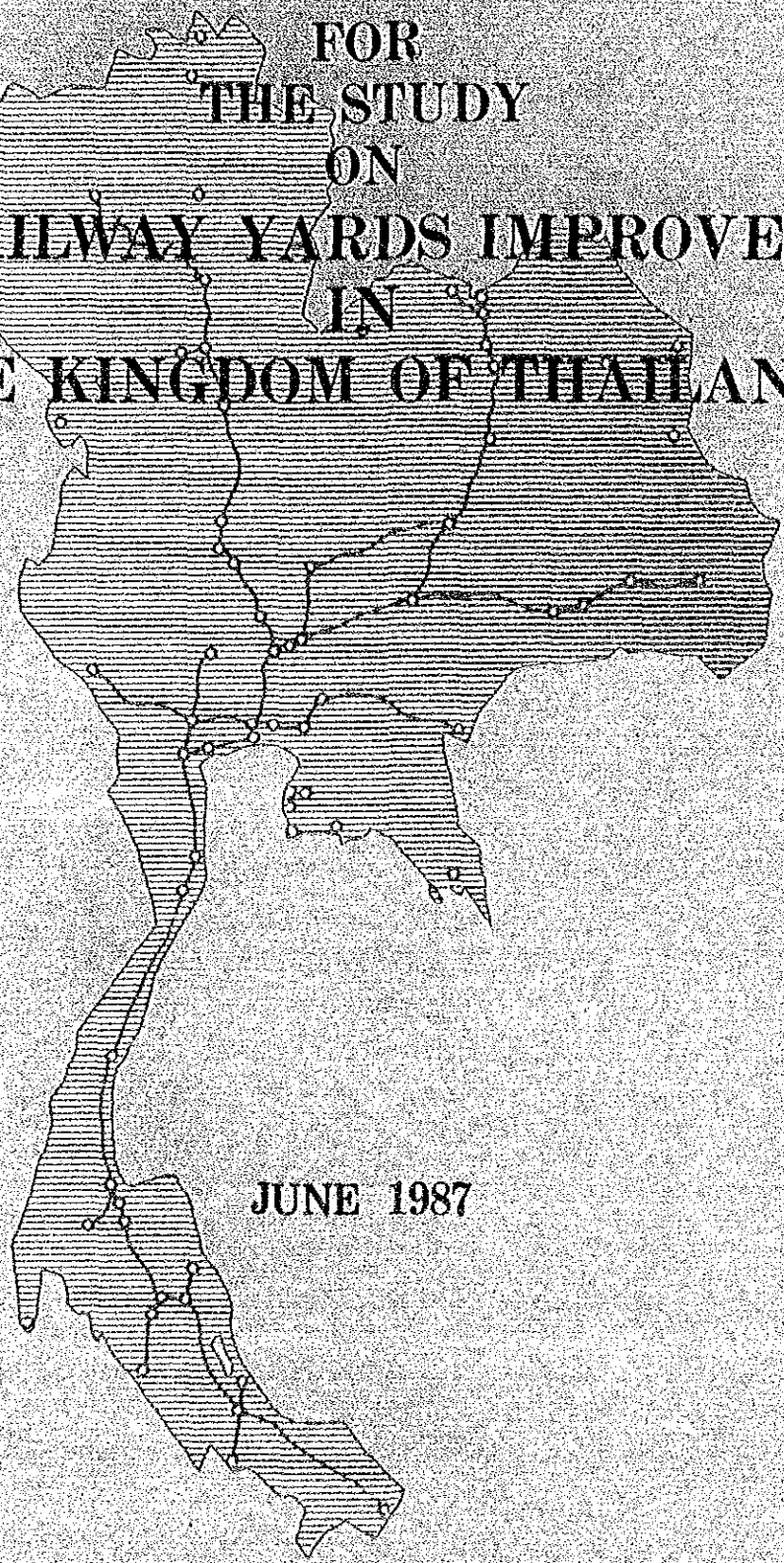
社会開発協力部報告書

No. 7

FINAL REPORT FOR THE STUDY ON THE RAILWAY YARDS IMPROVEMENT IN THE KINGDOM OF THAILAND



JUNE 1987

JAPAN INTERNATIONAL COOPERATION AGENCY

SDF

87-042

FINAL REPORT
FOR
THE STUDY
ON
THE RAILWAY YARDS IMPROVEMENT
IN
THE KINGDOM OF THAILAND

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JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

In response to the request of the Government of the Kingdom of Thailand, the Japanese Government has decided to conduct a feasibility study on the Railway Yards Improvement Project and entrusted the study to the Japan International Cooperation Agency.

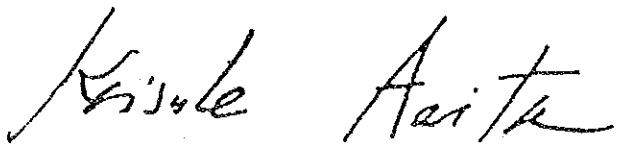
The J.I.C.A. sent to Thailand a study team headed by Mr. Sadaaki KURODA, executive vice-president, Japan Railway Technical Service (JARTS), several times in the period from December 1985 to September 1986.

The team had discussions on the project with the officials concerned of the Government of the Kingdom of Thailand and conducted a field survey in the country. After the team returned to Japan, further studies were made and the present report has been prepared.

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

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

June 1987



Keisuke Arita
President
Japan International Cooperation Agency

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June 1987

Mr. Keisuke Arita
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Sir,

LETTER OF TRANSMITTAL

We have the pleasure of submitting herewith the final report for the Feasibility Study on the Railway Yards Improvement in the Kingdom of Thailand, which was conducted from December 1985 to June 1987. During this period, two field surveys were carried out, from December 1985 to February 1986 and again from July to September 1986.

Based on this, a master plan for the improvement of ten major yards was prepared, and a feasibility study to improve the four most important yards carried out. We hope that this study will serve to implement this project and contribute to the improvement of railway management. We would like to express our sincere gratitude to the concerned officials of your Agency, the Advisory Committee, the Embassy of Japan in Thailand, as well as to those concerned in the Government of the Kingdom of Thailand, for the kind guidance and cooperation they extended to the Study Team.

Very truly yours,

Tatsuya Ishihara

Tatsuya Ishihara
President
Japan Railway Technical Service

EXECUTIVE SUMMARY

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Chapter 1 Introduction

1-1 Objectives of the Study

As one of the measures to strengthen the efficiency and role of railway transportation in Thailand, improvement of yards that now hinder smooth transportation is essential. In this regard, a master plan targeted for the year 2006 for ten major yards located throughout the country was prepared, with the yards requiring the most urgent attention among these ten selected for a feasibility study targeted for the year 1996. An evaluation was also done on the socio-economic contribution which the improvement of these yards would make to Thailand and the State Railway of Thailand (SRT).

1-2 Outline of the Study

The ten yards selected for the study are: Bangkok, Mae Nam, Bang Sue (three yards in the metropolitan area); and Ban Phachi, Phitsanulok, Nakhon Ratchasima, Chumphon, Sarat Thani, Thung Song and Hat Yai.

After site surveys were carried out at these yards, a review was done on transportation, operation and function assignment plans in the nationwide transportation network in accordance with the demand forecast of passenger and freight transportation in the year 2006. Further, a yard plan was also prepared with due consideration for improvement of work within each yard.

Out of these ten yards, four yards requiring urgent attention were selected: Bangkok, Mae Nam, Bang Sue, and Hat Yai. The selection was based on a comprehensive evaluation, and a secondary survey on selected yards was conducted as well.

In accordance with the demand forecast targeted for the year 1996, a more detailed economic and financial feasibility study was conducted.

Chapter 2 Socio-economic Conditions in Thailand

While the rate of population growth in Thailand appears to be on the decline, it is estimated that total population will be 56.35 million in 1990, and 64.39 million in 2000. On the other hand, the Thai economy has satisfactorily developed since implementation of the First Five Year Plan in 1961 through promotion of diversification, industrialisation and high added-valued processing of agriculture. For example, in the Sixth Five Year Plan (1987-1991), the economic growth rate is expected to reach about five percent through promotion of the Eastern Seaboard Development Program and industrialisation using domestic resources and labour-intensive export-oriented light industries, which Thailand is relatively good at.

As regards the transportation sector in Thailand, the Thai government has been implementing improvements, primarily development of a highway network. However, it has recently started to review this policy of putting emphasis on the highway sector, and has sharpened its awareness of establishing a harmonious transportation system. SRT is now studying a plan to further strengthen existing railway transportation through investment in the next five years (1987-1991).

Chapter 3 Demand Forecast

3-1 Basic Concept

Demand forecasts were conducted for the Master Plan Study and ensuing Feasibility Study. These surveys were in principle based upon the review of the SRT Improvement Plan already done by the Thai government and SRT. Then, by judging as accurately as possible the current situation and future prospects of social and economic data and information on passenger and freight transportation of other modes, a demand forecast for railway transportation using a four-stage estimate method was done.

For the demand forecast, the following two cases were assumed for passenger and freight transportation respectively, taking into consideration trends in transportation of SRT and competition from other modes, in addition to the foregoing view.

Passenger Case I: There is no particular improvement in the railways concerning traffic congestion in the Bangkok Metropolitan Area.

Case II: Railways carry out positive demand stimulation measures in the traffic congested Bangkok Metropolitan Area.

Freight Case I: Railways promote modernization and rationalization of freight transportation facilities, services and rolling stock.
Accordingly, the competitiveness of railways and the railway traffic share do not decrease further than what they are at present.

Case II: Envisaging the recent severe competitive conditions for railways continuing (due to such

factors as the priority put on investments for roads and progress of motorization thereby), the competitiveness of road transportation is assumed to be stronger than that of Case I.

A demand forecast for railway transportation was done for each of the above cases, then upon study and examination of the results of these forecasts, a more detailed survey was conducted on passenger and freight transportation in Case II. In this study, demand forecast in Case II was adopted taking into consideration the traffic situation in Thailand. Demand for railway transportation with improvement of all the yards, and for improvement of the four selected yards, was implemented in both the Master Plan Study and in the Feasibility Study.

3-2 Socio-economic Frame

In this survey, the total population was assumed to grow as shown in Table 1 at the annual rates of 1.5 and 1.2 percent during the periods 1984-1996 and 1996-2006, while GDP was assumed to increase at the annual rates of 5.1 percent and 4.5 percent respectively.

Table 1 Actual Value and Forecasting of the Population

Unit: Thousand persons

	Past			Future	
	1976	1980	1984	1996	2006
Population	43,213.7	46,961.3	50,583.1	60,478.1	68,140.2
	(2.1%)	(1.9%)	(1.5%)	(1.2%)	

Table 2 Actual Value and Forecasting of the GDP

Unit: Mil. Bahts (1972 price)

	Past			Future	
	1978	1980	1983	1996	2006
GDP	261,098.7	292,853.3	342,878.7	657,717.5	1,021,415.2
	(5.9%)	(5.4%)	(5.1%)	(4.5%)	

3-3 Results of Forecast

The results of the demand forecasts for railway transportation are as illustrated in Fig. 1 and Fig. 2. The traffic volume of railway passengers was forecasted to increase from the current 81,498,000 to 112,058,000 in 2006 for Case I and to 122,644,000 for Case II. The traffic volume of railway freight was forecasted to increase from the current 5,506,000 tons to 11,052,000 tons in 2006 for Case I and to 18,140,000 tons for Case II. Such an increase in the traffic volume of railway freight is mainly due to new demand arising from implementation of the Eastern Seaboard Development Program. Thus, it was forecasted that demand for passenger and freight transportation in Case II would be 120,509,000 passengers and 8,003,000 tons respectively.

Unit: Thousand persons per year

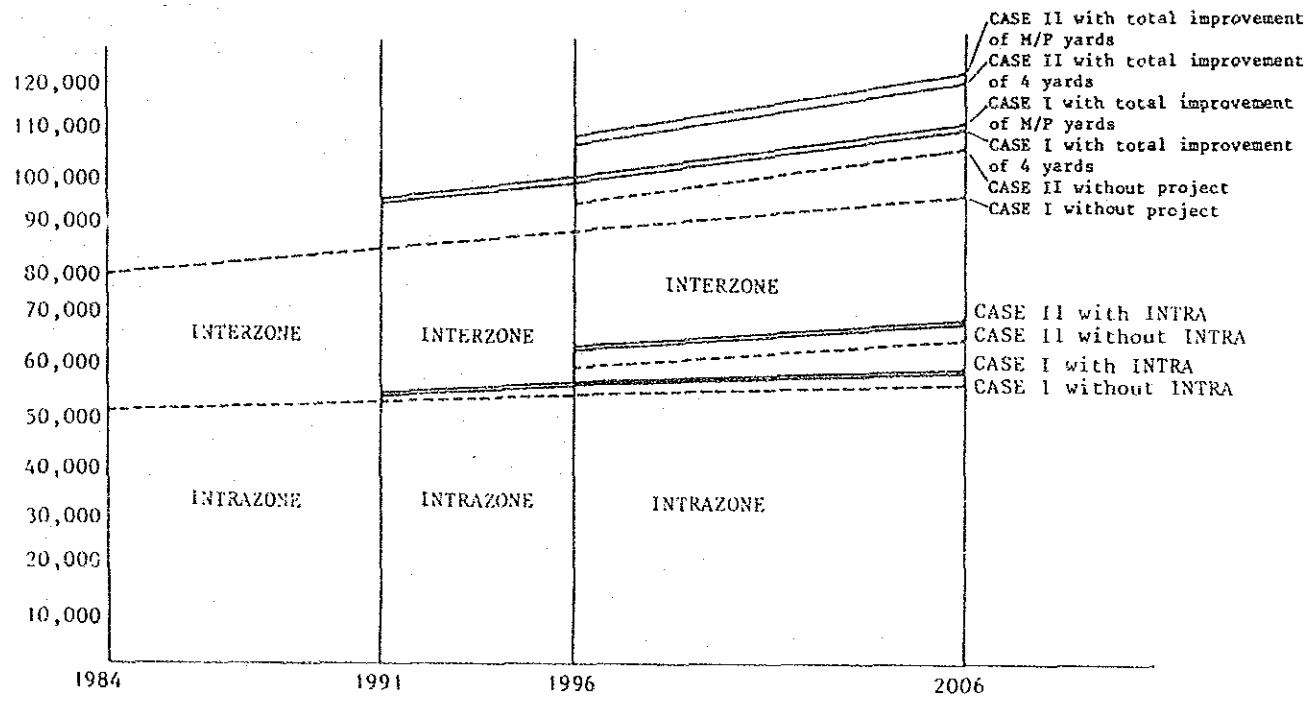


Fig. 1 Estimate of Passenger Traffic Volume

Unit: Thousand tons per year

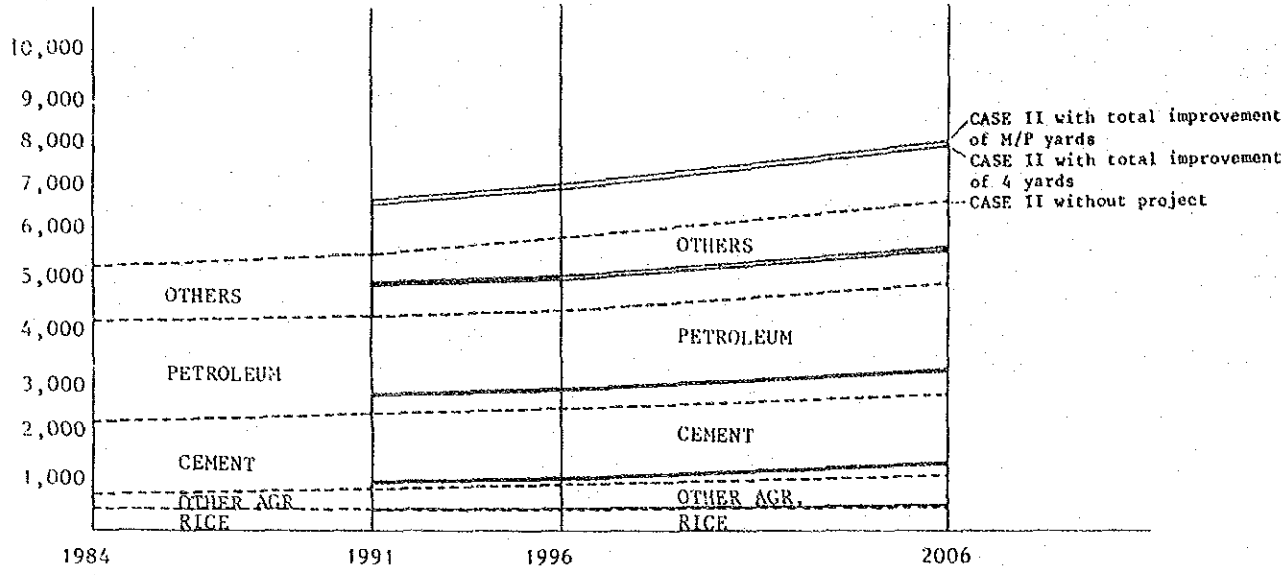


Fig. 2 Estimate of Freight Traffic Volume

Chapter 4 Railway Transportation and Train Operation Plan

4-1 Passenger Transportation

The future transportation should be oriented as follows:

(1) Because of strong competition from airways and bus services over long-and medium-distances, shortening travelling time and providing improved sleeping car service with express and rapid trains should be implemented to promote railway utilisation.

(2) Because of strong competition from buses and passenger cars over short distances, frequent service with diesel railcars should be increased. Particularly, because of growing urbanisation in the metropolitan area, efforts should be made to attract passengers, especially commuters, mainly in the Bangkok area to the railway.

4-2 Freight Transportation

The future freight transportation should be oriented as follows:

(1) Increased operation of unit commodity trains for chief items of railway freight, such as oil and cement.

(2) Concerning rice and maize, major products of agriculture (basis of Thai economy), warehouses and handling facilities should be suitably provided at their major collection and distribution bases to make their transportation more efficient.

(3) Introduction of container service for general commodities for quick service with definite delivery times to aggressively attract goods to utilise the railway freight service.

(4) Maximum rationalization in other aspects of transportation.

(5) As regards freight stations, integration of stations with small traffic handled, and modernisation of freight handling equipments and handling operations of major stations which are located in a strategic position regarding flow of goods.

Through promotion of the above, it is recommended that traffic be programmed into such a traffic system so that the railway can easily display its characteristics not only in existing bulk cargo, but also in other goods as agricultural products and general commodities.

4-3 Operation Plan

(1) Regarding operation of express, rapid and local trains for passenger transportation particularly, for short- and medium-distance service, diesel railcars are recommended from the viewpoint of speed, comfort and flexibility of car operation.

(2) For freight transportation, it is recommended to promote rapid freight trains for general commodities and containers with definite delivery times in addition to existing direct and general freight trains.

(3) Operation management requires improvement as train delay behind schedule is very common. Promotion of various measures to keep punctuality is necessary.

Table 1 No. of Trains

(No. of trains/daily Up and Down)

	1985	1996	2006
Passenger	198	304	350
Freight	112	112	130
Mixed	26	-	-
Total	336	416	480

(4) The number of rolling stock was obtained by dividing total car kilometers by kilometers per car in service per day for diesel locomotives, diesel railcars and passenger cars. For freight cars, this number was calculated by dividing the number of cars in service by operating efficiency. For car kilometers in service per day, actual figures for SRT for 1985 were used, while for operating efficiency, the value for 1980, the highest in the past was used.

Table 2 No. of Rolling Stock

	1985	1996	2006
DL	194	183	216
DRC	190	781	908
PC	822	686	870
FC	7,915	8,396	9,756

For 1985, figures indicate those in service.

Chapter 5 Yard Function Assignment

5-1 Concept of Yard Function Assignment

Maximum operation of freight trains that pass by yards, should be aimed at. The purpose of the study is optimize a collective transportation other than direct freight trains or containers, taking into consideration the capacities of each yard and the total network. For this purpose, optimisation of empty car operation at 25 yard blocks (minimisation of car kilometers), and linear programming calculation for minimisation of total car relay item with loaded cars were conducted.

5-2 Calculation Results

(1) Yard Sharing Rate

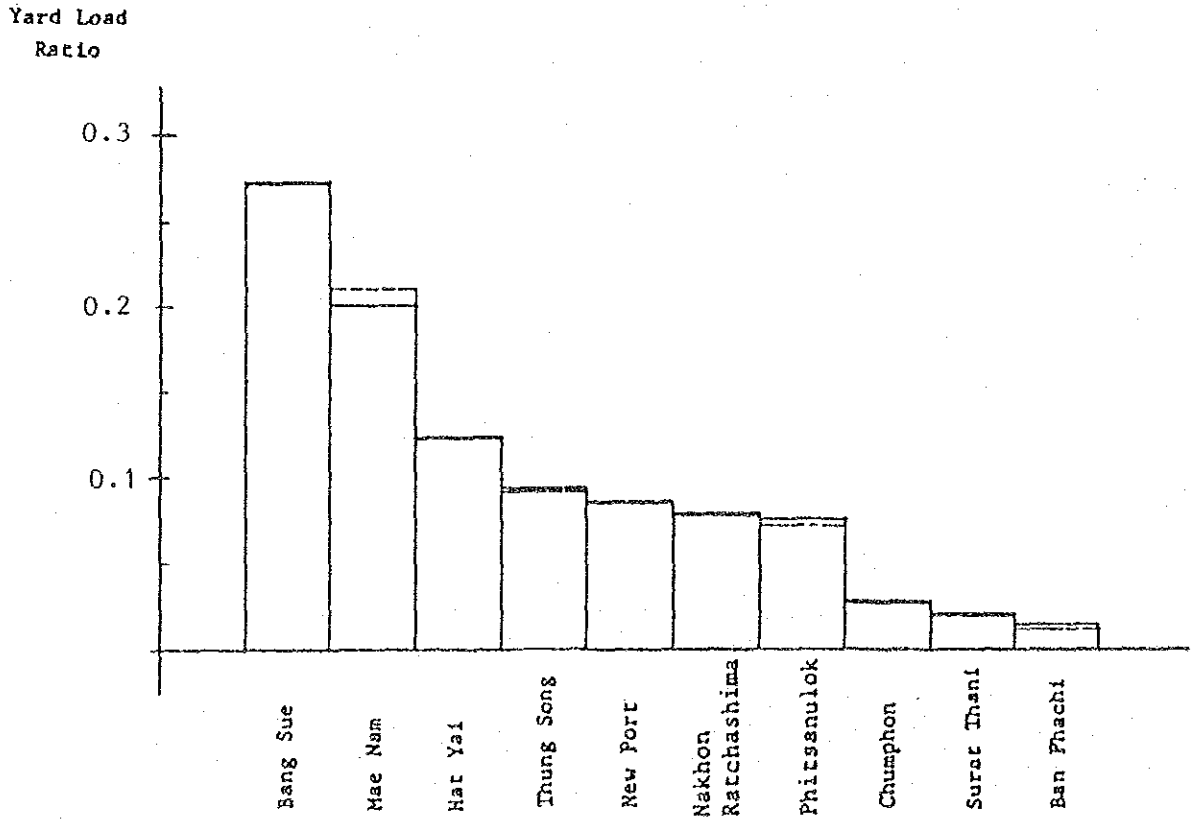


Fig. 1 Yard Load Ratio

(2) Improvement of Yard Relay Indices

Table 1 Yard Relay Indices of Total Freight Transportation System

Item \ Fiscal Year				1984	1996	2006
1	Number of cars generated	Direct		537	686	787
		Cars requiring coupling/ uncoupling	(Loaded)	477	661	739
			(Empty)	185	234	257
2	Total relay car time (hours)	WITHOUT		13,574	17,103	21,175
		WITH		13,574	15,240	14,350
		DIFFERENTIAL		0	1,863	6,825
3	Total number of cars relayed			1,100	1,270	1,400
4	Average relay time (hours)			12.34	12.00	10.25
5	Average frequency of relays per car			1.66	1.42	1.41

Chapter 6 Yard Work Plan

Function of major facilities in each yard are not adequate for the existing transportation system. While the work system is operated by experienced experts thoroughly familiar with site conditions, it seemed that there was the capability to do more work.

Both the number of trains and freight cars to be handled at each yard are expected to increase. For this reason, construction of required facilities and repair of deteriorated and obsolete low efficiency facilities are required to cope with the increasing volume. For yard work, application of a "yard work diagram" is required to introduce a more planned and efficient work system to reduce transportation costs while coping with expanding traffic volume.

Table 1 Improvement of Work in Each Yard

Name of Yard	Outline of Handling	Items for Improvement	Remarks
Bangkok	o Great increase in the number of departing and arriving trains Present → 1996 → 2006 118 150 176 o Shunting party: 3	o Increase in the capacity of arrival/departure tracks o Promotion of diesel rail-car operation	o Increased traffic
Mae Nam	o Annual freight handling of 3,030,000 tons, resulting in yard work operation at maximum capacity o Shunting party: 3	o Review of train scheduling during competing hours for departure and arrival work o Study of relaxation of yard work in relation to Bang Sue o Relaxation of work due to layout modification	o Maintenance of traffic volume o Reduction of shunting work party
Bang Sue	o Compared to actual handling capacity (2,500 cars), present handling is less Present → 1996 → 2006 900 1150 1300 Of the above, yard work accounts for: (580) (730) (810) o Shunting party: 4	o Review of scale and function corresponding to handling (Tentative) o Construction of direct access line for departure and arrival for cement trains o Reduce work system by concentrating uncoupling and hump work (Future) o Modification into compact layout suitable for future transport system	o Transfer to more efficient work system o Reduction of shunting party
Ban Phachi	o Being a junction of the Northern and North-eastern Lines, train frequency is high. Present → 1996 → 2006 126 168 190	o As for competition of out-bound Northern and the Northeastern Line, necessary steps will be taken in line with the future development	
Phitsanulok	o Being a central station in transport on the Northern Line, train frequency is high. Present → 1996 → 2006 46 58 66	o Construction of passenger carriage storage track to meet increase in train frequency	
Nakhon Ratchasima	o Being a central station in transport on the Northeastern Line, train frequency is high. Present → 1996 → 2006 64 72 80	o Construction of passenger car storage track	

Name of Yard	Outline of Handling	Items for Improvement	Remarks
Chumphon	o Train frequency Present → 1996 → 2006 30 38 48	No problem	
Surat Thani	o Train frequency Present → 1996 → 2006 32 38 44	No problem	
Thung Song	o Being a central station in transport on the Southern Line, train frequency is as follows: Present → 1996 → 2006 34 40 48 o Shunting party: 2	o Reduced work system by modification of low efficiency layout	o Reduction of shunting party
Hat Yai	o Being a central station transport in southern Thailand, train frequency is high. Present → 1996 → 2006 38 40 48 o Work complication due to common use of the same tracks for departure/ arrival track and for sorting track	o Relaxation of work by construction of sorting track	o Maintenance of traffic volume o Shortening of relay time and improved car relay accuracy by abolition of work complications

Chapter 7 Yard Facility Plan

Items for improvement of yard facilities are as follows:

Reference Nos. in the layout sketch refer to items for improvement in the Master Plan of Table 1 below:

Table 1 Items for Improvement

Station	Item for Improvement in Master Plan	Item for Improvement in Feasibility Study Plan
Bangkok	1)-a Construction of two arrival tracks	1)-a Same as left
	1)-b Conversion of track departure track 7 and 8 to departure/ arrival tracks	1)-b Same as left
	2)-a Construction of one departure track	2)-a Same as left
	2)-b Direct connection of diesel railcar terminal with departure track	2)-b Same as left
	3)-a Extension of effective length of track of passenger car yard, and increased storage capacity	3)-a Same as left
	3)-b Extension of effective length of tract of diesel railcar terminal, and increased storage capacity	3)-b Same as left
	4) Abolition of train competition between the Eastern and Northern Lines	
	5) Abolition of compound route	5) Same as left
	6) Improvement of interlocking devices, transfer of signals	6) Same as left
	Amount of investment: 162 million bahts	Amount of investment: 162 million bahts

Station	Item for Improvement in Master Plan	Item for Improvement in Feasibility Study Plan
Mae Nam	1)-a Improvement of sorting facilities at Bangkok Port 2)-a Construction of shortcut 3)-a Conversion of weighing track to departure/arrival tracks (already completed) 4)-a Construction of empty car storage track Amount of investment: 91.8 million bahts	1)-a Same as left 2)-a Same as left 3)-a Same as left 4)-a Same as left Amount of investment: 91.8 million bahts
Bang Sue	1)-a Construction of two departure/arrival tracks for the freight station 1)-b Conversion of six departure tracks at freight yard to departure/arrival tracks 2)-a Construction of signal stations at the exit of Bang Sue station on the Southern Line, and at the crossing of the passenger and freight tracks 2)-b Conversion of old diamond crossing on the level crossing of the freight track of the Southern and Northern Lines to the new type one. Amount of investment: 130.0 million bahts	1)-a Same as left Amount of investment: 51.3 million bahts

Station	Item for Improvement in Master Plan	Item for Improvement in Feasibility Study Plan
Hat Yai	1) Modification of layout for abolition of competition between freight trains on departure/ arrival tracks and shunting 2)-a Construction of additional sorting track 2)-b Removal of loading track 2)-c Transfer of refuelling facility 3) Construction of additional passenger car storage track Amount of investment: 48.2 million bahts	1) Same as left 2)-a Same as left 2)-b Same as left 2)-c Same as left 3) Same as left Amount of investment: 48.2 million bahts
Ban Phachi	1)-a Construction of additional sorting track 2)-a Modification of layout for abolition of train competition Amount of investment: 54.5 million bahts	
Phitsanulok	a) Construction of passenger car storage track Amount of investment: 12.7 million bahts	
Nakhon Ratchasima	a) Construction of passenger car storage track Amount of investment: 4.8 million bahts	

Station	Item for Improvement in Master Plan	Item for Improvement in Feasibility Study Plan
Chumphon	None	
Surat Thani	None	
Thung Song	1)-a Construction of loading track 1)-b Removal of loading facility 2)-a Construction of sorting track 2)-b Transfer of passenger car and freight car storage tracks 2)-c Transfer of refuelling track and refuelling facility 2)-d Removal turntable Amount of investment: 31.5 million bahts	

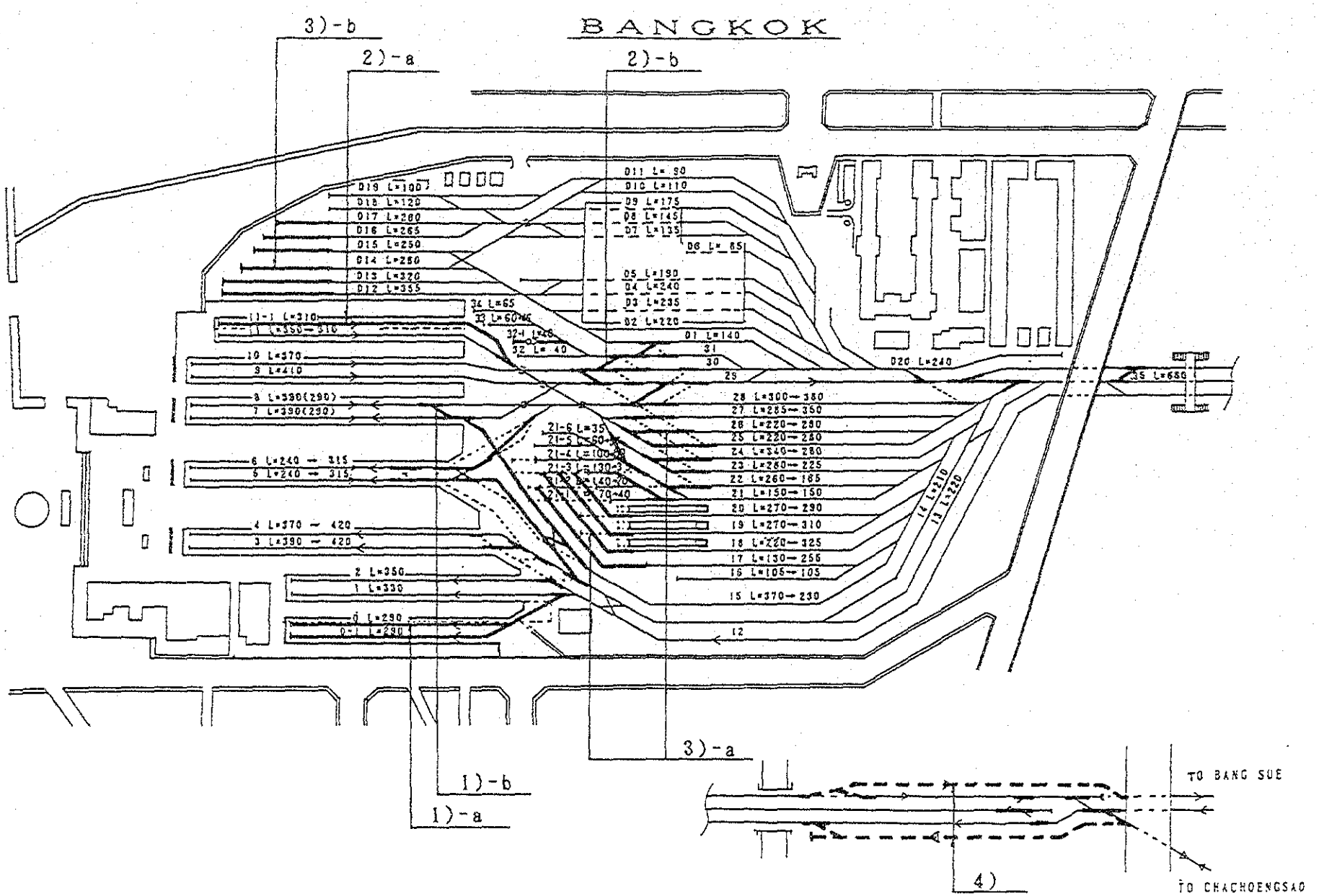


Fig. 1 Future Track Layout at Bangkok Station

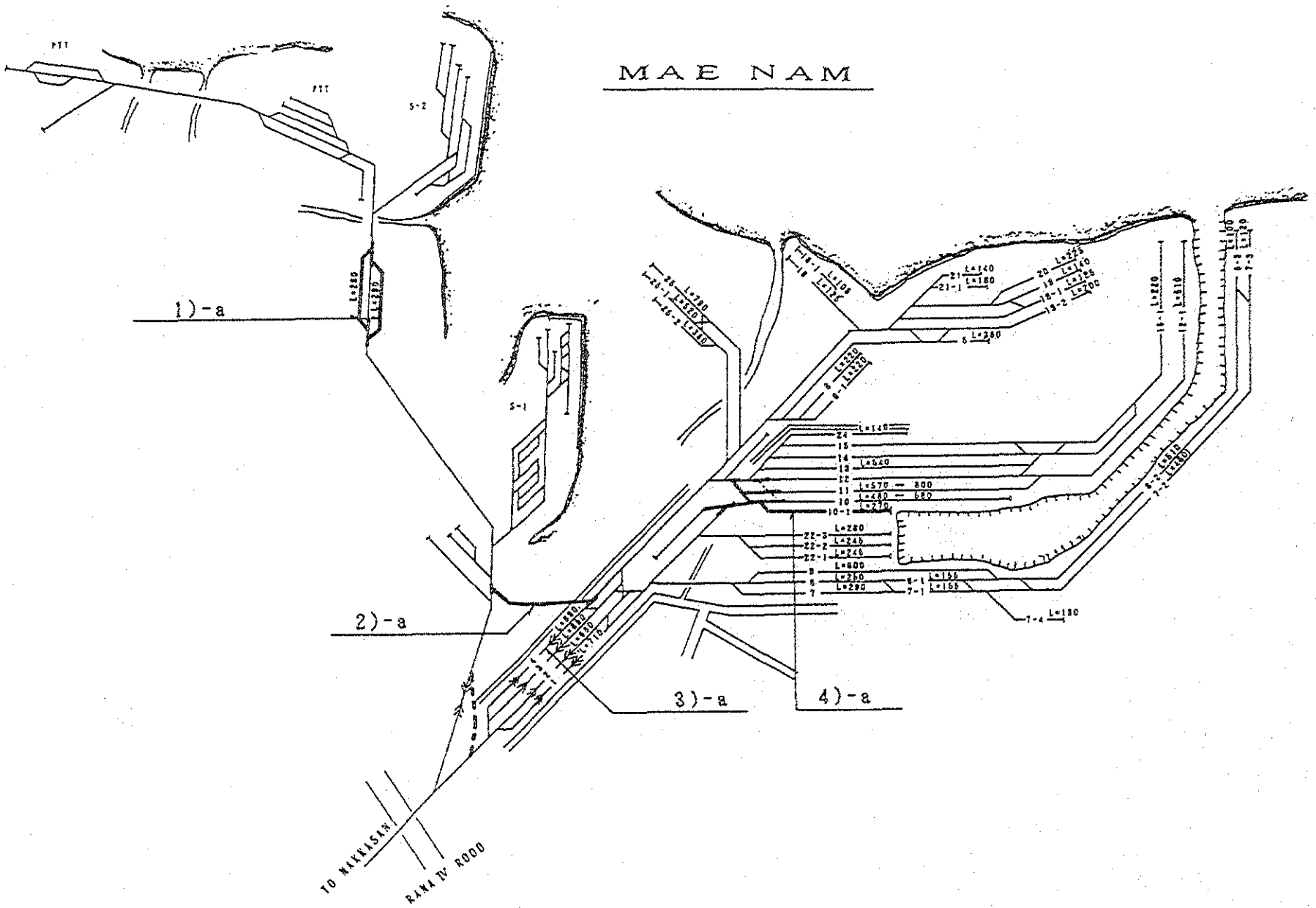


Fig. 2 Future Track Layout at Mae Nam Station

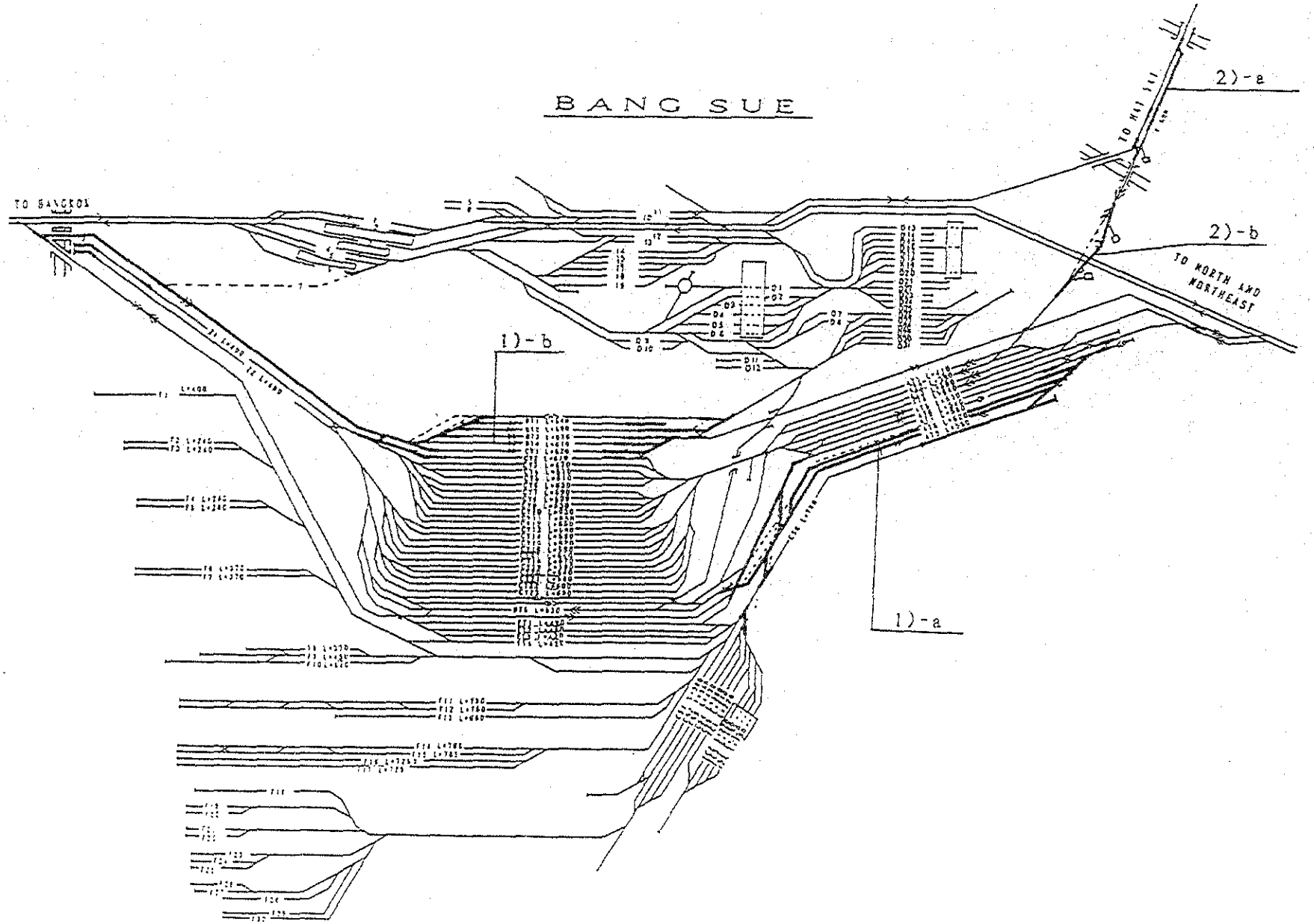


Fig. 3 Future Track Layout at Bang Sue Staion

HAT YAI

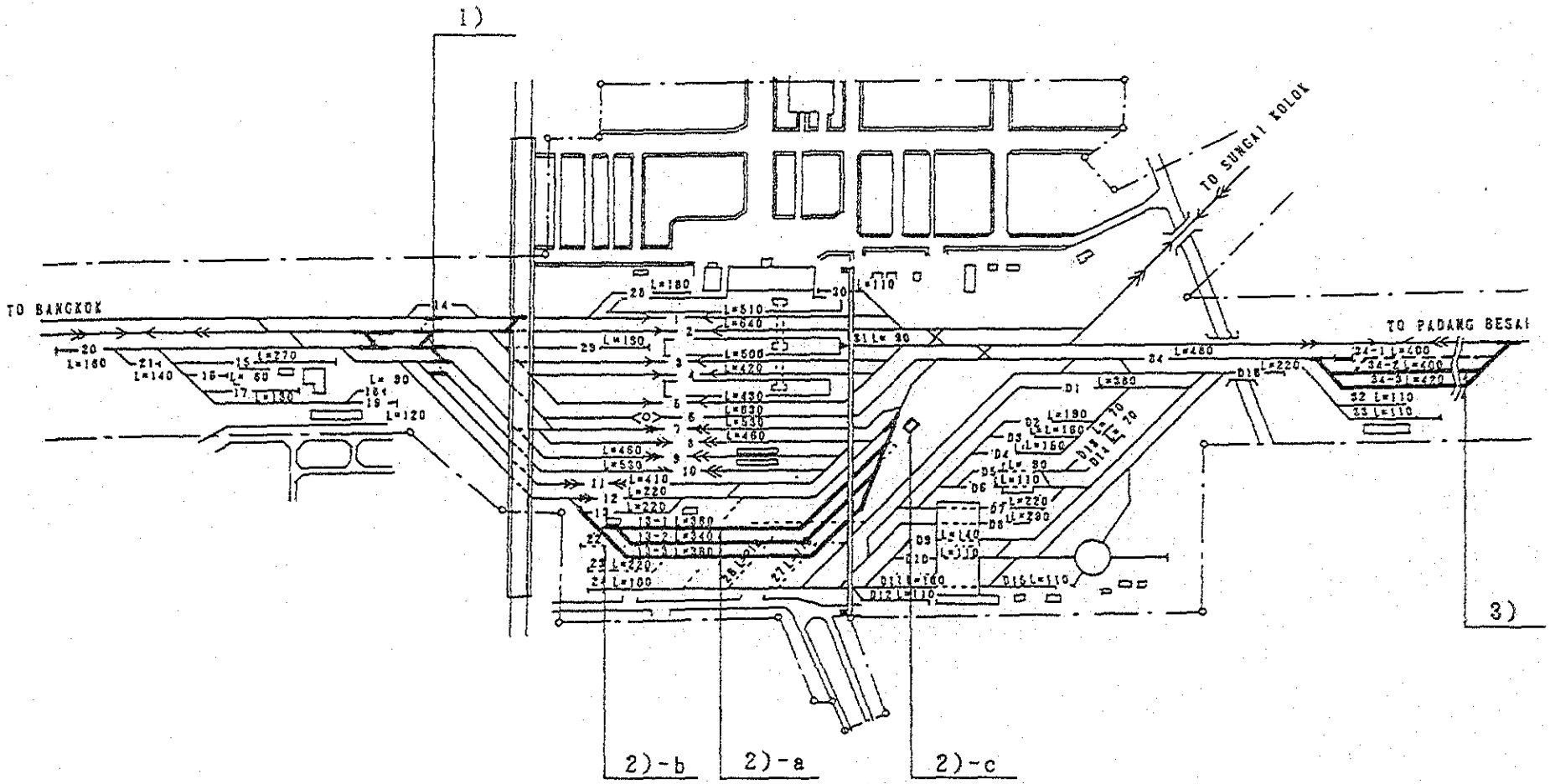


Fig. 4 Future Track Layout at Hat Yai Station

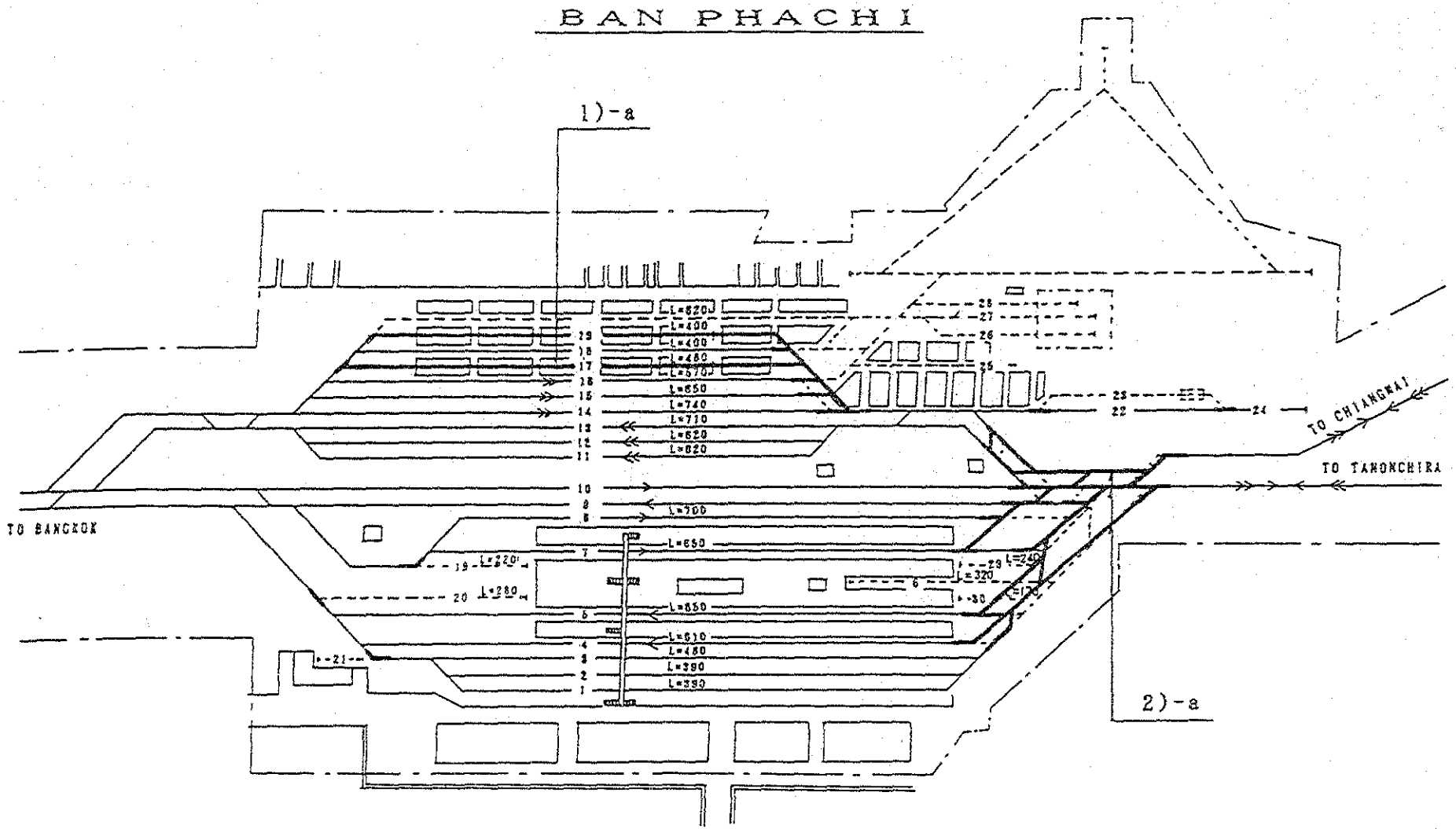


Fig. 5 Future Track Layout at Ban Phachi Station

PHITSANULOK

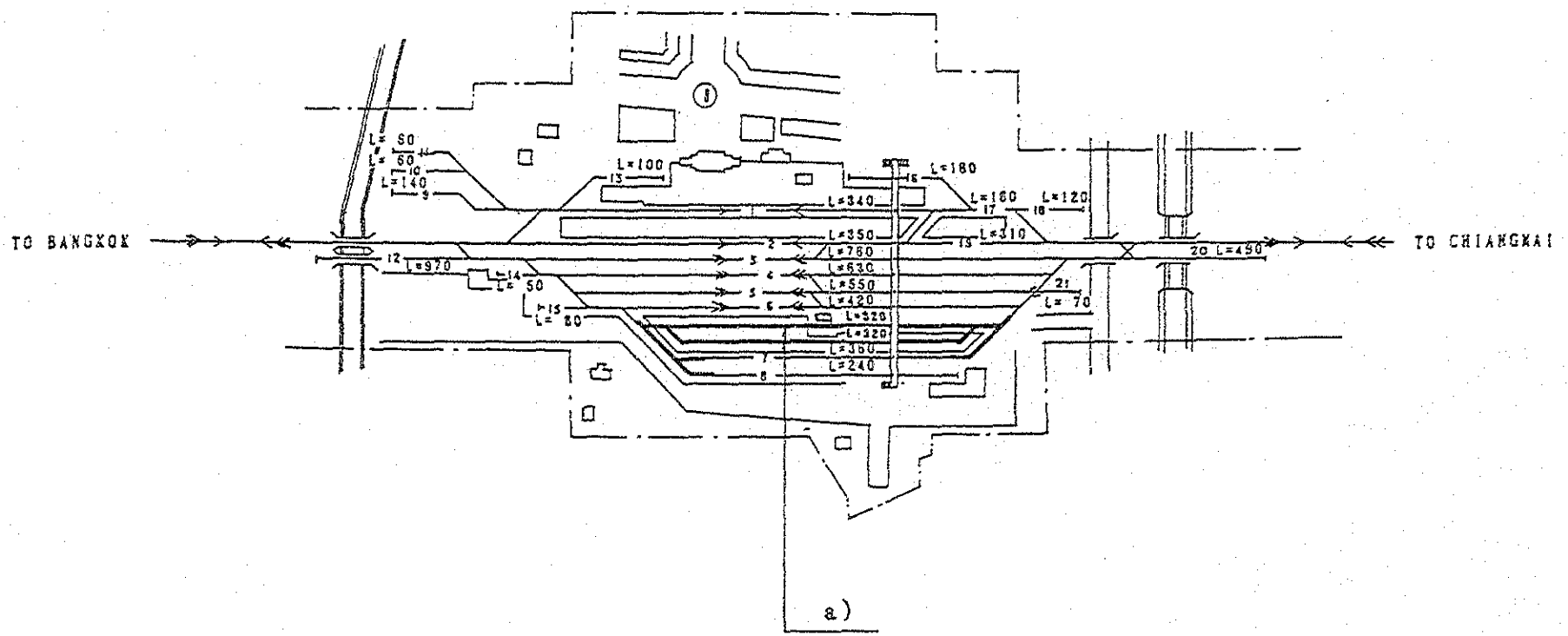


Fig. 6 Future Track Layout at Phitsanulok Station

NAKHON RATCHASIMA

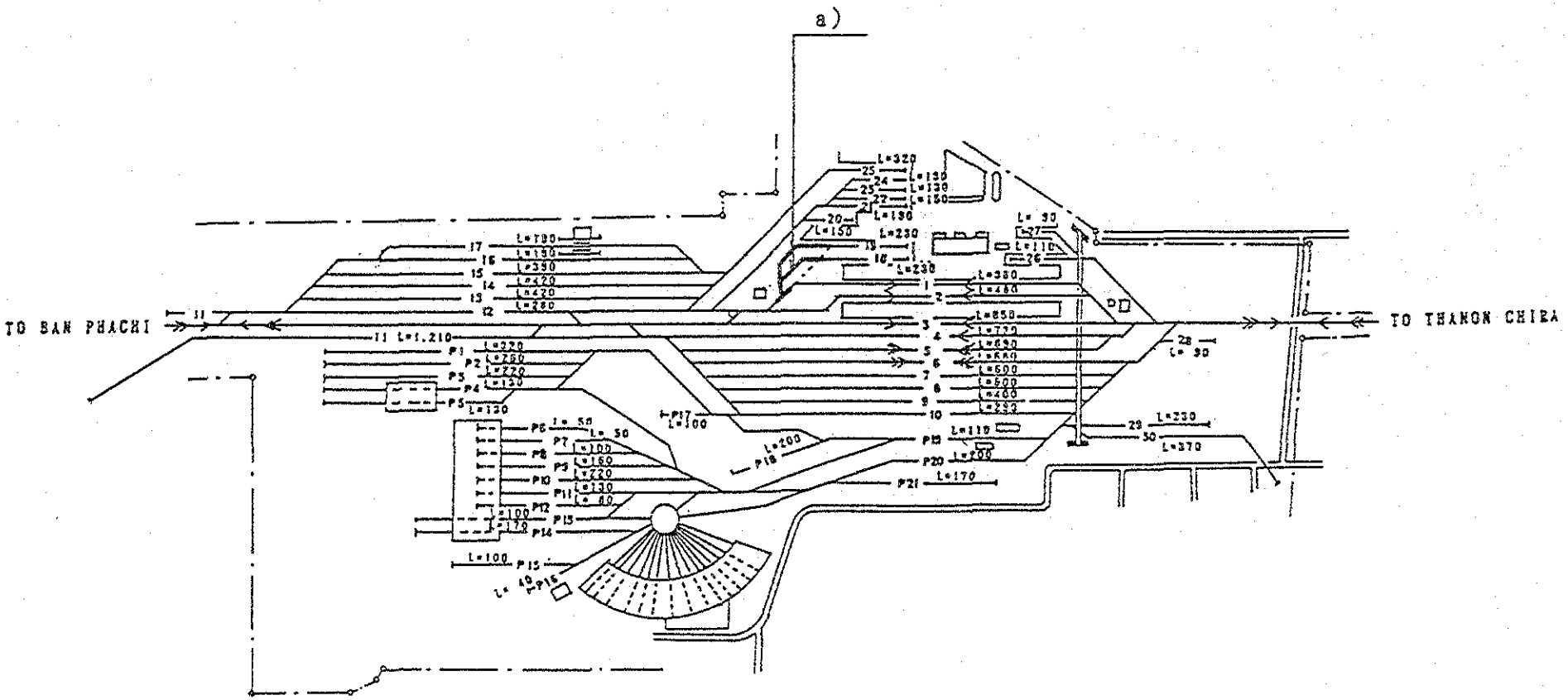


Fig. 7 Future Track Layout at Nakhon Ratchasima Station

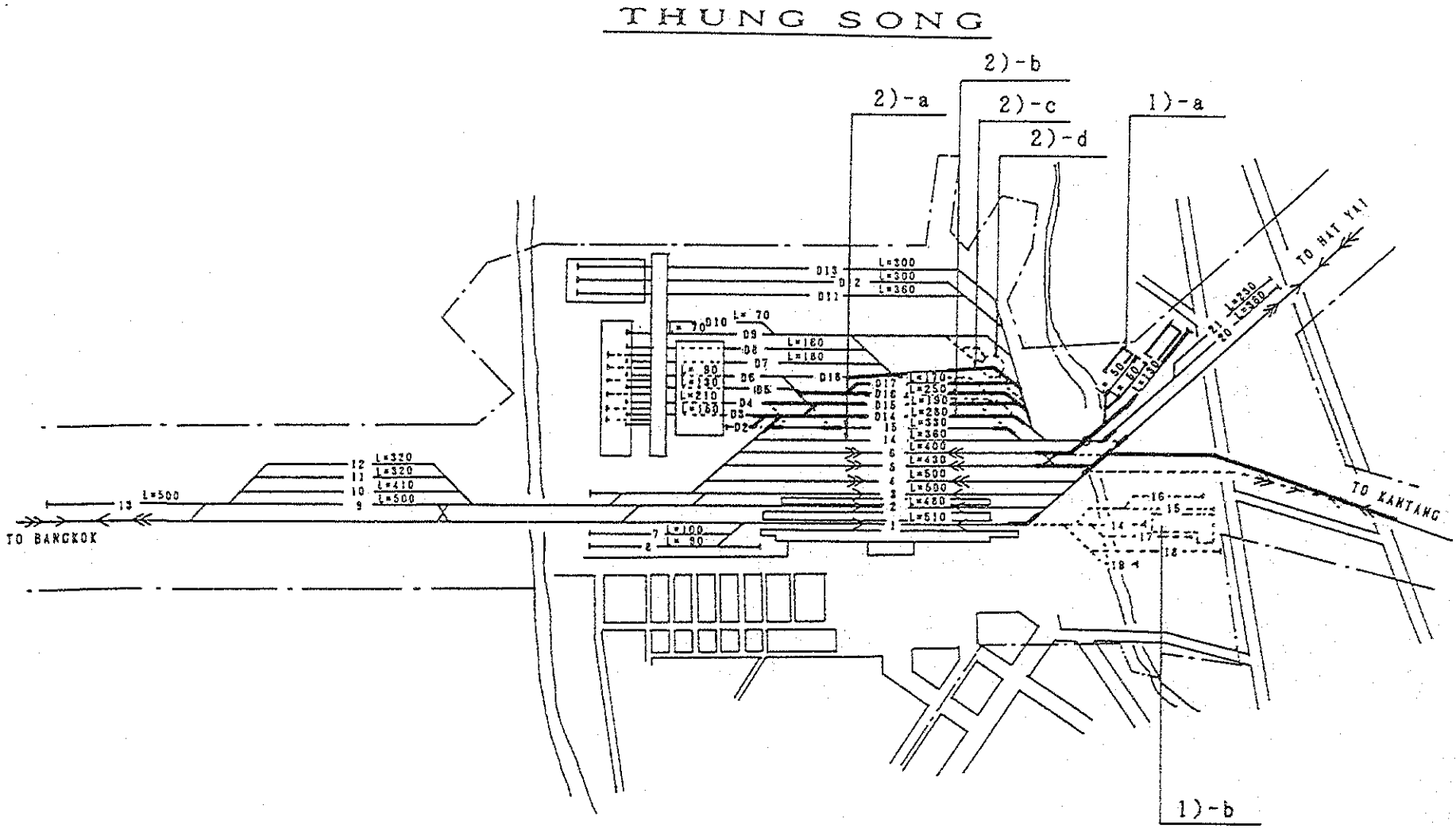


Fig. 8 Future Track Layout at Thung Song Station

Chapter 8 Economic and Financial Analyses

8-1 Methodology of Economic Analysis

Economic analysis is conducted under the orthodox principle of "with and without the project". Benefits of possible savings in both time and cost to be generated by the project are analysed. Investment and procurement costs to be analysed comprise railway facilities, rolling stock, railway right-of-way, and road vehicles.

8-2 Alternatives and Construction Schedule

See Table 8.3.1, in page 307.

8-3 Finance Plan

It is assumed that project costs are financed from the following sources:

SRT fund ..... Neither principal repayment, nor interest payment

Long-term loans .... 13.0% interest rate p.a., ten-year maturity with five-year grace period

In addition, short-term loans (13.0% interest rate p.a.) are financed if the available cash flow is deficient.

8-4 Results of Economic and Financial Analyses

Results of economic and financial analyses are summarized as Table 1. A sensitivity analysis is also conducted for deviations from the basic assumptions such as cost overrun, construction delay, demand forecast decrease, fare and tariff increase, etc.

Table 1. Results of Economic and Financial Analysis

		EIRR (%)	FIRR (RoI. %)	DSCR (Decimal)	SRT Funds (mil. baht)	Long-term Loans (mil. baht)	Maximum Amount of Short-term Loans (mil. bahts/year)	Maximum Balance of Short-term Loans (mil. bahts/year)	Year When Repayment of Short-term Loans Completed
I Direct effect	Alt. 1	72.21	6.55	0.05 - 3.00	208	208	290 (2021)	1,938 (2021)	Never completed
	Alt. 2	67.74	4.81	0.01 - 2.60	266	266	475 (2021)	3,683 (2021)	ditto
II Direct and indirect effect (1)	Alt. 1	18.29	19.72	1.21 - 4.05	208	208	0	0	-----
	Alt. 2	14.71	16.12	0.89 - 3.40	266	266	9 (1993)	9 (1993)	1995
III Direct and indirect effect (2)	Alt. 1	17.33	-20.52	Below 1.0	208	208	46,985 (2020)	444,677 (2021)	Never completed
	Alt. 2	13.40	-21.06	Below 1.0	266	266	54,695 (2020)	517,570 (2021)	ditto
	Alt. 3	15.95	-	-	-	-	-	-	-----
	Alt. 4	14.77	-	-	-	-	-	-	-----
IV 100% savings on rolling stock in III	Alt. 1	-	21.24	1.21 - 4.05	208	208	0	0	-----
	Alt. 2	-	18.09	0.89 - 3.40	266	266	9 (1993)	9 (1993)	1995

* Improvement cost: 353.3 mil. bahts for Alternative 1 and 456.8 mil. bahts for Alternative 2 4.

** See pp. 316~318 of the direct effect and the direct and indirect effects (1) and (2).

8-5 Concluding Remarks

(1) This yard improvement project is economically feasible since every figure of the economic internal rate of return exceeds the average discount rate (8.0% to 12.0%) of typical international aid and lending institutions such as USAID, ODM, IBRD, ADB, etc.

(2) Furthermore, this project retains its robustness despite deviations from the basic assumptions (e.g. cost overrun, construction delay, and demand forecast decrease).

(3) On the other hand, this project is financially viable if SRT's existing rolling stock is efficiently used and saved on new procurements money by increasing load factors, operation efficiencies, car-kms, etc.

(4) For further assurance of financial viability, project cost should be reduced as much as possible by effective utilization of present track materials (rail, sleeper, ballast, turnout, etc.); financial sources with better terms and conditions should be also sought.

Chapter 9 Conclusion

9-1 Improvement of the Passenger and Freight Services in Future

The plan proposed here for improvement of the yards at the Bangkok and other stations has been worked out in consideration of the "increase in income and reduction in expense" which are problems of prime importance requiring urgent resolution for SRT. But, these objectives are attainable only with promotion of the following improvement plans over the whole transportation services.

1) It is necessary to expand the traffic volume through installation of new stations and frequent services by DRC for improvement of the commuter transportation in the Bangkok Metropolitan area.

2) Being under strict competition with buses and airplanes, it is also necessary to improve the level of services including speed-up, more frequency and comfortability.

3) Stations handling a relatively small amount of cargos are likely to present a minus effect in the whole transportation, and such a freight handling work should be absorbed into that of large sations as far as practicable, while the central stations of regional distribution should have the necessary functions provided further for better services.

4) It is important to promote the transportation system which is capable of complying with the consignors' needs with quick delivery and definite time of arrival.

5) For securing the punctual train operation, freight handling stations should have an adequate time provided for the shunting work. The measure mentioned in 3) above is also effective in securing the punctual train operation.

6) Higher efficiency as well as productivity of the working system is required for improvement of the balance in management. Here, application of a "yard work diagram" is considered to be effective.

7) For higher efficiency of the operation of locomotives and cars, it is desired to strengthen the inspection and repair of troubled cars and to optimize the control of freight cars.

9-2 Recommendation

The project is feasible for the Thai economy, and if the following are carefully taken into consideration in implementing the project, it will contribute to the improvement of SRT's financial condition as well.

(1) In order to handle the increasing railway traffic demand that the project produces, SRT's existing rolling stocks should be utilized to a maximum extent and money for new procurements be economized as much as possible by raising load factors, operation efficiencies, car-kms, and being thorough in inspections and repairs.

(2) In executing the improvement work, SRT's used materials should be utilized as much as practicable, and for the required manpower, allocation of the current SRT personnel should be examined, so that the construction cost could be reduced.

(3) If the fund for the improvement is sought from any other sources than SRT itself, it should be secured under the advantageous conditions of the government subsidy, soft loan, etc.

(4) As the major purpose of the project is to improve yard operations and thus increase income and reduce expenses, SRT's management and financial condition are closely related with this project. So improvement in efficiency of the SRT management should be promoted simultaneously.

CONTENTS

CHAPTER 1 Introduction

CHAPTER 2 Socio-Economic Conditions in Thailand

CHAPTER 3 Demand Forecast

CHAPTER 5 Yard Function Assignment

CHAPTER 6 Yard Work Plan

CHAPTER 7 Yard Facility Plan

CHAPTER 8 Economic and Financial Analysis

CHAPTER 9 Conclusion

Appendix

LIST OF TABLES

Table

LIST OF FIGURES

CHAPTER 1 INTRODUCTION

CHAPTER 1 Introduction

1-1 Background of the Study

The economy of the Kingdom of Thailand maintained a yearly growth of about 7% in the 20 years from the start of the First National Economic and Social Development Plan (First Five-Year Plan) in 1961 to the end of the Fourth Five-Year Plan.

However, the sluggish growth of the world economy, triggered by the oil crisis, has had serious effects on the economy. Under these circumstances, Thailand has been carrying out its Fifth Five-Year Plan since 1981, which is directed toward further improvements in economic efficiency. With respect to transportation, this includes development of methods to save energy.

In line with national policy, the State Railway of Thailand (SRT) decided to expand the role of railway transportation, and prepared its Improvement Program for 1982 - 1986 to increase transportation demand. Under the program, transportation capacity improvement and system modernization are under way. Improvement of railway yards is also specified as an important task in this program, along with the improvement of tracks, rolling stock, and signalling and telecommunication systems. However, the railway yards that play the most important role in transportation have not yet received major improvements, and the result is that these yards have become bottlenecks, limiting transportation efficiency.

To eliminate such bottlenecks, SRT considered it necessary to make effective improvements in the ten principal yards, and requested the Japan International Cooperation Agency (JICA) to draw up a master plan and conduct a feasibility study on several of the ten principal yards in need of urgent improvement. Based on this request, a Scope of Work was concluded on August 29, 1985 between SRT and the JICA Preliminary Study Team headed by Dr. Tadatoshi Inoh.This study has been carried out on the basis of this Scope of Work.

1-2 Objectives of the Study

In order to increase railway transportation capacity, the study aims at formulating a master plan for the ten principal yards, with the target year set at 2006, and selecting from these yards which most need urgent improvement. Feasibility studies will then be conducted for the selected yards, with a target year of 1996.

The ten yards covered by the study are as follows:
Mae Nam, Bang Sue, Ban Phachi, Thung Song, Hat Yai, Bangkok, Phitsanulok, Chumphon, Surat Thani, and Nakhon Ratchasima (see Fig 1.2.1).

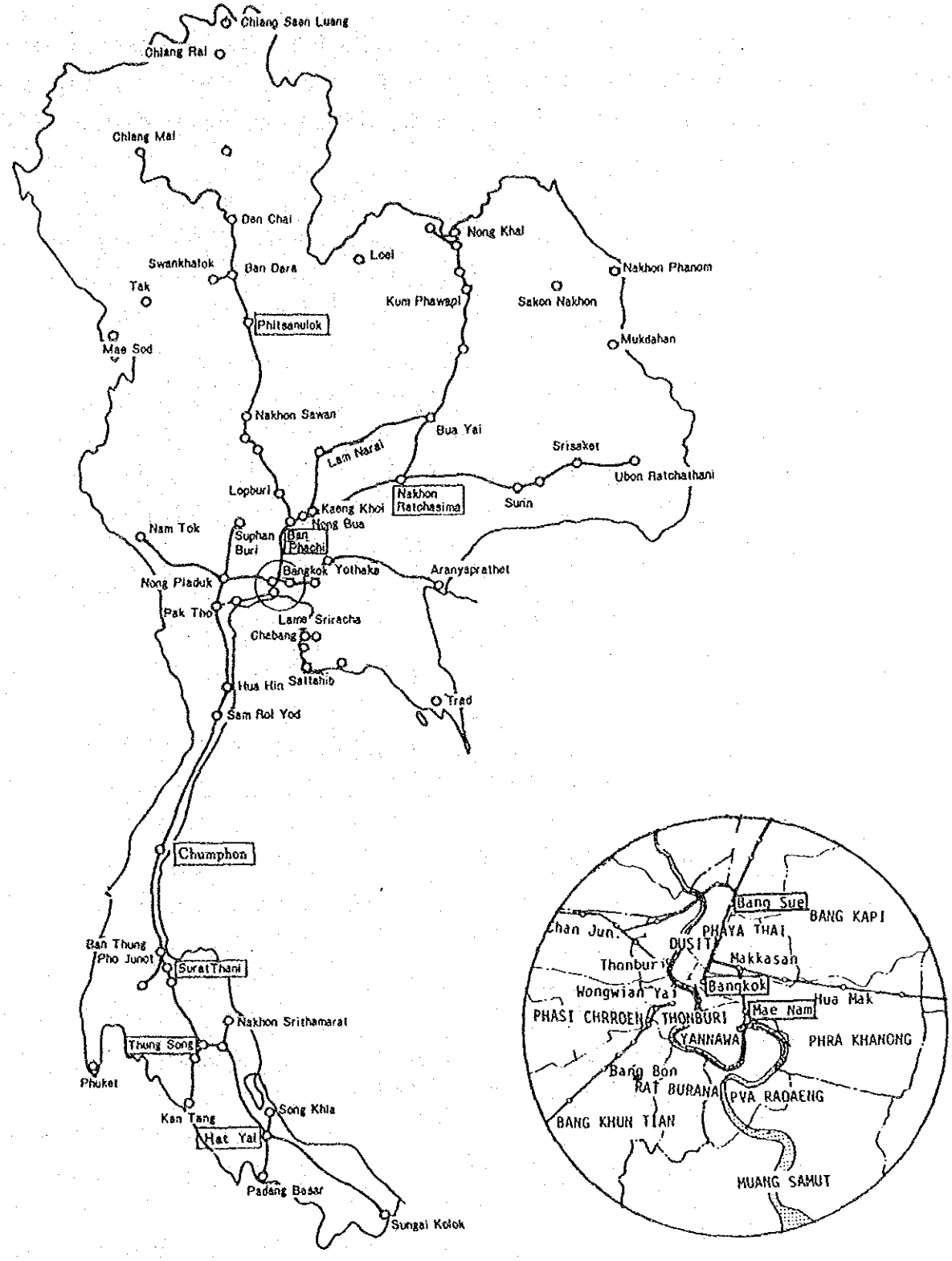


Fig. 1.2.1 Locations of the Ten Yards

1-3 Outline of the Study

The study was designed to formulate a master plan for the ten yards, with a demand forecast for the year 2006 taken as its basis. Four yards were then chosen from these ten yards and a feasibility study carried out with a target year of 1996.

The main work items in the respective stages are shown below.

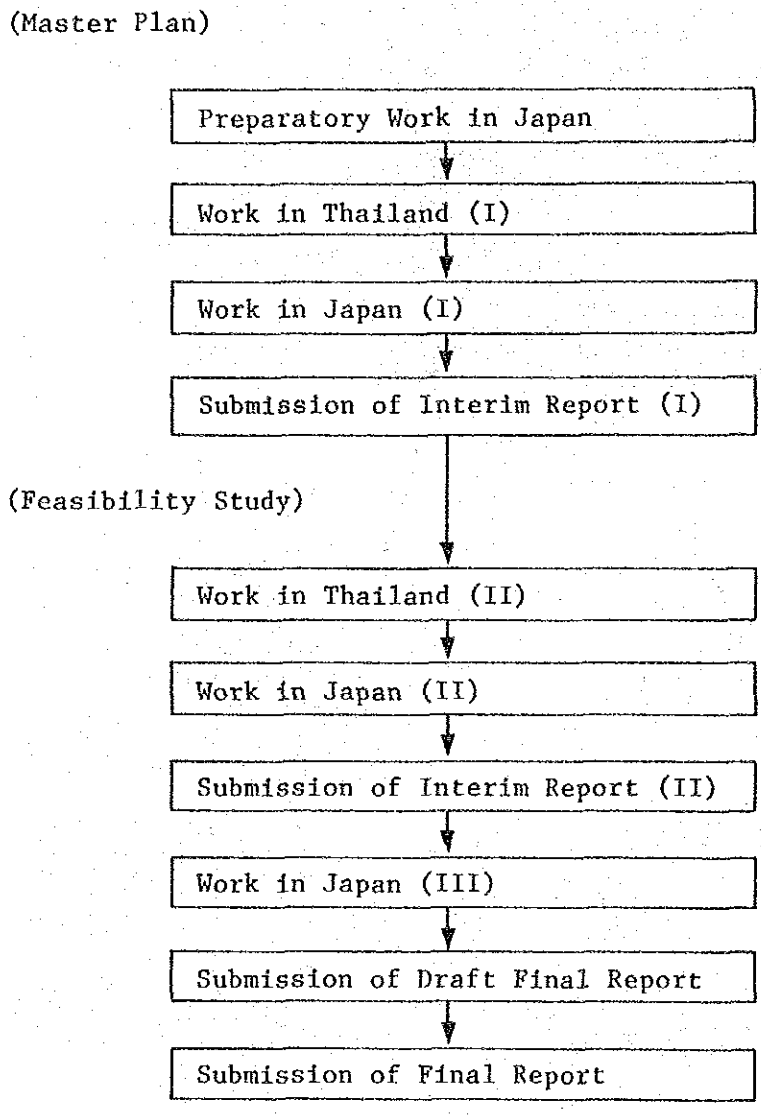


Fig. 1.3.1 Rough Flow of the Study

Master Plan

First stage: Preparatory work in Japan

(1) Examination of collected data.

(2) Examination of study policy.

(3) Preparation of Inception Report.

Second stage: Work in Thailand (I)

Work in Thailand (I) was carried out for 72 days from December 19, 1985 to February 28, 1986. The work was comprised mainly of the following.

(1) Explanation and discussion of Inception Report

(2) Data collection

(3) Field reconnaissance

(4) Clarification of the problems with the present state of railway traffic and a brief examination of basic policy.

(5) Preparation, explanation, and discussion of Progress Report

Third stage: Work in Japan (I)

In order to prepare Interim Report (I) to formulate the Master Plan, the following work was carried out.

(1) Analysis and examination of field survey results

(2) Examination of modernization for transportation

(3) Examination of basic policy for improvement plan

(4) Examination of the respective fields of speciality

(5) Preparation of basic plan for improvement

(6) Selecting yards to be taken up in the Feasibility Study (F/S)

Feasibility Study

Fourth stage: Work in Thailand (II)

Work in Thailand (II) was conducted for 45 days from July 29 to September 11, 1986.

(1) Submission and explanation of Interim Report (I)
Approval was obtained at the steering committee on the four yards selected for the F/S (Bangkok, Mae Nam, Bang Sue, Hat Yai).

(2) Collection of data for the F/S

(3) Supplementary field survey on the four yards

Fifth stage: Work in Japan (II)

For the four yards to be taken up in the F/S:

(1) Preparation of a draft improvement plan

(2) Preparation of Interim Report (II)

Sixth stage: Work in Thailand (III)

Submission and explanation of Interim Report (II)

At the Submission of Interim Report (II), it was explained to the steering committee. Regarding the four yards, the policy for preparation of the Draft Final Report was discussed.

Seventh stage: Work in Japan (III)

For the four yards to be taken up in the F/S:

(1) Preparation of improvement plan

(2) Evaluation of improvement plan

(3) Preparation of Draft Final Report

Eighth stage: Work in Thailand (IV)

(1) Submission and explanation of Draft Final Report

Ninth stage: Work in Japan (IV)

(1) Preparation of Final Report in accordance with SRT's comments

(2) Submission of Final Report

1-4 Basic Policy of the Study

The transportation share of SRT is greatly decreasing in both passengers and freight because of the development of the road network. Management problems have also continued to be an aggravation for the last several years. In order to get through such a situation and have the appropriate functions of a railway in Thailand exhibit themselves fully, it is necessary to secure reliability through reductions in the cost of transportation, and improve arrival time and regularity, thus increasing the share. Furthermore, it is necessary to offer services to comply with customer needs.

In the study, these points are taken into consideration, and a result aimed at in which existing facilities are fully utilized so as to reduce investment as much as practicable.

1-4-1 Method of Carrying out the Study

(1) Master Plan and F/S yard selection

The work flow is as shown in Fig. 1.4.1. The Master Plan's target year is 2006, with the demand forecast made for Case I and Case II for passengers and freight respectively.

For passengers, Case I is not adapted to positive traffic service, while Case II is designed for positive traffic inducement in a metropolitan area. In this study, Case II was employed.

For freight, Case I keeps railway competitiveness in its present condition, while Case II considers the more severe environmental conditions of SRT. In this study, Case II for freight was also employed.

Based on the demand forecast, the basic policy for yard improvement is examined in order to formulate a master plan for each specialty. Then, through evaluation, the yards to be taken up in the F/S are selected.

Although the evaluation is described in detail in Chapter 8, the four yards that were consequently selected are Bangkok, Mae Nam, Bang Sue and Hat Yai.

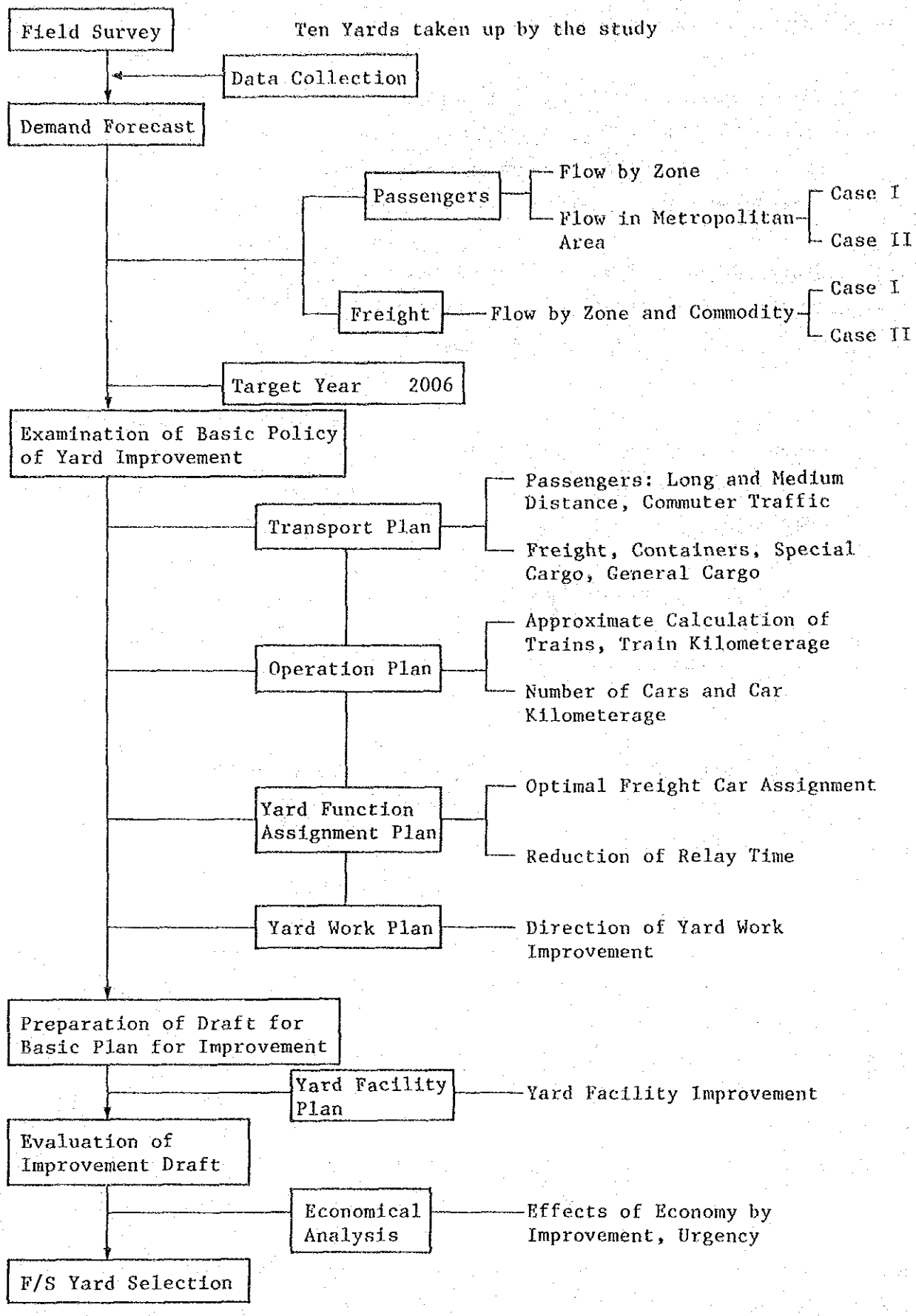


Fig. 1.4.1 Procedure of the Master Plan

(2) F/S Procedure

The work flow is as shown in Figure 1.4.2 Regarding the yards selected for the F/S, a supplementary field survey is done by reviewing the fields of speciality at F/S level for preparation of a draft F/S improvement plan with 1996 as the target year.

Then, after economic and financial evaluations, an optimum draft investment plan is prepared.

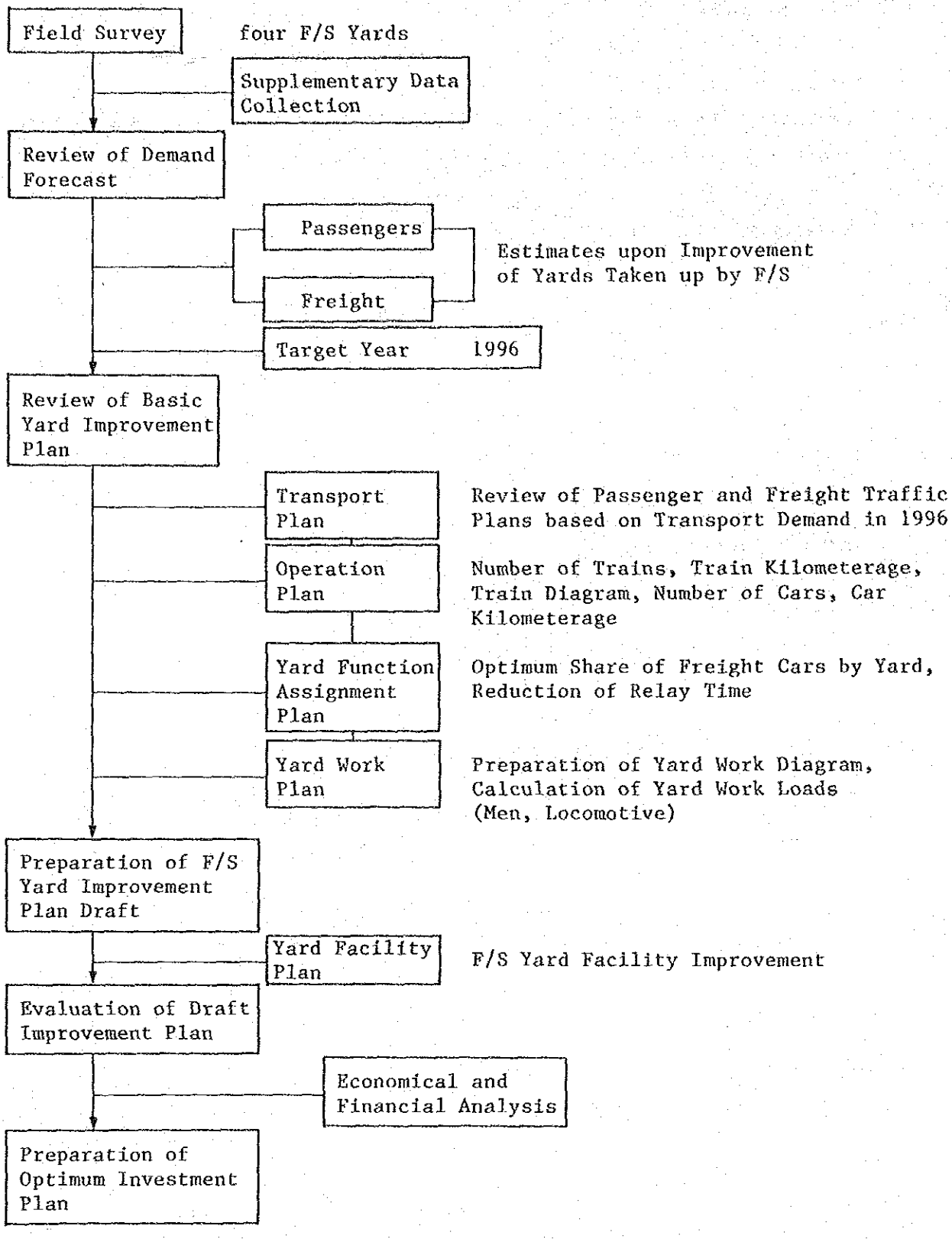


Fig. 1.4.2 Procedure of the F/S

1-5 Survey Organization

The personnel from Japan and Thailand involved with the study are as follows:

(1) Advisory Committee

Tadatoshi Inoh (Chairman)	Doctor of Engineering Professor, Kanazawa Institute of Technology
Shunsuke Sumida	Deputy Director, Safety Operation Division Secretariat to the Minister, Ministry of Transport
Shoichi Onaya	Chief of Civil Engineering Section of Facilities Division, Secretariat to the Minister, Ministry of Transport
Masayasu Kokubo	Chief of Cooperation Section of International Cooperation Division, International Transport and Tourism Bureau, Ministry of Transport

(2)	Study Team	Work Assignment
	Sadaaki Kuroda	Team leader
	Kunitaka Namikawa	Railway transportation plan
	Ryujirou Yamagishi	Transportation demand forecast
	Etsurou Horie	Train operation plan
	Minoru Harada	Yard functional assignment plan
	Takashi Joraku	Yard work plan
	Yoshiyuki Imai	Yard facility plan (passenger)
	Kiyoshi Kaneko	Yard facility plan (freight)
	Toshiaki Yamakawa	Design and cost estimates of tracks and structures
	Teruo Ootsuki	Construction plan
	Susumu Niikura	Design of signalling and telecommunication facilities
	Masami Shigematsu	Economic and financial analysis (till Interim (I))
	Yoshiaki Okada	Economic and financial analysis
(3)	JICA Staff	
	Atsushi Kawai	First Development Survey Division of Social Development Cooperation Department, JICA

(4) SRT Steering Committee

Choomsin Dabbhasuta (Chairman)	Deputy General Manager (Development and Planning)
Vatana Supornpaibul	Assistant General Manager 1
Wattana Asawakul	Chief Civil Engineer
Sommai Tamthai	Chief Mechanical Engineer
Ithipol Sucaromn	Traffic Manager
Thasanai Chantarangkul	Marketing Manager
Thavorn Ratanavaraha	Chief of Signalling & Telecommunication Bureau
Sriyoudh Sirivedhin	Chief of Development Coordinating Bureau
Vanich Pansuwan	Superintending Engineer, Project and Planning Division

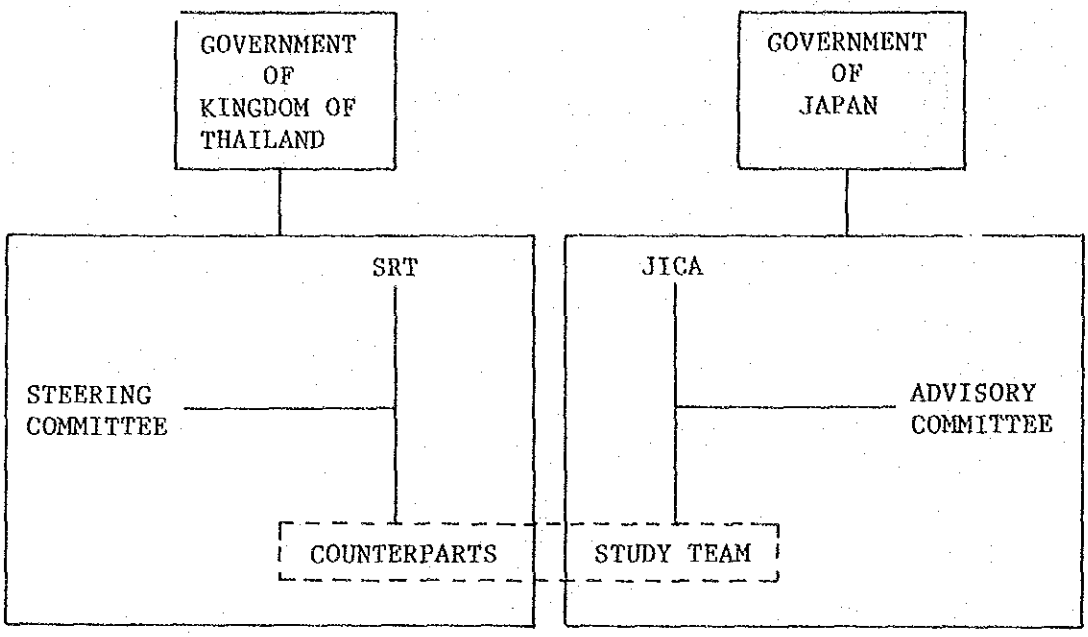
(5) SRT Counterpart Personnel

Vanich Pansuwan (Chairman)	Superintending Engineer, Projects and Planning Division
Somyot Rujimora	Chief, Transportation Division
Wayupol Chaisiri	Chief, Freight Marketing Division
Maitree Arayangkoon	Chief, Project Evaluation and Coordination Division 1.
Nimitchai Snitbhan	Civil Engineer, I/C Planning Section
Sin Buatongsri	Civil Engineer, I/C Permanent Way Section
Ukrit Sirisalee	Engineer, I/C Telecommunication Section
Yiemchai Chatkeo	District Engineer, Nakhonsawan District
Manop Chareonsit	Chief of Section Attached to Marketing Department
Naronk Pisitbannakorn	Engineer, I/C Carriage and Wagon Technical Section
Jain Boonsue	Assistant Engineer

Chatchai Koomsup	Assistant Engineer
Prasert Attanandana	Assistant Engineer

(6) Overall concept of study organization

The overall organization frame is shown below.



CHAPTER 2 SOCIO-ECONOMIC CONDITIONS IN THAILAND

CHAPTER 2 Socio-Economic Conditions in Thailand

2-1 Socio-Economic Overview

2-1-1 Population Tendency

As shown in Table 2.1.1, Thailand's population growth has been gradually decreasing in line with the effects of the population control policy of the government, and showed a growth rate of 31.0 per cent (average 2.74 per cent per year) during 1960 - 1970 and 30.3 per cent (2.68 per cent per year) during 1970 - 1980.

Regionally, however, the population concentration into Bangkok Metropolis, the center of economic activities in Thailand, has been highly progressing in recent years. The population of major cities is shown in Table 2.1.2. According to NESDB projections, Thailand future population is estimated to be 56.35 million in 1990, or in other words, to have a 20.6 per cent increase over 1980 - 1990, and 64.39 million in 2000, or a 14.3 per cent increase over 1990 - 2000.

2-1-2 Economy

(1) Overview of economy

Thailand's economy has achieved steady growth owing mainly to the progress of diversification in agriculture and industrialization since the commencement of a series of Five-Year Plans in 1961. During the 20 years covering the 1960s and 1970s the real economic growth rate had successfully reached as high as seven per cent annually. The national income had grown 12 times over that period and the per-capita national income (nominal) had increased to US$ 709 in 1980 from US$ 97 in 1960, lifting Thailand into the group of medium-income countries.

Table 2.1.1 Population by Region and Growth Rate

(Million persons)

Region	1960	1970	1980	Density per km² (persons)	Percent increase	
					1960-1970	1970-1980
Whole Kingdom	26.26	34.40	44.82	87	31.0	30.3
Central Region (BKK Metropolis)	8.27 (2.14)	10.61 (3.08)	14.42 (4.70)	139 (3,001)	28.3 (44.0)	35.9 (52.6)
Northeastern Region	8.99	12.03	15.70	93	33.7	30.5
Northern Region	5.72	7.49	9.07	54	30.8	21.2
Southern Region	3.27	4.27	5.63	80	30.6	31.7

Source: National Statistical Office

Table 2.1.2 Population of Major Cities (As of the end of December 1982)

(Unit: 1,000 persons)

Name of City	Population	Name of City	Population
1. Metropolitan Bangkok	5,468	6. Nakhon Sawan	93
2. Khon Kaen	108	7. Nakhon Ratchasima	89
3. Hat Yai	108	8. Nakhon Si Thammarat	89
4. Chiang Mai	104	9. Song Khla	78
5. Udon Thani	100	10. Phitsanulok	71

In recent years, however, the economic growth has been slowing down due to the declining growth of the export volume of cash crops as well as the depressed primary commodity prices, and has been showing an average growth rate of 5.6 per cent per annum over 1979 - 1983. Meanwhile, structural problems such as the expansion of fiscal deficits, deterioration in the balance of payments, accumulation of external debts and the income gap between regions as well as sectors have been emerging.

In the face of such problems, the Fifth Five-Year Plan started from October 1981 and has stressed economic structural adjustment and an increase in economic efficiency rather than economic growth, although it has the long-term perspective that Thailand will grow into one of the Newly Industrialized Countries (NICs) in 10 years through the promotion of heavy industry.

(2) Tendency of economic growth (GDP)

The targets and results of the real GDP growth rate for each Five-Year Plan are shown in Table 2.1.3. The result of economic growth during the Fifth Five-Year Plan period is estimated to be 5.3 per cent, being less than the target, due to a slump of the world economy.

In the Sixth Five-Year Plan (fiscal year 1987 - 1991), the economic growth target has been set to an average of 5.1 per cent per annum.

Table 2.1.3 GDP Growth Rate

	Target	Result
The First Plan (FY 1961 - 1966)	5.5%	7.3%
The Second Plan (FY 1967 - 1971)	8.5%	7.2%
The Third Plan (FY 1972 - 1976)	7.0%	6.2%
The Fourth Plan (FY 1977 - 1981)	7.0%	7.3%
The Fifth Plan (FY 1982 - 1986)	6.6%	5.3% (Estimate)
The Sixth Plan (FY 1987 - 1991)	5.1%	-

Note: FY (Fiscal Year); October 1 - September 30

Source: NESDB, "The Sixth Five-Year Plan"

Table 2.2.4 shows the industrial origin of the GDP and the number of employed persons by industry (sector). The agriculture sector has gradually declined as a proportion of the GDP, while the manufacturing sector is increasing. This means the economic structure of Thailand is changing towards industrialization.

Table 2.1.4 Industrial Origin of GDP Employed Persons by Industry

(Per cent)

	Industrial Origin of GDP			Employed Persons by Industry		
	1960	1970	1980	1960	1970	1980
Agriculture	39.8	28.5	25.4	82.3	79.3	71.3
Manufacturing	12.5	15.9	19.7	3.4	4.1	7.4
Commerce	15.1	19.1	18.8	5.7	5.5	6.9
Others	32.6	36.5	36.1	8.6	11.1	14.4

Source: National Statistical Office

The gap between the regions is characteristically observed in Table 2.1.5. Although Bangkok Metropolis takes a large share (33%) of the GDP and marks a considerable level of 3 times or 50,799 Baht as large as the average GDP per-capita for the whole of Thailand, each of the others is far below that level.

Table 2.1.5 GDP by Region (Nominal in 1982)

Region	GDP (Million Baht)	GDP Per-capita (Baht)	Comparison
Metropolitan Bangkok	281,317	50,799	100
East	121,372	33,518	66
West	84,391	25,847	51
Central	61,046	20,999	41
South	86,275	14,376	28
North	114,366	11,434	23
Northeast	109,603	6,390	13
Whole Kingdom	858,371	17,707	35

Source: NESDB "Gross Regional and Provincial Product 1982"

(3) Agriculture

The Thailand agricultural sector dominated 22 per cent of the GDP (in 1983), 60 per cent of the total export value and 71 per cent of the employed persons (in 1980) and is still defined as the key sector in Thailand. Major agricultural products are rice, tapioca, maize, sugar and rubber, and these 5 crops take 42 per cent of the nation's total export by value.

Production and export (in million tons) of the major crops are as follows:

(Rice)

	1982	1983	1984	Average
Production	17.7	16.9	19.5	18.0
Export	3.8	3.5	4.6	4.0

Source : National Statistical Office

Main planting area: The Central Plain, Basins of Northern Thailand

The increase in the yield per rai is now an important problem in conjunction with the recent difficulty in finding arable land for expansion.

(Tapioca)

	1982	1983	1984	Average
Production (Cassava root)	17.8	19.0	20.0	18.9
Export	7.8	5.2	6.7	6.7

Main planting area: Northeastern region

(Maize)

	1982	1983	1984	Average
Production	3.4	3.0	3.6	3.3
Export	2.8	2.7	3.1	2.9

Main planting area: Northeastern and Northern regions

(Sugar)

	1982	1983	1984	Average
Production (sugarcane)	30.2	24.4	23.9	26.2
Export	2.2	1.5	1.2	1.6

Main planting area: Central region

(Rubber)

	1982	1983	1984	Average
Production	0.5	0.6	0.6	0.6
Export	0.5	0.6	0.6	0.6

Main planting area: Southern region

(4) Mining and manufacturing

1) Mining

Thailand produces more than 30 kinds of minerals such as natural gas, crude oil, tin, fluorite, limestone and lignite. Although the mining sector's proportion of GDP is still small (about 2 per cent), more than 80 per cent of its production is exported, making 4 - 5 per cent of the nation's total exports by value. Moreover, the mining sector has an important role in labor force absorption amongst the nonagricultural sectors.

The major mineral production is shown in Table 2.1.6.

Table 2.1.6 Major Mineral Production

(Unit: Thousand tons)

	1982	1983	1984	Major producing area
Metallic Minerals				
Tin (metal base)	36	27	41	Phuket (S)
Tungsten	2	1	1	Nakhon Si Thammarat (S)
Lead	44	50	49	Kanchanaburi (C)
Non-Metallic Minerals				
Fluorite	283	241	217	Kanchanaburi, Lamphun (N)
Barite	331	187	175	Chiang Mai (N)
Limestone	6,371	8,936	n.a.	Saraburi (C), Nakhon Si Thammarat
Gypsum	753	760	1,111	Phichit (N), Surat Thani (S)
Energy Minerals				
Lignite	1,964	1,866	2,904	Lampang (N), Lamphun
Natural Gas*	47,142	57,020	85,505	Off-shore in Gulf of Thailand
Crude Oil**	-	2,218	5,100	Kamphang Phet (N)

Source: Dept. of Mineral Resources

Note: * in million cubic feet

** in thousand barrels

Remarks: S; Southern region, C; Central region, N; Northern region

2) Manufacturing

Thailand's manufacturing sector has expanded rapidly over the last 25 years and in recent years has been contributing just under 20 per cent of GDP (at current prices). This expansion has taken place since 1960 in which what little industry existed consisted mainly of rice mills and a few government owned agro-processing industries. Industrial growth has been facilitated by major improvements in the infrastructure and an investment incentive package for both domestic and foreign enterprises.

The major industries are dominated by cement plants and oil refineries with some steel and textile mills. All are located within 180 kms of the Bangkok area.

The production of selected manufacturers is shown in Table 2.1.7.

Table 2.1.7 Production of Selected Manufactures

	Unit	1982	1983	1984
Cement	'000 tons	6,609	7,263	8,239
Jute products	'000 tons	191	174	193
Cotton textiles	mn sq yards	936	976	n.a.
Sugar	'000 tons	2,768	2,035	2,431
Cigarettes	'000 tons	27	29	29
Petroleum products	mn liters	8,503	8,840	8,600
Galvanized iron	'000 tons	127	124	133

Source: Bank of Thailand Quarterly Bulletin

2-2 Transportation

2-2-1 Overview of Transportation

In accordance with the remarkable economic growth for the past two decades, the transportation sector has also achieved high growth with priority being mainly given to roads. The increases in freight and passenger traffic over the same period are said to show an average annual growth rate of 8 per cent and 12 per cent respectively. During the era of "less expensive oil", road transportation had overwhelmingly dominated other transportation modes as the most convenient and speedy transportation means.

As shown in Table 2.2.1 investment in roads had the lion's share of 70 - 80 per cent of all transportation modes during the Second to Fourth Plans in accordance with the transportation policy of the government.

Table 2.2.1 Investment for Transportation Sector in Five-Year Plan

(Unit: Million Baht)

Mode	The Second Plan*1 (1967 - 1971)	The Third Plan*1 (1972 - 1976)	The Fourth Plan*2 (1977 - 1981)
Road	11,800 (80.4)	16,600 (79.5)	20,720 (73.9)
Railway	1,640 (11.2)	2,470 (11.8)	1,750 (6.2)
Inland waterway	677 (4.6)	920 (4.4)	1,224 (4.4)
Aviation	563 (3.8)	890 (4.3)	4,348 (15.5)
Total	14,680 <24>	20,880 <20>	28,042 <11>

Source: World Bank

Note : *1; Actual expenditure, *2; Budget

Figures in ( ); $\frac{\text{Investment amount of each mode}}{\text{Total investment amount}} \times 100$ (%)

Figures in < >; $\frac{\text{Total investment amount of transport section}}{\text{Investment amount for economic development}} \times 100$ (%)

As a result of this, the greater portion of transportation has been performed by road transportation (See Table 2.2.2).

Table 2.2.2 Transportation by Mode (1978)

	Freight		Passenger	
Mode	Million tons	%	Million passenger-km	%
Road	79.0	85	83,700	93
Railway	8.4	9	6,030	6.7
Water	5.6	6	-	-
Air	-	-	270	0.3
Total	93.0	100	90,000	100.0

Data: NESDB "The Fifth National Economic and Social Development Plan"

The sharp increase in oil prices due to the two oil shocks in the 1970s had the Thai Government reconsider their transportation policy which had stressed road transportation. Thus, energy-saving in the transportation sector which is the largest energy-consuming sector of them all became one of the major targets of the Fifth Plan. For that purpose, investment towards roads has been controlled and the development of the other modes such as railways and inland waterways has been emphasized.

2-2-2 Road Transportation

Thailand's transportation network is dominated by the recently developed extensive network of highways with a total length of 48,000 kms, most of which is all-weathered. The highway network covers practically the whole country with the major highways radiating from Bangkok to north/north-eastern, southern and eastern directions, with a lateral highway running east-west through all regions, covering practically all urban areas. To this is added an extensive network of rural roads connecting most of the populated areas (see Fig. 2.2.1).

The numbers of motor vehicle registrations in Thailand have been steadily growing every year and a rapid increase in vans, trucks and motorcycles can be seen (see Table 2.2.3).

Table 2.2.3 Motor Vehicle Registration by Type

(Unit: Thousand)

		Passenger Cars	Buses	Vans & Trucks	Motor-cycles	Others	Total
Whole Kingdom	1966	97	19	79	158	20	373
	1971	235	18	147	364	19	789
	1976	298	20	285	512	30	1,145
	1981	451	64	472	1,141	50	2,178
	1982	388	210	555	1,368	60	2,578
BKK Metro-polis	1966	76	3	28	39	11	157
	1971	183	5	44	74	15	321
	1976	222	5	56	94	16	393
	1981	348	13	98	290	32	781
	1982	283	123	122	339	35	902

Note: From 1982, cars seating more than 7 persons are excluded from passenger cars and classified into buses.

Source: Police Dept., Ministry of Interior

2-2-3 Railway Transportation

Railway lines all radiate from Bangkok. The trunk lines consist of the Northern Line to Chiang Mai (751 kms), Northeastern Line to Nong Khai (624 kms) near the Laos border and to Ubon Ratchathani (575 kms) near the Cambodian border, Eastern Line to Aranyaprathet (255 kms) near the Cambodian border, and Southern Line to Sungai Kolok (1,159 kms), connecting with the Malaysian Railway.

Total route length in service is 3,735 kms, and a 140 km long new railway line from Chachoengsao down to Sattahip is under construction and will be opened in 1987. The number of stations in 1984 was 445 and the number of stopping places was 150 (see Fig. 2.2.2).

The density of railway routes is 7.3 km per 1,000 km^2 at present, being far inferior to the road density (only highways), 93.4 km per 1,000 km^2, and railways run through 41 of the 73 changwats in the whole country.

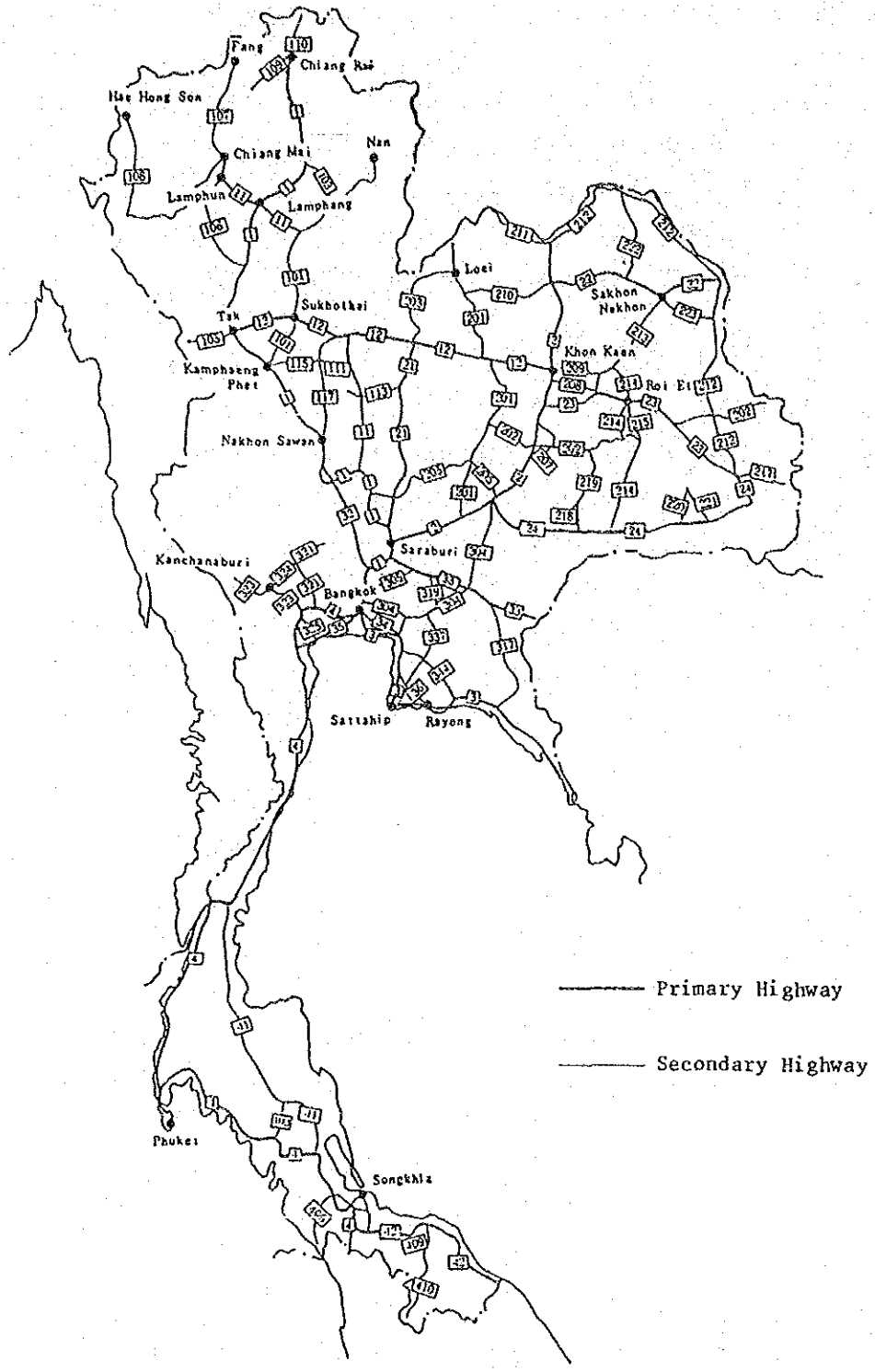


Fig. 2.2.1 Highway Network in Thailand

Table 2.2.4 Passenger and Freight Traffic Carried

	Number of passengers ($\times 10^3$)	Passenger-Km ($\times 10^6$)	Tonnage ($\times 10^3$)	Ton-Km ($\times 10^6$)
1975	61,567 (100)	5,640 (100)	5,052 (100)	2,353 (100)
1976	55,759 (91)	5,628 (100)	5,351 (106)	2,505 (106)
1977	57,974 (94)	5,649 (100)	6,310 (125)	2,912 (124)
1978	59,035 (96)	6,039 (107)	6,096 (121)	2,651 (113)
1979	64,398 (105)	7,029 (125)	6,366 (126)	2,747 (117)
1980	74,286 (121)	8,861 (157)	6,230 (123)	2,805 (119)
1981	78,824 (128)	9,483 (168)	6,041 (120)	2,601 (111)
1982	80,306 (130)	9,231 (164)	5,614 (111)	2,421 (103)
1983	81,404 (132)	9,699 (172)	5,259 (104)	2,413 (103)
1984	81,498 (132)	9,643 (171)	5,573 (110)	2,618 (111)

Note: ( ) indicates indices when the traffic in 1974 is 100.

Source: SRT booklet

The number of passengers carried by rail increased 1.32 times and 1.71 times in passenger-km during these ten years (see Table 2.2.4), showing an increase in average distance traveled per passenger. Freight traffic increased only 1.10 times in tonnage and 1.11 times in ton-km during the same period. The tonnage carried recorded a peak in 1979, but after that time, however, its growth rate showed a decrease.

There is no electrification section for the routes at present. Passenger trains are hauled by diesel locomotives or diesel railcars and freight trains by diesel locomotive. Table 2.2.5 shows the number of trains and train-kilometers scheduled per day.

Table 2.2.5 Number of Train and Train-Kilometers Scheduled (in 1985)

	Number of trains per day	Train-kms per day
Passenger train	198	53,489
Freight train	108	23,212
Mixed train	26	2,358
Total	332	79,059

Note: Freight trains excluding special trains

Source: SRT Information Booklet

Number of rolling stock in 1985 is shown in Table 2.2.6.

Table 2.2.6 Number of Rolling Stock (in 1985)

Rolling stock	Number	
	On books	In service
Diesel locomotive	277	194
Diesel railcar	204	190
Passenger car	1,111	828
Freight car	8,904	7,915

Source: SRT Information Booklet

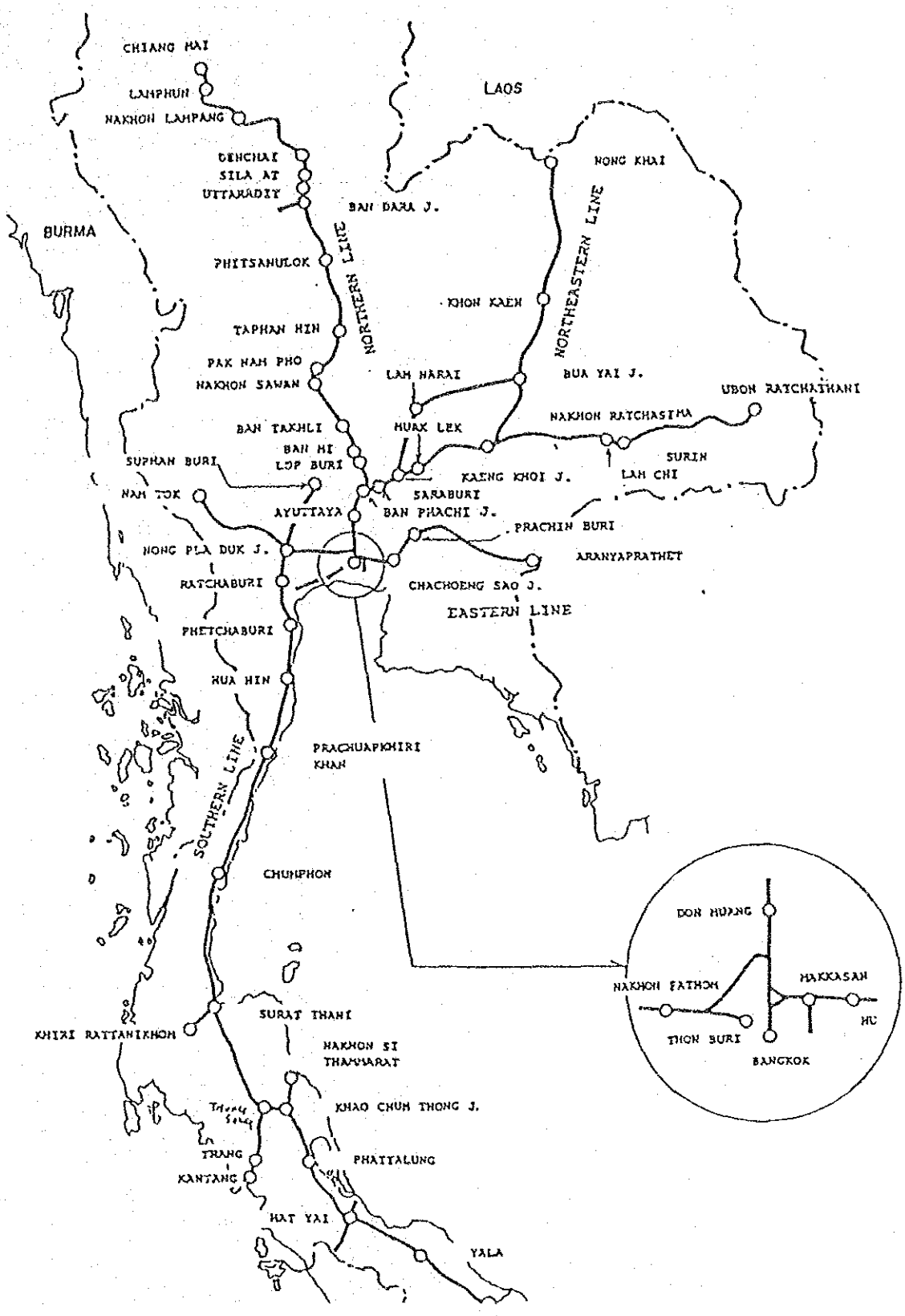


Fig. 2.2.2 Railway Network and Main Stations

Table 2.2.7 SRT Investment Program 1982 - 1986 (Reviewed as of July 19, 1985)

(Unit: Million Baht)

No.	Project	Unit	Cost	Yearly Budget Requirement		
				1982-1985*	1986**	1987-1990
1.	Diesel locomotive with spareparts	20 loco.	783.9	638.2	145.7	-
2.	Diesel railcars with spareparts (2 carset)	38 sets	957.1	885.1	72.0	-
3.	Passenger coaches	172 coaches 100 bogies	1,910.0	4.3	316.3	1,589.7
4.	Freight cars	336 cars	449.8	88.0	23.3	338.5
5.	Breakdown cranes (60 T capacity) with spareparts	2 cars	61.6	0.1	10.4	51.1
6.	Conversion from vacuum to air brake system	-	209.3	204.1	5.2	-
7.	Shunting locomotive with spareparts	10 loco.	130.9	24.3	106.9	-
8.	Improvement of workshop	-	175.2	3.6	61.0	110.6
9.	Rail replacement and rail welding	-	75.5	23.7	19.0	32.8
10.	Procurement and relaying of sleepers	-	375.0	65.0	150.0	160.0
11.	Rebuilding of timber bridge	-	148.1	59.9	36.3	51.9
12.	Strengthening/Replacement of steel bridges	-	107.2	11.3	41.4	54.5
13.	Vehicles and equipment for track maintenance	-	104.2	101.9	2.3	-
14.	Signalling and interlocking equipment	-	3,331.8	34.9	472.9	2,824.0
15.	Telecommunications	-	256.3	6.1	28.3	221.9
16.	Machine and equipment for workshop	-	7.9	1.9	2.4	3.6
17.	Siding and yards	-	147.4	35.9	55.0	56.5
	Sub-total	-	9,231.1	2,188.3	1,548.0	5,494.8
	Price contingency	-	423.5	71.3	77.4	274.8
	Total	-	9,654.6(A)	2,259.6(B)	1,625.4(C)	5,769.6
Remarks: *1985 Estimated **1986 Prospected			Implementation ratio	(B)/(A) 23%	(B)+(C)/(A) 40%	

Source: SRT

According to the government-approved SRT's the fifth five year investment program (reviewed as of July 19, 1985), which is shown in Table 2.2.7, the implementation ratio for the four years 1982 to 1985 stayed at only 23 per cent, and will hopefully reach 40 per cent for the 5 years 1982 to 1986 due mainly to insufficient funds both of the government and SRT side. The remaining portion will be carried out over a further four or five years.
The new five year investment plan (1987 - 1991), currently in preparation by the SRT, will be finalized in this year after deliberation between NESDB and other government agencies concerned.

2-2-4 Marine, Coastal and Inland Waterway Transportation

(1) Marine and coastal transportation

Thailand has at present two deep-sea ports, Bangkok port and Sattahip port, plus about 40 coastal ports.

The coastal navigation networks are mainly concentrated on the estuary port of Bangkok and on the east coast of southern Thailand (see Fig. 2.2.3). Navigation is presently limited to low draft vessels.

The berth capacity of Bangkok port (Klong Toey port under control of the Port Authority of Thailand) and Sattahip port is shown in Table 2.2.8.

Cargoes handled in Thailand, excluding inland movement, are shown in Table 2.2.9 and of which Bangkok port alone took a share of 97.4 per cent of the imports and 95.7 per cent of the exports in 1982. Containerization of cargoes handled at Klong Toey port accounted for 33 per cent of imported goods and 84 per cent of exported goods in 1983. Quantitatively, it is now approaching its full container handling capacity of 3 million tons per year. However, a larger gradeup of Klong Toey's capacity cannot be expected mainly because of the topographical limitations. To cope with the continuous increase in containerized cargo, various programmes such as the expansion of Sattahip port and the construction of the Laem Chabang new deep-sea port and of a container freight station in Bang Sue are now in the planning stage.

Table 2.2.8 Berth Capacity

Berth	Length (m)	Number of berths	Limited length/ draught of vessels (m)	Capacity (million ton/year)
KLONG TOEY PORT				
1. West Quay	1,660	10	172/8.2	2.7
2. East Quay				
- Quay for container vessels	1,240	6	172/8.2	3
- Quay for lighters	288	2	4.8	-
3. 36 Dolphins	-	7	172/8.2	0.8
4. 6 Buoys	-	6	135/-	0.5
SATTAHIP COMMERCIAL PORT				
1. West Quay	540	3	180/10.5	2.7
2. North Quay	350	2	150/8.5	2.7

Source: Port Authority of Thailand

(2) Inland waterway transportation

The inland waterway network lies in the Chao Phraya/Pasak River System with year-round navigation of 300-500 tons barges up to Ayutthaya and Tha Rua (150 kms). The upper Chao Phraya is now being improved to allow the same size vessels to navigate up to Nakhon Sawan (337 kms). Inland waterway cargoes carried toward Bangkok Metropolitan in the Central Plain in 1976 were about 8.6 million tons in total; of which, 6.0 million tons (70 per cent of total) were sand, 1.3 million tons (15 per cent) agricultural products such as maize, rice, 0.7 million tons (8 per cent) cement. Sand is mainly gathered downstream of the Chao Phraya River between Sing Buri and Angthong, and is used for construction materials in Bangkok. A large number of rice mills and warehouses are located in the loading area for rice and maize. Nakhon Sawan and Taphan Hin are major loading areas, facing Chao Phraya River and Nan River. As for the direction of cargo flow, cargoes toward Bangkok take up a large amount for 93 per cent to the total (Table 2.2.10).

Table 2.2.9 Cargoes Handled at Ports in Thailand

(Unit: Million tons)

	Import					Export				
	Port of Bangkok*1	Klong Toey*2	Con-tainers*3	Other Ports	Total	Port of Bangkok	Klong Toey	Con-tainers	Other Ports	Total
1976	12.94	2.98	0.20	0.15	13.09	11.78	0.37	0.17	0.88	12.66
1977	15.07	3.47	0.35	1.94	17.01	12.23	0.48	0.22	3.08	15.31
1978	15.82	3.34	0.58	1.76	17.58	12.14	0.72	0.47	0.73	12.87
1979	17.89	3.73	0.78	0.36	18.25	12.19	0.86	0.68	0.68	12.87
1980	18.55	3.59	0.84	0.31	18.86	12.46	1.02	0.90	0.75	13.21
1981	16.77	3.73	1.13	0.25	17.02	14.96	1.23	1.51	0.84	15.80
1982	15.16	3.38	1.10	0.40	15.56	19.15	1.44	1.16	0.85	20.00
1983	n.a.	4.36	1.50	n.a.	-	n.a.	1.58	1.33	n.a.	-

Note: *1 Port of Bangkok consists of Klong Toey Port and private wharves.

*2 Klong Toey Port is being operated by PAT (Port Authority of Thailand).

*3 Container cargoes are handled at Klong Toey Port.

Source: Port Authority of Thailand

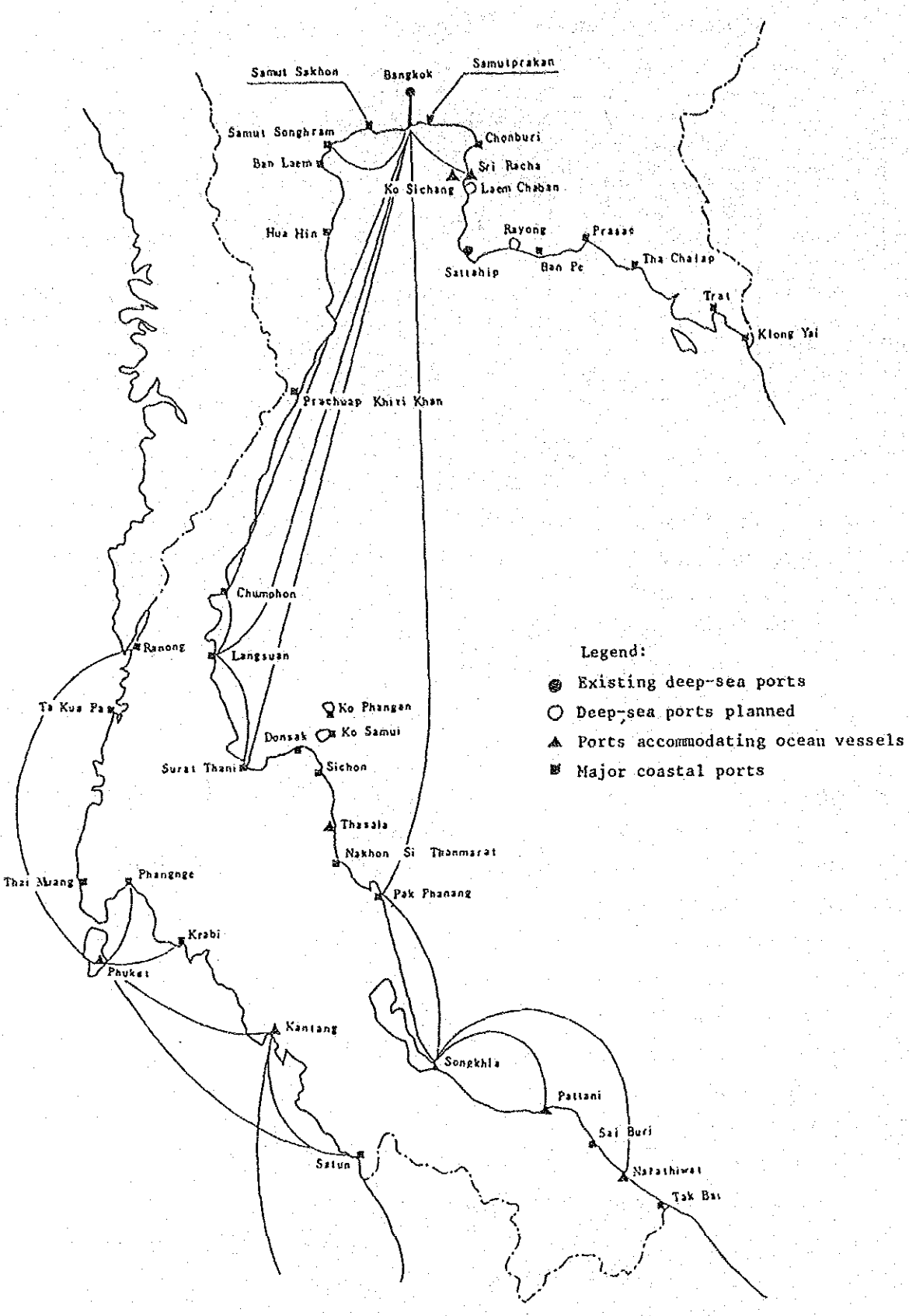


Fig. 2.2.3 Marine and Coastal Port Network

Table 2.2.10 Inland Waterway Cargo Carried Towards the Bangkok Metropolitan Area (1976)

(Unit: Thousand tons)

Loading Changwat	Rice	Maize	Other crops	Sand	Cement	Total
Sinburi and northern Changwat	118	192	151	3,989	-	4,552
Angthong	4	-	-	1,745	-	1,574
Tha Reua	22	664	35	251	676	1,736
Nakhon Luang	46	2	1	-	2	65
Ayutthaya	53	12	4	60	5	273
Other Changwat	-	9	6	14	3	38
Total	243	879	197	6,059	686	8,638

Source: World Bank

2-2-5 Aviation Transportation

There are four international airports, Bangkok, Chiang Mai, Phuket and Hat Yai, and 21 local airports. As shown in Table 2.2.11, the number of passengers and the amount of cargoes carried at Bangkok airport increased 2.2 times and 2.6 times respectively for those 10 years. The Bangkok airport facilities are now being expanded in order to cope with air traffic increases in the future.

Table 2.2.11 Civil Aviation - Bangkok Airport Service

		1974	1983
		Times	Times
No. of Landings	Domestic	6,089	10,246
	International	43,628	44,226
	Others	10,647	17,249
		Persons	Persons
No. of Passengers	Domestic	202,255	744,178
	International	2,997,186	6,218,892
		Tons	Tons
Chargoes Carried	Domestic	884	2,067
	International	44,980	119,638

Source: Airport Authority of Thailand

2-3 Financial State of SRT

(1) Revenue and expenses

The 5-year consecutive income statements (excluding Mae Klong Line), and the operating revenue and expenses for SRT are shown in Table 2.3.1 and Fig. 2.3.1, respectively. These statements show that SRT has been continuously in the red since fiscal year 1979. The operating ratio (ratio of operating expenses to operating revenue) for the past three years is around 110%. This means that the operating expenses are in excess of the revenue by approximately 10%.

Despite government subsidies being supplied to cover the deficit, they still have not made up for the deficit, resulting in a total retained loss of 644 million Bahts at the end of FY 1984 (if the Mae Klong Line is included, it amounts to 700 million Bahts).

1) Revenue

In recent years, the operating revenue of SRT have mainly consisted of passenger revenue. For instance, operating revenue in FY 1984 amounted to 3,308 million Bahts, of which 2,042 million Bahts, or 62%, came from passenger service. This figure is two times greater than the freight service figure of 1,016 million Bahts, or 31% of the operating revenue.

Passenger revenue from FY 1980 to FY 1984 increased by 60%, and was due to an increase in passenger fares in 1981 and to a favorable rise of passenger-kms. On the other hand, the growth of freight revenue for this period was 25%, relatively lower than that of passenger revenue, a result of the slowdown in ton-kms.

2) Expenses

As regards expenses, material and fuel costs have shown trends for stabilization for the past three years. Personnel costs, however, have increased constantly in spite of a gradual decrease in the number of employees, continuing at the level of around 55% of revenue.

Depreciation cost shows a rise of 57% in FY 1984 as compared to that of FY 1980, reflecting an increase in railway assets.

Concerning the other expenses, interest on funded debts has risen due to an increase in the average amount of borrowing by 240 million Bahts, and to a 6.4% rise in the average interest rate from 4.7% to 11.1% (FY 1980 to FY 1984).

(2) The increase in efficiency for the operation of SRT

To cope with the above mentioned financial situation, SRT has set up an increase in operating efficiency as one of its main targets.

1) Number of employees

The number of employees has changed as shown in Table 2.3.2 and Fig. 2.3.2, indicating a gradual decrease.

2) Productivity per employee $\left(\frac{\text{Passenger-kms plus ton-kms}}{\text{Total number of employees}}\right)$

In view of the productivity per employee, despite a 60% increase in passenger-kms plus ton-kms for 10 years from FY 1974 to FY 1984, the number of employees has decreased by 16%. As a result, the productivity per employee, being 232,500 in FY 1974 and 441,000 in FY 1984, has increased at the average annual rate of 6.7 per cent for that period.

Furthermore, SRT is going to proceed with the increases in its

operating efficiency by promoting such measures as mechanization, adequate reshuffling, and natural reductions in personnel.

(3) Tariff revision

Figure 2.2.3 shows the changes in passenger and freight traffic and the average rate of increase in fares.

Operations for FY 1977 and 1978 went into the black due to a substantial increase in fares in 1975 for the first time in twenty years since 1955 (see Fig. 2.3.2).

A substantial increase in fares in 1981, however, caused a lower passenger-kms growth and a slowdown in ton-kms. Since then, operations have not yet improved significantly.

The relationship between price increases and tariff revision is shown in Fig. 2.3.4. The prices in 1984 were 3.2 times higher than those of 1970. On the other hand, passenger and freight fares increased 2.1 and 2.5 times, respectively. This indicates that the increases in fares have not kept up with the rise in prices.

Table 2.3.1 Consecutive Income Statement (Excluding Mae Klong Line)

(Millions of Baht)

	FY 1980			1981			1982			1983			1984		
		P	C		P	C		P	C		P	C		P	C
Operating Revenue	2,227	100%	20%	2,577	100%	16%	3,058	100%	19%	3,141	100%	3%	3,308	100%	5%
Passenger	1,280	58	24	1,537	60	20	1,816	60	18	1,954	62	8	2,042	62	5
Freight	812	36	18	880	34	8	1,047	34	19	968	31	-8	1,016	31	5
Others	135	6	2	160	6	19	195	6	22	219	7	12	250	7	14
Operating Expenses	2,510	113	33	2,980	116	19	3,345	109	12	3,471	111	4	3,585	108	3
Personnel	1,224	55	22	1,378	54	13	1,593	52	16	1,770	57	11	1,832	55	4
Material	512	23	20	700	27	37	829	27	18	784	25	-5	784	24	0
Fuel	605	27	10	703	27	16	712	23	1	706	22	-1	703	21	-1
Depreciation	169	8	0	199	8	18	211	7	6	211	7	0	266	8	26
Operating Income	-283	-13		-403	-16		-287	-9		-330	-11		-277	-8	
Net Rent	18	1		14	1		13	-		21	1		20	1	
Other Income	73	3		2	-		1	-		1	-		2	-	
(-) Fixed Charges	80	4		84	3		95	3		112	4		201	6	
Ordinary Income	-272	-12		-471	-18		-368	-12		-420	-13		-456	-14	
Profit from sales of property	5	-		-	-		13	-		12	-		3	-	
Foreign exchange adjustment	17	1		136	5		148	5		45	1		134	4	
Net Income	-250	-11		-335	-13		-207	-7		-363	-12		-319	-10	
Subsidies	*334			140			97			259			-		
Retained Income	84			-111			-221			-325			-644		
Operating Ratio (%)	113			116			109			111			108		
Number of Employees	29,398			30,094			30,541			29,586			27,821		

Source: SRT

Note: P = Percentage of revenue, C = Change from a year ago

* = Estimated

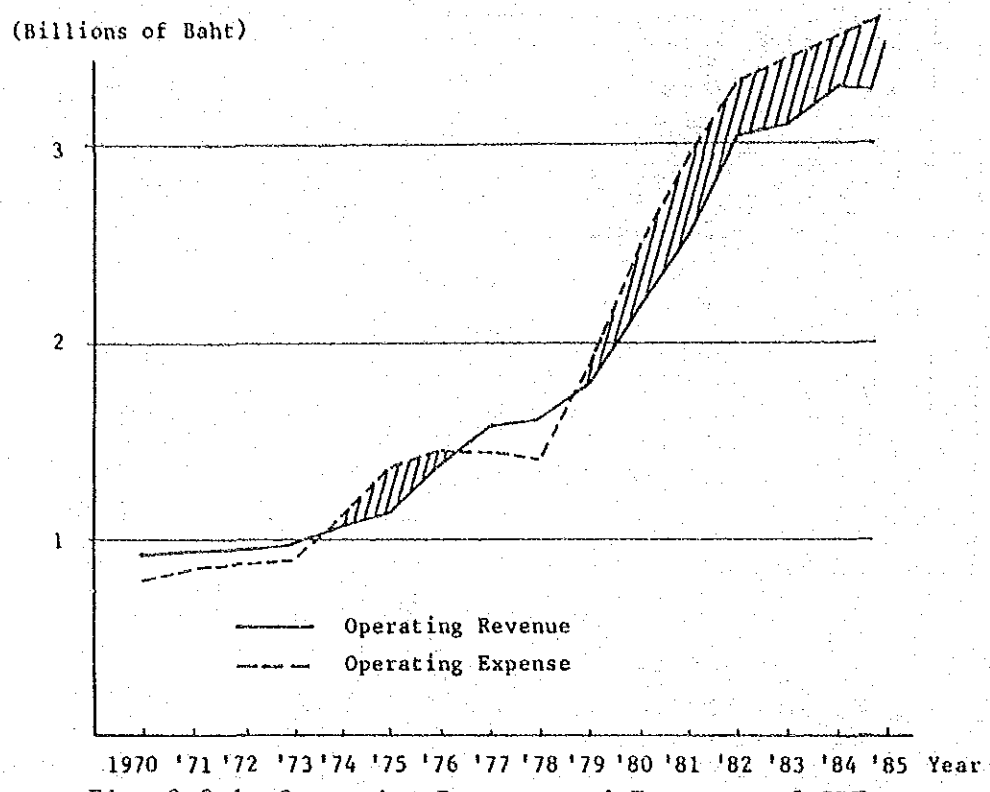


Fig. 2.3.1 Operating Revenue and Expenses of SRT

Table 2.3.2 Number of Employees (1975 - 1985)

Year	'75	'76	'77	'78	'79	'80	'81	'82	'83	'84	'85
No. of employees (1000)	31.9	31.0	29.9	29.9	29.4	29.4	30.1	30.5	29.6	27.8	27.2

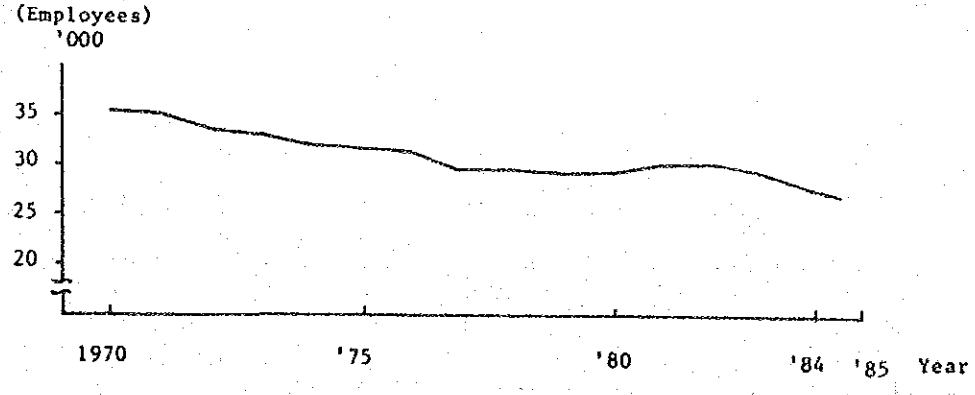
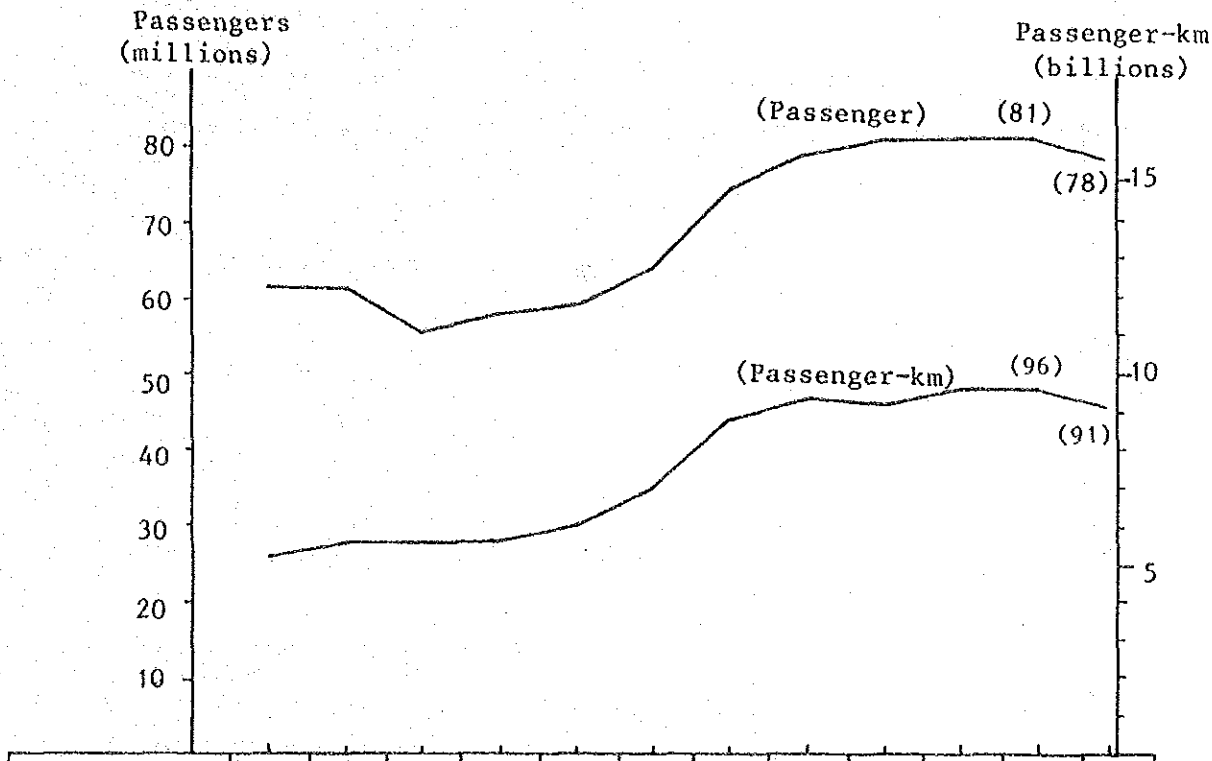
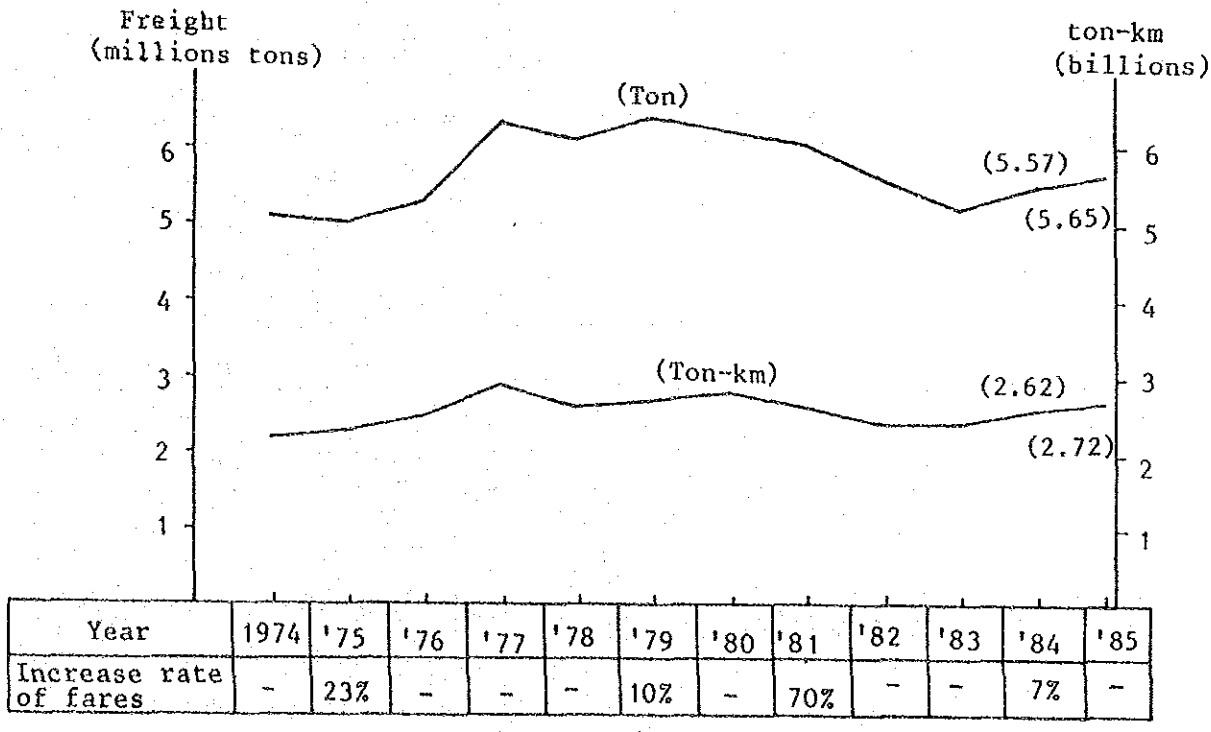


Fig. 2.3.2 Number of Employees (1970 - 1985)



Year	1974	'75	'76	'77	'78	'79	'80	'81	'82	'83	'84	'85
Increase rate of fares	-	50%	-	-	-	-	-	30%	-	7%	-	5%



Year	1974	'75	'76	'77	'78	'79	'80	'81	'82	'83	'84	'85
Increase rate of fares	-	23%	-	-	-	10%	-	70%	-	-	7%	-

Fig. 2.3.3 Changes in Fares and Traffic

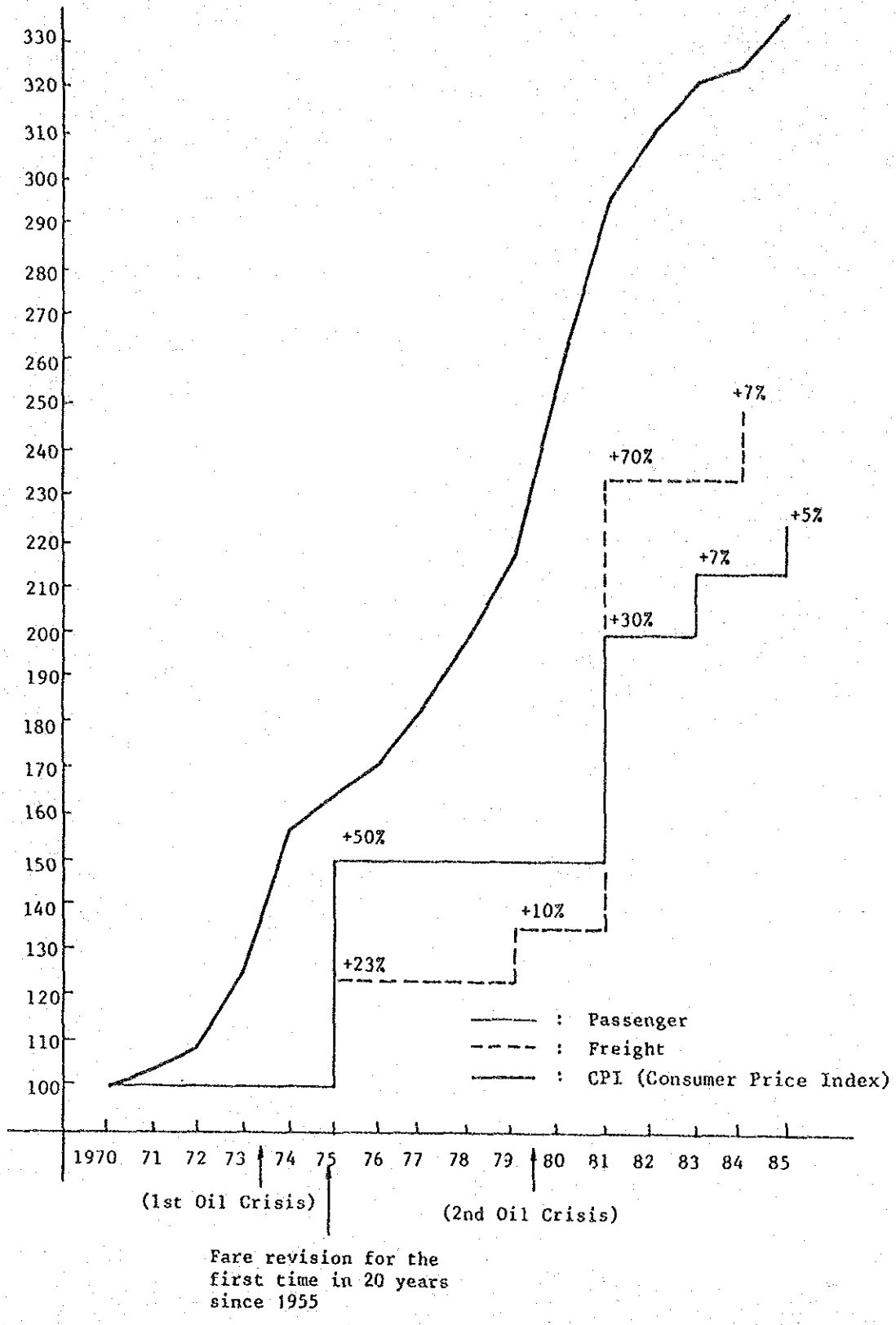


Fig. 2.3.4 Comparison of C.P.I. Growth Rate and Railway Fares (1970 = 100)