

**BASIC DESIGN STUDY REPORT  
ON  
THE CONSTRUCTION PROJECT  
OF  
CENTRAL STORE  
FOR  
MEDICAL SUPPLIES AND EQUIPMENT  
IN  
THE DEMOCRATIC SOCIALIST  
REPUBLIC OF SRI LANKA**

MAY, 1986

**JAPAN INTERNATIONAL COOPERATION AGENCY**

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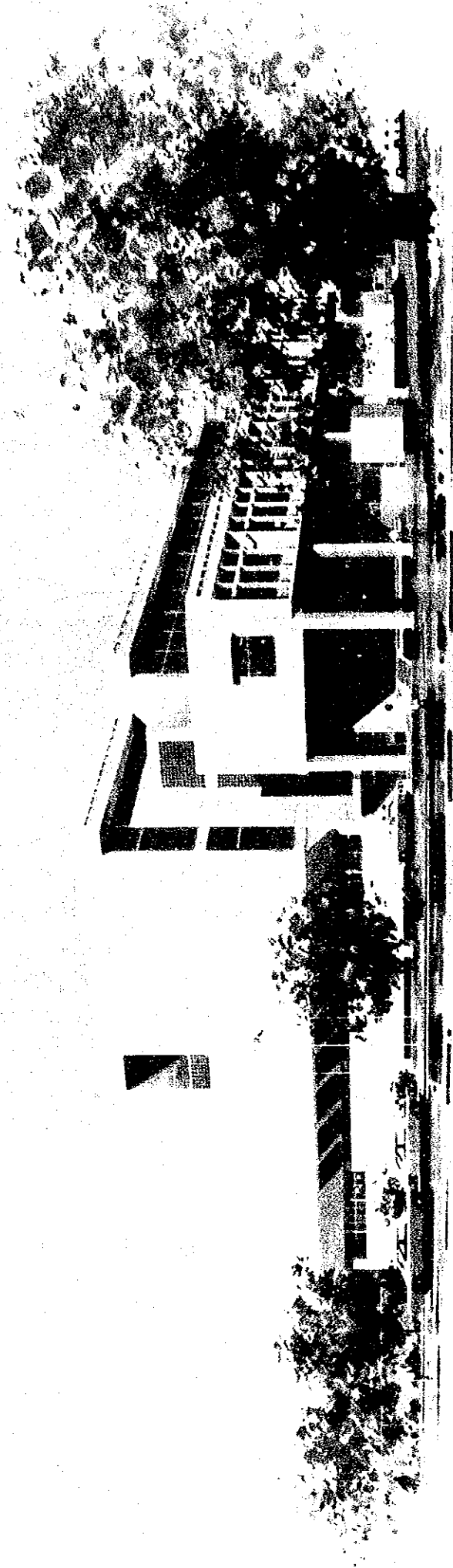
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MAY, 1986

**JAPAN INTERNATIONAL COOPERATION AGENCY**

国際協力事業団

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## P R E F A C E

In response to the request of the Government of the Democratic Socialist Republic of Sri Lanka, the Government of Japan has decided to conduct a basic design study on the Project for the Construction of the Central Store for Medical Supplies and Equipment and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Sri Lanka a study team headed by Mr. Hironao SUZUKI, Head, First Basic Design Study Division, Grant Aid Planning and Survey Department, JICA from January 20 to February 8, 1986.

The team had discussions on the Project with the officials concerned of the Government of Sri Lanka and conducted a field survey in the Colombo area. After the team returned to Japan, further studies were made, a draft report was prepared and, for the explanation and discussion of it, a mission headed by Mr. Mikio NAKAMURA, Deputy Head, First Basic Design Study Division, Grant Aid Planning and Survey Department, JICA was sent to Sri Lanka from April 21 to April 28, 1986. As a result, the present report has been prepared.

I hope that this report will serve for the development of the project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of Sri Lanka for their close cooperation extended to the team.

May, 1986



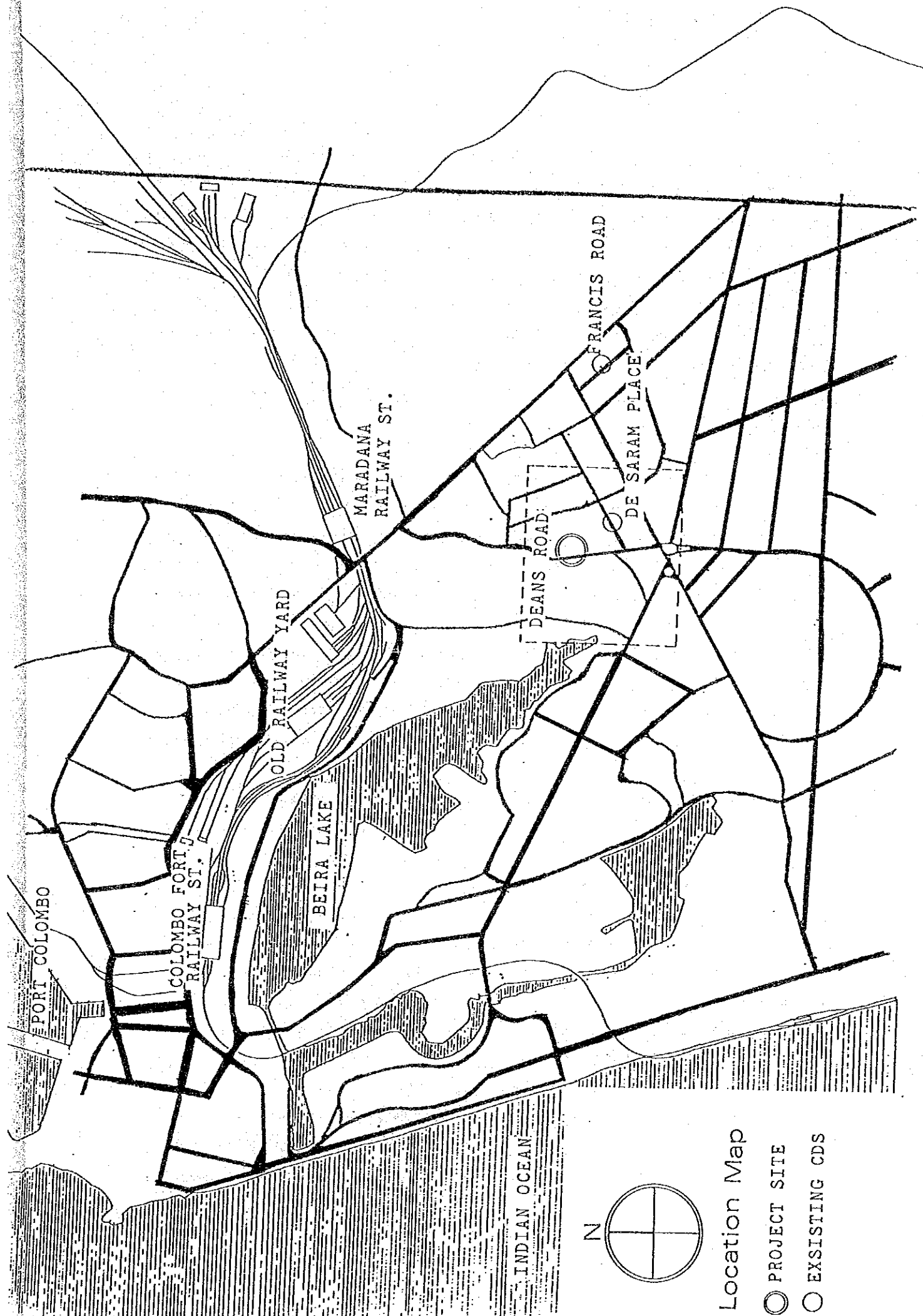
Keisuke Arita

President

Japan International Cooperation Agency







PORT COLOMBO

COLOMBO FORT  
RAILWAY ST.

OLD RAILWAY YARD

BEIRA LAKE

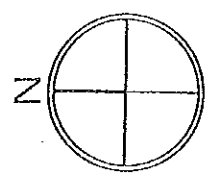
MARADANA  
RAILWAY ST.

INDIAN OCEAN

DEANS ROAD

DE SARAM PLACE

FRANCIS ROAD



Location Map

○ PROJECT SITE

○ EXISTING CDS



## Summary

The Government of the Social Democratic Republic of Sri Lanka (hereinafter called Sri Lanka) has been implementing free medical care to the people at the national and public medical institutions since shortly after the independence from Britain. Under the circumstances, the health conditions of the people improved conspicuously, but it must be borne in mind that the health care system for prevention of diseases is still lagging behind.

With the purpose of improving further the health level of the people, the Government of Sri Lanka is promoting the medical improvement program, based on the promotion of primary health care in conformity with the guideline of the WHO. This program is aimed at preventing diseases and improving the cure by perfecting the medical institution through such measures as development of human resources engaged in medical care, improvement of the various medical institutions, organization of the supporting systems, strengthening of the local sanitary administration, etc., as well as securing the stable supply and improving the quality of essential medical supplies indispensable for the sake of primary health care.

At the present time, Sri Lanka relies on imports for most of the medical supplies and equipment. The procurement and supply of these goods is under the control of the Medical Supplies Division (MSD), and medical supplies received once or twice a year in huge lots from foreign countries are gathered and stored in the 4 Central Drug Stores (CDS) of the MSD scattered at various places in Colombo, and then they are distributed to the medical institutions of the various parts of the country. These CDS, that play a key role in the supply and distribution of these medical supplies and equipment, are scattered at various places in Colombo however, and moreover they are timeworn buildings diverted from other uses that have nothing to do with the intrinsic function of warehouses. That being so, they are not provided with the functions required for storage and distribution of medical supplies, and as a consequence there are frequent cases of deterioration and disuse of the goods guarded therein.

With the object of solving the said problems, the Government of Sri Lanka is planning the construction of the Central Store aimed at functioning at a State Medical Store centralized at one place and provided with functions, environment and facilities appropriate for storage and distribution of medical supplies and equipment, and in this connection it has requested the Government of Japan for a grant aid for the implementation of the Project. In response to the request, the Government of Japan has decided to send a basic design survey team to Sri Lanka, which carried out the field survey from 20 January to 8 February 1986.

This project is part of the program for improvement of facilities for storage and distribution of medical supplies and equipment in Sri Lanka, and is aimed at realizing the provision of medical supplies of good quality and preventing their loss so as to cope with the demand in a satisfactory way, through such measures as implementation of efficient operation and administration for personnel affairs and financing related to the storage of medical supplies, as well as savings in expenses by improving the distribution efficiency.

Regarding the classification scheme and control system for medical supplies and equipment, however, the project does not consider a jump from the present system to a sophisticated modern system appropriate in view of the prevalent situation, and also, with respect to staff composition and assignment, it does not consider it appropriate to aim for manpower saving through mechanization but rather to aim for improved work efficiency by utilizing the existing manpower and thereby upgrade the current system to one that fully exploits the existing staff.

The quantity of medical supplies and equipment stored at CDS is about 10,800 m<sup>3</sup> during the peak time of the year. Those are stored in the existing facilities which have the combined total floor area of about 11,900 m<sup>2</sup>. The proposed project, however, does not call for reconstructing all of the existing facilities but for retaining a part of the facilities and constructing new facilities in addition. In other words, of the medical supplies and equipment handled by MSD, only those

for which specified conditions are indispensable for securing the quality and efficacy would be considered for storage in the new facilities while others will be stored in the existing facilities which are to be retained. The scale of the facilities was established on the premise of limiting the objects of storage to the medical supplies and equipment subject to constraints on storing temperatures and surgical instruments requiring clean storage, and also on the basis of the storage capacity (7,447 m<sup>3</sup>) adjusted in consideration of the delivery schedule of items to be supplied by the Pharmaceutical Formulation Centre of Essential Drugs now under construction with the grant aid of the Government of Japan.

As for the executive institution and the operation system, the MSD is virtually in charge of the pertinent affairs, and it is responsible for the estimation of the demand, determination of the quantities to be procured, procurement and distribution work related to the totality of medical supplies and equipment to be supplied to the national and public medical institutions of the country.

The construction site of this project is where MSD is located (335 Deans Road, Colombo 10). Its total area is 8,600 m<sup>2</sup>, and completely provided with infrastructure. There is a restriction, however, that none of the holy trees standing within the site can be felled or trimmed.

Brief description of the grant is as follows:

(1) Building	3-storied, Reinforced Concrete Structure	
Penthouse:	Machine room for lifts	63.0 m <sup>2</sup>
2nd floor:	Medical supplies and equipment store	2,276.6 m <sup>2</sup>
1st floor:	Administrative office, Narcotic store Air-conditioned store, Cold store Medical supplies and equipment store	3,427.8 m <sup>2</sup>
Ground floor:	Arrival, issue and marshaling space Medical supplies and equipment store Workshop, Rest room, Truck berth	2,925.4 m <sup>2</sup>
Total		9,212.4 m <sup>2</sup>

The building will be provided with two lifts for conveying cargoes, an emergency power generating set and a rack system for storage.

(2) Equipment

Conveying equipment: 5t Lorries, Fork lift trucks, Carts  
Storage equipment: Wooden pallets  
Others: Personal computers, wood working benches and tools

As for implementation schedule of the project, five months are considered necessary for concluding of agreement, detail designing and bidding after Exchange of Notes until work can be commenced, and about 14 months thereafter as construction period. As for the undertakings to be taken by Sri Lanka and Japan, Sri Lanka will undertake charge mainly of the demolition of the existing facilities, ground levelling, laying and connection of service lines of potable water, drainage, power, etc., while Japan will take charge mainly of the construction work, procurement of materials and equipment, and piping and wiring works.

The implementation of this project is expected to make substantial contributions to the medical care system of Sri Lanka, through the elimination of the current economic losses related to medical supplies caused by the inadequacy of the existing storage facilities, and through the distribution of medical supplies of good quality and guaranteed effect. Furthermore, the proposed facilities are indispensable in order to store and distribute the essential drugs produced by the Pharmaceutical Formulation Centre of Essential Drugs without deteriorating their quality and efficacy, and in this context, the two proposed projects to be implemented with the grant aid of the Government of Japan may be claimed to complement each other. As for the maintenance and administration expenses required in connection with these facilities, it was confirmed, as a result of trial calculations based on data presented by the MSD, that there is no risk of obstacle to the operation of the project.

As can be seen, this project has the object of improving the state of things of the storage and distribution of medical supplies and equipment to the national and public medical institutions of the country, therefore composing an important link within the chain of efforts being made by the Government of Sri Lanka within the context of the Program for Improvement of Medical Care, and its soonest implementation is highly recommendable. The implementation of the grant aid of the Government of Japan for the sake of raising the financial resources required by this project is very significant, because it is expected to make substantial contribution to the welfare of the people of Sri Lanka in the form of improved level of health care.

## CONTENTS

	<u>Page</u>
FOREWORD	
MAP	
SUMMARY	
CONTENTS	
CHAPTER 1 INTRODUCTION .....	1
CHAPTER 2 BACKGROUND OF THE PROJECT .....	5
2.1 Improvement to the Health Care Development .....	5
2.1.1 Primary Health Care .....	5
2.1.2 General .....	5
2.2 Status Quo and Problems of Sanitation and Medical Care ....	9
2.3 Outline of the MSD .....	11
2.4 Status Quo of the Distribution and Storage of Medical Supplies and Equipment .....	15
2.4.1 Distribution .....	15
2.4.2 Storage of Medical Supplies and Equipment .....	25
2.4.3 Arrival and Issue of Medical Supplies and Equipment .....	28
2.4.4 Economic Loss of Medical Supplies .....	29
2.5 Contents of the Request .....	31
2.5.1 Summary .....	31
2.5.2 Facilities and Equipment .....	33



	<u>Page</u>
CHAPTER 3 CONTENTS OF THE PROJECT .....	35
3.1 Objective .....	35
3.2 Study of the Request .....	36
3.2.1 Scale of Facility and Equipment .....	36
3.2.2 Formulation of Principal Factors .....	37
3.3 Outline of the Project .....	54
3.3.1 Institution in Charge of Execution and Organization for Operation .....	54
3.3.2 Outline of the Facilities and Equipment to be Donated .....	54
3.3.3 The Project Site .....	56
CHAPTER 4 BASIC DESIGN .....	63
4.1 Basic Policy .....	63
4.2 Basic Design .....	65
4.2.1 Plot Planning .....	65
4.2.2 Architectural Planning .....	67
4.2.3 Equipment Planning .....	90
4.2.4 Basic Design Drawings .....	91
4.3 Scheme for Execution of the Work .....	113
4.3.1 Situation of the Construction Industry and Work Execution Plan .....	113
4.3.2 Scope of Undertakings .....	114
4.3.3 Scheme for Supervision of the Work .....	116
4.3.4 Plan for Procurement of Equipment and Materials ....	120
4.4 Project Implementation Schedule .....	121

	<u>Page</u>
4.5 Maintenance and Management Scheme .....	123
4.5.1 Administrative Structure .....	123
4.5.2 Operation and Maintenance Cost .....	123
4.6 Approximate Estimate of Cost of Works to be Undertaken by the Government of Sri Lanka .....	125
 CHAPTER 5 PROJECT EVALUATION .....	 127
5.1 Social Impact .....	127
5.2 Economic and Financial Evaluation .....	129
5.3 Executing and Operation Structure .....	130
 CHAPTER 6 CONCLUSION AND PROPOSITIONS .....	 131
6.1 Conclusion .....	131
6.2 Propositions .....	132
 APPENDIX	
Appendix I Basic Design Survey	
Appendix II Collected Data	

## CHAPTER 1 INTRODUCTION

Backed by a relatively stable social situation, Sri Lanka has attained steady socio-economic development since its independence from Britain in 1948, in spite of the vicissitudes occurred in the meantime. Shortly after the independence, the Government of Sri Lanka has started the implementation of programs for welfare of the people, with particular importance attached to education, health care, food, nutrition and housing, and in this connection it has put into practice free compulsory education and free medical care in national and public medical institutions. The efforts of successive administrations to improve national health care as a priority policy have contributed to a conspicuous improvement in the health condition of the people, and the average life expectancy is becoming longer as well. Moreover, the Government of Sri Lanka is promoting the Improvement to the Health Care Development, which is a program based on the resolution of the international conference of the WHO held in 1978, having 2000 A.D. as target year and consisting mainly of the promotion of primary health care, with the purpose of further improving the health care level of the people. The program purports to improve the medical institutions in order to better prevent and treat diseases and also to upgrade the quality of essential drugs as well as assure their stable supply. Furthermore, such activities as programs for improvement and expansion of medical institutions, campaigns for prevention of malaria and other epidemic diseases, etc., are also included in the Public Investment Plan (1985-1989) and they are beginning to be put into practice.

It is indispensable to upgrade the level of the medical services and to secure the stable supply of drugs of good quality and guaranteed effectiveness, in order to realize the improvement of the health and medical care systems. Although a few medicine manufacturers exist in Sri Lanka, their combined total output is not large, with no production whatsoever of essential drugs. Consequently, Sri Lanka depends on imports for 78% of all medical supplies (in 1984). Particularly for essential drugs, which are vital for primary health care, it is compelled to depend totally on imports. Most of the essential medical

supplies are manufactured by small- and medium scale overseas pharmaceutical firms because they have low added value and poor profitability in terms of commodities, and there is concern about quality control during the manufacturing process. Moreover, there is lack of uniformity in terms of quality and there are many inferior articles as a consequence of the reliance on imports. As for other medical supplies, there is domestic production of such limited items as sanitary cotton, gauze and bandage, but in reality they rely mostly on imports.

In Sri Lanka, the Medical Supplies Division (MSD), which is a part of the Ministry of Health (MOH), is in charge of the procurement and distribution of the totality of medical supplies and equipment required by the national and public medical institutions of the country. The procured medical supplies are gathered and stored in the Central Drug Stores (CDS) which are under the jurisdiction of the MSD and located at 4 places in Colombo, from where most of them are supplied through the Divisional Drug Stores (DDS) located at 19 places throughout the country while some are supplied direct to the medical institutions at various locations.

Medical supplies and equipment in which MSD is involved are procured once a year by tender. However, as most of them are procured abroad and the use of Sri Lanka flag vessels is specified as a rule to transport them, a considerably long time is required from the time of placing an order to delivery. Moreover, as the frequency of delivery is extremely few, being only about once or twice a year, a large quantity is brought in at one time with the result that a large quantity must be stored at a time. Moreover, the various CDS existing in Colombo are located in old buildings such as a former residence, a locomotive depot abandoned in 1948 and a fiber warehouse, diverted for the current use, all aged about 100 years or more. That being so, they are not provided with the functions regarded as indispensable in centers for storage and distribution of medical supplies because in essence they are buildings diverted from uses that have nothing to do with storehouses of these kinds of goods. Furthermore, it must be borne in mind that there are frequent cases of deterioration and disuse of the medical supplies because these buildings are conspicuously timeworn.

As can be seen, medical supplies being distributed to the people of Sri Lanka are facing serious problems related to quality and stable supply, and these are long overdue problems for the Government of Sri Lanka.

With the object of getting rid of the full-scale reliance on imports for supply of essential pharmaceutical drugs and securing the stable supply of this category of commodities, the Government of Sri Lanka has the intention of domestically producing them, and has drawn up the project for construction of the pharmaceutical center for production of essential drugs. This project is being implemented under the auspices of the State Pharmaceutical Corporation (SPC), under direct control of the MOH, with financial resources provided by a grant aid of the Government of Japan in response to the request of the Government of Sri Lanka. The construction of this pharmaceutical center will be started in 1986 and the production is expected to start late 1987.

On the other hand, in connection with the facilities for storage and distribution of medical supplies, the construction of the Central Store at the proposed site for the Project (No. 355 Deans Road) was planned by the Government of Sri Lanka, based on the recommendation of the Consultant on Medical Stores Management, WHO, in 1978. The design of this project was completed, and part of the existing storehouses was demolished and removed with the purpose of starting the construction of the new facilities in 1980, but in reality it was abandoned in view of the shortage of financial resources.

If the status quo of the facilities for storage of medical supplies should be left untouched, it is obvious that not only the government would suffer increasing financial losses in connection with medical supplies, but also the medical care service itself would suffer conspicuous negative influence. Furthermore, since the demand for medical supplies is bound to increase with the promotion of the "Improvement to the Health Care Development" and good quality essential drugs will begin to be delivered as soon as the Pharmaceutical Formulation Centre of Essential Drugs to be constructed under the grant aid of the Govern-

ment of Japan starts operating, Sri Lanka is faced with an impending need to take measures to maintain the quality of these drugs. In substitution to these totally inadequate facilities, the Government of Sri Lanka is planning the Project for the Construction of the Central Store for Medical Supplies and Equipment (the Project) which is to construct facilities provided with the functions and equipment necessary and appropriate for storage and distribution of medical supplies, and requested the Government of Japan to extend a grant aid for the implementation of the Project.

In response to the request, the Government of Japan has decided to carry out the Basic Design Study through the Japan International Cooperation Agency (JICA) in order to study the viability of the Project, and to draw up adequate basic design for the Project. JICA has sent a study team to Sri Lanka from 20 January to 8 February 1986 to carry out the pertinent field survey. The study team has carried out such studies as the confirmation of the background and the contents of the request, examination of the status quo of the storage and distribution of medical supplies and equipment, exploration of the Project site, etc., has conducted discussions with the authorities concerned of the Government of Sri Lanka on the basic conditions related to the Project, and has summarized the contents agreed by both parties in the form of a Minute which was signed and exchanged between the parties. Besides the Minutes, the organization of the study team, agenda for the field survey and names of officials concerned in Sri Lanka have been appended to this report.

This Basic Design Study Report compiles the results of the study on the viability of the Project, and the contents of the optimum basic design for implementation of the Project, based on the field survey results and analysis of data and information.

## CHAPTER 2 BACKGROUND OF THE PROJECT

### 2.1 Improvement to the Health Care Development

#### 2.1.1 Primary Health Care

The International Conference on Primary Health Care of the WHO was held in Alma-Ata, USSR, in 1978, and a resolution, stating that governments of countries all over the world would implement measures for promoting the primary health care of the people and draw up concrete policies and action plans required in this connection with the object of "improving the health level of people all over the world by 2000 A.D.", was passed on that occasion. In concert with that resolution, the Government of Sri Lanka has drawn the "Improvement to the Health Care Development" program in 1981, by revising its medical care policy so as to realize an appropriate health level for the totality of the people by 2000 A.D., based on the conception of promotion of primary health care stated in the "Health for All" resolution.

#### 2.1.2 General

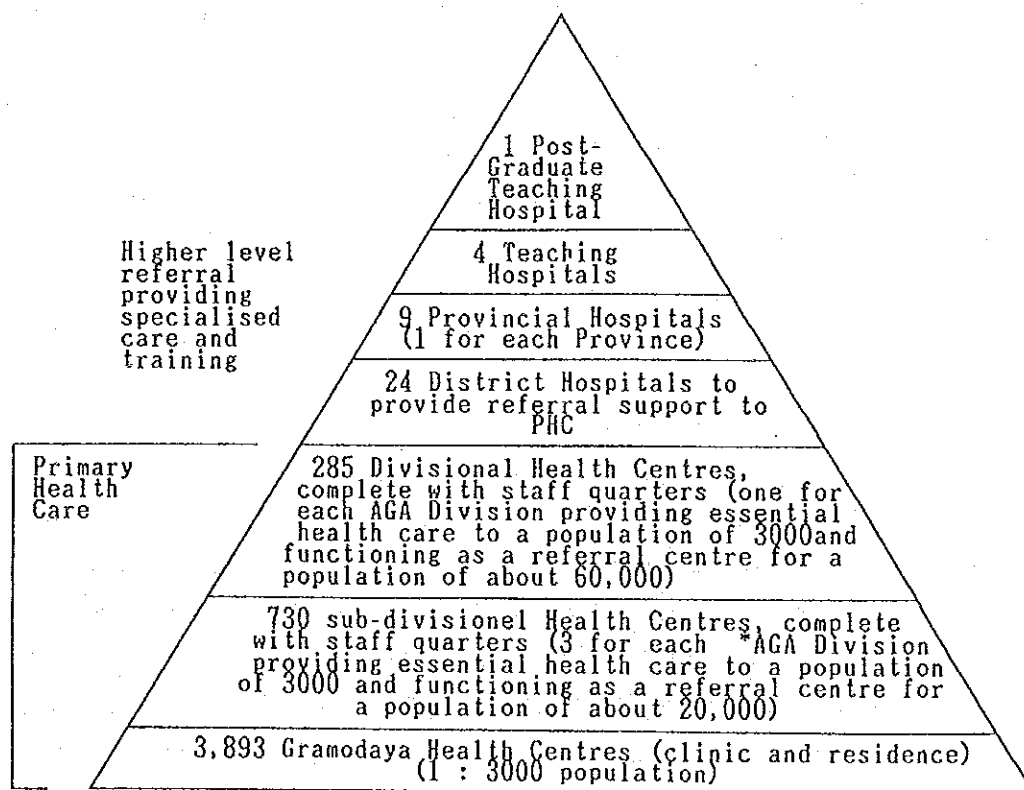
The program for improvement of sanitation and medical care of the Government of Sri Lanka consists of promoting a consistent sanitation and medical policy based mainly on the prevention and cure of diseases and improvement of medical facilities in the 1983-1993 period, and it is officially called as IMPROVEMENTS TO THE HEALTH CARE DELIVERY SYSTEM, PRIMARY HEALTH CARE INFRASTRUCTURE DEVELOPMENT. This project is also included as a part of the program.

##### (1) Basic Policy

The basic policy described in the followings is proposed in connection with the future conception of the sanitation and medical care system with the context of the improvement program.

- 1) Development of human resources engaged in the medical care sector.
- 2) Improvement of the medical institutions of various kinds including Teaching Hospitals and implementation of the supporting system.
- 3) Priority strengthening of the administrative system related to sanitation in provincial areas.
- 4) Consolidation of the Primary Health Care Complex in provincial areas as a measure to cope with the current state of things.

The aforementioned contents are shown schematically in Figure 2-1.



Note: This figure shows the future organization of the medical care system under the primary health care scheme, and the Base Hospital shown in Table 2-1 presented later corresponds to the District Hospital shown in this figure, and the District Hospital of Table 2-1 corresponds to the Divisional Hospital of this figure, respectively.

Figure 2-1 Future conception of medical institutions for the sake of primary health care



(2) Budget

Part of the "Improvement to the Health Care Development" program is already being implemented in 33 AGA Divisions since 1983, and its budget, including a US\$9.3 million loan from the ADB, amounts to US\$122 million in total.

On the other hand, the financial resources required to implement the program in other Divisions is budgeted in the following way.

- Total sum of financial investment  
Re3,720 million (US\$196 million)
- Portion accounting for total sum of current expenses  
Re660 million
- Annual current expenditure in the last year  
Re170 million

The breakdown of the budget in the various years is shown in Table 2-1.

Table 2-1 Project Costs PHC Infrastructure Development 1984-1993

(Unit: 1000 Rs)

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	Total
No. of P.H.C. Complexes	4	12	20	25	30	25	20	20	10	3	169
<u>CAPITAL (d)</u>											
1. Capital Costs (Constant) (a)	42485	123537	214229	267786	321344	267786	214229	214229	127114	32134	1810238
2. Capital Costs + 10% Inflation	47130	155530	285139	392066	517524	474409	417490	459243	252587	83353	3084475
3. In-service Training (b)	291	833	1334	1699	2063	1699	1334	1334	728	188	11539
4. Total Annual Capital Cost (2 + 3)	47421	156363	286473	393765	519587	476109	418824	460577	253315	83591	3095974
<u>RECURRENT (d)</u>											
5. Cumulative Recurrent Cost (c)	2550	10199	22948	38885	58009	73946	86695	9944	105818	107730	606224
6. Total Annual Cost (4 + 5)	49471	166562	309421	432650	577596	550054	505519	560021	359133	191271	3702238

## 2.2 Status Quo and Problems of Sanitation and Medical Care

In Sri Lanka, sanitation and medical care affairs are under the jurisdiction of the Ministry of Health (MOH) and the Ministry of Women's Affairs and Teaching Hospitals (MOWATH). MOWATH takes charge of 10 Teaching Hospitals all over the country, including the Sri Jayawardanapura General Hospital and the Colombo General Hospital, and the MOH takes charge of all other medical care affairs.

The Government of Sri Lanka is making continuous efforts in connection with the improvement of the conditions of sanitation of the people, which has been regarded as one of the main themes of the national policy, with 5 to 7% of the annual national expenditure allocated for the purpose. As the result of the said efforts, such demographic statistical data as natural mortality, infant mortality, maternal mortality, average life expectancy, etc., are showing conspicuous improvements in Sri Lanka. During the 35-year period from 1945 to 1980 the crude death rate improved from 21.9/1000 persons to 6.1/1000 persons, infant mortality improved from 139.7 to 37.0, maternal mortality improved from 16.5 to 0.8, and the average life expectancy improved from 41.6 years to 69 years, respectively, substantiating the correctness of the health care programs implements so far. It must be borne in mind however, that in spite of the declining mortality and the increasing life expectancy, no conspicuous change has occurred in the morbidity during the two decades extending from 1960 to 1980. From 1965 to 1970 the morbidity improved up to approximately 8%, but from 1970 to 1980 it worsened to 13%, and that high level remains unchanged also after 1980.

Under the circumstances, the Government of Sri Lanka is implementing the "Improvement to the Health Development" program based on the resolution of the International Conference of the WHO held in Alma-Ata in 1978, which consists basically of the promotion of primary health care and has 2000 A.D. as target year, with the object of further improving the health level of the people. This project has the object of

further improving the prevention and treatment of diseases by better equipping the medical institutions, upgrading the quality of essential medical supplies, and securing their stable supply.

At the present time, the shortage of human resources engaged in the medical field, particularly physicians and nurses, the timeworn medical institutions and other institutions concerned, and the quality and stable supply of essential medical supplies indispensable for the sake of primary health care are the most pressing problems in the medical care field of Sri Lanka. Problems related to essential medical supplies are caused by their total reliance on procurement from overseas, and their storage in totally inadequate facilities that are not equipped with appropriate storage functions.

The existing facilities for storage of medical supplies consist of the CDS under the control of the MSD, the Store Complex which guards part of the medical supplies handled by the SPC which is distributed to private sector, and facilities possessed by private pharmaceutical firms.

Of these facilities, the Store Complex of the SPC is a 3-storied slate-covered reinforced concrete building with 3,740 m<sup>2</sup> total floor area, and is a relatively new facility which began to be used in July 1984. It may safely be said that this is a very privileged facility compared with the existing CDS, that are located in timeworn slate-covered brick buildings that were diverted from uses that have nothing to do with warehouses, as mentioned in Chapter 1. Moreover, only one of the 4 CDS is equipped with cold store (approximately 10 m<sup>2</sup>), and to worsen the situation these storehouses are not provided with internal temperature control function, the ventilating conditions are bad and there is practically no storage fixtures. On the other hand the Store Complex is not provided with temperature control function such as air-conditioning, etc., but an appropriate internal temperature is secured nevertheless, because of an ingenious architectural design taking into consideration a sufficient ventilation effect by installing draughts and other contrivances.

### 2.3 Outline of the MSD

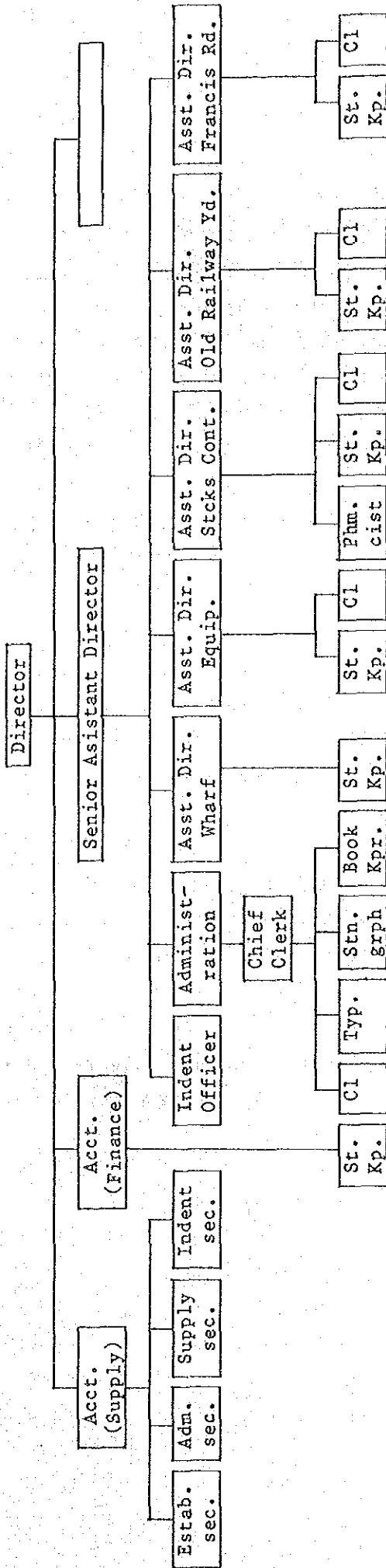
The Medical Supplies Division (MSD) is a lower branch of the Department of Health Services (DHS) of the Ministry of Health (MOH), and has the following responsibilities in connection with the totality of medical supplies and equipment distributed to the national and public medical institutions of Sri Lanka.

- (1) Estimation (Estimation of the demand)
- (2) Quantification (Determination of the quantities to be procured)
- (3) Procurement
- (4) Distribution

In connection with the procurement of medical supplies, the MSD commissions the State Pharmaceutical Corporation (SPC) to do the job, but in connection with medical equipment, narcotics, dangerous and poisonous drugs it is directly in charge of their procurement.

The MSD consists of 8 sections, administration, accounting, wharf, inventory control, equipment and the 3 storehouses (Old Railway Yard, Francis Road and De Saram Place), under the Director, as shown in Figure 2-2, and it has 369 positions. In reality however, its current staff consists of 339 persons, as shown in Table 2-2. The practical works inside the store, such as control, receiving and issuing of medical supplies, are performed by the staff shown in Table 2-2, Staff Allocation of MSD, headed by the Store Keeper as the responsible person in charge.

ORGANIZATION CHART OF MSD



Abbreviation:

- Acct. : Accountant
- Asst. Dir. : Assistant Director
- Estab. : Establishment
- Adm. : Administration
- St. Kp. : Store Keeper
- Cl. : Clerk
- Typ. : Typist
- Stn. grph : Stenographer
- Book Kpr. : Book Keeper
- Equip. : Equipment
- Phm. cist : Pharmacist

Table 2-2 Staff Allocation for MSD -1

STAFF ALLOCATION  
MSD

Post	Allotted Number	MSD		CDS					Total
		HQ.	Deans Road	Old Railway	Francis Road	De Saram Place			
Director	1	1							1
Sr. Asst. Director	1	1							1
Asst. Director	7	0	3 (3)	1 (2)	1	0 (1)			5
Accountant	2	2							2
Pharmacist	3	0	3						3
sub-total	14	4	6	1	1	0			12
Clerk	56	52	0	4	1	0			57
Typist (Sinhala)	1	1							1
(English)	3	3							3
Stenographer	1	1							1
Book keeper	2	2							2
Tel. operator	1	1							1
Room operator	1	1							1
Book binder	0	1							1
Cycle orderly	1	1							1
sub-total	66	63	0	4	1	0			68

Table 2-2 Staff Allocation for MSD-2

STAFF ALLOCATION  
MSD

Post	Allotted Number	MSD					CDS				Total
		HQ	Deans Rord	Old Railway	Francis Rord	De Saram Place					
Store Keeper I			2	4							6
Store Keeper Seg. A	48		5	8		3		3			19
Store Keeper Seg. B			10	9		2		1			22
Storeman II	20		6	7		3		1			17
Storeman III	20		5	12				1			18
Packer	29		10	13		4		3			30
Ordinary Labourer	90	10	16	45		12		3			86
Carpenter	29		4	14		2		1			21
Watcher	24			8		5		4			23
Sanitary Labourer	2			1							2
Casual Labourer	19										0
Truck Driver	1			1							1
Driver	7										12
Garden Labourer	0										2
sub-total	289	31	58	122	31	17					259
total	369	98	64	127	33	17					339



## 2.4 Status Quo of the Distribution and Storage of Medical Supplies and Equipment

### 2.4.1 Distribution

- (1) Most of the medical supplies and equipment being distributed at the present time in Sri Lanka rely on imports, and they are divided in two distinct groups handled through entirely distinct routes, those used for the sake of free medical care in national and public medical institutions, and those used for the sake of charged medical service and distributed through private medical institutions and pharmacies.

The totality of medicaments handled by national and public medical institutions rely on imports, and furthermore most of the medical supplies and equipment used therein excluding bandages and gauzes, are imported too. The procurement and distribution of these goods is totally under the jurisdiction of the MSD, which commissions the SPC, under the control of the MOH, to take charge of the procurement duties, but on the other hand the procurement of narcotics, dangerous drugs, poisons and medical equipment is directly executed by the MSD.

As for medicaments for private medical institutions, not only the SPC, but also private importers and private pharmaceutical firms take charge of their supply. At the present time, there are 7 private pharmaceutical firms in Sri Lanka, and they are engaged in independent production activities.

Moreover, the SPC itself is operating 4 retail outlets called Osu Sala at various parts of the country. The distribution routes of these medical supplies are shown in Figure 2-3.

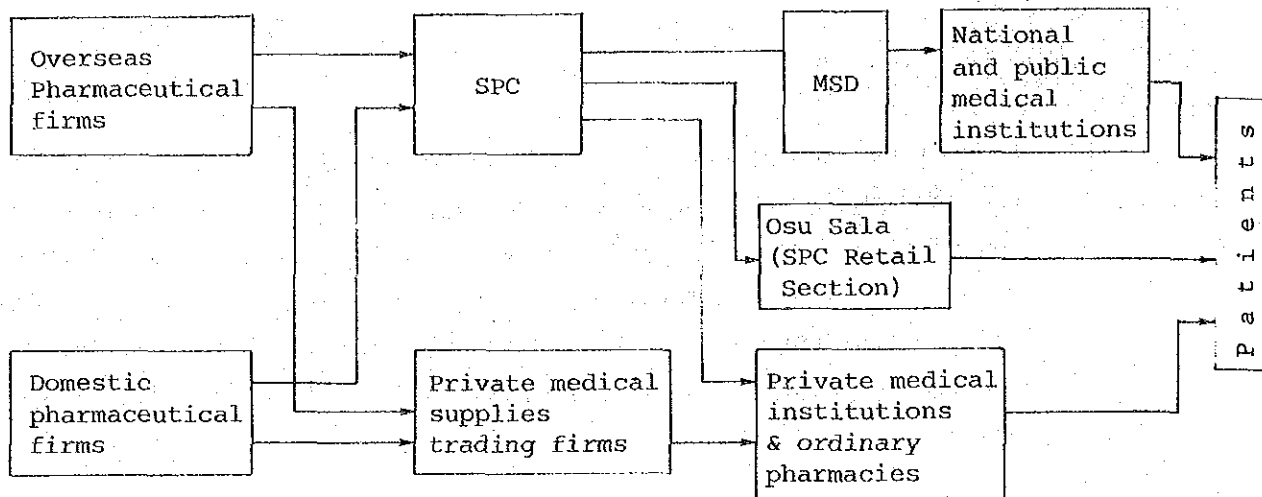


Fig. 2-3 Distribution routes of medical supplies in Sri Lanka

The sums of medical supplies distributed by the SPC to national public and private medical institutions, the sums handled by private imports and the outputs of private domestic pharmaceutical firms are shown in Table 2-3.

Table 2-3 Sums of medical supplies distributed in Sri Lanka  
(Unit: 1 million Rupees)

Year	National and public medical institutions	Private medical institutions & pharmacies			Total
	S P C	S P C	Private importers	Private domestic pharmaceutical firms	
1978	111.3	127.5	19.5	62.0	320.3
1979	116.7	78.45	30.1	63.0	288.25
1980	119.1	79.06	64.5	76.0	338.66
1981	162.7	63.6	84.6	90.0	400.94
1982	130.2	90.2	129.3	100.0	449.7
1983	111.3	89.24	153.7	120.0	474.24
1984	145.43	104.68	192.41	125.0	567.52

NOTE: Figures of private domestic pharmaceutical firms include deliveries to national and public medical institutions (via SPC), but they are negligible.

There are two routes for procurement of medical supplies and equipment from overseas.

- 1) Annual orders placed by MSD via SPC, on which the goods delivered in two lots, in June-July and January-February of the next year.
- 2) Annual orders placed directly by MSD, with lump delivery within 2 or 3 months.

In both cases the period of time from the order to the delivery is long because the goods are procured from overseas, and as a consequence the quantities delivered each time are very large, and exert conspicuous influence on the required storage space. The routes for procurement of the aforementioned goods, classified in terms of pharmaceutical drugs and medical supplies and equipment, are shown schematically in the following table.

Table 2-4 Procurement Pattern for Medical Supply and Equipment

Classification	Procurement Pattern	Procurement Frequency	Delivery Frequency
<ul style="list-style-type: none"> <li>• Pharmaceutical Drugs</li> </ul>	<pre> graph TD     A[MSD] --&gt; B[SPC]     B --&gt; C[MSD]           </pre>	Once/Year	Twice/Year
<ul style="list-style-type: none"> <li>• Narcotic Drugs</li> <li>• Surgical Non-Consumables</li> <li>• Surgical Consumables</li> <li>• Special Indents</li> <li>• Surgical Dressings</li> <li>• X'ray Films and Chemicals</li> </ul>	<pre> graph TD     A[MSD] --&gt; B[MSD]           </pre>	Once/Year	Once/Year (Feb. - March of the next year) Ditto Ditto Ditto Twice/Year (June - July and Jan. - Feb. of the next year) Ditto

The delivery of the ordered medical supplies and equipment is done 99% by sea transportation and the remaining 1% by air. In principle, the use of Sri-Lankan flag vessels is compulsory for sea transportation, and long waiting time may be required depending on the shipping schedule.

Under the circumstances, the following problems are occurring as a result of the said procurement method.

- 1) The procurement period from the placement of the order to the delivery of the goods is too long.
- 2) Huge quantities of goods are delivered at each time.
- 3) Large space is required for storage.

Moreover, there is no guarantee against accidents during the transportation, because cargo of vessels of Sri Lankan flag used to transport medical supplies are not insured.

(2) The CDS and Functions

Medical supplies and equipment arriving at the harbour are sent to the 4 CDS scattered throughout Colombo. The CDS and the main functions are shown in the following table.

Table 2-5 The CDS and Functions

Warehouse Name	Stored Items	Main Functions
① Deans Road ( 3.918 m <sup>2</sup> )	Storage of Distinct Items	<ul style="list-style-type: none"> <li>• Distribution to the 19 DDS located all over the country every 3 months, followed by distribution to the national and public medical institute.</li> <li>• Direct distribution of the national and public medical institutions. In cases of emergency however, the DDS may come to take the supplies or the CDS may send them.</li> </ul>
② Old Railway Yard ( 5.361 m <sup>2</sup> )		
③ Francis Road ( 2.201 m <sup>2</sup> )		
④ De Saram Place ( 406 m <sup>2</sup> )	All Items	<ul style="list-style-type: none"> <li>• Distribution to the Teaching Hospitals of Colombo, at 3 month intervals.</li> </ul>

It must be borne in mind however, that the existing CDS are scattered over 4 places, and the inconveniences mentioned in Table 2-6 are occurring in connection with their relationship with the MSD and the national and public medical institutions.

Table 2-6 Inconveniences due to the Decentralized Location of the CDS

MSD	National and public medical institutions
<p>The processing of slips takes long time</p> <p>It is difficult to centralize the inventory information.</p> <p>The distribution efficiency is low.</p> <p>Additional expenses are required.</p>	<p>It is troublesome to place orders to 4 distinct places.</p> <p>It is difficult to promptly cope with the needs, because the ordered goods are not delivered in a lump.</p>

There are two patterns regarding the transportation from the harbour to the CDS.

- 1) Goods ordered by SPC with commission of the MSD are forwarded by the staff of SPC to the CDS.
- 2) When the orders are placed directly by MSD, a carrier is contracted by MSD to take charge of the forwarding work.

(3) Distribution to the National and Public Medical Institutions

The routes for distribution from the 4 CDS possessed by the MSD to the DDS located at 19 places and the Teaching Hospitals are shown in the following figure.

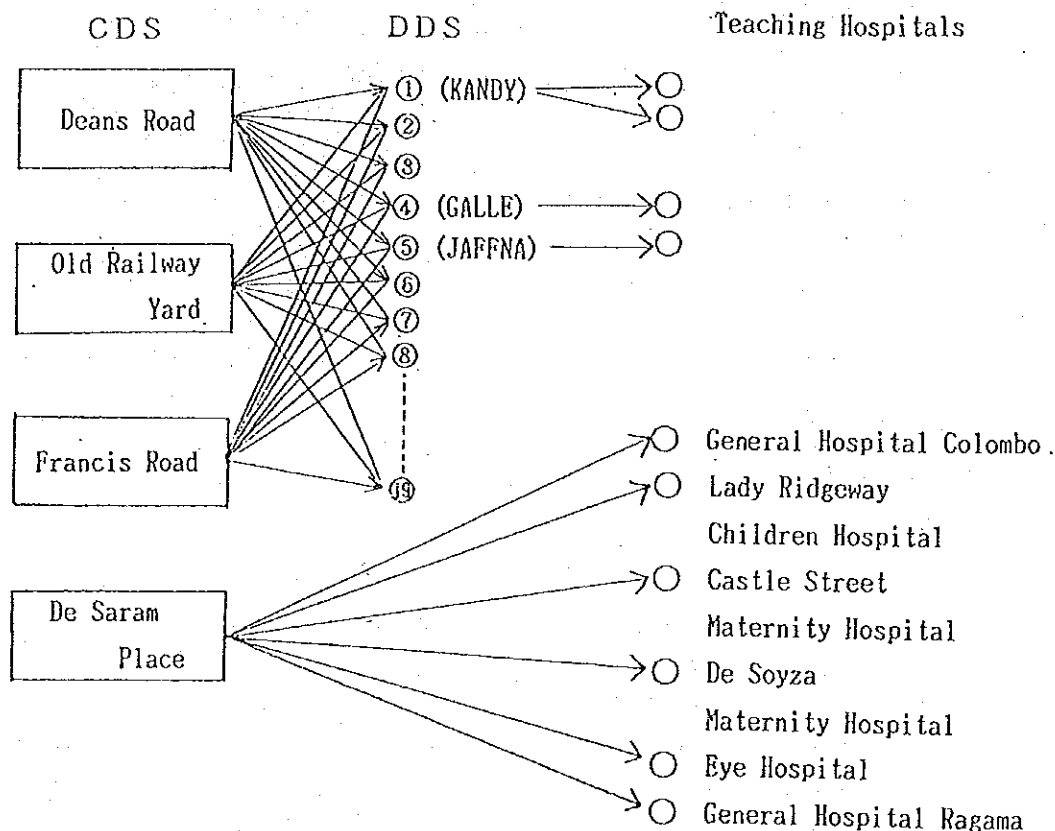


Fig. 2-2 Distribution Pattern from CDS to DDS and Hospitals

As can be seen, the distribution from the CDS to the DDS is carried out in accordance to an one-to-one pattern, and there is no case of one vehicle collecting medical supplies from the 4 CDS for subsequent distribution, nor case of one vehicle distributing medical supplies to various DDS. The destinations of the medical supplies and equipment distributed from the MSD are shown in the following table.

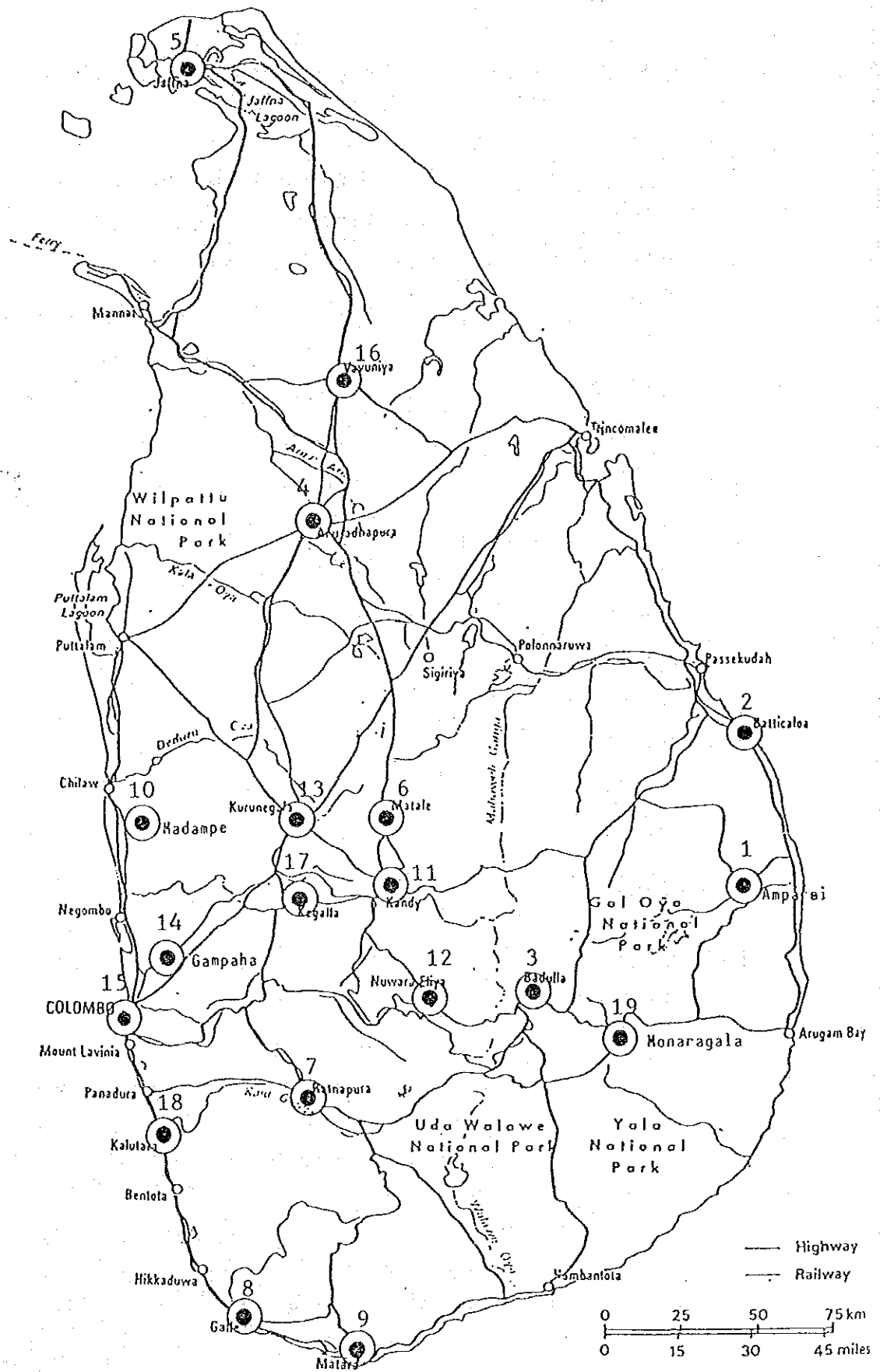


Table 2-7 Destinations of the medical supplies and equipment forwarded by the MSD

Name of D.D.S	Name of 10 Teaching Hospitals
1. AMPARAI	1. General Hospital Colombo
2. BATTICALOA	2. Lady Ridgeway Children Hospital
3. BADULLA	3. Castle Street Maternity Hospital
4. ANURADHAPURA	4. De Soyza Maternity Hospital
5. JAFFNA	5. Eye Hospital
6. NATALE	6. General Hospital Ragama
7. PATNAPURA	7. Kandy General Hospital
8. GALLE	8. Peradeniya Hospital
9. MATARA	9. Galle General Hospital
10. MADAMPE	10. Jaffna General Hospital
11. KANDY	The Teaching Hospitals 1 to 6 are located in Colombo.
12. NUWARA ELIYA	
13. KURUNEGALA	
14. GAMPAHA	
15. COLOMBO	
16. VAVUNIYA	
17. KEGALLA	
18. KALUTARA	
19. MONARAGALA	

The following means of transportation are used in this connection.

- 1) Lorry
- 2) Railway wagon
- 3) P.P.T. (Per Passenger Train)



Of the said means of transportation, 2) and 3) are not convenient because they deal mainly with food and as a consequence medical supplies have a low priority and their transportation takes long time. Under the circumstances, lorry is presumed to be the most convenient means of transportation, but the lorry fleet possessed by the MSD is considerably timeworn, and their quantity is insufficient to substitute 2) and 3).

#### 2.4.2 Storage of Medical Supplies and Equipment

The various CDS are old and timeworn, and they are very inadequate from the standpoint of functions for storage of medical supplies and equipment. Concretely speaking, the following problems are observed in these stores.

- (1) Damages to the medical supplies and equipment caused by leaks in the roof.
- (2) Quality deterioration due to the insufficiency of adequate facilities for control of temperature and humidity.
- (3) Damages to the medical supplies due to the presence of rats and noxious insects (presumably grain borers) in the timeworn store buildings.

Moreover, the following inconveniences are observed in connection with the storage method.

- (1) The goods sorted by item are placed directly on the floor, and moreover they are stacked up to 3 or 4 meters.
- (2) Stacks of goods packed in cardboard cases are either about to collapse or the cases of lower tiers are damaged, with frequent leak of liquid or exposure of goods contained therein.
- (3) The sizes and packing specifications are diverse and the storage efficiency is low, because most of the procurements rely on imports from overseas.

- (4) Goods imported from India contain noxious insects in wood pieces of the crate itself, and these insects gnaw the packing materials during the storage and scatter wood chips.
- (5) Part of medical equipment are stored in racks, but they are exposed to dust because the storage containers are made of rough-planed wood.

The causes of this chaotic situation are listed in the followings.

- (1) The very buildings are old and timeworn.
- (2) The maintenance and control of the buildings is not adequate, and there are such problems as leaks in the roof and the like.
- (3) The buildings of the stores have such construction that they facilitate the ventilation but on the other hand they are susceptible to the effects of the wind too.
- (4) There is conspicuous difference in levels between the lorry and the store floor, because the stores are not equipped with functions (platforms) for acceptance and delivery of goods.
- (5) The stores are not provided with adequate cargo handling facilities and storage facilities.
- (6) The packing specifications are multifarious, part of them are inadequate, the containers are damaged because of their fragility, and there are cases of leak of liquids.
- (7) The arriving goods are delivered in huge lots.
- (8) The period of storage is too long.
- (9) The stored goods are stacked at random, and the basic concept of first-arrive first-delivery is not being observed.
- (10) Control based on the fundamental concepts of organization, order and cleanliness is not being implemented.

It is presumed that the aforementioned problems are exerting decisive influence on the current chaotic situation. The methods of storage adopted in each storehouse are shown in the next table.

Table 2-8 Storing Method and Classification for Medical Supplies and Equipment at each CDS

Section	Classification	Deans Road		Old Rail-way Yard		Francis Road		De Saram Place	
		Stored with rack	On floor	Stored with rack	On floor	Stored with rack	On floor	Stored with rack	On floor
A	External preparation				○				○
B	Liquids			○	○				⊙
C-1	Vitamins, Antibiotics						○	○	⊙
C-1	X'ray Films & Chemicals					⊙	○		—
C-2	Transfusion Fluids External Preparations		○						⊙
C-2	Surgical Dressings		○						○
C-3	Tablets, Capsules				○		○		○
C-4	Injections				○			○	⊙
C-4	Vaccine and Sera			⊙					—
OP	Dangerous Drugs			○					—
D-1	Surgical Consumables		○						○
D-1	Dental Consumables		○						○
D-2	Surgical Non-Consumables	○							○
D-2	Dental Non-Consumables	○							○
D-2	Surgical Equipment Special		○						○
H	Gases			○	○				○
J	Printed Forms					○			○
I	Inventory Items (MSD office use)	○							
E	Despatch			○					
G	Preparation Room			○					

⊙ : Air-conditioning is required for storing

⊙ : Remarkably large volume is stored

### 2.4.3 Reception and Issue of Medical Supplies and Equipment

At the present time, most of the works related to the steps ranging from the reception to issue are being carried out mainly by hand, and moreover they involve many manpower and many kinds of occupations because each worker exclusively takes charge of the duty of his speciality and nothing else.

As for the cargo handling work carried out on the occasion of the arrival of the goods and their delivery, it is quite rough because the pertinent hardware, i.e., the equipment and facilities for cargo handling, are inadequate and furthermore the worker have not been submitted to adequate training and education for correct cargo handling. The concrete problems occurring in this connection are summarized in the followings.

- (1) On the occasion of the arrival of the goods at the stores and their delivery, the labourers are forced to throw the goods at a bounce from and to the lorry, because there is no platform and the difference in levels with regard to the lorry mounts to 1.2 to 1.3 m, and furthermore the crates and packages are heavy.
- (2) When carrying the goods to be picked up to the lorry, a correct transportation is impossible because there is no appropriate transportation equipment, and when there is any it is either broken or part of its functions is no available. For example, the cases of medical supplies are rubbed against the floor surface when they are transported in the storehouses, because the hydraulic system of the hand pallet truck is out of order and furthermore it is used without pallet in spite of being an apparatus designed for use with pallet.
- (3) When picking the goods, the workers can take only cases at the front of the stacks because they are piled up too high, and when taking cases of the upper tiers they are forced to step on the cases. Furthermore, cases of the lower tiers are deformed or

collapsed due to the weight of the upper tiers, and in the worst case there is leak of liquid. Members of the survey team were concerned about the epoch of picking and delivery of these cases. As can be seen from these considerations, it may safely be said that the basic principle of first-come first-delivery is neglected at all in these stores.

- (4) When loading the medical supplies on the lorry for delivery, no attention is paid to the characteristics of the individual products and their packing specifications, and they are stacked indiscriminately on the lorry by attaching importance only to loading as much as possible in each trip. For example, no attention is paid to cases that can not be turned over and to soft goods such as bandages and the like.
- (5) There are problems related to the lorry bed itself. Iron plates sized about 50 cm in diameter are nailed on the bed but they are partially off, and there is risk of damaging the cases when the medical supplies are being loaded on the lorry.

#### 2.4.4 Economic Loss of Medical Supplies

It is presumed that considerable loss of medical supplies is occurring as a consequence of the aforementioned state of storage. It is presumed that medical supplies are discarded due to the following reasons, and according to available data, the ratio of the amount of losses incurred (Rs 19,958,360.40) to the cumulative amount of purchases (Rs 1,201,973,252.82) during the 1980-1984 period was 1.66%, as shown in Table 2-9 below.

- (1) Damage and quality deterioration during transport
- (2) Damage and quality deterioration during the storage
- (3) Expiration of the period of availability

Annual Expenditure for Purchases of Medical Supplies and Equipment and  
 Amount of Losses 1980 - 1985 (per data supplied by MSD)

(units in rupees)

YEAR	PURCHASES	LOSSES
1980	181,348,481.61	66,090.39
1981	277,681,503.76	61,121.94
1982	235,371,093.94	3,325.65
1983	219,108,567.18	.
1984	288,463,606.33	*19,827,822.42
1985	343,306,558.91	

Note: The amount of losses recorded in 1984 reflects the results of physical inventory which had not been taken for several years previous to that time.



## 2.5 Contents of the Request

### 2.5.1 Summary

With the object of further improving the sanitation level of the people by 2000 A.D., the Government of Sri Lanka is implementing various health care improvement programs that are in conformity with the guideline of the WHO and consist mainly of the promotion of primary health care.

The Medical Supplies Division (MSD) is responsible for the procurement, storage and distribution of medical supplies and equipment for national and public medical institutions, and moreover it is the only institution in charge of the import and distribution of narcotics consumed in the country, but it will be required to cope with the storage and distribution of medical supplies and equipment that will be necessary for the sake of primary health care which will increase concurrently with the promotion of new medical care improvement programs.

The establishment of the MSD dates back to 1905, and the first CDS under its control began with the Francis Road store, followed by successive expansions at the Old Railway Yard store and Deans Road store in conformity with the demand. These stores are located in buildings diverted from such uses as warehouse and residence dealing with articles that have nothing to do with medical supplies, and to secure appropriate medical supplies is a long overdue question in this country. Becoming aware of this problem, the Government of Sri Lanka planned the construction of new facilities in 1978, at the site of the Deans Road, where the MSD is currently located, based on the advice of the WHO (construction of a modern building with low-temperature room and air-conditioned room). In reality however, this project was abandoned in 1980 due to shortage of financial resources, when part of the existing warehouse was demolished and removed, and the situation remains unchanged.

At the present time, the CDS, that play a key role in the supply and distribution of medical supplies and equipment to the national and public medical institutions of Sri Lanka, are scattered throughout 4 distinct places in Colombo, and it may safely be said that the existing facilities are totally inadequate from the standpoint of storage and guarantee of quality of medical supplies in view of their shortcomings mentioned in the followings.

- (1) There is no room temperature control function, which is indispensable for proper storage of medical supplies.
- (2) There are no appropriate facilities for storage and cargo handling.
- (3) The buildings are conspicuously timeworn, and furthermore the maintenance and control of the facilities is inadequate.

Inconveniences of various kinds, such as lack of smooth operation and control, difficulty to have an accurate idea of the inventory, loss of effectiveness and potency of the pharmaceutical drugs, frequent occurrence of losses and discarded goods, low distribution efficiency, etc., are occurring as a consequence of the current state of things. With the object of solving the said problems, the Government of Sri Lanka has drawn up plans to centralize the CDS, that are currently scattered throughout 4 distinct places in Colombo, at one place in the form of the Central Store to be constructed at the proposed site located at No. 355 Deans Road, Colombo 10, so as to realize a centralized State Medical Store provided with modern equipment and optimum functions and environment for storage of medical supplies and equipment, such as storage, cargo handling and conveying systems capable of securing efficient and rational work, temperature-control functions such as air-conditioning equipment, cold store, etc., and has asked for a grant aid of Government of Japan to raise the financial resources required to implement this project.

## 2.5.2 Facilities and Equipment

The contents of the request referring to facilities and equipment are mentioned in the followings.

- (1) Construction of storage and distribution facilities with 5,760 m<sup>2</sup> floor area, equipped with ordinary accessory equipment.

From the standpoint of work efficiency and ease of control, it is desirable to construct a single-storied or 2-storied building.

- (2) Utilities and equipment

- a. Cold store facilities
- b. Air-conditioning facilities
- c. Truck berth
- d. Fork lift trucks --- 5 units
- e. Complete rack system
- f. Pallets
- g. 5-t lorries --- 15 units



## CHAPTER 3 CONTENTS OF THE PROJECT

### 3.1 Objective

This project is a part of the program for improvement of storage and distribution facilities of medical supplies and equipment in Sri Lanka, and its purpose is to provide the Central Store for Medical Supplies and Equipment which was planned for the following purposes with storage and distribution facilities with proper functions and the required equipment for them:

- (1) To let administration and control of personnel affairs, accounting, and custody of drugs and other medical supplies function more efficiently and smoothly.
- (2) To secure the quality of drugs and thus eliminate losses such as unusable goods and discarded goods.
- (3) To secure drugs of good quality and high efficacy in response to needs.
- (4) To save fuel cost by improving the distribution efficiency.

## 3.2 Study of the Request

### 3.2.1 Scale of Facility and Equipment

The scale of the facilities stated in the request amounts to 5,760 m<sup>2</sup> floor area, but it must be borne in mind that the existing CDS facilities have total floor area amounting to approximately 11,900 m<sup>2</sup>, with approximately 10,200 m<sup>2</sup> of that total being used as a storehouse. Medical supplies and equipment that currently are being guarded in these facilities are directly placed on the floor, in the form of stacks with 3 to 4 m height, and it is presumed that at the peak time these facilities become virtually full. The maximum peak time capacity estimated on the basis of the data submitted by MSD exceeds 10,000 m<sup>2</sup>, it will be totally impossible to cope with the storage of the maximum quantities of all articles at the annual peak time by making use of the scale of the facilities stated in the request, even by attempting a rational storage with introduction of racks and other similar equipment. Furthermore, if an annual growth in requirements of 5% is assumed with the implementation of the Improvement to the Health Care Development, the physical volume is anticipated to double in the next 10 years, and the facilities that would be necessary to accommodate such a volume would be of a scale far beyond that which is stated in the request, and therefore, it may safely be said that there are problems in connection with the determination of the scale of the facilities stated in the request. It is presumed that some enlargement will be unavoidable in connection with the scale of the facilities, but anyway it will be impossible to cope with the storage of the aforementioned maximum quantity, and therefore it will be necessary to determine an appropriate scale by limiting the items to be stored in conformity with an appropriate order of priority, based on the conditions required for proper storage of medical supplies and other factors, and determined by taking into consideration restrictions of various kinds.

The necessity of the utilities and equipment listed in the request is unquestionable, but as for the quantities and scales of the individual items, it is necessary to determine them by examining their relationship with the scale of the Central Store as a whole. The intro-

duction of pallets will be indispensable in view of the use of fork lifts for efficient storage and transportation of large quantities of goods, but their quantity will be limited for use inside the storehouse. Trucks will be used to transport medical supplies from the CDS to the DDS or to the medical institutions. At the present time, two means of transportation, trucks and railway, are being used, but the MSD is planning a full-scale shift to truck transportation, and the afore-stated fleet was calculated by taking into consideration this fact. The ultimate decision about the appropriate size of the truck fleet however, will be taken by examining the project as a whole from a global standpoint.

### 3.2.2 Formulation of Principal Factors

#### (1) Distribution and Storing Plan

##### 1) Study of the storage capacity

The most important factors that must be taken into consideration when designing the scale of the facilities are the quantity of goods carried each time into the storehouse, the stock and the storage method, and an attempt will be made to cut down the total volume of medical supplies and equipment to be stored at the peak time in conformity with the following line of reasoning.

- a) The amount of materials handled on the occasion of each delivery can be reduced by increasing the frequency of delivery (2 deliveries/year) of medical supplies and equipment procured from overseas. Even though the immediate implementation of this change is not practicable, it is an important theme to be considered in the future.
- b) As for surgical dressing procured in the home market, the possibility of frequent delivery of small lots by increasing the frequency of delivery should be examined.

- c) The production plan and the distribution route of the Pharmaceutical Formulation Centre of Essential Drugs should be taken into consideration to revise the inventory of the corresponding drugs, as systematic production will become feasible.
- d) The total quantity of medical supplies to be stored should be restricted, by defining the order of priority by item, based on the necessary conditions applicable to the storage of these articles.
- e) All items out of the scope of storage and distribution of medical supplies, which is the purport of this project, should be excluded from the object of storage.

Therefore, it is impossible to cover the totality of goods of the 4 existing CDS, and it is presumably unavoidable to keep at least one of them in operation.

2) Calculation of the volume of goods to be stored

The total quantity of medical supplies and equipment to be stored is calculated in conformity with the "Flow of Calculation of the Physical Distribution" shown in Figure 3-1 below, and based on the basic policy mentioned before.



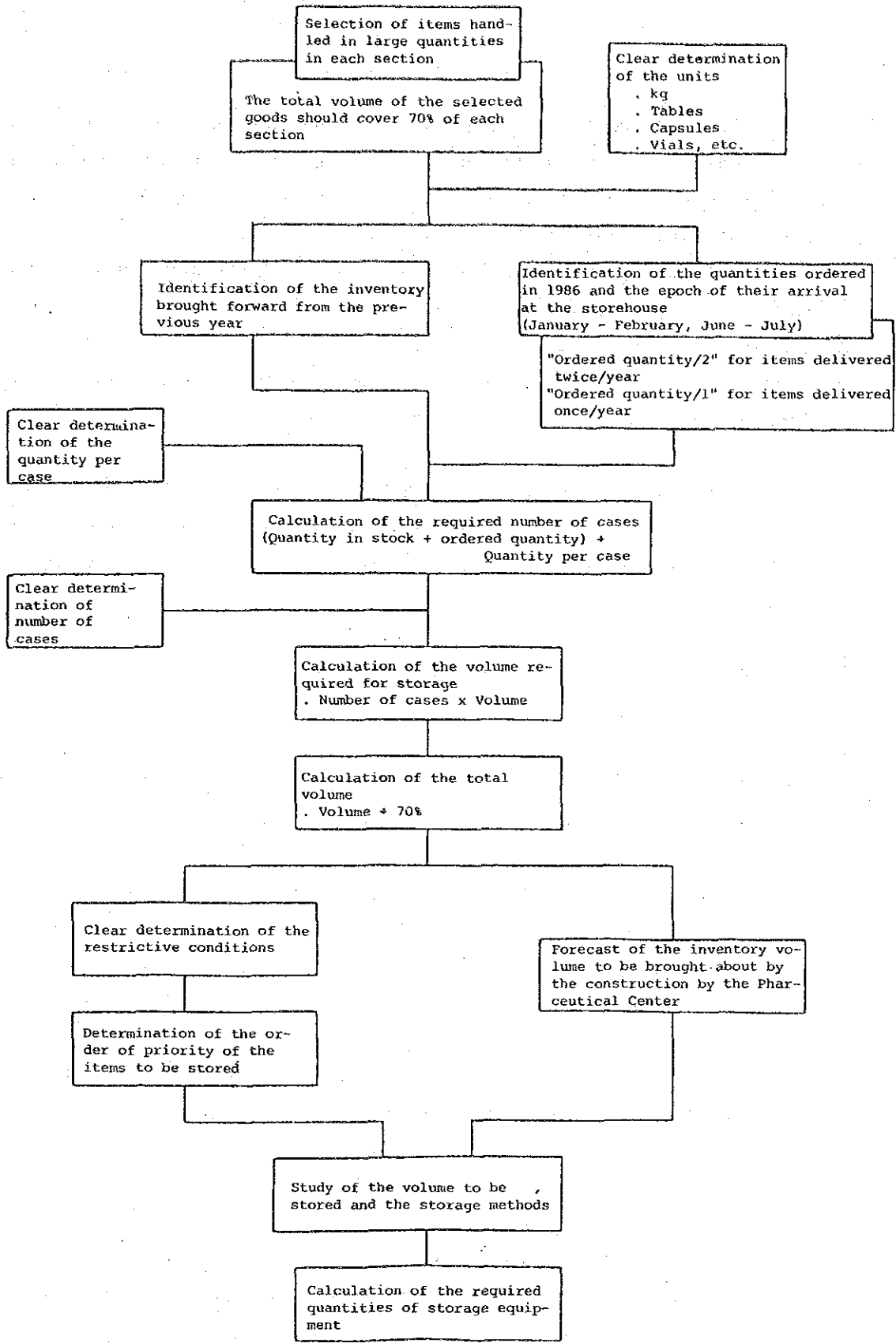


Figure 3-1 Flow of Calculation of the Physical Distribution

There is too much difference between the storage capacity requirement calculated on the basis of the total annual quantity of medical supplies being handled at the present time by the MSD (10,512 m<sup>3</sup>) and the scale of the facilities stated in the request (5,760 m<sup>2</sup>). That being so, the volume of the items to be stored in the new facilities, which will be the yardstick for calculation of the scale of the facilities, will be calculated by restricting the items to be stored therein. The following restrictive conditions are taken into consideration in connection with the items to be guarded in the new facilities.

- a) Importance will be attached to medical supplies indispensable for primary health care, requiring special attention to the upkeep of their effect during the storage, which is a serious problem being faced by the MSD.
- b) Medical supplies and equipment subject to restrictions referring to the storage temperature will be given priority.
- c) Small-sized surgical apparatuses that require clean storage will be included among items object of storage.
- d) In connection with items to be delivered from the Pharmaceutical Formulation Centre of Essential Drugs, the quantities to be stored will be revised and adjusted based on the production plan and delivery plan.
- e) Such articles as sanitary cotton, bandages, gauzes and surgical equipment that do not require severe storage temperature conditions are excluded from the scope of storage.

As a result of the said screening criteria, it is concluded that the total volume of medical supplies and equipment to be stored, which is the reference data to determine the scale of the facilities to be constructed anew, amounts to 7,447 m<sup>3</sup>. Table 3-1 "Volumes of Medical Supplies and Equipment to be Stored in the New Facilities" shows the volumes of the individual items as well as the total quantity.

Table 3-1 Volumes of medical supplies and equipment to be stored in the new facilities

Section	Classification	Volume(m <sup>3</sup> )	Evaluation of* the storage			Judgement of the storage	Volume to be stored
			(1)	(2)	(3)		
A	Solids	740	○	○		○	740
B	Liquids	835	○	○		○	835
C-1	Vitamins, Antibiotics	1,965	○	○		○	1,965
C-1	X'ray Films & Chemicals (A, C)	183		○		○	183
C-2	Transfusion Fluids External Preparations	2,264	○	○		○	2,264
C-2	Surgical Dressings	2,143	×			×	
C-3	Tablets, Capsules	592	○	○		○	592
C-4	Injections	354	○	○		○	354
C-4	Vaccine and Sera (2~4 °C)	142	○	○		○	142
	Polio Measles Vaccine (-20°C)	8	○	○		○	8
OP	Powerful, Poison	276	×			×	
OP	Narcotics	11		○	○	○	11
D-1	Surgical Consumables		○	○		○	
D-1	Dental Consumables	213	○	○		○	213
D-2	Surgical Non-Consumables				○	○	
D-2	Dental Non-Consumables	140			○	○	140
D-2	Surgical Equipment Special	646	×			×	
H	Gases		×			×	
	TOTAL	10,512					7,447
J	Printed Forms		×			×	
I	Inventory Items (MSD office use)		×			×	
E	Despatch		×			×	
G	Preparation Room		×			×	
others	Gifts (UNICEF...)		×			×	

\* Criteria for Evaluation of the storage

- (1) Essential medical supplies indispensable for primary health care.
- (2) Goods requiring given humidity and temperature conditions in order to prevent quality deterioration.
- (3) Goods requiring special handling.

### 3) Distribution and storage plan

#### a) Basic policy

The existing storage and distribution facilities are not provided with the functions that are indispensable to secure proper storage of medical supplies and equipment without deterioration of quality and to realize their proper distribution, and it may safely be said that they are totally inadequate from the standpoints of storage and distribution.

The basic policy regarding the various functions related to distribution and storage, which has the object of solving the aforementioned problems, is stated in the followings.

#### (i) Functions of the storehouse building

Study of the functions necessary to come up to the required environmental conditions, particularly cargo handling facilities to facilitate the cargo handling work which consists mainly of unloading and loading of goods, marshalling space for sorting and classification of arriving goods and articles to be delivered, and structure of the building to facilitate the ventilation and change of air and to prevent the infiltration of dust in all rooms except the low-temperature spaces.

#### (ii) Storage functions

Study of the appropriate storage facilities in conformity with the reliability and characteristics of the medical supplies, facilities appropriate to cope with the first-come first-delivery scheme, facilities suited for proper temperature control, and facilities and equipment suited for identification control and stock control, based on such conditions as appropriate stacking method to prevent

collapse of stacks and damage of products, storage method to facilitate clear definition of the storage period as well as classification, sorting, ordering and cleaning, etc., aiming at establishing a storage system making it possible to pick up fresh medical supplies at any time in correspondence to the demand.

(iii) Cargo handling function

Study related to the installation of appropriate facilities in order to make the cargo handling work easy and efficient, as a countermeasure to prevent the rough handling of the goods.

(iv) Information functions

Study of the introduction of appropriate OA (office automation) equipment and communication system based on the idea of simplification and centralization of data conservation as well as immediate obtainment, processing and transmission of the required information, aiming at improving the accuracy of physical distribution information through the use of information equipment.

(v) Transportation functions

Study of the functions to prevent damages and quality deterioration during the transportation, to improve the transportation efficiency, and to cut down the transportation expenses, aiming at realizing safe and economical transportation of the goods.

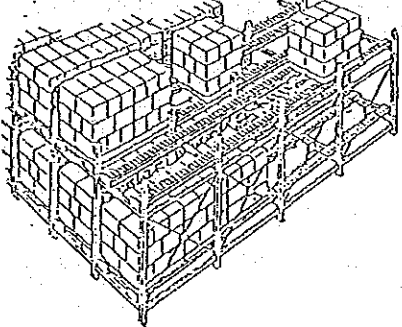
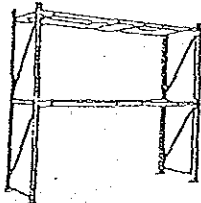
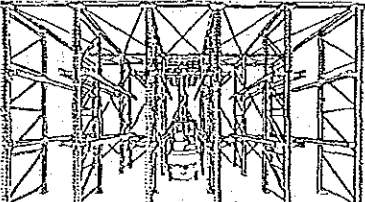

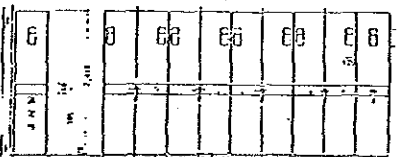
b) Selection of the storage equipment

Proper storage equipment are selected by taking into consideration the characteristics of each type of equipment, in order to secure the distribution and supply of effective medical supplies and equipment of good quality. The storage equipment must satisfy the following requisites.

- o Large storage capacity per unit area
- o Practicability of the first-accepted first-issue principle.

The individual storage equipment will be selected by taking into consideration volumes, handling and other pertinent particulars of the items to be stored.

Table 3-2 Particularity of Storing Equipment

Type	Outline	Quantity of goods to be stored	First-received/ First-issued	Variety of items	Adoption
Flow rack		○	○	×	○
Fixed rack		△	○	○	○
Drive-in rack		○	×	×	×
Movable rack		△	○	○	○
Light weight rack		×	○	○	○

The following storage equipment are selected as a result of the said process.

1. Flow racks
2. Fixed racks
3. Movable racks
4. Light weight racks

c) Calculation of storage capacity by storage method

The storage capacity by storage equipment is calculated on the basis of the aforementioned selection of the storage equipment.

(i) Items to be stored in the flow racks

The items to be stored in the flow racks are assumed to be those ones with 30 m<sup>3</sup> or more volume, in view of the storage capacity of each rack row, and they will be picked up from the various sections.

Sec- tion	Serial No	Name of Item	Volum (m <sup>3</sup> )	
			Indivi- dual	Total
A	0076	Calcium Lactate 300mg	157.8	416.0
	0334	Yellow Sort Paraffin	49.5	
	1643	Ferrous Salph 200mg	38.4	
	1866	Aspirin 300mg	170.3	



Section	Serial No	Name of Item	Volum(m <sup>3</sup> )	
			Individual	Total
B	0021	Solvent Ether	63.4	557.0
	0061	Benzyl Benzoate Application	145.0	
	0147	Extract of Liquorice BP	27.9	
	0230	Hydrogen Peroxide Solution 500ml	27.4	
	1651	Piporazine Citrate Elixir	143.4	
	5040	Chlorhexidine with Cetrimide Solution	149.9	
C-1	0639	Inj.Fortified Procaine Penicillin Vials	334.6	1,135.0
	0640	Inj.Penicillin 1,000,000unit Vials	400.7	
	0641	Inj.Penicillin 500,000unit Vials	84.5	
	1259	Inj.Streptomycin Sulphate 5G Vials	50.4	
	1880	Tetracycline HCL 250mg	36.6	
	5520	Inj.Ampicillin 250mg	62.1	
	5271	Ampicillin Syrup 100ml	30.2	
	0679	Inj.Vitamin B Complex	59.0	
	0120	Watel Fw Injection	76.9	
C-2	0293	Inj.Normal Saline 500ml	559.0	1,511.4
	0582	Inj.Dextrose 50%	46.5	
	1403	Inj.Hartman's Solution 500ml	73.9	
	1564	Inj.Deptrose 5% 500ml	674.6	
	5044	Inj.Sodium Chloride 0.45% and Dextrose 5% BP in 500ml	35.4	
	5045	Inj.Sodium Chloride 0.45% and Dextrose 5%	122.0	
C-3	0448	Sulphamexathine 0.5g	93.9	257.1
	1921	Aluminium Hydroxide 500mg	29.2	
	5143	Panactamol	134.0	
C-4	5065	Inj.Hydrocortisone Sodium	31.6	78.8
	5263	Inj.Dexamethasone 1mg	47.2	
		TOTAL		3,955.3

Total number of pallets:  $3,955 \text{ m}^3 \div 1.32 \text{ m}^3 = 2,996$  pallets

(ii) Items to be stored in the fixed racks

Items to be stored in the fixed racks are goods of the various sections, except those ones requiring special storage conditions (items requiring storage temperature control, items to be stored in movable racks and items to be stored in shelves (these items are listed in section 2)-c and on) and items to be stored in flow racks.

The volume by section is calculated as follows.

A	749 - 416 =	324 (m <sup>3</sup> )
B	835 - 557 =	278 (m <sup>3</sup> )
C-1	1,965 - 1,135 =	830 (m <sup>3</sup> )
C-2	2,264 - 1,511 =	753 (m <sup>3</sup> )
C-3	592 - 257 =	335 (m <sup>3</sup> )
C-4	354 - 79 =	275 (m <sup>3</sup> )
D-1	213 - 0 =	213 (m <sup>3</sup> )
	TOTAL	3,008 (m <sup>3</sup> )

(iii) Shelves and movable racks will be installed by the walls of the various floors and in part of the first floor. Items of sections D-1 and D-2 will be stored in these racks.

(iv) Low-temperature storage

Section	Classification	Volume (m <sup>3</sup> )	Temperature conditions	Storage method
C - 4	X'ray Films and Chemicals	183	Air-Condition	Light weight rack
C - 4	Vaccine and Sera	142	5°C	Light weight rack
	(Polio, Measles)	8	-20°C	Storage in shelves
	Total	333		

X'ray Films and Chemicals

\* Total number of pallets  $183 \text{ m}^3 \div 1.32 \text{ m}^3 = 139$  pallets

Vaccine and sera

\* Total number of pallets  $142 \text{ m}^3 \div 1.32 \text{ m}^3 = 108$  pallets

Vaccine (Polio, Measles)

\*  $8 \text{ m}^3 \div 1.8 \text{ m} = 4.4 \text{ m}^2$

\*  $4.4 \text{ m}^2 \div (0.9 \text{ m} \times 0.5 \text{ m}) = 10$  shelves

(v) Particular Storing

Section	Classification	Volum ( $\text{m}^3$ )	Storage method
OP	Narcotics	11	Storage in shelves
	T o t a l	11	

\* Required number of shelves

\*  $11 \text{ m}^3 \div 1.8 \text{ m} = 6.1$

\*  $6.1 \div (0.9 \times 0.5 \text{ m}) = 14$  shelves

d) Storage volume by section

The distribution by section of the storage volumes calculated in the sections a to e above is shown in the following table.

sec.	Storing Volume				
	Flow Rack (m <sup>3</sup> )	Fixed rack (m <sup>3</sup> )	Movable rack (m <sup>3</sup> )	Light weight rack (m <sup>3</sup> )	Total (m <sup>3</sup> )
A	416	324			740
B	557	278			835
C - 1	1,135	830			1,965
C - 1			183		
C - 2	1,511	753			2,264
C - 3	257	335			592
C - 4	79	275			354
C - 4			142		
C - 4				8	
D - 1	—	213			213
D - 2	—	—	140		140
OP	—	—	11		11
Total	3,955	3,008	476		7,447

e) Design of the cargo handling equipment

The cargo handling equipment will be designed on the premise of introducing equipment able to secure careful handling of the goods, as mentioned in section "3.2.2 Formulation of Principal Factors" and by taking into consideration their relationship with the storage facilities. There are two types of fork lifts, counter type and reach type, and the latter type will be introduced in this project because the load does not exceed 1 ton and the available passageway width is narrow.

As for the pallets, double-sized type pallets will be adopted in this project, because single-sided pallets can not be used in flow racks. Furthermore, flatcars will be introduced for the sake of efficient storage of small articles in the light weight racks and the like.

f) Design of the transportation equipment

Lorries (trucks) are the main means of transportation used to transport medical supplies and equipment from the existing CDS to the various transit centers (DDS) and medical institutions. Renovation of the truck fleet is necessary however, in view of the damaged state of the beds and the expensive maintenance expenses including fuel cost.

Particularly timeworn are the four 5-t trucks made in Rumania, and an urgent renovation is required in view of the difficulty to obtain parts.

g) Design of the information equipment

At the present time, there is practically no information processing equipment in the MSD. The control of the reception, issue and inventory of various thousands of items of medical supplies and equipment is carried out by entering the relevant data by hand work in the books, and large manpower is required in this connection. Accordingly, personal computers shall be induced to execute receiving and issuing control and inventory control accurately, promptly and efficiently.

h) Packing & unpacking

At the present time, wooden cases are being used for transportation of medical supplies and equipment to the national and public medical institutions. These cases are being made by carpenters of the MSD personnel, but the tools available for the purpose are not satisfactory. Therefore, the provision of carpenter's tools and utensils will contribute to improve the quality of the medical supplies and equipment, and to prevent theft. Furthermore, the provision of these carpenter's tools is expected to be useful to repair damages of wooden pallets to be used in the new Central Store.

## (2) Design of the Facilities

It is indispensable to secure clean spaces with controlled room temperature because these facilities compose a storehouse to keep medical supplies, but on the other hand the facilities satisfying the required conditions will be designed so as to the maintenance and running costs not to become an overburden to the Treasury of Sri Lanka. As for the scale of the facilities, they will be designed so as to improve the utilization efficiency by the various sections and to realize optimum economical efficiency without spoiling the functions and the expected object of the facilities.

### 1) Storage section

System taking into consideration the minimization of the maintenance and running costs will be adopted for the sake of design of the space having the environmental conditions regarded as indispensable for storage of medical supplies, since the storage section will be the main part of the facilities to be designed this time, and moreover it will account for the majority of the space of the facilities in question. To put it in the concrete, the room temperature control using refrigerating machine will be limited to the cold store aimed at keeping vaccines and to the air-conditioned store aimed at keeping X-ray films, and on the other hand the rise of internal temperature in the spaces for storage of other medical supplies will be dealt with by adopting a system which consists of an architectural design promoting positive air convection inside the storehouse, combined with forced ventilation to realize further effective convection. The standard values of internal temperature are under  $-20^{\circ}\text{C}$  in the freeze store, under  $5^{\circ}\text{C}$  in the cold store,  $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$  in the air-conditioned store and under  $35^{\circ}\text{C}$  in the other spaces for storage of medical supplies.

The scale of the various stores will be designed with the object of improving as much as possible the storage efficiency per unit area, based on the quantities of goods to stored and the storage equipment

determined as a result of the considerations mentioned in section 3.3.2-(1) Storage and Distribution Plan, and by taking into consideration the work efficiency related to reception, issue, etc. The stacking volume of 1.32 m<sup>3</sup> per pallet and the area requirement of 1.35 m<sup>2</sup> per rack, with each rack containing 3 tiers of pallets, are assumed as standard dimensions to determine the scale of the facilities.

2) Reception, issue and marshalling sections

Platforms will be required to facilitate the loading and unloading works on the occasion of the reception and issue of the goods, but the platforms for reception and issue will be installed separately in view of the different contents of the works, and each platform will have frontage sufficient to park 5 or more 5-ton lorries.

3) Administrative office section

The existing administrative office section of the MSD is an indispensable organization, because the very function of the MSD is the operation of the central store itself and it does nothing else, unlike in the case of ordinary storehouse office functions existing in Japan. The actual staff consisting of 80 persons will remain unchanged because the scope and contents of work of the MSD will remain essentially the same even after the completion of the new facilities, and therefore it will be necessary to provide office space for the said personnel. The scale of the office space will be the same as the existing one, by taking into consideration the current stage of things. The standard area requirements per capita taken into consideration to determine the office space are 10 m<sup>2</sup>/person for the Assistant Director room and 5 m<sup>2</sup>/person in the shared office room.

### 3.3 Outline of the project

#### 3.3.1 Institution in Charge of Execution and Organization for Operation

The institution in charge of the implementation of the project will be the Department of Health Services of the Ministry of Health (MOH), but duties of practical affairs level will be taken charge of by the Medical Supplies Division (MSD), a lower branch of the DHS.

In essence, the current organization, consisting mainly of the MSD, in charge of the operation of the CDS, will be kept unchanged, because this project refers to the improvement of the facilities of the CDS. Particulars on the organization of the MSD are described in section 2.3.

#### 3.3.2 Outline of the Facilities and Equipment to be Donated

##### (1) Facilities

The facilities should be provided with functions for storage and distribution of medical supplies and equipment, and moreover they should comprise the rooms and spaces mentioned below. The grade of the facilities will be formulated by referring to the Store Complex of the SPC, which is considered a modern facility in Sri Lanka in order to facilitate maintenance and control.

- 1) Store for medical supplies and equipment
  - a. Space with approximately 30°C room temperature
  - b. Space with room temperature under 5°C
  - c. Space with room temperature under -20°C
  - d. Space for narcotic drugs



- 2) Space for cargo handling and cargo sorting
- 3) Packing space
- 4) Issuing space
- 5) Workshop
- 6) Administrative office (including Superintendent Room)
- 7) Meeting room
- 8) Rest room
- 9) WC, shower room and worker's dressing room
- 10) Guard house
- 11) Driver's waiting room
- 12) Truck berth
- 13) Others, corridors, etc.

The facilities in question should be provided with the following utilities.

- 1) Air-conditioning and ventilation equipment
- 2) Cold store and freeze store facilities
- 3) Water supply & drainage and sanitary facilities
- 4) Electrical facilities
- 5) Telephone and interphone facilities
- 6) Public address system
- 7) Fire alarm system
- 8) Lifts

(2) Equipment

The equipment to be donated are listed in the followings.

- 1) Fork lift trucks
- 2) 5t lorries
- 3) Pallets
- 4) Worktable and carpentry tools
- 5) Personal computer

### 3.3.3 The Project Site

#### (1) Conditions of location

The proposed site, No. 355 Deans Road, Colombo 10, is located approximately 2 km to the south-east of the Colombo Fort Station, which is the terminal, in the urban area approximately 500 m to the east of the southern tip of the Beira Lake.

The traffic conditions in the streets of Colombo are considerably bad in view of the poor pavement of the streets, absence of traffic signals, etc., and cars, trucks, buses, tricycles, motorcycles, ox-carts, etc., are jammed together in a chaotic situation.

Deans Road, accessing the proposed site, is a two-way street with 12 m width (9 m driveway and sideways with 1.5 m each) located at the western side of the site in question, and is classified as Principal Street.

This access road with conspicuous characteristics of the city area has very large traffic volume and experiences prolonged traffic jam during the morning and evening rush hours. From the standpoint of road width there is no problem for access of large-sized vehicles (40 ft container lorries), but anyway the situation is by no means good. If possible, it would be desirable to select a site with better traffic conditions in the suburban area. Taking into consideration on the frequency of lorries in and out, it is considered that the operation of the Central Store will not be disturbed by the above condition.

DEANS ROAD TRAFFIC SURVEY

1.	10:55 AM to 11:05	1/29	L	R	T
	Truck		13	11	24
	Bus		10	6	16
	Passenger car, van, tricycle, etc.		81	110	191
	Motorcycle		13	18	31
			117	145	262
2.	4:10 PM to 4:20	1/30	L	R	T
	Truck		20	9	29
	Bus		16	8	24
	Passenger car, van, tricycle, etc.		59	105	164
	Motorcycle		12	23	35
			107	145	252
3.	9:15 AM to 9:25	1/31	L	R	T
	Truck		14	16	30
	Bus		8	7	15
	Passenger car, van, tricycle, etc.		102	78	180
	Motorcycle		21	20	41
			145	121	266

(2) Topographical, geological and soil conditions

The site is square with approximately 90 m side, and has approximately 8,600 m<sup>2</sup> area. At the present time, the Administration Office of the MSD and the storehouse functioning as CDS are located therein, and the new facilities will be built after demolishing the existing ones.

With exception of the subsidence (max. approx. 2 m) at the place where part of the existing buildings was demolished, the site as a whole is generally flat with practically no unevennesses, but it seems somewhat narrow to construct the facilities with the requested contents. As for the bearing power of the soil, peripheral data ob-

tained at the Building Research Organization (site of the General Hospital, Colombo, located approximately 500 m to the south-east of the proposed site) indicate values of 45 kg/cm<sup>2</sup> or more from approximately 2 m, and it may safely be said that this is a quite good value. On the other hand, it must be borne in mind that data of the peripheral area located at the sea side indicate the said value at approximately 20 m. Furthermore, it is feared that this site extends to the reclaimed area of the swamps of the Beira Lake, and therefore a minute geological survey is required prior to the detail design.

As for the soil quality, the survey team did not succeed at obtaining detailed data from the Sri Lankan side, but it is presumed that there is possibility of acid soil in view of construction survey at the periphery, and therefore a detailed soil investigation will be required in order to determine the applicable countermeasures.

(3) Investigation of the existing facilities

At the present time, there are two buildings at the proposed site, the 2-storied reinforced concrete administrative wing with approximately 13,790 sqft (approx. 1,281 m<sup>2</sup>) total area built in 1883, and the storehouse consisting of a slate-covered brick building with approximately 28,383 sqft (approx. 2,637 m<sup>2</sup>), and in principle these buildings will be totally demolished.

During the study carried out this time however, request was made to leave the existing administrative wing untouched in order to use it as office building during the construction work, and therefore it will be taken into consideration as a condition to plan the layout of the facilities.

(4) Situation of the pertinent infrastructure

There is no problem regarding the access of public services such as running water, sewer, electricity, telephone, etc. Concrete particulars of these services are described in the followings.

1) Running water

According to authorities of the CMC (Colombo Municipal Council) in charge of the running water services, water mains with 4 inch diameter are laid in the Deans Road, and there is sufficient water supply capacity. In view of the use of the building, it is presumed that there will be no conspicuous increase with regard to the current consumption of water, and therefore there is no problem related to the supply of running water.

2) Sewer

According to the survey carried out at the CMC, separate pipe lines for drainage of sewage and rain water are laid in the Deans Road, and these pipe lines have N2. 12 inch diameter. Therefore, there is no problem in connection with sewer, in the same way as in the case of running water.

3) Electricity

According to authorities of the CEB (Ceylon Electricity Board), there is sufficient power supply capacity in the area in question. It must be borne in mind however, that there are distinct power system depending on the consumption.

- i) Contracted power consumption up to 60 A  
3 $\phi$  4W 400V/230V low-voltage overhead service line
- ii) Contracted power consumption from more than 60A to 150A  
3 $\phi$  4W 400V/230V low-voltage underground service line
- iii) Contracted power consumption surpassing 150A  
3 $\phi$  3W 11KV ultra-high voltage underground service line  
In this case it is necessary to install a transformer substation in the site.

In the case of this project the alternative iii) will be presumably adopted in view of the size, use and contents of the building. Some investment will be required to lay the service line, but there is no problem in connection with the conditions of the site.

4) Telephone

According to the survey carried out at the telephone exchange, underground cable with 350 circuits is laid in the Deans Rd.

Answering to questions of the survey team authorities in charge of the matter assured that it is possible to cope with the installation of approximately 20 circuits that are presumed to be required after the completion of the project.

5) Others

If necessary, LPG will be used to cope with demands of gas within the context of this project, but in reality there is no problem because no gas will be required in the facilities in question.

(5) Characteristics of the construction at the Project site

There is a holy Bodhi Tree in the Project site. Prayer sessions are held at the beginning of every month by Buddhistic monks. These are big trees with branches extending over 40 m diameter, and they will exert decisive influence on the layout of the facilities, because not even small branches can be felled.

Besides the mentioned holy trees, the survey team has learned that there is no aspect related to construction method, style, customs and other special local factors that could exert influence on the construction work and the like.

(6) Weather conditions

Colombo is located at approximately latitude 6°55'N and longitude 79°50'E, and its weather has conspicuous characteristics of tropical monsoon type area, with high temperature, high humidity and much rain.

The annual average maximum temperature is 31°C to 33°C, the annual average minimum temperature is 21.5°C to 23.5°C, and the daytime average humidity is 72% to 81%.

There is large annual rainfall mounting to approximately 2,000 mm to 2,500 mm, the annual number of rainy days is 130 to 160, and the rain season occurs during the epoch of the monsoons in the April-June and September-October and monsoons in the April-June and September-October period. The predominant wind direction is NNE in December-March, and SSW in July-October. There is no record of storms such as cyclones and the like.

The aforementioned conditions must be taken into consideration in connection with the design.

(7) Construction regulations

The construction regulations applicable to the proposed site are those stipulated in the City of Colombo Development Plan Vol. I and Vol. II edited by the Urban Development Authority (UDA).

Regulations applicable to the structure are stipulated in the Reinforced Concrete Design edited by the Institute of Engineering, but there is no stipulation in particular regarding design load and other particulars, and they are dealt with in conformity with the BS. As for the fire fighting legislation, it is not systematically organized yet, and the survey team succeeded at collecting only general information in the form of memoranda. It will be necessary to conduct minute consultations based on concrete plans with the Fire Service Department, prior to the execution of the detail design work.





## CHAPTER 4 BASIC DESIGN

### 4.1 Basic Policy

The facilities taken into consideration in this project will be designed in such a way to compose optimum facilities and equipment fulfilling the functional requirements indispensable for efficient and rational storage and distribution of medical supplies and equipment, because they will be the central distribution facilities that must be provided with all functions for proper storage and distribution of the totality of medical supplies and equipment supplied to the national and public medical institutions of Sri Lanka, and furthermore they play a key role in the stable provision of medical supplies with guaranteed effect and quality within the context of the primary health care program being implemented by the Government of Sri Lanka.

The basic design will be drawn up by taking into consideration the local conditions of Sri Lanka, such as weather, natural conditions, situation of the construction industry, etc., and by paying attention to harmonizing these factors.

- (1) Mainly the north and south sides will be used for lighting in order to facilitate shut off direct sunlight, and materials with large heat convection resistance will be used in the outer walls.
- (2) The required functions and environment will be secured, and moreover the cost will be slashed as much as possible through such measures as design taking into consideration the economical efficiency on the basis of the local construction techniques and capability, adoption of local construction methods, use of locally-made materials, etc.

- (3) Ventilation will be realized as much as possible through natural convection of the room air so as to secure the room temperature conditions, and spaces requiring refrigerating machines will be minimized. Furthermore, natural lighting will be used as much as possible, so as to save energy and to cut running cost.
- (4) The facilities will be characterized by easy maintenance and control, and furthermore the equipment will be selected by attaching importance to easy maintenance and control and the possibility of using as much locally-procured parts as possible.

## 4.2 Basic Design

### 4.2.1 Plot Planning

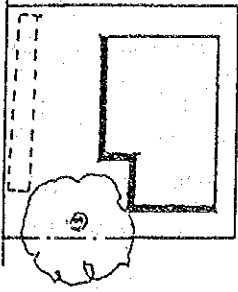
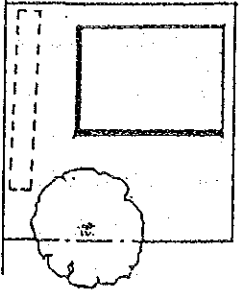
The following factors must be taken into consideration in the site layout scheme.

- (1) Conservation of the existing holy trees (Bodhi-Tree) and impossibility of felling or pruning even the smallest branch.
- (2) Necessity of planning the layout of the facility by taking into consideration the request to leave the existing 2-storied building at the Deans Road side, in which the MSD administrative section is housed, untouched during the work so as to let the said section work normally during the construction work, and to demolish and remove it after the completion of the work.
- (3) To secure the smooth access of vehicles for reception and delivery of goods.

In view of the aforesaid restrictive conditions, the access to the site from the Deans Road will be provided at the southern side, the arrival/issue yard, truck berth and lorry parking lot will be provided at the southern part of the site where the Bodhi-Tree is located because they do not obstruct the traffic of vehicles, and the building will be arranged at the northern part of the site.

The longer side of the building will be arranged in the E-W direction in order to facilitate natural lighting from the north and south sides, by taking into consideration the sunshine conditions of southern tropical areas. Moreover, the building is arranged in such a way to facilitate natural ventilation by taking into consideration the predominant wind direction in Colombo, the S-W and N-E winds, and Furthermore the possibility of enlargement at the Deans Road side is also taken into consideration so as to cope with future storage conditions.

(1) Study of the layout

ITEM			REMARKS
Considerations to the holy tree	<p>This alternative is impracticable, because it is necessary to trim the branches</p> <p style="text-align: center;">X</p>	<p>This alternative requires no trimming</p> <p style="text-align: center;">○</p>	<p>This is an indispensable condition in Sri Lanka, in view of the devoted Buddhist nature of most of its people</p>
Ventilation	<p>This alternative is inadequate from the ventilation standpoint, because the predominant wind directions in Colombo are SW and NE.</p> <p style="text-align: center;">X</p>	<p>This layout is convenient from the standpoint of ventilation, in view of the predominant wind directions.</p> <p style="text-align: center;">○</p>	<p>Natural ventilation is indispensable because air-conditioning in the totality of the storehouse is impracticable.</p>
Possibility of future enlargement	<p>Enlargement is possible only in the vertical direction, because there is no space in the NS direction.</p> <p style="text-align: center;">X</p>	<p>Enlargement into the road side is possible by removing the existing facilities</p> <p style="text-align: center;">○</p>	
Access of vehicles	<p>From the standpoint of the relationship with the front road, this layout is more convenient for reception and issue of goods.</p> <p style="text-align: center;">○</p>	<p>It is presumed to be perfectly possible to cope with the demand, in view of the reception and issue frequency.</p> <p style="text-align: center;">△</p>	
Extent of sunshine which the building is exposed to	<p>The building is exposed to much sunshine, because there is large wall area in the E-W directions.</p> <p style="text-align: center;">X</p>	<p>The extent of sunshine which the building is exposed to can be controlled by reducing the overall length in the E-W direction</p> <p style="text-align: center;">○</p>	<p>Control of the extent of sunshine is easier in the N-S direction, in view of the elevation of the sun.</p>
Adopted layout	<p style="text-align: center;">X</p>	<p>This layout is adopted as a result of a global judgement, although not satisfactory in connection with every condition.</p> <p style="text-align: center;">○</p>	

(2) Traffic line planning

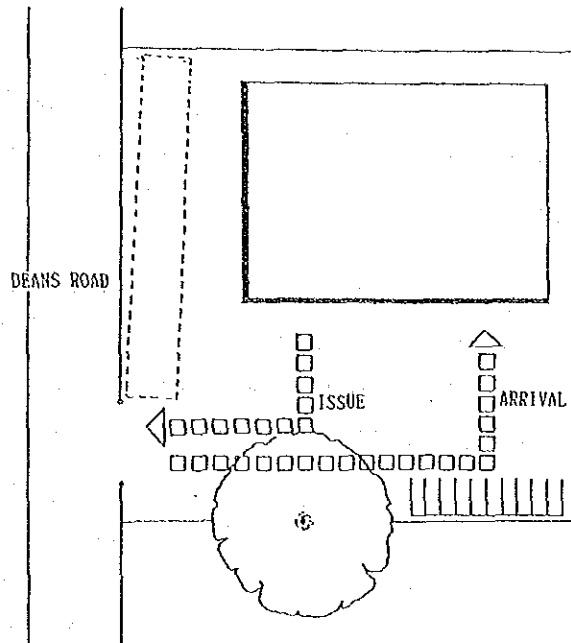


Figure 4-1 Traffic Line Planning Diagram

4.2.2 Architectural Planning

(1) Design of the facilities

There are 2 key points in connection with the architectural design of the facilities to be constructed in this project.

- 1) To secure maximum storage efficiency with the available floor area of the facilities.
- 2) To carry out proper temperature control and dust control in the normal temperature storage spaces. The following aspects become particularly important in this connection.

An appropriate span between columns should be selected in connection with 1), so as to realize an efficient arrangement of the fixed racks.

In connection with 2), special attention should be paid to the heat insulation and heat irradiation of the outer walls and roof, as well as to the internal ventilation.

Particularly in connection with 2), it will be presumably necessary to carry out convection and forced ventilation in building-wide scale by adopting large-scale draught, because temperature and humidity control using air-conditioning equipment is impracticable in view of the quantity of goods to be stored. On the other hand, materials with high heat insulation coefficient should be selected to improve the insulating performance of the roof and outer walls, and moreover measures should be taken to prevent the direct exposure of outer peripheral wall surfaces and roof surfaces in the inner space of the storehouse by taking into consideration some kind of double structure in the outer wall and roof in order to lower the heat conductivity. To put it in the concrete, the following countermeasures should be adopted to cope with the said problems.

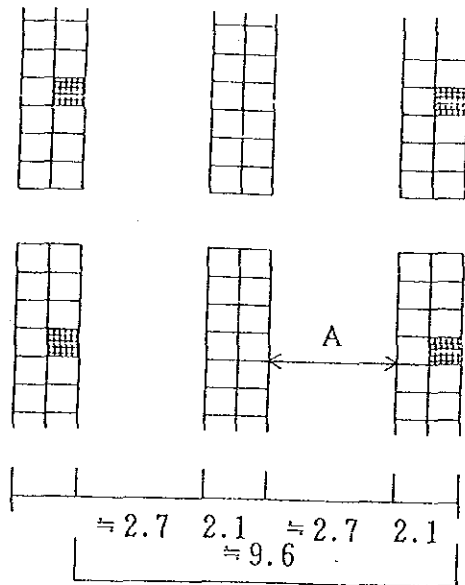
1. Abundant use of insulating materials.
2. Adoption of double walls (or double roofs), with the intermediate layer functioning as heat-insulating layer.
3. Use of grill bricks to provide shade on the wall surface.  
Improvement of the heat irradiation effect.
4. Provision of shadow on the wall surface with horizontal and vertical louvers, eaves, etc.

The contents, scale and other particulars of the facilities will be determined by taking into consideration the aforestated facts.

(a) Storehouse

The floor area of the storehouse will be designed in such a way to cope with the normal temperature storage of 7,447 m<sup>3</sup> of goods.

Assuming the adoption of the fixed rack system, the rack width will be 2.1 m, and the appropriate passageway width of the reach type fork lift will be 2.7 m. That being so, the span between columns will be approximately 9.6 m, calculated in terms of multiple of the said dimensions. Lightweight racks to house surgical non-consumables will be arranged by the peripheral walls of the storehouse for the sake of economy and effective use of the space.



Calculation of the span between columns of the storehouse

The floor areas of the rooms with temperature control will be designed in conformity with the quantities of goods to be stored in each room, i.e., 183 m<sup>3</sup> with temperature under 25°±

5°C, 142 m<sup>3</sup> with temperature under 5°C, and 8 m<sup>3</sup> with temperature under -20°C. Temperature control of the storage space requiring temperature under 25°C will be provided by ordinary air-conditioning equipment, prefabricated cold store and freeze store will be used to provide storage spaces with temperature under 5°C and -20°C, respectively, in view of their advantage regarding durability, ease of maintenance, ease of construction, etc.

The freeze store and the cold store require antechamber, and the cold store is designed to function as antechamber of the freeze store, and the storage space with temperature controlled under 25°C is designed to function as antechamber of the cold store, for the sake of economical efficiency.

(b) Arrival/issue yard, marshalling yard, etc.

The platforms for reception and delivery of goods should be designed with 1.0 m height.

In view of the ordering scheme adopted by the MSD, the arrival frequency is very low compared with the issue frequency. Under the circumstances, the arrival marshalling space must be large compared with the issue side, because the mentioned fact means arrival of large quantities of commodities at one time.

(c) Administrative office section

This section is examined by assuming the upkeep of the status quo, because its organization and operation are distinct of those existing in Japan.

(d) Welfare section

The rest room will be used by the personnel of the Central store at the lunch time to eat boxed lunch brought from home, and will be provided with kitchen facilities to provide simple tea service. The totality of the workers, excluding the mana-



gement personnel, is regarded as potential users of this space, but it will be designed by assuming its use in 3 shifts in view of the large number of personnel.

The shower room stated in the request will be designed with capacity for 15 persons.

(e) Lift

There are two possible alternatives regarding the lift, electric system and hydraulic system, but in connection with the hydraulic system there are some doubts about the operation and control under high temperature, and air-conditioning is required in the machine room in order to cope with the said problems. That being so, it is decided to adopt the electric system in view of its additional advantage regarding running cost.

As a lift is indispensable for the facilities to function as required, two units of lift shall be installed to provide for downtime of either one for maintenance and repair in the event of its failure. One of the lifts shall be of a size large enough to accommodate two pallets and a fork lift truck loaded with cargo stacked on a pallet, and with a loading capacity of 4 tons and the internal dimensions of the cage, 3.5 m x 4.0 m. The other one shall have the loading capacity of one ton and the internal dimensions of the cage, 1.7 m x 2.3 m.

(2) Scale of the facilities

The approximate floor area is calculated in the first place by taking into consideration the aforementioned conditions for calculation of the scale of the facilities. Next, the approximate floor area is superposed on the column span layout determined from the architectural standpoint, and then the floor area is determined by taking into account such factors as adjustment and compatibility of the various details on the ground plan.

Table 4-2 Store Area for each Classification

Section	Area	Base for calculation of the effective area, etc.		Number of pallets or Number of racks	Remarks
		Storage method, etc.	Quantity to be stored (m <sup>3</sup> )		
A	696.3	Flow rack	400	303	
		Fixed rack	347		
		Total	748		
B	786.5	Flow rack	541	410	
		Fixed rack	304		
		Total	845		
C - 1	1,819.4	Flow rack	1,172	888	
		Fixed rack	935		
		Total	2,107		
C - 1	190.1	Air conditioning 25°C + 5°C Movable rack	184	1,800 x 600 x 2,100 80 units	
C - 2	1,985.7	Flow rack	1,520	1,152	
		Fixed rack	768		
		Total	2,288		
C - 3	553.8	Flow rack	257	195	
		Fixed rack	338		
		Total	595		
C - 4	331.4	Flow rack	79	60	
		Fixed rack	277		
		Total	356		
C - 4	144.5	Prefabricated cold store	140	1,800 x 600 x 2,100 704	
		Movable rack			
C - 4 (polio)		Prefabricated cold store	8.0	1,800 x 600 x 2,100 124	
		Lightweight rack			
D - 1	199.2	Fixed rack	169	34	
		Lightweight rack	45		
		Total	214		
D - 2	184.3	Movable rack	144	1,800 x 600 x 2,100	
OP (Narcotics)	64.3	Special storage	11	Status quo	
TOTAL	6,972.6		7,640		

Table 4-3 Floor Area for each Rooms Excluding Store Area

	Room name	Area (m <sup>2</sup> )	Base for calculation of effective space, etc.	Remarks
ADMINISTRATIVE OFFICE	DIRECTOR	53.2	Status quo (2.3m <sup>2</sup> ) plus additional space for W.C.	
	SENIOR DIRECTOR	16.9	Status quo (12m <sup>2</sup> ) 4 x 4 = 16	
	ASST. DIRECTOR	10.1	Status quo 8.0 - 10.6m <sup>2</sup>	
	ACCOUNTANT	10.1	Status quo 8.0 - 10.6m <sup>2</sup>	
	PHARMASIST	10.1	3.5 x 3 m <sup>2</sup>	For 3 persons
	MEETING ROOM	21.5	For 14 to 15 persons	
	ORDINARY OFFICE	418.0	70 persons x 4.5m <sup>2</sup>	
	PRINTING ROOM	17.4	Mimeograph Photocopy + Worktable	
	LIBRARY	19.2	Lightweight racks	
	TELEPHONE EXCHANGE OFFICE	11.6		
		18.2		
	OTHERS	32.7	Warehouse, corridors, W.C.	
	WELFARE SECTION	REST ROOM	156.5	270 persons x 1/3 x 1.4m <sup>2</sup> Kitchen 18m <sup>2</sup>
SHOWER ROOM		30.2	Shower room for 15 persons x 1.4m <sup>2</sup> Dressing room 10.8m <sup>2</sup>	
OTHERS		78.5	W.C., Corridors, etc.	
Marshalling Section		574.2		

Room name		Area (m <sup>2</sup> )	Base for calculation of effective space, etc.	Remarks
O T H E R S	WORKSHOP	83.7	21 persons x 4 m <sup>2</sup>	
	DRIVER'S WAITING ROOM	25.5	12 persons x 2m <sup>2</sup>	
	OTHERS	581.4	ELV, ELV machine room (Ordinary passageway) Staircase	
TOTAL		9,212.4		

Calculating the overall scale of the facilities by taking into account the aforesaid facts, it is concluded that the floor area of the building as a whole will amount to approximately 9,200 m<sup>2</sup>, besides other parts such as truck berth, etc., amounting to approximately 700 m<sup>2</sup>.

### (3) Zoning

Making the calculation of the site area suited for construction from the layout plan, it is concluded that barely 3,800 m<sup>2</sup> are available for this purpose. Moreover, it is necessary to discount the portion corresponding to the truck berth from the said area, and therefore it is concluded that approximately 3,000 m<sup>2</sup> is the actual area available for one floor of the building itself.

Under the conditions, it is unavoidable to construct a 3-storied building in order to secure approximately 9,200 m<sup>2</sup> of overall floor area in the proposed site. The Sri Lankan authorities concerned expressed their wishes on the alternative consisting of a 2-storied building during the basic design study, but we are compelled to conclude that the said alternative is impracticable in view of the aforementioned reasons.

Broadly speaking, the building itself consists of 2 parts, storehouse and office. From the administrative and operational standpoints it is not necessary to divide these 2 parts in totally distinct wings, but from the standpoint of saving construction cost it is more advantageous to divide them into 2 distinct structures, because there are conspicuous differences in their floor design loads.

As for the truck berth, it is an outward space because loading and unloading works are carried out on the occasion of the arrival and issue of the goods, but on the other hand it must be protected with pent roof and the like.

In connection with this aspect, in this project the office is arranged at the first floor of a structure which is independent of the storehouse structure, and the pilotis space beneath the office floor is used as truck berth so as to realize the most effective use of the available site area. As a result of this arrangement, the facilities to be constructed anew are divided in two main parts, the 3-storied storehouse main structure comprising the storage zone and welfare zone, and the administrative space comprising the administrative office zone and truck-berth/marshalling zone.

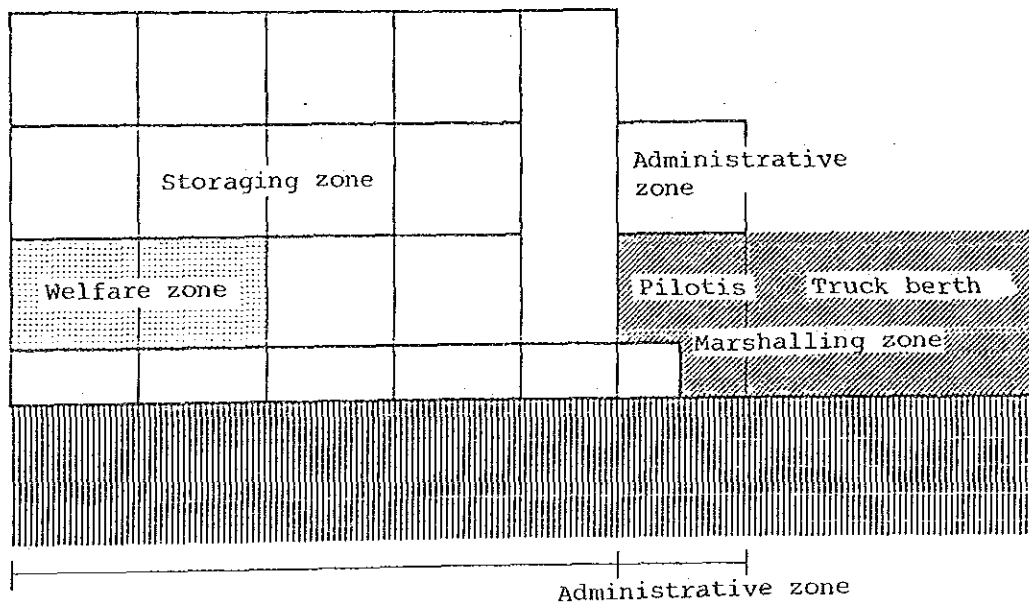


Fig. 4-2 Zoning Diagram

#### (4) Floor Plan Design

The ground plan is drawn up by taking into consideration the zoning scheme.

In connection with the storage spaces, the low-temperature stores consisting of the freeze store, cold store and air-conditioned room and the narcotic storage room are arranged at the first floor adjacent to the administrative zone, and the other storage spaces are arranged in the various floors according to the storage quantities, by taking care not to arrange distinct portions of the same section in distinct floors. In other words, the sections C-1 and C-2, that deal with large quantities of goods, are arranged in the first floor and ground floor, respectively, and the other sections dealing with smaller quantities of goods are arranged in the various floors.

On the other hand, the rest room of the welfare space is arranged at the ground floor (importance is attached to the accessibility from the outward space).

The workshop is arranged close to the arrival marshalling space. The air-feeding fan rooms in charge of the ventilation of the various floors are arranged at the eastern and western sides of the first floor, which is located at an intermediate position within the building.

Table 4-4 Floor Area Schedule

	Floor Area	Storing Section	Office Section	Welfare Section	Others
PH	63.0 m <sup>2</sup>	—	—	—	Elevator Machine Room
3F	2,796.6	Section A B C-3 C-4 D-1		Lavatory	Storage
2F	3,427.8	Section C-1 C-1 (A.C. Rm.) C-4 (Ref. Rm.) D-2 OP Freezing Rm.	Admini- strative Office		Refrigerat- ing Machine Room Fan Room
GF	2,925.4	Section C-2	Watcher's Room	Canteen Shower Lavatory	Marshalling Platform Work Shop Driver's Wait- ing room Generator Room Pump Room
Total		9,212.4 m <sup>2</sup>			

(5) Sectional Design

Big draught spaces are provided at the periphery of the storehouse with the object of coping with the temperature control problem in the normal temperature storage space, which is the most important point of the facilities to be constructed in this project. This design brings about the following merits.

- a) Stagnation of air in the storehouse is reduced as much as possible through the convection of air of the totality of the building.
- b) The exhaust corresponding to the longitudinal air feeding ducts provided in the design of the facilities is dealt with by the upward air current of these draught spaces. Exhaust ducts and exhaust fans are omitted thanks to this configuration.

For the sake of heat insulation, the roof will have double structure, consisting of concrete slabs with reliable waterproofing treatment and undulated slate plate covering placed on economical wooden framework which can be constructed with materials available on the local market.

As for the floor surface of the ground floor, the platform height is arranged 1 meter above the GL, and therefore the whole structure is elevated correspondingly. The span of the peripheral portion is given elevated floor configuration by making use of the said fact, with the object of coping with the high humidity problem.

(6) Structural design

A. Basic policy

Sri Lanka is far away from the various seismic activity zones of the world, and cases of earthquake recorded in the past are very rare. Furthermore, there is no conspicuous variation of temperature around the year and the maximum wind speed is of the order of 25 m/sec and no major storm has been observed. That being so, it is located at a very favourable place from the standpoint of structural design.

Under the circumstances, it is sufficient to take into consideration mainly the permanent load consisting of the fixed loads, the superimposed loads, and a small effect of the wind pressure working as horizontal load, for the sake of structural design.

In view of the historical circumstances of the country, the structural standards of the various kinds adopted in Sri Lanka are based on the BS code of Britain, and such being the case, this design will be based on domestic standards of Sri Lanka, and particulars with no applicable domestic code will be handled in conformity with the BS code.



The simplest concrete structure will be adopted as much as possible in this project, by taking into consideration such factors as availability of materials on the market, reliability of local work, durability and ease of maintenance.

B. Design policy

Broadly speaking, from the structural standpoint the building consists of the storehouse block and the office block. The storehouse block will be designed in the form of a 9.60 m x 9.60 m square grid in view of its functional advantages. Large slab thickness is indispensable in view of the large imposed load caused by the use of the building as storehouse, the necessity of preventing vibrations and cracks in the floor slab etc. Under the circumstances, the so-called flat slab method, which does not use beams, is presumed to be the most appropriate and economical alternative for this project.

Reinforced concrete rigid joint structure with beams and columns will be adopted in the office block.

Pile foundation will be used in this project because of the large weight of the building and the large loads applied on the columns in view of the large span. As for the pile length and foundation system, the final decision will be taken after the pertinent survey.

In general, it is said that there are many areas with acid soil in Sri Lanka. If the proposed site should have acid soil, concrete in contact with the soil would require some appropriate treatment. That being so, the chemical properties of the soil will be investigated concurrently with the subsoil survey, and the most appropriate and economical countermeasure will be decided after verifying the extent of soil acidity. The main loads to be used for the sake of design are listed in the followings.

1) Dead load:

Calculation of the actual loads working on the members composing the construction, such as structural members, finishing materials, etc.

2) Live load:

In principle, the superimposed load of ordinary rooms, such as office, toilet room, etc., will be calculated in conformity with the BS SP3 Chapter V Loading (Part I, Dead and Imposed Loads). As for special loads, their numerical values will be calculated according to the circumstances, and the live load on the floor of the storage which is its main use was determined to be 1,200 kg/m<sup>2</sup> based on the results of the following studies.

A. Flow rack system

Rack Pallet for 800 kg (area requirement approximately 1.50 m x 1.50 m)  
Dead weight of 3-tier pallets 35 kg/pallet

The live load per unit floor area assuming the afore-stated conditions is calculated as follows.

$$g = \frac{3 \times (800 + 35)}{1.50 \times 1.50} = 1,113.3 \text{ kg/m}^2 \quad 1,200 \text{ kg/m}^2$$

B. Fixed rack system

Pallets for 800 kg (area requirement approximately 1.0 m x 1.4 m) 3 tiers  
Pallet dead weight 35 kg/pallet

It is assumed that the said pallets stacked in 3 tiers will be placed at 27 places within the 9.60 m x 9.60 m grid surrounded by columns.

Furthermore, it is assumed that one fork lift with 1 t capacity (1.7 t dead weight) will travel between the pallet stacks. Therefore, the superimposed load per unit area is calculated as follows.

$$p = \frac{3 \times (800 + 35) \times 27 + (1,000 + 1,700) \times 1.25}{9.60 \times 9.60}$$
$$= 770.6 \text{ kg/m}^2 \text{ --- } 800 \text{ kg/m}^2$$

\* 1.25 is the impact coefficient due to movable load.

3) Wind load

The wind load will be handled in conformity with the stipulations of BS1 CP3 Chapter V (Part 2, Wind Loads). The wind velocity is assumed to be  $V = 25 \text{ m/sec}$ .

C. Structural materials

1) Concrete:

Ready-mixed concrete totally made of cement and aggregate on the local market will be used in this project.

2) Reinforcing bars:

Reinforcing bars will be imported mainly from Japan.

3) Piles:

Reinforced concrete piles will be manufactured in Sri Lanka.

Concrete and reinforcing bars used in this connection will be procured on the local market, in view of the term of delivery.

(7) Utility Design

1. Air-conditioning and ventilation installation

(1) Air-conditioning

Air-conditioning will be provided in the various storing spaces in conformity with the storing temperature conditions required by each stored article, in order to maintain the quality and effectiveness of medical supplies and equipment stored in this Central Store. It is obvious that the most appropriate air-conditioning system will be selected according to the storing temperature conditions, but on the other hand it is necessary to save the maintenance and running costs by taking such measures as subdivision of the equipment and simplification of the system, in order to minimize the maintenance and control cost burden within the scope of the annual budget. Moreover, the air-conditioning system should be designed on the basis of a comprehensive judgement in conformity with the local peculiarities, by taking into consideration such factors as simple system for routine operation of the installation.

Room name	Air-conditioning area (m <sup>2</sup> )	Air-conditioning conditions		Air-conditioning system
		Temp. (°C)	Hum. (%)	
Air-conditioned storehouse		25±5°C	50-60%	I
Cold store		5±3°C	Do	II
Freeze store		Below -20°C	Do	III

(Note 1) The air-conditioning systems are as follows.

- I Separate type cooler
- II Indoor fan coil w/C<sub>3</sub>-class compressor and outdoor condensor coil system.
- III Indoor fan coil w/F-class compressor and outdoor condensor coil system

(Note 2) The outdoor conditions for design basis are as follows:

Temperature: 33°C (D.B.)

Humidity: 88% (R.H.)

## (2) Ventilation

Mechanical ventilation system will be provided at the parts of the warehouse without the aforesaid air-conditioning equipment, for the sake of normal temperature storage of medical supplies and equipment. Dust prevention measures must be taken into consideration in view of the characteristics of the goods to be stored. The internal pressure of the storehouse as a whole will be kept always positive, and furthermore filters will be used for the sake of dust prevention. By the way, the same measures as those ones referring to the air-conditioning installation will be taken in connection with the economical efficiency of the maintenance and operation cost, ease of operation, etc.

The contents of the ventilation system are mentioned in the following table.

Room name	Ventilation system	Remarks
GF, 1F, 2F warehouse	I	Medium performance filter duct system
Office (including private rooms)	II	With control switch
Canteen	II	Ditto
Workshop	II	Ditto
Machine room, kitchen	III	Ditto

Note: The ventilation systems are classified as follows:

- I. Fan filter unit system (air feeder)
- II. Ceiling propeller fan 600 $\phi$  or 900 $\phi$
- III. Duct fan or wall-hung fan

## 2. Water supply, drainage and sanitary installation

### (1) Water supply

Running water will be supplied from the public mains laid in the front road (Deans Rd.) of the proposed site of this project. Water will be once received in the reservoir tank, and then it will be pumped up to the elevated tank. Subsequently, water will be supplied by gravity to the various consumption points.

The approximate consumption of running water in the facilities of this project is calculated in the followings.

- Personnel object of water supply      275 persons

- Water supply volume

- . Daily water supply volume  
 $150 \text{ liters/person} \times 275 \text{ persons} = 41,250 \text{ liters/day}$
- . Average water consumption per hour  
 $41,250 \text{ liters} \div 10 \text{ hours} = 4,125 \text{ liters/hr}$
- . Maximum water consumption per hour  
 $4,125 \text{ liters} \times 2 = 8,250 \text{ liters/hr}$
- . Maximum water consumption per minute  
 $8,250 \text{ liters} \div 60 = 137.5 \text{ liters/minute}$

Therefore, the reservoir tank for water receiving will be designed with  $25 \text{ m}^3$  capacity, and the elevated water tank will be designed with  $8 \text{ m}^3$  capacity. Furthermore, the lifting pump will have 120 liter/min. or more capacity, and 2 pumps will be automatically operated in alternation.

Both water reservoir tank and elevated tank will be made of FRP, and will be installed outdoors. The aforementioned mechanism is schematically shown in the following flowchart.

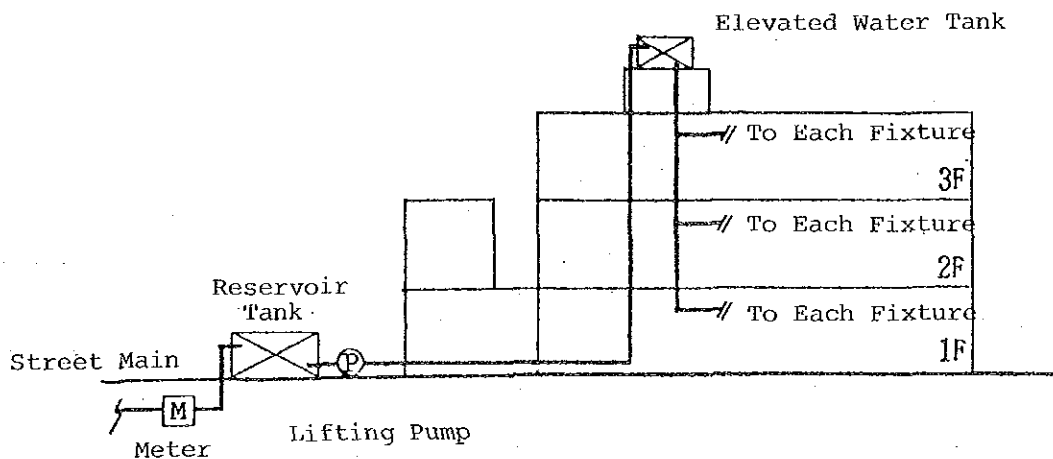


Fig. 4-3 Water Supply System Diagram

(2) Drainage

The drainage facilities will cope with sewage, ordinary waste water and rain water. Sewer and ordinary waste water will be drained in the public sewer mains. Rain water will be drained in the rain water drainage mains.

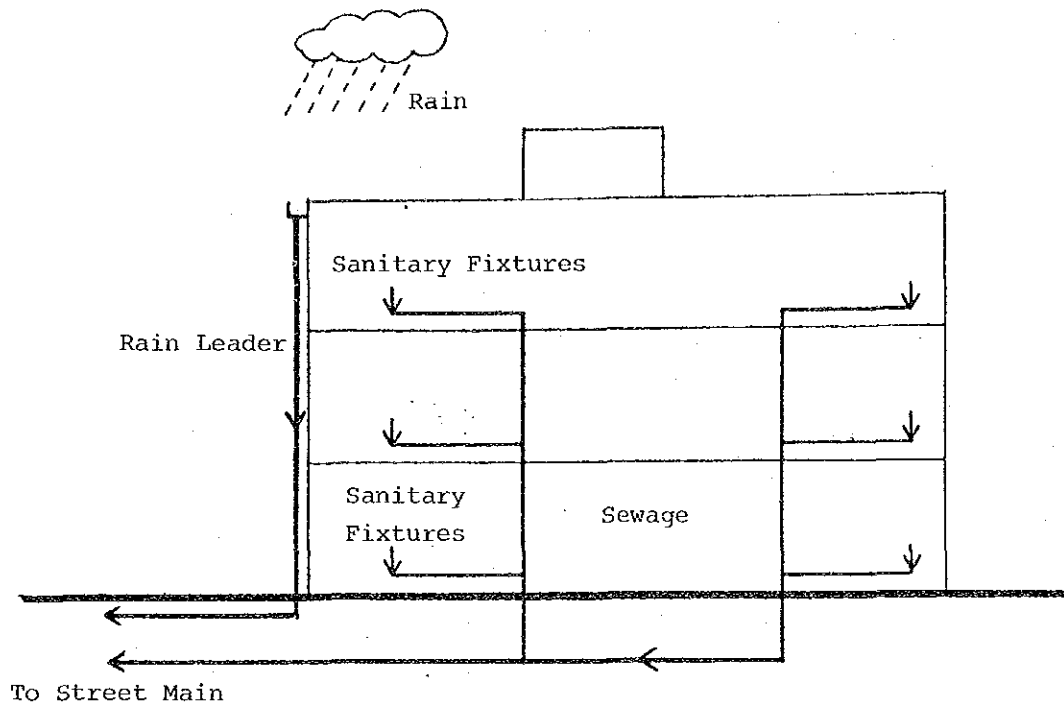


Fig. 4-4 Drainage & Sewage System Diagram

(3) Fire hydrants

Fire hydrants will be provided in conformity with the fire-fighting regulation of Sri Lanka. Fire hydrants will be provided at 3 places in each floor, and they will be wet type ones. Water tanks for fire-fighting will be provided on the ground, and water contained therein will be pumped with booster pumps. Booster pumps will be powered with generator units in case of power failure.



(4) Sanitary fixtures

The required sanitary fixtures will be installed in the lavatory toilet room, etc. Toilet bowls will be procured on the local market.

3. Electrical installation

(1) Power receiving and substation

A substation will be installed in the proposed site, in order to receive primary power of high tension 3 $\phi$  3W 11KW 50Hz from the Ceylon Electric Board (CEB). The presumable power requirement of the transformer is approximately 200KVA. The electric system of the secondary power is 3 $\phi$  4W 400V/230V.

(2) Generator

Power failure due to lightning is frequent in this region during the rainy season, and the installation of emergency generator equipment is indispensable in order to secure proper operation of the Central Store on the said occasions. The loads of the emergency generator will be limited to operation of refrigerating machines and pumps. The generator will be an indoor radiator-cooled type with 3 $\phi$  4W 400V/230V 50Hz, 100KVA capacity, and oil tank capacity for 30 hours or more continuous operation.

(3) Power mains

The power mains facilities consist of low-voltage power distribution mains from the power receiving and substation facilities to the various switchboards and power boards, and will be laid in conduits.

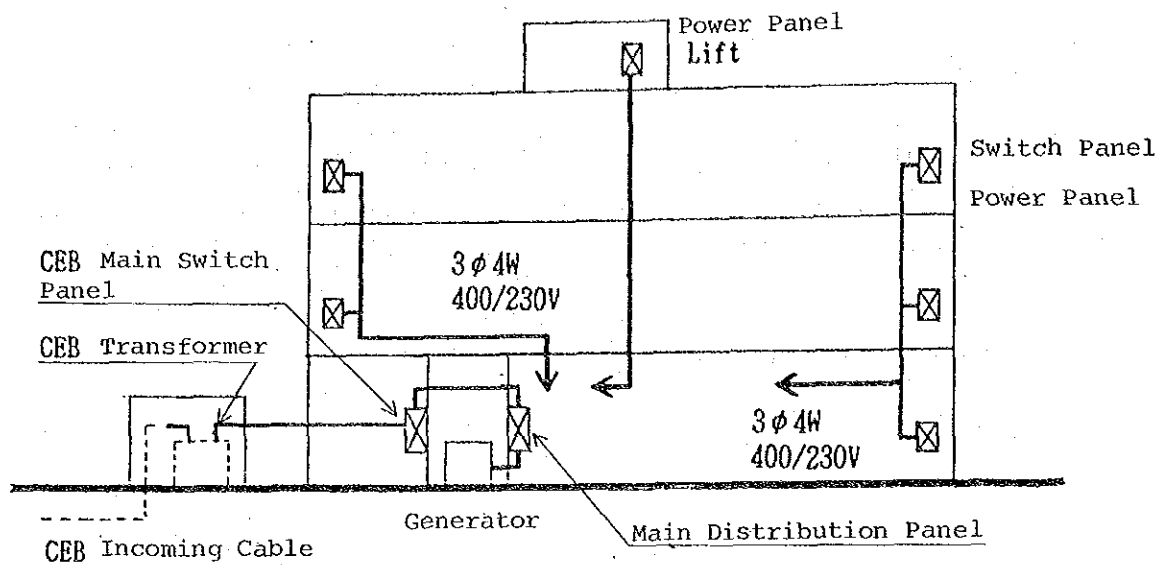


Fig. 4-5 Power Main Circuit Diagram

(4) Lighting and convenience outlet

Lighting and outlets of the various buildings will be powered by the switchboards installed at the various places, and distribution circuit breakers will be used to protect the various branch circuits.

The main rooms will be illuminated with fluorescent lighting fixtures, and their standard average design illuminance should be as follows.

i) Storehouse section	100 lx
ii) Office	300 lx
iii) Workshop	200 lx
iv) W.C., corridors, etc.	100 lx

The on-off operation of the lighting fixtures should be subdivided for the sake of energy saving. Emergency lighting fixtures equipped with built-in battery should be installed at strategic points of the passageways of the storehouse and corridors of the office wing. Emergency guide lights should be installed at the main doorways. Street lamps operated with timer should be installed outdoors.

(5) Wiring and conduits of the telephone system

Underground cables will be laid from the Deans Road into the project site. The telephone system will comprise 17 direct trunk telephone sets and 24 extension telephone sets operated via exchange.

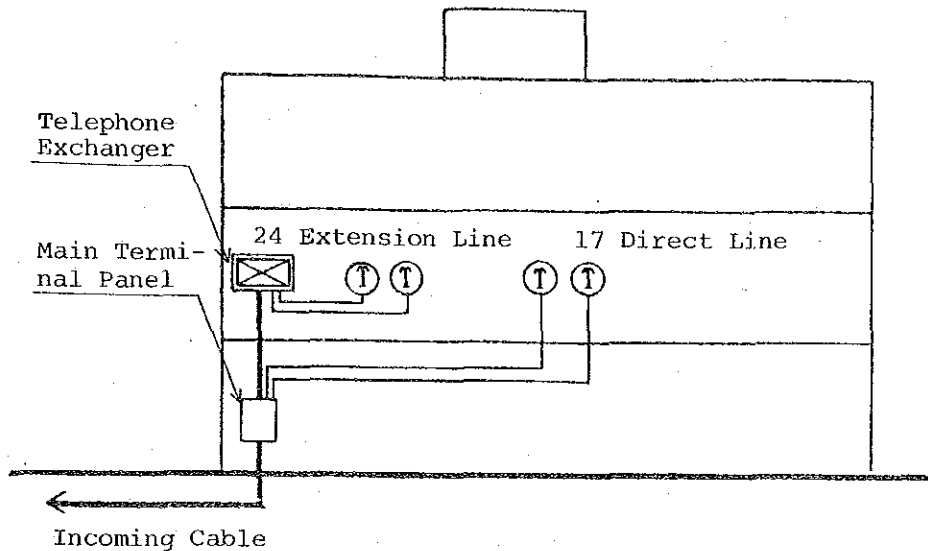


Fig. 4-6 Telephone System Diagram

(6) Public address system

The public address system will provide communication from the administrative office to the storehouse spaces of the various floors of the building. The amplifier will be installed in the office.

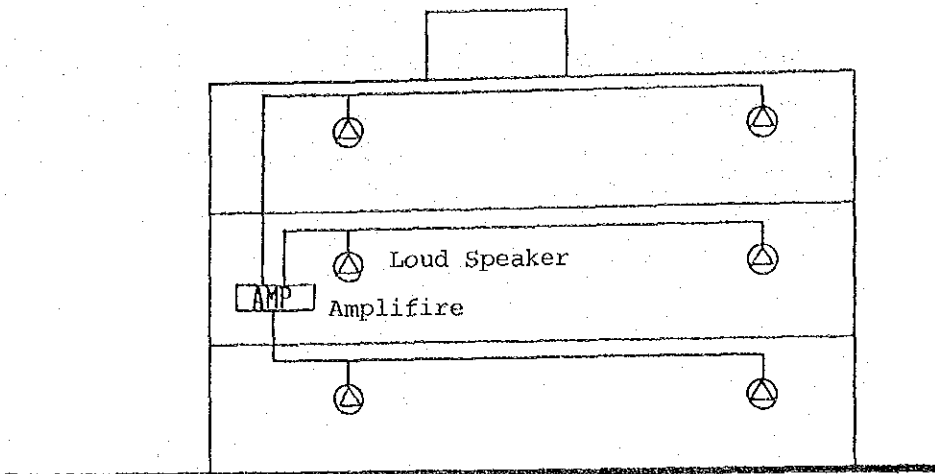


Fig. 4-7 Public Address System Diagram

(7) Automatic fire alarm system

These facilities will be provided with automatic fire alarm installation. The fire-fighting regulation of Japan will be used as a reference in this connection, because there are no concrete standards available in Sri Lanka for installation of automatic fire alarm installation.

(8) Lightning prevention

Lightning rods will be installed atop the building. These equipment will be installed in conformity with JIS.

4.2.3 Equipment Planning

Types and quantities of equipment of this project are planned in conformity with the considerations of section 3.3.2-(1) Distribution and Storage Plan. These equipment are selected by attaching primordial importance to the facility of operation, maintenance, inspection, repair, obtainment of parts, etc.

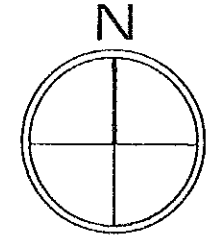
#### Equipment List

(1) Pallet	(Wooden, 1.2 m x 1.0 m)	6,000 pcs.
(2) Forklift Truck	(Reach type, Motor drive w/Spare parts)	5 cars
(3) Lorry	(5 t, Diesel engine drive w/Spare parts)	4 cars
(4) Cart	(500 kg, 1.2 m x 0.75 m)	5 cars
(5) Personnel Computer	(w/14" Display, Printer)	1 set
(6) Work Bench for Wood Work		1 pc.
(7) Carpentry Tool		1 set

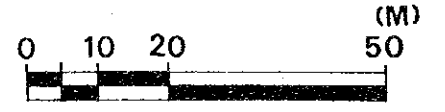
#### 4.2.4 Basic design drawings

Location Map	1/1,000
Plot Plan	1/ 500
Ground Floor Plan	1/ 300
1st Floor Plan	1/ 300
2nd Floor Plan	1/ 300
Elevations	1/ 300
Sections	1/ 300
Electric Distribution System	1/ 500
Water Supply and Sewage System	1/ 500



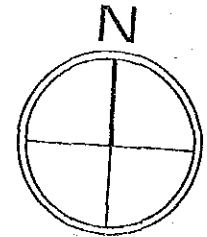
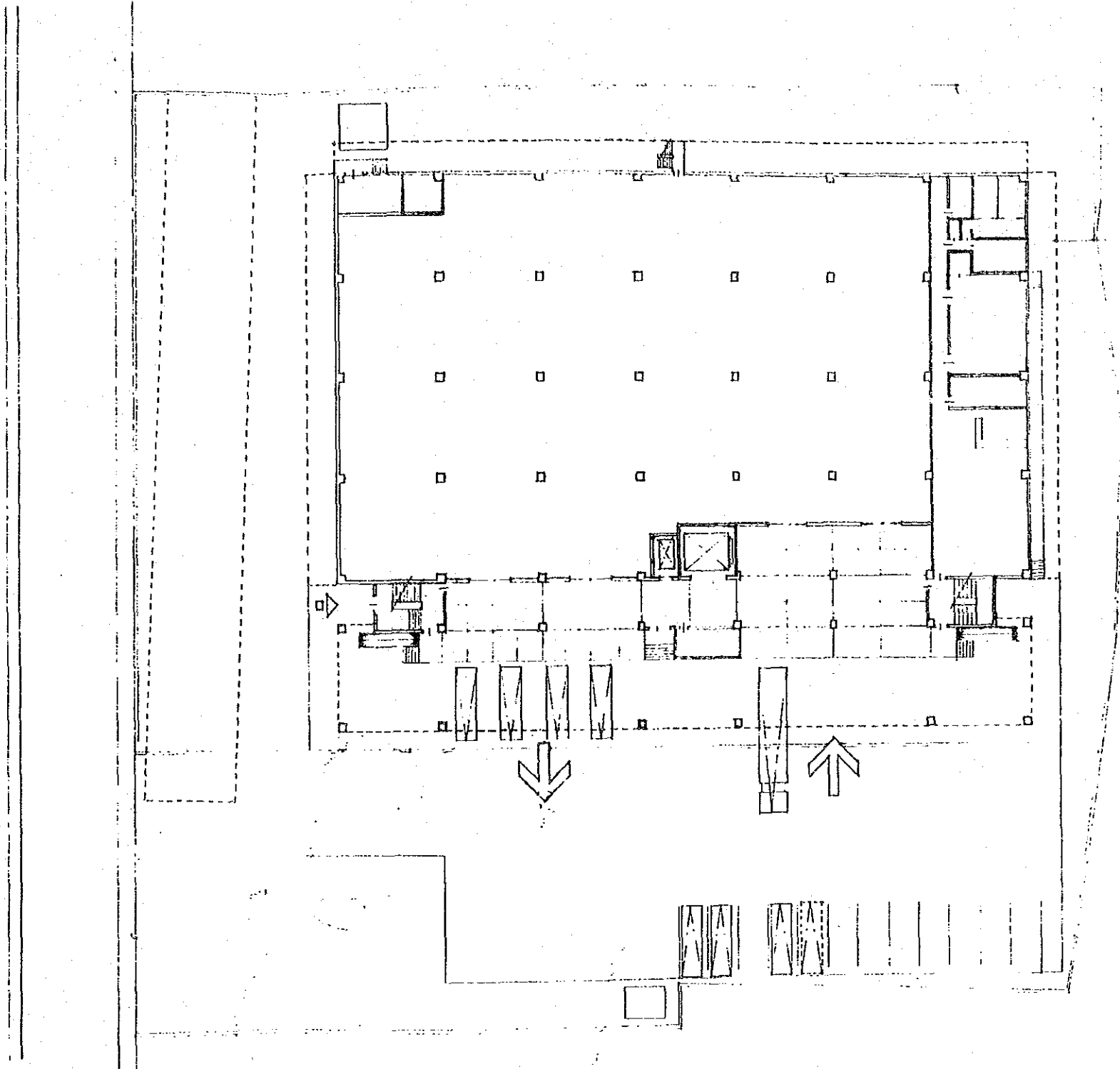


Location Map

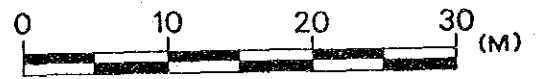




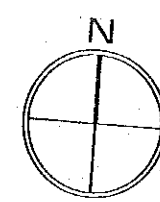
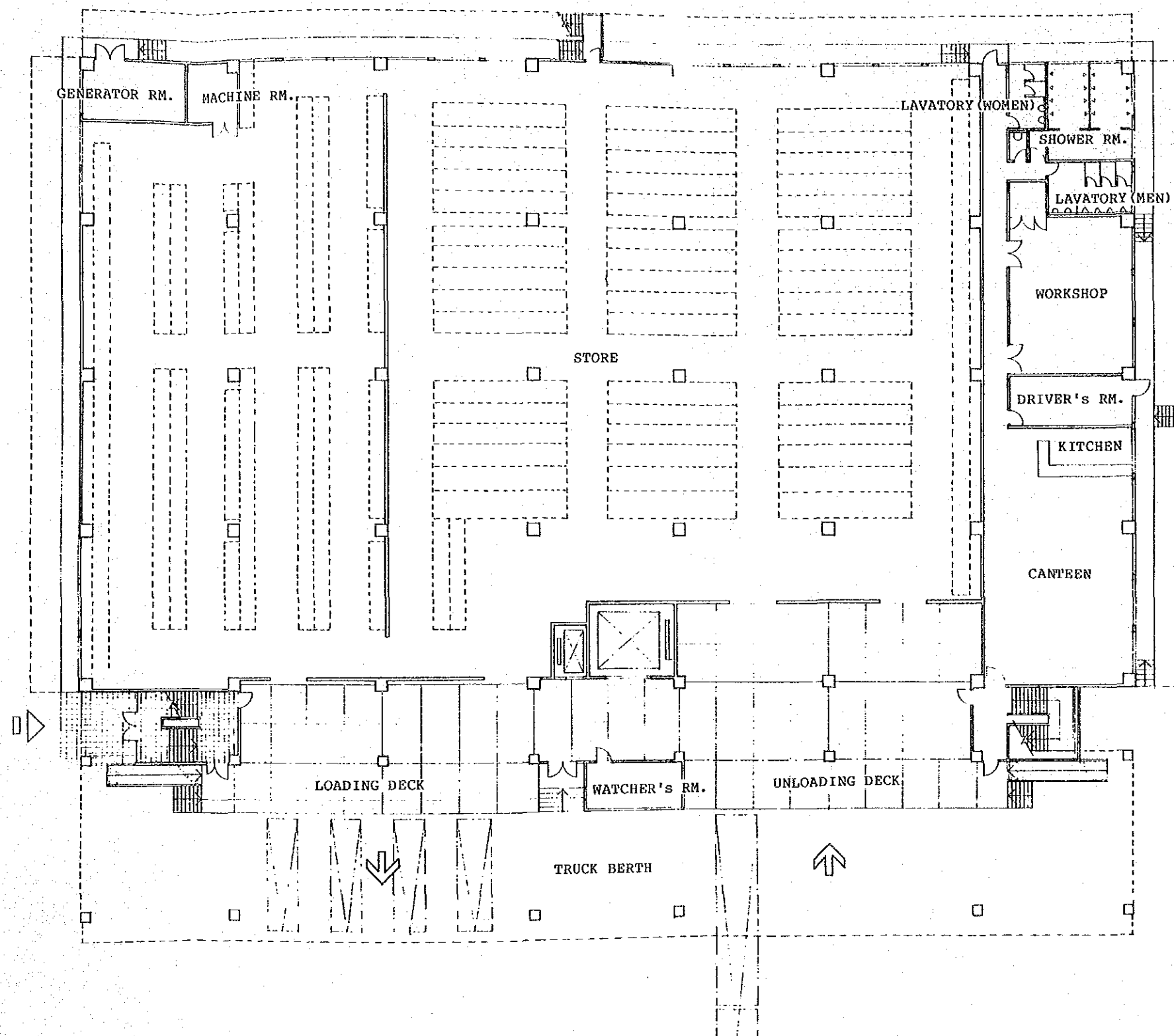




Plot Plan



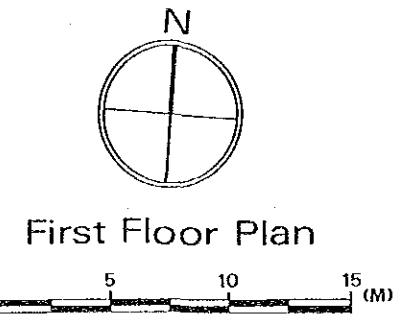
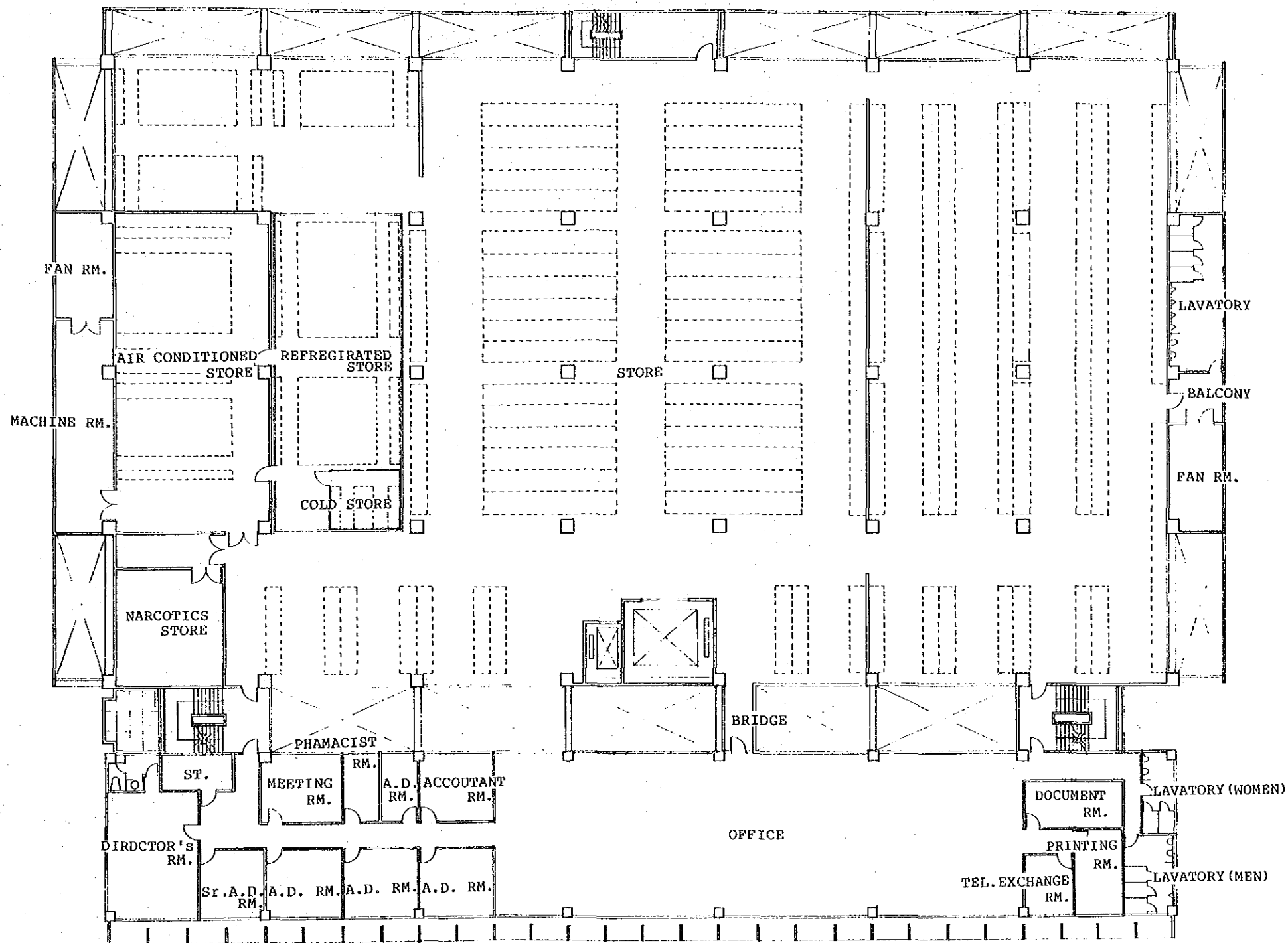




Ground Floor Plan

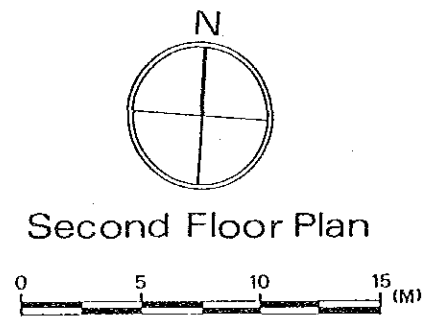
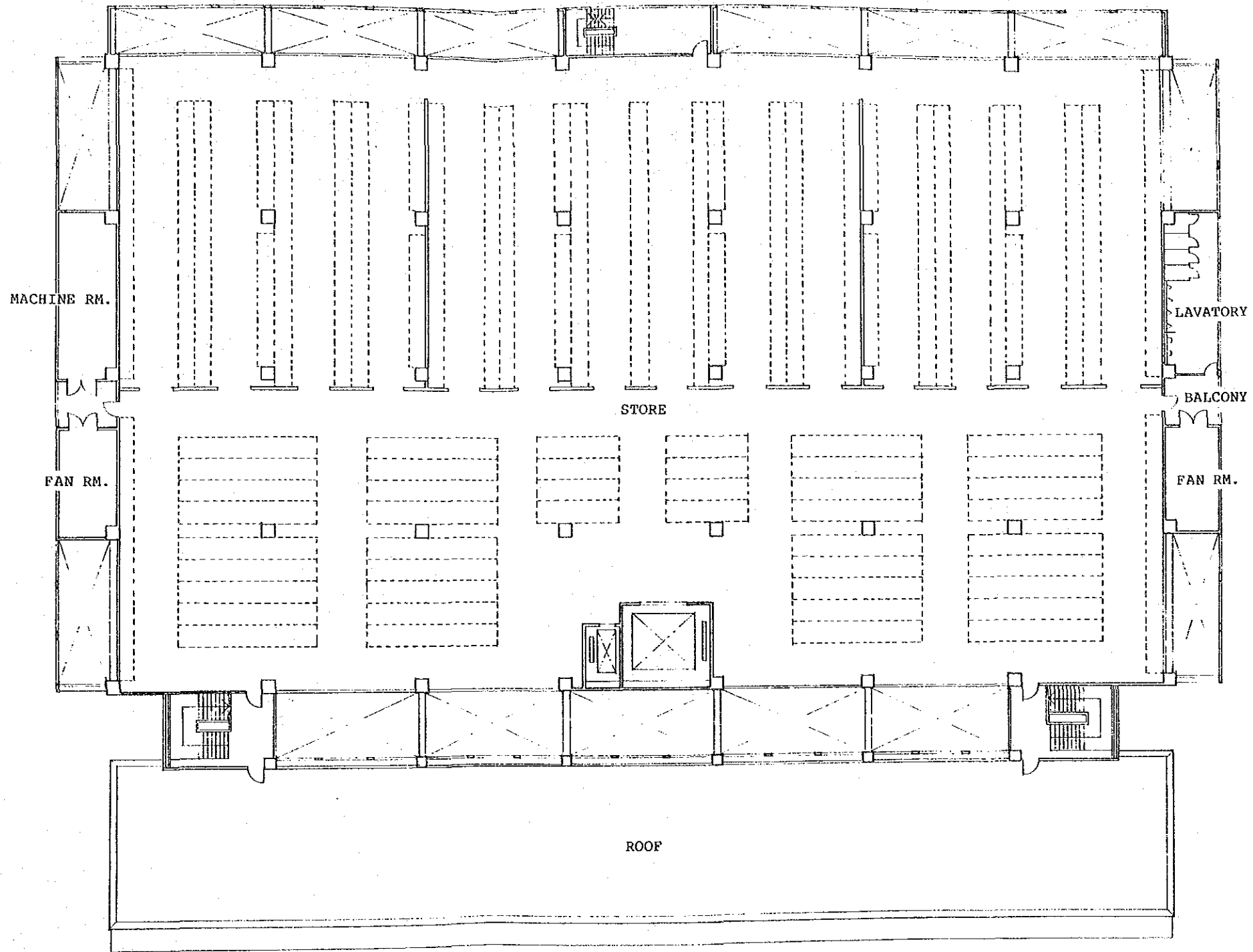






First Floor Plan

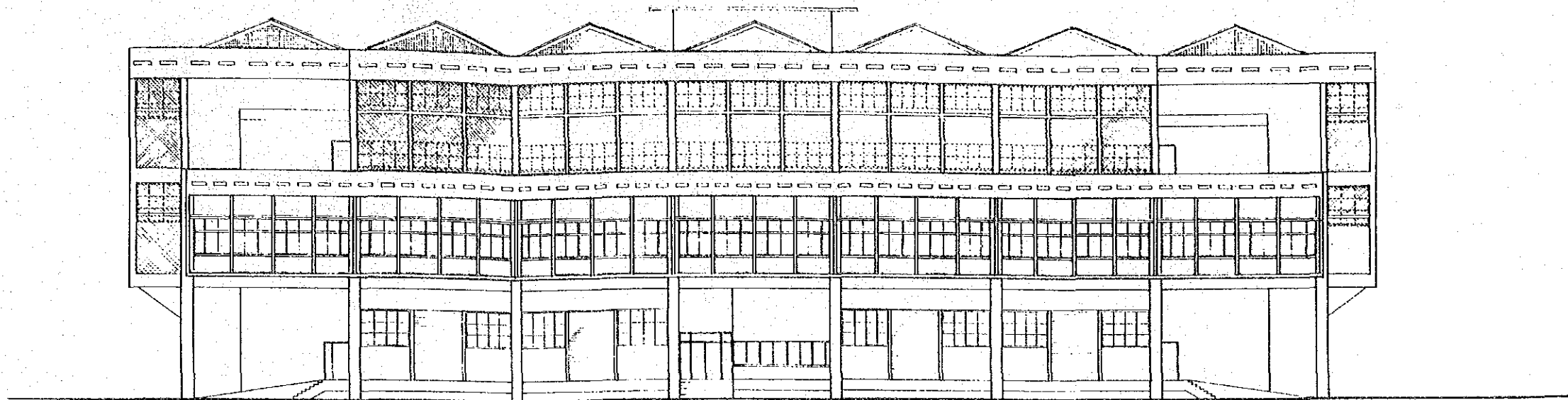




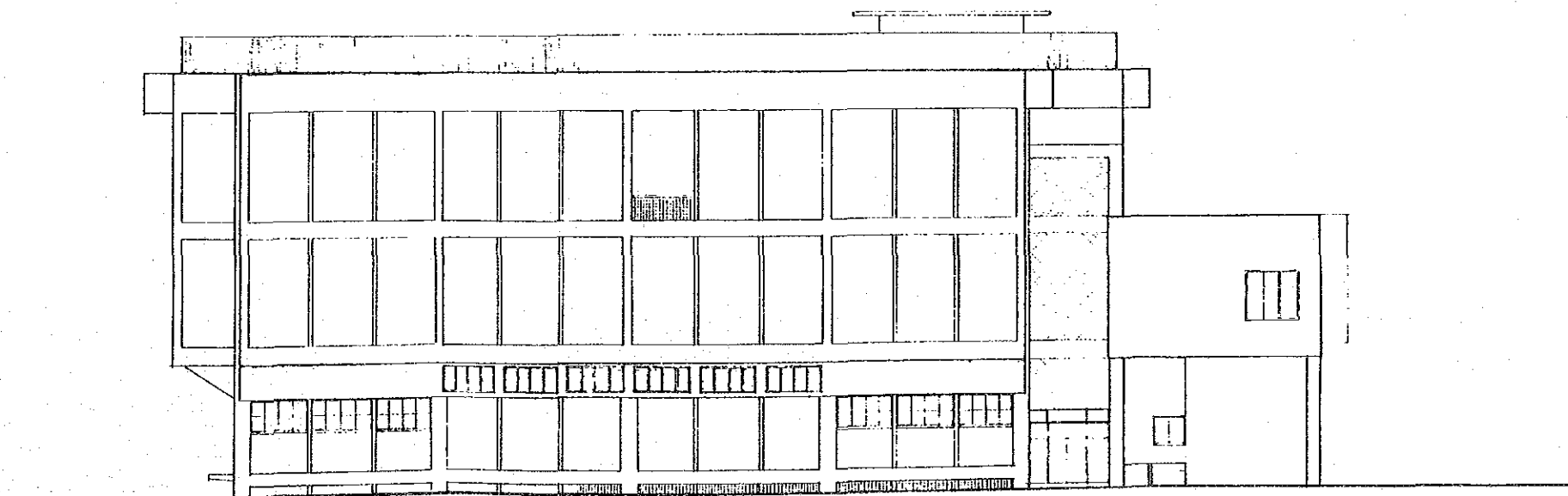
Second Floor Plan







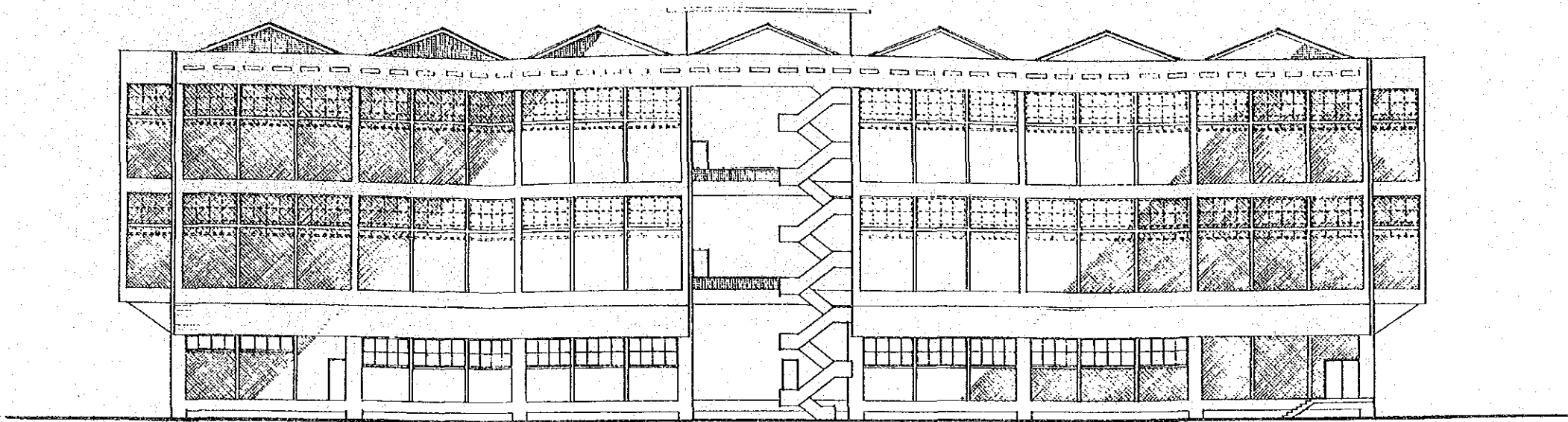
South Elevation



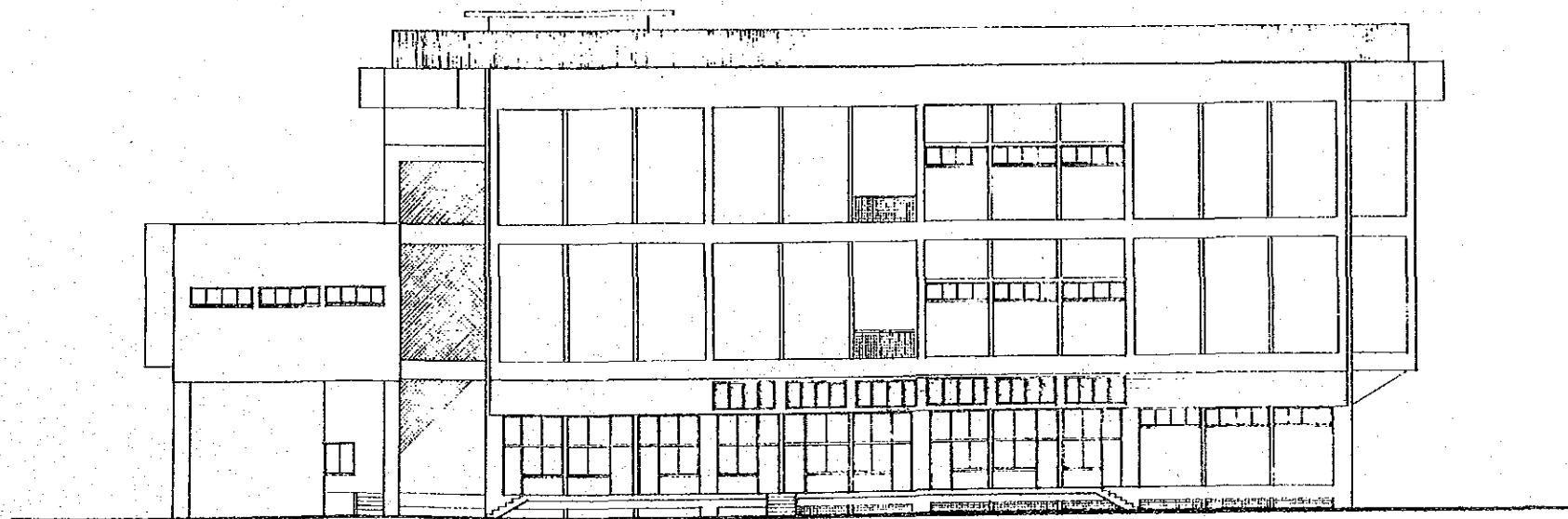
West Elevation







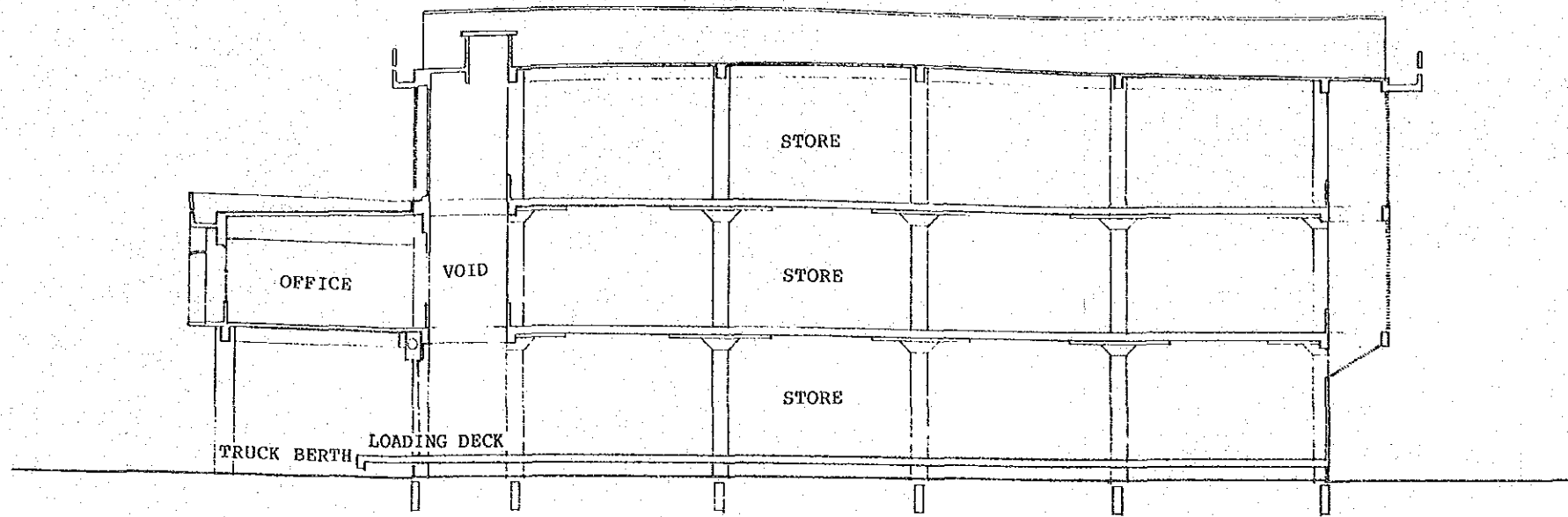
North Elevation



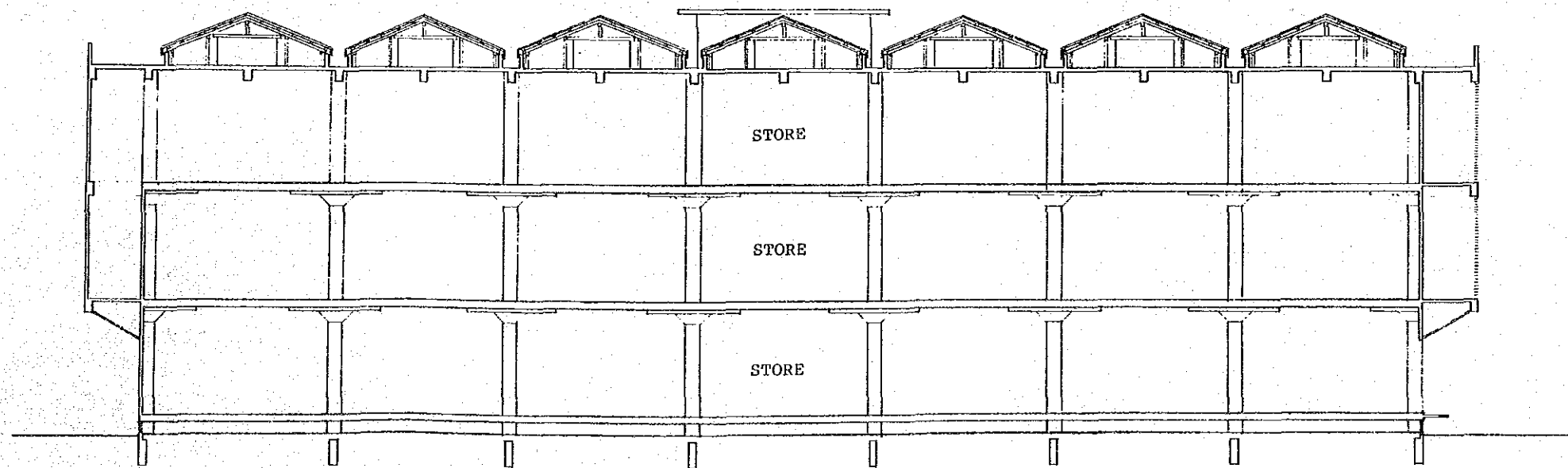
East Elevation



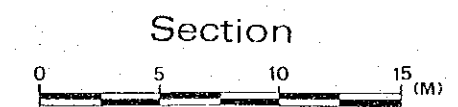




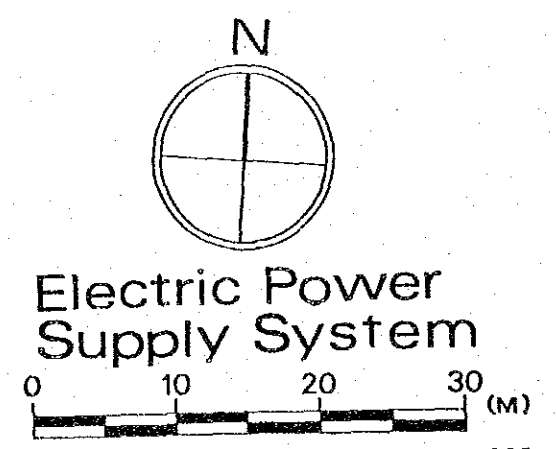
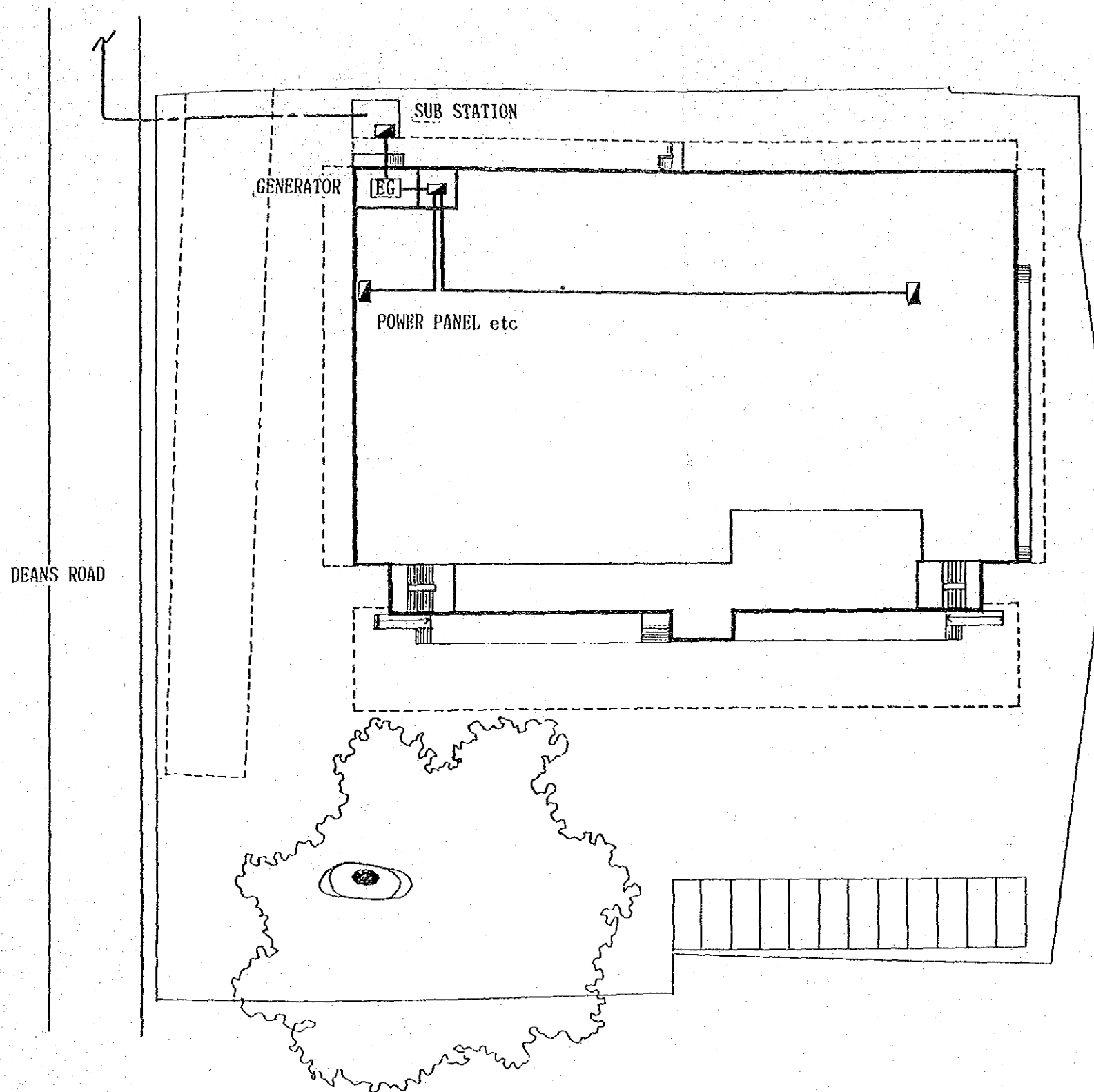
Y-Y' Section



X-X' Section







Electric Power  
Supply System





