CHAPTER 2 TRAFFIC DEMAND FORECAST

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2-1 Basic Principle

(1) Basically, the present situation is analyzed based on 1982 data (most updated data available).

(2) The Fourth Malaysia Plan (FMP) and the Mid-Term Review (MTR) are used as the basis of the socio-economic framework for the projection. Data obtained from various development plans are also used.

(3) The population and Gross Domestic Product (GDP) growth rates are assumed for three respective periods, namely, 1980 to 1985, 1985 to 1990 and 1990 to 2005, taking into consideration the Malaysian Government's policies (expressed at the Steering Committee, Oct. 25th, 1984).

(4) For forecasting conveniences, the Peninsular Malaysia is divided into 14 zones (basically one State is one zone, but some are subdivided or merged according to their size). Zone map is shown in Fig. 2-1-1 (when one State is divided into two or more zones, names of the districts composing each zone are shown). For passenger demand forecasting, Singapore and Thailand are added (consequently 16 zones).

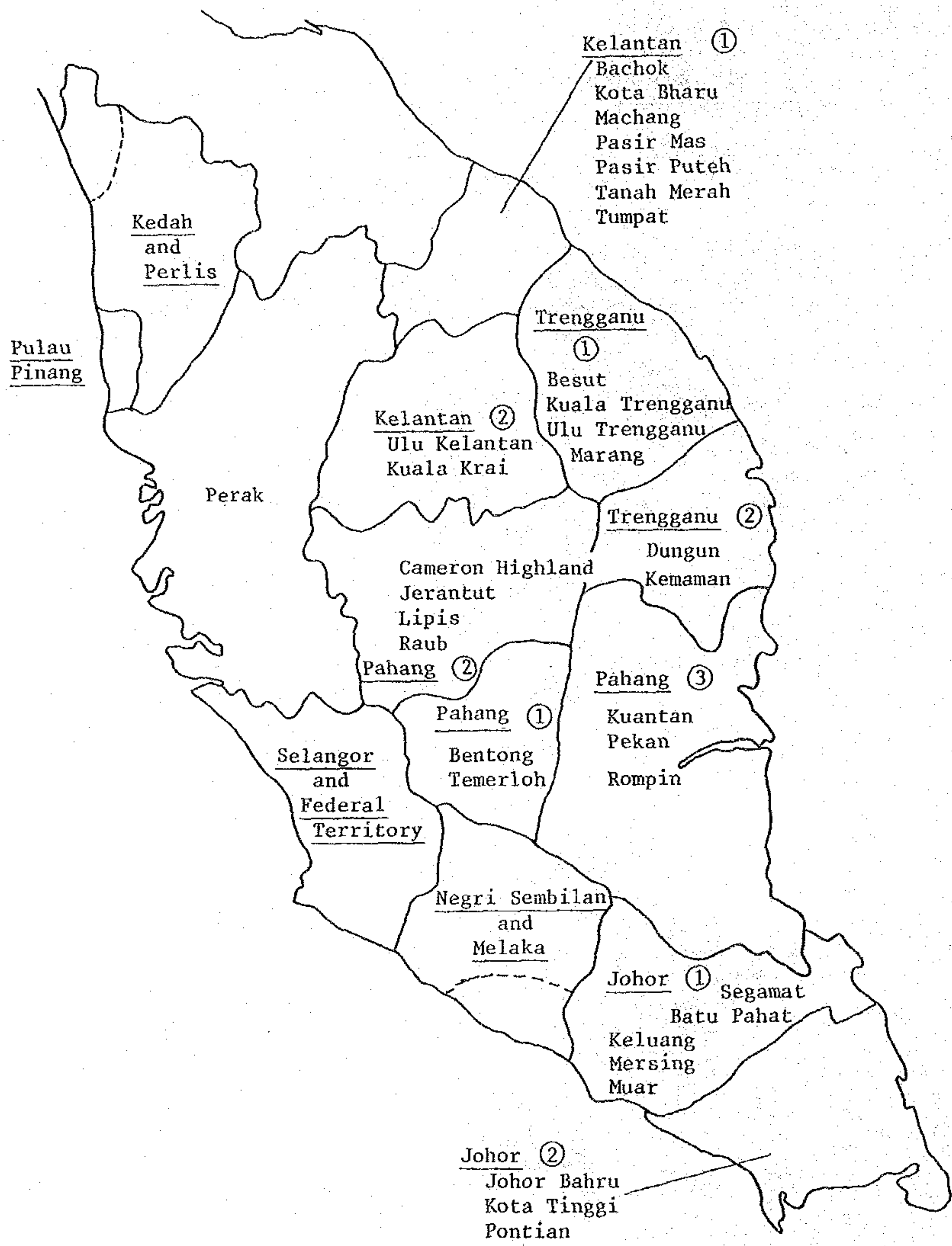


Fig. 2-1-1 Zone Map

2-2 Socio-Economic Framework

2-2-1 National economic planning

(1) National economic planning in Malaysia takes the form of five-year plans (Malaysia Plans) formulated in series since 1966, and now the Fourth Malaysia Plan (FMP) (1981 to 1985) is in force. Each Malaysia Plan has its Mid-Term Review (MTR) and MTR for FMP was made in 1984 and FMP targets are adjusted in accordance with actual performance of the plan during the period of 1981 to 1983.

(2) The Second Malaysia Plan (1971 to 1975) and the subsequent ones were regulated, in their basic planning policies and objectives, by the New Economic Policy (NEP), a 20 year plan 1971 to 1990, and by the Outline Perspective Plan (OPP), an implementation plan for NEP.

(3) NEP sets the two major objectives: namely, "eradication of poverty" and "restructuring of society" in order to accomplish a strong unification of Malaysia.

(4) The target of "eradication of poverty" is that the income group below the poverty line in the Peninsular Malaysia should decrease from 49.3% of the population in 1970 to 16.7% in 1990.

The target of "restructuring of society" is that employment opportunity should reflect actual racial composition by 1990, and Bumiputra ratio for share holding in industry and commerce sectors is aimed at reaching 30%.

(5) To accomplish these targets, a high economic growth rate was planned. This was based upon the strategy of "Growth with Distribution" i.e. redistributing national income not by taking from one and giving it to another, but by increasing total income and distributing it preferentially to those who have not been benefited well in the past. The target annual growth rate of GDP between 1970 and 1990 is 7.9%.

(6) Performance of Malaysian economy in the 1970's can be summarized as follows:

(a) The income group below the poverty line (in the Peninsular Malaysia) declined to 29.0% in 1980.

(b) Share holding by Bumiptra increased to 12.4% in 1980.

(c) Average annual growth rate of GDP was 7.9%.

(7) On the basis of the performance in the 1970s, FMP (1981 to 1985) was formulated with the following targets;

(a) Shifting of the working population from the agricultural sector, which has a larger number of people below the poverty line than in other sectors, to non-agricultural sectors is encouraged, and it is targeted for the manufacturing sector to exceed the agricultural sector in GDP share by 1985.

(b) Since it will be difficult for individuals to promote the Bumiptra share holding only by themselves, it will continue to be arranged through the public trust institutions.

(c) Average annual growth rate of GDP is targeted at 7.6%.

(8) Targets set in FMP were modified in MTR to reflect the performances of the plan during the period 1981 to 1983, and the Malaysian economy in 1985 is foreseen, where

(a) The population below the poverty line will be decreased to 24.1%.

(b) Bumiptra share holding is expected to reach 21.9%.

(c) The target average annual growth rate of GDP was modified downward to 6.4% from the original 7.6%.

(9) The performance of the Malaysian economy in the 1970's and early 1980's and also its future prospects can be summarized as follows.

(a) The high economic growth rate in the 1970's declined in the 1980's mainly due to worldwide recession although it remains still at a relatively high level compared with other countries.

(b) The structure of the economy was changed and shows an increase in the share of manufacturing sector in GDP and decrease in the share of the primary sector. Nevertheless, the manufacturing sector grew at a lower rate than planned in the early 1980's. It is now expected that projects initiated by the Heavy Industry Corporation of Malaysia (HICOM) will have a positive impact on the growth of the sector.

(c) The public sector has greatly contributed to economic growth in the past, particularly in recent years when the contribution of the exports has not reached the expected level. In the future, however, the government intends to curtail external borrowing which is a major source of public investment, and instead, is encouraging initiatives from the private sector, in other words, privatisation.

2-2-2 Future framework and development plans

(1) The population and GDP growth rates, as a basis of forecasting the traffic demand, are estimated based mainly upon the national economic plan and its performance.

(2) The total population growth rate is assumed to be 2.5% annually until 1990. This is equivalent to MTR estimation (based on the result of 1980 census) for the period of 1980 to 1985.

For 1990 to 2005, the rate is assumed to be 2.3%. This is in accordance with the Government's policy for 70 million population.

(3) The population growth rates in each zone is obtained from the past trends. It is so adjusted as to reflect the total population trend and projection.

(4) Summarized past characteristics are

(i) An inter-State migration survey for the period of 1970 to 1980 shows a high rate of in-migration in Pahang, Selangor and Federal Territory.

(ii) In terms of the growth rate of each State, Pahang, Selangor, Trengganu and Federal Territory show higher rates than the national average.

In general a significant population growth is observed in Selangor and the east coast States.

(5) The total GDP average annual growth rate is assumed at 6.4% from 1980 to 1985, (same as the modified FMP target), 6.0% for the period of 1985 to 1990, and 5.0% for 1990 to 2005.

(6) The GDP growth rate in each zone is estimated from the past trend. It is so adjusted as to reflect the total GDP trend and projection.

When a State is divided into some zones, the GDP in the zone is estimated in accordance with the proportion of the zone's population to the State population.

(7) Summarizing the past characteristics, those States which showed an average annual growth rate higher than 7% in the periods of both 1970 to 1980 and 1980 to 1983 are Pahang and Trengganu.

MTR presumes that this trend will continue until 1985.

(8) Rural development is considered to be a key to poverty eradication. Some 529,000 hectares of land are being developed for this purpose by public enterprises and the State Agency between 1980 and 1985. Pahang has the largest planned area.

(9) Urban development is another type of regional development. In 1980, 34.5% of the population lived in urban areas, and this rate is expected to increase to 37% in 1985 (average annual growth rate of urban population is 4.1%). Urban development is being carried out to deal with this urbanization. Average annual rate of urban population growth higher than 6% is presumed in Kelantan, Pahang and Trengganu for the period of 1980 to 1985.

(10) The manufacturing sector, particularly heavy/chemical industries led by Heavy Industrial Corporation of Malaysia (HICOM), are expected to play an important role in the economic growth of the future, and many project are being planned.

Resource based industries are also expected to grow and many industrial estates are planned.

(11) In addition, the KL II Plan is now under consideration, a new city in Janda Baik (Kg. Bukit Tinggi), 30 km northeast of Kuala Lumpur. Some governmental offices will move there. The future population of the city is expected to be 3 to 5 hundred thousand.

Table 2-2-1 Average Annual Growth Rate of Population and GDP of Total Malaysia

(1) Population	a) Base Case 1980 - 1985 2.5% 1985 - 1990 2.5% 1990 - 2005 2.3%
	b) Alternative Case for Sensitivity Analysis 1990 - 2005 1.9%
(2) GDP	a) Base Case 1980 - 1985 6.4% 1985 - 1990 6.0% 1990 - 2005 5.0%
	b) Alternative Cases for Sensitivity Analysis (i) High Case 1985 - 1990 6.5% 1990 - 2005 6.0% (ii) Low Case 1985 - 1990 5.5% 1990 - 2005 4.0%

Table 2-2-2 Population by Zone

Unit: thousand persons

	1970*	1980**	1985***	1990	2005
(1) Johor ①	826	939		1,100	1,222
(2) " ②	446	641		950	1,499
(Total Johor)	(1,272)	(1,580)	(1,835)	(2,050)	(2,721)
(3) Kedah, Perlis	1,073	1,223	1,350	1,437	1,652
(4) Kelantan ①	622	771		1,014	1,362
(5) " ②	62	88		133	217
(Total Kelantan)	(684)	(859)	(1,014)	(1,147)	(1,579)
(6) Melaka, Negri Sembilan	883	998	1,111	1,185	1,369
(7) Pahang ①	177	286		474	893
(8) " ②	160	211		285	393
(9) " ③	166	272		459	888
(Total Pahang)	(503)	(769)	(988)	(1,218)	(2,174)
(10) Perak	1,561	1,744	1,915	2,025	2,281
(11) Pulau Pinang	773	901	1,034	1,116	1,336
(12) Selangor, Federal Territory	1,626	2,346	3,012	3,627	6,031
(13) Trengganu ①	306	402		541	766
(14) " ②	99	123		156	201
(Total Trengganu)	(405)	(525)	(615)	(697)	(967)
Sabah & Sarawak	1,538	2,191	2,674	3,089	4,631
Total Malaysia	10,319	13,136	15,548	17,591	24,741

*, ** Source: Population Census
*** Source: Mid-Term Review

Table 2-2-3 GDP by Zone

Unit: mil. M$

	1971*	1980**	1985***	1990	2005
(1) Johor ①				2,796	4,340
(2) " ②				2,415	5,324
(Total Johor)	(1,476)	(3,057)	(4,032)	(5,211)	(9,664)
(3) Kedah, Perlis	828	1,483	1,827	2,206	3,341
(4) Kelantan ①				1,247	2,233
(5) " ②				163	356
(Total Kelantan)	(413)	(833)	(1,095)	(1,410)	(2,589)
(6) Melaka, Negri Sembilan	956	1,822	2,454	3,241	6,435
(7) Pahang ①				1,285	3,337
(8) " ②				773	1,468
(9) " ③				1,245	3,318
(Total Pahang)	(647)	(1,607)	(2,372)	(3,303)	(8,123)
(10) Perak	1,297	2,935	3,953	5,219	10,318
(11) Pulau Pinang	850	2,133	2,972	4,058	8,870
(12) Selangor, Federal Territory	3,826	8,014	10,855	14,412	28,982
(13) Trengganu ①				1,403	3,546
(14) " ②				404	930
(Total Trengganu)	(268)	(875)	(1,270)	(1,807)	(4,476)
Sabah & Sarawak	1,825	3,470	4,969	6,981	16,675
Total Malaysia	13,016	26,228	35,755	47,848	99,473

* Source: Fourth Malaysia Plan
, * Source: Mid-Term Review

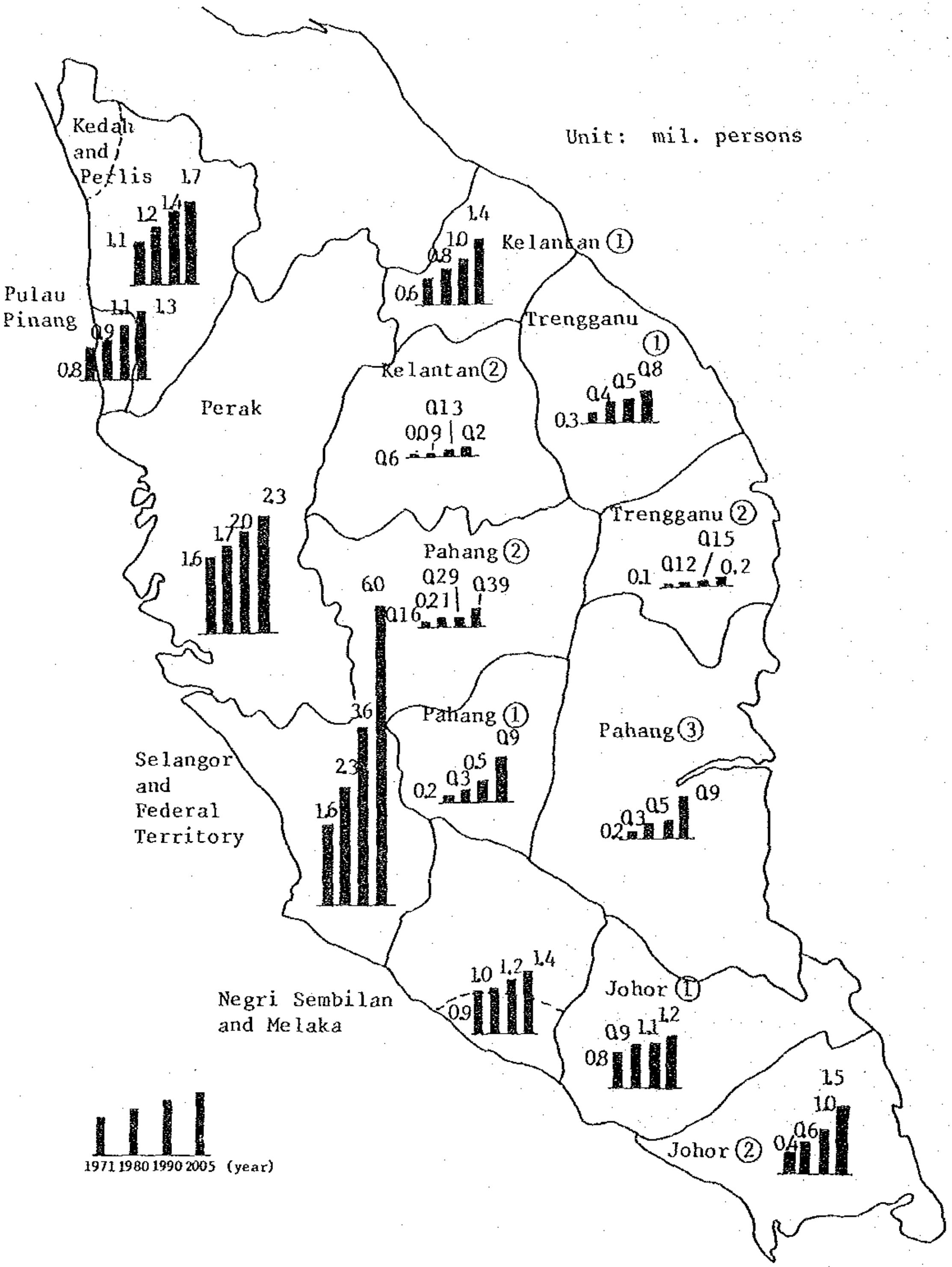


Fig. 2-2-1 Population Trend by Region

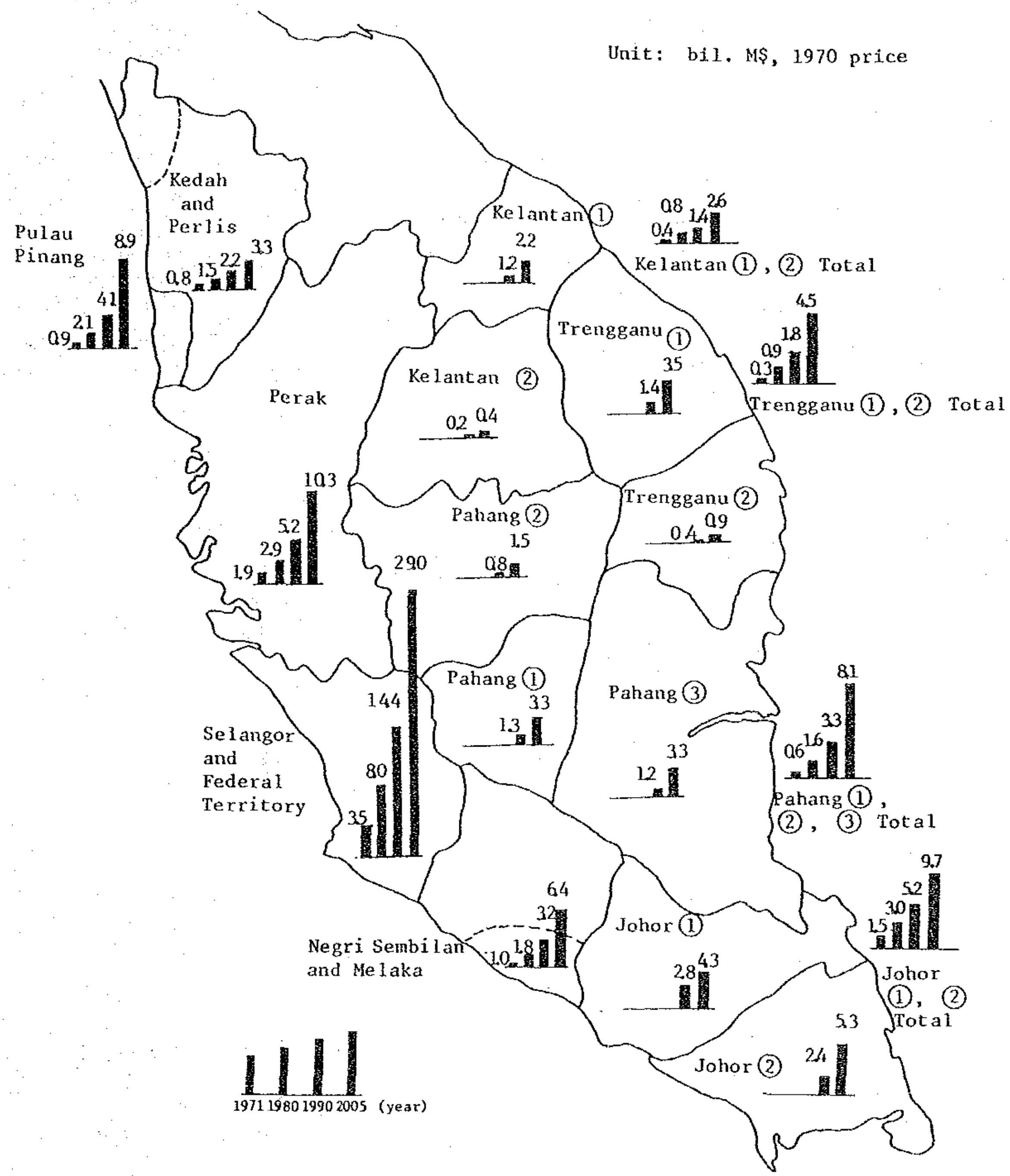


Fig. 2-2-2 GDP Trend by Region

Table 2-2-4 Heavy/Chemical Industry Projects

Project	Location	Target date of completion	Capacity	Executing agency
1. Melaka refinery	Tg. Kling (Melaka)	Undetermined	120,000 bpd	PETRONAS
2. LLN power station (2nd Phase)	Paka (Trengganu)	Undetermined	900 mw	LLN
3. Gas pipeline (for export)	Kerteh - Tg. Berhala (Trengganu)	Undetermined		PETRONAS
4. Cement/ceramic glass plant	Trengganu	Undetermined		
5. Ammonia	Trengganu	Undetermined	1,000 - 1,200 tpd	
6. Kedah cement	Pulau Langkawi (Kedah)	1985	1.2 mil. tons (clinker) 0.6 mil. tons (cement)	HICOM
	Pasir Gudang (Johor)	1985	0.6 mil. tons (cement)	HICOM
7. Sponge iron/ billet plant	Telok Kalong (Trengganu)	1985	0.6 mil. tons	HICOM
8. Steel section	Telok Kalong (Trengganu)	1989	0.3 mil. tons	HICOM
9. Cold roll mill	Telok Kalong (Trengganu)	1989	0.6 mil. tons	HICOM
10. Small engine projects				
10-1 Honda	Sungei Petani (Kedah)	1985	133 thousand units	HICOM - Honda
10-2 Yamaha	Shah Alam (Selangor)	1985	120 thousand units	HICOM - Yamaha
10-3 Suzuki	Prai (Pulau Pinang)	1985	120 thousand units	HICOM -Suzuki
11. Pulp & paper	Kuala Krai (Kelantan)	1987	0.1 mil. tons	HICOM
12. National car	Shah Alam (Selangor)	1985	100 thousand units	HICOM

Project	Location	Target date of completion	Capacity	Executing agency
13. Clinker grinding	Kemasin-Bachok (Kelantan)	Undetermined	0.4 mil. tons	HICOM
14. Ethylene complex	Trengganu	Undetermined	LDPE 0.05 mil. tons HDPE 0.05 mil. tons	HICOM - PETRONAS
15. Copper & copper alloy		Undetermined	0.03 mil. tons	HICOM
16. Clinker grinding	Kuantan	1990	0.3 mil. tons	HICOM

Source: PETRONAS, HICOM, etc.

2-3 Transportation Framework

2-3-1 Road, air and marine transportation (present and future plan)

(1) Road

(a) The total length of roads in the Peninsular Malaysia is 26,460 km (1982).

(b) Main road network

(i)	Federal Route 1:	Thailand border - Johor Bahru, along the west coast
(ii)	Federal Route 2:	Port Kelang on the west coast - Kuantan on the east coast
(iii)	Federal Route 3:	Kuantan - Kota Bharu, along the east coast

The traffic flows on these roads are visualized in Fig. 2-3-1.

(c) Other important roads

(i) East-West Highway across the northern Peninsula: Gerik - Jeli
(ii) East-South connecting road: Segamat - Gambang

(d) Road planning agencies are:

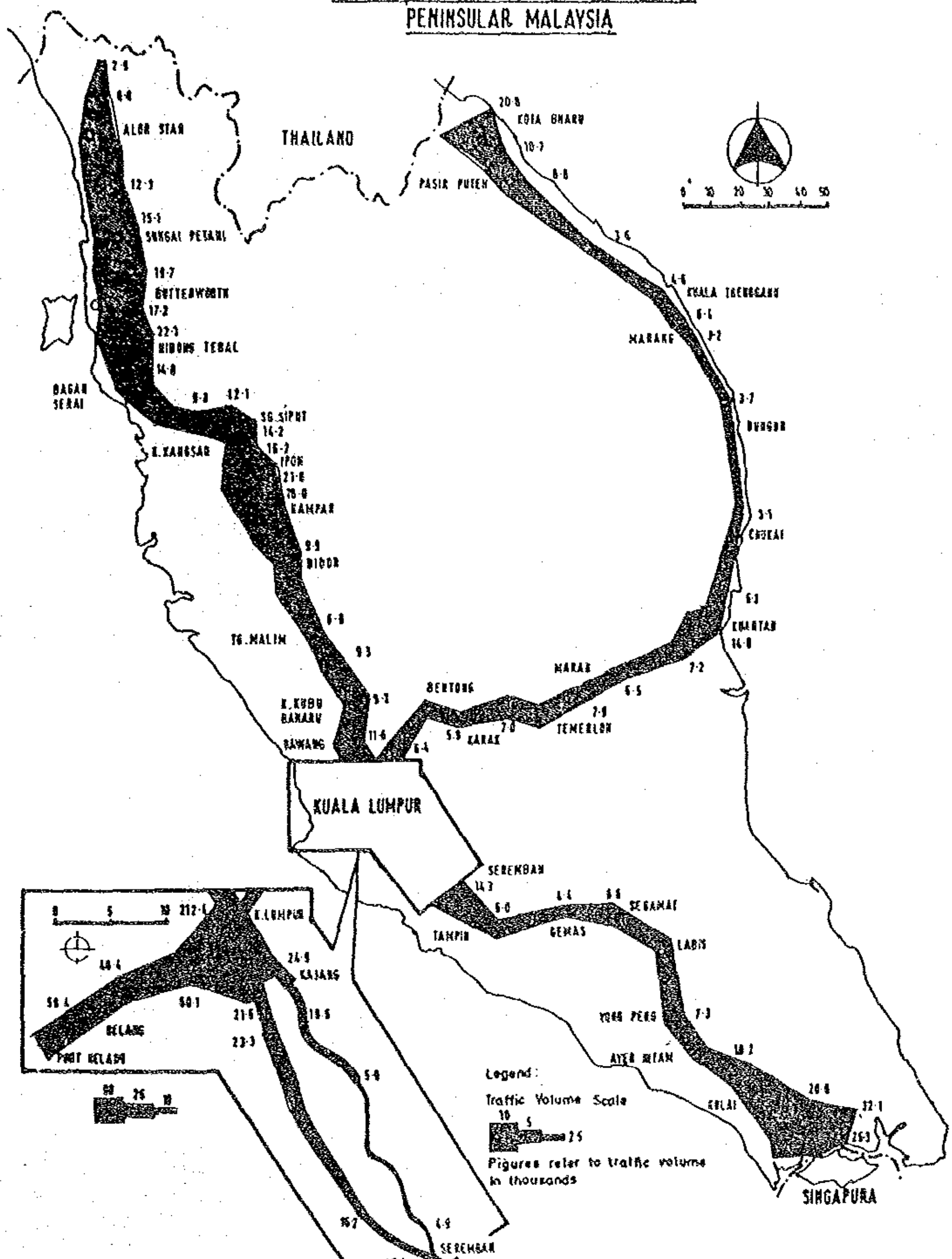
(i)	Federal roads :	Highway Planning Unit, Ministry of Works
(ii)	State roads :	State Public Works Department
(iii)	Toll expressways:	Malaysia Highway Authority

(e) The Government is planning a new network of toll expressway. A North-South link approximately parallel to the existing Federal Route 1 will be the main artery, and 14 sections are currently being planned or constructed, including Pinang bridge and Port Kelang - Kuala Lumpur - Karak link.
(Fig. 2-3-3 shows the network.)

(f) The total expressway network is scheduled to be completed in 1990, subject to some delays according to sections. The construction of the East-West Expressway connecting Karak - Kuantan, which might be serious to the viability of the New East-West Railway, is not envisaged in the near future.

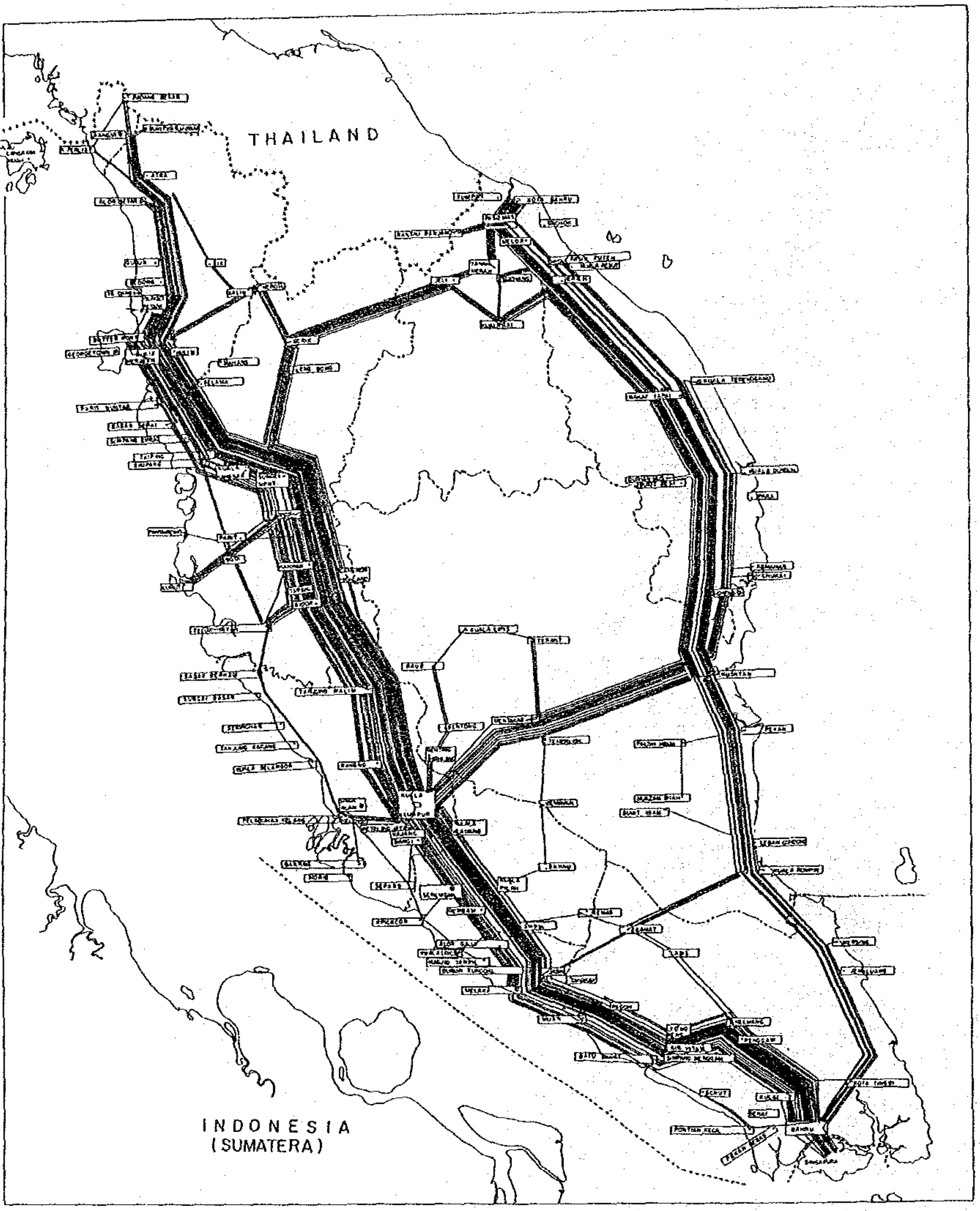
(g) At present, toll is charged not proportional to actual distance driven (open system). This will be changed to a closed system, the same system as that of Japan, when all the planned sections are opened.

AVERAGE DAILY TRAFFIC VOLUME 1982
PENINSULAR MALAYSIA



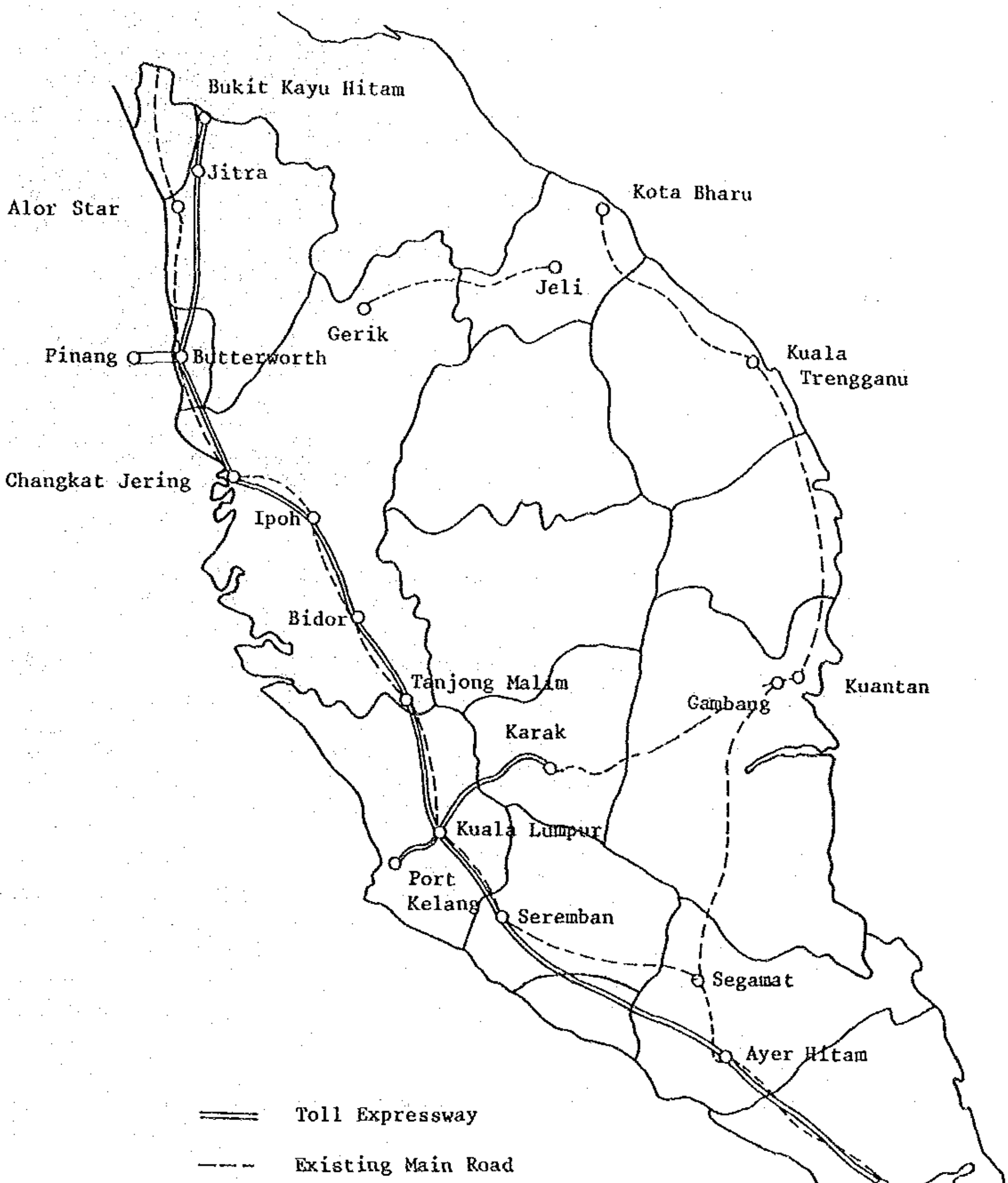
Source: Year Book of Transport Statistics, Malaysia, 1982

Fig. 2-3-1 Average Daily Traffic Volume 1982 in the Peninsular Malaysia



Source: Ministry of Transport

Fig. 2-3-2 Bus Route Map 1984



Source: Malaysia Highway Authority

Fig. 2-3-3 Road Network Plan

(2) Air transportation

(a) At present, there are nine airports in the Peninsular Malaysia for regular flights. Among them, Kuala Lumpur, Pinang and Johor Bahru are international airports and Alor Star, Ipoh, Melaka, Kuantan, Kuala Trengganu and Kota Bharu are for domestic flights. Table 2-3-1 shows the facility level of these airports.

(b) Malaysian Airline System (MAS), the national airline company of Malaysia, connects these airports. Table 2-3-2 shows the number of flights per week. Shuttle services are provided between Singapore and Kuala Lumpur jointly with Singapore Airlines.

B737 is typical in the domestic fleet. F27 is used for minor airports. Large planes like A300 and DC10 are also used for Pinang - Kuala Lumpur - Singapore services.

(c) The growth rate of air transportation has been very high with an average annual rate of 13.7% during late 70s to early 80s. (See Table 2-3-3.)

(d) The National Airport System Plan for the domestic air transportation system in Malaysia was proposed in December 1981.

This plan predicts that the annual growth rate of air passengers will be 10.7% in the 1980s and 6.7% after 1990.

(e) Larger aircrafts are expected to be introduced. Therefore, the plan places more emphasis on individual airport facility improvements, rather than on expansion of the air network.

(f) Principal cities in the Peninsular Malaysia are separated each other by distances ranging mainly from 200 to 500 km. This makes the airline look competitive with the new railway, but in reality the two modes complement each other in the overall domestic transportation system; the airline connects principal cities at the fastest speed, and the new railway offers mass-transportation at fairly high speeds and moderate fares.

Fig. 2-3-5 shows the future air network assumed.

Table 2-3-1 Airports and Their Facilities

	Runway length in meter	Biggest aircraft accommo-dation	Runway facil-ities	Radio navigational aids
INTERNATIONAL AIRPORT				
Kuala Lumpur	3475 x 45 LCN 100	B747	Daytime/ Nighttime	2NDB, 2L, LIZ/ILS VOR/DME
Pulau Pinang	3353 x 46 LCN 70	A300	Daytime/ Nighttime	L. VOR/DME, LIZ/ILS
Kota Kinabalu	2987 x 46 LCN 90	DC10	Daytime/ Nighttime	NDB, L, VOR/DME LIS/ILS
Kuching	2440 x 46 LCN 90	DC10	Daytime/ Nighttime	2NDB, VOR/DME, L
Johor Bahru	3354 x 46 LCN 100	B747	Daytime/ Nighttime	NDB, VOR/DME
DOMESTIC AIRPORTS PENINSULAR MALAYSIA				
Alor Star/Sultan Abdul Halim	1750 x 46 LCN 40	B737	Daytime/ Nighttime	NDB
Ipoh	1371 x 37	F27	Daytime	L
Kota Bharu	1981 x 46 LCN 81	B737	Daytime/ Nighttime	NDB, VOR/DME
Kuala Trengganu/ Sultan Mahmud	1371 x 36 LCN 28	F27	Daytime	L
Kuantan	2000 x 46 LCN 47	B737	Daytime/ Nighttime	L, NDB
Melaka	1372 x 37 LCN 42	F27	Daytime	L
SABAH/SARAWAK				
Sandakan	1372 x 30 LCN 20	F27	Daytime/ Nighttime	NDB, L

Source: Year Book of Transport Statistic, Malaysia, 1982

Table 2-3-2 Number of Flights per Week

	Alor Star	Pinang	Ipoh	Kuala Lumpur	Melaka	Johor Bahru	Singapore	Kuantan	Kuala Trengganu	Kota Bharu	Total
Alor Star											
Pinang											
Ipoh		14									
Kuala Lumpur	22	134	72								
Melaka				8							
Johor Bahru				42							
Singapore		81		328							
Kuantan		6		22	2		6				
Kuala Trengganu		6		50							
Kota Bharu	14	14		70		7					
Total	36	255	86	748	10	49	415	36	56	103	1796

Source: MAS, SIA, 1984

Table 2-3-3 Air Passenger Traffic by Airports

Unit: Person/Year

Airport \ Year	1976	1977	1978	1979	1980	1981	1982	Growth rate
Alor Star	19,922	21,961	19,200	25,012	40,285	63,614	83,977	27.1%
Pinang	588,577	635,829	685,483	757,111	938,286	1,099,881	1,144,784	11.7%
Ipoh	78,888	76,350	72,501	77,850	97,273	104,524	107,450	5.7%
Kuala Lumpur	1,524,410	1,842,777	1,823,201	2,013,635	2,505,851	3,044,056	3,183,014	13.1%
Melaka	27,263	14,334	10,743	10,264	10,292	12,184	7,878	-18.7%
Johor Bahru	29,752	30,624	37,057	50,204	104,083	168,472	192,664	36.5%
Kuantan	13,634	15,667	13,906	10,829	10,337	26,233	41,906	20.6%
Kota Bharu	92,448	112,075	105,394	127,782	169,776	234,884	239,448	17.2%
Kuala Trengganu	14,292	23,932	38,337	31,556	54,895	131,834	155,842	48.9%
Total	2,387,186	2,573,349	2,805,901	3,104,243	3,940,078	4,885,442	5,156,783	13.7%

Source: Year Book of Transport Statistics Malaysia

Note: Growth rate is an annual average for 1976 to 1982.

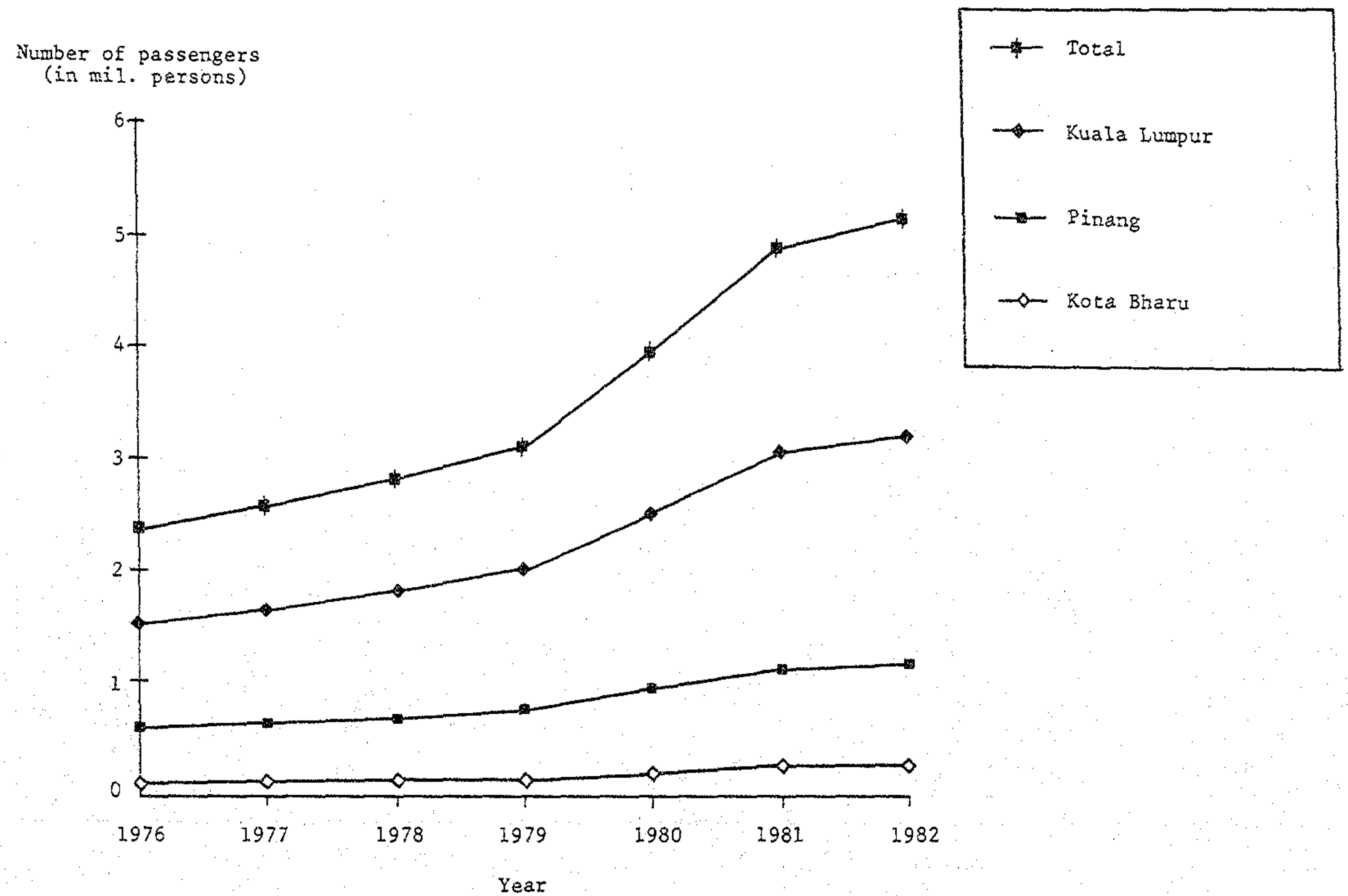


Fig. 2-3-4 Air Passenger Traffic by Airports

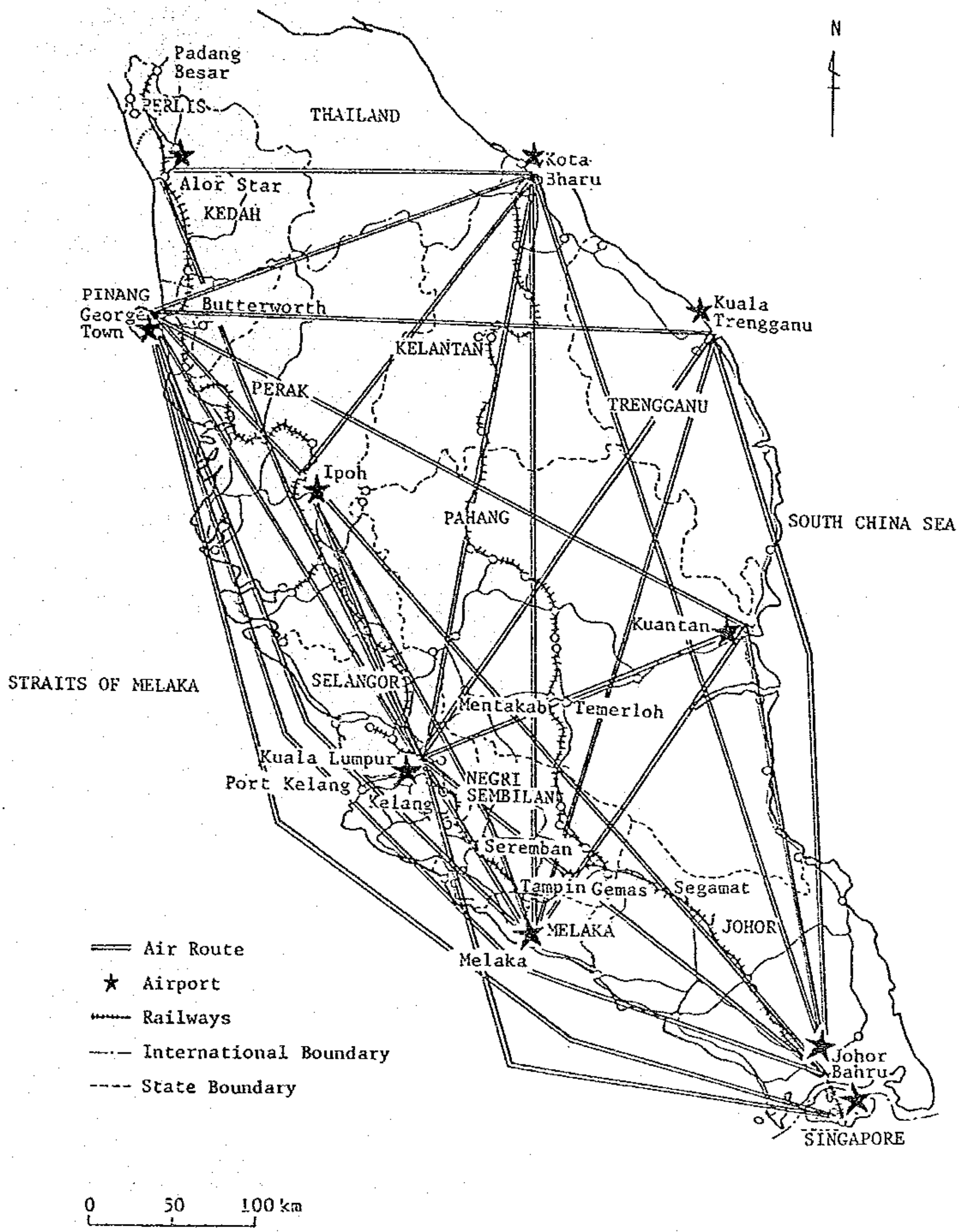


Fig. 2-3-5 Future Air Network

(3) Marine transportation

(a) There are four major ports (federal ports) in the Peninsular Malaysia, namely Port Kelang, Pinang Port, Johor Port and Kuantan Port. They are operated by individual port authority or port commission, under the jurisdiction of the Ministry of Transport.

The facilities of those ports and the volumes of cargo handled in 1982 are shown in Table 2-3-4 and the future plans are shown in Table 2-3-5.

(b) It is observed that marine transportation between Peninsula and Sabah/ Sarawak is more emphasized than that of among Peninsular Ports and this tendency seems to continue.

(c) Specialized ports now in operation or under construction.

Port Dickson	:	Petroleum
Pulau Langkawi	:	Cement
Kemaman	:	Oil development supply base

Table 2-3-4 Facilities and Cargo Volume of Major Ports in Peninsular Malaysia

Name	Facilities	Cargo Volume (1982) in thousand tons
Port Kelang	South Port 9 berths 4 Ocean-going 5 Coastal North Port 18 berths 3 Container 11 Conventional 2 Liquid bulk 2 Dry bulk Total length of berths 4,700 m	Loaded 3,070 Unloaded 4,279 Total 7,349
Pinang Port	Swettenham 2 berths 2 Conventional Butterworth 7 berths 4 Conventional 2 Container (1 with ro-ro facilities) 1 Vegetable oil Prai 1 berth 1 Dry/liquid bulk Total length of berths 1,559 m	Loaded 2,220 Unloaded 7,295 Total 9,515
Johor Port	6 berths 3 Ocean-going 1 Coastal 2 Oil Total length of berths 717 m	Loaded 1,802 Unloaded 1,340 Total 3,142

Name	Facilities		Cargo Volume (1982) in thousand tons	
Kuantan Port	6 berths		Loaded	333
	3 General cargo		Unloaded	372
	1 Mineral oil			
	1 Palm oil		Total	705
	1 Multi-purpose			
	Total length of berths	1,066 m		

Source: Year Book of Transport Statistics Malaysia 1982, Port authorities

Table 2-3-5 Expansion Plans of Major Ports in Peninsular Malaysia

Name	Expansion plan
Port Kelang	By 1990
	(i) 1,000 m General Cargo Berth (Pulau Lumut)
	(ii) Dolphin Berth for Petro-chemical
	(iii) Hazardous Material Handling Berth
	(iv) 800 m General Cargo Berth
Port Pinang	(i) 2 Container Berths (North Butterworth)
	(ii) 2 Bulk Cargo Berths
Johor Port	(i) 1 General Cargo/Dry Bulk Berth
	(ii) 1 Container Berth
Kuantan Port	None for the immediate future

Source: Year Book of Transport Statistics Malaysia 1982,
Port authorities

2-3-2 Railway

(1) Present state

(a) The Malayan Railway Administration (MRA) is a governmental administration established by the Railway Act. It has a staff of approximately 10,000 as of November 1984, and is operating some 1,650 km of routes throughout the Peninsular Malaysia.

(b) MRA operates 1,000 mm - gauged, non-electrified (diesel powered) single-tracked (except for near Kuala Lumpur) railway network. It possesses a fleet of 155 diesel locomotives, 355 coaches, and 5,365 wagons (including 3,246 bogie wagons).

(c) Most of the facilities and equipment are superannuated, and failures in the facilities and shortage of rolling stock in good condition often disrupt smooth transportation (particularly in goods traffic) and hinder the increase of railway traffic. In recent years, MRA is improving and renewing its facilities and equipment, e.g., strengthening the track structure, improving signalling systems, and introducing new rolling stock.

(d) In 1983, MRA transported around 6.59 million passengers or 1,500 million passenger-kilometers with 4.14 million train-kilometers, and 3.19 million tons of goods or 1,072 million ton-kilometers with 4.15 million train-kilometers. It earned 142.7 million M$ (56.3 million M$ from passenger service, 59.2 million M$ from goods service and 27.2 million M$ from other sources), with expenses of 186.3 million M$.

(e) The base rate for the passenger services is classified into three classes: 12.1 M¢/km for a first class passenger, 5.5 M¢/km for second class, and 3.4 M¢/km for third class as of November 1, 1984. The goods service is provided under standard rates, but actual rates are usually considerably lower than the standard rates through negotiation with each customer.

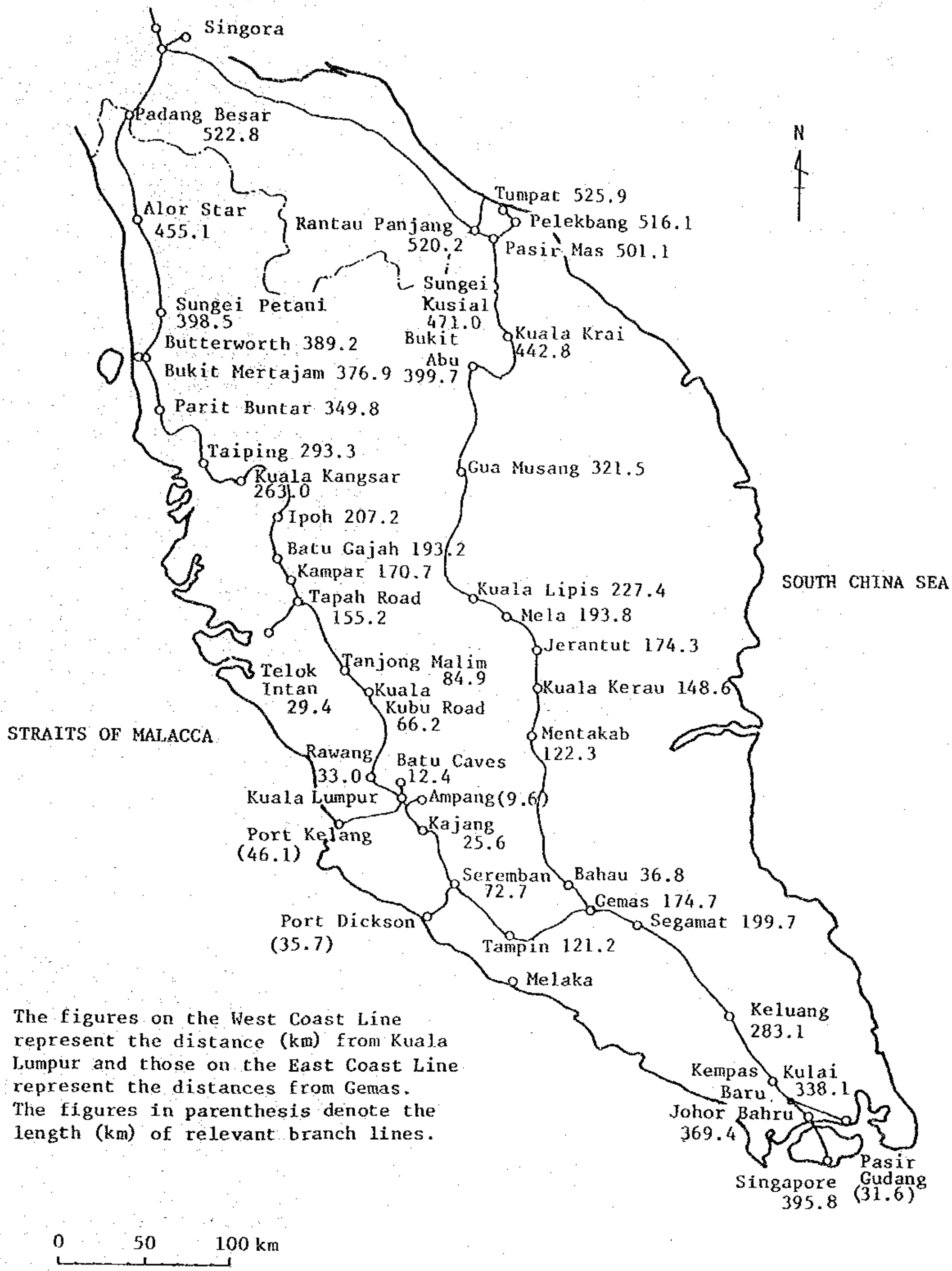
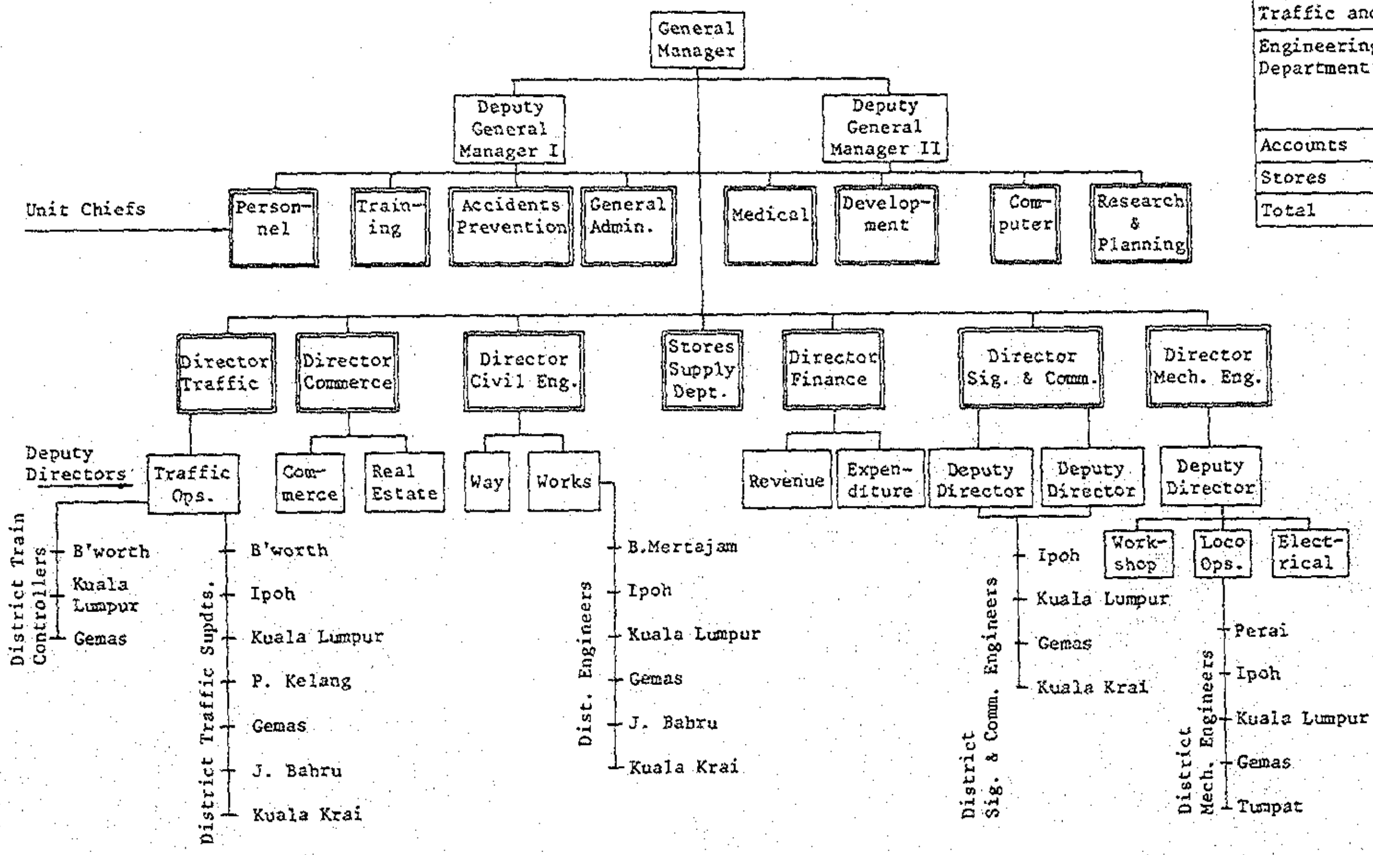


Fig. 2-3-6 Railway Network Map



Number of Staff in 1983

Administration		239
Traffic and commerce		3,208
Engineering Department	Mechanical	2,283
	Civil	3,371
	Signal and Communication	586
Accounts		153
Stores		106
Total		9,946

Year	Number of Staff
1975	10,323
1980	9,538
1981	10,012
1982	10,172
1983	9,946

Fig. 2-3-7 Organization Chart and Staff of MRA

Table 2-3-6 Route Length

Nov. 1984

No.	Name of line	Section	Length (km)
1	West Coast Line	Butterworth - Kuala Lumpur Kuala Lumpur - Singapore	389.2 395.8
2	East Coast Line	Gemas - Tumpat	525.9
3	East Coast Line Sg. Golok Branch	Pasir Mas - R. Panjang	19.1
4	Kedah Line	Bukit Mertajam - Padang Besar	145.9
5	Telok Intan Line	Tapah Road - Waf Telok Intan	29.4
6	Batu Caves Line	Kuala Lumpur - Batu Caves	12.4
7	Port Kelang Line	Kuala Lumpur - Port Kelang	46.1
8	Ampang Line	Spg. Salak Selatan - Ampang	9.6
9	Port Dickson Line	Seremban - Port Dickson	35.7
10	Pasir Gudang Line	Kempas Baru - Pasir Gudang	31.6
11	Jurong Line	Bt. Timah - Jurong	11.7
	Total		1652.4

Table 2-3-7 Trend of Annual Traffic Volume

Item / Year	Passenger traffic		Goods traffic	
	Passengers in thousand	Passenger-km in million	Tonnage in thousand	Ton-km in million
1975	6,109	1,014	2,782	822
1980	7,067	1,587	3,607	1,195
1981	7,356	1,640	3,374	1,123
1982	7,117	1,615	3,232	1,094
1983	6,591	1,499	3,187	1,072

Table 2-3-8 Traffic Volume by Month in 1983

Item / Month	Passenger traffic		Goods traffic	
	Passengers in thousand	Passenger-km in million	Tonnage in thousand	Ton-km in million
January	547	108.6	281	96.5
February	508	126.5	232	83.3
March	503	111.2	273	94.1
April	660	147.9	250	84.3
May	528	118.2	279	93.1
June	489	109.3	271	93.7
July	615	139.6	273	89.0
August	522	124.4	291	92.1
September	525	115.9	275	93.1
October	450	98.5	267	91.7
November	552	128.7	265	88.2
December	692	169.9	230	73.0

Table 2-3-9 Number of Rolling Stock
(As of Nov. 1, 1984)

Item	Type	Number
Locomotive	Class 23	15
	Class 22	39
	Class 21	24
	Class 20	22
	Class 19	10
	Class 18	10
	Class 17	15
	Class 15	20
	Total	155
Coach	Seating coach	213
	Sleeping coach	60
	Dining coach	33
	Others	49
	Total	355
Wagon	Bogie wagon	3246
	4 wheeled wagon	2119
	Total	5365

Table 2-3-10 Annual Revenue and Expenditure

Revenue Unit: mil. M$

Year	Passenger	Goods	Others	Total
1975	35.5	35.5	14.1	85.1
1980	57.9	62.8	20.1	140.8
1981	60.1	60.0	22.9	143.0
1982	60.1	57.8	24.3	142.2
1983	56.3	59.2	27.2	142.7

Expenditure Unit: mil. M$

Year	Operation and maintenance	Depreciation	Interest	Total
1975	86.5	11.1	3.7	101.3
1980	137.9	14.3	9.6	161.8
1981	158.7	15.3	11.2	185.2
1982	151.5	16.5	14.2	182.2
1983	143.6	21.8	20.9	186.3

Table 2-3-11 Train Speed and Train Formation
(as of November 1, 1984)

(A) Train speed

Item	Maximum speed
Express passenger train	80 km/h (50 mile/h)
Ordinary passenger train	72 km/h (45 mile/h)
Goods train	64 km/h (40 mile/h)

Between Butterworth and Singapore via Kuala Lumpur, the scheduled speed for the express passenger train is about 60 km/h.

(B) Train Formation

(a) Maximum number of coaches for passenger train

Express train: 12 coaches Ordinary train: 14 coaches

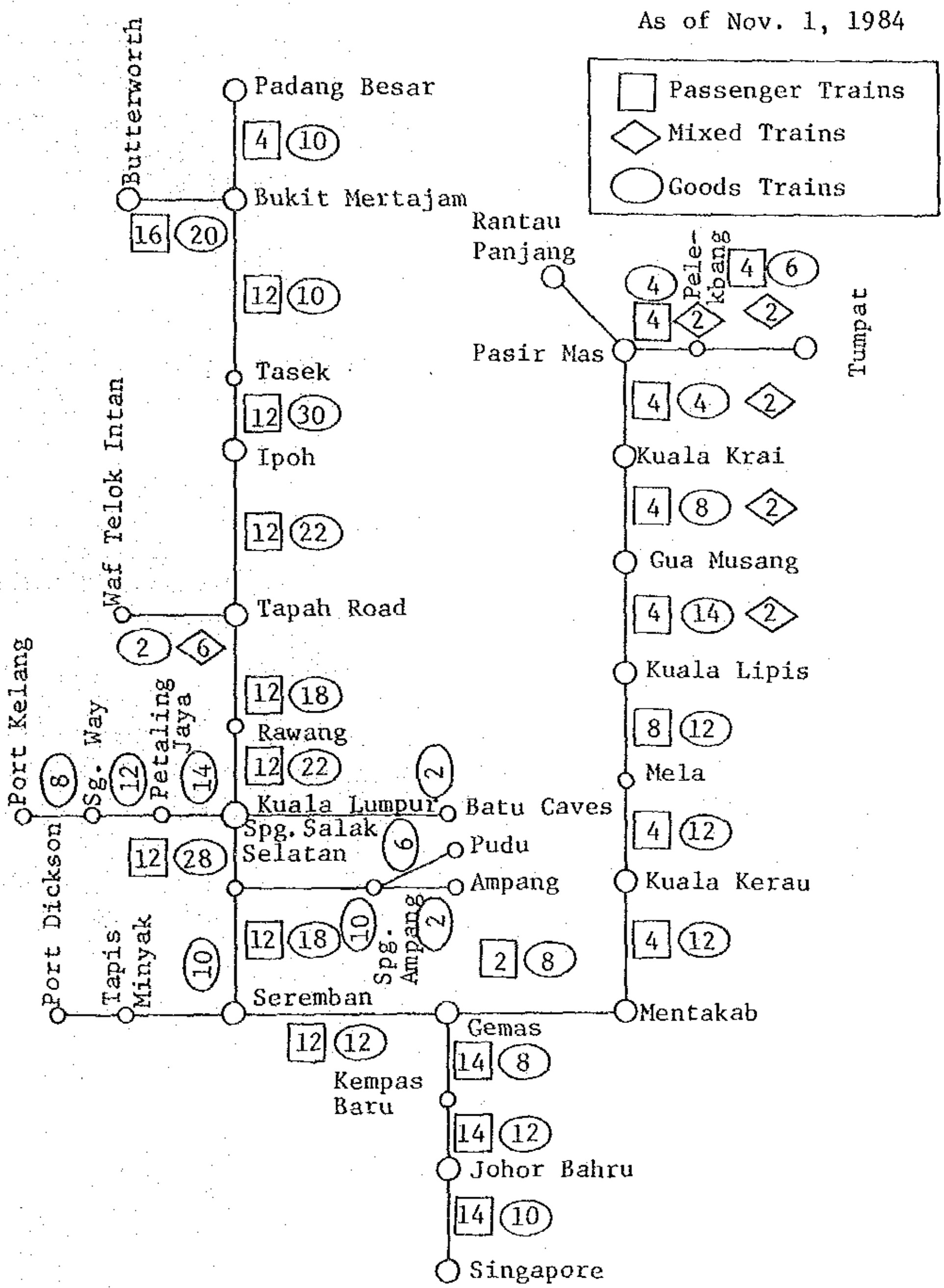
(b) Trailing load for goods train

Unit: tons

Section / Speed classification	Trunk line		Branch line
	Butterworth - Singapore (except Taiping - Padang Rengas)	Taiping - Padang Rengas	
64 km/h (40 mile/h)	800	800	900
56 km/h (35 mile/h)	930	800	930

Source: Keletapi Tanah Melayu Jadual
Waktu Kerja (No. 7)
1st September 1982

For special locomotives, the maximum trailing load is 1,000 tons except for the Taiping - Padang Rengas section.



Train Kilometers per Year

Unit: thousand train-kilometers

Train \ Year	1980	1981	1982	1983
Passenger train	4,182	4,256	4,166	4,137
Goods train	4,434	4,179	4,239	4,148

Fig. 2-3-8 Number of Trains in Operation per Day (for both directions)

(2) Prospect

(a) Projected network

The Malaysian Government considers constructing a new network of electrified, standard-gauged, high speed new railway. It consists of:

(i) The New East-West Railway

Port Kelang - Kuala Lumpur - Kuantan - Kuala Trengganu - Kota Bharu

(ii) The West Coast Railway

Butterworth - Kuala Lumpur - Johor Bahru - Singapore

including branch lines: Telok Intan Line, Port Dickson Line and Pasir Gudang Line.

(b) Maximum train speed

In the new railway network, a high-speed train operation is planned. All trains will be hauled by electric locomotives. Envisaged maximum train speeds are:

(i) Passenger train

Inter-city passenger train	160 km/h
KL urban train	120 km/h

(ii) Goods train

Express container train	120 km/h
Carload and ordinary container train	90 km/h

The demand forecast in this Study is conducted based on the above-mentioned train speed.

2-4 Passenger Traffic Demand Forecast

2-4-1 Method employed

(1) Procedure

Fig. 2-4-1 shows the demand forecast procedures adopted for this Study: namely, i) First, the current traffic volume, actual situation of various modes, passenger modal choice characteristics, etc. are analyzed to abstract therefrom important factors to be considered.

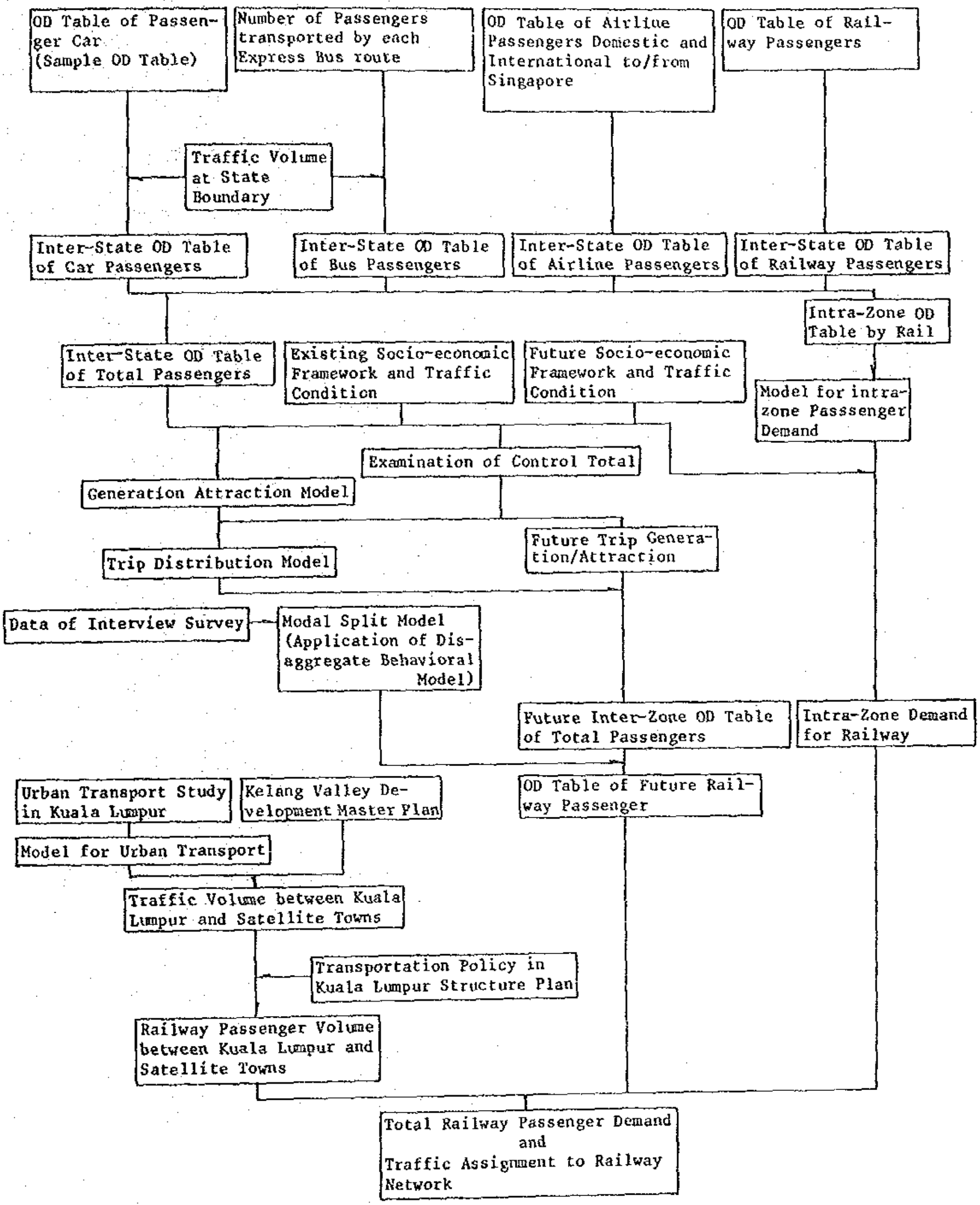


Fig. 2-4-1 Forecasting Flow Chart

ii) Second, simulation models are formulated to clarify the correlation among these factors, and the correlation between these factors and the socio-economic framework indices. iii) Third, future socio-economic framework indices, given in accordance with the policy decisions, are put into the models to estimate the future traffic.

The demand is estimated in terms of volume of the generated traffic, of the inter-zone traffic, and the modal split of these traffic. The demand of the urban traffic generated in the Kuala Lumpur area is forecasted separately.

(2) Modes analyzed

The modes that compete with the railway in Malaysia are cars, inter-city taxis, long-distance buses, and airlines. However, inter-city taxi is included in car, since the available data are poor and its share in the inter-zone traffic is considered very small.

(3) Data used for analysis

Comprehensive OD survey on the Peninsula-wide passenger flow has not been conducted so far. The Study compiles OD tables out of the data obtained from OD surveys on individual modes. Each of these OD surveys was conducted for different purposes, by different methods, and in different years. The standard year is set at 1982 when the latest data are obtainable. A direct interview survey is also conducted on the modal choice characteristics, in addition to collecting data from organizations concerned with passenger transport.

(4) Interview survey results

In order to grasp the actual situations of inter-city passengers, an interview survey is conducted questioning passengers of, i) their reasons for modal choice and ii) their present status (age, income, etc.).

It is meaningful to summarize the survey results, as they depict part of the Malaysian realities.

Samples interviewed numbered 2,700 (692 persons for Item i) and ii) mentioned above and more than 1,500 persons for Item ii)).

Survey results

(a) Reasons for modal choice

The reasons for using the railway are i) safety, ii) low fare, and iii) riding comfort. This indicates that the characteristics of the railway are well evaluated.

The reasons for not using the railway are i) slow speed, ii) ultimate origin or destination of the travel is too far from the railway stations, iii) poor frequency of service.

(b) Passenger profile

(Age)

Young people in the age group of 16 to 25 occupy a large portion of railway and long-distance bus passengers (especially bus passengers). The age group of 26 to 35 occupies a large portion of car and airline passengers. For the airline passengers, the 36 to 45 age group forms the largest portion.

(Occupation)

The ratios of service industry employees and students in the total number of passengers are high in the railway and bus passengers. The ratio of professional/technical is also high in the railway passengers.

Among car passengers, the ratios of professional/technical and administrative/managerial are high. In the airline travellers, the ratios of engineers, administrative/managerial, and commerce are high and those of service industry employees and students are low.

(Household income)

People of a higher household income are slightly larger for railway passengers than for bus passengers although there is not a significant difference in the distribution. The household income of airline passengers is high.

(Purpose of travelling)

Most of the railway and bus passengers travel for home town with the purpose of social visits. A good part of car travellers, for business/sales. The ratio of business/sales travel is extremely high among the airline passengers.

(Access/egress means)

The access/egress means that railway passengers use are 30% by bus, 40% by taxi, and 15% by car. As to bus passengers, 60% by local bus (to the bus terminal) and less than 20% by taxi (to the bus terminal). As to airline passengers 60% by taxi and 30% by car, and the local bus share is very small.

(Total travel time)

The total travel time of airline passengers is concentrated in the range of two to three hours; that of car and taxi passengers, two to five hours. As to bus passengers it is about six hours (although the distribution is wide). As to railway passengers it is distributed in the range of more than seven hours.

(Annual frequency of travelling)

As the household income increases, the annual frequency of travelling increases. It will sharply rise with the future income increases.

By occupational classification, people engaging in "administrative/managerial", "professional/technical", "factory", "construction", and "transport" travel frequently; and people in the categories of "housewife", "student", "agriculture/forestry/fishery" travel less frequently. (See Fig. 2-4-2.)

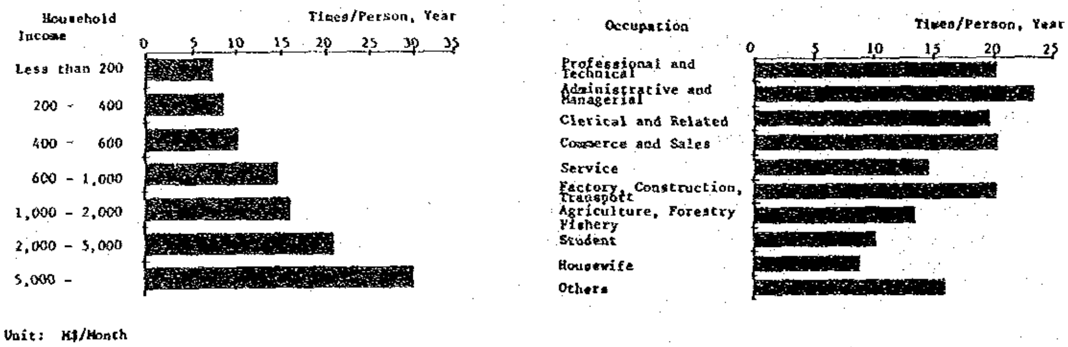


Fig. 2-4-2 Travelling Frequency - Long Distance

(5) Demand forecasting models

Inter-zone traffic

(a) Generation and attraction model

A generation and attraction model is formulated by using the compiled OD tables and the interview survey results.

For the explanatory variables, three factors are considered, that is, population in the zone, GDP in the zone and the zone area size.

$$GP = k \frac{P^{\alpha} \cdot GDP^{\beta}}{A^{\gamma}}$$

GP : Traffic volume of generation and attraction in the zone
P : Population in the zone
GDP: GDP in the zone
A : Area size of the zone
α, β, γ, k: Parameters

(b) Traffic distribution model
A gravity model is formulated by using the present traffic volume distribution pattern.

$$T_{ij} = k \frac{GP_i^{\alpha} \cdot GP_j^{\beta}}{D_{ij}^{\gamma}}$$

T_{ij} : Traffic volume between zone i and j
GP_i, GP_j: Traffic volume of generation and attraction in zones i and j, respectively
D_{ij} : Road length between zone i and j
k, α, β, γ: Parameters

The primary values obtained by the gravity model (T_{ij}) are adjusted by Fratar Method to coincide with generation and attraction (GP) of each zone calculated in the foregoing (5)(a).

(c) Modal split model

Estimation is made using the subsequent models:

- where the parameters (i.e., α, β and γ in the formula) are calculated, employing the disaggregate behavioral model analysis, based on data from the interview surveys, and

- where the parameters and variables (i.e., c_0, c_1 and c_2 in the formula) are calculated, employing the aggregate model, based on data from the OD tables for actual traffic flows.

$$\text{Share of Mode i in the volume of traffic carried by Mode i and Mode j} = \frac{1}{1 + \text{Exponential (Zi)}}$$

where:

$Zi = C_0$ (Exponential for Mode i)

$+ C_1$ (Dummy variable showing that originating zone and destination zone are connected by one railway, when Mode j is railway)

$+ C_2$ (Dummy variable showing that originating zone and destination zone are adjacent, when Mode j is railway)

$+ \alpha \times (Ti - Tj)$

Ti: (Travel time by Mode i), Tj: (Travel time by Mode j)

$$+ \beta \times \frac{Fi - Fj}{I}$$

Fi: (Travel expense by Mode i), Fj: (Travel expense by Mode j)

I: (Traveller's household income)

$+ \gamma \cdot Rl$

Rl: (Road length between originating zone to destination zone)

α, β, γ, C_0: Parameters

Intra-zone traffic

The gravity model is used to estimate the railway passenger traffic volume, using present railway traffic volume and related data.

(6) Premises for forecast

Between zones a city pair is chosen, each of the pair being a principal city in the zone, thereby to represent the various possible travels over the two zones. The calculation method for each explanatory factor is shown below.

(a) Travel time (= T)

(i) Railway: (T = on-vehicle time between stations + access/egress time + transfer time + waiting time)

where:

On-vehicle time between stations;

On the existing railway portion, average time calculated from the time table is used. On the new railway portion, 120 km/h for double track line and 105 km/h for single track line are used as the average speeds to calculate on-vehicle time.

Access/egress time;

Fixed, ranging 30 to 50 minutes according to zones, with reference to the survey, zone size and population distribution.

Transfer time;

Assumed 30 minutes for transfer between the new railway and the existing railway, and 20 minutes between new lines.

Waiting time;

Average time calculated based on the survey result.

(ii) Bus: (T = on-vehicle time between bus terminals of major cities + access/egress time + waiting time)

where:

On-vehicle time between bus terminals;

Calculated assuming the bus speeds of 50 km/h on ordinary roads and 70 km/h on toll expressways.

Access/egress time and
Waiting time;

Same as in (i).

(iii) Car/taxi: (T = distance between centers of zones ÷ travelling speed)

where:

travelling speed;

Assumed as 50 km/h on ordinary roads and 70 km/h on toll expressway, considering the time necessary to run through the congested area at both ends, and time for rest.

(iv) Airline: (T = flying time between airports + access/egress time + time required for check-in at the airport)

where:

Flying time between airports;

Time according to time table.

Access/egress time;

Fixed, ranging 20 to 40 minutes according to zones where the airports are located, with reference to the survey, zone size and population distribution. As to the zones without airport, the time to the nearest airport by road is considered.

Time required for check-in at the airport;

Assumed as 40 minutes with reference to the survey.

(b) Fare (= F)

(i) Railway: (F = on-rail fare + expenses for access/egress)

where:

Fare;

The current second class rate is applied.

Expenses for access/egress;

An average of 3M$ is applied based on the survey result.

(ii) Bus: (F = bus fare between terminals + expenses for access/egress)

where:

Fare;

The fare for an air-conditioned bus is applied. The toll is to be divided by the number of passengers in a bus.

Expenses for access/egress;

An average of 3M$ is applied based on the survey result.

(iii) Airline: (F = airfare between airports + expenses for access/egress)

where:

Fare;

The current airfare is applied.

Expenses for access/egress;

An average of 20M$ is applied based on the survey result.

(iv) Car/taxi: (F = (car driving cost + toll) ÷ (number of persons travelling in a car))

where:

Car driving cost;

The fuel and oil costs are included as perceptible expenses, while depreciation, repair, and maintenance costs are excluded.

Toll;

2.5M¢ per car-kilometer is applied based on the current toll system.

Number of persons travelling in a car;

2.49 persons/car is applied based on the survey result.

(c) Average household income of inter-zone passenger

The average household income is calculated with following process:

(i) First, the average household income in each zone is obtained from the actual survey result and the GDP per capita.

(ii) Next, the average value of the originating zone and the destination zone is applied to the household income for each traffic.

(d) Road distance

The road distance table between major cities is used.

(7) "Control Total"

Analyzing the trend of gross traffic volume in the Peninsula in terms of the number of railway and airline passengers, and registered vehicles, the growth rate of the annual travelling frequency per capita in Malaysia has exceeded that of the GDP per capita up to recently.

This growth rate of travel frequency is considered to slow down in future as the GDP per capita further increases, as the data in Japan shows. The estimated growth rate of GDP per capita, the travelling frequency and the total traffic in future are shown in Appendix 2-4-1.

Using this, total traffic is estimated, and, by this, trip generation and attraction and traffic distribution are controlled.

2-4-2 Forecast result

(1) Passenger traffic volume

Table 2-4-1 shows the numbers of long distance trips which are served by super express or express trains and the short distance trips which are served by the ordinary trains.

The total traffic volume in the year 2005 is 303,453 thousand persons per year, about three times as large as the volume in the year 1982.

The railway share of the total traffic volume is 10.9% (13.7% in long distance trips but 8% in short distance trips, each in the year 2005).

Table 2-4-1 Passenger Traffic Volume

Network C, year 2005

Unit: Thousand persons/year

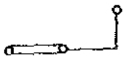
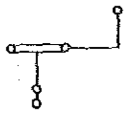
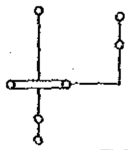
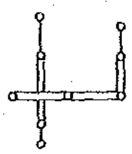
	Total Traffic Volume (A)	Railway Traffic Volume (B)	Ratio (%) (A)/(B)
Total	303,453	33,115	10.9
Long distance trip	153,264	21,063	13.7
Short distance trip	150,189	12,052	8.0

The Table 2-4-2 shows long distance passenger traffic by mode by Network.

As the number of short distance railway trips varies little, regardless of the train speed, it is excluded in the table.

Table 2-4-2 Passenger Traffic Demand and Share
(Inter-zone Long Distance Travel)

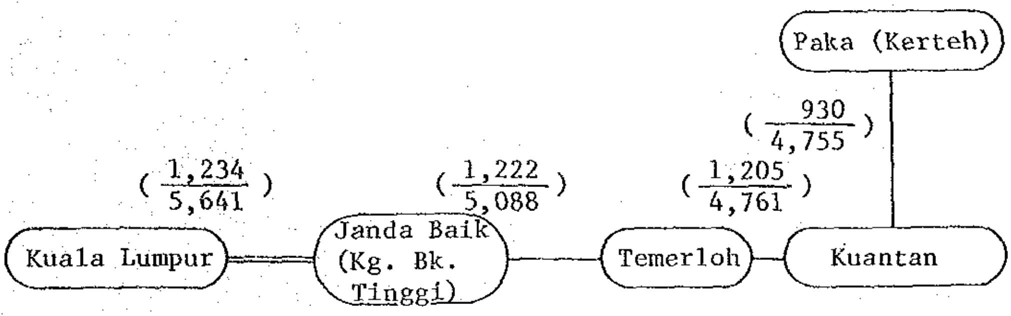
Unit: thousand persons

Network	Year	Railway	(Projected Railway)	Bus	Car/Taxi	Airline	Total
Existing Railway	1982	4,367 8.0%		15,346 28.1%	32,460 59.4%	2,513 4.6%	54,686 100.0%
A	1991	7,253 8.9%	(2,889 3.5%)	22,154 27.1%	48,404 59.2%	3,889 4.8%	81,700 100.0%
	2005	13,977 9.1%	(5,567 3.6%)	40,790 26.6%	90,366 59.0%	8,131 5.3%	153,264 100.0%
B	1996	11,962 11.5%	(10,016 9.6%)	27,260 26.2%	59,831 57.5%	5,041 4.8%	104,094 100.0%
	2005	17,754 11.6%	(14,868 9.7%)	39,646 25.9%	87,895 57.3%	7,969 5.2%	153,264 100.0%
C	2001	18,014 13.7%	(17,444 13.3%)	33,682 25.6%	73,659 56.0%	6,182 4.7%	131,537 100.0%
	2005	21,063 13.7%	(20,396 13.3%)	39,032 25.5%	85,774 56.0%	7,395 4.8%	153,264 100.0%
D	2001	18,750 14.3%	(18,157 13.8%)	33,388 25.4%	73,284 55.7%	6,115 4.6%	131,537 100.0%
	2005	21,920 14.3%	(21,256 13.9%)	38,759 25.3%	85,268 55.6%	7,317 4.8%	153,264 100.0%

Note : 1. The figures in the column "Car/Taxi" include the traffic on short-cut routes (Butterworth - Kota Bharu, Kuala Lumpur - Kuala Lipis - Kota Bharu, Segamat - Kuantan, Johor Bahru -Kuantan).

2. The figures in the column "Railway" include the demand for the projected railway and the existing railway.

Network A
1991



Note :

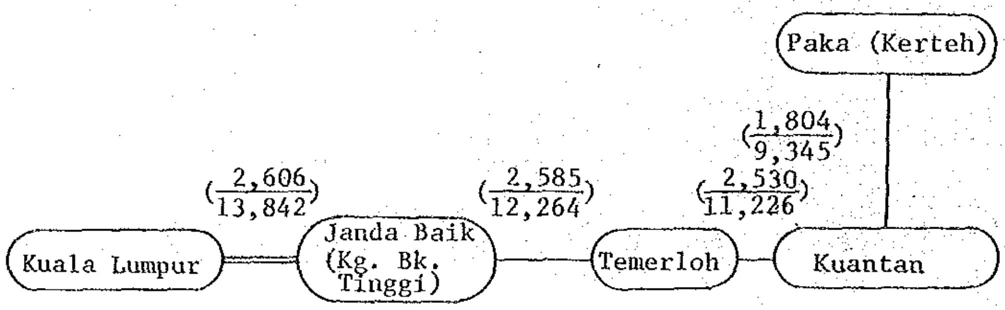
1. Figures above and below the bar (—) show railway passenger traffic volume and total passenger traffic volume in the year 1991, respectively.

2. Excluding traffic volume within each zone and short distance traffic between zones.

3. Unit: thousand persons/year, for each direction

Fig. 2-4-3 (A) Passenger Traffic Demand at Cross Section

Network A
2005



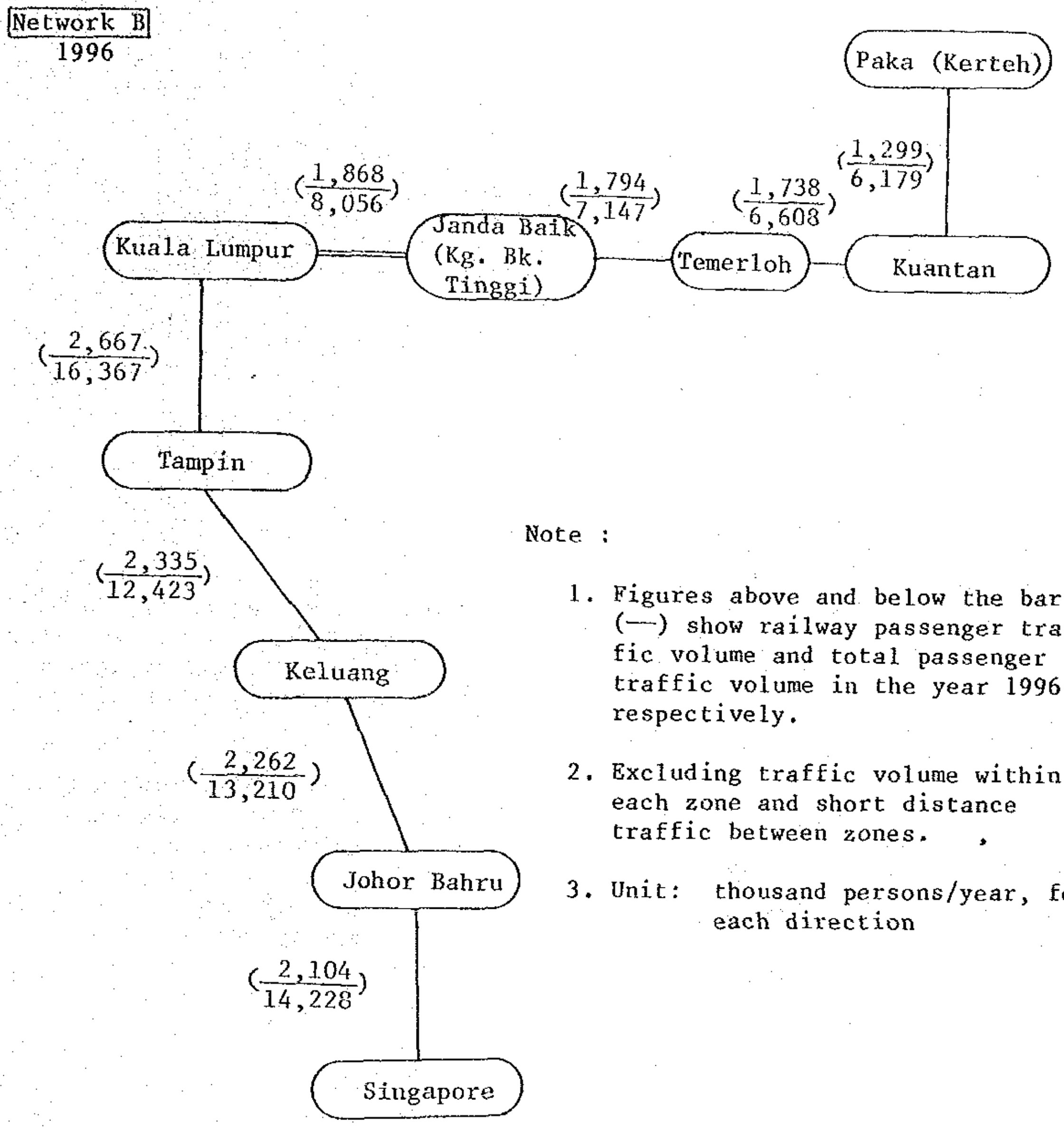
Note :

1. Figures above and below the bar (—) show railway passenger traffic volume and total passenger traffic volume in the year 2005, respectively.

2. Excluding traffic volume within each zone and short distance traffic between zones.

3. Unit: thousand persons/year, for each direction

Fig. 2-4-3 (B) Passenger Traffic Demand at Cross Section



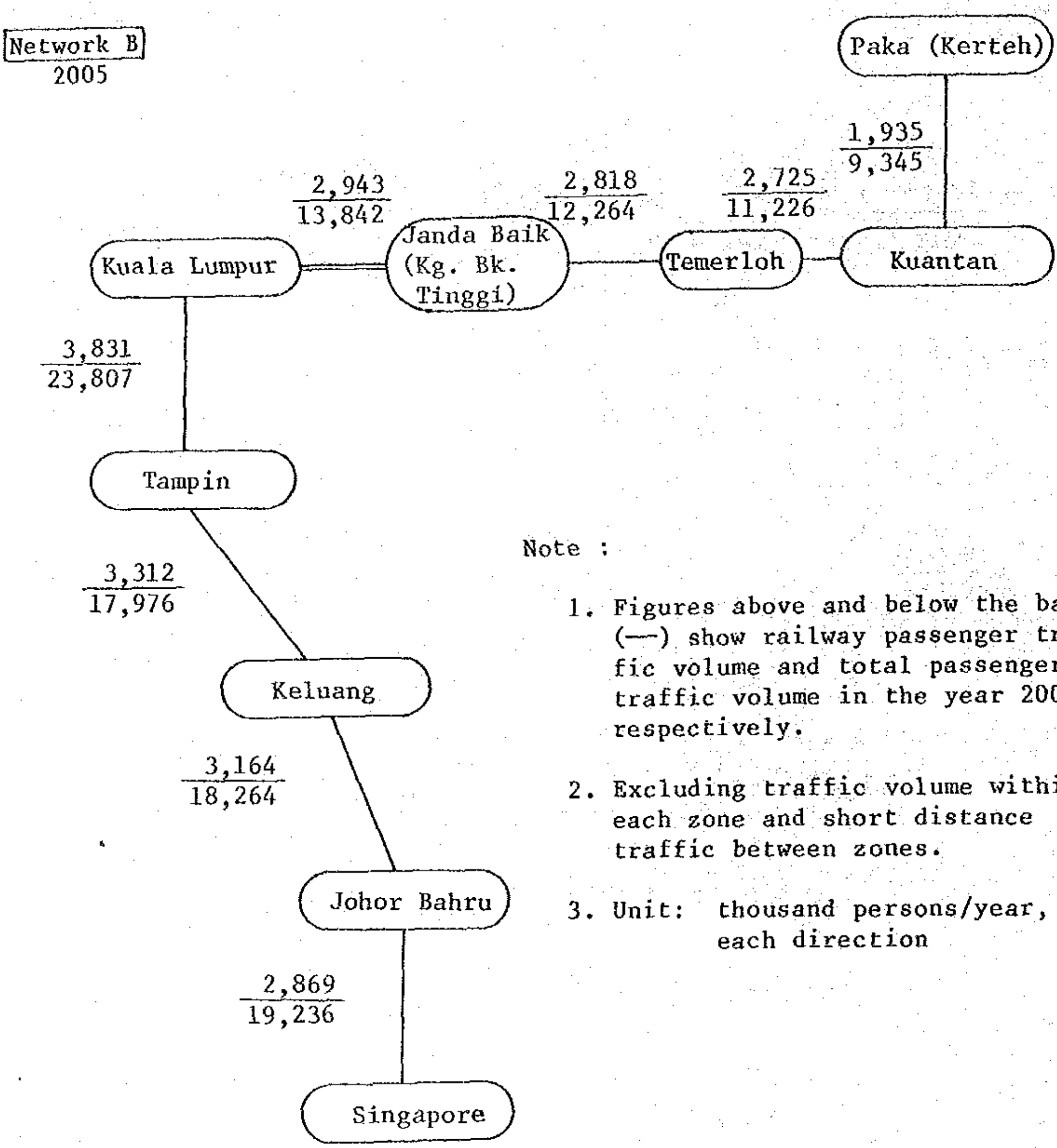
Note :

1. Figures above and below the bar (—) show railway passenger traffic volume and total passenger traffic volume in the year 1996, respectively.

2. Excluding traffic volume within each zone and short distance traffic between zones.

3. Unit: thousand persons/year, for each direction

Fig. 2-4-3 (C) Passenger Traffic Demand at Cross Section



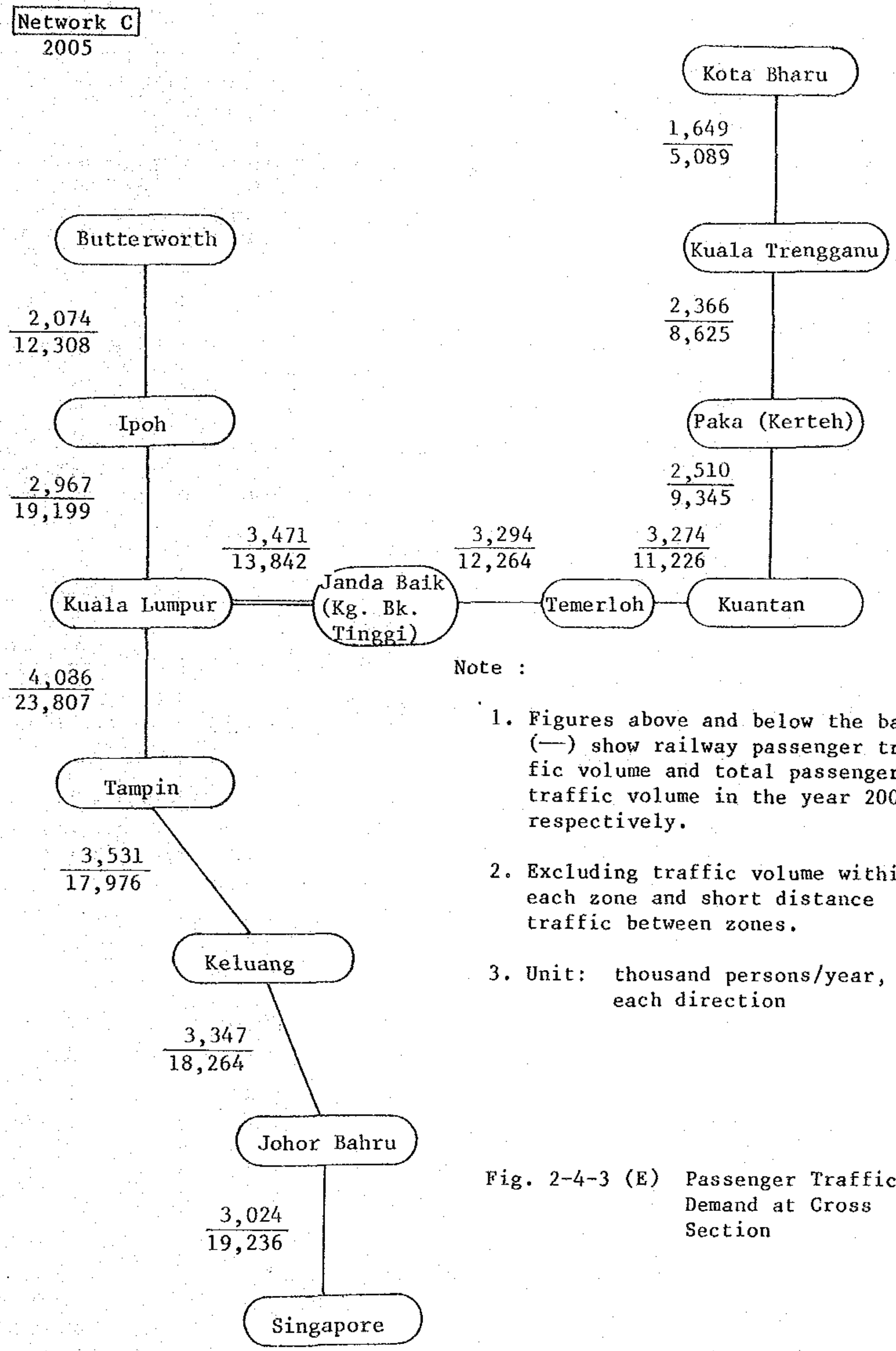
Note :

1. Figures above and below the bar (—) show railway passenger traffic volume and total passenger traffic volume in the year 2005, respectively.

2. Excluding traffic volume within each zone and short distance traffic between zones.

3. Unit: thousand persons/year, for each direction

Fig. 2-4-3 (D) Passenger Traffic Demand at Cross Section



Note :

1. Figures above and below the bar (—) show railway passenger traffic volume and total passenger traffic volume in the year 2005, respectively.

2. Excluding traffic volume within each zone and short distance traffic between zones.

3. Unit: thousand persons/year, for each direction

Fig. 2-4-3 (E) Passenger Traffic Demand at Cross Section

(2) Observations

(a) The railway share of long distance traffic is estimated to increase from 8.0% in 1982 (base year) to 13.7% in the year 2005 (Network C), and 14.3% (if Network D is constructed).

(b) The railway share will increase as the network expands. Without completion of the projected network, the railway share should decline, due to the expansion of highway networks and to the increase in the GDP per capita. The share would go down to 5.9% in 1991, from the present 8.0% share.

(c) The effect of double-tracking is as follows.
If the section between Janda Baik and Paka is double-tracked in Network A, the railway traffic in 1991 would increase by 2.6% in terms of passenger-kilometer.

If the section between Kuala Lumpur and Johor Bahru is double-tracked in Network B, the railway traffic in 1996 would increase by 2.3%, and in case that the sections between Johor Bahru and Ipoh, Janda Baik and Trengganu in Network C is double-tracked, the traffic in the year 2005 would increase by 5.4%.

(d) The airline share will also increase along with the evolution in GDP per capita. Each mode is expected to serve the increasing traffic in harmony with its own characteristics.

(e) The New East-West Railway share is expected to become considerably high since this Study assumes no highway construction in the relevant area.

(f) Forecast shows that short distance railway traffic demand, served mostly by ordinary trains, will reach about one third of the total railway traffic in terms of number of passengers (Table 2-4-1). However, its contribution to the revenue will be small.

Table 2-4-3 Inter-Zone Short Distance and Intra-Zone Railway Traffic

Unit: thousand persons/year, each direction

	Zone	1991		1996		2001		2005	
		Inter-zone	Intra-zone	Inter-zone	Intra-zone	Inter-zone	Intra-zone	Inter-zone	Intra-zone
New East-West Railway	Selangor (Kuala Lumpur)		-		-		-		-
		474		660		894		1000	
	Pahang (Temerloh)		17		20		23		26
		27		37		51		65	
	Pahang (Kuantan)		10		11		13		15
		43		57		74		88	
	Trengganu (Paka)		9		11		12		14
		-		-		81		95	
	Trengganu (K. Trengganu)		-		-		21		23
		-		-		436		506	
	Kelantan (Kota Bharu)		-		-		57		62
West Coast Railway	Singapore		-		-		-		-
		-		471		608		720	
	Johor (Johor Bahru)		-		13		15		16
		-		226		280		319	
	Johor (Keluang)		-		429		460		485
		-		18		21		23	
	N. Sembilan/Melaka (Tampin)		-		44		49		53
		-		644		789		896	
	Selangor (Kuala Lumpur)		-		-		108		118
		-		-		942		1045	
	Perak (Ipoh)		-		-		276		301
		-		-		709		797	
	Pinang (Butterworth)		-		-		10		11

* Description in parentheses shows the main station in each zone.

(3) Sensitivity analysis

(a) It is conceivable that the assumptions given for this Study may deviate over a long span of forecast extending to the year 2005 due to unforeseeable changes in socio-economic conditions.

For instance, if GDP grows at a lower rate than assumed, the growth rate of per capita trip will slow down, to result in traffic demand lower than Base Case.

(b) Even if population grows at a lower rate than assumed, the growth rate of passenger traffic demand will be only slightly affected, provided that GDP grows at more or less the same rate as assumed.

(c) If a highway is constructed between Kuantan and Karak, the New East-West Railway traffic in the year 2005 will be significantly affected with a 9.5% decrease in terms of passenger-kilometer, but about 3% decrease in the entire railway network.

(d) If toll charges for Expressway are raised four times as high as now (400%) in the year 2005, the traffic volume in the West Coast Railway will increase by about 10% in terms of passenger-kilometer, and in the New East-West Railway by 1.7%.

If the railway fares are raised to 150%, the traffic will decrease by about 5%.

If the fares or toll charges are revised now, the impact would be three times larger than in the year 2005. This is because their impact decreases, as the income per-capita increases.

(e) Generally, it can be said that the total traffic volume will be affected more by economic growth, and modal choice will be affected more by required travel time (or travel speed).

(f) Delay in the planned industrial development of the south Trengganu will affect the railway passenger traffic 1 to 3%, when the delay causes the GDP growth rate of the Trengganu State to stay at the national average.

Table 2-4-4 Result of Sensitivity Analysis

(a) By deviation in economic growth rate

Unit: percentage

Year	Low Case (Ratio to Base Case)			High Case (Ratio to Base Case)		
	GDP	GDP per Capita	Railway Traffic Volume in Passenger-km	GDP	GDP per Capita	Railway Traffic Volume in Passenger-km
1991	96.7	96.7	96.7	103.4	103.4	103.4
1996	92.2	92.2	92.2	108.4	108.4	107.7
2001	87.9	87.9	88.8	113.6	113.6	107.4
2005	84.6	84.6	88.6	118.0	118.0	106.6

Note: Growth rate (%)

Period	Base Case	Low Case	High Case
1980 - 1985	6.4	6.4	6.4
1985 - 1990	6.0	5.5	6.5
1990 - 2005	5.0	4.0	6.0

(b) By deviation in population growth rate

Unit: percentage

Year	Low Case (Ratio to Base Case)		
	Population	GDP per Capita	Railway Traffic Volume in Passenger-km
1991	99.6	100.4	99.9
1996	97.7	102.4	99.8
2001	95.8	104.4	98.3
2005	94.3	106.0	96.4

Note: Growth rate (%)

Period	Base Case	Low Case
1980 - 1985	2.5	2.5
1985 - 1990	2.5	2.5
1990 - 2005	2.3	1.9

(c) By construction of expressway between Karak and Kuantan

Unit: percentage in passenger-km, 2005

Item		Ratio to Base Case		
		Network A	Network C	Network D
		Single Track	Single Track	Double Track
New East-West Railway		90.5	92.7	92.5
West Coast Railway	Southern Portion	—	99.8	99.4
	Northern Portion	—	99.0	98.8
Total		90.5	96.9	96.6

(d) By expressway toll rate revision

Unit: percentage in passenger-km, 2005

Item		Ratio to Base Case		
Railway fare revision		100.0	150.0	150.0
Expressway toll rate revision		400.0	400.0	100.0
New East-West Railway		101.7	97.8	94.5
West Coast Railway	Southern Portion	110.1	106.7	95.8
	Northern Portion	109.5	106.2	95.3
Total		106.8	103.1	95.1

(e) By lowering down of GDP growth rate to the national average in the east coast

Unit: percentage in passenger-km, 2005

Item		Ratio to Base Case			
Network		A	B	C	D
New East-West Railway		97.0	97.0	98.4	98.4
West Coast Railway	Southern Portion	-	99.5	99.5	99.5
	Northern Portion	-	-	99.6	99.6
Total		97.0	98.7	99.1	99.1

Where; Deviation of socio-economic frame in Trengganu State from Base Case

GDP --- 78.9%

Population - 100.0%

2-4-3 Urban transport around Kuala Lumpur

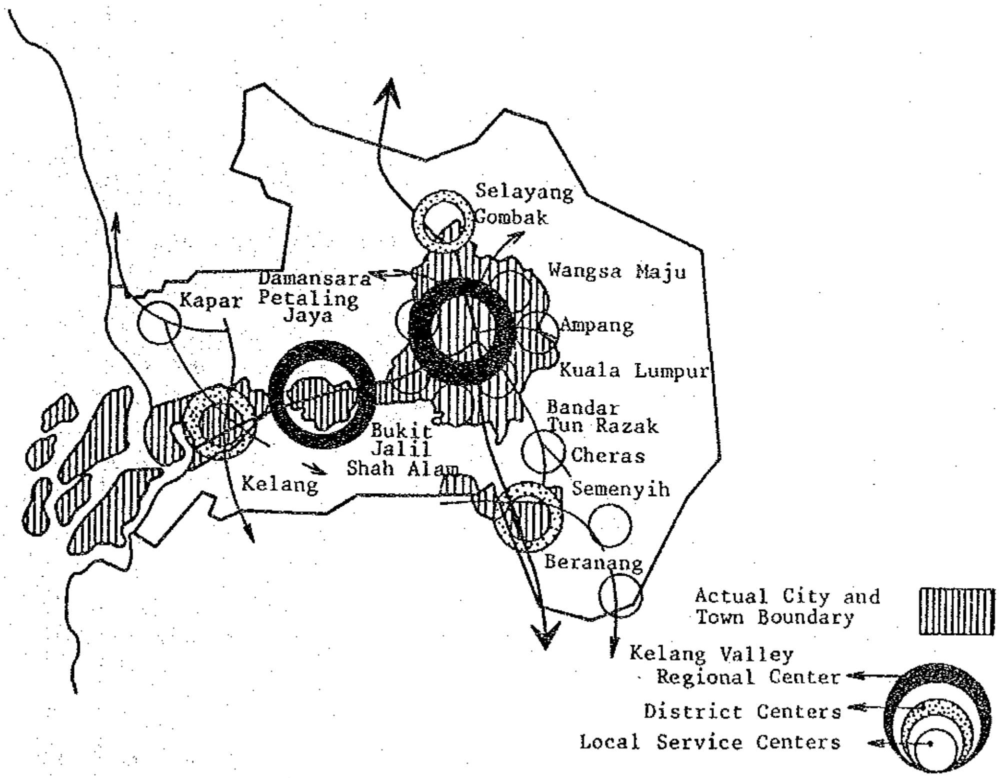
Along the projected railway, especially around Kuala Lumpur, various urban development projects are now being implemented.

They are meant to cope with the rapid concentration of population and serious increase of road traffic in the area. A number of various measures are considered, for example, introducing rail transport there, dispersing the population, etc.

The projected railway is basically for inter-State traffic, but it will definitely play an important role in this area, too.

(1) Outline of the Kelang Valley Development Plan

The Plan aims to develop a multi-nuclear area, incorporating the existing cities, specializing each city in function, thereby eliminating excessive concentration of the urban functions and population in Kuala Lumpur, and avoiding uncontrolled expansion of the area.



Source: Kuala Lumpur Structure Plan

Fig. 2-4-4 The Kelang Valley: Hierarchy of Urban Centers 1990 - 2000

Table 2-4-5 Urban Development Plan for Kelang Valley

Unit: thousand persons

City/Town \ Year	Population 1980	Population 1990	Population 2000	Arrangement	Important function
Kuala Lumpur	977	1490	2150	National Center	National administration, Business, Commerce
Shah Alam	20	260	370	State Center	State administration, Business, Commerce, Industry
Petaling Jaya	220	280	400	District Center	District administration, Transport industry
Kelang	203	300	430	District Center	District administration, Transport industry
Bandar Baru Bangi	33	125	180	District Center	District administration, Institute, Light industry
Bandar Baru Selayang	4	60	130	District Center	District administration, Light industry
Janda Baik (Kg. Bk. Tinggi)	-	100	230	Twin National Center	Institution, Commerce, Recreation, Housing
Other Urban Area	197	268	429		
Rural Area	365	501	671		

Source: Kelang Valley Secretariat and others

(2) Railway's role in urban transport

The traffic demand between Kuala Lumpur and several cities in the outskirts involves trip with distances ranging from 20 to 50 km which seems to be exceed the LRT service distances. The volume of traffic is beyond the transportation capacities of stage buses and minibuses. This type of traffic demand can be well served by the projected railway.

Fig. 2-4-5 shows the role of each mode in the urban transport.

Fig. 2-4-6 shows a concept of public transportation system in and around the Kuala Lumpur area. The area consists of Kuala Lumpur, Petaling Jaya, Selayang, Ulu Kelang and Ampang/Cheras.

- LRT will handle the traffic demand between the Kuala Lumpur City central area and its suburbs. Inter-station distances are short and the travelling speed is slow.

- The aero-bus serves business trips and the like, of comparatively short distances in the municipal area of the City.

- The railway is to serve the demand characterized as middle/long distance, high speed and frequent service. The distance between stations will be long and the railway must be backed up by secondary transportation measures.

- The projected railway is to serve the demand between Kuala Lumpur and the outskirt towns, i.e. Shah Alam, Kelang, Bangi and Janda Baik (Kg. Bukit Tinggi). Intra-urban transport and inter-urban transport between the outskirt towns by the projected railway is not taken into account.

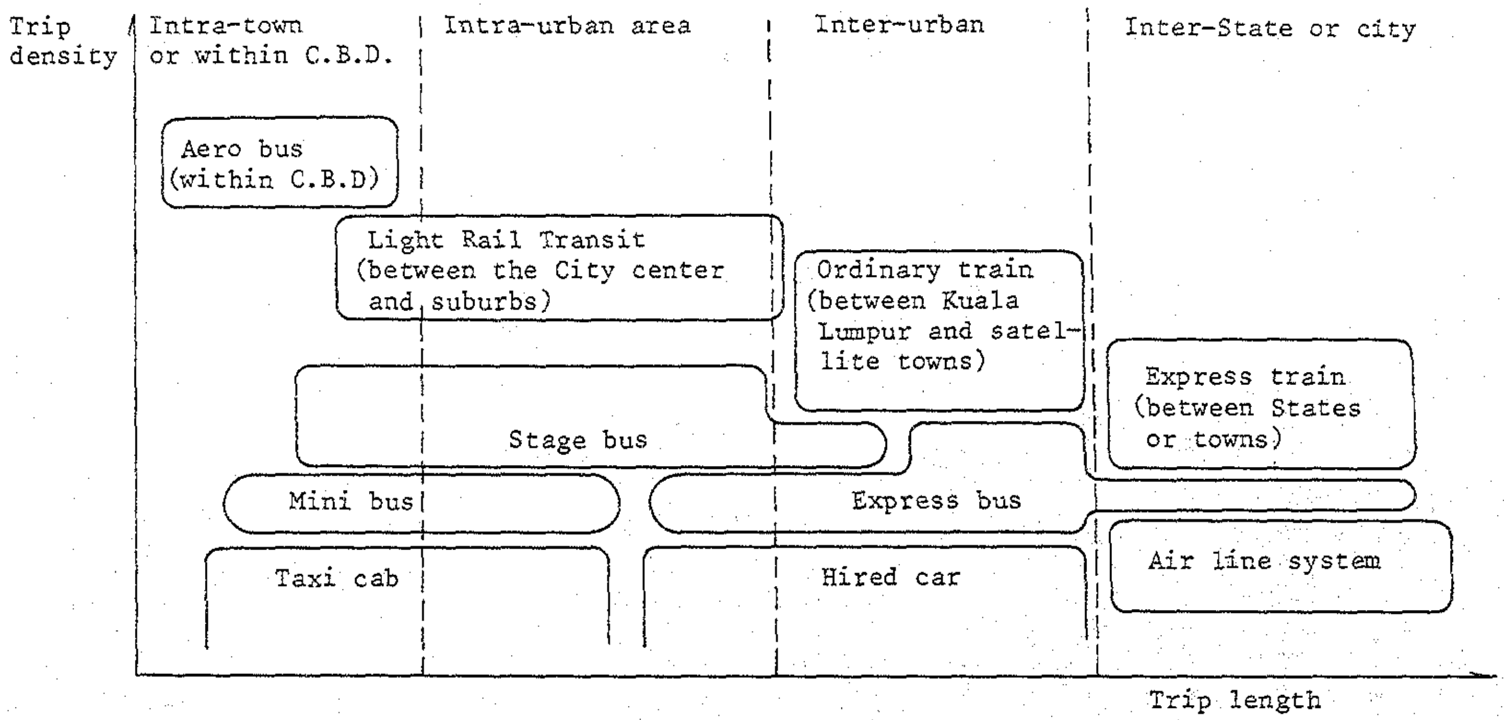


Fig. 2-4-5 Concept of Public Transportation Systems in and around Kuala Lumpur

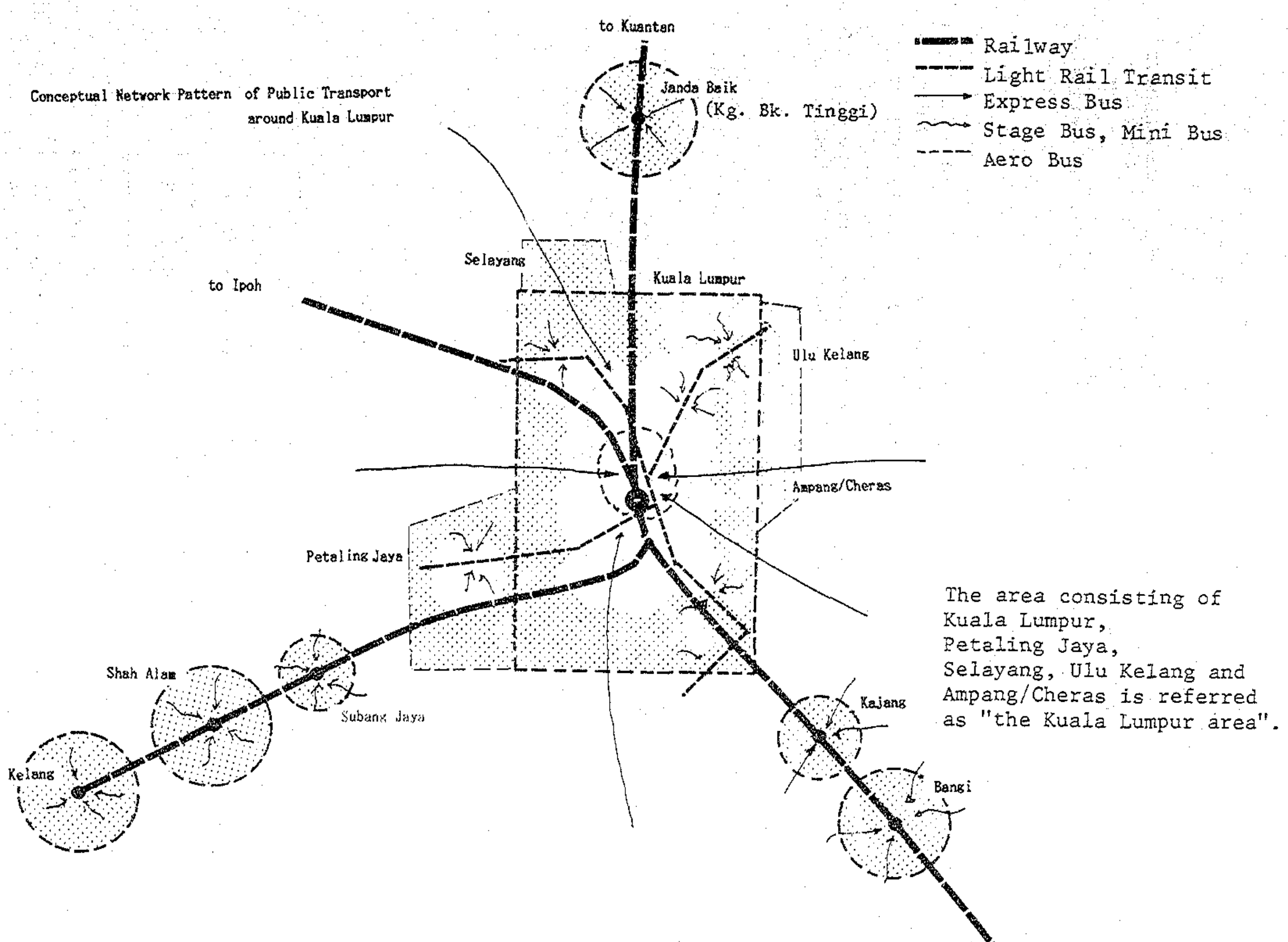


Fig. 2-4-6 Concept of Public Transportation in and around Kuala Lumpur

(3) Demand forecast

(a) Method employed

(i) Total traffic forecast

A gravity model is formulated based on the "Kuala Lumpur Master Plan Transportation Study - 1981."

The traffic volume is estimated by the model and verified by actual examples of Japan.

(ii) Modal split

The Kuala Lumpur Structure Plan states that since the road network capacity will become insufficient in the future, and about 60% of the private trips of the city must be shifted to mass-transit systems. Under the circumstances, between Kuala Lumpur and its satellite towns, the same 60% shift is assumed for mass-transit systems (including bus mode).

Though the railway mode is capable of providing a higher level service than the bus mode, it cannot cover the whole area. 70% is assigned to the railway.

(iii) Forecast result

Based on the population, road network planned, as well as the above assumptions, a demand forecast is conducted. The results are shown in Table 2-4-6.

Table 2-4-6 KL Urban Transport to/from Kuala Lumpur

Unit: persons/day

Year	1991	1996	2001	2005
Shah Alam	13,615	22,227	36,287	53,708
Kelang	10,146	16,643	27,301	40,564
Bangi	3,155	5,192	8,543	12,724
Janda Baik (Kg. Bk. Tinggi)	2,218	4,988	10,969	17,546
Total	29,134	49,050	83,100	124,542

Note: The forecast of the traffic volume between the outskirt towns is not made in this Study.

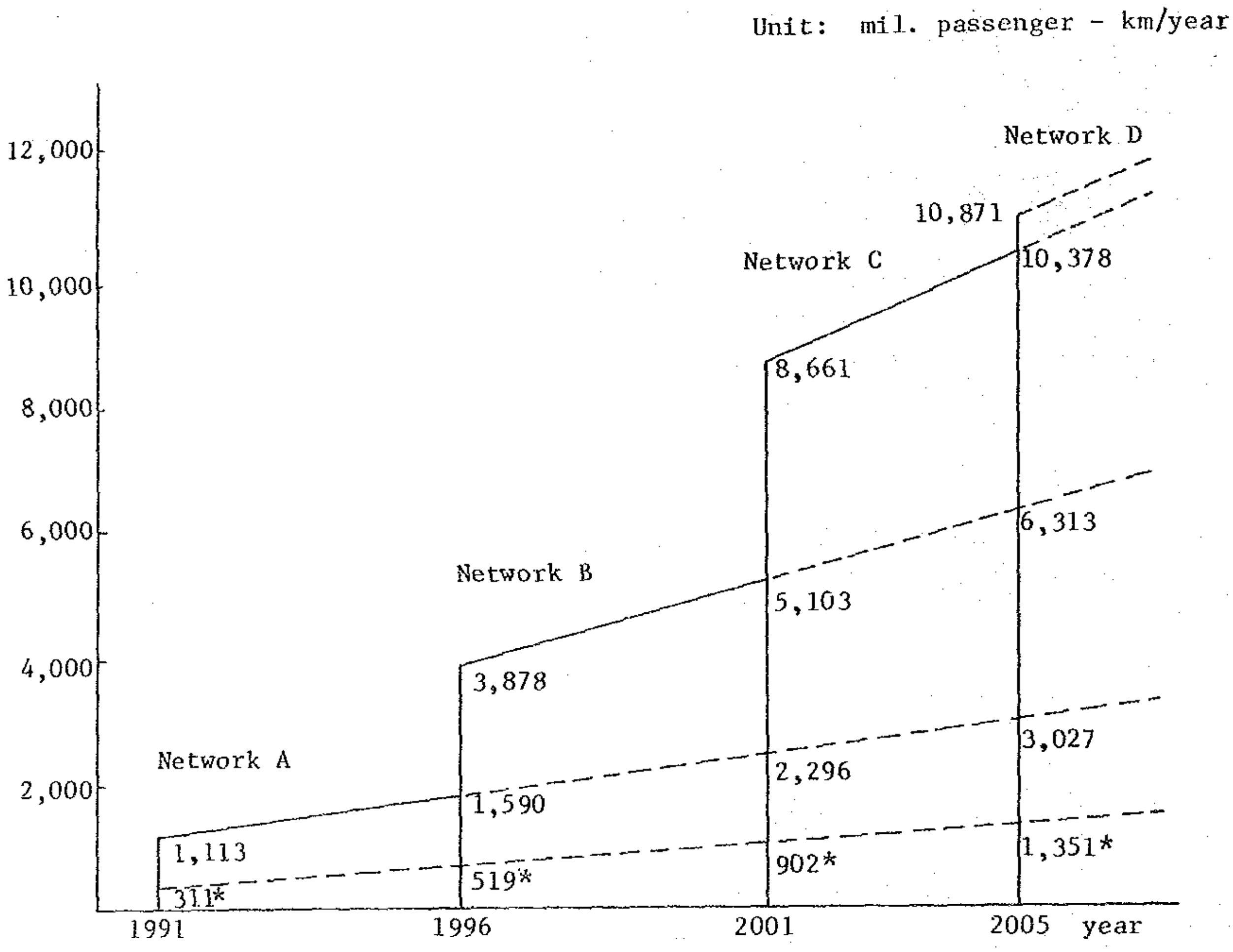
(iv) Remarks

- It is important for the stations of this urban transport to be connected conveniently with other feeder transports, such as mini bus, stage bus, car/taxi, LRT, etc.

- If a railway is planned for serving only Kuala Lumpur urban transport, its construction cost will be much less than in this Study because the high standards of the projected railway would become unnecessary.

2-4-4 Future trend in railway traffic volume

Future trends in the traffic volume of the projected railway are shown in Fig. 2-4-7. The traffic volume is expected to reach 1,100 million passenger-kilometers in the year 1991 when the New East-West Railway starts operation, and to achieve a ten-fold increase to some 10,400 million passenger-kilometers in the year 2005 when the Network C is completed.



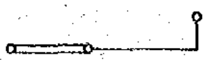
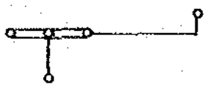
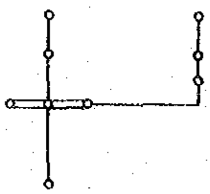
* Figures with asterisk denote the traffic when the section between Port Kelang and Janda Baik (Kg. Bukit Tinggi) alone is constructed.

Note. The traffic of Port Kelang Line will be considerably large in the proportion to the total, especially in Network A, 1991. However, this traffic will not contribute much to the revenue of Network A, as the fare rate of KL urban transport will be far less than that of inter-city transport.

Fig. 2-4-7 Trend of Railway Passenger Traffic Volume

The number of passengers per route kilometer will not necessarily increase in proportion to route-kilometerage in operation, as shown in Table 2-4-7.

Table 2-4-7 Trend of Railway Passenger Traffic Volume by Network

Network / Year	In million passenger kilometers 1991	1996	2001	2005	Passenger-km / Route length (in million) 2005
Network A 	1,113	1,590	2,296	3,027	8.83 (24.2 thousand persons/day)
Network B 	-	3,878	5,103	6,313	8.70 (23.8 thousand persons/day)
Network C 	-	-	8,661	10,378	7.82 (21.4 thousand persons/day)

2-5 Goods Traffic Demand Forecast

2-5-1 Method Employed

(1) Procedure

The goods traffic demand forecast in this F/S, aims principally at reviewing the M/P study result, supplementing it with the latest data and with methodological refinements.

This Study has also employed the same Four-Step Method as in the M/P. This means:

(a) The generation and attraction of goods traffic is estimated for each zone.

(b) Then, goods flows between zones, or "traffic distribution" is estimated using the present flow patterns and theoretical methods, quantitatively to match the estimated traffic generation and attraction in each zone.

(c) The modal share is estimated and the traffic demand volume for each mode is obtained therefrom. The railway traffic demand at cross section between zones along the projected railway are also estimated.

Fig. 2-5-1 shows the forecasting procedure employed for this Study.

The following two points differ significantly from the M/P study, in terms of work sequence and forecasting method.

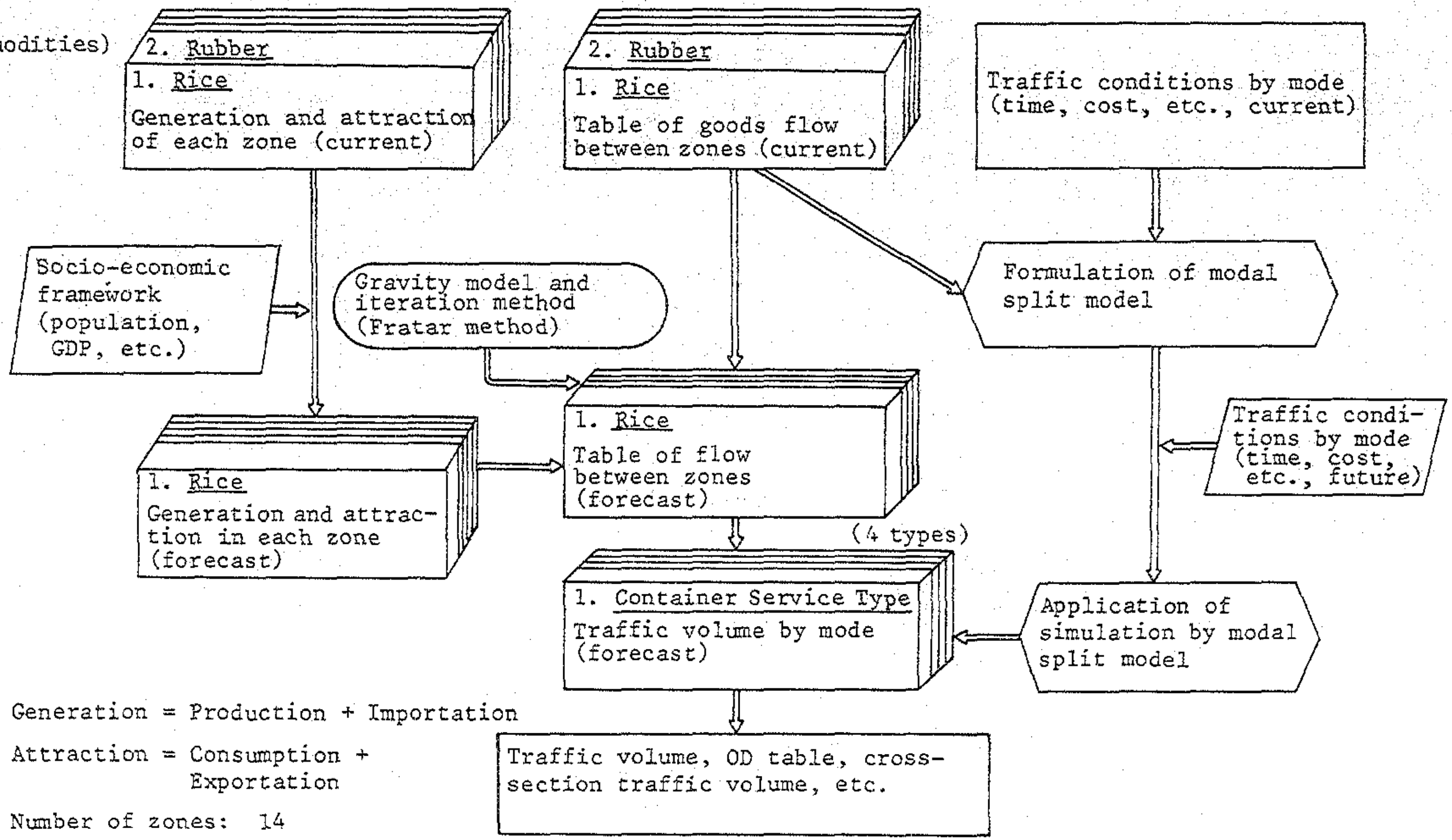
(a) The studied area is divided into 14 zones (9 in the M/P study).

(b) For the modal split model, the door-to-door haulage cost factor, rate and charges, is taken into account as an independent explanatory variable in addition to the door-to-door time factor. (the time factor only in the M/P study)

(2) Modes analyzed

Three modes are studied: road (lorry), coastal ship and railway.

The future capacity of roads, harbors, and fleet are assumed to impose no restriction for satisfying the demand.



Generation = Production + Importation

Attraction = Consumption + Exportation

Number of zones: 14

Fig. 2-5-1 Forcasting Flow Chart

(3) Commodities surveyed

The following nine commodities are surveyed.

① Rice
② Logs and Sawn timber
③ Rubber and Latex
④ Palm Oil and Kernel Oil
⑤ Mining Products (Tin, Bauxite and Iron Ore)
⑥ Petroleum
⑦ Cement
⑧ Fertilizer
⑨ Others

(4) Forecasting methodology and data used

(a) Forecast of generation and attraction

To forecast the generation and attraction (see Note at the end of this section) of goods transport in each zone, the production, consumption, export and import of all the nine commodities in each zone must be forecasted in terms of tons.

First, in this regard, the production data as of 1982 in each zone are provided by the Malaysian Government and other related organizations, and export/import data are provided by major port authorities.

Next, the future generation and attraction are estimated, in consideration of the future industrial/regional development plans and the estimates provided by the Malaysian Government and other related organizations, result being verified with reference to GDP growth rate.

Note: Generation and attraction of a zone

1. Generation in the zone = Production in the zone + Goods imported to the zone from areas outside the studied area

2. Attraction in the zone = Consumption in the zone + Goods exported from the zone to areas outside the studied area

(b) Forecast of traffic distribution

Forecasting the inter-zone traffic flow is conducted through two steps. First, the future flow pattern between zones is determined. Second, the traffic distribution is calculated using Fratar method, with above flow pattern, and generation and attraction forecasted.

For determining the flow patterns in the first step, two methods are adopted. One is to patternize the current flow and apply it directly to the future. (Present Pattern Method) The other is to use a theoretical model. (Gravity Model Method)

In this Study, with reference to "A Study for Increasing Market Share in Freight Traffic (MRA, 1983)", the present pattern method is applied for commodities whose flow pattern is not expected to change significantly in future, and a gravity model method, for other commodities. The gravity model is shown below:

$$\log Tm_{i-j} = \alpha + \beta \cdot \log (Tm_i \, . \, Tm_j) - \gamma \cdot \log D_{i-j} \quad \ldots (1)$$

where,

Tm_{i-j} : Traffic volume of commodity "m" between zone i and j
Tm_i : Generation of commodity "m" in zone i
Tm_j : Attraction of commodity "m" in zone j
D_{i-j} : Road distance between zone i and j
α, β, γ: Parameters

(c) Modal split estimate

(i) Modal split model

A model is formulated to estimate the sharing ratio of each mode.

The basic concept of the model is that the sharing ratio for each mode will be the result of shippers' rational decision in search for the most economical mode, comparing time factor and cost factor offered by various modes.

The model used is shown below, where the parameters are obtained from a regression analysis, based on the actual modal share data collected through the field surveys, such as door-to-door transport time and cost of each mode.

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} \cdot \mathrm{EXP.}[-\frac{1}{2}(\frac{x-\mu}{\sigma})^2] \qquad ....(2)$$

where

f(x): Probability density function
μ,σ : Parameters

$$SH_{NR} = \int_{X_{LR-NR}}^{X_{NR-CS}} f(x) \cdot dx \qquad ....(3)$$

$$X_{LR-NR} = \log_e \left(\frac{T_{NR}-T_{LR}}{C_{LR}-C_{NR}}\right)$$

$$.......(4)$$

$$X_{NR-CS} = \log_e \left(\frac{T_{CS}-T_{NR}}{C_{NR}-C_{CS}}\right)$$

where

SH_{NR} : The projected railway's share

X_{LR-NR}: Alternative ratio regarding haulage-time, rates and charges, between the projected railway and lorry.

X_{NR-CS}: Alternative ratio regarding haulage-time, rates and charges, between the projected railway and coastal ship.

T_{NR}, T_{LR}, T_{CS}: Door-to-door haulage time required by the projected railway, by lorry and by coastal ship, respectively.

Note: See Table 2-5-1.
For determining T_{NR}, stopping time at main stations is considered. As to T_{LR} and T_{CS}, no such modification is considered.

C_{NR}, C_{LR}, C_{CS}: Door-to-door haulage cost (rates and charges) required for the projected railway, for lorry and for coastal ship, respectively.

(ii) Time and cost factors

a) Time factor

Time required for the transport by each mode is defined as the total time necessary for door-to-door transport which includes loading, unloading, waiting, and on-vehicle time.

Average speed assumed for each mode in calculating on-vehicle time is shown in Table 2-5-1.

Table 2-5-1 Average Speed (for on-vehicle time)

Unit: km/h

Lorry		Railway		Coastal Ship
Highway	Ordinary Road	Projected Railway	Existing Railway	
80	50	Express container train 90* Carload and ordinary container 70*	Through-train 20	18

* Stopping time at intermediate main goods stations is excluded.

b) Cost factor

The relativity between modes in the door-to-door cost is assumed to remain constant as at present.

The current rates and charges of each mode are fixed at the average obtained from the survey (see Fig. 2-5-2).

(iii) Transport services provided by the projected railway

a) To estimate modal shares in goods transport, the transport services to be provided by the projected railway are classified broadly into carload type and container type. Different transport conditions are given to the two types of service, and applied to the model. (Particularly, there is great difference in handling time at stations between the two types of services.)

b) Only container goods can be transferred mutually between the projected railway and the existing railway.

c) The aforementioned nine commodities are assigned to either type of service as follows, in consideration of packaging and transporting unit,

Rice	Container
Logs and Sawn timber	Carload
Rubber and Latex	Container
Palm oil and Kernel oil	Carload
Mining products	Carload
Petroleum	Carload
Cement	Container (Bag) Carload (Bulk)
Fertilizer	Container
Others	Container (50% of the total demand) Carload (30% of the total demand) The remaining 20% is assumed to be unsuitable for railway transport.

d) The container service in this Study is classified into express container and ordinary container. (See the next item e).) Different door-to-door haulage time is assumed for each service.
The carload service is also classified into two types: i) for petroleum and bulk cement, and ii) for other commodities. Shorter door-to-door haulage time is assumed for the type i), shunting time is required less for these commodities because there are less stopping stations. Furthermore, it will be possible to carry petroleum or bulk cement by exclusive specialized train directly connecting the origin and destination stations.

e) The express container service is assigned to the transport of special commodities of "others", such as manufactured goods under customer's strict inventory control. Accordingly, the express container trains are operated in the daytime at the maximum speed of 120 km/h, realizing "shipment in the morning and delivery in the afternoon". (See 3-1-2, (5) and 3-2-1.)

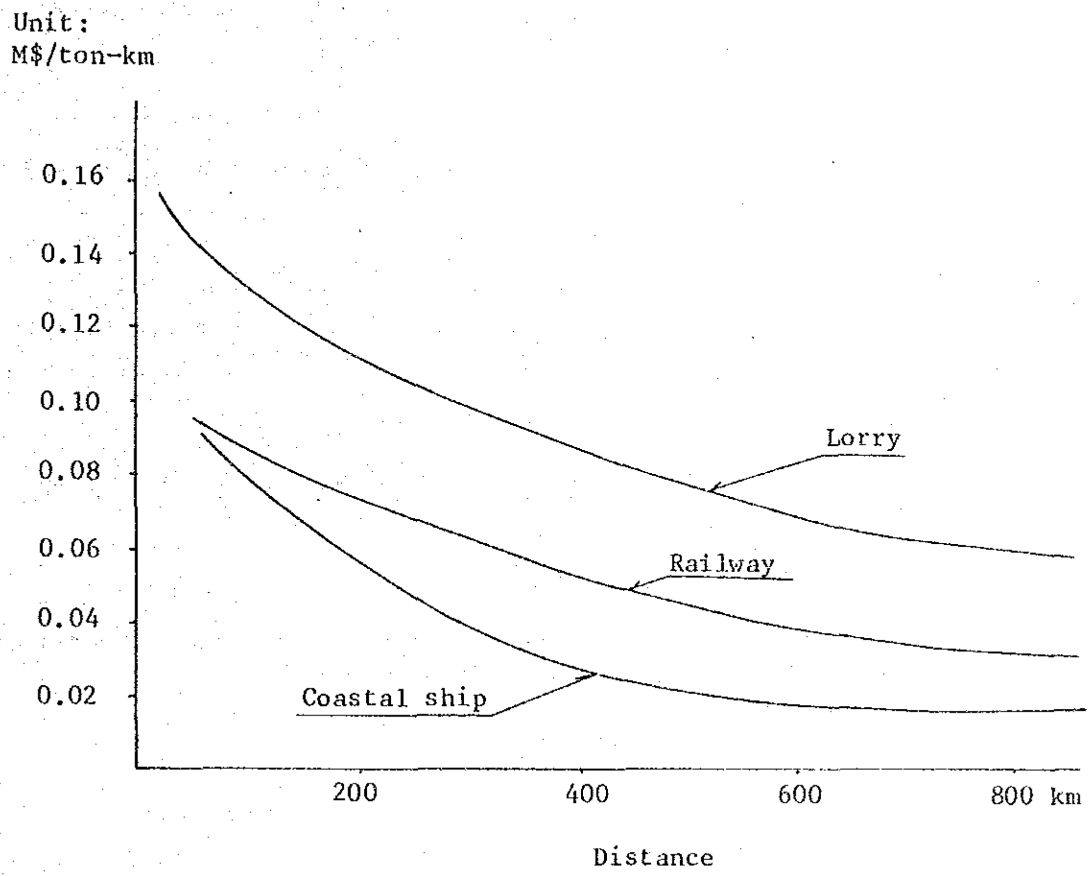


Fig. 2-5-2 Average Goods Haulage Rate by Various Transport Modes

2-5-2 Forecast Result

(1) Goods traffic volume

(i) Total goods traffic generation

Table 2-5-2 shows the forecast results of the traffic generation by commodities.

(ii) Demand by mode and network

Table 2-5-3 shows the forecast result of goods traffic by modes and by networks of the projected railway.

(iii) Demand of the projected railway by commodities

Table 2-5-4 shows the forecast result of the projected railway goods traffic by commodities.

(iv) Future trend of the railway traffic volume

Table 2-5-5 and Fig. 2-5-3 show the forecasted trend in ton-kilometers.

(v) Demand at cross sections

Fig. 2-5-4 (A) to (E) show the traffic demand at cross sections in each network of the projected railway.

Table 2-5-2 Total Goods Traffic Generation

Unit: thousand tons

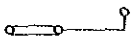
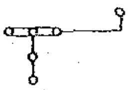
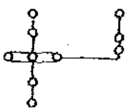
	Total generation				
	1982	1991	1996	2001	2005
1. Rice	1,348	1,667	1,845	2,041	2,214
2. Logs	6,986	7,093	7,093	7,093	7,093
3. Rubber	1,554	1,624	1,656	1,690	1,717
4. Palm Oil	4,232	8,944	10,368	12,020	13,528
5. Mining	1,430	1,430	1,430	1,430	1,430
6. Petroleum	7,981	13,401	16,456	19,112	21,542
7. Cement	3,459	5,745	7,228	9,093	10,927
8. Fertilizer	1,881	3,355	3,803	4,246	4,637
9. Others	13,775	33,164	45,177	61,542	78,104
Total	42,646	76,423	95,056	118,267	141,192

Unit: percentage

	Average annual growth rate		
	1982 - 1991	1991 - 1996	1996 - 2005
1. Rice	2.4	2.0	2.0
2. Logs	0.2	0	0
3. Rubber	0.5	0.4	0.4
4. Palm Oil	8.7	3.0	3.0
5. Mining	0	0	0
6. Petroleum	5.9	4.2	3.0
7. Cement	5.8	4.7	4.7
8. Fertilizer	6.6	2.5	2.5
9. Others	10.3	6.4	6.4
Total	6.7	4.5	4.5

Table 2-5-3 Goods Traffic Demand and Share

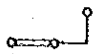
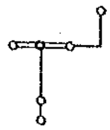
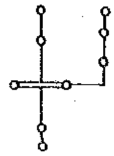
Unit: thousand tons

Network	Year	Projected* railway	** Lorry	Coastal shipping	Total
Existing Railway	1982	3,232 7.6%	38,089 89.3%	1,326 3.1%	42,647 100.0%
A 	1991	2,427 3.2%	68,124 89.1%	5,872 7.7%	76,423 100.0%
	2005	3,797 2.7%	128,271 90.8%	9,124 6.5%	141,192 100.0%
B 	1996	6,226 6.6%	82,264 86.5%	6,566 6.9%	95,056 100.0%
	2005	7,984 5.6%	124,773 88.4%	8,436 6.0%	141,193 100.0%
C 	2001	10,880 9.2%	100,230 84.7%	7,157 6.1%	118,267 100.0%
	2005	12,405 8.8%	120,966 85.7%	7,820 5.5%	141,191 100.0%

Note : 1. The traffic in the Network D is the same as in the Network C.
2. * Figures do not include the traffic of the existing railway (except in the row for 1982).
3. ** Figures include the traffic of the existing railway (except in the row for 1982).

Table 2-5-4 Projected Railway Goods Traffic by Commodities

Unit: thousand tons

Network / Commodity	2005 	2005 	2005 
1. Rice	52 (52)	84 (84)	215 (215)
2. Logs	35 (0)	137 (0)	192 (0)
3. Rubber	42 (42)	355 (355)	427 (427)
4. Palm Oil	251 (0)	615 (0)	653 (0)
5. Mining	0 (0)	34 (0)	81 (0)
6. Petroleum	418 (0)	1,336 (0)	1,933 (0)
7. Cement	363 (205)	861 (404)	2,346 (818)
8. Fertilizer	148 (148)	279 (279)	367 (367)
9. Others	2,488 (1,154)	4,283 (2,588)	6,191 (4,140)
Total	3,797 (1,601)	7,984 (3,710)	12,405 (5,967)

Note: Figures in parentheses show the container traffic volume, and are included in respective traffic.

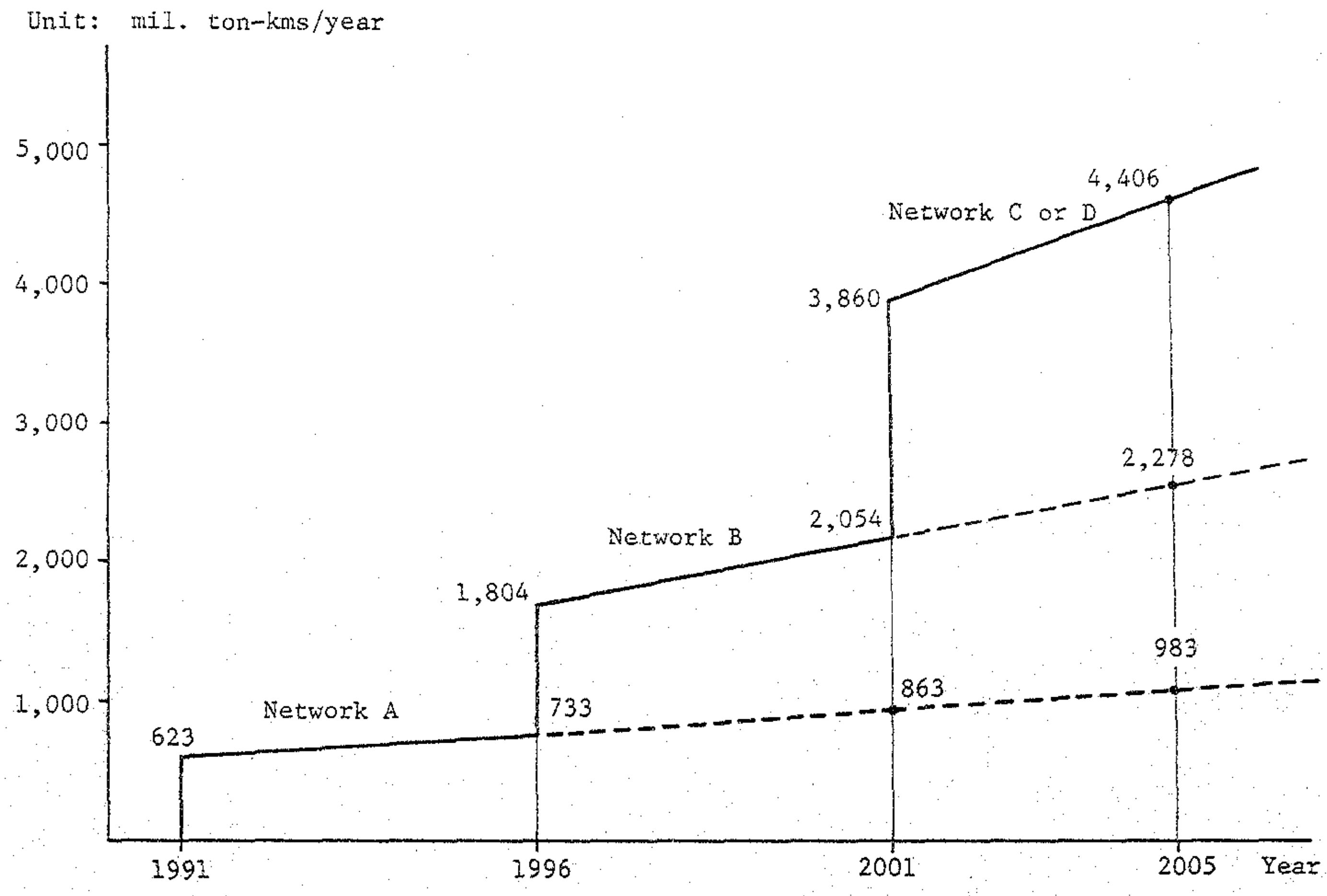
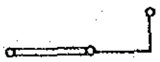
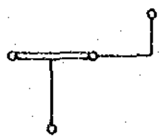
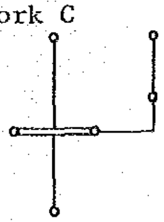
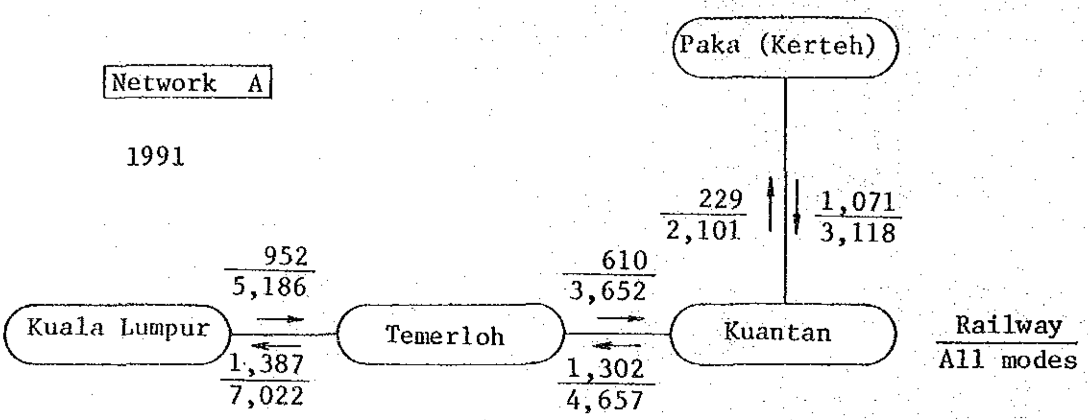


Fig. 2-5-3 Trend of Railway Goods Traffic Volume

Table 2-5-5 Trend of Railway Goods Traffic Volume by Network

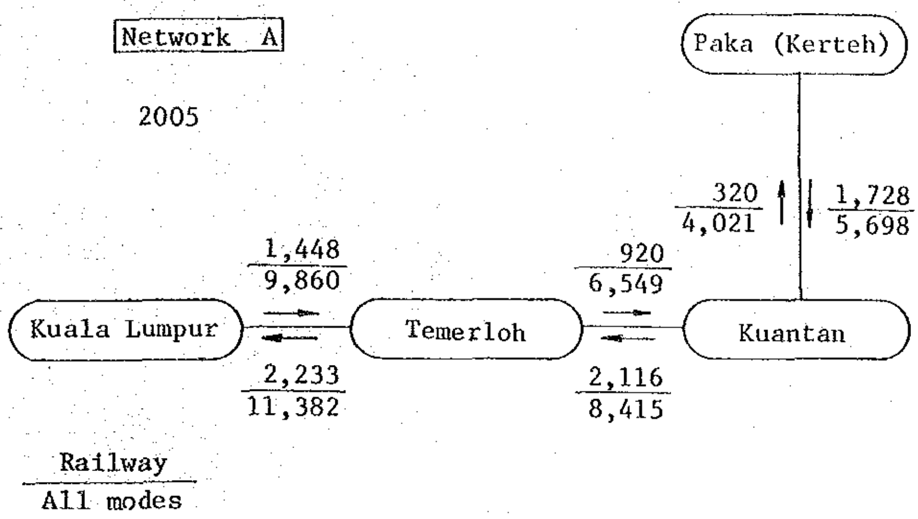
Item / Network	In million ton-kilometers				Ton-km / Route length 2005 (mil. tons)
	1991	1996	2001	2005	
Network A 	623	733	863	983	2.9
Network B 	-	1,804	2,054	2,278	3.1
Network C 	-	-	3,860	4,406	3.3



Note:

1. Figures above and below the bar (——) show railway goods traffic volume and total goods traffic volume in the year 1991, respectively.
2. Unit: thousand tons/year

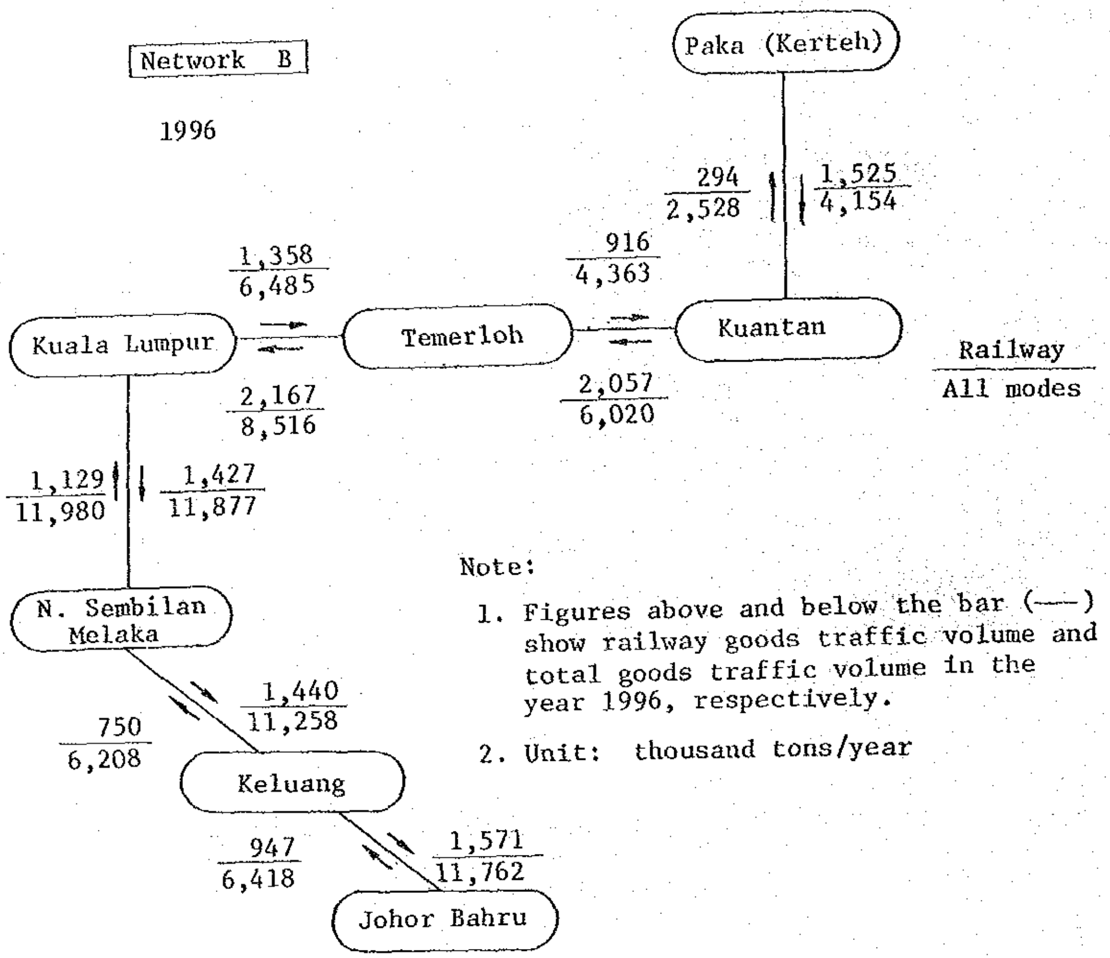
Fig. 2-5-4 (A) Goods Traffic Demand at Cross Section



Note:

1. Figures above and below the bar (——) show railway goods traffic volume and total traffic volume in the year 2005, respectively.
2. Unit: thousand tons/year

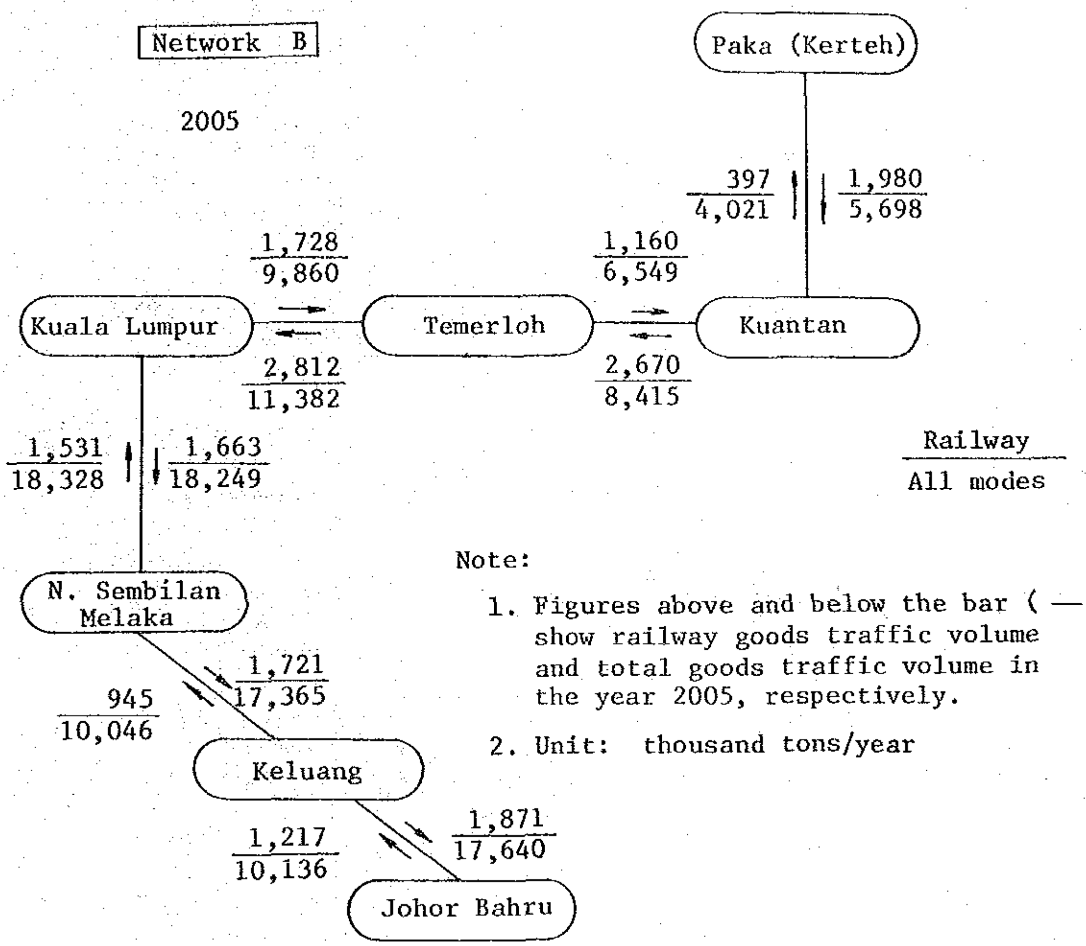
Fig. 2-5-4 (B) Goods Traffic Demand at Cross Section



Note:

1. Figures above and below the bar (——) show railway goods traffic volume and total goods traffic volume in the year 1996, respectively.
2. Unit: thousand tons/year

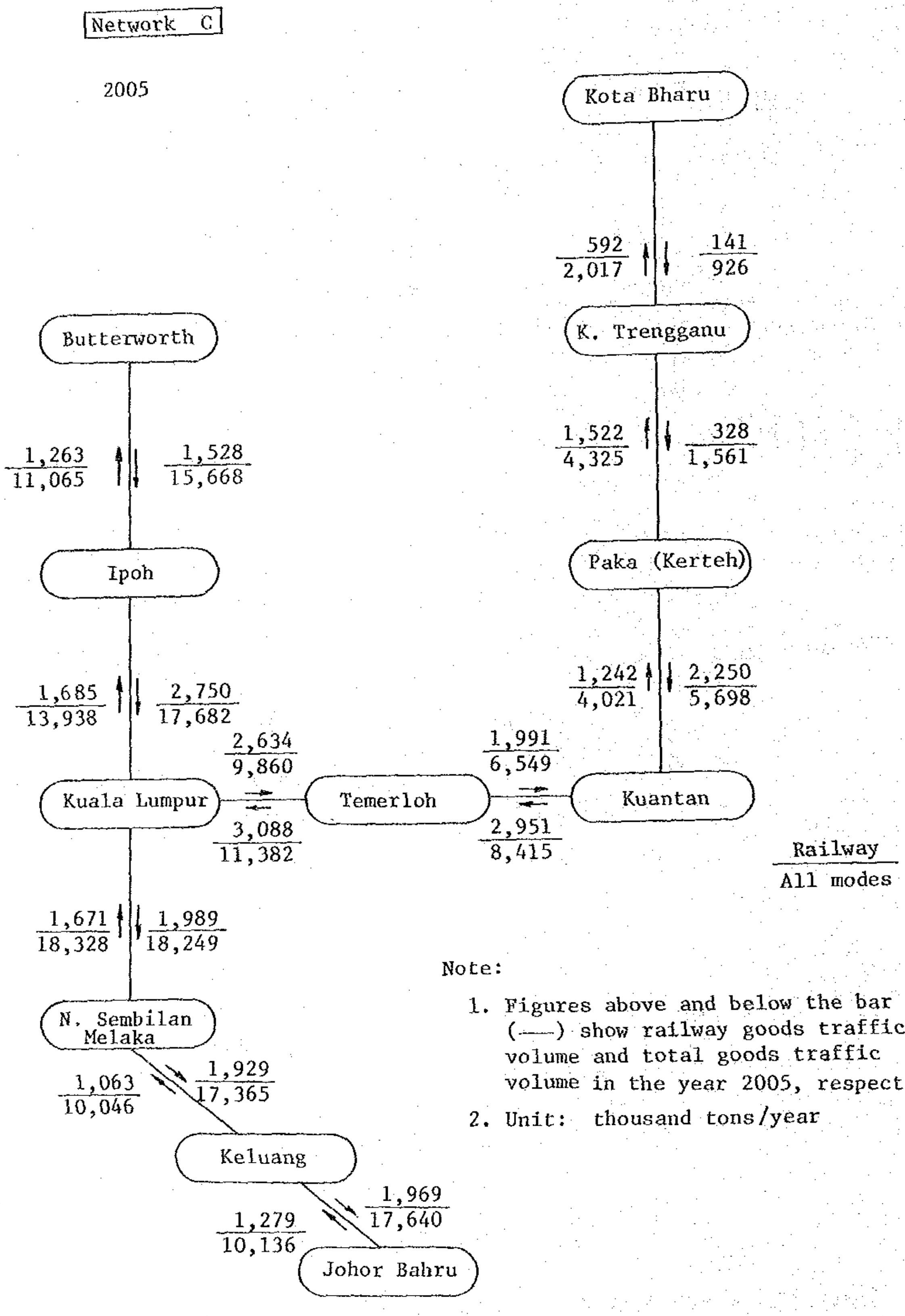
Fig. 2-5-4 (C) Goods Traffic Demand at Cross Section



Note:

1. Figures above and below the bar (—) show railway goods traffic volume and total goods traffic volume in the year 2005, respectively.
2. Unit: thousand tons/year

Fig. 2-5-4 (D) Goods Traffic Demand at Cross Section



Note:

1. Figures above and below the bar (——) show railway goods traffic volume and total goods traffic volume in the year 2005, respectively.
2. Unit: thousand tons/year

Fig. 2-5-4 (E) Goods Traffic Demand at Cross Section

(2) Observations

(a) Total goods traffic generated in the year 2005 is expected to reach 141.2 million tons, 3.3 times of that in 1982 (annual average growth rate of 5.3%).

Of all commodities, "others" are expected to grow at the largest rate (annual average rate of 7.8%) due to increase in manufactured products, followed by palm oil (5.2%) and cement (5.1%). (Table 2-5-2)

(b) In the year 2005 when the projected railway network is fully expanded, the railway will have a 8.8% share, the coastal ships 5.5%, and lorries 85.7%. The share of the railway will improve the present level, 7.6% in 1982. (Table 2-5-3)

(c) Railway goods traffic demand in the year 2005 is expected to reach 12.4 mil. tons, approximately 3.8 times as large as the 1982 level. Of the railway goods traffic, containers will represent 48%.

Of all commodities, "others" will represent almost half the total, followed by cement (20%) and petroleum (15%). (Table 2-5-4)

It should be noted, however, that container transport can reduce door-to-door transport time only when the intermodal connection with road transport is smoothly carried out. Thus, improvement of forwarding systems is required as well as efficient container handling equipment at stations.

(d) The index obtained by dividing the traffic demand by the operating railway length increases with the expansion of the railway network, indicating that the expansion will generate the new demand for railway transport. (See Table 2-5-5.)

(e) The estimated railway goods traffic for each network is observed as follows:

Network A

(i) On the New East-West Railway, more goods flow is expected from the eastern region than from the Kuala Lumpur side.

(ii) The major commodities transported from the eastern region to Kuala Lumpur are steel, iron, petroleum and palm oil.

(iii) The major commodities transported from Kuala Lumpur to the eastern region are manufactured goods ("others"), fertilizer and cement.

Network B

(i) The goods flow pattern of the New East-West Railway in Network B is more or less the same as in Network A.

(ii) Southern portion of the West Coast Railway

- Manufactured goods ("others") represents half of the railway goods traffic to the Johor Bahru side, followed by palm oil and petroleum (originated in the N. Sembilan zone).

- Rubber and petroleum represent a relatively large share in the railway goods traffic to Kuala Lumpur.

Network C or D

(i) The New East-West Railway

The goods flow pattern of the New East-West Railway in Network C or D is similar to those in Network A or B. The traffic undergoes a change with the expansion of the Network; more cement, manufactured goods ("others") and petroleum to Kota Bharu and Kuala Trengganu, and more rice, from Kelantan.

(ii) Southern portion of the West Coast Railway

The goods flow pattern of this portion is similar to that in Network B, and the opening of the northern portion of the West Coast Railway results in more traffic of petroleum to the northern portion and cement from there.

(iii) Northern portion of the West Coast Railway

- Manufactured goods ("others"), steel, iron and petroleum amount to most of the railway goods traffic to the Butterworth side.

- Manufactured goods ("others") and cement amount to most of the railway goods traffic to the Kuala Lumpur side.

(f) Container transport can offer more convenient service for shippers than carload transport because of the easier handling and the reduced door-to-door haulage time.

Accordingly, the projected railway service will be characterized by use of containers. The service will be supported by suitable and sufficient container handling facilities and container handling rolling stock.
In the demand forecast, the commodities to be transported by the railway container service are sorted out in consideration of package-form and unit of transport. JNR's experience is also considered. Further expansion of containerization would contribute to the increase of the railway goods traffic.
Provision of special containers, such as tank containers for palm oil is an example.

(g) In this demand forecast, only containers are assumed to be transported between the projected railway and the existing railway.
Carload type commodities are not assumed to move over the two different gauged railways. Therefore, if the commodities now assigned to carload type is containerized, it will result in the increase of the railway traffic that much.

(3) Sensitivity analysis

(a) Table 2-5-6 (a) shows the result of the sensitivity analysis made in regard with the deviation of GDP growth rate. Both lower and higher deviations in the rate are compared with Base Case.

It is noted that, in both Cases, the railway traffic volume would see smaller extent of deviations than that of GDP: For the GDP deviation of 15.4% assumed lower than Base Case in 2005, the railway traffic is estimated to undergo 14.6% decrease from Base Case. For the GDP deviation of 18.0% assumed higher than Base Case in the same year, the railway traffic is estimated to increase 17.0%.

(b) The impact of opening to traffic of the Karak to Kuantan expressway on the new railway goods traffic is estimated in Table 2-5-6 (b). The railway goods traffic demand is estimated to undergo smaller decrease of 0.3% than in case of passenger traffic, in the year 2005, Network C.

(c) Table 2-5-6 (c) denotes the sensitivity analysis regarding the impacts of changes in the levels of expressway toll and railway rates.

Assuming the expressway toll to be raised by 300% in Network C in the year 2005, while if the railway goods rates are;

(i) Kept at the same level, the railway goods traffic would increase by 19.3%.

(ii) Raised by 10%, the traffic would increase by 6.9%.

(iii) Reduced by 10% traffic would increase by 27.7%.

The above results indicate that railway goods rate are at a level competitive with lorries. This also means that impacts of other modes on railway traffic will depend more on their relative rate-and-cost structures, suggesting the importance of establishing competitive railway rates.

Therefore, railway goods rates should be established for commodity types and customers' requirements, in consideration of shippers' financial capability, preference and storage requirements.

(d) Impacts of the delay in the east coast industrial development on railway traffic demand are analyzed in Table 2-5-6 (d).

The "delay" can be identified in two ways:

(i) The GDP growth rate of the two zones of Trengganu (where the east coast industrial development projects are concentrated, and where the GDP is forecasted to show higher growth rates than in other States) will drop to the national average level and the traffic generation and attraction of the zones will be lowered down in compliance with this decrease.

(ii) The production of Petroleum and Steel of the said two zones of Trengganu will undergo a 30% decrease compared with the production plan.

This assumption derives from the fact that, in the initial estimation of the traffic generation of the two zones, Steel and Petroleum are estimated to increase at the rate identical with that of their production plan. The decrease rate (30%) is discretionary.

Under the assumption (i) above, the impact on railway traffic is calculated to decreased by 13.2% compared with Base Case, and under the assumption (ii) above, the impact will be a decrease of 1.8% in Petroleum and 6.4% in Steel, in the year 2005, for Network A.

The assumptions (i) and (ii) may take place either simultaneously or separately. It would be reasonable to assume that the delay in the east coast industrial development will have a bad impact on the projected railway goods traffic; at the worst, the combined effect of assumptions (i) and (ii), and at the least the effect of either assumption (i) or (ii), whichever the larger.

To sum up, the impacts on goods traffic would be, in the year 2005, for Network A, a decrease of 13.2% at the least and 21.4% at the worst (13.2 + 6.4 + 1.8).

Table 2-5-6 Result of Sensitivity Analysis

(a) By deviation in economic growth rate

Unit: percentage

Year	Low Case (Ratio to Base Case)		High Case (Ratio to Base Case)	
	GDP	Railway Traffic Volume in Ton-km	GDP	Railway Traffic Volume in Ton-km
1991	96.7	96.9	103.4	103.2
1996	92.2	92.6	108.4	107.9
2001	87.9	88.5	113.6	112.9
2005	84.6	85.4	118.0	117.0

Note: Growth rate (%)

Period	Base Case	Low Case	High Case
1980 - 1985	6.4	6.4	6.4
1985 - 1990	6.0	5.5	6.5
1990 - 2005	5.0	4.0	6.0

(b) By construction of expressway between Karak and Kuantan

Unit: percentage in ton-km, 2005

Item		Ratio to Base Case	
Network		A	C or D
New East-West Railway		98.8	99.5
West Coast Railway	Southern Portion	-	100.0
	Northern Portion	-	99.8
Total		98.8	99.7

(c) By expressway toll rate revision

Unit: percentage in ton-km, 2005

Item		Ratio to Base Case		
Railway fare revision		90.0	100.0	110.0
Expressway toll rate revision		400.0	400.0	400.0
New East-West Railway		112.0	104.7	94.1
West Coast Railway	Southern Portion	139.8	130.7	117.4
	Northern Portion	138.1	129.1	116.1
Total		127.7	119.3	106.9

(d) By the delay of the east coast industrial development

(i) Lowering down of GDP growth rate to the national average

Unit: percentage in ton-km, 2005

Item		Ratio to Base Case		
Network		A	B	C
New East-West Railway		86.8	87.6	87.6
West Coast Railway	Southern Portion	-	97.8	97.3
	Northern Portion	-	-	96.5
Total		86.8	92.5	93.5

where; Deviation of socio-economic frame in Trengganu State from Base Case
GDP --- 78.9%

(ii) Decreasing Steel and Petroleum production by 30%

Unit: percentage in ton-km, 2005

Item		Ratio to Base Case					
		Network A		Network B		NetworkC	
		Steel	Petroleum	Steel	Petroleum	Steel	Petroleum
New East-West Railway		93.6	98.2	94.8	98.5	96.0	98.9
West Coast Railway	Southern Portion	-	-	100.0	99.6	100.0	99.7
	Northern Portion	-	-	-	-	97.7	100.0
Total		93.6	98.2	97.3	99.1	97.8	99.5

CHAPTER 3 TRAIN OPERATION PLAN

CHAPTER 3 TRAIN OPERATION PLAN

3-1 Underlying Concept

The train operation plan for the projected railway network is formulated to meet each of the forecasted traffic demand for inter-city passenger transport, for goods transport and for urban passenger transport around Kuala Lumpur. (It does not include the plans for the existing meter gauge railway.) It is prepared on the basis of the following premises.

(a) Electrified standard gauge railway

(b) Single-tracked in the initial phase of operation for all sections, except for Port Kelang - Janda Baik (Kg. Bukit Tinggi).
(Signal stations where two trains can cross each other will be placed at approximately 20 km intervals between stations, when necessary.)

(c) Locomotive hauling, both passenger and goods trains. (One type of locomotive is used in common for all types of trains.)

3-1-1 Passenger Transport

(1) Super express and express trains are operated between major cities, providing a high speed service network. All trains between Kuala Lumpur and other major cities are planned for daytime operation, as the travel time from Kuala Lumpur is less than 3 to 4 hours.

(2) A required number of ordinary trains are planned in consideration of the traffic demand and the stations which are not served by express trains.

(3) Urban trains for passenger traffic around Kuala Lumpur are planned principally for commuter service.

(4) Accordingly planned passenger trains are as follows;

(a) Super express trains

(b) Express trains

(c) Ordinary trains

(d) KL urban trains

3-1-2 Goods Transport

(1) Direct transport system is introduced, operating "through-trains" between main goods stations (the conventional sorting of wagons at marshalling yards is minimized). Wagons originating at/destined to other stations are relayed at the main goods stations, from through-trains to ordinary trains, and vice versa. (See 3-4-3.)

(2) Containerization of goods transport is pushed on as far as possible to promote intermodal transport (particularly with road transport) and to simplify the handling at the goods stations. The containerization will cover rice, rubber, bagged cement, fertilizer and other manufactured goods pertinent for the purpose.

(3) Express container trains are planned for services between Kuala Lumpur and some other major cities. They are operated daytime, in order to realize "shipment in the morning and delivery in the afternoon".

(4) Transfer of goods between the projected railway (standard gauge) and the existing railway (meter gauge) at the connecting stations, which are Rawang-Kuang and Temerloh for Network A or B, and Perai and Temerloh for Network C or D, is limited to containers (no wagon transfer).

(5) Accordingly planned goods trains are as follows;

(a) Express container trains - With a fixed container wagon formation, loaded and unloaded at departure/arrival tracks at selected main goods stations (with no detaching/attaching of container wagons).

(b) Container trains - Exclusive for containers, stopping at selected main goods stations (with detaching/attaching of container wagons).

(c) Carload through-trains - For carloads (petroleum, bulk cement, palm oil, logs, etc.), stopping at selected main goods stations.

(d) Ordinary trains - For relaying between main goods stations and other goods stations.

The role of stations in the projected railway is shown in Table 3-1-1.

Table 3-1-1 The Role of Stations in the Projected Railway

New East-West Railway

Station	Passenger handling	Goods handling
Kuala Lumpur	◉ Δ	
Existing K. Lumpur	Δ	
Batu Caves	Δ	
Janda Baik (Kg. Bukit Tinggi)	◉ Δ	
Bentong	◎	
Temerloh	◉	⧈
Maran	◎	
Gambang	◎	
Kuantan	◉	[◎]
(Port Kuantan)		□
Chukai	◎	
(Port Chukai)		o
Paka (Kerteh)	◉	[◎]
Dungun	◎	o
Kuala Trengganu	◉	[◎]
Jerteh	◎	o
Pasir Puteh	◎	
Bachok	o	
Kemasin	o	
Kota Bharu	◉	⧈

West Coast Railway

Station	Passenger handling	Goods handling
Butterworth	◉	□
Perai		[◎]
Bukit Mertajam	◎	
Nibong Tebal	o	
Parit Buntar	o	o
Bagan Serai	o	
Taiping	◎	□
Padang Rengas	o	
Kuala Kangsar	◎	o
Ipoh	◉	[◎]
Batu Gajah	o	
Malim Nawar	o	
Kampar	o	o
Tapah Road	◎	□
(Telok Intan)		o
Bidor	o	
Sungkai	o	
Slim River	o	o
Behrang	o	
Tanjong Malim	◎	
Kuala Kubu Road	o	
Rawang	◎	
Rawang-Kuang (goods)		[◎]
Sungei Buloh	o	
Kuala Lumpur	◉	
Sungei Besi	o	

Station	Passenger handling	Goods handling
Kajang	◎	
Bangi		o
Seremban	◉	□
(Port Dickson)		o
Tampin	◎	[◎]
Batang Melaka	o	
Gemas	◎	⧈
Segamat	◎	o
Labis	o	o
Keluang	◉	[◎]
Kulai	o	
Kempas Baru	o	o
(Pasir Gudang)		[◎]
Johor Bahru	◉	
Singapore	◉	□

Port Kelang Line

Port Kelang	Δ	⧈
Kelang	Δ	
Shah Alam	Δ	
Subang Jaya	Δ	
Petaling Jaya	Δ	
Kuala Lumpur	◉ Δ	

Note:

1. Passenger stations

◉ : Super express trains stop
◎ : Express trains stop
o : Ordinary trains stop
Δ : KL urban trains stop

2. Goods stations

[◎] : Main goods station with express container handling

⧈ : Main goods station with container handling (no express container handling)

□ : Goods station with container handling

o : Goods station (no container handling)

3. Stations in parentheses denote those on the branch lines.

3-2 Train Operation Plan

3-2-1 Type of trains

Maximum speed, train formation and trailing load of each type of trains are shown in Table 3-2-1. All types of trains are hauled by one type of locomotive.

Table 3-2-1 Main Features of Trains

	Maximum speed (km/h)	Train formation (coach)	Trailing load (ton)	Brake system
Passenger train				Electro-magnetic air brake
Super express train	160	14	520	
Express train	160	14	520	do.
Ordinary train	160	14	520	do.
KL urban train*	120	8	300	do.
Goods train				Electro-magnetic air brake
Express container train	120	-	800	
Container train	90	-	1200	Air brake
Carload through-train	90	-	1200	do.
Ordinary train	90	-	1200	do.

* KL urban train is operated between Port Kelang and Janda Baik (kg. Bukit Tinggi).

3-2-2 Train transport capacity

(1) Passenger train

(a) Super express train: 1st class coach × 4 + 2nd class coach × 9 + dining coach × 1 (768 passengers)

(b) Express train : 1st class coach × 3 + 2nd class coach × 10 + dining coach × 1 (784 passengers)

(c) Ordinary train : 2nd class ordinary coach × 14 (1,232 passengers)

(d) KL urban train : 2nd class urban coach × 8 (976 passengers)

(e) Seating capacity of a coach is as follows;

1st class coach	:	48 passengers
2nd class coach	:	64 passengers
2nd class ordinary coach	:	88 passengers
2nd class KL urban coach	:	122 passengers (including a certain number standing)

(2) Goods train

Maximum permissible loading weight	:	40 tons
Weight of wagon	:	20 tons
Maximum weight of loaded wagon	:	60 tons

(A container wagon carries two 20 feet containers)

3-2-3 Required number of trains

(1) Calculation method

Required number of trains = Average daily traffic at cross section ÷ average transport capacity per train

The value "average daily traffic" in the above equation is derived from the railway traffic volume estimated in Chapter 2, namely:

(a) For passenger trains, the average daily traffic is derived;

- for super express and express trains, from the inter-zone long distance traffic,

- for ordinary trains, from the inter-zone short distance and intra-zone traffic,

- for KL urban trains, from the traffic around Kuala Lumpur.

(b) For goods trains, the average daily traffic is derived;

- for express container trains and container trains, from the inter-zone traffic of containerized goods,

- for carload through-trains from the inter-zone traffic of non-containerized goods

The inter-zone goods traffic volume differs according to the direction of transport. Required number of goods trains is calculated for each direction, and twice the larger of the two is applied for the required number of goods trains for both directions. Incidentally, the intra-zone goods traffic is not considered as railway traffic.

Average daily traffic at cross section is calculated as follows.

Passenger transport: Annual traffic at cross section ÷ 365 days

Goods transport : Annual traffic at cross section ÷ 300 days

Load factors of trains are assumed as follows.

- Passenger train
  Super express and express train: 80%
  Ordinary train : 100%
  KL urban train : 80%

- Goods train
  Average loading weight per loaded wagon: 32 tons, 80% of maximum loading weight. (Average loading weight of a wagon in train including empty wagon: 25 tons)

(2) Calculation result

The total number of trains for both directions required for each Network and year is shown in Fig. 3-2-1. (See Appendix 3-2-1 for the breakdown by type of trains).

In preparing the train operation plan, the following points are taken into consideration;

(a) New East-West Railway

In Network A and B, Kuala Lumpur - Paka (Kerteh) section, following types of trains are planned;

(i) Passenger trains (for inter-zone traffic)

- Super express trains

- Trains which stop at all the stations (classified either as express or ordinary train according to the current sales policy).

(ii) Goods trains

- All types of goods trains except ordinary goods trains. Ordinary goods trains are not planned because all the goods stations are the main goods stations, except Port Chukai and Port Kuantan stations.

(b) Sourthern portion of the West Coast Railway

(i) Pasir Gudang station is planned to be developed as a main goods station in the southern Johor zone, and Johor Bahru station will not handle goods traffic.

(ii) Goods traffic between Johor Bahru and Singapore is limited to those goods which are produced, consumed or processed in Singapore, so that the goods traffic exported from/imported to Malaysia via Johor is planned to be dealt with in Johor Port.

(c) Northern portion of the West Coast Railway

Perai station is planned as a main goods station in the Pulau Pinang zone, and Butterworth station will handle only marine containers exported and imported.

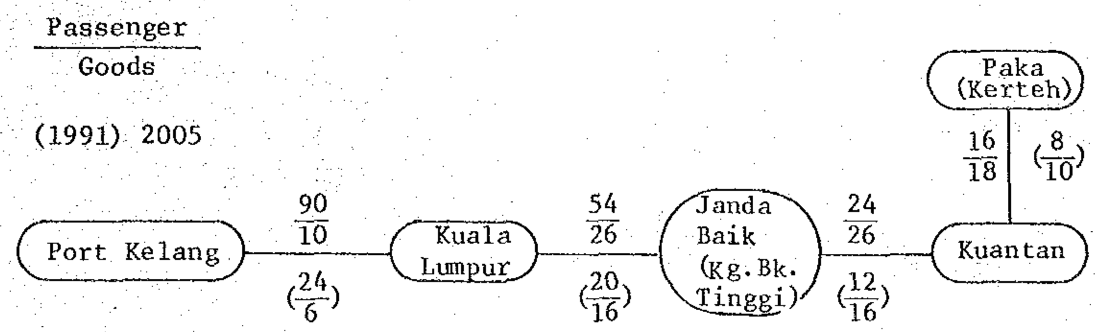
(d) Sections around Kuala Lumpur and Port Kelang Line

(i) New Rawang-Kuang goods station is planned to be the sole station of container handling around the Kuala Lumpur area, except Port Kelang station.

(ii) Goods wagons going to/from the Port Kelang line will be relayed, as a rule, at the Rawang-Kuang goods station.

(iii) KL urban passenger trains are planned to be operated between Port Kelang and Janda Baik. (Urban traffic around Kuala Lumpur in the West Coast Railway is planned to be served by the ordinary passenger trains).

Network A

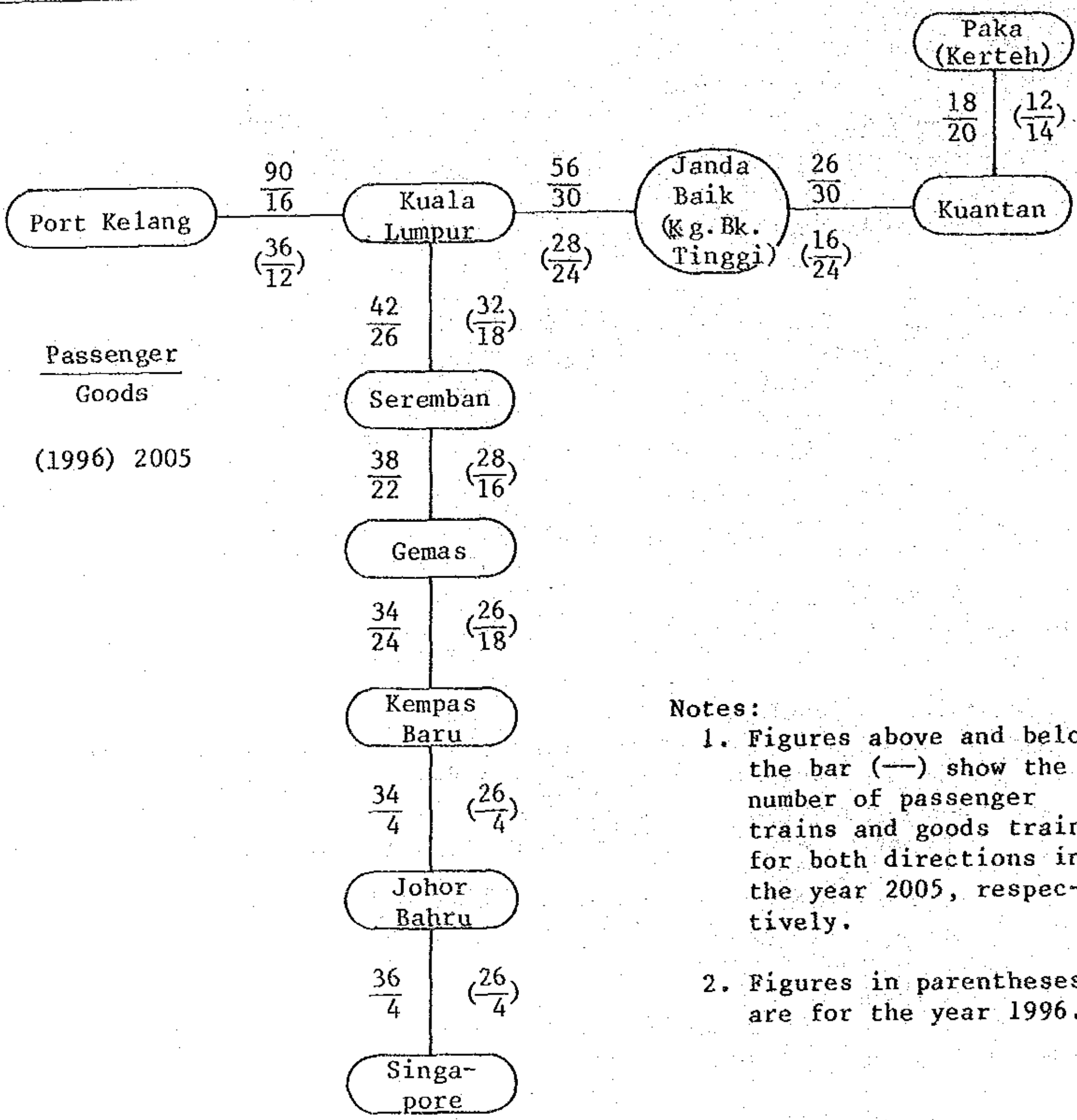


Note: 1. Figures above and below the bar (–) show the number of passenger trains and goods trains for both directions in the year 2005, respectively.

2. Figures in parentheses are for the year 1991.

Fig. 3-2-1 (a) Required Number of Trains by Section (for both directions)

Network B

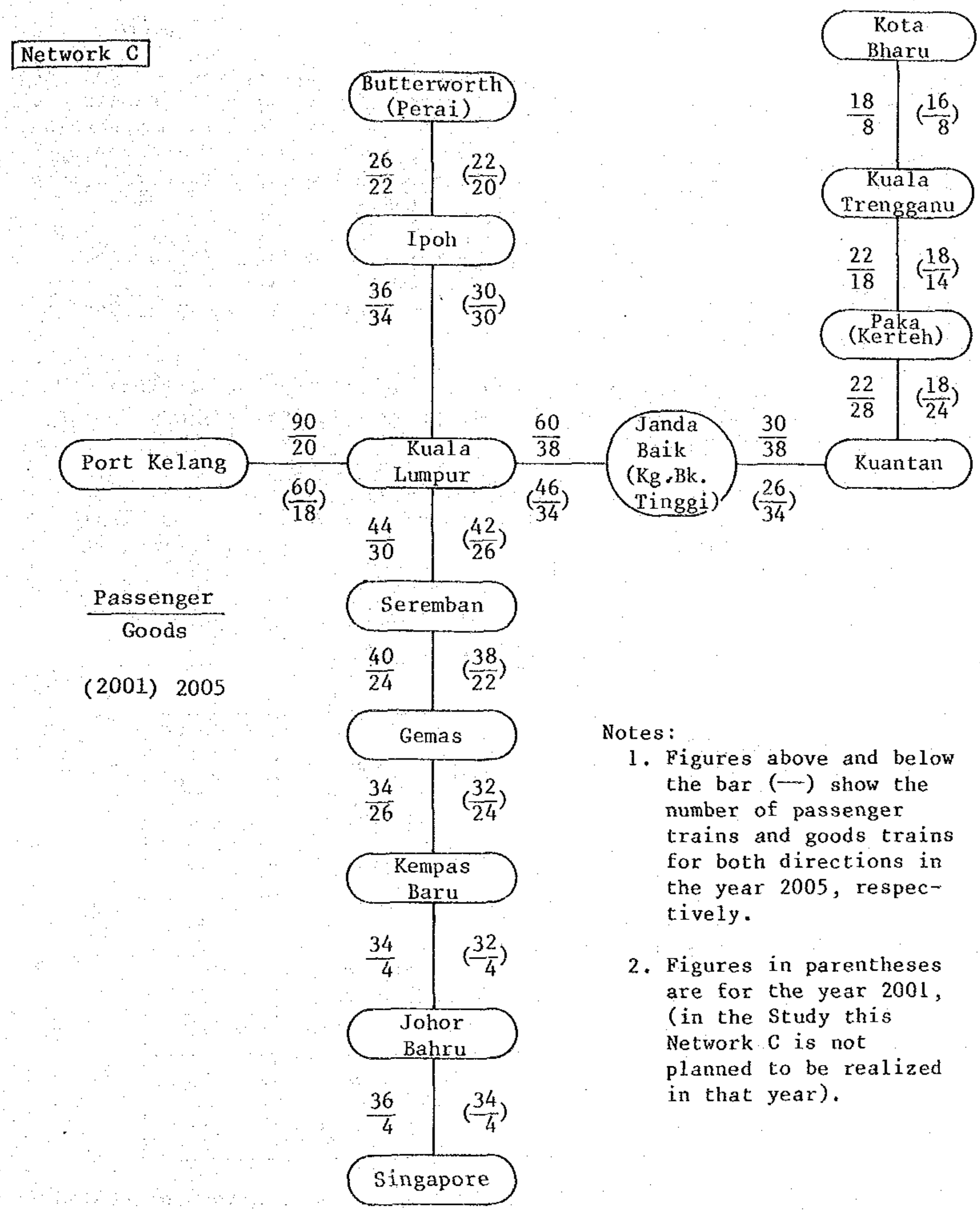


Notes:

1. Figures above and below the bar (—) show the number of passenger trains and goods trains for both directions in the year 2005, respectively.

2. Figures in parentheses are for the year 1996.

Fig. 3-2-1 (b) Required Number of Trains by Section (for both directions)



Notes:

1. Figures above and below the bar (—) show the number of passenger trains and goods trains for both directions in the year 2005, respectively.

2. Figures in parentheses are for the year 2001, (in the Study this Network C is not planned to be realized in that year).

Fig. 3-2-1 (c) Required Number of Trains by Section (for both directions)

3-2-4 Travel time and speed

The scheduled time required for a train to reach the destination from the origin (i.e. "travel time") theoretically consists of i) basic running time, ii) stopping time at stations, iii) margin time for train operation. It varies according to such factors as whether the train runs on a single-tracked section or double-tracked section and whether the train runs in a time zone where many other trains are operated.

(1) Basic running time (net running time between stations excluding stopping time) is calculated for each section on the basis of track conditions (gradient and curvature), performance of rolling stock and trailing weight. (See Appendix 3-2-2.)

(2) An assumption is made as to stopping time at stopping stations. Super express trains are planned to stop for two minutes at each station described in Table 3-1-1.

(3) Travel time by super express train is shown in Table 3-2-2. Flexibility will be limited in train scheduling in case of single track, but if priority is given to some super express trains, this travel time will be realizable.

Table 3-2-2 Travel Time from Kuala Lumpur to Principal Cities (by super express train)

Destination	Distance (km)	Travel Time	Scheduled Speed (km/h)
Kuantan	227	1 hour 50 minutes	124
Kuala Trengganu	405	3 h 10 m.	128
Kota Bharu	558	4 h 15 m.	131
Johor Bahru	352	2 h 40 m.	132
Singapore	379	3 h 00 m.	127
Ipoh	200	1 h 30 m.	133
Butterworth	357	2 h 45 m.	130

Note: Trains are assumed to stop at the stations described in Table 3-1-1.

3-2-5 Findings

The train operation planning has revealed two findings which will be noteworthy for future implementation of the project;

(i) that the projected Network A through C, single tracked, will see the traffic saturation sooner or later beyond the year 2000.

(ii) that the container traffic requiring transfer between the new and the existing networks at Kuala Lumpur will be 500 to 700 thousand tons in years 1991 to 2005 for Network A, and 700 to 800 thousand tons in years 1996 to 2005 for Network B.

(1) Capacity of single track

Single track capacity is calculated using the following formula.

$$N = \frac{1440}{\frac{S}{V} \times 60 + t} \times f$$

Where;

N: Maximum number of trains which can be operated (both directions)

S: Distance between adjacent stations or signal stations where passing loops are provided (km)

V: Average running speed on the above section (km/h)

t: Time required for handling the block system at the stations (min.)

f: Track utilization factor (See Note below.)

Note: Track utilization factor (f) is a coefficient measuring the fluidity of train operation in the conditions which prevail on the line; difficulties in crossings, malfunctioning probabilities of signalling/communication systems, failure of locomotives, time required for maintenance of ground facilities and available time for train operation, etc.

Assuming that signal stations (with passing loops) are placed at approximately 20 km intervals where necessary (S = 20), that an automatic block signalling system is used (t = 2), that the average running speed is 100 km/h (V = 100) and that the track utilization factor is 60% (f = 0.6), maximum number of trains will be about 60 (N = 60).

If more signal stations are provided and the distance (S) is reduced, the track capacity (N) may increase. However this will affect scheduled speed, and accordingly, the travel time. Assuming that the track capacity is about 60, the traffic volume carried will reach the capacity limit in following sections and years;

In Network A: Janda Baik - Kuantan section, around the year 2010

In Network B: Southern portion of the West Coast Railway, around the year 2005

In Network C: The New East West Railway (Janda Baik - Kuantan) and the West Coast Railway (Ipoh - Johor Bahru), by the year 2005 (around the year 2001)

(2) Transfer of goods between the railways with different gauge

Transfer of goods between the railways with different gauge will be provided by means of containers at Temerloh and Kuala Lumpur (Rawang-Kuang) in Network A and B, and at Temerloh and Perai in Network C and D. Table 3-2-3 shows the traffic volume of transfer estimated.

Table 3-2-3 Traffic Volume Transferred between Railways of Different Gauge

Unit: thousand tons/year

Network and Year / Transfer Station	Network A		Network B		Network C
	1991	2005	1996	2005	2005
Kuala Lumpur (Rawang-Kuang)	470 (100)	660 (140)	710 (150)	820 (170)	-
Temerloh	100 (20)	170 (35)	130 (30)	160 (35)	320 (70)
Perai	-	-	-	-	160 (35)

Note: Figures in parentheses show the estimated number of loaded containers transferred per day, using 20 feet container.