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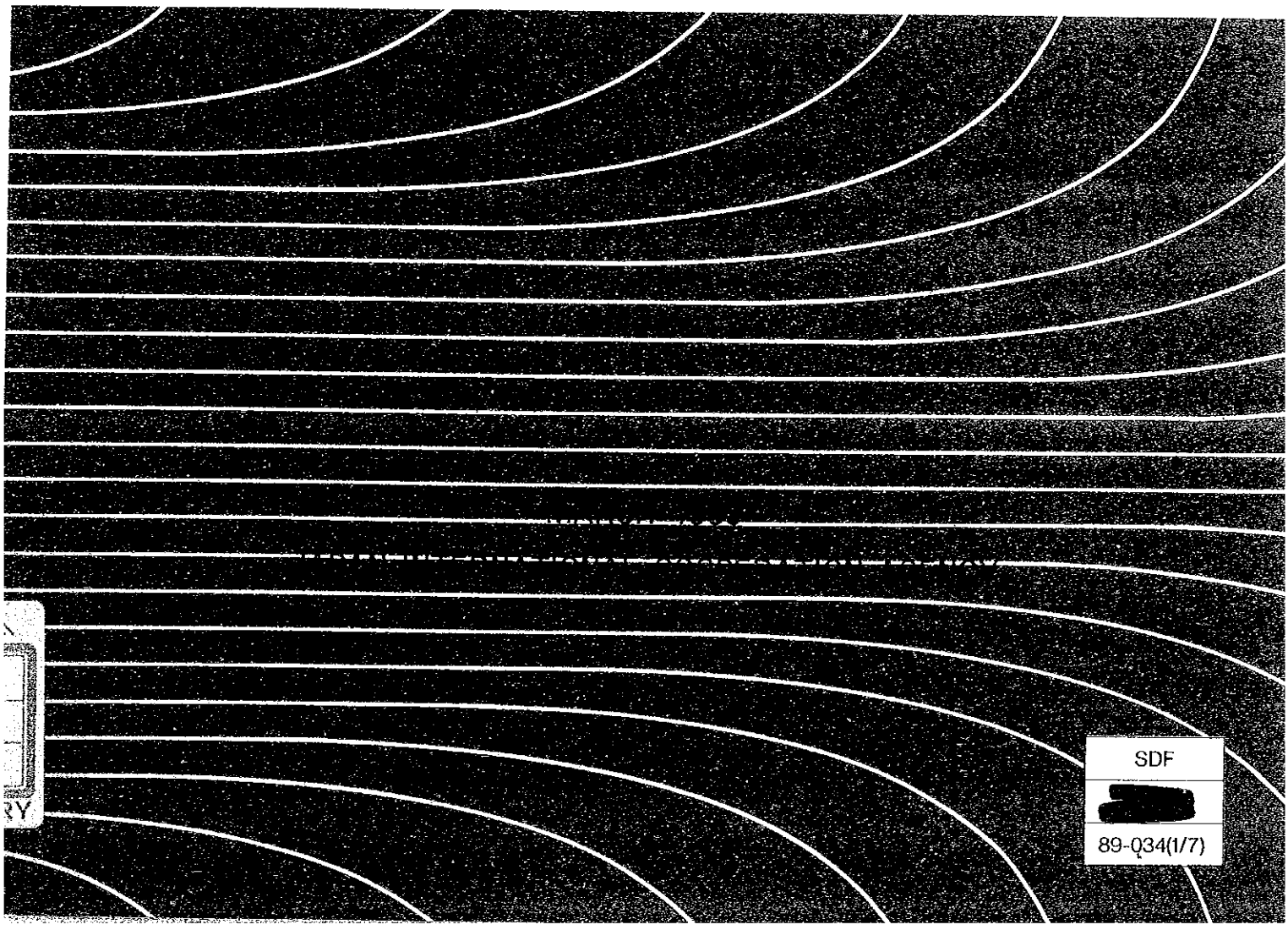
No. 02

KINGDOM OF THAILAND
MINISTRY OF TRANSPORT AND COMMUNICATIONS
DEPARTMENT OF HIGHWAYS

ROAD DEVELOPMENT STUDY IN THE CENTRAL REGION

FINAL REPORT
SUMMARY



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KINGDOM OF THAILAND
MINISTRY OF TRANSPORT AND COMMUNICATIONS
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ROAD DEVELOPMENT STUDY IN THE CENTRAL REGION

FINAL REPORT
SUMMARY REPORT

MARCH 1989
JAPAN INTERNATIONAL COOPERATION AGENCY

国際協力事業団
18938

PREFACE

In response to a request from the Government of the Kingdom of Thailand, the Government of Japan decided to conduct the Road Development Study in the Central Region of Thailand and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Thailand a study team headed by Mr. Masahiko Tohi comprising experts from Katahira & Engineers Inc. and Nippon Koei Co., Ltd. four times from August 25, 1987 to January 28, 1989.

The team held discussions with the officials concerned of the Government of Thailand, and conducted field surveys in the region involved. After the team returned to Japan, further studies were made and the present report was prepared.

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

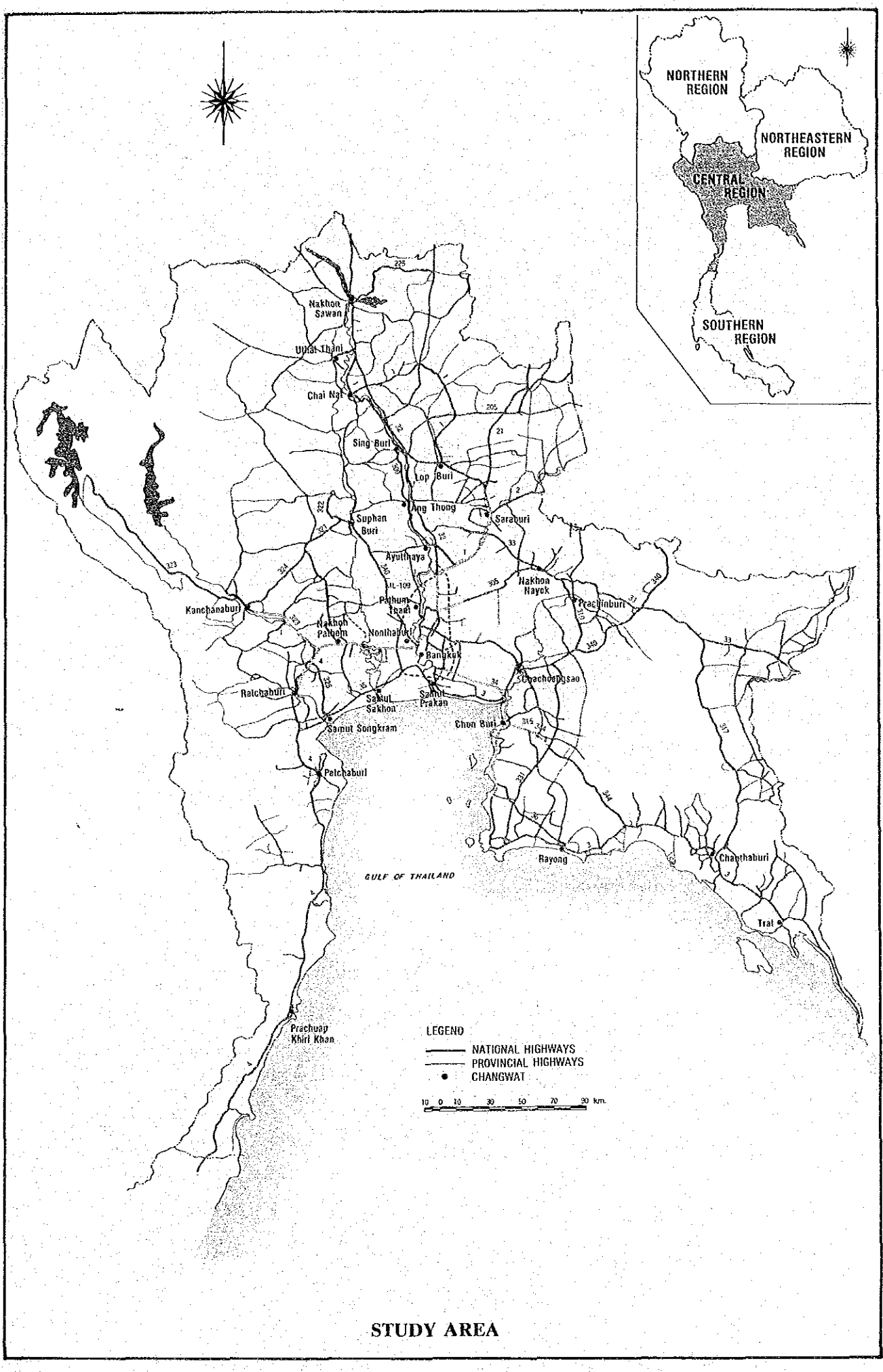
I wish to express my sincerest appreciation to the officials concerned of the Government of the Kingdom of Thailand for their close cooperation extended to the team.

March 1989

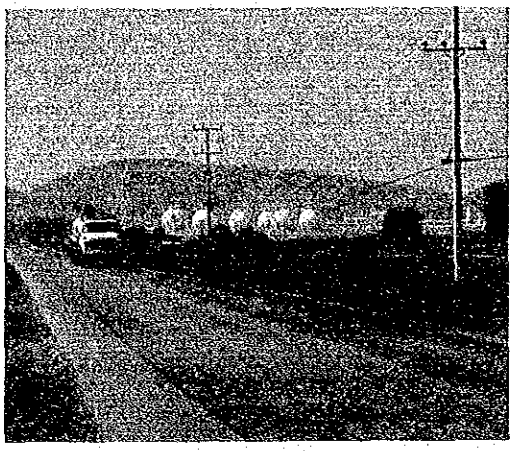
Kensuke Yanagiya

Kensuke Yanagiya
President

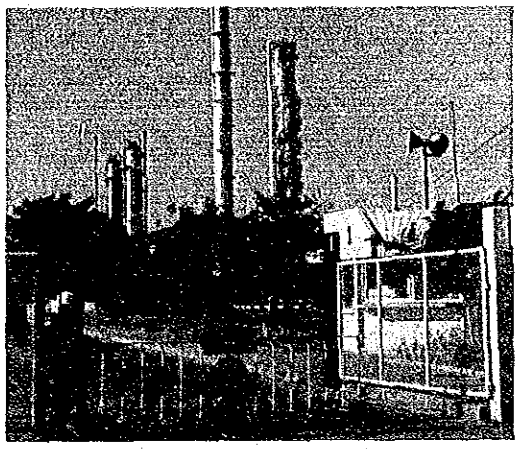
Japan International Cooperation Agency


NORTHERN REGION
NORTHEASTERN REGION
CENTRAL REGION
SOUTHERN REGION
Nakhon Sawan
Uthai Thani
Chai Nat
Sing Buri
Lop Buri
Ang Thong
Saraburi
Suphan Buri
Ayutthaya
Kanchanaburi
Pathum Thani
Nakhon Nayok
Prachinburi
Nakhon Pathom
Nonthaburi
Bangkok
Chachoengsao
Ratchaburi
Samut Sakhon
Samut Prakan
Samut Songkram
Chon Buri
Petchaburi
Rayong
Chanthaburi
Trat
Prachuap Khiri Khan
GULF OF THAILAND
LEGEND
NATIONAL HIGHWAYS
PROVINCIAL HIGHWAYS
CHANGWAT
10 0 10 30 50 70 90 km.

STUDY AREA



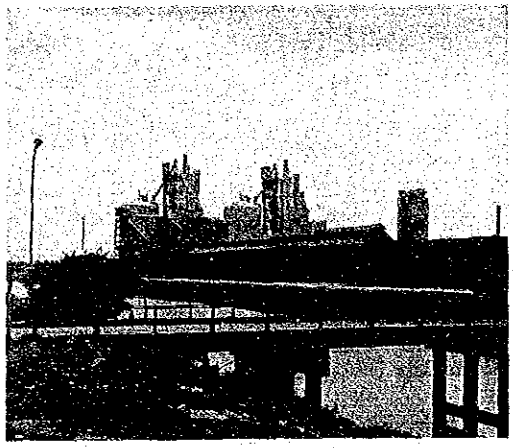
Laem Chabang Industrial Estate along Rt. 3



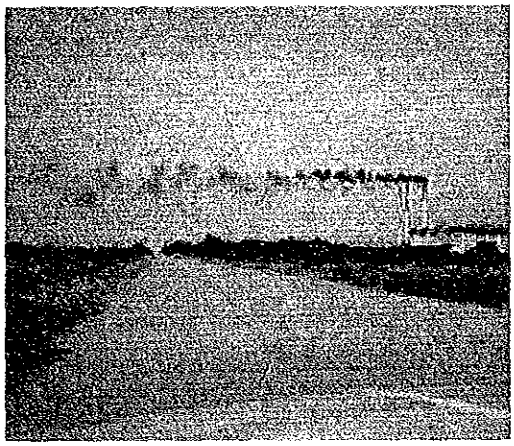
Map Ta Phut Industrial Estate along Rt. 3

Housing Development along Rt. 314

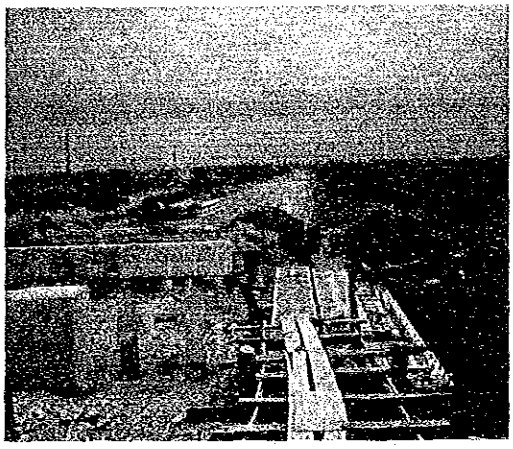
Agricultural Development (cassava field)



Cement Factory in Changwat Saraburi

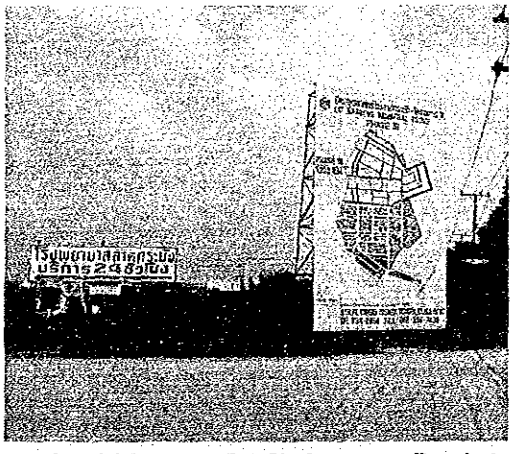


Rice Mill along Rural Road in Changwat Ang Thong



Industrial Estate Development near Bangkok

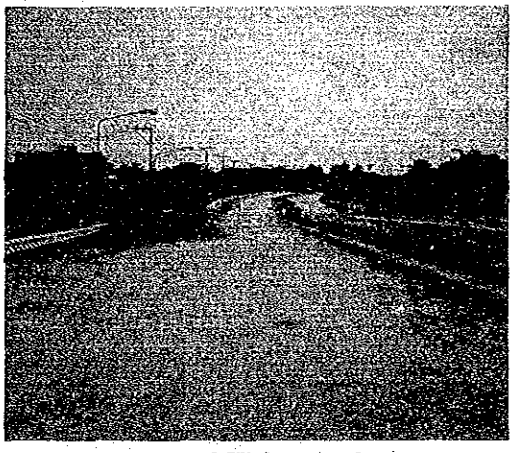
Agricultural Development (rice field)



Industrial Estate at Lat Krabang near Bangkok

Industrial Estate at Lat Krabang near Bangkok

Six-lane Provincial Highway with Good Alignment and Pavement Condition (Rt. 3344)

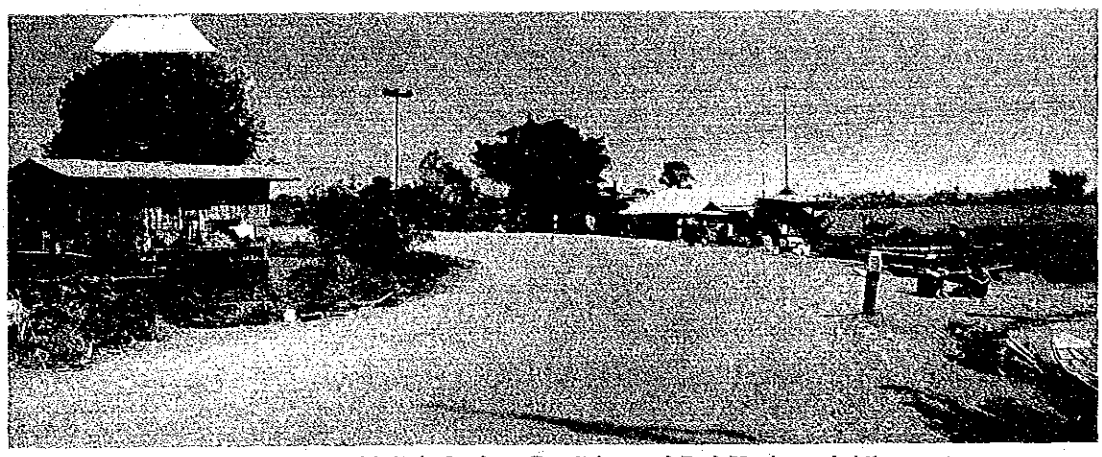


Four-lane National Highway under Construction (Rt. 309)

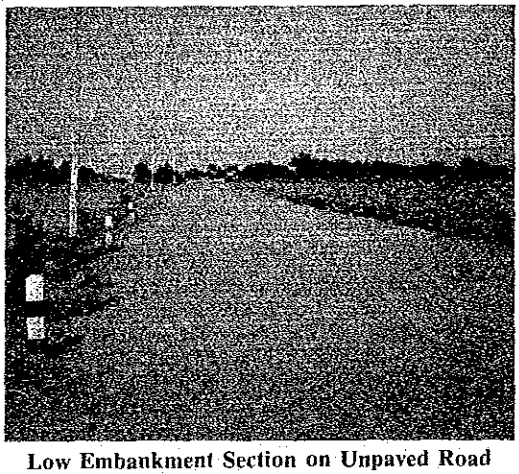
Urban Section of Six-lane National Highway (Rt. 3 Changwat Rayong)

Urban Section of Four-lane National Highway (Rt. 325)

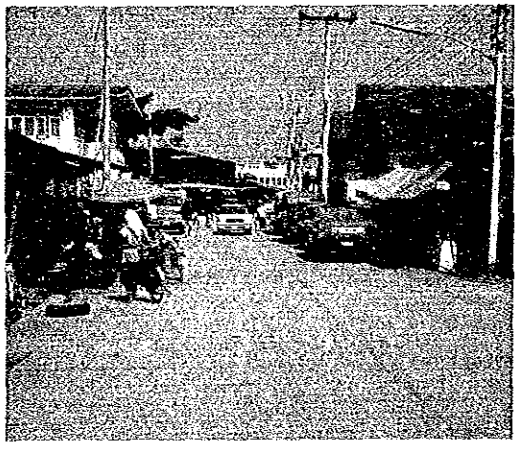
Urban Section of Two-lane National Highway



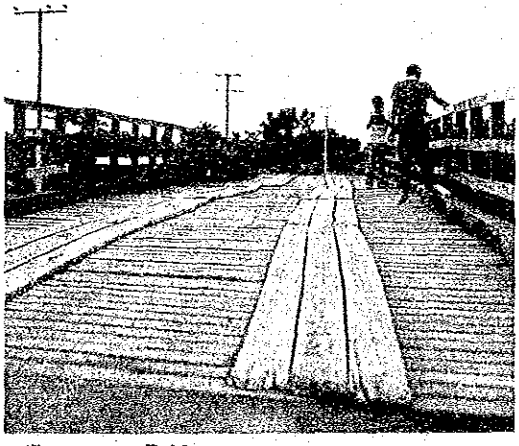
Unpaved Rural Laterite Road with Fair Surface Condition and Bad Horizontal Alignment



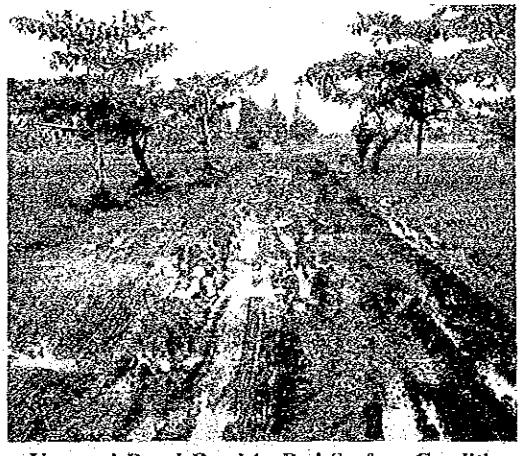
Low Embankment Section on Unpaved Road



Rural Road in Municipal Area

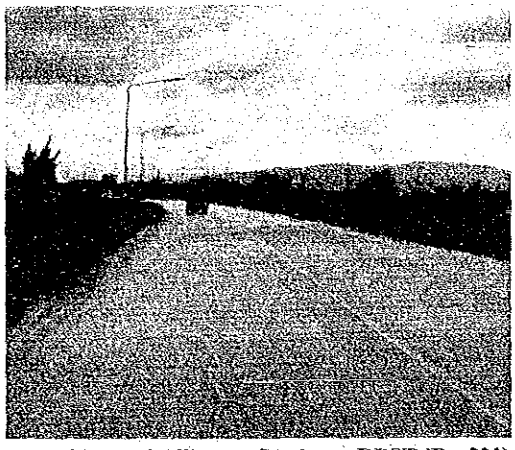


Temporary Bridge



Unpaved Rural Road in Bad Surface Condition

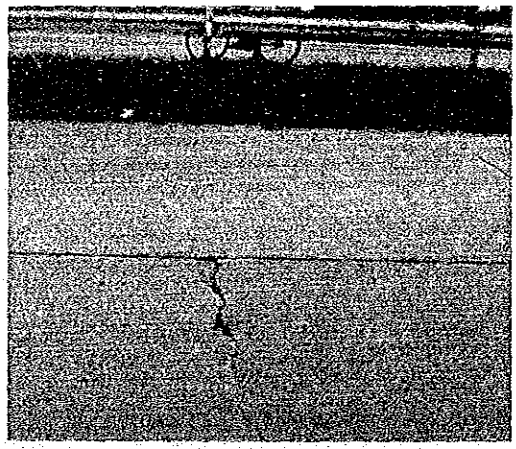
Deteriorated Surface Treatment Road (Rt. 225)



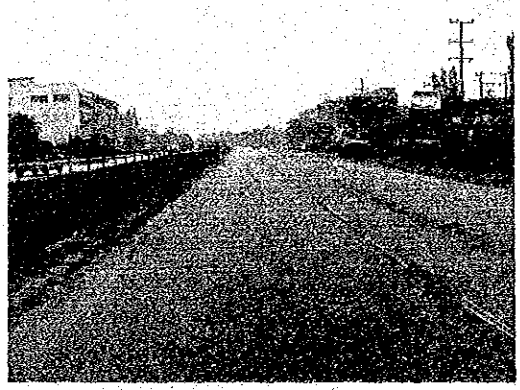
Patching and Alligator Cracks on DBST (Rt. 331)

Damage to Pavement Edge (Rt. 3195)

Deteriorated Pavement Structure (Rt. 3167)

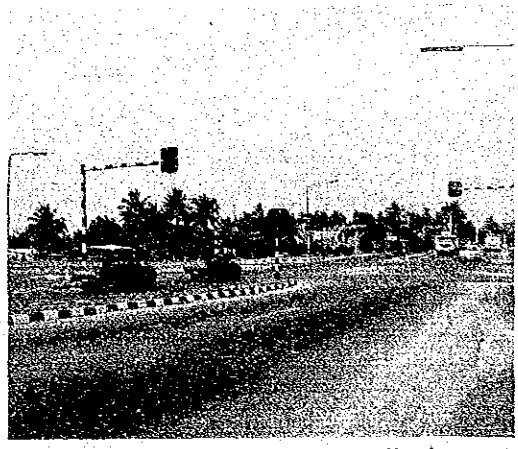


Transverse Cracks on Concrete Pavement (Rt. 34)

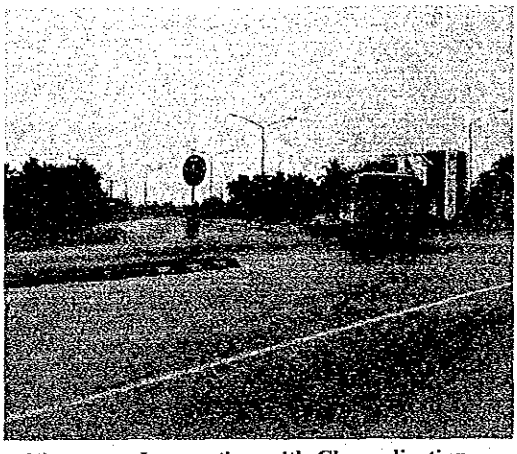


AC Overlay on Concrete Pavement with Longitudinal Cracks

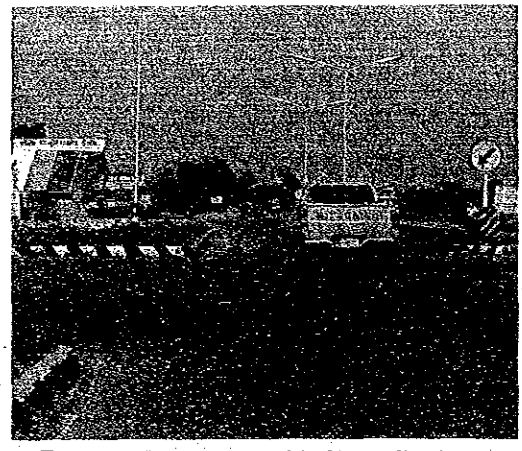
Four-way Intersection with Channelization and Signal



Four-way Intersection with Channelization and Signal

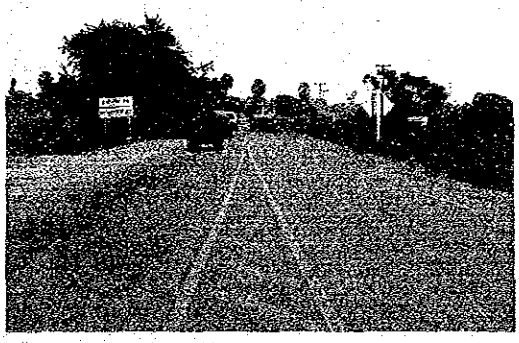


Three-way Intersection with Channelization

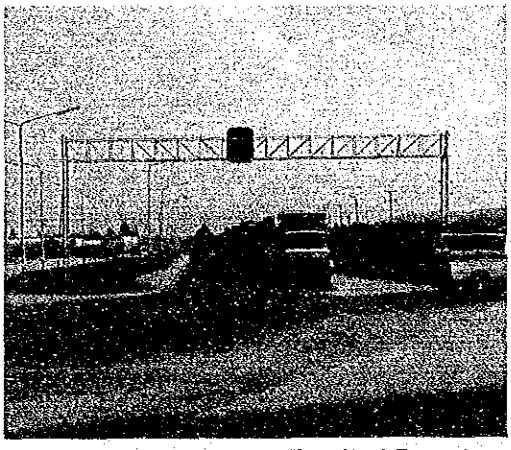


Four-way Intersection with Channelization

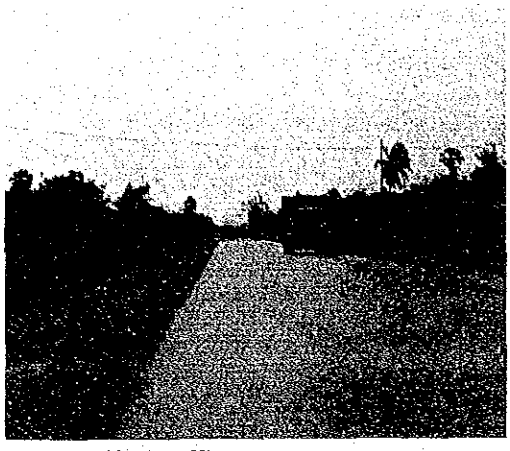
Four-way Intersection



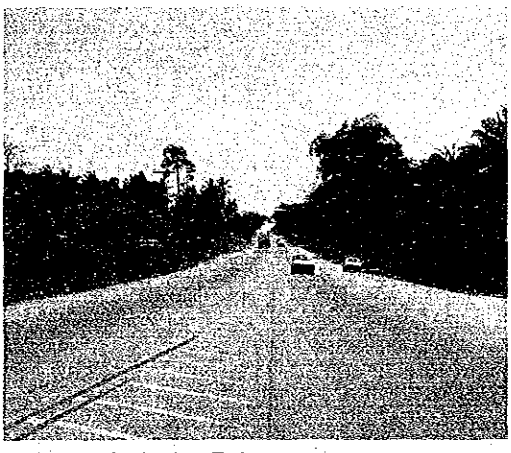
Four-way Intersection



ML-1 Beginning Point (Chon Buri Bypass)



ML-1 Typical View

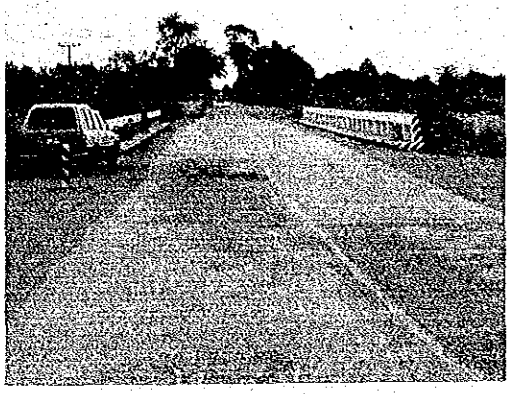


ML-2 Beginning Point

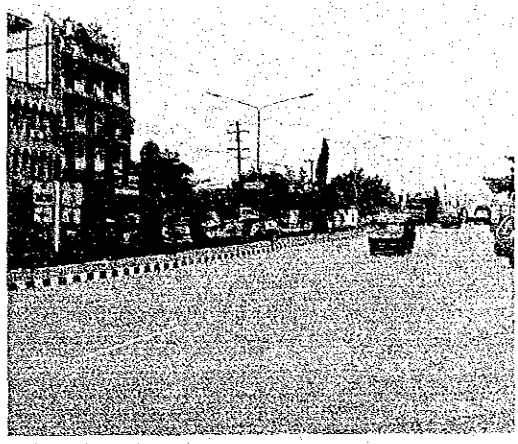
ML-2 End Point

ML-3 Beginning Point (Amphoe Sattahip)

ML-3 Narrow Bridge



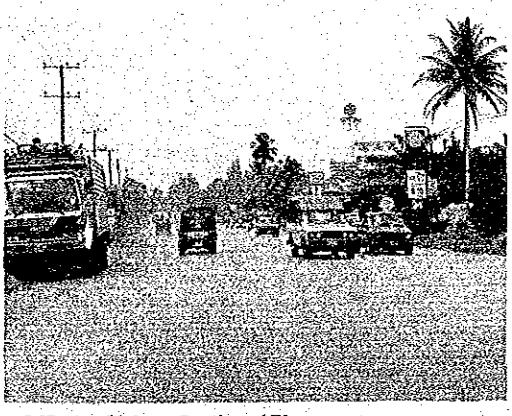
ML-3 Typical View



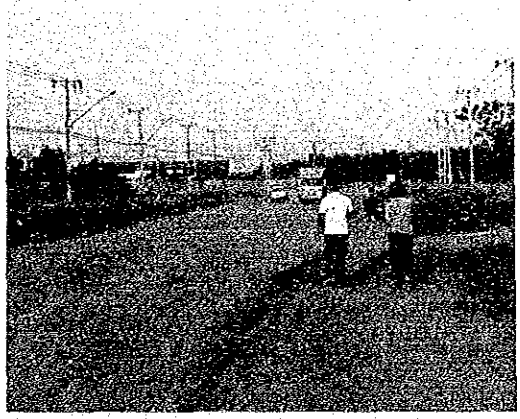
ML-3 End Point (Changwat Rayong)

ML-4 Beginning Point (Amphoe Kleang)

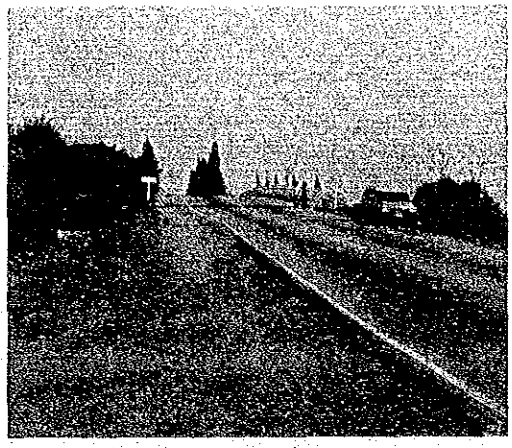
ML-4 Typical View



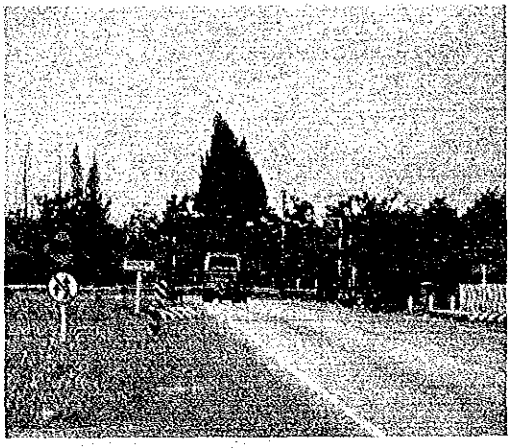
ML-4 Urban Section (Changwat Chanthaburi)



ML-7 Near Beginning Point (Amphoe Min Buri)



ML-7 Khlong Luang Phraeng Bridge



ML-7 Near End Point (Changwat Chachoengsao)

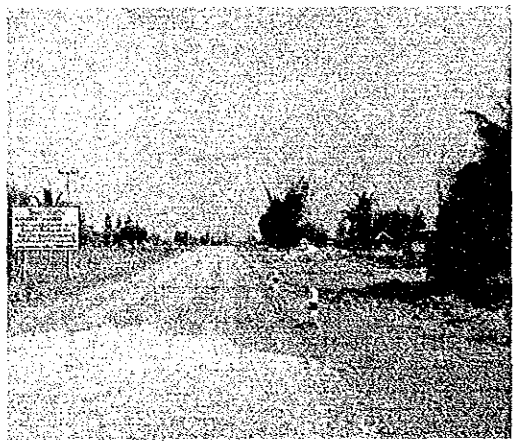
ML-9 Beginning Point (near Srinakarin Road)

ML-9 Landsat Satellite Receiver Station

ML-9 Soft Ground Section

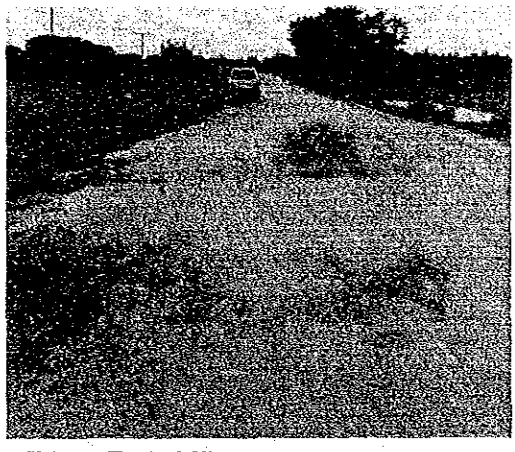
ML-9 Near End Point (in cassava field)

IM-1 Laterite Surface Condition in Rainy Season

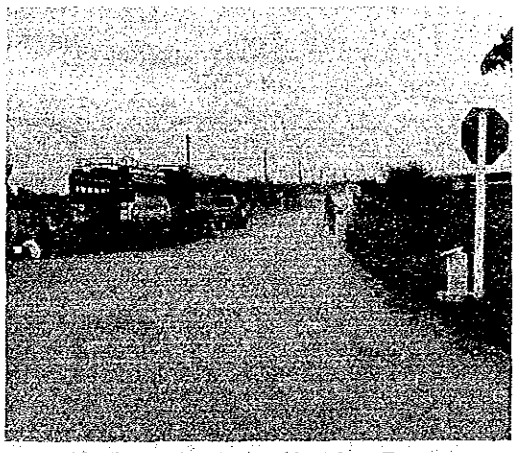


IM-2 End Point (near Amphoe Lao Khwan)

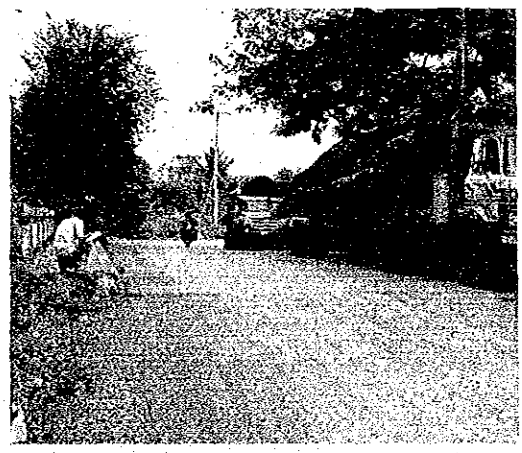
IM-11 Typical View



IM-12 Typical View



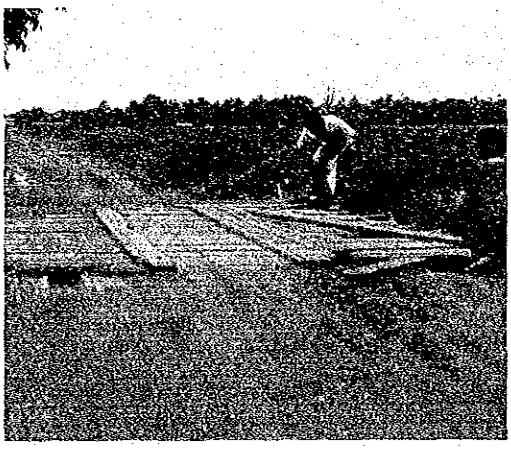
IM-13 Beginning Point (Amphoe Bang Pa-in)



IM-13 Near End Point (Changwat Ayutthaya)

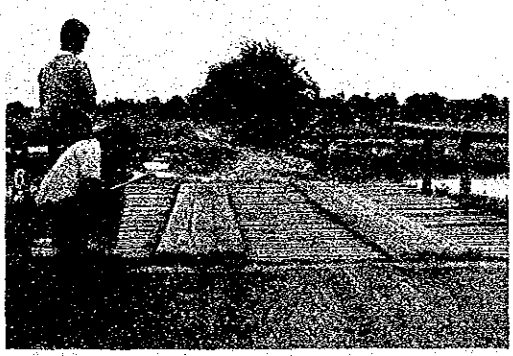
IM-14 Beginning Point (Amphoe Wang Noi)

IM-15 End Point (Amphoe Min Buri)

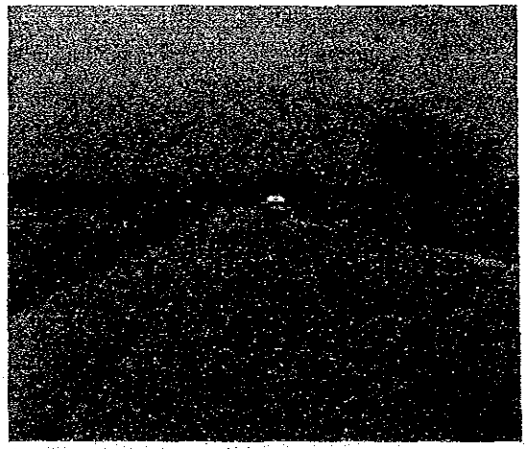


IM-16 Flooding Section

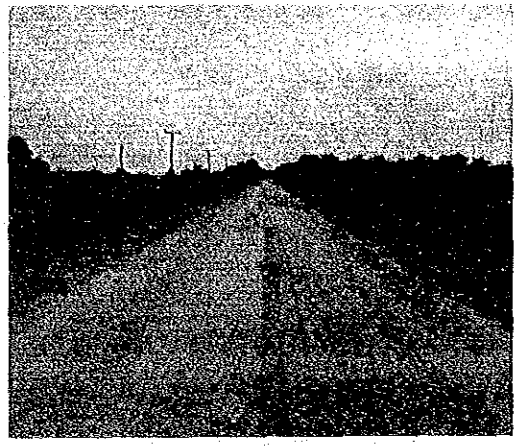
IM-17 Khlong Tup Yao Bridge



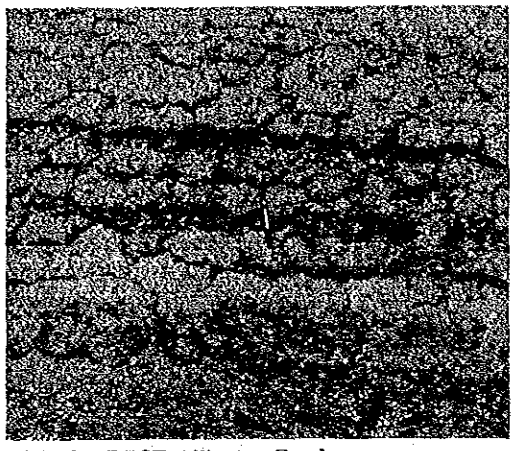
IM-22 Temporary Bridge & Typical View



IM-23 Typical View

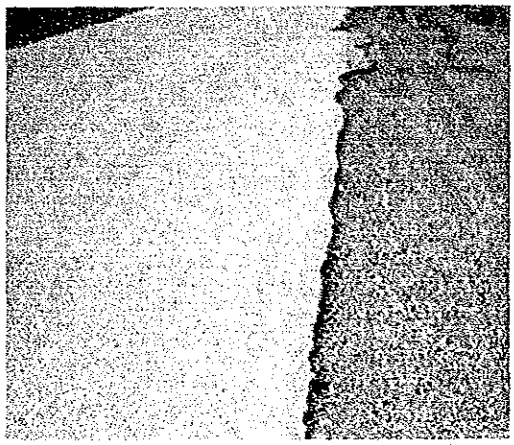


RH-2 Typical View (DBST Pavement)



RH-2 DBST Alligator Cracks

RH-3 Typical View (DBST Pavement)



RH-3 Damage to Pavement Edge

RH-5 Typical View (AC Pavement)

RH-5 Patching and Cracks on AC Pavement

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ABBREVIATIONS

AASHTO	:	American Association of State Highway and Transportation Officials
ADT	:	Average Daily Traffic
CBR	:	California Bearing Ratio
DOH	:	Department of Highways
ESA	:	Equivalent Standard Axles
GDP	:	Gross Domestic Product
GNP	:	Gross National Product
GPP	:	Gross Provincial Product
GRP	:	Gross Regional Product
HMC	:	Highway Capacity Manual
HB	:	Heavy Bus
HT	:	Heavy Truck
IM Projects	:	Improvement Projects
IRR	:	Internal Rate of Return
JICA	:	Japan International Corporation Agency
LB	:	Light Bus
LT	:	Light Truck
ML Projects	:	New Four-lane Highway or Additionai Two-lane Projects
MT	:	Medium Truck
MC	:	Motorcycle
NESDB	:	National Economic and Social Development Board
O/D	:	Origin and Destination
PC	:	Passenger Car
PSI	:	Present Serviceability
RH Projects	:	Rehabilitation Projects
SA	:	Soil Aggregate Surfacing

VOLUME I MASTER PLAN STUDY

VOLUME I MASTER PLAN STUDY

CHAPTER 1 INTRODUCTION

1.1 BACKGROUND

The Central Region with an area of 104,000 km2, population of 17,000,000 and share of GDP of 63% as of 1986 is the most densely populated and highly developed area in the Kingdom of Thailand. Bangkok, a major city in which all kinds of socio-economic activities and facilities are extremely concentrated, is located in the Region.

Sufficient water resources and favorable soil conditions in the wide-spreading Central Plain around the Chao Phya River and its tributaries have contributed to the high productivity in the agricultural sector which accounts for 70% of the country.

With rapid industrial development in the Central Region, however, the share of the manufacturing sector has become first in the Region's GRP, exceeding the agricultural sector. This tendency will be further promoted after the realization of the Eastern Seaboard and other large scale industrial development plans which are basic targets of the Sixth Five-Year National Economic and Social Development Plan (the Sixth Plan).

Promotion of the tourism industry is also one of the targets in the Sixth Plan. Two world-famous resorts, Pattaya and Hua Hin, and two well-known sightseeing places, Kanchanaburi and Ayutthaya, are located in the Region.

For twenty years, the Government of Thailand has put primary emphasis on road development to improve the nationwide transportation network system.

However, the road network in the Region has not been adequately developed to its advanced present state and future high development potential. The road length per GRP is the lowest among the regions. Reflecting the existing configuration of trunk roads intensely converging into Bangkok, traffic congestion is conspicuous in and around the Bangkok Metropolitan Area. With increased traffic, congestion might occur throughout the Region in the near future. Provincial or rural roads which supplement the arterial highways are also insufficient to fulfil the social and economic needs of the people. Deterioration of pavement will also be a pressing problem due to anticipated future increase in traffic volume and heavy vehicle load.

In consideration of the situation in the Region, the Government of Thailand requested that

the Government of Japan carry out a road development study for the Region. In response to the request, the Government of Japan conducted the Study, entrusting it to the Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of the technical cooperation programs by the Government of Japan. JICA organized a study team consisting of ten experts. The Study was commenced at the end of August 1987 and completed at the end of March 1989, taking about 20 months.

1.2 OBJECTIVE OF THE STUDY

The objectives of the Study are:

- To establish a master plan for a road network and to select priority projects.
- To consider the application of an inter-urban toll expressway to Thailand.
- To carry out a feasibility study for the selected priority projects.
- To perform technology transfer to Thai counterpart personnel in the course of the Study.

The study area covers the whole of the Central Region and two Changwats in the Northern Region, consisting of 26 Changwats, but excludes the Bangkok Metropolitan Area within the Outer Ring Road.

The road network to be studied involves national and provincial highways and other agency roads which are or will be under the jurisdiction of DOH in the study area.

1.3 STUDY FRAMEWORK

Schematic study work flows of the Master Plan Study and the Feasibility Study are shown in Figure 1.1.1.

1.4 REPORTING

Progress Reports and an Interim Report were submitted to DOH on schedule in the course of the Study.

The Final Report consists of the following eight volumes:

Summary

Volume I Master Plan Study

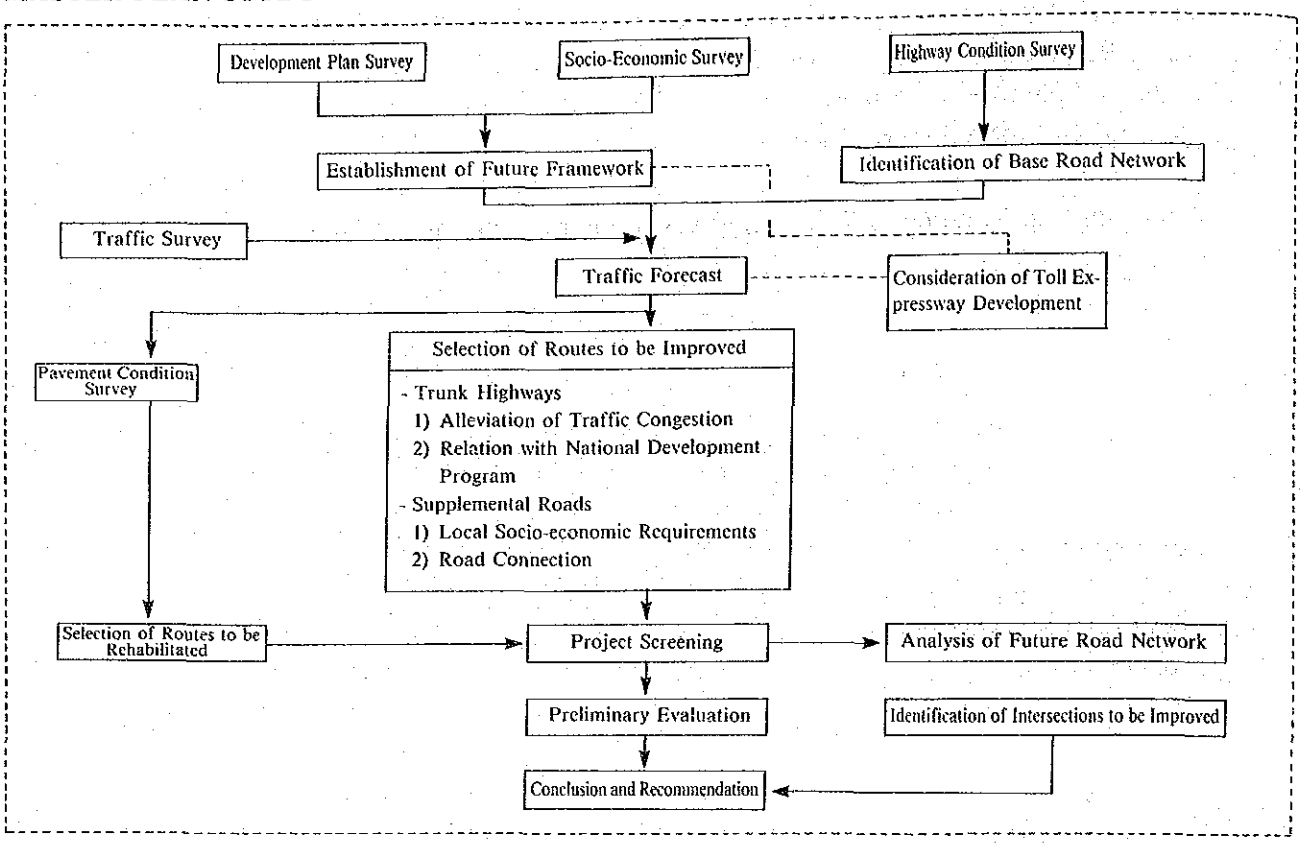
Volume I-1	Main Text
Volume I-2	Appendices
Volume I-3	Route Report

Volume II Feasibility Study

Volume II-1	Main Text
Volume II-2	Appendices
Volume II-3	Route Report

Report on Consideration of Toll Expressway in the Kingdom of Thailand.

MASTER PLAN STUDY



FEASIBILITY STUDY

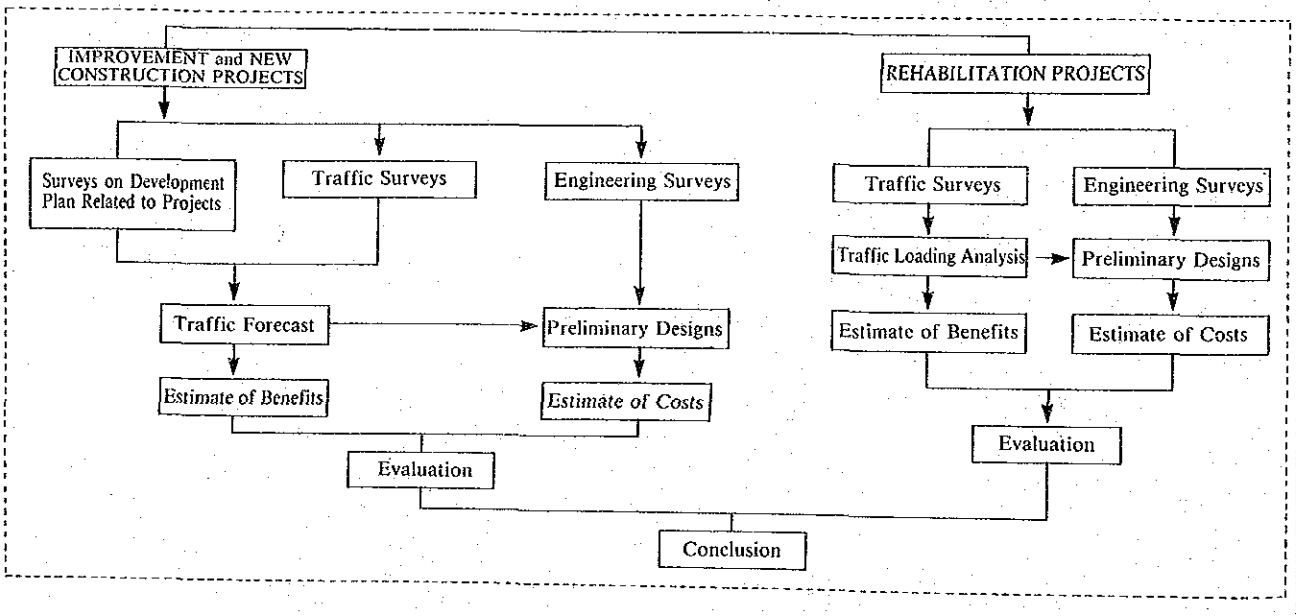


Figure 1.1.1 STUDY FLOWS

CHAPTER 2 OUTLINE OF THE REGION

2.1 LAND AND CLIMATE

The area of the Central Region (the Region) of 104,000 km^2, including the Bangkok Metropolitan Area, occupies 20% of Thailand.

The Region, which faces the Gulf of Thailand, spreads over a wide plain of the large grain producing area around the Chao Phya River. The Region is bounded by the Northern, Northeastern and Southern Regions, and also by Cambodia and Burma.

The temperature in the Central Region is high in April and May, about 31°C, and low in December and January, about 25°C. Annual average rainfall is concentrated in the rainy season from May through October.

2.2 SOCIAL CONDITIONS

For regional administration, Thailand is divided into Changwat, Amphoe, Tambon and Ban. The governors of Changwat and Amphoe are appointed by the central government, while the heads of Tambon and Ban are elected.

Out of the 73 Changwats in the Country, 27 Changwats are included in the study area.

Thailand had a total population of about 53 million persons or 103 persons per km^2 as of 1986. The Central Region makes up about 33% of total population. Population density is 167 persons per km^2. Changwats showing both high population density and average annual growth rate are located around Bangkok Metropolis.

In Changwat and Amphoe centers, social and educational facilities such as police stations, hospitals, and secondary schools are located.

2.3 ECONOMIC CONDITIONS

In 1985, the Gross Domestic Product (GDP) reached 1,047 billion Baht with an average annual growth rate of 5.0% during the period 1981 – 1985. The Gross Regional Product (GRP) of the Region reached 663 billion Baht, 63% of GDP.

Per capita GRP of the Central Region is 39,265 Baht, about twice the national average of 20,233 Baht and about five times as large as the Northeastern Region's GRP of 8,083 Baht.

Manufacturing is the most productive sector and made up 20% of total GDP in 1986 fol-

lowed by wholesaling and retailing 18.2%, agriculture with 17.4% and the service sector with 11.0%.

There were 21.5 million employed persons in the whole Kingdom in 1986. Of the total employed persons, the sector involving agriculture, forestry, hunting and fishing occupied about 60%, followed by services, manufacturing and commerce, with about 11% each.

In the Region, farm holding land shows the highest share with about 44%, followed by forest land of 25%. The planted area in the Region occupies the major portion of the whole Kingdom, amounting to 70% of the total planted area of the country in 1986. Paddy is the widest, followed by maize, cassava, sugarcane, sorghum and groundnuts.

Although industrial development has remarkably progressed recently in Thailand, the major manufacturing is agro-industry. Industrial factories of the whole Kingdom numbered about 85,500 in 1986. Among them, rice mill factories predominanted, coming to 55% of the total. However, the share of rice mill factories was 17% in the central Region, indicating the dominance of other industries in the Region.

Tourism development is one of the main national strategies of Thailand. In the Region, there are many famous tourism resources such as Pattaya, Hua Hin, Kanchanaburi and Ayutthaya. International tourist arrivals in Thailand reached 2.5 million with consumption expenditure of 31.7 billion Baht in 1985. The number of tourist arrivals has increased by 4% per annum.

2.4 TRANSPORTATION

Major transportation modes in the Region consist of highways, railways, inland waterways and aviation. Each transportation mode has been developed in such a manner to connect every part of the region and the country with Bangkok.

Model splits for passenger transport (passenger-km) and freight transportation (ton-km) are shown in Tables 1.2.1 and 1.2.2, respectively.

Table 1.2.1 MODAL SPLIT FOR PASSENGER TRANSPORT

(Unit: billion passenger-km)

Year	Road	Rail	Air	Total
1978	37,000	6,039	205	43,243
	(85.5)	(14.1)	(0.5)	(100.0)
1984	113,604	9,643	548	123,795
	(91.8)	(7.8)	(0.4)	(100.0)

Note: Percentage in ( )
Source: Annual Transport Statistics, Ministry of Communications

Table 1.2.2 MODAL SPLIT FOR FREIGHT TRANSPORT

(Unit: billion ton-km)

Year	Road	Rail	Waterways	Air	Total
1984	18,920	2,618	N.A.	1.8	21,540
	(87.8)	(12.2)	(–)	(0.0)	(100.0)

Note: Percentage in ( )
Source: Annual Transport Statistics, Ministry of Communications

As seen in the above tables, road transportation shares about 90% in both passenger and freight transportation.

CHAPTER 3 DEVELOPMENT PLANS AND SOCIO-ECONOMIC FRAMEWORK

3.1 DEVELOPMENT PLANS

Sixth National Economic and Social Development Plan

The main issue of the Sixth National Economic and Social Development Plan (1987 ~ 1991) is summarized as follows:

- To maintain at least 5% economic growth so as to absorb new labor of not less than 3.9 million persons.
- To promote the improvement of quality and equality of human life through social development.

In order to achieve the aforementioned objectives, the following strategies and programs are set forth:

- To increase the country's efficiency in development.
- To improve the production structures and raise the quality of basic services.
- To distribute prosperity and create equity.

Regional Development Plan

The Sixth Plan sets a strategy to disperse socio-economic activities concentrated in Bangkok to new economic zones in different parts of the country. In the study area, Chon Buri is designated as one of the five growth poles, while Nakhon Sawan, Saraburi, Kanchanaburi, Ratchaburi, Petchaburi, Chachoengsao and Rayong are included in the 19 designated growth centers.

According to the regional development plans formulated by the Department of Town and Country Planning, Ministry of Interior, urbanization outside of Bangkok is aimed at changing present economic structures and the pattern of industrialization in Thailand. Samut Prakan and Samut Sakhon, together with the aforementioned cities in the study area, are designated as industrialization cities.

Eastern Seaboard Development Program

The Eastern Seaboard Development Program is a development plan to which the highest priority is given in the Fifth and Sixth Plans. The program aims at the following:

- To develop light, labor-intensive industries at Laem Chabang, and natural gas related industries at Map Ta Phut (Figure 1.2.1).

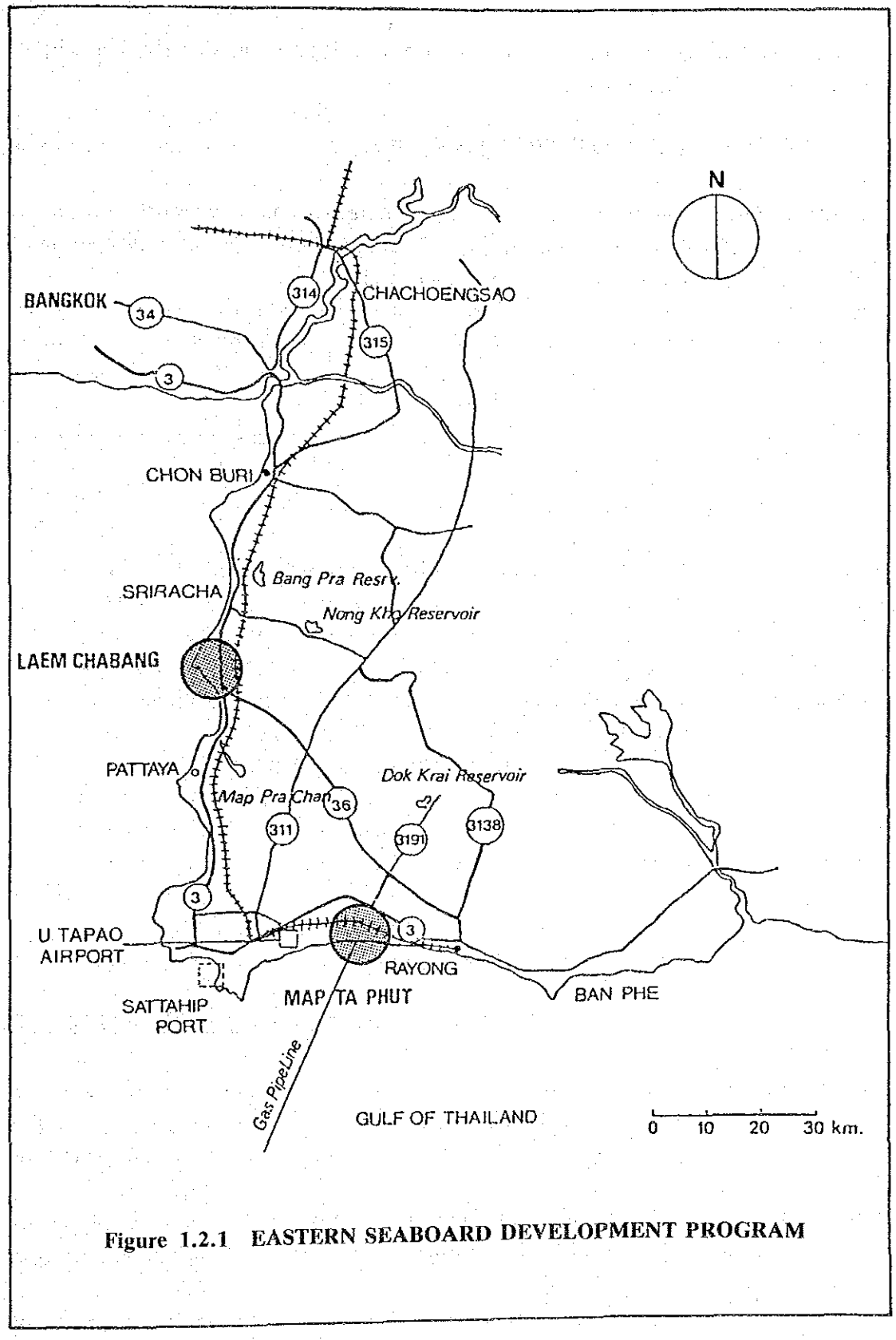


Figure 1.2.1 EASTERN SEABOARD DEVELOPMENT PROGRAM

- To provide jobs and facilities which will encourage urbanization outside of Bangkok.

Tourism development at Pattaya, improvement of Sattahip harbour and U Tapao airport are also included in the Program.

3.2 ESTABLISHMENT OF FUTURE FRAMEWORK

In order to forecast the future traffic volume, a future economic framework in the study area was established referring to the present socio-economic conditions and the abovementioned national, regional and specific development plans.

CHAPTER 4 ESTABLISHMENT OF BASE ROAD NETWORK

4.1 EXISTING ROAD NETWORK

The existing road network composed of national highways and provincial roads under DOH was identified on the basis of the DOH road map and road inventory data.

4.2. SIXTH HIGHWAY PLAN

The Department of Highways has formulated the Sixth Five-year Plan for construction and rehabilitation of highways following the policies of the Sixth National Economic and Social Development Plan (1987–1981).

Key strategies stated in the 6th Highway Plan are as follows:

- To emphasize maintenance and rehabilitation of existing highways to function effectively.
- To increase highway structure standards to meet traffic volume, especially on main highways.
- To make land transportation effective, convenient and smooth so as to support such development as exports, tourism and specific regional development.
- To strengthen required linkages between producing places, markets, transportation centers, etc. and to provide bypasses to reduce traffic congestion inside cities.
- To ease traffic congestion at important intersections.
- To prevent highway accidents.
- To invite private firms to participate in highway construction, maintenance and management in order not only to reduce government burden but also to work together in close cooperation.
- To increase toll roads for self-finance.
- To amend the road user's tax which is inequitable.

4.3 ESTABLISHMENT OF BASE ROAD NETWORK MAP

In order to examine and select routes to be improved or newly constructed in the future, a study road network was drawn on the assumption that ongoing and committed project roads have already been completed.

A road list was prepared by DOH jurisdiction office included in the study area,in which ongoing and committed project roads described in 4.2 are included as well as existing roads.

Road length in the base road network is as follows:

LENGTH OF BASE ROAD NETWORK (km)

National Highways			Provincial Highways			Total
Paved	Unpaved	Total	Paved	Unpaved	Total	
3,994	24	4,018	6,172	1,574	7,746	11,764

Applying the road list mentioned above, a base road network map comprised only of paved roads was prepared as the basic road network for the study. This is shown in Figure 1.4.1.

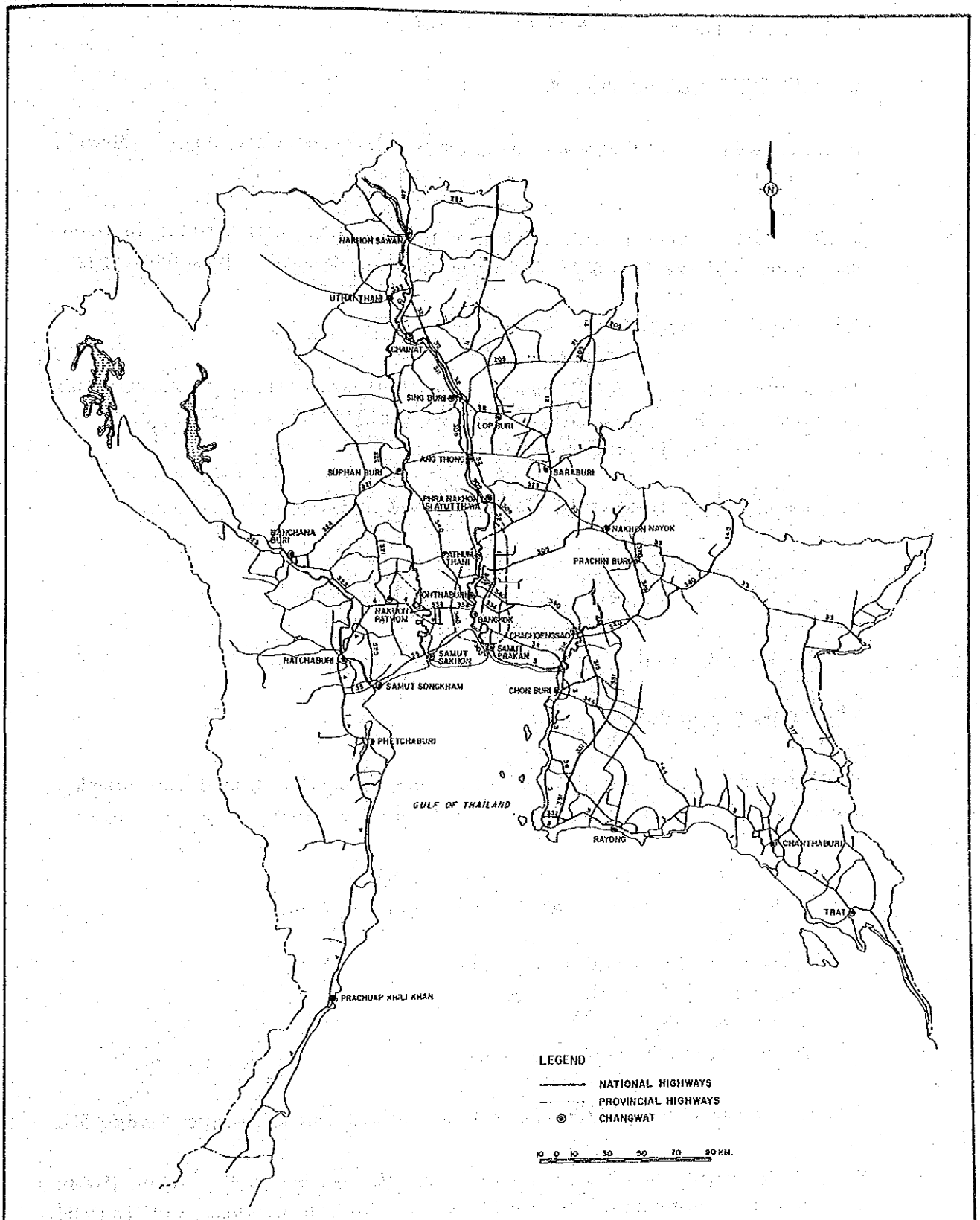


Figure 1.4.1 BASE ROAD NETWORK MAP

CHAPTER 5 TRAFFIC SURVEYS AND FORECAST

5.1 PRESENT TRAFFIC VOLUME

A traffic flow map of 1986 prepared on the basis of DOH traffic count data is shown in Figure 1.5.1.

Traffic volumes on primary national highways are from 15,000 to 57,000 ADT, on secondary national highways from 600 to 47,000, and on provincial highways from 100 to 20,000.

5.2. TRAFFIC SURVEYS

Traffic surveys composed of O/D surveys, manual traffic counts (12 hours) and automatic traffic counts (24 hours) were carried out to obtain general conditions of O/D patterns and traffic characteristics in the study area.

Question items of O/D surveys in roadside interview to drivers were as follows:

- Origin/destination of trip
- Vehicle characteristics
- Vehicle usage
- Freight movement

5.3 TRAFFIC FORECAST

Traffic forecast was performed on the basis of a gravity model made up of two variables, number of registered vehicles and travel time. The forecast procedures are as follows:

- Traffic zoning and preparation of road network
- Estimation of number of registered vehicles by traffic zone
- Formulation of a gravity model
- Preparation of present O/D tables as of 1986
- Preparation of future O/D tables
- Traffic assignment
- Analysis of validity of the gravity model

Future traffic volumes were estimated for 1993, 2000 and 2008 considering expected project life.

Vehicles were classified into six types, passenger car (P/C), light bus (L/B), heavy bus (H/B), light truck (4/T), medium truck (6/T) and heavy truck (10/T) in accordance with the DOH classification.

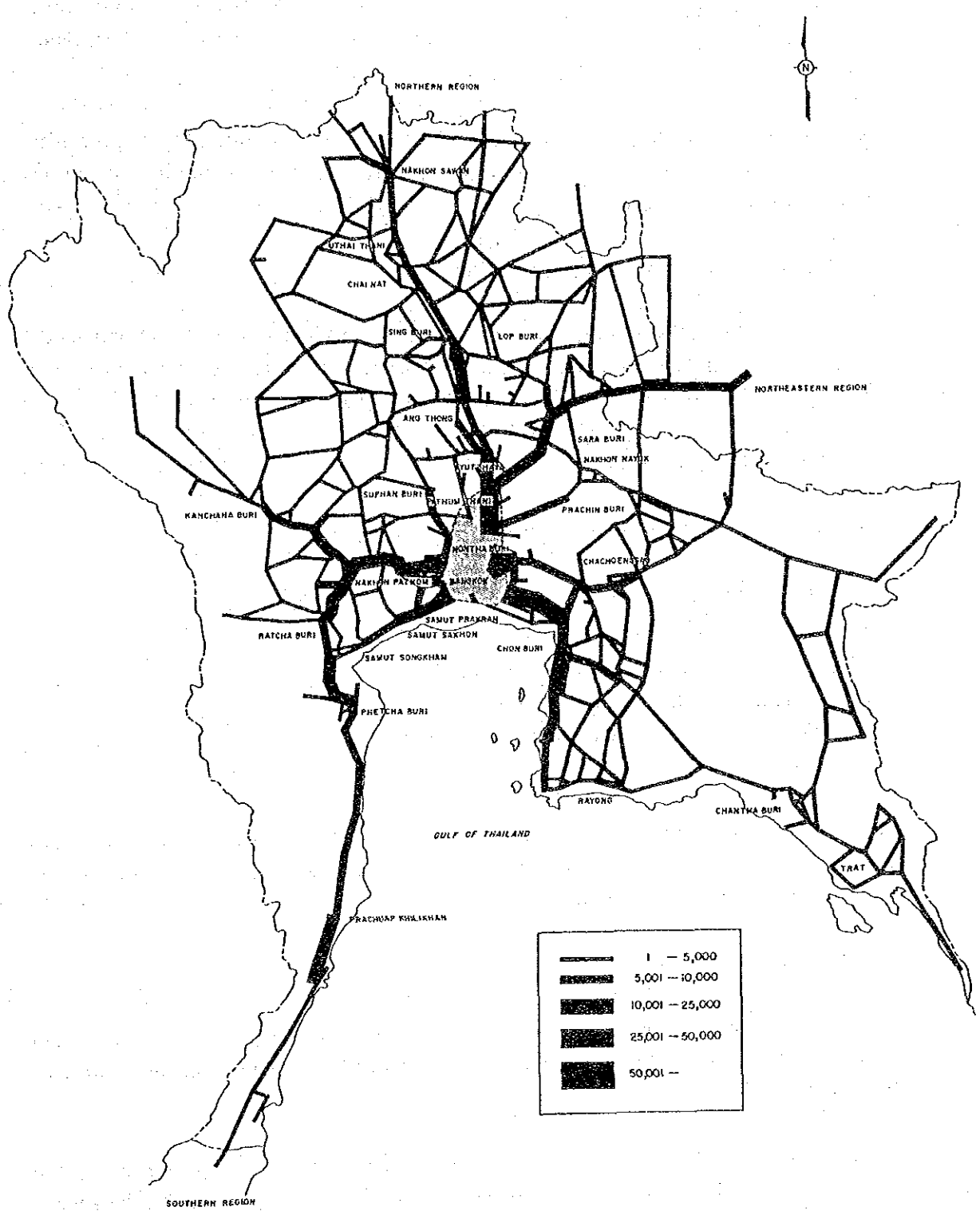


Figure 1.5.1 TRAFFIC VOLUME IN 1986 ROAD NETWORK

Traffic Zoning and Preparation of Road Networks

The number of established traffic zones is 213 in total. Each Amphoe was taken as one traffic zone, in principle, in the study area; however, outside of the study area was appropriately divided into three or four large traffic zones.

The routes involved in the road network were divided into links for traffic forecast considering topographic conditions, road classes, pavement types and surface conditions, and travel time was calculated for each link.

Estimation of Number of Registered Vehicles

A formula for estimating future number of registered vehicles to apply to the gravity model was constructed on the basis of a correlation analysis between GPP by industrial sector and number of registered vehicles from 1981 to 1985 by Changwat concerned.

Formulation of Gravity Model

The applied gravity model is shown below:

$$T_{ij} = \frac{\alpha \cdot (C_i \cdot C_j)^{0.5}}{D_{ij}^{\beta}}$$

T_{ij}	: Trips between zone i and j
C_i and $_j$	: Number of registered vehicles
D_{ij}	: Travel time (minutes) between zone i and j
α and β	: Parameter

In O/D tables by the gravity model, there are cases that traffic is unexpectedly assigned to zone pairs in which no actual traffic exists. In order to omit such errors, a screening of O/D pairs by discriminant function analysis was carried out.

Preparation of O/D Tables

O/D tables prepared by the above procedures were adjusted by applying Frater's Method so as to match attracted and generated traffic estimated beforehand from the number of registered vehicles.

Generated and attracted traffic by the Laem Chabang and Map Ta Phut Projects in the Eastern Seaboard Development Program were separately added to each concerned traffic zone.

Traffic Assignment

Traffic volume for each O/D pair was divided by allotment ratio between the minimum travel time route and the second best route, then assigned to the respective route.

Analysis of Validity of the Gravity Model

In order to analyze the validity of the applied gravity model, correlation coefficients between the following items were calculated:

- Attracted and generated traffic of the present O/D tables and the number of registered vehicles in 1986 (Case I)
- Traffic volumes assigned on links from the present O/D tables and traffic volumes actually measured in 1986 (Case II)

Calculated correlation coefficients are between 0.75 and 0.94; accordingly, the gravity model was judged to be practically applicable to the traffic analysis.

5.4 FUTURE TRAFFIC VOLUME

Future Number of Registered Vehicles

The future number of registered vehicles calculated as described in 5.3 and the socio-economic indices used for the estimation are given in Table 1.5.1.

Table 1.5.1 SOCIO-ECONOMIC INDICATORS AND NUMBER OF REGISTERED VEHICLES

Economic Indicators		1986	1993	2000	2008
Population (thousand)		18,662	20,648	22,667	24,655
		(100)	(111)	(121)	(132)
G P P (billion Baht)	Primary	34.2	41.0	49.3	60.7
	Secondary	92.4	135.1	197.2	303.4
	Services	133.3	198.8	280.3	415.1
	Total	259.9	374.9	526.8	779.2
		(100)	(144)	(203)	(300)
Vehicle Registration (thousand)	Passenger Car	533.1	829.1	1,229.9	1,930.7
	Bus	228.8	337.2	477.5	711.3
	Van & Truck	337.3	459.7	609.4	843.9
	Total	1,099.2	1,626.0	2,316.8	3,485.9
		(100)	(148)	(211)	(317)

As seen in the above table, vehicle registrations in 2000 and 2008 are respectively 2.11 times and 3.17 times 1986 registrations, indicating higher increase rates than the GPP increase rate.

O/D Tables

Attracted and generated traffic summarized by Changwat is shown in Table 1.5.2.

Table 1.5.2 ATTRACTED AND GENERATED TRAFFIC (EXCLUDING TRAFFIC INSIDE ZONES)

No.	Changwat Name	1986	1993	2000	2008
1	Bangkok	212,270	327,552	477,870	734,662
2	Nakhon Sawan	10,456	14,286	19,068	26,046
3	Uthai Thani	4,216	6,190	8,494	11,810
4	Chai Nat	1,894	2,556	3,274	4,278
5	Nonthaburi	39,074	58,756	84,330	127,710
6	Pathum Thani	20,930	37,100	58,680	95,626
7	Ayutthaya	13,632	20,352	28,998	42,698
8	Lop Buri	16,548	24,188	33,604	49,020
9	Saraburi	13,720	19,052	26,104	37,534
10	Sing Buri	2,646	3,974	5,630	8,094
11	Ang Thong	5,510	7,626	10,148	14,164
12	Kanchanaburi	19,878	27,082	36,190	50,474
13	Nakhon Pathom	37,078	49,578	65,564	92,142
14	Prachuap Khiri Khan	3,500	4,742	6,460	9,046
15	Phetchaburi	7,588	10,702	14,890	21,546
16	Ratchaburi	25,030	33,600	45,082	63,832
17	Samut Sakhon	20,244	34,848	52,348	81,802
18	Samut Songkhram	11,026	16,428	23,240	34,486
19	Suphanburi	15,788	22,876	30,886	43,646
20	Chachoengsao	16,720	28,436	42,448	65,924
21	Chon Buri	38,736	56,282	80,142	118,988
22	Trat	5,308	8,004	11,374	16,706
23	Nakhon Nayok	8,384	12,944	18,038	26,310
24	Prachin Buri	12,086	17,524	24,148	32,478
25	Rayong	16,796	28,094	44,100	68,850
26	Samut Prakan	48,480	73,512	107,488	165,292
27	Chanthaburi	12,482	16,618	21,662	29,874
Total		640,020 (100)	962,902 (150)	1,380,260 (216)	2,073,038 (324)

The estimated total number of trips between traffic zones including trips from/to outside the study area are shown in Table 1.5.3.

Table 1.5.3 ESTIMATED TOTAL NUMBER OF TRIPS (EXCLUDING TRIPS INSIDE ZONES)

Year	Passenger	Bus (L)	Bus (H)	Truck (L)	Truck (M)	Truck (H)	Total
1986	149,800	39,500	23,800	64,500	33,900	36,100	347,600
1993	237,200	59,900	35,400	89,600	47,500	50,300	519,900
2000	354,200	85,800	50,400	120,100	64,100	67,800	742,400
2008	558,300	128,600	74,300	166,700	89,000	93,700	1,110,600

Note: L: Light, M: Medium, H: Heavy

Growth rates of the total number of trips with 1986 figures as the base are shown in Table 1.5.4.

Table 1.5.4 GROWTH RATES FOR TOTAL NUMBER OF TRIPS (BASE YEAR 1986)

Year	Passenger	Bus (L)	Bus (H)	Truck (L)	Truck (M)	Truck (H)	Total
1986	1.	1.	1.	1.	1.	1.	1.
1993	1.583	1.516	1.487	1.389	1.401	1.393	1.496
2000	2.364	2.172	2.118	1.862	1.891	1.878	2.136
2008	3.727	3.256	3.122	2.584	2.625	2.596	3.195

Future Traffic Volume

Future traffic volumes forecasted for 2000 and 2008 are shown in Figures 1.5.2 and 1.5.3, respectively.

Based on this result, traffic volumes on links adjacent to Bangkok were summed up for each of four main directions, north (Rts. 1 and 34), northeast (Rts. 2 and 305), east (Rts. 3, 34 and 304) and west (Rts. 4, 35, 338 and 3035). Traffic volumes summed up by direction are shown in Figure 1.5.4.

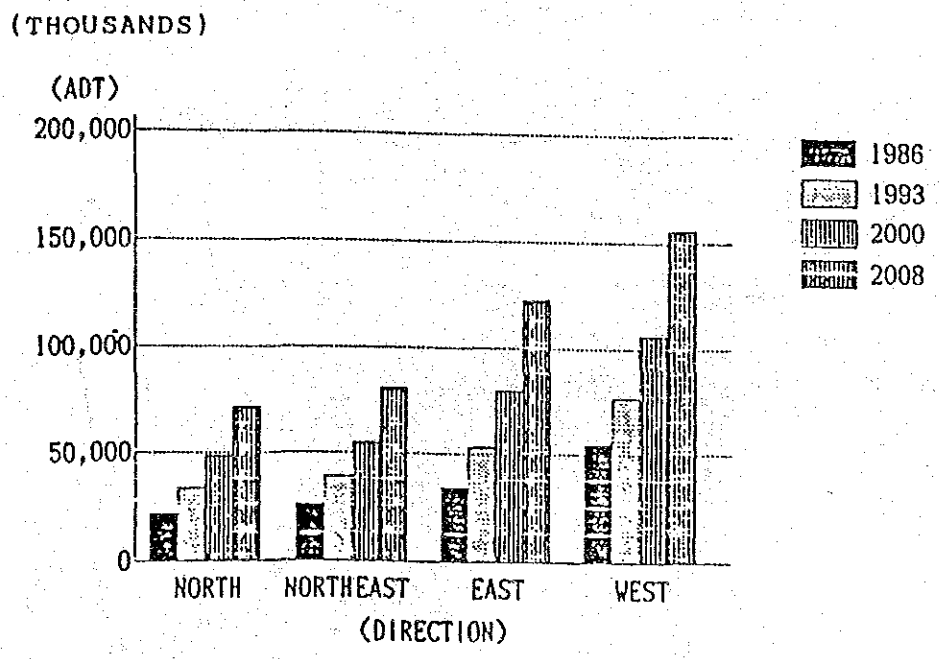


Figure 1.5.4 TRAFFIC FLOW IN AND OUT OF BANGKOK

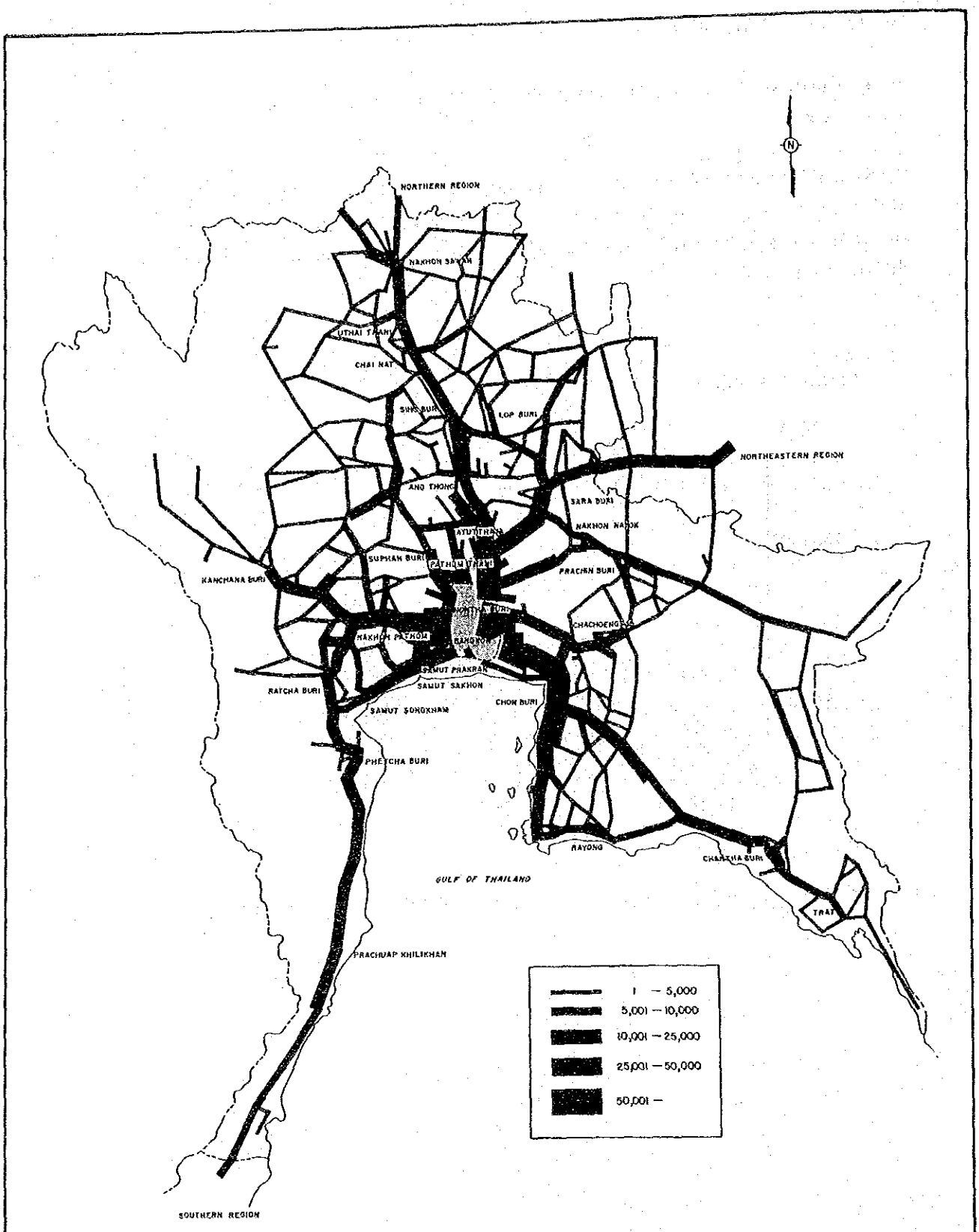


Figure 1.5.2 TRAFFIC VOLUME IN 2000 FOR THE FUTURE ROAD NETWORK

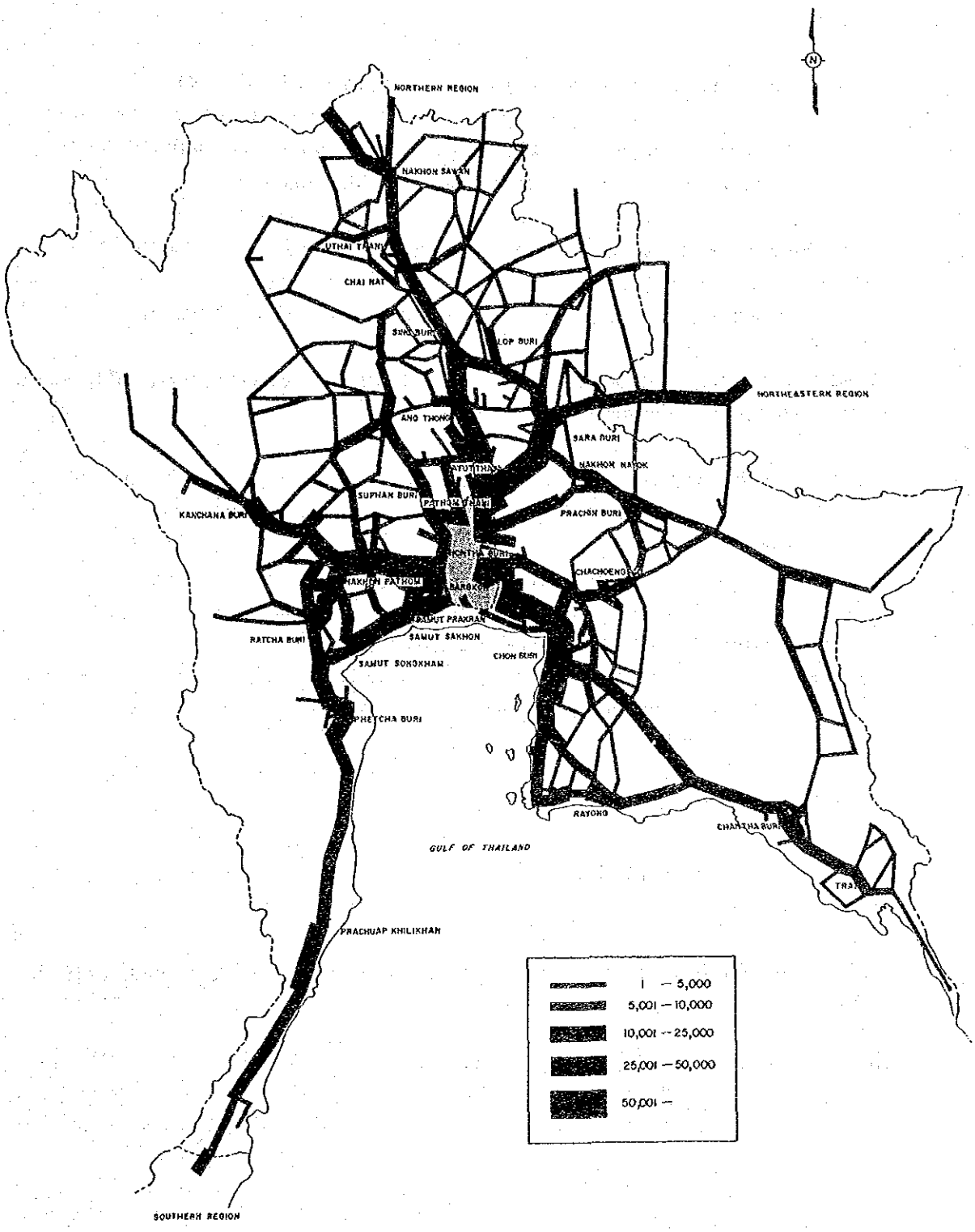


Figure 1.5.3 TRAFFIC VOLUME IN 2008 FOR THE FUTURE ROAD NETWORK