Table 2.25 Estimated Percentage Share of Mass Transit

	1995		2005	
	Trips (x1000)	(%)	Trips (x1000)	(%)
Person Trips by All Modes	9,487	(100.0)	12,421	(100.0)
Person Trips by Mass Transit	5,508	(58.1)	7,727	(62.2)

2.4.4 Forecast of Future Railway Passenger Traffic

(1) Modal split between railway and bus

Based on the up-dated 1983 O-D matrices for bus passengers and railway passengers, a modal split ratio was estimated comparing travel times by railway with those by bus for the interzonal volumes.

In order to simulate a travel time of interzonal trip by railway or bus the following preparatory work was carried out:

1) A road network with the information of link distance and travel speed by bus was prepared refering to the survey results of "Travel Time Study & Traffic Volume Count, DKI Jakarta, 1982/1983 by DLLAJR DKI JKT".

2) A railway network with the information of link distance and scheduled travel speed was prepared based on train operation diagrams.

3) A representative railway station was selected (if there was more than one station in the zone), based on the number of boarding passengers found by the traffic survey in this study.

4) A weighted average of the access/egress time between the representative station and the address of trip origin/destination was calculated based on the traffic survey and each zone centroid was linked to a representative railway station indicating the link data of the obtained average access/egress time.

5) Each of the representative railway stations was given the waiting time factor based on the frequency of train operation of each railway line.

To simplify the above description, Fig. 2.13 indicates a conceptual relation between road and railway network.

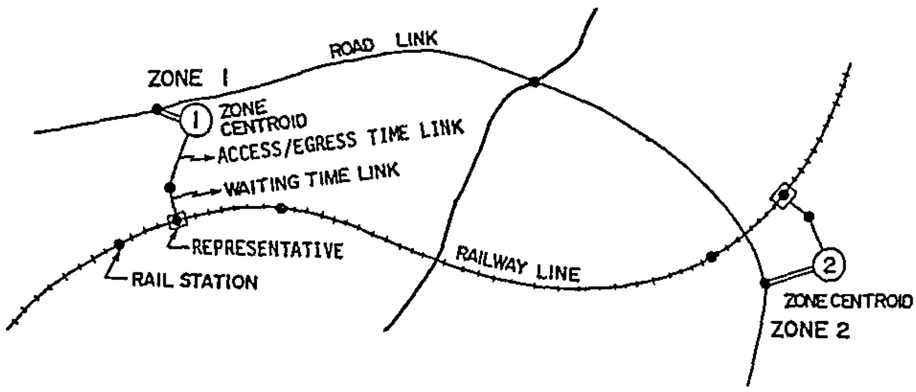


Fig. 2.13 Conceptual Relation between Road and Railway Network

Based on the data and information given by this preparatory work, a travel time for the interzonal trip by railway and bus was simulated by the minimum pass method on each of the railway and road networks. The distributed interzonal trip was thus examined to derive the travel time ratio of bus over railway, and the corresponding modal split ratio of railway passengers over bus passengers of the interzonal trips was computed and plotted to estimate a modal split curve for railway and bus passengers. As a result, Fig. 2.14 is the estimated modal split curve.

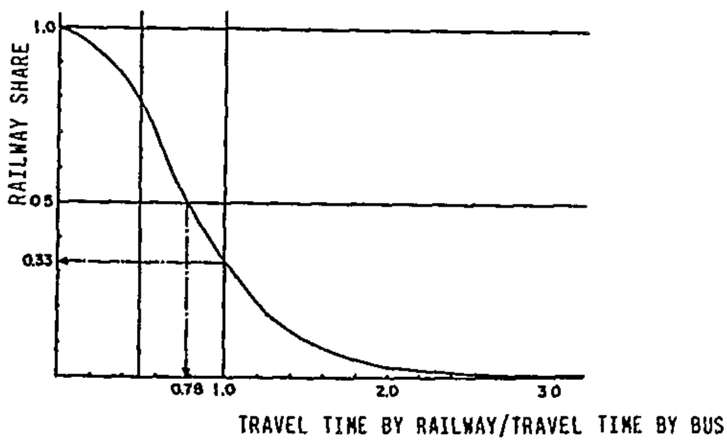


Fig. 2.14 Modal Split Curve between Railway and Bus

(2) Distribution of railway passengers

The future interzonal railway passenger traffic was computed from the four variables of the interzonal trips. These are travel times by bus, travel times by railway, access/egress times to/from railway stations and bus stops, and waiting times at the railway stations and bus stops. These variables of future travel time factors were assumed, based on the following considerations:

1) A future travel time by bus, inclusive of access/egress time and waiting time at bus stops, will not change in the central urban area but it will reduce by 5 km/hr in 1995 and by 10 km/hr in 2005 from the present for the area other than the central urban area of Jakarta. However, the travel speed by bus was assumed not to be less than 15 km/hr.

2) A future travel time by railway, inclusive of stopping time at stations, was planned to follow the Master Plan of JABOTABEK Railway.

3) A future access/egress time to/from railway station was considered to remain unchanged in the central urban area, but to be shortened by 10% and 20% from the present in 1995 and 2005 respectively for the area other than the central urban area of Jakarta. However, it was assumed that the average access/egress time for stations outside the central urban area was not reduced below 10 minutes.

4) The average waiting times at the railway stations were assumed to be 10(5) minutes and 20(10) minutes during peak hours and off-peak hours in 1995(2005) respectively.

Distribution of railway passengers was estimated on the established *modal split curve and the simulation of the travel time on road network and railway network with the above time variables. The share of railway transport and bus transport are shown in Table 2.26.

Note: * The fare level of the railway was assumed to be almost the same as that of the bus in both 1995 and 2005.

Table 2.26 Estimated Future Person Trips by Mode

Items	1995		2005	
	Trips (x1000)	(%)	Trips (x1000)	(%)
(1) Person Trips by All Modes	9,487	(100.0)	12,421	(100.0)
(2) Person Trips by Individual Transit	3,979	(41.9)	4,694	(37.8)
(3) Person Trips by Mass Transit:	5,508	(58.1)	7,727	(62.2)
Railway	(1,176)	((12.4))	(2,661)	((21.4))
Bus	(4,332)	((45.7))	(5,066)	((40.8))

The future distribution pattern of the movements of railway passengers is summarized in Table 2.27 and the desired traffic lines are shown in Figs. 2.15 - 2.18.

Table 2.27 Estimated Future OD Matrices of Railway Passengers in 1995 and 2005

(Unit: Person trip/day)

	Year	(1) DKI JKT	(2) BOTABEK	(3) OTHERS	(4) Total	Total Trips
(1)	1995	602,075	506,672	51,184	1,159,931	881,003
	2005	1,497,113	1,049,813	106,161	2,635,087	2,057,100
(2)	1995	-	14,804	852	15,656	268,566
	2005	-	24,330	1,953	26,263	550,213
(3)	1995	-	-	18	18	26,036
	2005	-	-	37	37	54,094
(4)	1995	602,075	521,476	52,054	1,175,605	1,175,605
	2005	1,479,113	1,074,143	108,151	2,661,407	2,661,407

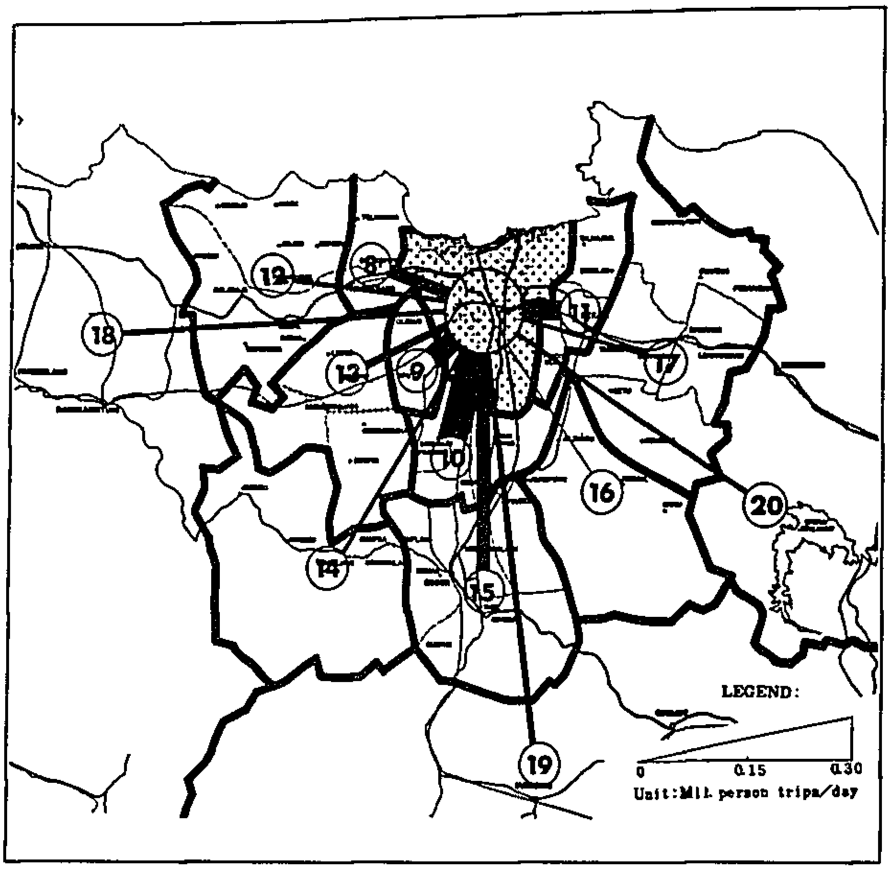


Fig. 2.15 Desire Traffic Lines of Railway Passengers Between Jakarta and Other Zones in 1995

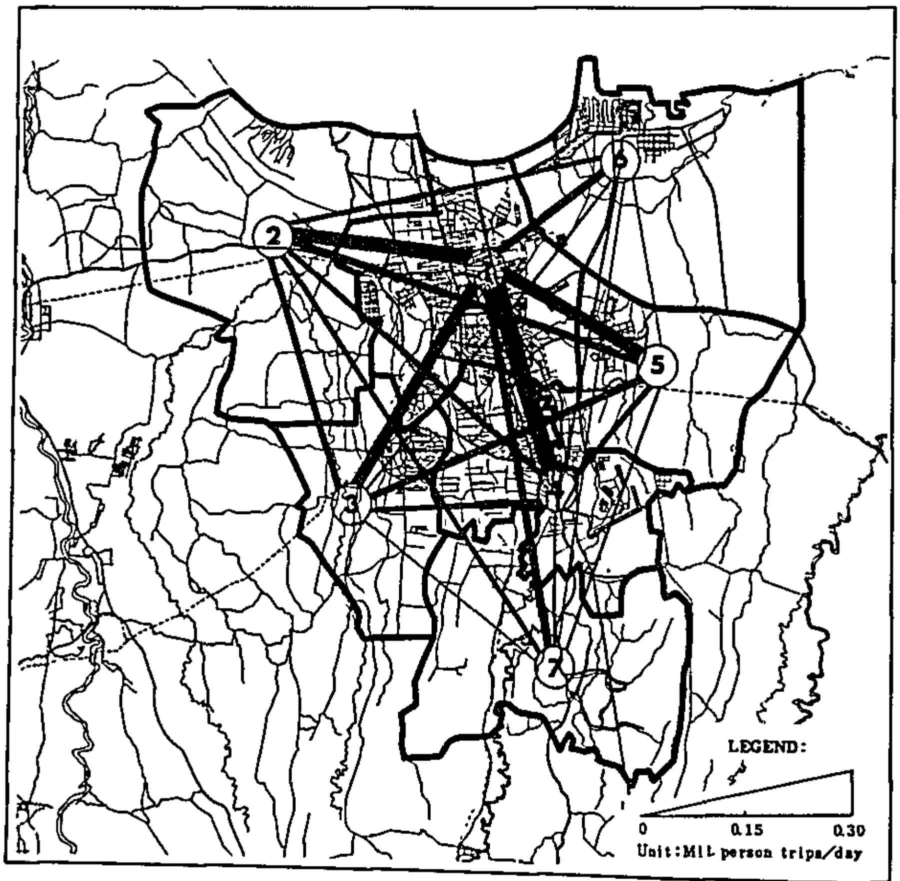


Fig. 2.16 Desire Traffic Lines of Railway Passengers Inside Jakarta in 1995

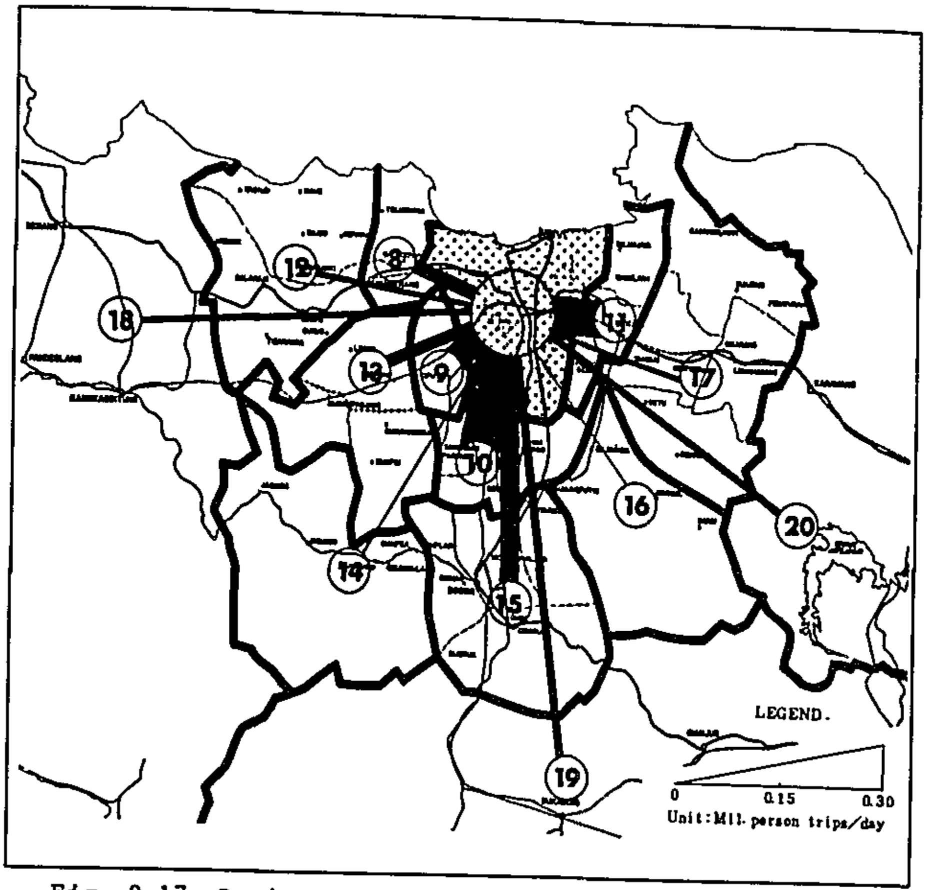


Fig. 2.17 Desire Traffic Lines of Railway Passengers between Jakarta and Other Zones in 2005

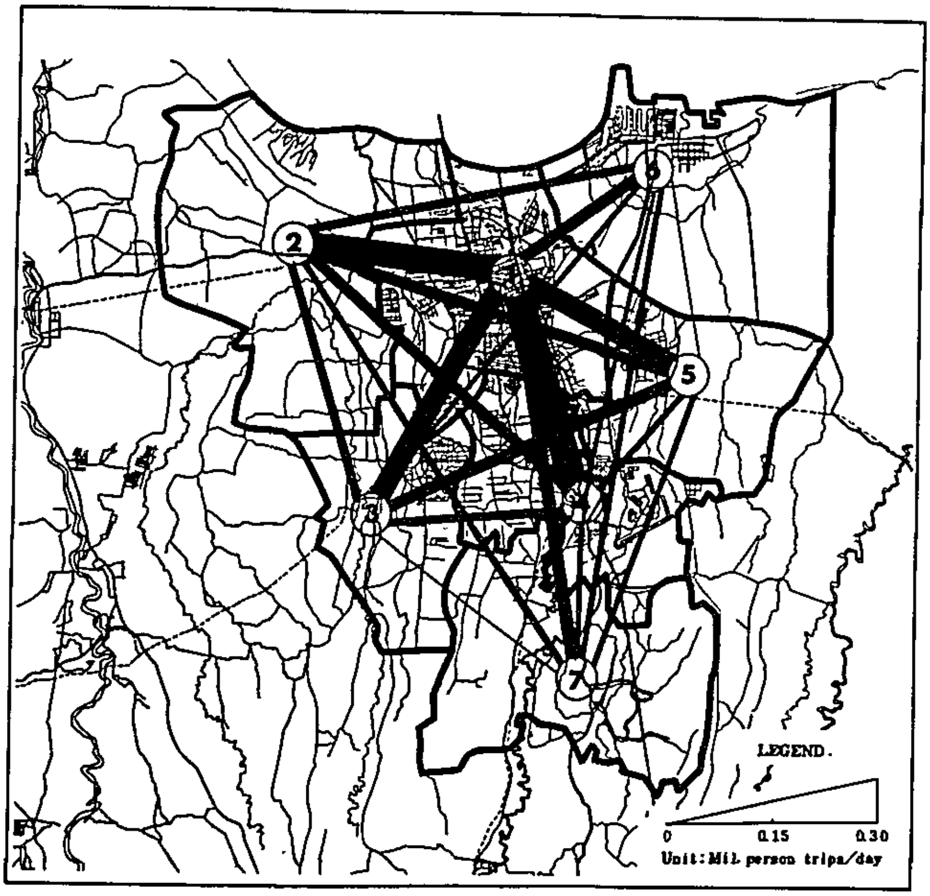


Fig. 2.18 Desire Traffic Lines of Railway Passengers Inside Jakarta in 2005

(3) Assigned traffic volumes on railway network

The estimated future interzonal volume of railway passengers were assigned to the railway network by the minimum pass method. On the Tangerang Line and the Merak Line the maximum link loads in 1995 were estimated to be 118,000 and 160,000 passengers per day respectively; and in 2005 were estimated to be 263,000 and 318,000 passengers per day respectively.

In addition, the new railway line for Cengkareng Airport is planned for future operation, and the study results for this new railway line are incorporated into the estimation of future link loads on the railway network.

The passenger volumes on the other railway links were also estimated and their maximum link loads are presented in Fig. 2.19.

(4) Peak hour ratio

According to the result of the survey for "Feasibility Study on Track Elevation of Central Line " and this study, the present peak hour railway traffic at the stations was found to be two hours from 7 to 9 in the morning in the central urban area and from 6 to 8 in the morning at the stations on the radial lines outside the loop. The number of arriving and departing passengers at major stations in the central urban area is presented in Table 2.28.

Peak ratios for the study of "Feasibility Study on Track Elevation of Central Line" were determined to be about 35% and 40% in 1980 and 2000 respectively.

It is considered that industrial activities in JABOTABEK area will stimulate traffic, and that this will induce the present peak ratio to become higher in future because of concentrating commuting passengers in the peak two hours.

Taking the above into consideration, future peak ratios during morning two hours per direction were assumed to be approximately 35% from 1985 to 1994 and 40% from 1995 to 2015.

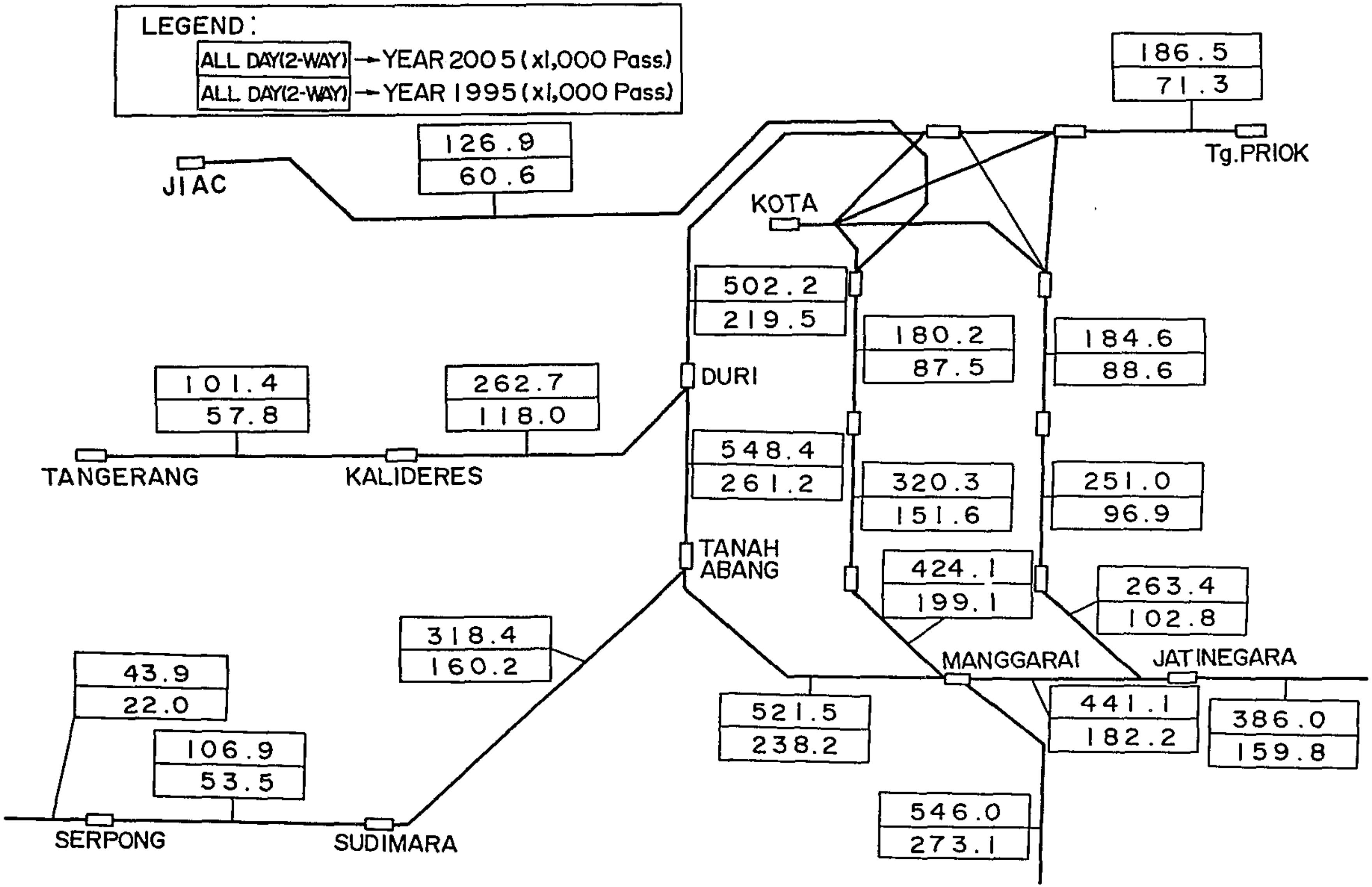


Fig. 2.19 Estimated Railway Passenger Volumes in 1995 and 2005

Table 2.28 Railway Passengers at Major Stations in Jakarta Central Urban Area, 1980

Hour	Jakrata-Kota		Sawah Besar		Gambir		Cikini		Manggarai		Pasar Senen		Tanah Abang	
Band	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off
5 - 6	107	0	-	-	71	0	-	-	81	16	-	-	-	-
6 - 7	91	317	-	-	166	461	-	-	136	238	-	-	-	-
7 - 8	348	3197	118	2166	79	1810	154	864	296	177	370	381	194	738
8 - 9	172	1225	96	359	103	1654	94	630	118	101	186	3497	472	112
9 - 10	198	172	31	6	287	1181	79	93	69	67	89	394	258	132
10 - 11	136	284	93	217	226	333	102	124	49	70	14	6	448	646
11 - 12	141	93	124	25	309	58	181	154	81	31	99	409	100	65
12 - 13	99	241	220	209	926	95	221	132	84	67	56	107	60	33
13 - 14	577	375	81	53	272	68	109	37	135	118	186	2838	139	38
14 - 15	808	205	380	81	275	165	183	90	131	337	236	1366	77	350
15 - 16	771	287	254	101	308	214	322	69	140	355	14	136	92	45
16 - 17	2738	413	308	7	803	141	340	120	197	454	1083	64	302	167
17 - 18	459	229	595	134	1152	119	243	98	85	528	1013	40	215	469
18 - 19	162	167	189	59	837	407	128	62	19	90	214	927	46	4
19 - 20	68	29	-	-	183	56	-	-	44	154	-	-	-	-
20 - 21	0	9	-	-	61	49	-	-	15	58	-	-	-	-
21 - 22	0	0	-	-	0	98	-	-	6	0	-	-	-	-
7 - 19	6609	6888	2489	3417	5577	6245	2156	2473	1404	2445	3560	10165	2403	2799
7 - 9	520	4422	214	2525	182	3464	248	1494	414	278	556	3878	666	850
5 - 22	6875	7243	-	-	6058	6909	-	-	1686	2906	-	-	-	-

Source: Feasibility Study on Track Elevation of Central Line.
Note: 1) Passengers/17 hours for Jakarta-Kota, Gambir and Manggarai.
2) Passengers/12 hours for the other stations.

2.5 MEASUREMENTS OF EFFECTS OF PROJECTS

2.5.1 Grade Separated Crossing in Manggarai Station

(1) Assumptions for the comparison of "With" and "Without" project

Assumptions for measuring effects of the project on roads and railways are described as follows:

1) The crossing capacity of Manggarai Station "Without" the grade separation project is estimated at 480,000 passengers per day.

2) The crossing capacity of Manggarai Station "With" the grade separation project is assumed to be the extent that a train service can be operated on a minimum head-way.

3) It was assumed that trains in the JABOTABEK area are operated by 10-minute (5-minute) head-way during peak hours and 20-minute (10-minute) during off-peak hours in 1995 (2005).

4) Travel times for interzonal trips by railway and bus are expected to change as explained in (2) of section 2.4.4.

(2) Effects on railway and road traffic

Based on the above assumptions for the "With" and "Without" project, future traffic flows on railway and road networks were analysed through the modal split and traffic assignment procedures and the results are summarized in Table 2.29.

(3) Passenger car unit (=PCU) and vehicle composition by type

The future road traffic demand was forecast by converting one vehicle (motorcycle, bus and truck) to the unit number of passenger cars (sedan) as follows.

Motorcycle	0.3 PCU
Sedan	1.0 PCU
Bus	2.0 PCU
Truck	2.0 PCU

Vehicle composition by type and vehicle composition converted to PCU were estimated as shown in Table 2.30.

Table 2.29 Comparison of "With" and "Without" Project for Manggarai Station

(a) Share of Railway and Bus Passengers

(Unit: person trips/day)

Conditions	Year	1995	2005
"With" Project	Railway	1,175,600	2,661,400
	Bus	4,332,000	5,065,600
"Without" Project	Railway	1,095,600	2,268,100
	Bus	4,412,000	5,458,900

(b) Assigned Traffic Volume on Railway and Road Networks

Conditions	Year		1995	2005
"With" Project	Railway	Pass.-Km/day	25,201,200	52,638,900
		Pass.-hr/day	728,300	1,537,500
	Road	PCU-Km/day	105,192,600	130,148,300
		PCU-hr/day	6,508,400	6,849,300
"Without" Project	Railway	Pass.-Km/day	23,106,100	42,793,600
		Pass.-hr/day	655,400	1,239,400
	Road	PCU-Km/day	105,687,400	133,661,600
		PCU-hr/day	6,538,100	6,965,700

Table 2.30 Vehicle Composition by Type

Year / Vehicle Type	1995 Vehicle Composition (%)	1995 Vehicle Composition Converted to PCU (%)	2005 Vehicle Composition (%)	2005 Vehicle Composition Converted to PCU (%)
Motorcycle	18.7	5.0	15.9	4.1
Sedan	55.3	49.0	57.7	50.1
Bus	11.2	19.9	11.0	19.1
Truck	14.8	26.1	15.4	26.7
Total	100.0	100.0	100.0	100.0

2.5.2 Track Addition and Other Improvements on Merak Line

(1) Assumptions for the comparison of "With" and "Without" project

For the comparison of the effects on road and railway networks by the improvement of the Merak Line the following assumptions have been made:

1) In case of "With" project, not only the Merak Line but also other railway lines were assumed to be improved as proposed in the Master Plan of JABOTABEK Railway.

2) In case of "Without" project, it was assumed that the JABOTABEK railway lines other than the Merak Line were improved following the Master Plan. Therefore, travel speed on Merak Line and the operation headway was assumed to remain as it is at present time.

3) Travel times of interzonal trips by bus were assumed to change as explained in (2) of section 2.4.4.

(2) Effects on railway and road traffic

Distribution of person trips was estimated for bus and railway following the modal split curve and the information given in the previous assumptions. Distributed and assigned traffic volumes on road and railway networks are compared for the conditions of "With" and "Without" project in Table 2.31.

Table 2.31 Comparison of "With" and "Without" Project for Merak Line

(a) Share of Railway and Bus Passengers

(Unit: person trips/day)

Conditions	Year	1995	2005
"With" Project	Railway	1,175,600	2,661,400
	Bus	4,332,000	5,065,600
"Without" Project	Railway	1,003,000	2,237,700
	Bus	4,504,600	5,489,300

(b) Assigned Traffic Volume on Railway and Road Networks

Conditions	Year		1995	2005
"With" Project	Railway	Pass.-Km /day	25,201,200	52,638,900
		Pass.-hr /day	728,300	1,537,500
	Road	PCU-Km/day	105,192,600	130,148,300
		PCU-hr/day	6,508,400	6,849,300
"Without" Project	Railway	Pass.-Km /day	22,327,800	46,375,300
		Pass.-hr /day	688,200	1,438,200
	Road	PCU-Km/day	105,585,400	131,878,700
		PCU-hr/day	6,549,800	6,915,000

2.5.3 Track Addition and Other Improvements on Tangerang Line

(1) Assumptions for the comparison of "With" and "Without" project

Similar to the assumptions for the Merak Line project, the following conditions were assumed for measuring the effects on railway and road networks under the conditions of "With" and "Without" the Tangerang Line project.

1) In case of "With" project, it was assumed that the Tangerang Line was improved together with other railway projects proposed in the Master Plan.

2) In case of "Without" project, the Tangerang Line was assumed to remain as it is, but other projects were carried out.

3) Travel times of interzonal trips by bus were assumed to change as same as the previous Manggarai Station and Merak Line projects.

(2) Effects on railway and road traffic

Future trip distribution and traffic volumes on the networks were computed by a similar method applied to the previous two projects. The results of computer simulation for "With" and "Without" project are summarized in Table 2.32.

Table 2.32 Comparison of "With" and 'Without" Project for Tangerang Line

(a) Shares of Railway and Bus Passengers

(Unit: person trips/day)

Conditions	Year	1995	2005
"With" Project	Railway	1,175,600	2,661,400
	Bus	4,332,000	5,065,600
"Without" Project	Railway	1,043,500	2,258,100
	Bus	4,464,100	5,468,900

(b) Assigned Traffic Volume on Railway and Road Networks

Conditions	Year		1995	2005
"With" Project	Railway	Pass.-Km /day	25,201,200	52,638,900
		Pass.-hr /day	728,300	1,537,500
	Road	PCU-Km/day	105,192,600	130,148,300
		PCU-hr/day	6,508,400	6,849,300
"Without" Project	Railway	Pass.-Km /day	23,290,600	47,068,800
		Pass.-hr /day	683,600	1,379,600
	Road	PCU-Km/day	105,433,700	131,672,500
		PCU-hr/day	6,543,700	6,906,600

CHAPTER 3

IMPROVEMENT PLAN OF MANGGARAI STATION

CHAPTER 3 IMPROVEMENT PLAN OF MANGGARAI STATION

3.1 MANGGARAI STATION ENVIRONS

(1) Present land use

The present land use around Manggarai station is as shown in Fig. 3.1. Most of the land is residential area with high density low rise housing.

In some places, home industries are mixed. Manggarai market on northeast side of the station and Bukit Duri market on southeast side of the depot are the commercial areas. Industries include a vehicle repair shop on the west side of the railway work shop. There is some open space to the south and west of the railway work shop.

Various kinds of schools and mosques are located around the station (Fig. 3.2).

The area surrounded by Cili Wung River is used exclusively as an army camp.

The present serious problems around Manggarai station are as follows:

- Low class residential environment with over-crowded housing.
- Traffic congestion at the underpath below the railway.
- Congestion at the Bus terminal due to lack of adequate space.
- Poor access to Manggarai Station.

(2) On-going Urban Renewal Plan

An urban renewal plan is being prepared for the over-crowded residential area on the west side of the railway work shop.

Commercial facilities, public welfare facilities, office and other business buildings are planned in combination with housing project (Fig. 3.3). A main-station front plaza with a bus terminal is planned to be on the west side of the existing station, with a pedestrian deck over the plaza (Fig. 3.4).

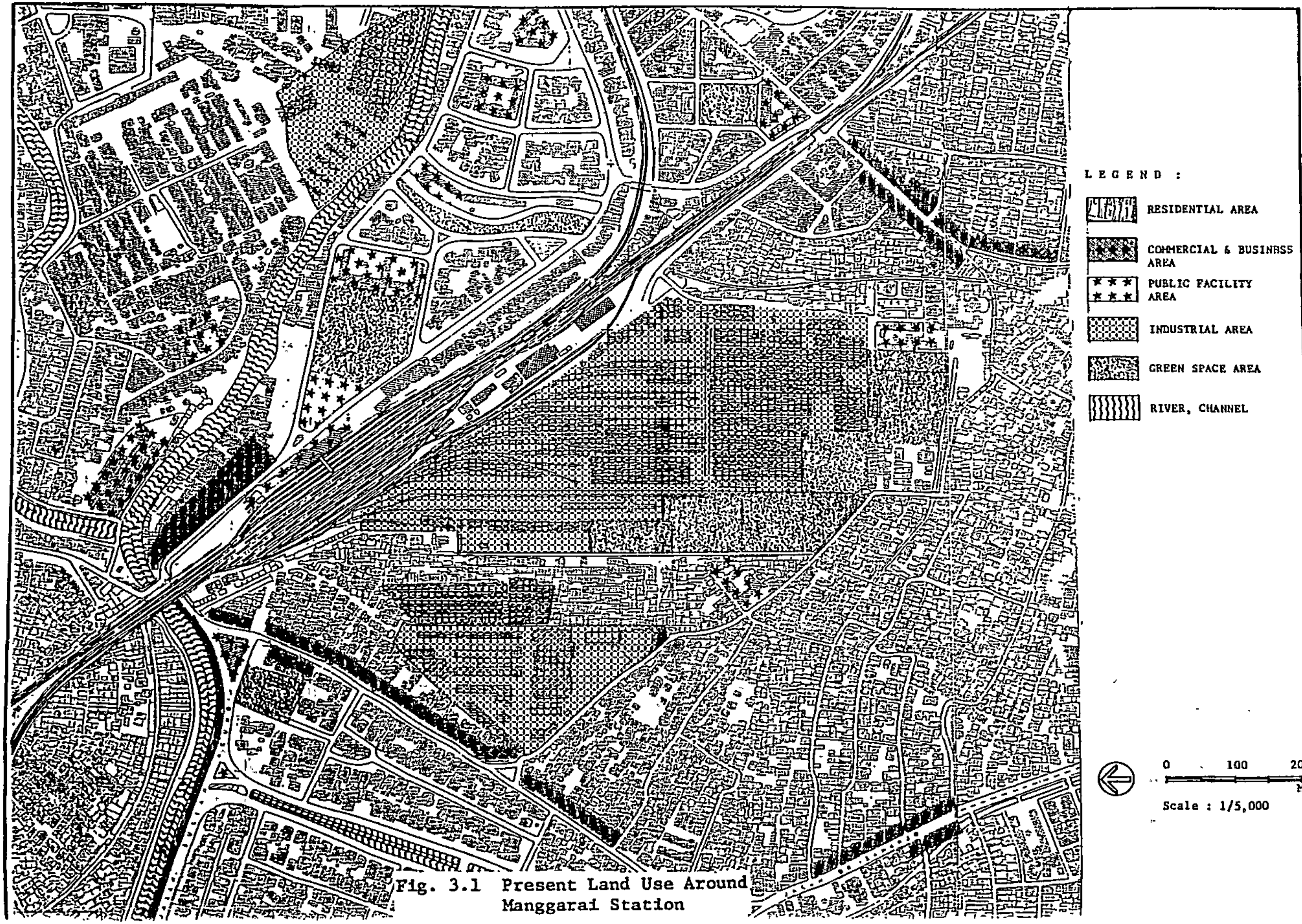


Fig. 3.1 Present Land Use Around Manggarai Station

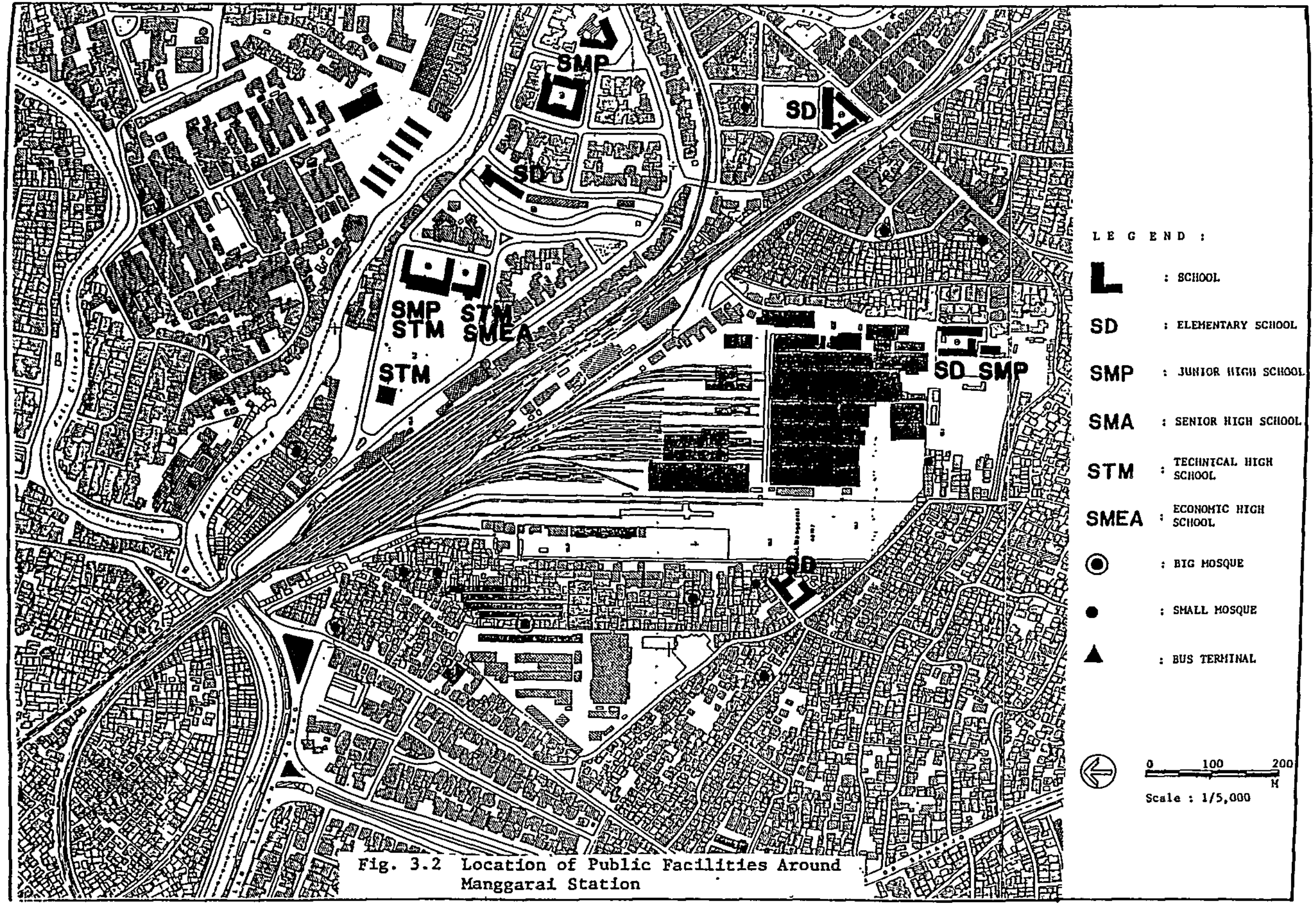


Fig. 3.2 Location of Public Facilities Around Manggarai Station

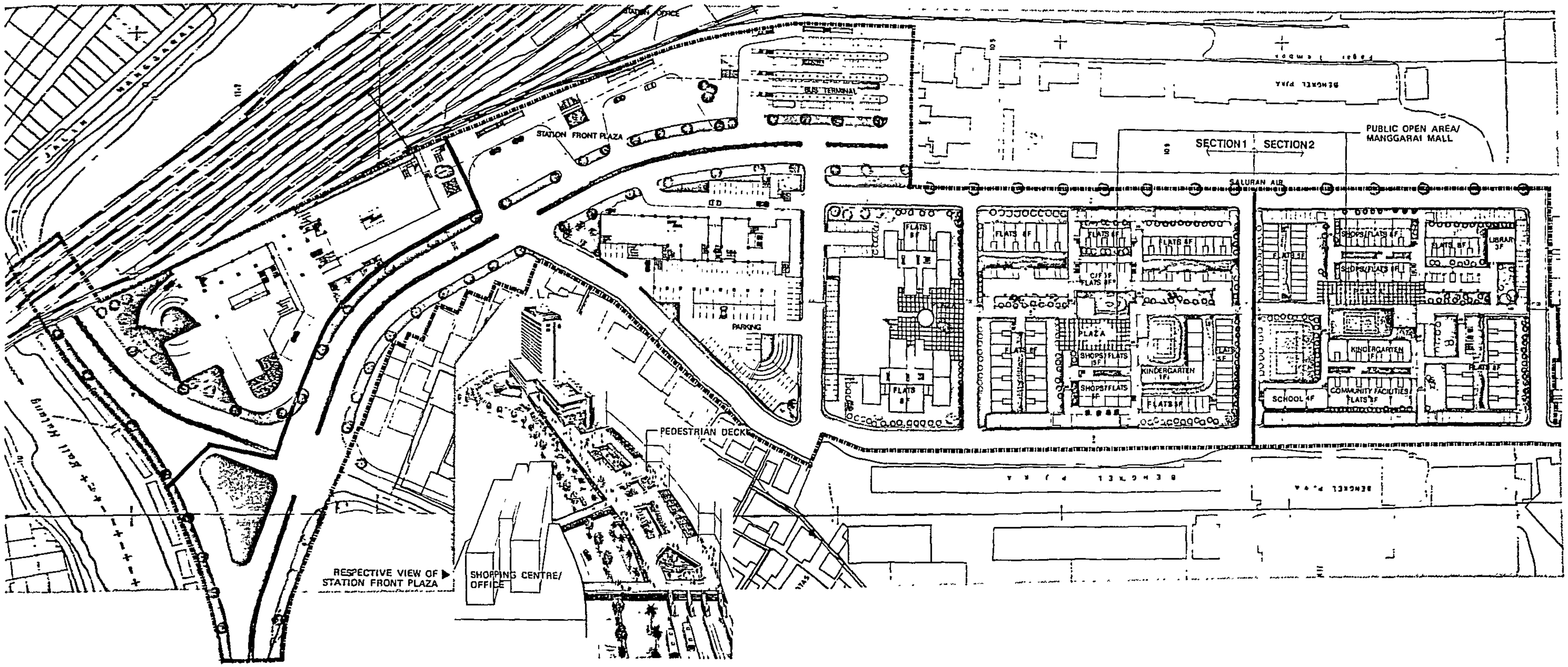


Fig. 3.3 Manggarai Urban Renewal Plan

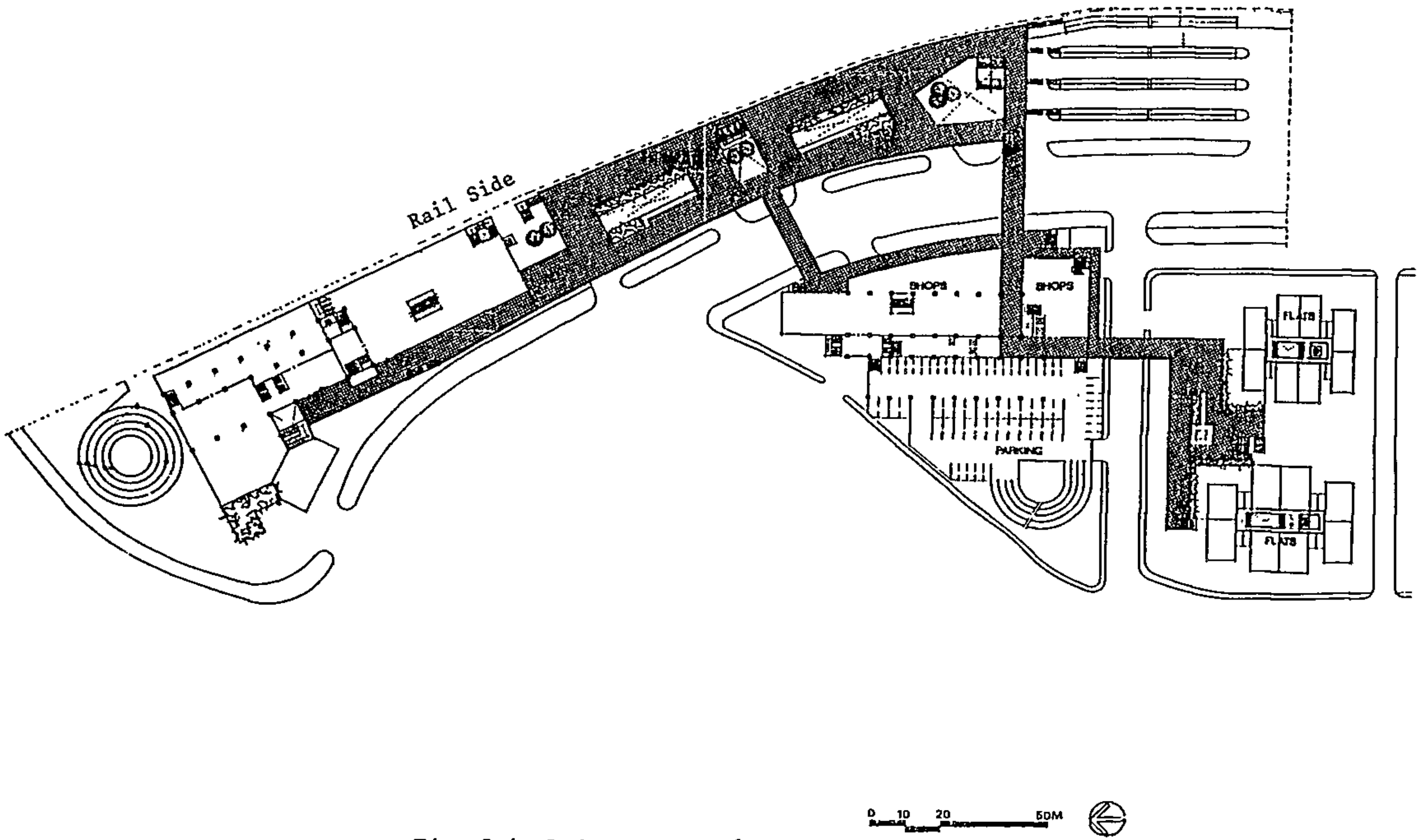


Fig. 3.4 Pedestrian Deck

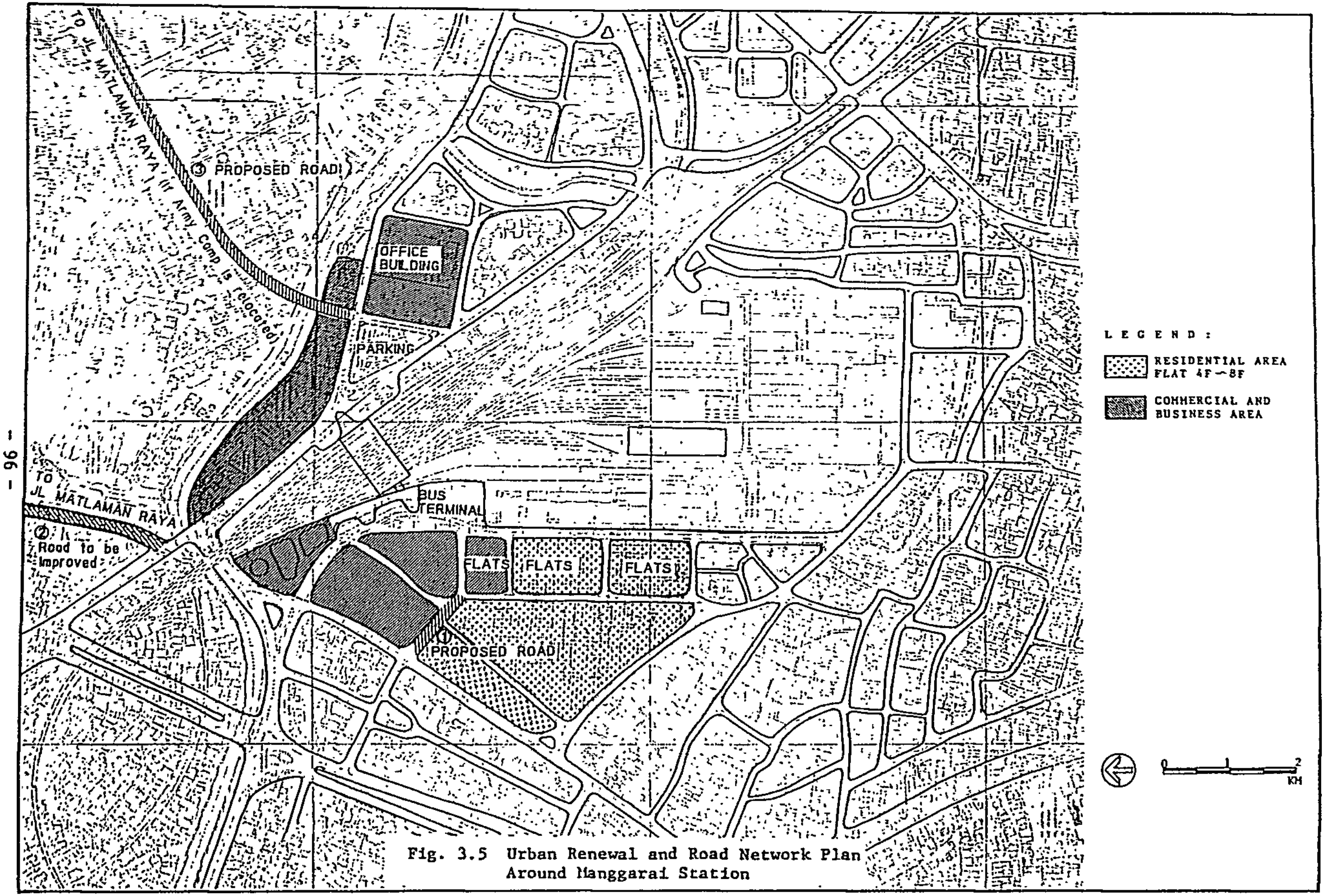


Fig. 3.5 Urban Renewal and Road Network Plan Around Manggarai Station

There is a plan for an office building and parking on the east side of the station and therefore it is recommended to install a small station-front plaza on the east side of the station.

Road improvement plan was made by the Town Planning Section of Government of DKI.

Road network improvement plan around the station is as shown in Fig. 3.5.

3.2 TRAFFIC DEMAND FOR TRAIN OPERATION

The future traffic demand on Manggarai Station was estimated in Chapter 2, (3) of section 2.4.4.

The number of passengers relating to Manggarai Station (the passengers on/off and passing through the Station) was estimated to be about 500,000 persons and 1,100,000 persons per day in 1995 and 2005 respectively. Those getting on and off at the Manggarai Station total 100,000 persons and 240,000 persons per day for the respective years.

The estimated passenger flows relating to the Station were analyzed for the years 1995 and 2005 as shown in Fig. 3 6.

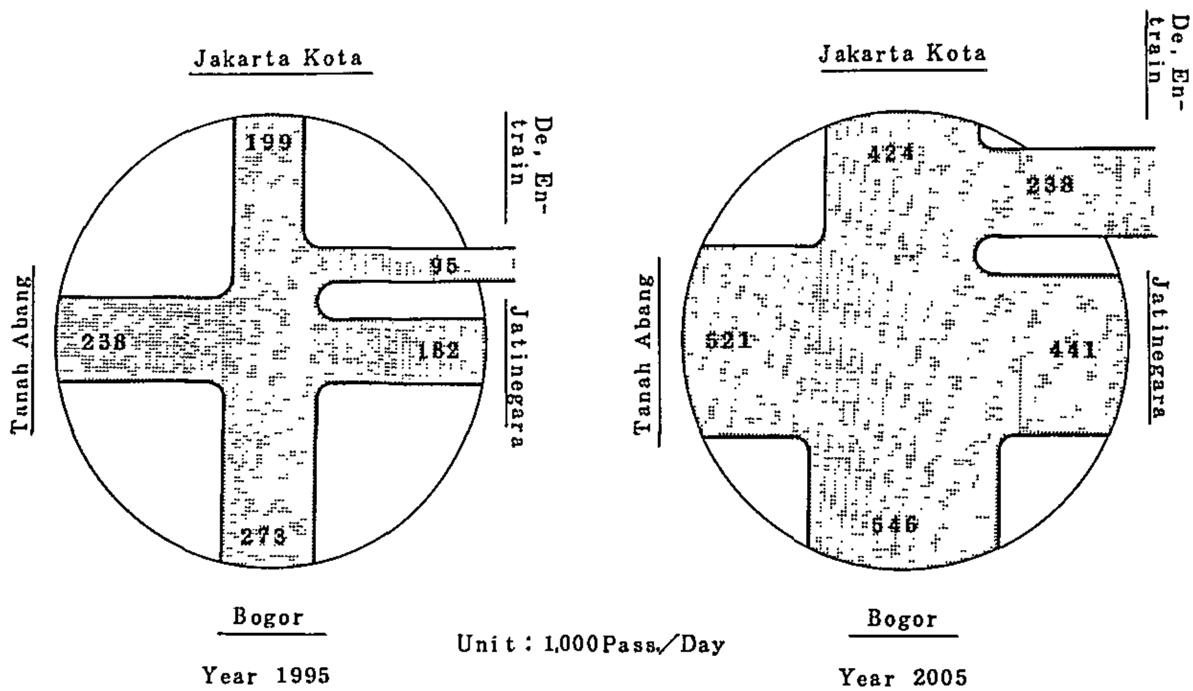


Fig. 3.6 Estimated Passenger Flows at Manggarai Sta.

In addition, the railway passenger volumes on Central Line and Western Line relating to the Station were estimated for the year 1985, 1995, 2005 and 2015 as shown in Fig. 3.7.

LEGEND:

ALL DAY(2-WAY)	PEAK 2-hr. (1-DIRECTION)	→ YEAR 2015 (×1,000Pass.)
ALL DAY(2-WAY)	PEAK 2-hr. (1-DIRECTION)	→ YEAR 2005 (×1,000Pass.)
ALL DAY(2-WAY)	PEAK 2-hr. (1-DIRECTION)	→ YEAR 1995 (×1,000Pass.)
ALL DAY(2-WAY)	PEAK 2-hr. (1-DIRECTION)	→ YEAR 1985 (×1,000Pass.)

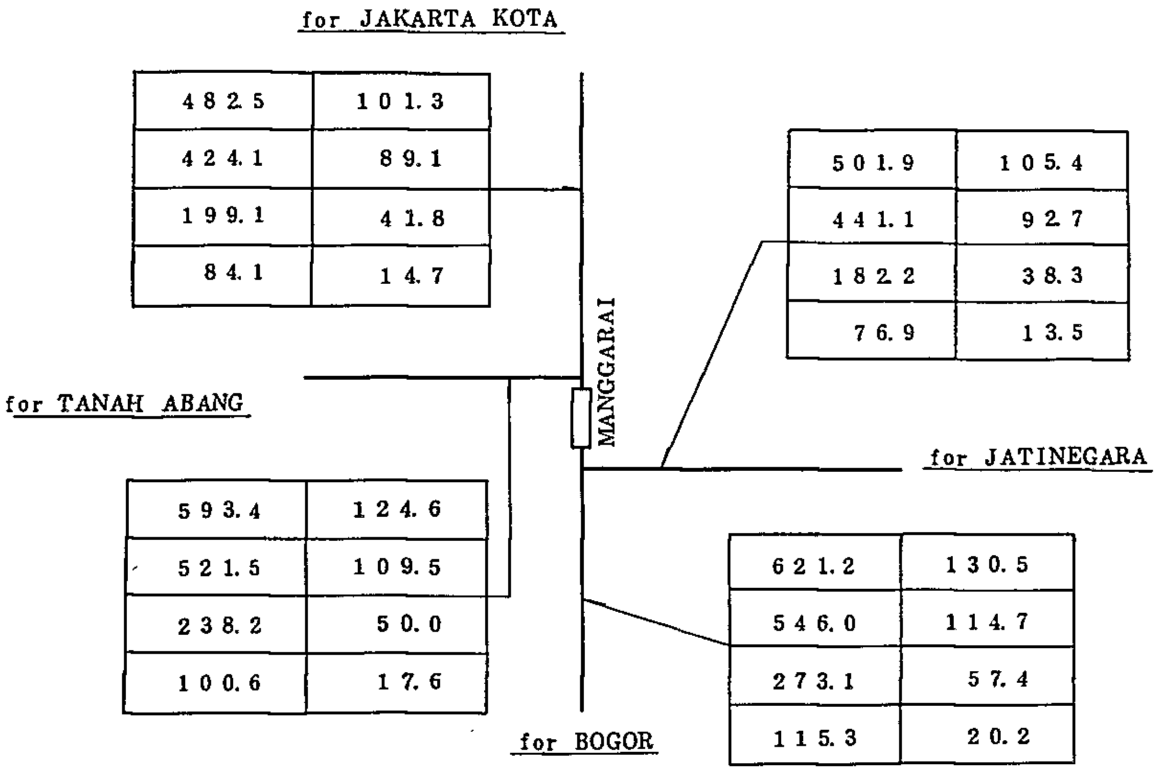


Fig. 3.7 Estimated Railway Passenger Volumes Relating to Manggarai Sta.

3.3 TRAIN OPERATION

3.3.1 Present Status

(1) Train flow coding

For study purposes, the train flows are coded as follows: (Fig. 3.8)

(1) - (4) ..... Trains that terminate or originate at Manggarai

(5) - (8) ..... Trains that pass through Manggarai

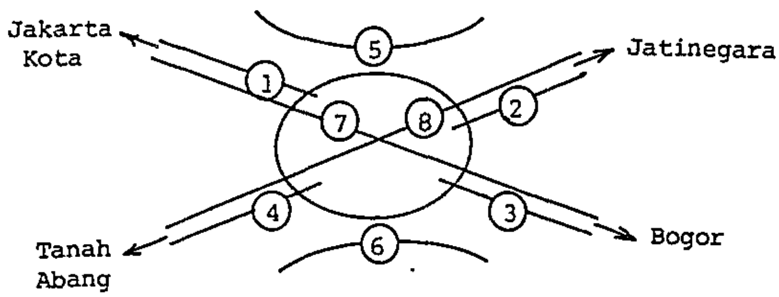


Fig. 3. 8 Train Flow

(2) Present track layout

Present track layout regarding train operation is indicated in Fig. 3. 9. Tracks No. I to No. 10 inclusive are for arriving or departing trains and tracks No. 11 /up are for shunting purposes. For route setting, the track layout is conveniently designed so that all tracks except track No. I and II can accommodate trains from all directions.

However the use of double slip switches at many places, with a speed restriction of less than 25 Km/h requires each train to take a long time to clear switches on arrival and departure. Consequently, the need for long arriving or departing times affects train operation efficiency.

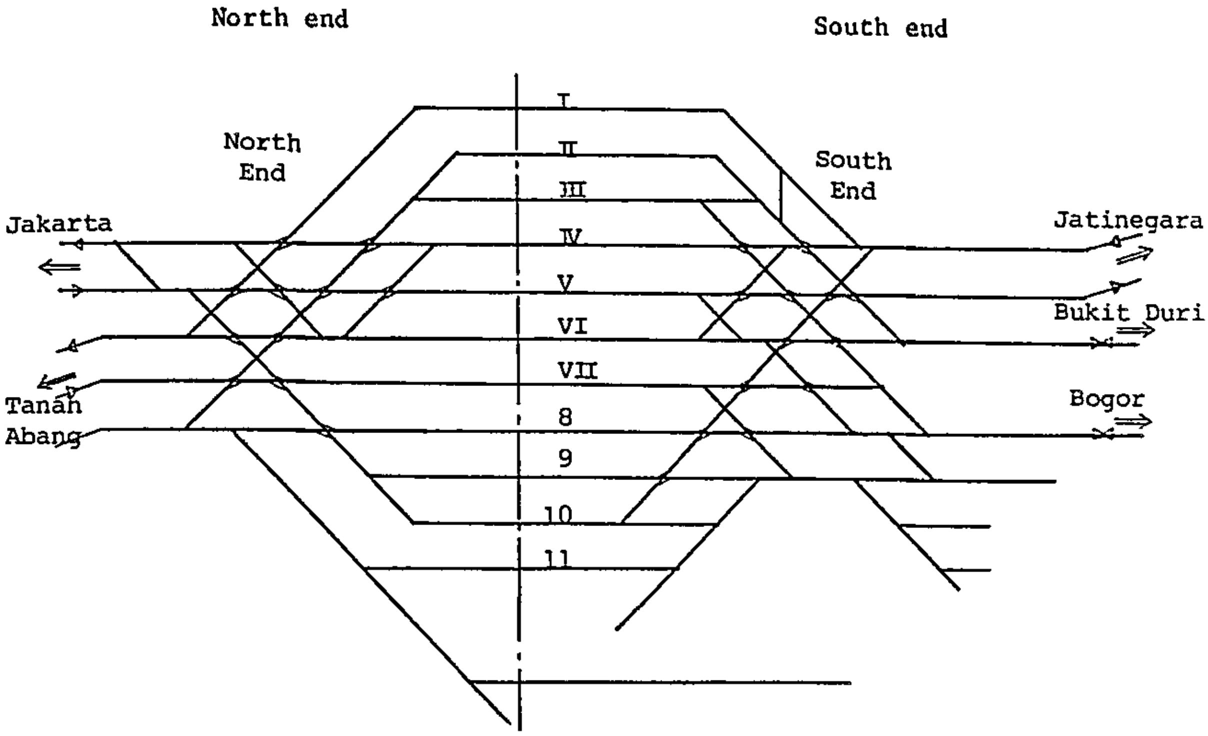


Fig. 3.9 Present Track Layout

(3) Train flow and track application

Present train flow and track uses are indicated in Fig. 3.10 and Table 3.1.

Points to be noted on train flow and track uses are as follows:

a) Tracks, numbers I and II are un-used.
b) No train flow (6) is observed.
c) The most of long distance trains to/from Gambir and Jatinegara pass through track No. IV for Jakarta Kota bound trains and No. V for Jatinegara bound trains, most of them do not stop at Manggarai station.
d) Train flow (7) (commuter train to/from Jakarta Kota and Depok or Bogor) crosses other train flows at the North end and merges with train flow (5) also at the North end. While, train flow (8) crosses other train flows, including train flow (7) at the south end. Tracks used by train flow (2) are widely spread out over III, IV, VI, VII and 8/9/10.

Table 3.1 Train Distribution at Manggarai Station
Based on
Daftar Seput 2 Yand Harus dijalani
disetansium Besar MANGGARAI

		①	②	③	④	⑤	⑥	⑦	⑧
I	D								
	U								
II	D								
	U								
III	D		207,269,319 205						
	U	260,3008	306,270,208 315,3078						
IV	D		3077,309			9,3025,15,13 3,31,1,19,33 1F,35,37,39 19F, 17			17F
	U								
V	D								
	U	274,350, 352,276, 354,356, 358,360, 278		210,212, 322,320, 214	3012,346	32,34,36,18F 10,14,38,2, 4,40,20,18, 16		236	
VI	D	374,349, 351,353, 355,267 357,275	2027	609,251, 329	335,3021			211,213,215 321,217,219E 221,323,223, 225,227,229, 231,233,235, 237,239,241, 243,245,247, 249	3019
	U								
VII	D								
	U	246		610,246	3002			216,218,220 222,224,226 228,230,232, 234E,324, 238,240,242, 244,248,250, 252	2072,2026
8/9/10	D		2001,	2013	3009,2027				2023,2025, 2033,2035
	U		2022,2000 2026	2014					2024,3018 2034

Remark: I - VII, 8/9/10 ... Track number

U .... Up train (Jatinegara or Bogor bound)

D .... Down train (Jakarta Kota or Tanah Abang bound)

Underlined train number is the train during peak 2 hrs.

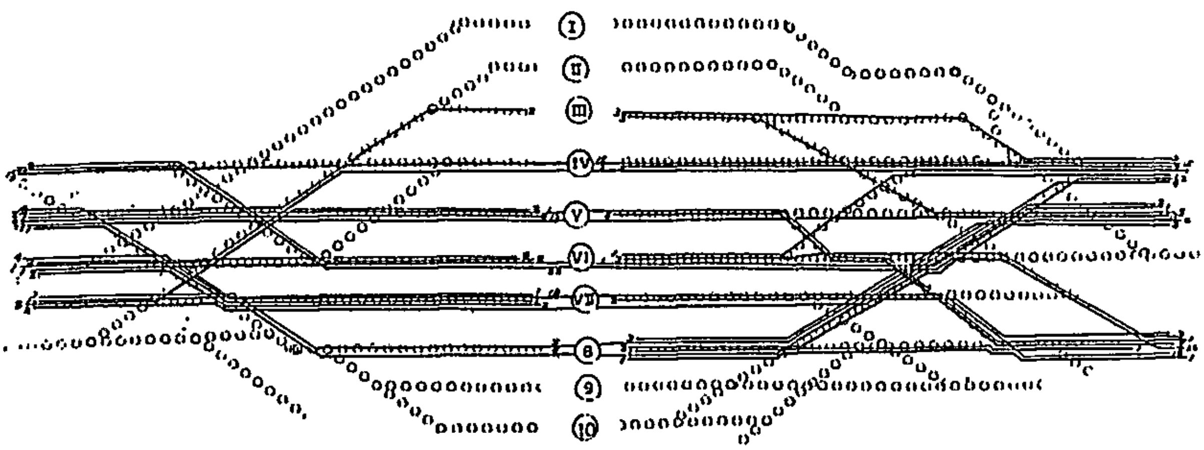


Fig. 3.10 Present Train Flow at Manggarai Station

3.3.2 Rate of Interference at Track Crossings

To measure interference of a train movement at a crossing, a Rate of Interference is applied generally. The Rate of Interference is calculated as the quotient of interference period per given time as follows. Interference period is the train movement time to pass a crossing. (See Appendix 3 for details).

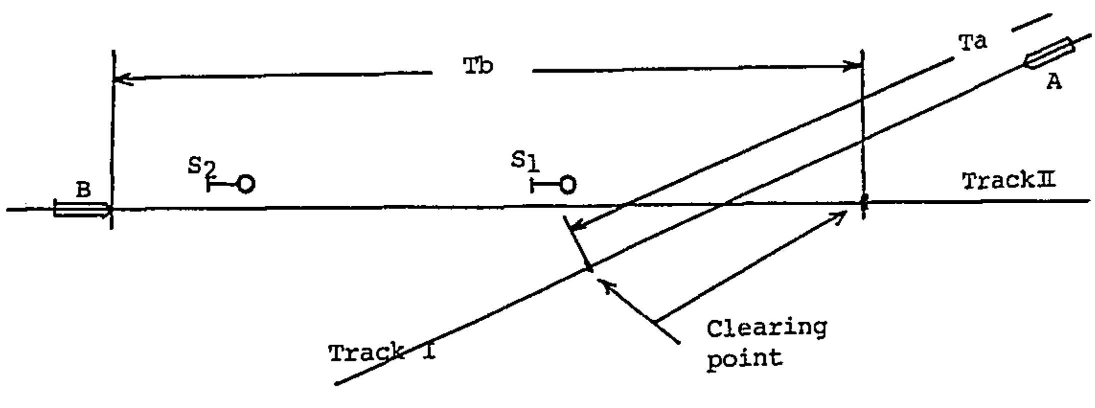


Fig. 3.11 Crossing Point

Rate of Interference of track crossing is:-

(for 24 Hrs)

Rate of Interference = Total time of Interference in a day/24Hrs × 100 (%)

(for peak 2 Hrs)

Rate of Interference = Total time of Interference in peak 2 Hrs/2 Hrs × 100 (%)

Generally, the Rate of Interference is evaluated as follows:

Below 40% ...... moderate value

40 - 60% ...... difficult to make the train operation plan depending upon the condition of train operation

Over 60% ...... impossible to make the train operation plan

The time studied at Manggarai showed that time of interference was 153 seconds for arriving train, 95 seconds for departing train and 244 seconds for passing (non-stop) train which are equivalent to variable Tb in Fig. 3.11. 30 seconds is time for restoring route and signal in case of Manggarai Station. (Refer to Fig. A.6 in Appendix 3.)

Thus, in case the Rate of Interference exceeds 60%, the appropriate countermeasure to reduce the Rate of Interference below 60% is required.

3.3.3 Rate of Interference at Present

The present Rate of Interference at each end, South and North, is indicated in Table 3.2 and Table 3.3. As seen in the Tables, during the peak two hours, 07:00 to 09:00, the Rate of Interference is higher than any other two hour period during whole day. Even so, the Rate of Interference during the peak 2 hours is staying within moderate values, 35.2 $\sim$ 33.7%, even with 6 long distance trains. But the transportation demand will expand rapidly each year. So, the Rate of Interference is expected to approach and exceed 60% in the near future.

Hence, a countermeasure such as a flyover for the conflicting route will be required to achieve smooth train operations.

Table 3.2 Computation of Rate of Interference
(North End)

North End

Items				Whole day	Peak 2 Hrs.
Number of Trains	Train flow ①		Departing	7	1
			Arriving	13	2
	Train flow ④		Departing	3	1
			Arriving	4	-
	Train flow ⑤		for Gambir	15	6
			from Gambir	13	-
	Train flow ⑦		for Gambir	22	5
			from Gambir	19	2
	Total	Ordinary train	Departing	32	7
			Arriving	35	4
		Non-stop train	for Gambir	15	6
			from Gambir	13	-
Time of interference (seconds)			Departing train	125 × 32 ≒ 4,000	125 × 7 = 875
			Arriving train	183 × 35 = 6405	183 × 4 = 732
			Non-stop train	274 × 28/2 = 3836	274 × 6/2 = 822
			Total	14241	2429
Rate of interfereance (%)				16.5 (14.6)	33.7 (29.8)

( ) ... with electric interlocking system

Table 3.3 Computation of Rate of Interference (South End)

South End

Items				Whole day	Peak 2 Hrs.
Number of Trains	Train flow ②		Departing	8	-
			Arriving	8 (4)	1
	Train flow ③		Departing	8 (1)	-
			Arriving	4 (1)	-
	Train flow ⑤		for Jatinegara	13	-
			from Jatinegara	15	6
	Train flow ⑦		for Depok	19	2
			from Depok	22	5
	Train flow ⑧		for Jatinegara	5	-
			from Jatinegara	6	2
	Total	Ordinary train	Departing train	40 (1)	2
			Arriving train	40 (5)	8
		Non-stop train	for Jatinegara	13	-
			from Jatinegara	15	-
Time of Interference (seconds)			Departing train	125 × (40-1) = 4875	125 × 2 = 250
			Arriving train	183 × (40-5) = 6405	183 × 8 = 1464
			Non-stop train	274 × 28/2 = 3836	274 × 6/2 = 822
			Total	15116	2536
Rate of Interference (%)				17.5 (15.5)*	35.2 (31.6)*

( )* ... with electric interlocking system

( ) .... Number of trains, not be interferred by nor interfere with other trains

3.3.4 Expected Number of Trains at Manggarai Station

To meet with the transportation demand described in paragraph 2.4.4 (3), the following number of trains and train headway during peak 2 Hrs are required.

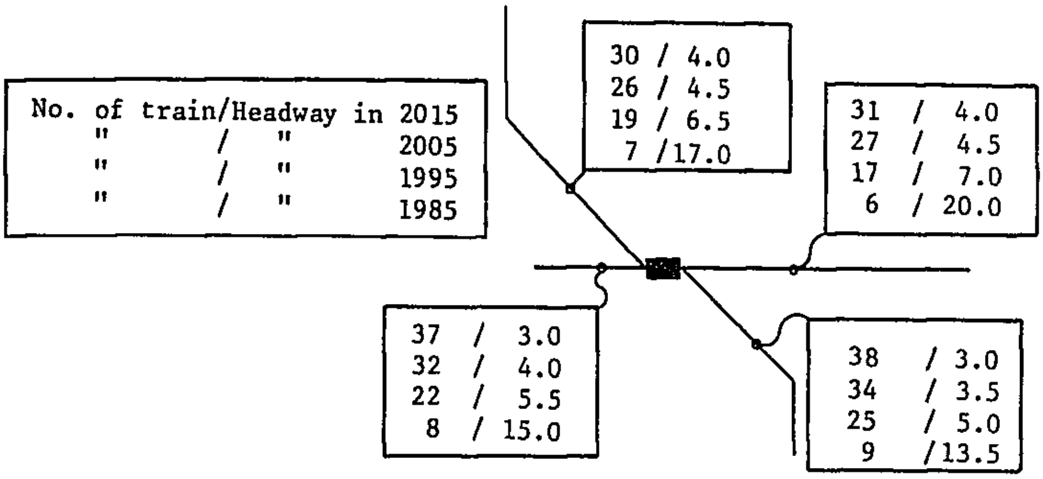


Fig. 3.12 Expected Number of Trains and Headway
(Peak 2Hrs, long distance Trains are excluded)

The transportation demand is so large in 2005 and 2015 that train sets should consist of 12 railcars, otherwise the train headway would be less than 3 minutes.

For the period between 1985 and 1994, the number of trains during the peak 2 Hrs in respective train flows are as follows.

Table 3.4 Number of Trains in Respective
Train flows

Item \ Year	85	86	87	88	89	90	91	92	93	94
Train flow ⑤	0	0	0	0	6	6	6	6	6	6
Train flow ⑥	2	2	3	3	4	5	6	7	8	9
Train flow ⑦	7	8	8	9	9	10	11	11	12	13
Train flow ⑧	6	6	7	7	8	8	9	9	10	10

Remark: Long distance trains are excluded

3.3.5 Estimated Rate of Interference in Future

For computation of the Rate of Interference, a simplified train routing sketch, Fig. 3.13 is used.

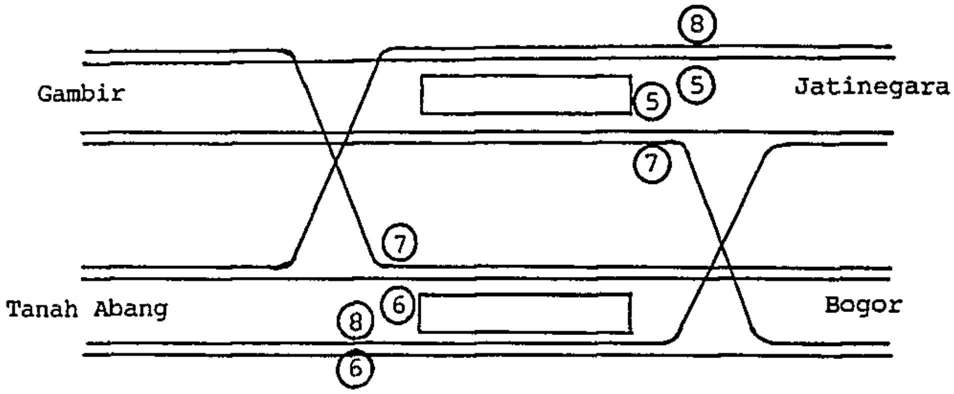


Fig. 3.13 Train Passage Routing

At the North end of the station, arriving trains of train flow ⑥ & ⑧ do not conflict and neither do arriving train flows ⑤ & ⑧ at the South end. Thus, these trains are excluded from the computation of the Rate of Interference.

Numbers of arriving trains, departing trains and Rate of Interference at the North end and South end of the station by train and by year are as indicated in Table 3.5 & 3.6.

Table 3.5 Numbers of Trains and Rate of Interference during peak 2 Hrs. (North End)

Item \ Year	85	86	87	88	89	90	91	92	93	94
⑤ Ar.					6	6	6	6	6	6
⑦ Ar.	7	8	8	9	9	10	11	11	12	13
⑤ Dep.					6	6	6	6	6	6
⑥ Dep.	2	2	3	3	4	5	6	7	8	9
⑦ Dep.	7	8	8	9	9	10	11	11	12	13
⑧ Dep.	6	6	7	7	8	8	9	9	10	10
Ar. Train	7	8	8	9	15	16	17	17	18	19
Dept. Train	15	16	18	19	27	29	32	33	36	39
Rate of Interfer.(%)	43.8	48.1	51.6	55.9	85.0	91.0	98.8	100.5	108.3	116.0

Remark: Long distance trains are excluded

Table 3.6 Numbers of Trains and Rate of Interference during peak 2 Hrs. (South End)

Item \ Year	85	86	87	88	89	90	91	92	93	94
⑥ Ar.	2	2	3	3	4	5	6	7	8	9
⑦ Ar.	7	8	8	9	9	10	11	11	12	13
⑤ Dep.					6	6	6	6	6	6
⑥ Dep.	2	2	3	3	4	5	6	7	8	9
⑦ Dep.	7	8	8	9	9	10	11	11	12	13
⑧ Dep.	6	6	7	7	8	8	9	9	10	10
Ar. Train	9	10	11	12	13	15	17	18	20	22
Dept. Train	15	16	18	19	27	29	32	33	36	38
Rate of Interfer.(%)	48.9	53.2	59.2	63.5	79.9	88.5	98.8	103.0	113.3	121.9

Remark: Long distance trains are excluded

As seen in Table 3.5 and 3.6, the Rate of Interference approaches 60% by 1988 and after 1989 exceeds 60%. To meet with the expanding transportation demand and to provide smooth train operations, it is considered that these conflicting train movements need to be eliminated by flyovers.

3.3.6 Rolling Stock

(1) Present status

In the design of grade separated crossings, the performance, starting torque for up-gradient and brake performance for down-gradient, of the rolling stock should be taken in consideration.

There are 5 kinds of rolling stocks, now in use by PJKA: i.e., Electric railcar, Diesel-railcar, and Passenger car or Freight car hauled by Diesel locomotive. The principle passenger train operating characteristics are shown in Table 3.7.

Table 3.7 Present Operations

Kind of rolling stock	Type	Rating	Operation section	No. of coaches	Train weight	Max. gradient
Diesel Locomotive	CC201	1950HP	Jakarta-Bandung	8	291(t)	16%.
	BB303	1000HP	Jakarta-Merak	7	246	10%.
	BB304	1500HP	Jakarta-Surabaya	8	420	9%.
Electric Railcar		120KW × 8(2M2T)	Jakarta-Bogor	4 or 8	210 (2M2T)	10%.
Diesel Railcar		286 × 4 HP	Duri - Tangerang	4	228	5%.

(2) Performance of electric railcar

Table 3.8 shows the balancing speed for a train formation, now in use by PJKA.

Table 3.8 Balancing Speed

Grade	Balancing speed
0 ‰	100 km/h
14 ‰	70 km/h
25 ‰	58 km/h

Remark; 14‰ is proposed to apply to flyover at Manggarai station.

If the gradient increases from 0‰ to 25‰, the balancing speed decreases from 100 km/h to 58 km/h.

No train operation problem is observed in existing services, since the length of 25‰ up-gradient for flyover is supposed to be comparatively short distance in general.

(3) Performance of brake

Table 3.9 shows the brake distance when the service brake is applied at the train speed of 40 km/h, 50 km/h and 60 km/h on a down-gradient.

Consequently, the electric railcar, with the performance indicated in Table 3.9, is able to stop at the required position.

Table 3.9 Brake Distance

Grade	40 km/h	50 km/h	60 km/h
Level line	100 m	170 m	240 m
14 ‰	150 m	220 m	310 m
25 ‰	170 m	260 m	390 m

(4) Accommodation

Table 3.10 shows capacity of Electric railcars now in use by PJKA.

Table 3.10 Capacity of Electric Railcar

		Seating	Standing	Total
Controlling car	Normal	51	80	131
	Maximum	51	240	291
Motor Car	Normal	82	67	149
	Maximum	82	201	283

Maximum capacity is 200% of normal capacity.

(5) Locomotive in future

An electric railcar, now in use by PJKA can be continued to use in the future. Regarding a locomotive-hauled train, the performance of the locomotive and hauled load should be taken into account. For instance, EF 64 type Electric locomotive and DE10 type Diesel locomotive, now in use by JNR, with 530 ton load, have respective performances indicated in Table 3.11. Accordingly, these locomotives are suitable for future operation.

Table 3.11 Balancing Speed of Locomotive

Grade	EF64 type	DE10 type
0 ‰	77 km/h	71 km/h
14 ‰	53 km/h	26 km/h

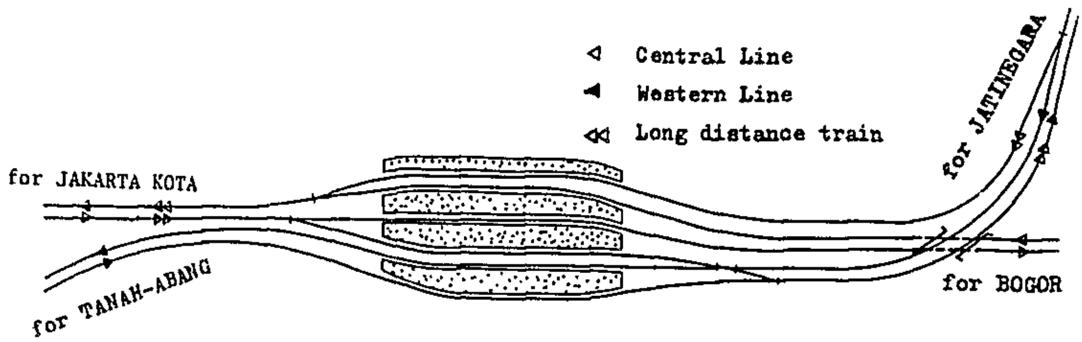
3.4 SELECTION OF ALTERNATIVES

3.4.1 Alternatives to be Examined

In the field investigation of Manggarai station, eleven alternatives for track layout of the grade separated crossing were studied and proposed. These alternatives are reviewed and rearranged to nine alternatives.

Following are schematic track layouts and description of these alternatives.

(1) Alternative A

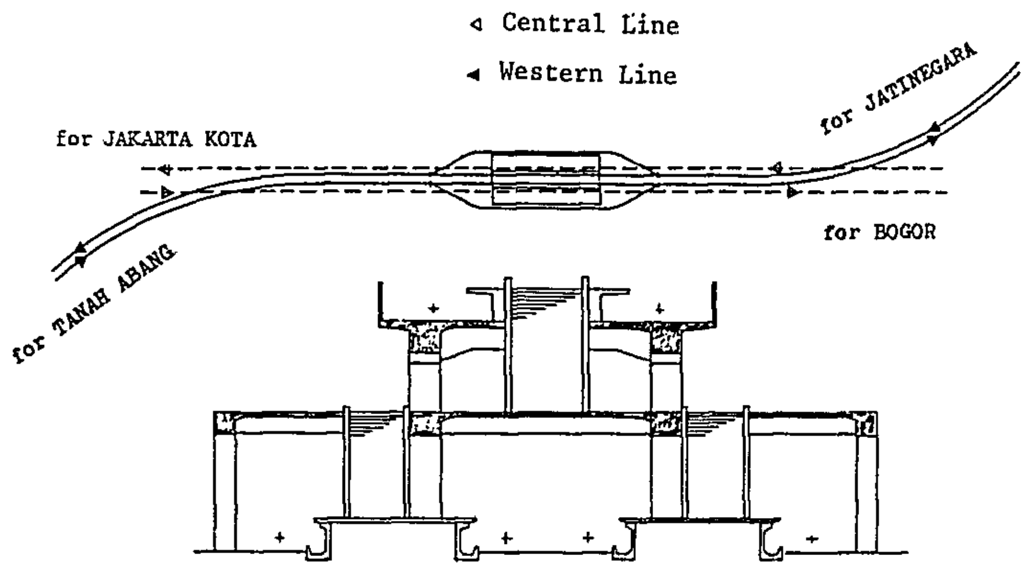


The route from the Western Line to the Central Line and the reverse route is only for long distance trains. Moreover, train operation is inconvenient, because long distance trains from Jakarta Kota will have a conflicting movement on a level crossing.

Commuter passengers will not be able to transfer from the Central Line to the Western Line on the same platform and vice versa.

The cost of construction will be low because of only one grade separated crossing.

(2) Alternative B



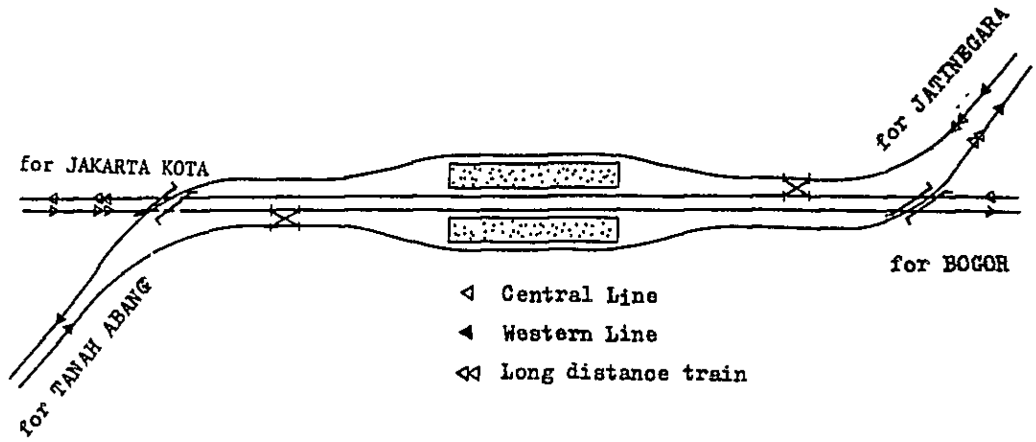
All operation routes cannot be obtained because the Central Line shall be on a viaduct in Manggarai station. Likewise the route for deadhead trains to/from Bukit Duri cannot be made. Therefore commuter passengers who change trains from the Western Line to Central Line and vice versa will be forced to change levels.

Because this layout requires the construction of a viaduct of two track for the Central Line, the construction cost will be high.

(3) Alternative C

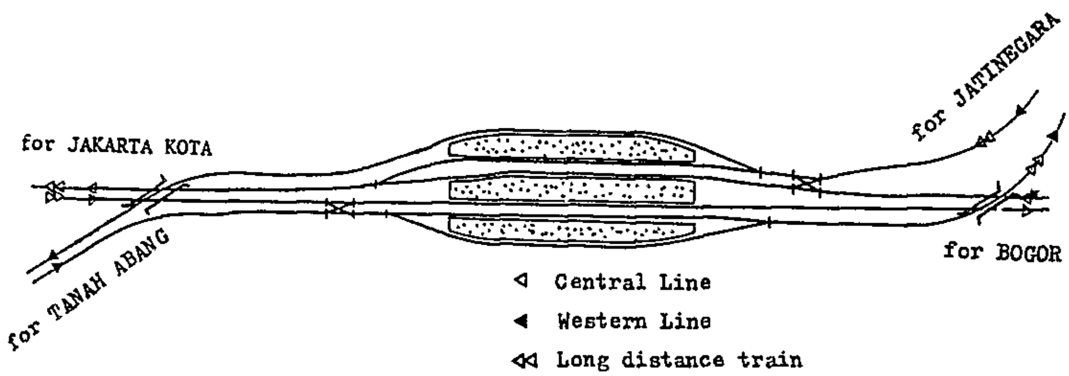
In order to employ a 10‰ or less gradient, the route shall pass through the area where houses are densely crowded, and a large area of land has to be acquired. Therefore, the cost of land acquisition and the compensation will be large and also the approach structures will be longer.

(4) Alternative D



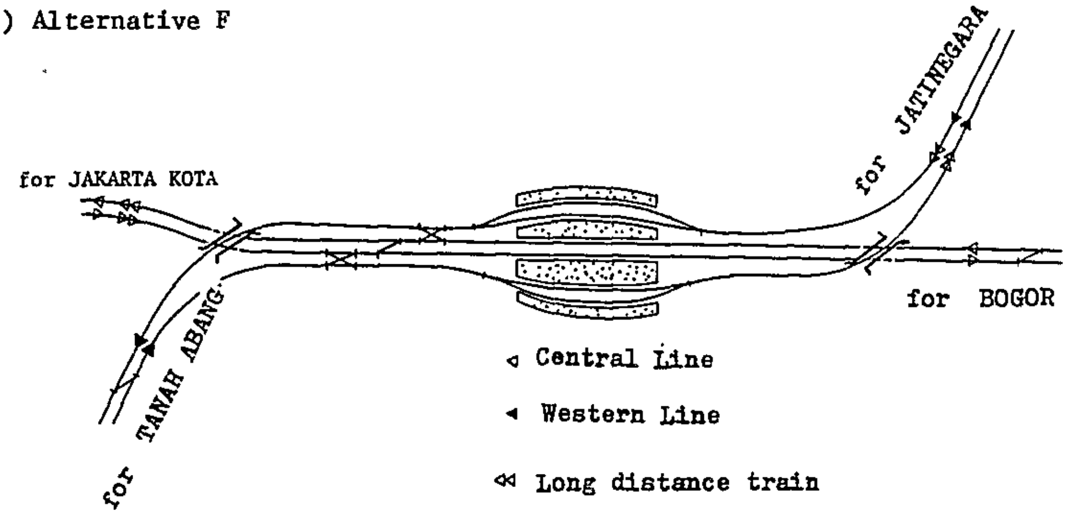
Operation on all routes will be obtained. However, convenience for passengers and train operations is not good because of a lack of tracks and platforms.

(5) Alternative E



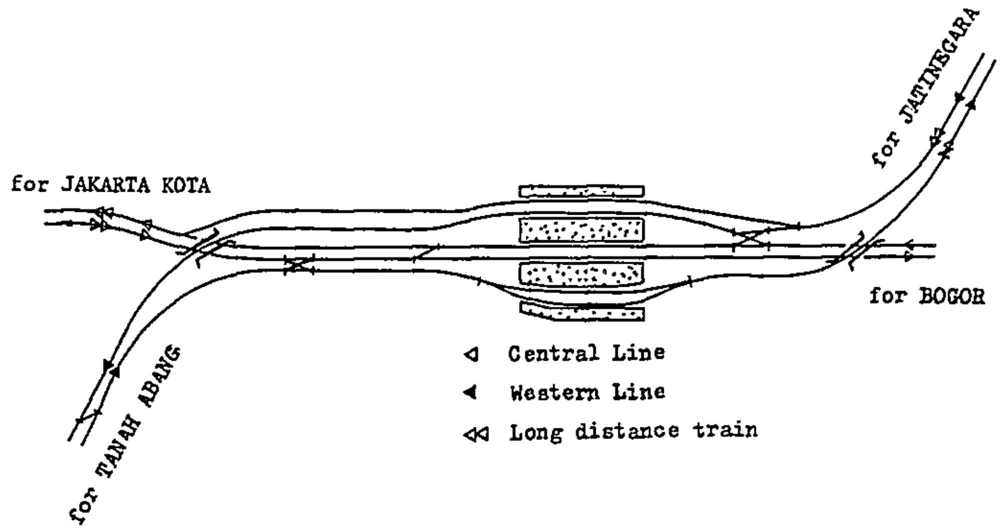
Although operation on all route will be obtained, it is inconvenient for passengers to transfer to other lines.

(6) Alternative F



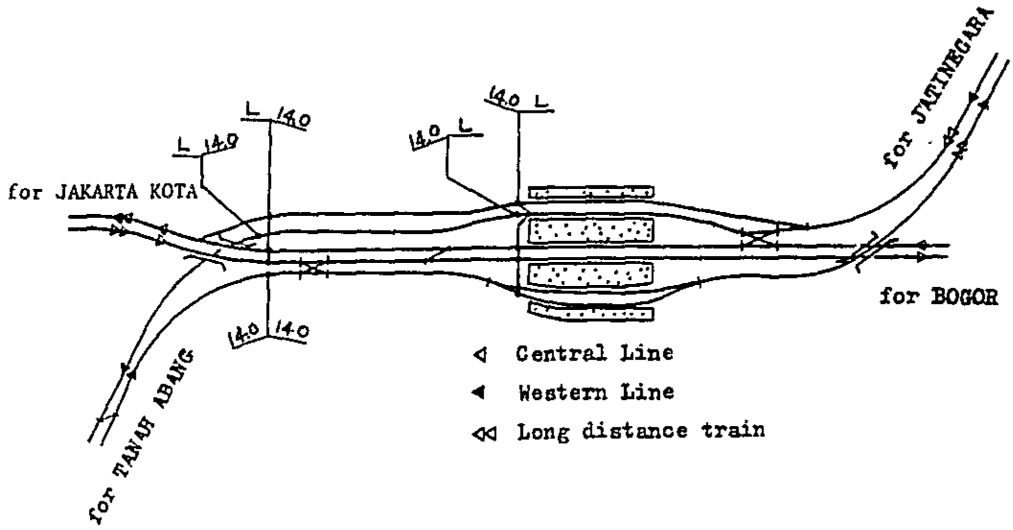
Operation on all routes can be obtained. Since one track in the Jakarta Kota direction is not required, this alternative may be more economical than alternative G.

(7) Alternative G



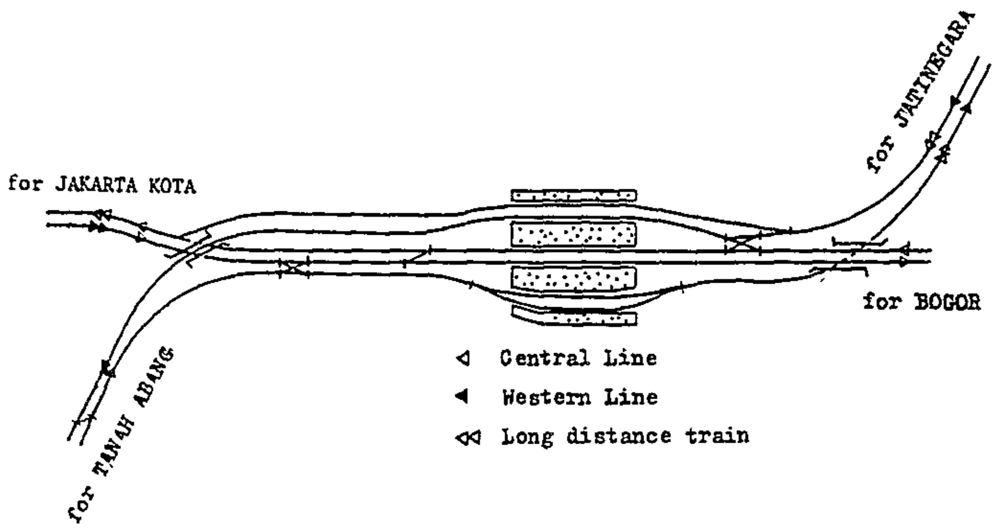
Operation on all routes will be obtained. And it is convenient for passengers to transfer to the other trains because of use of a common platform.

(8) Alternative H



The track layout is the same as alternative G. However, the Central Line has an upgrade and the Western Line has a down grade at North junction.

(9) Alternative I



The track layout is the same as alternative G. However, the Central Line has an upgrade and the Western Line has a down grade at South junction.

3.4.2 Evaluation of Alternatives

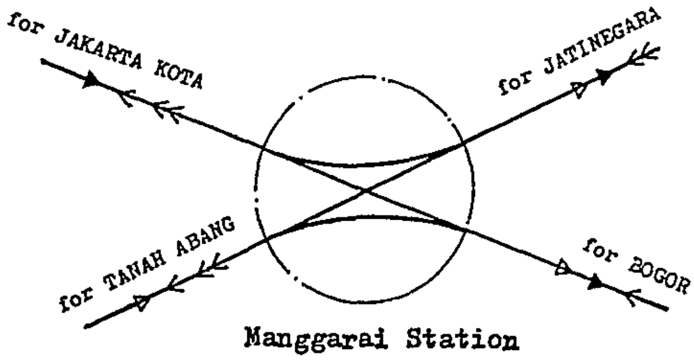
The track layout of Manggarai station must permit all train operations on the Central Line and the Western line and Manggarai station must not inhibit the required capacity of the lines.

In order to determine the best layout at Manggarai station from amongst the nine alternatives, the following items are set forth as criteria.

(1) Train flow at Manggarai Station

Although the future plan of train operation has not been decided, it is obvious that train flows should be planned to satisfy the passenger demand.

The scheme of train operations is based on the traffic demand forecast which is set out in a previous paragraph. In this scheme, routes, such as for long distance train between Jakarta Kota and Jatinegara, and for deadhead trains between Tanah Abang and Bukit Duri are considered. Therefore paths for these trains should be reserved in the design for Manggarai station as shown in the figure below.



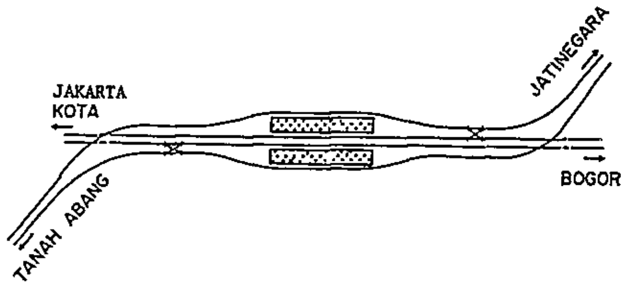
(2) Convenience for passengers and train operation

It is necessary to examine the number of platforms and the related track layouts for convenience of passengers and appropriate train flows.

(a) Arrangements of platform and track

Some different types of platform arrangement can be proposed for Manggarai station as follows;

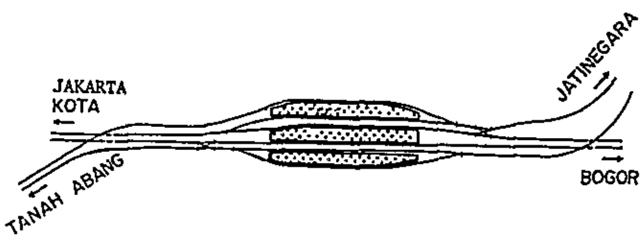
a) 2 Platform



Long distance trains need more standing time since passengers of these trains carry a lot of baggage and the platform will be congested with people meeting and sending off passengers.

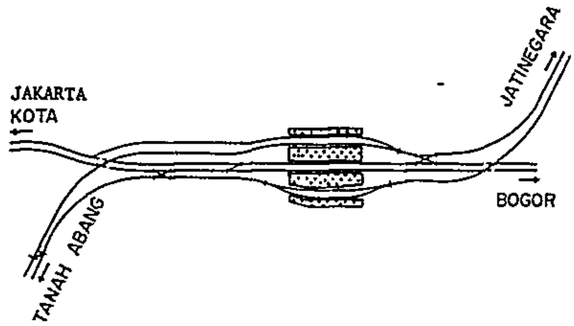
If platforms are to be shared by long distance and commuter trains, train operations will be complicated and the long distance trains will disturb commuter train running times because of the sharing of one track by each kind of train. However, the platform and track construction cost is small.

b) 3 Platform



Complexity of train operations will be reduced compared with type a), however congestion of passengers will be the same because the platform is still being shared by passengers for two kinds of trains. Furthermore, it is not convenient for passengers to transfer to other trains.

c) 4 Platform



Since platforms and tracks will be separated for exclusive use, congestion on platforms and complexity of train operations such as type a) and b) will be resolved.

It is convenient for commuter passengers to transfer to another line in same direction because the platform is shared by both Western and Central lines.

Finally, type c) is to be prefered from the viewpoint of convenience for changing trains, platform congestion and train operations, however construction cost is the highest.

(b) The location of scissor crossings

For the location of scissor crossings, two cases can be considered as shown in Fig. 3.14.

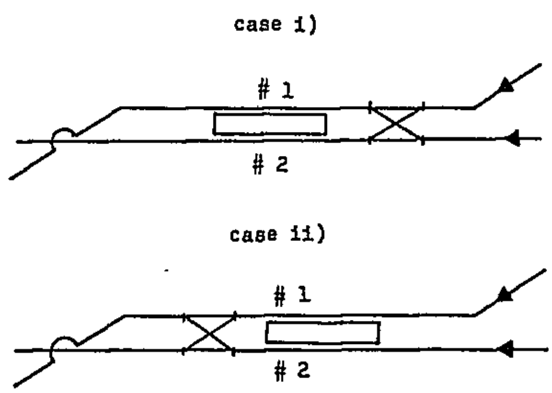


Fig. 3.14 Location of Turnout

In case i), trains for Tanah Abang from both Jatinegara and Bogor start from track # 1 and trains for Jakarta Kota from the said stations start from track # 2. Therefore passengers will not confuse their trains.

In case ii), trains for Tanah Abang start from both tracks #1 and #2 and trains for Jakarta Kota start from the same tracks. Therefore, passengers may mistake train destinations.

Consequently case i) is better than ii)from the viewpoint of passenger convenience.

(3) Reducing Land Acquisition

As far as possible, the track layout shall be designed within the right-of-way of PJKA.

In order to satisfy this requirement, a steeper gradient may have to be employed in the design in the areas where space is limited. It is preferable to adopt a gradient of less than 10‰ for an ordinary railway profile; however at Manggarai station if a 10‰ gradient is adopted, the land needed for construction will extend outside the PJKA boundry as shown in Fig. 3.15 and land acquisition will be expensive and difficult.

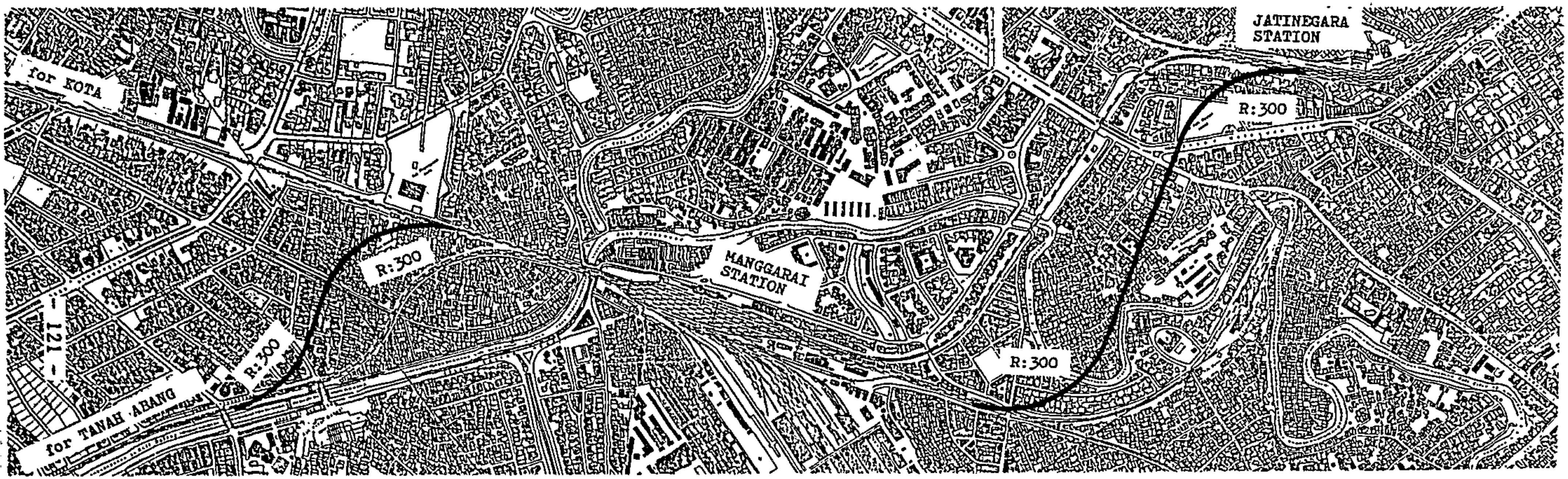


Fig. 3.15 Track Alignment with 10‰ Gradient

(4) Track Profile

A gradient of more than 10% employed for the flyover to be within the PJKA boundary, the track profile can be designed as,

Either

i) The Central Line or the Western Line will have a gradient to pass over the other line,

or

ii) Both lines will have gradient, i.e. one route goes down while the other goes up.

These two ways have to be considered in relation to the existing condition at each junction.

When considering the location of the grade separated crossing, it is necessary to determine which line and which track flys over the other. For this study, construction method, cost, function of the track layout and site layout should be considered.

The following are studies of the track profile and determination of the best flyover track for the North and South junction.

(a) South junction

If type i) design is adopted, the track alignment for the Western Line to Jatinegara cannot connect into the existing track alignment within the PJKA right-of-way because a longer gradient length to the crossing point over the other line will be required. However, if type ii) is adopted the track alignment can connect into the existing alignment within the PJKA right-of-way.

In examining which track is to be the flyover track, should the Western Line be under the Central Line, the track level of the Western Line will be lower than the existing track level at Jl. Manggarai Selatan II. This means that the road will have to be lowered to maintain the existing clearance height between the road and bridge soffits and the type of road work is difficult to achieve as shown in Fig. 3.16.

If the Western Line is over the Central Line, there will be no similar problem.

(b) North junction

It is obvious that type ii) is appropriate for the profile of track layout due to the same reason mentioned in (a) South junction. However in this case, there is the restriction of Cili Wung river.

If one line goes down grade, the track level will interfere with the clearance height of Jl. Sultan Agung and the existing railway bridge on Cili Wung river as shown in Fig. 3.17.

This construction will be difficult and of high cost, consequently a down grade should be avoided and either the Central Line or Western Line should go up separately.

For the Central Line to flyover the Western Line, the construction cost will be higher than the reverse, as there is a double tracked Central Line to be elevated. There is no secondary reason for the Central Line to be elevated as no road level crossing is in the section.

The Western Line should therefore flyover the Central Line.

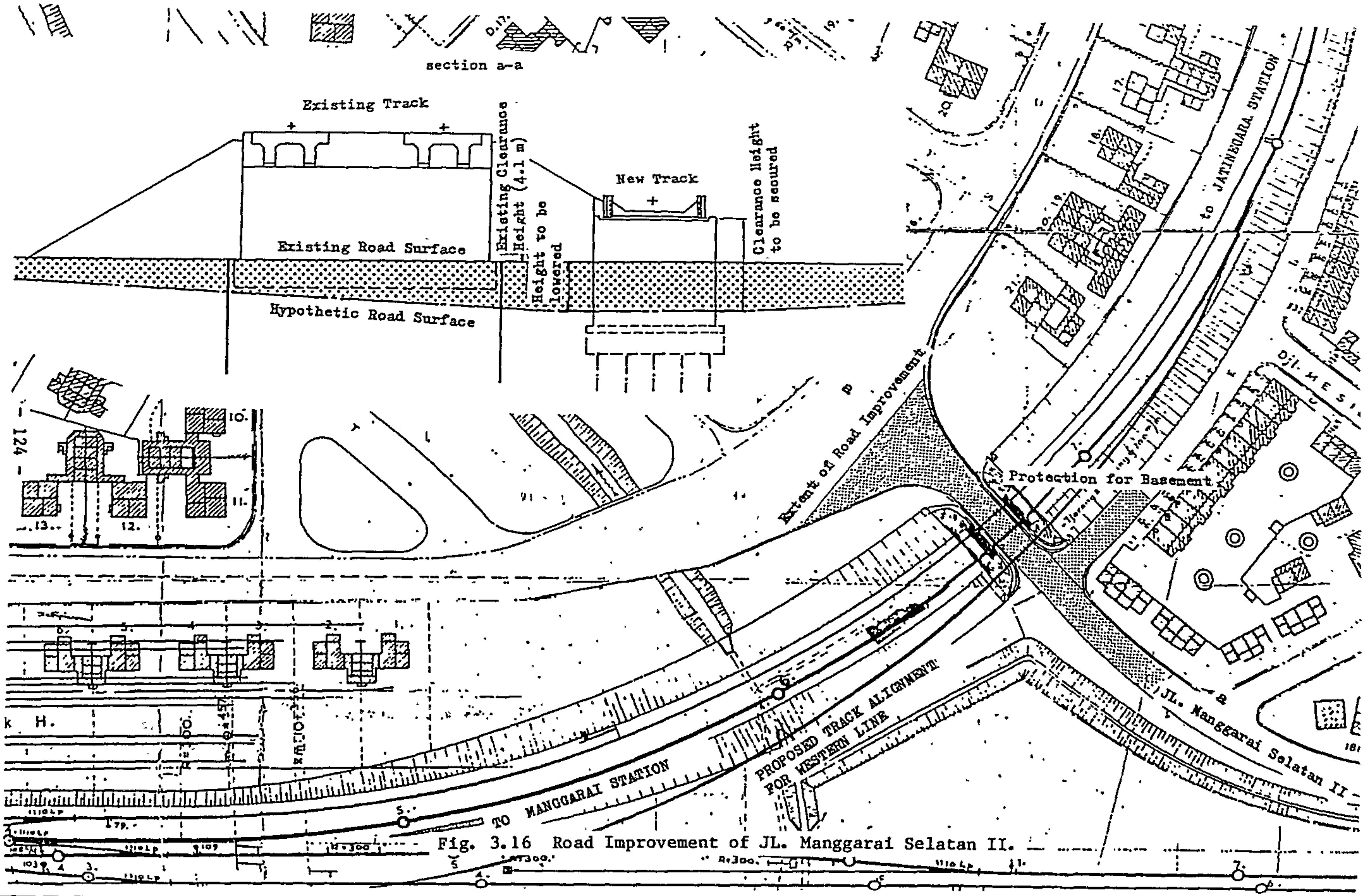


Fig. 3.16 Road Improvement of JL. Manggarai Selatan II.

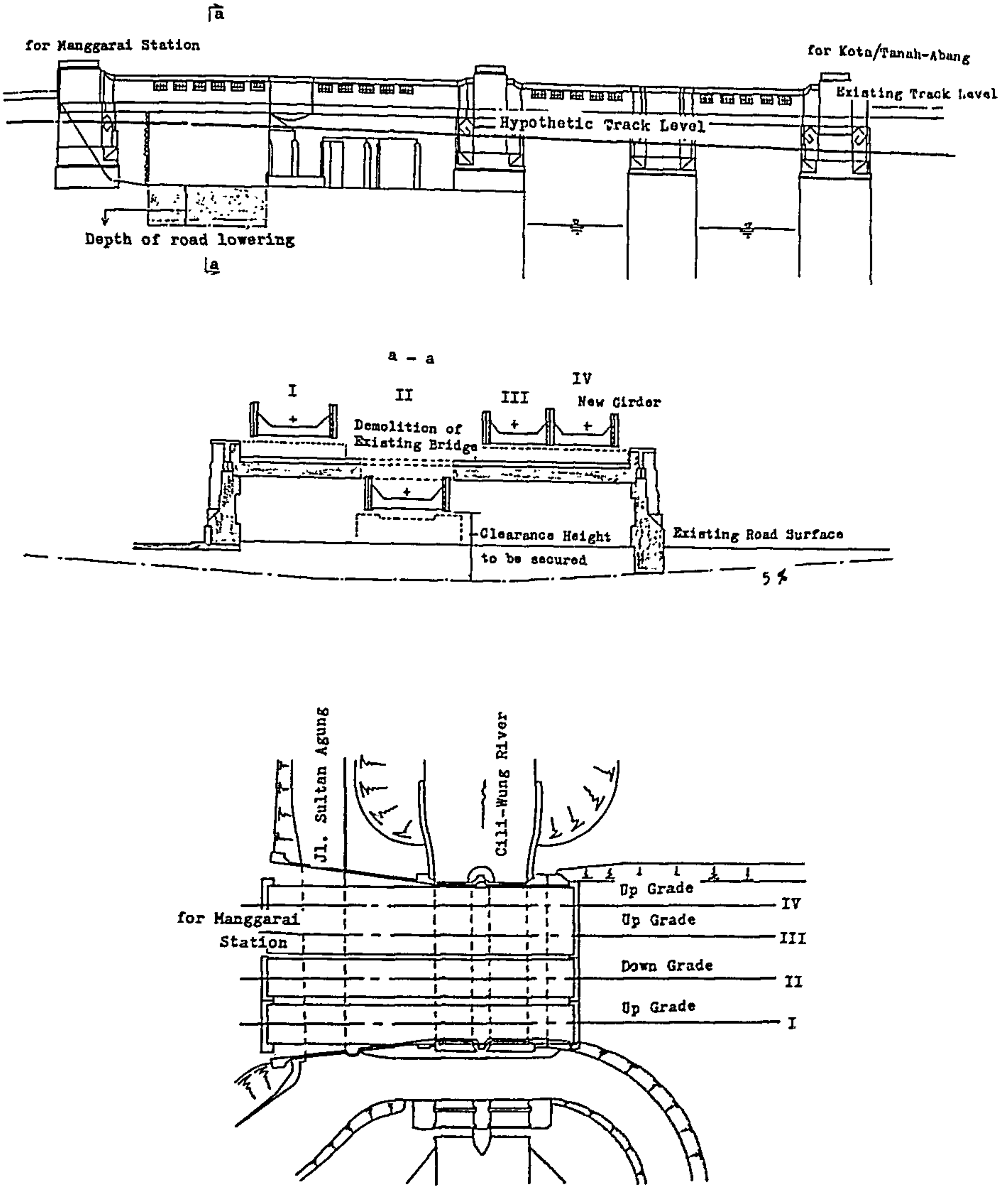


Fig. 3.17 Cili Wung Bridge

(5) Location of the Line

This section considers which line shall be laid outside of the other line in the station yard.

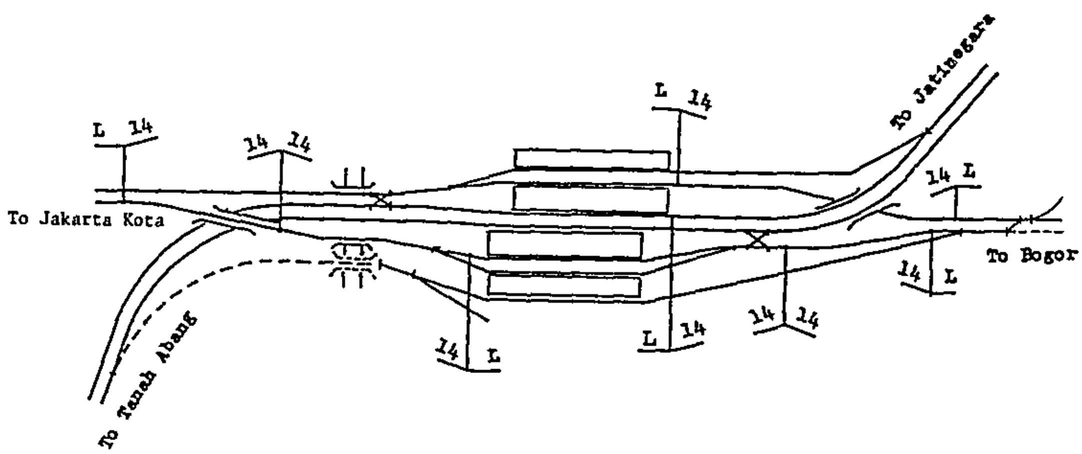
If the Western Line is laid inside the Central Line, the track layout can avoid having a curve of 300 m radius coexist with a gradient of 14‰. But this track layout is not preferable by the reasons as follows;

i) Long distance trains for Jatinegara shall run up two gradients of 14‰.

ii) Since the Central Line is planned to be on a viaduct, spurs for the workshop cannot connect with the main line on the level. Therefore a new track will be required with the construction of a new bridge at the southside of the existing Cili Wung bridge.

iii) Commuter trains for Bogor will be interrupted by long distance trains for Jatinegara.

iv) When quadrupling of the Central Line is planned, land space is not available; consequently, it will be necessary to build additional viaduct tracks.



As the result of above discussion, it is preferable to design track layout such that the Central Line will be installed inside of the Western Line.

As a result of the previous discussions the station function and design conditions have been determined.

i) Operation on all train routes is to be obtained.
ii) Long distance trains and commuter trains are to be separated.
iii) Commuter passengers are to transfer to another line in same direction at the same platform.
iv) Reduce land acquisition to the minimum.
v) Avoid road works under the railway.
vi) The tracks of the Western Line are to be laid outside of the Central Line.

(6) Comparative Evaluation

Based on these items, nine alternatives shall be evaluated. The comparison of these nine alternative is shown in the Table 3.12.

Table 3.12 Comparison of Alternatives

Alternative	A	B	C	D	E	F	G	H	I
All routes obtained	X	X	0	0	0	0	0	0	0
Separation long distance and commuter	△	0	0	X	△	0	0	0	0
Transfer of passenger	X	X	0	0	X	0	0	0	0
Reduce land acquisition	0	X	X	0	0	0	0	0	0
No road work	0	0	0	0	0	0	0	X	X
Comparative Evaluation	X	X	X	X	X	0	0	X	X

Note: 0: Better degree △: No bias X: Worse degree

Alternatives (A) to (E) may be clearly eliminated because all functions and convenience are not included in spite of the lower cost. Although alternative (H) and (I) has all function and convenience respectively, there are some difficulties in construction work.

It is obvious that alternative (F) or (G) will be the most preferable plan for the grade separated crossing.

3.4.3 Alternative to be Selected

In order to discuss the most suitable plan for the grade separated crossing, two alterntives F and G are to be examined in detail considering the following factors:

i) Comparison of gradient.
ii) Interruption of train operations due to interference.
iii) Track layout for future requirements.
iv) Construction cost.

(1) Gradient

A gradient of 14‰ is employed for the standard design based on "The Feasibility Study on Track Elevation of Central Line"[1]. However, as an alternative, a 22‰ gradient was examined for economic reasons.

The reason for using a 22‰ gradient is that the maximum gradient for the electric cars is 25‰ based on the capability of the cars, the hauling capacity with unserviceable equipment and the existing space in the yard.

As a gradient should be compensated when the track is on a curve to allow for curve resistance, the gradient of 25‰ is reduced by 3%. (=800/300: a curve with 300 m radius).

Consequently, these two kind of gradients will be studied for two alternatives F and G.

The schematic track layout for those alternatives are shown in the Figs. 3.18 ∿ 3.21.

At present, some long distance trains and freight trains are hauled by diesel locomotives. Even if that a train schedule to use existing diesel locomotives is planned, there will be a problem that these trains can not be operated on a gradient of 22‰.

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1) Report on Urban/Suburban Railway Transportation in "JABOTABEK" Area (Feasibility Study on Track Elevation of Central Line)
March 1982 JICA

For this situation the following relief plan is considered.

i) Use of double heading

ii) A level bypass track

iii) Employment of electric locomotives

Item i) and iii) require facilities and personnel for locomotive changes and time-wasting will occur in item ii) to operate such trains with diesel locomotives on level route in conflict with the interval train schedule.

Consequently, although the adoption of a 22‰ gradient is possible, it is undesirable for the reason given. There will be no problem concerning the tractive force of a diesel locomotive on a 14‰ gradient as was mentioned in "The Feasibility Study on Track Elevation of Central Line."

(2) Train Operation

In case of alternative F, commuter trains for Tanah Abang which are to be operated immediately after a long distance train for Jakarta Kota can not start freely because of the station/waiting time needed for clearing the route. This means that the operation of the Western Line will be tight and will lose the flexibility for recovery of delays.

In case of alternative G, trains on the Western Line for Tanah Abang can start more smoothly compared with alternative F, because a track for the long distance train for Jakarta Kota is availble for exclusive use.

As recommended by case D in the report of "Urban/Suburban Railway Transportation in JABOTABEK Area"[2), there is a possibility to operate trains which come from Bogor on the Central Line and go to Tanah Abang on the Western Line.

According to the train operation plan in this Report, train operation between Depok - Manggarai - Tanah Abang and between Jatinegara - Manggarai - Gambir are considered.

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2) Report on Urban/Suburban Railway Transportation in "JABOTABEK" Area. March 1981 JICA

By adopting the concenpt of this alternative "D", it is difficult to operate long distance train because commuter trains from Bogor to Tanah Abang have to operate across the route of the long distance train in alternative F.

There will be the same problem on the route from Jakarta Kota or Tanah Abang to Bogor or Jatinegara, on a scissor crossing at the intersection of both the Central Line and the Western Line.
However, the traffic volume on this route at peak hours will be smaller than on the route for Jakarta Kota and Tanah Abang at morning peak hours. This means that the loss of time can be allowed for both alternatives F and G.

(3) Consideration for Future Requirement

In future, the number of trains is expected to increase. The number of tracks shall also be increased according to the train operation schedule through Manggarai station. In that case, though a quadruple line (4 tracks) will be planned, the difference in construction for both alternatives F and G is as follows;

It is required that the track layout of alternative F be improved to that of alternative G, but the track addition work will be difficult due to the existence of the river and road bridge. Meanwhile, alternative G has the space to construct a bridge for additional track on the east side of existing Cili Wung bridge.

(4) Construction Cost

As low construction cost for this project is an important factor for the selection of alternatives, each alternative is studied taking the following items into consideration to reduce the cost.

i) Adoption of steeper gradient

ii) Reduction in number of tracks and track length.

iii) Type of structure.

Construction cost for each alternative is estimated as shown in Table 3.13.

Table 3.13 Comparison of Construction Cost

(Unit: Million Rupiah)

Work Item \ Alternative	F-14	G-14	F-22	G-22
Civil & Track	19,460	20,370	18,480	19,920
Electric	7,500	7,560	7,320	7,380
Signal & Communication	5,300	5,300	5,300	5,300
Land Acquisition & Compensation	1,290	1,520	1,290	1,520
Total	33,550	34,760	32,390	34,110

(a) Steeper Gradient

It is expected that the cost can be reduced by the use of steeper gradient, because the length of viaduct structures will be shortened. Therefore, it is anticipated that the track layout with 14‰ gradient will be more expensive than that of 22‰ gradient. However, the difference in construction cost between adoption of both gradients is small because of the following reasons;

- The structure for the longer section of 14‰. gradient alternative is to be earth embankment.
- Since the profile of track layout shall be designed to avoid a horizontal transition curve on a vertical curve, the elevation of the structures become higher and longer. And the height of structures for 22‰ gradient alternative will be higher than 14‰, i.e. construction cost will not become lower as expected.

(b) Number of Track

It is clear that the cost will vary according to the number of tracks to be installed. Alternative G has more tracks than F in the track layout completed. It is necessary, however, to consider the number of temporary tracks required during construction.

The construction work on the Cili Wung river bridge will be a bottleneck, because the width of the exsiting bridge is too narrow to maintain train operations during the construction. In order to operate trains as smoothly as the schedule, it will be necessary to maintain three or four tracks on the bridge.

Alternative G requires less temporary tracks than F. In the cost of alternative F-14, preparation of one temporary track is included.

(c) Type of Structure

The main structures for the grade separated crossings are concrete box section bridge, concrete viaducts and embankment at North and South junctions.

Comparing the cost, some alternative structures can be proposed such as steel piers and girders. And it is assumed that the cost of steel structures will be lower than concrete structures, for instance, the cost of 160 million Rupiah will be reduced by using steel material for the structure of the crossing point. But steel structures will cause more noise and require maintenance such as painting. And it is proposed that local materials shall be employed for projects in Indonesia as far as possible. Consequently, in both alternatives F and G concrete structures are adopted excepting the steel girders over the Cili Wung river.

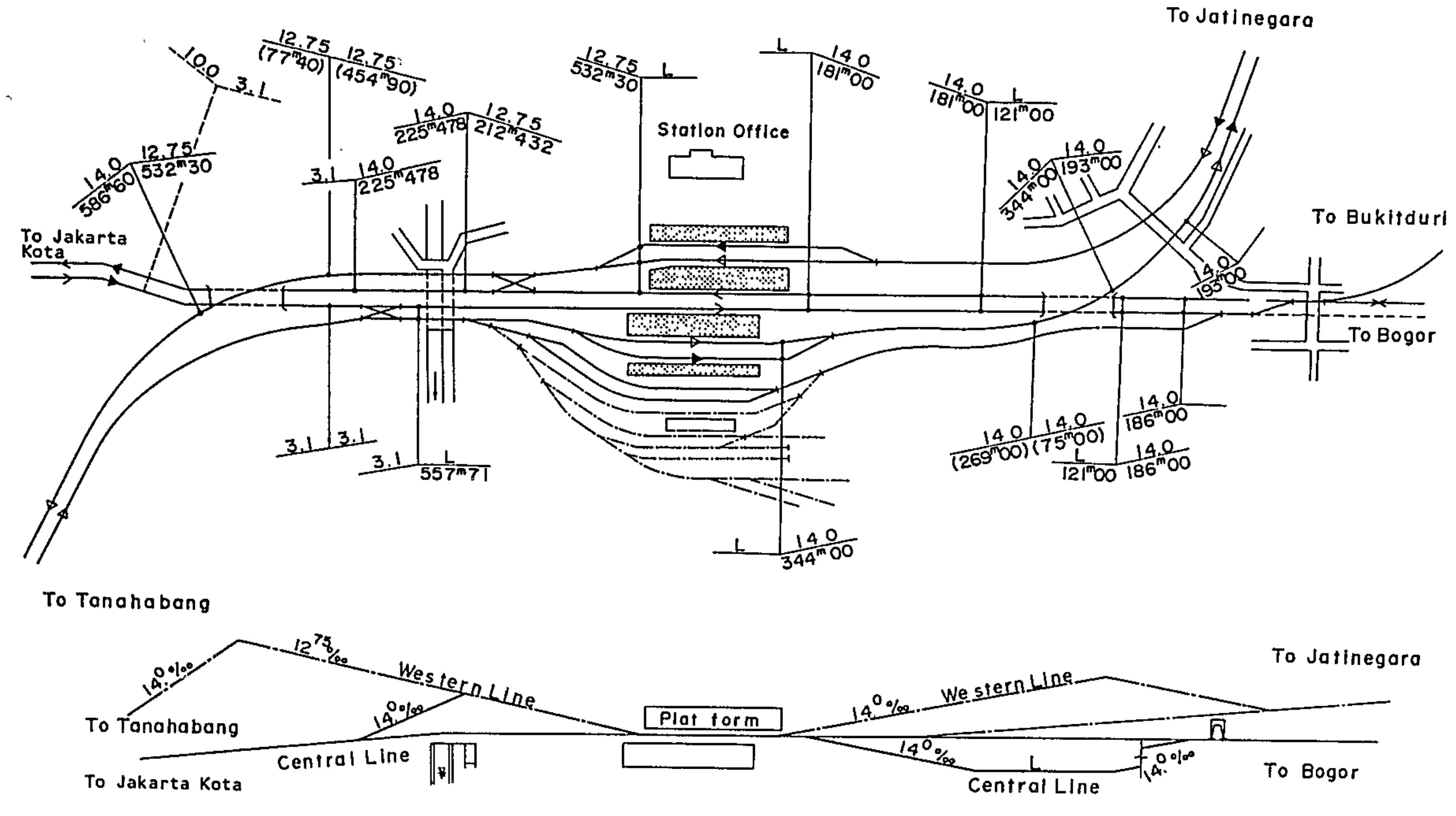


Fig. 3.18 Schematic Plan/Profile (F-14)

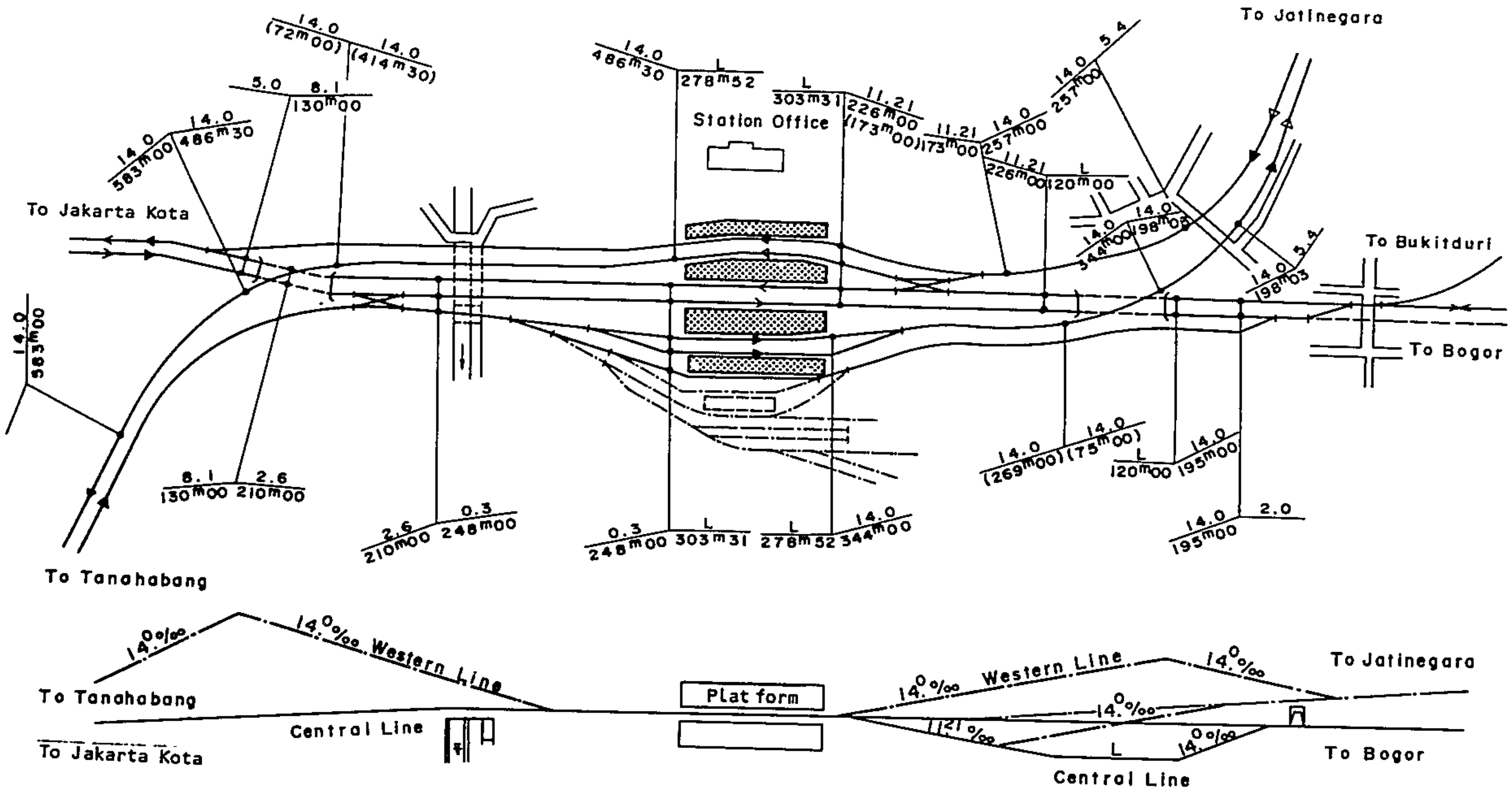


Fig. 3.19 Schematic Plan/Profile (G-14)

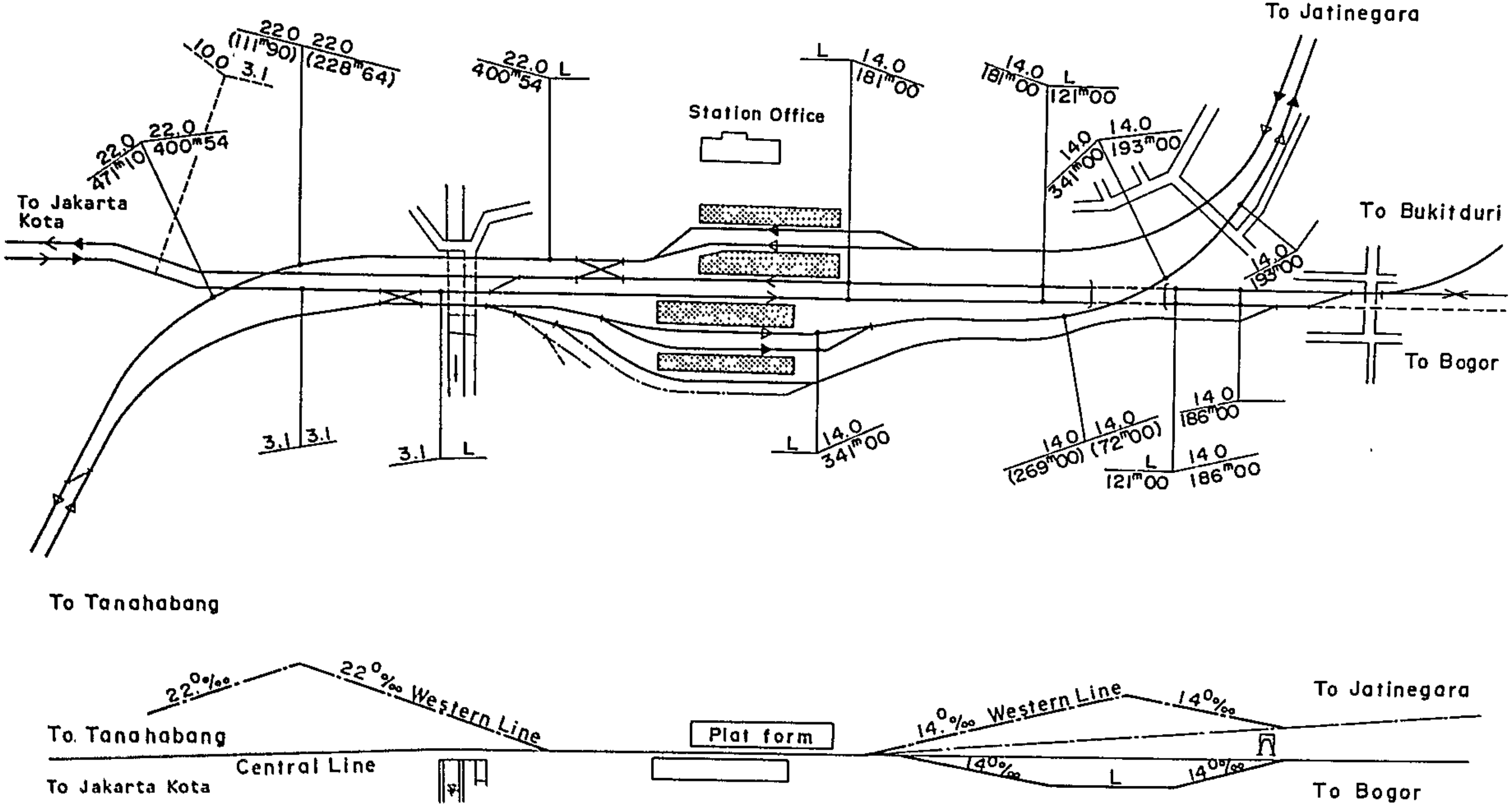


Fig. 3.20 Schematic Plan/Profile (F-22)

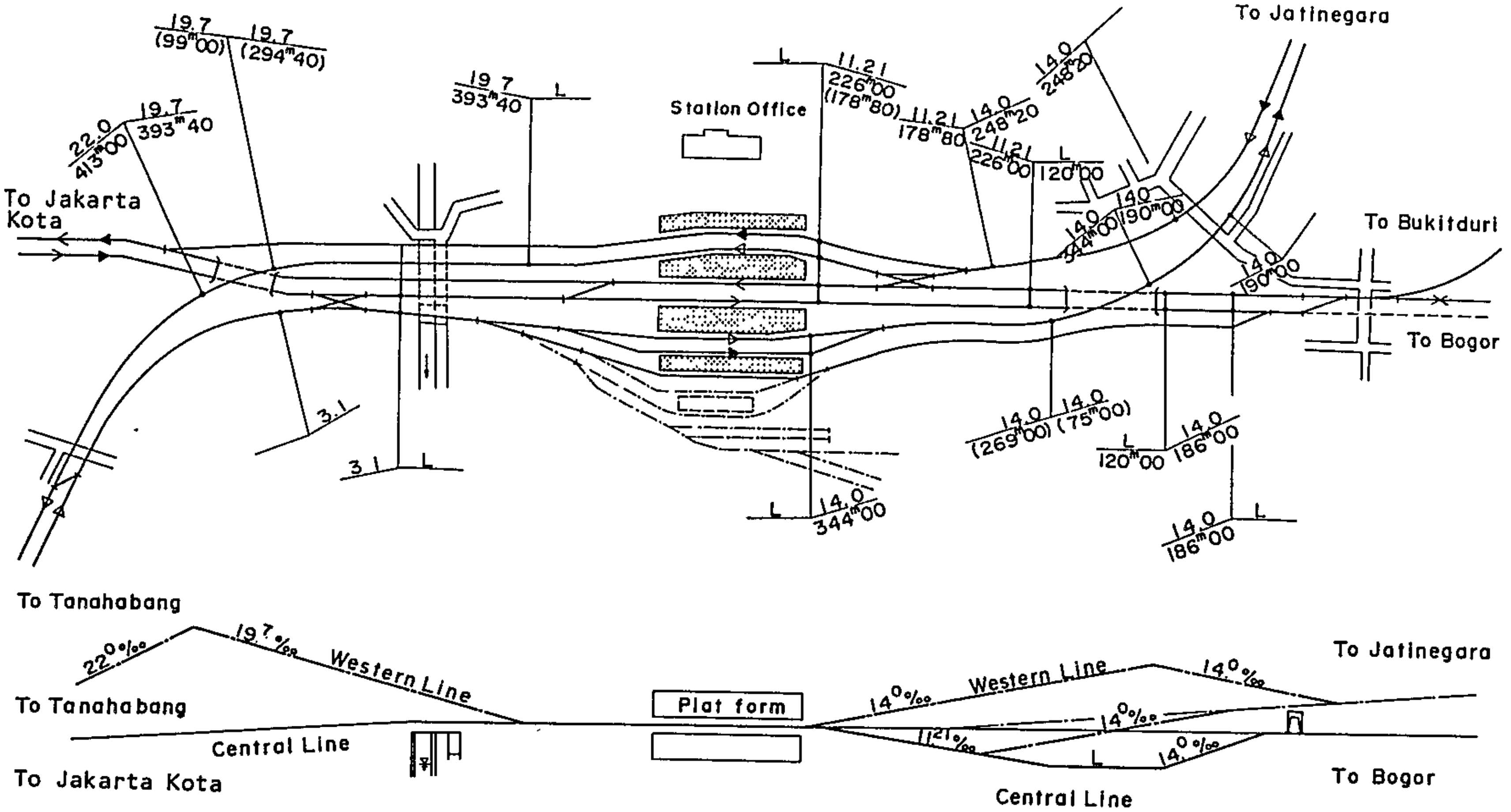


Fig. 3.21 Schematic Plan/Profile (G-22)

3.4.4 Optimum Alternative

Items to be considered in the selection of the optimum alternative are established in previous section. And an alternative shall be selected from among four alternatives to conduct the preliminary design of the grade separated crossing.

The study for the selection is summarized in the Table 3.14.

Table 3.14 Summary of Principal Study for Alternatives

Study Item \ Alternative	F-14	F-22	G-14	G-22	Remarks
Gradient	○	△	○	△	In case of using the gradient more steeper than 14‰ some counterplans are required.
Train Operation	×	×	○	○	In case of alternative F, train operation will be tight and lose the flexibility for recovery of delays.
Track Layout in Future	×	×	○	○	In case of the quadruple line construction, track addition work would be difficult in alternative F.
Construction Cost (Billion Rupiah)	33.5	32.4	34.7	34.1	
Total Estimation	×	×	○	×	

Note ○: Better degree
△: Judgement depends on counterplan
×: Worse degree

As the conclusion, by comparative evaluation alternative G - 14 will be recommended as the best plan.

Alternative G - 14 was selected to be optimum by the Indonesian Steering Committee after discussion with the Japanese Supervisary Committee held on 9th January, 1984 in Jakarta.

3.5 RAILWAY FACILITIES

Manggarai station shall be improved in accordance with the construction plan of the grade separated crossing. The proposed railway facilities intend to improve the function of the station and convenience of passengers.

3.5.1 Existing Facilities

(1) Station Facilities

Manggarai station has the following facilities.

(a) Station Building

The station building covers about 1,000 square meters and includes station masters' office, station office, ticket counter, signal cabin, shops, restaurant, lavatory and so forth.

(b) Station Yard

In the station yard, there are 16 tracks including sidings: 8 tracks are used as main line for ordinary train operation of the Central/Western lines and long distance trains and 4 tracks are used as sidings or spurs to/from Manggarai workshop. Some freight is handled in the sidings, however most of platforms for freight handling are not in use.

The track has two kinds of rail sections, principally R 14 (41.5 kg) and R 3 (33.4 kg), and turnouts are angles of 1:10 and 1:8.
The track layout is designed to give access to all routes, i.e. from the Western Line to the Central Line and vice versa, and many double slip crossings are installed for this purpose.

(c) Platform

There are 7 platforms for passengers, among which 5 platforms are in use.
The length varies between 200 m and 300 m. and the width from 1.9 m to 6.9 m.

Since each track has a platform on either side, passengers are able to get on/off either side.
These platforms have roof covering only in the central portion.

(d) Passageway

One passageway with width of 5 m is installed across 4 tracks on the same level.

(e) Station Plaza

There is some space which allows only a few cars to park at the east side of the station, but the area is not large enough to be considered as a station plaza.

(f) Drainage

There are no drainage facilities in the station yard, therefore surface water seems to flow naturally out of the yard.

(g) Cili Wung Bridge

There is a bridge constructed in 1918 over Cili Wung river.
The width and the length are about 21 m and 30 m, respectively.
The bridge has three spans and two abutments, with two spans over the river and one span over a 6 m wide road with 3 m headroom. Four tracks with scissor crossings are installed on the bridge.

(2) Electric, signalling and telecommunication facilities

(a) Switch House

There is a switch house adjacent to the station building. Since the existing capacity of power distribution is sufficient for the plan of station improvements and this building will not interfere with construction work, the switch house may be left in the existing position.

(b) Overhead Contact Wire System

The masts are all braced square lattice steel masts except for some short masts, and the masts are of differing heights.

No beam is used and cross catenary wires are used to suspend the overhead wires except for short beams.

The overhead contact wire system is all the double contact wire system except for some connecting tracks.

The messenger wire is copper 150 mm^2, and the contact wire is grooved copper 107 mm^2. The messenger wire is suspended by droper from the main cross catenary wire. Accordingly, removal of the overhead contact wire is very difficult because the height of the overhead contact wire is in balance with all of the overhead contact wires, and if a part of them is moved, the height of all wires is changed.

(c) Signalling System

At present a train is controlled by semaphore signals and the route is set by mechanical switches. Mechanical switch levers and signal levers are centralized in signal cabins, by which the remote turnouts and semaphore signals are activated through signal wires.

Known as the "Mechanical Interlocking Machine" the system was installed by Siemens in 1923. This obsolete equipment is approaching the economic maintenance life limit, and difficulties are being experienced in obtaining spare parts.

(d) Telecommunication System

A Philips "UH-200 Automatic Telephone Exchange" is installed at Manggarai station and the system which can have the maximum of 5 cabinets (1 cabinet = 5 subscribers) has 4 cabinets at present.

The equipment for the dedicated telecommunication system includes Morse telegraphs, magneto telephones and pulse selective telephones. These are used for exchange of information with neighbouring stations, coordination between substations and train control.

The magneto telephone is used for train operation messages, and the Morse telegraph (T type) is used for block messages and train dispatching.

The Morse telegraphs (A and B type) are used for exchange of train operation information. The pulse selective telephone is used for general communication.

Spare parts for Morse telegraph equipment are becoming difficult to obtain.

3.5.2 Design Criteria

(1) General

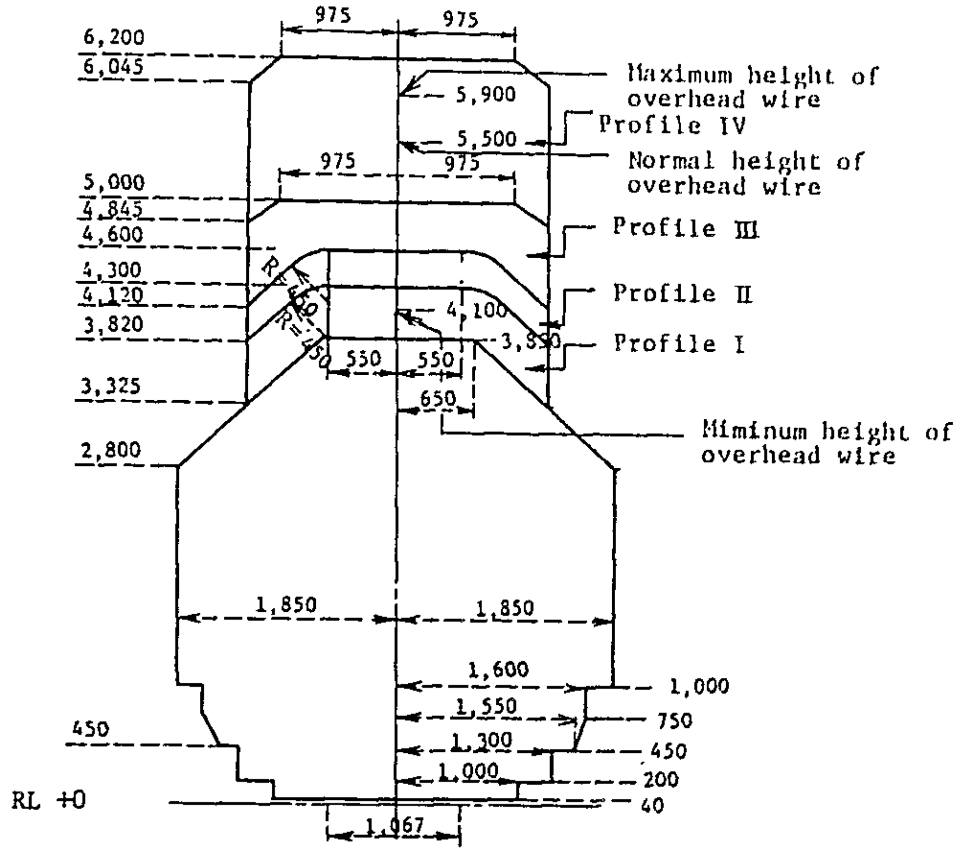
The grade separated crossing is planned in conjunction with the JABOTABEK project, therefore the design criteria shall be consistent with those projects.
The design criteria for this project will comply with various relevant standards and stipulations of PJKA to the maximum extent. However, some of the items shall be closely studied in detail and determined.
The design criteria as proposed and determined to be adopted for this project are shown in the Table 3.15.

Table 3.15 Design Criteria

ITEM		STANDARD
Radius of Curve	Main Track	300 m (250 m)
	Turnout Curve behind Frog	240 m (160 m)
	Secton along Platform	500 m (400 m)
	Side Track	160 m
Max. Gradient	Main Track along Platform	3 ‰
	Main Track in Station	14 ‰
Track-Centre Distance	Outside of Station	3.8 m
	Inside of Station	4.0 m
Track	Type of Rail	UIC 54
	Sleeper	P.C. Sleeper
	Turnout	#8, #10, #12, #16
	Gauge	1,067 mm
	Ballast Thickness	250 mm
	Maximum Design Speed	60 km/hr
	Maximum Cant	105 mm
Width of Formation Level (one side distance from the centre)		2.75 m
Bridge Bearing Capacity (standard design load)		KS-16
Platform	Distance from Platform to Track-Centre	1.6 m
	Width of Island Platform	8.0 m (3.0 m Minimum)
	Width of Side Platform	6.0 m (2.0 m Minimum)
	Height of Platform	0.95 m
	Length of Platform	270 m
Transition Curve	Type	Cubic Parabola
	Curve Length	Curve length is whichever longest among L1, L2, L3 $L1 = 0.6 \times C$ $L2 = 0.008 \times C \times V$ $L3 = 0.009 \times Cd \times V$ C : cant (mm) Cd : deficiency of cant (mm) V : max. train speed (km/hr)
Vertical Curve	Curve Radius	4,000 m in case where radius of horizontal curve is more than 800 m 3,000 m in other case

(2) Construction Gauge and Clearance Height

Construction Gauge of PJKA is as in Fig. 3.22.



Profile I : Minimum profile for Bridge with speed restriction 60 km/hour

ProfileII : Minimum profile for Tunnel and Viaduct with speed restriction 60 km/hour and for Bridge, no restriction

Profile III: Minimum profile for New Viaducts and New Construction, except tunnels and bridges

Profile IV : Normal profile for Electric Car

Fig. 3.22 Construction Gauge

Manggarai station is located in the section where Direct Current Traction Power is adopted. However considering the possibility of long distance trains which will be operated by AC/DC dual purpose electric cars, the following clearance height is required.

The clearance height employed in this design is 4.85 m as shown in Fig. 3.23.

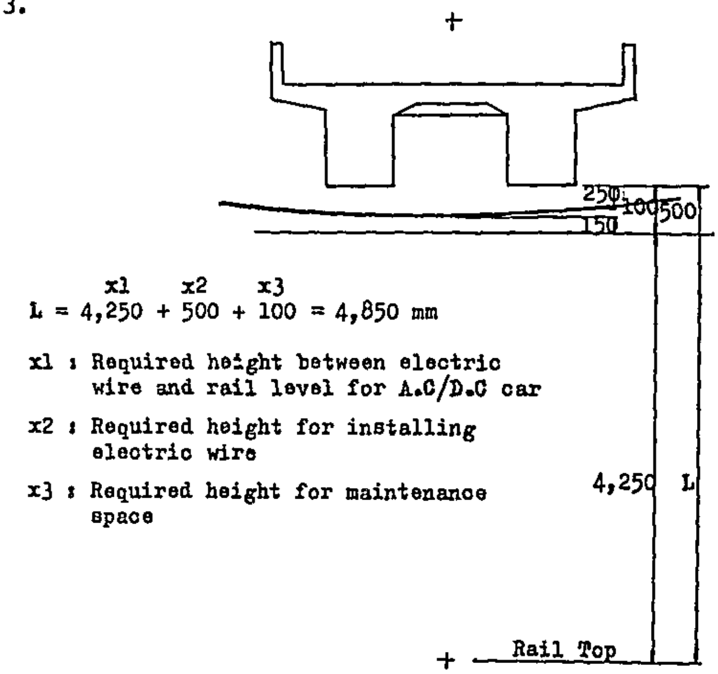


Fig. 3.23 Required Clearance Height between Railway Tracks

The clearance height with road is determined to be 5.1m for trunk road and 4.5m for ordinary road by the stipulation of Ministry of Public Works, Directorate General of Highways.

(3) Roadway Diagraph and Formation Level

The roadway diagraph and formation level employed in this study is refered from PJKA standard as shown in Fig. 3.24.

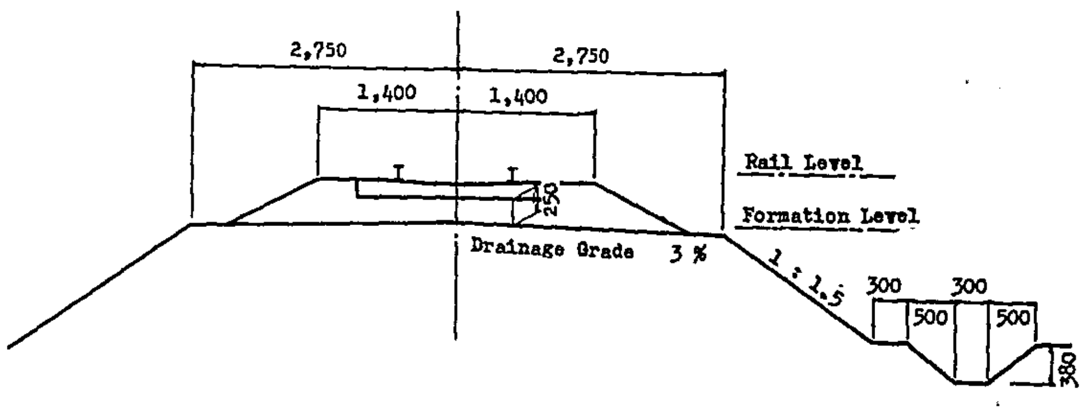


Fig. 3.24 Railway Diagraph

3.5.3 Geology

(1) Topography

Concerning the general elevation, the topography of Jakarta is grouped into two parts, each with its own characteristics: i.e., northern lowland plain and southern hills.

The northern part is bordered by the Java sea and approximately by the course of the Banjir Canal. This part extends westwards about 10 km and is only 5 m above sea level at Priok.

The southern part mainly consists of low ridges lying in a north-south direction with the elevation rising relatively steeply towards the south. This area extends about 18 km from the Banjir Canal and rises from 5 to 50 m.

Manggarai station is located in the southern area adjacent to the Banjir Canal (Cili Wung river).

(2) Geology

The northernmost belt of West Java consists of alluvial and often marshy lands. This lowland plain extends from Anyer (near Strait Sunda) to the Bay of Cirebon.

The coast line shifts northwards, due to the excessive silt loads of the rivers flowing into the Java Sea and the small depth of this submerged peneplain.

The Southern part of the marshy coastal belt is young Pleistocene ash and mudflows from the mountains in the hinterland, and forms low ridges only a few meters high. The broad alluvial river valleys is where the young ash flows, from Slak and Gedeh volcanoes near Bogor, spreads fan-like in the northern lowland to Tangerang, Jakarta and Bekasi.

The Outline of geological stratification in Jakarta is shown in Table 3.16.

Table 3.16 Stratification of Geology in Jakarata

Geological Period		Formation	Description
Quaternary	Holocene	Alluvium	Loose sediments composed principally from cohesive soil forming the delta.
	Pleisto-cene	Diluvium	Volcanic ash forming the diluvial pla-teau in the south which is lateritized to the substantial depth.
Neogene	Pliocene	Centen-Formation	Basement rock, alternation of thin sandstone and mudstone layers. The upper portion of this alternate layers is weathered and becomes soft.

(3) Soil Soundness

The bearing layer in the northern part of Jakarta varies between 10 and 25 meters deep and the boundry is approximately toward Jl. Jayakarta. Southwards the bearing layer is uncertain, in some places up to 40 m, but averages out between 8 and 15 meters deep.

In the southern part of the Banjir canal, where Manggarai Station is located, the bearing layer is generally shallow, averaging less than 10 meters depth.
It means that the soil soundness in this area is better than the northern part of the Banjir canal.

(4) Soil Condition in Manggarai Station

In order to define the soil condition in Manggarai station, Boring and Laboratory tests were executed at the location shown in Fig. 3.25.

(a) Stratum

The stratum in Manggarai station can be classified into three groups. The uppermost layer is composed of soft soil (unconsolidated sediment) with some debris and gravels in it, with a thickness range of 0.5 to 2 m.
The middle layer, with a thickness of 2 to 14 meters is composed of clayey or silty soil. This layer has standard penetration test (N value) of 6 to 44, however it can be considered to be alluvium.

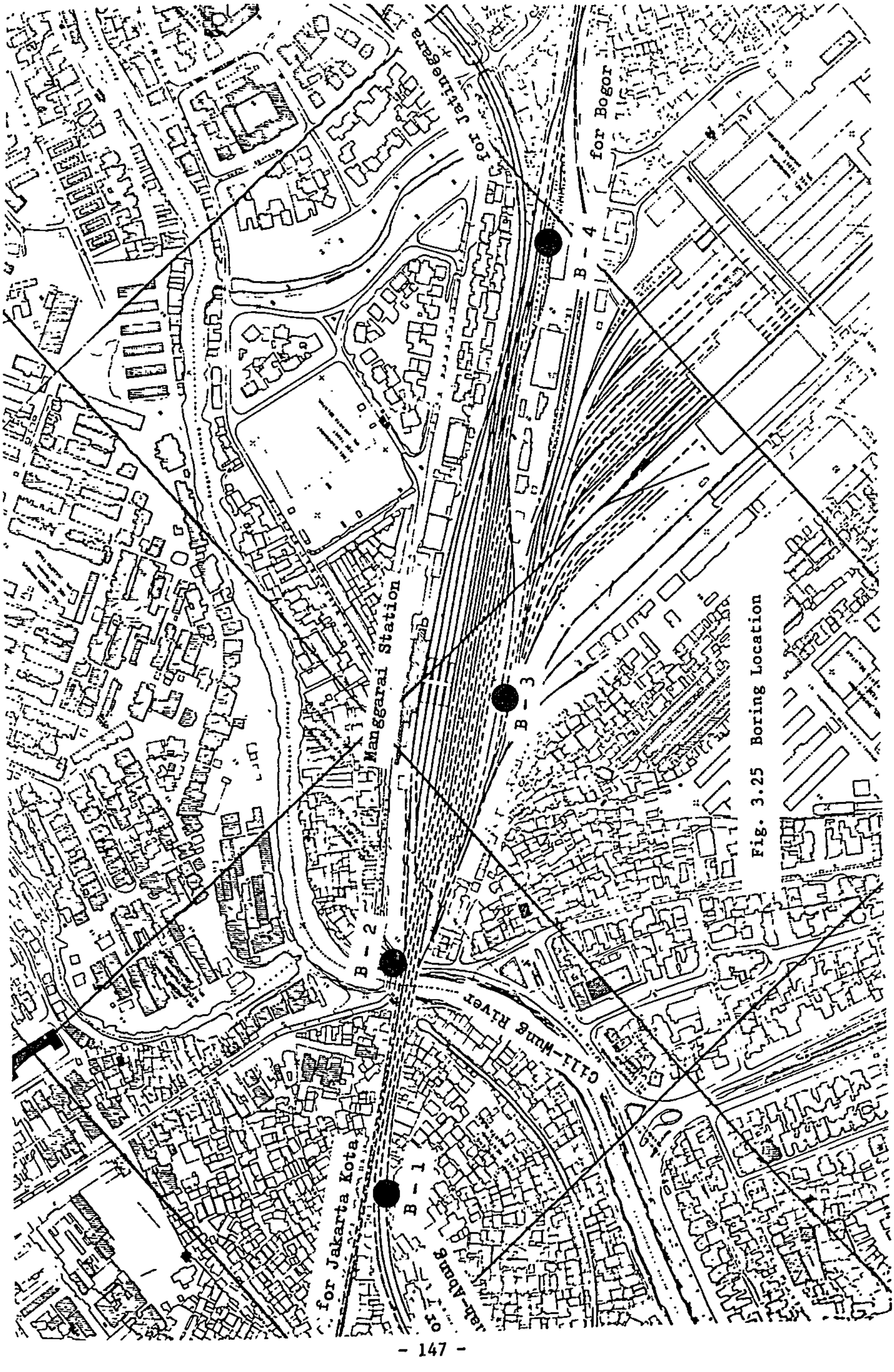


Fig. 3.25 Boring Location

Underneath, there is a comparative good soil layer with an N value of more than 50. The composition is diluvial sand or silty sand. Outline of the stratum is shown in Fig. 3.26.

(b) Result of Standard Penetration Test

Standard penetration test was carried out at each hole, and the results is shown in Fig. 3.27, 3.28, 3.29, 3.30. (See Appendix 6) According to the results on four holes, all sand and silty sand layers at the bottom of the bore holes are representative and can be recommended as a bearing layer.

(c) Foundation of Structures

There will be different types of structures for the grade separated crossing such as reinforced concrete (RC) viaduct, retaining walls, and box culverts. Some structures will require piles for foundations because of the loads acting on the foundations, the diluvium stratum can be the bearing layer for the pile foundation.

(d) Embankment

Some high embankments will be required for the construction of the grade separated crossings. As the surface ground is soft and lacks bearing strength for the weight of embankment, detailed examination shall be carried out in the design to avoid sliding and embankment collapse.

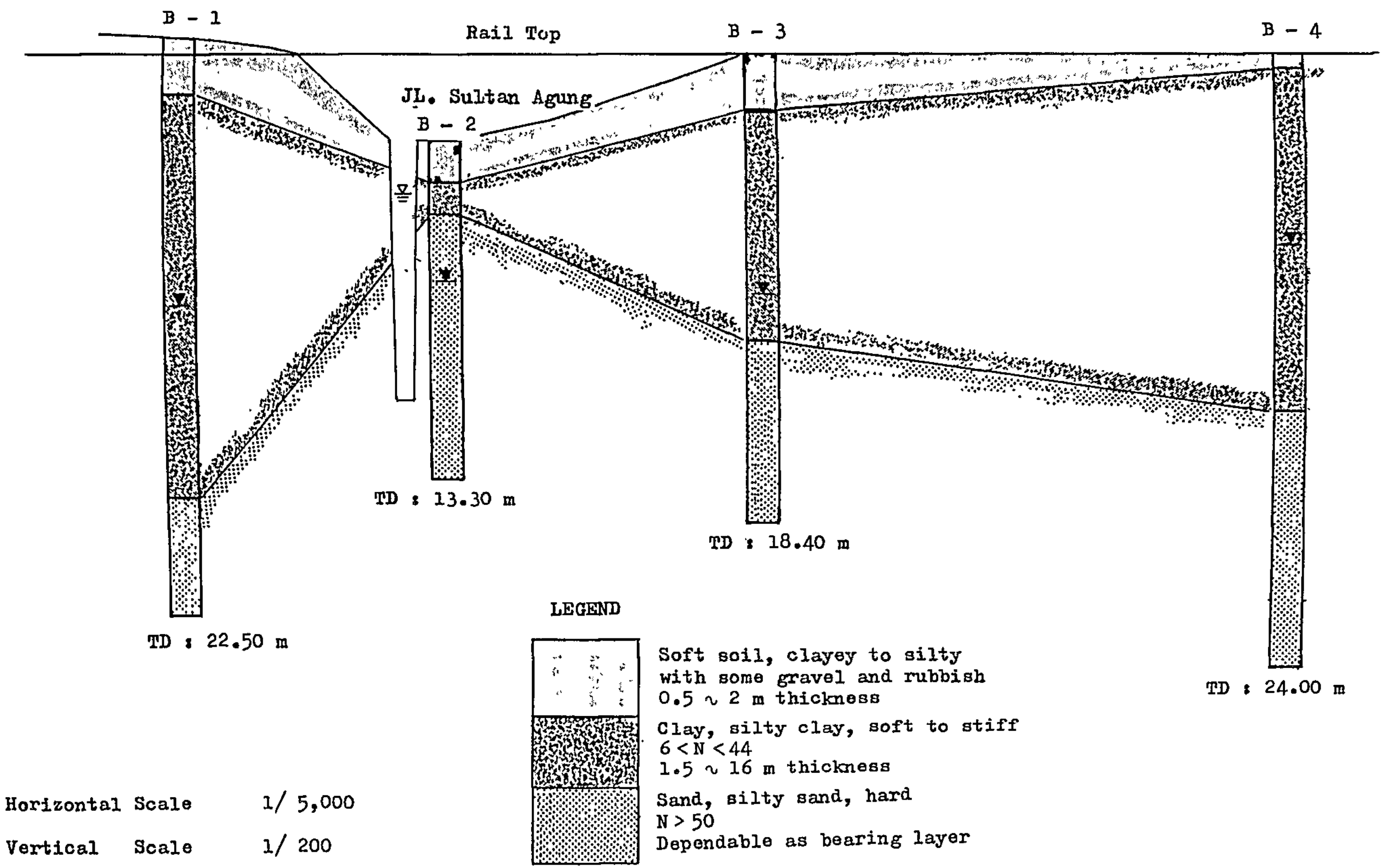


Fig. 3.26 Outline of Stratum in Manggarai Station

3.6 PRELIMINARY DESIGN OF THE GRADE SEPARATED CROSSING

In order to harmoniously treat the increasing passengers and the related train operation at Manggarai station, track layout G - 14 was determined to be the most suitable from among the alternatives.

The preliminary design was carried out by the following method.

3.6.1 Track layout in the Station Yard

(1) Basic Consideration

Following basic items are taken into account in the track layout design.

i) Manggarai station has the facility of 6 tracks and 4 platforms taking the convenience of passengers into account.

ii) Long distance trains can be operated on the route from Jatinegara to Jakarta Kota and vice versa.

iii) Commuter trains can be operated on the routes from Bogor to Jakarta Kota and Tanah Abang and on the reverse route.

iv) Commuter trains can be operated on the route from Jatinegara to Tanah Abang, and also to Jakarta Kota. Reverse routes are also available.

v) A scissor crossing is installed at the entrance to each platform to ensure consistent destination of trains at each platform.

vi) Maximum gradient of 14‰.

vii) Land space is secured for further improvements to the station

(2) Detailed Consideration

Following items are the requirements for designing the track layout in detail.

i) The effective platform length of 270 m is required for the operation of 12-car formations in future.

ii) It is preferable to install turnouts on level section. Some turnouts, however, are installed on a gradient of 14‰ where obtaining a level section is impossible in the limited area.

iii) Turnouts shall not be installed on a transition or vertical curve.

iv) Fewer types of turnouts are employed so as to reduce the custody of spare parts and to ease maintenance.

v) The dimension and the shape of turnout is dependent on the use of 50 N rail because the design of a UIC 54 turnout is not available. It is possible, however, to change the design to that of UIC 54 when it is available.

vi) It is desired to built the platforms at grade level, however a 3% gradient is adopted where this is unavoidable.

vii) No transition curves shall be designed on a vertical curve.

viii) A length of more than 5 m of tangent track is to be installed between tongue rail ends at back to back turnouts or between a turnout and the start of a curve.

ix) Curves with 250 m radius are employed in order to connect to existing tracks within PJKA right-of-way, to reduce land acquisition cost. Otherwise curves of 500 m minimum radius are employed along platforms in some portions because of the track alignment.

x) Since the maximum speed of passing train through Manggarai station will be 60 km/hr due to the speed restrictions for 300m radius, to maintain this speed through turnout branches crossing angles will be 1:16.

xi) The track layout does not require any road or bridge improvements at Jl. Sultan Agung and Jl. Manggarai Selatan II. A new bridge, however, is required adjacent to the existing Cili Wung bridge.

3.6.2 Right-of-Way

The track layout for the grade separated crossing was studied so that the track alignment may be within the PJKA right-of-way (ROW).
The alignment for the grade separation at the south junction may be within the ROW. The alignment at the north junction, however, requires some land acquisition along the Western and the Central

Lines. Because double track operation as well as the existing operation is planned, working space is required outside of the tracks.

The extent of land to be acquired is shown in the Dwgs. 1.21 ∿ 1.23. The area for land acquisition including the working space and the number of houses to be compensated are 7,540 m^2, and 150 houses respectively.

If construction time can be determined and the train schedule maintained by single track operation during construction, land acquisition can be reduced.

ROW limit for the land acquicition is determined as follows;

i) As for the embankment, the limit shall be outside the ditch at toe of embankment.

ii) As for rigid frame viaduct, the limit shall be outside the road for construction work.

3.6.3 Railway Facilities

(1) Station Facilities

(a) Station Building

Since the existing station building will not interfere with the future track layout and it has sufficient area for the requirement, it is to be utilized in its existing location.

Even though some extra facilities are required, it is better to avoid large scale work and to build temporary facilities during improvements to the station building.

(b) Passageway

Considering the safety of passengers and train operation, a passenger over bridge is to be built between the station building and the platforms.

The bridge crosses over six main tracks with a length of 60 m. The width of the bridge is decided by passenger volume which is estimated in the traffic forecast; the width is to be 6 m.

(c) Platform

The number of platforms is determined as four considering passengers' convenience of transfering trains as set out in paragraph 3.4.2.

The length of platform is 270 m, and the width is 6 m for long distance trains and 8 m for commuter trains.

The height of platform is to be 95 cm (from rail top to the platform edge) by considering the floor level of electric cars, deisel cars and other stocks hauled by diesel locomotive. (Refer to the Dwg. 1.17)

(d) Platform Shed

Two kinds of shed are to be built determined by the width of platform. The length is to be 160 m.

(2) Railway Structure

The main structures to be designed for the grade separated crossings are as follows;

(a) Reinforced Concrete Viaduct

Reinforced concrete rigid frame bridges (RC viaduct) are to be built as a portion of the approaches to the northern crossing on the Western Line.

RC viaduct is a beam slab type with a unit length of 30 m, with columns at 3 m, 8 m x 3 and 3 m from one end for the standard, and the height to very from 5 m to 9 m. (Refer to Dwgs. 1.9 and 1.10)

(b) RC Box Culvert

At northern and southern crossing points, the Western Line flies over the Central Line by RC box culverts.

RC box culverts have headroom of 5.9 m, width of 9.5 m and lengths of 69 m and 79 m. (Refer to the Dwgs. 1.12 and 1.15)

(c) New Bridge

A bridge with 50m steel truss girder is to be built over the existing Cili Wung bridge as a portion of the approaches to the northern crossing point. (Refer to the Dwg. 1.13)

A new bridge which has a 16 m steel through girder and 34 m PC girder is to be built adjacent to the Cili Wung bridge on the south side.

Over Jl. Manggarai Selatan II, a new bridge with 23 m PC girder is to be built adjacent to the existing bridge. (Refer to the Dwg. 1.16)

(d) Embankment and RC Retaining Wall

Approaches to southern crossing are to be embankment with maximum height of 7 m. And RC retaining walls with height of 2 m to 9 m. (Refer to the Dwg. 1.18)

(3) Drainage Facilities

On the alignment, there are three rivers or brooks which may be drains for rainfall or discharged water from the station yard/tracks.

In the station yard, a longitudinal drain with some cross drains are to be installed towards the Cili Wung river and the brook at about 600 m south of the existing station building.

Rainfall flow into the box culvert at the southern crossing can be also drained to the brook.

Rainwater on the viaducts at the northern crossing will naturally flow by ditches to the Cili Wung river and the brook at about the 5 km post on the Western Line.

The drain or ditch in the station yard is to be concrete pipe or channel.

3.6.4 Electric, Signalling and Telecommunication Facilities

(1) Electric Facilities

All of the existing system within the yard is to be replaced. However, the present switch houses and the station building will not interfere the construction works, and so these will remain at their present location.

The new overhead contact system will be as follows:

i) Supporting structures

The standards of supporting structures are prestressed concrete poles with V-truss beams. The prestressed concrete pole can be provided by the present production plant in Indonesia.

ii) Overhead contact wire

Catenary system

Simple catenary system

Messenger wire:	Galvanized steel wire	90 mm^2
Contact wire:	Hard-drawn grooved trolley wire	110 mm^2

Height of contact wire

Normal	5.3 m
Minimum	4.25 m (Refer to 3.6.5 (a) (C))
Maximum	5.9 m
Minimum on road level crossing	5.5 m

Minimum grade of contact wire

Main track	5/1,000
Sidings	15/1,000

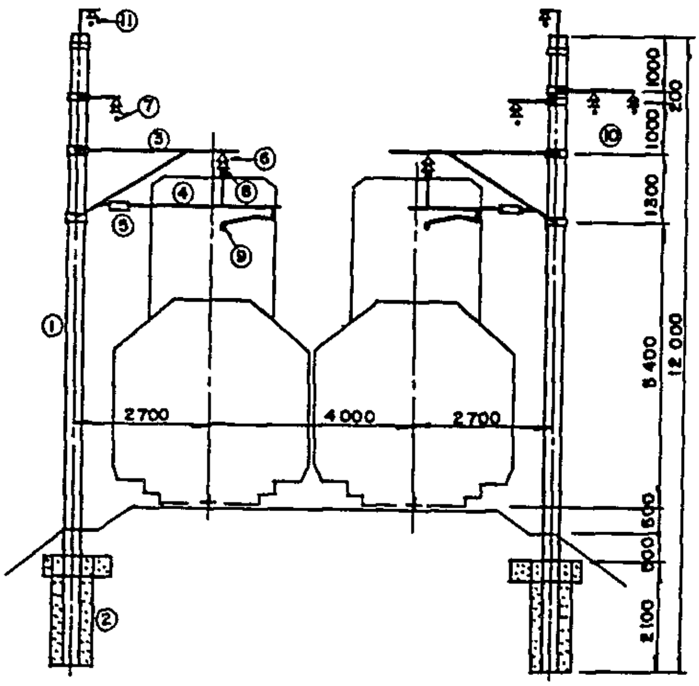
iii) Standard mounting of overhead contact wire

This is shown in Fig. 3.31 and Fig. 3.32.

(2) Signalling Facilities

As described in the preceding paragraph, the existing signalling system is old and inadequate to function well and to meet increasing traffic. In order to deal with further increases in traffic demand, it is essential to modernize the existing system. The modernization project is based on the following factors which will ensure safety, accuracy and swiftness:

- efficiency and safety for train operation
- adaptability to higher-speed and high-density operation
- facilitation of handling and maintenance of equipment
- economy



① Prestressed Concrete Pole
② Concrete Foundation
③ Cantilever Beam
④ Steadying Equipment
⑤ Stem Insulator
⑥ Suspension Insulator
⑦ Feeder Wire Cu 300∿400 mm^2
⑧ Messenger Wire St 90 mm^2
⑨ Trolley Wire Cu 110 mm^2
⑩ High Voltage Distribution Wire Cu 38 mm^2
⑪ Ground Wire St 55 mm^2

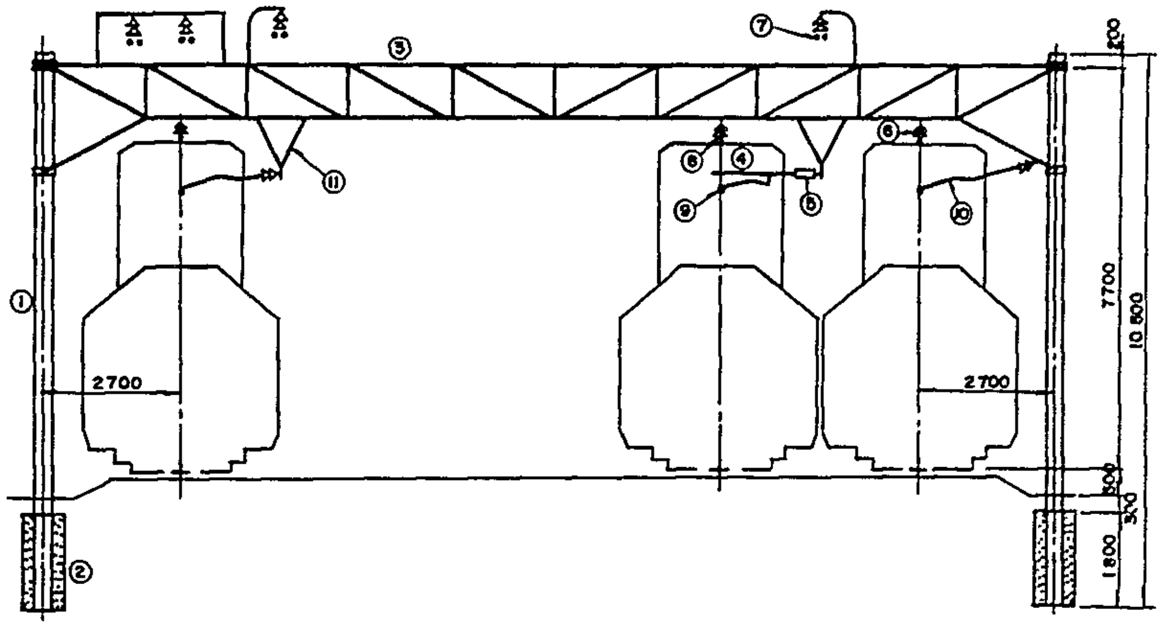
Fig. 3.31 Standard Mounting (Between Stations)

The initial and final signal arrangements are shown in Figs. 3.33 and 3.34 respectively.

(a) Block System

When a train is proceeding on a main-track route, no other trains or cars may be allowed on the same section of the route. In order to secure this, a block system which makes up a rute of blocking sections and allows only one train to operate in each section is to be planned.

The automatic section within a station yard linked with track circuits is blocked by train itself or signal operator, and covers the tracks between the home signal and starting signal as one block section.



① Prestressed Concrete Pole
② Concrete Foundation
③ V- Truss Beam
④ Steadying Equipment
⑤ Stem Insulator
⑥ Suspension Insulator
⑦ Feeder Wire Cu 300∿400 mm^2
⑧ Messenger Wire St 90 mm^2
⑨ Trolley Wire Cu 110 mm^2
⑩ Pull-off Equipment
⑪ Drop Arm

Fig. 3.32 Standard Mounting (In Station)

(b) Signal System

The signal system is to be such that speed conditions for the proceeding train is indicated by the signal aspect. A signal is to be provided at a boundary of blocking sections and automatically controlled by the train itself. Home and starting signals are to be manually controlled by the signal operator.

The signal aspects are basically to be 3 colours of green, yellow and red, and if necessary green-yellow and/or yellow-yellow are to be used.

For shunting a train or cars, a shunting signal of position lights is to be provided, which is designed to indicate the clearance of the route.

(c) Interlocking System

The interlocking system is to be a relay type designed to operate a route under remote control by levers for signals, shunting signals and related electric switch machines in order to increase the operator's efficiency and ensure safety. The interlocking device is to provide a lock between these controlled units on the fail-safe principle.

(d) Train Detecting System

Automatic signals and relay interlocking devices require train detection for which a commercial frequency AC track circuit system is to be adopted as the simplest and both highly reliable and economical system. Between track circuits, insulated rail joints are to be inserted and in order to make traction current return impedance bonds vided.

(e) Switch System

The switch system is to be a motor type to provide reduced switching time for a increased train speed and a traffic density. Electric switch machines controlled on the control panel of the relay interlocking device are to be provided.

(f) Automatic Train Stop System (ATS)

The train route is ensured by the relay interlocking device and the safety of the train is secured as long as the train enters at a speed in accordance with the signal aspect. Should the signal aspect be ignored due to sudden illness and negligence of the operator, a serious accident could occur.

In order to prevent such an accident, an automatic train stop system will be installed as a backup system to the operator.

(g) Signal Cable

Signal cables are to be installed to control signals, electric switch machines, etc. Signal cables in the station yards shall be housed in concrete troughs.

(3) Telecommunication

Under increasing train operation speed and density, the telecommunications system must be modernized to ensure safety and efficiency of operation, to improve services for users and to make railway management more efficient. The system is necessary to be optimal, and it will have to be compatible with the system proposed in the Intermediate Program for the JABOTABEK Area.

(a) Dispatch Telephone Equipment

In order to ensure the best train operation by recognizing operational condition such as delay of a train, dispatch telephone equipment designed to convey information from the center directly to the outstations is to be provided.

(b) Talk-Back Equipment

For shunting works, talk-back equipment is to be provided for communication between the signal cabin (signal operator) and the field man.

Talk-back broadcast equipment is to be provided for a passenger guide services.

(c) Subscriber Telephone

Subscriber telephones are to be provided for communication between stations, signal stations, substations, and administration and other sections in PJKA. They are to be connected to the automatic exchange device (Philips UH-200) installed in Manggarai Station.

(d) Train Radio Equipment

Train radio equipment is to be provided for transmitting operational instructions between the operator of a running train and the instructor, and for emergency communication in the event of an accident. The ground station is to be installed in this station as the plan in the Intermediate Program for the JABOTABEK Area.

(e) Electric Clock

To ensure the correctness of train schedule for the operational personnel and passengers, electric clocks are to be provide at station offices, signal cabins and platforms.

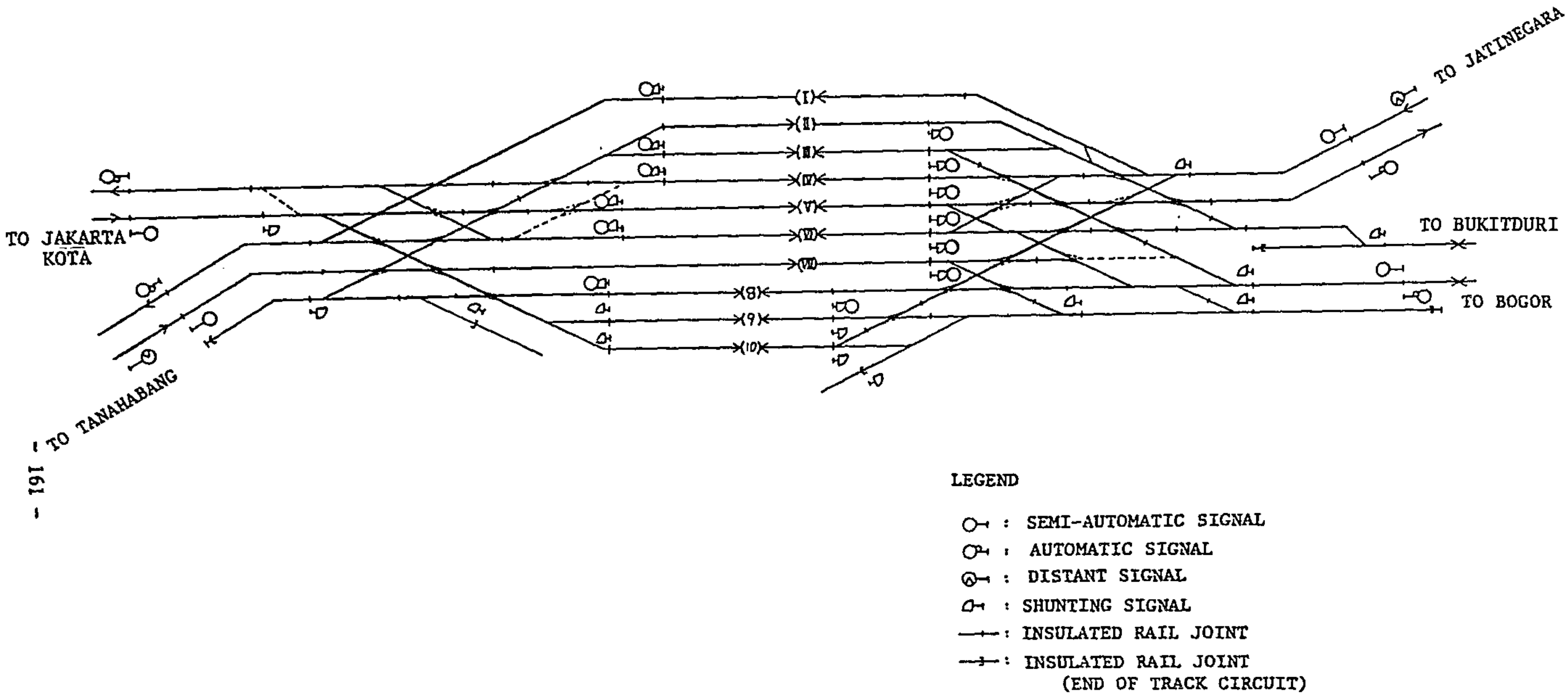


Fig. 3.33 Configuration of Signalling System, Manggarai Station. (Initial System)

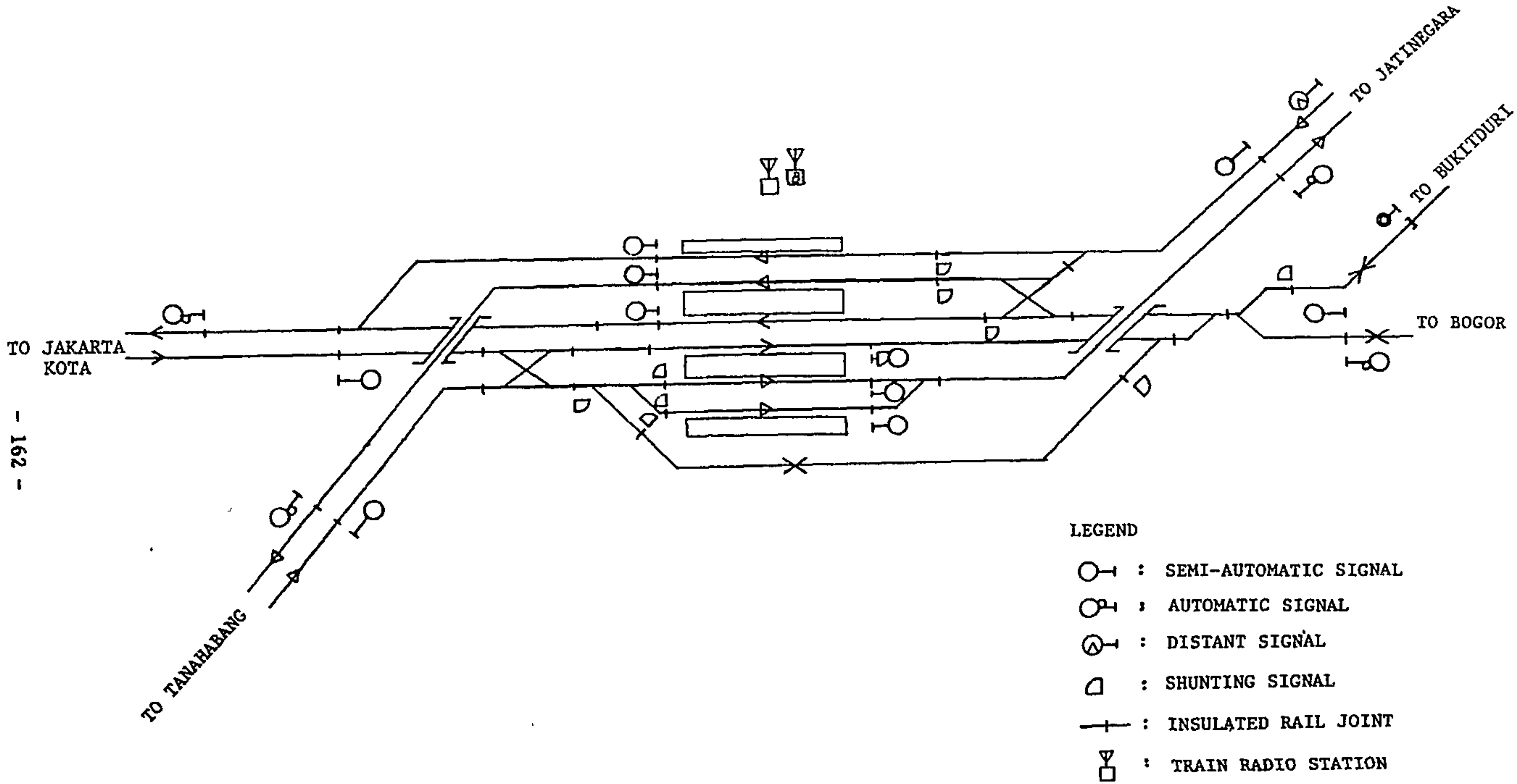


Fig. 3.34 Configuration of Signalling System, Manggarai Station. (Final Stage)

3.6.5 Execution Plan

It is considered that the construction of the grade separated crossings will be difficult because the construction shall be executed with maintenance of the train operations on schedule and in safety.

Since almost of the existing railway facilities may not be reused for the project, new facilities shall be gradually built while existing facilities are taken away.
Consequently, the execution shall be divided into several steps in accordance with the plan of track removal. And it is anticipated that the execution period requires four years.

(1) Execution of Railway Facilities

The construction of railway facilities require seven stages of track removal work.
The order of the work and the discription are as follows;
The schematic drawings of the work are shown on the Dwg. 1.24

(a) Step 1

a) Rearrange existing tracks and other facilities in the yard with the exception of five tracks and four platforms.
b) Construction of a new Cili Wung bridge (steel plate girders) for Western Line to Tanah Abang.
c) Construction of an RC box culvert at the North junction for the Central line.
d) Construction of an RC viaduct and retaining walls for the new track of the Western Line to Tanah Abang.

(b) Step 2

a) Construction of new platforms, #3 and #4.
b) Construction of new track for the Central Line towards to Bogor.
c) Construction of embankment, retaining wall and new bridge over JL.
d) Manggarai Selatan II for the Western Line to Jatinegara.

(c) Step 3

a) Removal of a portion of the existing platforms (#1 ∿ #4) and rearrangement of tracks.

b) Construction of an RC box culvert for the Central Line towards Bogor.

c) Construction of a new passageway bridge.

(d) Step 4

a) Removal of Central Line from existing to new alignment.

b) Removal of existing #4 platform.

c) Construction of a new bridge (truss girder) on Cili-Wung river for Western Line to Tanah Abang.

d) Construction of an RC viaduct for the Western Line to Tanah Abang.

(e) Setp 5

a) Removal of tracks towards the new platform for Western Line and long distance trains to Jatinegara.

b) Removal of existing #3 platform and construction of new #1 platform.

c) Removal of new tracks for the Western Line towards Jatinegara.

d) Installing roofs to new platforms.

(f) Step 6

a) Removal of tracks towards the new platform for Western Line and long distance trains to Tanah Abang.

b) Removal of existing #1 and #2 platforms.

c) Removal of new tracks on the Western Line in Tanah Abang side.

(g) Step 7

a) Removal of new tracks on the Western Line for Tanah Abang.

b) Construction of new #2 platform.

c) Readjustment in station yard.

(2) Execution of Electric Facilities

The improvement work will need the removal, temporary construction and reconstruction of the track within the yard as well as the removal, temporary construction and reconstruction of the overhead contact system.

Practically all of the work will be deadline work performed at night and will require a high degree of technical expertise.

The following works will require particular attention.

(a) Cross Catenary System

Since the wires suspended from cross catenary wires are balanced with the whole and it is difficult to move or remove individual parts, it is necessary to change all the cross catenary wires to temporary fixed beams.

(b) Space between Messenger Wire and Contact Wires

The space between the messenger wire and the contact wires is fairly Large and the messenger wires may be an obstruction to install the new fixed beams. Therefore it will be necessary to either reduce the space or lower all the overhead contact wires.

(c) Height of Contact Wires

The present minimum height of the contact wires is 4.1 m, but the structural clearances at grade separated crossings should be planned to raise it.

In the future when AC electrification will be brought to the Java Island Main Line, AC-DC dual purpose electric cars will be brought into Manggarai Station. It will therefore be necessary to provide contact wires at the height of 4.25 m to obtain the minimum ceiling height of these AC-DC dual purpose electric cars. The AC 25 kv insulator is taller than DC 1,500 V insulator.

(3) Execution of Signalling Facilities

Under the flyover construction, the existing semaphore signals will be replaced by colour light signals, as they will not only be difficult to relocate and to obtain spare parts but also it will be difficult to carry out the work without interfering with present train operations. Relay interlocking device and colour light signals, therefore, are to be installed in the initial stage before the commencement of flyover construction.

At the final stage of flyover construction, the final relay interlocking device shall be installed.

When installing the initial relay interlocking device, it is important to increase the operator's efficiency by unifying the signal cabins and to simplify the present train operation routes.

3.6.6 Construction Schedule

The period of the construction for this project is estimated to be four years. Furthermore, education in safety and job training will be required because this construction work is being carried out adjacent to operating lines.

The construction schedule is shown in the Table 3.17.

Table 3.17 Construction Schedule

Work Item	Execution Year						Remarks
	'84	'85	'86	'87	'88	'89	
Roadbed							
Flyover & Bridge							
Station Yard							
Track							Track removal, 7 times
Building & Others							
Electric & Signal							

period for Detailed Design and Project Financing

3.7 FUTURE PLAN

3.7.1 Station Building and Concourse to East Side Entrance

It is assumed that Manggarai station will operate as a terminal station for long distance passenger trains in 2005. The Station building is planned as a station over-bridge in order to increase the number of platforms for long distance passenger train services. A concourse is planned inside the building for pedestrians to pass from one side of the station to the other.

On the west side, the main station front plaza, and the pedestrian deck over it, are planned as part of the Manggarai urban renewal project. Therefore the concourse will be connected to the pedestrian deck.

The number of passengers using the station is estimated to be approximately 300 thousand per day after 2005.

(1) Approximate Size of Station Building

The relationship between passengers using the station and the size of the station building is obtained statistically from the following equation.

$$S = \frac{600}{N^{0.738}}$$ [obtained from J.N.R. Station studies].

In which S: Area of station building per 1,000 passengers (m^2)

N: Passenger using the station (1,000 passengers/day)

When N = 300 (1,000 passengers/day), S = 9 m^2/1,000 persons. Therefore, necessary area is 9 × 300 = 2,700 m^2 (Excluding the area of concourse and corridor to platform.)

(2) The Width of Concourse

As a standard, one meter is necessary per 3,600 passenger/hour. Peak ratio is almost 20%. From the future land use study it is assumed that 200,000 thousand passengers use the west side entrance and 100,000 passengers use the east side.

Considering the number of pedestrians who will pass through from the east side to the west side and vice versa, a 2 m allowance is added.

Width of west side corridor

200,000 × 0.2 ÷ 3600 = 11 m + 2 = 13 m

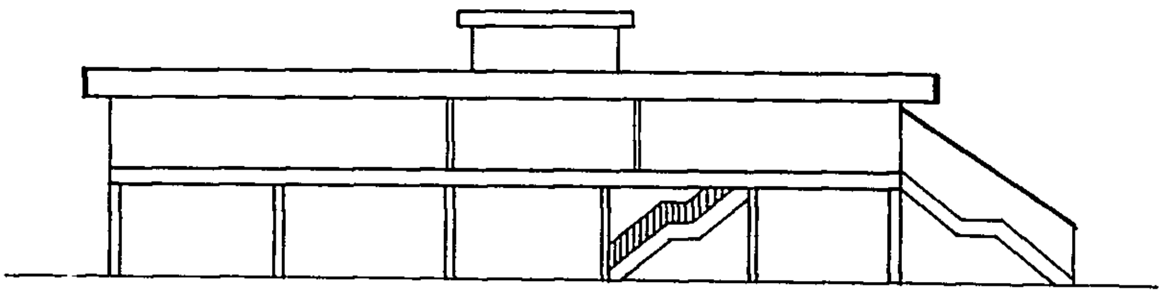
Width of east side corridor

100,000 × 0.2 ÷ 3600 = 6 m + 2 = 8 m

In the station building, the following facilities are required, offices, ticketing counter, station master's room, staff rest room, security room, storage rooms, machinery room, ticket check entrance, fare adjustment counter, long distance passenger waiting room, telephone, etc.

The station building will function as one of the community centers in the future. Accordingly, shops and restaurants are added to the plan.

Fig. 3.36 shows a schematic layout of the station building and Fig. 3.35 shows the side view. Fig. 3.37 shows the location of the station building including an addition passageway designed to reduce further anticipated congestion.



S=1:500

Fig. 3.35 Side View of Station Building

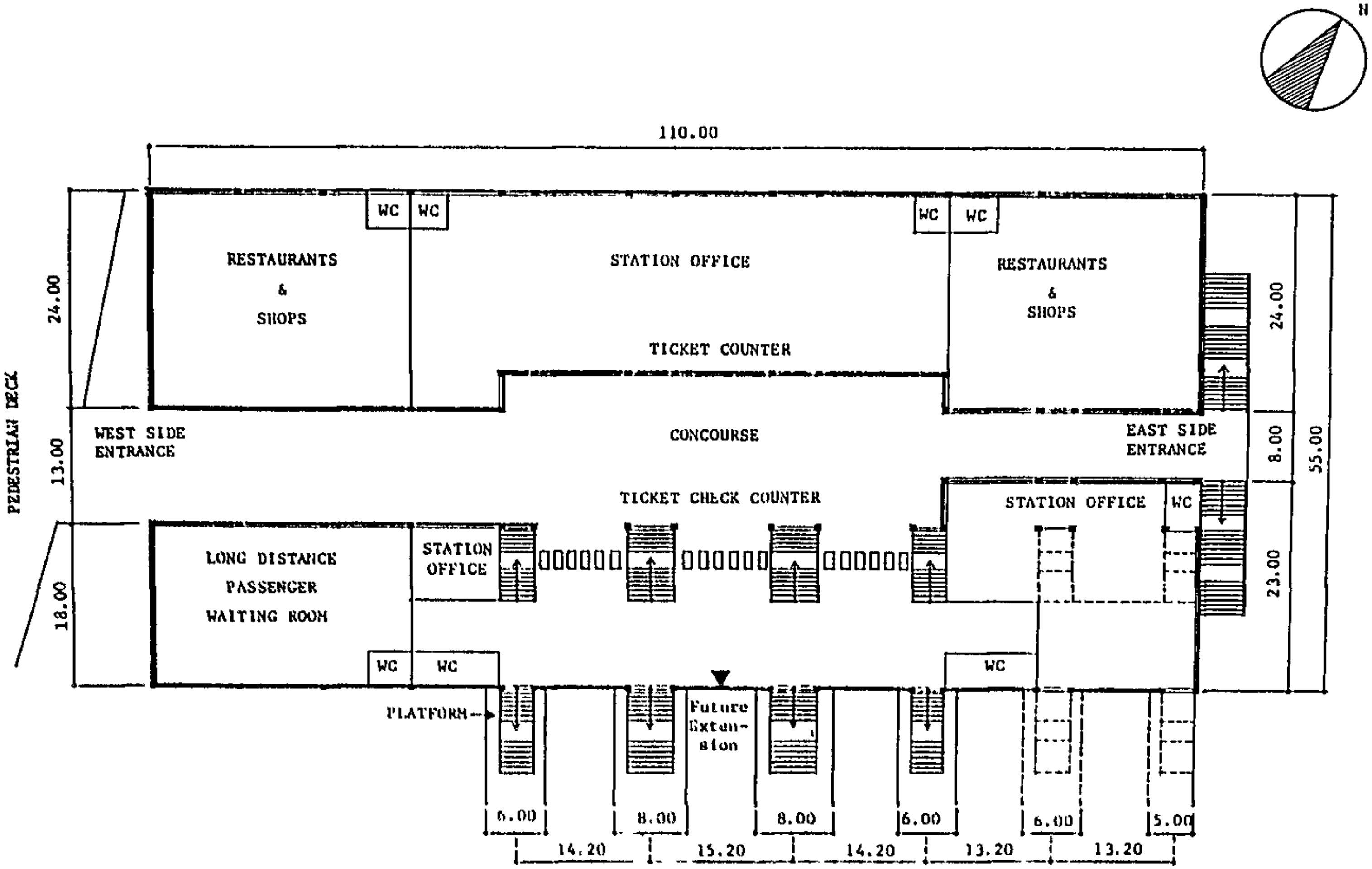


Fig. 3.36 Layout of Manggarai Station Building (Unit: m)

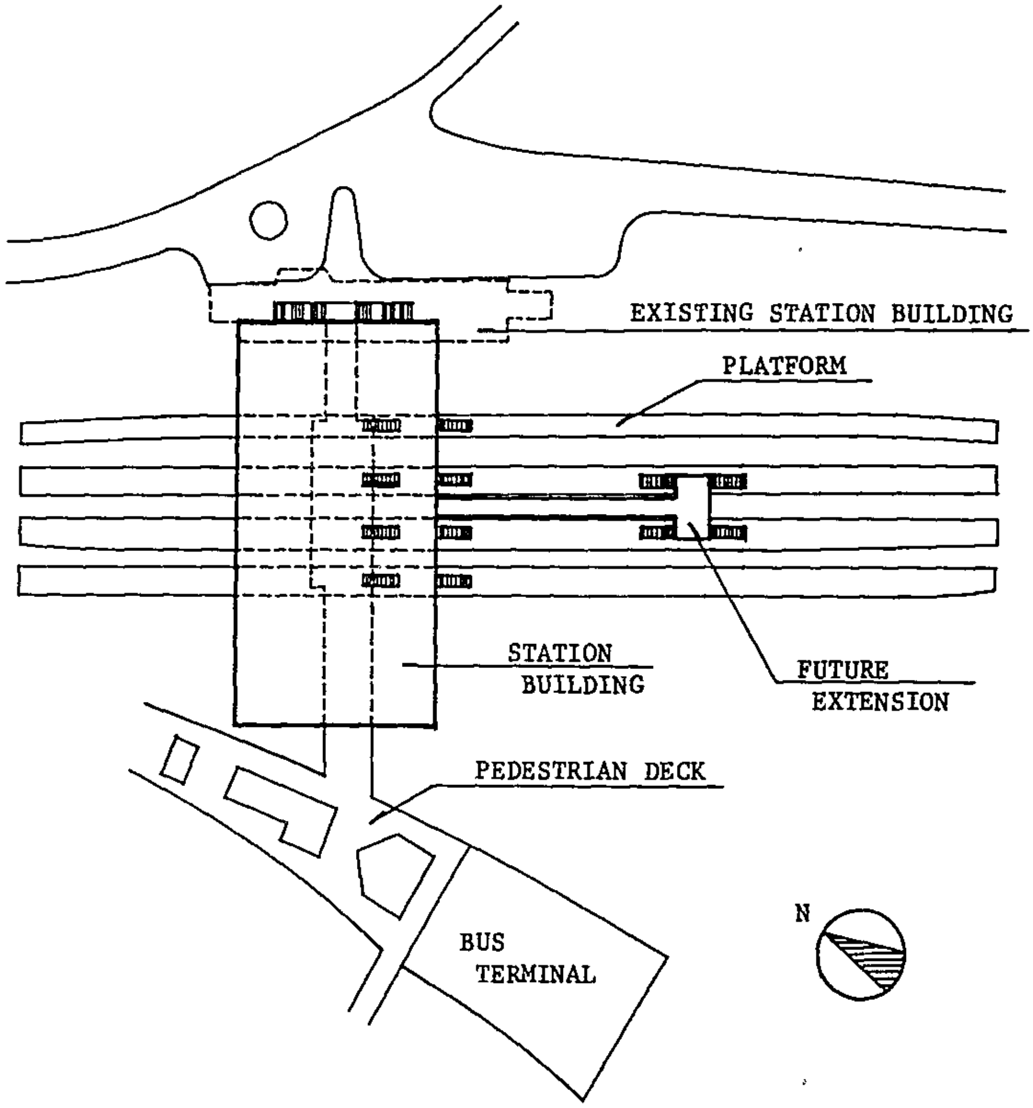


Fig. 3.37 Location of Station Building

3.7.2 Development Plan of Surrounding Area

(1) Land use plan around the station

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

The surrounding area therefore has potential to be developed as an urban sub-center. The area within 1 km radius from the center of the station should be developed as a commercial and business area and commercial residential mixed area. The industrial area within 1 km radius should be relocated gradually.

(2) Access plan to the station

The following two points are important for the access plan.

1) Smooth access to the station from arterial roads near the station. The width of an access should be at least 8m such that large city buses can pass each other.

2) The road network should be so arranged that people who live within 1 km radius from the station can reach the station easily.

Adding the presently planned road by DKI, the following three roads should be either constructed or improved. (Refer Fig. 3.5)

a) New access road from Jl. Dr Saharjo to the main station front plaza. (Planning road ①)

b) Should the army camp be moved, a new road from the east side station front plaza to Jl. Matraman Raya passing through the middle of the existing army camp should be constructed. (Planning road ②)

c) Improvements of the road which starts at the north of the station and goes northwards to Jl. Matraman Raya.

(3) Station front plazas

The main station front plaza on the west side, is already planned for 200,000 passengers per day by the Manggarai urban renewal project. The station front plaza on the east side is to be planned by this project for 100,000 passengers per day.

An equation to get the approximate area of a station front plaza is: (Refer 4-7 Access and Station Front Plaza Planning)

$$S = 0.0904 \times \frac{2}{3} N + 818$$

$$5,000 < N \leqq 100,000$$

In which, S: Necessary area of station front plaza (m^2)

N: Number of passengers per day

When N = 100,000, then S = 6,800 m^2

The transportation mode to get to the station are estimated from the traffic survey results that walking accounts for 45%, bus 15%, mini bus 35% and bicycle motorcycle 5% (Refer Table 4.14). Peak one-hour ratio for rush hour is about 20%.

Passengers at peak one hour is:

100,000 × 0.2 = 20,000 persons

Bus user	20,000 × 0.15 = 3,000/hour
Mini-bus user	20,000 × 0.35 = 7,000/hour
Bicycle motorcycle user	20,000 × 0.05 = 1,000/hour

For safety, bus zone and mini-bus zone should be separated, and in the bus zone, pedestrians and buses should be completely separated.

a) Bus

An average of 5 minutes is required for getting on and off a bus at a station, thus 12 buses can use one bus stop per hour. Assuming that the average number of passengers per bus per peak hour getting on or off is 60 then, 720 persons can be dealt with in one bus stop per hour, hence 3000 ÷ 720 = 4.2. Therefore, 5 bus stops are required.

b) Mini-bus

2.5 minutes is required for getting on and off and 24 mini-buses can use one mini-bus stop per hour. Assuming that average number of passenger getting on and off is 10, 240 passengers can be delt with at one mini-bus stop per hour. 7000 ÷ 240 = 29.2 therefore, 30 mini-bus stops are required.

c) Bicycle, motorcycle

1.5 m^2 is required for parking of bicycles and motorcycle including passageway. Assuming that parking ratio is 50%, necessary parking area is: $1000 \times 0.5 \times 1.5 = 750\ m^2$.

Fig. 3.38 shows the layout plan of east side station-front plaza.

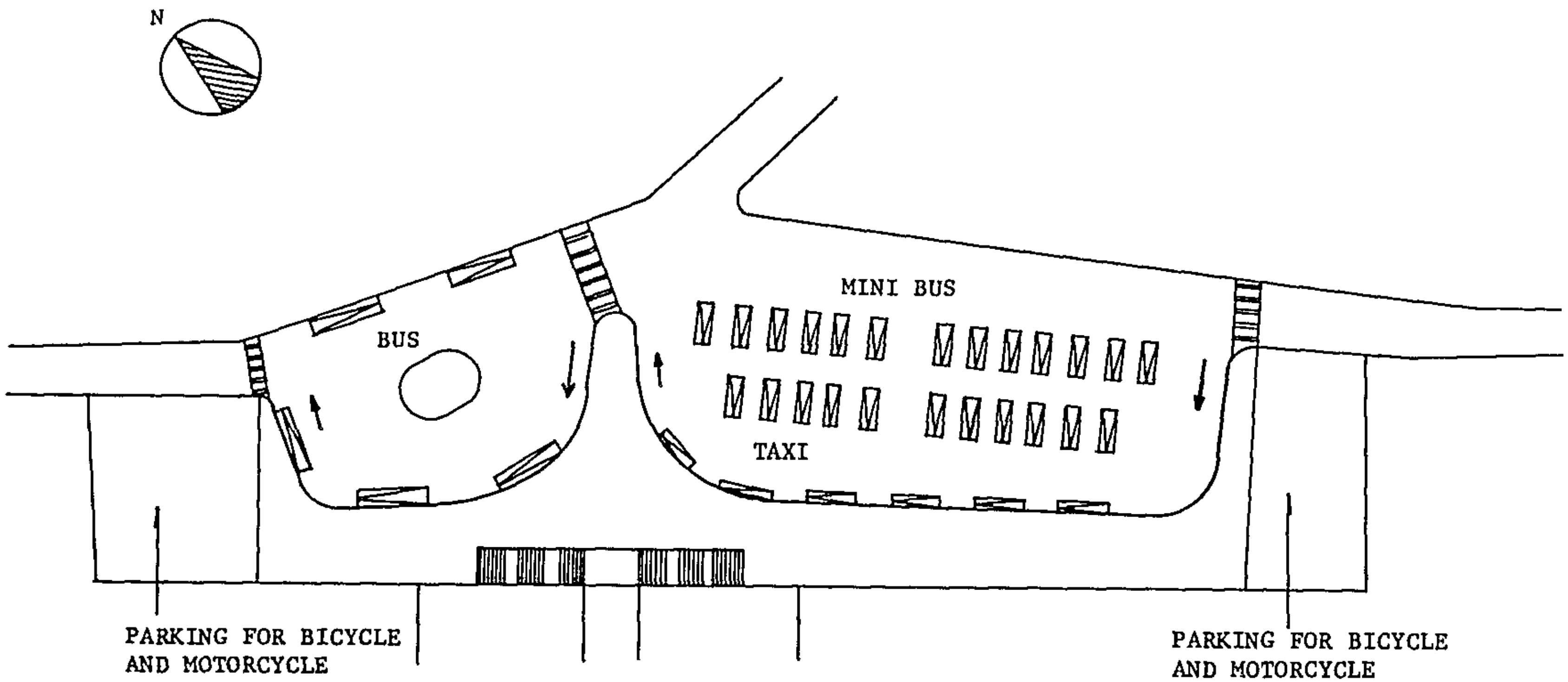


Fig. 3.38 Layout of Station Front Plaza on East Side of Manggarai Station

S=1:1,000

3.7.3 Plan of Quadruple Line

Three factors, the increase in the number of commuters due to future city development, the increased number of long distance trains following Java Island main line improvement, and new line operation between Cenkareng Airport and the Central line may necessitate quadruple track between Jakarta Kota and Manggarai.

Concerning the construction method for the additional two tracks, train operation shall be considered by line operation or by direction operation.

The scheme of a track layout which is related with grade separated crossings was studied. The schematic drawings are shown in Fig. 3.39 and Fig. 3.40.

3.7.4 Study for Plan of Manggarai Terminal Station

Manggarai Station, where the Western and Central lines cross, is located in a strategic transportation area. The importance of this station will increase because of the development of the neighbouring town.

It is proposed that Manggarai Station may be a terminal of long distance trains in the report of "The Study on Electrification Project[3]. The space for terminal station facilities will be reserved between existing station office and new platforms, from which the track layout in Fig. 3.41 can be proposed.

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3) The Study on Electrification Project of Main Railway in Java in The Republic of Indonesia (Master Plan)
March 1983 JICA

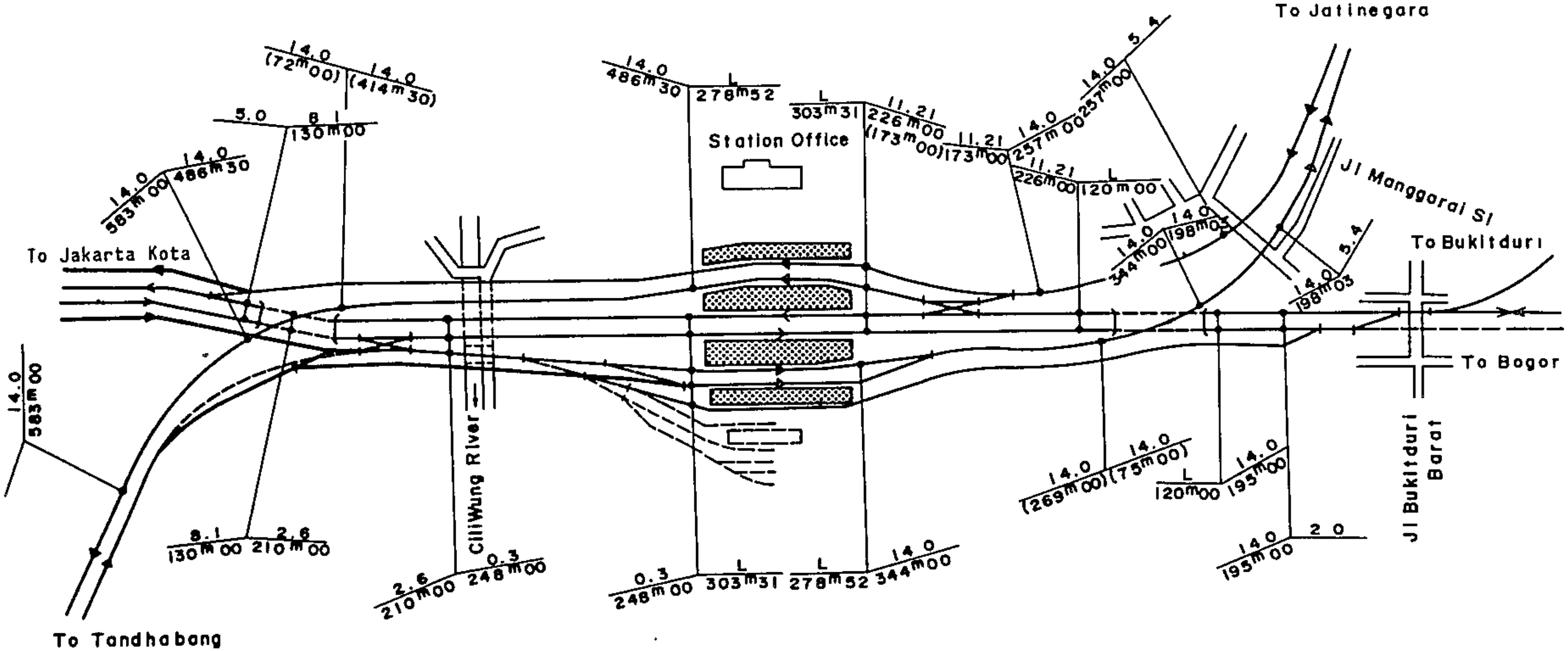


Fig. 3.39 Alternative Four Tracks (Direction Operation)

Schematic Plan

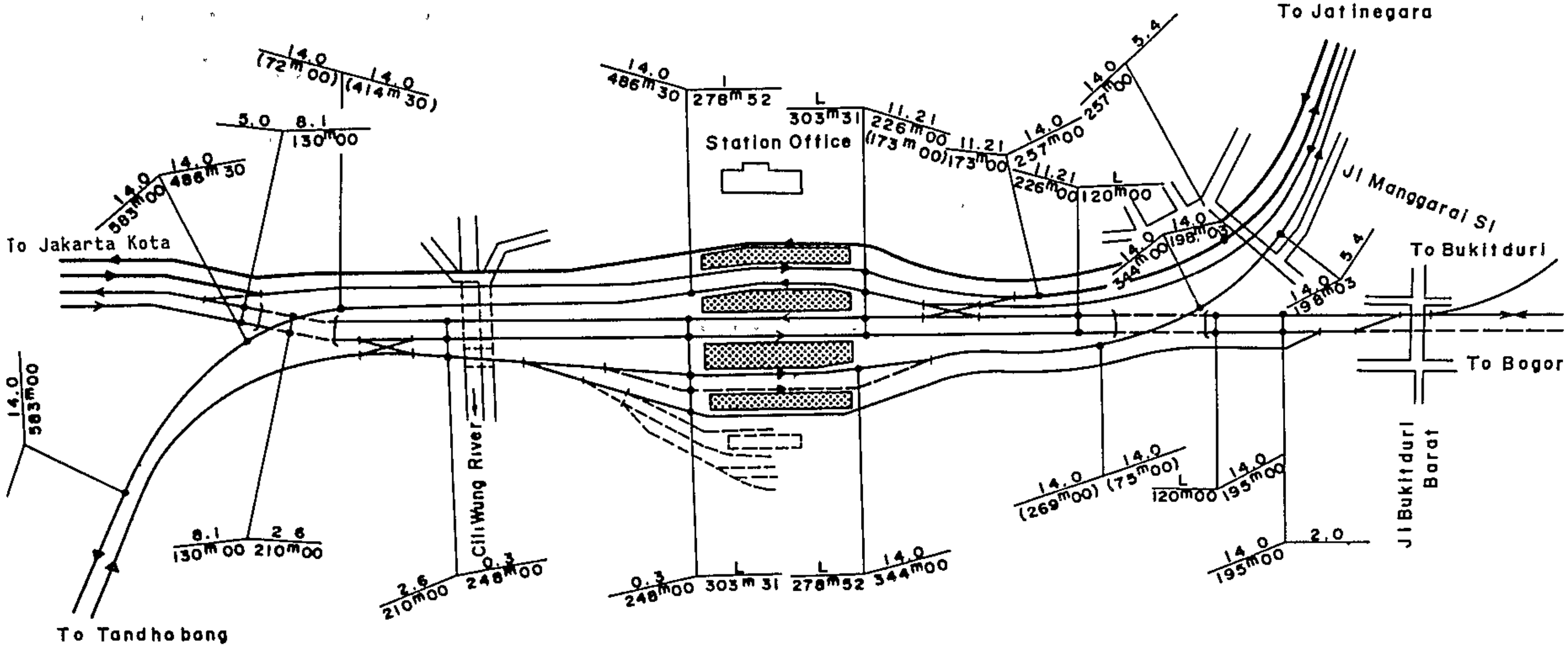


Fig. 3.40 Alternative Four Tracks (Line Operation)

Schematic Plan

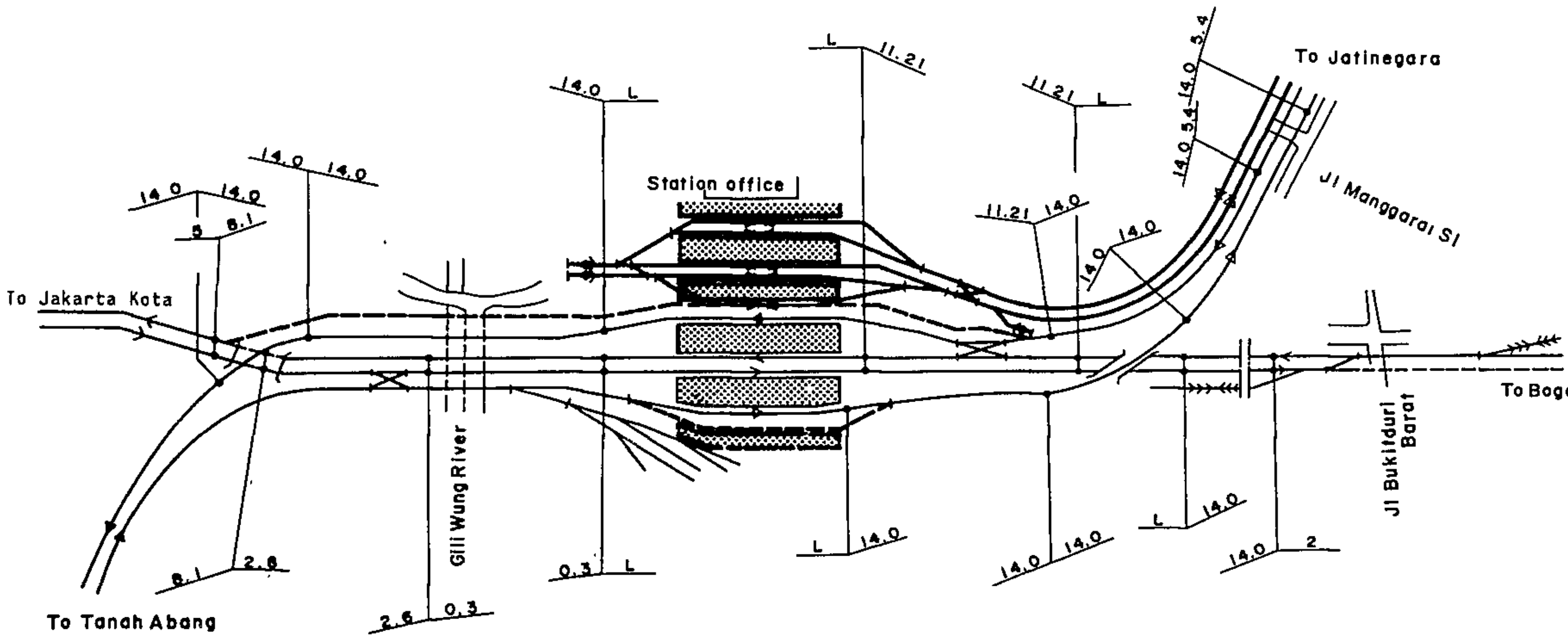


Fig. 3.41 Alternative for Terminal Station

Schematic Plan

3.7.5 Relation with Road

In the project area, there are some existing roads across the Central and Western lines. And under city planning a new road will be constructed across both lines.

Some of these roads are under railway bridges, but others are level crossings. Accordingly, there will be a big problem of traffic congestion at these level crossings in future.

In case of a level crossing with Jl. Bukit Duri Barat, since the Central Line is planned to be on the ground, some countermeasure will be required. It can be planned that either road or railway shall be over the other for this site. However, a railway bridge (Central Line) cannot be constructed because of the cost and the effect on the track layout to/from Bukit Duri. When a grade separated crossing is required, the road shall be elevated or lowered.

Meanwhile, in the case of city planning road as shown in Fig. 3.5 the road shall be constructed over or under the Central and Western lines. As any method for the work is complex, sufficient consultation with concerned authorities is required including a study of changing the bridge location.

3.7.6 Improvement of Jl. Sultan Agung

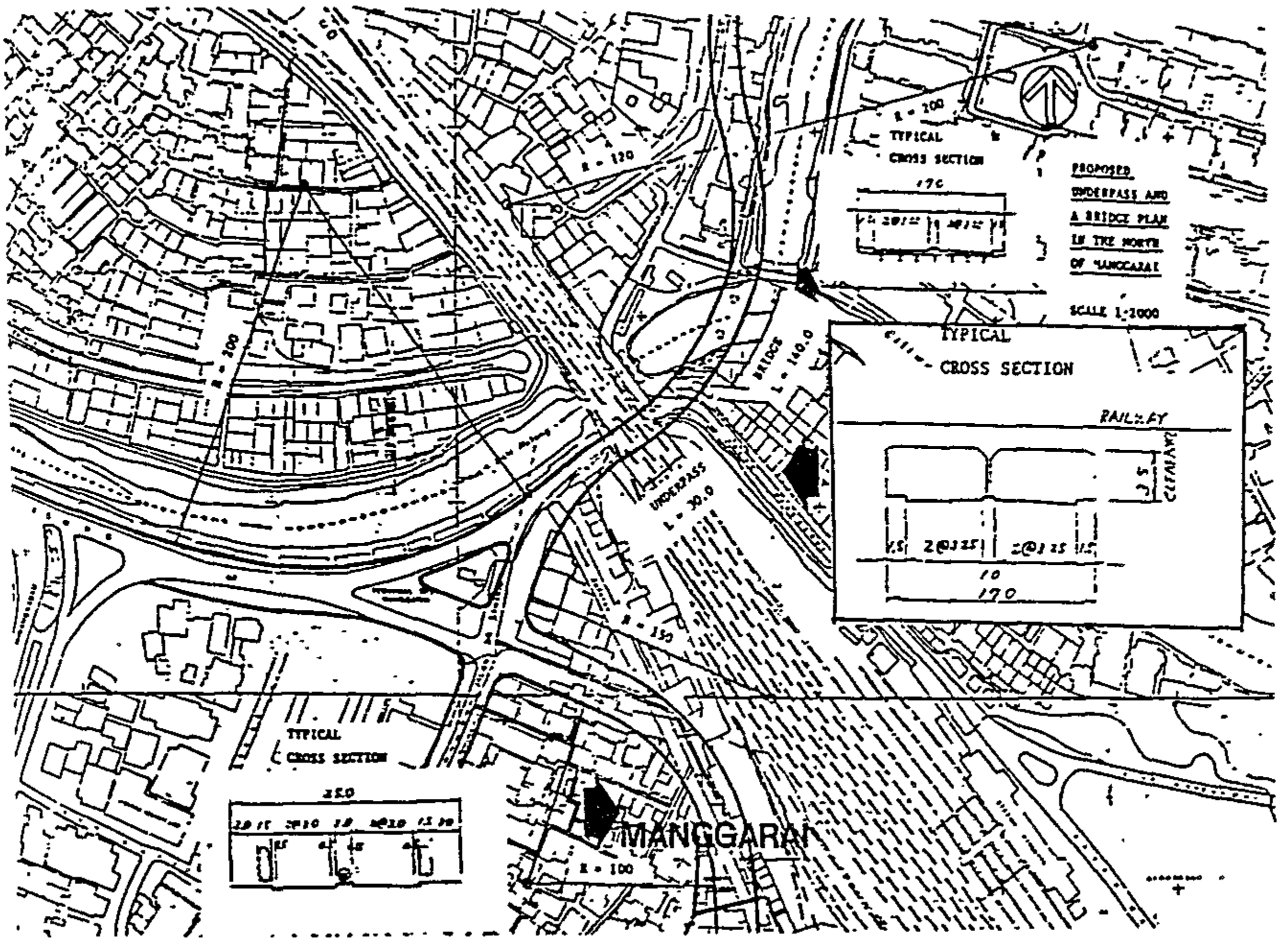
According to the city development plan, it is intended to develop many facilities such as bus terminal, shopping centre and residences on the west side of Manggarai Station.

Jl. S. Agung, which is only connection between the east and west sides of the station, has a width of 5.6 m and a headroom of 3.0 m. In the development plan, this road will be improved to 17.0 m width with four lanes and headroom increased to 3.5 m.

Considering construction cost, it will be expensive to increase the width for an additional two lanes adjacent to the existing road, because this is also required for the railway structures.
Consequently, the following method can be proposed. A new road with

two lanes shall be constructed behind the railway bridge, and then the surface of existing road shall be lowered 0.5m (Refer to Fig. 3.42).

As this road improvement will interfere with railway operations, it is hoped to construct the road at the same time as the grade separated crossing at North junction.



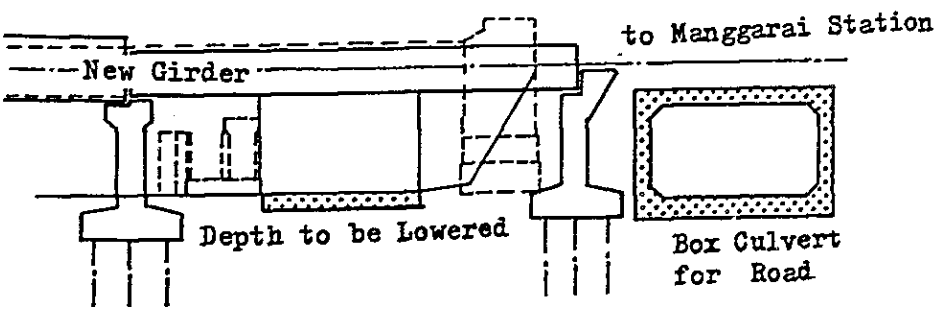


Fig. 3.42 Road Improvement

3.8 IMPACT DUE TO IMPROVEMENT OF MANGGARAI STATION

(1) Positive impact

Central Line and Western Line will be able to cross freely and a frequent service will be possible.

Train safety will increase without the at-grade crossing.

Part of the road traffic is transferred to the railway, consequently noise and pollution will decrease and road traffic congestion will be eased.

The benefit of road operation costs savings and time saving is calculated in Chapter 7. Moreover, road maintenance cost will decrease a little because of the reduced traffic volume.

Employment will be created by the work. (See also Chapter 7.)

Smooth transfer to the feeder bus system will be possible because of the improvement to the station front plaza.

Surrounding area of the station will be developed as a commercial and business area.

(2) Negative impact

Noise and vibration along the railway will increase due to the increase in average speed and reduction in headway. Usually the noise level of a train is between 75 and 85 dB. In some places, for example, near a hospital, a protective wall may be necessary in future. Noise will decrease about 7 dB by a protective wall of 1.9 m height.

Interference time at the road level crossings will increase on the Central Line and Western Lines.

There is a possibility that accidents at level crossings will increase, so an improvement in level crossing facilities is important.

At the section where the Central Line and the Western Line run at ground level, the community will be separated.

Noise and dust during construction should be minimized by careful execution, but this is only a temporary situation.

CHAPTER 4

IMPROVEMENT PLAN OF MERAK LINE

CHAPTER 4 IMPROVEMENT PLAN OF MERAK LINE

4.1 SURROUNDING CONDITION OF MERAK LINE

(1) Present land use

A high density residential area exists from Tanah Abang to Kebayoran, and low density housing area extends from Kebayoran to the boundary of DKI area. Outside DKI there are rice fields and dry fields until near Serpong. A few factories are distributed along the Merak Line (Fig. 4.1).

Squatters dwell on both sides of the line from Tanah Abang to Kebayoran. The poorest squatters live between Tanah Abang and the Malang River. In this area, the railway track is used as a pedestrian route.

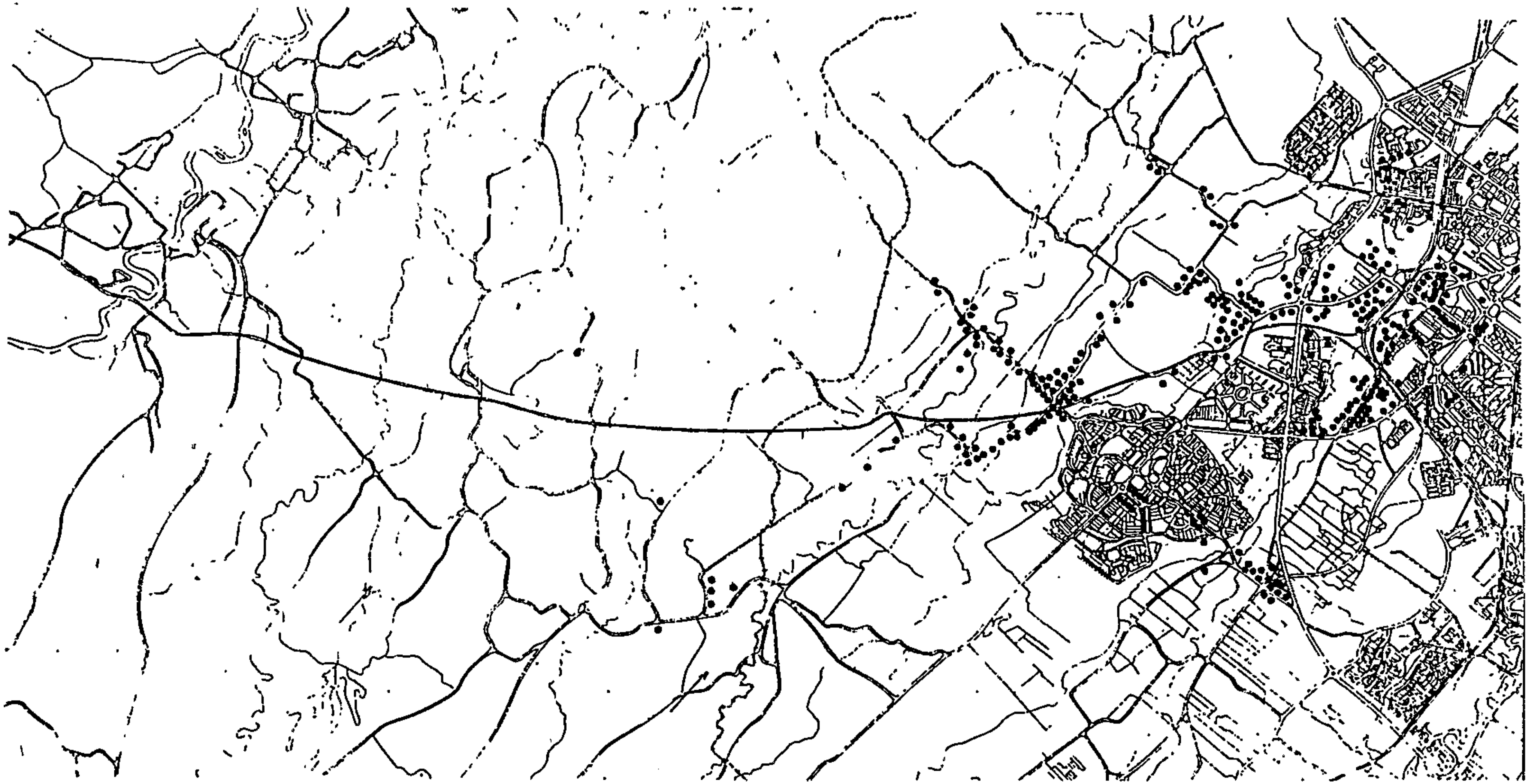
There are few public facilities near the line, and generally, access to the stations is very poor.

(2) Future land use plan

The environment and the ground condition of the land around the line is suitable for residential use and in the future land use plan, residential use is predominant (Fig. 4.2).

Road network plan around the line is shown in Fig. 4.3.

There are two on-going projects by PERUMNAS near Serpong. One is Serpong Housing Project (50 ha), and the other is Central Research Technology Hospital Project (350 ha).



L E G E N D : ● FACTORY

Fig. 4.1 Distribution of Factories Around

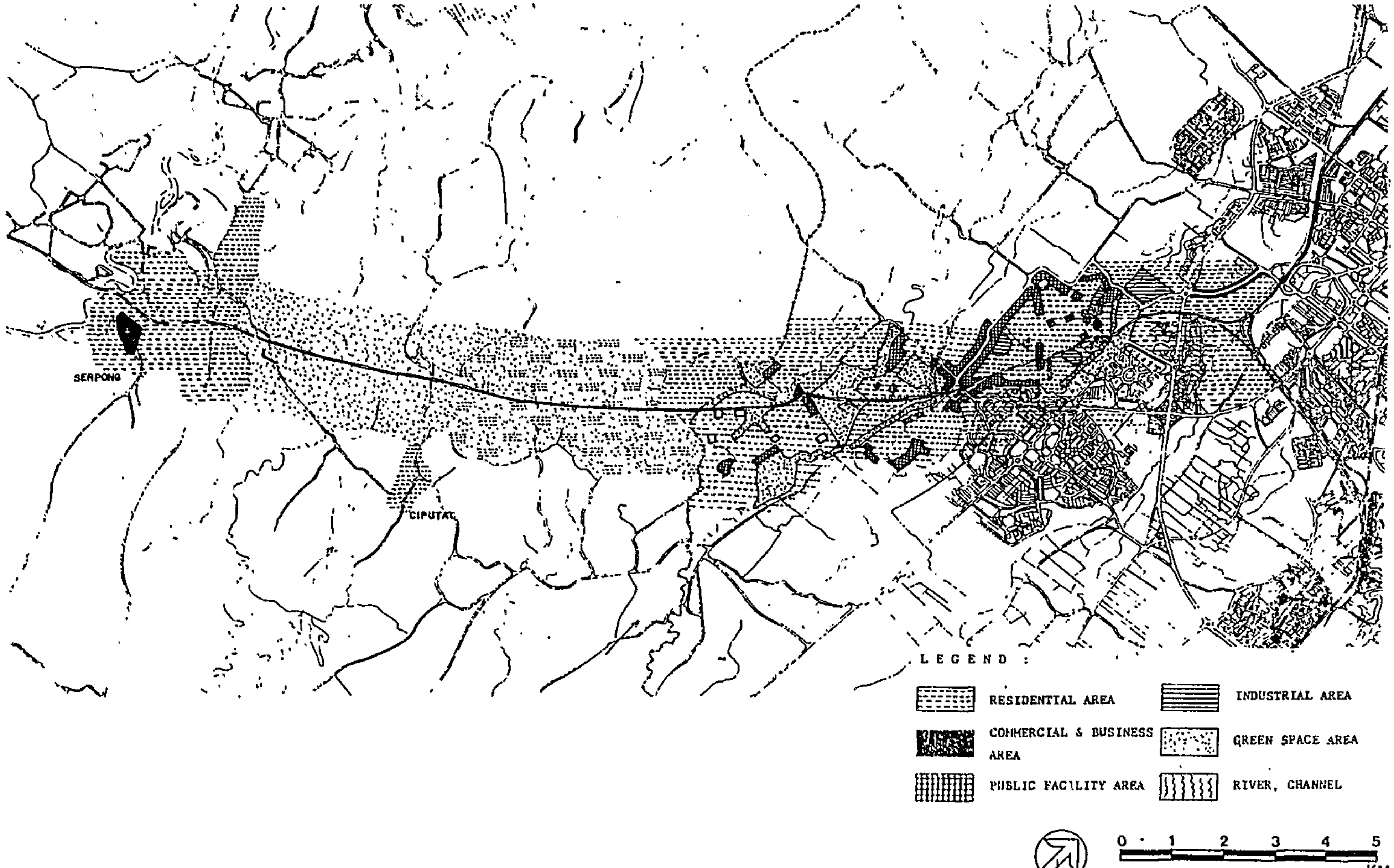


Fig. 4.2 Land Use Plan Around Merak Line


OUTER RING ROAD ROW=60m
ROW=26m
ROW=26m
ROW=47m
ROW=68m
LEGEND :
TOLL WAY
MAIN ARTERIAL ROAD
0 1 2 3 4 5
KM