2.5.2 Existing Conditions of Highways

1) Road Database of DOH

The DOH developed the existing road database in 1984 for the purpose of improving the efficiency of road administration works. The road database consists of fourteen database files as listed in Table 2.5.3. Due to a numerous data items, database maintenance is behind by some years.

Table 2.5.3 ROAD DATABASE OF DOH

Database File	No. of Items	No. of Records
Control Link	150	2,500
Horizontal Alignment	11	
Vertical Alignment	7	
Accident Data	8	2,200
Intersection	5	3,600
Railway Crossing	4	
Bridge	14	
Culverts	6	
Ferries/Floodways	3	
Flooding History	7	
Socioeconomic Data	4	
Utilities	5	
Benkelman Beam Def.	4	
Construction Materials	3	

Source: "Coding Manual of Road Database"
Department of Highways, MOC.

2) Current Statistics of DOH Highways

According to the current road database as of October 1990, the total length of DOH highway in the study area is 7,117 kilometers. Table 2.5.4 shows DOH highways by classification and district. Total length of national highways is 2,926 kilometers, accounting for 41 percent of the total highway length, and that of provincial highway is 4,190 kilometers, accounting for the remaining 59 percent. Almost all the highways in the Southern Region are of two lane carriageway.

Table 2.5.4 LENGTH OF DOH HIGHWAYS BY CLASSIFICATION AND BY DISTRICT

unit: kilometers

Changwat	National H/W Primary	National H/W Secondary	Provincial H/W	Total
Songkhla	90	262	128	480
Yala	0	189	274	462
Pattani	0	212	152	364
Phatthalung	65	35	305	405
Narathiwat	0	57	480	538
Satun	32	161	123	317
(Subtotal)	187	916	1,462	2,566
Nakhon S.T.	0	178	434	612
Trang	92	114	284	490
Krabi	129	57	402	588
Phuket	149	161	177	487
Surat Thani	0	254	534	787
Thungsong	0	171	487	658
(Subtotal)	370	935	2,318	3,622
Ranong	251	0	118	369
Chumphon	161	106	292	559
(Subtotal)	412	106	410	928
Total	969	1,957	4,190	7,117
(%)	(13.6)	(27.5)	(58.9)	(100.0)

Source: DOH Road Database, October 1990

The ratio of paved road to the total highway length is 85 percent including random paving such as surface treatment and macadam pavement as listed in Table 2.5.5. Real pavement with asphalt or concrete accounts for 36 percent.

Table 2.5.5 LENGTH OF DOH HIGHWAYS BY SURVEY SITE

unit: kilometers

Surface Type	National H/W Primary	National H/W Secondary	Provincial H/W	Total
Earth	0	0	31	31
Soil Aggr.	0	0	1,017	1,017
(Subtotal)	0	0	1,048	1,048 (14.7%)
Single S.T.	36	37	322	395
Double S.T.	112	473	1,896	2,481
Under STD P.M.	0	197	117	314
Pntr'n Macadam	93	64	53	210
(Subtotal)	241	771	2,388	3,400 (47.8%)
Asph. Concrete	728	1,164	573	2,465
Concrete	0	23	82	105
(Subtotal)	728	1,187	655	2,570 (36.1%)
Others	0	0	101	101 (1.4%)
Total	969	1,957	4,190	7,117 (100%)

Source: DOH Road Database, October 1990

Highway length by DOH design standard is listed in Table 2.5.6. Class "D" of four lanes is only 10 kilometers. Percentage share of classes of "1, 2 and 3" of which width of carriage way is six meters and above accounts for 100 % for primary highway, 83 % for secondary highway and 9 % for provincial highway.

Table 2.5.6 LENGTH OF DOH HIGHWAYS BY DESIGN STANDARD

unit: kilometers

Design Standard	Primary	Secondary	Provincial
Pd	0	--	--
P1	0	--	--
P2	189	--	--
P3	779	--	--
(subtotal)	969	--	--
Sd	--	10	--
S1	--	112	--
S2	--	124	--
S3	--	599	--
S4	--	159	--
S5	--	0	--
(subtotal)	--	1,004	--
Fd	--	--	0
F1	--	--	64
F2	--	--	71
F3	--	152	239
F4	--	223	2,331
F5	--	--	355
F6	--	--	1,003
(subtotal)	--	375	4,063
Others	0	578	127
Total	969	1,957	4,190

Source: DOH Road Database, October 1990

3) Pavement Surface Conditions

A Present Serviceability Index (PSI) survey was carried out by the study team in August 1990 to understand the existing conditions of pavement surface. The highway sections selected for the survey are shown in Fig. 2.5.7, the total amounting to 512 kilometers including 21 sections.

Table 2.5.7 shows the results of the survey. According to the AASHTO, surface conditions of PSI of lower than "2" need rehabilitation. As can be understood in the table, average PSIs of the selected sections are almost higher than "3" which means "fair, several defects but no need to repair". Even the lowest PSIs are higher than "2" which means "fair/poor, small repairs needed such as patching and partial seal coat". Only the section of Route No. 4178 Section 0100 is found PSI is lower than "2".

The results of the PSI survey indicate that pavement surface of the existing highways is well maintained, raising no particular requirements for rehabilitation.

2.5.3 Traffic Volume

Table 2.5.8 shows a steadily increasing trend of traffics on the highway network in the Southern Region. Annual average daily traffic (AADT) increased at an annual growth rate of 7.2 % during 1980 - 1985 and at a higher growth rate of 11.9 % during the most recent period of 1985 - 1989. AADT in 1989 reached 4,245 vehicles on national highways and 3,119 vehicles on provincial highways. These average traffic volume is equivalent to that of "P1/S1" standard for national highways and that of "F2" standard for provincial highways.

The average traffic growth rates of provincial highways were always higher than those of national highways: 7.3 % for 1980 - 1985; and 16.6 % for 1985 - 1989. Traffic volume on provincial highways increased from 1,182 AADT in 1980 to 1,688 AADT in 1985, and to 3,119 AADT in 1989. In terms of traffic volume, provincial highways need upgrading of highway standard.

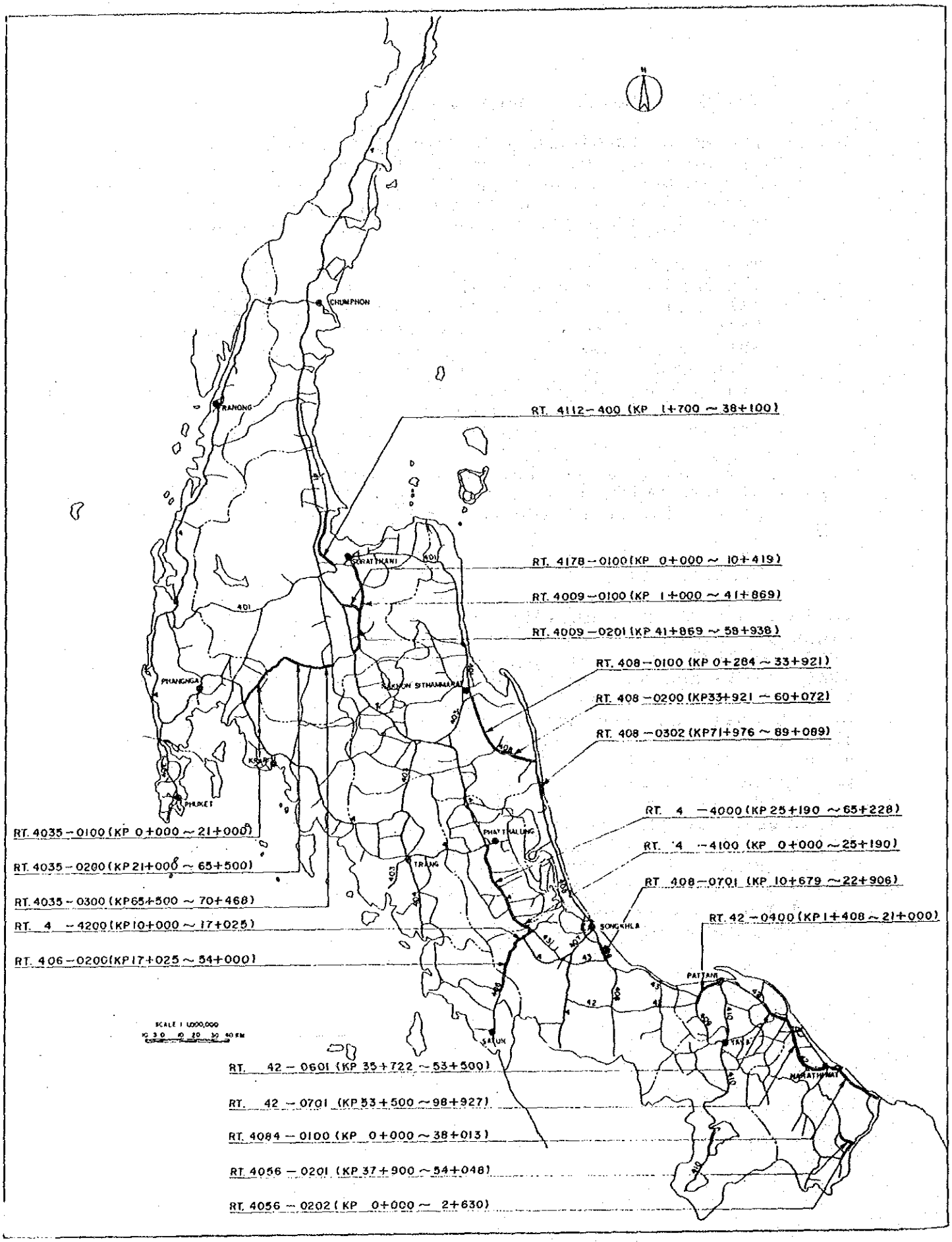

Fig. 2.5.7 PSI Survey Links

Table 2.5.7 SECTION OF REHABILITATION PROJECTS BY PSI SURVEY (1)

Route -Section	District	Length (km)	Road Class	Pavement Condition RDB	Surveyed	PSI(Ave./Min.)	Surface Type	AADT	Heavy Vehicles	
4-4000	Phattalung	40.0	P3	4(F/P)	3.0(F)	3.0/2.0	ASC	5,230	1,443	*
4-4100	Satun	25.2	P3	4(F/P)	2.6(F)	3.4/2.9	ASC	4,130	1,317	
4-4200	Satun	7.0	P3	1(G)	2.5(F)	3.5/3.3	ASC	6,266	1,178	
42-0400	Pattani	19.6	P3	3(F)	2.8(F)	3.2/2.4	ASC	5,492	988	
42-0601	Pattani	17.8	P2	3(F)	2.4(G/F)	3.6/3.1	ASC	2,712	608	
42-0701	Narathiwat	44.5	P2	3(F)	3.0(F)	3.0/2.4	ASC	2,516	418	*
406-0200	Satun	37.0	S3	4(F/P)	3.2(F)	2.8/2.4	SGST	1,635	396	*
408-0100	Nakhon ST	33.6		3(F)	2.6(F)	3.4/2.4	ASC	3,167	860	
408-0200	Nakhon ST	26.2		3(F)	2.9(F)	3.1/2.1	ASC	2,813	914	
408-0302	Song Khla	17.1	F3	3(F)	2.9(F)	3.1/2.4	ASC	2,516	727	
408-0701	Song Khla	12.2		3(F)	3.4(F)	2.6/2.3	DBST	2,403	624	*
4009-0100	Surat Thani	40.9	F4	3(F)	3.0(F)	3.0/2.3	ASC	3,889	1,080	*
4009-0201	Thung Song	17.1	F4	1(G)	2.9(F)	3.1/2.4	DBST	2,719	788	
4035-0100	Krabi	21.0	F4	2(G/F)	3.4(F)	2.6/2.1	DBST	974	156	
4035-0200	Krabi	44.5	F4	2(G/F)	3.0(F)	3.0/2.2	DBST	3,264	600	*
4035-0300	Thung Song	5.0	F4		3.3(F)	2.7/2.4	DBST	2,489	755	*
4056-0201	Narathiwat	16.1	F2	2(G/F)	2.7(F)	3.3/3.2	ASC	1,784	266	
4056-0202	Narathiwat	2.6	F4	2(G/F)	2.3(G/F)	3.7/3.7	ASC	4,282	860	
4084-0100	Narathiwat	38.0	F4	2(G/F)	2.7(F)	3.3/3.0	ASC	2,520	523	
4112-0400	Surat Thani	36.4	F4	3(F)	3.1(F)	2.9/2.2	DBST	1,516	78	
4178-0100	Surat Thani	10.4	F4	4(F/P)	3.9(F/P)	2.1/1.8	DBST	1,972	570	*
	Total	512.2 km								

Source; DOH Road Database, April 1990 and PSI Field Survey by Team.
Note ; Links marked with "*" are candidates for rehabilitation project due to the current PSI Index and Traffic Conditions.

Table 2.5.8 ANNUAL AVERAGE DAILY TRAFFIC (AADT) IN THE SOUTHERN REGION

	National Highways	Provincial Highways	Average AADT:
1980	2,024	1,182	1,728
1985	2,869	1,688	2,454
1989	4,245	3,119	3,849
Growth Rate (%pa):			
1980 - 85	7.2	7.3	7.2
1985 - 89	10.3	16.6	11.9
1980 - 89	8.6	11.4	9.3

Source: Annual Average Daily Traffic Volume, DOH

Table 2.5.9 shows highway sections of 6,000 AADT and over in 1989. Section of JCT Route No. 401 - Phun Phin (Route No. 4008) showed the highest AADT of 12,528, followed by sections of Muni. of Nakhon Si Thammarat - Ban Tan (Route No. 4016) of 11,559, JCT to Phun Phin - Surat Thani (Route No. 401) of 11,555, Muni. of Songkhla - JCT Kho Hong (Route No. 407) of 11,037, and Pattani - Pattani Port (Route No. 4210) of 9,642. Most of these sections are located in the vicinity of large cities like Hat Yai, Phuket, Nakhon Si Thammarat, Surat Thani, etc. It is a conspicuous characteristics that these sections of large traffic volume attained higher growth rates than the average throughout the period of 1980 - 1989.

According to the highway classification and standard, AADT of 8,000 is a critical traffic volume to introduce a four lane highway. The sections enumerated in Table 2.5.9 can be the candidates that need additional lanes. In order to alleviate traffic issues in major cities, a bypass construction would be another solution to accommodate increasing traffic volume in the vicinity of these cities.

Table 2.5.9 ROAD SECTION WITH AADT OF 6,000 AND OVER IN 1989

Route No.	Sec.	Name	AADT
4:	4400	JCT Kho Hong - JCT Khlong Ngae	7,566
41:	0200	JCT to Sawi - Jct to Lung Suan	6,162
43:	0102	Km. 11+160 - Hat Yai	7,091
327:	0200	JCT to Chumphon	8,437
401:	0601	JCT to Phun Phin - Surat Thani	11,555
:	0700	Surat Thani - Kanchanadit	8,107
402:	0201	Sarasin Br. - Muni of Phuket	7,511
407:	0100	Muni of Songkhla - JCT Kho Hong	11,037
411:	0100	JCT Route No. 4 - Krabi	7,034
4008:	0100	JCT Route No. 401 - Phun Phin	12,528
4016:	0100	Muni of Nakhon Si Thammarat - Ban Tan	11,559
4020:	0100	Muni of Phuket - Sala Ket Ho	6,896
4080:	0100	Muni of Ranong - Tha Rua Pramong	9,374
4153:	0100	JCT Route No. 41 - Phun Phin	8,016
4210:	0100	Pattani - Pattani Port	9,642

Source: Annual Average Daily Traffic Volume 1989, DOH

Fig. 2.5.8 outlines the traffic situations on the highway network in the Southern Region.

In the Southern Region, motorcycle traffic constitutes a substantial part of road traffic. Average motorcycle traffic on Route No. 4, for example, accounted for as large as 67 % of AADT in 1989. As touched upon in 2.3.5, necessity of highway improvement should be evaluated not only based on AADT but also by taking account of motorcycle traffics.

Average heavy vehicle composition ration on Route No. 4 was 23.9 % in 1989.

2.5.4 Damages by Natural Disaster

The highway network in the Southern Region is prone to suffer natural disasters such as flooding, debris flow, slope erosion and rock fall.

Table 2.5.10 shows frequency of highway damages in the Southern Region based on interview survey to the DOH district offices. Out of the total highway length of 7,117 kilometers, 2,631 kilometers (slightly more than one third of the highway network) suffer damage caused by natural disaster every year. If less frequent damage is included, highways of 3,940 kilometers (55 % of the highway network) have suffered damage in the past.

Every district suffers flooding every year. Ten districts suffer scouring and collapse of bridge, and nine districts suffer land slide and slope failure. Some districts suffer mud and debris flow (Songkhla, Nakhon Si Thammarat, Surat Thani and Phuket), and some suffer rock fall (Nakhon Si Thammarat and Phuket).

Fig. 2.5.9 depicts the points where highways suffered damages in the past. The provinces in the Southern Region can be classified into three groups in terms of highway damages by natural disaster:

(1) Disaster Prone Provinces

Phatthalung, Narathiwat, Nakhon Si Thammarat, Surat Thani, Thung Song and Chumphon

(2) Intermediate Provinces

Songkhla, Yala, Pattani and Trang

(3) Least Disaster Prone Provinces

Satun, Krabi, Phuket and Ranong

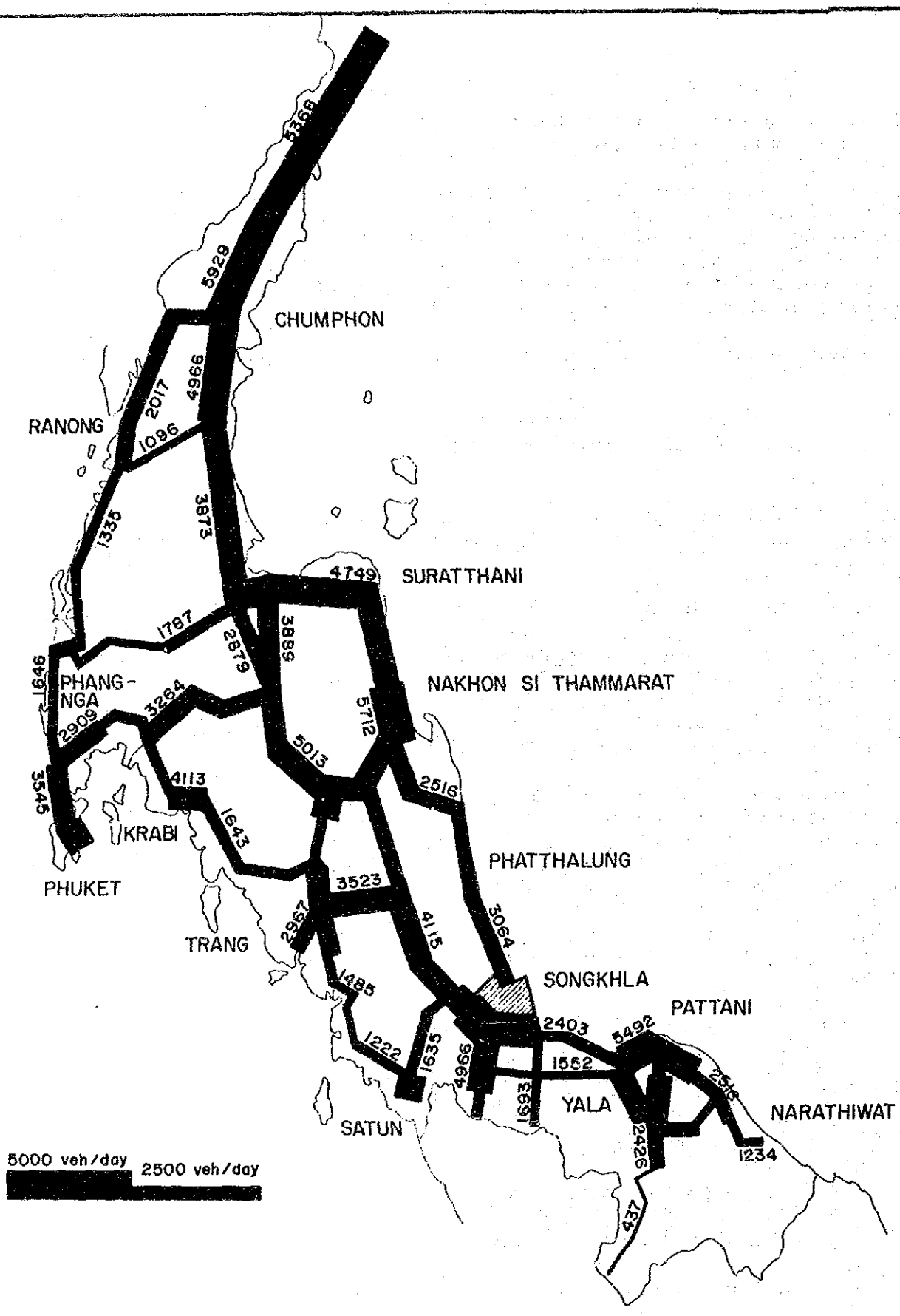

Fig. 2.5.8 ANNUAL AVERAGE DAILY TRAFFIC VOLUMES ON MAJOR HIGHWAYS, 1989

Table 2.5.10 ROAD DAMAGES AND DESTRUCTIONS

District	Type of Disaster	No. and Length of Road Links by Suffered Frequency (1)	(2)	(3)
Song Khla	F, B, M, S	14km/3	39km/2	110km/4
Yala	F, S	63km/3	30km/1	134km/7
Pattani	F, B, S	20km/2	30km/1	194km/9
Patthalung	F, B, S	59km/3	62km/3	225km/10
Narathiwat	F, B	11km/1	54km/4	332km/18
Satun	F	76km/4	37km/1	0 /0
Nakhon S.T.	F, B, S, M, R	39km/2	25km/1	357km/17
Trang	F, B, R	0 /0	29km/1	200km/8
Krabi	F	69km/3	21km/1	100km/3
Phuket	F, B, M, R	21km/2	42km/1	14km/1
Surat Thani	F, M, S	111km/10	0 /0	413km/16
Thung Song	F, B, S	104km/5	78km/4	351km/16
Ranong	F, B, S	3km/1	0 /0	69km/1
Chumphon	F, B, S	143km/9	127km/5	135km/7
Total		734km/48	575km/25	2,631km/117

Source; Road Database of DOH, 1990
Hearing of District Engineers, August 1990

Note: Type of Disaster F; Flooding (with Slope Erosion)
S; Land Slide, Slope Failure
B; Scouring, Collapse of Bridge
M; Mad Flow, Debris Flow
R; Rock Falls

Damage Frequency (1); Damaged in the Past
(2); Damaged almost more than once a every three years
(3); Damaged almost more than once a every year

Total Road Length ; 410 links 7,157km.

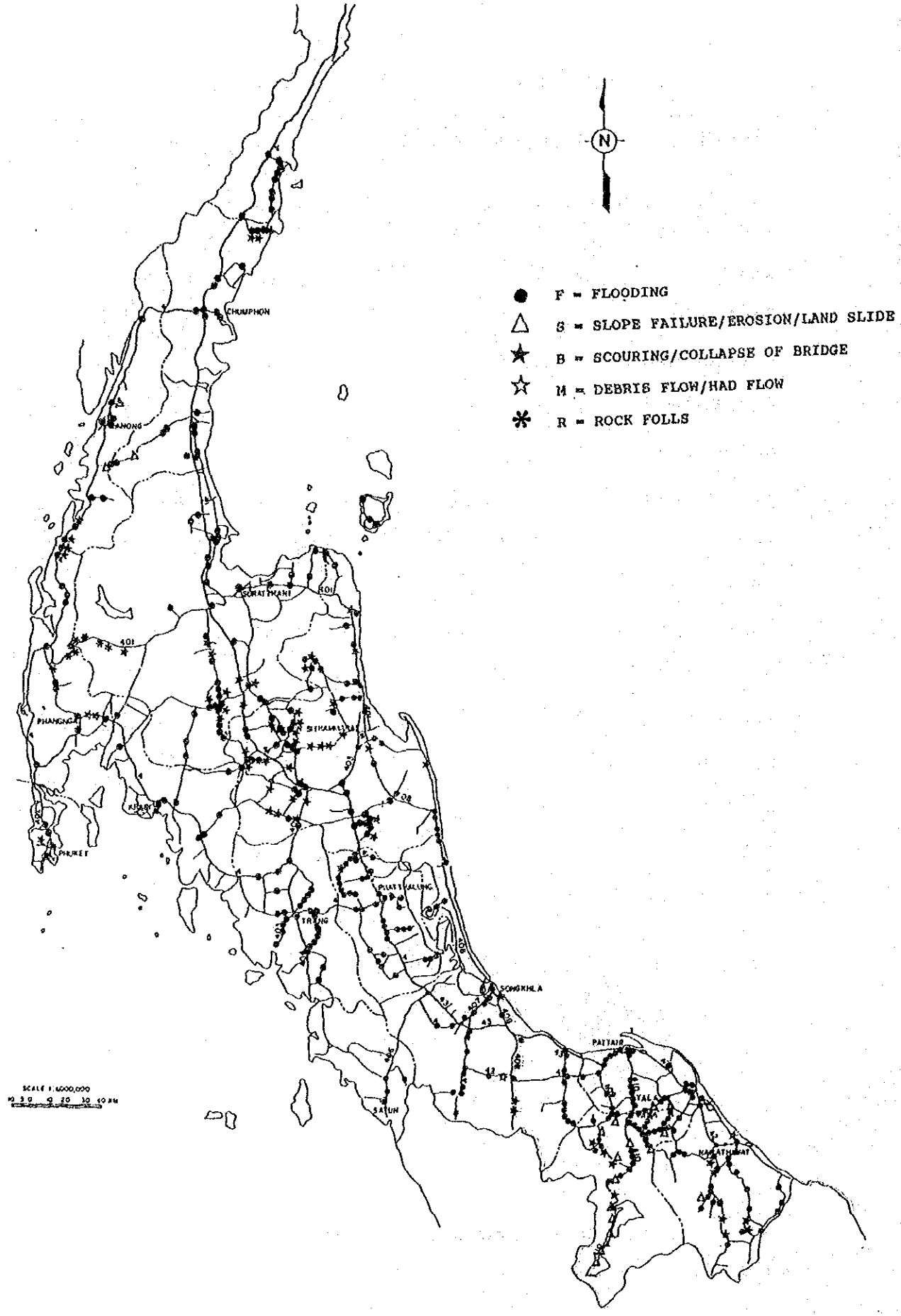

Fig. 2.5.9 HIGHWAYS DAMAGED BY NATURAL DISASTER

Table 2.5.11 identifies the highways which suffered damages by natural disaster, in the past. The Southern Region suffered the most serious damages in November 1988. Heavy rainfall of more than 1,000 mm poured in Nakhon Si Thammarat and Surat Thani. The rain caused flooding and debris flow which reportedly killed 356 persons, destroyed 1,560 bridges, 5,700 kilometers of roads and 55,600 houses, and inundated 6,060 square kilometers of agricultural fields.

A report titled "Effects of Floods of November 18 - 23, 1988 in Southern Thailand on Highway Bridges and Large Dam" identified the main cause of the disaster as follows:

- unusual heavy rainfall in the mountains;
- reduction of water retention capacity which is attributable to man-made activities such as deforestation, cultivation with rubber plantations and other crops; and
- steep mountain slopes with thin layer of weathered granite.

2.5.5 Traffic Accidents

There were 322 traffic accidents in the Southern Region in 1989 as shown below:

	Accident Highways		
	cases	kms	cases/km
National Highways	298	2,540	0.117
Primary Highway	99	968	0.102
Secondary Highway	199	1,572	0.127
Provincial Highway	24	4,449	0.005
Total	322	6,989	0.046

The frequency of accidents in the Southern Region is calculated at 0.046 cases per road kilometer: 0.117 for national highways and 0.005 for provincial highways. National highways thus have an extremely high frequency of accidents compared with provincial highways.

Fig. 2.5.10 depicts the locations where traffic accidents occurred.

Table 2.5.11 HIGHWAYS PRONE TO DAMAGES BY NATURAL DISASTER

RN	CSSN	RDDN	RNM	LCS	ADT	DHL
4	1500	332	BRIDGE KM.423+600 - N.HUAIPRAK BANG TALAI BRIDGE	26429	4361	2
4	1600	332	N.HUAIPRAK BANG TALAI BRIDGE - I.TO THA SAE	26516	5929	2
4	1700	332	I.TO THA SAE - I.PHATHOM PHON(CHUMPHON)	22725	4169	3
4	3601	322	TRANG/KRABI MUNICIPAL - JCT. TO KHAO VISAED	19390	2121	3
4	3800	322	CONTINUE TRANG MUNICIPAL - WEST KHLONG SAI KAO BRIDGE(PHATTHALUN	28335	3024	3
4	3900	314	KM.36+400 DIST.TRANG! - PHATTHALUNG MUNICIPAL	24611	3754	3
4	4000	314	PHATTHALUNG MUNICIPAL - J.TO PAK PHA YUN(DIST.SATUN)	40038	5230	3
4	4400	311	J.KHO HONG - J.KHLOING NGAE	26580	7567	3
4	4500	311	J.KHLONG NGAE - KHLONG PHRUAN	30879	4966	3
41	600	325	CHAI YA - R. 401(AT KM.17+602)(PHUN PHIN)	42091	4629	3
41	701	325	R. 401(AT KM.17+602)(PHUN PHIN) - KM.153+000(DIST. THUNGSONG)	38258	2391	3
41	900	326	CHAWANG - PAK PRAK MUNICIPAL	54953	5013	3
41	1001	326	THUNG SONG - RON PHIBUN	20273	5545	3
41	1002	326	RON PHIBUN - THA PRACHA(DIST. PHATTHALUNG)	34310	2703	3
42	400	313	J.BAN NAKET - J.TASSABAN PATTANI	19592	5492	3
42	501	313	BAN DONRAK - J.TO A BAN PALAS	35738	5988	3
42	502	313	J.TO A.PATTANI - KM.3+451	1786	3647	3
42	601	313	J.TO A PANARE - I TO A.SAI BURI	17778	2712	3
42	701	317	J TO A SAIBURI - J.A. MUANG NARATHIWAT	44527	2516	3
43	300	311	HAT YAI - CHANA	35984	4754	2
43	600	313	PAKNAM TEPHA - C.PATTANI B.NONGJIK	23063	3993	3
401	700	325	SURATTHANI MUNICIPAL - KANCHANADIT	15475	8109	3
401	801	325	KANCHANADIT - DIST. NAKHON SI THAMMARAT	35662	4749	3
401	900	321	KM.85+100 (J.TO KHANOM) - SI CHON	15198	3027	3
401	1001	321	SICHON - THA SALA	37140	3870	3
401	1002	321	THA SALA BY PASS	4279	3209	3
401	1100	321	THA SALA - THAPHAE	19375	5712	3
402	201	324	I SARASIN BRIDGE - C PHUKET MUNICIPAL	41719	7513	2
403	101	321	NAKHON SI THAMMARAT MUNICIPAL - RON PHIBUN	25709	4194	3
403	400	322	CONTINUE TRANG MUNICIPAL - CONTINUE A.KANTANG MUNICIPAL	18622	2967	3
407	100	311	SONGKHLA MUNICIPAL - J.KHO HONG	22730	11039	3
408	100	321	DISTRICT BOUNDARY - INTERSECTION TO KHAU CHIANG YAI	33637	3167	3
409	200	312	J.BAN NEANG - J.TASSABUN YALA	8660	5132	3
410	102	312	J.TO A.MAYO - J.TASSABUN YALA	21814	3823	3
410	200	312	J.TASSABUN YALA - J.TO A.BAN NANG SATA	33925	2426	3
4001	100	332	CHUMPHON MUNICIPAL - PAK NAM CHUMPHON	10000	3511	3
4009	201	326	BAN NASAN - BANSON	17069	2719	3
4009	202	326	BANSON - PHRA SAENG	18423	2719	3
4013	100	321	NAKHON SI THAMMARAT MUNICIPAL - PAK PHANANG MUNICIPAL	27650	2560	3
4015	100	321	BAN TAN - LANSAKA	13727	2983	3
4015	202	326	CHAN DI(DIST. NAKHON SI THAMMARAT) - CHAWANG	23536	2056	3
4016	200	321	BAN TAN - PHROM LOK - NOPPHITAM(NA RENG)	32024	2644	3
4021	100	324	CONTINUE PHUKET MUNICIPAL - J B NABON	13595	5716	3
4055	101	317	C NARATHIWAT - TANYONGMUS	17550	3925	3
4055	102	317	B.BUKAE SAMI(A RANGAE) - DUSUNGYO	15000	2039	3
4056	100	317	JR 4055(B.MANANG TAYO) - A SUNGAIPADI(RR)	37900	2271	3
4057	101	317	A.TAKBAI - A.SUNGAI KOLOK	32382	2489	3
4063	100	312	J.R.410 - B.KOTA BARU	9100	2272	3
4169	100	325	AROUND KO SAMUI	50115	2555	3

Abbreviation of Items:
RN : Route Number
CSSN : Control Section Subsection
RDDN : Region Division District Code
RNM : Route Name
LCS : Length of Control Section (m)
ADT : Average Daily Traffic
DHL : Disaster Frequency Level

District Code:
311 : Songkhla
312 : Yala
313 : Pattani
314 : Phatthalung
317 : Narathiwat
318 : Satun
321 : Nakhon Si Thammarat
322 : Trang
323 : Krabi
324 : Phuket
325 : Surat Thani
326 : Thung Song
331 : Ranong
332 : Chumphon

Disaster Frequency Level Code:
0 : No damage
1 : Damaged in the past
2 : Damaged almost more than once a every three years
3 : Damaged almost more than once a every year

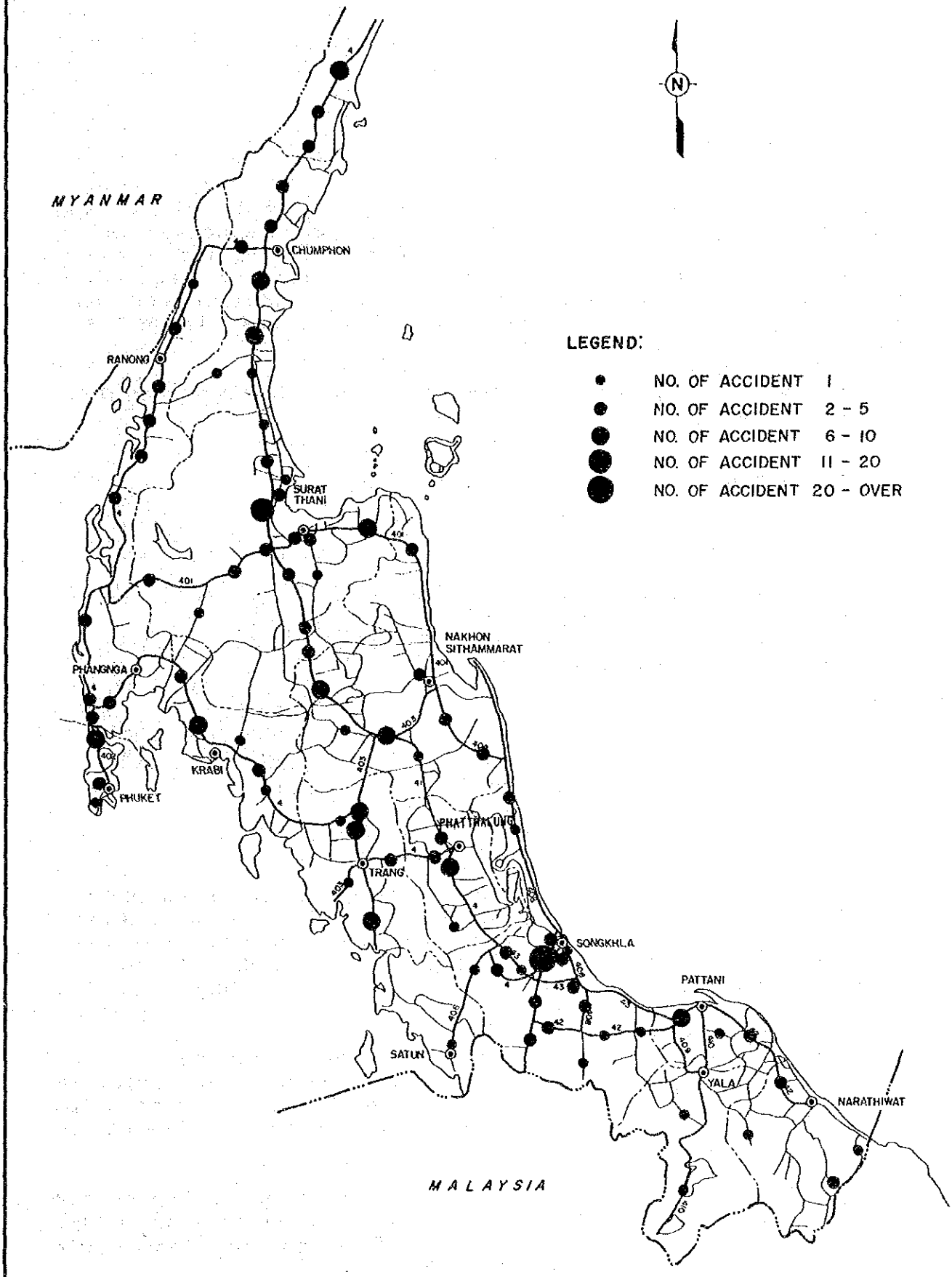

Fig. 2.5.10 TRAFFIC ACCIDENTS IN THE SOUTHERN REGION IN 1989

2.6 Rural Road

2.6.1 Rural Road Network

Rural road can be defined as all roads outside cities and municipalities, excluding national and provincial highways. There are about 50,000 kilometers of rural roads under the jurisdiction of the DOH. The rural road system is quite extensive, amounting to about 124,000 kilometers although it is unclear how many kilometers belong to city and municipality areas. Table 2.6.1 shows rural roads under various agencies.

Most of rural roads are not paved: 94 % for ARD roads and 90 % for PWD roads.

Table 2.6.1 Length of Road in 1988

Agencies	Length of Roads	%
Accelerated Rural Development (ARD)	19,506 km	11.0
Public Works Department (PWD)	6,173	3.5
The Royal Irrigation Department (RID)	5,173	2.9
Municipalities and Sanitaries	11,924	6.8
Others	81,073	45.9
Sub Total	123,849	70.2
DOH, ETA and Bangkok Metropolitan	52,680	29.8
Total	176,529	100.0

Source: "Highways in Thailand" by DOH

Fig. 2.6.1 shows the road network in the Southern Region including rural roads. Rural roads connect rural communities with the DOH highway system. Due to the mountain chains in the Southern Region, however, the density of rural roads differs from place to place: higher density along national highways and low density in mountain areas.

Length of ARD and PWD roads amounts to 3,562 kilometers: 2,609 kilometers for ARD and 953 kilometers for PWD. The length is about 42 percent of the DOH highways in the Southern Region. This percentage is lower than the national average by about 10 percent.

Average daily motor vehicle traffic on PWD roads is reportedly 350 vehicles on paved roads and 130 vehicles on unpaved roads. Motorcycle traffic accounts for about 50 percent on paved roads and as high as 80 percent on unpaved roads.

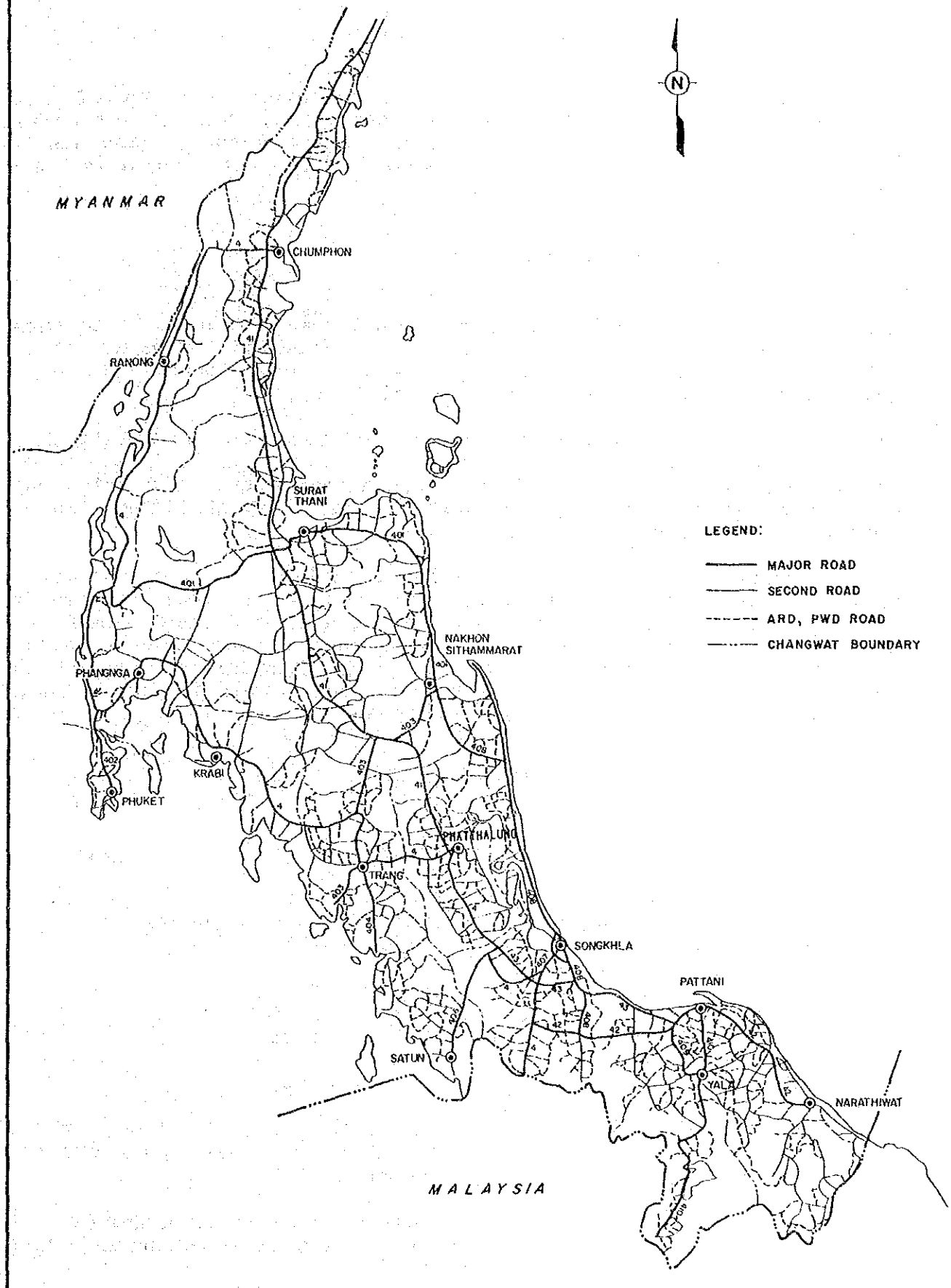

Fig. 2.6.1 ROAD NETWORK IN THE SOUTHERN REGION

Rural roads are of a low standard, the average width of the carriage way being as narrow as 4.5 meters. Although most of rural roads are usually in fair condition in dry season, many roads become impassable during rainy season. Little maintenance is done on these roads.

2.6.2 Accessibility in Rural Area

Rural roads are essential for rural population to approach to farm land, market, school, hospital, etc. Rural road extension, however, has been limited so far and consequently rural communities have quite a different condition of accessibility.

Fig. 2.6.2 shows sub-districts (tambon) of lower accessibility than others. There are 82 sub-districts of lower accessibility out of total 1,025 sub-districts. This is based on the survey carried out by Thammasat University in 1989 under the National Rural Development Cooperation Center (NRDCC).

In this survey, "lower accessibility" is defined either as an area where bus services are not available throughout a year or only in rainy season, or as an area where it takes longer than 30 minutes to an amphoe center by boat or railway (roads unavailable). Sub-districts of lower accessibility are generally located in national forest reserves, isolated coastal areas and on islands where rural roads have not been extended.

2.6.3 Agencies Related to Rural Roads

The agencies related to rural roads are:

(1) Public Works Department (PWD);
(2) Office of Accelerated Rural Development (ARD);
(3) Changwat Administration Office (CAO);
(4) Department of Highways (DOH);
(5) Royal Irrigation Department (RID);
(6) Agricultural Land Reform Office (ALRO);
(7) Community Development Department (CDD);
(8) National Security Command (NSC); and
(9) Self Help Settlement Division (SHLSD).

Due to different organizational objectives of each agency, their functions overlap each other to a considerable extent, particularly in giving assistance to local governments.

Most of the maintenance works are trusted to local governments. Due to lack of technical staff and budget, however, maintenance works have not been carried out satisfactorily.

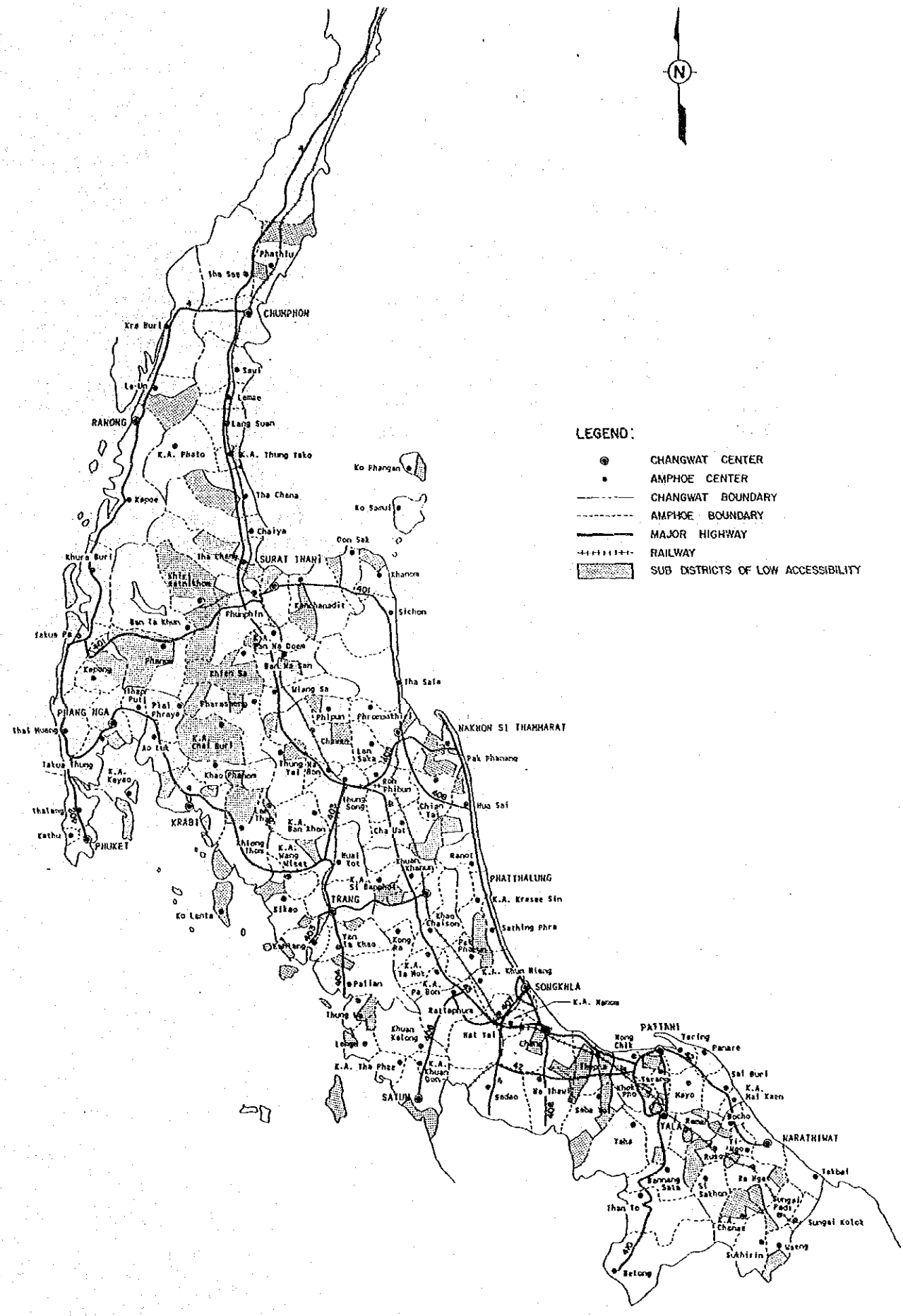

Fig. 2.6.2 SUB-DISTRICTS OF LOWER ACCESSIBILITY

2.6.4 Issues on Rural Roads

Main issues on rural roads are:

(1) Maintenance

The existing rural roads are not well maintained. Heavy rainfall during the rainy season makes most of the rural road impassable and the rugged surface caused during rainy season gives an extreme obstacle to vehicle passage during dry season. Maintenance system for rural roads has not been well developed, particularly for roads under the responsibility of local governments. The central government such as the Ministry of Interior should provide better maintenance support to the local governments.

(2) Upgrading to All Weather Standard

Rural roads of lower standard need to be upgraded to all weather roads to ensure better accessibility for rural communities throughout a year. Although greater initial investment is required for this purpose, the investment will assure uninterrupted accessibility all the year around and less routine maintenance works.

(3) Further Development of Rural Roads

There are still many villages in need of minimum level of accessibility to sub-district centers. Rural roads should be extended to these communities to assure civil minimum standard of daily life with due attention to the environmental impact assessment, particularly in mountain areas.

CHAPTER 3

Future Development Prospects of the Southern Region

3. FUTURE DEVELOPMENT PROSPECTS OF THE SOUTHERN REGION

3.1 General

This chapter discusses the future transport demand of the Southern Region based on the present transport demand and the future economic framework of the region.

The Southern Region is deemed as a promising region for the future economic development in a context of internationalization of the country. Upper Southern Sub-Region, Songkhla Lake Basin and Pak Phanang Basin are designated as "New Economic Areas" in the Sixth National Plan. Tourism development is going to be promoted in the areas of Surat Thani-Ko Samui, Songkhla-Hat Yai and Phuket based on the excellent natural endowment.

The economy of the Southern Region is estimated to grow at an average annual rate of 7.2 % during the period of 1988 - 2006 while the national growth rate is estimated at 6.5 % during the same period. Due to the higher growth rate of the Southern Region than the national average, the percentage share of GRP of the Southern Region is expected to increase from 10.0 % in 1988 to 11.5 % in 2006.

Vehicle trip production in the future is estimated to grow at an annual growth rate of 10.0 % during the period, faster than the economic growth by 2.8 %, reflecting the relationship between the GRP and vehicle trip production in the past.

Traffic volume on the highways near such large cities as Songkhla-Hat Yai, Surat Thani and Phuket is estimated to reach the range of 40,000 PCU in 2006. Traffic volume on the North-South Artery of Route No. 4, 41 and 43 from Chumphon to near Malaysian Border is estimated to reach 20,000 - 30,000 PCU. Traffic volume on Route No. 4 to Bangkok direction from the Southern Region is estimated to reach 30,000 - 40,000 PCU. The estimation suggests that capacity increase of the existing highways, additional lane construction in particular, would be the most important issues to be addressed for the future.

3.2 Development Plans in the Southern Region

3.2.1 National Development Plan

The Sixth National Economic and Social Development Plan (1987-1991) follows the preceding national development plans with an emphasis on restructuring the process of national development. The Plan aims that the Thai economy may grow at a higher rate than the Fifth Plan (1982-1986) by finding solutions to the balance of trade deficit, fiscal problems, employment conditions, the deterioration of the country's natural resources and environment and the declining economic condition of the farmers.

The objectives of the Sixth Plan are to:

(1) improve employment generation and income distribution;

(2) solve the problem of rural poverty; and

(3) maintain the economic equilibrium of the country in order to ensure that there exist opportunities for steady development in the years to come.

Table 3.2.1 shows the overall economic targets in the Sixth Plan. The GDP growth rate was set at 5.0 percent per annum, 0.6 percent higher than the achievement in the Fifth Plan period. Actual GDP growth rates attained in the years of 1987 and 1988 exceeded the originally planned target: 8.4 percent in 1987 and 11.0 percent in 1988. The target GDP growth rate for the Sixth Plan period in consequence was revised in 1989: average annual growth rate of 8.4 percent for 1987 - 1991 and 7.5 percent for 1989 - 1991.

Table 3.2.1 OVERALL ECONOMIC TARGETS IN THE SIXTH PLAN

Items	Fifth Plan Actual 1982-1986	Sixth Plan Target 1987-1991
1. Trade Deficit (current prices)		
1) Average value per year (million Baht)	55,600	35,900
2) Trade deficit/GDP (%)	5.8	2.7
2. Current Account deficit (current prices)		
1) Average value per year (million Baht)	36,000	11,800
2) Current Account deficit/GDP (%)	3.8	0.9
3. Export goods and services		
1) Value growth rate (%)	9.8	9.9
2) Volume growth rate (%)	8.4	7.4
4. Export of goods		
1) Value growth rate (%)	8.4	10.7
2) Volume growth rate (%)	8.3	8.1
3) Average value per year (million baht)	177,500	290,700
5. Income from tourism (current prices)		
1) Value growth rate (%)	12.2	7.4
6. Import of goods and services		
1) Value growth rate (%)	3.7	9.3
2) Volume growth rate (%)	2.0	4.5
7. Import of goods		
1) Value growth rate (%)	2.9	9.5
2) Volume growth rate (%)	2.9	4.6
3) Average value per year (million baht)	233,100	326,700
8. Economic growth (%/yr at constant prices)		
1) Agriculture	2.1	2.9
2) Manufacturing	5.1	6.6
3) Mining	6.1	6.4
4) Natural Gas (million cu ft/day)	*1 320	*2 720
5) GDP	4.4	5.0
9. Expenditure Growth (%/yr at constant prices)		
1) Private sector: - Consumption	4.3	3.7
- Investment	0.8	8.1
2) Public sector: - Consumption	3.3	5.3
- Investment	1.8	1.0
10. Government revenue/GDP (%)	14.8	15.8
11. Population growth rate (%)	*1 1.7	*2 1.3
- Municipal districts	2.7	2.5
- Sanitary districts	2.1	2.4
- Villages	1.4	0.8
12. Inflation rate (%)	2.9	2.3
13. Per capita income (baht)	*1 21,395	*2 27,783

Note: *1 in 1986
*2 in 1991
Source: The Sixth National Economic and Social Development Plan

The Sixth Plan intends to promote population distribution away from Bangkok corresponding to the regional economic base and the past employment trends which indicate a transition from rural to urban conditions:

(1) Continue to emphasize the development of Bangkok Metropolis and its vicinity towns which remain the largest economic and employment base of the country;

(2) Develop urban growth centers in provincial regions as the social and economic focus of each region. They will be able to support the activities decentralized from Bangkok and its vicinity areas and, in the future, serve as regional government administration centers;

(3) Develop the Eastern Seaboard Sub-region and other areas, such as the Upper South and Songkhla Lake Basin, into new economic zones for future population distribution; and

(4) Extend development to rural areas and improve the quality of life there through the acceleration of rural development activities.

The Sixth Plan stipulates the issues on infrastructure development to be addressed during the period based on the outcome of the Fifth Plan:

(1) Improve the quality of infrastructure services and maintain the existing networks in order to facilitate economic activities that will increase income and employment; and

(2) Incorporate missing links in the system of infrastructure services in order to increase the efficiency of the economic system as a whole. This will include connecting production sources with markets, coordinating the use of different transport systems and linking various urban areas.

Measures and work plans for road network development are enumerated in the Sixth Plan as follows:

(1) Emphasize the repair and maintenance of highways and roads in rural areas, particularly where there is an urgent need;

(2) Emphasize the upgrading of construction standards for key roads in the network, and build roads to fill in the missing links between production areas, markets and cargo depots in order to support exports;

(3) Encourage the private sector in investing in construction, repair and maintenance and revenue collection. The patterns, methods and procedures for participation will be clearly specified and made practicable; and

(4) Establish a coordinating system or organization to ensure that policies, work plans and operations concerning the construction and maintenance of highways and rural roads will harmonize and support one another in order to justify investments.

3.2.2 Development Plans in the Southern Region

1) Development of Urban and Specific Areas

The Sixth Plan, succeeding to the Fifth Plan, places an importance to urban and specific area development in order to promote balanced economic growth in urban and non-urban areas.

The targets for developing urban and specific areas in the Sixth Plan are:

(1) to develop Bangkok Metropolis and its vicinity towns as a single metropolitan region with self-contained polycentric pattern as well as with more efficient and orderly linkages;

(2) to develop regional urban growth centers to serve as the social and economic development base in each region. The centers will have the capacity to absorb economic activities decentralized from Bangkok, accommodate rural migrants and in the future, serve as the public administrative centers of the regions; and

(3) to develop the Eastern Seaboard sub-region and prepare to develop other areas, such as the **Upper South sub-region** and **Songkhla Lake Basin**, into new economic zones. This will provide alternative for future industrial locations and pave the way for strengthening the competitive position of national exports.

2) Development Plan for Regional Urban Growth Centers

The Sixth Plan stipulates the following priorities and procedures for developing urban centers:

(1) Regional Urban Centers

Development will continue in the 5 regional urban centers of Chiang Mai, Khon Kaen, Nakhon Ratchasima, **Songkhla-Hat Yai** and Chonburi. Emphasis will be placed on continuing and completing the on-going development programs and projects.

(2) Main Urban Centers

Development will be initiated in the 6 main urban centers of Phitsanulok, Nakhon Sawan, Udon Thani, Ratchaburi, **Surat Thani** and **Phuket**. Programs and projects will be prepared for implementation in the second half of the Sixth Plan period.

(3) Urban Growth Centers

Preparation will be made to develop 13 other urban growth centers: Lampang, Chiang Rai, Ubon Ratchathani, Roi Et, Surin, Sakon Nakhon, Rayong, Chachoengsao, Saraburi, Kanchanaburi, Phetchaburi, **Pattani** and **Nakhon Si Thammarat**.

Economic, social and environmental infrastructure services that conform with town planning measures will be provided to the above centers. The emphasis will be on improving public utilities in urban areas and on a major transport and communications network, such as airports and deep-sea ports, to link all regional urban centers with the national economy. At the same time, investment promotion for industry, tourism and the marketing system in the urban growth centers will be accelerated. Employment opportunities will be increased to absorb excess labor from the agricultural hinter-land.

3) Development of Other New Economic Areas

In the Sixth Plan, the Southern Region is designated as an area for potential future development. With the Andaman Sea to the west and the Gulf of Thailand to the east, the region enjoys two coastlines which may be developed into centers of international trade: the locational advantage will stimulate industrialization of the region. In addition the south has the potential to be developed into the most important tourism area in the country.

Policy guidelines for developing the Southern Region are based upon the suitability of particular areas. Songkhla-Hat Yai will be developed into the economic and administrative center of the whole region. The Andaman Sea Coast, centered on Phuket, will be systematically linked with the Gulf of Thailand coast, centered on Surat Thani, by efficient transport and communications system.

(1) **Upper Southern Sub-Region** will be the new economic base and commercial center for international trade. The subregion covers approximately 22,000 square kilometers and comprises 4 provinces: Surat Thani, Phuket, Phangnga and Krabi.

(2) **Songkhla Lake Basin** is an important area endowed with natural resources and fresh water, which will provide a base for promoting development of the southern subregion. It covers an area of 9,570 square kilometers and includes the whole of Phatthalung province; 6 districts and 2 minor districts of Songkhla province: Songkhla, Hat Yai, Sadao, Rattaphum, Ranot, Sathing Phra, Krasae Sin and Na Mom; and 2 districts in Nakhon Si Thammarat province: Cha-uat and Hua Sai.

(3) **Pak Phanang Basin** is in Nakhon Si Thammarat province, an important rice-producing region in the south. It encompasses 1.07 million rai (1.712 square kilometers) consisting of the districts of Cha-uat, Hua Sai, Chian Yai, Pak Phanang and Muang and part of Ron Phibun district.

4) Tourism Promotion and Development

Tourism promotion and development is planned in 8 main tourist centers in the provincial regions: Chiang Mai, Phitsanulok, Nakhon Ratchasima, Rayong, Kanchanaburi, **Surat Thani-Ko Samui**, **Songkhla-Hat Yai** and **Phuket**. Work plan includes to:

(1) Encourage local authorities to preserve natural tourism resources and draw up their own tourism development plans;

(2) Provide and upgrade necessary public utilities in tourist resorts, including roads, footpaths, parking lots, etc.;

(3) Promote design and quality improvements of local handicrafts in tourist resorts;

(4) Develop information systems and public relations for tourism, both domestically and overseas; and

(5) Important projects under this work plan are: a project to develop tourism by supporting improvements of public utilities at scenic tourist attractions and of small tourist facilities in the regions; a project to promote marketing and public relations for tourism; and a project to develop and improve souvenirs of important tourist resorts.

5) Rural Development

In order to ensure that the policy on rural development will contribute to overall national development by expanding the economy, developing society, improving the quality of life of the people and distributing wealth and prosperity to the rural areas, the following objectives, targets, and operational guidelines are established for rural development during the Sixth Plan period.

Objectives of rural development are:

(1) to improve the quality of life for socially and economically deprived rural people;

(2) to promote self-reliance; and

(3) to increase adaptability to economic and environmental conditions.

Target areas are classified into three groups depending on the problems of:

(1) inconvenient communications;
(2) insecure land tenure;
(3) low production or incomes;
(4) poor health, shortage of water for domestic consumption; and
(5) lack of knowledge concerning methods of self-improvement.

Backward areas in need of immediate development are defined as areas in which most of the people are economically deprived and which face four or five of the above problems.

Middle-level areas, the second priority in development, are areas in which most people are economically deprived and which are afflicted by one to three of the above problems.

Progressive areas are those in which most of the people have high production potential; such areas enjoy reasonably favorable economic conditions and suffer from few of the above problems.

Table 3.2.2 shows regional distribution of these areas. Though the Southern Region has the smallest number of villages of the four regions, the percentage composition of the Backward areas is the highest of the four regions, accounting for 16.2 percent, and that of the Progressive areas is the lowest, accounting for 7.1 percent. This will imply that the rural development is very urgent in the Southern Region.

Table 3.2.2 Villages for Rural Development

unit: number of villages

Region	Backward	%	Middle-level	%	Progressive	%	Total	%
North	1,065	9.8	6,672	61.7	3,079	28.5	10,816	100
Northeast	2,684	11.9	17,990	79.9	1,845	8.2	22,519	100
Central	954	7.4	5,731	44.4	6,221	48.2	12,906	100
Southern	1,084	16.2	5,121	76.7	476	7.1	6,681	100
Total	5,787	10.9	35,514	67.1	11,621	22.0	52,922	100

Source: The Sixth Plan

Operational guidelines are as follows:

(1) Accord priority to improving and maintaining existing rural highways, especially where there is an urgent need. New construction will be limited to missing links that are necessary to connect the network to national and provincial highways under the responsibility of the Department of Highways (DOH);

(2) Place special emphasis on the construction, improvement and maintenance of rural highways that directly support local and regional economic activities such as development of tourism and rural industry, transport of products to markets and exports. Routing priorities will be selected with due regard to the other development activities;

(3) Prioritize backward areas that have communication problems, especially in areas where there is an urgent need and border areas where there are security problems. Construction and maintenance should aim at ensuring the availability of all-weather roads;

(4) Encourage people's participation in building roads that link villages with fields and thus facilitate work activities and the transport of produce. This would develop the sense of ownership and the desire to keep the roads in good repair;

(5) Avoid duplication of efforts and unconnected roads by basing the selection of routes for construction on the areas of responsibility of each agency involved in road construction and maintenance. There are 57 provinces under the Office of Accelerated Rural Development, 35 provinces under the Public Works Department and the border areas come under the National Security Command Headquarters; and

(6) Establish working groups under the supervision of the Planning and Project Subcommittee to study guidelines for developing rural highways and ensure that they conform to rural development policies.

6) Southern Border Provinces

In the five (5) southern border provinces, development work will continue from the Fifth Plan, focusing on improvements in development administration that will increase efficiency in solving problems. The following measures are specified:

(1) Emphasize economic and social development in order to alleviate social and psychological conditions. The four major target groups are: poor fishermen in the coastal areas; poor farmers; small scale planters of local rubber trees; and youth and women;

(2) Review or implement at the policy level the following two issues that concern the administration of development for solving security problems in the southern border provinces: ensuring implementation according to the master plan for development designed by the Administrative Center for Southern Border Provinces; and reviewing the roles and responsibilities of the committees in charge of determining policy and development guidelines in order to solve the problems in the areas so that unity will be created to enable implementing agencies to have sufficient capability to achieve policy goals; and

(3) Develop areas under the influence of Malay communists by establishing community systems and providing the necessary basic economic and social services.

7) The Southern Seaboard Development Program (SSDP)

The Government announced the launching of a new development program in the Southern Seaboard in November 1989 to promote the development of peninsular Thailand, which program is allocated to the provinces surrounding and adjacent to Krabi on the Andaman Sea and Khanom in the Gulf of Thailand.

The SSDP is planned to be composed of the following major projects:

(1) A "Land Bridge" connecting Krabi on the west coast and Khanom on the east coast across a distance of about 180 kilometers which will include:

a) a high speed road;

b) a double-track railway with container handling and transshipment facilities; and

c) a pipeline system for overland transmission of crude oil, natural gas, petrochemical products and water supplies.

(2) A regional oil and petroleum products distribution center, storage facilities and oil refinery are planned to catalyze development activity by channeling crude oil between Middle Eastern and Far Eastern ports through the "Land Bridge";

(3) An offshore submarine gas pipeline will be constructed from the gas fields in the "B" structure to the Khanom oil terminal to provide the necessary energy for developing petrochemical and other gas-related industries;

(4) The following infrastructure will be constructed at the Krabi terminal and the Khanom terminal:

a) offshore sea berths and single mooring facilities with onshore tanks, an underwater pipeline and pumping stations for both crude oil and petroleum products;

b) two deep sea ports to accommodate international container ships together with modern transshipment and packaging facilities;

c) industrial estates for oil refineries, oil and gas-related industries, tank farms and agro-industries;

d) necessary urban centers at the two terminals with the usual urban services and social infrastructure;

e) transportation linkages with the existing road and rail networks, as well as connections with the existing telecommunication network; and

f) power and water supplies, telecommunications and coastal shipping facilities.

(5) a 200 meter width of land along the 180 kilometers length of the "Land Bridge" will be acquired by the Department of Highways (DOH) on behalf of the Government for implementing the program. Similarly, all necessary land for the long-term development of Krabi and Khanom will also be acquired for the orderly implementation of the program.

3.2.3 Transport Development Plans

1) Development Guidelines in the Sixth Plan

The policy of the Fifth Plan was to slow down the construction of main roads and emphasize the construction of feeder roads to connect production and community areas in principal towns. Road conditions, however, are generally poor, inadequately maintained and repairs are delayed due to budgetary limitations. Road maintenance and repair are very important because if roads continue to be neglected, large investments will be needed to rebuild them.

A good transport system is needed to meet the increased demand from exports, tourism and specific area development. The transport system should be improved in terms of quantity, standards, convenience and quality in order to satisfy the needs for economic development that emphasizes activities earning foreign exchange, improved national capabilities in competing with other countries and development of integrated industries in specific areas. The system should support the business sector directly and indirectly, both now and in the future.

The expansion of some aspects of transport services has not been able to keep pace with economic growth. In particular, tourism, export and urban expansion have not been adequately supported.

Based on the above recognition, the Sixth Plan stipulates development guidelines for transport as follows:

(1) Implement the transport restructuring policy by emphasizing water and rail transport. Major projects started during the Fifth Plan period will be completed including deep-sea ports at Songkhla and Phuket;

(2) Make full use of existing facilities. Emphasis will be placed on maintenance, improving standards and filling in the missing links in the networks;

(3) Enhance the capabilities of national transport services so that they are more flexible and faster and thus contribute to other developments, particularly exports, tourism and development of the Eastern Seaboard;

(4) Set fees to enable services to become self-reliant and reduce government subsidies. The collection of road tolls will be increased; and

(5) Encourage the private sector to play a greater role in investing in, operating and improving the service quality of basic transport activities in order to satisfy the growing demand, lessen the burden on the government and create a unified approach to development.

2) Transport Development Plans in the Southern Region

(1) Ports

In the Southern Region, there are no port development plans after the completion of Phuket and Songkhla deep sea ports.

(2) Airports

A new airport of Nakhon Si Thammarat is scheduled to be constructed during the period 1991 - 1993 due to the fact that the existing airport is located too close to the local community to expand the existing runway. The new airport is to be located at 4 - 5 kilometer south of the crossing of Route No. 408 and 4013 with a runway 30 meters wide and 1,500 meters long.

New airports at Chumphon and Ranong are scheduled to be constructed in 1991 - 1992 based on the existing air fields. Chumphon airport will be equipped with runway 30 meters wide and 1,200 meters long and Ranong airport 30 meters wide and 1,500 meters long.

(3) Railway

There is no railway construction plan in the Southern Region. Instead of expanding the network, it is very likely that train operation on some spur lines will be suspended to curtail the operation losses on these lines. Train operation on the spur from Hat Yai to Songkhla has been suspended for some years.

An "Orient Express" train which is owned by the private sector will be introduced on the Southern Railway Line between Bangkok and Singapore via Penang and Kuala Lumpur by the end of June 1991. This is a part of the privatization scheme to utilize the existing railway systems.

It is proposed by the SSDP that a new railway line connecting two deep sea ports at Krabi on the west coast and Khanom on the east coast be introduced as a part of the "Land Bridge". The railway is planned to be of double-track with standard gauge to facilitate container transport.

3) The Sixth Highway Development Plan

The target of the Sixth Highway Development Plan is as shown in Table 3.2.3. Total number of projects amounts to 421 projects with an estimated cost of 35.8 billion baht for the whole country. The Southern Region has 69 projects with an estimated cost of 5.2 billion baht (14.5 % of the total cost).

The Sixth Highway Development Plan puts an emphasis on:

(1) maintenance and rehabilitation of the existing highways;
(2) upgrading of highway standard to meet traffic volume, especially on main national highways;
(3) enhancement of efficiency of land transport;
(4) improvement of accessibility and bypass construction to alleviate traffic congestion in city areas;
(5) improvement of traffic flow at important intersections; and
(6) reduction of traffic accidents.

Highway projects are classified into the following six groups:

(1) New Road Construction;
(2) Improvement of Congested Road;
    - Additional Lane Construction
(3) Rehabilitation and Reconstruction Project;
    - Rehabilitation Project (Overlay)
    - Widening of Carriageway
    - Realignment
(4) Upgrading to Bitumen Standard;
(5) Interchange and Bridge Construction; and
(6) Other Works
    - Traffic Safety

Table 3.2.3 THE TARGET OF THE SIXTH PLAN FOR HIGHWAYS

Classification				Southern Region		
	No.of Project	Length (km)	Cost (M.Baht)	No.of Project	Length (km)	Cost (M.Baht)
Additional Lane Construction	33	684.8	14,877.6	8	148.6	1,096.0
Rehabilitation	177	3,195.8	8,346.4	29	542.9	1,389.2
New Road Construction	33	427.6	4,091.4	4	47.8	290.2
Interchange and Long-Span Bridge	12	13.5	989.1	1	0.1	29.0
Highway Traffic Safety	166	3,650.1	7,522.1	27	559.6	1,073.2
Total	421	7,971.9	35,826.6	69	1,299.0	5,177.2

Source : DOH

3.3 Planning Framework

3.3.1 National Planning Framework

Gross Domestic Product (GDP) of the country was estimated based on the World Bank's long term projection by the year 2001. The GDP in 2006 was estimated by applying a growth rate during the period of 1997 - 2001. The GDP of the country is estimated as shown Table 3.3.1 to grow from 1,449 billion baht in 1988 to 2,480 billion baht in 1996, 3,342 billion baht in 2001, and 4,504 billion baht in 2006 at an average annual growth rate of 6.5 %.

Population growth rate of the country is planned to be reduced to 1.3 % in 1991 according to the Sixth National Plan. This target, however, seems to be too low if compared with the actual growth rate of about 2.0 % during the period 1980 - 1988. It was assumed in this study that population growth rate will be reduced to 1.7 % in 1991 and to 1.3 % in 1996. As a result, population of the country is estimated as shown in Table 3.3.1 to grow from 55.0 million persons in 1988 to 62.3 million persons in 1966, 66.5 million persons in 2001, and 70.9 million persons in 2006 at an average annual growth rate of 1.42 %.

Per capita GDP, therefore, is expected to grow from a level of US$1,000 in 1988 to a level of US$2,000 in 2001, and a level of US$2,500 in 2006.

Table 3.3.1 National Economic Framework

	GDP (billion)	Population (thousand)	Per Capita GDP (baht)	(US$)
1988	1,449	54,961	26,364	1,042
1991	1,823	57,971	31,447	1,243
1996	2,480	62,303	39,805	1,574
2001	3,342	66,459	50,287	1,988
2006	4,504	70,893	63,532	2,512

Source: Study Team
Note: The SSDP is not included in the National Economic Framework because the framework has not been fixed by the government.

Sectoral composition of GDP was estimated also based on the World Bank's long term perspective by 2001 and extrapolation to 2006. Percentage share of agriculture is assumed to be contracted from 15.5 % in 1988 to 7.8 % in 2001 while manufacturing industry is assumed to gain the percentage share of 7 - 8 % which agriculture sector will lose. Service sector is expected to remain constant at a percentage share of about 50 %. The projection results are shown in Table 3.3.2.

Table 3.3.2 Sectoral Composition of GDP

	1988	1991	1996	2001	2006
(in billion baht)					
Agriculture	225	253	288	317	351
Industry	510	666	960	1,364	1,928
Services	714	904	1,232	1,661	2,225
Total	1,449	1,823	2,480	3,342	4,504
(in %)					
Agriculture	15.5	13.9	11.6	9.5	7.8
Industry	35.2	36.5	38.7	40.8	42.8
Services	49.3	49.6	49.7	49.7	49.4
Total	100.0	100.0	100.0	100.0	100.0

Source: Study Team

3.3.2 Planning Framework of the Southern Region

The Southern Region achieved the highest GRP share of 11.5 % of the country in 1980. The share has been declining to around 10 % in recent years. It is assumed in this study that the share will be restored to 11 % in 2001 and the past highest share of 11.5 % in 2011 through introducing various development programs such as:

- Urban and Special Area Development;
- New Economic Area Development;
- Tourism Development; and
- Development of the Southern Border Provinces.

Based on these assumptions, GRP of the Southern Region was estimated as shown in Table 3.3.3 to grow from 144.47 billion baht in 1988 to 262.63 billion baht in 1996, 367.62 billion baht in 2001, and 506.70 billion baht in 2006 at an average annual growth rate of 7.2 %, 0.7 % higher than the estimated national growth rate.

Table 3.3.3 GRP of the Southern Region

	GDP billion	GRP of the Southern Region share(%)	billion	rate(%pa)
1988	1,449	9.97	144.47	
1991	1,823	10.20	185.95	8.8
1996	2,480	10.59	262.63	7.1
2001	3,342	11.00	367.62	7.0
2006	4,504	11.25	506.70	6.6
2011		11.50		
		Average GRP Growth Rate		7.2%

Source: Study Team

Sectoral GRP share of the Southern Region in 1988 was 34 % for agriculture, 15 % for manufacturing industry, and 51 % for service sector. Taking account of the importance of agriculture and tourism in the Southern Region, it was assumed that the sectoral share of the region in 2006 will be 25 % for agriculture, 20 % for manufacturing industry, and 55 % for service sector. Table 3.3.4 shows the estimated sectoral GRP of the Southern Region. Manufacturing industry is expected to attain the highest growth rate of 8.9 % during the period 1988 - 2006.

Table 3.3.4 Sectoral GRP Composition of the Southern Region

unit: billion baht

	GRP	Agriculture	%	Industry	%	Services	%
1988	144.47	49.73	(34.3)	21.93	(15.2)	72.81	(50.5)
1991	185.95	63.78	(34.3)	28.26	(15.2)	93.91	(50.5)
1996	262.63	81.49	(31.0)	43.97	(16.8)	137.17	(52.2)
2001	367.62	102.64	(27.9)	67.44	(18.4)	197.54	(53.7)
2006	506.70	126.67	(25.0)	101.34	(20.0)	278.69	(55.0)

Source: Study Team

Population growth rate of the Southern Region was higher than the national average in the past. During the period 1980 - 1988, the region attained an average annual growth rate of 2.07 %. Population growth rate of the region will be higher than the national average for the future because of its high dependence on agriculture and less out-migration to the BMR in comparison with the other regions.

It is assumed of the Southern Region that the annual growth rate of 1.7 % which would be the national average in 1991 will be attained in 2001, ten years later than the national average. Based on these assumptions, population of the Southern Region is expected to increase from 6.9 million persons in 1988 to 8.0 million persons in 1996, 8.7 million persons in 2001, and 9.5 million persons in 2006 as shown in Table 3.3.5.

Per capita GRP of the Southern Region was calculated at 21,057 baht in 1988 which was equal to about 80 % of the national average. The per capita GRP gap between the national average and the Southern Region is expected to continue to the future with gradual reduction: 82.5 % in 1996; 83.8 % in 2001; and 84.3 % in 2006.

Table 3.3.5 Per capita GRP of the Southern Region

	GRP billion	Population thousand	Per capita GRP South	National	Gap (%)
1988	144.47	6,861	21,057	26,364	79.9
1991	185.95	7,283	25,532	31,447	81.2
1996	262.63	7,998	32,837	39,805	82.5
2001	367.62	8,724	42,139	50,287	83.8
2006	506.70	9,456	53,585	63,532	84.3
		Average Growth Rate			5.3 %pa

Source: Study Team

3.3.3 Planning Framework of the Provinces

Population of the provinces in the Southern Region was estimated through the following procedures:

(1) estimate future population of the provinces based on the growth rates achieved during the period 1980 - 1988;

(2) raise the population growth rates of the provinces with designated urban centers to the average population growth rate if their estimated growth rates in (1) above are lower than the average; and

(3) control the thus calculated population of the region to the population framework established in 3.3.2.

Table 3.3.6 shows the estimated population framework of the provinces in the Southern Region. Three provinces of Nakhon Si Thammarat, Songkhla and Surat Thani are estimated to have population of more than one million in 2006.

Table 3.3.6 POPULATION FRAMEWORK OF THE PROVINCES

unit: thousand persons

	1988	1991	1996	2001	2006
1. Krabi	281	307	354	406	461
2. Chumphon	383	404	438	470	502
3. Trang	503	533	583	633	681
4. Nakhon Si.	1,396	1,444	1,520	1,588	1,645
5. Narathiwat	537	576	643	712	784
6. Pattani	518	549	600	652	702
7. Phangnga	206	218	238	259	278
8. Phatthalung	449	462	481	497	511
9. Phuket	155	164	180	195	210
10. Yala	339	366	413	462	514
11. Ranong	108	119	137	156	178
12. Songkhla	1,060	1,148	1,301	1,465	1,637
13. Satun	212	230	264	298	336
14. Surat Thani	714	763	846	931	1,017
Total	6,861	7,283	7,998	8,724	9,456

Source: Study Team

In the Southern Region, there has been a close correlation between the provincial shares of population and gross provincial product (GPP). GPP framework of the provinces was estimated based on this relationship and estimated population share in the future as shown in Table 3.3.7.

Table 3.3.7 GPP FRAMEWORK OF THE PROVINCES

unit: million baht

	1988	1991	1996	2001	2006
1. Krabi	7,079	9,112	12,081	17,646	24,828
2. Chumphon	9,535	12,273	15,758	22,057	30,402
3. Trang	9,824	12,645	18,647	25,733	34,962
4. Nakhon Si.	19,792	25,475	36,243	51,099	70,938
5. Narathiwat	9,246	11,901	18,909	26,836	35,976
6. Pattani	7,224	9,297	16,546	22,057	30,402
7. Phangnga	7,946	10,227	11,293	15,440	21,281
8. Phatthalung	6,357	8,182	13,657	18,749	23,815
9. Phuket	6,501	8,368	12,081	17,278	24,322
10. Yala	7,223	9,297	13,394	18,749	25,842
11. Ranong	4,768	6,136	6,566	9,558	13,174
12. Songkhla	25,716	33,099	45,435	63,598	88,673
13. Satun	5,345	6,880	9,192	12,499	17,734
14. Surat Thani	17,914	23,058	32,828	46,321	64,351
Total	144,470	185,950	262,630	367,620	506,700

Source: Study Team

3.4 Future Transport Demand

3.4.1 Present Transport Demand

1) General

(1) Traffic Zones

The Southern Region was divided into sixty-eight (68) traffic zones to analyze and forecast transportation demand. Principles for zoning are that:

a) Amphoe is a minimum unit for traffic zones. A traffic zone consists of a single amphoe or plural amphoes;

b) A traffic zone does not extend over any changwat boundary;

c) A zone centroid coincides with an amphoe center of the largest population in a zone;

d) Maximum size of a traffic zones should be less than 50 kilometers in length along the existing highways; and

e) Traffic zoning along the Krabi - Khanom Highway Link should principally be based on a single amphoe.

The areas outside the study area were divided into seven (7) traffic zones including BMR, Western region, Central region, Eastern region, Northeastern region, Northern region and Malaysia. Total number of traffic zones in this study amounted to seventy-five (75) which are shown in Fig. 3.4.1.

(2) Road Network

A road network in 1990 denoted by nodes and links for computer processing was established based on the highway map and district map prepared by DOH. Data and information stored in the road data base system of DOH were fully made use of for identifying the specifications of traffic links. In order to supplement and update some link information, a series of field reconnaissance were carried out by the study team.

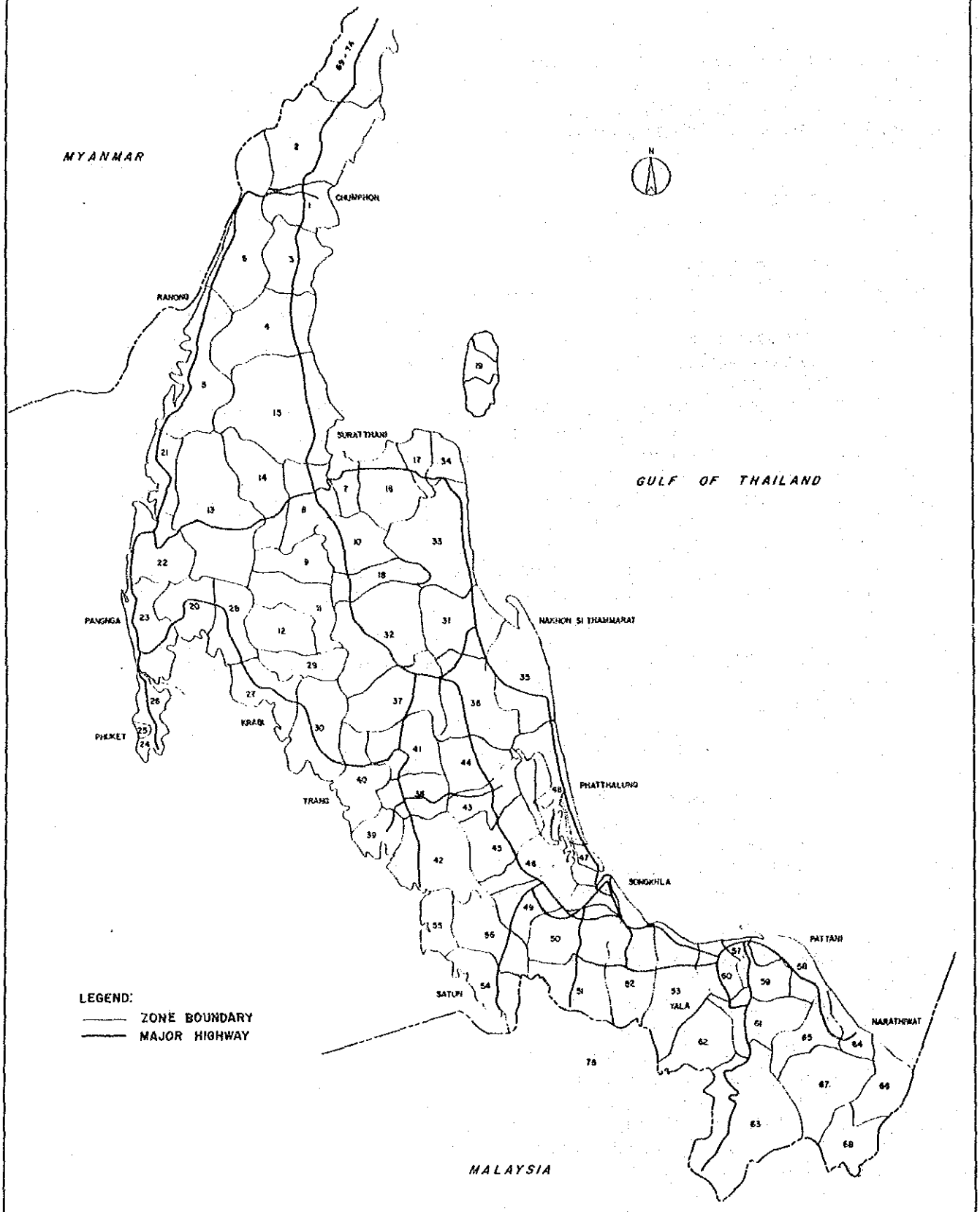

Fig. 3.4.1 TRAFFIC ZONES

In preparing the road network, a device was introduced to incorporate transport demand for ports, airports and railway stations. A kind of zone centroids were created to represent vehicle trip generation and attraction related to these three modes of transport.

All the national highways and most of the provincial highways were included in the road network. The road network was prepared based on the following considerations:

a) The road network should be as accurate as possible to reflect the existing highways;

b) Every traffic zone has at least one access to the road network; and

c) Other modes of transport such as ports, airports and railway station should have access to the road network.

Fig.3.4.2 shows a schematic diagram of the established road network in 1990.

(3) Vehicle Type

The Study classified the vehicle type into four (4) groups:

1. Car	Car and Pickup(Passenger)
2. Bus	Light Bus, Medium Bus and Heavy Bus
3. Truck	Pickup(Cargo), 4 wheel, 6 wheel and 10 wheel Truck
4. Motorcycle	

2) OD Tables in 1990

The OD tables by vehicle type in 1990 were estimated based on: (1) inter-changwat OD survey results (from March to May 1990) by the Toll Highways Development Study; (2) intra-changwat OD survey results (in August 1990) by this Study: and a most likelihood method. The estimated OD tables in 1990 are shown in Appendix A.3.4.7.

Total daily number of person trips was estimated at 601 thousand trips in 1990 by converting the number of vehicles into the number of passengers based on the loading factors by vehicle type. Cargo transport demand in 1990 was estimated at 129 thousand tons as well by converting the number of vehicles into the tonnage based on the loading factors. The loading factors are shown in Appendix A.3.4.8.

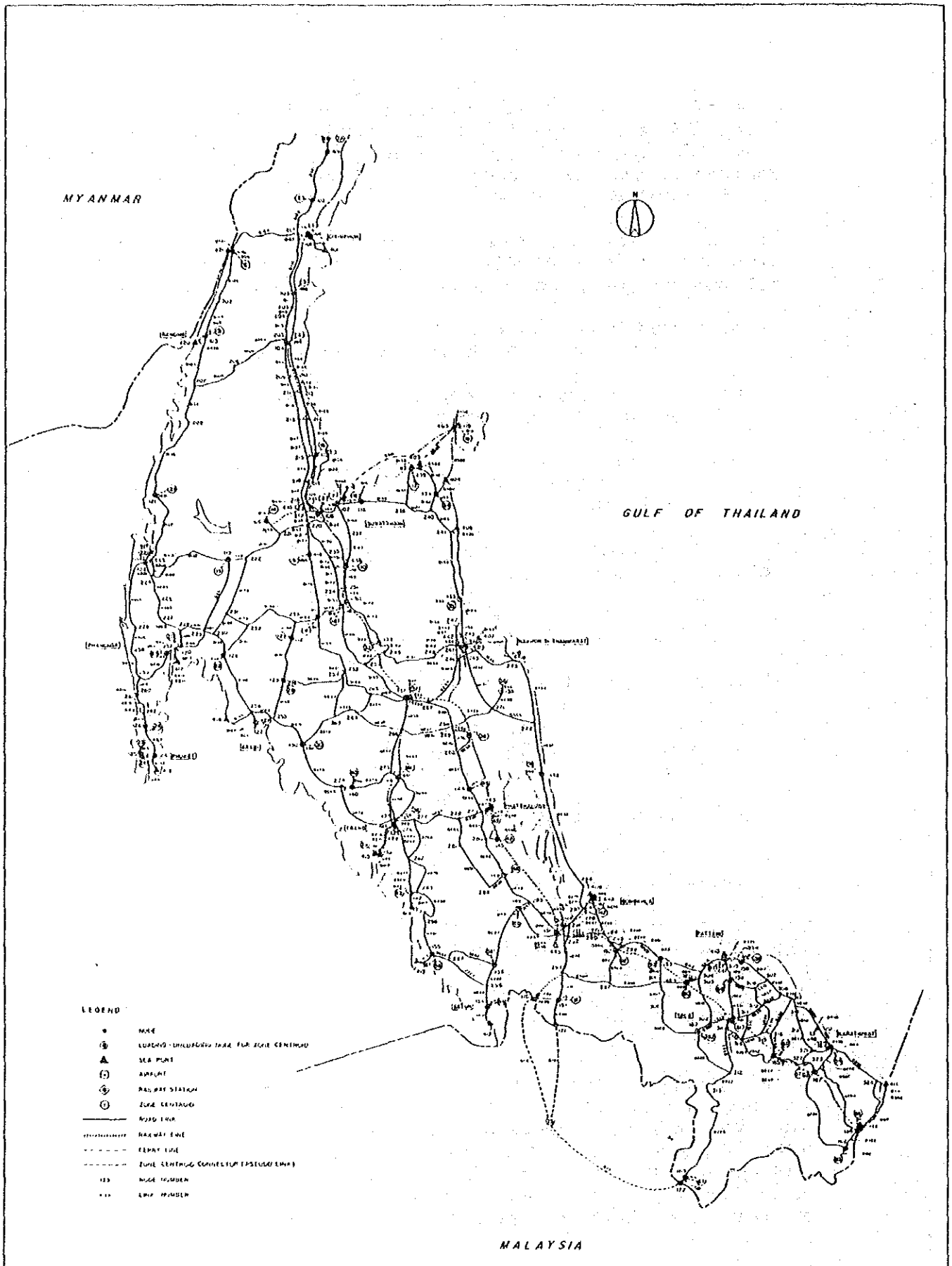

Fig. 3.4.2 PRESENT ROAD NETWORK

Fig. 3.4.3 and 3.4.4 outline the estimated generation and attraction of person and cargo trips by traffic zones in 1990 respectively. Hat Yai, Songkhla, Satun, Kathu, Nakhon Si Thammarat and Phuket zones have large generation and attraction of person trip. Hat Yai, Chana, Songkhla, Surat Thani and Phuket zones have large generation and attraction of cargo flow.

Fig. 3.4.5 and 3.4.6 show traffic flow between Changwats in 1990 for passenger and cargo, respectively. Pattani - Yala has the largest number of person trips of 26,000 , followed by Surat Thani - Nakhon Si Thammarat of 23,000, and Phuket - Phangnga of 21,000. As for cargo transport, Chumphon - the outside of the study area has the largest cargo flow of 5,600 tons, followed by Phuket - Phangnga of 5,600 tons, Songkhla - Nakhon Si Thammarat of 5,000 tons, Surat Thani - Nakhon Si Thammarat of 3,900 tons, Trang - Nakhon Si Thammarat of 3,400 tons, and Phatthalung - Nakhon Si Thammarat of 3,200 tons.

3) Assigned Traffic Volume on the Highway Network in 1990

The traffic assignment model used in this study was a model of capacity constraint type with QV formulas which are attached in Appendix A.3.4.9. Traffic assignment was repeated five times with one-fifth of vehicle OD traffics every time. In every assignment, minimum path routes between zone pairs were searched based on the travel speed which was calculated by assigned traffic volume and a QV formula specified for each link.

Passenger Car Units (PCU) which convert traffic volume by vehicle type into an equivalent passenger car traffic were assumed as follows by reflecting the existing composition of light, medium and large sizes of buses and trucks:

Car	:	1.000
Bus	:	1.579
Truck	:	1.628
Motorcycle	:	0.300

The estimated traffic volume were compared with the results of traffic counting survey to examine the plausibility of the various assumptions applied in this study including link data of highway network, QV formulas, and vehicle OD tables. Table 3.4.1 compares the simulated traffic volume with the results of the traffic count survey at the locations indicated in Fig. 3.4.7. The correlation coefficient between the simulated and the observed traffic volume was 0.9770 on an average. It is judged based on the verification that the simulated results are quite satisfactory.

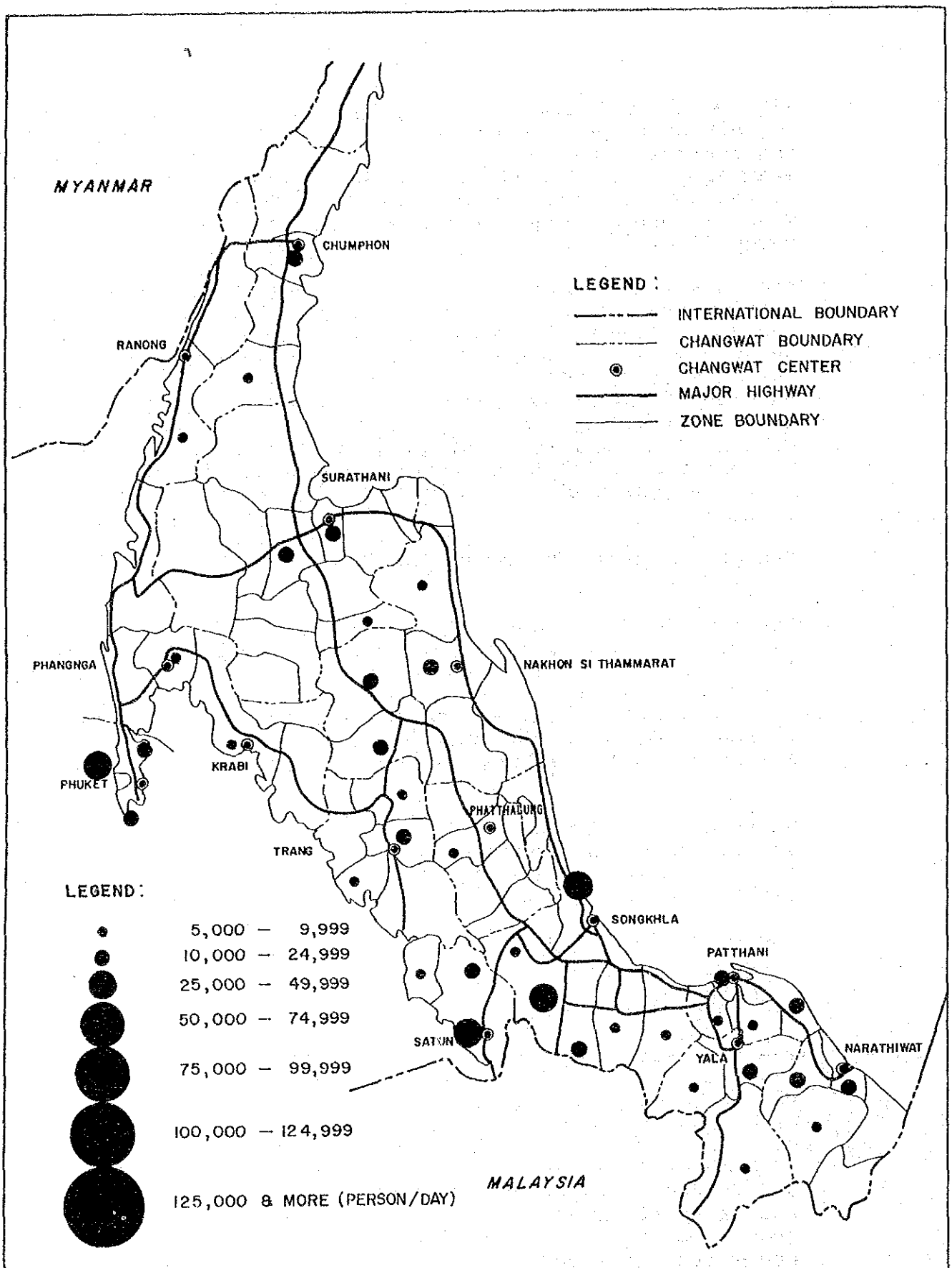

Fig. 3.4.3 TRIP GENERATION & ATTRACTION OF PERSON (1990)

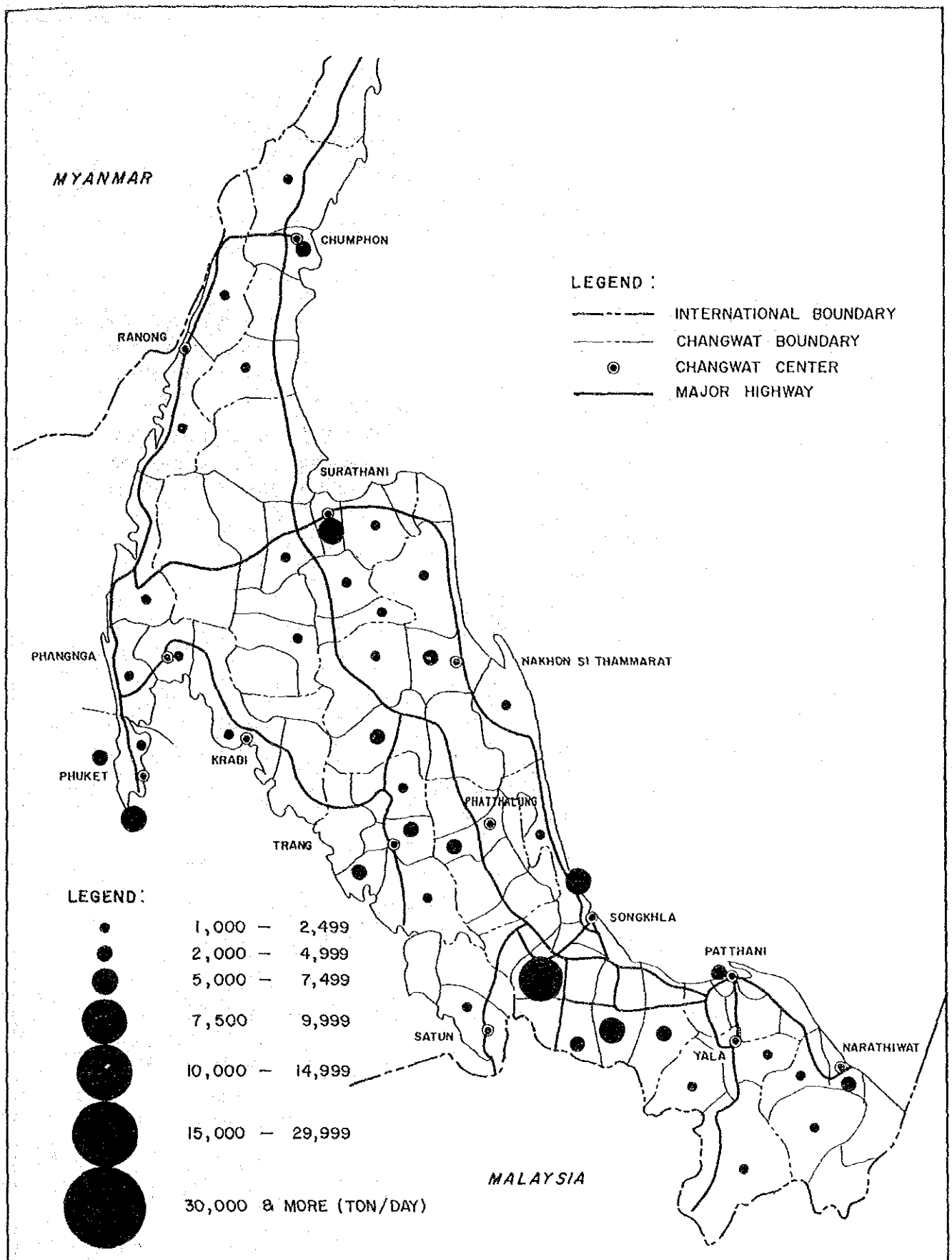

Fig. 3.4.4 TRIP GENERATION & ATTRACTION OF FREIGHT (1990)

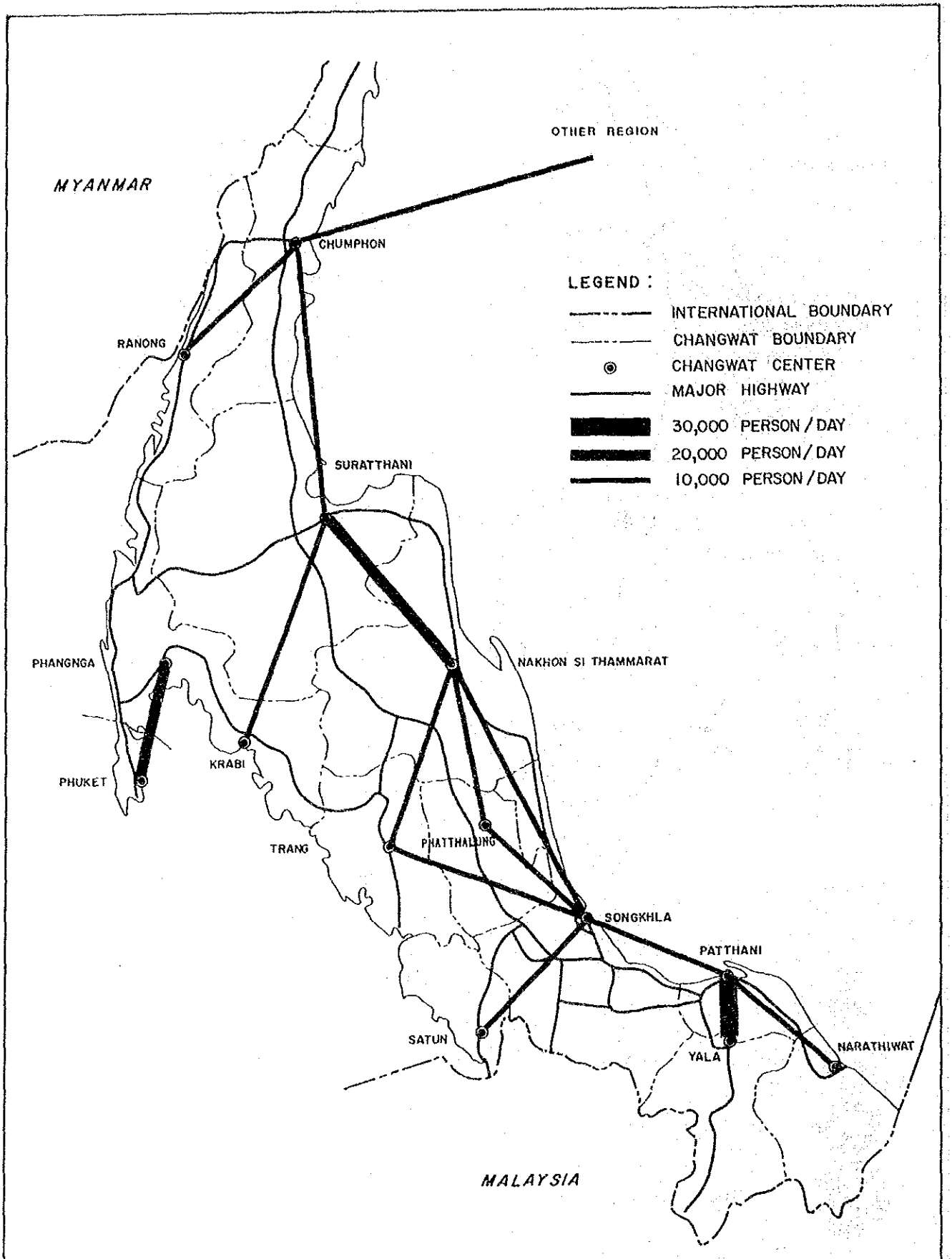

Fig. 3.4.5 PASSENGER FLOW IN THE SOUTHERN REGION (1990)

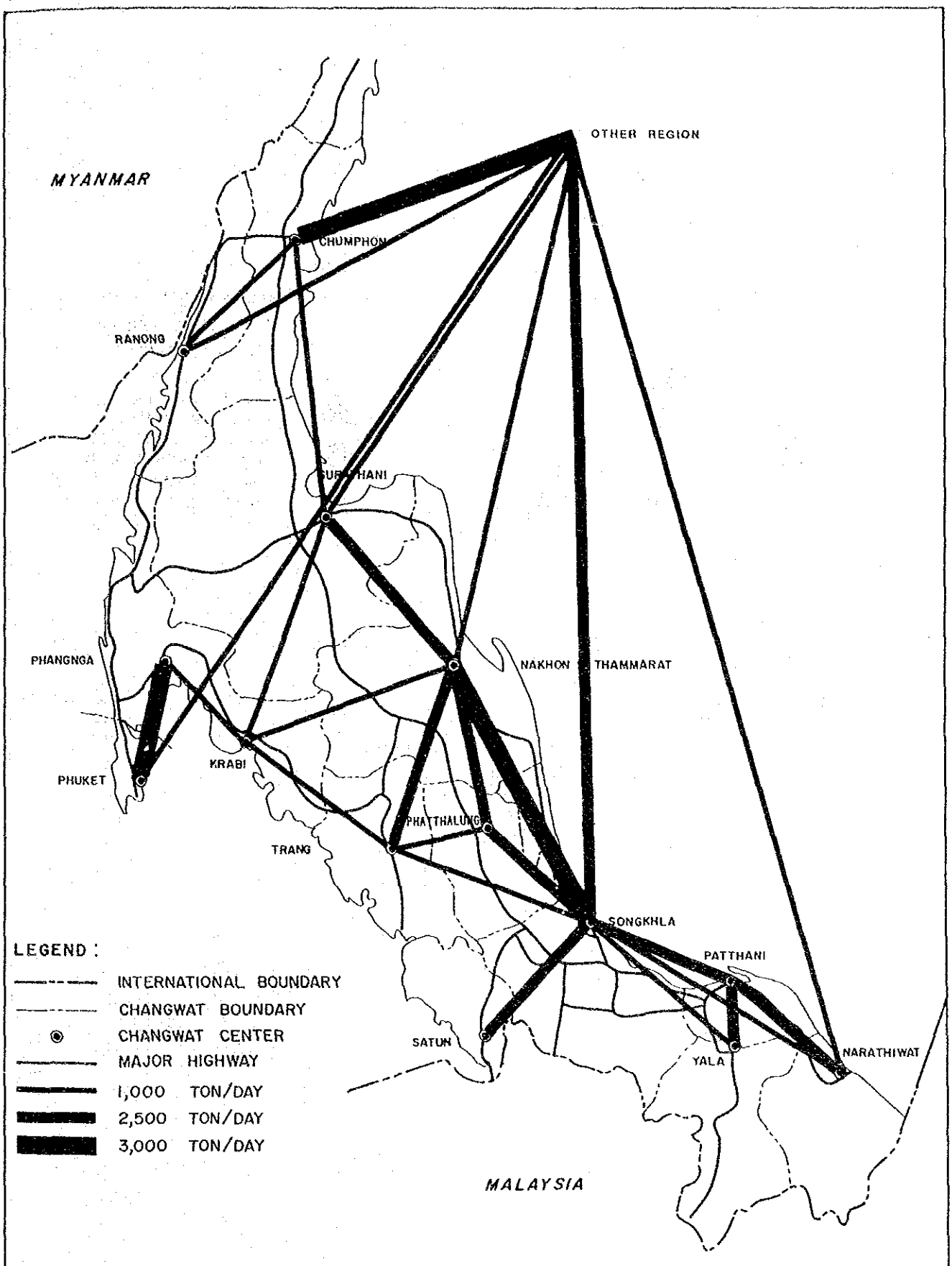

Fig. 3.4.6 CARGO FLOW IN THE SOUTHERN REGION (1990)

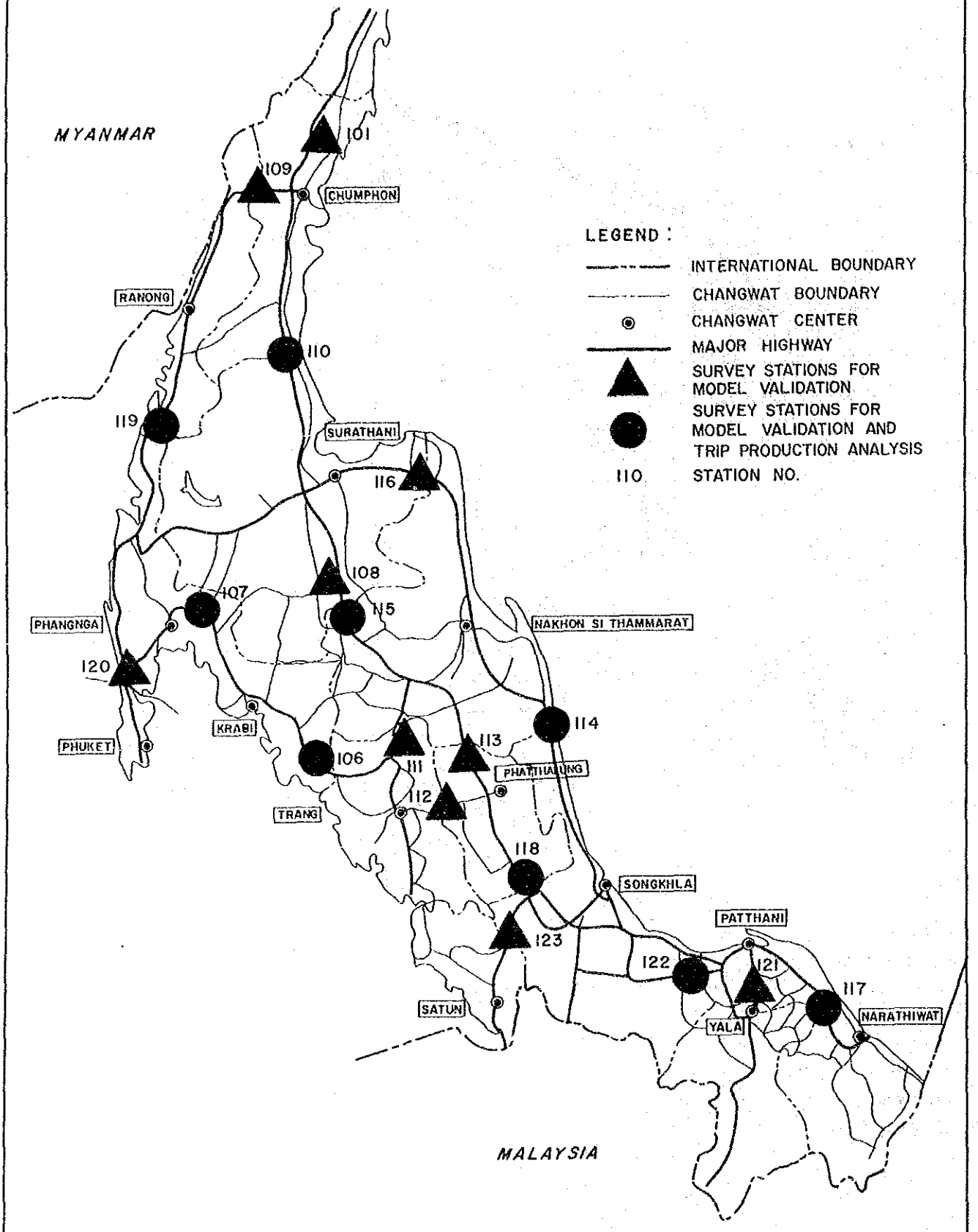

Fig. 3.4.7 TRAFFIC COUNT SURVEY STATIONS FOR MODEL VALIDATION AND TRIP PRODUCTION ANALYSIS

Table 3.4.1 COMPARISON BETWEEN COUNTED AND SIMULATED TRAFFIC VOLUMES ON CHANGWAT BOUNDARY, 1990

Sta. 1/	Link No.	From Node	To Node	Car		Bus		Truck		Motorcycle 2/		Total (pcu)		Diff. (%)
				Counted	Simulated	Counted	Simulated	Counted	Simulated	Counted	Simulated	Counted	Simulated	
101	101	102	169	1,675	1,850	624	799	3,321	3,258	-	- 3/	8,067	8,416	4.33
106	275	130	274	1,052	1,114	245	153	651	473	900	936	2,769	2,406	-13.08
107	197	229	230	928	1,009	193	213	709	581	-	-	2,387	2,291	-4.00
108	175	111	118	556	447	124	231	737	785	1,724	1,480	2,469	2,534	2.62
109	104	106	201	733	781	269	232	860	775	1,314	1,314	2,952	2,803	-5.05
110	115	209	211	1,942	1,734	435	497	2,455	2,386	1,015	1,082	6,930	6,728	-2.92
111	262	266	275	1,324	822	213	184	910	1,001	2,487	3,030	3,888	3,651	-6.09
112	267	277	278	1,180	1,404	266	244	675	469	3,903	4,000	3,870	3,753	-3.03
113	257	144	270	1,258	856	231	248	1,306	1,943	2,153	2,182	4,395	5,065	15.25
114	237	148	272	1,346	1,103	247	225	1,010	1,193	543	582	3,543	3,575	0.89
115	189	118	252	1,451	1,048	192	258	1,835	1,659	3,689	3,180	5,848	5,110	-12.62
116	151	238	240	1,316	1,311	337	256	1,239	893	-	-	3,865	3,169	-18.01
117	348	318	319	1,171	456	230	175	802	655	3,086	3,450	3,766	2,834	-24.75
118	249	146	285	2,202	2,182	481	448	1,801	1,983	1,492	1,534	6,341	6,578	3.73
119	136	121	208	369	398	151	137	380	400	1,408	1,422	1,648	1,692	2.65
120	214	260	261	1,984	1,866	498	521	1,660	1,686	-	-	5,473	5,433	-0.72
121	322	159	161	1,388	1,660	411	374	857	563	5,749	5,760	5,157	4,895	-5.07
122	312	153	304	2,169	1,354	153	162	1,533	1,734	2,351	2,140	5,612	5,075	-9.57
123	287	149	156	1,030	1,112	170	152	704	605	854	868	2,701	2,597	-3.83
		Total		25,073	22,507	5,470	5,509	23,446	23,042	32,668	32,960	81,680	78,606	-3.76

Note: 1. Numbers of station are related to the Toll Highway Study.
2. Counted motorcycle volumes were estimated from DOH counts in 1989.
3. The traffic counts of DOH are different locations from the Toll Highway Study.

Fig. 3.4.8 illustrates the results of traffic assignment for the year 1990. The section between Songkhla and Hat Yai showed the largest traffic volume of more than 10,000 PCU. The sections of estimated traffic volume between 5,000 and 10,000 PCU are:

- North-South Artery from Chumphon to Malaysian Border via Hat Yai, consisting of Route No. 4, 41, 43 and 4;
- Phuket - Kok Kloi on Route No. 402;
- Phun Phin - east of Surat Thani on Route No. 401;
- Some Sections on Route No. 43 between Hat Yai and Pattani; and
- Some Sections near Provincial Centers like Nakhon Si Thammarat, Satun and Pattani.

3.4.2 Future Transport Demand

Future transport demand on highway network in the Southern Region was forecasted through a Four Step Estimation Method with the target years of 1996, 2001 and 2006. Future transport demand on the other modes of transport such as ports, airports and railway, however, were forecasted separately with that of highways. A general procedure for the demand forecast adopted in this study is shown in Fig. 3.4.9:

1) Trip Production

Fig. 3.4.10 shows an increasing trend of traffic volume by vehicle type on highways in the Southern Region from 1983 to 1988. The traffic volume is the aggregated traffic volume of the selected nine survey stations of DOH as illustrated in Fig. 3.4.7. A series of analyses were performed to find relationships between this traffic volume and socio-economic indicators of the Region.

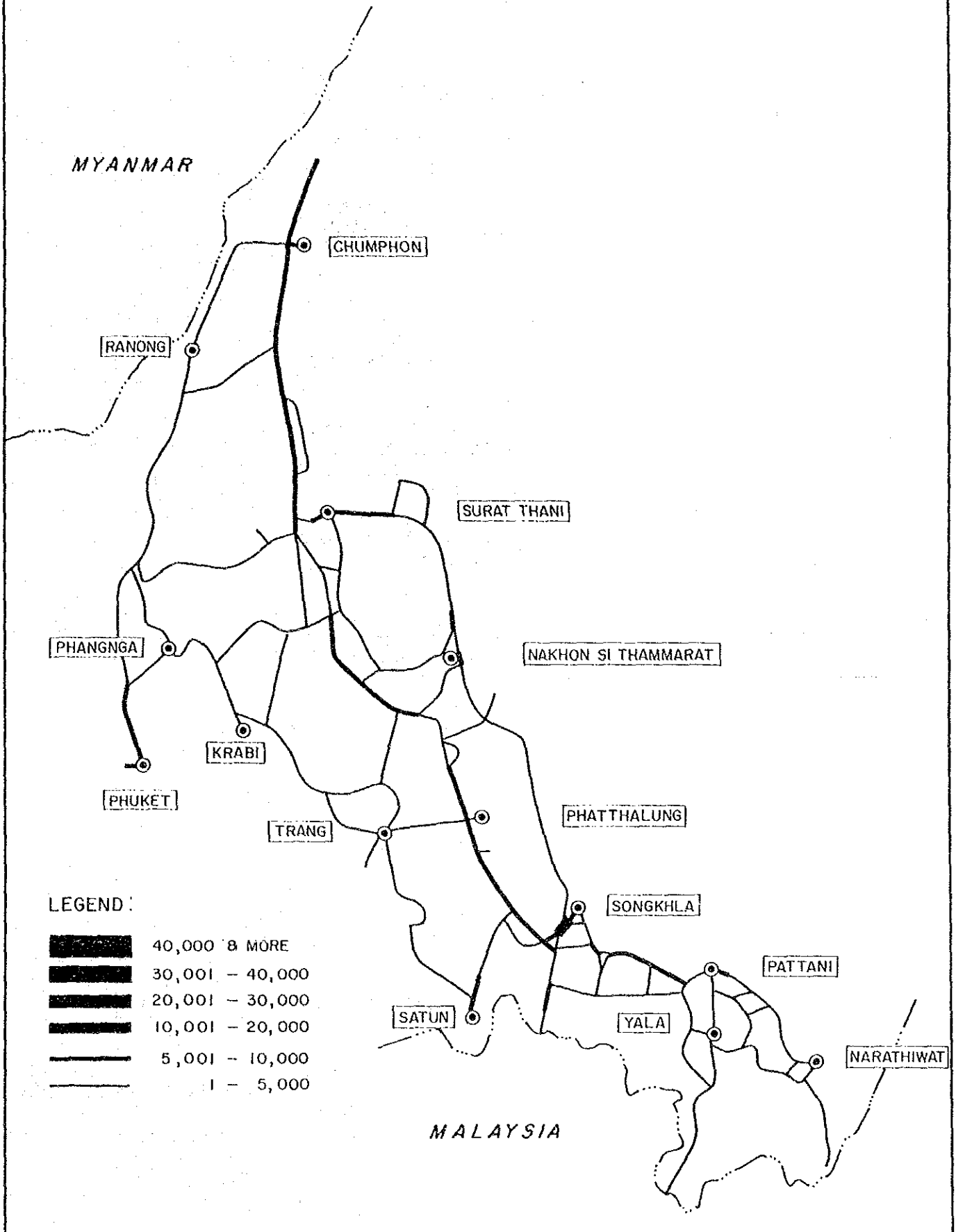

Fig. 3.4.8 TRAFFIC VOLUME IN 1990 (PCU)

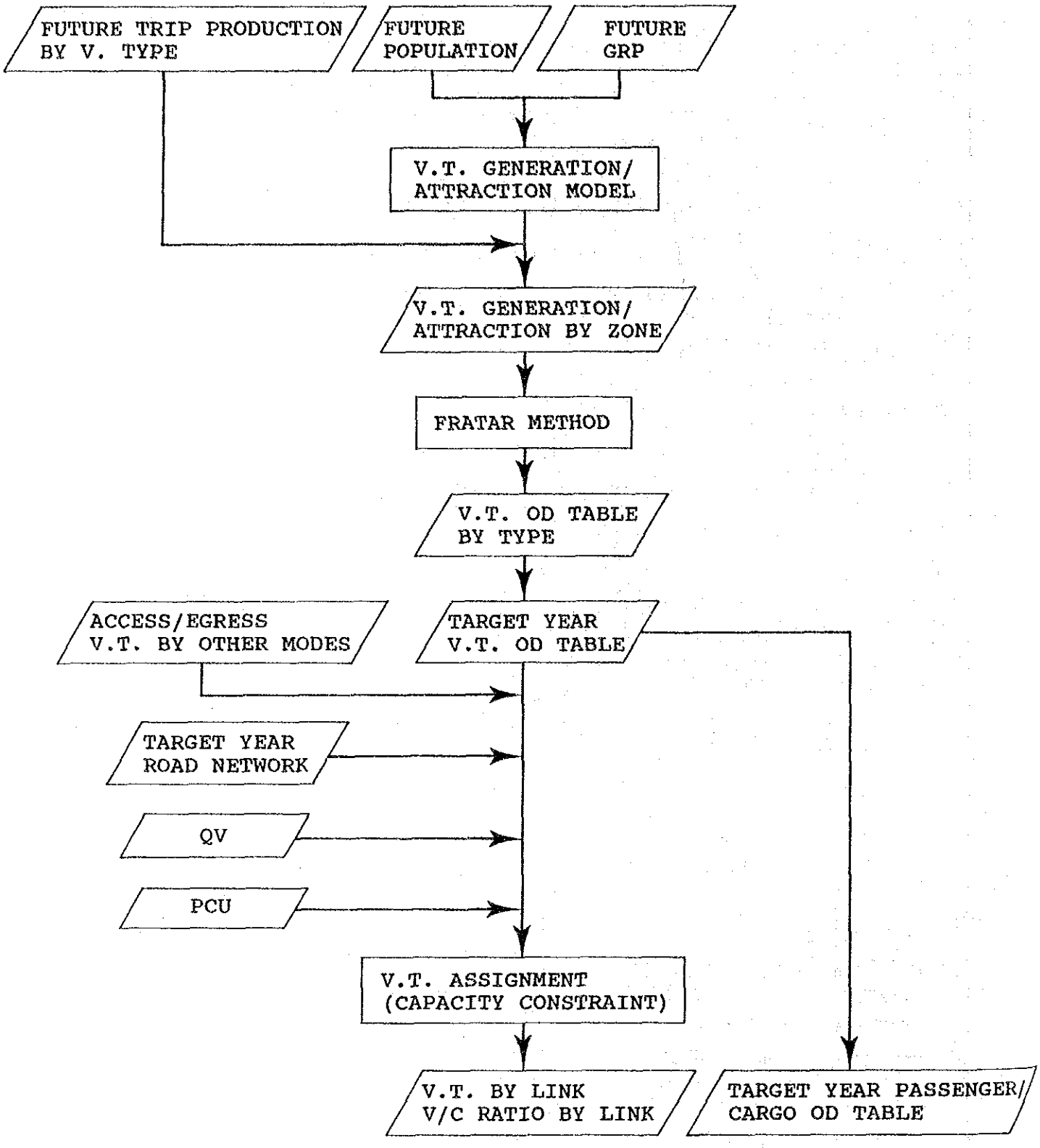

Fig. 3.4.9 TRANSPORTATION DEMAND FORECAST PROCEDURE FOR MASTER PLAN

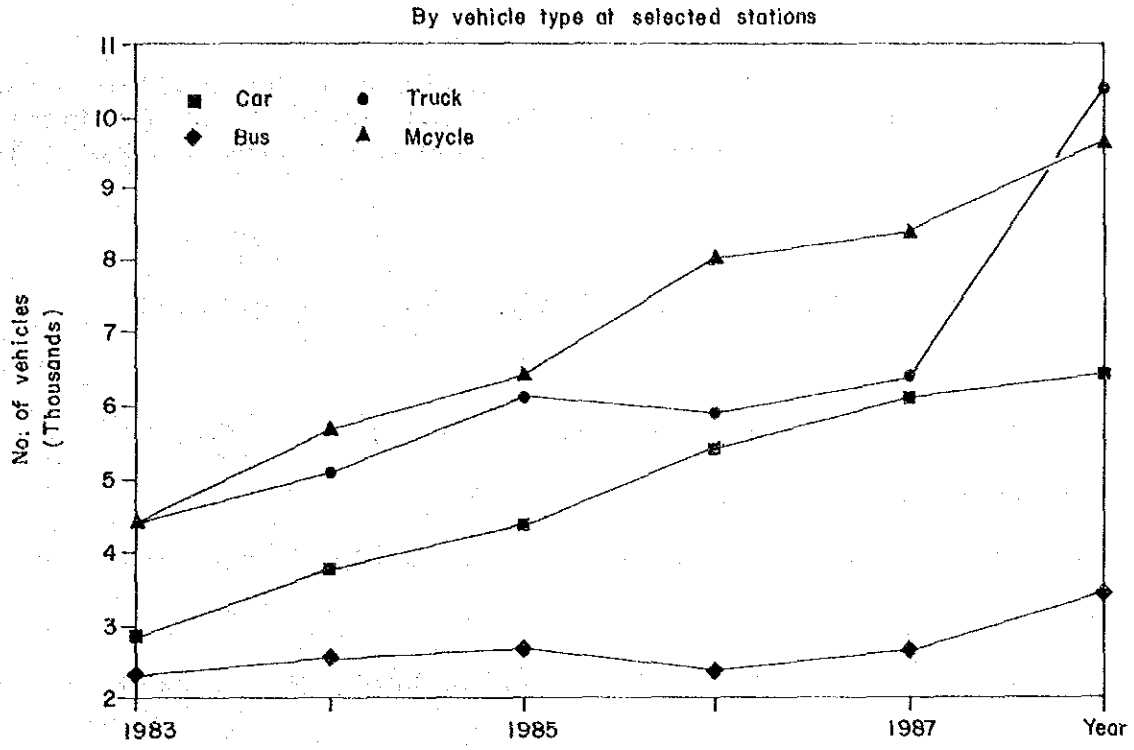

Fig. 3.4.10 TREND OF TRAFFIC VOLUME IN THE SOUTHERN REGION

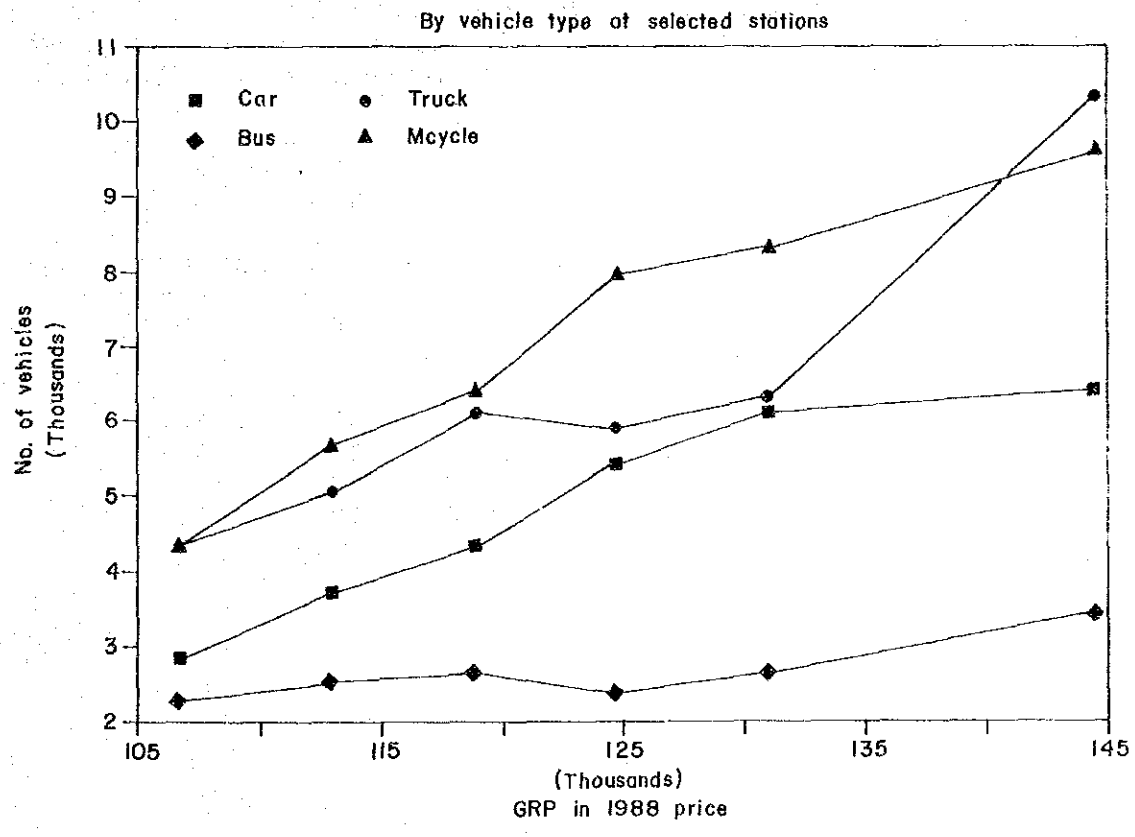

Fig. 3.4.11 TRAFFIC VOLUME VS. GRP IN THE SOUTHERN REGION

Fig. 3.4.11 shows the relationship between the traffic volume and the GRP in the Region. The following trip production models by vehicle type were derived from linear regression analyses:

Car:

-7250.0 + 0.097863 x GRP(million Baht) R = 0.9544

Bus:

-473.16 + 0.025474 x GRP(million Baht) R = 0.8491

Motorcycle:

-10019.00 + 0.138635 x GRP(million Baht) R = 0.9762

Truck:

-11286.60 + 0.143319 x GRP(million Baht) R = 0.9273

The above estimated relationship between trip production and GRP was used to estimate future trip production of the Southern Region based on the GRP of the region discussed in section 3.3.2. Table 3.4.2 and Fig. 3.4.12 show the estimated vehicle trip production. Average daily traffic volume was estimated to increase from 69.5 thousand trips in 1990 to 319.6 thousand trips in 2006 at an average annual growth rate of 10.0 %.

Table 3.4.2 Future Vehicle Trip Production

unit: 1,000 vehicles/day

	1990	1996	2001	2006
Car	30.8	63.7	99.1	146.1
Bus	11.3	18.8	27.0	37.7
Truck	27.4	58.3	91.6	135.8
Sub Total	69.5	140.8	217.7	319.6
Motorcycle	119.7	245.1	380.3	559.4

Source: Study Team

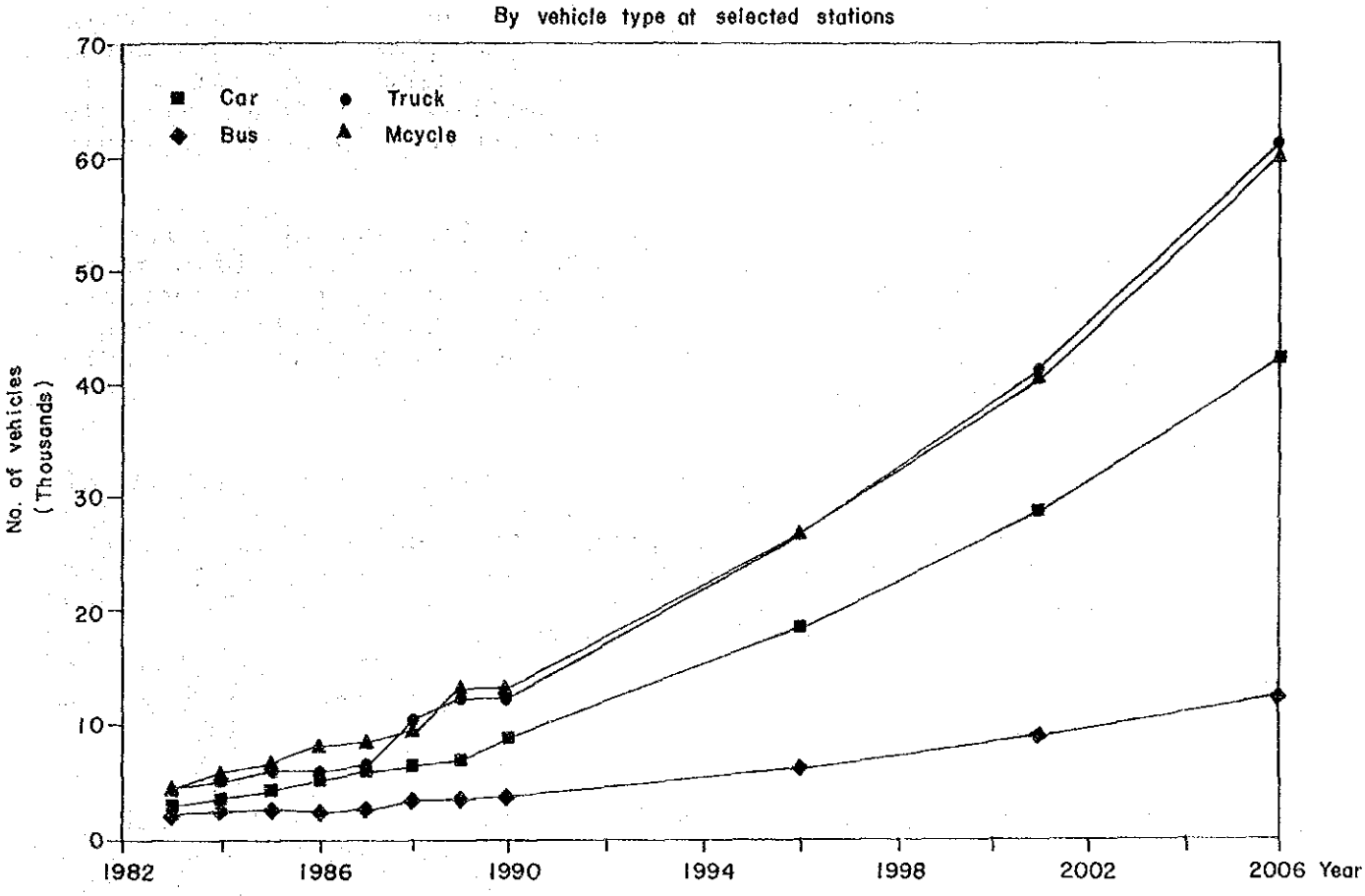

Fig. 3.4.12 FORECASTED TRAFFIC DEMAND

2) Trip Generation and Attraction

To develop vehicle trip generation and attraction models, linear and log linear regression models were analyzed. There were, however, no conspicuous relationship between the trip generation / attraction and zonal socio-economic indicators. This can be attributable partly to the insufficient data availability at the amphoe level and partly to the large difference of production activities by amphoes. The study, in consequence, adopted a trip rate method: passenger vehicle trip rate per unit population and truck trip rate per unit production.

Fig. 3.4.13 illustrates trip generation and attraction of passengers by traffic zone in 2006. Hat Yai was estimated to have the largest number of passenger trips of 160 thousand persons in 2006, followed by Songkhla, Satun, Pattani, Surat Thani, Phuket, Yala, Kathu and Nakhon Si Thammarat of more than 80 thousand persons.

Fig. 3.4.14 illustrates trip generation and attraction of cargos by zone in 2006. Hat Yai is estimated to have the largest number of cargo trips of 40 thousand tons in 2006, followed by Surat Thani of more than 30 thousand tons, and Shongkhla, Chana, Phuket, Nakhon Si Thammarat, Satun and Pattani of more than 20 thousand tons.

3) Trip Distribution

Trip distribution analysis was performed to find relationships between zonal socio-economic indicators and vehicle trip distributions based on the estimated OD tables in 1990. Based on the analysis, present pattern method with Frator iteration was adopted to estimate future vehicle trip distribution between zones. This is because the relative size of population and production of each changwat in the Southern Region in the future will not significantly be changed from the present pattern as shown in Table 3.3.6 and 3.3.7.

Trip distribution patterns for the target years were estimated by vehicle type based on the present distribution pattern and the estimated number of vehicle trip generation and attraction by traffic zone.

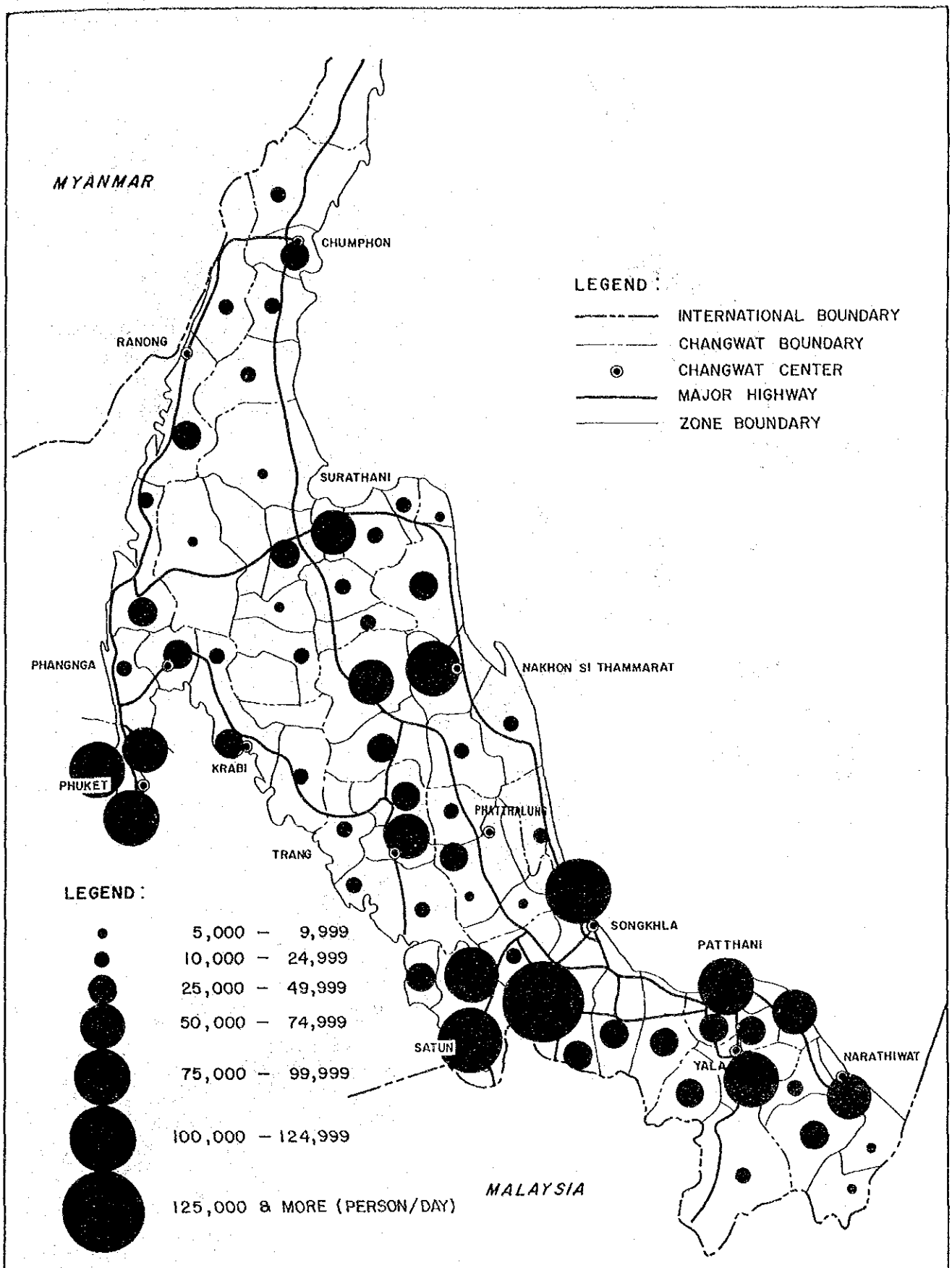

Fig. 3.4.13 TRIP GENERATION & ATTRACTION OF PERSON (2006)

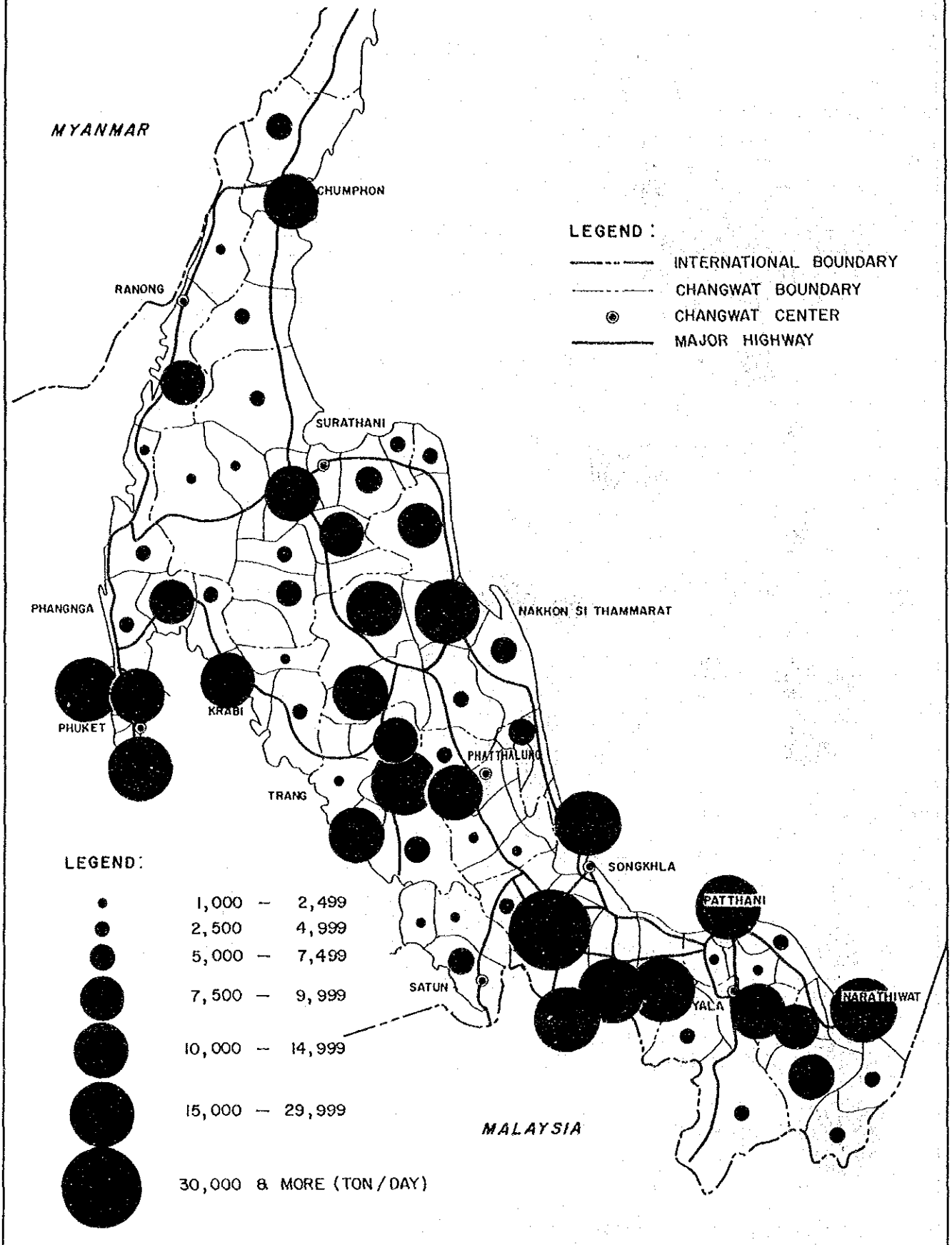

Fig. 3.4.14 TRIP GENERATION & ATTRACTION OF FREIGHT (2006)

Vehicle trip distribution to and from such other modes of transport as ports, airports and railway stations were incorporated into the vehicle trip distribution. Vehicle traffic related to the other modes of transport usually has the largest traffic impact on highway sections near these terminals and major urban centers in the vicinity. Paying attention to the fact, it was assumed that vehicle trip distribution to and from the terminals are concentrated on the most adjacent province. As for Phuket Airport, however, it was assumed that passengers will be distributed to Phuket and Phangnga proportionate to their population size.

Fig. 3.4.15 and 3.4.16 illustrate the estimated trip distribution between Changwat in 2006 for passengers and cargos, respectively. As to passenger trip distribution in 2006, Pattani - Yala is estimated to have the largest number of passenger trips of more than 100 thousand trips per day, followed by Surat Thani - Nakhon Si Thammarat of 95 thousand trips and Phuket - Phangnga of 83 thousand trips.

As to cargo trip distribution in 2006, Phuket - Phangnga and Songkhla - Nakhon Si Thammarat are estimated to have the largest volume of cargo transport of 25 thousand tons per day, followed by Chumphon - other regions of 24 thousand tons and Surat Thani - Nakhon Si Thammarat of 21 thousand tons.

4) Assigned Traffic Volume

The above estimated future OD tables by vehicle type were then assigned on the future road network. For the master plan purposes, the estimated traffic demand between traffic zones were assigned on the road network without capacity constraint solely based on the minimum time route. Fig. 4.3.17 illustrates the assignment procedure in the case of capacity constraint for preliminary feasibility study purposes:

a) the number of assignment times was decided at five times to better simulate the possible change of route selection based on the minimum travel time search between traffic zones;

b) a time minimum path was initially searched for each OD pair solely based on the road link information;

c) one fifth of the estimated traffic volume for each OD pair was assigned to the minimum route searched;

d) vehicle speed on each link was calculated and revised based on the QV formula of each link and the assigned traffic volume;

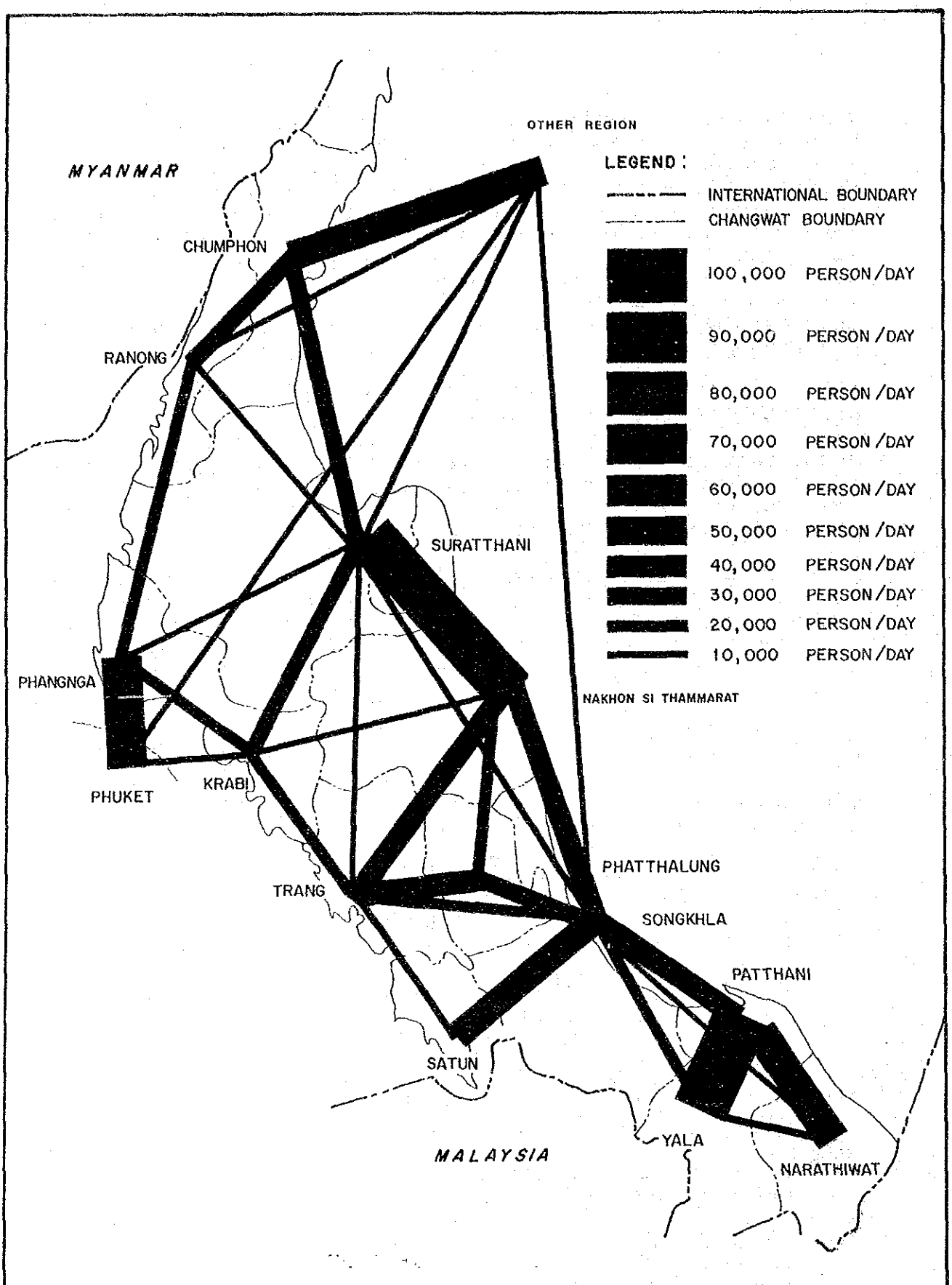

Fig. 3.4.15 PASSENGER FLOW IN THE SOUTHERN REGION (2006)

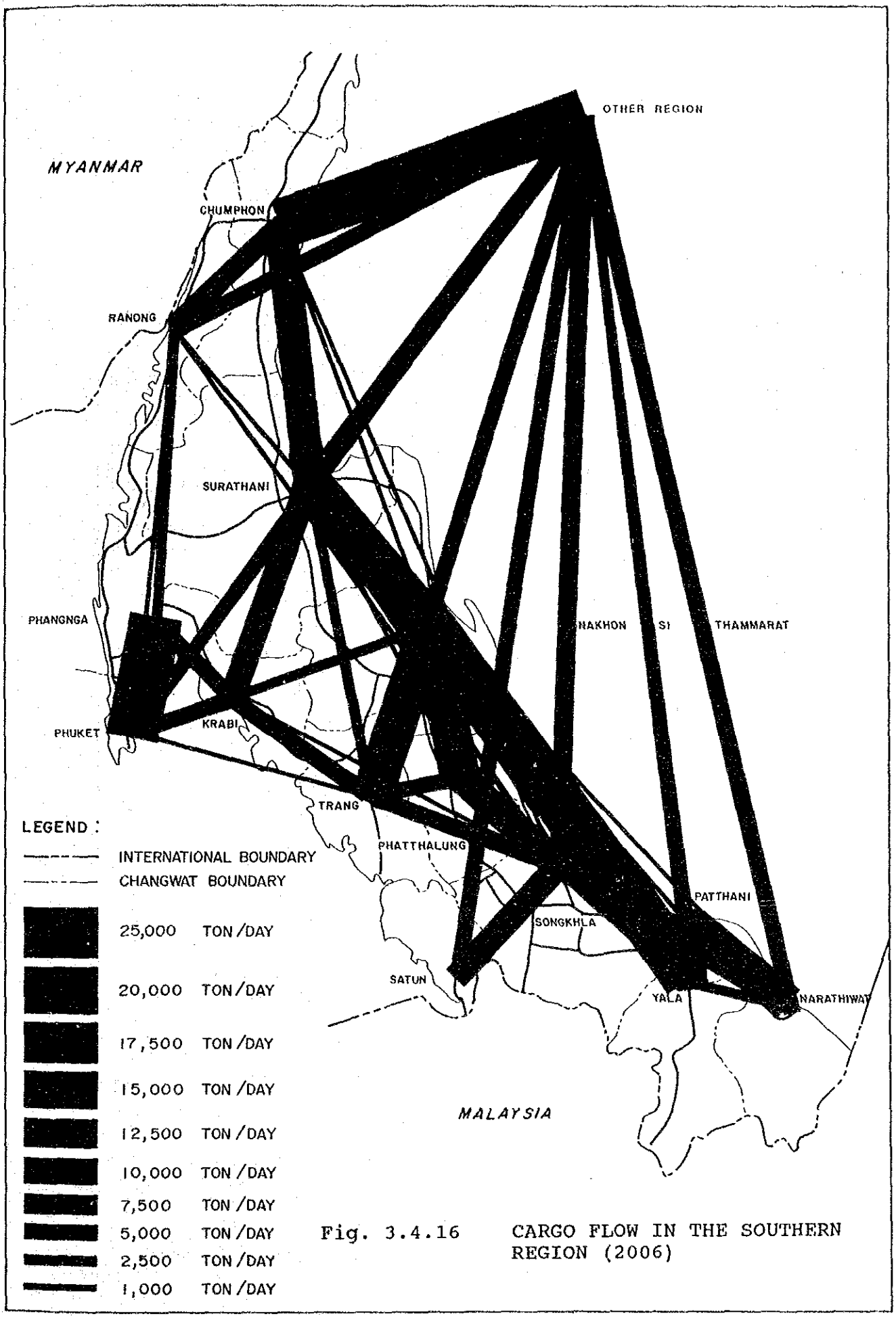

Fig. 3.4.16 CARGO FLOW IN THE SOUTHERN REGION (2006)

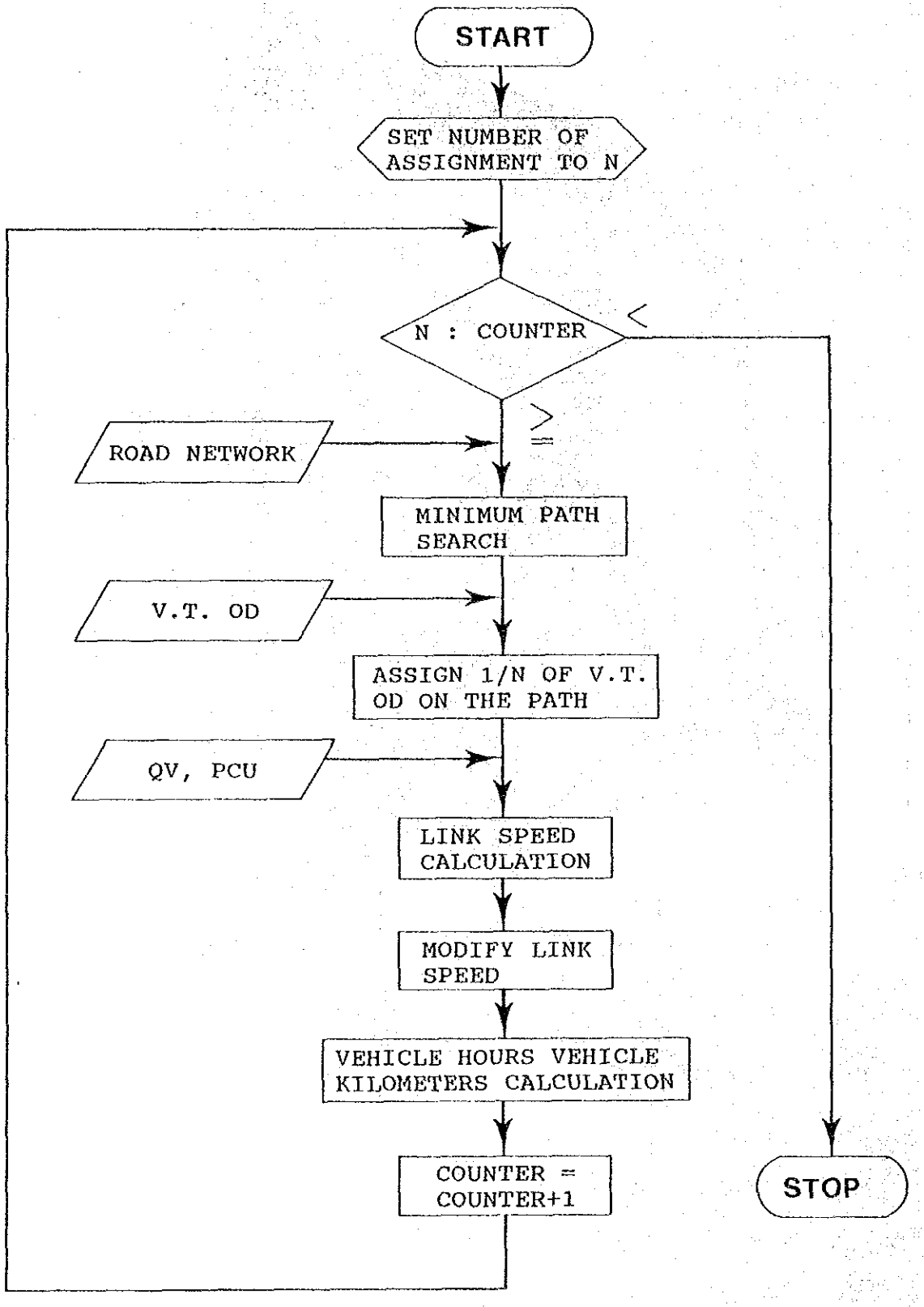

Fig. 3.4.17 TRAFFIC ASSIGNMENT PROCEDURE

e) link information such as vehicle hours, vehicle kilometers and other necessary figures were calculated and stored on each link; and

f) The traffic assignment procedure from c) to e) was repeated another four times to assign the remaining traffic volume between traffic zones.

Fig. 3.4.18 and 3.4.19 illustrates the assigned traffic volume on the road network for 1996 and 2006 respectively in the case of no capacity constraint for master plan purposes.

In 2006, traffic volume on the highways near large cities such as Songkhla - Hat Yai, Surat Thani and Phuket is estimated to reach 40,000 PCU. Traffic volume on the north-south artery of Route No. 4, 41 and 43 is estimated to reach in the range of 20,000 - 30,000 PCU. Traffic volume on Route No. 4 to Bangkok direction from the Southern Region is estimated to reach in the range of 30,000 - 40,000 PCU. The result of the traffic assignment infers that capacity increase of the existing highways, additional lane construction in particular, will be the most important issues to be addressed from now on.

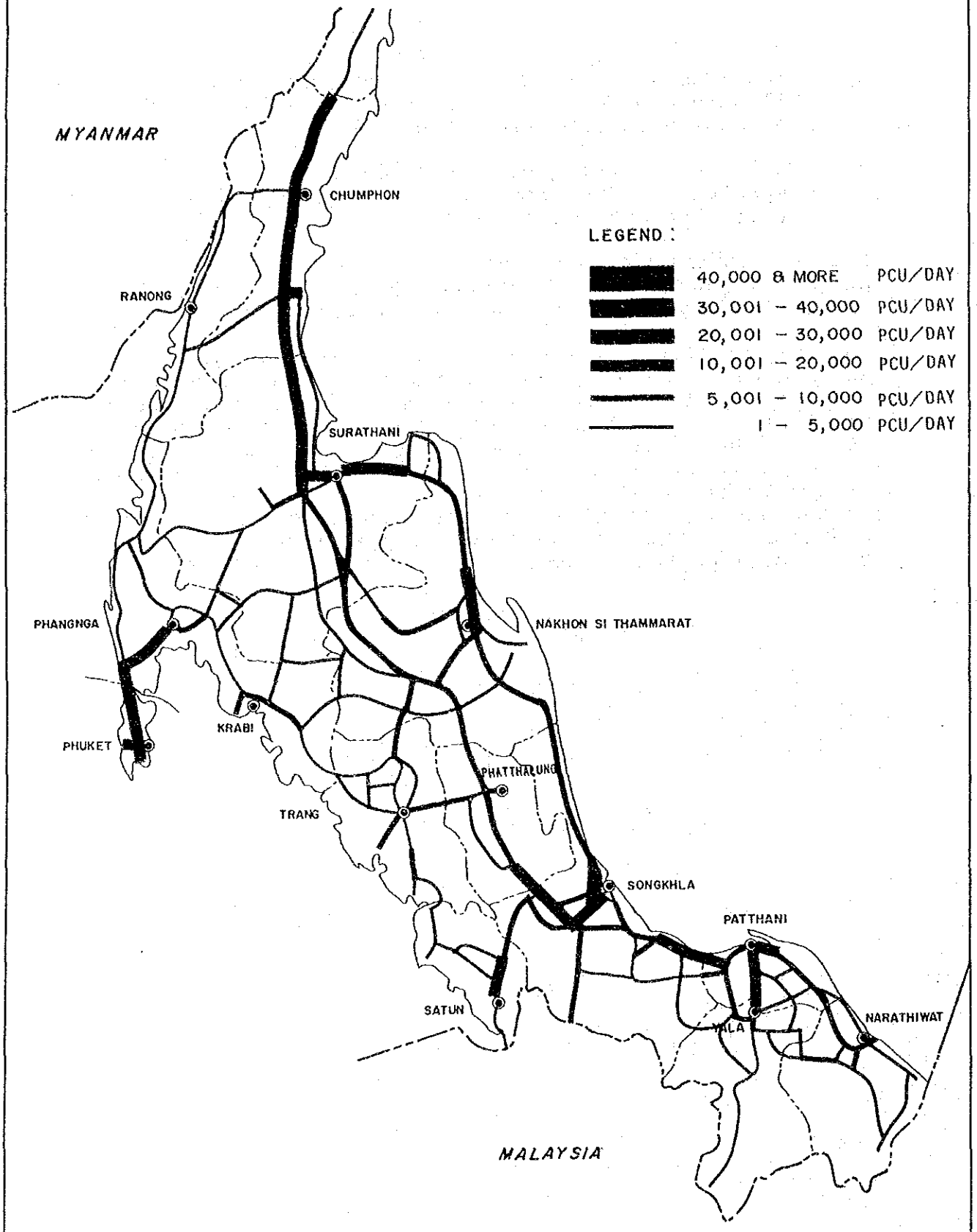

Fig. 3.4.18 ASSIGNED TRAFFIC VOLUME IN 1996 (PCU)

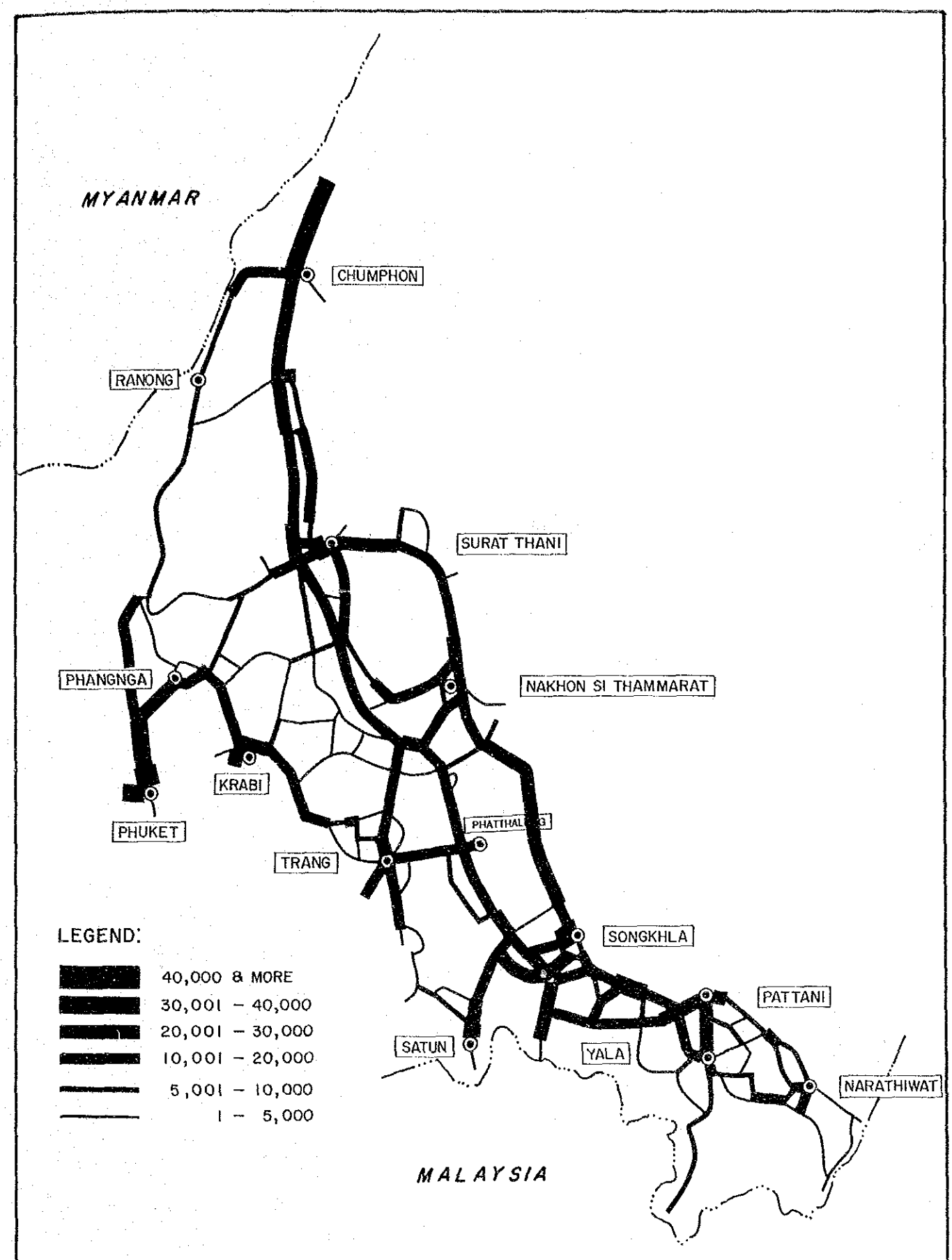

Fig. 3.4.19 ASSIGNED TRAFFIC VOLUME IN 2006 (PCU)

CHAPTER 4

Highway Development Master Plan toward the Year 2001

4. HIGHWAY DEVELOPMENT MASTER PLAN TOWARD THE YEAR 2001

4.1 General

This chapter discusses the highway development master plan for the year 2001. The Southern Region needs more attention to natural environment and disasters in considering a proposed highway network than other regions of the country.

The main purpose of the highway network development is to effectively support the regional development plans prepared by the Government as well as to minimize existing and anticipated traffic bottlenecks.

This chapter first discusses the concept to support the regional development plans, secondly the increase of network capacity in consideration of environmental conservation and disaster prevention, and lastly the highway development master plan.

4.2 Highway Development Concept

4.2.1 General

The Southern Region is located on the northern part of the Malay Peninsula, facing the Gulf of Thailand to the east and the Andaman Sea to the west. The Phuket and Nakhon Si Thammarat mountain ranges stretching north-south wise separate the east and west coasts, and the Sankalakhiri mountain range separates Thailand from Malaysia.

The Southern Region is away from Bangkok, 460 kilometers to Chumphon and 1,150 kilometers to Narathiwat. The region is connected to Bangkok by all transport modes of sea, air, rail and road transport. Intermodal connection between highways and other transport modes is very important in the region particularly to facilitate passenger and cargo flows to and from Bangkok and other regions.

In the Southern Region, highway plays an outstandingly important role to effectively utilize the vast land area and connecting a district center with another or with a provincial center. Rural roads branch out from highways to local communities and farm land. An emphasis has been given to the extension of the road network to deep inland in order to develop various part of the region.

Due to the rapid economic growth in recent years and resultant increase of motorization, traffic volume on national and provincial highways has been increasing to exceed the highway capacity, particularly in the vicinity of major provincial centers. Taking these phenomena into consideration, DOH intends to place more focus on highway capacity increase than highway network extension for the coming Road Development Plan in the Seventh Five Year Plan.

On the basis of the above background, this section discusses the highway development concept of the Southern Region in view of the future regional development plans, including:

(1) developing better linkage with the outside;
(2) improving accessibility between urban centers;
(3) developing the Southern Border Provinces;
(4) stimulating tourism development;
(5) easing urban traffic problems; and
(6) supporting the Southern Seaboard Development Program (SSDP).

4.2.2 Better Transport Linkage with the Outside

The Southern Region is connected with Bangkok to the north and with Malaysia to the south. The national highways of Route No. 4 and 41 constitute the mainstay of the region as illustrated in Fig. 4.2.1. With a view to ensuring better accessibility to the mainstay from various parts of the region, several ribs are required to be located:

- from Phunphin to Phuket;
- from Phunphin to Sichon;
- from Thung Song to Trang;
- from Thung Song to Nakhon Si Thammarat;
- from Rattaphum to Satun;
- from Hat Yai to Songkhla; and
- from Hat Yai to Narathiwat.

From intermodal point of view, highway links should be improved or developed to this mainstay or these ribs particularly from major airports of Hat Yai, Phuket and Surat Thani as well as major deep seaports of Songkhla and Phuket.

The Government has determined to construct additional two lanes along the existing highways of Route No. 4 and 41 from Bangkok to the Malaysian border in the long term perspective. This decision is inferred very important to accelerate the development of the Southern Region in general coupled with the SSDP as well as to strengthen the international connection with Malaysia and Singapore through the Trans Malaysian Highway System.

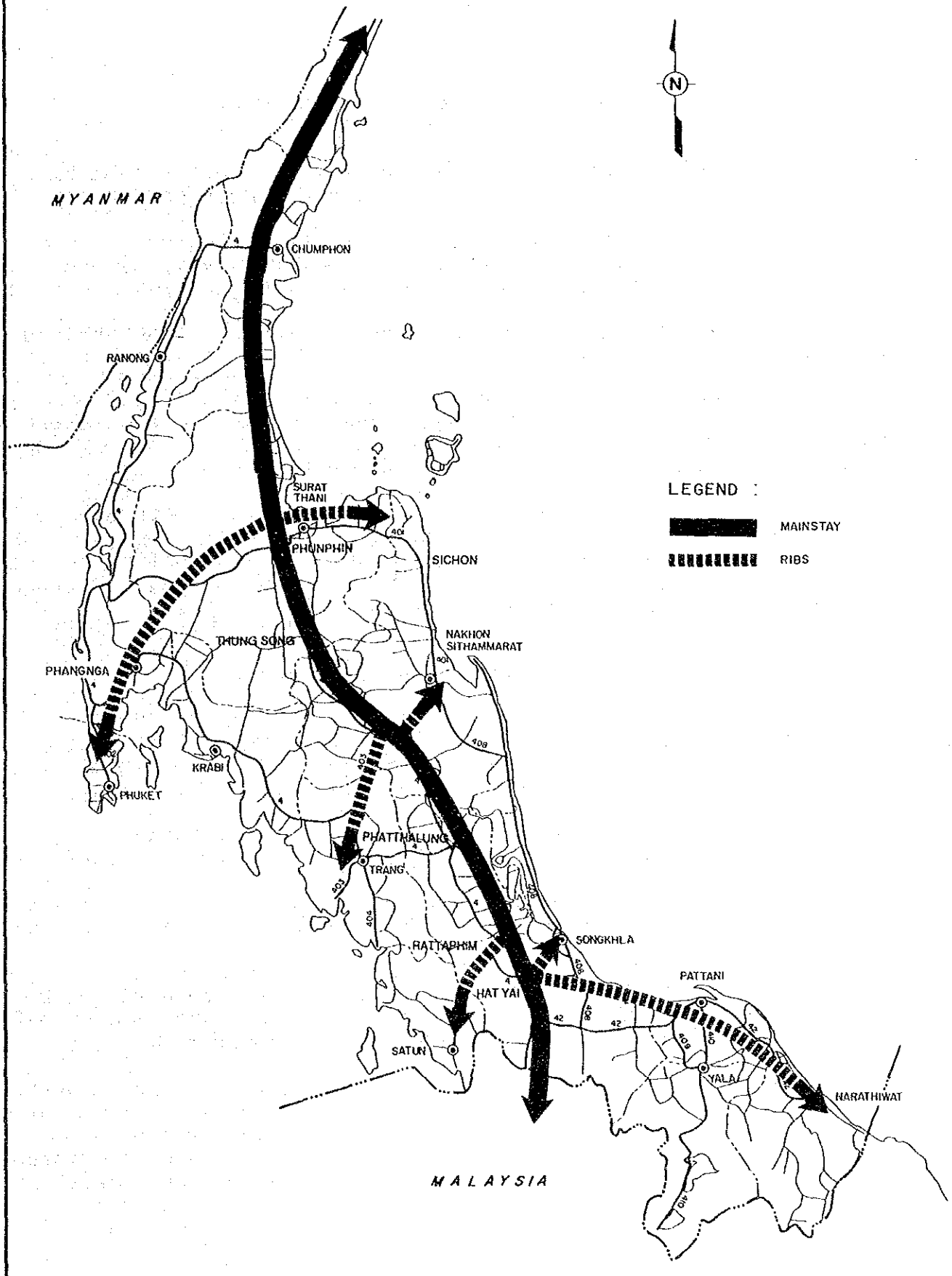

Fig. 4.2.1 ACCESSIBILITY IMPROVEMENT TO AND FROM BANGKOK

4.2.3 Improving Accessibility between Urban Centers

Five provincial centers have been designated as urban centers out of the fourteen provincial centers in the Southern Region:

(1) Songkhla-Hat Yai as a Regional Urban Center;
(2) Surat Thani and Phuket as Main Urban Centers; and
(3) Nakhon Si Thammarat and Pattani as Urban Growth Centers.

As illustrated in Fig. 4.2.2, three urban centers of Songkhla-Hat Yai, Surat Thani and Phuket form a triangular spacial structure just in the center of the region, providing easy access to provincial centers in the surroundings. Songkhla- Hat Yai is expected to be a core for the New Economic Area of the Songkhla Lake Basin, Surat Thani and Phuket for the Upper Central Sub-Region, and Nakhon Si Thammarat for the Pak Phanan Basin.

With a view to achieving the urban development strategy in a triangular structure, highway network should be improved and developed in a dual way: one for improving accessibility between the urban centers; and another for improving accessibility between an urban center and provincial centers in the vicinity.

4.2.4 Developing the Southern Border Provinces

The Southern Border Provinces include five provinces of Songkhla, Pattani, Yala, Narathiwat and Satun. The Sixth Five Year Plan specifies the main objectives of the development as follows:

(1) to improve social and psychological conditions of fishermen, farmers, local rubber planters, and youth and women;
(2) to solve security problems; and
(3) to provide necessary basic economic and social services.

A "Provincial Committee for Southern Border Development" was established in April 1990 within the framework of the National Plan for the purpose of improving social welfare and encouraging economic activities through infrastructure development.

The geographical condition, however, is one of the greatest constraints for developing the border area, inland mountain area in particular. Highway network in the southern border provinces has been developed only along the east coast line, leaving inland highways directing to the west coast of the Peninsula undeveloped due to steep mountainous terrain.

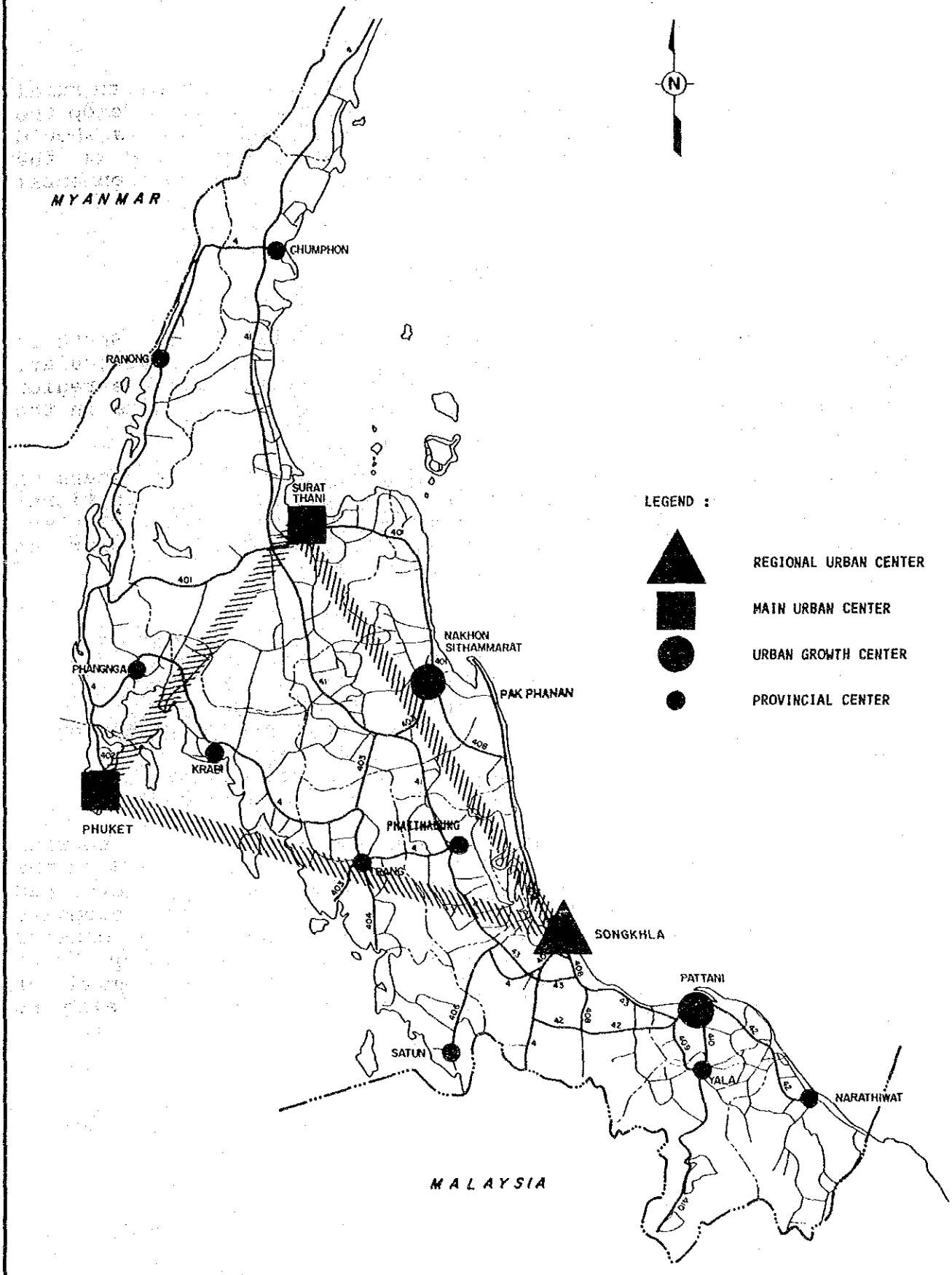

Fig. 4.2.2 DEVELOPMENT PROGRAM URBAN CENTERS

Policy coordination between DOH and the agencies related with rural road development is likely the most important issue to develop the highway network in this border area. Some inland highways should be constructed towards the west coast primarily based on the existing rural roads so as to minimize the possible environmental impact.

4.2.5 Stimulating Tourism Development

Tourism is one of the most promising industries in the Southern Region, beach resorts like Phuket and Ko Samui in particular. International as well as domestic tourist arrivals to the region are expected to increase for the future with rising share in the whole country.

The Southern Region can be grouped into three tourism clusters on a basis of their tourism resource characteristics and locations: Songkhla-Hat Yai Cluster; Phuket Cluster; and Surat Thani Cluster, as illustrated in Fig. 4.2.3. Each Tourism Cluster comprises several tourism development areas as shown below:

Name of Tourism Cluster	Development Areas
Songkhla-Hat Yai Cluster:	Songkhla/Hat Yai, Satun, Phatthalung, Pattani, Yala, and Narathiwat
Phuket Cluster:	Phuket, Phangnga, Krabi, and Ranong
Surat Thani Cluster:	Ko Samui, Surat Thani, Nakhon Si Thammarat, Chumphon

Improvement of accessibility is a focal issue to stimulate tourism development in the Southern Region. Firstly, highway network in the above tourism development areas should be improved and developed for ensuring easy access to tourist spots in these areas. Secondly, highways connecting every development area in each tourism cluster should be improved for the sake of encouraging excursion trips between the tourism development areas. Lastly, improvement of highways connecting tourism clusters each other would also be required.

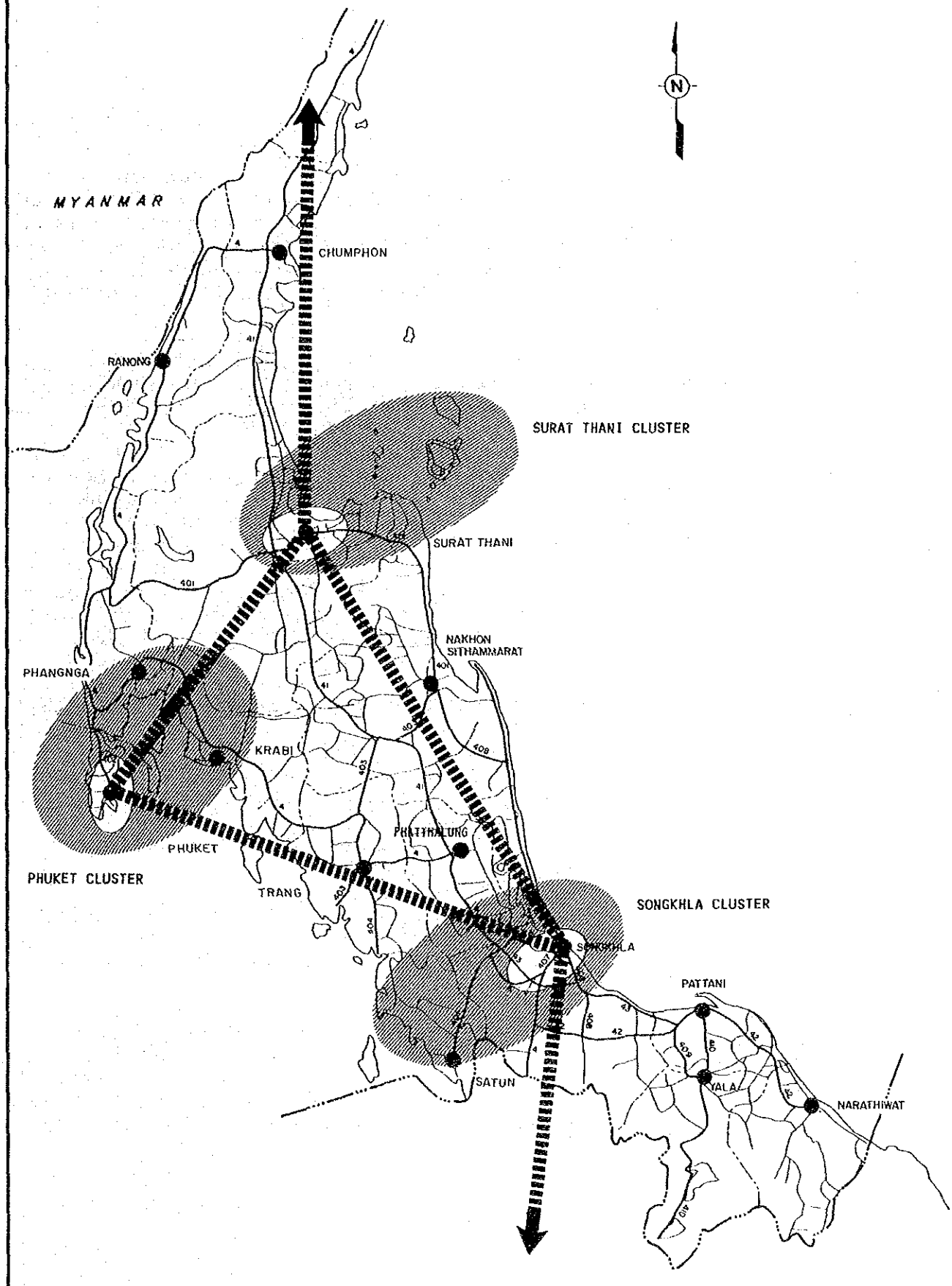

Fig. 4.2.3 MAJOR TOURISM CLUSTERS IN THE SOUTHERN REGION

4.2.6 Easing Urban Traffic

Many cities in the Southern Region have been developed along the existing highways. Due to the increase of both intra urban traffics generated by city activities and inter provincial/regional traffics generated by increasing interdependence between provinces/regions, traffic congestions in city area have been aggravated in recent years, causing longer travelling time, more traffic accident, deteriorated living environment, etc.

DOH has been addressing itself to improve these problems in some cities, and intends to put higher priority on the improvement of urban traffic flow in the coming Seventh Five Year Plan.

The measures to cope with the increasing urban traffic would include additional capacity to the existing highways, bypass construction to detour the city centers and introduction of effective traffic control system. New bypass construction to the city center will be required especially for provincial centers and some big district centers. For smaller sub-district centers and local communities, however, it would be a likely way to introduce realignment of some part of the existing highways to avoid community centers when they are to be improved in the future.

4.2.7 Supporting the Southern Seaboard Development Program (SSDP)

The Southern Seaboard Development Program (SSDP) is the greatest development program that the government is going to introduce after the completion of the Eastern Seaboard Development Program (ESSB) in the context of internationalization, industrialization and decentralization from Bangkok.

The SSDP is planned to be located in the corridor between Krabi on the west coast and Khanom on the east coast of the Peninsula, consisting of deep seaports, land bridge, industrial estates, distribution centers, urban centers, etc.

Economic development impact of the SSDP on the Southern Region is likely to be centered mainly on construction works in the initial stage of development toward the year 2000. Beyond the year, economic development effects will spread to every part of the region with tapering degree depending on distance from the corridor as illustrated in Fig. 4.2.4.

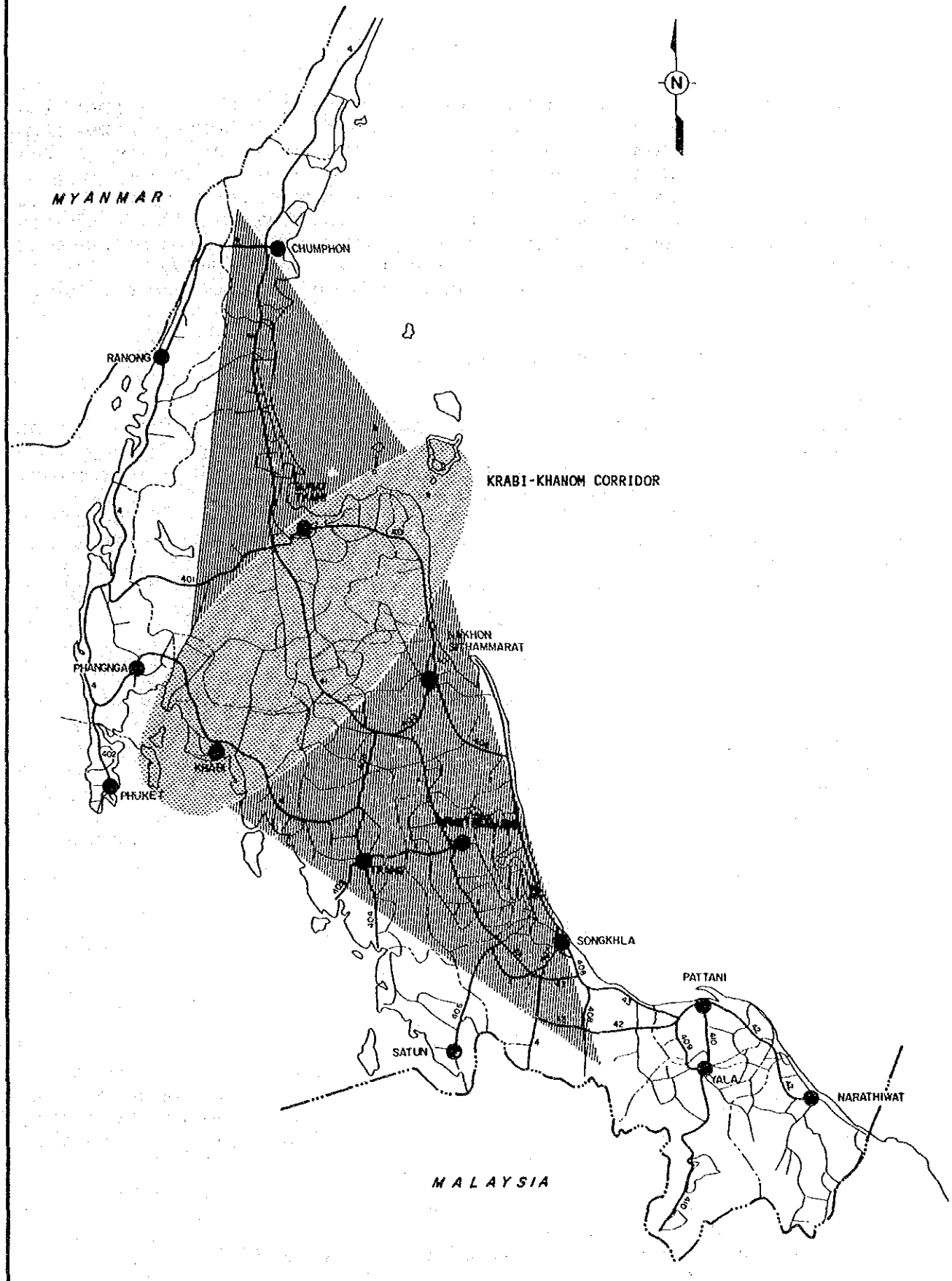

Fig. 4.2.4 DEVELOPMENT IMPACT BY THE SSDP

Highway network development in this regard should aim at supporting construction works of the SSDP in the short/mid term perspective and diffusing economic development effects to wider areas in the long term perspective. For the former purposes, highway network improvement will be necessary on the highways directing to Krabi, Khanom and Ban Na Doem and the highways parallel to the proposed Land Bridge. For the latter purposes, improvement should be focused on such national highways running north-south wise as Route No. 4, 41 and 401 to diffuse the development effect to the wider areas.

4.2.8 Conceptual Highway Development Scheme

Based on the above discussions, a functional highway scheme can be depicted as shown in Fig. 4.2.5. The highway sections with plural lines imply that they are expected to serve various development objectives of the Southern Region at the same time. Surat Thani - Hat Yai and Phuket - Khanom sections are those of multiple purposes. By contrast, the highway sections with plural lines can hardly been found in the Southern Border Provinces, indicating that any specific development plans have not been prepared at least in the Sixth Five Year Plan.

The functional highway scheme does not simply imply that the highway sections with plural lines are more important than those of single line. It would rather indicate that the highway sections with plural lines have higher potentials to produce higher investment returns than those of single line. It is likely, however, that policy decision will not solely based on economic efficiencies but also on social equity that people can equally enjoy the effects of economic development. The functional highway scheme is thus important to develop the highway development master plan for the future.

4.3 Highway Development Master Plan

4.3.1 General

On preparation of a highway development master plan of the Southern Region, regional variables should be taken into account, in addition to the highway development concept discussed in the above, to properly reflect the present situations of the region, including:

(1) environmental protection;
(2) disaster prevention;
(3) existing conditions of highways; and
(4) future transport demand.

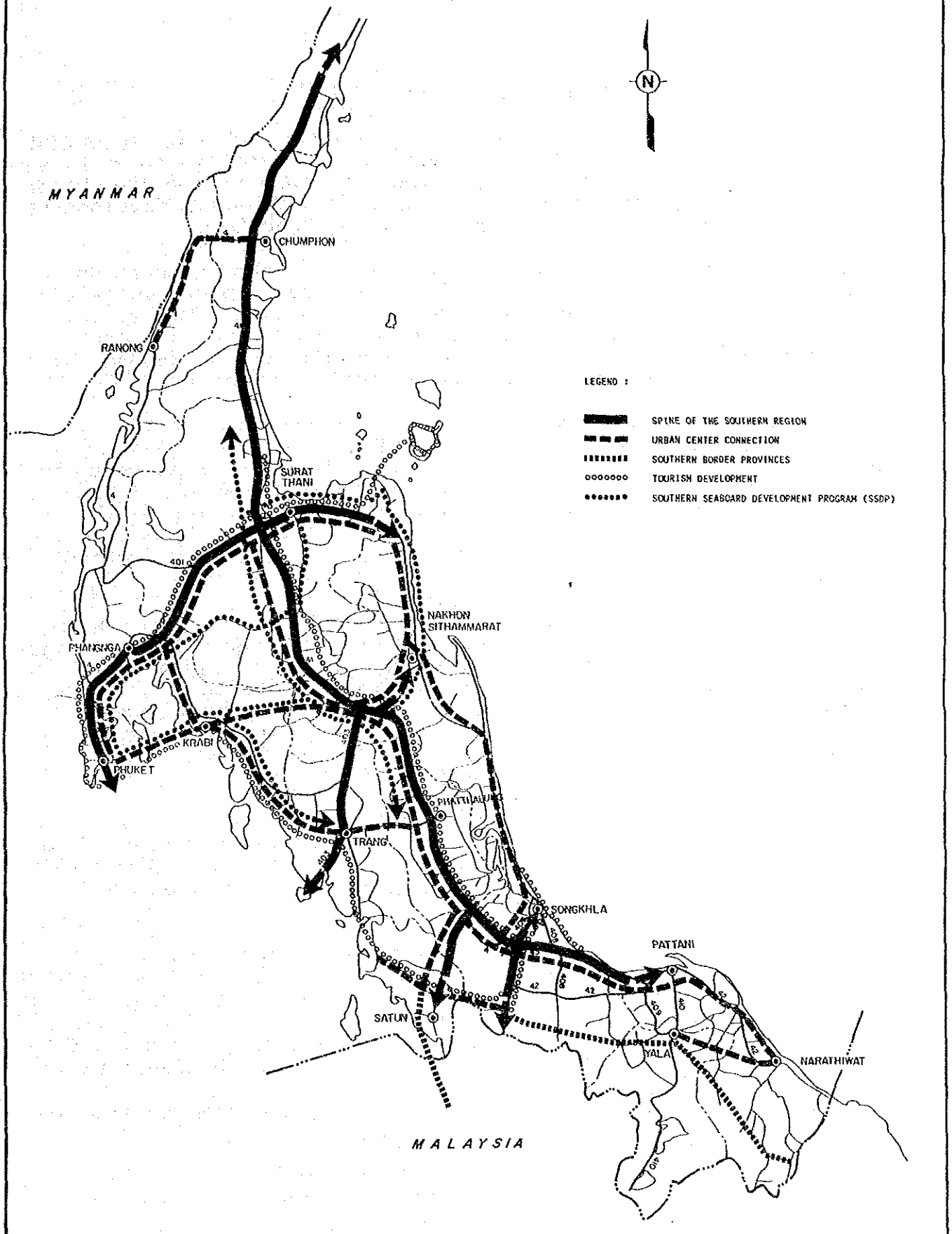

Fig. 4.2.5 HIGHWAY SCHEME FOR THE SOUTHERN REGION DEVELOPMENT