

**BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR THE EXTENSION OF
THE MAHARAJ NAKORN SRI
THAMMARAJ HOSPITAL
IN
THE KINGDOM OF THAILAND**

SEPTEMBER, 1991

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to a request from the Government of the Kingdom of Thailand, the Government of Japan decided to conduct a basic design study on the Project for the Extension of the Maharaj Nakorn Sri Thammaraj Hospital and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Thailand a study team headed by Dr. Akira Suto, Department of International Cooperation, National Medical Center Hospital, from April 8 to 30, 1991.

The team held discussions with the officials concerned of the Government of Thailand, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Thailand in order to discuss a draft report, and the present report was prepared.

I hope that this report will contribute to the promotion of the Project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Kingdom of Thailand for their close cooperation extended to the teams.

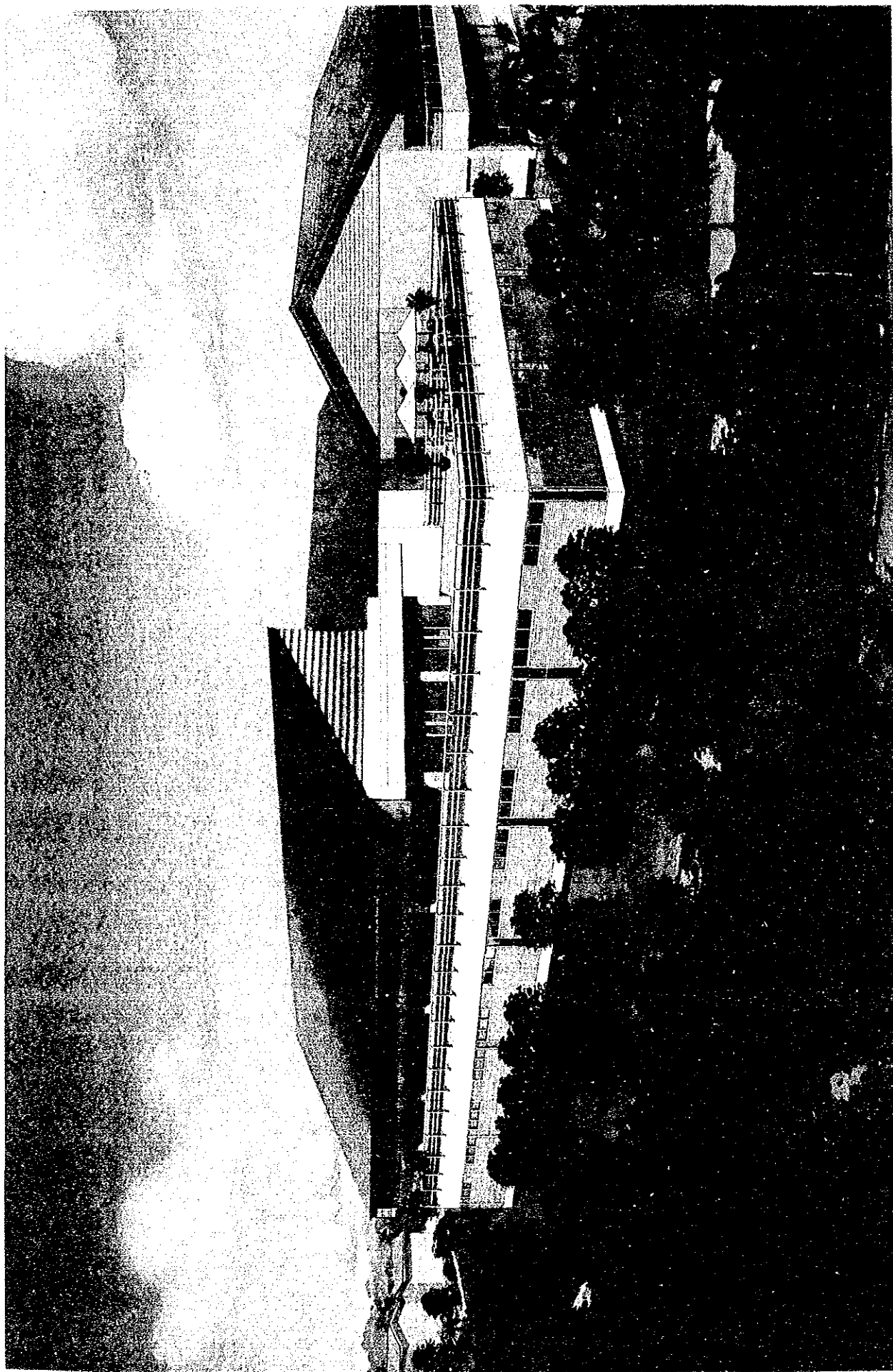
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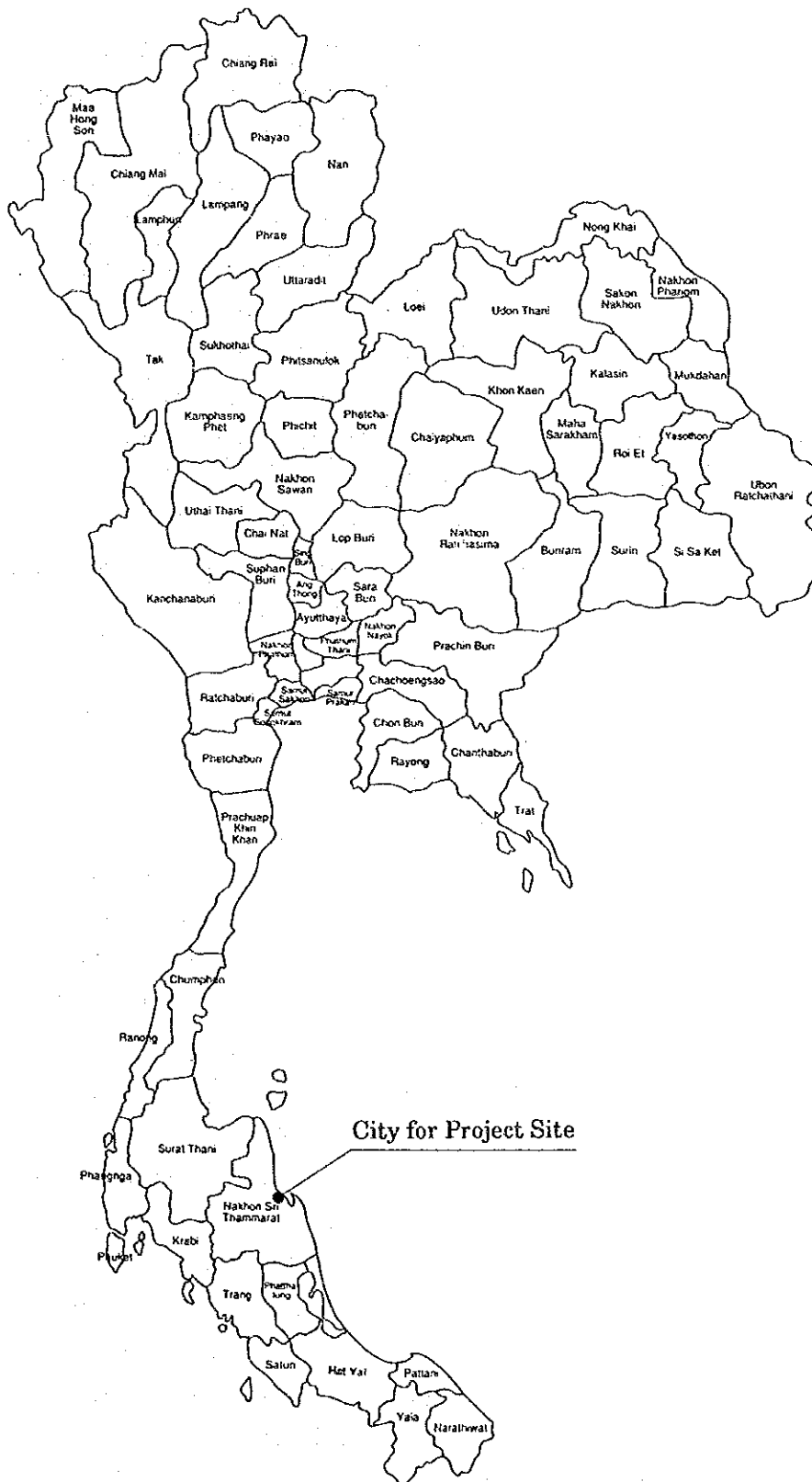
A handwritten signature in cursive script, reading "Kensuke Yanagiya".

Kensuke Yanagiya

President

Japan International Cooperation Agency





MAP OF THAILAND

SUMMARY

For over 20 years the Government of Thailand has emphasized the improvement of "Medical Services in the Provinces" and has executed a plan to construct 1,000-bed class core provincial hospitals in four parts of the country. The health and medical administration in Thailand is controlled by the Ministry of Public Health (MPH). Although Thailand's core hospitals are under the supervision of the provincial administration in MPH, MPH gives specially high priority to public medical services in rural regions so that the provincial hospitals are directly controlled by the Office of the Permanent Secretary of Public Health. Under these hospitals there are Regional/General Hospitals, Community Hospitals and Health Centers. The Government of Thailand decided on a plan to develop and extend the Nakorn Sri Thammaraj Provincial Hospital (334 beds as of 1982) into the largest core hospital in Southern Thailand. The extension and development project was carried out, through Japan's Grant Aid in 1982 and 1983, to realize a major 800-bed hospital of which name was also memorially changed to Maharaj Nakorn Sri Thammaraj Hospital (hereinafter called "Maharaj Hospital").

About 10 years have passed since the completion of the Maharaj Hospital. During last 10 years the Hospital has handled so many patients and examinations that the average number of cases has nearly doubled. The Hospital records show that 1,000 outpatients are treated daily, and over 100% inpatient occupancy and 2,600 cases of clinical examinations per day are normal for the Hospital. In addition, as the Maharaj Hospital is the main emergency surgical hospital in the region, it was performing approximately 10,000 major operations and over 17,000 total operations per year using only the 6 existing operating rooms.

Therefore the Maharaj Hospital requires immediate measures, in its Surgical, Emergency and Clinical Examination Departments, to cope with the seriously increasing work volume which has escalated to a level far beyond which was initially estimated before. The Surgical Department in particular has reached its physical limit. The number of surgical operations mentioned above means that around six major operations are being performed per day in each operating room.

In order to improve the situation, the Government of Thailand has formulated a plan for extending the hospital's Surgical Department and asked the Government of Japan for Grant Aid for executing the plan. In response, the Government of Japan has decided to implement a basic design study and Japan International Cooperation Agency (hereinafter

called "JICA") dispatched a basic design study team from April 8 to 30, 1991. The team consulted with the Thai Government officials over their concerns, and those in charge at the Maharaj Hospital, and conducted an on-the-site survey. Through an examination and further study upon returning to Japan, the team prepared and provided an explanation of the draft's final report from September 2 to 11, 1991.

Both of the facilities completed through Japan's Grant Aid in 1982 and 1983 and those constructed before are efficiently connected using corridors and slopes. The Maharaj Hospital is managed and operated by one director, two deputy directors and seven departments. The Medical Department of the Hospital is made up of the Outpatient Department, Traumatic and Forensic Department, Medicine Department, Surgical Department, Orthopedics Department, Obstetrics and Gynecology Department, Pediatrics Department, Psychiatric Department, Ophthalmic Department, Otolaryngological Department, Anesthetic Department, Pathological Department, Radiation Department, Rehabilitation Department, Dentistry Department and Pharmaceutical Department. It is staffed by 46 doctors, 6 dentists, 9 pharmacists, 265 registered nurses, 190 technical nurses, 62 practical nurses, 105 paramedical personnel, 292 permanent workers and 430 temporary workers for a total of 1,405. The total number of Hospital employees has increased more than 70% since 1983 when the Hospital was extended. The increase in manpower is composed of 230% for nurses, 200% for doctors and 300% for paramedical personnel.

In general the regional hospitals (average number of beds: 655) in Thailand have an overall average of 62 doctors and 320 nurses per hospital. At present Maharaj Hospital has approximately 16 doctors assigned to the Surgical Department. However compared to the Hospital's surgical activities 1983, it now performs 40% more major operations and 100% more minor operations so that there is an average of six (6) major operations per day in each room, which is a considerable overload compared to those of two (2) to three (3) per day per room which should be considered the reasonable level by Japanese standards.

Based on survey of present situation at Maharaj Hospital and the content of the request by the Government of Thailand, JICA determined the building facility and the medical equipment plan to match the extension project. Particular consideration has been given to planning of medical equipment so that the minimum and appropriate equipment functions effectively with new operation facilities and should meet requirements for smooth maintenance under feasible conditions of a maintenance contract.

Facility and equipment formulated are outlined as follows:

Outline of Facility and Scale

1) Construction site: The premises of the Maharaj Hospital, next to the existing operation theater

2) Building area: 1,232 m²

3) Total floor area: 1,699 m²

4) Story and structure: Reinforced concrete partly steel structure 2-story building

5) Outline of facilities per floor:

- 1st Floor 1,231.94 m²

- Six operating rooms; Orthopedic operating room (54 m² × 1)

- Neurosurgical operating room (42 m² × 1)

- General operating rooms (42 m² × 3 and 54 m² × 1)

- Sterilizing room (washing room, assembling room, sterilized equipment storage, dressing room, etc.) (189 m²)

- Operating hall (234 m²)

- Temporary washing room (10 m² × 3)

- Instrument storage (10 m² × 3)

- 2nd Floor 466.64 m²

- Dressing rooms (separate rooms for males and females)

- Lounges (separate rooms for males and females)

- Dining room

- Conference room

- Night duty room (separate rooms for males and females)

- Toilet and shower rooms (separate rooms for males and females)

- Other

- Balcony and Terrace 757 m²

Medical Equipment

1) Equipment related to Operating Theater:

Operating table, Operating light, Anesthetic apparatus, Anesthetic ventilator, ECG monitor with blood pressure monitor, Defibrillator, Pulse oxymeter, Electric surgical unit, Electric suction, Sterilizer, Endoscope, Ultrasonic apparatus, Surgical TV X-ray apparatus, etc.

2) Equipment related to ICU (Intensive Care Unit):

Ventilator, Infant ventilator, ECG monitor with blood pressure monitor, Pulse oxymeter, etc.

3) Other equipment:

Operating table, Ventilator, ECG monitor, etc.

In addition to this extension project, it is necessary to improve the existing Surgical Department facilities in the Hospital in order that both of new operating theaters and existing ones should be effectively utilized in a functional and coordinated way. Therefore the Study Team fully consulted with the Government of Thailand regarding how to renovate the rooms, which will be the responsibility of the Government of Thailand.

It was indicated that major improvements of the existing facility should be done for upgrading of cleanliness. Such improvements include 2 existing operating rooms to be modified to infectious disease operating rooms, all operating rooms' doorways to be replaced with airtight type and anesthesia room to be renewed.

The Government of Japan will basically be responsible for the insite infrastructure needed by the new operating theater and the Government of Thailand will be responsible for renovating the existing facilities.

In regards to the drainage facility, the existing purification equipment has been damaged. However, since the facility can process 1,000 m³ a day, by repairing and using it, it can fully process the waste water discharged from the total facilities of existing as well as new operating theater. The Government of Thailand emphasizes prevention of environmental pollution in the provinces. Taking this view into consideration, the repair work for the existing purification equipment is to be covered under this project due to the Government of Japan.

Construction term including procurement of medical equipment for the project will have Phase I and II. Phase I will take approximately 12 months to complete, and phase II will take approximately 8 months to complete.

The most important goal of the Project is to normalize the number of surgical operations performed at the Hospital which now exceeds the physical limit. Conclusively the six new operating rooms and the related support facilities are expected to develop the quality of surgical operations, reduce the load on doctors, paramedics and nurses. On these own merits, it will improve the cleanliness of the washing, sterilization and the clean zone which are basically essential in preparing for the operations. Coupled with the development of the medical staff's research and technical capacities they are expected to enhance the quality and quantity of the medical services provided. The new facilities will also activate the Hospital activities as a whole enabling it to fully serve its functions as a core provincial hospital thereby greatly contributing toward provincial medical care and welfare.

Also the two new special operating rooms for orthopedic and neurosurgery will enable the Hospital to cope with the rapid increase of traffic accident patients, and will also contribute toward developing the high neurosurgical technology for performing advanced surgical operations on serious patients often resulting from traffic accidents. Hence it is believed appropriate that the Project be implemented through Japan's Grant Aid.

The extension project of operating rooms should require renovation of the existing rooms so as to ensure efficient connection with the new facilities. Through the functional integration of the operating rooms and the existing facilities of the renovated rooms, the level of cleanliness in Surgical Department will be totally promoted and so the overall efficiency will double in qualitative technology and in activities of both renovated existing rooms and new operating rooms of which adequate support facilities are closely attached.

It is suggested that upon implementing the construction of this project there is a necessity to prepare budgeting and issuing of works by the Government of Thailand in order to realize the renovation plans of existing facilities without delay.

CONTENTS

PREFACE

PERSPECTIVE

MAP

SUMMARY	i
CHAPTER 1 INTRODUCTION	1
CHAPTER 2 BACKGROUND OF THE PROJECT	3
2-1 Public Health and Medical Services in Southern Thailand	3
2-1-1 Regional Administrative Organization of Medical Services and Public Health	3
2-1-2 Current State of Medical Services	11
2-1-3 Current Diseases	13
2-2 Background and Outline of the Request	16
2-2-1 Background of the Request	16
2-2-2 Outline of the Request	17
CHAPTER 3 CURRENT STATE OF MAHARAJ NAKORN SRI THAMMARAJ HOSPITAL	19
3-1 State of Medical Service Activities	19
3-1-1 Trend of Diseases	19
3-1-2 Medical Services	20
3-1-3 Organization and Personnel	26
3-1-4 Change in Budget	28
3-2 Utilization and Maintenance Condition of Existing Facilities	30
3-2-1 Present Condition of Buildings.....	30
3-2-2 Present Condition of Building Facilities	34
3-2-3 Present Condition of Medical Equipment	37

CHAPTER 4	OUTLINE OF THE PROJECT	43
4-1	Objective	43
4-2	Study and Examination of the Request	44
4-2-1	Justification of the Project	44
4-2-2	Study of Implementation and Operational Plan	44
4-2-3	Study of Requested Facilities	45
4-2-4	Study of Requested Medical Equipment	48
4-3	Project Outline	51
4-3-1	Executing Agency and Operational Structure	51
4-3-2	Plan of Operation (Activity)	51
4-3-3	Location and Condition of Project Site	52
4-3-4	Outline of Facilities and Medical Equipment	57
4-3-5	Maintenance and Management Plan	60
CHAPTER 5	BASIC DESIGN	69
5-1	Design Policy	69
5-2	Study of Design Condition	71
5-2-1	Setting Facility Grade	71
5-2-2	Setting Facility Size	71
5-2-3	Basis for Floor Area Requirement	73
5-3	Basic Plan	77
5-3-1	Site and Layout Plan	77
5-3-2	Architectural Plan	79
5-3-3	Structural Plan	85
5-3-4	Building Facility Plan	87
5-3-5	Construction Material Plan	101
5-3-6	Medical Equipment Plan	102
5-3-7	Basic Design Drawings	107
5-4	Construction Plan	121
5-4-1	Construction Policy	121
5-4-2	Situation and Remarks about Construction	123
5-4-3	Construction and Supervision Plan	123
5-4-4	Procurement Plan	123
5-4-5	Implementation Schedule	124
5-4-6	Estimated Project Cost	127

CHAPTER 6 PROJECT EFFECTIVENESS AND CONCLUSION 129

6-1 Effectiveness..... 129

6-2 Conclusion 132

6-3 Recommendation 133

APPENDIX

- 1. Member List of Survey Team**
- 2. Survey Schedule**
- 3. List of People Interviewed**
- 4. Minutes of Discussions**
- 5. List of Hospitals Observed**
- 6. List of Materials Collected**
- 7. Data for Soil Test**

CHAPTER 1 INTRODUCTION

CHAPTER 1 INTRODUCTION

Maharaj Nakorn Sri Thammaraj Hospital (hereinafter called "Maharaj Hospital") became a large hospital of about 800 beds consisting of 400 beds ward, a central ancillary and support facilities which were added to the Nakorn Sri Thammaraj Hospital (about 340 beds at that time) under the Japan's Grant Aid in 1982 - 1983.

However, as about 10 years have passed since this Japan's Grant Aid, the number of patients and the number of examinations at this hospital have nearly doubled during this period. Especially, the rapid increase of patients requiring serious operations due to traffic accidents are bringing about a shortage of operating rooms.

About 17,000 operation cases are performed yearly at Maharaj Hospital and 10,000 of them can be classified as major operations. The Hospital now has 6 operating rooms. This means that about 6 major operations are performed per room daily. The number of emergency operations due to traffic accidents reaches 2,800 in some years. This means that 2 operations due to traffic accidents are performed per room daily. Therefore, the other operations must be performed between these emergency operations.

In order to relieve such an overcrowded hospital situation, the Government of Thailand has requested the Japan's Grant Aid to construct six new operating rooms, attached support rooms and related medical equipment which are urgently needed by the Hospital.

In accordance with the request, the Government of Japan decided to conduct a Basic Design Study, and the JICA sent a study team to Thailand from April 8th to 30th, 1991, headed by Dr. Akira Suto of the National Medical Center Hospital. The study team held discussions on the contents of the request for the Japan's Grant Aid and background circumstances, and performed the following investigation concerning the possibility of providing the Japan's Grant Aid for the Project.

- (1) an analysis of the background and implementability of the plan
- (2) current conditions of medical treatment and facilities in Southern Thailand
- (3) discussions of the content and scale of the plan
- (4) confirmation of project implementation policy, operations management policy, and work costs and budgetting to be borne by the Government of Thailand
- (5) a survey of the planned construction site
- (6) a survey of the existing facilities and medical equipments of the Maharaj Hospital
- (7) a survey of current status of operations at the Maharaj Hospital
- (8) a survey of construction in Thailand

Based on these results, JICA studied the content, scale, period and the cost of the Project in further details in Japan. The study was summarized in the Basic Design Study Report

(draft final report). A explanation of basic design study was conducted from September 2 through September 11, 1991. The study team presented and explained the Basic Design Study to the Thai government officials concerned. The two parties confirmed the content and the items studied by the field survey. As a result, the two parties arrived at a basic agreement about the Basic Design Study Report and signed and exchanged the Minutes of Discussions on September 9.

This report was analyzed, basd upon the study result mentioned above and was summarized as a Basic Design Study Report. Member List of Survey Team, Survey Schedule, List of People Interviewed and copy of Minutes of Discussions are compiled in the Appendix.

A

CHAPTER 2 BACKGROUND OF THE PROJECT

CHAPTER 2 BACKGROUND OF THE PROJECT

2-1 Public Health and Medical Services in Southern Thailand

2-1-1 Regional Administrative Organization of Medical Services and Public Health

(1) Regional Administrative Organization of Medical Service System

In Thailand, the public health is controlled under the jurisdiction of the Ministry of Public Health (MPH). The hospitals can be classified broadly into those which are under the direction of the Department of Medical Services, the Department of Communicable Disease Control, and those which are under the Provincial Administration.

MPH gives specially high priority to public health in rural regions. The Permanent Secretary for Public Health directly controls the Provincial Administration which manages medical services in the 72 provinces in Thailand. The Provincial Health Office and the District Health Office operate under the Provincial Administration, and have the following functions:

- **Provincial Health Office**

One office is established in each of the country's 72 provinces, and run by a doctor who is called the Provincial Chief Medical Officer. He has the highest responsibility for the management and operation of the public medical service facilities in the province. However, because routine hospital administration is left to the director of each hospital, his duties are mainly supervisory. His duty is to report technical and strategic issues directly to the Permanent Secretary of MPH and to report administrative issues to the provincial governor and others.

- **District Health Office**

The District Health Office is an organizational entity which includes technical and administrative staff. Its chief is called District Officer and has a duty to make reports to the Ministry of Interior. However, most of the district health office's technical and managerial support and supervision is coordinated by the Provincial Health Office.

Figure 2-1-1 shows the position of these organizations within MPH.

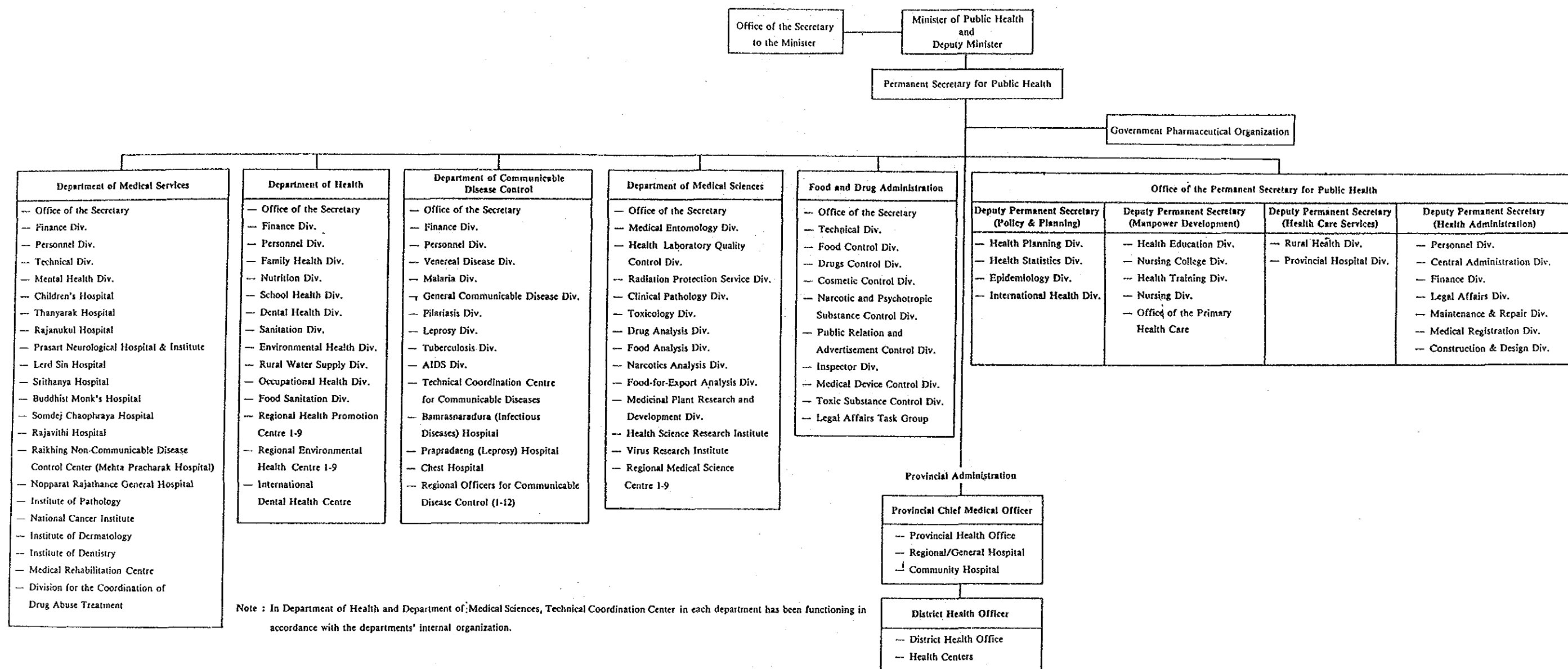
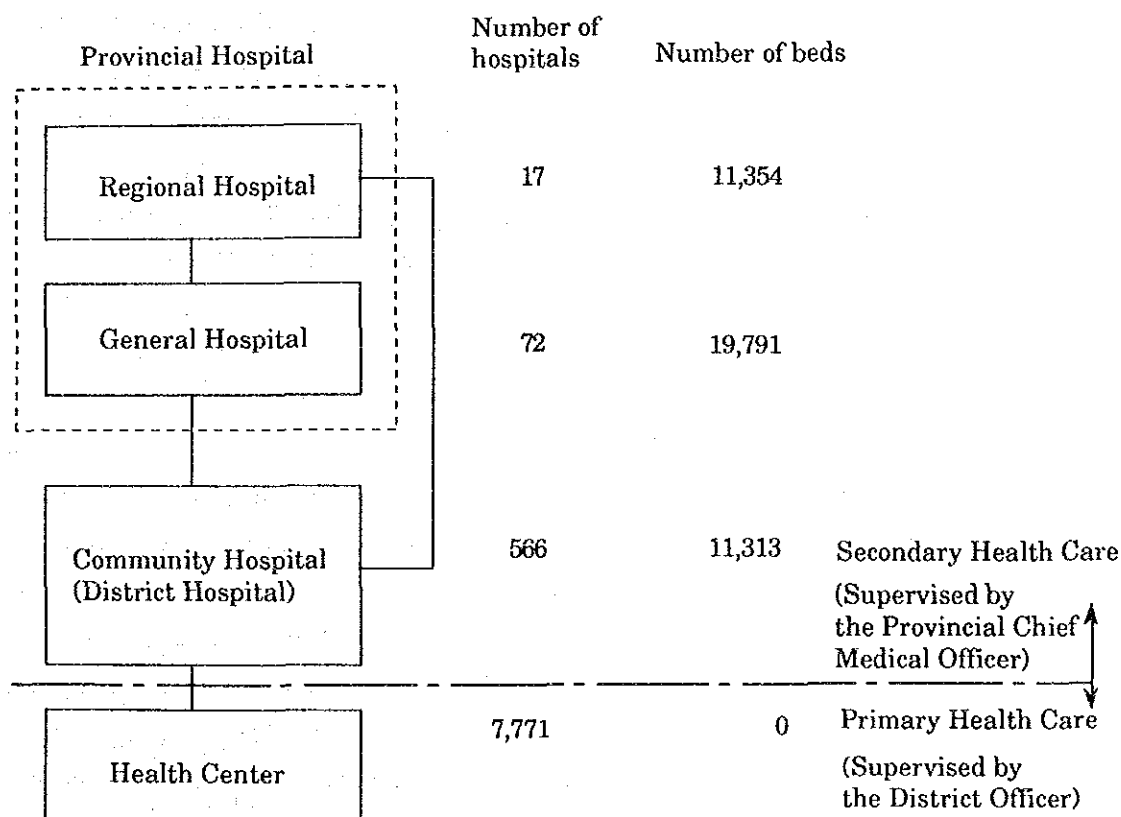


Figure 2-1-1 Organization of the Ministry of Public Health

(2) Medical Service System

In regard to the relationship between administrative organizations and medical facilities, Provincial Hospitals and Community Hospitals are managed under the direction of the Provincial Chief Medical Officer, and Health Centers are managed under the direction of the District Officer. Each province has at least one Provincial Hospital. In each province there are several Community Hospitals having 10 to 100 beds. There are Health Centers for primary health care which are staffed by nurses, but have neither beds nor doctors. The numbers and the relation between these medical facilities are shown in Figure 2-1-2. Under this system, serious patients are moved to hospitals of a secondary health care, and telephones or microwave transmissions are used for communications between them.



Source: Office of the Permanent Secretary of Public Health, 1988

Figure 2-1-2 Relation and Current State of Hospitals

1) Primary Health Care Service

The concept of primary health care was actually implemented in 1977 by the Ministry of Public Health as a program in the Fourth Five-Year Health Development Plan (1977~1981) in accordance with a policy of "Health for All by the Year 2000." The main effort in the implementation of the primary health care program during the Fourth Plan was in the recruitment and training of volunteers as health manpower. In the Fifth (1982~1986) and Sixth (1987~1991) Plans, the training of volunteers was continued, and a system was established whereby primary health care could be provided to all villages. The number of field volunteers (VHC: Village Health Communicators) reached 598,902 persons as of 1990. VHCs serve as disseminators of health information to their group of 8~15 households each. Also, one out of every ten VHCs has been selected to be given more intensive training and responsibilities in the primary health care service. These persons are called VHV (Village Health Volunteers), and there were 63,150 of them throughout the country as of 1990. In 1988, 7,771 Health Centers had been established throughout the country as primary health care centers, with nurses always on duty to perform medical duties such as prenatal, delivery, and postnatal services, immunization, nutrition, and family planning. The supervision and support to VHCs and VHVs are also an important duty of Health Centers.

2) Hospital Service

• Regional Hospitals

As shown in Figure 2-1-2, Regional Hospitals and General Hospitals are called "Provincial Hospitals". The Regional Hospital normally has 500 to 1,000 beds, and generally functions as a referral center for the region. It is engaged in the training of medical workers in addition to medical services. There are four Regional Hospitals in each of the Northeastern, Northern, and Southern Thailand, two each in the Eastern and Western, and one in Central Thailand, for a total of seventeen (17), as shown in Table 2-1-1 and Figure 2-1-3. The total number of beds for the 17 Regional Hospitals is 11,138 and the average number is 655 beds/hospital. The total number of doctors and graduate nurses is 1,049 and 3,353 respectively. The average number of doctors and graduate nurses is 62 doctors/hospital and 197 graduate nurses/hospital respectively. The hospital with the largest number of beds is the Regional Hospital in Nakhon Ratchasima, Northeastern Thailand, with 970 beds. The General Hospital, one located in each province, generally has 150~500 beds. There are 72 hospitals nationwide as of 1988 and the total number of beds is 19,791. The General

Hospital gives medical services mainly to the residents near a provincial capital.

- Community Hospitals (District Hospitals)

District Hospitals (now renamed Community Hospitals) are located in approximately 90 percent of the country's districts, with a total number of 566 as of 1988. The Community Hospital usually has 10-60 beds (a few have 90 beds). A 10-bed hospital normally has two physicians. A 30-bed, 60-bed, and 90-bed hospitals can have 3, 4 and 6 physicians, respectively.

The Community Hospital provides treatment, prevention, and rehabilitation services and has official responsibility for the over-all supervision and technical support of Health Center's activities and public health programs in the district in where the hospital is located. The Community Hospital also serves as a referral center at the secondary level of the health care service infrastructure.

Table 2-1-1 Current State of Regional Hospital (1990)

Province	Region *	Doctor	Graduate Nurse	Technical Nurse	Beds
1. Sara Buri	Central	45	202	121	710
2. Chanthaburi	Eastern	83	213	127	660
3. Chon Buri	Eastern	81	237	114	705
4. Nakhon Ratchasima	North Eastern	114	307	204	970
5. Ubon Ratchathani	North Eastern	83	237	156	900
6. Khon Kaen	North Eastern	71	172	115	614
7. Udon Thani	North Eastern	57	175	108	612
8. Chiang Rai	Northern	52	158	84	592
9. Lampang	Northern	66	197	123	739
10. Phitsanulok	Northern	75	252	147	668
11. Nakhon Sawan	Northern	54	219	101	660
12. Ratchaburi	Western	42	165	103	652
13. Nakhon Phathom	Western	44	163	78	480
14. Surat Thani	Southern	43	173	130	600
15. <u>Nakorn Sri Thammaraj</u>	<u>Southern</u>	<u>50</u>	<u>206</u>	<u>202</u>	<u>736</u>
16. Yala	Southern	33	115	73	264
17. Hat Yai	Southern	56	162	116	576
Total		1,049	3,353	2,102	11,138

* See Figure 2-1-3.

Source: Maharaj Nakorn Sri Thammaraj Hospital

2-1-2 Current State of Medical Services

(1) Medical Services in Southern Thailand

The types and number of beds for hospitals in Southern Thailand are shown in Table 2-1-2. Southern Thailand consists of 14 provinces, and there are 4 Regional Hospitals in the provinces of Surat Thani, Nakorn Sri Thammaraj, Hat Yai, and Yala. Of these four, the Maharaj Hospital in Nakorn Sri Thammaraj is the largest, with 805 beds. Following this is the Surat Thani Province with 600 beds, Hat Yai Province with 564 beds, and Yala Province with 271 beds, thus making the total for Regional Hospitals in this region 2,240 beds. In short, this area comprises 20 percent of the total number of beds in Regional Hospitals nationwide. There are 12 General Hospitals (3,367 beds total) and Community Hospitals having 1,615 beds total.

Table 2-1-2 Hospitals and Number of Beds in Southern Thailand in 1990

Provinces	Regional Hospital (Beds)	General Hospital (Beds)	Community Hospital (Beds)
Chumphon		336	120
Ranong		252	20
Surat Thani	600	95	190
Phangnga		320	50
Phuket		254	20
Krabi		260	40
<u>Nakorn Sri Thammaraj</u>	<u>805</u>		<u>370</u>
Trang		277	90
Patthalung		255	100
Tat Yai	564	440	150
Satun		254	40
Pattani		264	150
Yala	271		60
Narathiwat		360	215
Total	2,240	3,367	1,615

Source: Maharaj Hospital

(2) Medical Services in Nakorn Sri Thammaraj Province

Table 2-1-3 shows the population and number of hospital beds for all districts in the Nakorn Sri Thammaraj Province. The Nakorn Sri Thammaraj Province is composed of 17 districts, and the population as of 1989 was 1,322,277 persons. The population of the Nakorn Sri Thammaraj district, which is the capital of the province, is the largest, with 224,450 persons. This province has Maharaj Hospital, which is a Regional Hospital, and 16 Community Hospitals (330 beds total). It also has 207 Health Centers (about 1 health center for every 6,000 people) for primary health care. In addition, it has 2 army hospitals (205 beds total), which are outside the jurisdiction of MPH, and 4 private hospitals (80 beds total).

Table 2-1-3 Population, Hospital Establishment and Beds in Each District of Nakorn Sri Thammaraj Province (1989)

District	Population	Hospital (Beds)	No. of Health Center
<u>Nakorn sri Thammaraj</u>	<u>224,450</u>	<u>Maharaj Hospital (805)</u>	<u>27</u>
Promkhiri	33,499	Community Hospital (10)	7
Lansaka	39,345	" (10)	6
Chawang	104,361	" (60)	14
Phipun	25,876	" (10)	6
Chienyai	75,795	" (10)	16
Chauat	84,738	" (10)	14
Thasala	132,688	" (10)	17
Thungsong	112,571	" (90)	18
Nabon	28,239	" (10)	6
Thungy ai	54,466	" (10)	9
Pakphanang	93,022	" (30)	21
Ronphibun	114,946	" (10)	14
Sichon	75,088	" (30)	12
Khanom	25,675	" (10)	4
Huasai	71,089	" (10)	12
Bangkan	26,379	" (10)	4
Total	1,322,227	(1,135)	207

Source: Maharaj Hospital

(3) Outline of Health Care Workers

The number of doctors throughout the nation in 1987 was 9,600, and of these approximately 90 percent were working for public organizations. At that time, approximately 44 percent of all doctors in Thailand (4,400 doctors) were working in Bangkok, and approximately 9.5 percent (910 doctors) were working in Southern Thailand. Considering the fact that the city of Bangkok represents 10 percent of the population of Thailand as a whole, the above mentioned high percentage of doctors in Bangkok becomes apparent. In contrast with this, population of Southern Thailand is roughly 12 percent of the entire population. Also, with respect to nurses, 18 percent of all nurses work in Bangkok, and 14 percent work in Southern Thailand.

Table 2-1-4 Population per Medical Worker and per Bed

	(1987) Nakorn Sri Thammaraj Province	(1987) National average of Thailand	(1984) National average of Japan
People/Bed	990	722	80
People/Doctor	12,749	5,595	670
People/Nurse	1,439	1,190	200
People/Dentist	152,992	36,515	1,900
People/Pharmacist	105,917	14,799	930

Source: Maharaj Hospital and Ministry of Health and Welfare of Japan

Table 2-1-4 shows the average population per health care worker and per hospital bed for Nakorn Sri Thammaraj Province and for the nation as a whole. The average figures for Japan have been included as a reference. Those figures are below average for the nation as a whole, and the number of doctors, dentists, and pharmacists is exceedingly small. 108 doctors and 957 nurses are working in the Nakorn Sri Thammaraj Province as of 1987. In conclusion, while doctors are centrally concentrated to an extreme degree, nurses are distributed in the provinces in a concentration proportionally appropriate to population.

2-1-3 Current Diseases

(1) Disease Trends

The ten most common diseases of outpatients and inpatients in hospitals are shown in table 2-1-5 and 2-1-6 respectively, broken down by region. On a nationwide level for

outpatients, leaving out undetermined disorders, diseases of the respiratory system are the most common, with diseases of the digestive system second, and infectious and parasitic diseases third. These disease trends are exactly the same in Southern Thailand. In contrast with this, the top ten causes of diseases of inpatients, leaving out undetermined disorders, diseases such as the complications of pregnancy are most common, followed in second place by the diarrhoeal diseases, with accidents other than traffic accidents third. Trends in Southern Thailand, with the exception of the position of traffic accident in third place, show the same tendencies.

**Table 2-1-5 Outpatients by Major Causes of Diseases
(Excl. Bangkok Metropolis) by Region 1988**

Cause Groups	Whole Country	Northern Region	North-Eastern Region	Central Region	Southern Region
Diseases of the Respiratory System	1	1	1	1	1
Symptoms and Ill-defined Conditions	2	2	3	2	2
Diseases of the Digestive System	3	3	2	3	3
Infectious and Parasitic Diseases	4	4	4	5	4
Accidents, Poisoning and Violence	5	6	5	4	5
Disease of the Skin and Subcutaneous	6	7	6	6	6
Disease of the Musculoskeletal System	7	5	7	8	7
Diseases of the Nervous System and Sense Organs	8	8	8	7	8
Diseases of the Genito-urinary System	9	9	9	9	9
Diseases of the Circulatory System	10	10	10	10	10

Source: MPH

**Table 2-1-6 Inpatients by Major Causes of Diseases
(Excl. Bangkok Metropolis) by Region 1988**

Cause Groups	Whole Country	Northern Region	North-Eastern Region	Central Region	Southern Region
Complications of pregnancy etc.	1	1	1	1	1
Enteritis and other diarrhoeal diseases	2	3	2	3	2
Symptoms and ill-defined conditions	3	2	3	2	3
Accidents except motor vehicle accidents	4	4	4	4	5
Motor vehicle accidents	5	5	7	5	4
Pyrexia of unknown origin	6	6	5	7	6
Malaria	7	9	9	6	7
Infective and parasitic diseases	8	7	10	8	8
Pneumonia	9	8	6	9	9
Abortion	10	10	8	10	10

(2) Causes of Death

One characteristic of the occurrence of diseases in Thailand is the simultaneous occurrence of disorders such as infectious diseases, obesity together with disorders caused by parasites, diabetes, and heart disease. Table 2-1-7 shows the change in the top ten causes of death in Thailand between 1984 and 1988. In sequence by fatality rate, heart disorders are first, followed second by digestive disorders, cancer and accidents in third and fourth place, thus showing a pattern similar to that of the developed countries. Furthermore, from statistics, the death rate per one thousand population is five to six, which is approximately the same as Japan. However, there are also reports which say that the cause of death is clear for only 50 percent of the 250,000 people who die each year, and thus there are aspects from which it is difficult to judge purely on the basis of statistical values. According to trends from 1984-1988, traffic accidents, which had held tenth place in 1986, have risen to sixth, and thus its position amongst the top ten causes of death has risen.

Table 2-1-7 Ten Leading Causes of Death per 100,000 Population in the Kingdom of Thailand

Cause Group	1984		1985		1986		1987		1988	
	Order	Rate	Order	Rate	Order	Rate	Order	Rate	Order	Rate
Diseases of pulmonary circulation and other forms of heart disease	1	33.3	1	34.6	1	35.5	1	40.3	1	42.1
Diseases of the digestive system other than oral cavity, salivary glands and jaws	2	20.1	2	19.9	2	18.6	2	19.8	2	18.8
Malignant neoplasm of other and unspecified sites	4	14.9	4	16.3	3	16.9	3	17.8	3	18.7
Other accidents, including late effect	3	18.7	3	19.3	4	15.4	4	16.4	3	18.7
Diseases of the respiratory system other than the upper respiratory tract	6	13.5	5	12.8	5	11.3	5	12.6	5	12.6
Transport accidents	7	11.6	9	8.6	10	8.4	10	8.6	6	10.4
Homicide and injury purposely inflicted by other persons	5	14.9	6	11.9	6	10.3	8	9.8	7	10.0
Disease of nervous system	10	9.1	10	8.5	9	9.0	6	10.4	8	9.9
Cerebrovascular diseases	8	11.0	8	9.3	8	9.2	9	9.5	9	9.6
Tuberculosis	9	10.2	7	10.3	7	9.8	7	10.2	10	8.2

Source: MPH

2-2 Background and Outline of the Request

2-2-1 Background of the Request

Maharaj Hospital was extended from a 340-bed to a 800-bed hospital in 1982 and 1983 by Japan's Grant Aid. As a result, it became the largest hospital in Southern Thailand. However, as about 10 years have passed since this Japan's Grant Aid, the number of patients and the number of examinations at the Hospital have nearly doubled during this period. Especially, the rapid increase of patients requiring serious operations due to traffic accidents is bringing about a shortage of operating rooms.

The number of motorcycles and automobiles has multiplied tenfold between 1980 and 1988 in Nakorn Sri Thammaraj province. Since many bicycles and motorcycles in addition to automobiles travel in roadways, traffic accidents are increasing rapidly. This doubled emergency surgical operations at hospitals in the province.

About 17,000 operations are performed yearly at Maharaj Hospital and 10,000 of them can be classified as major operations. The Hospital has 6 operating rooms. This means that about 6 major operations are performed per room daily. The number of emergency operations due to traffic accidents reaches 2,800 in some years. This means that 2 operations due to traffic accidents are performed per room daily. Therefore, the other operations must be performed between these emergency operations.

In addition, the surgery facilities of other hospitals in this region were hardly expanded during this period. Patients are often sent to Maharaj Hospital if their operations require advanced technology. As a result, the demand is beginning to exceed the capacity of the Hospital. Thus, it is becoming impossible to administer adequate medical services to regional residents.

Because of the above background, the Hospital has an urgent need to increase the number of operating rooms in order to maintain and improve the quality of medical services to regional residents in future as the main hospital in Southern Thailand. The Government of Thailand, Maharaj Hospital as an implementing agency, requested the Government of Japan to provide the Grant Aid for the extension of operating theater and related facilities and the installation of medical equipment.

2-2-2 Outline of the Request

The content of the request is the extension of the operating theater (six operating rooms) and installation of the necessary medical equipment.

The executing agencies are the Maharaj Hospital and the office of permanent secretary for MPH.

The project site is located next to the existing operating theater in the Maharaj Hospital.

The requests made by the Government of Thailand are listed as follows: Six (6) operation rooms are used for the orthopedic, neurosurgical, cardiac and general surgical.

1. Building Related to the Project

1) Six (6) Operating Rooms

- Orthopedic operating room
- Neurosurgical operating room
- Cardiac and general surgical operating room
- Three (3) general surgical operating rooms

2) Supporting Facilities

- Sterilizing room
- Washing room
- Dressing room (male, female)
- Conference room
- Dinning room
- Night duty staff room
- Medical gas facilities
- Others

2. Medical Equipment Related to the Project

- Operating table
- Operation light for major operation
- Anesthetic apparatus
- Anesthetic ventilator
- Blood pressure monitor + ECG monitor
- Defibrillator
- Pulse oxymeter
- Electro surgical unit
- Wall suction unit

- Electric suction
- Film viewer for x-ray photo
- Instrument cabinet
- Sterilizer
- Endoscope
- Ultrasonic sonograms
- Laser apparatus for opthalmic
- Electric ultrasonic scan
- X-ray apparatus
- Respirator
- Infant Ventilator
- Bed side monitor
- Others

CHAPTER 3 CURRENT STATE OF MAHARAJ NAKORN SRI THAMMARAJ HOSPITAL

CHAPTER 3 CURRENT STATE OF MAHARAJ NAKORN SRI THAMMARAJ HOSPITAL

3-1 State of Medical Service Activities

3-1-1 Trend of Diseases

Table 3-1-1 and 3-1-2 shows the ten leading diseases of the outpatients and inpatients at Maharaj Hospital from 1986 through 1990. The diseases of the respiratory system have ranked 1st among the outpatients for the last 5 years, and the diseases of the digestive system have been 2nd. This trend reflects the national statistics. However, among the inpatients traffic accidents have always been one of the leading causes of hospitalization. According to the top ten diseases of inpatients in the whole country of Thailand, the traffic accident takes the 5th place. On the other hand, in Maharaj Hospital the traffic accident takes the second place in 1990 and the first place in 1986~1989. In 1990, the number of inpatients due to the traffic accident is occupied approximately 20 percent of the total number of inpatients in Maharaj Hospital.

**Table 3-1-1 Outpatients by Major Causes of Diseases 1986 - 1990
in Maharaj Hospital**

Number	1986	1987	1988	1989	1990
1.	Diseases of Respiratory Sys. 41,509	Diseases of Respiratory Sys. 55,949	Diseases of Respiratory Sys. 31,944	Diseases of Respiratory Sys. 32,676	Diseases of Respiratory Sys. 35,248
2.	Diseases of Digestive Sys. 31,600	Diseases of Digestive Sys. 25,998	Diseases of Genito-urinary 25,947	Diseases of Digestive Sys. 22,639	Diseases of Digestive Sys. 19,821
3.	Diseases of Nervous Sys. and Sense Organ 27,812	Diseases of Genito-urinary sys. 27,468	Diseases of Digestive Sys. 25,908	Diseases of Musculoskeletal Sys. 20,297	Symptoms, Signs and Ill defined conditions 19,615
4.	Diseases of Genito-urinary Sys. 25,539	Diseases of Musculoskeletal Sys. 25,222	Diseases of Musculoskeletal Sys. 24,966	Diseases of Genito-urinary sys. 19,397	Infectious and Parasitic Dis. 17,333
5.	Diseases of Musculoskeletal Sys. 22,526	Diseases of Nervous Sys. and Sense Organ 22,600	Diseases of Nervous Sys. and Sense Organ 21,321	Diseases of Nervous Sys. and Sense Organ 17,777	Diseases of Musculoskeletal Sys. 17,253
6.	Infectious and Parasitic Sys. 20,140	Infectious and Parasitic Sys. 19,811	Diseases of Musculoskeletal Sys. 18,805	Accidents, Poisonings and Violence 15,752	Accidents, Poisoning and Violence 15,027
7.	Mental Disorders 15,920	Diseases of Skin and Sub- cutaneous Tissue 15,667	Infectious and Parasitic Dis. 16,260	Infectious and Parasitic Dis. 15,049	Diseases of Genito-urinary Sys. 14,525
8.	Diseases of Skin and Sub- cutaneous Tissue 12,646	Accidents, Poisonings and violence 14,542	Accidents, Poisonings and violence 15,500	Diseases of Skin and Sub- cutaneous Tissue 14,193	Diseases of Nervous Sys. and Sense Organ 14,290
9.	Accidents, Poisonings and Violence 11,682	Mental Disorders 10,680	Mental Disorders 9,684	Mental Disorders 9,749	Diseases of Skin and Sub- cutaneous Tissue 11,458
10.	Endocrine, Nutritional and Metabolic Dis. 9,983	Endocrine, Nutritional and Metabolic Dis. 9,983	Diseases of Circulatory Sys. 8,655	Diseases of Circulatory 8,365	Endocrine, Nutritional and Metabolic Sys. 9,117

Source: Maharaj Hospital

**Table 3-1-2 Inpatients by Major Causes of Diseases 1986 - 1990
in Maharaj Hospital**

Number	1986	1987	1988	1989	1990
1.	Motor vehicle accidents 1,684	Motor vehicle accidents 1,667	Motor vehicle accidents 1,664	Motor vehicle accidents 2,200	Haemorrhagic Fever 2,527
2.	Enteritis and other diarrheal diseases 1,060	Gastrointestinal Sys. 1,168	Gastrointestinal Sys. 1,520	Enteritis and other diarrheal disease 1,459	Motor vehicle accidents 2,423
3.	Pneumonia 688	All other infective and parasitic diseases 681	All other infective and parasitic diseases 689	Prematurity, other cause of perinatal mortality 874	Enteritis and other diarrheal disease 1,502
4.	Abortion 672	Pneumonitis 847	Prematurity, other causes of Perinatal mortality 886	Pneumonitis 841	Prematurity, other causes of Perinatal mortality 942
5.	Appendicitis 552	Abortion 697	Pneumonitis 753	Malignant neoplasms including neoplasms of lymphatic Sys. 717	Pneumonitis 875
6.	All other infective and parasitic disease 508	Appendicitis 624	Benign Neoplasms 630	All other infective and Parasitic Dis. 714	All other infective and parasitic diseases 840
7.	Bronchitis, emphysema and asthma 500	Bronchitis, emphysema asthma 550	Abortion 663	Appendicitis 630	Malignant neoplasms including neoplasms of lymphatic system 804
8.	Benign neoplasms 485	Benign Neoplasms 639	Haemorrhagic Fever 628	Bronchitis emphysema, Asthma 611	Other forms of heart diseases 618
9.	Diseases of the skin and subcutaneous tissue 487	Diseases of the skin and subcutaneous tissue 538	Appendicitis 620	Other form of heart diseases 691	Diseases of the skin and subcutaneous tissue 609
10.	Anemias 472	Diseases of the Blood 489	Other forms of heart Dis. 591	Diseases of the Skin and Subcutaneous tissue 625	Anemias 603

Source: Maharaj Hospital

3-1-2 Medical Services

(1) Number of Outpatients

Table 3-1-3 shows the number of outpatients, the number of inpatients and the number of newly admitted inpatients per day during the last 5 years. The data shows that the number of outpatients has remained nearly unchanged at 1,057 persons/day in 1990. However, the number of inpatients has been increasing at the annual rate of 3 ~ 4%. It reached 825 persons/day in 1990. This reflects the overflowing number of inpatients because the Hospital has only 800 beds. It indicates the increase of patients who must be hospitalized.

Compared with 1983 when the Hospital was extended, the number of outpatients has decreased by about 20%. According to the data, the number of outpatients was 1,360 persons/day in 1983, 1,580 persons/day in 1984 and 1,280 persons/day in 1985. The number reached its peak in 1984 and has remained around 1,100 persons/day since then. On the other hand, the average admission number/day was 96 patients/day in 1983 and has increased yearly at the rate of approximately 40%, reaching 140 patients/day in 1990.

Table 3-1-3 Average Daily Numbers of Outpatients and Inpatients in Maharaj Hospital

	1983	1984	1985	1986	1987	1988	1989	1990
Average Outpatient Number/Day	1,360	1,580	1,280	1,088	1,144	1,049	1,008	1,057
Average Inpatient Number/Day	—	—	—	692	748	769	802	825
Average Admission Number/Day	96	104	107	105	115	121	127	140

Source: Maharaj Hospital

Table 3-1-4 shows the average daily number of patients of the emergency section. It is 42 persons/day in the internal medicine department, 34 persons/day in the surgery department and 40 persons/day in the pediatrics department (including surgery).

Table 3-1-4 Number of Outpatients in Emergency Section of Maharaj Hospital 1990

	Daily average	Total number
Medicine	41.76	15,242
Surgery (trauma, etc.)	33.5	12,228
Pediatrics (including surgery)	39.48	14,412
Obstetric Delivery	11.98	4,372
Observation Care Case	4.94	1,803

Source: Maharaj Hospital

(2) Classification by Departments and Medical Examination

Table 3-1-5 shows the medical departments and their percentages of outpatients. The 70% of total number of outpatients are occupied by Internal Medicine, Surgery, Obstetrics Gynecology and Pediatrics.

Table 3-1-5 Main Departments and Outpatient Percentages in Maharaj Hospital 1990

Departments	Percentage of outpatients (%)	Approx. number of patients/year
Internal Medicine	26	78,000
Surgery	14	42,000
Orthopedics	6	18,000
Obstetrics and Gynecology	17	51,000
Pediatrics	13	39,000
Ophthalmology	4	12,000
Otolaryngology	6	18,000
Others	14	42,000

Source: Maharaj Hospital

The situation in the radiology and the clinical test departments are shown in the following table. Both the number of X-ray photographs and the number of clinical tests have remained unchanged during the last several years. The annual X-ray film consumption at the Hospital was 50,886 pictures in 1990. It means about 180 X-rays per day on average. Since the Hospital currently has 4 X-ray rooms, 45 X-ray pictures are taken daily per room.

Table 3-1-6 Number of Tests in Radiology Department of Maharaj Hospital

	1986	1987	1988	1989	1990
Plain Film	37,355	45,523	49,276	49,474	41,631
Special Investigation	5,729	6,782	6,661	6,232	6,186
Ultrasonography	2,273	3,122	3,149	3,248	3,069

Source: Maharaj Hospital

Table 3-1-7 Number of Tests in Physiology Department of Maharaj Hospital

	1986	1987	1988	1989	1990
Inpatient	15,809	28,801	33,532	33,348	28,686
Outpatient	7,589	18,192	22,418	20,367	15,271

Source: Maharaj Hospital

**Table 3-1-8 Number of Tests in Clinical Test Department of
Maharaj Hospital**

	1986	1987	1988	1989	1990
Complete Blood Count	382,242	377,508	424,984	432,635	521,854
Urinary Analysis	117,272	120,343	118,291	115,839	121,399
Stool Examination	15,221	8,659	8,554	8,475	8,885
Blood Chemistry	124,037	134,315	148,504	151,478	151,015

Source: Maharaj Hospital

(3) Number of Beds

As the following table shows, the Hospital has 768 beds at present, or 806 beds if the nurseries in the pediatric departments are included. They consist of 544 beds in common rooms (Nightingale type) and 142 beds in private rooms (single and double rooms).

Table 3-1-9 Total Number of Beds in Each Section of Maharaj Hospital

Section	Type of Ward	Total Beds
Medicine	Common : Male	50
	Common : Female	50
	Private I	25
	Private II	26
	Monk	22
	Total	173
Surgery	Common : Male I	40
	Male II	40
	Female	39
	Private	25
	Total	144
Orthopaedics	Common : Female	45
	Male	50
	Private	30
	Total	125
Paediatrics	Common I	40
	Common II	40
	Nursery I	(19)
	Nursery II	(19)
	Total	118
Obstetric and Gynecology	Common Obstetric	45
	Common Gynecology	45
	Private	12
	Total	102
Eye and ENT	Common & Private Male	30
	Female	30
	Total	60
Infectious	Common	60
	Private	24
	Total	84
Overall	Common	544
	Private	142
	Others	82 (38)
	Total	768 (806)

Source: Maharaj Hospital

(4) Number of Operations

The number of operations (See Table 3-1-10) at the Hospital has remained nearly unchanged during the last 5 years. The number of major operations is about 10,000/year and the number of minor operations is about 7,000/year. The number of major operations has increased by 40% and the number of minor operations has increased by 100% since 1983 when the Hospital was extended. Table 3-1-11 shows the breakdown of the major operations in 1990. The total number of operations was 9,530, and included the number of emergency operations (2,750) and the number of operations on infectious disease patients (1,350). It means that 6 operations are performed daily in one operating room. In light of the fact that the average number of operations/room/day is 2 ~ 3, this means considerable overcrowding.

Table 3-1-10 Transition of Number of Operations in Maharaj Hospital

	Number of major operations	Number of minor operations	Total number of operations
1983	6,970	3,472	10,442
1986	10,064	5,809	15,873
1987	11,161	6,414	17,575
1988	10,563	5,570	16,133
1989	10,437	7,499	17,936
1990	9,530	6,990	16,520

Source: Maharaj Hospital

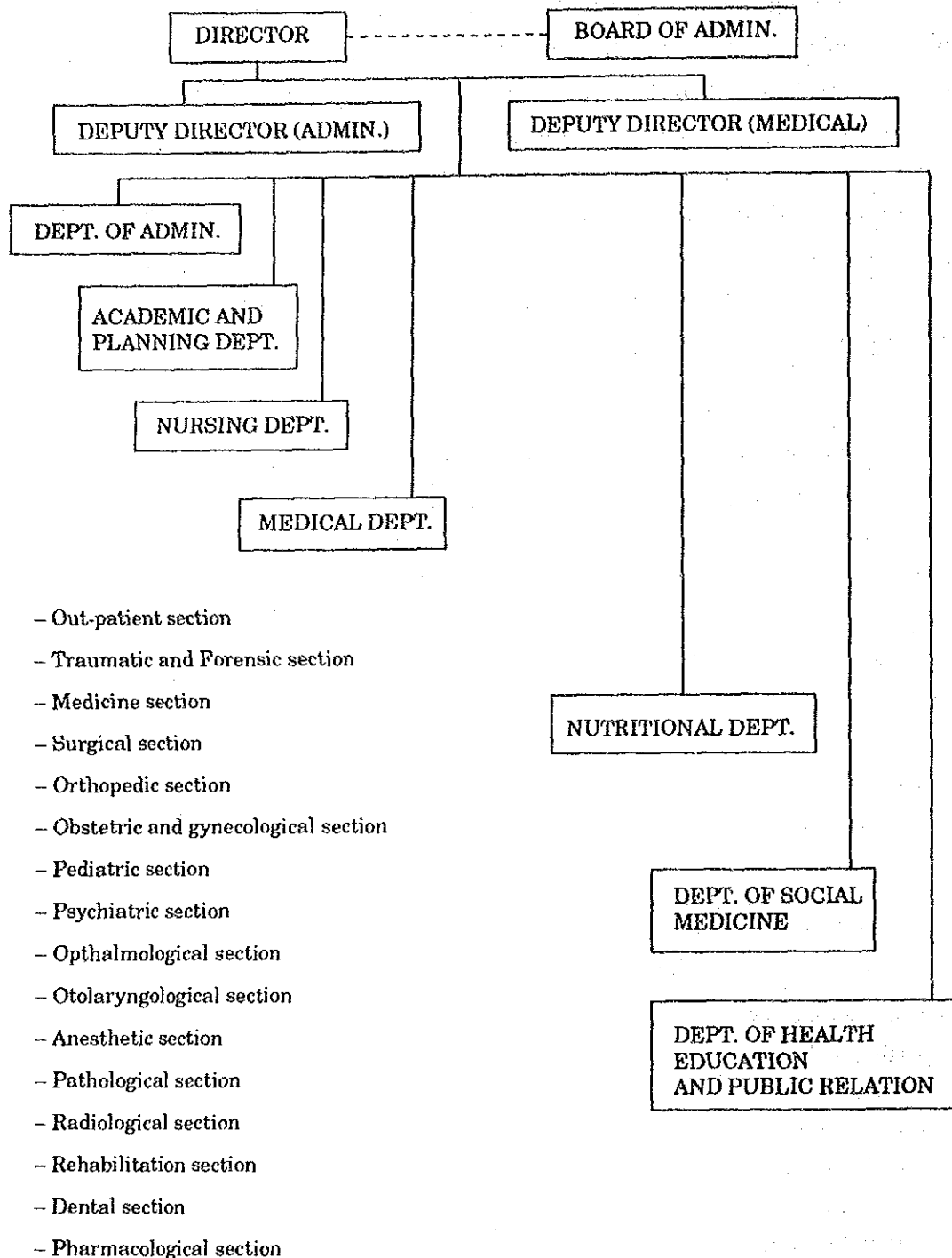
Table 3-1-11 Breakdown of Major Operations in Maharaj Hospital 1990

Classification	Number of operations
General Surgery	3,950
Orthopaedic	1,745
Obstetric	1,221
Gynecology	835
Oto-Laryngology	793
Ophthalmology	510
Tubal Resection	476
Total	9,530
(including emergency operations)	(2,750)
(including operations on infectious disease patients)	(1,350)

Source: Maharaj Hospital

3-1-3 Organization and Personnel

The organization chart of Maharaj Hospital is shown below.



Source: Maharaj Hospital

Figure 3-1-1 Organization Chart of Maharaj Hospital

The Hospital is headed by the director, with one deputy director in charge of administration and the other deputy director in charge of medical services. There are seven departments under them. The Academic and Planning Department is in charge of the training of medical staff, including doctors. The Department of Social Medicine and the Department of Health Education and Public Relation are engaged in the distribution of preventive medicine for infectious diseases and the general knowledge about public health, respectively.

Table 3-1-12 shows the transition of the number of employees during the last 5 years. The total number of employees, including temporary workers, was 1,405 in 1990.

The total number of the Hospital employees has increased by slightly more than 70% since 1983 when the Hospital was extended. The number of nurses increased by 230%, the number of doctors increased by 200% and the number of paramedical personnels increased by 300%. The number of permanent workers has remained nearly unchanged. They are supplemented by an increase in temporary workers. The number of doctors has not changed much during the last 5 years, but the number of registered nurses increased considerably. The problem with the lack of doctors is offset by an increasing number of registered nurses.

Table 3-1-12 Change in the Number of Personnel in Maharaj Hospital

Personnels	1983	1986	1987	1988	1989	1990
Doctors	24	51	50	46	50	46
Dentists	4	5	5	5	5	6
Pharmacists	5	3	5	8	8	9
Registered Nurses	78	138	175	204	249	265
Technical Nurses	37	135	171	200	192	190
Practical Nurses	109	98	92	86	72	62
Paramedical Personnels	32	67	73	84	92	105
Permanent Workers	232	240	242	284	285	292
Temporary Workers	292	357	430	430	430	430
Total	813	1,078	1,243	1,347	1,383	1,405

Source: Maharaj Hospital

3-1-4 Change in Budget

The total expenditure of the Hospital in 1990 was about 145 million baht. The salaries and wages, the medicine expense and the cost of medical instruments and equipment account for 40%, 33% and 15%, respectively. The fixed expenditures amounted to about 10 million baht, or 7% of the whole.

The total expenditure has increased more than 5 times since 1982. The salaries and wages increased by 4 times and the fixture expenditures increased by 8 times. The cost of medical instruments and equipment and the medicine expense multiplied by 140 times and 45 times, respectively. This can be accounted for mainly by the fact that the medicine expense and the cost of medical instruments and equipment have soared relatively.

Table 3-1-13 Transition of Expenses in Maharaj Hospital

(Unit: baht)

Item	1982	1989	1990
Salaries and Wages	15,501,121	46,229,953	57,858,374
Fixed Expenditures	1,222,123	10,024,674	10,191,066
Medicine Expense	1,078,853	42,000,000	48,000,00
Traffic Expense	500,031	612,789	728,246
Material Cost	9,136,276	19,700,717	7,197,454
Purchase of Medical Instruments and Equipment	156,500	19,699,756	21,525,053
Total	26,494,904	138,267,889	144,500,193

Source: Maharaj Hospital

The Hospital's revenue sources consist of government grants, medical expenses paid by patients and donations by wealthy people, which is a practice peculiar to Thailand. The donations are said to account for a large proportion of the Hospital's overall income. Since the Hospital is a public hospital it treats charity patients like monks, poor families, and these patients account for around 40% of the outpatients. This ratio is high compared to other hospitals (around 20% at Songkhla Hospital), therefore its income from treatment expenses is small, thus the Hospital is not providing these patients with sufficient treatment due to budgetary reasons.

Table 3-1-14 shows the transition of the Hospital's budget from 1988 through 1990.

The Government Grant and the Medical Fee & Donation etc. have increased at the average of 10% and 9%, respectively, during the last 3 years.

Table 3-1-14 Transition of Budget in Maharaj Hospital

(Unit: 1,000 baht)

	Government Grant	Medical Fee, Donation etc.	Total Revenue
1988	17,930	78,680	96,610
1989	20,350	84,100	104,450
1990	21,360	94,210	115,570

Source: Maharaj Hospital

3-2 Utilization and Maintenance Condition of Existing Facilities

3-2-1 Present Condition of Buildings

(1) Facility Utilization

The facility which was completed through the Japan's Grant Aid between 1982 and 1983 and the facility which was constructed before that are connected efficiently by means of a corridor and a slope. The facilities have been slightly remodeled due to changes in medical demands and the increase in medical staff since the completion of Maharaj Hospital. However, the facilities in all the departments are being used extremely well.

The outpatient department had 302,259 outpatients in 1990. If the number of working days per year is assumed to be 300, they have approximately 1,000 outpatients daily. This figure is nearly equal to the figure which was estimated at the time of the previous grant aid. It reached the peak in 1984 and has remained nearly unchanged since 1986 as the following Figure 3-2-1.

Under Thailand's medical system, Community Hospitals and Health Centers are operated under Regional Hospitals. It is because these hospitals and centers have recently been undergoing development in Nakorn Sri Thammaraj Province that the foregoing phenomena are believed to be occurring in regards to outpatients.



Source: Maharaj Hospital

Figure 3-2-1 Transition of Annual Number of Outpatients

Because the Hospital is a core medical institution in Southern Thailand, its operation department also treats serious cases which cannot be handled at Community Hospitals and Health Centers. Also, although the latter institutions are being developed, Community Hospitals only have one or two operating rooms and Health Centers have none.

Hence the annual number of operations performed at the Hospital is not decreasing. In the last few years it has been performing around 10,000 operations a year. This means that around six operations are being performed per day per operating room. The equivalent number in Japan is usually less than two operations.

Table 3-2-1 Annual Number of Major Operation

Data	1987	1988	1989	1990	1991 Oct. - Mar.
Orthopaedic	1,732	1,598	1,811	1,745	988
General Surgery	4,690	4,642	4,104	3,950	1,910
Obstetric	882	931	1,008	1,221	631
Gynecology	866	971	957	835	486
Ophthalmology	1,288	769	1,150	510	302
Oto-Laryngology	1,001	911	943	793	367
Tubal Resection	702	741	464	476	226
Total Major Operation	11,161	10,563	10,437	9,530	4,910

Source: Maharaj Hospital

As shown in Table 3-1-9, the Hospital wards can be divided into general (Nightingale) and private types. Most of the wards constructed with the Japan's Grant Aid in 1983 were of the general type. They are operated the basis of a nursing unit of 32 beds.

This hospital however treats more charity patients than other hospitals. Such patients account for around 40% of all its patients and are accepted into the general type wards. Hence, the number of beds per nursing unit sometimes increases to 40.

The Hospital's radiation and examination departments conduct the numbers of X-rays and examinations shown in Tables 3-1-6 to 3-1-8. Since the charity patients are not provided expensive diagnosis and examination such as radiography the departments are operated without problems with their existing facilities. However, if the ratio of charity patients decreases in the future, the frequency of use of these departments could increase, giving rise to space-related problems.

(2) Major Extensions and Alterations

The major extensions and alterations which have been made since the completion of the building under the previous Japan's Grant Aid in 1983 are listed below.

- 1) The waiting room of the obstetric and gynecology department on the first floor was remodeled and is being used as a medical examination booth.
- 2) One of the medical examination booths of the internal department is being used as a social workers room.
- 3) The waiting room of the dentistry department on the second floor was remodeled and is being used as a treatment unit and a preparation room.
- 4) The doctor's room and the nurses' room on the second floor are being used as special examination rooms.
- 5) Room No. 4 of the radiology department was a spare room, but is now being used as a X-ray CT room.
- 6) The office of the radiology department was remodeled and ultra sound equipment is installed in it.
- 7) The electro encephalograph (EEG) room and the electrocardiograph (ECG) were moved and the space for them is being used as an AIDS test room and an administration office.
- 8) The sterilizing room was remodeled and being used as an auto analyzer room.
- 9) The balcony on the side of the north stairs on the second floor is being used as a washing room.
- 10) A rest room, a shower room and a toilet for the staff of the anesthesia department were newly built on the north side of the recovery room.
- 11) Six beds were planned in the recovery room under the previous Japan's Grand Aid, however, only 3 beds are being used at present. The remaining space is being used as a rest room for nurses.
- 12) The lounge of the surgery department is being used as an ultrascope room.
- 13) Two delivery rooms are used as an operation room.
- 14) Half of the balcony on the west side of the delivery section was remodeled into an indoor room and being used as a blood collecting room.
- 15) A pharmaceutical building was constructed in 1985 on the south side of the kitchen.
- 16) A liquid oxygen tank for medical gas was installed on the east side of the operating section.

The locations of the major extensions and alterations mentioned above are shown in Figure 3-2-2.

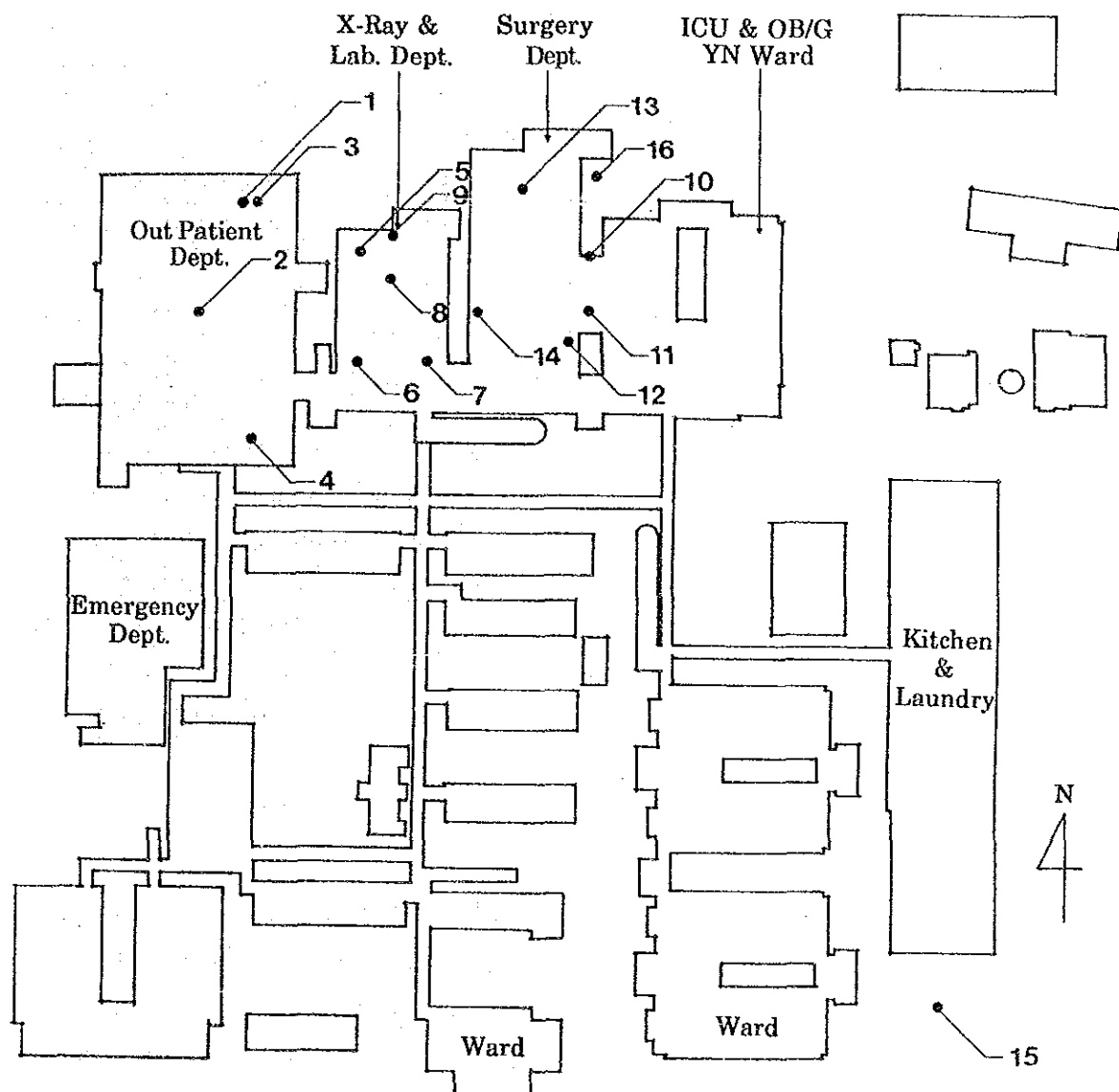


Figure 3-2-2 Major Extensions and Alterations Since 1983

3-2-2 Present Condition of Building Facilities

(1) Emergency Power Generating Facilities

All the facilities of the Hospital, except the building (hereinafter called as New Building) which was constructed by the Japan's Grant Aid, were flooded 3 years ago (April, 1988). After the flood, a repair and recovery budget was provided by MPH and materials and equipment were purchased. At the same time, the emergency generator at Maharaj Hospital was changed from 100 kVA to 500 kVA. The Hospital has 3 generators at present. The first (500 kVA) is used for supplying power to New Building as the second one (100 kVA) cannot operate at present because of trouble with the starting air controller. The third one 100 kVA was used for the all buildings excluding the New Building, however, it too currently out of order. Therefore, only one emergency generator (500 kVA) is currently available for all the Hospital facilities. The Hospital's intention is to use one 100 kVA generator for all the facilities, excluding the New Building, another 100 kVA generator for the Hospital, houses and dormitories, and the 500 kVA generator for the New Building. It should be noted that the stability of the power supply is low in this region. (The frequency of power failures is high) A power failure occurs 2 or 3 times a day for approximately 5 to 10 minutes, however, a power failure often lasts several hours during the rainy season.

(2) Automatic Voltage Regulators (AVR)

The stability of the power supply is low and the voltage fluctuation is extremely high both day and night in this region, sometimes as much as $\pm 20\%$. AVR was built into the medical equipment using advanced medical electronics. As a result, simple equipment, which is not expected to be affected by $\pm 20\%$ voltage fluctuations, such as operating light, autoclaves, film viewer, etc. was affected by unexpected high voltage fluctuations. This resulted in damage to bulbs, heaters, etc. In order to deal with the problem of voltage fluctuations, the Hospital has installed AVRs made in Thailand where necessary.

(3) Water Supply Plant

The water supply plant was designed to supply water only to the New Building. However, it now supplies water to the entire hospital, including the existing facilities. As a result, the capacity of the water supply plant is insufficient for the demand.

Since the amount of water available from the wells in the Hospital is insufficient, water is also being obtained from the public water system. However, even if it is obtained from both the wells and public service water, it is not enough to satisfy current demand,

especially during the dry season. In order to cope with this problem, the Hospital limits water supply and installs water storage tanks at important facilities, such as operating theater. Currently, a new well is being planned in order to solve the water shortage problem.

The valve which switches between well water and service water is operated manually at present. The water plant is operated manually because the automatic control equipment is out of order. (The level controller is normal.)

A water treatment system was installed at the water plant. However, after handing over in 1984, it has never been used. The request for clean water was strong 10 years ago and it is still strong now. The water treatment system was installed in response to a strong request from Thailand. It seems that Thai people do not have a strong awareness of actually maintaining clean water because they do not have a habit of drinking service water directly.

However, clean water is essential because of the nature of the Hospital. It will be important to discuss this issue with the Thai government officials concerned in order to establish a sufficient maintenance system in the future.

The current water supply capacity of the water plant is 250 m³/day. The rate of water intake from service water is also 250 m³/day. The necessary water supply is 500 m³/day for the Project.

(4) Sewage Treatment Plant

Most of the blowers and pumps are out of order. The water level regulator and the rotary part of the clarifier of the sedimentation tank also have troubles. At present, sewage is treated only by aeration, which is the minimum treatment. It seems difficult for the Hospital to maintain the sewage treatment plant without external help because it requires considerably specialized knowledge. A sewage treatment plant of this size should basically be maintained by an agency at least once a year. Both the water plant and the sewage treatment plant require maintenance by manufacturers. In installing and improving equipment it is necessary to construct a system which will not breakdown easily. It is also necessary to examine the maintainability and the possibility of constructing a good maintenance system.

In Thailand the different regulations for sewage treatment are provided to the different facilities. The current required level of treatment of the Hospital are BOD 20 ppm and SS 50 ppm. It is essential to operate the treatment facilities of the Hospital normally in order to meet these regulations.

(5) Medical Gas Facility

At present, gas cylinder is exchanged by T.I.G. (Thai Instrument Gas) in Bangkok once a month. Gas can be obtained in 2 to 3 days in case of an emergency.

As for oxygen, a liquid oxygen tank was installed instead of gas cylinders because of cost. The medical gas supply facilities have the following troubles at present.

- About a half of the connected parts of the oxygen gas facility are leaking.
- Compressed air is unavailable because the air dryer cannot be used due to an air leakage from the auto drain. For this reason, water remains undischarged in the pipe.
- The suction force at the end of the vacuum pipe is weak probably because it is clogged with sludge. For this reason, the Hospital has installed another portable vacuum pumps for temporary.

(6) Air Conditioners

Since the room air conditioner and air cooled package air conditioner, which are used all over Thailand, can be repaired even in Nakorn Sri Thammaraj City, most of them seem to be working smoothly.

(7) Others

Among the other facilities, one refrigerator and one dish dryer in the kitchen and one sterilizer in the laundry are out of order.

(8) Maintenance System

Two mechanical engineers are engaged to maintain the Hospital. One engineer is assigned to the maintenance and management of air conditioners and another is assigned to plumbing maintenance. Although the air conditioners are maintained quite well, the same cannot be said of the other facilities. On the other hand two electrical engineers are assigned to maintain the facilities. Electrical systems shall be introduced not to introduce complicated systems to consider engineer's maintenance capability.

3-2-3 Present Condition of Medical Equipment

The condition of the existing medical equipment, which was provided by Japan's Grant Aid in 1982 and 1983, was examined during the basic design study. It was found that they are utilized fully in all the sections and that all the medical equipment are used quite frequently.

Maharaj Hospital is a main hospital in Southern Thailand and their examinations, treatments and operations exceed their capacity by far. This seems to account for the frequent use of medical equipment in all the department.

(1) Existing Medical Equipment

The existing medical equipment can be classified broadly into those which were provided by Japan's Grant Aid (1982 and 1983) and it's Follow-up (1987) and those which were purchased by the Hospital (1987).

1) The major medical equipment which was provided by Japan's Grant Aid in 1982 and 1983 are listed below.

a) Radiological diagnosis and treatment department

- 300 mA X-ray apparatus
- 300 mA TV apparatus
- 450 mA movable X-ray apparatus
- Automatic film processor
- Film viewer for X-ray photo

b) Surgery department

- Operating table
- Operating light
- Anesthetic apparatus
- Electric suction
- O₂, NO₂ piping system
- Bronchoscope
- Gastroscope
- Colonoscope
- Microsurgical instruments
- ECG cardiograph
- Fiberscope
- Sphygmomanometer
- Operating instrument set

- Sterilizer
- c) ICU (Intensive Care Unit)
 - Cardiac monitor
 - Defibrillator
 - Resuscitator
 - Pressure type ventilator
- d) Anesthetic section
 - Anesthetic apparatus
- e) Pathological department
 - Spectrophotometer
 - Blood PH analyzer
 - Blood WBC counter
 - Flame photometer
 - CO₂ and chloride analyzer
 - Deep freezer
 - Expiration gas analyzer
 - Centrifuge
 - Microscope
 - Microtome
- f) Blood examination section
 - Machine for separating plasma and blood cells
 - Blood bank refrigerator
- g) Ophthalmic department
 - Digital lensemeter
 - Retinoscope
 - Fundus camera
- h) Dental department
 - Dental unit & chair
 - Ultrasonic scaler
 - Dental X-ray
 - Sterilizer

i) Department for social medicine

- Color TV set
- 16 mm cinema projector & camera
- Projector & cassette tape recorder

2) The major medical equipment which were provided by the Follow-up of Japan's Grant Aid in 1987 are listed below.

• Steam sterilizer	1 unit
• Multianalyzing system	1 unit
• Electric surgical unit	1 unit
• Cardiac resuscitation system	1 unit
• Respirator	1 unit
• Infant ventilator with compressor	1 unit
• Blood pressure amplifier	1 unit
• Blood pressure transducer	1 unit
• Bilirubinometer	1 unit
• Dental unit	1 unit
• Spare parts	1 lot

3) The major medical equipment which were purchased by Maharaj Hospital since 1983 are listed below.

- X-ray CT scanner
- Spectro photometer
- Spectro analyzer

(2) Maintenance and Management Conditions of Medical Equipment

The adequate service life of medical equipment is ordinarily 5 ~ 10 years. However, most of the equipment at Maharaj Hospital has been used for nearly 10 years. It was found that some of them were left out of order and unused or not operating smoothly due to the lack of spare parts. (See Table 3-2-2.) The two main reasons for this follow.

- 1) The maintenance system at the Hospital and the supporting system outside the Hospital have been established, even though for some equipment it is hard to get spare parts because there is no agent in Bangkok.

At present, the Hospital has 3 full-time maintenance staff. One of them is a graduate of a professional school and has about 5 years of experience in maintenance. The other two have about 2.5 years of experience.

A member of Japan Overseas Cooperation Volunteers of JICA was dispatched to the Hospital for 2 years from March, 1987, for the purpose of giving guidance on the maintenance of medical equipment. The maintenance staff's technical ability was raised by his guidance in repairing and they became able to repair simple troubles. The maintenance staff's report and the observation of the existing medical equipment repairing tools lead the team to believe that simple repair work is performed at the Hospital.

Because most of the medical equipment at the Hospital is nearly 10 years old, the end of its service life is approaching. In addition, it is not possible to easily make contact with the manufacturer's agent in some cases because the agent is not in Bangkok.

- 2) The purchase route of spare parts and consumable supplies is not established.

The availability of spare parts and consumable supplies depends highly on each manufacturer's and agent's business policy. Necessary parts are not sufficiently stocked in some cases. In such cases, it takes time to obtain them or their prices rise relatively, giving the Hospital budget problems. Those which cannot be repaired at the Hospital must be sent to Bangkok (or even to Japan in some cases.) In such cases, it takes at least 2 ~ 3 months to repair them and the cost of repair is very high. However, it seems natural that the cost of purchasing parts and the cost of repairing this equipment is relatively high because of the geographical condition of the Hospital.

Table 3-2-2 Troubles of Existing Medical Equipment

Room	Item	Remarks
OPD	Electro-cardiograph	The test needle fluctuates
OPD	Electro Encephalo Graphy	The test needle fluctuates. No ink comes out from the mark pen.
OPD	Dental Unit	Water circulation trouble.
OPD	Eye Fundus Camera	It sometimes fails to take a picture.
LAB	Auto Still	The heater is broken.
LAB	Medical Refrigerator	The temperature control does not operated.

Room	Item	Remarks
LAB	Steam Sterilizer	The temperature regulator does not operate smoothly.
LAB	CO ₂ Incubator	Dial regulation trouble.
LAB	Micro Scope	The lens is moldy.
LAB	Micro Scope	The 100 × object lens is broken.
LAB	Microcell Counter	The ability to reproduce hemoglobin (HGB) is poor due to low sensitivity.
LAB	Platelet Counter	No measurements can be taken due to low sensitivity.
LAB	Photoelectric Colorimeter	Dirty lens. Battery deterioration
LAB	Specto Photometer	The recorder does not operate due to electrical problems.
LAB (Blood Bank)	Tube Sealer	Incomplete sealing
Delivery Room	Fetal Monitor	Display recorder trouble
Delivery Room	Resuscitator	Parts trouble
Delivery Room	Suction Unit	Air leakage due to joint trouble
Nursery (1)	Infant Pressure Ventilator	Oxygen, connector and pressure meter trouble, sensor trouble
Anesthetist	ECG Monitor	No wave form is outputted.
	Suction Unit	Gas leakage due to connector trouble
OP	Gastro Fiberscope	Dirty lens due to long use
	Broncho Scope	Dirty lens due to long use
	X-ray	No image is outputted on CRT
ICU	Defibrillator	Repairs are being requested for the manufacturer.

Room	Item	Remarks
ICU	Vacuum, Oxygen Unit	Leakage due to connector trouble
	Bed Side Monitor	Display trouble
	Compressor	Overheating of compressor motor
	Ventilator	Trouble of volume control system
Supply Center	Auto Clave	Fan motor trouble
	Steam Sterilizer	Solenoid trouble
ECG	Electro Cardiograph	Meter trouble
X-ray	X-ray Unit	There are 3 sets, but the function has been lowered considerably due to heavy use for 10 years.

(3) Thai Agents of Existing Medical Equipment

The Hospital pointed out the poor service they receive from the agents when they desire to purchase spare parts and consumable supplies. This seems to be because most of the agents are located in Bangkok, and the Hospital is far from Bangkok.

The Thai agents which provide the existing medical equipment are listed below.

According to the information we obtained from these agents, it was concluded that the following existing equipment cannot be repaired.

Table 3-2-3 Irreparable Medical Equipment in Maharaj Hospital

Department	Equipment	Q'ty
OPD	Autoclave	2
BOPD	Retinoscope	1
LAB	Flame Photometer	1
LAB	Auto Still	2
LAB	Pure Water Equipment	2
Blood Bank	Tube Sealer	1
OP	Operation Table	1
OP	X-ray	1
OP	Surgical Glove Conditioner	1
OP	Suction Unit	5
ICU	Pressure Type Ventilator	5
Nursery 2	Compressor	2

CHAPTER 4 OUTLINE OF THE PROJECT

CHAPTER 4 OUTLINE OF THE PROJECT

4-1 Objective

Maharaj Hospital was expanded from 340-beds to 800-beds under the extension project which was carried out in 1982 and 1983 by the Japan's Grant Aid. It became the main hospital in Southern Thailand both in name and reality. For example, it plays the role of a referral hospital and a medical staff training center for the region. In the year following the completion of extension of the Hospital, the number of outpatients doubled, the number of inpatients increased by 20%, and the number of operations increased by 50%. Until now, the Hospital has provided medical services without any major extension work. However, as the number of operations due to traffic accidents has recently increased enormously due to rapid motorization, it is becoming difficult to maintain the previous quality of medical services in the existing operating rooms and the related facilities.

The Project was planned in consideration of the above. Its objective is to improve the situation of the operating rooms by increasing the number of operating rooms and the related facilities and by installing the medical equipment which is necessary for their function. Its' goal is to continue to offer appropriate medical services to people of the region as the main hospital in Southern Thailand.

4.2 Study and Examination of the Request

4.2.1 Justification of the Project

The number of outpatients has not increased in 1990 due to the improvement of the other hospitals located in the region, but the number of inpatients has increased by 40% and the number of operations has increased by 60% compared with 1983 when the Hospital was extended. Patients of traffic accidents have always been one of the leading groups of inpatients during the last 5 years. According to 1990 data, approximately 6 major operations are performed daily in each of the 6 existing operating rooms. In view of the criteria that 2 to 3 operations/room · day is considered to be normal, the current occupation rate is 200 ~ 300% of the normal level. The fact that the operations for traffic accident patients account for 1/3 of all the operations indicates that general operations must be performed between them. Due to these conditions, it is difficult for the Hospital to maintain the role as the main hospital of the region.

Therefore, this project can be deemed justifiable because the extension of operating rooms and the installation of medical equipment required for operations will enable the Hospital to offer adequate medical services to people of the Southern Thailand.

4.2.2 Study of Implementation and Operational Plan

When this project is completed, Maharaj Hospital will have a total of 12 operating rooms. The Hospital plans to operate the surgery department by 30 doctors and 80 nurses.

Currently, the entire hospital is run by 50 doctors and 518 nurses (about 400 registered nurses). A Japanese hospital of the same size (800 beds) has 165 doctors and 330 nurses on average. A regional hospital (655 beds on average) in Thailand has 62 doctors and 320 nurses on average. Maharaj Hospital obviously has a shortage of doctors, but has more nurses than the average. At present, about 16 doctors are assigned to the surgery department. The Hospital plans to assign 30 doctors to the surgery department, increasing by 14, in the near future when the operating rooms are extended. The number of doctors at the Hospital has been kept about 50 during the last 5 years and no increase has been made. However, both the Hospital and MPH indicate a plan to increase the doctors quickly after the completion of this project. It is supposed possible to increase doctors at this hospital because the number of doctors belonging to MPH increased yearly by 6 ~8% (300 ~400 doctors) between 1984 and 1988.

If an operating room is used 3 times a day, 36 operations can be performed in the 12 operating rooms. This means about 10,000 operations per year. Therefore, the Hospital will have enough capacity for the total number of operations (9,530) in the 1990 fiscal year. Since 2 doctors are ordinarily assigned to one operation, 15 teams can be formed by 30

doctors. If 15 teams perform 36 operations per day, 1 team will be assigned to 2.4 operations per day. The surgery department will be improved remarkably in view of the fact that nearly 10,000 operations are performed by 16 doctors in 6 operating rooms at present.

The personnel expenses due to the staff increase, light and fuel expenses, maintenance and management expenses and repair expenses will increase when this project is completed. The estimated total increase is about 16 million Baht. Maharaj Hospital's budget has increased at the annual rate of 7 ~ 8% (about 10 million Baht in the amount) during the last 3 years. Therefore, it will be difficult to operate the extended part with the ordinary budget growth rate. On the other hand, the average annual budget growth rate of the Office of the Permanent Secretary, MPH, by which the Maharaj Hospital is supervised, was about 10% (about 773 million Baht) during the last 3 years. The budget for Maharaj Hospital must be increased by MPH when this project is completed. This is judged as possible, because the necessary budget (16 million Baht) for the Hospital is equivalent to 2% of the increased budget (773 million Baht) for the office of the Permanent Secretary of MPH.

Table 4-2-1 Annual Budget for Office of the Permanent Secretary

(Unit: million baht)

	1987	1988	1989
Annual budget for Office of the Permanent Secretary, MPH	7,188	7,769	8,735

Source: Ministry of Public Health

4-2-3 Study of Requested Facilities

Six operating rooms and supporting facilities were requested by the Government of Thailand. The extension of the surgery department seems to be justifiable as explained in 4-2-1. The current surgery department is operational due to excessive work by the staff. It is not only necessary to increase the staff, but also to extend and improve the surgery department for restoring a normal working schedule.

An increase in the number of operating rooms will inevitably increase the post-operation treatment of patients. In other words, recovery beds and ICU beds must also be increased. The current recovery room was planned for 6 beds, however, only 3 beds are being used and the remaining space is being used as a nurses rest room. Six beds can be installed in the recovery room by providing a space for nurses separately. Therefore, it can be concluded that this section does not have to be extended under the present project. At present some medical equipment is placed in the ICU room. By removing these equipment and installing medical gas pipes which are carried out by the Government of Thailand, it becomes possible to install three new ICU beds. These equipment should be placed in the

space which is now being used as the anesthesia department's rest room, and this is appropriate in terms of location and space. The anesthesia department's rest room should be set up on the second floor of the new building with the surgery department staff's rest room.

In other words, the facilities which support operating rooms constitute an extremely important factor of the present request although the extension of operating rooms is of course important. Enriching the facilities to support the surgery department will enable securing of facilities for post-operation patients, such as recovery and ICU beds. The study of each of the facilities is summarized hereinafter.

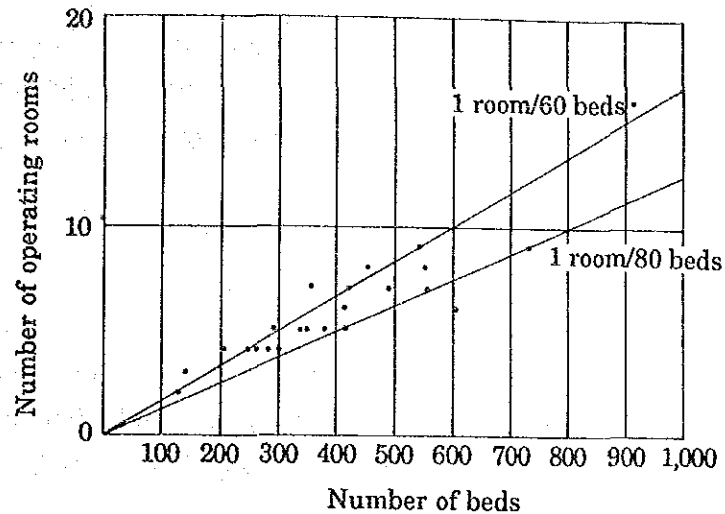
(1) Operating Room

- 1) Approximately 6 operations are performed daily in one operating room. In addition, about two operations per day are connected with traffic accidents. This makes it difficult to perform ordinary operations (operations not connected with traffic accidents). Therefore, it may be concluded that the increase of operating rooms is necessary under present conditions.
- 2) Figure 4-2-1 shows the Japanese data. It shows that a hospital of the 800-bed class needs 10 to 13 operating rooms. In view of the fact that the daily number of operations per operating room is usually below 2 in Japan, it is necessary to construct 6 new operating rooms. The total number of operating rooms will be increased to 12 by constructing 6 new operating rooms under the present project. Then, the daily number of operations per room will become 2 ~ 3.
- 3) At present Maharaj Hospital is performing a considerable number of operations due to traffic accidents. Hence it often performs orthopedic operations. Since it also performs neurosurgery due to traffic accidents it has already installed a X-ray CT scanner. Since these operations comprise special neurosurgical and orthopedic operations it is necessary to construct operating rooms specially designed for them.

The new operating rooms will be more convenient to use if two of them are designed as special operating rooms. One for the neurosurgery operating room, another for the orthopedics operating room and the other four are designed as standard operating rooms. This will be better than fixing each of the six for a specific operation.

- 4) The linkage between the newly extended operating rooms and the existing operating rooms is essential. From the standpoint of conducting operations, it is not desirable to adopt a system which is completely different from the system of the existing operating rooms. It will be the best to continue using the current

system. Therefore, incidental facilities, such as an equipment storage room and an operation hall, will be necessary for the six new operating rooms.



Source: Outline of Architectural Standard

Figure 4-2-1 Number of Beds and Number of Operating Rooms

(2) Sterilizing Room

- 1) The increase of operating rooms will inevitably increase the machinery and equipment. As a result, the capacity of the existing sterilizing room will be insufficient. Therefore, it is also not desirable to divide up the sterilizing room either operation- or function-wise, so that it will be appropriate to plan a new sterilizing room which is large enough for 12 operating rooms.

(3) Other Supporting Facilities

- 1) The existing locker space and the resting space are too small for the current number of the staff assigned to the operating rooms. Since some increases in the staff is planned after the construction of 6 new operating rooms, a locker space and a resting space which are large enough for the planned number of staff must be provided.
- 2) The dining space which is next to the existing kitchen is not large enough for the current number of staff. It was observed that some of the staff take lunch in their own departments. A space to be used exclusively as a dining space should be designated in order to raise the cleanliness of the surgery department.

- 3) Maharaj Hospital is currently engaged in 24 hour emergency medical service. Therefore, it is essential to provide a night duty staff's room for the surgery department.
- 4) A conference room is necessary for holding a meeting before an operation.
- 5) It is necessary to take a shower after an operation. Therefore, a shower will be planned for every locker room. It is undesirable to go to a toilet outside the zone of the surgery department. Therefore, it is necessary to plan a toilet also for each locker room.

4-2-4 Study of Requested Medical Equipment

It was judged appropriate to construct six (6) new operating rooms and related facilities. A supply of 21 types of major medical equipment and other related equipment was requested in order to assure smooth medical activities in the facilities.

(1) Content of Medical Equipment

The requested medical equipment can be broadly classified into those for the operating section, those for ICU and those for the other sections. They were studied in relation to the facilities where they are to be used. As a result, it was concluded that the requested equipment can strengthen the functions of not only the operating section, but also the related sections. The requested equipment was judged to be appropriate, with some exceptions, as explained below.

1) Operating theater

- Operating table:

Operating tables for general operations and those for orthopedic surgery and neurosurgery are requested. These operations require specially designed operating tables.

- Anesthetic ventilator:

Long operations have recently been increasing in Thailand due to the diversification of operations, technological changes and because of the fact that conventional manual anesthesia has become insufficient. This equipment enables the anesthesia to be automatically administered.

- ECG monitor with blood pressure monitor:

This equipment is used for monitoring the patient's ECG data and blood pressure continuously during the operation in order to ensure his safety. It is essential for operations.

- Defibrillator:

This equipment restores the heart which has stopped pulsation to the normal state. It is essential not only in operating rooms, but also in ICU.

- Pulse oximeter:

This equipment is used for continuously measuring a patient's oxygen saturation in arterial blood during an operation in order to ensure his safety. It is essential for operations.

- Endoscope:

This equipment is used for diagnosing troubles of the lungs, broncho and digestive organs before an operation. Specially, an endoscope with a TV system is very useful for operations because an affected part can be observed in real time by more than one person.

- Ultrasonic apparatus:

This equipment is used for diagnosing the affected part ultrasonic waves. Before the operation, it is very useful for making a quick diagnosis and for raising the safety level.

- X-ray apparatus:

Orthopedic surgery requires this equipment for checking the position of bones before the operation. Specially, an X-ray apparatus with a TV system is very useful for operations because it enables more than one person to observe a patient simultaneously.

- Laser apparatus for ophthalmic:

Ophthalmic operations account for only about 4% of all the operations. Since cases which need a laser apparatus will be very rare, it was judged early to supply this apparatus in consideration of the operating efficiency.

2) ICU

- Volume ventilator:

An volume ventilator is essential not only for the treatment of respiration troubles, but also for the preventive respiration management of patients suffering from shock or serious injuries and patients after operations.

- Wall type suction unit:

Since various equipment is installed around the bed in ICU, a wall type suction unit is essential for sucking dirty substances, blood, saliva etc.

3) Other sections

- Emergency equipment:

The other sections require various equipment, such as universal operating table, operating lights, defibrillator, ECG monitor with B.P. monitor, etc.

(2) Operation, Maintenance and Management Ability

In order to avoid trouble and confusion regarding equipment usage, it is best to select medical equipment with which the Hospital staff are familiar. Technological guidance on the operation and the maintenance of the equipment is to be given at the time of delivery in order to avoid confusion and to assure the smooth operation of equipment.

As the Hospital has its own maintenance staff, good maintenance can be expected by giving technological guidance of maintenance and inspection procedures at the time of delivery and by establishing the routes with agents.

Maintaining the planned equipment to be provided will require a cost of roughly 5 million baht a year. In the last two years the Hospital has paid maintenance expenses of 392,000 baht a year. While the expenses are rapidly increasing at a rate of around 20% a year (around 85,000 baht), covering the expenses for maintaining the equipment to be provided by this program will require a budget increase of 13 times. It is difficult to rely solely on the Hospital's income in covering this increases, so that it will be necessary to increase the budget appropriated by MPH.

4.3 Project Outline

4.3-1 Executing Agency and Operational Structure

The six new operating rooms and the related facilities to be constructed by this program will be incorporated into the surgery department of the existing organization of the Hospital. They will be operated by Maharaj Hospital.

In 1990 Maharaj Hospital had 46 doctors and 455 nurses. The number of doctors will increase to 60 if they are increased by 14 during the five years as planned. The number will approach 62, the average number at the 17 Regional Hospitals in Thailand. However, for a large 800-bed hospital the number at Maharaj Hospital is still small compared to 81 doctors at Chon Buri Hospital (705 beds) and 83 at Ubon Ratchathani Hospital (900 beds). On the other hand the number of nurses at Maharaj Hospital is 455 while Chon Buri is 351 and Ubon Ratchathani is 393. Hence as a whole the Hospital can be said to be compensating for the shortage of doctors with nurses.

The increase in operating rooms will only change the Hospital's operation department and will not greatly affect the existing organization or the operational structure of the Hospital as a whole. Due to the increase of staff caused by the enlargement, the operation department will ultimately be made up of 30 doctors, 80 nurses and other supporting staff for the sterilization room. The operations will be performed by teams organized for specific purposes. If each team is made up of the usual number of staff (two doctors and five nurses) the new operational structure will enable the formation of 15 teams. If one team performs two to three operations a day it becomes possible to perform the annual number of major operations currently performed at the Hospital (around 10,000).

4.3-2 Plan of Operation (Activity)

The Hospital will have 12 operating rooms after this project is completed by the Japan's Grant Aid. The Hospital currently has 6 operating rooms. One of them can be used for operations on infectious disease patients. The Maharaj Hospital has a plan to modify one of the existing operating rooms (to be carried out by the Government of Thailand) for operations on infectious diseases after the present project is completed. When the modification is completed, infectious disease operations can be performed in 2 operating rooms total. The other 4 existing operating rooms can be used for various operations. Emergency operations are performed mainly in these 4 rooms. The six new operating rooms will be constructed under the present project. They will have a higher cleanliness standard than the existing ones in order to meet the recent advanced technology and safety. One will be used for orthopedics, another for neurosurgery and the remaining 4 for

general operations. One of these 4 general operating rooms is large enough to be modified into a room for heart operation in consideration of the future medical demand and activities, which will be carried out by the Government of Thailand.

The Hospital currently sends several doctors to Bangkok every year for a training in order to raise the standards of the medical technology. They are also planning to increase the number of doctors by about 5 yearly in the future.

4-3-3 Location and Condition of Project Site

(1) Location

The site of the Project is located in Maharaj Hospital in Nakorn Sri Thammaraj province. It is about 800 km from Bangkok and takes about 2 hours from Bangkok by air. The site is convenient for cars because it faces a main road in the city.

Nakorn Sri Thammaraj province is the largest province (approx. 10,170,000 km²) in Southern Thailand. Surattani Province is located in the north while Songkhla, Surani and Pattalung Provinces are located in the south. Krabi Province is located along the western side of Nakorn Sri Thammaraj Province while the eastern side is bordered by the ocean.

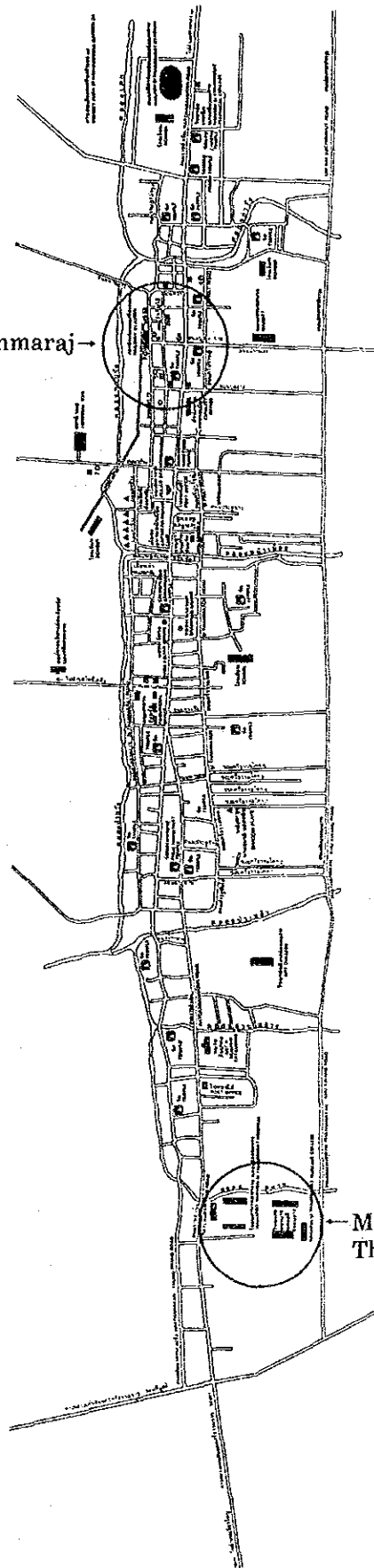
(2) Site Description

The site forms a trapezoid about 750 m long from east to west, and 200 m – 300 m long in the south north direction on the west side and the east side, respectively. It faces main roads on both the east side and the west side.

Most of the Hospital facilities including the main hospital entrance are located on the western side of the site. The Primary Health Care Center, which was constructed under the Japan's Grant Aid, is located on the eastern side at the site while a nursing school is located at the center.

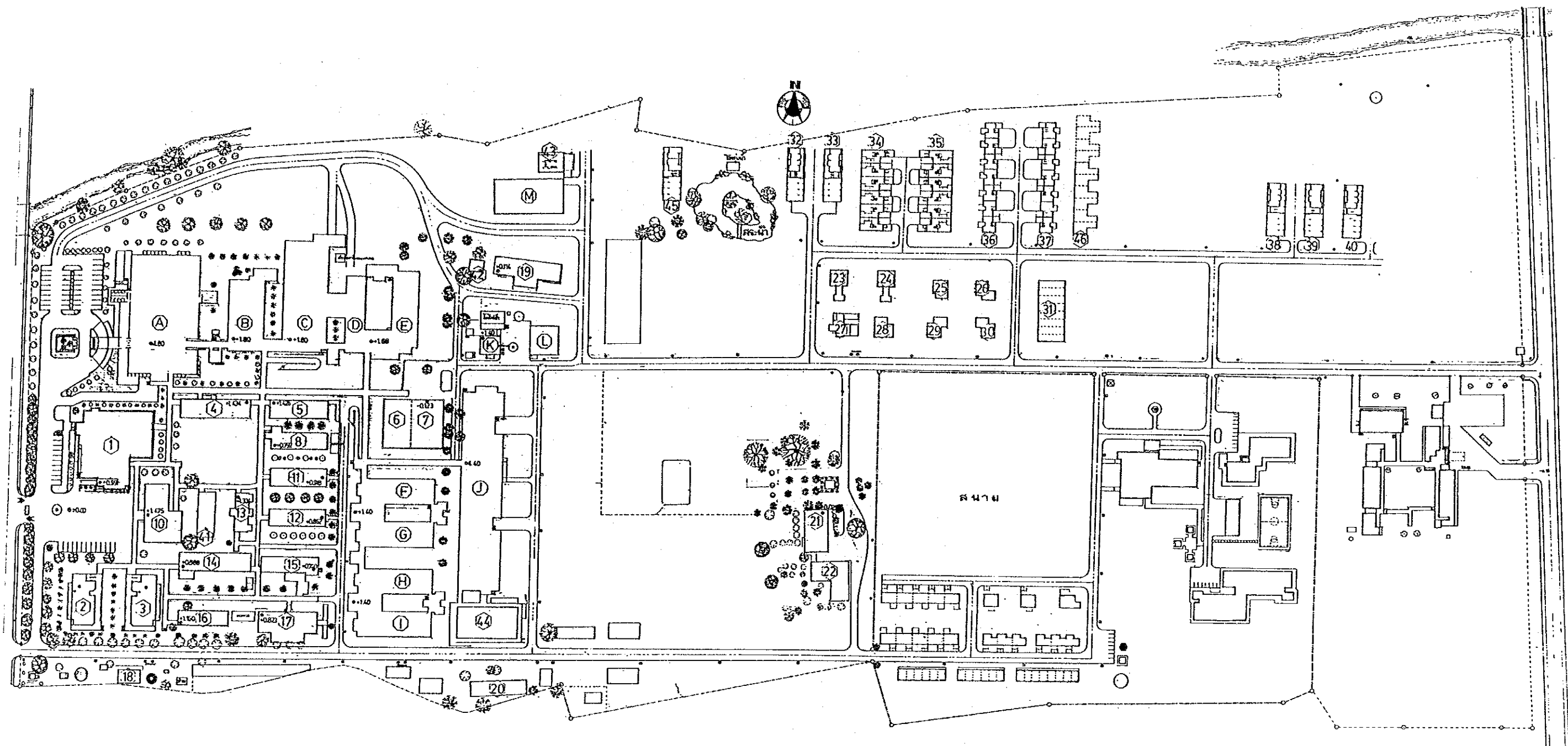
The project site is on an incline facing the river. Therefore, it is about 1.5 m lower in some places. The Hospital ground is flooded 2 or 3 times every year during the rainy season, with the water depth ranging from about 50 cm to 1.0 m in some cases.

Nakorn Sri Thammaraj →
Railway Station



→ Maharaj Nakorn Sri
Thammaraj Hospital

Figure 4-3-1 City Map of Nakorn Sri Thammaraj



- | | | | | | |
|-----|------------------------------------|-------|---------------------------------------|-------|-----------------------------------|
| A | : Outpatient treatment ward | 1 | : Management and emergency ward | 17 | : Supplies ward |
| B | : Examination and radiography ward | 2-3 | : General ward | 18 | : Electricity room and water tank |
| C | : Operation and delivery ward | 4 | : Management ward | 19-43 | : Hospital quarters |
| D | : ICU ward | 5 | : Case history ward | 44 | : Medicine manufacturing ward |
| E | : Rehabilitation ward | 6-7 | : Service ward | 45 | : Hospital quarters |
| F-I | : General ward | 8 | : General ward | | |
| J | : Kitchen and washing Linen ward | 9 | : | | |
| K | : Electricity room | 10 | : Examination and nurses' office ward | | |
| L | : Water tank | 11-15 | : General ward | | |
| M | : Water-purifier tank | 16 | : Nurses' quarters | | |

Figure 4-3-2 Existing Buildings in Mahareaj Hospital

(3) Ground Conditions

A standard penetration test was given to the ground of this site up to -21.0 m from ground level. The result showed that a silty clay layer which changes from to compact exists up to a depth of about 13 m. Then a sand layer exists up to -21.0 m from ground level. The ground-water level was -1.8 m from ground level.

The silty clay layer, which is the surface layer, is insufficient for supporting this building. Therefore, it is judged that a pile foundation is adequate for this building.

Concrete pile of 25 to 40 cm in diameter which are supported by the sand layer at GL-14.0 m are adequate for this building. The yield strength of a pile will be determined by adding the frictional resistance of the surface of a pile to the bearing power at the end of a pile and by dividing the result by a safety factor (2.5 - 3.0).

(4) Meteorological Conditions

The temperature ranges from 17.6°C to 38.5°C, with average temperate approximately 27.6°C. The relative humidity rarely goes below 70%, and is usually about 80 - 90%.

The heaviest amount of rainfall occurs during the rainy season (October through January). The amount of rainfall is over 500 mm/month during the rainy season. From January through April, the wind comes from the East, May through September, the wind comes from the Southeast and October through December has a Northern wind. The average wind velocity is 2.6 m/sec., however wind can reach speeds up to 28 m/sec.

(5) Earthquakes

It may be said that Thailand has almost no earthquakes because it is outside both the circum-Pan-Pacific earthquake belt and the Himalaya earthquake belt. However, small earthquakes have been known to occur in the past, though they have hardly caused any damage.

4-3-4 Outline of Facilities and Medical Equipment

(1) Outline of Facilities

The major facilities which are planned under the present project are listed below.

- 6 operating rooms

- 1 orthopedic operating room (54 m²)

- 1 neurosurgical operating room (42 m²)

- 4 general surgical operating rooms (42 m² × 3, 54 m² × 1)

One of the general surgical operating rooms is to be large enough to perform cardiac surgical operations in future. However, the modification and the installation of equipment which is necessary will be carried out by the Government of Thailand.

- Sterilizing room (washing room, assembling room, existing sterilizing room, dressing room, etc.) (189 m²)
- Operating hall (234 m²)
- Temporary washing room (10 m² × 3)
- Instrument storage (10 m² × 3)
- Dressing room (separate rooms for males and females)
- Lounge (separate rooms for males and females)
- Dining room
- Conference room
- Night duty staff's room (separate rooms for males and females)
- Toilet, shower room (separate rooms for males and females)
- Others

A building of the following specifications satisfies the above functions and has a linkage with the existing facilities.

- Story and structure: Reinforced concrete partly steel structure, 2-storied building
- Building area: 1,232 m²
- Total floor area: 1,699 m²
(Floor area for balcony, terrace 757 m²)
- Facilities:
 - 1st floor – Operating rooms, sterilizing rooms
 - 2nd floor – Staff rooms for surgery department

The present project is the extension of operating rooms. The linkage with the existing operating rooms is important for using the new rooms efficiently. Therefore, it is important to consider not only the 6 new operating rooms, but the entire operation theater comprising 12 operating rooms. It is essential to modify the existing operation theater, which will be carried out by the Government of Thailand. The major necessary modifications to function the whole operation theater as a combined theater are given below.

- 1) Connect the new operating building and the existing operating theater by moving the washing rooms of the existing operating rooms (No. 3, No. 5) to the north corridor.
- 2) Modify the existing sterilizing room completely and change it to rooms for the anesthetics department, a arthroscope room and the office of the surgery department.
- 3) Enlarge the waiting corridor by eliminating the office of the existing operation theater.

- 4) Modify the existing doctors' lounge and dressing room and change them to an endoscope room.
- 5) Raise the cleanness of the existing operating rooms by modifying their entries on the corridor side.
- 6) Modify the existing rooms of the anesthetics department (to be extended by the Government of Thailand on the north side of the recovery room) and change them to ICU instrument storage.
- 7) Install a floor drain on the floor of the toilet space and construct a low rising structure along the boundary with the operating hall for stopping water.
- 8) Construct a doorway on the corridor side of the existing operating room No. 2 so as to make it into an operating room for performing operations on infected patients.

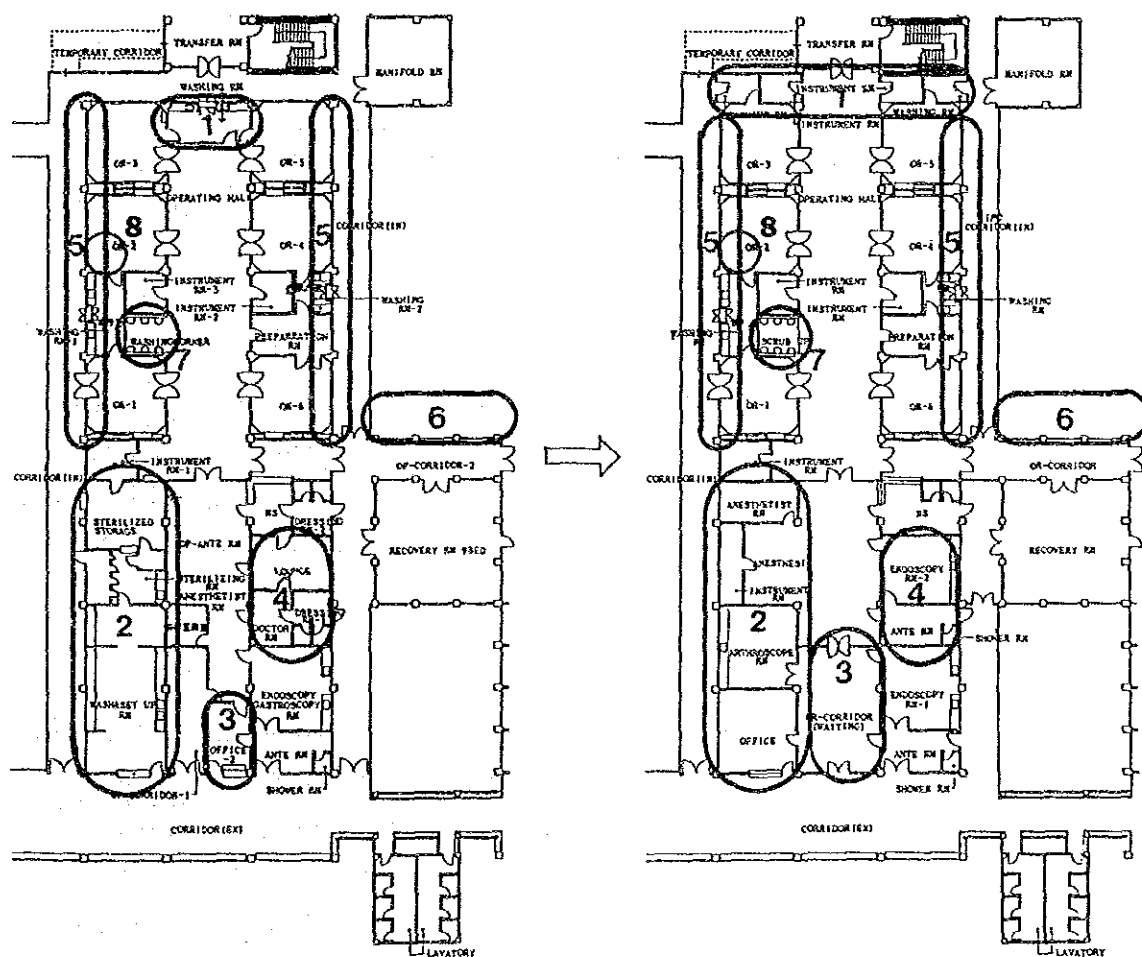


Figure 4-3-6 Major Necessary Modifications

(2) Outline of Medical Equipment

The major medical equipment which is planned under the present project is listed below.

1) Equipment related to operating theater:

Operating table, Operating light, Anesthetic apparatus, Anesthetic ventilator, ECG monitor with blood pressure monitor, Defibrillator, Pulse oxymeter, Electric surgical unit, Electric suction, Sterilizer, Endoscope, Ultrasonic apparatus, Surgical TV X-ray apparatus, etc.

2) Equipment related to ICU (Intensive Care Unit):

Ventilator, Infant ventilator, ECG monitor with blood pressure monitor, Pulse oxymeter, etc.

3) Other equipment:

Operating table, Ventilator, ECG monitor, etc.

4-3-5 Maintenance and Management Plan

(1) Facility Maintenance and Management Plan

1) Operation and management

When this project is completed, the facilities will be operated and managed by Maharaj Hospital and MPH. Maharaj Hospital must establish a system not only for continuing medical activities, but also for cleaning, repairing and inspecting the facilities. The Hospital needs MPH's cooperation for the personnel plan, the budget plan, etc.

2) Personnel plan

The number of medical staff at Maharaj Hospital is currently 1/3 to 1/2 of MPH's standards. As a result, the surgery department also has a shortage of staff. It is essential to increase the number of medical staff after the completion of this project. In order to do this MPH's cooperation is necessary.

In 1991 the total number of doctors will be increased by 6, with those relating to operations will be increased by 4. The number of doctors will subsequently be increased by 4 or 5 every year.

Table 4-3-1 Number of Physicians

	1988	1989	1989	1991
Outpatient Section				
- Physician	1	1	1	1
Traumatic and Forensic Section				
- Physician	1	1	1	1
Medicine Section				
- Physician	9	9	9	10 (1 will begin in June '91)
- Compulsory Doctor	1	1	1	1
Surgical Section				
- General Surgeon	2	4	3	2
- Neurosurgeon	1	1	1	1
- Urological surgeon	1	1	-	-
- Plastic Surgeon	1	-	-	-
- Paediatric Surgeon	1	1	1	1
- Compulsory Doctor	2	3	2	5 (3 will begin in Apr. '91)
Orthopaedic Section				
- Physician	3	3	4	5 (1 will begin in June '91)
Obstetric and Gynecological Section				
- Physician	7	7	7	7
Paediatric Section				
- Physician	5	6	5	6 (1 will begin in June '91)
- Compulsory Doctor	1	2	2	2
Ophthalmological Section				
- Ophthalmologist	1	1	2	2
- Compulsory Doctor	-	-	-	-
Oto-Laryngological Section				
- Oto-Laryngologist	3	3	2	2
Anaesthesiological Section				
- Anaesthesiologist	1	1	1	-
Pathological Section				
- Physician	1	1	1	1
Radiological Section				
- Radiologist	3	3	2	2
Department of Social Medicine	1	1	1	1
Department of Health Education and Public Relation Health (also work in Med. Sect.)	-	-	(1)	(1)
Technical Training Section (also work in Med. Sect.)	-	-	(1)	(1)

Source: Maharaj Hospital

3) Building maintenance

The normal maintenance of the building will consist of routine cleaning and repairing of the wear and tear due to use and aging. Since the present project is an extension of the operating theater, it requires a higher degree of cleanliness than ordinary rooms. Since the new facilities must be cleaned thoroughly and frequently, it will exert a good influence on the users of the facilities. They will use the facilities carefully and discover breakages and troubles more quickly. This will prolong the service life of the medical facilities and equipment.

The body of the building may not require any repairs during the next 30 years. Therefore, the repair work will consist mostly repairs to interiors and exteriors. The Hospital must establish a planned inspection and repair system for ensuring smooth and adequate repair work.

4) Building facility

The maintenance work required for the building facilities includes routine operation management of various equipment (electric, air-conditioning, ventilating, water supply, sewage water treatment, sanitary facilities and medical gas equipment), the periodical inspection and repair of equipment and instruments and the acquisition of spare parts. Therefore, technicians who understand the above equipment and instruments must be employed as full-time maintenance staff. In addition, the maintenance and management of water supply and sewage treatment facilities are an important issue at Maharaj Hospital. Concerning the water supply and sewage treatment facilities, the expenses required to dispatch engineers from external manufacturers and to conduct periodical inspections should be secured. The service life of building equipment is generally 10 to 15 years. Therefore, renovation expenses must be secured when they reach the end of their service life.

5) Medical equipment

a) The medical equipment which is to be installed under the Project must be ready to use for 24-hour medical services. Therefore, they must always be maintained in good condition. For this purpose, the Hospital should conclude a periodical inspection service contract with their suppliers. They must establish an intermittent maintenance system comprising the required periodical services to execute. The Hospital must also establish an internal maintenance system and conduct sufficient routine maintenance and

inspections. The medical equipment which require routine maintenance and inspection can be classified as follows.

- Equipment for X-ray examinations
- Equipment for ultrasonic examinations
- Equipment for patient monitor
- Endoscopes
- Sterilizing equipment and apparatuses
- Equipment and apparatuses for operations

b) Securing experienced maintenance staff

If experienced maintenance and management staff are employed, initial troubles can be repaired. Since it will increase the use rate of the medical equipment, it is necessary to secure experienced maintenance and management staff.

c) Securing consumable supplies

The use of consumable supplies is anticipated to be quite heavy under 24-hour medical services. Each section of the Hospital should make a list of consumable supplies and keep a stock of some quantity at all times.

d) Establishment of maintenance and management system

Medical equipment can be serviced quickly at the Hospital by establishing a routine maintenance and management system. Maintenance staff and repair equipment must be secured for this purpose. The Hospital has three maintenance staff at present. However, they are unable to maintain medical equipment sufficiently because they do not have enough experience and they are responsible also for other equipment (electric equipment). It is necessary to increase the maintenance staff by two in light of the quantity of medical equipment and the frequency of their uses at the Hospital. A system of intermittent maintenance can be established and it can be carried out by securing enough staff.

e) Training in equipment operations

Some troubles with equipment due to incorrect usage were reported during the initial period. Sufficient care must be taken with the new equipment which is to be provided under the Project. Since the existing equipment is nearly 10 years old, new equipment is quite different. Therefore, its operations must be learned thoroughly. Operation training under dispatched experts from Japan is planned under the Project just before the completion of the Project. The use

rate of equipment will be increased and its contribution to medical services will be increased by means of routine maintenance and management.

(2) Estimate of Maintenance and Management Cost

1) Personnel expenses: 7,196,400 baht/year

The personnel expenses for the new staff in connection with the Project are estimated below. The estimate is based on the monthly salaries of the Hospital staff shown in the following table. The personnel expenses immediately after the completion of the Project are estimated. (The average salary is adopted when the range of salaries is large.)

Table 4-3-2 Average Monthly Payroll

Occupation	Monthly Payroll	
Physician	4,850 ~24,000	baht
Nurse	4,250 ~18,100	baht
Technician	3,210 ~12,580	baht
Clerk	2,350	baht
Other personel	2,350	baht

Source: Maharaj Hospital

Doctors:	14 persons × 14,500 baht/month × 12 =	2,436,000 baht/year
Nurses:	35 persons × 11,200 baht/month × 12 =	4,704,000 baht/year
Others:	2 persons × 2,350 baht/month × 12 =	56,400 baht/year
		<u>Total: 7,196,400 baht/year</u>

2) Facility running cost: 3,142,000 baht/year

The annual cost of running the facilities which are installed under the Project was estimated. The cost estimate includes the cost of electric power, and other consumable supplies.

a) Power Charges: 1,507,000 baht/year

• Power consumption:

Lights, receptacles: $60 \text{ kW} \times 10 \text{ h/day} \times 365 \text{ days/year} \times 6/7 \text{ days}$
 $= 188,000 \text{ kWh/year}$

Air-conditioning of operating rooms: $135 \text{ kW} \times 10 \text{ h/day} \times 365 \text{ days/year} \times 6/7 \text{ days} = 422,000 \text{ kWh/year}$

General air-conditioning: $40 \text{ kW} \times 10 \text{ h/day} \times 365 \text{ days/year} \times 6/7 \text{ days} = 125,000 \text{ kWh/year}$

Water supply facilities: $0.9 \text{ kWh/m}^3 \times 125 \text{ m}^3/\text{day} \times 365 \text{ days/year} \times 6/7 \text{ days} = 35,000 \text{ kWh/year}$

Sewage facilities: $7 \text{ kW} \times 24 \text{ h/day} \times 365 \text{ days/year} \times 6/7 \text{ days} = 53,000 \text{ kWh/year}$

Medical gas facilities: $2.6 \text{ kW} \times 0.6 \times 10 \text{ h/day} \times 365 \text{ days/year} \times 6/7 \text{ days} = 5,000 \text{ kWh/year}$

Total Power Consumption: 828,000 kWh/year

• Power Charges:

$828,000 \text{ kWh/year} \times 1.82 \text{ baht/kWh} = \underline{1,507,000 \text{ baht/year}}$

b) Water and Sewage Treatment Chemicals and Sludge Treatment Charges:

396,000 baht/year

• Water treatment chemicals: $0.7 \text{ Baht/m}^3 \times 125 \text{ m}^3/\text{day} \times 365 \text{ days/year} \times 6/7 \text{ days} = 27,000 \text{ baht/year}$

• Sewage treatment chemicals: $10 \text{ ppm} \times 125 \text{ m}^3/\text{day} \times 365 \text{ days/year} \times 10^{-3} \times 330 \text{ baht/kg} \times 6/7 \text{ days} = 129,000 \text{ baht/year}$

• Sludge treatment: $4.2 \text{ m}^3/\text{week} \times 52 \text{ weeks/year} \times 1,100 \text{ baht/m}^3 = 240,000 \text{ baht/year}$

Total: 396,000 baht/year

c) Air Filter Replacement Charges: 304,000 baht/year

• Replacement of filters for operating rooms: 276,000 baht/year

• Replacement of filters for ordinary rooms: 28,000 baht/year

Total: 304,000 baht/year

d) External Subcontracting Charges: 366,000 baht/year

• Water supply facilities periodical inspection cost: 183,000 baht/year

• Sewage treatment facilities periodical inspection cost: 183,000 baht/year

Total: 366,000 baht/year

e) Other Consumable Supplies Cost: 569,000 baht/year

It is estimated to be 569,000 baht/year on the basis of the facility size.

It is assumed that well water is used for water supply. Therefore, power charges are included, but service water charges are not included.

The estimated annual running cost for the facilities are summarized in the following table.

Table 4-3-3 Annual Running Cost for the Facilities

Item	Amount (baht/year)
a) Power Charges	1,507,000
b) Water and Sewage Treatment Chemicals and Sludge Treatment Charges	396,000
c) Air Filter Replacement Charges	304,000
d) External Subcontracting Charges	366,000
e) Other Consumable Supplies and Repairing Cost	569,000
Total	3,142,000

(The running cost of medical gas facilities is excluded.)

3) Facility maintenance and management cost: 200,000 baht/year

The facility maintenance and management cost includes the cleaning, maintenance, inspection, and repairing cost of facilities and of the building.

Since the above cost will increase substantially after the first 5 years, the annual average cost during 10 to 30 years will be estimated as follows.

$$\bullet \ 80 \text{ baht/m}^2 \text{ year} \times 2,455.86 \text{ m}^2 \quad \div \quad \underline{200,000 \text{ baht/year}}$$

4) Medical equipment maintenance and management cost: 5,048,180 baht/year

a) Cost of Maintenance Parts: 887,300 baht/year

(It is assumed as 5% of the cost of each equipment.)

- X-ray apparatus 133,000 baht/year
- Ultrasonic apparatus 181,000 baht/year
- ECG monitor 233,000 baht/year
- Instruments and apparatus for internal medicine 209,800 baht/year
- Sterilizing apparatus 130,500 baht/year

Total: 887,300 baht/year

b) Cost of Maintenance Contract: 335,700 baht/year

This cost becomes necessary after the 1-year free guarantee period following the delivery of medical equipment. The following cost is estimated from the 2nd year. The equipment for periodical inspection are included in the present plan.

The manufacturers' engineering charges by a service contract are estimated below.

- X-ray apparatus: 1 man (3 days) 92,000 × once a year = 50,000 baht/year
- Ultrasonic apparatus: 1 man (3 days) 100,000 × once a year
= 54,500 baht/year
- Anesthetic apparatus: 1 man (2 days) 82,000 × once a year
= 29,800 baht/year
- ECG monitor: 2 men (3 days) 83,000 × once a year
= 90,500 baht/year
- Ventilator: 2 men (3 days) 80,000 × once a year
= 87,300 baht/year
- Sterilizer: 1 man (2 days) 65,000 × once a year = 23,600 baht/year
- Total: 335,700 baht/year

(Travel Expenses)

- 9 persons × 3,300 baht/person = 29,700 baht
Bangkok – Nakorn Sri Thammaraj Air Fare 3,300 baht/person

c) Personnel Expenses: 240,000 baht/year

About two new technicians should be employed in order to improve the maintenance system of the medical equipment which are planned under the Project.

ME (medical electronics technician)	1 person
(At least a graduate of an advanced professional school)	
Medical technician	1 person
(At least a graduate of an advanced professional school)	

The salary for a technician at Maharaj Hospital is 3,219 – 12,500 Baht per month (in 1990 fiscal year). The salary depends on the skill level. The skill level was assumed as 80% in the following estimate.

- $12,500 \times 0.8 = 10,000$ baht × 2 persons × 12 months = 240,000 baht/year

d) Cost of Consumable Supplies: 3,555,480 baht/year

• X-ray photos: 41,631 men × @80 baht = 3,330,480 baht

• Ultrasonic examinations (gel etc.): 4,500 men × @50 baht = 225,000 baht

Total: 3,555,480 baht

(The above cost estimate of consumable supplies is based on the number of patients at Maharaj Hospital in 1990.)

The estimated annual maintenance costs of medical equipment are summarized in the following table.

Table 4-3-4 Annual Maintenance Cost for the Medical Equipment

Item	Amount (baht)
a) Cost of Maintenance Parts	887,300
b) Cost of Maintenance Contract	335,700
(Travel Expenses)	29,700
c) Personnel Expenses	240,000
d) Cost of Consumable Supplies	3,555,480
Total	5,048,180

5) Summary of Estimated Cost

The estimated annual costs for maintenance and management of the planned facilities and medical equipment are summarized in the following table.

Table 4-3-5 Total Cost for Maintenance and Management

Item	Amount (baht/year)
1) Personnel Expenses	7,196,400
2) Facility Running Cost	3,142,000
3) Facility Maintenance and Management Cost	200,000
4) Medical Equipment Maintenance and Management Cost	5,048,180
Total	15,586,580

CHAPTER 5 BASIC DESIGN

CHAPTER 5 BASIC DESIGN

5-1 Design Policy

The implementation of the Project was planned with the recognition that the extension of Maharaj Hospital is important for medical services in Southern Thailand. The study team obtained a sufficient understanding of the background, position, purpose and function of the Project. The team set the following policy on the basis of this understanding in order to plan medical facilities and equipment which are both efficient and easy to use.

- 1) The extension plan of Maharaj Hospital is to be carried out in consideration of its importance and urgency in the medical activities in Southern Thailand and Nakorn Sri Thammaraj province.
- 2) Operating rooms which can function in coordination with the existing facilities are to be planned.
- 3) With a full understanding of the medical examinations, treatments and equipment at the Hospital, the new facilities are to attain higher cleanliness than the existing facilities through the advanced medical technology.
- 4) Most of the facilities under the Project must be air-conditioned in order to increase the cleanliness of the operating rooms. Therefore, air-conditioning efficiency is to be considered in the planning of the facilities.
- 5) The meteorological conditions at the site, including high temperature, high humidity and the concentration of rain during the rainy season, are to be considered for the plan. Importance is to be attached to natural ventilation for those rooms which do not require a high degree of cleanliness. Natural lighting and a floor height which provides enough protection from floods are to be adopted for the entire facility.
- 6) The materials which are available in Nakorn Sri Thammaraj province are to be used as much as possible.
- 7) Medical Equipment Plan

The medical equipment which is considered necessary for the operating rooms the related facilities was selected according to the following basic policy.

- Select those equipment which the Hospital is used to operating and maintaining as much as possible in order to avoid confusion about their operation.

- Select those which are durable and easy to maintain and manage in order to minimize the hospital's burden of maintenance and management expenses.
- Concerning the equipment which is difficult to operate, select those manufacturers which are ready to give an operational training and a technological training at the time of delivery and whenever requested.
- Select those manufacturers which have an agent in Thailand or in an area where equivalent service is possible (such as Malaysia). Select equipment whose spare parts and consumable supplies can be obtained easily.
- Select those manufacturers which have a good after-sales service system.

5.2 Study of Design Condition

5.2-1 Setting Facility Grade

Maharaj Hospital is the central hospital in Southern Thailand. It is one of the largest public hospitals in Thailand. For this reason, it must offer advanced medical services and make a large contribution to the region. However, the operating rooms are currently unable to fulfill the mission sufficiently due to the increased patient load caused by a higher rate of traffic accidents.

The Project extends and improves the operating rooms. The grade of the new operating rooms should be set to attain higher cleanliness than the existing operating rooms in order to meet the needs of recent medical services.

When constructing the new operating rooms, their walls and ceilings should be finished using the dry method (such as using steel panels) which has been developed around ten years ago and is a quite prevalent method recently. The existing operating rooms were planned around ten years ago so that their interior was finished using the wet method (tiles). The dry method will reduce joints on the wall, facilitating cleaning and making it easier to maintain cleanliness. Also, using the dry method will make it easier to install equipment inside the walls, thus reducing unevenness inside the operating rooms.

The floors should be finished in the same way as the old operating rooms (wet method). This will enable staff to clean the floors of the new rooms after an operation in the same way as in the existing rooms without becoming confused. Other support facilities should be planned more or less in the same grade as in the existing set-up.

5.2-2 Setting Facility Size

- (1) The Project covers the extension of the building which was constructed by the Japan's Grant Aid in 1982 and 1983. The linkage and the unity between the existing facilities and the new facilities is one of the most important factors of the plan. A large structural difference between the existing and the new operating rooms is undesirable because it will inhibit the function of the surgical area; therefore, the facility configuration is to be planned on the basis of the existing facilities. The sizes of the facilities are to be planned so as to provide enough space for medical equipment and maneuverability in consideration of the recent medical activities.
- (2) The structure of the whole building is to be planned under the basic policy of maintaining unity with the existing buildings. The shape of the roof, the eaves, the balcony, etc. are to be planned in accordance with this basic policy.

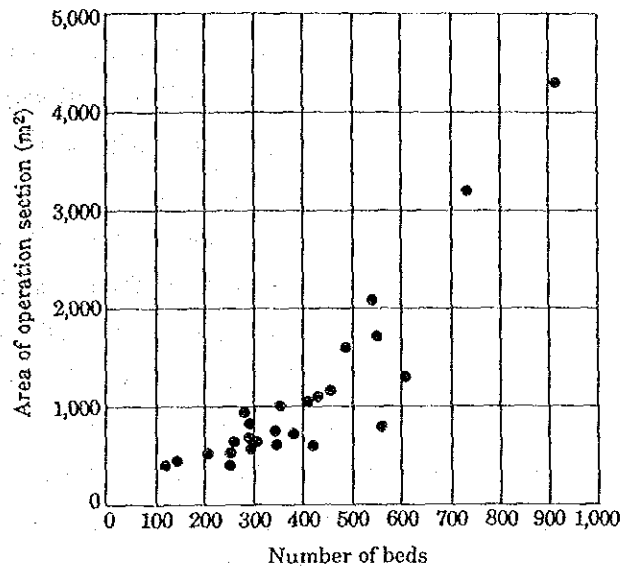
- (3) About 8 years have passed since the completion of Maharaj Hospital. The Hospital staff have increased during this period. An additional staff increase is planned after the Project. Therefore, better staff rooms (dressing room, resting room, etc.) will be necessary as the supporting facilities of the surgery department.

The facility sizes were studied on the basis of the medical activities of the surgery department and by a comparison with facilities in Japan. As a result, the following sizes and floor areas are set for the major rooms.

Table 5-2-1 Floor Area and Function of Major Room

Floor	Room name	Area (m ²)	Function
1	Operating room	42	General operation, neurosurgical operation
	Operating room (Large)	54	Orthopedic operation, general operation (cardiac surgical operation in future)
	Ante room	24	Pre-operation treatment, equipment storage
	Operation hall	234	Clean equipment, hall for staff and patients
	Sterilizing room	189	Washing, assembling, sterilizing, storing operation equipment 126 m ² (existing sterilizing room) × 1.5 = 189 m ²
2	Changing room, Lounge (Nurse)	107	Changing room and lounge for 80 staff of surgery department Locker (900 mm × 600 mm for 4 persons)
	Changing room, Lounge (Doctor)	69	Changing room and lounge for 30 staff of surgery department Locker (900 mm × 600 mm for 4 persons)
	Dining room	52	Dining room for operation staff and sterilizing room staff (30 persons) Kitchen 10 m ² , Dining 1.4 m ² /person × 30 persons = 42 m ²
	Conference room	30	Conference room for 8 – 10 persons 1.5 m ² /person × 10 persons = 15 m ² /room
	Machine room	140	Air-conditioning machine room for operating rooms

The total floor area of the existing surgery department and the extension surgery department will be approximately 3,100 m². This is almost equivalent to the floor area of surgery department at a 800-bed hospital (same size of the Maharaj Hospital) in the following figure.



Source: Outline of Architectural Standard

Figure 5-2-1 Number of Beds and Surgery Department Floor

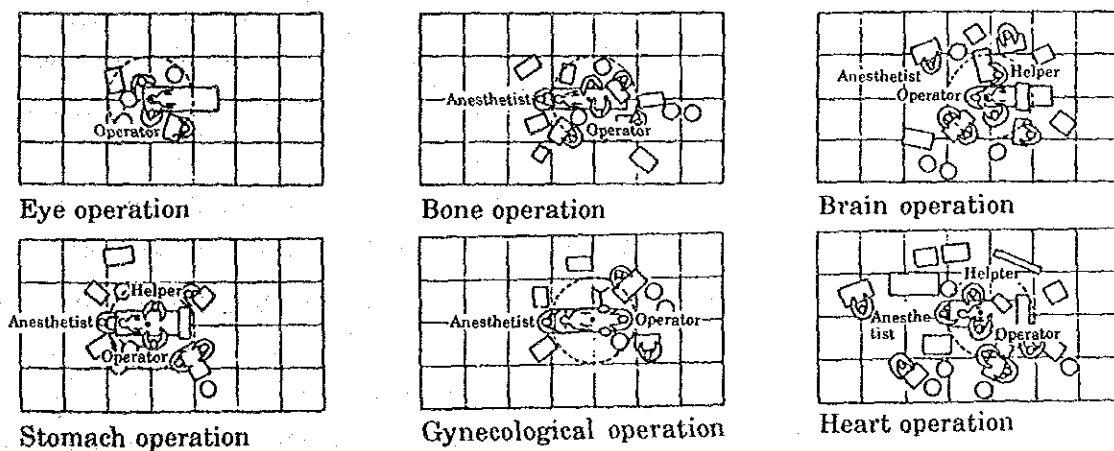
Table 5-2-2 Floor Area of Surgery Department Constructed under Present Project

	1st Floor (m ²)	2nd Floor (m ²)	Total (m ²)
Total Floor Area	1231.92	466.64	1,698.56
Balcony, Terrace Floor Area	—	757.30	757.30

Notes: "Total Floor Area" excludes floors outside the rooms.

5-2-3 Basis for Floor Area Requirement

(1) Operating Theater



Source: Collection of Architectural Data

Figure 5-2-2 Layout of Men and Equipment in Operating Room

As the above drawings show, general operations (stomach, gynecological operations, etc.) differ from bone, brain and heart operations in the medical equipment required. The latter procedures require more equipment; therefore, the operating rooms for bone, brain, and heart operations must be more spacious.

Using space requirements for a stomach operation as a guide, the minimum space required for an operation is 4 m × 4 m. When the floor space for the staff's movement is considered, an operating room of about 6 m × 6 m will be necessary. Since a gynecological operation requires a larger width than a stomach operation according to Fig. 5-2-2, an operating room of about 6 m × 7 m will be necessary.

Current medical equipment tends to have more functions and occupy a larger space than the previous ones along with the recent progress and development. Since ultrasonic sonograms, whose use has recently been spreading in Thailand, are beginning to be installed in operating rooms, operating rooms should be larger than before. The space of 6 m × 7 m is considered the best for general operating rooms of the Project in order to be able to serve for all kinds of operations.

An orthopedic operating room and a cardiosurgical operating room are to be 6 m × 9 m because they require more equipment like a movable X-ray equipment, etc. than general operations.

(2) Operating Theater Support Facilities

The support facilities which are planned are dressing rooms, toilets, shower rooms, lounges, night duty staff's rooms, conference rooms and a dining room. Dressing rooms, toilets and shower rooms exclusively for operation staff are necessary in order to maintain a high degree of cleanliness. Lounges are necessary for waiting for the next operation and for resting. A lounge for doctors and a lounge for nurses should be separate allowing the staff to relax easily. Night duty staff's rooms are necessary because at present the night duty staff are taking naps on recovery beds and the Hospital offers 24-hour emergency medical services.

A dining room is necessary for the staff to have lunch and to have a snack after an operation. Since the staff's dining room has become too small because of the staff increase, large pots containing food are often carried from the kitchen to working rooms. In order to maintain a higher degree of cleanliness food should not be taken into the dressing rooms and the lounges. Therefore, a dining room is necessary.

The sizes of these support facilities are determined by the number of staff belonging to the surgery department and the number of operations per day. At present an average operation at the Hospital is performed by 2 doctors, 1 anesthetist and 5 nurses. It has been determined that 2 operations/day are the maximum desirable for each staff. Since more

than 30 operations are performed daily on average at the Hospital, about 30 doctors (30 operations + 2 operations × 2 doctors) and about 75 nurses (30 operations + 2 operations × 5 nurses) are required. These figures agree with the hospital's staff plan (made in 1991) for the surgery department (30 doctors, 80 nurses) after the completion of the Project.

Therefore, a dressing room must accommodate lockers for 30 doctors and 80 nurses. The locker space for the existing operating rooms is very small. Operating gowns after an operation and those before an operation can be inadvertently mixed even if it is used by the current number of the staff. It will be remodeled into an endoscope room after this project. An ordinary operation requires 4 ~ 5 hours. 30 minutes ~ 1 hour for preparation, 2 ~ 3 hours for the operation, and about 1 hour for cleaning, etc.

The following Figure 5-2-3 shows the planned time schedule of the 12 operating rooms.

According to this chart, 4 ~ 8 rooms are under preparation and cleaning at the same time. The staff are able to rest during this period. Therefore, a lounge for doctors should be large enough to accommodate 8 ~ 16 people at the same time. A lounge for nurses should be large enough to accommodate 20 ~ 40 people at the same time.

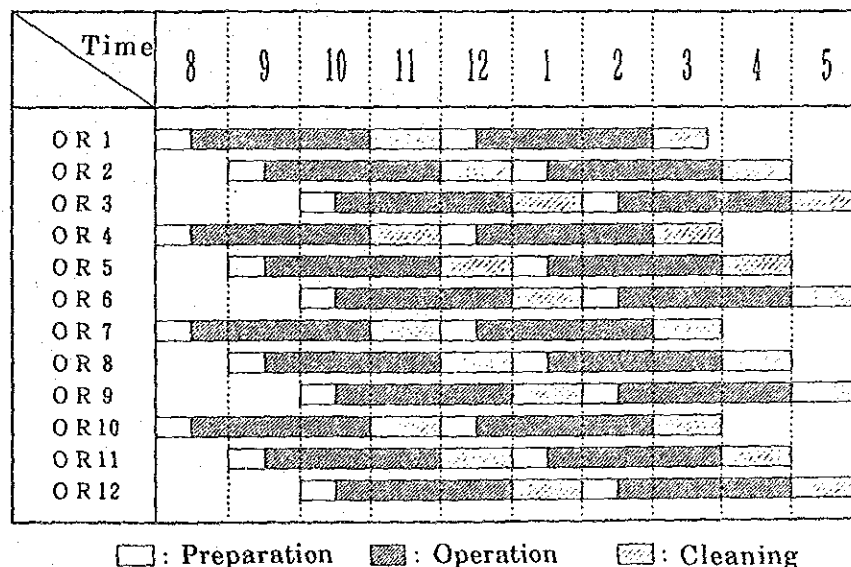


Figure 5-2-3 Planned Time Schedule for the Surgery Department

The dining room may also be used during rest periods. Therefore, it should be large enough to enable 28 to 56 people (doctors and nurses) or 35 to 65 people, including the sterilizing room staff, to take meals. In consideration of the turnover rate (about twice) during lunch hours, the dining room should have a capacity for 30 people.

Conference rooms are used to be the operating staff for making preliminary arrangements on the day before an operation or on the day of an operation. Therefore, the number of the conference rooms must be determined on the basis of the number of the operating rooms. If it is assumed that from 30 minutes to 1 hour is spent on average for a meeting, at least 2 conference rooms are necessary for making preliminary arrangements for about 30 operations performed daily during an 8 hours period.

The layout of the support facilities is shown below.

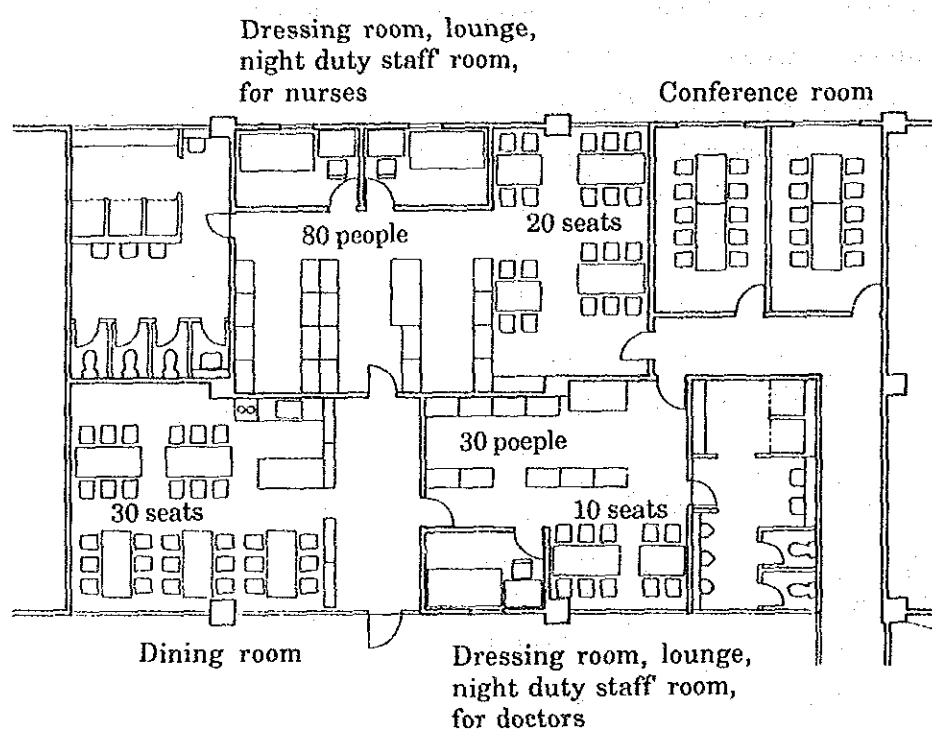


Figure 5-2-4 Layout of Support Facility