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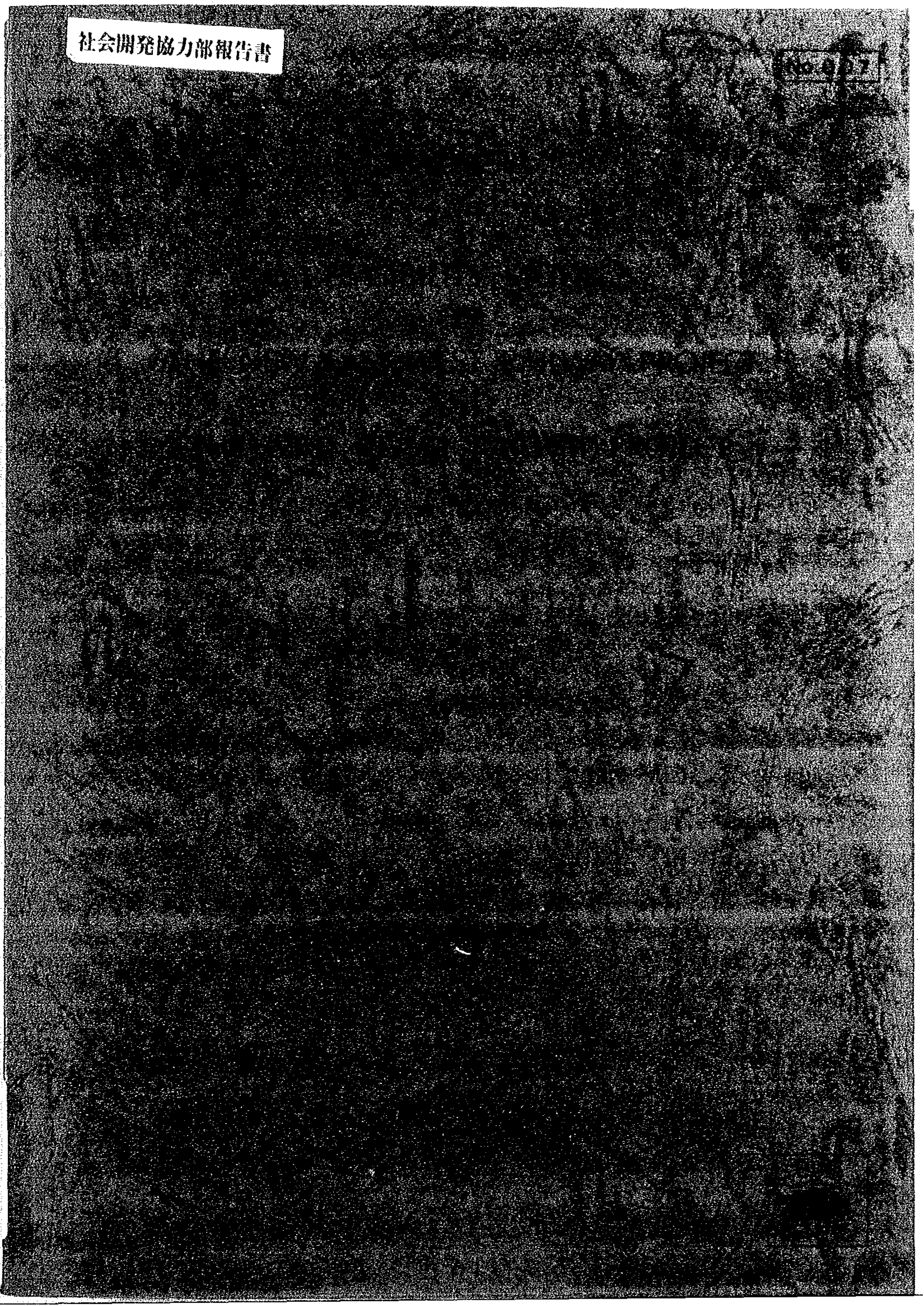

No.

MALAYSIA

FEASIBILITY STUDY
ON
THE NEW EAST-WEST RAILWAY PROJECT
AND
THE WEST COAST RAILWAY PROJECT

DECEMBER 1985

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

PREFACE

In response to the request of the Government of Malaysia, the Japanese Government decided to conduct a feasibility study on the New East-West Railway Project and the West Coast Railway Project in Malaysia and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Malaysia a study team headed by Mr. Hotsumi Harada of the Japan Railway Technical Service from July to August, 1984.

The Team had discussions on the Projects with the officials concerned of the Government of Malaysia including those of the Malayan Railway Administration and conducted a field survey. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the policy-making on the transportation and contribute to the promotion of friendly relations between our two countries.

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

December, 1985

Keisuke Arita
President
Japan International
Cooperation Agency

December, 1985

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

Dear Sir,

LETTER OF TRANSMITTAL

We have the pleasure of submitting herewith the final report of the "Feasibility Study on the New East-West Railway Project and the West Coast Railway Project in Malaysia".

The Study was conducted from July, 1984 to November, 1985. During this period investigations and surveys were carried out in Malaysia from July to August and again in October, 1984.

The Study examined the effects of the Projects' implementation on the nation's economy and railway administration. In this context, the Study assumed four cases. Completion of the entire network, as suggested in the "Master Plan" (JICA Report "Railway Development Plan in Malaysia", October, 1983), would be achieved by one case, while the other three would suspend part of the network construction indefinitely. We hope this report and the alternatives it offers will aid in the policy-making on the transportation in Malaysia.

We would like to express our sincere gratitude to the officials of your Agency, the Advisory Committee, the Embassy of Japan in Malaysia, and to those concerned in the Government of Malaysia, including the Malayan Railway Administration for the kind assistance and cooperation they extended to the Study Team.

Very truly yours,

M. Takiyama

Mamoru Takiyama
President
Japan Railway Technical Service

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SUMMARY

1. Background, Objectives and Method of the Study

1-1 Background of the Study

Malaysia has been undertaking a series of five year development plans beginning with the First Malaysia Plan (1966-1970). The thrust of the successive plans, beginning with the Second Malaysia Plan (1971 - 75) is on the implementation of the New Economic Policy which has the main objectives of the eradication of poverty and the restructuring of society. This project aims, in this connection, at constructing a modern high-speed railway network in Malaysia, to found a new infrastructure which will support the industrial development of the country, and will vitalize the daily life and mobility of the nation. The objective of this project is to place all the Peninsular large cities in a "One-Day Zone" to and from the Capital through providing modernized railway passenger service, and also to contribute to the industrialization of the east coast area including the southern part of Trengganu State which has been relatively underdeveloped but now is rapidly developing, through improved goods service as well as passenger service.

(Reference) Present state of MRA

(1) Railway network

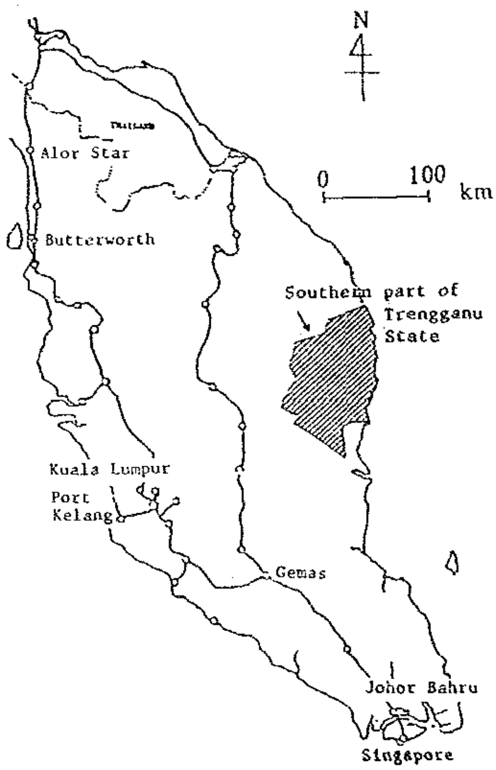
All lines are meter-gauged, single-tracked and dieselized (not electrified).

(2) Number of staff

10,000 staff (in 1983)

(3) Train speeds, fares and rates

	Passenger	Goods
Maximum speed (km/h)	Express 80 Ordinary 72	64
Fares & Rates (M¢/Passenger or ton/km)	1st class 12.14 2nd class 5.47 3rd class 3.36	To be negotiated on the basis of scheduled rates



(4) Trend of annual traffic volume

Item / Year	Passenger traffic		Goods traffic	
	Number of passenger (thousand)	Passenger-km (million)	Tonnage (thousand)	Ton-km (million)
1975	6,109	1,014	2,782	822
1980	7,067	1,589	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

(5) 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

1-2 Objectives of the Study

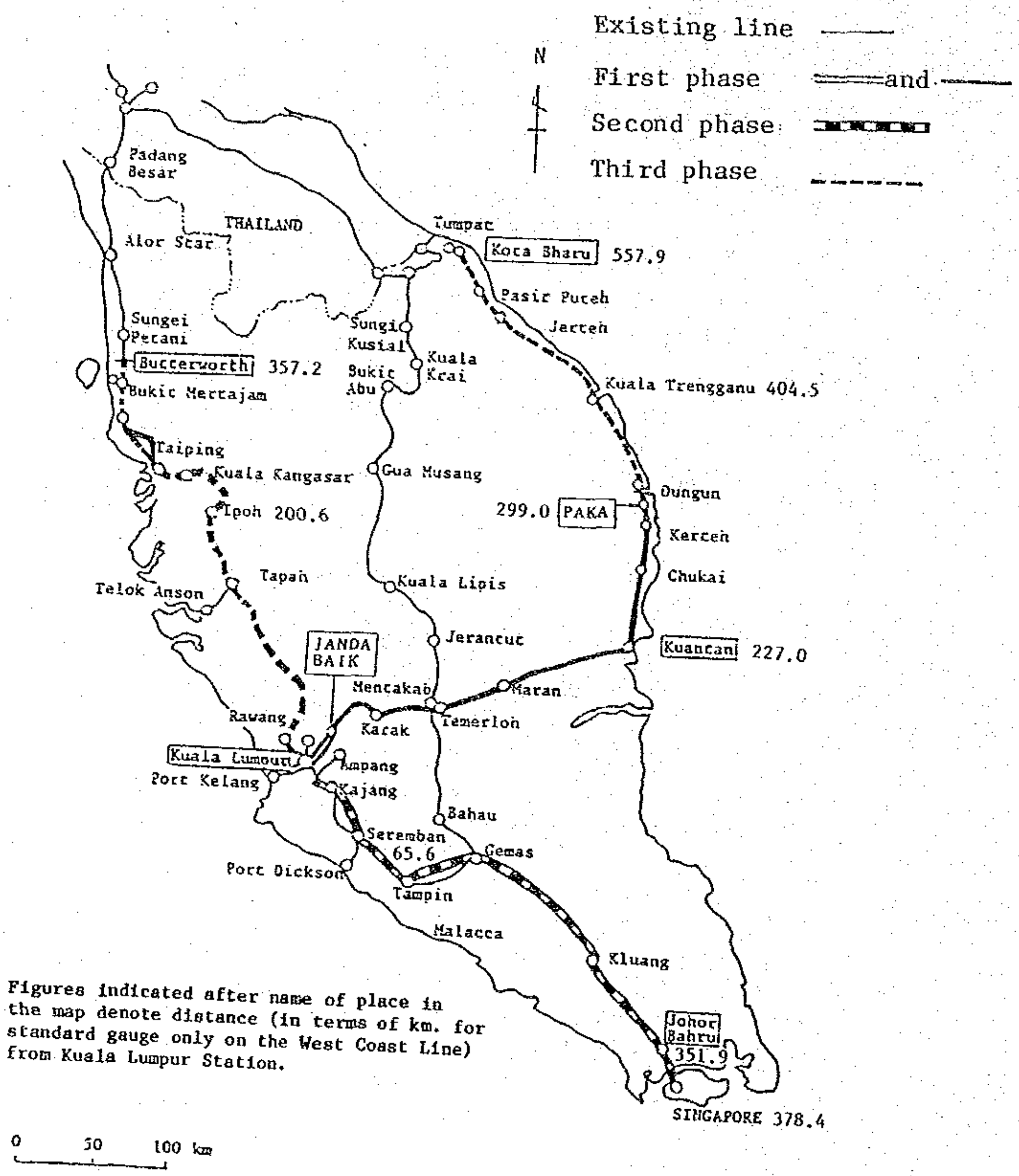
This Study, which will be hereinafter referred to as "the F/S" signifying the Feasibility Study on the New East-West Railway Project and the West Coast Railway Project, aims to evaluate the technical/economic/financial feasibilities of the "Case A-A" of the Master Plan (hereinafter referred to as the "M/P", a JICA study conducted Sept. 1982 - Nov. 1984, entitled "Railway Development Plan in Malaysia" which suggested more detailed analysis of the "Case A-A"). The content of the Case A-A, one of the alternatives considered in the M/P, is to improve and upgrade the existing West Coast Line (Butterworth - KL - Singapore, 750 km, single track, meter gauge at present) and to construct the New East-West Railway (Port Kelang - KL - Kuantan - Kota Bharu, 550 km, double track, standard gauge, and electrified), totaling 11,589 mil. M$ (West Coast Line 6,415 mil. M$, New East-West Railway 5,174 mil. M$).

The F/S had originally been designed to formulate some alternatives for construction sequence of each portion of the network. Upon calculation of the revenue and cost of each of these alternatives, the construction sequence most recommendable from the economic viewpoint would have been selected. In fact, however, under the explicit request of the Malaysian Government in July 1984, it was agreed that the F/S would be conducted on the basis of the following sequence and priority of the project implementation.

1st: Section between Port Kelang and Paka (340 km); double track for Port Kelang - Janda Baik (Kg. Bukit Tinggi), single track for Janda Baik (Kg. Bukit Tinggi) - Paka
(New East-West Railway)

2nd: Section between Kuala Lumpur and Singapore (380 km)
(southern portion of West Coast Railway), not necessarily double-tracked

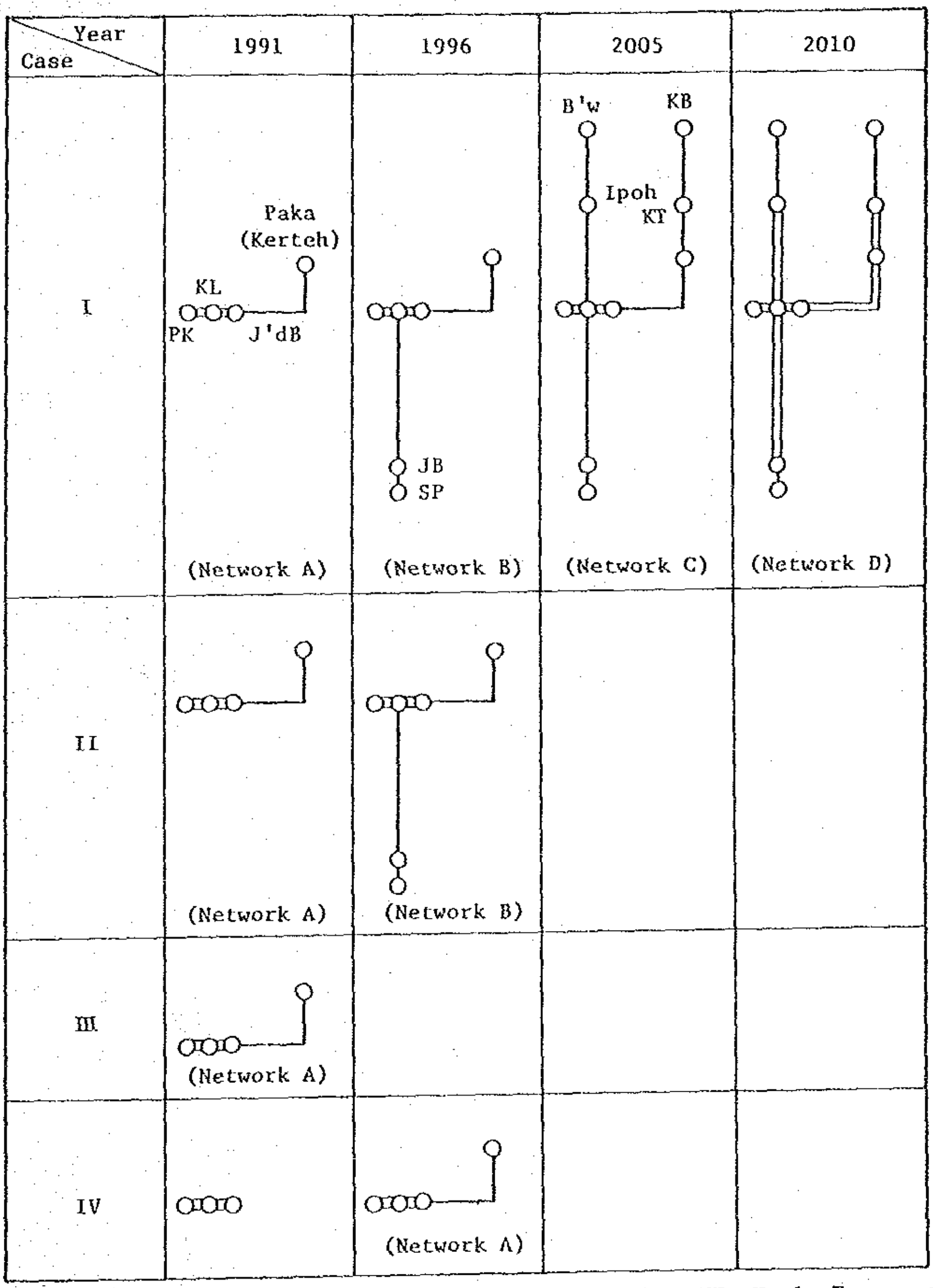
3rd: Section between Kuala Lumpur and Butterworth
(northern portion of West Coast Railway), not necessarily double-tracked
Section between Paka and Kota Bharu
(remaining portion of New East-West Railway), not necessarily double-tracked



Figures indicated after name of place in the map denote distance (in terms of km. for standard gauge only on the West Coast Line) from Kuala Lumpur Station.

1-3 Method of the Study

(1) Within the framework of the above construction sequence four cases are considered in accordance with the objective of the Study. The four cases and the years of opening to traffic are shown in Fig. 1-2-1.



— Single track
= Double track

PK: Port Kelang
KL: Kuala Lumpur
J'dB: Janda Baik (Kg.Bukit Tinggi)

JB: Johor Bahru
SP: Singapore
B'w: Butterworth

KT: Kuala Trengganu
KB: Kota Bharu

Fig. 1-2-1 Cases Studied

(2) The evaluation of each case is conducted by following procedures:

(a) Setting up the socio-economic framework which provides the premises of the Study.

(b) Forecasting the traffic demand for each case. (The traffic demand differs in each case in accordance with the networks and their years of opening to traffic.)

(c) Economic analysis (to evaluate the benefits and costs to the national economy).

(d) Financial analysis (to evaluate the financial burden of the project for the Government and the Entity*).

(3) Conclusion and recommendation are prepared on the basis of the above-mentioned evaluations.

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* Entity: The Organization which will be responsible for construction/operation of the new railway network.

2. Socio-Economic Framework

2-1 Population and GDP Growth Rate

The population and GDP growth rates, used as the premises for the Study, are based on the actual figures and the development plans of national/regional governments, taking into account the data obtained from the International Bank for Reconstruction and Development, and the Institute of Developing Economies.

Average annual growth rates agreed with the Malaysian Government are as follows:

(1) Average annual population growth rate

a. Base case

1980 - 1985	2.5%
1985 - 1990	2.5%
1990 - 2005	2.3%

b. Alternative case for sensitivity analysis of demand forecast

1990 - 2005	1.9%

(2) Average annual GDP growth rate

a. Base case

1980 - 1985	6.4%
1985 - 1990	6.0%
1990 - 2005	5.0%

b. Alternative cases for sensitivity analysis of demand forecast

(i)	1985 - 1990	6.5%
	1990 - 2005	6.0%
(ii)	1985 - 1990	5.5%
	1990 - 2005	4.0%

2-2 Population and GDP Growth Rates by Zone

The Peninsula is divided into the 14 zones, then the growth rates in popultion and GDP are assumed zone by zone as shown in the figure below.

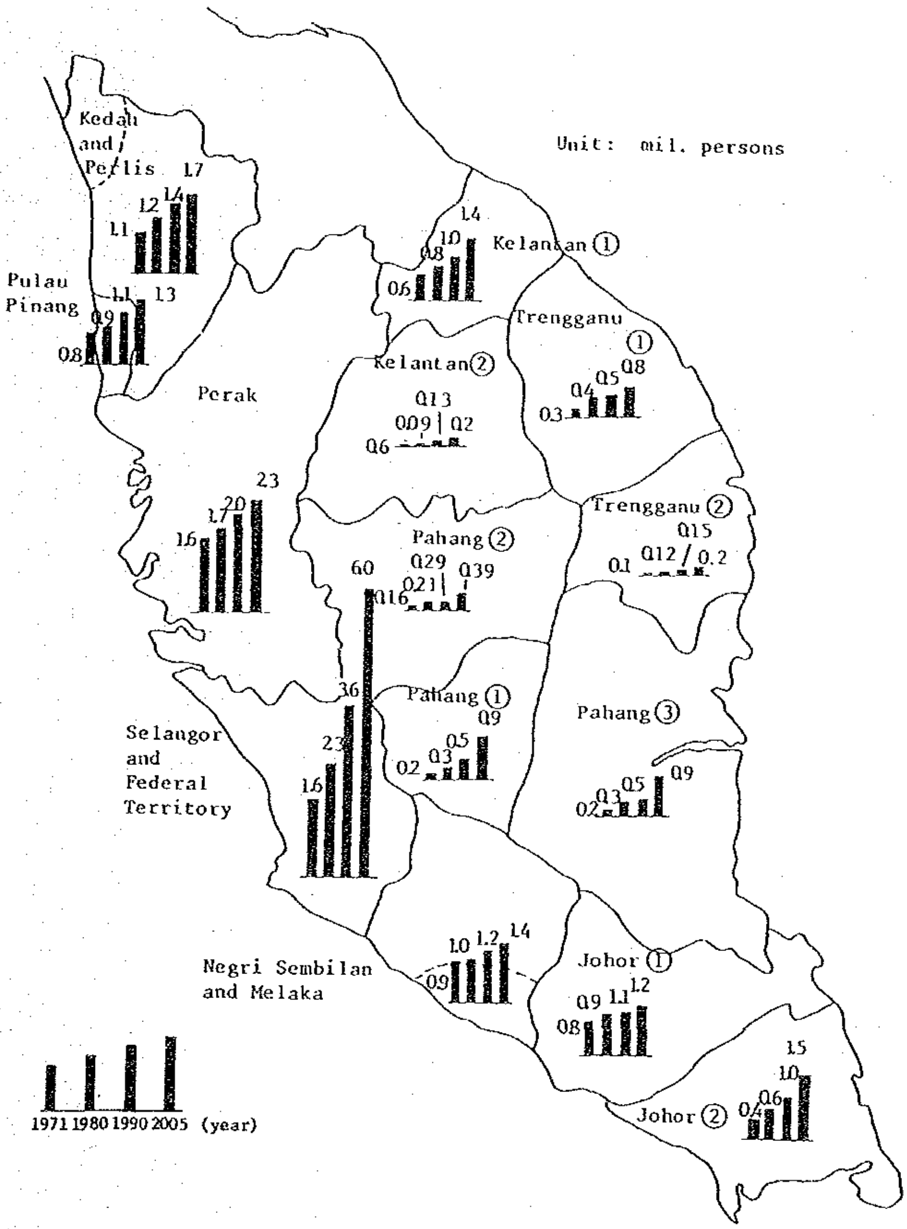


Fig. 2-2-1 Population Trend by Region

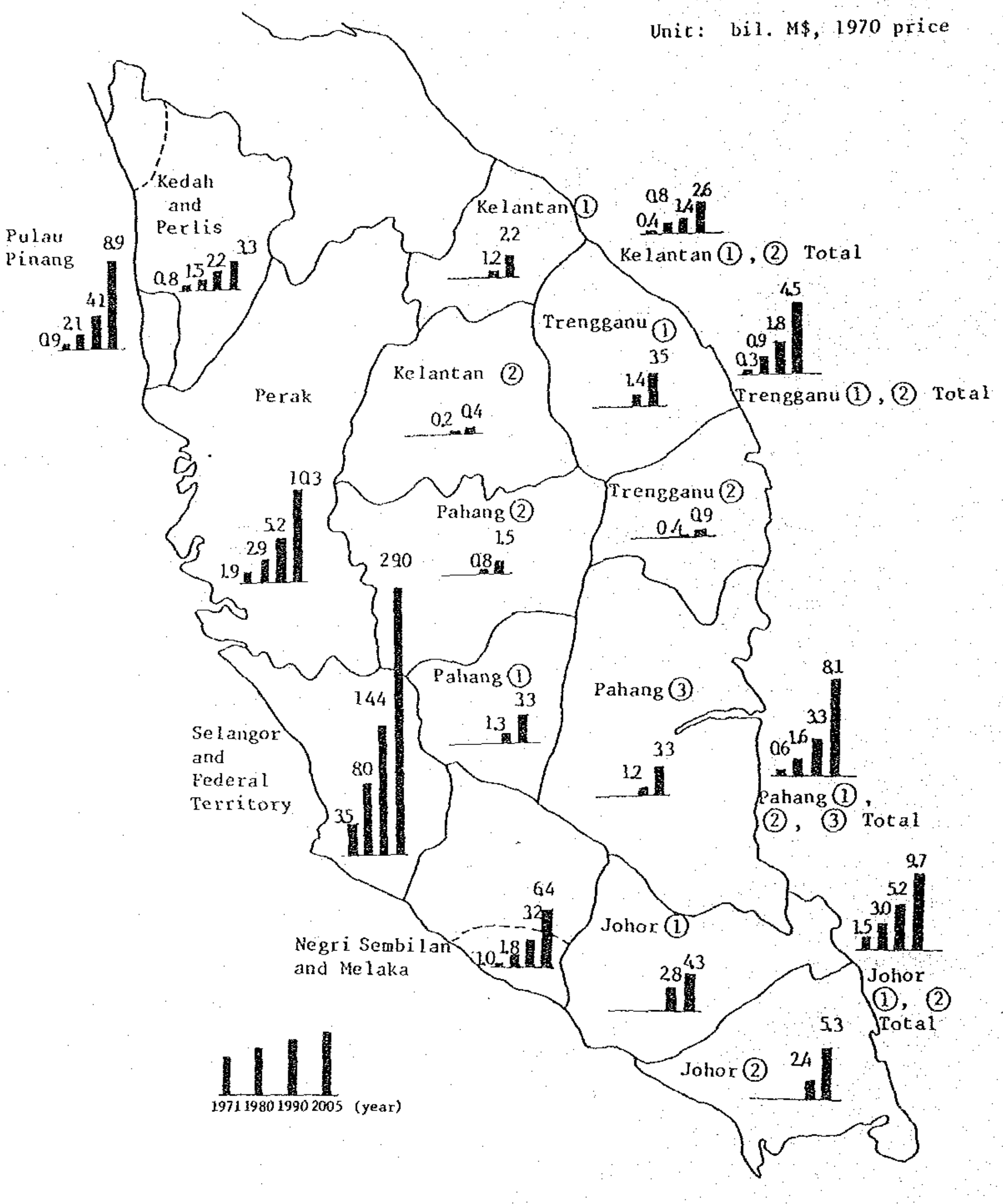


Fig. 2-2-2 GDP Trend by Region

3. Demand Forecast

3-1 Methodology Employed

The Four-Step Method which is widely accepted in transportation planning is employed:

(1) Forecasting of generation and attraction

The traffic generation is estimated for each zone. The traffic attraction is also estimated for each zone. For the passenger traffic, household income statistics are used. For the goods traffic, commodity transportation statistics are used. Forecasting their future values is made based on the socio-economic framework.

(2) Forecasting of distribution

The traffic generation and attraction of each zone is combined with that of all other zones, obtaining the distribution of the traffic among the zones which shows the flows of traffic between each pair of zones.

(3) Forecasting of modal share

The traffic flow is allotted to modes of transport (for passengers, railway, long distance bus, car/taxi and airline; for goods, rail-way, lorry and coastal shipping). The assignment is made according to the share ratio estimated by the travel time and cost compared between the relevant modes.

(4) Determination of future volume of traffic

From the traffic distribution ((2) above) and traffic share ((3) above), the traffic volume of each mode between zones is calculated, for passengers in terms of number of passengers, and for goods in tons.

3-2 Premises Used for the Demand Forecast

(1) Future transport network

At the request of the Malaysian Government, the following conditions are assumed as a base case.

(a) Railway

New railway networks are assumed to start operation as shown in the Fig. 1-2-1.

(b) Highway

North-South Expressway is assumed to be completed in the year 1990. Karak - Kuantan Expressway which may have a serious impact on the feasibility of the New East-West Railway, is assumed not to be constructed in the project life.

(c) Others

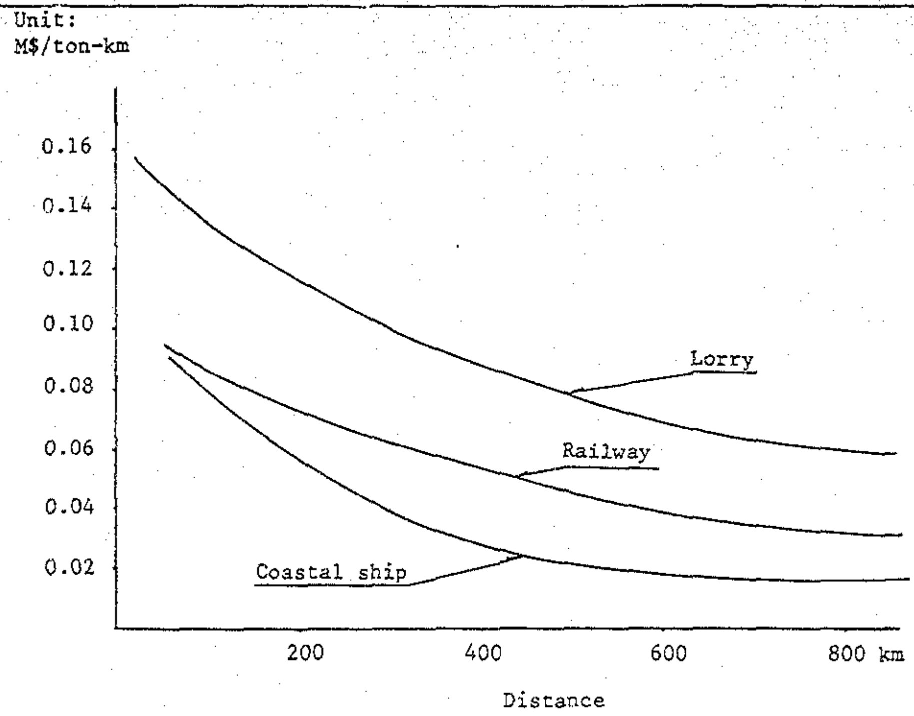
Ports, airports and other modes are assumed to be upgraded to provide with sufficient capacity as required according to the growth of traffic demand.

(2) Assumption for passenger demand forecast

Mode	Travel Time	Travel Cost
Railway	Train hour by scheduled-speed (120 km/h, maximum speed 160 km/h), access/egress time (30 to 50 min.) and transfer time (20 min. in "the projected railway", 30 min. for transfer between "the projected" and "the existing railway network").	The current 2nd class fare (5.5 MC/km) and access/egress expense (3 M$).
Bus	On vehicle time by the speed of 50 km/h (ordinary road), 70 km/h (expressway), access/egress time (30 to 50 min.) and waiting time.	Air-conditioned bus fare, highway toll per capita, and access/egress expense (3 M$).
Car/taxi	On-vehicle time same as bus.	Fuel/oil cost, and highway toll per capita. Depreciation and repair cost excluded.
Airline	On-vehicle time according to time table, time for check-in (40 min.) and access/egress time (20 to 40 min.).	Current airfare, and access/egress expense (20 M$).

(3) Assumption for goods demand forecast

Mode	Haulage Time	Cost
Railway	On-vehicle time between origin and destination station by the speed of 20 km/h for "the existing railway", 90 km/h for "the projected railway, express container", and 70 km/h for "the projected railway, carload", + access/egress time, + loading/unloading time, + waiting time, + intermediate station stopping time for "the projected railway".	
Lorry	On-vehicle time by the speed of 50 km/h for ordinary road and 80 km/h for expressway, loading/unloading time and waiting time.	
Coastal Ship	On-vehicle time by the speed of 18 km/h, access/egress time, ro/ro time and waiting time	



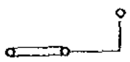
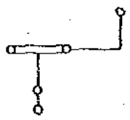
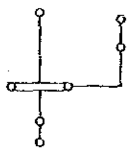
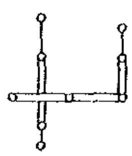
Average Goods Haulage Rate by Various Transport Modes

3-3 Passenger Traffic Demand Forecast

(1) Passenger traffic volume

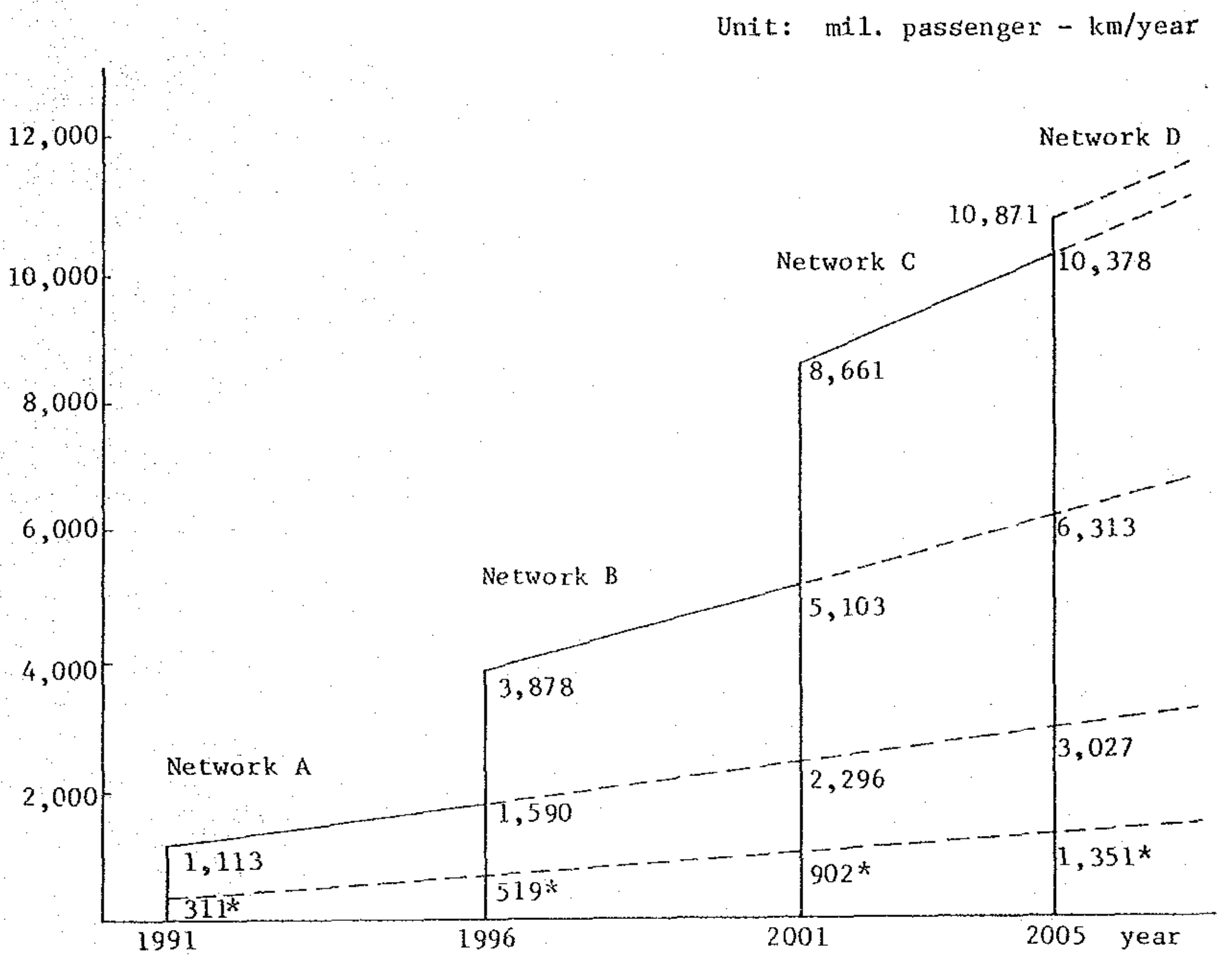
Table 2-4-2 Passenger Traffic Demand and Share (Inter-zone Long Distance Travel)

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%

Notes:
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 existing railway.

(2) Future trends in railway traffic volume



* Figures with asterisk denote the traffic when the section between Port Kelang and Janda Baik alone is constructed.

Note: The traffic of Port Kelang Line will be cosiderably 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

(3) Sensitivity analysis

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 to 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%

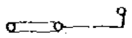
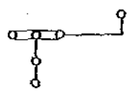
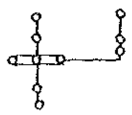
Population --- 100.0%

3-4 Goods Traffic Demand Forecast

(1) Projected railway goods traffic

Table 2-5-3 Goods Traffic Demand and Share

Unit: thousand tons

Network	Year	* 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%

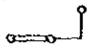
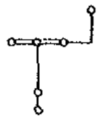
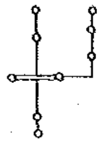
Note: 1. The traffic in the Network D is the same as in the Network C.

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, which are included in the relevant total traffic volume. "9. Others" consists of about one hundred commodities other than 1 through 8. The traffic of this category is assumed to increase by 10.3% annually until 1990, and by 6.4%, from 1991. These increase rates are obtained by adjusting the past actual result (14% annually).

(2) Trend of railway goods traffic volume

Unit: mil. ton-kms/year

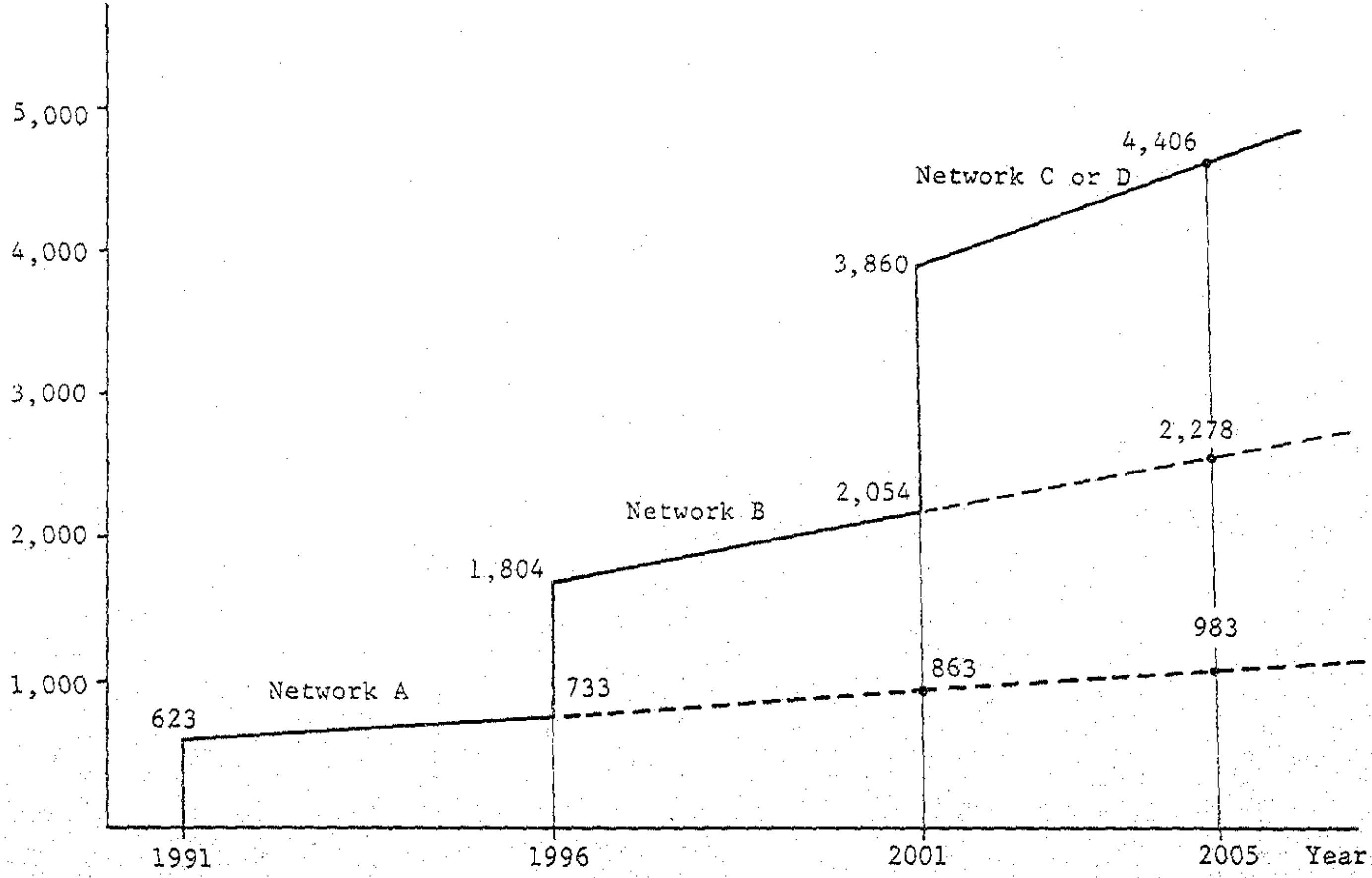


Fig. 2-5-3 Trend of Railway Goods Traffic Volume

(3) Result of sensitivity analysis

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) Decrease in Steel and Petroleum production by 30%

Unit: percentage in ton-km, 2005

Item		Ratio to Base Case					
		Network A		Network B		Network C	
		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

4. Train Operation Plan

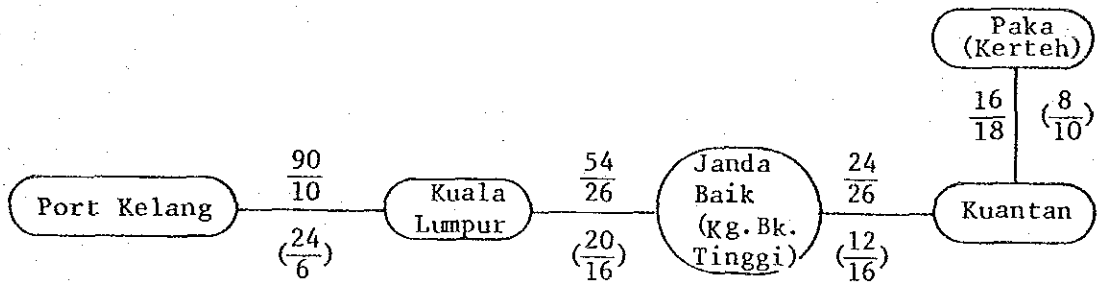
4-1 Number of Trains

To meet the traffic demand forecasted in the preceding chapter, trains are planned to be operated for each Network, as shown below.

For example, between Janda Baik and Kuantan, 12 passenger trains and 16 goods trains will be operated for Network A, in 1991.

Network A

Passenger trains
goods trains
(1991) 2005

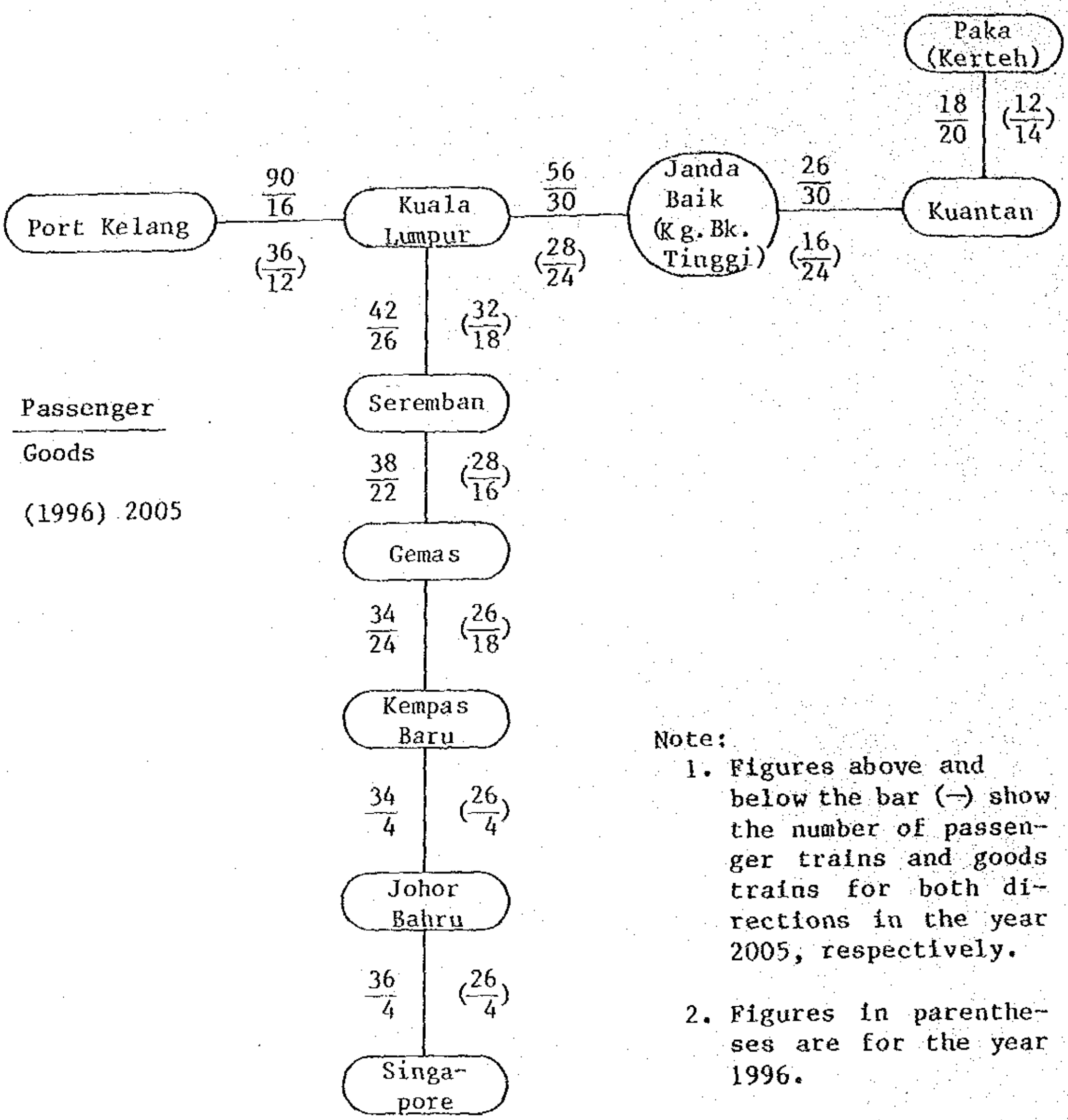


Notes: 1. Figures above and below the bar (-) show the number of passenger trains and goods trains for both directions in the year 2005, respectively.

2. Figures in parentheses are for the year 1991.

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

Network B

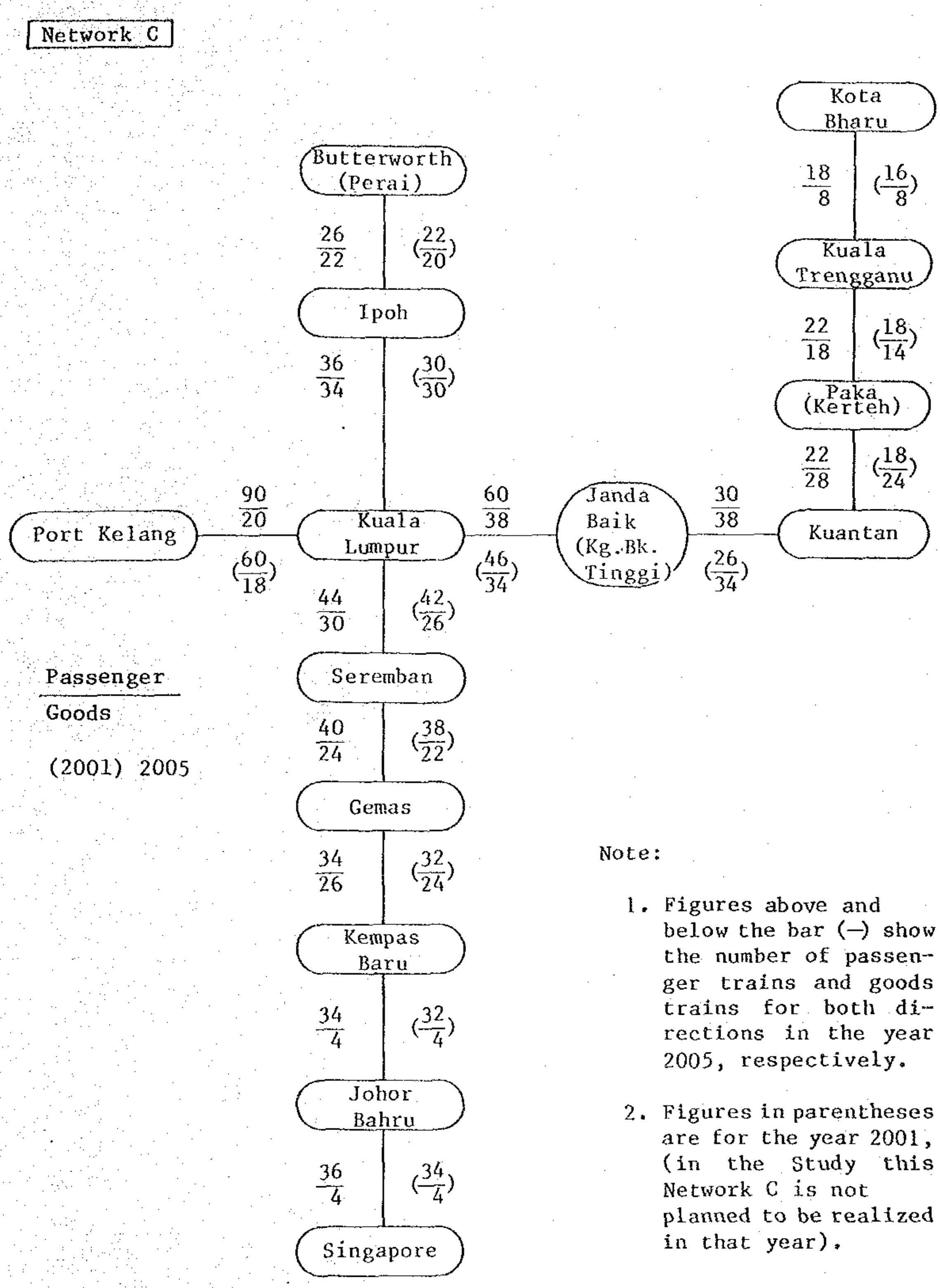


Note:

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 1996.

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



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 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)

4-2 Station

These trains will serve the stations listed in Table 3-1-1.

The number of stations for Network A will be four between Port Kelang and Kuala Lumpur, nine between Kuala Lumpur and Paka (Kerteh), each figure excluding the stations on both ends of the sections and the stations in the branch lines (Port Kuantan and Port Chukai). Super express trains will stop at Kuala Lumpur, Janda Baik, Temerloh, Kuantan and Paka (Kerteh). Express container trains will stop at Rawang-Kuang, Kuantan and Paka (Kerteh).

4-3 Feature of Trains

Super express trains will run at the maximum speed of 160 km/h, and express container trains, at 120 km/h. See Table 3-2-1.

4-4 Travel Time

A super express train will connect Kuala Lumpur and Kuantan (227 km) in 1 hour and 50 minutes. See Table 3-2-2.

4-5 Findings

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

(1) that the projected Networks A through C, when single-tracked, will see the traffic saturation sooner or later beyond the year 2000.

(2) that the annual container traffic requiring transfer between the new and existing networks at Kuala Lumpur (Rawang-Kuang) 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.

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

Station	Passenger handling	Goods handling
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.

Table 3-2-1 Main Features of Trains

	Maximum Speed (km/h)	Train Formation (coach)	Trailing Load (ton)	Brake System
Passenger train				
Super express train	160	14	520	Electro-magnetic air brake
Express train	160	14	520	do.
Ordinary train	160	14	520	do.
KL urban train*	120	8	300	do.
Goods train				
Express container train	120	-	800	Electro-magnetic air brake
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).

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

4-6 Fleet

Required number of passenger rolling stock for Network A in 1991 will be 24 electric locomotives (used in common for passenger and goods transport) and 115 coaches. Wagons and containers required will be 925 and 935, respectively.

See Table 3-3-1, below.

Table 3-3-1 Scale of Fleet

Rolling stock \ Network and year	Network A		Network B		Network C	
	1991	2005	1996	2005	2001	2005
Electric locomotive	24	38	59	73	97	111
Diesel locomotive						
(Large-size)	7	7	19	19	31	31
(Small-size)	1	1	5	5	14	14
Coach (for super express and express train)	80	143	252	364	539	617
(for ordinary train)	-	-	64	64	158	158
(for KL urban train)	36	100	55	100	81	100
Total	116	243	371	528	778	875
Wagon						
Container wagon	655	1,100	1,445	1,909	1,946	2,293
Low side wagon	42	57	156	188	767	795
Tank wagon	163	197	481	566	669	741
Hopper wagon	26	50	92	139	399	465
Brake van	33	54	87	114	180	201
Service wagon	6	6	12	12	20	20
Total	925	1,474	2,273	2,928	3,981	4,515
* Container (in terms of 20 feet type)	935	1,561	2,366	3,025	3,515	4,150

* The number of containers denotes those to be owned by the railway, which is assumed as a half of the required number.

4-7 Depot and Workshop

For Network A, rolling stock depots will be located in Kuala Lumpur and Kuantan, and a workshop, in Rawang - Kuang.

See Table 3-4-1.

Table 3-4-1 Location of Rolling Stock Depots

Rolling Stock / Location	Electric Locomotive	Diesel Locomotive	Coach	Wagon
Kuala Lumpur	◎ (Segambut)	◎ (Rawang-Kuang)	◎ (Segambut)	◎ (Rawang-Kuang)
Kuantan	o	o	o	◎
Kota Bharu	◎	◎	◎	◎
Gemas	-	-	-	◎
Johor Bahru	◎	◎	◎	◎
Singapore	o	-	o	-
Ipoh	-	-	-	◎
Perai	◎	◎	◎	◎

Note: 1. Marks in the Table denote the type of inspections carried out; (See 5-2-4 of the report.)

◎: Type A (daily) and Type B (regular) inspections

o: Type A (daily) inspection

-: No inspection

2. Kuala Lumpur depot is the sole depot where the Type C inspection for electric and diesel locomotives is carried out.

5. Construction Plan

5-1 Construction Standards

The construction standards are listed in the table below.

List of Construction Standards

Maximum speed	Passenger train 160 km/h Express container train 120 km/h Other goods train 90 km/h
Standard curve radius	New East-West Railway 4,000 m West Coast Railway 2,000 m
Trailing load	Passenger train 520 tons Goods train 1,200 tons (90 km/h) 800 tons (120 km/h)
Maximum gradient	15%
Track effective length in stations	Track for passenger train 370 m Track for goods trian 500 m
Roadway dimension	Width for a single track 8,500 mm Width for a double track 13,000 mm
Design axle load	18 tons (corresponding to a locomotive trailing 1,300 tons)
Track on soft soil ground	Embankment 3 m high as a rule
Electricity	Power received by one line at substation (except KL area) Signalling power --- distributed by overhead wire
Feeding	25 kV AT
Catenary	Heavy simple catenary Messenger wire 135 mm^2 (section) Contact wire 110 mm^2 (section)
Signal	Automatic block system Color light signal CTC system ATS system with speed checking and intermittent control
Transmission	Optical communication system (8 M bits/sec), and multiplex radio circuit
Train radio	UHF LCX (for tunnel)
Locomotive (electric)	Common use for passenger trains (160 km/h) and goods trains (1,200 tons)

Shunting locomotive (diesel)	210 HP for small station 850 HP for larger station
Coach	Capacity 1st class 48 persons 2nd class 64 persons Ordinary 88 persons KL urban 122 persons
Wagon	Express container wagon operated at 120 km/h. Low side wagon, tank wagon, hopper wagon, ordinary container wagon, etc. operated at 90 km/h.
Container	Half fleet to be owned by the Entity
Workshop	Rawang-Kuang for standard/meter gauge rolling stock, and Mentakab for meter gauge rolling stock

5-2 Maximum Speed

The construction standards are determined mainly by the maximum train speed which is aimed to be attained. It is planned to be 160 km/h for the project.

The reasons for aiming at this speed are as follows:

- Passengers' selection of modes is subject to factors such as travel time, travel cost, comfort, access/egress time, etc.

- In order for the railway to be ensured of superiority over other modes even after the completion of the expressway network, it should excell in travel time factor so much so that the comparison in other factors will be out of question.

- Travel time saving must be large enough to be felt meaningful for passengers: Compare a train at 160 km/h scheduled speed with a car at 100 km/h scheduled speed on super-expressway.
  For a travel distance of 100 km, for example, the train will save only 20 minutes in travel time compared with car. This will not be so meaningful. While for a travel distance of 500 km, the train will save 2 hours. And this will be meaningful for passengers. In this regard, the Malaysian principal cities are 300 to 500 km apart.

- In consideration of the maximum car speed on expressway (100 km/h) the maximum train speed of the new railway in Malaysia must be therefore at least 160 km/h.

5-3 Design Speed

The construction standards must be determined at a level to leave room for the future innovation of the system to attain a higher train speed, because, once constructed, it is hardly possible for a railway to be remodeled for a higher speed, and because it must remain competitive in speed with cars even after the completion of super-expressway network.

In consideration of the cost for the right of way acquisition, the New East-West Railway is designed for the maximum speed of 260 km/h, and the West Coast Railway, for 200 km/h.

Such high scheduled speeds would be unnecessary, however, for the projected railway at the present moment, since the average time value of Malaysian customers is not high enough to justify the cost and, accordingly the fare, for such speeds service.

5-4 Track Gauge

(1) Adoption of standard gauge

Theoretically speaking, standard gauge track is better suited for a high-speed railway than narrow gauge track, because of its i) better running stability, ii) lower rate of degrading in terms of track irregularity, iii) larger tolerance in maintenance for track irregularity and iv) availability of locomotives with larger output.

As a matter-of-fact, the world's railways having experience in high-speed operation over 200 km/h in maximum speed are, all of them, standard-gauged.

(2) Coexistence of different gauges

Coexistence of different gauge railways in one country is problematic. The obstacles related to the goods transfer between the projected railway and the existing one, is expected to be surmounted by use of containers to the fullest extent. The containerization in the existing network is already going on.

5-5 Curve Radius

(1) Standard curve radii

New East-West Railway	4,000 m	(Leaving room for future 260 km/h operation)
West Coast Railway	2,000 m	(Leaving room for future 200 km/h operation)

It should be noted that, if the high-speed tilting type rolling stock is fully developed for use in the West Coast Railway, 260 km/h operation would be within reach for the West Coast Railway also.

(2) Shift from existing system to new system

When the new standard gauge track with a standard curve radius of 2,000 m is laid within the existing right of way of the West Coast Line, it will cross the existing track which has steep curves with radii 500 m or so, at more than 100 points. If the existing railway is to continue the operation after the new railway is built, many sections of it would have to be moved to give way to the new railway. This displacement would require considerably large expense. It is assumed in this Study therefore, that the operation of the existing railway will be terminated some time (two months or less) before the new railway enters commercial operation. The length of "some time" depends on the incremental expense for the displacement. And in the section Kuala Lumpur to Singapore for Network B and the section Kuala Lumpur to Butterworth for Network C, during the period where there is no railway service, new or old, substitute transport using bus, lorry and other modes needs to be provided. Containerization of goods will facilitate this shift.

5-6 Gradient and Design Load

The steepest gradient comes out not to exceed 15‰, based on the route selection.

Design load is determined from a locomotive having six axles of each 18 tons and the capability of trailing 1,300 tons.

Design load of bridges and other structures whose reconstruction is not easy, is determined at a weight of two locomotives coupled.

5-7 Route Selection

As the route selection was accepted in the Interim Report, explanation is limited to the modifications compared with the plans in the M/P and the F/S (Interim Report), and to some important technical features.

(1) Modification

(a) Between Johor Bahru station and Singapore station, the original plan of improving the route alignment is found impossible, because the route has to be selected within the existing right of way.

(b) The construction of Port Kerteh branch line is not planned.

(c) The Pasir Gudang line is added.

(d) The turning track (Batu Caves to Kg. Kepong) is not planned, although it should be considered in future.

(e) The Port Kelang line is changed to a part of the main line. (The line was planned as a branch line in the M/P.)

(f) A branch line between Rawang and Kuala Lumpur is planned to be constructed in Network A and B. This will become the main line between Butterworth and Kuala Lumpur in Network C and D.

(g) All branch lines will handle goods traffic only.

(2) Feature of the New East-West Railway

(a) As this route crosses the mountain range of the Peninsula, a number of tunnels must be constructed, totaling approximately 50 km, the longest of which being 10 km. A maximum gradient of 15‰ is used in this section.

(b) A 960 m long bridge will be constructed to cross the Pahang River, the largest river in the Peninsula.

(c) The route cannot detour all of the soft ground scattered along the east coast because of the requirements of the minimum curve radius. Particularly near Chukai, the route has to pass through the soft ground zone for a total length of 7 km.

(d) For other features, see 4-2-5, (2), (d) through (f) of the report.

(3) Features of the West Coast Railway

(a) The route is selected fully rspecting the existing railway reserve, using a curve radius of 2,000 m. As the result, 49% of the route length is within the existing right of way. It should be noted, however, that the land to be acquired should be determined in the detailed design stage, after having carefully studied the new and existing structures and the relevant construction methods.

(b) The route around Kuala Lumpur will be constructed on existing right of way wherever possible using a minimum curve radius of 800 m, as the area is extremely urbanized and land acquisition is considered difficult. The route alignment will not be much improved. All the routes in Singapore will be constructed within the existing right of way, complying with the request to such effect by the Malaysian side.

(c) The route between Ipoh and Kuala Kangsar will be constructed along the existing railway. A short-cut route is conceivable but it requires construction of a 12 km long tunnel. To economize the cost, the short-cut route is avoided.

(d) For other features, see 4-2-5, (3), (d) through (g) of the report.

5-8 Technical Features

Technical features of the new railway are given in detail:
See 4-3 of the report, for structures and stations.
See 4-4, for electrical system, and
See 4-5, for rolling stock and workshop.

5-9 Construction Cost and Construction Schedule

The construction cost of Network A is estimated at 3,078 million M$ in 1984 price, with contingency included (10%), with rolling stock for the year 2005 demand 543 million (18%), civil works, track and right of way 1,572 million (51%).
See Table 4-6-1.

The construction schedule is as shown in Table 4-7-1. It will take 5 years for constructing Network A, five years to expand it to Network B, another five years to expand Network B to Network C. For doubling the tracks of Network C to Network D, it will require 4 years.

6. Operation and Maintenance Systems

6-1 Traffic

(1) Station staff

The CTC will be introduced to handle trains from the center, minimizing the railway staff assigned to stations. They should be trained to handle as many types of jobs as possible.

Most of ticketing and ticket checking work will be contracted out.

(2) Crew assignment

Driver : One driver for one train (also for shunting)

Conductors: Two guards for super express and express, and one guard for other trains.

6-2 Maintenance of Track and Structures

The railway staff will be responsible for planning and management of inspection and repair. Repair works will be contracted out wherever possible.

Table 4-6-1 Summary of Construction Cost

Unit: mil. M$

Category	Case I			Case II			Case III			Case IV			Remarks
	Foreign currency	Local currency	Total	Foreign currency	Local currency	Total	Foreign currency	Local currency	Total	Foreign currency	Local currency	Total	
1. Land	0	345	345	0	249	249	0	166	166	0	166	166	
2.1 Civil works	993	2,048	3,041	494	1,096	1,590	414	782	1,196	414	782	1,196	
2.2 Track	729	1,049	1,778	316	401	717	168	208	376	168	208	376	
2. Sub-total	1,722	3,097	4,819	810	1,497	2,307	582	990	1,572	582	990	1,572	2.1+2.2
3.1 Electrification facilities	647	117	764	259	47	306	121	22	143	121	22	143	
3.2 Signalling	120	24	144	60	12	72	30	6	36	30	6	36	
3.3 Telecommunication	258	31	289	122	15	137	61	7	68	61	7	68	
3. Sub total	1,025	172	1,197	441	74	515	212	35	247	212	35	247	3.1+3.2+3.3
4. Rolling stock	1,359	733	2,092	739	376	1,115	369	174	543	369	174	543	
5. Workshop,etc.	228	103	331	169	90	259	102	61	163	102	61	163	
6. Total	4,334	4,450	8,784	2,159	2,286	4,445	1,265	1,426	2,691	1,265	1,426	2,691	Sum of 1 to 5
7. Eng. Fee	145	185	330	69	95	164	44	63	107	44	63	107	
8. Sub total	4,479	4,635	9,114	2,228	2,381	4,609	1,309	1,489	2,798	1,309	1,489	2,798	6 + 7
9. Contingency	448	463	911	223	238	461	131	149	280	131	149	280	
10. Grand total	4,927	5,098	10,025	2,451	2,619	5,070	1,440	1,638	3,078	1,440	1,638	3,078	8 + 9

Note: 1. Figures are indicated in 1984 prices.
2. Case I corresponds to the traffic volume in the year 2010, and other cases to the traffic volume in the year 2005.
3. Costs of rolling stock corresponding to 1991 traffic demand are as follows:
- 329 mil. M$ for Case I, II and III.
- 46 mil. M$ for Case IV.
4. The engineering fee is 5% of the total cost excluding rolling stock and container handling equipment, and the contingency is 10% of "8. Sub total".

Table 4-7-1 Construction Schedule in Each Phase

Work category	Year 1st year	2nd year	3rd year	4th year	5th year	Remarks
Land acquisition	←———	———→				
Civil work	←———	————	————	————	——→	
Track		←———	————	————	——→	
Electrification		←———	————	————	——→	
Signalling		←———	————	————	——→	
Telecommunication		←———	————	————	——→	
Rolling stock				←———	———→	
Workshop			←———	———— ←– – –	——→ – –→ *	* Mentakab workshop
Survey/design/ system examination	←———	———→			←——→	

Table 4-7-2 Track-Doubling Schedule

Work category	Year 1st year	2nd year	3rd year	4th year	Remarks
Civil work	←———	————	————	——→	
Track		←———	————	——→	
Electrification		←—	————	——→	
Signalling		←—	————	——→	
Telecommunication		←—	————	——→	

Note: Rolling stock are procured as required.

6-3 Maintenance of Electrical Facilities

(1) On the premise that electrical facilities for the projected railway will be designed to be highly reliable and free from maintenance, the captioned work can be divided into:
i) "preventive maintenance", meaning to take failure preventive measures at regular interval before actual breakdown, and ii) "after failure maintenance" meaning repair after breakdown.

(2) Preventive maintenance will be performed on important facilities whose breakdown would seriously affect railway operation and security, and after failure maintenance will be applied to lighting and other less important facilities.

(3) The railway staff will mainly be responsible for inspections, with most of repair work being contracted out.

6-4 Maintenance of Rolling Stock

Inspection Type and Interval

Unit: day in the column "Type A", month in other columns

		Type A Inspection	Type B Inspection	Type C Inspection	Type D Inspection	Type E Inspection	Type F Inspection
Electric locomotive		2	2	9	28	36	
Diesel locomotive		2	2	15	30	60	
Coach	Super express, Express	2	2	12	-	24	As required
	Ordinary, KL urban	2	2	18	-	36	
Wagon	Express - container	2	2	15	-	30	
	Except the above	2	2	18	-	36	
Place of inspection		Rolling stock depot			Workshop		Rolling stock depot or workshop

6-5 Operation and Maintenance Cost

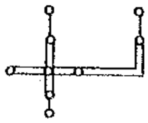
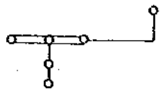
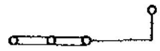
Operation and Maintenance Cost is estimated at an annual sum of 68 million M$, for Network A in the year 2005.

The number of employees are estimated at approximately 5,100 for Network D.

For details, see Table 5-3-1.

Table 5-3-1 Summary of Operation and Maintenance Cost

Unit: mil. M$
In 1984 price

Case (Year) / Item	Case I (2010) 	Case II (2005) 	Case III, IV (2005) 
Structure	5	2	2
Track	62	25	13
Electrification facilities	21	8	4
Signalling	4	3	1
Telecommunication	8	3	2
Rolling stock	78	41	20
Traffic and commerce	27	14	8
Power cost	88	39	16
Administration	3	2	2
Total	296	137	68
(Estimated personnel cost)*	(62)	(33)	(18)

* The estimated personnel costs are included in the row "Total".

(Reference) The estimated number of railway staff for Case I in the year 2010, Network D, is shown below.

Administration	400 persons	(Head office staff)
Traffic and commerce	1,800 persons	(Drivers, guards and station staff)
Civil	700 persons	(Track/structure maintenance staff)
Electrical	400 persons	(Electrical facilities maintenance staff)
Mechanical	1,800 persons	(Rolling stock maintenance staff)
Total	5,100 persons	

7. Economic and Financial Analysis

7-1 Economic Analysis

(1) In order to evaluate the project's contribution to the national economy from the viewpoint of optimum resource allocation, the Economic Internal Rate of Return (EIRR) is calculated.

In the formula:

$$d(\rho) = \sum_i \frac{Bi}{(1+\rho)^i} - \sum_i \frac{vCi}{(1+\rho)^i}$$

where: Bi: Benefit in the year i
Ci: Cost in the year i

EIRR is defined as ρ at which $\phi(\rho) = 0$.

Benefits and costs are compared between the two cases:
"With" (the case where the project is implemented, and the future traffic demand is satisfied by the new railway Networks and other modes) and "Without" (the case where the project is not implemented, and the future traffic demand is satisfied by conventional railway and other modes. It is assumed there that sufficient number of the vehicles and vessels will be provided, and the infrastructures will also be sufficiently expanded and maintained as the traffic requires.)

(2) Assumption

(a) Benefit

Benefits of possible savings in both travel time and travel cost.

(b) Cost (incremental cost)

Cost of case "With" which exceeds that of case "Without".

(c) Economic price

Market prices are converted to economic prices, by adjusting taxes and subsidies, etc.

(d) Project life

Case I : 45 years
Case II : 33 years
Case III: 30 years
Case IV : 33 years

(e) For other assumptions on time-saving benefits, see 6-2-3, (1) and for cost saving benefits, see 6-2-3, (2) of the report.

(3) Economic Internal Rate of Return (EIRR)

The EIRR of Cases I to IV is respectively 14.1%, 13.5%, 13.3%, 13.3%. This indicates that the economic effectiveness of the project for the national economy is similar in all four cases under the premises assumed by this Study.

7-2 Financial Analysis

(1) In order to evaluate the profitability of the project, the Financial Internal Rate of Return (FIRR) is calculated.

In the formula:

$$\phi(\rho) = \sum_{i} [(Ri - Ci)/(1 + \rho)^{i}]$$

where: Ri: Operating profit (before depreciation) in the year i and residual value
Ci: Construction cost in the year i

FIRR is defined as ρ at which $\phi(\rho) = 0$.
Items included in this analysis are:

Operating revenue: Traffic volume × unit fare (tariff)
Operating expense: Maintenance, replacement, personnel, power and administration costs.

(2) Assumption

(a) Fare and rate (per passenger-km or ton-km)

Super express train (= 1.2 × actual fare for "Rakyat", as of Aug. 1, 1984)	M¢6.56	M¢6.02/p.km
Express train (same as actual fare for "Rakyat")	M¢5.47	
KL urban train (same as actual fare for ordinary 3rd class)	M¢3.36	

Container train (1.2 × actual average rate of 19 commodities)	M¢7.56	M¢6.93/t.km
Carload train (same as actual average rate of 19 commodities)	M¢6.30	

(b) Price escalation: +5% p.a.

Fares and rates are also placed under the same escalation rate.

(3) Financial Internal Rate of Return (FIRR)

(a) Below current funding interest rate

The financial analysis indicates that the highest FIRR is 11.5% for Case I, the lowest 5.9% for Case III. Case II and Case IV are in-between (8.5% and 6.8% respectively). All the indices, except for Case I, are observed to be below the current interest rate in the international finance market. (See Table 6-5-1.)

(b) Network coverage and FIRR

It is observed that, the more area the network will cover, the better the FIRR of the network will be. This is because the initial portion of the entire network, Port Kelang to Paka (Network A), requires the most intensive investments (90% of tunnel length, workshop, depots, marshalling yard, centralized train control system, Kuala Lumpur Station, etc.), and other portions (extended lines in Networks B and C) can be constructed at a smaller cost per route kilometer. The operational revenue per route kilometer being similar in any Network, the FIRR will improve as the network covers more area.

(c) Less interest payment

The FIRRs lower than market interest rate in Cases II through IV show that it is necessary for the project to be financed at a higher equity and/or subsidy ratio than 50% (see 7-3 of the report.), by securing more interest-free fund for the construction cost.

7-3 Cash Flow Analysis

(1) In order to evaluate the Entity's capability for repaying the borrowings and paying the interest, and to visualize the Government requirement for subsidy and/or short-term loan, etc., a cash flow analysis is conducted in the framework of the Financial Analysis. The cash flow analysis calculates, under the following assumptions, the cash-in and cash-out, cumulative long-term and short-term loans (working capital required), the Debt Service Coverage Ratio, etc.

(a) Financing of initial construction cost:

- Paid-up equity and/or subsidy (including sales proceeds of MRA land) 50%
- Long-term loan (10% interest p.a., 10 year maturity and 5 year grace) 50%

(b) Financing of investment other than initial construction cost (e.g. re-investments after depreciation, additional procurement of rolling stock, etc.) is made either by the available cash flow and/or the short-term loan with 10% interest p.a.

The assumption (a) - 50% by interest-free fund, and 50% by loan - relates directly to the amount of the working capital required in future.

The assumed rate of 50% for interest-free fund constitutes a severe assumption in view of the recent Government financial scheme which supposes more interest-free fund than 50%.

The assumption (b) - cash flow and/or the short-term loan with 10% interest p.a. - is also considered as severe assumption, in view of the fact that the projects of this kind are subsidized, or financed by the Government with an interest rate lower than 10% p.a.

(2) The comparison of operating revenue with operating expense and capital expense for each construction cost, the interest of its fund during construction term, reinvestment after depreciation and additional procurement cost of rolling stock, is shown in Fig. 6-3-1.

(3) In Case I which shows the highest FIRR, the annual borrowings in the year 1991 through 1999, will be 121 million M$ in the best year and 345 million in the worst year (each in current price, the same in subsequent description). The cumulative borrowing will reach the peak of 1,563 million M$ in the year 1999, and the year of the final maturity when all the borrowings are repaid, will be the year 2019.

In Case III, which shows the small FIRR, the annual borrowing will be 86 million M$ in the best year and 524 million in the worst year. The cumulative borrowing will reach the peak of 2,391 million M$ in the year 2000, and the maturity of all the borrowings, in the year 2008.

Case IV shows slightly better FIRR and DSCR (Debt Service Coverage Ratio) than Case III, as initial investment is less than in Case III.

To sum up, all the Cases I through IV are observed to be in need of considerable sums of borrowings to cover the deficit in the first ten years.

(4) The outstanding of the long-term and short-term loan for the construction cost and for the working capital required after the completion will reach in Case I, Case II, Case III and Case IV, each approximate sum of 7.0 billion, 4.2 billion, 2.7 billion and 2.9 billion M$, respectively (Fig. 6-3-2).

Although each of these sums is below the construction cost of the relevant Network, it is a large sum. In order to prevent the project from being put into a serious financial difficulty, it is necessary to reduce the sum of the outstanding of loans to the smallest possible by increasing the equity and/or subsidy portion of the initial construction cost to the largest possible.

(5) The key issue is to reduce the sum total, throughout the project life, of repayment of the principal and interest for initial construction cost.

When an amount of interest-free fund is placed initially in the equity and/or subsidy portion of the initial construction cost, it will contribute more to the cash flow improvement, than when the equivalent amount will be placed later as subsidy in filling up the negative cash flow.

Hence, the upgrading of the equity and/or subsidy ratio to initial construction cost is essential for the success of the project.

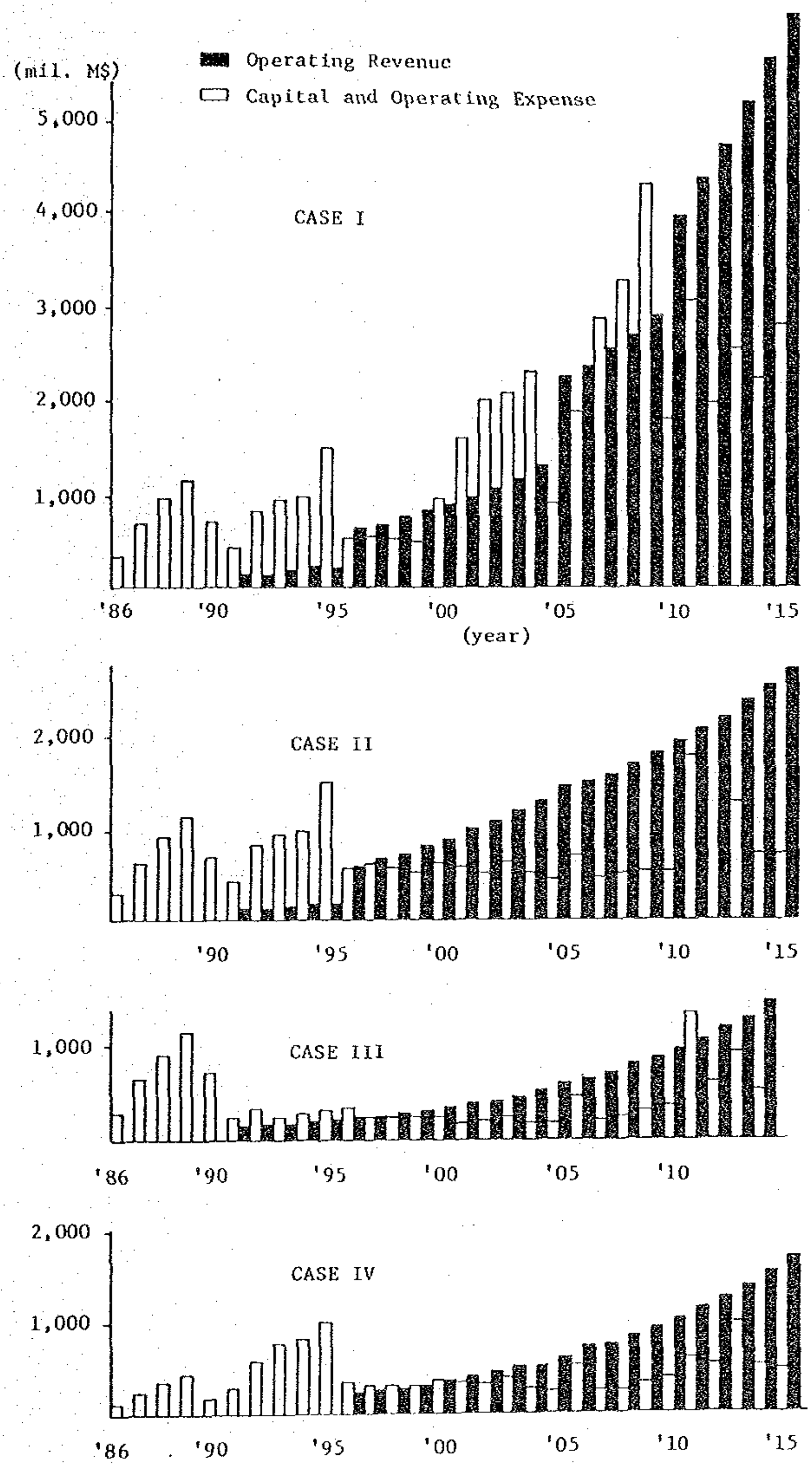


Fig. 6-3-1 Financial Analysis

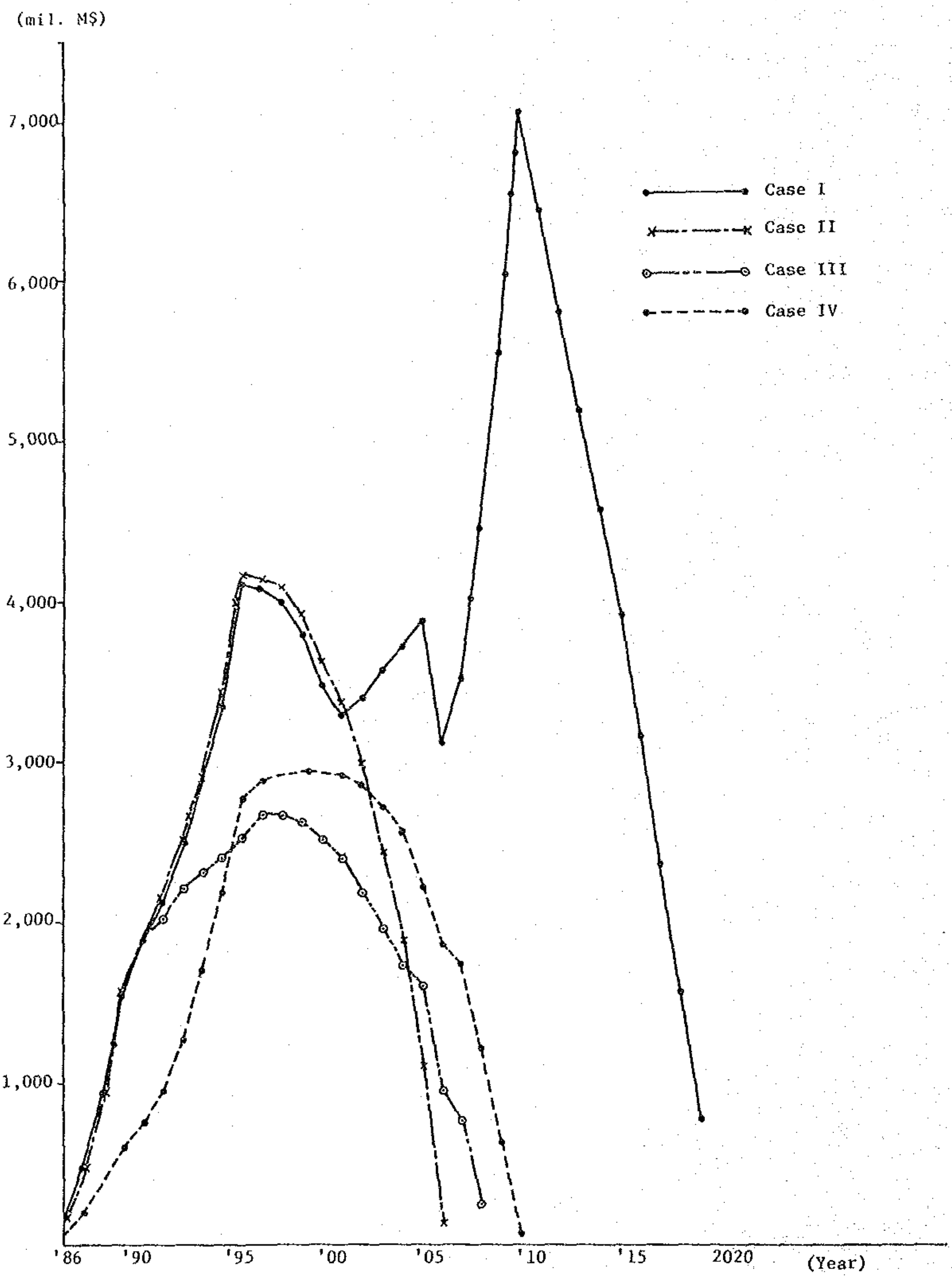


Fig. 6-3-2 Outstandings (Long-term loan and short-term loan)

Table 6-5-1 Results of Economic/Financial Analysis

	EIRR	FIRR	Debt Service Cover. Ratio	Working Capital Required (WCR)*	Maximum* Cumulative WCR i.e., Short-term Loan	CASH FLOW: Maximum* Cumulative Long-term Loan	Maximum* Cumulative Long-term and Short-term Loan	Final Maturity of Short-term Loan / Final Maturity of Long-term Loan	Construction** Cost
			min. - max.*** during the first decade	min. - max.*** during the first decade	(in year ——)	(in year ——)	(in year ——)		
	(%)	(%)		(mil. M$)	(mil. M$)	(mil. M$)	(mil. M$)		(mil. M$)
Case I	14.1	11.5	0.36 - 1.09	121 - 345	1,563 (yr 1999)	7,021 (yr 2009)	7,021 (yr 2009)	yr 2005 / yr 2019	10,025
Case II	13.5	8.5	0.36 - 1.09	121 - 345	1,682 (yr 2000)	3,441 (yr 1995)	4,154 (yr 1995)	yr 2006 / yr 2005	5,070
Case III	13.3	5.9	0.36 - 0.70	86 - 524	2,391 (yr 2000)	1,903 (yr 1990 - 1995)	2,675 (yr 1996 - 1997)	yr 2008 / yr 2000	3,078
Case IV	13.3	6.8	0.00 - 0.83	86 - 243	2,013 (yr 2003)	2,147 (yr 1995)	2,926 (yr 1998)	yr 2010 / yr 2005	3,078

Note: * in current price
** 1984 price
*** 1991 to 2000

(6) According to the Malaysian side, the amount of available fund such as equity and sales proceeds of the MRA land, which could be allocated to the equity and/or subsidy portion of the project cost, is assumed to be 1.5 to 2.0 billion M$.

Case I or II, is estimated to cost 10.1 and 5.1 billion M$, respectively. The said amount 1.5 to 2.0 billion does not suffice even the equity and/or subsidy ratio assumed at 50% in the cash flow simulation for these Cases.

Meanwhile, Case III or IV, is estimated to cost of 3.1 billion M$. The said amount, 1.5 to 2.0 billion, would improve the equity and/or subsidy ratio, considerably over 50%.

Accordingly, despite its FIRR, Case III or IV is considered to have the highest feasibility, since the equity and/or subsidy ratio for Case III or IV has the highest possibility of being increased.

7-4 Sensitivity Analysis

Social and economic framework (economic growth rates, population growth rates, distribution of national wealth among regions, income groups, etc.) may deviate from premises assumed in this Study in the long project life. The deviation will give rise to changes in traffic demand forecast, cost estimates, etc., and accordingly, it will cause changes in EIRR, FIRR and cash flow.

Therefore, the impact of unfavorable deviations are examined to provide elements to be considered in the decision-making. The analysis is made on Case III, which seems to have a highest feasibility in over-all perspective, assuming discretionary rates of decriations.

On the other hand, the impact of favorable deviations, such as raise in fare level and in equity and/or subsidy ratio, are also studied.

From the results of risk analysis mentioned below, it is pointed out that this project has several elements of uncertainty in the sense that deviations in GDP and population growth rate, project cost and industrial development pace of the east coast area might lead to considerable decrease in feasibility of the project.

Impacts from other favorable deviations, such as a higher case in GDP growth rate, are not calculated, because an approximate value of impact could be obtained using Tables 2-4-4, 2-5-6 and Figures 6-4-1 and 6-4-2.

The result is shown in Table 6-4-1.

(1) It is observed that the impact of decrease in traffic demand is the greatest on FIRR, while the impact of the increase in construction cost is the greatest on the required sums of the borrowings ("Working Capital Required").

(a) 30% decrease in traffic demand would decrease the FIRR to 2.9%, from 5.9% of Base Case, and increase the maximum cumulative borrowing to 3,104 million M$ (current price, the same in subsequent descriptions), compared with 2,391 million of the Base Case.

(b) 30% increase in construction cost would decrease FIRR to 4.0%, and increase the working capital required up to 3,683 million M$.

(c) The effect of a 5 year delay in construction period is not significant.

(2) An increase in equity and/or subsidy ratio to 70% would alleviate the working capital required to between 6 and 284 million M$ (Base Case, between 86 and 524 million M$), and the maximum cumulative borrowing, to 950 million M$ (Base Case, 2,391 million M$).

(3) 50% raise in fare-level and resultant 10% decrease in traffic demand as to inter-city passenger traffic would improve FIRR up to 7.2% and alleviate working capital required to between 53 and 482 million M$ and the cumulative borrowing down to 1,980 million M$.

(4) Actual amount of the Governmental subsidy accorded to MRA is approximately 40 million M$ annually. This is equivalent to 83 million M$ in the year 2000 (at +5% p.a. escalation). The working capital required between 6 to 284 million M$ calculated in (2) might seem to be manageable with Governmental subsidies.

However, since the possibility of situation mentioned in (1) can not be excluded, necessity of maximization of equity and/or subsidy ratio or Governmental support should also be considered.

(5) Impact of delay in industrial development in the east coast (Trengganu zones ① & ②)

Decrease in GDP and population growth rates to the national average in the two zones of Trengganu State will cause 3% decrease in passenger traffic (X)

Decrease in GDP growth rate to national average in the two zones will cause 13% decrease in goods traffic (Y).

30% decrease in Steel and Petroleum production in Trengganu State will cause 8% decrease in goods traffic (Z).

Table 6-4-1 Result of Sensitivity Analysis

See 6-4-1	Item	FIRR (%)	Cash Flow		
			Debt Service* Coverage Ratio min. - max.	(Unit: mil. M$) Working Capital Required (WCR) min. - max. *	(Unit: mil. M$) Cumulative WCR max. (in year ---)
	Base Case	5.9	0.36 - 0.70	86 - 524	2,391 (2000)
(a)	30% decrease traffic	2.9	0.13 - 0.57	145 - 596	3,104 (2000)
(b)	30% increase in construction costs	4.0	0.23 - 0.61	158 - 739	3,683 (2000)
(c)	Delay in industrial development in the east coast - GDP/population growth rate at national average - 30% decrease in Steel/Petroleum production	(5.0) obtained from Fig. 6-4-1.	-	-	-
(d)	5 year delay in construction period	5.9	0.55 - 0.94	176 - 522	2,269 (2005)
(e)	50% decrease (i.e. 0%) in equity and/or subsidy ratio	5.9	0.16 - 0.54	311 - 1198	6,434 (2000)
(f)	20% increase (i.e. 70%) in equity and/or subsidy ratio	5.9	0.62 - 1.04	6.3 - 284	950 (2000)
(g)	50% raise in inter-city passenger fare with 10% decrease in traffic	7.1	0.36 - 0.79	53 - 482	1,980 (2000)

Notes: 1. * During the first decade (i.e. 1991 - 2000)
2. WCR is in current price.

The maximum traffic decrease will be X + Y + Z.
The minimum will be within X + Y.

Such maximum and minimum decreases in traffic demand correspond to 8 and 6% decreases in total revenue, respectively. Assuming it at 10%, and applying it to the curve given in Fig. 6-4-1 FIRR would be 5.0% and the maximum cumulative working capital required would be 2,600 million M$.

(6) Impact of the Construction of Karak to Kuantan Highway

In this case, FIRR would be 5.5%.

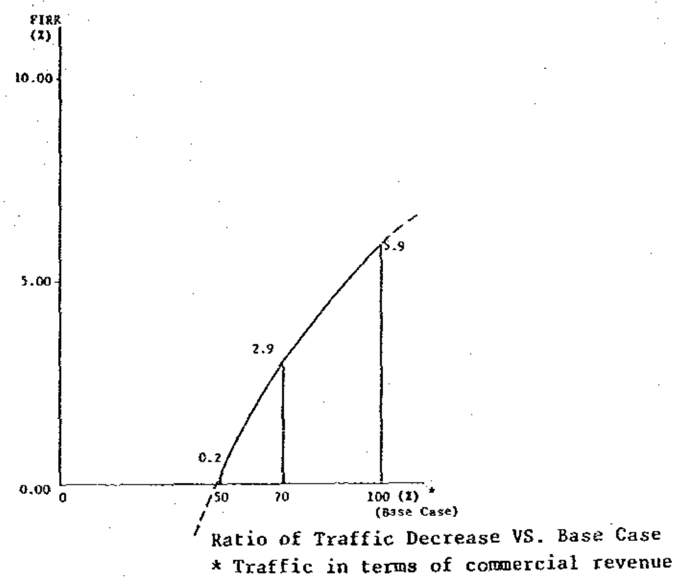


Fig. 6-4-1 Relationship between Traffic Decrease and FIRR (Case III)

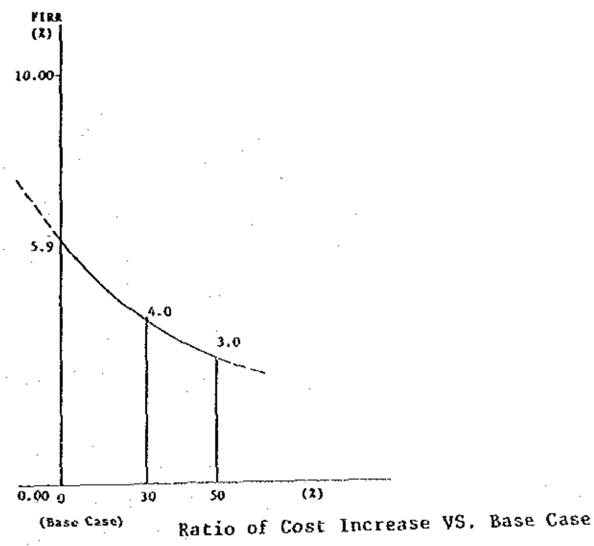


Fig. 6-4-2 Relationship between Construction Cost Increase and FIRR (Case III)

CONCLUSION AND RECOMMENDATION

CONCLUSION AND RECOMMENDATION

1. Limitation of the Study

The object of the present Study is a project which aims at providing a modernized high-speed railway network in Malaysia. The project is purposed to realize an all-round development of the Peninsula through founding a general basis for expediting industrial activities and people's mobility at large. The project is also intended to encourage the industrialization of the east coast, southern Trengganu, etc. The area had been characterized until recently with a lower GDP, where a rapid industrialization is now under way.

Prior to the evaluation of the project, attentions are to be paid to the following limitations of the Study.

(1) Limitation in construction sequence

Comparison is not made in this Study between the case where New East-West Railway is built in the first phase and the other cases where, for example, the southern portion of West Coast Railway which covers relatively developed area is built first. This is because the sequence of project implementation was set at the strong request of the Malaysian Government as follows:

1st: Section between Port Kelang and Paka (340 km); double track for Port Kelang - Janda Baik, single track for Janda Baik - Paka (New East-West Railway)

2nd: Section between Kuala Lumpur and Singapore (380 km) (southern portion of West Coast Railway), not necessarily double-tracked

3rd: Section between Kuala Lumpur and Butterworth (northern portion of West Coast Railway), not necessarily double-tracked
Section between Paka and Kota Bharu (remaining portion of New East-West Railway), not necessarily double-tracked

(2) Limitation in modes compared

Comparison is not made in this Study between the railway and other alternative modes. The Malaysian Government has no implementation plan for the East-West Expressway at present. An analysis is made to study its impact on the new railway network, but it is not considered as an alternative.

(3) Possible deviation in long-term forecast of premises

Traffic demand forecast and cost estimate, bases for economic and financial analysis of this Feasibility Study, assume certain trend for long-term forecast of economic and population growth during the next thirty (30) to forty-five (45) years. These forecasts may deviate from real figures in the long run and result in large fluctuations in project evaluation indices including FIRR. Forecasts concern-ing the New East-West Railway have a larger possibility for fluctuations particularly because they depend largely on the progress of the development of the industrialization in the east coast area. Therefore, this Study includes sensitivity analysis concerning the effects of fluctuations in important premises.

2. Recommendation

(1) Based on the results of the Study which is conducted with the limited scope mentioned in the preceding section 1, cases III and IV are evaluated to have relative superiority among the four cases studied. However, even in these cases, this project has several elements of uncertainty in the sense that the deviations in GDP and population growth rates, the project cost and industrial development pace in the east coast area might lead to considerable decrease in the feasibility of the project as is shown in Sensitivity Analysis. (See 6-4 of the Summary.) Hence, for the success of the project, it is indispensable that the prerequisites enumerated in subsequent (2) will be realized. Therefore, it is recommended that the possibility of fulfilling these prerequisites should be deliberately examined at first. Implementation of the project should not be decided until these prerequisites are certain to be fulfilled.

(2) Prerequisites for the success of the project

(a) Socio-economic condition

It is essential for the success of the project that the economic and social conditions do not deviate much from the premises assumed in the socio-economic framework. (See 2-2-2 of the report.)

The judgement on the implementation of the project and the decision on the scale of the project should be taken after careful consideration of social conditions and economic trend of the nation and the region.

The trend of the east coast development needs special attention. Upon any deviation from premises the plan should be reconsidered rapidly and carefully.

(b) Transport policies

The project should be established and fortified as a national project based on the Governmental consensus considering that a huge sum of money is required, continuous financial support from the Government is essential and, several generations of Malaysian people are to be involved in both costs and benefits. The project should be firmly established in transport policies and following transport policies should be implemented.

(i) Since it is necessary to bear large capital expenditure for a certain period of time after start of the operation of the Railway, Railway favoring policies have to be taken as much as possible until prospect for the stable management of the Railway becomes certain.

In addition, it should be considered that the simultaneous construction of a new transport mode other than railway, for example, an expressway in parallel with the New East-West Railway will lead to the decrease in the traffic demand for the Railway.

(ii) When the traffic demand grows enough to introduce free competition, it is necessary to coordinate the conditions for competition among traffic modes so that overall efficiency may be maximized with below-mentioned measures:

Fair competition

Competition must be fair: Conventional privileges and obligations, imposed or accorded on particular modes should be eliminated, such as: Financial assistance to construction/maintenance/operation of infrastructure, application of favored or disfavored tax/toll rates.

Competition must be orderly: Strict observance of the loading limits of vehicles, of the minimum rate application, maximum length of haul, etc., should be enforced.

Coordination

In order to obtain most efficient and organic connection between the networks of railway and other modes, and in order to make each mode play the best of the role according to its inherent characteristics, the policies should be oriented to coordinate these networks and their operation schedules, as well as to provide appropriate connecting facilities (e.g., car parks, bus terminals in railway station plaza; container terminals, etc.). The policies should also aim at reorganizing the existing transport networks based on the new perspective (esp. Kelang Valley).

(iii) The Entity should be remunerated or compensated for the public service specifically requested by the Government and performed.

(c) Financing program

Since alleviation of capital expenditure burden determines the success of the project, it is necessary to increase the Governmental subsidies or interest-free fund as much as possible so that the equity and/or subsidy portion of the initial construction cost be maximized.

For the working capital required, the Governmental subsidies or credits with specially favorable conditions are desired.

Under the given financial premises of the present cash flow simulation, it is observed that, in many fiscal years, the negative balance due to the interest payment will have to be covered by new borrowing. Such a vicious circle should be avoided by all means.

(d) Construction

(i) Construction timing, phasing, sections to be operated have to be selected everytime, investments are made with careful consideration of economic conditions and the trend of traffic demand.

Rather than preceding the growth of traffic demand, investments following after the growth ensure a higher rate of return.

(ii) Appropriate project management should be undertaken.

a. Technical control
b. Cost control
c. Schedule control (particularly regarding the acquisition of right of way)
d. Fund control (particularly regarding the allocation of the fund to adequate item of outlay according to the cost of funding)

Emphasis of the project management should be placed on avoiding the following;

- Cost-overrun
- Delay in construction
- Defects in constructed facilities

(e) Operation

(i) Training

The operation of the projected network calls for the new capabilities of officers and employees. Education and training should be carefully prepared. A new administrative system should be established in the Entity to make its operation most efficient.

(ii) Fare and rate system

Based on the continued adequate market surveys, new fare/rate systems should be developed, flexibly suited to the competitiveness of the new railway (particularly concerning goods rate system).

(iii) Diversification of business

The Entity should be prepared to make the best profits from what values the Entity has added to the land, along the line, around the stations by building the railway.

For this, the Entity should be able to run realty development/leasing businesses, endeavoring to maximize the value of the space it creates, through multipurpose use of the railway properties.

It is necessary to make efforts to induce passenger traffic demand or absorb development benefits through the high-degree and multipurpose utilization of the Railway site and real estate development along the Railway.

The Entity should also reserve rights to manage such business concerning transport as feeder service, forwarder service, warehousing, travel agents, hotels, and so on.

(3) The economic/financial analysis of this Study is conducted under a certain assumption that 50% of the initial construction cost will be financed by equity and/or subsidy, and another 50% by bank loan with 10% interest p.a., etc.

It is desirable, at a stage where the overall funding program, will be formulated concretely, that a review of the feasibility of the project based on the said funding program will be solicited from a neutral and credible third party, such as an international financial institution.

(4) Cases I and II should be regarded as matters for future consideration. It is recommended that whether or not these plans should be implemented is to be determined based on careful feasibility studies which should consider the general economic conditions and availability of financial resources.

CHAPTER 1 INTRODUCTION

CHAPTER 1 INTRODUCTION

1-1 Background

Malaysia has been undertaking a series of five year development plans beginning with the First Malaysia Plan (1966 - 1970). The thrust of the successive plans, beginning with the Second Malaysia Plan (1971 - 75) is on the implementation of the New Economic Policy which has the main objectives of the eradication of poverty and the restructuring of society. This project aims in this connection at constructing a modern high-speed railway network in Malaysia, to found a new infrastructure which will support the industrial development of the country, and will vitalize the daily life and mobility of the nation. This project will place all the Peninsula large cities in a "One-Day Zone" to and from the Capital through its modernized passenger service, and its goods service will contribute to the industrialization of the relatively under-developed east coast area now being rapidly developed. Under these circumstances;

(1) The Malaysian Government requested the Japanese Government to undertake the Study on the Railway Development Plan in Malaysia (Master Plan, hereinafter referred to as the M/P).

Upon this request the Japan International Cooperation Agency (JICA) sent a contact mission and a preliminary study team to Malaysia in April and August 1982, respectively. They reached an agreement with the Malaysian Government on the contents of the study.

(2) The M/P study was started in September 1982, and its final report was submitted in October 1983.

The report suggested to set the standards for the West Coast Railway and the New East-West Railway, namely, "standard gauge", "double-tracked" and "electrified".

This suggestion was considered by the Malaysian Government to be suitable for the planned future socio-economic framework of the country.

(3) With the study results, the Malaysian Government started to work on realizing the project and requested the Japanese Government to conduct a feasibility study and an engineering study.

Upon this request, in February 1983, JICA sent a contact mission for the Engineering Study on the New East-West Railway Project (hereinafter referred to as the E/S).

The E/S was started in May 1983 and its interim report was submitted in February 1984.

(4) In the same month, February 1984, JICA sent a contact mission for the Feasibility Study on the New East-West Railway Project and the West Coast Railway Project (hereinafter referred to as the F/S). An agreement was reached between the Governments that the F/S would incorporate the E/S in progress, and cover the entire railway network including the West Coast Railway.

(5) The Study had originally been designed to formulate some alternatives for construction sequence of each portion of the network. Upon calculation of the revenue and cost of each of these alternatives, the construction sequence most recommendable from the economic viewpoint would have been selected. In fact, however, under the explicit request of the Steering Committee in July 1984, the following sequence and priority of the project implementation was agreed between both sides.

Since then, the Study has been focused on working out the data for evaluating the project, if and when the project is performed under the given construction sequence, no other sequences being studied in this F/S.

1st: Section between Port Kelang and Paka; double track for Port Kelang - Janda Baik, single track for Janda Baik - Paka. (New East-West Railway)

2nd: Section between Kuala Lumpur and Singapore (southern portion of West Coast Railway)

3rd: Section between Kuala Lumpur and Butterworth (northern portion of West Coast Railway)
Section between Paka and Kota Bharu (remaining portion of New East-West Railway)

The F/S is still to cover the entire railway network studied in the M/P as a final goal of the project.

1-2 Basic Policy and the Schedule of the Study

(1) The objectives of the F/S are to evaluate the economic impact of the construction of the railway network as studied in the M/P on the national economy.

(2) The demand forecast and the cost estimates (construction cost, operation and maintenance cost) of the M/P are reviewed and updated through this F/S, thereby to improve their reliability and to provide more accurate criteria for the evaluation and judgement.

(3) Among the possible project phasing for the demand forecast and cost estimate considering aforementioned sequences, 4 cases are selected to be studied in this F/S.

Case I : Completing the case A-A of the M/P (the final goal of this project) according to the sequence set by the Steering Committee.

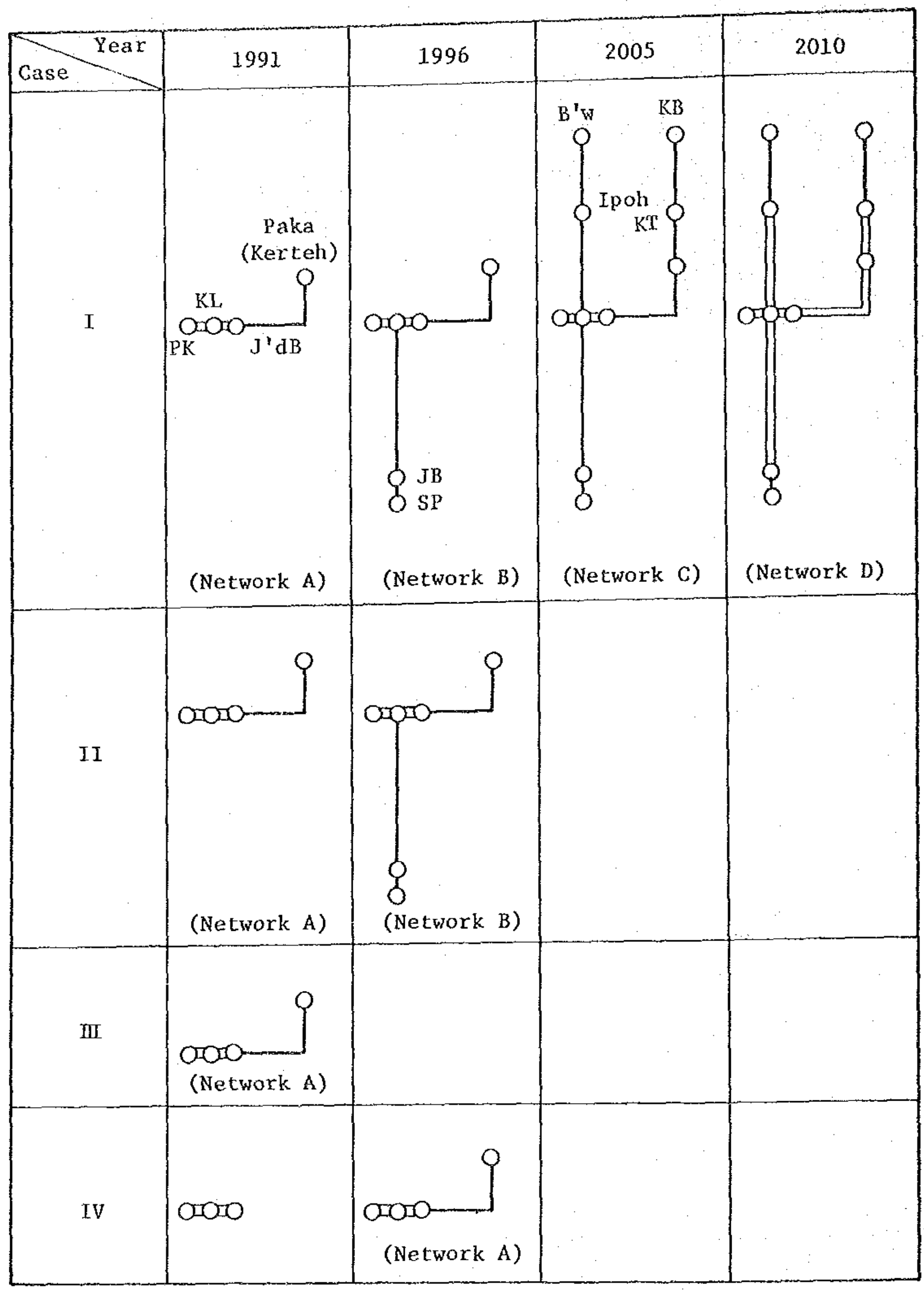
Case II : Completing the sections sequenced No. 1 and No. 2 (This can be regarded as the case where the completion of the rest of the entire network is deferred to indefinite future).

Case III: Completing the section sequenced No. 1 only (This can be regarded as the case where the completion of the rest of the entire network is deferred to indefinite future).

Case IV : Subdividing the section sequenced No. 1 into two sections of which the eastern portion (Janda Baik to Paka) is deferred for five years compared with Case III. This case is studied to examine the effect of leveling the capital investment by extending the construction period and of synchronizing the timing of construction with traffic demand increase.

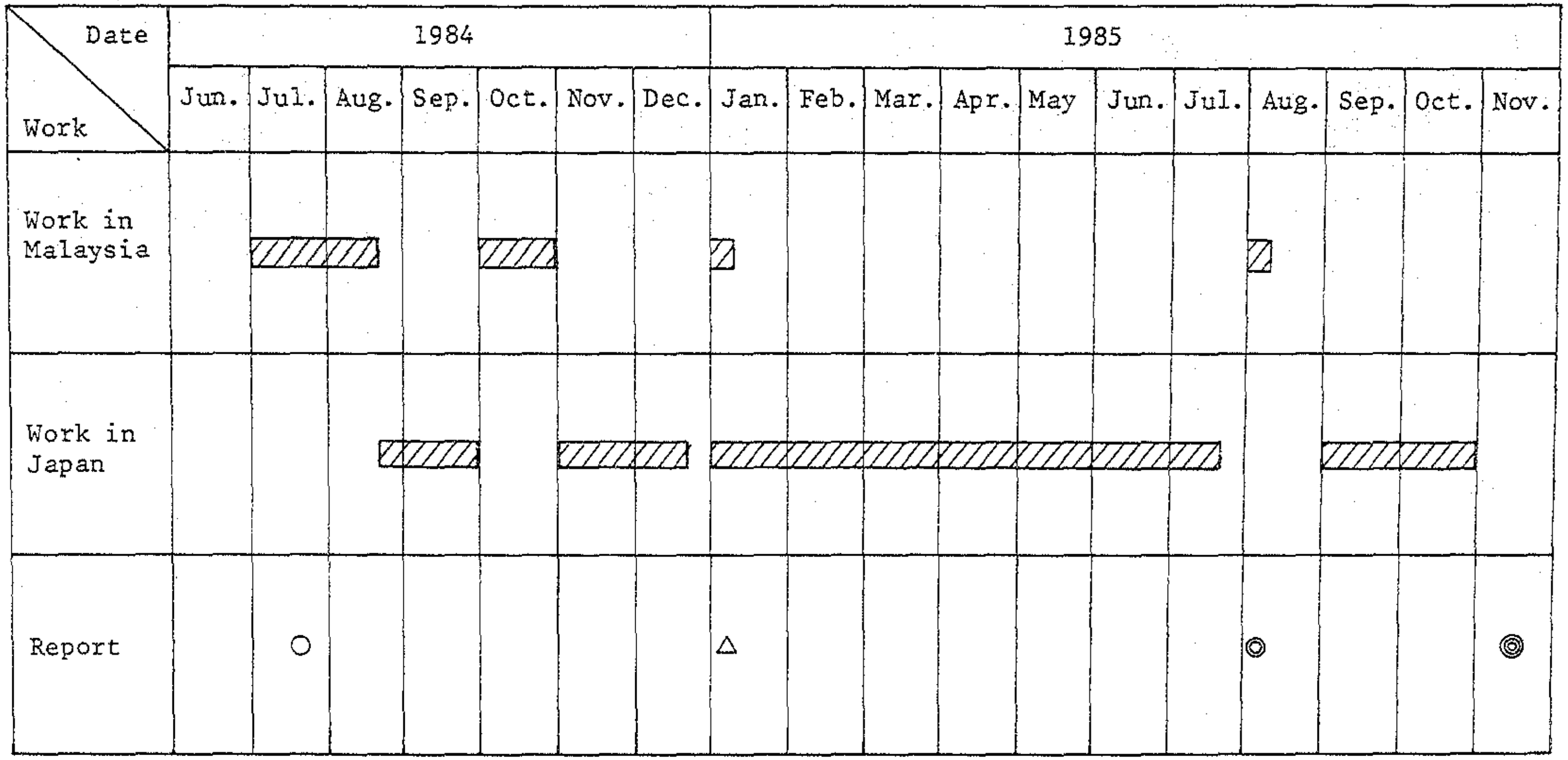
Fig. 1-2-1 shows the routes and completion schedules of each of the four cases.

(4) The implementation schedule for the Study is shown in Fig. 1-2-2.



— Single track　PK: Port Kelang　JB: Johor Bahru　KT: Kuala Trengganu
= Double track　KL: Kuala Lumpur　SP: Singapore　KB: Kota Bharu
J'dB: Janda Baik (Kg.Bukit Tinggi)　B'w: Butterworth

Fig. 1-2-1 Cases Studied



○ Inception Report　△ Interim Report　◎ Draft Final Report　◎ Final Report

Fig. 1-2-2 Study Schedule

1-3 Organization for the Study

(1) Advisory Committee

Shigeru Morichi (Chairman)	Associate Professor, Department of Civil Engineering, Tokyo Institute of Technology
Koichi Aoki (Member)	Director of the Designing Department, Japan Railway Construction Public Corporation
Keizo Kasuga (Member)	Director General, Railways Department, Hokkaido District Transport Bureau, Ministry of Transport
Satoru Onoyama (Member)	Director General, Railways Department, Chugoku District Transport Bureau, Ministry of Transport
Masao Wada (Member)	Special Assistant to the Director of International Cooperation Division, International Transport and Tourism Bureau, Ministry of Transport
Norio Fukushiro	Staff, Social Development Cooperation Department, JICA
Atsushi Kawai	Staff, Social Development Cooperation Department, JICA

(2) Study Team

Hotsumi Harada	Leader
Makoto Shinoda	Acting Leader
Nobuaki Hagura	Regional Development Plan
Hirotoshi Yamakawa	Traffic Demand Forecast (Passenger)
Ryujiro Yamagishi	Traffic Demand Forecast (Goods)
Mamoru Mori	Train Operation Plan
Tetsuya Yamagata	Rolling Stock Plan
Makoto Sawai	Electrification Plan

Takashi Taneichi	Signalling/Telecommunication Plan
Noriaki Koshiba	Route Selection
Yuichiro Kanazawa	Route Selection
Hitoshi Ishihara	Construction Plan
Shizuo Sakamoto	Track Plan
Junjiro Nakagawa	Structure Plan
Akira Honda	Car Depot/Workshop Plan
Yoshiaki Okada	Economic/Financial Analysis

(3) Government officials concerned and other related organizations in Malaysia

Economic Planning Unit (EPU)

(Tan Sri Dato' Sallehuddin bin Mohamed) Dato' Seri Radian Soenarno Alhaj	Director General
Abdul Rahim bin Din	Deputy Director General
(Ali Abul Hassan bin Sulaiman) Dr. Mohd. Noor bin Haji Harun	Director, Infrastructure and Public Utilities Section
Siti Hadzar bt. Mohd. Ismail	Deputy Director, Infrastucture and Public Utilities Section
Kamaruzzaman bin Shariff	Director, External Assistance and General Service Section
Ismail bin Mohamed	Principal Assistant Director (Land Transport)
Wong Peg Har	Principal Assistant Director (External Assistance)
Mohd. Afzal Ditali	Engineer, Technical Section
Yap Siew Hong	Principal Assistant Director (Macro Section)
Faridatul Akmar Taib	Assistant Director (Railway)
Halipah Esa	Principal Assistant Director (Macro Sector)
Mariani bt. Hashim	Assistant Director (Regional Section)
Mohd. Adminuddin Hashim	Assistant Director (External Assistance)
Farida Mohd. Ali	Assistant Director (Infrastructure)

Malayan Railway Administration (MRA)

Dato' Ahmad Badri bin Mohamed Basir	General Manager
Abdul Rahim bin Abdul Jalal	Deputy General Manager
Dr. Mohamed Iwaz bin Abdul Karim	Deputy General Manager (Development)
Hanim bt. Ali	Chief, Research and Planning Unit
Samat bin Mahat	Chief, Administration Unit
Shaikh Ahmad bin Abu Bakar	Chief, Personnel Unit
Chan Kim Beng	Chief, Computer Unit
S. Doraipandian	Chief, Investigation & Accident Prevention Unit

Mohamed Zin bin Yusop	Director, Traffic Department
Abdul Rahim bin Osman	Director, Commercial Department
Chuah Chow Hee	Director, Civil Engineering Department
D. Gabriel	Director, Financial Department
P. Satyamoorthy	Director, Signalling and Communication Department
Lee Jee Luan	Director, Mechanical Engineering Department
Shariff bin Abdullah	Chief Train Controller
Wee Tim Jee	Deputy Director, Civil Engineering Department (Development)
C. Mahadevan	Deputy Director, Civil Engineering Department
R. Paranchothi	Deputy Diretor, Signalling and Communication Department
Mazlan bin Hj. Waad	Deputy Director, Mechanical Engineering Department
Madzin Majid	Deputy Director, Mechanical Engineering Department, Workshop Section
S. Apputhurai	Deputy Director, Commercial Department
P.P. Abdul Razak	Deputy Director, Traffic Department
Anthony Durairajah	Deputy Director, Traffic Department
Azhar bin Darus	Senior Engineer, Civil Engineering Department, Work Section
Ahmad Rahimi bin Jaafar	Senior Engineer, Signalling and Communication Department
Selamat bin Hj. Tahir	Senior Engineer, Civil Engineering Department (Development)
Goh Poey Hong	Senior Engineer, Civil Engineering Department, Way Section
Mansor bin Razali	Senior Engineer, Mechanical Engineering Department
Zakaria bin Sulong	Traffic Officer, Research and Planning Unit
Cheah Chew Kee	Assistant Administrative Officer, Administration Unit

Zainal bin Abdullah	Deputy Director, Mechanical Engineering Department, Electrical Section

Ministry of Transport (MOT)

(Datuk Syed Zainal Abidin bin S.A.M. Jamallulail) Norminshah Sabirin	Deputy Secretary General I
Heidi Ng Poh Mooi	Principal Assistant Secretary (Railway)
Cleopas Lim	Mechanical Engineer
Zainul Abidin Abdullah	Assistant Secretary (Railway)
Patmawen Menon	Assistant Secretary (Railway)

Implementation Coordination Unit (ICU)

Bakri Ismail	Engineer, Infrastucture Section

Ministry of Foreign Affairs

Syed Sultan Idris	Assistant Secretary (Political East Asia)

Ministry of Trade and Industry

Mohd. Zaharil Kassim	Assistant Director, Domestic Trade Division
T. Nagalingam	Principal Assistant Secretary (Domestic Trade Division)

Ministry of Works

Heng Aik Koon	Assistant Director, Project Planning
Ong Eng Poe	Deputy Director, Highway Planning

Ministry of Finance

Lim Boh Ang	Deputy Manager, Financial Management Systems Unit

Wong Yoi Mun	Assistant Manager, Financial Management Systems Unit

Highway Planning Unit (HPU)

Mohd. Amir bin Hj. Kassim	Senior Executive Engineer

Directorate of National Mapping

Chia Wee Tong	Deputy Director II, Topographical Survey Division
Major Yap Ing Fun	Deputy Assistant Director of Mapping (Military)
Chan Peng Yue	Director, Topographical Survey Division

Public Works Department (PWD)

Mohd. Othman bin Zainal Azim	Assistant Director, Road Section Design Unit
Chan Gim Tian	Senior Executive Engineer, Road Section Design Unit

National Electricity Board (NEB)

Azemi Zainol Abidin	Assistant Senior Planning Engineer
T. A. Aziz	Officer at Planning Department

Malaysian Industrial Development Authority (MIDA)

K. Haridass	Economist, Planning Research and International Cooperation Division

Heavy Industries Corporation in Malaysia (HICOM)

Abdul Rahim Abdul Manaf	Deputy Manager, Corporate Planning Division
Francis Khoo Soon Hock	Assistant Manager, Corporate Planning Division
Adnan Zain	Assistant, Corporate Planning Division

Ahmad Zahar bin Mohd Liki	Assistant Manager, Project Implementation Division
Safaeyah bt. Baba	Assistant Manager, Corporate Planning Division
M.T.S. Phung KMN	Manager, Project Development & Monitoring Division
Kelang Valley Planning Secretariat	
Dr. Johari bin Mat	Director, Kelang Valley Planning Secretariat
State Economic Planning Unit, Kelantan	
Tengku Shah Buddin bin Tengku Mohd. Maasom	Principal Assistant Director
Johor Port Authority	
Zulkipli Shamsuddin	Assistant Traffic Manager
Tomingan Bin Kamaron	Public Relations & Marketing Officer
Kuantan Port Authority	
Abdul Aziz Yaakub	Traffic Manager
PETRONAS	
Anwarrudin Ahamad Osman	Manager, Corporate Planning
Kelang Port Authority	
V. Balakrishnan	Assistant Traffic Manager
Malaysian International Shipping Corporation	
R. Panchacharam	Manager, Planning Division
Shell Malaysia Trading SDN. BHD.	
L.D. Chabra FICS	Shipping Operation Manager
Malaysia Mining Corporation Berhad	
Dr. Mustapha Kamal Shahrom	Special Project Manager, Technical Services & Development Division
Dr. Abdul Wahid bin Abdul Karim	Deputy Special Project Manager, Technical Services & Development Division