4.2.2 Facility Sizes

The rooms and their sizes requested by the Kenyan side, classroom use based on the planned curricula, the number and distribution of teachers and staff members and the relevant standards of the Kenyan Commission for Higher Education (CHE) of the Ministry of Education were referred to in deciding the facility sizes. The standard floor areas to be adopted for each type of room are as follows:

- Offices
  Depending on the desk distribution, the standard floor area with each office worker being allocated a desk is generally 4.5 - 7m^2/person while the CHE standard for office space is 7m^2/person. In the case of the present Project, however, those with the status of assistant registrar or higher will be allocated a floor area of 13m^2/person (including space for a visitor). Other staff will be housed in a large room with a standard floor area of 6 - 7m^2/person for senior administrative assistants and 3m^2/person for others.

- Lecture Rooms
  The required number of lecture rooms is calculated based on a lecture room utilization rate of 70 - 80%, which is in turn based on the number of lecture hours and the number of classroom lecture hours included in those courses mainly conducted in the laboratories/workshops in accordance with the planned curricula.
  The number of classroom lecture hours, including seminars, accounts for 65% of the total hours and the provision of the lecture rooms shown in the following table has been decided on.

Size and Number of Lecture Rooms

Size (Seating Capacity)	Original Request			Examination Results		
	Existing	New	Total	Existing	New	Total
20	6	0	6	6	0	6
40	3	12	15	3	11	14
60	2	3	5	6	0	6
100	-	4	4	-	-	-
120	-	-	-	-	1	1
Total	11	19	30	15	12	27

The expected operation ratio of these lecture rooms is 76%. The standard floor area for the combination of a desk and chair will be 2m²/person while the standard floor area for a lecture theatre with a seating capacity of 120 persons will be 1.8m²/person in view of the maximum utilization of the available floor area. The CHE standard is a minimum of 1.9m²/person for lecture rooms in general and 1.7m²/person for large lecture rooms.

- Lecturers' Rooms

  At present, 2 staff members share a single room with a standard floor area of 6.5m²/person but the space is extremely crowded requiring improvement under the Project. The CHE standard of 13m²/person will be uniformly adopted for the full-time teaching staff planned for 1994/95 excepting those absent due to training, research abroad or other reasons.

  Although the standard floor area for a lecturer's room in Japan is not specifically given, the sizes adopted in the Tsukuba University Master Plan were 27.9m²/person for professors, 18.6m²/person for assistant professors and 13.9m²/person for lecturers.

  Preparation rooms attached to laboratories and workshops will be provided for other staff, including technicians and demonstrators, as is presently the case. As for the number of lecturer's rooms, the detail is shown in the table on the next page.

- Drawing Rooms

  The actual floor area for drawing rooms is calculated based on a maximum utilization rate of 80%. The Faculty of Agriculture and the Departments of Mechanical Engineering and Electrical and Electronic Engineering will have a common drawing room each while the Department of Civil Engineering and Architecture will have a drawing room for each course. A standard floor area of 4.7m²/person will be adopted for the drawing rooms for the Department of Civil Engineering and Architecture and for the Faculty of Agriculture (Department of Agricultural Engineering) to allow the use of drawing boards up to A1 size while the common drawing rooms for the Departments of Mechanical Engineering and Electrical and Electronic Engineering will have a standard floor area of 3.7m²/person to allow the use of drawing boards up to A2 size.

No. of Lecturers' Room

Department	Existing			Planned			
				Use of existing rooms		New	Total
	Lecturers' Room	Chairman's Room	Total	Lecturers' room	Chairman's room	Lecturers' room	
Horticulture	7	1	8	7	1	16	24
Agricultural Engineering	8	1	9	0	1	22	23
Food Engineering	8	1	9	16	1	11	28
Total, Faculty of Agriculture	23	3	26	23	3	49	75
Architecture & Civil Engineering	15	1	16	12	1	19	32
Mechanical Engineering	11	1	12	5	1	16	22
Electrical & Electronic Engineering	8	1	9	17	1	3	21
Total, Faculty of Engineering	34	3	37	34	3	38	75
Liberal Arts & Science	5	-	5	5	-	37	42
Farm	4	-	4	4	-	0	4
Grant Total	66	6	72	66	6	124	196

- Laboratories

With regard to those laboratories for such general studies as physics, chemistry and biology, the standard floor area generally varies from 2.8m^2/person to 3.7m^2/person depending on the laboratory table size and equipment layout. The standard floor area in the case of the present Project will be approximately 2.7m^2/person for the physics laboratory (with a

preparation room) and approximately 3.1m²/person for the chemistry and biology laboratories (with separate preparation rooms) based on the trial equipment layout.

The standard floor areas for those laboratories for specialized subjects will be determined based on the actual equipment layout for each laboratory.

- Library

1) Book Stack

The CHE standard for a constituent college is 30 books/person (i.e., 41,160 books for 1,372 students) and this standard is raised to 100 books/person in the case of a university. According to the Guide for Library Improvement issued by the Japanese Ministry of Education, the minimum number of required books is 30,000 for up to 1,000 students and an additional 5,000 books for each additional 1,000 students. The minimum number of required books is 35,000 based on this criterion. As the CHE standard is almost the same as other standards, a book stock of 41,160 in 1994/95 will be adopted as the planning basis for the Project.

2) Number of Staff

The total number of Library and Resource Centre staff is 72 (i.e., 12 librarians with the rank of officer or higher and 60 ordinary staff).

The number of staff required to run the Library is 34, including 8 officers or higher ranks (i.e., Librarian, Deputy Librarian and 32 others, including 10 for binding, book acceptance and other work). The standard floor area for binding work is 6 - 11m²/person and 7m²/person will be adopted for the present Project. The standard floor area for the 11 librarians working in the office will also be 7m²/person in view of the general office floor area adopted for the Project.

3) Library Size

The CHE standard for the library of a constituent college is 2,144m² while the Japanese Ministry of Education standard (Standard Floor Area for National Educational Institutions 1978) is 2,246m². According to the Moi University standard (UGC Methodology), the required library size for JKUCAT is 2,527m². As the CHE standard appears sufficient, however, this standard will be adopted.

(Adopted Planning Conditions Based on CHE Standards)

- Subject number of students simultaneously using the reading room (30% of the total number of students) 411
- Reading room space ..... 1.9m^2/person
- Reference, periodicals and book stack space ..... 10.8m^2/1,000 books

- Resource Centre

  Teaching materials are prepared at the Resource Centre which is under the jurisdiction of the Library although it is functionally separated from the Library. The Resource Centre has a total staff of 38, i.e., head, deputy head and 36 others (6 office clerks, 22 staff for printing, binding and other work, 3 photography technicians and 5 assistants).

  As in the case of the library work space, the standard floor area for printing and bookbinding work will be 6m^2/person.

- Canteen

  The required floor area is calculated based on the number of students following the completion of the Project, i.e., 652 (1,372 - 720). The current turnover rate of 2.6 times will be adopted for the new canteen and the resulting number of required seats is 250. Appropriate canteen space is generally considered to be 1.2 - 1.7m^2/person for a university canteen and the CHE standard of 1.25m^2/person will be adopted for the Project.

I-1 Faculty of Agriculture

Department	Room	Calculation Basis	Planned Floor Area (m^2)
Horticulture	Plant Nutrition Laboratory	based on equipment layout (including Preparation Room)	189
	Environmental Control Laboratory	as above (including Preparation Room)	135
	Lecturers' Rooms (16 Lecturers and their Secretaries)	(24-8) x $13m^2$/person + $14m^2$/2 persons = $222m^2$. Existing 8 rooms will be used as the chairman's room and 7 lecturer's rooms while technicians will use preparation rooms.	209
	Soil Sterilization Room	based onm equipment layout	25
Agricultural Engineering	Irrigation and Drainage Laboratory	based on equipment layout (including surveying preparation room, etc.)	477
	Agricultural Machinery Workshop	based on equipment layout (including preparation room, parts storage and agri. processing)	594
	Soil Physics Laboratory	Existing laboratory ($95m^2$, incl. preparation room) will be relocated.	95
	Soil Mechanics Laboratory	Existing laboratory ($95m^2$, incl. preparation room) will be relocated.	95
	Agricultural Engineering Laboratory	Existing laboratory ($149m^2$, cnl. preparation room) will be relocated.	149
	Lecturers' Rooms (22 lecturers and their secretaries)	(23 - 1) x $13m^2$/person + $14m^2$/2 persons = $300m^2$ The chairman will use the existing room. Technicians will use Preparation Rooms.	285
Food Technology	Food Biochemistry Laboratory	based on equipment layout (incl. analysis room and preparation room)	135
	Micro-Biology Laboratory	Existing laboratory will be used (incl. preparation room)	use of existing facility
	Postharvest Laboratory	Existing laboratory will be used (incl. preparation room)	use of existing facility
	Lecturers' Rooms (11 Lecturers and Their Secretaries)	(28-17) x $13m^2$/person + $14m^2$/2 persons = $157m^2$. Existing 17 rooms will be used as the chairman's room and 16 lecturer's rooms while technicians will use preparation roms	146

Common Use for the Faculty	Lecture Room Drawing Room	2.0m²/person x 40 = 80m² 4.7m²/person x 20 + 28m² = 122 (including Preparation Room)	81 121
	Sub-Total		2,711
	Corridors, Stairs, Lavatories and Pantry, etc.		643
	Total		3,354

I-2 Faculty of Engineering

Department	Room	Calculation Basis	Planned Floor Area (m^2)
Building and Civil Engineering	Construction Material Testing Laboratory	based on equipment layout (including storage)	504
	Physical Environmental Laboratory	based on equipment layout (including instrument store room and dark room)	146
	Drawing Rooms (1 each for Civil Engineering and Architecture)	($4.7m^2$/person x 20 + $28m^2$) x 2 = $240m^2$ including preparation rooms	243
	Architectural Model Work Room and Model Room	based on equipment layout	216
	Lecturers' Rooms (19 Lecturers and Their Secretaries)	(32-13) x $13m^2$/person + $14m^2$/2 persons = $261m^2$ Existing 13 rooms will be used as the chairman's room and 12 lecturer's rooms while technicians will use preparation rooms	255
	Reference and Printing Room (Common Use by Faculty of Engineering)	Exisitng laboratory building will be used.	use of existing facility
Mechanical Engineering	Metrology Laboratory	based on equipment layout (including preparation room)	95
	Thermodynamics Laboratory	as above (")	162
	Fluid Engineering Laboratory	as above (")	144
	Mechanical Science and Elemntary Fluid Laboratory	Existing laboratory ($176m^2$, including preparation room) will be relocated	176
	Material Science Laboratory	Exisgting laboratory ($95m^2$, including preparation room) will be relocated	126
	Lecturers' Rooms (16 Lecturers and Their Secretaries)	(22-6) x $13m^2$/person + $14m^2$/2 persons = $222m^2$. Existing 6 rooms will be used as the chairman's room and 5 lecturer's rooms. technicians will use Preparation Room	210
	Machinery Hard Standing	3 tractors + work space	300

Electrical and Electronics Engineering	Digital Electronics Laboratory	based on equipment (incl. preparation room)	108
	Control Laboratory	as above	108
	Illumination Laboratory	as above	108
	Electrical Measurement Laboratory	as above. Existing laboratory building will be used (incl. preparation room)	Use of existing facility
	Communication Laboratory	as above. Existing laboratory building will be used (incl. preparation room)	Use of existing facility
	Lecturers' Rooms (3 Lecturers and Their Secretaries)	(21-18) x 13m^2/person + 14m^2/2persons = 53m^2 Existing 18 rooms will be used as the chairman's room and 17 lecturer's rooms while technicians will use preparation rooms	46
Common use for the Faculty	Lecture Room	2.0m^2/person x 40 = 80m^2	81
	Drawing Room	3.7m^2/person x 20 + 28m^2 = 102m^2	95
	Sub-Total		3,123
	Corridors, Stairs, Lavatories and Pantry, etc.		719
	Total		3,842

I-3 New Common Lecture Building

Department	Room	Calculation Basis	Planned Floor Area (m^2)
Common Subjects	Physics Laboratory (40 Students x 2 rooms)	based on equipment layout	270
	Chemistry Laboratory (40 Students x 1 room)	as above	162
	Biology Laboratory (40 Students 1 room)	as above	162
	Lecturers' Rooms (37 Lecturers and Their Secretaries)	42 (lecturers) - 5 (in exisgting bldg.) = 37 35 lecturers: 35 persons x $13m^2$/person + $28m^2$/4persons = $483m^2$ 2 heads : 2 persons x $13m^2$/person + $14m^2$/2persons = $40m^2$ Total 523m2	use of existing facility
	Lecture Theatre (120 Students x 1 room)	$1.8m^2$/person x 60 x 4 = $216m^2$	216
	Lecture Rooms (60 Students x 4 rooms)	$2.0m^2$/person x 60 x 4 = $480m^2$	use of existing facility
	Lecture Rooms (40 students x 9 rooms)	$2.0m^2$/person x 40 x 9 = $720m^2$	717
	Computer Practice Room	total floor area of Computer Room for 20 students Practice Room, Preparation Room and Seminar Room is $170m^2$	162
	Sub-Total		1,689
	Corridors, Stairs, Lavatories and Pantry, etc.		510
	Total		2,199

I-4 Water Purification Plant

	Calculation Basis	Planned Floor Area (m^2)
Water Purification Plant	$80m^2$ for building, $159m^2$ for water tank and $277m^2$ for water purification unit	516

I-5 Library

Room	Personnel Distribution (persons)	Calculation Basis	Planned Floor Area (m^2)
Reading Room	411 (seats)	411 x $1.9m^2$/person = $782m^2$	785
Seminar Room		8 x $2m^2$/person = $16m^2$	22
Book Stack Space		1,372 x 30 books/person x $10.75m^2$/1,000 books = $422m^2$	443
Reference Desk and Periodical Space		280 periodicals x 60 months x $10.75m^2$/1,000 books = $180m^2$	191
Locker Room	2	based on layout of lockers of 350mm in width and 400mm in height each for half of 411 readers	25
Reception Counter	4		13
Office	11	11 x $7m^2$/person = $77m^2$	68
Work Rooms·Binding room	10	10 x $7m^2$/person = $70m^2$	80
Librarian's Room	1	(including reception space and secretary's room)	23
Deputy Librarian's room	1		9

Meeting room	8 (sets)	8 person x $2m^2$/person = $16m^2$	16
Sub-Total			1,653
Corridors, Stairs, Lavatories and Pantry, etc.			479
Total			2,132

I-6 Resource Centre

Name	Personnel Distribution (persons)	Calculation Basis	Planned Floor Area (m^2)
Office	8	6 x $6m^2$/person + $18m^2$ (storage) = $54m^2$	use of existing facility
Printing and Binding Room	22	22 x $7m^2$/person = $154m^2$	as above
Audio-Visual Room	2	maximum of 40 seats + 10 independent booths (including storage stack space) $80m^2$	90
Audio-Visual Preparation Room		2 x $7m^2$/person + storage stack space $20m^2$	15
		The above rooms will be planned within the library	
Total			105

II Administration

Room	Personnel Distribution (persons)	Calculation Basis	Planned Floor Area (m^2)
Provisional Lecturer's Room		including lavatory	63
UC Council Chairman's Room			36
Principal's Room	1 + 1	including reception space and Secretary's Room	81
Deputy Principal's Room	1 + 1	as above	54
Project Team Leader's Room	1	Including space for meeting	18
Project Team Office	3 + 2	5 x $7m^2$/person for office space + $20m^2$ for meeting and reception space = $55m^2$	54
Offices			
- Registrar (Administration)	1 + 1	including reception space and Secreatry's Room	36
- Deputy Registrar (Administration)	1 + 1	as above	36
- Personnel Administration	20	3 x $13m^2$/person + 5 x $6m^2$/person + 12 x $3m^2$/person = $105m^2$	108
- Recruitment and Training	15	3 x $13m^2$/person + 5 x $6m^2$/person + 7 x $3m^2$/person = $90m^2$	90
- Estate Management	7	2 x $13m^2$/person + 5 x $6m^2$/person = $56m^2$	54
- Information and Public Relations	8	2 x $13m^2$/person + 3 x $6m^2$/person + 3 x $3m^2$/person = $53m^2$	54
- Registrar (Academics)	1 + 1	including reception space and Secretary's Room	use of existing room
- Deputy registrar (Academics)	1 + 1	as above	as above
- Examinations	9	2 x $13m^2$/person + 7 x $7m^2$/person = $75m^2$	as above
- Admissions and Records	10	2 x $13m^2$/person + 8 x $7m^2$/person = $82m^2$	as above

- Staff Development - Accounting Conference Room PABX Room Reception Rooms (2)	8 14	2 x 13m²/person + 6 x 7m²/person = 68m² 3 x 13m²/person + 11 x 7m²/person = 116m² 40 seats	as above as above 135 18 54
Sub-Total			891
Corridors, Stairs, Lavatories and Pantry, etc.			463
Administration Building Total			1,354
Maintenance Workshop			120
Grand Total			1,474

III Welfare Facilities

	Personnel Distribution (persons)		Planned Floor Area (m²)
Canteen Kitchen Corridor	250seats	(1,372 - 720) - 2.6 x 1.25m²/person = 313m² 250 x 0.4m²/person = 100m² connecting new and old canteens	324 108 18
Total			450

The floor areas of the new buildings to be constructed under the Project are as follows.

Name	Planned Floor Area (m^2)
Agricultural New Laboratory Building	1,404
Agricultural Engineering Laboratory Building	845
Agricultural Engineering Workshop Building	1,080
Soil Sterilization Building	25
Engineering New Laboratory Building	2,318
Civil and Mechanical Engineering Laboratory Building	1,224
Machinery Hard Standing Building	420 *
New Common Lecture Building	2,199
Water Purification Plant	516
Library Building	2,237
New Administration Building	1,354
Canteen Building	450
Total	14,072

* including Maintenance Workshop 120m^2

The details of the planned conversion of the existing buildings which is part of the Project are given in the following tables.

IV Conversion Plan

- Existing Agricultural Laboratory Building

Planned Rooms After Conversion	Current Rooms Before Conversion	Calculation Basis	Planned Floor Area (m^2)
Postharvest Laboratory (1)	Agricultural Engineering Laboratory	based on equipment layout, including preparation room	149
ditto (2)	Soil Mechanics Laboratory	based on equipment layout	81
Microbiology Laboratory	Soil Physics Laboratory	based on equipment layout, including preparation room	95
Materials Storage	Preparation Room		13

- Existing Engineering Laboratory Building

Planned Rooms After Conversion	Current Rooms Before Conversion	Calculation Basis	Planned Floor Area (m^2)
Electrical Measurement Laboratory	Material Science Laboratory	based on equipment layout, including preparation room	95
Communication Laboratory	Mechanical Science & Elementary Fluid Laboratory	based on equipment layout, including preparation room	122
Data Room, Printing Room	ditto		54

- Existing Common Lecture Building and Library

Planned Rooms After Conversion	Current Use (m^2)		Personnel Distribution (persons)	Calculation Basis	Planned Floor Area (m^2)
4 Lecture Rooms (60 Students each)	4 Drawing Rooms	461	41	Refer to I-3, "New Common Lecture Bldg." $480m^2$.	461
Lecturers' Rooms (37 Lecturers and Their Secretaries)	Reading Room	558*		Refer to I-3, "New Common Lecture Bldg." $523m^2$ + corridors.	594
	Entrance Hall	36*			
Printing and Binding Room	Office	54	22	Refer to I-6, "Resource Center" $154m^2$	144
	Storage	9			
	Librarian's Office	9			
	Binding Room	72*			
Office	Work Room	54*	8	Refer to "I-6 Resource Centre" $54m^2$	54

* Such improvement work as the provision of additional partitions and the removal of walls will be required in the case of the total floor area of those rooms marked with an asterisk ($720m^2$)

- Existing Administration Building

Planned Rooms After Conversion	Current Use (m^2)		Personnel Distribution (persons)	Calculation Basis	Planned Floor Area (m^2)
Registrar's Room and Secretary's Room	Principal's Office	42	1 + 2	including Secretary's Room	42
Deputy Registrar's Room	Deputy Registrar's Secretary's Office	18	1		18
Office (Examinations)	Deputy Principal's Office	36	9	Refer to "II Administration" $75m^2$	84
	Secretary's Room	18			
	Examination Control Office	30			

Transport Office	PABX Room	18	2	also serves as Driver's Waiting Room	18
Office (Admissions and Records)	Registry Office	36	10	Refer to II. Administration. 82m^2	85
	Registry Officer's Room	13			
	Registry's Office	18			
	Secretary's Office (including storage)	18			
Staff Lounge-cum-Small Conference Room	Staff Lounge	54*			54
Office (Staff Development)	Conference Room	72*	8	Refer to II. Administration. 68m^2	72
Office (Accounting)	Administration Office	36	14	Refer to II. Administration. 116m2	120
	Administration Officer's Room	18			
	Accounting Office	54			
	Accounting Officer's Room	12			

Note: Such improvement work as the provision of additional partitions and the removal of walls will be required in the case of the total floor area of those rooms marked with an asterisk (126m^2)

4.3 Basic Plan

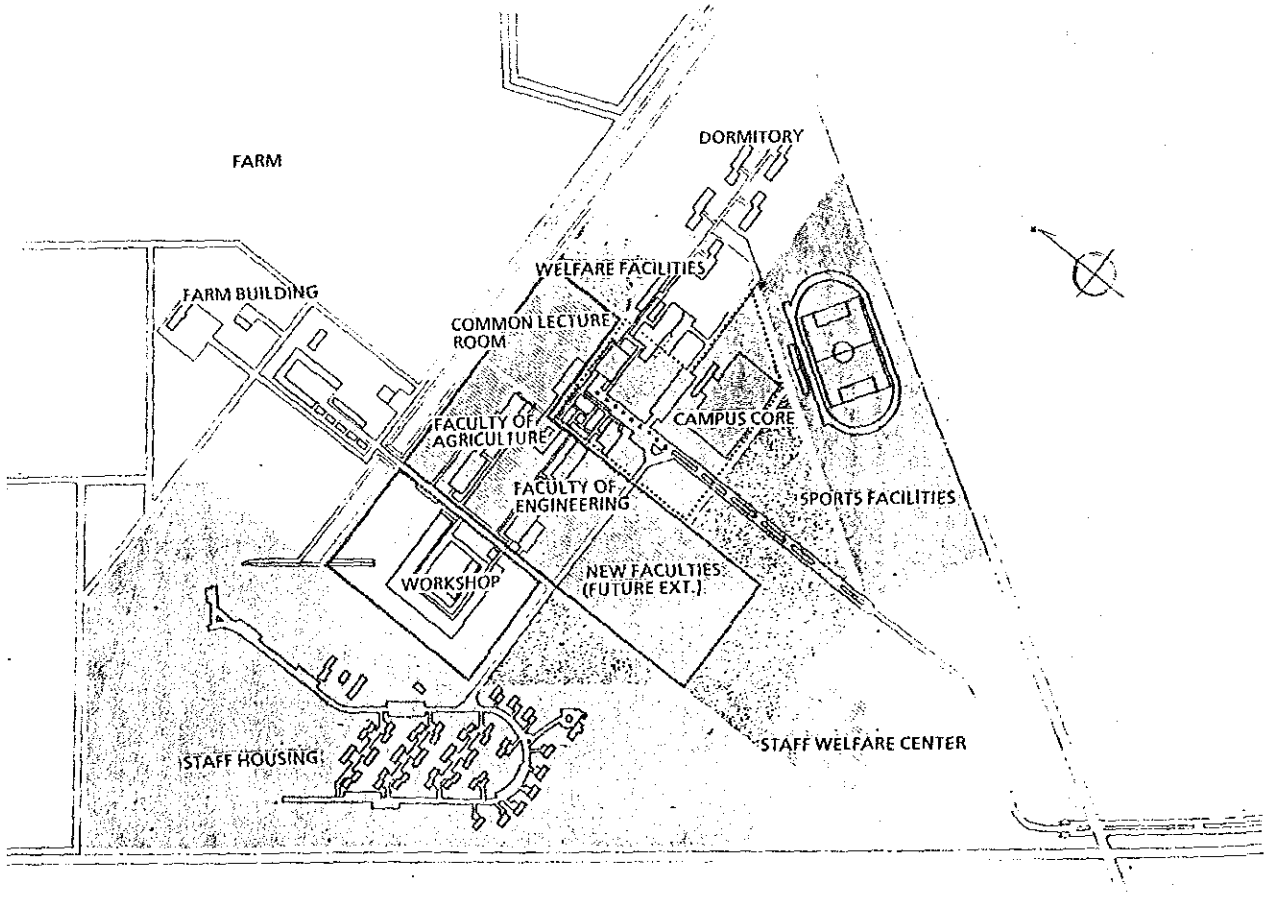
4.3.1 Campus Plan

(1) Zoning

In principle, the zoning plan adopted for the construction of the existing facilities will be respected and extended. The northern and southern parts of the campus will be considered the experimental farm area and college facility area respectively and, therefore, all facilities closely related to the farm will be located in the northern part of the campus while other facilities will be located in the southern part.

The University College facility area will be divided into several zones, i.e., a common facility zone in the centre, a welfare zone to the east and a laboratory/workshop zone to the west. An additional zone will also be planned in order to meet the possible future expansion of the college as shown in the following illustration.

ZONING CONCEPT



(2) Facility Distribution

The area around the existing Administration Building will be considered the core of the campus and the Library and new Administration Building will be located in this area. A graduation courtyard, where graduation ceremonies attended by the President of Kenya and other events can be held, will be introduced at the centre of this campus core.

Laboratory/workshop buildings will be located next to the existing departmental buildings but at the north side of the Faculty of Agriculture Building and the south side of the Faculty of Engineering Building so that the construction work does not disturb the ongoing teaching activities.

The Common Lecture Building will be located at the north side of the existing building.

4.3.2 Building Plan

(1) Plan

The climate of the project site is generally mild with an average temperature of 17°C - 22°C throughout the year. Natural ventilation will be adopted to secure comfortable room conditions without relying on mechanical methods. In view of the favourable climate, a middle corridor-type plan will, in principle, be adopted to efficiently use the available space. However, the plan for the new Administration Building will include a quadrangle to provide better comfort and privacy.

Although the climate is generally mild, the sunshine is very intense. The axis of the buildings will, therefore, be in the east-west direction to provide a comfortable environment by avoiding the intense sunshine from the east and west sides. A sufficient number of windows will be planned for the north and south sides to facilitate natural lighting and ventilation.

- Faculty of Agriculture

The lecture rooms and drawing room commonly used by the Horticulture, Food Processing and other courses will be grouped in the Common Laboratory Building of the Faculty of Agriculture. The Agricultural Engineering Department (Agricultural Engineering Workshop, Irrigation and Drainage

Laboratory) and the Agricultural Engineering Laboratory, both of which are closely related to the Farm, will be planned as two separate buildings, each to be arranged east of the Farm Building. The Soil Sterilization Laboratory will be located to the north of the existing Farm Administration Building. The Faculty of Agriculture will consequently consist of the following 4 buildings.

- Agricultural New Laboratory Building
- Agricultural Engineering Laboratory Building
- Agricultural Engineering Workshop Building
- Soil Conservation Building

- Faculty of Engineering
  The Department of Electrical and Electronic Engineering, the architectural engineering course of the Department of Civil Engineering and Architecture, drawing room and the common lecture rooms of the Faculty of Engineering will be grouped in the Engineering New Laboratory Building. The material laboratory for the Department of Building and Civil Engineering and the 3 laboratories for the Department of Mechanical Engineering, all of which require a large floor area, will be grouped in the building to be constructed to the south of the existing Engineering Workshop. The machinery hardstanding, together with the maintenance workshop for the administration section, will be located in the building to be constructed to the north of the present Engineering Workshop Building. The Faculty of Engineering will consequently consist of the following 3 buildings.

  - Engineering New Laboratory Building
  - Civil and Mechanical Engineering Laboratory Building
  - Machinery Hardstanding Building

- Common Lecture Building
  Except one for each faculty, all the lecture rooms will be housed in this building to achieve high efficiency. In addition to the common lecture rooms for the faculties of Agriculture and Engineering, the laboratories for general studies (i.e., physics, chemistry and biology) and the computer room will also be housed in this building.
  All offices for those teaching staff related to general studies will be housed in the existing Library as described later.

- Library Building
  All library functions will be grouped in the new Library Building in view of

providing an efficient library service and for the convenience of all members of the college. The new Library will, therefore, cater to the total of 1,372 students planned for 1994/95. After the existing library functions have been moved to the new Library, the old Library space will be used to house the offices for the teaching staff of general studies. The audiovisual room requested as part of the Resource Centre will be housed in the new Library Building in view of its close connection with library functions.

- Resource Centre

  The existing Resource Centre to prepare teaching materials is located next to the Library in the Library and Common Lecture Building and the request for the project is to expand the same function as those of the existing resource centre. The office and binding room space of the existing Library will be used to expand the Resource Centre following the transfer of the library functions to the new Library. No new building construction is, therefore, planned for the Resource Centre.

- Administration Building

  The college administration organization will be renewed and the number of staff increased following the expansion of the college. Efficient use of the existing Administration Building will be taken into consideration in the planning of the new Administration Building. The new Administration Building will house the administration offices, as well as the Provisional Lecturer's Room, the Principal's office, Deputy Principal's office, University College Council Chairman's office, and Conference Room, etc.

  As the Provisional Lecturer's Room will be used as a sitting room by the President of Kenya when he attends college ceremonies, the interior and layout, etc., of this room should be appropriately designed.

  University College Council meetings will be held in the Conference Room and the room size must be capable of holding a maximum of 40 people, including some 35 Council members, a secretary and observers. A sliding partition will be introduced to separate the room into 2 smaller rooms so that 2 small meetings can be held simultaneously.

- Canteen

  A new canteen will be constructed next to the existing Faculty Dinning Room and will be connected to the latter by a corridor. This location will give the new canteen access to the service yard and propane gas supply facility, etc., of the existing Dining Hall. A separate kitchen will be provided to avoid any

major alteration of the existing kitchen. A connecting corridor with the existing kitchen will be built for convenience.

The following conversion of the existing facilities is planned.

- New Common Lecture Building
  As the drawing rooms will be exclusively used for the relevant courses, all the drawing rooms will be provided in the New Laboratory Buildings of the Faculties of Agriculture and Engineering. The existing drawing rooms will be converted to common lecture rooms to house 60 students each.
  The existing Library will be used to expand the Resource Centre and to house offices for teaching staff relating to general studies.

- Administration Building
  The existing Administration Building will only house those sections closely related to students, including the finance and academic (registration, examination and staff development) sections. As the floor area of the existing building is insufficient to house all these sections, however, the existing meeting room will be converted to an office. While the meeting room in the new Administration Building should, in principle, be sufficient for major meeting requirements, the existing staff lounge may be used as a small meeting room when necessary.

(2) Elevation and Section

- Elevation
  In principle, the elevation adopted for the existing buildings will be adopted in view of achieving harmony between the old and new buildings. Eaves will be introduced for all new buildings to shut out intense sunshine and rain. The visual effect of the shadows caused by the eaves and frames will be well considered in the elevation to generate an impressive appearance when viewed from the direction of the access road.

- Section
  All the new buildings will be 2 stories in height to maintain harmony with the existing buildings to emphasise the integrity of JKUCAT and to complete the construction work in the limited period.
  The floor height will be 50.8 with a GL of 50.5 in line with the existing buildings. With regard to the Agricultural Machinery Laboratory Building and the Irrigation and Drainage Laboratory Building, a GL of 51.5 will be

adopted in line with the height of the existing Farm building in view of the high ground. A GL of 49.0 is desirable for the student accommodations to be constructed by the Kenyan side in line with the GL of the existing student accommodations.

Skylights will be introduced in those rooms on the first floor of the Agricultural New Laboratory Building and the Engineering New Laboratory Building which will, in addition to the natural lighting from 2 sides, secure a suitable environment for the drawing and other rooms.

The entrances to the Agricultural Machinery Laboratory Building and the Civil and Mechanical Engineering Laboratory Building must be high enough to allow large machinery and equipment to pass through. An effective minimum height of approximately 4m will, therefore, be adopted for the Agricultural Machinery Laboratory Building while that of the Civil and Mechanical Engineering Laboratory Building will be approximately 5m.

(3) Structural Plan

The following basic policies have been adopted for the structural plan.

- The buildings should be durable in view of their public character.
- Clear and simple structures should be adopted to suit the local conditions.
- Local methods to determine the external force and to select the structural design standards and building materials should be employed where possible.
- The buildings should be economical.

1) Laws, Regulations and Structural Design Standards

The building design should be based on the Kenyan Building Code and other Kenyan standards while using British Standards (BS) as supplements. Japanese design standards should also be referred to in the design of steel structures, etc. The main standards and codes to be referred to are as follows:

- Building Code, Republic of Kenya (1968)
- Code of Practice for the Design and Construction of Buildings and Other Structures in Relation to Earthquakes, Kenya (1973)
- General Specification for Building Works, Republic of Kenya (1976)
- BS: Load Conditions
- BS: Reinforced Concrete Structure Standards
- Japan Architects Association: Steel Structure Design Standards

SEISMIC ZONING MAP OF KENYA
AFTER I. S. LOUPEKINE

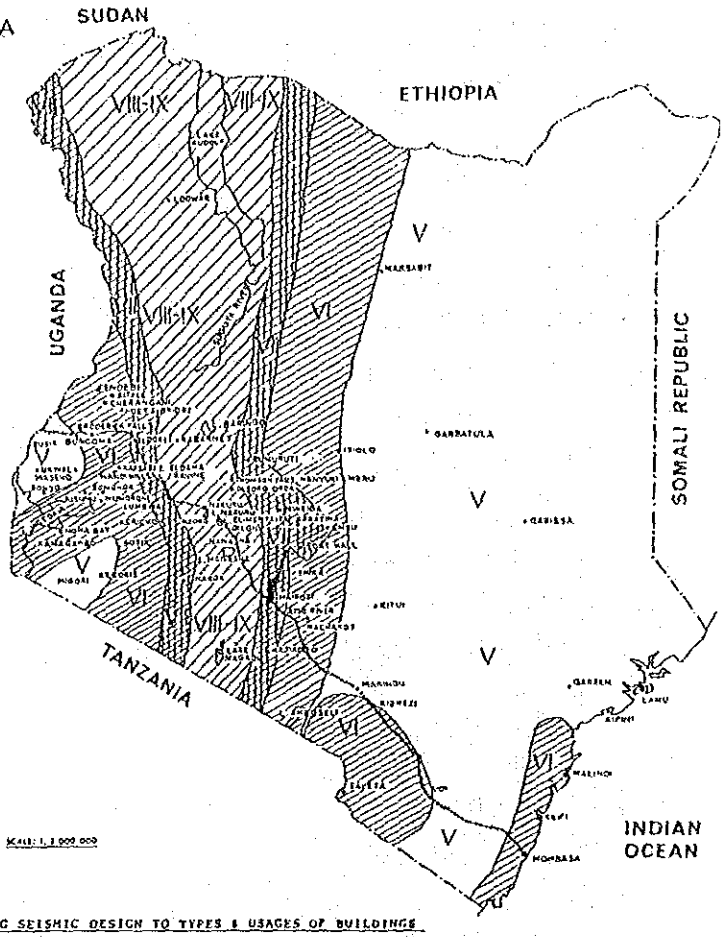


TABLE 1 TABLE RELATING SEISMIC DESIGN TO TYPES & USAGES OF BUILDINGS

TYPE OF STRUCTURE & USAGE CLASS.		ZONE V		ZONE VI		ZONE VII		ZONE VIII – IX	
		SEISMIC DESIGN REQUIRED	LIMITING STOREYS OR HEIGHT.	SEISMIC DESIGN REQUIRED	LIMITING STOREYS OR HEIGHT.	SEISMIC DESIGN REQUIRED	LIMITING STOREYS OR HEIGHT	SEISMIC DESIGN REQUIRED	LIMITING STOREYS OR HEIGHT
R.C., Steel, etc. Framed Structures (Flexible or Rigid)	Class A	No	No limit	No Unless 12 storeys or over	No limit	No Unless 8 storeys or over	No limit	Yes	No limit, but special precautions
	Class B	No	3 storeys for offices, hotels etc. 4 storeys for flats	No	3 storeys for offices, hotels etc. 4 storeys for flats	No	3 storeys for offices, hotels etc. 4 storeys for flats	Yes if 3-4 storeys	3 storeys for offices, hotels etc. 4 storeys for flats
	Class C	No	No limit	No	No limit	Depends on use and importance and level of damage acceptable. At Engineer's discretion.			
	Class D	No	2 storeys	No	2 storeys	No	2 storeys	No	2 storeys
Load Bearing Walls	Class A	No	No limit	Yes	Not more than four storeys	Yes	Not more than three storeys	Yes	Not more than two storeys
	Class B	No	3 storeys for offices, hotels etc. 4 storeys for flats	Yes	3 storeys for offices, hotels etc. 4 storeys for flats	Yes	3 storeys for offices, hotels etc. 4 storeys for flats	Yes	Not more than 3 storeys in in all cases
	Class C	No	Not over 3 storeys	No	Not over 3 storeys	Load bearing walls for installations not recommended over 2 storeys. At Engineer's discretion.			
	Class D	No	3 storeys	No	3 storeys	Yes	3 storeys	Yes	2 storeys
	Class E	No control of domestic buildings in Rural areas is envisaged, but buildings over 3 storeys should be discouraged, because of likely poor design and construction.							

Note: Where "Seismic Design" is referred to this means:
In case of Framed Buildings - Engineering Computation of effect of forces on frame as recommended in this Code.
" " " Load Bearing - Compliance with particular Recommendations in this Code.

2) Load and External Force

The following loads will be considered as the external force on the buildings.

- Dead Load

The dead load will be calculated in accordance with the load of the structural materials, finishing materials and other items fixed to the buildings.

- Live Load

The following values given by the Kenyan Building Code will be used as the design live loads and will be supplemented by the BS load conditions.

- Wind Load

The wind pressure (F) is calculated by the following equation based on the BS. $F = C \times q \times A$

Where C : wind pressure coefficient (depends on building shape and other conditions)

Room Type	Floor Live Load (kg/m^2)
Office	245
Bedroom	200
Canteen	395
Library	980
Lecture Room	295
Classroom	295
Workshop	490
Staff Office	490

Note: The load of heavy equipment is considered separately.

q : wind pressure (at Nairobi; $q = 33.1 kg/m^2$)

A : effective building area vis-a-vis wind pressure

- Earthquake Load

The Kenyan Code of Practice relating to earthquakes classifies Nairobi as Zone VII. Since the planned buildings are classified as Class A, no special consideration is required in regard to earthquakes.

3) Upper Structure

The planned upper structure for each building is as follows.

Building	Structure	Floor (GF)	Roof
Common Lecture Room, Library & Administration, etc.	Reinforced Concrete, 2 Stories	Floor Slabs	Reinforced Concrete
Laboratories of Faculties of Agriculture & Engineering & Others	Steel Frame	Slab on Grade	Steel Frame Truss

4) Ground Conditions and Foundation Structure

The ground of the project site consists of clayey or hard granular soil (Murrum) under the surface soil with a tuff layer further below. The tuff layer is found to be as shallow as GL -1m in places. Either the Murrum or tuff layer will be used to support the buildings and the bearing strength for design purposes is expected to be as follows based on boring data and the Kenyan Building Code.

Murrum : fe = 30 tons/m^2 (long-term)

tuff : fe = 60 tons/m^2 (long-term)

Direct foundations with independent footings for the foundation slabs will be employed for all buildings.

5) Structural Materials

While common structural materials are generally available in Kenya, the prices of steel materials are higher than those in Japan due to the necessity of importing the raw materials. The use of the following structural materials is planned for the Project taking the supply capacity, quality, workability and price, etc., into consideration.

- Concrete

Type : ordinary concrete class 20

Strength : 205kg/cm^2 (4 weeks strength)

Aggregates : The rough aggregate will be crushed stones and the fine aggregate will be river sand, pit sand and crushed sand. Both will satisfy BS 882.

- Reinforcing Bars
  (locally produced based on BS 4449)
  Mild Steel Bars : D6, D10 and D12
  High Yield Steel Bars : D16, D20 and D25
  The requirements of the relevant BS are as follows:

Type	Mild Steel Bar	High Yield Steel Bar
Yield Strength (kg/mm^2)	25.5	41.8
Elongation (%)	22	14

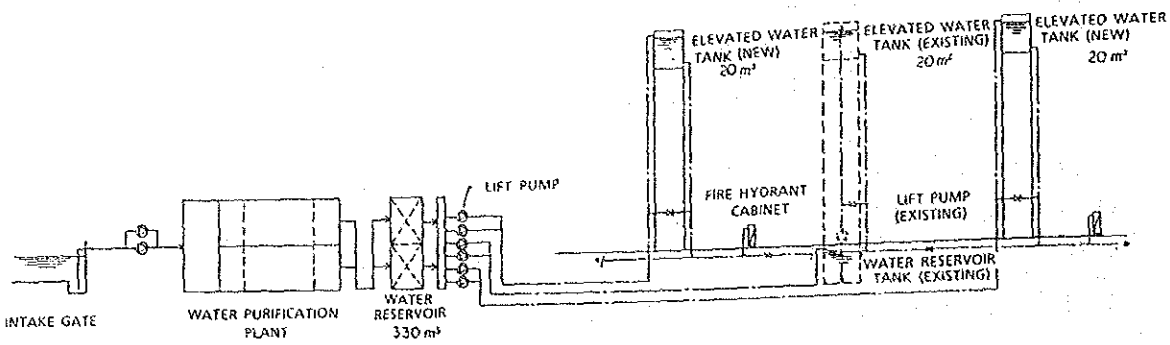
- Steel Frames
  Lightweight steel frames will be either purchased or manufactured locally

  While heavyweight steel frames for the pillars and beams will be either purchased or manufactured in Japan.

(4) Building Service Plan

1) Plumbing

- Water Supply
  The irrigation reservoir will be used as the domestic water supply source and water from the reservoir will be sent to the quick filtration facility by the intake pump to undergo filtration and sterilization. Water equivalent to half a day's consumption volume will be stored in the water tanks. After being pumped to the 2 new elevated water tanks and the existing water tank, water will be supplied to the buildings by the gravity water supply method. Loop piping will be employed to connect with the existing water pipes.



WATER SUPPLY SYSTEM

Based on the average water consumption volume per person and the number of people using the college facilities, the maximum water consumption volume per day is calculated as follows:

Students	1,372 x 40ℓ/person/day = 54.9m³
Lecturers and Nonteaching Staff	494 x 50ℓ/person/day = 24.7m³
Other Staff	438 x 50ℓ/person/day = 21.9m³
Canteen	2,284 x 20ℓ/person/day = 45.7m³
Laboratories & Workshops	= 50m³
Student Dormitory	1,372 x 150ℓ/person/day = 205.8m³
Staff Housing (30 persons/building)	1,700 x 150ℓ/person/day = 255m³
Total	: 658m³

The daily water consumption volume is given as 660m³ and the water tank capacity will be half of this consumption volume as mentioned earlier. The total capacity of the elevated water tanks if planned to meet water consumption of approximately 1 hours' equivalent. Based on the above, the actual capacities of the water tank and elevated water tanks will be as follows.

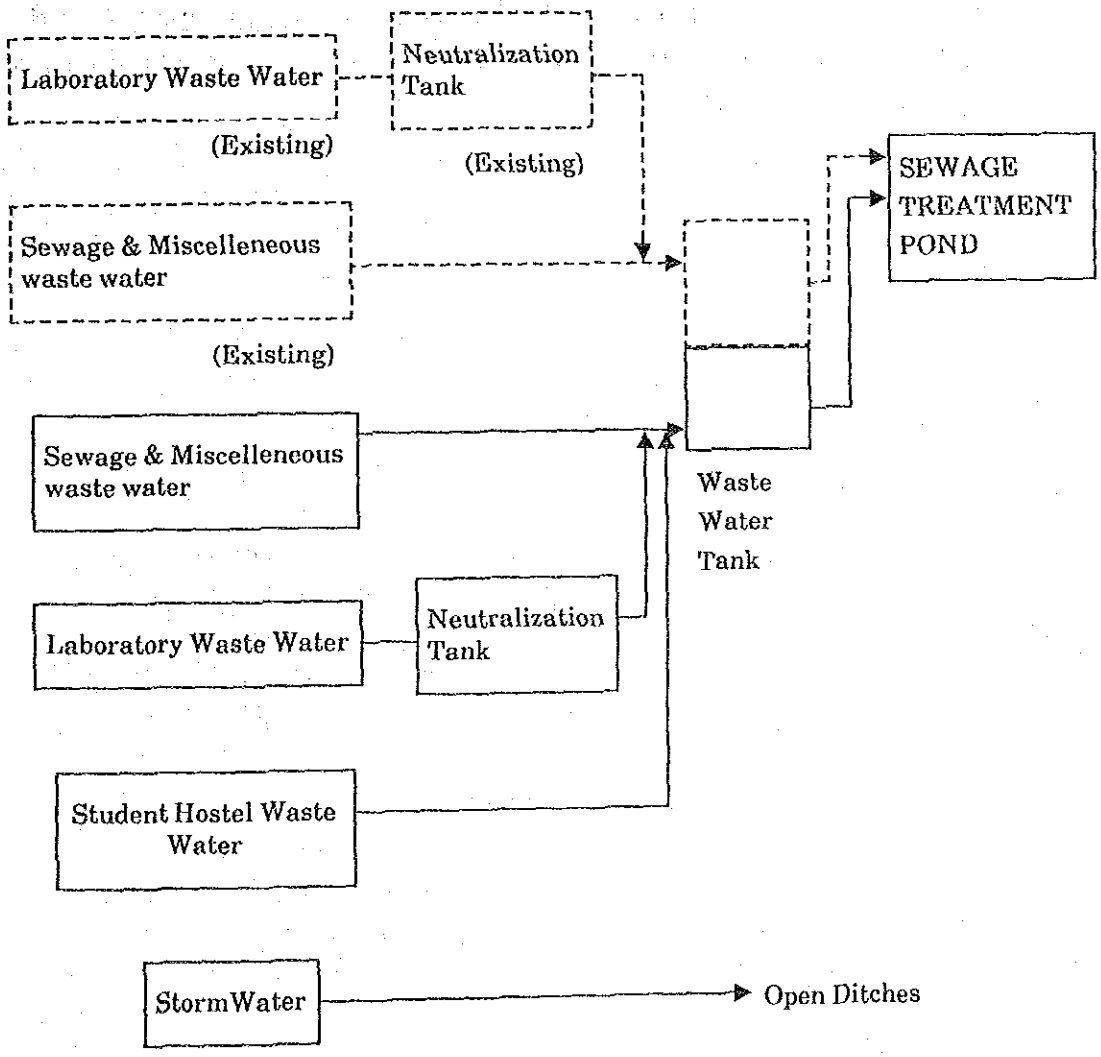
Water Tank Capacity: $660m^3 \times 1/2 = 330m^3$
Elevated Water Tank Capacity: $660m^3 \times 1/10 = 66m^3$

- Hot Water Supply
  Independent electric water heaters (for drinking purposes) will be provided where required in the new buildings.

- Drainage
  The new buildings will have 3 separate drainage systems, i.e., for sewage and miscellaneous wastewater, laboratory wastewater and stormwater.

Sewage and miscellaneous wastewater will have separate indoor piping systems but will use the same pipes outdoors. A separate piping system will be introduced for laboratory wastewater. Following treatment at an outdoor neutralization tank, the laboratory wastewater will join the sewage and miscellaneous wastewater and will flow into the wastewater tank to be constructed under the Project. The wastewater will then be discharged from the wastewater tank to a sewage treatment pond located outside the campus by means of an outfitted discharge pump. Stormwater will be discharged to the nearest open ditch.

Drainage System



- Sanitary Equipment
  Sanitary equipment will be provided where required in accordance with the building plan.

- Firefighting Equipment
  Indoor fireplugs will be provided in all the new buildings and the water pumps will be used as fire pumps when required to assist fire-fighting activities.

- Gas Installation
  LPG cylinders will be provided in such places as the kitchen and laboratories.

- Kitchen Equipment
  Kitchen equipment required to cater to the increased number of students (i.e. 652) will be added to the existing kitchen equipment which caters to 720 students and 129 staff members.

■ LIST OF KITCHEN EQUIPMENT

	ITEM	QTY.		ITEM	QTY.
1	Cold room	1	16	Electric tilting pan	2
2	Pan rack	2	17	Steem pot	3
3	Poteto peeler	1	18	Chill room	1
4	Peeler sink	1	19	Cold room	1
5	Mixer	1	20	Sterilizer cupboard	1
6	Vegitable preparation machine	1	21	Hot electrical cupboard	2
7	Stainless steel rack	1	22	Cold electrical cupboard	1
8	Stainless steel preparation table	21	23	Coffee (tea) urn	1
9	Stainless steel pan sink	1	24	Juice dispenser	1
10	Stainless steel double sink	5	25	Stainless steel table w/drawers	3
11	Over shelves	5	26	Warmer table	1
12	Electric Slicer	1	27	Cold table	1
13	General purpose convection oven	1	28	Ice maker	1
14	Gas fryer (shallow, deep)	2	29	Shower sink	2
15	Electric cooker	2			

2) AirConditioning

Such elements of the building plan as the maximum use of natural ventilation, heat insulation and measures to avoid intense sunshine, etc., will be fully incorporated in the airconditioning planning in view of achieving easy maintenance and a low maintenance cost.

- AirConditioning Equipment

An air-cooling type airconditioner will be separately installed in the reagent storage room and the analytical laboratory of the Faculty of Agriculture's Department of Food Engineering to properly maintain the equipment in these rooms.

- Ventilation

Although natural ventilation will in principle be employed, a mechanical ventilation system will be introduced for those rooms where required in view of their functions.

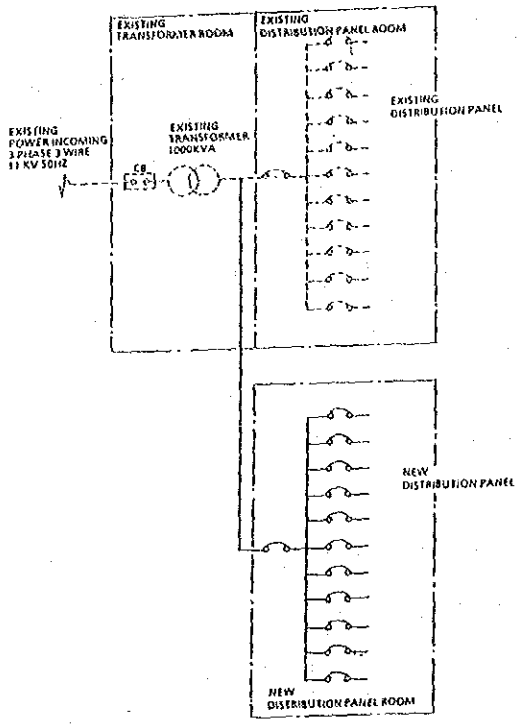
3) Electricity

- Initial Power Receiving and Transforming Equipment

High voltage power (11KV, 50Hz) is currently supplied to the KPL substation on the campus and is transformed to 415/240V (3φ, 4W) by a transformer via a high-voltage breaker. Low-voltage power is then supplied to each existing building via the low-voltage power control board which is located next to the transformer at the substation.

As the additional installation of a KPL transformer is not planned under the Project, the construction of a new substation is unnecessary. In view of the increased load, however, a new low-voltage power control room will be constructed to house the relevant power control boards to supply power to each new building (see Power Receiving and Transforming System shown below).

ELECTRICAL POWER SUPPLY SYSTEM



- Trunk and Power Lines

  Power (3ϕ, 4W, 415/240V) will be supplied to the lighting panel boards, power control boards and panel boards for laboratory and workshop use in the new buildings. While the routes for the trunk lines will follow the existing routes where possible, new underground routes will be introduced in those places where the building plan does not provide a covered way.

- Wiring

  The installation of panel boards and wiring on the secondary sides of these boards will be conducted for lighting equipment, socket outlets and laboratory/workshop equipment.

  While a general panel board will be installed at the common use section on each floor, those for laboratory/workshop use will be installed in the most convenient places in the laboratories/workshops or work sections.

  The rated voltages, capacities and locations of the socket outlets for laboratory/workshop use will be determined in view of their use in accordance with the equipment specifications given in the equipment plan. In addition, ordinary socket outlets will be installed where necessary.

  Vinyl pipes will be used to cover the wires where necessary. Wires, etc., will be similar to those currently used to conform to the BS.

- Lighting

  Fluorescent lamps will be used as the main light sources in view of energy

efficiency, and incandescent lamps will also be used where necessary in view of design or special requirements.

A small lighting compartment system will be introduced to reduce the running cost and thinned-out lighting will be possible for common corridors and other places.

The rated voltage of the lighting equipment will be 240V and earths will be provided.

The luminous intensity of the main rooms will be as follows.

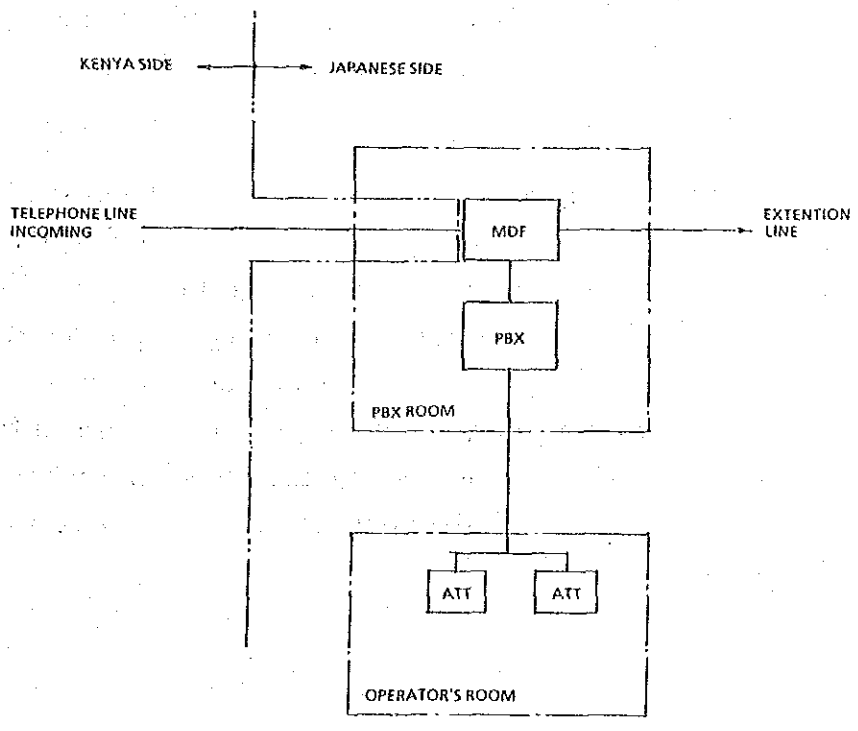
Drawing Rooms and Library Reading Room	400 - 500 lux
Lecture Rooms, Offices and Meeting Rooms	350 - 400 lux
Halls and Corridors	100 - 150 lux
Connecting Corridors	50 - 100 lux
Laboratories and Workshops	350 - 450 lux

- Telephone System

In view of the sizes and functions of the facilities to be constructed under the Project, an additional 15 trunk lines will be required (for the Principal's office, Deans' offices, telex, facsimile and public telephones, etc.)

The KPTC will extend its telephone cable to the MDF in the new Administration Building and extension lines will be connected to the MDF via the intermediate terminal cabinet in each building/floor. Wiring using vinyl pipes will be conducted from the MDF to the extension outlets via these intermediate terminal cabinets. The switchboard will be capable of handling some 300 lines (see Telephone System shown below).

TELEPHONE SYSTEM



- Paging System
  The introduction of a paging system is planned to facilitate the administration of the college in view of a number of there being buildings scattered over a vast campus. The main amplifier will be installed in the new Administration Building so that individual messages can be sent to each building or department. In addition, a separate loudspeaker system will also be introduced in one of the large lecture rooms.

- Fire-Warning System
  A push-button fire-warning system with warning bells will be introduced for early warning and evacuation purposes. An additional fire-warning panel will also be installed.

- Lightning Rod
  A lightning rod will be installed at the elevated water tanks and copper plates will be buried in the ground for earthing purposes.

- Outdoor Lighting
  Similar outdoor lamps to those currently provided near the main existing buildings and along the access road are planned for the new buildings.

(5) Construction Materials Plan

Particular attention should be paid in the selection of construction materials to their suitability vis-a-vis the local climate, and the use of locally familiar materials and construction methods should be promoted where possible. The following materials are planned for each part of the buildings taking economy, durability and easy maintenance into consideration.

i) Exterior Finishing Materials
The exterior design, using a stucco finish for the walls of the reinforced concrete buildings (except for a few simple concrete walls), will give a new image to JKUCAT as a university. Similar cement roof tiles as the existing buildings will be used as the roof finishing on steel roof deck which increases the water proofing function. As for the steel frame buildings, locally manufactured corrugated asbestos board will be used for the roofing and exterior wall finishing. Alumite treated aluminum window frames will be used in view of their durability and maintenance-free specifications.

ii) Interior Finishing Materials

The rooms have been classified into the following groups, based on their individual requirements, for the selection of the most suitable interior finishing materials.

Group A : public spaces and lecture rooms, etc., used by many people requiring durable materials which are easy to maintain

Group B : offices and lecturers' rooms, etc., requiring a standard finish which is durable and economical

Group C : lavatories and kitchen , etc., requiring easy cleaning in view of the use of water

Group D : reading room and audiovisual room requiring superior noise absorption and easy maintenance

Group E : Principal's room and others requiring special comfort and noise absorption

Group F : laboratories, including those of the Department of Agricultural Engineering and the Construction Material Testing Laboratory, requiring a durable and easily maintained finish rather than an attractive appearance

Group	Floor	Walls	Ceiling
A	terrazzo finish	mortar with vinyl paint finish	fibreboard with paint finish
B	vinyl tiles	mortar with vinyl paint finish	fibreboard with paint finish
C	terrazzo finish, tile finish in parts	semi-ceramic tiles	fibreboard with paint finish, soft rockwool board and vinyl paint finish in parts
D	wooden parquet vinyl tiles	mortar with vinyl paint finish	rockwool acoustic board
E	carpet	mortar with vinyl paint finish	rockwool acoustic board
F	mortar dust-proof finish	mortar and exposed structure	exposed structure

4.3.3 Water Purification Plant Plan

(1) Water Resources

There is currently an irrigation reservoir on the campus with a capacity of 82,000m^3 for which the original water source is the Ndargu River. The Ndargu River flows between the Thililika River and the Thika River on an almost parallel course to these two rivers. All three rivers are located on the Yak Plain of the Aberdare Mountains, originating from Mount Kinangop which is approximately 2,600m high. The rivers the join Athi River which meet the Chabo River some 300km downstream where the name changes to the Galana River. The Galana River eventually into the Indian Ocean.

The water flow of the Ndargu River has been monitored at a point 15km downstream from Juja since 1950 and the average monthly discharge is as follows;

Month	1	2	3	4	5	6	7	8	9	10	11	12
Discharge (m^3/sec)	1.46	1.36	1.55	4.88	8.87	4.57	2.44	1.51	1.13	1.34	3.57	3.61
	Dry Season			Rainy Season				Dry Season			Minor Rainy Season	

Source: 3CB5 Observation Station Data, Ministry of Water Resources

The average annual discharge at the observation point is 94.6 million m^3 and the catchment area for this point is 312km^2, with an average gradient of 1/65. The water rights relating to the Ndargu River are currently controlled by the Ministry of Water Development (MOWD),

(2) Water Balance of Existing Reservoir

The water balance of the existing reservoir was examined, based on the following conditions.

- Daily demand for domestic use of 660m^3 (refer to 3.5.7 (4)).
- The following volumes of water is required for irrigation purposes.

Month	Irrigation Water Volume	Month	Irrigation Water Volume
January	157.0mm	July	106.0mm
February	197.0mm	August	119.0mm
March	96.0mm	September	167.0mm
April	-	October	144.0mm
May	20.0mm	November	-
June	92.0mm	December	128.0mm

According to the above conditions and the assumed existing water rights of 1,000m^3/day, the following calculation results have been obtained, based on maintain the reservoir at full capacity.

	Daily Requirement	Daily Shortage	Monthly Shortage	(Unit: m^3)
January	1,787	787 (287)	24,397 (8,897)	
February	2,153	1,153 (653)	32,284 (18,284)	
March	1,352	352 (0)	10,912 -	
April	637	-	- -	
May	707	-	- -	
June	1,330	330 (0)	9,900 -	
July	1,404	404 (0)	12,524 -	
August	1,492	492 (0)	15,252 -	
September	1,892	852 (352)	25,560 (10,560)	
October	1,671	671 (171)	20,801 (5,301)	
November	669	-	- -	
December	1,563	563 (63)	17,453 (1,953)	

Note: Figures in brackets show the shortage with water rights of 1,500m^3/day

Given the present water rights of 1,000 m^3/day, the total supply shortage will amount to 85,046m^3 in the 4 month period between December and March and again 84,037m^3 in the 5 month period between June and October which cannot be met by the existing reservoir capacity.

An increase of the water rights is, therefore, required to secure a stable water supply for the college facilities. In view of an increased water loss due to the deterioration of the existing reservoir, the adverse effect of sediment deposits on the reservoir capacity and an increased demand due to the expansion of the

college facilities in the future, the present water rights of 1,000m3/day should be increased to 1,500m3/day.

(3) Water Quality

The water quality test on samples from the Ndargu River and the existing reservoir gave the following results.

Records on the water quality of the Ndargu River for the past 7 years show a turbidity as high as 140 caused by colloidal minerals originating from dissolved reddish brown clayey soil. Although the iron content is fairly high, it is not high enough to be harmful to the human body.

The reservoir water has an extremely low turbidity of only 2 which can be explained by the fact that water was not taken from the river for almost 2 months prior to the test because of an abnormal amount of rain. The growth of waterweeds and algae was observed. The COD value is rather high and common bacteria were detected, suggesting the influence of organic matter, but the water is serviceable with appropriate treatment.

The water quality laboratory of the Ministry of Water Development found the water from both the reservoir and the Ndargu River to be potable.

■ Test Dater of Water Quality

Test Item	Standard by WHO	Result	Remarks
· Nitrate Nitrogen / Nitrite Nitrogen	(10mg/1)	-	
· Chlorine Ion	(200mg/1)	Nil	
· Organic Substance (Potassium Permanganate consumed)	(10mg/1)	3.70	o.k
· Bacteria	(100mg/1)	70.00	o.k
· Coliform Group	(no find)	-	
· Cyanogen	(no find)	-	
· Hydrargyrum	(no find)	-	
· Phosphorous Compound	(no find)	-	

Test Item	Standard by WHO	Result	Remarks
· Copper	(1.0mg/1)	0.50	o.k
· Iron	(0.3mg/1)	0.20	o.k
· Manganese	(0.3mg/1)	0.10	o.k
· Zinc	(1.0mg/1)	0.50	o.k
· Lead	(0.1mg/1)	-	
· Hexad chrome	(0.05mg/1)	-	
· Cadmium	(0.01mg/1)	-	
· Arsenic	(0.05mg/1)	-	
· Fluorine	(0.8mg/1)	0.14	o.k
· Calcium	(300mg/1)	300.00	o.k
· Magnesium		-	
· Evaporation residue	(500mg/1)	-	
· Hydroxy Benzene / Fhenol	(0.005mg/1)	-	
· Anironic Surface Active Agent	(0.5mg/1)	-	
· P.H.Value	(5.8 to 8.6)	8.50	o.k
· Stench	(no abnormal)	-	
· Taste	(no abnormal)	-	
· Colour	(5deg.)	50.00	
· Turbidity	(2deg.)	16.00	

Date Source: Ministry of Water Development

(4) Water Purification Plant

Either a slow or rapid filtration method can be adopted for the planned water purification plant. However, the performance of the former is restricted by the original water quality and the slow purification speed makes control difficult and tends to cause clogging of the filters. In comparison, the latter is less affected by changes in water quality and is easy to control. We would, therefore, propose that the rapid filtration method is employed. Although the maintenance cost of this method is higher than that of the slow filtration method, its use is believed appropriate in view of its easy control vis-a-vis changes in the water turbidity and COD value, etc. (refer to comparison table slow and rapid filtration).

■ Comparison Table Slow & Rapid Filtration

Slow Filtration	Rapid Filtration
Processing : The mucilaginous membrance, which is formed the surface and inside of sand filter by algaes, bacteria and organism to fungus, is eliminated and decomposed the turbided material, suspended matter of bacteria, ammonia, manganese and dissolved solids to be caused by stench at physically, chemically and biologically.	Processing : The flocculate of aluminium hydroxide is formed in the rapided mixing by pouring the coagulant (aluminium sulfate and so on.) into raw water, and adsorb the turbided material and suspended matter of bacteria in the raw water. The obstacle matter grow up the floc by slow mixing in the flocculation and settle in the sedimentation basin. After then the treatment water is filtrated in the sand filter basin.
Raw Water Quality : Turbidity : 10 deg. B.O.D : 3 ppm Dissolved oxygen : 5ppm Ammonia nitrogen : 0.5ppm Coliform group (100mℓ) : MPN 5000.	Raw Water Quality : Turbidity : B.O.D : Depending upon the Dissolved oxygen : Design Ammonia nitrogen : Coliform group :
Processing Speed : 4 to 5 m / day.	Processing Speed : 120 to 150 m / day.
Defect : In case of many algaes and planktons in the raw water, the filter is clogged,and decreasing the volume of treatment water and hindrance of clean water plant. In case of more continue the turbidity, decreasing the oxide in the water and spending the large amount of oxide to be oxidize the organic matter and ammonia, therefore, the oxide in the sand filter become shortage, and the insolved iron and manganese melt, and staining and coloring the clean water.	Defect : The pouring rate of coagulate has to measure the adequate volume after checked by Jar test so as to avoid the deterioration of sedimentated effective.

The water quality test and field survey results indicate that the following should be taken into consideration in the planning of the water purification facility.

- In view of the given COD value, aeration basins should be introduced to remove free carbons from the water and to facilitate the oxidation of dissolved iron to make the water active. Bad odour caused by hydrogen sulphide, etc., should be removed.

- Pretreatment using chlorine should be conducted to remove common bacteria, colon bacilli and vermin.

- A flocking basin should be installed to facilitate sedimentation.

- Two mud tanks should be installed to each sedimentation basin for the easy maintenance.

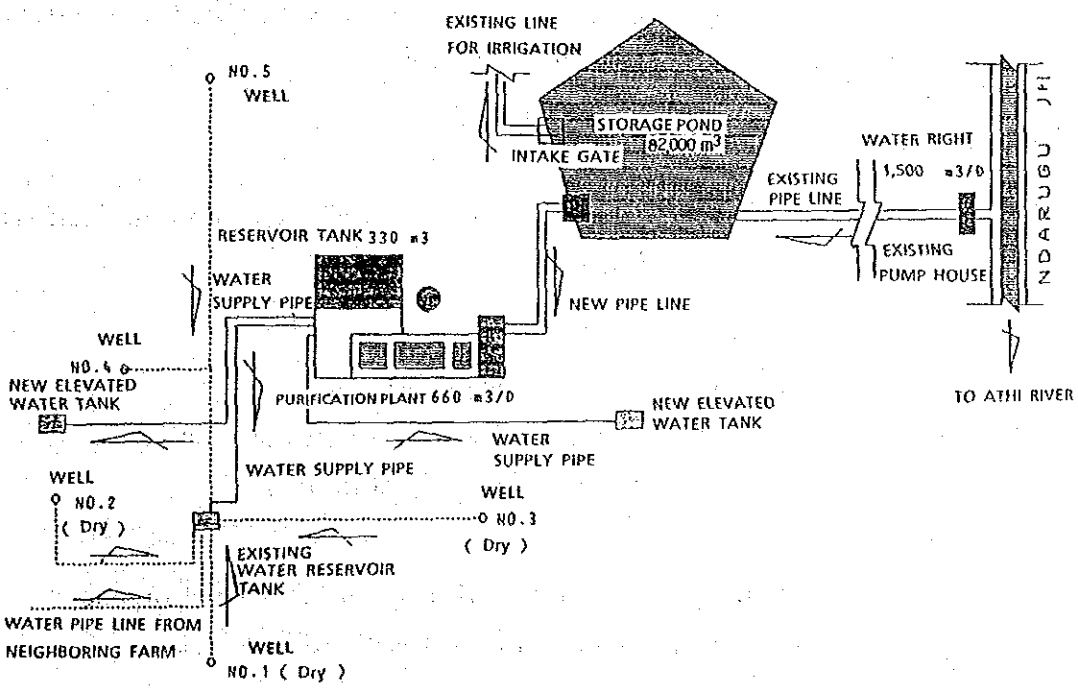
- Purification should be carried out by sand filters.

Particular attention should be paid to preventing the clogging of the filters.

The water purification plant will consist of a administration building including a laboratory, mixing room, pump room, and warehouse, and a purification basin, supply pump house, reservion tank and elevated tank being the main facility.

Two pumps will be installed in the control house to operate consecutively for water intake from the reservoir. Two pumps each will be installed in the water supply pump room for the 3 separate water supply systems for the student dormitory, staff housing and the existing water tank. Two additional pumps will be installed for the reservoir.

The reservoir tank will have a capacity of 330m^3 which is half of a the daily consumption volume and the elevated tank will hold 40 M^3 of water each. (see Water Supply Plan shown below).



WATER SUPPLY PLAN

4.3.4 Equipment Plan

(1) Basic Policy

The following will be noted in the planning of the equipment required for the educational activities which are suggested by the Work Assignment Plan described in 3-3-2.

1) The equipment to be provided should correspond to the level and contents of the intended educational activities with due attention paid to the conformity of the new equipment with the syllabuses and curricula in of the departments/courses.

2) The existing equipment and the conditions of their usage and maintenance should be thoroughly examined for the effective continued use of the equipment provided by the past grant aid and technical cooperation projects. The existing equipment and the new equipment should be coordinated taking the contents of ongoing technical cooperation projects into consideration.

3) The new equipment should serve the University College's (future University's) educational activities for a long time. The spare parts supply and equipment maintenance situation in Kenya should be taken into consideration in the selection of equipment so that the current maintenance system is not seriously affected.

(2) Equipment List

The types of equipment required for the university's educational activities are as follows (refer to Equipment List):

- Faculty of Agriculture
  - A. Equipment for the Department of Horticulture
  - B. Equipment for the Department of Agricultural Engineering
  - C. Equipment for the Department of Food Technology
- Faculty of Engineering
  - D. Equipment for the Department of Building and Civil Engineering
  - E. Equipment for the Department of Electrical and Electronics Engineering
  - F. Equipment for the Department of Mechanical Engineering

- Mathematics and Science
  G. Equipment for chemistry and biology studies
  H. Equipment for physics and mathematics studies
  I. Equipment for computer practice
- Others
  J. Equipment for the Library

(3) List of Equipment

A. Department of Horticulture

Item	Description	Total Q'ty	Room		
			1	2	3
A-1	Automatic Muffle Furnace	3	1	1	1
A-2	Drying Oven (Mechanical Convectional Large Type)	3	1	1	1
A-3	Kjeldahl Sets	7	6	1	
A-4	pH Meter	10	5	5	
A-5	EC Meter	10	5	5	
A-6	Hydroponic Sets	2		2	
A-7	Chemical Balance (Digital) & Table	3	2	1	
A-8	Electronic Balance	3	1	1	1
A-9	Growth Cabinets	4		4	
A-10	Phytotron Chamber	2		2	
A-11	Prefabricated Incubator	1		1	
A-12a	Center Table with Sink	6	6		
A-12b	Center Table with Sink	2		2	
A-13	Draft Chamber	1	1		
A-14a	Side Table	16	8	8	
A-14b	Side Table with Sink	1			1
A-15	Work Table	1			1
A-16	Teacher's Table	1	1		
A-17	Teacher's Chair	2	1	1	
A-18	Student's Chair	72	48	20	4
A-19	Reagent Storage Cabinet	3	2	1	
A-20	Shelf	5	2	2	1

Room 1 : Plant Nutrition Laboratory
2 : Environmental Control Laboratory
3 : Soil Conservation Bldg.

B. Department of Agricultural Engineering

Item	Description	Total Q'ty	Room	
			1	2
B-1	Hoist Crane (3 Ton)	2	1	1
B-2	Drilling Machine (1-25 MM)	1		1
B-3	Power Hacksaw	1		1
B-4	Pedestal Grinding Machine	1		1
B-5	Power Saw (Wood)	1		1
B-6	Electric Pipe Threading Machine	1		1
B-7	Open Channel Experiment Apparatus	1	1	
B-8	Tractor (4 Wheel Drive, 70pH)	1		1
B-9	Tractor (2 Wheel Drive, 35-40pH)	1		1
B-10	Metal Shear	1		1
B-11	Work Table	4	2	2
B-12	Student's Chair	40	20	20
B-13	Shelf	4	2	2

Room 1 : Irrigation & Drainage Laboratory
2 : Agricultural Machinery Hard Standing

C. Department of Food Technology

Item	Description	Total Q'ty	Room		
			1	2	3
C-1	Center Table	10	4	2	4
C-2a	Side Table	16	6	6	4
C-2b	Sink Unit	6	2	2	2
C-3	Constant Low Temperature & Humidity Room	4			4
C-4	Draft Chamber	1	1		
C-5a	Reagent Storage Cabinet	5	2	2	1
C-5b	Shelf	5	2	2	1
C-6	Spray Dryer	1			1
C-7	Milling Machine	1			1
C-8	Fermentation Box	1			1
C-9	Automatic Water Distilling Apparatus	1	1		
C-10	Clean Bench	1	1		
C-11	Autoclave	2	1	1	
C-12	Teacher's Table	3	1	1	1
C-13	Teacher's Chair	3	1	1	1
C-14	Student's Chair	72	24	24	24

Room 1 : Food Biochemistry Laboratory
2 : Micro-Biology Laboratory
3 : Post-Harvest Laboratory

D. Department of Building & Civil Engineering

Item	Description	Total Q'ty	Room					
			1	2	3	4	5	6
D-1	Hoist Crane	1	1					
D-2	Saddle Units	1	1					
D-3	Guide Rail System	1	1					
D-4	Universal Testing Machine	1	1					
D-5	A set of Drafting Machine	40		20	20			
D-6	A set of Drawing Instruments	40		20	20			
D-7	Work Tables	4	4					
D-8	Work Bench	10				4	4	2
D-9	Teacher's Table	4		1	1	1	1	
D-10	Student's Chair	92	24			24	24	20
D-11	Teacher's Chair	4		1	1	1	1	
D-12	Shelf	8	2			2	2	2
D-13	Drawing Case	4		2	2			
D-14	Side Table	9				6	3	

Room 1 : Construction Material Testing Laboratory
2 : Drawing Room -1
3 : Drawing Room -2
4 : Physical Environmental Laboratory
5 : Architectural model Work Room
6 : Architectrual model Room

E. Department of Electrical and Electronics

Item	Description	Total Q'ty	Room				
			1	2	3	4	5
E-1	Power Electronics Control Unit	1	1				
E-2	Power Electronics Shunt Motor Control	1		1			
E-3	Transformer Trainer	1				1	
E-4	DC Servo System	1		1			
E-5	Process Control Simulator W/Personal Computer	1		1			
E-6	AC Servo System	1		1			
E-7	Thyristor Trainer	1		1			
E-8	Telephone System	1					1
E-9	Servo Feedback Unit	1		1			
E-10	Microprocessor Applications Trainer W/Personal Computer	1	1				
E-11	Transducers & Instrumentation Kit	1				1	
E-12	Variable Speed Drive Unit	1		1			
E-13	Motor Load Unit	1		1			
E-14	Power Supply Unit	1		1			
E-15	Thyristor Control of Machines Kit	1		1			
E-16	Machine Control Panel	1		1			
E-17	He-Ne Gas Laser complete Apparatus	1			1		
E-18	Optical Fiber Connector Assembly	1			1		
E-19	Experimental He-Ne Laser Beam Launching into O.F.	1			1		
E-20	Laser Power Meter	1			1		
E-21	Optical Fiber Set	1			1		
E-22	Semiconductor Laser	1			1		
E-23	E/O Converter & Modulater	1			1		

Room 1 : Digital Electronics Laboratory
2 : Control Laboratory
3 : Illumination Laboratory
4 : Fundamental Measurement Laboratory
5 : Communication Laboratory

E. Department of Electrical and Electronics

Item	Description	Total Q'ty	Room				
			1	2	3	4	5
E-24	O/E Converter & Demodulater	2			2		
E-25	Oscilloscope	2				1	1
E-26	Sweep Generator	2				2	
E-27	Filter Circuit Trainer	2				2	
E-28	A/D Converter W/Personal Computer	2		1		1	
E-29	D/A Converter W/Personal Computer	2		1		1	
E-30	Antenna System Demonstrator	2					2
E-31	Symetric Board Computer	2	2				
E-32	Symetric Robot	2	2				
E-33	High Voltage Experimental Equipment	1				1	
E-34	Work Table	10	2	2	2	2	2
E-35	Teacher's Chair	5	1	1	1	1	1
E-36	Student's Chair	100	20	20	20	20	20
E-37	Teacher's Table	5	1	1	1	1	1
E-38	Side Table	20	4	4	4	4	4
E-39	Shelf	10	2	2	2	2	2

Room 1 : Digital Electronics Laboratory
2 : Control Laboratory
3 : Illumination Laboratory
4 : Fundamental Measurement Laboratory
5 : Communication Laboratory

F. Department of Mechanical Engineering

Item	Description	Total Q'ty	Room			
			1	2	3	4
F-1	Hoist with Trolly	2		2		
F-2	Total Hydraulics Experimental Equipment	1			1	
F-3	Experimental Steam Power Unit	1		1		
F-4	Experimental Device for Performance of Refrigeration & Air-Conditioning	1		1		
F-5	High Speed High Temperature Rotaly Bending Fatigue Testing Machine	1				1
F-6	Dynamic Balancing Machine	1	1			
F-7	Vibration Experimental Equipment	1	1			
F-8	Process Feedback Control Study Unit	1	1			
F-9a	Work Table	4		2	2	
F-9b	Work Table	2	2			
F-10	Student's Chair	60	20	20	20	
F-11	Shelf	6	2	2	2	

Room 1 : Metrology Laboratory
2 : Thermodynamics Laboratory
3 : Fluids Engineering Laboratory
4 : Material Testing Laboratory

G. Others / Chemical & Biology Laboratory

Item	Description	Total Q'ty	Room	
			1	2
G-1	Draft Chamber	2	2	
G-2a	Side Table	6	3	3
G-2b	Side Table with Sink	4	2	2
G-3	Center Table	12	6	6
G-4a	Reagent Storage Cabinet	4	2	2
G-4b	Shelf	4	2	2
G-5	Centrifuge	4	1	3
G-6	Laboratory Balance & Table	3	2	1
G-7	Refrigerator	2	1	1

Room 1 : Chemistry Laboratory
2 : Biology Laboratory

G. Others / Chemical & Biology Laboratory

Item	Description	Total Q'ty	Room	
			1	2
G-8	Drying Oven	2	2	
G-9	Water Distinlling Apparatus	1	1	
G-10	Constant Temperature Water Bath	1	1	
G-11	Magnetic Stirrer	6	6	
G-12	Electronic Balance	7	5	2
G-13	Biological Microscope	6		6
G-14	Stereo Microscope	6		6
G-15	Freezer	1		1
G-16	Incubator	2		2
G-17	Oven	1		1
G-18	Teacher's Chair	2	1	1
G-19	Student's Chair	96	48	48
G-20	Teacher's Table	2	1	1
G-21	Work Table	2	1	1

Room 1 : Chemistry Laboratory
2 : Biology Laboratory

H. Others / Physical & Mathematics Laboratory

Item	Description	Total Q'ty	Room		
			1	2	3
H-1	Side Table	2	1	1	
H-2	Center Table	12	6	6	
H-3	Shelf	4	2	2	
H-4	Oscilloscope	4	4		
H-5	Mathematical Models	4			4
H-6	Teacher's Chair	2	1	1	
H-7	Student's Chair	96	48	48	
H-8	Teacher's Table	2	1	1	
H-9	Side Table	10	5	5	
H-10	Side Table with Sink	4	2	2	

Room 1 : Physics Laboratory -1
2 : Physics Laboratory -2
3 : Class Room

I. Others / Computer Practice Rm.

Item	Description	Q' ty
I-1	Personal Computer	20
I-2	Personal Computer for Teacher	1
I-3	Monitor Screen	2
I-4	Laser Pointer	1
I-5	Printer	6
I-6	Student's Table	5
I-7	Teacher's Table	1
I-8	X-Y Plotter	6
I-9	Teacher's Chair	1
I-10	Student's Chair	20
I-11	Shelf	1

Room : Computer Practice Room

J. Others / Library

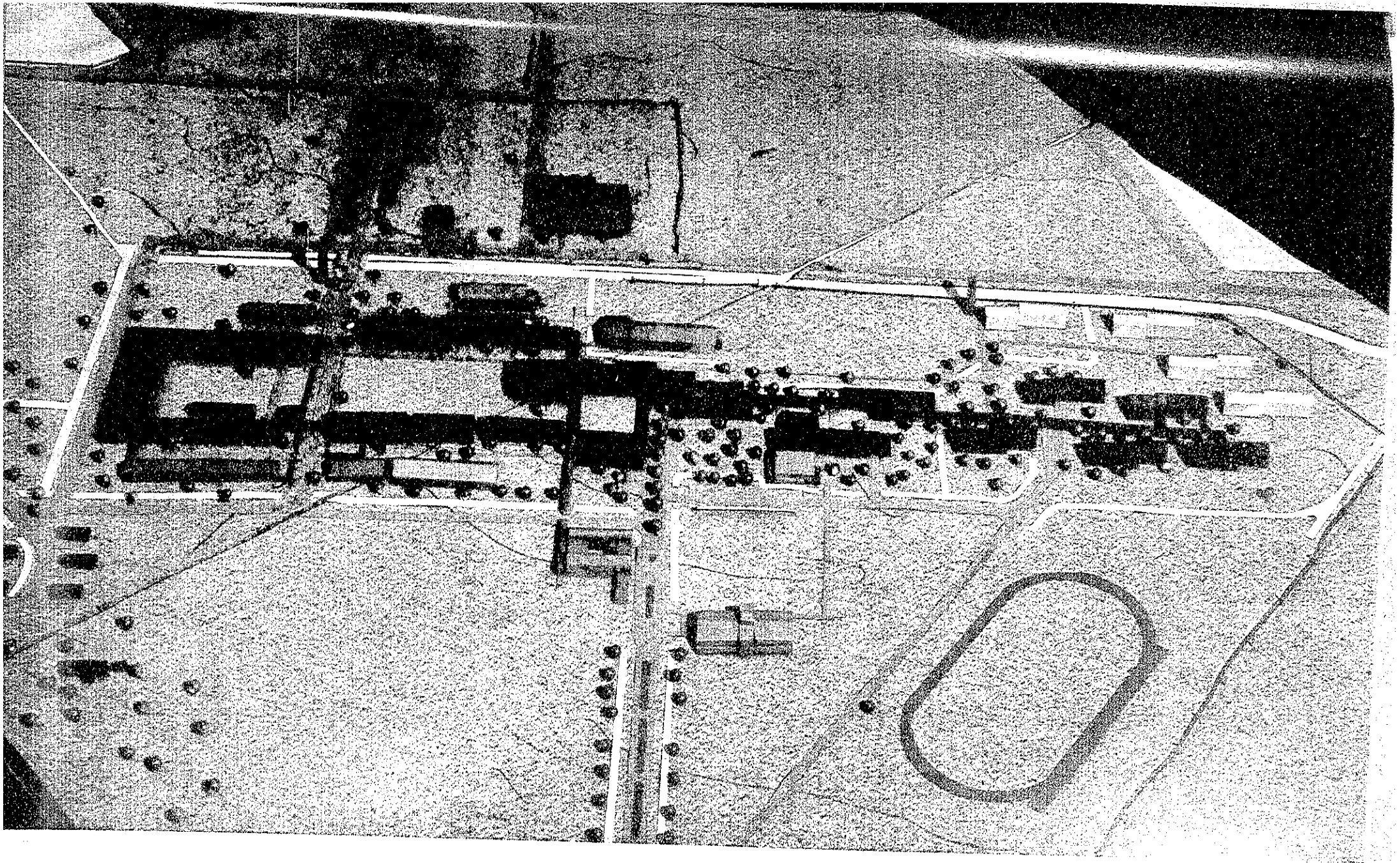
Item	Description	Q' ty
J-1	Syncronized Tape / Slide Projector	10
J-2	Home Video System Record / Play	3
J-3	Foil Block Machine	1
J-4	Nipping Machine	1
J-5	Rounding and Backing Machine	1
J-6	Self Feeding Enlarging / Reducing Photocopier	3
J-7	High Capacity Duplicator	3
J-8	Micro Film Reader / Printer	1
J-9	Work Table	2
J-10	Anti-Theft Book Detector	1

Room : Library

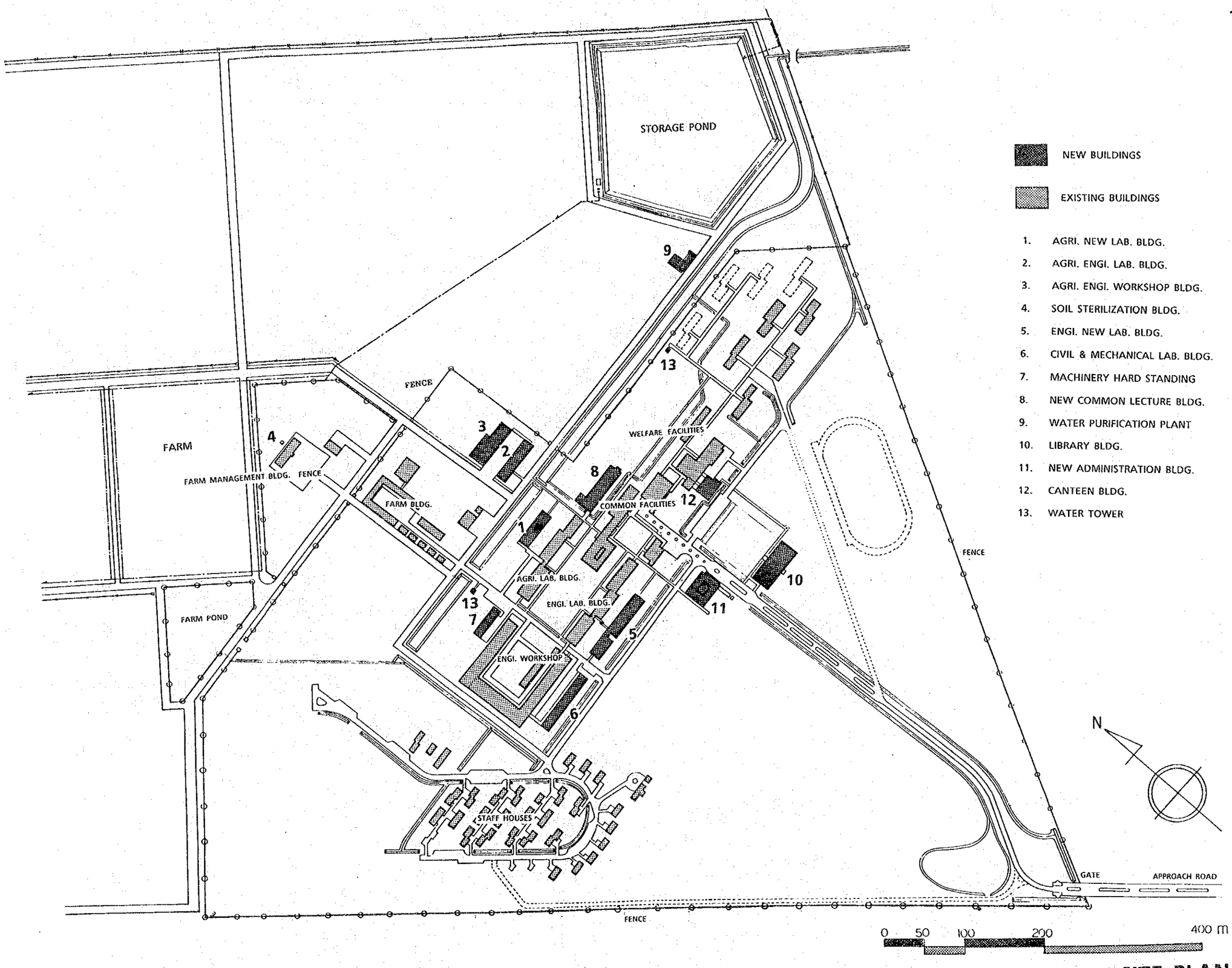
4.3.5 Drawings of Basic Design

1. Site Plan
2. Agricultural New Laboratory Bldg. Ground Floor Plan
3. Agricultural New Laboratory Bldg. 1st Floor Plan
4. Agricultural New Laboratory Bldg. Elevation & Section
5. Agricultural Engineering Laboratory Bldg. Plan
   Agricultural Engineering Workshop Bldg. Plan
6. Agricultural Engineering Laboratory Bldg. Elevation & Section
   Agricultural Engineering Workshop Bldg. Elevation & Section
7. Soil Sterilization Bldg. & Water Purification Plant
   Plan, Elevation & Section
8. Engineering New Laboratory Bldg. Ground Floor Plan
9. Engineering New Laboratory Bldg. 1st Floor Plan
10. Engineering New Laboratory Bldg. Elevation & Section
11. Civil & Mechanical Engineering Laboratory Bldg.
    Ground Floor Plan
12. Civil & Mechanical Engineering Laboratory Bldg.
    1st Floor Plan, Elevation & Section
13. Machinery Hard Standing Plan, Elevation & Section
14. New Common Lecture Bldg. Plan
15. New Common Lecture Bldg. Elevation & Section
16. Library Building Plan
17. Library Building Elevation & Section
18. New Administration Bldg. Plan, Elevation & Section
19. Canteen Building Plan
20. Canteen Building Elevation & Section
21. Existing Common Lecture Bldg. Ground Floor Plan
22. Existing Administration Bldg. Ground Floor & 1st Floor Plan
23. Water Supply Distribution System Plan
24. Drainage & Sewage System Plan
25. Electric Power Supply & Telephone Main Plan
26. Water Purification System Diagram

27.	Water Purification Plant Plan	
28.	Water Purification Plant Section	
29.	Lay out of Equipment	No. 1
30.	〃	No. 2
31.	〃	No. 3
32.	〃	No. 4
33.	〃	No. 5
34.	〃	No. 6
35.	〃	No. 7



- BIRD'S-EYE VIEW FROM SOUTH SIDE -

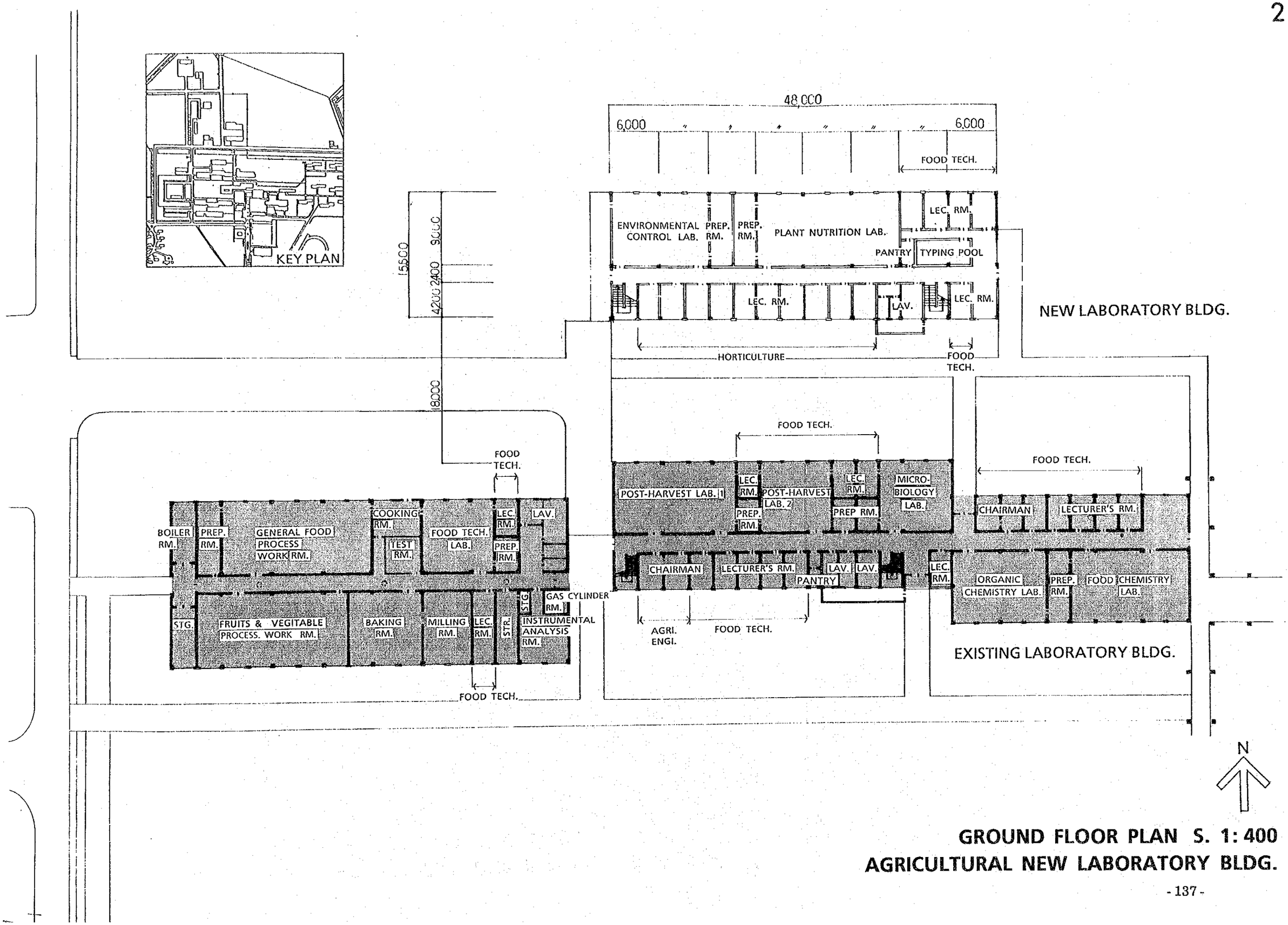


NEW BUILDINGS

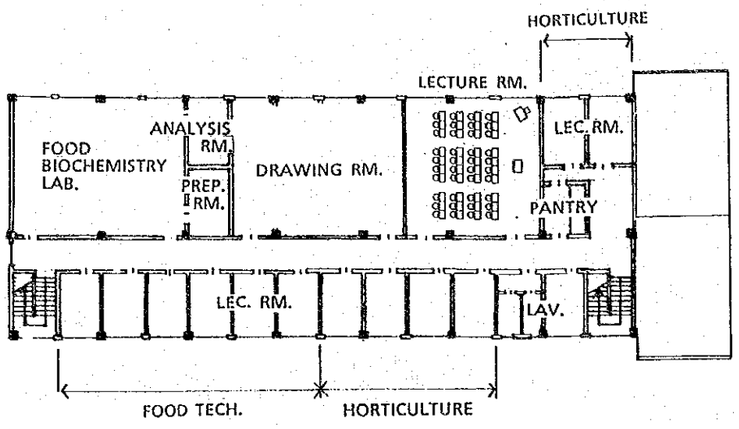
EXISTING BUILDINGS

1. AGRI. NEW LAB. BLDG.
2. AGRI. ENGI. LAB. BLDG.
3. AGRI. ENGI. WORKSHOP BLDG.
4. SOIL STERILIZATION BLDG.
5. ENGI. NEW LAB. BLDG.
6. CIVIL & MECHANICAL LAB. BLDG.
7. MACHINERY HARD STANDING
8. NEW COMMON LECTURE BLDG.
9. WATER PURIFICATION PLANT
10. LIBRARY BLDG.
11. NEW ADMINISTRATION BLDG.
12. CANTEEN BLDG.
13. WATER TOWER

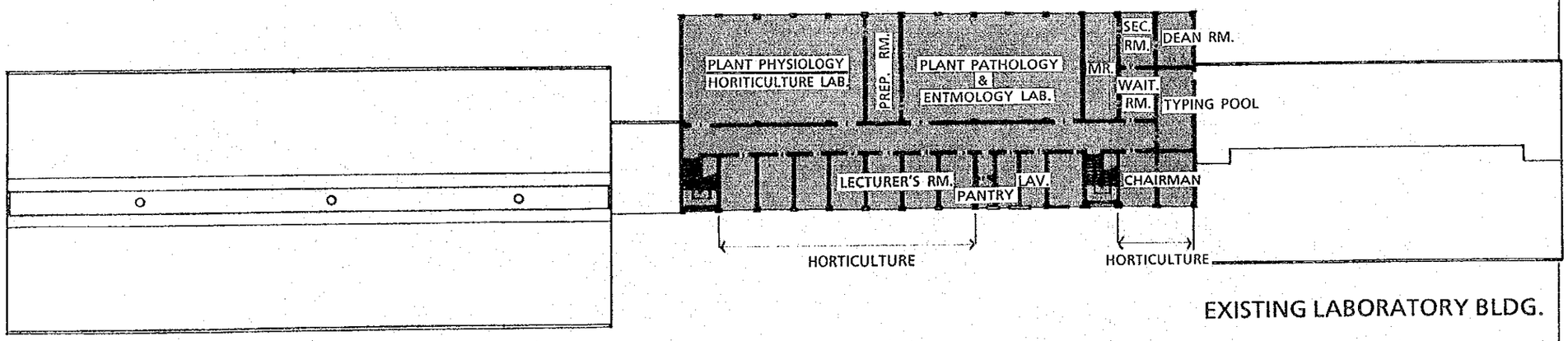
SITE PLAN



GROUND FLOOR PLAN S. 1: 400
AGRICULTURAL NEW LABORATORY BLDG.

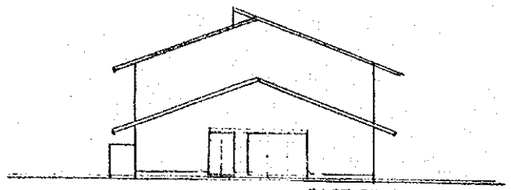


NEW LABORATORY BLDG.

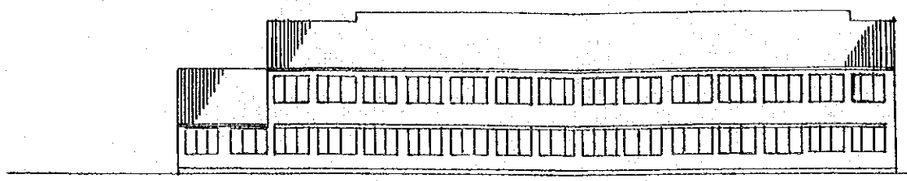


EXISTING LABORATORY BLDG.

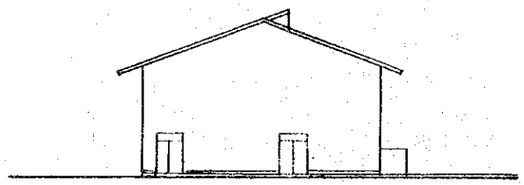
1ST FLOOR PLAN S. 1:400
AGRICULTURAL NEW LABORATORY BLDG.



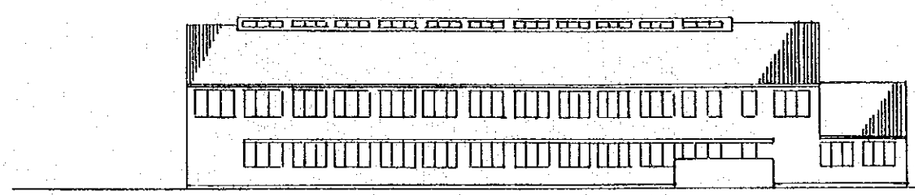
EAST SIDE ELEVATION



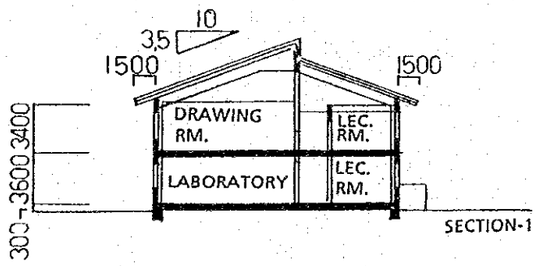
NORTH SIDE ELEVATION



WEST SIDE ELEVATION

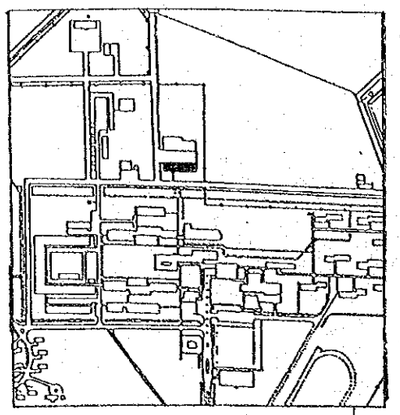


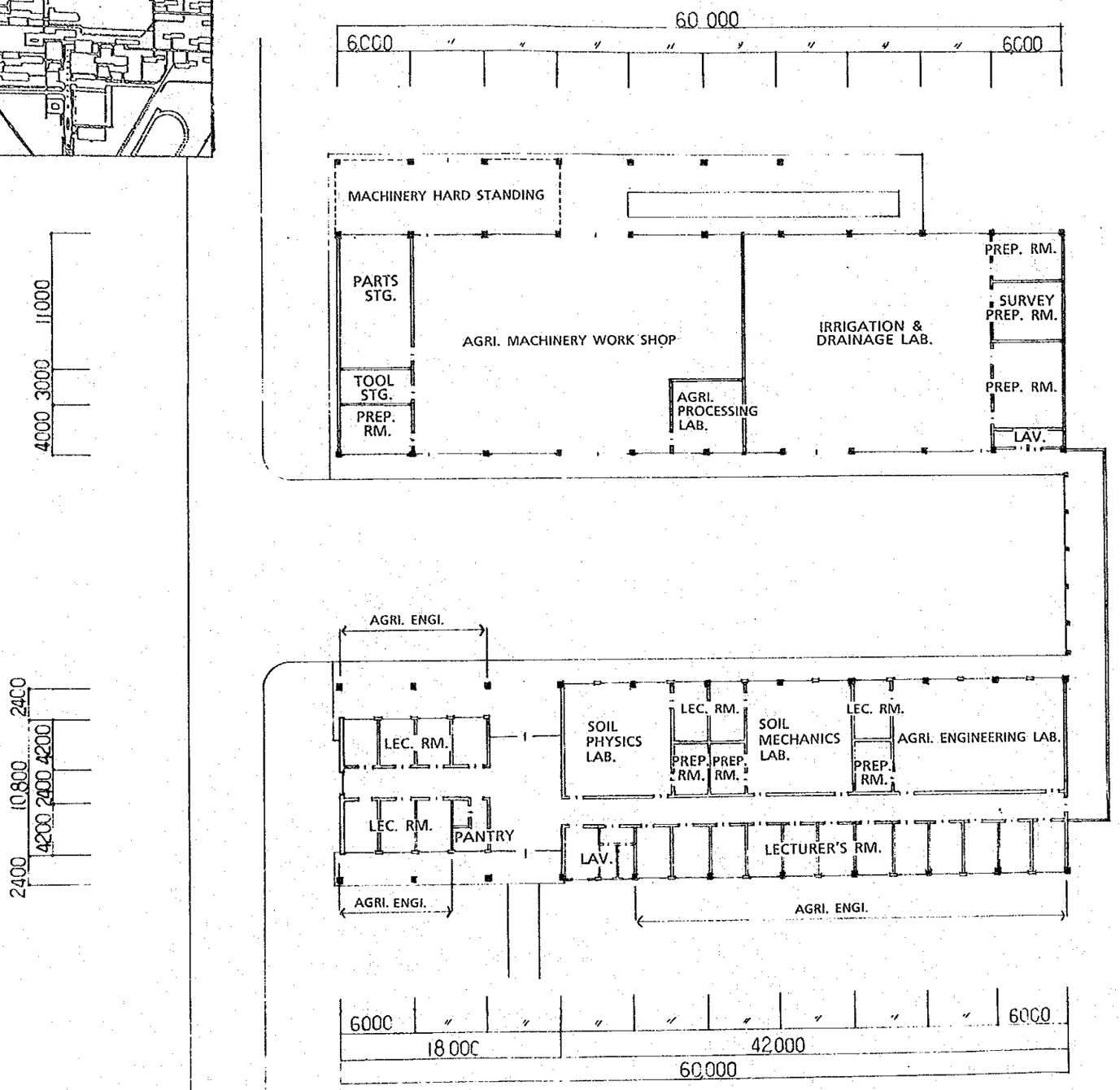
SOUTH SIDE ELVATION

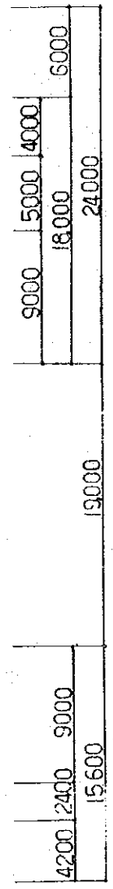


SECTION-1

ELEVATION & SECTION S. 1: 400
AGRICULTURAL NEW LABORATORY BLDG.







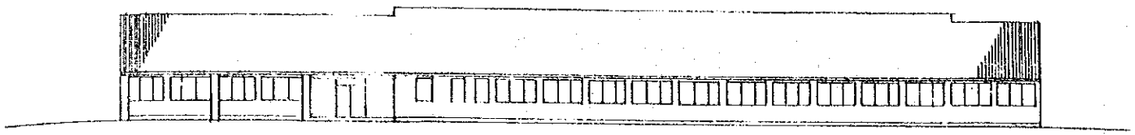
AGRI. ENGI. WORKSHOP BLDG.

AGRI. ENGI. LABORATORY BLDG

N

PLAN S. 1:400

AGRI. ENGI. LABORATORY & WORKSHOP BLDG.



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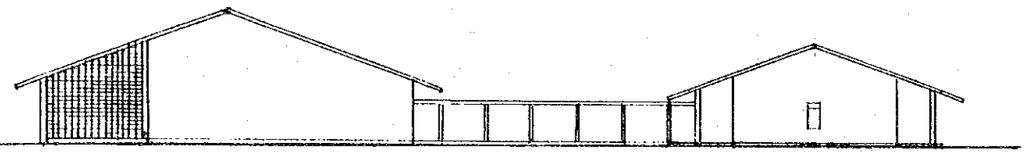
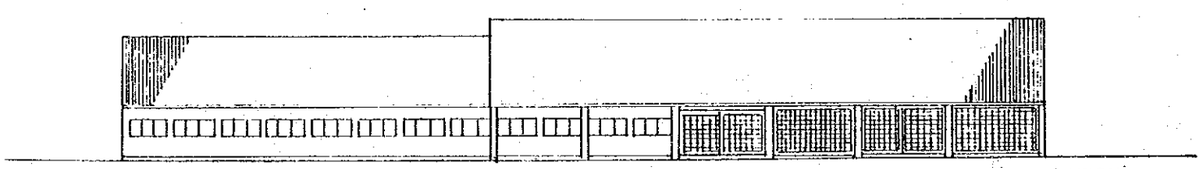
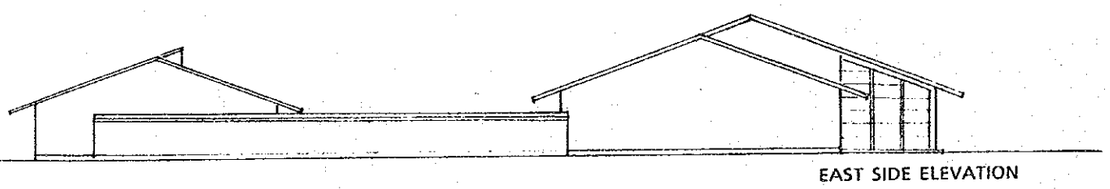


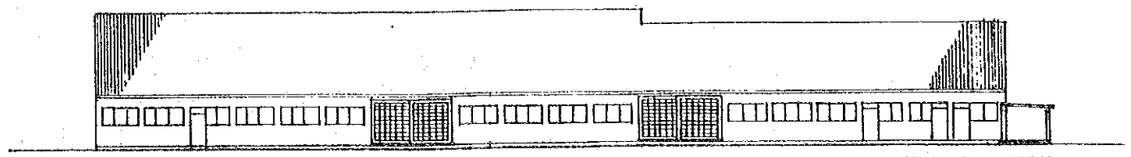
EAST SIDE ELEVATION



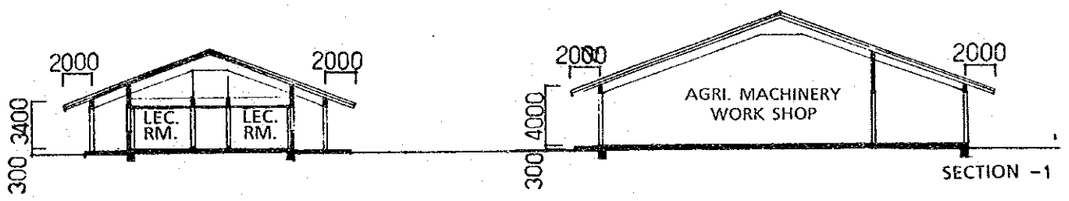
NORTH SIDE ELEVATION



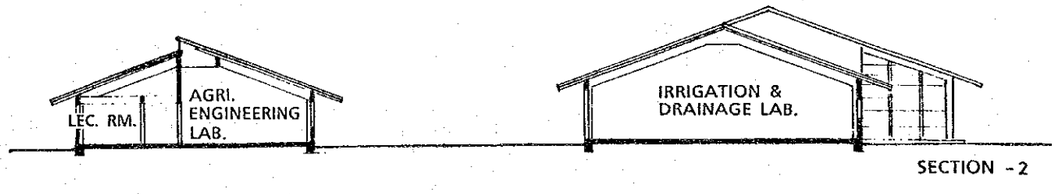
EAST SIDE ELEVATION



SOUTH SIDE ELEVATION
AGRI. ENGI. WORKSHOP BLDG.

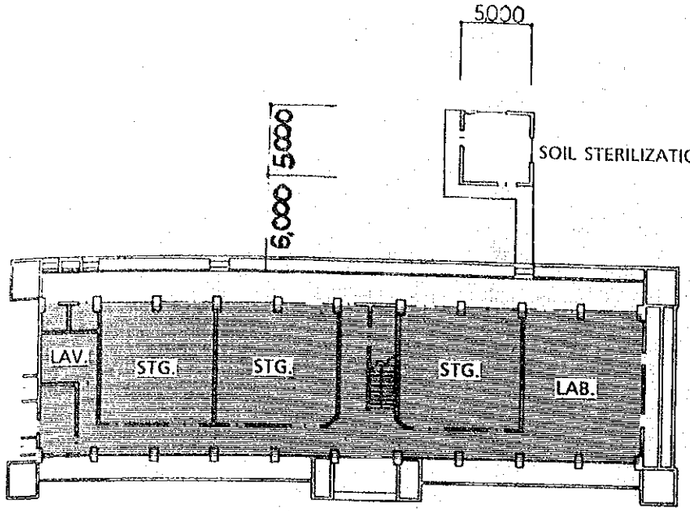


SECTION -1



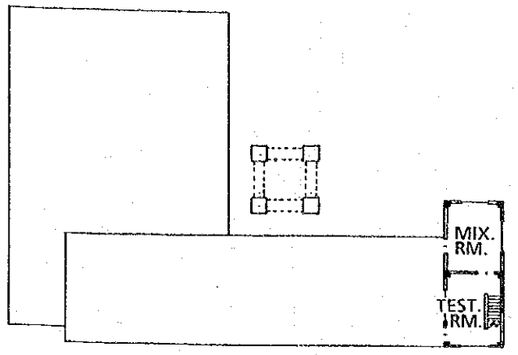
SECTION - 2

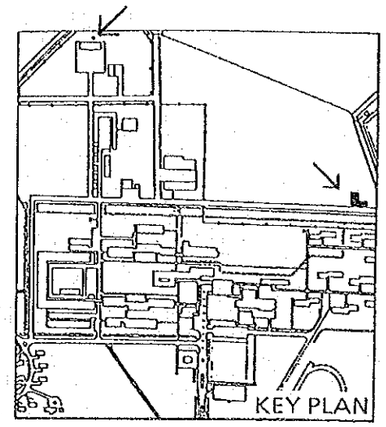
ELEVATION & SECTION S. 1: 400
AGRI. ENGI. LABORATORY & WORKSHOP BLGD.

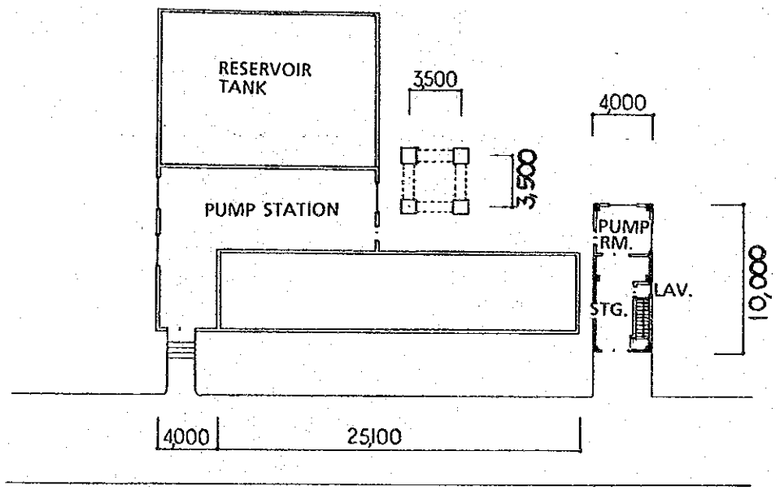


SOIL STERILIZATION BLDG. PLAN

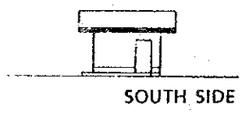
EXISTING FARM BLDG. PLAN





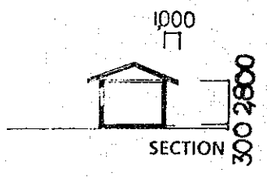


WATER PURIFICATION PLANT PLAN

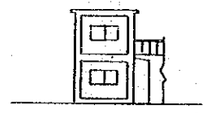

SOUTH SIDE

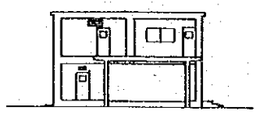

WEST SIDE

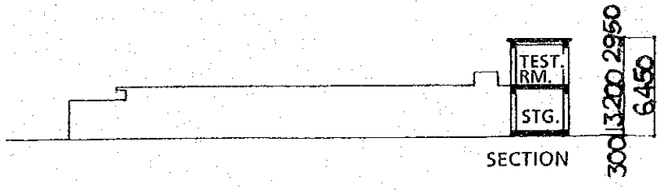

NORTH SIDE

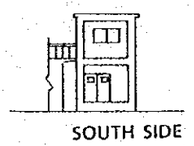


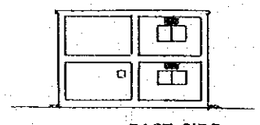
SOIL STERILIZATION BLDG.


NORTH SIDE


WEST SIDE

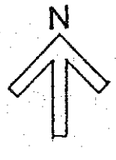



SOUTH SIDE


EAST SIDE

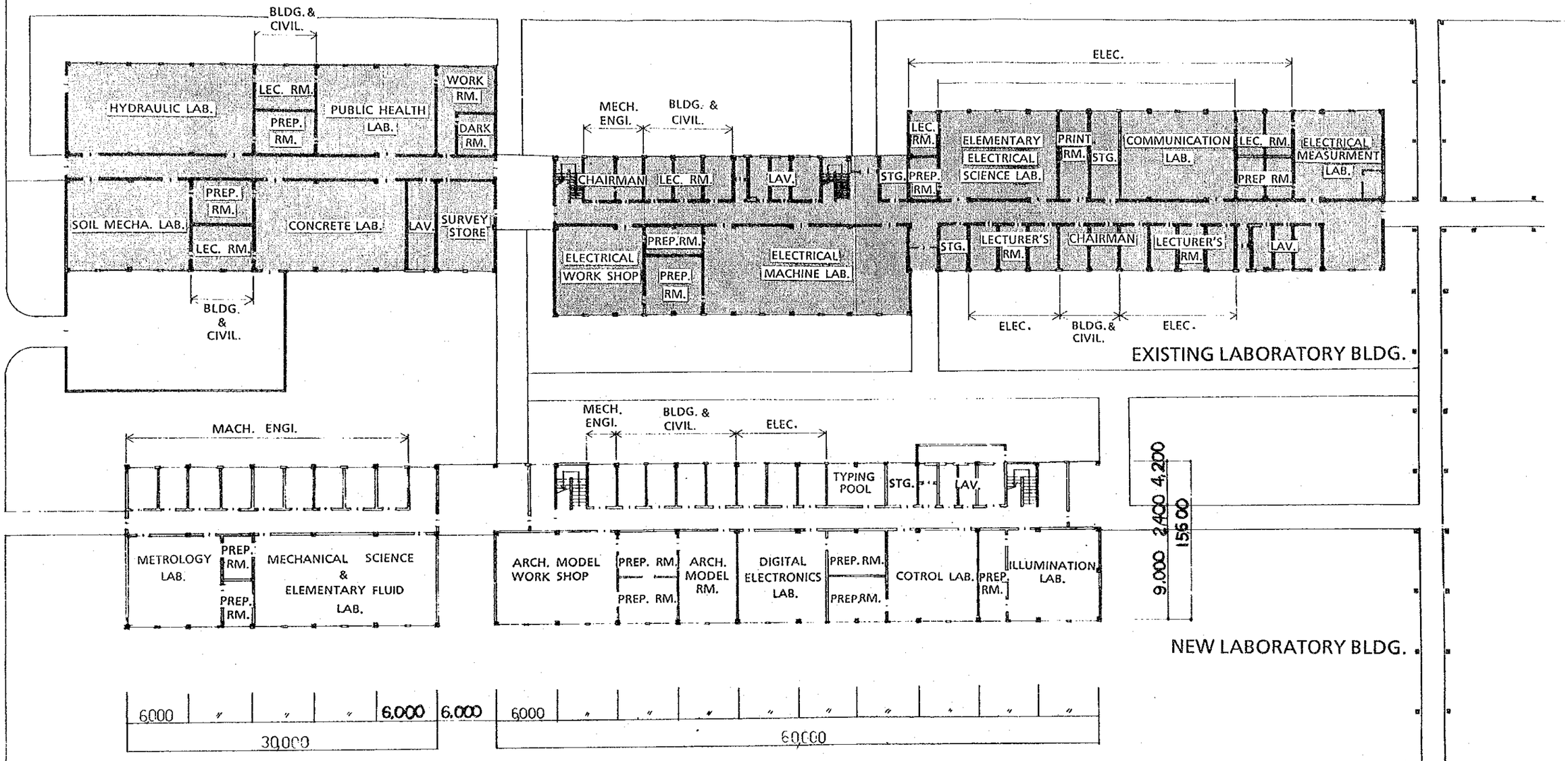
ELEVATION

WATER PURIFICATION PLANT



PLAN ELEVATION & SECTION S. 1: 400

SOIL STERILIZATION BLDG. & WATER PURIFICATION PLANT



GROUND FLOOR PLAN S. 1: 400
ENGINEERING NEW LABORATORY BLDG.