Postgraduate Medical Research Institute
University of Ghana
Medical School

MARCH 1977

JAPAN INTERNATIONAL COOPERATION AGENCY

CONTENTS

PREFACE

In response to the request of the Government of the Republic of Ghana, the Government of Japan decided to cooperate in the construction of Postgraduate Medical Research Institute which was planned by the Government of Ghana as part of its overseas technical cooperation programs, and Japan International Cooperation Agency conducted a detailed study for the construction of the Institute.

Japan International Cooperation Agency dispatched a detailed design team consisting of seven specialists to Ghana from November 21, to December 4, 1976.

While in Ghana, the team made studies on detailed design in consultation with the officials concerned and collected necessary materials and information. Results of these investigations are summarized in this report submitted herewith.

I sincerely hope that this report would contribute to the progress of this project and also to promotion of the basic medical researches in the Republic of Ghana and at the same time serve to strenghten the friendly relations now existing between the two countries.

I avail myself of this opportunity to express my heartful appreciation to the Ministry of Economic Planning of the Government of Ghana, the University of Ghana personnel concerned, the Japanese Embassy in Ghana and Japanese specialists at the Medical School for the cooperation and hospitality extended to the team during the study period.

Shinsaku Hogen

President

JAPAN INTERNATIONAL COOPERATION AGENCY

CHAPTER 1. DESPATCH OF SURVEY TEAM

1. PURPOSE OF SURVEY

The servey team was dispatched for the purpose of producing the final drawing of the construction of Postgraduate Medical Research Institute to be attached to University of Ghana Medical School. Prior to this survey, preliminary drawing had been submitted and confirmed by the Ministry of Economic Planning by consultations with the Principal Secretary.

With regards to the details of the scope of work to be performed, discussions were made with the personnel of the Development Office of Ghana University, and their basic agreement was obtained.

Through these meeting, all the conditions necessary for the drafting of the final drawing were obtained and the final report were provided.

2. SURVEY TEAM

The survey team which was led by Mr. Seiichi Matsuda from Kume Architects-Engineers made the survey about two weeks, from November 21 to December 4, 1976 and members were composed of following seven engineers.

Seiichi MATSUDA
- Qualified Architect
- Director of Overseas Division
- Kume Architects-Engineers

Takeshi HAMAJIMA
- Qualified Architect
- Structural Engineer
- Structural Design Division
- Kume Architects-Engineers

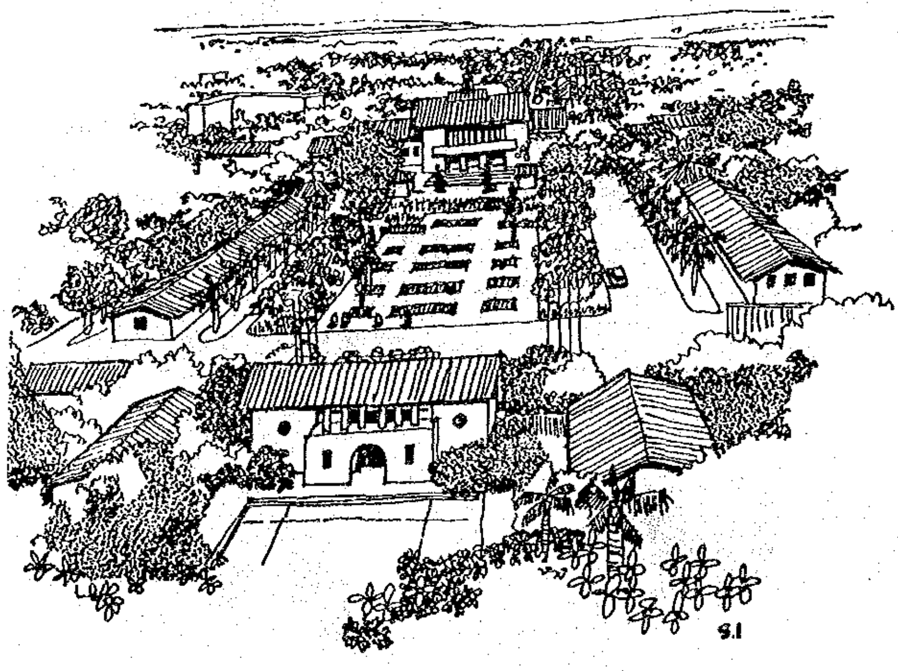
Hidefumi INOUE
- Qualified Architect
- Engineer, Overseas Division
- Kume Architects-Engineers

Koji KODAMA
- Engineer, Overseas Division
- Kume Architects-Engineers

Hidezo KOIKE
- Qualified Architect
- Manager of Quantity Surveying Division
- Kume Architects-Engineers

Yuzo NAGASHIMA
- Electrical Engineer
- Mechanical Design Division
- Kume Architects-Engineers

Shunji NAGATA
- Engineer, Overseas Division
- Kume Architects-Engineers



CHAPTER 2. OUTLINE OF SURVEY

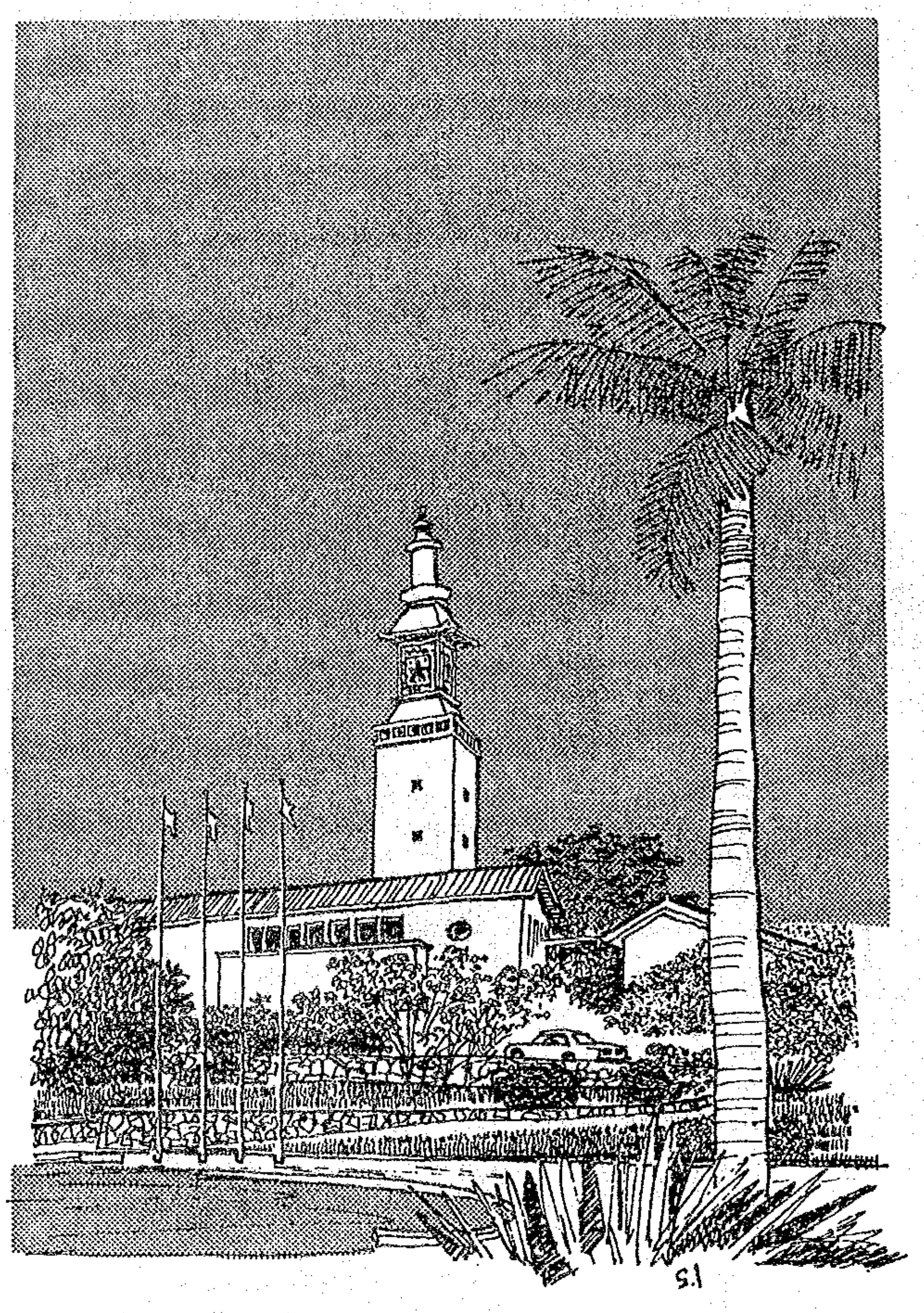
This survey was carried out as a supplementation to the previous survey which was performed for three weeks from August 10 to August 30, 1976, to establish and confirm the conditions necessary for the preparation of the final report. Prior to the survey of Ghana, the specialists in respective fields together with Dr. Honda from Fukushima Medical School were requested to prepare the fundamental conditions necessary for the drawing in each field, and these conditions were incorporated in the drawings for the presentation to the specialists in Ghana for their review.

Upon arrival in Ghana, active discussions were held with the professors in each department, including Professor Phillips, the dean of University of Ghana Medical School, regarding these drawings.

As the result of the discussions held between the members of the survey team and the staff of the University on the details of the plan, it became possible to formalize all the conditions of architectural, mechanical, electrical and structural information necessary in the final drawing of the Research Institute, by also including the local conditions.

On the other hand, Development Office of Ghana University has made arrangements to supply the reports required in the commencement of preliminary works such as water supply, electricity, and other works necessary for the functioning of Research Institute, as requested by the survey team during the preliminary study. Further, organization of personnel for this construction project has started and was understand the keen interest held by Ghana in regards to this project. The proposed construction site is already cleared of trees and bushes, and the setting of bench marks has been confirmed during the field survey. At present, the work that has to be carried out by Ghana is seen as proceeding satisfactorily.

The confirmation of matters for previous survey and the additional survey were done satisfactorily with the close cooperation of the personnel of the Medical School in charge of their respective fields, enabling the team to collect the materials such as design conditions for respective research laboratories, necessary in the final drawing. Upon returning to Japan, the requirements for the final drawing were once again discussed with the specialists at Fukushima Medical School and their suggestions were obtained.



CHAPTER 3. DESCRIPTION FOR WORKING DRAWINGS

3-1 DESCRIPTION OF PLANS

3-1-1 BUILDING PLANNING

i) LAYOUT

Layout of buildings was determined in relations with various facilities of University of Ghana Medical School. Main entrance to the Institute and corridor leading to the court are located on the axis of future Medical School facilities. The Institute which is planned as a 2-storey building, is located opposite each other along central axis and bordering on center court, arranged in shape. The corridors of this building are faced to outside and room faced to inside court therefore all laboratory rooms are oriented toward central court. By this arrangement, it will provide scenic view into the court, and also it will provide security as there is a corridor between exterior wall and laboratory room wall.

ii) PLANNING

Basic policy of planning is in concurrence with preliminary planning, such basic criteria are given below.

1) Medical equipments which are now in Ghana from Japan International Cooperation Agency, as a part of their technical cooperation program, are to be installed in wing on south side of central axis, and those expected to be sent as the that cooperation are to be installed in north wing and arranged in their respective position within the laboratories.

2) Arrangement of Medical School facilities is to be coordinated with Ghana University so that their future expansion plans for the Medical School and this program will not conflict.

3) A 2-storey building is planned to be adopted in consideration of function between laboratories, hauling in and out of laboratory equipment, construction costs, construction period, and local construction technique.

Construction planning was formulated in consideration of above points as well as local climatic and weather conditions.

LEVEL 1.

Looking from access road, porch is located at 16 the center of building. If one pass through a vestibule, he will be led to the entrance hall.

Adjacent to this entrance hall, and along the south side of main axis are situated reception, telephone exchange room, administration office, head office, deputy head office, beyond which are located electron microscope section, x-ray room, electric room, common laboratory room. Whereas on north side of main axis are located haematology section, germ free animal house, physiology section and workshop. At each corners of the building are located air conditioning machinery room, toilets and stair case for that particular wing of the building. Also located in each corners are lounges, where laboratory personnel may gather to communicate and, exchange views and small talks.

LEVEL 2

Stair case at entrance lobby will lead to first floor level. On south side of main axis are laboratories of bacteriology section, chemical pathology section, virology section, whereas on north side of main axis are laboratories of histo-pathology section, special experimental laboratory, parasitology section. Similarly with ground floor, located at each corners are air conditioning machinery rooms, toilets, stair cases and lounges.

COURT

As one walks out into court from entrance hall on ground floor, one will be let to Arbour in the center of the court through louvered cover. Arbour at center of court may be used for small group gathering.

This Arbour may be used for variety of uses, such as strolling, relaxation, informal or formal gathering, etc. Court will be sodded to present soft pleasant air.

Facilities to be housed in the institute building are listed in Table 1

iii) EXTERIOR FINISHES OF THE BUILDING

Exterior finishes of the building, for roof, exterior walls, windows, balconies, skirtings are planned as follows: The roof, in consideration of waterproofing methods, materials, and construction method, is to be sloped, whereby effect on radiant heat is planned to be processed behind sheathing material. Roofing materials to be used and application, thereof, are the asbesto roof tiles, which possess durable weather resistant properties. It will be applied on sheathing material which is placed on light gauge steel section purlins. Glass wool mats are to be applied on underside of sheathing for insulation. Window sashes on exterior walls are to be fabricated from anodized aluminum extrudes, and are to be glazed with window panes possessing high ratio of heat reflection. Exterior walls are to be cladded with weather resistant colored asbesto cement panels, also with glass wool insulation lining between asbesto cement panels and concrete block exterior walls. Use of insulation materials on the roof and walls will reduce heat loads on air conditioning system and is planned to make buiilding more habitable.

Balconies are provided at first floor level, at walls facing the court, where the compressors for laboratory room cooler will be installed. Equipment will be hidden behind horizontal louvers.

iv) FRAME WORKS OF THE BUILDING

The building as now proposed is to be steel frame building founded on reinforced concrete footings. Steel frame work is made up on 9.2m x 9.2m grid system. Roof structure is scheduled to be constructed of steel frame work, also. Exterior wall partitions, and interior walls are to be constructed of locally produced concrete blocks. Ground floor slabs are to be slabs on grade, whereas, first floor slabs are to be poured on steel deck plates. This construction method was selected to enhance accuracy of the building as well as to shorten construction time. For structural details, please refer to section under "Structural Planning."

v) INTERIOR FINISHES OF THE BUILDING

Interior finishes of the building will vary from room to room depending on their function, however, finishes for laboratories may be largely divided into three categories. In addition, finishes for common facilities such as offices, machinery rooms, wash rooms, staircases, store rooms, are to be suitably finished according to their uses. Selection of finishing materials was made toward simplification of construction method as well as simplification of maintenance, afterward.

Type A Laboratories

Type A laboratories are common laboratories, which acounts for about 80% laboratories of the proposed bilding. Standard laboratory room units are about 4.6m x 6.9m in size and planned interior finishes are polished terrazzo floor, hard vinyl base, emulsion paint finished plastered wall and rock wool accoustic tiled ceiling.

Table 1 Facilities List

Room Number	Room Name	REMARKS
101	RECEPTION & P.B.X.	Administration
102	ADMINISTRATION OFFICE	
103	STORAGE	
104	W. C.	Common Facilities
105	STORAGE	
106	AIR CONDITIONING MACHINE ROOM	
107	DEPUTY HEAD OFFICE	Offices
108	SECRETARY ROOM	
109	HEAD OFFICE	
110	CONFERENCE ROOM	
111	STAFF ROOM	Staff Rooms
112	STAFF ROOM	
113	STAFF ROOM	
114	LABORATORY	Dept of Electron Microscopy
	ULTRA MICROTOME ROOM,	
	DARK ROOM & PREPARATION ROOM	
115	LARGE ELECTRON MICROSCOPE &	
	SCANNING ELECTRON MICROSCOPE	
116	STAFF ROOM	
117	STORAGE	
118	AIR CONDITIONING MACHINE ROOM	Common Facilities
119	STORAGE	
120	ELECTRICAL ROOM & ENGINEER ROOM	
121	X-RAY ROOM & DARK ROOM	X-Ray Room
122	STAFF ROOM	Staff Rooms
123	STAFF ROOM	
124	STAFF ROOM	

Room Number	Room Name	REMARKS
125	DATA SECRETARIAL & RECEPTION	Dept of Haematology
126	AUTOCOUNTERS ACCESSORIES	
127	HAEMOGLOBINOPHY INVESTIGATION	
128	WASHING ROOM	
129	W.C.	Common Facilities
130	STORAGE	
131	AIR CONDITIONING MACHINE ROOM	
132	IMMUNO HAEMATOLOGY	Dept of Haematology
133	COAGULATION	
134	PREPARATION & DARK ROOM	
135	STORAGE	
136	WORK SHOP	Work Shop
137	BREEDING ROOM	Special Experimental Room
138	ANIMAL OPERATION ROOM	
139	ANIMAL EXPERIMENTAL ROOM	
140	ANIMAL ROOM (GERM FREE)	
141	AIR CONDITIONING MACHINE ROOM	Common Facilities
142	STORAGE	
143	ENGINEER'S ROOM	Eugiueer & Staff Room
144	STAFF ROOM	
145	STAFF ROOM	
146	STAFF ROOM	
147	STAFF ROOM	
148	ENGINEER'S ROOM	

Table 1 Facilities List

Room Number	Room Name	REMARKS
201	WASHING & STERILIZATION	Dept of Bacteriology
202	PREPARATION ROOM & DARK ROOM	
203	OFFICE & LABORATORY	
204	MEDIA POURING & PREPARATION	
205	COLD ROOM	
206	W.C	
207	STORAGE	
208	AIR CONDITIONING MACHINE ROOM	
209	OFFICE & LABORATORY	
210	OFFICE & LABORATORY	
211	STORAGE	Common Facilities
212	CONFERENCE ROOM	
213	WASHING & STERILIZATION	Dept of Virology
214	OFFICE & LABORATORY	
215	INSTRUMENT ROOM	
216	OFFICE & LABORATORY	
217	OFFICE & LABORATORY	
218	TISSUE CULTURE ROOM & PREPARATION ROOM	
219	CONSTANT TEMPERATURE ROOM & DARK ROOM	
220	IMMUNO-CHEMISTRY & RADIOIMMUNOASSAY	Dept of Chemical Patholcgy
221	COLD ROOM	
222	AIR CONDITIONING ROOM	
223	STORAGE	
224	DEIONIZER WASHING ROOM	
225	AAS & FLAME PHOTOMETER	
226	SEPERATION ROOM	
227	BALANCE ROOM & LABORATORY	
228	ENZYMOLOGY	
229	DATA & SECRETARIAL	
230	CONFERENCE ROOM	

Room Number	Room Name	REMARKS
231	STAFF ROOM	Dept of Histo-Pathology
232	DATA & SECRETARIAL ROOM	
233	PREPARATION ROOM	
234	HISTOCHEMISTRY, MICROTOMY. & STAINNING	
235	COLD ROOM	
236	W.C	
237	STORAGE	
238	AIR CONDITIONING MACHINE ROOM	
239	RECEPTION & PREPARATION	
240	CYTOLOGY	
241	WASHING ROOM	
242	TUMOUR TISSUE CULTURE & PREPARATION ROOM	
243	PREPARATION ROOM & DARK ROOM	
244	ANIMAL STORAGE	
245	ANIMAL ELECTRO-PHYSIOLOGY	Dept of Physiology
246	HUMAN ELECTRO-PHYSIOLOGY	
247	CVS/R.S	
248	GENERAL LABORATORY	
249	PREPARATION ROOM	
250	COLD ROOM	
251	AIR CONDITIONING MACHINE ROOM	
252	STORAGE	
253	DATA STORAGE	
254	ENGINEER'S ROOM	
255	DARK ROOM	Dept of Parasitology
256	OFFICE & LABORATORY	
257	OFFICE & LABORATORY	
258	OFFICE & LABORATORY	

Type B Laboratories

Standard laboratory room units are of same size as with Type A laboratories, and with same interior finishes with the exception of lower half of room walls being tile lined. These laboratories will be used principally for wet work, such as dark room.

Type C Laboratories

Standard laboratory units are of same size as with Type A, but are to be used for special purpose such as rearing germ free animals and tissue culture room which must be airtight. All walls will be tiled and ceilings are to be lined with waterproof gypsum board. Doors and windows used here are to be air tight.

X-Ray Room

All walls of x-ray room are to be constructed of reinforced concrete. Doors are to be made of steel and lead lined, however, interior finishes are to be same as those designated for Type A Laboratories.

Cold Room

Cold Room is planned to be constructed from prefabricated component complete with insulated panels, to ensure close tolerance work.

Offices

Offices are consisted of laboratory director's office, assistant laboratory director's office, secretaries' offices, and general offices. Finishes for these rooms are, wall to wall carpeted floor, hard vinyl skirtings, plastered walls and rock wool accoustic tiled ceiling.

Machinery Rooms

Air conditioning machine rooms are to have steel troweled cement mortar finished floor, base, and lower half of the walls. Upper half of the walls are to be finished with cemented excelsior boards with glass wool insulation backing, whereas ceiling is to be finished with steel deck plates, backing, whereas ceiling is to be finished with steel deck plates, backed with glass wool insulation. Noise generated in these rooms are expected to be effectively contained with the finished materials selected.

Toilets

In following with local practice, separate toilets are to be provided for senior staff members, ladies and staff in general. A set of toilets are to be provided on each floors of each wings. Fixtures to be installed are for water closet and laboratory for senior staff and ladies' toilet, whereas toilets for staff in general are to be provided with laboratories, urinals and water closets.

Staircases

All staircases are fabricated from structural steel and are to be erected simultaneously with steel frame erection work These staircases are to be used during construction stage, which will serve toward shortening construction period.

vi) LABORATORY

All laboratories are to be provided with requisite number of laboratory benches. Fume Hoods, shield rooms, stone tables, wash sinks, etc. are also to be provided as required. Work benches and shelvings in workshop are to be provided in requisite quantities.

vii) FURNITURES

Appropriate furnitures are planned to be provided in laboratory director's office, assistant laboratory directors' office, secretaries' offices, general offices and lounges. Directory, bulletin board and room name plates are planned to be provided.

3-1-2 EXTERNAL WORK PLANNING

As the building site is located on a slope, and because land adjacent to building site is yet to be landscaped, therefore, considerable thoughts were given in landscaping of immediate area surrounding the proposed building. Approach road to the building from access road provided by Ghana University Authority, and service road are included as a part of this scheme. Minimum planting and sodding work, in addition to site storm water drainage planning, are also planned as a part of overall scheme.

3-1-3 STRUCTURAL WORK PLANNING

i) BASIC POLICY ON STRUCTURAL WORK PLANNING

Ghana is not located in any of the known major earthquake belts. Available earthquake records indicated intensity to be small, and few and far in between. Wind record of maximum gust of 28.3 m per sec was the greatest recorded.

These records indicated that buildings in this region of the world are subject to much lesser horizontal forces than those experienced in Japan, permitting greater freedom in structural framework planning. Therefore, in the designing of 2 storey building, no special structural considerations are required as frame work consisting of columns and beams are adequate to support vertical and horizontal forces.

Type of frame work believed to be most advantageous for the proposed site, in consideration of availability of skilled laborers and construction period, is to have structural steel framework fully fabricated in Japan, ready to be erected in the field, ship it to Ghana for erection and bolting at the site.

A 9.2 meters squared column grid was selected in consideration of required magnitude of laboratory room sizes their functions, climatic condition of the region and type of structural frame construction.

Foundation condition found at the site is that 1 to 2 meters is clay stratum, with 2 meter hard clay stratum underneath and beforfe sandstone stratum is encountered. Soil stratification at the site consists of above mentioned three principal classifications of soils. Supporting stratum for the proposed building may be either hard clay or sandstone stratum Direct bearing foundation method may be used. Piling foundation is believed not necessary. Although, off hand, it is believed that there is no danger of consolidation settlement, however, as hard clay stratum, depending on location, is weathered, care should be used, in determining bottom level of foundation excavations.

ii) EXTERNAL FORCES TO BE CONSIDERED IN THE DESIGN

Types and sizes of external forces and loads working on the proposed building, in consideration of local climatic, geographical, and soil conditions and usage of building, are believed to be those given below:

1) Dead Load

Dead loads of structural and finishing materials are to be calculated.

2) Live Loads

As a rule, values as required of Building Standard Law of Japan are adopted, however, values for special rooms such as air conditioning machinery rooms and electrical room are to be calculated separately, using actual values. Given in the table below are live loads for typical rooms.

Live Loads (Unit: Kg/m^2)

Floors	Columns and Beams	Seismic
Roof	40	20
Laboratories	300	80
Offices	300	80

3) Wind Forces

According to data available at Accra Weather Station, maximum wind velocity recorded between 1946 — 1972 period were

Average Maximum Wind Speed	25 Knots (13m/sec)
Time of duration	22 minutes
Direction	SE — NW
Maximum Speed	55 Knots (28.3m/sec)

In consideration of life of proposed building, if maximum wind velocity for design purposes of 40 m per sec is assumed and wind force is calculated with hydrodynamics formula, it will be 92—8 kg per sq. m. Therefore, design wind force of 100 kg per sq. m. is adopted.

4) Seismic Forces

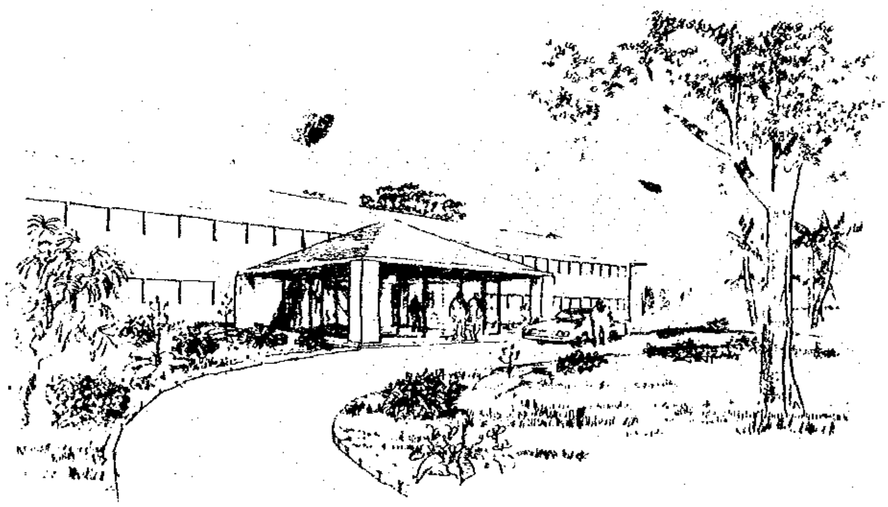
Because there was an earthquake experienced in Accra during June 1939, earthquake related regulation was promulgated. Isoseismal zones are fixed on revised scale. Design seismic factor of 0.33 is used in this design.

iii) STRUCTURAL MATERIALS

Structural materials were selected in consideration of size of building, structural design, usage and quality of material, supply capability, construction method, transportation condition from Japan, price etc. Following principal materials are to be used:

Fine concrete aggregate	Local beach sand. Beach sand should be thoroughly washed with sweet water to reduce, if not completely wash away salt content.
Coarse concrete aggregate	Local crushed stone
Portland cement	Normal portland cement produced in Japan or local product conforming to BS-12.
Reinforcing Bars and Welded Wire Mesh	Japanese product conforming to SD-30 grade
Structural steel	Japanese product conforming to SD-41 grade

Design compressive strength of concrete is Fc=180kg per cm^2 will allow deviation as σ = 45kg per cm^2 and mix design compressive strength of F = 225 kg per cm^2 or more shall be planned. Deck plates shall be used for level 2 floor slab concrete form toward reducing labor force and construction period. Shop joints of structural steel members are to be welded joints, whereas field joints are to be bolted joints.



3-1-4 AIR-CONDITIONING AND VENTILATION PLANNING

Mechanical work planning for proposed research laboratory building was completed in consideration of following points:

1) Climatic conditions at the proposed construction site is that average temperature range throughout the year is between 25° and 30°C and average humidity exceeding 80% zone of which is generally known as high humidity tropical climate. Under the circumstances, it is deemed necessary that air conditioning, dehumidification and ventilation are required throughout the year not only for the comfort of the research staff members, but also for maintaining laboratory equipment in good operating condition as well as to maintain supplies and data in satisfactory condition.

2) Review of characteristics of respective laboratories revealed that working hours, heat load generation and radiation conditions are not constant and varies from laboratory to laboratory, however, requirements of each individual laboratories must be satisfied.

3) Operation and maintenance of machineries must be adequate and smooth even by local technicians.

4) Interchangeability of spare parts of machinery used must be considered so that in case of breakdown, repair or periodical inspection parts can be changed without undue inconvenience to the operation of the research laboratory.

5) Rooms, such as constant temperature humidity room, cold room, germ free room, etc., where special air conditioning is required 24 hours a day, is to be provided with backup air conditioning machinery.

6) Toward reducing operating costs, machineries to be operated during off hours, holidays and Sundays, are to be kept to absolute minimum.

7) Air conditioner are to be provided with adequate dust proofing facility so that dusts due to sandstorm may be controlled. Filters are to be of such construction whereby they can be replaced simply and with relative ease.

8) Machineries are to be selected so that repair and replacement of machineries and pipings may be made using locally available parts and supplies.

Above criteria were studied during field survey and during preliminary planning of proposed research laboratory building, which resulted in formulation of mechanical work planning for this project, given below.

Air Conditioning and Ventilation Facilities

i) DESIGN CRITERIA

Outside Conditions

Outside air temperature	D.B 33°C	W.B 30.5°C
Outside air enthalpy	18.0 Kcal/kg	

Inside Conditions

	Temp.	RH.
General Laboratories and offices:	26°C	50% ±5%
Constant temperature and Humidity Room:	32°C – 37°C;	50% ±5% (24hr. cct)
Chilled Room, Laboratory:	0°C – 4°C (24 hour circuit)	

ii) AIR-CONDITIONING EQUIPMENT

Air conditioning system for this research laboratory building was studied by considering air supply, exhaust and heat load generation volumes of respective laboratories, equipment necessary for off hours operation, supplies, operation and maintenance and operating cost. As a result, it was decided to package air conditioners for primary air handling with room cooler units installed at respective laboratories and respective needs. In other words, air conditioning system for the proposed building is combination of central and individual systems.

1) Ground floor is made up of 7 zone, whereas, first floor is provided with eight air conditioning zone, with a package air conditioner for each laboratory section. Air conditioners are installed at the Air-Conditioning Machine room, wherefrom primary processed air is ducted to all rooms of that particular section for cooling and ventilation. Package air conditioners consist of compressor, direct expansion coil, fan and filter. Condenser cooling is on air cool system units of which are to be installed at outdoors. Package air conditioners' ducting systems are to be provided with by-pass connecting system so that backup can be provided in case of breakdown or failure of any unit.

2) All rooms are to be provided with separate type room coolers for individual air conditioning and dehumidification. Units to be installed in laboratory rooms are to be suspended from ceiling, whereas, units to be installed in offices are to be floor-mounted type, all of which will be of same capacity. This was done to enhance interchangeability and allow possibility of backup in case of breakdown or during repair. Outdoor units are to be installed on lean-to roof. Indoor and outdoor units are to be provided with necessary pipings and wiring works for circulation of coolant and to make possible control of two complementary units.

3) Constant temperature and humidity room is to be provided with two package air conditioner units, with outdoor air cooled condensor units, for controlling room temperature and humidity. One of two air conditioner is for backup purpose. These air conditioners consist of humidifier, electric heater, compressor, direct expansion coil, fan and filters, and are equipped with room thermostats and humidistats, necessary for maintaining constant temperature and humidity, and designed for 25 hour operation. Electric power sources are to be provided with emergency power source so that air conditioning of this area may be continued even during power failure.

4) Animal House

Total heat exchangers, air supply and exhaust fans, two package type air-conditioning units, electric heaters, humidifiers, and two air-conditioning units with built-in filter shall be provided in the Equipment Room of the Animal House. The air-conditioning of the Germ Free Animal House shall be effected by total air-exhaust method at a rate of 40 ventilating cycles per hour. All ductways and their air outlets shall be provided with a high-performance filter and an exhaust air handling unit so that the atmospheric pressure in the Equipment Room and the functions of the Germ Free Animal House will be maintained at constant rates and that the room temperatures and humidifiers will be controlled. The Animal Experimental Laboratory shall be supplied with primary air from the package type air-conditioning units in the same line. The exhaust air shall be totally disposed of by means of the exhaust air handling filter to prevent escape of bad odor. In order to effect 24-hour air-conditioning, emergency power supply shall be provided.

iii) DUCTING

There is a total of 16 duct system, one to each package air-conditioner. Ducts will connect each air-conditioner to all rooms that is to be air conditioned and ventilate by supplying primary processed air. All ducts are to be insulated for heat and sound. Switch dampers are provided in ducting according to zone so that in case of failure on the part of any one package air conditioner, ready backup can be provided. Return air will re-enter air conditioner through filter after which it will be mixed with fresh air for recirculation. Air flow control dampers are provided at special room so that air flow into such room may be properly controlled.

iv) VENTILATION SYSTEM

All toilets, wash rooms, rooms fune hood, cold room, electrical room, where forced ventilation is required are provided with extractor fan and/or ventilation fan together with exhaust parts connected to exhaust duct system, toward providing adequate ventilation. All rooms in general, and laboratory rooms are to be provided with 15 air changes per hour to remove odor and heat generated and toward maintaining habitable environment in the rooms.

v) AUTOMATIC CONTROLS

Room thermostats and humidistats are provided in constant temperature and humidity rooms and in germ free animal rearing rooms for automatic control of compressor, electric heater and humidifier housed in package air conditioners to maintain given temperature and humidity conditions. Primary processed air from package air conditioners to these special rooms are supplied at given temperature, by the function of body thermostats installed on package air conditioners. All automatic controls are operated on electrical system.

vi) COLD ROOM LABORATORY

Cold room as designed is to be supplied and erected in prefabricated panel units, complete with two sets of condensors and chillers, to maintain room temperature of 0°C to 4°C. Temperature control for cold room is planned so that when one set of chiller unit is in operation, room temperature of 4°C can be maintained, whereas, 0°C room temperature can be maintained by operating both chiller units. In addition to normal electric power source, emergency power sources are to be provided so that in case of any power failure, cold room will not be affected. Condensor units for cold room are also to be outdoor air cooled type. Necessary piping and wiring connections are to be provided between indoor and outdoor units so that circulation of coolant and electrical controls of complementary units can be maintained.

3-1-5 WATER SUPPLY AND DRAINAGE SYSTEMS

i) WATER SUPPLY SYSTEM

Water supply to respective points of use within the proposed research laboratory building is to be made by gravity flow by taking a branch off existing distribution main system of Campus, which is gravity fed from high pressure reservior located at elevation of 430 feet. Piping method to be used in 4 inch loop outdoor water main, which is believed adequate for maintaining required water supply volume and pressure. Water supply to all laboratory rooms and other points are to be taken off from 4 inch loop main with a stop valve at each branch points, and piped to points of use in laboratories in exposed piping. Exposed piping was selected in favor over concealed piping as it will provide ready access to piping work, making for easier maintenance. Piping material to be used, in consideration of operating water pressure and corrosion, is vinyl chloride lined steel galvanized pipes. Branch off from existing water distribution main is to be made with 4 inch pipe, however, bringing this 4 inch branch line to point of supply under front road of the site is the responsibility of Ghana University Authority, whereas, work beyond point of supply is to be included within the scope of work to be performed under this proposed project.

ii) HOT WATER SUPPLY SYSTEM

Hot water to laboratory rooms and wash room, where it is required, is to be supplied locally using small storage type electric hot water heaters. Copper tubings are to be used for hot water piping work.

iii) DRAINAGE AND VENT SYSTEM

Soil water, waste water, and storm water from proposed research laboratory building are to be piped individually to nearest catch basins under front road of the proposed site as a part of the scope of this work. All drainage piping works within the building, for maintenance purposes, are to be exposed piping using hard vinyl chloride pipes for drainage work. All outdoor piping works are designed to use spun concrete pipes, with catch basins strategically located on soil water, waste water, and storm water lines to facilitate maintenance and cleaning of drain lines. Ghana University Authority is to construct a septic tank after first exterior catch basin for treating soil and waste water, and lay drain pipe between, and make connections, septic tank and the nearest catch basin on Legoncampus sewer main. It was determined that storm water main work is to be performed by Ghana University Authority.

iv) SUNITARY FIXTURES

Sanitary fixtures to be installed in laboratories and toilets are to be provided in accordance with building work planning.

v) FIRE FIGHTING FACILITIES

Indoor fire hydrants are provided at four points on each floor levels of the proposed research laboratory building to be used in case of fire. There is a difference in elevation between 180 feet between high pressure reservoir and proposed site, which is equivalent to 6 kg per cm^2, therefore, water to fire hydrants are to be fed by gravity. Each fire hydrant is to be provided with two lengths of 15 meter long hose, nozzle and stop valve, housed in fire hydrant cabinets.

vi) GAS SUPPLY FACILITY

Gas to be used in the laboratories is to be liquid petroleum gas (LPG). Because of the danger involved in housing gas cylinders in the building and also the need to replace gas cylinders when emptied, this plan calls for independent gas tank house to be built, and gas piped to places of use from central gas station. In order to maintain even pressure throughout gas distribution, irregardless of volume of use in any one point, loop system is adopted. Stop valves are provided at all branch points to laboratories to ensure safety. Central gas supply system will simplify supply of gas from gas supply company.

vii) EMERGENCY SHOWERS

An emergency shower room is provided at a corner in the corridor for each laboratory section to provide ready access in case of laboratory accident. Showers are to be provided with lever valves.

3-1-6 ELECTRICAL EQUIPMENT PLANNING

i) POWER RECEIVING FACILITY

Electricity to proposed research laboratory building is to be supplied from medical school substation to be constructed by Ghana University Authority. Electric power is to be received on 240/415V, 3 phase, 4 wire system at 50 Hz frequency, with underground cable from substation to electrical room within the proposed research laboratory building. Electric power thus received is distributed throughout the building through breaker of cubical type low tension distribution panel. 100V power, required for laboratory purpose, is to be distributed on 100/173V 3 phase, 4 wire system, after having been dropped with a step-down transformer built in the cubicle.

ii) ELECTRIC POWER GENERATOR

Although power failure in Legon area is very rare and infrequent, in order to provide uninterrupted power supply, in case of power failure to critical zones within the proposed building, a diesel engine alternate current electric power generator is included in this scheme. Electricity is scheduled to be supplied to following section in case of power failure.

1. Chilled rooms of bacteriology section and chemical pathology section.
2. Constant temperature and humidity room of virology section.
3. Electron microscope section microscope room power sources.
4. Chilled rooms of histro-pathology section and parasitology section.
5. Germ free animal house
6. Power sources to chillers for chilled rooms.

A generator having generating capacity of 150 KVA is to be installed in consideration of load requirements. Generator engine is designed to start automatically and immediately, in case of power failure. This generator unit is to be installed in Medical School substation to be constructed by Ghana University Authority.

iii) POWER DISTRIBUTION FACILITY

Electric power is to be supplied from cubical type low tension distribution panel, in the electrical room, to power control panels, lighting and respectacle distribution panels, laboratory equipment distribution panels. Wirings to respective power units are to be made from corridor ceiling to respective power units, as a rule. All wirings, as a rule, shall pass through conduit tubes of requisite sizes.

Power distribution system and electric system to be used are as given below:

Power, lighting and receptacles: 340/415V, 3 phase, 4 wires

100 volts receptacles: 100/173, 3 phase, 4 wires

iv) LIGHTING AND RECEPTACLE FACILITIES

Lighting fixtures, receptacles, and tumbler switches are to be installed to complete wiring work beyond distribution panels. However, in the laboratory sections each laboratory room is to be provided with a distribution panel, wherefrom wirings to laboratory equipments, room coolers, electric water heaters, 100 volt laboratory equipments, lighting fixtures and receptacles are to be made. This design was adopted as it is believed that it would provide better control over power supply.

v) LIGHTING FIXTURES

Lighting fixtures, as a rule, are to be fluorescent lamp type fixtures. Sterilization lamps, dark room lamps, incandescent lamps are to be provided where required. Lighting fixtures are to be installed on 240V circuit, therefore, they will be operable on 240V current. Types of fixtures to be installed and light intensity thereof for principal rooms are given below:

Laboratory Room: Fluorescent lamps, directly mounted, type H	300 Lux
Offices: Fluorescent lamps	300 Lux
Corridor: Fluorescent lamps, recessed type	100 Lux
Store Rooms: Fluorescent lamps, directly mounted, trough type	50 Lux

vi) TELEPHONE EXCHANGER

An independent cross bar telephone exchanger is to be installed for exclusive use of the proposed building. Because requisite number of station lines is not available, 2 station lines are to be provided by the time of completion of this construction scheme. Until such time as more station lines can be made available, 10 lines from existing Legon Campus telephone exchanger, 5 incoming lines and 5 outgoing lines are to serve this telephone exchange. Station lines and connections between existing and new telephone exchanges are to be provided by Ghana University Authority. Specification of telephone exchange to be installed in the proposed buidling is as follows:

Type of Exchange: Cross bar type, Capacity, 100 lines.

Board: Cordless desk type.

Telephone Sets: Dial type.

vii) IN AND OUT INDICATOR

In and out indicators for senior staff members of the research laboratory is to be provided for the convenience of the laboratory staff in general as well as for the benefit of the telephone operator. Master 20 window panel, with switches, is to be installed at ground floor receptionist counter, with 20 window indicator panels to be installed at administrative offices.

viii) FIRE ALARM FACILITY

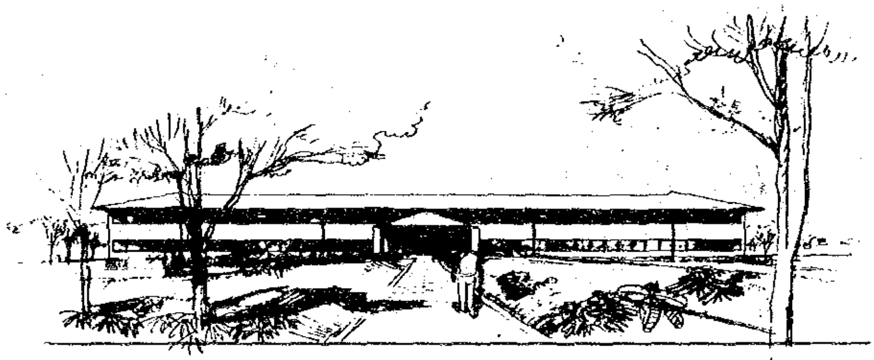
Push buttons and alarm bells are provided in strategic locations within the proposed building so that alarm can be sounded for evacuation and/or fire fighting in case of outbreak of fire or other diaster. Fire detectors are installed in air conditioning machine rooms of constant temperature and humidity rooms, chilled rooms, animal house, where air conditioning is provided 24 hours a day.

ix) LIGHTNING ARRESTOR FACILITY

Lightning rods are to be installed on ridges of the proposed building. Structural steel frame is to be used for earthing by connecting lightning rods and earth terminals. Earth resistant test terminals are to be installed on structural steel frame at ground floor level.

x) OUTDOOR LIGHTING

Outdoor lightings are to be provided at doorways and in the court area. Light fixtures to be used are fluorescent and mercury vapor lamps. Time switches are provided for automatic switching of light fixtures.



3-2 WORK TO BE PERFORMED BY UNIVERSITY OF GHANA AUTHORITY

In formulating construction planning for the proposed research laboratory building, it came to the attention of the planner that to have this proposed project completed according to schedule, Ghana University Authority will have to have the following undertaken and completed as required:

1) Access Road to the Size from Legon Campus.
   To be completed in early March 1977.

2) Site Boundary Bench Marks.
   To be established during this survey period.

3) Water Supply to Proposed Site.
   Necessary drawings for laying of water main is to be completed by March 1, 1977.

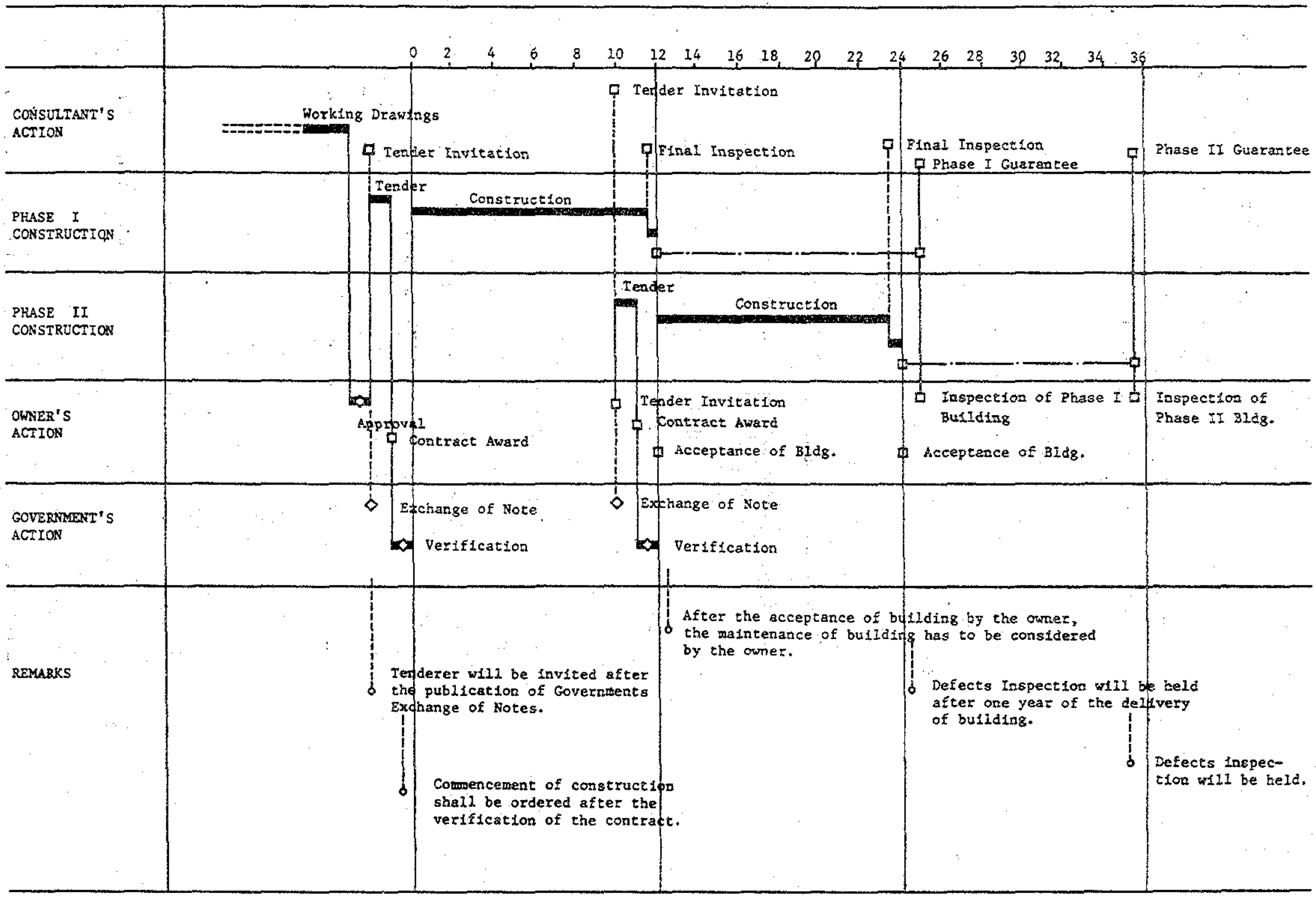
4) Drainage from Proposed Site (Soil, waste and storm waters).
   Soak-through type septic tank is to be installed for the proposed building as a temporary measure.

5) Electric Power Supply to the Proposed Site
   Temporary overhead line is to be used to supply 11KVA power to the proposed site. This work is to be completed by March 1977, permanent underground cable to be used to supply electric power to the proposed research laboratory and is to be used to connect electrical room within the proposed buidling and proposed Medical School substation to be constructed within 150 meters of proposed property line of this site.

6) Arrangement for Station Telephone Lines.
   Existing 2 lines used by Ghana University Authority are to be used as temporary and permanent station lines for this project and research laboratory use.

7) Others
   Electric power tariff chargeable during construction period of this project is to be paid for by Ghana University Authority, at no cost to Japanese side.

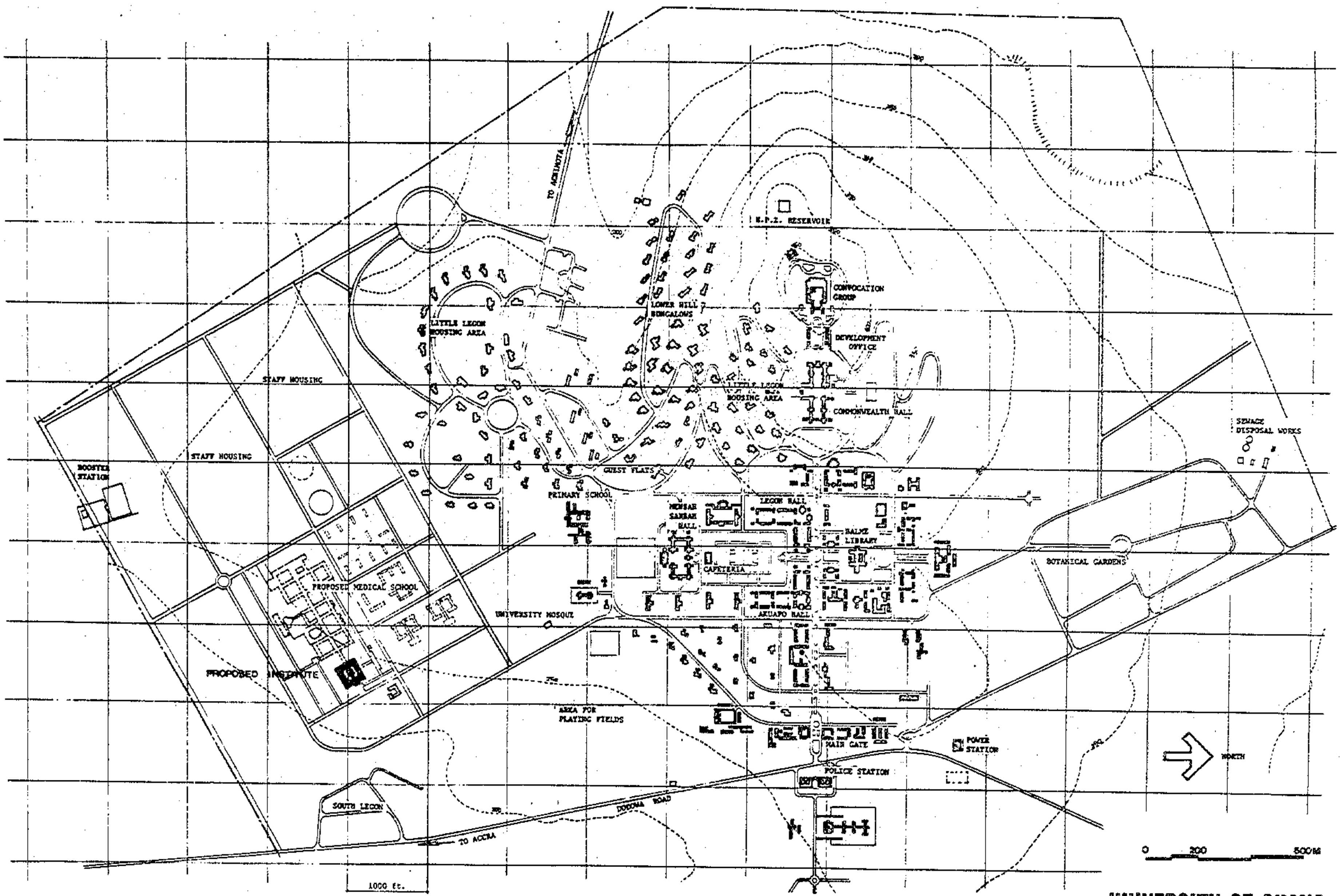
CONSTRUCTION SCHEDULE



3-3 CONSTRUCTION SCHEDULE

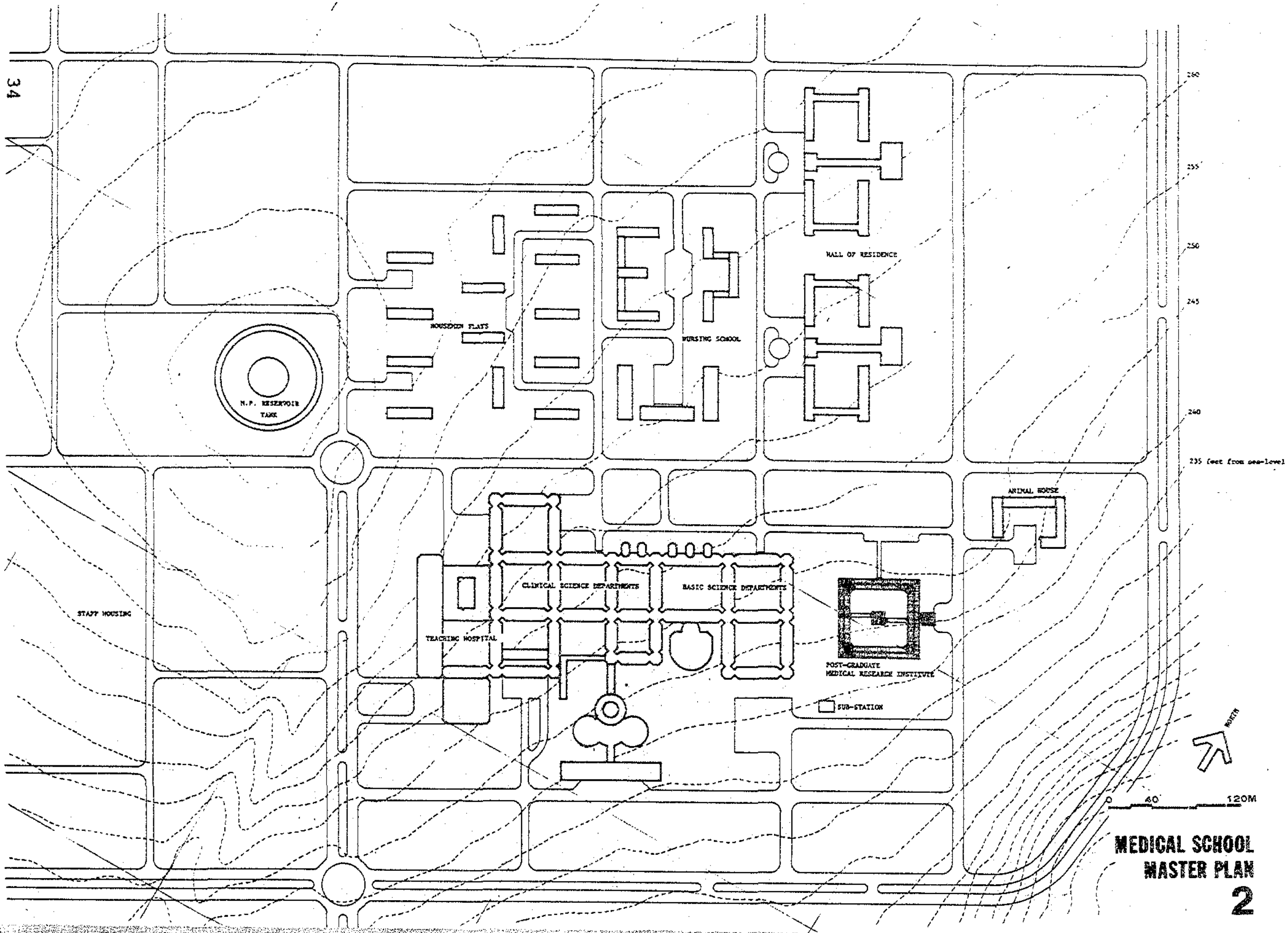
Plannd construction schedule for the proposed Postgraduate Medical Institute building is projected as 24 months. From the technical point of view, having taken local condition into consideration, 24 months is believed to be enough.
When fiscal matter of Ghana University Authority, such as construction found and fiscal year budgeting are entered into this consideration, it is possible that proposed project could be divided into two stages. The actual exercise of division of the project may be performed when availability of funds become known, Building itself is planned to be divided in stages without difficulties. However, because of the nature of the proposed institute which should be placed in the quiet place and also most case, the construction beside the Institute may always disturb the activity of research, it is better that project be carried out without phasing. Construction schedule attached to this document is that which was prepared during preliminary design stage, however, it will serve as basis for actual construction schedule for the coordination of Ghana University Authority, and necessary adjustments will be entered.

1. UNIVERSITY OF GHANA MASTER PLAN
2. MEDICAL SCHOOL MASTER PLAN
3. SITE PLAN
4. FLOOR PLAN LEVEL 1
5. FLOOR PLAN LEVEL 2
6. ELEVATION & SECTION

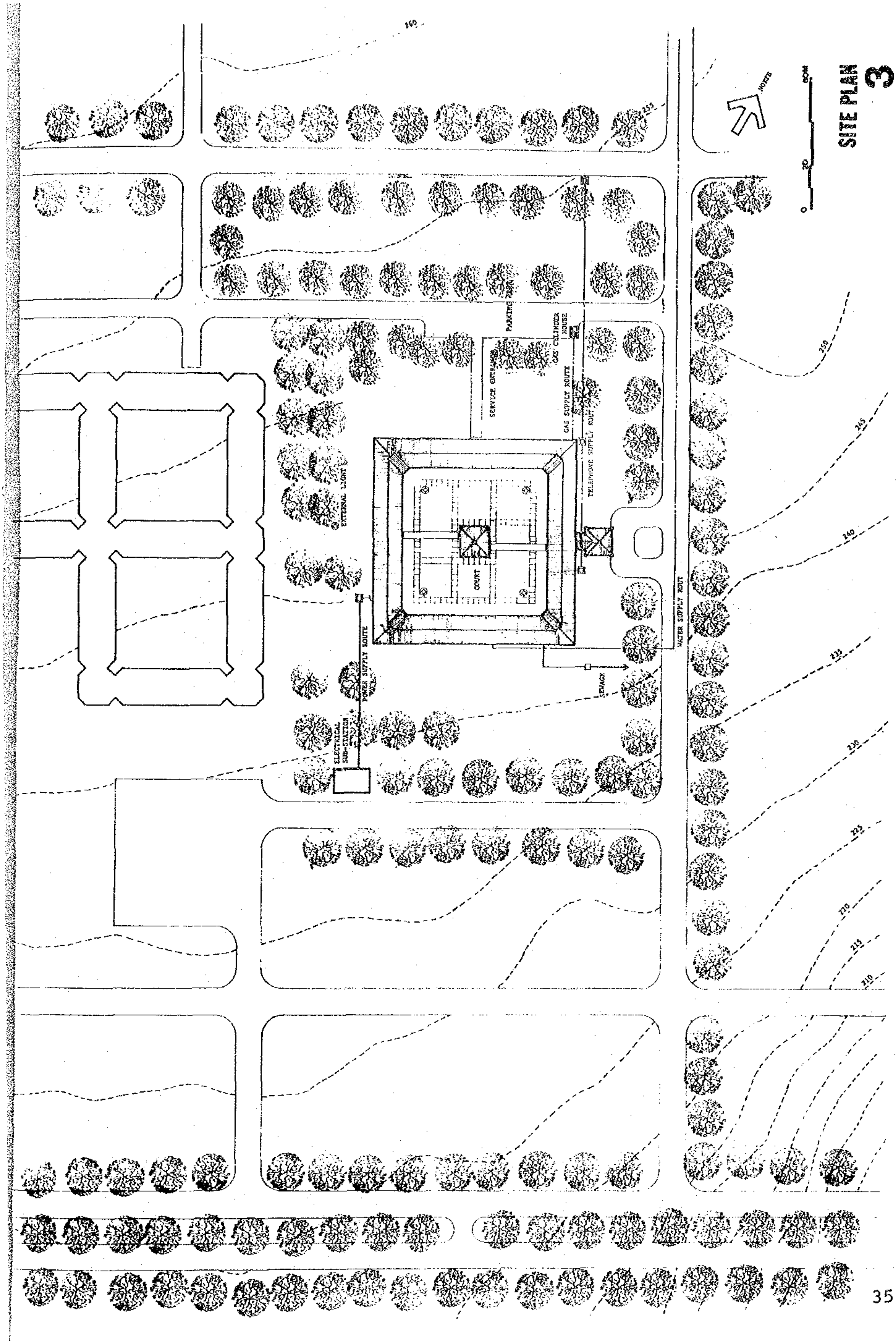


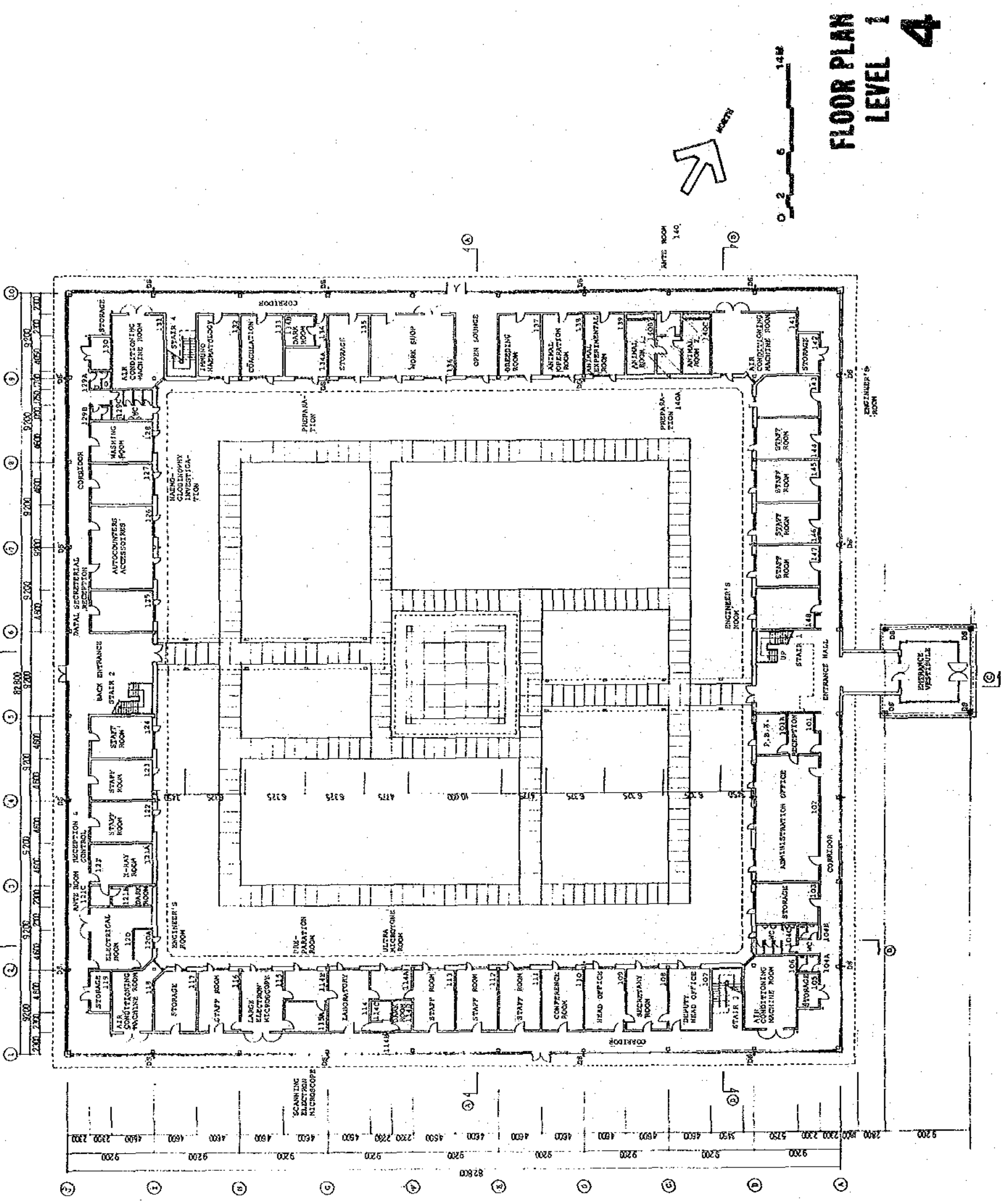
UNIVERSITY OF GHANA MASTER PLAN

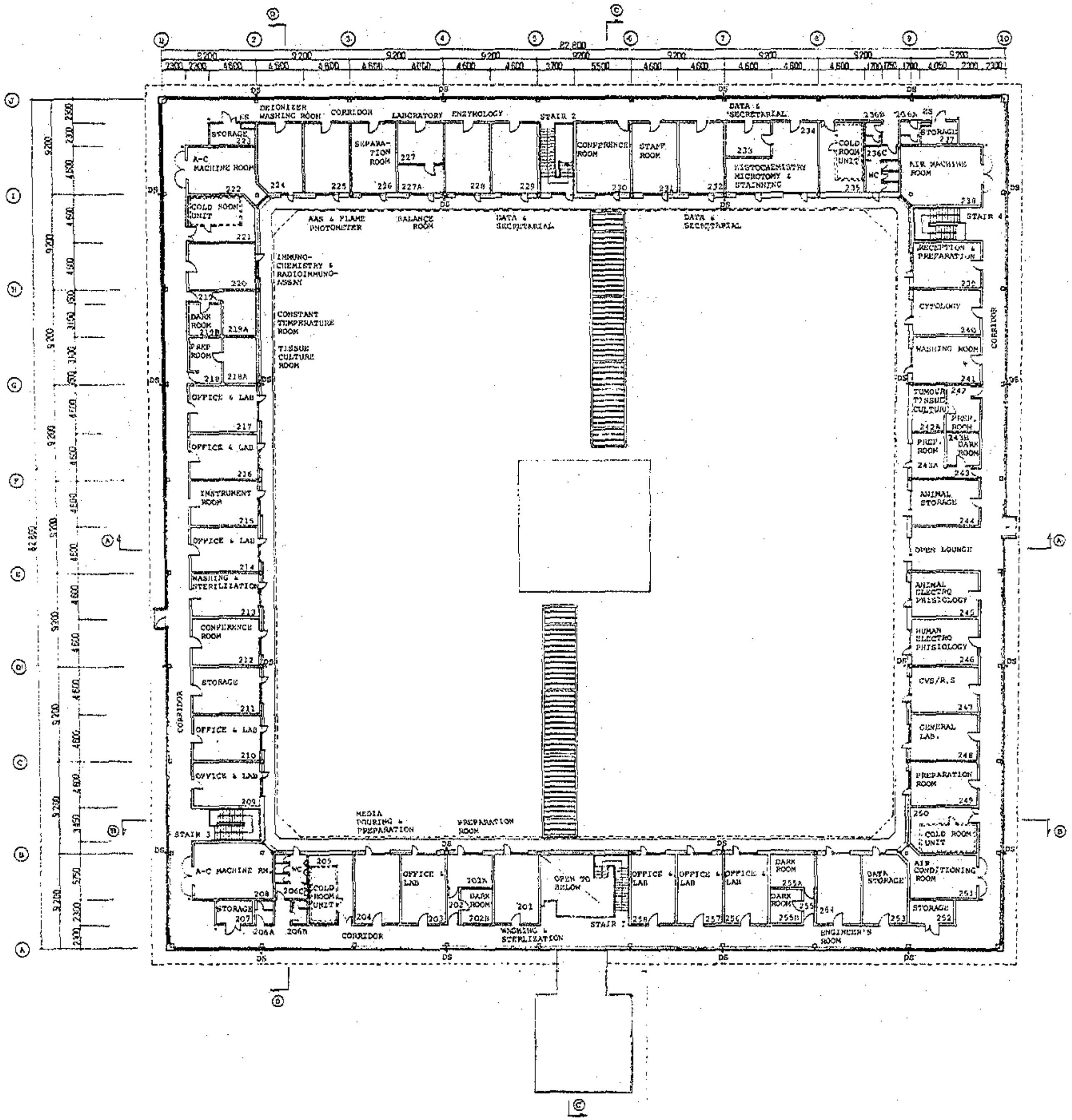
1

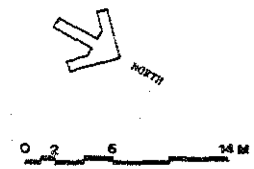


MEDICAL SCHOOL MASTER PLAN
2


SITE PLAN
3
NORTH
PARKING AREA
SERVICE ENTRANCE
GAS CYLINDER HOUSE
GAS SUPPLY ROUTE
TELEPHONE SUPPLY ROUTE
EXTERNAL LIGHT
COURT
WATER SUPPLY ROUT
SEWAGE
POWER SUPPLY ROUTE
ELECTRICAL SUB-STATION
260
255
250
245
240
235
230
225
220
215
210

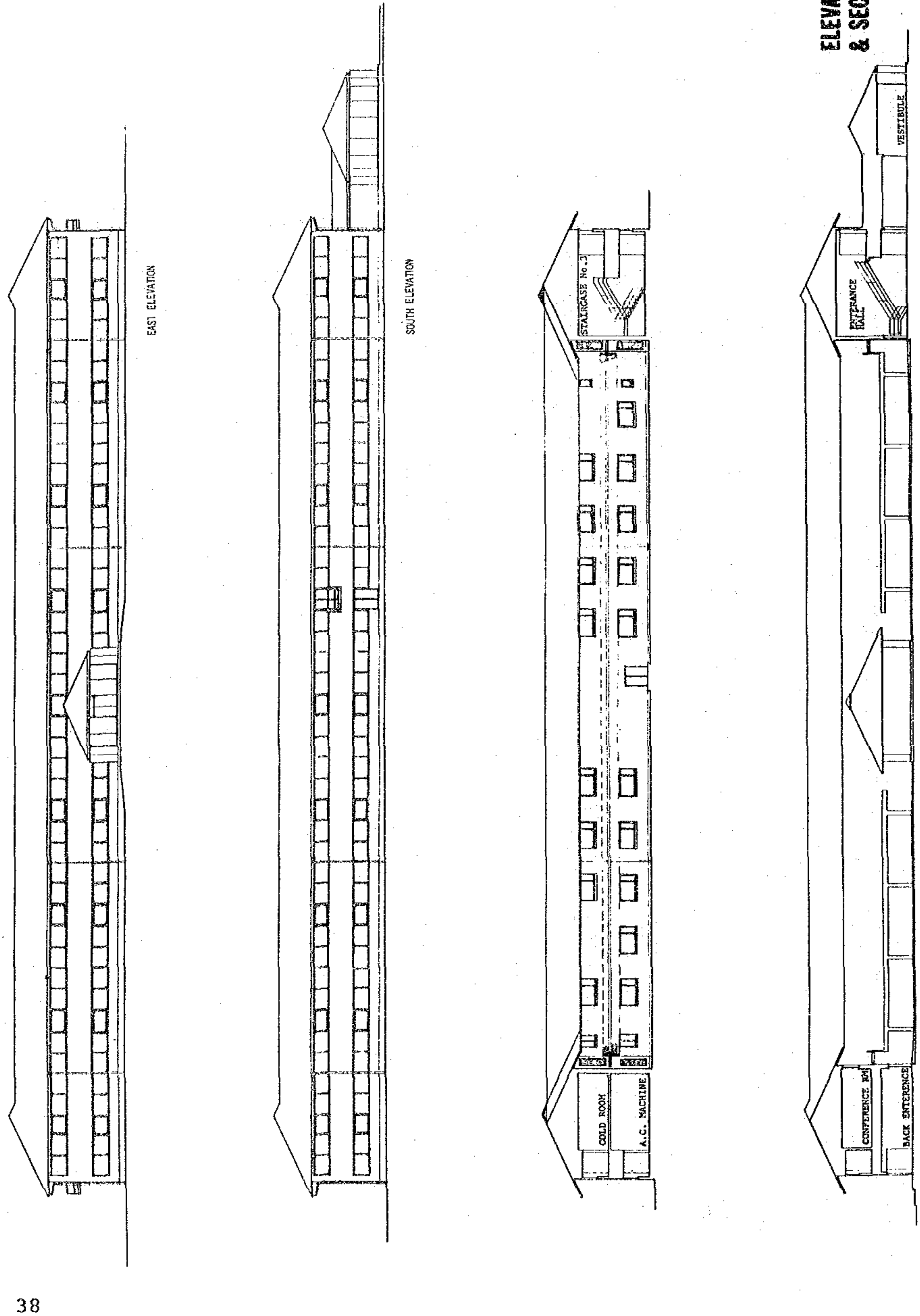

FLOOR PLAN
LEVEL 1
4
NORTH
CORRIDOR
ENTRANCE HALL
ENTRANCE VESTIBULE
ADMINISTRATION OFFICE
STORAGE
STAFF ROOM
CONFERENCE ROOM
HEAD OFFICE
SECRETARY ROOM
DEPUTY HEAD OFFICE
LABORATORY
LARGE ELECTRON MICROSCOPE
SCANNING ELECTRON MICROSCOPE
ULTRA MICROTOME ROOM
PRE-PARATION ROOM
AIR CONDITIONING MACHINE ROOM
ELECTRICAL ROOM
ENGINEER'S ROOM
X-RAY ROOM
DARK ROOM
ANTE ROOM
RECEPTION & CONTROL
BACK ENTRANCE
STAIR 1
STAIR 2
STAIR 3
STAIR 4
AUTOCOUNTERS ACCESSORIES
WASHING ROOM
IMMUNO HAEMATOLOGY
COAGULATION
WORK SHOP
OPEN LOUNGE
BREEDING ROOM
ANIMAL OPERATION ROOM
ANIMAL EXPERIMENTAL ROOM
PREPARATION
RECEPTION
P.B.X.
82800





FLOOR PLAN
LEVEL 2
5

ELEVATION & SECTION 6



APPENDIX

1. Foundation Investigation
   University Medical School Site
2. Temporary Supply for Construction Purpose
3. Preliminary Report on Water Supply and Sewerage
   Proposed Medical School and Medical Centre Complex

Appendix — 1

FOUNDATION INVESTIGATION
UNIVERSITY MEDICAL SCHOOL BUILDING SITE

The contract given by the University of Ghana Development Office to the Geological Survey Department on 14th June 1976 to undertake foundation investigation on gelogic basis at the site for the proposed buildings of the University of Ghana Medical Schoo, was completed on 27th August 1976.

The investigation consisted of pitting, drilling and geophysical investigations. Two base-lines, each measuring more thatn 600 metres were cut thourght the site. Three cross-lines with a total length of about 1,800 metres were also cut. These enabled the work to be done without hindrances and also helped systematic plotting and successful attempt on correlation. See site plan.

GEOLOGY OF THE AREA

The area is underlain y Togo series consisting of quartz mica schist. In the southern corner of the site, forming about 1/5th part of the site, the quartz grains are fine and are mixed with specks of mica without any cementing or binding medium. Because of lack of cementing material, the schist tends to be friable. It has a tendency of weathering into grey, micaceous "fine" sand. In the rest of the site the top part of the schist, up to about 10 metres thick, is made up of quartz schist mixed with lateritic pan. The quartz grains are bound together by ferruginous cement. Below this is the quartz schist without the binding mdeium and with very few mica specks. This grades into quartz-mica schist which lies below, as shoun in the sections of figs. 20 — 25.

SEISMIC INTERPRETATION

In seismic interpretation, one considers the fact that unconsolidated or soft rocks possess low seismic velocities while consolidated or hard rocks bear higher velocities. Well layered rocks indicate on seismic traces, records and graphs, distinct alignments and breaks. These in turn show the change of rock media and they take place when the interfaces of the rock strata are traversed by the seismic waves. Where there are more that two layers refraction seismic graph indicates more than two straight lines that have different slopes. The straight line that passes through the exial origin of a distance-time graph always represents the seismic velocity of the top layer or the surface layer. In interpreting the seismic records the traverses are here grouped according to lateral proximity. In this case there are overlaps that may be note.

TRAVERSES IN GROUPS

TRAVERSE GROUP 1

Refer to graphs representing 2BT6, ICT7, ICT8, and 2BT5 (fig 6, 7, 8, 5). In 2BT5 and 6 the straight lines through the origin have average seismic velocity of 450 m/sec. This indicates the to soil or clay. The velocity of the top soil as seen from figs. 7 and 8 is higher, about 750 m/sec. It is an indication of a harder material than clay. Correlation shows that compact lateritic gravel is involved at the surface.

The second layer is represented in the graphs of fif. 7, 8 as straight lines close to the origin and possessing velocities of the order of 1500 m/sec. It indicates the hardest rock. This velocity is associated with very hard lateritic pan. It is to be noted athat the straight lines with the highest velocity range between 1400 and 1600 m/sec. in fig. 7, 8 are short, but are continued by straight lines with lower velocities having an average of 750 m/sec. This means that below the very hard material a layer having relatively less compactness occur. In fig. 6 a transitional rock between the hardest and the unconsolidate, with a seismic velocity of about 1,000 m/sec. is indicated as the second layer while in fig. 5 the second layer shows about 750 m/sec seismic velocity, with least compctness. Thus a seismic velocity of about 1,000 m/sec. may be associated with a rock type, weathered quartz schist.

It is evident from the graphs that in the area, the top layer is partly clay at one section and partly lateritic gravel at the other section. While the second layer is hard lateritic pan at one part of the area, the other part is lateritic gravel. There is indication of a smooth transition between the lateritic gravel and the "pan" as well as between the "pan" and quartz-schist and again between the quartz-schist containing a few specks of mica and quartz-mica schist. A fourth layer is represented by a straight line assodiated with ab out 1500 m/sec. seismic velocity in fig. 8. By correlating with pit logs and bore-hole logs it can be seen that such velocity is related to a mixture of quartz-schist and lateritic pan. See sections of figs 21, 22.

TRAVERSE GROUP 2

Refer to figs 4, 9, 9R, 10, 3 representing traverses 2BT4, 2CT9, R2CT9, 2CT10. The straight lines passing through the axial origin of the time-distance graphs indicate an average velocity between 300 and 450 m/sec. This invariably is clay, top layer. The next straight lines in all the figures have inherent in them velocities lying between 270 m/sec. and 360 m/sec. Here, laterite and also a mixture of lateritic pan and quartz schist are involved, and they lie below the first layer. In both figs 9 and 9R one deduces a third layer that has the hardness of lateritic pan, and has about 1500 m/sec seismic velocity. It lies more than 25 metres below the surface and may be fresh unweathered schist. See figs, 21 and 23.

TRAVERSES GROUP 3

This group includes traverses 2BT2, 3CTII, RRCTII, 3CT13 and 2BT3 that are represented in the graphs of figs 2, II, IIRR, 13, and 3 respectively. Group 3 can be interpreted as Group 3 with only one or two changes. In fig IIRR the graphs sequentially indicate clay top layer, followed below by lateritic gravel then lateritic pan and finally a mixture of lateritic pan and quartz-schist at depth. Refer to figs 21 and 24.

TRAVERSES GROUP 4

Figs 1, 3, 14, 16 refer to seismic traverses "BT1, 2BT2, 2BT14, 2BT16 respectively. The graphs of fig 1 and 2 indicate clay top layer underlain by a harder rock material. In fig 14, lateritic gravel top layer is indicated and it is underlain by a harder rock. Two "breaks" appear in the graphs of fig. 16, and the line through the origin shows that the top layer is clay or lose gravel. See fig. 21.

TRAVERSES GROUP 5

The graphs representing the seismic traverses 3CT12, 3CT15, RR3CTII are shown in figs 12, 15 and IIRR. They all indicate three layers namely sandy clay, lateritic gravel, lateritic pan or quartz mica schist. Consult fig. 24.

TRAVERSES GROUP 6

Fig 17, 18, 19 corresponding to seismic traverses IBT17, IBT18, IBT19 show time-distance graphs. They indicate sandy clay top layer about 2 metres thick. The second layer is indicated by the second straight lines bearing velocities lying between 900 and 1600 m/sec. The range of velocities are derived from rocks of slightly differing compactness. These rocks in this area are lateritic gravel, lateritic pan, a mixture of lateritic pan and quartz schist. In fig 18 for instance a very hard but thins lateritic pan (about 2m thick) is indicated as lying below the sandy clay. It has the seismic velocity of 1500 m/sec. Below this comes a mixture of lateritic pan and quartz schist but the velocity indicates that this rock is of slightly less compactness. In fig 17 the second layer is a gradation from lateritic pan to a mixture of lateritic pan and quartz schist. The third layer is slightly harder. One deduces from fig. 19 that the lateritic pan investigated in this traverse is of slightly less compactness than the hardest lateritic pan in the area. This gruades into quartz schist.

SUMMARY OF SEISMIC DATA ANALYSIS

The details evinced by the seismic graphs were produced by the sensitive seismic instrument Model FS3. Taking the overall subsurface picture into account, some of these details may be neglected due to the fact that they are very small and that the causative media are localized. There is differential compactness, even within the same medium both vertically and laterally. Again intra-atrsta gradation occur. For instance the distinction between sendy clay and clay in this area is not so sharp, like-wise, lateritic pan and very hard lateritic pan, can be grouped together as lateritic pan.

It is to be noted also that quartz schist contains very few specks of mica. Nowever the mica specks in the schist increase in quantity downward. Instances of smooth gradation in the beds from the unconsolidated top layer down to the bedrock may be cited as follows: the sandy clay or clay, grades into laterite, and the laterite into lateritic pan. Next there is a mixture of lateritic pan and quartz schist, and then the quartz schist in turn changes gradually into quartz-mica schist in which spcks of mica and quartz grains are present in almost equal quantities. The achist however is devoid of binding medium.

In another way, one may conside;the difference in the succession of rocks in terms of qualitative compactness or hardness. For instance sandy clay may be considered as least compact, clays and lateritic gravel as less compact, laterite as compact, lateritic pan as more compact and hard lateritic pan as most compact. A mixture of lateritic pan and quartz schist may be considered as of equal compactness as that of "pan" while quartz schist may be compared with laterite as of roughly the same degree of compactness' Again compactness and hardness may somehow be related. It is to be noted that there are intermediate stages of the degree of compactness of hardness mentioned above.

ASPECTS OF FOUNDATION PROBLEMS

The general succession of rock layers in the area consist of soil or reddish-brown clay cover of about 2 metres thick. Below this cover is a hard lateritic pan which has an average thickness of 2 metres.

Quartz-schist or mixture of lateritic pan and quartz-schist underlie the pan and have an average thickness of about 6 metres although the actual thickness increases from less than 5 metres in the west to more than 6 metres in the eastern section of the site. These in turn overlie the quartz-mica shist. (See sections 20 — 25).

The latter rock is incompetent and more so in view of the fact that the mica is abundant, and within the schist, it has a specific alignment that tends to trigger slipping if the dip (slope) of the bed is too steep. However the dip of the strata in this grea is negligible.

Again the quartz grains without any cementing or binding media have loose compactness. The schist is very thick compared to the other overlying rocks for it is more than 20 metres thick. It forms part of the Togo schist that is badly decomposed.

The hard lateritic pan and the mixture of quartz schist and lateritic pan, are, however competent, and they cover the incompetent rock like a mat or "raft." They are made up of limonitic or iron oxide medium on the one hand, and on the other schistose sandstone pebbles comented together by the same ferric oxide medium.

The level of the water table is deep. Bore-hole measurements show that the top level of the underground water is at a depth of more than 15 metres at this time of the year 1st September 1976. But the possibility of the change of the level of subsurface water during the rainy season cannot be ruled out.

CONCLUSION

No faults were detected at the site. Sharp or steep rock contacts were not found beneath the top layer. Rather, rock contacts that showed gradation into each other and had nearly horizontal slope were detected. Both competent and incompetent rock were found in the area with the competent overlying the incompetent stratum.

RECOMMENDATION

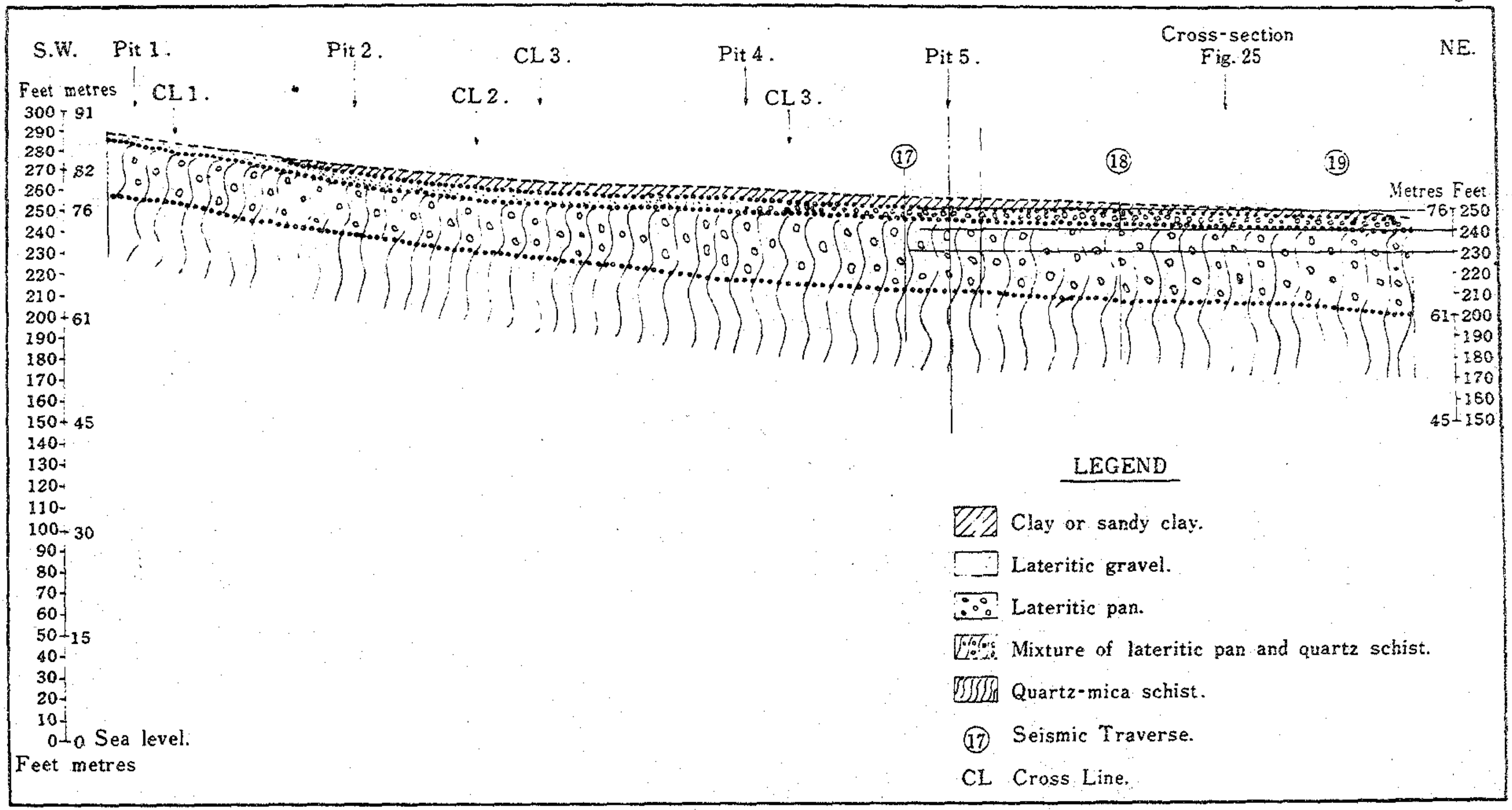
It is recommened that any building designing be made to take into account the possibility of, but improbable, subsurface creep and slipping in view of the abundant mica in the weathered or decomposed schist mentioned in the text, especially when the moisture content is high. It is therefore recommended that the necessary engineering soil test be conducted to determine the moisture content of the schist.

for: DIRECTOR, GEOLOGICAL SURVEY
(C.E. ODURO)

Mr. J.K. GBEWONYO,
UNIVERSITY DEVELOPMENT OFFICE,
LEGON.

UNIVERSITY MEDICAL SCHOOL SITE
SUBSURFACE CROSS-SECTION ALONG
BASE LINE 1

Fig 20



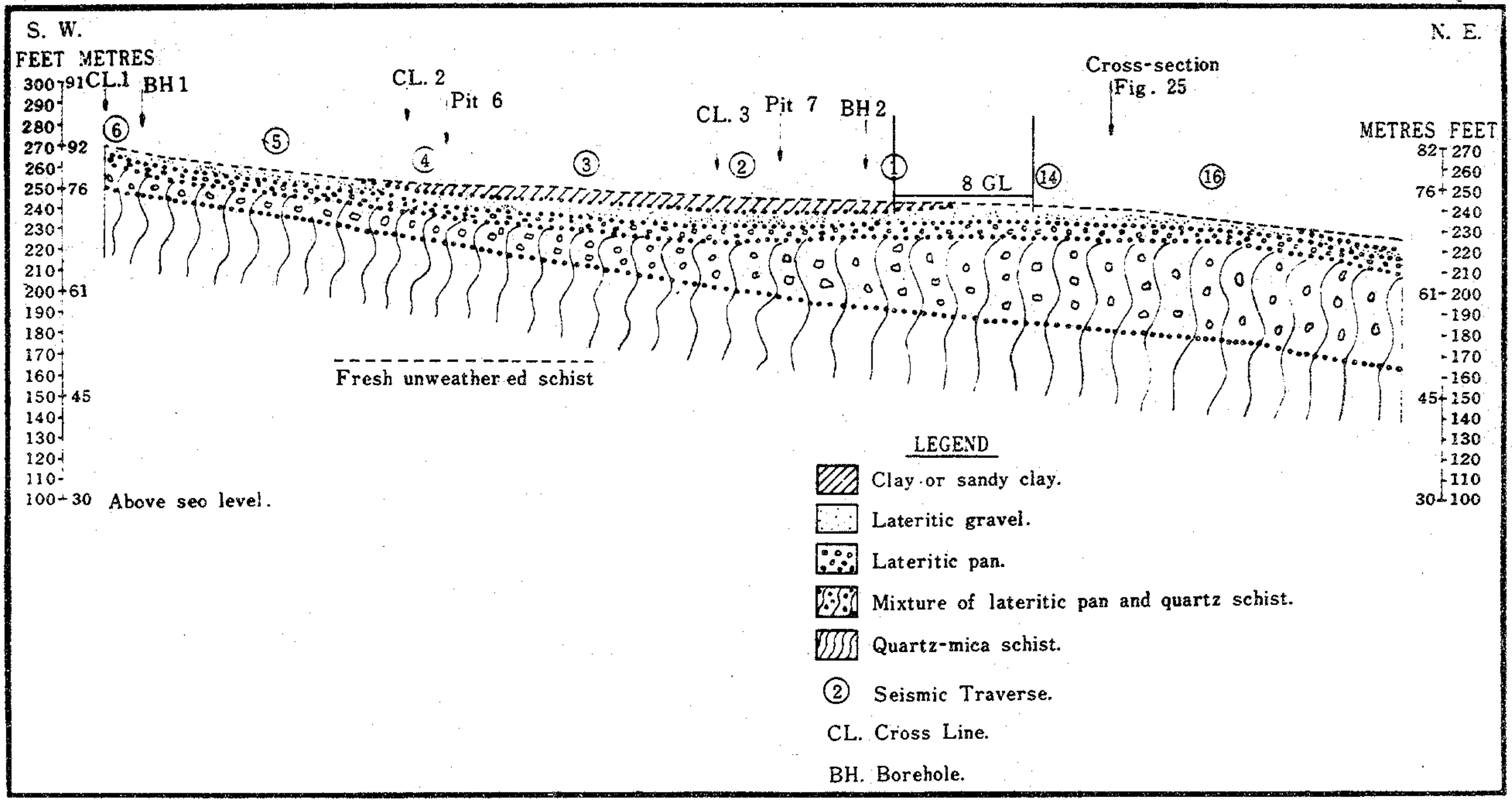
Ghana Geological Survey, 1976
C. E. Oduro, Geophysicist.

HORIZONTAL SCALE 1 : 2500

EAA/275A
J. K. D.
14 : 9 : 76.

UNIVERSITY MEDICAL SCHOOL SITE
SUBSURFACE CROSS-SECTION ALONG
BASE LINE 2

Fig. 21



Ghana Geological Survey. 1976.
C. E. Oduro. Geophysicist.

EAA 275B
J : K. D.
16 : 9 : 76.

HORIZONTAL SCALE 1 : 2500

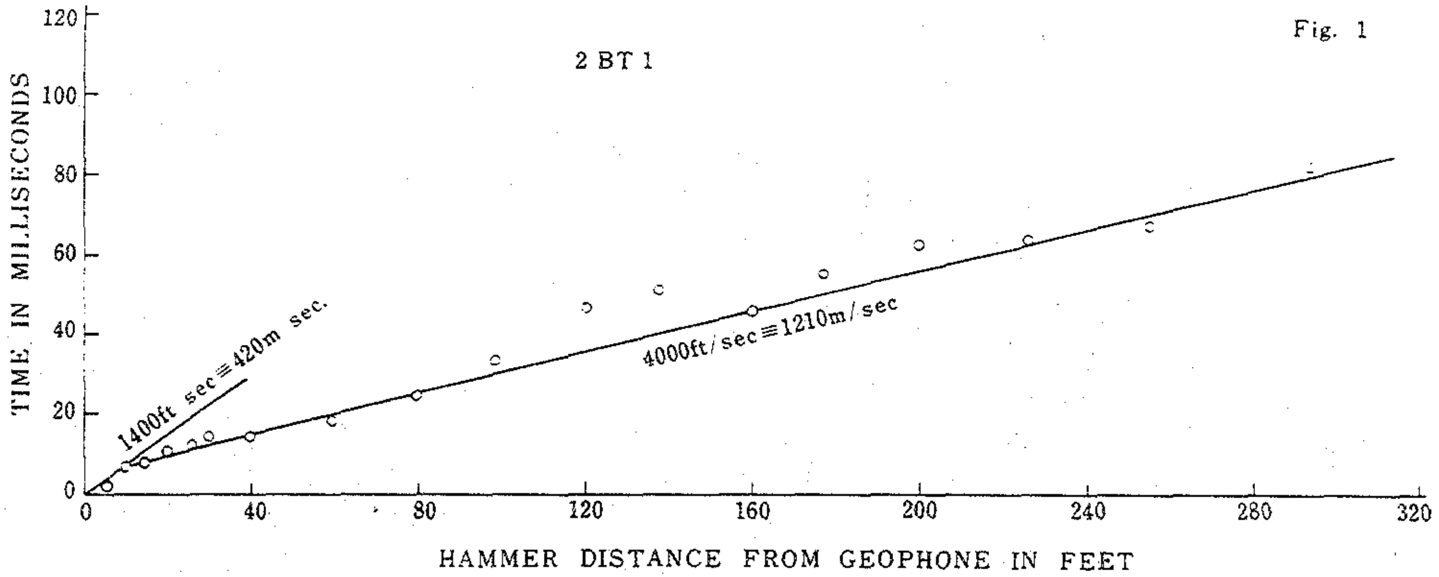

2 BT 1
TIME IN MILLISECONDS
1400ft sec≡420m sec.
4000ft/sec≡1210m/sec
HAMMER DISTANCE FROM GEOPHONE IN FEET

Fig. 1

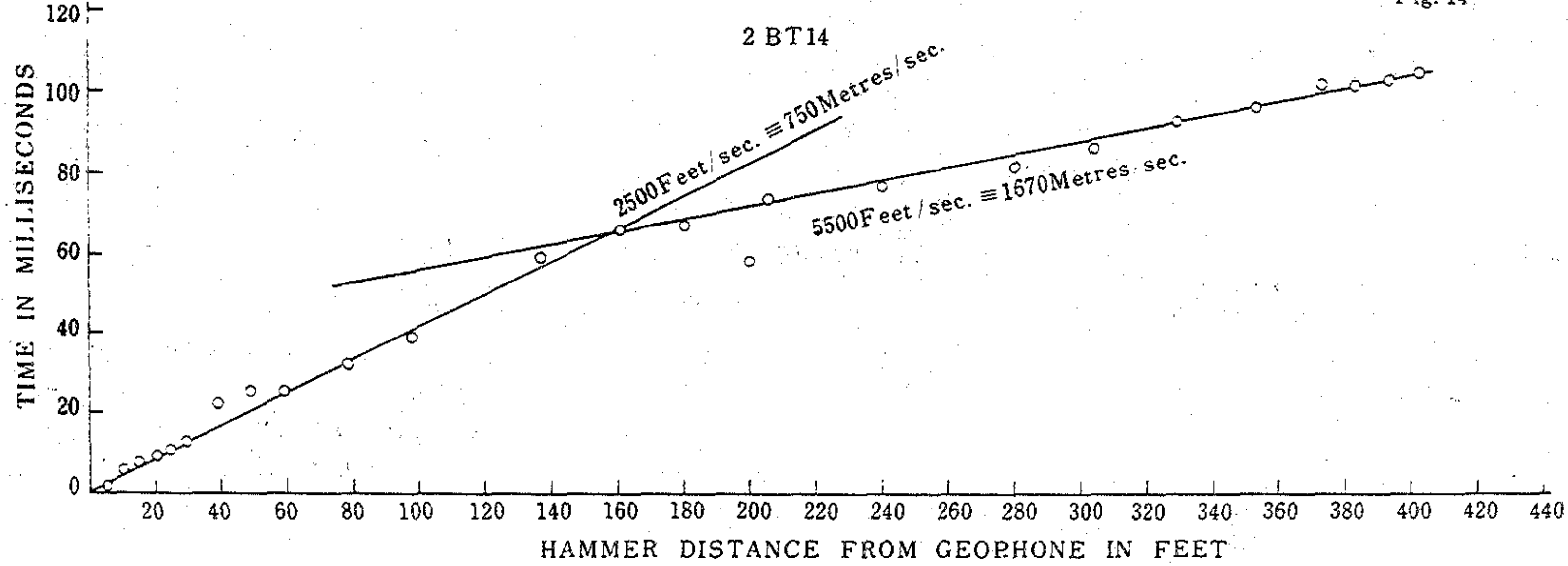

2 BT14
TIME IN MILLISECONDS
2500Feet/sec. ≡750Metres/sec.
5500Feet/sec. ≡1670Metres sec.
HAMMER DISTANCE FROM GEOPHONE IN FEET

Fig. 14

Appendix – 2

TEMPORARY SUPPLY FOR CONSTRUCTION PURPOSE

The nearest electricity supply is about 800 metres to the site.

It has been estimated that about 80KVA, 414/240 volts 50Hz will be required at the site for construction purposes. The University must make this supply available by March if construction is to start on schedule.

The nearest 11KV/415 volt substation (south Legon) is about 800 metres to the Site. The nearest 415V under ground cable distribution does not come naywhere near the site.

The following stops will therefore be taken to make electricity supply available on the site for construction.

1. The 11KV network is to be extended from Sough Legon Substation (TS1/IC) to the Site – a distance of about 800 metres.
2. A Ring Main Unit is to be installed at Sough Legon Substation.
3. A temporaty structure is to be erected at the site to house temporary substation equipment.
4. A temporary transformer and medium voltage gear is to be provided.

A. Ring Main Unit

The Ring Main Unit to be used in the premenent power supply to the Medical Complex is yet to be purchased and will not be available. It is therefore intended to install a temporary RMU which may be of the Long and Crawford type or equal used on the E.C.G. system. Arrangements are being made with the Electricity Corporation and we are sure that this will be available time to provide temporary supply to the site.

B. 11KV Cable

Since this cable will eventually form part of the permanent 11KV distribution network for the medical complex. it is intended that a cable of the proper size and specification should be laid so as to avoid duplication of work.

Arrengements are being made to obtain this cable locally.

Cable size 3/0.15 square inch (3 x 95mm2) Paper Insulated, lead covered, Steel Wire Armoured, PVC sheathed copper cables).

If the cable is found to be available locally, it will be recommended for installation to start immediately in order for the supply to be ready by March.

If attempts to obtain the cable locally fails, it will be recommended that an express order be placed immediately for the cable to be here by mid February in order for the temporary supply to be available by March.

C. Temporary Structure to House Substation

It is recommened that constuction work on this Structure should be started immediately so as to be available by the end of February.

D. Temporary Transformer

This University has spare 100KVA 11KV/415V 3ϕ transformers and one of them will have to be utilized at the site to provide the temporary supply.

E. Medium Voltage Temporary Distribution Board

This will be erected from pieces of Medium voltage Gear available in the University stores.

F. Electricity Charges

Power consumption during construction will be metered by the University. The rate of charge will be as per the attache Tarriff sheet.

G. Permenent Power Supply

The Permanent power supply will generally follow the routes marked in the Preliminary Report on Infra-structure (Electrical Services). The Consultants are currently working on the final design and the Specifications and Bill of Quantities will shortly be madeavailable to the University to go to tender.

Erection of the 11KV Network and the associated sub-stations will be phased out to follow the construction programme for the Medical Complex. This will ensure that permanent supply will be available when the first phase of the Noguchi Memorial Institute is completed.

H. Telephones

There are about 50 to 60 junction lines going from the Cantonments Exchange to the University Exchange. It is possible to divert two of these lines to the site so as to facilitate communication during construction.

This work will have to be given to contract immediately if Telephone facility is to be available at the site by March.

Since these junction lines are owned by the P & T it will be adviseable to ask P / T immediately for the necessary details to be finalised.

I. Electrical Specifications

This is largely based on the Specifications of Electrical Equipment currently in use at the University. It is in the interest of the University to standardise on equipment for ease of maintenance and replacement. We would therefore recommend the same equipment to be supplied wherever possible.

Appendix — 3

PROPOSED MEDICAL SCHOOL AND
MEDICAL CENTER COMPLEX

INFRASTRUCTURAL WORKS

1. WATER SUPPLY

1.1 Introduction

The University of Ghana, Legon, is in the High Pressure Zone (HPZ) in the water distribution network of Accra. This zone is served by a 2mg Reservoir with a Top Water Level (TWL) of 450.00 sited near the residence of the Vice-Chancellor of the University. Apart from the University, the HPZ Reservoir serves the Ghana Atomic Energy Commission, Kwabenya, Madina District. The reservoir is fed by GWSC's Booster Station which is on the South-Western corner of the Project Site.

The Ghana Atomic Energy Commission is currently planning an expansion programme and the Madina district is expanding fast. The Bank for Housing and Construction has proposed an extensive Housing Estate on the Dodowa Road. Water for all these developments will be supplied from the HPZ reservoir.

1.2 Permanent Water Supply

1.2.1 Reservoir

In view of the present high demand on HPZ *reservoir and also the extra strain* developments outlined in Para. 1 would impose, it is felt that there is need to consider a system of sipply independent the existing HPZ reservoir for this project. In this connection, an Elevated reservoir is proposed near site of the existing Medium Pressure Zone reservoir (which is at present out of commission due to leakage).

Due to the height of multi-storey blocks in the project area and other factors, the reservoir will need to be raised approximately 110ft. high. This reservoir will hold 500,000 gallons which is the assessed requirement per day for the full development. The reservoir will be fed by the GWSC booster and for this, extra pumpingmachinery will be required. It is our feeling that GWSC may be agreeable to contribute to the cost of the reservoir and the pumping machinery required.

1.2.2 Water Distribution

We show on Drg. No. 1 the main water distribution network from which connections to the various buildings may be made.

Asbestos Cement Pipes and uPVC pipes are proposed. These pipes are available locally but fittings, e.g. valves, fire hydrants etc. will have to be imported.

1.3 Temporary Water Supply

1.3.1 Post-Graduate Medical Research Institute

As we are informed, the Research Institute will be the first building to be constructed and we believe that the implementation of the rest of the project may not follow immediately. In this connection, it is suggested the temporary supply which will be required for constructional works of this Institute be such that it may be retained to supply all the water needed for the building on completion.

1.3.2 Water Supply for the construction of the Research Institute will be taken off the existing 9in. dia. main in the Dodowa road. The route of this supply is shown on Drg. No. 2. For the constructional works a 2in. dia. connection would have been sufficient. However, as mentioned above, to enable the pipe to be retained to satisfy the water requirement of the building, a 4in. dia. connection is provided as this is the size shown on the Drawings from Japan. We find this size rather large, but we believe that this may be due to the requirement of the equipment to be installed.

1.4 Cost

1.4.1 The cost below covers only the temporary water supply which is intended for use during construction but which may be retained to serve the building after construction.

Toe total cost i.c.
materials and labour is ₵11,000.00

1.4.2 Water Rate

The current water rates are as follows:

During construction: ₵1.35 per 1000 gallons
After construction : ₵0.60 per 1000 gallons

2. SEWARAGE

2.1 Introduction

Most of the University's development is served by a network of sewers and a central sewage treatment plant on the North-Eastern boundary of the University site. Behind the Estate yard is the East Sewage pumping station into which drains sewage from most of the halls of residence and staff houses including the hospital, police station etc. From this pumping station, sewage is pumped to the head of a 15in. dia. gravity sewer which then carries it to the treatment works.

2.2 Present Conditions

The East Sewage Pumping Station has two pumps (one duty, one standby) which are connected to 9in. dia. rising main. Provision has been made in the design of the pumping station for two additional pumps and additional 12in. dia. rising main.

The sewage disposal works has provision for primary sedimentation, biological filtration, humus tanks, sand filtration (tertiary), sludge digestion (primary and secondary) and sludge drying beds. Final effluent is pumped to the University nursery and gardens for watering.

From our observation, the Sewage Disposal Works need considerable amount of rehabilitation as most of the units are not functioning satisfactorily. We are currently studying the extent of rehabilitation works necessary.

2.3 Permanent Sewerage

2.3.1 Sewerage of the Medical Centre

We have shown on Drg. No. 3 a network of sewers for full development of the Medical Centre. From this Drawing, it would be observed that all the sewage is collected to a point in the South-Eastern corner of the project site. From this point, two main alternatives are open:

2.3.2 The sewage may be pumped to the East Pumping Station for it to be re-pumped to the existing sewage works for treatment.

In this alternative, it would be necessary first to carry out complete rehabilitation of the existing sewerege works and then also extend the works by approximately 50 percent.

Following the rehabilitation works, the expansion of the treatment works would cover the following additinal unts:

(a) 2 No. Biological Filters and their accompanying Dosing Chamber

(b) 1 No. Sedimentation Tank

(c) 1 No. Humus Tank

(d) 3 No. Sand Filters.

There will be no need for increase sludge digestion tanks and sludge drying beds.

2.3.3 The second alternative depends on the Second Stage of the Accra Sewerage Programme. From information recei ved from the GWSC, all indications show that the Second Stage of the Accra Sewerage is likely to be implemented within the next five years.

Work in this stage would cover the Cantonments area of Accra, and one of the trunk sewers in the system would reach the Giffard Circle.

Under these conditions, consideration is to be given to the outfall of sewage from the project as follows:

Following the collection of the sewage to ghe South-Eastern corner of the project site, the sewage would flow by gravity to Pumping Station Q (See Drg. No. 4) near the start of the Accra-Tema Motorway. From this station sewage would be pumped to the head of the trunk sewer at Giffard Circle.

It is hoped that GWSC could be involved financially in this scheme as the pumping station could serve most of the Airport Residential Area, the Government Chemical Laboratory and any development in the neighbourhood.

It is appreciated that the choice between these two alternatives would depend on the cost and this is under study.

2.4 Temporary Sewerage

2.4.1 Post-Graduate Research Centre

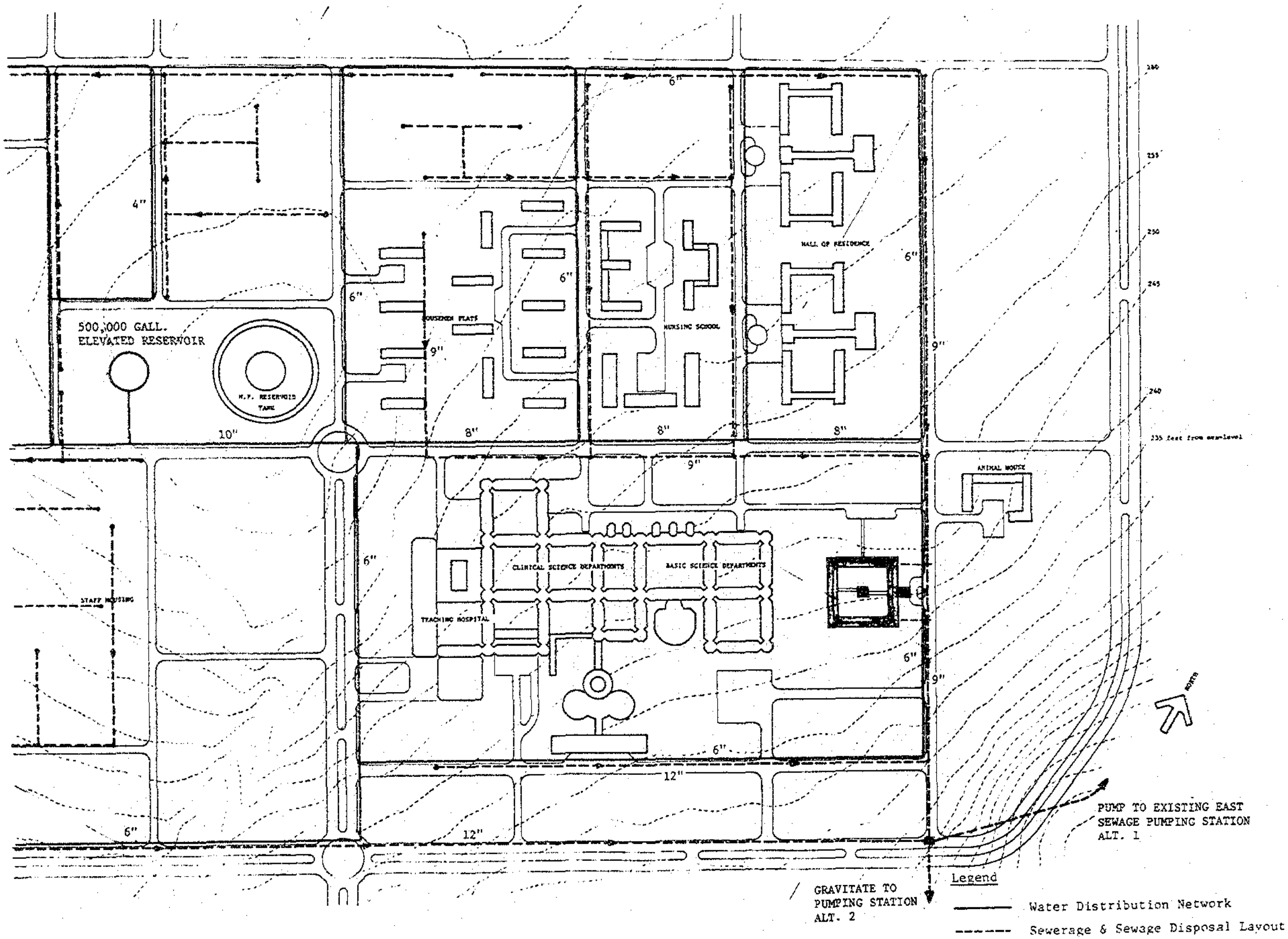
As with the Water Supply, it is considered necessary to make provision for temporary Sewerage System for the Research Centre and in this connection, on Drg. No. 2 we show a 9in. drain from the Research Centre leading to the Spetic Tank with soakaways. When the overall sewerage system is constructed at full development, this tank can be easily by-passed and the Research Centre brought into the main system.

2.5 Cost of Temporary Sewerage

The cost of the temporary sewerage system system for the Post-Graduate Research Centre is as follows:

9in. Dia. Concrete Pipework laid complete	₵20,000.00
Septic Tank with 3 Soakaways	38,000.00
Total	₵58,000.00
Say	₵60,000.00

MEDICAL SCHOOL PLUMBING WORK PROGRAM
WATER DISTRIBUTION NETWORK, SEWERAGE & SEWAGE DISPOSAL LAYOUT



TEMPORARY WORK
WATER CONNECTION & SEWERAGE