CHAPTER 2. FORECAST OF RAILWAY DEMAND

CHAPER 2 FORECAST OF RAILWAY DEMAND

2.1 Railway Passengers in JABOTABEK Area

2.1.1 Socio-economic and land use study

1) Framing of population of JABOTABEK Area in year 2000
The framing of the future population in JABOTABEK Area classified by Kabupaten is as shown in Table 2.1.1.

Table 2.1.1 Future Population of Kabupaten

(Unit: 1,000 persons)

Kabupaten	1978	2000
D.K.I. Jakarta	6,082	10,500
Bogor	2,236	4,606
Bekasi	953	2,610
Tangerang	1,288	2,451
*Karawang	81	240
Cikampek	82	186
R. Bitung	50	63

Source: – City Planning Reports by Cipta Karya
– D.K.I. Reports

Note:
1. Populations are based on the reports and the city planning of D.K.I., local governments concerned and Cipta Karya.
The populations for Bogor, however, were calculated based on the assumption that natural increase ratio of population outside city area is 2% per year.
2. Karawang is outside of JABOTABEK Area, but it is taken into account because it is situated in the influential area of the JABOTABEK train.
3. The future population in year 2003 is estimated in JABOTABEK Metropolitan Development Planning (Cipta Karya, June 1980) as follows:

(Unit: 1,000 persons)

BOTABEK	Kabupaten Bogar	4,398
	Kabupaten Tangerang	2,819
	Kabupaten Bekasi	2,258
BOTABEK sub-taotal		9,475
D.K.I. Jakarta		11,315
JABOTABEK Total		20,790

The sub-total for the BOTABEK Area is less than the figure estimated by JICA Team by approximately 2 per cent.

2) Land Use Plan

i) Housing development

Raiway Line	Location of new town	Estimated dwelling population (1,000 persons)
Central Line	Five places such as Bogor and Depok	Approx. 1,596
Bekasi Line	Cikarang, Bekasi	Approx. 900
Merak Line	Serpong, Ciptat	Approx. 350
Tangerang Line	Tangerang	Approx. 800
Intermediate area between Merak Line and Tangerang Line	Cileduk	Approx. 100

ii) Industrial development

Large scale industrial development is planned up to the year 2000 in the following cities.

a.	Kabupaten Bogor	Cibinong	350 HA
		Jonggol	100
b.	Kabupaten Bekasi	Cikarang	330
c.	Kabupaten Tangeran	Tangerang	1,179

In addition, construction of a huge industrial complex is planned in East Jakarta, northeastern part of Cakung.

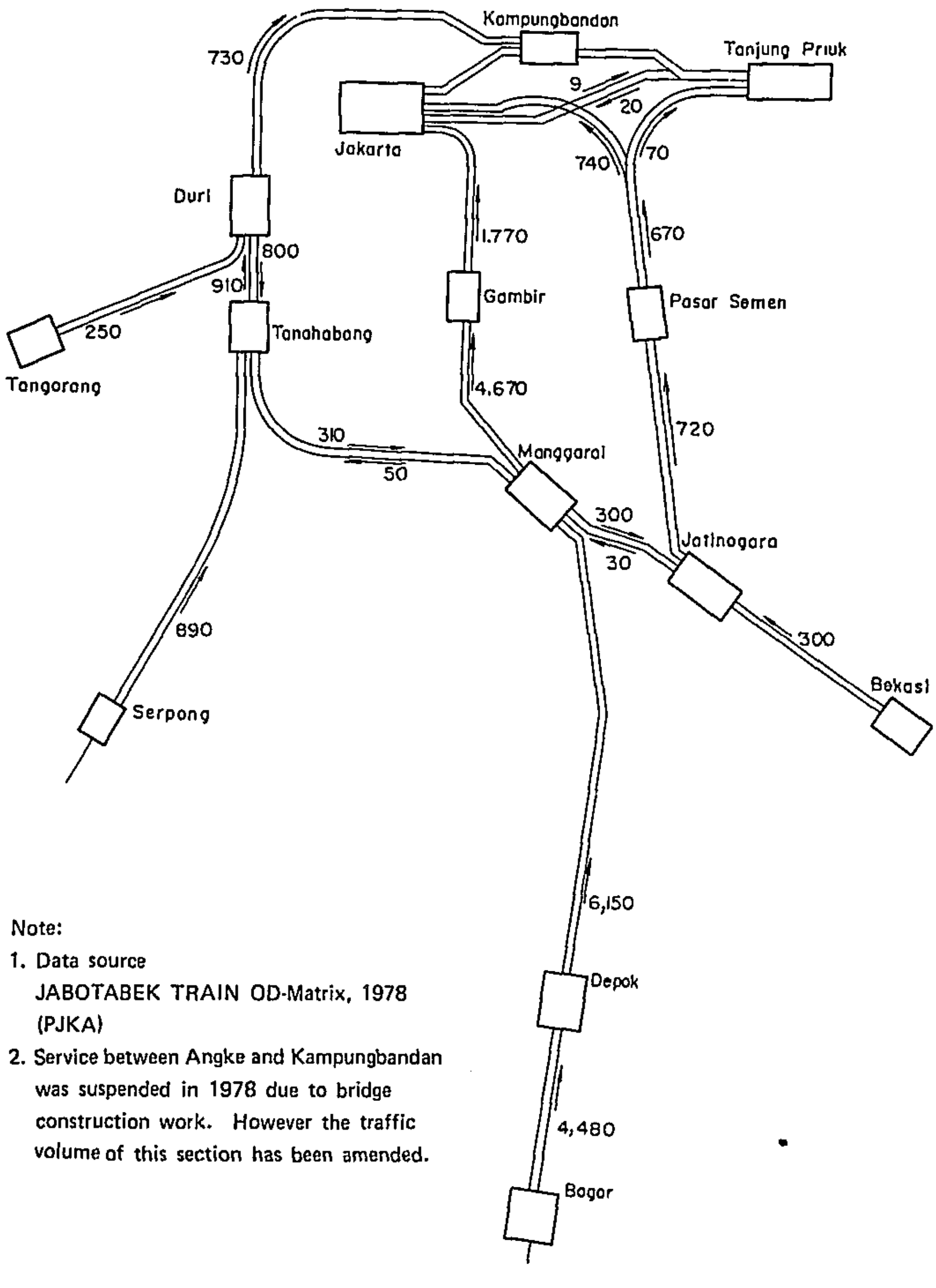
3) New Airport Plan

Construction of a new airport (New Cengkareng Jakarta Airport) in Bataceper, Kabupaten Tangerang, which it is scheduled to be opened in 1984 is planned.

2.1.2 Present situation of railway use

1) Passenger between Origin-Destination stations

The cross-sectional link loads between stations of various lines are as shown in Fig. 2.1.1.



Note:

1. Data source
   JABOTABEK TRAIN OD-Matrix, 1978
   (PJKA)
2. Service between Angke and Kampungbandan was suspended in 1978 due to bridge construction work. However the traffic volume of this section has been amended.

Fig. 2.1.1 Cross-sectional Link Load of Each Railway Line	Legend Unit: Passengers/day
JABOTABEK Area Railway Transportation Study	

2) Commuter ratio

Commuter's ratio during peak hours =

$$\frac{\text{Commuters in Peak}}{\text{All Passenger in Peak}} = \alpha'$$

Peak Ratio =

$$\frac{\text{All Passengers in Peak 2 Hours}}{\text{Daily Passengers}} = \beta$$

Commuter's Peak Ratio =

$$\frac{\text{Commuters in Peak 2 Hours}}{\text{Daily Commuters}} = \beta'$$

Under the assumption given above,

Commuter Ratio =

$$\frac{\text{Daily Commuters}}{\text{Daily Passengers}} = \alpha$$

can be obtained from $\alpha = \frac{\beta}{\beta'} \alpha'$

The value of Commuter's ratio of each line can be calculated as shown in Table 2.1.2 from above formula.

Table 2.1.2 Commuter's Ratio in Each Line

Line	Commuter's Ratio in Peak	Daily Commuter's Ratio
Central	87.5%	49.5%
Bekasi	86.7%	49.1%
Merak	61.7%	34.9%
Tangerang	94.1%	53.3%

Note: The Commuter's ratio during peak hours is quoted from Train Interview Survey (July 16/17 1980, JICA Team).
Other assumptions are as follows:
1. Peak ratio in 2 hours is assumed to be 30%.
2. Commuter's peak ratio in 2 hours is assumed to be 53%. (Peak 3 hours 75% x 70%).

3) Feeder mode and station influence sphere

The following matters can be pointed out regarding the feeder modes.

a. About one half of the feeder modes is walking mode.
b. Bus mode is predominant at urban stations, and colt mode is predominant at suburban stations.
c. Beca mode is used early in the morning.

The following matters can be pointed out regarding the station influence sphere.

a. Origin-Station influence sphere is broader than that of Destination-Station

b. The trip time to Origin-Station is about 20 minutes with every mode except for extreme special cases.

Note: 1. The results were obtained through interview survey conducted in trains on July 16/17, 1980 by JICA Team.

2. Colt includes Bajaj, Oplet, Bemo, Helicak

2.1.3 Estimation of generated demand for railway in JABOTABEK Area

(1) Generated demand in BOTABEK Area

The generated demand for railway from BOTABEK Area to D.K.I. Jakarta is estimated as shown in Table 2.1.3.

The figures in this table were led out with the three factors; such as the ratio of economic active population, commuting ratio for D.K.I. Jakarta and commuting ratio taken into consideration based on the population in each station influence sphere.

Note: 1. The population in each station influence sphere was calculated from the population density in urban and rural areas classified by Kecamotan.

2. The following assumption was used regarding establishment of each station influence sphere.

on foot; 20 min. (1.33 km radius)

by car; 20 min. (15 km length along highway)
and 500 m each for both sides of highway.

(from interview survey results in 1980)

3. The ratio of economic active population was assumed as 28 per cent. (Intra Urban Tollway Phase I Report, 1979)

4. The commuting ratio of D.K.I. Jakarta was assumed as follows:

Already builtup area: 40%

New developed area: 60%

(from data obtained through hearing interview survey)

5. Commuting Ratio by line is estimated as follows respecting interview survey results in 1980.

Central Line	=	49.5%
Bekasi Line	=	49.1%
Merak Line	=	34.9%
Tangerang Line	=	53.3%

(2) Generated demand in D.K.I. Jakarta Area in the year 2000

The generated demand in D.K.I. Jakarta in year 2000 was calculated with the role of railway and commuting ratio of purposes taken into account based on all-mode commuters classified by the station influence sphere. The results are shown in Table 2.1.4.

Note: 1. The number of all-mode commuters classified by zone was obtained from Intra Urban Tollway Phase I Report, 1978.

Table 2.1.3 Generated Demand in BOTABEK Area in 2000 v.s. 1987

(Unit: 1,000 persons)

		2000			1987		
Line	Station	Railway Commuter	Railway Passengers	Passengers in Peak 2hr	Railway Commuter	Railway Passengers	Passengers in Peak 2hr
Central	Bogor	20.4	41.2	12.4	8.0	16.2	4.9
	Kebon Pedes	1.3	2.6	0.8	0.5	1.0	0.5
	Cilebut	1.3	2.6	0.8	0.5	1.0	0.5
	Bojonggede	3.0	6.1	1.8	1.2	2.4	0 7
	Citayan	4.9	9.9	3.0	1.9	3.9	1.2
	Pondokterum	8.2	16.6	5.0	3.2	6.5	2.0
	Depok	11.3	22.8	6.8	4.4	9.0	2.7
	Depok Baru	6.4	12.9	3.9	2.5	5.1	1.5
	Sub-Total	56.8	114.8	34.4	22.3	45.2	13.5
Bekasi	Lewahabang	5.8	11.8	3.5	1.4	2 9	0.9
	Cikarang	8.4	17.1	5.1	2.0	4.2	1.2
	Cipinung	3.3	6.7	2.0	0.8	1.6	0.5
	Tambun	3.3	6.7	2.0	0.8	1.6	0.5
	Bekasi	8.3	16.9	5.1	2.0	4.1	1.2
	Kranji	1.6	3.3	1.0	0.4	0.8	0.2
	Krawang	6.6	13.4	4.0	1.6	3.3	1.0
	Cikampek	5.1	10.4	3.1	1.2	2.5	0.8
	Sub-Total	42.4	85.2	25.6	10.3	20.7	6.2
Merak	Tenjo	2.4	6.9	2.1	0.5	1.5	0.5
	Daru	2.4	6.9	2.1	0.5	1.5	0.5
	Cilejut	2.4	6.9	2.1	0.5	1.5	0.5
	Parung Panjang	6.9	19.8	5.9	1.5	4.3	1.3
	Cicayur	0.2	0.6	0.2	0 0	0.1	0.0
	Cisauk	0.2	0.6	0.2	0.0	0.1	0.0
	Serpong	8.1	23.2	7.0	1.8	5.0	1.5
	Rawabufu	8.1	23.2	7.0	1.8	5.0	1.5
	Sudimara	1.8	5.2	1.6	0.4	1.1	0.3
	Jurangumangu	0.5	1.4	0.4	0.1	0.3	0.0
	Rangkas Bitung	3.7	10.7	3.2	0.8	2.3	0.7
	Sub-Total	34.3	14.0	29.4	7.5	3.0	6.4
Tangerang	Tangerang	14.0	26.3	7.9	3.2	6.0	1.8
	Batuceper	7.7	14.4	4.3	1.8	3.3	1.0
	Sub-Total	21.7	40.9	12.2	5.0	9.4	2.8
Total	–	155.2	339.0	101.6	45.1	78.3	28.9

Table 2.1.4 Generated Demand in D.K.I. Jakarta in 2000 v.s. 1987

(Unit: 1,000 persons)

		2000			1987		
Line	Station	Railway Commuter	Railway Passengers	Passengers in Peak 2hrs	Railway Commuter	Railway Passengers	Passengers in Peak 2hrs
Central	Lentengagung	6.2	18.8	6.6	2.0	6.2	2.2
	Tanjung Barat	6.8	20.6	7.2	2.2	6 8	2.4
	Pasar Minggu	6.5	19.7	6.9	2.1	6.5	2.3
	Durenkalibata	8.8	26.7	9.3	2.9	8.8	3.1
	Manggarai	9.1	27.6	9.7	3.0	9.1	3.2
	Sub-Total	37.3	113.0	39.6	12.3	37.1	13.0
Bekasi	Klender	8.9	27.0	9.5	2.2	6.6	2 3
	Cipinang	9.8	29.7	10.4	2.4	7.2	2.5
	Jatinegara	6.9	20.9	7.3	1.7	5.1	1.8
	Sub-Total	25.6	77.4	27.1	6.2	18.9	6.6
Merak	Pondokbitung	11.2	33.9	11.9	2.4	7.4	2.6
	Kebayoran	11.5	34.8	12.2	2.5	7.6	2.7
	Palmerah	14.9	45.2	15.8	3.2	9.8	3.4
	Tanahabang	8.4	25.5	8.9	1.8	5.5	1.9
	Sub-Total	45.9	139.0	48.7	10.0	30.2	10.6
Tangerang	Kalderes	6.6	20.0	7.0	1.5	4.6	1.6
	Rawabuaya	6.6	20.0	7.0	1.5	4.6	1.6
	Pesing	7.8	23.6	8.3	1.8	5.4	1.9
	Grogol	13.4	40.6	14.2	3.1	9.3	3.3
	Duri	12.1	36 7	12.8	2.8	8.4	2.9
	Sub-Total	46.4	140.5	49.2	10.6	32.2	11.3
Tanjung Priuk	Tanjung Priuk	6.5	19.7	6.9	2.7	8.0	2.8
	Sungatirem	6.5	19.7	6.9	2.7	8.0	2.8
	Ancol	5.7	17.3	6.1	2.3	7.1	2.5
	Sub-Total	18.7	56.7	19.8	7.6	23.2	8.1
City	Pegangsaan	0.8	2.4	0.8	0.3	1.0	0.3
	Gondangdia	0.7	2.1	0.7	0.3	0.8	0.3
	Gambir	0 6	1.8	0.6	0.2	0.7	0.3
	Pintuair	0.3	0.9	0.3	0.1	0.3	0.1
	Sawahbesar	0.8	2.4	0.8	0.3	1.0	0.3
	Jakarta Kota	0.9	2.7	1.0	0.4	1.1	0.4
	Pondok Jati	1.1	3.2	1.1	0.4	1.3	0.5
	Kramat	1.0	3.1	1.1	0.4	1.3	0.4
	Gang Sentiong	1.0	3.1	1.1	0.4	1.3	0.4
	Pasar Senen	0.9	2.6	0.9	0.4	1.1	0.4
	Kemayoran	0.9	2.9	1.0	0.4	1.2	0.4
	Dukuh	0.6	1.8	0.6	0.2	0.7	0.3
	Karet	0.6	1.8	0.6	0.2	0.7	0.3
	Angke	1.2	3.5	1.2	0.5	1.4	0.5
	Gudang	0.6	1.7	0.6	0.2	0.7	0.2
	Kampung Bandan	0.4	1.2	0.4	0.2	0.5	0.2
	Gunung Sahari	0.3	1.0	0.4	0.1	0.4	0.1
	Sub-Total	12.4	37.7	13.2	5.1	15.4	5.4
	Total	186.3	564.5	197.5	51.8	157.0	55.0

2. The station influence sphere was assumed as follows:
   Central district: 1.0 km radius on foot
   Out of central district: 1.33 km radius on foot.
3. The role of railway was estimated as follows:
   Central area: 5.0%
   Out of central area: 50.0%
4. The commuting ratio of purpose was calculated as follows:
   35% of all passengers is concentrated to the peak two hours. 65% of the passengers during peak two hours is for commuting. As it can be estimated that 70% of all commuting passengers is concentrated to peak two hours, it can be estimated that the ratio of all commuting passengers to the total number of passengers is 33%.

2.2 Assumption of Railway Passengers Classified by Line

2.2.1 Demand distribution

The generated gross demand in JABOTABEK Area (demand to make entry into D.K.I. Jakarta and demand generated in D.K.I.) is distributed in proportion of station factors along the routes to be in operation in year 2000. The result is shown in Tables 2.2.1 ~ 2.

Note: 1. Each station factor was calculated as follows:
From concentrated demand by zone by all-mode in year 2000 (Intra Urban) Tollway Phase I Report, 1978).
At a station where concentrated demand exceeds generated demand:
(Concentrated demand by all-mode in year 2000 in the zone in which the station is located) + 1/2 x Σ (concentrated demand by all-mode in year 2000 in adjacent zone).

2. Distribution was calculated by the operation unit of each line.

Suburban Line		City Line
Central Line	→	Central Line
	→	Western Line
Bekasi Line	→	Eastern Line
	→	Central Line
	→	Western Line
Merak Line	→	Western Line
Tangerang Line	→	Western Line

2.2.2 Cross-sectional traffic loads classified by line

(1) Gross railway demand
Railway demand of 299,100 persons will be generated in peak two hours in year 2000.

Table 2.2.1 Distribution of Demand Generated in BOTABEK Area

(Peak 2 hour period) (Unit: 1,000 passengers)

Line	Station		
Central Line	Lenteng Agung	1 52	0 60
	Pasar Minggu	1.82	0 72
	Duren Kalibata	2.23	0 88
	Manggarai	1.79	0.70
	Gambir	4.83	1 90
	Jakarta Kota	2.98	1.17
	Jatinegara	1.52	0.60
	Tanahabang	3.66	1.44
	Duri	2.67	1.05
	Angke	2.67	1.05
	Kampungbandan	2.59	1.02
	Ancol	2.84	1.12
	Tanjung Priok	3.28	1.29
Bekasi Line	Klender	1.99	0 48
	Jatinegara	0.88	0 21
	Pondok Jati	0.92	0 22
	Kramat	0 76	0 19
	Gang Sentiong	0.76	0 19
	Pasar Senen	2.28	0 56
	Kemayoran	2.22	0 54
	Jakarta Kota	1.72	0.42
	Ancol	1.64	0 40
	Tanjung Priok	1 90	0.46
	Manggarai	1 04	0 25
	Tanahahang	2 12	0 52
	Duri	1.55	0 38
	Angke	1.55	0 38
	Kampung Bandan	1 50	0 37
	Gambir	2.80	0 68

Line	Station		
Merak Line	Kebayoran	2.41	0.52
	Palmerah	2.55	0.55
	Tanahabang	3.72	0 81
	Jatinegara	1.55	0 34
	Manggarai	1.82	0.40
	Duri	2.72	0 59
	Angke	2 72	0 59
	Kampungbandan	2 63	0 57
	Jakarta Kota	3 03	0 66
	Ancol	2.89	0 63
	Tanjung Priok	3 34	0.73
Tangerang Line	Kalideres	0 81	0 18
	Rawabuaya	0 81	0.18
	Pesing	0.66	0 14
	Grogol	1.08	0 23
	Duri	0 98	0 21
	Jatinegara	0.56	0 12
	Manggarai	0 66	0.14
	Tanahabang	1.35	0 29
	Angke	0 98	0 21
	Kampung Bandan	0.95	0 21
	Jakarta Kota	1 10	0 24
	Ancol	1 05	0 23
	Tanjung Priok	1.21	0 26

Table 2.2.2 Distribution of Demand Generated in D.K.I. (Peak 2 hour period)

(Unit: 1,000 passengers)

Line	Station		
Central Line	Lentengagung	2 462	0.685
	Pasar Minggu	2 543	0.708
	Duren Kalibata	3.036	0 845
	Manggarai	2 430	0 677
	Gambir	3 528	0 982
	Jakarta Kota	1 892	0 527
	Jatinegara	2 021	0 563
	Tanahabang	4 756	1.324
	Duri	3 320	0.925
	Angke	3 802	1.064
	Kampungbandan	3 708	1 033
	Ancol	3 809	0 295
	Tanjung Priok	4 370	1 217
Bekasi Line	Klender	4 367	1.216
	Jatinegara	1 131	0 315
	Pondok Jati	1.281	0 357
	Kramat	1 062	0 296
	Gang Sentiong	1.345	0 375
	Pasar Senen	3.209	0.894
	Kemayoran	3 130	0 872
	Jakarta Kota	2 429	0 676
	Ancol	1 151	0 321
	Tanjung Priok	1.326	0 369
	Manggarai	0 553	0 043
	Tanahabang	1.128	0 314
	Duri	0.826	0 230
	Angke	0.826	0.230
	Kampung Bandan	0 798	0.222
	Gambir	2.046	0.570

Line	Staiton		
Merak Line	Kebayoran	3 452	0 961
	Palmerah	3.409	0 949
	Tanah Abang	2 271	0 632
	Duri	1.704	0 475
	Angke	1.704	0.475
	Kampungbandan	1 646	0 458
	Ancol	1.762	0 491
	Tanjung Priok	2 036	0 567
	Jakarta Kota	2 977	0 829
	Manggarai	1 113	0 310
	Jatinegara	0 947	0 264
Tangerang Line	Kalideres	3 196	0 890
	Rawabuaya	3 196	0 890
	Pesing	2 544	0 708
	Grogol	4 182	1.165
	Duri	1 522	0 424
	Angke	1 503	0 419
	Kampunbandan	1 529	0 426
	Ancol	1.713	0 133
	Tanjung Priok	1.799	0 501
	Jakarta Kota	1.844	0 514
	Tanah Abang	1 667	0 464
	Manggarai	1.022	0 285
	Jatinegara	0 867	0.241

The breakdown is 101,600 persons which make entry from BOTABEK Area to D.K.I. and 197,500 persons generated in D.K.I. In year 1987, the railway demand will be 83,900 persons in total in peak two hours, that is, 28,900 persons making inflow from BOTABEK Area to D.K.I. and 55,000 persons generated in D.K.I.

(2) Fig. 2.2.1 (Cross-Sectional Traffic Load Classified by Line) indicates the demand distributed to stations in Item 2.2.1 as cross-section traffic load. The cross-sectional traffic load between Tanahabang and Duri in 1987 will be 11,270 persons (peak two hours).

1) The cross-sectional traffic load between Tanahabang and Duri will become the largest of all the routes in both 1987 and 2000.
Angke, Duri and Tanahabang located along Western Line are growing to become the centers of commerce and business, and therefore, reinforcement of the transport capacity of the Western Line is very important.

2) The cross-sectional traffic load of the railway demand for making entry into D.K.I. from BOTABEK Area is the largest between Depok and Manggarai of Central Line.

3) It is estimated that the cross-sectional loads between Bekasi and Jatinegara, between Serpong and Tanahabang and also between Tangerang and Duri will also make a great increase in the future.

2.2.3 Change by stage in cross-sectional traffic loads

The change by stage in the forecasted values of growth of demand from year 1978 through year 2000 for the section of the largest cross-sectional traffic load of every line is indicated in Table 2.2.3.

According to the result shown in Table 2.2.3 rapid growth will be made after 1985 with every line. Forcasted figures for year 1987 compared to year 1978 are 8 times at Central line (Depok ~ Manggarai), 33 times at Bekasi line, 33 times at Merak line, 69 times at Tangerang line, and 42 times at Western line.

Note: Linear growth of the forecasted figures for year 2000 which are beyond 100 times of the figures in 1978 will not occur. Because of the fact that the increase of the share of railway in all-mode transportation appears as the effects of improvement, forecast was made with both of the growth of demand in the past and the expected growth of demand in the future taken into consideration.

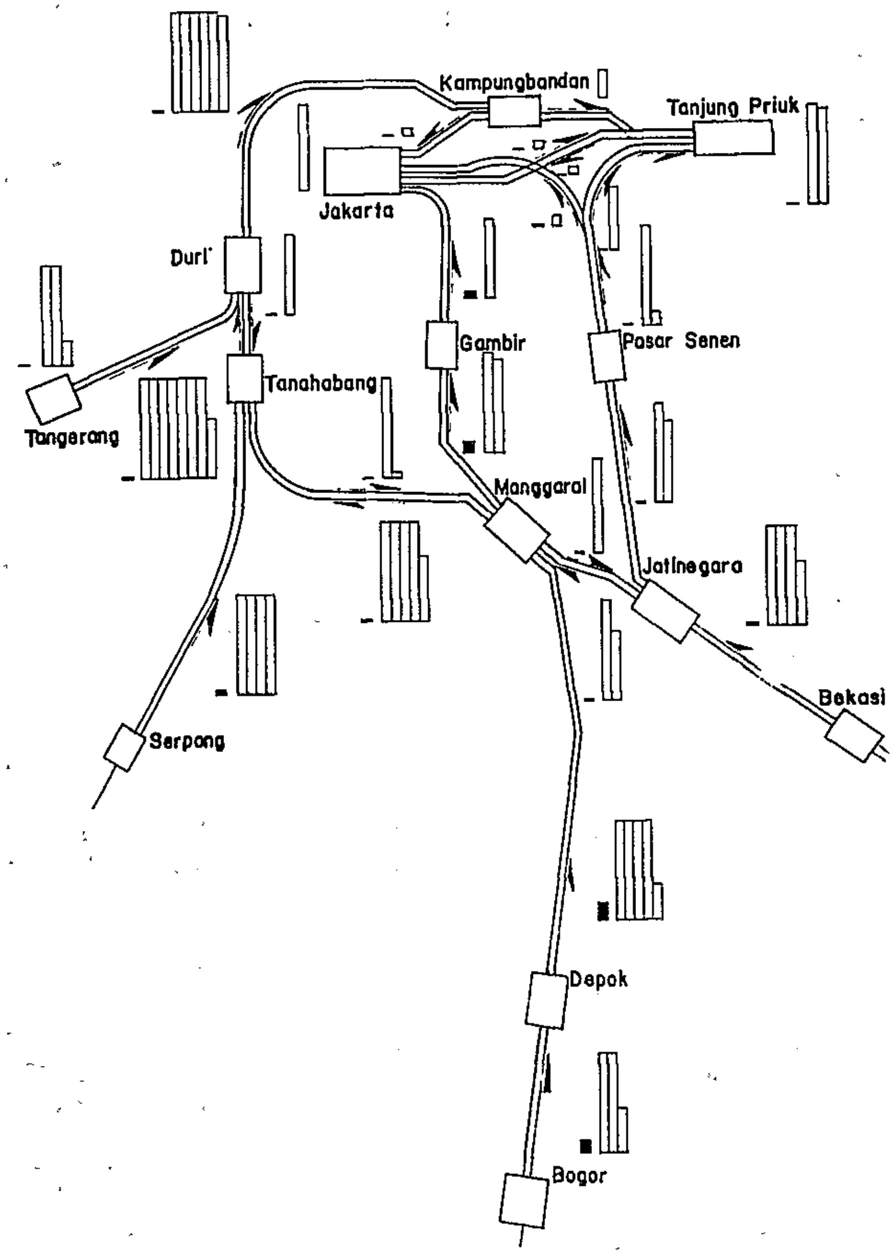


Fig. 2.2.1

Cross-sectional Traffic Load 1978 V.S.2000

JABOTABEK Area Railway Transportation Study

Legend

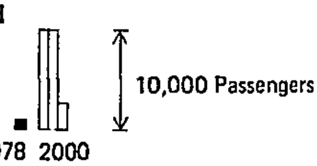


Table 2.2.3 Largest Cross-sectional Traffic Load by Fiscal Year (Peak 2 hour period)

(Unit: 1,000 passengers)

Line	Fiscal Year	1978	85	87	90	95	2000
Central	All mode	38.4	65.5	74.38	87.7	109.9	138.0
(Bogor–Depok)	Railway	1.34	6.89	9.01	12.18	17.50	22.39
	Ratio	3.49 %	10.52 %	12.11 %	13.89 %	15.59 %	16.59 %
(Depok –	All mode	38.4	65.5	74.38	87.7	109.9	138.0
Manggarai)	Railway	1.85	10.17	14.35	20.61	31.57	43.64
	Ratio	4.81 %	15.53 %	19.29 %	23.50 %	28.73 %	31.62 %
Bekasi	All mode	23.4	47.2	54.88	66.4	85.5	106.3
	Railway	0.27	5.51	8.86	13.89	22.83	36.38
	Ratio	1.15 %	11.67 %	16.14 %	19.19 %	26.70 %	34.22 %
Merak	All mode	21.0	44.1	50.46	60.0	81.3	100.6
	Railway	0.27	5.98	8.94	13.38	25 25	40.05
	Ratio	1.29 %	13.55 %	17.72 %	22.30 %	31.06 %	39.81 %
Tangerang	All mode	9.4	18.4	21.32	25.7	32.9	40.5
	Railway	0.075	3.36	5.18	7.90	14.22	22.57
	Ratio	0.80 %	18.27 %	24.30 %	30.75 %	43.22 %	55.70 %
Western	*	2.47	25.02	37.32	55.78	93.87	142.64
	Railway	0.27	6.11	11.27	19.01	41.04	76.12
	Ratio	10.93 %	24.43 %	30.20 %	34.08 %	43.72 %	53.37 %

* Railway passengers from each lines into city lines.

CHAPTER 3. PLANNING OF RAILWAY TRANSPORTATION

CHAPTER 3 PLANNING OF RAILWAY TRANSPORTATION

The improvement plan of ground facilities, as the basis of planning of railway transportation, toward the end of 1987 in which doubling of the track between Manggarai and Depok of Central Line, electrification of Bekasi Line and other works is as summarized in Table 3.1.1.

Table 3.1.1 Improvement Plan of Ground Facilities (1987)

Line	Section	Track			Electrification		Signal and Blocking	
		Double track	Single track	Max. operating speed	Electrified	Non electrified	Automatic	Non automatic
Central Line	Jakarta~Manggarai	o		60km/h	o			o
	Manggarai~Depok	o		100	o		o	
	Depok~Bogor		o	100	o			o
Eastern & Bekasi Line	Jakarta~Jatinegara	o		60	o			o
	Jatinegara~Bekasi	o		100	o		o	
Western Line	Jakarta~Jatinegara	o		60	o			o
Merak Line	Tanahabang~Serpong		o	100		o		o
Tangerang Line	Duri~Tangerang		o	100		o		o

The maximum speed of urban lines will be increased to 60 km/h from the present 40 km/h and that of suburban lines will be increased to 100 km/h from the present 70 ~ 80 km/h because rehabilitation of tracks and crossings and installation of fences will be completed.

As double tracking between Manggarai and Depok of Central Line will be completed and the transport capacity will be improved by a major extent, and in addition, the completion of electrification of Bekasi Line will provide increase of train speed. It is most economical to install signals and blocking facilities in parallel with track addition of electrification work, therefore, installation of signals and blocking facilities will be completed first between Manggarai and Depok of Central Line and between Jatinegara and Bekasi of Bekasi Line. However, automatic signalling system of all lines in JABOTABEK Area will be completed at the end of fiscal 1991 because of the relationship with elevation of tracks of Central Line, track addition and electrification of Merak and Tangerang Lines. The following operation program is drawn up under the conditions of the ground facilities toward the end of fiscal 1987 stated above.

3.1 Train Operation Route

It is usual that a number of plans are thought out regarding formation of train operation route, and every one of these plans contains advantages and disadvantages. Selection of a plan out of many plans is made from many viewpoints including the following:

a. Traffic demand

b. Convenience of passengers
c. Number of railcars to be used
d. Management of railcars and crewmen

Alternative D is selected in the Master Plan out of five Alternatives proposed in Chapter 3 of the Master Plan of this Report from the viewpoints stated above. For accomplishment of train operation included in Alternative D, however, improvement of Kampungbandan Station, improvement of track between Kampungbandan and Tanjung priuk and so forth are required. But the time of completion of these projects is 1989 as indicated in the Master Plan. Furthermore, main purpose of Alternative D is to make efficiencial transport capacity to meet the rapidly increasing traffic demand between Duri and Tanahabang, but the traffic demand in this section is not very large yet in 1987.

Under these circumstances it is desirable that transition to Alternative D is made in 1990, and that present train operation route is used as the basis as shown in Fig. 3.1.1 up to 1990.

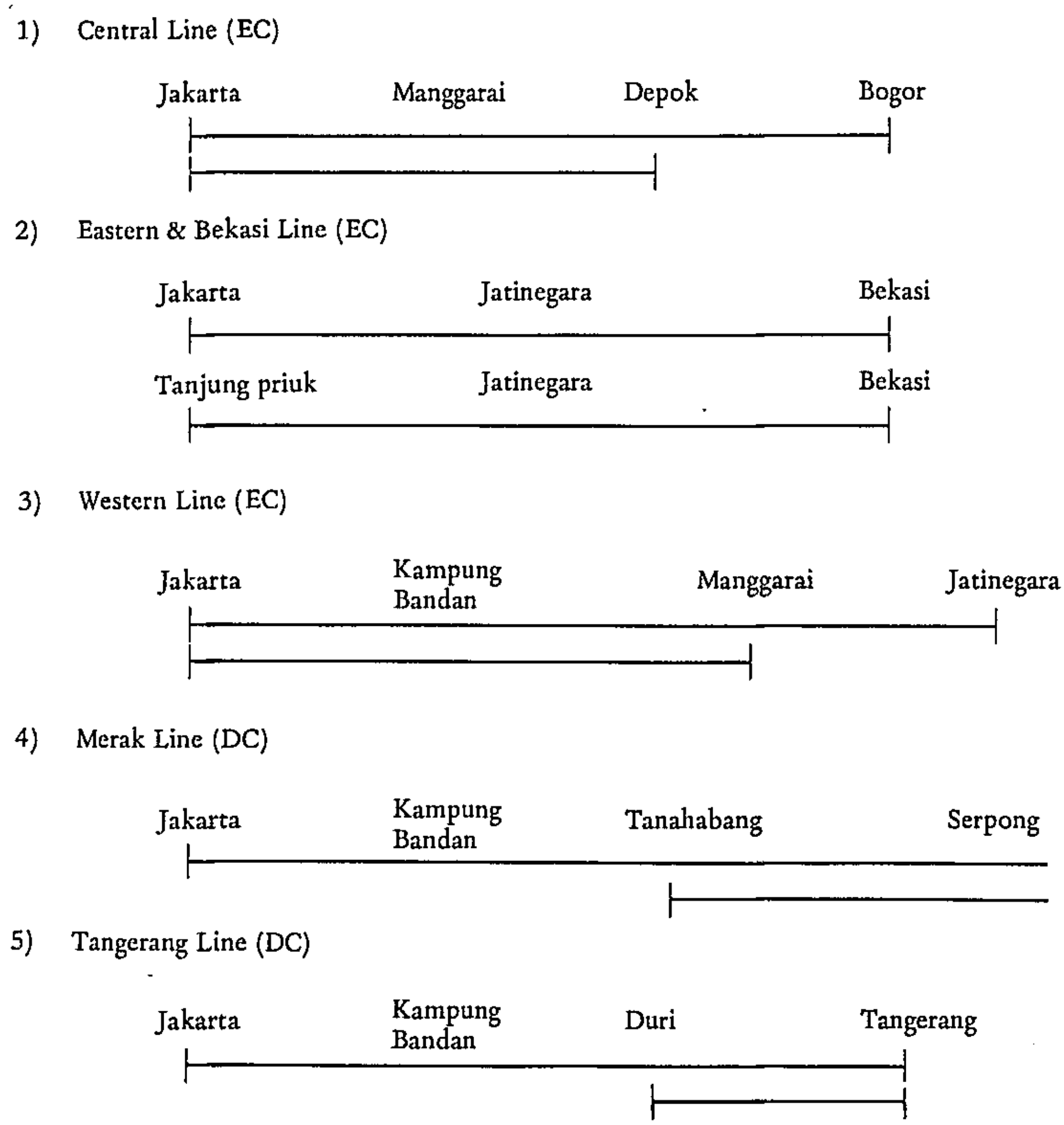


Fig. 3.1.1 Train Operation Routes

On Central Line, trains departing from Depok will be additionally operated to meet the traffic demand, as the transport capacity between Manggarai and Depok will be largely increased as a result of track addition. In Bekasi Line, electric railcar trains are operated in two routes, that is, between Jakarta and Bekasi and between Tanjung priuk and Bekasi, because of completion of electrification. However, diesel railcar trains starting from stations beyond Bekasi will be operated as far as Jakarta as it is made today. Western Line will be operated between Jakarta and Jatinegara, but some of trains will be operated only betweeen Jakarta and Manggarai because the number of passengers between Manggarai and Jatinegara is small. All the trains of Western Line will be of turning-back operation at Kampungbandan, but level crossings cause no problems to this train operation program because the operation headway is long in 1987.

Only improvement of tracks is made for Merak and Tangerang Lines, and diesel railcar train operation will remain at these two lines like the present situation, and operation will be of two routes for each one of these two lines, for example, as for Tangerang Line, one operation route is terminated at Jakarta and the other is terminated at Duri and trains are operated similarly to Jakarta and Tanahabang on Merak Line.

3.2 Running Time and Running Speed

3.2.1 Train operation curves

Train operation curves illustrate how running speed and running time of each train change in accordance with running of the train. They are drawn up by the following method.

1) An accelerating force and speed curve is obtained from the traction force and speed curve of an electric railcar and train resistance.
2) Speed and distance curves classified by gradient are obtained from the acceleration and speed curve.
3) Changing situation of operation of a train from its starting point is drawn in correspondence to the gradient of the actual track by using speed and distance curves classified by gradient.
4) When brakes are used, drawing is made in accordance with the predetermined brake deceleration.
5) A time and distance curve is drawn.

Train operation curves for Central Line, train operation curves for Bekasi Line, legends, symbols, etc. used in train operation curves are shown in the Figures of the APPENDIX.

The running time (hours and minutes) obtained from train operation curves is the foundation of train operation planning, and speed changes of trains are guidelines for work for allowing train operators to operate trains on schedule.

3.2.2 Running time

The running time obtained from train operation curves is rearranged in the unit of 30 seconds, and approximately three per cent of each time is added as the allowance for temporary slowing down accompanying track construction or maintenance work. The running time obtained as a result is shown in Table 3.2.1 and Table 3.2.2. The running time for the sections between main stations is shown in Table 3.2.3.

Table 3.2.1 Running Time and Speed at Central Line (Electric Railcar)

Station	Distance of center of station (km)	Distance between stations	Running time (min. sec.)		Stopping time (min.)	Sectional schedule running time and schedule running speed	
			Down	Up		Down	Up
Jakarta Kota	0.136					23' (25.4 km/h) [Jakarta Kota–Manggarai]; 61' (32.0 km/h) [Jakarta Kota–Depok]; 93' (35.3 km/h) [Jakarta Kota–Bogor]	22.'30" (26.0 km/h) [Jakarta Kota–Manggarai]; 60' (32.5 km/h) [Jakarta Kota–Depok]; 90'30" (36.2 km/h) [Jakarta Kota–Bogor]
		3.700km	5.'00"	5.'00"			
Sawahbesar	3.836				1'		
		1.704	3. 00	3. 00			
Gambir	5.540				2		
		1.156	2. 30	2.30			
Gandangdia	6.696				1		
		1.337	2. 00	2. 00			
Cikini	8.033				1		
		0.554	1. 30	1. 00			
Pegangsaan	8.587				1		
		1.303	3. 00	3. 00			
Manggarai	9.890				2	36' (38.0 km/h) [Manggarai–Depok]	35.'30" (38.5 km/h) [Manggarai–Depok]
		2.610	3. 30	3. 30			
Tebet	12.500				1		
		2.776	3. 30	3. 30			
Durenkalibata	15.276				1		
		3.322	4. 00	4. 00			
Pasarminggu	18.598				2		
		2.623	3. 00	3. 00			
Tanjungbarat	21.221				1		
		2.750	3. 30	3. 30			
Lentengagung	23.971				1		
		4.402	5. 00	4. 30			
Pondokcina	28.373				1		
		2.570	3. 00	3. 00			
Depokbaru	30.943				1		
		1.741	2. 30	2. 30			
Depok	32.684				2	30' (44.3 km/h) [Depok–Bogor]	28.'30" (46.6 km/h) [Depok–Bogor]
		3.256	3. 30	3. 00			
Pondokterang	35.940				1		
		1.828	2. 30	2. 30			
Citayam	37.768				1		
		5.197	5. 30	5. 00			
Bojonggedeh	42.965				1		
		4.327	5. 00	5. 00			
Cilebut	47.292				1		
		3.808	4. 00	3. 30			
Kebonpedes	51.100				1		
		3.710	4. 30	4. 30			
Bogor	54.810						
Total		54.674	70.'00"	67.'30"	23'		

Note: (1) "Down" direction is Jakarta → Bogor direction.

(2) Figures in parentheses indicate schedule running speed obtained by the following formula.

$$\text{Schedule running speed} = \frac{\text{Length of section (km)}}{\text{(Net running time + stopping time)}}$$

Table 3.2.2 Running Time and Speed at Eastern & Bekasi Line (Electric Railcar)

Station	Distance of center of station (km)	Distance between stations	Running time (min. sec.) Down	Running time (min. sec.) Up	Stopping time (min.)
Jakarta Kota	−0.739				
		3.518 km	5.'00"	5.'00"	
Rajawali	2.779				1'
		1.930	3. 00	3. 00	
Kemayoran	4.709				1
		1.436	3. 30	3. 30	
Pasarsenen	6.145				2
		1.568	2. 30	2. 30	
Gangsentiang	7.713				1
		0.972	1. 30	1. 30	
Kramat	8.685				1
		1.829	2. 30	2. 30	
Pondokjati	10.514				1
		1.236	2. 30	2. 30	
Jatinegara	11.750				2
		1.631	2. 30	2. 30	
Cipinang	13.381				1
		1.764	2. 30	2. 30	
Klender	15.145				1
		2.000	3. 30	3. 30	
New Klender	17.145				1
		3.778	3. 00	2. 30	
Cakung	20.923				1
		3.109	3. 00	3. 00	
Kranji	24.032				1
		2.520	3. 30	3. 30	
Bekasi	26.552				
Total		27.291km	38.'30"	38.'00"	14'

Sectional schedule running:

Section	Down	Up
Jakarta Kota – Jatinegara	27'30" (27.2 km/h)	27'30" (27.2 km/h)
Jatinegara – Bekasi	23' (38.6 km/h)	22'30" (39.5 km/h)
Jakarta Kota – Bekasi	52'30" (31.2 km/h)	52' (31.5 km/h)

The schedule running time includes stopping time. The stopping time is assumed as 2 minutes at a large station and 1 minute at a small station, but it can probably be shortened in the future through elevation of station platforms and habituation of passengers.

Table 3.2.3 indicates the schedule running time in the case where a train stops at all stations. The schedule running time in practice will be shorter than what is indicated in this table, because some stations will be passed as matched with the number of passengers in the train operation planning.

Table 3.2.3 Schedule Running Time in Main Sections

Line	Section	Schedule running time (min. sec.) Down	Schedule running time (min. sec.) Up
Central Line	Jakarta – Manggarai	23.'00"	22.'30"
	Jakarta – Depok	61. 00	60. 00
	Jakarta – Bogor	93. 00	90. 30
Eastern & Bekasi Line	Jakarta – Jatinegara	27. 30	27. 30
	Jakarta – Bekasi	52. 30	52. 00

3.2.3 Running speed

The running speed is assumed as 60 km/h at maximum for urban lines and 100 km/h at maximum for suburban lines. As seen in train operation curves, the sections in which a speed beyond 60 km/h can be produced are minor at Central and Eastern & Bekasi Lines even when no speed limit is provided, because distances between stations are short.

Even at suburban lines the sections in which the speed exceeds 100 km/h are minor, and only three sections between Bogor and Depok of Central Line can recognized as such sections.

Schedule running speed and average running speed for main sections are shown in Table 3.2.4.

Table 3.2.4 Running Speed in Main Sections

Line	Section	Average running speed		Schedule running speed	
		Down	Up	Down	Up
Center Line	Jakarta – Manggarai	34.4 km/h	35.5 km/h	25.4 km/h	26.0 km/h
	Jakarta – Depok	43.4	44.4	32.0	32.5
	Jakarta – Bogor	46.9	48.6	35.3	36.2
Eastern & Bekasi Line	Jakarta – Jatinegara	36.6	36.6	27.2	27.2
	Jakarta – Bekasi	42.5	43.1	31.2	31.5

3.3 Train Operation Diagram

3.3.1 Precondition for draw-up of train operation diagram

It should be kept in mind to secure the transport capacity matched with the traffic demand with railcars and crewmen of minimum numbers of course. The train operation diagram is drawn up under the following preconditions with this basic thought.

1) Train operating time zone and rush hour zone

   The train operating time zone should be 4 : 00 or later for starting the terminal station and arrival at the terminal station should be up to 23 : 00.

   The morning rush hour zone should be two hours between 6 : 30 and 8 : 30 at arrival at Jakarta Kota.

   The evening rush hour should be three hours between 15 : 00 and 18 : 00 at departure from Jakarta Kota.

2) Train operation headway

   The train operation headway during morning rush hours should be determined for securing the number of trains which generally satisfies the traffic demand stated in the preceding Chapter, with boarding of 200 per cent of normal accommodation capacity as the precondition. The train operation headway during the evening rush hours should be 1.5 times of that during morning rush hours at standard.

   The train operation headway in the daytime other than rush hour zones should be around two times of that of rush hour zones from the standpoint of provision of service to passengers. Trains should be operated at the rate of one per hour in the time zones of early in the morning and midnight. Freight trains should be operated in the time zones other than rush hours as it is made today.

3) Stopping stations and stopping time

Diagram should be made based on the assumption that every electric railcar train stops at every station, but consideration should be made so that rapid trains can also be operated as required.

The stopping time should be 2 minutes at large stations such as Gambir and Manggarai and 1 minute at other stations until elevation of platforms is completed.

It is considered suitable that the stopping time is shortened to 1 minute and 30 seconds rescpectively after completion of elevation of platforms.

4) Handling time for blocking and so forth

If currently used blocking facilities are used, diagram should be made with minimum time for blocking handling assumed as 1 minute.

In the case of passing-by of electric railcar trains at stations in a single track section, diagram should be made with station arrival minimum time interval assumed as 1 minute 30 seconds and with departure minimum time interval assumed as 30 seconds.

3.3.2 Number of railcars per train-set and transport capacity

The normal accommodation capacity per train and transportable number of passengers when boarded by 200 per cent of the normal accommodation capacity of an electric railcar train and a diesel railcar train classified by the number of railcars per train should be as shown in Table 3.3.1.

Table 3.3.1 Number of Railcars per Train-set and Transportable Number of Passengers

Railcar type	No. of railcars per train-set	Normal accommodation capacity	Transportable No. of passengers
EC	4	566	1,132
	8	1,132	2,264
DC	4	544	1,088
	6	816	1,632
	8	1,088	2,176

The number of railcars per train-set should be as shown in Table 3.3.2 with the traffic demand, required number of trains and track capacity of each line taken into consideration.

Table 3.3.2 Number of Railcars per Train-set Classified by Year

Line \ Fiscal year	1984	1985	1986	1987	1988	Note
Central	8	8	8	8	8	EC
Bekasi	4	4	4	4	8	DC, EC beginning in 1988
Eastern	4	4	4	4	8	EC
Western	4	4	8	8	8	EC
Merak	6	6	8	8	8	DC
Tangerang	8	8	8	8	8	DC

3.3.3 Number of trains operated during rush hour zones

The train operation diagram should be determined under the conditions stated earlier. The relationship among traffic demand, number of operated trains, train operation headway and transportable number of passengers during the rush hour zones classified by year should be as shown in the Table 3.3.3.

Table 3.3.3 Traffic Demand, Number of Operated Trains and Transport Capacity

Line	Section	Fiscal year	Traffic demand (1,000 persons)	No. of trains operated	Operation headway (min.)	Transport capacity (1,000 persons)
Central	Manggarai ~ Depok	1985 1986	10.2	7	16~17	15.8
		1987	14.0	8	15	18.1
		1988	15.9	10	12	22.6
	Depok ~ Bogor	1985 ~ 1988	6.9	5	24	11.3
Bekasi	Jatinegara ~ Bekasi	1985	5.5	6	20	6.5
		1986 1987	7.2	8	15	8.7
		1988	10.5	8	15	15.4
Western	Duri ~ Tanahabang	1985	6.1	6	20	6.8
		1986	8.2	5	25	9.1
		1987 1988	10.6	6	20	13.6
Merak	Tanahabang ~ Serpong	1985	5.5	4	30	6.5
		1986	6.5	4	30	8.7
		1987 1988	8.0	5	24	10.9
Tangerang	Duri ~ Tangerang	1985	3.4	2	60	4.4
		1986 1987 1988	4.1	3	40	6.5

Note: If two or more fiscal years are indicated in a "fiscal year" column, it is indicated that no revision will be made to the diagram in the mean time. The traffic demand in this case indicates the value at the beginning of the fiscal year in which the diagram was revised.

A train operation diagram during rush hour zones after completion of electrification of Bekasi Line and double tracking between Manggarai and Depok of Central Line, that is, in fiscal 1988, is indicated in the APPENDIX as an example.

3.3.4 Others

The influence exerted over other trains by the delay of a train gradually increases as the number of trains operated increases. If any delay occurs to a train, therefore, quick adjustment of operation such as change to switching and change to the relief station is very important.

In addition, it also becomes necessary to quickly make transport arrangement such as suspension and restoration of operation of trains and turn-back operation of trains on occurrence of an accident or disaster as well as change arrangement of crewmen and railcar operation accompanying these changes. The operation dispatcher who is in charge of these works is indispensable as the nucleus of the information system connected with stationmasters and train drivers.

Today operation dispatchers are provided for Eastern Line only, but command communication facilities for dispatching should be consolidated and operation dispatching system should be reinforced as matched with electrification of Bekasi Line because of the reasons stated above. The dispatchers related to electricals should be arranged at one place, and efforts should be made to secure normal operation of trains and to prevent operational accidents with such a structure that is capable of quickly and positively making mutual communication suitable established.

3.4 Railcar Operation Program and Required Number of Railcars

It is decided not to make separation or coupling of trains at intermediate stations, and railcar operation is planned based on the assumption that turn-back time at a terminal station is 5 minutes or longer.

The Figure 5 in the Appendix indicates the electric railcar train operation after completion of electrification of Bekasi Line. As seen in this figure, railcars of 22 train-sets will be operated using 176 railcars.

The required number of railcars classified by fiscal years is indicated in Table 3.4.1 as classified by the number of railcars including stand-by railcars.

Table 3.4.1 Required Number of Railcars

Railcar type	Line \ Fiscal year	1984	1985	1986	1987	1988
EC	Central	64	64	80	96	96
	Eastern and Bekasi	16	20	20	64	64
	Western	20	32	32	32	32
	Sub-total	100	116	132	192	192
	Stand-by railcars	12	12	20	24	24
	Total	112	128	152	216	216
DC	Bekasi	16	20	20	–	–
	Merak	24	32	40	48	48
	Tangerang	16	16	16	16	16
	Sub-total	56	68	76	64	72
	Stand-by railcars	12	16	16	16	16
	Total	68	84	92	80	88

The required number of railcars after completion of electrification of Bekasi Line becomes 200 railcars including stand-by. The number of railcars which should be increased in every fiscal year is shown in Table 3.4.2.

Table 3.4.2 Number of Railcars to be Increased Every Fiscal Year

Railcar type \ Fiscal year	1984	1985	1986	1987	Total
EC	12	16	24	64	116
DC	12	16	8	–	36

Although it is assumed to replace all of diesel railcar trains with electric railcar trains after completion of electrification of Bekasi Line, it may also be necessary to examine sequential replacement with electric railcar trains with some diesel railcar trains for the purpose of averaging the number of electric railcars to be introduced.

CHAPTER 4. TRANSPORT CAPACITY EXPANSION PROGRAM

CHAPTER 4 TRANSPORT CAPACITY EXPANSION PROGRAM

4.1 Track Facilities

It can be hardly said that the track facilities in JABOTABEK Area have been well maintained, and it is obliged to provide speed limits due to deteriorated track facilities. The planned maximum running speed in the future is 60 km/h in the urban area and 100 km/h in the suburban area as the targets, and it is scheduled in the Intermediate Program that renewal of tracks of urban lines will be made in 1981–83 period.

The object of reinforcement of tracks to be made under the JOBOTABEK Area Railway Transportion Improvement Program is Central, Bekasi, Tangerang and Merak Lines, at which track renewal using R-3 rails is being made, is excluded.

4-1-1 Types and time-elapses of rails

Table 4.1.1 indicates the type and time-elapses of use of the rails used at the present time. All of these rails are old deteriorated. Renewal of tracks of Tangerang Line is particularly desired in early stage.

Table 4.1.1 Type and Time-elapses of Rails

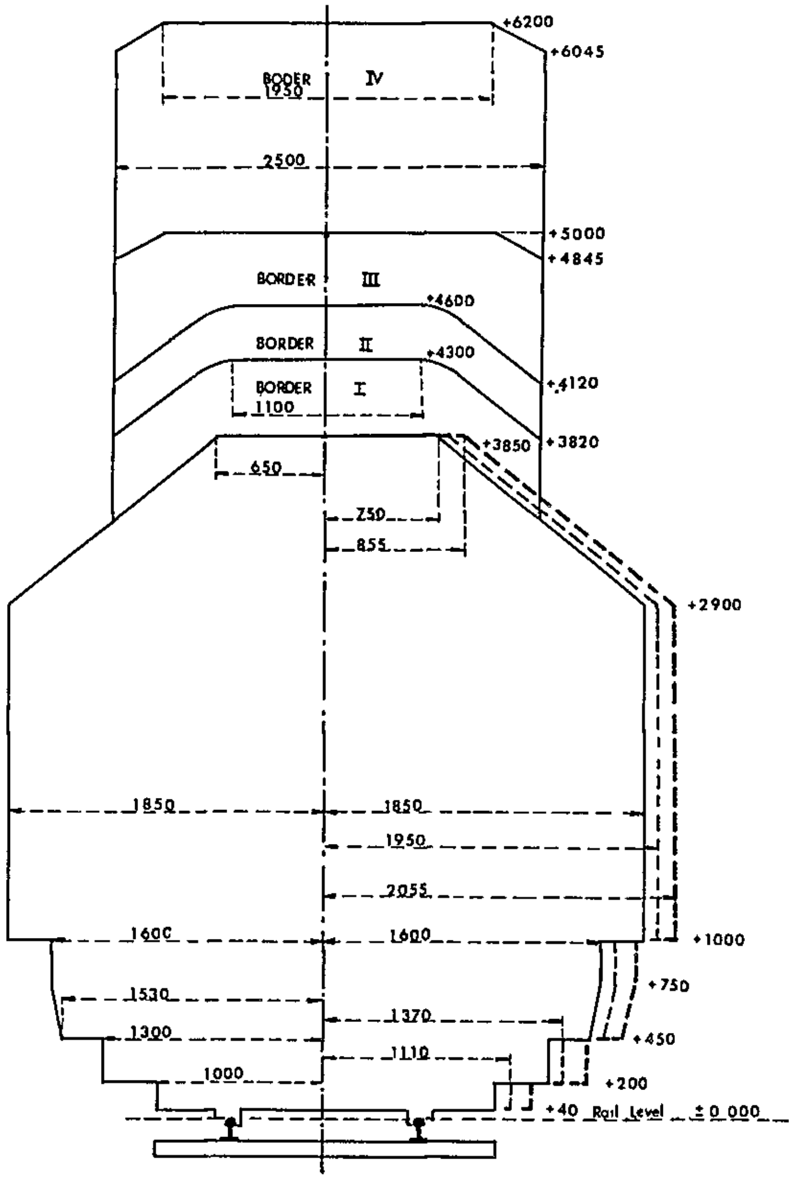
Line name and section			Type of rail	Time elapse
1. Central Line				
Manggarai	~	Pasarminggu	R-14 (41.52 kg/m)	1960
Pasarminggu	~	Bogor	R-14 (41.52 kg/m)	1963
2. Bekasi Line				
Jatinegara	~	Bekasi	R-14 (41.52 kg/m)	1960
3. Tangerang Line				
Duri	~	Tangerang	R-2 (25.75 kg/m)	1899

4.1.2 Track facilities

1) Structure gauge
Fig. 4.1.1 indicates the structure gauge specified in the construction regulations of Indonesian State Railways.

2) Roadway diagraph
Fig. 4.1.2 indicates the roadway diagraph specified in the construction regulations of Indonesian State Railways. Although the ballast thickness to correspond to 100 km/h is specified as 20 cm in the construction regulations, it was determined to adopt 25 cm to correspond to 120 km/h with increased burden to the tracks in the future accompanying increase of passing tonnage taken into account.

3) Track components
The components required for the track renewal are shown in Table 4.1.2.



NOTE:

1. BORDER I FOR BRIDGE WITH SPEED LIMITATION UNTIL 60 km/hr.
2. BORDER II FOR OLD ROAD FLY OVER. AND TUNNEL WITH SPEED LIMITATION FOR 60km/hr AND ALSO FOR BRIDGE WITHOUT SPEED LIMITATION.
3. BORDER III FOR NEW ROAD FLY OVER AND OLD BUILDING EXCEPT TUNNEL AND BRIDGE.
4. BORDER IV FOR ELECTRIFIED TRACK
5. FOR NEW BUILDING, IT IS BETTER ADDED THE HEIGHT 100mm.

Fig. 4.1.1.

Construction Gauge

JABOTABEK Area Railway Transportation Study

Legend

——— = From Straight Line to Curve of 3,000 Radias
– – – = " from 3,000 to 300 Radias
—·—· = " less than 300 Radias

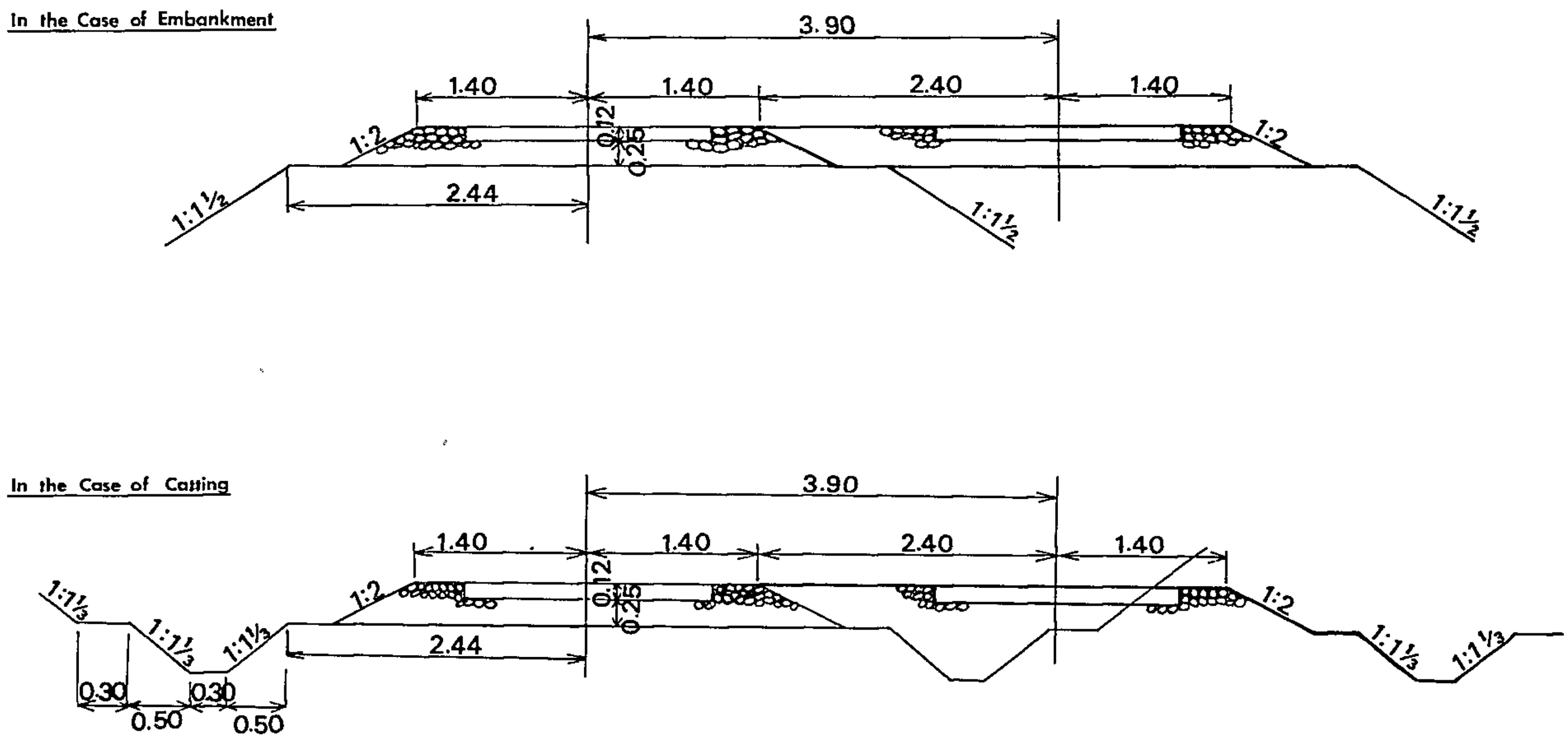


Fig. 4.1.2. Standard Cross Section for New Double Track

JABOTABEK Area Railway Transportation Study

Legend

Table 4.1.2 Track Components

	Linear section	Curved section (curve radius less than 800m)	Rail joint
Rail	R14A Rail 85m long, End hardened rail	R14A Rail 85m long, End hardened rail	R14A Rail 85m long, End hardened rail
Sleeper	Oil treated wooden sleeper 1,600 pcs per kilo-meter (62.5 cm)	Oil treated wooden sleeper 1,680 pcs per kilo-meter (59.5 cm)	Oil treated large wooden sleeper Supported joint, width 350 mm
Fastening	Double Elastic Fastening for ordinary F type	Double elastic fastening for ordinary F type	Double elastic fastening F type for rail joint
Ballast	Crushed stone depth 250 mm	Crushed stone depth 250 mm	Crushed stone depth 250 mm

4.1.3 Renewal of tracks classified by line

(1) Renewal of tracks for single track sections

Renewal of tracks for single track sections will be made between Duri and Tangerange of Tangerang Line and also between Depok and Bogor of Central Line. It is planned that these sections will be double tracked in the near future. Therefore, it was decided to make track renewal in station yards having pass-by facilities at the time when double tracking is accomplished, and the works to be performed in the subject program will be limited to replacement of sleepers and input of ballast only.

1) Tangerang Line

Pesing Station and Kalideres Station having pass-by facilities as well as Duri Station and Tangerang Station, which are starting and terminal stations, will be improved at the time when double tracking is accomplished in the future, and track renewal will be made in the sections excluding these stations. (Fig. 4.1.3)

The total extension of track renewal sections is 18 km 100 m, and the total extension of the sections in which replacement of sleepers and input of ballast will be made, is 23 km 000 m, because the stations stated above in which track renewal will not be made are also included.

Damage to partial roadbed is observed at some sections, but it was decided to make temporary rehabilitation only this time and to be renewed in full scale at the time when double tracking is accomplished in the future, because the damage to roadbed does not adversely affect traveling of trains in particular.

2) Central Line (Depok ~ Bogor)

Track renewal between Depok and Bogor will be made in the sections excluding Citayan, Bojonggedeh, Cilebut and Bogor Stations, which require yard improvement on completion of double tracking in the future.

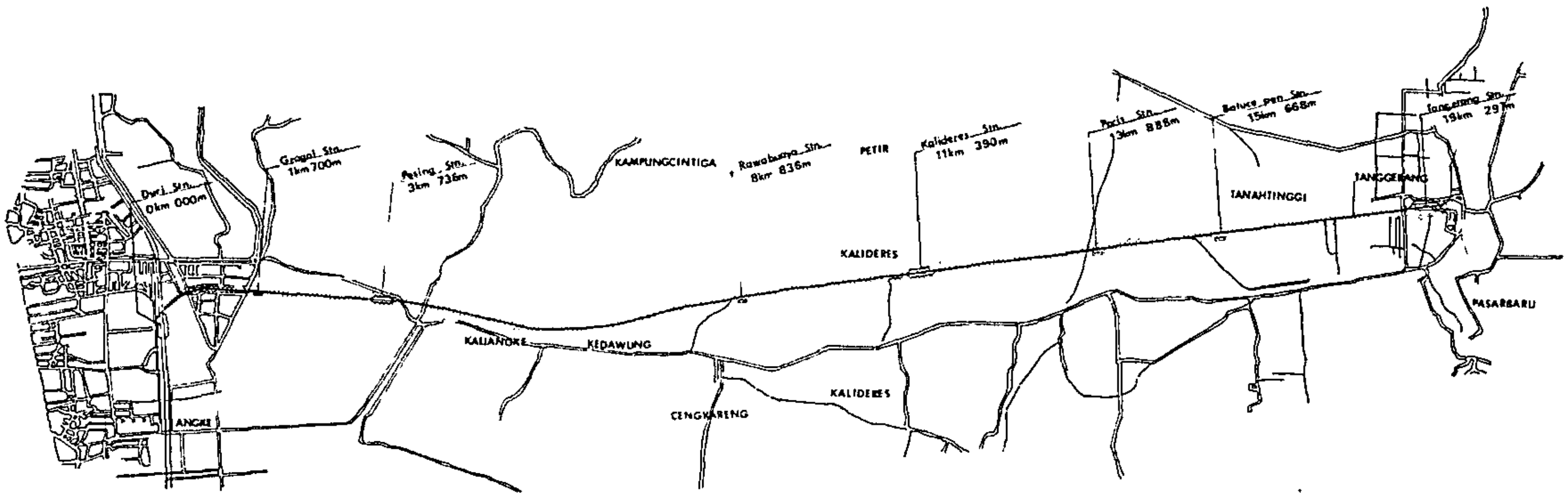


Fig. 4.1.3

Layout of Track Renewal in Tangerang Line

JABOTABEK Area Railway Transportation Study

Legend

- Existing Rail
- Renewal of Rail
- Ballast

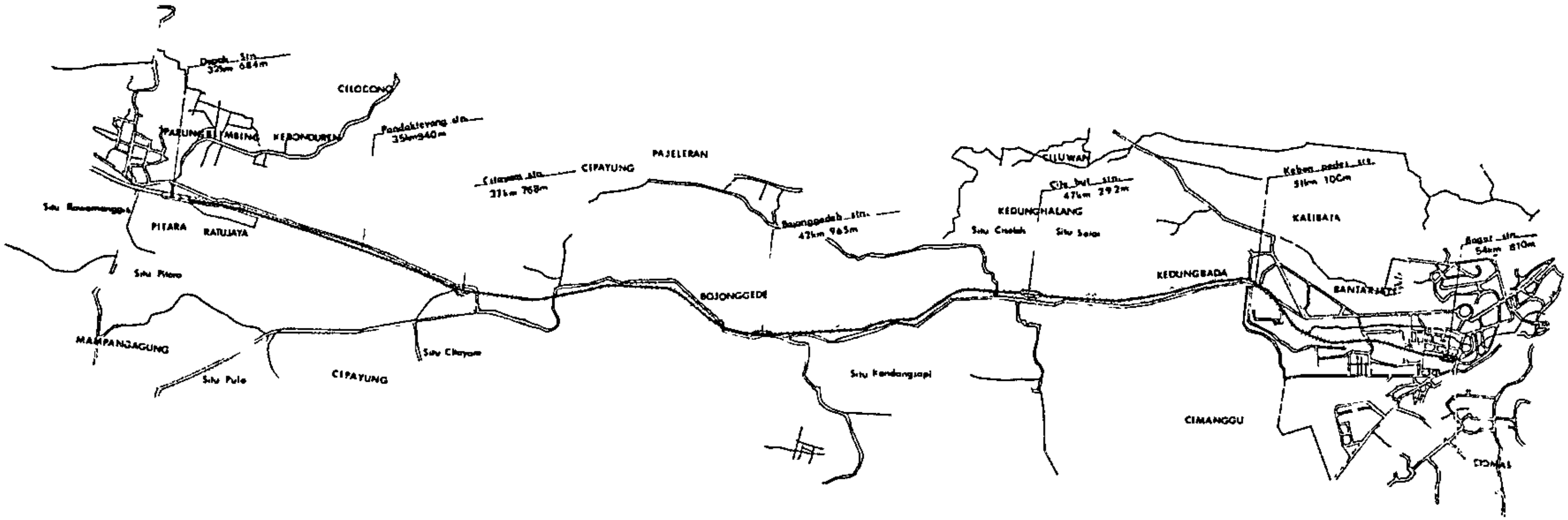


Fig. 4.1.4

Layout of Track Renewal in Central Line

JABOTABEK Area Railway Transportation Study

Legend

Existing Rail

Renewal of Rail

Ballast

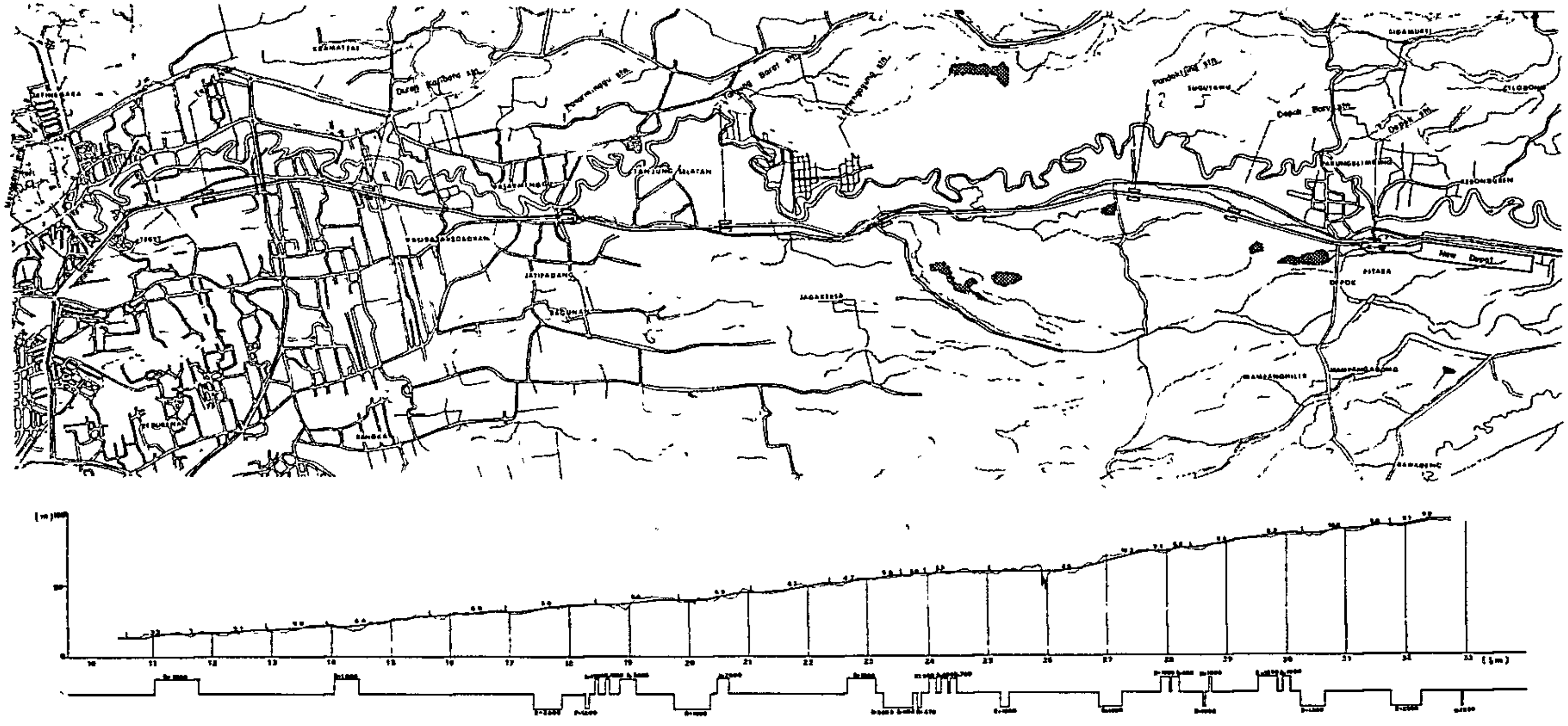


Fig. 4.1.5 Layout of Track Addition in Central Line	Legend
JABOTABEK Area Railway Transportation Study	

The total extension of track renewal sections is 21 km 200 mm, and the total extension of the sections in which replacement of sleepers and input of ballast will be made is 24 km 800 m because the stations stated above in which track renewal will not be made are also included.

Fig. 4.1.4 indicates track renewal sections between Depok and Bogor of Central Line.

(2) Renewal of tracks for double track sections

The object of renewal of tracks for double track sections is the track addition section between Manggarai and Depok of Central Line and also between Jatinegara and Bekasi of already double tracked Bekasi Line.

For track addition between Manggarai and Depok of Central Line, it was decided to add a track in parallel with the existing track at the position that is spaced apart from the existing track by 3.9 m in the plane plan with economy taken into consideration, and the track was determined to be added opposit side of the existing contact wire posts.

The track to be added will be of the gradient identical to that of the existing track in the vertical plan;

Fig. 4.1.5 indicates the track renewal sections between Manggarai and Depok of Central Line.

Track renewal work between Jatinegara and Bekasi of Bekasi Line will be performed in accordance with station yard track program for the station areas, and in the sections between stations, existing R-14 rails will be replaced with R-14A rails and ballast will be input for securing ballast thickness of 25 cm.

4.2 Station Facilities

4.2.1 Outline

Improvement of station facilities are executed on the occasion of improvement of railway facilities, electrification facilities, signalling facilities and so forth in many cases. Consequently, it is desirable from economical standpoint that improvement of station facilities is made in parallel with improvement of these related projects. Therefore, the stations which are included in the object Project of this Feasibility Study are eight stations between Tebet and Depok of Central Line related to track addition between Manggarai and Depok of Central Line and electrification of Bekasi Line as well as six stations between Jatinegara and Bekasi of Bekasi Line.

A rough plane view of the platform and so forth of each station is shown in Fig. 4.2.1 ~ 2 The concrete improvement plan of each facility is indicated in Item 4.2.2 and subsequent.

4.2.2 Platform

The current platforms can be generally classified into the following two types from the height from rail level and so forth. (Fig. 4.2.3)

1) Height from rail level, H = 430 mm; distance from center of track, D = 1,350

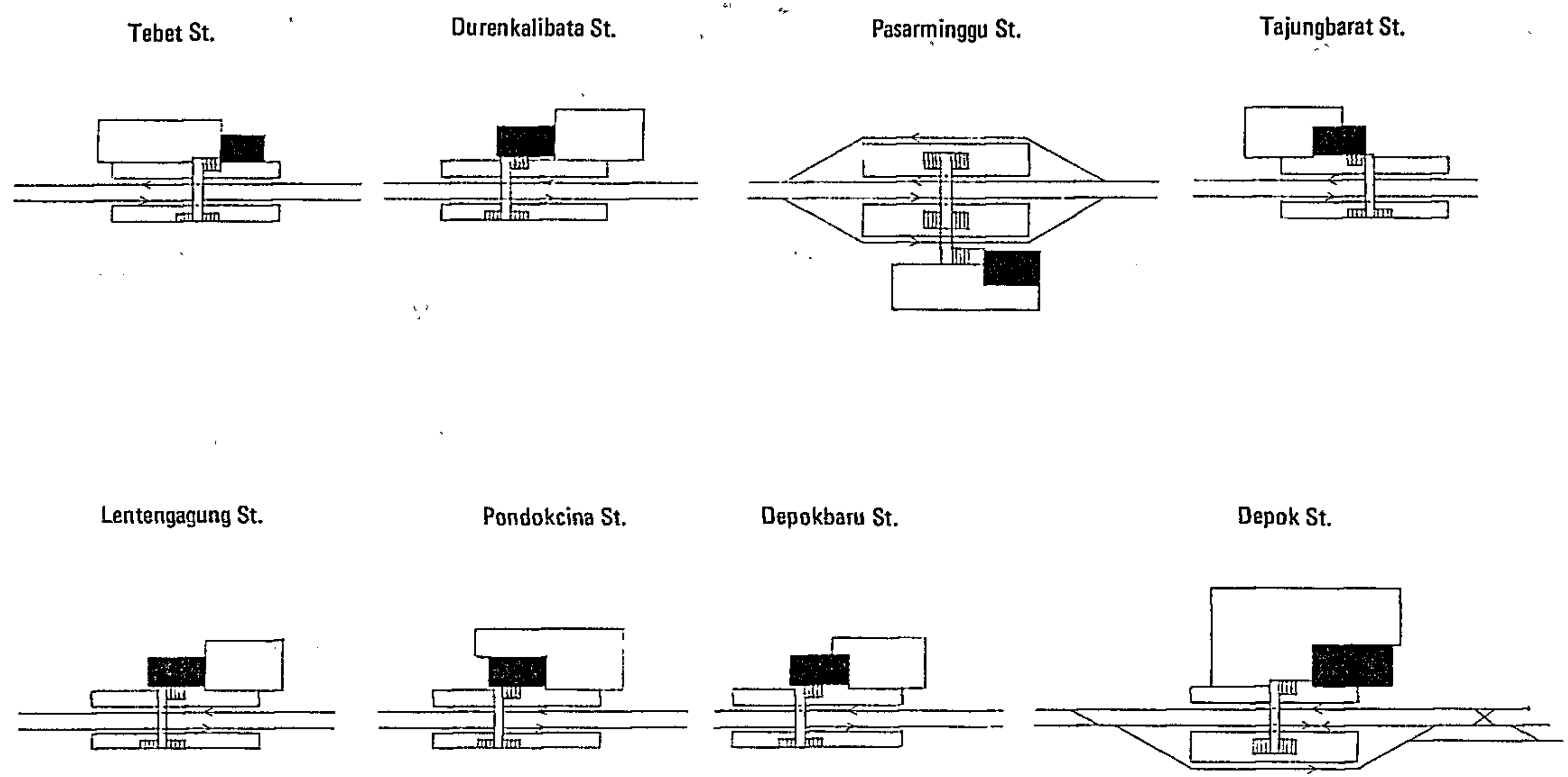


Fig. 4.2.1

Schematic View of Stations (Central Line)

JABOTABEK Area Railway Transportation Study

Legend

■ : Station Main Building

□ : Station Front Area

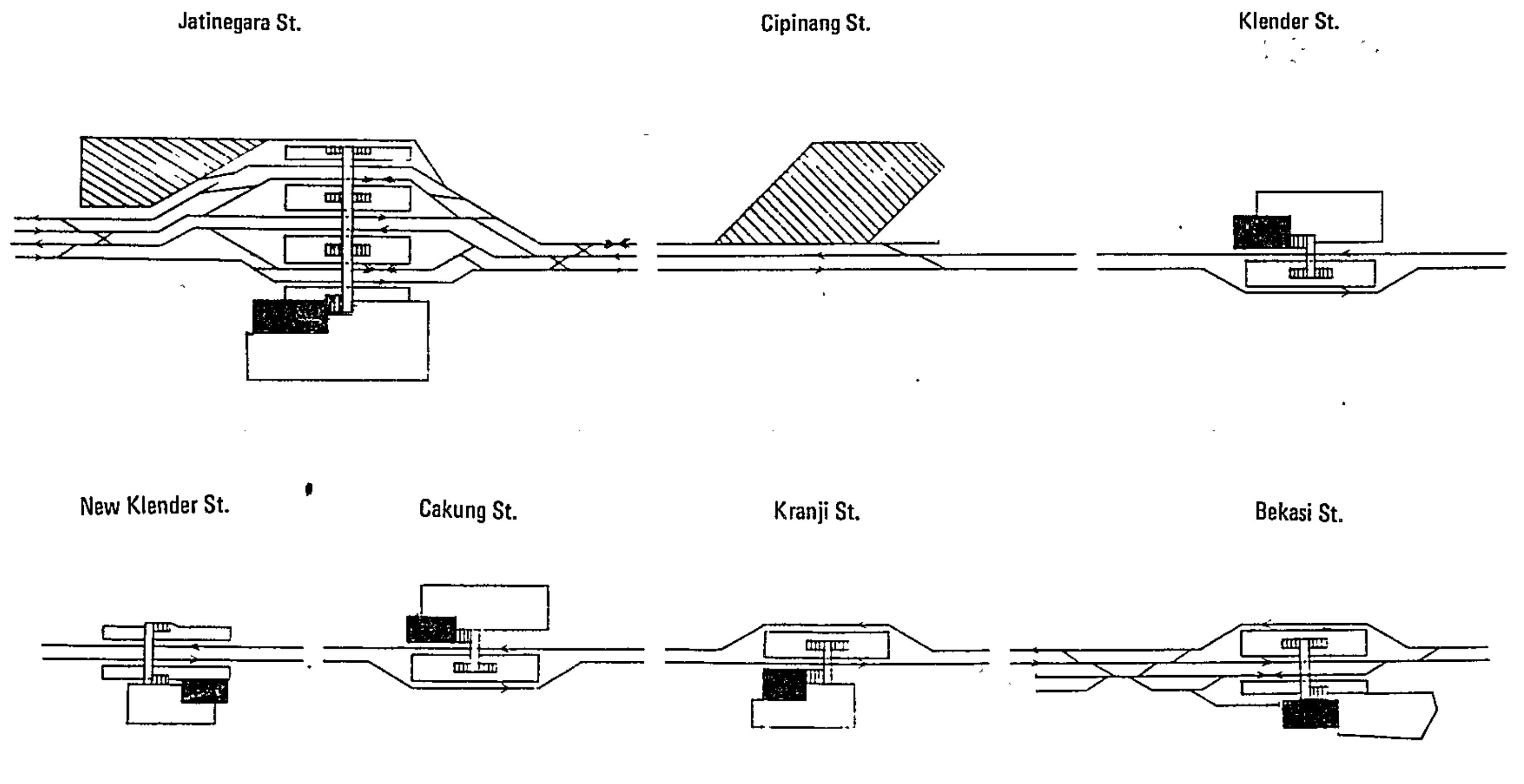


Fig. 4.2.2

Schematic View of Stations (Bekasi Line)

JABOTABEK Area Railway Transportation Study

Legend

■ : Station Main Building

□ : Station Front Area

2) Height from rail level, H = 180 mm; distance from center of track, D = 1,050

According to the results of site investigation, the majority of newly constructed or reconstructed platforms are of (a) type, and it was considered that improvement program is being executed. Even with platforms of this type, however, the difference in level between the platform and railcar's floor is as much as 750 mm and one step is provided inside of the railcar and another step is provided outside of the railcar for enabling boarding and alighting of passengers. Boarding and alighting are very dangerous in such a situation for the old and children, and it is anticipated that this access system will become a problem also in the aspect of boarding and alighting time which is directly related to the headway, besides the aspect of safety, when increase of number of passengers in the future is taken into account. Regarding the distance of platform from center of track, it is presently of such a form that the edge of the platform is overlapped under the car body, which is very dangerous for passengers on the platform.

Under these circumstances, height from rail level, H = 950 mm and distance from center of railway, D = 1,600 mm are adopted in the plan. (Fig. 4.2.4)

Although it is desirable that the height from rail level becomes level with the railcar's floor, planning was made based on the assumption to keep the steps of the existing railcars without removing, because major modification to railcars is required for removing them. The platform width is basically planned to be 8 m for an island platform and 4 m for a side platform with provision of overpass bridges taken into consideration. The platform length is planned to be 180 m with introduction of trains formed with eight railcars taken into account. However, planning of track laying has been made for enabling expansion of the platform length to 260 m with the fact it is planned to operate trains formed with twelve railcars in the future taken into consideration.

The structure of the platform is of embankment type using retaining walls, and planning was made to pave the top surface with asphalt.

4.2.3 Passenger shed

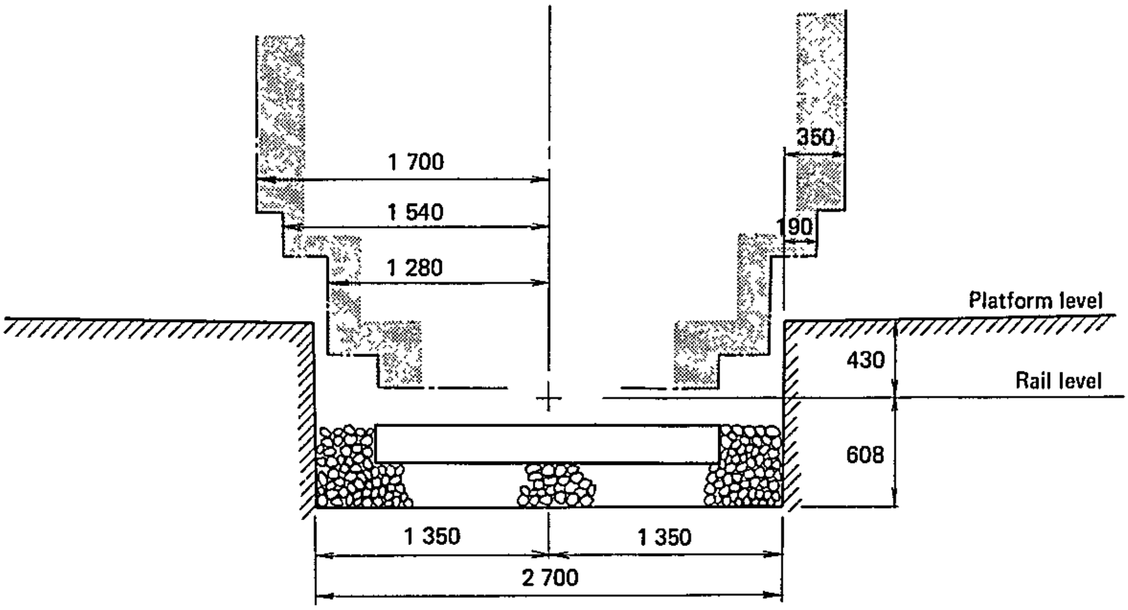
It is the present situation that almost no stations in the suburbs are equipped with passenger sheds, although main stations in the heart of the town have been equipped with them. When judgement is made from meteorological conditions and so forth, it is desirable that passenger sheds are also provided for the stations in the suburbs. The range of provision of passenger shed is determined from the number of passengers getting on and off at each station and from other factors in many cases, but the length of passenger shed is considered equal to one half of the platform in the plan. The structure and other details are show in Fig. 4.2.5.

4.2.4 Overpass bridge

Out of passages connecting the station main building and platform and between platforms, the passages which cross railways are of level crossing at the present time. Passages of this type are very dangerous for passengers, besides, it obstructs normal train operation, and therefore, it is necessary to make grade separated crossing when increase of number of passengers and number of trains in the future is taken into account.

Grade separated crossing is available in two types, that is, overpass bridge and under-

(a) type



(b) type

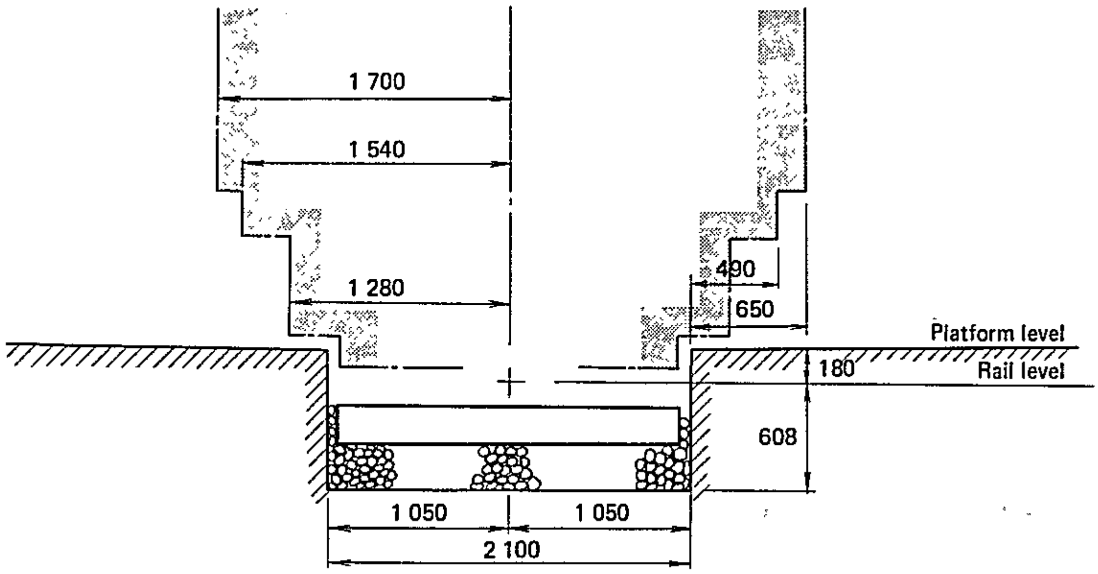


Fig. 4.2.3 Cross-section of Present Platform	Legend Car Clearance
JABOTABEK Area Railway Transportation Study	

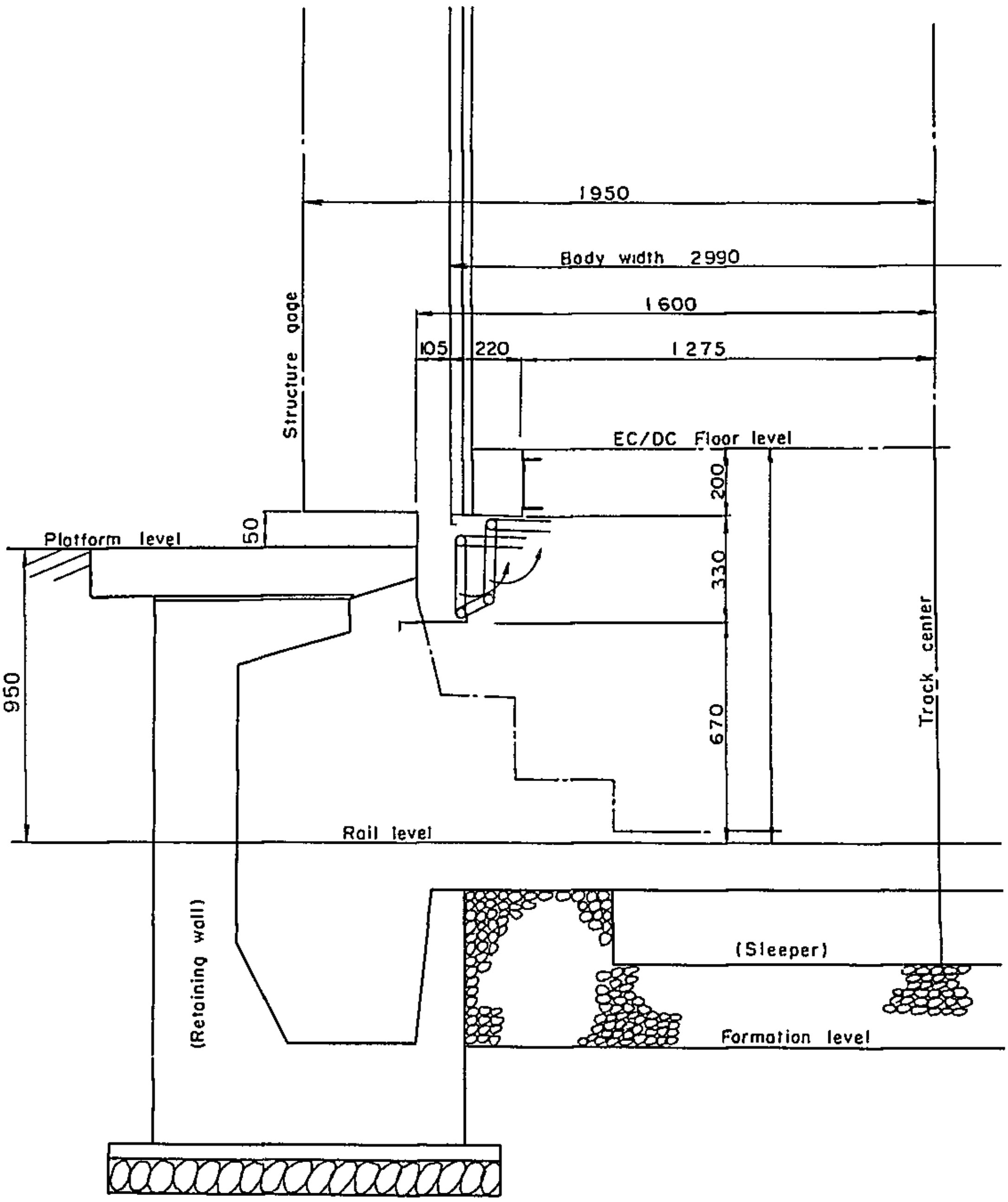


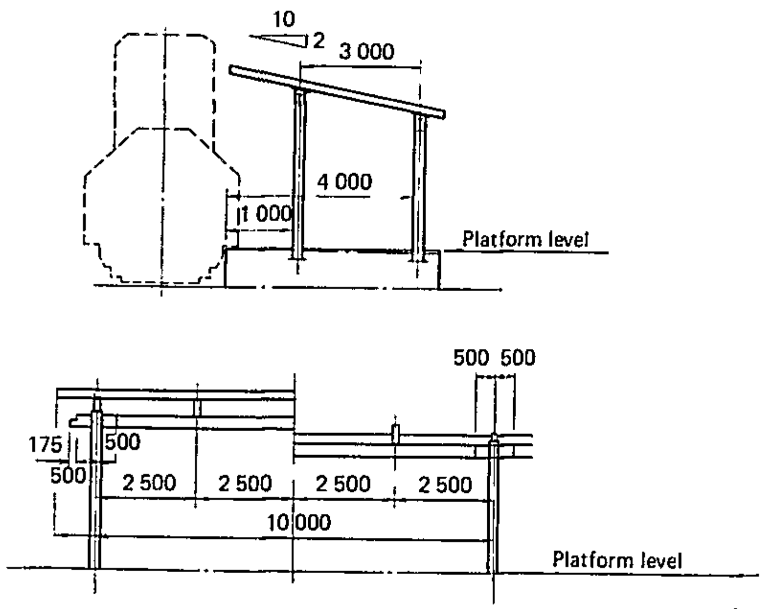
Fig. 4.2.4

Side Elevation of Platform

Legend

JABOTABEK Area Railway Transportation Study

(a) Passenger shed for side platform



(b) Passenger shed for island platform

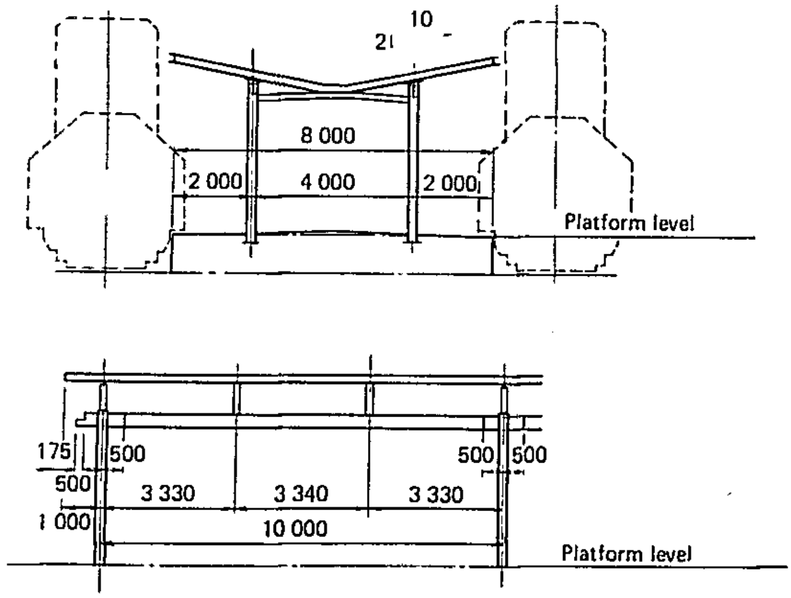


Fig. 4.2.5 **Standard Design of Passenger Shed**	**Legend**
JABOTABEK Area Railway Transportation Study	

ground passage, but planning was made with more economical overpass bridges. A general overpass bridge is shown in Fig. 4.2.6.

4.2.5 Station main building

The station main building is the point of contact between the railway and passengers. It is necessary to provide fluidizing function connecting the station front area and platforms as well as staying function required for waiting for trains and so forth. Consequently, it is necessary to provide the following facilities for fulfilling these functions.

(a) Fluidizing facilities: Concourse, passages, etc.
(b) Passenger contact facilities: Ticket counter, wickets, fare adjustment counter, etc.
(c) Service facilities: Waiting room, lavatory, shop, etc.
(d) Station business facilities: Stationmaster's room, office, resting room, etc.

The existing station main buildings vary from what are generally equipped with these facilities to what are almost unequipped with them. When future increase of number of users is taken into account, it is apparent that passenger contact facilities and so forth will become short, and reconstruction of station main buildings will become necessary, The scale of each station main building is determined from the number of users, number of station staff members and other factors, but total floor space of 1,000 m^2 was planned for Jatinegara, Bekasi, Pasarminggu Stations and Depok Station, and total floor space of 500 m^2 was planned for other stations. General facilities arrangement plans in station main buildings of these two scale levels are shown in Fig. 4.2.7.

4.2.6 Station front area

Every station front area is the point of contact between railway transportation and road transportation. It also provides the functions as the gateway to the subject area. Therefore, facilities such as footways, motorways, bus stops and taxi stops will be arranged in the station front area, and suitable green belts or the like will be provided in addition with appearance taken into account. It will also be good if a symbol of the area is installed.

The scales of these facilities are determined by the number of passengers who make use of the station, number of routes of bus service beginning and terminating at or operated through the station, number of taxi cabs and other factors.

Stations are classified in this plan into two categories by scale, that is, large stations and small stations. The standard area of the station front area of a large station is about 10,000 m^2, and the standard area of the station front area of a small station is about 5,000 m^2. (Fig. 4.2.8 ~ 9) Various facilities are functionally laid out in this area for each station with the road conditions in the neighborhood taken into account. The "bus" zone and the "mini bus & taxi" zone are completely separated in the planning, and level intersection of men and vehicles is completely avoided in the bus zone. Regarding the subject of parking of private cars, stopping only for meeting or see-off is permitted, and public facilities for park and ride will not be provided. Because of the fact that pedestrians are not fond of making detours, efforts were made in the layout planning so that the flow line of pedestrians is as simple as possible. Typical layouts

Plan

A - A Section

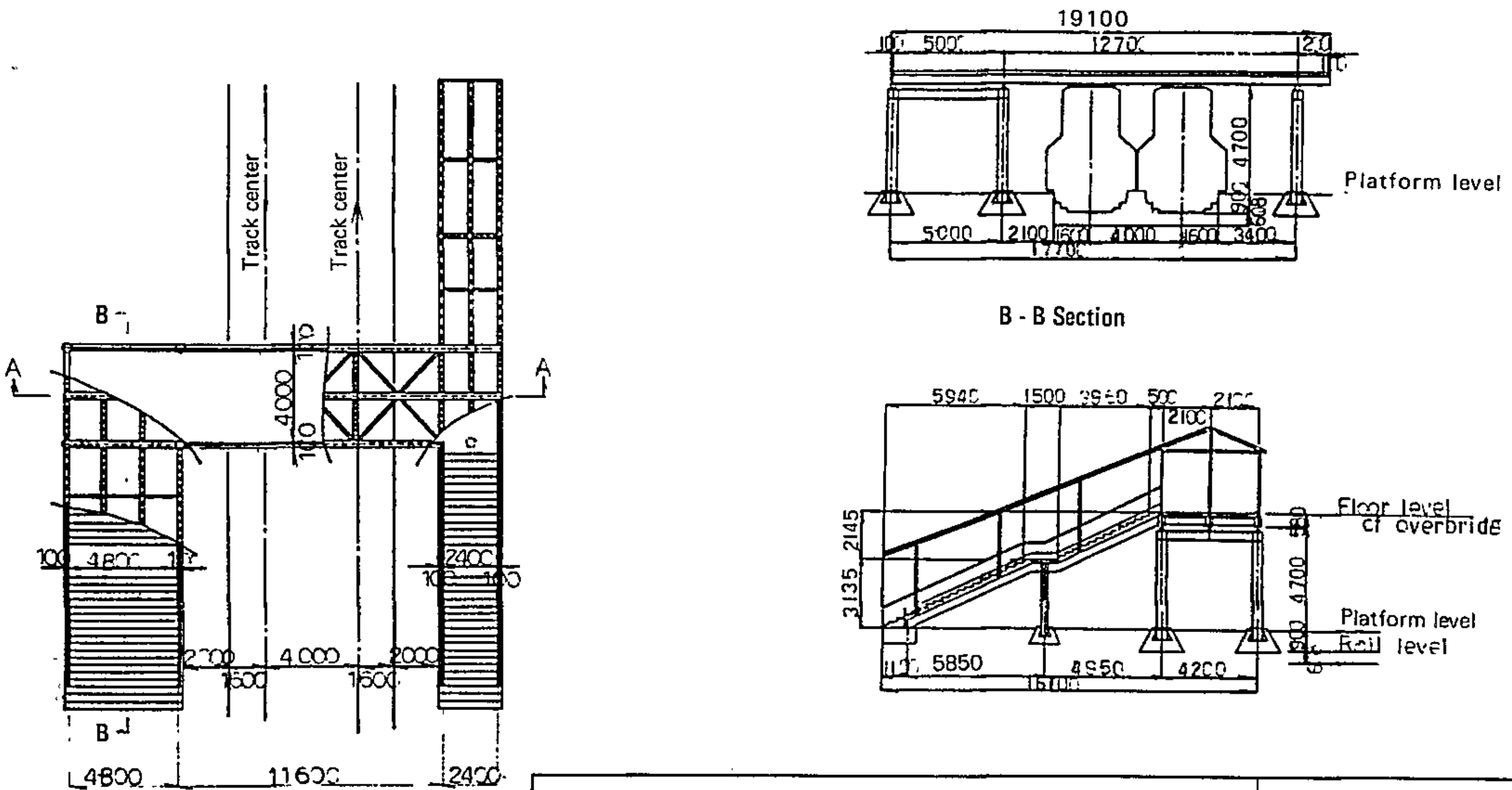


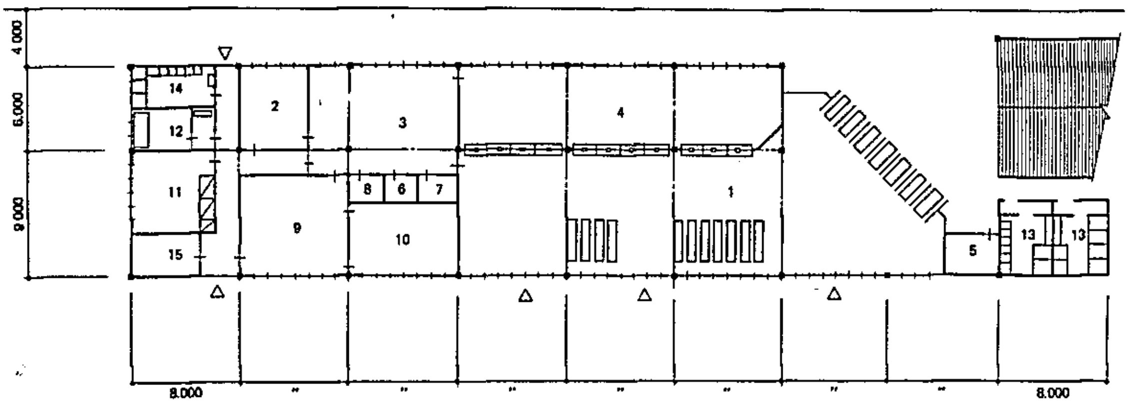
Fig. 4.2.6

Standard Design of Overpass Bridges

JABOTABEK Area Railway Transportation Study

Legend

(a) Large Scale Station

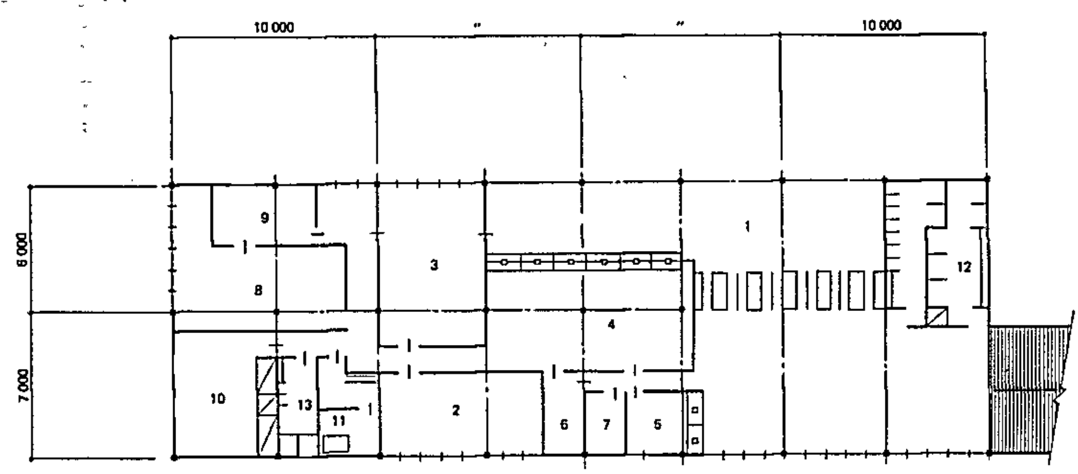


1/300

1. concourse
2. station master room
3
4. booking office
5
6. strong room
7. stock room for ticket
8. kitchen room
9. rest room
10 locker room
11. bed room
12. bath room
13. toilet for passenger
14. toilet
15. storage

15 0 x 64.0 + 5.5 x 8 0 = 1,016 0 M²

(b) Medium Scale Station



1/200

1. concourse
2. station master room
3.
4. booking office
5.
6. strong room
7. stock room for ticket
8. rest room
9. locker room
10. bed room
11. bath room
12. toilet for passenger
13 toilet

13° x 40° = 520° M²

Fig. 4.2.7

Standard Design of Station Main Building

Legend

JABOTABEK Area Railway Transportation Study

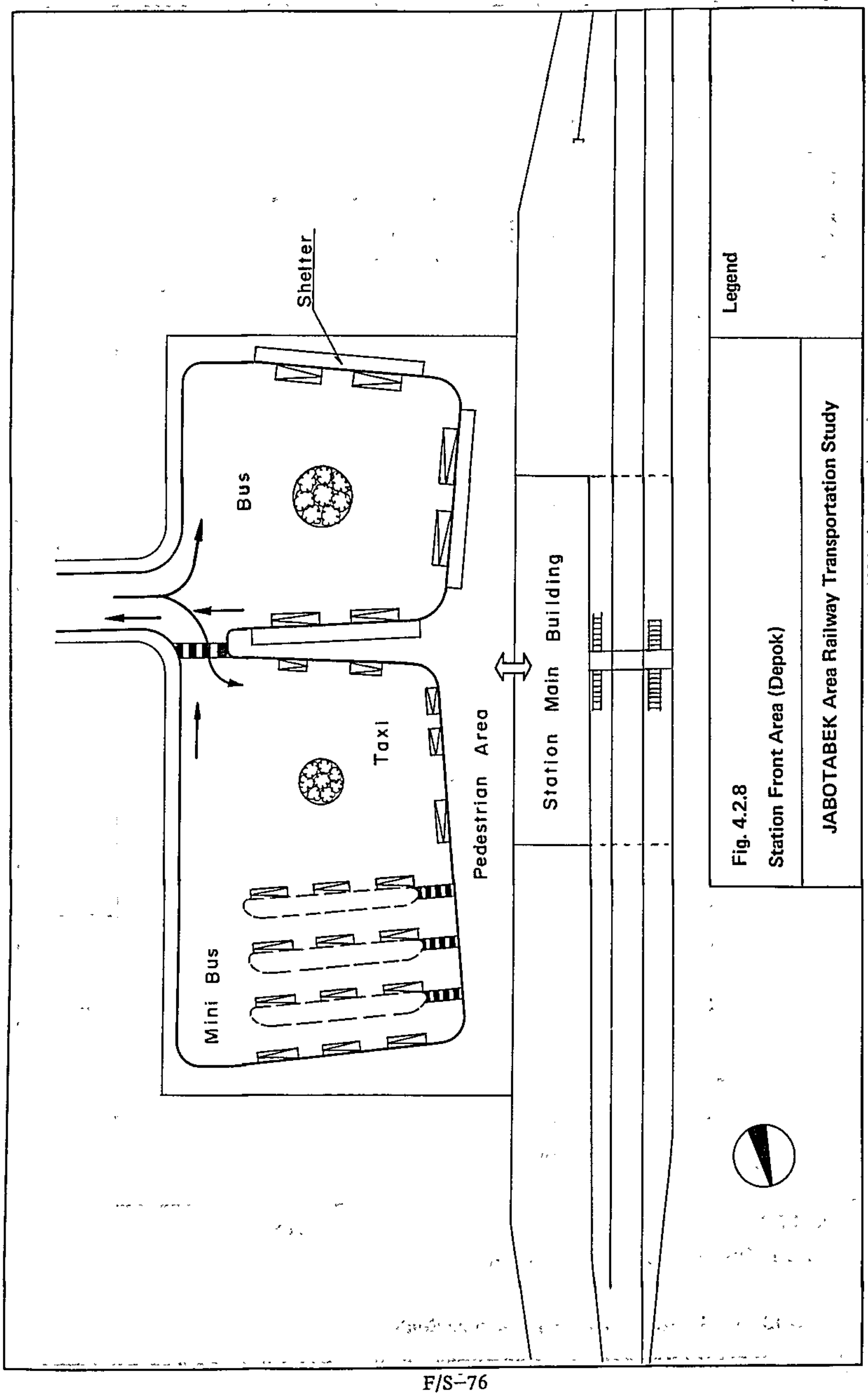


Fig. 4.2.8
Station Front Area (Depok)

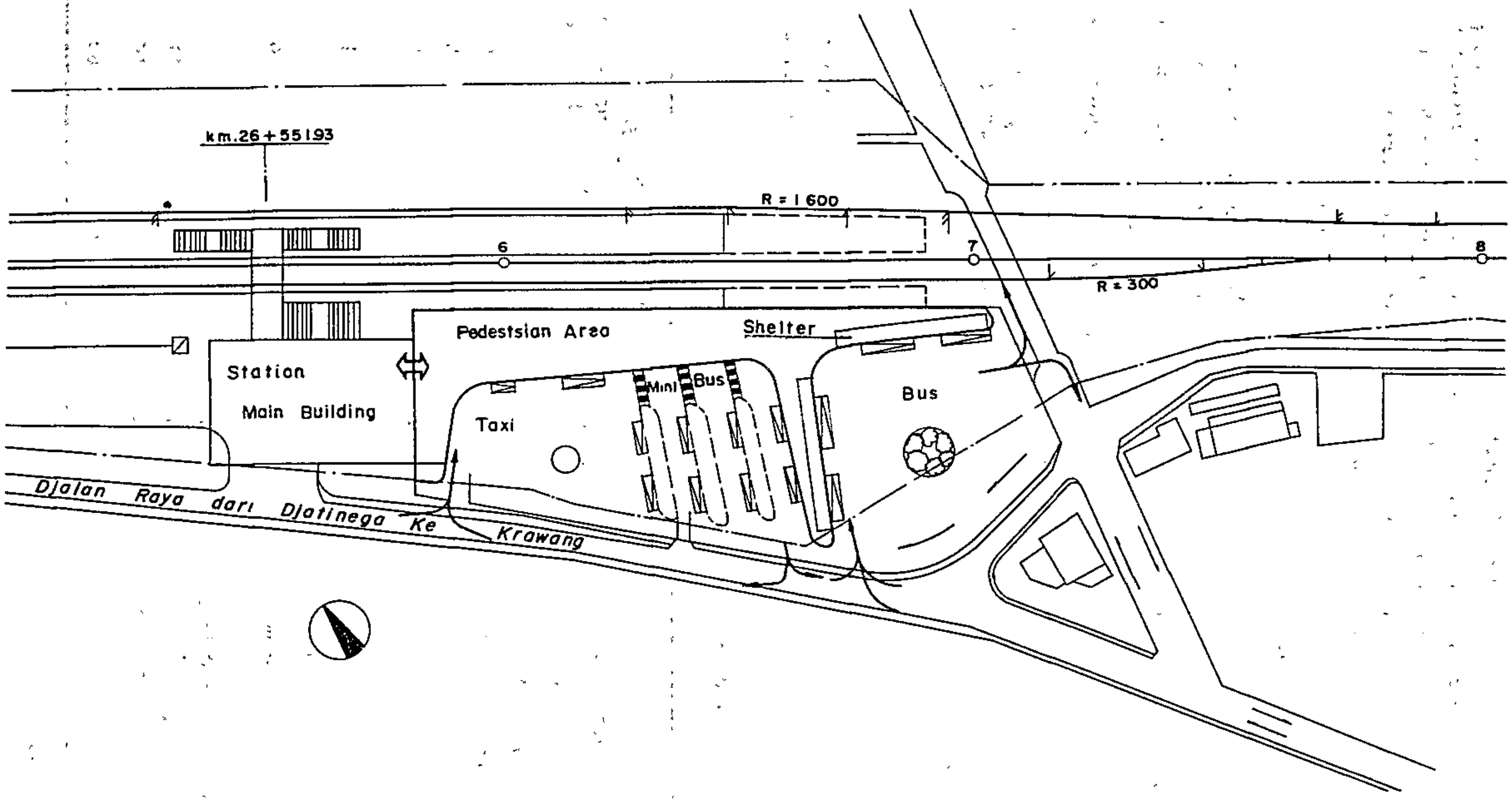


Fig. 4.2.9
Station Front Area (Bekasi)

JABOTABEK Area Railway Transportation Study

Legend

of station front areas are shown in Fig. 4.2.8 and 9.

It is not favorable that high-rise commercial buildings are located near the station front area from the standpoint of amenity and future development. It is desirable that low-rise shopping arcades are located as connected with the station front area and that high-rise commercial buildings are located behind these shopping arcades.

4.3 Crossing Facilities

Manual crossing barriers operated by gatemen located on the field are installed as the present crossing facilities. Consequently, crossing closing time is long at the present time because crossing barriers are operated based on visual judgement of gatemen, under the situation that no equipment for notification of approach of trains to gatemen are available.

In addition, crossing roads obstruct smooth flow of motor traffic across crossings, because pavement of crossing roads is not well maintained.

Installation of crossing alarms and motor-operated crossing barriers is going on at some of crossings under the Intermediate Program. Improvement of crossings in JABOTABEK Area Railway Transportion Improvement Program, therefore, will be made at other crossings.

4.3.1 Scope of improvement of crossings

The scope of improvement of crossings will cover the places presently equipped with facilities as crossings. Table 4.3.1 indicates the number of crossings to be improved as classified by line.

Table 4.3.1 Number of Crossings to be Improved

Line and section	No. of existing crossings	No. of crossings improved under Intermediate Program	No. of crossings improved under Feasibility Study
1. Central Line			
Jakarta Kota ~ Manggarai	19	19	0
Manggarai ~ Depok	17	9	8
Depok ~ Bogor	8	3	5
2. Eastern & Bekasi Line			
Tanjung priuk ~ Kemayoran	1	0	1
Jakarta Kota ~ Jatinegara	14	7	7
Jatinegara ~ Bekasi	8	0	8
3. Western Line			
Jakarta Kota ~ Manggarai	10	4	6
4. Tangerang Line	11		11
5. Merak Line	14		14
Total	102	42	60

4.3.2 Crossing facilities plan

1) Crossing alarm
Each crossing alarm is installed on the left-hand side of the road as a rule, and its basic appearance and dimensions are as shown in Fig. 4.3.1.

2) Motor-operated crosssing barrier
Motor-operated crossing barriers of the appearance and dimensions shown in Fig. 4.3.2 will be used, and X-mark crossing signal units for notifying traincrews of lowering of gate arms will be provided.
In addition, fences will be installed using used rails for the purpose of protection of crossing alarms and barriers and of prevention of illegal entry into the right of way.

3) Alarm control
When a train approaches a crossing, it is detected with the track circuit and an alarm is issued. The fundamentals of controlling method of alarm time are shown in Fig. 4.3.3.
Control with the track circuit requires sleepers to have electric insulation property such as that of wood. At Merak Line, therefore, it is necessary to replace iron sleepers with wood sleepers in the section of about 1 km before and after every crossing. In the case where an alarm starting point is located in a station yard, rout setting condition of the interlocking device is required. Therefore, the subject crossing alarm will be operated in manual mode until completion of installation of relay inter locking devices.

4) Reconditioning of crossing road
The boundaries between rails and pavement are damaged at many crossings, obstructing smooth flow of motor traffic. It was decided, therefore, to protect the boundaries between rails and pavement by using guard rail spacers with the present situation taken into consideration for reconditioning of crossing roads.
Reconditioning of crossing roads will be made for double tracks for Bekasi Line, Western Line and between Manggarai and Depok of Central Line and for single track for other lines. But reconditioning of the section between Manggarai and Depok of Central Line will be made at the time of execution of track addition work, because it is planned that nine crossings will be reconditioned under the Intermediate Program. (Fig. 4.3.4)
Although present crossing roads cause traffic jam, reconditioning of crossing roads will not be a radical solution for the traffic jam, but improvement is required in the following points.

i) Bus, oplet and bajai stops
When a crossing is opened, buses, oplets and bajais converge to one place after passing through the cross. Therefore, one or more lanes are occupied by them, and flow of other vehicles is extremely obstructed. Measures such as provision of a bus bay or separation of the bus stop apart from the crossing should be taken.

ii) Mixed traffic
Vehicles such as bajai of extremely small acceleration capacity are mixed among

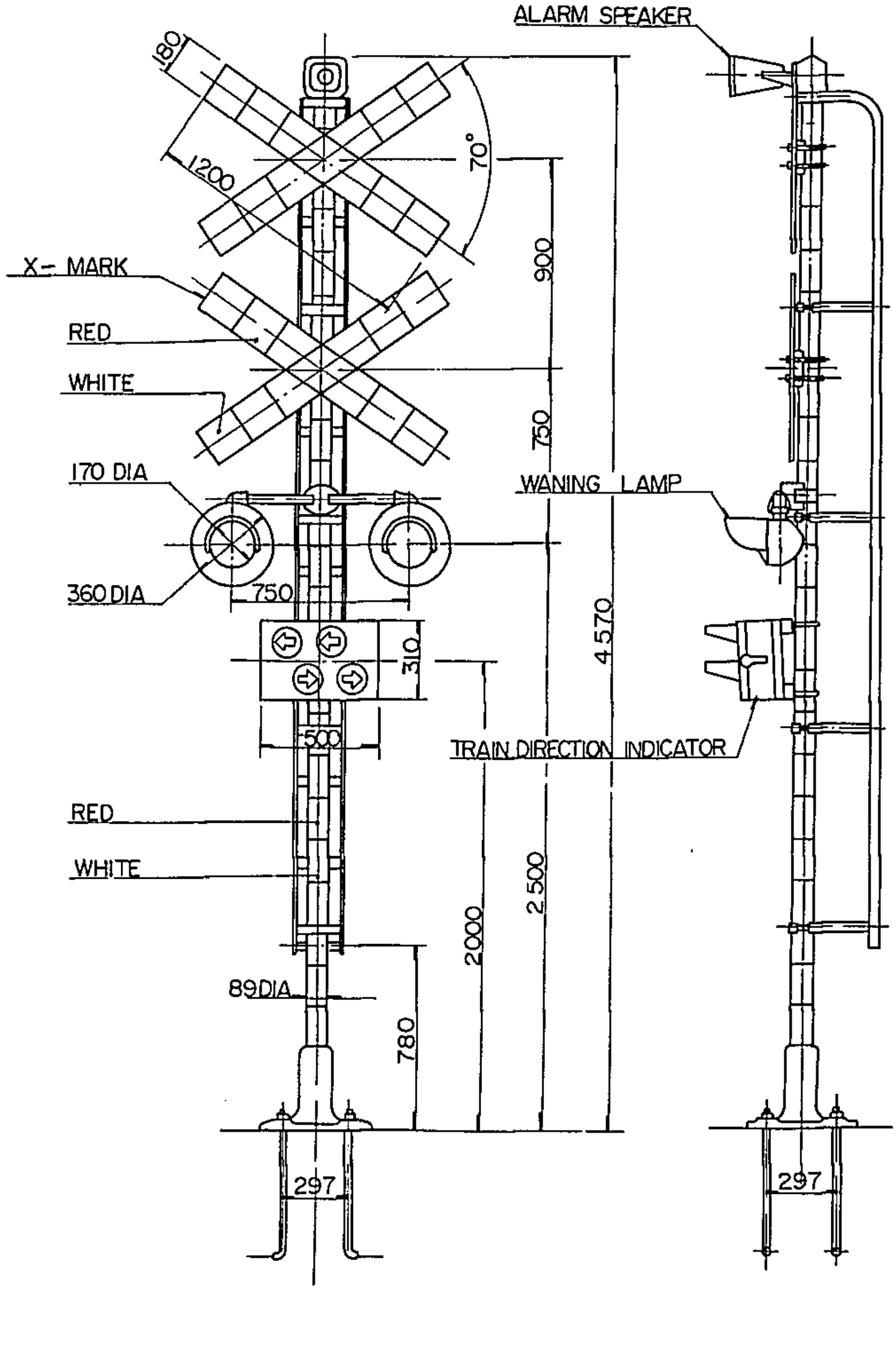


Fig. 4. 3. 1.

Standard Desing of Crossing Alarm

JABOTABEK Area Railway Transportation Study

Legend

Scale Unit: in mm

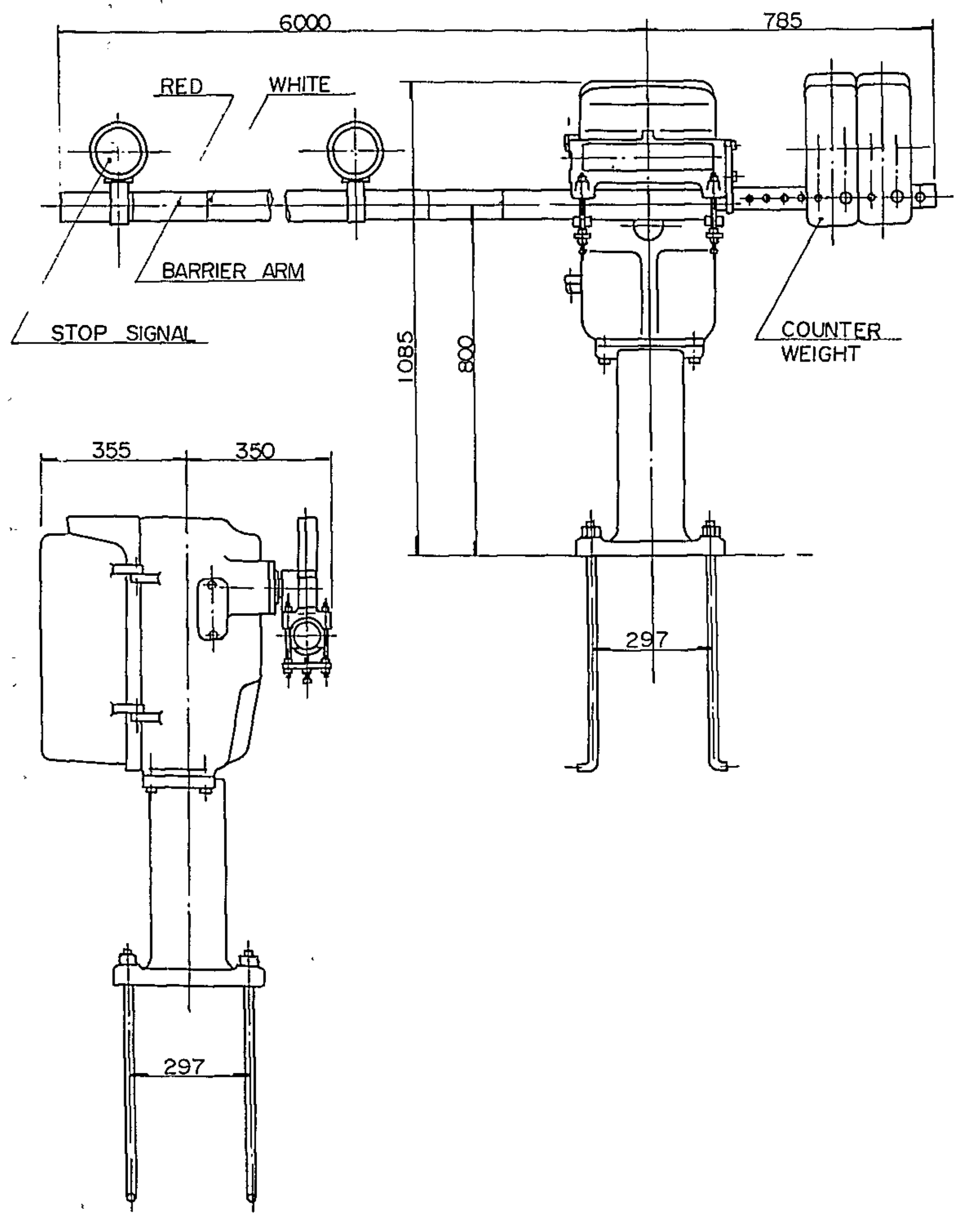


Fig. 4. 3. 2. Motor Operated Crossing Barrier	Legend
JABOTABEK Area Railway Transportation Study	Scale Unit: in mm

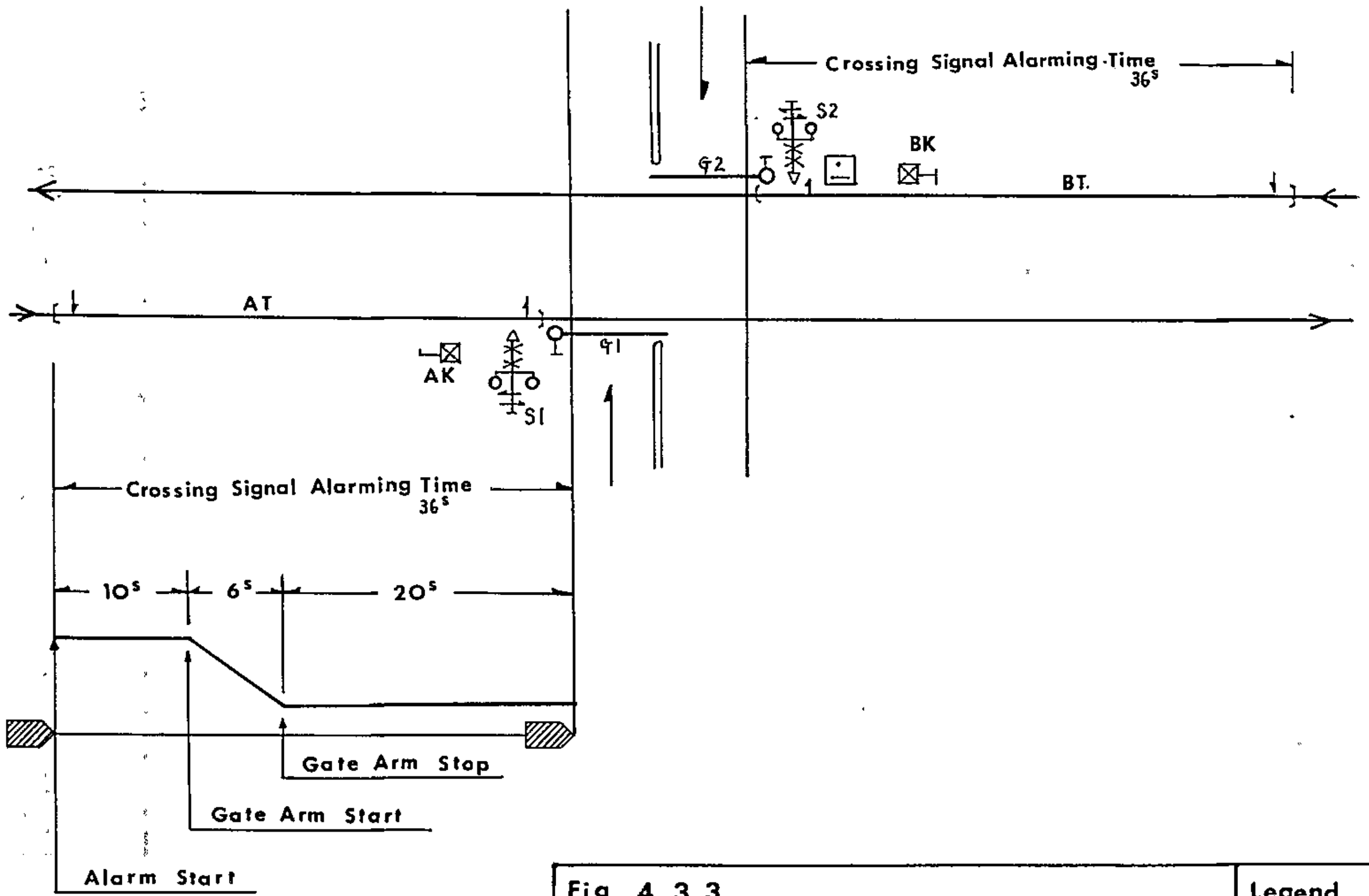


Fig. 4.3.3.

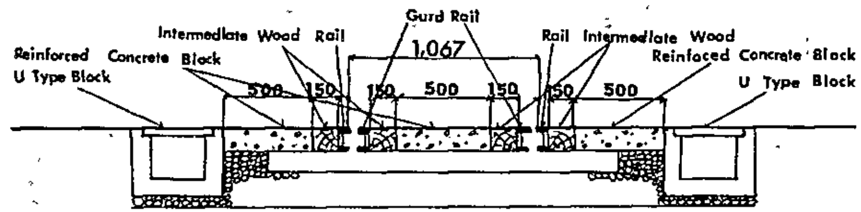
Controlling Method of Alarm Time

JABOTABEK Area Railway Transportation Study

Legend

- Motor Operated Crossing Barrier
- Crossing Alarm
- Detector Circuit
- X-Mark Signal
- Control Panel

In the Case of Single Track.



In the Case of Double Track.

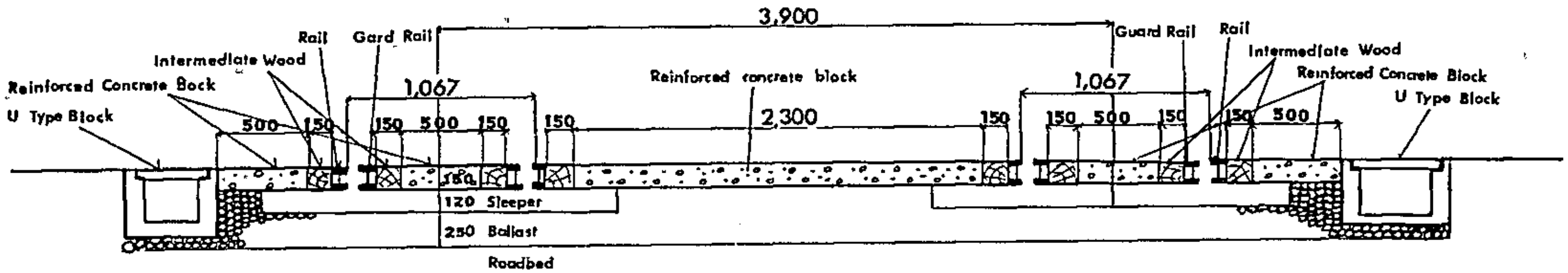


Fig. 4.3.4. Standard Cross Section of Railway Crossing at Grade	Legend
JABOTABEK Area Railway Transportation Study	

vehicles which stay before the crossing when it is closed. Consequently, crossing speed of all vehicles is reduced. It is necessary to provide crossing passing regulations for assigning different lanes for vehicles of different types or other suitable means for solving this problem.

iii) Improvement of traffic moral
Among vehicles staying before the crossing when it is closed are some which drive into the opposite lanes. When the crossing is opened up, smooth motor traffic cannot be obtained in such a case. It is necessary to improve the facilities by providing a divider strip or other suitable means and also to improve traffic moral of drivers by providing suitable guidance to them for solving this problem.

4.4 Electrification

The majority of electrified sections in and around Jakarta were completed in 1920's, and some portions only such as overhead contact wires were recently renewed or improved. Electrification of Western Line is being made as a part of the Intermediate Program, and it is scheduled that modern facilities will be completed in the near future.

In the current situation, however, reconditioning of overhead contact wires has been delayed together with restoration of tracks. In addition, high voltage distribution equipment for automatic signalling are almost none or have been deteriorated, and therefore, cannot be used as they are. Improvement of dispatching system is also required.

Improvement of facilities is made in this Feasibility Study for getting rid of such present situation and to make recovery of railway functions.

New provision and improvement of facilities will be consecutively made in accordance with the Master Plan.

The matters which require particular attention at the occasion of new provision and improvement of facilities accompanying increase of transport capacity are described below.

4.4.1 Substation facilities

Main equipment of substations have been replaced up to the Intermediate Program. Silicon rectifiers, high-speed DC circuit-breakers, wave filters and their switchboards have been replaced with most updated equipment and have been satisfactorily operating.

High voltage distributing equipment, protective devices, supervisory remote control system and so forth, however, are not yet sufficient.

1) Power supply facilities for signalling
High voltage distributing equipment are provided only at some limited substations at the present time. In the Feasibility Study, automatic signalling and provision of relay interlocking devices, which are essential for safety of train operation, will be executed.
For supplying power to these equipment, high voltage distributing wires will be laid along tracks and distributing equipment will be installed at all substations. The power source for signalling should be stabilized with very high degree of reliability. A private transformer will be provided besides the one for silicon rectifier, and its

supervisory control will be made with excellent protective relays at each substation. In addition, such functions that adjacent substations automatically become spares for the other will also be provided.

2) Receiving circuit breaker

It is necessary to provide harmony of protection by providing a circuit breaker at the receiving point in order to protect both of the power source for signalling which is required to have reliability of high degree stated earlier and the power for feeding involving rapid fluctuation, in order not to allow adverse effects to be exerted over the power supply side of PLN on occurrence of an accident.

3) Interlinked breaking device

Protection of the feeder side is dependent only on the overcurrent breaking function provided by the high speed DC circuit breaker itself and on Δ I type relay at the present time. When the traffic load increases in the future and feeding current increases accordingly, it will gradually become difficult to make distinction between feeding current and fault current. Depending on the situation of a ground fault, even when the high speed circuit breaker for feeding on one side breaks out of parallel high speed DC circuit breakers, another high speed circuit breaker for feeding is not capable of detecting abnormality and continues feed of power. Consequently, there is a possibility where a ground fault is expanded to a railcar fire or fusing of a wire. A pair of private circuits and interlinked breaking device are provided between parallel feeding circuit breakers for preventing accidents of this kind.

4) Dispatching system

Supervisory control system for substations should be integrally seized in the entire feeding system in accordance with employment of interlinked breaking system. Therefore, centralized supervisory control equipment providing superior functions should be introduced and dispatching system should be arranged accordingly. The dispatching system will be described in Item 4.4.4.

5) Breaking capacity

When the frequency of train operation and number of railcars forming a train-set increase in the future and feeding current also increases in accordance with augment of traffic demand, addition of silicon rectifiers will become necessary. When the load increases, PLN will probably made addition or expansion of power plants and substations as well as strenthening of transmission lines. It tends to be forgotten in such expansion that the short-circuit capacity of power source has become large without knowing, and breaking capacity of the circuit breaker has become insufficient.

At the occasions of expansion and modification to power source equipment and facilities, it is necessary to enforce the program with the future properly foreseen and also to provide coordination with existing equipment and facilities with the existing equipment and facilities carefully reviewed at all times.

6) Return circuit

Return circuit tends to be overlooked among substation equipments. At a DC substation, insulated wires should be used and they should be positively connected to rails through impedance bond for the purpose of avoiding occurrence of electrolytic corrosion to iron pipes or the like buried in the vicinity of railways.

Grounding of a substation is important for protecting circuits from abnormal voltages caused by lightning and operation of circuit breakers and for preventing deterioration of insulation. It is necessary to carefully perform grounding work for minimizing the grounding resistance and also for reducing the potential difference in the substation. At the same time, coordination of insulation should be provided for the circuits such as telecommunication circuits which are led into the substation from the exterior.

7) Outdoor substation

With electric railways, power failure, even though it may be of short period of time only, causes disorder of operation of trains and brings confusion of transportation. Influence of power failure expands acceleratedly as the transport load increases. On the other hand, there is such a fatality that the opportunity of occurrence of faults with feeding circuits is larger than that of general distributing wires. Consequently, it is desirable that incoming lines to substations for electric railways are directly connected with substations of PLN. The receiving voltage will become 70 KV or more and outdoor substations such as that is shown in Fig. 4.4.1 will be constructed in the future.

8) Experience in electrification work

The works of construction of substation facilities are being carried out at Western Line. To be directly engaged in assembly, adjustment and test of equipment, wiring and connection of control wires and test of protective interlocking devices will be greatly useful for performing maintenance works in the future.

4.4.2 Overhead catenary system

Although the existing overhead catenary system is considerably old, posts and so forth have been maintained to good conditions with recoating frequently made.

Contact wires and so forth were recently replaced, but attention should be paid to the following matters for operating many electric railcar trains in the future.

1) Adjustment of overhead contact wires

It appears that existing overhead contact wires are not necessarily sufficiently adjusted. The relative positions of overhead contact wires to track will change in the future in accordance with improvement of tracks in the future. At point, in particular, overhead contact wires also make intersection, and smooth sliding of pantographs is important. Large hardship is involved to maintain overhead contact wires at points, at which oscillation of railcars is also severe, in good conditions at all times, it is most important. When the railcar speed increases, minor problem of the overhead contact

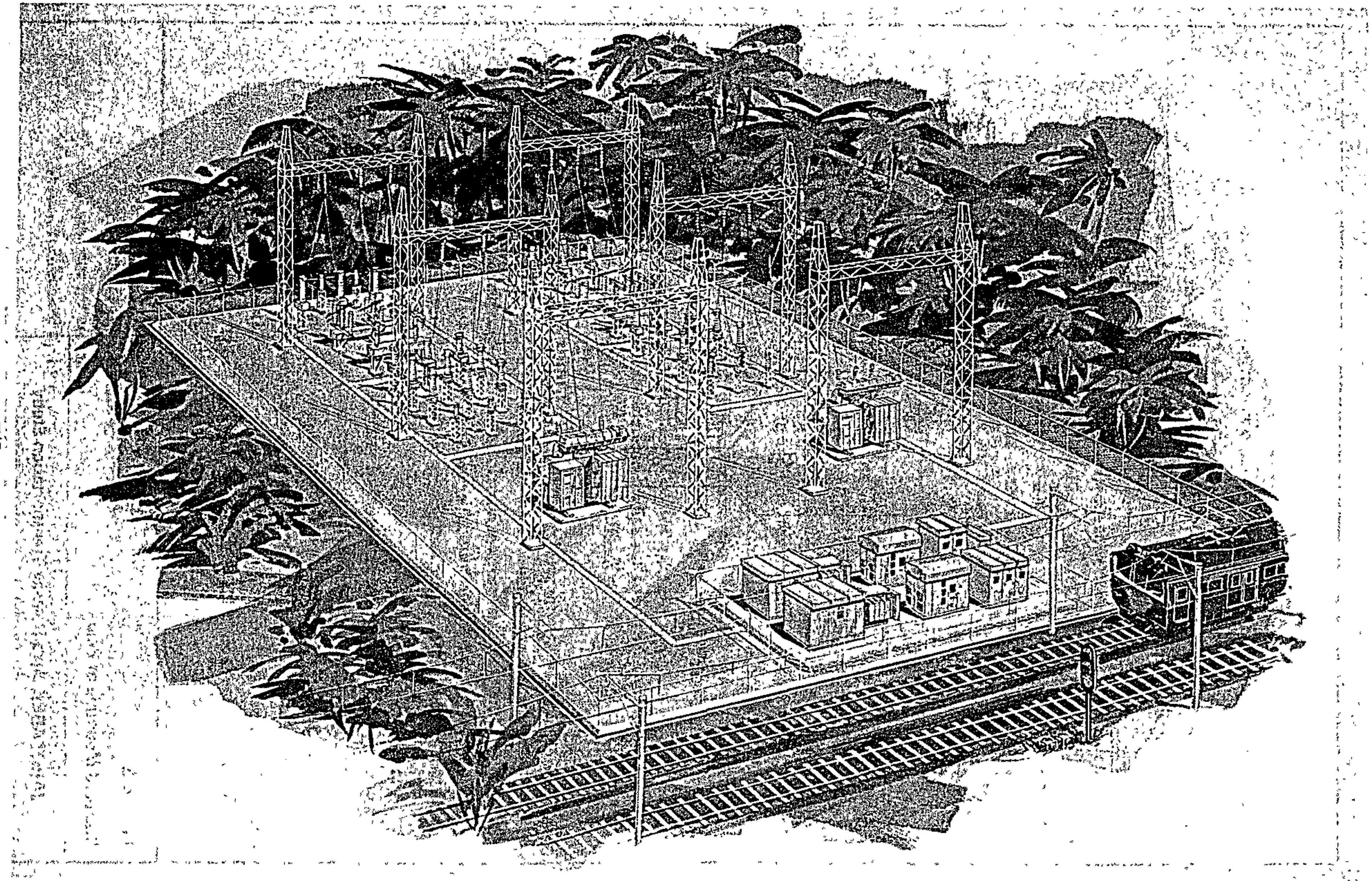


Fig. 4.4.1 Substation for Electric Traction

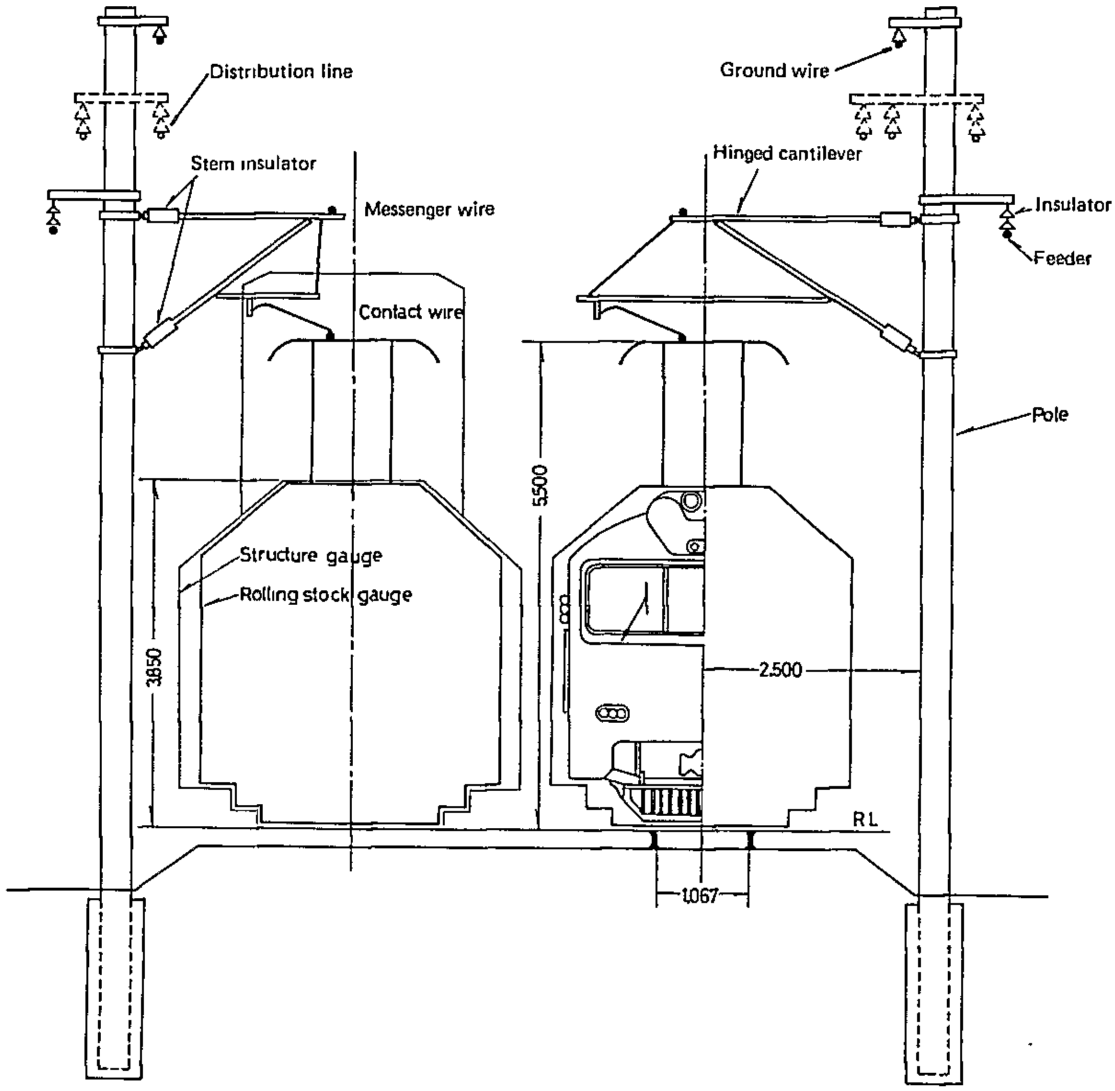


Fig. 4.4.2

Standard Mounting of Pole

Legend

JABOTABEK Area Railway Transportation Study

wire causes rapid advancement of local wear of the contact wire, and wire disconnection will occur within a short period of time in an extreme case. It is considered to be necessary to examine mechanization of maintenance work for periodic inspection of overhead contact wires and for peroming necessary corrections quickly.

2) Monitoring of temperature at points of connection
The feeding current increases as the frequency of operation of electric railcar trains increases and number of railcars forming a train-set increases. What will appear as a fault under these circumstances is overheating of points of connection of wires. The calorific value is proportional to the square of the current. It is caused by defects in the former method of work, and it can be hardly identified with usual means of maintenance. It is necessary to locate overheated points as early as possible using thermo-labels or other suitable means.

3) Return circuit
It was observed at a number of places that rail bonds which electrically connect rails as the return circuit are dropped off. If rail bonds are dropped off, the voltage supplied to traction motors of railcars is reduced, motors are not capable of producing sufficient output. In addition, the current which leaks to the earth out of rails causes occurrence of electrolytic corrosion and local overheating. When track circuits are completed in accordance with automatic signalling, rail bonds will bear a more important role. Therefore, all the rail bonds should be provided in dual, and they should be completely connected.
At the same time, iron sleepers, iron bridges and so forth with which electrical insulation between right and left rails is difficult should be replaced.

4) Lightning arrester
Lightning frequently occurs in the area of Jakarta through Bogor. The exsiting lightning arresters for electric railways were mounted long time ago, and their functions are not sufficient. Therefore, lightning arresters of high performance will be mounted at the lead-out point of each substation and also at important places of wiring. Gapless lightning arresters of easy maintenance are available these days.

5) Changing plan of the installations
There are cases where it is necessary to change wiring in the station yards and to construct elevated railways with operation of electric trains continued. Overhead catenary system have to be constructed at the occasion of track improvement work. At such an occasion, there are many restrictions in the works such as temporary removal of supports, transfer of wires to which tension of 1,000 kg is applied, insulation of electric wiring of 1,500 V and prevention of electric shock to those who are engaged in the work. It is necessary to establish a changing plan of the installations with these matters carefully taken into account. It is therefore, necessary to deliberate the measures for smooth execution of works among the departments concerned such as ground facility department and train operation department.

6) Work practice for personnel
Special skill backed up by experience on the field is required to the maintenance

personnels for overhead equipment besides theory because of the followingwing reasons:

a. Overhead equipments are unique to those of railways.
b. Provision in dual is difficult.
c. Faults tend to occur in a broad range as related with pantographs.
d. Opportunity of occurrence of wire disconnection is large compared to general transmission and distribution lines.
e. Complicated movement occurs due to the influence of changes in atmospheric temperature, vibration of pantographs and so forth, and it is hard to maintain good overhead contact wire conditions.

It is desirable, therefore, to provide overhead catenary system for practice at a suitable place for up-grading of workers and to let workers to practice at all times. Electrification work is going on at Western Line at the present time. It is a very rare wonderful opportunity for practice of workers. It is important for the maintenance workers to be engaged in this electrification work, and they learn the procedure and gist by their bodies.

4.4.3 Other power facilities

Substations and electric railway facilities will be newly provided accompanying electrification. It is desirable that high voltage distributing equipments are provided in parallel with new provision of these facilities and power is supplied to signals and relay interlocking devices as well as to lighting fixture at stations, and various motors located at workshops and depots. High voltage is stepped down to low voltage with transformers at substations and with pole transformers and so forth provided at stations. Because the power supply for signalling require particularly high reliability as already described, it is necessary to thoroughly examine protection systems and coordination of insulation of these facilities.
tion of these facilities.

Precautions related to facilities are as follows:

1) Provision of power supply system in dual

Power failure of high voltage distributing lines is not allowed even for a second, because they bear important loads. Therefore, planning is made so that power can be supplied from either one of two adjacent substations. Supply of power from these substations can be made under remote supervisory control by the dispatcher and automatic switching function is also provided. The dispatching station is equipped with storage batteries and emergency generators in preparation for occurrence of power failure.

2) Protection coordination

It is necessary to mount protective relays and non-fuse circuit breakers in important parts of the circuits for facilitating detection of faults in the circuits. It is also important to thoroughly investigate characteristics of fault detection, operation time limit and so forth and to provide the protection system from power supply of PLN through loading ends with coordinatability.

3) Coordination of insulation
Circuits of different purposes are connnected in mixture as a speciality of electrical railways, and voltages and currents of these circuits are diversified. In addition, wiring should be made along the currently used tracks. Consequently, it is not possible to freely avoid passage through places where lightning hazard frequently occurs, places where wind is strong, places which suffer from flooding almost every year and so forth. In order to maintain reliability of high degree in such unavoidable adverse environment, coordination of insulation is important, and the circuits have to be designed so as to be free from influence of transfered surge, induction and so forth.

4) Additional mounting of distribution lines
The construction cost can be saved if the distribution lines which make connection between substations can be additionally mounted on the posts for overhead catenary. If distribution lines are additionally mounted to posts erected long time ago, whether reinforcemnt is required or not should be examined in advance, and suitable measures should be taken if required.

5) Suitable intensity of illumination
It is necessary to provide suitable illumination at each one of station office, ticket window, wicket, platforms, staircases, overpass bridges, station front area and so forth with lamps added accompanying improvement of every station. Furthermore, it is necessary to use emergency lamps with built-in batteries as some of lighting equipment and to mix incandescent lamps among mercury-arc lamps in the yard in preparation for momentary power failure.

4.4.4 Dispatching system

Railways have the responsibility for safety transport. When electric power is used for train operation, three more requirements, that is, prevention of electrical faults, prevention of faults to the power source system and prevention of electric shocks, are added on top of safety transport.

Execution of works using suitably designed equipment and exercising extreme care will provide considerable effects for preventing these faults.

If a fault occurs in practice, quick correspondence is required in relation to transportion in addition to electrical facilities. Therefore, excellent dispatching personnels should be selected and should be on duty for 24 hours a day.

The matters which require attention regarding the dispatching system are described below:

1) Dispatching work
Dispatching work can be generally divided into dispatching work in normal state and dispatching work on occurrence of abnormality.
The main work items which should be performed as dispatching work in normal state are as follows.
a. Monitoring of receiving power source, conditions of feeding and distribu-

tion, functions of equipment and so forth.

b. ON-OFF of circuit breaker and system change of electric power.

c. Grasp of real states of the maintenance and construction.

d. Seizure of result of demand and supply of power and future prospect.

e. Close exchange of information with operation dispatchers, commands from PLN and so forth.

f. Collection of data related to maintenance and running.

g. Planning and notification of changes to power system.

h. Running management of power facilities.

It will not be possible to thoroughly cope with the situation on occurrence of abnormality, unless normal conditions are fully seized.

2) Correspondence to be made at the occasion of abnormality.

On occurrence of an incidental abnormality dispatchers should quickly make communication with operation dispatchers and commands of PLN, should establish the structure for recovery, should make arrangement of workers, materials and so forth, should make arrangement for countermeasures for passengers, cargo, etc., should make guidance regarding the method of recovery, control over works in the case where works are over a broad range, should take suitable countermeasures for preventing occurrence of electric shock and other accompanying accidents. Thus dispatchers should give suitable instructions and to provide information in many aspects. Therefore, it is important to replete the equipment related to dispatching and to upbring excellent personnels.

Dispatchers of minimum required number to be able to cope with an abnormal situation should be secured even at midnight when the number of operated trains decreases.

3) Major equipments for dispatching

It is necessary to provide the following equipment for coping with the situations on occurrence of abnormality in addition to normal state.

a. Remote supervisory control equipment for substations and other necessary places.

b. Power supply system panel

c. Equipment commonly used with operation dispatching.

d. Centralized telephone and information transmitting equipment.

e. Recording equipment of various kinds of data and informations.

f. Automatic data processing equipment.

g. Power supply unit free from power failure.

4) Control center building

The control center requires airconditioning for the equipment stated earlier, and it should be a comfortable room for the dispatchers who are on duty for 24 hours a day. In order to accomplish this objective, consideration should be made on various matters with building structure, lighting and equipment in the room.

It is important, before everything else, that electrical dispatcher should be on duty in the same room with operation dispatchers for smoothly performing the disposition on occurrence of abnormality. The nuclei of railway transportation are concentrated to the building of the control center, and therefore, it is desirable that its location is close to the administration department. But it is not necessary to be close to field organizations for maintenance or lodging of maintenance staff, as long as close communication can be made with them.

4.5 Signalling and Telecommunication

4.5.1 Signalling facilities

Signalling facilities are important for operating trains safely and quickly to the destinations. They are planned, therefore, with the following matters taken into consideration.

i) To improve the degree of security of operation.
ii) Handling is easy.
iii) Faults are minor and maintenance is easy.
iv) It is possible to cope with high speed and high density operation.

1) Block system
Automatic block system that automatically detects a train with a track circuit and protects the trains in the rear will be used as the block system.
A signal will be provided at the border between blocking sections, and trains will be operated in accordance with the indication of the signal. (Fig. 4.5.1)

2) Signal equipment
The signals used for automatic block system will be color light signals. The indication will include home signal, starting signal and block system as shown in Fig. 4.5.2 with green (go), yellow (caution) and red (stop) as the basis. Trains are operated in accordance with the indication of the signal.
Each station that involves switching work will be equipped with a switching signal, and switching work will be performed in accordance with the indication of this signal.

3) Track circuit
The track circuit is such that a circuit is constituted with rails used as a part of an electrical circuit for automatic detection of presence of a train by short-circuiting of rails with acces of the train. It is a basic facility for providing information required for train and related facilities, and it is the foundation for all the signal equipment.
Track circuits are available in various kinds by the used signal current, but AC track circuits using commercial frequency are adopted because they are the simplest, they provide reliability of high degree and they are economical in addition to the fact that they are technically suitable in DC electrified sections in which DC electric railcars are operated. The basic circuit is shown in Fig. 4.5.3.
For constituting a track circuit, iron sleepers are replaced with wood sleepers or the like which provide electrical insulatability.

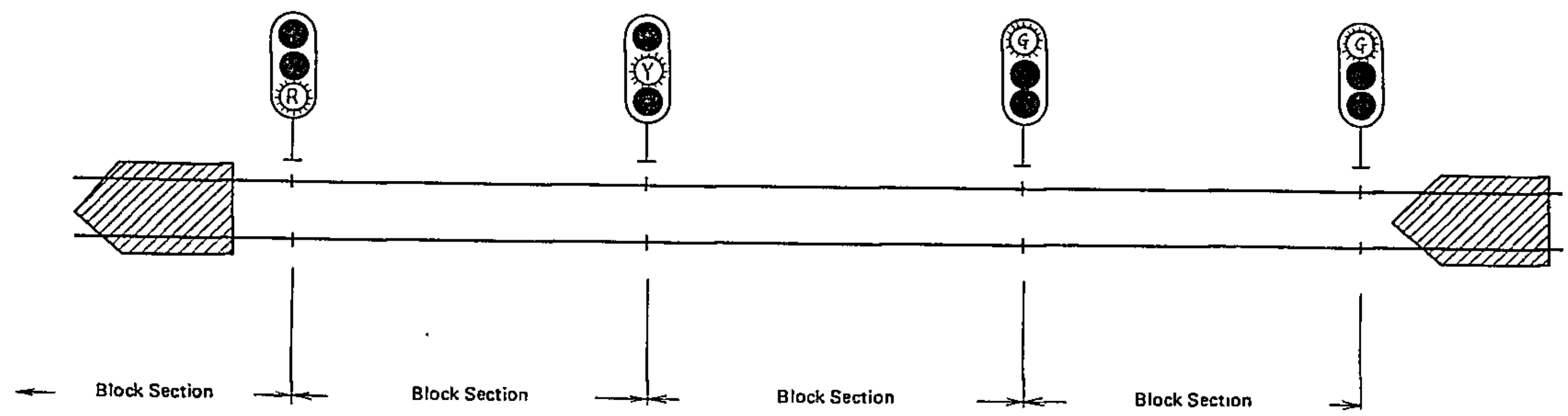


Fig. 4.5.1

Automatic Block System

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Legend

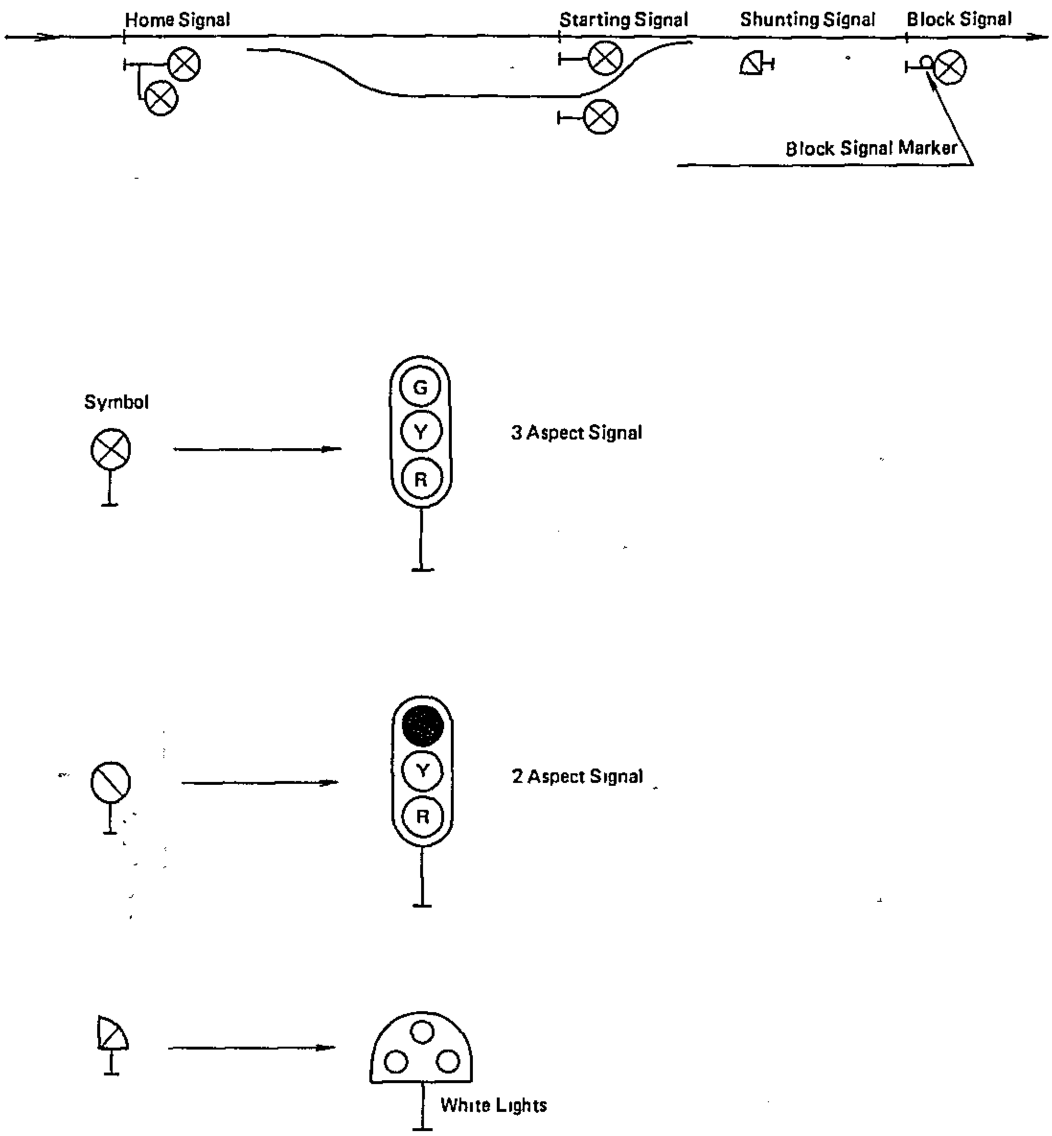

Fig. 4.5.2

Color Light Signal & Shunting Signal

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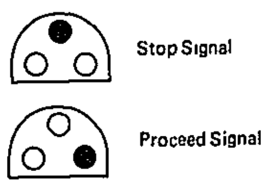
Legend



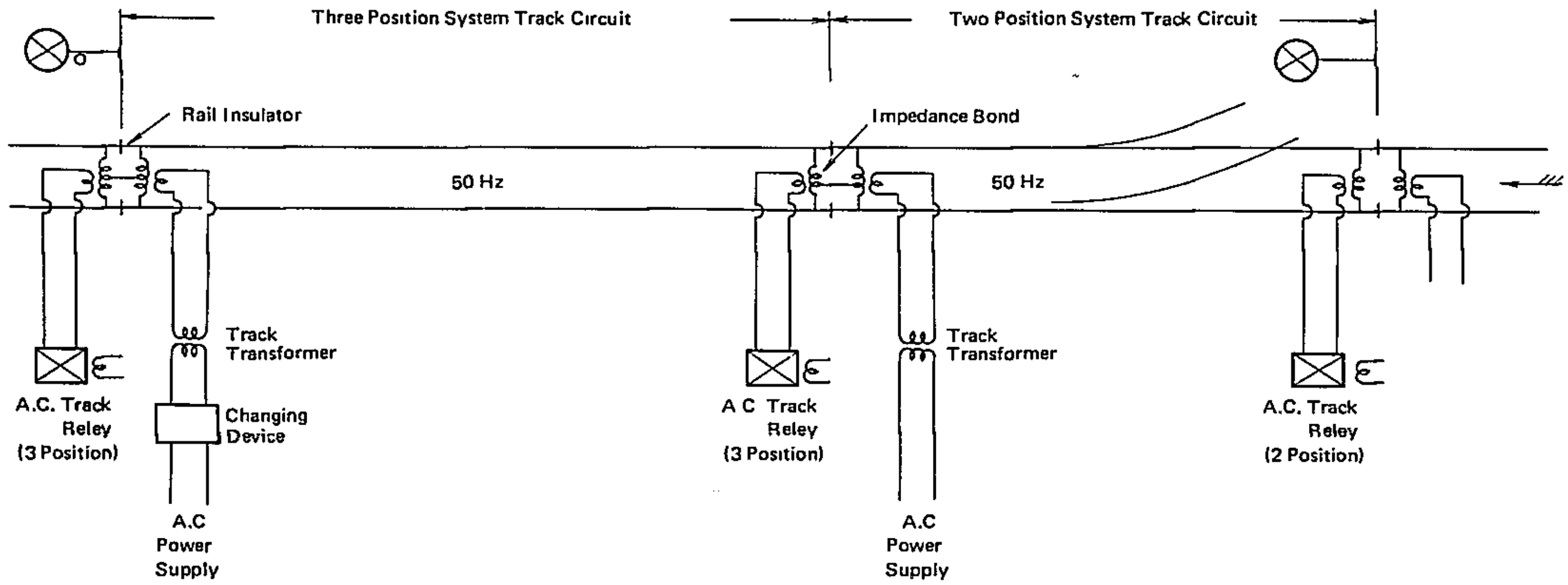


Fig. 4.5.3 Track Circuit	Legend
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4) Switch machine

An electric switch machine operated with a motor is used for switching.

When an electric switch machine is used, whether switching and locking of the switch machine are positively made or not can be indicated by using electricity. In addition, it can be easily made to electrically establish the relationship between a train and its course. Therefore, it is a device of high degree of security that keeps extremely high reliability together with shortening of switching time.

An electrical switch machine and its operation are shown in Fig. 4.5.4.

5) Interlocking device

Relay interlocking by the combination of a group of relays is used as the interlocking device.

The advantages of relay interlocking from the standpoint of security degree and handling are as follows:

i) Interlocking between a signal and a signal, between a signal and a switch machine and so forth are entirely constituted with a relay circuit. Therefore, erroneous faults caused by mechanical wear will never occur.

ii) All the circuits have been designed to operate on the safety side.

iii) Every possible interlocking is made with the information from the track circuit as the fundamental conditions of the equipment, handling is easy and it is possible to eliminate human errors.

iv) Route setting can be quickly made because it can be simply made with a switch and pushbutton provided on the control panel compared to handling of a mechanical lever, which is nearly a manual labor. In addition, the set route is indicated with a lamp on the panel surface, and erroneous route setting can be checked.

v) Handling becomes easy and the interlocking device can be reduced in size and scale. Therefore, it is possible to integrate lever handling places located at a number of locations to one location. It is more advantageous for operation handling.

vi) All of the conditions required by the handler are accommodated on the control panel. Therefore, it is not necessary that the lever handling place has a good vision of the station yard, and the floor space of the building can also be reduced.

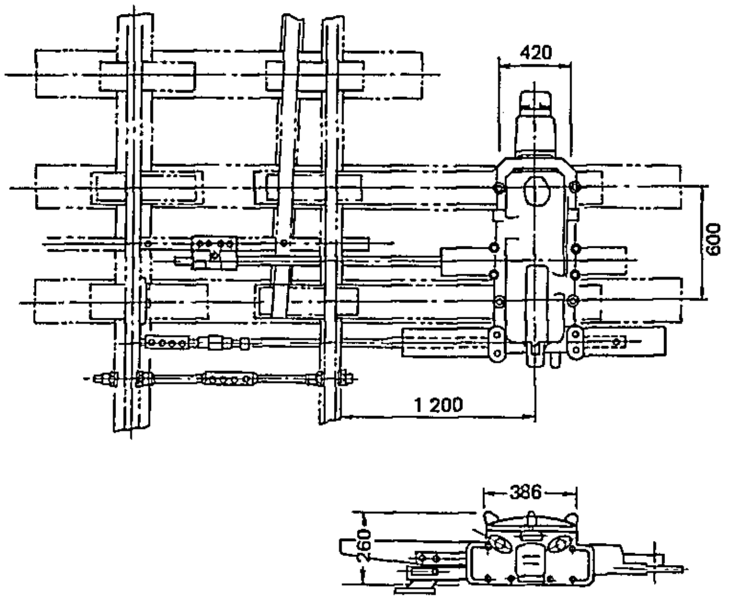
vii) When it is necessary to change the tractk layout, change work of layout can be made very easily compared to mechanical system.

The system and composition of a relay interlocking device are shown in Fig. 4.5.5.

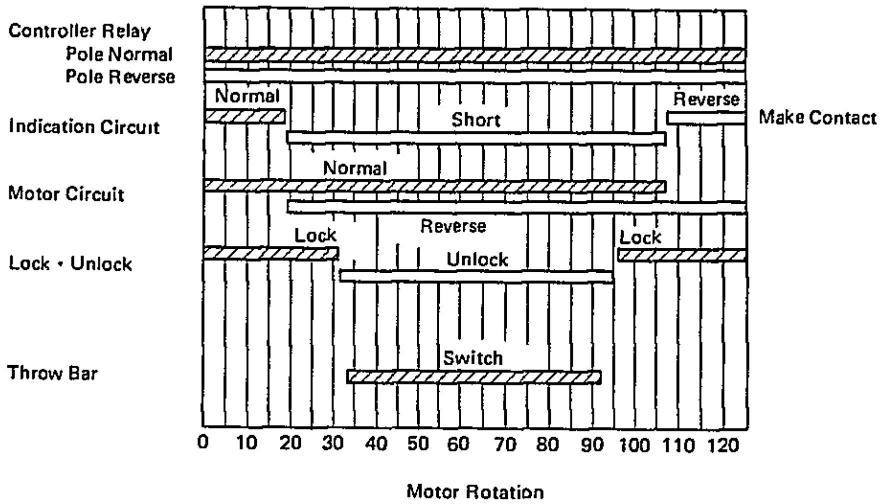
4.5.2 Telecommunication equipment

Telecommunication equipment is used for exchanging information of various kinds for smoothly performing of transportation work.

Reconditioning and improvement are being made under the Intermediate Program and so



Scale unit in: mm



Electric Switch Machine Movement

Fig. 4.5.4

Electric Switch Machine

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Legend

Scale Unit: in mm

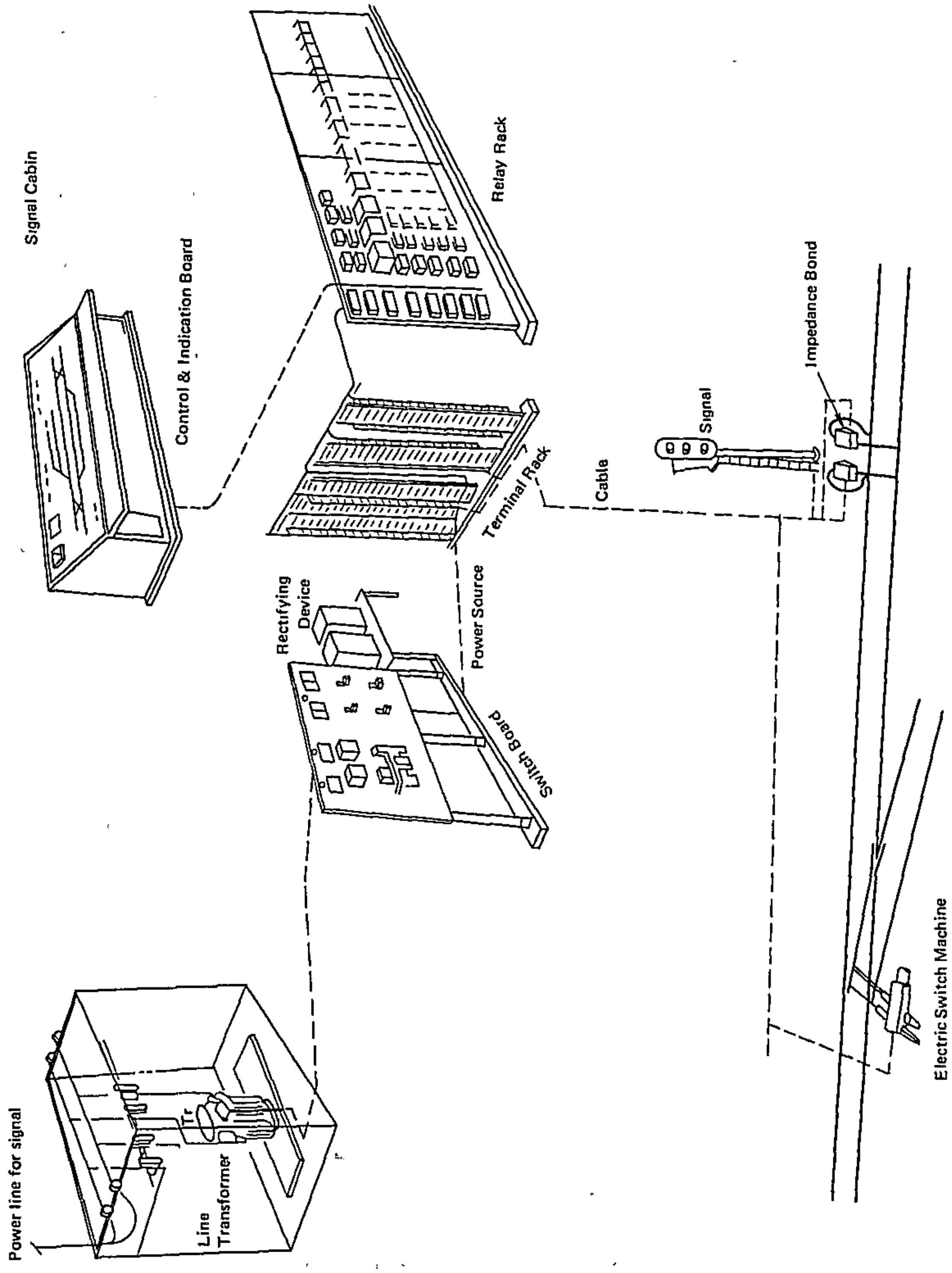


Fig. 4.5.5 Relay Interlocking Device	Legend
JABOTABEK Area Railway Transportation Study	

forth in JABOTABEK Area and Serpong Area on many matters including commanding telephone system, train wireless telecommunication equipment, PCM carrier equipment and use of cables for transmission circuits. In this plan, therefore, telecommunication equipment for yard workers will be provided accompanying provision of relay interlocking devices.

Telecommunication equipment for yard workers.

The equipment used for mutual telecommunication among signalmen, switchingmen and train operators at the time of performance of shunting works at station yards, railcar deports, etc., for performing route composition, coupling and releasing of railcars and so forth at high efficiency.

Besides, the places where home signals are provided will be equipped with telephone sets of voice calling system for enabling telecommunication with signal boxes.

4.6 Railcars and Inspection and Rapair System for Railcar

4.6.1 Outline

The number of electric railcars and diesel railcars, input of which by the Indonesian State Railways was commenced in 1976 as a part of the railway improvement program in JABOTABEK Area reached a level of 40 and 46 respectively as of December 1, 1980.

Electric railcars are being operated in the train-set of four railcars, mainly between Jakarta and Bogor. Diesel railcars are being operated in the train-set of two or four railcars for medium distance transportation among Jakarta, Krawang, Purwakarta, etc. as well as in the non-electrified sections in the suburbs of Jakarta. Although the railcars to be added together with advancement of the railway improvement program may basically be sufficient to be of the specifications identical to those of the existing railcars, it is necessary to improve the railcar inspection and repair system to match new railcars.

4.6.2 Performance and structure of railcar

The railcar performance and structure were partially modified with the local situations and working conditions reviewed after introduction of railcars under the Intermediate Program Phase I. Main contents of the modifications are shown in Table 4.6.1

Although introduction of railcars of new types such as thyrister controlled railcars can be assumed together with advancement of technology regarding performance and structure of railcars to be input in the future, it is recommended that the specifications for the existing rail-cars are basically followed as viewed from the line conditions and operation plan in JABOTABEK Area.

Large economic effects can be expected in the aspects of both operation and maintenance by the input of railcars of same specifications.

Table 4.6.1 Main Modifications in Specifications (EC/DC)

Kind of railcar	Item	1st stage railcar	Post 1st stage railcar
Electric railcar	No. of side entrances	2 on one side	3 on one side
	Height of entrance from floor level	1,535 mm	1,760 mm
	Structure of entrance step	2 stages fixed	1 stage fixed 1stage tip-up type
	Lavatory	None.	Installed on the opposit side of driver's cab
	Seat arrangement	–	Changed to all bench type
	Car-end coupling electric wire	–	New installation of coupling wire to connect additional railcar
Diesel railcar	No. of side entrance	2 on one side manual operation	3 on one side automatic operation
	Height of entrance from floor level	1535 mm	1760 mm
	Structure of entrance step	2 stage fixed	1 stage fixed 1 stage tip-up type
	Type of diesel engine	DMH 17H 180 PS/1500 r.p.m.	DMH 17HSA 290 PS/1800 r.p.m.
	Type of hydraulic torque converter	TC2A	TC25A with reversing gear
	Structure of Bogie	Mono axle driving gear system Body suspention by center plate	Two axles driving gear system Body suspention by side bearings

4.6.3 Railcar inspection and repair system

(1) Basic thought

As railcars are used and as time elapses, wear, deterioration, corrosion and so forth occur to them, and performance and functions gradually decrease. After railcars have traveled a certain distance or during certain period of time, it is necessary to inspect various conditions of railcars and to make restoration to the original conditions by carrying out repair as required.

It is necessary to determine the contents and frequency of this inspection and repair in order that performance and functions of railcars are maintained at a fixed level and also that the maintenance cost is limited to the minimum. It is because railcar maintenance cost occupies a relatively large weight in the railway management expenses.

For accomplishing the purpose stated above, the inspection and repair is set as clas-

Table 4.6.2 Types, Details, Cycles and Site of Inspection (EC)

Types and Details of Inspection			Periodicities		Site of Inspection
Types		Details	Intervals	Running Distance	
Periodical Inspection	General inspection	Inspection conducted comprehensively in detail by dismantling each component part at prescribed intervals depending on the state of use of the electric car.	4 years or less	600,000 km or less	Workshop
Periodical Inspection	Principal equipment inspection	Inspection conducted at prescribed intervals depending on the state of operation of cars for the condition of principal equipments such as traction motors, trucks, running gears, brake equipments, current collectors, auxiliary motors, relays, contactors, couplers, ATC devices, instruments etc., and by dismantling specified principal parts for details.	2 years or less	300,000 km or less	Workshop
Periodical Inspection	Bogie inspection	Inspection conducted in detail at prescribed intervals depending on the state of operation of cars by dismantling specified principal equipments such as traction motors, trucks, running gears, brake equipments, etc., and by disassembling specified principal parts for details.	1 year or less	150,000 km or less	Depot
Periodical Inspection	Regular inspection	Inspection conducted at prescribed intervals depending on the state of operation of cars for the condition, actions and functions of pantographs, high tension circuits, main circuit system, rotary machines, door operating devices, brake equipment, trucks, running gears, ATC devices, instruments, etc. in as installed state.	60 days or less	30,000 km or less	Car depot
Daily	Trip inspection	Inspection conducted from outisde in conformity to the state of operation of cars for replenishment and replacement of abrasive parts and for condition and action of pantograph, door operating devices, interior equipment, trucks, running gears, coupling devices, etc.	48 hours or less	3,000 km or less	Car depot
Occasional	Extra inspection	Inspection conducted whenever need arises because of trouble of rolling stock.	Occasional	–	Workshop, Car depot

sified into the following three kinds based on the experience gained in Japan for a long period of time as well as one the present situation in Indonesia.

a. Daily inspection, adjustment and servicing accompanying operation . . . Trip inspection

b. Periodically conducted inspection and repair . . . General inspection, inspection of principal equipment, bogie inspection and regular inspection.

c. Occasional inspection conducted as required . . . Extra inspection

(2) Inspection system (Type, detail, cycle and site of inspection)

The inspection system is needed for the purpose of clarifying the inspection cycles and roles of the departments in charge of inspection and repair, and therefore, it is what should be specified with examination made in detail.

The type, detail and inspection cycle are established for guaranteeing the performance and functions of railcars until the next inspection in such a manner that excessive repair is not made.

The site of inspection is determined with the relationship between the length of time required for inspection and railcar operation, extent of disassembly accompanying inspection and integration of required facilities taken into consideration.

The new inspection system is shown in Table 4.6.2. The new inspection system has been largely changed compared to the existing system, but it was judged that it is possible to conduct inspection in accordance with this system through materialization of improvement of inspection and repair equipment, grading-up of maintenance workers and smoothening of purchase of materials.

4.7 Manggarai Workshop Improvement Program

4.7.1 Outline

Manggarai Workshop is currently in charge of general inspection (including one year inspection) of about 650 passenger cars, 40 electric railcars and 46 diesel railcars.

According to the Master Plan of the Railway Transport Improvement Program in JABOTABEK Area, the number of electric railcars will increase to 584 and the number of diesel railcars will increase to 104 by year 2000. (Table 4.7.1.)

Table 4.7.1 Trends in Number of Vehicles

Item	Phase 1 (1984 ~ 1987)	Phase 2 (1988 ~ 1991)	Phase 3 (1992 ~ 2000)	Total
Electric railcar	116	128	318	562
Diesel railcar	36	12	–	48
Total	152	140	318	610

A workshop improvement program is proposed based on the assumption that general inspection and principal equipment inspection of these railcars are conducted at Manggarai Workshop. Main contents of the proposal are as follows:

a. Method of inspection and repair of railcars at the workshop
b. Four basic layout plans of the workshop with year 2000 as the target is a typical a typical layout plan in the case where inspection of passenger cars is transferred to another workshops
c. The steps of investment with the most favorable plan and their contents
d. Details of investment to be made in the first step

e. Basic thought of material management system

4.7.2 Scope and description of works of workshop

Besides inspection and repair of railcars, Manggarai Workshop is in charge of many kinds of works such as welding of rails, casting, repair of signalling equipment, provision of services to depots such as distribution of railcar component parts to depots as well as maintenance of workshop facilities.

The contents of main works to be conducted at the workshop regarding inspection and repair of railcars are as follows :

a. General inspection and principal equipment inspection
b. Occasionally required inspection and repair
c. Repair and management of spare parts
d. Managment of purchased parts
e. Distribution of railcar component parts to depots
f. Maintenance of workshop facilities
g. Maintenance and control of measuring instruments and testers
h. A part of technical training of workshop staff members (on-the-job training, etc.)

4.7.3 Scale of workshop

The future scale of the workshop is determined based on the precondition that it will be in charge of inspection and repair of about 700 electric railcars, about 110 diesel railcars and about 700 passenger cars (the present number was adopted for passenger cars because the future transportation plan has not yet been determined) as described in Item 4.7.2 . It is estimated that the number of railcars inspected and repaired at this workshop per year will increase as shown in Fig. 4.7.1.

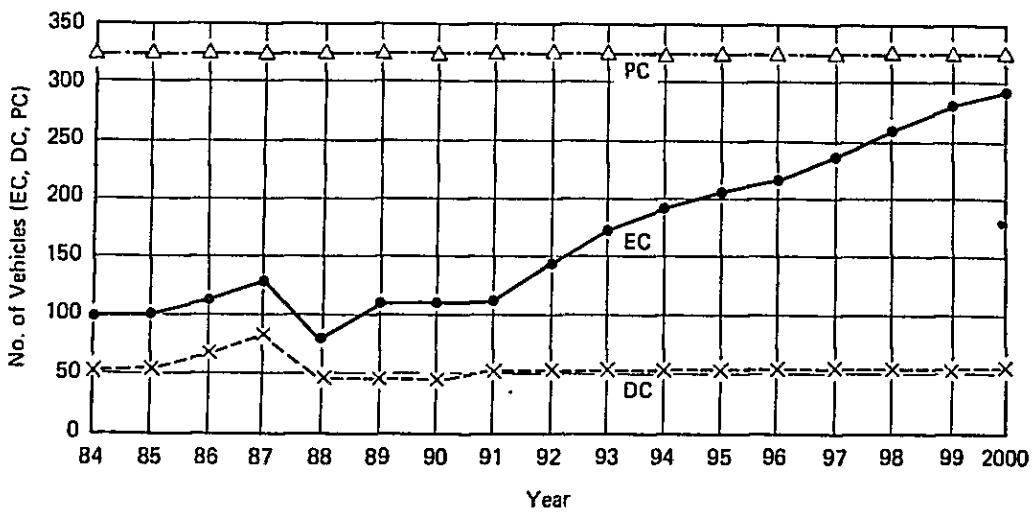


Fig. 4.7.1 Trends of Number of Vehicles to be Inspected

4.7.4 Inspection and repair system at workshop

It is necessary that railcar inspection and repair works at the workshop are performed as matched with the purpose and details classified by the type of inspection and repair specified in Table 4.6.2 and with sufficient accuracy, rationality and high efficiency. The fundamentals of the inspection and repair system are determined as follows to accomplish is objective:

1) Periodic inspection should be conducted in accordance with the predetermined time schedule.
2) Trial running should be made with railcars which were subjected to periodic inspection or occasional inspection or modification to principal components such as drive units, control units and brakes.
3) The railcar repair is classified into three processes shown in Fig. 4.7.2 and Table 4.7.2, and independent control should made in each of these processes.
   It will become possible to accomplish shortening and stabilization of processes and smoothening of works as a result.

Table 4.7.2 Processes for Inspection and Repair

Processes	Work
No. 1	Body and equipment as assembled in body are inspected.
No. 2	Equipment disassembled from body are inspected.
No. 3	Necessary parts and materials for No. 1 and No. 2 processes are manufactured or prepared.

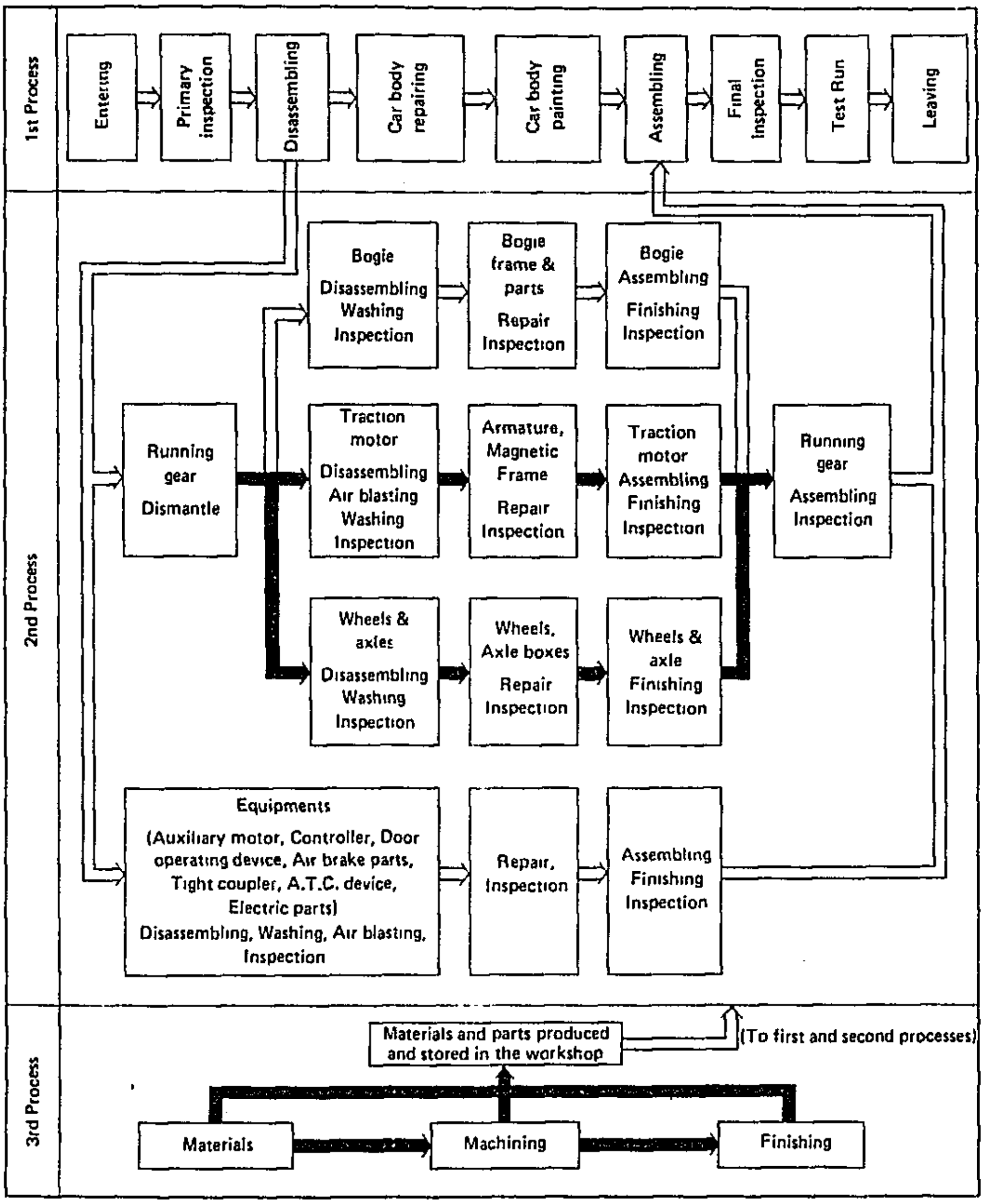
4.7.5 Basic thought of equipment improvement plan

It is necessary to examine the basic matters for designing the workshop equipment improvement plan from many different viewpoints. This plan is based on the following thoughts with the present situation of the existing workshop and developability to the future taken into consideration.

a. The plan should have flexibility to cope with changes to the plan in the future.
b. The existing building should be utilized as much as possible.
c. Identical works should be centralized.
d. Good working environment should be secured.
e. Works which are directly and closely related should be combined as a rule.
f. Machining of parts should be centralized.

4.7.6 Number of days to be required for inspection and repair of railcars

Both electric and diesel railcars make entry into the workshop in train-sets, and the number of days to be required for inspection and repair is 30 days per train-set, but 25 days per train-set is the target after completion of improvement of equipment in the Stage 2. Standard processes for the inspection and repair are shown in Fig. 4.7.3.



Note: ➡ indicates the flow not directly affected by the first process.
In the second process, recirculated spare parts are to be used.

Fig.4.7.2 Basic Flow Chart in the Inspection and Repair Process	Legend
JABOTABEK Area Railway Transportation Study	

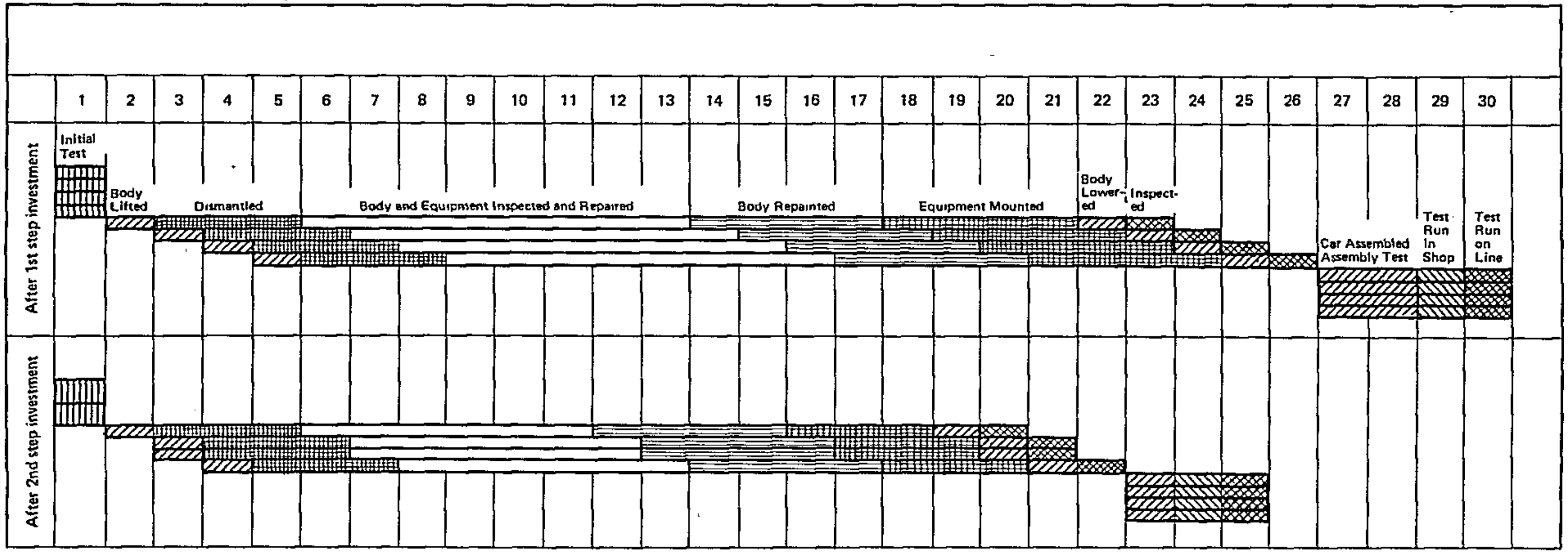


Fig. 4.7.3

Standard Process of Electric Railcar Inspection and Repair

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Legend

The number of days to be required for inspection and repair is affected by the inspection and repair is affected by the inspection and repair equipment, number of workers, railcar conditions, technical level of workers and procurement of materials. The basic and standard flow should be determined for each type inspection and control should be made so that the works are conducted in accordance with this standard flow.

The basic and standard process proposed is determined based on the result of simulation assuming the expected number of railcars to be inspected and repaired per year and contents of equipment improvement plan as the factors and with present situation of inspection and repair at Manggarai Workshop taken into account.

4.7.7 Alternatives of basic layout

Four Alternatives of the basic layout of the workshop in year 2000 are drawn up with conditions stated above as the basis.

These Alternatives are shown in Appendix Fig. 18 through Fig. 21. Their features are described below;

Alternative A:

Emphasis is laid on provision of rational flow of railcars and parts and on provision of flexibility to future changes to the plan. Consequently, it is necessary to remove the existing equipment to a major extent. The flow of works in this Alternative is shown in Fig. 4.7.4.

Alternative B:

The existing body repair shop is utilized to the maximum in this alternative. Required addition to the body repair shop is minor as a result, but flexibility to increase of equipment capacity is insufficient. The flow of body and parts is not good, either.

Alternative C:

The layout is basically identical to that of Alternative A, but the body paint shop is of tandem system. The flow of bodies is improved to a certain extent compared to Alternative B, but expansion of the paint shop is extremely difficult.

Alternative D:

This is a typical layout applicable to the case where inspection and repair of cars are transferred to another workshop. Although changes to the existing equipment are the minimum, there is a possibility where a large investment is required at the workshop which newly accepts cars.

Table 4.7.3 indicates a comparison of these Alternatives.

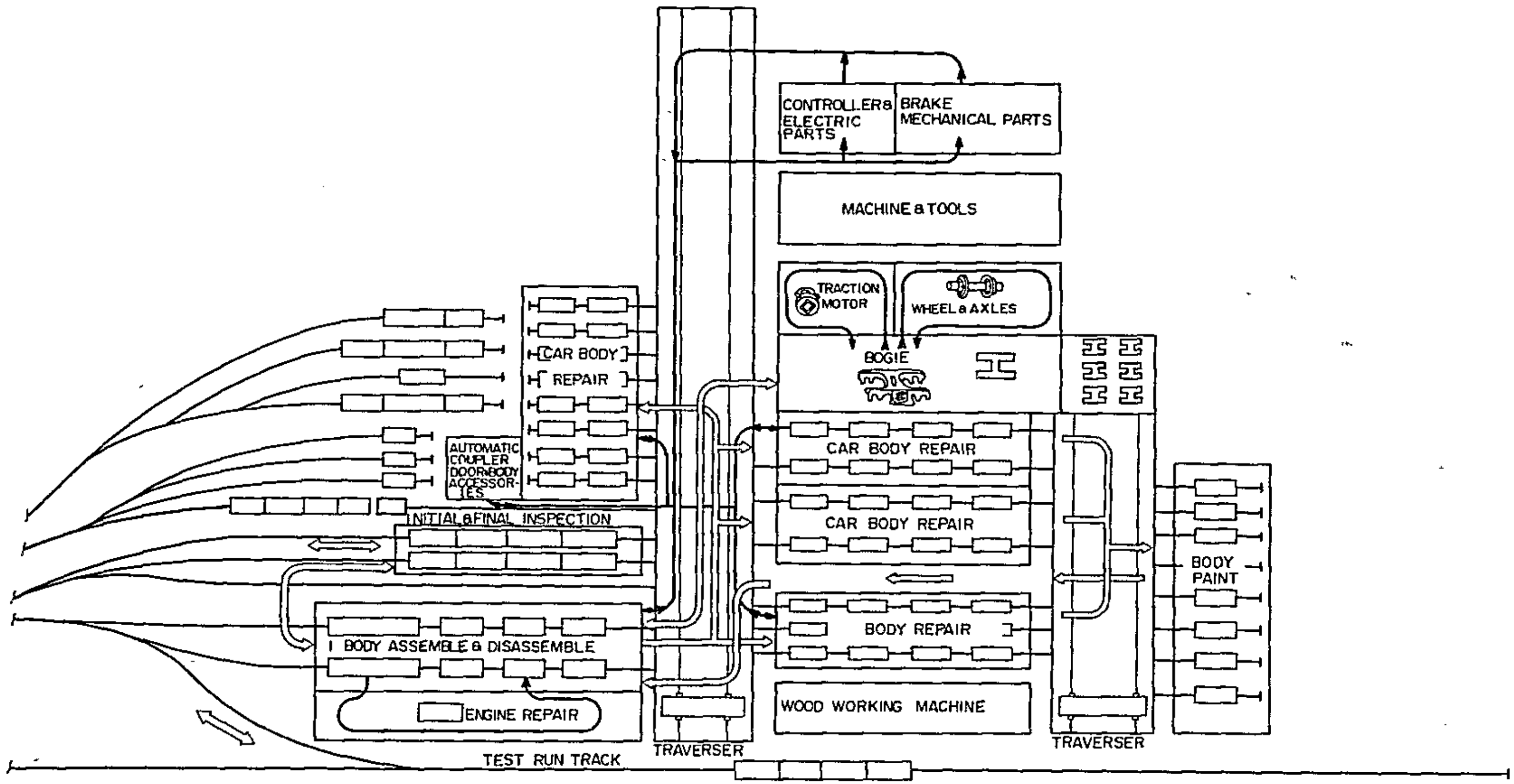

Fig. 4.7.4

Flow Chart of Main Works (Manggarai Work Shop)

JABOTABEK Area Railway Transportation Study

Legend

Table 4.7.3 Comparison of Alternatives A ~ D

Item \ Alternative	A	B	C	D
Flexibility for expansion of facilities	good	not good	not good	not good
Transport distance of body and parts	good	good	good	good
Flow of inspection and repair works	good	not good	not good	not good
Environment in shops	good	good	good	not good
Investment costs	high	medium	medium	low

Alternative A (hereinafter referred to as "A") is the plan selected for the object idea in this feasibility study.

Main reasons are as follows:

1) "A" has a rationality in the flow line of car bodies and parts to be inspected and repaired, consequently providing effective flow of works. Effective flow is one of the most important conditions for the good process control in workshop.
2) "A" is the most appropriate of the four Alternatives for coping with any changes in future.
   It is very important that the plan is flexible for any change, because this reinforcement project of workshops needs a large-scale investment to be accomplished in the coming 20 years.

4.7.8 Stages of improvement of equipment

It is necessary to execute the workshop equipment improvement plan step by step so that it becomes possible to conduct inspection and repair in correspondence to the increase in the number of railcars and cars assigned to this workshop. The time and basic contents of improvement were already described in the Master Plan. The time and contents of improvement of the Stage 1 and Stage 2, however, should be reviewed in the future in correspondence to the progress of improvement of transportation. The concrete contents of improvement in each step are indicated in the Appendix Fig. 22 and Fig. 23.

4.7.9 Improvement plan - Stage 1

The details of the improvement plan in the Stage 1 is shown in Table 4.7.4.

4.7.10 Material management system

Repair materials such as raw materials, parts, stock and consumables (hereinafter

Table 4.7.4 Improvement Plan - Stage 1

Item	Content/Function	Remarks
1. Test run track	Test running of train-sets after completion of inspection and repair	*Track length about 600 m *Overhead wire will be reconditioned
2. Inspection shed	Shed for initial and final inspection of train-sets	*Shed length of 100 m *With W-type-pit of 100 m length
3. Building for carbody repair		
4. Building for carbody painting		*Painting machine will be installed in 2nd step
5. Car transfer bridge		*Replacement of existing one *New construction for carbody painting work.
6. Equipments for inspection and repair of electric parts	(1) Lightning arrester testing machine. (2) Relay tester (3) Electromagnetic valve tester. (4) High speed circuit breaker testing machine. (5) Speed meter testing machine (6) Jumper coupler testing machine (7) Main controller testing machine (8) Pantograph testing machine (9) Others.	*1 set of each facility/ equipment is installed on electric parts repair shop.
7. Equipments for inspection and repair of air brake parts	(1) Air brake valve tester (2) Others.	*1 set, mechanical parts repair shop
8. Facilities and equipments for inspection and repair of rotary machines	(1) Tan δ measuring device (2) DC component measuring device (3) Layer shortcircuit testing machine (4) Commutator bar voltage drop measuring device (5) Terminal heat resisitance tester. (6) TIG welder (7) Ultrasonic defectscope	*1 set of each facility/ equipment is installed on rotary machines repair shop.
9. Facilities and equipments for inspection and repair of wheels and axles.	(1) Magnetic defectscope (2) Wheel sets washing machine (3) Washing machine for roller bearing and axle boxes (4) Others.	*1 set of each facility/ equipment is installed on wheels and axles shop.

Item	Content/Main Function	Remarks
10. Equipment for final inspection of train-set	(1) EC wiring tester (2) EC brake tester (3) High-pressure air compressor. (4) Testing power source (DC 100V)	*Train-set inspection shed.
11. Others.	(1) Underbody equipment fitter-unfitter. (2) Movable stand for working. (3) Others.	*Body repair shop.

generally called materials) of many kinds are required for conducting inspection and repair of railcars and cars. Whether these materials are suitably prepared or not exerts major influence over the following matters:

i) Number of days required for inspection and repair of railcars

ii) Quality of railcars and cars

iii) Railcar and car maintenance cost

In the case where main materials are dependent on import in particular, there are many cases where it becomes difficult to conduct inspection and repair due to lack of materials. The basic conception of material management is described below;

1) Basic works of material management

The works of material management can be generally classified into the following four categories:

a. Material planning

b. Purchase

c. Custody and distribution

d. Spares control

There are many cases where the required repair of railcars does not become clear unless railcars and equipment are dismantled, and it is difficult to correctly forecast the required materials in advance. However, it is essential to forecast the required repair to the most possible extent through reffering good records of repair history regarding the extent of deterioration of railcars and equipment as well as their operating conditions.

2) Spares control

Of the works of material management, spares mangement is extremely important for stabilization of number of days required for inspection and management and for smoothening of inspection and repair work volume, in other words, for reduction of inspection and maintenance cost.

Spares management is a repair process management independent from railcar bodies out of parts and equipment permitting repeated repair. Spares are determined based on the following thoughts:

i) Reuse should be possible through repair.

ii) Repair cost should be lower than the cost of purchase of new parts.

iii) The period of time required for repair should be longer than that for railcar bodies.

iv) The repair work volume should be adjustable.

It is a large loss from the aspects of both transportation and economy of the country if operation of valuable assets, namely, railcars, is suspended due to lack of a single part. We hope that the material management system is reviewed and established.

4.8 Railcar Depots

4.8.1 Necessity of reinforcement of railcar depots

The railcar depot in Bukitduri is used as a depot for electric railcars, diesel railcars and diesel locomotives, but its railcar storage capacity is extremely small. Even when electric railcars only are stored, it is considered that about 70 railcars is the limit, and expansion of this depot is extremely difficult because it is surrounded by dwellings and streets on both sides.

The number of electric railcars will become 200 and all the trains will be of eight railcar train-set at the time of completion of electrification of Bekasi Line because of advancement of the project, as shown in Table 3.4.1 and Table 3.4.2. The following problems are involved if regular inspection and bogie inspection of all of these electric railcars should be conducted at the railcar depot in Bukitduri, and it is considered to be advantageous to make haste to construct a new railcar depot.

1) The regular inspection shed is a facility that corresponds to a train of four railcar train-set. Regular inspection of a train of eight railcar train-set is conducted with a train split into two sections, and the working efficiency decreases.
2) The effective line lengths of storage tracks are short, and the number of tracks capable of storing trains of eight railcar train-set is minor. Separating and coupling works will become difficult as the number of electric railcars and diesel railcars increases.
3) The incoming/outgoing line between the railcar depot and Manggarai Station is of single track and the distance is as long as about 1.5 km, and incoming/outgoing works are difficult.
4) Because of the fact that trip inspection of diesel railcars are conducted in the same inspection shed, there is a fear that oil and dust attach to the electrical equipment of electric railcars. It is desirable that inspection and repair of diesel railcars and electric railcars are conducted at different places.

It is considered that a period of four years is required for construction of a new railcar depot. Therefore, its construction should be started simultaneously with start-up of the project so that the new railcar depot can be used at the time when electrification of Bekasi Line is completed, in order to solve the problems stated above and to improve efficiency of inspection and repair works.

Furthermore, the storage tracks of the car depot in Jakarta Kota will be reinforced to be used for storage of electric railcars in order to cope with increase of number of electric railcars until beginning of use of the new railcar depot. This depot is extremely and conveniently located for railcar operation because it is close to Jakarta Kota Station and Tanjung priuk Station, which are terminal stations of Central, Eastern and Western Lines. Therefore, the equipment for trip inspection and body cleaning will also be provided at this depot for making effective use of electric railcars. These equipment will also be used after completion of the new railcar depot.

If trip inspection and body cleaning are performed at this car depot, it becomes unnecessary to return electric railcars back to the new railcar depot at all times. It will become satisfactory if the train operation diagram is considered so that electric railcars are brought to the new railcar depot at the time of regular inspection and bogie inspection.

4.8.2 Improvement of Jakarta Kota railcar depot

(1) Addition of storage tracks

It is expected that 48 railcars of 6 train-sets will stay at Jakarta Kota railcar depot after completion of electrification of Bekasi Line as shown in Fig. 4.8.1. Accordingly, the layout of the group of storage tracks on the northern side of the car depot will be made and the effective track length will be extended as shown in Fig. 4.8.1. Table 4.8.1 indicates a comparison of track effective length between the present and after completion of extension work. The effective length will be extended by about 1,000 m in total.

Table 4.8.1 Comparison of Track Effective Length at Jakarta Kota Railcar Depot

Track No.	Present effective length (A)	Effective length after completion of extension work (B)	Balance (B – A)
1	180 m	370 m	190 m
2	170	330	160
3	205	370	165
4	155	190	35
5	155	190	35
6	185	230	45
7	185	240	55
8	230	290	60
9	165	270	105
10	105	270	165
Total	1,735	2,750	1,015

Electric railcars of two train-sets will be stored per track, and one trip inspection track, three storage tracks and one turn-out track will be added, and an electric railcar track will be added to the incoming and outgoing section track from and to Jakarta Kota Station. One track out of three storage tracks will be used as a passage track.

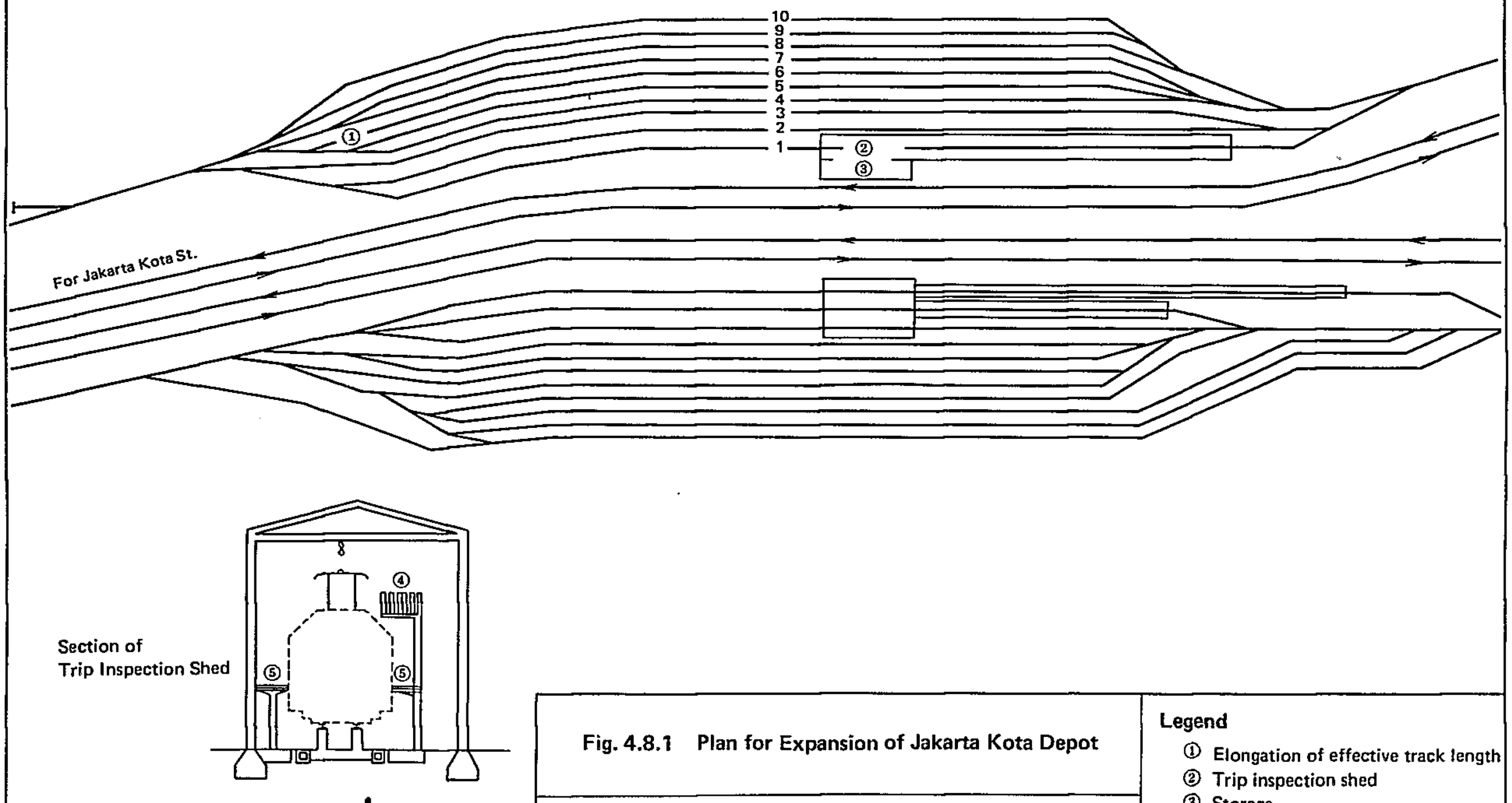

Fig. 4.8.1 Plan for Expansion of Jakarta Kota Depot	Legend ① Elongation of effective track length ② Trip inspection shed ③ Storage ④ Inspection stand for pantograph ⑤ Body wash stand
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(2) Trip inspection and cleaning equipment

Track No. 1 is assigned as the track for trip inspection and cleaning, and trip inspection equipment such as inspection shed, pantograph inspection platform, overhead wire disconnecting switch, warehouse and office as well as cleaning platform, water supply equipment and so forth will be newly provided. The outline of these equipment is shown in Fig. 4.8.1

4.8.3 New railcar depot in Depok

(1) Location

Inside of Jakarta, Bogor, Depok, Bekasi and so forth can be considered as the location of the new railcar depot, but Depok was selected because of the following reasons:

1) It is hard to secure the land in Jakarta.
2) Although Bogor is a terminal station of already electrified Central Line and it is favorably located from the standpoint of electric train operation, the time of completion of double tracking is too late. It will become impossible to make diagram setting in accordance with increase of traffic loads and increase of number of deadhead trains.
3) Bekasi is suitably located, but the time of completion of the depot will be the same as the time of completion of electrification. It is necessary to hasten completion of electrification facilities for conducting inspection and trial running of additional railcars for commencing electrified services.
4) Depok is also located along already electrified Central Line. Double tracking to the urban line is same as the time of completion of the electric train depot, and there is no problem from the standpoint of diagram formation. Furthermore, there are steps in the passenger traffic loads, and both starting and termination of trains will be continually involved in the future, and therefore, it is favorably located from the standpoint of operation of electric trains.

(2) Scale of railcar depot in Depok

The number of electric railcars in JABOTABEK Area will become as many as 662 in year 2000 as already described in the Master Plan. The railcar depot in Depok will be of a scale that will be capable of coping with increase of number of railcars to be made after 2000 to a certain extent, and it will be reinforced in three phases with the final target of storage of 700 railcars.

In Stage 1, urgently required equipment, that is, equipment for trip inspection, regular inspection and bogie inspection as well as minimum required storage tracks will be reinforced. Those items of Stage 2 and subsequent which are of large duplicate effort such as buildings will be reinforced in Stage 1. In Stage 2 and subsequent, the equipment for improving efficiency of inspection, repair and so forth of electric railcars, that is, the equipment required for employment of bogie replacement system in bogie inspection, wheel milling machine, body automatic cleaning machine and so forth will be introduced to build up a modern railcar depot.

(3) Layout of railcar depot in Depok

Typical layouts of a railcar depot includes a case where inspection and repair lines are arranged in tandem with storage lines and a case where they are arranged in parallel, as shown in Fig. 4.8.2. The latter is easy to use because the range of yard work is relatively concentrated. However, shunting work becomes difficult as the scale of the depot increases, because shunting of railcars is concentrated to one place. With the former, on the other hand, shunting work can be easily performed, although the working range is broad.

As the railcar depot in Depok will become a large of the final scale of 700 railcars, the layout to arrange storage lines and inspection and repair lines in tandem is adopted.

The principal inspection and repair facilities to be constructed in Stage 1 are two inspection tracks good for eight-railcar train-set, three trip inspection tracks, one bogie inspection track corresponding to two railcars and one repair track as well as buildings such as sheds for these railcars and offices. The regular inspection tracks and preoperational inspection tracks will be equipped with overhead wire disconnecting switches and roof top inspection platforms. The trip inspection tracks will also be equipped with cleaning platforms and plumbing facilities, as they will also be used as cleaning tracks.

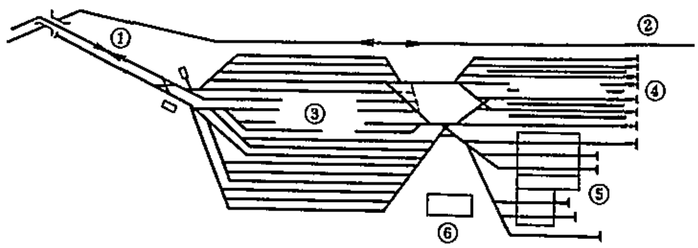
The machinery and equipment to be installed include two overhead traveling cranes, three lifting jacks, air compressors, machine tools, incinerators and so forth.

The storage tracks will be of the lengths which are capable of storing two train-sets per track as required, and it is planned to construct 20 storage tracks in Stage 1. This storage capacity is corresponding to the number of railcars to be increased up to 1994 in which construction works of Stage 2 will begin. At the time of commencement of use of the railcar depot in 1988, it will be satisfactory as shown in Fig. 4.8.2 if storage capacity of 12 train-sets, 96 railcars is provided. In other words, nine storage tracks are sufficient. Therefore, it is necessary to examine sequential addition of storage tracks unless there is any problem in the execution of works.

Fig. 4.8.3 indicates the layout of the entire depot including building facilities. Dotted lines indicated in this figure show what will be reinforced in the works of Stage 2 and subsequent.

Interlocking range covers between the Depok Station and arriving and leaving lines in depot. Trains between the Depok Station and depot are operated by switching signal. Other lines except arriving and leaving lines in depot are out of interlocking range.

(a) Typical layout in which storage lines are arranged in series with inspection and repair lines



(b) Typical layout in which storage lines are arranged in paralled with inspection and repair lines

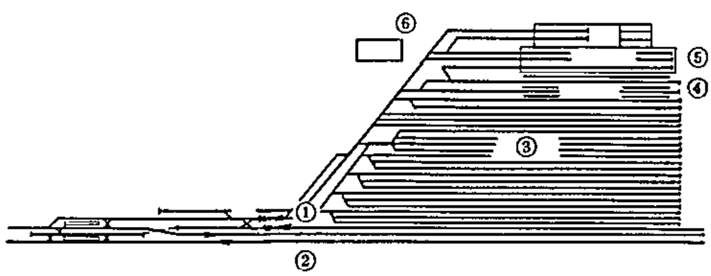


Fig. 4.8.2 **Typical Layouts of Railcar Depots**	**Legend** ① Access Line ② Main Line ③ Sidings ④ Body Wash Stand ⑤ Inspection Shed ⑥ Train Operation Center
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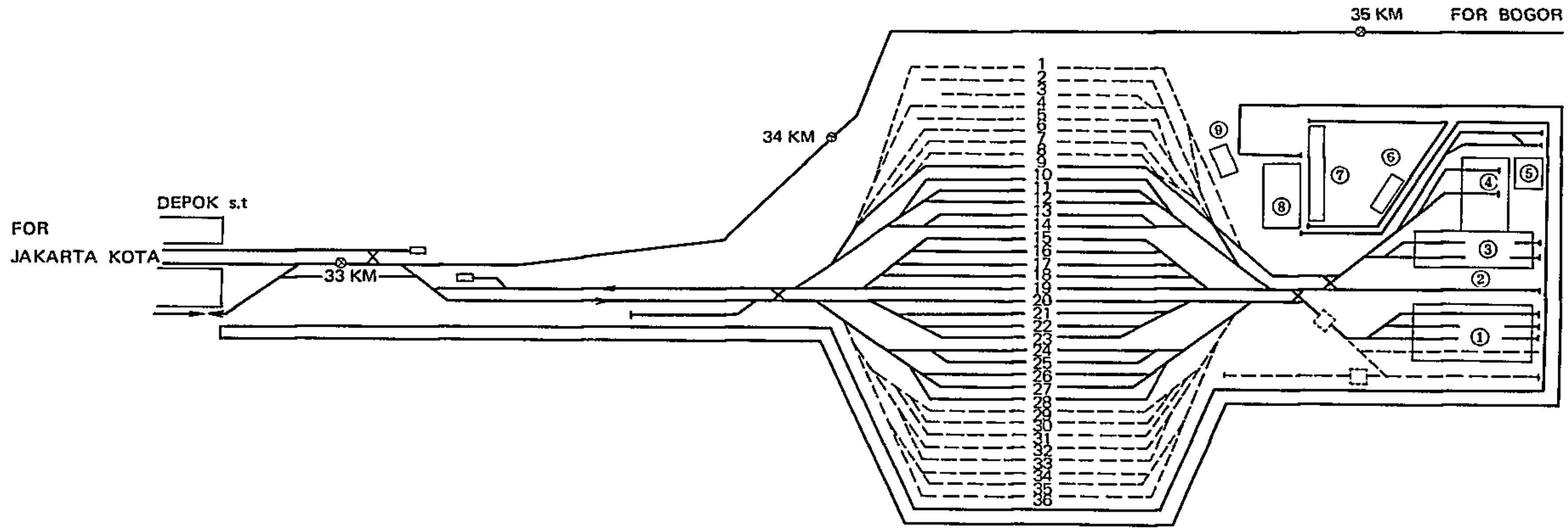

Fig. 4.8.3

Layout of New Depot at Depok

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Legend

① TRIP INSPECTION AND CAR WASHING TRACK
② TRAIN MAKE UP TRACK
③ REGULAR INSPECTION TRACK
④ ENGINE DEPOT TRACK
⑤ STORAGE
⑥ INSPECTION DEPOT
⑦ QUARTER FOR DRIVER & CONDUCTOR
⑧ TRAIN OPERATION CENTER
⑨ TRAIN DISPATCH CENTER OF DEPOT