3-3 Forecast of Future Socio-Economic Framework

Under this Project the base year for forecast has been set at 1990 and 2005. Thus, the socio-economic framework has been forecasted respectively for each target year.

3-3-1 Economic growth

As stated earlier, the Malaysian Government are carrying out concrete measures in line with the Outline Prospective Plan (OPP), the master plan for the nation's economy for the long range of 1970 to 1990.

This OPP aims at an annual growth rate of 7.9% as the GDP target growth for the 1970 - 1990 period. Throughout 1970s the Malaysian economy attained the targeted growth rate of 7.9% per year by and large. The same target rate of 7.9% is set again for the decade of the 1980s. As the propulsion force toward this goal, the Government puts priorities on (1) export promotion, (2) substitution of locally produced goods for imported goods and (3) expansion of private investment.

Table 3-3-1 Forecast on Annual Average Increase Rate of Expenditures by Categories

(%)

	1971-1980	1981-1990
Total consumption	8.4	7.9
Private	7.7	7.4
Public	10.7	9.1
+Total investment	12.2	7.6
Private	12.0	9.0
Public	12.6	4.1
+Change in stocks	-	-
+Exports of goods and non-factor services	7.6	9.1
-Imports of goods and non-factor services	9.8	8.7
=Gross domestic product at purchasers' value	7.9	7.9

Source: 4th Malaysia Plan

As concerns exporting activities, it is anticipated that the general environment will be turning from bad to worse especially in the former half of the 1980s, in the face of lingering economic depression in the developed countries, rising mood toward trade protectionism in those countries and uneasy feeling about creditabilities of developing countries. In case of Malaysian export, however, is sustained by internationally competitive items such as petroleum, natural gas, palm oil and rubber. Therefore, the future prospect in the 1980s is basically encouraging toward steady growth.

In the field of import, further effort will be executed for import substitution, following after the preceding decade of the 1970s. As a result, it is expected that import may increase only at a relatively low level, because import substitution is promoted even in capital and intermediate goods in 1980s.

With regard to investments, it is considered necessary to stimulate private investments for further expansion, in anticipation of tightening financial situation in 1980s, as compared with the preceding decade. To comply with this need, it is to be recognized that foreign investments must be induced in a fullfledged manner and positive means should be taken for the improvement of the environment for foreign investments.

In the OPP scheme as aforestated, however, actual growth rate of the GDP has been registered to 6.9% and 3.9% in 1981 and 1982 respectively, pretty down below the target level originally set up under the plan.

At present, the Malaysian Government still keeps on hoping for achieving the planned target of 7.9% for the GDP's growth, with an intention to place the top priority upon bringing up to the high economic growth. Taking into consideration of such potential facts that there was brisk activities for export in the preceding decade of the 1970s, the export items comprise of internationally competitive items such as petroleum and LNG, and the ground for investment from abroad as being backed up by export of those goods is really attractive to foreign investors more conspicuously in any other developing countries, no one can deny that the Government will be able to achieve the target growth to the highest rate of 7.9%.

Incidentally, the results of forecast conducted by other research institutions may be compared as shown in the following table, and the outcomes in regard to Malaysia are of close proximity to what has been forecasted by the Malaysian Government.

Forecasted Growth Rate of World Economy (%)

	Warton School	World Bank		Institute of Development Economy of Japan	
	1981 - 1986	1985	1990	1981 - 1990 H	L
Malaysia	8.5	7.6	8.1	9	7
Korea	6.3	7.3	7.3	8	6.5
Taiwan	7.3			10	8
Hong Kong	9.2			7.8	6.2
Singapore	9.8			9	8.5
Thailand	6.6	6.8	7.3	8	6.5
Philippine	5.4	7.3	7.6	7	5
Indonesia	8.4	7.3	8.2	7	5.5

Note: H : High economic growth
L : Low economic growth

Source: Article entitled to 'Growth in Asia' published by Institute of Development Economy of Japan

The result of those researches points out the importance of export drive and enhanced multiplier effect from improvement of the investment efficiency as the determinative factors to help economic growth in those South-East Asian countries including Malaysia. In this regard, it depends importantly upon how the Government will steer up its economic policy toward high growth.

Generally, however, there seems to be a doubt as to if such a high economic growth could continue long ahead to the target year of 2005. In fact, none of any developed countries has so far achieved such a high economic growth rate of 8% per annum for the long term over 30 to 40 years. Although we do not want to state expressly that it would be impossible for Malaysia to make this record-making success, it should be noted that it would be considerably difficult to achieve it.

Especially, the OPP expects that the nation's economy should reach the stage of maturity similar to the economy in the developed countries most probably by 1990. Then, it is anticipated that it would be difficult to keep on growing at equal paces to the past after the nation's economy has reached that stage.

In the light of the above, the economic growth rates, in terms of GDP, have been predicted as follows in this study:

Up to and including 1990: 7.9%/year
In and after 1991 : 6.5%/year

3-3-2 Industrial structure

The industrial structure forecasted for the 1980s under the OPP is as shown in the following table.

Table 3-3-2 Changing Trend of Industrial Structure for the Period of 1980 - 1990

Million M$ in 1970 price

		1970	Share of GDP (%)	1980	Share of GDP (%)	1990	Share of GDP (%)
GDP by sector of origin	Agriculture, forestry & fishing	3,797	30.8	5,809	22.2	8,193	14.4
	Mining & quarrying	778	6.3	1,214	4.6	1,863	3.3
	Manufacturing	1,650	13.4	5,374	20.5	15,121	26.6
	(Sub-total)	(6,225)	(50.5)	(12,397)	(47.3)	(25,177)	(44.3)
	Construction	475	3.9	1,186	4.5	2,938	5.2
	Utilities	229	1.9	592	2.3	1,500	2.6
	Others	5,379	43.7	12,013	45.9	27,145	47.9
	(Sub-total)	(6,083)	(49.5)	(13,791)	(52.7)	(31,583)	(55.7)
	Total	12,308	100	26,188	100	56,760	100

Source: 4th Malaysia Plan

As noted from the table, it is predicted that the similar tendency as represented by a large reform of the industrial structure during the 1970s will further continue for the new decade of 1980s in Malaysia. To further explain this, it is presumed under the OPP that with declining in the share of agricultural, forestry and fishery industries down to 14.4% by 1990, further strides will be made toward industrialization by increase of the weight of the manufacturing sector up to 26.6 %. Indeed, the manufacturing industry is expected to keep its high growth rate as the source of producing export goods and alternative goods to import. However, in Malaysia, where the wages are showing the upward tendency, all available domestic resources (such as rubber, timber and palm oil) must be utilized most effectively and labour productivity must be boosted up further.

Incidentally, the OPP predicts that the nation's industrial structure will be developed to the maturity level close to the prevailing pattern in the developed countries by 1990. If this can be accomplished successfully, there seems to be no significant change in and after 1991, as far as the industrial structure is concerned. Therefore, this Report is based on the assumption that the industrial structure in 1990 would remain unchanged up to the year 2005.

3-3-3 Population

In anticipation that the declining tendency in both birth and death rates would further continue, it is estimated that the population increase may be tapering as a general tendency in 1980s as compared with 1970s. According to the 4th Malaysian Plan the probable rate of increase for the decade is estimated at 2.4% annually and the pattern of population distribution by regions will remain almost unchanged from that in the decade of 1970s.

It is predicted that the increasing tendency of population would take a downturn in and after 1991 in view of the past trend actually experienced. In the light of the above, the rate of population increase of Malaysia from 1991 through 2005 is assumed to be 2.0% per year for this study. It has also been assumed that the inter-state share of population would carry its pattern of 1990 without any change-up to the year 2005.

Table 3-3-3 Malaysia: Population by State 1970, 1980 & 1990

1,000 persons

State	1970		1980		1990 *	
	Number	%	Number	%	Number	%
Johor	1,326.1	12.3	1,703.7	12.0	2,113.3	11.7
Kedah	991.5	9.2	1,172.5	8.2	1,327.9	7.3
Kelantan	710.9	6.6	933.6	6.5	1,170.1	6.4
Malacca	419.6	3.9	482.1	3.4	526.1	2.9
Negeri Sembilan	500.1	4.6	599.9	4.2	689.1	3.8
Pahang	524.3	4.9	819.8	5.7	1,201.9	6.6
Penang	805.8	7.5	969.8	6.8	1,132.9	6.2
Perak	1,629.2	15.1	1,874.7	13.2	2,049.6	11.3
Perlis	125.7	1.2	157.2	1.1	191.2	1.1
Selangor & F. Territory	1,692.9	15.7	-	-	-	-
Selangor	-	-	1,561.1	11.0	2,303.4	12.7
F. Territory	-	-	997.7	7.0	1,352.8	7.5
Trengganu	420.9	3.9	576.9	4.0	761.7	4.2
Peninsular Malaysia	9,147.0	84.9	11,849.0	83.1	14,820.0	81.7
Sabah	653.6	6.0	1,097.8	7.7	1,513.4	8.3
Sarawak	976.3	9.1	1,314.4	9.2	1,809.6	10.0
Total Malaysia	10,776.9	100	14,261.2	100	18,143.0	100

* Projection

Source: 4th Malaysia Plan

3-3-4 Industrial and regional development plans

The regional development plan of the Malaysian Government is centered in the underdeveloped states such as Kedah, Perlis, Kelantan and Trengganu. As the main approach toward implementation, the plan aims at in-situ agricultural development, land development and industrial dispersion. As stated earlier, the 1970s achieved fruitful results on the basis of the governmental policy in this direction. It is expected that regional development plan will be carried out along the lines of this policy in the 1980s as well.

(1) In-situ agricultural development

The core of this development plan is the integrated development of agriculture, coupled with re-planting and farm land reclamation. Re-planting is planned mainly for rubber and cocoa. RISDA has already established a re-planting plan for rubber cultivation over totaling about 142 thousand hectares for the period of 1981 to 1985.

With regard to resuscitation of farm land FELCRA is planning reclamation and soil improvement over a total area of 25 thousand hectares, for the 1981 - 1985 period, mainly in the States of Kelantan, Pahang and Perak.

Agricultural integrated development aims at diversification of products and effective utilization of land. Major projects of this pattern are proposed in Rompin-Endau, Trans-Perak, Western Johor Phase II, Kedah Valley, Malacca, Phang Barat and Lower Trengganu.

(2) Farm land development

On the basis of a great contribution achieved by land development in the 1970s toward promotion of job opportunities and increase of people's income, it is planned that the positive action will be taken to carry out the land development projects.

Table 3-3-4 Land Development, Target & Performance

Unit: 1,000 hectares

State	1971-1990 Target	1971-1980 Performance	1981-1990 Target
Johor	237	143	94
Kedah/Perlis	61	27	34
Kelantan	76	36	40
Malacca	9	7	2
Negri Sembilan	124	91	33
Pahang	479	262	217
Penang	2	-	2
Perak	89	54	35
Sabah	208	59	149
Sarawak	240	77	163
Selangor	36	19	17
Trengganu	177	91	86
Total	1,738	866	872

Source: 3rd & 4th Malaysia Plan

In line with the aforestated target, farm land development projects will be carried out as planned, for the period of 1981 to 1985, over a total land area of about 540 thousand hectares mainly in FELDA, FELCRA and RISDA.

(3) Industrial dispersion policy

As one of the measures to reduce regional imbalances the Government encourages the development of industries in the less-developed areas. Concrete measures now being carried out are as follows:

1) Improvement of infrastructure facilities
2) Construction of industrial estates and free trade zones
3) Incentives to encourage investors to locate their projects in industrially less-developed areas.

(Example) Locational incentive

Areas which have been declared as Locational Incentive Areas until 31st December, 1983 are Kedah, excluding Kuala Muda District, Kulim District and Bandar Baru District, Pahang excluding Kuantan District, Kelantan, Trengganu, Perlis, Sabah and Sarawak and Johore Tenggara Area. Companies which are approved for location in any one of these areas, may be eligible to apply for tax exemption up to a maximum of 10 years.

Table 3-3-5 Position of Industrial Estates as at 31st December, 1982

State	Existing industrial estates		Industrial estates construction plan	
	Number	Area (Hectare)	Number	Area (Hectare)
Perlis	1	13.68	-	-
Penang	8	1,356.00	-	-
Kedah	5	478.20	1	80.9
Perak	8	822.19	7	806.85
Kelantan	6	621.26	3	283.68
Trengganu	9	596.61	3	2,003.19
Pahang	8	1,304.50	1	103.60
Selangor	16	2,407.09	8	349.34
Negri Sembilan	5	280.05	3	148.93
Malacca	7	344.84	2	121.41
Johor	12	1,656.11		
Sarawak	5	713.44	6	538.73
Sabah	6	290.84	2	12.34
Total	96	10,844.81	36	4,448.97

Source: MIDA

(4) Heavy & chemical industry

As a characteristic point of the industrial development in and after 1980 in this country, the heavy and chemical industry are expected to make its rapid strides with support of rich resources of petroleum and natural gas.

The heavy chemical industrialization projects are being planned and implemented by the related government authorities such as HICOM and PETRONAS.

Main projects for development of heavy and chemical industries are listed up hereunder. Especially, a large number of those projects are planned to be located in the Trengganu State. Those are highly expected to greatly contribute to economic growth of eastern states of Peninsular Malaysia.

Table 3-3-6 Heavy and Chemical Industry Projects under Schedule

Project	Location	Target date of completion	Executing agency
1. Malacca refinery	Tg. Kling, Malacca	1987	PETRONAS
2. Lubricating oil refinery	Tg. Kling, Malacca	1985	PETRONAS
3. Trengganu refinery	Industrial area between Paka-Kerteh	1983	PETRONAS
4. Oil pipeline and terminal	Trengganu	Mid 1982	EPMI under PSC
5. Supply base	Tg. Berhala Trengganu	July 1982	Trengganu
6. Offshore gas pipeline scheme	Trengganu	May 1984	PETRONAS Carigali
7. Gas processing plant	Industrial area, Trengganu	Early 1984	PETRONAS
8. Petro-chemical	Possibly Trengganu	-	PETRONAS
9. LLN Power station	Paka, Trengganu	April 1984 (1st Phase)	LLN
10. Onshore gas pipeline scheme	Trengganu	April 1984	PETRONAS
11. Cement/ceramic glass plant	Trengganu	n.a.	n.a.
12. Ammonia	Trengganu	1985/1986	n.a.
13. Mini LPG gas extraction plant	Trengganu	End 1982	PETRONAS
14. Peninsular Malaysia gas pipeline scheme Phase I	Peninsular Malaysia	April 1984	PETRONAS

(to be continued)

Project	Location	Target date of completion	Executing agency
15. Kedah cement	Pulau Langkawi, Kedah	Original = September 1984 Additional = March 1985 (within 6 months after completion of original plant)	HICOM
16. Sponge iron/ billet plant	Telok Kalong, Trengganu	Early 1985	HICOM
17. Cold rolling mill	Telok Kalong, Trengganu	Late 1985	HICOM
18. Engineering complex	Bukit Rajah Industrial Estate, Kelang, Selangor	Sept. 1984 ~Feb. 1985 Expected commencement of production	HICOM
19. Small engine project	SUZUKI, Perai HONDA, Bakar Alang, Kedah YAMAHA, Bukit Rajah Industrial Estate, Kelang, Selangor	Early 1984	HICOM
20. Copper and copper alley semi-finished products	Site not determined yet	1985	n.a.
21. Pulp and paper mill	Kuala Kerai, Kelantan	1985	HICOM
22. National car	Damansara Estate	Latter half of 1985	HICOM
23. Clinker grinding plant	Kemasin-Bachok area (exact site not decided yet)	Mid 1984	HICOM

Soure: EPU, PETRONAS, HICOM, etc.

3-3-5 Economic growth in each state

By enforcement of the aforesaid measures for promotion of regional development, it is expected that the gap between regions will be further narrowed down by 1990 than the present level as indicated in the following table.

Table 3-3-7 Malaysia: Gross Domestic Product by Industry of Origin and State, 1990

Million M$ in 1970 price

	GDP at purchases' value	Population (1,000)	Per capita GDP (M$)	Ratio to Malaysian average
Johor	6,461	2,113.3	3,057.3	0.98
Kedah	2,872	1,327.9	2,162.8	0.69
Perlis	415	191.2	2,170.5	0.69
Kelantan	2,524	1,170.1	2,157.1	0.69
Malacca	1,394	526.1	2,649.7	0.85
Negri Sembilan	2,234	689.1	3,241.9	1.04
Pahang	4,413	1,201.9	3,671.7	1.17
Perak	5,719	2,049.6	2,790.3	0.89
Penang	4,515	1,132.9	3,985.3	1.27
Selangor	9,148	2,303.4	3,971.5	1.27
Federal Territory	6,395	1,352.8	4,727.2	1.51
Trengganu	2,254	761.7	2,959.2	0.95
Peninsular Malaysia	48,354	14,820.0	3,262.1	1.04
Sabah	4,249	1,513.4	2,807.6	0.90
Saravak	4,167	1,809.6	2,302.7	0.74
Malaysia	56,760	18,143.0	3,128.5	1.00

Source: 4th Malaysia Plan

It is also anticipated that the economy will continue its growth at well-balanced paces even in and after 1991. However, this Report is based solely upon the assumption that the economic weight of balance between the States in 1990 would continue without change toward and until 2005.

3-3-6 Summary on the forecast of future socio-economic framework

(1) Trends of population and GDP growth

For estimation of traffic demand under this study both population and size of economy in each region serves as the most important factors.

Although past and future trends of population and GDP were referred in some depth in preceding parts, again further attempt is made in this section in order to summarize the changing trend of regional weight.

1) Premises

Population:	1981 - 1990	2.4% annually
	1991 - 2005	2.0% annually
GDP :	1981 - 1990	7.9% annually
	1991 - 2005	6.5% annually

2) Trends of population and GDP growth

Figures in the foregoing Tables 3-2-7, 3-2-8 and 3-3-7 may be mapped as shown in Fig. 3-3-1 and Fig. 3-3-2 respectively. From those maps it can be predicted that the weight of the eastern states in the share of population and GDP will be enhanced while it is anticipated that the State of Selangor (including Federal Territory) may take the overwhelming weight of share in terms of economy and population in future as well.

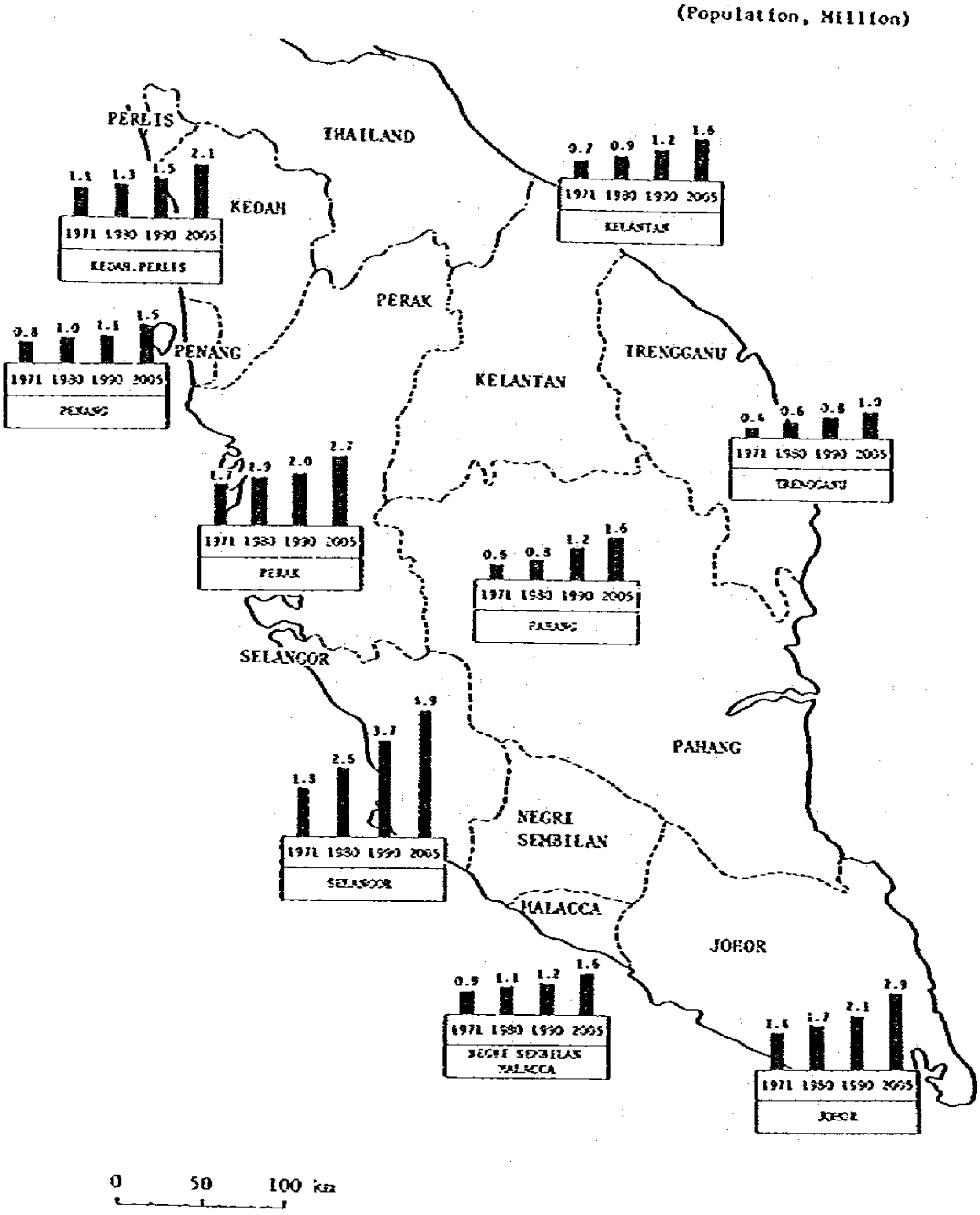


Fig. 3-3-1 Future Population Trend by States

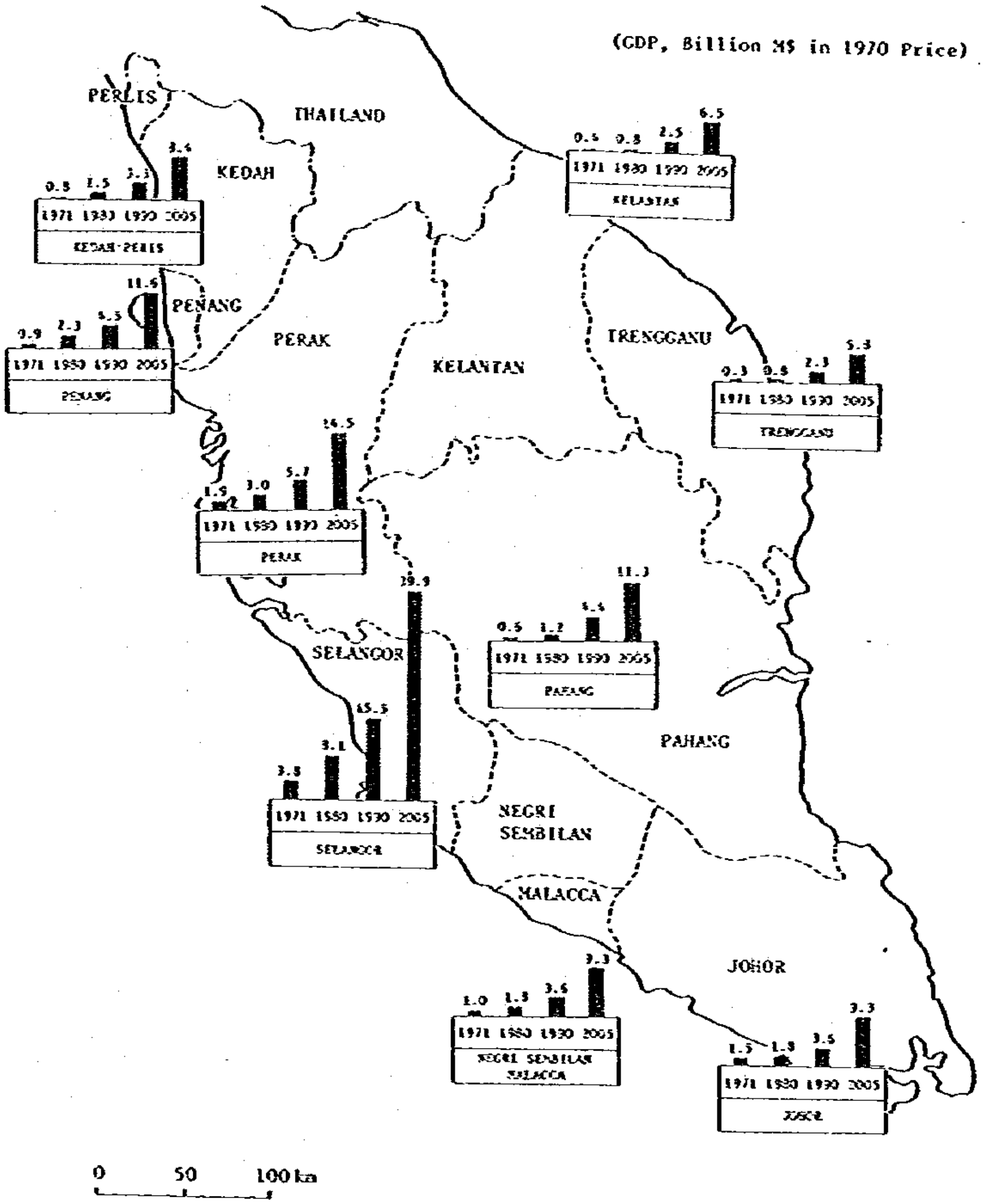


Fig. 3-3-2 Future GDP Trend by States

3) Trend of population and GDP by regions

Here, forecast is made to see the changing trend of relative weight of share in population and GDP among regional divisions of a larger unit than the State.

Regional divisions

Four (4) states in the northwest	:	Perlis, Kedah, Penang and Perak
Selangor	:	Federal Territory and Selangor
Three (3) states in the south	:	Negeri Sembilan, Malacca and Johor
Three (3) states in the east	:	Kelantan, Trengganu and Pahang

Table 3-3-8 Population by Region

(1971, 1980, 1990, 2005)

Regional divisions	Number of persons (1,000)				Composition ratio (%)				Average annual increase rate (%)		
	1971	1980	1990	2005	1971	1980	1990	2005	1971/1980	1980/1990	1980/2005
4 states in the northwest	3,610	4,174.2	4,701.6	6,327.7	38.4	35.2	31.7	31.7	1.63	1.20	1.68
Selangor	1,777	2,558.8	3,656.2	4,920.8	18.9	21.6	24.7	24.7	4.14	3.63	2.65
3 states in the south	2,237	2,785.7	3,328.5	4,479.7	24.4	23.5	22.5	22.5	2.17	1.80	1.92
3 states in the east	1,721	2,330.3	3,333.7	4,217.5	18.3	19.7	21.1	21.1	3.52	3.01	2.40
Peninsular Malaysia	9,405	11,849.0	14,820.0	19,945.8	100	100	100	100	2.60	2.26	2.10

Table 3-3-9 GDP by Region

(1971, 1980, 1990, 2005)

Regional divisions	GDP (1 million M$)				Composition ratio (%)				Average annual increase rate (%)		
	1971	1980	1990	2005	1971	1980	1990	2005	1971/1980	1980/1990	1980/2005
4 states in the northwest	3,605	6,716	13,521	35,774	32.2	30.1	28.0	28.0	7.16	7.25	6.80
Selangor	3,826	8,125	15,543	39,974	34.2	36.4	32.2	32.2	8.73	6.70	6.58
3 states in the south	2,432	4,739	10,089	25,947	21.7	21.2	20.9	20.9	7.69	7.85	7.04
3 states in the east	1,328	2,763	9,191	23,638	11.9	12.4	19.0	19.0	8.48	12.77	8.97
Peninsular Malaysia	11,191	22,344	48,344	124,333	100	100	100	100	7.93	8.02	7.11

The following is the summary of study by reference to the foregoing tables:

i) On a regional basis, it is predictable that the weight of the eastern region will continue to grow in terms of both population and GDP. This is, as stated often so far, due to the fact that the effect from the governmental concentrated effort for promotion of regional development in and after 1970 is taking concrete shape by steady growth.

   The 4th Malaysia Plan also reflects the governmental attitude of eagerly pursuing economic development in those underdeveloped states mainly in the eastern region, pursuant to the past achievements in the 1970s. If this target can be realized, it is anticipated that the three (3) states in the eastern region will become well-comparable to the four (4) states in the northwest and the three (3) states in the south by 1990.

ii) On the whole peninsular basis, the following socio-economic conditions may be foreseeable by 2005.

Population	:	About 20 million, a rise of 70 percent from the present level (1980)
Economic scale:		5.6 times over the present level (1980) on a GDP basis

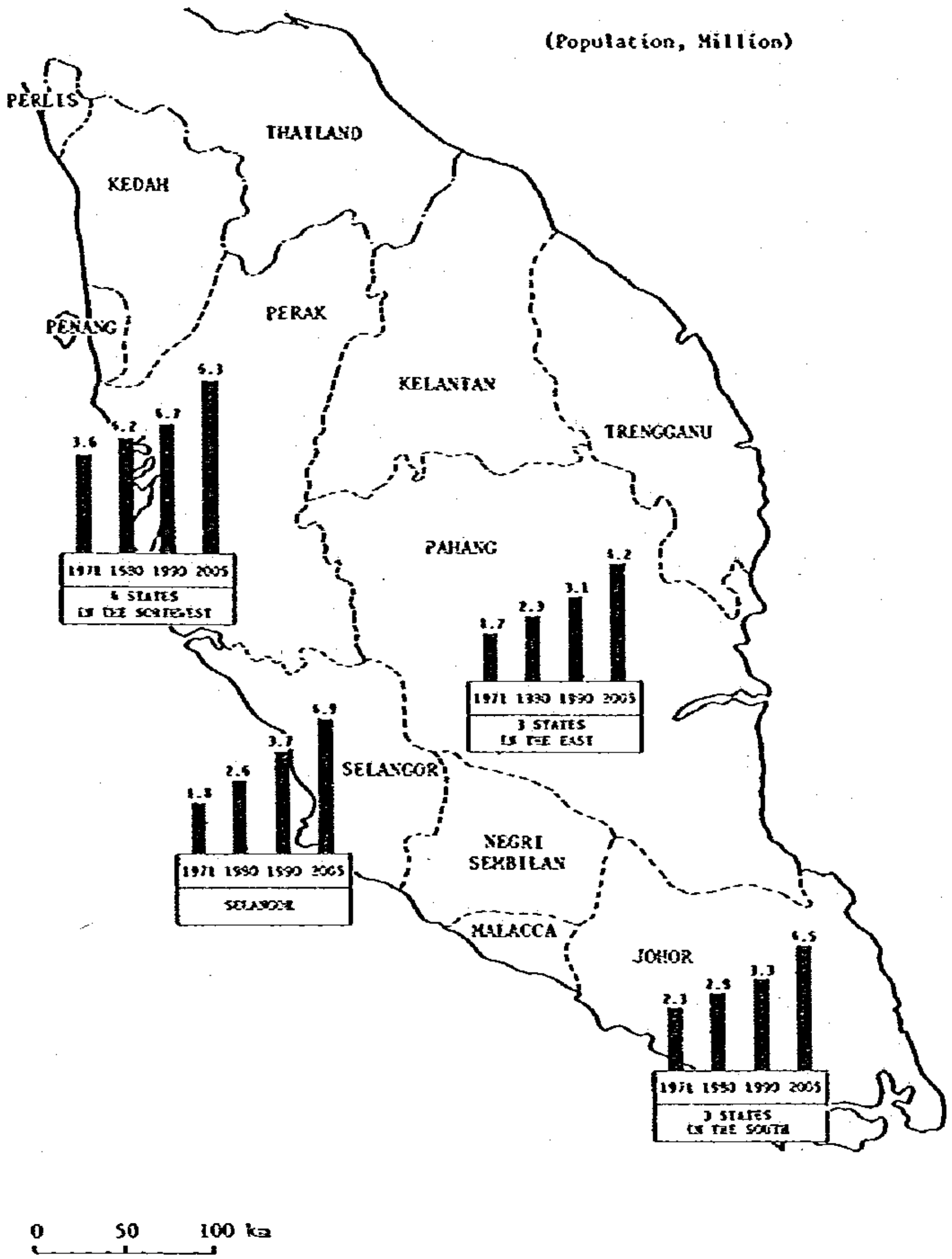


Fig. 3-3-3 Future Population Trend by Regions

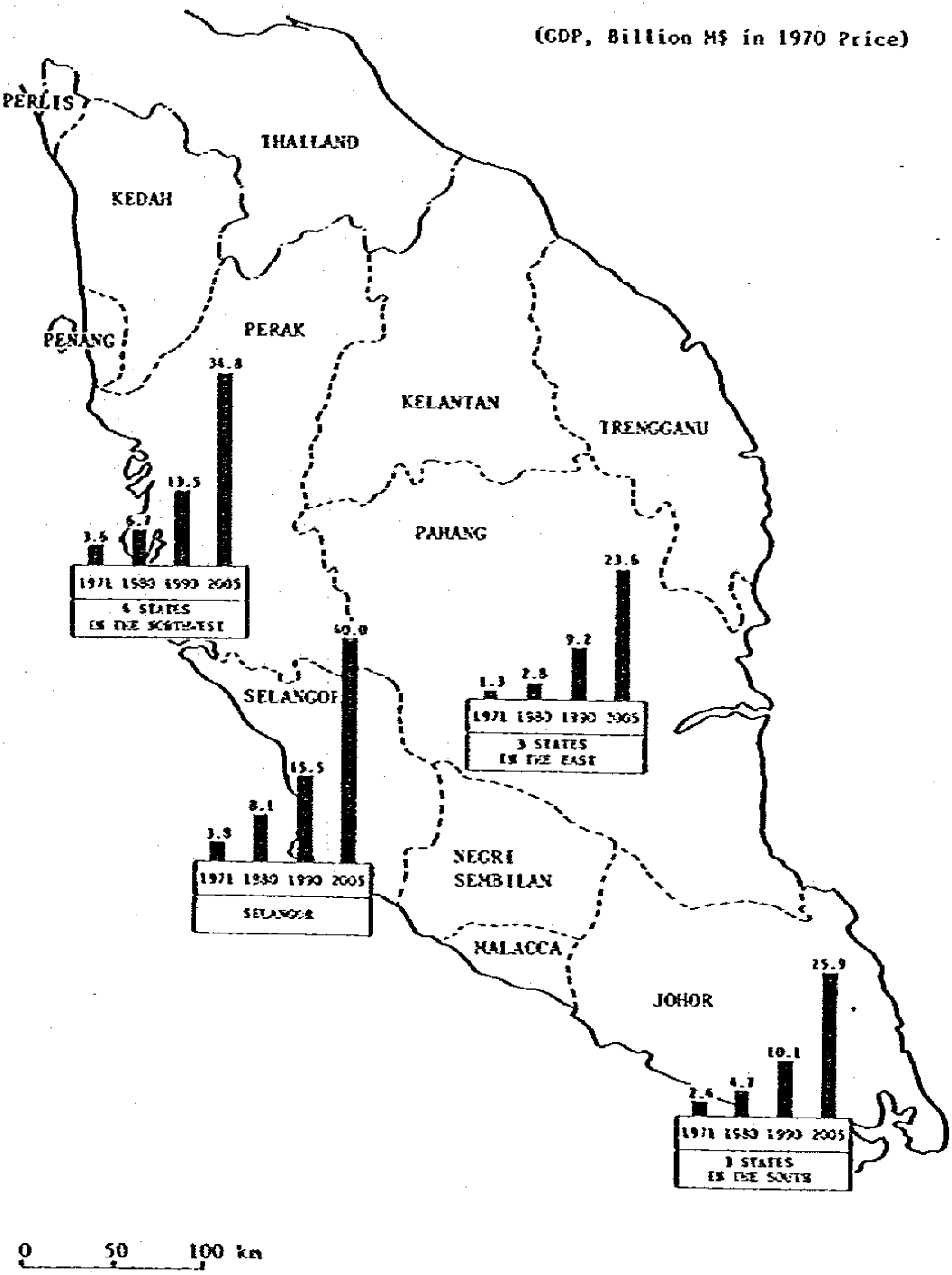


Fig. 3-3-4 Future GDP Trend by Regions

4) With rapid strides in the economic growth, in addition to the population growth all over the country, it is anticipated that the population in the major cities in each region will increase accordingly. The table below is based upon the population census conduated in 1957, 1970 and 1980. One of special features is sharp increase in the population of those eastern major cities. If this growing tendency continues, the eastern major cities such as Kuantan, Kota Bharu and Kuala Trengganu are expected to grow up to cities with a half million population.

Table 3-3-10 Number of Residents in Major Cities

Unit: 1,000 persons, %

Name of city	Number of residents			Average increase rate		Forecasted number of residents as of 2005	
	1957	1970	1980	1957 -1980	1970 -1980	Annual increase of 4%	Annual increase of 5%
Alor Star	52.9	66.2	71.7	1.33	0.80	-	-
Georgetown/Butterworth	277.4	331.2	327.2	0.72	-0.12	-	-
Ipoh	165.8	247.7	300.7	2.62	1.96	-	-
K.L. & Petaling Jaya	332.8	544.3	1,157.2	5.57	7.83	3,084.9	3,918.7
Seremban	52.0	79.7	136.3	4.28	5.49	363.4	461.6
Malacca	69.9	86.4	88.1	1.01	0.20	-	-
Johor Baharu	75.1	135.9	247.1	5.31	6.16	658.7	836.8
Kuantan	23.1	43.4	136.6	8.03	12.15	364.2	462.6
Kota Bharu	38.1	55.1	170.6	6.73	11.97	454.8	577.7
Kuala Trengganu	29.4	53.3	184.3	8.31	13.21	491.3	624.1

(2) Industrial development plan

The regional development plan by the Malaysian Government places its focus upon promotion of both agricultural and manufacturing industries. Above all, promotion of the heavy and chemical industry has been one of the priority measures since the latter half of the 1970s.

In line with this policy a great number of projects are proposed. Those projects may give rise to big impacts to the existing distribution system of goods, thus effecting future railway traffic demand. Therefore, a special attention has been paid to those projects in the estimation of traffic demand in this study.

Major projects now being carried out or planned for development of heavy and chemical industries are shown in Table 3-3-6. Their locations are as per Fig. 3-3-5. As noted clearly from the figure, many projects are in progress in and around the Trengganu State of the eastern region.

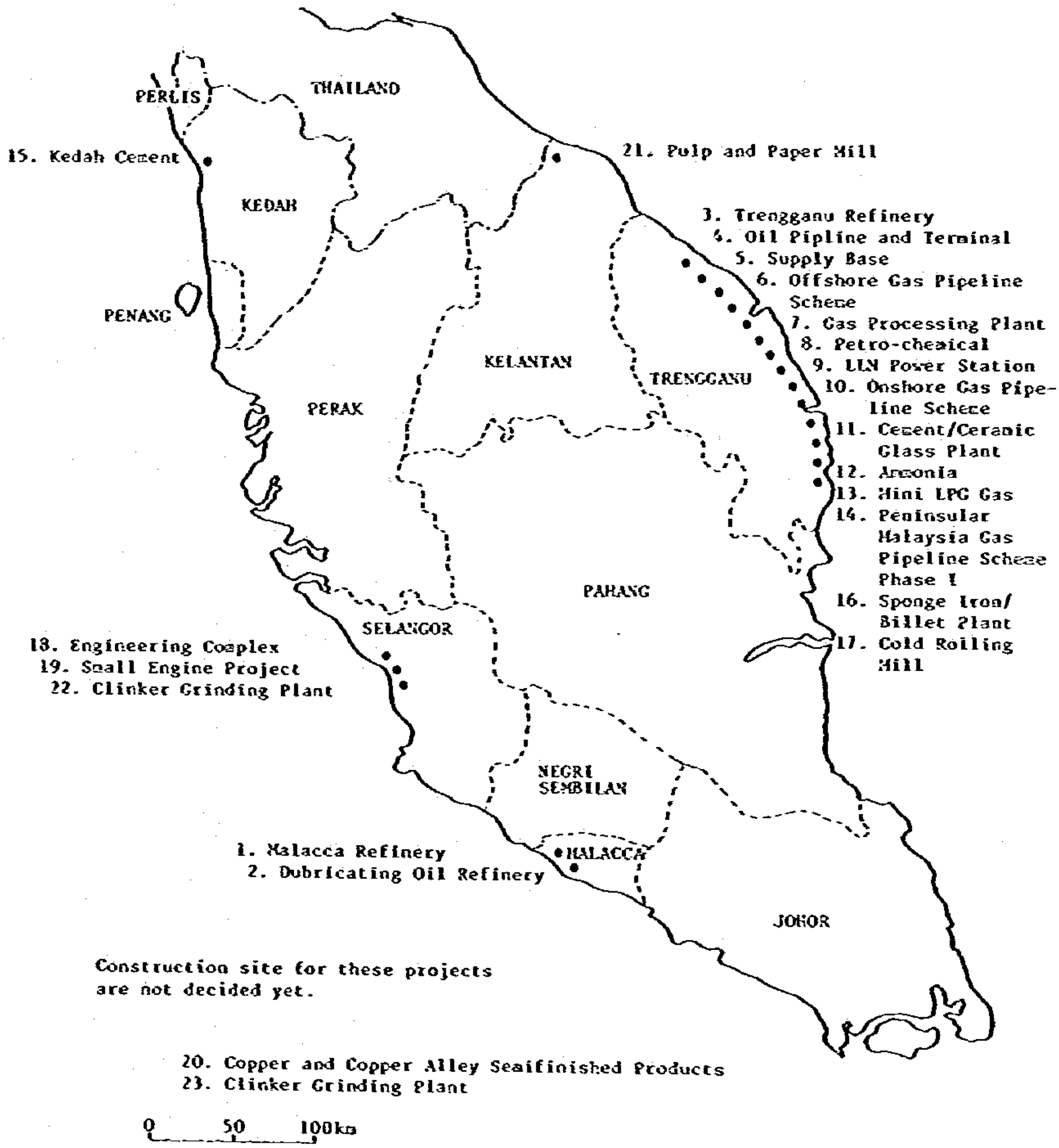


Fig. 3-3-5 Heavy Chemical Industry Project Location Map

3-4 Role of Railway in Future Society

3-4-1 Role of railway in future society of Malaysia

(1) The political and economic center of Malaysia is Kuala Lumpur and the State of Selangor, which are at the central part of the west coast of the Peninsula. In particular, this area accounts for the overwhelming share in Malaysia as far as economic activities are concerned. It is not exaggerated to say that both persons and goods in the Peninsula are moving solely to and from Kuala Lumpur.

(2) The Malaysian Government has been, since 1970, taking up the task of regional development as one of its priority political measures, making its concentrated effort for development in the underdeveloped region, eastern states of Peninsular Malaysia in particular. Workforce and industries must be allocated in a good aptitude for achievement of its goal. This should require, in turn, infrastructural development.

In the case of transport facilities, for instance, it is necessary to provide the project area with the traffic system of well-balanced. In this sense, with regard to inland transport the railway should take some share of it at least. It contributes greatly as the public transport means with is more reliable then road transport in terms of riding quality, puctuality and safety, and more helpful to the low-income people of the nation.

At present, in the eastern part of the Peninsular Malaysia, where the Government are planning to execute many development project, the road is the only means of transport throughout the region. If the railway is constructed in such region, it goes without saying that it would yield significant effect of development, thus contributing much toward future transfer of population and industries into the eastern part of the Peninsular Malaysia.

(3) Not only in the eastern part of the country but also in other regions, it is expected that the regional centers be developed by the local dispersion policy of the Government. Such major centers are Penang at north, Johor (Singapore) at south and Kota Bharu, Kuala Trengganu and Kuantan at east.

All those cities are distanced 300 to 500 km from Kuala Lumpur, which is the optimum distance for the railway traffic to prove itself to be fully capable of performing the function by maximum use of its own specialities.

(4) While Malaysia is an oil producing country, the Government endeavors to encourage saving of energy resources by adoption of the energy-curving policy.

From short term view point, the demand and supply balance of oil has been eased and the energy problem has been somewhat cooled down. In the medium and long range, however, the present effort for energy saving on the governmental side should further continue, since the energy problem is always a matter of vital importance. From this point of view, it can also be said that growth of the railway traffic as the less energy consuming facilities is really meaningful.

(5) In the field of the commodities distribution system, Malaysia appears, at present, to have strong resemblance to Japan of the period of high economic growth. This tendency is expected still to continue further for a pretty long period, attaching increased importance to such goods as iron, cement and oil, which may be better suited for transportation of large quantity and fixed pattern from one base station to the other. Again, the railway can be expected from its brisk activities in this field.

CHAPTER 4.

FUTURE TRAFFIC NETWORK (EXCLUSIVE OF RAILWAY)

MALAYSIA RAILWAY DEVELOPMENT

CASE D-C FIRR : 7.8%

	2010	2011	2012	2013	2014
REVENUE & EXPENSE					
REVENUE	3277	3592	3935	4306	4711
PASSENGER	2004	2183	2375	2580	2800
GOODS	1273	1409	1560	1727	1911
EXPENSE	1278	1376	1485	1605	1735
MAINT.& REPLACE.	296	318	341	370	396
PERSONNEL	371	396	426	458	492
FUEL	323	352	384	417	456
DEPRECIATION	289	310	334	361	391
NET INCOME	2000	2216	2449	2701	2976
CAPITAL INVESTMENT					
INVESTMENT	460	511	569	631	-10368
CIVIL WORK					
SIGNAL & TELECOM					
ELECT.P. & ELECTRIF.					
ROLLING STOCK	460	511	569	631	
WORKSHOP					
LAND					
SALVAGE VALUE					10368
CF(ROI)	1828	2015	2215	2432	13735

CHAPTER 4 FUTURE TRAFFIC NETWORK (EXCLUSIVE OF RAILWAY)

4-1 Roads

4-1-1 Present status of roads

The existing roads in the Malaysia Peninsula comprise of federal, state and municipal roads. Of them all, federal roads extend to a total length of 3,672 km (at paved ratio of 76%) and state roads, to a total length of 8,839 km (at paved ratio of 70%).

The trunk routes of the existing road network in Peninsular Malaysia consist of Federal Route 1 (904 km) from the border with Thailand to Johor Bharu all the way along the west coast through the Peninsula, Federal Route 2 (307 km) connecting Port Kelang on the west coast and Kuantan on the east coast across nearly the central zone of the Peninsula and Federal Route 3 (382 km) going northwards to Kota Bharu along the east coast from Kuantan.

In addition to those, the section between Gerik and Jeli (of 115 km) on the East-West Highway running across the north of the Peninsula between Penang and Kota Bharu was opened in 1982. However, the existing roads at both ends of the highway, between Gerik and Butterworth and between Jeli and Pasir Puteh, are not improved yet.

In regards to data of road traffic, the Highway Planning Unit has been collecting data by measuring the passing traffic volume at census station set up on the road, since 1967. As of 1982, such census stations total to 417 and are scattered all over the peninsula. Traffic volume for each road section as of April in 1980 is shown in Fig. 4-1-1. However, the recorded data only show the number and type of passing vehicles on the road, and such a systematic data collection as clarifying origin and destination, number of passengers and loaded freight volume and contents of each vehicle is not undertaken.

Table 4-1-1 shows cumulative total of registered vehicles by types in and after 1970. As noted from the table, it is obvious that motorization substantially progressed in the preceding decade of 1970s in Malaysia.

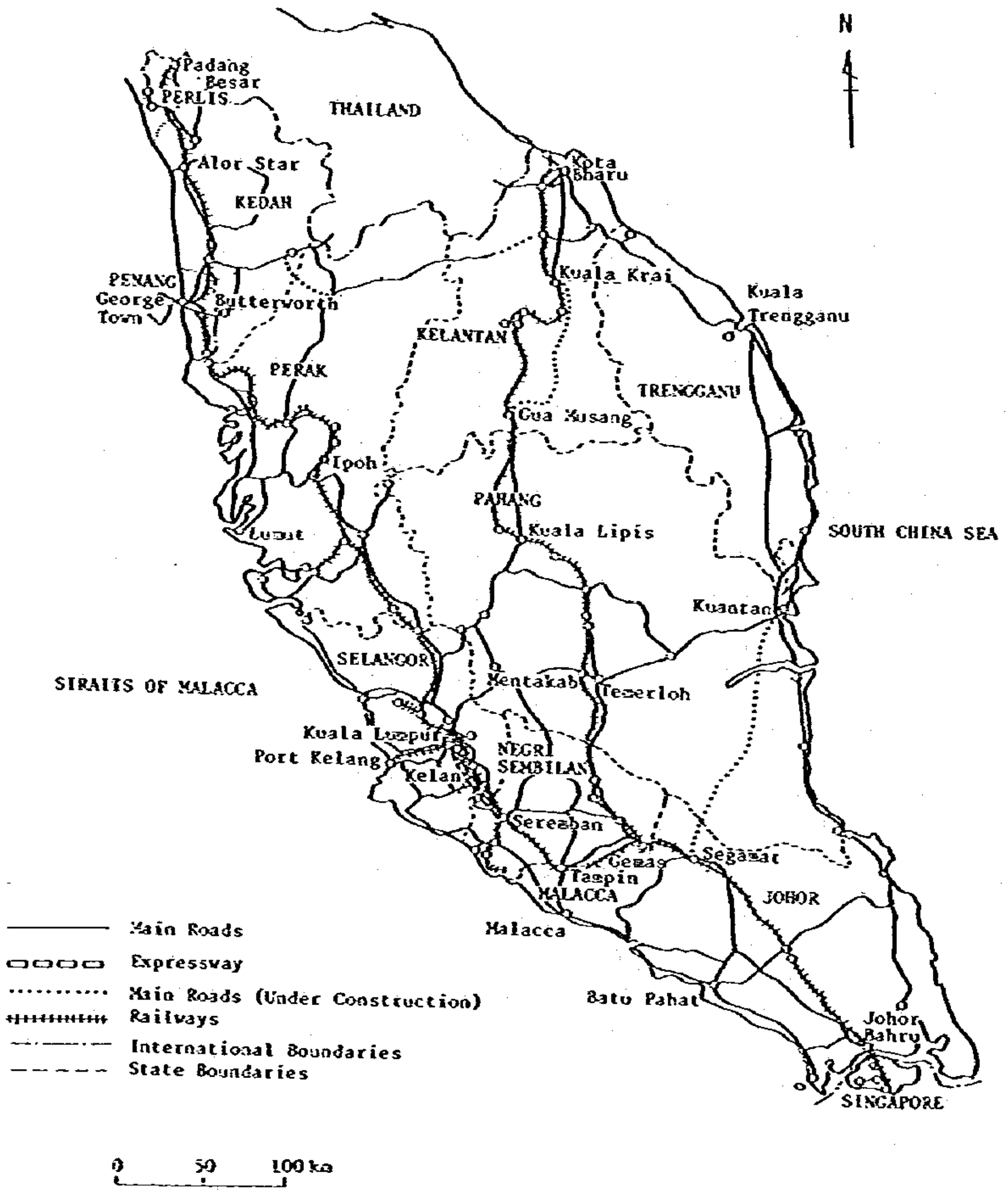
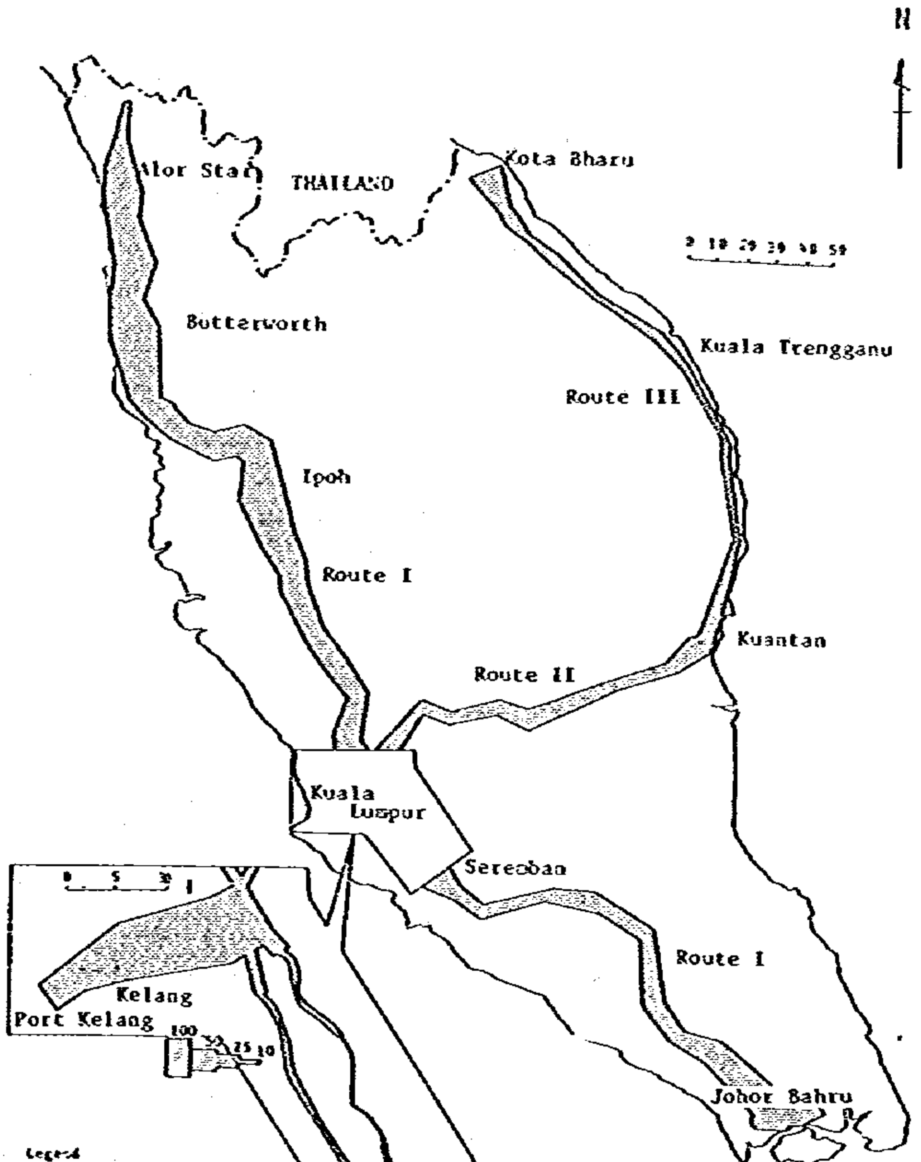


Fig. 4-1-1 Existing Road Network (1982)



Source: Year Book of Transport Statistics, Malaysia, 1980

Fig. 4-1-2 Daily Traffic Volume (16 Hours) on Route I, II, III Peninsular Malaysia, April 1980

Table 4-1-1 Motor Vehicles by Type Registered in Peninsular Malaysia

Year	Motor cycles	Motor cars	Buses	Taxis	Lorries and vans	Other motor vehicles 3)	Total
1970	350,049	231,539	5,932	6,827	55,823	19,124	669,294
1971	389,133	253,491	6,447	7,377	60,543	22,174	739,165
1972	435,334	279,300	6,839	7,427	64,979	24,778	818,657
1973	507,096	316,894	7,274	7,562	72,164	28,961	939,951
1974	611,822	357,910	7,738	8,200	81,584	33,031	1,100,285
1975	722,309	398,014	8,688	9,239	92,207	36,662	1,267,119
1976	830,834	436,939	9,735	10,432	101,620	40,295	1,429,845
1977	951,080	491,933	10,545	11,285	112,025	44,403	1,621,271
1978	1,079,020	555,358	11,589	12,051	122,543	49,397	1,829,958
1979	1,183,391	595,600	12,094	12,034	131,723	54,084	1,988,926
1980	1,391,899	714,742	13,079	13,644	154,533	68,786	2,356,683
Average annual increase rate (%) 1970-1980	14.8	11.9	8.2	7.2	10.7	13.7	13.4

Notes:

1. Vehicles figures given are cumulative total from previous years.
2. The figures for hired cars, "hire and drive" cars are included under taxis.
3. The vehicles types included are tractors, rollers, trailers, etc.

Source: Road Transport Department, Ministry of Transport, Kuala Lumpur

4-1-2 Future road network

The existing Federal Routes 1, 2 and 3 and the East-West Highway across the north of Malaysia will constitute the basic network of roads in Malaysia in the future as well as at present. New roads, however, are currently being constructed on a nationwide scale. If the plan is carried out as originally scheduled, the nation's road network will undergo a drastic change by 1990.

Major projects now underway are as follows.

(1) Toll expressway construction project

The toll way in Malaysia is now under construction. The main section of the Project is the expressway running through nearly in parallel with Federal Route 1, over a total length of 773 km, starting from the border with Thailand and leading to Johor Bahru at the southern tip.

The other sections include the Penang Bridge construction connecting both Penang Island and the main land and the New Kelang Valley Expressway Construction to connect Port Kelang and Kuala Lumpur running along with Federal Route 2.

Above anything else, this Project is now being undertaken as the top priority item in the road construction sector under the 4th Malaysia Plan (1981 - 1985). The Highway Authority of Malaysia established at the end of 1980 is responsible, as the executing agency, for implementation of this Project.

The section of 60 km length between Kuala Lumpur and Seremban has already been completed with a median strip and four (4) lanes, opened to the public as the toll expressway. It is expected that the rest sections will be accomplished by 1990.

(2) Supporting road system for East-West Highway

As stated earlier, whilst the East-West Highway across the north of Malaysia between Gerik and Jeli has been opened, the service level of each existing road between Gerik and Butterworth and between Jeli and Pasir Puteh is lower than the desirable standard and, therefore, requires improvement on an extensive scale.

To meet this requirement, feasibility study for the Supporting Road System at both ends of the highway was completed with the finance of Asian Development Bank. All construction works of these supporting roads are expected to be completed by 1990.

In addition to the above, there are other important projects which will form components of the future road network. They are as follows:

① Kuantan - Segamat Highway Project (149 km)

② Gua Musang - Kuala Kurai Road Project (115 km)

Both of those projects are scheduled to complete by the end of 1983; the former will serve as the trunk route between Johor Bahru, Singapore and the east coast zone now being industrialized at rapid tempo and the latter will perform its important role as the connecting route between Kota Bharu, the major city in the east coast, and Kuala Lumpur.

Table 4-1-2 summarizes the general outline of those projects. There are two more projects under the future development plan, such as Karak - Kuantan Expressway Project and Kuala Kangsar - Kuala Trengganu Expressway Project. Since they have not even reached the phase of feasibility study yet and will not be most probably completed before 1990 even if executed, those projects are not regarded as the component of the future network in this study.

Fig. 4-1-3 shows the future road network envisaged for the year 1990 with those projects. As a result, the road distance between major cities will be significantly shortened compared with the distance at present, as shown in Table 4-1-3. Thus, it is expected that they will contribute greatly toward efficient ties of inter-regional activities.

Table 4-1-2 Network of Major Roads in Peninsular Malaysia (1990)

Name of road	Section	Distance (km)	Designed speed	Type of road, (tollway, federal road, state road & others)	No. of Lanes	Paved or not	Year of completion
A. Completed projects up to October, 1982							
1. East-West Highway		115	96	Federal	2	Paved	1982
2. Jerangan - Johor		109	96	Federal	2	Paved	1981
3. Kuala Lumpur - Karak Highway		68	80-96	Federal	2	Paved	1980
B. Under construction							
1. Kuantan - Segamat Highway		149	96	Federal	2	Paved	1983
2. North Klang Straits Bypass		15.2	96	Federal	2	Paved	1983
3. Kuala Krai - Gua Musang		115	96	Federal	2	Paved	1983
C. Under study/detailed engineering							
1. Inter-urban Toll Expressway between Tampoi - Bukit Kayu Hitam except for Kuala Lumpur - Seremban and Tanjung Malim section		643	112	Federal/ tollway	4/ dual	Paved	1986
2. New Klang Valley Expressway		61	112	Federal/ tollway	4/ dual	Paved	1986
3. Bidor - Tanjung Malim		60	112	Federal/ tollway	4/ dual	Paved	before 1990
4. Supporting Road System East-West Highway							
i) Butterworth - Gerik		115	96	Federal	2	Paved	before 1990
i) Jeli - Pasir Putih		84	96	Federal	2	Paved	1986
5. Gua Musang - Kuala Lipis - Raub - Bentong		182	96	Federal	2	Paved	before 1990
D. Future development							
1. Karak - Kuantan Expressway		170	112	Federal/ tollway	4/ dual	Paved	after 1990
2. Kuala Kangsar - Kuala Trengganu		296	96	Federal	2	Paved	after 1990

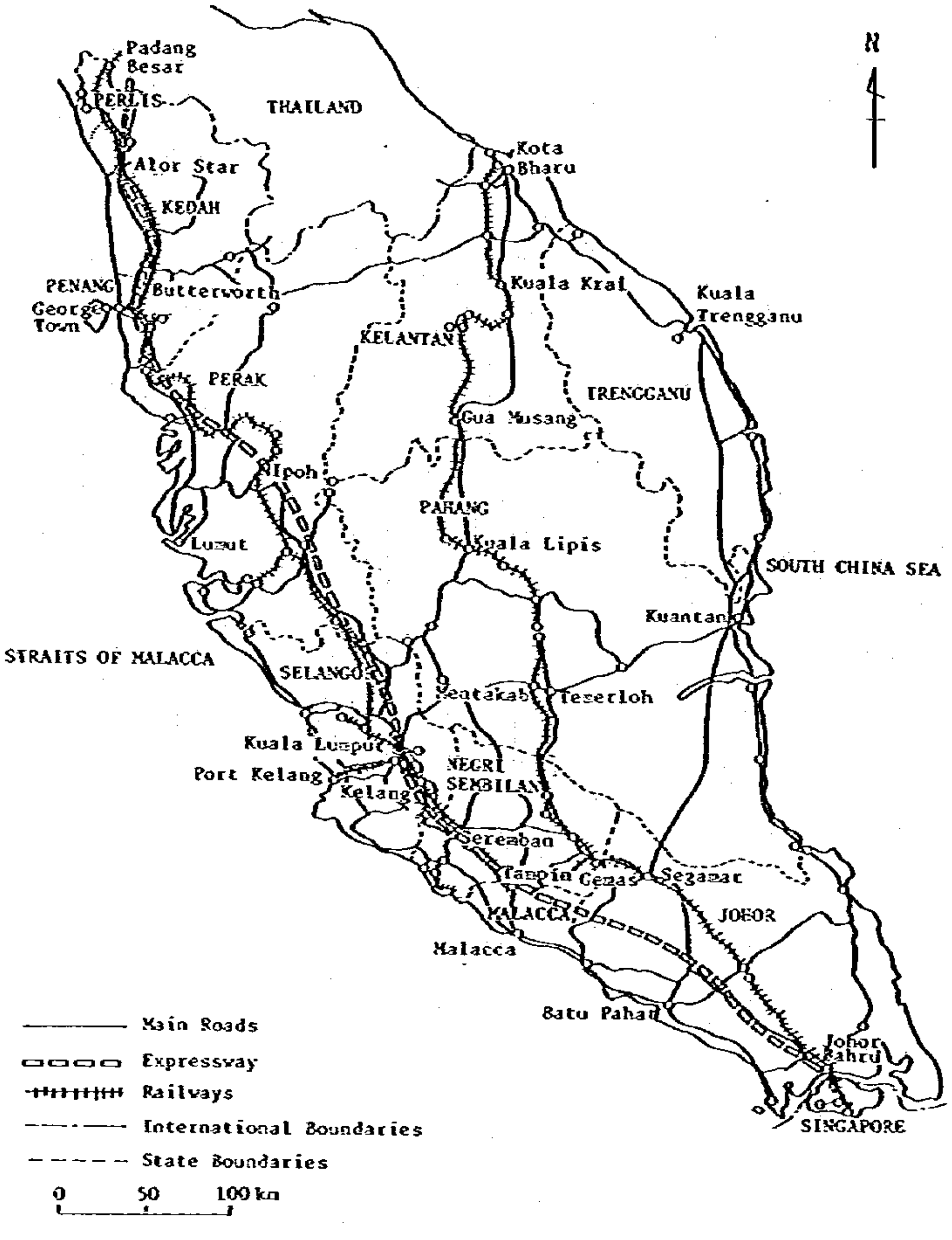


Fig. 4-1-3 Future Road Network (1990 - 2005)

Table 4-1-3 Road Distance between Major Cities (1990)

O \ D	Alor Star	Butter-worth	Ipoh	Kuala Lumpur	Seremban	Johor Bahru	Singapore	Kuantan	Kuala Trengganu	Kota Bharu
Alor Star										
Butterworth	96									
Ipoh	227	131								
Kuala Lumpur	410	314	183							
Seremban	470	374	243	60						
Johor Bahru	730	634	503	320	260					
Singapore	758	662	531	348	288	28				
Kuantan	663	567	436	253	313	320	348			
Kuala Trengganu	532	436	468	473	533	540	568	220		
Kota Bharu	430	334	383	429	489	704	732	384	164	

4-2 Air Traffic

4-2-1 Present status of the air traffic

At present, there exist nine (9) airports available for regular flights throughout Peninsular Malaysia. Out of them all, the international airports are two, one at Kuala Lumpur and the other at Penang. The other seven (7) are operated for domestic service, those are Alor Star, Ipoh, Malacca, Johor Bahru, Kuantan, Kuala Trengganu and Kota Bharu. Outline of facilities at the international airports of Kuala Lumpur and Penang are as shown in Table 4-2-1.

Table 4-2-1 Airport Facilities at Kuala Lumpur and Penang

Kuala Lumpur	Runway	15/33 (3,474 m × 45 m, LCN 100, 27 m above sea level, ICAO CAT-I)
	Lighting facilities	Runway lights, Approach lights R/W 15/33 LIH Centerline lights, VASIS R/W 15/33, Thr, Taxiway lights
	Navigational aids	VOR/DME, NDB, ASR, ILS CAT-I
Penang	Runway	04/22 (11,000 ft × 150 ft, asphalt, LCN 70)
	Lighting facilities	T-VASIS, Approach lights, Centerline lights, Runway lights, Thr
	Navigational aids	ILS (R/W 04), T-VOR/DME, NDB

Source: Ministry of Transport

The air transport business between all those airports is undertaken by Malaysia Airlines System (MAS) which is wholly owned by the government. Table 4-2-2 shows the frequency of flights of a week in the Peninsula. The shuttle service is available between Singapore and Kuala Lumpur by joint undertaking with the Singapore Airlines. Since the air traffic in Malaysia is at the threshold toward future development, the expansion speed of its operation is quite high, showing such high average annual rate of increase as 15.3% for five (5) years between 1976 and 1981, as can be seen from the statistic data on the number of passengers by airports in Table 4-2-3.

The main type of plane being operated on domestic routes is B737. Furthermore, F27 is in service between the airports with facilities of lower standard. The big size planes such as A300 or DC10 are put in service on the trunk route between Kuala Lumpur, Penang and Singapore.

Table 4-2-2 Flight Schedule (Nov. 1982)

Peninsular Malaysia only per week

	Alor Star	Penang	Ipoh	Kuala Lumpur	Malacca	Johor Bahru	Singapore	Kuantan	Kuala Trengganu	Kota Bharu	Total
Alor Star											
Penang											
Ipoh		28									28
Kuala Lumpur	22	187	84								293
Malacca				14							14
Johor Bahru				84							84
Singapore		28		229		42					299
Kuantan				14		4					18
Kuala Trengganu		6		50							56
Kota Bharu	14	14		42							70
Total	36	263	84	433		46					862

Table 4-2-3 Air Passenger Traffic by Airports

Unit: Person, %

Airport \ Year	1976	1977	1978	1979	1980	1981	1981/1976 Average growth rate
Alor Star	19,922	21,961	19,299	25,012	40,285	63,614	26.1
Penang	588,577	635,629	685,463	757,111	938,286	1,099,661	13.3
Ipoh	76,888	76,350	72,501	77,850	97,273	104,524	6.3
Kuala Lumpur	1,524,410	1,642,777	1,823,201	2,013,635	2,505,851	3,044,056	14.8
Malacca	27,263	14,334	10,743	10,264	10,292	12,164	-14.9
Johor Bahru	29,752	30,624	37,057	50,204	104,083	168,472	41.4
Kuantan	13,634	15,667	13,906	10,829	19,337	26,233	14.0
Kota Bharu	92,448	112,075	105,394	127,782	169,776	234,884	20.5
Kuala Trengganu	14,292	23,932	38,337	31,556	54,895	131,834	56.0
Total	2,397,191	2,555,349	2,805,901	3,153,017	3,940,078	4,885,442	15.3

Source: Annual Air Transport Statistics, 1981

4-2-2 Future air traffic network

The future plan for airports in Malaysia was worked out by a group of consultants led by the British Airports International in December 1981, and it was summarized in a report of Malaysia National Airport Study (Vols. I - V). The study makes analysis of the necessity for expansion of each airport so as to catch up with the future increase of air traffic demand, on assumption that Malaysia would rush into the new aerial age at accelerated paces. This serves as the fundamental guideline for implementation of the expansion project at each airport.

By the result of study it is estimated that the increase rate of passengers would be 11% per year for the period between 1979 (base year) and 1990 and 6% between 1991 and 2000 respectively. The increase rate of freight is also estimated at 12% and 9% per year respectively for each of the corresponding periods. The number of flights for take-off and landing is estimated at an annual increase rate of 4.5% and 2.5% respectively, on the assumption that the large-size planes would be put into service increasingly to meet the future increasing demand.

It should be noted, however, that at the time when the Malaysia National Airport Study was prepared the railway traffic was not regarded in the least, as the object competitive to the air traffic, because the development plan for the Malayan Railway did not as yet take its definite shape at that time.

Although each city is scattered over the national land far and wide, the distance between main cities is mostly within a range of 200 to 500 km. In particular, the main air routes between Kuala Lumpur and Penang (Butterworth) and between Kuala Lumpur and Singapore are within a distance of 300 to 400 km, which may presumably be affected to some extent, if the high-speed railway system is constructed, as easily imagined from the precedent abroad. Therefore, if the railway development project is decided to implement the Malaysia National Airport Study may require review for revision.

Nevertheless, even though the relative share of importance between the air traffic mode and other competitive traffic modes may be changed, the important role to be played by the air traffic mode in the future domestic traffic system would remain unchanged in its importance because of its operational function featured by the quickest speed as the inter-urban transport facilities.

For all those reasons mentioned above, this study applies to Fig. 4-2-1 as the future projected air traffic network in and after 1990, on the premises that the existing air traffic network could be maintained as it is now even if the high-speed railway system is introduced.

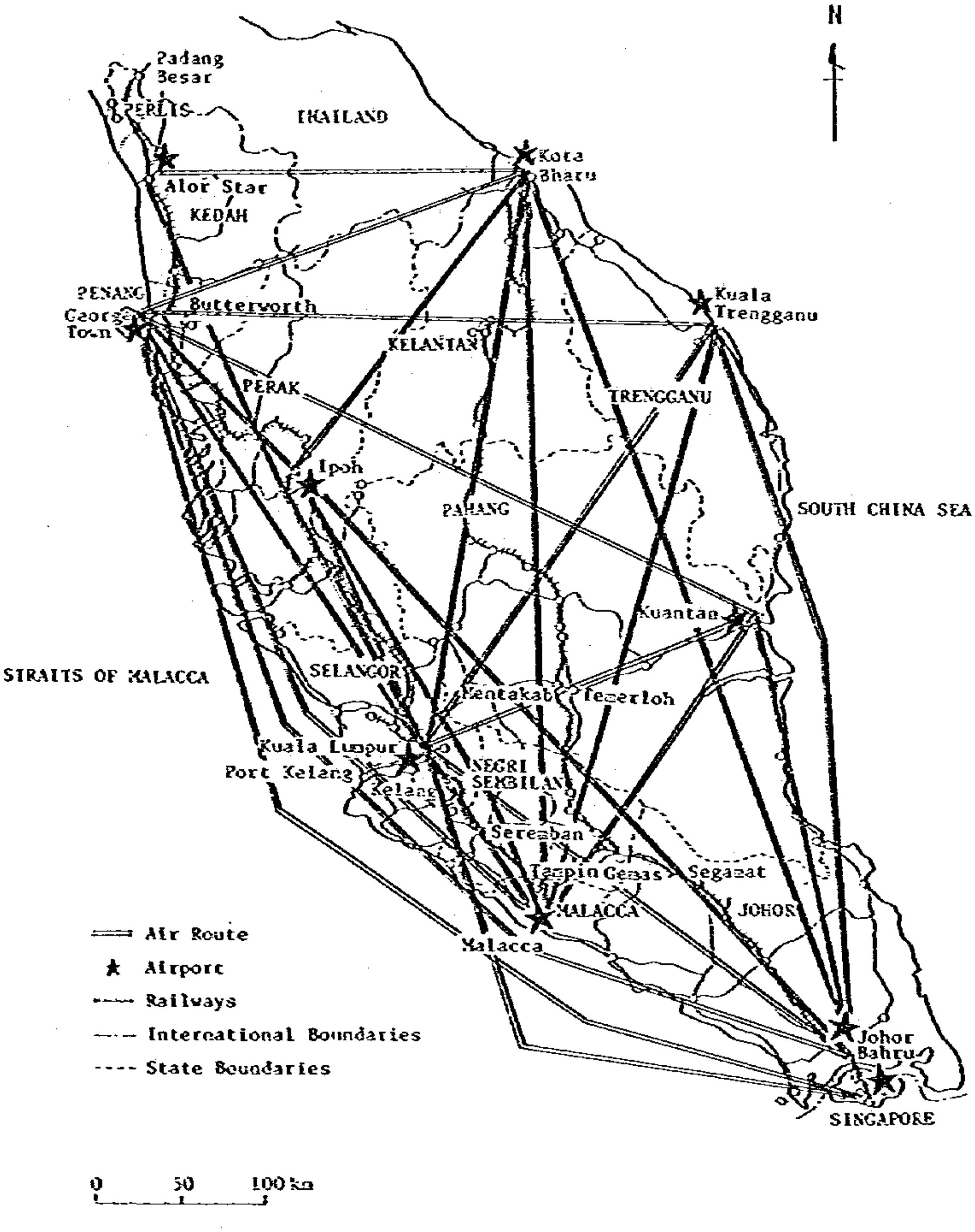


Fig. 4-2-1 Air Transport Network

4-3 Port and Coastal Marine Transport

4-3-1 Present status of port and harbour

Peninsular Malaysia has its own long coastal line. Besides that, the centers of economic activities and population are mostly situated within a range of 50 km from coastal line. Therefore, it can be said that the nation has a growing potential in the coastwise marine service. The total volume being handled by marine transport, however, is limited to a relative low level, since the existing port facilities remain undeveloped yet.

However, as a result of cement plant construction in Langkawi Island and oil refinery plant construction in Malacca and Trengganu, it is expected that the domestic coastal liners service will be strengthened in the future.

Major ports existing in Malaysia are four (4) such as Kelang and Penang (on the west coast) and Johor and Kuantan (on the east coast). It is conceivable that those four (4) ports will still play dominant role in Malaysian marine transport in the future as well as in the past.

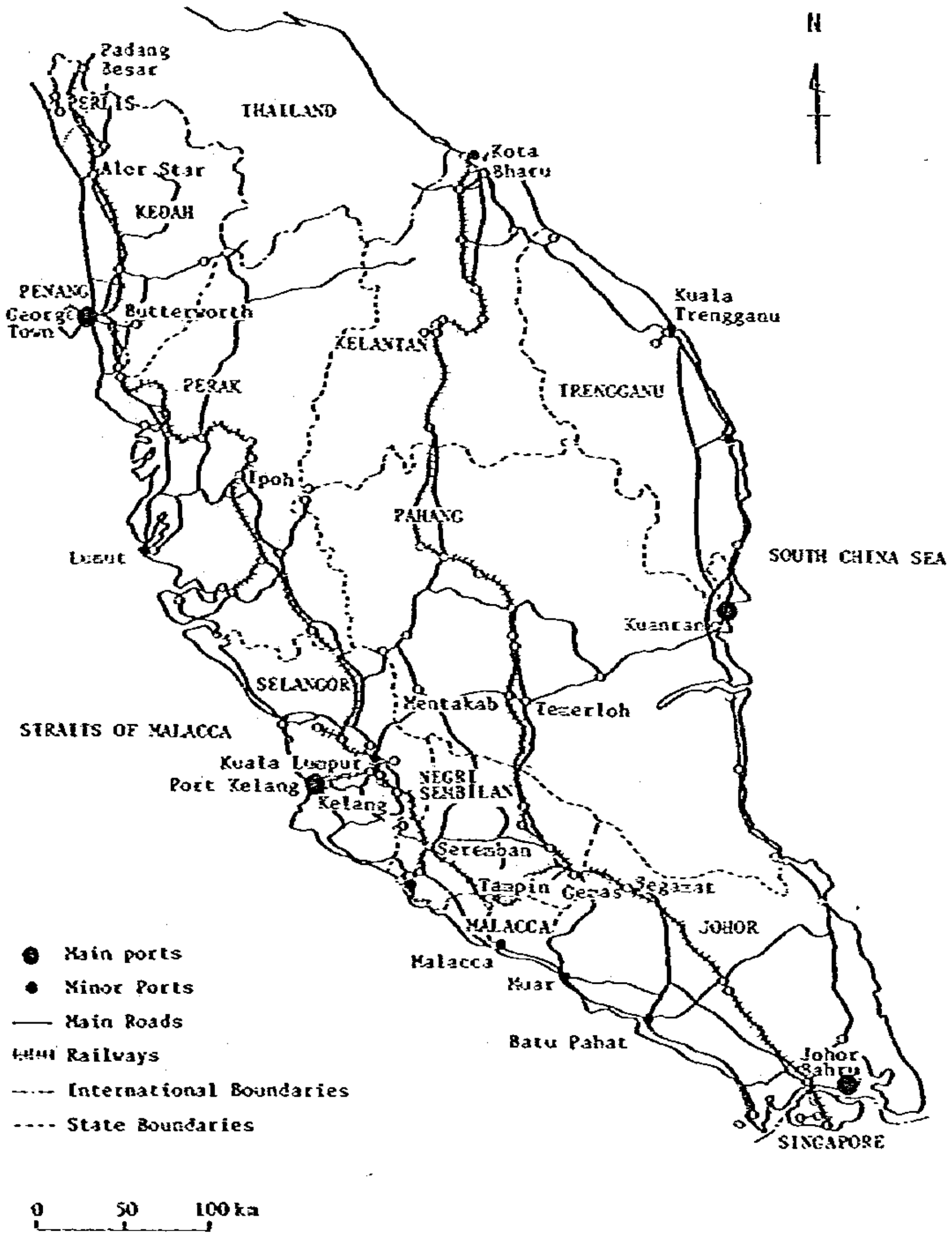
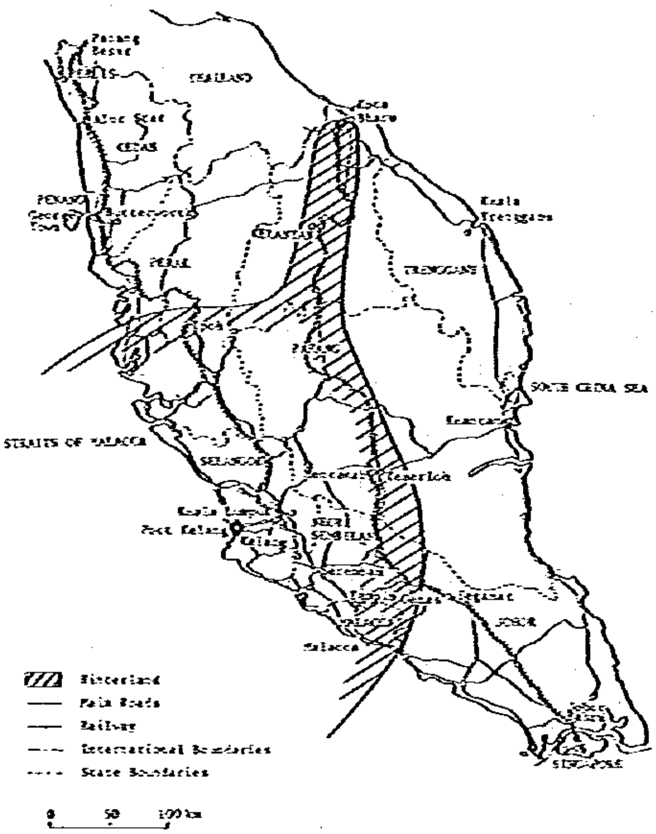


Fig. 4-3-1 Ports of Peninsular Malaysia

(1) Port Kelang

The Port of Kelang, ranking the top in terms of the handling volume of export and import goods, is situated about 40 km west of Kuala Lumpur as its outer port.



With the strength of its prominent site condition right at the center of the west coast and its deep water (-10 m in depth at South Port and -13.4 km in depth at North Port) which enables the port to accommodate the vessel of 70,000 DWT, the hinterland of the Port has a wide and large expansion, as shown in Fig. 4-3-2, covering the whole of Selangor State and Negri Sembilan State, the west of Pahang State, the south of Perak State and a part of Trengganu and Kelantan States respectively.

Fig. 4-3-2 Hinterland of Port Kelang

The Port is under the management and control of the Kelang Port Authority. The berths in the Port are assigned for the following purposes.

1) South Port

a) 4 berths: Loading or unloading to or from ocean-going vessels

b) 3 berths: Loading or unloading to or from mainly vessels for coastal service

c) 1 berth : Exclusively for palm oil

d) 5 buoys for anchorage: Barge service for ocean-going vessels

e) 2 anchorages : Ditto

2) North Port

a) 9 berths : Loading or unloading of general cargoes to or from ocean-going vessels

b) 2 berths : Loading or unloading of containers to or from ocean-going vessels

c) 2 berths : Loading or unloading of bulk cargo

3) Private oil jetty for petroleum shipping

(2) Penang Port

The Penang Port is the second largest next to the Kelang Port in terms of handling export and import goods.

The first point featuring Penang Port lies in the fact that it has a wide expansion of port territory, managing lots of port facilities such as Butterworth wharves, Prai piers and Bulk Cargo Terminal on the Province Wellesley side and Swettenham Pier in the Penang Island. The second point is the fact that the volume of cargoes handled on private jetties reaches as much as 36.6% of total volume being handled in the Port. This share is far ahead of those of other ports of the country.

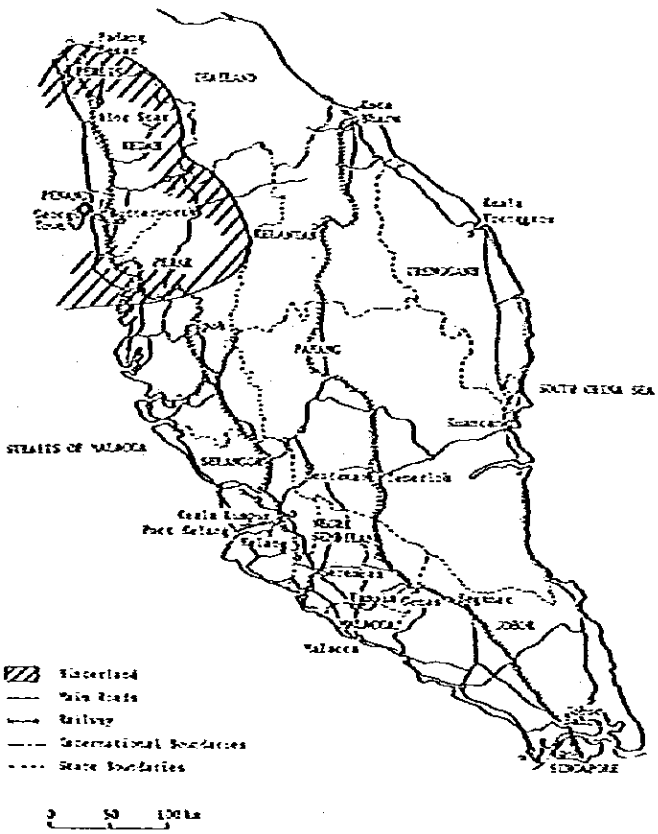


Fig. 4-3-3 Hinterland of Penang Port

The hinterland of the Penang Port covers the whole of the northern part of Malaysia Peninsula, extending even to the whole territory of three states such as Perlis, Kedah and Penang and the northern part of Perak State.

To the further advantage, cargoes can be carried from this Port to the whole territory of Malaysia Peninsula by way of road vehicles or railway. (Freight transport is, in fact, available to the area of Kota Bharu in Kelantan State by way of the railway in the southern Thailand.)

The Penang Port has a water depth of -9.7 m, thus permitting approach of the vessel of 35,000 DWT class to the quay.

(3) Johor Port

The Johor Port is located at the extreme south of the Peninsula, facing the Johor Straits. Formerly, the greater majority of freight was handled through the Singapore Port for export and import in this region. At present, the Johor Port is taking its active part as the representative in the southern Peninsula.

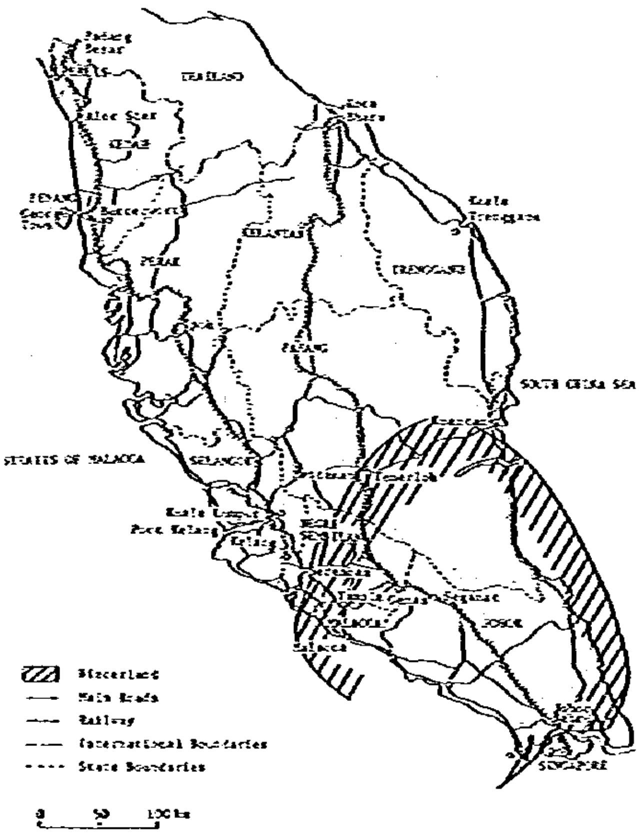


Fig. 4-3-4 Hinterland of Johor Port

This Port is situated about 32 km (20 miles) east of Johor Bahru, the Capital of the State, and the newly constructed railway is serving to the port together with the existing road transportation.

The hinterland of the Johor Port covers as far as the whole area of Johor State and the southern parts of Malacca, Negri Sembilan and Pahang States.

The Port has a water depth of -11 m, easy to accommodate the vessel of 35,000 DWT class.

(4) Kuantan Port

The Kuantan Port is situated at Tanjung Gelang about 25.6 km north from Kuantan along the road leading to Kuala Trengganu and Kota Bharu.

Because of its existence as the largest port on the east coast, the Port has wide hinterland covering the main areas of Pahang and Trengganu States, a part of Negri Sembilan and Kelantan States. Most of potential industrial zones in that region are covered by the Port.

However, unlike the west coast the east coast is generally shallow to a distance from the shore and featured by severe sand sedimentation. Because of these site conditions, the port expansion project is not so smoothly progressed as originally planned, and maintenance of the port is quite hard. Consequently, only the ships of 10,000 to 30,000 DWT can have an access to this port.

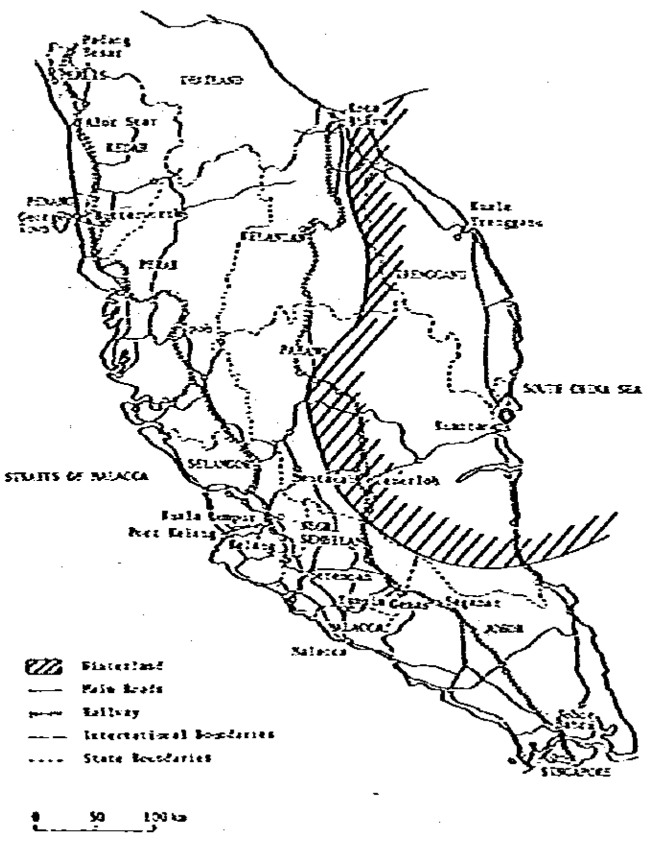


Fig. 4-3-5 Hinterland of Kuantan Port

Under the present circumstance, the Port does not perform its fullest function yet in all respects. As stated earlier, however, the Government endeavour its effort toward expansion and rehabilitation of the port as the leading port on the east coast of the Peninsula. Therefore, with further progress of the industrialization project it is expected that the Port will establish its important position as one of the nation's major ports ranking the fourth throughout the Peninsula.

Table 4-3-1 Outline of Major Ports on Peninsular Malaysia

Name of port	Present facilities	Present capacity (1,000 DWT)
Port Kelang	(1) South port 7 berths 1 lighterage 1 palm oil jetty (2) North port 13 berths	(1) North south port General & container cargo 4,245 Bulk cargo 325 Liquid cargo 1,400 (Sub-total 5,970) (2) Stream/deep water points General cargo & timber 1,000 (3) Private oil jetty Petroleum 500 (Total 7,470)
Penang Port	12 berths 10 berths - Butterworth 1 " - Swetterhaul 1 " - Prai	(1) Penang port commission General cargo 2,100 Container cargo 670 Liquid bulk cargo 1,950 Dry bulk cargo 1,000 (Sub-total 5,720) (2) Private jetties Liquid bulk cargo 2,000 General cargo 1,300 (Total 9,020)
Johor Port	2 berths - Ocean going vessels 1 berth - Coastal vessel Twin berth - Liquid bulk cargo	(1) Johor port authority General cargo 210 Dry bulk cargo 600 Liquid bulk cargo 500 (Sub-total 2,310) (2) Private jetties General cargo 180 Dry bulk cargo 300 Liquid bulk cargo 500 (Total 3,290)
Kuantan Port	3 berths - General cargo 1 berth - Palm oil 1 " - Mineral oil 1 wharf - Multi-purpose	(1) Private jetties Liquid bulk cargo 160 General cargo 300 (Total 460)

Source: Ministry of Transport

4-3-2 Expansion projects of major ports under the 4th Malaysia Plan

(1) Kelang Port expansion project

A wharf of 1,000 m in length will be constructed for both bulk cargo and general cargo at Pulau Lumit. When completed, the handling capacity of the Port will be increased up to around 11 million DWT each year.

(2) Penang Port expansion project

The project plans construction of a container terminal and a berth for bulk cargo handling. The target capacity after completion is set at around 12 million DWT each year.

(3) Johor Port expansion project

Three wharves will be constructed for general cargo, dry bulk cargo and liquid bulk cargo.

The Port will have a capacity of around 8 million DWT when completed.

(4) Kuantan Port expansion project

After completion of the general cargo berth and the liquid bulk cargo berth now under construction, the total capacity will be increased to around 3.6 million DWT each year.

(5) Expansion of other ports

1) Extension of the Kuala Trengganu Port

2) Expansion of the Kelantan Mini-port

3) Construction of Pulau Langkawi

4) Private jetty construction

i) Chukai : for import of materials (iron ore, coal for coke and fluorite) for iron manufacturing.
for export of products (cold roll plate, hot roll thick plate and iron rod).

ii) Kerteh : for LNG export

The detailed future capacity after expansion of four major ports is as shown table:

Table 4-3-2 Future Capacity of 4 Major Ports

Name of port	Future capacity	1,000 DWT
Port Kelang	(1) North, south port	
	General cargo } Container cargo }	4,985
	Bulk cargo	1,700
	Liquid cargo	2,900
	(Sub-total)	(9,585)
	(2) Stream/deep water points	
	General cargo & timber	1,000
	(3) Private oil jetty	500
	(Sub-total)	(1,500)
	Total	11,085
Penang Port	(1) Penang port commission	
	General cargo	2,310
	Container cargo	1,790
	Liquid cargo	2,700
	Dry bulk cargo	1,750
	(Sub-total)	(8,550)
	(2) Private jetty	
	Liquid bulk cargo	2,000
	General cargo	1,300
	(Sub-total)	(3,300)
	Total	11,850
Johor Port	(1) Port authority	
	General cargo	625
	Dry bulk cargo	2,500
	Liquid bulk cargo	2,250
	Container cargo	222
	(Sub-total)	(5,597)
	(2) Private jetty	
	General cargo	180
	Dry bulk cargo	300
	Liquid bulk cargo	1,750
	(Sub-total)	(2,230)
	Total	7,827
Port Kuantan	(1) Port authority	
	General cargo	840
	Liquid cargo	2,300
	(Sub-total)	(3,140)
	(2) Private jetties	
	General cargo	300
	Liquid cargo	160
	(Sub-total)	(460)
	Total	3,600

4-3-3 Future prospect of coastal shipping service in Malaysia

As stated previously in 4-3-1, the present coastal shipping service carries mainly petroleum, but only in a limited quantity.

However, with expansion and strengthening of such facilities as pneumatic and backet conveyors for grain, feed and cement cilo, large-size backet crane for coal and iron core and crane and forklift for strengthening of loading/unloading capacity of general cargo handling, etc., the total capacity of the coastal transport will be considerably increased.

If there are increases in the number of oil tankers for domestic use, carriage boats for bulk cement and pusher barges for steel product, coupled with the reinforcement of port facilities, the coastal shipping system in Malaysia certainly has high potentiality for future greater growth.

CHAPTER 5.
TRAFFIC DEMAND FORECAST

CHAPTER 5 TRAFFIC DEMAND FORECAST

5-1 Premises for Demand Forecast

5-1-1 Alternatives for demand forecast

As formulated in the foregoing Chapter 1, demand forecast has been conducted for the four (4) combined alternatives in this study.

West Coast Line \ New East-West Line	Case A	Case B	Case C
Case A	O	*	*
Case B	*	O	*
Case C	*	O	*
Case D	*	*	O

1) Case A-A: Construction of standard gauge track for the whole line

2) Case B-B: Combined use of both new standard gauge track and existing meter gauge track on the West Coast Line. Construction of new standard gauge track on the New East-West Line.

3) Case C-B: Improvement of existing meter gauge track (with future potentiality for conversion into standard gauge) on the West Coast Line. Construction of new standard gauge track on the New East-West Line.

4) Case D-C: Improvement of existing meter gauge track on the West Coast Line. Construction of meter gauge track on the New East-West Line.

5-1-2 Construction time schedule

All construction works are assumed to be completed by 1989, so that the new railway facilities will be put into service in and from 1990.

It should be noted, however, that this premise has been set only for the purpose of estimating traffic demand, therefore, this does not necessarily mean that the actual construction works can be completed by 1989 as a matter of fact.

5-1-3 Socio-economic framework

In the foregoing Chapter 3, explanation is made in details with regard to the socio-economic framework in Malaysia. As for the growth rate of GDP and population, the following rates have been used as the base for demand forecast in consultation with the Malaysian government.

	Average Annual Growth Rate of GDP	Average Annual Growth Rate of Population
1981 ∿ 1990	7.9%	2.4%
1991 ∿ 2005	6.5%	2.0%

The rate of growth by States is exactly what is predicted under the 4th Malaysia Plan up to the year 1990. Therefore, it is estimated that the relatively high growth will be achieved in the eastern states of Peninsular Malaysia. If the current depression of world economy further continues, it is most probable that the figures set under the framework may be subject to revision of downward.

Forecast in and after 1991 is based upon the assumption that the social economic structure in 1990 would remain unchanged even after that year, that is to say, the GDP and population in each state would continue growth at an equal rate of increase.

5-1-4 Comparison of transport conditions

1) The conditions of transport for any other traffic means (such as road, air and sea) would basically remain unchanged up to the year 2005 from the prevailing conditions in 1990.

2) In relation to the modal split analysis of traffic demand, it is assumed that the capacity of each traffic means has no limit.

3) With regard to the relative fare rate for each mode of traffic, the present structure is assumed to continue for the whole period of the forecast.

4) Scheduled speed of trains is set as shown in the following table:

Train classification \ Alternatives		West Coast Line			New East-West Line (km/h)		
		A	B	C & D	A	B	C
Passenger	Super Express	130	130	100	130	130	100
	Express	110	110	80	110	110	80
	Local	80	60	60	80	80	60
Freight	Through	80	60	60	80	80	60
	Local	60	50	50	60	60	50

As for the conditions of any other transport means than the railway, whether there exists any expressway as the alternative means or not is an important factor for the modal split of traffic. Forecast under this study is based upon such assumption that the expressway extending from the boader with Thailand to Johor Bahru along the west coast would be completed and put into traffic service by 1990 and, besides that, the expressway connecting Kuala Lumpur and Kuantan along with Federal Road 2 would not be completed.

5-1-5 Zoning

Since the Project is located within the Malaysian Peninsula, the area under the Project does not include the two regions of Saba and Sarawak, leaving them out of the project zone. However, Thailand and Singapore, contiguous to the Peninsula, are added to the project zone. Finally, the Project Area has been divided into eleven (11) zones including Thailand and Singapore. (Fig. 5-1-1)

5-1-6 Premises for sensitivity analysis

Sensitivity analysis will be made for the following items.

The purpose of this analysis is to study the size of impact to traffic demand which will be brought about by the change of such items mentioned below.

Therefore, this analysis precludes any such instance that changes would take place at the same time. This analysis does not measure changes in the economic and financial internal rate of return, since this analysis is solely to check only variations of the traffic volume.

[Study Items]

Study Items	Premises for Base Case	Premises for Sensitivity
Growth rate of GDP	∿ 1990, 7.9%/year 1991∿ , 6.5%/year	∿1990, 7.9%/year 1991 ∿, 5.0%/year
Construction of expressway to the east coast	-	New construction between Kuala Lumpur ∿Kuantan Construction by 2005
Railway fare (for passenger only)	Application of the existing rate system	20% increase of fare rate for railway as compared with other traffic means

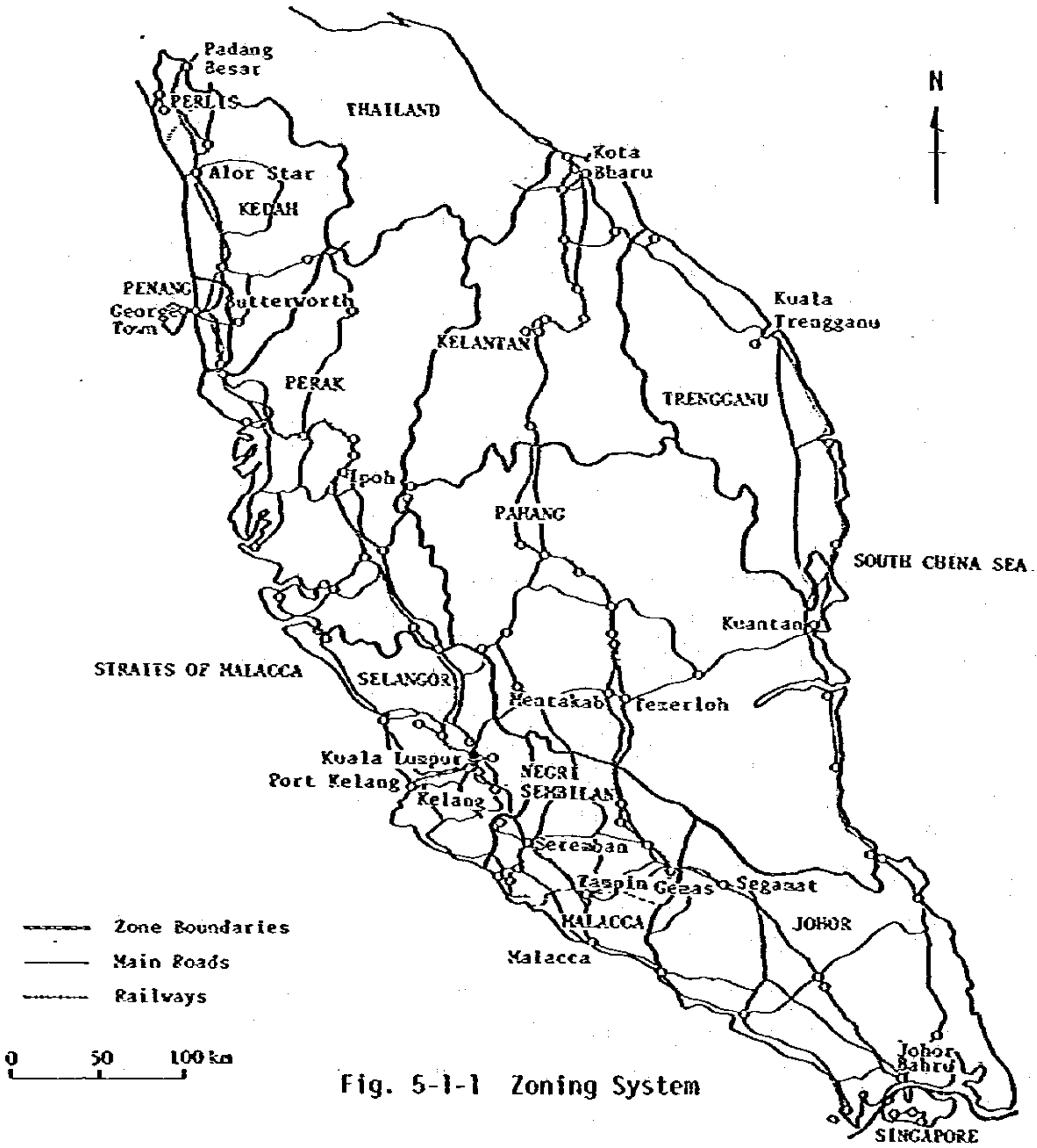


Fig. 5-1-1 Zoning System

5-2 Passenger Demand Forecast

5-2-1 Data used for analysis

In forecasting passenger demand for the railway traffic, demand has been estimated in comparison with demand for other competitive means of transport. At present, the inter-urban passenger traffic is shared mainly by train, private car, taxi, bus and plane. It is quite hard to predict that new transportation modes will emerge and take substantial share of inter-urban passenger traffic within the period of this forecast. The above five (5) transport modes now being operated have been taken up as the competitive alternatives for this analysis. In this connection, because of limited availability of the data, both of passenger car and taxi are categorized into one mode.

Demand forecast under this study is basically relying on the data provided by Malaysian government authorities concerned. Any particular researches to collect new data have not been conducted. Regarding to the basic data upon which demand forecast is based, no survey has not yet been conducted in Malaysia, ever since the 1970s, in accordance with the uniform standard and methodology to grasp the nationwide traffic conditions. For this reason, forecast has been made based on the data collected in non-systematic manner for each transport mode in terms of standard, method and timing of survey. The year 1981 was selected as the base year for projection in view of the availability of data.

(1) Railway

In respect of passenger railway traffic, the Origin-Destination data between the railway administrative zones prepared by the MRA was available. In fact, however, differences were found in each data source. Therefore, aggregation of data was conducted in such a way as mentioned below.

Firstly, "Origin & Destination of Passenger Flow in Administration Zone, 1981" was used for the study of distribution pattern of traffic.

Secondly, the total volume of passenger traffic was taken from "Performance of Malayan Railway 1960 - 1981, 14th August 1982", because it provides the total volume of passenger traffic chronologically.

Finally, the distribution pattern and total traffic volume, calculated in the above process, were incorporated with each other.

(2) Car and taxi

With regard to the traffic volume at cross sections of main roads, annual survey is conducted each year by the Highway Planning Unit on a nationwide scale, thus making it possible to grasp the traffic volume by car types at the cross section of each trunk road. However, as far as the distribution of traffic is concerned, no nationwide survey was ever made, but only some partial surveys were undertaken in some feasibility studies of toll expressway construction projects.

Therefore, under this study the distributed volume of traffic between zones has been estimated by selecting data (covering 8 check points), monitored at each point near to the boundary of each zone in this analysis, out of all the past O-D data available at the Highway Planning Unit. Some adjustment on the above estimate was made by using data of other feasibility studies.

The monitoring years under those O-D data are spread from 1977 to 1981. The data in the past years was corrected into the traffic volume for the base year by multiplying with the increase rate of traffic volume at the corresponding traffic count stations on the road.

(3) Long-distance bus

With regard to the long-distance bus service, each bus service company is obligated to submit to the Road Transport Department in April each year a report containing total monthly number of passengers by routes. Under this study this data has been used for the estimation of annual number of long-distance bus passengers between each zone.

(4) Airline

Regarding air traffic, analysis has been made by use of the data containing the number of trips between airports as of 1981 which is reported by the Malaysian Airlines System to the Civil Aviation Department.

5-2-2 Method of forecasting

(1) Modes and zoning

Traffic modes for this study consist of four (4) categories such as railway, car and taxi, long-distance bus and airplane, same as the modes at present. The area related to traffic forecast is grouped into nine (9) zones in Malaysia, and Singapore and Thailand are added, thus totalling to eleven (11) zones.

(2) Sequential steps of forecast for passenger demand between each zone

The sequential step taken for forecast of the inter-zone passenger demand is as shown in Fig. 5-2-1. The traffic volume of generation and attraction, of inter-zone distribution and of share by each transport mode has been estimated step by step, by use of the predicted socio-economic indices.

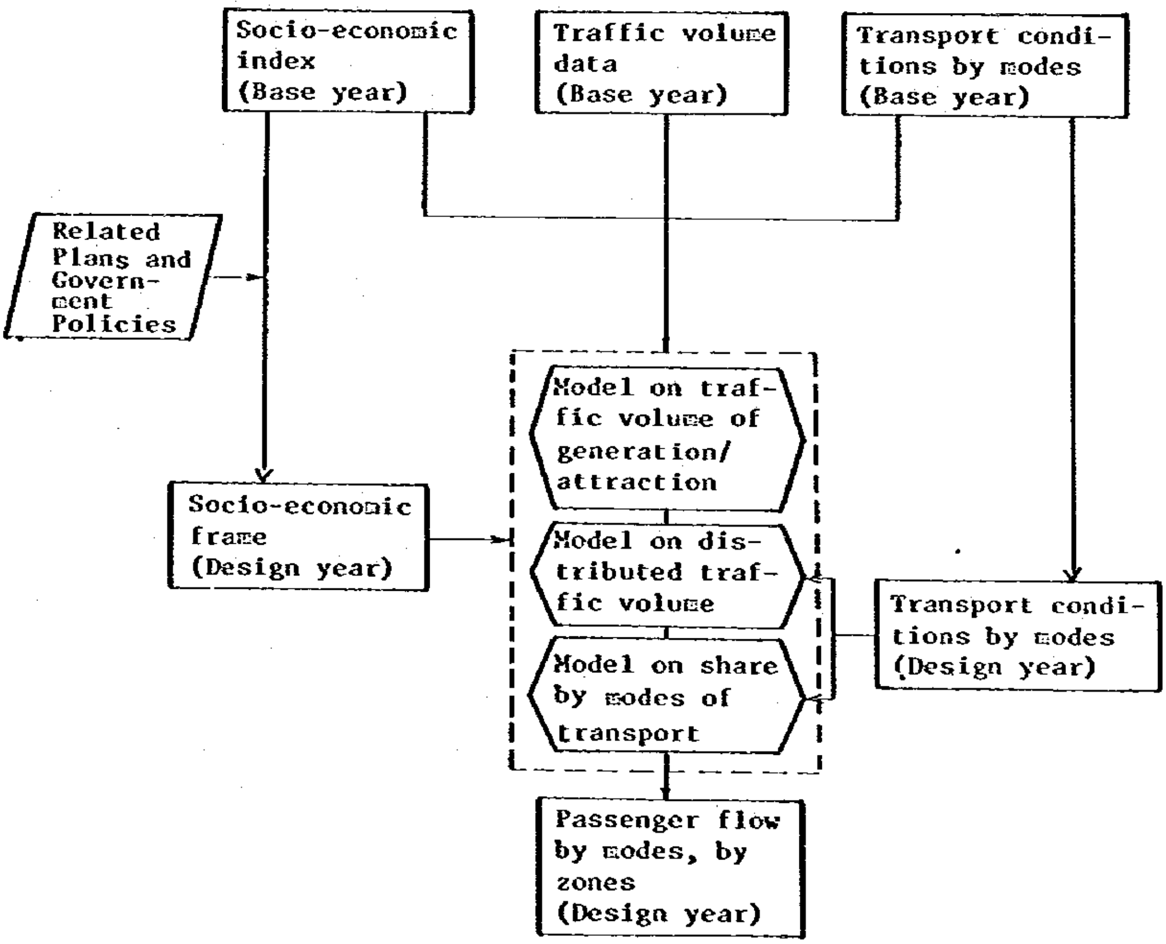


Fig. 5-2-1 Passenger Traffic Demand Forecast System

1) Traffic volume of generation and attraction

Firstly, the explanatory formula of generation and attraction of traffic by zones has been estimated as follows by use of the multiple regression model. The explanatory variables are such factors as GDP, population and size of area of each zone in the base year (1981):

$$Ti = \alpha + \sum_k \beta_k Xik \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where, Ti : Traffic volume of generation and attraction of i zone

Xik : Value of explanatory variable, X_k at zone i

α, β_k: Parameter

Secondly, traffic volumes of generation and attraction of the design years have been estimated by applying the predicted value, for each explanatory variable in each design year, to the above model. Those values for explanatory variables were forecasted by the socio-economic analysis mentioned in the previous chapter.

2) Distributed traffic volume

The gravity model has been formulated as follows by analyzing present pattern of traffic distribution. Then, the distributed volume of traffic between zones in the future was estimated by applying the predicted value for each explanatory variable of Gi, Aj, dij in the design year to the said model.

$$Tij = \alpha(Gi\ Aj)^{\beta} dij^{\gamma} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

Where, Tij : Passenger traffic volume between i and j

Gi : GDP at i zone (generation zone)

Aj : GDP at i zone (atraction zone)

dij : Road distance between i and j zones

α, β, γ : Parameter

The distributed traffic volume, estimated in the above step, was further converged to the volume of generation and attraction calculated in the foregoing 1).

3) Share of each transport mode

For calculation of the modal split of traffic the following assumptions, related to the transportation condition of each transport mode, have been added to those already stated in the basic framework of demand forecast in the foregoing 5-1.

(i) Railway

① 10 minutes is given for access or egress to the station on the West Coast Line and 20 minutes on the New East-West Line. Time to be required for change of trains is estimated at 20 minutes.

② With regard to the fare rate system, the existing "Express Rakyat" 2nd-class rate is applied to both super express and express trains and the 3rd-class rate applies to local trains.

(ii) Car and taxi

① Perceived costs include costs for fuel and engine oil but not including such costs as depreciation, maintenance, repair and tire wear.

② The toll charge for the expressway is determined in accordance with the existing toll rate applied for the section of Kuala Lumpur and Seremban.

③ Running speed including rest time has been set at 80 km/h for the expressway section and 60 km/h for the rest.

(iii) Long-distance bus

① Running speed including rest time has been set at 60 km/h for the expressway section and at the present speed for the rest.

② The fare rate is based upon the existing rate system.

(iv) Airline

① Travelling time includes access time to and from airport, check-in time at airport, flight time and required time for formalities after landing.

② The fare rate is based upon the existing rate system.

Generalized cost (sum of fare plus time cost) of traffic between zones by modes has been calculated under the assumed conditions as aforestated. The share for each mode has thus been calculated by the following formula:

$$S_A = \frac{1}{1 + (\frac{C_A}{C_B})^{\alpha}}$$

Where, S_A : Share for A-mode

C_A : Generalized cost for A-mode

C_B : Generalized cost for B-mode

α : Parameter

(3) Passenger traffic demand forecast within zone

With regard to the data for forecast of passenger traffic within a zone, cross section railway traffic between stations provided by MRA and cross section road traffic offered by Highway Planning Unit were used because O-D data of passenger traffic were incomplete.

Actual estimate was made in the following way.

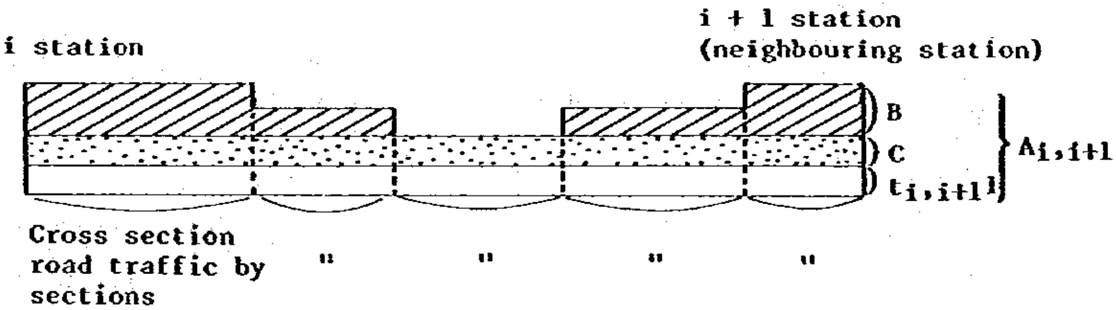
$$t_{i,i+1} = A_{i,i+1} - B - C$$

Where, $t_{i,i+1}$: Passenger demand for local trains at cross section between two neighbouring stations

$A_{i,i+1}$: Total traffic volume at cross section between two neighbouring stations

B : Passengers of short-distance trip not for local trains at cross section between two neighbouring stations

C : Inter-zone traffic volume at cross section between two neighbouring stations



Number of railway passengers, $t_{i,i+1}$, have been estimated according to the foregoing procedure of calculating the share of each transport mode.

(4) Points to be noted as for forecast

As the determinative factors for railway passenger traffic demand, there are some other factors influential to demand, in addition to fare rate and required time for travelling by each mode which are referred in the foregoing item 2). Those factors are as follows.

1) Frequency of train operation service

2) Punctuality of train operation

3) Whether or not effective service system for railway passengers can be established.

   Conceivable measures are as follows.

   a) Establishment of effective feeder transport service at each railway station.

   b) Planning and sales of new merchandize like package tours.

   c) Establishment of the system for sales of ticket outside the station.

4) Whether or not there are any restrictive measures enforced against utilization of private cars (i.e. restriction on access or car parking in specified areas, or toll rate increase for expressway).

This demand forecast has been inevitably executed under such condition that it should be based on only available data in Malaysia. Since all those aforecited influential factors must be considered in connection with the MRA's future management strategy of railway and, furthermore, the governmental traffic policy, they are not incorporated expressly into the process of forecast under this study. In other words, it is expected that the railway traffic would naturally be improved to such an extent that it can be well competitive to any other traffic modes as far as item 1) through 3) are concerned.

In brief, as it were, those prerequisite conditions as specified in the foregoing 5-1 and 5-2 may be replaced by expression in such a different way that all the passengers can choose their means of transport freely from whatsoever it may be such as trains, private cars, bus service and airline and their choice depends solely upon the factors of both fare rate and required travelling time.

Besides that, in order to forecast passenger demand in precise details within the zone, it would become necessary to collect the socio-economic data as well as the traffic information dealing with a small zone fractionalized even to the influential sphere of each railway station. Since there were not, in fact, any available data to meet this requirement, forecast had inevitably to be made in such a way as mentioned in the foregoing (3).

Hence, it can be said that any data of further detail must be collected so as to enable more probable forecast on passenger traffic demand within the zone as well as between the zones.

5-2-3 Result of forecast

The railway passenger traffic demand estimated by the aforestated method between zones for each case in the design year is as shown in Table 5-2-1. It is estimated that the share by railway taking only 8.3% at present (on a passenger basis) will increase up to 17.4% in Case A-A or B-B. This shows the fact that the railway traffic has increased its competitive power to the other modes to a great extent by introduction of high-speed trains running at scheduled speed of 130 km/h.

In case of D-C, however, there is no remarkable increase in the share of railway traffic as compared with the present share. This may mean that the scheduled speed of 100 km/h for railway is not competitive enough to the increased speed of road traffic vehicles when the expressway is completed.

The upward tendency of the railway share for the period of 1990 to 2005 reflects upturn of the time value with uprising of general income level.

Fig. 5-2-2 shows the railway traffic volume at cross section between main stations for each alternative case in comparison with the traffic volume of total modes. In each alternative case, the share of railway traffic against the total traffic volume is much higher on the New East-West Line than on the West Coast Line.

This evidently reflects the situation, as described in details in Chapter 4, that expressway now under construction along the West Coast Line is scheduled to open to the traffic by 1990 while no such expressway construction project is planned alongside the New East-West Line.

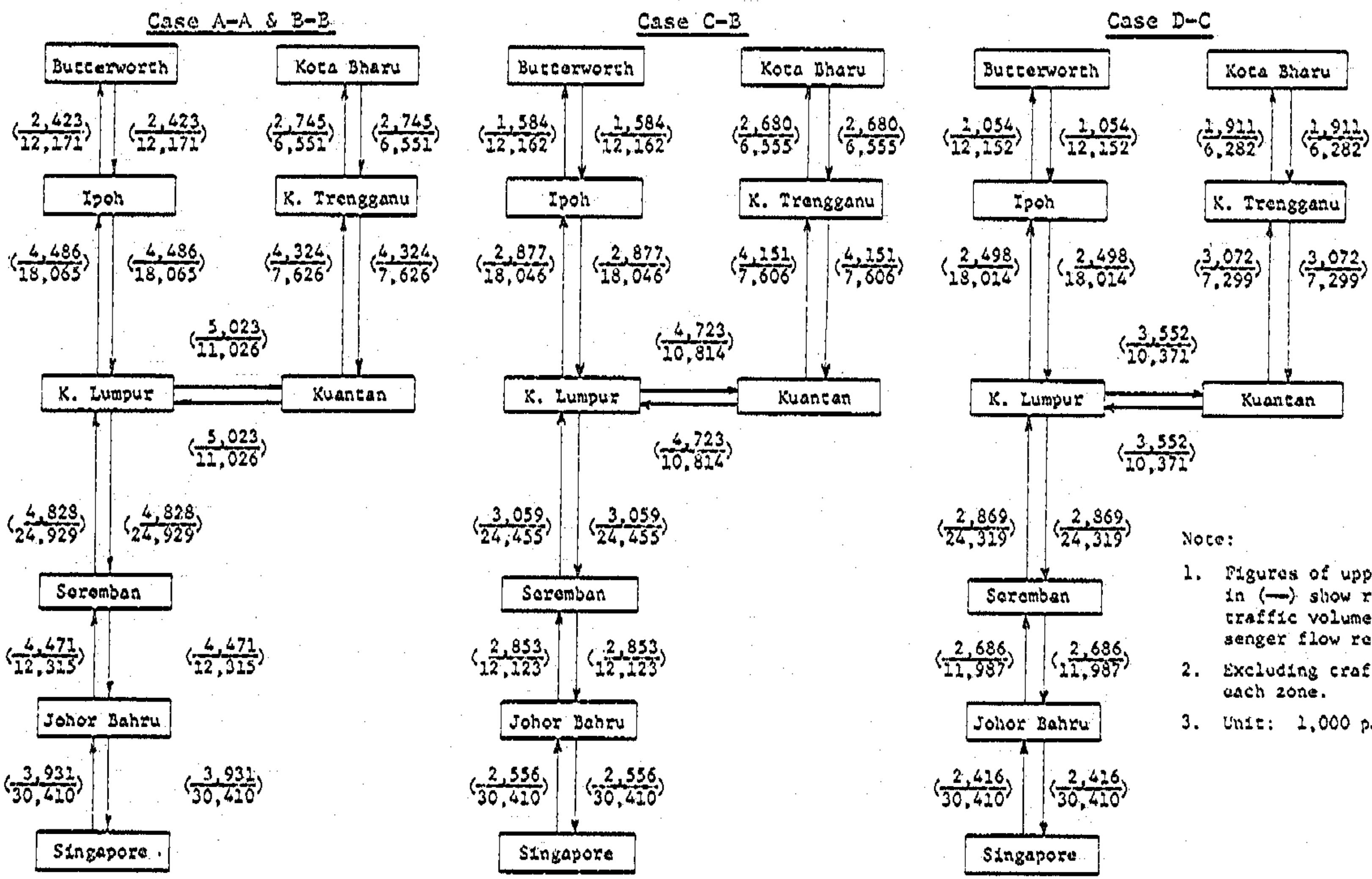
The expressway to be newly constructed all the way along the West Coast Line will bring about the benefits of not only increased running speed of private cars and buses on the road but also largely reduced road distance as compared with the distance of the existing road or the railway to be newly constructed. For instance, with regard to Kuala Lumpur - Butterworth, as shown in Table 5-2-2, whilest the distance of the existing road, the existing railway and the new railway (Case A-A and B-B) are 389 km, 379 km and 342 km respectively, the distance of the expressway under construction will be shortened to 314 km, which is beneficial to the road traffic mode.

Table 5-2-1 Passenger Traffic Demand (Inter-zone traffic)

Unit: 1,000 persons, (%)

Year·Case \ Traffic means		Railway	Private car Taxi	Long-distance Bus	Airline	Total
1981 (share)		4,618 (8.3)	32,232 (57.8)	16,460 (29.5)	2,464 (4.4)	55,773 (100)
1990	A-A (share)	9,169 (9.6)	66,008 (69.4)	17,919 (18.8)	1,985 (2.1)	95,081 (100)
	B-B (share)	9,169 (9.6)	66,008 (69.4)	17,919 (18.8)	1,985 (2.1)	95,081 (100)
	C-B (share)	7,728 (8.1)	67,089 (70.6)	18,208 (19.1)	2,056 (2.2)	95,081 (100)
	D-C (share)	6,427 (6.8)	68,047 (71.5)	18,507 (19.5)	2,100 (2.2)	95,081 (100)
2005	A-A (share)	31,794 (17.3)	115,828 (63.1)	30,045 (16.4)	5,825 (3.2)	183,492 (100)
	B-B (share)	31,794 (17.3)	115,828 (63.1)	30,045 (16.4)	5,825 (3.2)	183,492 (100)
	C-B (share)	25,156 (13.7)	120,605 (65.7)	31,368 (17.1)	6,362 (3.5)	183,492 (100)
	D-C (share)	20,690 (11.3)	123,750 (67.5)	32,356 (17.6)	6,696 (3.6)	183,492 (100)

Note:
1. Excluding the traffic volume between Thailand and Malaysia.
2. Including the traffic volume between Thailand and Singapore.
3. Including the traffic volume on short-cut routes (Butterworth - Kota Bharu, Kuala Lumpur - Kuala Lipis - Kota Bharu and Segamat - Kuantan), in respect of the road traffic mode, as compared with the railway routes.



Note:

1. Figures of upper and lower row in (—) show railway passenger traffic volume and total passenger flow respectively.
2. Excluding traffic volume within each zone.
3. Unit: 1,000 passengers/year

Fig. 5-2-2 Passenger Traffic Demand at Cross Section between Main Stations (2005)

Table 5-2-2 Distance and Required Time for Travelling between Major Cities

Section		K.L. - Butterworth	K.L. - Singapore	K.L. - Kuantan	K.L. - K.Trengganu	K.L. - Kota Bharu
Road distance (km)		314	348	253	473	429
Railway distance (km)	A-A B-B	342	376	222	402	544
	C-B	343	383	222	402	544
	D-C	379	383	222	402	544
At present		389	394	-	-	685
Required time by private car (min)		236 (4 h)	268 (4 h 28 m)	236 (4 h)	456 (7 h 30 m)	414 (7 h)
Required time by bus (min)		314 (5 h 14 m)	354 (6 h)	290 (5 h)	554 (9 h 14 m)	503 (8h 23 m)
Required time by railway (min)	A-A B-B	178 (3 h)	194 (3 h 14 m)	132 (2 h 12 m)	216 (8 h 36 m)	281 (4 h 41 m)
	C-B	226 (3 h 46 m)	250 (4 h 10 m)	132 (2 h 12 m)	216 (3 h 36 m)	281 (4 h 41 m)
	D-C	247 (4 h)	250 (4 h 10 m)	153 (2 h 33 m)	271 (4 h 31 m)	356 (6 h)

Note: Road distance and required time by private car and bus are based upon assumption that the expressway would be utilized for trips.

However, the East-West Expressway is assumed as being not yet constructed.

On the contrary, since there is no construction plan of the expressway alongside the New East-West Line, the railway distance is shorter than the existing road distance by 31 km between Kuala Lumpur and Kuantan and by 71 km up to Kuala Trengganu.

As far as the distance between Kuala Lumpur and Kota Bharu is concerned, road is shorter than the railway distance, because it takes the route via Kuala Lipis and Gua Musang which is the shortest cut.

Required time for each traffic mode is influenced by the fact of whether there exists any expressway or not. Since there is no large difference in respect of required time for travelling between railway and road traffic modes, only a difference in travelling cost makes the road traffic more beneficial to passengers than the railway traffic as far as the West Coast Line is concerned. In contrast with that, as far as the New East-West Line goes, the competitive conditions are benefitial overwhelmingly to the railway traffic mode apparently because of difference in required time for travelling between railway and road traffic modes as well as that in travelling cost.

The result of this comparative study is, as shown in Fig. 5-2-2, that the railway traffic would take a larger share on and along the New East-West Line, notwithstanding the fact that the total flow of passengers as mentioned at the cross section between major stations is larger along the West Coast Line than along the New East-West Line.

On the other hand, the intra-zonal passenger traffic demand on both West Coast and the New East-West Lines in each alternative Case is as shown in Table 5-2-3 and Table 5-2-4 respectively.

Table 5-2-3 Number of Passengers for Local Trains on West Coast Line (Single way)

(Unit: 1,000 passengers/year)

Case / Year / Station	A-A		B-B, C-B, D-C	
	1990	2005	1990	2005
Butterworth				
	281	604	211	453
Bukit Mertajam				
	281	604	211	453
Taiping				
	250	536	187	402
Kuala Kangsar				
	507	1,088	380	816
Ipoh				
	660	1,416	495	1,062
Kampar				
	273	585	205	439
Tapah				
	133	285	102	219
Rawang				
	404	867	303	650
Kuala Lumpur				
	1,115	2,392	836	1,794
Seremban				
	203	435	152	326
Tampin				
	112	240	84	180
Gemas				
	112	240	84	180
Segamat				
	140	300	105	225
Kluang				
	561	1,203	420	902
Johor Bahru				
	1,024	2,197	738	1,583
Singapore				

Table 5-2-4 Number of Passengers for Local Trains on the New East-West Line (Single way)

(Unit: 1,000 passenger/year)

Station \ Case / Year	A-A, B-B, C-B		D-C	
	1990	2005	1990	2005
Kuala Lumpur				
Karak	305	654	228	490
Temerloh	223	479	167	359
Maran	172	370	129	277
Kuantan	79	169	59	127
Chukai	197	422	147	316
Kerteh	111	239	84	180
Dungun	156	334	117	251
Kuala Trengganu	138	295	103	222
Jerteh	126	270	94	202
Pasir Puteh	444	952	333	714
Kota Bharu	587	1,260	440	945

5-2-4 Sensitivity analysis

The foregoing result of forecast has been achieved from various assumed conditions in regard to the socio-economic frame and the method of demand forecast.

In fact, however, because forecast is made over such a long range as ahead up to the year 2005, there would inevitably be uncertainty as to whether the premises can be realized as originally assumed. In particular, the result of forecast may be influenced largely if the following conditions are not satisfied as assumed, in addition to the influential factors as referred to in the foregoing 5-2-2 (4).

1) Is it possible that the nation's economy in Malaysia would continue its growth at the rate as presumed by the 4th Malaysia Plan under the prevailing worldwide recession of economy?

2) Isn't there any possibility that the assumed traffic conditions, including new construction of the expressway between Kuala Lumpur - Kuantan might be changed?

The result as shown in Table 5-2-5 is what has been attained from the sensitivity analysis on Case A-A in respect of the items as given in the foregoing 5-1-6, in order to see how much influence will be exerted as the result of changes in these assumed conditions.

Table 5-2-5 Result of Sensitivity Analysis (Case A-A)

Unit: 1,000 persons, (%)

		Basic case	Sensitivity analysis
① Changes in economic growth rate	Assumption	Average growth of 6.5% annually in and after 1991	Average growth of 5.0% annually in and after 1991
	Total passenger traffic demand in 2005	183,492 (100.0)	154,168 (84.0)
② With or without expressway	Assumption	No expressway between Kuala Lumpur and Kuantan	
	Railway traffic passenger demand in 2005	Total demand 31,794 (100.0) {West Coast Line 19,504 (100.0) New East-West Line 14,944 (100.0)}	Total demand 30,036 (94.5) West Coast Line 19,322 (99.1) New East-West Line 13,186 (88.2)
③ Fare rate revision	Assumption	No revision to the relative rate of fare for existing each mode	20% increase in railway fare as compared with other modes
	Railway total demand in 2005	Total demand 31,794 (100.0)	Total demand 28,218 (85.0)

5-3 Freight Traffic Demand Forecast

5-3-1 Problems related to forecast of freight traffic demand

(1) Statistical problems on the present traffic situation

In the general grasp of the present traffic volume (in 1980) as the starting point for demand forecast, there was not any complete statistical data available concerning the freight transport of other modes than the railway such as trucks and coastal ships by items of goods within and between the states. In the above circumstance, there have been no other ways than the methods of estimation taken as follows:

1) Generated volume

With regard to some other 'manufactured products' than petroleum, cement, fertilizer and steel, their production volumes were not measured in weight, but measured in dozens, pieces and m^2 etc. Therefore, the weight of such items were estimated in consideration of their unit volume.

2) Attracted volume

Because of lack of statistics showing quantities of delivery and consumption by items of goods in each state, the total quantities of attracted goods have been allotted into each state according to the weight of share by populations (applicable to agricultural products) and GDP of each state (applicable to any other products than agricultural products).

3) Modal split

As a general practice for modal split, both time and cost, which are quite influencial to the customer's selection of transport means, are used as explanatory parameters. As a result of study, however, it is found quite difficult to select representative freights for each mode and distance regarding road traffic as the tariff of lorries is featured by its own strong individuality. Therefore, only required time has been used as the explanatory factor.

(2) Socio-economic framework

Because of tight time limit, the process of forecast on the socio-economic frame under this study has been simplified to a considerable extent.

1) Data

Forecast has been based on the existing data authorized by the Malaysian Government. Many of those data had been prepared before the world economy took its downturn into the long-continued depression as is seen today. Therefore, the data apparently look rather optimistic when compared with the severe environment at the present. Furthermore, most of the data available now cover only up to and including 1990. Nearly none of the basic data for reference beyond 1991 is available. For this reason, the process of forecast for the period of 1991 to 2005 has been based upon a pretty bold and rough approach.

2) Number of socio-economic framework

Basically, only one socio-economic framework applied.

5-3-2 Data used for forecast

(1) Production volume of Malaysia in 1980 have been obtained from the statistical data published by the governmental agencies as follows:

a) Farm product (Rice)	Statistics Department
b) Log and timber	Forestry Department
c) Rubber	Ministry of Primary Commodities
d) Palm oil	Statistics Department
e) Tin, iron ore and bauxite, etc.	Mines Department
f) Petroleum	Research Department, PETRONAS
g) Cement h) Fertiliser i) Other products	Statistics Department

(2) Data related to railway freight traffic in 1980 has been provided by the MRA.

(3) Volume of freight by coastal ships in 1980 has been estimated on the basis of the export/import data available from port authorities.

5-3-3 Process of forecasting

The process of forecasting freight traffic demand in Penisular Malaysia includes the following approaches:

i) To define classification of commodity items

ii) To select competitive freight traffic modes for forecast

iii) To grasp O-D traffic volume by items and by modes at present

iv) To estimate total freight traffic volume in 1990 and 2005

v) To calculate inter-zonal traffic demand by items and by traffic modes on a basis of total freight traffic volume

Fig. 5-3-1 shows the flow of forecast on freight traffic demand.
Further details to explain each of the foregoing items are given hereunder.

(1) Classification of items

Although goods of many varieties are being produced in Malaysia, all the products are classified into the following nine (9) items for forecast of freight traffic demand.

Table 5-3-1 Freight Classification for Demand Forecast

Classification	Major items
1. Farm products	Rice and wheat
2. Forestry products	Log and timber
3. Rubber	Rubber
4. Palm oil	Palm oil
5. Mineral products	Tin, iron ore and bauxite
6. Petroleum	Petroleum products, crude oil
7. Cement	Cement
8. Chemical products	Fertilizer, ethylene and propylene
9. Other products	Steel and others

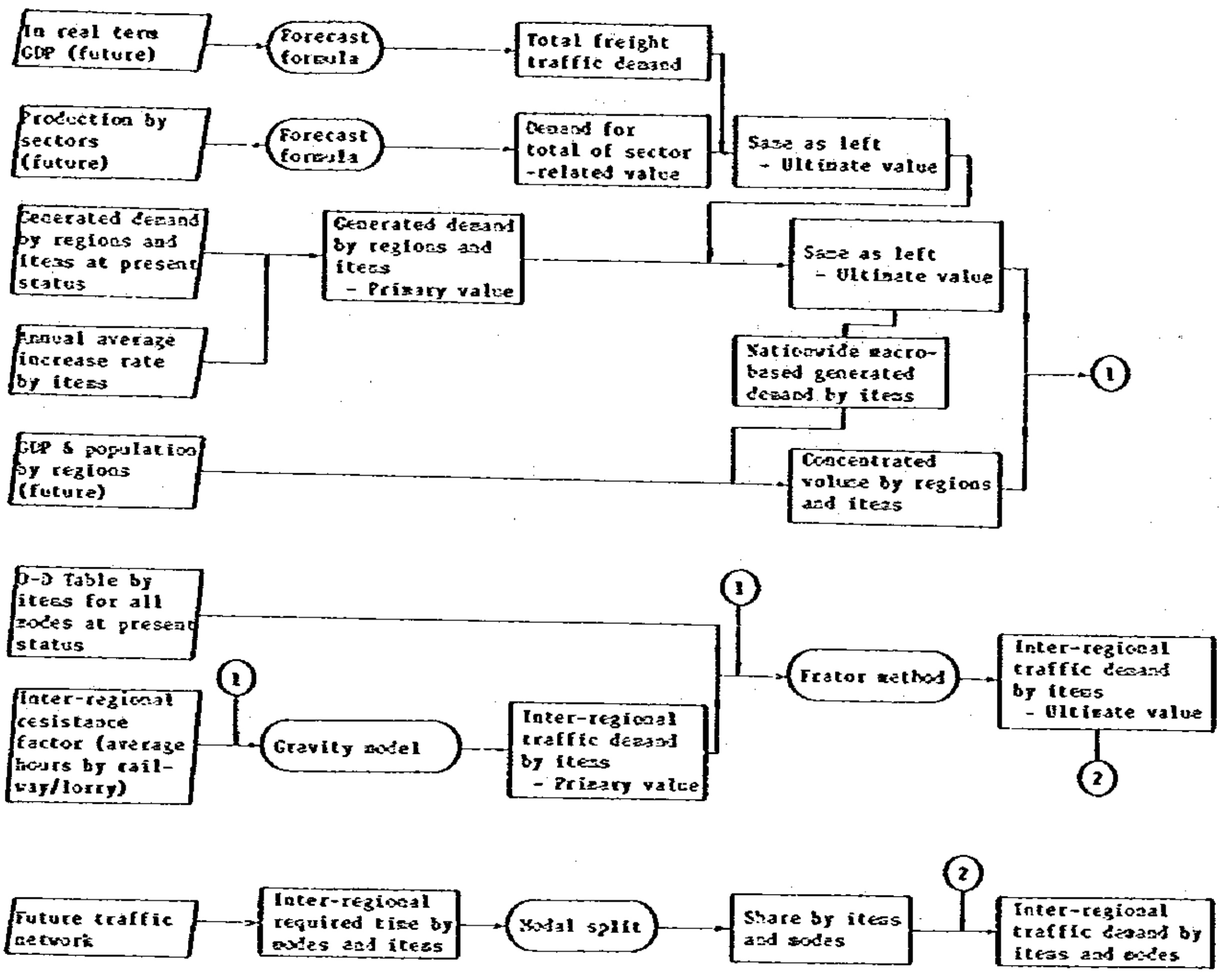


Fig. 5-3-1 Freight Traffic Demand Forecast System

(2) Competitive traffic modes

Three traffic modes of railway, lorry and coastal ship have been selected for demand forecast.

(3) O-D freight traffic volume by items and by modes at present (1980)

For estimation of the present freight traffic volume it has been assumed that total supplies (production plus import) for each item of products would be all distributed into markets for sales. Although there are some gaps between produced volume and distributed volume due to, for example, self consumption by producers, they have been regarded as being negligibly small from the macroscopic view. In other words, present traffic demand for each zone has been estimated on assumption that total generation (production plus importation) on a nationwide macroscopic basis would equal to total attraction (consumption plus exportation). Since the existing statistical traffic data except for railway is not complete with accuracy, the O-D schedule of coastal ships and lorries has been estimated as stated hereunder.

1) Generated freight volume in 1980
(Generated due to production and importation)

Total generated volume covering a range from Item 1 as classified for farm products to Item 8 for chemical products has been fully made known by states from data provided by E.P.U. and other related government agencies as stated in the foregoing section 5-3-1. However, since with regard to Item 9 for 'other products' data by each state were not available the allotment of volume by zones has been estimated according to the GDP weight by states.

2) Import volume (by ports) by items and by zones in 1980

Total export and import data from main four (4) ports of Kelang, Penang, Johor and Kuantan have been categorized by items of goods, by coastal or ocean services and by export or import. Then, total import of items carried by ocean shipping services has been allotted into the zones in which such ports are located.

Note: Export or import to and from the States of Saba and Sarawak have been regarded as the category of export and import by ocean shipping service, since forecast under this study is limited solely to the Peninsular Malaysia.

In addition to the above, since port Dickson accepts concentrated entry of imported oil and crude oil being produced at offshore of Trengganu for refinery, total volume of such oil import has been added to the States of Negri Sembilan and Malacca.

3) Attracted freight volume in 1980
(attracted due to domestic demand and export)

To grasp the volume, the balance, after deduction of the export volume leaving each port by ocean shipment from the total generated volume, by items and by zones estimated in the foregoing item 2) has been allotted to each zone according to the weight of population (for farm products) or of GDP (for other items than farm products) of each zone. After that, export volume from the main port has been added to each of the zones where the said ports are situated.

4) Estimate of distribution pattern in 1980

It has been assumed that a pattern of distribution by items of goods could be determined by the following formula by use of the generated and the attracted volume as obtained from the process above and the inter-zone distance (which means a road distance herein):

$$Tij = Ti \cdot Tj / Dij^2$$

where, Tij: Volume of traffic flow from i zone to j zone

Ti: Generated volume in i zone

Tj: Attracted volume in j zone

Dij: Distance between i and j zones

Since the total sum as obtained from the formula above does not accord with the volumes of generation and attraction as sought before, those were converged to the volumes of generation and attraction.

5) Estimation of O-D Table for coastal ships and lorries in 1980

The statistical data on the present traffic is not completely arranged except for the railway traffic. Nevertheless, in order to make analysis of the share as mentioned later it is necessary by any means possible to estimate the O-D Table of items for coastal ships and lorries.

a) In estimating the O-D of the coastal shipping service, the volume outgoing from the port has been regarded as the generated volume and that incoming into the port has been regarded as the attracted volume. Flow of goods, however, has been allotted by share of weight in the generated and attracted volumes from and to each port, because no data were available as for the volume of traffic flow between ports.

b) In estimating the O-D of the lorry traffic, it has been attained after subtraction of the O-D Table for each of railway and coastal shipping from the O-D Table for the total traffic system.

6) Generated freight volume and economic frame

The relationship between the generated volume of freight traffic and the economic frame (GDP and value added for each sector) in 1980 has been sought by regression analysis. Then, the model, which was formulated in the above analysis, has been applied to forecasting of the future traffic volume. The parameter thus obtained has been assumed to remain unvaried ahead in the future. The calculation formula is based upon the single regression equation as shown hereunder.

$$\log T = \log \alpha + \beta \log X \qquad \text{(Formula -1)}$$

$$T = \alpha + \beta X \qquad \text{(Formula -2)}$$

Where, T: Generated volume

X: Value added

α,β: Parameter

Formula -1 has been used respectively to seek the relationship between total freight volume and GDP, freight traffic volume and value added of agricultural, forestry and fishing sector, and freight traffic volume and value added of manufacturing sector.

Formula -2 has been applied to the relationship between freight traffic volume and value added of mining sector.

(4) Estimation of total freight traffic volume in 1990 and 2005

The following methods have been used for estimation of the total freight traffic volume on assumption that the GDP would grow at a rate of 7.9% per year for a decade from 1981 as the base year up to 1990 and 6.5% per year for a period of 1991 to 2005.

1) The primary total of generated volume for each item and each zone in 1990 has been sought by application of the increase rate set up for each item as follows to the volume in 1980.

   Average annual increase rate for each item for the period of 1981 to 1990:

a)	Farm products	3.0%
b)	Forestry products	-5.5% for log, 4.4% for timber
c)	Rubber	0.7%
d)	Palm oil	8.5%
e)	Mineral products	0.8% for tin -6.2% for iron ore and bauxite
f)	Petroleum	8.1%
g)	Cement	5.2%
h)	Chemical fertiliser	4.7%
i)	Other products	17.9% for steel, 11.1% for others

2) For estimation of the generated volume by items and by zones after 1990 up to 2005, the average annual rate of increase has been set up as follows, on the assumed basis that the GDP would grow at an annual rate of 6.5% at average and in consideration of the characteristics of products by items in the past.

   a) Four (4) agricultural and forestry products

Farm products	2.0%
Forestry products	0.1% (reduced production of log as against increased production of timber)
Rubber	0.3%
Palm oil	8.0%

b) Mineral products

Minerals	-1.5% (no encouraging prospect for increased production of tin, bauxite and iron ore)

c) Four (4) manufacturing products (encouraging prospect for further growth)

Petroleum	8.0%
Cement	7.0%
Synthetic chemical products	4.0%
Other manufacturing products	9.0% (including iron and steel)

3) The generated traffic volume for each item and each zone has been converged to the volume which more estimated for 1990 and 2005 by the formula set up in the preceding 5-3-3 (3) 6).

(5) Distribution pattern of traffic volume

With regard to the distribution of traffic volume, it has been estimated on such assumption that the present pattern of distribution (1980) for categories of products other than cement and petroleum which may probably be subject to structural changes in the future, would remain unchanged toward the future as well as in the past. The process of calculation is named the Frator method of convergence by application of future generation and attraction of traffic demand as control total to the present distribution pattern as the initial value. The following gravity model has been applied to the estimation of volume for cement and petroleum on the other hand.

$$Tij = \alpha \frac{(Ti \cdot Tj)^{\beta}}{(Dij)^{\gamma}}$$

Where, Tij: Traffic volume between i and j
Ti: Traffic generation at j zone
Tj: Traffic attraction at j zone
Dij: Required time between i and j
α,β,γ: Parameter

(6) Modal split

Only a factor of required time for travelling has been used as the explanatory factor for forecast. Ideally, the cost factor should be also incorporated into the explanatory parameter. However, it has been regarded as being unsuitable as the calculating data for forecast, because the freight rate system is very complexed in diversity and subjective, particularly the lorry freightage has its own individuality to a remarkable extent. The logistic functional pattern as shown below has been assumed as the forecasting formula for estimation on a step-by-step basis:

$$S^{x}ij = 1/\{1+\exp(\alpha+\beta\cdot x)\}$$

Where, $S^{x}ij$: Share of X-mode between i and j

x: Relative ratio of required time for X-mode and other modes between i and j

α,β: Parameter

(Sequential steps of estimation)

	First step	Second step
Coastal shipping vs. Inland transport (railway plus lorry)		Railway vs. Lorry

In determining the parameter for the formula above, it is risky to use the data for each zone pair as the sample, because the present O - D data by transport modes were incomplete and were foreced to estimate in the way aforementioned. For this reason, cumulative total of the traffic demand for zones of same distance has been sought for each traffic mode, and parameter were seeked by applying the share and required time of each transport mode and distance to the formular shown below.

$$\log({}^{K}Sij^{L}/{}^{K}Sij^{R}) = \alpha + \beta\cdot({}^{K}T^{R}/{}^{K}T^{L})$$

Where, ${}^{K}Sij^{L}$: Share of Distance K in L-mode in 1980

${}^{K}Sij^{R}$: Share of Distance K in R-mode in 1980

${}^{K}T^{R}$: Average required time of Distance K in R-mode in 1980

${}^{K}T^{L}$: Average required time of Distance K in L-mode in 1980

5-3-4 Result of forecast

(1) General outline

The pattern of freight traffic, when compared between the traffic in 1980 and that in the future years of 1990 and 2005, appears to be altered especially in the inter-state traffic pattern, because some items will bring about different distribution patterns from those of present patterns due to the new construction of industrial plants and factories.

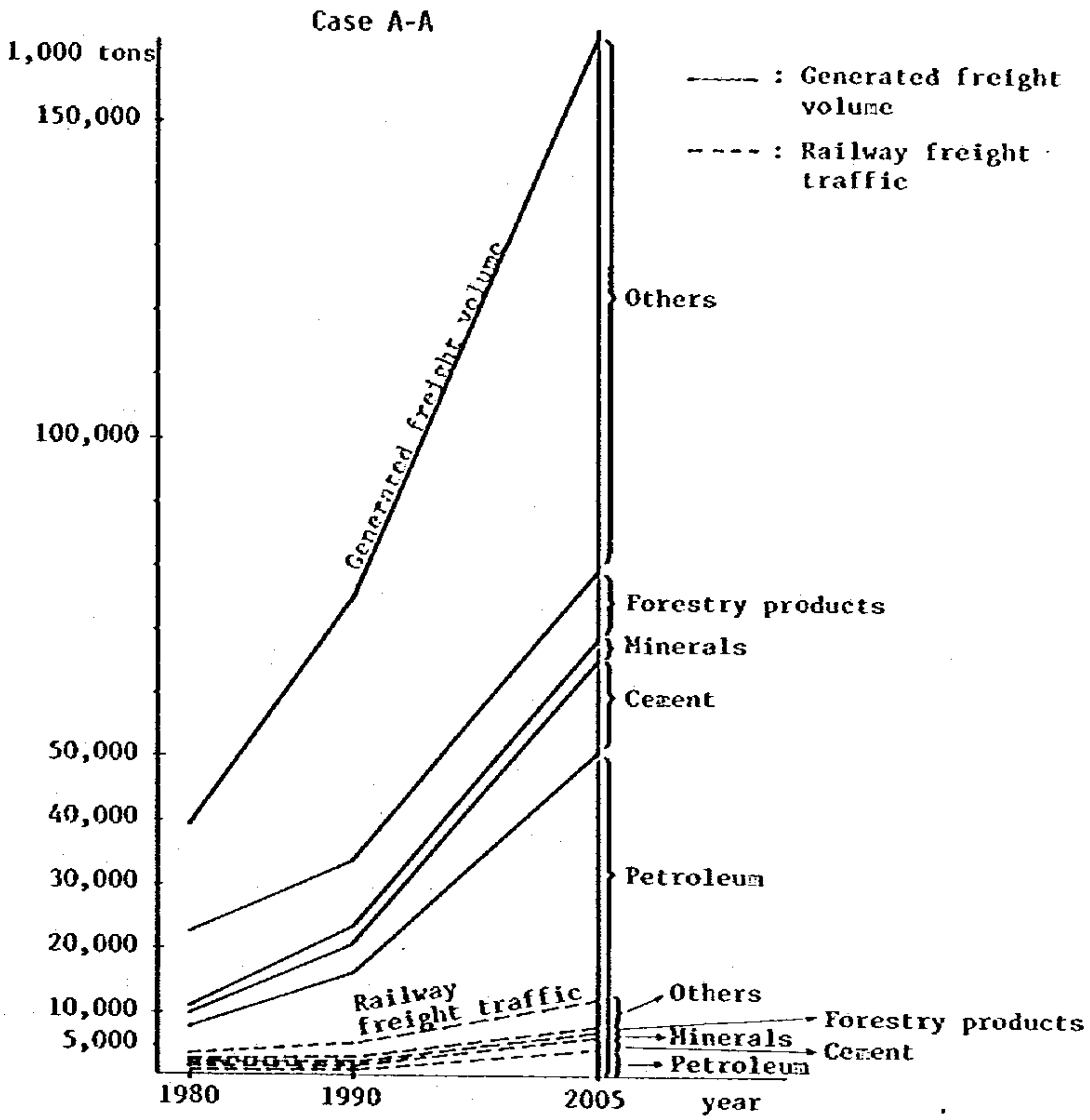
To further explain this, it can be said that distribution patterns of the primary industry, such as agricultural and forestry products, rubber, palm oil and minerals (except imported coal) may not change sustantially, while those of the secondary industry such as petroleum products, cement, synthetic chemicals and others (inclusive of imported coal), may be altered considerably. In particular, products of the manufacturing industry are expected to increase remarkably, from which it can be predicted that Malaysia is making big strides toward the similar industrial structure of the developed country.

Total generated traffic demand by items and railway traffic demand by Cases for each projected year are shown in Table 5-3-2 and Fig. 5-3-2.

Table 5-3-2 Generated Freight Traffic Demand Versus Railway Traffic Volume (by years and items)

Unit: 1,000 tons

	1980		1990	Railway traffic 1990				2005	Railway traffic 2005			
	Total generation	Railway traffic demand	Total generation	A-A	B-B	C-B	D-C	Total generation	A-A	B-B	C-B	D-C
1. Form products	1,542.1	55.7	1,935.9	213.1	202.3	223.5	225.2	2,319.9	212.6	197.9	218.5	220.3
2. Forestry products	11,196.9	470.0	10,245.1	436.3	295.6	304.5	394.8	10,449.2	454.9	341.5	353.5	409.4
3. Rubber	1,537.1	254.0	1,701.2	347.7	296.0	361.7	313.2	1,680.0	181.3	166.7	227.4	171.5
4. Palm oil	2,418.9	89.0	5,470.0	87.6	53.7	57.8	73.8	9,231.9	131.1	81.0	87.1	110.7
5. Minerals (not including steel)	1,423.4	285.7	2,437.8 coal imported	525.5	282.9	284.9	499.6	3,039.0 including imported coal	875.9	800.0	811.4	857.7
6. Petroleum	7,449.0	768.2	16,155.1	1,235.6	416.4	473.4	1,059.2	51,097.6	4,329.2	1,621.1	1,841.6	3,013.0
7. Cement	2,364.4	887.6	4,765.0	731.3	624.3	680.4	674.0	14,664.1	2,029.7	1,717.1	1,888.2	1,878.4
8. Fertilizer	1,451.3	106.7	2,621.2	208.9	181.4	205.1	203.0	4,823.9	479.4	360.8	406.0	411.5
9. Others	10,055.2	612.4	24,356.2	1,320.3	1,028.0	1,137.1	1,118.3	64,808.4	3,568.7	2,804.0	3,087.1	3,009.1
Total	39,438.3	3,529.3	74,465.1	5,106.3	3,380.6	3,728.4	4,561.1	162,114.0	12,262.8	8,090.1	8,920.8	10,081.6



Note: The traffic demand for railway, of case A-A, is assumed to account for 7.6% of the total traffic volume in 2005 in terms of ton.

However, the traffic demand for railway is expected to take the share of 14.8% as of 2005 in terms of ton·km. This happens due to the longer trip length of railway compared with road traffic.

Fig. 5-3-2 Generated Freight Traffic Demand Versus Railway Traffic Volume (by years and items)

(2) Traffic demand and share by each competitive traffic mode in 1990 and 2005 are as follows:

Table 5-3-3 Traffic Demand and Share by Traffic Modes and Cases

Unit: 1,000 tons (%)

Year · Case		Railway	Lorry	Coastal Shipping	Total
1980 (Share)		3,529.3 (10.9)	25,438.3 (78.2)	3,544.2 (10.9)	32,511.8 (100)
1990	A-A (Share)	5,106.3 (6.9)	62,674.6 (84.1)	6,684.2 (9.0)	74,465.1 (100)
	B-B (Share)	3,380.6 (4.6)	63,767.6 (85.6)	7,316.9 (9.8)	74,465.1 (100)
	C-B (Share)	3,728.4 (5.0)	64,340.2 (86.4)	6,396.5 (8.6)	74,465.1 (100)
	D-C (Share)	4,561.1 (6.1)	63,010.0 (84.6)	6,894.0 (9.3)	74,465.1 (100)
2005	A-A (Share)	12,262.8 (7.6)	129,816.0 (80.1)	20,035.2 (12.3)	162,114.0 (100)
	B-B (Share)	8,090.1 (5.0)	133,129.5 (82.1)	20,894.4 (12.9)	162,114.0 (100)
	C-B (Share)	8,920.8 (5.5)	133,749.7 (82.5)	19,443.5 (12.0)	162,114.0 (100)
	D-C (Share)	10,081.6 (6.2)	131,317.7 (81.0)	20,714.7 (12.8)	162,114.0 (100)

As noted from the foregoing Table, even after completion of the Project the share of railway traffic is almost same as the present. However, if the Case is without Project, the share of railway traffic would fall further down to the utterly negligible level because more freight volume would be absorbed into the traffic of lorry and coastal shipping.

(3) Traffic volume at cross section of railway freight traffic between main cities in 1990 and 2005

In the process of forecast eleven (11) states of the Peninsula have been merged into nine (9) zones and each State has been represented by the name of major freight station in the said State. The State and the name of its representative Station are as shown in the following Table:

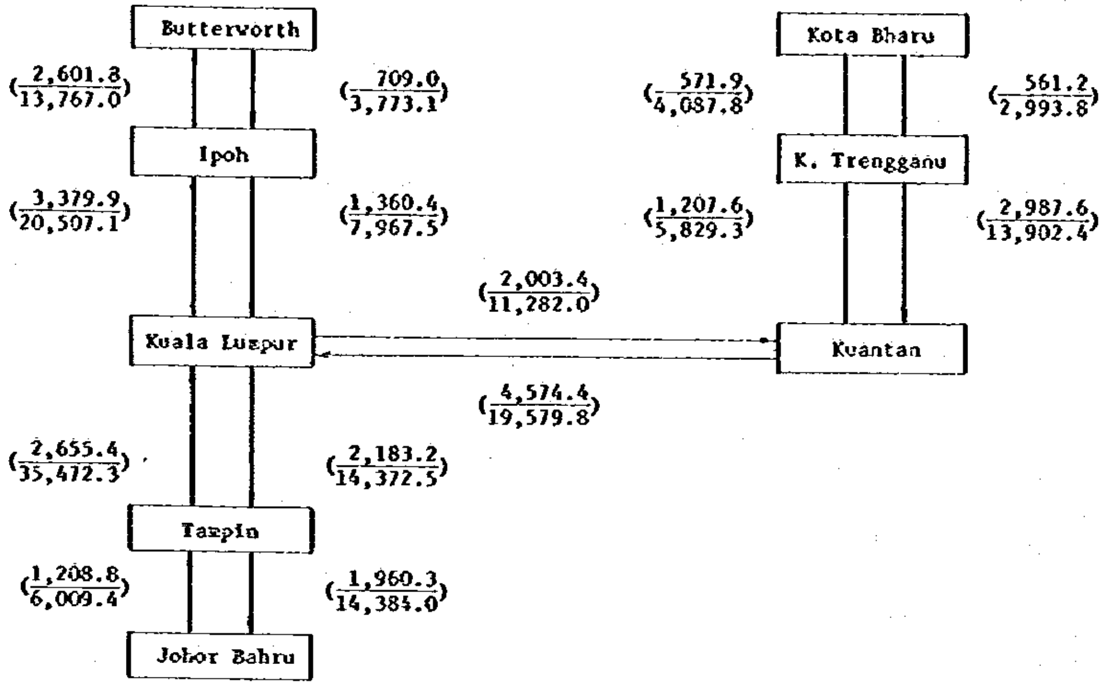
Table 5-3-4 Zone and Each Main Freight Station

Name of State	Major Freight Station	Remarks
1. Perlis, Kedah	Alor Star	
2. Penang	Butterworth	
3. Perak	Ipoh	
4. Selangor	Kuala Lumpur	
5. Negri Sembilan, Malacca	Tampin	
6. Johor	Johor Bahru	Including freight traffic arriving at and leaving Singapore
7. Kuantan	Kuantan	
8. Kelantan	Kota Bharu	
9. Trengganu	Kuala Trengganu	

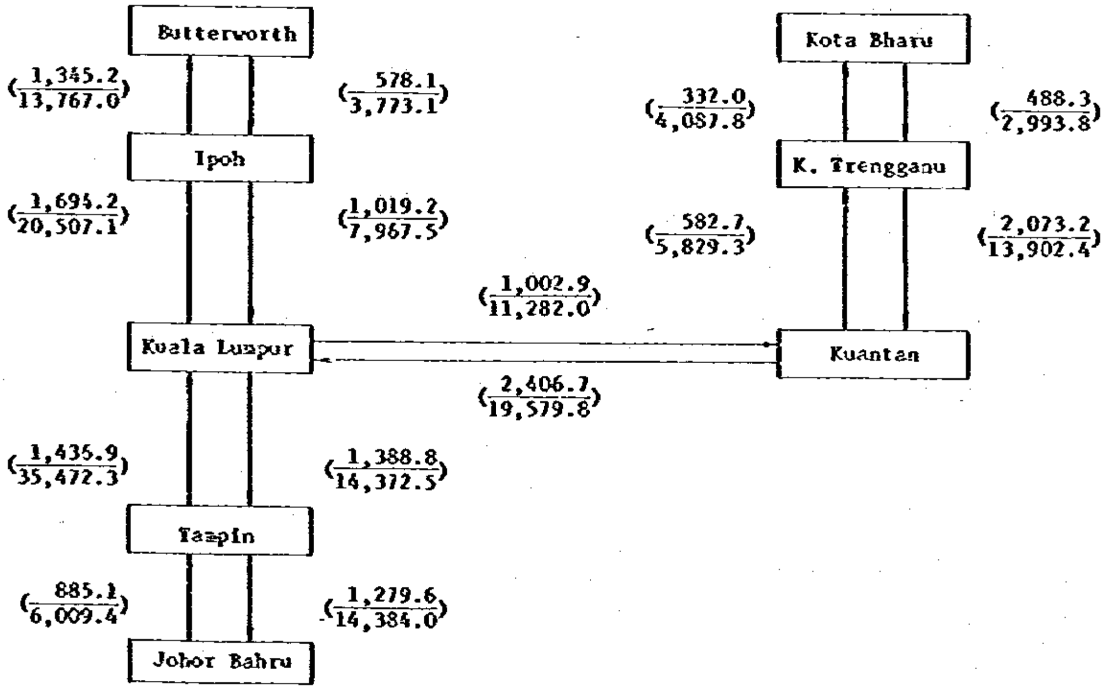
(4) Railway freight traffic at cross section between major cities (between main States)

Railway freight traffic volume in 2005 projected at cross section in each Case of A-A, B-B, C-B and D-C is as shown in Figs. 5-3-3 thru 5-3-6 respectively.

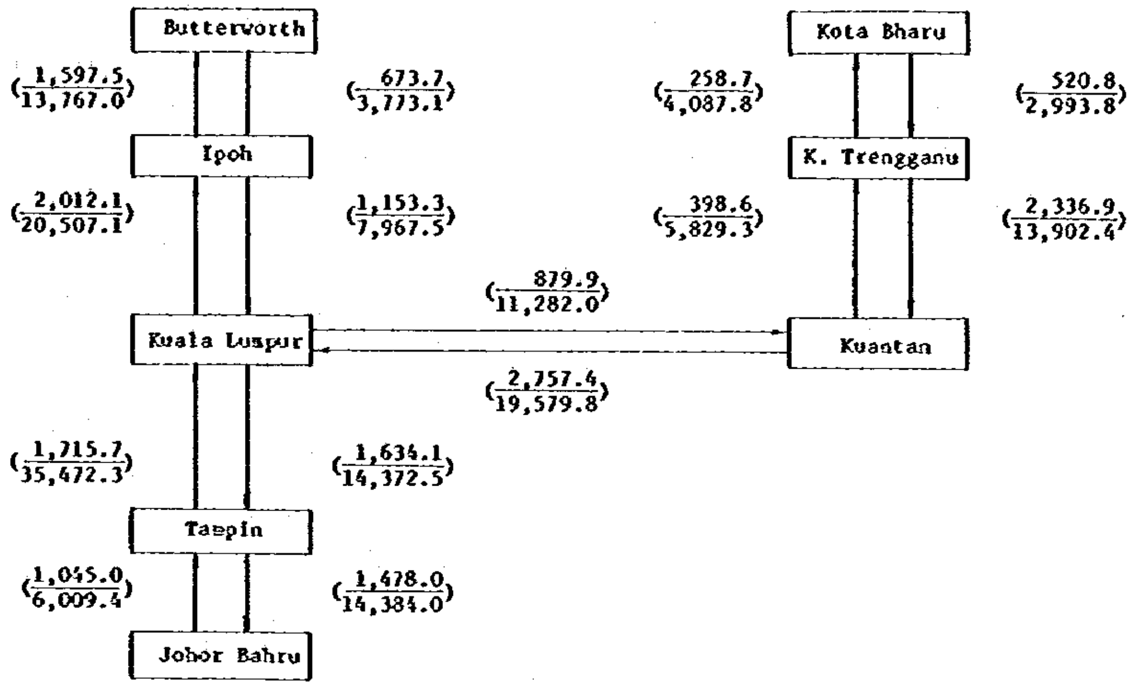
Case A-A



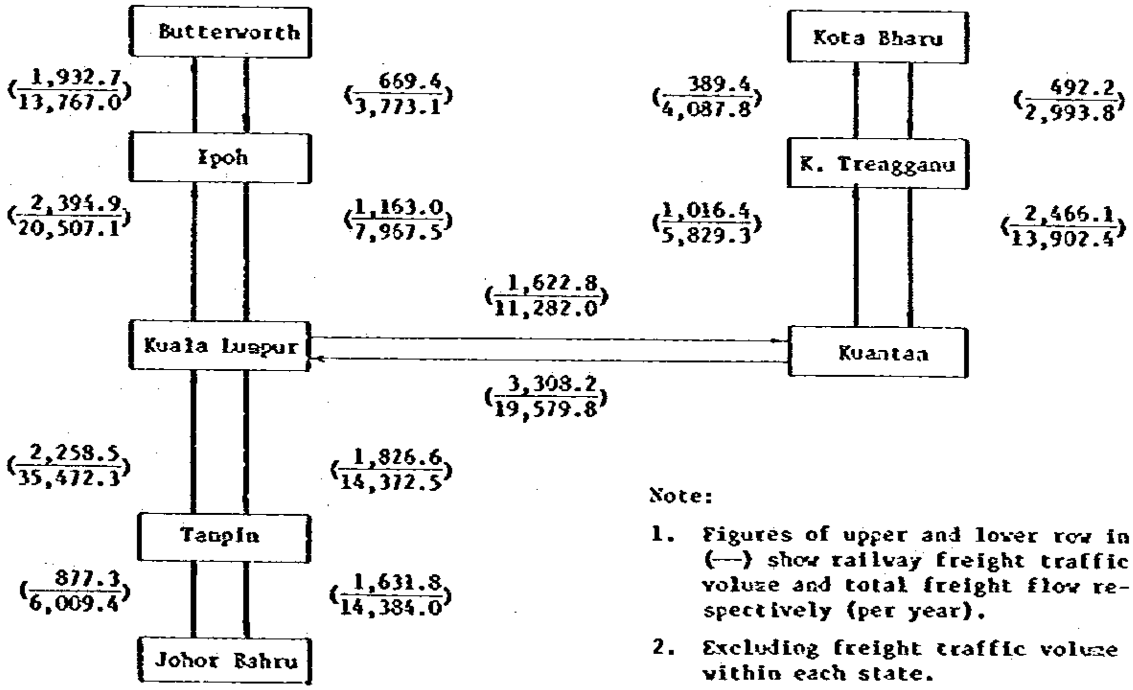
Case B-B



Case C-B



Case D-C



Note:

1. Figures of upper and lower row in (—) show railway freight traffic volume and total freight flow respectively (per year).
2. Excluding freight traffic volume within each state.
3. Unit: 1,000 tons/year

Fig. 5-3-3 Traffic Demand at Cross Section between Main Stations (2005)

5-3-5 Sensitivity analysis

(1) Since this process of forecast is extended over a long range up to 2005, there are many unknown factors as a matter of course. Therefore, in order to make review of critical factors it is necessary to adopt the process of sensitivity analysis, so that the degree of fluctuation in the traffic demand as may be influenced by variation of the factors affecting the demand largely can be measured for estimation. Under this study, sensitivity analysis has been conducted so as to estimate possible fluctuation of the railway traffic demand due to variations of two factors in the following way.

1) 5% per year in the growth rate of GDP during the period of 1991 to 2005

2) Opening of the expressway to the traffic between Kuala Lumpur and Kuantan by 2005

(2) Result of sensitivity analysis for Case A-A

1) Railway traffic demand in 2005 in the case of the GDP growing at an increase rate of 5% per year during the period of 1991 to 2005.

	5% growth rate	Base case	Plus on minus in percentage
Ton (1,000 tons)	9,913	12,263	-19.2
Ton·km (1 million ton·km)	4,243	5,238	-19.0

2) Railway traffic demand in 2005 in the case of the expressway being opened to traffic between Kuala Lumpur and Kuantan by 2005.

	Opening of expressway	Base case	Plus on minus in percentage
Ton (1,000 tons)	10,953	12,263	- 10.6
Ton·km (1 million ton·km)	4,688	5,238	- 10.5

CHAPTER 6.
TRAIN OPERATION PLAN

CHAPTER 6 TRAIN OPERATION PLAN

6-1 Basic Policy for Formulation of Operation Plan

The following conditions will be determined in respect of the train operation plan.

(1) Train classification

Passenger trains: Super express train
Express train
Local train

Freight trains : Through train
Local train

(2) Passenger train formation and seating capacity

Train makeup:

Super express train

Locomotive + 1st-class coach × 4 + Restaurant car × 1 + 2nd-class coach × 9 = Locomotive + 14 coaches

Express train

Locomotive + 1st-class coach × 3 + Restaurant car × 1 + 2nd-class coach × 10 = Locomotive + 14 coaches

Local train

Locomotive + 2nd-class coach × 14

Seating capacity:

For super express & express trains

1st-class coach: 30 passengers
2nd-class coach: 60 passengers

For local trains

2nd-class coach: 76 passengers

Therefore, the seating capacity per each train will be calculated as follows:

Super express train

$30 \times 4 + 60 \times 9 = 660$ passengers

Express train

$30 \times 3 + 60 \times 10 = 690$ passengers

Local train

$76 \times 14 = 1,064$ passengers

(3) Hauling tonnage of freight trains

Standard Gauge : 1,600 tons

Meter Gauge : 1,200 tons

(4) Maximum train speed

Table 6-1-1 Maximum Speed of Train

(Unit: km/h)

Type of train \ Gauge		Standard	Meter
Passenger	Super express	160	120
	Express	160	120
	Local	120	100
Freight	Through	120	100
	Local	120	100

6-2 Train Operation Plan

(1) Number of trains

The assumed conditions for estimation of required number of trains are as follows:

Ratio of passengers by super express versus passengers by express: 2:1

Passenger load factor *1:

Super express train	:	80%
Express train	:	80%
Local train	:	100%

Freight load factor *2 : 90%

Empty rate of freight car *3 : 90%

Note *1: Rate of the number of passengers aboard the train to the seating capacity of a passenger train.

*2: Rate of the actual freight tonnage to the maximum loading capacity of a freight train.

*3: Rate of dead heading of unloaded freight car after arrival at the station.

Necessary number of trains in operation per day for each section under the assumed conditions as stated above are shown in Fig. 6-2-1 through Fig. 6-2-4.

(2) Track capacity

Track capacity of the single track, i.e. the maximum number of trains operable on a certain section (both directions) is calculated by the following formula:

$$N = \frac{1,440}{\frac{S}{V} \times 60 + t} \times K$$

N: Operable number of trains (both directions)

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

V: Speed (km/h) at weighted average of trains for the said section

t: Time (minutes) required for handling block system

K: Track utilization factor

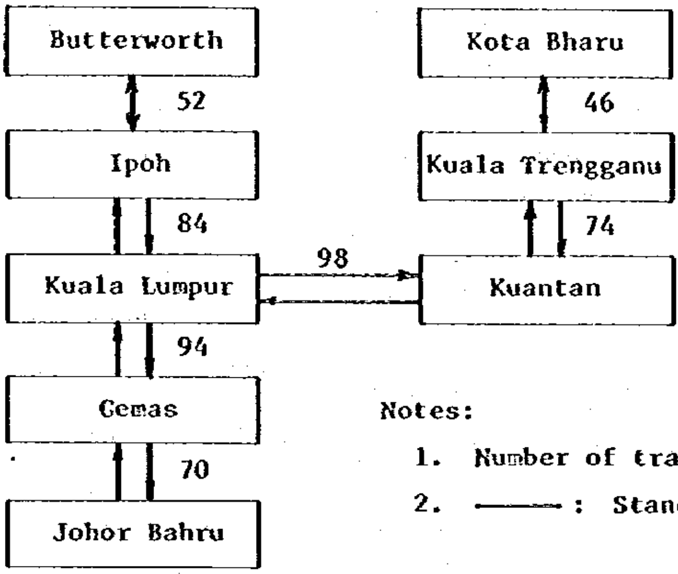
Supposing the provision of passing loops in every 20 km, the required track capacity of the single track is calculated as follows:

Standard Gauge: 60 trains (both directions)

Meter Gauge : 48 trains (both directions)

Comparing these capacities with the number of necessary trains on respective sections as shown in Fig. 6-2-1-through 6-2-4, selection of single or double track is made.

Case A – A



Notes:

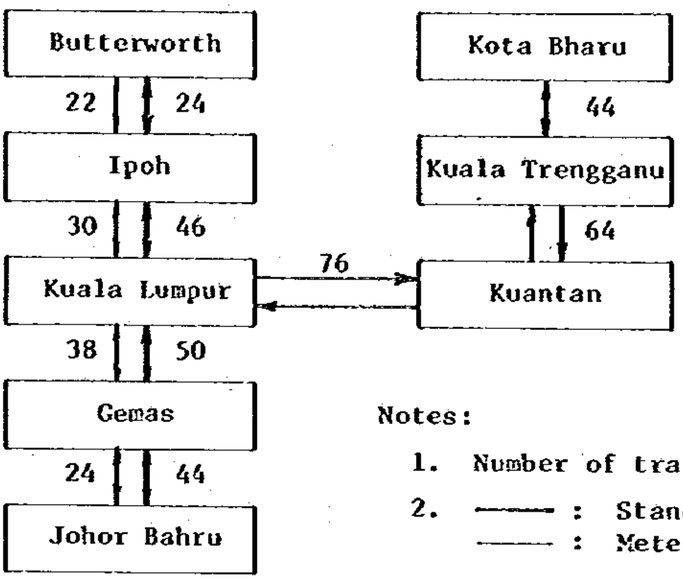
1. Number of trains for both directions
2. ——→ : Standard Gauge line

(2005)

Line	Section	Number of trains (per day)							
		Passenger train				Freight train			Grand total
		Super express	Express	Local	Total	Through	Local	Total	
West Coast (Standard Gauge)	Butterworth – Ipoh	16	8	6	30	20	2	22	52
	Ipoh – Kuala Lumpur	32	14	8	54	26	4	30	84
	Kuala Lumpur – Gemas	34	16	12	62	28	4	32	94
	Gemas – Johor Bahru	30	14	6	50	18	2	20	70
New East-West (Standard Gauge)	Kuala Lampur – Kuantan	34	16	4	54	40	4	44	98
	Kuantan – Kuala Trengganu	30	14	2	46	24	4	28	74
	Kuala Trengganu – Kota Bharu	20	10	6	36	8	2	10	46

Fig. 6-2-1 Number of Trains by Section (Both Directions) (Case A-A)

Case B - B



Notes:

1. Number of trains for both directions
2. ——— : Standard Gauge line
   ——— : Meter Gauge line

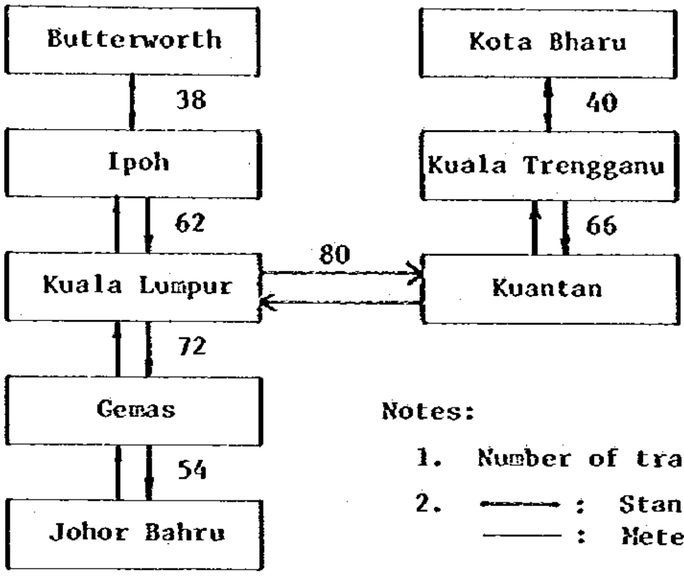
(2005)

Line	Section	Passenger train: Super express	Passenger train: Express	Passenger train: Local	Passenger train: Total	Freight train: Through	Freight train: Local	Freight train: Total	Grand total
West Coast (Standard Gauge & Meter Gauge)	Butterworth – Ipoh (upper)	16	8	–	24	–	–	–	24
	Butterworth – Ipoh (lower)	–	–	6	6	14	2	16	22
	Ipoh – Kuala Lumpur (upper)	32	14	–	46	–	–	–	46
	Ipoh – Kuala Lumpur (lower)	–	–	8	8	20	2	22	30
	Kuala Lumpur – Gemas (upper)	34	16	–	50	–	–	–	50
	Kuala Lumpur – Gemas (lower)	–	–	12	12	22	4	26	38
	Gemas – Johor Bahru (upper)	30	14	–	44	–	–	–	44
	Gemas – Johor Bahru (lower)	–	–	6	6	16	2	18	24
New East-West (Standard Gauge)	Kuala Lumpur – Kuantan	34	16	4	54	20	2	22	76
	Kuantan – Kuala Trengganu	30	14	2	46	16	2	18	64
	Kuala Trengganu – Kota Bharu	20	10	6	36	6	2	8	44

Upper row: Standard Gauge line
Lower row: Meter Gauge line

Fig. 6-2-2 Number of Trains by Section (Both Directions) (Case B-B)

Case C - B



Notes:

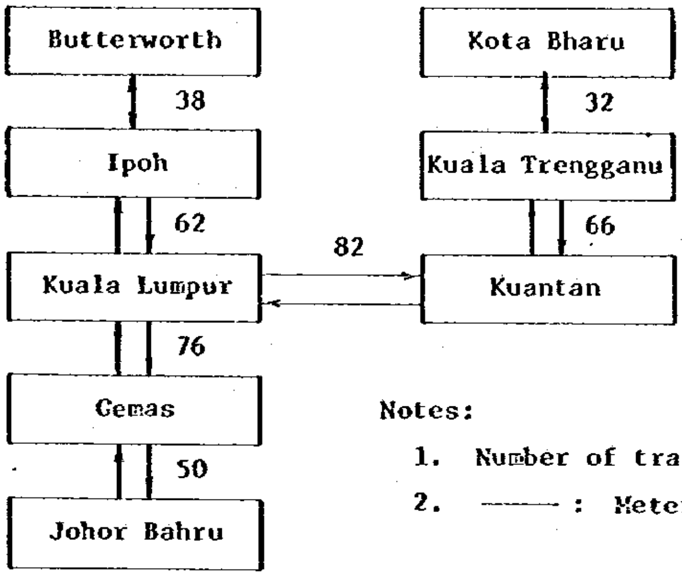
1. Number of trains for both directions
2. ━━━ : Standard Gauge line
   ——— : Meter Gauge line

(2005)

Line	Section	Passenger train: Super express	Passenger train: Express	Passenger train: Local	Passenger train: Total	Freight train: Through	Freight train: Local	Freight train: Total	Grand total
West Coast (Meter Gauge)	Butterworth – Ipoh	10	6	4	20	16	2	18	38
	Ipoh – Kuala Lumpur	20	10	6	36	22	4	26	62
	Kuala Lumpur – Gemas	22	10	10	42	26	4	30	72
	Gemas – Johor Bahru	20	10	4	34	18	2	20	54
New East-West (Standard Gauge)	Kuala Lumpur – Kuantan	32	16	4	52	24	4	28	80
	Kuantan – Kuala Trengganu	30	14	2	46	18	2	20	66
	Kuala Trengganu – Kota Bharu	18	8	6	32	6	2	8	40

Fig. 6-2-3 Number of Trains by Section (Both Directions) (Case C-B)

Case D - C



Notes:

1. Number of trains for both directions
2. ——— : Meter Gauge line

(2005)

Line	Section	Passenger train: Super Express	Passenger train: Express	Passenger train: Local	Passenger train: Total	Freight train: Through	Freight train: Local	Freight train: Total	Grand total
West Coast (Meter Gauge)	Butterworth – Ipoh	8	4	4	16	20	2	22	38
	Ipoh – Kuala Lumpur	18	8	6	32	26	4	30	62
	Kuala Lumpur – Gemas	20	10	10	40	32	4	36	76
	Gemas – Johor Bahru	18	8	4	30	18	2	20	50
New East-West (Meter Gauge)	Kuala Lumpur – Kuantan	24	12	2	38	40	4	44	82
	Kuantan – Kuala Trengganu	22	10	2	34	28	4	32	66
	Kuala Trengganu – Kota Bharu	14	6	4	24	6	2	8	32

Fig. 6-2-4 Number of Trains by Section (Both Directions) (Case D-C)

6-3 Number of Rolling Stock and Placement of Car Depot

(1) Number of rolling stock

Required number of locomotives, passenger cars and freight cars for operation of trains as referred to in the foregoing 6-2 are shown in Tables 6-3-1, 6-3-2 and 6-3-3 respectively.

(2) Placement of car depot

In planning the car depot placement, effective operation and use of rolling stock should be adequately planned for cost saving by reducing the number of depots to the minimum extent. It should also be planned that respective depots for locomotives, passenger cars, and freight cars will be centralized at the same area.

It is recommended to allocate car depots at locations as follows:

Prai, Kuala Lumpur, Johor Bahru, Kuantan and Kota Bharu

Table 6-3-1 Number of Locomotives

2005

Case	Gauge	EL, DL	Type / Item	Number of locomotive: West Coast	New East-West	Total
A - A	S	EL	Passenger	38	25	65
			Freight	22	20	42
			Total	60	45	105
		DL	Shunting	26	20	46
B - B	S	EL	Passenger	29	25	54
			Freight	-	11	11
			Total	29	36	65
		DL	Shunting	8	17	25
	M	EL	Passenger	9	-	9
			Freight	25	-	25
			Total	34	-	34
		DL	Shunting	21	-	21
C - B	S	EL	Passenger	-	24	24
			Freight	-	13	13
			Total	-	37	37
		DL	Shunting	-	21	21
	M	EL	Passenger	36	-	36
			Freight	29	-	29
			Total	65	-	65
		DL	Shunting	25	-	25
D - C	M	EL	Passenger	31	24	55
			Freight	32	28	60
			Total	63	52	115
		DL	Shunting	26	20	46

Table 6-3-2 Number of Passenger Cars

2005

Case	Gauge	West Coast	New East-West	Total
		Number of passenger cars		
A - A	S	585	380	965
B - B	S	427	380	807
	M	127	-	127
C - B	S	-	364	364
	M	554	-	554
D - C	M	475	364	839

Table 6-3-3 Number of Wagons

2005

Case	Gauge	Type	West Coast	New East-West	Total
			Number of wagons		
A - A	S	Covered wagon	972	760	1,732
		Flat & container wagon	840	658	1,498
		Tank & hopper wagon	672	525	1,197
		Total	2,484	1,943	4,427
B - B	S	Covered wagon	-	485	485
		Flat & container wagon	-	433	433
		Tank & hopper wagon	-	255	255
		Total	-	1,173	1,173
	M	Covered wagon	658	-	658
		Flat & container wagon	588	-	588
		Tank & hopper wavon	346	-	346
		Total	1,592	-	1,592
C - B	S	Covered wagon	-	539	539
		Flat & container wagon	-	464	464
		Tank & hopper wagon	-	331	331
		Total	-	1,334	1,334
	M	Covered wagon	735	-	735
		Flat & container wagon	634	-	634
		Tank & hopper wagon	451	-	451
		Total	1,820	-	1,820
D - C	M	Covered wagon	867	664	1,531
		Flat & container wagon	723	554	1,277
		Tank & hopper wagon	524	402	926
		Total	2,114	1,620	3,734

CHAPTER 7.

CONSTRUCTION AND MAINTENANCE OF RAILWAY

CHAPTER 7.

CONSTRUCTION AND MAINTENANCE OF RAILWAY

7-1 Construction

7-1-1 Basic conception

The following basic criteria and standards are established for planning the new railway facilities and for estimating their construction costs.

	Standard Gauge	Meter Gauge
Gauge	1,435 mm	1,000 mm
Maximum speed	160 km/h	120 km/h
Minimum radius of curvature	4,000 m	1,200 m
Maximum grade	20‰	15‰
Track effective length		
Passenger	380 m	350 m
Freight	750 m	600 m
Construction gauge and rolling stock clearance	UIC*1 standard Fig. 7-1-1	JNR*2 standard Fig. 7-1-2
Formation level and diagram of earthwork	Fig. 7-1-3	Fig. 7-1-4
Live load	Special design Fig. 7-1-5	MRA standard Fig. 7-1-6

Note: *1 International Unions of Railways (UIC)
*2 Japanese National Railways (JNR)

Minimum radius of curvature and live load for the standard gauge allow for future potentiality of high-speed operation in excess of 200 km/h.

Track effective length is determined at 750 m on the standard gauge and 600 m on the meter gauge in preparation for the future increase in the train length.

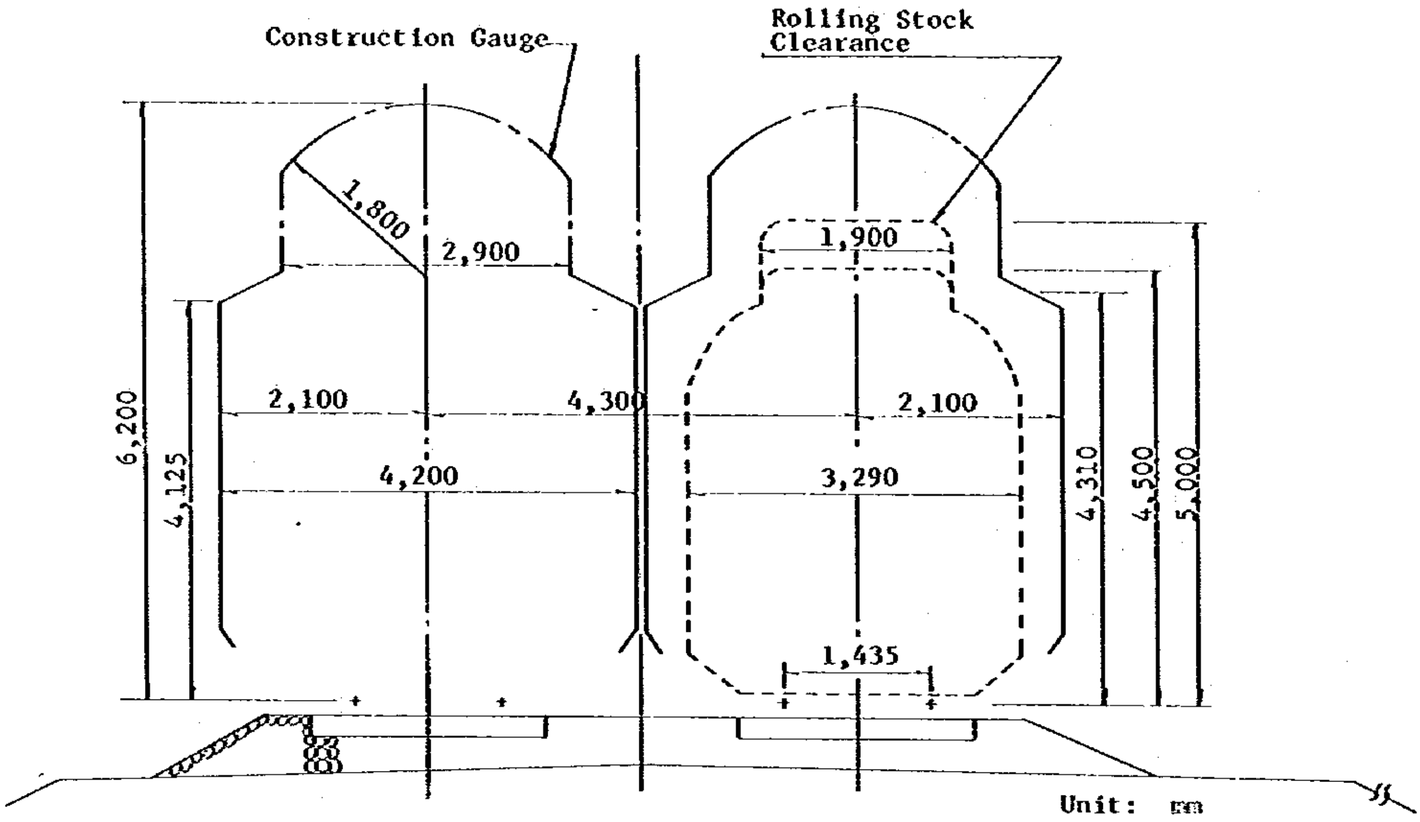


Fig. 7-1-1 Standard Gauge

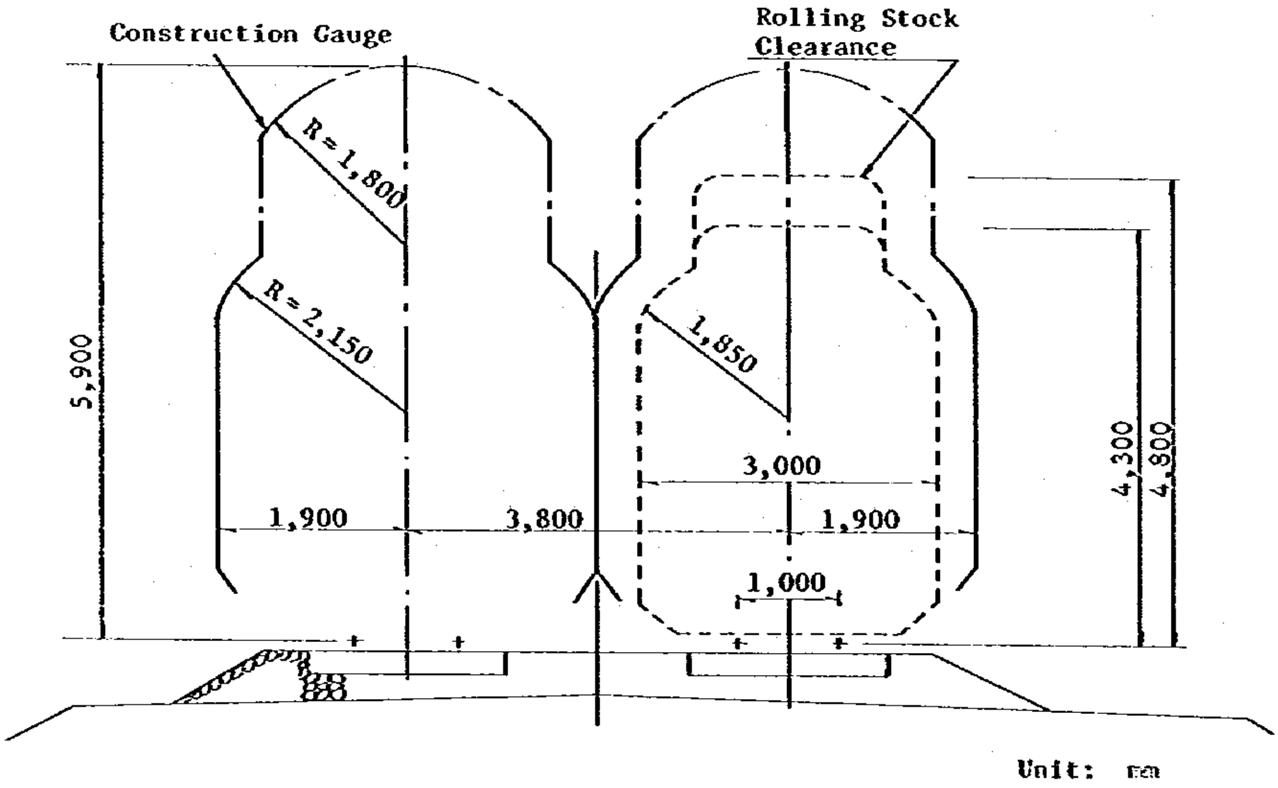
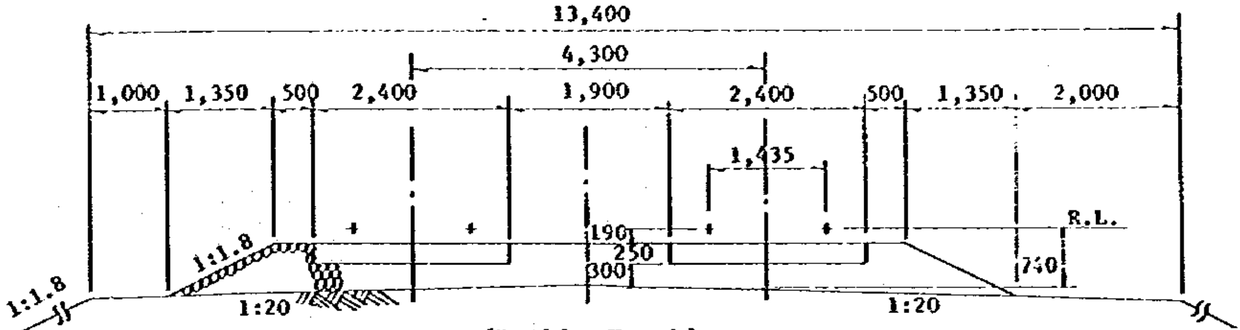
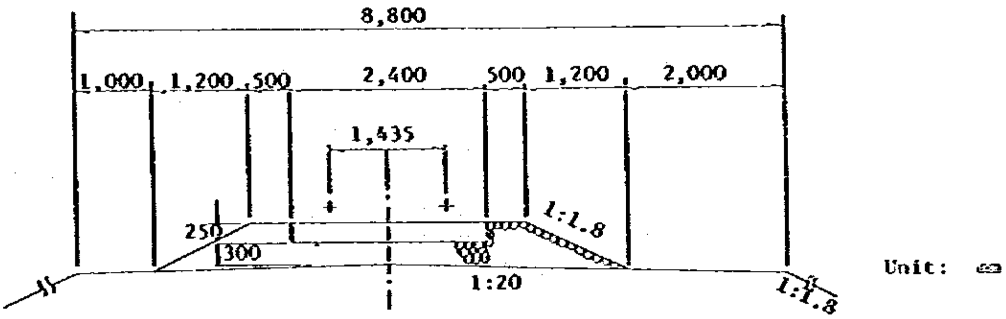


Fig. 7-1-2 Meter Gauge

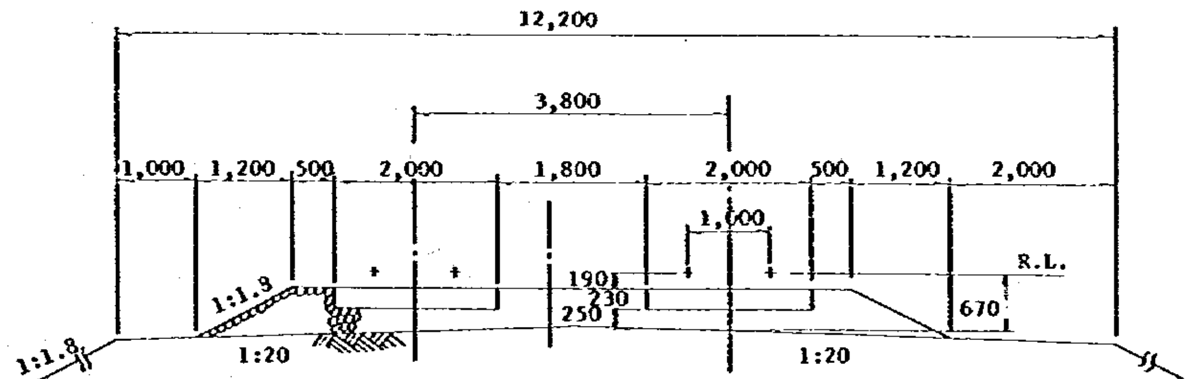


(Double Track)

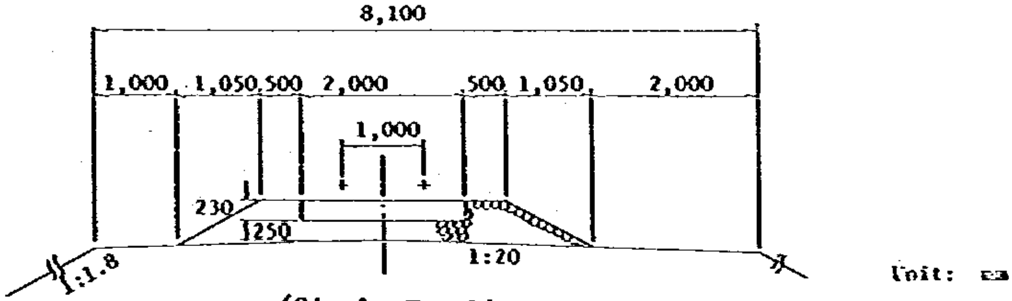


(Single Track)

Fig. 7-1-3 Standard Gauge



(Double Track)



(Single Track)

Fig. 7-1-4 Meter Gauge

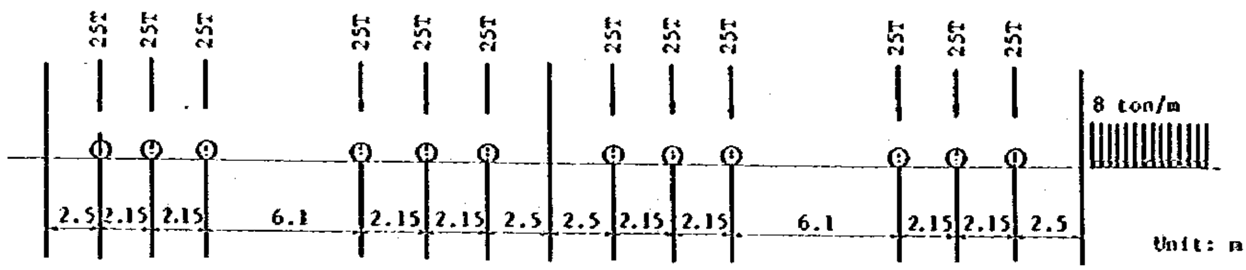


Fig. 7-1-5 Live Load (Standard Gauge)

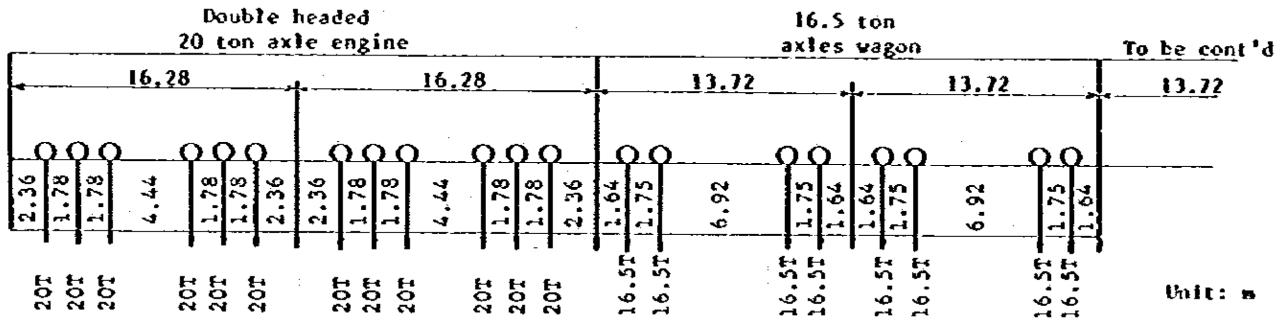


Fig. 7-1-6 Live Load (Meter Gauge, MRA Standard)

7-1-2 Route location

This study has been conducted by reference to the topographical maps on a scale of 1/63,360 and the geological maps on a scale of 1/500,000. Either construction or abolition of a station has been determined as per request made by the MRA (Table 7-1-1 and 7-1-2).

(1) The route has been selected to the possible shortest length in consideration of the following points for minimizing the total construction cost.

① To make use of the existing roadway (of 40 m width) to the possible extent.

② To lower the height of banking or cutting if possible.

③ To shorten the tunnel length.

④ To avoid passage through the zone of soft soil foundation wherever possible.

On the West Coast Line, in order to increase running speed of trains, curves have been improved at about 500 sections on the standard gauge line and 300 to 350 sections on the meter gauge line.

(2) In city areas of Kuala Lumpur and Johor Bahru, the existing roadway will be utilized to the possible maximum in anticipation of difficulty in land acquisition while there may exist lots of small curves.

Since the existing Kuala Lumpur Station would not allow expansion in any ways, the new K.L. station will be built about 1 km south where the freight station exists at present. Therefore, the new freight station, shunting yard and car workshop will be constructed at Rawang Kuang in the suburbs of Kuala Lumpur.

For freight transportation of the New East-West Line, a connection route (of 22.5 km length) will be laid between Rawang Kuang and the New East-West Line, bypassing the city area of Kuala Lumpur.

(3) For construction of the New East-West Line a long tunnel must inevitably be constructed, because there exists, in close proximity to Kuala Lumpur, a mountain range running through the Peninsula. Further consideration has been given in seeking the bypass route off the swampy zones existing in many places from Kuantan to Kota Bharu. Prior to planning the execution of construction, it is advisable that the geological study should be made to obtain more detailed information to decide the design and the method of construction.

Each alternative case of construction plan of the New East-West Line is designed at the same route and location of station, except only Case C for the meter gauge being proposed for construction of the junction lines to the Central Line at Mentakab and Kota Bharu.

(4) For the section between Bagan Serai and Ipoh on the West Coast Line, the short-cut route is introduced in Case A, Case B (only for the standard gauge line) and Case C.

Table 7-1-1 List of Kilometerage on West Coast Line

Unit: km

Names of stations \ Case / Distance	Exist line Cumulative	Exist line Between	A Cumulative	A Between	B Cumulative*	B Between*	C Cumulative	C Between	D Cumulative	D Between	Classification of Freight Station
BUTTERWORTH	0.0		◉ 0.0		◉ 0.0		◉ 0.0		◉ 0.0		□
Prai	1.8	1.8									□
Bukit Tengah	8.0	6.2		11.5		11.5		11.5		11.5	□
Bukit Mertajam	12.3	4.3	○ 11.5		○ 11.5		○ 11.5		○ 11.5		
Simpang Ampat	21.2	8.9	△	22.3	△		△	22.3	△	22.3	
Nibong Tebal	34.6	13.4	○ 33.8		○		○ 33.8		○ 33.8		
Parit Buntar	39.4	4.8	○ 38.6	4.8	○		○ 38.6	4.8	○ 38.6	4.8	□
Bagan Serai	52.5	13.1	○ 51.7	13.1	○	70.6	○ 51.7	13.1	○ 51.7	13.1	□
Bukit Merah	67.4	14.9	△		○		△		○ 66.5	14.9	
Pondok Tanjong	77.5	10.1	△	30.4	△		△	30.4	△		
Kamunting	90.5	13.0	△		△		△		△	25.1	
Taiping	95.9	5.4	○ 82.1		○ 82.1		○ 82.1		○ 94.6		□
Bukit Berapit	110.0	14.1	△	16.9	△		△	16.9	△	16.9	
Padang Rengas	116.0	6.0	○ 99.0		○	26.7	○ 99.0		○ 111.5		
Kuala Kangsar	126.2	10.2	○ 108.8	9.8	○ 108.8		○ 108.8	9.8	○ 121.5	10.0	□
Salak North	140.4	14.2	△		△		△		△	21.3	
Sungei Siput	147.8	7.4	△		○		△		○ 142.8		
Chemor	160.5	12.7	△	31.6	○	31.6	△	31.6	○ 155.5	12.7	
Tanjong Rambutan	168.2	7.7	△		○		△		○ 163.5	8.0	
Tasek	173.4	5.2	△		△		△		△	12.5	
IPOH	181.5	8.1	◉ 140.4		◉ 140.4		◉ 140.4		◉ 176.0		□
Lahat	188.5	7.0	△		△		△	14.5	△	14.5	
Batu Gajah	195.0	7.5	△	18.9	○		○ 154.9		○ 190.5		
Gopeng (new)		8.9	○ 159.3								
Kota Bharu	204.9		△		△	53.5	△	15.9	△	15.9	
Malim Nawar	211.9	7.0	△		○		○ 170.8		○ 206.4		
Kampar	218.5	6.6	△	34.6	○		○ 177.1	6.3	○ 212.7	6.3	□
Temoh	226.3	7.8	△		△		△		△		
Tapah (new)		7.7	○ 193.9		○ 193.9			15.5		15.5	□
Tapah Road	234.0		△	10.1	○		○ 192.6		○ 228.2		□
Bidor	245.0	12.0	○ 204.0		○		○ 203.6	11.0	○ 239.2	11.0	
Sungkai	258.3	12.3	○ 217.3	13.3	○		○ 217.6	14.0	○ 253.2	14.0	
Trolak	273.9	15.6		21.7				21.7		21.7	□
Slim River	282.3	8.4	○ 239.0		○		○ 239.3		○ 274.9		□
Behrang	293.6	11.3	○ 249.8	10.8	○		○ 250.1	10.5	○ 265.7	10.8	
Tanjong Malim	304.3	10.7	○ 260.9	11.1	○	115.1	○ 261.2	11.1	○ 296.8	11.1	
Kalumpang	309.6	5.3	△		△		△		△		
Kerling	318.5	8.9	△	16.5	△		△	16.5	△	16.5	
Kuala Kubu Road	323.0	4.5	○ 277.4		○		○ 277.7		○ 313.3		
Rasa	330.8	7.8	△		△		△		△		
Ulu Yam	336.8	6.0	△	31.6	△		△	33.1	△	33.1	
Serendah	347.6	10.8	△		△		△		△		
Rawang	356.2	8.6	○ 309.0		○ 309.0		○ 310.8		○ 345.4		□
Sungei Buloh	370.4	14.2	○ 323.9	14.9	○ 323.9	14.9	○ 325.7	14.9	○ 361.3	14.9	□
Segambut	381.1	10.7	△	17.9	△	17.9	△	17.9	△	17.9	
KUALA LUMPUR	389.2	8.1	◉ 341.8		◉ 341.8		◉ 343.6		◉ 379.2		

- cont'd -

Unit: km

Names of stations \ Case / Distance	Exist line Cumulative	Exist line Between	A Cumulative	A Between	B Cumulative*	B Between*	C Cumulative	C Between	D Cumulative	D Between	Classification of Freight Station
KUALA LUMPUR	389.2		◉ 341.8		◉ 341.8		◉ 343.6		◉ 379.2		
Spg. P. Kelang	390.5	1.3	△		△		△		△		
Spg. Salak Selatan	395.5	5.0	△	21.9	△	21.9	△	23.6	△	23.6	
Serdang	404.7	9.2	△		△		△		△		
Kajang	414.8	10.1	◯ 363.7		◯ 363.7		◯ 367.2		◯ 402.8		
Bangi (new)		20.9	◯ 375.0	11.3	◯ 375.0	11.3	◯ 378.1	10.9	◯ 413.7	10.9	□
Batang Benar	435.7		△		△		△		△		
Labu	447.3	11.6	△	32.2	△	32.2	△	33.7	△	33.7	
SEREMBAN	461.9	14.6	◉ 407.2		◉ 407.2		◉ 411.8		◉ 447.4		□
Rembau	485.4	23.5	△ 429.3	22.1	○	43.4	○ 434.2	22.4	○ 469.8	22.4	
Tampin	510.4	25.0	◯ 450.6	21.3	◯ 450.6		◯ 455.5	21.3	◯ 493.1	21.3	□
Tebong	525.2	14.8	△	23.7	△		△	24.2	△	24.2	
Batang Melaka	536.1	10.9	○ 476.3		○	50.3	○ 479.7		○ 515.3		
Ayer Kuning South	544.5	8.4	△	26.6	△		△	26.6	△	26.6	
Gemas	563.9	19.4	◯ 500.9		◯ 500.9		◯ 506.3		◯ 541.9		□
Batu Anam	573.5	9.6	△	26.6	△	26.6	△	24.9	△	24.9	
Segamat	588.9	15.4	◯ 527.5		◯ 527.5		◯ 531.2		◯ 566.8		□
Genuang	597.3	8.4	△		△		△		△		
Tenang	606.1	8.8	△	25.5	△		△	29.0	△	29.0	
Labis	618.5	12.4	○ 553.0		○		○ 560.2		○ 595.8		□
Lenek	627.3	8.8	△		△		△		△		
Bekok	634.7	7.4	△		△	78.8	△		△		
Paloh	649.0	14.3	△	53.3	△		△	53.8	△	53.8	
Chamek	655.6	7.6	△		△		△		△		
Niyor	654.4	7.8	△		△		△		△		
KLUANG	672.3	7.9	◉ 606.3		◉ 606.3		◉ 614.0		◉ 649.6		□
Mengkibol	679.1	6.8	△		△		△		△		
Rengam	692.0	12.9	△		△		△		△		
Layang Layang	703.9	11.9	△	54.1	△		△	55.0	△	55.0	
Sedenak	717.3	13.4	△		△	84.9	△		△		
Kulai	727.3	10.0	○ 660.4		○		○ 669.0		○ 704.6		
Kempas	744.7	17.4	○ 678.1	17.7	○		○ 686.8	17.8	○ 722.4	17.8	□
JOHOR BAHRU	758.6	13.9	◉ 691.2	13.1	◉ 691.2		◉ 700.0	13.2	◉ 735.6	13.2	

Branch line (Figures as indicated on the branch line are limited only to those for terminal stations.)

Station	Exist line Cumulative	Exist line Between	A Cumulative	A Between	B Cumulative	B Between	C Cumulative	C Between	D Cumulative	D Between	Classification of Freight Station
Tapah Road/Tapah (new)	0.0	28.5	0.0	40.0	0.0	28.5	0.0	28.5	0.0	28.5	
Telok Anson	28.5		○ 40.0		○ 28.5		○ 28.5		○ 28.5		□
Kuala Lumpur	0.0	46.9	0.0	46.9	0.0	45.9	0.0	46.9	0.0	46.9	
Port Kelang	46.9		○ 46.9		○ 45.9		○ 45.9		○ 46.9		▣
Seremban	0.0	40.0	0.0	40.0	0.0	40.0	0.0	40.0	0.0	40.0	
Port Dickson	40.0		○ 40.0		○ 40.0		○ 40.0		○ 40.0		▣

Note:
- ◉ : Stoppage station for super express train
- ◯ : Stoppage station for express train
- ○ : Station for local train
- △ : Station destined for abolishment
- ▣ : Main freight station
- □ : Freight station

* Distance indicates a value in case of Standard Gauge line. Meter Gauge line is same as Case D.

Table 7-1-2 List of Stations on the New East-West Line

Unit: km

Names of stations	Classification of stations		Cumulative	Between
Kuala Lumpur	◎		0.0	
Karak	◯	□	65.0	65.0
Temerloh	◎	▣	111.1	46.1
Maran	◯		155.4	44.3
Gambang	○		195.6	40.2
Kuantan	◎	▣	222.1	26.5
Chukai	◯	□	272.8	50.7
Kerteh	◯	□	304.7	31.9
Dungun	◯		332.4	27.7
Kuala Trengganu	◎	▣	401.8	69.4
Jerteh	◯	□	486.9	85.1
Pasir Puteh	◯		503.2	16.3
Malor	○		523.7	20.5
Kubang Kerian	○		538.2	14.5
Kota Bharu	◎	▣	544.0	5.8

Branch Line

Kuantan			0.0	
Port Kuantan		▣	5.6	5.6
Chukai			0.0	
Port Chukai		▣	8.0	8.0
Kerteh			0.0	
Port Kerteh		▣	2.0	2.0

Note: ◎ : Stoppage station for super express train
◯ : Stoppage station for express train
○ : Station for local train
▣ : Main freight station
□ : Freight station

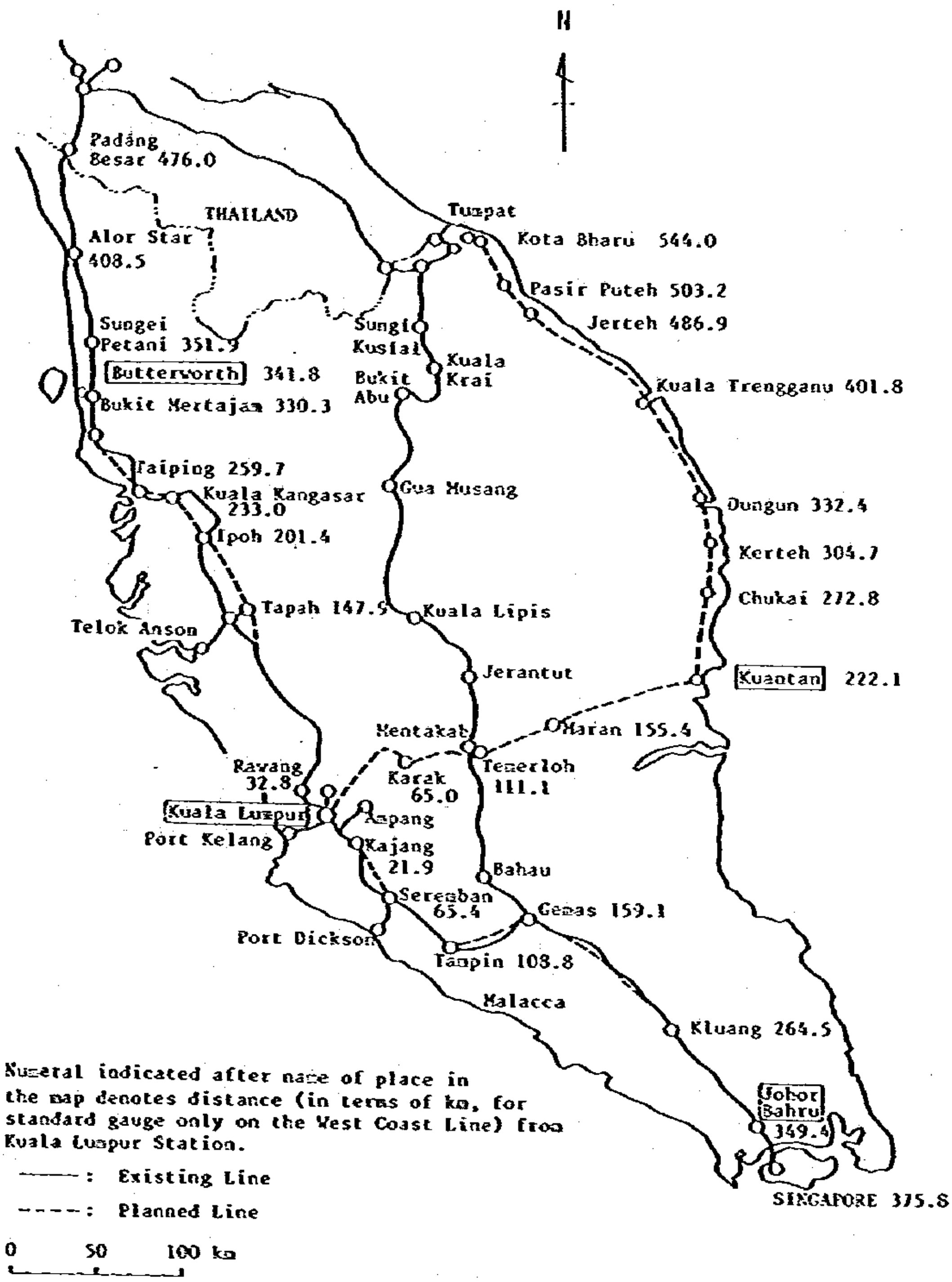


Fig. 7-1-7 Malayan Railway Development Plan

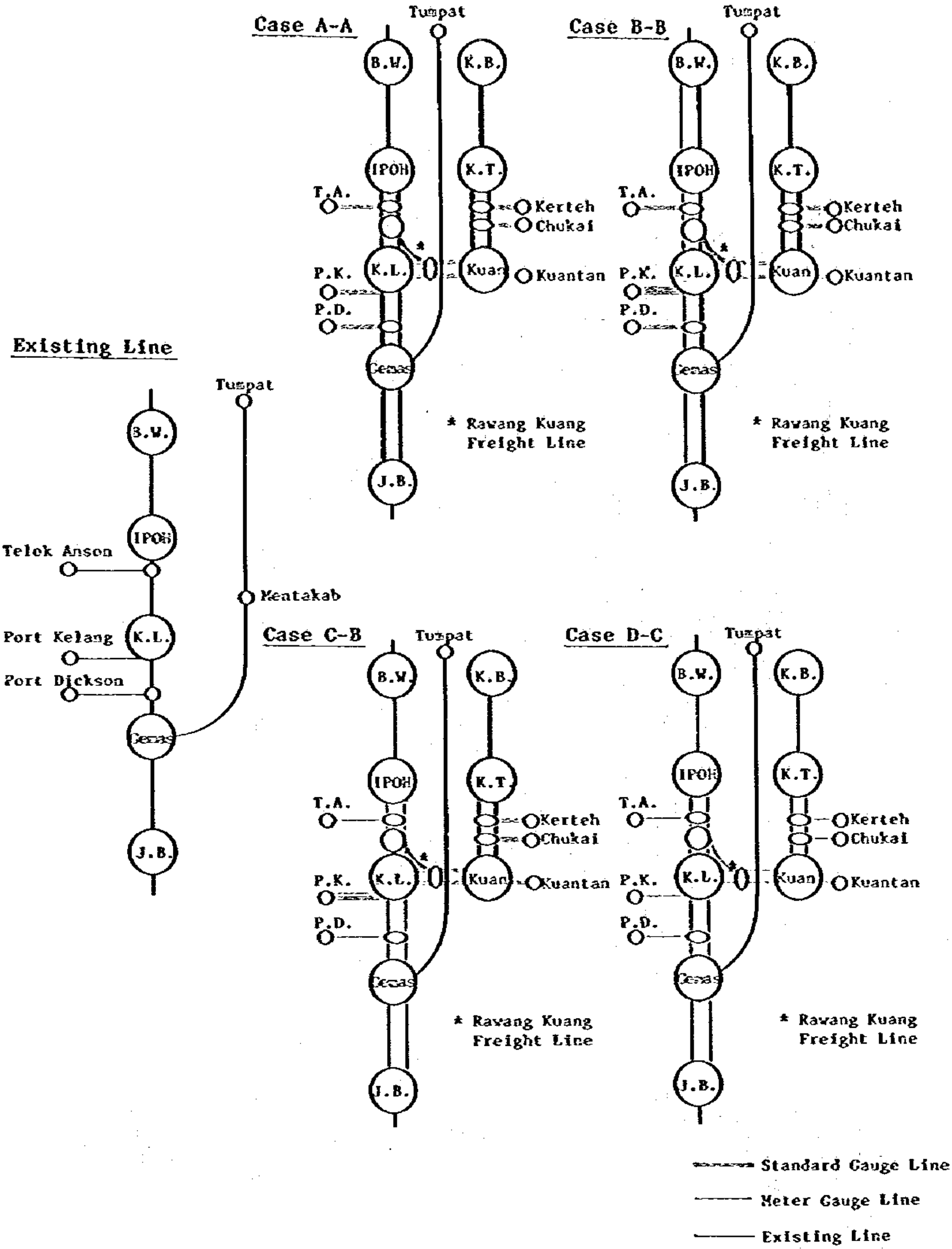


Fig. 7-1-8 (a) Rough Route Sketch

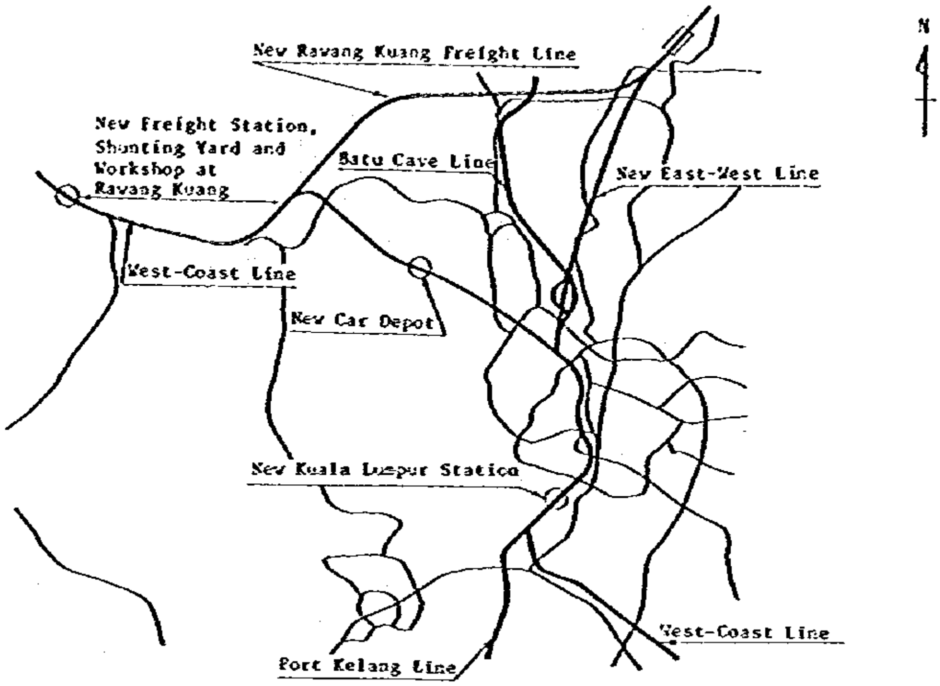


Fig. 7-1-8 (b) Railway Routes in Kuala Lumpur

7-1-3 Track and civil structure

(1) Civil structure

Each structure has been planned by assumption of the following model case.

1) Earthwork (Fig. 7-1-9)

- Embankment Height: 1 m, 3 m and 5 m
- Cutting Height: 3 m, 7 m and 15 m

2) Bridges

- Steel truss bridge (Span: 60 m, Well length: 25 m)
- Prestressed concrete bridge (Span: 30 m, Pile length: 10 m) (Fig. 7-1-10)
- Reinforced concrete bridge (Span: 10 m, Pile length: 10 m)

3) Tunnels

- For single track
- For double track (Fig. 7-1-11)

4) Culvert

- Box culvert (Section: 3 m × 3 m)
- Pipe culvert (Diameter: 0.9 m)

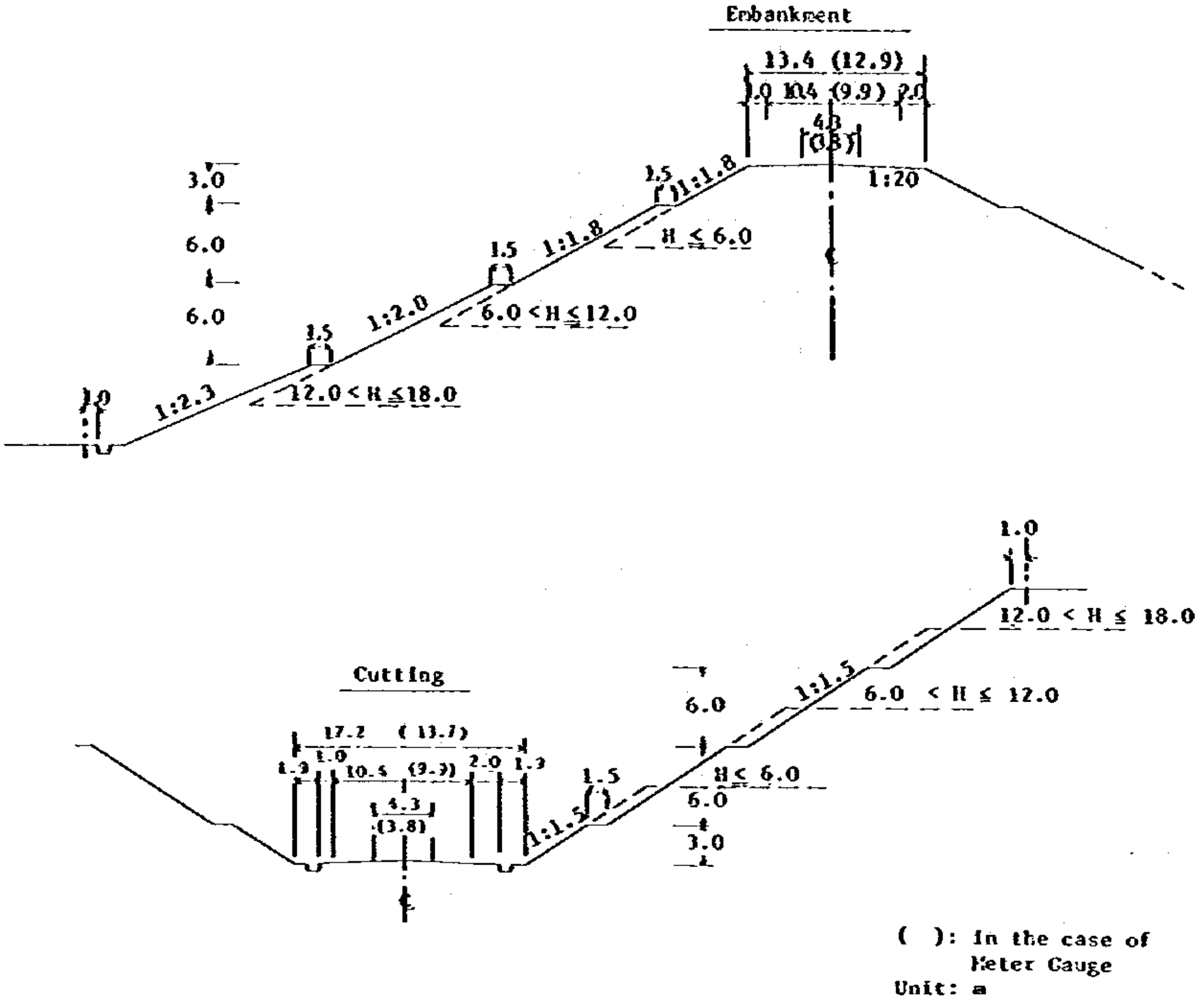


Fig. 7-1-9 Diagram of Earthwork

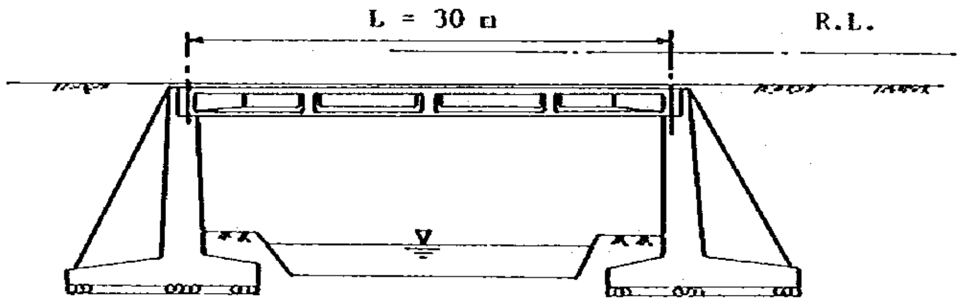
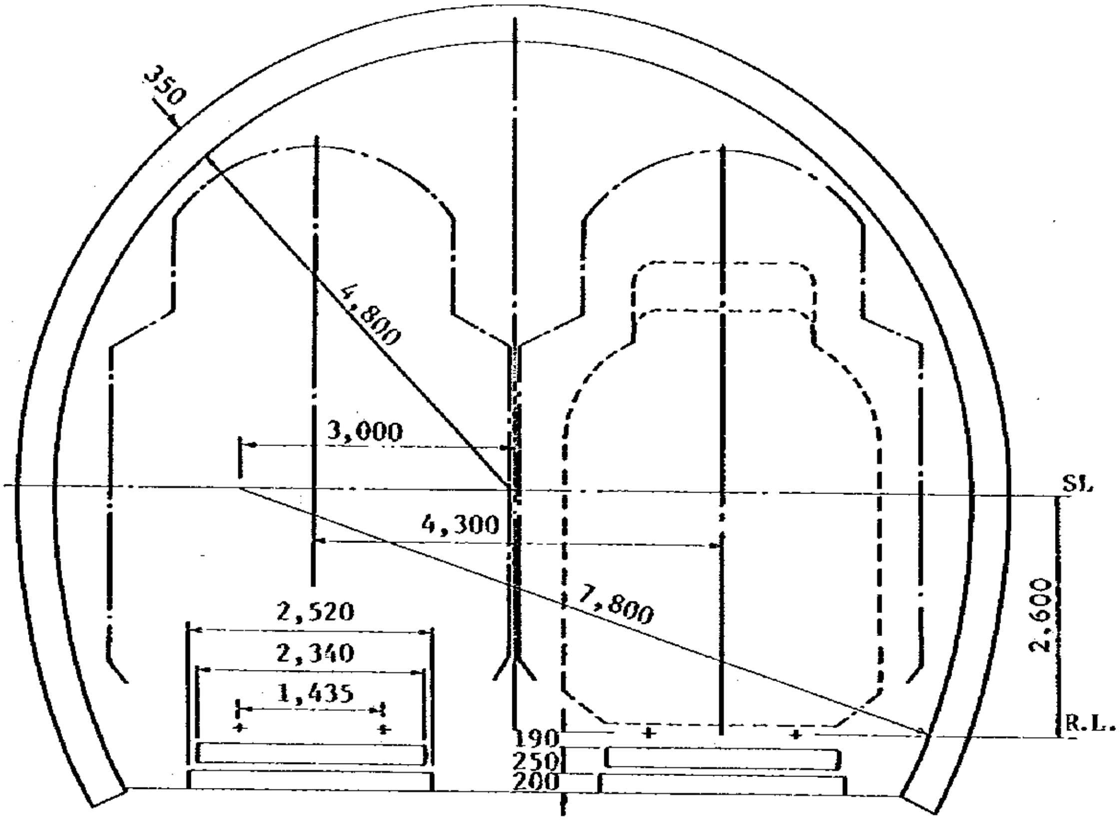
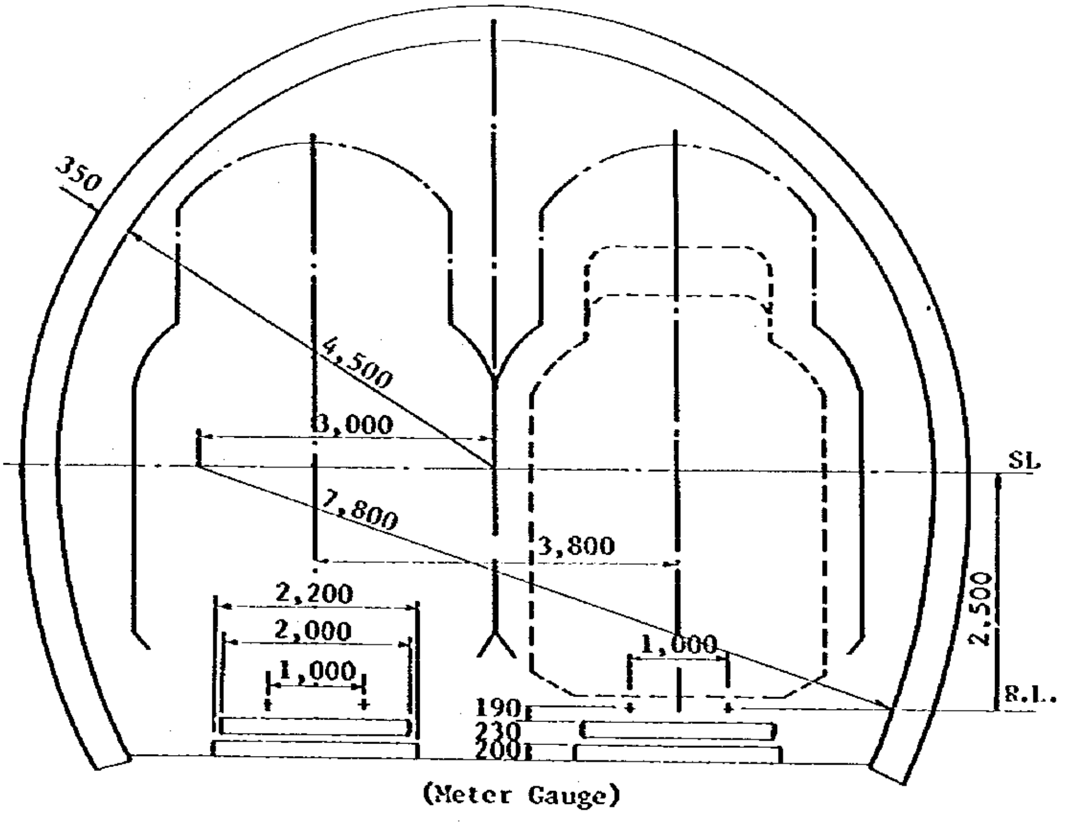


Fig. 7-1-10 Prestressed Concrete Bridge



(Standard Gauge)



(Meter Gauge)

Fig. 7-1-11 Tunnel

Unit: mm

(2) Stations

1) Passenger station

The passenger station is basically designed with two Island-type platforms and four tracks as shown below.

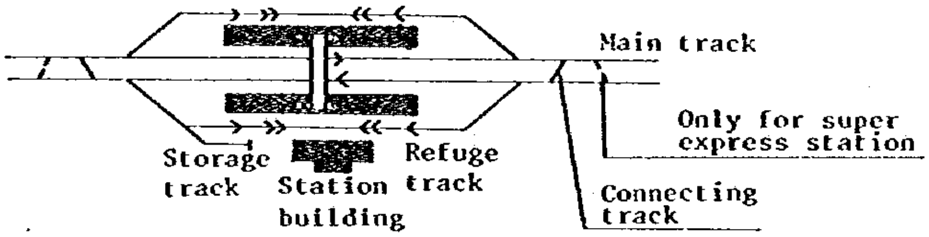


Fig. 7-1-12 Passenger Station

Station	Platform length	Platform width	Platform shed length	Overbridge width	Station building	Notice
Super express	350 m	10 m	330 m	4 m	1,000 m^2	Kuala Lumpur 2,000 m^2
Limited express	350 m	7 m	330 m	4 m	500 m^2	
Local train	350 m	5 m	160 m	4 m	500 m^2	

For main passenger stations on the West Coast Line the existing stations will be used, in principle, with improvement.

In the following Fig. 7-1-13 rough sketches are shown in respect of track arrangement at the main stations in Case A-A.

In any other cases, no difference will be presumed in regard to the size of station yard and the total number of platforms and tracks except only distinction by gauges.

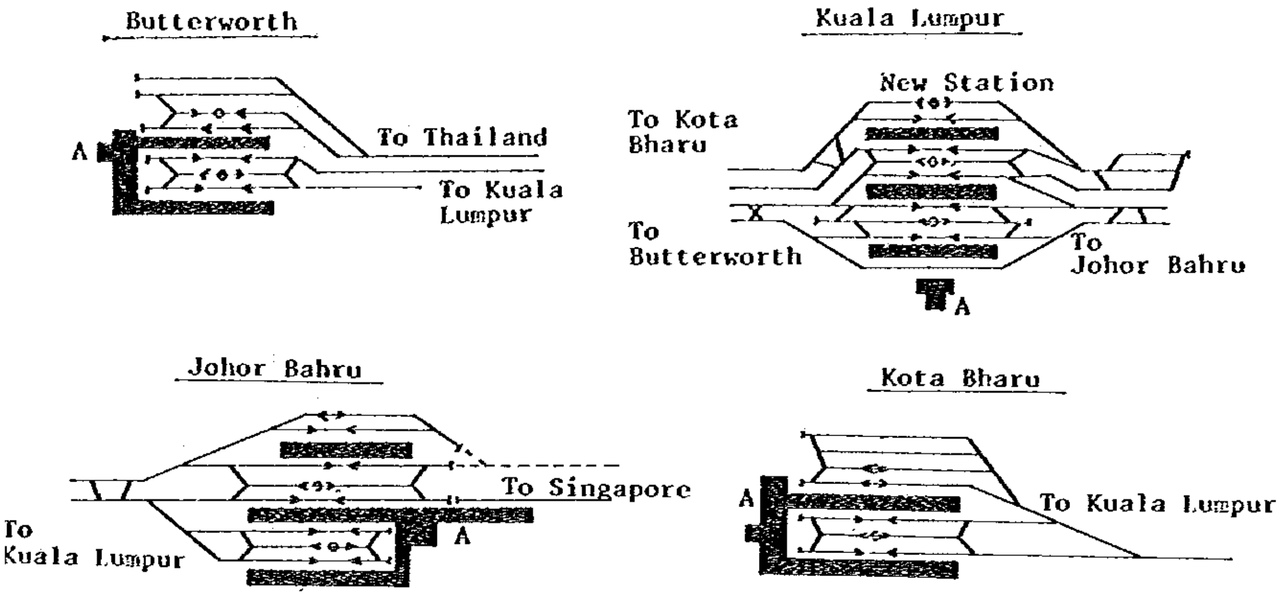


Fig. 7-1-13 Main Passenger Stations

2) Freight station

Any main station capable of handling more than 1 million tons of freight annually will be designed as an independent freight station, while any other stations capable of 200 to 500 thousand tons will be planned as the joint facility with the passenger station.

The figures below show rough sketches on track arrangement at main and small freight stations.

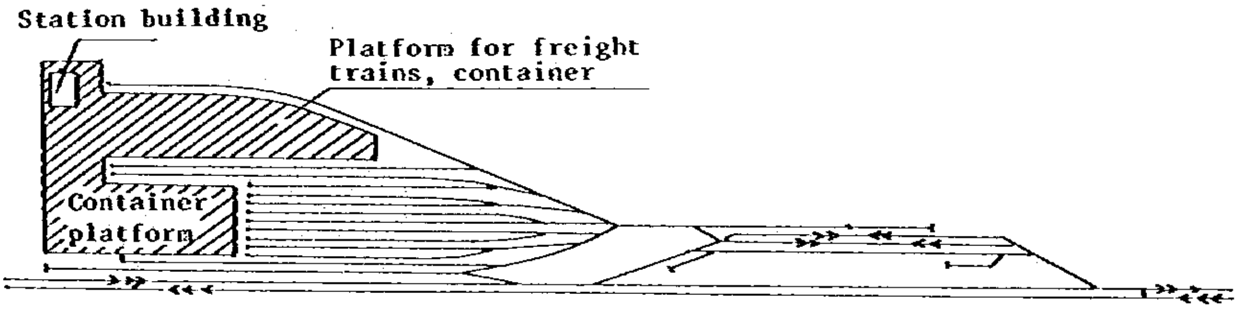


Fig. 7-1-14 (a) Main Freight Station (Capable of Handling 2 Million Tons)

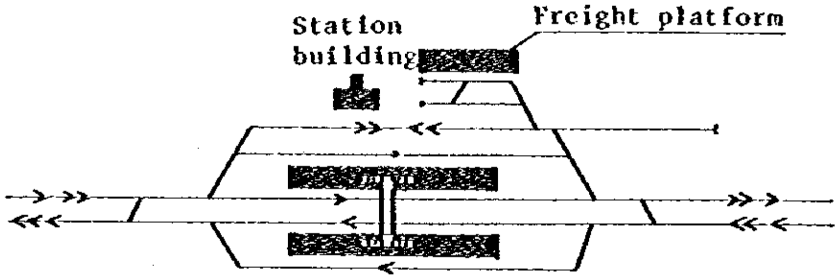


Fig. 7-1-14 (b) Small Freight Station
(200 - 500 thousand tons)

3) Freight car shunting yard

A new hump-type shunting yard for freight trains will be constructed at Rawang Kuang in the northern suburbs of Kuala Lumpur, where there will be incoming flows of freight cars to and from either the New East-West Line or the West Coast Line.

The shunting yard will be capable of accommodating 500 cars for the standard gauge in Case A-A and 400 cars for the meter gauge in Case D-C.

In Case B-B and Case C-B, the shunting yard is not necessary to be planned, but a container yard will be constructed, because freight trains can not run through service between the West Coast Line and the New East-West Line owing to difference of gauge. Rough sketch of shunting yard arrangement (500 cars per day) is given in Fig. 7-1-15.

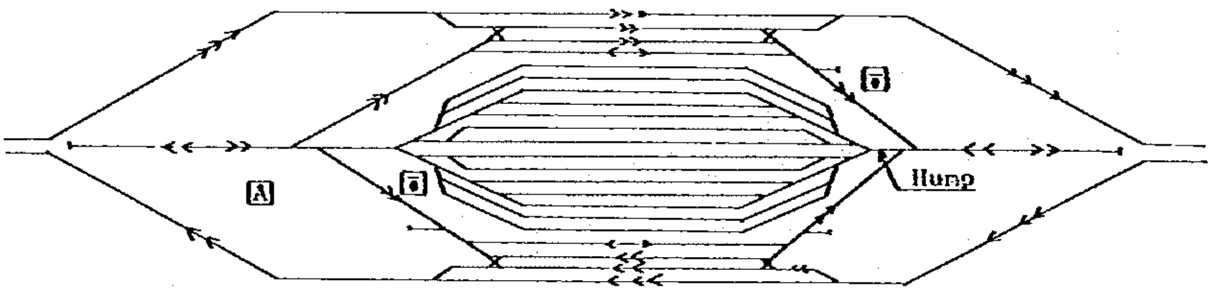


Fig. 7-1-15 Rawang Kuang Freight Car Shunting Yard

4) Rolling stock depot

The main car depot will be newly constructed at the site as stated in the foregoing 6-3. The capacity for the depot will be sufficient to accommodate 5 to 16 train sets for daily storage. The depot will be facilitated with tracks for arrival, departure and storage, for regular and trip inspections, for truck inspection, for temporary repair and for wheel grinding work. Rough sketch on track arrangement at the car depot (capable of 16 train sets) in Kuala Lumpur is shown below.

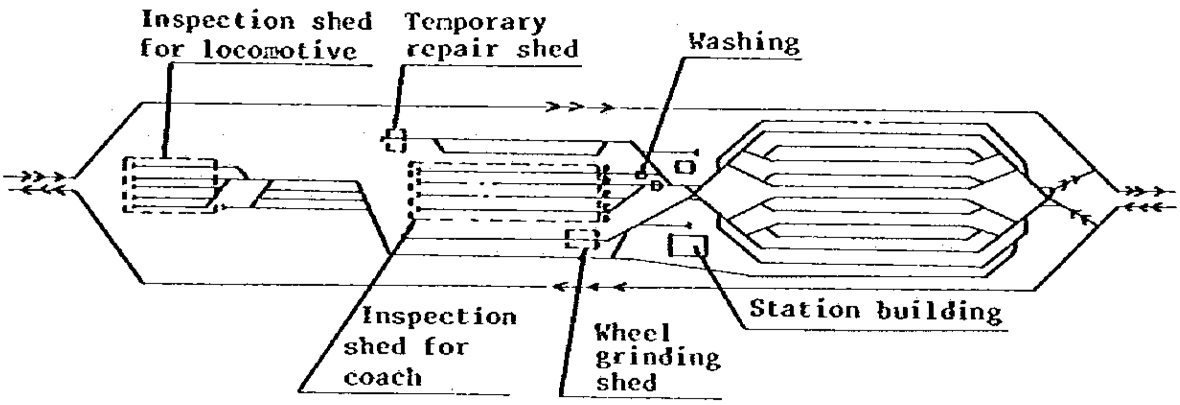


Fig. 7-1-16 Rolling Stock Depot

(3) Track

Track construction is planned with the aim to reduce maintenance cost and manpower to a great extent, and to allow future increases in running speed and passing tonnage on the track. Rail of 60 kg per m class will be used.

The whole track will be of ballast track, except the tunnel section to be designed for slab track in order to save the maintenance manpower because of anticipated difficulty in the futre maintenance work inside the tunnel.

Major design standards are as follows:

1) Ballast track

	Standard Gauge	Meter Gauge
Rail	60 kg/m	60 kg/m
Sleeper		
Main track	Prestressed concrete 43 pieces/25 m	Prestressed concrete 43 pieces/25 m
Side track	Wood (150 mm×240 mm×2600 mm) 39 pieces/25 m	Wood (140 mm×200 mm×2100 mm) 39 pieces/25 m
Fastening (Double elastic type)		
PC sleepers	JNR's high-speed type	JNR's high-speed type
Slab track	JNR's direct No. 4 type	JNR's direct No. 4 type
Ballast depth		
Main track	300 mm	250 mm
Side track	200 mm	150 mm

2) Slab track

Track slab thickness	200 mm	180 mm

3) Turnout

Main track	Movable frog No. 18 (straight)	Rigid frog No. 16 (straight)
Sub-main track	Rigid frog No. 14 (double)	Rigid frog No. 14 (double)
Side track	Rigid frog No. 9	Rigid frog No. 9

With regard to the turnout, the movable frog No. 18 will be used for high-speed operation as the turnout for main-track on the standard gauge. For all the rest, rigid frogs will be used.

The cross section views of track designed by the standards above are shown in Fig. 7-1-3, Fig. 7-1-4 and Fig. 7-1-11.

7-1-4 Electric facilities

(1) Electrification

1) The electrification system is designed for the single-phase, 50Hz, 25kV AT feeding system.

2) The electric power will be received from the N E B with the three-phase, 50Hz, 132kV double circuit lines.

3) Since the single-phase fluctuating load of electric railway gives various influence to the NEB's power supply network system, JNR's allowable limit was applied to design the substation facilities.

4) The feeder transformer will be of Scott connection with a capacity of 20MVA for the standard gauge and 15MVA for the meter gauge.

5) Substations (Fig. 7-1-17) will be unattended and all the electric equipment will be controlled under supervisory remote control system from Kuala Lumpur.

6) Overhead contact wire system (Fig. 7-1-18)

   Standard Gauge: Heavy simple catenary system
   Meter Gauge : Simple catenary system

7) As the supporting structure, PC poles will be used in view of maintenance saving and economic advantage. Aluminum wire will be used for feeder and protective wire.

8) Preventive measures against lightning has been taken into consideration since the project area is noted as a heavy lightning area.

(2) Financial analysis on electrification

Financial analysis has been made to find whether electrification is advantageous or not. In the case of electrification, construction cost will be more expensive than the case of non-electrification but operation and maintenance cost will be cheaper (Table 7-1-3).

F.I.R.R. values of electrification compared with non-electrification in Case A-A and Case D-C has been calculated as follows, and the values show electrification is advantageous over non-electrification.

Case A-A 20.5%

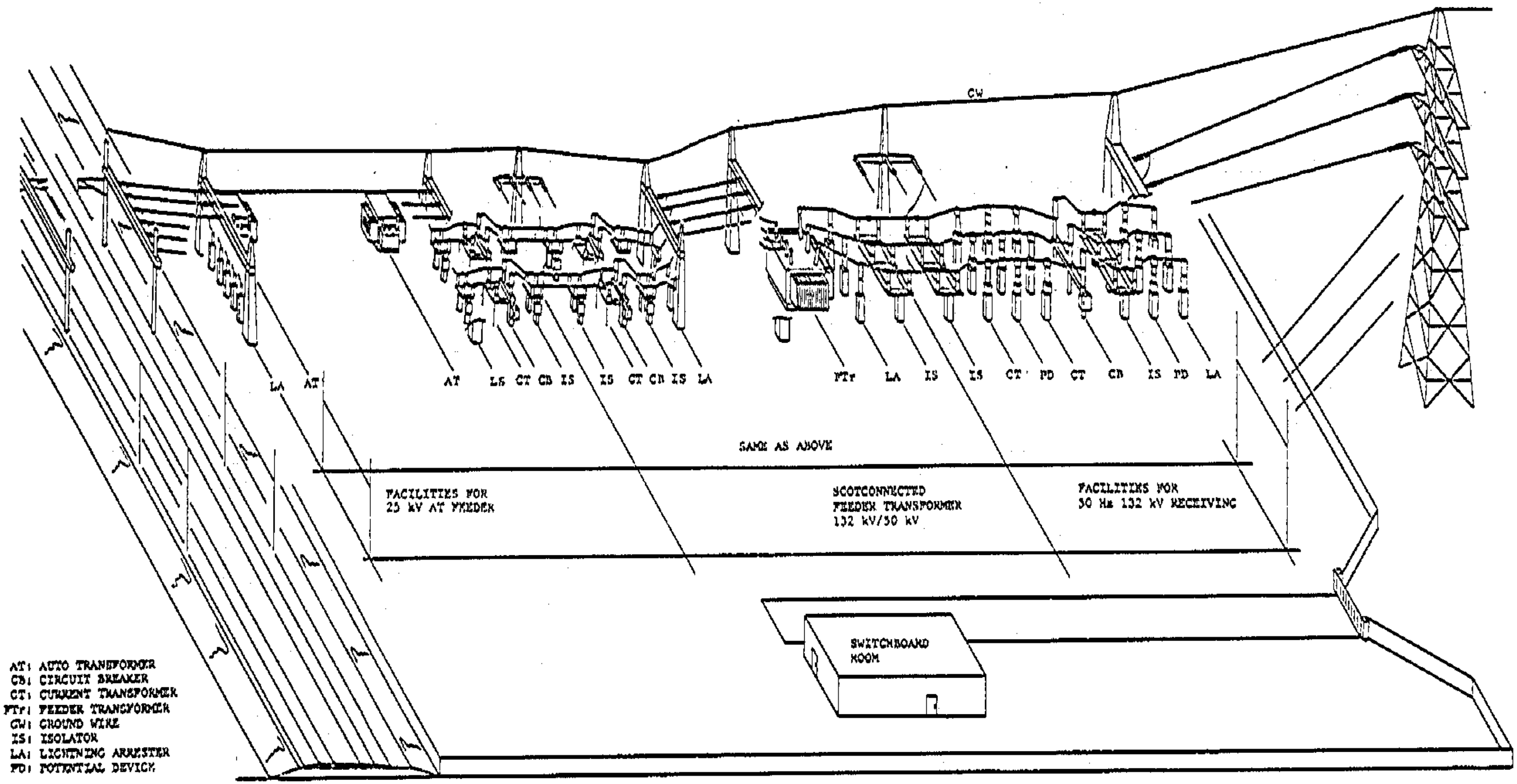
Case D-C 14.7%

Table 7-1-3 Costs for Financial Analysis on Electrification

Unit: 1 million M$ (in 1981)

Item	Case A-A		Case D-C	
	Electrification	Non-electrification	Electrification	Non-electrification
Construction cost				
Ground facilities	746	102 *1	602	102 *1
Rolling stock and workshop *2	552	676	431	504
Difference	520		427	
Operation and maintenance cost				
Ground facilities	6	0	6	0
Rolling stock and workshop *2	15	55	12	35
Fuel cost	130	263	65	120
Difference	167		72	

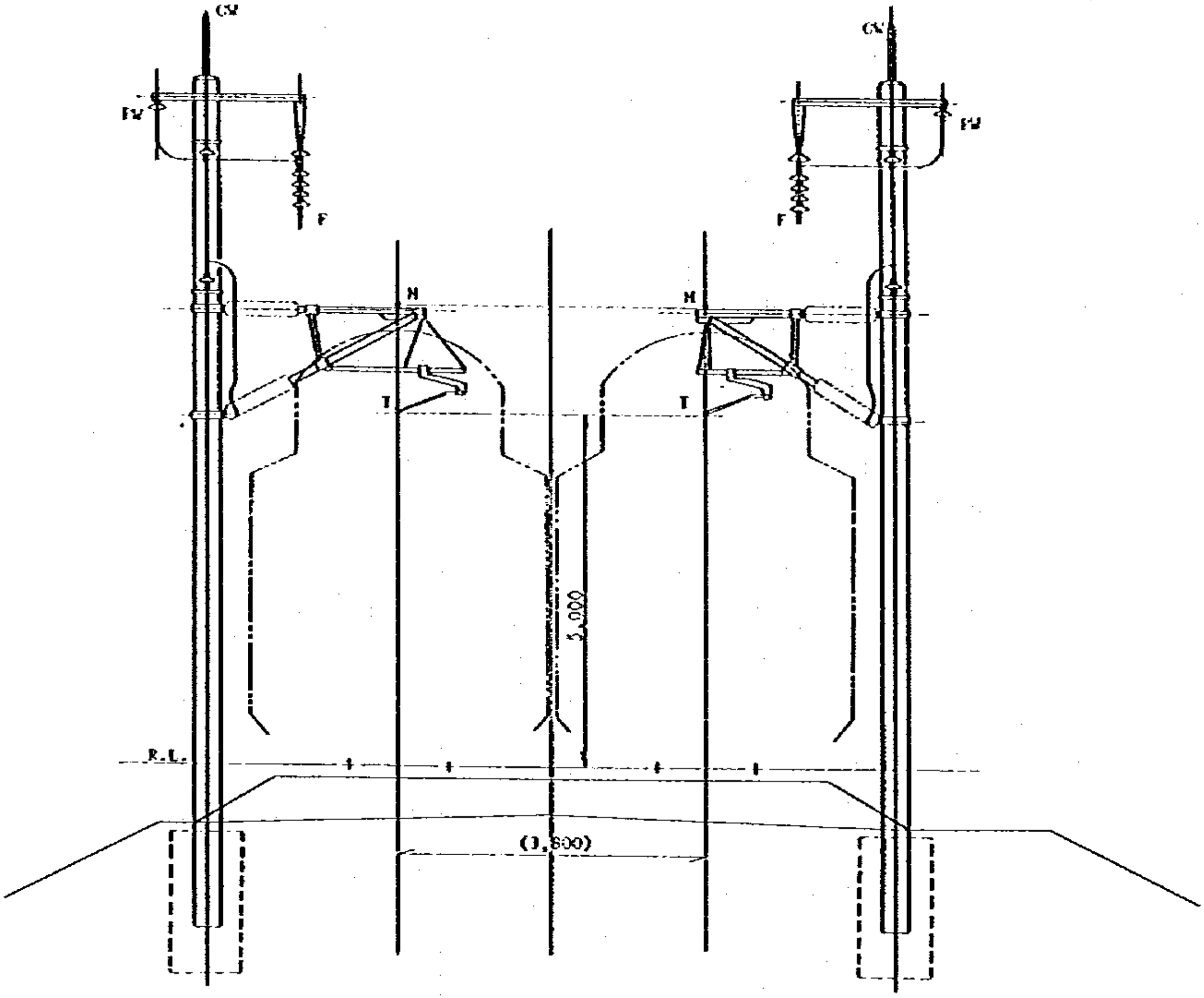
*1 High-voltage power source for signalling
*2 Limited only to the cost for locomotives



NOTE AT: AUTO TRANSFORMER
CB: CIRCUIT BREAKER
CT: CURRENT TRANSFORMER
PTr: FEEDER TRANSFORMER
GW: GROUND WIRE
IS: ISOLATOR
LA: LIGHTNING ARRESTER
PD: POTENTIAL DEVICE

Note: Only authorised persons can enter.

Fig. 7-1-17 Conceptual Drawing of AC-substation for AT Feeding System



Unit: mm

NOTE

F : FEEDER WIRE
GW : GROUND WIRE
M : MESSENGER WIRE
PW : PROTECTIVE WIRE
T : TROLLEY WIRE
( ): FOR METER GAUGE

Fig. 7-1-18 Standard Mounting of Pole

(3) Signalling

The signalling system is planned on a basis of the Automatic Train Stop (ATS) device as trains will be operated at 160 km/h for the time being. (The Automatic Train Control (ATC) device will be installed in the future when train speed may be increased to a higher rate.)

The main outline is shown in Fig. 7-1-19.

1) Interlocking device

The first-class electric relay interlocking device will be used because of its greater advantage in safety and maintenanceability.

2) Centralized traffic control device (CTC)

The CTC Center will be established in Kuala Lumpur with the role to supervise and control the performance of the signalling system at each station and operation of all trains.

3) Block system

The automatic block system will be used. The track circuit is 80Hz cord type with a standard length of 4 km. The block signal will be installed at the boundary to the block section.

4) ATS device

The control system of ATS will be designed for the intermittent control system with the checking type on both cab and ground.

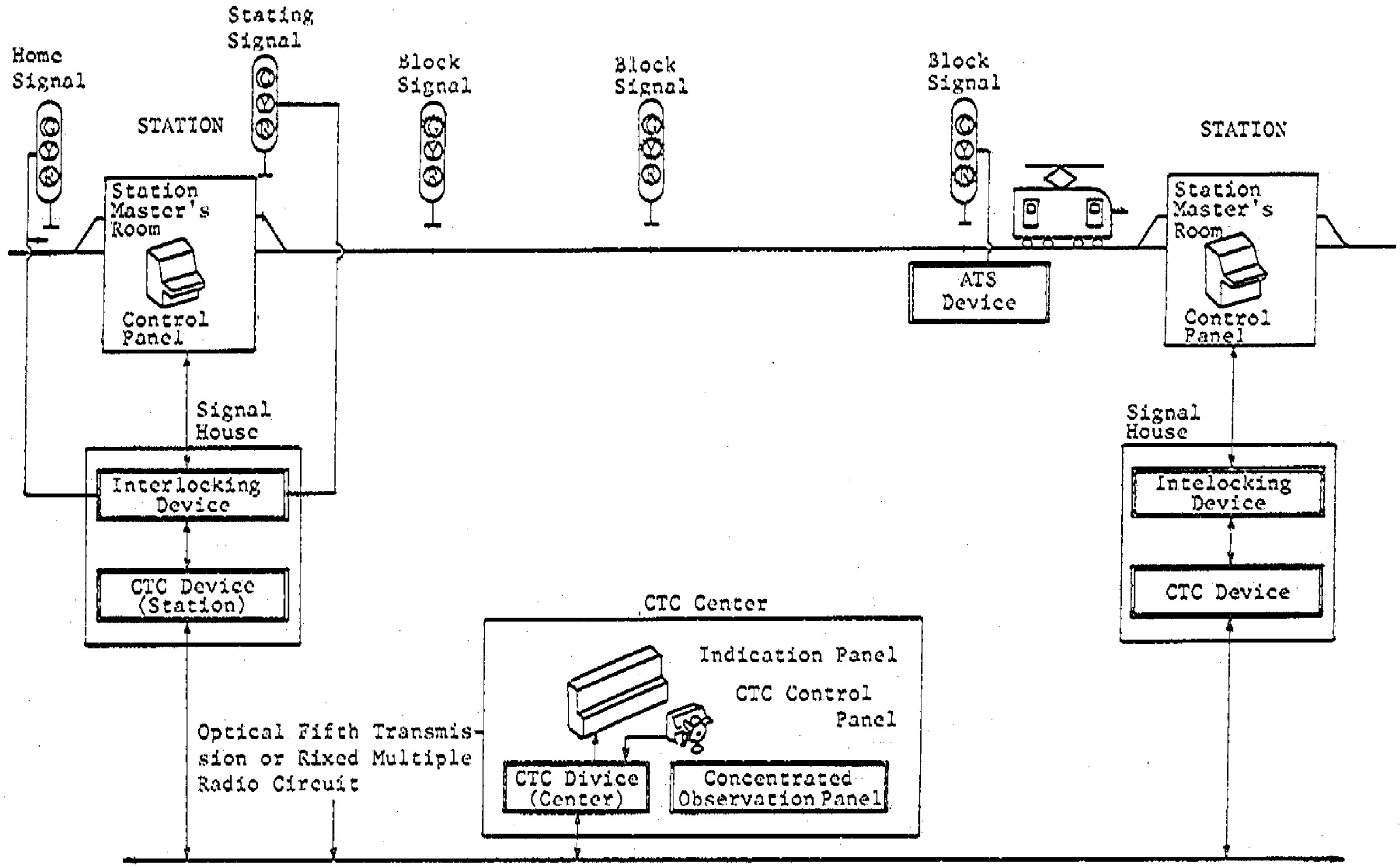


Fig. 7-1-19 Signal Equipment Composition

(4) Telecommunication

The system outline is shown in Fig. 7-1-20.

1) Telecommunication system

a) Optical fiber cable transmission system

The optical fiber cable transmission system will be installed so as to secure transmission circuit of large capacity, long-distance, superior quality and to keep the designed composition channels free from inductive disturbance of AC electrification.

b) Fixed multiplex radio circuit

The fixed multiplex radio circuit will be installed as the back-up circuit for important channels for CTC, substation control and dispatch telephone, etc.

c) Cable

Optical fiber cable for main channels and copper cable for local channels.

d) Automatic telephone exchange

The automatic telephone exchange network exclusively for railway operation will be installed so as to ensure prompt and smooth intercommunications between stations and other service organizations.

e) Train radio

A train radio system will be installed for communication between the running train and the offices.

f) Telephones

The dispatching telephone system will be installed for the exclusive direct communication of the traffic dispatcher or the electric power dispatcher, etc. The wayside telephone will be installed between the stations for the inspection gang.

g) Other devices

i) The yard radio and talk-back system will be provided for services within the station yard, the shunting yard and other yard.

ii) The paging system will be installed to call up the staffs working between the stations.

iii) The teletypewriter will be provided for dispatching and business communication services.

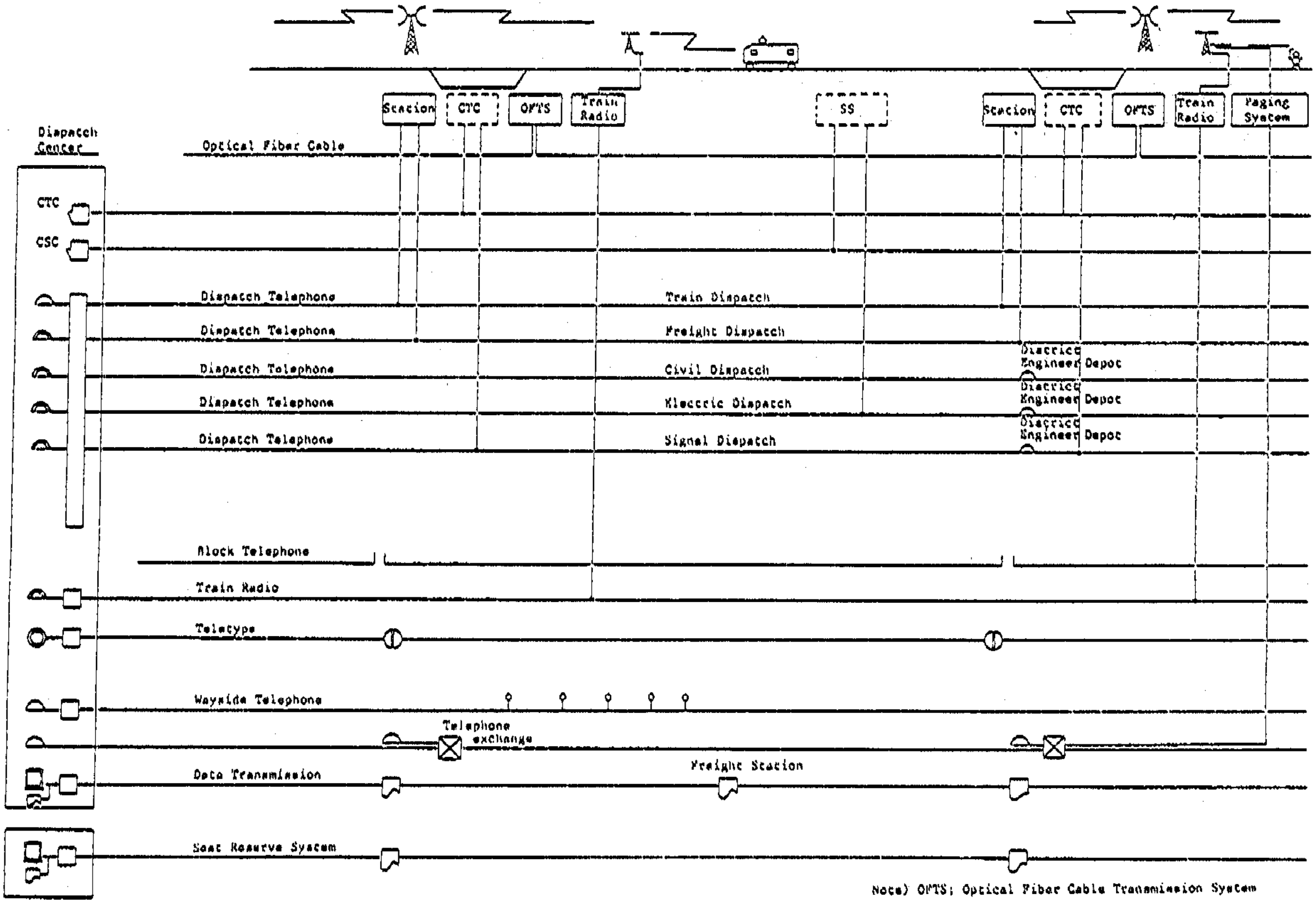
h) Inductive disturbance

It will become necessary to compensate for possible inductive disturbance to the public telecommunication facilities existing in close proximity to the railway track, as the result of installation of AC electrification.

2) Computer system

The computer system will be provided for the following items:

i) Ticket sales and seat reservation system
ii) Traffic data system
iii) Freight data system
iv) Stock inventory system
v) Other management system



Note) OFTS; Optical Fiber Cable Transmission System

Fig. 7-1-20 Telecommunication System Plan

7-1-5 Rolling stock and workshop

(1) Rolling stock

1) AC electric locomotive for main track

a) Locomotives will be distincted exclusively for passenger and freight trains for the following reasons:

- It is preferable to separate the locomotive for the passenger train from that for the freight train because of large difference in both running speed and haulage between passenger and freight trains.
- Even though locomotives are divided into for passenger and for freight, they can form up each separate group consisting of sufficient number for the scale merit.

b) In order to reduce the number of standby locomotives, they should have such performance as may be operable commonly for both of the West Coast Line and the New East-West Line, in so far as the track is designed with the identical type of gauge.

c) Main design factors are as follows:

	Gauge	Max. speed	Output	Axle arrangement	Weight in working order
Passenger	Standard Gauge	160 km/h	3,200kW	B-B	approx. 100 t
	Meter Gauge	120 km/h	1,900kW	B-B	approx. 70 t
Freight	Standard Gauge	120 km/h	4,200kW	C-C	approx. 120 t
	Meter Gauge	100 km/h	2,900kW	C-C	approx. 100 t

2) Electric diesel locomotive for shunting

a) Shunting locomotives will be newly manufactured for the meter gauge as well as for the standard gauge for the following reasons:

- The locomotives of suitable size for shunting use in the present holding are already aged over 15 years and seem to have reached the critical time for replacement.

- All those locomotives which may become unused any longer after implementation of this project will, nevertheless, be transferrable to other railway divisions without any economic loss or waste.

b) Main design factors are as follows:

	Max. speed	Output	Axle arrangement	Weight in working order
Standard Gauge	55 km/h	1,000 HP	B-B	approx. 60 t
Meter Gauge	55 km/h	800 HP	B-B	approx. 50 t

3) Passenger cars

a) Passenger cars will be designed at 21 m in length for both standard and meter gauges. The maximum speed will be set as specified hereunder:

	Super express and express	Local
Standard Gauge	160 km/h	120 km/h
Meter Gauge	120 km/h	100 km/h

b) The passenger service facilities will be as follows, taking into consideration the facts that the train have to compete with the airplane and the motorcar.

	Seating capacity		Air conditioning	Seat	Baggage compart.	Toilet
	1st	2nd				
Super express & express	30	60	Provided	Recylining	Provided	Provided
Local	–	76	Provided	Simplified reclining	Not provided	Provided

4) Freight cars

a) Freight cars will be designed all for bogies of various types such as covered wagon, low side wagon, flat wagon, container wagon, tank wagon, hopper wagon and brake van.

b) All those freight cars will be designed as to meet requirement of running speed at 120 km/h for the standard gauge and 100 km/h for the meter gauge.

c) Weight of load will be designed at 40 tons.

(2) Workshop

1) The existing facilities at the Sentul Workshop require drastic change and improvement, since they are rather superannuated and their layout are not suited for the modernized inspection process of rolling stock. Moreover, if the present facilities are modified largely for improvement without suspension of inspection and repair works, they may not turn out to be so much improved for pretty high expenses to be required. Therefore, it is planned that the new workshop will be built at Rawang Kuang by abolition of the existing factory at Sentul.

2) The new workshop will be mechanized as much as possible within the financially-allowable limit.

3) The new workshop is planned on the following conditions:

a) The factory will accommodate the rolling stock to be operated only on the West Coast Line (from Butterworth southwards) and the New East-West Line.

b) Number of rolling stock for inspection and repair will be calculated for estimation by due reference to the JNR's standard of cycling period for inspection (on a basis of operating kilometerage) (Table 7-2-3)

c) Required time for inspection and repair will be extended a little longer in consideration of availability of spare parts from abroad.

7-1-6 Construction costs

Construction costs are estimated, not only for the West Coast Line and the New East-West Line, but also for their branch lines to the ports. In the alternatives of Case B-B and C-B, the standard-gauge track will be added between Kuala Lumpur and Port Kelang so as to meet the need of operating through freight trains from the New East-West Line.

Incidentally, since the study period was limited, cost estimation at the 1981 price has been roughly made. Therefore, futher study for the construction cost estimate will have to be made in details together with the geological study.

Table 7-1-4 Construction Costs

Unit: Million M$
(Price level in 1981)

	West Coast Line		New East-West Line		Total	
Case A-A	(691.2 km)		(544.0 km)		(1,235.2 km)	
Land acquisition	16%	1,013	17%	905	17%	1,918
Civil & track	50%	3,188	53%	2,759	51%	5,947
Power, signalling & telecommunication	13%	817	10%	492	11%	1,309
Rolling stock & workshop	21%	1,397	20%	1,018	21%	2,415
Total	100%	6,415 (9.3/km)	100%	5,174 (9.5/km)	100%	11,589 (9.4/km)
Case B-B	(S 691.2km Av. M 735.6km 713.4km)		(544.0 km)		(1,257.4 km)	
Land acquisition	17%	1,145	17%	839	17%	1,984
Civil & track	53%	3,515	57%	2,794	55%	6,309
Power, signalling & telecommunication	13%	848	10%	507	11%	1,355
Rolling stock & workshop	17%	1,121	16%	803	17%	1,924
Total	100%	6,629 (9.3/km)	100%	4,943 (9.1/km)	100%	11,572 (9.2/km)
Case C-B	(700.0 km)		(544.0 km)		(1,244.0 km)	
Land acquisition	16%	807	17%	839	17%	1,646
Civil & track	48%	2,376	56%	2,797	52%	5,173
Power, signalling & telecommunication	13%	668	10%	507	11%	1,175
Rolling stock & workshop	23%	1,121	17%	844	20%	1,965
Total	100%	4,972 (7.1/km)	100%	4,987 (9.2/km)	100%	9,959 (8.0/km)
Case D-C	(735.6 km)		(544.0 km)		(1,279.6 km)	
Land acquisition	16%	755	18%	831	17%	1,586
Civil & track	46%	2,179	53%	2,366	49%	4,545
Power, signalling & telecommunication	15%	699	10%	427	12%	1,126
Rolling stock & workshop	23%	1,098	19%	875	22%	1,973
Total	100%	4,731 (6.4/km)	100%	4,499 (8.3/km)	100%	9,230 (7.2/km)