THE REPUBLIC OF INDONESIA

REPORT ON FEASIBILITY STUDY

OF

GRADE SEPARATED CROSSING IN MANGGARAI STATION

TRACK ADDITION AND OTHER IMPROVEMENTS ON MERAK LINE
AND
TRACK ADDITION AND OTHER IMPROVEMENTS ON TANGERANG LINE

JUNE 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

(JICA)

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PREFACE

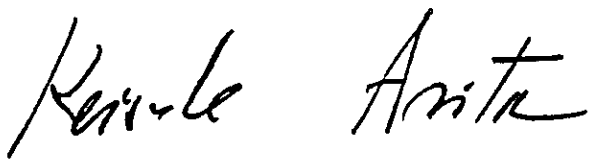
In response to the request of the Government of the Republic of Indonesia, the Government of Japan decided to conduct a feasibility study on the Project for Grade Separated Crossing in Manggarai Station and Track Addition and other Improvements on Merak Line and Tangerang Line, and entrusted the study to the Japan International Cooperation Agency (JICA). The JICA sent to Indonesia a study team headed by Mr. Akira Tamura, Director of the Japan Railway Technical Service, for three months starting July 1984 under the guidance of the Supervisory Committee Chaired by Dr. Fumio Nishino, Professor of the University of Tokyo.

The team held discussions with the officials concerned of the Government of Indonesia on the Project and conducted a field survey in Indonesia. After the team returned to Japan, further studies were made and the present report has been prepared.

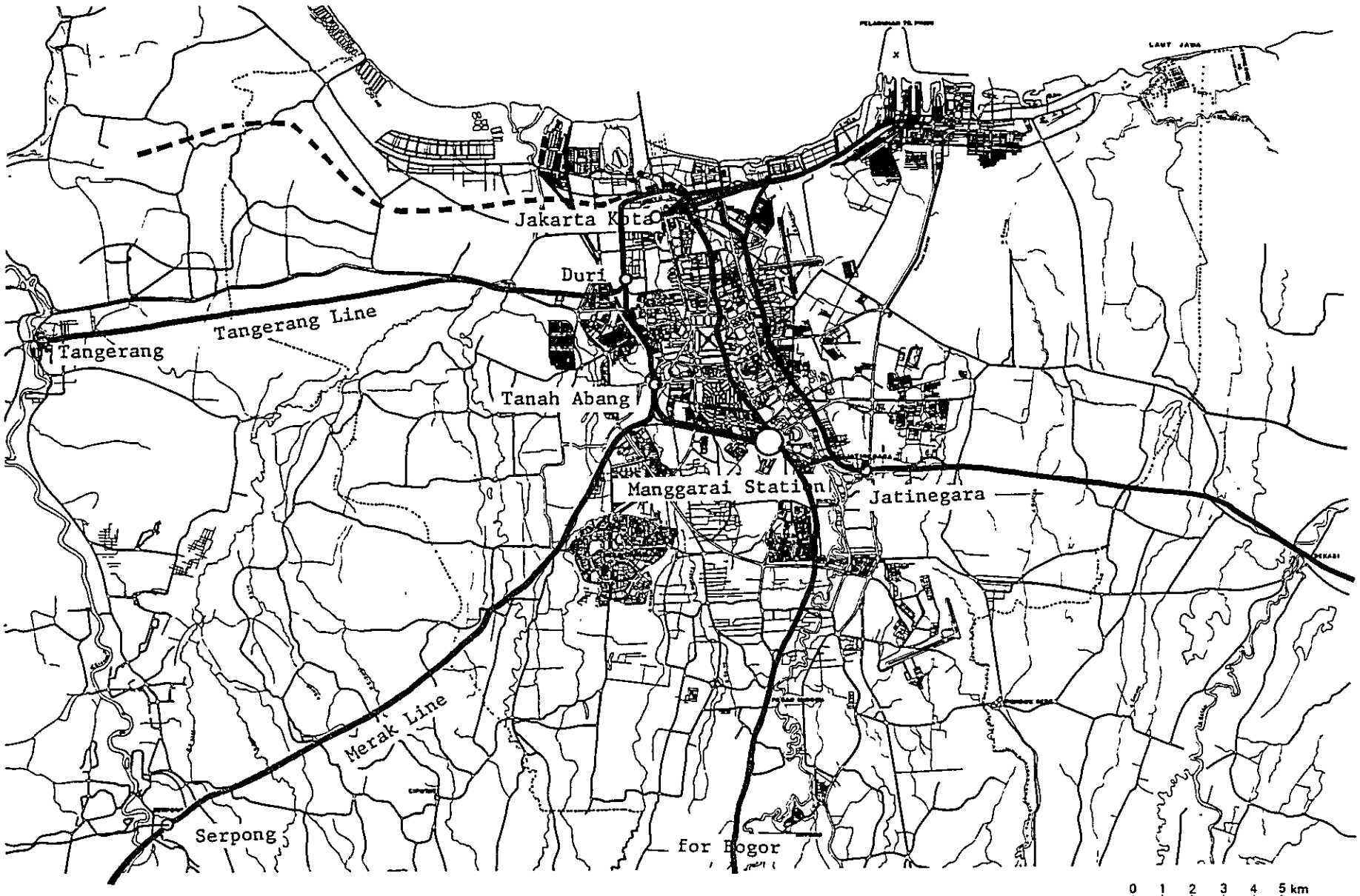
I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

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

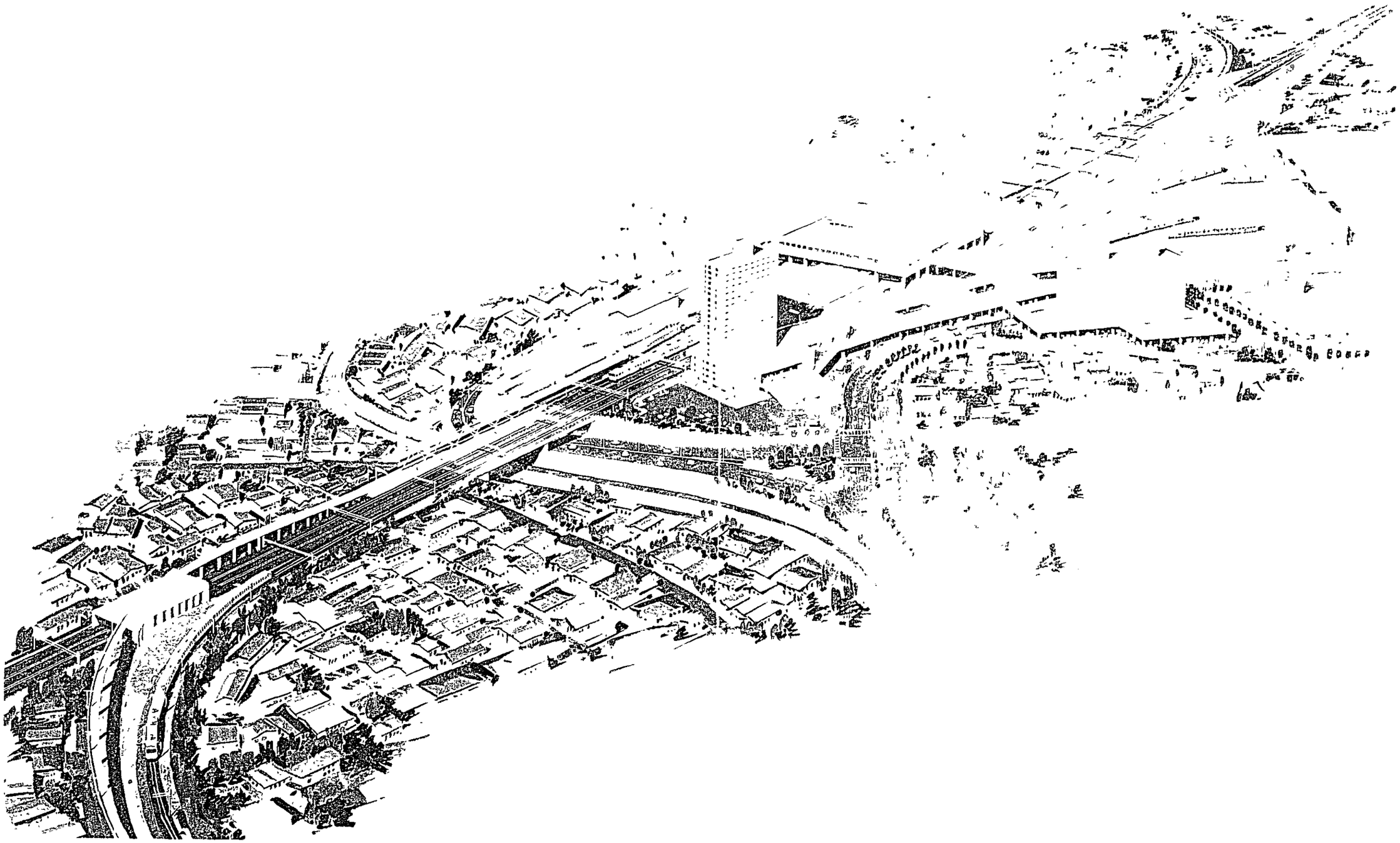
June 1984



Keisuke Arita
President
Japan International Cooperation Agency



PROJECT LOCATION MAP



Grade Separated Crossing at Main Street

SUMMARY

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INTRODUCTION

The JABOTABEK population has been rising rapidly, due largely in part to Indonesia's recent vigorous industrial and economic growth. Social and economic development planning needs have been increasing proportionately.

The JABOTABEK Metropolitan Development Plan (JMDP), a comprehensive development plan for the entire area, was presented in 1980.

At present, road traffic accounts for the greater portion of land transportation. The extremely congested roads cause delays, pollution and an increasing number of traffic accidents.

In order to remedy this situation, the Government of Indonesia has planned to improve its railway system to make it safer and faster in addition to increasing its punctuality and fuel efficiency.

To promote technical cooperation, the following three feasibility study were conducted by the Government of Japan through the Japan International Cooperation Agency (JICA) in response to a request from the Government of Indonesia.

(1) Feasibility study on the grade separated crossing in Manggarai Station which will eliminate interference in train operations between the Central Line and the Western Line

(2) Feasibility study on track addition and other improvements between Tanah Abang and Serpong on the Merak Line

(3) Feasibility study on track addition and other improvements between Duri and Tangerang on the Tangerang Line.

I. GRADE SEPARATED CROSSING IN MANGGARAI STATION

NECESSITY OF THE PROJECT

Manggarai Station, approximately 5 km south of the city center, is the interchange station between the Central Line and Western Line.

If Manggarai Station is not improved the rail transportation capacity will be forced below the demand level from 1988 onwards, and other investments to improve the Central and Western lines will be rendered ineffective since Manggarai Station will act as a bottleneck.

"The rate of interference" by percentage was utilized to indicate the degree of interference. Where the rate of interference exceeds 60%, train operation planning becomes impossible. At level crossings in Manggarai Station, the rate of interference will exceed 60% in 1988 and early 1989 for both the North and South ends of the station as shown in the following Table S.1.

Table S.1 Number of Trains and Rate of Interference

Year / The number of trains	85	86	87	88	89	90	91	92	93	94
Cengkareng Airport Train	-	-	-	-	6	6	6	6	6	6
From Borgor to Tanah Abang	2	2	3	3	4	5	6	7	8	9
From Bogor to Gambir	7	8	8	9	9	10	11	11	12	13
From Jatinegara to Tanah Abang	6	6	7	7	8	8	9	9	10	10
Total	15	16	18	19	27	29	32	33	36	38
Rate of Interference (North end %)	43.8	48.1	51.6	55.9	85.0	91.0	98.8	100.5		
Rate of Interference (South end %)	48.9	53.2	59.2	63.5	79.9	88.5	98.8	103.0		

Note: Long distance trains not included

Therefore, to maintain the mass transit function for commuters, the construction of flyover crossings at Manggarai station should be completed by 1988. However, even if the project were to commence now, the completion date would be in 1990 since the required construction time is approximately 6 years.

SELECTION OF ALTERNATIVES

In order to choose the optimum proposal for this project, 9 alternatives (A to I) were considered according to the following criteria:

(1) Topographical conditions of the site
(2) Minimization of land acquisition
(3) Achievement of the most well integrated mass transit system possible by:
   - Smooth operation of all train routes
   - Separating long distance trains and commuter trains (Long distance trains require more station time than commuter trains, and long distance train riders and those who meet or send them off will occupy the platform for longer time periods.)
   - Facilitating transfer of commuter passengers to the other line in the same direction at the same platform to reduce passenger congestion

Based on the above criteria, alternative G-14 was selected out of nine alternatives. With this alternative, 4 platforms and 6 tracks are planned for Manggarai Station to ensure the smooth flow of passengers and trains. Two flyover crossings are to be constructed at each end of the station. Fig. S.1 shows both the location and profile of the proposed flyover crossings and the track and platform layout.

DEMAND FORECAST AND TRAIN REQUIREMENT

The number of passengers to be passing through Manggarai Station in 1995 per day is estimated to be about 500,000 and the figure for 2005 is 1,100,000. Of these totals, the projected number of passengers getting on and off at Manggarai Station will be 100,000 and 240,000 per day respectively.

The estimated passenger flows for the years 1995 and 2005 are shown in Fig. S.2.

To meet the forecast traffic demand, the following number of trains and train headways are required during the peak 2 hours as shown in Tables S.2, S.3.

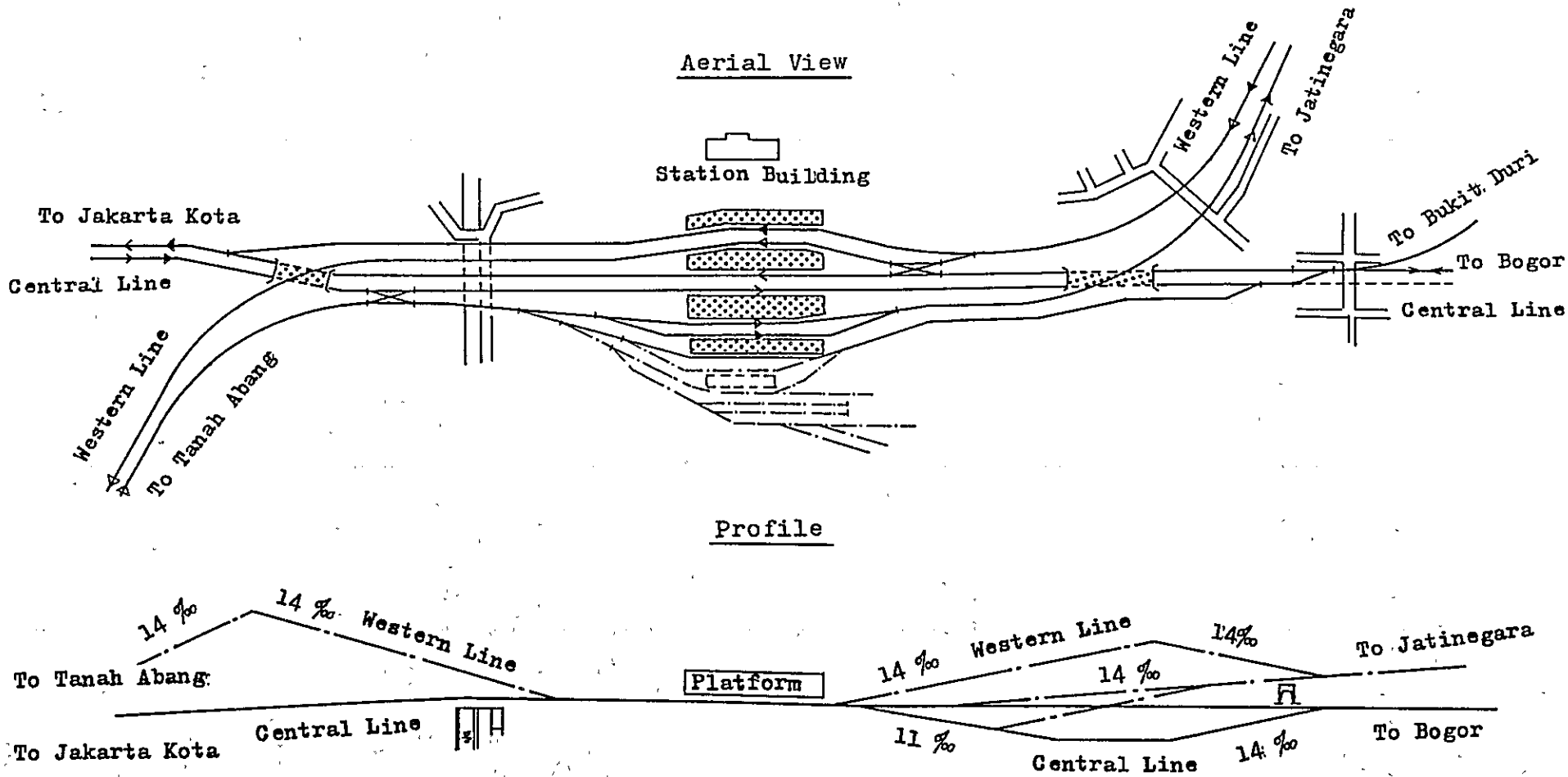


Fig. S.1 Proposed Flyover Crossings at Mangarai Station
(Alternative G-14)

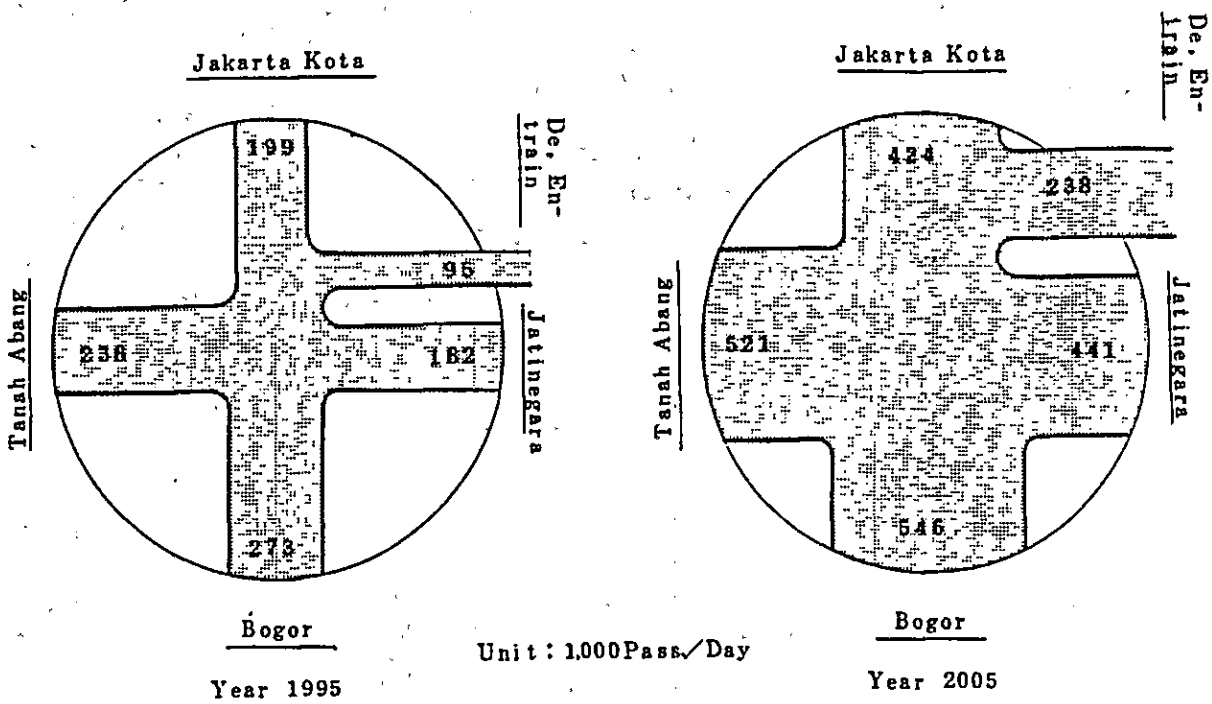


Fig. S.2 Estimated Passenger Flows at Manggarai Station

Table S.2 Number of Trains*

(minute)

	Central Line		Western Line	
	To Jakarta Kota	From Bogor	To Tanah Abang	From Jatinegera
1985	7	9	8	6
1995	19	25	22	17
2005	26	34	32	27
2015	30	38	37	31

Table S.3 Train Headway

(minute)

	Central Line		Western Line	
	To Jakarta Kota	From Bogor	To Tanah Abang	From Jatinegara
1985	17.0	13.5	15.0	20.0
1995	6.5	5.0	5.5	7.0
2005	4.5	3.5	4.0	4.5
2015	4.0	3.0	3.0	4.0

*Note: 1985/1995: 8 cars/train set
2005/2015:12 cars/train set

PRELIMINARY DESIGN OF THE GRADE SEPARATED CROSSINGS

In order that presently operational electric car trains and locomotive hauled trains can continue to be used, a 14‰ gradient is designated.

The standards of electric facilities are to be same as those of other electrified lines in the JABOTABEK Area.

The interlocking system is to be a relay-type designed to set a route under remote control in order to increase operator efficiency and ensure safety of train operations.

The flyover at the north junction will be constructed while maintaining full operation on both the Central and Western lines. Therefore, land outside the PJKA right-of-way must be purchased, particularly on the north side of the Western line, and many houses will have to be removed.

IMPLEMENTATION SCHEDULE

For the construction work to be completed in time to permit an increase in the number of trains, project funding and detailed design work should begin in early 1984. The overall project implementation schedule is shown in Table S.4.

Table S.4 Manggarai Station Implementation Schedule

Work Item	Execution Year					
	'84	'85	'86	'87	'88	'89
Roadbed						
Bridge						
Station Yard						
Track						
Building & Others						
Electric & Signal						

⊏⊐ Period for detailed design

Construction work is to be carried out alongside operating lines and, therefore, special attention must be paid to both passengers' and workers' safety.

The existing facilities are to be entirely replaced. However, because there is not sufficient space to construct all of the facilities at one time while maintaining the existing function of the station, construction work will be carried out step by step. This will involve repeated switching of train operations from present tracks to new tracks. A construction period of four years is required.

INVESTMENT

The total cost of the project is estimated to be 34,760 million Rp. The local currency portion is 16,380 million Rp and foreign currency portion is 18,380 million Rp as shown in Table S.5.

Table S.5 Total Project Cost

Unit: Mil. Rp.

Work Item	Investment by Source		
	Foreign	Local	Total
1. Civil structure of track construction	10,410	9,960	20,370
2. Electrification	3,570	3,990	7,560
3. Signal & telecommunication	4,400	900	5,300
4. Compensation		1,530	1,530
5. Grand Total	18,380	16,380	34,760

Note: September 1983 value
Rp 980 = US$ 1.00 = yen 245

BENEFIT

It is clear that a grade separated crossing is the most advantageous way to eliminate level crossing interference. However, the benefits of the project are greater since the grade separated crossings at Manggarai Station will alleviate a critical railway traffic problem in the JABOTABEK railway network given the station's pivotal role therein.

The grade separated crossings will permit an increase in the number of trains and train riders. The motor vehicle congestion on the roads will decrease, as shown in Table S.6.

Table S.6 Change of Daily Traffic Volume

	1995	2005
Road (Decrease) pcu.km	494,800	3,513,300
(Decrease) pcu.hr	29,700	116,400
Railway (Increase) pass.km	2,095,100	9,845,300
(Increase) pass.hr	72,900	298,100

A cost saving benefit of 2,208 billion Rp (including fuel savings of 667 billion Rp) and a time saving benefit of 704 billion Rp will be obtained by the implementation of this project.

In addition, this project will create many employment opportunities, as shown in Table S.7.

Table S.7 Employment Creation

1) For construction	8,800 man-years
2) Operational PJKA workers	
1990	120 persons
2000	1,034 persons
2010	1,248 persons

ECONOMIC EVALUATION

Evaluation of the economic feasibility of the project is based on the cost difference of rolling stock and related personnel (drivers and conductors) which pass through Manggarai Station between cases "with" and "without" the project in addition to the construction cost of the station.

The existing facilities are considered to be sunk costs, and, therefore, not included for the calculation of the EIRR (Economic Internal Rate of Return).

The EIRR for the case obtained by the aforementioned method is 37.2%, which exceeds the standard level of Indonesian railway projects. Hence, it is considered that this project is fully feasible.

In order to confirm the viability of this conclusion, a sensitivity analysis was made assuming more pessimistic values for construction costs and traffic volume.

The results show that even with a 20% cost overrun or a decrease of 30% in traffic volume, the EIRR would be 35.1% and 31.1% respectively. Even with both a 20% cost overrun and a decrease of 30% in traffic volume in extreme cases, the EIRR will be 29.2%. This indicates that this project is sufficiently viable to satisfy the extreme cases in the sensitivity analysis.

FINANCIAL EVALUATION

In consideration of a finance program, a cash flow projection was prepared and an evaluation was carried out from the following standpoints:

- Profit and loss projection of this project, to determine necessity of government subsidies
- Financing of debt for this project and debt repayment ability from the cash flow projection
- Fare level

The conclusion of the financial evaluation is as follows.

Under the following two basic conditions:

- Local portion is financed by means of the government budget.
- Low interest (4%) and long-term concessional loans from overseas are sought for the foreign currency portion.

(1) Present railway fares will be sufficient to cover operating expenses throughout the project life, if debt service for overseas loans is carried out by the government.

(2) Present railway fares must be increased by 21%, if debt service for overseas loans is covered by the fare income.

The above conclusion is based on the premise that all other projects in the JABOTABEK railway network are implemented in addition to this "point project".

FUTURE PLAN

The Urban Renewal Plan in the Manggarai Station vicinity is to be integrated with the improvement of the station. Access roads to the station and the station front plaza should be jointly arranged with the Manggarai Station project.

The quadrupling of tracks is planned between Jakarta Kota and Manggarai. Two tracks can be easily added to the new layout.

Space can be allocated for terminating trains at Manggarai Station when more facilities for long distance trains are necessary, since it is possible to lay additional platforms and tracks.

CONCLUSION

This project is technically and economically feasible. Since this project is one of the improvement projects of the Central and Western lines, it should be implemented at the same pace as the other improvement projects.

The priority of this project's promotion is clearly recognized.

II. TRACK ADDITION AND OTHER IMPROVEMENTS ON THE MERAK LINE

NECESSITY OF THE PROJECT

The transportation capacity of the single track with 8 car trains in peak 2 hours is 18,000 passengers per direction. Therefore, it is necessary to complete the construction of the double track before the railway traffic demand in peak 2 hours exceeds 18,000 passengers forecast for 1993. The relation between transportation capacity and passenger traffic demand is shown in Fig. S.3.

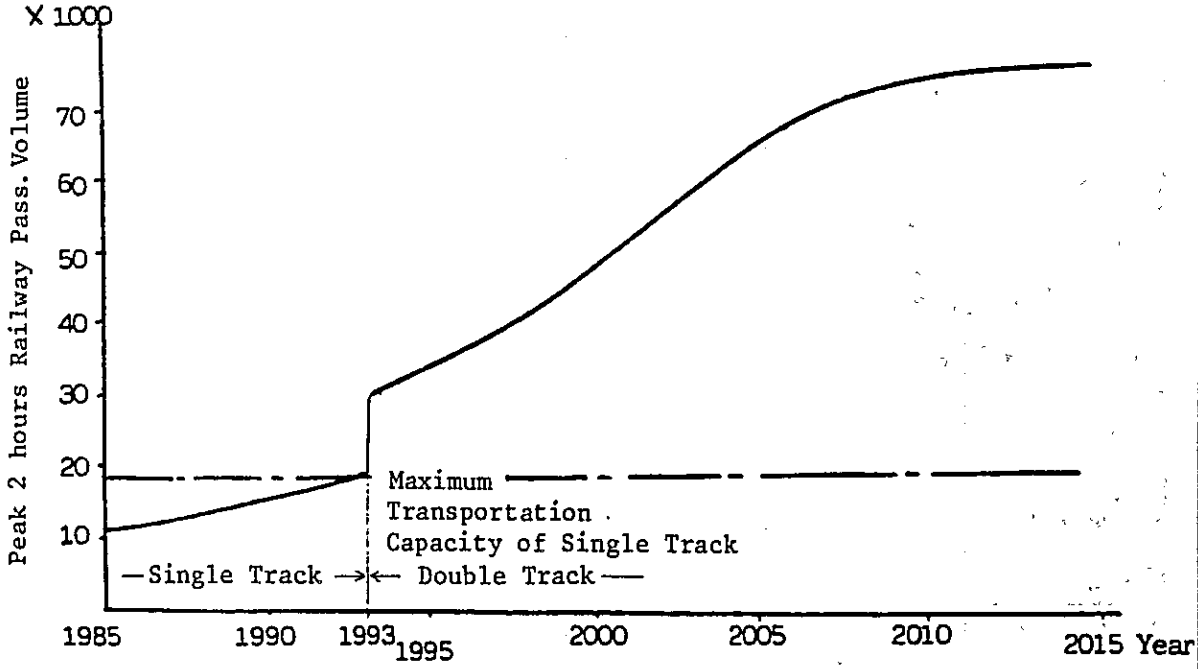


Fig. S.3 Transportation Capacity and Passenger Traffic Demand

Furthermore, the need for railways as a major mode of urban transportation is becoming apparent since road traffic is always congested. However, to function as urban passenger transportation, many improvements are needed, for at present the Merak Line is mainly used for medium and long distance passenger and freight service.

TRAFFIC DEMAND FOR TRAIN OPERATION

At present, there are only 2 trains bound for Tanah Abang during the peak 2 hours in the morning. Only the trains numbered in the 600's and 300's are considered commuter trains since they are shuttling between Tanah Abang and Rangkasbitung. Given this, it can be said that the railway offers commuters little service.

With the improvements, the passenger traffic in the peak 2 hours is forecast to grow to 33,000 per direction in 1995, increasing to 66,000 per direction in 2005, as shown in Table S.8.

Table S.8 Forecast of Passenger Flows on Merak Line

Year	1995	2005
1) Maximum Link Traffic : (pass./day)	160,000	318,000
(pass./direction/peak-2 hr)	33,000	66,000
2) Passenger-hour/day	73,412	134,284
3) Passenger-km/day	2,723,587	4,981,922
4) Average travel speed (km/hr)	37.1	37.1
5) Average cross-sectional traffic (pass./km)	117,396	214,738

(Operating distance: 23.3 km between Tanah Abang and Serpong)

PROJECT PLAN

This project involves electrification and track addition for the Merak Line (23.3 km between Tanah Abang and Serpong, part of the trunk line through Java Island and linking to Sumatra Island). In the final stage, 3 minute headway train service with 8 car trains will be possible. There are no technical problems projected for the electrification and track addition work.

The project is divided into the following 3 stages based on demand rise considerations and the effective use of capital.

1ST STAGE: REHABILITATION

The 1st stage involves the rehabilitation of the track and road level crossings, already in progress. The major work is replacement of the R3 rail to R14A rail between stations.

2ND STAGE: EXPANSION

Step-by-step investment of electrification and related improvements is required for rising demand. This will allow frequent commuter service of 15 minute headways with 4 to 8 electric car trains.

This stage involves electrification, replacement of turnouts and steel sleepers in station yards, improvement of crossing loops and new establishment of crossing stations, and improvement of signalling system and telecommunication system.

3RD STAGE: TRACK DOUBLING

For demand which exceeds the carrying capacity of single electrified track in the 2nd stage of 15 minute headways with 8 car trains, track doubling is to be carried out so that more frequent service of 10 to 3 minute headways with 8 car trains can be achieved.

This stage involves track addition and completion of all previously started rehabilitation work. Access roads to the stations and station front plazas must be arranged in accordance with the improvement work. In addition, there is a illegal housing problem in the area. The time-consuming removal

of these illegal houses will be performed in conjunction with the land acquisition for the track doubling.

In addition to the above mentioned improvements in the railway system, transportation capacity will need to be increased continually over the years to meet the continual rise of forecast passenger demand. The number of railcars will need to be increased from 72 in 1989 to 216 in 2006 as shown in Table S.9.

Table S.9 Train Headway, Transportation Capacity and Number of Railcars Required

Year	Track Condition	Train Headway	Passenger Capacity (×1,000)	Number of Train set	Number of Railcars Required
1989-92	Single	15 min.	18.1	8	72
1993-95	Double	8 min.	34.0	11	96
1996-99	Double	6 min.	45.3	15	132
2000-01	Double	5 min.	54.3	18	156
2002-05	Double	4 min.	67.9	22	192
2006-	Double	3.5 min.	108.7	25	216

Remarks: Load factor during peak 2 hours is 200%.
Train headway is for peak 2 hours.
Train formation is 8 cars in all cases.

DESIGN STANDARD

The design standard for this project is outlined below. For the 1st and 2nd stages, a temporary standard noted in parentheses below is provided, taking into consideration the work method and procedure and present conditions.

a. Maximum speed
100 km/h (In the 1st and 2nd stages - 80 km/h)

b. Maximum gradient and minimum radius of curvature of main track
10‰ (gradient), as the existing track (curvature)

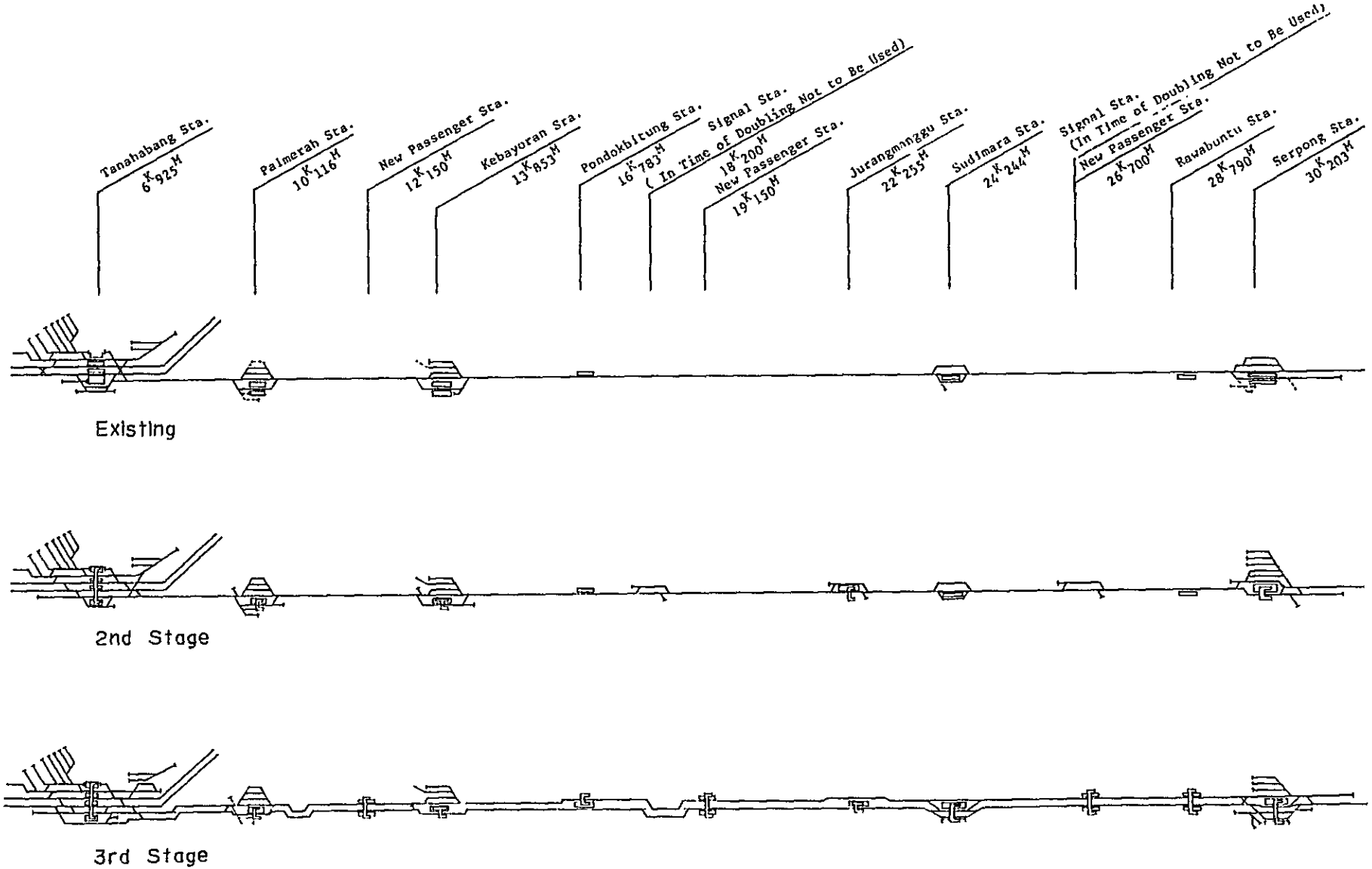


Fig.S.4 Track Layout of Each Stage

c. Track

Rail UIC54 (or equivalent) (In the 1st and 2nd stages between stations - R14A)

Sleeper PC 1,666/km (In the 1st and 2nd stages - Steel 120/85 m)

d. Bridge bearing capacity

KS-16 (In the 1st and 2nd stage - As the existing state)

e. Width of formation level and track center to center distance

2.75 m (from track center), 4.0 m

f. Electrification

DC 1,500 V, simple catenary system.

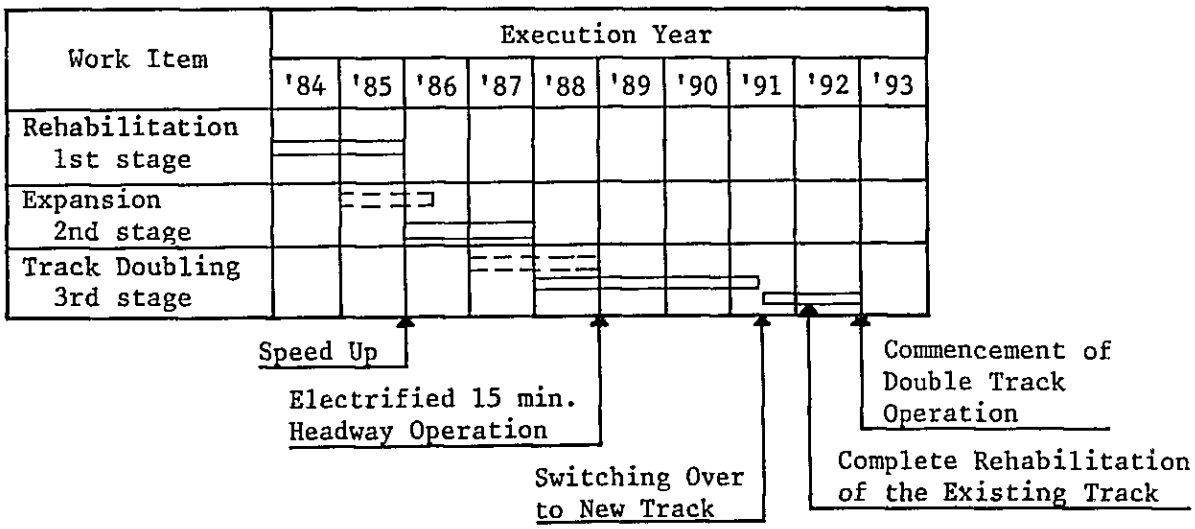
g. Signalling system

Automatic block system and relay interlocking system (In the 2nd stage - Tokenless system due to continued use of steel sleepers)

IMPLEMENTATION SCHEDULE

For maximum capital efficiency and to meet the forecast demand, the three project stages previously outlined were scheduled over 9 years starting in 1984, to be completed by 1992. The implementation schedule is shown in Table S.10.

Table S.10 Merak Line Implementation Schedule



INVESTMENT

Total project cost is estimated at 202,100 million Rp (Local currency portion 36,100 million Rp, Foreign currency portion 166,000 million Rp) as shown in Table S.11.

Table S.11 Estimated Cost of Merak Line Improvements

(Unit: Million Rp)

Work classification	Investment by source		
	Foreign	Local	Total
Civil structure of track construction	22,600	16,400	39,000
Electrification	11,500	11,100	22,600
Signal & Telecommunication	9,200	2,600	11,800
Compensation		2,100	2,100
Rolling stock	122,700	3,900	126,600
Grand total	166,000	36,100	202,100

Note: September 1983 value
Rp 980 = US$ 1.00 = yen 245

BENEFIT

It is expected that accompanying the improvement of rail facilities the Merak Line can be a main axis for promoting urban development of the area surrounding the Line.

On introduction of the electric railcar trains on single track after electrification and establishment of two additional signal stations at 18 km 200 m and 26 km 700 m, travelling time between Tanah Abang and Serpong will be reduced to 44 minutes from the present approximate 48 minutes. After completion of track doubling and with three new Passenger Stations, this time will be further reduced to about 39 minutes.

In addition, when frequent service is made possible, a part of the road traffic will be transferred to railway. Congestion of the roads will be eased, accompanied by a decrease in noise and air pollution.

The decrease in motor vehicle congestion and the increase in train riders are shown in Table S.12.

Table S.12 Change of Daily Traffic Volume

	1995	2005
Road (Decrease) pcu.km	392,800	1,730,400
pcu.hr	41,400	65,700
Railway (Increase) pass.km	2,873,400	6,263,600
pass.hr	40,100	99,300

Therefore, a cost saving benefit of 1,065 billion Rp. (including fuel saving of 390 billion Rp) and a time saving benefit of 572 billion Rp are obtained by the implementation of this project.

In addition, this project will create many employment opportunities as shown in Table S.13.

Table S.13 Employment Creation

1) For construction	17,300 man-years
2) Operational PJKA workers	
1990	253 persons
2000	453 persons
2010	559 persons

ECONOMIC EVALUATION

The EIRR for the base case is 24.8%, exceeding the standard level for evaluation of Indonesian railway projects and showing the feasibility of this project.

In order to confirm the viability of this project, a sensitivity analysis was made assuming more pessimistic values for construction cost and traffic volumes.

The results show that even with a 20% cost overrun or a decrease of 30% in traffic volume, the EIRR would be 22.5% and 18.5% respectively. Even with both a 20% cost overrun and a decrease of 30% in traffic volume in extreme cases, the EIRR will be 16.6%. This indicates that this project is sufficiently viable.

FINANCIAL EVALUATION

In consideration of a finance programme, a cash flow projection was prepared and an evaluation was carried out from the following standpoints:

- Profit and loss projection of this project, to determine the necessity of government subsidies
- Financing of debt for this project and debt repayment ability from the cash flow projection
- Fare level

The conclusion of the financial evaluation is as follows.

Under the following two basic conditions:

- Local currency portion is financed by means of the government budget.
- Low interest (4%) and long-term concessional loans from overseas are sought for the foreign currency portion.

(1) Present railway fares must be increased by 38% to cover operating expenses throughout the project life, if debt service for overseas loans is carried out by the government.

(2) Present railway fares must be increased by 98% if debt service for overseas loans is covered by the fare income.

CONCLUSION

This project is technically and economically feasible.

At least a 38% increase in fare level is necessary to cover operating expense with fare revenue, assuming the initial cost is subsidized by the government.

The significance of this project's promotion is clearly recognized.

III. TRACK ADDITION AND OTHER IMPROVEMENTS ON THE TANGERANG LINE

NECESSITY OF THE PROJECT

The transportation capacity of the single track with 8 car trains in peak 2 hours is 18,000 passengers per direction. Therefore, it is necessary to complete the construction of the double track and up-grading work before the railway traffic demand in peak 2 hours exceeds 18,000 passengers forecast for 1997. The relation between transportation capacity and passenger traffic demand is shown in Fig. S.5.

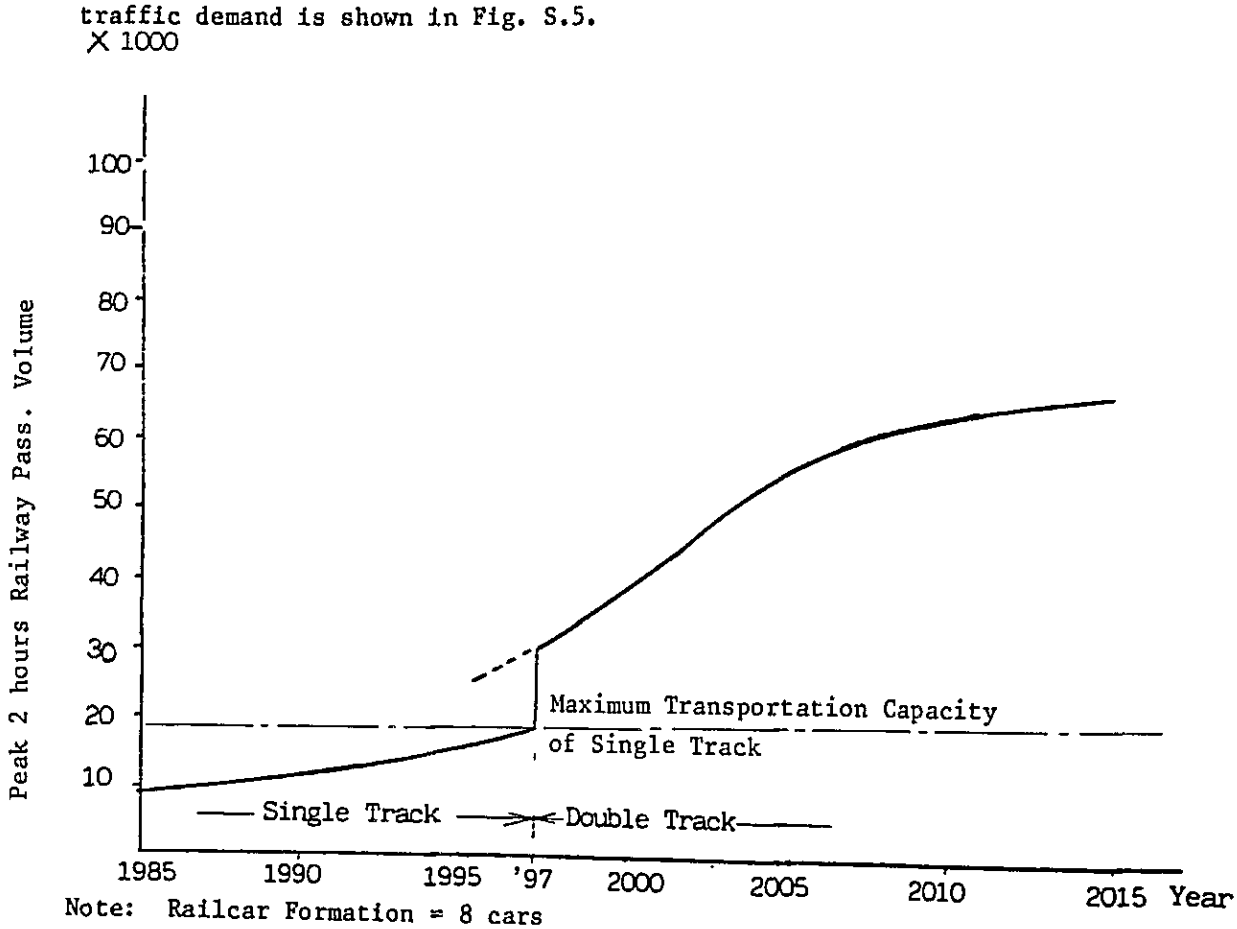


Fig. S.5 Transportation Capacity and Passenger Traffic Demand

The facilities of the Tangerang Line are in poor condition as outlined below due in large part to deterioration during suspension of service from 1975 to 1977.

- The extremely bad condition of the road bed makes train operation dangerous. The embankments have subsided and collapsed at the shoulders, but the remaining portions are stable.

- The bridge structures are not in good condition. Although they can be used for present transportation service, but are insufficient for frequent higher speed transportation service in future.

- The track of this line is in a bad and dangerous state. The rails are 25 kg/m rails and lack many joint bolts and spikes. The project of rail replacing is in progress, but some emergency rehabilitation is also necessary.

- The signalling system and telecommunication system is now out of use with the exception of the telegram system in Tangerang Station.

Although the Tangerang Line was constructed as an urban railway, it is not fully utilized at present.

The area surrounding the Tangerang Line is undergoing both residential and industrial development. Industries are rapidly developing. The area around Tangerang City itself is seeing active growth. Furthermore, railways are increasing as a major mode of urban transportation. At present, road traffic is always congested and Tangerang highway is particularly congested. It will be difficult to manage future urban traffic unless rail lines are put into greater use.

TRAFFIC DEMAND FOR TRAIN OPERATION

Present status of train operation on the Tangerang Line is very poor as only 10 trains operate between Jakarta and Tangerang with a single train set. The travelling time between Duri and Tangerang is about 48 minutes since the train speed is restricted to not more than 25 km/h due to poor track conditions.

With the improvements, the passenger traffic in the peak 2 hours is forecast to grow to 25,000 and 56,000 passengers per direction in 1995 and 2005 respectively, as shown in Table S.14.

Table S.14 Forecast of Passenger Flows on Tangerang Line

Year	1995	2005
1) Maximum Link Traffic : (pass./day)	118,000	263,000
(pass./direction/peak-2 hr)	25,000	56,000
2) Passenger-hour/day	37,484	67,419
3) Passenger-km/day	1,204,712	2,231,582
4) Average travel speed (km/hr)	33.1	33.1
5) Average cross-sectional traffic (pass./km)	64,286	115,626

(Operating distance: 19.3 km between Duri and Tangerang)

PROJECT PLAN

This project involves electrification and track addition for the Tangerang Line (19.3 km between Duri and Tangerang). In the final stage, 3 minute headway train service with 8 car trains will be possible. There are no technical problems for the projected electrification and track addition work.

The project is divided into the following 3 stages from consideration of the rise in demand and the effective use of capital.

1ST STAGE: REHABILITATION

The 1st stage involves the rehabilitation of the track and road level crossings, already in progress. The major work is replacement of 25 kg/m rail to UIC54 rail between stations.

2ND STAGE: EXPANSION

Step-by-step investment of electrification and related improvements is required for rising demand. This will allow frequent commuter service of 15 minute headways with 4 to 8 electric car trains.

This stage involves electrification, replacement of turnouts, improvement of crossing loops and new establishment of crossing stations, and improvement of signalling system and telecommunication system.

3RD STAGE: TRACK DOUBLING

For demand which exceeds the carrying capacity of single electrified track in the 2nd stage of 15 minute headways with 8 car trains, track doubling is to be carried out so that more frequent service of 10 to 3 minute headways with 8-car trains can be achieved.

This stage involves track addition and completion of all previously started rehabilitation work. Access roads to the stations and station front plazas must be arranged in accordance with the improvement work. In addition, there is an illegal housing problem in the area. The time-consuming removal of these illegal houses will be performed in conjunction with the land acquisition for the track doubling.

In addition to the above mentioned improvements in the railway system, transportation capacity will need to be increased continuously over the years to meet the continued rise of forecast passenger demand. The number of railcars will need to be increased from 60 in 1989 to 176 in 2005 as shown in Table S.15.

Table S.15 Train Headway, Transport Capacity and Number of Railcars Required

Year	Track Condition	Train Headway	Passenger Capacity (x1,000)	Number of Train set	Number of Railcars Required
1989-96	Single	15 min.	18.1	7	60
1997-98	Double	8 min.	34.0	10	88
1999-01	Double	6 min.	45.3	14	124
2002-04	Double	5 min.	54.3	16	140
2005-	Double	4 min.	67.9	20	176

Remarks: Load factor during peak 2 hours is 200%.
Train headway is for peak 2 hours.
8 car train formation in all cases

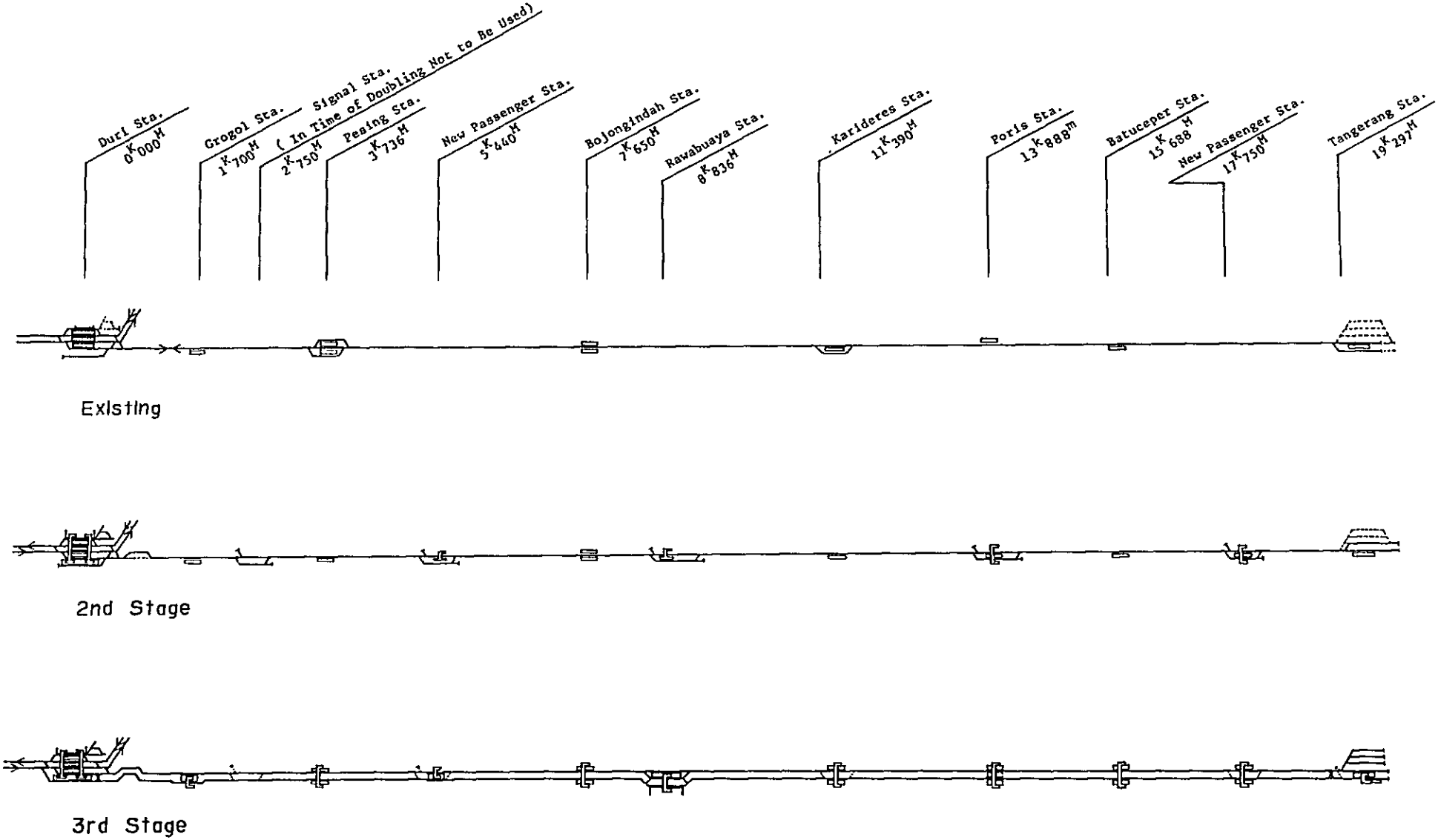


Fig.S.6 Track Layout of Each Stage

DESIGN STANDARD

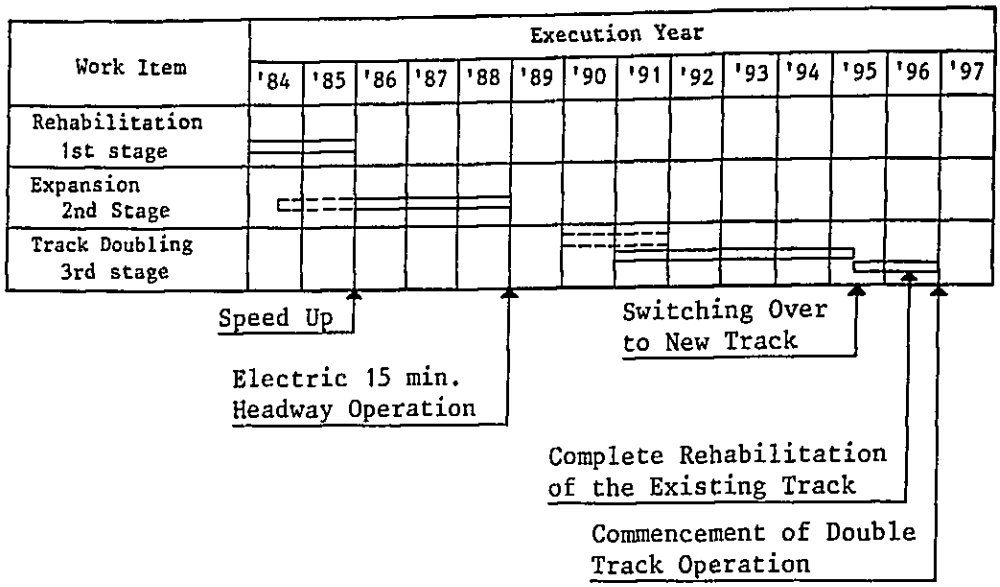
The design standard for this project is outlined below. For the 1st and 2nd stages, a temporary standard noted below in parentheses is provided taking into consideration the work method and procedure and present conditions.

a. Maximum Speed
   80 km/h
b. Maximum gradient and minimum radius of curvature of main line
   10‰ (gradient), as the existing track (curvature)
c. Track
   Rail UIC54 (or equivalent)
   Sleeper PC 1,666 /km
d. Bridge bearing capacity
   KS - 16 (In the 1st and 2nd stage - As the existing state)
e. Width of formation level and track center to center distance
   2.75 m (from track center), 4.0 m
f. Electrification
   DC 1,500 V, simple catenary system
g. Signalling system
   Automatic block system and relay interlocking system

IMPLEMENTATION SCHEDULE

For maximum capital efficiency and to meet the forecasted demand, the three project stages previously outlined were scheduled over 13 years starting in 1984, to be completed by 1996. The construction schedule is shown in Table S.16.

Table S.16 Tangerang Line Implementation Schedule



⊏⊐⊐⊐ Period for detailed design

INVESTMENT

Total project cost is estimated at 181,600 million Rp (Local currency portion 41,000 million Rp, foreign currency portion 140,600 million Rp) as shown in Table S.17.

Table S.17 Estimated Cost of Tangerang Line

(Unit: Million Rp)

Work classification	Investment by source		
	Foreign	Local	Total
Civil structure of track construction	22,800	21,200	44,000
Electrification	10,500	10,000	20,500
Signal & telecommunication	7,300	2,100	9,400
Compensation		4,400	4,400
Rolling stock	100,000	3,300	103,300
Grand Total	140,600	41,000	181,600

Note: September 1983 price

Rp 980 = US$ 1.00 = yen 245

BENEFIT

It is expected that the Tangerang Line can be a main axis for urban traffic.

After electrification of the single track and the establishment of one signal station and two new commuter passenger stations, commuter trains with 15 minute headway in the peak two hours can reduce travelling time to within 42 minutes from the present 48 minutes. After completion of track doubling, at which time the signal station will be abolished, travelling time will be reduced further to 35 minutes.

In addition, when frequent service is made possible, a part of the road traffic will be transferred to the railway. Congestion of the roads will be eased, accompanied by a decrease in noise and air pollution.

The decrease in motor vehicle congestion and the increase in train riders are shown in Table S.18.

Table S.18 Change of Daily Traffic Volume

	1995	2005
Road (Decrease) pcu.km	241,100	1,524,200
pcu.hr	35,300	57,300
Railway (Increase) pass.km	1,910,600	5,570,100
pass.hr	44,700	157.900

Therefore, cost saving benefit of 912 billion Rp (including fuel saving of 332 billion Rp) and a time saving benefit of 439 billion Rp are obtained by the implementaiton of this project.

In addition, this project will create many employment opportunities as shown in Table S.19.

Tabls S.19 Employment Creation

1) For construction	15,800 man-years
2) Operational PJKA workers	
1990	373 persons
2000	458 persons
2010	549 persons

ECONOMIC EVALUATION

The EIRR for the base case is 23.2%, exceeding the standard level for evaluation of Indonesian railway projects showing the feasibility of this project.

In order to confirm the viability of this project, a sensitivity analysis was made assuming more pessimistic value for construction cost and traffic volumes.

The results show that even with a 20% cost overrun or a decrease of 30% in traffic volume, the EIRR would be 21.2% and 17.6% respectively. Even with both a 20% cost overrun and a decrease of 30% in traffic volume in extreme cases, the EIRR will be 15.9%. This indicates that this project is sufficiently viable.

FINANCIAL EVALUATION

In consideration of a finance programme, a cash flow projection was prepared and an evaluation was carried out from the following standpoints:

- Profit and loss projection of this project, to determine the necessity of government subsidies
- Financing of debt for this project and debt repayment ability from the cash flow projection
- Fare level

The conclusion of the financial evaluation is as follows.

Under the following two basic conditions:

- Local currency portion is financed by means of the government budget.
- Low interest (4%) and long-term concessional loans from overseas are sought for the foreign currency portion.

(1) Present railway fares must be increased by 34% to cover operating expenses throughout the project life, if debt service for overseas loans is carried out by the government.

(2) Present railway fares must be increased by 96% if debt service for overseas loans is covered by the fare income.

CONCLUSION

This project is technically and economically feasible.

At least a 34% increase in fare level is necessary to cover operating expenses with fare revenues, assuming the initial cost is subsidized by the government.

The significance of this project's promotion is clearly recognized.

MAIN REPORT

CONTENTS

CHAPTER 3 IMPROVEMENT PLAN OF MANGGARAI STATION

CHAPTER 4 IMPROVEMENT PLAN OF MERAK LINE

CHAPTER 5 IMPROVEMENT PLAN OF TANGERANG LINE

CHAPTER 8 FINANCIAL EVALUATION

CHAPTER 9 TOTAL EVALUATION

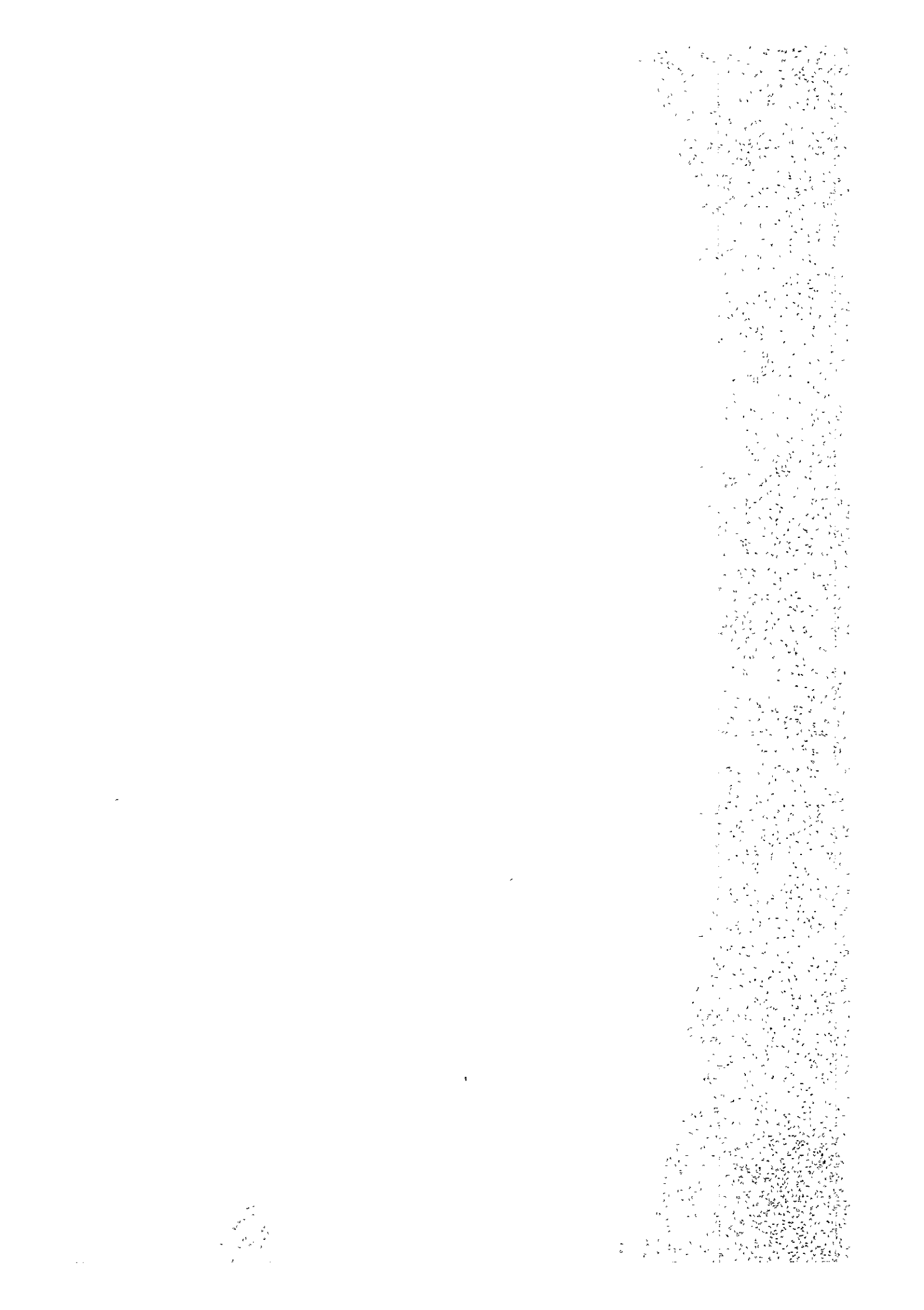
Figure List

Table List

ABBREVIATION LIST

1.	JABOTABEK	Jakarta Bogor Tangerang and Bekasi
2.	BOTABEK	Bogor Tangerang and Bekasi
3.	JMDP	JABOTABEK Metropolitan Development Planning
4.	GDP	Gross Domestic Product
5.	GRDP	Gross Regional Domestic Product
6.	CBD	Central Business District
7.	PERUMNAS	Perkenbangan Perumahan Nasional
8.	JICA	Japan International Cooperation Agency
9.	OECF	The Overseas Economic Cooperation Fund
10.	JHRP	Feasibility Study on Jakarta Harbour Road Project
11.	OD	Origin and Destination
12.	PCU	Passenger Car Unit

INTRODUCTION



INTRODUCTION

1. BACKGROUND OF THE STUDY

Recent vigorous industrial and economic developments in Indonesia have fueled a steady rapid growth in the population of the JABOTABEK Area, giving rise to overwhelming social and economic development requirements. These include large scale plans for housing projects, industrial plants and an overhaul of the transportation infrastructure.

The ever-increasing road traffic, which makes up the greater portion of land transportation, is causing serious problems normally associated with heavy traffic congestion. DKI Jakarta and its outstkirts have been plagued with chronic traffic jams, air pollution and a sharp increase in the number of traffic accidents.

In order to remedy this situation, the Government of Indonesia has planned to improve its railway system to make it safer and faster in addition to increasing its punctuality and fuel efficiency.

The JABOTABEK Metropolitan Development Plan (JMDP), a comprehensive development plan for the entire area, was presented in 1980.

In accordance with a request by the Government of Indonesia, the Government of Japan carried out railway improvement studies through the Japan International Cooperation Agency (JICA) to promote as technical coorperation. The Master Plan "Urban/Suburban Railway Transportation in JABOTABEK Area" was established in 1981. Subsequently, the Feasibility Study of Track Elevation on the Central Line and the Feasibility Study of the New Railway Line for Cengkareng Airport have been conducted.

The grade separated crossing project in Manggarai station, the track addition and other improvement projects on the Tangerang Line and the Merak Line are urgent projects which are designed to meet ever-increasing transportation demands.

This Study, a feasibility study of the above mentioned projects, is based on the Scope of Work agreed upon by the Government of Indonesia and the Japanese preliminary survey team which was headed by Dr. Hideo Nakamura on 9th July 1981.

2. OBJECTIVE OF THE STUDY

(1) To carry out a feasibility study on the grade separated crossing in Manggarai station, which will eliminate interference to train operations between the Central Line and the Western Line

(2) To carry out a feasibility study on track addition and other improvements between Tanahabang and Serpong on the Merak Line, and between Duri and Tangerang on the Tangerang Line

"Other improvements" involve track, station facility, signalling system and telecommunication system improvements, electrification, and rolling stock procurement.

3. OUTLINE AND SCHEDULE OF THE STUDY

(1) Preparatory work in Japan

1. Examination of data already collected
2. General review of the study methodology
3. Preparation of the Inception Report

(2) Work in Indonesia

1. Presentation and explanation of the Inception Report
2. Receiving comments from the Indonesian authorities concerned
3. Collection of data and information
4. Field and site survey
5. Study on socio-economic framework
6. Land use survey along Merak Line and Tangerang Line
7. Survey of plans to integrate project into the surrounding area
8. Traffic demand forecast
9. Determination of time value and vehicle and train operation cost
10. Planning of train operation and study of Manggarai workshop
11. Planning of alternatives for the flyovers at Manggarai Station
12. Planning of electrification, signalling system and telecommunication system
13. Planning of track addition on the Merak Line and Tangerang Line
14. Soil survey

15. Hydrology study
16. Planning of structure
17. Aerial photograph survey

(3) Work in Japan (1)

1. Planning of station squares
2. Impact study
3. Benefit and revenue calculation
4. Estimate of train operation cost
5. Estimate of construction cost and maintenance cost
6. Construction planning
7. Planning of Implementation Schedule
8. Preparation of 1/500 map
9. Preparation of Interim report

(4) Work in Japan (2)

1. Economic analysis and financial evaluation
2. Preliminary design of Manggarai Station
3. Preparation of draft final report

(5) Presentation, explanation and discussion of Reports in Indonesia

1. Interim report
2. Draft final report

An outline of the work completed is shown in Fig. 1.1.

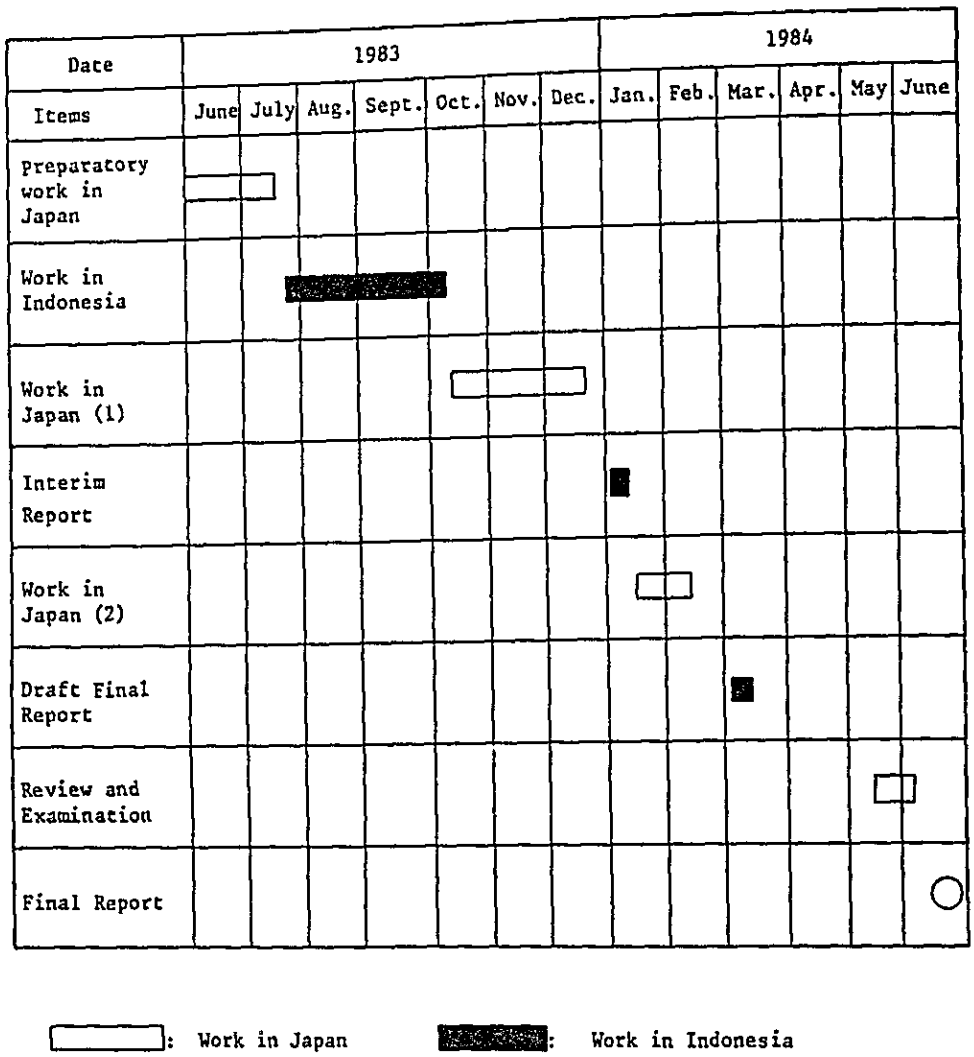


Fig. 1.1 Outline of the Schedule

4. ORGANIZATION

The Japanese Supervisory Committee members, Indonesian Steering Committee members, Study Team members and Counterparts are listed hereunder.

JAPANESE SUPERVISORY COMMITTEE MEMBERS

Fumio NISHINO (Chairman)	Professor, Department of Civil Engineering University of Tokyo.
Takao KAKEI	Special Assistant to the Director, International Affairs Division, Secretariat to the Minister, Ministry of Transport.
Kazuyoshi MATSUMOTO	Senior Officer for International Cooperation, Railway Supervision Bureau, Ministry of Transport.
Kazuo NOTAKE	Director, Engineering Division, Railway Department, Tokyo District Land Transport Bureau, Ministry of Transport.
Tadami KITANO	Section Chief, Civil Engineering and Electricity Division, Private Railways Department, Railway Supervision Bureau, Ministry of Transport.

INDONESIAN STEERING COMMITTEE MEMBERS

1. Ir. Giri S. Hadihardjono	Directorate General of Land Transport and Inland Waterways.
2. Gatot Soedjantoko	Directorate General of Land Transport and Inland Waterways
3. Pudjo Sumarno	Directorate General of Land Transport and Inland Waterways
4. Ir. Mulyadi	Directorate General of Land Transport and Inland Waterways
5. Ir. Eddy Ruslani	Indonesian State Railways
6. Eddy Soewarde	Indonesian State Railways
7. Wahjudi	Indonesian State Railways
8. Koestomo	Indonesian State Railways
9. Hardi	Indonesian State Railways
10. Abd. Sapari	Indonesian State Railways
11. Gatot. K. Mashuri	Indonesian State Railways
12. Soeharto	Indonesian State Railways
13. Imam Suharto	Indonesian State Railways
14. Sukiswo	Indoneisan State Railways
15. Djafar	Indonesian State Railways
16. Nugroho	West Region of Indonesia State Railways
17. Ir. Soeparto	JABOTABEK Railway Project
18. Soemarjo	JABOTABEK Railway Project

19. Tohir Kartabrata	JABOTABEK Railway Project
20. Zulfiar Sani	JABOTABEK Railway Project
21. Ir. Soerjanto	JABOTABEK Railway Project
22. Rahardjo	JABOTABEK Railway Project
23. Ir. Syahriar Bachtiar	JABOTABEK Railway Project
24. Ir. Daniel Asril	JABOTABEK Railway Project
25. Ir. S. Handayani	Board of Planning and Development of DKI Jaya
26. Ir. Mauritz	Development Beareu of DKI Jaya
27. T. Matsumoto	Advisory Team to Directorate General of Land Transport and Inland Waterways
28. M. Yoshida	Advisory Team to Directorate General of Land Transport and Inland Waterways
29. N. Fukui	Advisory Team to Directorate General of Land Transport and Inland Waterways
30. K. Ashina	Advisory Team to Directorate General of Land Transport and Inland Waterways
31. T. Hata	Advisoty Team to Directorate General of Land Transport and Inland Waterways
32. S. Shibuya	Advisory Team to Directorate General of Land Transport and Inland Waterways
33. S. Honda	Expert of JABOTABEK Railway Project

STUDY TEAM MEMBERS

	Name	Assignment
1.	Akira TAMURA	Team leader
2.	Hironobu SAKAI	Related development planning & traffic demand
3.	Isamu GUNJI	Related development planning & traffic demand
4.	Keiji YOKOYAMA	Economic and financial evaluation
5.	Osami MATSUMOTO	Track addition planning
6.	Mitsuhiko SUGIYAMA	Station planning
7.	Mitsuiku NAKAJIMA	Station planning
8.	Tatsuro WADA	Structure planning
9.	Hiroshi HARADA	Implementation planning
10.	Isao KAWAHARA	Structure planning
11.	Akio ISHIGURO	Train operation & rolling stocks planning
12.	Satoshi TAKEDA	Train operation & rolling stocks planning
13.	Zenji KOBAYASHI	Electrification, signalling and telecommunication planning
14.	Kazusaburo HASHIMOTO	Electrification, signalling and telecommunication planning
15.	Takeshi NAKAGAWA	Topographic survey & aerial photograph
16.	Hisao TANOUE	Topographic survey & aerial photograph
17.	Yutaka WATANABE	Topographic survey & aerial photograph

COUNTERPARTS

NAME	POSITION IN THE TEAM
1. Ir. Djauhari P.	Project Officer
2. Drs. Yunus	Administrator I
3. Sri Ratna Mutiarawati	Administrator II
4. Surandi	Administrator III
5. Ir. Satrio K.	Civil Engineer
6. Ir. Dharma Setiabudi	Civil Engineer
7. Ir. Heru S.	Train Operation
8. Marjono	Electrification Planner
9. Ir. Abdulmadjid A.	Signalling & Telecommunication System
10. Ir. Parlindungan T.	Traffic Demand Forecast
11. Drs. Dharma Manulang	Traffic Demand Forecast and City Planner
12. Soemaryo	Station Planner
13. Ir. Bilkio Marbun	Station Planner
14. Ir. Djoko M.	Rolling Stock & Workshop Engineer
15. Ir. Tanjung	Rolling Stock & Workshop Engineer
16. Drs. Henny P.	Economist

CHAPTER 1

PRESENT AND FUTURE SOCIO-ECONOMIC LAND USE CONDITION

CHAPTER 1 PRESENT AND FUTURE SOCIO-ECONOMIC LAND USE CONDITION

1.1 PHYSICAL CONDITION OF THE STUDY AREA

(1) Geography

DKI Jakarta is situated in the northwest region of Java Island approximately south 6°12' in latitude and east 106°48' in longitude, facing the Java Sea.

The urban area is spread out on the flat alluvial plain at the mouth of the Chili Wung River and partly on the southern diluvial plateau. The area of the city is 655.7 km^2 and the average level of the city is 7 m above sea level.

(2) Climate

The climate is described as tropical with high temperatures and high humidity. Average monthly temperature varies only from 25.5°C to 28°C throughout the year and average relative humidity varies from 74% to 98%. The period from May to October is called the "dry season" with comparatively less rain and the period from November to April is called "the wet season" with much rainfall. The greater part of the yearly rainfall occurs during the wet season. The dominant wind direction is easterly in the dry season and westerly and northerly in the wet season due to the monsoon.

Table 1.1 Climate of JAKARTA (1981)

Month	Average Temperature (°C)	Actual Humidity (%)	Actual Rainfall (mm)	Wind Direction	Wind Velocity (m/sec)
January	25.5	85	576.1	NW	0.9
February	26.6	81	179.3	N	2.0
March	27.3	80	266.1	N	1.5
April	27.6	80	283.4	E	1.4
May	27.9	78	66.7	E	1.7
June	27.8	77	90.4	E	1.4
July	27.2	77	70.0	E	1.4
August	27.5	74	47.4	E	1.6
September	27.7	75	85.7	E	1.5
October	28.0	74	84.6	E	1.5
November	27.2	79	209.0	W	1.8
December	27.0	98	379.0	W	1.9
Annual Average	27.3	79.8	2,337.7	E	1.6

Source: Statistical Yearbook of Jakarta 1982

1.2 SOCIAL CONDITION

(1) Administrative zoning

DKI Jakarta is the capital of the Republic of Indonesia and the center of social and economic activities. It is divided into 5 Wilayah and these are further divided into 30 Kecamatan which are subdivided into 237 Kelurahan.

DKI Jakarta and surrounding Tangerang, Bogor and Bekasi districts are called the JABOTABEK area. Kabupaten Tangerang is divided into 17 Kecamatan. Kabupaten Bogor and Kotamadya Bogor are divided into 24 Kecamatan and 5 Kecamatan respectively. Kabupaten Bekasi is divided into 13 Kecamatan.

(2) Residential population

The population of Indonesia was 147 million in 1980. Average annual growth rate between 1971 and 1980 was 2.32%. The population of Java Island was 91 million in 1980 which represented 62% of the population of Indonesia. Annual growth rate was 2.02%, a little smaller than the Indonesian average. The population of west Java was 27 million in 1980 with an annual growth rate of 2.66% including social increase, a little higher than that of Java Island. It may be thought that annual growth rate will gradually decrease due to the family planning policy. The population of Indonesia in 2000 is forecast to be 213.8 million by the Central Statistic Bureau (Statistical Yearbook of Indonesia, 1981 edition). The population of Indonesia, Java Island and west Java is forecast as shown in Table 1.2. Java Island and West Java population is forecast considering the difference of annual growth rate within Indonesia.

The population of DKI Jakarta was 6.47 million in 1980. Average annual growth rate between 1971 and 1980 was 3.9% (natural increase 2.0%, social increase 1.9%). Future population is forecast as shown in Table 1.3 by DKI Jakarta Master Plan 2005 considering the population density, economic development and policy, etc.

The population of Bogor, Tangerang and Bekasi (BOTABEK area) was 5.36 million in 1980 having increased rapidly at the annual rate of 5.6% between 1975 and 1980. The population of JABOTABEK (DKI Jakarta and BOTABEK areas) was 11.83 million in 1980. 13% of the population of Java Island was concentrated in JABOTABEK. The future population of BOTABEK is forecast as shown in Table 1.5 based on the forecast of JABOTABEK Metropolitan Development Plan (JMDP) (Table 1.4). As a result, the future population of JABOTABEK is forecast as Table 1.6.

(3) Work place (Number of jobs)

The economically active population in Indonesia was 35.3% of the total population in 1980, and the employed population was 34.7%. The rate of employed population by sector is, sector I 54.8%, sector II 12.3% and sector III 32.9% (Statistical Yearbook of Indonesia 1982).

Present (1980) and future work place (number of jobs) in DKI Jakarta is presented in Table 1.7 by DKI Jakarta Master Plan 2005.

Present (1978) and future work place in BOTABEK area is presented in Table 1.8 by JMDP. From this forecast, the frame of work place of sector II and sector III is tabulated as shown in Table 1.9.

Table 1.2 Population Forecast in Indonesia, Java and West Java

	Indonesia		Java/Madura		West Java	
	Population ($\times 10^6$ persons)	Average Annual Growth Rates (%)	Population ($\times 10^6$) persons)	Average Annual Growth Rates (%)	Population ($\times 10^6$ persons)	Average Annual Growth Rates (%)
1961	97.1		63.1		17.6	
		2.10		1.91		2.09
1971	119.2		76.1		21.6	
		2.32		2.02		2.66
1980	147.5		91.3		27.5	
		2.3		1.9		2.4
1985	165.3		100.3		30.9	
		2.0		1.7		2.0
1990	182.5		109.1		34.2	
		1.7		1.5		1.8
1995	198.5		117.5		37.4	
		1.5		1.3		1.6
2000	213.8		121.4		40.4	
		1.3		1.2		1.4
2005	228.1		128.8		43.4	

1961 ∿ 1980 Data from Population Census
Source: Statistical Yearbook of Indonesia 1982
1985 ∿ 2005 Forecast Value

Table 1.3 Population Forecast in DKI Jakarta

	DKI Jakarta	
	Population ($\times 10^3$ persons)	Annual Growth Rate (%)
1961	2,907	
		4.6
1971	4,576	
		3.9
1980	6,467	
		3.4
1985	7,630	
		3.1
1990	8,870	
		2.3
1995	9,950	
		2.0
2000	11,000	
		1.8
2005	12,000	

1961 ∿ 1980 Source: Statistical Yearbook of Indonesia 1982
1985 ∿ 2005 Source: DKI Jakarta Master Plan 2005

Table 1.4 Summary of Population in BOTABEK

	Bogor		Tangerang		Bekasi		BOTABEK	
	Population ($\times 10^3$ persons)	Annual Growth Rate (%)	Population ($\times 10^3$ persons)	Annual Growth Rate (%)	Population ($\times 10^3$ persons)	Annual Growth Rate (%)	Population ($\times 10^3$ persons)	Annual Growth Rate (%)
1978	2,278		1,257		950		4,485	
		3.65		3.28		4.00		3.63
1993	3.903		2,041		1,712		7,656	
		1.20		3.28		2.81		2.15
2003	4,398		2,819		2,258		9,475	

Source: JABOTABEK Metropolitan Development Planning

Table 1.5 Population Forecast in BOTABEK

	Bogor		Tangerang		Bekasi		BOTABEK	
	Population ($\times 10^3$ persons)	Annual Growth Rate (%)	Population ($\times 10^3$ persons)	Annual Growth Rate (%)	Population ($\times 10^3$ persons)	Annual Growth Rate (%)	Population ($\times 10^3$ persons)	Annual Growth Rate (%)
1975	2,023		1,155		897		4,075	
		6.3		5.2		4.6		5.6
1980	2,748		1,489		1,124		5,361	
		3.5		3.9		4.0		3.7
1985	3,270		1,800		1,370		6,440	
		2.5		3.2		3.2		2.8
1990	3,700		2,110		1,600		7,410	
		1.8		2.7		3.1		2.3
1995	4,040		2,410		1,860		8,310	
		1.3		2.0		2.6		1.8
2000	4,300		2,660		2,110		9,070	
		0.7		1.7		1.9		1.3
2005	4,450		2,900		2,320		9,670	

Table 1.6 Population Forecast in JABOTABEK

	Population ($\times 10^3$ persons)	Annual Growth Rate (%)
1980	11,828	
		3.5
1985	14,070	
		3.0
1990	16,280	
		2.3
1995	18,260	
		1.9
2000	20.070	
		1.5
2005	21,670	

Table 1.7 Forecast of Work Place in DKI Jakarta

	1980		1995		2005	
	(× 1000 jobs)	%	(× 1000 jobs)	%	(× 1000 jobs)	%
Sector I	47.7	2.6	52.0	1.6	55.0	1.2
Sector II	248.5	13.5	496.2	15.2	646.6	13.8
Sector III	1,547.2	83.9	2,723.6	83.2	3,983.3	85.0
Total	1,843.5	100	3,271.2	100	4,684.9	100
Sector II & Sector III	1,795.7	97.4	3,219.8	98.4	4,629.9	98.8

Source: DKI Jakarta Master Plan 2005

Table 1.8 Summary of Work Place in BOTABEK

		1978		1993		2003	
		(× 1000 jobs)	%	(× 1000 jobs)	%	(× 1000 jobs)	%
Bogor	Sector I	489.0	64.4	713.6	55.7	909.1	51.2
	Sector II	55.2	7.3	113.2	8.8	200.1	11.3
	Sector III	214.6	28.3	454.2	35.5	666.0	37.5
	Total	758.8	100	1,281.0	100	1,775.2	100
	Sector II & Sector III	269.8	35.6	567.4	44.3	866.1	48.8
Tangerang	Sector I	221.6	57.7	307.1	46.7	380.0	34.4
	Sector II	50.1	13.1	122.4	18.6	222.8	20.2
	Sector III	111.9	29.2	228.4	34.7	502.7	45.4
	Total	383.9	100	657.9	100	1,105.5	100
	Sector II & Sector III	162.0	42.3	350.8	53.3	725.5	65.6
Bekasi	Sector I	203.8	67.1	298.8	54.1	382.6	43.8
	Sector II	26.0	8.6	77.0	13.9	161.6	18.5
	Sector III	74.1	24.3	176.7	32.0	328.5	37.7
	Total	303.9	100	552.5	100	872.7	100
	Sector II & Sector III	100.1	32.9	253.7	45.9	490.1	56.2
BOTABEK	Sector I	914.4	63.2	1,319.5	53.0	1,671.7	44.5
	Sector II	131.3	9.1	312.6	12.5	584.5	15.6
	Sector III	400.6	27.7	859.3	34.5	1,497.2	39.9
	Total	1,446.3	100	2,491.4	100	3,753.4	100
	Sector II & Sector III	531.9	36.8	1,171.9	47.0	2,081.7	55.5

Source: JMDP Prospects for Regional Development in JABOTABEK

Table 1.9 Forecast of Work Place in BOTABEK

(Sector II & Sector III)

	Bogor	Tangerang	Bekasi	BOTABEK
1980	300	180	110	590
1985	380	250	150	780
1995	615	465	290	1,370
2005	900	800	560	2,260

1.3 ECONOMIC CONDITION

The GDP of Indonesia increased at an actual annual growth rate of 7.3% between 1970 and 1980. 6.5% actual annual growth rate is targeted by Pelita III (1980 - 1984). In general the economic growth of a nation follows the pattern, stagnation → take off → maturity → decline. The Indonesian economy is at the stage of "take off" and will show a tendency to advance in the coming ten years. But the growth rate will decrease due to the limitation of natural resources, etc. in the future. Annual growth rate of 6.3 to 7.7% between 1980 and 1990 is forecast by "Urban Development Planning Study on Surabaya Metropolitan Area". Per capita GDP is 122,500 Rp (at 1975 price) in 1980.

GRDP of DKI Jakarta increased at an actual annual growth rate of 10.2% between 1975 and 1980. Per capita GRDP is 264,600 Rp (at 1975 price) in 1980, that is 2.16 times the Indonesia average. Per capita GRDP in future is forecast as shown in Table 1.11 by assuming a moderate growth of GRDP by sector in DKI Jakarta (Table 1.10). Per capita GRDP in 1995 will be 1.5 times that of the present (1983), and in 2005 will be 1.9 times. This means that the workers time value will increase almost at the same rate.

Average monthly consumption expenditure per capita is as shown in Table 1.12. Only a small amount is available for transportation, so that in order to attract bus passengers to rail, the level of rail fares should be equal to or a little lower than that of buses.

Table 1.10 Forecast of GRDP in DKI Jakarta
(Billion Rp. in 1975 Constant Price)

	Sector I		Sector II		Sector III		GRDP	
	(Billion Rp)	Annual Growth Rate (%)	(Billion Rp)	Annual Growth Rate (%)	(Billion Rp)	Annual Growth Rate (%)	(Billion Rp)	Annual Growth Rate (%)
1975	21.7	4.3	161.1	14.8	854.0	9.4	1,036.9	10.2
1980	26.8		321.6		1,337.9		1,686.4	
		3.0		12.0		7.0		8.0
1985	31.1		567		1,877		2,474	
		2.5		10.0		6.0		6.9
1990	35.2		913		2,511		3,459	
		2.0		8.0		5.0		5.8
1995	38.8		1,341		3,205		4,585	
		1.5		6.0		4.0		4.6
2000	41.8		1,795		3,899		5,736	
		1.0		4.0		3.0		3.3
2005	43.9		2,184		4,520		6,748	

1975 ∿ 1980 Source: Regional Income of Jakarta 1975 ∿ 1980

Table 1.11 Per Capita GRDP in DKI Jakarta
(In 1975 Constant Price)

	Population		GRDP		Per Capita GRDP	
	(× 1000 persons)	%	(Billion Rp)	%	(1000 Rp)	%
1975	5,315	4.0	1,036.9	10.2	195.9	6.2
1980	6,467		1,686.4		264.6	
		3.5		8.2		4.2
1985	7,630		2,474		324	
		3.1		6.9		3.8
1990	8,870		3,459		390	
		2.3		5.8		3.4
1995	9,950		4,585		461	
		2.0		4.6		2.5
2000	11,000		5,736		521	
		1.8		3.3		1.5
2005	12,000		6,748		562	

Table 1.12 Average Monthly Consumption Expenditure per Capital in DKI JAKARTA 1977/78

	Rp	%
Food	5,030	37.0
Housing	3,452	25.4
(Water Electricity, etc.)	(648)	(4.8)
Clothes	1,267	9.3
Other service	2,782	20.5
(Traffic)	(1,009)	(7.4)
Other	1,071	7.8
Total	13.602	100.0

Source: Cost of Living Survey Jakarta 1977/78

1.4 LAND USE

(1) JABOTABEK Area

The study of development planning in JABOTABEK area commenced in 1976 in accordance with a Presidential Instruction. JABOTABEK Metropolitan Development Planning (JMDP) was prepared in 1980 adjusting individual plans prepared by Ministry of Home Affairs and Public Works, and the Provincial Governments of DKI Jakarta and West Java.

In this planning, JABOTABEK area is divided into 5 zones and the development policy of each zone was determined. Fig. 1.1 shows the structure plan of JABOTABEK area. Residential population and employment (work place origin) by zone in 1993 and 2003 are forecast.

(2) DKI Jakarta

In DKI Jakarta, only 10% of the population live in the favourable residential areas, such as Menteng Housing Area constructed in the colonial age and Kebayoran Baru District which has been developed since World War II. Population density of Kebayoran Baru District was 164 persons/ha in 1981. On the other hand, 50% of the population live

in Kampungs where the infrastructure is not well provided or in squatter areas where the housing density is too high and sanitary conditions are extremely poor. The population density of Kampungs averages about 420 persons/ha. Kampung improvement projects are on-going by the government of DKI Jakarta with the aid of the World Bank. 25% of the house building is supplied by public funds. Fig. 1.2 shows the location of housing development by PERUMNUS, almost all projects are scattered in the suburbs of DKI Jakarta.

The commercial and business area of DKI Jakarta is concentrated at the central core, centering on Monas Tower and spreading southwards along the major arterial road. Traffic congestion is frequent at the arterial road around Monas Plaza. Many small scale district centres are distributed inside the city.

Manufacturing industry in DKI Jakarta is distributed widely over the city creating residential and industrial mixed areas. Manufacturing industry started from Pulogadun district and is spreading along the Tangerang and Bekasi highways.

As a whole, recreational area is scarce. The main recreation areas are only Taman Ria playland, Ancol sea side park, the zoo and Taman Mini playland, etc.

The first master plan of DKI Jakarta was decided in 1965 and has been partially amended every year. Revised DKI Jakarta Master Plan 2005 was drafted in 1983 based on the development policy of JMDP. Fig. 1.3 shows the structure plan. It has been decided that public infrastructures will not be provided to the northeast and northwest of the city because the ground condition is not suitable for urbanization. The southern part of the city is to be reserved as an agricultural area because it is an important area for water penetration to the ground water system.

As a result, the middle part of the city will be the main development area in future.

A polycentric city layout is required to minimize traffic demand. New commercial and business areas are planned along the major arterial roads conforming with the present trend. Sub-centres are to be located around the intersections of major arterial roads.

Industrial areas are planned along the Tangerang and Bekasi highways.

It is estimated in this master plan that the ratio of private transport to public transport will be 30:70 in 2005 and that the railway share of public transport will be 7 to 10%.

Residential population and employment by zone in 1995 and 2005 are also forecast.

In the master plan 2005 the role of public transportation is largely expected to handle the increasing urban traffic.

In order to minimize traffic pollution, it is also expected that the share of railways in public transportation will be increased and that railways will be the main axis of urban transportation in the future.

Table 1.14 summarizes the future land use.

Table 1.13 Level of Housing in DKI Jakarta

	Permanent (%)	Semi-Permanent (%)	Temporary (%)
1975	32	31	37
1980	39	32	29
1982	42	36	22

Source: Statistic Wilayah DKI Jakarta 1982

Table 1.14 Summary of Land use in DKI Jakarta

	1980	2005
Residential Population (× 1000)	6,467	12,000
Population in Residential Area (× 1000)	5,174	9,600
(1) Residential Area (ha)	23,394	35,194*
Density in residential area (persons/ha)	221	273
(2) Commercial and business area (ha) 1/	1,934*	3,914
Area per person (m^2/person)	3.0	3.3
(3) Industrial area (ha)	2,442*	5,264*
Employment of Sector II (× 1000)	248.5	646.6
Density of worker (person/ha)	102	123
(4) Recreation area (ha)	1,430	3,600
Area per person (m^2/person)	2.2	3.0
(5) Others (agricultural area, river, army camp, etc.)	36,420	17,648
Total area (ha)	64,827	64,827
Density (person/ha)	100	185

* Source : DKI Jakarta Master Plan 2005

1/ excluding public facility area.

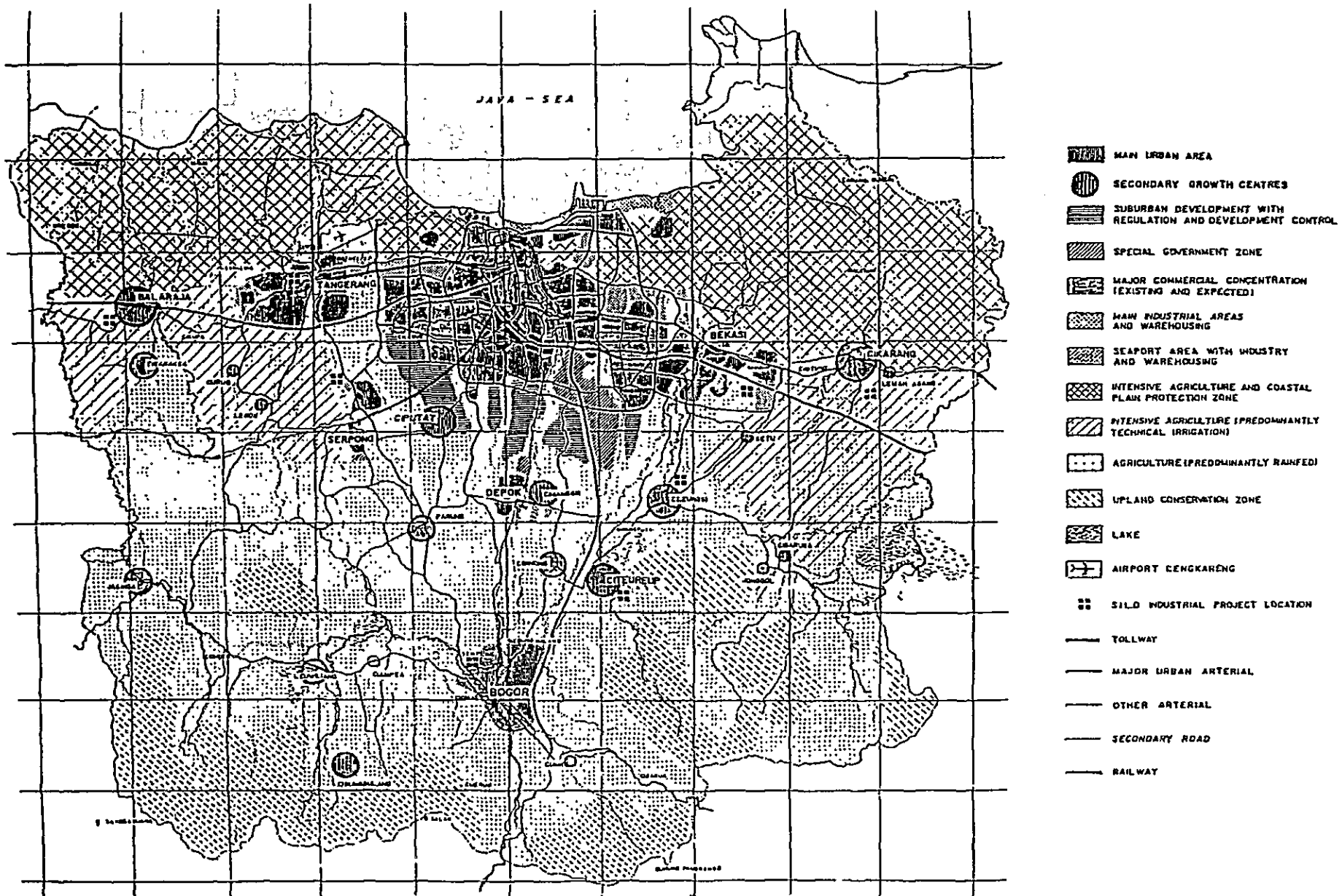


Fig. 1.1 Outline of Regional Structures
Plan: JABOTABEK 2003

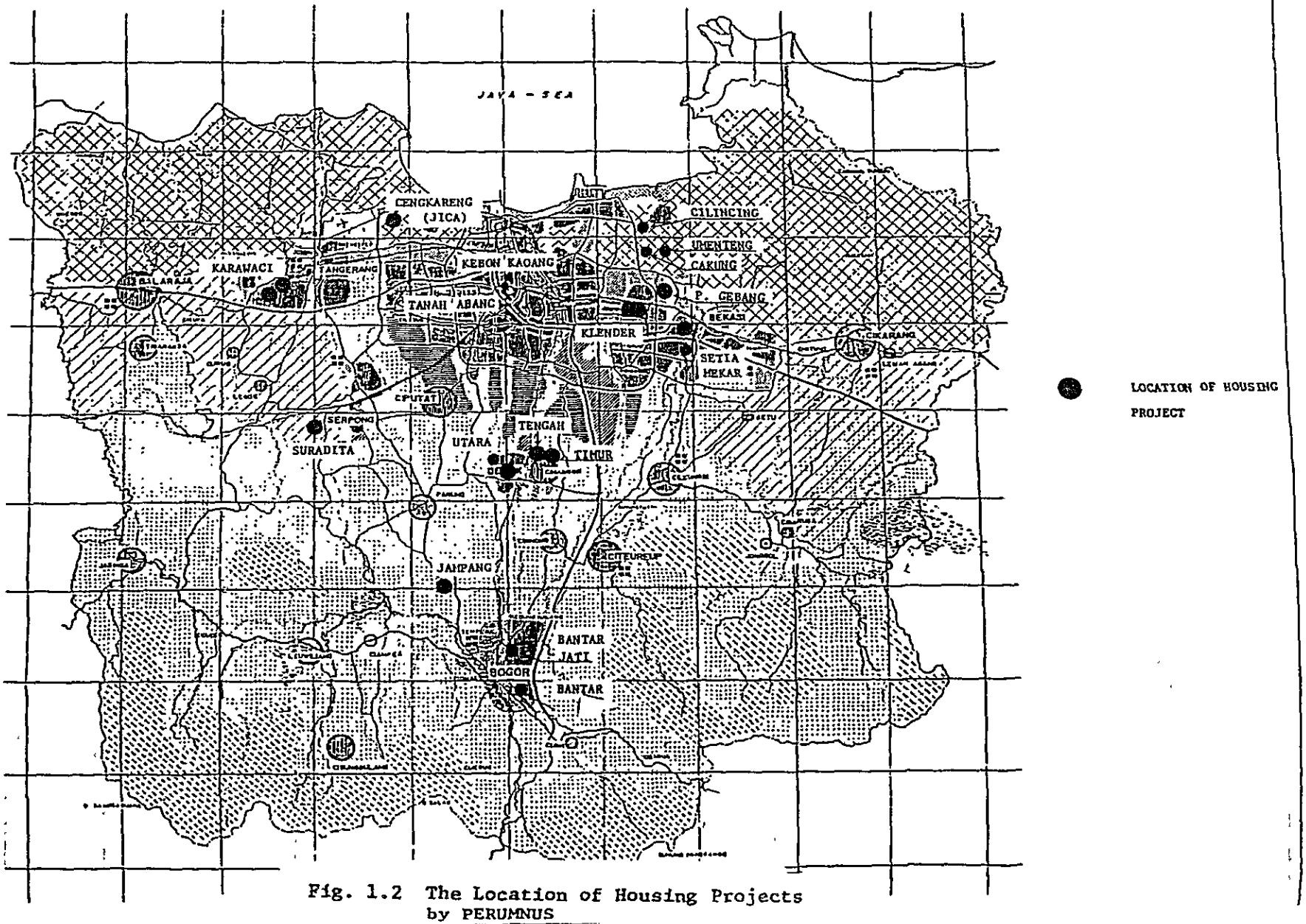


Fig. 1.2 The Location of Housing Projects by PERUMNUS

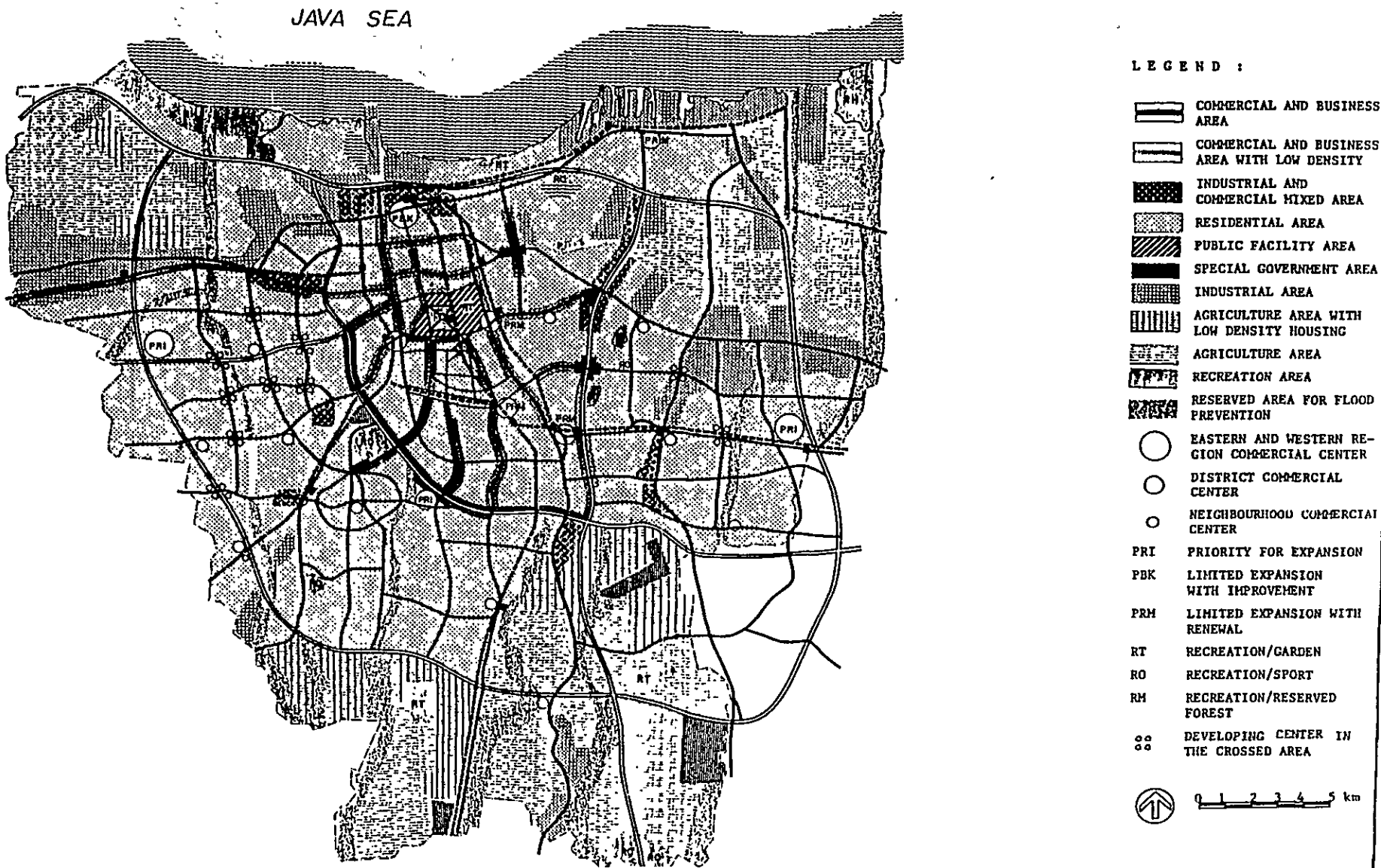


Fig. 1.3 DKI Jakarta Structure Plan

1.5 SITUATION OF EACH PROJECT FROM LAND USE POINT OF VIEW

(1) Manggarai Station improvement project

a) Although the existing railway network is functional for the purpose of long distance passenger and cargo transportation, it is necessary to reorganize the railway network in order to deal with urban traffic efficiently.

Manggarai station must be so planned that it can easily be adjusted to the future changes in the railway network system.

b) As a principle of urban railway networks, major radial rail routes should pass through the Central Business District (CBD) area to meet needs of the commuters. The Central Line is reasonably arranged in this respect. Therefore the present route arrangement should be maintained and only the capacity should be increased.

c) The future traffic demand on the Central Line south of Manggarai Station indicates the necessity of dual double track. However, instead of four tracks, it is considered better to increase the radial routes from south to north.

But considering this increase of a route may not be possible to implement, Manggarai Station should be planned to be adjusted to the dual double track of Central Line.

d) It is convenient and desirable for the terminal of long distance passenger trains to be located at the population centre. Fig. 1.4 shows the centre calculated based on the population distribution forecast by DKI Jakarta Master Plan 2005 (Draft).

In 1980, the centre is near Gambir Station, but it will move south nearer to the middle between Gambir Station and Manggarai Station by the year 2005. Therefore Manggarai Station is planned in this study to act as one of the future terminals for long distance passenger trains.

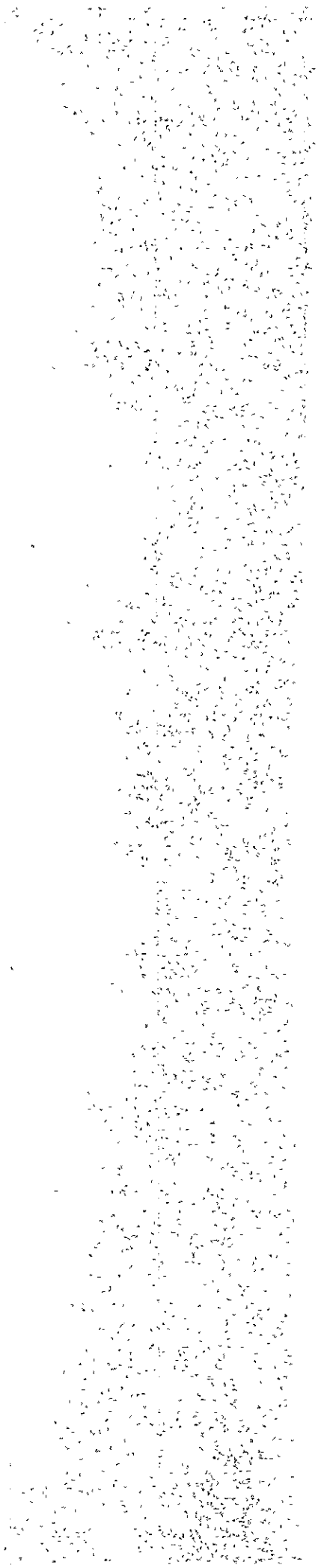
(2) Merak line and Tangerang line improvement project

Since the main radial line should pass through the CBD area, it is desirable (if possible) to extend the Merak Line and Tangerang Line to the CBD in future. The possibility for the trains to go into Western Line from Merak Line or Tangerang Line should be considered during the study phase of the Western Line improvement project. Consequently, in this improvement plan, the study area should be defined up to the connecting station with Western Line.

Fig. 1.4 The Position of Gravity Center of Population Distribution

CHAPTER 2

ANALYSIS AND FORECAST OF TRAFFIC DEMAND



CHAPTER 2 ANALYSIS AND FORECAST OF TRAFFIC DEMAND

2.1 EXISTING TRANSPORTATION NETWORK AND TRAFFIC SITUATION

2.1.1 Transportation Network and Facilities

(1) Railway network

The railway network in Indonesia is mostly limited to the islands of Java (including Madura) with about 4,900 km and Sumatra with about 2,000 km of route length.

The number of passengers and the passenger-kms in Java and Madura increased during 1977/1981 at the rate of 17.5% p.a. and 12.5% p.a. respectively but the average passenger travel distance decreased during the four year period from 165 km to 138 km.

Freight traffic has been declining since 1979. The average haul was 227 km in 1981.

The main features of railway passenger and freight traffic in Java and Madura are summarized in Table 2.1.

Table 2.1 Railway Passengers and Freight Traffic in Java and Madura

	1977	1978	1979	1980	1981
(1) Passenger Traffic					
Passengers carried (million)	21	29	37	38	40
Passenger-km (million)	3,460	4,306	5,142	5,410	5,537
Average travel distance (km)	165	149	139	142	138
(2) Freight Traffic					
Tons loaded (thousand)	2,584	3,196	3,789	3,005	2,837
Ton-km (million)	634	775	750	657	643
Average haul distance (km)	245	242	198	219	227

Source: Statistical Yearbook of Indonesia, 1982

The railway transport in Indonesia has been playing a major role in long distance travel but now it is expected to extend its services to the urban and suburban areas. The JABOTABEK train started operations in 1977 and the passenger volume for the area has increased.

The railway system in the JABOTABEK area consists of the Central Line, Western Line, and Eastern Line in Jakarta, and the four radial routes of the Tangerang, Merak, Bogor and Bekasi lines. In JABOTABEK, the railway network is *156 route km.

The outline of railway network in JABOTABEK area is given in Table 2.2 and Fig. 2.1.

The JABOTABEK trains are operated on four routes between Jakarta Kota and Tangerang, Rangkasbitung, Bogor and Purwakarta. The major railway stations on these radial lines are listed in Table 2.3.

(2) Road network and motorization

In DKI Jakarta, the number of motor vehicles registered in 1982 was about one million including motorcycles, with the latter amounting to about 570,000. It is calculated that the vehicle ownership rate per one thousand capita was 150 and the equivalent Sedan ownership rate was 41. The growth of motorization in Jakarta averages about 13.4% per annum including motorcycles and 12.5% per annum excluding motorcycles during 1972/1982 as shown in Table 2.4. The growth rate of vehicle ownership in Jakarta is very high compared with other local cities. Road facilities in DKI Jakarta are not sufficient to meet the traffic demand, this applies both to the arterial road system and the feeder road system, hence an increase in cost of transportation of goods and people are caused by delays due to congestion.

Inevitably, lower rates of road density in DKI Jakarta require the arterial roads to provide the services of arterial, as well as collector and local roads at the same time. This is, therefore, likely to block effective traffic flows in the center of DKI Jakarta. The existing road networks in Jakarta and BOTABEK area are presented in Fig. 2.2 and Fig. 2.3.

Note: * Total length of double track route in km is approx. 66 km, and total length of single track route in km is approx. 90 km.

Table 2.2 Outline of Railway Network in JABOTABEK Area

Line	Section	Distance (km)	Single or Double Track	Electrified (Yes/No)
Eastern Line	JKT Kota - Jatinegara	11.8	Double	Yes
	JKT Kota - Tg. Priok	8.1	Double	Yes
	Tg. Priok - Kemayoran	4.2	Double	Yes
Central Line	JKT Kota - Manggarai	9.7	Double	Yes
Western Line	JKT Kota - Kp. Bandan	2.7	Double	Yes
	Kp. Bandan - Duri - Tanah Abang - Manggarai	14.3	Double	No
	Manggarai - Jatinegara	2.9	Double	Yes
Tangerang Line	Duri - Tangerang	19.3	Single	No
Merak Line	Tanah Abang - Serpong*- Parung Panjang - Rangkasbitung	(*23.3) 72.8	Single	No
Bogor Line	Manggarai - Bogor	44.9	Single	Yes
Bekasi Line	Jatinegara - Bekasi*- Karawang - Cikampek - Purwakarta	(*14.8) 91.0	Double	No

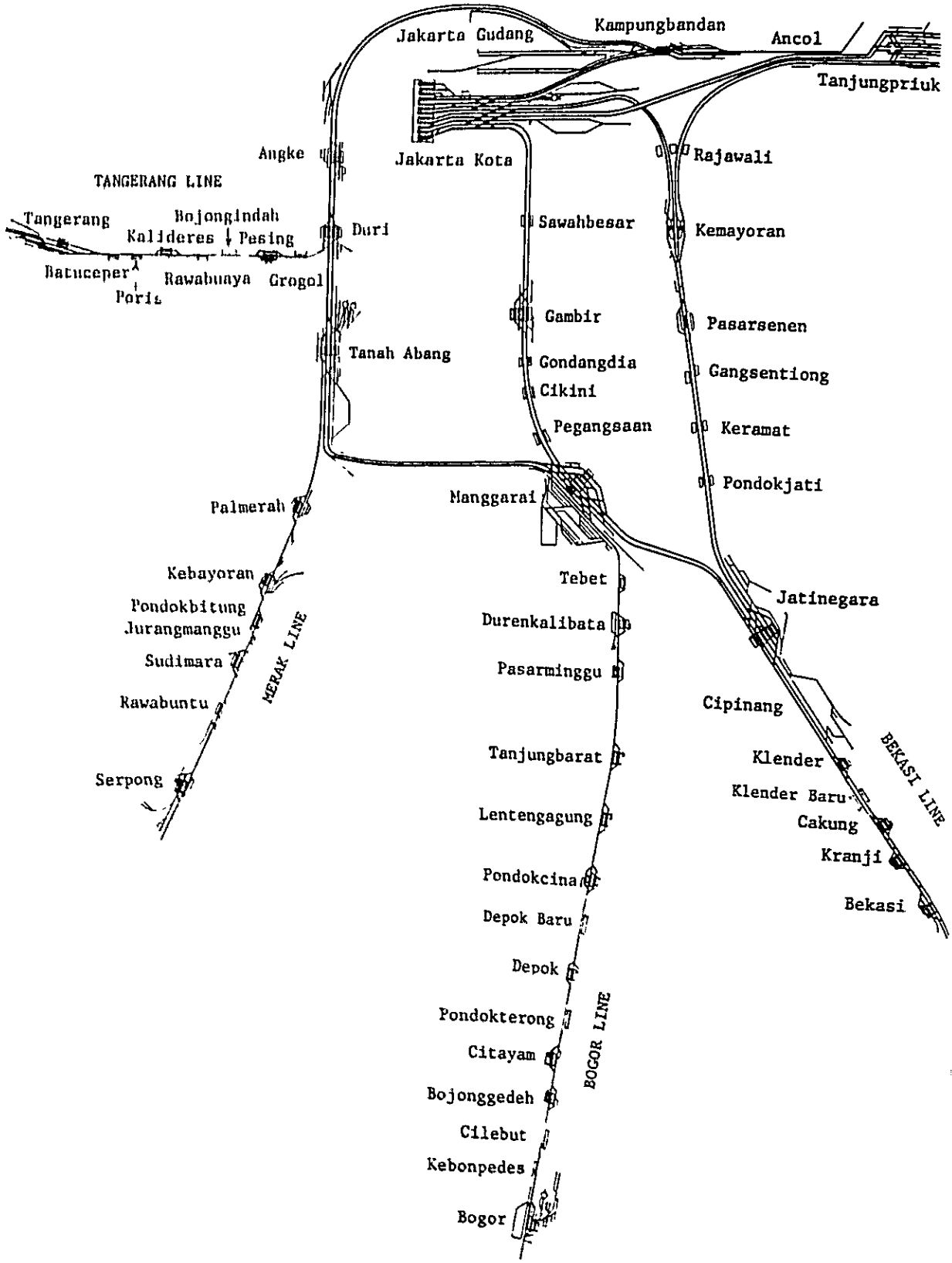


Fig. 2.1 Railway Network in JABOTABEK Area

Table 2.3 Location of Railway Stations on Radial JABOTABEK Lines

Tangerang Line		
Station	Kilometerage	Distance (km)
Duri	0	0
Grogol	1.700	1.700
Pesing	3.736	3.736
Bojongindah	7.648	7.648
Rawabuaya	8.836	8.836
Kalideres	11.390	11.390
Poris	13.888	13.888
Batuceper	15.688	15.688
Tangerang	19.297	19.297

Merak Line		
Station	Kilometerage	Distance (km)
Tanah Abang	6.925	0
Palmerah	10.116	3.191
Kebayoran	13.853	6.928
(Pondokbitung)	16.783	9.858
(Jurangmanggu)	22.255	15.330
Sudimara	24.244	17.319
Rawabuntu	28.790	21.865
Serpong	30.203	23.278
Cisauk	32.987	26.062
Cicayur	35.506	28.581
Parung Panjang	41.463	34.538
Rangkasbitung	79.694	72.769

Bekasi Line		
Station	Kilometerage	Distance (km)
Jatinegara	11.750	0
(Cipinang)	13.381	(1.631)
Klender	15.145	3.395
Klender Baru	19.800	8.050
Cakung	20.923	9.173
Kranji	24.032	12.282
Bekasi	26.552	14.802
Tambun	33.359	21.609
Cikarang	43.289	31.539
Lemahabang	47.693	35.943
Kedunggedeh	56.621	44.871
Karawang	62.710	50.960
Cikampek	84.007	72.257
Purwakarta	103.070	91.320

Bogor Line		
Station	Kilometerage	Distance (km)
Manggarai	9.890	0
Tebet	12.500	2.610
Durenkalibata	15.276	5.386
Pasarminggu	18.598	8.708
(Tanjungbarat)	21.221	11.331
Lentengagung	23.971	14.081
Pondokcina	28.373	18.483
Depok Baru	30.943	21.053
Depok	32.684	22.794
(Pondokterong)	35.940	26.050
Citayam	37.768	27.878
Bojonggedeh	42.965	33.075
Cilebut	47.292	37.402
(Kebonpedes)	51.100	41.210
Bogor	54.810	44.920

Table 2,4 Development of Registered Motor Vehicles in JAKARTA

(Unit: 1000 veh.)

Year	Motor-cycle	Sedan	Truck	Bus	Total	Ownership* rate of Sedan
1972	153.1	103.2	24.9	6.7	287.9	21.6
1973	186.3	113.5	29.0	7.6	336.4	22.8
1974	237.1	131.6	37.4	8.6	414.7	25.4
1975	281.7	152.5	44.7	9.8	488.7	28.8
1976	313.6	170.3	48.4	11.0	543.2	30.7
1977	339.6	177.8	52.8	13.4	583.6	30.6
1978	369.4	190.6	58.4	17.1	635.5	31.7
1979	403.7	202.8	64.7	21.7	692.9	32.5
1980	428.1	222.3	77.8	29.4	757.6	34.9
1981	495.5	247.1	95.6	33.5	871.7	37.8
1982	571.0	275.1	112.5	49.8	1,008.4	41.1
Average annual growth rate (%)	14.1	10.3	16.3	22.2	13.4	6.6

Source: Jakarta Metropolitan Police

Note: * Number of sedans owned per 1000 population.

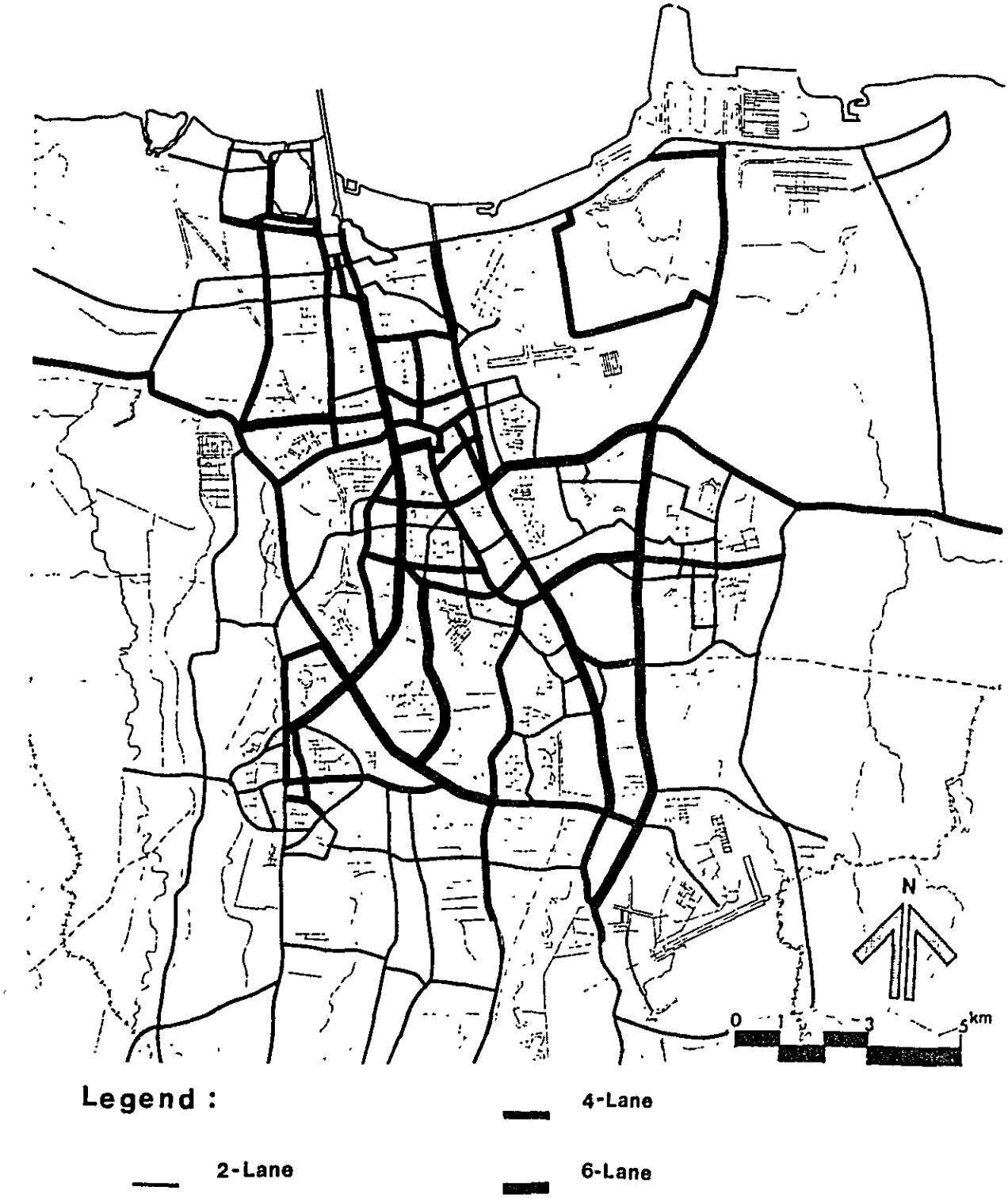
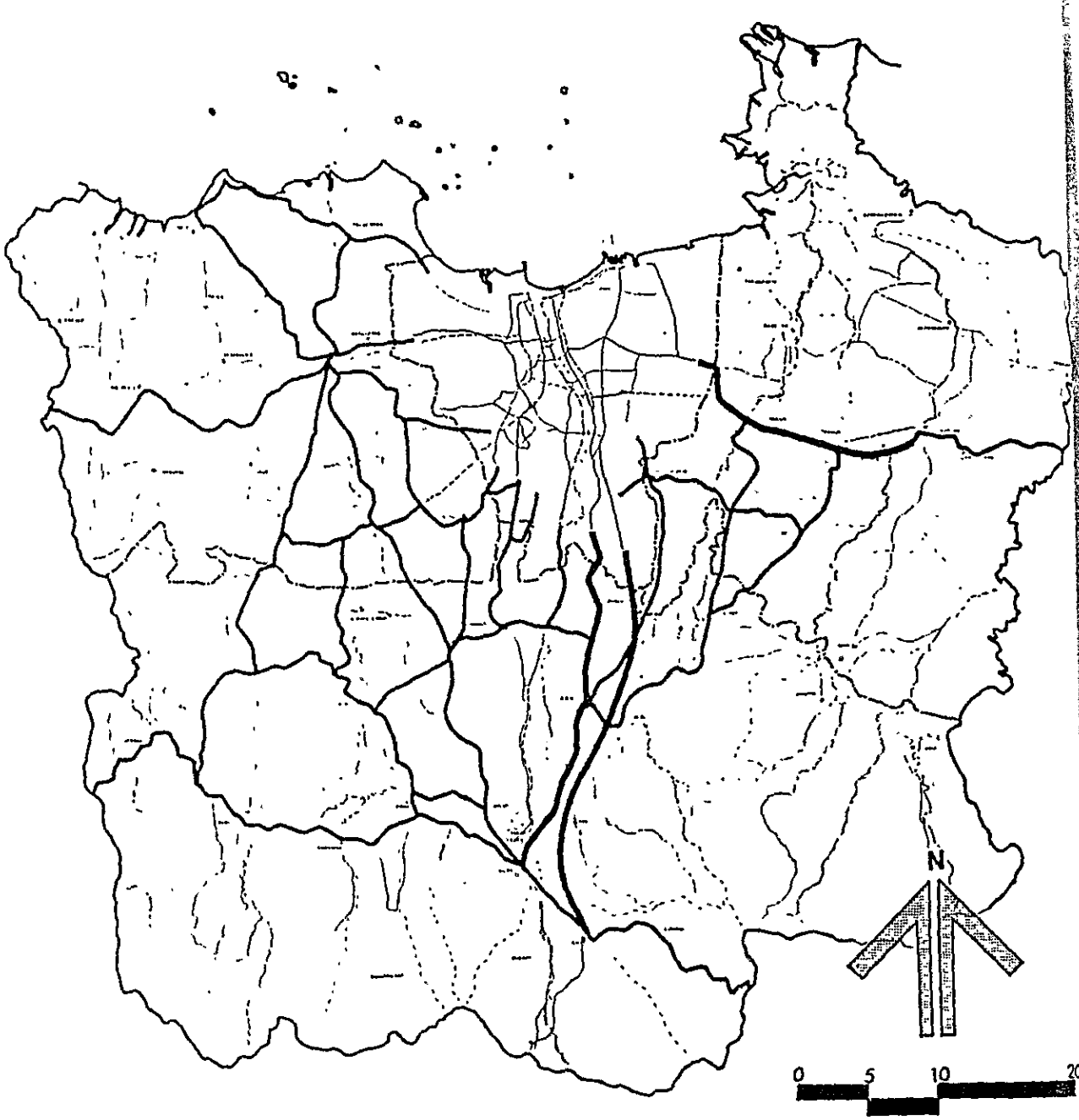


Fig. 2.2 Existing Road Network in Jakarta



Legend :

Boundary of Jakarta, Bogor, Bekasi & Tanggerang

2-Lane

4-Lane

Fig. 2.3 Existing Road Network in BOTABEK Area

2.1.2 Railway Passengers and Cargoes in JABOTABEK Area

(1) Passenger traffic

The number of passengers carried by JABOTABEK trains exceeded 16 million in 1981 and 1982, as shown in Table 2.5.

Table 2.5 Number of Passengers on JABOTABEK Trains (Electric and Diesel Railcars)

(Unit: 1000 persons)

Year / Month	1977*	1978	1979	1980	1981	1982	1983 **
January	-	649	841	1,157	1,362	1,363	1,502
February	-	651	828	1,101	1,292	1,317	1,185
March	-	696	932	1,157	1,435	1,323	1,226
April		705	978	1,187	1,448	1,246	1,134
May	-	709	986	1,317	1,462	1,365	1,541
June	-	708	1,093	1,390	1,446	1,292	1,502
July	-	770	1,074	1,414	1,403	1,376	1,656
August	-	784	1,183	1,557	1,521	1,152	n.a
September	630	864	1,032	1,239	1,322	1,332	n.a
October	597	767	1,047	1,316	1,417	1,368	n.a
November	607	792	1,098	1,335	1,354	1,388	n.a
December	619	843	1,174	1,335	1,361	1,498	n.a
Total	2,453	8,938	12,266	15,505	16,823	16,020	9,746

Source: Inspeksi I of West Java, PJKA

Note: * JABOTABEK train started operation from September 1977

** Data is only available up to July 1983.

The number of railway passengers boarding in JABOTABEK is based on the number of tickets and commuting passes sold at the stations in the area as shown in Table 2.6.

Table 2.6 Railway Passengers from Stations in JABOTABEK Area

(Unit: 1000 persons)

	Stations	Year			
		1980	1981	1982	1983 *
	1. Jakarta	1,902	2,183	2,246	1,377
	2. Gambir	61	64	584	368
	3. Tg. Priok	65	52	42	13
	4. Kemayoran	215	210	203	103
	5. Pasar Senen	130	136	411	211
A	6. Jatinegara	152	89	648	326
A	7. Klender	356	475	540	268
A	8. Bekasi	193	216	235	110
	9. Angke	288	44	190	102
B	10. Duri	214	188	150	68
B	11. Tangerang	265	237	186	82
C	12. Tanah Abang	7	10	148	126
C	13. Palmerah	2	4	31	26
C	14. Kebayoran	4	12	45	129
D	15. Manggarai	917	984	1,047	676
D	16. Duren Kalibata	72	79	91	85
D	17. Pasar Minggu	606	710	617	420
D	18. Lenteng Agung	110	132	168	132
D	19. Pondok Cina	31	45	84	65
D	20. Depok	2,156	2,248	2,114	1,198
D	21. Citayam	345	408	336	252
D	22. Bojong Gedeh	325	371	318	240
D	23. Cilebut	182	211	170	144
D	24. Bogor	2,473	2,629	2,572	1,559
	Total	11,071	11,737	13,176	8,080

Source : Inspeksi I of West Java, PJKA
: *January to July

A : Bekasi Line
B : Tangerang Line
C : Merak Line
D : Bogor Line

Major stations which generated more than one million passengers per year are Jakarta, Manggarai, Depok and Bogor stations from those listed in Table 2.6. Generally the numbers of passengers in the last few years is increasing.

The total traffic volume for Depok and Bogor stations exceeded 2 million passengers per year and this indicates that the Bogor Line is used for commuting between Bogor and Jakarta. The Bekasi Line also shows a steady growth in passenger volume.

Major factors effecting these passenger volume trends for both Bogor and Bekasi Lines are considered to be the housing development around the railway stations, easier access to the stations and the frequent train operations.

Compared with the Bogor and Bekasi Lines, the frequency of train operation in Tangerang Line and Merak Line is low, railway facilities are relatively poor, particularly for the Tangerang Line and the operation schedule is not reliable. Therefore, the passenger volumes from Tangerang and Duri stations show a decreasing trend over the past few years.

The number of scheduled train operations is shown in Fig. 2.4 for the major railway sections in JABOTABEK area.

Train fare for passengers varies with the travelling distance as shown in Table 2.7.

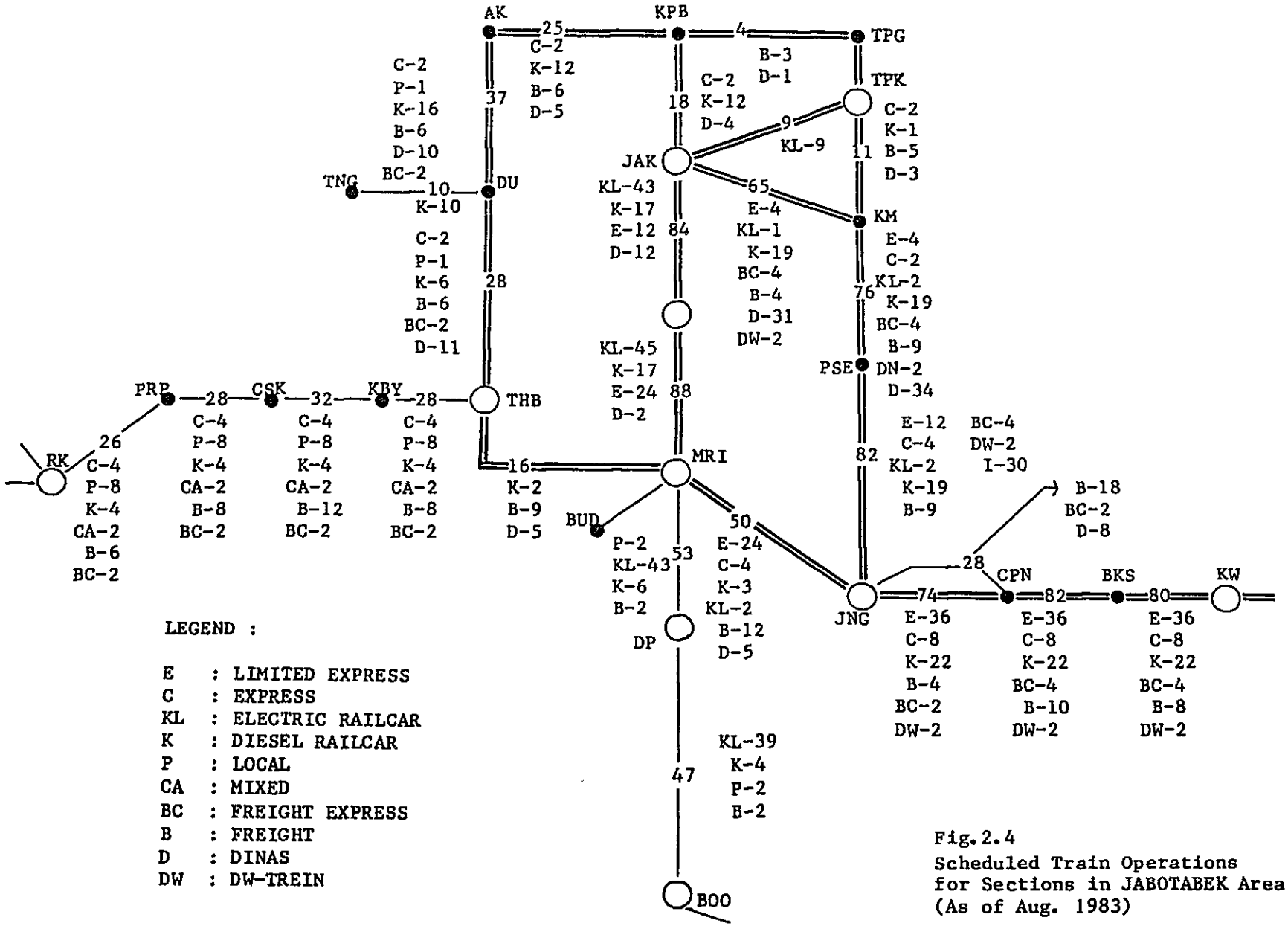


Fig. 2.4
Scheduled Train Operations
for Sections in JABOTABEK Area
(As of Aug. 1983)

Table 2.7 Railway Passengers Fares

(In September, 1983)

Total Distance (km)	Fares (Rp)
1 ∿ 10	100
11 ∿ 20	150
21 ∿ 30	150
31 ∿ 40	250
41 ∿ 50	250
51 ∿ 60	300
61 ∿ 70	350
71 ∿ 80	350
81 ∿ 90	350
91 ∿ 100	450

Source: Inspeksi I Jakarta, PJKA.

(2) Cargo traffic in JABOTABEK area

Tg. Priok station is the dominant cargo generating station in JABOTABEK area and it accounts for 60 to 85% of the total cargo loaded in the stations listed in Table 2.8.

A major cargo receiving station is Kebayoran station which accounts for about 50% of the total cargo unloaded in the area. A major commodity handled at Kebayoran station is sand hauled from Serpong for the construction of the Jakarta International Airport at Cengkareng, which is scheduled to open in 1984. The next major station is Jatinegara which accounts for about 20 to 30% of the total unloaded.

Generally, the cargo transport by railway seems to be declining and shifting to road transport, particularly on Java Island.

Table 2.8 Cargo Loaded and Unloaded at Major Station in JABOTABEK Area

(Unit: tons)

Stations	1981		1982		1983	
	Loaded(%)	Unloaded(%)	Loaded(%)	Unloaded(%)	Loaded(%)	Unloaded(%)
1. Jakarta	13,895(4.1)	3,922(1.6)	14,543(12.6)	4,534(2.6)	5,921(9.3)	2,674(3.9)
2. Gambir	3,178(0.9)	5,687(2.3)	3,572(3.1)	2,218(1.3)	1,916(3.0)	1,124(1.7)
3. Tg.Priok	290,524(86.1)	15,247(6.1)	70,667(61.0)	10,696(6.1)	45,494(71.8)	10,234(15.1)
4. Kemayoran	24(-)	- (-)	23(- _	-	11(-)	-
5. Pasar Senen	5,651(1.7)	4,348(1.7)	5,053(4.4)	2,267(1.3)	2,735(4.3)	1,469(2.2)
6. Jatinegara	440(0.1)	42,254(16,8)	7,084(6,1)	35,334(20.3)	66(0.1)	20,811(30.7)
7. Klender	-	19,295(7.7)	-	10,652(6.1)	-	5,980(8.8)
8. Bekasi	-	3,964(1.6)	-	4,107(2.4)	492(0.8)	-
9. Angke	11,424(3.4)	14,337(5.7)	7,787(6.8)	10,927(6.3)	2,776(4.4)	3,557(5.2)
10. Duri	6,990(2.1)	210(-)	4,040(3.5)	-	2,244(3.5)	95(0.1)
11. Tangerang	-	-	-	-	-	-
12. Manggarai	3,891(1.2)	11,669(4.6)	1,723(1.5)	3,223(1.8)	934(1.5)	384(0.6)
13. Palmerah	128(-)	12(-)	281(0.2)	-	60(0.1)	-
14. Kebayoran	389(0.1)	111,572(44.4)	376(0.3)	85,370(48.9)	174(0.3)	19,174(28.3)
15. Duren Kalibata	-	3,110(1.2)	-	-	-	510(0.8)
16. Pasar Minggu	-	-	-	-	-	-
17. Lenteng Agung	-	-	-	-	-	-
18. Pondok Cina	-	-	1(-)	-	-	-
19. Depok	22(-)	-	184(0.2)	-	-	-
20. Citayama	378(0.1)	-	89(0.1)	-	41(0.1)	-
21. Bojong Gedeh	192(-)	-	59(0.1)	-	74(0.1)	-
22. Cilebut	110(-)	2,186(0.9)	-	-	90(0.1)	-
23. Bogor	10(-)	13,209(5.3)	190(0.2)	5,106(2.9)	336(0.5)	1,781(2.6)
Total	337,241(100.0)	251,022(100.0)	115,763(100.0)	74,434(100.0)	63,364(100.0)	67,793(100.0)

Source: Inspkesi I Jakarta, PJKA

Note: *Up to the end of July.

2.2 TRAFFIC SURVEYS FOR RAILWAY PASSENGERS

2.2.1 General

The purpose of the traffic survey is to provide data compatible with the actual traffic situation and to check the method of traffic demand forecast.

The traffic survey was carried out at railway stations of Tangerang Line, Merak Line, Bekasi Line and Bogor Line in the JABOTABEK area. The survey dates were weekdays from September 19 (Monday), 1983 to September 22 (Thursday), 1983 during train operation. The survey consisted of two kinds of survey, namely, interview survey and traffic count survey of the Jakarta-bound passengers. In parallel with the traffic survey, a questionnaire about the number of tickets sold for trains in the Jakarta direction and also monthly commuter passes was sent to each of the survey stations.

Main output obtained from the survey (for Jakarta-bound traffic) are, characteristics of trip purpose and access/egress. These basic data are applied to the traffic demand forecast for these projects. The detailed traffic survey method and the survey forms are presented in Appendix 2.

2.2.2 Traffic Survey Results

(1) Passenger traffic at survey stations

(a) Hourly Fluctuation of Jakarta-bound traffic

According to the traffic count survey, the hourly fluctuations of Jakarta-bound traffic on the radial railway lines are shown in Table 2.9. Except for the Bogor Line, train operation is not frequent enough to cover every hour.

Therefore, the peak hour ratio found in the Tangerang, Merak and Bekasi Lines might be biased to a higher level. The peak hour ratio in the Bogor Line is about 25% in the morning per one hour and one direction. If 2-hour peak ratio is taken it will be about 42% per direction from 6:00 to 8:00 in the morning.

Table 2.9 Hourly Fluctuation of JAKARTA-Bound Traffic on Weekday in September, 1983

Hour-band	Tangerang Line (Grogol-Tangerang)		Merak Line (Sudimara-Parung Panjang)		Bogor Line (Tebet-Bogor)		Bekasi Line (Klender-Karawang)		Total	
	Passen-ger	%	Passen-ger	%	Passen-ger	%	Passen-ger	%	Passen-ger	%
5-6			391	16.3	2,761	11.2	1,098	19.2	4,250	12.5
6-7	375	31.1	1,163	48.7	6,145	24,9	2,145	37.4	9,828	29.0
7-8					4,122	16.8	1	0.0	4,123	12.2
8-9					1,277	5.2			1,277	3.8
9-10	216	18.0	109	4.6	1,329	5.4			1,654	4.9
10-11	49	4.1			931	3.8	668	11.7	1,648	4.9
11-12			98	4.1	1,218	5.0	230	4.0	1,546	4.6
12-13	122	10.2	241	10.1	1,058	4.3			1,421	4.2
13-14	82	6.8	64	2.7	683	2.8	485	8.5	1,314	3.9
14-15					1,175	4.8	320	5.6	1,495	4.4
15-16	116	9.7	104	4.3	727	3.0	201	3.5	1,148	3.4
16-17	38	3.2	94	3.9	1,212	4.9			1,344	4.0
17-18					912	3.7	233	4.1	1,145	3.4
18-19	200	16.7	106	4.4	756	3.1	289	5.0	1,351	4.0
19-20					277	1.1	59	1.0	336	1.0
20-21			22	0.9	1	0.0			23	0.0
Total	1,198	100.0	2,392	100.0	24,584	100.0	5,729	100.0	33,903	100.0

(b) Daily and monthly fluctuation of Jakarta-bound traffic

Data on tickets and commuter passes sold at the survey stations were collected and the daily and monthly fluctuation of Jakarta-bound traffic were obtained as shown in Table 2.10 and 2.11. However, actual number of boarding passengers from these stations can be about 40% higher than the collected data, because of the non-ticket travellers. See Table 2.16.

Table 2.10 Daily Fluctuation of Jakarta-Bound Traffic in a Week, September 1983

Day of the Week	Tangerang Line (Grogol-Tangerang)		Merak Line (Sudimara-Parung Panjang)		Bogor Line (Tebet-Bogor)		Bekasi Line (Kelender-Karawang)		Total	
	Passenger	%	Passenger	%	Passenger	%	Passenger	%	Passenger	%
Sunday	155	5.7	594	6.9	11,834	10.9	2,544	13.7	15,127	10.9
Monday	292	10.8	2,143	24.8	21,180	19.4	3,435	18.5	27,050	19.4
Tuesday	485	17.9	1,105	12.8	17,083	15.6	2,762	14.9	21,435	15.4
Wednesday	496	18.3	1,338	15.5	15,485	14.2	2,774	14.9	20,093	14.4
Thursday	508	18.7	1,279	14.8	14,983	13.7	2,566	13.8	19,336	13.9
Friday	352	13.0	1,024	11.8	14,095	12.9	2,451	13.2	17,922	12.9
Saturday	423	15.6	1,155	13.4	14,524	13.3	2,039	11.0	18,141	13.1
Total	2,711	100.0	8,638	100.0	109,184	100.0	18,571	100.0	139,104	100.0

Table 2.11 Monthly Fluctuation of Jakarta-Bound Traffic in 1982

Month in 1982	Tangerang Line (Grogol-Tangerang)		Merak Line (Sudimara-Parung Panjang)		Bogor Line (Tebet-Bogor)		Bakasi Line (Kelender-Karawang)		Total	
	Passenger	%	Passenger	%	Passenger	%	Passenger	%	Passenger	%
January	24,571	11.5	40,211	8.7	446,732	8.2	153,340	10.2	664,854	8.7
February	26,071	12.2	35,494	7.7	429,520	7.9	130,367	8.7	621,452	8.2
March	21,903	10.3	40,501	8.9	447,916	8.2	135,037	9.0	645,357	8.5
April	14,481	6.8	37,942	8.2	415,472	7.7	121,821	8.1	589,716	7.7
May	20,712	9.7	36,697	8.0	443,140	8.2	129,977	8.6	630,526	8.3
June	19,385	9.1	40,585	8.8	471,017	8.7	121,148	8.0	652,135	8.6
July	23,266	10.9	42,286	9.2	477,268	8.8	123,116	8.2	665,936	8.7
August	16,687	7.8	33,311	7.2	433,183	8.0	116,723	7.7	599,904	7.9
September	13,787	6.5	34,926	7.6	451,513	8.3	109,569	7.3	609,795	8.0
October	13,024	6.2	35,307	7.6	446,163	8.2	120,966	8.0	615,460	8.1
November	4,617	2.2	38,874	8.4	466,307	8.6	119,136	7.9	628,934	8.3
December	14,481	6.8	44,680	9.7	499,584	9.2	124,499	8.3	683,244	9.0
Total	212,985	100.0	460,814	100.0	5,427,815	100.0	1,505,699	100.0	7,607,313	100.0

(2) Distribution of trip purposes (Jakarta-Bound traffic)

The distribution of trip purposes for those bound for Jakarta direction was found as shown in Table 2.12.

Table 2.12 Distribution of Trip Purposes of Passengers for Jakarta Direction

Trip Purposes	Tangerang Line	Merak Line	Bogor Line	Bekasi Line	Total
1) Home to Work	265 (23.0)	776 (38.3)	10,438 (41.8)	1,769 (31.5)	13,275 (39.2)
2) Home to School	12 (1.0)	98 (4.8)	3,457 (13.8)	632 (11.2)	4,210 (12.4)
3) Business	97 (8.4)	84 (4.1)	1,735 (6.9)	337 (6.0)	2,266 (6.7)
4) Merchandise	197 (17.1)	402 (19.8)	2,803 (11.2)	833 (14.8)	4,255 (12.5)
5) Return home	222 (19.3)	295 (14.5)	3,897 (15.6)	894 (15.9)	5,337 (15.7)
6) Others	359 (31.2)	375 (18.5)	2,668 (10.7)	1,158 (20.6)	4,581 (13.5)
Total	1,152 (100.0)	2,030 (100.0)	24,998 (100.0)	5,623 (100.0)	33,924 (100.0)

According to the above table, Bogor Line, Bekasi Line and Merak Line are used for commuting (home to work and school purposes) purposes which totals more than 40% of the Jakarta bound traffic. However, the commuting purpose of the Tangerang Line occupies only 24% which is about a half of other Lines. Tangerang Line also shows a relatively higher proportion of "other" purposes. The improvement of the Tangerang and Merak Lines would seem to encourage an increase in demand for commuting transportation as experienced by the Bogor Line.

Distribution of the trip purposes during the determined hour bands is shown in Table 2.13.

Table 2.13 Percentage Distribution of Trip Purposes for the Total of Radial Lines (Passengers bound for Jakarta Direction only)

(%)

Hour Band	Home to Work	Home to School	Merchan-dize	Business	Return Home	Others	Total
5 - 6	51.7	20.2	0.4	23.2	0.9	3.6	100.0
6 - 8	55.0	14.0	7.0	11.3	4.3	8.4	100.0
8 - 12	33.8	12.0	5.5	8.5	13.0	27.2	100.0
12 - 16	13.5	10.0	9.1	15.2	33.0	19.2	100.0
16 - 19	11.2	5.8	6.2	10.0	51.4	15.4	100.0
19 - 20	44.9	0.0	25.3	8.4	19.5	1.9	100.0

(3) Access modes and time

Access modes and time to the survey stations are summarized in Table 2.14. Most of the passengers come to railway stations on foot which accounts for about 43% and by microbus for 40% of the total passengers. Railway stations in the outskirt of Jakarta and BOTABEK area are accessed by microbus but not by conventional city type buses. This is because of the lower traffic demand for railways and insufficient space in the forecourt area for such access modes.

Access time concentrates within 15 minutes and accounts for about 78% of the total passengers. In other words, it can be said that the influence area of a railway station extends about 15 minutes travel time in radius. Therefore, it is necessary to prepare the access mode and facility to enable potential passengers to reach the railway station within 15 minutes travel time. This would be one of the key factors to attract people to the railway.

Table 2.14 Access Mode and Time to the Survey Stations

Access Mode	Percentage Distribution (%)	Access Time (minutes)	Percentage Distribution (%)
1) On foot	42.5	0 ~ 5	28.1
		5 ~ 10	26.4
2) Bicycle	0.5	10 ~ 15	23.0
		15 ~ 20	5.1
3) Motorcycle	6.8	20 ~ 25	2.4
		25 ~ 30	10.7
4) Becak	3.9	30 ~ 40	0.5
		40 ~ 50	0.6
5) Microbus	40.3	50 ~ 60	2.2
		60 ~ 75	0.0
6) Bus	3.7	75 ~ 90	0.0
		90 ~ 105	0.0
7) Sedan/Jeep	0.6	105 ~ 120	0.4
		Over 120	0.7
8) Truck	0.1		
9) Others	1.6		

(4) Egress modes and time

Similarly, egress modes and time from the destination station to the ending address of the trip are summarized with percentage distribution of the passengers as shown in Table 2.15.

Table 2.15 Egress Mode and Time from Arrival Station

Egress Mode	Percentage Distribution (%)	Egress Time (minutes)	Percentage Distribution (%)
1) On foot	43.9	0 ~ 5	28.1
		5 ~ 10	30.2
2) Bicycle	0.5	10 ~ 15	19.6
		15 ~ 20	6.2
3) Motorcycle	1.7	20 ~ 25	1.9
		25 ~ 30	8.4
4) Becak	6.4	30 ~ 40	0.7
		40 ~ 50	1.8
5) Microbus	20.1	50 ~ 60	1.6
		60 ~ 75	0
6) Bus	23.9	75 ~ 90	0
		90 ~ 105	0
7) Sedan/Jeep	0.3	105 ~ 120	0.4
		Over 120	1.2
8) Truck	0.0		
9) Others	3.2		

The people interviewed at the survey stations are bound for the central urban area of Jakarta. Therefore, the access and egress modes used by those passengers is found that they use both microbus and conventional bus for the egress mode in equal proportions of about 20% each. "On foot" is still the majority egress mode and the egress time is also confined to within 15 minutes travel time for 78% of all passengers.

2.3 TRANSPORTATION DEVELOPMENT PLANS

2.3.1 Railway Development Plans

The study "Urban/Suburban Railway Transportation in JABOTABEK area" was carried out in 1980. A railway master plan was prepared in this study and it proposed the completion of track doubling, electrification and installation of automatic signalling on all the lines and construction of the new Kampung Bandan Station and a new connection line between the Eastern and Western Lines. The plan also includes construction of new railway line to the new Jakarta Airport Cengkareng and freight line to Cibinong.

The master plan also proposes other development plans as listed below:

(1) Rehabilitation program

1) Renewal of track between Depok and Bogor
2) Renewal of track Bekasi Line
3) Renewal of track Merak Line
4) Renewal of track Tangerang Line
5) Improvement of Manggarai Workshop
6) Improvement of rolling stock depot at Jakarta Kota
7) Improvement of railway crossings on East and West Lines
8) Additional supplies of rolling stock

(2) Transport capacity expansion program

(a) Central Line

9) Track elevation between Kota and Manggarai
10) Grade separated crossings at Manggarai Station
11) Track addition (Manggarai - Depok)
12) Track addition (Depok - Bogor)

(b) Eastern Line

13) Track elevation of Eastern Line
(Kota - Gong Sentiong)

14) Installation of automatic signals on Eastern Line
(Gong Sentiong - Jatinegara)

15) Improvement of station facilities at Kampung Bandan

(c) Western Line

16) Installation of automatic signal and station facility improvement

17) Installation of automatic signal and station facility improvement between Kampung Bandan and Tanjung Priok

18) Flyovers on Western Line

(d) Other Line

19) Electrification of Bekasi Line
(Jatinegara - Bekasi)

20) Track addition and other improvements on Merak Line

21) Track addition and other improvements on Tangerang Line

(e) Car Depot

22) Establishment of new electric rail car depot at Depok

23) Reinforcement of Manggarai Workshop

24) Establishment of rolling stock depot for passenger coaches

A regional plan of the JABOTABEK Metropolitan Development Planning (JMDP) also proposes a future railway network as shown in Fig. 2.9.

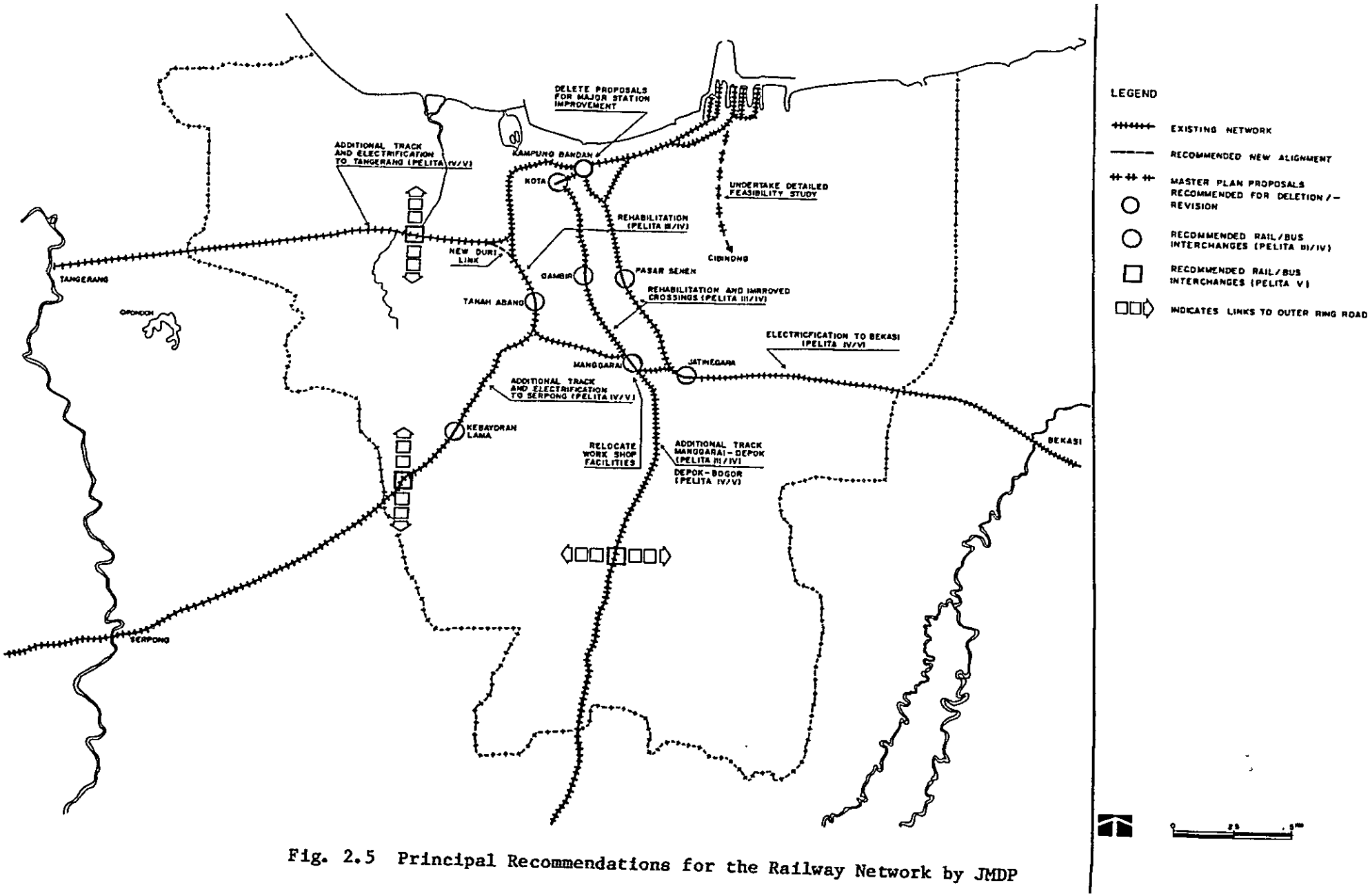


Fig. 2.5 Principal Recommendations for the Railway Network by JMDP

2.3.2 Road Tollway Network

A draft master plan of DKI Jakarta 2005 was prepared in 1983 and it proposes a future arterial road network as shown in Fig. 2.6. The JABOTABEK Metropolitan Development Planning also recommends the road network for the years 1993 and 2003 as shown in Fig. 2.7.

Construction of the Jakarta - West Java Tollway System is now underway in order to promote the unification of JABOTABEK area as a metropolis and to relieve traffic congestion in the area. The system consists of the following tollways:

Jakarta - Tangerang Freeway
Jagorawi Freeway
Jakarta - Cikampek Freeway
Jakarta Outer Ring Road
Cengkareng Access
Jakarta Harbour Road
Jakarta Intra Urban Tollway

The Jakarta - West Java Tollway System is the backbone of the highway network in Jakarta Metropolitan area. In general, the objectives of the Jakarta - West Java Tollway system are as follows:

1) To prevent immigration to the capital city of Jakarta, and encourage the development of the satellite towns in the peripheral area.

2) To promote more efficient coordination of JABOTABEK area as a Metropolitan region.

3) To assist and improve the port activities of Tg. Priok with respect to land access, which serves not only for DKI Jakarta but also for West Java and now parts of South Sumatra.

4) To serve and maintain DKI Jakarta as the capital city and enable it to continue to function as such.

By pursuing the above objectives and clarifying the land use zoning, manufacturing industries are expected to be encouraged to locate outside DKI Jakarta. Local government's guidance in the relocation of manufacturing outside DKI Jakarta and provision of good access to the Tollway System will enable those manufacturers to achieve faster access to the trading port by trunk highways. This will result in reduced transportation costs and thus encourage other factories to locate further outside the city. The resultant increase in job opportunities in the peripheral area will work to prevent the inflow of population.

Following this concept, the policy of regional freeways was established. These freeways run in three directions from Jakarta: to south, west and east. The Jagorawi Freeway, extending to south, is now in operation; the construction of Jakarta-Merak Highway (i.e. Jakarta-Tangerang Freeway, Ci Ujung Bypass and Serang Bypass) is now in progress assisted by an OECF loan and is scheduled to be completed by the middle of 1984. By the use of the regional freeways and other radial arteries, traffic volumes to Jakarta will increase.

In order to allow Tanjung Priok Port, which has DKI Jakarta and West Java as hinterlands, to function effectively and to make direct links with the peripheral area, Jakarta Harbour Road and Jakarta Outer Ring Road are being planned. These roads will not only serve as bypasses but will also have development impacts on the peripheral area.

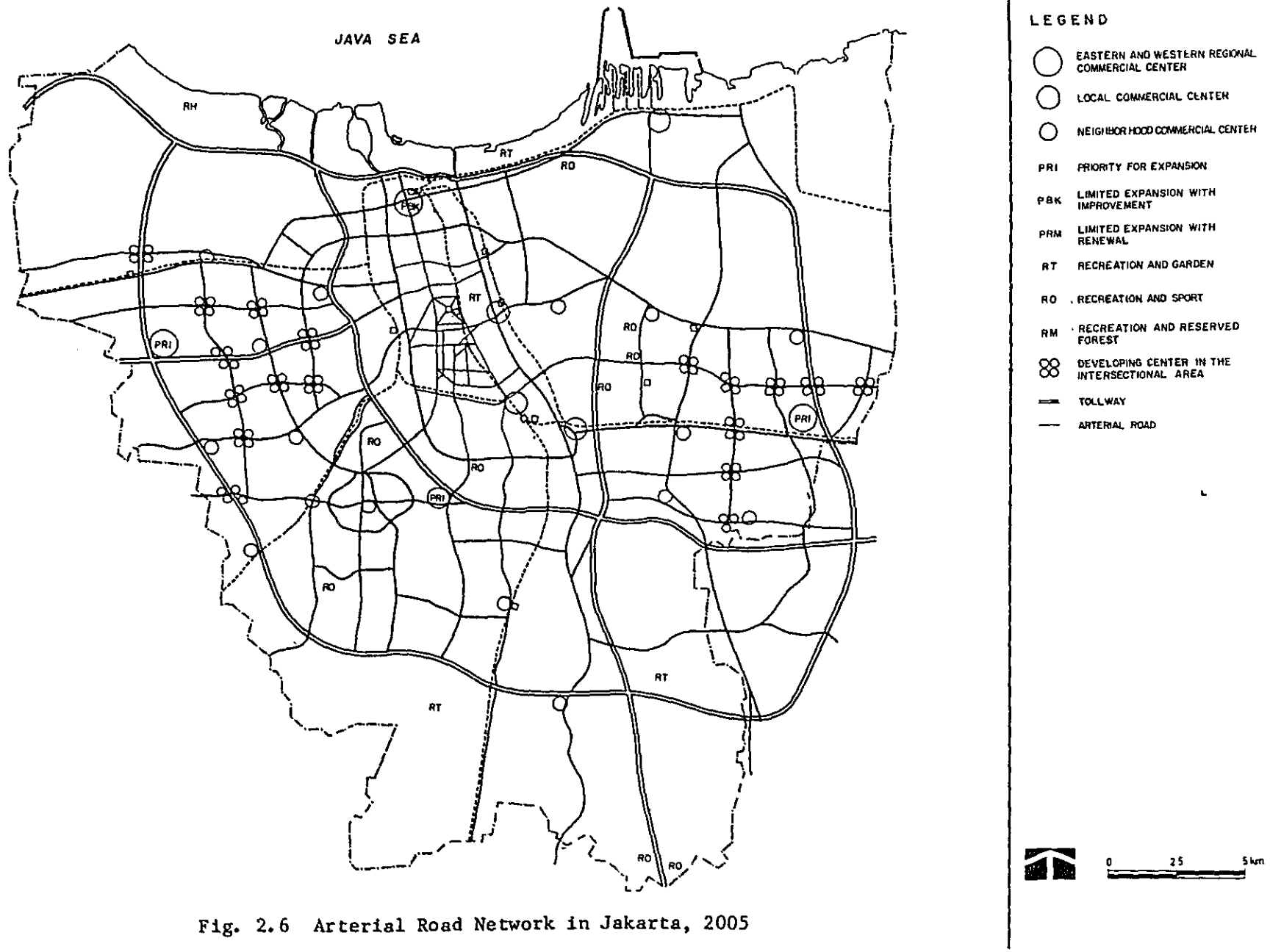
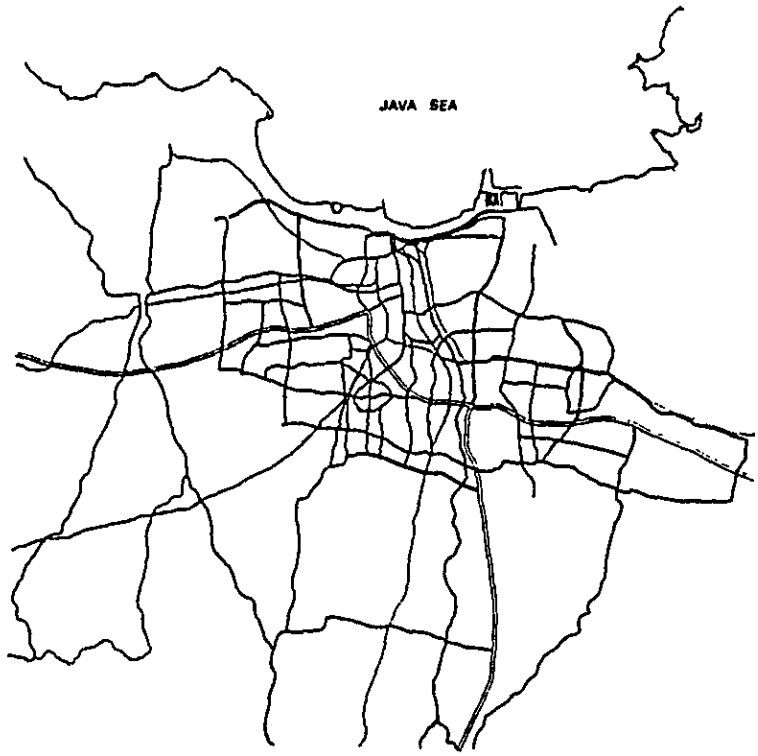


Fig. 2.6 Arterial Road Network in Jakarta, 2005

Year 1993



Year 2003

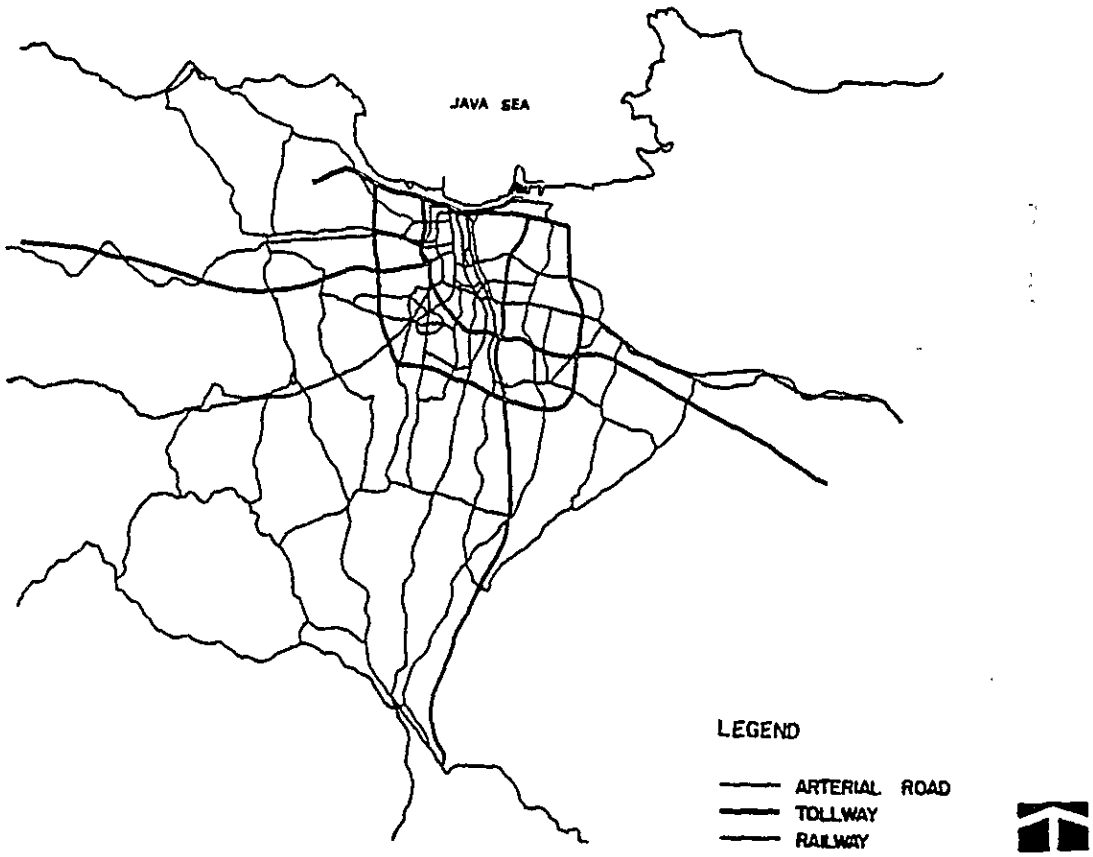


Fig. 2.7 Arterial Road Network in JABOTABEK Area in 1993 and 2003

2.4 TRAFFIC DEMAND FORECAST

2.4.1 Availability of Traffic Data

(1) Origin and destination matrix

The existing person trip O-D matrix were established by using the up-to-date statistics and results from the traffic survey for the study. The 1980 person trip O-D matrix derived from "Feasibility Study on Jakarta Harbour Road Project, 1981" (to be called JHRP hereinafter), which is the latest study, were also incorporated.

The long distance rail passengers were estimated with reference to the recent study report of "The Study on Electrification Project of Main Railway Lines in Java, March 1983" which was the only available data for those passengers.

(2) Traffic count data

The number of passengers who buy tickets or possess monthly commuting passes are recorded at most of the stations in the Study area.

However, it is a well-known fact that there is a considerable proportion of non-ticketed travellers. Therefore the actual number of rail passengers travelling for short and medium distances in particular is not correctly shown in any of the railway statistics and study reports.

As a matter of fact, the difference between the actual traffic counts at survey stations and the reports on the number of tickets sold at these stations is shown in Table 2.16.

Table 2.16 Estimation of Non-Ticketed Travellers

Railway Lines	Traffic Counts	Reports* from Stations	Non-ticket Travellers
(1) Tangerang Line ** (Tangerang - Pesing)	558(100%)	292(52.3%)	266(47.7%)
(2) Merak Line (Parung Panjang-Sudimara)	2,392(100%)	1,105(46.2%)	1,287(53.8%)
(3) Bogor Line (Bogor - Tebet)	24,583(100%)	14,983(60.9%)	9,600(39.1%)
(4) Bekasi Line (Karawang - Klender)	5,729(100%)	2,774(48.4%)	2,955(51.6%)
Total	33,262(100%)	19,154(57.6%)	14,108(42.4%)

Note: * Including commuting pass holders.
** Trains were operated only in the afternoon on the survey data.

Source: Traffic Survey by JICA Study Team from 19 to 22 September, 1983

Non-ticketed travellers accounted for about 40% of the total passengers bound for Jakarta. Although some percentage of the non-ticketed travellers will pay their fares on board, it should be taken into account that any statistics on the railway passengers are under-estimated, particularly for short and medium distance journeys.

It is necessary to set up adequate measures which prevent non-ticketed travellers from getting on the train in order to ensure the financial resources of JABOTABEK trains.

2.4.2 Planning Parameters by Zone

Residential population by zone and employment (Sector II + Sector III) by zone, are suitable parameters for estimating traffic generation and attraction by zone (all purposes).

The population census was carried out in 1980 and this was adopted as a base year. Future zonal parameters in years 1985, 1995 and 2005 are forecast based on the DKI Jakarta Master Plan (Draft, 1983) (Pola Dasar Tata Ruang Daerah DKI Jakarta 2005) and the JABOTABEK Metropolitan Development Planning (until 2003) 1980.

Therefore, the change in development policy of DKI Jakarta is taken into account in this traffic forecast.

(1) Residential population by zone

The future residential population in DKI Jakarta is based on the DKI Jakarta Master Plan, 2005. Residential population by zone in 1980 is obtained from the population census (Statistic Wilayah Jakarta 1980). Growth rate of residential population by zone between 1980 and 2005 is based on the DKI Jakarta Master Plan, 2005.

The future residential population in BOTABEK area is based on the JABOTABEK Metropolitan Development Planning. Residential Population by zone in 1980 is based on the population census (Penduduk Jawa Barat per Kecamatan tahun 1980). Growth rate by zone between 1980 and 2005 is based on the JABOTABEK Metropolitan Development Planning.

Residential population by zone outside JABOTABEK area is obtained by considering the growth of population in Java and West Java. The result of the forecast is shown in Tables 2.17, 2.18 and 2.19.

Table 2.17 Residential Population in DKI Jakarta

(× 1000 Persons)

Zone No.	Zone Name	1980	1985	1995	2005
1	Tamansari	150	157	172	181
2	Tambora	270	283	309	326
3	Grogol Petamburan	131	137	149	158
4	Tomang	271	284	310	327
5	Tanah Abang	239	265	315	357
6	Gambir	145	154	173	187
7	Penjaringan	145	172	226	273
8	Cengkareng	238	304	436	556
9	Kebon Jeruk	171	263	449	622
10	Cipulir	179	275	470	651
11	Kebayoran Lama	135	208	355	491
12	Kebayoran Baru	202	224	266	302
13	Mampang Prapatan	231	256	304	345
14	Tebet	257	284	339	384
15	Menteng	116	129	155	174
16	Setia Budi	231	256	304	345
17	Cilandak	116	147	210	268
18	Pasar Minggu	228	292	422	539
19	Pasar Rebo	200	263	388	504
20	Kramatjati	269	328	446	553
21	Jatinegara	404	484	642	783
22	Matraman	180	216	286	349
23	Senen, Cempaka Putih	350	368	401	423
24	Sawah Besar	157	164	179	189
25	Kemayoran	230	242	263	278
26	Pulo Gadung	256	295	372	440
27	Cakung	147	190	277	356
28	Cilincing	152	196	287	369
29	Tanjung Priok, Koja	507	626	862	1076
30	Penjaringan	160	168	183	193
	Jakarta Total	6467	7630	9950	12000

Table 2.18 Residential Population in BOTABEK

(× 1000 Persons)

Zone No.	Zone Name	1980	1985	1995	2005
31	Tangerang	195	244	341	422
32	Teluknaga	190	214	259	271
33	Mauk	338	369	427	465
34	Cikupa	396	492	681	836
35	Serpong	145	185	265	332
36	Ciputat	225	296	436	555
	Tangerang Total	1489	1800	2410	2900
37	Sawangan	94	114	146	164
38	Depok	196	240	305	343
39	Cibinong	330	439	617	729
40	Citeureup	108	142	199	234
41	Cileungsi	254	288	333	351
42	Bogor	688	866	1147	1312
43	Ciawi	329	360	394	399
44	Rumpin	186	212	248	263
45	Parung Panjang	66	70	71	72
46	Leuwiliang	498	539	581	582
	Bogor Total	2749	3270	4040	4450
47	Pondok Gede	107	167	288	404
48	Bekasi	191	242	341	436
49	Babelan	75	80	89	97
50	Tambun	184	233	329	420
51	Cikarang	205	253	346	434
52	Setu	159	181	225	265
53	Sukatani	202	215	241	263
	Bekasi Total	1123	1370	1860	2320
	BOTABEK Total	5361	6440	8310	9670
	(JABOTABEK Total)	(11828)	(14070)	(18260)	(21670)

Table 2.19 Residential Population in Java

(× 1000 Persons)

Zone No.	Zone Name	1980	1985	1995	2005
54	Outside West	2487	2679	3048	3434
55	Outside South	1628	1754	1996	2249
56	Outside East	75327	81773	94216	101465

(2) Employment in Sector II and Sector III by Zone

Future employment (number of jobs in Sector II + Sector III) in DKI Jakarta is based on the DKI Jakarta Master Plan, 2005. Employment by zone in 1980 is estimated from the result of the OD Survey at the time of the JHRP.

Table 2.20 Employment (Sector II + Sector III) in DKI Jakarta

(× 1000 Persons)

Zone No.	Zone Name	1980	1985	1995	2005
1	Tamansari	51	52	57	70
2	Tambora	54	55	61	74
3	Grogol Petamburan	51	52	57	70
4	Tomang	112	114	127	154
5	Tanah Abang	92	94	103	126
6	Gambir	86	87	97	118
7	Penjaringan	61	110	217	355
8	Cengkareng	40	70	143	232
9	Kebon Jeruk	38	77	168	279
10	Cipulir	35	70	154	257
11	Kebayoran Lama	22	44	97	161
12	Kebayoran Baru	98	111	152	210
13	Mampang Prapatan	63	71	98	135
14	Tabet	68	77	105	145
15	Menteng	71	81	111	152
16	Setia Budi	58	66	90	124
17	Cilandak	20	32	58	92
18	Pasar Minggu	42	67	123	193
19	Pasar Rebo	27	50	108	177
20	Kramatjati	70	100	170	261
21	Jatinegara	89	128	217	332
22	Matraman	44	46	52	64
23	Senen, Cempaka Putih	111	113	129	160
24	Sawah Besar	49	50	57	71
25	Kemayoran	63	65	74	91
26	Pulo Gadung	78	80	90	112
27	Cakung	17	19	26	35
28	Cilincing	21	23	31	43
29	Tanjung Priok, Koja	128	144	192	262
30	Penjaringan	37	42	55	76
	Jakarta Total	1796	2190	3219	4630

In BOTABEK area, future employment by zone in 1980 and growth rate by zone between 1980 and 2005 are based on the JABOTABEK Metropolitan Development Planning.

Tables 2.20 and 2.21 show the result of the forecast.

Tables 2.21 Employment (Sector II + Sector III) in BOTABEK

(× 1000 Persons)

Zone No.	Zone Name	1980	1985	1995	2005
31	Tangerang	29	41	77	132
32	Teluknaga	48	54	85	137
33	Mauk	18	20	29	47
34	Cikupa	39	59	117	206
35	Serpong	22	34	69	112
36	Ciputat	25	42	88	156
	Tangerang Total	180	250	465	800
37	Sawangan	16	21	33	49
38	Depok	12	15	25	37
39	Cibinong	52	75	134	206
40	Citeureup	3	5	9	14
41	Cileungsi	17	20	31	43
42	Bogor	125	163	270	401
43	Ciawi	26	28	39	52
44	Rumpin	21	24	35	49
45	Parung Panjang	9	9	11	14
46	Leuwiliang	19	20	27	36
	Bogor Total	300	380	615	900
47	Pondok Gede	10	21	48	99
48	Bekasi	28	39	77	149
49	Babelan	15	14	21	35
50	Tambun	19	26	52	101
51	Cikarang	20	31	63	125
52	Setu	15	15	24	42
53	Sukatani	4	4	5	9
	Bekasi Total	110	150	290	560
	BOTABEK Total	590	780	1370	2260
	(JABOTABEK Total)	(2386)	(2970)	(4589)	(6890)

2.4.3 Methodology of Traffic Demand Forecast

(1) General

The methodological flow of the traffic demand forecast has followed the conventional 4-step process. The basis of estimating future traffic flows relays much on the results of the person trip analyses in the JHRP for the overall movements in JABOTABEK area and the results of the traffic survey conducted during this study at the selected rail stations on the four radial lines from Jakarta.

The modal split between bus and railway was estimated based on the traffic survey results and the up-dated bus passenger O-D matrix from JHRP.

The conceptual working flow for the traffic demand forecast is shown in Fig. 2.8.

(2) Production of future person trips

The population frameworks in Jakarta and JABOTABEK area were determined based on the "DKI Jakarta Draft Master Plan, 2005" and the "JABOTABEK Metropolitan Development Plan (JMDP)".

The future person trip O-D matrices from JHRP were revised using the growth factors of area population and resulted as shown in Table 2.22.

Table 2.22 Estimated Future Person Trip Production
(Excluding intra-zonal trips)

(Unit: 1000 person trips/day)

	Year	(1) DKI JKT	(2) BOTABEK	(3) Others	(4) Total	Total Trips
(1)	1995	6,768	2,317	239	9,324	8,046
	2005	8,821	3,063	332	12,216	10,519
(2)	1995	-	131	31	162	1,305
	2005	-	162	42	204	1,714
(3)	1995	-	-	1	1	136
	2005	-	-	2	2	189
(4)	1995	6,768	2,448	271	9,487	9,487
	2005	8,821	3,225	376	12,422	12,422

(3) Generation of person trips by zone

The future development framework was broken down into the traffic zones. Zonal planning parameters such as residential population and number of jobs were prepared with reference to the future land use plans and structure plans of the study area as discussed in section 2.4.2.

A regression equation to explain the zonal trip generation by the land use variables has been tried, however, it was not possible to obtain a good correlation coefficient. Therefore, future residential population and the number of jobs by zone were taken as growth factors of zonal trip generation and was adjusted to coincide with the total trip production of the area as determined previously in section (2).

Finally, estimated person trips generated from each zone are shown in Table 2.23.

(4) Distribution of person trips (O-D matrix)

In order to estimate the future distribution of person trips, comparison was made between the gravity model method and a present pattern method. The correlation coefficient obtained from the equation of the gravity model of the 1980 O-D matrix of JHRP was very low and it was concluded not to use the gravity model method.

The existing pattern of traffic distribution fulfills the person trip movements among the traffic zones and a drastic change in a future land use in the JABOTABEK area is not expected. Accordingly, the future distribution of person trips was estimated using Fratar's method.

Based on the estimated future trip distribution, the initial 56 traffic zones were integrated into 20 zones in order to visualize the major traffic movement patterns of the study area as shown in Figs. 2.9 ∿ 2.12.

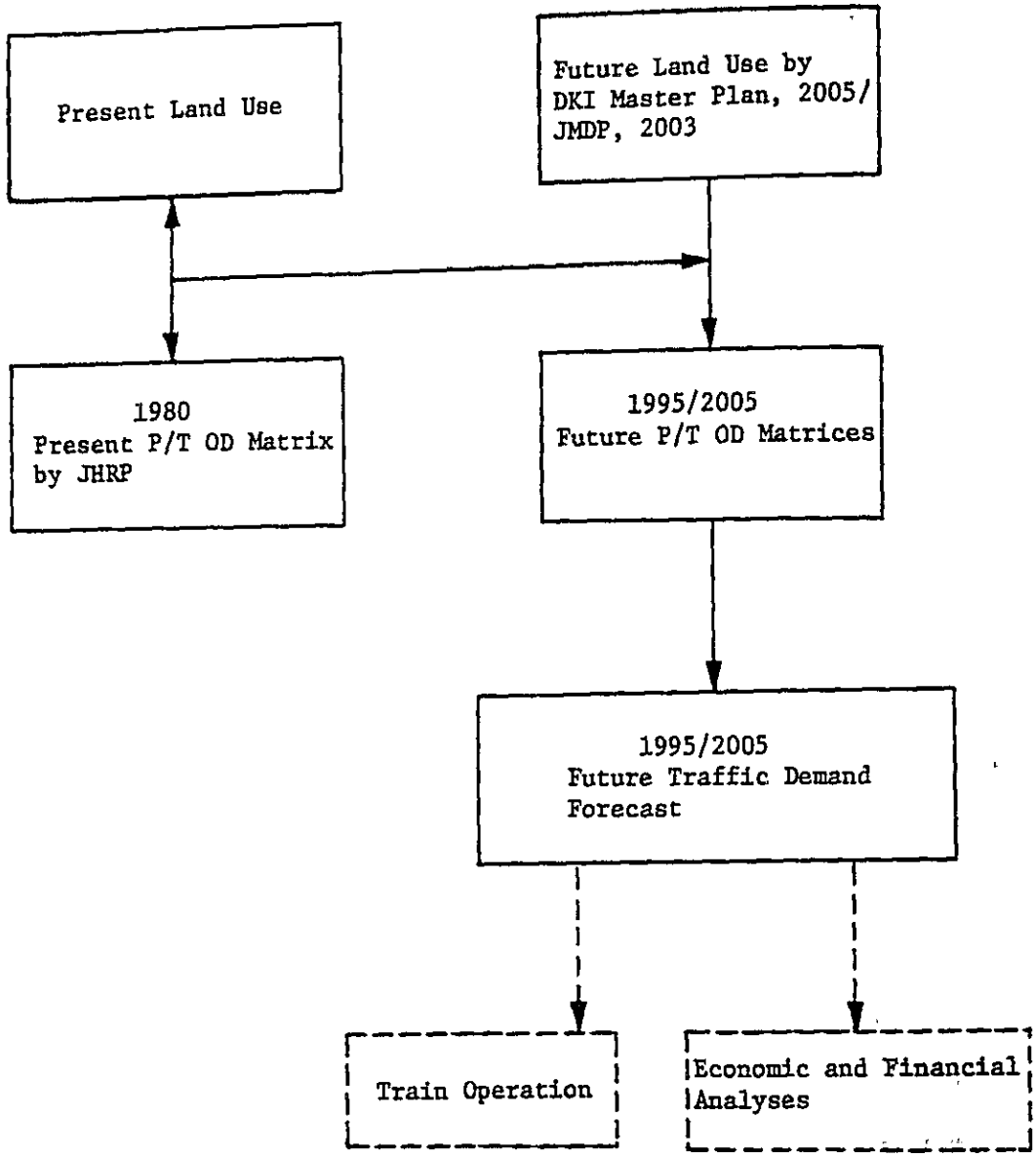


Fig. 2.8 Conceputual Flow Chart for Traffic Demand Forecast

Table 2.23 Estimated Future Person Trips by Zone

(Unit: Person trips/day)

Zone No.	Zone Name	Person Trip Generation (= Attraction)		
		1983	1995	2005
1	Tamansari	132,378	147,595	170,310
2	Tambora	99,053	123,061	140,150
3	Grogol Petamburan	239,079	264,894	308,897
4	Tomang	456,394	501,075	581,809
5	Tanah Abang	309,689	373,687	454,257
6	Gambir	298,448	335,658	399,286
7	Penjaringan	226,917	492,062	729,522
8	Cengkareng	60,531	136,256	195,347
9	Kebon Jeruk	131,957	365,914	562,603
10	Cipulir	71,670	204,915	314,212
11	Kebayoran Lama	49,501	142,480	216,573
12	Kebayoran Baru	367,885	495,071	638,669
13	Mampang Prapatan	182,421	243,162	306,090
14	Tebet	207,393	266,025	333,823
15	Mentent	257,808	344,636	444,646
16	Setia Budi	155,163	202,077	253,291
17	Cilandak	49,357	95,649	135,441
18	Pasar Minggu	107,599	212,744	301,060
19	Pasar Rebo	68,936	159,554	230,209
20	Kramatjati	256,282	483,486	672,238
21	Jatinegara	269,855	482,898	658,335
22	Matraman	97,858	140,061	180,176
23	Senen, Cempaka Putih	292,606	326,164	378,277
24	Sawah Besar	113,238	133,648	155,081
25	Kemayoran	168,684	183,315	211,442
26	Pulo Gadung	307,061	416,580	524,708
27	Cakung	43,904	86,236	117,315
28	Cilincing	42,619	79,534	108,624
29	Tanjung Priok, Koja	282,694	501,187	669,677
30	Penjaringan	86,550	105,600	125,811
	Jakarta Total	5,433,536	8,045,225	10,518,079

Table 2.23 Continued

(Unit: Person trips/day)

Zone No.	Zone Name	Person Trip Generation (= Attraction)		
		1983	1995	2005
31	Tangerang	65,142	132,069	174,254
32	Taluknaga	26,894	3,107	3,569
33	Mauk	2,372	4,375	4,891
34	Cikupa	12,128	29,638	38,559
35	Serpong	2,321	95,864	128,346
36	Ciputat	124,767	158,615	215,420
	Tangerang Total	233,624	423,668	565,039
37	Sawangan	8,965	14,616	17,322
38	Depok	83,205	121,124	138,862
39	Cibinong	88,083	205,092	254,110
40	Citeureup	9,325	17,449	20,704
41	Cileungsi	3,079	4,813	5,190
42	Bogor	44,171	97,811	117,676
43	Ciawi	8,061	12,386	12,855
44	Rumpin	524	2,195	2,416
45	Parung Panjang	480	19,757	28,003
46	Leuwiliang	6,249	6,217	6,290
	Bogor Total	252,742	501,460	603,428
47	Ponduk Gede	68,319	222,449	331,597
48	Bekasi	46,867	108,492	151,220
49	Babelan	1,837	2,323	2,778
50	Tambun	7,048	21,796	29,707
51	Cikarang	1,488	7,456	10,137
52	Setu	6,449	8,348	10,242
53	Sukatani	247	8,979	10,222
	Bekasi Total	132,255	379,843	545,903
	BOTABEK Total	618,621	1,304,971	1,714,370
	JABOTABEK Total	6,052,157	9,350,196	12,232,449
54	Outside West	11,458	29,327	41,229
55	Outside South	27,568	63,424	89,108
56	Outside East	19,802	43,599	58,544
Outside of JABOTABEK		588,828	136,350	188,882
Total		6,110,985	9,486,546	12,421,331

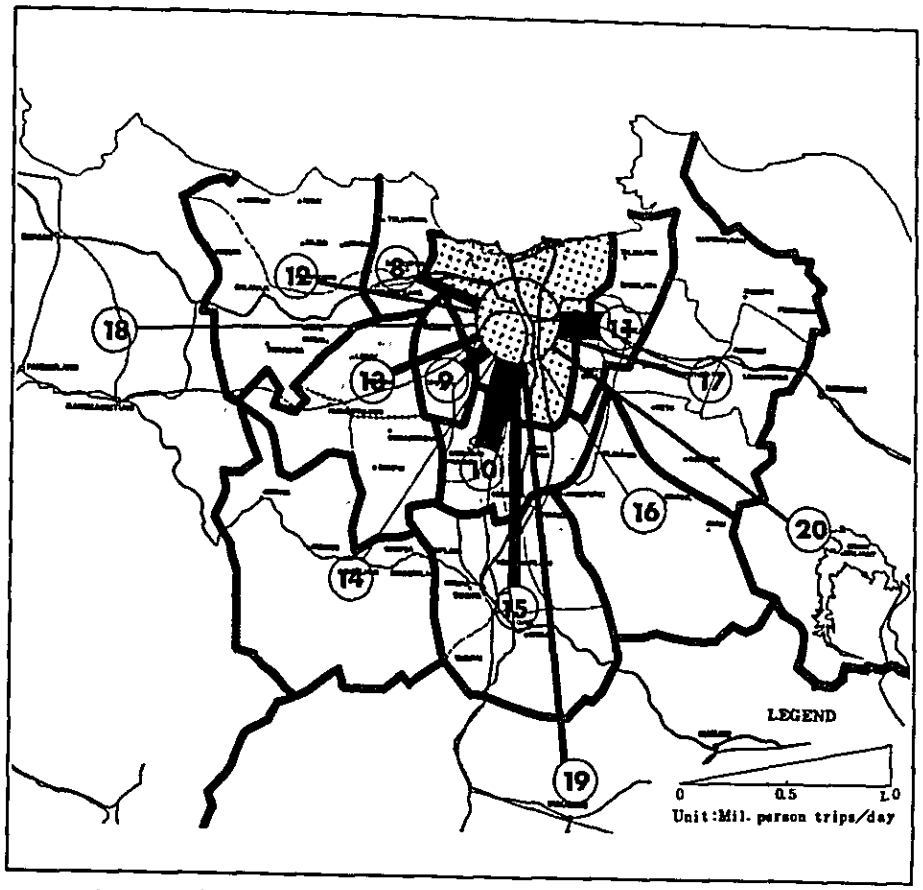


Fig. 2.9 Desire Traffic Lines of Person Trips
Between Jakarta and Other Zones in 1995

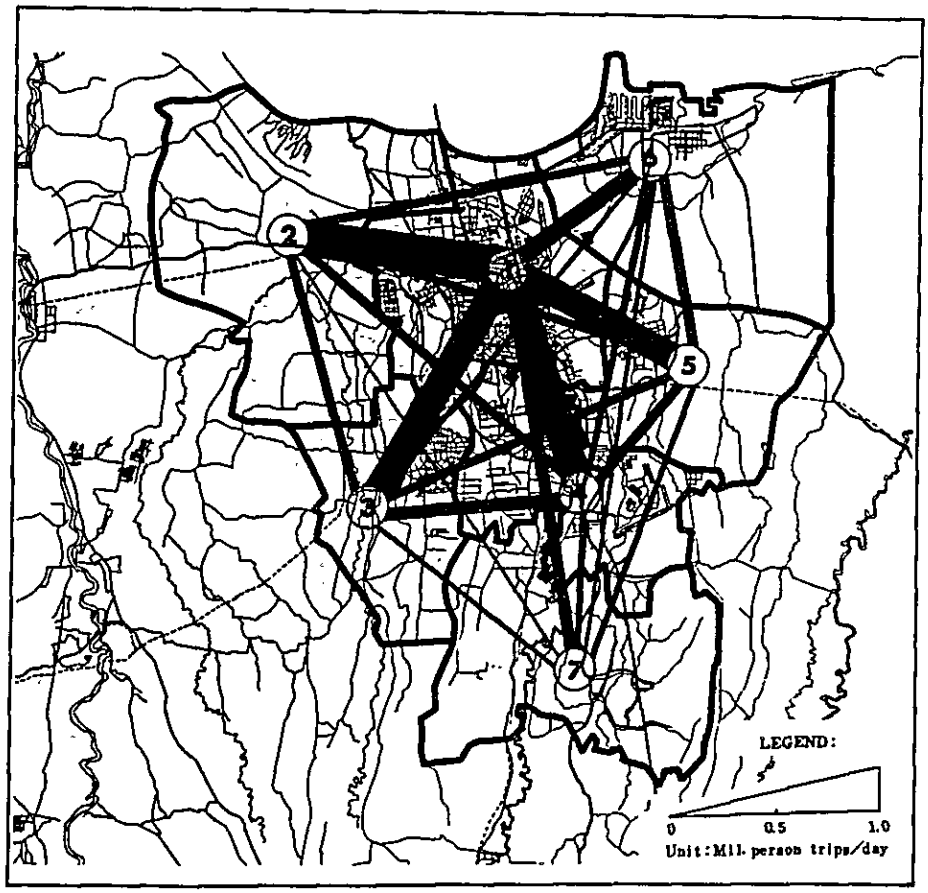


Fig. 2.10 Desire Traffic Lines of Person Trips
Inside Jakarta in 1995

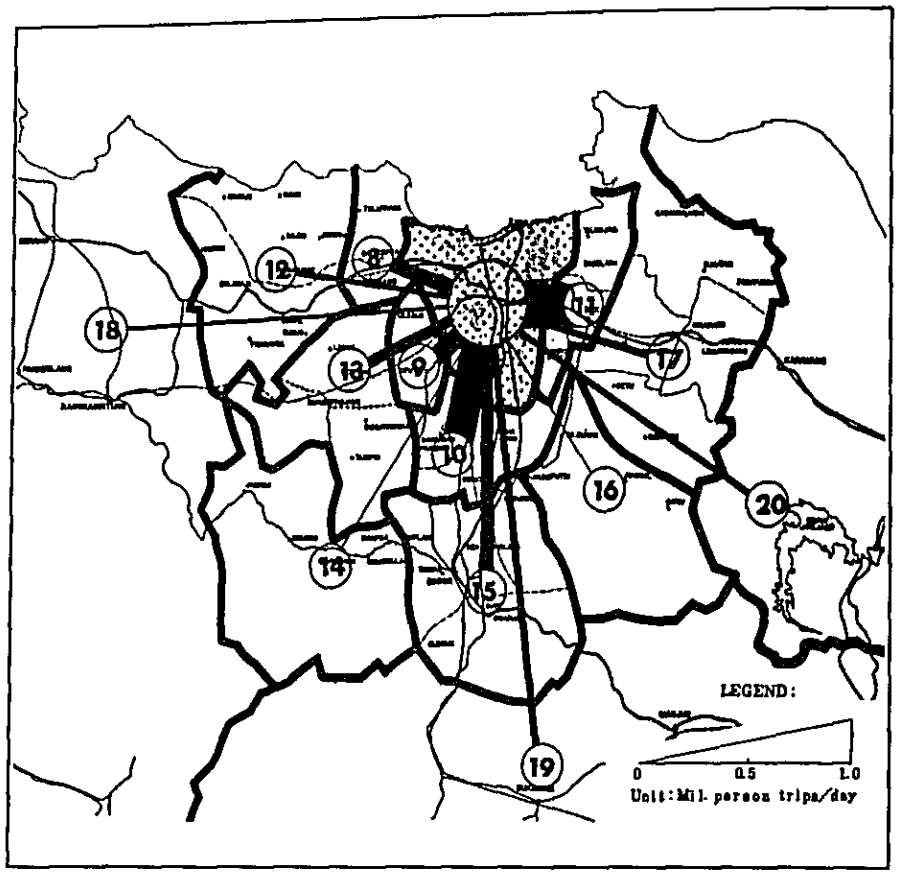


Fig. 2.11 Desire Traffic Lines of Person Trips Between Jakarta and Other Zones in 2005

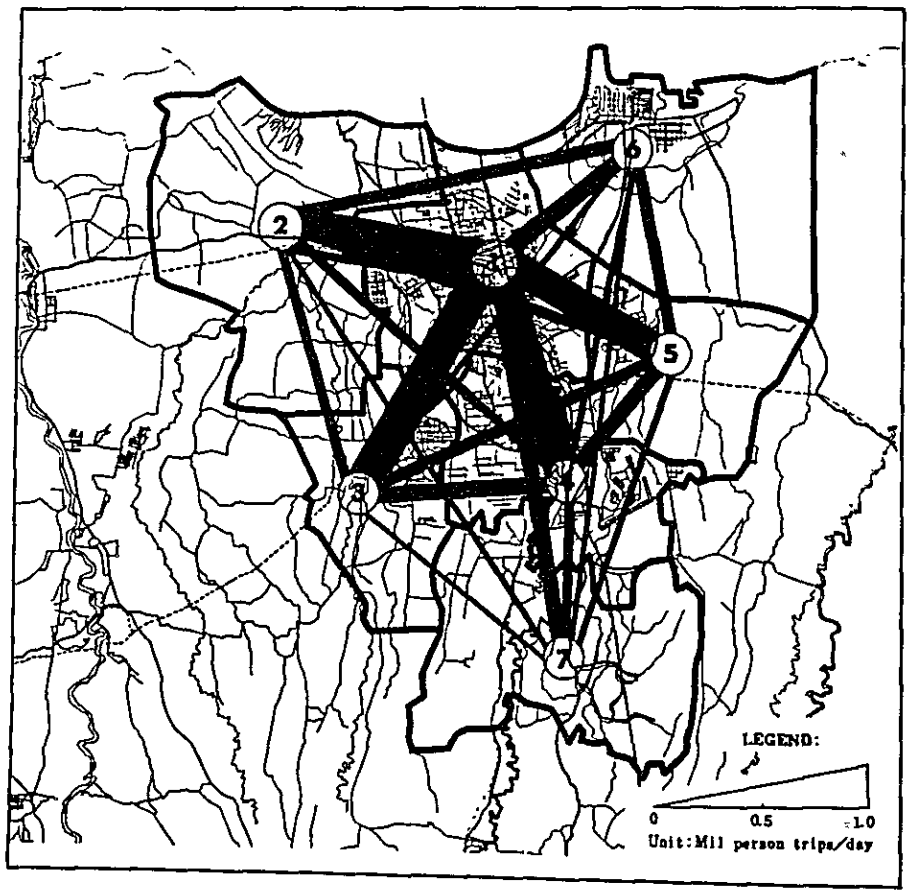


Fig. 2.12 Desire Traffic Lines of Person Trips Inside Jakarta in 2005

(5) Share of mass transit

Mass transit, in general, consists of railway transport and bus transport which are defined to be the representative modes of mass transit in this study.

According to the study results of JHRP, the share of each transportation mode was estimated and is shown in Table 2.24.

Table 2.24 Percentage Share of Modal Transport by JHRP

(Unit: %)

Mode of Transport	1980	1990	2000	2010
(1) Motorcycle	11.4	7.5	5.9	4.8
(2) Sedan	30.8	36.1	32.9	29.2
(3) Mass Transit:	57.8	56.4	61.2	66.0
Bus	(57.2)	(48.0)	(47.5)	(49.5)
Railway	(0.6)	(8.4)	(13.7)	(16.5)

Source: Feasibility Study on Jakarta Harbour Road Project, 1981

The above percentage share does not include the intra-zonal person trips. Considering the future growth of sedan and motorcycle ownership, the above share of mass transit in future was taken as a basis to analyse a modal split between bus and railway.

Proportions of the mass transit modes in the interzonal person trips were assumed to follow those derived from the JHRP. Consequently, distribution of person trips (excluding intra-zonal trips) for mass transit was estimated to be 58.1% and 62.2% of the total trip production in the study area for the years 1995 and 2005 respectively and is shown in Table 2.25.