


BASIC DESIGN STUDY
ON
THE ESTABLISHMENT PROJECT
OF
THE KHARTOUM TRAINING HOSPITAL
IN
THE DEMOCRATIC REPUBLIC OF THE SUDAN

SEPTEMBER, 1982

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to the request of the Government of the Democratic Republic of the Sudan, the Government of Japan decided to conduct a survey on the Khartoum Hospital Construction Project and entrusted the survey to the Japan International Cooperation Agency (JICA).

The JICA sent to Sudan a survey team from May 6th to May 28th, 1982. The team had discussions with the officials concerned of the Government of the Democratic Republic of the Sudan and conducted a field survey in Khartoum.

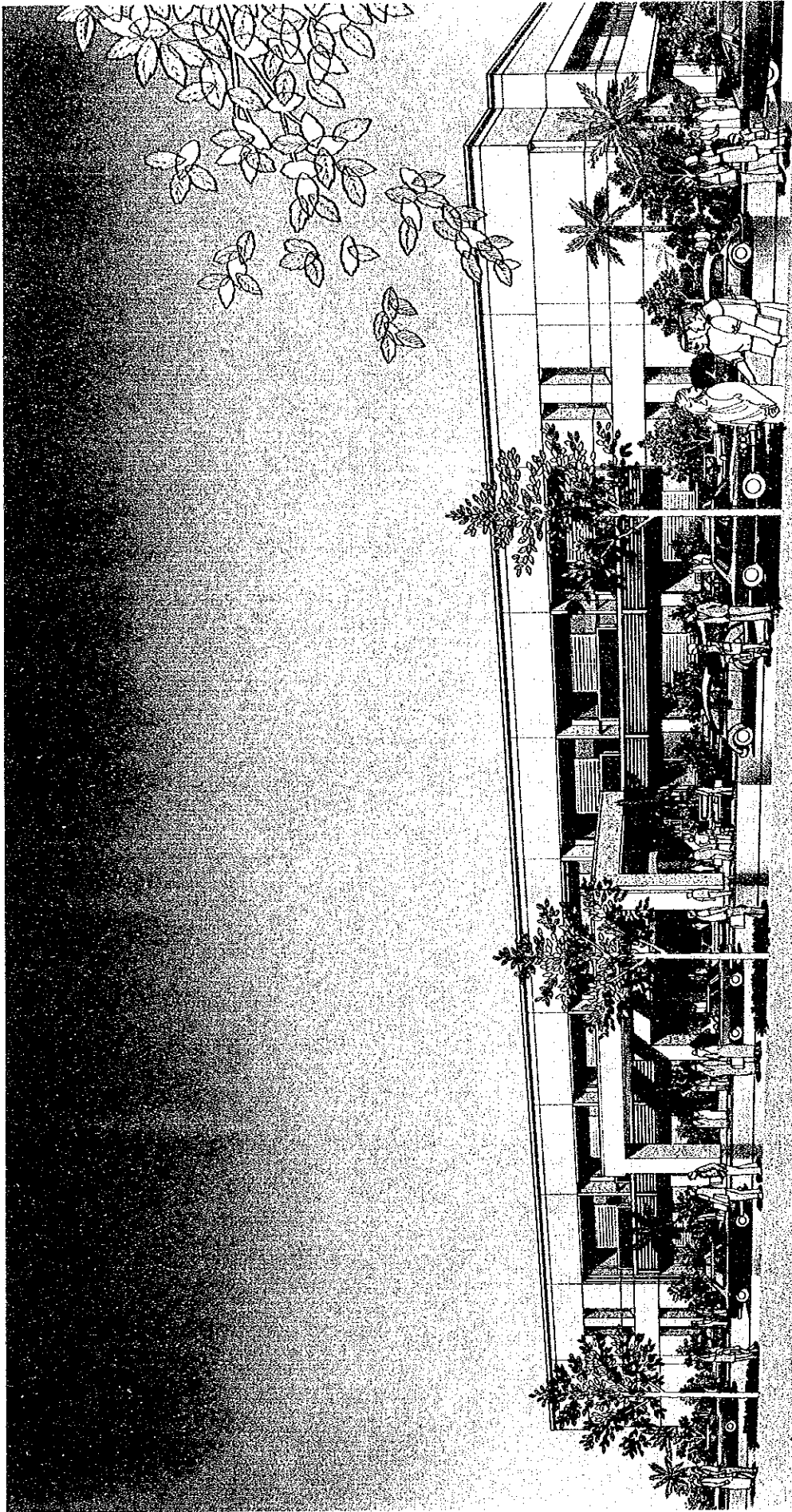
After the team returned to Japan, further studies were made and the present report has been prepared. I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Democratic Republic of the Sudan for their close cooperation extended to the team.

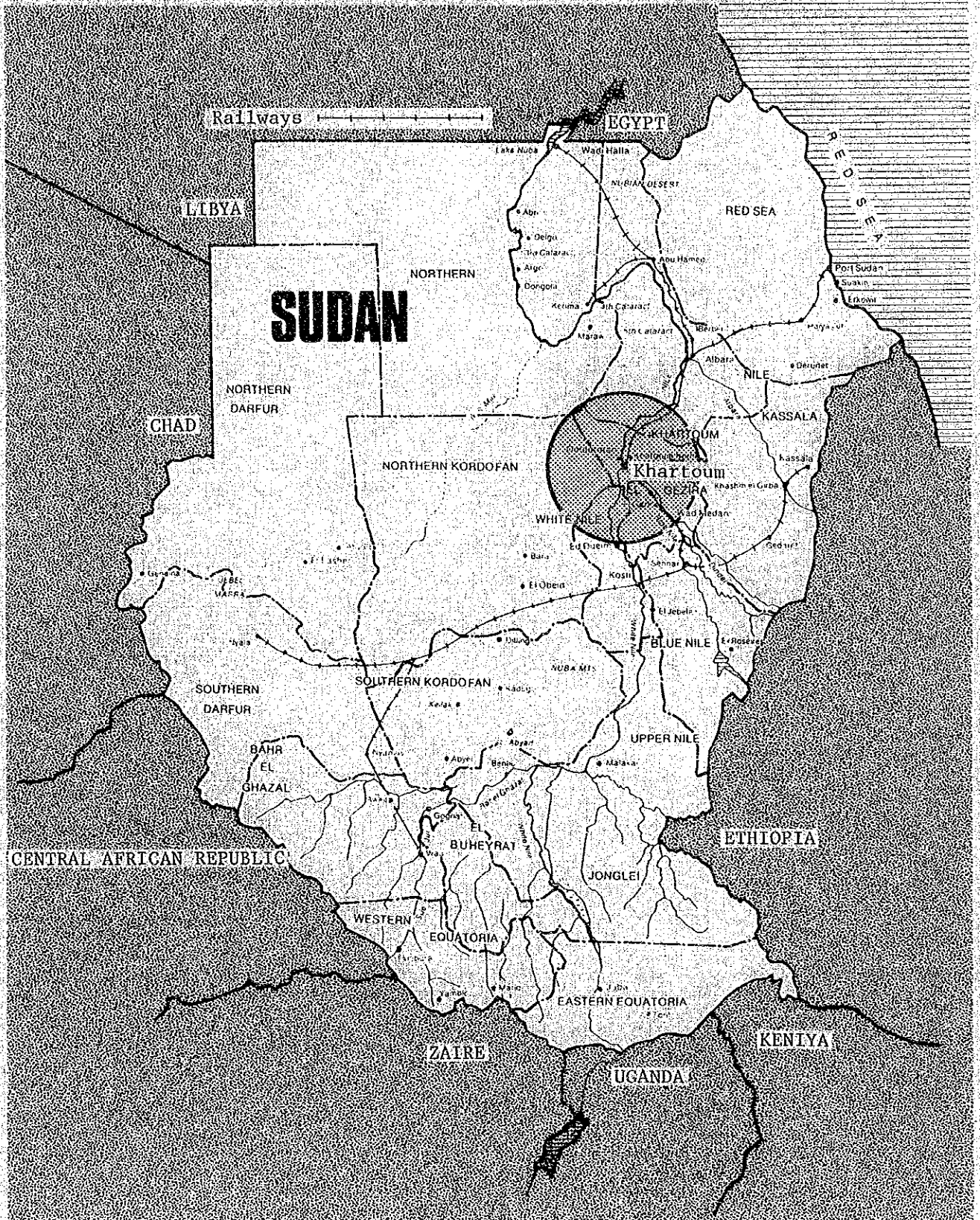
September, 1982



Keisuke Arita
President
Japan International Cooperation Agency



KHARTOUM TRAINING HOSPITAL



MAP OF SUDAN

SUMMARY

The Democratic Republic of the Sudan has planned establishment of the Training Hospital for the purpose to educate specialty doctor, to improve medical service in the country and has made request for cooperation by grant-aid to the Government of Japan. In response to this, the Government of Japan dispatched through Japan International Cooperation Agency, Preliminary Study Team to confirm details of request and to study propriety of the said cooperation in January 1982, and based on the report of said team, the Basic Design Study Team was dispatched in May, 1982.

Medical service in Sudan are planned and executed, concentrating on preventive and clinical medicine by nationwide rigidly organized system under the control of the Ministry of Health. Because of shortage of training facilities for specialty doctors and flow-out of specialty doctors to overseas, the said doctors who should be the nucleus of medical service are in shortage.

Especially in Sudan, diseases belong to Gastroenterology, Ear, Nose and Throat Surgery, and Urology disciplines are very common, training of these specialty doctors is urgent problem.

Preparation in medical faculty of universities is advancing, but because of shortage of high grade training facilities in process from non-specialty doctor to specialty doctor, study abroad is necessary at the present stage.

Improvement of Gastroenterology, ENT and Urology disciplines is the very important factor for medical care in Sudan. Quantities of diseases belong to above mentioned disciplines, clinic effect will be enhanced at the hospital with high grade function.

Necessity to establish the Training Hospital for these three disciplines prior to others is stimulated. As for training system, number of specialty doctors to become instructor will be 14, including 3 months, 6 months and 1 year course, maximum 80

doctors will be assumed to be trained annually, number of doctors to be trained simultaneously in the proposed Hospital will be 37 persons. Operation of the Hospital, medical training and maintenance will be driven wholly by Sudanese side.

The Basic Design Study Team has investigated natural conditions, economical situation, site condition, existing medical facilities and construction circumstances considering the request of facility details submitted by Sudanese side.

Result of analysis, adequate outlines and scopes of the project are as follows and basic layout has been programmed.

- Contents of facilities : Training Hospital for Gastroenterology, ENT and Urology disciplines, with 120 beds.
- Type of building : Reinforced concrete structure, 2-storied, floor area ca. 7,300 M².

As for materials and construction method, local products and method should be used as much as possible.

As for building itself and also for medical equipment, easiness and low cost of maintenance should be taken into account.

Necessity to establish the Training Hospital is quite high, when the Hospital is constructed it will play a role to support substantial improvement of Sudanese medical service successively, resultantly contribute to upgrading public welfare and economic stability in Sudan. By above reasons, the project is considered to be significant, grant-aid by the Government of Japan for establishment of the Training Hospital will be considered to have sufficient relevance.

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CHAPTER 1

INTRODUCTION

1-1 INTRODUCTION

Health and medical service in Sudan is projected and executed and concentrating on preventive and clinical medicine by nationwide rigidly organized system under the control of the Ministry of Health, and education of doctor is urgent problem.

But because of shortage of training facilities for specialty doctors in this country, increase of doctors is liable to retard. Previously, medical study in overseas to acquire qualification as specialty doctors resulting time and economical loss; moreover, as well as technicians in other fields, graduated doctor flows out to other countries such as Saudi Arabia etc., consequently spurs the shortage of doctors. Therefore, Sudan Government has projected construction of Training Hospital to aim at training of specialty doctors, and has made request of cooperation to Japanese Government for necessary fund as grant-aid. In response to this, through Japan International Cooperation Agency, Japanese Government has dispatched Preliminary Study Team in January 1982; and based on the study report, the Government has dispatched Basic Design Study Team in May 1982.

Purpose of the survey is to confirm intention of Sudanese side, and investigate present aspect of Sudanese health, medical situation, social condition and architectural affairs, with propriety of the project, ascertain the effect of grant-aid and to prepare appropriate design of the project.

CHAPTER 2

BACKGROUND OF THE PROJECT

2-1 RECENT ASPECT OF MEDICAL SERVICE

In Sudan, as medical administration region, whole country is divided into 6 regions and Khartoum special province, and in each of these 6 regions 1 provincial mother hospital with 300 to 500 beds are placed respectively. These hospitals accommodate full clinical disciplines and each is directed by highly trained specialty doctors. In Khartoum special province, 4 large scale general hospitals are placed, their capacities reach ca. 2,500 beds in total.

And also in this province, 9 mono-discipline specialty hospitals are installed; i.e. ophthalmic, obstetrics and gynecology, tropical, chest surgery, respiratory, mental, pediatric, pediatric surgery and radiology hospitals. Situation in these hospitals, occupancy of bed exceeds 100%; (e.g. admits 2 patients on 1 bed or on floors and corridors), and average period of stay is 7 to 11 days (38 days in Japan). And at examination process, priority is offered to an inspections which can diagnose decisively to patient's disease.

In each region, regional hospitals are placed under provincial hospital, with 100 to 300 beds capacity, where surgery, internal and obstetrics and gynecology disciplines are accommodated.

As more lower organization than the regional hospital, 2 or 3 district hospitals per 1 regional one are arranged and around them numbers of health centre, dispensary and primary health care unit are located; groups which are termed primary health care complex should be formed.

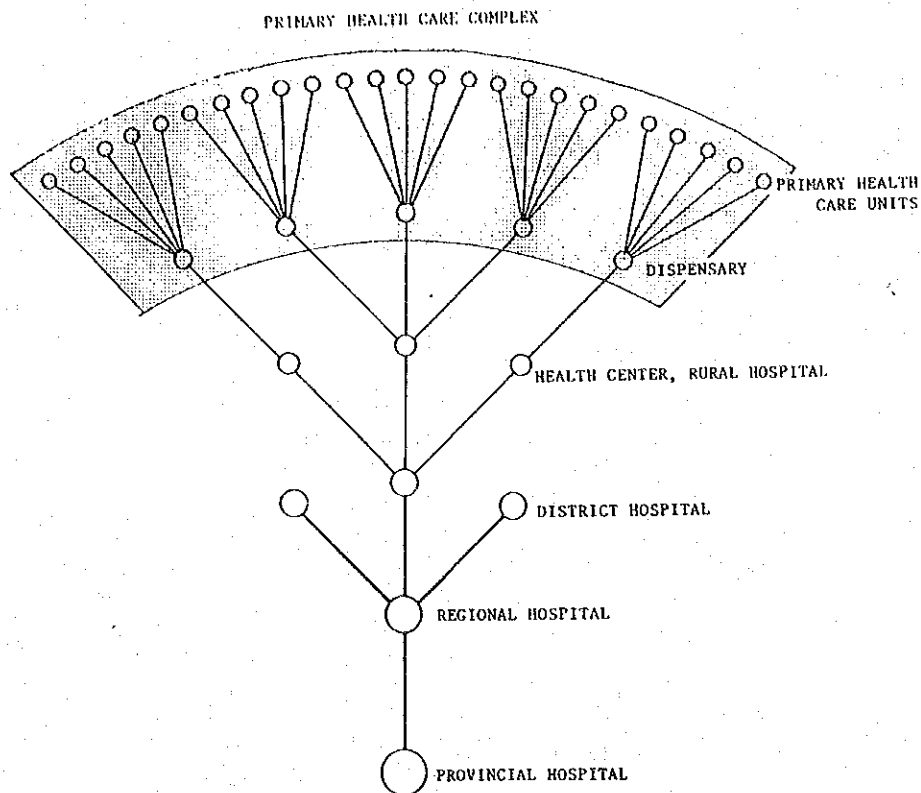


Fig. 2-1 Medical Composition Diagram in Sudan

Population, number of doctors, hospitals and beds in each province are as follows.

NAME OF PROVINCE	POPULATION (1,000 pers)	DOCTORS	HOSPITALS	BEDS
KHARTOUM	1,703	1,267	22	3,528
GEZIRA	5,022	151	20	2,078
WHITE NILE		54	9	863
BLUE NILE		67	13	1,188
Nile		65	10	955
NORTHERN	1,013	29	11	628
KASSALA	1,408	107	9	1,354
RED SEA	581	88	5	654
N. KORDOFAN	2,441	78	8	1,051
S. KORDOFAN		25	8	606
N. DAFUR	2,699	34	6	578
S. DAFUR		30	6	427
EQUATORIA	880	127	11	1,266
BAHR EL GHAZAL	1,610		10	1,077
UPPER NILE	927		10	952
TOTAL	18,284	2,122	158	17,205

Table 2-1 (Source: Statistics by the Ministry of Health, 1981)

Comparison of Sudanese medical situation with those of foreign countries is shown in following table, yet poor situation is observed.

NAME OF COUNTRY	DOCTORS*	BEDS*	HOSPITALS*
AFRICA			
LIBYA	111.3	510.2	2.28
EGYPT	91.6	203.9	4.00
SUDAN	11.5	99.9	0.88

ZAIRE	6.2	284.0	15.80
UGANDA	3.6	148.0	3.40
CENTRAL AFRICA	3.5	99.4	2.00
CHAD	2.4	84.7	0.78
ETHIOPIA	1.4	30.2	0.29
ASIA			
JAPAN	118.3	1,070.0	7.50
KOREA	47.9	145.0	15.20
CHINA	38.4	199.0	6.90
INDIA	27.4	72.8	0.94
EUROPE			
WEST GERMANY	204.0	1,177.5	5.60
SWITZERLAND	201.0	1,144.9	7.50
EAST GERMANY	189.5	1,065.0	3.40
SPAIN	179.6	534.8	3.50
SWEDEN	177.5	1,490.0	8.70
FRANCE	163.2	1,055.0	6.70
ENGLAND	151.7	785.4	4.60

* Number per 100,000 population

Table 2-2 World Medical Situation
 (Source: WHO Annual Report, 1980,
 but values are as of 1977)

2-2 COMPOSITION OF DISEASES

Based on the statistics issued by the Ministry of Health in 1978, composition of diseases in Sudan can be analyzed as follows.

- Typhoid, amoebic dysentery, food poisoning, and diarrhea etc. of Digestive tract diseases. : 20,612 cases
- Diphtheria, acute tonsillitis, asthma, and other respiratory trouble etc. of ENT Surgery diseases. : 10,241 cases
- Kidney, ureter trouble and protatomegaly etc. of Urology diseases. : 9,471 cases

Particular increase of Gastroenterology diseases is remarkable as following Table.

	1970	1980
Duodenal ulcer	1,672	4,258
Cholelithiasis	4,237	10,445
Digestive cancer	2,341	7,735

Table 2-3 Transition of Causes of Digestive Tract Diseases
(Source: Statistics by the Ministry of Health)

Besides, diseases of ENT Surgery and Urology system which are considered to outbreak by an influence of sandstorm or by ingredient of drinking water have an aspect of endemic disease and holding high ratio in numbers.

Diffusion of preventive medicine is not sufficient for these 3 disciplines such as Gastroenterology, ENT Surgery and Urology, and inspections with apparatus and remedy techniques are required particularly at treatment, and also frequent operation occasion than other clinical disciplines are assumed, hence superior training as specialty doctor is necessary.

Training for specialty doctors of these 3 disciplines is urgent programme for improvement of Sudanese medical service.

2-3 RECENT ASPECT ON EDUCATION, TRAINING OF DOCTORS

Sudanese characteristic regard to classification of doctor is different from Japan, strict classification followed to practical experience and examination for qualification are applied.

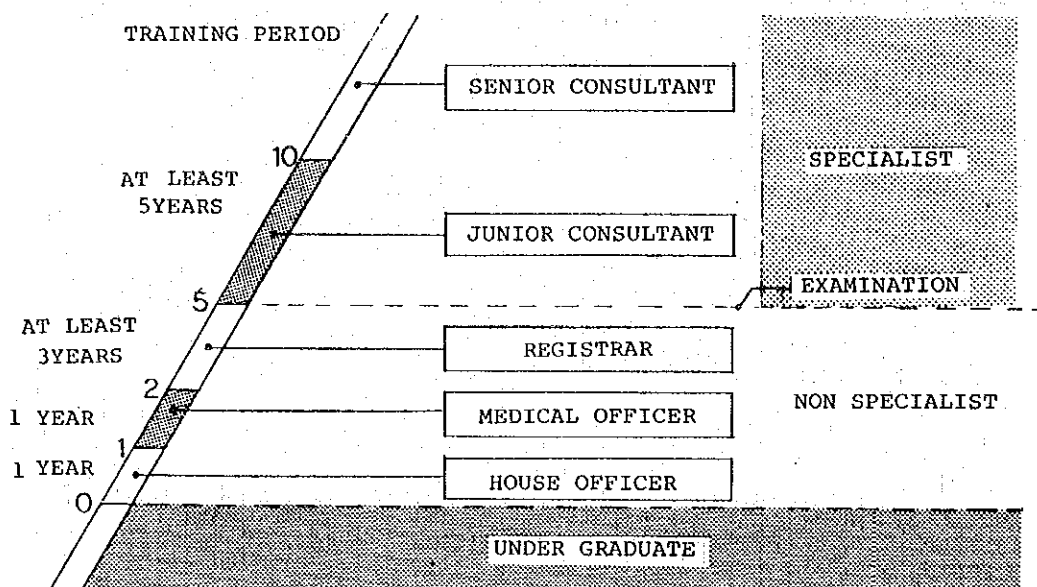


Fig. 2-2 Classification of Sudanese Doctor

Specialists are 437 persons in total number of 2,122 doctors (as of 1980), doctors who are qualified as specialist at present have acquired superior knowledges and techniques by studying abroad.

Some of superior specialty doctors of Sudan studied in West Germany or Japan for the purpose to study specific technique, especially endoscope techniques is at high level of research.

In Sudan, since all education costs are provided by national expenses, doctors and other medical technicians are being educated without personal expenses.

Medical faculty of university is in charge of academic lecture and guidance, whereas 70% of clinical education is provided at teaching hospitals which are isolated from the university, specialty doctors from the Ministry of Health are in charge of the education.

At training hospital, different from teaching hospital, main object is not to train medical students but to train leading doctors who have several year experiences. Recent number of students in medical faculty of university are as follows.

Name of university	Established year	Annual number of student
Khartoum univ.	1924	200
Gezira univ.	1978	40
Juba univ.	1976	40

Table 2-4 Synopsis of Student Number in Medical Faculty of Sudanese Univ.
(Source: Statistics by the Ministry of Health)

Besides, scheduled openings of medical faculty are as follows, but date and student numbers are not yet fixed.

- Kordofan Univ.
- Darfur Univ.
- Khartoum branch school of Cairo Univ.

Preparations for medical faculty are being expedited. As regard to training of House-officer at directly after the graduation from medical faculty or Medical-officer after 1 year from graduation, its training programmes are an extension of basic stage, hence training at other domestic hospitals is possible.

During the process from Registrar to specialist, as superior training facilities are insufficient domestically, study abroad is necessary, when a training facilities with superior functions is established in the country, specialist training will be operated efficiently, resulting increase of specialty doctors and improvement of medical service can be expected.

CHAPTER 3

OUTLINE OF THE PROJECT

3-1 THE NECESSITY OF TRAINING HOSPITAL ESTABLISHMENT

As obvious by the study of recent aspect on medical service and education or training of doctor, repletion of 3 disciplines such as Gastroenterology, ENT and Urology are an urgent problem in Sudan. And various diseases which exist in the range of these 3 disciplines are abound in quantity, its diagnosis depends largely on high grade and complex medical equipment, effect of diagnosis will solely be expected at the proposed hospital.

On the other hand, through the medical practice, training of specialty doctors on each discipline will be repleted.

As described in items of disease composition, diseases of these 3 disciplines reach ca. 40,000 cases annually. Assuming the number of beds as 120, with ca. 10 days of period of stay and 100% of bed occupancy rate, capacity of handling of ca. 4,000 inpatients will be realized, when the Training Hospital is completed, at least 10% of 40,000 cases can be treated in this Hospital. For specialty doctor training of these 3 disciplines, establishment of Training Hospital is highly required. Besides, principal trainees in this Training Hospital are doctors who have been sifted by examination with several year experiences after graduation from medical faculty of university. To train them for specialty doctor, the Training Hospital should accommodate high function training facilities to achieve equal effect as those of studied abroad.

3-2 POSITION OF TRAINING HOSPITAL

3 disciplines special training hospital of Gastroenterology, ENT Surgery and Urology is located as following diagram in Sudanese medical system, e.g. a patient who has been detected at primary health care unit stage and need higher grade inspection and treatment, is shifted to higher stage rural hospital, but in case of the type of disease is too complex, the patient is to be transferred to district hospital or to regional hospital. The Training Hospital will situate at summit of system and handle solely the patient whose inspection or treatment is impossible at any other facilities.

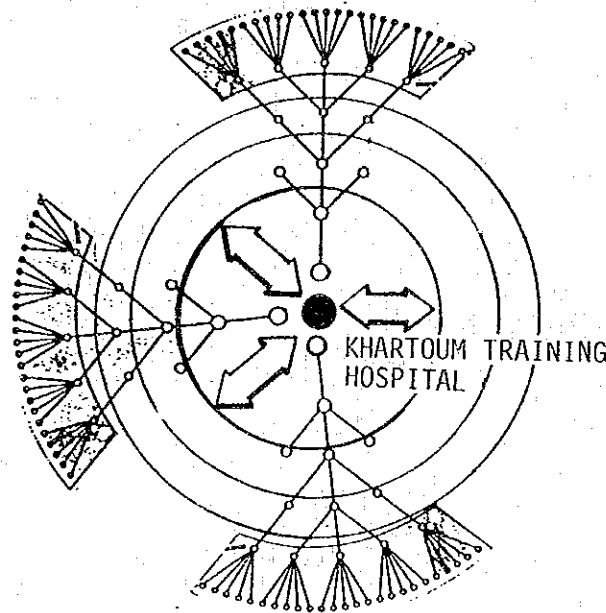


Fig. 3-1 Position of Khartoum Training Hospital

3-3 TRAINING AND OPERATION SYSTEM

Number of trainees and training period of classified course in the Training Hospital will be planned as following table, instructors will be 14 in total, 4 for Gastroenterology, 6 for ENT and 4 for Urology.

Course	Month	1	2	3	4	5	6	7	8	9	10	11	12	No. of Trainees
	House Officer		13			13			13			13		
Medical Officer		11												11
Registrar	GAST.	2						2						4
	ENT	3												3
	URO	2						2						4
Junior Consultant		6												6
Number of Trainees		37						Number of Trainees (Annually)						80

Table 3-1 Training Schedule

Annually acceptable trainees to the Hospital will be 80 persons in total. But all of the doctors who finished House-officer course are not always be adopted to Medical-officer course of the Hospital, some of them are to be trained in other facilities. As regard to Registrar or Junior Consultant, they must receive high grade training at high qualified facilities like this Hospital, and at practical study, training should need backed up by House-officers or Medical officers.

The number of trainees per instructor is 2.6 ($37/14 \div 2.6$), and just for Registrar and Junior Consultant, it will become 1.2, so the number of instructors will be sufficient.

As 120 beds are required to this Training Hospital, average 3.2 beds will be taken care by 1 trainee ($120/37 \div 3.2$). In Sudan, as mean period of stay at general ward is about 10 days, average 10 beds (3.2×3) during 1 month will be taken care by 1 trainee. In case of House officer, training period will be 3 months, so

he can receive clinical training to ca. $10 \times 3 = 30$ in-patients. These experiences will be sufficient to doctors of House officer rank.

Doctors in each rank will be dispatched to local hospital after they have finished trainings in this Training Hospital and return to this Hospital again. Trainings will be repeated by this rotation, they will gradually be promoted to specialty doctors. Previously, after graduation from domestic medical faculty of university and study abroad, then the doctor successively flowed out to other countries.

However when the Training Hospital is established, flow-out of the trainee will be banned and duties during definite period in region where medical service is in low level, will be obligated.

Operation system when the training hospital is established, is indicated in following organization chart.

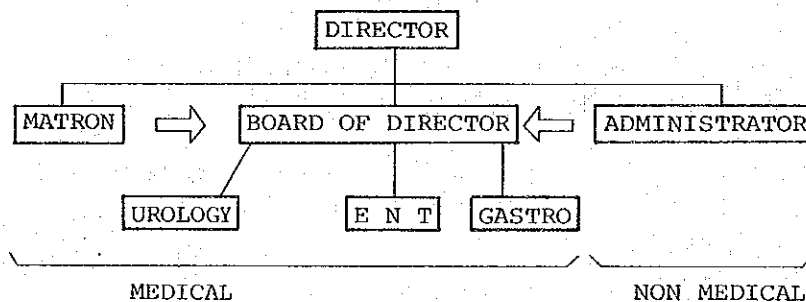


Fig. 3-2 Organization chart of Khartoum Training Hospital

Because specialty doctors who possess knowledges and techniques for training instruction, are ensured sufficiently, and preparation of school for specific personnel such as nurse, technicians and clinical assistant is advanced, so the hospital will be smoothly operated by Sudanese manpower.

For example, the number of nurses are 12,970 as of 1980, i.e. 0.75 person/bed (12,970/17,205 beds).

Compare with those of Japan; i.e. 487,169 nurses as of 1980, 0.37 person/bed (487,169/1,319,406 beds), as to the number, the former exceeds about twice to that of the latter, hence these personnel is in abundance compare with doctors.

CHAPTER 4

SITE CONDITIONS

4-1 PROPOSED CONSTRUCTION SITE

4-1-1 Location and Environmental Conditions

Proposed site situates in new extension district, southern part of Khartoum City. At surrounding area, foreign embassies, 5 to 7 storied apartment and office buildings of foreign firm are existing.

With availability to access within 10 minutes by car from city centre, no locational problems are observed for the Hospital construction. Although no public transportation facilities is available at present, when the Hospital is established, opening of municipal bus route will be anticipated same as the case at other hospitals. Traffic measures in Khartoum City are mainly by bus, taxi and private car, roads are paved generally. The site has been designated as high storied building district in city planning, therefore altitude utilization should be desirable. The site is surrounded by roads with residential area at south and west side, post office, mosque and high storied apartment at north side, girl's high school at east side. As the site is located in new extension district, no future project for road alteration or widening are planned.

4-1-2 Configuration of the Site

Site survey map has been prepared by brief survey. Though the site is flat but lower than surrounding road, filling is necessary. Along north and west road, roadside trees has been planted at 10M spacing, but no trees exist in the site.

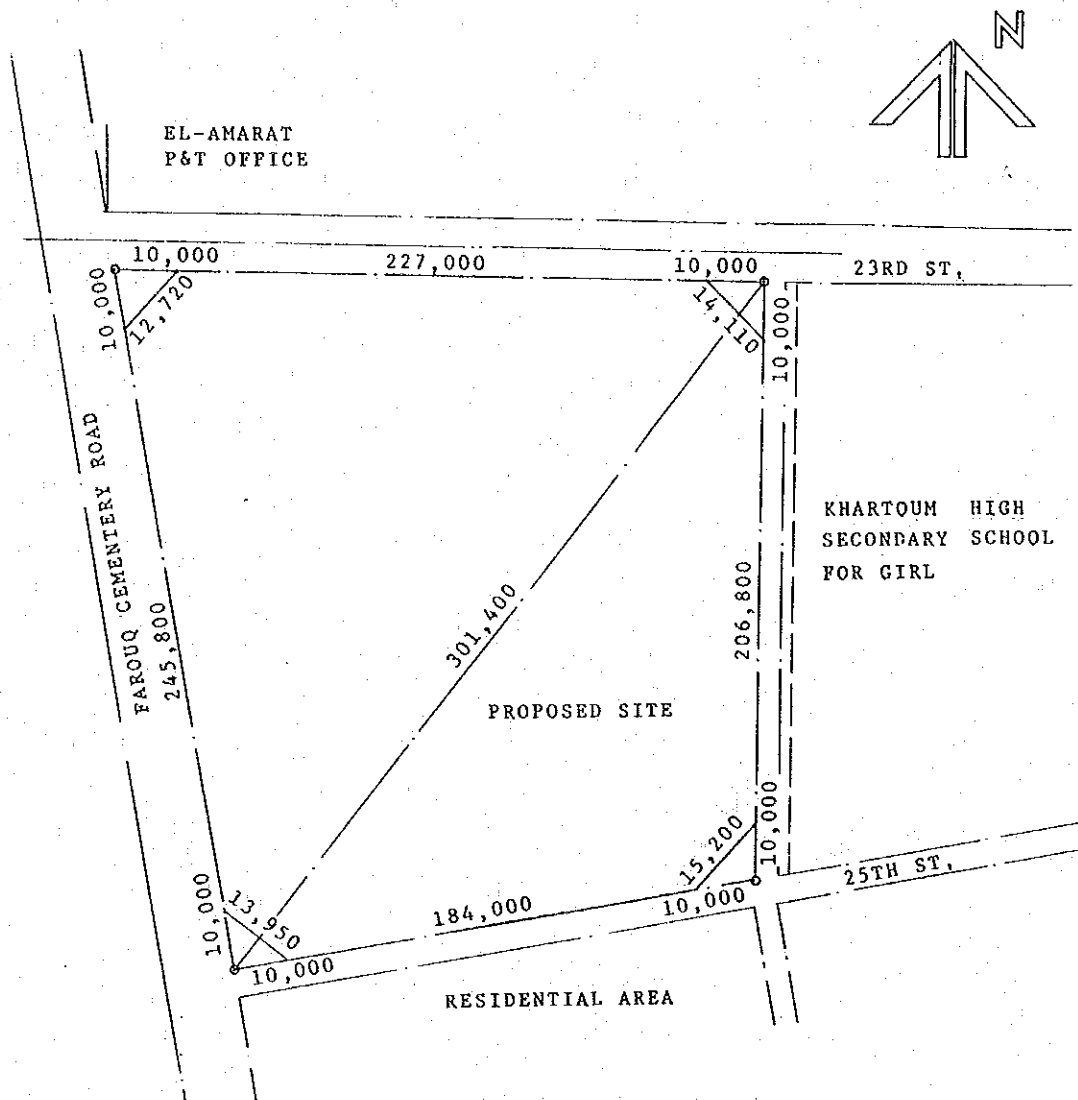


Fig. 4-1 Survey Map of Proposed Site

4-2 NATURAL CONDITIONS

The Democratic Republic of the Sudan situates at northeast of African Continent ranging from 4° to 22° of north latitude, and from 24° to 38° of east longitude, with 2.5 million sq.km of area; i.e. ca. 7 times of Japan. Climatic situation ranges to various climatic zones such as desert climate at north, savanna climate at south and tropical-rainforest climate.

Most part of the land lies in Nile River basin, White Nile which bound north from Lake Victoria in Uganda, flows through southern district of Sudan, and joins at Khartoum with Blue Nile which flows from Lake Tana in Ethiopia.

Khartoum situates at 15° of north latitude and 32° of east longitude, average temperature is ca. 24°C in winter and ca. 35°C in summer, maximum temperature in summer season exceeds 47°C . Average humidity shows between 18% in April and 55% in August. Rainfall concentrates in summer but annual precipitation reaches only ca. 160 m/m, and it can be considered as high temperature and low humidity climate. Wind direction is always north or south, sand storm frequently occurs from May to August.

4-3 INFRASTRUCTURE

4-3-1 Electric Power

Power will be conveyed from existing substation at south-east corner in the site to the building by underground cable of 11kV. The substation is supplying 415V/240V power to the building in the vicinity, hence overhead wiring exists along east side road of the site. Power circumstances in Sudan is poor, failure of supply occurs frequently throughout the year and in some occasion it remains long hours in Summer; e.g. residences and general shops accommodating small generator to cope with such failure of supply.

At construction work of the project, emergency generator must be provided for security of working power.

4-3-2 Water Supply and Sewerage

City water main (100 m/m i.d.) is laid under south side road, draw in of water supply is possible. Water pressure in main pipe is ca. 1kg/cm^2 , but drops in Summer season.

Water appears sometimes brownish or turbid by floating particles but almost no failure of supply is observed.

As for sewer line, main pipes (175 m/m i.d. for soil and waste water drain) are installed under south, north and east roads. Direct discharge of sewage is possible.

The quantity of soil and waste drain of the proposed hospital is ca. $42\text{m}^3/\text{day}$. Considering this quantity, size of above said pipe is large enough. But it is necessary for Sudanese side to consider about the quantities of drain from the surroundings and also from the future plannings of the hospital facilities. As for storm drain, draining gutter (1m W. x 1m D.) is installed along the southside road, direct discharge is also possible.

4-3-3 Telephone and Gas Service

Main line of telephone service to the said district is existing, so conveying to the site is possible. No city gas is available, butane gas cylinder should be used for heat source. 2 Gas firms are engaging in business in Khartoum City, bus supply conditions are not uniform. The calorific value of butane gas in Sudan is about 21,000 BTU/lb. (ca. 11,700 kcal/kg).

4-4 CONSTRUCTION CIRCUMSTANCES

4-4-1 General Circumstances for Construction

Structural analysis of buildings in Khartoum; capital of Sudan, reveals that majority of residences and shops etc. are of brick masonry; principal public building and medium or high storied buildings are of reinforced concrete structures. Due to no seismic influence is observed in the country, all walls are built by brick masonry, for columns, beams, girders and slabs are of reinforced concrete.

Medium or minor scale buildings which are built by local contractors yet reveals insufficient in the aspect of working accuracy and schedule control, whereas almost all of large scale buildings are being built by alien contractor, keeping construction machine and temporary materials abundantly, and with smooth material transportation, hence fairly high grade buildings are being built at present aspect.

As regard to construction materials, in the case of large scale construction works, applicable local materials in view of production capacity and quality are limited to gravel, sand, brick, terrazzo block and paint. Other materials such as cement, reinforcing bar etc. must depend on imported supply.

As for labor situation, labor power for simple work is abundant, but skilled laborer such as carpenter and reinforcing bar placer are remarkably scarce because of flow-out to Middle East countries.

During the Ramadan (ca. 1 month in Summer season), labor hours for respective laborer reduces 20% or so.

Rainy season extends July to August, monthly precipitation is ca. 40 to 70 m/m, but almost no influence is observed upon the construction schedule.

4-4-2 Codes and Standards

As codes and standards for architecture, Regulation of Building is being executed but any are not enacted yet to electrical, airconditioning and plumbing categories. Almost all buildings are constructed by application of British Standards and Criteria.

As for construction work, various applications such that confirmations for building, site boundary and water or electric conveyance is necessary, the Ministry of Health will act on such procedure in the project.

At basic and detail design, Japanese Codes and Standards will be applied as basis, and local circumstances will also be added as basic policy.

CHAPTER 5

BASIC DESIGN

5-1 BASIC DESIGN POLICY

The basic design has been prepared in accordance with the Preliminary Study Report prepared in February 1982 and with result of discussions and field surveys by Basic Design Study Team, dispatched in May 1982.

The report has been compiled by said study team after returning to Japan.

The design concept of the Hospital is based on the following basic design policies.

- (1) As for detail of facilities which are requested from Sudanese side, reconfirming its function and the building layout should be programmed so as not to impede future extension in the site.
- (2) Technical substance to cope with highly advancing and diversification of medical service should be provided, the building must keep such function as Training Hospital for long period.
- (3) Although layout should be programmed mainly for the function of medical training, needless to say, delicate considerations for patients should be taken within corresponding scope.
- (4) Environmental condition such as climate, natural feature, living and domestic situation of construction should fully be considered, with building type, material and process to fit local conditions, the building should be of easy maintenance.
- (5) The building should harmonize with surrounding conditions and also by creating superior environment, the Training Hospital would become beloved building by Sudanese people.

5-2 DETAILS OF FACILITIES

Requests as regard to facility element which have been offered from Sudanese side at the meeting of basic design study are comprehended in its opinion, taking various conditions into consideration; as a result of review in Japan, following items will be proposed for optimum facility element of the Training Hospital.

Table 5-1 Synopsis of Facility Elements
Classified by Department

Departments	Facility Elements
Medical Department	
Gastroenterology Section	Examination RM, Treatment RM, Endoscopy RM, ERCP RM, Preparation RM, Office RM
ENT Section	Examination RM, Treatment RM, Equilibrium RM, Audiometry RM, Phoniatic RM, Ear Mould Labo, Dry-Temporal Bone Labo
Urology Section	Examination RM, Treatment RM, Cystoscopy RM, Preparation RM, Kidney Dialysis RM, Rube Peritoneum RM, Observation RM, Urodynamics RM.
Diagnostic X-Ray Section	X-Ray RM, Office RM, Dark RM, Control RM, Staff RM
Laboratory Section	General Lab. Biochemistry Lab. Haematology Lab. Histology Lab. Bacteriology Lab. Parastitorogy Lab. Cyringe RM, Office RM, Bleeding RM, Blood Store.
Physiological Examination Section	USW Testing RM, ECG Testing RM
Pharmacy	Preparation RM, Drug Store, Office RM
Recording and Statistics Section	Medical Record RM, Office
Training Unit Department	Lecture RM, Library, Text Preparation RM, Dark RM, Director's Office RM, Office RM, Secretary's RM, Board RM, Cafeteria,
Operating Theatre Department	Operation RM, Anesthetic RM, Sterile Store, Changing RM, Recording RM, Recovery RM, I.C.U., Nurse Station, Central Supply,
Administrative Department	Accountant Office, Cashier RM, Chief Administrator's RM, Matron's RM, Secretary's RM, Office RM
Service Department	Kitchen, Laundry, Mechanical RM, Electrical RM, Telephone Exchange RM, Emergency Generator RM
Ward Department	6-Bed RM, 2-Bed RM, Nurse Station, Treatment RM, Linen Closet, Doctor's RM, Toilet, Shower RM, Filth-Treating RM
Others	Corridor, Staircase, Lift, Rampway, Pantry, Toilet,

5-3 SITE PLANNING

The building which is required by Sudanese side for the project will be Training Hospital.

But because of the proposed site situates near city centre and the land is evaluated high with its complete surrounding basic facilities and also site area covers ca. 4.5 ha with sufficient allowance for the mere hospital construction project, hence the projected hospital will be as compacted type as possible, providing anticipated construction area for hospital annex elements such as medical facilities, nurse dormitory or staff quarters which may be constructed by Sudanese side in future.

Compacted type will be also evaluated for improvement of function and flow-line reduction of the building itself.

Four sides of the construction site abut on respective road, west and north side road are wide, easy access from city centre and east and south side front on girls high school and residential quarter. Hence, main entrance of the hospital with heavy traffic is considered appropriate to locate at west side. Northeast of the site is assumed for future annex medical facilities, and south portion is reserved for future nurse dormitory and staff quarters, thus harmony with environmental conditions are considered.

Hospital will be located at northwest, with adequate arrangement of forecourt, parking area and service yard, and by traffic separation of pedestrian and vehicle, function is enhanced by landscape architecture with abundant planting in the premises; hospital of intimate atmosphere should be considered.

Wind direction of this area is always north or south, so building layout should be projected rectangular of east-to-west axis so as to allow easy natural ventilation.

5-4 ARCHITECTURAL PLANNING

5-4-1 Plan

Entrance hall is arranged at centre of westside mainly for out-patient. Considering daily utilization, out-patient examination rooms for Gastroenterology, ENT and Urology, receptions for new patient and pharmacy are arranged near to entrance hall.

Breadth of corridor in front of examination room is 2.7M providing sufficient waiting area for out-patient and also view of courtyard greens can be enjoyed from every waiting area. Successive to examination section, diagnostic x-ray section, physiological examination section, dialysis rooms and laboratory section are arranged, so as to meet frequency of out-patient.

Entrance for staff is arranged at south side, smooth liaison with training, operation and ward departments on the first floor will be performed by means of lift. Service entrance is arranged at southeast corner in sequence so as to handle raw materials by grade of species. Kitchen and laundry are located closely to lift and rampway.

At operation section on the first floor, clean and semi-clean zones are separated clearly, compact layout is pursued. Operation theatre rooms are three, one is wider than others providing united use with other room simultaneously to comply with progress of medical treatment such as internal transplantation etc.

All wards should be arranged on east-west axis, exposed corridor or eaves are planned at south and north side to protect from strong sunshine; large window provides natural ventilation by south or north wind. Due to the wards are located on the first floor, patients will be able to receive remedies at calm atmosphere isolated from noise of out-patient department, and also control of enter and outgoing of visitors will become easy. Administrative department on the ground floor and training department on the first floor are planned at key position of the building, efficient management and effective training can be possible.

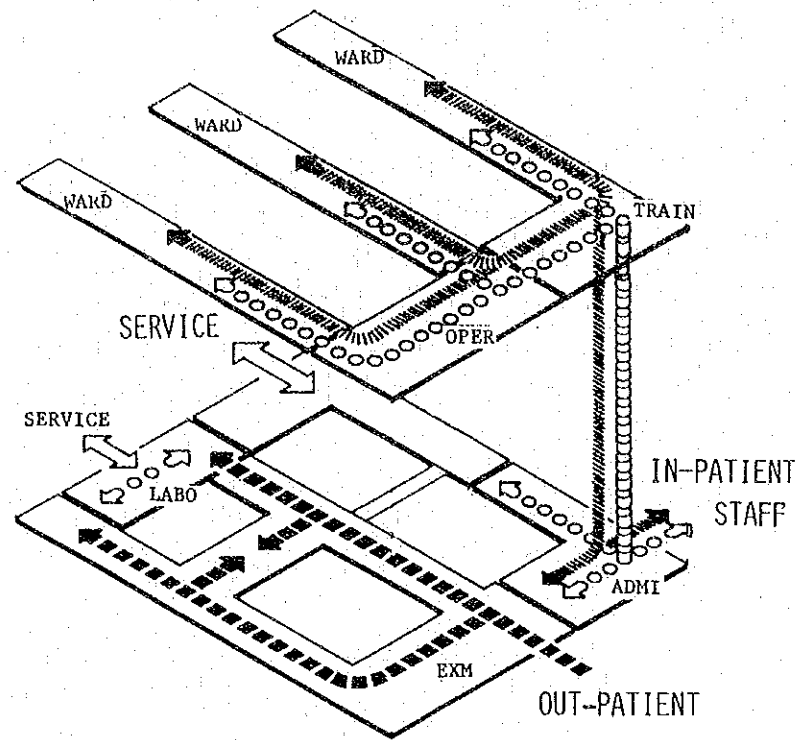


Fig. 5-2 Flow of Functions

Functions should be most preference consideration at hospital building, they are illustrated in Fig. 5-2. Any function which can not displayed in the diagram is numbered in priority order to each element and composed referencing with other conditions. Although this hospital is for doctor training, at planning the floor layout, it should be programmed by thinking mainly about the in-patient and out-patient. At column spacing, 6.0M of Japanese standard span for hospital building is adopted. Considering installation of medical equipment, natural and ceiling fan ventilation, floor height is determined 4.0M for both ground and first floor.

5-4-2 Programmes for Materials

(1) Structural Materials

As for structure, locally adopted combination of reinforced concrete frame with brick walls is applied as standard. Gravels, sands and bricks of local product should be procured.

(2) Finishing Materials

Through the investigation of finishing materials at existing medical facilities in Sudan, when functional adequacy is observed, materials of local product will be used as much as possible. Above stated materials (L) and proposed finishing materials (P) in the project are compared and studied by classification for hospital disciplines and building elements. Any materials which are judged necessary for functional improvement of the hospital, imported materials will be applied within the range to need no large increase of construction cost.

Departments	Main interior finish			
	Element	Floor	Wall	Ceiling
Out-patient	L	Plastic tile	Painting on cement Mortar Steel Trowel Finish	Painting on exposed Concrete
	P	Ditto	Ditto	Ditto
Training	L	Ditto	Ditto	Ditto
	P	Ditto	Ditto	Ditto
Operation	L	Ditto	Mosaic tile	Painting on Plaster board
	P	Terrazzo	Steel panel	Rock-wool sound absorbing board
Ward	L	Plastic	Painting on Cement Mortar Steel Trowel Finish	Painting on exposed Concrete
	P	Ditto	Ditto	Ditto
Corridor and hall	L	Terrazzo	Ditto	Ditto
	P	Ditto	Ditto	Ditto

Table 5-2 Comparison of Interior Finish Materials

Main exterior finish			
Element	Exterior wall	Roof	Fittings
L	Painting on Cement Mortar Steel Trowel Finish	Asphalt water proofing "FLINT KOTE" process	Steel sash
P	Ditto	Ditto	Aluminum sash

Table 5-3 Comparison of Exterior Finish Materials

In operation room, when floor is finished by plastic tile, indented troubles may appear in future at moving of heavy equipment, floor will be finished by terrazzo blocks, walls will be of nonstaining steel panel, rock-wool sound absorbing board is programmed to apply on ceiling. For exterior windows, aluminum sash is mainly programmed for durability and dust proofing purpose.

5-5 STRUCTURAL PLANNING

Land of Sudan is isolated from any principal seismic zone of the world, no seismic record is observed in the past. For wind pressure, 70 mile/hr (31,1M/sec) of wind velocity will be assumed sufficient for structural analysis. As horizontal force is small, no specific structural consideration for horizontal force is necessary. Hence, pure rahmen structure of reinforced concrete is adequate for the building. As all of the projected structures are low storied building, (2-storied and 1 story partially), direct foundation will be sufficient.

According to the soil investigation on proposed site, the bearing capacity of supporting ground can be analyzed as follows.

Top soil measures ca. 2.0M depth from ground surface, composed by sandy clay with limestone concretions, beneath it 1.0M thick compacted silty fine sand with limestone concretions layer situates and succeeding to full compacted silty fine sand layer with sandwiched hard clayey silt.

In case of 2-storied reinforced concrete structure, upper sandy clay layer of ca. 1.0M depth from ground surface will be adequate for supporting ground. From the result of laboratory test and "N" value of SPT, $20\text{t/m}^2 \sim 30\text{t/m}^2$ can be taken for the bearing capacity of supporting ground. By considering the safety factor, 20t/m^2 of bearing capacity will be adopted for design. Boring data of proposed site are shown in APPENDIX as for reference.

Considering expansion or contraction of concrete to thermal fluctuation of the building and differential settlement of ground, expansion joint should be planned at distance of 50M or less along with the lengthwise direction of the building.

The external force and working load on the buildings are set up as follows.

1. Seismic force: $K = 0$
2. Wind velocity: 35 M/sec

3. Live load: follow Japanese Building Code
4. Bearing capacity of soil: 20 t/m^2
5. Supporting ground: designed GL-1.5 M or deeper sandy clay layer.

Structural materials

1. Concrete: $F_c = 210 \text{ kg/cm}^2$
(Compressive strength at 28 days)
2. Reinforcing bar: SD 35 (over 19 m/m d.)
SD 30 (under 16 m/m d.)
3. Steel: SS 41

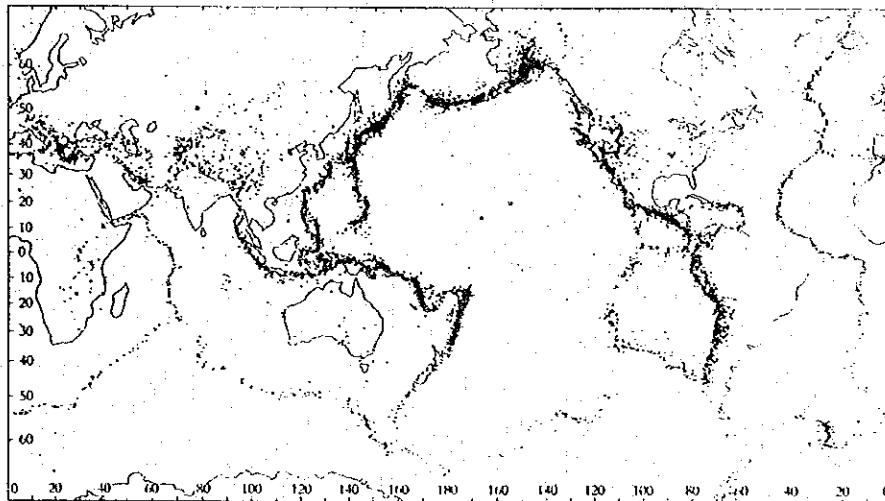


Fig. 5-3 Seismic distribution of the world

5-6 SERVICE PLANNING

5-6-1 Applicable Standards for Equipment and Materials

Japanese standard shall be applied, except those of local procured substances or those of Japanese standard application is considered improper to local situation.

5-6-2 Electrical Works

(1) Power Supply System

(1)-1 Receiving and Transforming System

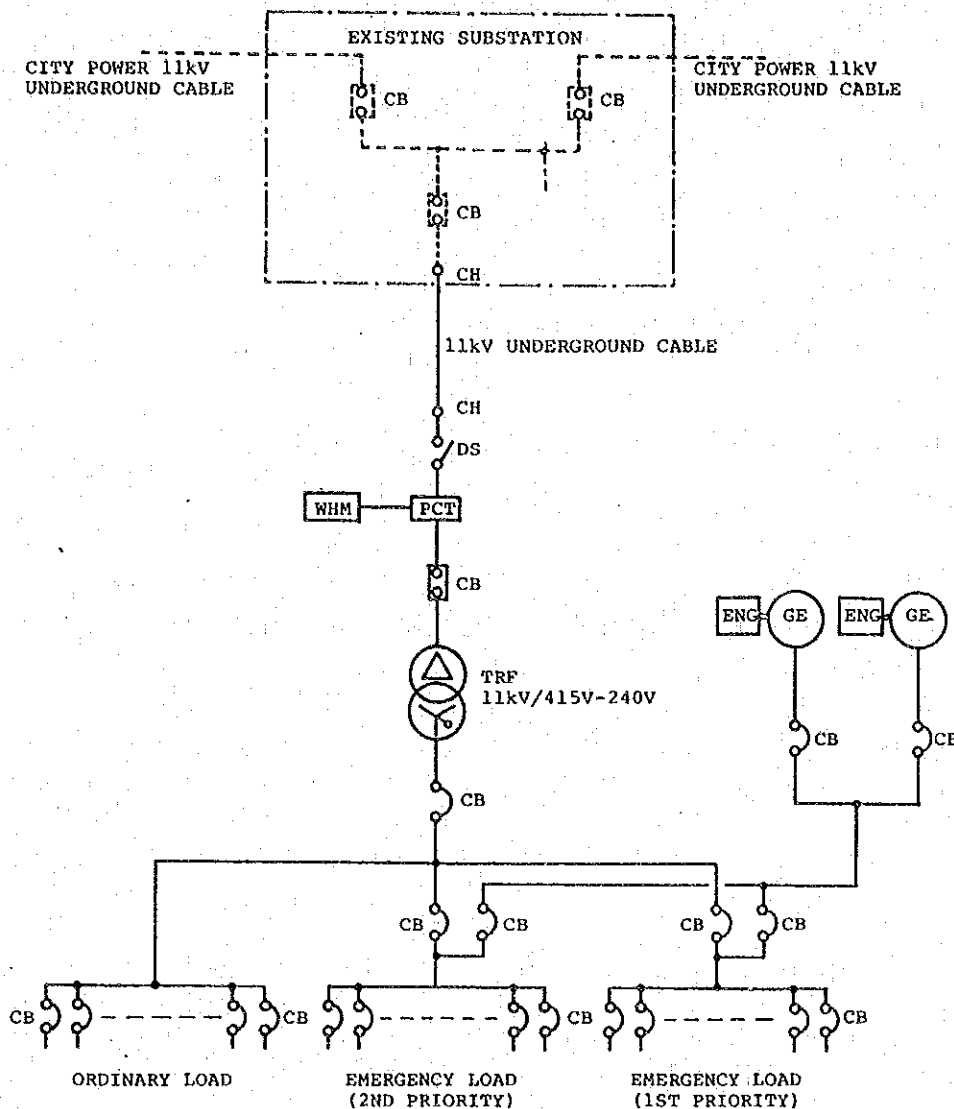
11 kV (3 phase, 3 wire, 50 Hz) electric power will be laid by underground cable from existing substation in the site to substation in the projected hospital and transformed to 415 V - 240 V (3 phase, 4 wire, 50 Hz) then distributed to each branch circuit.

(1)-2 Generator System

As projected area suffers with long hour failure of power supply with no previous notification, to prevent suspension of hospital function caused by such failure of power supply, 2 sets of generators should be installed.

When one set is off by any trouble or for maintenance, other set will be able to supply minimum necessary power for the hospital activities.

(1)-3 Outline of power supply system diagram is as follows.



Note

1. The followings are generator load
 - 1st priority load ----- Operation theatre, Artificial kidney, etc.
 - 2nd priority load ----- Examination, laboratory, treatment, etc.
2. The parts which are indicated by dotted lines shall be equipped and supplied by the Sudanese side.

Legend

- | | |
|---|-------------------------|
| CB ----- Circuit breaker | ENG ----- Diesel engine |
| DS ----- Disconnecting switch | GE ----- Generator |
| WHM ----- Watt-hour meter | |
| PCT ----- Potential current transformer | |

Fig. 5-4 Outline of Power Supply System

(2) Lighting System

Fluorescent lamps should be mainly used as light source for lighting fixtures.

Illumination level of main rooms will be as follows.

<u>Name of Room</u>	<u>Average Illumination Level</u>
Office RM Lecture RM	300 lux
Examination RM Laboratory	300 lux
Operation theatre	500 lux
Ward	100 lux

Lighting fixtures should be of surface mounting or pipe pendant type, enclosed type fixture will be installed in operation theatre.

(3) Nurse call Intercom System

For liaison between nurse station and each patient, nurse call intercom system will be equipped.

Nurse station	:	Nurse call intercom master
Each bed	:	Wall unit (receptacle, reset button, call assurance lamp, speaker, microphone, call button)
Toilet and shower RM:		Nurse call push button with call assurance lamp.
Carridor wall of ward, toilet and shower RM	:	Call indication lamp.

(4) Clock System

All clocks should be of dry cell operated.

2 hands clock (hr, min) for main rooms and surgical operation time gauge clock (hr, min, sec) for operation theatre will be installed.

(5) Telephone System

Telephone piping will be installed from telephone exchange room to main rooms. Telephone exchanger with capacity of 10 circuits for city line and 100 circuits for extension line (actual telephone set on extension line are to be 60 to 70 sets) will be required.

(6) Call System

Loudspeaker for calling out-patient from reception will be installed.

5-6-3 Plumbing and Sanitary Works

(1) Water Supply System

City water will be drawn from city branch pipe at south boundary of the site to an underground water reservoir in premises (concrete-made: ca. 200 m³), after filtering treatment (sand system), the water will be lifted to an elevated water tank (FRP-made: ca. 30 m³) with pump; then supply to each necessary places by gravity.

Piping material should be of galvanized carbon steel pipe.

(2) Drainage System

Sanitary soil and waste water will be discharged to city main sewer pipe at north boundary line of the site.

Interior piping will be separated system (sanitary soil, waste, kitchen and medical drains), these separated drains should be combined at exterior of the building. Storm water will be discharged to the drain pit near the south boundary of the site. Piping materials are as follows.

Sanitary soil pipe	: Cast iron pipe
Waste pipe	: Galvanized carbon steel pipe (PVC pipe partially)
Vent pipe	: Galvanized carbon steel pipe
Exterior drain pipe	: Concrete pipe

Kitchen drains will be discharged through grease trap. The developer liquid from Automatic processor will be stored in vessels and carried to outside. Medical drains will be discharged directly to the main sewer pipe as no poison will be used in this hospital, except little amount of reagents.

(3) High Pressure Steam System

High pressure steam which is generated with electric steam boilers (ca. 7 kg/cm²) will be supplied after pressure modulation to each medical apparatus, laundry equipment and other necessary locations.

Piping materials will be carbon steel pipe and as for condensed water, galvanized carbon steel pipe will be used.

(4) Hot Water Supply System

High pressure steam is used as heat source, hot water will be supplied by storage tank to medical apparatus, kitchen equipment and other necessary locations.

Piping material will be of acid extracted copper pipe.
(M type)

(5) Butane Gas Supply System

Butane gas cylinder will be installed at exterior, gas will be supplied to kitchen equipment and medical apparatus. Piping material will be of galvanized carbon steel pipe.

(6) Medical Gas Supply System

By central system, oxygen gas, nitrous oxide gas and compressed air will be supplied to operation theatre, recovery and ICU rooms, and vacuum system will be equipped in the said rooms.

Piping materials are as follows:

Oxygen gas pipe : Acid extracted copper pipe
Nitrous oxide gas pipe : Ditto
Compressed air pipe : Ditto
Vacuum pipe : Galvanized carbon steel pipe

(7) Fire Extinguishing System

Comply with Japanese Fire law, interior fire hydrant system will be equipped. Piping material will be of galvanized carbon steel pipe.

(8) Sanitary Fixtures

Sanitary fixtures to meet local custom (e.g. install a water faucet in each toilet booth) will be selected and installed rigidly.

(9) Kitchen Equipment

Range, fryer, sink, refrigerator, rice cooker and cooking table will be equipped, and those equipment should be of hygienic, having enough cooking capacity and to meet local dietary customs.

(10) Laundry Equipment

Wet system will be adopted, interchangeability between equipment should be considered at planning.

5-6-4 Air Conditioning and Ventilation Works

(1) Air Conditioning System

In order to maintain essential functions in the hospital, control of indoor cleanliness, room air static pressure, temperature and humidity should be controlled by means of packaged type air conditioner of water cooling system for operation theatre, recovery, ICU, central sterilizing unit, cystoscope, dialysis and X-ray rooms.

Whereas out-patient examination, treatment and laboratory rooms should be cooled by means of window type cooler.

And as for zoning of air conditioning system are as follows.

Zoning of air conditioning system

- Zone No. 1 : Operation theatre RM (2)
- Zone No. 2 : Operation theatre RM (3), (1)
- Zone No. 3 : ICU & recovery RM
- Zone No. 4 : Kidney dialysis, tube peritoneum and cystoscope RM.
- Zone No. 5 : X-ray diagnosis RM.

(2) Ventilation System

Wards, administration zone and other necessary rooms should be ventilated by means of ceiling fan or other ventilating system.

5-7 MEDICAL EQUIPMENT PROGRAMME

Recently, with the development of electronics, new type equipment has been displayed as so called medical electronics successively in diagnostic field especially. But in Japan, medical service side has hurdle to correspond to its variation, and evaluation of several equipment is not determined yet.

Now at the selection of medical equipment for the project, basic conception to medical service should be reconfirmed, and regard as following items, selection will be programmed.

- (1) Optimum equipment for the purpose as Training Hospital.
- (2) Equipment should meet the level of Sudanese medical service and technique.
- (3) Maintenance and repair work of equipment should be dealt easy and simple with Sudanese side personnel.
- (4) Maximum effect should be attained with minimum expenses.

Principal equipment of each department are shown in following table.

At execution of the project, prior to operation of equipment application, apart from any unit which is able to operate by handling manuals, as regard, execution of practical operating study and maintenance training at medical faculty in Japanese university or at manufacturer's firm is considered necessary.

Table 5-4 Medical Equipment List

1. Out-patient Department

(1) Gastroenterology section

Mobile C-Arm X-ray TV unit	51
Cold light supply	4
Electro surgical unit	1
Proctoscopic table	4
Chart for endoscope	4
Oxygen unhaler apparatus	2
Film illuminator, wall type	1
Operating light, stand type	2
Cabinet for gastro-camera	1
Gastrointestinal fiberscope	2
Duodenofiberscope	2
Colonofiberscope/Sigmoidofiberscope	2
Rectoscope	1
Esophagofiberscope	1
Rino-Laryngofiberscope	1
Bronchofiberscope	1
Laparoscope	1
Water sterilizer	2
Lecturescope	2
Laryngoscope, rigidscopes	1
Universal forceps	1
Instrument cabinet	1
Others	

(2) E.N.T. section

E.N.T. treatment unit	3
E.N.T. treatment chair	3
Nebulizer unit	1
Suction unit	1
Optokinetic nystagmus stimulator	1
Nystagmograph	1
Speech Audiometer	1

Infant audiometer	1
Brain stem audiometer	1
Bekeeshy audiometer	1
Audiometry training simulator	1
Middle ear analyzer	1
Laryngo stroboscope	1
Phonatory function analyzer	1
Pitch-extractor	1
Hearing aid tester	1
Auditory trainer	1
Dry temporal bone surgery set	1
Others	

(3) Urology section

Film illuminator	3
Instrument cabinet	2
Urological out-patient instruments set	1
Cystoscope table with chair	2
Uro-sterilized water supplying apparatus	1
Cysto-Urethroscope, Resectoscope	1
High intensity cold light supply	1
Lecturescope	1
Urological sterilizing cabinet	1
Urological unit	2
Binocular microscope	1
Urine lab instruments set	2
Unit laboratory table	1
Unit sink	1
Artificial kidney system (2 bed)	1
Water processing unit	1
Automatic peritoneal dialysis (2 bed)	1
Uro-Dynamics	1
Others	

(4) Diagnostic X-ray section	
Urological radiographic apparatus	1
X-ray TV - (1)	1
X-ray TV - (2)	1
Diagnostic radiographic apparatus	1
Automatic processor	1
X-ray dark room set	1
Film illuminator	2
Others	
(5) Laboratory section	
Automatic analyzer	1
Photo-electric spectrophotometer	1
Flame photometer	1
Refrigerated centrifuge	2
Self recording densitometer	1
Draft chamber	1
Na. K. analyzer	1
Automatic counter	1
Discussion microscope	2
Blood bank refrigerator (1)	1
Ultra-low-temperature freezer (1)	1
Micro-assay system	1
Clean bench	1
Specimen automatically burying equipment	1
Centrifuge	4
Distilling apparatus	3
Oven constant temperature	1
Pharmaceutical refrigerator	2
Chloridometer	1
Water bath, shaking	1
Unit laboratory table	19
Unit sink	7
Biochemistry ordinary lab. instruments	1
Laboratory center table	1
Incubator	3
Direct reading balance	2

Deep freezer	6
Hot air sterilizer	1
Large freezing microtome	1
Large sledge microtome	1
Ultrasonic cleaner	1
Histologic lab. instruments set	1
Blood cell counting lab. instruments set	1
Bacteriology ordinary lab. instruments set	1
Blood gas analyzer	1
Blood bank refrigerator (2)	2
Ultra-low-temperature freezer (2)	1
Others	
(6) Physiological examination section	
Ultrasound tomographic apparatus	1
Electronic spirometry apparatus	1
1-channel portable ECG	1
3-channel ECG	1
(7) Pharmacy section	
Tablet medicine dispense counter	3
Medicinal refrigerator	2
Draft chamber	1
Prescription counter for liquid medicine	1
Prescription counter for ointment medicine	1
Ampoule cabinet	1
Pharmacy testing set	1
Others	

2. Training Unit Department

VTR system	1
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3. Operating Theatre Department

(1) Operating rm, recovery rm, ICU

Operating table	3
Operating light	3
Anesthesia apparatus	3
Ventilator	2
Operating binocular microscope	1
Cryo-surgery apparatus	1
Mobile C-ARM X-ray TV unit	1
Cardiac monitoring & resuscitating apparatus	1
Electrosurgical unit solid type	3
Wall recessed illuminator	3
Wall recessed instrument cabinet	3
Warming cabinet	3
Automatic infusion pump	3
Water sterilizer	4
Instrument cabinet	4
Laparotomy set	5
Proctotomy set	2
Nephrolithotomy set	2
Cholecystotomy set	2
Gastrectomy set	2
Urological surgical basic set	5
Ureterolithotomy set	2
Prostectomy set	2
Nasal sinoplasty set	3
Pharyngotomy set	2
Rectal/Colonoscopy anastomosis	1
Nasal-Polypus surgical set	2
Blood bank refrigerator	1
Intensive care unit for 2 patients	1
Ventilator	1
I.C.U. bed with spring mattress	2
Ultrasonic nebulizer	1
Cardiosuper with standard accessories	1
Recovery bed	4
Others	

(2) Central supply	
High pressure steam sterilizer	2
Ultrasonic cleaner	1
Drier tank	1
Instrument cabinet	4
Working table	1
Dressing case	1
Others	

4. Ward

1-crank gatch bed	108
2-crank Hi-Low and gatch	12
Ice machine	3
High capacity mobile X-ray unit	1
Medicine cabinet	3
Medicine cart	3
Bed pan & Urinal washer-sterilizer	3
Urine storage rack	6
Others	