

**BASIC DESIGN STUDY REPORT  
ON  
THE PROJECT  
FOR  
IMPROVING PUBLIC TRANSPORTATION  
IN  
VIENTIANE  
IN  
THE LAO PEOPLE'S DEMOCRATIC REPUBLIC**

**MARCH 1989**

**JAPAN INTERNATIONAL COOPERATION AGENCY**

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## PREFACE


In response to the request of the Government of the LAO People's Democratic Republic, the Government of Japan has decided to conduct a Basic Design Study on the Project for Improving Public Transportation in Vientiane and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to LAO PDR a survey team headed by Mr. Takao Dohi, Chief of the Service Section, Vehicle Service Division, Ministry of Transport, from November 7 to 30, 1988.

The team exchanged views with the officials concerned of the Government of LAO PDR and conducted a field survey (in Vientiane area). After the team returned to Japan, further studies were made. Then, a mission headed by Mr. Akira Ouchi, Economic Cooperation Bureau, Ministry of Foreign Affairs was sent to LAO PDR from February 1 to 12, 1989 in order to discuss the draft report and the present report has been prepared.

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

I wish to express my sincere appreciation to the officials concerned of the Government of the LAO People's Democratic Republic for their close cooperation extended to the team.

March, 1989



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Kensuke Yanagiya  
President  
Japan International Cooperation Agency

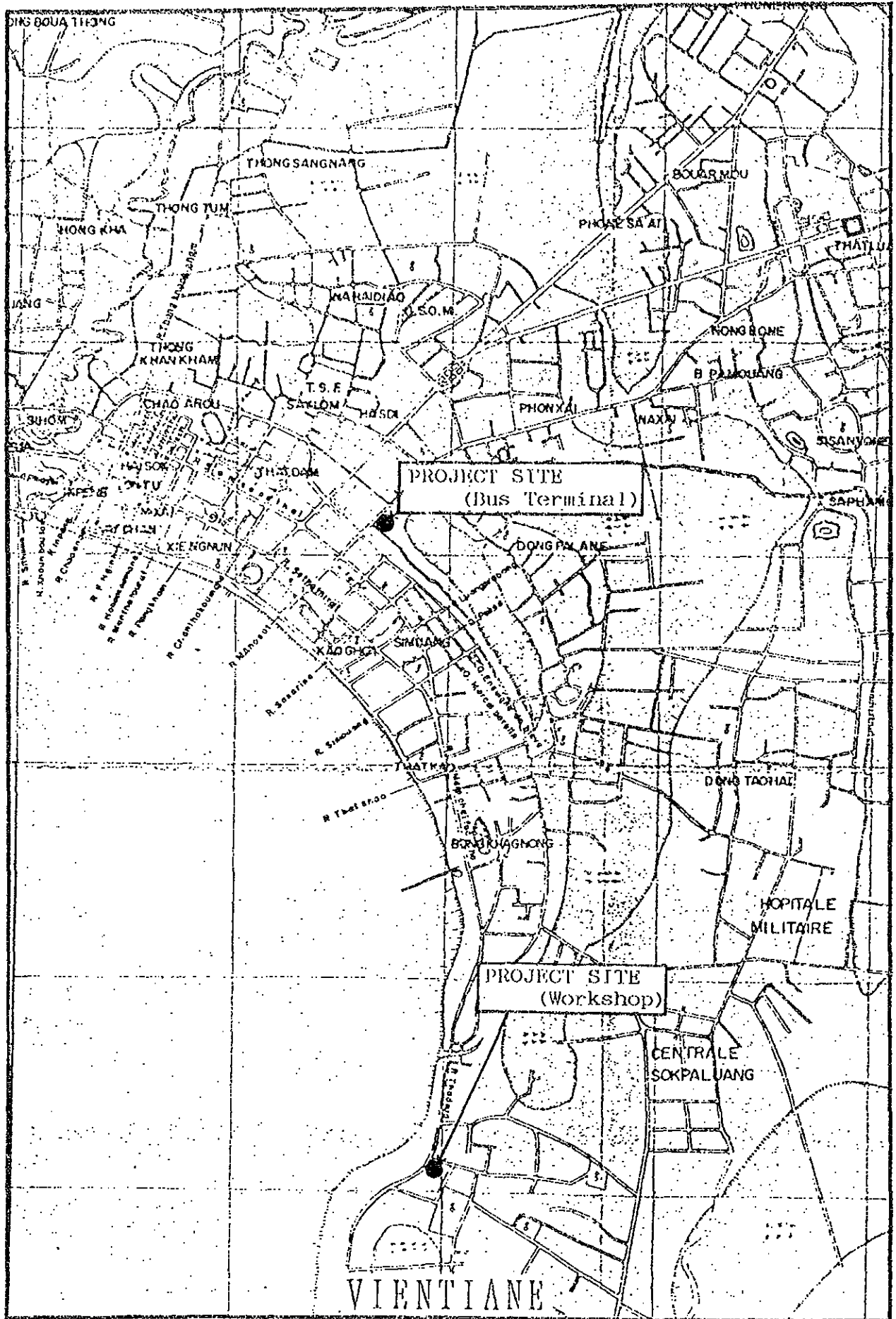




— National Boundaries  
 - - - Province Boundaries (approx.)  
 ● Capital City  
 • Towns

- Provinces
- |                 |                |
|-----------------|----------------|
| 1 Luang Nam Tha | 9 Khammouane   |
| 2 Oudomsay      | 10 Savannakhet |
| 3 Luang Prabang | 11 Saravane    |
| 4 Phong Saly    | 12 Attapeu     |
| 5 Houa Phan     | 13 Champassak  |
| 6 Xiang Khouang | 14 Sekong      |
| 7 Vientiane     | 15 Bolikhamsai |
| 8 Sayaboury     | 16 Bokeo       |

# LAOS





## SUMMARY



## SUMMARY

Land transportation in the Lao People's Democratic Republic depends greatly on buses. Today, buses are the principal means of transportation for the people living in Vientiane Municipality which includes Vientiane City and its vicinity.

In 1976 the Prefecture Bus Company was established in the Vientiane Municipality as part of the program for a Vientiane Municipality transportation network. The Prefecture Bus Company was provided with 29 buses in 1977 and 1978 under grant aid from the Government of Japan and is presently the public transportation system in Laos.

However, since buses are operating under severe conditions such as poor roads, the establishment of a good maintenance and operation system is an urgent matter for the Prefecture Bus Company. In order to resolve this problem, the Government of Laos set up a Municipal Transportation Network Program and requested grant aid of the Government of Japan to provide buses and to construct a maintenance workshop and a bus terminal.

In response to this request, the Japan International Cooperation Agency (JICA) agreed to provide bus spare parts, 50 new buses and 2 service vehicles under the Grant Aid Program of 1988. Also counting on the grant aid for the following year, it was decided to conduct a basic design study for the construction of a maintenance workshop, including necessary workshop equipment, as well as a bus terminal. The Japan International Cooperation Agency (JICA) sent a basic design study team headed by Mr. Takao DOHT, Chief of the Service Section, Vehicle Service Division, Ministry of Transport, to Laos for a period of 24 days from November 7 to November 30, 1988.

The study team met with the authorities concerned of the Government of Laos and discussed the contents of the request, surveyed the proposed construction site including conditions related to construction, and collected necessary information and data. After returning to Japan, the

study team analyzed and studied the survey results together with the collected information, and prepared a basic design consisting of a policy plan, tools and equipment selection, and a maintenance plan. A draft final report of the basic design study was also prepared.

JICA sent the study team to Laos again for a period of 12 days from February 1 to 12, 1989 to submit and explain the draft final report of the basic design study.

In this plan, a maintenance workshop and an administration office with parking lot are to be constructed at the present maintenance workshop site at Chnaimo District in the suburbs of Vientiane in order to centralize the maintenance and operation function of the Prefecture Bus Company. In addition, a bus terminal to be is constructed in the center of Vientiane City near the central market.

The outline of the project, based on the 50 buses provided under the 1988 Grant Aid, is as follows:

(1) Facility

	Facility	Main Functions
Maintenance workshop	Workshop	Overhaul of main parts such as engine and transmissions
	Administration office	Office work such as administration accounting, operation, supply and training
	Parking lot	Parking for buses to be repaired and buses waiting for departure
Terminal	Office	Issuing tickets to passengers and collecting sales revenue
	Driver rest area	Rest area for drivers waiting until departure time
	Boarding & off-boarding berths	Berths for parked buses and island

(2) Tools and Equipment

	Facility	Main Functions
Maintenance workshop	Workshop	auto-lift, wheel balancer, air compressor, etc.
	Administration office	Copy machine, OHP, time recorder, etc.
	Parking lot	Bus washing machine, fuel supply stand, etc.

Regarding implementation of the project, from execution of Exchange of Notes between the Government of Laos and the Government of Japan, 5 months are required for the execution of consultant contract, preparation of the detailed design and tender documents, and conducting of the tendering process. After evaluation of the tenders, the construction contract is executed and construction will start. Twelve months are necessary for construction.

The executing agency of the Government of Laos for this project is the Prefecture Bus Company under the jurisdiction of the Department of Communication, Transportation and Construction of Vientiane Municipality. Since the Prefecture Bus Company is operated as an independent agency, it will conduct all operations and maintenance during construction and after completion.

The implementation of this project is expected to enlarge the bus maintenance capacity, improve bus operation, and contribute largely to the sound management of the Prefecture Bus Company. It will also improve safety, reliability and sound operation of buses, thus providing a much better bus service for the people of Laos.

Since the significance of implementing this project through the Grant Aid Program of the Government of Japan is very great, an early execution of this project is desired.

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## CHAPTER 1 INTRODUCTION



## CHAPTER 1 INTRODUCTION

The main form of passenger land transport in Laos is the bus, and since buses provide the only scheduled transportation, with the exception of air transportation between distant cities, the bus system is an important service. In 1976, as part of the organization of the Vientiane Municipality transportation system, the Prefecture Bus Company (hereinafter referred to as PBC) was established to provide scheduled public bus transportation.

Today, it is an urgent matter for PBC to improve the operation and maintenance of its buses in order to provide a good bus service. In view of this urgent necessity, the Government of Laos prepared a Municipal Transportation Network Program to upgrade the bus maintenance and repair system, and requested grant aid of the Government of Japan for implementing this project.

In response to this request, the Japan International Cooperation Agency (JICA) sent a study team to Laos in June 1988. The team met and held discussions with the authorities of the Government of Laos and verified that a two-year grant aid project is necessary. In 1988, JICA decided to provide grant aid for 50 buses, 2 service vehicles, and spare parts for buses, as well as to conduct a basic design study for constructing a maintenance workshop, including tools and equipment, and a bus terminal for the newly granted 50 buses. For this purpose, JICA sent to Laos a basic design study team headed by Mr. Takao DOUJ, Chief of the Service Section, Vehicle Service Division, Ministry of Transportation.

After returning to Japan, the study team reviewed the suitability of the project based on its site survey, and prepared a project plan, a tools and equipment selection plan, a maintenance and administration plan, and a cost estimate of the project.

JICA summarized these results and prepared a "Draft Final Report of the Basic Design Study." Then a study team headed by Mr. Akira OUCHI, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs, was sent to Laos for 12 days from February 1 to February 12, 1989 to explain the contents of the report.

The study team met the authorities concerned of the Government of Laos and explained, discussed and confirmed the contents of the draft report. The aforementioned results of the basic design study are summarized in this report.

## CHAPTER 2 BACKGROUND



## CHAPTER 2 BACKGROUND

### 2.1 General Conditions

#### 2.1.1 General Conditions

Laos is a landlocked country bordered by Vietnam in the east, Burma in the west, Thailand and Cambodia in the south and China in the north (refer to Fig. 1). The country is located between 14° - 22° north latitude and 100° - 108° east longitude. The weather is tropical with two seasons: a hot, humid wet season (May - October) and a dry season (November - April).

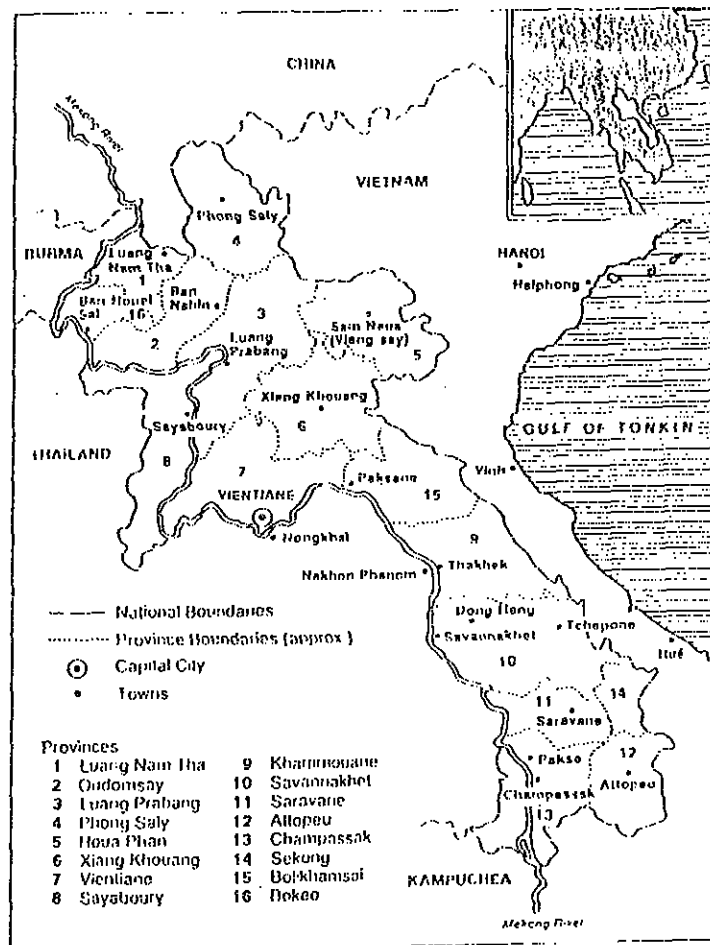


Fig. 1 Map of Cities in Laos

The temperature does not vary much throughout the year nor does the high temperature drop below 30°C. Humidity is also high throughout the year, ranging from 52% - 91% and averaging 72% (refer to Table 1).

Table 1 Temperature and Rainfall in Vientiane

Month		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Temperature (°C)	Maximum	33.7	33.6	36.7	38.4	35.8	34.8	34.3	33.4	33.6	33.6	32.2	31.8
	Minimum	14.5	15.1	18.8	20.0	21.2	23.4	22.8	23.0	22.7	15.3	15.9	11.8
	Average	23.5	24.2	28.2	29.0	28.5	28.7	27.4	27.8	27.3	27.0	25.3	23.1
Rainfall (mm)		11.2	15.5	30.3	96.6	252.3	276.3	275.4	317.4	317.3	87.7	16.0	2.5

(Rainfall record: Feb. 1914 - 1986)

Laos is an agricultural country with a population of 3.7 million and an area of about 236,800 km<sup>2</sup>. The population density is about 15 persons per kilometer and 90% of the population is engaged in agriculture. Mining and industries are underdeveloped, employing only some 0.2% of the population. Hydroelectric power is abundant and power is exported to Thailand. Some consumer goods such as soft drinks are produced on a small scale in and around Vientiane, but most raw materials must be imported.



### 2.1.2 General Transportation Conditions

Since there is no railway in Laos, transportation is by air or road, or by river utilizing the Mekong River.

Air transport is provided by the government-operated Laos Airway which connects Vientiane and 9 local airports. River transport on the Mekong River is conducted in only a limited area, so road transportation is the principal means of transport for economic activity. However, owing to lack of capital, it has not been developed to a satisfactory degree. The main roads from Vientiane Municipality are shown in Fig. 2.

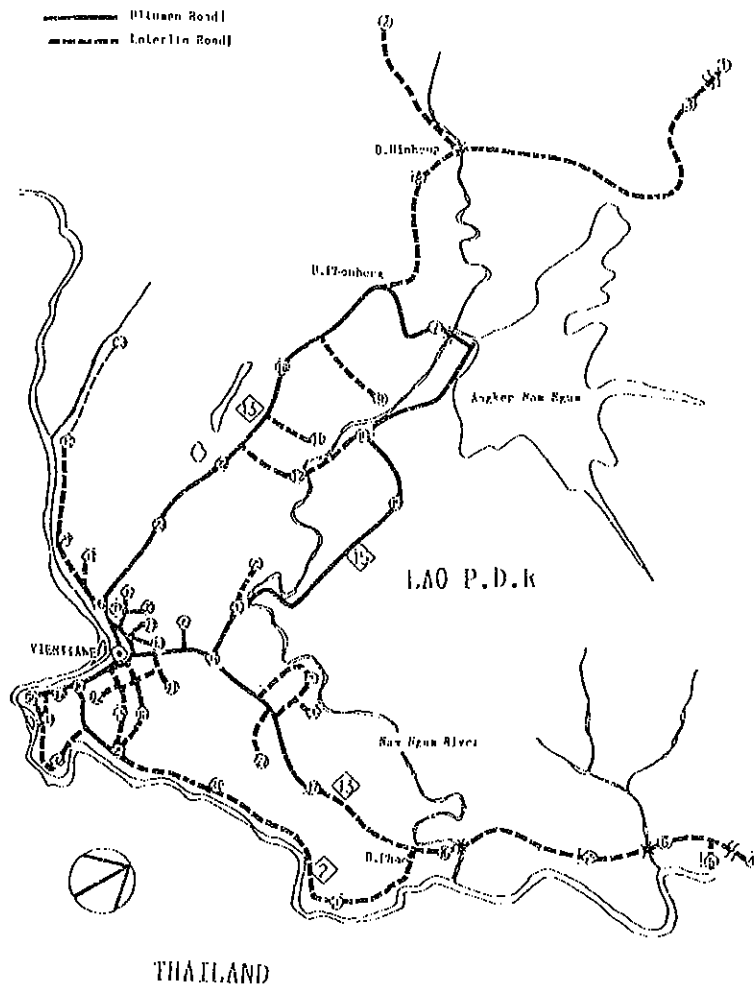


Fig. 2 Main Roads Between Cities

### 2.1.3 Public Transportation System

There is no public road transport corporation operating between cities and the only public road transport corporation is the Prefecture Bus Company operating in Vientiane Municipality. However, the number of bus passengers utilizing public transport is gradually decreasing after reaching a peak in 1980, in spite of the recent increase in the population of Vientiane Municipality. The main reason for this decrease is that the number of buses operating on scheduled bus routes has decreased. These buses, which were mainly provided through Japanese grant aid are old and many are not operable. Another reason is the lack of tools and equipment.

Table 2 Population of Vientiane Municipality  
(Area 3,267 km<sup>2</sup>)

Unit: 1,000 people

1985	1986	1987	1988
381	392	404	416

Table 3 Population of Vientiane City  
(Area 93.4 km<sup>2</sup>)

Unit: 1,000 people

1985	1986	1987	1988
110	128	136	150

Table 4 Number of Operating Buses and Number of Passengers

Unit: 1,000 people

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Total number of buses	12	29	29	29	29	29	29	35	35	33	33
Number of operating buses	10	25	25	22	20	20	18	15	14	14	14
Number of passengers	3,878	2,246	5,078	3,465	2,947	2,981	2,665	2,197	1,291	1,233	1,382

Other means of transport are small buses, taxis, motor-bikes and samlors, but they are not well maintained and their operation is unreliable. Furthermore, with a GDP per capita of only US\$ 288 (1986), the common people do not have the income to utilize these types transport, so economic activities rely mostly on motor-bikes and bicycles. The number of registered vehicles in Vientiane Municipality in 1985 is as shown in the following table.

Table 5 Number of Registered Vehicles

	State and International Organization	Vientiane (city excluded)	Chanthabouly district	Sisattanak district	Sikhottaboung district	Xaisettha district	Xaithany district	Naxaythong district	Hatxaythong district
Truck	3,424	645	474	10	11	58	59	42	42
Pick-up		161		15	8	33	30	24	43
Car	3,160	1,258	524	346	112	177	10	27	62
Tractor		84		11			33	0	36
Motor cycle, 50 cc	213	4,867	1,936	446	456	812	173	107	549
Motor cycle, >50 cc	1,249	6,897							
Motor samlor		89	45	30	41	6			
Pedal samlor		379	197	85	167				74
Bicycle		31,672	7,574	10,122	681	2,137	2,196	1,332	3,844
Cart		3,795	474	723	127	130	401	184	1,122
Population		377,409	48,846	45,965	53,004	51,562	78,879	44,250	58,903
Persons/car		300	93	133	473	291	7,188	1,639	950
Persons/motor cycle		32	25	103	114	64	433	414	107
Persons/bicycle		12	6	5	78	24	34	33	15

## 2.2 Bus Transportation Corporation

### 2.2.1 Organization and Management

The Prefecture Bus Company (PBC) was established in 1976 under the jurisdiction of the Department of Communication, Transport and Construction of Vientiane Municipality and conducts passenger transport operations in Vientiane Municipality. Table 6 gives the organization of Vientiane Municipality and Table 7 gives the organization of the Prefecture Bus Company.

Table 6 - Vientiane Municipality Organization

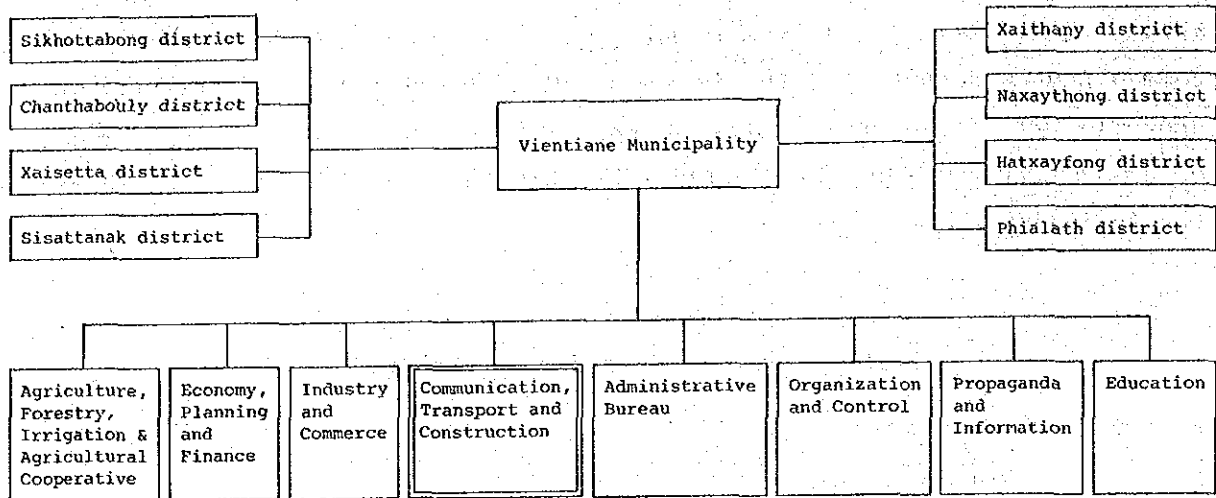
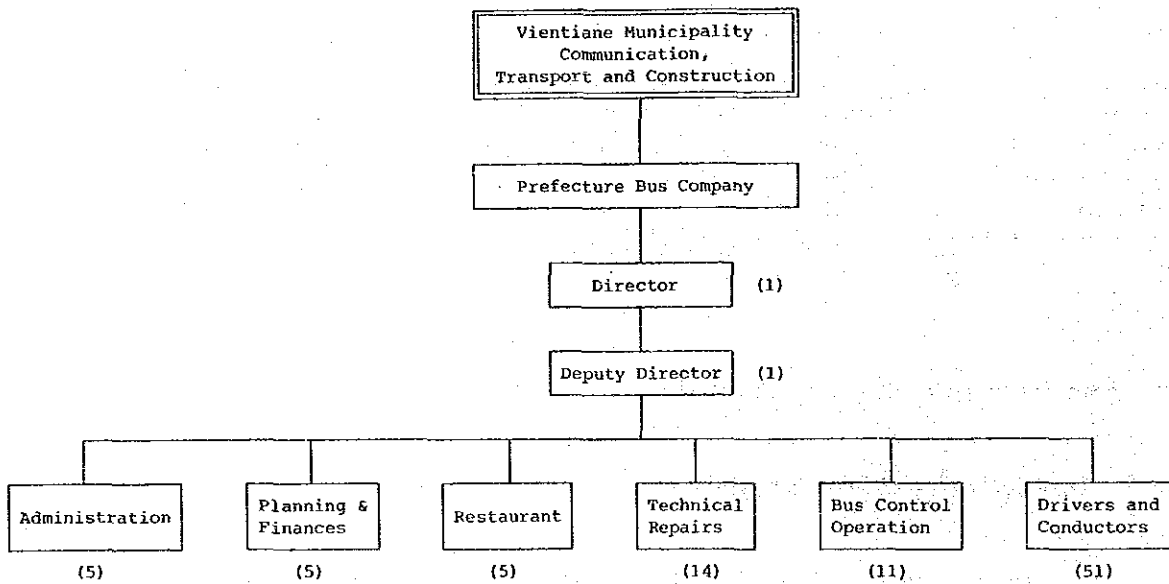


Table 7 Prefecture Bus Company Organization



There is an office in the present workshop for the director, office personnel and technical personnel. Here operational policy is decided, office work is conducted, and bus repairs are performed. A cafeteria, and ticket sales, bookkeeping, and bus operations are located at the bus terminal.

## 2.2.2 Bus Operation

### (1) Condition of present buses

Today, PBC has a total of 33 buses as follows:

Japanese buses	29 buses (55 passengers)
Russian buses	4 buses (35 passengers)

However, there are only 14 buses operating daily, the remaining buses cannot be operated and are serving as sources of spare parts for the operating buses. The technicians of PBC are diligently carrying out their duties trying to secure the daily necessary number of operating buses. But since the presently operating 14 buses are now reaching 10 years of age, even this number of buses are not secured. (Bus service life in Japan is 5 years.)

### (2) Bus operations

There are 12 - 14 bus routes around Vientiane City (connecting 12 - 14 cities, towns, or villages) (refer to Table 8).

Since the number of buses that can be operated each day is determined early in the morning, regularly scheduled bus operations are impossible, so the people have no confidence in the bus service.

Table 8 Bus Routes

Present bus routes (operating)

No.	Route	City*	Distance (km)	No. of Operations (operation/day)
1	Vientiane-Thabok	6	93	1
2	Vientiane-Ban Hai	16	62	2
3	Vientiane-Veunkham	29	36	3
4	Vientiane-Paksab	26	38	3
5	Vientiane-Dong dok	35	12	5
6	Vientiane-Thalat	7	84	2
7	Vientiane-Sen Soum	8	80	2
8	Vientiane-Pak cheng	9	75	2
9	Vientiane-Km 52	10	52	2
10	Vientiane-Ling xane	11	56	2
11	Vientiane-Ban Don	20	59	2
12	Vientiane-Sithantai	32	26	3
13	Vientiane-Ban Keun	18	65	2

\*: Cities along the route

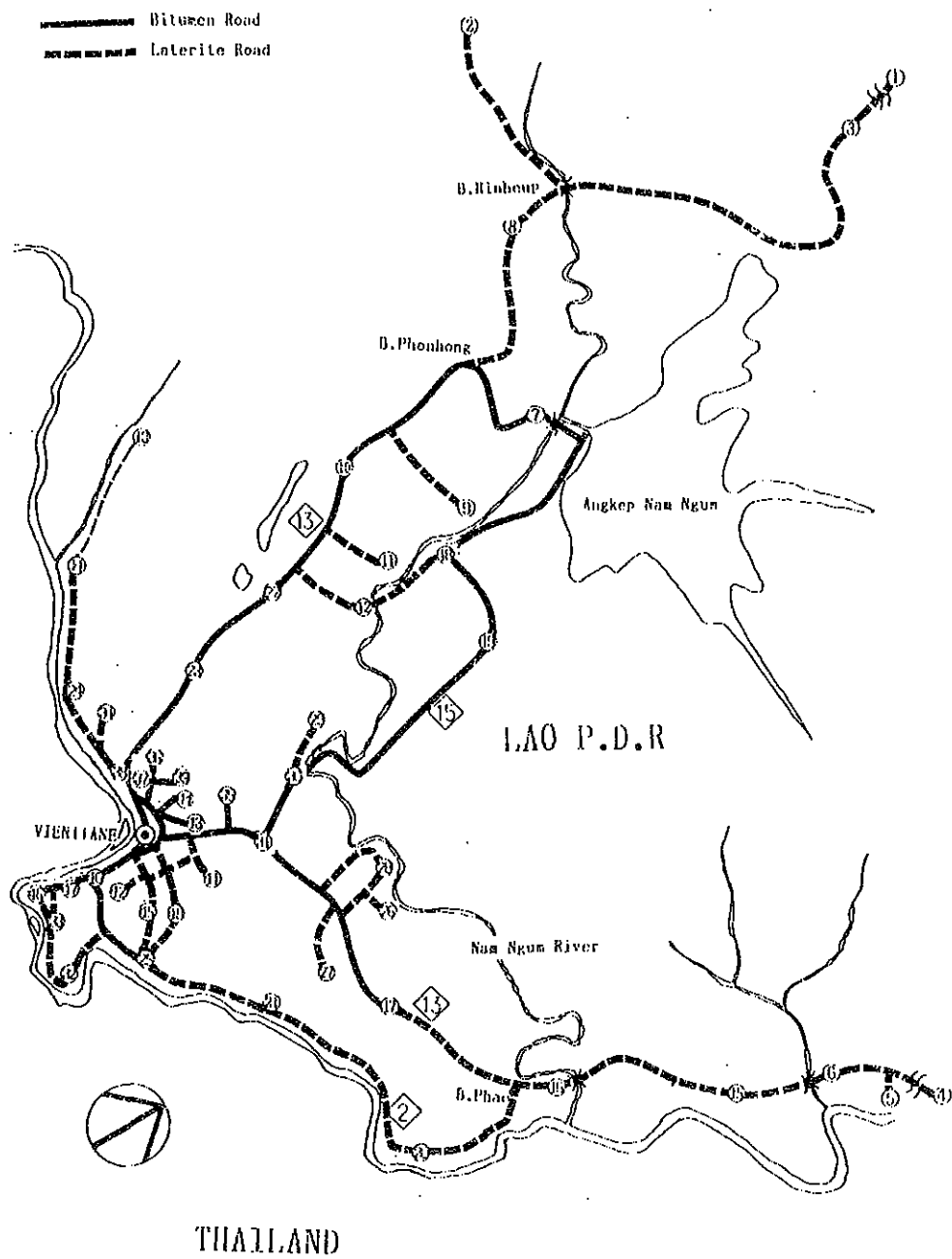


Fig. 3 Bus Route Map

### 2.2.3 Bus Maintenance Shop

#### (1) Facility

The present maintenance shop is located on Thadua Road 3 km south of the city center. It was a former private gasoline station and maintenance shop which was taken over by PBC and PBC's head office is also located here.

The site area is 5,200 m<sup>2</sup> and includes repair shop, spare parts storage, bus washing stand, administration office and gasoline stand. However, since this was mainly a gasoline station, the layout is unsuitable for a maintenance shop.

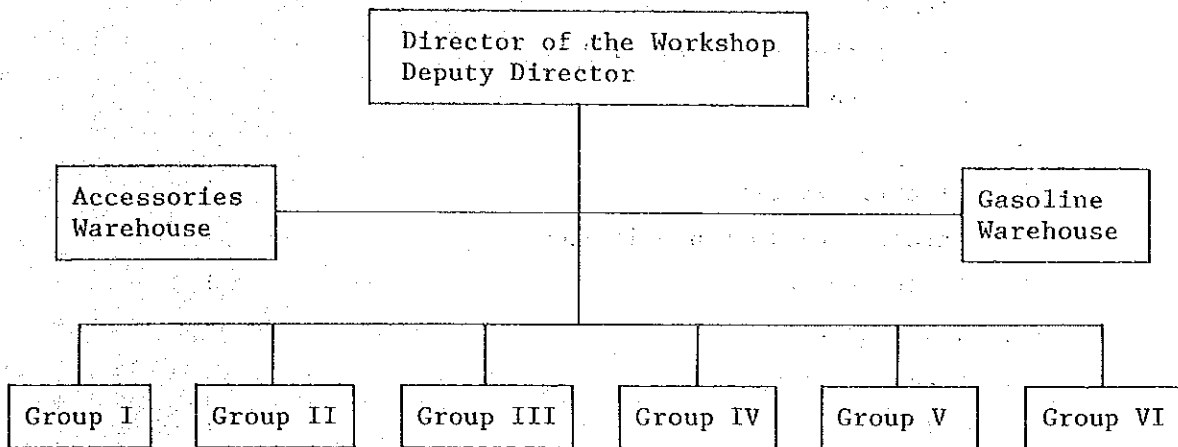
Furthermore, the facilities are principally for small vehicles and are not designed for large and medium size buses. There is an auto-lift, but the capacity is too small and it cannot be used. There are 8 covered repair docks, but the width between the columns is narrow and it is very difficult for buses to enter the docks. Actually, bus repairs are all carried out outside in an uncovered area, so repairs during the wet season are difficult.

Engine and transmission overhauls are conducted indoors, but inspection pits are not used for daily inspection. Also, since road conditions are poor and are mainly of acidic laterite soil, vehicle undercarriages become very dirty, preventing the discovery of cracks in frames, the loosening of bolts, and contaminated oil. Since this hinders maintenance and repairs, high pressure washing equipment is necessary to improve maintenance efficiency.



(2) Maintenance and repair personnel

The personnel working in the maintenance shop number 14 persons divided into different special jobs as shown in the following figure.



Group I: Washing group  
Groups II, III, IV, V, VI: General Repairs

Fig. 4 Organization of Maintenance Workshop

Maintenance work is all repair work based on the experience of the repair workers. They are ill prepared for conducting preventive maintenance, but since they are diligent workers, it should not take much time for them to learn basic skills.

#### 2.2.4 Status of Tools and Equipment

The present main equipment is listed below.

1. Air compressor	1
2. Auto-lift	1
3. Work stand	1
4. Air compressor (portable)	1
5. Grease pump	1
6. Oil pump	1
7. Electric welder	1
8. Garage jack 10 ton -- 15 ton	1
9. Engine stand	1
10. Vise stand	1
11. Chain block	1
12. Lathe	1
13. Drill	1
14. Grinder	1
15. Gasoline stand	1
16. Hand tools	1
17. Valve lifter	1

The tools and equipment are those which were at the small private maintenance shop before the revolution (1975), and there are no tools or equipment for large vehicles. Furthermore, they are old and obsolete and would be expensive to repair for further use.

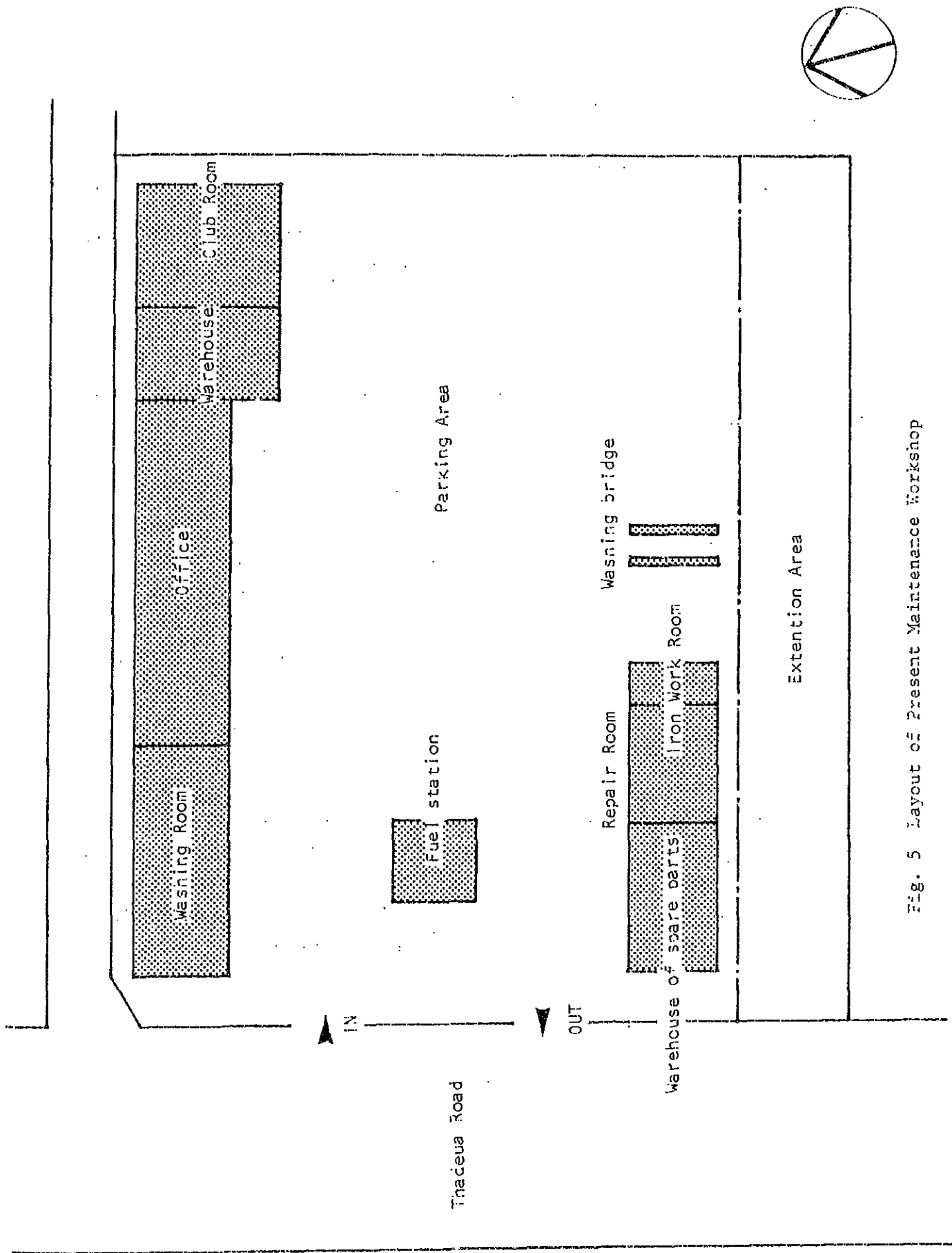


Fig. 5 Layout of Present Maintenance Workshop

## 2.3 Background and Contents of Request

### 2.3.1 Background of Request

As of November 1988, PBC owns 33 buses, but actually only 14 buses are operating, mainly due to the following reasons.

- (1) The buses are all old and worn.
- (2) The present maintenance shop is not designed for maintaining large vehicles.
- (3) The present tools and equipment are all old and worn.

In order to resolve this unsatisfactory situation regarding its only public transport service, the Prefecture Bus Company, and also to improve bus operation efficiency, upgrade reliability and expand its service, the Government of Laos prepared the Municipal Transportation Network Program and requested the Government of Japan to provide grant aid for this project.

In response to this request, the Japan International Cooperation Agency (JICA) sent a Project Study Mission to Laos in June 1988, and verified the necessity of grant aid over a two-year period. The Government of Japan is to provide 50 new buses, 2 service vehicles and spare parts for buses in the first year, and sent a basic design study team to perform a study on the construction of a maintenance workshop and a bus terminal.

### 2.3.2 Contents of Request

The contents of the request forwarded by the Government of Laos may be summarized as follows:

(1) Bus terminal

- 1) A terminal with boarding and off-boarding island
- 2) Administration office, driver rest area and waiting room

(2) Maintenance workshop

- 1) Bus maintenance workshop
- 2) Spare parts storage
- 3) Fuel stand
- 4) Administration office rooms
- 5) Parking lot

(3) Tools and equipment

- 1) Maintenance and repair tools
- 2) Vehicle maintenance and repair equipment
- 3) Bus washing stand and site drainage plan



## CHAPTER 3 DESCRIPTION OF THE PROJECT





## CHAPTER 3 DESCRIPTION OF THE PROJECT

### 3.1 Objective of the Project

The objective of this project is to improve and expand the facilities (bus terminal and bus maintenance shop) of the sole public land transport service of Laos, the Vientiane Prefecture Bus Company, in order to improve bus operation and bus maintenance capacities, which will raise the confidence of the people of Vientiane in bus service and contribute to promoting economic activities in Vientiane Municipality. For this purpose, the following two items should be implemented.

- (1) Secure a bus maintenance system for the 50 new buses to be provided under the 1988 Grant Aid Program of Japan in order to improve the bus operation rate.
- (2) Establish a thorough regular inspection and maintenance procedure for preventing breakdowns due to poor maintenance, thus increasing the reliability of bus operations.

### 3.2 Study of the Project

#### 3.2.1 Bus Maintenance Shop

The inspection and maintenance of buses, excluding tire changing and oil and grease changing, are insufficient because of the heavy repair workload due to breakdowns. The breakdowns mainly concern engines, differential gears, suspensions, clutches and transmissions which are major repairs requiring much time. Furthermore, there is a serious shortage of technicians and skilled workers.

The supply of 50 new buses under grant aid from Japan is already definite, and as a result, PBC will be expected to carry out its mission to provide reliable bus service. However, for this purpose, a bus

maintenance system consisting of preventive maintenance, including a regular inspection and maintenance program, must be set up, in addition to upgrading the technical skills of technician and skilled workers.

### 3.2.2 Bus Terminal

Today, PBC bus operations of within Vientiane Municipality and between cities are at the limit of PBC's capability and the main concern is to expand services. In order to enlarge PBC's services, the Government of Laos is planning to increase the present 14 routes to 48 routes by utilizing the 50 buses provided by the Government of Japan under grant aid. But unfortunately, the present terminal is not large enough to cope with such increase.

Therefore, it is planned to construct a new bus terminal consisting of an office, driver rest area, waiting room and bus berths for boarding and off-boarding at the present temporary market site.

In order to operate 50 buses efficiently, a good operation time table should be established for the convenience of passengers and for securing sufficient time for scheduled inspection and maintenance.

### 3.2.3 Tools and Equipment

At present, the existing tools and equipment are only those listed in paragraph 2.2.4. Furthermore, since the present maintenance shop was originally for private vehicles, tools and equipment for maintaining large buses are insufficient, also old and worn. They are both inadequate in quality and quantity to service the 50 buses from Japan; as a result new tools and equipment must be provided for the maintenance shop.

It is not necessary to provide the most advanced tools and equipment, so tools and equipment which are sturdy and which can be easily used by the present technicians and workers should be selected.

### 3.3 Outline of the Project

#### 3.3.1 Executing Agency

##### (1) Executing agency

The executing agency for this project is the Prefecture Bus Company (PBC) which is under the jurisdiction of the Department of Communication, Transport and Construction of Vientiane Municipality. The facilities and tools and equipment provided under grant aid are government property entrusted to PBC for their operation. Although PBC is a government agency, it is not subsidized and is operated as an independent corporation. PBC is the local counterpart in this project.

##### (2) Operating organization

After this project is completed, PBC will operate the facilities with a reorganized structure as shown in Fig. 6. The reorganization is initiated in order to upgrade workers' technical skills by dividing maintenance activities into separate groups such as for inspection and maintenance activities, to intensify inventory control of spare parts and oil, and to provide a leader for each group. The leaders will be trained so that they can transfer their skills to group members.

The reorganization is planned so as to provide an efficient form of rational operation as described above which should eliminate confusion due to overlapping work in administration and operation. It is expected that the results of this reorganization will be demonstrated when provision of facilities, tools and equipment has been completed.

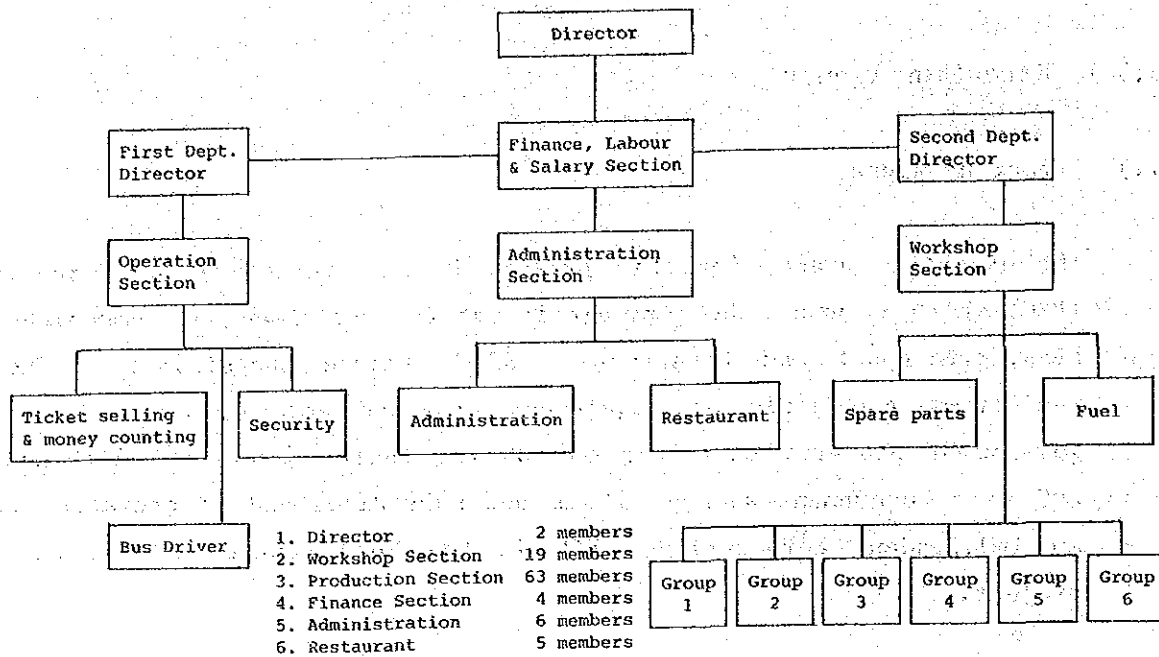


Fig. 6 Operation Organization

### 3.3.2 Project Plan

#### (1) Maintenance shop

The newly constructed maintenance shop is for conducting scheduled inspection and maintenance as well as 12 months inspection and maintenance for large buses (55 passengers) and small buses (18 passengers). Two bays (maintenance spaces) are provided for overhaul and major repair. The 12 months maintenance is for overhauling steering, transmission, brake and suspension, and if necessary, engines will also be overhauled.

Since road condition outside Vientiane are very poor, it was observed that grease consumption was considerable and that suspension and tire wear were very rapid.

In order to improve bus operation efficiency, it is desirable to adopt an assembly replacement method for the 50 buses and spare parts granted under the 1988 Grant Aid Program. In this method, main assemblies such as engine, transmission, differential gear and spring assemblies will be preassembled so that the entire assembly can be replaced on buses as a unit which will reduce repair time, leading to shorter operating time losses caused by waiting for spare parts and repairs. The procedure will be as follows:

- 1) Remove damaged assembly component from chassis
- 2) Install preassembled assembly component to chassis
- 3) Clean, disassemble, repair and assemble damaged component, then store it.

This method will reduce bus maintenance time to a minimum raising bus operation rate. However, it is most important to record which parts were replaced for which buses and when repairs were made. Repair costs can be greatly reduced by implementing this method.

## (2) Bus operation program

The bus operation program which will be reviewed here is the model case (refer to Appendix, Bus Operation Program) prepared by the basic design study team based on data collected in the project study team survey conducted in June 1988.

Since this program is based on the operation of 50 buses, for actual operation, PBC should prepare its own program, based on a survey of bus passengers for each route, passengers for different time span and road conditions.

### 3.3.3 Project Site

#### (1) Maintenance shop site

The proposed site is the present maintenance shop site with its old wooden buildings. Since this shop was constructed before the revolution and is unsuitable for a bus maintenance shop, it is to be torn down by the Laotian side, so that an ideal layout can be developed.

The proposed site has an area of 6,000 m<sup>2</sup> including some 850 m<sup>2</sup> extended by the Laotian side. The entrance is open to Thadua Road with an 18 m width, while the north side is next to a 5 m road.

The ground level is lower than the road level and inclines gradually downward toward the back of the site. As a result, storm water flows into the site (wet season, April - October) and flows to the back of the site. Therefore a drainage plan for the entire site must be developed to drain water into the road.

However, since the proposed site is located at the highest place in Vientiane city, it will not be affected by the flooding of the Mekong River. Furthermore since power, telephone and water supply lines lie nearby, they are easily accessible.

#### (2) Bus terminal site

Since the proposed bus terminal site is located in the center of commercial activities in Vientiane, it is most suitable for bus operation.

The site is at present a temporary market, but it is to be removed by the autumn of 1989 by Vientiane Municipality. The area of the site is about 7,000 m<sup>2</sup> and the entrance is open to the main Road in Vientiane, 22 m Nounbon Road, and the bus exit is open to 24 m Comboron Road.

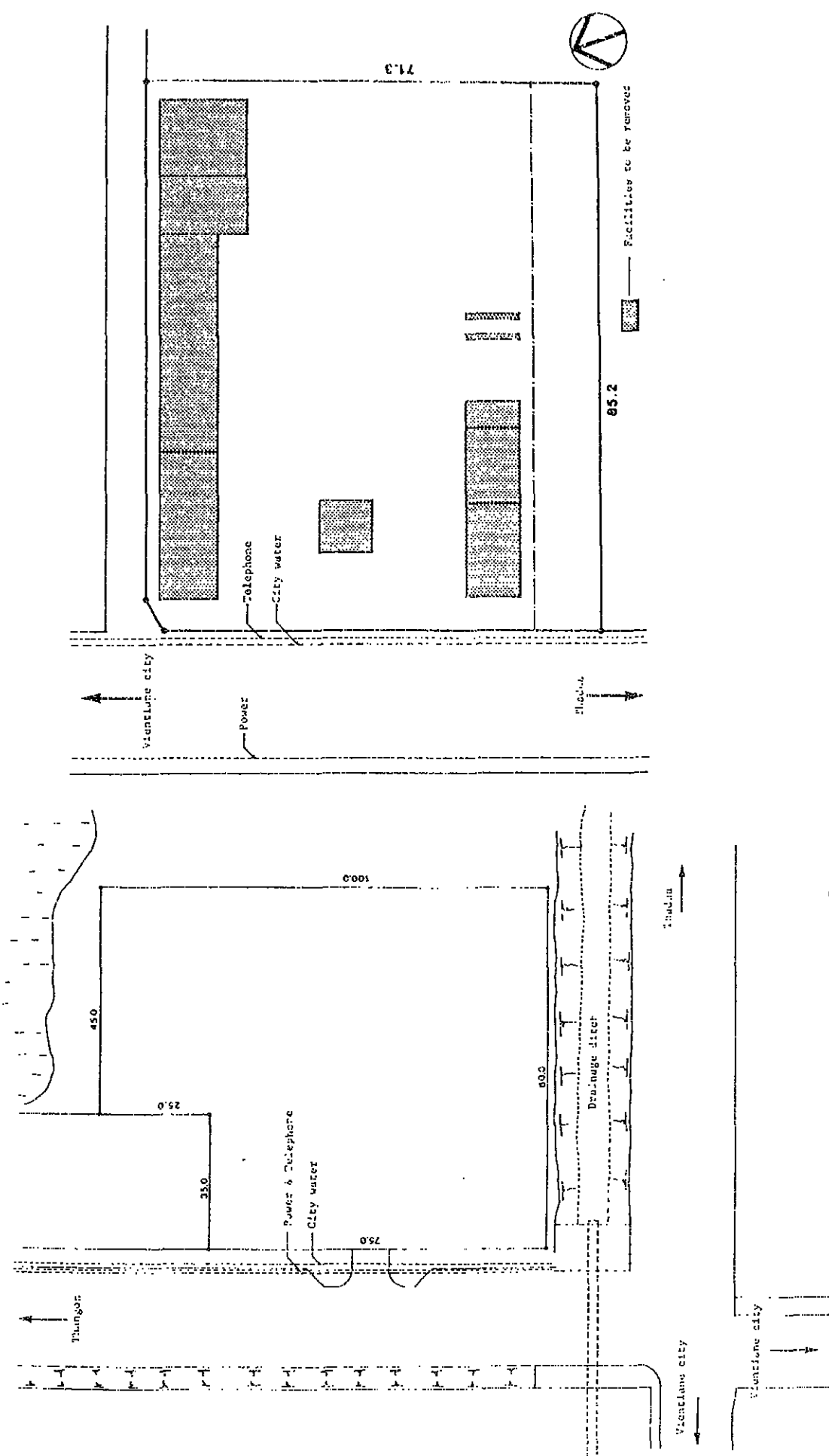


Fig. 7 Outline of Construction Site

Although the site level is lower than the road level and inclines gradually toward the back, a drainage ditch exists along Comboron Road so there is no problem regarding drainage of the site. However, the drainage of the entire site should be carefully studied.

### 3.3.4 Outline of Equipment and Facility

After studying the Project, it was decided that the equipment and facility suitable for grant aid from Japan would be as listed below.

#### (1) Facility

##### 1) Maintenance shop

- a) Maintenance workshop: Maintenance shop, workshop (engine, transmission, differential gear, overhaul, metal sheet work, machining, painting, etc.) oil storage, tire repair shop, spare parts storage, tool storage, maintenance record storage, locker room, toilet etc. In order to utilize the site efficiently, maintenance workshop and administration department is located in one building.
- b) Administration department: Manager office, Deputy manager office, accounting office, administration office, conference room, etc.
- c) Parking lot: The entire lot will be concrete pavement, and bus circulation will be planned in accordance with work flow to provide an efficient circulation.

##### 2) Bus Terminal

- a) Administration department: Ticket office, driver rest area.
- b) Passenger: Waiting room, toilet



- c) Bus boarding and off boarding: The area is concrete pavement and an island is provided for the safety of passenger, also a roof for shelter from rain is provided.

(2) Equipment

1) Maintenance shop

- a) Maintenance workshop: wheel balancer, auto-lift, air compressor, etc.
- b) Administration office: Time recorder, overhead projector, copy machine, etc.
- c) Parking lot: Bus washing equipment, fuel supply stand, etc.



## CHAPTER 4 BASIC DESIGN



## CHAPTER 4 BASIC DESIGN

### 4.1 Basic Plan

The basic design of facilities, materials and equipment was prepared under the following basic plan.

#### (1) Building Plan

- 1) Plan building layout for most efficient operation within the limited site space.
- 2) Plan well-equipped facility, based on flow of repair work suitable as a complete maintenance shop for large buses.
- 3) Construct a facility which is easy to operate and maintain using local materials, equipment and work methods as much as possible.
- 4) Design facility giving full consideration to the natural, historical, cultural and social environment of Laos.
- 5) Plan a project with low operating costs to reduce excessive economic burden on the Laotian side.

#### (2) Tools and Equipment Plan

- 1) Review existing tools and equipment to provide a well-balanced selection of types, kinds and numbers of tools and equipment.
- 2) Select simple, rugged, easy to use tools and equipment.
- 3) Select tools and equipment which can be used safely, in order to upgrade working efficiency and rationalize working conditions.

4.2 Basic Design Criteria

Table 9 Rooms for Each Department (Workshop) (1/2)

Department	Room	Description
Workshop	Minor repairs shop	Overhauling of simple parts, excluding engines and transmissions; disassembling and reassembling parts.
	Major repairs shop	Washing and cleaning carbon, grease and oil of engines; overhauling engine transmissions and differential gears; metal sheet work; painting, overhauling electrical parts; repairing batteries; welding work, etc.
	Parts storage	Storage of spare parts
	Oil Storage	Storage of machine oil, grease, paint, etc.
	Tool storage	Storage of tools
	Tire repair shop	Repairing and maintaining tires
	Record storage room	Storing and maintaining repair records of each bus including repairs and replacement of parts, together with records of stored parts.
	Others	Locker room, toilet, corridor, entrance hall, stair way, air compressor room, etc.

Table 9 Rooms for Each Department (Workshop) (2/2)

Department	Room	Description
Administration	Director's office	The area shall be large enough to provide space for guests; also a secretary's room shall be provided next door.
	Deputy Director's office	Located near the general director's room.
	Accountant's office	Daily sales revenue counter, book-keeping, accounting and fiscal work.
	Administration office	General affairs, procurement, room personnel, labor management, operation management and other office work.
	Technicians' room	Rest area for technicians working in workshop.
	Conference room	Room large enough for regular meetings as well as meetings for discussing bus operation program and repair process control.

Table 10 Rooms for Each Department (Terminal)

Department	Room	Description
Terminal	Waiting room	Waiting room for bus passengers. Provide seating such as benches.
	Ticket sales office	Counter for selling tickets to passengers.
	Drivers rest area	Rest area for drivers.
	Others	Provide toilet for bus passengers.

(2) Calculation of necessary area

Calculation of the number of bays (maintenance spaces) required in the workshop which is the main facility of this project.

1) Description of work in the workshop. The types of work carried out in the workshop may be broken down as follows:

- a) Scheduled maintenance
- b) Overhaul maintenance
- c) Breakdown repairs
- d) Accident repairs

a) Scheduled maintenance

Scheduled maintenance is preventive maintenance performed regularly after a bus is operated for a fixed period or runs a fixed distance. This is the main work to be carried out in this maintenance workshop.

The Prefecture Bus Company has a program to maintain buses regularly at every 3,000 km of operation (about 15 days), every 12,000 km of operation (about 2 months) and every 36,000 km of operation (about 6 months). The inspection items are increased for each longer scheduled maintenance period. However, owing to the lack of maintenance equipment and maintenance technicians, this maintenance program is not being fully carried out.

In order to raise the operation rate and meet the goal of efficient public transportation, it is necessary to fully implement this scheduled maintenance program.



The scheduled maintenance is based on every 3,000 km of operation owing to the poor road conditions in Laos with a large proportion of unpaved roads as well as much dust and many insects which stick to radiator causing overheating. Furthermore, since gasoline contains a high lead content, and kerosine contains a high sulfur content carbon easily builds up causing a high wear rate bearings.

Note: According to the "Transport Road Vehicle Regulation" in Japan, the scheduled maintenance of commercial buses is set at every 1 month, every 2 months, and every 3 months with inspection items increased for each longer scheduled maintenance period.

However, in order to prevent accidents and to conduct safe bus operations, many bus companies are carrying out scheduled maintenance every 15 days.

b) Overhaul maintenance

Overhaul maintenance is conducted when a bus reaches about half of its expected service life, and the extent of maintenance differs according to the amount of wear and tear, but normally engine, transmission, brake, suspension and electrical equipment are overhauled together with repair of the undercarriage.

c) Breakdown repairs

The ideal situation is to eliminate breakdowns through full implementation of scheduled maintenance; however, this is not possible and sudden breakdowns will inevitably occur, so provisions should be made to cover a certain amount of breakdowns.

d) Accident repairs

Damaged parts of buses involved in traffic accidents are repaired, including body metal sheet repair and painting.

2) Basic data

a) Number and types of buses:

Large buses	32 buses
Medium buses	18 buses
Total	50 buses

b) Travelling distance and number of operating days:

Daily travelling distance	200 km
Monthly operating days	25 days
Yearly operating days	300 days

c) Number of working days of workshop:

Daily working hours	8 hours
Monthly working days	23 days
Yearly working days	300 days

d) Type of maintenance and frequency:

① Scheduled maintenance

3,000 km (every 15 days) maintenance, 18 times a year

12,000 km (every 2 months) maintenance, 4 times a year

36,000 km (every 6 months) maintenance, 2 times a year

② Overhaul maintenance

300,000 km (after 4 years)

③ Breakdown frequency

18 breakdowns a year<sup>\*1</sup>

④ Accident frequency

28 accidents for 50 operating buses a year<sup>\*2</sup>

3) Standard maintenance and repair time

Standard maintenance and repair time is calculated after analyzing the present operations. It is observed that work efficiency is one half of that in Japan due to lack of parts and equipment as well as to poor work skill. The work time referred here is the time necessary to maintain and repair bus in the bay or the time the bay is occupied.

a) Scheduled maintenance

3,000 km maintenance	8 hours
12,000 km maintenance	12 hours
36,000 km maintenance	24 hours

b) Overhaul maintenance

Engine overhaul	80 hours
Transmission overhaul	50 hours
Differential overhaul	50 hours
Overhaul of other equipment	35 hours

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Total	215 hours
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\*1,2 Based on the operation data of 29 buses, the frequency of breakdowns and accidents for 50 buses was estimated. The workshop employees are working in 3 shifts (6:00-16:00, 16:00-22:00 and 22:00-24:00), but in order to prevent labor accidents, overhauls and scheduled maintenances are based on 8 working hours.



b) Number of bays for overhaul maintenance

$$\frac{215 \text{ hours} \times 50 \text{ buses} \times 1 \text{ repair}}{280 \text{ days} \times 8 \text{ hours} \times 4 \text{ years}} = 1.19$$

c) Number of bays for breakdown repair

$$\frac{8 \text{ hours} \times 50 \text{ buses} \times 18 \text{ repairs}}{280 \text{ days} \times 8 \text{ hours}} = 3.2$$

d) Number of bays for accident repair

$$\frac{160 \text{ hours} \times 28 \text{ repairs}}{280 \text{ days} \times 8 \text{ hours}} = 2$$

The number of bays is summarized as follows:

Scheduled maintenance	5.35
Overhaul maintenance	1.19
Breakdown repair	3.2
Accident repair	2.0
<hr/>	
Total	11.74 bays

Since the above maintenance and repairs are to be carried out in this workshop, 12 bays are necessary. But due to the configuration and area of the site, 10 bays would be the limit for this workshop. Furthermore, if the number of bays is increased, the number of technicians and workers must be greatly increased at once, which will not only lower the quality of maintenance, but will also be undesirable from the viewpoint of management. It is considered that upgrading the skill level of technicians and workers will be much more effective in improving the efficiency of the operation.

From this viewpoint, the area of the workshop was calculated for 10 bays as shown in Table 11.

Table 11 Calculation of Room Area for Workshop

Room	Number	Designed Area (m <sup>2</sup> )	Calculation
Minor repairs shop	1	809.4	Space for. 1 bus: 5.4 m x 4.0 m 10 buses: 5.4 m x 4.0 m x 10 = 756.0 m <sup>2</sup> Passway 53.4 m <sup>2</sup> Total 809.4 m <sup>2</sup>
Major repairs shop	1	97.5	Span 7.5 m x 13 m = 97.5 m <sup>2</sup>
Parts storage	1	60.0	Span 7.5 m x 8 m = 60.0 m <sup>2</sup>
Oil storage	1	15.0	Span 7.5 m x 2 m = 15.0 m <sup>2</sup>
Tools storage	1	86.4	Span (5.4 x 2) x 8 m = 86.4 m <sup>2</sup>
Tire repair shop	1	45.0	Span 7.5 m x 6 m = 45.0 m <sup>2</sup>
Record storage room	1	16.2	Span 5.4 m x 3 m = 16.2 m <sup>2</sup>
Battery room	1	8.75	Span 3.5 m x 2.5 m = 8.75 m <sup>2</sup>
Welding room	1	8.75	Span 3.5 m x 2.5 m = 8.75 m <sup>2</sup>
Subtotal		1,147 m <sup>2</sup>	

Table 12 Calculation of Room Area for Administration Department

Room	Number	Designed Area (m <sup>2</sup> )	Calculation
Director's office	1	35.0	With parlor set & toilet Span (5.4 m x 5.6 m) + (2.4 x 2) = 35.0 m <sup>2</sup>
Deputy Director's office	1	30.2	Small office with water kitchenet Span 5.4 m x 5.6 m = 30.2 m <sup>2</sup>
Accountant's office	1	43.2	Span 5.4 m x 8.0 m = 43.2 m <sup>2</sup>
Administration office	1	43.2	Span 5.4 m x 8.0 m = 43.2 m <sup>2</sup>
Technician's room	1	30.2	Span 5.4 m x 5.6 m = 30.2 m <sup>2</sup>
Conference room	1	64.8	Span (5.4 m + 2.7 m) x 8.0 m = 64.8 m <sup>2</sup> (1.6 m <sup>2</sup> x 40 persons = 64.8 m <sup>2</sup> )
Subtotal		246.6	
Common area		184.4	
Total		1,578 m <sup>2</sup>	Workshop & Administration

(3) Determination of bus berths (boarding/off-boarding) at bus terminal

In the survey of bus operation, it was observed that buses are utilized not only for passenger transportation, but also to transport agricultural products from the countryside into the city as well as to move daily necessities from the city to the countryside. This is because railway and truck transportation are not developed in Laos. When considering such conditions, long route buses should be provided with sufficient boarding and off-boarding time at the bus terminal. Therefore, it is not desirable to have urban buses, which arrive and depart frequently, use the same berths used for long route buses.

After studying the time table and diagram of long route buses attached in the appendix, it was determined that 9 berths were necessary for 30 buses.

When studying the operations of urban route buses, it was found that 18 buses (50 total buses including 2 spare buses) were allocated to this route. Urban route buses will be entering and leaving the bus terminal at about 11 minute intervals when estimating their operating speed as 30 km/hr and one urban round trip as 95 km. Since this is an astonishingly short operating interval, it is desirable to have one berth serve two bus routes to prevent passengers from becoming confused.

Therefore, in order to serve 10 urban bus routes (based on 10 destinations), five berths are secured. Based on the above estimate, a total of 14 buses will be necessary, so the bus terminal arrangement provides for 15 berths.

Table 13 Calculation of Bus Terminal Area

Room	Number	Designed Area (m <sup>2</sup> )	Calculation
Ticket sales office	1	15.0	Office room for 4 persons 3.75 m <sup>2</sup> x 4 persons = 15.0 m <sup>2</sup>
Driver rest area	1	48.0	Rest area for 20 persons 2.4 m <sup>2</sup> x 20 persons = 48.0 m <sup>2</sup>
Common area		336.0	Toilet, waiting room, corridor, etc.
Total		399.0 m <sup>2</sup>	



## 4.3 Basic Plan

### 4.3.1 Site Plan

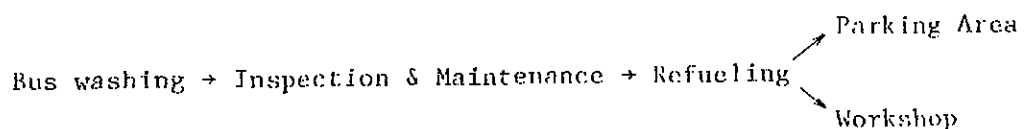
#### (1) Facility layout

##### 1) Terminal

In order to avoid confusion, bus arrivals and departures are separated with off-boarding islands located on the road side of the terminal office and on-boarding islands located in back of the terminal office. At the basic design survey stage, 4 islands were designed with bus berthes on one side of the island, but when the draft final report was explained, the Laotian side strongly requested to create a green center for planting trees and plants. Therefore, the original design of 4 islands were revised to 2 islands with bus berthes on both sides of the island. Also, a one-way traffic system is adopted to prevent traffic confusion. Also, a parking area for 10 buses is provided at the northeast side of the terminal for buses with long waiting time before departure.

##### 2) Workshop

The workshop is laid out in accordance with the flow of maintenance and repairs, which is as follows:



Since traffic in Laos uses right side driving system, the steering wheel of buses is located on the left side, so the maintenance flow is counterclockwise to provide a wider view for the driver. For this purpose, facilities including the workshop and administration area are located on the north side, while the

bus washing stand and inspection space are located on the south side, the refueling stand on the east side, and the bus parking area in the center.

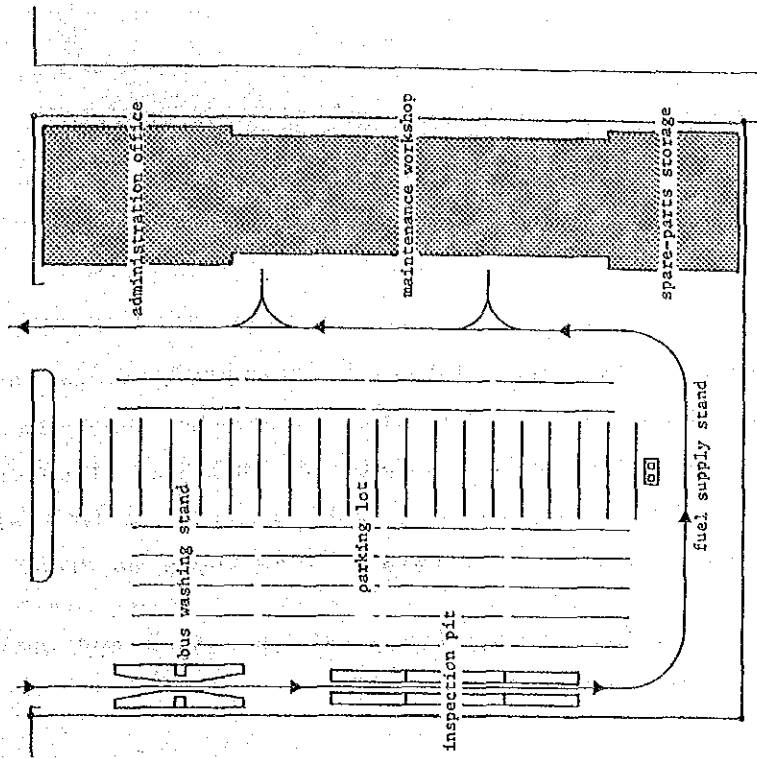
(2) Exterior work

1) Terminal

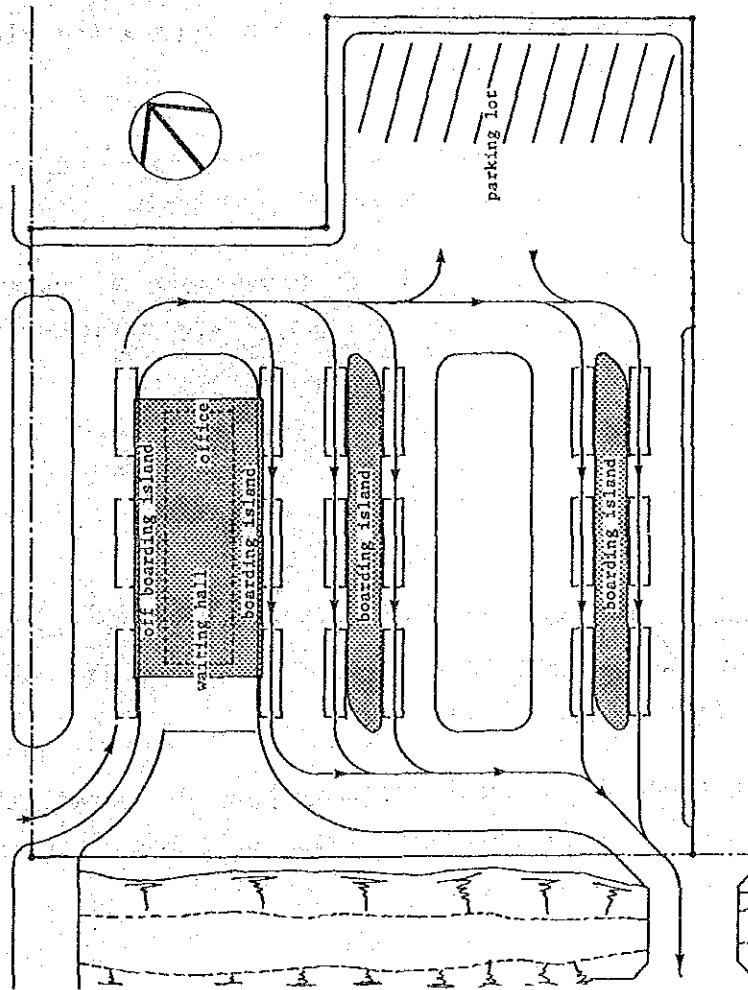
- a) Since the area where buses pass, such as the parking lot, is easily corroded from oil leakage, the entire to be area is paved with concrete.
- b) An island is provided for passenger boarding, off-boarding and waiting.
- c) A water drainage plan is provided to drain storm water from the entire area. Storm water is collected in a sump and then discharged into the drainage line.

2) Workshop

- a) The entire parking lot is paved with concrete.
- b) Drains are provided around the workshop to prevent storm water from flowing into the workshop. Storm water is collected in a sump and then discharged into the drainage line.



Workshop



Terminal

Fig. 8 Facility Layout

#### 4.3.2 Building Plan

##### (1) Basic concept

###### 1) Workshop

- a) In order to make maximum use of the site, shops and offices are contained in one building. But the shop area and the office area are clearly separated, and the circulation flow is separated to prevent accidents as well as to restrict the entrance of unauthorized persons into the shop area.
- b) To assure safety within the plant, passages and working area are clearly separated.

###### 2) Terminal

- a) The convenience and safety of bus passengers are given first consideration in the plan.
- b) Boarding area and off-boarding area are clearly separated for better control of bus departures and arrivals.
- c) A waiting room is provided for passengers of buses with a long waiting time in order to facilitate efficient utilization of bus berths.

##### (2) Floor plan

###### 1) Workshop

- a) The repair shop and the administration office are separated by locating the shop on the first floor and the administration office on the second floor.
- b) Different shops are located surrounding the repair shop, and a compact floor is designed with each shop having direct access to the repair shop.

(3) Elevation plan

- 1) The ceiling height for ordinary rooms was fixed at a minimum of 3 m in accordance with the customary practice in Laos. The effective ceiling height for large buses was fixed at 6 m and for medium size buses was fixed at 4.5 m.
- 2) The exterior wall is a double wall structure to shut out direct sunlight and to improve heat insulation. The roof is also a double roof structure to improve heat insulation and is an assembly of a water-proofed concrete slab and local materials to achieve economy in construction.
- 3) The workshop is basically an open structure with only a roof, but shutters are provided to prevent wind and rain from reaching the main parts of the bus.

(4) Structure plan

1) Basic plan

- a) The main structure is of reinforced concrete with steel beams for the ceiling of the shop area. The frame is a rigid structure with brick walls for exterior and partition walls.
- b) Since the soil of the proposed site is expected to have sufficient load bearing capacity, a direct foundation is adopted.
- c) Since records of earthquakes around the construction site show that they are few and not strong small, and also since local building designs do not consider seismic condition, a seismic design is not adopted in this structure plan.

## 2) Structure design

This design is based on the building code of Japan.

### a) Dead load

Dead load is calculated for structure members and finishing materials as required in the building code.

### b) Live load

Live load is calculated based on the loads specified for different buildings and rooms in the building code of Japan.

## 3) Structural members and others

The structural members are determined after taking into consideration the building size, structure, application, and quantity and quality of locally available materials and local building practices, as well as transportation conditions and costs of imported materials. In this project, the following materials are considered to be suitable.

### a) Concrete

Cement produced in the Soviet Union and Vietnam is available, but supply and quality are not always reliable, so most cement is imported from Thailand. Coarse and fine aggregates are locally available.

A batcher plant is planned for controlling concrete mix, and in view of the quality of local aggregates, a 28-day strength of  $180 \text{ kg/cm}^2$  for ordinary concrete is considered to be suitable. Actually, concrete mix strength will be determined after considering differences due to construction practices.

b) Steel bar

Japanese deformed bars (SD30) are used for main bars, since Thai manufacturers are too busy supplying bars for domestic demand and cannot supply bars as required.

Since most of the materials will be supplied from Japan, the specifications of the Japanese building code are applied for the allowable stress of materials.

Unit: kg/cm<sup>2</sup>

Room	Floor, Joint	Beam, Column & Foundation
Rooms for living purposes	180	130
Office & conference rooms	300	180
Storage	500	400

c) Wind load

$$P = C \cdot Q \quad Q = 60 \sqrt{h}$$

P: wind load kg/m<sup>2</sup>

C: wind force factor (according to Japanese building code)

Q: velocity force

h: height from ground level (m)

d) Soil load bearing capacity

Load bearing capacity of 8 t/m<sup>2</sup> (long term) may be expected according to boring data in the vicinity.

(5) Electrical work

1) Basic conditions

Since detailed standards and regulations for electrical work are not established in Laos, Japanese electrical standards and regulations are applied giving due consideration to conditions in Laos. The specifications for equipment and materials are the Japanese Industrial Standards (JIS).

2) Bus workshop

a) Power station

Power supply in Laos is quite stable and is supplied at 3-phase 220 V/380 V, 50 Hz. Since power supply and power voltage fluctuation are stable, and load capacity of 150 - 250 kVA is estimated for this project, the power receiving capacity is planned as 3-phase x 300 kVA x 50 Hz.

① Power receiving equipment

Power will be received from E.D.L. power lines at 22 kV. This power take-in work will be performed by E.D.L.

② Substation

The 22 kV high tension power will be transformed to 380 V/220 V, 50 Hz. E.D.L. will install the substation and perform the cable laying work up to the substation.

b) Power distribution

Power is distributed to the respective power and lighting panels from the cubicle distribution panel by cables, and where necessary the cable is protected by a cable conduit.



c) Lighting

The lights are supplied at 220 V and lighting for different departments is supplied on the following basis.

Department	Light equipment	Brightness (Ix)
Administration department	Fl 40 W x 2 directly fixed V type	500
Workshop	Fl 40 W x 2 directly fixed with reflector	300
Storage	Fl 40 W x 2 directly fixed with reflector	150
Outside, parking lot	Mercury lamp 400 W x 2 Y type pole	10
Outside building	Incandescent lamp 1 kW x 2 flood light	

d) Outlets

Single-phase 220 V outlets are provided as necessary in the administration department, workshop and storage; also, 3-phase 220 V and 3-phase 380 V outlets are provided for necessary tools and equipment. A special outlet for recharging batteries is provided in the battery room.

e) Telephones

The administration office is provided with three direct circuits from the telephone exchange, and extensions are provided at suitable places for communication between offices and between office and workshop.

f) Lightning rods

Since lightning often strikes during the rainy season in Vientiane, lightning rods are provided regardless of the height of buildings.

g) Public address system

A public address loudspeaker is installed for outside service and an amplifier is installed in the administration office.

h) Clocks

Clocks are planned for installation outside and inside the buildings. Dew resistant type clocks are considered for outdoor installation.

3) Bus Terminal

a) Substation

Power can be received at 3-phase, 200 V/380 V, 50 Hz.

① Power receiving equipment

One 22 kV high tension power line is connected to the power receiving panel within the site from the E.D.L. power line. The wiring and connection will be performed by E.D.L.

② Transformer

The high tension power is transformed to 380 V/220 V, 50 Hz by a transformer installed in the substation.

b) Power distribution

Power is distributed to the power control and the lighting panel by cable from the low tension distribution panel.

c) Lighting

Lights are supplied at 220 V and lighting for different departments is supplied on the following basis.

Department	Light equipment	Brightness (lx)
Administration department	F2 40 W x 2 directly fixed V type	500
Waiting room	F2 40 W x 2 directly fixed V type	300
Others	F2 40 W x 2 directly fixed V type	150
Outside, parking lot	Mercury lamp 400 W x 2 Y type pole	10

d) Outlets

Single-phase 220 V outlets are provided as necessary.

e) Telephones

The administration office is provided with one direct circuit from the telephone exchange and no extension is provided.

f) Lightning rods

Since lightning often strikes during the rainy season in Vientiane, lightning rods are provided.

g) Public address system

A public address loudspeaker is installed to announce bus operation conditions and an amplifier is installed in the administration office.

h) Clocks

Clocks are installed at the outside terminal, inside building and ticket counter. Dew resistant type clocks are considered for outdoor installation.

(6) Water supply, drainage, sanitary equipment, cooling and ventilation systems

1) Basic policy

Since there are no detailed standards and regulations in Laos, the system and equipment are designed according to the standards and regulations of the Ministry of Construction, Building Equipment Design Standard of Japan and the Japan Air Ventilation and Sanitary Engineering Society standard, giving due consideration to the condition in Laos.

2) Bus workshop

a) Water supply facility

① Water supply system

Since the water supply situation is good with no fear of water shortages, the supply system is designed to receive water from the city water main 450  $\phi$  pipeline (4 kg/cm<sup>2</sup>) running under the road in front of the site. A 100  $\phi$  branch pipe will be connected to the main pipeline to take in water to a receiving storage tank from where water will be pumped by a water pump to the necessary locations. A by-pass pipeline will be provided as a safeguard against pump breakdowns. The water supply system is shown in Fig. 9.

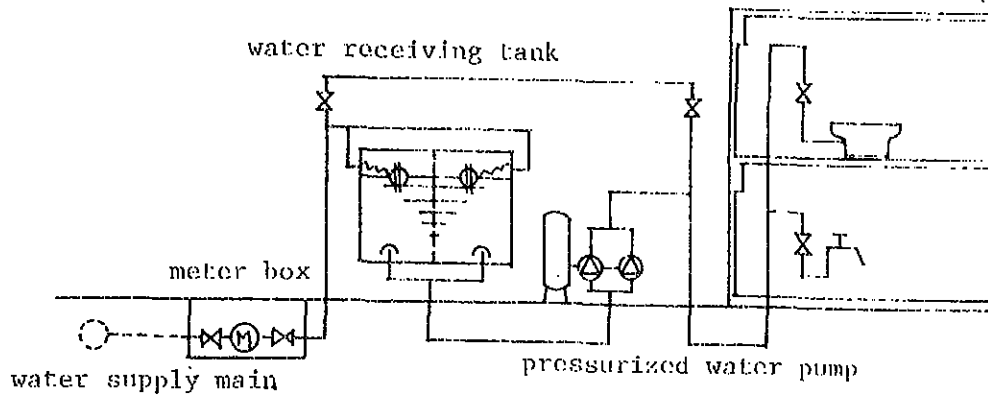


Fig. 9 Water Supply System for Bus Maintenance Workshop

② Planned water supply

Personnel usage	
162 persons x 100 l/person/day	= 16.2 m <sup>3</sup> /day
Washing bus parts	
50 buses x 0.05 x 0.36 m <sup>3</sup> /bus	= 0.9 m <sup>3</sup> /day
Washing buses	
50 buses x 0.9 x 0.2 m <sup>3</sup> /bus	= 9 m <sup>3</sup> /day
Washing bus interiors	
50 buses x 0.9 x 0.1 m <sup>3</sup> /bus	= 4.5 m <sup>3</sup> /day
High pressure washing	
50 buses x 0.9 x 0.3 m <sup>3</sup> /bus	= 13.5 m <sup>3</sup> /day
Floor washing	
1 set	3 m <sup>3</sup> /day
<hr/>	
Total	47.1 m <sup>3</sup> /day

The daily water supply is determined as 50 m<sup>3</sup>/day. However, water for washing equipment is supplied directly from the water main and only water inside the building (personnel use) is supplied from the receiving tank. The figures are based on data provided by the Society of Heating, Air Conditioning, and Sanitary Engineers in Japan and measured data.

③ Receiving storage tank capacity

One half of the daily personnel usage is stored in the tank.

$$16.2 \text{ m}^3/\text{day} \times 1/2 = 8.1 \text{ m}^3 \text{ (effective capacity)}$$

The specifications are as follows:

Material: sandwich panel (light insulated type)

Dimension (reference): 4 m x 3 m x 1.35 m  
(with partition)

④ Water supply pump

The capacity of the pump is as follows:

Maximum hourly supply capacity

$$(16.2 \text{ m}^3/\text{day} : 8 \text{ h/day}) \times 2 = 4.05 \text{ m}^3/\text{day} \\ = 4,050 \text{ l/h (67.5 l/min)}$$

Pressure pump

32  $\phi$  x 75 l/min x 25 m x 2 pumps (constant pressure type)

Operation system

2 pumps are operated alternately (with spare)

b) Drainage and ventilation facility

Since sewage treatment facilities are not developed in this site, the drainage system is planned as described below.

Sewage and other wastewater are drained through separate lines and collected in a sump located outside the building. From this sump, the sewage and wastewater are introduced into a treatment tank where they are treated and then discharged into the Mekong River through the last sump within the site.

The workshop wastewater, which is contaminated with oil passes through another line equipped with an oil trap and a special permeating tank. The wastewater from the permeating tank flows into the ordinary wastewater line and discharges into the Mekong River.

Storm water on the site is also drained through a separate line which is lead into the last sump within the site from where it is discharged together with other wastewater into the Mekong River. The water drainage flow system is shown in Fig. 10.

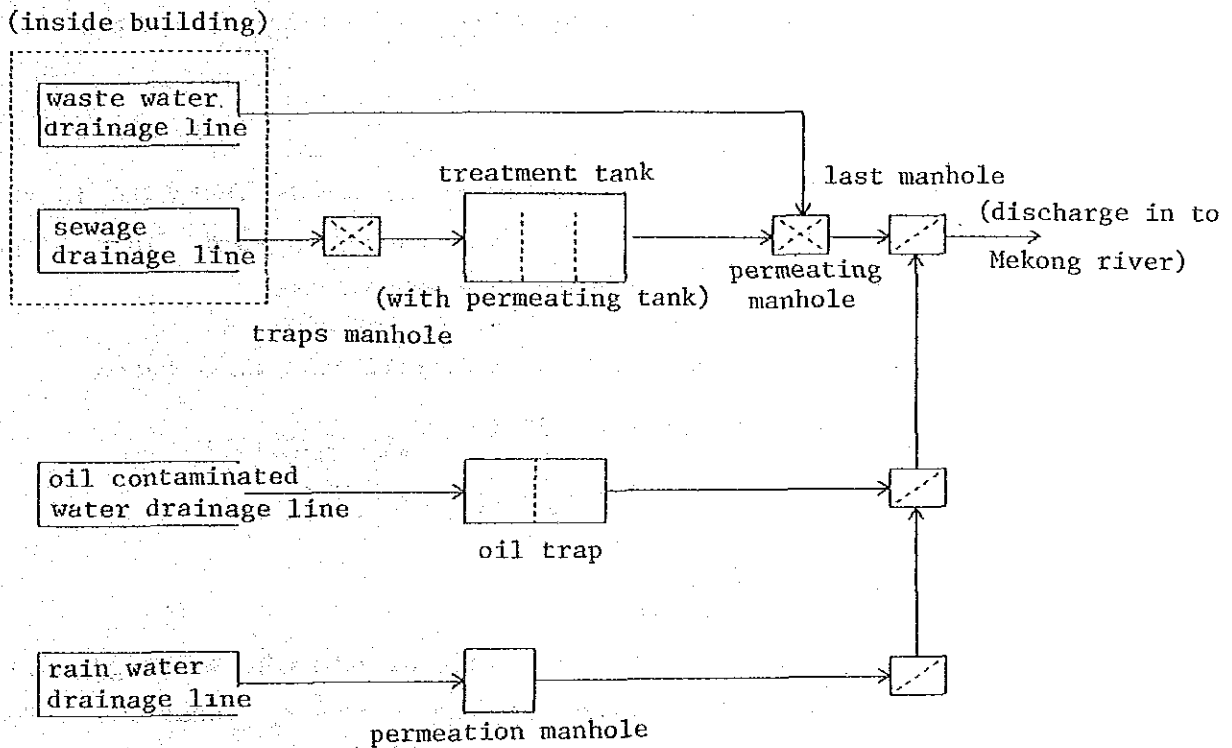


Fig. 10 Water Drainage Flow System

① Sewage treatment tank

Drainage water treatment in Laos is normally conducted through permeation treatment within the site. In this project, the following sewage treatment tank was selected in view of the purpose of the building.

Treatment method: Decomposition method  
(with permeation tank)

Number of persons: 100 persons

② Permeation sump

As described, drainage systems in Laos are all by the permeation method, therefore permeating tanks are installed to treat wastewater before final discharge.

c) Hot water supply

An individual electric hot water heater is installed in the hot water supply room located on the second floor. The specifications of the heater are as follows:

Type: Floor type storage tank electric hot water heater

Hot water tank capacity: 20 l

Electric capacity: 3  $\phi$  x 220 V x 1.5 kW

d) Sanitary equipment

Sanitary equipment such as toilets, urinals, washing basins and faucets are located at the necessary locations. The toilets are planned as follows:

1st floor, 2nd floor, ordinary toilet

..... Asian style

2nd floor, official purpose toilet

..... Western style (with low tank)



e) Fire extinguishing equipment

Since there are no standards for fire extinguishing equipment in Laos, fire extinguishing equipment is provided for initial fire fighting purposes.

Powder fire extinguishers ..... Located around the workshop

Outdoor hydrants ..... Hydrants are located at 2 locations

f) Cooling equipment

Window type room coolers and ceiling fans are provided as cooling equipment.

Second floor administration office

..... Window type room cooler, ceiling fan

All other rooms ..... Ceiling fan

g) Ventilation equipment

The building is mainly ventilated naturally, but mechanical ventilation is provided for the following rooms.

Workshop ..... Ceiling fan and natural ventilation

Mechanical room, storage, toilet, etc.

..... Ceiling fan and ventilation fan

3) Bus terminal

a) Water supply facility

① Water supply system

Water is supplied to all locations from the 200  $\phi$  (3 kg/cm<sup>3</sup>) wooden pipeline running under the front road through a 50  $\phi$  branch pipe connected to the main pipeline. The water supply system is shown in Fig. 11.

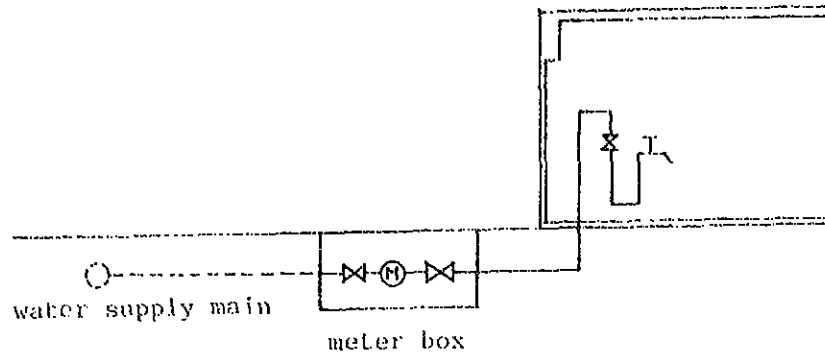


Fig. 11 Bus Terminal Water Supply System

② Planned water supply

Daily number of persons boarding and off-boarding buses is estimated as 2,000 persons.

Passengers	2,000 persons x 3 ℓ/day	= 6 m <sup>3</sup> /day
Others (water spraying, etc.)		2 m <sup>3</sup> /day
<hr/>		
Total		8 m <sup>3</sup> /day

Daily water supply is determined as 8 m<sup>3</sup>/day.

(Source: The Society of Heating, Air Conditioning and Sanitary Engineers in Japan)

b) Drainage and ventilation facility

Sewage and other wastewater are drained through separate lines and collected in a sump located outside the building. From this sump, sewage and other wastewater are introduced into a treatment tank where they are treated and then discharged into the drainage running along the project site through the last sump within the site.

① Sewage treatment tank

The permeation treatment system is adopted for the sewage treatment tank.

Treatment method: Decomposition system  
(with permeation tank)

Number of persons: 100 persons  
(5% of the total passengers)

c) Hot water supply

Hot water supply equipment is not provided.

d) Sanitary equipment

Since the bus terminal is utilized mainly by common people, durable, easy-to-use equipment is provided and Asian style toilets were selected.

e) Fire extinguishing equipment

Although there is no fire code requirement, small fire extinguishing equipment for initial fire fighting is provided in the administration office because many common people gather here.

f) Cooling equipment

Ceiling fans are provided as cooling equipment.

g) Ventilation equipment

The building is mainly ventilated naturally but mechanical equipment such as ceiling fans are provided in toilets.

(7) Building materials

1) Basic conditions

Based on the site survey, building materials are selected according to the following basis.

- a) Materials easy to maintain and repair
- b) Materials of reliable quality and stable price
- c) Materials suitable for local environment and rational work methods
- d) Materials which are sturdy and do not easily become dirty

2) Exterior finishing materials

Workshop

- a) Exterior wall: Bricks coated with cement mortar
- b) Roof: Reinforced concrete - Urethane waterproof coating with direct sunlight insulation covered with slate roofing.  
Steel frame - Long corrugated steel sheets

Terminal

- a) Exterior wall: Bricks coated with cement mortar
- b) Roof: Reinforced concrete - Urethane waterproof coating with direct sunlight insulation covered with slate roofing.

The bus boarding, off-boarding islands are provided with semi-transparent plastic panels to provide a roof for protection from rainfall.

3) Interior finish

Workshop

Room	Floor	Skirt	Wall	Ceiling
<u>1st floor</u>				
Workshop	Steel trowelled concrete with surface hardener finish	Mortar VP	Mortar VP	Long steel sheet roof, concrete, exposed end
Overhaul shop	ditto	ditto	ditto	Concrete, exposed end
Parts storage	ditto	ditto	ditto	ditto
Oil storage	ditto	ditto	ditto	ditto
Tool storage	ditto	ditto	ditto	ditto
Tire repair shop	ditto	ditto	ditto	ditto
Battery room	ditto	ditto	ditto	ditto
Welding room	ditto	ditto	ditto	ditto
Record storage	Steel trowelled concrete (dust prevention coating)	ditto	ditto	Plaster board EP
<u>2nd floor</u>				
Director's office	Wooden floor	Wood	Mortar EP	Plaster board EP
Deputy Director's office	ditto	ditto	ditto	ditto
Accounting office	ditto	ditto	ditto	ditto
Technicians' room	ditto	ditto	ditto	ditto
Conference room	ditto	ditto	ditto	ditto
Toilet	Ceramic tile		Ceramic tile	Hardboard exposed end
Locker room	ditto	Mortar VP	Mortar VP	ditto

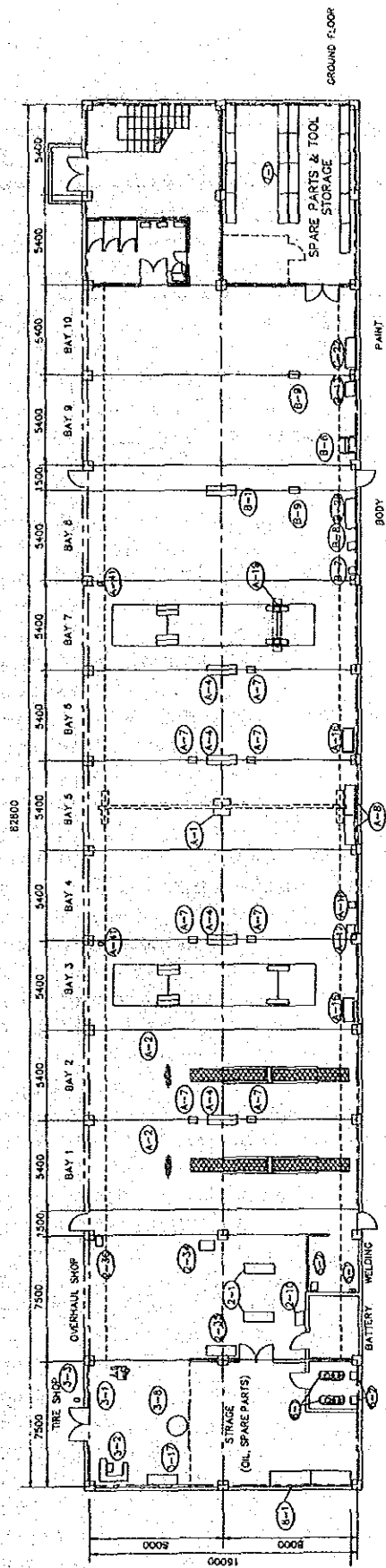
### Terminal

Room	Floor	Skirt	Wall	Ceiling
Waiting room	Steel trowelled concrete (dust prevention coating)	Mortar VP	Mortar EP	Hardboard EP
Ticket office	ditto	ditto	ditto	Plaster board EP
Driver's room	ditto	ditto	ditto	ditto
Toilet	Ceramic tile		Ceramic tile	Hardboard EP

#### 4.3.3 Tools and Equipment

##### (1) Bases for selection of tools and equipment

After preparing the existing tools and equipment list, oil leakage around the engine, wear, etc. were surveyed and the following tools and equipment are selected in accordance with 4.1 Basic Plan.



GROUND FLOOR

PAINT

BODY

BATTERY WELDING

No.	MODEL	DESCRIPTION	Qty
A-1		OVERHEAD CRANE 3 ton	1
A-2	WSL-220ESP-NB	AUTO LIFT 22 ton	2
A-4	T-1000	WORK BENCH	4
A-7	TS-30	TOOL STAND	7
A-8	B-1744	TOOL SHELF	2
A-16	WG-90	PARTS WASHING STAND	2
A-17	B-13	BENCH DRILL	1
A-18	ABT-4	BENCH GRINDER	1
A-19	MB-J50K	TURNING RADIUS GAUGE	1
A-41	PC-1	AIR INFLATOR	2
B-1	T-1000	WORK BENCH	1
B-6	HE-90E	HYDRAULIC PRESS 35ton	1
B-7	ABT-4	BENCH GRINDER	1
B-8	B-13	BENCH DRILL	1
B-9	TS-40	TOOL STAND	2
B-13	E127	SURFACE PLATE	1
B-28	B-1744	TOOL SHELF	1
C-22	B-1744	TOOL SHELF	1
2-1	T-1000	WORK BENCH	2
2-10	MB-145	VALVE REACER	1
2-34	E127	SURFACE PLATE	1
2-35	B1744	TOOL SHELF	1
2-38	H-169	CUT-OFF MACHINE	1
3-1	TRH-25W	WHEEL BALANCER	1
3-2	KING-25	TIRE CHANGER	1
3-3	PEL-1	AIR INFLATOR	1
3-8	TT	TUBE TEST TANK	1
3-17	B1744	TOOL SHELF	1
3-1	CS-10	GAS CUTTING & WELDING	1
5-2	AT-55S-250	ARC WELDER	1
6-1	SP-75P	AIR COMPRESSOR	2
6-2	RDA-75	AIR DRYER	2
7-1	B1744	TOOL SHELF	17
8-1	3Y23C 08-3	TOOL SHELF	2
85-10	85-10	CAR WASHING MACHINE FOR BUS	1

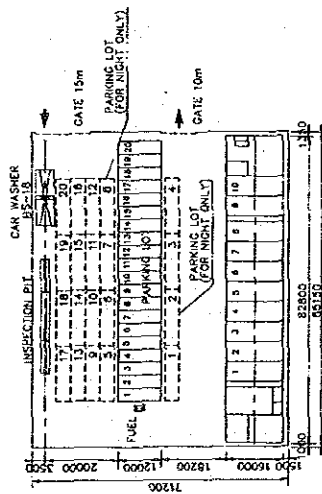


Fig. 12 Location of Tools and Equipment in Maintenance Workshop

1. MAINTENANCE WORKSHOP

Description		Q'ty
(1)	Workshop (Service Bay: 10 bays)	
A)	General Repair (7 bays)	
1	Overhead Crane, 3 tons, Manual Type Span: 16 m Lift: 5 m Travelling Distance: 61.5 m	1 set
2	Test Lift (Single post lift), 22 tons, with Moving Rock	1 set
3	Portable Crane, 2 tons	1 set
4	Work Bench	4 sets
5	Machine Vice, Fixed Type, 150 mm	2 sets
6	Machine Vice, Swivel Type, 150 mm	2 sets
7	Tool Stand	7 sets
8	Tool Shelf	2 sets
9	Portable Jack, 10 tons	2 sets
10	Portable Jack, 20 tons	2 sets
11	Portable Jack, 30 tons	2 sets
12	Hydraulic Garage Jack, 5 tons	1 set
13	Hydraulic Garage Jack, 10 tons	2 sets
14	Rigid Rack, 5 tons x 2 pcs.	7 sets
15	Engine Service Jack, 1.5 tons	2 sets
16	Parts Washing Stand	2 sets
17	Bench Drilling Machine, 13 mm with Drill Stand	1 set
18	Bench Grinder, 255 mm with Eye Shields, Water Cup, Floor Stand	1 set
19	Turning Radius Gauge	1 set
20	Camber Caster Kingpin Gauge	1 set
21	Toe-in Gauge	1 set
22	Chassis Lubricator	1 set
23	Oil Lubricator	1 set
24	Oil Drain Pump	1 set
25	Grease Gun, 500 cc with 3 kinds of Micro Hose	1 set
26	Oil Measure, 2 liters and 4 liters	2 sets
27	Piston Oiler, 250 cc	2 pcs.
28	Funnel, 220 $\phi$ mm	2 pcs.
29	Drum Pump	2 pcs.
30	Drum Can Carrier	2 pcs.
31	Drum Stand	2 pcs.
32	Drum Tap	5 pcs.
33	Drum Spanner	2 pcs.
34	Drain Plug Wrench	2 pcs.
35	Oil Filter Wrench	2 pcs.
36	Car Air-Conditioner Service Kit	1 set
37	Vacuum Pump for Air-conditioner	1 set
38	Refrigerant Leak Detector	1 set
39	Radiator Cap Tester with Adapter	1 set
40	Sound Scope	1 set
41	Air Inflator	2 sets
42	Stretcher	2 sets



Description		Q'ty
B)	Body Repair (2 bays)	
1	Work Bench	1 set
2	Machine Vice, 150 mm	1 set
3	Hydraulic Garage Jack, 5 tons	1 set
4	Hydraulic Garage Jack, 10 tons	1 set
5	Rigid Rack, 5 tons x 2 pcs.	4 sets
6	Hydraulic Press, 35 tons	1 set
7	Bench Grinder, 255 mm with Eye Shields, Water Cup, Floor Stand.	1 set
8	Bench Drill, 13 mm with Drill Stand	1 set
9	Tool Stand	2 sets
10	Port-Power Set, 10 tons	1 set
11	Body Fender Tool Set	1 set
12	Body Repair Tool Set	1 set
13	Surface Plate, 600 x 900 mm with Stand	1 set
14	Cast Iron Anvil, 50 kg	1 pc.
15	Cast Iron Sewage Block, 45 kg	1 pc.
16	Body Puller Set	1 set
17	Metal Cutting Snips, 3 kinds/set	1 set
18	Hack Saw Frame	5 pcs.
19	Hack Saw Blade, 250 mm	12 doz.
20	Sanding Paper Holder	2 pcs.
21	Sanding Cloth #60, #120, #240, #400, each 50 pcs	2 sets
22	Sanding Paper #240, #320, #600, each 100 pcs.	2 sets
23	Safety Goggles	2 pairs
24	Air Riveter	1 set
25	Air Disc Sander, 100 $\phi$ mm	1 set
26	Air Polisher	1 set
27	Air Impact Cutter Set	1 set
28	Tool Shelf	1 set
C)	Repainting (1 bay)	
1	Paint Spray Gun, Suction Type, 1.3 mm	2 pcs.
2	Paint Spray Gun, Suction Type, 1.5 mm	2 pcs.
3	Paint Spray Gun, Gravity Type, 1.3 mm	2 pcs.
4	Spray Gun Container, 1,000 cc	2 pcs.
5	Spray Gun Container, 600 cc	2 pcs.
6	Spray Gun Container, 400 cc	2 pcs.
7	Air Transformer	2 sets
8	Paint Spray Mask	2 pcs.
9	Paint Scale	1 set
10	Paint Filter, 100 pcs/set, with Stand	1 set
11	Paint Cup, 300 cc, 30 pcs/set	1 set
12	Paint Cup, 500 cc, 20 pcs/set	1 set
13	Paint Cup, 1,000 cc	2 pcs.
14	Paint Cup, 3,000 cc	2 pcs.
15	Paint Cup, 5,000 cc	2 pcs.
16	Paddle, 1 liter	5 pcs.

Description		Q'ty
17	Paddle, 4 liters	2 pcs.
18	Agitator, 1 liter	2 pcs.
19	Agitator, 4 liters	2 pcs.
20	Plastic Putty Knife, 90 mm	20 pcs.
21	Air Blow Gun	3 pcs.
22	Tool Shelf	1 set
(2)	Overhaul Shop (Engine, Transmission, Diff., etc.)	
1	Work Bench	2 sets
2	Machine Vice, Fixed Type, 150 mm	1 set
3	Transmission Jack, 1.5 tons	1 set
4	Differential Jack, 0.5 ton	1 set
5	Chassis Spring Jack, 0.5 ton	1 set
6	Nozzle Tester	1 set
7	Compression Gauge for Gasoline Engines	1 set
8	Compression Gauge for Diesel Engines	1 set
9	Diesel Timing & Tacho Tester	1 set
10	Valve Refacer with Stand	1 set
11	Valve Seat Grinder	1 set
12	Con-Rod Aligner	1 set
13	Valve Seat Cutter Set	1 set
14	Hand Valve Lapper, 30 $\phi$ mm	10 pcs.
15	Hand Valve Lapper, 35 $\phi$ mm	10 pcs.
16	Hand Valve Lapper, 45 $\phi$ mm	10 pcs.
17	Valve Lapping Compound, Coarse	12 pcs.
18	Valve Lapping Compound, Fine	12 pcs.
19	Piston Ring Compressor, 75 - 175 mm	2 pcs.
20	Piston Feeler	2 pcs.
21	Piston Ring Tool	2 pcs.
22	Cylinder Gauge, 50 - 100 mm	1 set
23	Cylinder Gauge, 100 - 160 mm	1 set
24	Cylinder Gauge, 160 - 250 mm	1 set
25	Plasti-Gauge, 0.025 - 0.076 mm	6 doz.
26	Plasti-Gauge, 0.051 - 0.152 mm	6 doz.
27	Plasti-Gauge, 0.102 - 0.229 mm	6 doz.
28	Valve Lifter & Compressor, 30 - 120 mm	1 set
29	Valve Lifter & Compressor, 50 - 225 mm	1 set
30	Valve Spring Tester, 120 kg	1 set
31	Vacuum Gauge	1 set
32	Clutch Aligner	1 set
33	Hydraulic Test Pump	1 set
34	Surface Plate, 600 x 900 mm with Stand	1 set
35	Tool Shelf	1 set
36	High-Speed Cut-off Machine, 405 mm	1 set

Description		Q'ty
(3)	Tire Shop	
1	Tire Changer, 14 - 26"	1 set
2	Air Inflator	1 set
3	Tire Pressure Gauge, 14 kg/cm <sup>2</sup>	4 pcs.
4	Chuck Gauge, 11 kg/cm <sup>2</sup>	1 pc.
5	Air Impact Wrench 38 mm with Impact Wrench Holder	1 set
6	Air Impact Wrench, 16 mm	2 sets
7	Tube Test Tank	1 set
8	Hot Patch & Clamp Set	4 sets
	Contents (per set.):	
	1. Clamp	1 pc.
	2. Hot Patch, 60 φmm	10 pcs.
	3. Hot Patch, 43x33 mm	30 pcs.
	4. Hot Patch, 47x23 mm	30 pcs.
	5. Hot Patch, 65x35 mm	20 pcs.
9	Tube Vulcanizer Set	1 set
10	Tire Bead Remover	2 pcs.
11	Tire Service Tool Set	2 sets
12	Wheel Dolly	1 set
13	High Power Wrench	1 set
14	Housing Nut Wrench	2 sets
15	Universal Housing Nut Wrench	2 sets
16	Tool Shell	1 set
(4)	Battery & Electric Shop	
1	Battery Charger, Quick	1 set
2	Battery Charger, Slow	1 set
3	Battery Hydrometer Set	5 sets
4	Battery Tester	2 sets
5	Volt Ampere Meter	2 sets
6	Timing Light	1 set
7	Circuit Tester	5 sets
8	Booster Cable, 300 Amp.	5 sets
9	Battery Filler, 4 liters	2 pcs.
10	Polyethylene Funnel	2 pcs.
11	Polyethylene Measure, 2 liters	2 pcs.
(5)	Welding Booth	
1	Gas Cutting & Welding with Cylinder and Cylinder Carrier	1 set
2	Electric Welding Machine, 250 Amp. with Welding Accessories	1 set
3	Electric Soldering Iron, 60 W	2 pcs.
4	Electric Soldering Iron, 150 W	2 pcs.
5	Solder, 500 g	10 pcs.
6	Torch Lamp, Gasoline, 1 liter	2 pcs.
7	Clamp Set, Consists of 50, 100 and 150 mm, 3 kinds/set	2 sets
8	Vice Grip Wrench & Welding Pliers, 7 kinds/set	2 sets
9	Electrode Driver, 5 kg	1 set

Description		Q'ty
(6)	Air Compressor	
1	Air Compressor, 7.5 kW	2 sets
2	Refrigerated Air Dryer	2 sets
3	Air Regulator	1 set
4	Air Hose, 6 $\phi$ mm x 50 m	4 pcs.
5	Air Hose, 9 $\phi$ mm x 10 mm	2 pcs.
6	Air Hose, 12 $\phi$ mm x 10 mm	2 pcs.
7	Quick Hose Connector, Socket, 1/2"	40 pcs.
8	Quick Hose Connector, Plug, 1/4"	30 pcs.
9	Quick Hose Connector, Plug, 3/8"	10 pcs.
10	Quick Hose Connector, Plug, 1/2"	10 pcs.
11	Hose Band, for 6 $\phi$ mm Air Hose	100 pcs.
12	Hose Band, for 9 $\phi$ mm Air Hose	20 pcs.
13	Hose Band, for 12 $\phi$ mm Air Hose	20 pcs.
(7)	Spare Parts (Light Duty) and Tool Storage	
1	Tool & Parts Shelf 1,800(L) x 600(D) x 1,800(H) mm	17 sets
2	Air Blow Gun	10 pcs.
3	Electric Drill, 6.5 mm	2 sets
4	Electric Drill, 13 mm	2 sets
5	Drill Set, 1 - 13 mm, 0.5 mm steps	10 sets
6	Electric Portable Grinder, 100 $\phi$ mm	2 sets
7	Portable Grinder, 100 $\phi$ mm	1 set
8	Electric Jig Saw	1 set
9	Hack Saw Frame	5 pcs.
10	Hack Saw Blade, 250 mm	12 doz.
11	Open End Wrench Set, 8 - 26 mm, 6 kinds/set	2 sets
12	Double Offset Box Wrench Set, 10 - 26 mm, 7 kinds/set	2 sets
13	Combination Wrench Set, 8 - 22 mm, 10 kinds/set	2 sets
14	Ignition Wrench Set	2 sets
15	Socket Wrench Set, 1/2" sq. drive	1 set
16	Socket Wrench Set, 3/4" sq. drive	1 set
17	Socket Wrench Set, 1" sq. drive	1 set
18	T Type Wrench, 8 - 21 mm, 10 kinds/set	1 set
19	Hexagon Wrench Set, 2.5 - 10 mm, 7 kinds/set	2 sets
20	Adjustable Wrench, 250 mm	2 pcs.
21	Adjustable Wrench, 450 mm	1 pc.
22	Adjustable Pipe Wrench, 250 mm	2 pcs.
23	Adjustable Pipe Wrench, 450 mm	1 pc.
24	Adjustable Pipe Wrench, 900 mm	1 pc.
25	Combination Plier, 200 mm	2 pcs.
26	Long Nose Plier, 150 mm	2 pcs.
27	Water Pump Plier, 250 mm	2 pcs.
28	Cutting Plier, 200 mm	2 pcs.
29	Diagonal Cutting Plier, 150 mm	2 pcs.
30	Bolt Clipper, 600 mm	1 pc.
31	Wire Stripper, 0.2 - 3.3 mm	1 pc.
32	Solderless Terminal Kit	2 sets
33	Snap Ring Plier Set	1 set

	Description	Q'ty
34	Brake Service Tool Set	1 set
35	Driver Set (-), 4 kinds/set	2 sets
36	Driver Set (+), 4 kinds/set	2 sets
37	Bearing Scrapper, 2 kinds/set	2 sets
38	Integral Handle Screw Driver, 2 kinds/set	1 set
39	Spark Test Screw Driver	2 sets
40	Stubby Driver, 2 kinds/set	2 sets
41	"TORX" Socket Wrench Set	1 set
42	Impact Driver Set	2 sets
43	Ball Peen Hammer, 2 kinds/set	2 sets
44	Test Hammer	2 pcs.
45	Plastic Hammer	2 pcs.
46	Soft Hammer	2 pcs.
47	Wood Hammer	2 pcs.
48	Copper Hammer, 2 kinds/set	2 sets
49	Rubber Hammer	2 pcs.
50	Sledge Hammer, 3 kinds/set	2 sets
51	Tool Set, Portable Type	10 sets
52	Tool Set, for Heavy Duty	5 sets
53	Tool Box	4 pcs.
54	Torque Wrench, 3 kinds/set	1 set
55	Universal Puller Set	1 set
56	Front Hub Puller	1 set
57	Pilot Bearing Puller	1 set
58	Mighty Puller Set	1 set
59	Pitman Arm Puller	1 set
60	Ancher-Pin Puller	1 set
61	Adjustable Reamer Set	1 set
62	Tap & Dice Set	2 sets
63	Chisel & Punch Set	3 sets
64	Set of Needle Files	5 sets
65	Engineer's File Set	5 sets
66	Stud Remover Set	2 sets
67	Screw Extractor Set	2 sets
68	Tube Flaring & Cutting Tool, Double Type	1 set
69	Tube Flaring & Cutting Tool, Single Type	1 set
70	Tie-Rod End Remover	1 pc.
71	Tie-Rod End Lifter	1 pc.
72	Hand Rivetter Tool Kit	1 set
73	Thread Restorer	1 pc.
74	Gasket Cutting Punch Set	1 set
75	Magnetic Finger	2 pcs.
76	Electric Soldering Iron, 60 W	2 pcs.
77	Electric Soldering Iron, 150 W	2 pcs.
78	Solder	10 pcs.
79	Scrapper Blade	5 pcs.
80	Oil Stone, 2 kinds/set	5 sets
81	Wire Brush, 2 kinds/set	20 sets
82	Engine Brush, 2 kinds/set	20 sets
83	Tool Tray, 415 x 250 mm	10 pcs.
84	Tool Tray, 600 x 450 mm	10 pcs.

Description		Q'ty
85	Service Creeper	10 pcs.
86	Garage Lamp with Bulb	10 sets.
87	Hand Truck, 300 kg	5 pcs.
88	Lever Block, 3 tons	1 set
89	Vernier Caliper, 150 mm	2 pcs.
90	Vernier Caliper, 300 mm	2 pcs.
91	Outside Micrometer Set, 0 - 150 mm	2 sets
92	Rule, 300 & 1,000 mm, 2 kinds/set	2 sets
93	Tape Measure, 5 m	2 pcs.
94	Tape Measure, 20 m	1 pc.
95	Inside Micrometer, 25 - 50 mm	1 set
96	Inside Micrometer, 50 - 300 mm	1 set
97	Straight Edge, 500 mm	1 pc.
98	Dial Gauge	2 pcs.
99	Magnetic Base	1 pc.
100	Angle Level Gauge	1 pc.
101	Thermometer	2 pcs.
102	Protractor, 320 mm	1 pc.
103	Thickness Gauge	4 pcs.
104	Thickness Gauge	10 pcs.
105	Square, 3 kinds/set	1 set
106	Iron Bench Level, 2 kinds/set	1 set
107	Outside Caliper, 150 mm	2 pcs.
108	Inside Caliper, 150 mm	2 pcs.
109	Divider, 3 kinds/set	1 set
110	Surface Gauge, 2 kinds/set	1 set
111	Screw Pitch Gauge	2 pcs.
112	Hand Spring Balance, 3 kinds/set	1 set
113	Scale Spring Balance	1 set
114	Hand Tachometer	1 set
115	Hand Tachometer	1 set
116	V Block	2 sets
(8)	Storage (Oil, Heavy Duty Parts)	
1	Heavy Duty Shelf, 2,400(L) x 900(W) x 3,000(H) mm	2 sets
2	Pallet, Plastic Type, 1,100 x 1,100 mm	10 pcs.
3	Hand Pallet Truck, 2 tons	1 set

2. CAR WASHING AREA

Description		Q'ty
1	Car Washing Machine for Buses	1 set
2	Steam Cleaner	1 set
3	High Pressure Car Washer	1 set

3. FUEL STATION

Description		Q'ty
1	Fuel Dispenser (Diesel) Double Pump Capacity: 85 liters/min./pump	1 set
2	Fuel Tank (Underground Tank) Capacity: 20 k liters	1 set

4. CONFERENCE ROOM

Description		Q'ty
1	First-aid box	1 set

#### 4.3.4 Basic Design Drawing

(1) Floor area table

Building	Structure, Height	Total Floor Area
Workshop	Reinforced concrete, 2 stories	1,578 m <sup>2</sup>
Terminal	Reinforced Concrete, 1 story	399 m <sup>2</sup>
	Total	1,977 m <sup>2</sup>

(2) Drawing list

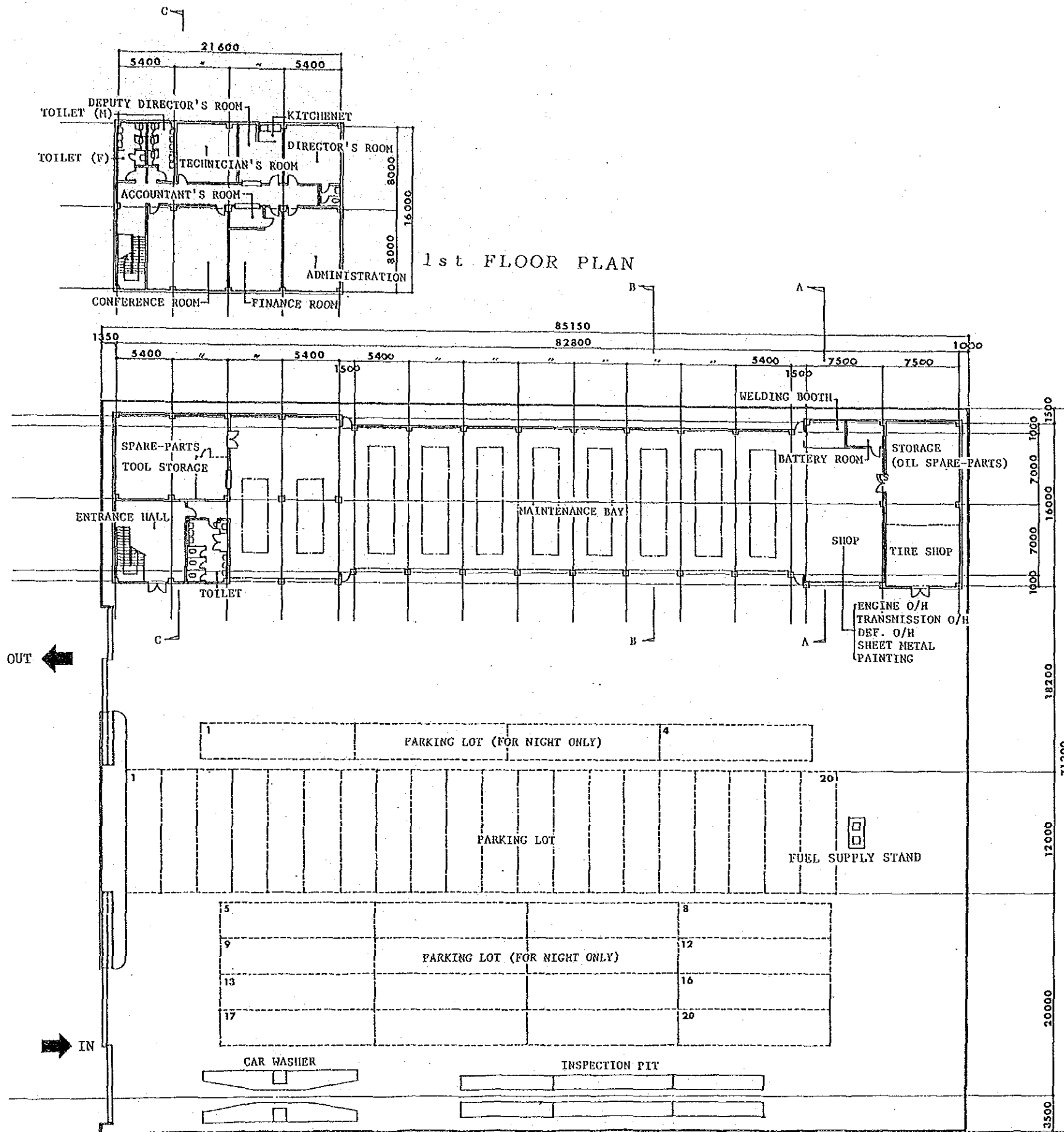
1) Workshop

- a) Layout scale 1/400
- b) Workshop first floor plan scale 1/400
- c) Workshop second floor plan scale 1/400
- d) Workshop elevation, section scale 1/400

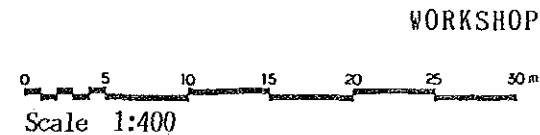
2) Terminal

- a) Layout scale 1/400
- b) Terminal first floor scale 1/400
- c) Terminal elevation, section scale 1/200

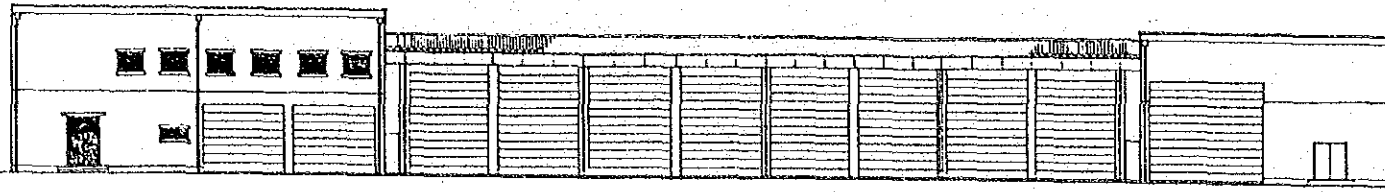




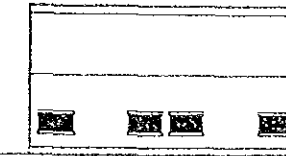
SITE PLAN AND GROUND FLOOR PLAN



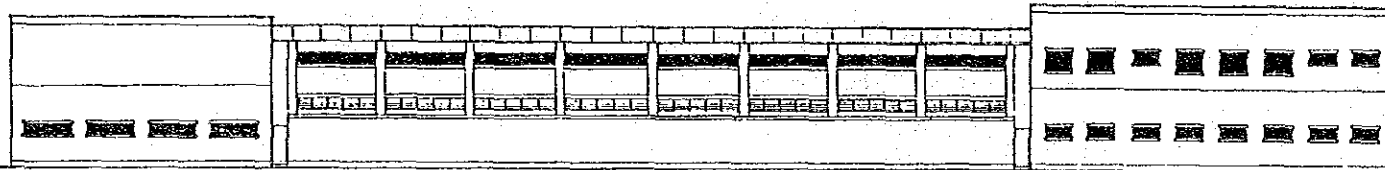
PROJECT FOR IMPROVING  
PUBLIC TRANSPORTATION IN VIENTIANE



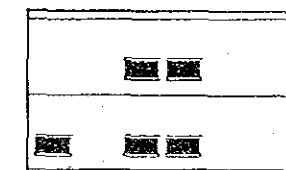
SOUTH ELEVATION



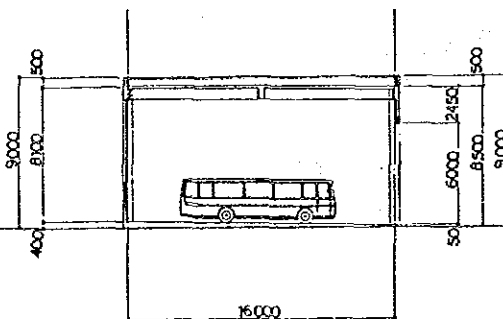
EAST ELEVATION



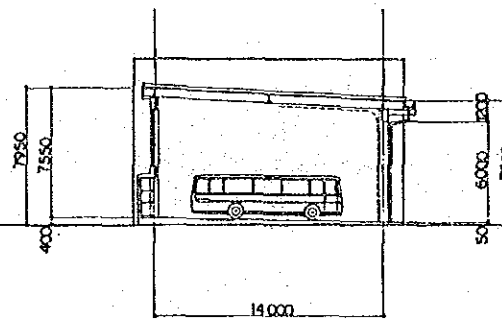
NORTH ELEVATION



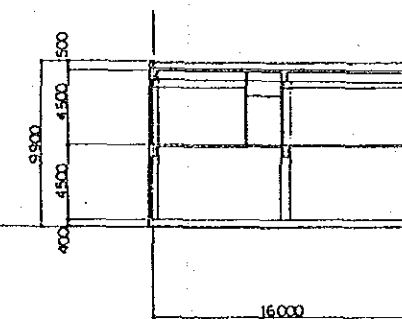
WEST ELEVATION



A-A SECTION



B-B SECTION

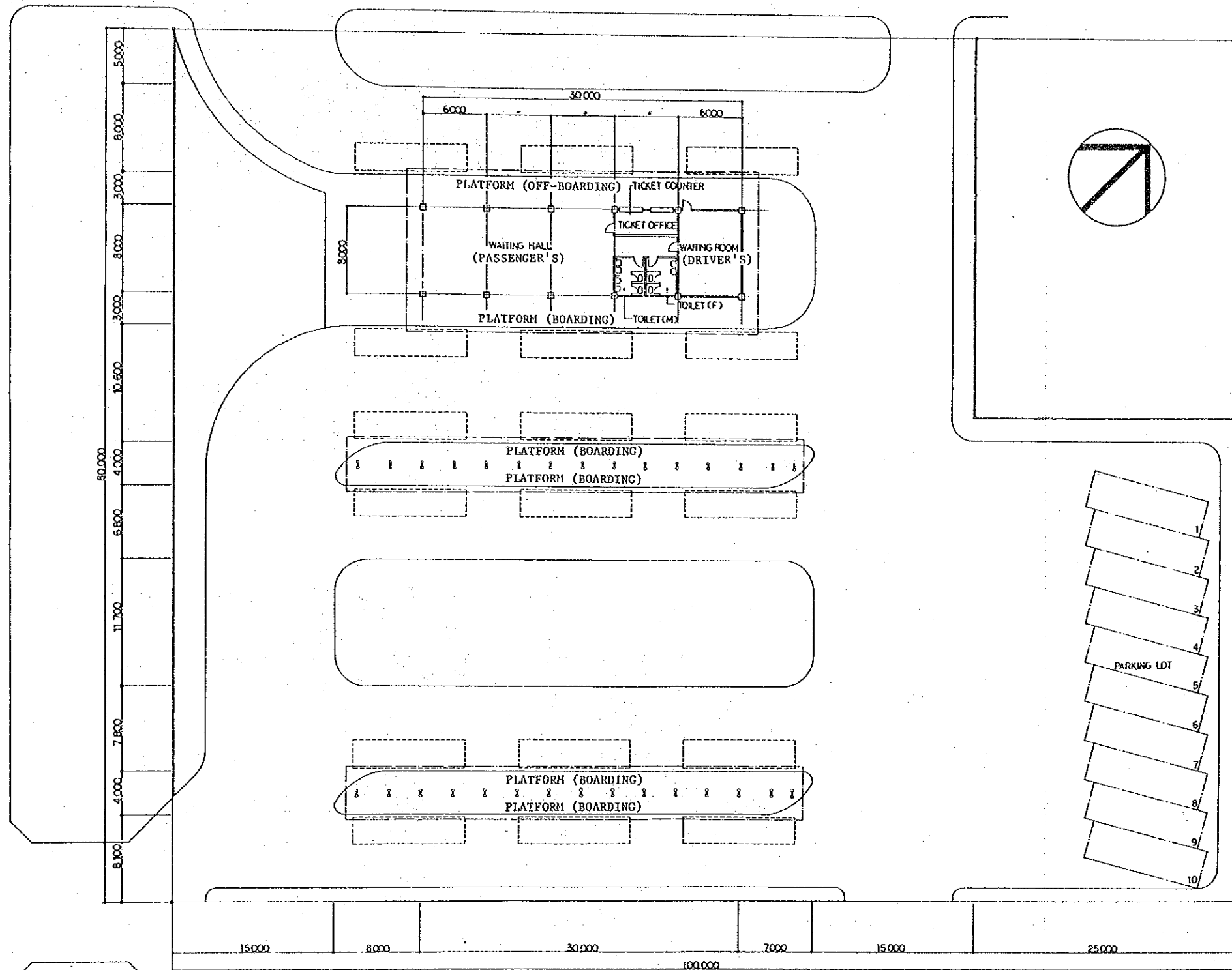


C-C SECTION

WORKSHOP



PROJECT FOR IMPROVING  
PUBLIC TRANSPORTATION IN VIENTIANE

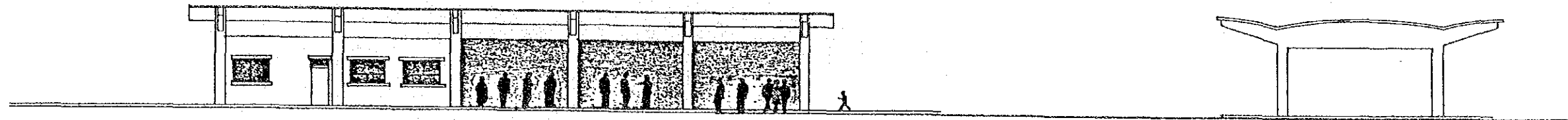


SITE PLAN AND GROUND FLOOR PLAN

0 5 10 15 20 25 30m

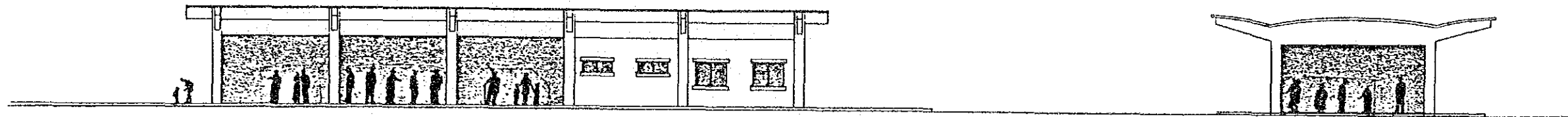
PROJECT FOR IMPROVING PUBLIC TRANSPORTATION IN VIENTIANE

BUS TERMINAL  
Scale 1:400



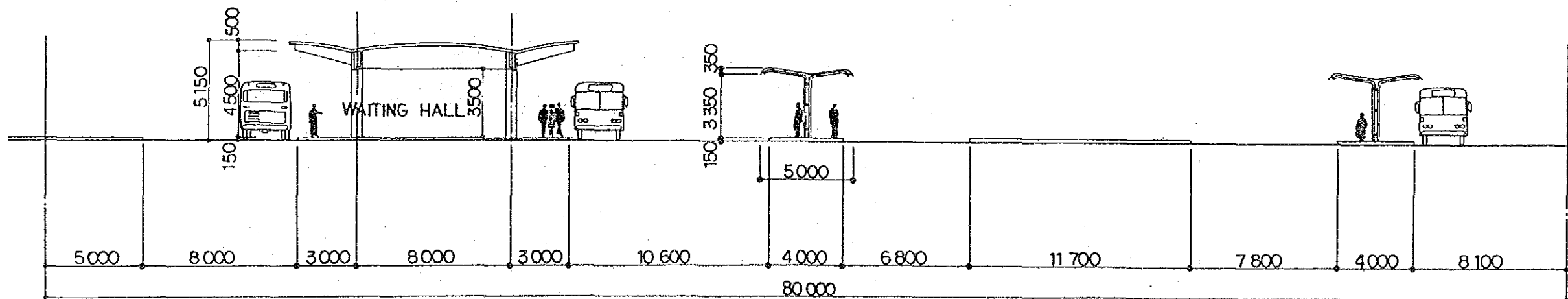
NORTH ELEVATION

EAST ELEVATION



SOUTH ELEVATION

WEST ELEVATION



A-A SECTION



Scale 1:200

PROJECT FOR IMPROVING  
PUBLIC TRANSPORTATION IN VIENTIANE



## CHAPTER 5 PROJECT EXECUTION PLAN



## CHAPTER 5 PROJECT EXECUTION PLAN

### 5.1 Execution Plan

The executing agency for the project is the Prefecture Bus Company (PBC) which is under the Communication, Transport and Construction Bureau of the Vientiane Municipality.

The project construction and installation of equipment will be designed by a Japanese consultant, selected in accordance with the Grant Aid Program of Japan. After a detailed design is completed, a Japanese construction company selected by tender will conduct the construction.

### 5.2 Respective of Undertakings

The respective undertakings of the Japanese and Laotian sides are as listed in the following table.

Item	Undertakings of Japanese Side	Undertakings of Laotian Side
(1) Basic construction		
① Site preparation		. Site preparation
② Water supply	. Pipeline installation within the site	. Branch pipeline installation from main pipeline up to receiving storage tank
③ Drainage	. Installation of drainage facility . Pipeline installation within the site	



Item	Undertakings of Japanese Side	Undertakings of Laotian Side
④ Power	<ul style="list-style-type: none"> <li>. Cable wiring from sub-station to respective facility</li> </ul>	<ul style="list-style-type: none"> <li>. Cable wiring from power line to sub-station</li> <li>. Expenses associated with power intake</li> </ul>
⑤ Telephone	<ul style="list-style-type: none"> <li>. Wiring after terminal board (terminal board is installed by Japanese side)</li> </ul>	<ul style="list-style-type: none"> <li>. Wiring from telephone line to terminal board</li> <li>. Expenses associated with phone circuit intake</li> </ul>
(2) Building	<ul style="list-style-type: none"> <li>. Project facility construction and related installation</li> </ul>	<ul style="list-style-type: none"> <li>. License and permit application and associated expenses</li> <li>. Construction of facilities not undertaken by Japanese side</li> </ul>
(3) Outside work	<ul style="list-style-type: none"> <li>. Construction of bus parking lot</li> </ul>	
(4) Tools & equipment	<ul style="list-style-type: none"> <li>. Procurement and installation of tools and equipment</li> </ul>	
(5) Furniture & fixtures		<ul style="list-style-type: none"> <li>. Carpets, curtains, desks, chairs and other fixtures</li> </ul>
(6) Transportation of materials & equipment	<ul style="list-style-type: none"> <li>. Ocean freight, insurance &amp; local land transportation charge</li> </ul>	<ul style="list-style-type: none"> <li>. Custom clearance &amp; duty exemption</li> <li>. Opening bank account &amp; associated expenses</li> </ul>
(7) Other work related to the execution of this project		<ul style="list-style-type: none"> <li>. Formalities related to entrance/exit of consultant &amp; contractor personnel; also exemption of duties and local taxes</li> </ul>

### 5.3 Construction and Supervision Program

#### (1) Construction and Supervision Program

The following items are included in the construction and supervision program.

##### 1) Provide assistance and guidance for construction contract

Evaluate tenderer's qualifications, prepare and conduct tender process, evaluate tenders, select construction contractor and attend construction contract signing.

##### 2) Review and approve shop drawings, etc.

Review and approve shop drawings, material samples, tools and equipment submitted by construction contractors.

##### 3) Supervise and inspect construction

Review and supervise implementation program and schedule, monitor and supervise construction progress, and execute inspection at necessary stages of construction.

##### 4) Approve payment

Inspect and certify construction progress during execution and after completion so that payment can be made.

##### 5) Submit construction progress report

Submit construction progress report regularly to the owner and to concerned agencies of the Japanese Government so that both the Laotian side and the Japanese side can implement their respective undertakings smoothly.

## 6) Handover of facilities and equipment

After completion of the construction, verify that contract conditions have been satisfied, and attend the handing over of facilities and equipment in accordance with the contract. The project is completed with the issuance of the owners' receipt.

## 5.4 Procurement Plan for Construction

### 5.4.1 Construction Materials and Equipment

Among the construction materials produced in Laos, the following materials are available for this project.

#### (1) Aggregates for concrete and mortar

Sand for fine aggregate can be collected from the Mekong River. Since fine particles and clay are contained in the sand, it must be washed and mixed with care. Good quality gravel suitable for coarse aggregate is also available from the Mekong River.

#### (2) Bricks

Bricks are the most common building material produced in Laos, but since the burning temperature is low, the bricks tends to be soft, although they may be used as base material.

#### (3) Lumber

Lumber is exported from Laos and is quite abundant, so it is available for the interior finish.

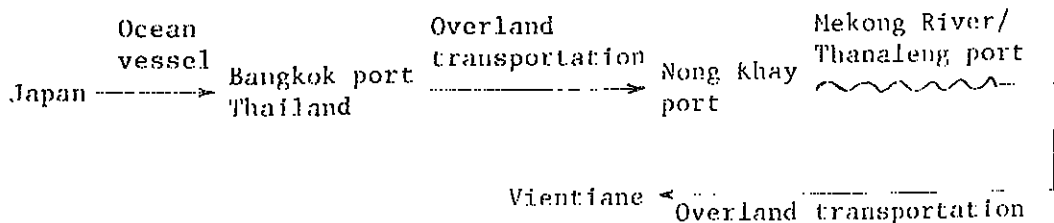
Construction materials available in Laos are very few, and most materials including finishing materials must be imported from Japan and other countries. Materials procured in Japan must be shipped first by ship then overland through Thailand. Two months must be estimated for shipment from Japan to Vientiane including customs clearance in Thailand.

Table 14 Procurement of Materials

Materials	Laos	Japan	Other Countries
Aggregates	o		
Cement			o
Steel bars		o	
Steel frames		o	
Bricks	o		
Lumber	o		
Tile	o		
Window frame			o
Shutter		o	
Main finishing material			o
Main tools & equipment			o

(4) Other Materials

Materials not available in Laos are unloaded in Bangkok, Thailand, and shipped overland to Laos. The most common transportation route is shown in the following diagram and is the main route from Bangkok since it is closest to the Laotian capital, Vientiane.



#### 5.4.2 Tools and Equipment

Tools and equipment for this project are all imported from Japan, and experts will be dispatched for supervision and trial operation.

#### 5.5 Implementation Schedule

After the Exchange of Notes (according to the Grant Aid Program) signed between the Governments of Laos and Japan becomes effective, a consultant contract for this project will be signed and detailed design will be commenced. The implementation work after the Exchange of Notes becomes effective may be broken down into the following stages which are shown in the work schedule shown in the below.

##### (1) Detailed design

After the Exchange of Notes becomes effective, a consultant agreement will be signed and a detailed design will be commenced. Before commencing the detailed design, however, the basic design report will be fully discussed with the agency of the Laotian side, and then tender documents will be executing prepared. Since this will take 2 months, it is estimated that the tender documents will be completed 3 months after the Exchange of Notes.

##### (2) Tender

After completion of tender preparations such as prequalification evaluation and tender notice, tender procedure, which is expected to take about 2 months, will be conducted in the following order.

Issuance of tender documents and instructions

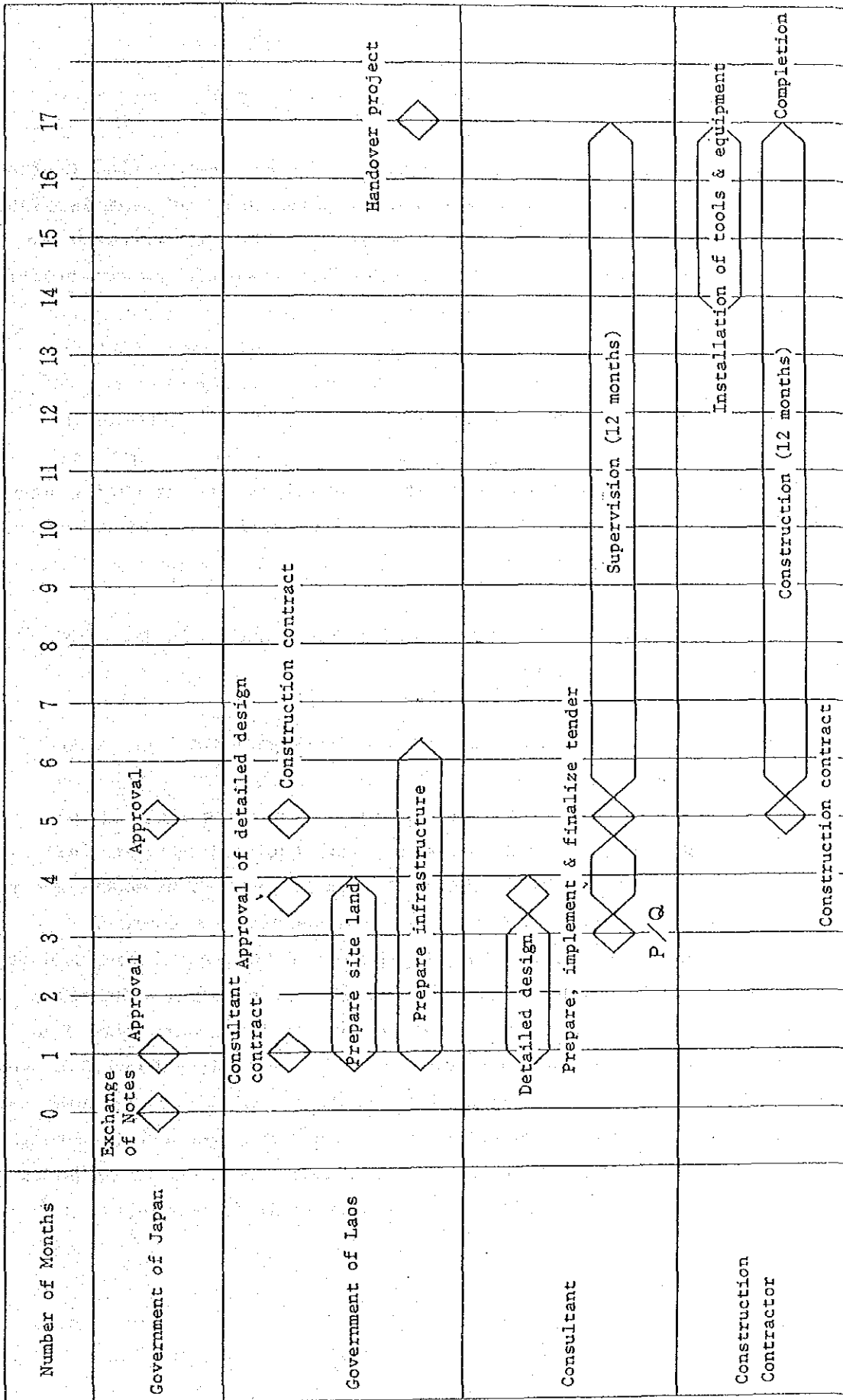
Tender

Evaluation of tenders

Selection of successful tenderer

Signing of construction contract

Commencing of construction



### (3) Construction

Construction will start after approval of the construction contract between the successful tenderer and the Government of Laos is issued by the Government of Japan. The construction is expected to be completed in about 12 months after handing over of the construction site.

## 5.6 Maintenance and Administration Plan

In order to operate these facilities smoothly, the executing agency (PBC) should secure an appropriate budget and establish a good maintenance and administration organization.

### 5.6.1 Maintenance and Administration

- (1) Establish maintenance and administration organization and secure necessary personnel

The facility should be maintained and administered by full-time technicians of PBC, since regular inspection and maintenance according to the operation manual, special measures for emergency conditions, can only be taken by technicians fully acquainted with the facility as well as the different pieces of equipment. Therefore, it is necessary to secure and train technicians who are qualified to perform the aforementioned tasks. The best way to train such technicians is to select them when construction starts and help them appreciate the design and structure of the facility, and to have them receive training during construction so that they will be prepared to operate and maintain the facility as soon as it is completed.

(2) Secure expendable spare parts and emergency spare parts

In this project, local construction materials are used as much as possible, but some materials are procured from Japan and Thailand.

In order to facilitate procurement of expendable spare parts and emergency spare parts, the type number of parts and supplies as well as their local sales agents, manufacturers and communication routes will be clearly recorded on completion of the project. However, it is necessary to have a sufficient amount of maintenance expenses included in the yearly operation budget.

### 5.6.2 Maintenance of Tools and Equipment

(1) Establish maintenance management organization and secure necessary personnel

Tools and equipment which can be repaired and maintained by PBC personnel are mainly selected, but for equipment which requires repair and maintenance by the manufacturer's technicians, it is necessary to conclude a maintenance contract with the manufacturer's agent.

On completion of the project, maintenance and operation persons should be selected and secured. Daily maintenance is the duty of the personnel operating the equipment. Since the main cause of trouble is misoperation of the equipment, operational personnel should receive good training on operation and maintenance from Japanese technicians based on the operation manual.

The following training should be provided when handing over tools and equipment.

- ① Provide inventory management methods of expendable spare parts and emergency spare parts and train PBC personnel.



- ② Provide a maintenance manual for repairing tools and equipment and train PBC maintenance personnel.
- ③ Operation and maintenance methods will be explained by experienced Japanese technicians.

(2) Secure expandable spare parts and emergency spare parts

The many parts which constitute a piece of equipment may be separated into expendable spare parts which are replaced regularly and emergency spare parts which are replaced when they are damaged. The one or three year supply of spare parts which are normally supplied cannot be expected to cover all damages or breakdowns which may occur.

Therefore, PBC should secure a budget to procure the necessary expendable and emergency spare parts. Even if sufficient maintenance personnel are secured, adequate maintenance is impossible when spare parts are lacking.

### 5.6.3 Maintenance and Administration Expenses

Maintenance and administration expenses consist mainly of operation costs, maintenance costs and labor costs. The yearly maintenance and administration expenses upon completion of the facilities are estimated as 31,890,960 Kip, which includes 14,403,600 Kip for additional personnel. Personnel expense including additional personnel is 12% of total yearly expense of PBC and additional personnel expense only is 5%.

Since the Laotian side has made assurances that the necessary budget for this project will be secured and also since PBC has earmarked substantial operation expense, it is believed without doubt that smooth management and administration of this project are possible.

Item		Yearly Expense (Kip/year)	
Operation	Power	1,008,000	(about 302,400 Yen)
	Water	90,000	(about 27,000 Yen)
Subtotal		1,098,000	(about 329,400 Yen)
Labor	Total	30,792,960	(about 9,237,888 Yen)
	(Additional)	(13,305,600)	(about 3,991,680 Yen)
Total		31,890,960 (14,403,600)	(about 9,567,288 Yen) (about 4,321,080 Yen)

(1) Power

- 1) Estimated average monthly consumption  
12,000 kW
- 2) Yearly power cost  
84,000 Kip x 12 months = 1,008,000 Kip/year

(2) Water

- 1) Estimated average monthly consumption  
250 m<sup>3</sup>
- 2) Water price  
30 Kip/m<sup>3</sup>
- 3) Yearly water cost  
7,500 Kip x 12 months = 90,000 Kip/year

(3) Maintenance and administration expenses

Since maintenance and administration expenses are not shown in either the budget or the settlement of accounts of PBC, the actual financial condition is not clear, but since they are expected to be very low, they are not included in this estimate.

(4) Labor cost

The yearly labor cost is estimated as 144,000 Kip (12,000 Kip/man-months x 12 months) with a yearly increase of 15%. The expenses for the first 2 years are as follows:

Yearly labor cost

All personnel:

$$144,000 \times 162 \text{ persons} \times (1.32\%) = 30,792,960 \text{ Kip}$$

Additional personnel:

$$144,000 \times 70 \text{ persons} \times (1.32\%) = 13,305,600 \text{ Kip}$$

5.7 Project Cost

Laotian side contribution

The Laotian side contribution is estimated to be about 14,635 thousand Kip (about 4.4 million Yen). The breakdown is shown in the following table.

Unit: Kip

Item	Workshop	Bus Terminal	Total
Outside work	7,125,000	6,074,000	13,199,000
Water supply intake work	157,500	157,500	315,000
Power intake work	202,500	202,500	405,000
Telephone intake work	135,000	135,000	270,000
Furniture & fixtures	342,000	104,000	446,000
Total	7,962,000	6,673,000	14,635,000

## CHAPTER 6 PROJECT EVALUATION



## CHAPTER 6 PROJECT EVALUATION

### 6.1 Benefits of the Project

The benefits expected from this project are described in the following paragraphs.

#### (1) Improvement of PBC operation

By implementing this project, PBC's bus operation rate will rise (present 42%, after implementation 80%), resulting in increased operational revenues which are expected to provide sound stable operation of PBC.

- 1) By implementing scheduled inspection and maintenance, bus breakdown will decrease and a constant number of operating buses can be maintained. Furthermore, the service life of main parts will be extended, for example clutch-disc and universal-joint, which are replaced after 20,000 km, can be changed after 100,000 km by implementing scheduled inspection and maintenance, which will permit an orderly purchase of spare parts.
- 2) As bus operation efficiency rises, consistent efficient operation is possible, which in turn provides more time for inspections and maintenance.

The practice of scheduled inspections and maintenance at PBC will improve operational safety and reliability will make workers realize the importance of maintaining scheduled inspections and maintenance. Since this will also result in a reduction of costs, other transportation agencies (trucks, taxis, samlores, etc.) can be expected to take up this practice. Furthermore, PBC is expected to provide a model for efficient bus operation by implementing its route reorganization, rational operation schedule and efficient bus operation in Vientiane Municipality, and benefits will accrue to the public transportation system of Vientiane Municipality.

(2) Upgrading of transportation service

1) Improved operational reliability through regular bus operation

When the workshop is improved, the bus repair capacity will be enlarged, the bus operation rate raised, bus breakdowns and loss of operation time reduced, and overall bus operation efficiency raised which will result in higher reliability.

2) Improved operational safety

When buses are well maintained, operational safety is improved which contributes to higher reliability.

3) Stabilize bus fare increase

The rise of operational efficiency will lower costs and the scheduled bus operation will increase revenues. Therefore, even though cost index rises at 20% per annum, a bus fare which people can afford can be set.

## 6.2 Suitability of the Project

The purpose of this project is to provide safe, sound bus operations to secure the trust of bus passengers. This will directly contribute to the sound operation of PBC by improving the following matters.

(1) Establish a reliable maintenance system to raise operational efficiency.

(2) Improve the operating system to provide regular reliable service.

The first goal, which raises operation rate of 42%, since only 14 buses out of 33 buses are operating, up to 80%, since 40 buses out of 50 buses are operating and 10 buses are being maintained, may be achieved by introducing scheduled inspections and maintenance. This will require the workshop to be extended, the number of technicians to be increased, and their skills to be upgraded.

The second goal may be achieved by changing the present unreliable operation schedule, which is decided each morning based on the daily operable number of buses, to an efficient operation schedule, which assures scheduled arrival and departure, to regain the confidence of bus passengers, by conducting a thorough demand survey of different bus routes and time bands.

Although personnel must be increased to maintain and administer this project, the increased costs are expected to be fully covered by the increased revenues resulting from the higher bus operation rate as well as by safer operation. Furthermore, through the training of key technicians, maintenance technology, skills and work efficiency will improve.

As described in the preceding paragraphs, the extension of bus maintenance, improvement of PBC's operations and the safe reliable bus operation resulting from Japan's grant aid will contribute greatly to the development of bus service for the people of Laos. The significance of this project is very high and it is considered most suitable for Japanese grant aid.





## CHAPTER 7 CONCLUSION AND RECOMMENDATIONS



## CHAPTER 7 CONCLUSION AND RECOMMENDATIONS

The implementation of this project is expected to improve the safety and reliability of PBC's bus operation and to contribute to the development of bus transportation service for the people of Laos. The implementation of the following items is necessary for achieving the best results of this project.

(1) Increase the number of technicians and workers

In order to operate the shop immediately after its completion, training should be provided to key technicians and workers from the present workshop, together with newly employed personnel, before transferring them to the new workshop.

(2) Review operation schedule

Reviewing of the operation schedule should be done after studying passenger demand for different routes and different time bands in order to establish an efficient operation schedule which addresses rush hour demand as well as low daytime demand.

(3) Retrain bus drivers

In order to operate buses safely and to prevent breakdowns, drivers and conductors should be retrained to improve their driving techniques, as well as to encourage them to observe traffic rules and perform inspections before driving.

(4) Establish scheduled inspection and maintenance system

The daily, 3,000 km (about half month), 12,000 km (about 2 months) and 36,000 km (about 6 months) inspection and maintenance schedule stipulated in PBC's program should be strictly enforced.

(5) Quick efficient supply of spare parts

In order to raise bus operations efficiency, quick, efficient supply of spare parts is just as important as improving repair techniques. An inventory control system should be implemented to assure a constant supply of minimum necessary stock through early ordering of spare parts based on historical records of scheduled inspections and maintenance.

(6) Technical Assistance from Japan

In view of implementing the above items smoothly, the Government of Laos, during the detailed study survey, requested short and long term technical assistance for developing and upgrading the technical level of PBC staff especially for maintenance staff, operation control staff and inventory control staff in order to establish a good operating system and organization at the bus maintenance workshop. The fields of technical assistance which would be most effective is believed to be the following fields.

- a) Train leaders in inspection, maintenance and repair
- b) Establish efficient operation schedule based on demand survey
- c) Establish workshop operation control and suitable inventory control
- d) Train technicians for electrical instruments, tires and welding

Studies to train staff in Japan should also prove effective to assure the development of this project.

## APPENDIX



## APPENDIX

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1. Basic Design Study

1.1 Minutes of Meeting (Site Survey) Copy

MINUTES OF DISCUSSIONS  
ON  
THE PROJECT FOR THE IMPROVING OF THE PUBLIC TRANSPORTATION  
IN  
VIENTIANE  
IN  
LAO PEOPLE'S DEMOCRATIC REPUBLIC

In response to the request made by the Government of Lao People's Democratic Republic (LAO PDR) for Grant Aid for the Project for Improving of the Public Transportation in Vientiane (hereinafter referred to as "the Project"), the Government of Japan decided to conduct a basic design study on the project and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent a basic design study team headed by Mr. Takao DOHI, Chief of Service Section, Vehicle Service Division, Ministry of Transport, to LAO PDR from 7th of November to 30th of November, 1988.

The Team had a series of discussions with the authorities concerned of the Government of LAO PDR and conducted a field survey in Vientiane. As a result of the study, both parties agreed to recommend to their respective Governments that major points of understandings reached between them as attached herewith should be examined towards the realization of the Project.

Vientiane, November 16, 1988

*T. Dohi*

Takao DOHI

Leader

Basic Design Study Team  
Japan International  
Cooperation Agency

*Bounmaly*

Bounmaly VILAVONG

On behalf of Lao Team  
Chief Division of External  
Economic Relation of Vientiane  
Municipality

## ATTACHMENT

### 1. OBJECTIVE OF THE PROJECT

The general objective of the Project is to improve and strengthen the public transportation services in LAO PDR. And the specific objective of the Project is to establish bus terminal and a complete scheduled maintenance system for 50 buses supplied under Japanese grant aid programme in 1989, and to keep smooth, full bus operation in the public bus route.

### 2. EXECUTING AGENCY

The executing agency for the implementation of the Project is the Department of Communication, Transportation and Construction of Vientiane Municipality.

### 3. SITES OF THE PROJECT

The proposed site of the bus terminal is next to the existing bus terminal area and a new workshop should be built after removing the existing workshop. Each site is shown in Annex I-1 and Annex I-2.

### 4. REQUEST BY THE GOVERNMENT OF LAO PDR

The team will convey to the Government of Japan the request of the Government of LAO PDR that the Government of Japan takes necessary measures to cooperate in implementing the project and provide necessary facilities and equipment as listed in Annex II within the scope of Japanese economic cooperation programme in grant form.

### 5. JAPAN'S GRANT AID SYSTEM

The LAO PDR side has understood the Japan's grant aid system explained by the team including the principle that a Japanese consultant firm and a Japanese general contractor should be used for the implementation of the Project.

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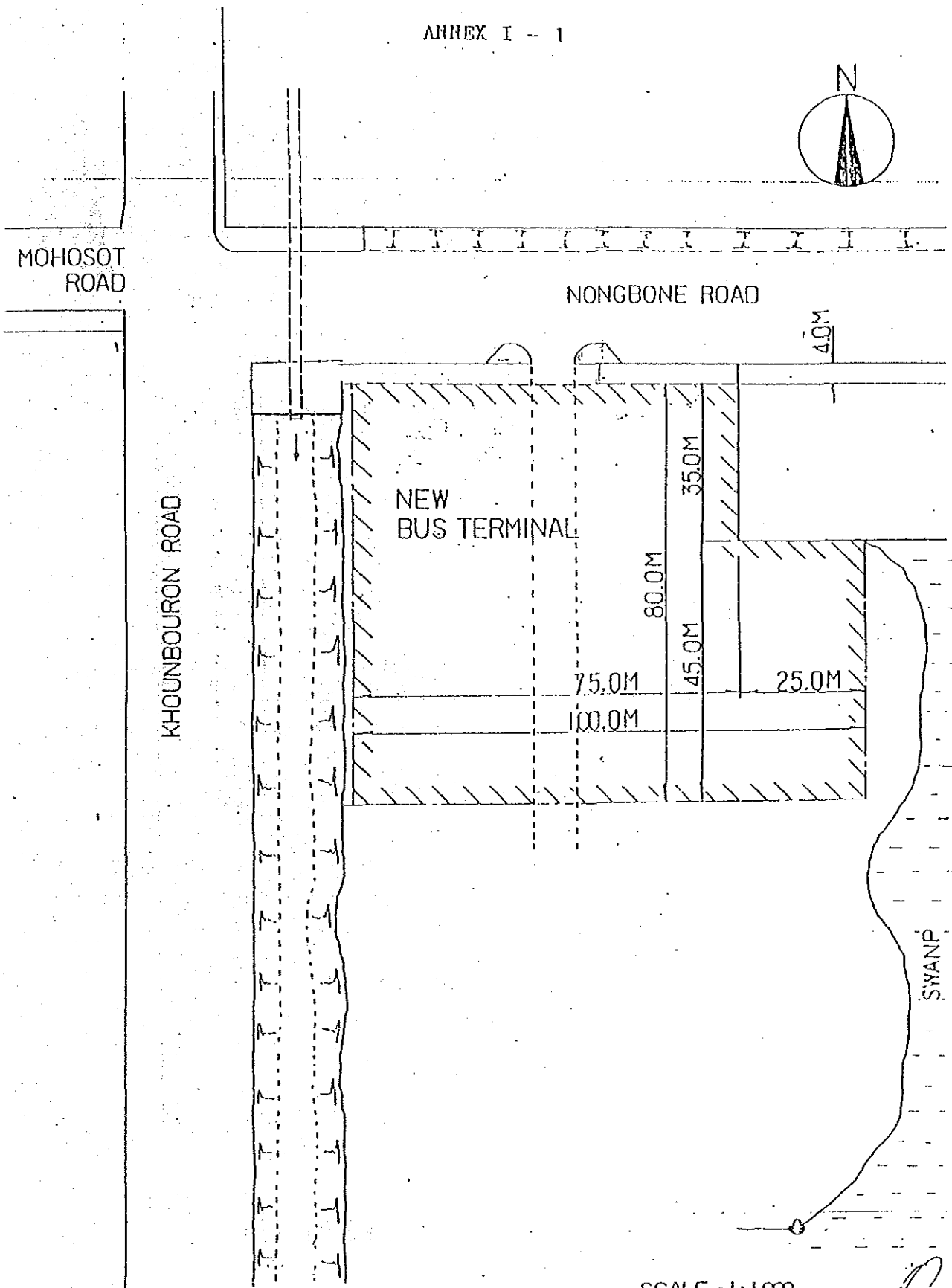
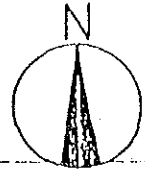
6. MEASURES TO BE TAKEN BY THE GOVERNMENT OF LAO PDR

The Government of LAO PDR will take necessary measures as listed in Annex III on condition that the grant aid by the Government of Japan is extended to the Project.

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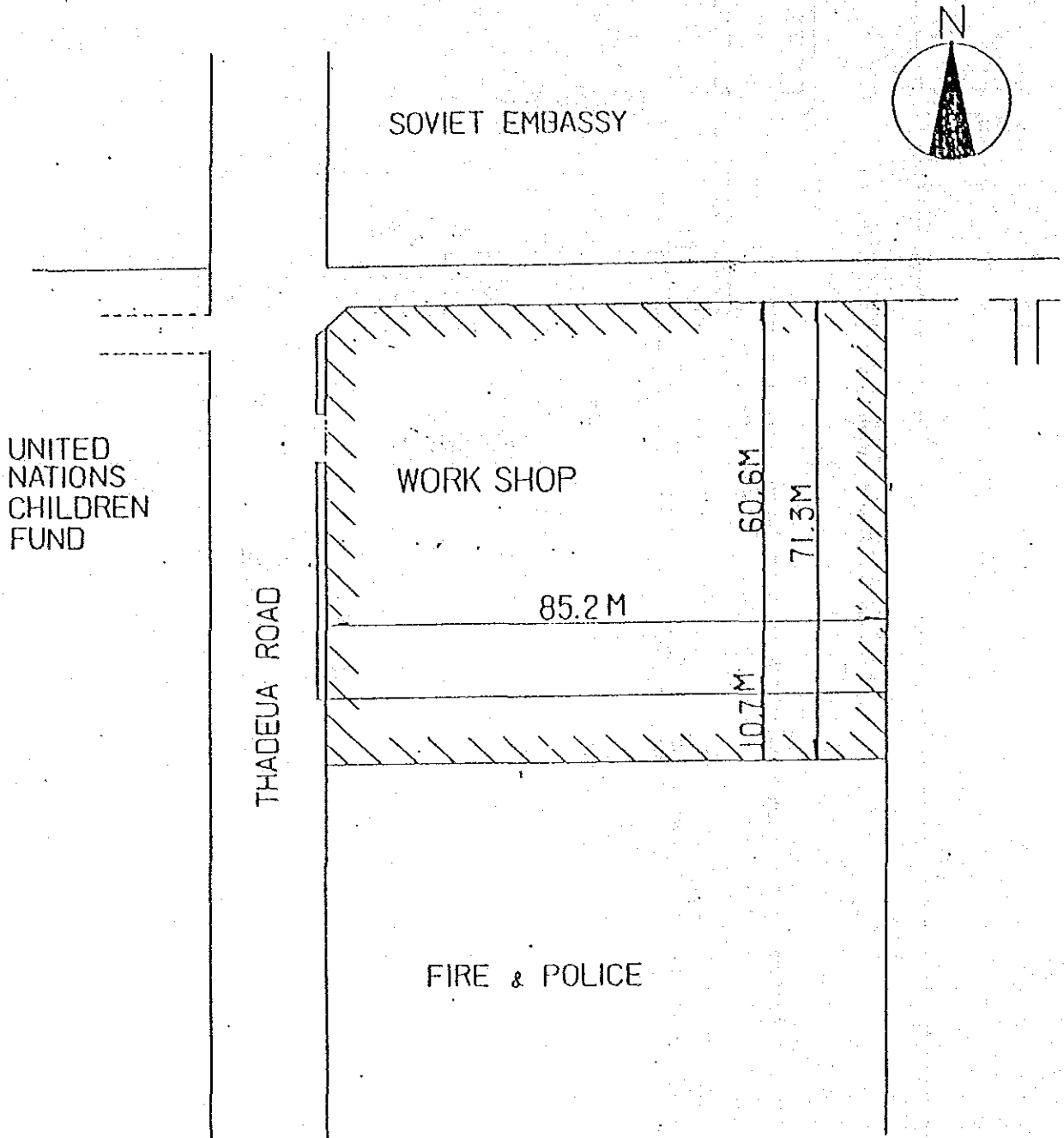


ANNEX I - 1



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SCALE = 1 : 1,000

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ANNEX II

Items to be requested by the Government of Lao PDR for Japanese Grant Assistant.

1. Facilities

- 1 - 1. Bus terminal
  - a. Parking lot
  - b. Administration office, drivers room and waiting room
  
- 1 - 2. Workshop
  - a. Body workshop
  - b. Administration office
  - c. Spare parts storage
  - d. Fuel station
  - e. Parking lot

2. Equipment

- 2 - 1
  - a. Equipment for repair shop
  - b. Equipment for body workshop
  - c. Bus washing and drainage system

3. Technical cooperation to maintain workshop and to assist training technical personnel

- a. Both long term and short term Japanese experts
- b. Sending Laotian trainee in Japan.

T.D



### ANNEX III

Necessary measures to be taken by the Government of LAO PDR.

- 1) To secure land necessary for the execution of the project and provide enough space for such construction as temporary offices, working area, stockyard and others.
- 2) To clear, level and reclaim the site prior to commencement of the construction.
- 3) To provide facilities for distribution of electricity, water supply, drainage, telephone system and other incidental facilities to the site.
- 4) To provide an appropriate temporary workshop during the construction period of new workshop.
- 5) To provide data and information necessary for the Project.
- 6) To ensure prompt unloading, tax exemption and customs clearance of materials and equipment under the Grant Aid at the port of disembarkation in LAO PDR and also to facilitate the internal transportation of them.
- 7) To exempt Japanese nationals engaged in the Project from customs duties, internal taxes and other fiscal levies which may be imposed in LAO PDR with respect to the supply of the products and the services under the verified contracts.
- 8) To provide and/or acquire necessary permissions, licences and other authorizations necessary for carrying out the Project.
- 9) To bear all expenses other than those borne by the Grant such as gardening, fencing, gates, and exterior lighting.

T. D



10) To maintain and use properly and effectively the facilities constructed and equipment provided under the Japanese Grant Aid programme and to provide the maintenance cost for the facilities and equipment sufficiently after completion of the Project.

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1.2 Minutes of Meeting (Draft Explanation) Copy

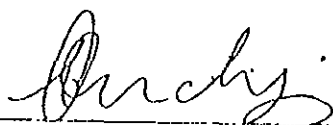
MINUTES OF DISCUSSIONS  
ON  
THE PROJECT FOR IMPROVING PUBLIC TRANSPORTATION  
IN  
VIENTIANE  
IN  
LAO PEOPLE'S DEMOCRATIC REPUBLIC

In response to the request made by the Government of LAO People's Democratic Republic (LAO PDR) for Grant Aid for the Project for Improving Public Transportation in Vientiane (hereinafter referred to as "the Project"), the Government of Japan decided to conduct a basic design study on the project and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent a basic design study team headed by Mr. Takao DOHI, Chief of Service Section, Vehicle Service Division, Ministry of Transport, to LAO PDR from 7th of November to 30th of November, 1988.

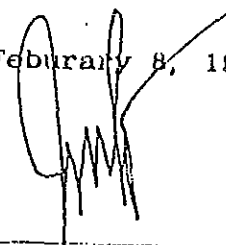
As a result of the study, JICA prepared a Draft Final Report and dispatched a team headed by Akira OUCHI, official of Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs to explain and discuss it with the relevant officials of the Government of LAO PDR from February 1st to 12th, 1989.

Both parties had a series of discussions on the Draft final Report and agreed to recommend to their respective Governments that the major points of understanding reached between them, attached herewith, should be examined towards the realization of the Project.

Vientiane, February 8, 1989



Akira Ouchi  
Leader  
Basic Design Study Team  
Japan International  
Cooperation Agency

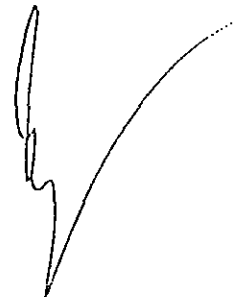


Xay Phakaxoum  
Director  
Department of Communication,  
Transport and Construction  
Vientiane Municipality

ATTACHMENT

1. The Lao side agreed in principle on the basic design proposed in the Draft Final Report.
2. The Lao side has understood Japan's grant aid system and reconfirmed that necessary measures which are manifested in the Annex III of the Minutes of Discussions on the Project signed on November 16, 1988, will be taken by the Lao side on condition that the grant aid by the Government of Japan is extended to the Project.
3. The Lao side ensured that the necessary budget and the adequate number of the personnel for the proper and effective operation and maintenance of the Bus Terminal and the Workshop will be secured.
4. The Final Report (10 copies in English) will be submitted to the Lao side at the beginning of April, 1989.

S. O.



### 1.3 Itinerary of Team

#### (1) Basic Design Study Team

Date	Members	Activities	Place
7, Monday	Dohi, Toyokawa, Ishikawa, Ushida, Anai	Leave Tokyo by TG-641	Bangkok
8, Tuesday	Dohi, Toyokawa, Ishikawa, Ushida, Anai	Arrive Vientiane by QV-422  (1) Courtesy visit to Japanese Embassy	Vientiane
9, Wednesday	Dohi, Toyokawa, Ishikawa, Ushida, Anai	(1) Courtesy visit to Director of Department II, Ministry of Foreign Affairs  (2) Courtesy visit to Deputy Minister of External Economic & Commerce  (3) Courtesy visit to Vientiane Municipality  (4) Survey of project site	
10, Thursday	Dohi, Toyokawa, Ishikawa, Ushida, Anai	(1) Conference at municipality office Submit questionnaire & discuss data collection schedule  (2) Site survey	
11, Friday	Dohi, Toyokawa, Ishikawa, Ushida, Anai  Ishikawa	(1) Conference at municipality office Receive bus operation Program, budget chart, plan, organiza- tion present statur chart, & map Discussion within team  (1) Prepare connection plan	

Date	Members	Activities	Place
12, Saturday	Dohi, Toyokawa, Ushida, Anai  Ishikawa	(1) Conference at municipality office Discuss undertaking by Laos side  (1) Prepare conception plan & sketch	
13, Sunday	Dohi, Toyokawa, Ishikawa Ushida, Anai	(1) Survey road transport condi- tion (route 13, route 15)	
14, Monday	Dohi, Toyokawa, Ishikawa, Ushida, Anai	Conference at municipality office Discuss minute draft	
15, Tuesday	Dohi, Toyokawa, Ishikawa, Ushida, Anai	(1) Survey of similar facility . Sweden, Volvo workshop . Soviet workshop . Australia, workshop	
16, Wednesday	Dohi, Toyokawa, Ishikawa, Ushida, Anai  Dohi, Toyokawa, Ushida, Anai  Ishikawa	(1) Sign minutes  (1) Visit telephone bureau and water supply bureau  (1) Prepare basic design & Sketch	
17, Thursday	Dohi  Takahashi, Ikeda  Ushida, Anai  Toyokawa, Ishikawa	Leave Vientiane by TC-691  Arrive Vientiane by TG-690  (1) Survey water supply facility & water intake  (1) Arrange data	

Date	Members	Activities	Place
18, Friday	Toyokawa, Ishikawa, Ushida, Anai, Ikeda, Takahashi	(1) Survey grant aid projects medicine production center (2) Survey Thanaleng port, Test boring of project site	
19, Saturday	Ushida, Anai  Toyokawa, Ishikawa, Ushida, Anai, Ikeda, Takahashi	(1) Survey transport & road condition  (1) Discussion within team	
20, Sunday	Ishikawa Ushida, Anai Toyokawa, Ushida, Anai	Leave Vientiane by QV-416  (1) Survey crushed rock plant, brick plant precast plant	
21, Monday	Ikeda, Takahashi Ikeda, Takahashi, Ushida, Anai, Toyokawa	(Municipality representative election)  Discussion within team	
22, Tuesday	Ikeda, Takahashi, Ushida, Anai, Toyokawa  Ushida  Takahashi	(1) Conference at municipality office (2) Survey present maintenance workshop (3) Survey bus terminal site (4) Interim report to Embassy	
22, Tuesday	Toyokawa, Anai, Ikeda  Ushida  Takahashi	(1) Level survey of proposed terminal site  (1) Meeting at present Maintenance workshop  (1) Survey of prices & collection of samples	

Date	Members	Activities	Place
23, Wednesday	Toyokawa, Ushida, Anai  Takahashi, Ikeda	(1) Survey of transport & road condition  (1) Survey of price, visit power bureau	
24, Thursday	Anai, Ushida, Toyokawa  Takahashi, Ushida	(1) Survey passenger of different route at terminal  (2) Survey present municipality office site  Leave Vientiane by TG-691  (1) Meeting at present maintenance workshop  Discussion within Team	Takahashi survey prices in Thai
25, Friday	Ushida  Toyokawa, Anai, Ikeda	(1) Conduct vehicle maintenance seminar at present maintenance workshop  (1) Review survey data of passenger of different route	
26, Saturday	Ushida  Toyokawa, Anai, Ikeda	(1) Conduct vehicle maintenance seminar at present maintenance workshop  (1) Arrange data Survey Thanaleng port, receive organization chart of Vientiane municipality  (2) Exchange minutes at municipality	
27, Sunday	Toyokawa, Ushida, Anai, Ikeda	(1) Discussion within team. Arrange data	

Date	Members	Activities	Place
28, Monday	Toyokawa, Ikeda	(1) Report & courtesy visit to Ambassador  (2) Hear report on road improvement plan from UNDP and construction bureau	
29, Tuesday	Toyokawa, Ushida, Anai, Ikeda	Leave Vientiane by QV-412	Bangkok
30, Wednesday	Toyokawa, Ushida, Anai, Ikeda, Takahashi	Arrive at Narita by TG-740	

(2) Draft Final Report Explanation Team

Date	Members	Activities	Place
February 1, Wednesday	Toyokawa, Ushida, Anai	Leave Tokyo by TG-641	Bangkok
2, Thursday	Toyokawa, Ushida, Anai	Arrive Vientiane by TG-960  (1) Conference at municipality office	Vientiane
3, Friday	Toyokawa, Ushida, Anai	(1) Conference at municipality office	
4, Saturday	Toyokawa, Ushida, Anai	(1) Submit minutes and memorandum  (2) Conduct seminar on bus operation program and its key control points at Prefecture Bus Company	
5, Sunday	Ouchi, Dohi	Arrive Vientiane  (1) Discussion within team	
6, Monday	Ouchi, Dohi, Toyokawa, Ushida, Anai	(1) Courtesy visit to Japanese Embassy  (2) Courtesy visit to Director of Department II, Ministry of Foreign Affairs  (3) Courtesy visit to Ministry of External Economic & Commerce  (4) Courtesy visit to Vientiane Municipality, discuss contents of draft basic design	



Date	Members	Activities	Place
February 7, Tuesday	Ouchi, Dohi, Toyokawa, Ushida, Anai	(1) Discuss and agree final minutes and memorandum	
8, Wednesday	Ouchi, Dohi, Toyokawa, Ushida, Anai	(1) Survey similar installation (Sweden, Volvo workshop)  (2) Sign and exchange minutes	
9, Thursday	Ouchi  Dohi, Toyokawa, Ushida, Anai	(1) Leave Vientiane by TG-961  (1) Survey transport and road condition of one long distance route up to Vang Vieng	
10, Friday	Dohi, Toyokawa, Ushida, Anai	(1) Conference of Japanese Embassy  (2) Survey transport and road condition up to Ban Hai	
11, Saturday	Dohi, Toyokawa, Ushida, Anai	Leave Vientiane by QV-416	Bangkok
12, Sunday	Dohi, Toyokawa, Ushida, Anai	Arrive Narita by TG-640	

## 1.4 Members of Team

### (1) Basic Design Study Team

Leader Takao DOHI

Members	Hiroyasu TOYOKAWA (Building plan)	Azusa Sekkei Co., Ltd.
	Yasushi ISHIKAWA (Building design)	Azusa Sekkei Co., Ltd.
	Susumu USHIDA (Tool & equipment plan)	Azusa Sekkei Co., Ltd.
	Junji ANAI (Civil work design)	Azusa Sekkei Co., Ltd.
	Shuhei IKEDA (Building equipment plan)	Azusa Sekkei Co., Ltd.
	Mitsuaki TAKAHASHI (Quantity survey)	Azusa Sekkei Co., Ltd.

### (2) Draft Final Report Explanation Team

Leader Akira OUCHI                      Grant Aid Division  
Department, Economic Cooperation Bureau,  
Ministry of Foreign Affairs

Members	Takao DOHI	Chief of Service Section, Vehicle Service Division, Ministry of Transport
	Hiroyasu TOYOKAWA (Building plan)	Azusa Sekkei Co., Ltd.
	Susumu USHIDA (Tool & equipment plan)	Azusa Sekkei Co., Ltd.
	Junji ANAI (Civil work design)	Azusa Sekkei Co., Ltd.

## 2. List of Persons Met

### (1) Basic Design Study

Embassy of Japan in Laos	Hayakawa, Ambassador Kamihigashi, Councilor Manabe, Secretary Inada, Secretary Suzuki, Secretary
Vice President of Vientiane Municipality	Mr. Siho BANNAVONG
Director of the Department of Communication, Transport and Construction, Vientiane Municipality	Mr. Xay PHAKASOUM
Director of Department II Ministry of Foreign Affairs	Mr. Sombath
Department II Ministry of Foreign Affairs	Mrs. Somsanuk
Ministry of Commerce and External Economic Relations	Mr. Bountheuang
Department of Economic Planning and Finance of Vientiane Municipality	Mr. Boummaly UULAVONG
Department of Communication, Transport and Construction, Vientiane Municipality	Mr. Khamla
Department of Communication, Transport and Construction, Vientiane Municipality	Mr. Phomma SINGANONH
Director of Prefecture Bus Company	Mr. Negone KEO
Deputy Director of Prefecture Bus Company	Mr. Choum SOSTISAVANG
Secretary of Mr. Xay Phakasoun	Mr. Lamnegeunh

(2) Draft Final Report Explanation

Embassy of Japan in Laos	Hayakawa, Ambassador Mauabe, Secretary Inada, Secretary Suzuki, Secretary
Vice-President of Vientiane Municipality	Dr. Siho BANNAVONG
Director of the Department of Planning and Finance, Vientiane Municipality	Mr. Sithonh STIBOUNHEUANG
Director of the Department of Communication, Transport and Construction, Vientiane Municipality	Mr. Xay PHAKASOUM
Department II, Ministry of Foreign Affairs	Mrs. Somsanuk VONGSACK
Ministry of Commerce and External Economic Relations	Dr. Bountheuang MOUNLASI
Department of Economic Planning and Finance of Vientiane Municipality	Mr. Bounmaly VILAVONG
Department of Communication, Transport and Construction, Vientiane Municipality	Mr. Khamla
Department of Communication, Transport and Construction, Vientiane Municipality	Mr. Phomma SINGANONH
Department of Communication, Transport and Construction, Vientiane Municipality	Mr. Oudone
Deputy Director of Prefecture Bus Company	Mr. Choum SOSTISAVANG

### 3. Bus Operation Plan

This bus operation plan was prepared as an example of a model case to determine the size of the bus terminal based on the bus route provided by the Laotian side. Although this plan will serve as a reference for operating 50 buses, PBC should set up its own detailed plan after surveying passenger utilization for different routes and different time band as well as road condition.

#### (1) Bus route plan

PBC is planning 48 routes (Ref. 1), but during site survey, it was observed that PBC defines routes by destination and that some destinations lie on the same route. The above 48 destinations planned by PBC are plotted on a route network to determine different routes. (Ref. 2).

##### 1) Loop route

The route network shows that 3 loop routes can be set up. By setting up such loop routes, buses can service many destinations efficiently.

##### a) National road 13 & 15 loop route (Ref. 3)

This will be a loop route of 178 km servicing 9 destinations, among the 48 destinations, north of Vientiane by connecting national road 13 north and national road 15.

##### b) National road 13 & 2 loop route (Ref. 3)

This will be a loop route of 132 km servicing 6 destinations, among the 48 destinations, by connecting National road 13 south and national road 2 running along the Mekong River.

c) Ban Hom loop route (Ref. 3)

This will be a loop route of 35 km (49 km when Vientiane/Chinaimo round trip is included) servicing 5 destinations, among the 48 destinations, in the Ban Hom district south of Vientiane.

2) Long distance route

In order to service distant destinations excluding those serviced by loop routes, 11 routes are set up. These routes excluding the underlisted 3 routes connect Vientiane and destination, and where they overlap with loop routes, the buses are scheduled to stop only at main stations.

a) Kasi route

This will be a 224 km route connecting Vientiane and Kasi, but since 147 km is unpaved, a round trip in one day seems difficult. So one trip from Vientiane to Kasi and one trip from Kasi to Vientiane is planned each day.

b) Lingxan Hatsiao route and Packcheng route

Both destinations branches off from the National road 13 & 15 loop route at respectively Phonmouang and 52 km points PBC plans 2 trips a day for both destinations but since much of the route overlaps with the loop route, operation efficiency is low. Therefore it is planned to send buses early in the morning to both Phonmouang and 52 km points and to service the destinations two times a day from these points.

c) City loop routes

The destinations to be serviced by the city loop route will be 10 destinations. Since the routes will be most important for city activity, it should be easy to use and should connect main points such as government offices in the city. Therefore the number of services should be the highest. In this survey, routes are not planned since the movement of people must be studied to set up the most suitable route.

(2) Bus operation

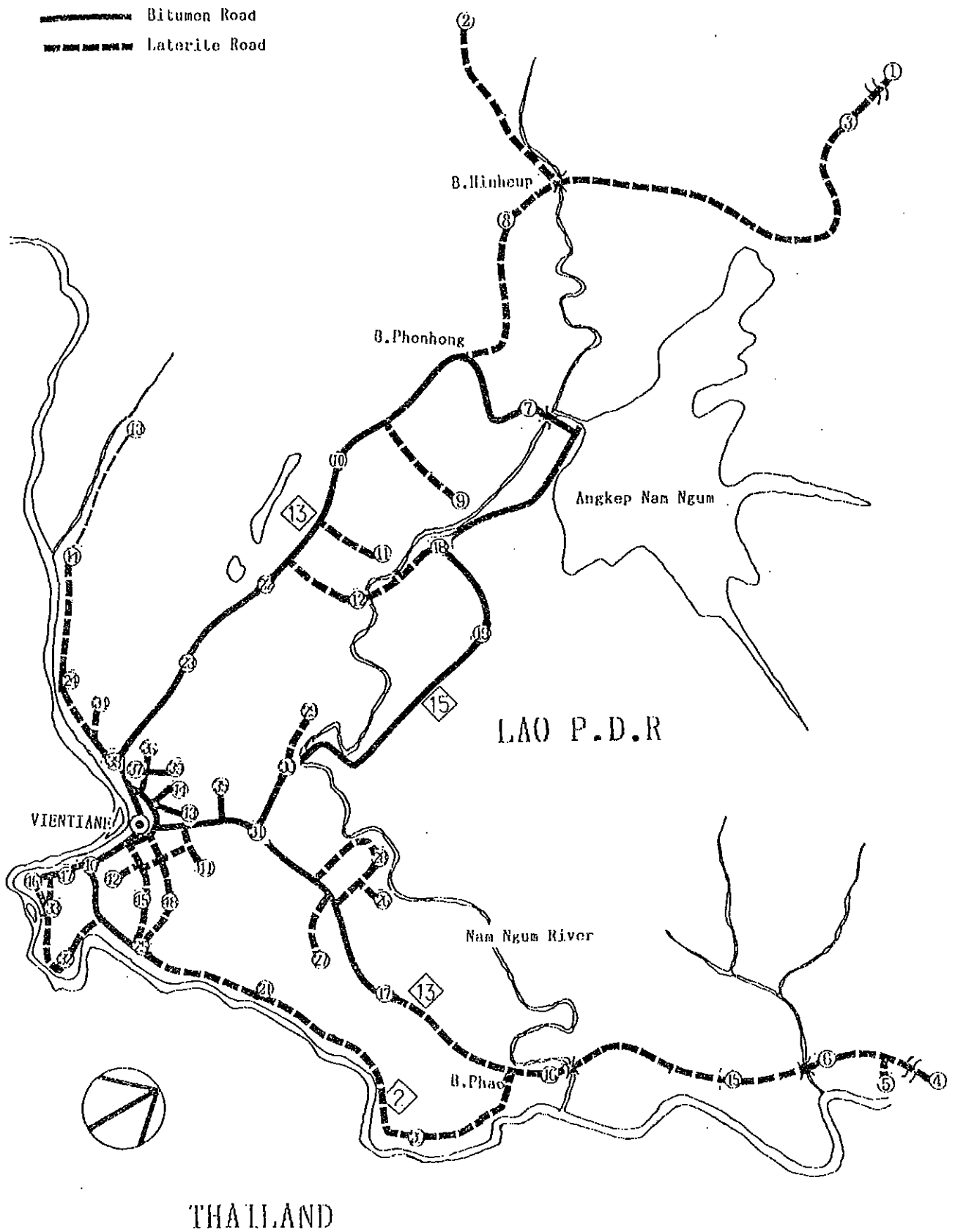
A bus operation diagram is prepared based on the above bus route plan (Ref. 5). The diagram was prepared to satisfy the number of services to the 48 destinations requested by PBC. The number of bus operation to respective destination based on the diagram is summarized in Ref. 4. Since this shows that the requested number of services to respective destination is similar or exceeds the desire of PBC, this plan is believed to be acceptable. According to the diagram, 30 buses are necessary for long distant route services.

Ref. 1 Planned Routes by PBC

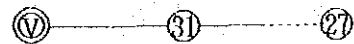
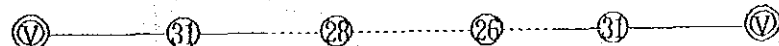
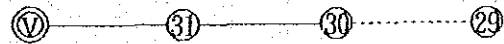
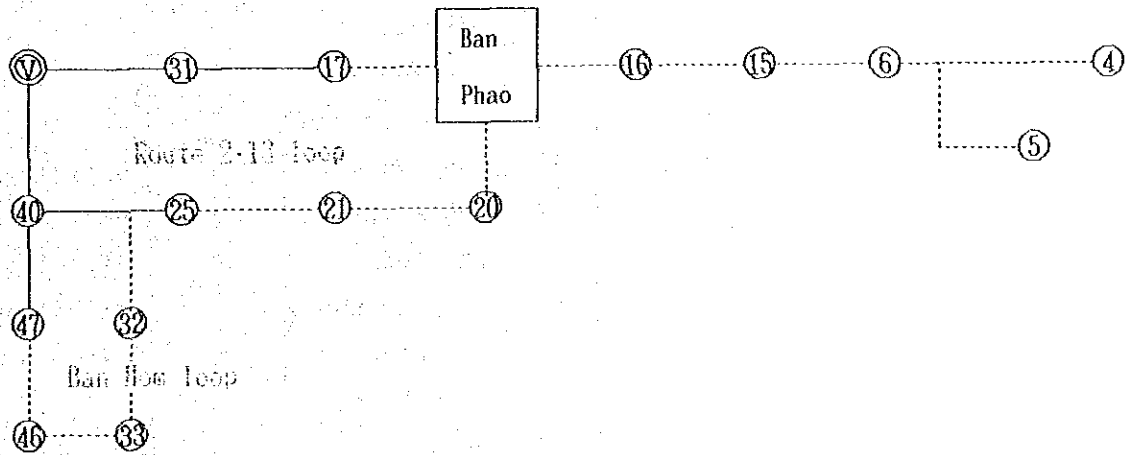
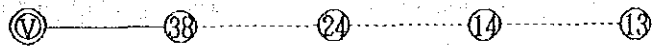
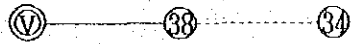
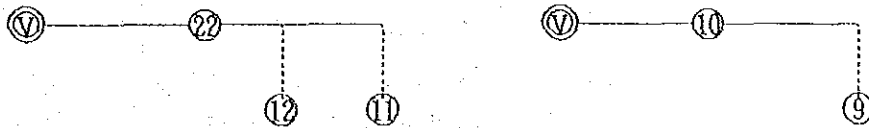
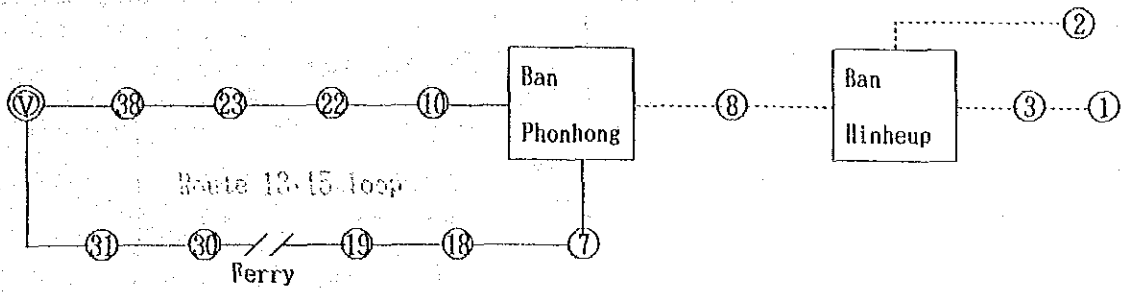
No.	Destination	Distance (km)	No.	Destination	Distance (km)
1	Kasi	224	26	Paksab	38
2	Ban Done	130	27	Houaxiang	30
3	Vang Viang	165	28	Thadindeng	35
4	Paksan	150	29	Veunkham	37
5	Nakham	104	30	Thangon	23
6	Thabok	93	31	Donmou	18
7	Thalat	84	32	Sithan-Tai	26
8	Sensoum	80	33	Ban Hom	20
9	Pakcheng	75	34	Tattong	12
10	Km52 (Lak-Hasipsong)	52	35	Dongdok	12
11	Jingxan	56	36	Pakthang	7
12	Hatsiao	48	37	Vat-Tai (Air-Port)	5
13	phialat	55	38	Sikhay	7
14	Paktone	40	39	Dongnasok	8
15	B. Thoay	88	40	Chinaimo	7
16	B. Hai	62	41	Ban Sok	12
17	Km39 (Lak-Samsip)	39	42	Don Paina	8
18	B. Keun	65	43	Phontong	9
19	Napheng	55	44	Nongbouathong	5
20	B. Don	59	45	Ban Xieng Da	11
21	Simmano	39	46	Hatdokka	14
22	Phonmoang	36	47	Bo-O	11
23	Naxaythong	18	48	Nakhoay	17
24	Houayhom	20			
25	Thadua	22			



Ref. 2 Route Network Covering Destinations



Ref. 3 Route Diagram



Ⓟ : VIENTIANE

Ref. 4 Requested Services of PRC and Planned Services

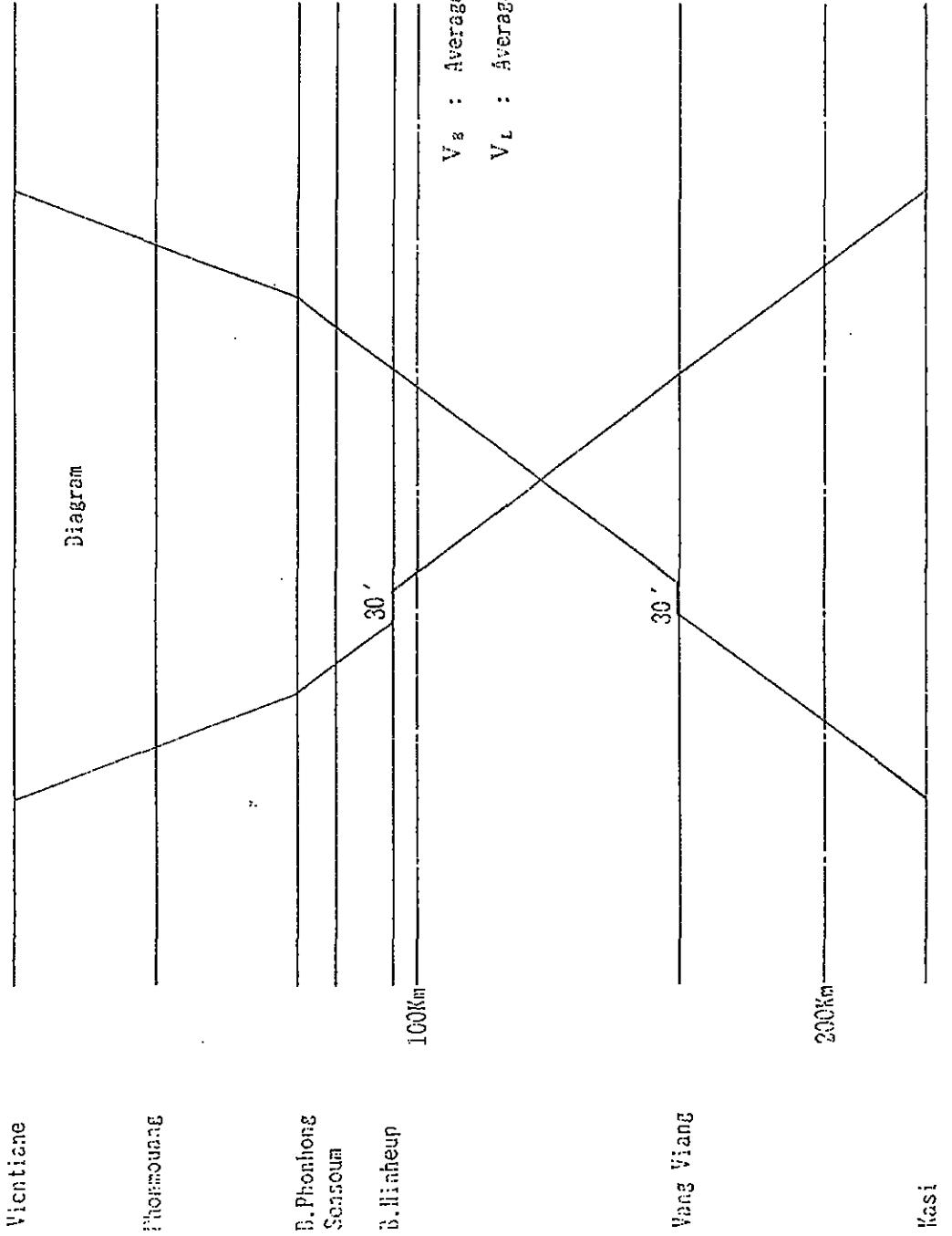
No.	Destination	No. of Service		No.	Destination	No. of Service	
		Request	Plan			Request	Plan
1	Kasi	1	1	26	Paksab	3	5
2	Ban Done	1	1	27	Houaxiang	3	3
3	Vang Viang	1	1	28	Thadindeng	3	5
4	Paksan	1	1	29	Veunkham	3	3
5	Nakham	1	1	30	Thangon	5	6
6	Thabok	1	2	31	Donnoun	5	17
7	Thalat	3	3	32	Sithan-Tai	3	4
8	Sensoum	2	2	33	Ban Hom	4	4
9	Pakcheng	2	2	34	Tattong	6	6
10	Km52 (Lak- Hasipsong)	2	3	35	Dongdok	6	city loop
11	Lingxan	2	2	36	Pakthang	7	city loop
12	Hatsiao	2	2	37	Vat-Tai (Air-Port)	7	city loop
13	phialat	2	2	38	Sikhay	7	11
14	Paktone	2	2	39	Dongnasok	7	city loop
15	B. Thoay	1	2	40	Chinaimo	7	16
16	B. Hai	2	2	41	Ban Sok	4	city loop
17	Km39 (Lak- Samsip)	2	5	42	Don Paina	7	city loop
18	B. Keun	3	3	43	Phontong	6	city loop
19	Napheng	2	3	44	Nongbouathong	7	city loop
20	B. Don	2	3	45	Ban Xieng Da	4	city loop
21	Sinmauo	3	3	46	Hatdokkeo	3	4
22	Phomuoang	3	5	47	Bo-O	6	13
23	Naxaythong	4	3	48	Nakhoay	5	city loop
24	Houayhom	3	2				
25	Thadua	5	3				

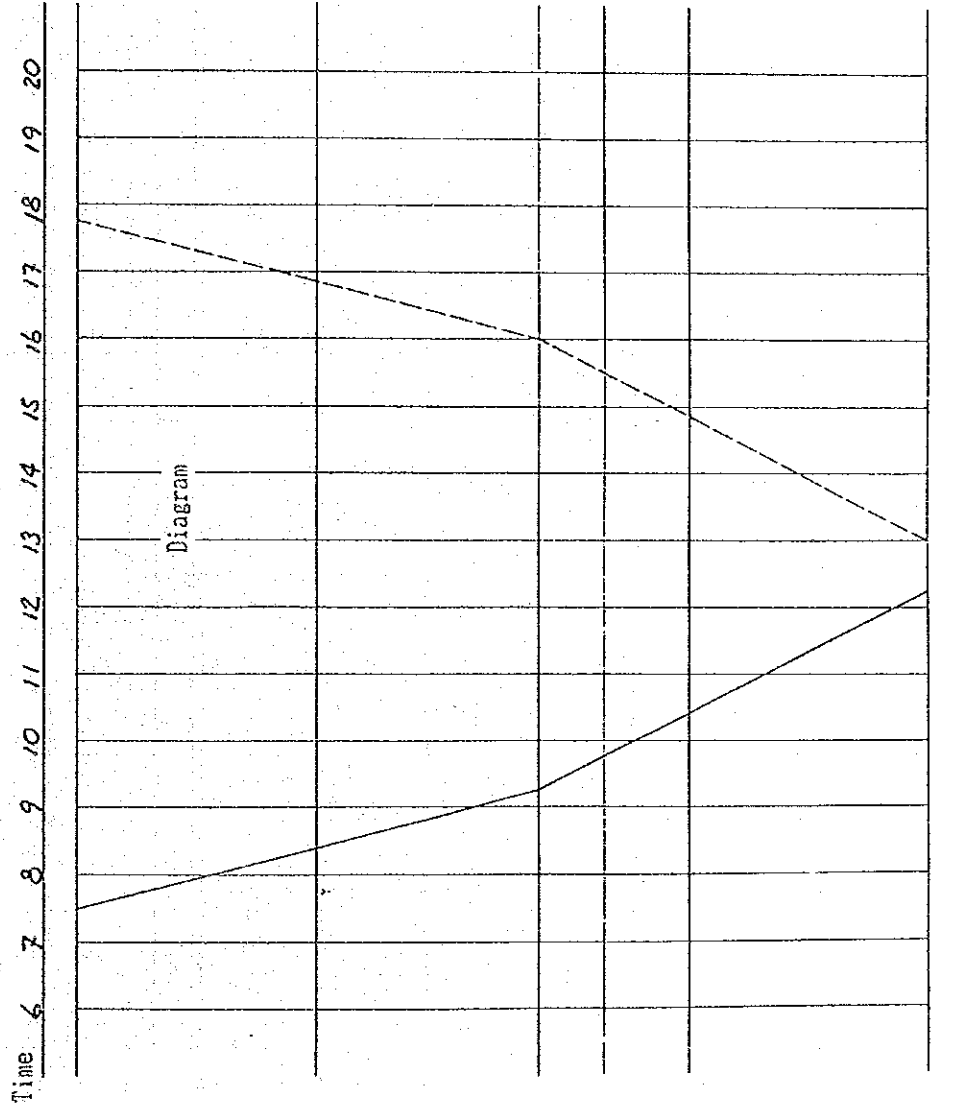
Ref. 5 Bus Operation Diagram

Time Table

Route No.	Destination					
1.	Kasi	8:00				
2.	Ban Done	7:30				
3.	Paksan	6:30				
4.	Nakham	8:00				
5.	Loop route 13, 15 via Sikhay	7:30	9:30	12:00		
6.	Loop route 13, 15 via Donnoun	7:00	9:30	12:00		
7.	Loop route 13, 2 via Donnoun	7:00	9:30	12:00		
8.	Loop route 13, 2 via Chinaimo	7:00	9:30	12:00		
9.	Paksab Thadindeng	6:00	8:30	11:00	13:00	15:00
10.	B. Hom loop route west to east	6:00	8:00	15:00	16:30	
11.	B. Hom loop route east to east	7:00	8:30	14:30	16:00	
12.	Pakcheng	7:00				
13.	Hatsiao	6:30				
	Lingxau					
14.	Veunkham	7:00	11:00	15:00		
15.	Phialat	6:00	7:00	11:00		
16.	Taffong	6:00	7:30	10:00	13:00	16:00 17:30
17.	Houaxing	7:00	10:30	14:00		

Time 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20





Vientiano

Phonmouang

B. Phonhong

Sensoum

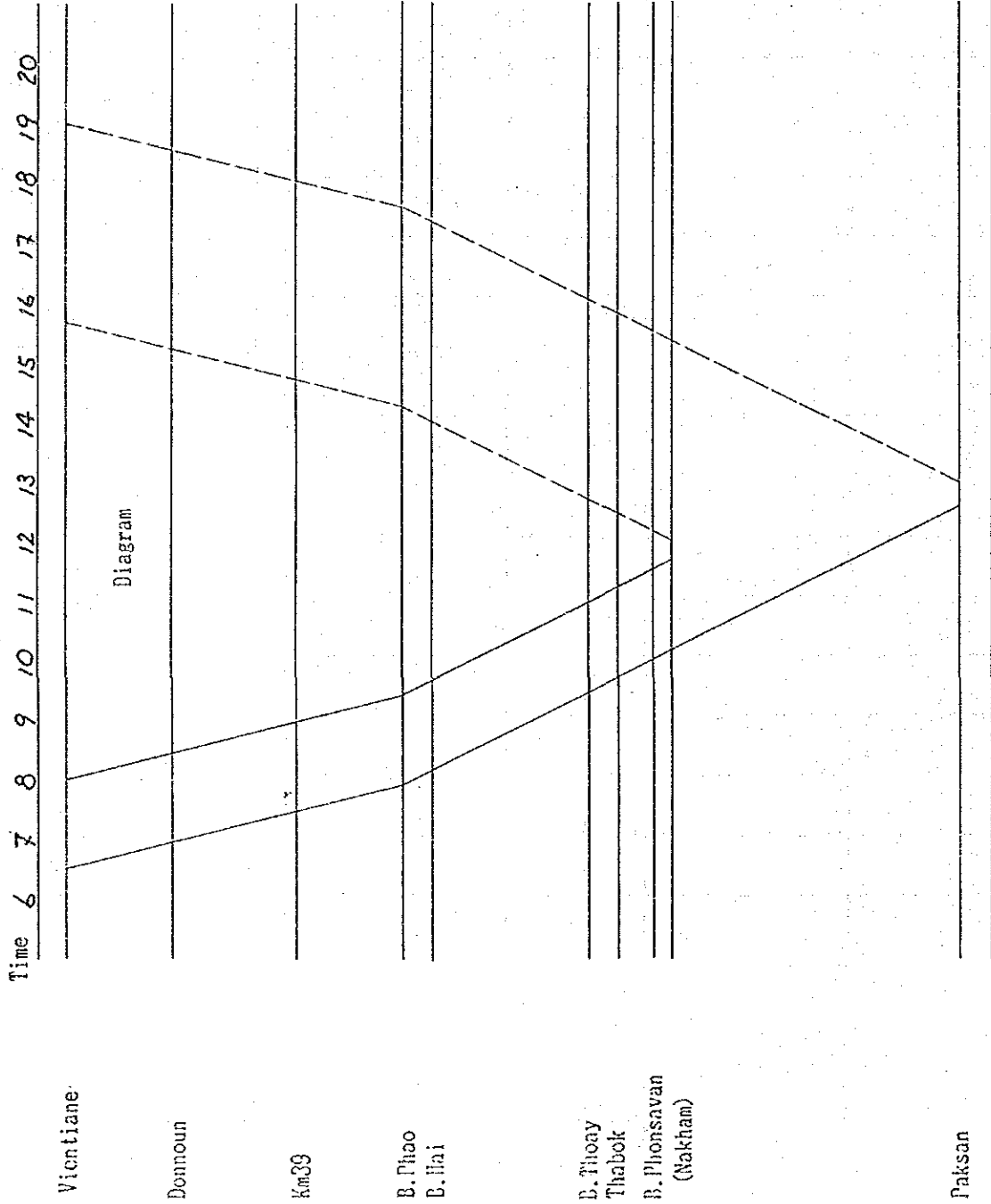
B. Hinheup

B. Done

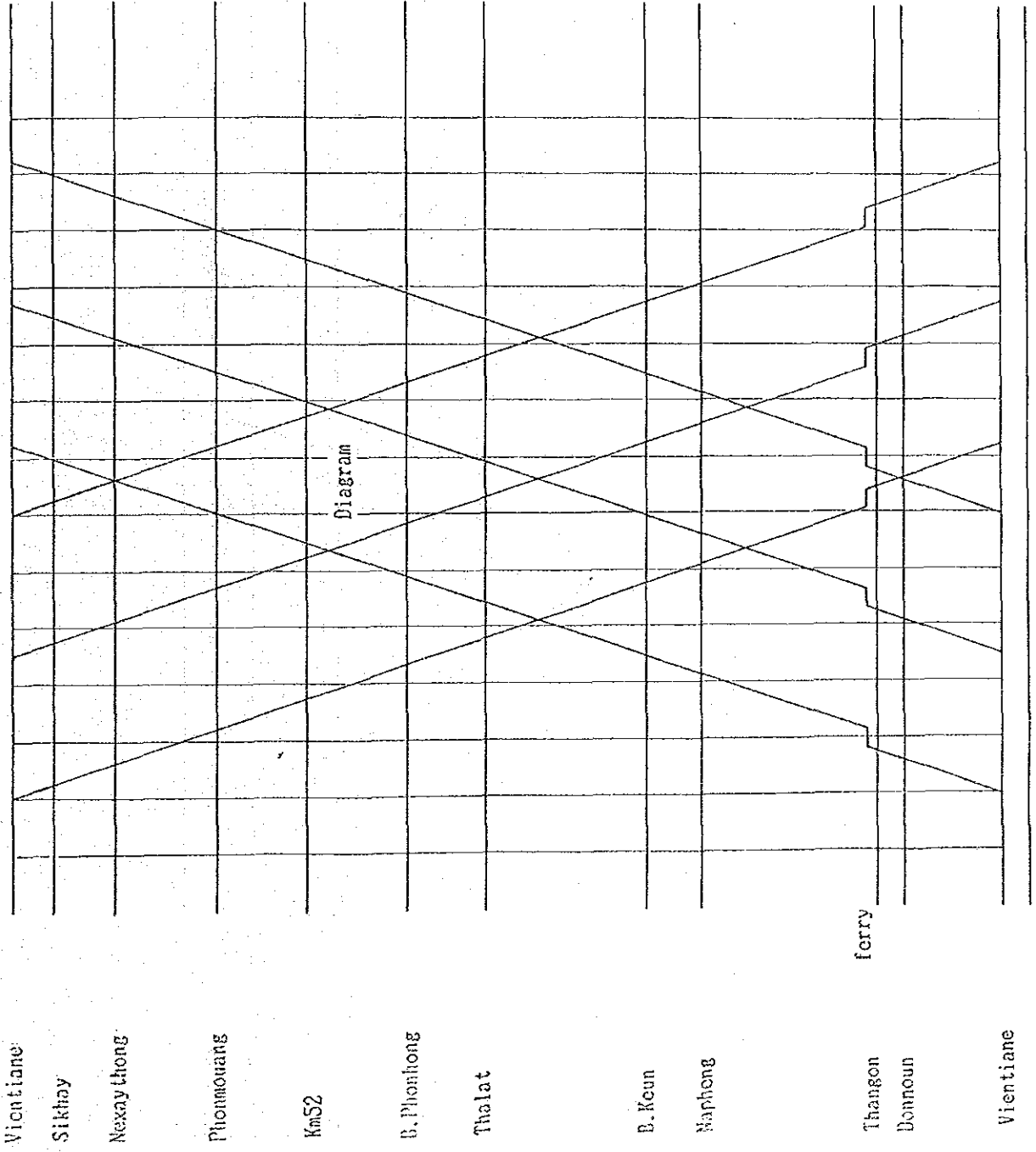
$V_B = 40 \text{ Km/hr}$

$V_L = 20 \text{ Km/hr}$

Number of Bus : 1



Time 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

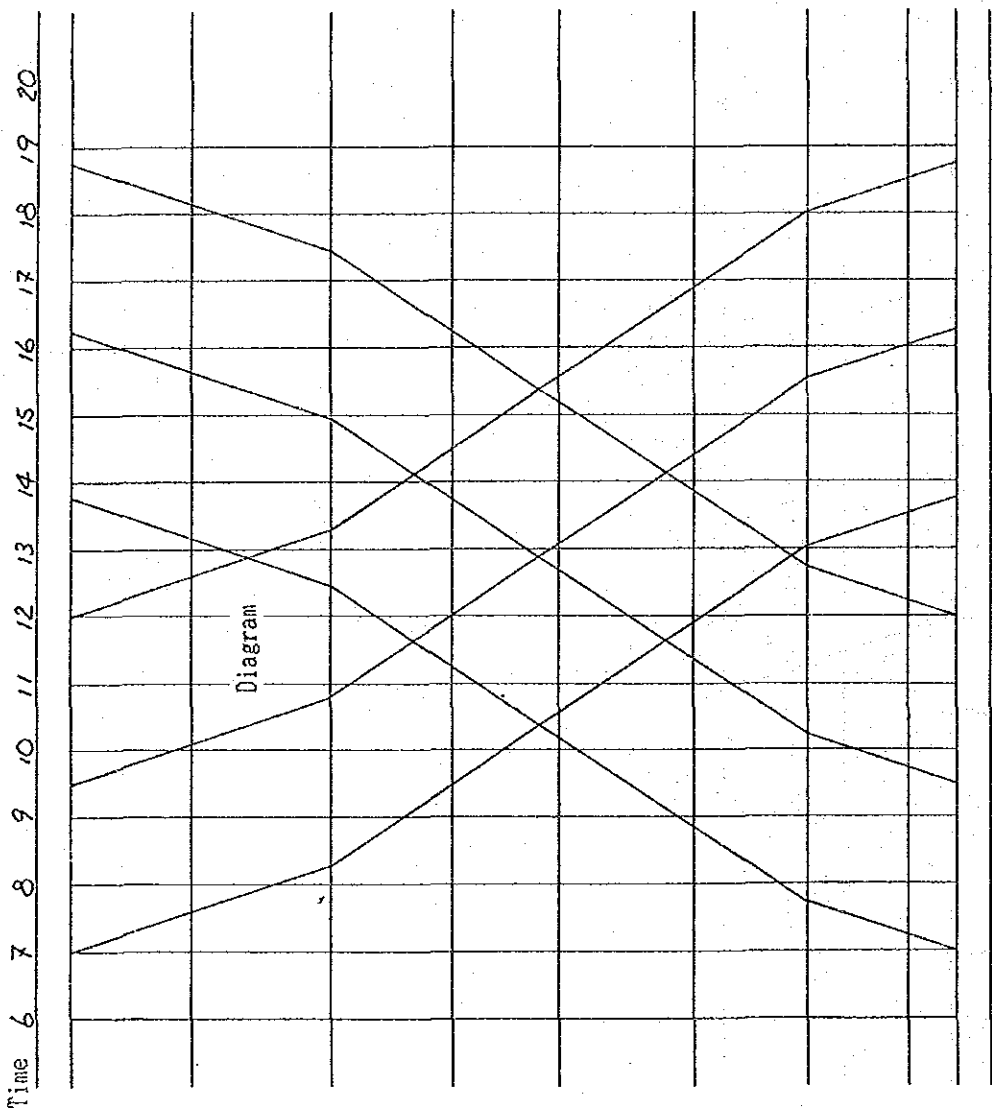


$V_B = 30 \text{ Km/hr}$

$V_L = 15 \text{ Km/hr}$

Number of Buses : 6 , (3+3)





$V_2 = 30 \text{ Km/hr}$

$V_1 = 15 \text{ Km/hr}$

Number of Buses : 6 , (3+3)

Vientiane

Donnoun.

Km39 (Lak-Samsip)

B. Phao

B. Don

Simmano

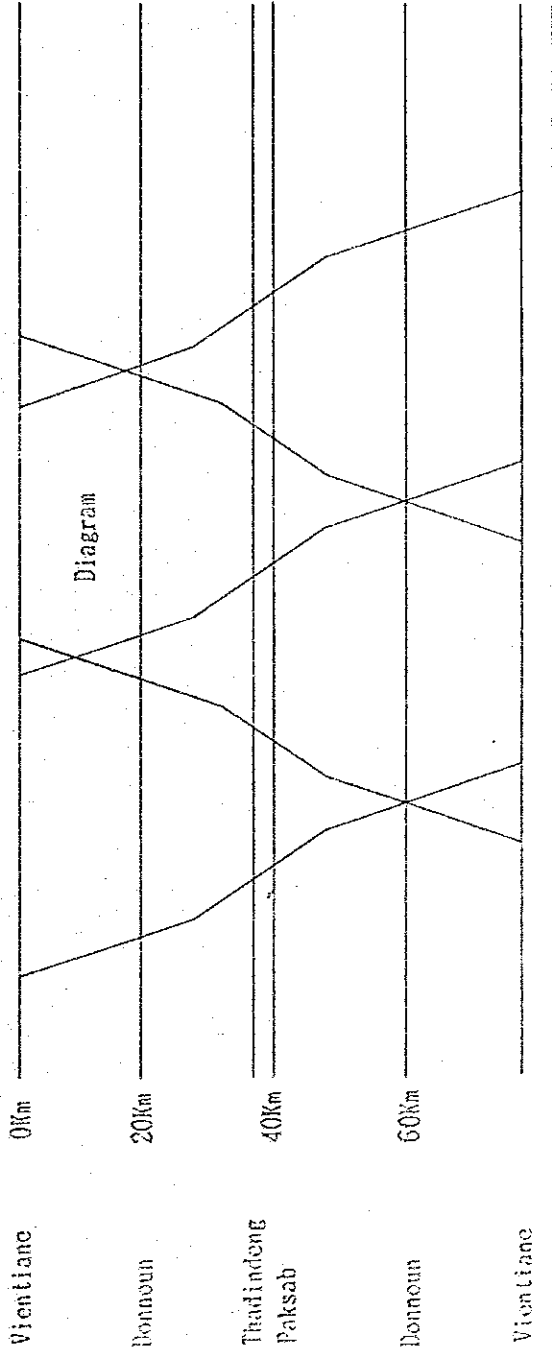
Thadua

Chinaimo

Vientiane

Time 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Time 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

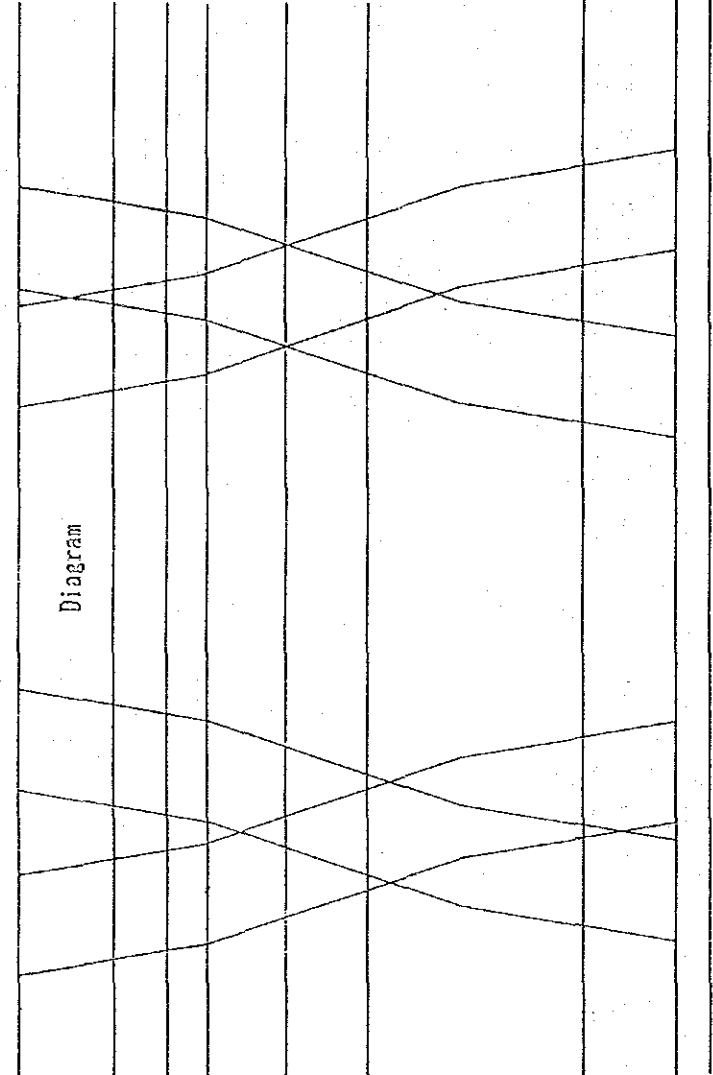


$$V_D = 30 \text{ km/hr}$$

$$V_L = 15 \text{ km/hr}$$

Number of Buses : 2, (1+1)

Time 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20



Vientiane

Chinaimo

Bo.0

Haikokiteo

B.Hom

Si than-Tai

Chinaimo

Vientiane

$V_b = 30 \text{ Km/hr}$

$V_t = 15 \text{ Km/hr}$

Number of Buses : 4 , (2+2)

Time 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Vientiane

Vientiane ~ Km52

$V = 40 \text{ Km/hr}$

$V_B = 30 \text{ Km/hr}$

$V_L = 15 \text{ Km/hr}$

Number of Bus : 1

Diagram

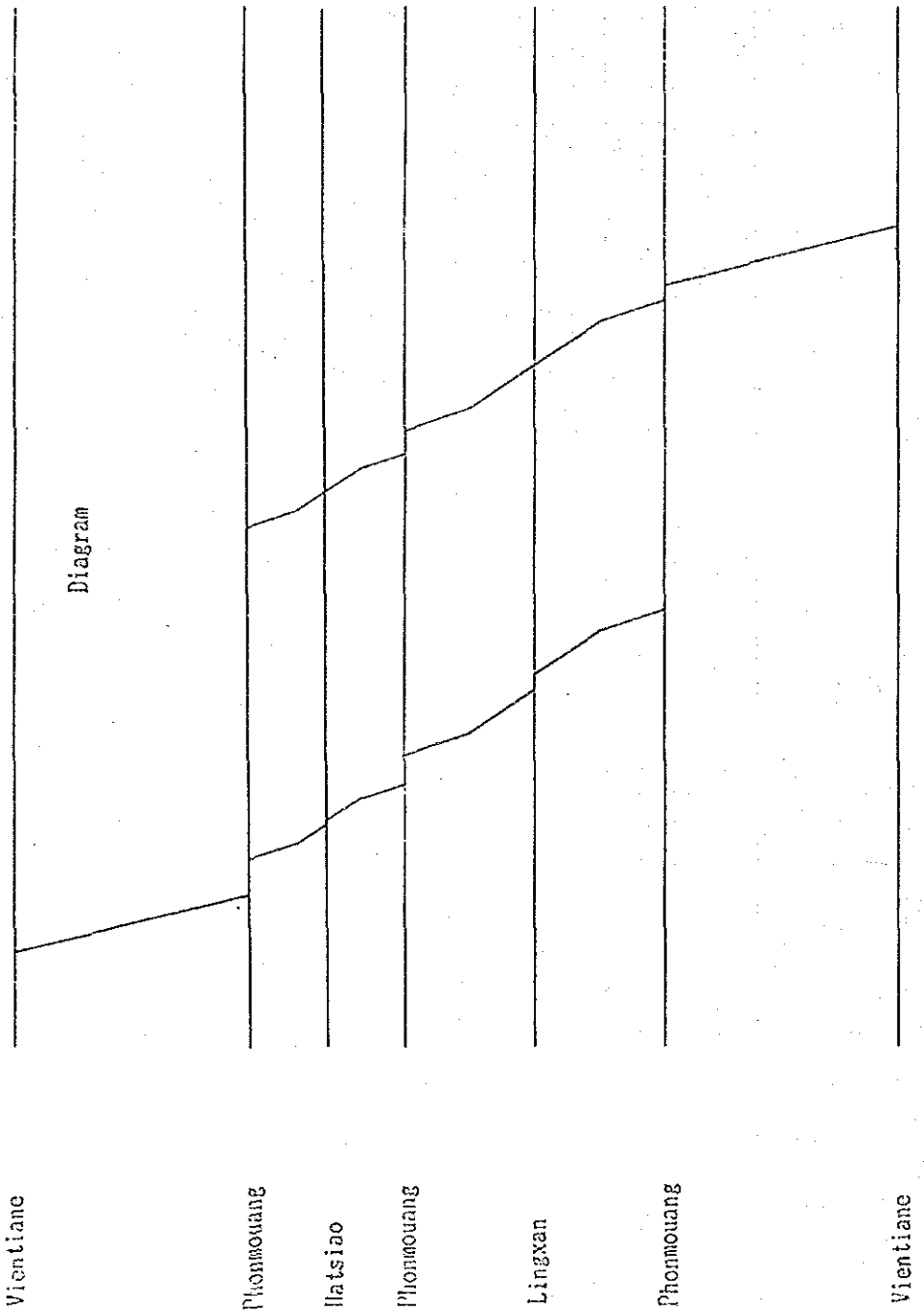
Km52

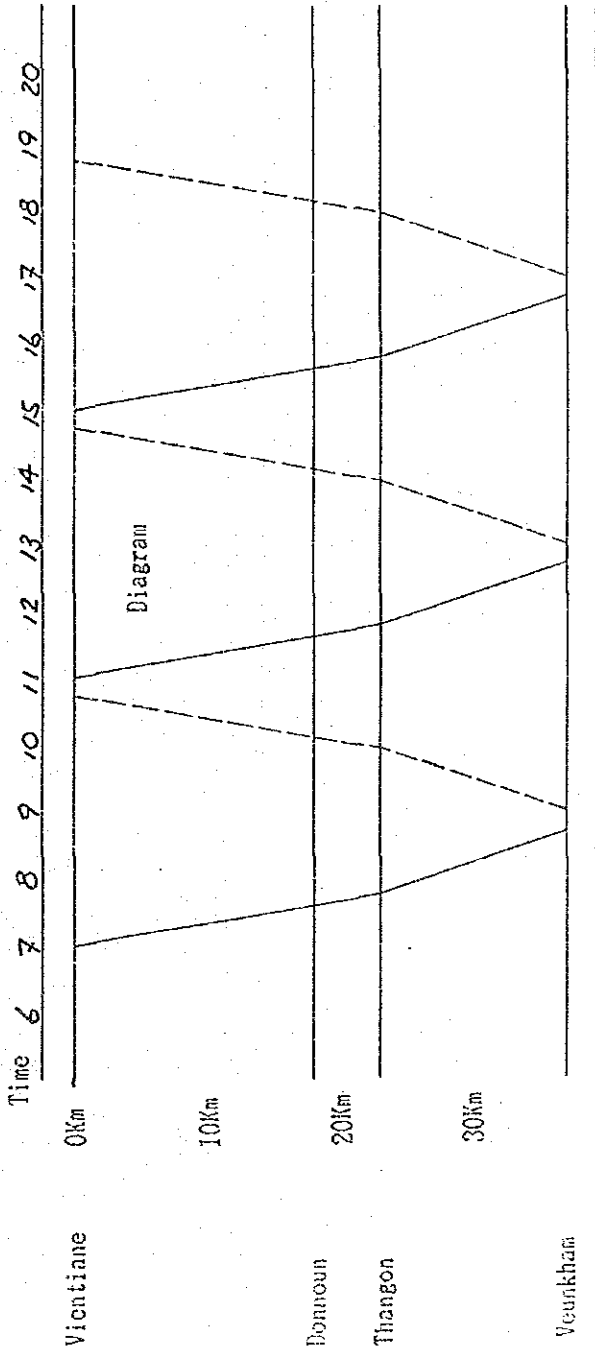
Paicheng

Km52

Vientiane

Time 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

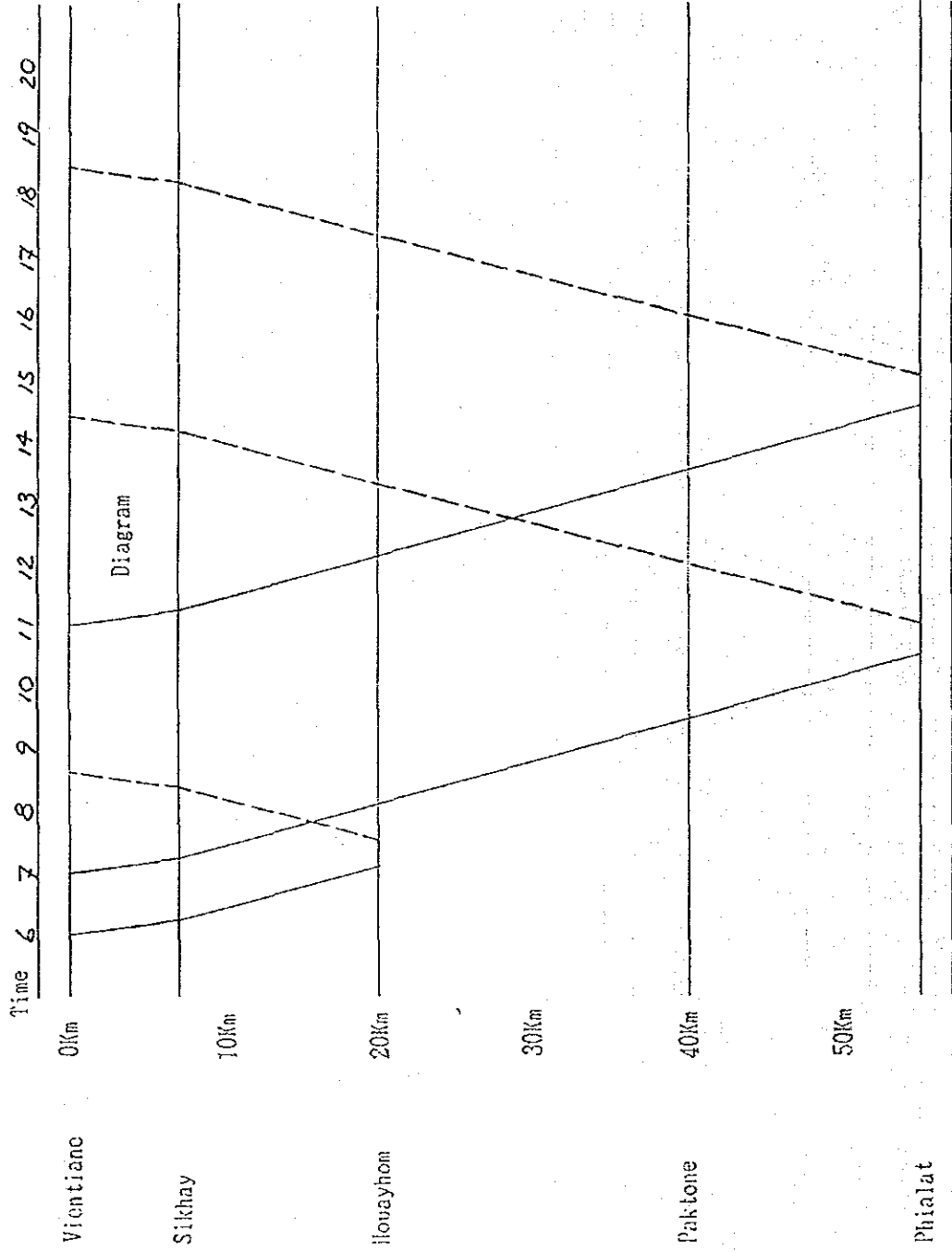


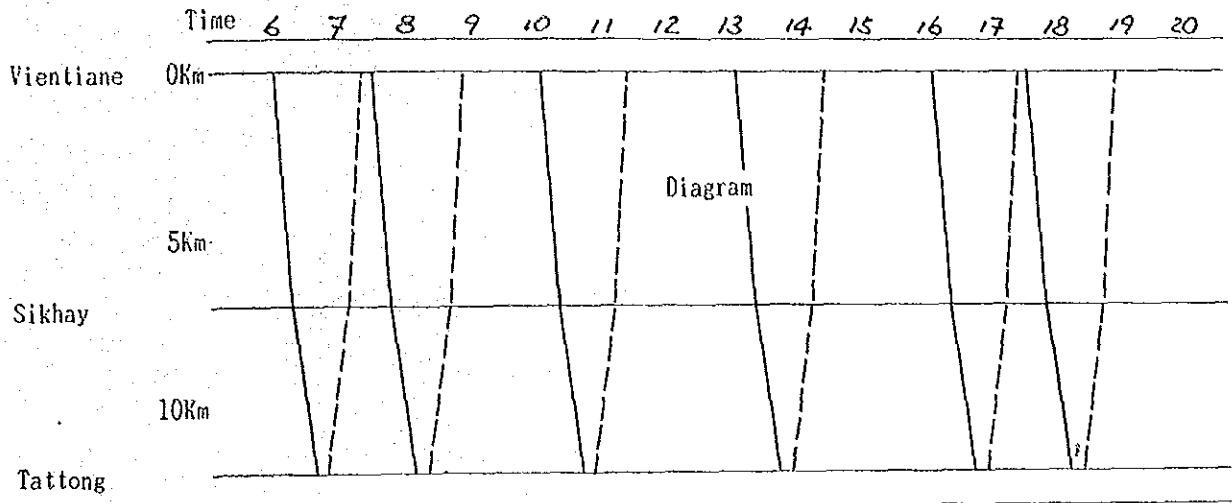


$V_g = 30 \text{ Km/hr}$

$V_L = 15 \text{ Km/hr}$

Number of Bus : 1

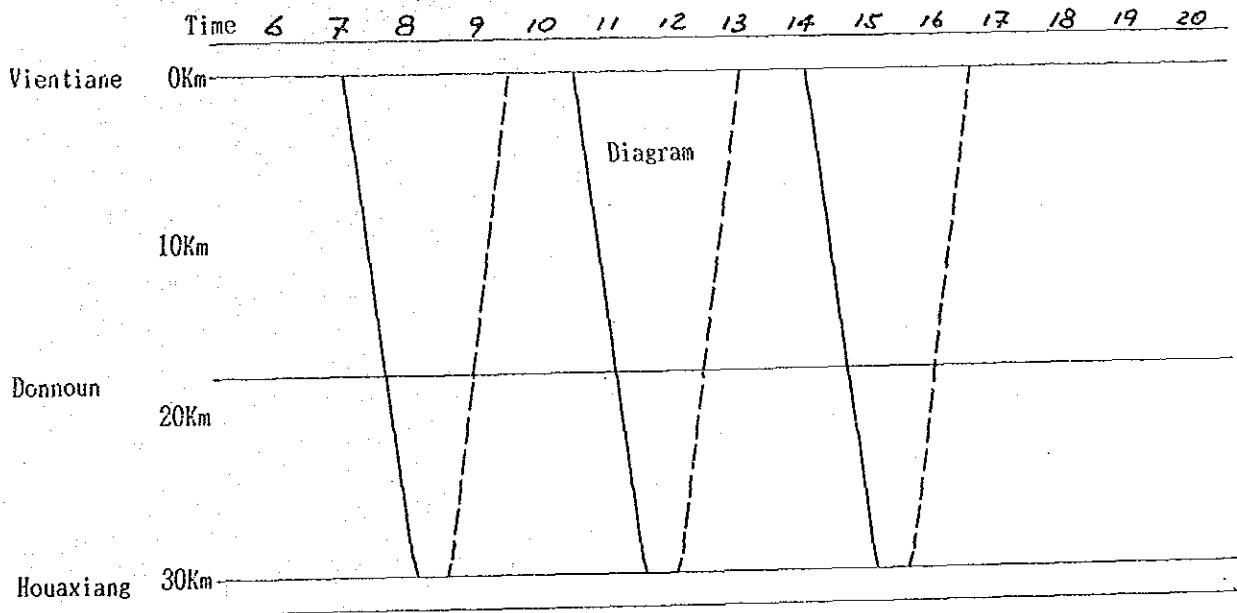




$$V_B = 30 \text{ Km/hr}$$

$$V_L = 15 \text{ Km/hr}$$

Number of Bus : 1



$$V_B = 30 \text{ Km/hr}$$

$$V_L = 15 \text{ Km/hr}$$

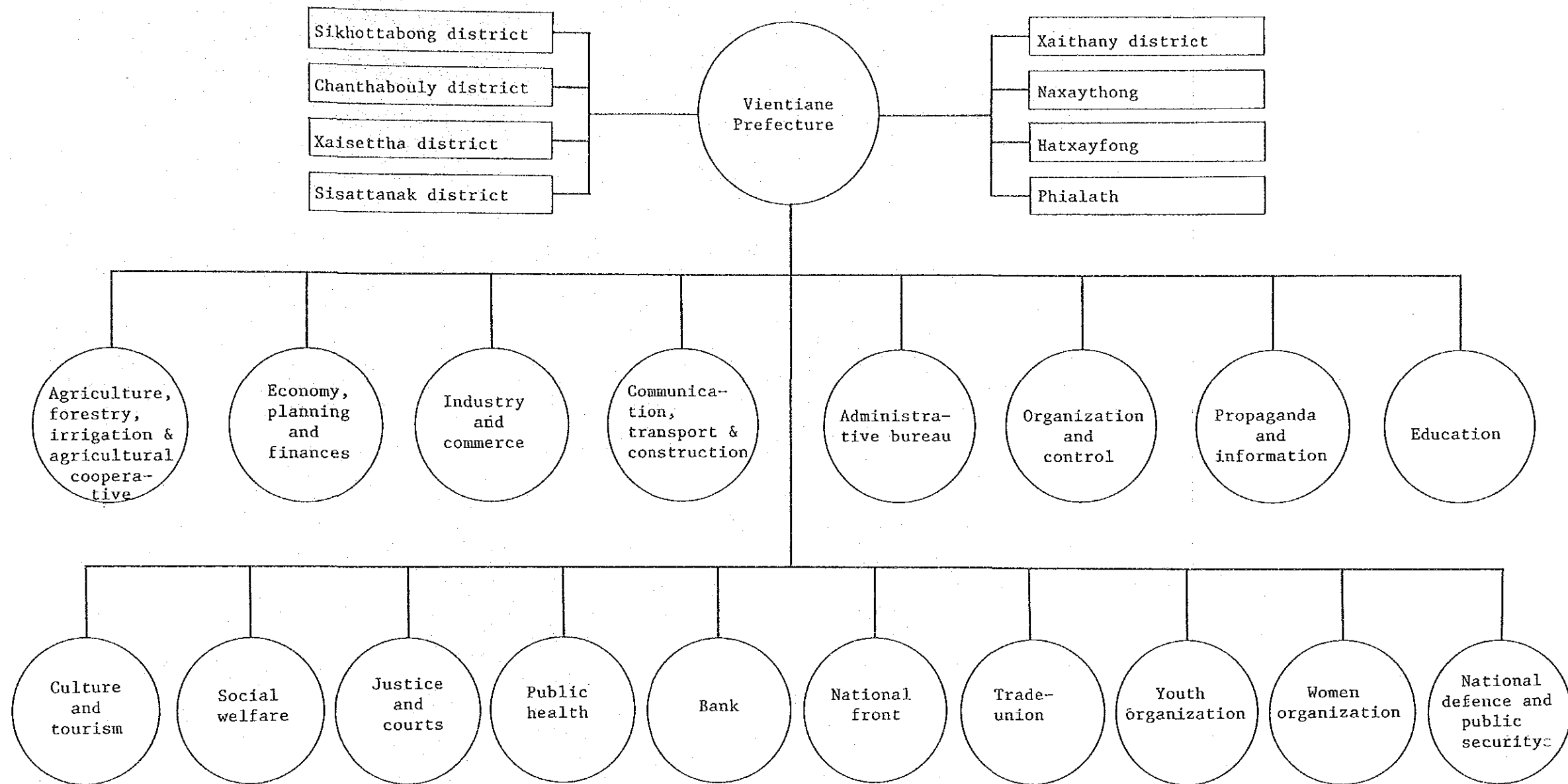
Number of Bus : 1





4. List of Collected Data and Reference

(1) Organization Chart of Vientiane Municipality



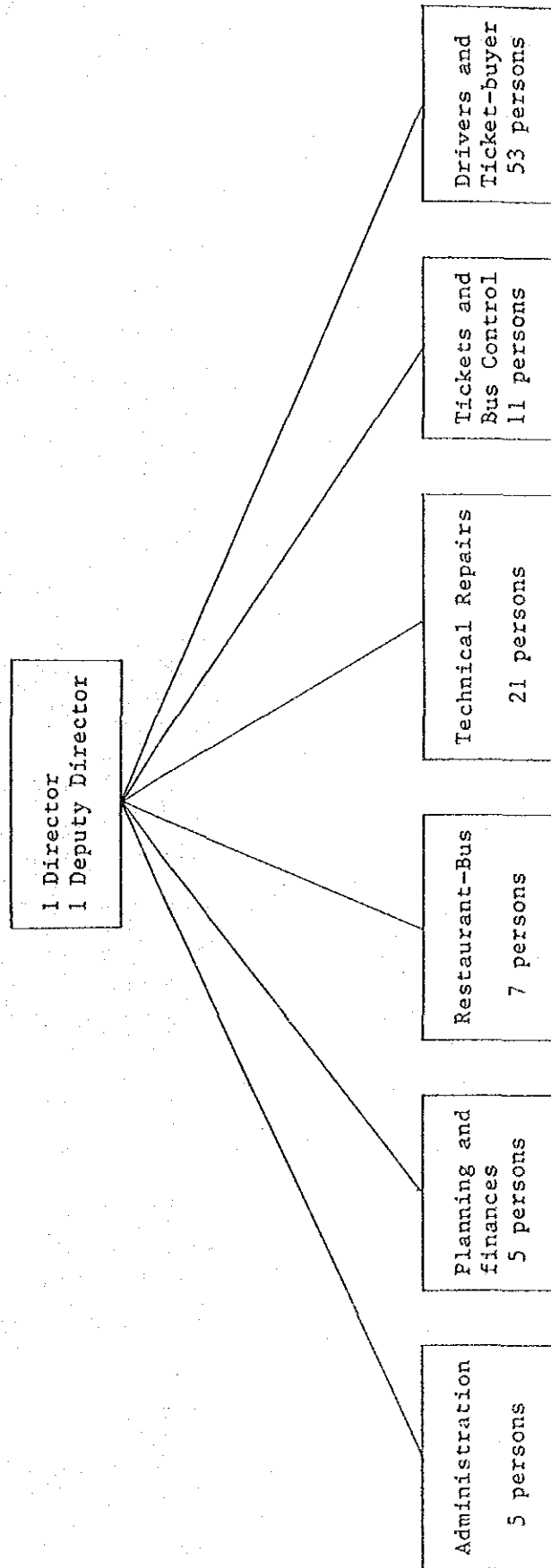
Population of 1988: 416,000 (Total)

Population of the 4 control districts: 150,000



(2) Organization Chart of Prefecture Bus Company

ORGANIZATION OF THE SOCIETY OF BUS 1988



Remarks: Total number of employees 104 persons including 13 women.



(3) Table of Population Within the Administration of Vientiane Municipality

No.	Names of District	Superficies (ha)	Populations																Density persons/hectare	
			1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	1985	2000
A.	<u>Sisattanak</u>																			
I.	<u>Tassèng Phiawat</u>																			
1	Ban Phiawat	12.1	924	951	979	1007	1036	1066	1097	1129	1162	1196	1231	1267	1304	1342	1381	1421	76	117
2	Ban Kaognot	18.4	1392	1446	1502	1561	1622	1685	1752	1819	1890	1964	2041	2121	2204	2290	2370	2472	76	134
3	Ban Simuong	11.5	1659	1707	1757	1808	1860	1914	1970	2027	2086	2146	2208	2272	2338	2406	2476	2548	144	222
4	Ban Nongchanh	31.6	2588	2663	2470	2819	2901	2985	3072	3161	3253	3347	3444	3544	3647	3753	3862	3974	82	126
5	Ban Phonesinouane	43.5	1874	1985	2102	2226	2357	2496	2643	2799	2964	3139	3324	3520	3728	3948	4181	4428	43	102
6	Ban Saphanthong Neua	93.8	3356	3554	3764	3986	4221	4470	4734	5013	5309	5622	5954	6305	6677	7071	7488	7930	36	85
7	Ban Dongpalane Thong	10.7	1270	1307	1345	1384	1424	1465	1507	1551	1591	1542	1690	1739	1789	1841	1894	1949	68	182
8	Ban Dongpalane Tha	10.2	1356	1395	1435	1477	1520	1564	1609	1656	1704	1753	1804	1856	1910	1965	2022	2081	133	204
II.	<u>Tassèng Thatkao</u>																			
9	Ban Thatkao	11.3	1264	1301	1339	1378	1418	1459	1501	1545	1590	1636	1683	1732	1782	1834	1887	1842	112	172
10	Ban Phapho	13.8	982	1020	1060	1101	1144	1189	1235	1283	1333	1385	1439	1495	1553	1614	1677	1742	71	126
11	Ban Phasay	7.2	1007	1036	1066	1097	1129	1162	1196	1231	1267	1304	1342	1381	1421	1462	1504	1548	140	215
12	Ban Phonesavanh	30.1	2185	2292	2404	2522	2646	2776	2912	3055	3205	3362	3527	3700	3881	4071	4270	4479	73	419
13	Ban Bungkhagnong Neua	11.9	957	985	1014	1043	1073	1104	1136	1169	1203	1238	1274	1311	1349	1388	1428	1469	80	123
14	Ban Bungkhagnong Tay	17.7	1139	1183	1229	1277	1327	1379	1433	1489	1547	1607	1670	1735	1803	1873	1946	2022	64	114
III.	<u>Tassèng Watsob</u>																			
15	Ban Watsob	14.0	577	594	611	629	647	666	685	705	725	746	768	790	813	837	869	886	41	63
16	Ban Phoxay	16.4	674	694	714	735	756	778	801	824	848	873	898	924	951	979	1007	1036	47	63
17	Ban Souanemone	17.9	957	985	1014	1043	1073	1104	1136	1169	1203	1238	1274	1311	1349	1388	1428	1469	53	82
IV.	<u>Tassèng Chomchèng</u>																			
18	Ban Chom Chèng	16.7	774	796	819	843	867	892	918	945	972	1000	1029	1059	1090	1122	1155	1188	46	71
19	Ban Khokninh	11.5	676	696	716	737	758	780	803	826	850	875	900	926	953	981	1009	1038	99	90
20	Ban Saysathane	15.6	820	844	868	893	919	946	973	1001	1030	1060	1091	1123	1156	1190	1225	1261	53	83
B.	<u>Chanthaboury</u>																			
I.	<u>T. Sisavath</u>																			
21	Ban Sisavath	44.8	4210	4332	4458	4587	4720	4857	4998	5143	5292	5445	5603	5765	5932	6104	6281	6463	94	144
22	Ban Hatsady	36.0	2374	2443	2514	2587	2662	2739	2818	2900	2984	3071	3160	3252	3346	3443	3543	3646	67	101
23	Ban Saylom	8.7	1014	1043	1073	1104	1136	1465	1507	1551	1596	1642	1690	1739	1789	1841	1894	1949	117	224
24	Ban Sidamdouane	23.0	1433	1489	1547	1607	1670	1735	1803	1873	1946	2022	2101	2183	2268	2356	2448	2543	62	111
25	Ban Sibounheuang	42.9	1513	1602	1697	1797	1903	2015	2134	2260	2393	2534	2684	2842	3010	3188	3376	3575	35	83
II.	<u>T. Phonethong</u>																			
26	Ban Savang	45.8	1512	1601	1695	1795	1901	2013	2132	2258	2391	2532	2681	2835	3007	3184	3372	3571	33	78
27	Ban Thongsangnang	48.4	1602	1697	1797	1903	2015	2134	2260	2393	2534	2684	2842	3010	3188	3376	3575	3786	33	78
28	Ban Dongmieng	29.4	1862	1953	2049	2149	2254	2364	2480	2602	2729	2863	3003	3150	3304	3466	3636	3814	63	130
III.	<u>T. Thongtoun</u>																			
29	Ban Thongtoun	24.6	1704	1757	1875	1967	2063	2164	2270	2381	2498	2620	2748	2883	3024	3172	3327	3490	69	142
30	Ban Thongkhankham	30.1	2534	2607	2683	2761	2841	2923	3008	3095	3185	3277	3372	3470	3571	3675	3782	3892	81	129
IV.	<u>T. Watehanh</u>																			
31	Ban Watchanh Tha	21.4	2814	2896	2980	3066	3155	3246	3340	3437	4434	4563	4695	4831	4971	5115	5263	5416	132	253
32	Ban Watchanh Thong	10.4	1630	1677	1726	1776	1828	1881	1936	1992	2050	2109	2170	2233	2298	2365	2434	2505	157	241
33	Ban Yienggnune	48.3	3428	3527	3629	3734	3842	3933	4068	4186	4307	4432	4561	4693	4829	4969	5113	5261	71	109
34	Ban Mixay	13.2	1488	1531	1575	1621	1668	1716	1766	1817	1870	1924	1980	2037	2096	2157	2220	2284	113	173
35	Ban Khoualouang Neua	11.1	2200	2264	2330	2398	2468	2540	2614	2690	2768	2848	2931	3016	3103	3193	3286	3389	198	305
36	Ban Khoualouang Tay	13.3	2102	2163	2226	2291	2357	2425	2495	2567	2641	2718	2797	2878	2961	3047	3135	3226	158	243
37	Ban Sihom	17.2	1875	1929	1985	2043	2102	2163	2226	2291	2357	2425	2495	2567	2641	2718	2797	2878	109	167

No.	Names of District	Superficies (ha)	Populations																Density persons/hectare	
			1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	1985	2000
C.	<u>Saysetha</u>																			
I.	<u>Tassèng Phonexay</u>																			
38	Ban Fay	20.9	1664	1729	1796	1866	1939	2015	2094	2176	2261	2349	2441	2536	2635	2738	2845	2956	80	141
39	Ban Naxay	46.8	2035	2155	2282	2417	2560	2711	2871	3040	3219	3409	3610	3823	4049	4288	4551	4809	43	103
40	Ban Phonexay	55.1	2249	2359	2475	2596	2723	2856	2996	3143	3297	3459	3628	3906	3992	4188	4393	4608	41	84
II.	<u>T. Thatluang</u>																			
41	Ban Thatluang Neua	37.8	1833	1923	2017	2116	2220	2329	2443	2563	2689	2821	2959	3104	3256	3416	3583	3759	48	99
42	Ban Thatluang Kang	18.5	1804	1856	1910	1965	2022	2081	2141	2203	2267	2333	2401	2471	2543	2617	2693	2771	98	150
43	Ban Thatluang Tay	43.7	2466	2587	2714	2847	2987	3133	3287	3448	3617	3794	3980	4175	4380	4595	4820	5056	56	116
44	Ban Sisangvone	32.5	1418	1459	1501	1545	1590	1636	1683	1732	1782	1834	1887	1942	1998	2056	2116	2177	44	67
III.	<u>T. Nongbone</u>																			
45	Ban Nongbone	54.3	2626	2702	2780	2861	2944	3029	3117	3207	3300	3396	3494	3595	3699	3806	3916	4030	48	74
46	Ban Phonesath	27.0	1311	1349	1388	1428	1469	1512	1556	1601	1647	1695	1744	1795	1847	1901	1956	2013	49	75
47	Ban Nongsangtho	25.6	1115	1147	1180	1214	1249	1285	1322	1360	1399	1440	1482	1525	1569	1615	1662	1710	44	67
48	Ban Phonekhèng	53.6	2228	2337	2452	2572	2698	2830	2969	3114	3267	3427	3595	3771	3956	4150	4353	4566	42	85
D.	<u>Sikhottabong</u>																			
I.	<u>Tassèng Sikhay</u>																			
49	Ban Sikhay Thong	7.5	1838	1891	1946	2002	2060	2120	2181	2244	2309	2376	2445	2516	2589	2664	2741	2820	245	376
50	Ban Sikhay Tha	9.3	1463	1505	1549	1594	1640	1688	1737	1787	1839	1892	1947	2003	2061	2121	2183	2246	157	242
51	Ban Muengva Thong	10.5	1607	1654	1702	1751	1802	1854	1908	1963	2020	2079	2139	2201	2265	2331	2399	2469	153	235
52	Ban Muengva Tha	6.2	805	828	852	877	902	928	955	983	1012	1041	1071	1102	1134	1167	1201	1236	130	199
55	Ban Sibounheuang	40.7	1957	2053	2154	2260	2371	2487	2609	2737	2871	3012	3160	3315	3477	3647	3826	4013	48	99
II.	<u>T. Nongdouang</u>																			
54	Ban Nongdouang Neua	25.8	1207	1266	1328	1393	1461	1533	1608	1687	1770	1857	1948	2043	2143	2248	2358	2474	47	96
55	Ban Nongdouang Tay	74.3	2493	2640	2796	2961	3136	3321	3517	3725	3945	4178	4425	4686	4962	5255	5565	5893	34	79
III.	<u>T. Sithane Neua</u>																			
56	Ban Akhat	19.0	1388	1428	1469	1512	1556	1601	1647	1695	1744	1795	1847	1901	1956	2013	2071	2131	73	112
57	Ban Wattay Gnay	29.6	1722	1806	1894	1987	2084	2186	2293	2405	2523	2647	2777	2913	3056	3206	3363	3528	58	119
58	Ban Wattay Noy	75.5	2566	2717	2877	3047	3227	3417	3619	3833	4059	4298	4552	4821	5105	5406	5725	6063	34	80
59	Ban Nongpanay	9.3	1050	1080	1111	1143	1176	1210	1245	1281	1318	1356	1395	1435	1477	1520	1564	1609	113	173
60	Ban Oubmoung	11.1	905	931	958	986	1015	1044	1074	1105	1137	1170	1204	1239	1275	1312	1350	1389	82	125
61	Ban Nakham	40.6	1797	1903	2015	2134	2260	2393	2534	2684	2842	3010	3188	3376	3575	3786	4009	4246	44	105
62	Ban Khounta	33.4	1826	1897	1971	2048	2128	2211	2297	2387	2480	2577	2678	2782	2890	2977	3093	3214	55	96
63	Ban Sithane Neua	32.9	2473	2545	2619	2695	2773	2853	2936	3021	3109	3199	3292	3387	3485	3586	3690	3797	75	115
TOTAL			107,572																194,596	

## (4) Balance Sheet (1976-1985) of Prefecture Bus Company

Vientiane Prefecture  
Service of Communication, Transport and Port  
Society of Transport by Bus

Lao People's Democratic Republic  
Peace, Independence, Unity, Socialism

No.60/Bus

Balance of the Past 10 Years  
Calculated by Bank Kip

Order	Content	Unit	Year 1976	Year 1977	Year 1978	Year 1979	Year 1980	Year 1981	Year 1982	Year 1983	Year 1984	Year 1985
I.	<u>Total of Volume of Activities</u>											
1	Number of passengers	persons	41,336	135,861	3,878,096	2,246,453	5,078,318	3,465,647	2,946,782	2,981,401	2,665,283	2,196,697
2	Volume of traffic	person/km	323,174	1,073,302	31,024,767	22,356,792	47,880,562	44,457,888	77,794,727	74,472,620	79,652,521	81,716,339
3	Number of kilometers	km	40,589	49,316	496,032	365,811	1,431,148	1,316,456	1,475,091	1,536,358	1,506,050	1,457,158
4	Number of times running	times	2,194	3,189	20,332	20,680	48,294	32,574	34,636	33,976	25,881	20,361
II.	<u>Total of the Expenditures</u>				635,880.25	639,772.50	5,415,658.52	7,368,583.37	18,505,209.06	19,691,292.24	19,802,039	40,023,154
1	Gasoline and oil				315,833.40	222,700.87	1,798,541.01	2,480,522.77	7,524,007.79	7,821,563.50	7,354,748.80	15,236,524.55
2	Repairs accessories of tyre	Kip			67,857.68	92,852.44	887,418.72	635,062.49	2,244,055.44	2,518,683.03	3,682,605.42	7,872,163.28
3	Administration				47,364.13	102,246.67	669,615.14	671,875.60	650,254.20	1,581,879.40	1,773,472.92	3,307,584.89
4	Basic sinking fund				49,427.04	60,315.47	890,040.50	1,106,721.76	3,005,113.29	3,144,419.78	2,545,370.29	5,618,344.00
5	Repairs sinking fund				24,713.52	15,318.75	501,484.08	1,452,981.68	3,260,956.04	1,570,184.98	1,397,996.89	2,900,862.00
6	Labor and salary				106,908.29	112,455.44	383,443.37	640,039.33	971,814.74	2,076,647.95	2,000,871.32	3,798,288.68
	Social insurance											178,713.80
	Social welfare											178,712.80
III.	<u>Total of Custom</u>	Kip			23,776.19	33,882.86	285,115.70	381,379.74	850,007.56	977,813.60	1,046,973.36	931,958.00
1	Income tax	Kip			22,191.39	31,519.02	205,224.51	354,771.54	790,714.60	908,908.80	973,938.06	862,061.00
	Business tax	Kip			1,584.80	2,363.84	79,891.19	26,608.20	59,292.96	68,904.80	73,035.30	69,897.00
IV.	<u>Total of Receipts</u>				554,784.72	787,976.30	6,630,614.64	8,869,298.22	19,767,878.22	22,722,799.00	24,348,487.52	47,918,587.00
V.	<u>Total of Benefit</u>	Kip				148,203.80	1,214,056.13	1,400,705.53	1,261,631.16	3,031,519.56	4,546,448.38	7,895,437.00
	<u>Total of Deficit</u>				81,096.53							
VI.	<u>Total Expenditure to State Budget</u>				97,916.82	242,602.88	2,613,145.02	2,022,202.80	4,537,984.84	5,905,944.62	5,894,966.32	5,883,654.67
VII.	<u>Total of Money kept in the Bank by the Society</u> The society should receive .....	Kip					77,957.31	966,603.20	578,976.16	1,247,811.02	2,243,795.70	4,724,812.33
VIII.	<u>Total of Capital</u>	Kip			10,213,828.74	10,096,263.93	11,576,629.73	10,899,533.62	16,095,680.30	30,648,447.86	28,371,046.54	36,630,386.37
	Total of fixed capital	Kip			9,830,137.66	9,780,710.62	8,890,670.00	7,783,948.36	6,327,617.07	20,308,101.33	17,333,692.32	13,521,698.54
	Total of floating capital	Kip			383,691.08	315,553.31	2,685,969.73	3,115,585.26	9,768,063.23	10,340,346.53	11,037,354.22	23,108,787.83
IX.	<u>Percentage of Productive Employees</u>	Kip	45	64	95	186	204	166	164	145	145	158
	Direct productive employees		33	50	76	151	160	130	133	111	111	126
	Indirect productive employees		12	16	19	35	44	36	31	34	34	32

Calculator

Statistics and Finances

Vientiane, February 5, 1988



DATA OF 10 YEARS

Order	Transport Data	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Units
1	Number of good vehicles	11	16	22	25	26	29	29	29	29	31	Vehicles
2	Vehicle planned to be used	11	16	22	25	26	29	29	29	29	31	Vehicles
3	Vehicle really used	8	12	16	18	19	21	19	18	17		Vehicles
4	Days of repairs of vehicles	781	1,136	1,562	2,075	2,158	2,407	3,103	3,476	3,787		Days/vehicles
5	Days of non-repairs of vehicles	3,234	4,704	6,468	7,050	7,332	8,178	7,482	7,109	6,857.50		Days
6	Days of vehicles stopped running	198	288	396	450	468	522	522	497	522		Days/vehicles
7	Days of vehicles running	3,036	4,416	6,072	6,600	6,864	7,656	6,960	6,612	6,335.50	5,592.50	Days
8	Number of times running	2,194	3,189	40,332	20,680	48,295	32,574	34,636	33,976	25,881	20,361	Times/days
9	Number of kilometers running	40,589	59,316	496,032	365,811	1,431,158	1,316,456	1,475,091	1,536,358	1,506,050	1,457,158	km
10	Number of passengers	41,336	135,861	3,878,096	2,246,553	5,078,318	3,465,697	2,946,782	2,981,401	2,665,283	2,196,697	Persons
11	Volume of persons per km	323,174	1,073,302	31,024,867	22,356,792	47,880,562	45,457,888	77,795,727	74,472,620	79,652,521	61,716,339	Persons/km
12	Kilometer having passengers	17,153	25,193	322,656	205,799	455,345	430,988	914,398	848,688	773,458	757,225	km
13	Chair kilometer	205,836	629,825	14,519,520	11,318,945	25,046,975	23,704,340	50,291,890	46,677,840	42,540,190	1,199,855	Chair/km
14	Receipts from transport			354,784.32	787,976.30	6,630,614.65	8,869,288.22	19,767,878.22	22,722,799	24,348,487.58	47,918,587	Kip
15	Days percentage of good vehicles	294	294	294	282	282	282	258	245	236		Days
16	Days percentage of vehicles running	18	12	16	18	19	21	19	18	17		Days
17	Kilometer percentage of vehicles running	18.50	18.60	29	17.60	29.60	40.40	42	45	58		km
18	Percentage of heavy use	1.61	1.00	2.13	1.97	1.91	1.91	1.54	1.59	1.87		
19	Percentage of road rise	0.42	0.42	0.54	0.56	0.31	0.32	0.61	0.35	0.51		
20	Percentage of days of good vehicles	0.80	0.80	0.80	0.77	0.77	0.77	0.70	0.67	0.64		
21	Percentage of days of vehicles running	0.75	0.75	0.75	0.72	0.72	0.78	0.65	0.62	0.59		
22	Percentage of days of vehicles repairs	0.19	0.19	0.19	0.22	0.22	0.22	0.29	0.32	0.35		



## (5) Bus Operation Diagram (1988) of Prefecture Bus Company

THE SCHEDULE

20.6.88

L/I	Bus No.	Destination	Trip	1st Trip	2nd Trip	3rd Trip	4th Trip	5th Trip
1	051	THABOK	1	7:00				
2	27, 35	THALAT	3	7:00	10:00	13:00		
3	045	SENSOUM	2	7:00	13:00			
4	041	PAKCHENE	2	7:00	13:00			
5	050	KM 52	2	7:00	13:00			
6	048	LINGSANE	2	7:00	13:00			
7	046	BANDOLN	2	7:00	13:00			
8	036	BAN HAI	2	7:00	13:00			
9	047	VEUNKHAM	3	7:00	11:00	15:00		
10	042	PAKSAB	3	7:00	11:00	15:00		
11	038	THADINDENG	3	7:00	11:00	15:00		
12	043	HOUAXIENG	3	7:00	11:00	15:00		
13	026	THADEUA	5	7:00	9:30	12:00	14:30	16:30
14	040	SITHAN	3	7:00	11:00	15:00		
15	032	THAGONE	5	7:00	9:30	12:00	14:30	16:30
16	059	DONGDOK	5	7:00	9:30	12:00	14:00	17:00





JICA