社会開発協力部報告書

[redacted]

REPORT
OF
THE FEASIBILITY STUDY
ON
THE ELECTRIFICATION OF RANGOON CIRCULAR RAILWAY LINE
IN
THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

MARCH, 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

(JICA)

PREFACE

In response to the request of the Government of the Socialist Republic of the Union of Burma, the Government of Japan decided to conduct a feasibility study on the Project for Electrification of Rangoon Circular Railway Line and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Burma a 12-man study team headed by Mr. Tatsuya Ishihara, Vice President of the Japan Railway Technical Service for one month in March and June respectively, under the guidance of the Supervisory Committee chaired by Dr. Yasuji Sekine, Professor of the University of Tokyo.

The team exchanged views on the Project with the officials concerned of the Government of Burma, including those of the Burma Railways Corporation and conducted field surveys and collected reference materials.

After the team returned to Japan, further studies were made and the present report has been prepared.

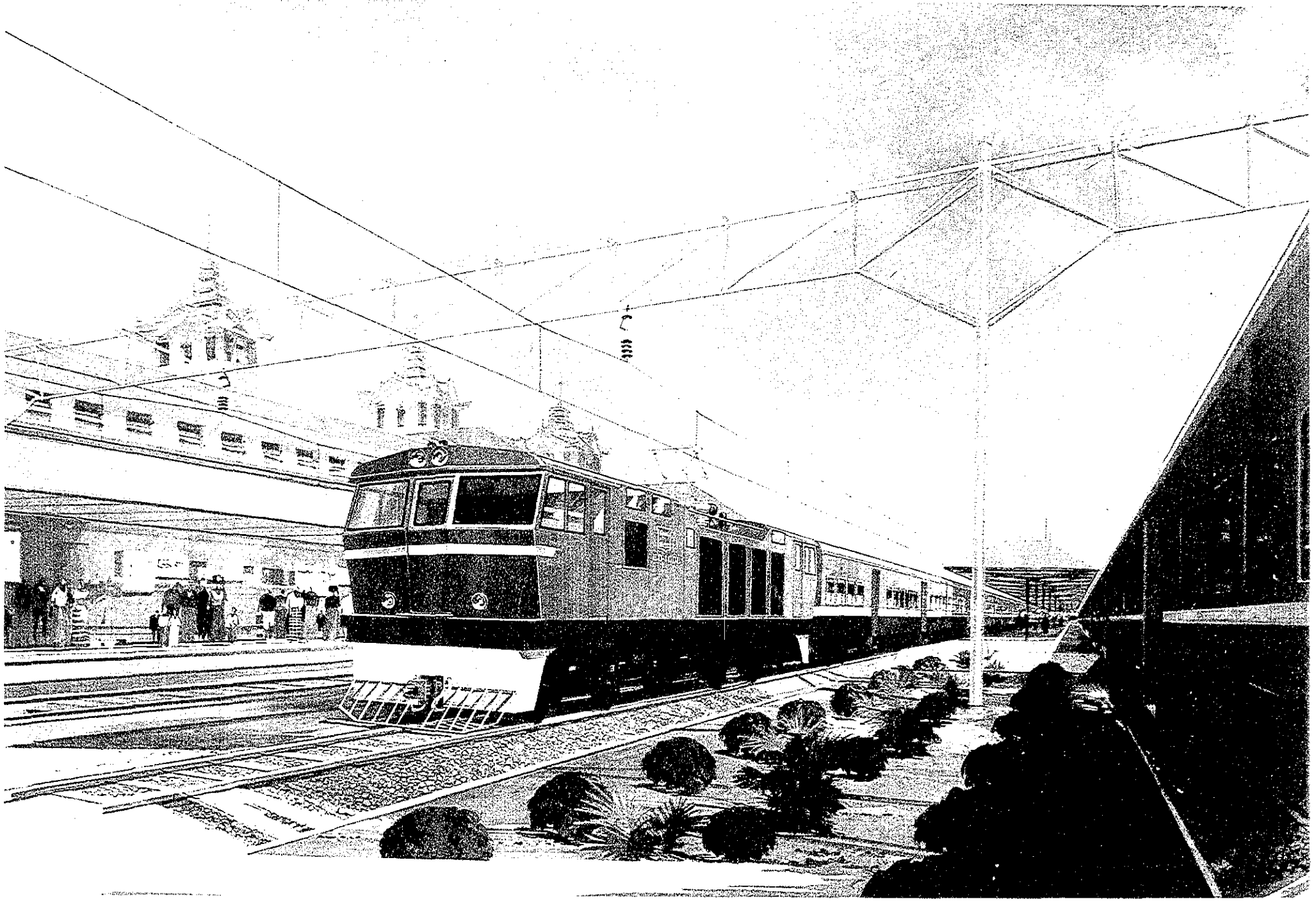
I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to all the officials concerned of the Government of the Socialist Republic of the Union of Burma for their close cooperation extended to the team.

March, 1985

Keisuke Arita

Keisuke Arita
President
Japan International
Cooperation Agency



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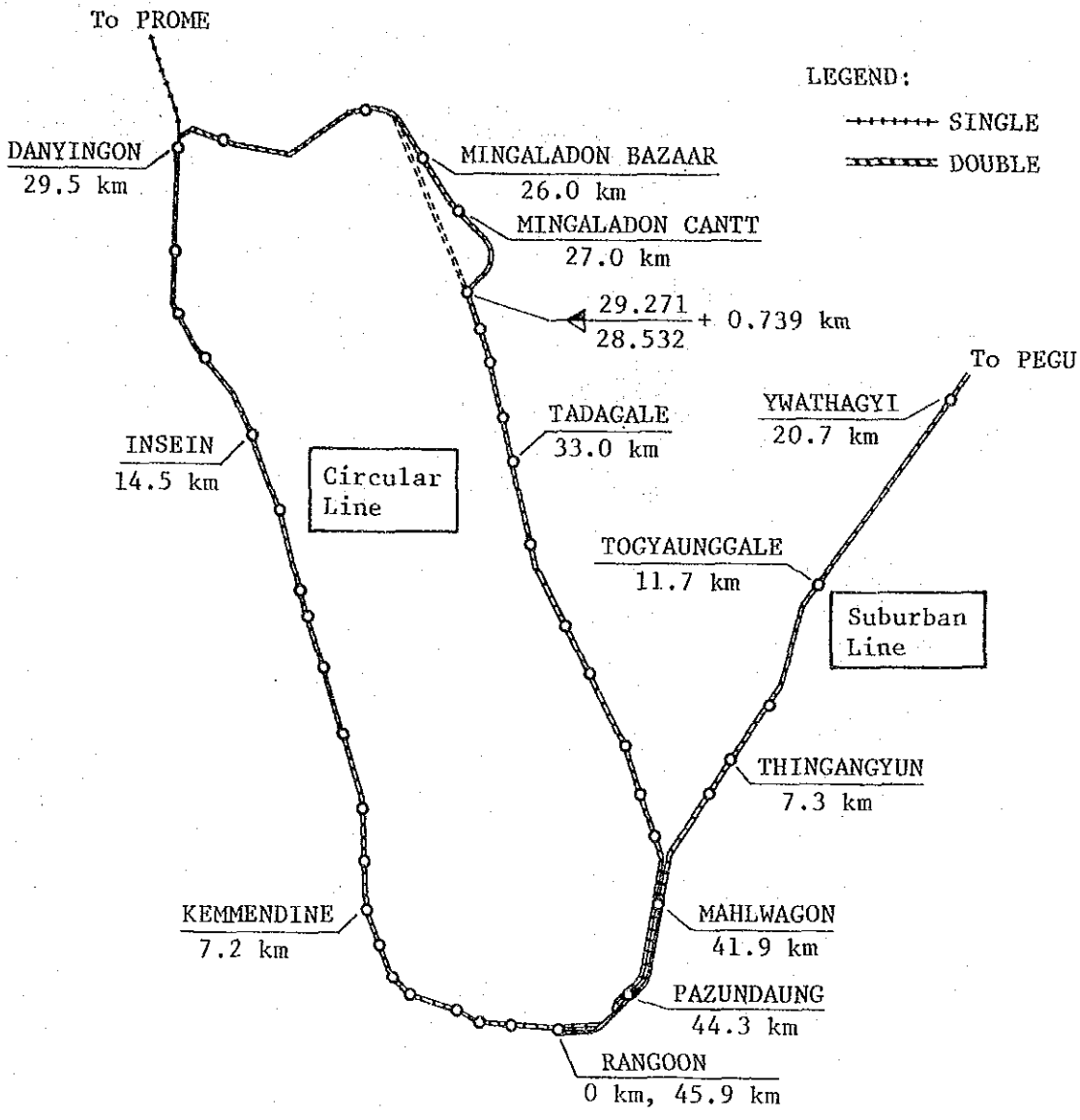
SUMMARY

1. Scope of the Study

(1) Objective

The study objective is to investigate the feasibility of the electrification project for the Circular and Suburban Lines.

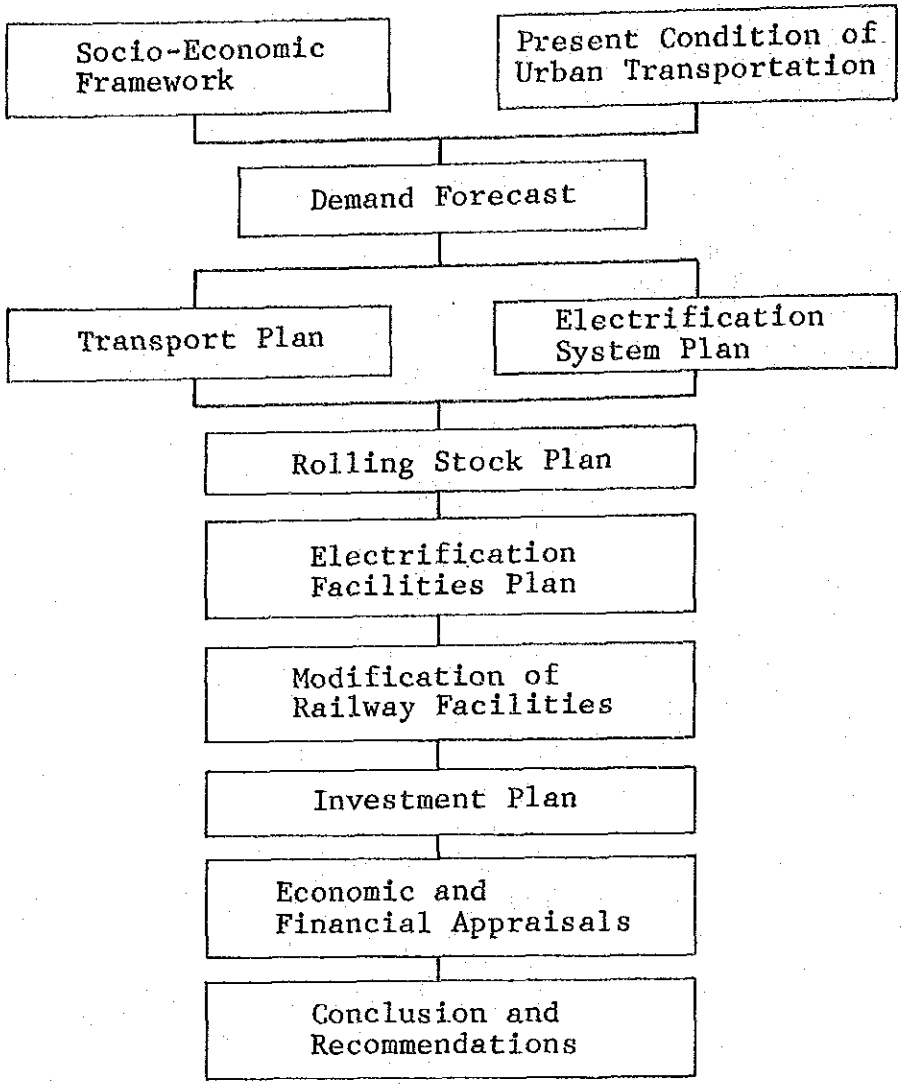
The study covers the following lines.



Circular and Suburban Lines

(2) Method

The study was conducted in the following manner. Each work element will be explained in later sections.



Study Flow

2. Socio-Economic Framework

(1) National economy

Burma has a population of 36 million (1982/83), and has had an annual growth rate of 2.2% for the past 20 years. The 1982/83 GDP was 46,945 million Kyats (equivalent to US$5,868 million) and the per capita GDP was 1,316 Kyats (equivalent to US$165) in nominal terms. The economy is greatly dependent upon agriculture, and rice cultivation in particular.

Burma has improved its economic performance through steady growth in the agricultural sector and by the rapid expansion of investment, and so the GDP growth rate has been averaging 6.4% in real terms since 1976/77. Stable prices have also encouraged this improvement.

(2) Economic plan

Burma has drawn up a Twenty-Year Plan (for 1974/75 to 1993/94) and five consecutive Four-Year Plans for which the major objectives are to double the standard of living through changes in the economic structure from an agricultural base to an agricultural-industrial one. The Plans have been successfully implemented on the whole. In addition, Burma has high potential for economic growth, and so, in accordance with the Plans, the estimation of future growth for the purpose of the study is set as follows.

Future Growth Estimation

	1983-1985	1986-1989	1990-2019
GDP Growth Rate	6.2%	7.0%	7.6%
Per Capita GDP Growth Rate	3.5%	4.6%	5.2%

(3) Energy situation

Burma is presently self-sufficient in energy, with the major energy sources being crude oil, natural gas, and hydro-electric power. Crude oil production has been constant between 10 and 11 million U.S. barrels, while the utilization of natural gas and electric power generation has rapidly increased.

The programmed consumption of oil and the utilization of natural gas and electric power are becoming important parts of the policy to maintain energy self-sufficiency.

(4) Development in Rangoon

Rangoon City belongs to the Rangoon Division and is composed of 27 townships. Its population of 2.5 million in an area of 209 square kilometres results in a population density of 11.9 thousand persons per square kilometre (1983/84).

The CBD and its adjacent townships also have high population densities as well as large numbers of employed. However, their growth rate has slowed or declined. The development policy also incorporates the dispersal of population and employment from the CBD to the suburban areas of Rangoon, with Insein, Mingaladon, Mayangon and Thingangyun being planned as areas for development.

3. Present Condition of Urban Transportation

Land transportation in Rangoon is mainly provided by railways, buses and express buses called "pick-ups".

Railway passenger services are provided by the Rangoon Circular Line (45.9 km) covering almost all of Rangoon City, and the suburban section (20.7 km) of the Mandalay Line extending north-east from Rangoon. Trains consist of one diesel electric locomotive and six carriages.

There is a large number of passengers between Insein and Rangoon, between Mingaladon Cantt and Rangoon, and between Thingangyun and Rangoon. In peak hours, trains have a capacity of over 200% in the most congested sections.

Bus and express services are provided by the Road Transport Corporation (R.T.C.) and also by the private sector controlled by the Rangoon Division Buses Control Committee (R.D.B.C.C.). R.T.C. has 11 normal bus lines and 7 special bus lines, while R.D.B.C.C. controls 16 bus lines and 12 express lines (by giving permission for service routes to private owners).

On some bus lines, passengers have to cling to the outside of the vehicle, with many passengers being left at stops in peak hours. Nearly all R.T.C. and R.D.B.C.C. vehicles are old, and some are well past their service life. Old buses are uncomfortable and have maintenance troubles.

Present Condition of Railways, Buses and Expresses

(1982/83)

	Railway	Bus	Express
Transport Volume			
Person (Thousand/day)	86	1,161	348
Share (%)	5.4	72.8	21.8
Headway of Peak Time (minutes)	15-20	1-3	1-3
Average Speed (km/hour)	21	19	23

4. Demand Forecast

(1) Method

Should the project be adopted ("With the Project"), the relative competitiveness of railways will increase due to improvements in the operational conditions, and so divert some passengers from the bus and express services.

Should the electrification project not be implemented ("Without the Project"), the railway will maintain its present share.

According to the above concept, the railway demand was forecast in the following manner.

Step 1: Estimation of the present origin and destination (OD)

Based on the OD survey, field observations and interviews with the concerned persons, the OD for the present status is estimated.

Step 2: Forecast of production-attraction

The future production and attraction volume for each township is estimated using a regression formula with the passenger volume and economic indices.

Step 3: Forecast of total OD

The OD for the total future demand can then be estimated by using the results of steps 1 and 2.

Step 4: Forecast of modal split

The future demand for each mode is forecast by using the modal split model which explains the preference for transport mode in terms of time and fare. In this model, the travelling time consists of access time, waiting time, the time on board and the transfer time and is calculated using the following competitive factors.

Competitive Factor Improvements

	Present	Electrification
Scheduled Speed (km/hour)		
Circular Line	19.7	23.0
Suburban Line	23.3	30.8
Average	20.8	25.3
Dependability (%)	92	95
Headway Ratio		
1990	100	70
2000	100	60
2010	100	50

(2) Results

The demand is forecast to be 233 thousand per day (equivalent to 2.7 times that for 1982) with an increase in share from 5.4% to 10.7% by 1990. This forecast is rather conservative, considering the dramatic diversion accompanying similar electrification projects in Japan and the much higher share held by railways in Tokyo and Osaka.

Demand Forecast

	1982	1990	2000	2010	2020
Passengers (Thousand/day)	1,597	2,179	2,860	3,691	4,705
Railway:					
Demand Forecast (Thousand/day)	86	233 (118)	323 (154)	436 (199)	555 (254)
Share (%)	5.4	10.7 (5.4)	11.3 (5.4)	11.8 (5.4)	11.8 (5.4)
Index Number (1982=1)	1	2.7 (1.4)	3.8 (1.8)	5.1 (2.3)	6.5 (3.0)
Bus and Express:					
Demand Forecast (Thousand/day)	1,511	1,946 (2,061)	2,537 (2,706)	3,255 (3,492)	4,150 (4,451)
Share (%)	94.6	89.3 (94.6)	88.6 (94.6)	88.2 (94.6)	88.2 (94.6)
Index Number (1982=1)	1	1.3 (1.4)	1.7 (1.8)	2.2 (2.3)	2.7 (2.9)

Remark: ( ) Without the Project

5. Transport Plan

(1) Basis for transport plan

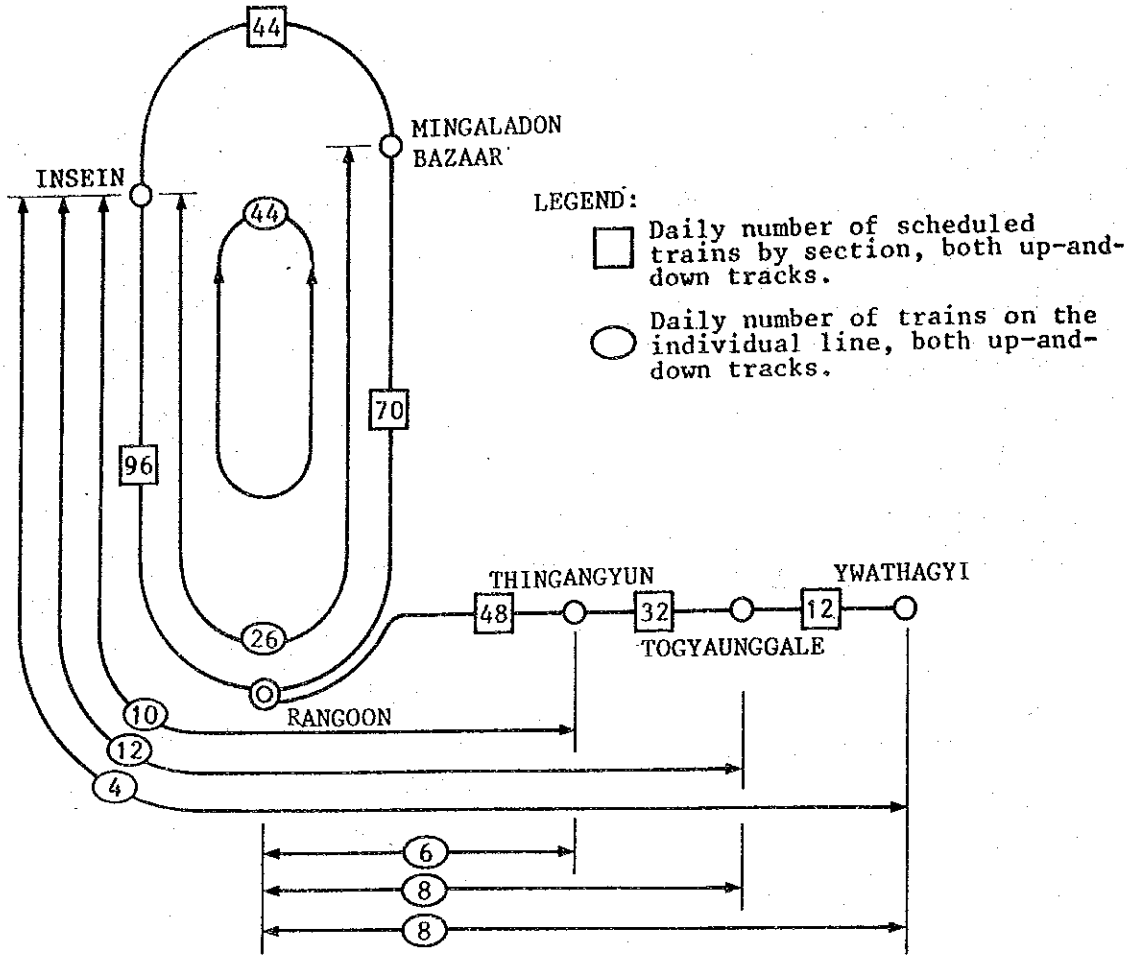
The transport plan is based on the railway demand forecast. For diversion it is necessary to increase the train frequency, with minimal switching of locomotives in stations and with an increase in the scheduled speed.

Major Items for Transport Plan

Unit Train Formation	1 Electric Locomotive and 6 Carriages
Riding Efficiency	
Peak Time	150% (900 persons)
Other Time	125% (750 persons)
Maximum Speed	
Circular Line	48 km/hour
Suburban Line	56 km/hour
Scheduled Time	
Circular Line	120 minutes for a round trip
Suburban Line	40 minutes between Rangoon and Ywathagyi
Minimum Possible Headway	7.5 minutes

(2) Transport network

Terminal stations are proposed for Insein, Mingaladon Bazaar, Thingangyun, Togyaunggale, Ywathagyi and Rangoon, with the following network and the number of scheduled trains adjusted to conform to the passenger flow.



Number of Scheduled Trains (1990)

(3) Number of rolling stock

The rolling stock fleet will consist of 19 locomotives and 105 carriages, based on train diagram for 1990. Modifications of the train diagram are planned for 2000 and 2010, accompanying the additional procurement of rolling stock.

Rolling Stock Procurement

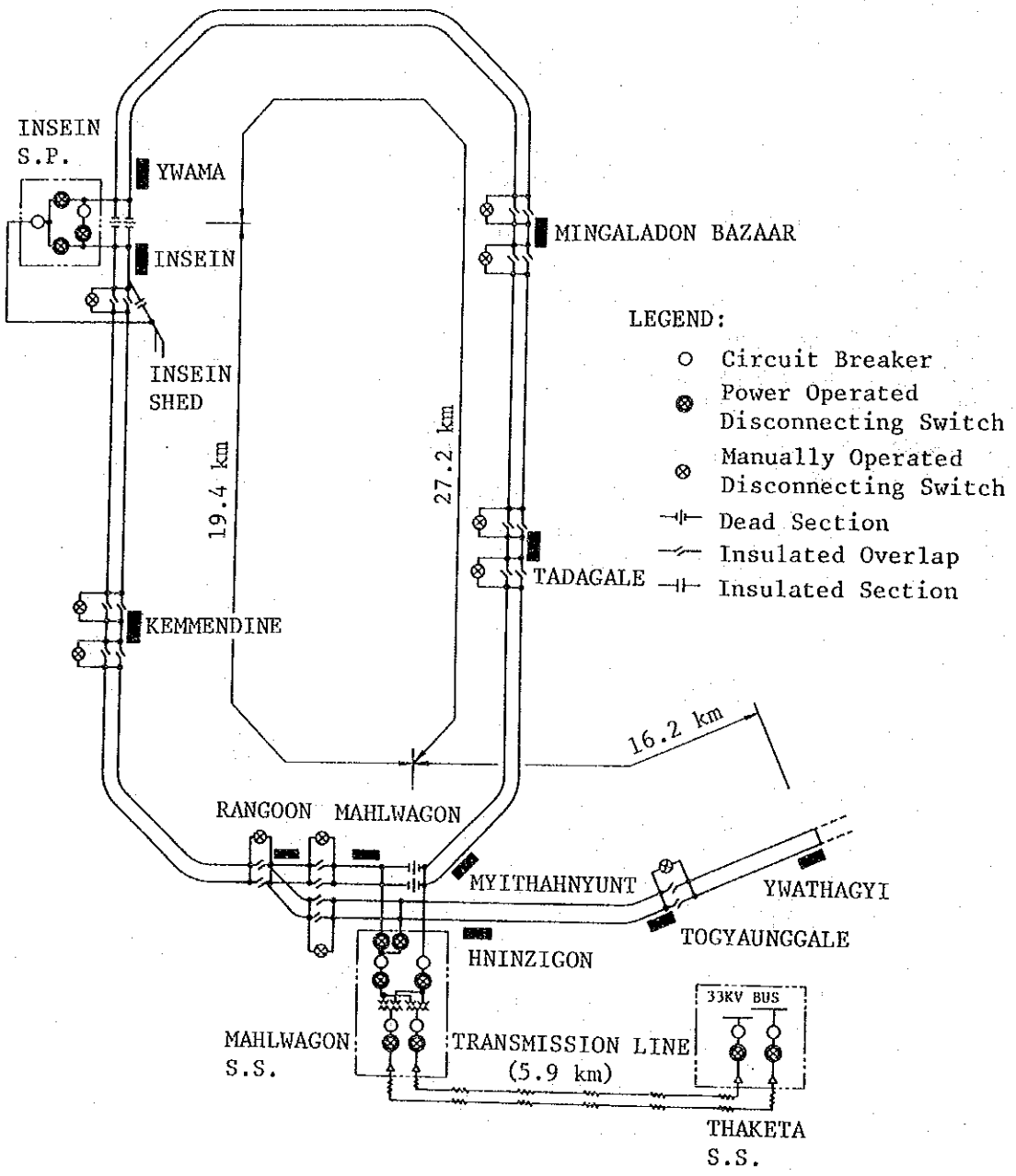
Fiscal Year	Train-km (km/day)	Total Number of Scheduled Trains	Locomotives	Carriages
1990	3,939.2	302	19(3)	105 (9)
2000	4,952.6	368	24(3)	136(10)
2010	6,358.4	458	31(5)	173(17)

Remark: Numbers in parentheses are the maintenance and stand-by rolling stock.

6. Electrification System Plan

The commercial frequency single-phase AC 25 kV simple feeding system is selected for this project.

The diagram for this feeding system is shown below.



Feeding System Diagram

7. Rolling Stock Plan

High performance electric locomotives are planned for increasing the scheduled speed. The height, with the pantograph folded down, is set on the basis of the present diesel electric locomotives.

Major Features of Rolling Stock

Electric locomotives	
Weight	
Working Order	48.0 ton
Axle Load	12.0 ton
Maximum Height	3,505 mm
Performance	
Continuous Rated:	
Output	1,000 kw
Tractive Effort	12,000 kg
Speed	30 km/hour
Maximum Service Speed	80 km/hour
Control System	Thyristor controlled with silicon rectifier
Brake System	Air brake system
Carriages	
Tare Weight	25 ton
Nominal Passenger Capacity	100 persons (seating 64, standing 36)
Maximum Height	3,405 mm
Side Entrance	2 on 1 side
Brake System	Air brake system

8. Electrification Facilities Plan

(1) Power source

The site selected for the railway substation is near Mahlwagon Junction. It is planned that the railway substation receives power from Thaketa substation of the Electric Power Corporation.

The maximum hourly demand for the electric traction power in the first year of electrification, is equivalent to 0.22% of the 1982/83 Burmese electric power capacity, while the annual consumption is equivalent to 0.67% of the 1982/83 Burmese power consumption results.

Furthermore, the single-phase electric traction power gives no adverse effect upon the general three-phase power network.

(2) Transmission line

Transmission lines between the Mahlwagon railway substation and Thaketa substation are underground cables having two circuits.

(3) Substation

The substation is of the outdoor type.

Two 10 MVA Scott-connected transformers are installed with the power receiving equipment. One is for normal use and the other kept as reserve.

Feeding circuit breakers are provided for each of the single-phases.

(4) Overhead contact system

The overhead contact wire has a minimum height of 3,800 mm, a standard height of 4,500 mm and a maximum height of 5,200 mm above rail level.

The simple catenary system is used, but overhead contact wires beneath road overbridges use two parallel contact wires only.

Equipment for Overhead Contact System

Overhead Contact Line Equipment		
Messenger Wire	Galvanized zinc steel	90 mm^2
Contact Wire	Grooved hard-drawn copper	110 mm^2
Support Equipment		
Poles	Prestressed concrete	
Beams	Rigid	
Protective Equipment		
Negative Feeder	Aluminum cable steel reinforced	58 mm^2

9. Modification of Railway Facilities

Major modifications to the railway facilities for electrification are as follows.

(1) Track

The number of intersections of the Circular and Suburban Lines between Rangoon and Pazundaung is reduced.

New shuttle operation facilities are installed at Mingaladon Bazaar and Togyaunggale.

Since the clearance beneath road overbridges is set at 4,100 mm above rail level, the roadbeds are lowered to secure the necessary clearance.

(2) Structures

Since the clearance beneath passenger overbridges is set at 4,550 mm above rail level, passenger overbridges are raised to secure the necessary clearance.

A passenger overbridge is to be newly constructed at Rangoon because of changes in the train arrival-departure platforms.

Concrete rainwater drains are constructed along track in cut regions and other regions susceptible to flooding.

Buildings required for the electrificaton will be constructed.

(3) Rolling stock shed

Insein shed is equipped with facilities for the daily inspection and light repair of electric locomotives.

Electric locomotives are stored in Insein shed, and carriages in Insein shed and Rangoon carriage shed. Storage track need not be newly installed at the initial stage, but in the future it is necessary with the increase of carriages.

(4) Workshop

Insein workshop is used for the inspection and repair of electric locomotives. The workshop is modified with an equipment and supply room, and a test running track for electric locomotives.

Myitnge workshop will still be used for the inspection and repair of carriages.

(5) Power distribution

Power distribution lines crossing the track are removed to meet safety requirements.

New line transformers connected to the overhead contact wires for signalling facilities are installed at each point where power supply is required.

(6) Signalling facilities

The present track circuits are upgraded to single-rail track circuits within stations, and to audio frequency non-insulated track circuits between stations, as measures to prevent inductive interference caused by AC electrification.

The present block system is changed to an automatic check-in check-out block system to secure a minimum train headway of 7.5 minutes.

Interlocking systems are installed at Insein, Mingaladon Bazaar and Togyaunggale stations to enable smooth shuttle operation.

Level crossing signals are installed at the main crossings.

(7) Telecommunication facilities

The overhead bare wires of the Posts and Telecommunications Corporation are replaced by underground cables to immunize inductive interference.

The present manual telephone exchanges are replaced with automatic ones at two stations. New telephones are installed for the dispatch and maintenance of the electrification facilities.

10. Investment Plan

(1) Investment costs

Initial investment costs are estimated on the basis of April 1984 economic conditions. An escalation factor is not considered.

Initial Investment Costs

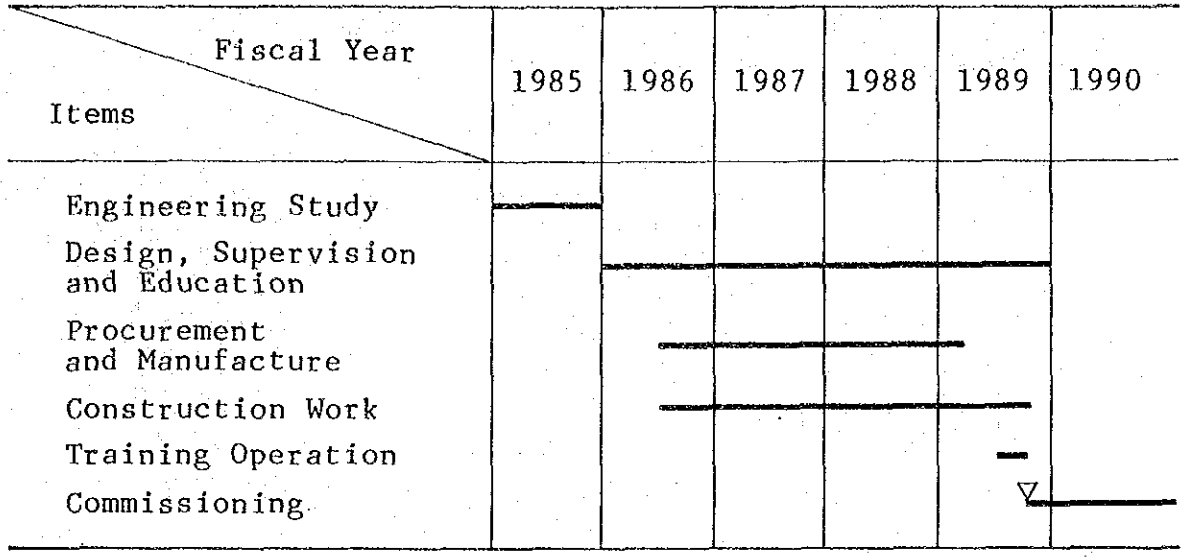
(Unit: Thousand Kyats)

Items	1986 - 1990		
	Local	Foreign	Total
Rolling Stock	-	216,775	216,775
Electric Facilities	2,974	86,544	89,518
Civil Engineering	32,087	15,176	47,263
Inspection and Repair Equipments	105	8,552	8,657
Signalling Facilities	814	29,772	30,586
Telecommunication Facilities	202	24,015	24,217
(Subtotal)	36,182	380,834	417,016
Engineering and Education	351	33,338	33,689
Tariffs and Taxes	164,926	-	164,926
Contingencies	1,827	18,374	20,201
(Subtotal)	167,104	51,712	218,816
Grand Total	203,286	432,546	635,832

(2) Construction schedule

Construction is scheduled so as to commence the electric traction in January 1990.

Construction Schedule



11. Economic and Financial Appraisals

Major premises are set as follows for the economic and financial appraisals.

Major Premises

Exchange Rate	¥100 = 3.5 Kyats US$1 = 8 Kyats	
Prices	The April 1984 prices, no escalation	
Oil Prices	Domestic Price for Financial Appraisal:	2.95 Kyats/gallon
	International Price for Economic Appraisal:	6.28 Kyats/gallon

(1) Economic appraisal

The purpose of the economic appraisal is to evaluate the economic significance of the project from the point of view of the Burmese economy. The economic significance is appraised by the EIRR based on a cost-benefit analysis and other benefits.

a. Cost-benefit analysis

The cost-benefit analysis is conducted on the incremental costs and benefits between the "With the Project" and the "Without the Project" cases which are composed of railway investments, passenger time savings, railway maintenance and operation costs, bus and express costs and road investments.

(a) Results

EIRR: 15.4%

(b) Sensitivity test

The results of the sensitivity test for the following cases show that all exceed the criteria of the Government of Burma, that the EIRR be greater than 10 - 12%.

Results of EIRR Calculations

Case	EIRR
Base Case	15.4%
10% Investment Cost Overrun	14.6%
20% Investment Cost Overrun	13.8%
10% Demand Decrease	14.4%
5% Inflation	21.3%

b. Evaluation

The project is judged as being highly significant since it has an acceptable EIRR as well as the following benefits which will contribute to Burmese development.

(a) Fuel savings: 69 million gallons

(b) Traffic congestion relief:

- Traffic accident reduction
- Alleviation of air pollution

(c) Employment creation for construction work: 331 thousand man·days

(d) Technology advances

(e) Hinterland development

(2) Financial appraisal

The purpose of the financial appraisal is to provide a reference for financial management of B.R.C. on this project, with the feasibility being appraised from both the profitability and the stability. The profitability is measured by the FIRR for the incremental cash flow between the "With the Project" and the "Without the Project" cases, while the stability is measured by the future financial indicators for the Circular and Suburban Lines.

a. Project profitability

The FIRR is calculated on the incremental cash flow which is composed of investments, revenues, expenses and turn over taxes.

(a) Results

FIRR: 5.1%

(b) Sensitivity test

The results of the sensitivity test for the following cases show that all exceed the B.R.C. average cost of funds of 3.8% and the weighted average interest rate of the project of 3.5%.

Results of FIRR Calculations

Case	FIRR
Base Case	5.1%
10% Investment Cost Overrun	4.5%
20% Investment Cost Overrun	3.9%
10% Demand Decrease	4.6%
5% Escalation	5.8%

b. Project stability

The future financial statements are projected on the basis of the following funding scheme.

° Investments

Concessional Loans: Foreign currency portion

° Maturity/Grace Period - 30 years including 10-year grace period

° Repayment - Equal annual instalments

° Interest Rates - 2.75% annually

Myanma Economic Bank (M.E.B.) Loans:

Local currency portion

° Maturity/Grace period - 10 years including 5-year grace period

° Repayment - Equal annual instalments

° Interest Rates - 5% annually

° Working Capital

M.E.B. Financial and Revenue Loans

° Interest Rates - 8% annually

(a) Results

Year of First Profit: 2007/08 (18 years)
Year of First Retained Profit: 2019/20 (30 years)
Year of Debt Service Cover Ratio> 1: 2009/10 (20 years)
Working Capital Shortfall: 7 years incurred

(b) Sensitivity test

The results of the sensitivity test for the following measures and funding options show that all cases will show a profit and exceed the debt service cover ratio of 1.0 within the project life.

Results of Financial Projections

Case	Year of First Profit	Year of First Retained Profit	Year of DSCR > 1	Working Capital Shortfall
Base case	2007	2019	2009	7 years
Measures;				
10% traffic demand increase	1995	2006	1999	3 years
10% fare rises by 10 years	1995	2008	1999	4 years
50% exemption of tariffs and taxes	1995	2005	1997	Nil
Funding options;				
50% debt equity ratio for local portion	1997	2009	2000	Nil
Two extensions of M.E.B. repayments	2004	2014	2008	3 years
Suspending M.E.B. repayments	2005	-	2003	Nil
3.5% interest rate for foreign loans	2019	-	2018	12 years

c. Evaluation

The project is judged as being financially feasible since it has both a reasonable profitability and an acceptable stability.

12. Conclusion and Recommendations

(1) Conclusion

The technical study was conducted on the basis of the demand forecast and in order to formulate an electrification plan. It was concluded that the electrification is technically feasible at the minimum cost.

The economic and financial appraisals were conducted on the basis of the investment plan provided by the technical study. The project is evaluated as being capable of making a great contribution to the development of Rangoon and to Burmese economic development in general, and as being feasible from the financial points of view.

The implementation of the project is therefore highly recommended.

(2) Recommendations

The following several supporting steps are recommended to be taken for the smooth implementation of construction and for sound operation after commissioning.

a. Maintenance of the electrified railway

The Circular and Suburban Lines should be maintained as a reliable transport system, and it is advisable to make a continuous effort to maintain the condition of the lines through the proper allocation of funds, materials and personnel.

b. Safety assurance

To secure safety assurance, safety facilities and measures are to be fully instituted. The installation of track fencing will also be recommended.

c. Electrification standards

The standard is to be established for the electrification prior to the implementation of the project.

d. Passenger information

Clear indications and easy-to-read signs will be necessary to minimize confusion accompanying changes in train operation, track layout and platform allocation.

e. Education system

On-the-job-training by foreign engineers and a programme of overseas study are essential in the education programme for smooth introduction of technology.

f. Fare adjustment

In order to improve the financial position of the lines, fare adjustment will be made in the long-term.

g. Funding scheme

The electrification is a large project for B.R.C. and is closely linked to the B.R.C. financial position. As regards the local currency portion it is advisable that government equity be increased to lower the debt equity ratio and that the M.E.B. loan conditions be relaxed to improve the financial position. As regards the foreign currency portion it is also advisable that concessional loans with low interest rates be raised.

h. Coordination with other transportation

The electrified Circular and Suburban Lines can play a major role in mass transportation between the CBD and the suburban areas, while buses and expresses will provide feeder services.

CHAPTER 1 INTRODUCTION

CHAPTER 1 INTRODUCTION

1-1 Background to the Study

Rangoon is the capital of Burma and is the political, cultural, economic, industrial and trade centre for the country. The present population of Rangoon is approximately 2.5 million, and the rate of increase for the last ten years is estimated at 2 percent.

Urban transportation is mainly provided by a road transport system which includes public and private buses, and a railway system consisting of the Rangoon Circular Railway Line (hereinafter referred to as the Circular Line) and the suburban section of the Mandalay Line (hereinafter referred to as the Suburban Line). In 1982, Rangoon's bus and pick-up services carried a daily total of 1.51 million passengers, while that for the railways was only 90 thousand.

In the centre of Rangoon City, traffic regulation by a one-way traffic system has been put in effect, but the main roads remain congested and traffic jams are increasing in severity. In such circumstances, public and private buses run 46 services between the main centres of passenger concentration. The buses are always full and the demand is not met. In addition, many of the buses operated are small and dilapidated.

The Circular Line is an unelectrified, double track line covering almost all of Rangoon City, and has a total length of 45.9 kilometres. The Suburban Line is an unelectrified, double track line extending north-east from Rangoon and runs the 20.7 kilometres between Rangoon and Ywathagyi. The passenger service on the Circular and Suburban Lines is currently provided by trains which are configured with a diesel locomotive and six carriages. However, even the busiest section during peak hours, has only two or three trains per hour. A round trip on the Circular Line takes 2 hours 20 minutes while it takes 53 minutes on the Suburban Line from Rangoon to Ywathagyi. With such a slow speed and infrequent service, the trains are used to their full capacity during the peak hours in the morning and evening. Overall improvement is required for the urban transportation infrastructure, but that for the railway passenger service is particularly urgent since the passenger train service is not making a great contribution to urban transportation.

The railway transport volume in Rangoon City can be markedly augmented through increasing the transport capacity by raising the

frequency of train service and the speed of the trains. This will both attract users and shift passengers from road vehicles to railways. However, these measures cannot be taken at present because of the physical condition of the railway facilities and rolling stock.

Under such circumstances, the Government of the Socialist Republic of the Union of Burma, and the Japan International Cooperation Agency reached an agreement to prepare a feasibility study for the electrification of the Circular and Suburban Lines. The study commenced in February 1984, according to the scope of work established in August 1983.

1-2 Objective of the Study

The objective of the study is to investigate the feasibility of the electrification project for the Circular and Suburban Lines. The ultimate objective of the project is to increase the railway capacity as well as to improve the railway passenger service as a means of solving the urban traffic problem in Rangoon.

1-3 Outline of the Study

The study covered Rangoon City and part of Hlegu township, and focused on the area along the lines (cf. Fig. 1.3.1), in accordance with the following policies.

(1) Safety and standards

Safety and standardization of the new system were stressed in the study, and due consideration was given to the local circumstances.

(2) Technology transfer

Technology transfer was pursued to the Burmese counterpart personnel during the course of the study.

The followings are the outlines of the study.

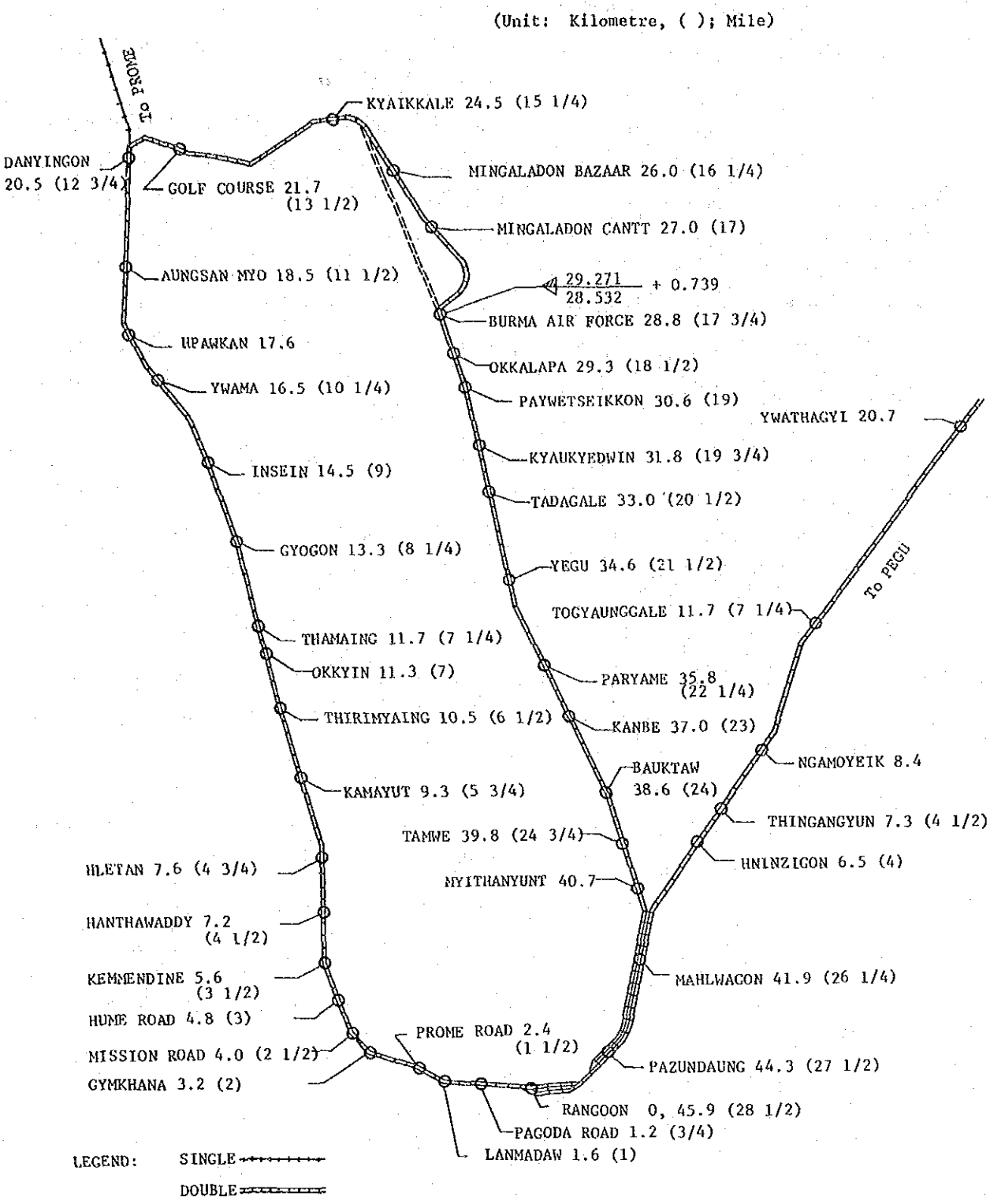


Fig. 1.3.1 The Map of the Circular and Suburban Lines

Source: B.R.C.

1-3-1 Socio-Economic Framework

The socio-economic framework forms a basis for the railway demand forecast and for economic and financial appraisals.

The socio-economic background, economic plans and energy situation in Burma, and the present condition and future development of Rangoon have been studied through statistics and discussions with the governmental organizations concerned.

1-3-2 Railway Demand Forecast

The railway demand was forecast in the following way, based on a thorough analysis on the present status:

(a) Present passenger flow pattern was estimated by mode.

(b) Production and attraction volume was forecast in relation to the economic indicators.

(c) Distribution pattern was projected.

(d) The railway demand was forecast using the modal split model.

1-3-3 Electrification System

The AC electrification system was selected after taking worldwide technical trends, the power supply, the railway conditions in Rangoon and the initial costs into consideration.

The electric locomotive traction system was selected after consideration of the transport capacity and the economic comparison with the electric car system.

The direct feeding system was selected as a result of considering the feeding distance, the inductive interference, the rail potential and the construction costs.

1-3-4 Train Operation Plan

The train diagram after electrification was the result of considering the train frequency, the formation and running time necessary to meet the demand under the conditions of the railway facilities.

1-3-5 Rolling Stock Plan

The principal specifications of the electric locomotives and carriages were determined. Modifications to the existing workshops and sheds were planned to accompany electrification.

1-3-6 Electrification Facilities Plan

The power receiving point of the traction power was planned to be located at the Thaketa substation after studying the future expansion and the impact which railway electrification would have on the power network system.

The location of the railway substation and capacity of the transformers were determined along with the overhead contact system and the tracks to be wired. The contact wire height above the rail level is set so as to minimize modification of the existing road overbridges.

1-3-7 Modification of Structures and Facilities for Electrification

Track lowering and passenger overbridge raising were planned to ensure sufficient clearance between the live parts and the ground. The necessary changes of the track layout were planned, and drainage to prevent track inundation was also included.

It was also planned to change the block system and the track circuit system, and to newly install relay interlocking device and level crossing alarms.

Modernization of the telecommunications system, including counter-measures against inductive interference, was also planned.

1-3-8 Investment Plan

The investment costs were estimated for both the local and foreign currency portions, and the construction schedule was prepared.

1-3-9 Economic and Financial Appraisals

An economic appraisal with respect to the national economy and a financial appraisal with respect to B.R.C. were performed in the following manner.

The economic feasibility was evaluated not only by the EIRR for the incremental costs and benefits between "With the Project" and "Without the Project", but also for the other social benefits which are difficult to quantify.

The financial feasibility was evaluated by the FIRR for the incremental cash flow between "With the Project" and "Without the Project", and by the financial ratio of the Circular and Suburban Lines.

1-4 Study Schedule

The study schedule is shown in Table 1.4.1.

Table 1.4.1 Study Schedule

Item	1984											1985		
	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Preparatory Work in Japan														
Work in Burma (1)														
Work in Japan (1)														
Work in Burma (2)														
Work in Japan (2)														
Presentation and discussion of the Interim Report														
Work in Japan (3)														
Presentation and discussion of the Draft Final Report														
Final Work in Japan														
Submission of the Reports		0 Inception				0 Progress			0 Interim		0 Draft Final			0 Final

: Work in Japan : Work in Burma

1-5 Organizations for the Study

1-5-1 Supervisory Committee

Yasuji SEKINE - Chairman

Professor, Department of Electrical Engineering, University of Tokyo

Yuhei SHIMAZAKI - Demand Forecast, Economic and Financial Analysis

Deputy Director of Transport Promotion Division, Regional Transport Bureau, Ministry of Transport

Taichi KANEKO - Railway Facilities

Chief of Special Railway Section, Railway Facilities Division, Land Transport Engineering Department, Regional Transport Bureau, Ministry of Transport

Hideharu YOSHIOKA - Electrification

Chief of Engineering Section, Railway Facilities Division, Land Transport Engineering Department, Regional Transport Bureau, Ministy of Transport

1-5-2 Study Team

Tatsuya ISHIHARA	- Team Leader
Takayuki TERAI	- Deputy-Leader/System Engineering
Hiroyuki INONE	- Electrification
Naoyuki TESHIMA	- Transport Demand Forecast
Tatsuhiko HOSAKA	- Train Operation
Wasaku OKADA	- Rolling Stock and Workshop
Koichi ISUMI	- Structures and Track
Satoshi MURATA	- Power Supply
Yoshikazu NAGASHIMA (Work in Burma-1)	- Overhead Contact System and Substation
Fumiyuki KONNO	- Overhead Contact System and Substation
Sadao SUZUKI	- Signalling and Telecommunications
Junichi YASUDA	- Economic and Financial Appraisals
Masatoshi KAMIKUBO	- Economic and Financial Appraisals

1-5-3 Burma Railways Corporation Counterparts

Mechanical and Electrical Engineering Department

U Shwe Win	- Chief Mechanical and Electrical Engineer
U Maung Maung Aye	- Deputy Chief Electrical Engineer
U Kyaw Myint	- Deputy Chief Mechanical Engineer (Carriage)
U Hla Myint	- Deputy Chief Mechanical Engineer (Locomotive)
U Tin Hlaing	- Divisional Electrical Engineer

Civil Engineering Department

U Tun Thein	- Chief Engineer
U Thin Tu	- Deputy Chief Engineer (Planning & Administration)
U Kyi Nyunt	- Deputy Chief Engineer (Signal & Telecommunication)
U Than Myint	- Senior Staff Engineer (Planning & Design)

Traffic Department

U Mya Than	- Chief Traffic Manager
U Htun Kywe	- Deputy Chief Traffic Manager (Operating)
U Chan Tun Aung	- Deputy Chief Traffic Manager (Passenger)
U Tin Yee	- Manager (Operating)

Account Department

U Kan Tun	- Controller of Railways Accounts
U Maung Maung	- Deputy Controller of Railways Accounts
U Nyan Win	- Senior Accounts Officer
U Maung Maung Lwin	- Accounts Officer

1-5-4 Persons Concerned in Governmental and Other Organizations

Planning Department (P.D.), Ministry of Planning and Finance

U Kyaw Sein	- Additional Director
Daw Yi Yi Thwe	- Additional Director
Daw Mya Mya Kyi	- Sr. Deputy Director
U Ye Myint	- Deputy Director
U Kyaw Han	- Assistant Director

Foreign Economic Relations Department (F.E.R.D.),
Ministry of Planning and Finance

U Khin Maung	- Adviser
U Than Myint	- Chief of Section
U Maung Maung Lay	- Chief of Section

Myanma Foreign Trade Bank (M.F.T.B.), Ministry of Planning and Finance

U Aung Nyunt Pe	- Managing Director

Central Statistical Organization (C.S.O.),
Ministry of Planning and Finance

Daw Tin Tin Shwe	- Additional Director
U Htin Gyaw	- Additional Director
U Aung Sein	- Deputy Director
Daw Hla Tint	- Deputy Director
U Aung Myint Thein	- Assistant Director

Ministry of Transport and Communication

Col. Sein Ya	- Deputy Minister

Transport and Communication Planning and Operation Department (T.C.P.O.D.), Ministry of Transport and Communication

U Pe Maung Tin - Director
U Kyin Htwe - Additional Director

Burma Railways Corporation (B.R.C.), Ministry of Transport and Communication

U Tin Tun - Managing Director
U Saw Clyde - General Manager
U Kyaw Hlaing - Deputy General Manager
U Aung Kyaw San - Manager (Administration)

Road Transport Corporation (R.T.C.), Ministry of Transport and Communication

U Tin Tun Aung - General Manager
U Thayne Toon - Administrative Manager
U Khin Maung Myint - Deputy Traffic Manager
U Wai Lynn - Statistical Officer
U Myo Nyunt - Assistant Statistical Officer

Posts and Telecommunications Corporation (P.T.C), Ministry of Transport and Communication

U Tin - General Manager
U Pe Than - Deputy General Manager
U Myint Win - Deputy Project Manager

Department of Meteorology and Hydrology (D.M.H.), Ministry of Transport and Communication

U Sein Shwe U - Director

Department of Civil Aviation (D.C.A.), Ministry of Transport and Communication

U Tun Aye - Project Manager
U Win Bo - Assistant Project Manager

Concrete Pipe Construction Plant (C.P.C.P.), Ministry of Industry - 1

U Sein Han - Manager

Electric Power Corporation (E.P.C.), Ministry of Industry - 2

U Maung Maung Aye - Chief Engineer
U Nyunt Hlaing - Deputy Chief Engineer (Planning)
U Bo Kyin - Superintending Engineer (Planning)
U Kyaw Myint - Divisional Electrical Engineer (Rangoon Division)
U Hla - Electrical Engineer (Planning)

Technical Services Corporation (T.S.C), Ministry of Industry - 2

U Win Myint	- Assistant Director

Housing Department (H.D.), Ministry of Construction

U Tun Shwe	- Director General
U San Tun Aung	- Director
U Kyan Thein	- Deputy Director
U Than Moe	- Assistant Director
U Htin Myaing	- Assistant Director
U Kyaw Latt	- Assistant Director
U Than Hnit	- Assistant Director

Department of Labour (D.L.), Ministry of Labour

U Ngwe Tun	- Director General
U San Thein	- Additional Director
Daw Sein Sein	- Additional Director
Daw Myint Myint Aye	- Deputy Assistant Director

Rangoon Division Buses Control Committee (R.D.B.C.C.)

U Chit Sein	- Secretary of R.D.B.C.C.
Lt. Col. Tin Oo	- Member of R.D.B.C.C.
U Mya Win	- E.C. Member, Rangoon Division People's Council
U Hla Min	- Member of R.D.B.C.C.
U Thaw Zin Thann	- Member of R.D.B.C.C.
U Maung Than	- Member of R.D.B.C.C.

Rangoon City Development Committee (R.C.D.C.)

U Kyi Lwin	- Assistant Engineer

Names of organizations are abbreviated for the remainder of this report.

CHAPTER 2 SOCIO-ECONOMIC FRAMEWORK

CHAPTER 2 SOCIO-ECONOMIC FRAMEWORK

2-1 National Economy

2-1-1 Population and Labour Force

Burma has a population of 35,684 thousand (1982/83), with an annual average growth rate of 2.2% for the past 20 years. The labour force was estimated at 14,185 thousand (1982/83), which is equivalent to 39.8% of the population. By industry, agriculture employed 63.6%, while processing and manufacturing, and trade were the only other industries exceeding 5%. By sector, the co-operative and private sectors employed 89.2%, with the state sector accounting for the remainder.

Table 2.1.1 Estimated Labour Force (1982/83)

(Unit: Thousand)

	State	Co-operative and Private	Total	Percentage Distribution
Agriculture	77	8,951	9,028	63.6
Livestock and fishery	15	175	190	1.3
Forestry	95	87	182	1.3
Mining	70	13	83	0.6
Processing and manufacturing	184	966	1,150	8.1
Power	16	-	16	0.1
Construction	147	72	219	1.5
Transport and communications	114	356	470	3.3
Social services	222	81	303	2.1
Administration	522	27	549	3.9
Trade	64	1,322	1,386	9.8
Workers n.e.s.	-	609	609	4.3
Total	1,526	12,659	14,185	100.0
(Percentage distribution)	(10.8)	(89.2)	(100)	

Source: Report to the Pyithu Hluttaw

2-1-2 Overall Economy

The GDP was 46,945 million kyats equivalent to US$5,868 million and the per capita GDP was 1,316 Kyats (equivalent to US$165) in nominal terms (US$1 = 8 Kyats). These figures indicate Burma to be a typical developing country.

The Burmese Government has been endeavouring to develop the economy and has attained some successes, after a period of stagnation during the 1960s and early 1970s. The GDP growth rate is high, and has been averaging 6.4% in real terms since 1976/77.

Stable prices have encouraged this improvement, and the inflation rate (in terms of GDP deflators) has remained below 6% since 1977/78.

Table 2.1.2 GDP Trends

(Unit: Million Kyats)

	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
GDP (in real terms)	12,265	12,996	13,843	14,562	15,718	16,716	17,905
Growth rate (%)	6.1	6.0	6.5	5.2	7.9	6.3	7.1
GDP (in nominal terms)	27,427	29,618	31,800	35,333	38,609	42,850	46,945
Growth rate (%)	16.8	8.0	7.4	11.1	9.3	11.0	9.6
GDP deflater (%)	223.6	227.9	229.7	242.6	245.6	256.3	262.2
Inflation rate (%)	10.1	1.9	0.8	5.6	1.2	4.4	2.3

Note: Hereinafter "in real terms" means in 1969/70 constant producers price.
Source: Report to the Pyithu Hluttaw

This improvement has been largely attributed to steady increase in agriculture production. Agriculture contributed 2.1% to GDP growth rate of 6.4%. Production increases in rice have played a major role on the agricultural development.

Table 2.1.3 Contribution Rates to GDP

(Unit: %)

Sector	Growth Rate from 1975 to 1982	GDP Share	Contribution Rate
Agriculture	7.7	27.0	2.1
Livestock & fishery	5.1	7.2	0.4
Forestry	6.5	2.3	0.1
Mining	10.8	1.0	0.1
Processing & manufacturing	6.3	10.4	0.7
Power	14.7	0.8	0.1
Construction	14.2	1.7	0.2
Transport & communications	7.0	5.4	0.4
Social & administration services	6.8	19.4	1.3
Trade	3.8	24.8	0.9
Total	6.4	100.0	6.4

Note: Contribution rates are calculated by multiplying the sectoral growth rates by their GDP shares.

Source:Report to the Pyithu Hluttaw

Investment in real terms has rapidly increased at an annual rate of 20.1% since 1976. This growth in investment is partially attributable to the high growth rate of the GDP.

Table 2.1.4 Growth Rates of Major Macro-Indicators

(Unit: %)

Particular	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	Average
GDP	6.1	6.0	6.5	5.2	7.9	6.3	7.1	6.4
Imports	0.0	25.1	37.8	27.1	3.3	8.7	31.1	21.6
Exports	9.6	16.6	Δ3.0	34.6	9.1	0.6	20.2	12.1
Consumption	5.9	4.5	4.5	3.3	7.9	5.7	6.4	5.4
Investment	19.4	48.2	29.5	19.1	Δ2.2	13.0	19.6	20.1

Source: Report to the Pyithu Hluttaw

2-1-3 Public Finance

The state administrative organizations have maintained a surplus for the last five years because of the steady growth of receipts, and the rapid increases in foreign loans and aid.

The current revenue of the state economic enterprises has also increased rapidly, accompanying the expansion of foreign loans and aids, and domestic bank financing for capital expenditure.

Table 2.1.5 Public Finance

(Unit: Million Kyats)

Particulars	1978/79	1979/80	1980/81	1981/82	1982/83	Growth Rate
State Administrative Organizations						
Receipts	4,553	5,452	5,939	7,033	6,256	8.3%
1. Revenue from Taxes	3,183	3,608	3,711	4,257	4,134	6.8%
2. Receipts from State Economic Enterprises	1,000	1,401	1,712	2,217	1,543	11.4%
3. Others	369	443	516	559	579	11.9%
Current Expenditure	3,483	3,719	4,081	4,667	4,874	8.8%
Foreign Loans and Aids	596	788	922	854	1,126	17.2%
Financial Account	(-)222	(-)200	(-)202	(-)81	(-)162	-
Amount Available for Investment	1,444	2,322	2,578	3,140	2,346	12.9%
Investment	682	952	1,219	129	1,984	30.6%
Surplus (+)/Deficit (-)	(+)762	(+)1,370	(+)1,360	(+)1,849	(+)361	-
State Enterprises						
Current Revenue	13,613	15,428	17,966	19,677	21,701	12.4%
Current Expenditure	13,993	15,310	18,122	20,253	22,166	12.2%
Foreign Loans and Aids	1,381	2,150	1,406	2,153	2,701	18.3%
Financial Account	(-)197	(-)427	(-)534	(-)629	(-)843	-
Volume of Capital Expenditure	3,200	4,506	4,014	5,142	6,386	18.9%
Others	868	-	-	-	-	-
Bank Financing (+)/ Deposits (-)	(+)1,528	(+)2,666	(+)3,298	(+)4,194	(+)4,984	34.4%
Town and City Development Committees						
Current Revenue	142	149	165	203	218	11.4%
Current Expenditure	95	111	129	143	173	16.2%
Foreign Loans and Aids	23	10	21	-	22	-
Financial Account	-	-	-	(-)4	(-)4	-
Volume of Capital Expenditure	72	51	71	66	110	11.3%
Bank Financing (+)/ Deposits (-)	(+)2	(+)2	(+)13	(+)3	(+)48	130.2%

Source: Report to the Pyithu Hluttaw

2-1-4 Balance of Payments

(1) Trade

There have been deficits in the trade balance since 1977/78. These deficits have expanded due to the 24.8% annual increase in imports, which is higher than the 18.4% annual increase in exports, for the period from 1977/78 to 1981/82.

Exports totalling 3,453 million Kyats were equivalent to 8.1% of the GDP in 1981/82. By commodity, rice, rice products, teak and hardwood were major export items, and accounted for 66.1% of the total.

Imports totalling 5,057 million Kyats were equivalent to 11.8% of the GDP in 1981/82. The Burmese Government controls all imports and places priority on industrial materials and goods such as raw materials, tools and spare parts, machinery and equipment which account for 69.3% of all imports. Consumer goods account for less than 10% of imports.

Table 2.1.6 Trade Balance

(Unit: Million Kyats)

	1977/78		1978/79		1979/80		1980/81		1981/82		Growth Rate
EXPORTS											
Agricultural products	1,070	60.9%	540	29.1%	1,534	56.9%	1,761	54.6%	1,952	56.5%	16.2%
(Rice & Rice products)	(868)	(49.4%)	(288)	(15.5%)	(1,214)	(45.0%)	(1,355)	(42.0%)	(1,509)	(43.7%)	14.8%
Animal & marine products	37	2.1%	57	3.1%	82	3.0%	95	2.9%	125	3.6%	35.6%
Forest products	398	22.7%	909	49.1%	558	20.7%	798	24.7%	776	22.5%	18.2%
(Teak & Hardwood)	(397)	(22.6%)	(905)	(48.8%)	(550)	(20.4%)	(793)	(24.6%)	(772)	(22.4%)	18.1%
Minerals & gems	196	11.2%	290	15.7%	460	17.1%	468	14.5%	474	13.7%	24.7%
Others	56	3.2%	57	3.1%	62	2.3%	103	3.2%	126	3.6%	22.5%
Total	1,757	100.0%	1,853	100.0%	2,696	100.0%	3,225	100.0%	3,453	100.0%	18.4%
IMPORTS											
Consumer goods	217	10.4%	214	6.6%	189	4.5%	285	6.4%	427	8.4%	18.4%
Raw materials	636	30.5%	766	23.8%	839	20.0%	1,309	29.3%	1,380	27.3%	21.4%
Tools & spares	227	10.9%	309	9.6%	479	11.4%	727	16.3%	636	12.6%	29.4%
Construction materials	255	12.2%	266	8.3%	451	10.7%	513	11.5%	484	9.6%	17.4%
Machinery & equipment	495	23.7%	1,349	41.8%	1,848	44.0%	1,368	30.6%	1,488	29.4%	31.7%
Transport equipment	200	9.6%	245	7.6%	303	7.2%	144	3.2%	440	8.7%	21.8%
Others	57	2.7%	75	2.3%	92	2.2%	119	2.7%	202	4.0%	37.2%
Total	2,087	100.0%	3,224	100.0%	4,201	100.0%	4,465	100.0%	5,057	100.0%	24.8%
DEFICIT	330		1,371		1,505		1,240		1,604		48.5%

Source: Report to the Pyithu Hluttaw, Selected Monthly Economic Indicators

(2) Capital balance

The capital balance showed a surplus due to foreign grants and loans to make up for the trade deficit. Repayments and interest on loans have therefore shown recent increases.

Table 2.1.7 Balance of Payments

(Unit: Million Kyats)

	1977/78	1978/79	1979/80	1980/81	1981/82	Growth Rate
TRADE						
Exports	1,714	1,632	2,634	3,180	3,462	19.2%
Imports	2,968	3,815	4,270	4,603	5,951	19.0%
Balance	-1,254	-2,183	-1,636	-1,423	-2,489	18.7%
SERVICES & TRANSFERS						
Receipts	214	249	457	608	657	32.4%
Payments	293	398	574	720	881	31.7%
(Interest)	(60)	(144)	(160)	(168)	(379)	58.5%
Balance	-79	-149	-117	-112	-224	29.8%
CURRENT BALANCE	-1,333	-2,332	-1,753	-1,535	-2,713	19.4%
CAPITAL						
Grants & loans	2,015	2,926	3,088	2,459	3,237	12.6%
Repayments	592	442	686	791	961	12.9%
Balance	1,423	2,484	2,402	1,668	2,276	12.5%
Errors & omissions	21	54	-45	85	128	57.1%
OVERALL BALANCE	111	206	604	218	-309	
FOREIGN EXCHANGE RESERVES	870	1,074	6,177	1,895	1,587	16.2%

Source: Report to the Pyithu Hluttaw

(3) Foreign exchange rates

In April 1984, the exchange rate for the Kyat was 3.5 Kyats per 100 Yen and 8.0 Kyats to the US dollar, but the rate against the Yen and the dollar has dropped slightly in recent years.

Table 2.1.8 Exchange Rates

(Unit: Kyats/Unit)

	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	Annual Change Rate
Japanese 100 Yen	2.7606	3.3295	2.9292	3.0538	3.2792	3.1250	2.4%
U.S. Dollar	7.1042	6.7884	6.5720	6.6194	7.3173	7.7596	1.5%

Source: Selected Monthly Economic Indicators (Central Statistical Organization)

2-1-5 Prices

Prices have been stable in recent years, especially since the average inflation rate for domestic products was 2.8%. The inflation rate for imported goods was slightly higher than this, but has been stable since 1979/80, at a rate of less than 4.5%.

Stable prices are assumed to continue during the project life because:

(a) prices of domestic products are regulated by the Government,

(b) foreign exchange rates and imports are controlled by the Government,

(c) world market prices for transportation goods are stable because of fierce competition.

Escalation factors will not be considered in the base case for the economic and financial appraisals.

Table 2.1.9 Inflation Rates

(Unit: %)

	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	Average
GDP Deflator	227.9	229.7	242.6	245.6	256.3	262.2	
Inflation Rate of Domestic Products	1.9	0.8	5.6	1.2	4.4	2.3	2.8
Import Deflator	367.1	411.7	422.2	434.1	452.2	469.0	
Inflation Rate of Import Goods	2.4	12.1	2.6	2.8	4.2	3.8	5.0

Note : The deflator is calculated by dividing the indicator at the current price by that for 1969/70 constant price
Source: Report to the Pyithu Hluttaw

2-2 Economic Plan

2-2-1 Twenty-Year Plan

Burma has drawn up a Twenty-Year Plan (for 1974/75 to 1993/94) in order to define the national long-term objectives and the action to be taken to achieve it.

(1) Major objectives

(a) To double the standard of living;

In order to provide sufficient food, clothing, housing and other goods, the GDP per capita will be doubled by expanding the GDP by 320% (in real terms) by 1993/94. Investment has been rising, supported by the rapid increase in export earnings.

Table 2.2.1 Macro-Economic Goals

	Growth Rate	Times
Population	2.3%	1.6
GDP	5.9	3.2
Consumption	4.8	2.6
Investment	9.6	6.2
Imports	8.2	4.9
Exports	10.9	7.9
Per Capita GDP	3.5	2.0

Source: An Outline of Directives for the Twenty-Year Plan and Second Four-Year Plan

(b) To change the economic base from an agricultural one to an agricultural-industrial one;

The processing and manufacturing sector will be dramatically developed to account for 22.1% of the GDP. Mining, power, construction, transportation and communication sectors were also set higher growth rates than the GDP for industrialization.

Table 2.2.2 Structural Targets

(Unit: %)

Sector	1973/74	1993/94	Annual Growth Rate
Goods	51.4	56.5	6.4
Agriculture	25.7	20.9	4.8
Livestock & fishery	7.8	6.3	4.8
Forestry	2.6	2.1	4.8
Mining	1.2	1.3	6.5
Processing & manufacturing	11.5	22.1	9.4
Power	0.7	1.4	9.4
Construction	1.9	2.4	7.1
Services	23.6	22.8	5.7
Transportation	5.8	7.8	7.3
Communications	0.3	0.4	7.5
Others	17.5	14.3	4.9
Trade	25.0	20.7	4.9
GDP	100.0	100.0	5.9

Source: An Outline of the Directive for the Twenty-Year Plan and the Second Four-Year Plan.

c) To reinforce the government and co-operative sectors

Highest priority will be given to government and co-operative sectors in developments which will account for 48% and 26% of GDP in 1993/94, respectively.

Table 2.2.3 Targets for Ownership Change in Real Terms

(Unit: %)

Ownership	1973/74	1993/94	Annual Growth Rate
State	35	48	8.0
Co-operative	8	26	13.0
Private	57	26	1.9
Total	100	100	5.9

Source: An outline of Directives for the Twenty-Year Plan and the Second Four-Year Plan

(2) Four-Year Plans

The Twenty-Year Plan is divided into five consecutive Four-Year Plans. The GDP growth rate targets are planned to rise yearly resulting in an average annual GDP growth rate of 5.9% in real terms for the entire twenty year period.

Table 2.2.4 GDP Growth Rate Targets

(Unit: %)

Period	Four-Year Plan	Annual Growth Rate
1974/75 to 1977/78	Second Four -Year Plan	4.0
1978/79 to 1981/82	Third Four -Year Plan	5.0
1982/83 to 1985/86	Fourth Four -Year Plan	6.0
1986/87 to 1989/90	Fifth Four -Year Plan	7.0
1990/91 to 1993/94	Sixth Four -Year Plan	7.6
Entire Period		5.9

Note: Real terms
Source: An outline of Directives for the Twenty-Year Plan and the Second Four-Year Plan

2-2-2 Fourth Four-Year Plan

The Fourth Four-Year Plan is formulated for the realization of the objectives of the Twenty-Year Plan.

(1) Overall targets

In the Fourth Four-Year Plan, the GDP growth rate is to be raised to 6.2%, while investment will be set at the lower growth rate of 7.6% in comparison with the Twenty-Year Plan.

Table 2.2.5 Macro-Economic Targets

(Unit: %)

Indicator	Annual Growth Rate
Population	2.3
GDP	6.2
Consumption	5.4
Investment	7.6
Imports	7.0
Exports	13.0
Per Capita GDP	3.8

Source: An outline of the Fourth Four-Year Plan

(2) Structural targets

In the Fourth Four-Year Plan, livestock and fishery, mining, processing and manufacturing, power, transport, communications sectors are given higher growth rates than that for the GDP. In particular, the mining, power and communications sectors are planned to increase at an annual growth rate of more than 10%.

Table 2.2.6 Structural Targets of Fourth Four-Year Plan

(Unit: %)

Sector	1981/82	1985/86	Annual Growth Rate
Goods	53.6	54.9	6.9
Agriculture	28.4	27.5	5.4
Livestock & fishery	6.6	7.0	8.2
Forestry	2.4	2.3	5.0
Mining	1.5	2.0	12.8
Processing & manufacturing	10.7	11.6	8.4
Power	1.2	1.9	18.2
Construction	2.8	2.6	4.4
Services	24.8	24.0	5.4
Transport	4.9	5.0	6.9
Communication	0.4	0.6	16.4
Financial institutions	3.1	3.1	5.3
Social and administrative services	10.4	10.0	5.4
Others	6.0	5.3	3.1
Trade	21.6	21.1	5.7
GDP	100.0	100.0	6.2

Source: An Outline of the Fourth Four-Year Plan

2-2-3 Plan Performance

(1) The Third Four-Year Plan

The Third Four-Year Plan was successfully implemented on the whole, and an average annual growth rate of 6.5% was achieved for the four year period. This overall performance was due to agricultural development. The mining and the processing and manufacturing sectors, which require high growth for the realization of the transfer to an industrial-agricultural economy, showed relatively poor performance. It is a major policy to develop these sectors during the rest of the Twenty-Year Plan period.

Table 2.2.7 Plan Performance of Third Four-Year Plan

(Unit: %)

Sector	Average Performance
GDP	99.8
Consumption	99.1
Investment	98.6
Import	88.7
Export	75.6
Goods	99.0
Agriculture	102.2
Livestock & fishery	101.0
Forestry	98.0
Mining	82.4
Processing & manufacturing	90.9
Power	99.1
Construction	106.5
Services	102.7
Transportation	99.3
Communications	121.6
Financial institutions	143.8
Social & administrative	95.6
Others	99.8
Trade	98.5

Source: Report to the Pyithu Hluttaw

(2) Future performance

Burma has high potential for economic growth in that it has abundant agricultural, forest and mining resources, relatively high educational level, stable population increase and a food and energy self-sufficient economy. It will be impossible to maintain high economic growth if Burma fails to manage her economy. In the study, the targets of the Twenty-Year Plan are assumed to have been attained during the plan period. The final economic performance of the Sixth Four-Year Plan which forms the last part of the Twenty-Year Plan, is assumed to continue during the remainder of the project life.

2-3 Energy Situation

2-3-1 Overall Demand and Supply Situation

Burma is presently self-sufficient in energy, with the major energy sources being crude oil, natural gas and hydro-electric power. The original energy sources are estimated 28,998 million kcal, with the breakdown being 54% for oil, 38% for natural gas and 8% for hydro-electricity.

Table 2.3.1 Original Energy Supply

(Unit: Million kcal)

	1978/79			1982/83		
	Volume	Calorie	%	Volume	Calorie	%
Crude oil (US 1000 barrels)	9,999	14,946	71.3	10,549	15,764	54.3
Natural gas (million Cu. feet)	9,892	4,296	20.5	24,640	10,931	37.7
Hydro-electricity (10^6 kWh)	703	1,722	8.2	940	2,303	7.9
		20,964	100.0		28,998	100.0

note : Crude Oil 9,400 kcal/litre
Natural Gas 9,400 kcal/litre (liquid base)
Hydro-electric power 2,450 kcal/kwh
Source: Report to the Pyithu Hluttaw

2-3-2 Crude Oil

(1) Demand and supply

There are almost no oil imports except for special oil products such as high octane jet fuel. Crude oil used to be exported, but the recent year exhaustion of domestic reserves has meant that crude oil production since the steady increases between 1974 and 1979, has remained constant between 10 and 11 million U.S. barrels.

Programmed consumption of oil and the utilization of alternative energy sources are becoming important policies since no dramatic increases in the crude oil production can be expected.

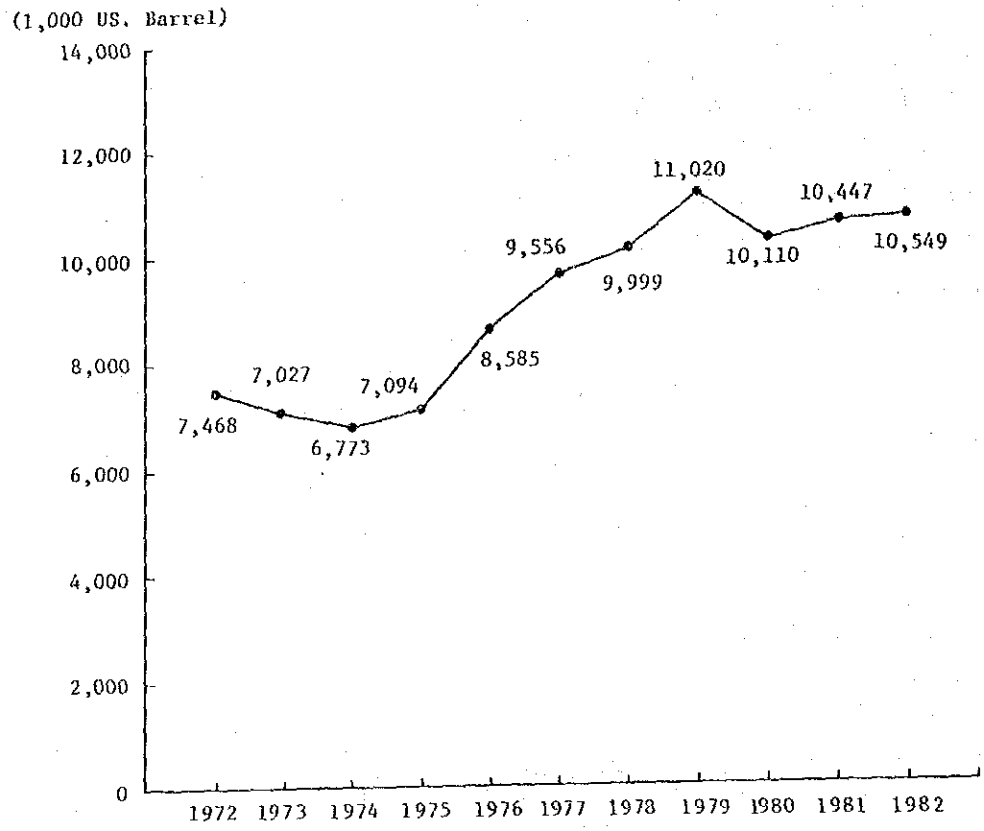


Fig. 2.3.1 Crude Oil Production

Source: Report to the Pyithu Hluttaw

(2) Oil price

The international price of oil has been fluctuating largely and has recently shown a downward trend. The 1984 spot price of light oil in Rotterdam was US$0.79 per gallon. Burmese diesel high speed oil is of almost equal quality as light oil, and costs 2.95 Kyats per gallon (equivalent to US$0.37). The domestic oil price has been kept at 47% of the international price.

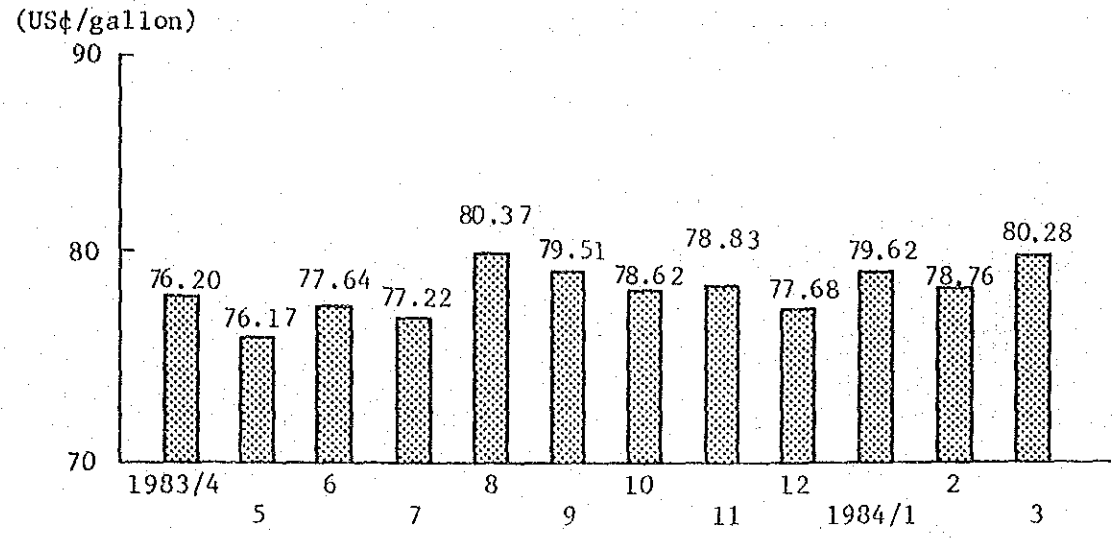


Fig. 2.3.2 Light Oil Spot Price

Source: Rotterdam Spot Market

2-3-3 Electric Power

(1) Demand and supply

Electric power consumption has increased at an average annual rate of 8.3% for the last ten years, and there has been a remarkable increase in that for industrial use. This, domestic use and miscellaneous use account for 55%, 28% and 17%, respectively of the 1982/83 electric power consumption. The electric demand elasticity against the GDP was 1.56. This demand will increase higher than GDP growth if the past trends continue into the future.

Electric power plants have been installed to meet the increasing demand, and the total installed capacity was 741MW in 1982/83 compared to 253MW in 1972/73, representing a 12.7% average annual increase. New installations have increased the electric power generation from 651 million kWh in 1972/73 to 1,516 million kWh in 1982/83, at an average annual growth rate of 8.8%.

Electricity losses account for 28% of the power generated. A total of 66% of these losses occurred in distribution as a result of the antiquated distribution lines. It is a major policy to improve the distribution network.

Table 2.3.2 Generation, Consumption and Loss of Electric Power

		1972/73	(%)	1982/83	(%)	Growth Rate (%)
Capacity	(MW)	253	-	741	-	12.7
Generation	(Million kWh)	651	100.0	1,516	100.0	8.8
Loss	(Million kWh)	158	24.2	424	28.0	10.4
Consumption	(Million kWh)	493	75.8	1,092	72.0	8.3
Industrial		261	(52.9)	603	(55.2)	8.7
Domestic		131	(26.6)	308	(28.2)	8.9
Miscellaneous		101	(20.5)	181	(16.6)	6.0
GDP	(Million Kyats)	10,538		17,905		5.4

Note : ( ) shows percentage of consumption
Source: Report to the Pyithu Hluttaw

The 1982/83 breakdown for the sources of electric power shows that 62% was by hydro-electric generators, 29% by gas turbine generators, 6% by thermal power generators and 3% by diesel generators. In the future, the generating capacity will increase with the installation of gas turbine plants for the short term, and by the installation of hydro-electric power plants for the long term. Electric generation will meet the future demand since hydro-electric power and natural gas are abundant resources.

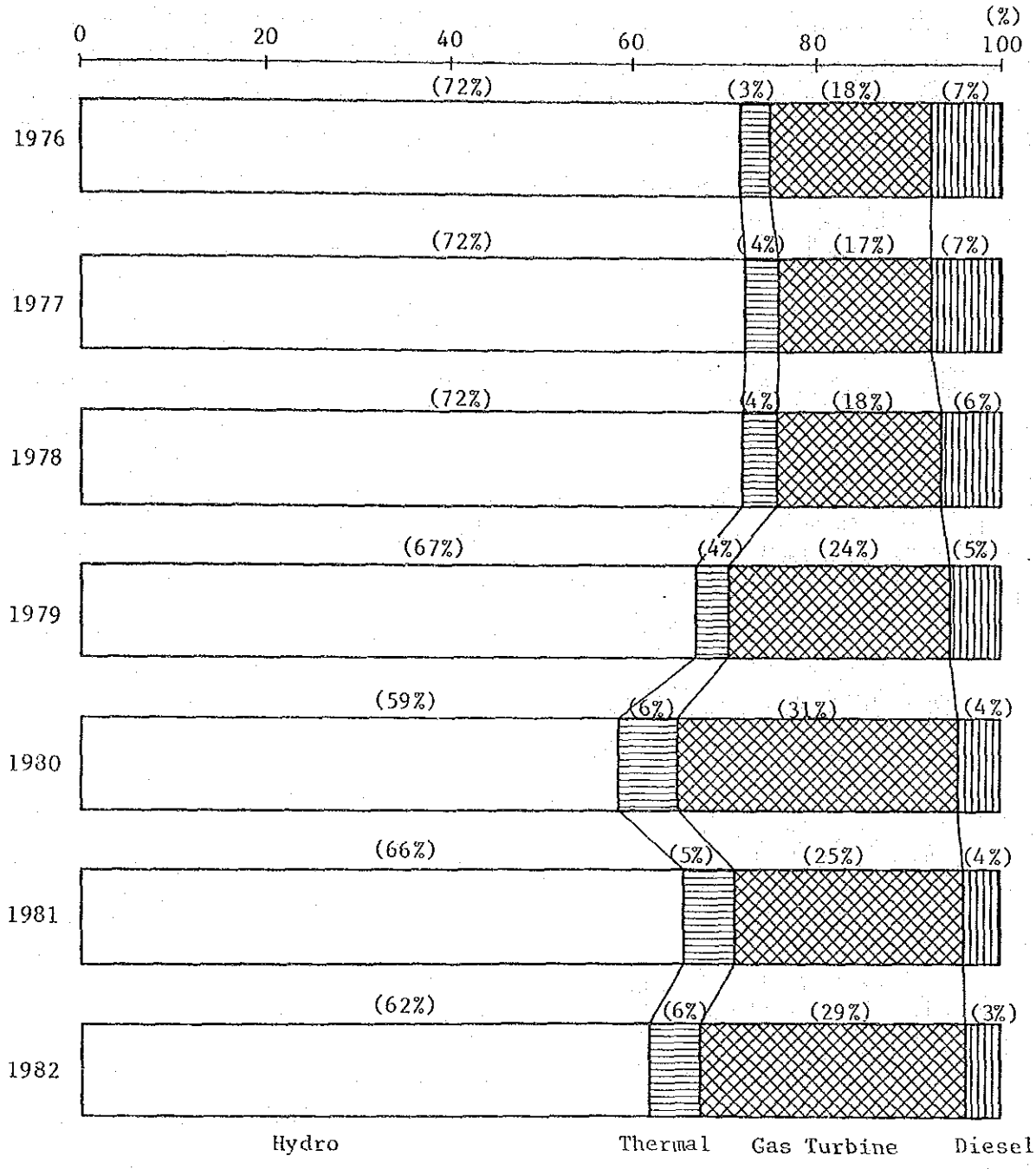


Fig. 2.3.3 Share of Generation by Type

Source: Report to the Pyithu Hluttaw

(2) Costs and prices

The 1982/83 unit cost and sales price were 24.9 Pyas per kWh and 29.0 Pyas per kWh, respectively. Since 1979, the sales price has increased in proportion to the increase in the unit cost due to the installation of gas turbine power plants which have relatively high running costs. Hydro-electricity will increase in importance in the long term, but the huge initial investment required for hydro-electric plants with a low cost operation will mean that the increase of the interest burden will do little to decrease the total running cost.

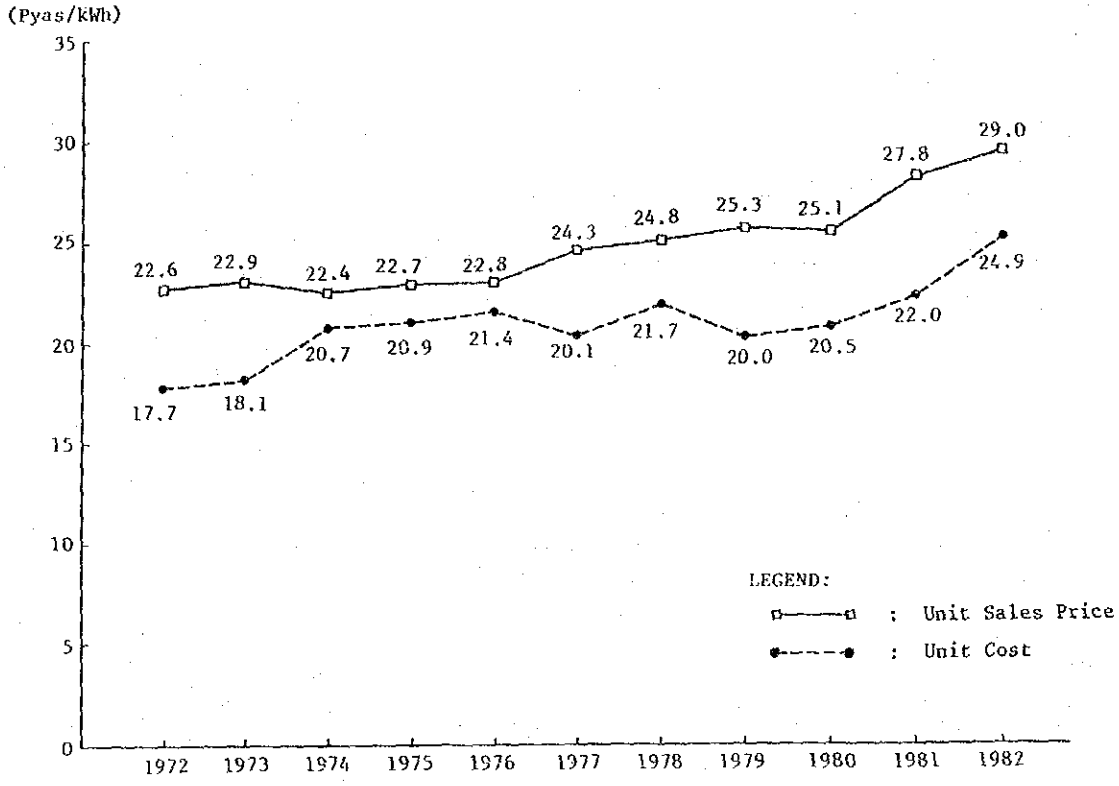


Fig. 2.3.4 Unit Prices and Costs of Electric Energy

Source: Report to the Pyithu Hluttaw

2-4 Development in Rangoon

2-4-1 Population

Rangoon City belongs to the Rangoon Division and is composed of 27 townships. (Ywathagi station is located in Hlegu township outside of Rangoon City.) In 1983, Rangoon City had a population of 2.5 million in an area of 209 square kilometres, making the population density 11.9 thousand persons per square kilometre.

The population of Rangoon City accounts for 6.7% of that of Burma. The growth rate of the population was 2.0% lower than the Burmese population growth rate of 2.2%. The Housing Department estimated that the population of Rangoon City will increase at a higher growth rate than in the past.

The townships of Pabedan, Kyauktada, Latha, Pazundaung and Lanmadaw have extremely high population densities of over 30 thousand persons per square kilometre, while those of Ahlone, Sanchaung, Tamwe and Mingalataungnyunt also have high population densities of over 20 thousand persons per square kilometre. These townships are all located in the southern part of Rangoon City. On the other hand the population of these townships has either decreased or stayed constant with the population dispersal to suburban areas such as Hlaing, Insein, Mayangon, Thingangyun, Dawbon and Thaketa, where the growth rates were more than 2.5% (cf. Fig. 2.4.1).

2-4-2 Employment

The number of employed totals 606 thousand persons and is 24.3% of the population. The ratio of the number of employed to the population shows the characteristics of townships. Pazundaung, Botataung, Kyauktada, Pabedan, Latha, Lanmadaw, Seikkan and Dagon have ratios of above 70%, and are thus typical central business districts (CBD). Mingaladon, North Okkalapa, South Okkalapa, Yankin, Thingangyun, Dawbon and Thaketa have ratios of less than 15%, and are typical residential areas (cf. Fig. 2.4.2).

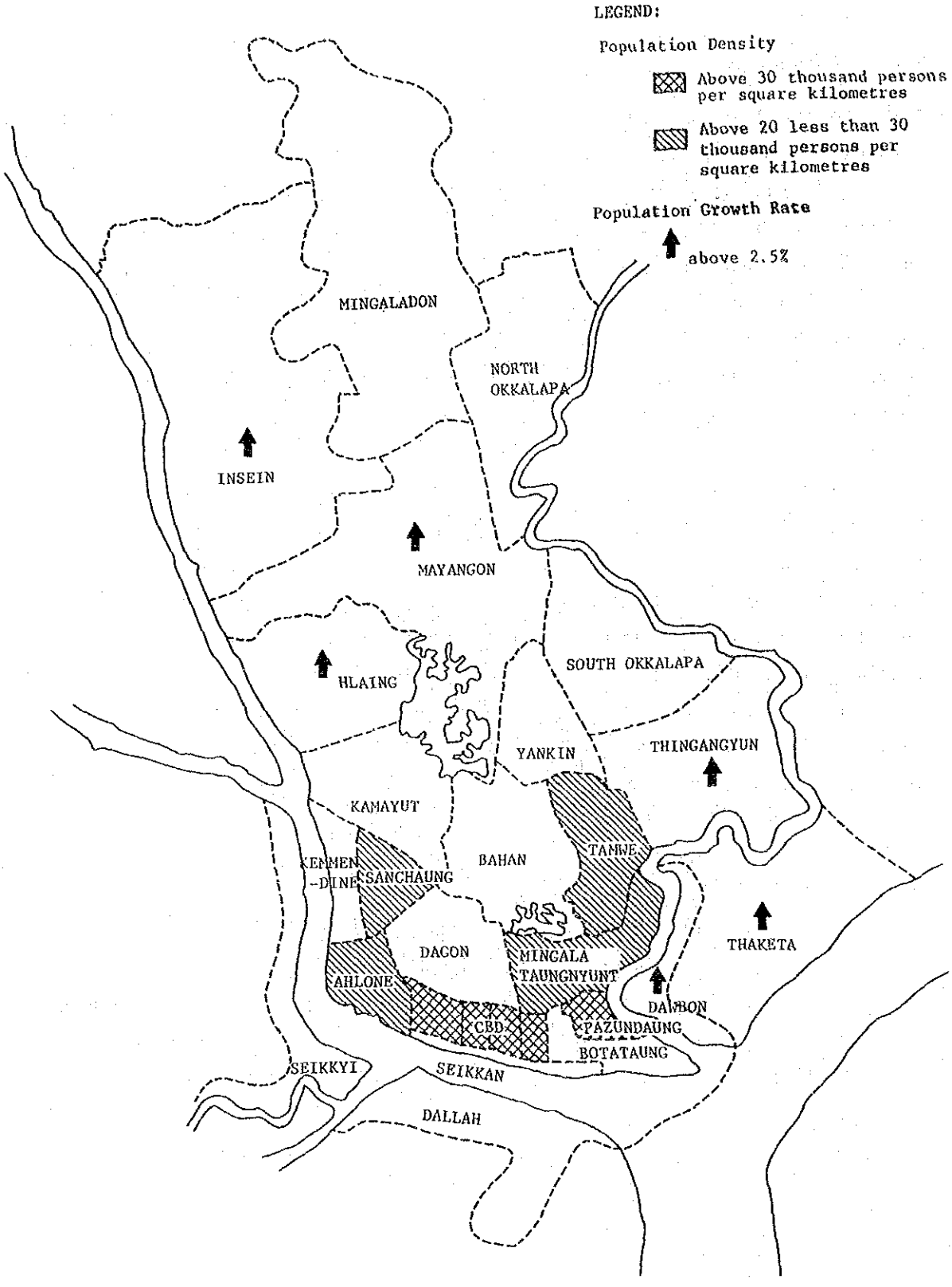


Fig. 2.4.1 Population and Population Density

Table 2.4.1 Township Statistics

	Area (sq.km)	Population 1973	Population 1983	Change Rate	Population Density	No. of Employed	Employed/ Pop.Ratio
1 Pazundaung	1.0	34,763	38,812	1.11%	37,463		
2 Botataung	2.6	44,057	49,103	1.09%	18,959		
3 Kyauktada	0.5	37,772	37,649	-0.03%	72,682		
4 Pabedan	0.5	40,718	41,914	0.29%	80,915	200,000	81.5%
5 Latha	0.8	31,646	30,857	-0.25%	39,713		
6 Lanmadaw	1.3	42,691	41,704	-0.23%	32,204		
7 Seikkan	1.1	7,732	5,288	-3.73%	4,640		
8 Dagon	5.2	35,746	35,541	-0.06%	6,861	25,000	70.3%
9 Ahlone	2.6	46,547	51,864	1.09%	20,025	24,000	46.3%
10 Kemmendine	5.2	64,145	69,907	0.86%	13,496	16,000	22.9%
11 Sanchaung	2.6	66,593	68,891	0.34%	26,599	18,000	26.1%
12 Kamayut	6.2	67,309	75,254	1.12%	12,107	37,000	49.2%
13 Hlaing	12.9	131,587	172,031	2.72%	13,284	34,000	19.8%
14 Insein	20.0	160,957	229,033	3.59%	11,469	36,000	15.7%
15 Mingaladon	29.0	90,845	92,440	0.17%	3,187	12,000	13.0%
16 N. Okkalapa	12.9	155,259	190,965	2.09%	14,746	17,000	8.9%
17 Mayangon	25.9	108,749	152,684	3.45%	5,895	32,000	21.0%
18 S. Okkalapa	10.4	149,409	183,276	2.06%	17,691	17,000	9.3%
19 Yankin	5.2	68,818	82,705	1.86%	15,966	10,000	12.1%
20 Thingangyun	11.4	141,209	193,973	3.23%	17,021	17,000	8.8%
21 Tamwe	5.2	106,628	119,991	1.19%	23,164	20,000	16.7%
22 Bahan	8.8	85,757	102,084	1.76%	11,593	20,000	19.6%
23 Mingala T.N.	5.2	96,287	110,595	1.40%	21,350	36,000	32.6%
24 Dawbon	3.6	37,439	49,872	2.91%	13,754	17,000	7.0%
25 Thaketa	12.9	145,888	193,190	2.85%	14,918		
26 Dallah	10.4	43,503	54,177	2.22%	5,229	18,000	25.9%
27 Seikkyi	5.7	12,458	15,372	2.12%	2,698		
Total	209.1	2,054,512	2,489,172	1.94%	11,902	606,000	24.3%

Source: Housing Department

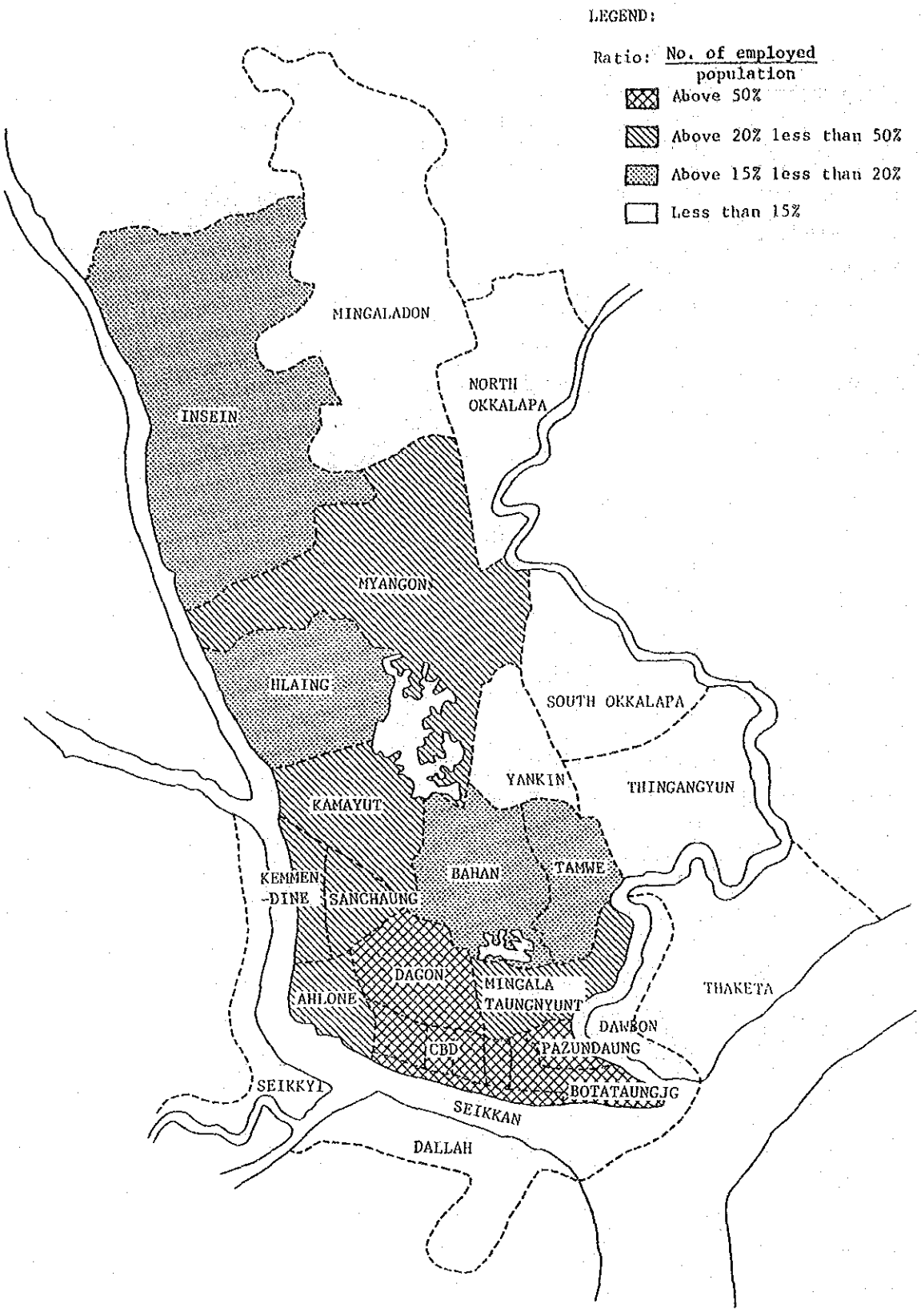


Fig. 2.4.2 Township Characteristics

2-4-3 Development Plan

(1) Development policy

The Housing Department is formulating proposals for long-term development of Rangoon City and Division. The main components of the physical development proposals are:

(a) to be flexible in planning for a population growth of Rangoon City,

(b) to disperse population and employment in Rangoon City,

(c) to form urban migrant satellite towns in suburban areas such as Insein, Mingaladon, Thingangyun and Thaketa, and

(d) to create employment in the suburban areas in order to enhance decentralization of urban functions, such as central government offices, hospitals, educational institutes and shopping centres.

(2) Population

The future population of Rangoon City is conservatively projected to increase at an average annual growth rate of 2%, considering the past trend and the tentative study results of Rangoon development plan conducted by the Housing Department whose projection is more than 2%. The population is projected to reach 2,827 thousand in 1990/91 and 5,136 thousand in 2020/21.

Table 2.4.2 Future Population of Rangoon City

(Unit: Thousand persons)

F/Y	1983/84	1990/91	2000/01	2010/11	2020/21
Population	2,459	2,827	3,450	4,209	5,136

Source: Study estimates

In comparison with other Asian capital cities, Jakarta, Kuala Lumpur, Manila and Bangkok, the population of Rangoon City for the year 2020 will still be less than the present population of these other cities, excepting Kuala Lumpur. These other cities also showed considerably higher growth rates than the projected growth rate for Rangoon City. The projection is regarded as conservative.

Table 2.4.3 Population of Asian Cities

	Jakarta 1980	Kuala Lumpur 1980	Manila 1980	Bangkok 1980
Population (million)	6.5	1.5	5.9	5.2
Growth Rate (%)	3.9 (1970 to 80)	6.9 (1973 to 80)	3.6 (1978 to 80)	5.3 (1970 to 80)

Source: Population count for each city according to 1980 census statistics

The population in the townships, the CBD and around the CBD (i.e. Kyauktada, Pabedan, Latha, Lanmadaw, Seikkan, Dagon, Ahlone, Kemmendine and Sanchaung), are projected to slightly decrease or remain constant, but the populations of Hlaing, Insein, Mingaladon, Mayangon, Thingangyun, Mingalataungnyunt, Dawbon and Thaketa are projected to increase at an average annual growth of above 2.5% until 1990.

Table 2.4.4 Future Framework of Rangoon City

(Unit: Person)

	Population 1982	Population 1990	Growth Rate	No.of Employed 1982	No.of Employed 1997	Increase 1982-1997	(%)	Growth Rate
1 Pazundaung	38,387	41,893	1.1%					
2 Botataung	48,574	52,943	1.1%					
3 Kyauktada	37,661	37,535	-0.0%					
4 Pabedan	41,793	42,740	0.3%	200,000	237,000	37,000	12.8%	1.1%
5 Latha	30,935	30,294	-0.3%					
6 Lanmadaw	41,802	40,996	-0.2%					
7 Seikkan	5,493	4,050	-3.7%					
8 Dagon	35,561	35,372	-0.1%	25,000	29,000	4,000	1.4%	1.0%
9 Ahlone	53,923	39,464	-3.8%	24,000	27,000	3,000	1.0%	0.8%
10 Kemmendine	69,308	74,190	0.9%	16,000	20,000	4,000	1.4%	1.5%
11 Sanchaung	68,657	70,494	0.3%	18,000	19,000	1,000	0.3%	0.4%
12 Kamayut	74,419	81,307	1.1%	37,000	48,000	11,000	3.8%	1.8%
13 Hlaing	166,586	207,376	2.8%	34,000	47,000	13,000	4.5%	2.2%
14 Insein	192,244	248,932	3.3%	36,000	62,000	26,000	9.0%	3.7%
15 Mingaladon	89,754	113,539	3.0%	12,000	31,000	19,000	6.6%	6.5%
16 N. Okkalapa	187,057	220,576	2.1%	17,000	51,000	34,000	11.8%	7.6%
17 Mayangon	147,590	193,476	3.4%	32,000	48,000	16,000	5.5%	2.7%
18 S. Okkalapa	179,569	211,297	2.1%	17,000	30,000	13,000	4.5%	3.9%
19 Yankin	81,199	93,992	1.8%	10,000	14,000	4,000	1.4%	2.3%
20 Thingangyun	187,912	242,066	3.2%	17,000	44,000	27,000	9.3%	6.5%
21 Tamwe	118,589	130,186	1.2%	20,000	28,000	8,000	2.8%	2.3%
22 Bahan	100,320	115,243	1.7%	20,000	29,000	9,000	3.1%	2.5%
23 Mingalataungnyunt	109,073	121,767	1.4%	36,000	54,000	18,000	6.2%	2.7%
24 Dawbon	48,462	60,912	2.9%	17,000	50,000	33,000	11.4%	7.5%
25 Thaketa	187,840	234,983	2.8%					
26 Dallah	53,001	63,125	2.2%	18,000	27,000	9,000	3.1%	2.7%
27 Seikkyi	15,052	17,795	2.1%					
Total	2,410,761	2,826,545	2.0%	606,000	895,000	289,000	100.0%	2.6%

Source: Housing Department, B.R.C., C.S.O.

(3) Employment

In accordance with the tentative study results conducted by the Housing Department, employment for about 290 thousand persons will be created by 1997 to bring the total employment of Rangoon City to 895 thousand persons. More than half of this new employment will be created in the residential areas of Insein, Mingaladon, North Okkalapa, South Okkalapa, Thingangyun, Dawbon and Thaketa.

(4) Major development projects

Major development projects related the Circular and Suburban Lines are as shown below.

a. National stadiums

Indoor and outdoor stadiums are under construction close to Tamwe Station. This sports complex will have a capacity of 70,000 persons, many of whom are expected to use the railways.

b. Extension of Mingaladon Airport

Mingaladon Airport is planned to have its runway extended for the use of large aircraft. The extension of the runway from 2.5 kilometres to 3.4 kilometres will be accompanied by the removal of the Circular Line track and stations between Kyaikkale and Burma Air Force stations. This removal will extend the track length from 45.9 kilometres to 46.6 kilometres. After extension, the Circular Line is expected to be used for transporting people to and from the airport.

c. Ywathagyi food complex

A large food production complex is being constructed on the east side of Ywathagyi station in order to supply livestock products and dairy products to Rangoon. This project involves the construction of housing for the 6000 persons who will be employed there after its completion. The Suburban Line is expected to become an important means of transport for day-trip travel to the CBD.

d. Road and bridge construction

There has been no new road construction in recent years. Several road and bridge construction projects are planned, but it is expected to take a considerably long time for them to be completed. Major plans are for:

d-1 a bypass road from the CBD to Insein

d-2 a bypass road from North Okkalapa to Thaketa

d-3 a bridge with cargo railway from Thaketa to Syrian over the Pegu river

d-4 a bridge from Thingangyun to Thaketa over Pazundaung creek

d-5 a bridge from Insein to Yandoor over the Hlaing river

e. Housing plan

Satellite town construction is planned as an important alternative for the absorption of the population increases. Thingangyun, Hlaing, Mingaladon, and Insein townships are likely sites for satellite towns.

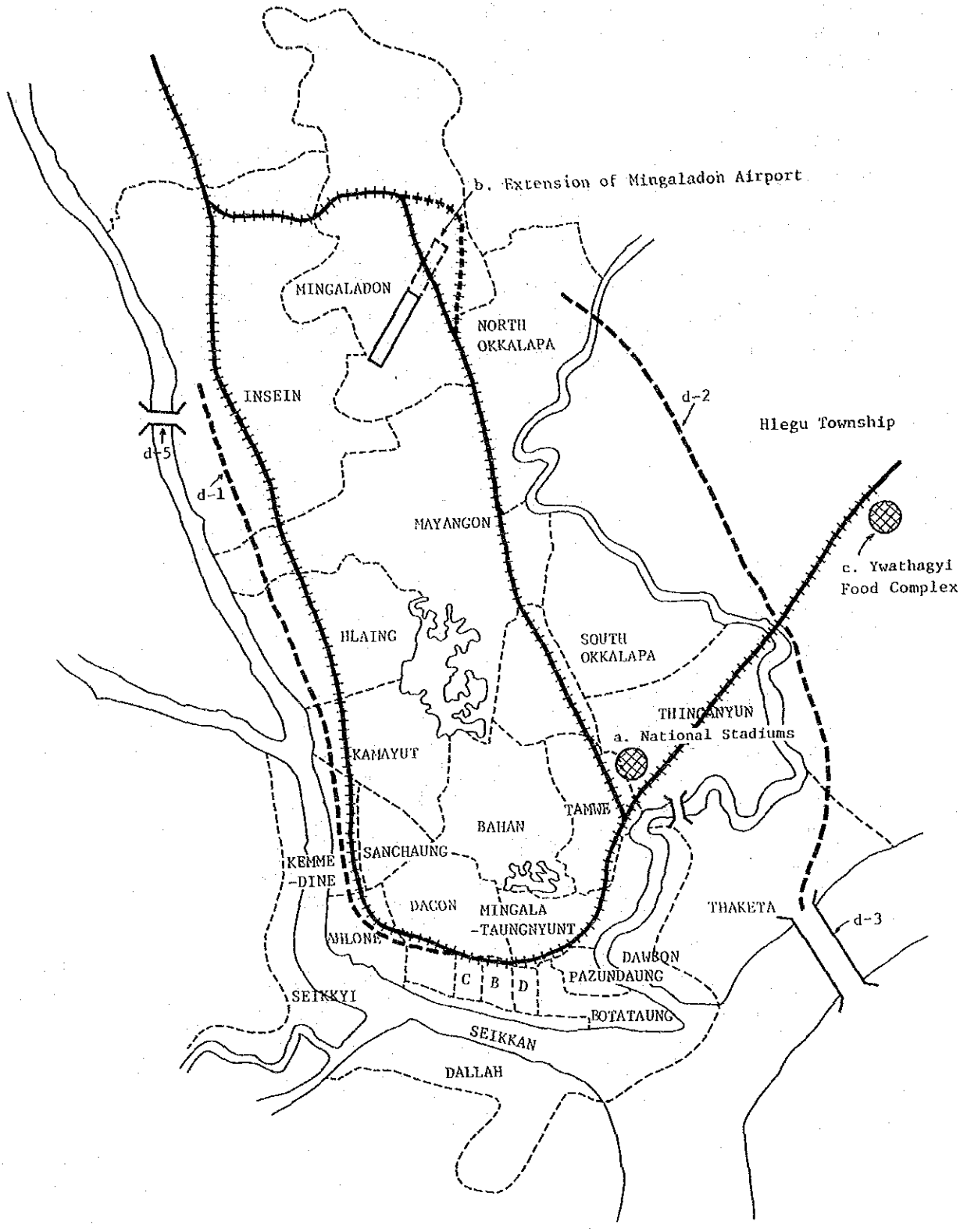


Fig. 2.4.3 Development Plan Map

2-4-4 Traffic Accidents

The number of traffic accidents has been constant since 1979, despite an increase in the number of the registered vehicles.

This is attributed to the increase in the number of traffic police and to the increasing observance of traffic regulations.

Table 2.4.5 Road Traffic Accident in Rangoon City

	Total No. of Accident	No. of Persons		Percentage (%)		No. of Vehicles
		Killed	Injured	Killed	Injured	
1979/80	3,319	259	1,856	7.8	55.9	53,989
1980/81	2,891	255	1,916	8.8	66.1	57,366
1981/82	2,598	268	1,792	10.3	68.9	60,792
1982/83	2,387	168	1,822	7.0	76.3	64,962
1983/84	2,471	150	1,772	6.1	71.7	

Source: Road and Inland Transport Authority
Remarks: 1982/83, 1983/84 More Enforcement in Traffic Police Force.

CHAPTER 3 URBAN TRANSPORT IN RANGOON

CHAPTER 3 URBAN TRANSPORT IN RANGOON

3-1 Outline

3-1-1 Transport Network

Railways, roads and waterways form the basis for urban transport in Rangoon City.

The railways begin at Rangoon station which lies at the north end of the CBD in the south of Rangoon City, and join Insein and Kemmendine to the west of the city, the residential districts of North Okkalapa and South Okkalapa to the east of the city, and Thingangyun and Hlegu which are expected to develop as satellite towns of Rangoon.

Two well-paved, principal roads extend north and south; Prome Road meeting with Insein Road and Kaba Aye Pagoda Road, which form the network with others shown in Fig. 3.1.1. The roads in the CBD are laid out in a grid which has had a one-way traffic system since 1970. The total length of roads in the city is 802 kilometres, 64% of which are paved. However, except for the principal roads, the roads in the city are not well maintained.

Rangoon City lies on the delta of the Irrawaddy River which has extensive inland water transport. In this study, inland water transport was excluded from the investigation for the reason that it does not compete directly with railways.

3-1-2 Transportation Modes

Land transportation in Rangoon is provided by railways, buses, pick-ups, taxies, trishaws, private cars, bicycles and motorcycles.

Buses and pick-ups supplement the railways for medium-distance transport while pick-ups are small-sized trucks with seats and are used for R.D.B.C.C. express services along the same routes as buses, although the number of the stops is less, and the speed and charge is higher than for bus services. R.T.C. also provides the express services called "special buses". Both express services are defined as "Express" in this study.

Outlines of the other means are as follows. A taxi service by small three- or four-wheel vehicles chiefly provides short distance transport. Trishaws (bicycles equipped with seats at the side) chiefly operate over short distances. Saloon cars are expensive, and it is unusual for private cars to be used for commuting or shopping. Motorcycles and bicycles are used for short distance trips.

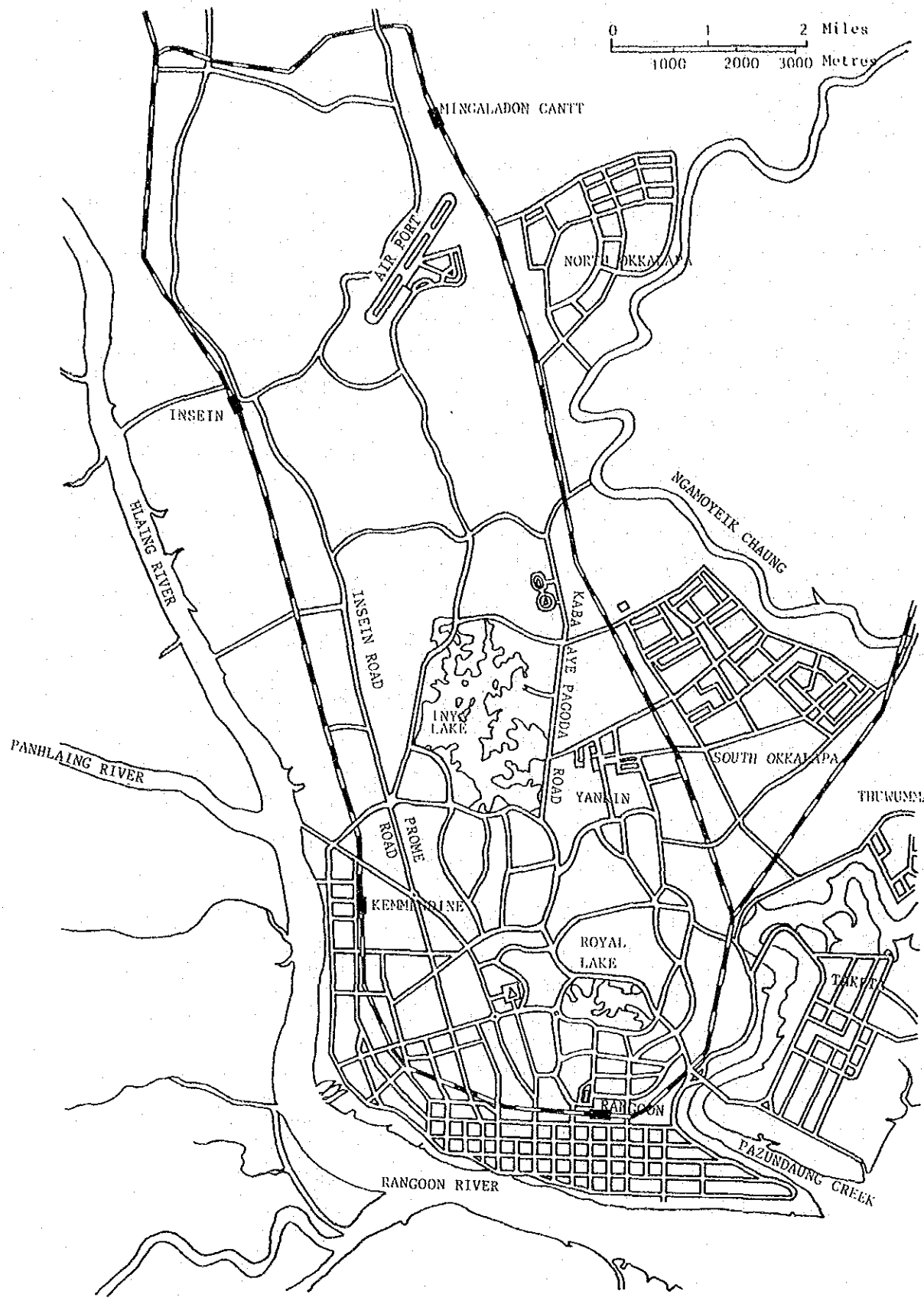


Fig. 3.1.1 Road Network and Railways

The number of pick-ups and motor-cycles have increased at a large rate, while that of taxis and buses has not increased.

Table 3.1.1 Vehicle Registration in Rangoon Division

Type	1979/80	1980/81	1981/82	1982/83	Average Growth Rate Per Year 79/80-82/83
Buses	4,765	4,919	4,885	4,907	1.0%
Taxis (Tri-Wheeler)	1,841	1,852	1,543	1,406	-8.6%
Vans, Pick-ups	10,234	11,146	12,914	14,911	13.4%
Light vans Light trucks Trucks, Lorries	11,238	11,780	12,245	12,820	4.5%
Saloon cars (including jeeps, wagons)	19,305	19,976	20,657	21,119	9.4%
Others (tractors, etc.)	1,614	1,698	1,708	1,852	4.7%
Motor-cycles	4,992	5,995	6,840	7,947	16.8%
Total	53,989	57,366	60,792	64,962	6.4%

Note: Cumulative numbers
Source: Road and Inland Transport Authority

3-1-3 Passengers Carried by Each Mode

The total number of passengers (including railways and buses) has a recent annual increase of 6%.

The number of passengers carried by B.R.C. increased 139% over the nine years from 1974/75 to 1982/83 but a large decrease was recorded for the two years of 1976/77 and 1977/78. In 1979/80, the number recovered to the previous level and has been increasing at a rate of 8% per year. The passenger-kilometres in 1982/83 was 279 million person-kilometres, which corresponds to a record of 8.8 kilometres per person on average. The total numbers of bus passengers for R.T.C. and R.D.B.C.C. show a 6.3% average growth over the nine years.

The number of R.T.C. bus passengers increased only 106% from 1974/75 to 1982/83. This resulted from the lack of bus repair parts, from limitations in the fuel supply, and from passengers changing to R.D.B.C.C. buses due to a rise in the fare with the introduction of a flat fare

system (1981). The passenger-kilometres of R.T.C. buses was 1,003 million kilometres in 1982 (representing an average of 6.9 kilometres per person).

The number of bus passengers for R.D.B.C.C. has increased 220% (10.3% a year on the average growth rate) for the last nine years. In 1981/82, a temporary decrease was recorded because of a lack of fuel. The passenger-kilometres for 1982/83 was 2,165 million representing an average of 7.2 kilometres per person (cf. Table 3.1.2).

Table 3.1.2 Passengers Carried by Main Mode in Rangoon

Period	B.R.C.				
	Passenger (1,000)	Growth Rate	Passenger Kilometres (1,000)	Growth Rate	Average Kilometres
1974/75	22,778		184,211		8.1
75/76	21,741	-4.6%	180,205	-2.2%	8.3
76/77	10,845	-50.1%	91,499	-49.2%	8.4
77/78	11,822	9.0%	98,082	7.2%	8.3
78/79	20,479	73.2%	170,702	74.0%	8.3
79/80	23,288	13.7%	196,568	15.2%	8.4
80/81	27,945	20.0%	234,738	19.4%	8.4
81/82	30,358	8.6%	267,150	13.8%	8.8
82/83	31,738	4.5%	279,294	4.5%	8.8
Average		4.2%		5.3%	8.4

Period	R.T.C. BUS					R.D.B.C.C. BUS					Bus Total			
	Passenger (1,000)	Growth Rate	Passenger Kilometres (1,000)	Growth Rate	Average Kilometres	Passenger (1,000)	Growth Rate	Passenger Kilometres (1,000)	Growth Rate	Average Kilometres	Passenger (1,000)	Growth Rate	Passenger Kilometres (1,000)	Growth Rate
1974/75	136,673		751,654		5.5	136,402		350,083		2.6	273,075		1,101,738	
75/76	140,849	3.1%	740,454	-1.5%	5.3	169,815	24.5%	970,643	177.3%	5.7	310,664	13.8%	1,711,098	55.3%
76/77	170,676	21.2%	1,120,130	51.3%	6.6	220,345	29.8%	1,558,922	60.6%	7.1	391,021	25.9%	2,679,051	56.6%
77/78	184,120	7.9%	1,203,539	7.4%	6.5	245,668	11.5%	1,777,997	14.1%	7.2	429,788	9.9%	2,981,536	11.3%
78/79	162,429	-11.8%	1,035,714	-13.9%	6.4	274,413	11.7%	2,000,701	12.5%	7.3	436,842	1.6%	3,036,414	1.8%
79/80	151,794	-6.5%	1,057,757	2.1%	7.0	303,609	10.6%	2,197,083	9.8%	7.2	455,403	4.2%	3,254,840	7.2%
80/81	132,870	-12.5%	1,064,706	0.7%	8.0	312,669	3.0%	2,255,182	2.6%	7.2	445,539	-2.2%	3,319,888	2.0%
81/82	150,403	13.2%	1,164,067	9.3%	7.7	289,496	-7.4%	2,091,979	-7.2%	7.2	439,899	-1.3%	3,256,046	-1.9%
82/83	144,574	-3.9%	1,002,981	-13.8%	6.9	299,900	3.6%	2,165,064	3.5%	7.2	444,474	1.0%	3,168,045	-2.7%
Average		0.7%		3.7%	6.7		10.3%		25.6%			6.3%		14.1%

Source: B.R.C., R.T.C., R.D.B.C.C.

The transportation results for R.D.B.C.C. pick-ups show 262 thousand persons/day for Jan. 1984, accounting for 27 percent of the total R.D.B.C.C. results. As pick-ups have increased at 13% on the average for the four years since 1980, the number of passengers has increased at roughly the same pace as for pick-ups (cf. see Table 3.1.1).

The total passenger numbers for the three modes (railway, bus and express) in 1982/83 are estimated at 1.6 million, accounting for 0.66 daily trip and is low when compared to that for other large cities in Asia, but is considered to increase with future economic growth (cf. Table 3.1.3, 3.1.4).

Table 3.1.3 Daily Public Transport Trip Rate in Rangoon (1982/83)

Daily Passengers (in thousand)	
Railway	86.8
Bus	1,161.7
Express	348.5
Total	1,597.0
Population (in thousand)	2,411.0
Daily Public Transport Trip Rate	0.66

Source: B.R.C., R.T.C., R.D.B.C.C., Housing Department

Table 3.1.4 Daily Public Transport Trip Rate in Asian Cities

Jakarta	(1972)	0.86
Kuala Lumpur	(1973)	1.76
Manila	(1980)	2.20
Bangkok	(1972)	1.15
Rangoon	(1982)	0.66

Source: Census statistics and transport studies for each city.

3-2 The Present Condition of Bus Transport (including Expresses)

3-2-1 Operation Organization

Bus services are provided by R.T.C., R.D.B.C.C. and cooperatives, and chiefly cover medium-distances. R.T.C. is a state corporation and operates its own buses. In addition to ordinary buses, R.T.C. operates another bus service called 'special buses' with higher speed and fares. R.D.B.C.C. controls bus services and express services by giving permission for service routes to private owners. The cooperative bus service covers only a few routes, and therefore accounts for an extremely small proportion of the total land traffic. Cooperative buses were therefore excluded from this study.

The passenger service division of R.T.C., has seven departments of which five departments are in charge of bus services in Rangoon City. Each department has a traffic group to take charge of bus operation, a motor transport group to maintain buses, a workshop to repair buses and a finance group to take charge of accounts.

Under the head office R.D.B.C.C. has seven branches, and each of these controls two to six bus and express routes. The branch carries out bus operation on the routes in charge, finances and administration.

R.T.C. and R.D.B.C.C. communicate closely with each other on the control of bus operation.

The number of employees by job of both R.T.C. and R.D.B.C.C. is given in Table 3.2.1.

Table 3.2.1 Number of Employees by Job of R.T.C. and R.D.B.C.C.

		R.T.C.	R.D.B.C.C.
Operational	Drivers	1,386	1,777
	Conductors	2,045	1,860
Non operational		717	1,040
Managerial		10	24
	Total	4,158	4,701

Source: R.T.C., R.D.B.C.C.

(1) Vehicles operated

R.T.C. and R.D.B.C.C. had about 3,500 buses and pick-ups registered in 1983/84 and 2,100 vehicles operated correspond to 60% of the registered number (cf. Table 3.2.2).

Table 3.2.2 Registered and Operated Vehicles

			1979/80	80/81	81/82	82/83	83/84
R.T.C.	Bus	Registered	1489	1565	1543	1480	1455
		Operated	637	619	542	624	675
		Ratio: O/R	42.8%	39.6%	35.1%	42.2%	46.4%
R.D.B.C.C.	Bus	Registered	959	988	877	889	889
		Operated	671	691	613	622	622
		Ratio: O/R	70.0%	69.9%	69.9%	70.0%	70.0%
	Pickup	Registered	765	771	894	1068	1169
		Operated	535	539	625	747	818
		Ratio: O/R	69.9%	69.9%	69.9%	69.9%	70.0%
	Total	Registered	1724	1759	1771	1957	2058
		Operated	1206	1230	1238	1369	1440
		Ratio: O/R	70.0%	69.9%	69.9%	70.0%	70.0%

Source: R.T.C., R.D.B.C.C.

(2) Capacity and age

There are few large-scale buses while the remainder has small capacity.

R.T.C. operates both medium- and large-sized buses, which have a capacity of 25 seated and 10 standing, and 42 seated and 10 standing, respectively.

R.D.B.C.C. operates relatively small capacity vehicles, medium-sized buses (24 to 30 persons) acounts for 40% and pick-ups (13 to 17 persons) make up the remainder.

Nearly all of the vehicles of R.T.C. and R.D.B.C.C. are old, and some are well past their service life. A large proportion of the buses running are over thirty years old, with some being more than forty years old.

Old buses are uncomfortable and have maintenance troubles. According to R.T.C. data, the breakdown rate during operation is 5% .

(3) Overview for the future

According to the Fourth Four-Year Plan, R.T.C. will purchase 200 buses, which may be a limit of increasing the large buses. Most private owners cannot afford to purchase buses and so they are obliged to purchase pick-ups. As a consequence, despite the increasing transportation demand, the number of buses with a large capacity will increase slowly, while the number of small-capacity pick-ups will increase rapidly.

3-2-2 Operation Control System

R.T.C. operates 251 buses on the eleven normal bus lines and 75 buses on the seven special bus lines (cf. Table 3.2.3). The buses are operated by a system where the driver and conductor bear responsibility for their bus. This system was introduced in Apr. 1984, for the purposes of the complete repair and maintenance of buses.

Gatekeepers and timekeepers at start-, mid- and end-points perform operation control for departure instruction, passing and arrival times, and record the number of tickets sold by vehicle conductors.

R.D.B.C.C. operates 602 buses on the sixteen bus lines and 814 pick-ups on the twelve express lines, using the same control method as R.T.C. (cf Table 3.2.4). Drivers and conductors are contracted with individual owners while gatekeepers and timekeepers are employed by R.D.B.C.C.

Rangoon University is assisting R.D.B.C.C. in the development of a computer schedule management system.

3-2-3 Transport Conditions

(1) Speed and frequency

Normal buses run at an average scheduled speed of 19 km/hour, while special buses operated by R.T.C. and expresses by R.D.B.C.C. run at 23 km/hour. They cannot maintain their average scheduled speeds because of frequent traffic congestion in peak hours. (cf. Tables 3.2.3 and 3.2.4.)

The average operating frequencies are one R.T.C. normal bus every 11 minutes; one R.D.B.C.C. bus every 7 minutes; one R.T.C. special buses every 17 minutes and one R.D.B.C.C. express every 4 minutes. Many lines provide more frequent (1 to 3 minutes) services in the peak hours (cf. Tables 3.2.3 and 3.2.4.).

Table 3.2.3 R.T.C. Outline

	Line*1	Service*5 Section	No./Buses (operated)	Oneway*2 Trip Time (min.)	Round Trip Distance (Km)	No. of Bus stop (Outward)	No. of Bus stop (Return)	Average*3 Speed (Km/h)	Headway (min.) *4
	(Normal Bus)								
1	No. 2 WHITE	S/OKLP-RN	21	60	32.0	31	31	16.0	10.7
2	No. 2 YELLOW	N/OKLP-RN	18	68	36.2	34	31	16.0	11.5
3	No. 5 WHITE	N/OKLP-RN	18	60	44.2	41	40	22.1	11.6
4	No. 5 GREEN	N/OKLP-RN	27	75	49.6	50	45	19.8	7.7
5	No. 8	ISN-RN	72	60	35.5	36	35	17.8	3.2
6	No. 9 HTAUKKYANT	-MGDN	8	40	32.6	20	21	24.5	17.7
7	No. 9 WIRELESS	MGDN-RN	18	72	56.6	41	40	23.6	13.8
8	No. 9 MAIN	MGDN-RN	17	90	81.6	55	54	27.2	16.9
9	No.10	BAHAN-RN	10	63	31.7	36	39	15.1	12.7
10	No.12 BLUE	SNCNG-RN	18	50	22.1	26	22	13.2	9.0
11	No.12 GREEN	KMDN-TKT	24	55	33.3	36	34	18.2	9.8
	Normal Total		251					19.4	11.3
	(Special Bus)								
1	No. 2 SPECIAL-L	S/OKLP-RN	9	40	28.8	7	7	21.6	17.6
2	No. 2 SPECIAL-P	S/OKLP-RN	12	50	31.7	12	12	19.0	17.6
3	No. 5 SPECIAL-1	N/OKLP-RN	7	40	40.0	9	8	30.0	20.6
4	No. 5 SPECIAL-2	N/OKLP-RN	8	50	44.2	12	6	26.5	20.6
5	No. 8 SPECIAL	ISN-RN	18	40	28.8	6	6	21.6	6.8
6	No.12 SPECIAL-B	BAHAN-RN	10	50	30.4	14	14	18.2	15.7
7	No.12 SPECIAL-G	KMDN-TKT	11	49	33.3	12	12	20.4	17.1
	Special Total		75					22.5	16.6
	Total		326						

Source: R.T.C., January 1984.

Notes: *1 Markings of bus lines have been completely changed in May to July 1984.
*2 In R.T.C., the terms of "One way Trip" and "Round Trip" are used in the same meaning. In this study, "One way Trip" means a half of "Round Trip".
*3 Average Speed = Distance ÷ Trip Time
*4 Headway = Service Hours ÷ Number of Round Trip (cf. Table 3.2.5)
*5 S/OKP: South Okkalapa, RN: Rangoon, N/OKLP: North Okkalapa, ISN; Insein, MGDN: Mingaladon, SNCNG: Sanchaung, KMDN: Kemmendine and TKT: Thaketa.

Table 3.2.4 R.D.B.C.C. Outline

	Line	Service*3 Section	No./Buses (operated)	Oneway Trip Time (min.)	Round Trip Distance (Km)	No. of Bus stop (Outward)	No. of Bus stop (Return)	Average*1 Speed (Km/h)	Headway *2 (min.)
	(BUS)								
1	No. 1	S/OKLP-RN	56	50	28.8	34	31	17.3	3.76
2	No. 1	KMDN-RN	47	35	19.2	34	31	16.5	2.89
3	No. 3	RN-TKT	31	45	25.6	30	26	17.1	5.00
4	No. 3	RN-KMDN	31	30	19.2	16	17	19.2	4.25
5	No. 4	RN-TKT	35	45	28.8	25	25	19.2	5.76
6	No. 7(R)	RN-S/OKLP	38	45	25.6	23	22	17.1	4.63
7	No. 7(Y)	RN-S/OKLP	33	45	25.6	24	23	17.1	5.29
8	No. 11	ALN-TWNA	23	55	32.0	33	33	17.5	10.49
9	No. 13(R)	TGN-RN	32	50	32.0	35	33	19.2	7.04
10	No. 13(G)	TGN-RN	13	50	32.0	33	31	19.2	18.00
11	No. 14	S/OKLP-RN	30	60	35.2	40	38	17.6	7.80
12	No. 15	S/OKLP-ALN	26	60	41.6	47	47	20.8	10.91
13	No. 16	RN-YKN	49	60	36.8	35	35	18.4	5.37
14	No. 16(S)	TMWE-ISN	24	70	38.4	41	41	16.5	11.25
15	No. 17	ALN-N/OKLP	59	60	44.8	37	38	22.4	4.60
16	No. 17	THM-ALN	75	50	43.2	37	36	25.9	2.90
	Bus Total		602					18.8	6.87
	(EXPRESS)								
1	No. 1	RN-S/OKLP	48	35	27.2	28	29	23.3	3.82
2	No. 3	KMDN-TKT	67	45	36.8	26	25	24.5	2.78
3	No. 4	RN-TKT	114	35	28.8	30	28	24.7	1.51
4	No. 7	RN-S/OKLP	64	25	28.8	12	13	34.6	2.60
5	No. 11	RN-TWNA	39	60	46.4	37	37	23.2	7.69
6	No. 11	RN-TWNA	42	40	28.8	26	26	21.6	3.81
7	No. 13	RN-TGN	62	35	28.8	17	17	24.7	2.84
8	No. 16	TMWE-ISN	42	50	40.0	39	38	24.0	6.69
9	No. 16	TKT-TMWE	41	30	23.5	44	44	23.5	5.64
10	No. 16	TMWE-KMDN	55	30	22.4	18	17	22.4	2.29
11	No. 17	RN-ISN	141	35	32.0	27	27	27.4	0.99
12	No. 17	RN-N/OKLP	99	50	43.2	36	38	25.9	2.05
	Express Total		814					25.0	3.56
	Grand Total		1,416						

Source: R.D.B.C.C., February 1984.

Note: *1 Average Speed = Distance ÷ Trip Time
*2 Headway = Service Hours ÷ Number of Round Trip (cf. Table 3.2.6)
*3 TWNA: Thuwunna, TNG: Thingangyun, ALN: Ahlone, TMWE: Tamwe and THM: Thamaing.

(2) Passengers

R.T.C. buses account for 250 thousand passengers daily and R.D.B.C.C. buses for 730 thousand, to give a total of about one million passengers carried. Express services by R.T.C. carry 40 thousand and those by R.D.B.C.C. carry 260 thousand to give a total of 300 thousand. (cf. Tables 3.2.5 and 3.2.6). Considering that there are 850 buses and 890 expresses operating, each bus carries 1,170 passengers/day and each express 340 passengers/day, producing a capacity difference of about 350%.

There are many passengers between the CBD and Insein, North Okkalapa and South Okkalapa.

The average travel distance is 7.5 kilometres for R.T.C. normal buses and 13.6 kilometres for special buses. The longer distance for special buses seems to result from the different fares (cf. Table 3.2.5).

The passenger concentration ratios for peak hour are given in Table 3.2.7. Some lines have concentrations so high that passengers have to cling to the outside of the vehicle, with many passengers being left at stops in peak hours.

In the morning and evening peak hours, the demand for the highest frequency of traffic is between the residential areas and the CBD.

3-2-4 Fares and Revenue

(1) Fare system

R.T.C. has a flat fare system while R.D.B.C.C. uses a flat fare of 1 Kyat for the express, and a sliding fare for distance except for some lines at the bus service. There is no commuter discount system.

(2) Revenue

The average daily revenue is 90 thousand Kyats for R.T.C. normal buses and 175 thousand Kyats for R.D.B.C.C. buses, amounting to 265 thousand Kyats in total. R.T.C. special buses earn 40 thousand Kyats, while R.D.B.C.C. expresses earn 190 thousand Kyats, with the total being 230 thousand Kyats. The difference in revenue between buses and expresses is small when compared to the difference in the numbers of passengers (10:3) between them. This is because of the fare difference.

Table 3.2.5 R.T.C. Passenger Volume & Revenue

	Line	Service Section	Passenger No./Day	Passenger No./Oneway Trip	Oneway Trip No. /Day	Oneway Trip No. /Bus/Day	Bus Km /Day (Km)	Passenger Km/Day (Km)	Distance*1 Carried (Km)	Fare(Flat) (Pyas)	Revenue (Kyats/Day)	Marginal Fare*2 /Distance (Pyas/Km)
	(NORMAL BUS)											
1	NO. 2 WHITE	S/OKLP-RN	15,924	79	202	12.6	3,006	132,488	8.3	40	6,369	3.6
2	NO. 2 YELLOW	N/OKLP-RN	21,326	114	188	11.0	3,399	146,723	6.9	30	6,398	2.9
3	NO. 5 WHITE	N/OKLP-RN	15,227	82	186	10.4	4,092	146,179	9.6	40	6,091	3.1
4	NO. 5 GREEN	N/OKLP-RN	28,245	100	282	10.8	6,881	266,633	9.4	40	11,298	3.2
5	NO. 8	ISN-RN	69,376	102	680	12.2	12,077	532,808	7.7	30	20,813	2.6
6	NO. 9 HTAUKKYANT	-MGDN	6,539	54	122	13.6	1,991	40,803	6.2	50	3,269	6.4
7	NO. 9 WIRELESS	MGDN-RN	21,751	140	156	9.0	4,418	135,726	6.2	80	8,309	11.2
8	NO. 9 MAIN	MGDN-RN	16,853	132	128	7.4	5,171	105,163	6.2	100	7,946	14.4
9	NO.10	BAHAN-RN	15,200	90	170	10.6	2,666	109,440	7.2	30	4,560	2.8
10	NO.12 BLUE	SNCNG-RN	21,906	91	240	12.0	2,765	129,684	5.9	30	6,572	3.4
11	NO.12 GREEN	KMDN-TKT	22,240	101	220	10.4	3,538	160,128	7.2	30	6,672	2.8
	NORMAL TOTAL		254,587		2,574		50,003	1,905,774	7.5		88,297	5.1
	(SPECIAL BUS)											
1	NO. 2 SPECIAL-L	S/OKLP-RN	8,842	36	246	14.4	3,542	101,860	11.5	100	8,842	
2	NO. 2 SPECIAL-P	S/OKLP-RN		36						100		
3	NO. 5 SPECIAL-1	N/OKLP-RN	8,386	37	210	14.0	4,385	139,543	16.6	100	8,386	
4	NO. 5 SPECIAL-2	N/OKLP-RN		37						100		
5	NO. 8 SPECIAL	ISN-RN	11,784	37	320	16.8	5,683	167,804	14.2	100	11,784	
6	NO.12 SPECIAL-B	BAHAN-RN	5,207	38	138	12.2	2,098	63,317	12.2	100	5,207	
7	NO.12 SPECIAL-G	KMDN-TKT	4,691	38	126	12.6	1,915	57,043	12.2	100	4,691	
	SPECIAL TOTAL		38,910		1,040		17,623	529,567	13.6		38,910	
	TOTAL		293,497		3,614		67,626	2,435,341	8.3		127,207	

Source: R.T.C., February 1984.

Notes : *1 Average distance carried = Passenger Km ÷ Number of Passenger
*2 Marginal Fare = (Fare - 10) ÷ Average distance carried

Table 3.2.6 R.D.B.C.C. Passenger Volume & Revenue

	Route	Service Section	Passenger No./Day	Passenger No./Oneway Trip	Oneway Trip No. /Day	Oneway Trip No. /Bus/Day	Bus Km /Day (km)	Fare*1 (Pyas)	Av. Fare*2 (Pyas)	Revenue (Kyats/Day)
	(BUS)									
1	NO. 1	S/OKLP-RN	53,731	93	575	10.3	8,280	40	40	21,492
2	NO. 1	KMDN-RN	62,145	83	748	15.9	7,181	30	30	18,644
3	NO. 3	RN-TKT	28,634	66	432	13.9	5,530	40	40	11,454
4	NO. 3	RN-KMDN	31,866	62	508	16.4	4,877	30	30	9,560
5	NO. 4	RN-TKT	43,839	117	375	10.7	5,400	10,(10), 50	21.1	9,270
6	NO. 7(R)	RN-S/OKLP	52,662	113	467	12.3	5,978	10, (5), 50	19.7	10,353
7	NO. 7(Y)	RN-S/OKLP	46,009	113	408	12.4	5,222	10, (5), 45	19.7	9,045
8	NO.11	ALN-TWNA	34,620	168	206	9.0	3,296	10,(10), 50	19.0	6,566
9	NO.13(R)	TGN-RN	46,310	151	307	9.6	4,912	10, (5), 45	18.6	8,617
10	NO.13(G)	TGN-RN	18,102	151	120	9.2	1,920	10, (5), 45	18.6	3,368
11	NO.14	S/OKLP-RN	49,199	178	277	9.2	4,875	10, (5), 45	16.9	8,322
12	NO.15	S/OKLP-ALN	37,966	192	198	7.6	4,118	10,(10), 60	19.9	7,538
13	NO.16	RN-YKN	99,694	248	402	8.2	7,397	10, (5), 45	13.2	13,178
14	NO.16(S)	TMWE-ISN	19,639	102	192	8.0	3,686	30, 60	36.2	7,117
15	NO.17	ALN-N/OKLP	81,332	173	470	8.0	10,528	10,(10), 70	19.7	15,986
16	NO.17	THM-ALN	21,612	29	746	9.9	16,114	50,100	70.3	15,184
	BUS TOTAL		727,360	113	6,431	10.7	99,314		24.2	175,696
	(EXPRESS)									
1	NO. 1	RN-S/OKLP	13,090	23	566	11.8	7,698	100	79.0	10,336
2	NO. 3	KMDN-TKT	23,182	30	776	11.6	14,278	100	72.6	16,834
3	NO. 4	RN-TKT	35,742	25	1,431	12.6	20,606	100	73.3	26,200
4	NO. 7	RN-S/OKLP	14,341	17	831	13.0	11,966	100	85.2	12,212
5	NO.11	RN-TWNA	9,267	33	281	7.2	6,519	100	63.5	5,883
6	NO.11	RN-TWNA	11,675	21	567	13.5	8,165	100	76.2	8,898
7	NO.13	RN-TGN	18,440	24	761	12.3	10,958	100	73.1	13,477
8	NO.16	TMWE-ISN	13,284	41	323	7.7	6,460	100	66.4	8,826
9	NO.16	TKT-TMWE	22,899	60	383	9.3	4,504	100	50.1	11,470
10	NO.16	TMWE-KMDN	20,355	22	944	17.2	10,573	100	70.7	14,388
11	NO.17	RN-ISN	54,698	25	2,185	15.5	34,960	100	74.0	40,475
12	NO.17	RN-N/OKLP	24,806	24	1,054	10.6	22,766	100	96.9	24,043
	EXPRESS TOTAL		261,779	26	10,102	12.4	159,454		73.7	193,042
	GRAND TOTAL		989,139	59	16,533	11.7	258,768			368,738

Source: R.D.B.C.C., January 1984.

Notes : *1 R.D.B.C.C. has fixed fare lines and variable fare lines by distance. In the latter case, the figures in the left column show the minimum fare, the centre column in parentheses the unit of fare advancement, and the right column the maximum fare.

*2 Average Fare = Revenue ÷ No. of Passengers

Table 3.2.7 R.D.B.C.C. Passenger Volume by Peak Hours

	Route	Service Section	Passenger No./Day	Peak Hours				
				Passenger No./7-10 hour *		Passenger No./15-19 hour *		Total
	(BUS)							
1	NO. 1	S/OKLP-RN	53,731	11,400	21%	12,000	22%	44%
2	NO. 1	KMDN-RN	62,145	7,000	11%	8,000	13%	24%
3	NO. 3	RN-TKT	28,634	7,158	25%	9,544	33%	58%
4	NO. 3	RN-KMDN	31,866	7,966	25%	10,622	33%	58%
5	NO. 4	RN-TKT	43,839	17,360	40%	17,360	40%	79%
6	NO. 7(R)	RN-S/OKLP	52,662	6,480	12%	10,440	20%	32%
7	NO. 7(Y)	RN-S/OKLP	46,009	6,080	13%	9,600	21%	34%
8	NO.11	ALN-TWNA	34,620	12,000	35%	12,000	35%	69%
9	NO.13(R)	TGN-RN	46,310	11,577	25%	15,436	33%	58%
10	NO.13(G)	TGN-RN	18,102	4,525	25%	6,033	33%	58%
11	NO.14	S/OKLP-RN	49,199	12,299	25%	16,399	33%	58%
12	NO.15	S/OKLP-ALN	37,966	9,491	25%	12,654	33%	58%
13	NO.16	RN-YKN	99,694	26,350	26%	24,800	25%	51%
14	NO.16(S)	TMWE-ISN	19,639	6,000	31%	5,000	25%	56%
15	NO.17	ALN-N/OKLP	81,332	20,332	25%	27,110	33%	58%
16	NO.17	TIM-ALN	21,612	5,403	25%	7,204	33%	58%
	BUS TOTAL		727,360	171,421	24%	204,202	28%	52%
	(EXPRESS)							
1	NO. 1	RN-S/OKLP	13,090	3,200	24%	2,300	18%	42%
2	NO. 3	KMDN-TKT	23,182	6,365	27%	9,648	42%	69%
3	NO. 4	RN-TKT	35,742	13,664	38%	13,664	38%	76%
4	NO. 7	RN-S/OKLP	14,341	3,920	27%	3,920	27%	55%
5	NO.11	RN-TWNA	9,267	1,680	18%	1,680	18%	36%
6	NO.11	RN-TWNA	11,675	5,400	46%	5,400	46%	93%
7	NO.13	RN-TGN	18,440	8,733	47%	8,432	46%	93%
8	NO.16	TMWE-ISN	13,284	3,060	23%	3,060	23%	46%
9	NO.16	TKT-TMWE	22,899	5,400	24%	5,400	24%	47%
10	NO.16	TMWE-KMDN	20,355	4,140	20%	4,140	20%	41%
11	NO.17	RN-ISN	54,698	15,836	29%	21,608	40%	68%
12	NO.17	RN-N/OKLP	24,806	7,575	31%	12,423	50%	81%
	EXPRESS TOTAL		261,779	78,973	30%	91,675	35%	65%
	GRAND TOTAL		989,139	250,394	25%	295,877	30%	55%

Source: R.D.B.C.C., January 1984.

Notes : * Peak hours ratio = Peak hours passengers ÷ One day total passengers

3-3 The Present Condition of Railways

3-3-1 Outline of B.R.C. Railways

B.R.C had 4,442 track kilometres with one metre gauge in 1982/83 (cf. Fig. 3.3.1).

The transportation results for 1982/83 are given in Table 3.3.1. In this, there are 60 million passengers and 3,525 million passenger--kilometres, while freight shows 2.7 million tons and 648 million ton--kilometres.

Table 3.3.1 B.R.C. Results

Year	No. of Passenger (in Thousand)	Passenger kilometres (in Million)	Freight ton (in Thousand)	Freight ton-kilometres (in Million)
1978/79	45,544	3,045	1,884	460
1979/80	49,614	3,212	2,191	522
1980/81	52,821	3,388	2,258	533
1981/82	57,745	3,394	2,337	556
1982/83	59,739	3,525	2,650	648

Source: Report to the Pyithu Hluttaw

As shown in Fig. 3.3.2, B.R.C. has six departments and eight divisions. The Circular and Suburban Lines belong to the sixth division.

B.R.C. employs 30,154 employees who have an oppotunity to be trained at the Central Training School of Transport and Communication (CTSTC) near Thazi, and at the Railways Technical Training Centre (RTTC) at Ywataung workshop near Mandalay.

3-3-2 Brief History of the Circular Line

The section between Danyingon and Mingaladon Cantt was opened on May 1, 1959 and the entire double track of the Circular Line was completed on November 1, 1960.

There was an attempt to increase the traffic frequency by introducing diesel railcars equipped with air brakes in 1959 but these diesel railcars fell into disuse after about thirteen years because of frequent trouble.

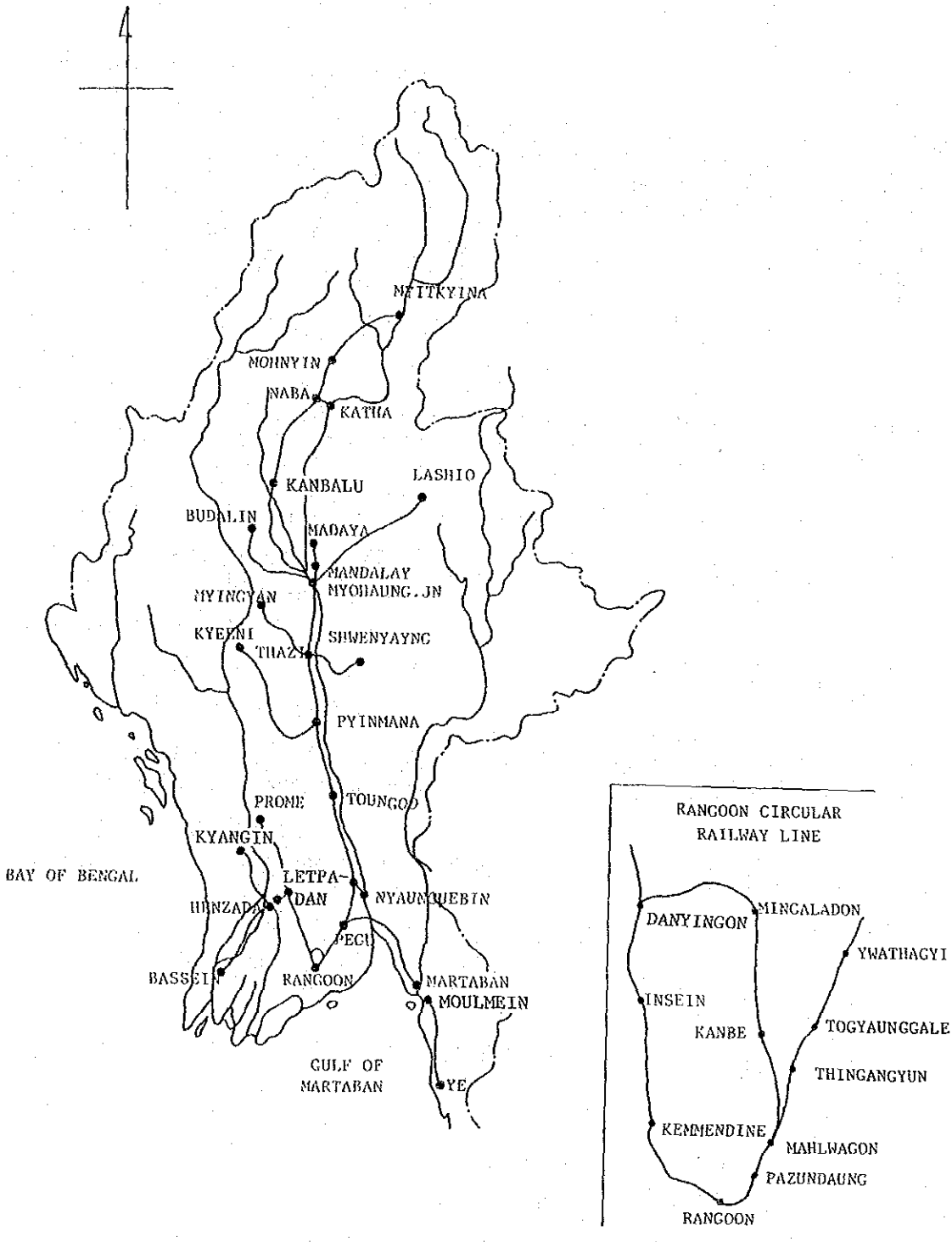


Fig. 3.3.1 Key Map of Burma Railways

Source: B.R.C.

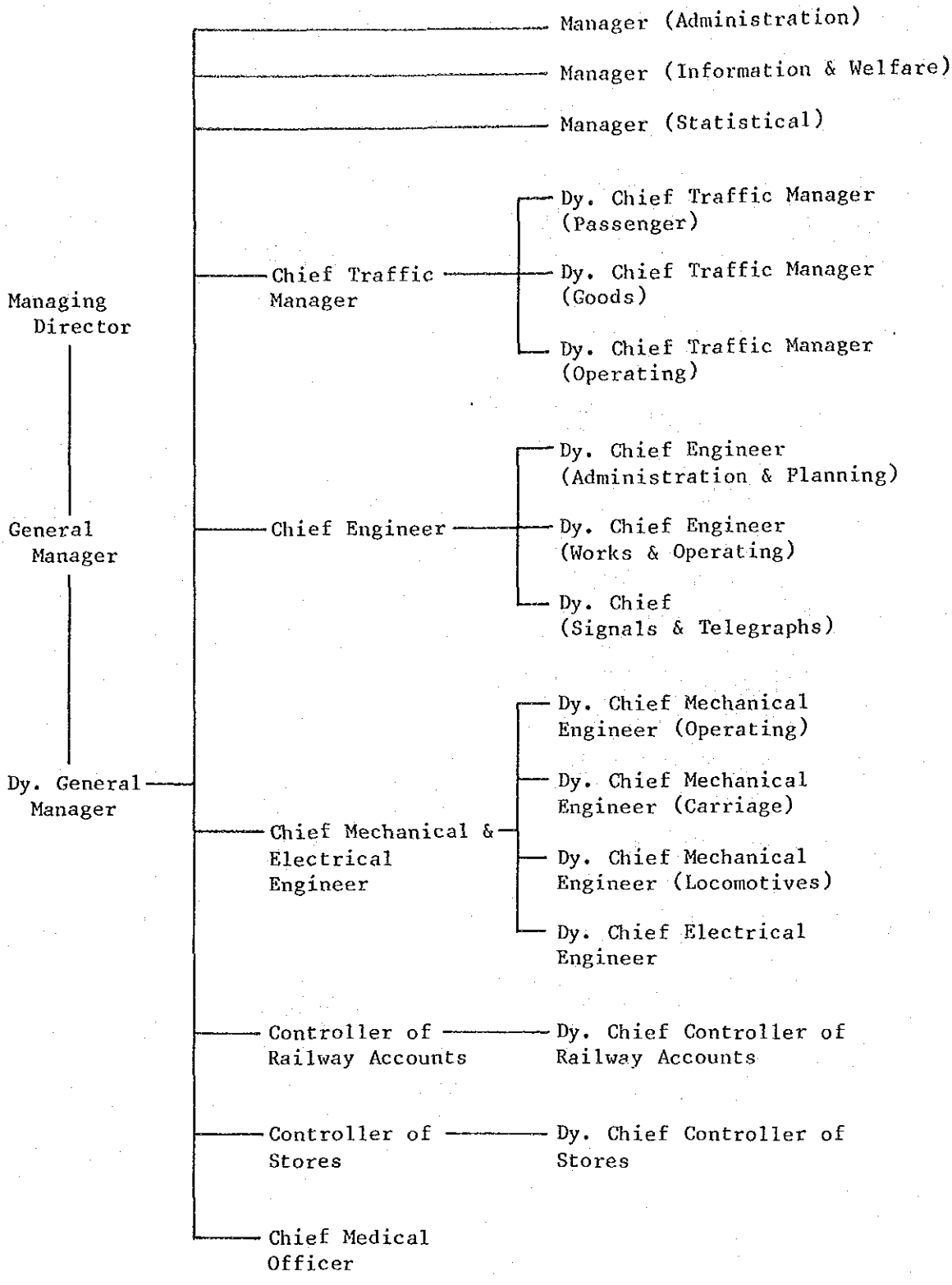


Fig. 3.3.2 Organization Chart of B.R.C.

Source: B.R.C.

In 1973, speed increases were attempted by push-pull operation with diesel-electric locomotives, but management problems including the lack of parts for repair forced the discontinuation of push-pull operation after one year.

3-3-3 Station Surroundings

There are 37 stations on the Circular Line and 8 stations (including 3 stations jointly used with the Circular Line) on the Suburban Line. These stations are classified into two types: block station having a stationmaster and clerks, and pick-up station having only station clerks. There are 17 stations (including Rangoon, Insein, etc.) of the former type, and the remaining 25 stations are of the latter. The outline of these station surroundings was obtained by observation and by interviews with stationmasters and clerks.

While bus stops are arranged close to the centres of the CBD and residential areas, the stations are located slightly away from the centre. For example, stations such as Rangoon, Pagoda Road and Lanmadow lie at the northern end of the CBD, and Okkalapa and Paywetseikkon are at the west end of North Okkalapa new town, and Kanbe and Bauktaw at the west end of South Okkalapa new town.

Almost no stations have either station plazas or well-developed shopping centres nearby.

Except for a few stations, access roads are not well constructed, and there are only narrow paths. Connections between bus routes and railways are not properly made and so only a few passengers change cars at places such as Insein, Pazundaung, and Tadagale, where bus stops are located close to stations.

There is insufficient fencing around the station yards and track, and many persons walk freely onto the track.

3-3-4 Train Operation

(1) Train diagram

The Circular and Suburban Lines are operated separately. On the Circular Line there is both loop and shuttle operations (Rangoon-Insein and Rangoon-Mingaladon Cantt), while the Suburban Line has three shuttle operations (Rangoon-Thingangyun, Rangoon-Togyaunggale and Rangoon-Ywathagyi).

A train is composed of a diesel electric locomotive and six carriages. According to the existing train schedule, 87 trains are operated every day amounting to 2,229 train-kilometres on the Circular Line and 38 trains operate 435.8 train-kilometres on the Suburban Line. (cf. Table 3.3.2.)

Table 3.3.2 Current Number of Trains in Operation per Day

1.	Outer Turn Circular Trains	-	12
2.	Inner Turn Circular Trains	-	15
3.	Rangoon - Insein	-	16
4.	Insein - Rangoon	-	17
5.	Rangoon - Mingaladon	-	10
6.	Mingaladon - Rangoon	-	10
7.	Insein - Mingaladon - Rangoon	-	2
8.	Rangoon - Mingaladon - Insein	-	3
9.	Rangoon - Ywathagyi	-	3
10.	Ywathagyi - Rangoon	-	3
11.	Rangoon - Togyaunggale	-	9
12.	Togyaunggale - Rangoon	-	9
13.	Rangoon - Thingangyun	-	7
14.	Thingangyun - Rangoon	-	7
	Total		123
15.	Special on Saturday	-	2
			125

Source: B.R.C.
Note : 1983/84 Train Running kilometres per Day 2664.8 Train km

There are four trains operated in the peak two hours, and at least one train operated in the off-peak hour.

(2) Operating time and speed

The schedule shows that it takes 140 to 145 minutes for a round trip on the Circular Line (45.9 kilometres), and 53 minutes for a train to travel on the Suburban Line between Rangoon and Ywathagyi (20.7 kilometres).

The scheduled speed for the Circular and Suburban Lines is 19.7 km/hour and 23.3 km/hour respectively. The low scheduled speed for the Circular Line is due to the short distances between stations.

The maximum speed for the Circular Line is 48 km/hour, and that for the Suburban Line, between Mahlwagon Junction and Ywathagyi, is 56 km/hour.

(3) Train configuration and allocation

There are 125 trains per day and these are operated with 10 diesel electric locomotives (another 3 for maintenance and stand-by) and 60 carriages (another 24 awaiting spares). All diesel locomotives are based at the Insein shed. Carriages are separately based at the Insein and Rangoon sheds. Every day, ten train units are configured with one diesel electric locomotive and six carriages each, at both Insein and Rangoon sheds. Diesel electric locomotives are sent back to the Insein shed.

(4) Train operation control

Three train dispatchers work in the operation control room at the Rangoon station signal cabin where the necessary telephones are provided. Each diesel electric locomotive is operated by a driver and an assistant driver, and there are 26 such driver pairs.

(5) Operation accidents and troubles

Data for the type and number of operating accidents and troubles occurring in the previous two years, shows that there are frequent engine and signal failures (cf. Table 3.3.3.).

According to results for the 1983, cancellations and delays longer than 30 minutes occurred at an average rate of 8% (cf. Table 3.3.4.).

Table 3.3.3 Train Operation Accidents and Troubles

Type of Accidents and Troubles	1982/83	1983/84 (up to 7.3.84)
Engine Failure	307	556
Signals Failure	109	234
Railway Level Crossing Accident	2	2
Total Derailments Including Goods (mostly minor yard derailments)	53	37
Derailments of Passenger Train and carriage	3	8
Collision of Trains	-	1
Fire on Train	-	1

Source: B.R.C.

Table 3.3.4 Rangoon Suburban Trains Punctuallity in Percentage

Year	Month	On Time	1" to 10"	11" to 30"	Above 30"	Cancelled
1983	January	88	4	4	3	1
	February	86	5	4	3	2
	March	81	3	6	5	5
	April	82	3	5	5	5
	May	82	6	5	3	4
	June	84	5	5	3	3
	July	82	4	6	4	4
	August	84	5	4	4	3
	September	82	6	4	5	3
	October	79	5	4	8	4
	November	80	5	6	6	3
	December	80	5	4	7	4
1984	January	70	7	6	11	6
	February	66	6	6	20	2

Source: B.R.C.

3-3-5 Passengers

(1) Changes in passenger numbers

The Circular and Suburban Lines carried 32 million passengers in 1983/84. The monthly change of passengers fluctuates within ± 10% (cf. Table 3.3.5.).

Table 3.3.5 Number of Passengers of the Circular and Suburban Lines

(Unit: Thousand)

	1981/82 Number	Index	1982/83 Number	Index	1983/84 Number	Index
Apr.	2,358	93.2	2,519	95.2	2,486	94.3
May	2,464	97.4	2,717	102.7	2,728	103.5
Jun.	2,406	95.1	2,695	101.9	2,656	100.7
Jul.	2,549	100.8	2,765	104.5	2,726	103.4
Aug.	2,534	100.2	2,608	98.6	2,615	99.2
Sep.	2,457	97.1	2,687	101.6	2,628	99.7
Oct.	2,684	106.1	2,792	105.6	2,717	103.1
Nov.	2,502	98.9	2,649	100.2	2,645	100.3
Dec.	2,615	103.4	2,515	95.1	2,649	100.5
Jan.	2,895	114.4	2,684	101.5	2,549	96.7
Feb.	2,382	94.2	2,431	91.9	2,501	94.9
Mar.	2,512	99.3	2,676	101.2	2,735	103.7
Total	30,358		31,738		31,635	
Average	2,530	100.0	2,645	100.0	2,636	100.0

Source: B.R.C.

(2) Origin destination (OD) table between stations (cf. Table 3.3.6)

At the request of the study team, the B.R.C. carried out an OD survey based on the number of tickets sold for each time zone and each destination at stations on three occasions (Mar. 1, Mar. 15 to 21, June 25 to July 1, 1984).

Table 3.3.7 shows the ranking of the stations in boarding passenger number. The top twelve stations account for about 60% of all passengers. On the other hand, stations with a passenger ratio of less than one percent (corresponding to passengers taking a train per day less than 1,000) amount to about ten.

The major passenger flow from Rangoon station is to Thingangyun, to between Kamayut and Insein, to Tadagale and to Kanbe.

From Insein station, there are many short distance passengers to Okkyin, Thamaing and Gyogon, in order. Rangoon station ranks fourth.

From Mingaladon Cantt, there are also many short distance passengers to Paywetseikkon, Tadagale and Okkalapa.

(3) Cross-section passenger volume

The cross section passenger volume between all stations was calculated on the basis of the OD survey. In the morning peak hours (7:00 to 9:00), the maximum value of 1,533 persons/hour was shown from Kamayut to Hletan, followed by 865 persons/hour from Mahlwagon to Pazundaung on the Suburban Line. In the evening peak hours (15:00 to 17:00), a lesser maximum value than for the morning was given for the same section between stations in the reverse direction.

As regards the daily total, there are large passenger volumes between Insein and Rangoon, between Mingaladon Cantt and Rangoon and between Thingangyun and Rangoon, on the other hand, there are extremely small cross section passenger volumes between Insein and Mingaladon Cantt and between Thingangyun and Ywathagyi (cf. Fig. 3.3.3, Table 3.3.8.).

Table 3.3.6 Daily Railway OD between Stations (Present)

(Unit: Person per day)

Origin \ Destination	1. RN	2. PZG	3. MLG	4. MTNY	5. TMWE	6. BKW	7. KNBE	8. PYMR	9. YEGU	10. TDGL	11. KKYD	12. PYSK	13. OKLP	14. BAF	15. MGCT	16. MGTA	17. KKLE	18. GCS	19. DNGN	20. AGSM	21. HPK	22. YAA
1. Rangoon	10	423	326	172	167	157	244	139	86	276	108	160	133	116	198	255	29	11	4	3	15	28
2. Pazundaung	319	3	119	53	50	168	240	139	70	346	179	157	127	66	186	23	38	10	10	1	2	4
3. Mahlwagon	396	106	2	58	56	78	119	97	49	158	65	98	81	25	87	43	18	9	5	4	6	34
4. Myithayunt	158	68	65	1	36	67	71	41	21	157	80	64	53	28	58	29	20	0	0	2	3	6
5. Tamwe	125	54	45	24	0	48	96	71	36	141	72	109	62	32	108	25	17	3	3	0	1	2
6. Bauktaw	192	96	66	35	32	2	113	56	48	154	78	101	83	43	165	82	34	12	7	5	8	2
7. Kanbe	240	241	130	69	116	117	0	37	100	154	79	153	126	65	306	153	126	14	15	8	12	22
8. Paryame	135	58	28	15	14	45	24	2	80	251	78	118	97	16	203	52	35	13	14	10	8	15
9. Yegu	38	86	55	30	28	39	44	93	13	100	27	33	27	14	36	18	5	2	2	1	2	1
10. Tadagale	288	122	144	76	73	141	217	195	120	5	29	106	89	71	239	81	54	22	22	14	21	21
11. Kyaukyedwin	115	164	107	101	98	48	74	42	17	17	0	15	5	46	153	56	3	11	4	5	8	15
12. Paywetseikkon	221	96	88	46	67	91	146	84	42	99	27	1	16	77	256	98	66	25	12	9	13	13
13. Okkalapa	191	82	61	32	30	39	60	65	33	90	46	27	0	88	243	79	53	18	18	12	18	14
14. Burma Air Force	89	40	26	28	27	26	40	23	21	68	34	52	80	0	31	62	7	2	6	5	4	7
15. Mingaladon Cantt	230	176	74	39	111	151	209	120	59	244	123	279	230	30	4	75	40	27	14	10	15	12
16. Mingaladon Bazaar	112	49	49	26	24	75	80	46	35	111	57	139	115	54	44	0	18	18	6	9	14	27
17. Kyaikkale	67	32	22	22	21	28	58	33	17	70	35	63	52	27	31	20	0	32	5	4	13	25
18. Golf Course	26	12	9	5	5	8	23	11	6	25	17	38	5	4	25	12	19	0	3	3	2	1
19. Danyingon	13	6	6	3	3	4	11	13	6	21	10	6	13	6	22	11	7	4	0	9	13	13
20. Aungsan Myo	10	4	2	1	1	9	14	0	3	10	5	9	7	2	6	3	4	4	4	0	3	11
21. Hpawkan	28	5	6	3	3	9	13	8	1	14	7	8	6	3	12	6	4	2	13	0	1	8
22. Ywama	52	4	3	6	5	7	20	11	5	17	26	39	32	9	30	21	14	11	11	4	9	1
23. Insein	324	139	9	19	18	25	38	22	10	34	33	56	46	24	58	29	19	10	30	24	14	26
24. Gyogon	66	28	8	2	2	3	5	3	1	5	3	13	5	3	9	12	8	8	8	7	11	40
25. Thamaing	423	43	28	7	7	8	12	5	3	8	4	6	5	5	26	13	28	4	9	8	16	29
26. Okkyin	412	93	29	7	7	10	15	9	4	14	7	9	7	4	39	20	13	15	11	9	23	44
27. Thirimyaing	163	46	10	5	2	4	6	5	8	11	0	0	0	0	9	13	0	3	7	17	0	0
28. Kamayut	433	64	41	36	35	15	32	18	4	17	14	0	11	6	19	14	24	8	8	10	16	30
29. Hletan	81	35	5	1	2	3	3	2	1	4	2	4	3	2	6	3	5	2	8	7	10	25
30. Hanthawaddy	46	38	5	5	5	2	5	2	0	3	1	3	5	3	8	2	4	2	2	4	6	30
31. Kemmendine	112	22	14	10	10	13	18	11	0	10	5	8	11	6	20	14	18	5	6	6	10	18
32. Hume Road	56	25	9	5	5	7	10	6	3	15	5	8	7	4	13	6	3	4	6	5	10	19
33. Mission Road	24	10	7	6	6	6	9	5	3	8	5	7	6	2	8	4	3	2	1	8	13	14
34. Gymkhana	70	27	17	36	35	20	31	17	5	16	9	9	7	4	10	12	1	5	3	5	8	16
35. Prome Road	71	13	8	21	20	27	26	14	7	28	12	18	15	8	25	4	2	2	2	1	2	4
36. Lanmadaw	35	15	10	23	23	30	23	13	7	26	13	24	19	12	40	6	4	1	1	0	5	10
37. Pagoda Road	25	15	10	49	48	64	45	25	13	30	16	23	67	35	87	44	19	6	1	15	80	158
38. Hninzigon	541	232	120	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39. Thingangyun	894	469	308	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40. Ngamoyeik	125	53	41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41. Togyaunggale	253	52	105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42. Ywathagyi	56	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Attraction Total	7,263	3,355	2,224	1,077	1,195	1,592	2,196	1,481	936	2,756	1,310	1,961	1,651	939	2,821	1,400	762	331	284	248	415	745

Source: Study Estimates Based on B.R.C. OD Survey (June 25 to July 1, 1984)

Table 3.3.6 - continued -

(Unit: Person per day)

Origin \ Destination	23. ISN	24. GON	25. THM	26. OYN	27. THRM	28. KYT	29. HLT	30. HWY	31. KMDN	32. HMD	33. MIX	34. GYM	35. PMRD	36. LAW	37. POR	38. HZGN	39. TGN	40. NMYK	41. TGL	42. YTHG	Production TOTAL
1. Rangoon	357	139	238	289	150	492	149	115	122	114	53	107	63	73	161	1,309	202	1,235	191	37	8,655
2. Pazundaung	106	8	32	131	23	67	41	30	18	13	11	26	17	45	18	59	545	98	122	10	3,731
3. Mahlwagon	5	4	18	21	11	31	32	15	19	18	8	20	12	16	35	107	270	48	116	7	2,408
4. Myithayunt	6	3	5	6	4	10	5	4	5	5	21	52	31	40	46	0	0	0	0	0	1,271
5. Tamwe	14	5	9	11	7	19	6	4	5	5	6	15	9	12	26	0	0	0	0	0	1,227
6. Bauktaw	9	10	19	20	5	14	5	2	16	15	7	17	19	25	56	0	0	0	0	0	1,654
7. Kanbe	33	13	9	11	5	15	6	19	23	21	12	30	18	23	51	0	0	0	0	0	2,574
8. Paryame	26	10	3	19	3	8	6	5	7	7	2	13	7	10	22	0	0	0	0	0	1,459
9. Yegu	4	1	0	0	0	1	0	0	2	3	2	4	4	5	11	0	0	0	0	0	731
10. Tadagale	56	6	4	5	5	15	8	6	8	15	6	18	11	14	31	0	0	0	0	0	2,360
11. Kyaukyedwin	7	7	4	2	3	2	3	0	8	7	3	5	3	14	32	0	0	0	0	0	1,205
12. Paywetseikkon	67	8	7	8	4	11	3	3	10	9	4	11	15	19	43	0	0	0	0	0	1,816
13. Okkalapa	72	7	4	5	3	7	7	6	7	11	6	15	9	12	26	0	0	0	0	0	1,494
14. Burma Air Force	17	6	3	3	2	6	2	2	4	4	2	12	7	9	20	0	0	0	0	0	776
15. Mingaladon Cantt	63	8	15	23	6	16	5	4	28	30	13	33	21	28	63	0	0	0	0	0	2,628
16. Mingaladon Bazaar	40	16	20	24	12	19	10	7	9	8	4	9	5	5	10	0	0	0	0	0	1,304
17. Kyaikkale	35	14	25	17	9	25	10	8	10	9	4	7	4	6	13	0	0	0	0	0	871
18. Golf Course	16	10	5	6	3	12	5	3	3	3	1	2	1	1	1	0	0	0	0	0	332
19. Danyingon	67	4	7	13	5	9	5	5	6	7	2	3	1	2	3	0	0	0	0	0	340
20. Aungsan Myo	17	7	11	13	7	19	17	13	15	8	2	7	6	3	12	0	0	0	0	0	267
21. Hpawkan	28	14	26	32	8	22	22	17	20	18	3	8	5	6	8	0	0	0	0	0	398
22. Ywama	52	21	29	35	18	61	19	14	36	33	17	24	14	18	41	0	0	0	0	0	771
23. Insein	2	368	445	543	112	313	186	143	172	160	57	138	82	106	94	0	0	12	6	0	3,946
24. Gyogon	377	0	145	117	60	107	33	25	114	104	50	42	25	32	72	2	1	0	0	0	1,555
25. Thamaing	382	124	0	114	60	235	123	94	115	202	92	227	134	55	122	1	11	3	1	0	2,790
26. Okkyin	412	163	40	0	46	381	321	247	298	66	69	175	101	130	126	2	8	6	0	0	3,393
27. Thirimyaing	163	46	46	56	0	207	148	75	195	180	15	36	53	69	154	0	0	0	5	0	1,755
28. Kamayut	339	132	226	274	130	0	393	320	329	308	143	354	202	261	578	3	23	1	2	0	4,871
29. Hletan	130	74	134	162	134	377	1	26	36	32	13	33	20	26	56	2	5	0	2	0	1,481
30. Hanthawaddy	169	37	159	150	71	237	17	0	17	11	10	16	6	7	45	1	3	1	0	0	1,137
31. Kemmendine	253	97	106	128	66	185	40	29	0	25	12	28	16	14	32	0	14	0	0	0	1,394
32. Hume Road	164	63	116	186	98	272	54	41	30	2	7	16	11	13	16	2	3	2	0	0	1,325
33. Mission Road	72	31	55	67	35	78	24	11	10	9	0	7	4	11	24	0	0	0	0	0	593
34. Gymkhana	167	66	105	127	66	232	71	54	49	18	9	1	27	36	21	37	15	0	3	0	1,466
35. Prome Road	53	21	49	60	31	85	29	22	31	29	6	15	1	24	52	6	14	3	1	0	863
36. Lanmadaw	82	33	58	141	73	201	33	25	30	24	12	21	12	0	10	8	20	2	1	0	1,125
37. Pagoda Road	219	87	100	121	168	462	152	8	75	13	25	59	42	55	3	0	22	3	5	0	2,498
38. Hninzigon	2	1	2	3	0	3	0	0	2	2	1	8	5	6	13	0	188	32	16	2	1,177
39. Thingangyun	8	3	9	11	6	20	10	8	78	56	34	97	89	115	255	144	0	113	193	47	2,966
40. Ngamoyeik	3	0	3	0	0	2	4	0	0	0	5	13	0	0	0	34	52	8	54	11	408
41. Togyaunggale	3	2	0	0	0	4	0	0	3	0	12	0	0	0	9	24	152	71	0	12	703
42. Ywathagyi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	48	21	9	0	170
Attraction Total	4,097	1,672	2,294	2,953	1,450	4,286	2,003	1,407	1,966	1,602	761	1,722	1,110	1,345	2,413	1,755	1,596	1,660	729	126	73,887

Table 3.3.7 Ranking of Boarding Passengers

Ranking	Station	Daily Passenge Number	Percentage (%)
1	Rangoon	8,655	11.7
2	Kamayut	4,871	6.6
3	Insein	3,946	5.3
4	Pazundaung	3,731	5.0
5	Okkyin	3,393	4.6
6	Thingangyun	2,966	4.0
7	Thamaing	2,790	3.8
8	Mingaladon Cantt	2,628	3.6
9	Kanbe	2,574	3.5
10	Pagoda Road	2,498	3.4
11	Mahlwagon	2,408	3.3
12	Tadagale	2,360	3.2
13	Paywetseikkon	1,816	2.5
14	Thirimyaing	1,755	2.4
15	Bauktaw	1,654	2.2
16	Gyogon	1,555	2.1
17	Okkalapa	1,494	2.0
18	Hletan	1,481	2.0
19	Gymkhana	1,466	2.0
20	Paryame	1,459	2.0
21	Kemmendine	1,394	1.9
22	Hume Road	1,325	1.8
23	Mingaladon Bazaar	1,304	1.8
24	Myithanyunt	1,271	1.7
25	Tamwe	1,227	1.7
26	Kyaukyedwin	1,205	1.6
27	Hninzigon	1,177	1.6
28	Hanthawaddy	1,137	1.5
29	Lanmadaw	1,125	1.5
30	Kyaikkale	871	1.2
31	Prome Road	863	1.2
32	Burma Air Force	776	1.1
33	Ywama	771	1.0
34	Yegu	731	1.0
35	Togyuaunggale	703	1.0
36	Mission Road	593	0.8
37	Ngamoyeik	408	0.6
38	Hpawkan	398	0.5
39	Danyingon	340	0.5
40	Golf Course	332	0.4
41	Aungsan Myo	267	0.4
42	Ywathagyi	170	0.2
	Total	73,887	100.0

Source: B.R.C., OD Survey (June 25 to July 1, 1984)

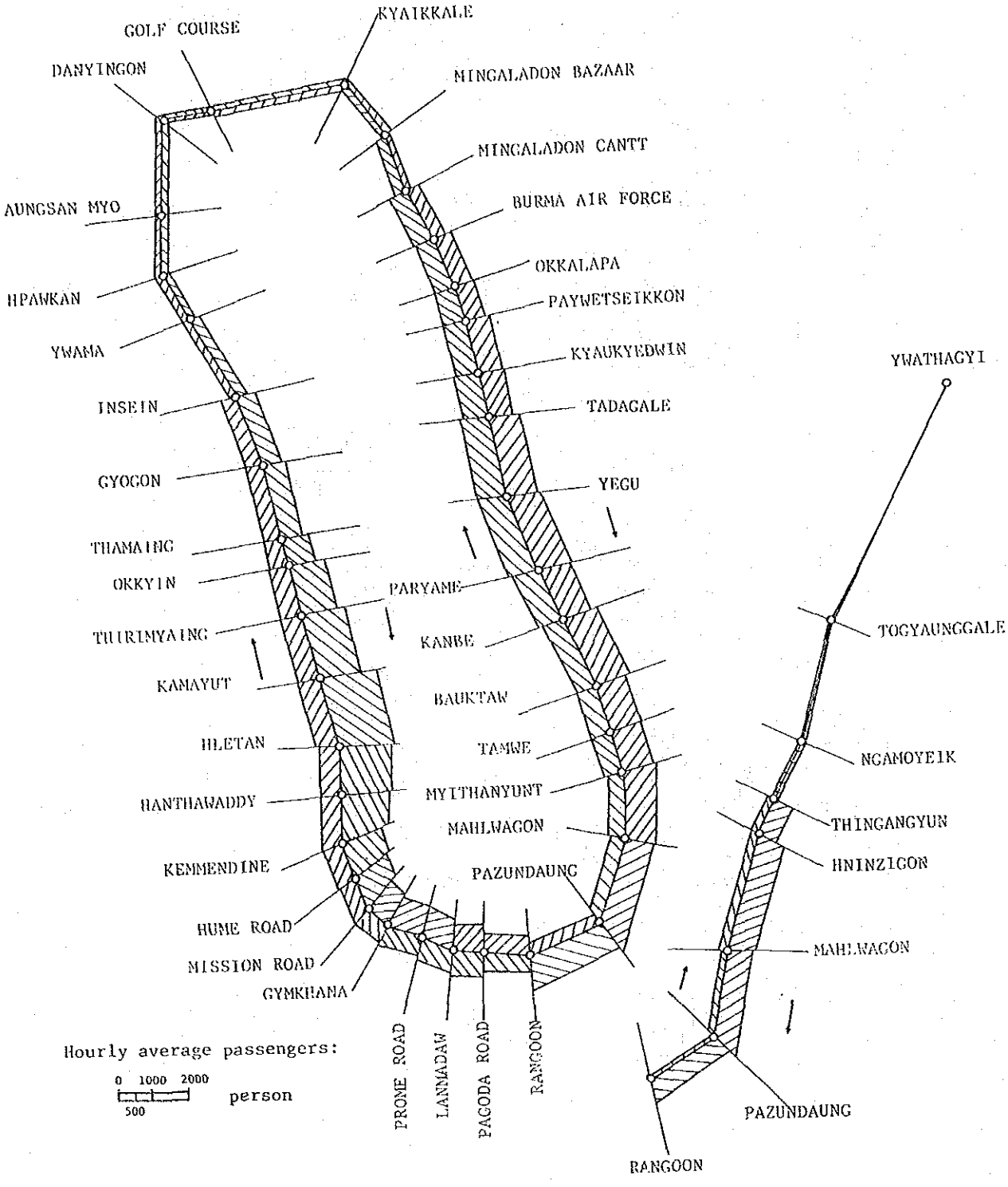


Fig. 3.3.3 Cross Section Passengers in Morning Peak Hours (7:00-9:00)

Source: Study estimates, based on B.R.C.OD servey

Table 3.3.8 Cross Section Passengers Daily Average
(4:00-22:00)

(Unit: Number per hour)

CIRCULAR LINE			Clockwise	Anti Clockwise	Total
37. Pagoda Road	-	1. Rangoon	355	338	693
1. Rangoon	-	2. Pazundaung	370	372	742
2. Pazundaung	-	3. Mahlwagon	405	431	835
3. Mahlwagon	-	4. Myithanyunt	415	456	872
4. Myithanyunt	-	5. Tamwe	417	469	886
5. Tamwe	-	6. Bauktaw	433	487	920
6. Bauktaw	-	7. Kanbe	446	503	949
7. Kanbe	-	8. Paryame	438	521	958
8. Paryame	-	9. Yegu	459	542	1,000
9. Yegu	-	10. Tadagale	455	524	979
10. Tadagale	-	11. Kyaukyedwin	413	455	868
11. Kyaukyedwin	-	12. Paywetseikkon	387	421	808
12. Paywetseikkon	-	13. Okkalapa	363	388	751
13. Okkalapa	-	14. Burma Air Force	349	364	713
14. Burma Air Force	-	15. Mingaladon Cantt.	322	325	647
15. Mingaladon Cantt.	-	16. Mingaladon Bazaar	200	193	393
16. Mingaladon Bazaar	-	17. Kyaikkale	150	133	283
17. Kyaikkale	-	18. Golf Course	125	115	240
18. Golf Course	-	19. Danyingon	118	109	227
19. Danyingon	-	20. Aungsan Myo	119	113	233
20. Aungsan Myo	-	21. Hpawkan	123	119	242
21. Hpawkan	-	22. Ywama	130	125	255
22. Ywama	-	23. Insein	149	145	294
23. Insein	-	24. Gyogon	345	331	676
24. Gyogon	-	25. Thamaing	388	366	755
25. Thamaing	-	26. Okkyin	445	456	901
26. Okkyin	-	27. Thirimyaing	519	559	1,079
27. Thirimyaing	-	28. Kamayut	567	627	1,195
28. Kamayut	-	29. Hletan	668	766	1,434
29. Hletan	-	30. Hanthawaddy	641	707	1,348
30. Hanthawaddy	-	31. Kemmendine	614	656	1,271
31. Kemmendine	-	32. Hume Road	583	590	1,172
32. Hume Road	-	33. Mission Road	539	527	1,066
33. Mission Road	-	34. Gymkhana	531	507	1,038
34. Gymkhana	-	35. Prome Road	502	461	963
35. Prome Road	-	36. Lanmadaw	501	442	943
36. Lanmadaw	-	37. Pagoda Road	495	412	907

SUBURBAN LINE			To West	To East	Total
1. Rangoon	-	2. Pazundaung	180	211	391
2. Pazundaung	-	3. Mahlwagon	234	264	498
3. Mahlwagon	-	38. Hninzigon	271	301	572
38. Hninzigon	-	39. Thingangyun	225	215	440
39. Thingangyun	-	40. Ngamoyeik	71	151	222
40. Ngamoyeik	-	41. Togyaunggale	55	54	109
41. Togyaunggale	-	42. Ywathagyi	11	8	19

Source: Study estimates based on B.R.C. OD survey (June 25 to July 1, 1984)

Note: These figure was adjusted to the base data.

(4) Weekly changes, time zone changes

As shown in Table 3.3.9, the total number of passengers is 10% more for the weekends than for weekdays.

The time zone changes of the number of passengers give a two-hour morning peak between 7 and 9 o'clock, and an evening peak hours between 15 and 17 o'clock, with these two periods accounting for 33% of the total number of passengers per day (cf. Table 3.3.9.).

A study of the number of passengers boarding and alighting at each station and for each time zone gives an indication of the station characteristics (cf. Fig. 3.3.4 and Table 3.3.10.).

Table 3.3.9 Hourly Passengers

(Unit: Person)

Time	Total Average	Index	Weekday Average	Index	Weekend Average	Index
4:00 - 5:00	1,630	39.7	1,632	39.8	1,627	39.6
5:00 - 6:00	3,804	92.7	3,784	92.2	3,855	93.9
6:00 - 7:00	4,596	112.0	4,458	108.6	4,940	120.3
7:00 - 8:00	6,989	170.3	7,022	171.1	6,906	168.2
8:00 - 9:00	5,759	140.3	5,738	139.8	5,812	141.6
9:00 -10:00	4,936	120.2	4,669	113.7	5,605	136.5
10:00 -11:00	4,459	108.6	4,191	102.1	5,129	125.0
11:00 -12:00	5,239	127.6	4,890	119.1	6,111	148.9
12:00 -13:00	4,854	118.3	4,573	111.4	5,555	135.3
13:00 -14:00	4,536	110.5	4,256	103.7	5,238	127.6
14:00 -15:00	4,565	111.2	4,304	104.9	5,216	127.1
15:00 -16:00	5,638	137.4	5,496	133.9	5,992	146.0
16:00 -17:00	5,826	141.9	5,739	139.8	6,043	147.2
17:00 -18:00	4,838	117.9	4,612	112.4	5,403	131.6
18:00 -19:00	3,375	82.2	3,148	76.7	3,943	96.1
19:00 -20:00	1,891	46.1	1,822	44.4	2,066	50.3
20:00 -21:00	735	17.9	728	17.7	754	18.4
21:00 -22:00	217	5.3	189	4.6	287	7.0
Total	73,887		71,251		80,482	
Average	4,105	100.0	3,958	96.4	4,471	108.9

Source: B.R.C. OD Survey (June 25 - July 1, 1984)

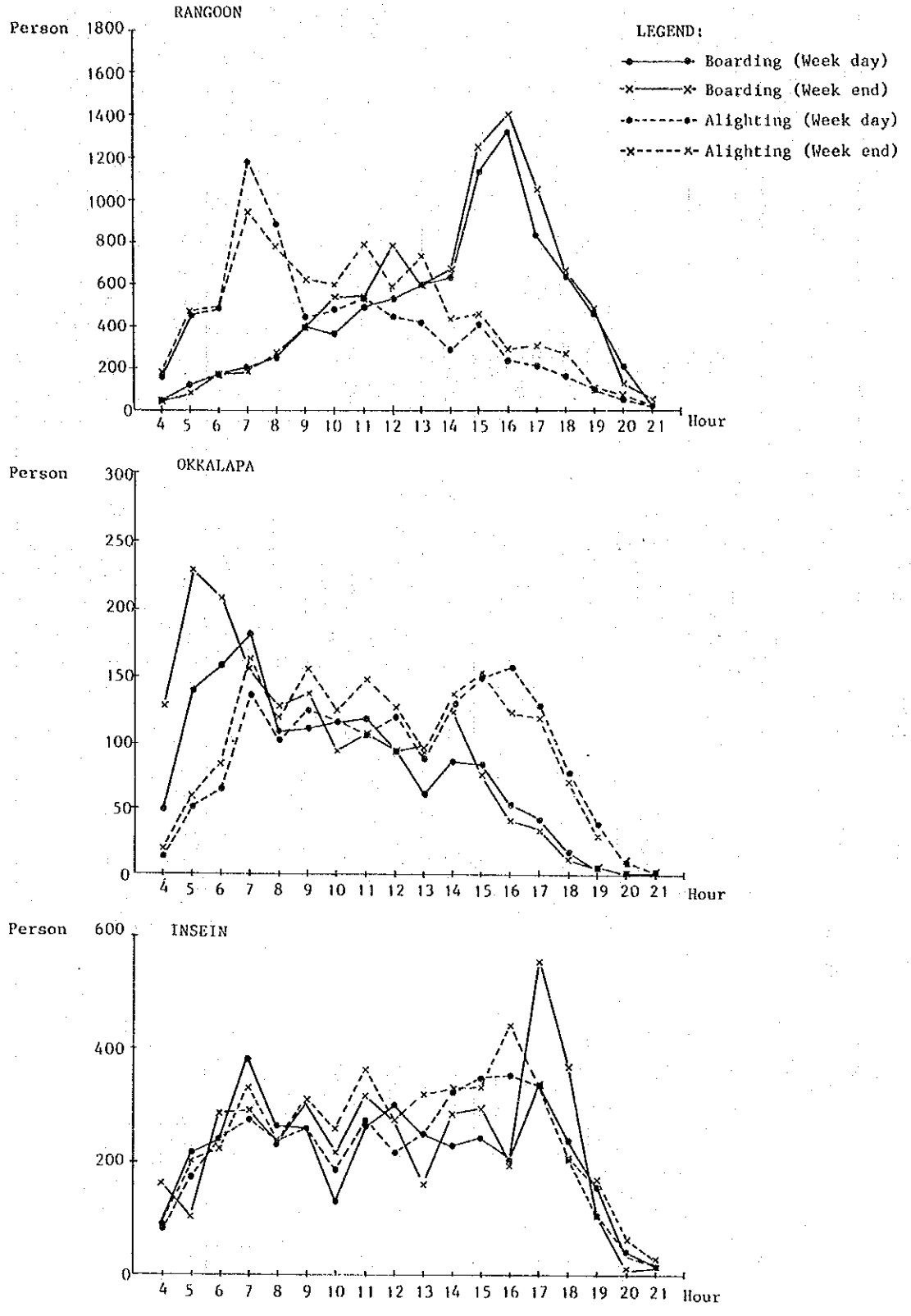


Fig. 3.3.4 Hourly Fluctuation at Stations

Source: Study estimates

Table 3.3.10 Characteristics of Stations

Passenger Volume / Hourly Fluctuation	More than 2,000	1,000 – 2,000	Less than 1,000
(A) Higher Percentage of Passengers Boarding at the Morning Peak Hours and Alighting at the Evening Peak Hours	Large Residential Type	Medium Residential Type	Rural Residential Type
	Kamayut Okkyin Thingangyun Thamaing Tadagale	Thirimyaing Okkalapa Myithanyunt Kyaukyedwin Hninzigon	Ywama Yegu Togyaunggale Ngamoyeik Hpawkan Golf Course Aungsan Myo Ywathagyi
(B) Medium Pattern of Passengers Boarding and Alighting between (A) and (B)	Large Mix Type	Medium Mix Type	Small Mix Type
	Insein Pazundaung Mingaladon Cantt Kanbe Mahlwagon	Paywetseikkon Bauktaw Gyogon Hletan Paryame Mingaladon Bazaar Tamwe Hanthawaddy	Kyaikkale Burma Air force Mission Road
(C) Higher Percentage of Passengers Boarding at the Evening Peak Hours and Alighting at the morning Peak hours	Large Business Type	Medium Business Type	Small Business Type
	Rangoon Pagoda Road	Gymkhana Kemmendine Hume Road Lanmadaw	Prome Road Danyingon

Source: Study estimates based on B.R.C. OD Survey (June 25 to July 1, 1984)

3-3-6 Fares and Revenue

(1) Fare system

The 5.2 Pyas/mile fare for the Circular and Suburban Lines is relatively cheaper than the 6.8 Pyas/mile for the Main line.

Passengers using monthly season tickets receive a discount fare, and there are about eight thousand commuters, who constitute about 12% of the total passengers (cf. Table 3.3.11).

The fare is paid at the station booking offices. Tickets are sold 30 minutes before the train arrival at small stations, and two hours before arrival at large stations. B.R.C. estimates that there is an illegal ride rate of five percent.

Table 3.3.11 Season Ticket

(Unit: Thousand)

Year	Month	Season Ticket: Ticket Holder	Season Ticket: No. of Estimated Passengers*1 (A)	No. of Total Passengers*2 (B)	Ratio (A/B)
1983	Oct.	7.490	300	2,717	11.0%
	Nov.	8.180	327	2,645	12.4%
	Dec.	8.164	327	2,649	12.3%
	Total		954	8,011	11.9%

Source: B.R.C.
Note : *1 20 days × 2 × No. of Season Ticket Holder
*2 cf. Table 3.3.5

(2) Revenue

The revenue of the Circular and Suburban Lines has increased to account for about 11 million Kyats in 1982/83, while the revenue per passenger has slightly risen since 1980/81 (cf. Table 3.3.12.).

Table 3.3.12 Revenue of the Circular and Suburban Lines

Year	Revenue (1,000 Kyats)	Number of passengers (1,000)	Revenue per passengers (Pyas)
1978/79	6,027	20,479	29.4
79/80	6,886	23,288	29.6
80/81	7,715	27,945	27.6
81/82	9,819	30,358	32.3
82/83	10,644	31,738	33.5

Source: B.R.C.

CHAPTER 4 DEMAND FORECAST

CHAPTER 4 DEMAND FORECAST

4-1 Premises

(1) Objective modes

Bus and express are set as objective modes, because they are major and middle-distance transportation modes which compete with railway.

(2) Zoning

The township is the administrative unit and is also a well-defined regional unit for which statistics are readily available. The township is therefore taken as the zone for use in this study.

(3) Base data for forecasting

Much data has been obtained through the two field studies. As there are some discrepancies between the data depending on their sources, the data from the most authoritative sources are selected for use as the base data for this study.

The year 1982/83 is set as the reference year since a fairly full complement of data is available for this year.

(4) Time frame

The year 2019 is set as the final year for assessment since the project life will be 30 years from the time the electrification services begin in 1990.

(5) Expected difference between "With the Project" and "Without the Project"

"With the Project" means the case of the project being adopted. In this case, it is expected that the relative competitiveness of the railway will increase due to improvements in the operational conditions, and will thereby take some passengers from the bus and express services. The potential demand to be newly generated by electrification is considered to be very small, and is therefore not included in the scope of the forecast.

"Without the Project" means the case of the project not being implemented. In this case, the current mode share will be assumed to continue.

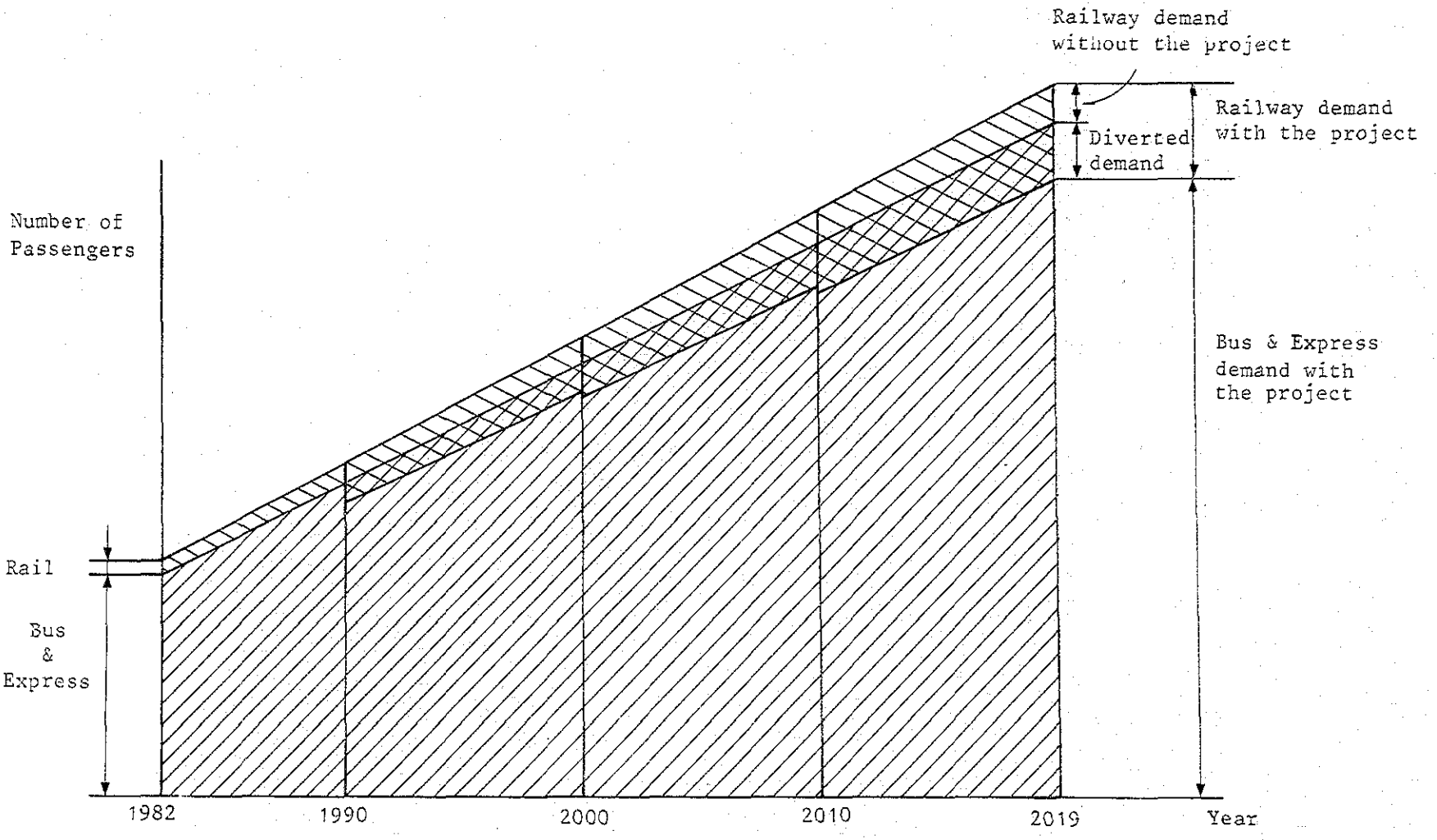


Fig. 4.1.1 Transport Demand With and Without the Project

Source: Study draws

4-2 Method of Demand Forecasting

The demand forecast for railways is performed by the following four steps.

Step 1: Estimation of the present OD

Based on the OD survey, field observations and interviews with the persons concerned, the OD table for the present status is estimated by mode; railways, buses and expresses.

Step 2: Forecast of production-attraction

From the relationship between the production-attraction for each zone in the OD table for the present status and economic indices, a regression formula is determined, and the future production-attraction is estimated by using the obtained formula and the future economic indices.

Step 3: Forecast of distribution

The OD table (distribution) for the total future demand can then be estimated by using the forecast production-attraction.

Step 4: Forecast of modal split

The modal split model is developed by using the present OD table, and then the estimated distribution is allotted for each traffic mode.

Fig. 4.2.1 gives the flowchart for the demand forecast in this study. The method of estimation and forecast by step are as follows.

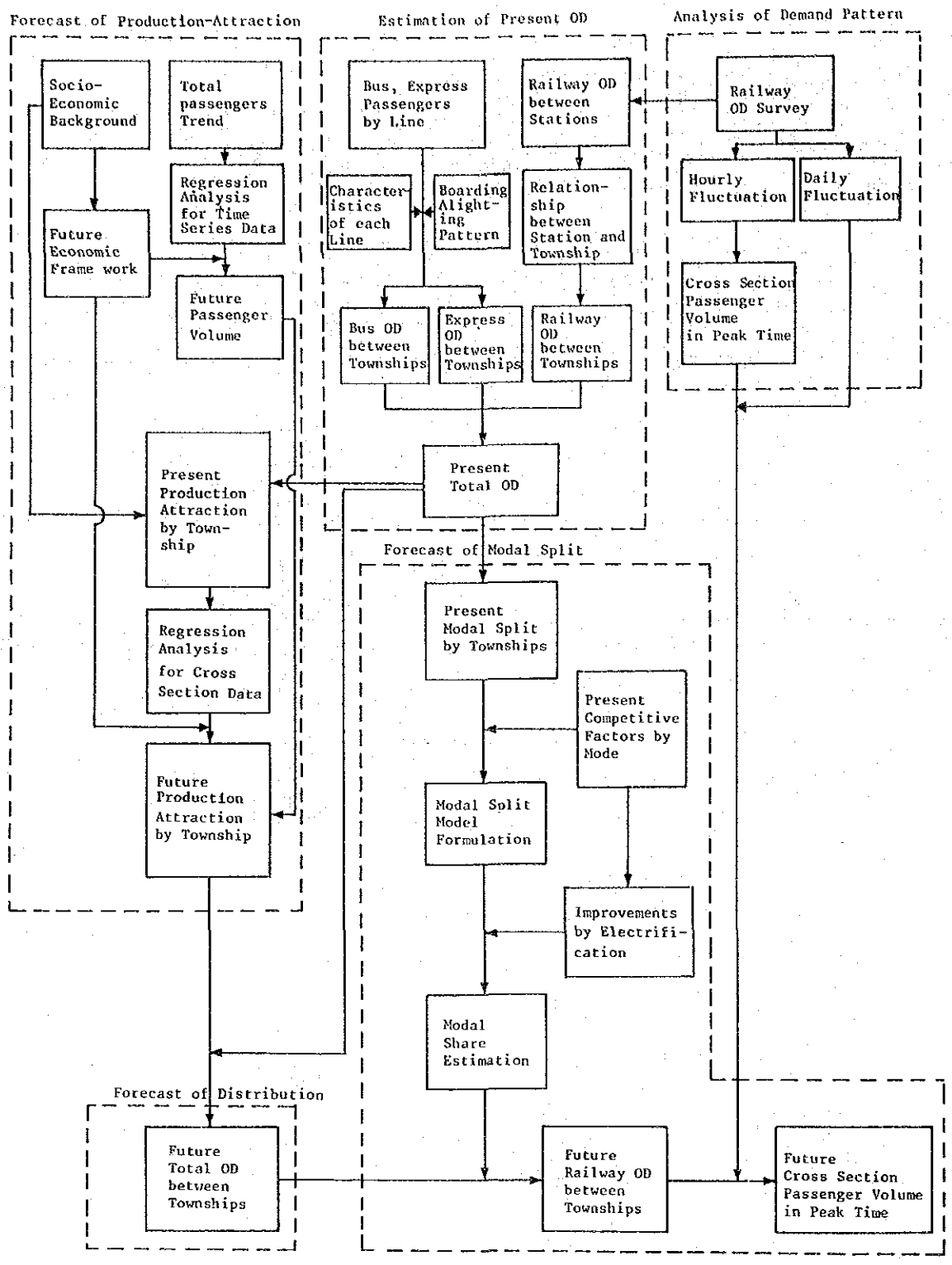


Fig. 4.2.1 Flow Chart for Demand Forecast