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THE REPUBLIC OF INDONESIA

THE STUDY ON INTEGRATED TRANSPORTATION SYSTEM IMPROVEMENT BY RAILWAY AND FEEDER SERVICE IN JABOTABEK AREA

FINAL REPORT

VOLUME II
FEASIBILITY STUDY

AUGUST 1990

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

THE REPUBLIC OF INDONESIA

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PREFACE

In response to a request from the Government of the Republic of Indonesia, the Japanese Government decided to conduct a study on the Integrated Transportation System Improvement by Railway and Feeder Service in Jabotabek Area and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Indonesia a study team headed by Misao Sugawara, Japan Railway Technical Service (JARTS) , composed of members from the Pacific Consultants International (PCI) four times, from November 1988 to March 1989, from September to November 1989, from January to February 1990 and June 1990.

The team held discussions with concerned officials of the Government of Indonesia, and conducted field surveys. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

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

August, 1990

Kensuke Yanagiya

President

Japan International Cooperation Agency

August 1990

Mr. Kensuke YANAGIYA
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Sir,

LETTER OF TRANSMITTAL

We have the pleasure of submitting herewith the final report of the Study on Integrated Transportation System Improvement by Railway and Feeder Service in JABOTABEK Area in the Republic of Indonesia.

The Study was conducted from November 1988 to August 1990 by a team of experts from Japan Railway Technical Service and Pacific Consultants International.

Based on the Scope of Work agreed upon in February 1988 by the Japan International Cooperation Agency and the Indonesian Government, the study team sought for appropriate measures for establishing an integrated transportation system in the JABOTABEK Area. The Study includes drawing up a master plan which would be fully harmonized with related development projects and related transportation projects in the area, as well as the feasibility studies conducted for urgent projects, with cooperation of the Indonesian counterparts.

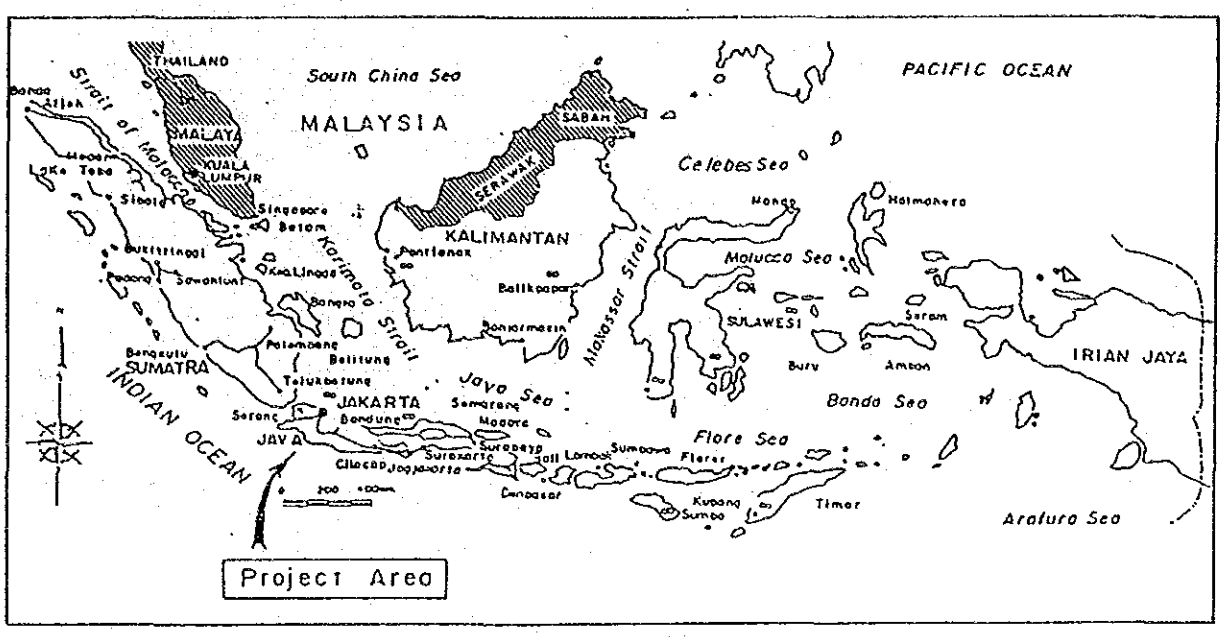
We hope that the Study will greatly contribute to the implementation of this project and to the transportation system improvement in the JABOTABEK Area.

We wish to express our sincere gratitude to the officials of your Agency, the Advisory Committee, the Embassy of Japan in Indonesia, as well as to those concerned of the Government of the Republic of Indonesia, for the kind assistance and cooperation they extended to the study team.

Very truly yours,

M. Sugawara

Misao Sugawara, Dr. Eng.
Study Team Leader
Integrated Transportation System
Improvement by Railway and Feeder
Service in JABOTABEK Area,
Indonesia



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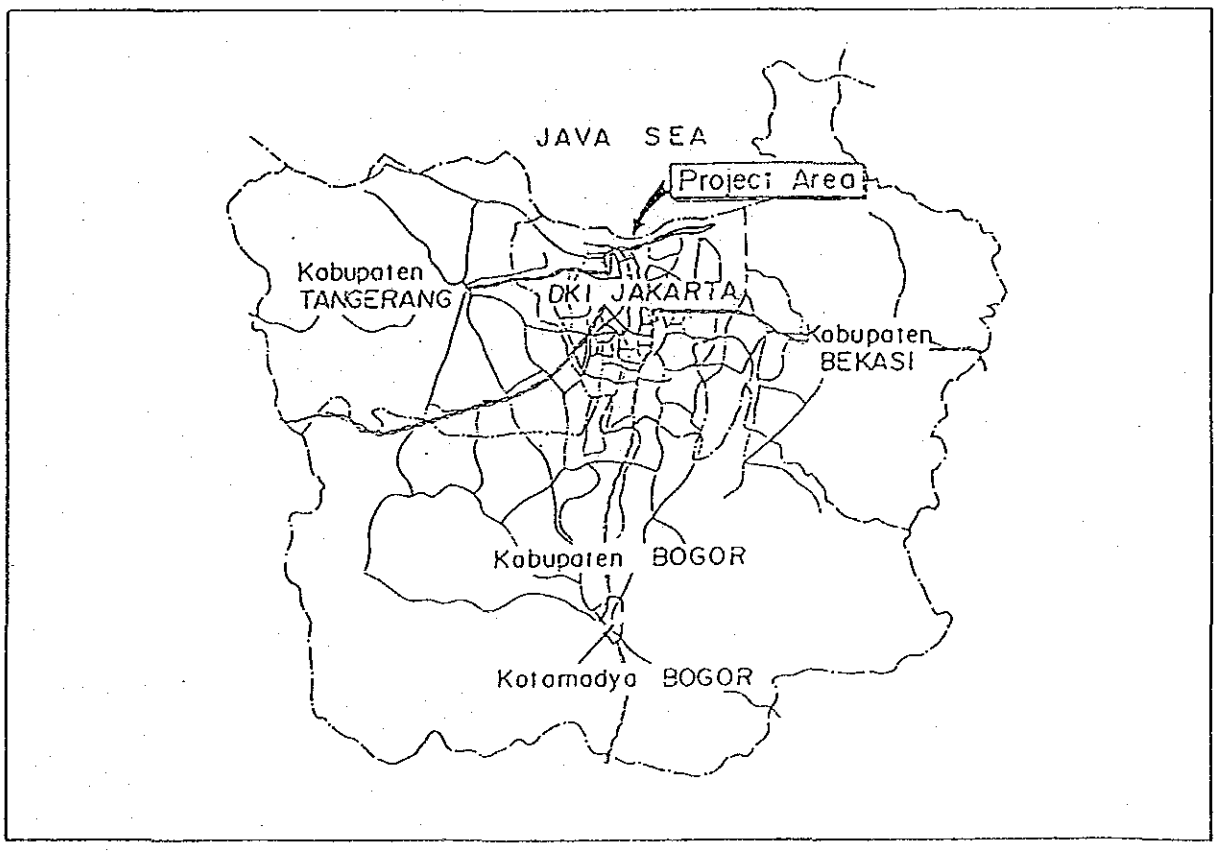

JABOTABEK

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List of Abbreviations

ABBREVIATION	FULL NAME	LOCATION
Ac	Ancol Station	Tangjungpriok Line
Ak	Angke Station	Western Line
Bid	Bojonggede Station	Central Line
Bin	Bintaro	Serpong Line
Bks	Bekasi Station	Bekasi Line
Boo	Bogor Station	Central Line
Cit	Cilebut Station	Central Line
Cki	Cikini Station	Central Line
Cpn	Chipinang Staton	Bekasi Line
Cta	Citayam Station	Central line
Cuk	Cakung Station	Bekasi Line
Dp	Depok Station	Central Line
Dpb	Depok baru Station	Central Line
Drn	Duren kalibata Station	Central Line
Du	Duri Station	Western Line
Dkh	Dukuh Station	Western station
Gdd	Gondangdia Station	Central Line
Gmr	Gambir Station	Central Line
Gsi	Gang Sentiong Station	Eastern Line
Jng	Jatinegara Station	Western Line
Jak	Jakarta Kota Station	Central Line
Kat	Karet Station	Western Line
Kby	Kebayoran Station	Serpong Line
Kds	Kalideres Station	Tangerang Line
Kld	Klender Station	Bekasi Line

Kldb	Klender baru Station	Bekasi Line
Kmo	Kemayoran Station	Eastern Line
Kmt	Kramat Station	Eastern Line
Kpb	Kampungbandan Station	East of Jakg Station
Kri	Kranji Station	Bekasi Line
Lna	Lenteng Agung Station	Central Line
Mam	Mampang Station	Western Line
Mri	Manggarai Station	Western Line
N-Jak	New Jakartakota Station	Central Line
N-Kpb	New Kampungbandan Station	Eastern Line
Plm	Palmerah Station	Serpong Line
Pnd	Pondok bitung Station	Serpong Line
Poc	Pondok Station	Central Line
Pok	Pondok Jati Station	Eastern Line
Pse	Paser Senen Station	Eastern Line
Psg	Pesing Station	Tangerang Line
Psm	Pasarminggu Station	Central Line
Rjw	Rajawari Station	Eastern Line
Rk	Rangkrsbetung	Serpong Line
Ru	Rawabuntu Station	Serpong Line
Rw	Rawabuaya Station	Tangerang Line
Sdm	Sudimara Station	Serpong Line
Srp	Serpong Station	Serpong Line
Sw	Sawahbesar Station	Central Line
Teb	Tebet Station	Central Line
Thb	Tanah Abang Station	Western Line
Tng	Tangerang Station	Tangerang Line
Tpk	Tajungpriok Station	Tanjungpriok Line
Ui	Uni. Pancasila Station	Central Line
Up	Uni. Indonesia Station	Central Line

ABBREVIATION	FULL NAME	LOCATION
C/L	Central Line	Jak-Boo
E/L	Eastern Line	Jak-Pse-Jng Tpk-Kmo
W/L	Western Line	Jak-Thb-Jng
Bks/L	Bekasi Line	Jng-Bks
Tpk/L	Tanjungpriok Line	Jak-Tpk
Tng/L	Tangerang Line	Du-Tng
Srp/L	Serpong Line	Thb-Srp

Abbreviations and Acronyms for Jabotabek Study

ARSDS	- Arterial Road Systems Development Study
BAPPENDA, DKI	- DKI Jakarta Region Development Planning Board
BAPPENAS	- National Development Planning Agency
Bina Marga	- Directorate General Bina Marga (Highways), MPW
BKSP	- Jabotabek Level I Planning Coordination Unit
DAMRI	- State-owned Bus Company Serving Regional Cities
Dinas LLAJR	- Traffic and Highway Transportation Department, DKI-Jakarta
Dinas PU	- Public Works Department, DKI Jakarta
Dinas Tatakota	- Urban Planning Department, DKI Jakarta
DKI Jakarta	- Jakarta Special Capital Province
GOI	- Government of Indonesia
INPRES	- Central Government Grant to Local Governments
ITSI	- The Study on Integrated Transportation System Improvement by Railway and Feeder Service in Jabotabek Area
JABOTABEK	- Region comprising Jakarta, Bogor, Tangerang and Bekasi local government administrative areas
JASA Marga	- Public Corporation responsible for constructing expressways
JICA	- Japan International Cooperation Agency
JUDP	- Jabotabek Urban Development Project
JUPCO	- Project Coordination Unit in DKI-Jakarta BAPPEDA
JUTP	- Jakarta Urban Transport Project
KIP	- Kampung(Village) Improvement Program
LLAJR	- Directorate of Highway Transport, PHBD
LLAK	- Directorate of Urban Traffic and Transport, PHBD
MHA	- Ministry of Home Affairs
MOC	- Ministry of Communication

MOF	- Ministry of Finance
MPW	- Ministry of Public Works
PHBD	- Directorate General Perhubungan Darat (Land Transport), MOC
PJKA	- State Railway
PPD	- State-Owned bus company serving Jakarta
REPELITA	- National Five-year Development Plan (Repelita IV, 1984-89; Repelita V, 1989-94)
TKPP	- Tim Koordinasi Pembangunan Perkotaan (Interagency Coordinating Team for Urban Development

CHAPTER 1 INTRODUCTION

CHAPTER 1 Introduction

1-1 Objective of Feasibility Study

In the Master Plan, projects that should be implemented by the year 2005, for the purpose of achieving an optimal transportation system in JABOTABRK area, were proposed. In addition, those projects requiring urgent action were singled out.

The purpose of this feasibility study, which applies techniques commonly seen in other feasibility studies, is to confirm the practicability of the urgent projects, by evaluating such factors as their target year for completion and their economic and financial merits and demerits.

1-2 F/S Projects to be Studied

In the Volume I, the Master Plan and Urgent Projects for F/S were presented and it was decided with the agreement of Indonesian Government that among the proposed Urgent Projects the following three will be carried out in the feasibility study excluding the flyover of the Western Line.

(1) Feeder service improvement
(2) Station facilities improvement
(3) Grade seperation of the Eastern Line

Of these, feeder service improvement and station facilities improvement will involve the same stations, as will be described later, and thus can be combined into one project. As a result there will be two projects taken up in the feasibility study.

1-2-1 Feeder Service Improvement

In the Master Plan, it was pointed out that one of the reasons for fewer people using the railway than the road is that the connecting between the railway and road are inadequate. In order to ease access for Peches trains as well as for people using buses, Bajaj and other means of road transportation, it was proposed that access for pedestrians and cars be seperated, that roads

leading to the stations be widened, that signals and pedestrian bridges be installed, and that bus bays be installed in the station plaza.

Thus, through consultation with the counterpart team, 21 urgent stations were chosen from the 53 total existing stations of the Jabotabek railway and the 10 proposed new stations. Of these 21 stations, 3 stations were chosen as the most important stations for which the F/S should be carried out. It was also agreed that a Pre F/S should be conducted for the remaining 18 stations. These 21 stations are listed below.

Angke, Bekasi, Cikini, Depok Baru, Dukuh, Duren Kalibata, Gambir, Jakarta Kota, Jatinegara, Kebon Pedes, Kemayoran, Klender, Manggarai, New Kampung Bandan, Passar Minggu, Pasar Senen, Sawah Besar, Tanah Abang, Tanjung Priok, Palmerah, Kebayoran

Of these, Pasar Senen, Jatinegara and Kemayoran were chosen as the three stations to be taken up in the F/S.

1-2-2 Station Facilities Improvement

In the Master Plan, it was proposed, in order for the station facilities to cope with an increasing number of trains and commuter services in the future, that obsolete passenger facilities be improved, that the layout of the facilities in the station be improved in order to ensure smooth passenger flows, and that low-bed platforms be modified into high-bed platforms. Since these facilities are closely related to feeder services, it would be effective to make the improvements simultaneously with the improvements in feeder services. Thus, the same 21 stations were chosen as urgent for feeder service improvement, and the same three stations, namely Pasar Senen, Jatinegara and Kemayoran as the objectives of the F/S and the same remaining 18 stations as the objectives of Pre F/S.

1-2-3 Grade Seperation of the Eastern Line

As the motor vehicle traffic volume increases and the number of trains increases in the future, the amount of crossing delay time of motor vehicles will increase and have an adverse effect on urban transportation system. It

was therefore proposed in the Volume I that the railway and road be continuously grade seperated on the Eastern Line stating from about Kota Station to about Gangesentiong Station.

Through disscussion with the counterpart team, it was decided to consider not only the continuous track elevation of the Eastern Line but to consider the possibility of subway and flyover. Further it was decided that with respect to continuous track elevation plan, the continuous track elevation southward over Gangsentiong Station to about Jatinegara should be added. That is, a comparative examination would be made of:

- Subway
- Flyover
- Continuous track elevation
  near Kota - near Gangsentiong
  near Kota - near Jatinegara

1-3 Organization of the Study

The JICA Advisory Committee, Study Team and Indonesian Counterparts concerned with the study are as follows.

(1) JICA advisory committee

1)	Makoto MOMOSE	Chairman
2)	Naoto EGAWA	Railway Facilities Planning
3)	Katsuhiko HARA	Public Transportation Planning

(2) JICA staff

Toshiichi MINATANI Shingo SAITOH	Coordinator

(3) Study team

Misao SUGAWARA	Study Team Leader
Sadaaki KURODA	Deputy Team Leader

Kunitaka NAMIKAWA	Acting Leader/System Planning
Yoshikazu UMEKI	Transportation Demand Forcast/Economic Analysis
Tei KOJIN	Transportation Planning
Harumi TAKASHIMA	Track and Structure Planning
Yukinori WATANABE	Station Yard Planning
Susumu SHIBUYA	Rolling Stock Planning
Yukio CHIKADA	Electrification Planning
Kazumaru SHINOYA	Signalling & Telecommunication Planning
Kenji MAEDA	Feeder Service Planning
Chiaki KURANAMI	Public Transportation Analysis
Hiroyuki TAKANO	Feeder Facilities Planning
Takashi KADOTA	Related Development Planning
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38.	Ir. Yudarso	Direktorat Teknik.
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40.	Drs. Hadiyono	Direktorat Keuangan.
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CHAPTER 2 TRANSPORTATION DEMAND FORECAST

CHAPTER 2 Transportation Demand Forecast

2-1 General

Transportation demand forecasts were conducted for the two feasibility studies and one preliminary feasibility study. They are the "Eastern Line Grade Separation Project", "Feeder Service and Station Facilities Improvement Project for High Priority Stations" and the "Feeder Service and Station Facilities Improvement Project for 16 Other High Priority Stations", respectively.

The methodology and models used in these studies are almost as common as the master plan formation study presented in the Master Plan.

A socio-economic framework of the JABOTABEK area in the year of 2005 is common to the master plan formation study. The frameworks for intermediate target years were not estimated, because trip tables for the target years were forecasted by direct interpolation of the estimated 2005 and 1992 trip tables.

2-2 Feeder Service and Station Facilities Improvement for High Priority Stations

2-2-1 General

This project aims to improve the existing service level of feeder services and station facilities. Three stations were selected to measure the viability of the improvement project: Pasar Senen, Jatinegara and Kemayoran Stations. The difference from the third project is the accuracy of the cost estimation and the reduced time estimation.

The improvements per se are described in Chapter 4. The level of service which affects transportation demand for the railway service relates mainly to reduced transfer time between railway and feeder services. In addition to the reduction, the effects of improved station facilities were considered.

2-2-2 Premises

(1) Target years

Target years of the demand forecast were 1995 and 2005. The former is the year proposed for completion of the feeder service and the station facilities improvement project.

(2) Transfer time reduction

The transfer time reduction by the improvement were estimated as shown in Table 2.2.2.1. They were derived from site surveys and the improvement plans as described in Chapter 4.

Table 2.2.2.1 Estimated Time Saved by Station Improvement

Station name	Improvement (sec) by		Total (sec)	(min)
	Station Plaza	Building		
PASAR SENEN	127	138	265	4.4
JATINEGARA	148	92	240	4.0
KEMAYORAN(New)	95	84	179	3.0

(3) Forecast cases

The transportation demand forecasts for this project were conducted on 'with' cases and 'without' cases to obtain the information necessary for economic and financial analyses.

This 'with' cases represent situation cases in which the improvements have been completed, while the 'without' cases represent cases in which no improvements have been realized. The latter cases have no improvements neither on railway nor road network. The assumption was made to understand the effects easily.

Table 2.2.2.2 shows the cases forecasted indicating the assumed railway, bus and road networks.

Table 2.2.2.2 Demand Forecast Cases for Feeder Service and Station Facilities Improvement for High Priority Stations

Case	Year	Transportation Network		
		Rail	Bus	Road
95FO	1995	92B	1992	BC00
05FO	2005	92B	1992	BC00
95FW	1995	92F	1992	BC00
05FW	2005	92F	1992	BC00

Note: Railway network 92B represents the service level of option "b", while 92F represents completion of feeder improvement in addition to the 92B service level.
FO: "without" case FW: "with" case

(4) Time value

The time values to estimate the modal share between railway and bus passengers were obtained by the same method as the master plan selection. The results are shown in Table 2.2.2.3.

Table 2.2.2.3 Time Values by Year

Year	Time Value (Rp./hour)	mu	DKI Jakarta percapita GDP (Rp.000)
1995	535	6.2823	2,480
2005	949	6.8558	4,407

Note: 1989 constant prices

2-2-3 Forecast Result

Results of forecasts by the cases defined above are shown in Table 2.2.3.1.

Table 2.2.3.1 Forecast Results by Case (000 trips)

Case	Year	Public	Railway	Bus	Private	M-cycle	Sedan
95FO	1995	5052	1089	3963	4701	1531	3170
05FO	2005	7745	1810	5934	5716	2207	3510
95FW	1995	5052	1122	3929	4701	1531	3170
05FW	2005	7745	1864	5880	5716	2207	3510

With completion of this project, the number of railway passengers would increase by 33,000 and 54,000 by 1995 and 2005 respectively.

2-3 Eastern Line Grade Separation

2-3-1 General

This project aims to solve traffic problems at the railway and road level crossing along the Eastern Line.

Three plans were proposed to improve the existing situation. They are track elevation of the Eastern Line between Jakarta Kota and Gang Sentiong Station, track elevation between Jakarta Kota and Jatinegara Station and flyover construction between Jakarta Kota and Jatinegara Station instead of the track elevation. In addition to the above three plans, a subway plan was examined (Refer to Chapter 5).

A transportation demand forecast for the Eastern Line Grade Separation Project was conducted for the above three plans.

Railway passenger demand was forecasted by the models which were developed for the selection of the optimum pattern in this study, as described before.

Regarding the road vehicle traffic demand forecast, a traffic count survey at the railway level crossings between Jakarta Kota and Jatinegara Station was carried out to obtain information on the existing traffic volume at the

crossings. Future road traffic was forecasted by analyzing the survey results and the growth rate of road traffic estimated by the models.

2-3-2 Traffic Count Survey

(1) Outline of the survey

Major benefits expected from completion of the grade separation project on the Eastern Line are waiting time savings by road vehicles and their users, including pedestrians who pass through the railway crossings along the line. In this study, a traffic count survey at the railway crossing was carried out to confirm the existing traffic volume and to estimate future volume on them.

The objective railway level crossings along the Eastern Line between Jakarta and Jatinegara Station are shown in Table 2.3.2.1. The total number is 15. The names of the roads of the crossings are given below.

1 Jl. Manggadua
2 Jl. Gunung Sahari
3 Jl. Industri
4 Jl. Angkasa
5 Gang Spoor
6 Jl. Garuda
7 Jl. Kepu Selatan
8 Jl. Jend. Suprapto
9 Jl. Tanah Tinggi
10 Jl. Kramat Sentiong
11 Jl. Percetakan Negara
12 Jl. Salemba Tengah
13 Jl. Pramuka
14 Jl. Tegalan
15 Jl. Achmad Dahlan

The survey intended to get the information on the road traffic volume at the crossings by vehicle type, by time zone, by direction and by crossings, including the number of pedestrians.

The survey was conducted on Oct. 3, 4 and 5 in 1989 over 16 hours from 6 a.m. to 10 p.m. Road vehicles and pedestrians were classified into the following 9 categories for the survey;

1) Motorcycles and scooters
2) Sedans, station wagons and jeeps
3) Wagons, minibuses, minicabs, combis and ambulances
4) Taxis, Bemo and Bajaj
5) Microlet and minibuses for public use
6) Bus Micro, Metromini and Kopaja for public use
7) Bus besar, PPD, Mayasari Bakti and Bus Tingkat for public use
8) All kinds of trucks
9) Pedestrians, bicycles, Becak and carts

(2) Survey results

1) Daily traffic volume

The survey results are summarized in Table 2.3.2.1. Fig. 2.3.2.1 shows daily traffic volume (16 hours) in passenger car units (PCU) by crossing. Most crossings have a daily traffic volume of more than 10 thousand PCU except Gang Spoor and Jl. Tegalan. They serve mainly pedestrians and non-motorized vehicles such as bicycles and becak. Five of the fifteen crossings have more than 50 thousand PCU daily.

Fig. 2.3.2.3 and Table 2.3.2.2 shows vehicle type by crossing. Gang Spoor (No. 5) and Jl. Tegalan (No. 14) indicate a greater proportion of pedestrians, including non-motorized traffic, while Jl. Pramuka (No. 13), Jl. Percetakan Negara (No. 11). Jl. Gunung Sahari (No. 2), Jl. Angkasa (No. 4), Jl. Kepu Selatan (No. 7) and Jl. Jend. Suprapto show a greater proportion of motorized traffic.

Table 2.3.2.1 Railway Level-crossing Traffic Count Survey Results

No.		Name of Road	Direction from	Direction to	Survey date	Pede-strian	Motor-cycle	Sedan	Wagon	Taxi Bajaj	Bus Small	Bus Medium	Bus Large	Truck	Total (pcu)
1	I	Jl.Manggadua	Ancol	Kota	Oct.3	6660	7080	5775	1432	4200	317	247	187	2705	21160
1	O	Jl.Manggadua	Kota	Ancol	Oct.3	4397	7390	5828	1934	4611	369	315	187	2446	21918
2	I	Jl.Gunung Sahari	Ancol	Pasar Senen	Oct.4	3135	11767	13009	4142	6933	56	678	400	4168	39933
2	O	Jl.Gunung Sahari	Pasar Senen	Ancol	Oct.4	1980	11256	12590	3131	5992	29	516	539	4228	37327
3	I	Jl.Industri	Kemayoran	Gunung Sahari	Oct.3	4901	4577	2471	895	3841	5	339	53	1151	12072
3	O	Jl.Industri	Gunung Sahari	Kemayoran	Oct.3	4663	4477	2518	1003	4047	9	239	51	946	11817
4	I	Jl.Angkasa	Kemayoran	Gunung Sahari	Oct.3	1915	8645	8909	3355	8118	83	1300	455	1252	29645
4	O	Jl.Angkasa	Gunung Sahari	Kemayoran	Oct.3	3305	9543	5078	2848	5010	162	1432	329	1569	23138
5		Gang Spoor	Garuda	Bungur Besar	Oct.3	6691	616	236	129	216	0	0	0	26	868
6	I	Jl.Garuda	Kemayoran	Gunung Sahari	Oct.4	1815	11825	8054	3015	9503	48	534	183	1772	30236
6	O	Jl.Garuda	Gunung Sahari	Kemayoran	Oct.4	3261	9586	4743	3142	5062	16	495	237	1876	22139
7		Jl.Kepu Selatan	Bungur Besar	Rawamangun	Oct.4	6185	8060	7124	3205	6405	4404	2290	44	1828	32901
8	I	Jl.Jend.Suprapto	Kemayoran	Pasar Senen	Oct.5	8337	12839	17481	5698	8747	83	2455	2602	4139	55477
8	O	Jl.Jend.Suprapto	Pasar Senen	Kemayoran	Oct.5	9132	12190	16548	5107	8119	52	464	2019	4408	49400
9		Jl.Tanah Tinggi	Kemayoran	Kramat Raya	Oct.3	5936	2810	1046	581	1228	4454	0	0	373	10071
10	I	Jl.Kramat Sentiong	Johar Baru	Salemba	Oct.5	9838	2662	718	372	2732	139	10	1	233	5476
10	O	Jl.Kramat Sentiong	Salemba	Johar Baru	Oct.5	7066	2231	959	462	2972	65	32	26	304	6075
11	I	Jl.Percetakan Negara	Rawamangun	Salemba	Oct.4	2249	4243	4298	2013	6411	20	28	19	657	16087
11	O	Jl.Percetakan Negara	Salemba	Rawamangun	Oct.4	1683	2634	2526	1196	4602	12	10	19	430	10454
12	I	Jl.Salewba Tengah	Rawamangun	Salemba	Oct.4	1780	2171	1340	592	1575	27	116	3	192	4980
12	O	Jl.Salewba Tengah	Salemba	Rawamangun	Oct.4	953	2027	601	464	1392	1	120	0	51	3513
13	I	Jl.Pramuka	Bypass	Salemba	Oct.5	2032	12499	21163	4389	8473	13	606	1404	2869	49129
13	O	Jl.Pramuka	Salemba	Bypass	Oct.5	1971	11883	18225	7215	9487	88	619	1601	2205	49423
14	I	Jl.Tegalan	Kayu Manis Barat	Matraman	Oct.5	4903	1329	0	0	18	0	0	0	0	457
14	O	Jl.Tegalan	Matraman	Kayu Manis Barat	Oct.5	4963	1464	0	0	111	0	0	0	0	594
15	I	Jl.Achmad Dahlan	Kayu Manis Barat	Matraman	Oct.5	3221	2011	902	491	1833	632	0	0	159	5099
15	O	Jl.Achmad Dahlan	Matraman	Kayu Manis Barat	Oct.5	5322	2650	1043	653	1577	659	3	0	142	5389

Source:Traffic count survey conducted by the study team

Note :16-hour survey(06:00-22:00)

:'I' indicates inbound trips. 'O' indicates outbound trips.

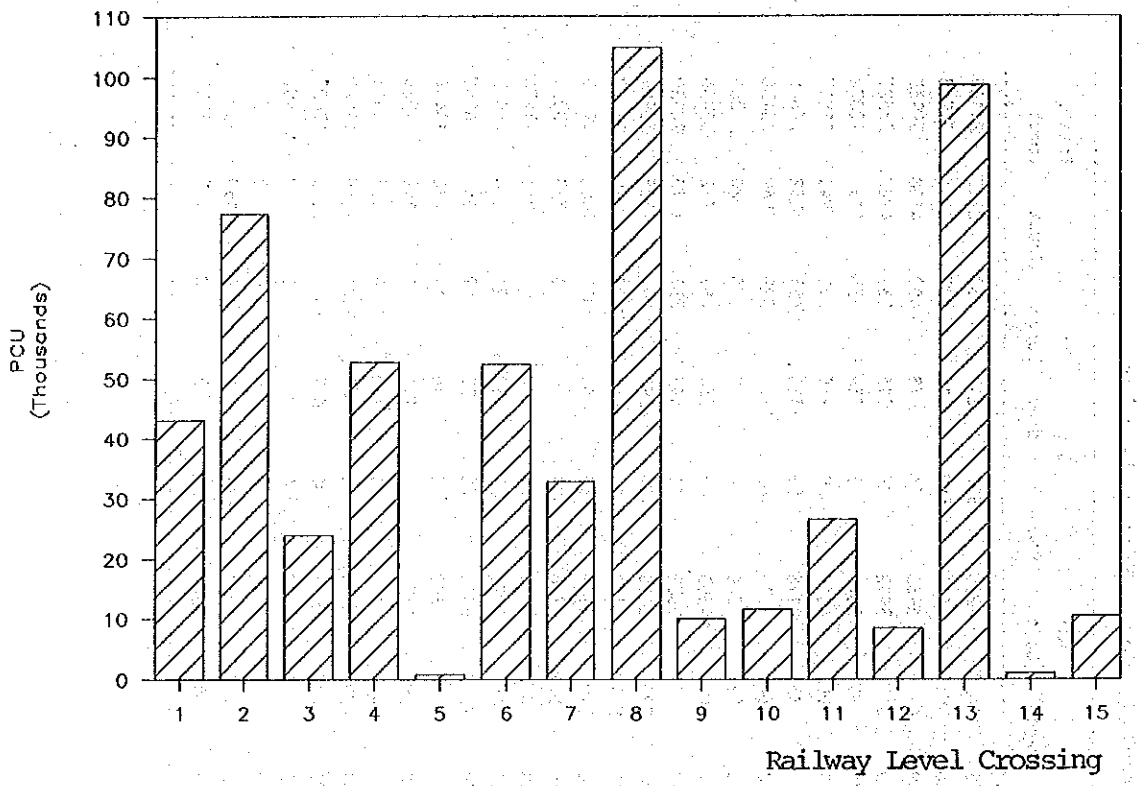

Fig. 2.3.2.1 Traffic Volume at Railway Level Crossings

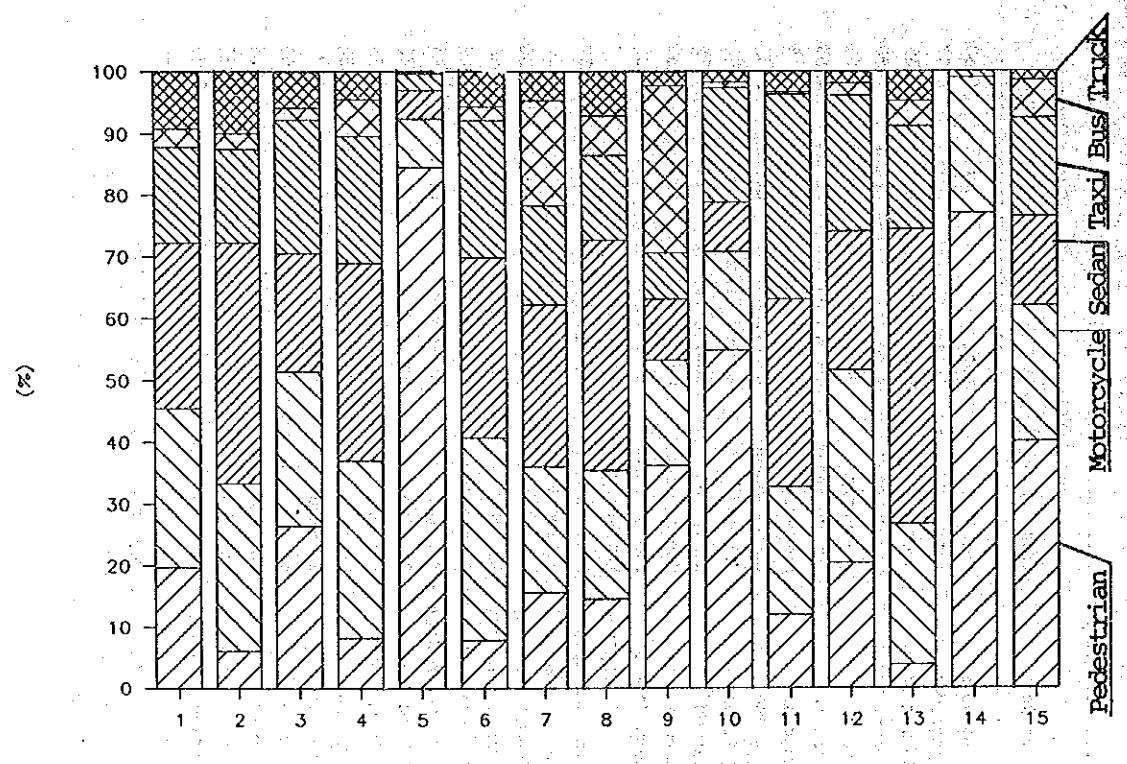

Fig. 2.3.2.2 Vehicle Type

Table 2.3.2.2 Vehicle Type

(Both Directions) (percentage)

No.	Name of Road	Pede-strian	Motor-cycle	Sedan Wagon	Taxi Bajaj	Bus	Truck
1	Jl.Manggadua	19.7	25.8	26.7	15.7	2.9	9.2
2	Jl.Gunung Sahari	6.0	27.2	38.9	15.3	2.6	9.9
3	Jl.Industri	26.4	25.0	19.0	21.8	1.9	5.8
4	Jl.Angkasa	8.2	28.7	31.9	20.7	5.9	4.5
5	Gang Spoor	84.5	7.8	4.6	2.7	0.0	0.3
6	Jl.Garuda	7.8	32.9	29.1	22.4	2.3	5.6
7	Jl.Kepu Selatan	15.6	20.4	26.1	16.2	17.0	4.6
8	Jl.Jend.Suprapto	14.5	20.8	37.2	14.0	6.4	7.1
9	Jl.Tanah Tinggi	36.1	17.1	9.9	7.5	27.1	2.3
10	Jl.Kramat Sentiong	54.8	15.9	8.1	18.5	0.9	1.7
11	Jl.Percetakan Negara	11.9	20.8	30.4	33.3	0.3	3.3
12	Jl.Salewba Tengah	20.4	31.3	22.4	22.1	2.0	1.8
13	Jl.Pramuka	3.8	22.8	47.8	16.8	4.1	4.8
14	Jl.Tegalan	77.2	21.8	0.0	1.0	0.0	0.0
15	Jl.Achmad Dahlan	40.1	21.9	14.5	16.0	6.1	1.4

2) Hourly traffic volume

Fig. 2.3.2.3 shows a typical fluctuation pattern in directional traffic volume at Jl. Mangga Dua by time zone. During the morning peak hour, traffic volume from Ancol to Kota is bigger than the volume in the opposite direction at Jl. Mangga Dua crossing. On the contrary, the latter is greater than the former during the evening peak hours.

Fig. 2.3.2.4 shows hourly traffic volume on the level crossings along the Eastern Line. Inbound traffic reaches its peak from 7 to 9 o'clock in the morning, while outbound traffic reaches its peak from 5 to 7 o'clock in the evening. The concentration ratios of the traffic during the morning and the evening peak hours were 15.7% and 16.2% respectively.

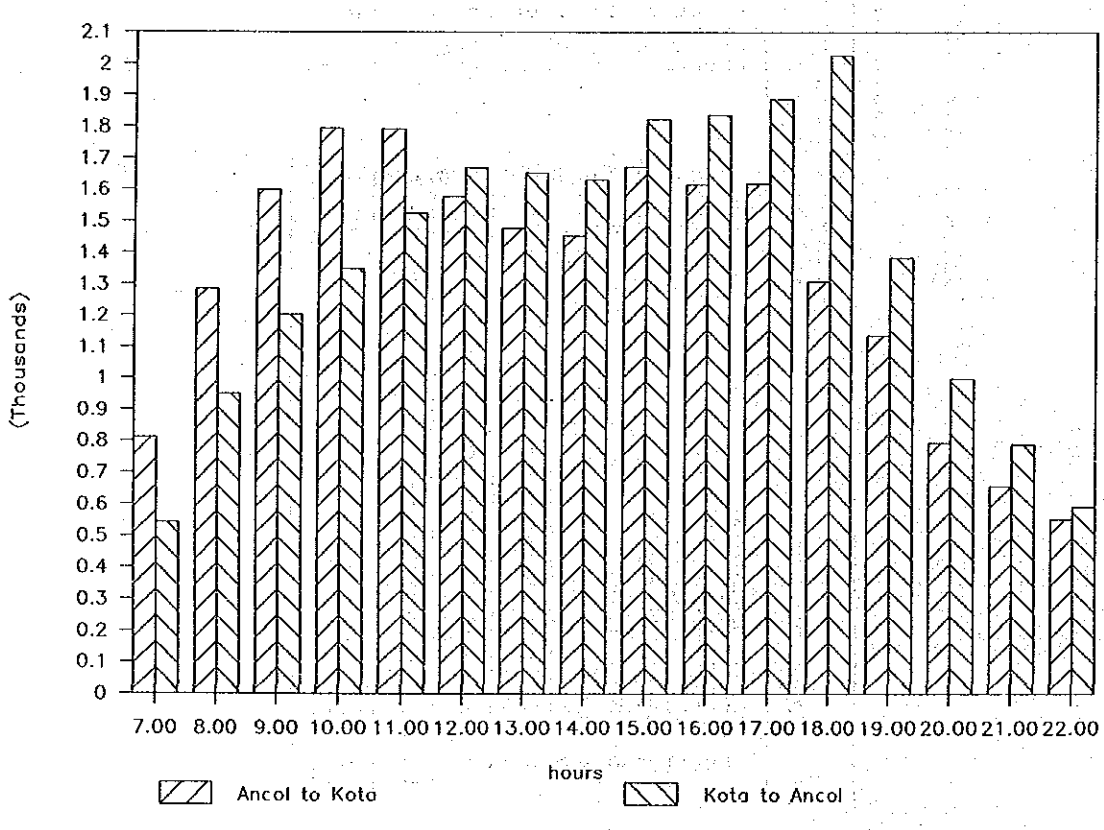

Fig. 2.3.2.3 Hourly Traffic Volume at Jl. Mangga Dua

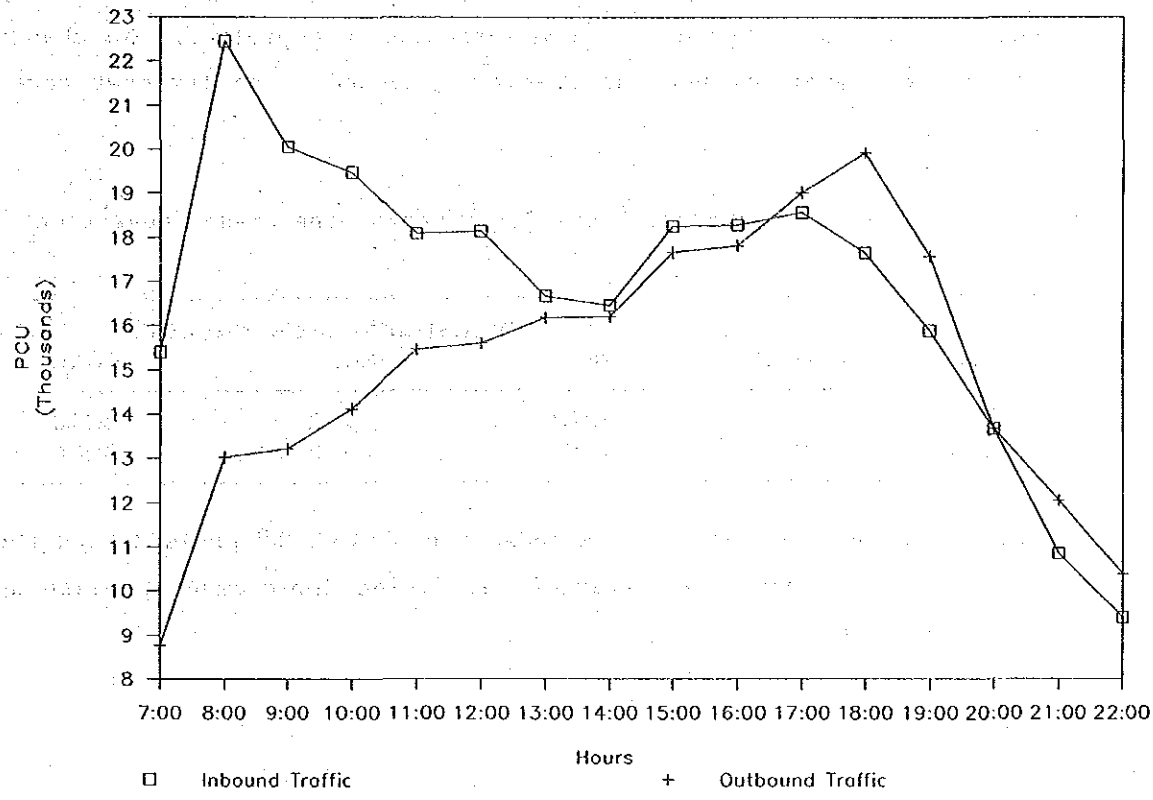

Fig. 2.3.2.4 Traffic Volume by Time Zone
(All crossings)

2-3-3 Premises

(1) Target years

Target years for the demand forecast were 1998 and 2005. The former is the year proposed for completion of the grade separation project.

(2) Forecast cases

As described before, three grade separation plans were prepared to select the best alternative plan among them. But only one forecast case was considered for each target year because the number of future railway passengers is expected to remain unchanged even if

the grade separation project is completed. The level of railway service will not change with completion of the project. No change in service level produces no change in demand. The forecast cases are shown below.

Table 2.3.3.1 Demand Forecast Cases for Eastern Line Grade Separation

Case	Year	Transportation Network		
		Rail	Bus	Road
E98	1998	92B'	1992	BC00
E05	2005	92B'	1992	BC00

Note: Railway network 92B' includes the option "b" projects and the feeder service and station facilities improvement project up to 1997.

(3) Time value

The time values to estimate the modal share between railway and bus passengers were obtained the same method as the master plan selection. The results are shown in Table 2.3.3.2.

Table 2.3.3.2 Time Values by Year

Year	Time Value (Rp./hour)	mu	DKI Jakarta percapita GDP (Rp.000)
1998	635	6.4536	2,948
2005	949	6.8558	4,407

Note: 1989 constant prices

2-3-4 Forecast Results

The results of the forecast cases are shown in Table 2.3.4.1.

Table 2.3.4.1 Forecast Results by Case (000 trips)

Case	Year	Public	Railway	Bus	Private	M-cycle	Sedan
E98	1998	5860	1464	4395	5064	1737	3326
E05	2005	7745	2065	5679	5716	2207	3510

The future road vehicle traffic volumes in the target years are estimated for each level crossing as shown below. The number of categories of vehicle type was changed to four, corresponding to the demand forecast models.

Table 2.3.4.2 Traffic Volume at Railway Crossings in 1998

(Both Directions/day)

	Name of Road	Pede-strian	Motor-cycle	Sedan	Bus	Truck
1	Jl. Manggadua	16894	16006	33347	2478	12954
2	Jl. Gunung Sahari	6359	28156	57044	2832	13097
3	Jl. Industri	11566	11814	17419	915	2544
4	Jl. Angkasa	5970	19666	35506	5110	3842
5	Gang Spoor	8775	789	748	0	37
6	Jl. Garuda	7533	31075	50569	1943	5418
7	Jl. Kepu Selatan	8682	11390	23855	9195	2581
8	Jl. Jend.Suprapto	24115	34552	85271	10595	11799
9	Jl. Tanah Tinggi	8163	3891	3932	6120	523
10	Jl. Kramat Sentiong	23155	6881	11122	326	933
11	Jl. Percetakan Negara	5808	12026	29837	163	1889
12	Jl. Salemba Tengah	4109	7080	7980	371	650
13	Jl. Pramuka	6123	40694	90581	6004	14579
14	Jl. Tegalan	15090	4669	184	0	0
15	Jl. Achmad Dahlan	13067	7791	9270	1721	799

Table 2.3.4.3 Traffic Volume at Railway Crossings in 2005

(Both Directions/day)

Name of Road	Pede-strian	Motor-cycle	Sedan	Bus	Truck
1 Jl. Manggadua	21435	17200	40787	3144	19023
2 Jl. Gunung Sahari	7905	32147	65792	3310	16753
3 Jl. Industri	13123	13960	19476	1085	2891
4 Jl. Angkasa	6553	20815	37207	6159	4636
5 Gang Spoor	10396	924	878	0	46
6 Jl. Garuda	9444	38591	63829	2277	6794
7 Jl. Kepu Selatan	10625	13980	29394	11105	3166
8 Jl. Jend.Suprapto	29285	41958	103550	12866	14328
9 Jl. Tanah Tinggi	9896	4732	4770	7416	639
10 Jl. Kramat Sentiong	28016	8427	13383	367	1242
11 Jl. Percetakan Negara	7266	16032	36675	206	2514
12 Jl. Salemba Tengah	5179	9322	9548	452	966
13 Jl. Pramuka	7771	53381	107404	7305	21972
14 Jl. Tegalan	19153	6128	227	0	0
15 Jl. Achmad Dahlan	16585	10226	11425	2054	1186

2-4 Feeder Service and Station Facilities Improvement for 16 Others High Priority Stations

2-4-1 General

As described in Chapter 4, "Feeder Service and Station Facilities Improvement" was proposed for 21 stations in JABOTABEK area. In order to evaluate the effects of the project, the transportation demand corresponding to the three stations improvement was conducted with a level of full feasibility study.

In this section, transportation demend by the execution of the improvement for 16 other high priority stations was carried out. It should be noted that among 18 stations other than three "High Priority Stations" 16 stations were chosen for evaluation. Because two stations have no plans to improve during the proposed first phase.

2-4-2 Premises

(1) Target years

Target years for the demand forecast were 1995 and 2005 as same as the project of the three stations. For, the improvement for the 16 stations shall be included in the first phase as well.

(2) Transfer time reduction

The transfer time reduction by the improvement were estimated as shown in Table 2.4.2.1. Among the improvement plan of 16 stations, time reduction at Depok Baru, Kebon Pedes, New Kampung Bandan and Angke stations were not taken into consideration, because the coded railway network did not have the codes of those stations. Estimated future demand by these improvements might be conservative.

The transfer time reduction were estimated according to the assumed "Composition of Transfer Factors" described in Chapter 4 of the Master Plan. The accuracy of the estimates can't be enough when compared with those of "Three High Priority Stations".

Table 2.4.2.1 Estimated Time Saved by Station Improvements

(hours)

Station	Reduced Transfer Time
Tanah Abang	0.08
Palmerah	0.12
Kebayoran	0.12
Jakarta Kota	0.04
Sawah Besar	0.06
Cikini	0.03
Durenkalibata	0.04
Pasar Minggu	0.07
Dukuh	0.05
Klender	0.10
Bekasi	0.08
T. Priok	0.08

Note: Terminal time reduction at Depok Baru, Kebon Pedes, New Kampung Bandan and Angke stations were not considered.

(3) Forecast cases

Two forecast cases were prepared for each target year as well as the Three Stations improvement.

The "without" cases represent the situation in which the Three Stations project has completed, while the "with" cases represent the situation in which the 16 station improvements were completed. These cases were established to clarify the effect of the improvement separately from the effect of the Three Stations. It should be noted that the road and bus network were set up as BC00 in all the cases. It was because of easy understandings of the results.

The transportation networks used for the demend forecast were shown in Table 2.4.2.2. by case.

Table 2.4.2.2 Demand Forecast Cases for Feeder Service and Station Facility Improvement for 16 Other High Priority Stations

		Transportation Network		
Case	Year	Rail	Bus	Road
95FW	1995	92F	1992	BC00
05FW	2005	92F	1992	BC00
95PW	1995	92P	1992	BC00
05PW	2005	92P	1992	BC00

Note: Railway network 92F represents the service level of completion of "Three Stations" improvement in addition to the 92B service level, while 92P represents the completion of 16 other High Priority Stations improvement in addition to the "Three Stations".

FW: "without" case PW: "with" case

(4) Time value

The time values to estimate the modal share between railway and bus were the same as the values estimated for the "Three Stations" improvement since the target years are same. Refer to Table 2.2.2.3.

2-4-3 Forecast Result

Table 2.4.3.1 shows the result of demand forecast for the "16 Other High Priority Stations."

Table 2.4.3.1 Forecast Result by Case

(000 trips)

Case	Year	Public	Railway	Bus	Private	M-cycle	Sedan
F95F	1995	5052	1122	3929	4701	1531	3170
F05F	2005	7745	1864	5880	5716	2207	3510
F95P	1995	5052	1197	3854	4701	1531	3170
F05P	2005	7745	2008	5736	5716	2207	3510

With completion of this project, would increase by 75,000 and 144,000 by 1995 and 2005 respectively. When compare the effect of this project with the "Three Stations" improvement, the increase of railway passengers is 2.2 and 2.7 times in 1995 and 2005 respectively.

CHAPTER 3 TRAIN OPERATION

CHAPTER 3 Train Operation

3-1 Existing Situation

3-1-1 General

The Train operation route, number of trains (per day, in both directions), train operation head, arrival time and scheduled speed of electric railcar trains (hereafter EC train) and diesel railcar trains (DC train) are in the volume I, 3-2-1.

The details of middle- and long-distance passenger trains and freight trains on the Eastern, Central and Western Lines are as follows.

Table 3.1.1.1 shows middle- and long-distance passenger trains which are operated every day and connect JABOTABEK with East Java.

Table 3.1.1.1 Middle- and Long-Distance Passenger Train (Oct. 1989)

Train No.	Name of Train	Operation Section	Operation Route in Jabotabek
1,2	Bima	Jakarta - Surabaya	Central Line (C.L)
3,4	Mutiara	Jakarta - Surabaya	C.L
7,8	GBM Utara	Pse - Surabaya	Eastern Line (E.L)
9,10	GBM Selatan	Gmr - Surabaya	C.L
13,14	Matarmaja	Gmr - Malang	C.L
15,16	Jombang	Gmr - Jombang	C.L
31,32	Senja Utama	Gmr - Solobalapan	C.L
33,34	Senja Utama	Gmr - Yogyakarta	C.L
35,36	Senja Utama	Pse - Semarang	E.L
37,38	Senja Ekonomi	Thb - Solobalapan	Western Line (W.L)
39,40	Senja Ekonomi	Gmr - Yogyakarta	C.L
41,42	Sawunggalih	Pse - Kutoarjo	E.L
43,44	Senja Ekonomi	Pse - Semarang	E.L
45A,46	Fajar	Gmr - Yogyakarta	C.L
113,114	Cn Expres	Jak - Cirebon	E.L
115,116	Cn Expres	Jak - Cirebon	C.L
117,118	Gunung Jati	Jak - Cirebon	E.L
119,120	Gunung Jati	Jak - Cirebon	E.L
201,202	Cepat Solo	Pse - Solobalapan	E.L
203,204	Cepat Sm	Pse - Semarang	E.L
207A,208	Patas Sdr	Jak - Sidoarjo	C.L
8023,8022A	Fajar	Jak - Semarang	E.L

Source: PJKA Inspection 1
Note : Parahyangan trains (total 12 trains per day) are not included. These trains are operated on the Central Line.

Table 3.1.1.2 shows the number of trains by line. Trains are operated on the Central, Eastern and Western Lines.

Table 3.1.1.2 No. of Middle- and Long-Distance Trains by Line in JABOTABEK (Oct. 1989)

Operation route in JABOTABEK	No. of Trains	Starting and terminated stations in JABOTABEK
Central Line	34	Jak 18 trains, Gmr 16
Eastern Line	20	Jak 8, Pse 12
Western Line	2	Thb 2

Source: PJKA Inspection 1

Fig. 3.1.1.1 shows number of middle- and long-distance trains by time zone. Trains are concentrated in the morning peak hours (6:00 - 8:00) and the evening peak hours (16:00 - 19:00).

When the operation headway of JABOTABEK trains is shortened in future, it will be difficult to operate many middle- and long-distance trains in accordance with the pattern of Fig. 3.1.1.1.

Table 3.1.1.3 and Table 3.1.1.4 are the result of freight train operation in Sep. 1989. Fig. 3.1.1.2 shows the operation route of freight trains which transport general commodity. Fig. 3.1.1.3 shows the operation route of coal, oil and sand freight trains.

3-1-2 Eastern Line

Table 3.1.2.1 shows the number of trains on the Eastern Line. Diesel railcar trains are operated between Jakarta and Cikampek.

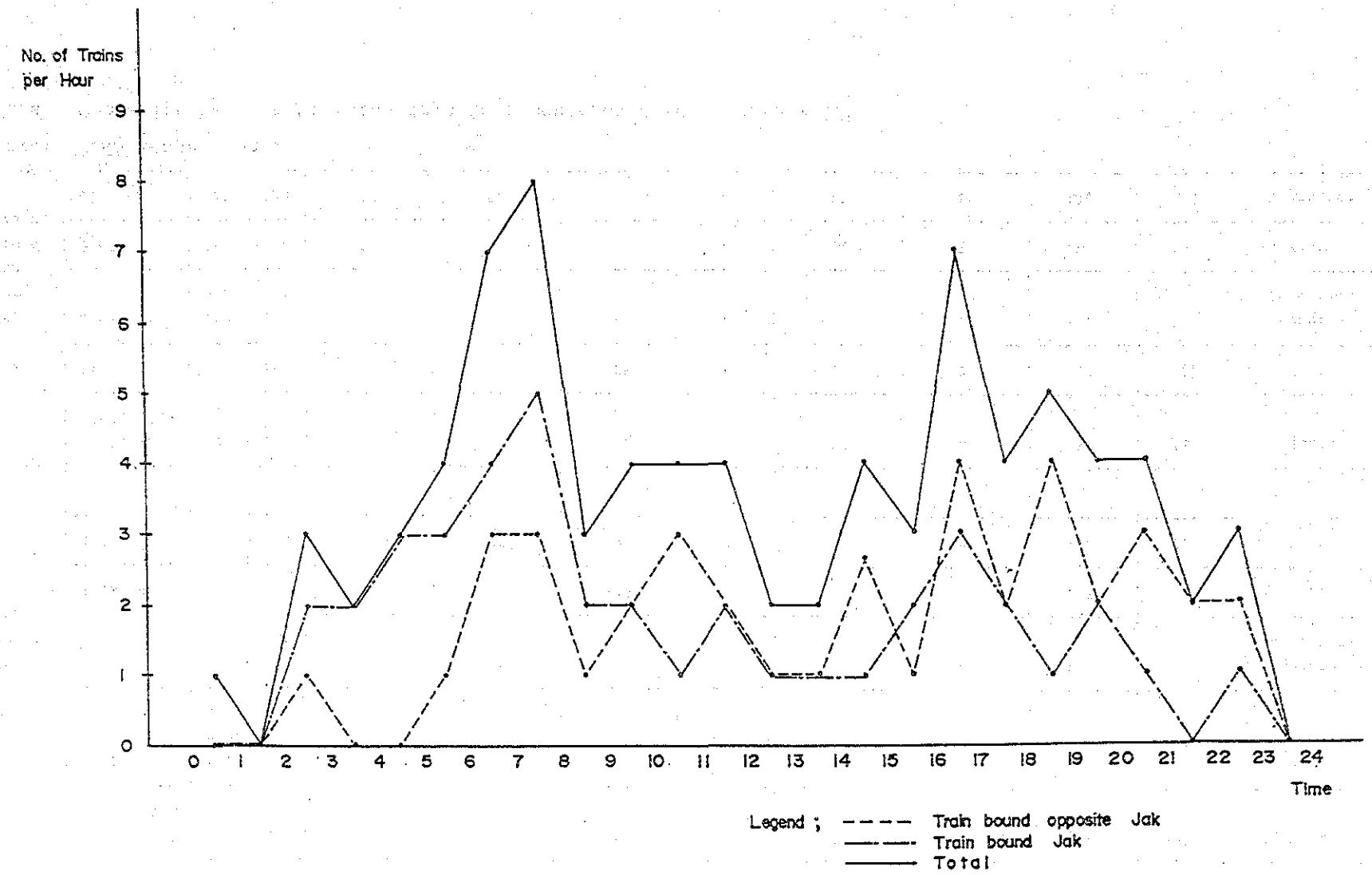

Fig. 3.1.1.1 Number of Trains by Time Zone
(Middle- and Long-Distance Train, At Jatinegara St., by Train Diagram, Sep. 1987)

Table 3.1.1.3 Results of Freight Train Operation In JABOTABEK Area (Sep. 1989)

Up or Down	Train No.	Operation section	Operation days in a month per train	Operation ratio (%)	Mean delay time (min.)		No. of freight cars in a train set		Locomotive hauling tonnages		Loading commodities
					Departure	Arrival	Loaded car	Empty car	Heaviest	Lightest	
	4001, 4003 4005, 4015	Ckp-Cpn	27	91	393	4141	13	0	704	572	Sand
Up (Cpn, Jak, Thb bound train)	1151, 1153 1155	Mer Thb Prp - Ak Csk	17	57	31	44	9.7	0.3	480	198	General Commodity
	3105, 3107	Cpn - Jak Thb	24	80	-	-	11.5	6	491	252	General Commodity
	1109, 4087	Ckp - Thb	15	50	249	280	8	5	723	279	Oil
	4057	Prp - Thb	11	37	-	-	9	0	410	360	Sand
	4002, 4004 4006, 4014	Cpn - Ckp	21	70	440	438	13	0	252	182	Empty
Down (Ckp, Mer, Cpn, bound train)	1150	Ak - Mer	17	57	108	167	6	2	266	152	Empty
	3104, 3106	Thb - Cpn Jak	27	90	-	-	8.5	3.5	477	254	General Commodity
	3162	Tpk - Ckp	20	67	-	-	14	2	790	440	Empty
	4040	Jak - Ckp	15	50	-	-	13	1	494	456	Container

Source: PJKA Inspection 1

Note: Operation Ratio = Operated days in a month/days in a month x 100

Table 3.1.1.4 Results of Freight Train Operation in JABOTABEK Area (Sep. 1989)

Up or Down	Train No.	Operation section	Mean Operation days in a month	Operation ratio (%)	Mean delay time (min.)		No. of freight cars in a train set		Locomotive hauling tonnages		Loading commodities
					Departure	Arrival	Loaded car	Empty car	Heaviest	Lightest	
Up	1011, 1013	Ckp-Thb, Jak.	25	83	529	550	26.5	6	550	524	General Commodity
	1032, 1034 1040, 1042	Thb-Bks	30	100	125	158	18	0	792	792	Empty
	1044, 1046 1050, 1052	Thb-Cgd	30	100	39.5	94	18	0	288	286	Empty
	1056, 1058	Thb-Clg	21	70	26	88	15	0	342	219	Empty
	4010	Thb-Bks	30	100	181	204	18	0	792	792	Coal
Down	1010, 1012	Thb, Jak-Ckp	27.5	92	3.5	15	22	9	551	587	Empty
	1031, 1033 1039, 1041	Cgd-Thb	30	100	32	115	18	0	792	792	Coal
	1043, 1045 1049, 1051	Bks-Thb	30	100	16	25	18	0	288	258	Coal
	1055	Clg-Thb	28	93	25	144	10	0	444	358	Steel
	4099	Cgd-Thb	30	100	89	176	18	0	792	792	Coal

Source: PJKA Inspection 1

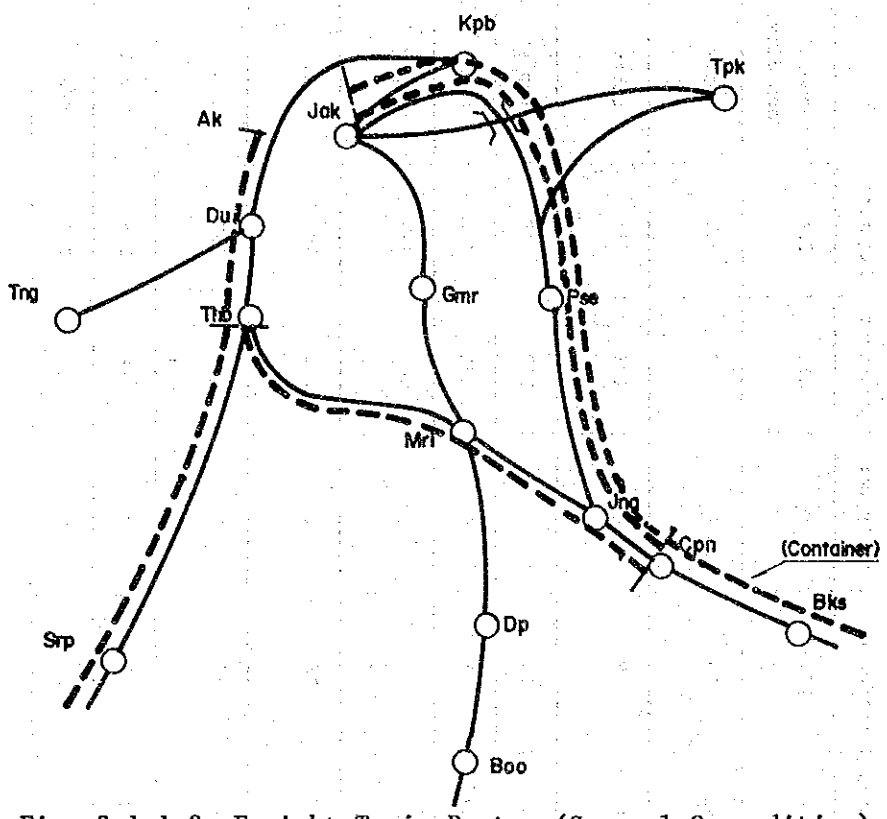

Fig. 3.1.1.2 Freight Train Routes (General Commodities)

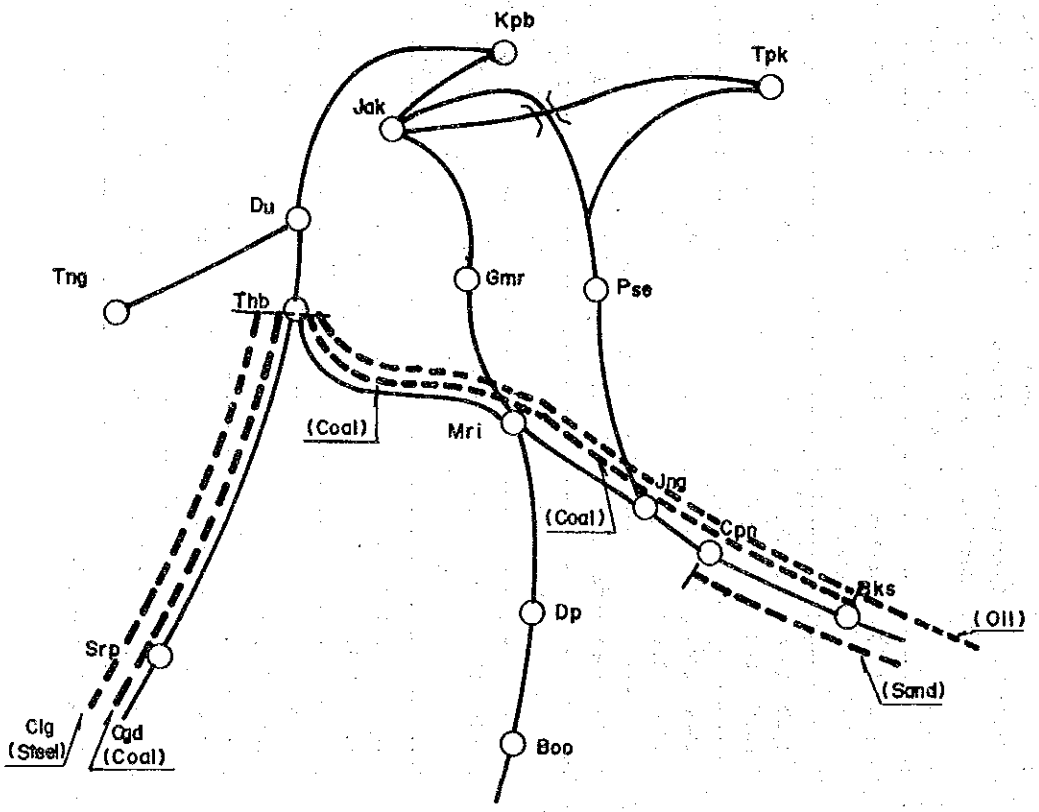

Fig. 3.1.1.3 Freight Train Routes (Coal, Oil, Sand)

Table 3.1.2.1 No. of Trains on Eastern Line
(1989, per day, in both directions)

Line	Electric Railcar Trains	Diesel Railcar Trains	Middle- and Long-Distance Passenger Trains	Freight Trains	Total
Eastern Line	26	16	34	2	100

Source: PJKA Inspection 1

3-1-3 Central Line

Table 3.1.3.1 shows the number of trains on the Central Line. Diesel railcar trains are for the students of two universities. These trains are in temporary use pending electrification between Manggarai and Depok.

Double tracking has been completed but one track is not yet electrified. Therefore, EC trains are operated on one track and DC trains on the other.

Freights trains are not operated on the Central Line.

Table 3.1.3.1 No. of Trains on Central Line
(1989, per day, in both directions)

Line	Electric Railcar Train	Diesel Railcar Train	Middle- and Long-Distance Passenger Train	Freight Train	Total
Central Line	57	9	22	0	88

Source: PJKA Inspection 1

Note: Diesel railcar trains were stopped operating since Jan. 1990.

3-1-4 Western Line

Table 3.1.4.1 shows the number of trains on the Western Line. Many coal trains run between Tanah Abang and Bekasi.

Table 3.1.4.1 No. of Trains on Western Line
(1989, per day, in both directions)

Line	Electric Railcar Trains	Diesel Railcar Trains	Middle- and Long-Distance Passenger Trains	Freight Trains	Total
Western Line	31	2	2	36	71

Source: PJKA Inspection 1

3-2 Train Operation under Construction

3-2-1 Number of Trains on Each Line (1998)

Construction for track elevation of the Eastern Line is scheduled to begin in fiscal year 1993 and last through the end of fiscal year 1997. The number of trains in 1993 and 1998 are forecasted as follows.

(1) EC trains

Table 3.2.1.1 shows the number of EC trains by line.

Table 3.2.1.1 Operation Headway of EC trains
during Construction (per day, in both ways)

Year	Line	Section	Headway morning peak hours (min.)	Train make-up	No. of trains per day	Load factor (%)
1993	Central Line	Jak-Mri-Dp	7.5	8	138	194
	Western, Bekasi Line	Du-Jng-Bks	10.5	8	140	197
	Eastern Line	Jng-N.Kpb-Du -Jng-Bks	13.0	8	114	201
1998	C.L	Jak-Mri-Dp	5.5	8	188	207
	W.L, Bks.L	Du-Jng-BKs	6.5	8	226	196
	E.L	Jng-N.Kpb-Du -Jng-BKs	10.0	8	148	206

(2) Middle- and long-distance passenger trains

The number of middle- and long-distance passenger trains operated between JABOTABEK and East Java (Cirebon, Surabaya, Bandung etc.) is shown in Table 3.2.1.2.

Table 3.2.1.2 No. of Middle- and Long-Distance Passenger Trains (per day, in both ways)

Line, section	Year	
	1993	1998
Eastern Line (Jak - Jng)	34	38
Central Line (Mri St. Start/Arrive)	38	46
Western Line (Thb - Mri - Jng)	2	4
Total	74	88

(3) Middle-distance DC trains

Middle-distance DC trains between Jakarta and CiKampek are operated on the Eastern Line. The number of trains is shown in Table 3.2.1.3.

Table 3.2.1.3 No. of Middle-Distance DC Trains (per day, in both ways)

Year	Line	Section	No. of trains
1993	Eastern, Bekasi Line	Jak - Jng - BKs - CKp	34
1998	ditto	ditto	34

Note: Middle-distance DC trains are operated between Jakarta and CiKampek; they run on the Eastern Line (Jak - Pse - Jng) and the Bekasi Line (Jng - BKs - CKp)

(4) Freight trains

Table 3.2.1.4 shows the number of freight trains. The greater part of freight trains are coal trains. At present these coal trains are hauled by one diesel locomotive, but after 1993 coal trains are to be hauled by two diesel locomotives.

Table 3.2.1.4 No. of Freight Trains
(per day, in both ways)

Line, section	Year	
	1993	1998
Eastern Line (Jak - Jng)	3	3
Western, BeKasi Line (Thb - Jng - BKs)	23	31

Note: Double diesel locomotives hauling is planned for coal trains operated between Thb and Bekasi.

Table 3.2.1.5 shows the number of trains by line, in 1993 and 1998.

Table 3.2.1.5 No. of Trains by Lines (per day, in both ways)

Year	Line	Section	EC Train	Middle- and Long-Distance Passenger Train	Middle-Distance DC Train	Freight Train	Total
1993	Central Line	JaK-Mri-Dp	138	(38)			176
	Western, BeKasi Line	Du-Jng-BKs	140	2	34	23	199
	Eastern Line	Jak-Pse-Jng	114	34	34	3	185
1998	Central Line	Jak-Mri-Dp	188	(46)			234
	Western, BeKasi Line	Du-Jng-BKs	226	4	34	31	295
	Eastern Line	Jak-Pse-Jng	148	38	34	3	223

Note: Middle-distance passenger trains on the Central Line stop and start at Manggarai Station.

Fig. 3.2.1.1 shows the number of trains (1998) of Table 3.2.1.5

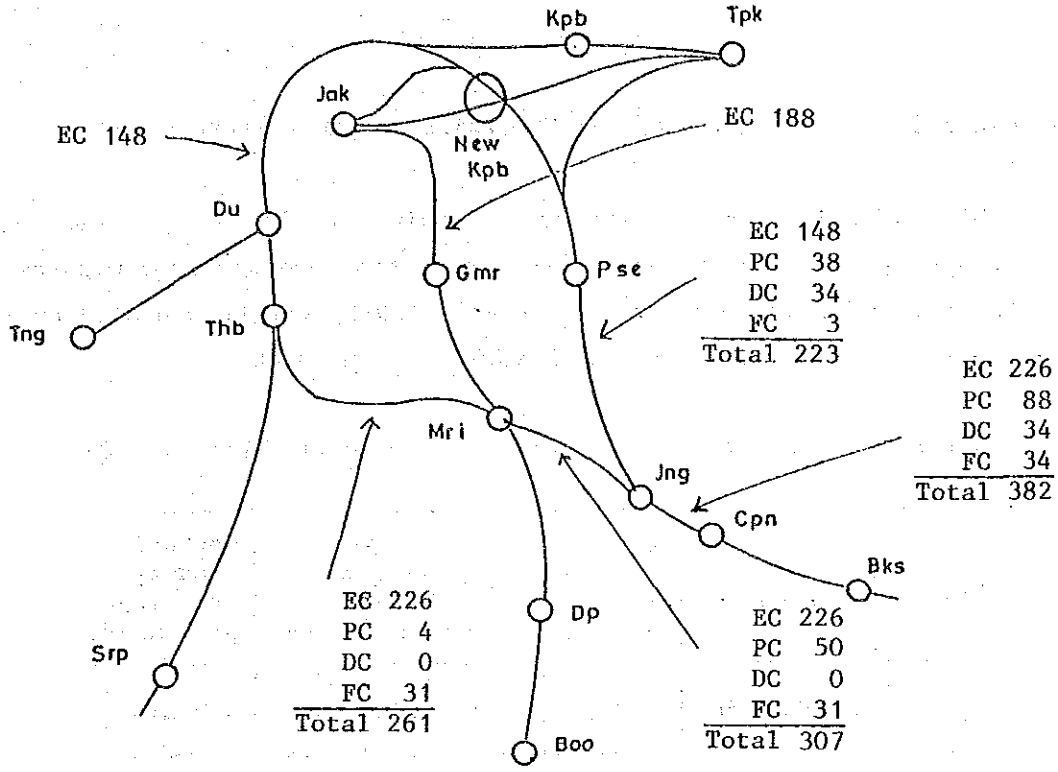

Fig. 3.2.1.1 No. of Trains (1998)

3-2-2 Alternative A

(1) Train operation alternatives during construction

Three alternatives for train operation are assumed during construction for track elevation:

Alternative A Suspension of all train operation on the Eastern Line.
Alternative B Single track operation on the Eastern Line.
Alternative C Double track operation on the Eastern Line.

(2) Train operation on the other lines

In the case of alternative A, all trains on the Eastern Line should be operated on other line.

1) Central Line operation of all EC trains on the Eastern Line

Table 3.2.2.1 shows the number of trains in this case. The total number of EC trains is 336. Train operation headway is 3 minutes in the morning peak hour. All EC trains (1998) can be operated on the Central Line, because minimum headway is 3 minutes.

Table 3.2.2.1. No. of EC Trains on the Central Line (1998)

Line	Section	No. of EC Trains (per day, in both ways)			Operation Headway (Morning peak hour)
		Central	From East-	Total	
Central Line	JaK-Gmr-Mri	188	148	336	3.0 min.

2) Western Line operation of all but EC trains on the Eastern Line

The number of trains on the Western Line is shown in Table 3.2.2.2.

Table 3.2.2.2 No. of Trains on the Western Line (Alternative A, 1998)

Line	Section	No. of Trains (per day, in both ways)				
		EC	PC	DC	FC	Total
Western Line	Thb-Mri	226	42	34	34	336
	Mri-Jng	226	88	34	34	382

Table 3.2.2.3 shows headway by time zone for EC and DC trains on the Western Line.

Table 3.2.2.3 Operation Headway of EC and DC Trains on the Western Line by Time Zone (1998)

Time Zone		Length of Time Zone	No. of Trains (per day, in both ways)	Operation Headway (min.)
Early morning	04:00 - 07:00	3	44	8.25
Morning Peak	07:00 - 09:00	2	64	3.75
Off Peak	09:00 - 14:00	5	50	12
Evening Peak	14:00 - 17:00	3	60	6
Night	17:00 - 23:00	6	42	17

When EC trains are operated together with middle- and long-distance passenger trains, the minimum headway of EC trains is 12 minutes, as shown in Fig. 3.2.2.1.

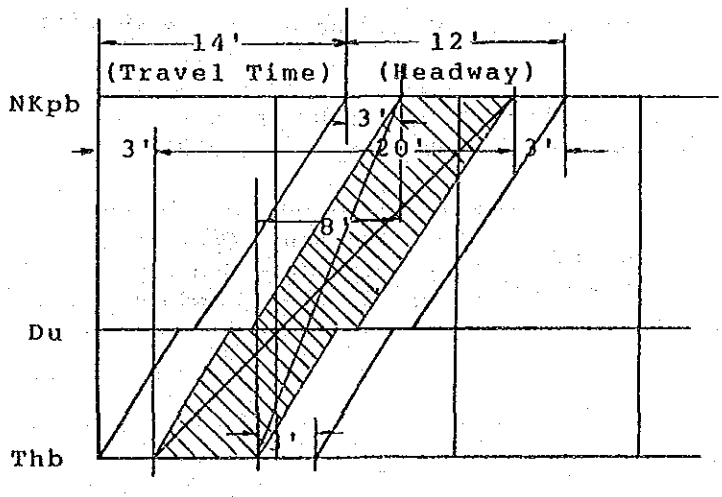

Fig. 3.2.2.1 Time Band Applicable for Additional Train

As shown in Table 3.2.2.3, time zones where operation headway is over 12 minutes are off peak and night time zone.

The number of middle- and long-distance passenger trains and freight trains which can be operated over 11 hours (off peak, 5 hours + night, 6 hours) are 92 (both ways).

As shown in Table 3.2.2.2, the total number of PC and FC train is 122. Therefore, all trains can not be operated on the Western Line.

3-2-3 Alternative B

Alternative B is single track operation on the Eastern Line.

(1) Minimum operation headway

For maximum train operation, all trains meet opposite trains at every station. In this case, minimum train headway is 9 minutes for EC trains and 11 minutes for PC trains.

(2) Operation headway of EC and DC train by time zone

Table 3.2.3.1 shows operation headway of EC and DC trains in 1998.

Table 3.2.3.1 Operation Headway of EC and DC Trains on the Eastern Line by Time Zone (1998)

Time Zone		Length of Time Zone (hr.)	No. of Trains (per day, in both ways)	Operation Headway (min.)
Early morning	04:00 - 07:00	3	30	12.0
Morning Peak	07:00 - 09:00	2	44	5.5
Off Peak	09:00 - 14:00	5	36	16.75
Evening Peak	14:00 - 17:00	3	42	8.5
Night	17:00 - 23:00	6	30	24.0

Not all trains can be operated because the operation headways of the morning and evening peak hours are less than 9 minutes.

(3) Single track capacity

Table 3.2.3.2 shows single track capacity by time zone on the Eastern Line.

Table 3.2.3.2 Possibility of Single Track Operation on the Eastern Line (1998)

Time Zone		Operation Headway (Plan) (min.)	Line Capacity (A) (both ways)	No. of EC and DC Trains (B) (both ways)	(A) - (B)	
Zone	Time				EC, DC Train	PC, FC Train
Early Morning	04:00 - 07:00	11	32	30		2
Morning Peak	07:00 - 09:00	9	26	44	-18	
Off Peak	09:00 - 14:00	11	54	42		12
Evening Peak	14:00 - 17:00	9	40	42	-2	
Night	17:00 - 23:00	11	64	30		34
Total			216	188	-20	48

As shown in "(A) - (B)" in Table 3.2.3.2, 20 EC and DC trains are over the line capacity. Therefore, these trains cannot be operated on the Eastern Line. 20 Trains must be operated on the Central Line. In this case, operation headway during morning peak hours of the Central Line will be 3 minutes.

The number of trains of middle- and long-distance passenger and fright trains are 41. These trains can be operated in time zone other than peak hours.

(4) Problems of single track operation

1) Single track operation assumes that all trains operate on time. Delay of one train drastically lowers track capacity, and it takes a long time to return to on time operation.

2) In this single track operation plan, all trains meet trains going in the opposite direction at each station from 04:00 to 23:00. Train operation handling will be very difficult under these conditions.

3) For single track operation, the following facilities will be necessary on the Eastern Line.
. Train meeting facilities (Platform and track) at each station
. Signals and blocking facilities

3-2-4 Alternative C

Double track train operation as at present is continued during the construction period. This is the same construction method as for track elevation on the Central Line. This method presents no problems to train operation.

3-2-5 Selection of Alternative

Table 3.2.5.1 shows the problems for train operation presented by each alternative.

Alternative A is not a good plan because 30 middle- and long- distance passenger and freight trains cannot be operated.

Alternative B presents the following problems:

(1) If train operation of part of EC and DC trains changes from the Eastern Line to the Central Line, all trains can be operated. But passenger travel time from Jatinegara St. to Pasar Senen St. or New Kampungbandan St. is more than four times longer.

Table 3.2.5.1 Problems of Train Operation by Alternatives

Item \ Alternative	Alternative A (Suspension of Train operation on Eastern Line)		Alternative B (Single track operation on Eastern Line)	Alternative C (Double track operation on Eastern Line)
Train Operation	(1) Middle and Long distance passenger trains and freight trains are changed to operate from Eastern Line to Western Line ,but 30 trains of them can not operate (2) Switchback of PC and FC train at New Kpb Station is difficult		(1) Operation handling is difficult to operate many trains on single track (2) 20 trains of EC and DC train are changed to operate from Eastern Line to Central Line	———
Travel Time	Section Jng-Pse	Via Central Line 40.5 min + Bus Via Western Line 37.5 min + Bus	Via Central Line 40.5 min + Bus	Via Eastern Line 10.5 min
	Jng-N.Kpb	Via Central Line 40.5min Via Western Line 37.5min	Via Central Line 40.5 min + Bus	20.5 min
Transportation by bus	Bus route (1) Jatinegara - Pasarsenen (2) Jatinegara - Jakarta		Transportation by Bus will be not necessary because trains changed from Eastern Line to Western Line are not so many	———
Facilities	(1) Improvement of siding track of New Kpb Station (2) Improvement of station yard and platform		(1) Train meeting facilities for every station of Eastern Line (2) Signal and blocking facilities of Eastern Line	———

(2) The greatest problem is the long delays of middle- and long-distance trains. The mean delay time of down trains would be over 100 minutes. Alternative B assumes that all trains run on time.

For these reasons, Alternative B is not desirable.

Therefore Alternative C is the best way to operate trains during the period of construction.

3-3 Train Operation after Completion of Grade Separation

At present, trains decrease speed or frequently stop in front of railway crossings. After completion of track elevation, trains can operate without decreasing speed or stopping at railway crossings and train operation accident at railway crossing disappears. This is very effective for on-time train operation.

Train operation after track elevation is as follows.

3-3-1 EC Trains

Table 3.3.1.1 shows EC train operation on the Eastern Line.

Table 3.3.1.1 EC Train Operation (Eastern Line)

Year	Operation head way (min.)	Train make up (cars)	No. of trains (per day, in both ways)
1998	10	8	148
2005	8	8	184

3-3-2 Middle-Distance DC Trains

Table 3.3.2.1 shows DC trains (via Eastern Line) between Jakarta and Cikampek.

Table 3.3.2.1 DC Train Operation (Eastern Line)

Year	Operation head way (min.)	Train make up (cars)	No. of trains (per day, in both ways)
1998	43	4	34
2005	43	5	34

3-3-3 Middle- and Long-Distance Passenger Trains

(1) Terminal

Terminal stations for middle- and long-distance passenger trains in JABOTABEK are the following:

Eastern Line Jakarta, Pasar Senen, Jatinegara, (New Jakarta)

Central Line Gambir, Manggarai, (New Jakarta)

Western Line Tanah Abang

(2) Operating route

Fig. 3.3.3.1 and Fig. 3.3.3.2 show operation route (Year 1989) of middle- and long-distance passenger trains. These operation routes will be not changed in future. With completion of the JABOTABEK improvement projects, these operation routes may change.

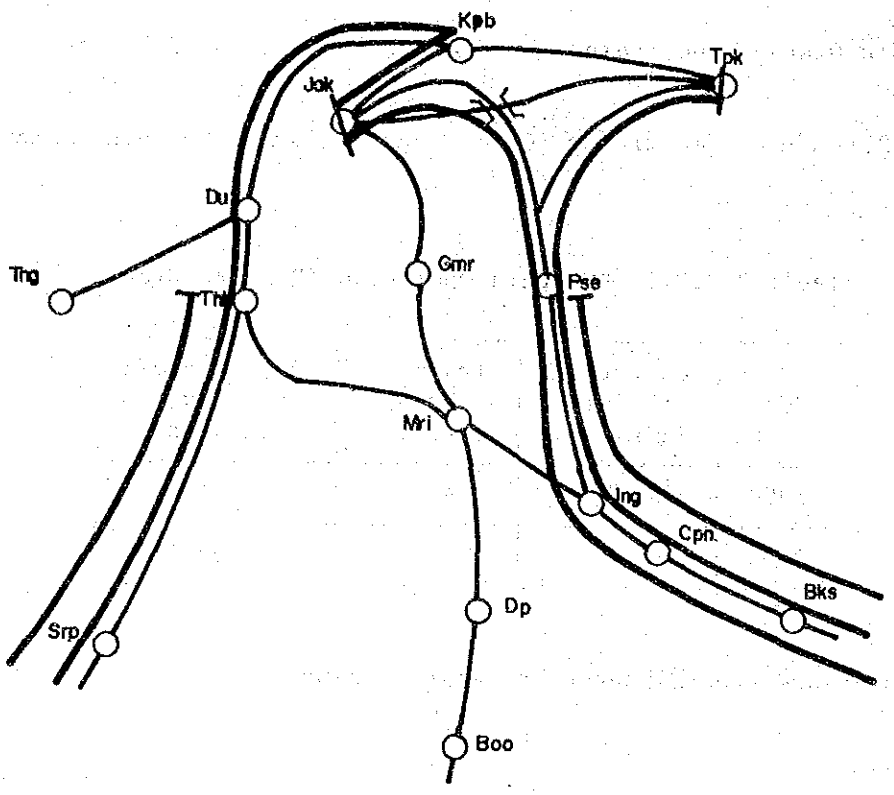

Fig. 3.3.3.1 Operation Route of Middle- and Long-Distance Passenger Train (1) (Year 1989)

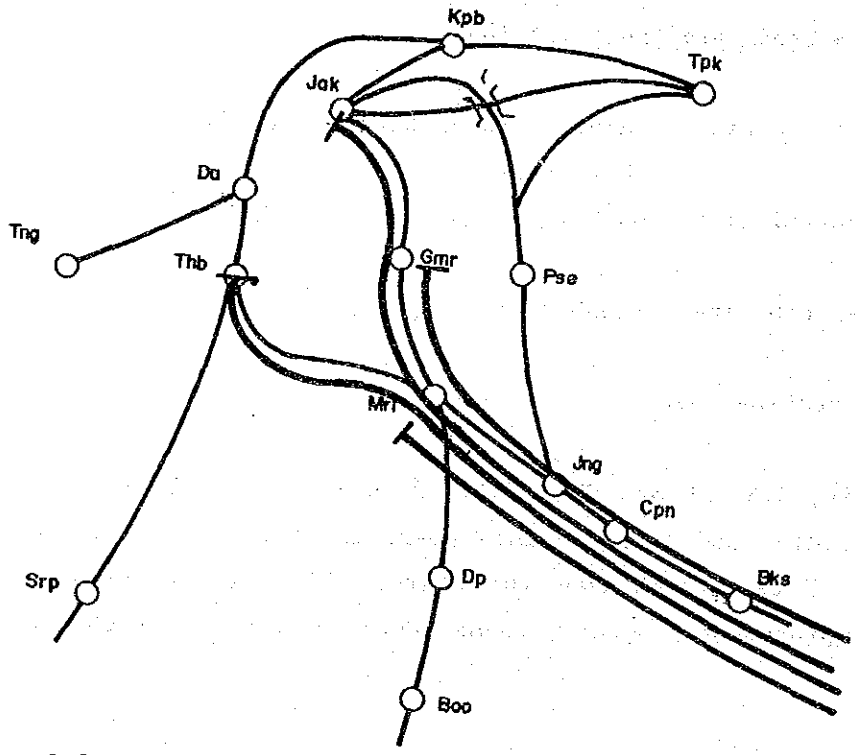

Fig. 3.3.3.2 Operation Route of Middle-and Long-Distance Passenger Train (2) (Year 1989)

After completion of track elevation of the Central Line, Parahiyangan trains will terminate at and start from Gambir Station.

(3) Facilities

Facilities for daily inspection, water supply, cleaning and washing for passenger car will become necessary at Manggarai and Tanah Abang stabling yard.

3-3-4 Freight Train

At present four freight yards (Jakarta Gudang, Tanjungpriok Gudang, Cipinang, Tanah Abang) are terminals for freight trains. After construction of New Jakarta Station, Jakarta Gudang will be annexed to Tanjungpriok Gudang.

3-3-5 Car Depot

Depots in JABOTABEK are Bukitduri (EC, DC), Jatinegara (DL), Tanah Abang (DL, DC), Jakarta (PC, EC) and Bogor (EC, DC). Depok depot (EC) will be constructed in near future. Depok depot is very important depot for electric railcars. Bekasi (EC), Serpong (EC) and Tangerang subdepot are now planning and effective for rostering of EC.

After construction of New Jakarta station, Jakarta depot cannot be used for passenger car and electric railcar. Jakarta depot will be moved to near Tanjungpriok or west side of Jakarta.

3-3-6 Number of Electric and Diesel Cars

The required number of electric cars and diesel cars by alternative are as shown in Table 3.3.6.1.

Table 3.3.6.1 Number of Electric Railcars and Diesel Railcars

Alternative			Electric Railcar	Diesel Railcar		Total
				Tng/L	Bks/L	
Feeder Service	Year 1995	With Project	408	23	32	463
		Without	400	23	32	455
	Year 2005	With	700	40	38	778
		Without	676	40	38	754
Grade Seperation on E/L	Year 1998	With	524	30	35	589
	Year 2005	With	736	42	40	818

3-4 Examination of Train Operation

3-4-1 Short Cut Line

(1) Necessity

Fig. 3.4.1.1 shows the track layout near New Kampung Bandan Station. The Eastern Line and Jakarta Kota station are connected. Therefore middle- and long-distance trains on the Eastern Line can run to Jakarta Station. EC trains on the Eastern Line do not run to Jakarta Station.

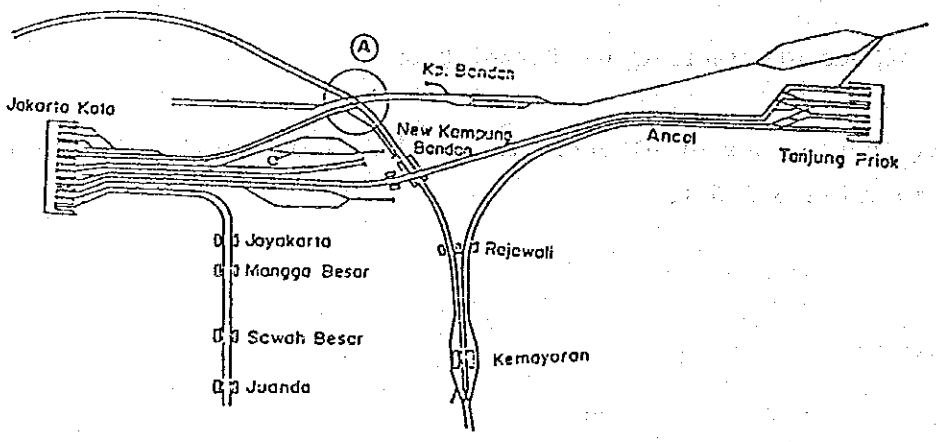

Fig. 3.4.1.1 Sketch Drawing at Kampung Bandan

Fig. 3.4.1.2 shows the future plan near New Kampung Bandan Station. The short-cut line is planned to connect Rajawali - Tanjungpriok Line and New Jakarta - Tanjungpriok Line.

New Jakarta Station has one platform and two tracks for the Eastern Line, and three platforms and six tracks for the New Jakarta - Tanjungpriok Line.

Purposes of the short-cut line are as follows:

1) Before construction of New Jakarta Station

a) According to the present plan, middle- and long-distance train can not operate to Jakarta Kota Station after completion of track elevation of the Central Line. Because tracks in Jakarta Kota Station that trains on the Central Line can use are only two, and effective length of tracks is for eight cars.

b) Therefore long-distance trains have to be changed operation route from the Central Line to the Eastern Line. Middle-distance trains are terminated at Manggarai Station, but number of long-distance trains on the Eastern Line increases.

c) Electric railcar trains on the Eastern Line are not operated to Jakarta Kota Station and long-distance trains are operated to Jakarta Kota Station. As Fig. 3.4.1.1, electric railcar trains and long-distance trains cross near New Kampung Bandan Station. First purpose of the short-cut line is solution of level crossing.

2) After construction of New Jakarta Station

a) According to the present plan, track layout of New Jakarta Station is as shown in Fig. 3.4.1.2.

b) New Jakarta Station have total six platforms and eleven tracks, but for the Eastern Line one platform and two tracks. One

platform and two tracks are not enough for trains on the Eastern Line. This is second purpose of the short-cut line.

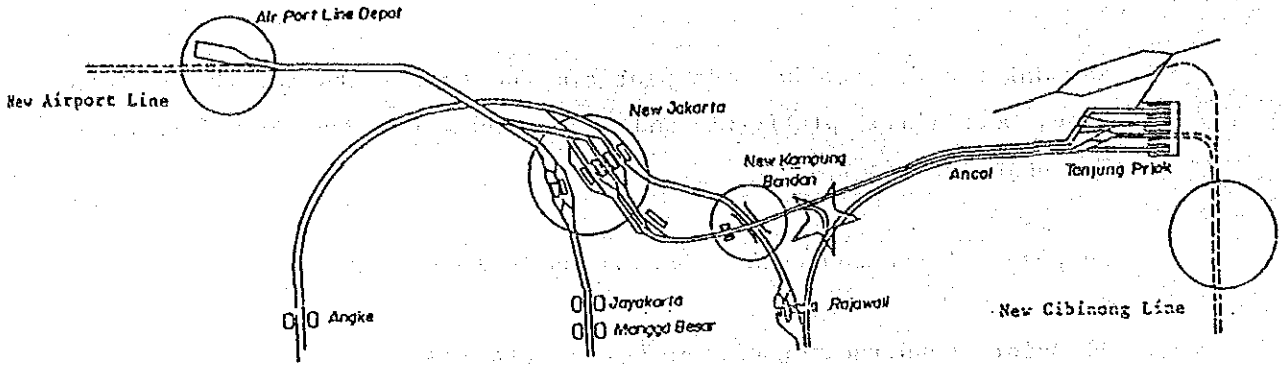

Fig. 3.4.1.2 Relation Between Each Project

(2) Examination of the short-cut line

In this report, the short-cut line is expected by following reasons:

1) The interference rate of level crossing at New Kampung Bandan Station is 39.6% in year 2005 (PMS Report). The criteria of interference rate is described as follows:

40% or less ----- Possible of train control
40% - 60% ----- Difficult of train control
more than 60% ----- Impossible of train control

Train operation is possible without the short-cut line until year 2005.

2) When New Jakarta Station is constructed, it is necessary to investigate having more platforms and more tracks in New Jakarta Station on the Eastern Line.

(3) Facilities

Fig. 3.4.1.3 shows the track layout of the short-cut line. The short-cut line has two confluence points and two crossing points. Complete safety facilities are necessary for safe train operation.

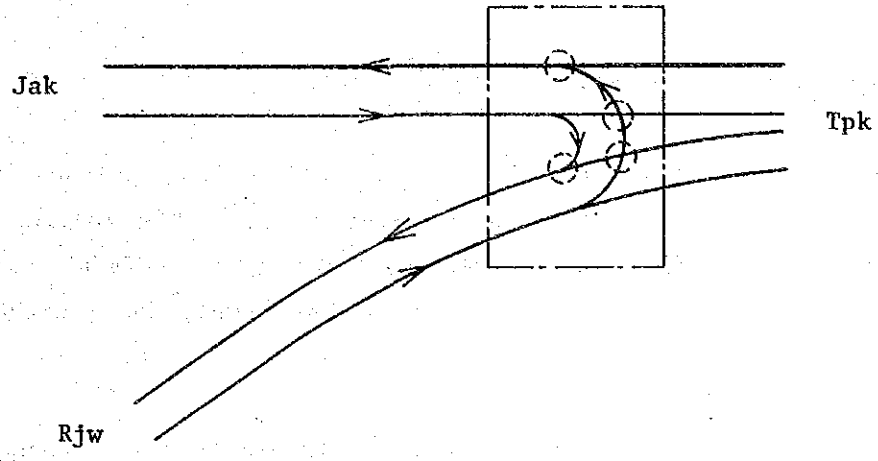

Fig. 3.4.1.3 Short-Cut Line

3-4-2 Gradient of Track Elevation and Hauling Tonnage

Gradient of the Eastern Line track elevation is planned at 12‰. Both sides of the elevated track curve on the grade track.
The compensation gradient with curve resistance is 12.6‰, on both sides.

The tractive effort of PJKA Type CC-201 Diesel locomotive is 760t at 30 km/h, gradient 12‰. Type BB304 is 590t under the same conditions.

At present, maximum tonnage of passenger trains is 400t and mean tonnage of freight trains on the Eastern Line is 560t.

There is no problem to operate these trains on the gradient track.

3-4-3 Platforms of Pasar Senen Station

Pasar Senen Station is the terminal station for middle- and long-distance passenger train and many trains start and arrive at this station.
Pasar Senen Station is planned to have two tracks for departure/arrival of long-distance train, one track for baggage handling, and two tracks for JABOTABEK trains, a total of five tracks and three platforms.

3-5 Rolling Stock Plan

3-5-1 The Basic Concept for Rolling Stock Planning

In JABOTABEK, middle- and long-distance trains, which include freight trains, operate on the same track as commuter trains. The rolling stock for these trains consists of electric railcars (ECs), diesel railcars (DCs), diesel locomotives (DLs), passenger coaches (PCs), and freight cars (FCs).

Of the above-mentioned rolling stock, it is desirable to first standardize commuter railcars in respect to operation and maintenance from an economic viewpoint, since it this rolling stock that will probably bear a large portion of the future transport load. It is therefore necessary to sufficiently examine and decide the future use of train types and to make point by point reassessments (see Table 3.5.1.1).

Table 3.5.1.1 Present and Future Use of Train Types

Train type	Present	Future
Commuter	EC DC DL+PC	EC
Middle-distance	DC DL+PC	DC DL+PC
		EC (for electrified sections) EL+PC
Long-distance	DL+PC/FC	DL+PC/FC
		EL+PC/FC (for electrified sections)

Taking the future use of rolling stock into consideration, with ECs as the focus, the basic concepts for rolling stock in JABOTABEK are as enumerated below.

(1) For commuter ECs, judging from future track and operational conditions, the present specifications are to serve as a basis for additional cars.

(2) The basic dimensions and performance characteristics of rolling stock in JABOTABEK are to be standardized, making it possible to use any car on any section.

(3) The standardization of materials and equipment, screw threads, and electric equipment in accordance with the UIC, ISO, and IEC, respectively, are to be promoted mainly for the purpose of reducing or restricting the increase in maintenance work with the addition of new car.

(4) Present maintenance facilities and workshops are to be upgraded and expanded to cope with additional cars.

(5) New technologies are to be introduced to reduce rolling stock maintenance costs and the increase in repairs that occurs with aging.

(6) The modernization of accommodations, such as the interior design or air-conditioning, is to be done by considering the changes in the lifestyle of the public.

(7) ECs, PCs, and some EC accommodations are being domestically produced in Indonesia. However, EC bodies that can be totally built in Indonesia should be adopted.

3-5-2 An Example of Rolling Stock Standardization

(1) General

An example of standardizing rolling stock, based on the fundamental concepts of rolling stock planning outlined above, is set forth below.

(2) Standardization

1) Standardization of basic railcar dimensions

a) Rolling stock gauge

The basic railcar dimensions, which are closely correlated with

rolling stock gauge, are being standardized for ECs, DCs, and PCs as shown below. This work will have to continue.

- Length of car body: 20,000 mm
- Width of car body: 2,990 mm
- Distance from roof to top of rail: 3,700 mm
- Distance between the centers of two bogies: 14,000 mm
- Distance between axles of a bogie: 2,200 mm
- Distance from coupler center to top of rail: $775^{+10\ mm}_{-15\ mm}$

Easier boarding and alighting, as well as improving passenger safety by making car and platform floors level with each other, will have to be studied in the future. Consequently, the necessity of extending the upper part of the rolling stock gauge and other related problems will also have to be studied.

b) Other dimensions

Basic car dimensions based mainly on track and operating conditions have almost been standardized for ECs, DCs, and PCs as shown below.

- EC wheel diameter: 860 mm (DC/PC:774 mm)
- Distance from floor of ECs/DCs to top or rail: 1,202 mm (PCs:1,000mm)
- Distance from door area of ECs/DCs to top of rail: 1,000 mm
- EC/DC axle load (for max. loading condition): 14,000 kg (PC:12,000kg)
- Minimum curve for ECs/DCs/PCs: 80 mm

The above-mentioned existing dimensions will be suitable for the rolling stock of JABOTABEK in the future. As for sections to be constructed for special use, the reduction of axle load or some other measures will be considered.

2) Standardization of basic car performance characteristics

The basic performance characteristics of ECs, which play a leading role in JABOTABEK, are as shown below:

- Acceleration: 0.5 m/s^2
- Deceleration (service brake): 0.8 m/s^2
  (emergency brake): 1.0 m/s^2
- Maximum speed: 100 km/h

The performance characteristics shown above are suitable for the existing commuter trains in JABOTABEK, and will be sufficient for even achieving a 3 minute headway.
Accordingly, the introduction of future VVVF ECs with better acceleration and deceleration than the existing rheostatic controlling ECs, which will produce an economic effect by reducing the M/T ratio (e.g. 2M4T) and keeping performance identical with that existing EC trains, should be studied.

In the future, 4M4T VVVF trains with quick acceleration and deceleration, the same as the present EC train composition, can be used for specific sections with very short headways.

The present adoption of an automatic brake system, which can be used when cars of a train are the same or different (such as connecting ECs and PCs) when there is a breakdown, will be continued in the future.

3) Standardization of common parts for different kinds of rolling stock

Common parts for different kinds of rolling stock (i.e., ECs, DCs, PCs, DLs, and FCs) should be standardized if possible. A few examples of these common parts are listed below:

- Wheels and axles
- Automatic tight lock couplers
- Brake equipment

- Electric equipment
- Accommodations
- Instruments
- Bearings
- Springs
- Gangway diaphragms

In the future, many common parts for different types of ECs (i.e., commuter, middle-distance, and long-distance ECs), such as traction motors, wheels and axles, and pantographs, will have to be adopted.

4) UIC standardization of materials and equipment

UIC (International Union of Railways) standardization of materials and equipment will have to be promoted.

As for materials, the sizes and kinds of materials for steel should comply with UIC Standards as much as possible.

Regarding equipment, etc., those in compliance with UIC Standards, such as the gangway diaphragms, brake performance characteristics, and rotating electrical machines will have to be increased.

5) ISO standardization of screw threads

Screw threads, bolts, studs, and nuts should be in compliance with ISO (International Organization for Standardization) Standards as much as possible.

6) IEC standardization of electric equipment

The resistance and capacity of resistors, and the static capacitance and rated voltage of condensers will be brought into compliance with IEC (International Electrotechnical Commission) Standards.

The IEC rules for the characteristics and ratings of electric equipment for rolling stock (which are included in the UIC as well) will be applied.

7) Interchangeability of equipment

In principle, each piece of equipment will have the equality of interchangeability.

Taking the above statement into consideration, decisions on whether or not to introduce noninterchangeable equipment will be decided by comparing the economic and technological factors.
The introduction of new equipment is economically effective when its introduction results in a greater savings (reduction in maintenance and procurement costs) than the costs for new spare parts and maintenance machinery.

Here, "the reduction in costs" is proportional to the number of equipment, while "the new expenses" are hardly related at all. It is adequate, therefore, to introduce new equipment only when the quantity can produce an economic effect.

(3) Elevating reliability and modernizations

To elevate the reliability of railcars, new technologies will be introduced to mainly reduce or restrict the increase in maintenance work, thereby maintenance costs, as the cars age. It is also important when operating railways to induce and secure passenger demand by promoting railcar modernization in coordination with social needs.

A few examples of raising the reliability and implementing the modernization of ECs are as listed below:

a) Car bodies are left unpainted to facilitate maintenance work.

b) Bolsterless type of bogies are used to facilitate maintenance work and reduce weight.

c) A VVVF control system is installed to facilitate maintenance work and decrease power consumption.

d) Accommodations such as the interior and air-conditioning are modernized.

e) Devices such as ATS for operational safety are added.

(4) Railcar structures that facilitate domestic production

FCs, PCS, and the accomodations for ECs are being domestically produced in Indonesia. However, EC bodies that can be totally built in the country should be adopted.

An example of EC bodies that can facilitate domestic production is as outlined below:

1) Car body

a) A structure that can be processed and assembled easily, such as a structure having many arc welded sections.

b) Materials that can be easily worked, such as those in stainless steel selected for that purpose.

c) Structure simplification, such as simple side door pockets.

d) Along with trying to curb distortions in welding, sections that can be welded, despite big errors, using suitably thick steel plates and appropriate roof coating methods, etc.

e) Adoption of many parts that can be easily worked, such as ordinary pressed steel plates.

2) Car parts

Car equipment for facilitating local production will be considered based on the above ideas for car bodies.

3-6 Rolling Stock Maintenance Plan

3-6-1 New EC Maintenance System

Considering the actual result of railcar maintenance, future railcar structure, and improvement plans for railcar maintenance facilities, the underlying concepts for a new EC maintenance system, with mainly the purpose of reducing maintenance work, are as follows:

(1) The new EC maintenance system will be based on the maintenance system proposed in the Master Plan (JICA, 1981).

(2) The names of inspections at workshops will be changed to reflect the type of maintenance.

(3) To equalize the work volume of different types of inspections in workshops, an inspection that combines the general overhaul and semi-overhaul inspections is to be adopted.

(4) To suppress the increase in dead-head time that will accompany the future growth in railcars, the daily inspection of a railcar is to be performed at a station yard on its respective line of operation.

(5) Judging from actual condition of bogies that are now being used, bogie inspections are to be abolished after the completion of the 2nd stage of the improvement work for Manggarai workshop.

(6) To facilitate the management of railcar operation, inspection cycles will be based on time intervals only, given the following preconditions:

a) The running kilometerage of each railcar will be roughly equalized.

b) The average daily running kilometerage of a railcar is assumed hereafter to be 400 km.

(7) Judging from the actual use of railcars and the condition of parts, as well as the inspection cycles of railcars in other countries with structures similar to those in JABOTABEK, inspection intervals will be prolonged as stated below:

a) Inspection intervals in the new maintenance system will be made 50 percent longer than the existing intervals.

b) The lengthening of intervals will be adopted along with the abolishment of the bogie inspection.

Taking into account the simplification, interval lengthening and review of the existing inspection system mentioned above, an example of the new system is as shown in Table 3.6.1.1.

3-6-2 An Example of Improvement Work for Manggarai Workshop

(1) Outline of improvement plan for Manggarai Workshop

To upgrade the capacity and quality of the Manggarai Workshop, the 1st stage improvement work is now being implemented.

In this connection, in order to cope with the inspections for the rapidly increasing ECs, an example of the 2nd stage improvement work for the workshop is given below.

1) Preconditions of improvement work

a) Priority is given to investment for improving and expanding the EC maintenance facilities.

b) The existing PC maintenance facilities will be partially upgraded.

c) For DCs, only incidental inspections will be carried out, excluding engine and converter work.

d) The manufacturing of spare parts, such as the brake blocks and bogie springs, will be continued.

2) Reduction of EC inspection time

An integrated bogie, wheel and axle, and traction motor shop will be built to reduce the EC maintenance work and thereby the inspection time.

Table 3.6.1.1 Types, Contents, Intervals and Places in Charge of EC Inspections

Types	Contents	Inspection cycle		Places in charge
		Intervals	Running kilometerage	
General overhaul	Inspection conducted comprehensively by dismantling each component at prescribed intervals depending on the state of use of an EC.	6 years or less	—	Workshop
Semi-overhaul	Inspection conducted at prescribed intervals by dismantling specified principal parts depending on the condition of principal equipment such as traction motors, bogies, running gears, brake equipment, current collectors, auxiliary motors, relays, contactors, couplers, instruments, etc.	3 years or less	—	Workshop
Monthly inspection	Inspection conducted at prescribed intervals depending on the state of pantographs, high tension circuits, main circuit system, rotating machines, door operation devices, brake equipment, bogies, running gears, instruments, etc., in their installed state.	90 days or less	—	Depot
Daily inspection	Surface inspection conducted to replace worn parts and check the state of wear and movement of pantographs, door operating devices, interior equipment, bogies, running gears, coupling devices, etc.	72 hours or less	—	Depot, yard
Incidental inspection	Inspection conducted whenever the need arises.	As required	—	Workshop, depot

To prevent an increase in the time needed for EC periodical inspections, some of the inspection methods indicated below will be adopted.

a) A method that combines the general overhaul and semi-overhaul inspections.

b) Incidental inspections will be carried out separately from overhaul work.

3) Prolongation of inspection intervals

Assuming that facilities for bogie maintenance play an important part in railcar repairs, their improvement should result in fewer inspections, meaning that the interval between inspections will be 50 percent longer than at present and the bogie inspection will be abolished.

4) Flexibility for future planning changes

EC maintenance facilities will be constructed to have flexibility for future planning changes.

As for PC facilities, only the existing ones will be improved, since the long-term plans are still unclear as of this time. In the future, the layout of PC maintenance facilities will be reviewed and expanded if necessary.

5) Scale of workshop

a) EC inspection capacity (for the year 2005)

- Maximum EC overhaul capacity: 250 per year
- Maximum number of ECs assigned: 750
  - Number of ECs that can be accommodated in the car body shop: 12
  - Days required for car body maintenance: 9

- Actual working days: 250 per year
- Work fluctuation factor: 0.75
- Inspection cycle: every 3 years

b) PC inspection capacity

- Maximum PC overhaul capacity: 320 per year
- Maximum number of PCs assigned: 900

6) Improvement work outline

a) Facilities for EC maintenance work to be constructed or upgraded.

- An integrated bogie, wheel and axle, and traction motor shop to be constructed.
- Car body shop to be upgraded.
- Machinery to be installed, etc.

b) PC maintenance facilities to be upgraded.

- PC initial and final check pits to be constructed, etc.

c) DC incidental inspection tracks to be laid, etc.

(2) Main content of improvement work

An example of the contents of the 2nd stage improvement work for Manggarai Workshop, based on an outline of the above-mentioned workshop improvement plan is as follows:

1) The present method of moving car bodies with dummy bogies will be continued.

2) An integrated bogie, wheel and axle, and traction motor shop will be constructed.

a) An integrated bogie, wheel and axle, and traction motor shop, adjoining the lift and mount shop, will be constructed. The proximity of these shops will result in a much smoother EC maintenance work flow.

b) Both EC and PC bogies will be repaired at the integrated shop

c) Bogies will be moved with a bogie traverser that will be installed at the shop.

3) Upgrading of car body repair shop

a) The existing car body repair shop will be expanded and upgraded, and the existing bogie shop will be turned into an additional car body repair shop, so that the number of EC repair tracks will be increased from 5 to 10.

b) A part of the new car body shop will be used for the prefinishing work that precedes the painting work.

4) A new equipment shop

a) The existing machine maintenance shop will be turned into a new equipment shop.

b) Some of the small parts on the ECs and PCs, such as electric, brake, and car body parts, which do not need cranes, will be inspected and repaired at this shop.

5) Others

a) Additional dummy bogies will be procured to cope with the increasing maintenance work from additional railcars.

b) New pits for the exclusive use of PC initial and final check work will be installed in order to separate this work from that for ECs, resulting in the EC work flow being vastly improved.