites along the Mauritius coast.

The requested equipment is needed to expand the performance of the present inadequate equipment in ecosystem research and water surveys and analyses at these monitoring points. The equipment comprises ecosystem research apparatus for conducting studies aimed at ecosystems in coral reefs, chemical analysis equipment for periodic chemical analysis of water quality at monitoring locations, bacterial culture and test equipment for bacteriological testing, and marine observation equipment for oceanographic survey. Also included are data processing equipment, educational and informational equipment, boats, and vehicles in support of the above activities.

Some the most important research themes at the MCD are ecological studies in coral reef areas, studies on water contaminants in and around the lagoon, marine physics studies, and data collection based on these projects. Considering the requirement for this sort of research and the need to replace certain aging equipment items, such as the research boats and vehicles,we feel that the requested items are generally appropriate.

(2) Equipment for aquaculture use:

In the Aquaculture Division, the existing Marine Shrimp Experimental Station is developing an aquaculture research for giant tiger prawn (*penaeus monodon*), silver bream (*sparus sarbu*), and red tilapia(*Tilapia nilotica*), improving aquaculture technology for giant

freshwater prawn (*Macrobrachium rosenbergii*), and developing experiments on net cage and pen culture in Barachois. The requested equipment is intended to further invigorate the AD through the provision of equipment items in short supply or items whose performance is no longer adequate, as a result of the expanding research programs. The nature of this equipment is considered to be appropriate for these purposes. However, the feed manufacturing and ozone generating equipment have been excluded from the equipment plan for the following reasons:

1) Feed manufacturing equipment

This equipment was requested for the experimental production of floating pellets for use in the red tilapia program. However the models presently on the market are still experimental in nature and so not suitable for small production runs, while considerable specialized technology would be needed for ingredient blending and equipment operation to permit a stable production program. In addition,experimental production of floating pellets is feasible to some extent using existing feed manufacturing equipment, by raising the levels of ingredient treatment and drying. For the above reasons, this equipment has been excluded from the subject Plan.

2) Ozone Generating Equipment

While the effectiveness of ozone use for in-water bacteria, viruses, and Protozoa is well-known, damage often develops in the cultured fish owing to residual ozone, and very large facilities are required to completely solve this problem. However, ultra-violet sterilizers are being incorporated in the subject plan which are capable of reducing bacteria and viruses, while Protozoa can also be eliminated by raising the filtration accuracy of secondary filtration equipment. For these reasons,we have deferred the introduction of ozone-generating equipment.

Following is a list of the facilities and equipment required for the expansion plan at AFRC, based on an examination of the request from the Mauritius Government:

1. Building Facilities:

(1) Research rooms:

1) Study rooms (7)
2) Marine physical research lab
3) Marine bacteriological lab and sterilization room
4) Marine ecological lab
5) Chemical lab
6) Data room
7) Expert's room

(2) Administration areas:

8) Administrative offices
9) Reseption
10) PFO's room
11) Secretary's office
12) Audio-visual room
13) Conference room
14) Conference hall
15) Dining room and kitchen

(3) Auxiliary space:

16) Wet lab for research on marine ecology
17) Air-compression room / room for diving equipment.
18) Generator room
19) Workshop
20) Storage room

(4) Common areas:

21) Utility room
22) Rest rooms, storage rooms, and corridors

2 Equipment:

(1) Equipment for ecological lab.
(2) Equipment for chemical lab.
(3) Equipment for bacteriological lab.
(4) Equipment for physical lab.
(5) Data processing equipment
(6) Educational and training equipment
(7) Aquaculture equipment and materials
(8) Workshop equipment
(9) Boats and vehicles
(10) Furniture and fixtures for research use

3. 2. 7 Basic Guidelines for Implementing Cooperation Aid:

The Albion district, where the ARFC is located, is about 10 km southwest of the capital, Port Louis. The environs are a quiet pastoral setting dotted with houses and sugar cane plantations. The plan site is gently sloping flatland covering an area of about 18ha. The area is deemed ample as a site for research activity, and no problems exist with respect to power, water supply, roads or other infrastructure. The site is, therefore, considered most suitable, endowed with excellent socio-geographic conditions.

The implementation body for the Plan will be the Ministry of Fisheries and Marine Resources, with facility and equipment supervision to be provided by AFRC, which is under the direct supervision of this Ministry and controls all research activity in this sector. The management structure is composed of 4 research and 1 administrative divisions reporting to a Director General. Since AFRC was established in 1982, it has accumulated considerable managerial experience, and so no particular problems are anticipated with respect to securing budgets and personnel.

AFRC has complete charge of all technical R&D areas in the fishery and marine sector and has made a major contribution to the growth of the country's marine fisheries, aquaculture development, management of fishery stocks, and conservation of the ecosystem. Pursuant to the National Development Plan, which seeks maximum utilization of fishery resources within sustainable limits while conserving marine resources and the marine environment, the Center maintains an active research program for environmental preservation, undertaking basic research studies on the social environment (population,industries) and the natural environment (meteorology and oceanography). It is expected to play a growing role in the area of environmental conservation on both the sociological and natural level, pivoted around its fishery-related research programs. These activities, moreover, are linked to educational programs for fishermen, the general public,and primary and junior high school students. In the field of tuna resource studies, the Center holds regular international conferences as the central country in the Indian Ocean region and is steadily expanding its international role as a venue for the presentation of research findings and the exchange of views and ideas. AFRC thus plays a major international role in regional fishery research.

Based on the demonstrated results, relevancy, and implementation capabilities of Mauritius, and the compatibility between the subject Plan and the principles of Japan's grant-aid program, we have determined that it would be proper to implement the plan through a grant-

aid. Accordingly, we shall now consider the Plan outline on the assumption that it will be implemented under a grant-aid from the Government of Japan.

However, with respect to the Plan contents, we have considered it appropriate to make certain modifications in the requested equipment, as already discussed during our review of the request list.

3.3 Outline of the Plan:

3.3.1 Implementing Structure:

The AFRC, under the leadership of its PFO is organized into 5 Divisions: Aquaculture, Artisanal & Bank, Marine Conservation, Offshore Fisheries, and Administration.

There are 54 researchers and staff in the organization: 15 in Aquaculture, 10 in Artisanal, 13 in Marine Conservation, and 16 in Offshore. A JICA expert is presently working with the Aquaculture Division under the technical cooperation programs.

The organization chart for AFRC is shown in Figure 3.3.1 following:

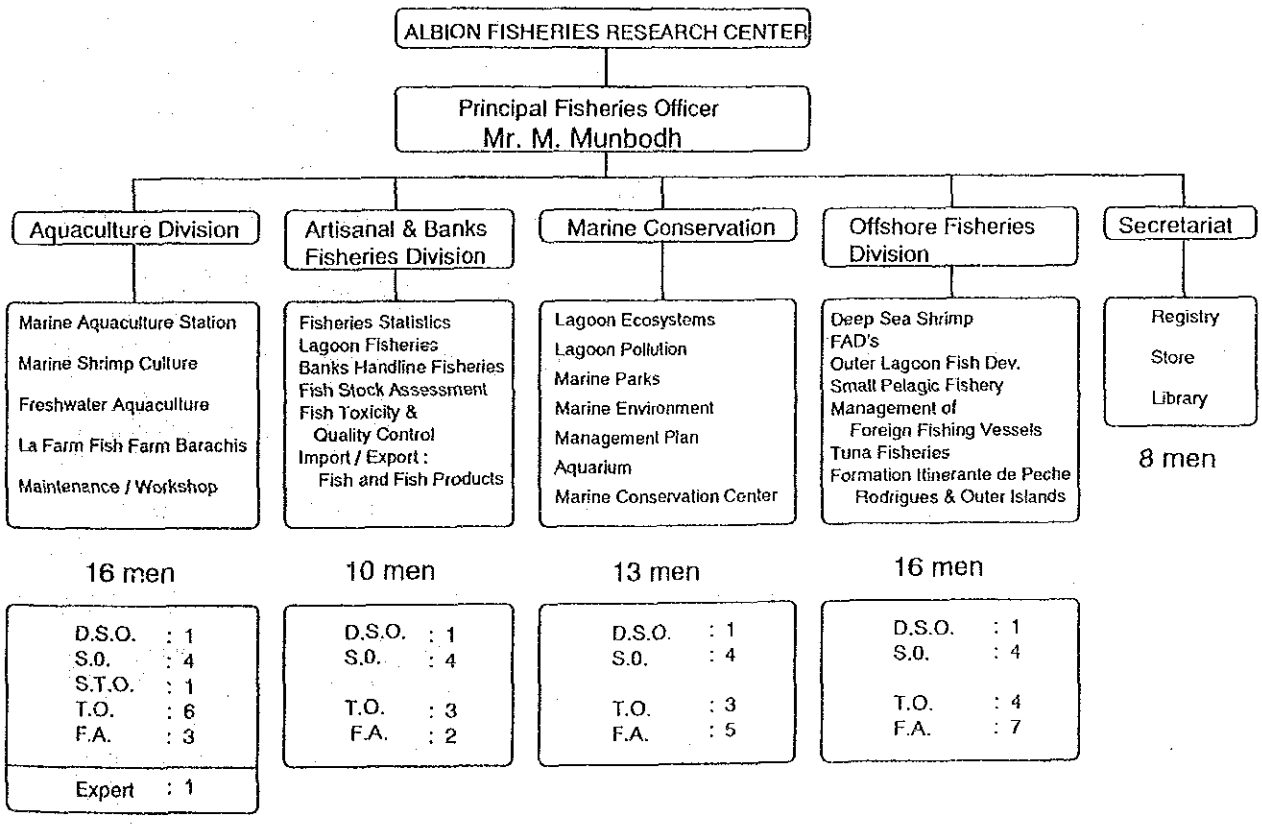


Figure 3.3.1: Organizational Chart of the AFRC

3.3.2 Description of the Plan Site:

The Plan site is located at Albion, Petite Riviere, Riviere Nord, about 10 kilometers southwest of the capital, Port Louis. The northern side of the site faces a calm sea, Petite Riviere Bay, formed by the lagoon, the back side borders the Belle Eau River, while the southern perimeter is bordered by the estuary. The longer side of the site is a sandy area running in a north-south direction. The land is flat, with a gentle slope toward the beach on the south from an elevation of 3.7 m. Owned by the Government, it has an area of about 18 ha. The center of the site contains the existing AFRC facilities. With the exception only of the dry riverbed on the east and a surrounding low-level swamp area, the remaining sections -- 1.4 ha on the southern perimeter adjoining the estuary and approximately 4 ha on the northern side -- are both usable for this Plan. The Plan site is diagrammed in Figure 3.3.2.

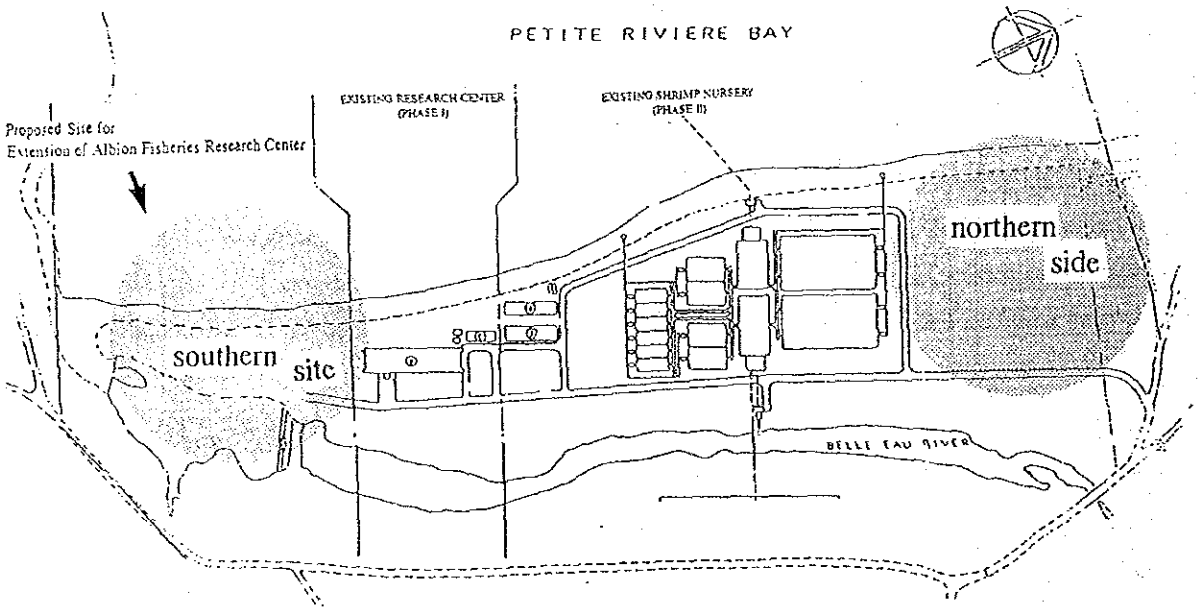


Figure 3.3.2: Map of the Plan Site

3.3.3 Examination of the Plan Scope:

3.3.3.1 Room Layouts:

The room layouts have been planned with reference to the special functions and interrelationships among the various components. The rooms in each building will be similar or related in function, posing no physical incompatibilities.

The bulk of the research rooms and administrative offices have been grouped in the same building, as they are closely related yet have very few reciprocal obstructions. However, in the case of the wet lab for the Marine Ecology Laboratory, since the research specimens to be collected are corals, this wet lab will perform only primary processing operations, such as bleaching and washing; thus the operations leaving a foul odor will be performed in the other building. As to the dining room and kitchen, included with the administrative offices, since the functions of these areas are somewhat different, it would have been difficult to place them as independent units. And since they will be used by the entire Center staff, it is desirable that they be placed in the center of the AFRC. Accordingly, we plan to relocate the entire Marine Conservation Division in the new facility and locate the dining room/kitchen area in the north operating block of the present main Fisheries Research Building, which will be vacated by the Marine Conservation Division.

The workshop, diving equipment room, generator room, storage areas, and rest rooms pose few functional incompatibilities, while the workshop must be located in the center of the facilities to make it accessible to other rooms. We plan, therefore, to place all of these rooms in the same building. In addition, since the wet lab for the Marine Ecological Lab will be an operating facility, making it functionally similar to the other rooms, it too will be placed in the same building.

Based on the above considerations, the Plan will provide for two buildings: one containing the research and administrative areas and the other housing areas with incidental functions. These two buildings are designated the Administration/Research Building" and "Annex Building", respectively.

3.3.3.2 Room Size:

The rooms for the Plan facilities will comprise: research rooms directly supporting the research project, administrative offices, and incidental areas.

Let us now consider the sizes of the rooms assigned to the Administration /Research Building, the Annex Building, and other areas.

Room sizes have been calculated in the following procedural sequence:

1. Determination of room function and the number of occupants.
2. Determination of the required equipment and fixtures.
3. Placement and operations of the required equipment and fixtures;calculation of the requisite work space.
4. Verification of the appropriateness of the floor space so calculated from the standpoint of relevant laws and regulations, standards,and comparison with similar facilities.
5. The total facility size will comprise the total room area, as calculated above, plus an allowance for common areas, such as corridors and entrance hall.
6. With respect to the experimental research areas, floor space will not only accommodate the Plan equipment but will also contain a liberal allowance for the installation of supplemental equipment in connection with future changes in research requirements.

Table 3.3.1 shows the types, functions, and occupancy of the rooms to be incorporated in the Plan facilities.

Table 3.3.1: Plan Rooms, Functions, and Occupancy

Room Designatio	No of Occupants	Functions
A. Administration Research Building:		
1) P.F.O. Office	1	A private room to be occupied by the PFO
2) Administrative Office	5	To be used as a single large room for all administrative operations
3) Secretary' room	1	A private office for the executive secretary
4) Reception	1	To greet and assist visitors
5) AV room	-	For editing operations and equipment storage
6) Conference Room	14	For small internal meetings attended by staff and research personnel
7) Study rooms (7)	1 each	Private rooms for researchers
8) Data room	2	A private room for data analysis
9) Marine Physical Lab	6	
10) Marine Bact Lab	6	Dry labs for experiments in support of
11) Marine Ecological Lab	6	research projects
12) Chemical Lab	6	
13) Expert Office	5	A large room for experts/scientists
14) Conference hall	60	For large conferences and assemblies
15) Utility room, rest rooms storage areas, corridors, waiting room, and other common areas	--	Common areas equipped to meet various objectives
B Annex Building:		
1) Wet lab for marine ecological research	4	A work area for bleaching and washing coral specimens that have been collected
2) Diving equipment room	--	A work area, equipment storage and a compressed air tank
3) Machine room	--	A machine room equipped with generator main and branch powerboards
4) Workshop	-	A work area for maintenance of equipment,vehicles, and other items
5) Storage area	-	For storage of materials and equipment
6) Rest rooms	-	Common areas, including fixtures
C. Existing Research Building:		
1) Dining room/kitchen2	4	For food service to staff

(1) Administration/Research Building:

1) P.F.O.Office

This room is planned as a private office for the P.F.O.of the AFRC. In addition to the PFO's own duties, space must also be provided for small conferences attended by up to 6 persons. Furnishings should include desks/chairs for the P.F.O., tables and chairs for conferees (6 persons), bookshelves, file cabinets, and chairs for the reception area (corner). Allowing for placement of these furnishings as well as adequate working space, the space requirement comes to 31.5 m^2. The layout plan for the P.F.O. office is shown in Figure 3.3.3.

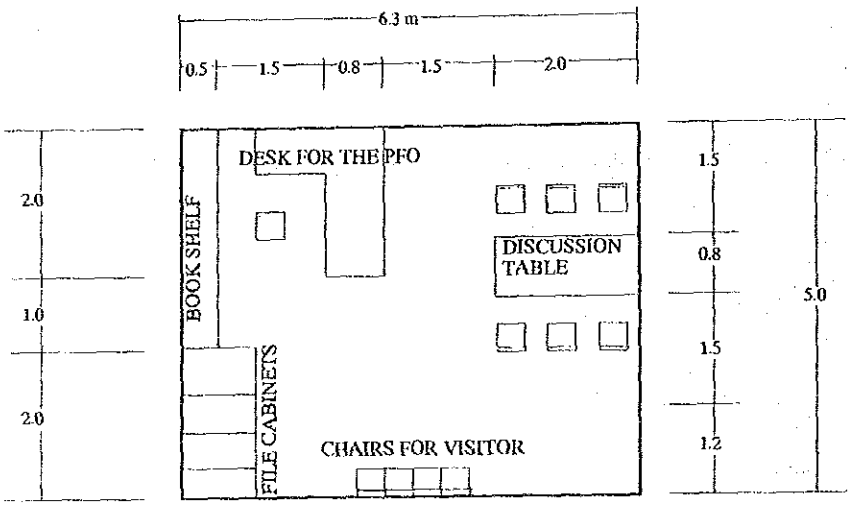


Figure 3.3.3: Layout Plan for the P.F.O. Office

2) Administrative office

This office will be occupied by the administrative staff. Space is required for administrative operations, general management, seed distribution and procurement of research materials plus a small liaison area for up to 6 people for external negotiations on labor relations and other operational matters. The room should accommodate a total of 5 office workers-- 2 in personnel and 3 in accounting. The required furnishings will include desks and chairs, a tale and chairs for meetings (of up to 6 persons), bookcase, and file cabinets. Allowing for the placement of these items and adequate work space, the area requirement comes to 36.64 m^2. The layout plan for the administration office is given in Figure 3.3.4.

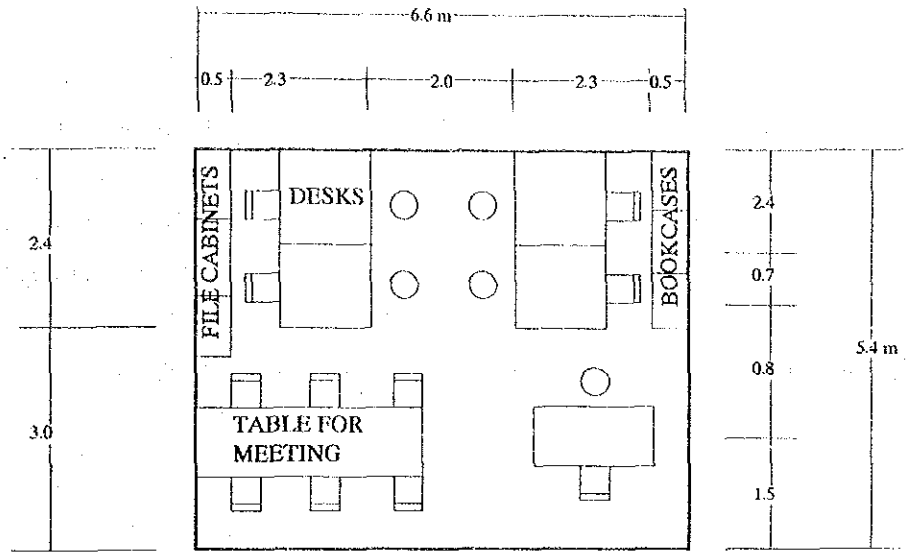


Figure 3.3.4: Layout Plan for the Administration Office

3) Executive secretary's office

This room will be the office for the executive secretary of the Administration Division, who will be in charge of personnel, education, training, and public relations, and other duties relevant to the assistant to the PFO. These functions are indispensable to the smooth running of the facility. The office will be occupied by one person, with furnishings to include a desk and chair, bookcase, file cabinet, and a chair for visitors. Allowing for placement of these items, reception space, and suitable work space, the required area has been set at 16.96m^2.

4) Reception area

This should be a small room to for greeting and directing visitors. It will be occupied by one receptionist. The required furnishes include a reception desk and chair and a reception counter. Allowing for placement of furnishings and work space, the total requirement will be 6.60m^2.

5) AV room

This room will be used to store an HOP for conference use, a video projector, editing equipment, and other AV equipment and should accommodate editing operations by 2 people plus a storage area for tapes, cassettes, and other materials. The required furnishings will include tables and chairs, materials cabinet, and equipment storage space. Allowing for placement of these items and adequate working space, the total area requirement will be 20.04m^2.

6) Conference room

This facility will be used for small meetings involving Center staff. Space must provide for such conferences along with a small area for storage of small amounts of related materials. Since the conferences anticipate attendance by both internal staff and outside technicians, we are planning on a maximum occupancy of 14 persons -- i.e., the average size of a research division. Furnishings will include 15 chairs and tables, a rack/cabinet for storage of materials, charts, and documents, and a secretarial desk and chair. Allowing for placement of these furnishings and proper work space, the total area requirement will be 57.04 m^2.

The layout for this room is shown in Figure 3.3.5

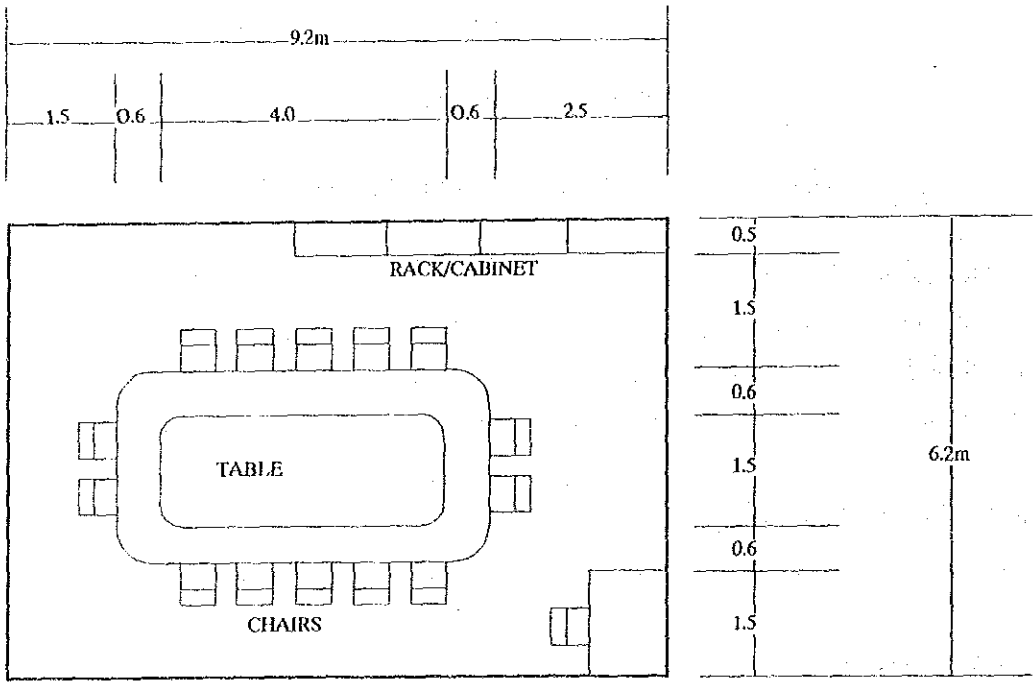


Figure 3.3.5: Layout Plan for the Conference Room

7) Research rooms (7)

A total of 7 individuals will be using this space: a Divisional Scientific Officer (DSO), 4 Scientific officers (SO) and 2 Technical Offices (TO). We have planned 7 private rooms for the senior researchers. Space will be required for research operations and a filing corner for a small volume of relevant materials. The required furnishings will include desks/chairs, bookcases, file cabinets, and chairs for liaison purposes. Allowing for the placement of these furnishings, liaison chairs, and work space, the total required area works out to 16.96 m^2. The layout plan for the research rooms is given in Figure 3.3.6

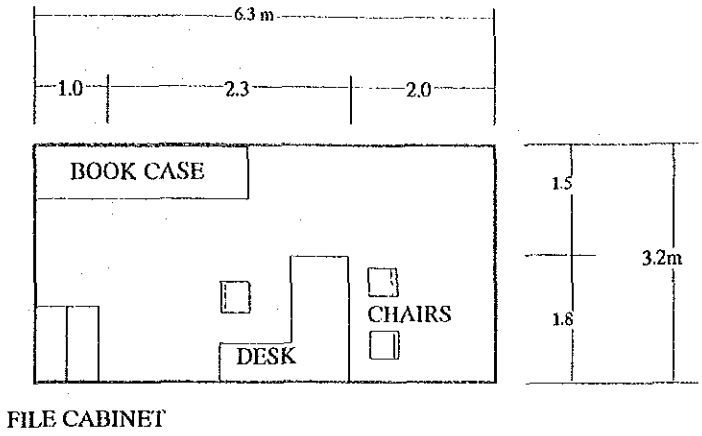


Figure 3.3.6: Layout Plan for the Senior Researchers' Rooms

8) Data room

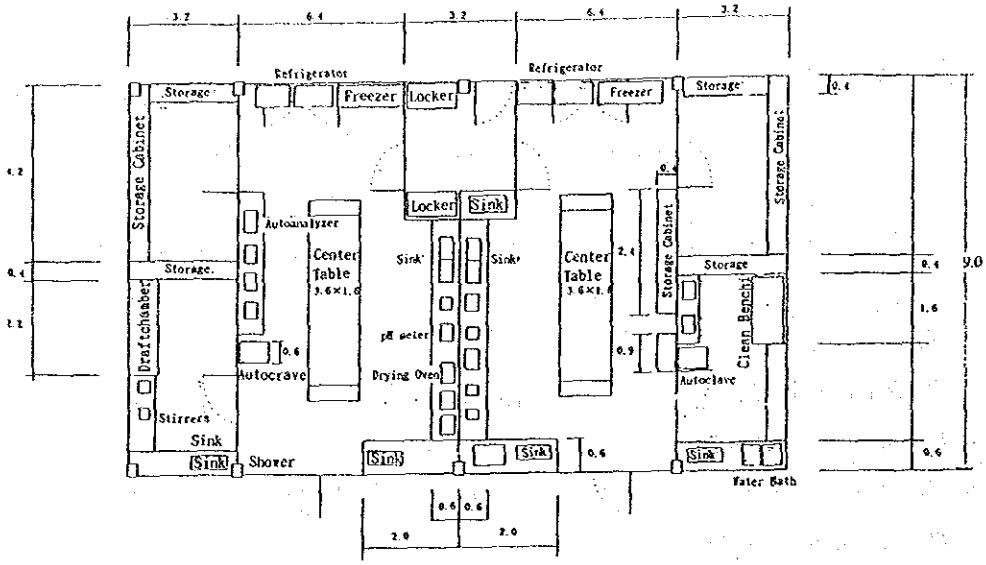
This room is intended to be used for data analysis, and so space must be provided for the installation and operation of computers and other equipment for this purpose, together with a small storage area for a limited volume of materials. The room will be planned to accommodate 2 persons-- a researcher and assistant officer. Furnishings will include a computer table and chair, file cabinet, and storage cabinet. Allowing for placement of these furnishings and proper work space, the required area becomes 16.50 m^2.

9) Experimental (dry) labs

The experimental labs, comprising a Marine Physical, Marine Bacteriological, Marine Ecological, and Chemical labs, will have to accommodate up to 6 researchers each. The total area must incorporate the required equipment layout, space for research operations, space for additional equipment that may be added in the future. In the case of the Marine Bacteriological and Chemical labs, we have also provided space for accessories, storage, and an anteroom. Common fixtures will include a central experimental table, counter for experimental equipment, and a cabinet for fixtures. The main furnishings and fixtures in the 4 labs, requiring separate space provisions, are as follows:

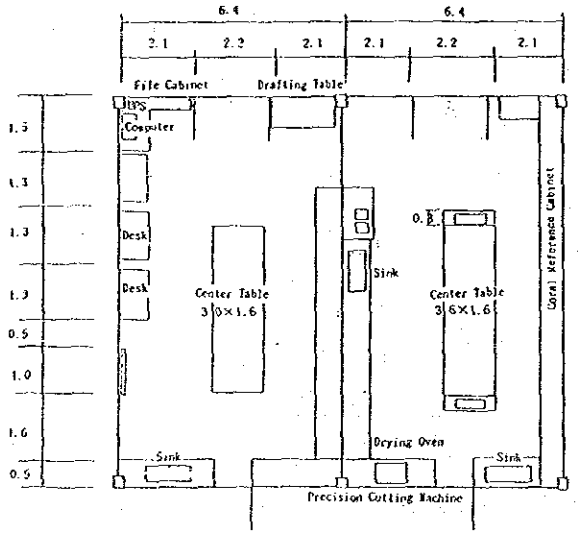
Marine Bacteriological Lab:	Clean bench, center table,refrigerator, freezer, cabinets for chemicals and apparatus
Chemical Lab:	Draft chamber, center table, autoclave, refrigerator, freezer, cabinets for chemicals and apparatus
Marine Physical Lab:	Drafting table, center table, sediment grain-size analysis equipment
Marine Ecological Lab;	Coral reference cabinet,center table

Allowing for the placement of these furnishings and work space, the total required area and the layout plan for the each labs are given in Figure 3.3.7-8



Chemical Lab: Marine (80.40m^2) Bacteriological Lab(92.40m^2)

Figure 3.3.7: Layout Plan for the Chemical Lab:: Marine Bacteriological Lab.



Physical Lab:Marine (57.60m^2) Marine Ecological Lab(57.60m^2)

Figure 3.3.8: Layout Plan for the Marine Physical Lab:Marine Ecological Lab.

10) Expert room

This room is to accommodate guest researchers, with space required for research activity and a small area for meetings of up to 6 persons. The number of guests at any one time is targeted at 5 persons, who will be invited to provide technical counsel and guidance. Furnishings should include desks and chairs, a conference table and chairs (for 6 persons), bookcase, file cabinet, and other items. With due allowance for the furnishings layout and proper work space, the required area will be 60.72 m^2. The layout for the expert room is as shown in Figure 3.3.9.

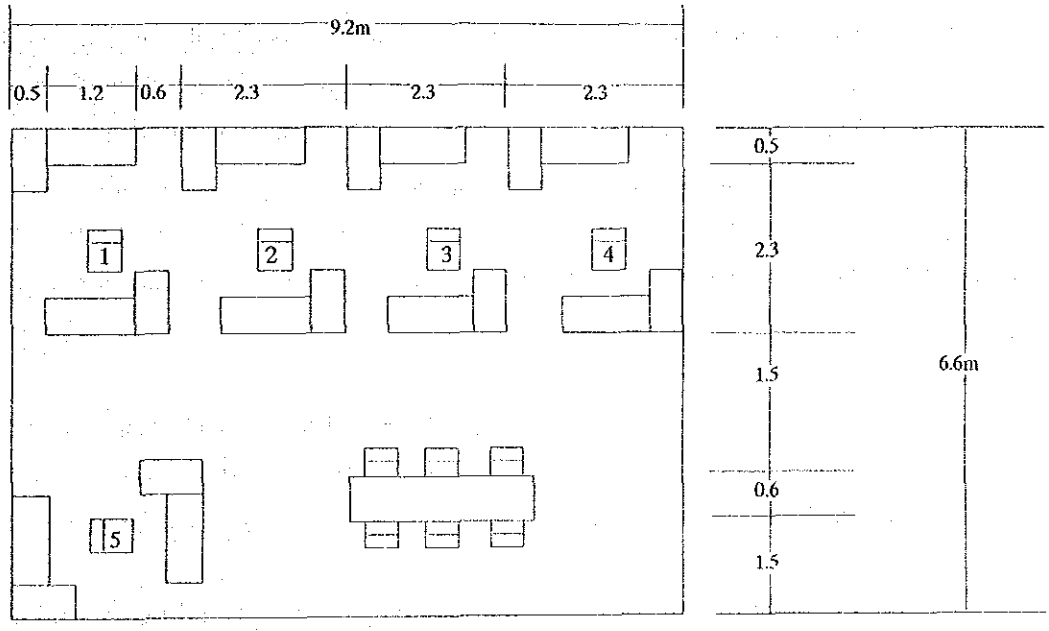


Figure 3.3.9: Layout Plan for the Expert Room

11) Conference hall

In addition to internal meetings of staff and researchers, this area will also be involved in educational programs aimed at fishermen, the public, and elementary and junior high school students. The space must also be sufficient to permit the convening of international conferences for announcing research findings and exchanges of views. The functions, therefore, must include a lecture dais and a storage area for fixtures. Based on these diverse functions, we have set the hall capacity, using on a table and chair configuration, at 60 persons, based both on the size of the Center staff and attendance at past international conferences. The furnishings will include conference table sets for 3 persons and folding chairs. Allowing for the placement of these furnishings and adequate working space, the required area has been set at 141.90m^2 for conference attenders and 38.70m^2 for the stage and storage areas, for a total of 180.60m^2.

12)Entrance hall, vestibule, rest rooms, storage areas, utility rooms, and other common areas

Rest rooms-

The toilet areas must serve the administration and research staff as well as visitors. They should be designed to accommodate 20 staff members and a small number of visitors, with provisions for both men's and ladies' rooms. Considering the size of the facility and the use patterns for the conference hall, toilets will be installed 2 locations.

Utility rooms-

Based on the room composition and facility size, utility rooms, which will also serve as a storage area for cleaning gear, will be provided at two locations. Furnishings will include a reserve supply of chairs and desks, sink, cupboard, refrigerator, storage area for sanitary supplies, and a storage cabinet for cleaning supplies. Allowing for placement of these items as well as suitable work space, the required sizes of the 2 utility rooms have been set at 15.50 m^2 and 8.25 m^2.

Other common areas-

The configuration and area of the other common areas, primarily entrance hall, vestibule, and storage areas, will be considered in connection with the surface plan for the Administration Building.

The sizes of the rooms in the Administration/Research Building, including space for furnishings and intended usage as well as proper work space, are summarized in Table 3.3.2 below

Table 3.3.2: Room Sizes for the Administration/Research Building

Room Designation	Required Area (m^2)
1) P.F.O. Office	31.50
2) Administrative Office	36.64
3) Secretary's' room	16.96
4) Reception	6.60
5) AV room	22.40
6) Conference Room	57.04
7) Study rooms (7)	16.96 (x 7)
8) Data room	16.96

9)	Marine Physical Lab	57.60
10)	Marine Bacteriological Lab	92.40
11)	Marine Ecological Lab	57.60
12)	Chemical Lab	80.40
13)	Expert Office	60.72
14)	Conference hall	180.60
15)	Utility room	23.75
16)	Other: entrance hall, waiting room, rest rooms, storage area, corridors, other common areas	(to be considered in connection with the Surface Plan)
	Total floor area	876.85m^2

(2) Annex Building:

The required rooms in this building comprise a wet lab, to serve as a back-up facility for the on-site surveys in the Marine Conservation Division, a diving room for maintenance and checks on diving equipment and compressed air operations, a workshop for maintenance, repairs, and check-ups on research equipment, the buildings, and vehicles, a generator room to house a back-up generator for use during periods of power failure, storage areas for materials, and rest rooms, including showers.

The wet lab will be a primary treatment facility for washing, bleaching, and drying coral specimens. The space should accommodate a counter table, worktable, and wash table, along with adequate work space.

The diving room should be large enough to permit storage of, and maintenance checks on, the diving air tanks, dry suits, and other equipment as well as the installation of a compressor for use in compressed air filling operations.

The workshop area should be sufficient to permit equipment checks and repairs and fabrication of wood, steel, and piping materials.

The generator room will house an emergency generator and power distribution boards.

The storage area is intended for materials used in the repair of equipment and facilities. The items to be stored include spare pumps and piping materials for repair use, FRP tanks, and a handcart.

1) Wet lab

This facility will conduct primary processing of coral specimens, essentially washing, bleaching, and drying operations. Space requirements include a work counter, work table, wash basin, as well as adequate work space. The primary processing operations, to be performed by about 5 researchers, will center on the washing and drying, on the work table, of the coral specimens brought in from an outdoor bleach tank as well as counters and storage shelves for preservation bottles, test chemicals, and scales. The required area for these operating and storage functions has been set at 26.40m^2. Since the bleach tank will emit a foul odor during operations, the plan is to install this tank outside under a 15.0m^2 roof.

2) Diving room

This room will be used for storage and maintenance checks on the diving cylinders, dry suits, outboard motors, and research equipment water and bottom sampling units and other research items, and to fill compressed air tanks. Space has been allowed for storage shelves for compressors and other equipment and a small working area for 3 staff members. Allowing for these operations and fixtures, the total required area for the diving room has been set at 25.30m^2.

3) Workshop

This area will be used for storage and preparation of pumps and machinery as well as for the processing of wood and piping materials. All of these operations will be modest in nature, with hand tools comprising the bulk of the requirement equipment. The only large installations will be a bench drill and work table. Space has been provided for 2 technicians making equipment repairs, mainly at the work table. With respect to the woodworking operations, since the most frequent use will be for facility repairs and for culture pond structures such as gate boards and screen frame production, we have provided space for operations by 4 technicians, primarily at the woodworking table. Allowing for these fixtures and proper working space, the required area for the workshop will be 29.15m^2.

4) Machine room

This room is to provide back-up for the new Administration/Research Building in the form of an emergency generator and power distribution boards. Allowing for the placement of these items and space for maintenance checks, the required area has been set at 25.00m^2.

5) Storage area

This area will be used as a storage room for materials involved in equipment repairs. Pumps and parts will be stored on shelves at the rear of the room, with the FRP tank in the center, while oversized equipment will be raised onto shelves, using the hand cart. Allowing space for shelving, storage, and removal operations, the required area for the material storage room has been set at 25.00m^2.

6) Rest rooms

These facilities will be targeted at the approximately 10 researchers and operators from the Marine Conservation Division, who will be working in the Annex Building. We have included showers for bathing after diving operations. Since women can also be expected to use these facilities, toilets and showers will be installed for both sexes.

Allowing for placement of the toilets and showers as well as a suitable area for movement, the required area of the rest rooms will be 25.00m^2.

Table 3.3.4 following summarizes the room areas, as calculated above:

Table 3.3.4 Summary of Room Sizes in the Attached Building

Room Designation	Required Area (m^2)
Wet lab	26.40
Diving equipment room	25.30
Workshop	29.15
machine room	20.00
Storage room	25.00
Rest rooms	25.00
Bleach tank (outdoors)	15.00
Total Area: Indoor equipment	150.85 m^2
Outdoor bleach tank	15.00 m^2

(3) Dining room and kitchen in the existing facility:

This facility will serve lunches and light snacks to researchers and other staff members. Since 1/3 to 1/2 of all employees are expected to make use of the dining room, we have assumed that maximum usage at any given time will be 24 persons.

1) Dining room

The required furnishings will be tables and chairs. Allowing for their placement plus suitable space for movement, as per the detailed layout plan, the required space has been set at 44.40m^2.

2) Kitchen

The required fixtures will include a sink, cooking table, ranges, and refrigerator. Allowing for the placement of these items plus suitable work space, the required area calculated from the layout plan comes to 30.00m^2.

The combined area requirement for the dining room and kitchen will be 74.00m^2. The layout Plan is shown in Figure 3.3.10.

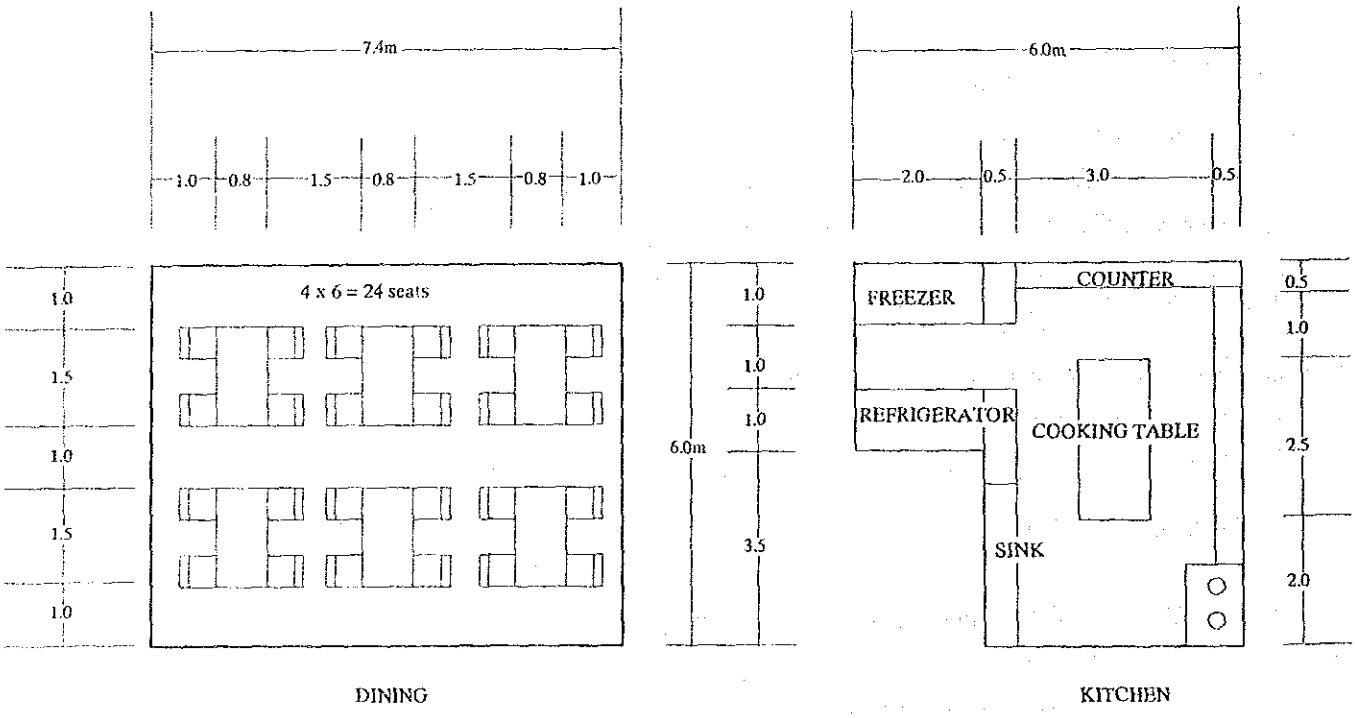


Figure 3.3.10: Layout Plan for Dining Room and Kitchen

3.3.4 Equipment Plan

The Plan equipment will be classified by application area as follows: the Marine Ecological and Chemistry Labs, bacteria culture , marine observations, data processing, education/training, aquaculture, workshop, boats, vehicles, and furnishings.

(1) Equipment for the Marine Ecological Lab.:

This equipment will be composed mainly of items used in field surveys within the coral reef ecosystem research program. The principal operations in the field studies will be underwater observation of marine species and collection of specimens. The required equipment includes dry suits for protection against cold during long hours working in the water, an underwater camera and underwater recording paper. Since the dry suits will have to be individually tailored for the exclusive use of each researcher, we have allocated 5 suits. And to improve the performance of the present underwater video cameras, we plan to include lighting equipment and color filters. With regard to communications between research boats and the shore, in the interest of compatibility with existing radio units, we plan total of six portable VHF radio telephones of about 1 W. Equipment to be used in the Ecological Lab will include a desiccator for storage of under water photographic/video apparatus, a stereo microscope and photographic gear for use in coral classification and tissue observations, as well as a diamond saw for sectional tissue observations.

(2) Equipment for Chemical Lab.:

This equipment will be used for analysis, at regular intervals, of the bio-chemical characteristics of sea water at the previously described 8 monitoring points. It will be deployed mainly in the Chemical Lab. Under the present routine, water quality measurement are being taken for nutritive salts such as silicate, nitrate, phosphate, and sulfate. Regular observations are also made on BOD, nitrate-nitrogen (NO_3-N), phosphate phosphorus(PO_4-P), and Chromium (VI) compound as water pollution indicators. Accordingly, while the equipment plan will of course incorporate these measurements, it can be expected that, in the future, measurements will be extended to include environmental pollution arising from industrial and household effluents and agricultural chemicals together with pollution measurements based on biological indicators. We have thus incorporated these measurements into the picture.

For the analysis of nutritive salts, in order to improve measurement accuracy, the Plan requires analytical values for at least 20 specimens per analysis at each monitoring locations. In order to treat a large number of specimens, an auto analyzer will be essential. It is appropriate to use an auto analyzer for BOD measurements as well. And, in preparation for future extended requirements for more complicated pollution indicators, it is planned to add a measurement program mainly for heavy metals and, to deal with this, a chemical kit for seawater analysis will be needed. As other related equipment for water quality analysis, we plan to provide turbidity meter, conductivity meter, DO meters, salinity refract meters, and pH meter for lab use.

As general-purpose equipment for use in physicochemical experiments, a muffle furnace, drying oven, incubator, refrigerator, freezer, deionized distillery still, analytical balances, magnetic stirrer, autoclave, draft chamber, general-use glass instruments, and safety items have also been included. In addition, since the general-use glass utensils, such as pipettes, measuring cylinders, and beakers, tend will be used mostly in Chemical lab, these have been incorporated in this genre, including items to be used in other laboratories.

(3) Equipment for Bacteriological Lab.:

This equipment , which is to be located in the Bacteriological Lab, will comprise mainly items needed to take regular measurements of the water quality at premonitoring points, using coliform bacilli and streptococcus as indicators, The equipment plan should also be amenable to future research on fish diseases.

For detection of coliform bacilli, we plan to use the M.F.method. Equipment required for this purpose includes petridishes, membrane filters, coliform confirmation kits, vacuum pumps, media, incubators, and microscopes. In addition to the ordinary biological microscope, we plan to use a stereo microscope for colony observations and an inverted microscope for observing the water microorganisms. Other essential equipment for this type of research include such general-purpose items as a clean bench, ultra-violet (UV) sterilizer, autoclave, drying oven, water bath, incubator, refrigerator, freezer, centrifuge, deionized distillery still, analytical balance, magnetic stirrer, pH meter, sterilizing cabinet, and safety items.

(4) Equipment for physical lab.:

The planned research targets include water quality, marine sediment, topography, currents, and wind direction and velocity in shallow lagoon and coastal waters.

Whereas water quality measurement in the chemistry lab is oriented mainly to biochemical subjects, the research here is based principally on field measurements of the physical environment, such as water temperature, conductivity, and DO volume. Since the marine studies in the subject Plan are conducted principally at depths below 50m, the field equipment has been designed for shallow-water use. While the bulk of the equipment will be used in the fields, the storage of these items as well as the deployment of certain pieces of equipment will be in the Physical Lab.

For specimen collection, we have designated Niskin and Van Dorn water samplers, which are widely used throughout the world in shall-water and have a fine performance history. For obtaining sediment specimens, we plan to make use of both the Ecman-Berge sediment grab and the Nauman bottom corer. With regard to water quality, since the plan is to perform continuous observations in a vertical direction, CSTD will be necessary to measure conductivity, salinity, temperature and depth simultaneously.

As to current measurement,we plan to use flow meters and buoys for flotsam. In other to understand the influences of winds, it will be necessary to provide a hand-held wind direction and velocity meter which can be used at sea. For purposes of measuring observation positions, sextants will be required, while an echo sounder will be needed to gain an understanding of sea bed topography.

As equipment for Physical Lab, we intend to furnish a drying oven for drying specimens, sieve-analysis equipment for granular tests of sand and mud, and a fluorescent photometer for measuring the volume of chlorophyll.

(5) Data Processing Equipment::

Two computers will be provided for use in analyzing marine data and preparing research papers, along with 3 laptops for use in labs and in the field. As peripheral equipment, we will furnish digitizers, printers, and UPS(uninterruptible power supply). In addition, 2 copying machines will be needed for report preparation.

(6) Educational and Extension Equipment:

This will be AV equipment for use in preparation of research, educational and information materials, and conferences. In this connection, we plan to provide a video camera,

video editor, video recorder/player, and video monitor. In addition, there will be a need for conventional projection equipment, such as slide and overhead projectors. In the conference hall, broadcasting equipment will be provided for loudspeaker use along with a video projector.

(7) Aquaculture Equipment:

1) Intake Pumps

Rearing water for aquaculture is currently supplied via 3 engine pumps at a capacity of 1 m^3/minute.Considering that with the diversification of aquaculture experiments, the volume of seawater usage has grown substantially, so that the pumping (lifting) capacity of the existing pumps has become inadequate. We have decided to switch from the engine pumps to simple electric-powered pumps. At the same time, we have confirmed the need to secure water supply capacity matching current and future requirements.

In addition, the current piping system has become quite heterogeneous, we have therefore decided to remodel the seawater supply system for the indoor tank, by replacing the present facilities with a filtration tank and by modification of seawater reservoir tanks. The water supply system for the Plan is diagrammed in Figure 3.3.11.

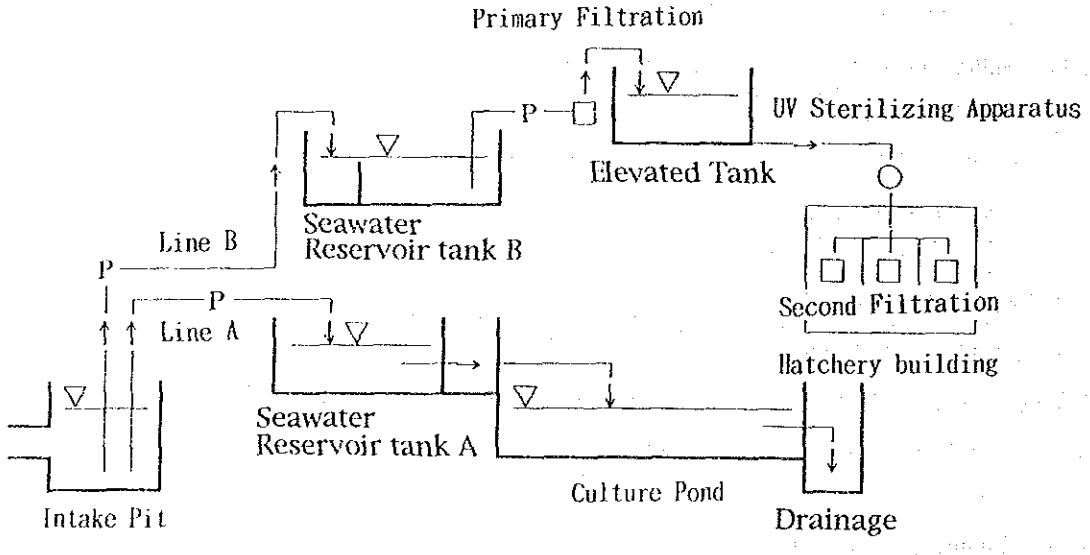


Figure 3.3.11: Plan Water Supply System

a) Pumps for culture pond (Line A)

This pump is used to lift the seawater using in the culture ponds with a total water volume of 13,950 m^3 from the existing intake pit to the seawater reservoir (A). As shown in Table 3.3.5, the required water volume for this operation is normally 2.9 m^3/minute. Furthermore, when a sudden deterioration of the rearing water in the culture pond is observed, the water should be replaced immediately. For this emergency purpose, 80% of the rearing water of the grow-out ponds (with water volume of 9,ooom^3) being renewed every 8 hours, when the water volume that must be supplied to other ponds during this time is confined to only about 1/3 of normal levels, the required pump capacity becomes 12 m^3/minute. Thus, given a supply requirement of about 3 m^3/minute, the pumping capacity of each pump may be set at this figure (3m^3/minute). We plan, therefore, to install 4 pumps which will be operated alternately.

Table 3.3.5: Required Water Volume for the Culture Ponds

Pond Designation	Water Volume	Exchange Rate	Required Capacity (m^3)
Growing-out	9,000	30%/24hr	1.9m^3/min.
Nursery	1,575	30%/24hr	0.3m^3/min.
Brood stock	1,575	30%/24hr	0.3m^3/min.
Experimental	1,800	30%/24hr	0.4m^3/min
Total	13,950		2.9m^3/min.

b) Pumps for water supply to the hatcheries (Line B):

This is the pump used to lift the water from the intake pit to the seawater reservoir B. The water is pumped up to a elevated tank and fed to tanks (mainly indoor) such as the ones in the Hatchery Building attached to the Fishery Research Center including small outdoor rearing tanks for research use and the hatchery attached to the Marine Shrimp Culture Experimental Station including the wet lab. The required water volume, as shown in Table 3.3.6, is 0.06 m^3/minute at normal load, and 0.94 m^3/min. during cleaning periods. During these cleaning periods, as is the present operating procedure, 80% of the total water volume is drained while removing residue, and the Plan is to restore normal water levels in 4 hours.

Table 3.3.6 Required Water Volume for the Hatcheries

Facility	Water Volume	Normal load		During Cleaning		(m^3)
		Exchange Ratio	Required Volume	Exchange Ratio	Required Capacity	
Hatching Building	92	30%/24hr	0.02m^3/min	80%/4hr	0.31m^3/min	
Hatchery	190	30%/24hr	0.04m^3/min	80%/4hr	0.63m^3/min	
Total	282		0.06m^3/min		0.94m^3/min	

Based on the above, in order to obtain an adequate water volume during cleaning periods, the pump must have a capacity of 1 m^3/minute. To guard against breakdowns, a reserve pump of identical size is planned. During normal periods, the two pumps will be operated alternately.

2) Filtration and Seawater Sterilization Equipment:

a) Primary filtration

In order to obtain suitable quality seawater for rearing purposes, the plan is to remove up to 50 microns of dirt via filtration. The target facilities for the water from the primary filtration unit will be the previously mentioned hatching building and hatchery, with a required filtration capacity of 1 m^3/min. The filtration unit will employ the sand filter method, which is easy to handle and causes few maintenance problems. Two units will be provided to permit continuing filtration , even during system maintenance as well as backwashing.

b) Secondary filtration

It is desirable that precision-filtered seawater be utilized for rearing incipient feed such as diatoms and rotifers and for seed production. In the present Plan, in accordance with the usage objectives, we are considering second-stage filtration, from 0.5 - 1 microns. The target facility is the 115m^3 rearing tank within the hatchery. Anticipating a 100% water exchange ratio per day, the required filtration capacity becomes:

115 m^3 / 24 hrs./ 60 min. = 80 liters/min.

For the filtration process, we have selected the cartridge method, which is generally used in comparable aquaculture research facilities. It is planned to use existing piping for installing

this secondary filtration tank in the hatchery, but, for the piping from the filtration tank onward, we will adapt to conditions at the site, as appropriate.

c) UV Sterilizing Apparatus

After settling treatment in seawater reservoir B, the seawater that has been brought in will flow through the primary filtration units for storage in the elevated tanks. At this stage, since the water contains bacteria and viruses which can cause diseases in the fish, it is vital, particularly in the case of water used for seed production, that these disease organisms be eliminated. As the sterilizing method, we plan to install a UV sterilization system. The treatment capacity should be 1 m^3/minute, which is equivalent to the water usage volume at the facility.

3) Heating Equipment

The most suitable water temperature for spawning giant tiger prawns is 28-30°C. However, since the season for these temperatures in seawater is very short in Mauritius--only about 3 months--, the rearing water is heated by electric heaters before being used for seed production. However, for maturation of spawners, the 20 of 1kw electric heaters are not sufficient to produce the needed heat supplement, which means that an adequate number of eggs cannot be obtained. Accordingly, additional electric heaters must be provided to eliminate this deficiency, and we are also planning an equivalent number of controllers for this temperature adjustment.

4) Water Tank for Rearing Experiments

In addition to feed and grow-out examination centering on giant tiger prawns, seabream, and red tilapia, various rearing experiments are planned at the semi-production scale pond. However, at the present time, suitable facilities are not available to conduct these new experiments. In the subject Plan, therefore, we have decided to develop test facilities based on a simply assembled water tank. The plan is to us 12 circular water tanks, assembled from an FRP frame, with a 6m diameter, appropriate to carry out variety of examination simultaneously.

5) Materials for Cage and Pen Culture Experiments

Cage and pen culture experiments are planned in Barachois at 3 locations, directed at seabream and red tilapia, and shall prepare the aquaculture materials required for these

experiments. Since all are being introduced on an experimental scale, one cage culture experiment will be a small crawl (2m x 2m x 2m) for juveniles rearing use, and another in a larger (4m x 4m x 4m)crawl for grow-out use. Since net mesh will have to be gradually expanded to keep pace with the growth stages, the mesh sizes for the cage culture experiments will be set at 2 mm, 3mm, 5 mm, 8 mm, 10 mm, 15 mm, 20 mm, 30 mm, and 40 mm.

For the pen culture experiments, a small site will be selected with a relatively narrow frontage with a cove-like shape within a Barachois. The partitions will be given a depth of 4m and a length of 100 m. Since growing-out will be the prime objection, we plan mesh sizes of 5 mm and over in the sizes shown above.

6) Emergency Generator

The generator capacity at the existing Marine Shrimp Culture Experimental Station is 100 KVA, which will not be adequate to secure power during blackouts for the additional lift pumps to be provided under this Plan. Thus, a second emergency generator will have to be installed for back-up use to meet the following pumping load:

Pumps for culture ponds :	11 kw x 2 units =	22 kw
Pumps for hatcheries :	11 kw x 2 units =	22 kw
Total		44 kw

Accordingly, in order to meet this demand of 44 kw, the additional generator should have a rated capacity of 55 KVA.

7) Other Materials

As additional materials for aquaculture use, we plan to provide shield nets, sheets for mending membrane laid at the bottom of the existing culture pond, rope for a cage culture facility, and a live-fish tanks for transporting fingerlings.

(8) Workshop Equipment:

We have planned a set of repair machinery and tools capable of making light repairs on facilities and equipment as well as producing supplementary research apparatus. There will be a

requirement for a variety of hand tools, including drills, grinders, woodworking saws, spanners, wrenches, and drivers.

(9) Boats and Vehicles:

1) Boats

The boats will be research vessels for use in ecological surveys and marine observation work in the lagoon and shallow coastal waters. Two types will be required: a lagoon boat for ecosystem research, primarily inside the lagoon and a shall-water boat for marine observations in shallow water.

a) Lagoon research boat

This boat is to be used principally in the lagoon to survey coral distribution and ecology. In principle, it will not be operated at night; the plan is transport it overland to survey locations. Thanks to its light weight, it will be propelled by an outboard motor. When used in research operations, the boat will typically have a 6-man crew: 5 researchers and a skipper but, considering the additional load of equipments and the specimens that will be collected, a 8-man vessel will be required. Since operations will be primarily in reef areas, the draft should be made as shallow as possible. And since these vessels will have to be transported by human power overland, an inflatable pneumatic boat, with a TL of about 5m and a TW of about 2m would be appropriate. In the interest of hull stability and cruisability, the boat bottom should be light-weight FRP boards, which have excellent durability. In order to protect the rubber tubing along the sides from the sharp-edged coral, the specifications will call for protective side materials on the draft (water) line. Rigging will include 2 extra life-jackets in addition ladder for diving use and other fittings. Reflecting a priority on mobility, the main outboard motor will be 40 ps.However, a spare 15 ps outboard will also be carried for use when the main engine breaks down.

b) Shallow-water research boat

This boat will be used primarily for marine observations in shallow coastal areas. Cruising and haulage conditions will be identical to those for the lagoon boat. The crew will again comprise 5 researchers and a skipper but, considering the additional load of measuring equipment and specimens, the deck size should be set at the equivalent of a 10-man vessel. For hull materials, aluminum, FRP and steel are the logical candidates, but, considering the operating environment and the need for portability during overland movements using human

labor, we have specified FRP construction, which is both light-weight and durable, can be fabricated with relative ease, and can be procured locally. Based on the above considerations, the boat will be given a TL of about 7.5 m and a TW of about 2.5 m. Rigging will include awnings, fenders, diving ladder, and other fitting including life jackets. The outboard motor will correspond to that of the lagoon boat.

2) Vehicles

a) Small van

This van will be used mainly for marine observation surveys. A small van will be appropriate for 5-6 passengers and a cargo of measuring equipment. In order to haul the shallow-water research boat to a shore point close to the survey location, it is planned to fit the van with a trailer and winch. The vehicle will be 4-wheel drive, which is suitable for driving on sandy beaches.

b) Pickup truck

This vehicle is intended to transport personnel and equipment together with the research boat for use in ecosystem surveys. Considering the requirement for 5 passenger seats, we have specified a double-cabin truck. In order to transport the lagoon boat, the required gear, as in the case of the small van, will include a trailer and winch. The pickup will also have 4-wheel drive.

c) Minibus

A minibus will be needed to make commuting more convenient for Center employees and will replace the present superannuated vehicle. Since the number of employees totals about 60, we have decided to furnish 2 minibuses, each with a 15-seat capacity, for the round-trip journey.

(10) Furniture for Research Use:

A lab table will be placed in the center of the lab facilities. The specifications of this table will be determined with reference to existing research labs, and the plan is to equip it with a. sink. Liberal provision should be made for shelve space for the storage of equipment and documents, since storage space is rather tight at the existing facilities. The ecological lab will require shelves for storage of the coral specimens. Other research furniture will be given the same specifications as existing items. Considering that the lab table top must be resistant to both heat and chemicals, it will be difficult to procure this item locally. However, with the exception

of such special items, the Plan calls for the rest of the furniture to be, in principle, locally sourced.

3.4 Management and Maintenance Plan:

Management and maintenance responsibility after completion of the Plan facilities will continue under the present structure of the AFRC. Since research activity will be continued by the present research staff at the Marine Conservation Division, which will use the Plan facilities, no new personnel or research overhead will be created by Plan implementation. Accordingly, with respect to management and maintenance budgets, such as the anticipated increase in operating and maintenance costs associated with the expansion of Plan facilities and equipment, we shall be guided by the budgetary measures used by the Mauritius Government.

The assumptions which have been applied in estimating operating costs are as follows:

No. of operating days for the AFRC	250 days/year
No. of days of water intake pumps operation	300 days/year
Electricity rate	Rs 2.50/kwh
Water rate	Rs 6.00/m^3
Gasoline	Rs 9.50/liter
Diesel fuel	Rs 5.50/liter

(1) Electricity:

1) Aquaculture Division

Regarding to the power requirements including two types of pumps, the UV sterilizing apparatus and heaters, we have estimated the increase in annual power consumption at the Aquaculture Division, based on the replacement or introduction of new pumps and other equipment, as shown in Table 3.4.1:

Table 3.4.1 Estimated Increase in Annual Power Consumption in the Aquaculture Division

Pumps for water supply to culture pond:	11.0kw x 1 unit x 24 hrs./day x 300 days	=	79,200 kw
Pumps for water supply to lab.:	11.0kw x 2 units x 24 hrs/day x 300 days	=	158,400 kw
UV sterilizing apparatus :	2.5 kw x 1 unit x 24 hrs/day x 300 days	=	18,000 kw
Heaters:	1.0kw x 20 units x 20hrs/day x 90 days	=	36,000 kw
	TOTAL	=	291,600 kw

On the other hand, since the fuel cost presently incurred to operate the engine pump for water intake use can be offset against the changeover to electric power pumps, we estimate that the net increase in budgets for the Aquaculture Division will be in the order of Rs 267,000 per year, as shown in Table 3.4.2.

Table 3.4.2: Estimated Net Annual Increase in the Budget for the Aquaculture Division

Electricity:	291,600 kw x Rs 2.50	=	Rs 729,000
Less; Diesel fuel savings:	Δ (84,000 liters) x Rs 5.50	=	Δ (Rs 462,000)
Net Increment:			Rs 267,000

2) Marine Conservation Division:

The increase in utility costs association with the expansion of facilities and equipment under this Plan have been estimated on the basis of Table 3.4.3:

Table 3.4.3 Estimated Power Consumption at Plan Facilities

		Demand Capacity	Load	Hours	Days	Annual Power Consumption
Lighting	Indoor	20.0kw	0.5	1 hr	250	2,500kw
	Outdoor	5.0kw	1.0	10 hrs	365	18,250kw
Research equipment		40.0 kw	0.4	5 hrs	250	20,000kw
Air conditioning		100.0kw	0.6	7 hrs	250	105,000kw
Sockets		30.0kw	0.2	2 hrs	250	3,000kw
			TOTAL			148,750kw

(2) Fuel:

The fuel consuming equipment provided under the Plan will include: the minibus for Center employees, the small van and pick-up truck for use in marine and ecosystem research, and the outboard motors fitted to the research boats.

The fuel charges for the emergency generator are likely to offset the electric power charges saved during power blackouts and so need not be considered as a net cost item.

Table 3.4.4 Fuel Consumption by Plan Equipment

	Minibuses	Research Vehicles	Outboards
Ful type	Diesel	Diesel	Gasoline
No. of units	2	2	2
Fuel efficiency	6 km/ltr	8 km/ltr	15 ltr/hr
Distance traveled	30 km/day	60 km/day	1 hr/day
No. of operating days	250 days	100 days	100 days
Annual fuel consumption	2,500 lit/yr	1,500 lit/yr	3,000 lit/yr

(3) Water:

The use of water for general purposes and for equipment washing is estimated as follows:

Tap water usage: 150 lit/person/day x 28 persons x 250 days = 1.050 m^3/year

(4) Maintenance Costs:

Newly incurred maintenance expenses for the facilities and equipment under this Plan will limited, in the case of the buildings, to painting of exterior walls and, in the case of equipment, to maintenance costs and purchases of expendable. We have assumed that an additional RS 200,000 of maintenance expenses will be generated by this Plan.

Based on the above, the total increase in expenditures resulting from Plan implementation may be estimated as shown in Table 3.4.5 below:

Table 3.4.5: Estimated Increase in Operating Costs Based on Plan Implementation

Item	Consumption	Unit price	Total
Electric power:			
Aquaculture Division			Rs 267,000
Marine Conservation Div.	148,750 kw	Rs 2.50	Rs 371,875
Fuel:			
Diesel	4,000 ltr	Rs 5.50	Rs 22,000
Gasoline	3,000 ltr	Rs 9.50	Rs 28,500
Water	1,050 m^3	Rs 6.00	Rs 6,300
Maintenance			Rs 200,000
TOTAL			Rs 895,675

Considering that the total budget for the Ministry of Fisheries and Natural Resources during fiscal 1993/94 (before the separation of the new Ministry) amounted to Rs 37,140,000, it is anticipated that adequate funding will be found to cover the projected net increase of 2.4% in this budget resulting from Plan implementation.

3.5 Technical Cooperation:

Technical cooperation from the Government of Japan for AFRC has been extended since 1988. It has involved the dispatch of a specialist from JICA to the Aquaculture Division for assistance on marine shrimp cultivation. Technical cooperation had also been provided from 1991 to 1994 by the OFCF to the Artisanal/Banks Fisheries Division.

In August, 1993, JICA dispatched a project formation study team for a possible project in the fisheries sector. As a result of this mission, the need has been confirmed for technical cooperation in order to promote R&D activity in aquaculture conducted in harmony with environmental preservation, and for conservation of the marine environment in the lagoon and surrounding waters.

SECTION FOUR: BASIC DESIGN

4.1 Basic Policies:

The subject Plan forms part of the fishery resource development plan in the Republic of Mauritius as well as part of the marine conservation plan, which has been accorded high priority in the 6th National Development Plan. The Plan seeks to overcome the inadequacies in both facilities and equipment at the Albion Fishery Research Center (AFRC), the country's only marine and fishery research organ. The improvements to be made under this Plan are expected to promote research activity at the Center, enabling it to respond effectively to the increasing demand for research services in this field.

The Plan facilities and equipment comprise: laboratory facilities required for analyzing a variety of samples and specimens, research equipment, private research rooms which are indispensable to researchers for data analysis and preparation of reports and papers, administrative offices, and common areas. It is necessary to integrate organically these varied functions.

(1) Facilities:

When the existing Center was first established, the scale of the facility was based on a staff of only about 11 researchers and technicians. At present, however, the Center has been occupied by some 50 researchers and staff at in 4 Divisions: the Artisanal Banks Fisheries, Marine Conservation, Offshore Fisheries and Aquaculture. The growing space needs of these Divisions have been met by converting a part of the administrative facilities (such as the PFO room, general offices, conference room, guard room, dining room, and garage) to research use as rooms for data analysis, technical staff, and a library. The Marine Shrimp Culture Experimental Station is completely equipped with aquaculture experimental facilities, including a hatchery, wet lab,and seawater intake and drainage facilities, and this operation by the Aquaculture Division will continue in its present form. Based on this current situation, it has been determined that the handicaps to the present research programs at AFRC that had developed from a shortage of space will have been removed by continuous use of the existing Center facilities for the Artisanal Banks Fisheries and offshore Fisheries, the existing Station facilities for the Aquaculture Division and by housing the Marine Conservation Division into the new facilities under the subject Plan. The target facilities for the present expansion plan include

researcher rooms for the Marine Conservation Division, administrative and operational rooms to be incorporated in the Administration Division, and repair facilities, such as a generator room and workshop.

Based on the above conditions, the basic design for the facilities will be guided by the following basic policies:

1) The new facilities should blend harmoniously into the overall AFRC complex, including existing facilities.

2) Those existing facilities that are functioning efficiently will continue to be used to the maximum extent.

3) Special consideration will be given in the facility design to enable ARFC to carry out its present research projects more effectively and respond flexibly to future research needs as well.

4) The facilities should be compatible with the natural environment at the Plan site, particularly the high heat and humidity and the strong sunlight.

5) The Plan site is located in a superb natural environment, surrounded by mangrove forests and lagoons. The facility plan must, therefore, give careful consideration to achieving harmony with the natural conditions and surrounding environment at the site.

6) We will use structural forms, materials, and construction methods that take into account local building conditions. Plan implementation should make maximum use of local labor resources, materials, and construction equipment, so as to be able to contribute, through this construction project, to vitalization of the regional economy.

(2) Equipment:

The equipment that has been requested by the Mauritius Government comprises equipment relating to both the Marine Conservation and Aquaculture Divisions along with items for educational and dissemination activities.

The basic design for the equipment plan will be developed in accordance with the following basic policies:

1) We will provide basic equipment for observation and research activities, in which the AFRC is presently deficient.

2) We will furnish equipment that is deemed to be specifically required for expansion in the aquaculture area.

3) We will select equipment reflecting local capabilities in industrial production and equipment repairs and maintenance. At the implementation stage, we plan, wherever feasible, to utilize locally produced products or imported items which can be maintained in the area, with a view toward contributing to the vitalization of the regional economy through the equipment procurement program.

4.2 Design Conditions:

4.2.1 Natural Conditions:

4.2.1.1 Geographic and Meteorological Characteristics:

(1) Location and Area:

Mauritius is located some 800km east of Madagascar. It is an island nation composed of Mauritius Island (20° S, 57°E), containing the capital, Port Louis, Rodrigues Island (19° s, 64° E), and various small islands.

Mauritius Island has an area of 1,865km^2, Rodriguez 100km^2, and the other islands 80km^2 in all, yielding a total area of 2,045km^2.

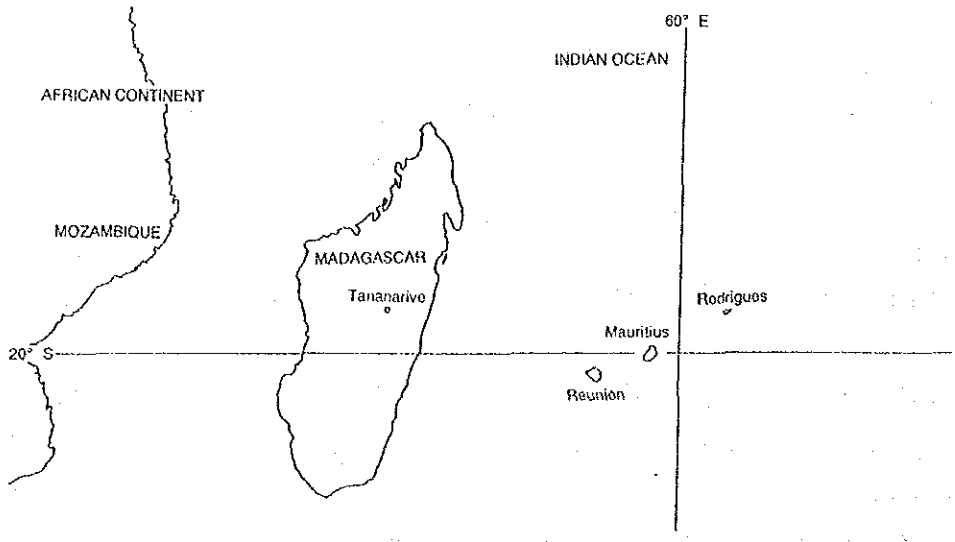


Figure 4.2.1: Location Map of Mauritius

(2) Topography:

Mauritius was forced by volcanic activity, it is a volcanic island that was thrust up from deep waters. This volcanic action, however, ended some 100,000 years ago; today, dead craters are seen throughout the island.

The central part of Mauritius Island is a highland area a few hundred feet above sea level. With the exception of a small portion of coast line, including Port Louis harbor, the island is surrounded by coral reefs. A simplified geological map of Mauritius Island is given in Figure 4.2.2.

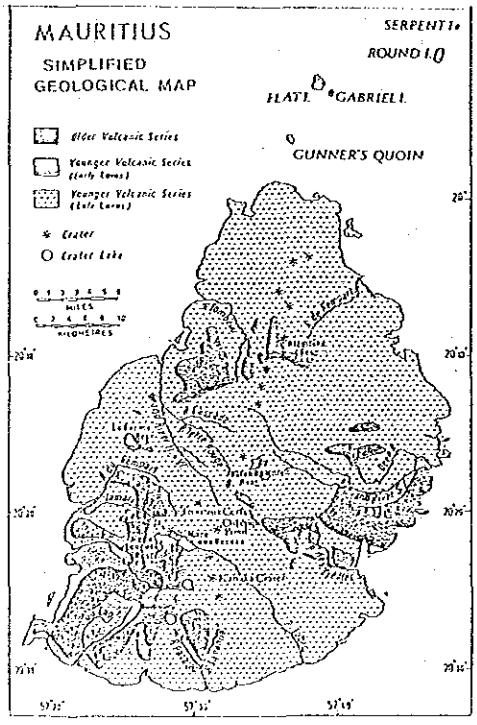


Figure 4.2.2: Simplified Geological Map of Mauritius Island

(3) Climate:

Mauritius has a subtropical oceanic climate, with annual average temperatures of about 25° C. During the winter (July and August), the temperature is chilly, averaging about 20° C, but in summer (January - April), the average rises to 30° C. In the central highlands, winter readings sometimes drop to as low as 12-13 C during the night.

As shown in Figure 4.2.3, rainfall is highest between January and April, when precipitation reaches 170 mm/month. Cyclones tend to cluster during this season, often causing severe damage to the Island's main crops. From August to October, rainfall is only about 20mm/month. Humidity tends to be generally on the high side, reflecting the influence of the southeasterly trade winds. There are virtually no earthquakes, since the area is far removed from seismic belts. Average temperatures and rainfall are shown in Figure 4.2.3.

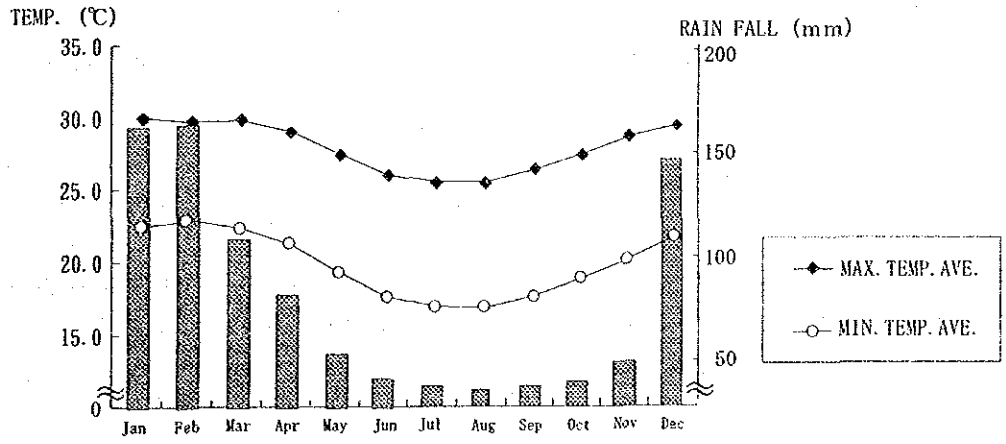


Figure 4.2.3: Average Temperature and Rainfall (1981 - 1990)

4) Winds and Cyclones

As a result of the influence of trade winds, southeasterlies prevail throughout the year. As shown in Table 4.2.1, the island receives the full brunt of cyclones every year between January and April, and suffer enormous crop damage each time. A list of the cyclones visiting Mauritius Island over the past decade is shown in chronological order in Table 4.2.1.

Table 4.2.1: Cyclones Hitting Mauritius (1994 - 1993)

Year & Month		Name of Cyclone	Maximum Wind Velocity (m / hr)
1984	January	Dmoina	15
1985	January	Celestina	25
	January	Ditra	14
	February	Gerimena	25
1986	February	Erinesta	21
1987	February	Clothilda	29
1989	January	Firinga	53
	April	Krissy	42
1990	January	Edissona	25
1991	January	Bolla	21
1992	March	Gerda	25
1993	January	Colina	32
	January	Edwina	34

4.2.1.2 Topographical Conditions:

In order to obtain a firm grasp of the topographical conditions in the site, as required for the Plan facility design, we conducted the site level measurement and surveys. The results of these tests are given in Appendix 5-1.

The area that is to be used for the Plan facilities is 100m east of the main building of Center, covering an area of about 4,000m2 , with an east-west span of about 40 m. The section north of the site has an elevation of 3.7m, sloping toward the south. With the gradient only 1.5m, the land is relatively flat and is presently being used as a parking lot. There are no obstructions -- facilities or trees -- on the site that would have to be removed, but, as preparation for the construction, the gradient will have to be leveled, while a 1.5m retaining wall would be required on the eastern perimeter.

4.2.1.3 Soil Conditions:

In order to understand the soil stratum and soil characteristics at the Plan site, as necessary for the foundation design for the Plan facilities, we conducted a series of soil surveys, including core drill at 3 locations within the Plan site. During the boring survey, in addition to standard penetration tests (S.P.T.), we collected a variety of materials and performed laboratory tests relating to sieve analysis, specific gravity, and moisture content. The borib log are included in Appendix 5.2.

Based on the results of the soil tests carried out for the site, the bulk of soil up to 6m below the surface stratum at the construction site for the Administration/Research Building is composed of sand with medium density having an N value of 13-25. Below 6m layer,there was about 9 m thick basalt layer which had been created by lava following a volcanic eruption.

The foundation section of the building, extending about 2-3m below the surface, is composed of good-quality sand. We can expect that this soil condition is able to support an allowable stress for sustained loading in the order of 10-25 tons / m^2.

Findings from the S.P.T. and particle size accumulation curves are given in Figures 4.2.4 and 4.2.5 following.

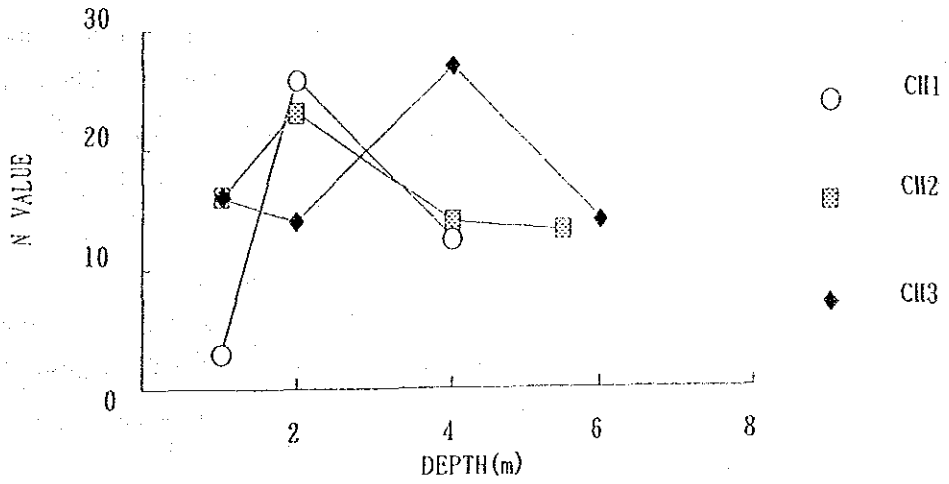


Figure 4.2.4: Results of the Standard Penetration Tests

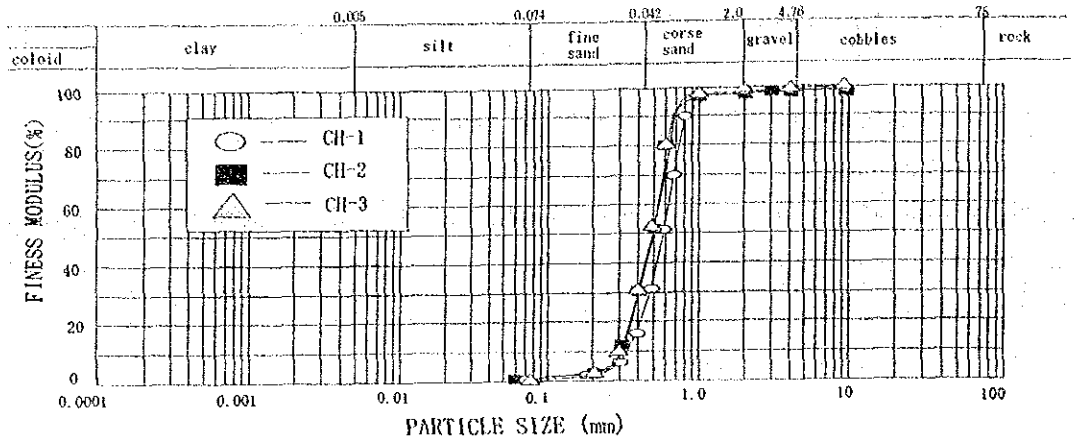


Figure 4.2.5: Particle Size Accumulation Curves

4.2.1.4 Seismic Conditions:

Since no earthquakes have ever been recorded at the Plan site, seismic strength is not considered in the design of buildings or engineering structures in Mauritius.

4.2.2 Infrastructure Condition in the Plan Area:

The access road from the nearby town to the entrance gate of the Plan site is paved in its entirety, so that transportation to the site during the construction phase will pose no problems, even for large vehicles. The main road from the gate to the main building has also been lightly paved.

Electric power is furnished by the Central Electricity Board. The power is received over a 22kva high-tension overhead line which has been brought into the Plan area. There are 2 pole-mounted 50 kva transformers at the AFRC which step the voltage down to 400V/230V for distribution to the various facilities. Trunk power line capacity is adequate to meet the demand stemming from the Plan facilities and equipment.

Water reaches the site via water mains. 65 mm pipes have been laid along an interior road from the entrance gate to the main building from which it is branched to consuming locations. Water supply facilities in Albion are relatively good. The Center presently uses only one telephone line which had been brought in from outside.

There are no municipal gas facilities in the area nor is there any public sewage system. For gas, the new facilities will use propane gas, supplied in cylinders. Sewage disposal will be via a septic tank and permeation into the ground.

4.2.3 Governing Standards:

There are no governing standards in Mauritius in codified form for facility design, but British standards (BS Code) are widely used.

Based on the results of the field survey and drawing from previous grant-aid experience in Mauritius, in the design of the Plan facilities, we will conform to Japanese standards while also respecting British standards.

4.3 Basic Plan:

4.3.1 Layout Plan:

The layout plan has been designed on the basis of the following guidelines:

1) In view of the separate functions and characteristics of the Plan facilities, the layout plan attaches great importance to the organic relationship between the new and existing facilities at the AFRC while giving consideration also to the independence of the new facilities.

2) Since the Plan facilities will be placed within a confined area, the layout must seek efficient use of the site based on the integration and intensive use of the facilities while maintaining separate characteristics in the individual rooms.

3) The climate at the Plan site is characterized by high heat and humidity, typical of the sub-tropic marine climatic belt to which it belongs. Although, during the monsoons, there will be short severe cloudbursts, compared to the rest of the island, the site has relatively low rainfall. The layout plan was developed with due regard to these natural conditions, particularly the low angle of sunlight in the morning and evening as well as the prevailing wind direction, which is largely unvarying throughout the year.

The Administration/Research and Annex Buildings have been positioned to insure that all related facilities, old and new, will function organically. Care has also been taken to facilitate the movement of people and goods to the other facilities, particularly the key gateway facilities: aquaculture ponds, the Technical/ Administration Building, and the Main of Building.

On the northwest site, the Plan site faces the calm waters of Petite Riviere Bay, formed by the lagoon, while the Belle Eau River flow behind the property. The southern side of the site is a flat piece of land with a gradient falling to the south in a north-south direction and extending to a long sandbar bordering the estuary area. In the center of the site are found the main existing facilities, including the Main Building, the Technical/Administration building and the aquaculture ponds, running from south to north in that order.

As to the new Plan facilities, from the standpoint of reciprocal use vis-a-vis the existing functions and the fact that, separation of these areas would cause considerable inconvenience to the users, as well as the fact that administration will be simplified by grouping related facilities

together while related facilities can be organized in a more effective way, we believe that positioning the new Administration/Research and Annex Buildings, in that order, adjacent to the southern side of the main building of the Center would be ideal from the standpoint of site configuration, facility functions, related facilities, and the smooth flow of both people and materials. The new layout plan for the AFRC is shown in Figure 4.3.1

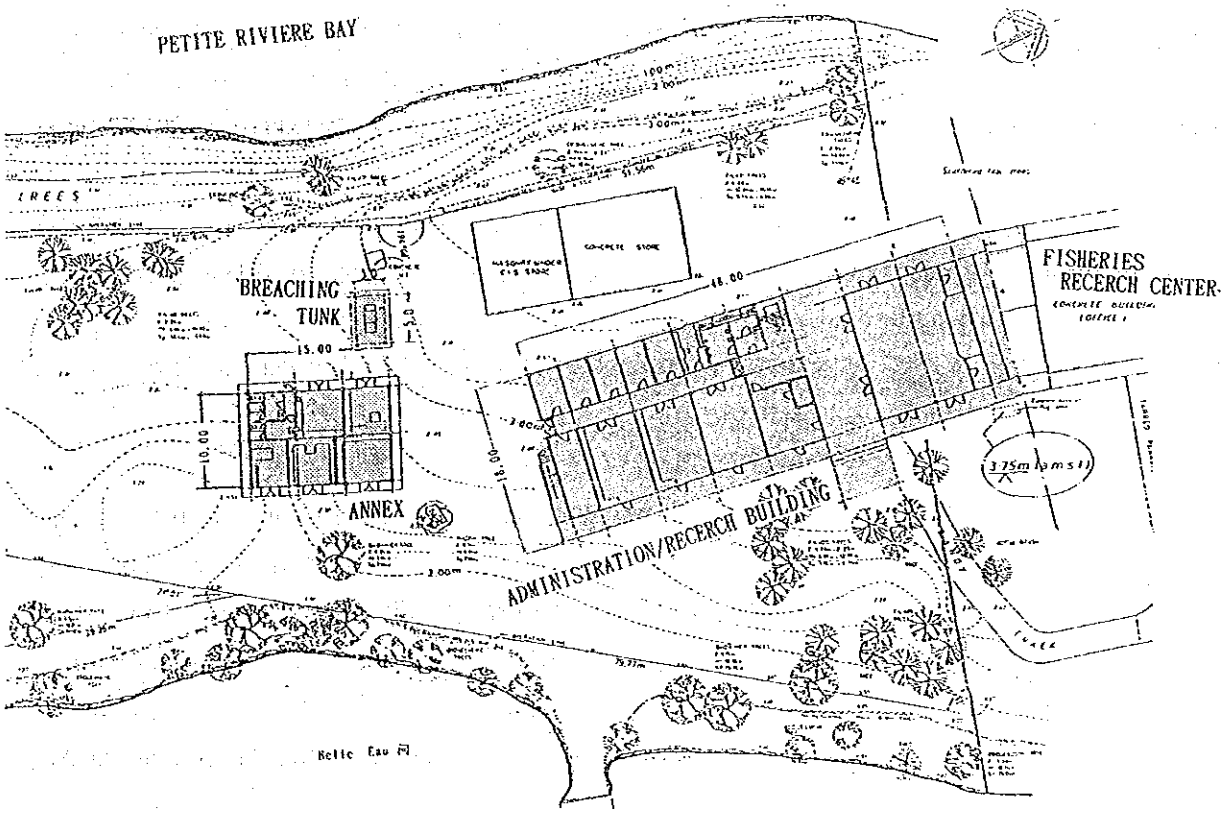


Figure 4.3.1: New Layout Plan for the AFRC

4.3.2 Construction Plan:

4.3.2.1 Floor Plan:

(1) Administration/Research Building:

From the standpoint of effective use of the facilities in terms of a surrounding green belt and parking space as well as minimizing moving distances, we have made the building 2 stories.

In the floor plan, we have located the research rooms and administrative offices, constituting the main functional areas of the facility, on both sides of the central corridor as parallel configuration in recognition of both the independent character of , and the organic relationship among, these rooms.

Since the span-interval plan will influence not only the floor plan but the exterior and structural plan as well, this has been carefully prepared with reference to existing facilities in the site. In the main building of the Center, the basic span interval is set at 6.4 m on the longer side and 18.0 (9m + 9.0 m) on the short side in a parallel configuration. Similarly, the Shrimp Culture Experimental Station, uses the same basic unit (5.7m x 9.5 m) in a series configuration.

In the subject Plan, since a parallel configuration has been established for the rooms, centering around the central corridor, a 9.5 m span interval on the short side would fail to provide the desired length. And, since the facilities will be arranged as a continuation of the main building, with a need for exterior harmony and continuity, we will use as same a basic unit as Maine Bldg.of 6.4 m x 18.0 m.

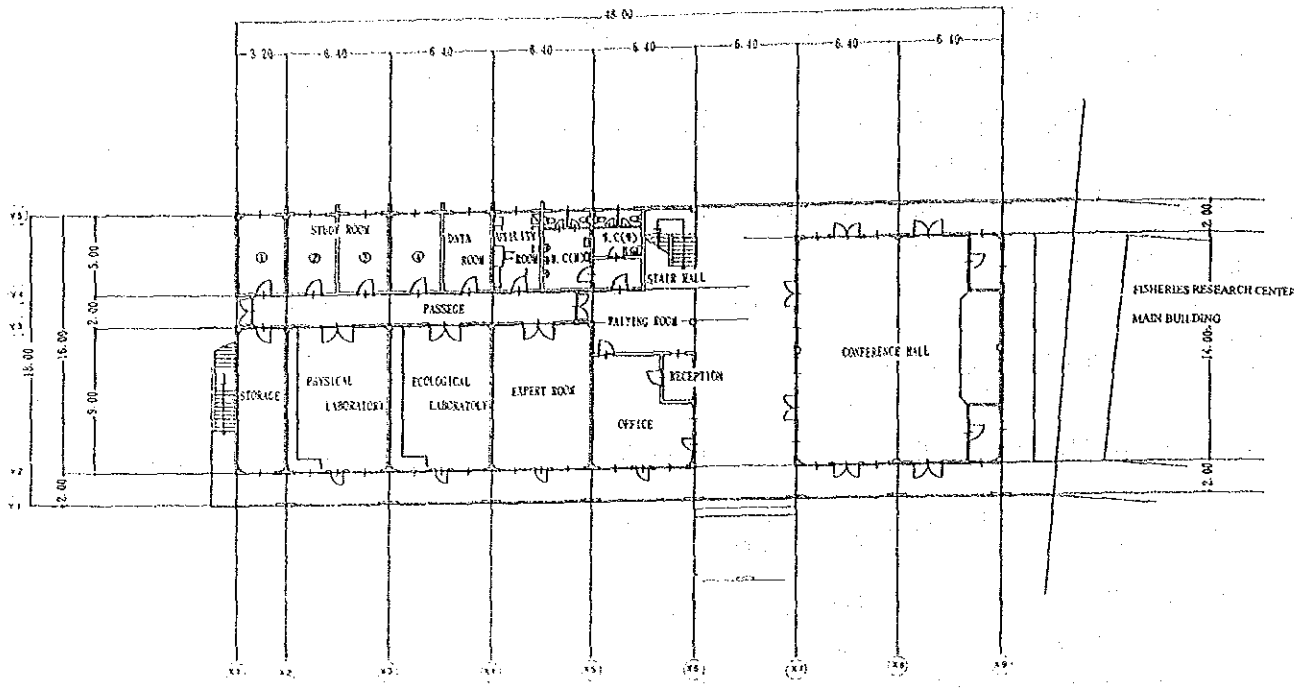
With respect to the research rooms, we have located these on two floors out of consideration for the interrelationship between the experimental labs and the study rooms as well as to provide adequate movement space to and from these rooms. In the case of the labs, we have placed the Marine Ecological and Marine Physical Labs next to their companions study rooms on the first floor, in view of the large amount of materials that will be brought in from outside, while the Marine Bacteriological and Chemical Labs together with related study areas have been located on the second floor.

In the case of the administrative offices and common areas, taking visitor traffic into account, we have given location priority to the administrative offices, reception area, and conference hall, centering them around the entrance hall placed in the center of the ground floor, while the PFO room, executive secretary's office, and the conference room have been located on the first floor. The utility rooms and rest rooms have been located on both floors near the stairway., The floor areas for these facilities are as shown in Table 4.3.1.

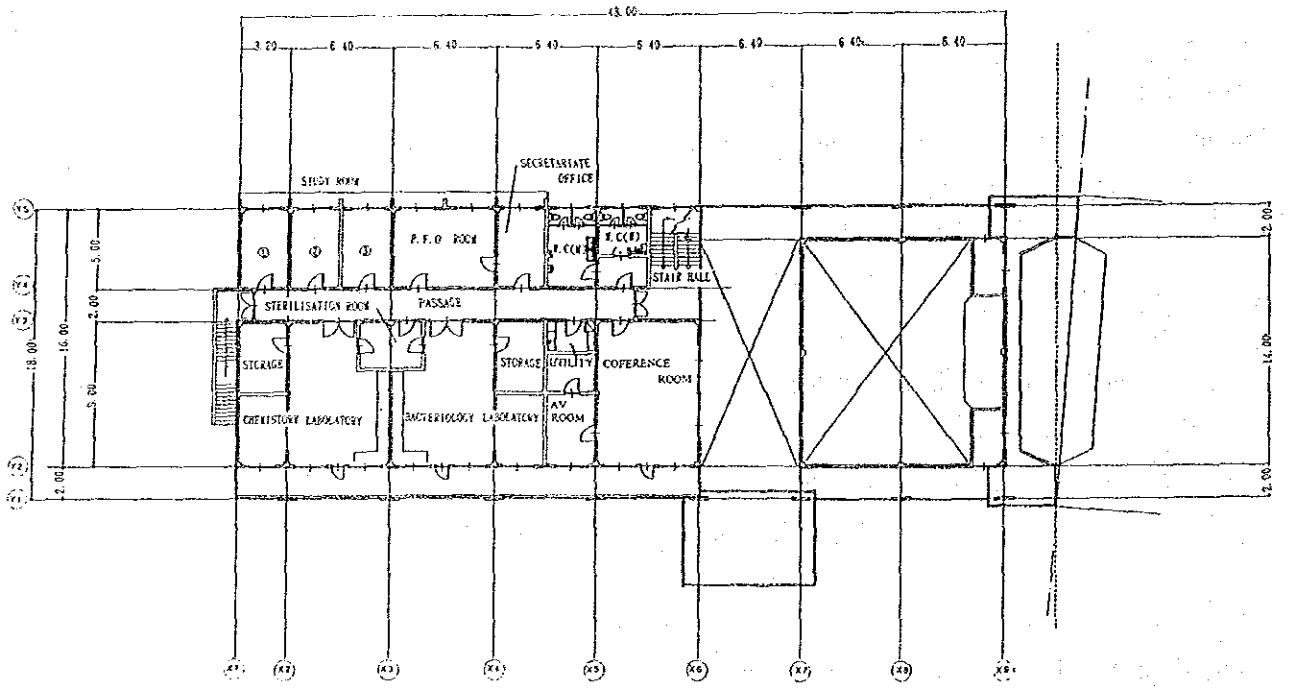
Table 4.3.1: The floor areas for Administration/Research Building

	Room Designation	Required Area (m^2)
Grand Floor		
1)	Administrative Office	37.80
2)	Reception	7.00
3)	Study rooms (4 x 16.00)	64.00
4)	Data room	16.00
5)	Marine Physical Lab	57.60
6)	Marine Ecological Lab	57.60
7)	Expert Office	57.60
8)	Conference hall	179.20
9)	Rest rooms	32.00
10)	Utility room	16.00
11)	Corridor,Waiting area	70.40
12)	Entrance hall	89.60
13)	Stairway.	16.00
14)	Storage	28.80
	Grand Floor area	(729.60 m^2)
First Floor		
15)	P.F.O. Office	32.00 m^2
16)	Secretary's' room	16.00
17)	Conference Room	57.60
18)	AV room	22.40
19)	Study rooms (3 x 16.00)	48.00
20)	Marine Bacteriological Lab	99.20
21)	Chemical Lab	73.60
22)	Rest rooms	32.00
23)	Utility room	6.40
24)	Corridor.	64.00
	First Floor area	(451.20m^2)
	Total floor area	1,180.80m^2

The floor plan for the new Administration/Research Building is given in Figure 4.3.2.



Ground Floor Plan



First Floor Plan

Figure 4.3.2: Floor Plan Administration/Research Building.

(2) Annex Building:

The rooms that are to be located in this building include the research functions for the Marine Conservation Division, the workshop function relating to repairs and checks on aquaculture equipment as well as vehicles, and the generator room housing the back-up generator.

Giving due considerable to the effectiveness of the various rooms, including proper working space, along with ease of access from outside, the workshop, storage , and generator room have been placed on the eastern side facing access road of the Annex Building, while the wet lab, diving equipment room, and rest rooms (including shower rooms) have been located on the western side facing the beach. The outdoor bleach tank has been placed directly in front of the wet lab to facilitate such operations as the delivery of coral specimens.

The floor areas of the rooms in the Annex Building, calculated in the course of setting the span intervals and Floor Plan, are as shown in Table 4.3.2.

Table 4.3.2: The floor areas for Annex Building

Room Designation	Required Area (m^2)
Wet lab	25.00
Diving equipment room	25.00
Workshop	30.00
Machine room	20.00
Storage room	25.00
Rest rooms	25.00
Bleach tank (outdoors)	15.00
Total Area: Indoor equipment	150.00 m^2
Outdoor bleach tank	15.00 m^2

The Floor Plan for this building is given in Figure 4.3.3.

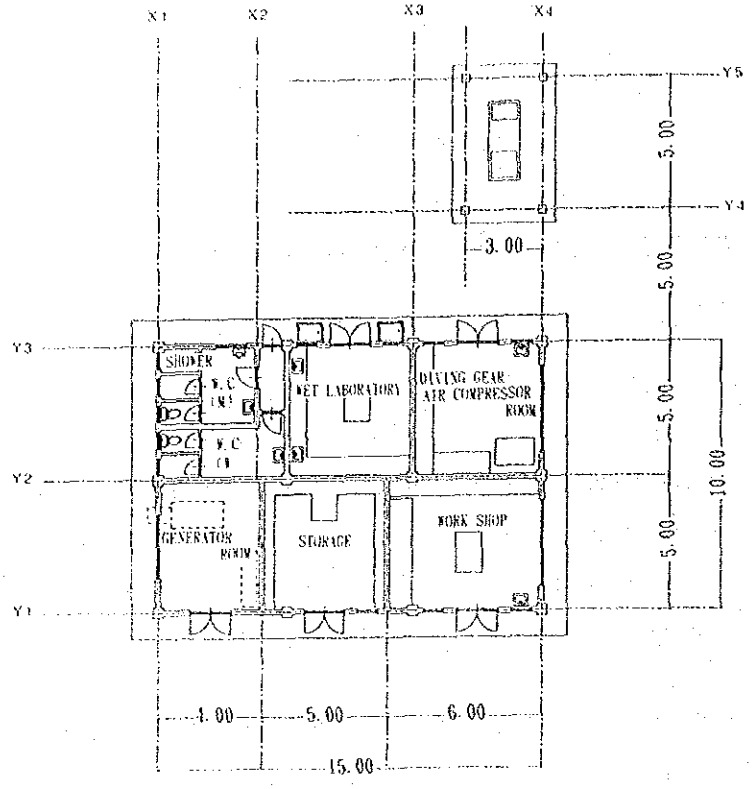


Figure 4.3.3: Floor Plan for the Auxiliary Building

(3) Dining Room/Kitchen:

A floor areas of about 81.00m^2 has been reserved at the main building of the Center for the dining room and kitchen. This is to be composed of 2 rather large rooms (46.00m^2 and 23.00m^2) plus a small room of 12m^2.

Since the required area as calculated on the basis of placement of the required furnishings and fixtures, was 77.40m2, it has been determined that the rooms reserved for the dining/kitchen facilities are adequate. We plan, therefore to place the dining room in the existing 46.00m^2 room, with the other rooms to house the kitchen and a storage room for supplies and utensils. The Floor Plan for the dining room/kitchen areas is given in Figure 4.3.4.

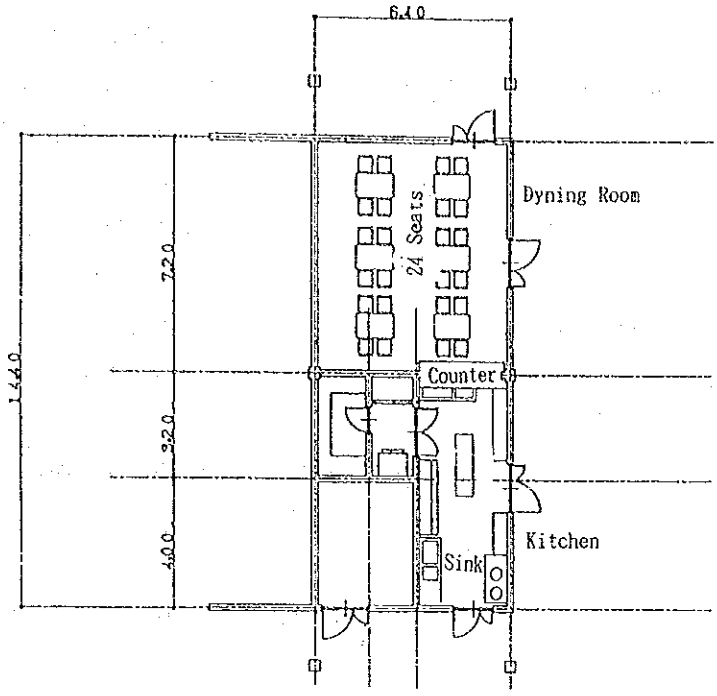


Figure 4.3.4: Floor Plan for the Dining Room/Kitchen

The scale of the expansion facilities at ARFC, as above calculated, are summarized in Table 4.3.3 below.

Table 4.3.3: Scale of Facilities for the AFRC Expansion Program

Facility	Plan Area	Renovation Existing Facility
Administration		
Research Building	1,180.8 m^2	-
Auxiliary Building	150.0 m^2	-
Bleach Tank	15.0 m^2	
Dining Room/Kitchen	-	80.0 m^2
TOTAL	1,345.8 m^2	80.0 m^2

4.3.2.2 Sectional Plan:

The Sectional Plan is closely related to the ventilation, air flow, light, and insulation of the component rooms. In the Administration/Research Building, in view of the need to plan carefully for adequate ventilation and light, the rooms have been placed on either side of the central corridor, with provision for opening directly connected to the open air. In addition,

giving due consideration to protection against direct sunlight and ease of movement within the facility, as well as harmony and continuity with respect to external appearance, we have made use of the outside corridor, as used in the main building of the Center, as the east and west sides of the new facility. With respect to ceiling heights, high ceilings are a common building technique in Mauritius
for insuring good air flow through the windows as well as for solving the problem of heat in the Plan area. Ceiling heights in the existing research building run 2.70 m - 3.00 m, or 3.70 m, including ceiling plenum. These heights were widely observed in comparable buildings.

The ceiling height in the Plan facilities, then, based on these survey values, have been established as shown in Table 4.3.4 below.

Table 4.3.4: Plan Ceiling Heights

Facility	Room Designation	Ceiling Height	Remarks
Administration Research Bldg.	Researchers' rooms, offices and other room	3.0 m	Ground floor : 3.70 m
	Conference hall	5.0 m	Eave height : 7.50 m
	Storage areas, rest rooms	2.5 m	
Annex Bldg.	Generator room, Parts storeroom	3.0 m	Eave height: 3.50 m
	Workshop, wet lab	3.0 m	
	Rest rooms, other	2.5 m	

4.3.3 Components Plan:

The following natural and sociological conditions should be taken into account when considering the components plan:

-- Since the facilities will be on the sea, they will be subject to damage from strong salt winds, including high tides and salt water, particularly during cyclones.

-- The weather is very hot and humid all year round.
-- During cyclones, heavy rainfall is concentrated in very short periods.

-- Since the bulk of the key building materials will be imported products, the Plan should allow ample time for procurement.
-- The size of the building industry in the Plan area is quite small and so cannot handle a large order at one time.
-- Since the Plan is to be implemented under a grant-aid from Japan, the construction period will be limited.

The components plan will be developed on the basis of the above conditions. Unless otherwise noted, the comments in this section apply to both the Administration/Research and Auxiliary Buildings.

(1) Exterior finishes:

1) Exterior walls

The wall materials used in low-to-medium rise buildings in the Plan area are reinforced concrete or hollow concrete block. When finishes are applied, the finishing is done with paint on mortar surfacing. Reinforced concrete and hollow concrete block are the most common materials used in Mauritius and so are readily available at low prices.

In this Plan, we will use hollow concrete block as the basic wall materials and the external wall finish will be paint on a mortar finish.

2) Exterior openings

In the Plan area, wooden or aluminum doors are normally used for openings in commercial structures, while steel doors are used for large openings, as in factories. In this Plan, aluminum doors will, in principle, be used for normal size openings for the offices and private rooms. This material was chosen for its resistance to corrosion from salt winds.

For ordinary windows, the most common materials in the area are wood and steel sash. However, with the spread of air conditioning, many problems have developed with air tightness and rust, and so regular painting is mandatory. Also, since the facilities will be on the seashore, they will be subject to salt damage from sea winds. In deference to the these conditions, aluminum sash windows will, in principle, be specified in this project.

When designing the openings, special consideration must be given to preventing direct sunlight through the use of deep eaves and to preventing rain from blowing in from the sides by paying particular attention to water-tightness.

(2) Interior finishes:

1) Floors

In the principal rooms, such as the PFO room, general offices, study rooms, and the conference room, the standard floor finish will be concrete slab with a mortar coating, covered by vinyl floor tile. In the workshop, diving equipments room, and storage areas, it will be mortar coating on concrete slab.

The entrance hall and outer corridors will be finished with ceramic tiles, for both appearance sake and ease of cleaning.

In the labs, dining room/kitchen, and toilet areas, ceramic tile finish will be used for sanitary reasons.

2) Ceilings and wall finishes

Ceilings will be provided in the offices, study rooms, and conference hall. Open ceilings will, in principle, be used in the generator room, workshop, and storage rooms.

The following materials and finishing will be used, as appropriate, for floors, ceilings, and interior walls.

Ceilings:	paint finish on wood strip sound-absorbent texture, veneers,and waterproof boards.
Walls:	Paint finish on a mortar base, veneer finish.

4.3.4 Structural Plan:

The Plan buildings comprise the Administration/Research and Annex Buildings. The structural system has been determined with reference to the uses, scale, material procurement conditions during the construction phase, and ease of maintenance.

(1) Structural Method:

As both buildings are composed of relatively small rooms, there is no requirement for particularly large spans. And, since the facilities will be built on the seashore, concrete will be used for the pillars and beams, as this material will not require any countermeasures for rust caused by salt air damage and is most widely used in the Plan area. Walls be made of concrete block.

(2) Foundation Method:

At the site for the Administration/Research Building, the surface layer to a depth of about 6m is sand strata of medium density, with an N value of 13-25, followed by a basalt foundation layer. Based on the findings from our soil tests, including core borings, the surface layer is composed of fine quality sand, and it has been determined that the foundation composition can be expected to support a long-term stress for sustained loading of 10-25 tons/ m^2. Since the Plan structure will be a relatively light low-rise (2-story) building, this site is deemed suitable for a supporting foundation, and so the direct foundation method will be used.

4.3.5 Electrical and Mechanical Equipment Plan:

(1) Electrical Equipment:

22KV high-tension overhead lines have been brought into the site. The power for the planned facilities will be supplied from a newly installed pole-mounted transformer to step down to 400V/230V and will be distributed to the main receiving switchboard for branching via a power board. The required power will be branched further at the distribution boards to the final place of use.

The trunk lines will, in principle, be laid underground and within the building, PVC conduit pipes will be used. In planning the power equipment, we have avoided items that are

complex to handle or require considerable maintenance, selecting items that are simple yet effective. From a maintenance standpoint, the items have been chosen wherever possible on the basis of local specifications that are easy to source in Mauritius. The electrical equipment may be classified into lighting equipment and power equipment. Maximum power loads are estimated as follows:

Administration/Research Building:	
Lighting, socket load	45 kva
Power equipment load	
(e.g., Air conditioning equipment)	100 kva
Total	145 kva
Annex Building	
Lighting, socket load	5 kva
Power equipment load	
(e.g., Mechanical equipment)	20 kva
Total	25 kva

Based on the demand loads, as calculated above, the required transformer capacity has been estimated at about 150 kva.

1) Lighting, Socket Equipment

Lighting fixtures in Mauritius are both fluorescent and incandescent; all are imported. For this Plan, we plan to use Japanese made powerboards from the standpoint of safety and reliability, but, in the case of lighting equipment and wiring, we plan to use products that are available locally on the basis of compatibility with local parts, competitive prices, stable supply, and product reliability. Illuminance in the Plan rooms have been established as follows:

Offices, researchers' rooms, general rooms	200 lux
Workshop, utility rooms	150 lux
Corridors, storage areas	100 lux
Rest rooms	100 lux
Outdoor lighting (on premises)	10 lux

Two kinds of sockets will be used: ordinary outlets placed in offices, study rooms, and other locations, and those used for research equipment and instruments in the labs and

workshop. Load voltage will be 230 v/50Hz for general outlets and both single-phase 230v/50Hz and 3-phase 400v/50 Hz for specialized sockets.

2) Power equipment

The load voltage for the power equipment, mainly air conditioning, will be 400 v/50 Hz.

3) Telephone equipment

The main telephone work will be the responsibility of the Mauritius side. In this Plan, we will be concerned only with conduit piping work to the various rooms.

4) In-house generator

A generator will be installed as a standby power source for the lighting and outlet fixtures as well as for the air-conditioning in research areas and the precision instruments located therein. The generator will be equipped with an automatic start-up and shut-off switch.

Engine:	Diesel
Supply voltage:	3-phase, 4 line, 400 V/230 V, 50 Hz
Generating capacity:	50kva

(2) Water supply and drainage; sanitary facilities:

1) Water supply

Water supplied from municipal water mains for storage in a receiving tank, from which it will be pumped up to an elevated tank and then distributed via a gravity feed method to the consuming locations in the Administration Research and Annex Buildings.

Potable water will be used for general purposes in the Administration/Research Building and for equipment washing and similar applications in the labs and for general purposes in the Annex Building. Combined consumption of water in the labs for research purposes and throughout the two buildings for general purposes has been set at 4.0 m^3/day, and we have assumed that the elevated tank will furnish half (2.0 m^3) of daily consumption.

The majority of the water equipment will, in principle, be procured locally, since local supplies are available and no particular problems exist in terms of quality or prices.

2) Drainage equipment

Drainage from the facilities will emanate from the research labs, general water, and soil water. In the Plan, waste water from the research labs will be treated and permeated, while the drainage from the Chemical Lab and the Marine Bacteriological Lab will be drained into a separate tank to make an appropriate treatment.

Waste water will be permeated through soak-away pit, while soil water will first be treated in a septic tank before permeation. Rainwater and miscellaneous water will be directly released into drainage ditches on the premises and treated

Drainage from the workshop will be separated and treated before discharge. For other types drainage, there are no special regulations that must be considered in terms of environmental protection.

(3) Air conditioning equipment:

1) Air conditioners

While the average temperature in Mauritius is about 25℃, it may at times reached 31℃, and so air conditioning equipment is found in the bulk of the existing research facilities. In this Plan, therefore, we shall install air conditioner in the principal rooms of the Administration /Research Building, the conference hall, and the study rooms and labs.

2) Ventilation Equipment

In the general-type rooms which are not air-conditioned, such as the utility rooms, we shall install ceiling fans, and, in the rest rooms, chemical lab, bacteriological lab, wet lab, and dining/kitchen area, ventilating fans will be used.

6) Fire extinguishers

Based on current local laws and ordinances governing fire protection, fire extinguishers will be installed in the storage areas in the chemical and bacteriological labs, corridors, conference hall, Workshop, material storage room, and machine room. The extinguishers will include CO_2, H_2O, dry powder, and ABC type,to be installed according to their respective use. Fireproof doors are required for storage in the chemical and bacteriological Labs.

4.3.6 Equipment Plan:

The equipment has been selected as shown in the Equipment List in Appendix 6. In choosing this equipment, we have tried to attain a level needed to expand research functions at the Plan facility, based on the original request list from the Mauritius Government and after taking into account the specifications and inventory of existing equipment. And since it is anticipated that project-type technical cooperation will be implemented, we have planned the equipment with an emphasis on those items considered to have a high degree of necessity at the present time or items that have a high degree of general application.

The power supply for the equipments has been set at single-phase 230v, 50 Hz and 3-phase 400v/50 Hz.

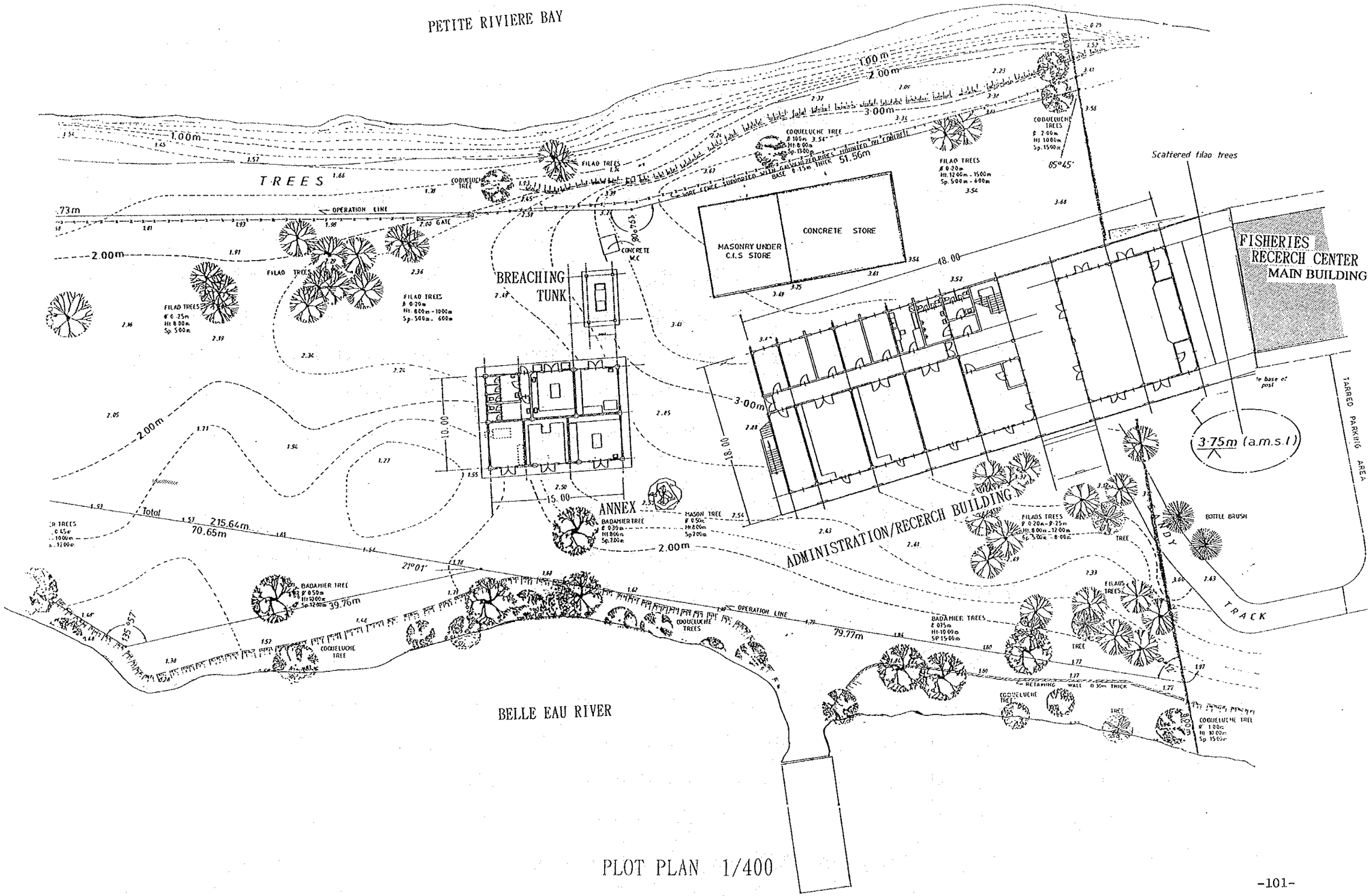
We plan to procure as much of the machinery as possible in Mauritius, particularly in the case of items requiring regular maintenance. It will be necessary to select specific models from the standpoint of local availability of replacement parts and expendables.

The main equipment items are as shown below:

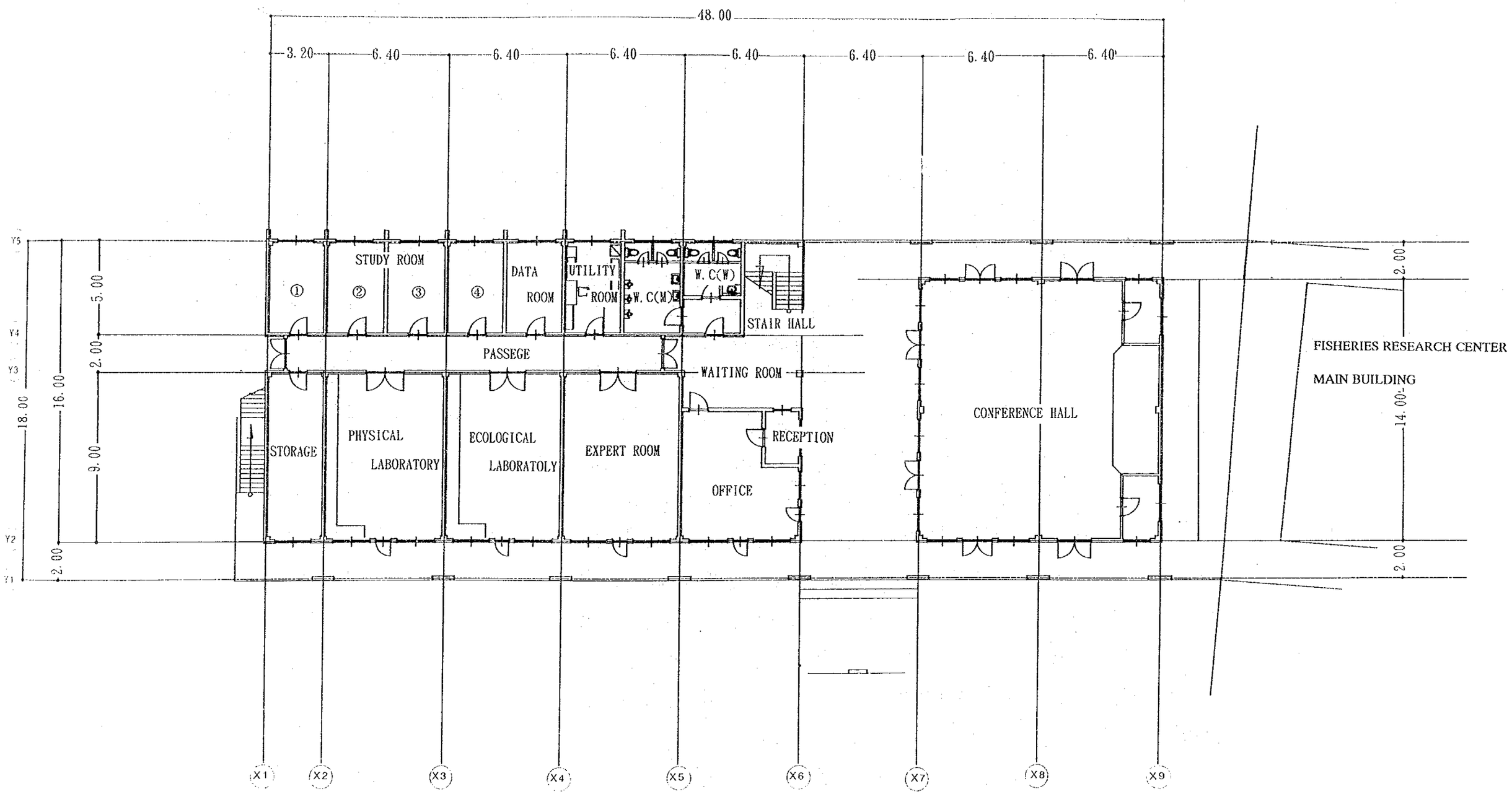
Equipment List

1. Equipment for Ecological Lab.		
Underwater camera	35mm, 28mm, 20mm, 15mm lenses	1 set
Dissection microscope	20x~300x, with camera	1 sceet
Diamond saw	0~300rpm	1 number
2. Equipment for chemical Lab.		
Deionized distillery still	1.8 litters/hour	1 set
Seawater analyses kit	Cr(VI), NO2-N, No3-N, NH4-N, PO4-P	1 set
Auto analyzer	Sulfate ,silicate, nitrate, phosphate	1 set
Supersonic pipet washer	50W, 28kHz	1 number
Turbidity meter	0~1,000NTU, acculacy:±2%	1 number
3. Equipment for Bacteriological Lab.		
Incubator(water bath)	27℃~60℃	1 number
Biological microscope	1,000×, with teaching head set, camera	1 number
Inverted microscope	40×~400×, w/camera	1 number
Clean bench	1,600x800mm	1 number
4. Equipment for Physical Lab.		
Current meter	Range:0.03~3m/sec	2 numbers
Fluorescene analyser	5~200mm	1 number
Echo sounder	Measurable depth:0.3~120m, min. reading 0.1m	1 number
C S T D	salinity/conductivity:0~100ppt/ms, temp. -5~+45℃, depth: 50m	1 number
5. Data Processing Equipment		
Desktop computer	32bit, 25MHz, HD:120MB, RAM:4MB	2 numbers
Photocopier	Copy size: A3(max), 30sheets/min(A4)	2 numbers
6. Educational and Extention Equipment		
Video-camera	8mm, 3CCD	1 number
Video projector	Projected picture size: 100"	1 number
7. Aquaculture Equipment		
Sand filter	60cu.m/hour	2 numbers
UV water sterilizer	60cu.m/hour	2 numbers
Water pump	3 cu.m/min. seawater pump	4 numbers
Fishculture cages	2m x 2m x 4 cages	6 sets
	4m x 4m x 4 cages	6 sets
8. Workshop Equipment		
Electric drills	6.5, 13 mm	1 set
Electric grinder	ϕ100mm	1 set
Hand tools	Plane, files, vise, cutting pliers, wrenches, screw drivers, et	1 lot
9. Boats, Vehicles & Others		
Boat for lagoon research	Pneumatic boat, : length 5m, width 2m	1 number
Boat for shallow water research	FRP, length 7.5m, width 2.5m	1 number
Wagon type vehicle	4WD, diesel, 2,400cc, 5 seater, w/winch	1 number
Pick-up truck	4WD, diesel, 2,500cc, w/winch	1 number
Mini-bus	Diesel, 2,400cc, 15 seater	2 numbers

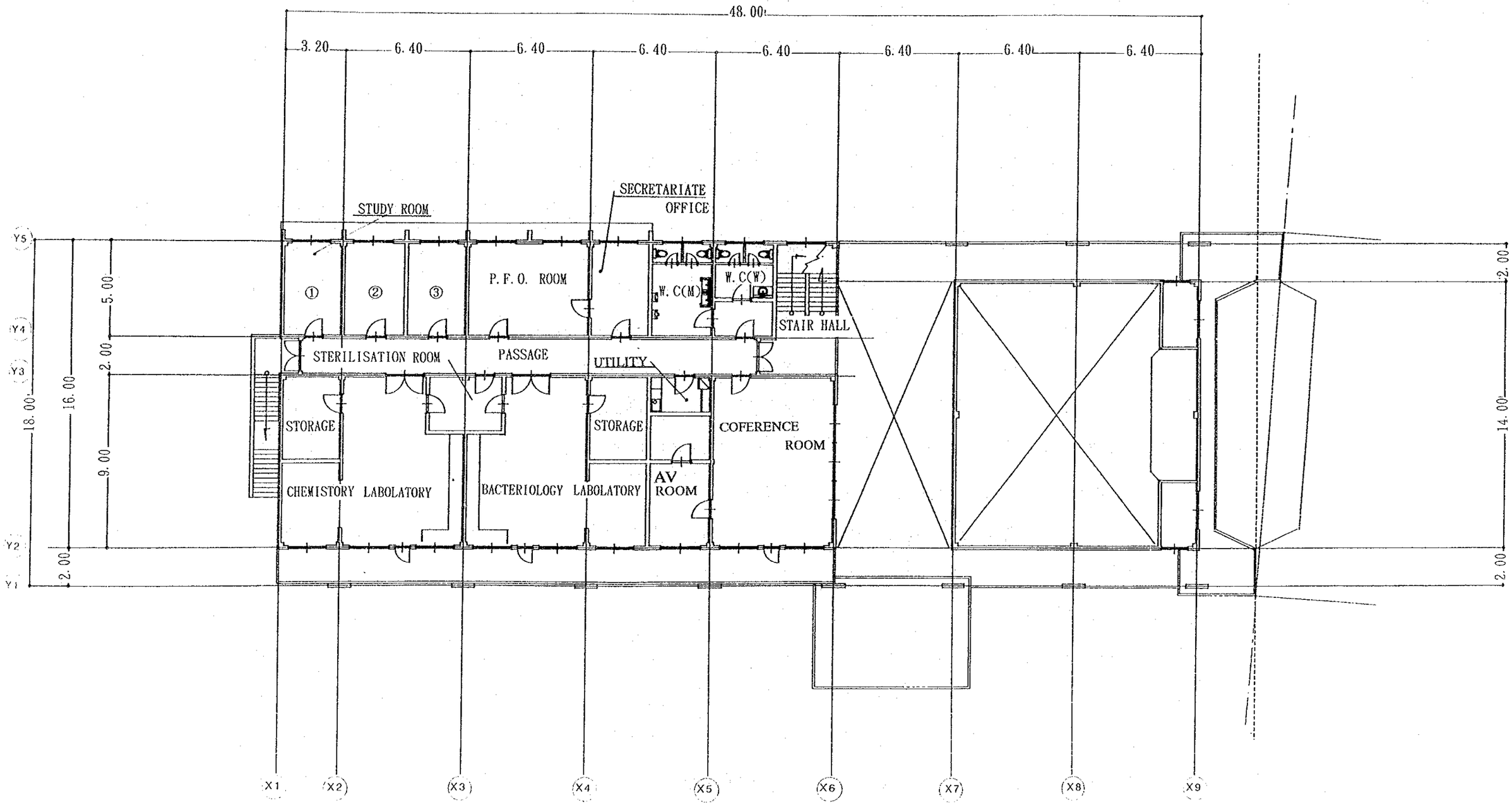
4.4. Basic Design Plans:



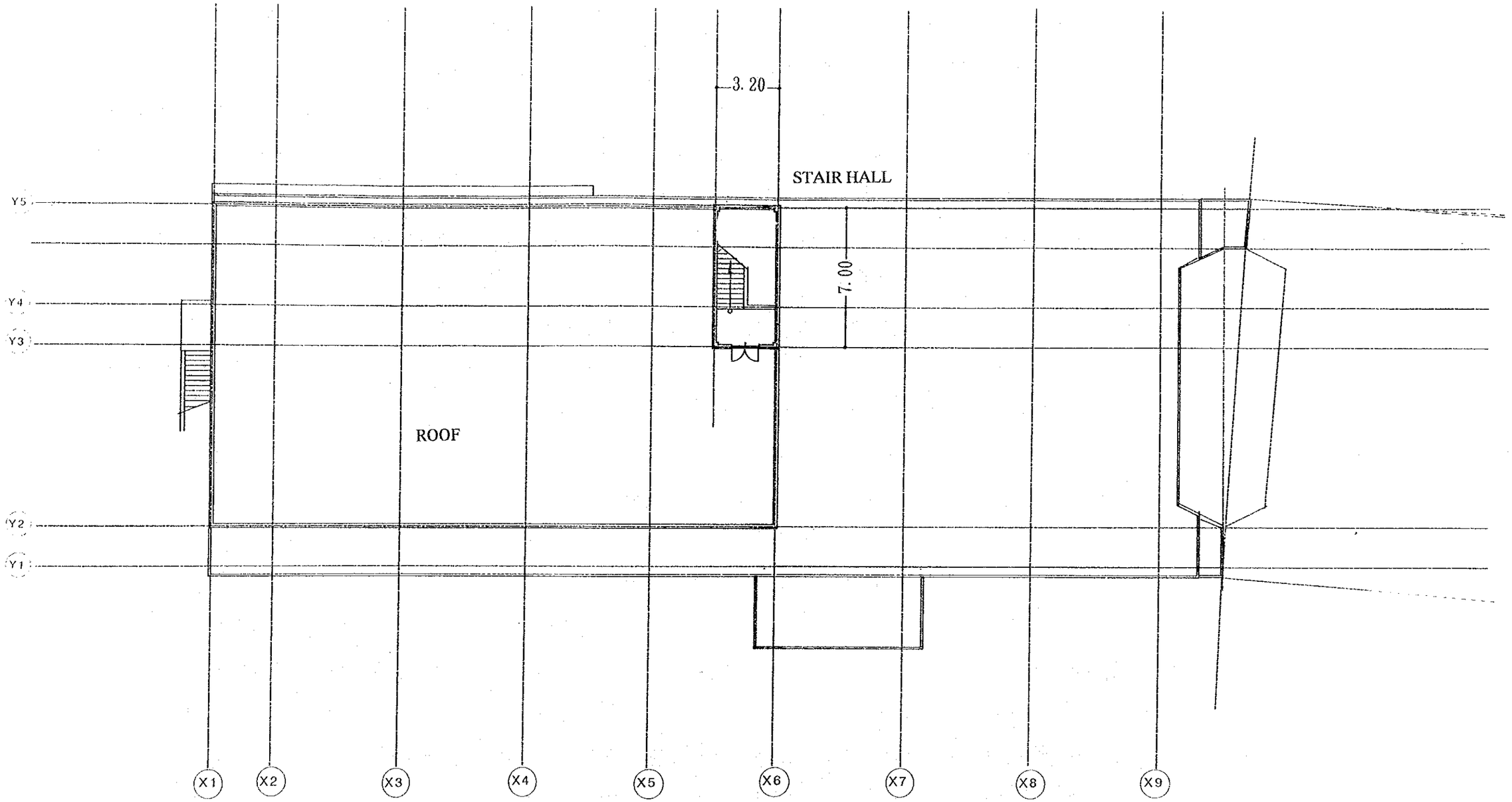
PLOT PLAN 1/400



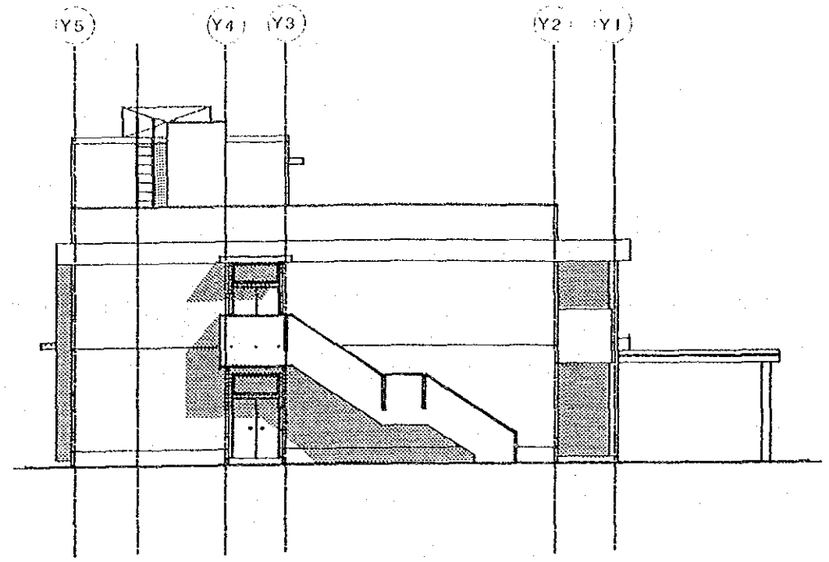
ADMINISTRATION/RESERCH BUILDING GROUND FLOOR 1/200



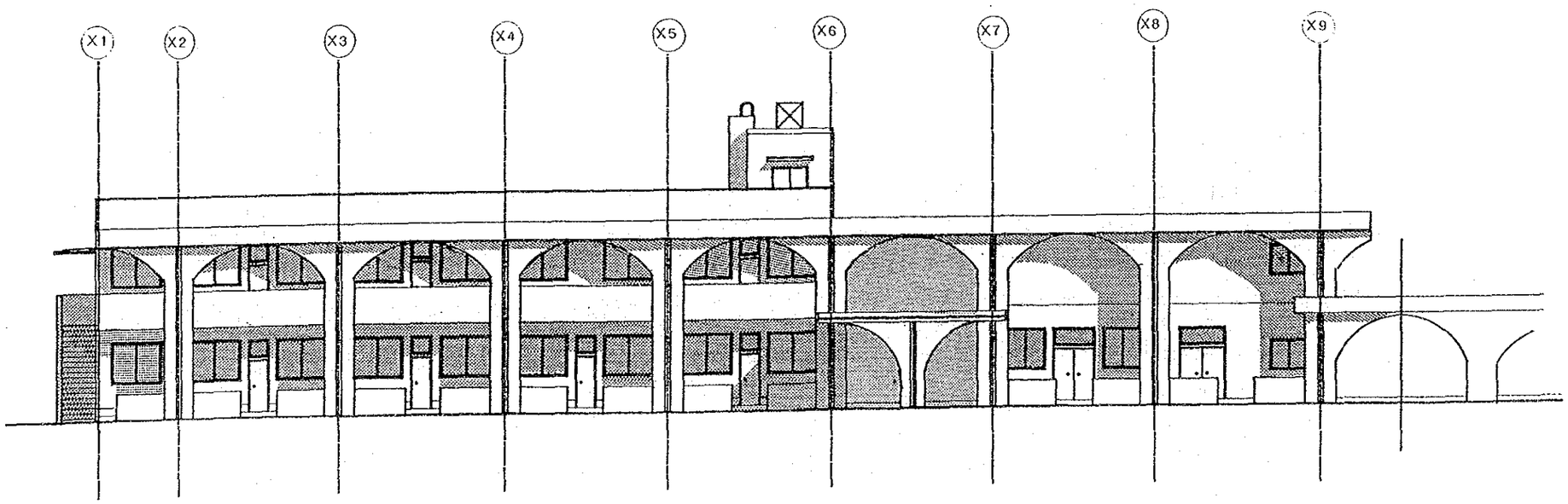
ADMINISTRATION/RESERCH BUILDING FAST FLOOR 1/200



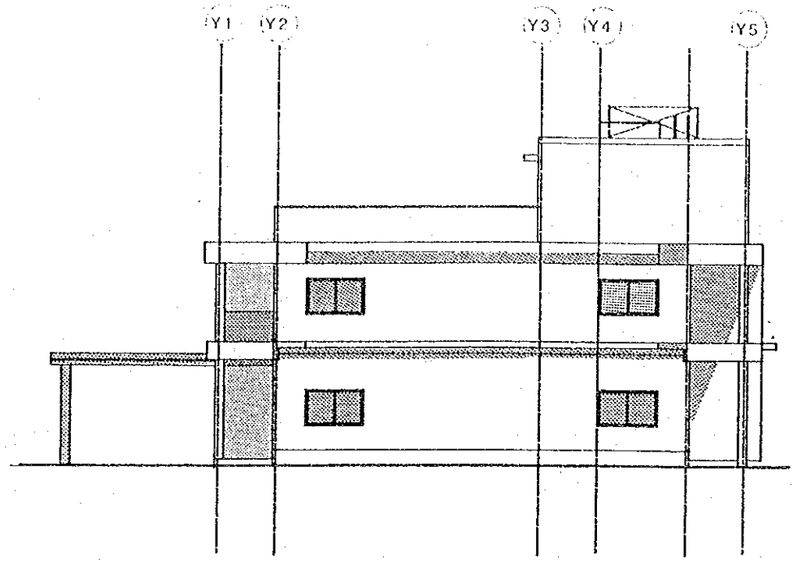
ROOF PLAN 1/200



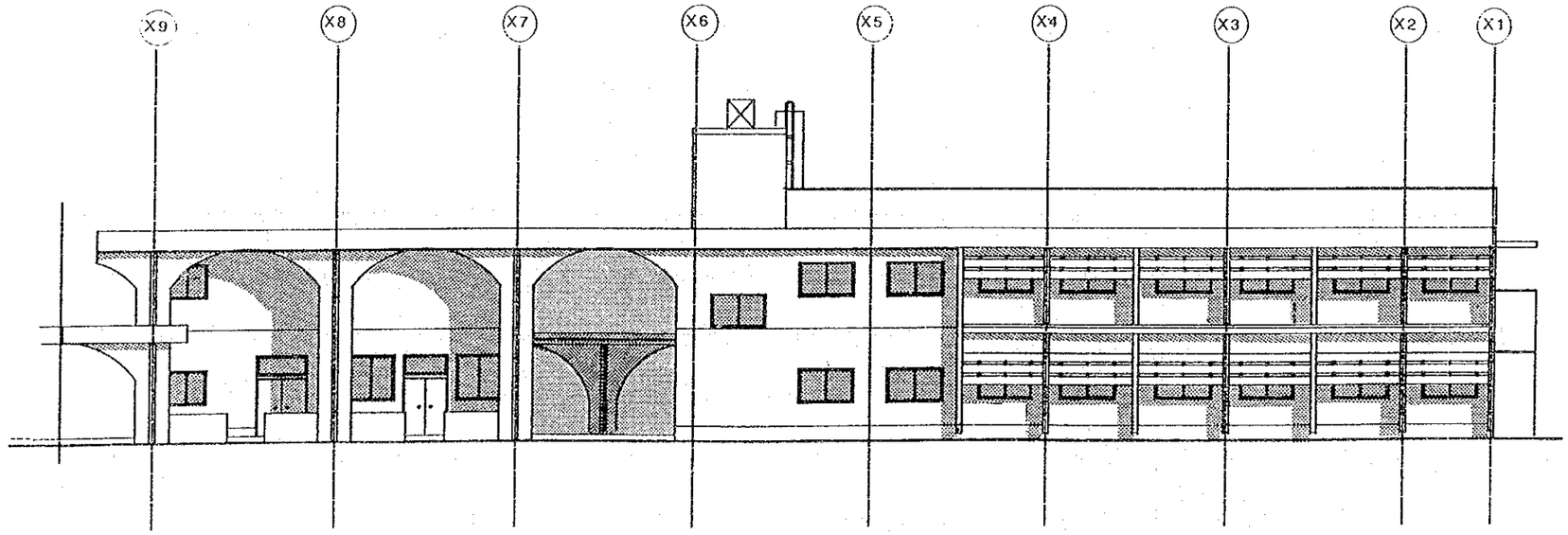
ELEVATION(SOUTHSIDE)



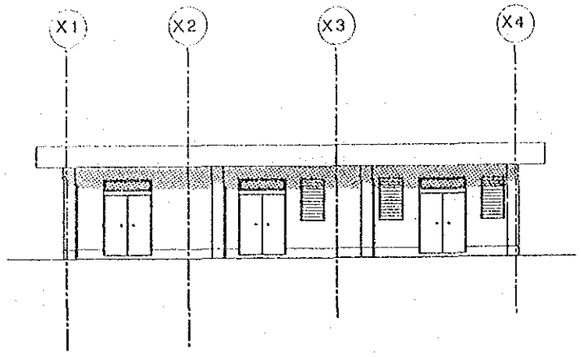
ADMINISTRATION/RECERCH BUILDING ELEVATION(EASTSIDE)



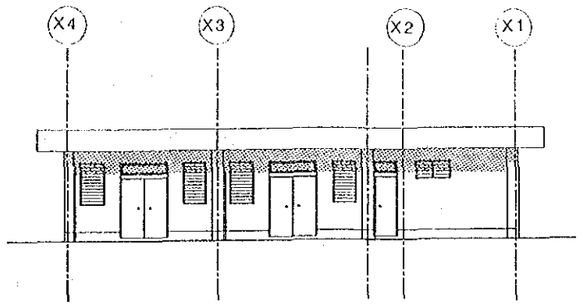
ELEVATION(NORTHSIDE)



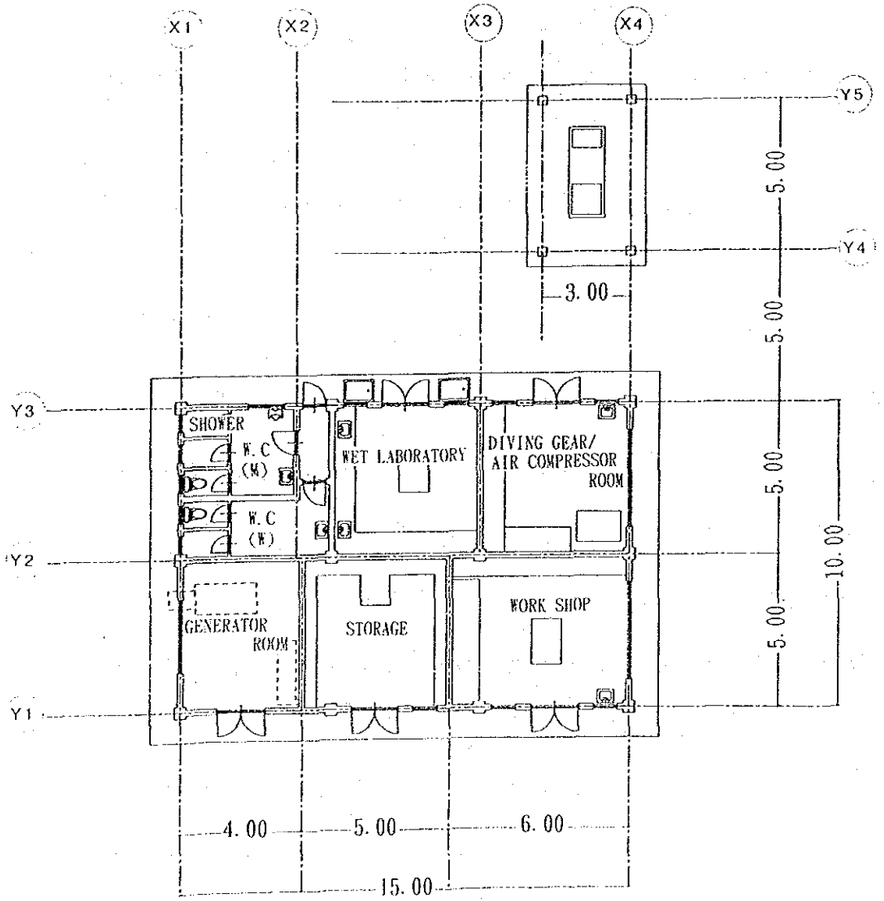
ADMINISTRATION/RECERCH BUILDING ELEVATION(WESTSIDE)

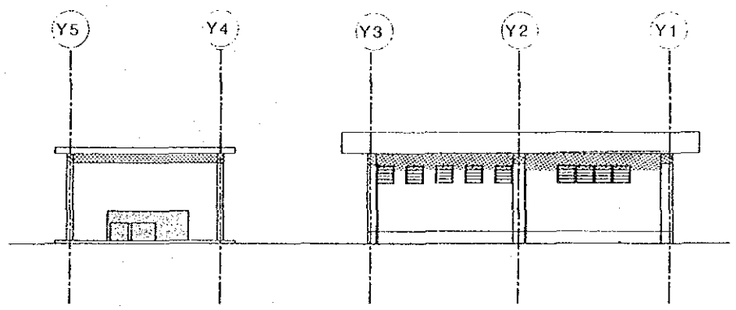


ELEVATION (EASTSIDE)

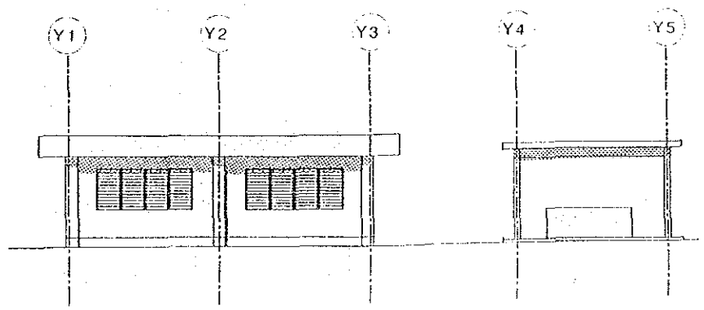


ELEVATION (WESTSIDE)





ELEVATION (SOUTHSIDE)



ELEVATION (NORTHSIDE)

ANNEX 1/200

4.5 Construction Plan:

4.5.1 Construction Policies:

The construction phase of the project can, for the most part, be fully handled with local building methods. The work will progress from the temporary work to foundation, structural, and finishing work, delivery and installation of equipment and materials. The following points should be considered with regard to construction policy:

1) Labor supply, both of skilled and unskilled workers, is ample.
2) The bulk of the materials and equipment under the Plan, with the exception of certain items and electrical materials, are obtainable locally.
   The main procurement materials include concrete, steel frames, and finishing materials. While all can be sourced from local production or imports, in the case of specialty items, or to avoid possible material shortage when placing large orders at one time, careful advance liaison and planning are mandatory.
3) While rainfall at the site is not particularly heavy -- about 800 mm per year --, during the summer months, from October to March, there is a concentration of cyclones. Thus, the first-stage foundation work and final finishing work, which are easily affected by weather, should be carefully programmed.

4.5.2 Special Construction Conditions relative to the Construction Plan:

(1) Special Construction: Condition:

The Plan construction involves buildings, with the target facilities to include a Administration/Research Building and Annex Building. Both structures will incorporate construction techniques that are generally accepted in the area and so will pose few problems.

The construction site is in the suburbs of the capital, and few problems are anticipated with respect to either labor supply or material procurement, though careful controls and supervision are essential to maintain the overall schedule.

(2) Construction Plan:

Local building techniques have been completely incorporated into the construction plan; except for finishing materials and certain equipment and electrical items, the bulk of the Plan materials and labor will be procured locally. Since this project is to be implemented under a grant-aid from the Government of Japan, the understanding and cooperation of local contractors is essential to maintaining grant-aid schedules and securing quality and accuracy in the construction work. Careful liaison and coordination are essential to this end.

With respect to construction supervision, an resident supervisor will be required. Also, in addition to the superintendent provided by the general contractor, construction supervisor, operational supervisor, and mechanical engineer have to be dispatched to the site for required periods, while technicians must also be dispatched for short periods in connection with the construction and electrical work and installation and test operation of equipment.

4.5.3 Construction Supervision Plan:

The Plan will be implemented in accordance with the following procedures. First, after the Exchange of Note between the Government of Japan and the Mauritius Government, a Consultant contract will be signed between a consultant recommended by JICA and the Mauritius Government. The consultant will prepare all detailed plans and drawings, specification sheets, cost estimates along with tender and contract documents, as required for Plan implementation and, subject to the approval of the Mauritius Government, will carry out all procedures relating to tender qualification and evaluation of tenders and tender documents and will select the general contractor, which must be a Japanese national.

Following the signing of the construction contract between the Mauritius Government and the general contractor, the latter will obtain all approvals of construction plans from on consultant, inspect the manufacture of construction equipment, and exercise local supervision of the construction work, with technicians to be dispatched to the site to insure that the work is progressing properly as well as accuracy in the construction work.

4.5.4 Procurement Breakdown for Construction Materials:

(1) Main Materials:

The construction materials used in the Plan will, in principle, be sourced wherever

possible in Mauritius. Sand, gravel, concrete blocks,lumber products, and cement are all produced in the country.

In addition, steel components and fixtures, aluminum sashes and doors are locally assembled, while imported supplies of electrical materials, sanitary materials, glass, and tile are available on the local market. We have established that a portion of these materials can be procured locally in the volume required for the project.

However, certain items that are neither imported nor made locally, plus certain other equipment, like water pumps, which it is advantageous to import, from the standpoint of quality, delivery time, or price, as well as powerboards and other electrical supplies, where a reliable system is essential, we plan to use Japanese products.

The procurement breakdown by source area for the principal construction materials is shown below:

Main construction materials	Source
Construction Material	
Sand	Mauritius
Gravel	Mauritius
Cement	Mauritius
Steel frames	Mauritius
Wood products	Mauritius
Fittings	Mauritius
Paint	Mauritius
Main equipment items	
Electric wire	Mauritius
Lighting fixtures	Mauritius
Ceiling fans	Mauritius
Switches and sockets	Mauritius
Main /branch powerboards	Japan
Air Conditioner	Japan/Mauritius
Water and drainage pipes	Japan/Mauritius
Sanitary equipment	Mauritius
Pumps and valve	Japan/Mauritius

(2) Construction Machinery:

The Plan does not require any specialized construction machinery but general construction machinery will be required to move the materials. Since a lease system is well established for machinery in Mauritius, the requisite equipment can be sourced as needed, and it has been determined that no special problems exists with booking this equipment at the appropriate time. Accordingly, we do not plan to bring in construction equipment from Japan.

(3) Equipment:

The equipment will, in principle, be sourced from Japan, but the FRP boats, personal computer,photocopy machine, and research furnishings can be more properly maintained if supplied within Mauritius. Accordingly, price-competitive items in this category will be sourced locally.

4.5.5 Transport Plan:

The principal items to be procured from Japan for this Plan are a portion of the equipment and materials of the facilities, research and aquaculture equipment, vehicles, and rubber boats for research use. There are roughly 10 scheduled sailing a month from Japan to Port Louis, and the route is serviced by a number of shipping companies. While transit time varies by company, it generally runs about one month. The equipment will be transshipped at Port Louis for overland shipment to the Plan site.

4.5.6 Division of Responsibility:

(1) Areas for which the Government of Japan will assume responsibility:

If the Plan is implemented on the basis of a grant-aid from Japan, the Government of Japan will assume responsibility for the following items:

1) Construction of the Administration/ Research and Annex Building, which constitute the main structures.

2) Procurement and installation of the research and aquaculture equipment.
3) Consulting services, including implementing design, assistance with tenders, and construction supervision.

(2) Areas for which the Mauritius Government will assume responsibility:

If the subject Plan is implemented on the basis of a grant-aid from Japan, the Mauritius Government will assume responsibility for the following items:

1) Securing and preparing the construction site, plus required landscaping after completion of the work.
2) Acquiring all construction and other necessary permits and licenses, as required for Plan implementation.
3) Removal and dismantling of obstructions on the site or underground.
4) Intake work for power and water into the site as well as procedures and costs related to this work.
5) Obtaining duty exemptions and expediting customs clearance of all imported materials under the Plan.
6) Exempting Japanese nationals present in Mauritius for Plan implementation from all taxes and surcharges with respect to the performance of Project services.
7) All other items required for Plan implementation not specifically included in the responsibilities assumed by the Government of Japan.

The estimated project cost tobe borne by the Government of Mauritius as followings.

1)	Site levering work	approx,	Rs. 165,500
2)	Power supply work	approx,	Rs. 827,800
		Total approx,	Rs. 993,300

4.5.7 Implementation Schedule:

The Plan implementation schedule will be divided into the following phases: detail design, including tender services; construction work on the Administration/Research and Auxiliary Buildings; and equipment supply.

While the Plan site is in the capital area and, based on existing conditions in Mauritius, no problems are envisaged with respect to the availability of skilled labor for the construction

phase or with the procurement base for construction equipment and materials, in planning the implementation schedule, by the very nature of the project, to adhere strictly to construction schedules, a detailed implementation schedule will be required, based on due consideration of the sourcing plan for materials and labor as well as natural conditions.

In connection with the implementation schedule, consideration will be given to a realistic progress plan for facility construction phases, Construction work should be classified by its particular character: construction that must be done ahead of the main construction work; construction that can be done concurrently, and construction can be carried out independently. After due consideration from the standpoint of the preparation plan, materials procurement, construction period, and construction costs, the optimum construction schedule will be set. With respect to equipment, it is expected that the main items will be procured in Japan, for selected items, we believe that provision will have to be made for installation and test operations.

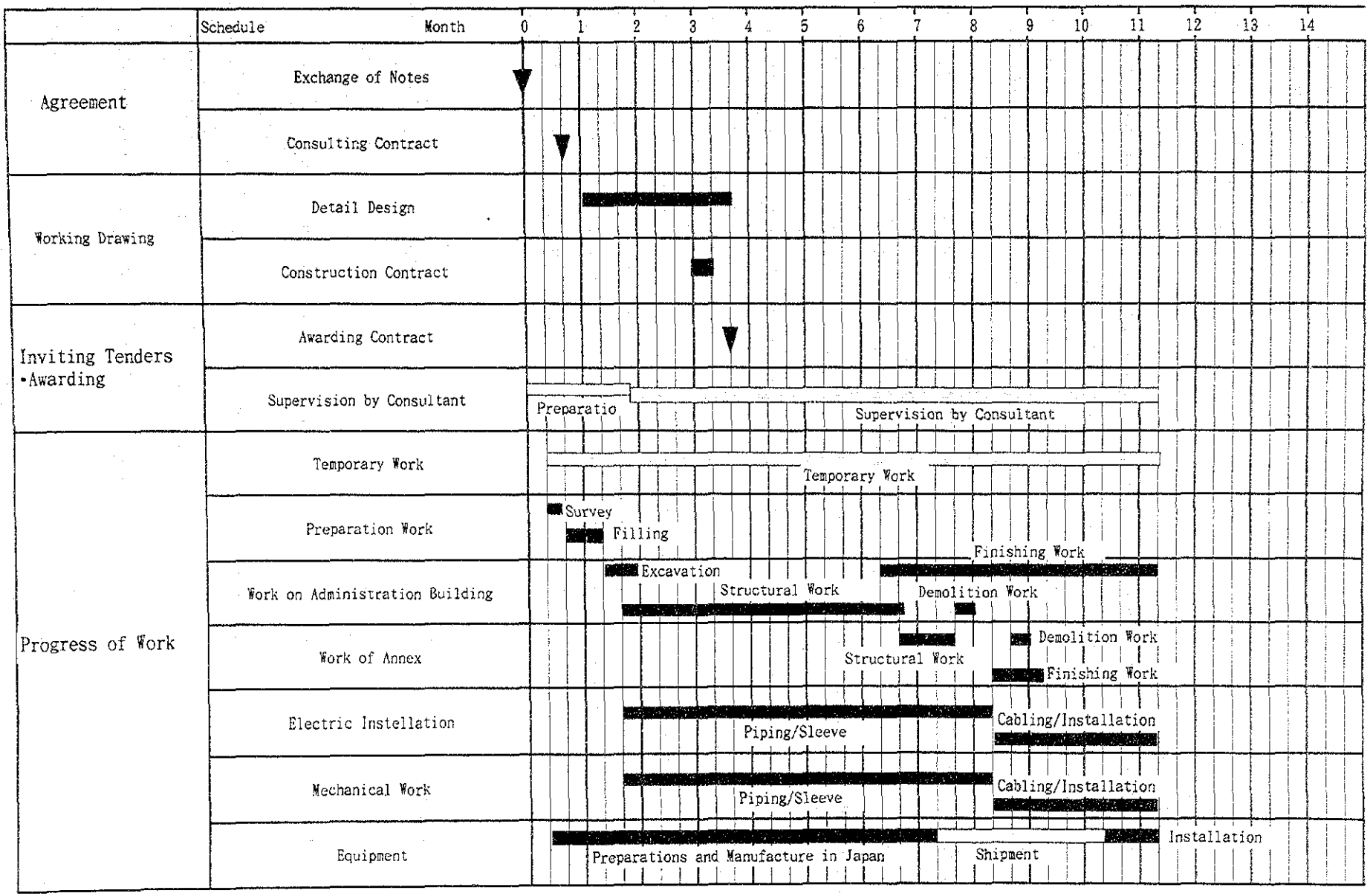
The principal procedures in the construction phase may be broadly classified as follows:

1. Construction work--
   Administration/Research and Annex Buildings
2. Electricity, water supply/drainage, and sanitary equipment--
   Intake construction, construction of trunk lines, wiring, piping, and installation of instruments and equipment
3. Equipment supply--
   Transport and installation of the equipment to be used in the project

The facilities involving the longest construction time will be the Administration/Research Building, which is expected to require 10 months, and the Annex Building, which will be completed in 5 months. While the construction work is technically divided between these two buildings, we have determined that, on the basis of building conditions in Mauritius, there would be no obstacle, in terms of either construction type or scope, to performing the work on these two buildings simultaneously. Accordingly, we consider it appropriate that the construction work and equipment supply under the Plan be undertaken as a single project.

The implementation schedule is shown in Table 4.5.1

Project Implementation Schedule



SECTION FIVE: PROJECT EVALUATION AND CONCLUSIONS

5.1 Project Evaluation:

Although the Republic of Mauritius relies heavily on food imports, it also earns foreign exchange from exports of fish products, mainly tunas. Yet the country continues to depend on imports for its domestic fish consumption, with imports equal to or sometimes even exceeding fish exports. The Government, moreover, projects a further increase in domestic fish demand in the future.

Against this background, the Government has adopted policies to expand fish production. However, the coastal fishery has been overfishing in the lagoons and so is not in a position to meet the rising demand. The Government, therefore, has been applying its energies to aquaculture development and to achieving effective utilization of the Banks and offshore fishery resources, primarily through the Albion Fisheries Research Center (AFRC), the country's only research organization in the fisheries field.

On the other hand, the magnificent scenery created by coral concentrations along the Mauritius coastline has become a major tourism resource. In this connection, preservation of this superb natural environment is of vital importance, not only to the conservation of fishery resources but to the development of the Mauritius economy as well. In addition, the clamor of the Mauritius people for improvements in the quality of life has become increasingly insistent, particularly the desire to preserve the country's rich and beautiful environment.

This matter has now developed into a public issue, and the research projects being conducted by AFRC in the field of marine conservation represent the foundation of a concerted effort to respond to this issue.

In this respect, proper implementation of the Expansion Plan for the Albion Fisheries Research Center has major significance not only as a means of responding to the policy initiatives of the Mauritius Government but also as a guarantee to the Mauritius people that their demand for environmental conservation will be met.

Based on implementation of this Plan, it is expected that: