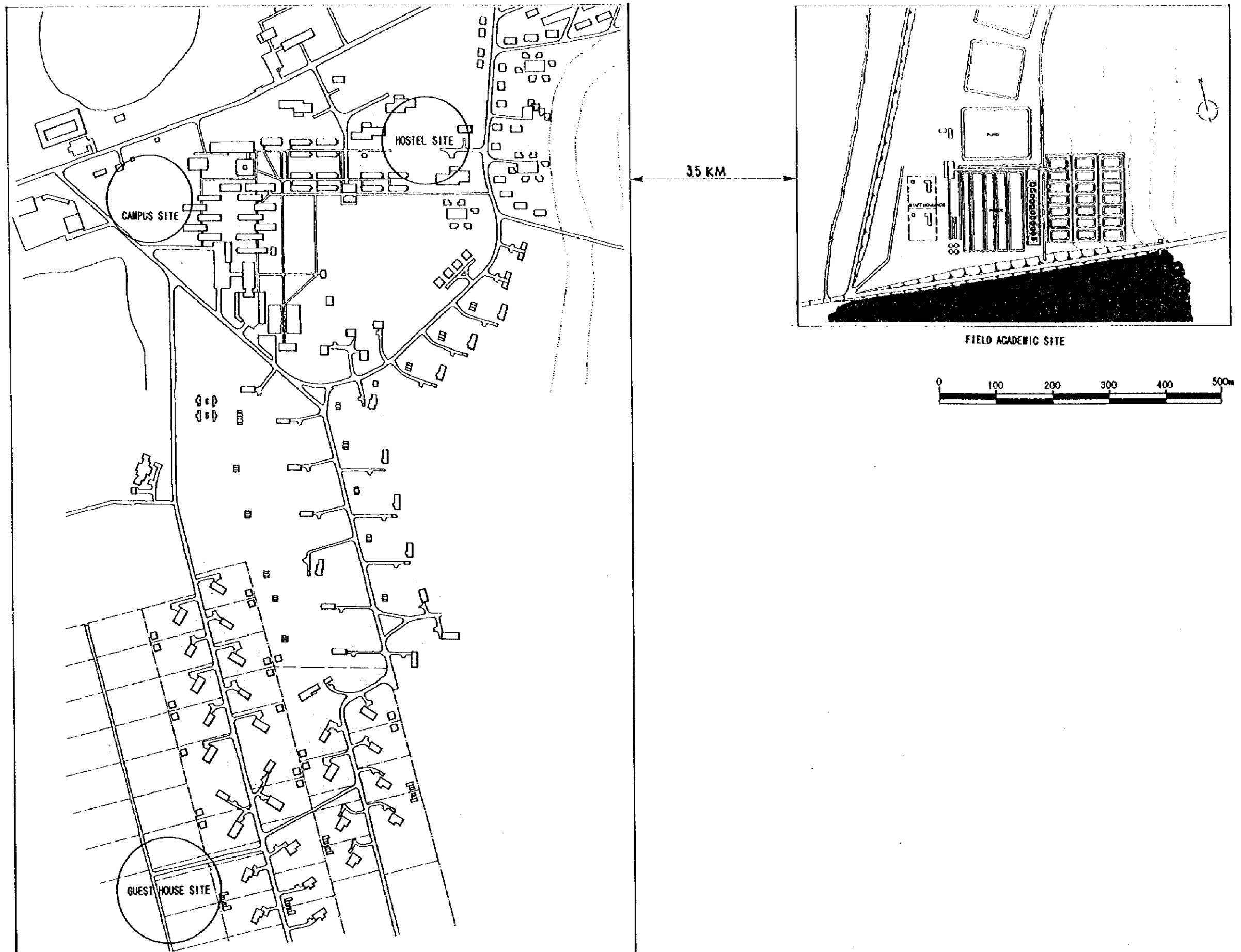
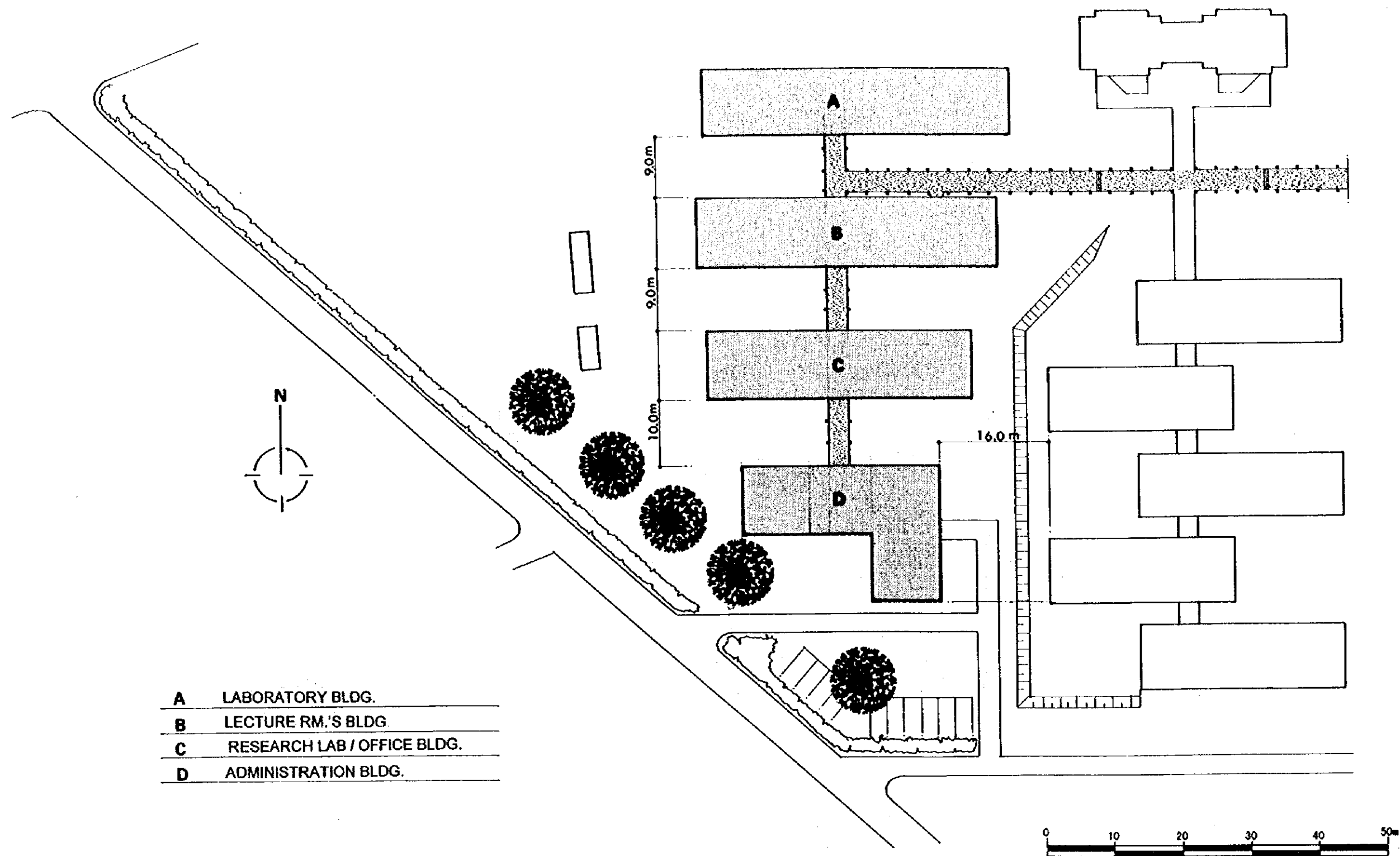


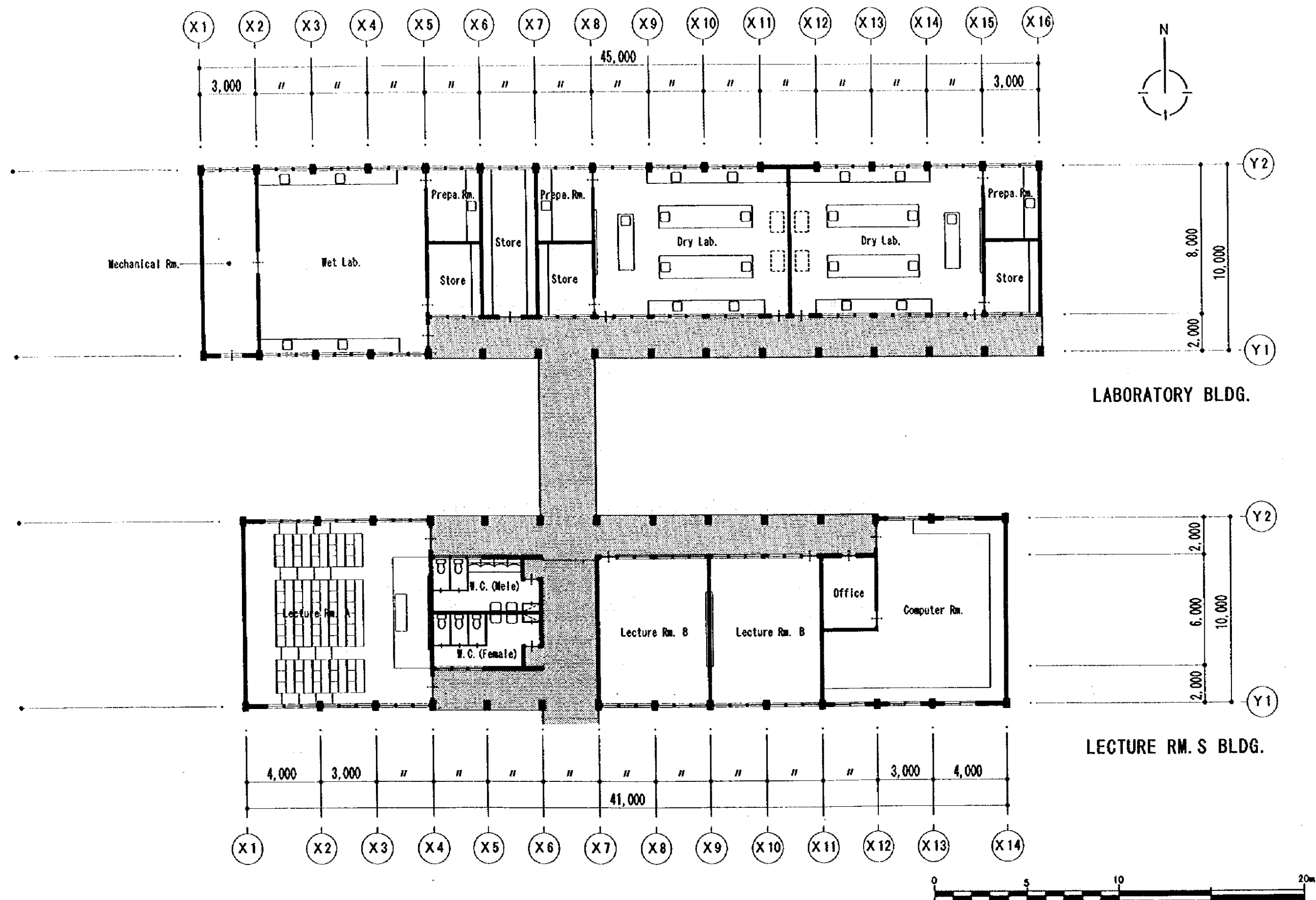
## **BASIC DESIGN PLAN**



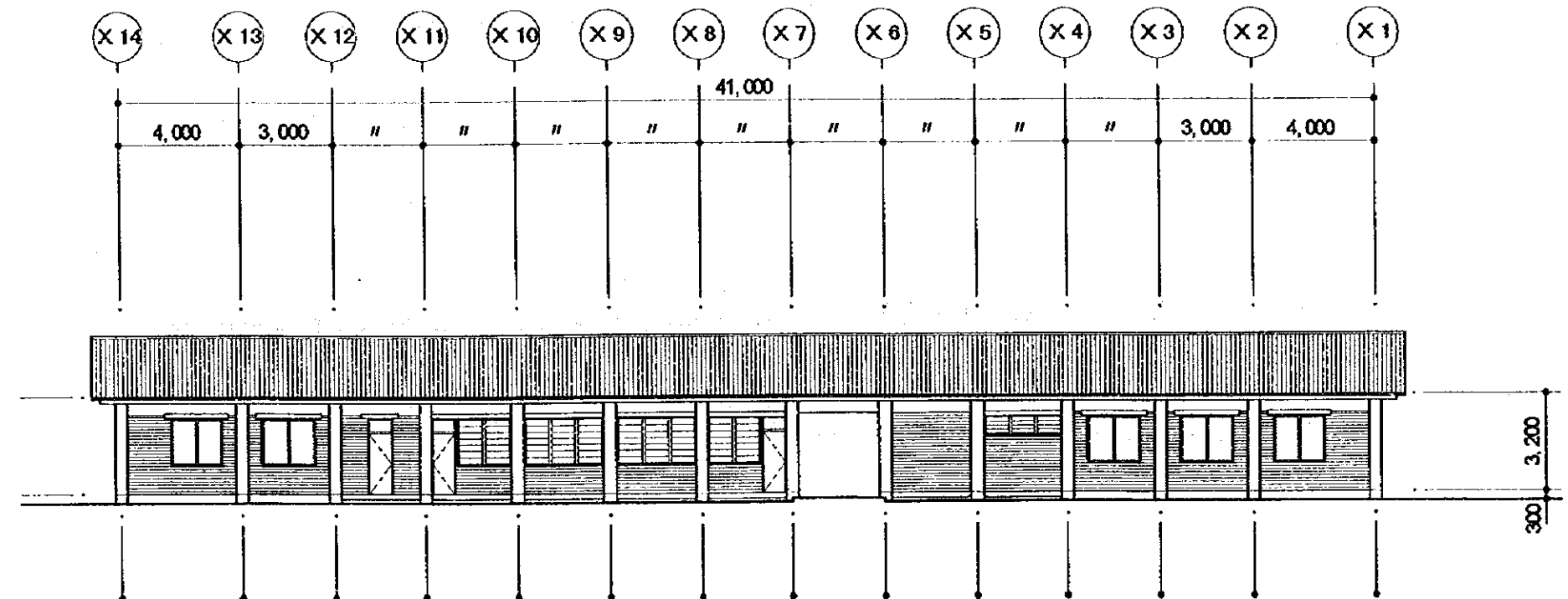
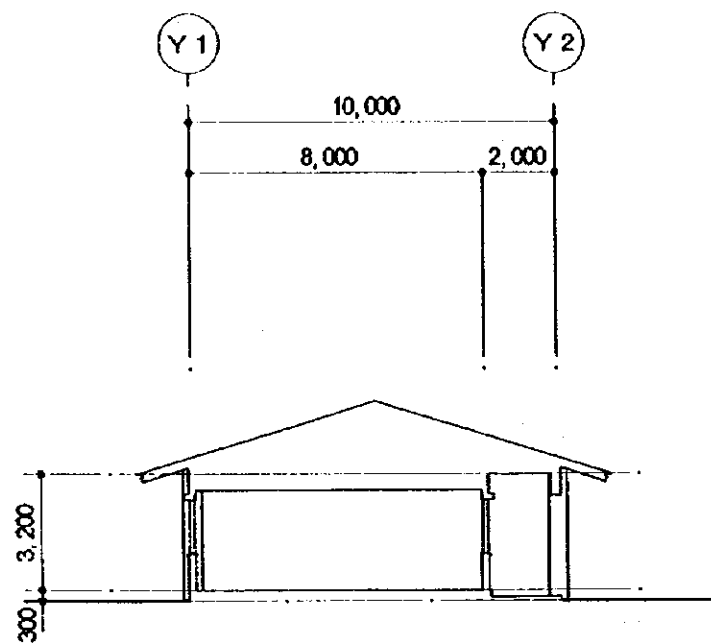
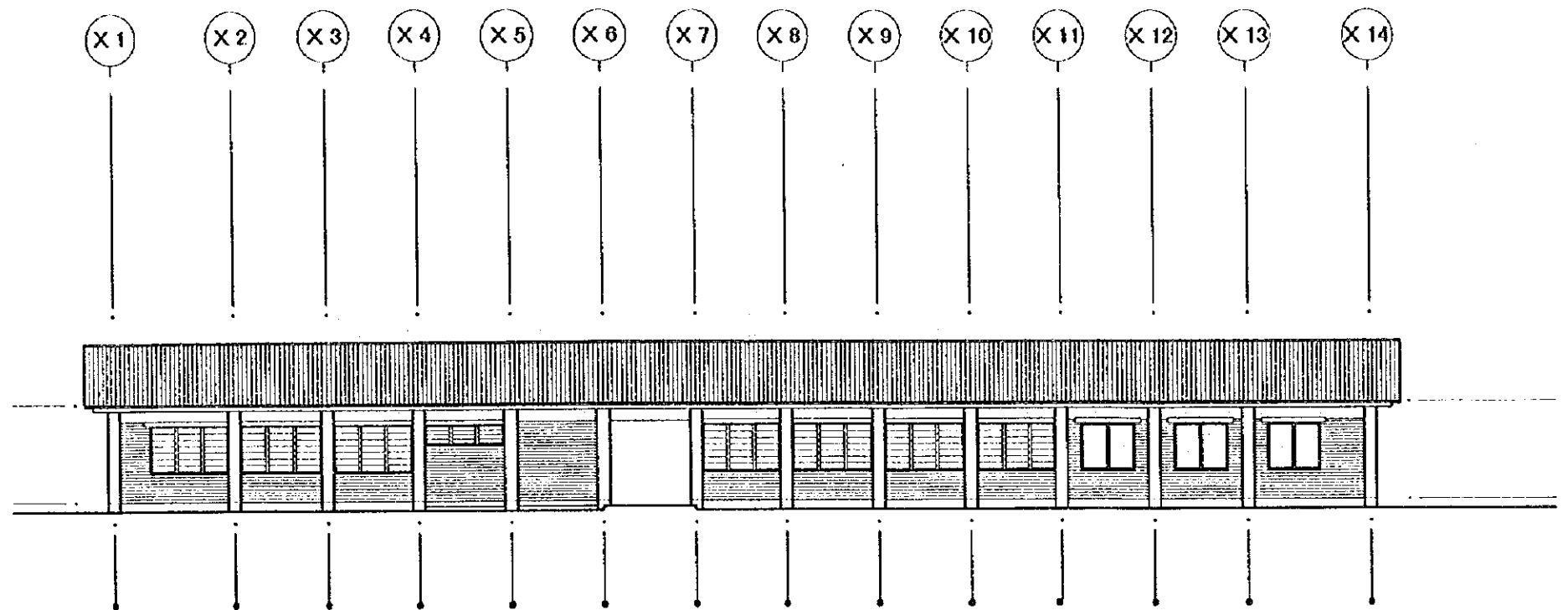
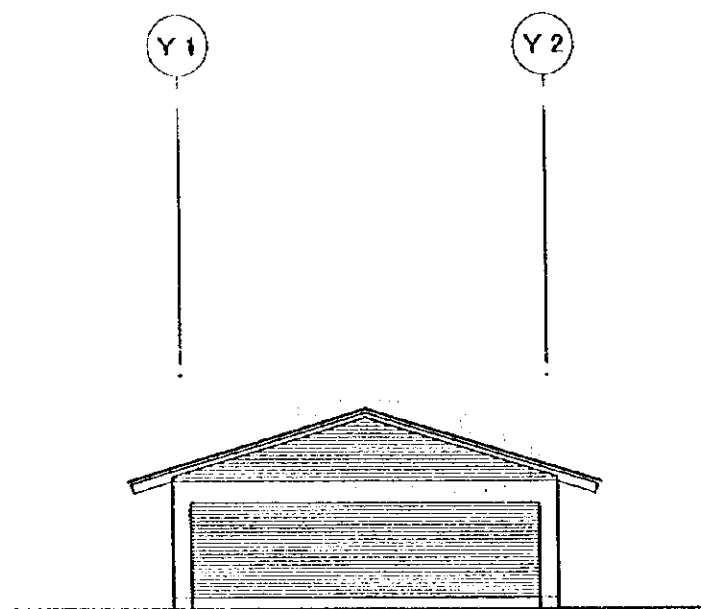


LOCATION PLAN

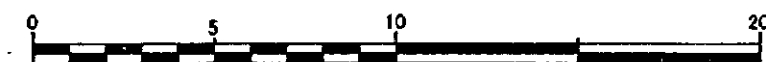
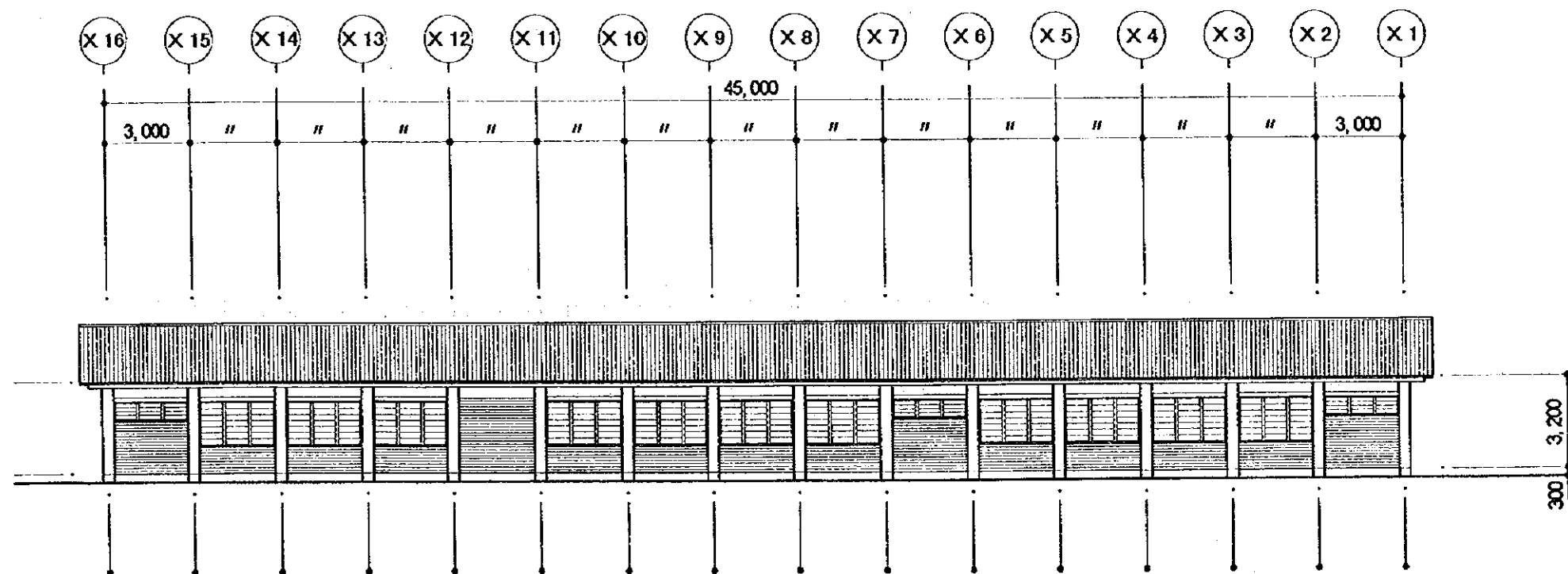
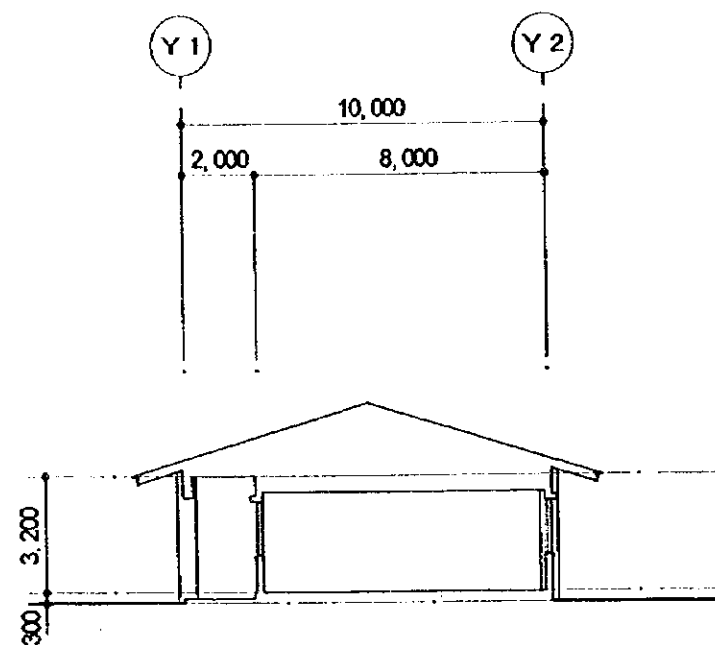
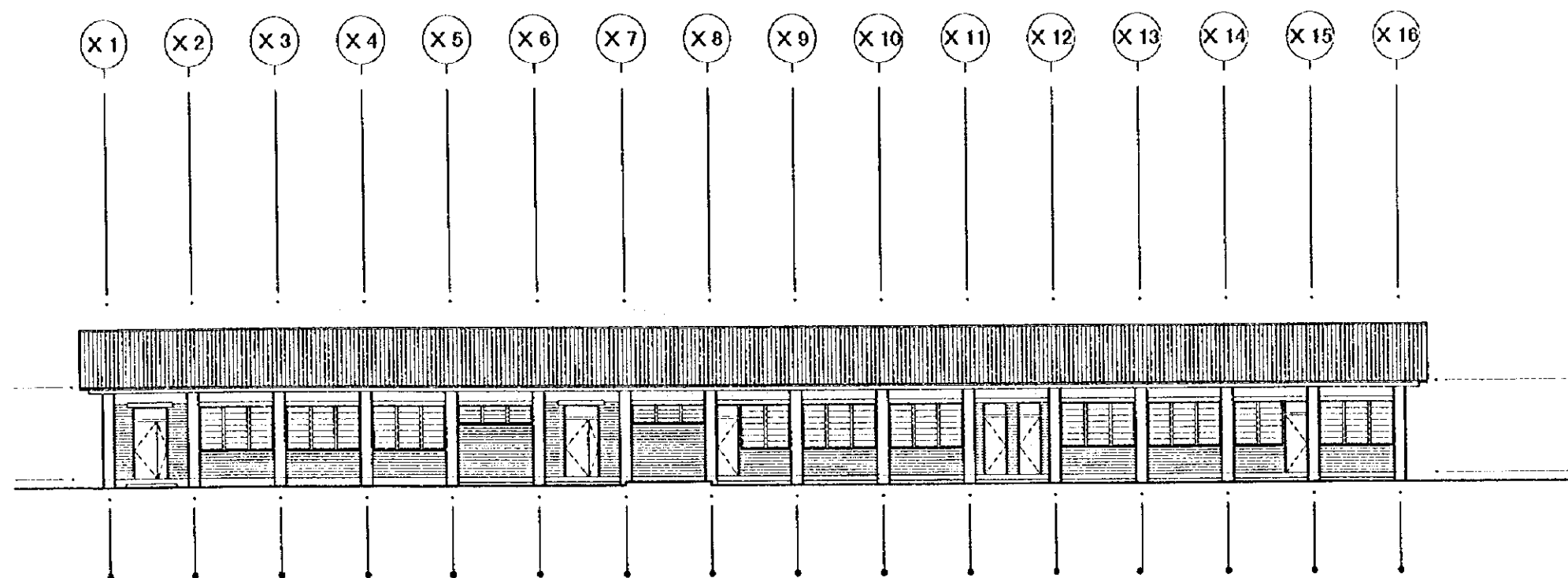
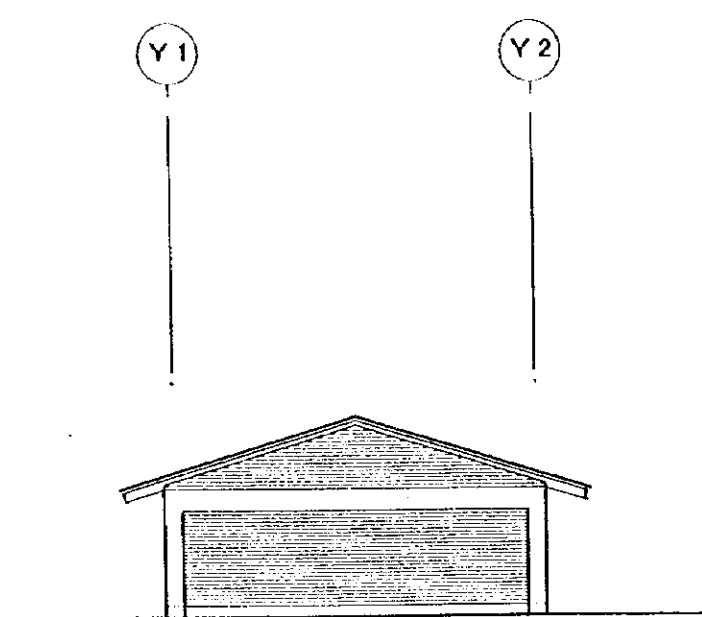




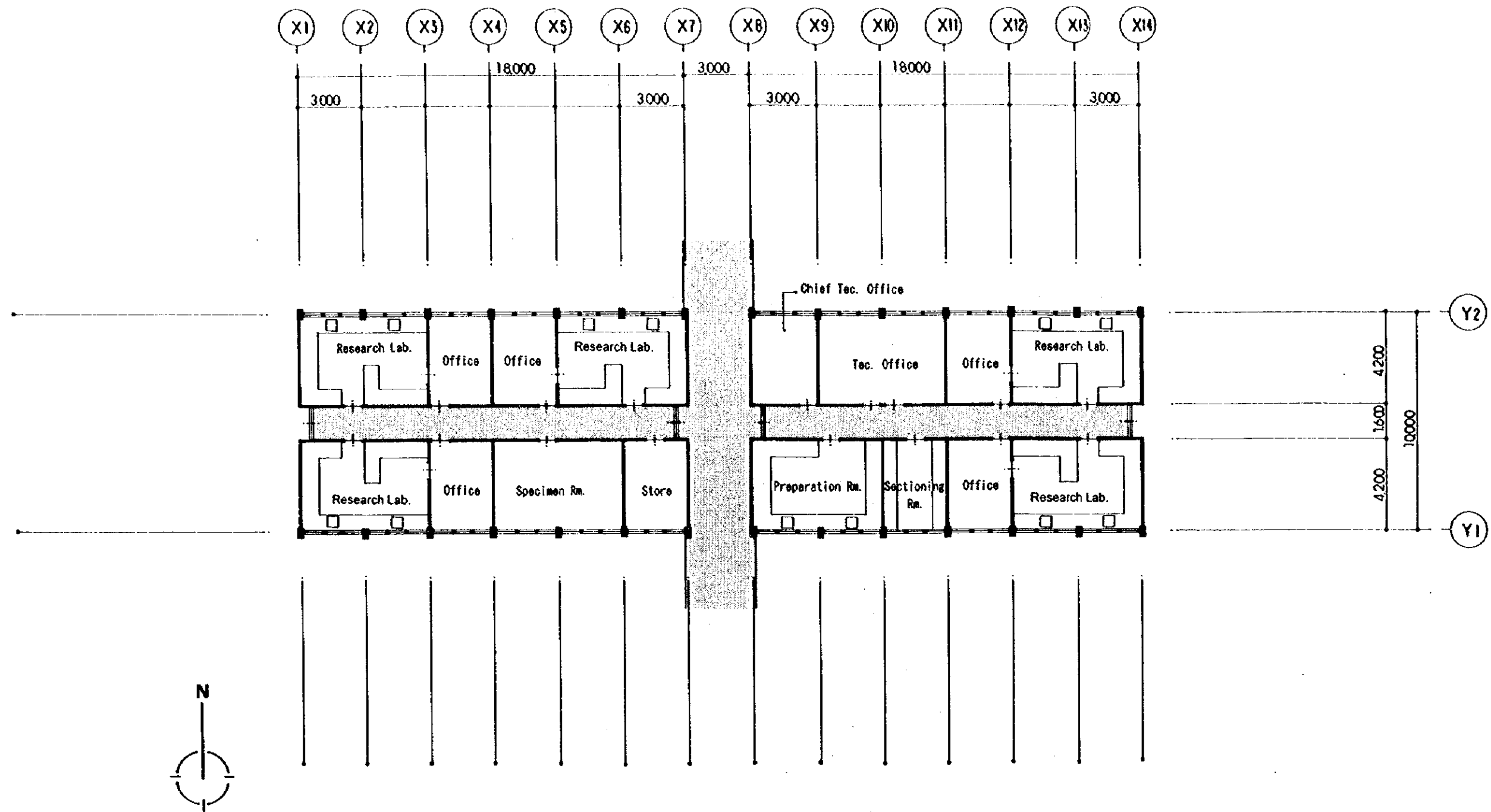
LABORATORY BLDG. / LECTURE RM. S BLDG. GROUND FLOOR PLAN



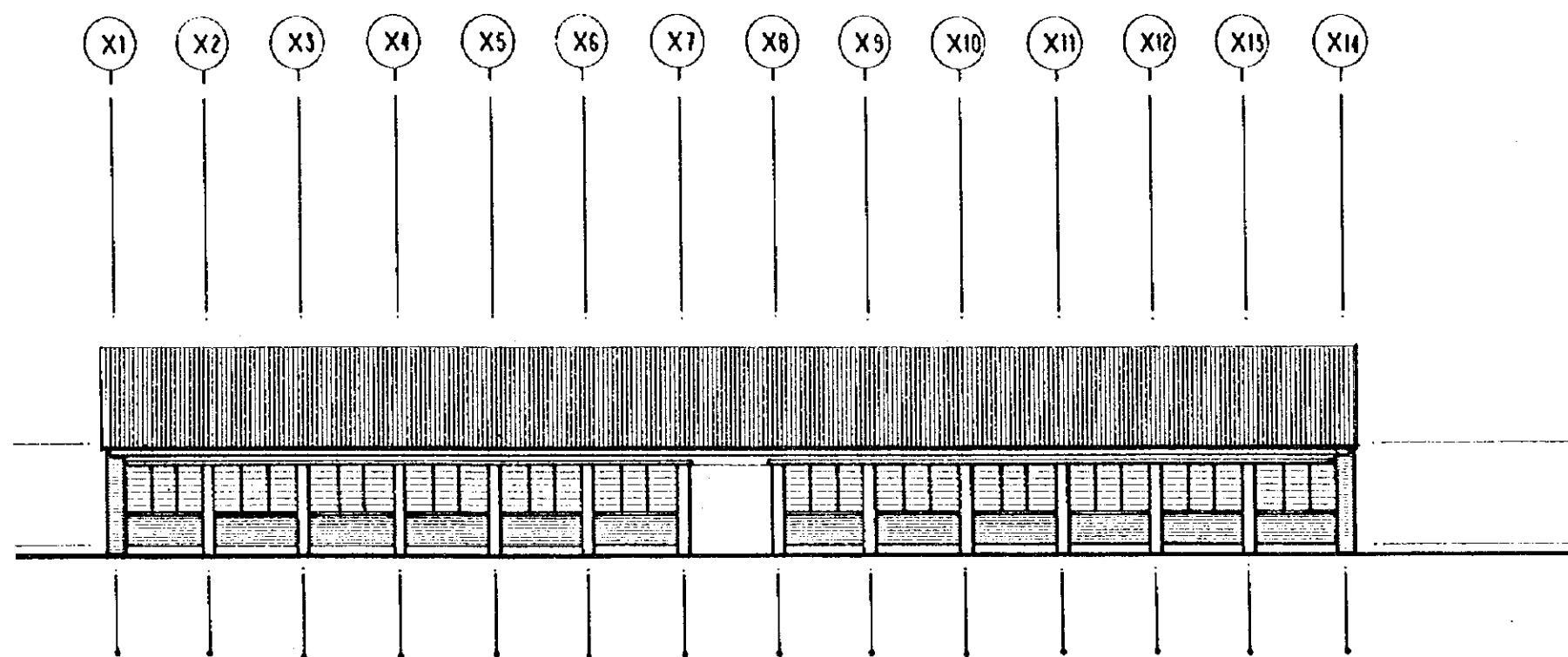
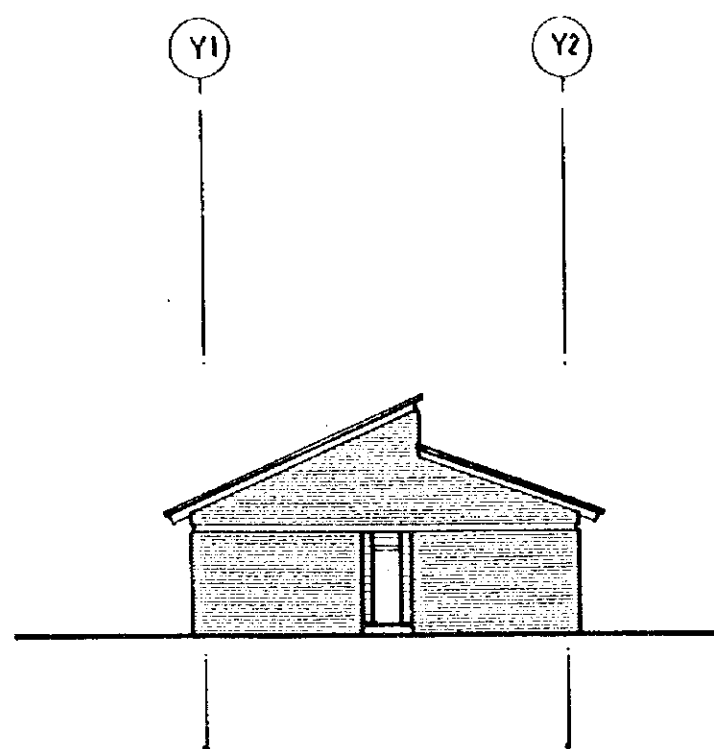
LECTURE RM. S BLDG ELEVATION & SECTION



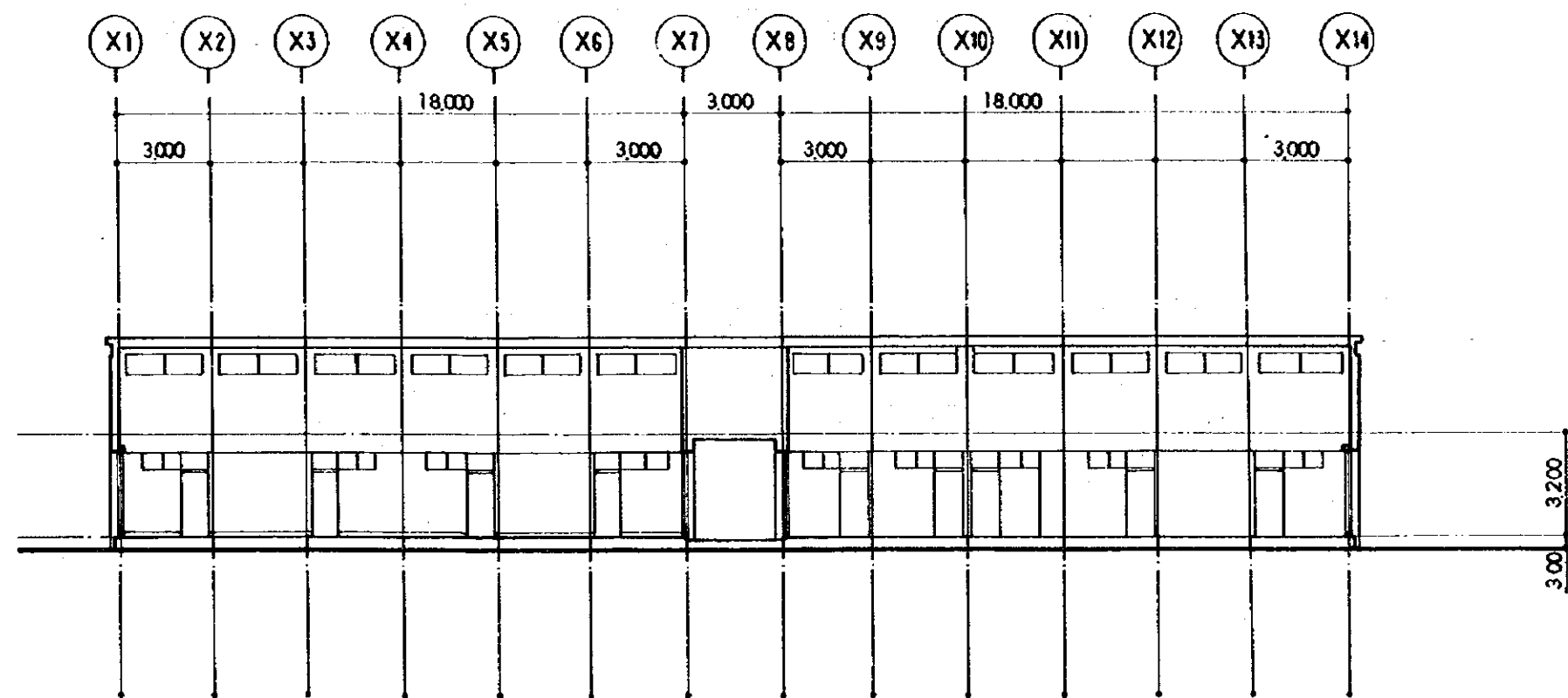
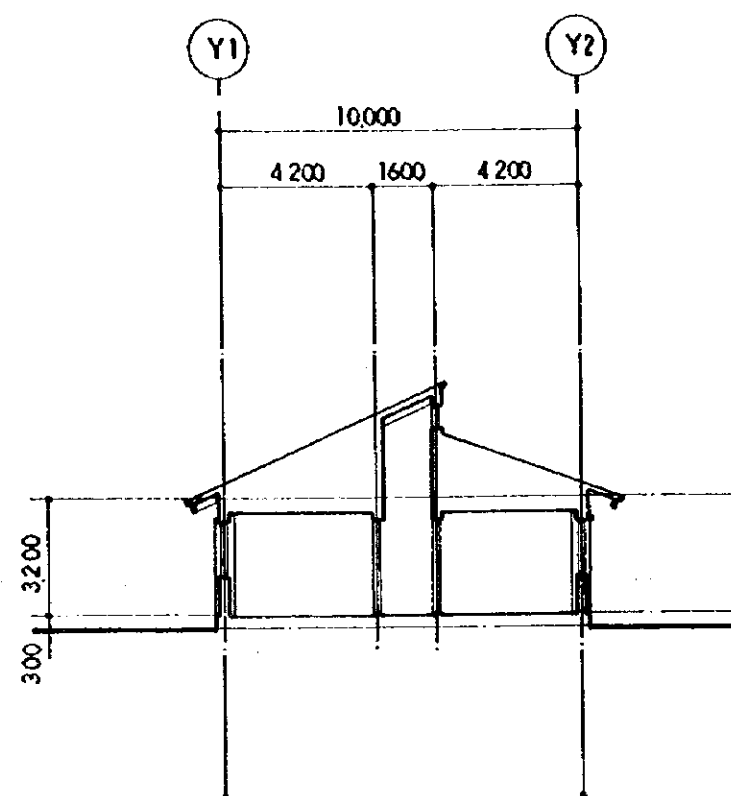
LABORATORY BLDG. ELEVATION & SECTION





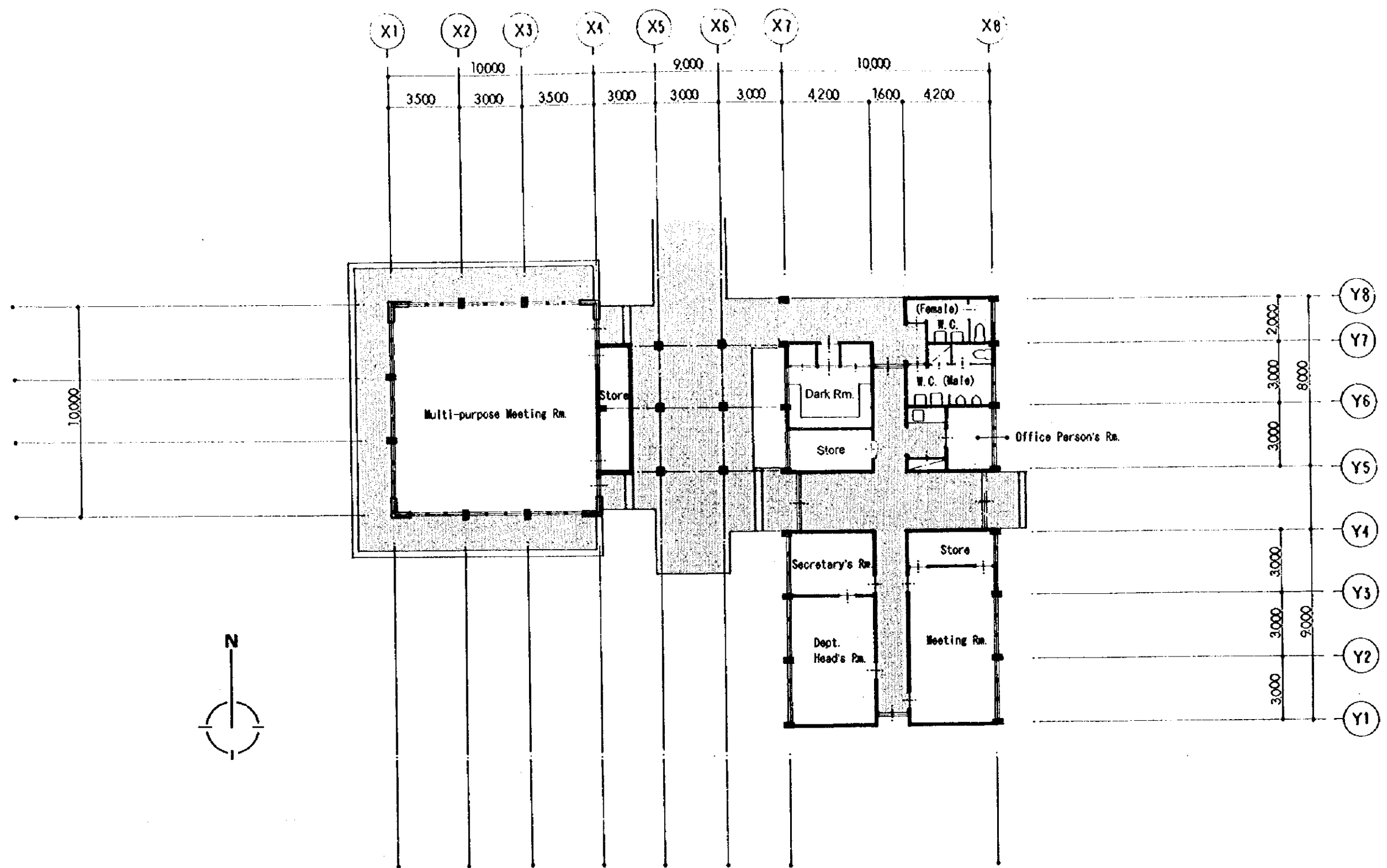


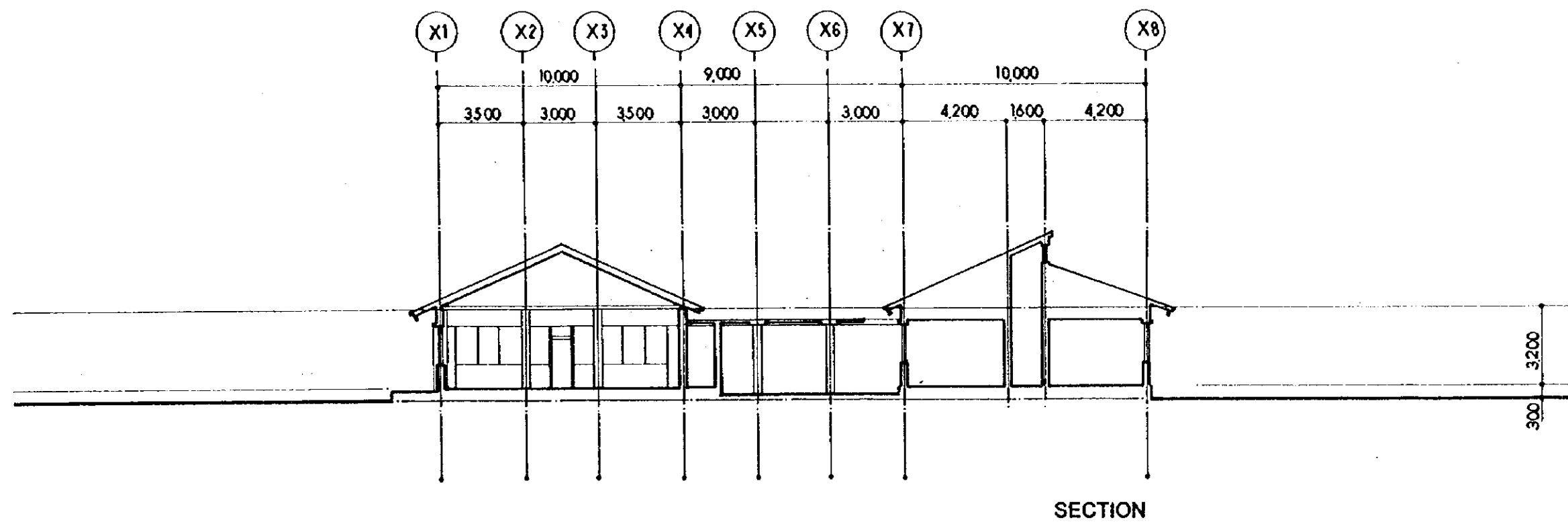
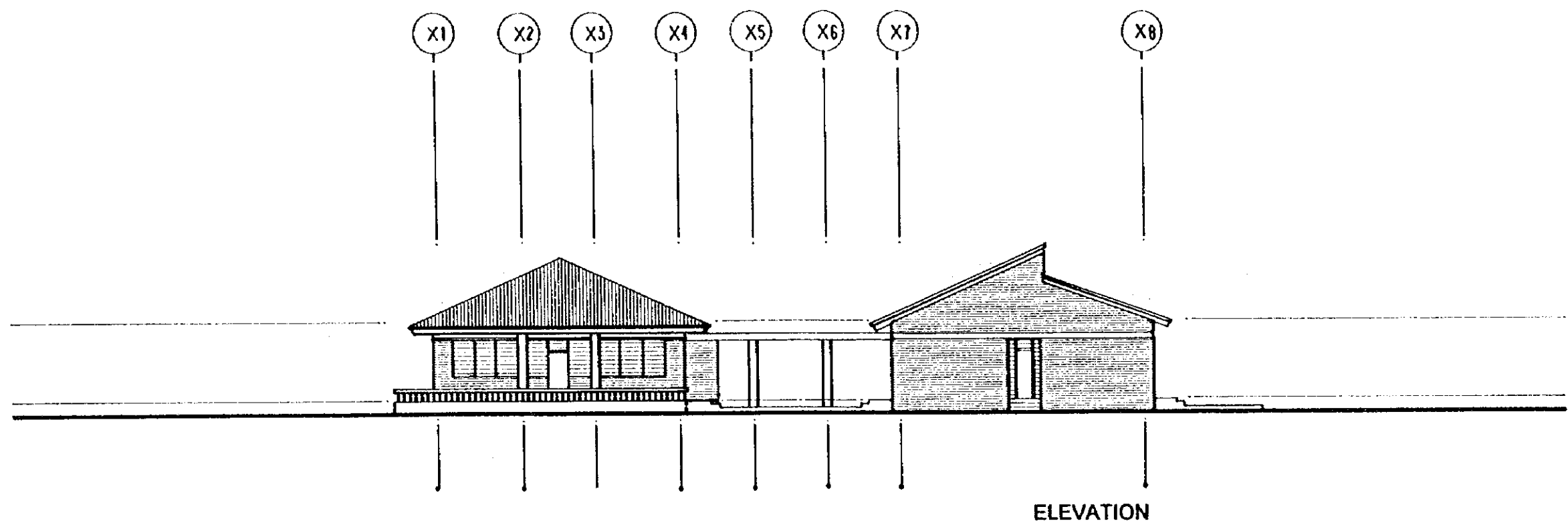
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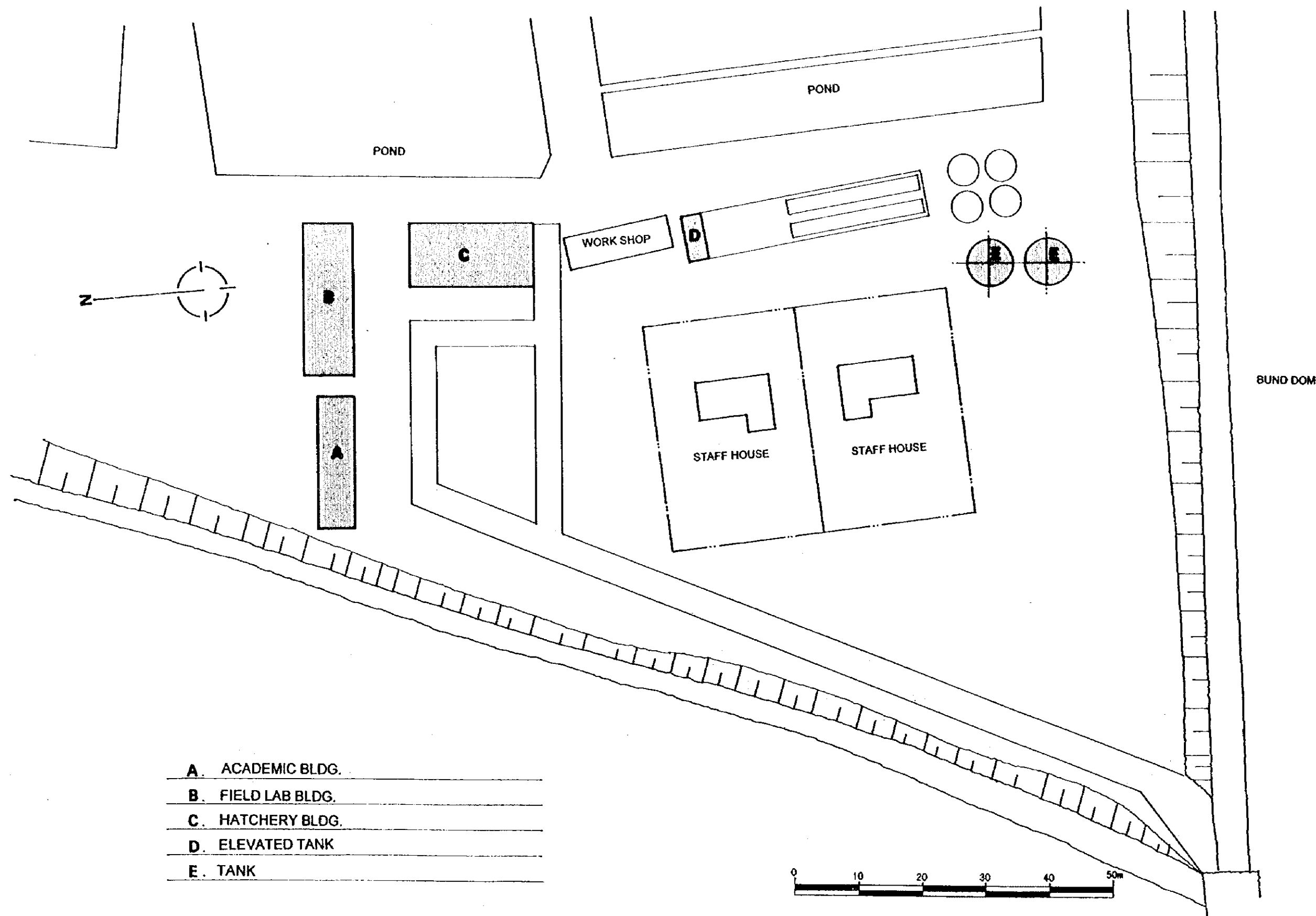


SECTION

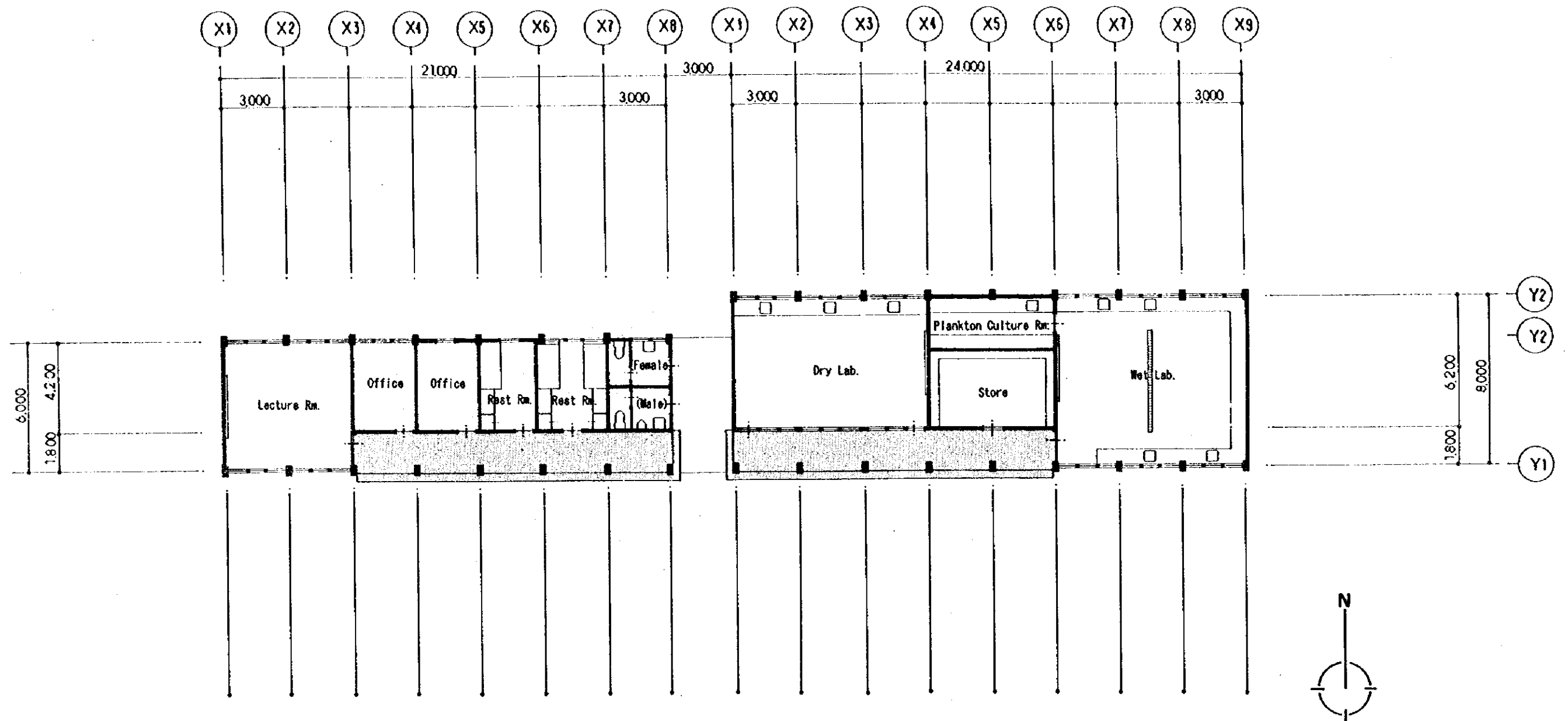


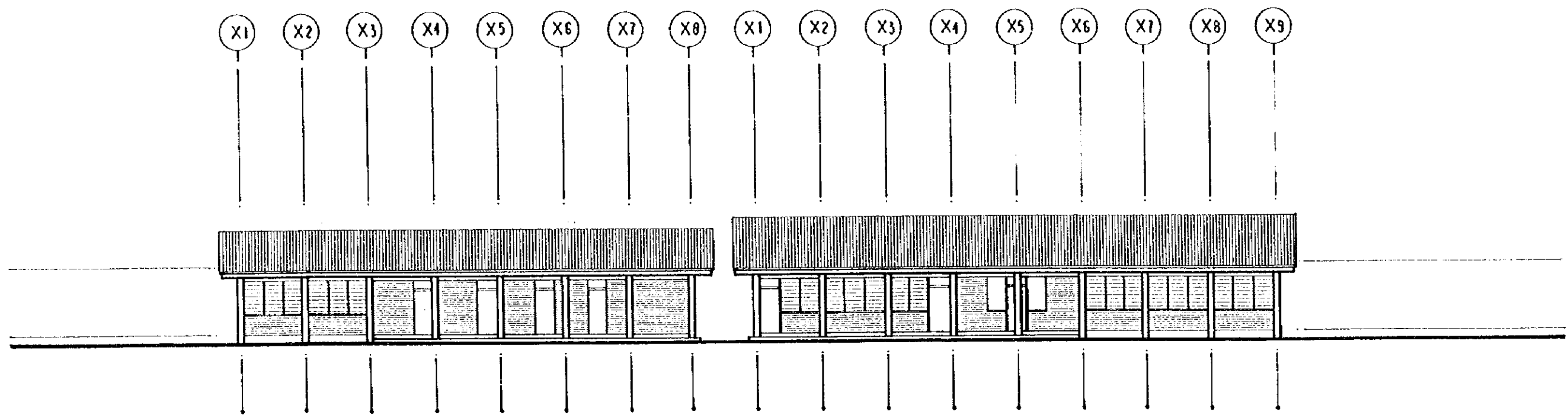




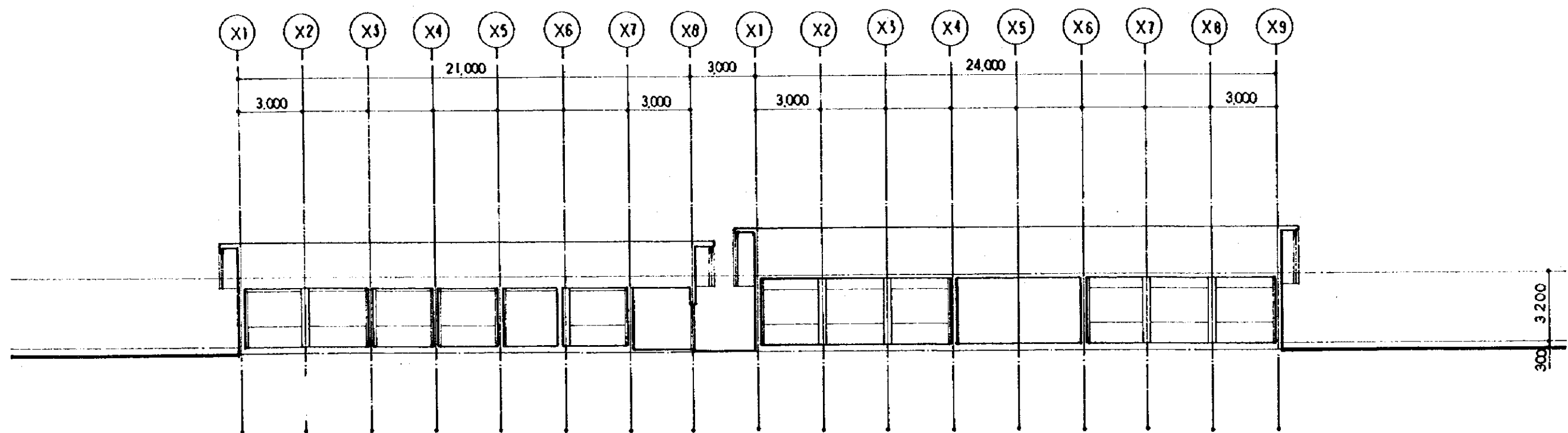


- A. ACADEMIC BLDG.
- B. FIELD LAB BLDG.
- C. HATCHERY BLDG.
- D. ELEVATED TANK
- E. TANK



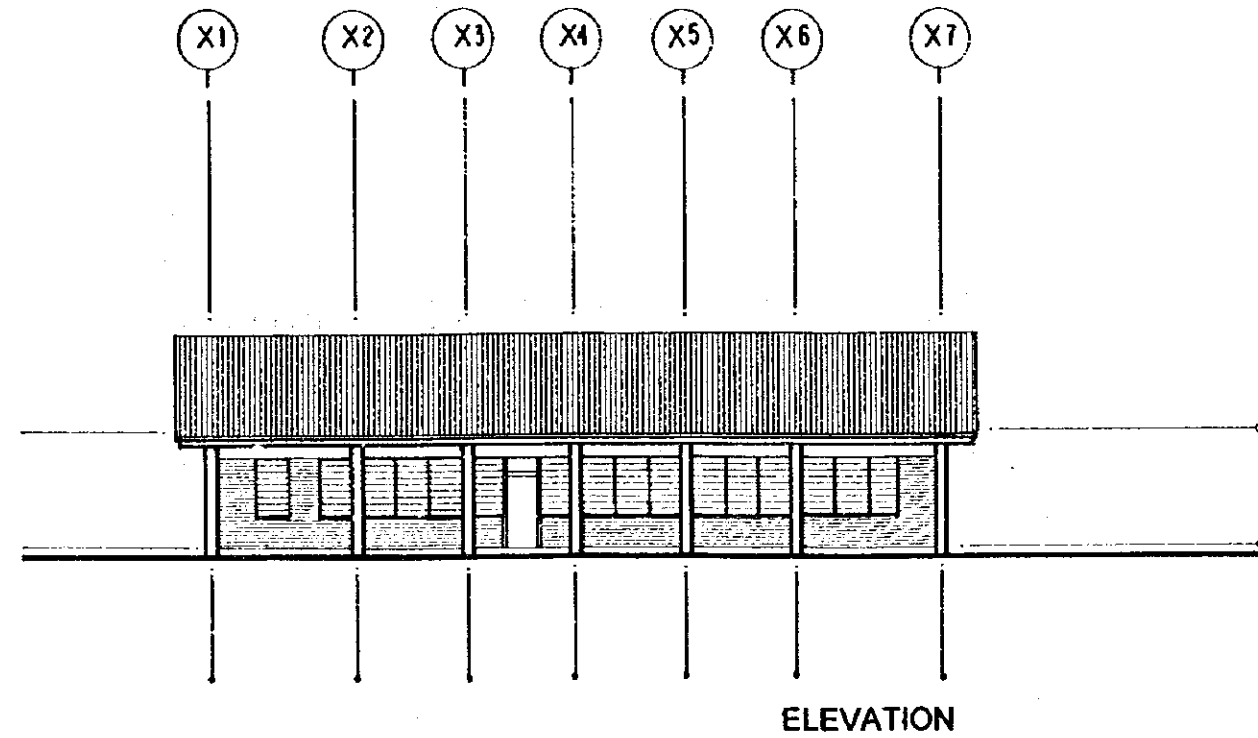
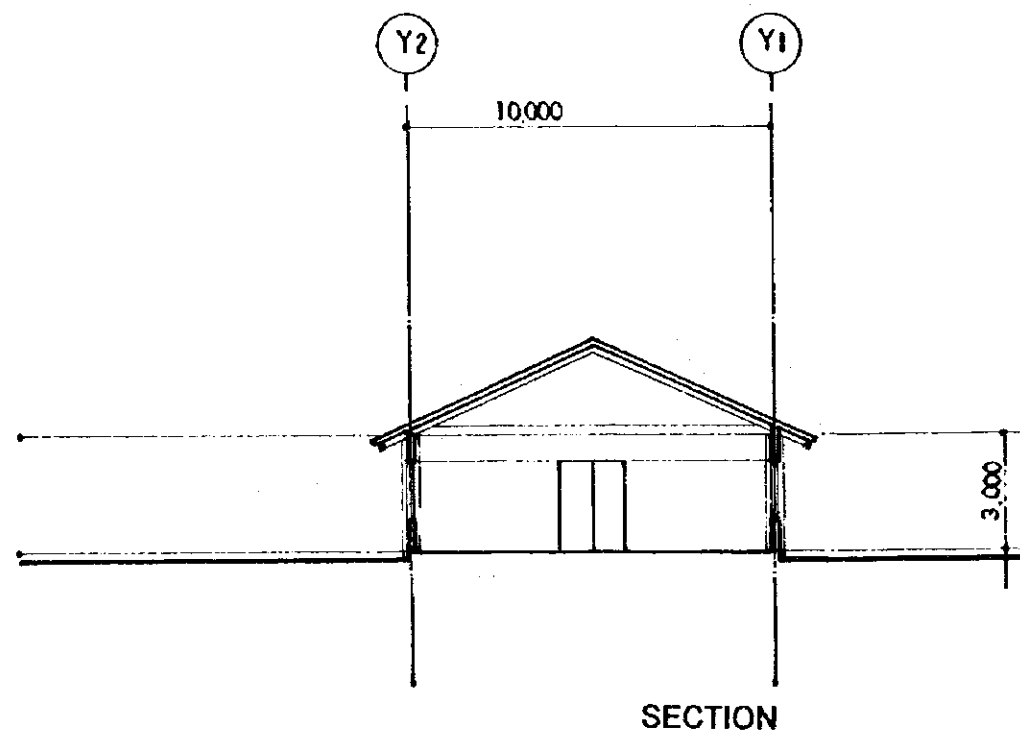
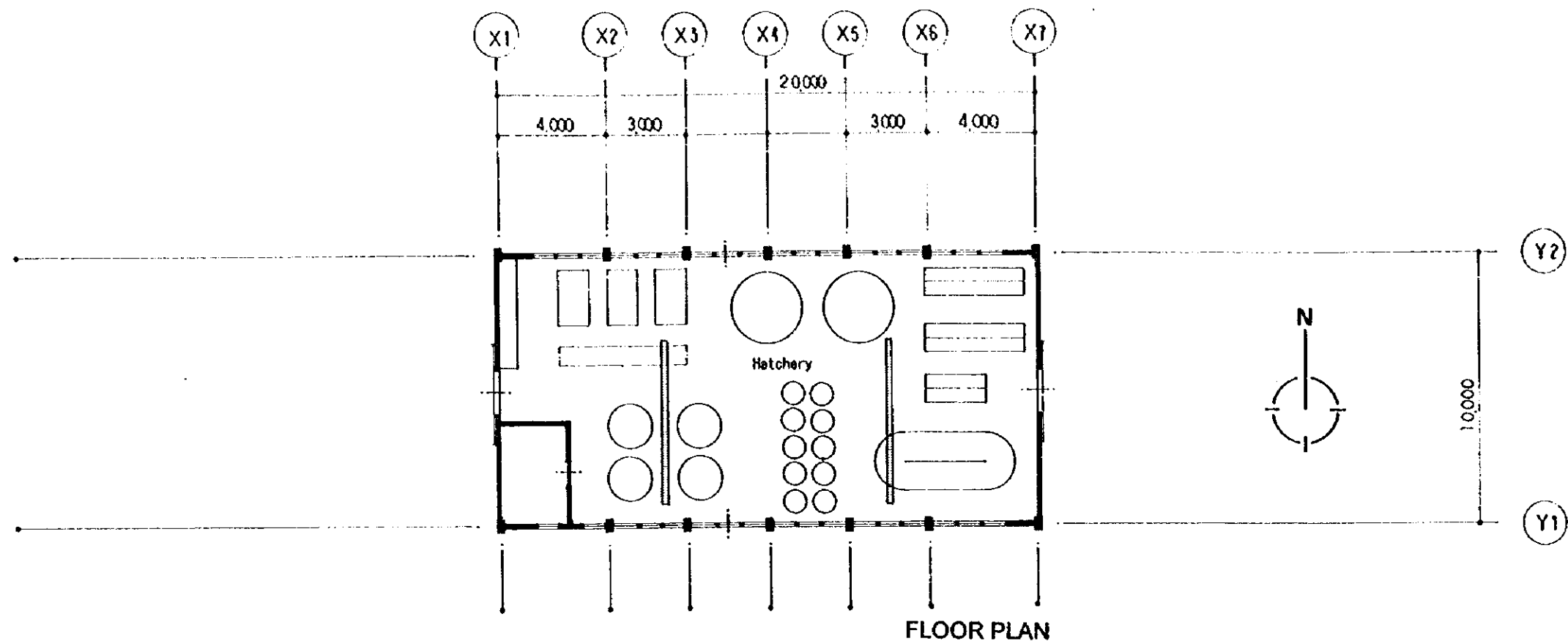


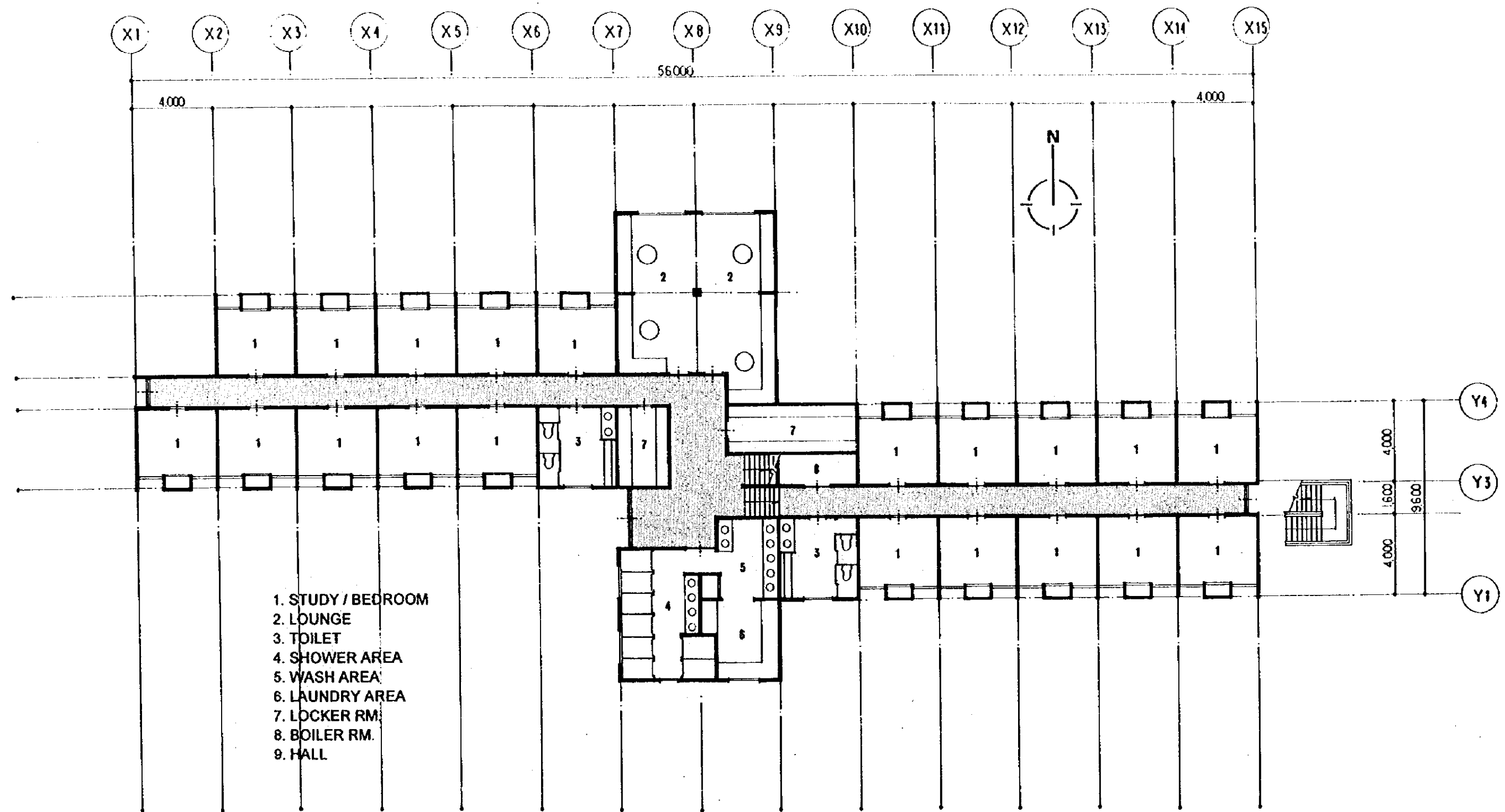
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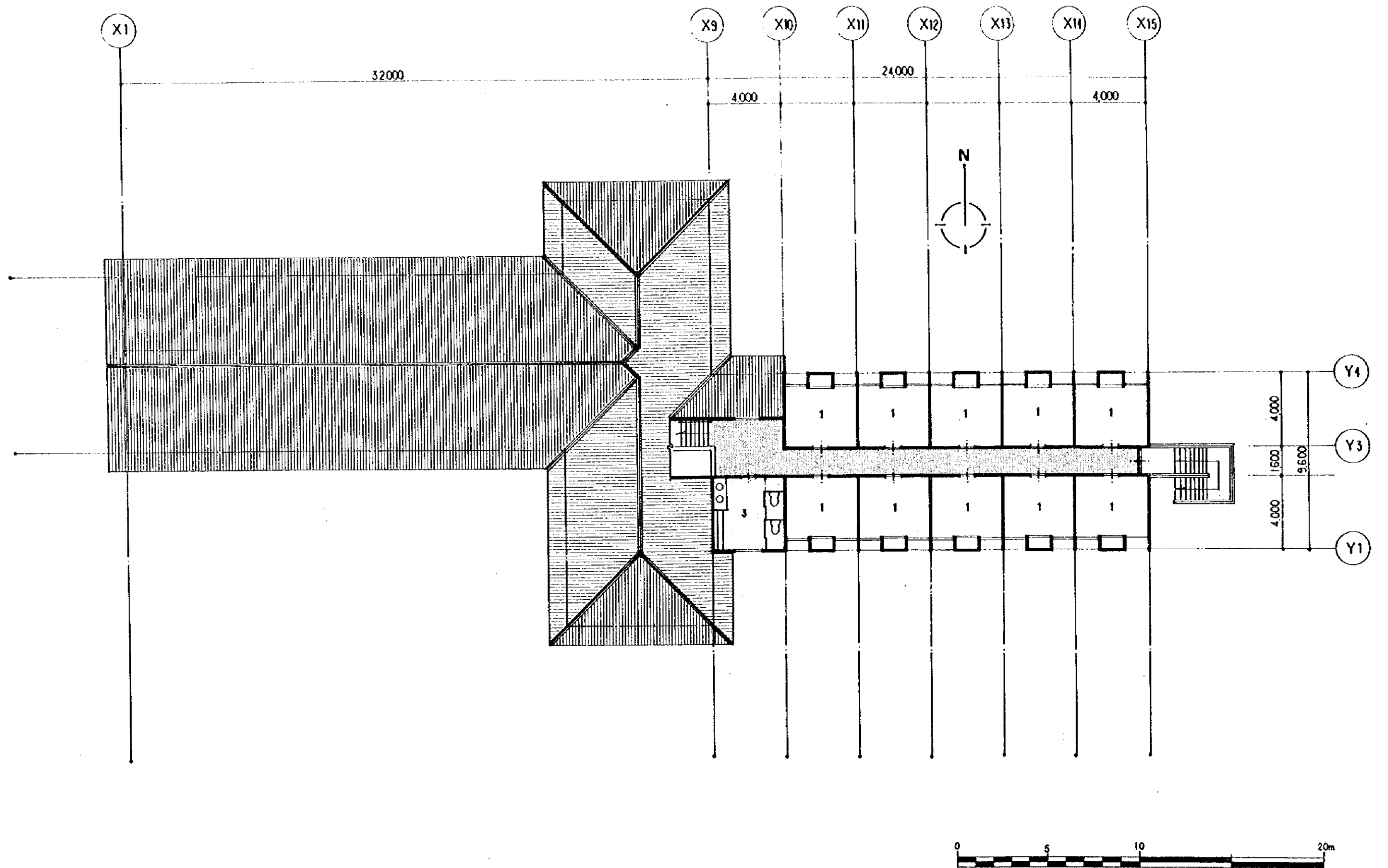
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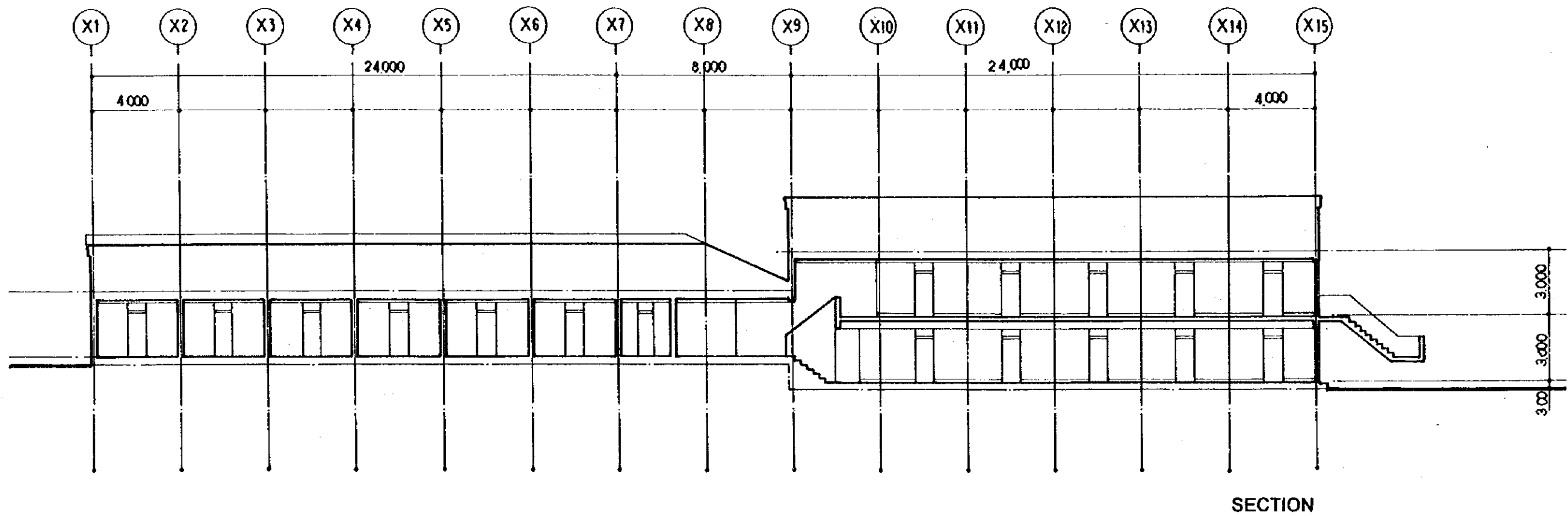
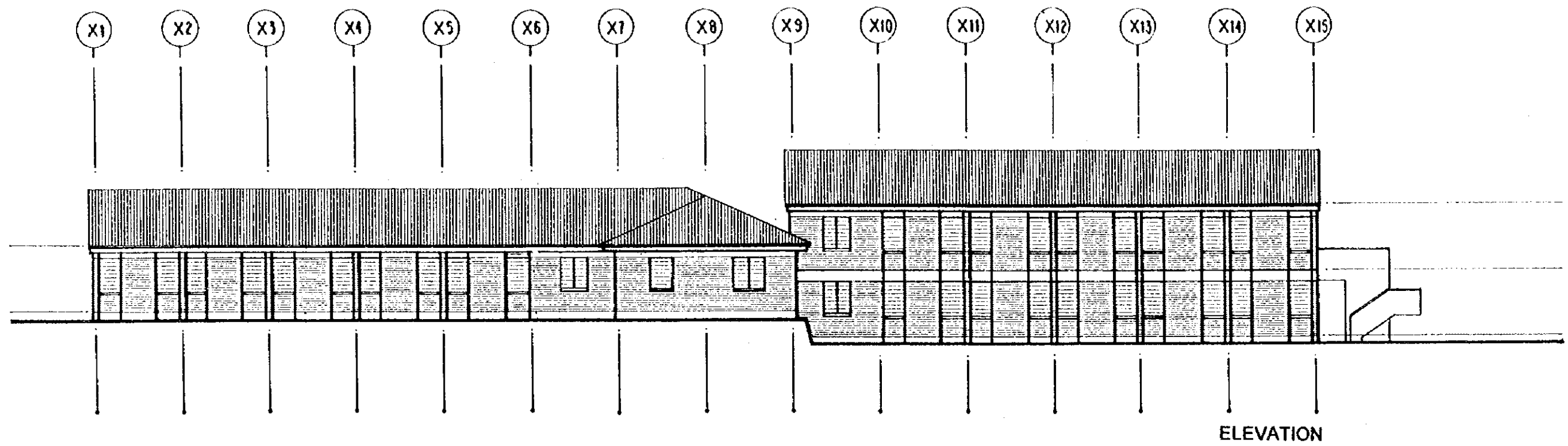


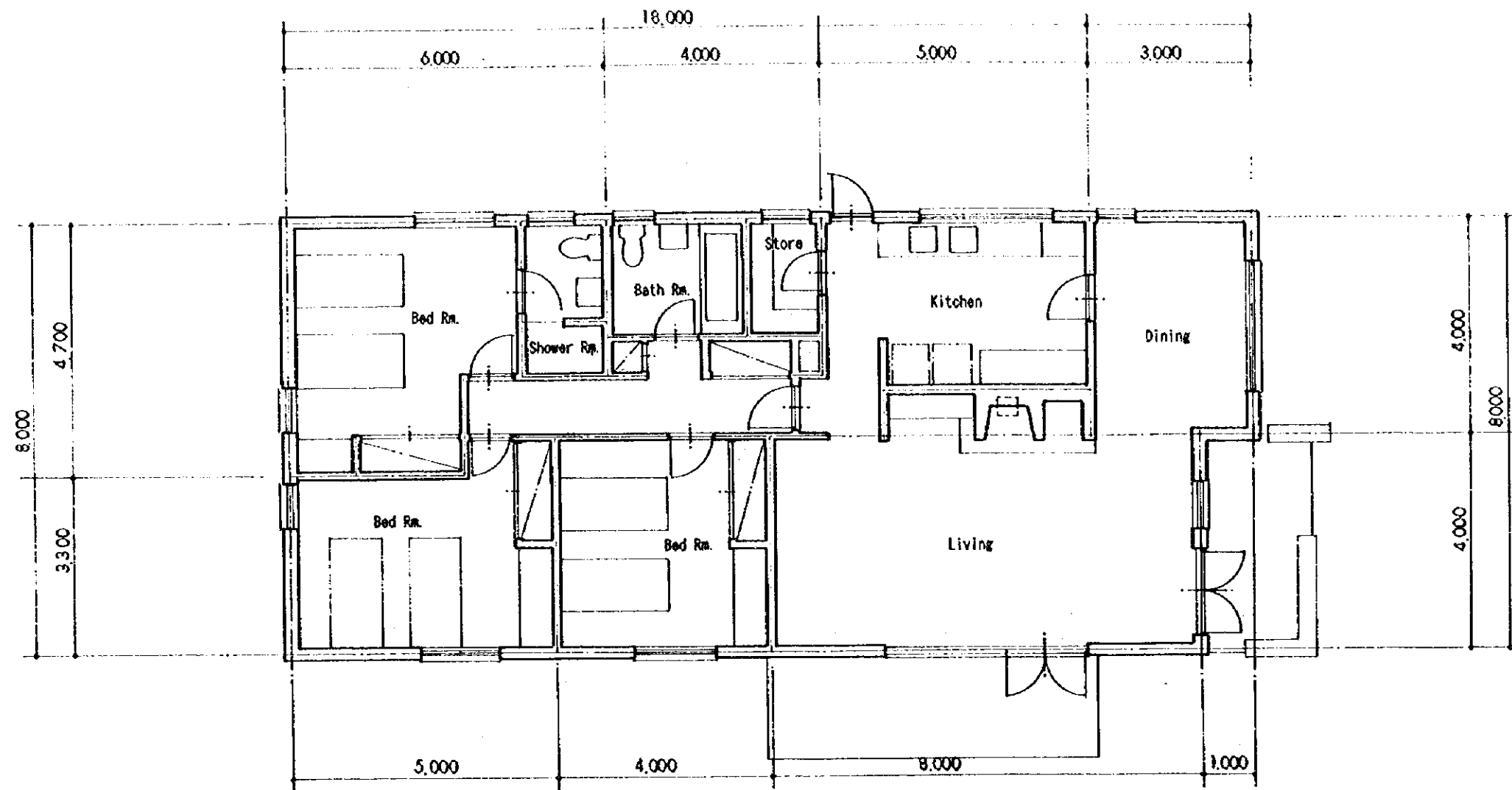




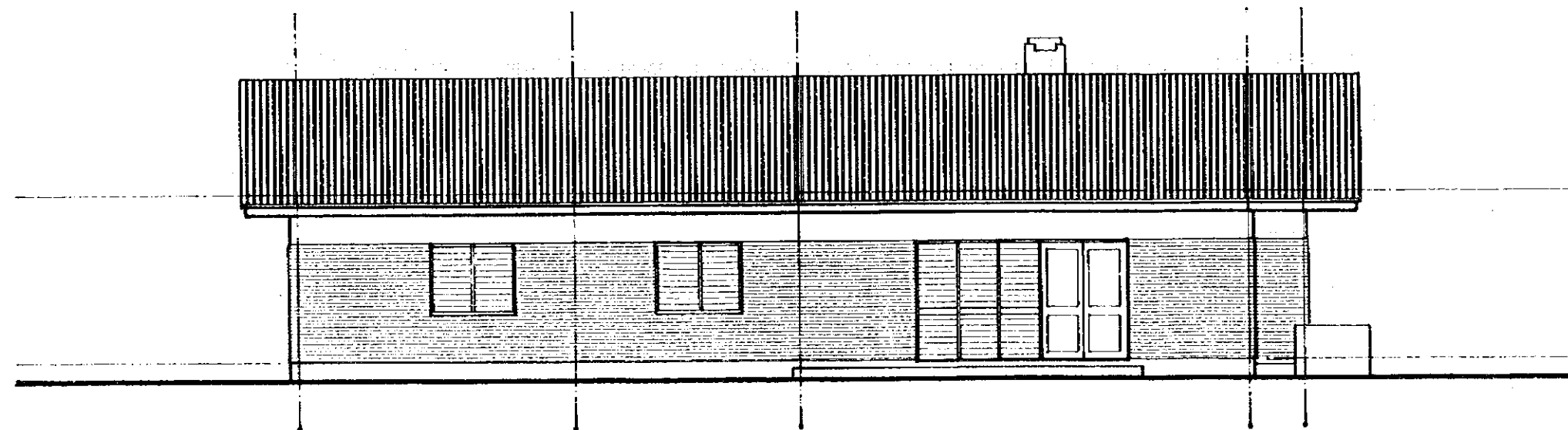




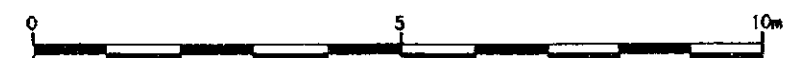




FLOOR PLAN

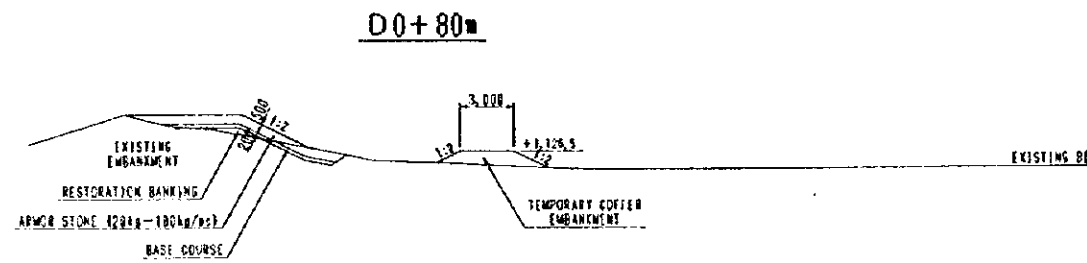
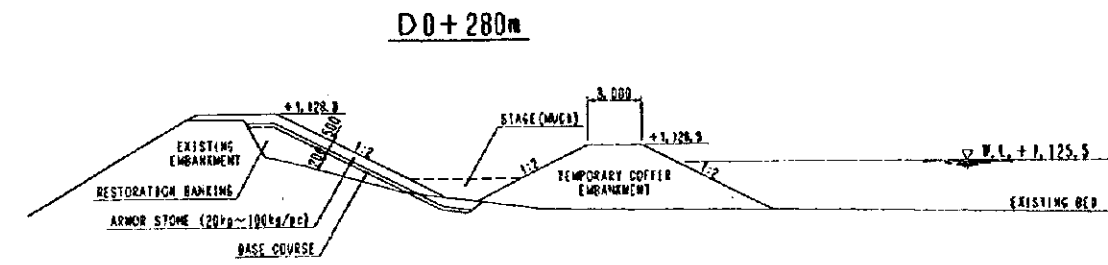
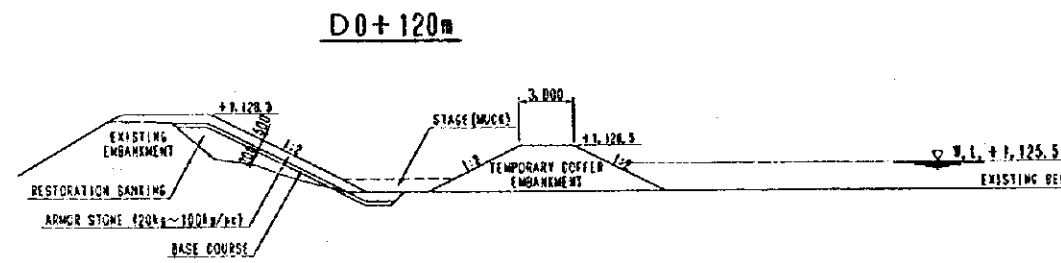
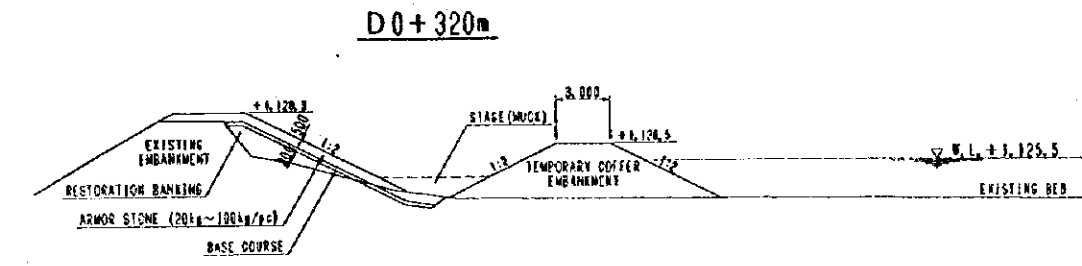
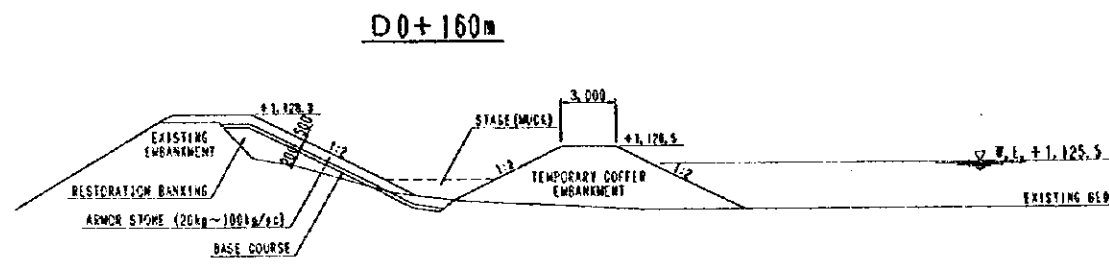
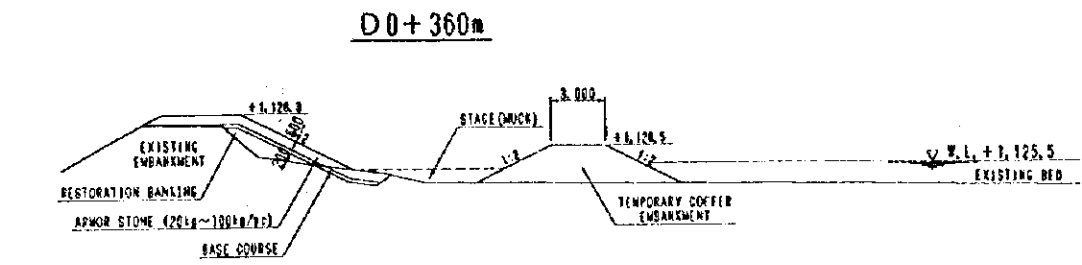
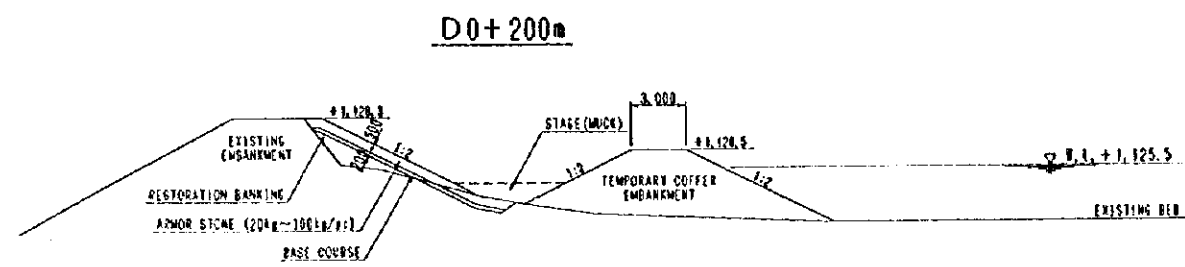
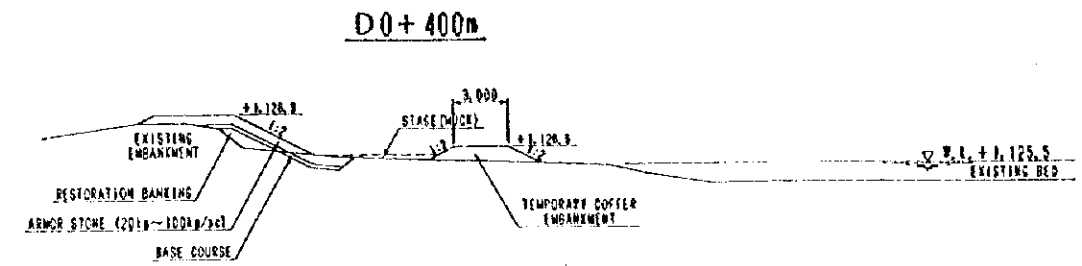
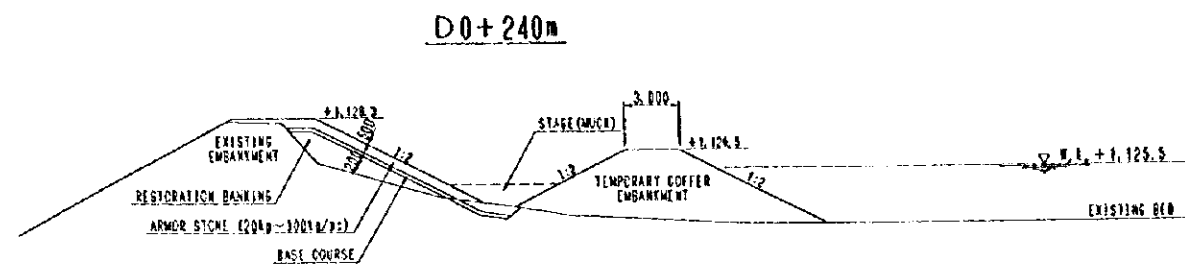


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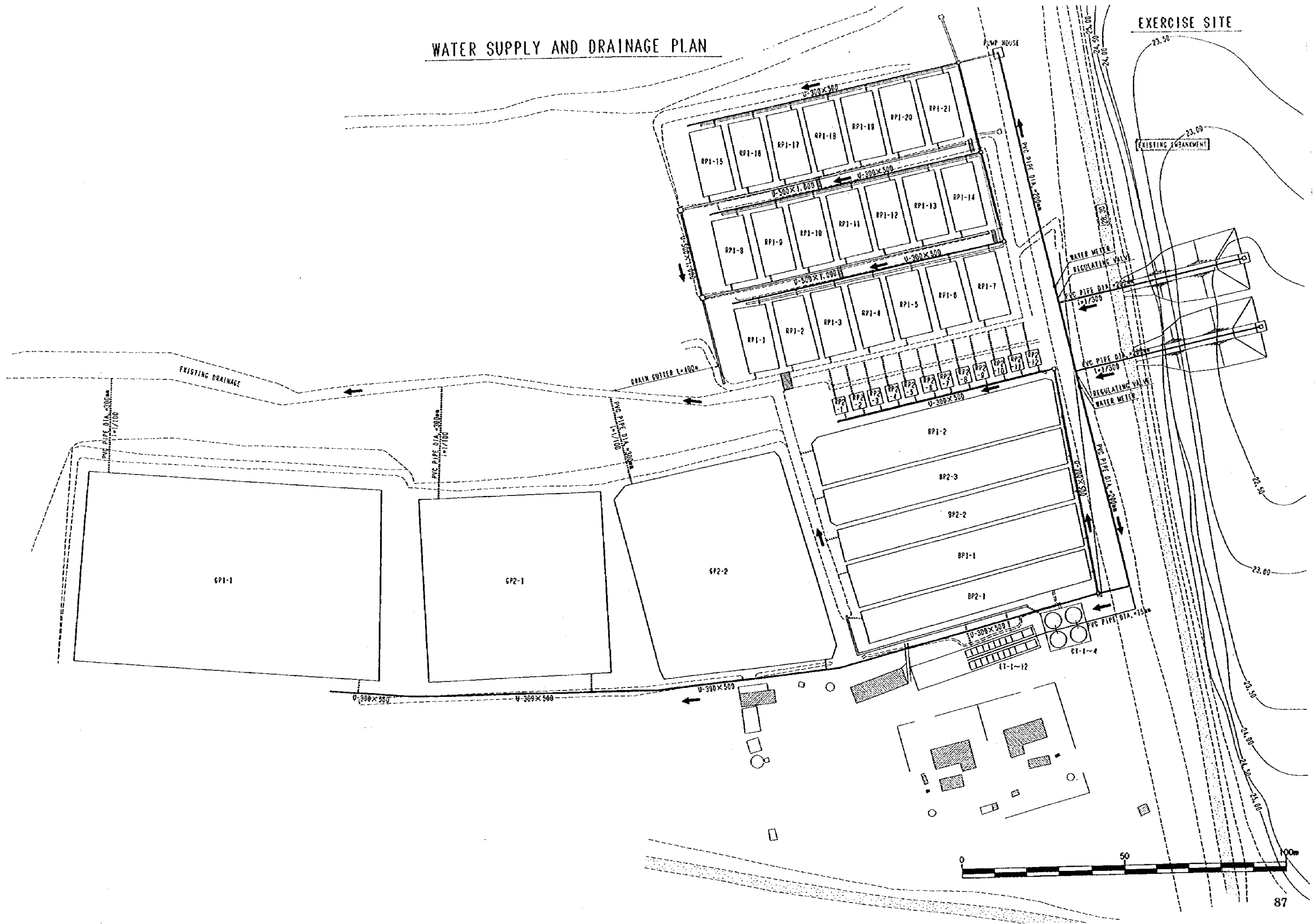


# SECTION OF EXISTING EMBANKMENT REHABILITATION



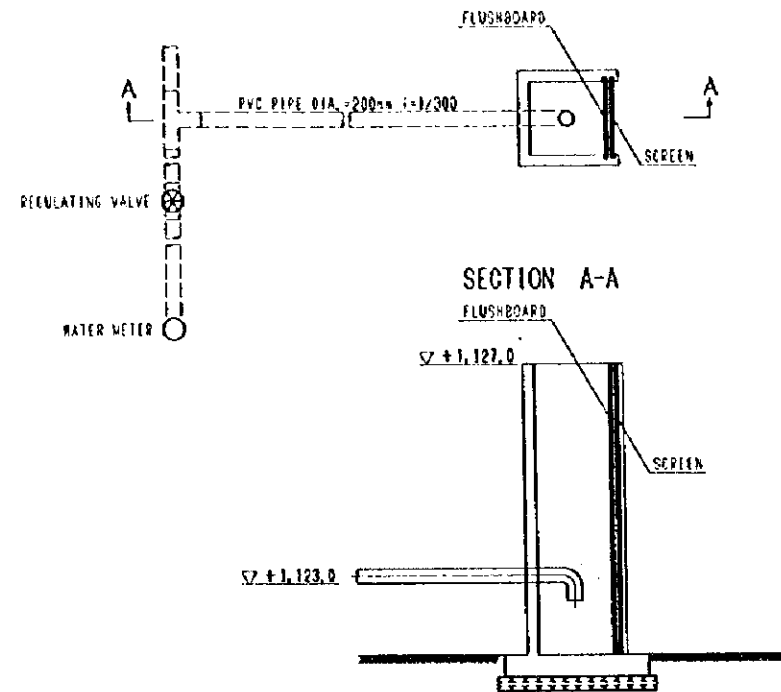
# WATER SUPPLY AND DRAINAGE PLAN

EXERCISE SITE

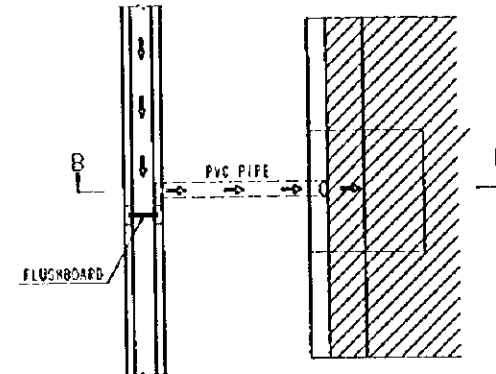


## DETAIL PIPING SCHEDULE

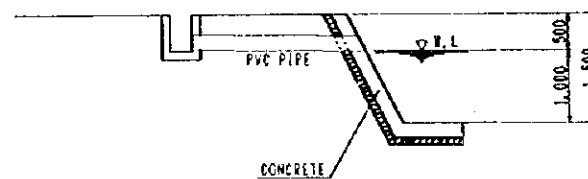
WATER INTAKE FROM RESERVOIR POND  
PLAN



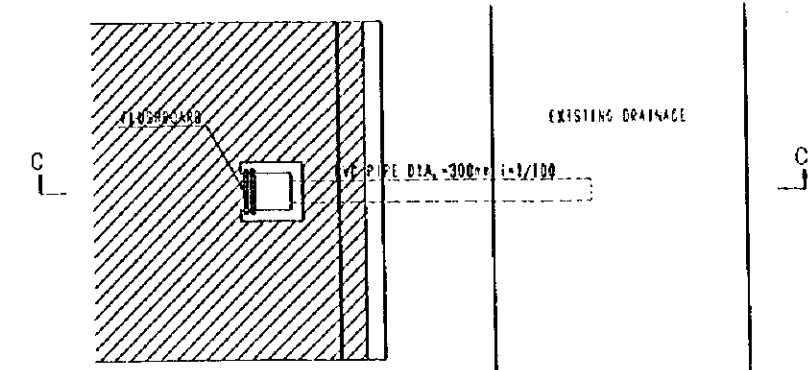
WATER SUPPLY PIPE TO BREEDING POND  
PLAN



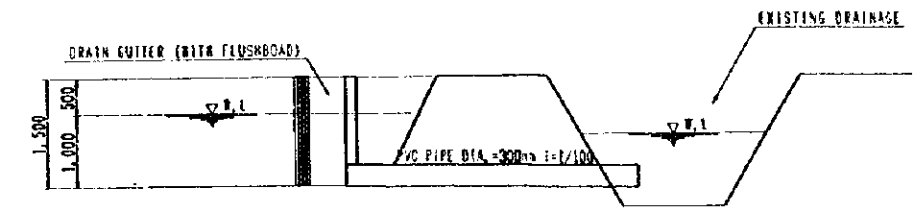
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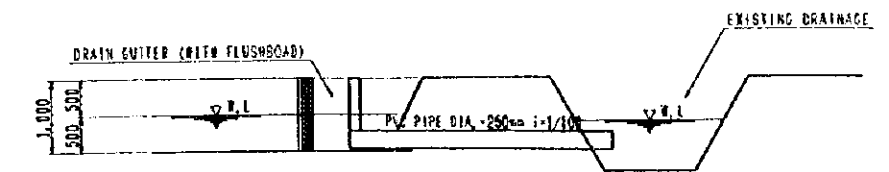
DRAINAGE FROM BREEDING POND  
PLAN



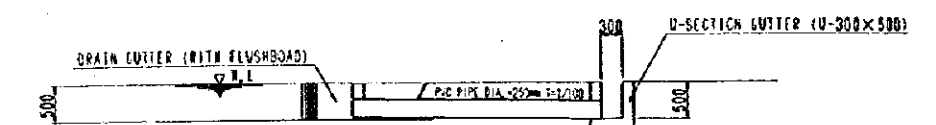
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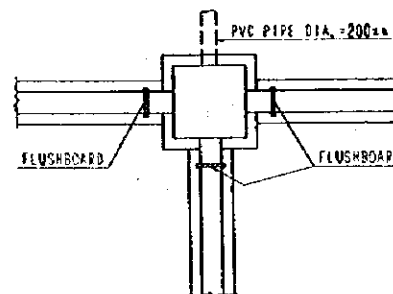
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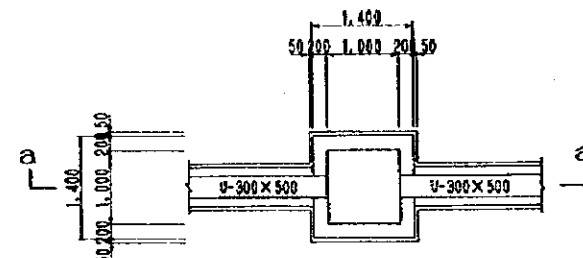
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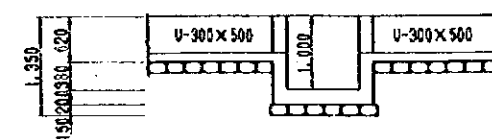
DISTRIBUTION PIT PLAN



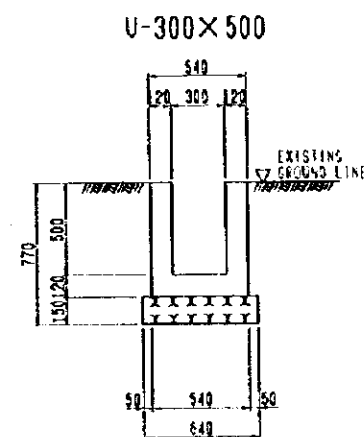
DETAIL OF COLLECTION PIT



Sect. a-a



DETAIL OF U-SECTION GUTTER







## CHAPTER 3 IMPLEMENTATION PLAN

### 3-1 Construction Plan

#### 3-1-1 Construction Guidelines

The bulk of the construction work for this Plan can be amply handled via local building methods. The construction plan will proceed in the following sequence: temporary construction phase, foundation work, structural phase, finishing work, and equipment procurement and installation.

Considering that this plan is to be implemented under grant-aid cooperation from Japan, the construction plan has been prepared subject to the following guidelines.

#### 3-1-2 Special Considerations in Connection with the Construction Phase

The following considerations will be borne in mind in connection with the construction work :

- (1) With regard to the equipment and materials, while the major share of these requirements can be procured locally, a carefully prepared procurement plan will be essential to avoid a wide quality dispersion as well a shortage of supplies on the local market when inundated with large concentrated orders.
- (2) There is an ample supply of both skilled and unskilled labor in the Plan area.
- (3) While rainfall at the Plan sites is not particularly heavy, there is a distinct rainy season from October to April. Thus, early construction phases which are weather-sensitive, such as the foundation work and repairs to the reservoir embankment, should be planned with weather patterns clearly in mind.
- (4) Since a number of existing facilities, particularly those adjacent to the Campus Site, are continuously involved in teaching and research activity, careful consideration must be given during the construction period to suppressing noise and dust.

#### 3-1-3 Division of Construction Responsibility

The project responsibilities to be assumed by the beneficiary country (Republic of Malawi) will be as shown below :

- (1) Confirming titles and boundaries of the Plan Sites, securing these sites and preparing them for the start of construction work (e.g., mowing, etc.).
- (2) Defraying standard charges levied by the foreign exchange bank in Japan.

- (3) Temporary relocation of fish in the breeding pond in connection with the implementation of the construction project by Japan.
- (4) All procedures relating to duty exemption and customs clearance
- (5) Securing building approvals.

In connection with the construction phases for which the beneficiary is responsible, the latter will be advised of the payment dates and approximate amounts of remittances. Assistance will also be provided to ensure that the necessary procedures, such as those related to securing budgets, will be speedily completed. The extent of project responsibility under this Plan is outlined below.

**Table 3-1.1 Allocation of Construction Responsibility**

No.	RESPONSIBILITY	JAPAN	MALAWI
1	Confirming titles and boundaries of the Plan Sites, securing these sites		○
2	Preparing the Plan Sites for the start of construction work.		○
3	Temporary relocation of fish in the breeding pond in connection with the implementation of the construction project by Japan.		○
4	Acquiring all construction and other necessary permits and licenses, as required for plan implementation		○
5	Construction of the Plan facilities	○	
6	Procurement, installation, instruction of the Plan equipment	○	
7	Import and customs formality		
	a Transportation of construction materials and equipment to the sites	○	○
	b All procedures relating to duty exemption and customs clearance		
8	To defray standard charges levied by the foreign exchange bank in Japan.		○
9	To accord Japanese nationals whose services may be required in connection with the verified contracts for their entry into Malawi and stay therein for the performance of their work.		○
10	To ensure that the facilities constructed and equipment purchased under the Japan's Grant Aid be maintained and used properly and effectively for the project.		○
11	To bear all the expenses, other than those covered by the Japan's Grant Aid, necessary for the Project		○
12	To exempt Japanese nationals from customs duties, internal taxes and fiscal levies which may be imposed in Malawi with respect to the supply of the products and services under the verified contracts.		○

#### 3-1-4 Construction Supervision Plan

The basic guidelines and special considerations relating to the construction supervision plan for the subject project are as follows.

- (1) In order to facilitate the construction work and procurement and installation of equipment, the Consultant will maintain close coordination with the authorities of Bunda

College. Since the academic year at Malawi University is divided into two semesters, February - June and July - November, it is essential that the construction work be carried out in accordance of the Construction Progress Plan.

The beneficiary side and the specialists on the donor side will coordinate closely regarding the starting date for the construction program.

- (2) In advance of the start of construction activity, the Consultant will carefully review the implementation plan and construction diagrams submitted by the Contractor and evaluate the appropriateness of the temporary construction plan, the quality of the Plan materials, and construction methods.
- (3) In connection with project turnover following completion of the construction work, the Consultant will inspect and confirm that the completed work is in conformity with the contract specifications and plans and will, as necessary, issue appropriate instructions to modify or correct any faulty aspects.
- (4) The three fields involved in this Plan -- engineering, construction, and equipment work -- are all intertwined. The technicians responsible for each field must develop supervisory systems for their respective phases so that they can be efficiently integrated within the overall project.

### 3-1-5 Procurement Plan for Equipment and Materials :

#### (1) Materials Plan

The bulk of the Plan materials can be sourced locally, primarily bricks, concrete, R-bars, and finishing materials. These items will comprise both imported and domestically produced products.

Brick production in Malawi is large but quality disparities are quite marked. Careful advance planning is, therefore, essential to the procurement of high-quality bricks.

Table 3-1.2 Source Area for The Principal Construction Materials

No.	MAIN CONSTRUCTION MATERIAL	SOURCE
1	Concrete	Malawi
2	Gravel	Malawi
3	Brick	Malawi
4	Steel flames	Malawi
5	Mold	Malawi
6	Sash	Malawi
7	Roof material	Malawi
8	Lighting fixtures	Malawi / Japan
9	Control box	Japan
10	Fittings	Malawi / Japan
11	Sanitary ware	Malawi
12	Pumps	Japan

## (2) Transport Routes

Malawi is a landlocked country surrounded by Tanzania, Mozambique, and Zambia. The 3 main import routes from overseas for the Plan equipment and materials are understood to be :

- a. South Africa -- Zimbabwe --
- b. Tanzania -- Malawi, and
- c. Mozambique -- Malawi.

These same routes apply to imported items produced in other African nations, primarily South Africa and Zimbabwe.

## 3-1-6 Implementation Schedule

Table 3-1.3 Project Implementation Schedule (plan)

	1	2	3	4	5	6	7	8	9	10	11
Field Survey	■										
Detail Design		■	■	■							
Confirmation			■								
Preparation Work	■	■									
Temporary work		■	■	■	■	■	■	■	■	■	■
Earth work		■	■	■	■						
Concrete work				■	■	■	■	■	■	■	■
Construction work				■	■	■	■	■	■	■	■
Electric & mechanical work							■	■	■	■	■
Civil Engineering Work		■	■	■	■	■	■	■	■	■	■
Equipment											
Manufacturing			■	■	■	■	■	■	■	■	■
Shipping								■	■	■	■
Installation										■	■

Assuming that this Plan is implemented under a grant-aid from the Government of Japan, following the Exchange of Official Documents, tender documents will be prepared and contracts signed for the construction and equipment procurement phases, followed by the construction work and equipment procurement and installation. The implementation schedule will follow the following procedures :

### (1) Implementation Design

The project design and tender specifications will be implemented on the basis of the Basic Design Report. A period of about 3 months is estimated for this phase.

### (2) Tender Operations

Upon completion of the Implementation Design, bids will be solicited in Japan, through advertisements, from companies interested in participating in the construction and/or

equipment procurement phases of the project. The eligible bidders will be determined on the basis of a vendor evaluation. Based on this evaluation, the implementing organization will assemble the tender participants and carry out the tender process in the presence of concerned parties. The process from solicitation of tenders through construction contracts can be expected to take about 2 months.

### **(3) Construction Work and Equipment Procurement and Installation**

Following the signing of the construction contracts, the successful bidder will initiate the construction work after attestation by the Government of Japan. Assuming that the construction work for which the Malawi side is responsible is carried out smoothly, the time requirement for this phase can be estimated at about 9.5 months.

### **3-1-7 Items for which the Beneficiary Country is Responsible**

#### **(1) Duty Exemption and Custom Clearance**

While arrangements will be made with the responsible organization in the beneficiary country to insure duty-free entry of Plan materials, careful attention must be paid to the following procedures and considerations with respect to duties and customs clearance :

##### **1) Equipment and Materials Procured from Japan or Third Countries**

All imports into Malawi are subject to duty and customs clearance charges. The following measures are being considered to certify the items which are being brought in for the subject project:

- A clause will be incorporated into the Consultant and Contractor contracts specifically relating to duty exemptions.
- A certificate will be obtained from the National Tax Bureau approving the duty and tax exemptions.
- When necessary, copies of the above documents will be shown to concerned parties to obtain duty exemptions.

##### **2) Domestically Sourced Materials**

The following procedures must followed to secure tax exemptions on locally procured materials

- A certificate must be obtained from the National Tax Bureau approving the tax exemption.
- A purchase application must be prepared in the name of each contractor, showing a description of the goods purchased for this project.

### 3) Obtaining Construction Permits

In the case of public construction projects, an application must be submitted to the Ministry of Construction prior to the start of the work. Bunda College is to take care of these applications.

### 4) Banking Arrangements

The Malawi Government will be obliged to establish an account in its name at an authorized foreign exchange bank in Japan.

### 5) Issuance of Payment Authorizations

After concluding each contract, the Malawi Government is obliged to promptly issue a Payment Authorization (A / P)

## 3-2 Maintenance and Administration Plan

The maintenance and administration plan for the Plan facilities will be continuously implemented in accordance with the present system in effect at Bunda College. That is to say, facility maintenance, repair, and utility costs (fuel, light, and water) will be defrayed from the overall College budget, while the cost of equipment maintenance, including expendables and spare parts, along with research and other operating expenses will be covered out of the operating budget of the Aquaculture Department. In this section, we shall examine the maintenance and administrative costs for the Plan facilities and equipment as a guide for the College and Aquaculture Department when making the necessary budgetary provisions.

However, with regard to the 2 new members of the aquaculture faculty, since the recruitment process will take some time and Bunda College is capable of calculating the costs involved, while, with respect to student expenses, the Plan scale has already been based on a constant enrollment, these expenses have been excluded from this analysis.

The premises applied to the tentative estimates of maintenance and administrative costs are as outlined in Table 3-2-1.

### (1) Maintenance Costs for the Engineering Facilities

The anticipated maintenance and operating expenses for the engineering facilities will include mowing the embankment and maintaining the water supply and drainage conduits. However, since care of the latter facilities should be reduced through Plan implementation, we believe that these added tasks can be handled by the present 2-man team managing the pond. Accordingly, personnel costs will not be considered in this analysis.

## (2) Administrative Expenses for the Building Facilities

For purposes of calculating maintenance costs for the Plan building facilities, we have assumed the following number of operating days and operating conditions.

**Table 3-2.1 The parameters of Calculating maintenance & Operating cost**

Items	Operating days / conditions
No. of operation days	250 days
No. of lecture days	210 days
Unit rate for electricity	MK 0.68 / kW
Unit rate for water	MK 7.65 / m <sup>3</sup>
Unit rate for diesel oil	MK 7.0 / lit.
Unit rate for propane gas	MK 23.5 / kg

### 1) Power Costs

Power consumption for Plan operations has been estimated as per the following table.

In the case of those equipment items that will be operated continuously, such as the blowers and refrigerators, excluding downtime for maintenance and repairs, we are projecting 300 operating days per year. It is assumed that the other equipment items, principally these used in the laboratories, will be operated only on an intermittent basis.

**Table 3-2.3 Power consumption for Plan operations**

Equipment : Consumption Area	Capacity (kW)	Demand Ratio	Operating Time / Day	Operating Days / Year	Power Consumption / Year (kW)
Indoor lighting	72.9	0.8	4 hours	250 days	58,320
Outdoor lighting	6.6	1.0	10 hours	365 days	24,090
Continuously operating equipments	35.5	0.5	24 hours	300 days	127,800
Other equipments	35.5	0.3	6 hours	250 days	15,975
Air conditioning	6.6	0.7	24 hours	250 days	27,720
Total					253,905

### 2) Water Costs

The volume of water usage has been estimated as shown in the following table.

**Table 3-2.4 Estimated Water Usage Classification**

Object	Estimating Basis	Annual Usage
City water	200 liters / person / day x 250 days	3,500 m <sup>3</sup> / year
Aquaculture pond	15 m <sup>3</sup> x 20 times	300 m <sup>3</sup> / year
Total		3,800 m <sup>3</sup> / year

### 3) Facility Maintenance Costs

Based on past experience at Bunda College, facility maintenance expenses, excluding personnel cost, have averaged MK50 per square meters of floor area. Since the total floor area for the plan facilities has been set about 3,000 m<sup>2</sup>, an annual maintenance budget of approximately MK150,000 will presumably be required to cover purchase of material.

### 4) Vehicle Operating Costs

The transport vehicle will be in use almost all day carrying tank fish, equipment, and materials between the Campus and Field Academic Sites. These vehicles will be occasionally needed also to transfer sample fish supplies from Lake Malawi and the Domasi Aquaculture Research Center. The required maintenance costs have been calculated on the assumption that the vehicle will operate 10 km /day on campus and about twice a month outside the College to collect and transfer samples, at an average round trip distance of 500 km. Figuring diesel fuel efficiency at 8 km / liter, the vehicles would consume about 1,200 liters per year on the above basis. Adding the cost of replacement parts and repairs, the annual maintenance budget required for vehicle operation has been estimated at about MK 9,000.

### 5) Equipment Maintenance Costs

Annual maintenance cost for all equipment is set 5% of total equipment cost.

### 6) Other Items

Based on the above, the total cost of maintenance and administration resulting from Plan implementation has been estimated at MK 375,225 for Bunda College and MK 79,000 for the aquaculture program, yielding a combined total of MK 454,225

Table 3-2.5 Estimated Maintenance and Operation Costs Based on the Plan Implementation

Item	Itemization & Operating Expenses	Annual Expense
Portion to be Funded from the Bunda agricultural college Budget		
Power	253,905 kW x MK 0.68 / kW	MK 172,655 / year
Water	3,800 m <sup>3</sup> x MK 7.65 / m <sup>3</sup>	MK 29,070 / year
Facility maintenance & administration	3,000 m <sup>2</sup> x MK 50.0	MK 150,000 / year
Portion to be Funded from the Aquaculture course Budget		
Vehicle Operation	Including repairs	MK 9,000 / year
Equipment maintenance & repairs		MK 70,000 / year
Propane gas	1,000 kg x MK 23.5 / kg	MK 23,500 / year
Total		MK 454,225 / year

Among the current operating expenses at the College, fuel, light, water, and facility maintenance costs are disbursed on a College-wide basis by the Facilities Management Department. In fiscal 1995, excluding personnel expenses, the utility budget came to MK536,00 and the facilities budget to MK1,072,000, for a combined total of



MK1,608,000. Based on Plan implementation, the total budget requirements can be expected to increase by some MK 375,225, meaning that the Facilities Management Department would have to seek an additional appropriation of about 23%.

At present, the Animal Science Department makes all the necessary budgetary arrangements for the aquaculture program, which is under its wing, but if the Aquaculture course were to be upgraded to the status of an independent Department, the new DAFS would then be obliged to secure its own separate

The annual budget for the Animal Science Department, including the aquaculture program, is in the order of MK400,000, but additional funding will be required about MK 79,000, apart from personnel and other Departmental requirements, in connection with Plan implementation to cover such items as vehicle operation, equipment maintenance, and procurement of reagents.

## **CHAPTER 4    EVALUATION AND RECOMMENDATIONS**

### **4-1      Verification of Appropriateness and Project Benefits :**

Implementation of the subject Plan will result in an expansion of the functional capabilities of the Aquaculture facility at the Bunda College of Agriculture, Malawi University, which has been positioned as the nation's highest-level educational facility for teaching and research in this field. A direct benefit of the project will be the expected vitalization of aquaculture teaching and research programs together with the cultivation of aquaculture-literate leadership personnel in both Malawi and other SADC countries. A secondary benefit of the Plan will be the anticipated upgrading of faculty research capabilities at the College level, based on the construction of new facilities and provision of equipment.

Students graduating from this improved educational environment can, by virtue of their leadership positions, be expected to make important contributions to aquaculture development in both Malawi and other SADC countries.

The following specific benefits may be expected from Plan implementations :

#### **(1) Improved Study Environment**

Bunda College has been plagued by a chronic facility shortage that has imposed serious constraints on the aquaculture course, which lacks exclusive lecture and laboratory facilities, in terms of both curriculum development and lecture and training content in current courses. Under the subject Plan, the Aquaculture course, which is presently attached to the Animal Science Department, will be moved to a newly established Department of Aquaculture and Fisheries Science and, with the provision of wholly-owned facilities and equipment, will offer a vastly improved study

#### **(2) Improved Research Results**

It may be confidently expected that, based on the introduction of research and instructional facilities and equipment which are currently lacking in Aquaculture courses, such as a wet laboratory and hatchery, the level of research activity will be greatly enhanced through coordination and joint programs with the network of 27 fisheries branches and 2 aquaculture experimental stations scattered throughout the country and foreign universities and institutions for agriculture, along with increased opportunities for receiving technical cooperation from other countries.

**(3) Responding to the Needs of the SADC Community**

As already noted, Malawi has been positioned within the SADC Community as the coordinating country for inland water fisheries, including freshwater aquaculture, and so is responsible for accommodating exchange students in these fields from other SADC countries. While a need has been identified for admitting some 15 degree candidates from SADC members, at present only 7 such students can be accommodated, primarily in the short-term course. The subject Plan will create a much improved educational program in terms of its ability to respond adequately to SADC requirements.

**(4) Development of the Aquaculture Industry in Malawi**

The aquaculture industry in Malawi is still in an incubational phase, handicapped by a serious deficiency in technical assistance programs from public sources for the petty farmers entering this field. The primary channel for introducing aquaculture techniques in Malawi is the farming sector, where aquaculture is typically pursued only on a secondary basis within a complex aquaculture format. The present project is intended to raise the level of teaching and research activity at the new Department of Aquaculture and Fishery Science at Bunda College. However, while all students majoring in fishery studies are required to take agriculture-related courses, it should also become possible to study and acquire aquaculture technology, which conforms so well with real-world conditions in this country. It is expected that the large number of students turned out by the new Department will be in a position to provide leadership and guidance for future aquaculture development, while also developing and transferring suitable aquaculture technology, and thereby contribute significantly to the growth of the aquaculture industry in Malawi.

**4.2 Technical Cooperation; Connection with Other Donors**

**(1) Individual Experts Dispatched by JICA**

Two experts have been dispatched to Malawi to serve as instructors in the Aquaculture course at Bunda Agricultural College. One served from September 1993 to September, 1996, while the other arrived in March, 1996 on a three-year contract.

These experts have played an indispensable role in implementing the aquaculture curriculum, with one individual now single-handedly carrying on this cooperation program. When the Aquaculture facility is promoted to the newly established Department of Aquaculture and Fishery Science, a 5-person faculty will be required. At the present time, however, only 3 full-time instructors have been secured, including the above-

mentioned Japanese expert, and so the remaining positions will have to be filled by drawing on the teaching staffs of other Departments. While the technical cooperation program for the dispatch of individual experts is due to terminate in 1999, such cooperation should be continued beyond that date to further enhance the quality of teaching and research programs, utilizing the improved facilities and equipment that are to be furnished under this Plan.

In addition to the above individuals, three other Japanese specialists have been dispatched under a project-type JICA technical cooperation program in Domashi at the Breeding and Aquaculture Center for Species Native to Lake Malawi, with an additional expert scheduled to be added for Phase II of this project. If the services of these specialists could be obtained as instructors for the present short-term aquaculture course and related field training programs at Bunda College, the effectiveness of the subject Plan could be considerably enhanced.

## (2) Connection with Other Donors

A considerable amount of aid has been received to date by the Bunda College of Agriculture as a whole, primarily of an infrastructure nature, from many donor countries and international agencies. However, with regard to the Aquaculture course itself, apart from the donation of student scholarship funds and instructor subsidies by ICEIDA, the only tangible assistance thus far has been the development of aquaculture ponds by ICLARM. But, as previously noted, the faculty shortage at the Department of Aquaculture and Fishery Science is quite serious, so that it would clearly be desirable to establish relationships with other donors in the form of either direct faculty dispatch or assistance in faculty recruitment. Good possibilities would appear to exist for aid cooperation with such organizations as FAO, the World Bank, USAID, and GTZ. Accordingly, an exchange of views and information on this plan between Japan and Malawi should be arranged.

## 4-3 Recommendations

As discussed above, a variety of benefits can be expected from Plan implementation. Through the medium of teaching and research, this project should contribute in a major way to aquaculture development, not only within Malawi itself but also throughout the SADC community. There would, therefore, be considerable significance in implementing the subject Plan via grant-aid cooperation. However, in order to achieve more effective use of the improved facilities to be provided under this Plan, it is essential that a full complement of instructors and researchers be secured, that facility functions be properly administered, and that stable revenue sources be developed for these purposes.

On the external front, in order to respond fully to the needs of the SADC community, ties should be strengthened between aquacultural research facilities within Malawi and outside aid organizations so as to produce teaching and research programs of a consistently high caliber.

We would like to offer the following suggestions as specific measures for achieving the above objectives:

(1) Obtaining Budgets for Facility Operation

The Bunda College of Agriculture should take steps to appropriate firm and ongoing budgets for the Department of Aquaculture and Fishery Science, which is to be established in connection with the subject Plan.

(2) Proper Maintenance and Administration

In order to properly maintain Plan functions after implementation, it is essential that maintenance programs be carried out on a regular or continuous basis.

(3) Recruitment of Instructors and Researchers:

When the Plan facilities are activated, the Department of Aquaculture and Fishery Science will also inaugurate operations as an independent Department within Bunda Agricultural College. Although a 5-person faculty has been deemed necessary for this new Department, only 3 members have been recruited to date. The remaining two positions, therefore, must be filled as soon as possible.

(4) Management Plan for Reservoir Water Usage

It has been estimated through hydrographic survey that the volume of water stored in the Bunda Reservoir ranges between a maximum of 410,000 m<sup>3</sup> and a minimum of 4,000 m<sup>3</sup>. It will be possible, based on the use of the depth gauges which are to be installed under the subject Plan, to determine this storage volume at any given time, and so, with a regular series of observations, the reservoir pondage can also be monitored. With regard to water supply volume, the amount available for aquaculture purposes can be determined using the water meters included in this project, while that for irrigation use can be estimated on the basis of pump capacity and operating

Based on a proper understanding of the relationship between potential water supply and supply capacity, as determined via the above methods, Bunda College of Agriculture will be

in a position to prepare annual planning charts for the Departments concerned with water usage from the subject reservoir, based on monthly entries of required water supply for both agriculture and aquaculture use. A planned program for water usage management can, accordingly, be developed from these charts.