CHAPTER 8

DESIGN STANDARD AND ALTERNATIVES

Chapter 8 DESIGN STANDARD AND ALTERNATIVES

8.1 General

In this chapter, the planning aspects of the engineering field, such as design standard and alternative routes study, are made for Harbour Rarbour Road, Tg. Priok Access Road, interchanges and intersections.

In order to examine the possible practical alternatives, and field reconnaissance along the project corridor, collection/analysis of data were conducted. Field reconnaissance was carried out using aerial photos, topographic maps and working mosaics, each of a scale of 1:5,000, provided by DKI Jakarta or produced by the Study team.

Meetings with many agencies such as Bina Marga, DKI Jakarta, PJKA, Jasa Marga and other organizations concerned were held many times for the collection of information and discussion of pertinent points.

8.2 Design Standards

8.2.1 Traffic Capacity

A traffic capacity analysis was conducted using the traffic volumes predicted for various target years described in Chapter 6. The concepts and methodology used for the analysis are based on the "Highway Capacity Manual" of Highway Research Board, U.S.A." Some adjustments were made however to reflect local conditions based on the results of studies accomplished by "Road Design Standard", Japan since similar operating conditions, type and size of vehicles, are found in Indonesia and Japan.

(1) Throughway and Tg. Priok Access Road Capacity

Table 8.1 summarizes the road capacity for cases including the staged construction of the Project Road. For the Harbour Road only two cases for percentage of heavy vehicle (13% & 18%) were computed and tabulated. The exact number of lanes required for the segments was established by using each heavy vehicle ratio predicted assigned by segments. These are analyzed in 9.4.1. Fig. 8.1 shows the case for 18 percent of heavy vehicles.

(2) Ramp Capacity

The ramp capacity is generally limited by that of ramp terminal. The capacity at terminals was established by using the design charts of "Road Design Standard", Japan. In the case where a ramp requires more than two lanes, an auxiliary lane was provided in order to minimize the

Table 8.1 Design Traffic Capacity Analysis

Item		Design Speed (Km/hr.)	Lane Width (M)	Lateral Clearance		Heavy Vehicles		Coefficient of Adjustment					Basic Capacity (P.C. U/hr.)	Possible Capacity (Veh./hr.)	Design Level	Adjustment of Design Level	Design Capacity (Veh./hr.)	Peak Factor (%)	Rate of Direction (%)	Design Daily Volume (Veh./day)	Remarks
				Left	Right	% of H.V.	Passenger Car Equivalent	Lane Width	Lateral Clear-ance	Heavy Veh.	Sight Con-ditions	Total									
				(M)	(M)	PT	ET	γL	γC	γT	γI		CB	C			CD	K	D	ADT	
Harbor Road	4 Lane, 2 Way	80	3.50	1.75	0.75	13	1.79	1.00	0.97	0.91	1.00	0.88	2,500	2,200	2	0.9	1,980	9	55	80,000	
	4 Lane, 2 Way	80	3.50	1.75	0.75	18	1.76	1.00	0.97	0.88	1.00	0.85	2,500	2,125	2	0.9	1,913	9	55	77,000	
	6 Lane, 2 Way	80	3.50	1.75	0.75	13	1.79	1.00	0.97	0.91	1.00	0.88	2,500	2,200	2	0.9	1,980	9	55	120,000	
	6 Lane, 2 Way	80	3.50	1.75	0.75	18	1.76	1.00	0.97	0.88	1.00	0.85	2,500	2,125	2	0.9	1,913	9	55	116,000	
Tg. Priok Access	4 Lane, 2 Way	60	3.50	0.75	0.75	22	1.74	1.00	0.94	0.86	1.00	0.81	2,500	2,025	2	0.9	1,823	9	55	74,000	
	6 Lane, 2 Way	60	3.50	0.75	0.75	22	1.74	1.00	0.94	0.86	1.00	0.81	2,500	2,025	2	0.9	1,823	9	55	110,000	

$$\gamma t = \frac{100}{100 - PT + ET \cdot PT}$$

$$C_D = C_B \cdot \gamma L \cdot \gamma C \cdot \gamma T \cdot \gamma I$$

ADT (Multiple Lanes)

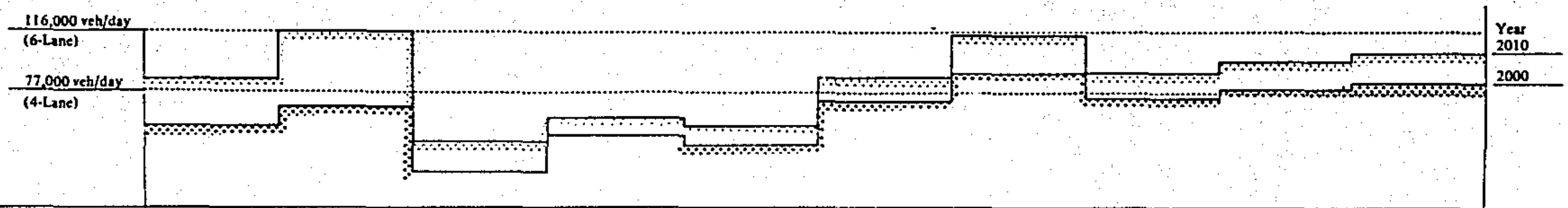
$$= \frac{5000 \cdot C_D \cdot N}{K \cdot D}$$

Where

- PT : Percentage of Heavy Vehicles
- ET : Passenger Car Equivalent of Heavy Vehicles.
- γL : Coefficient of Adjustment for Lane Width
- γC : Coefficient of Adjustment for Lateral Clearance
- γT : Coefficient of Adjustment for Heavy Vehicles
- γI : Coefficient of Adjustment for Sight Conditions
- C_B : Basic Capacity (P.C. U/hr.)
- C_D : Design Capacity (Veh./hr.)
- K : Peak Factor (%)
- D : Rate of Direction (%)
- N : Number of Lanes

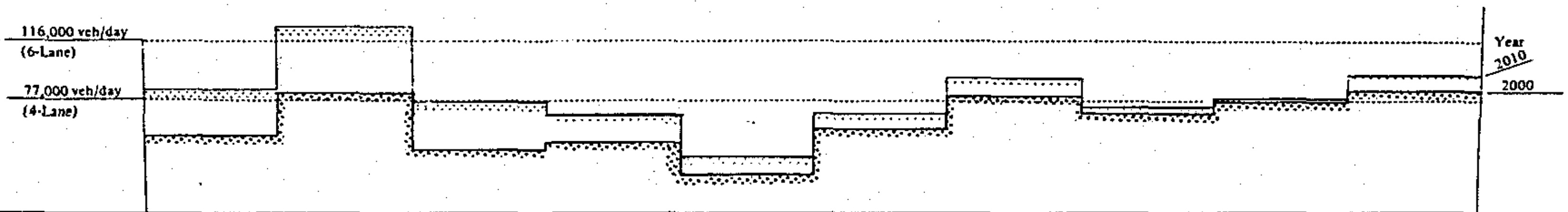
Fig. 8.1 Traffic Volume by Segment

(1) CASE-1



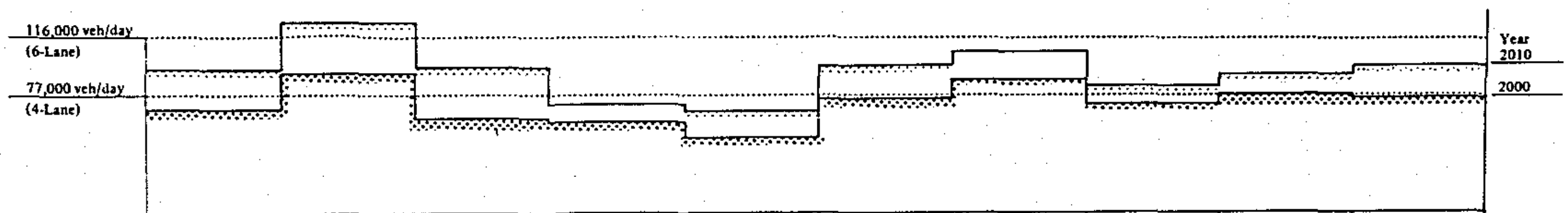
Road Segment Number	-	-	-	2	4	6	10	10, 13	13, 14	17, 18, 20
Road Segment	Air Port ~ Cengkareng J.C	Cengkareng J.C ~ Pluit I.C	Pluit I.C ~ Pluit J.C	Pluit J.C ~ Kota West I.C	Kota West I.C ~ Kota East I.C	Kota East I.C ~ Ancol I.C	Ancol I.C ~ Sunter West I.C	Sunter West I.C ~ Sunter East I.C	Sunter East I.C ~ Tg. Priok J.C/I.C	Tg. Priok J.C/I.C ~Cilincing J.C/I.C

(2) CASE-2



Road Segment Number	-	-	-	2	4	6	10	10, 13	13, 14	17, 18, 20
Road Segment	Air Port ~ Cengkareng J.C	Cengkareng J.C ~ Pluit I.C	Pluit I.C ~ Pluit J.C	Pluit J.C ~ Kota West I.C	Kota West I.C ~ Kota East I.C	Kota East I.C ~ Ancol I.C	Ancol I.C ~ Sunter West I.C	Sunter West I.C ~ Sunter East I.C	Sunter East I.C ~ Tg. Priok J.C/I.C	Tg. Priok J.C/I.C ~Cilincing J.C/I.C

(3) CASE-3



Road Segment Number	-	-	-	2	4	6	10	10, 13	13, 14	17, 18, 20
Road Segment	Air Port ~ Cengkareng J C	Cengkareng J.C ~ Pluit I.C	Pluit I.C ~ Pluit J.C	Pluit J.C ~ Kota West I.C	Kota West I.C ~ Kota East I.C	Kota East I.C ~ Ancol I.C	Ancol I.C ~ Sunter West I.C	Sunter West I.C ~ Sunter East I.C	Sunter East I.C ~ Tg. Priok J.C/I.C	Tg. Priok J.C/I.C ~Cilincing J.C/I.C

capacity reduction at the ramp terminal and to avoid the unpractical provision of three lane ramps approaching the throughway.

8.2.2 Geometric Design Standards

The standards for Harbour Road and Tg. Priok Access made reference to Bina Marga Standard (Standard Specification for Geometric Design of Expressway and Freeway - No. 13A/1976), AASHTO and Japanese Standards.

The adjustment of the main design criteria items was made by using mainly the "Road Design Standard", Japan, since the Bina Marga Standard is for rural highways. The brief description for each item of the geometric design criteria and other standards and the reasons for making certain modification to Bina Marga design standards are presented below.

(1) Harbour Road

1) Terrain Condition

The entire route of the Project Road passes through flat land.

2) Design Speed

The summary of surrounding conditions for the Project Road is as follows:

(a) Area classification and land use in direct influence Zone

According to the city planning map by DKI Jakarta the existing and future features are as follows:

Section	Area Classification	Land Use
Cengkareng- Kali Angke	Sub-Urban Area	Rice field, fish pond, kampung green
Kali Angke- Jakarta By-pass	Urban Area	Commercial, residential and industrial area
Jakarta By-pass- Jakarta Ring Road	Sub-Urban Area	Kampung, rice field and some residential area

(b) Design Speed

The design speed of existing and planned tollways and freeways in Jakarta is shown in Fig. 8.2 and was established as follows:

	Design Speed
Jakarta Intra Urban Tollway	80 Km/h
Jakarta Ring Road	100 or 120
Jakarta-Tangerang Freeway	100
Jagorawi Freeway	120
Jakarta-Cikampek Freeway	120

The Harbour Road is located in the coastal area and links Jakarta Intra Urban Tollway and Jakarta Ring Road. The design speed of the Project Road must therefore be in harmony with that of these tollways.

For both wings of Harbour Road, Cengkareng-Kali Angke and Jakarta By-Pass- Jakarta Ring Road, it is possible to adopt a design speed of 100 Km/h considering the existing land use mentioned above.

Future prospects for the corridor however, based on recent development trends is also an important factor in establishing the design speed. Especially in Kel. Kanal Muara, Kapuk Muara and Kapur, many industries have been located supported by good access, low cost land and available man-power.

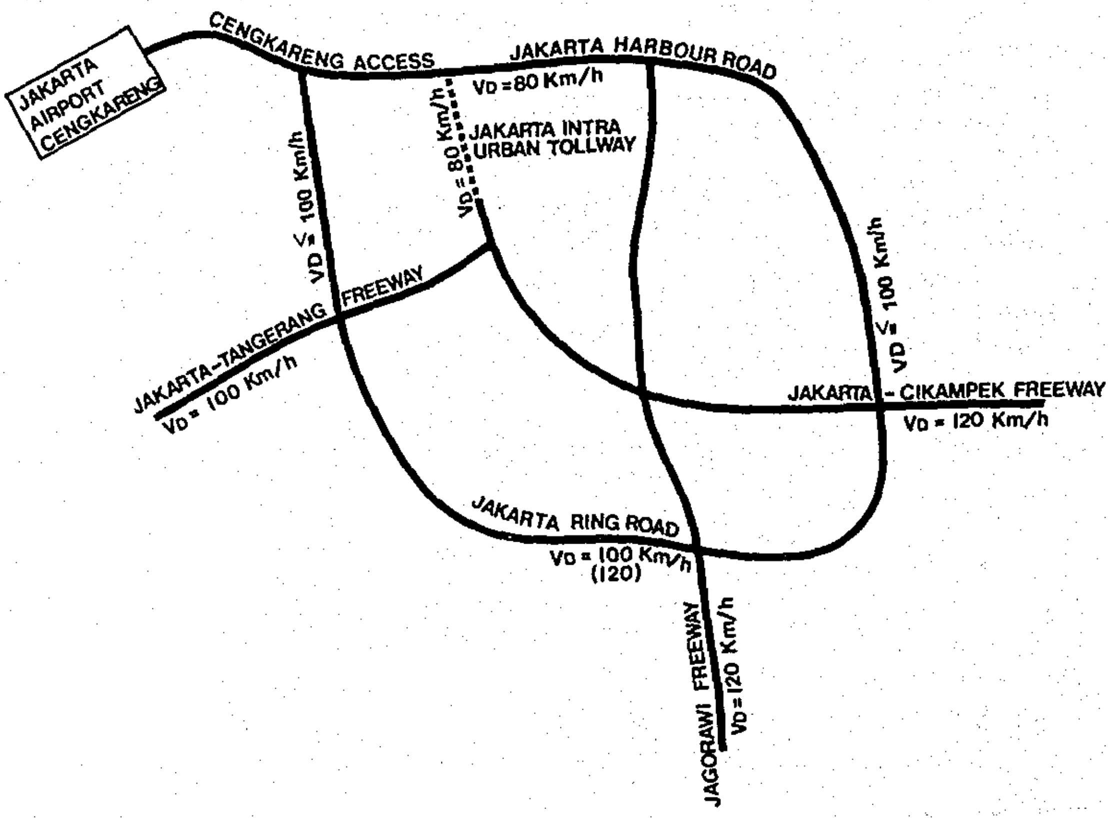
In the Jabotabek Plan the future population of Jabotabek area is expected to be 20 million and it is inevitable that the existing out-lying area will thus be urbanized in future.

The design speed of Harbour Road is therefore recommended to be 80 Km/h for its entire length as the highest possible value in an urban area considering future urbanization and the short length of both side sections.

3) Lane Width

A lane width of 3.5 m is recommended considering lateral clearance and the standard vehicle width of 2.5 m.

Fig. 8.2 Design Speed of Related Tollways/Freeways



Note : The design speed for the access sections of Jakarta Ring Road to Harbour Road is expected to be less than 100 Km/h.

4) Shoulder Width

Considering the difficult situation for land acquisition in Jakarta, the following shoulder widths are recommended:

Section	Outer Shoulder (M)	Inner Shoulder (M)
Kali Angke - Jakarta By-pass	1.50	0.75
Jakarta By-pass - Jakarta Ring Road	1.75	0.75

For a bridge of more than 100 meter length an outer shoulder width of 1.25 meter is adopted.

5) Median Width

Median width of 3.0 m (mount-up median = 2.0 m) is recommended considering the space for ramp bridge piers and guardrails.

6) Cross Slope of Pavement

A standard pavement cross slope of 2.0 percent is recommended based on the Bina Marga Standard.

7) Maximum Superelevation

The outside edge of the road will be rotated with respect to the inside edge along the horizontal curves. In areas subject to flooding, care must be taken to ensure that the lowest elevation of the roadway will maintain the required freeboard above the water surface.

A lower value of superelevation is desirable to ensure more comfort for the highway users.

8) Minimum Horizontal Radii

The largest radius of curvature compatible with the existing facilities should be used whenever possible.

9) Other Road Design Elements

(a) Frontage Road

Frontage Road is provided for local traffic. A one-way two-lane frontage road is recommended for both sides of Harbour Road in the developed areas because of the local situation.

No frontage road will be provided during the initial stage, in the area where the existing land use is predominantly for fishponds and rice paddies. The future construction of the frontage roads in the areas presently undeveoped however, is taken into account in determining the Right-of-way width to be reserved.

A carriageway width of 6.0 m (2 lanes) is recommended to give adequate space for stalled or disabled vehicles. A shoulder width of 0.50 m is recommended for both sides of the frontage road.

The frontage road is an independent facility for tollway traffic and is separated from Harbour Road. In case of connection with the diamond rampway from Harbour Road the frontage road also functions as an access ramp to street intersections.

(b) Side Walk

Side walk 3.0 m wide is provided on one side of both of the frontage roads based on the local situation.

10) Clearance

The clearance for roadways, pedestrian and railway is shown in Fig. 8.3.

11) Other items

The other main items of the recommended design standards are presented in Table 8.2.

From the aesthetic point of view as much planting as possible is planned.

Typical cross sections for Harbour Road are shown in Fig. 8.4 and 8.5.

Fig. 8.3 Clearance Limits

		Vertical Clearance
Tollway		5.1 m
Arterial Street		5.1 m
Minor Street		3.0 m
Pedestrian		2.5 m
Railway	Vertical	5.5 m (From rail surface)
	Horizontal	4.0 m (From edge of roadbed)

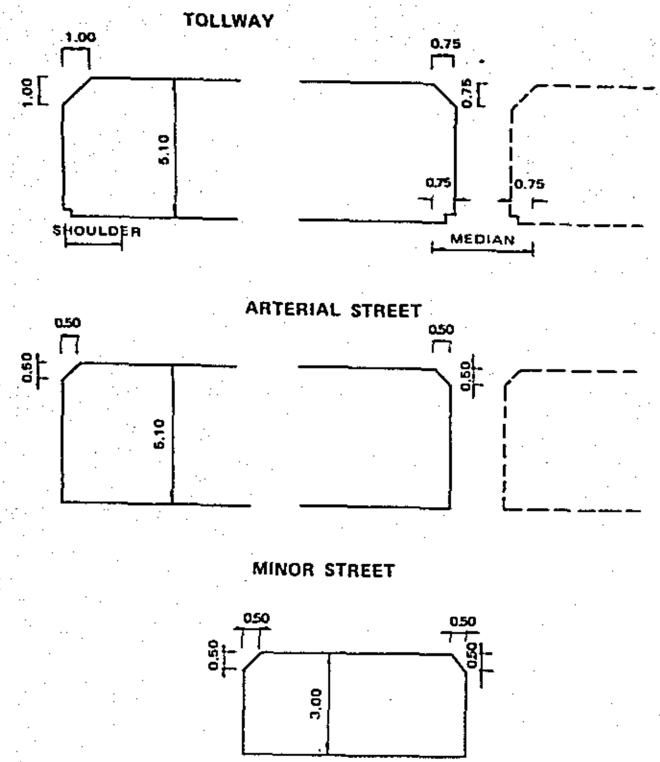


Table 8.2 Harbour Road Geometric Design Standard

Design Speed – 80 Km/h

Item	Unit	Recommended Standard	Intra Urban Tollway Standard	Bina Marga Standard (1976)(1970)	Design Standard in Japan
Terrain	–	Flat	Flat	Flat	Flat
Design Speed	*km/h*	*80*	80	80	*80*
Min. R.O.W. Width	m		–	40 or 60	–
Lane Width	m	3.50	3.50	3.50 or 3.75	3.50
Shoulder Width					
Outer	m	1.75 or 1.50 (1.25)	2.00 (1.75)	2.50 or 3.00	1.75 or 1.50 (1.25)
Inner	m	0.75	0.75	–	0.75
Median Width	m	3.00	2.50 – 5.00	5.00	3.00 or 2.25
Crossfall of Carriageway	%	2	2	2	2
Crossfall of Shoulder	%	2	2	4	2
Maximum Superelevation	%	10	10	10	10
Minimum Radii	m	230	230	210	230
Maximum Gradient	%	4	4 or 6	6	4
Stopping Sight Distance	m	115	115	115	110
Minimum Vertical *Curve Length*	m	See Appendix 8.1			70
Minimum Horizontal Curve Length	m	140 or 1000/θ	140 or 1000/θ	–	140 or 1000/θ
Super-elevation on Curvature	–	See Appendix 8.1			

Note: 1. θ shows intersection angle for horizontal curve.
2. The figures in brackets for the width indicate the value for bridge section.

Fig. 8.4 Typical Cross Section of Harbour Road (1)

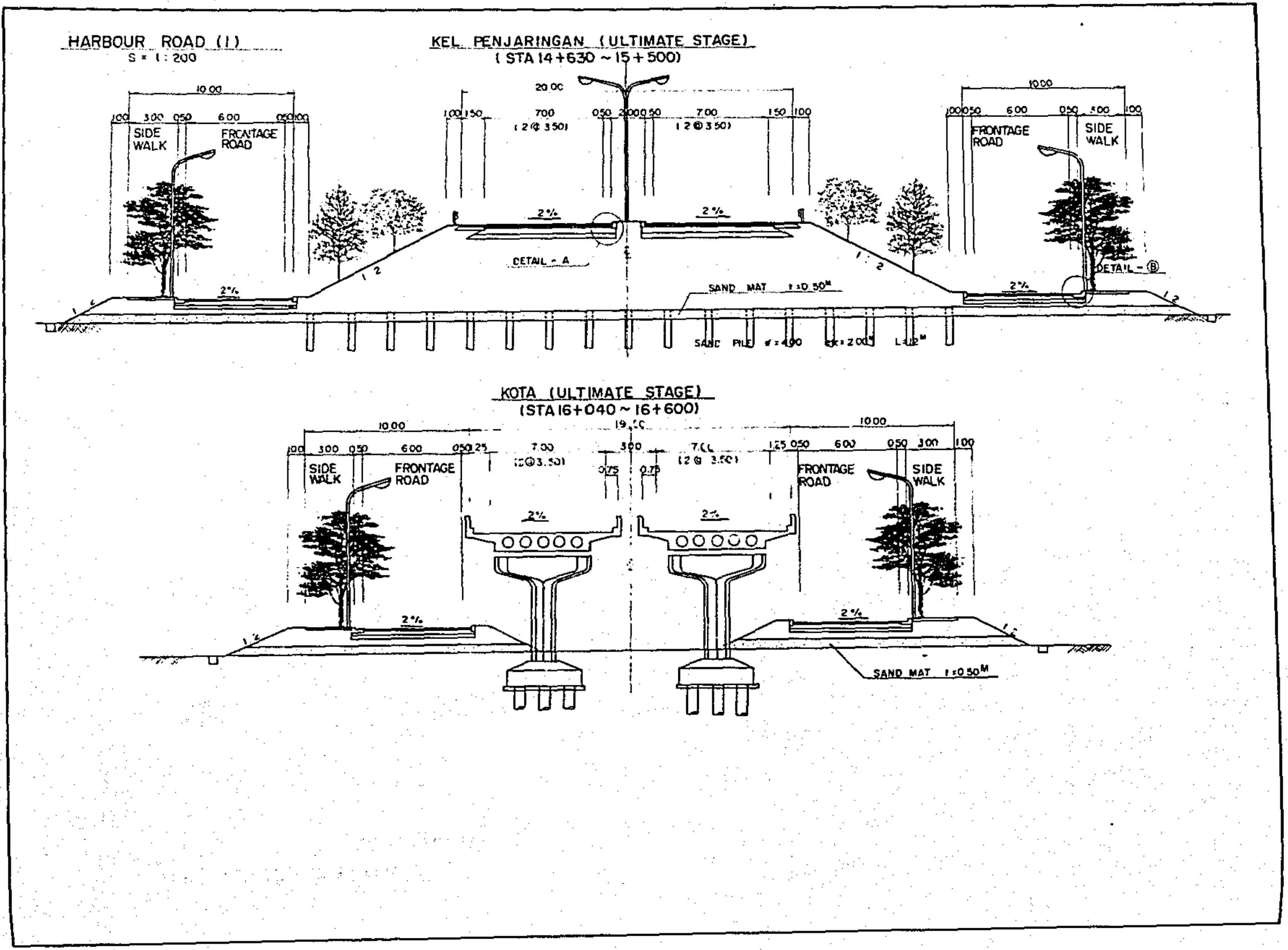
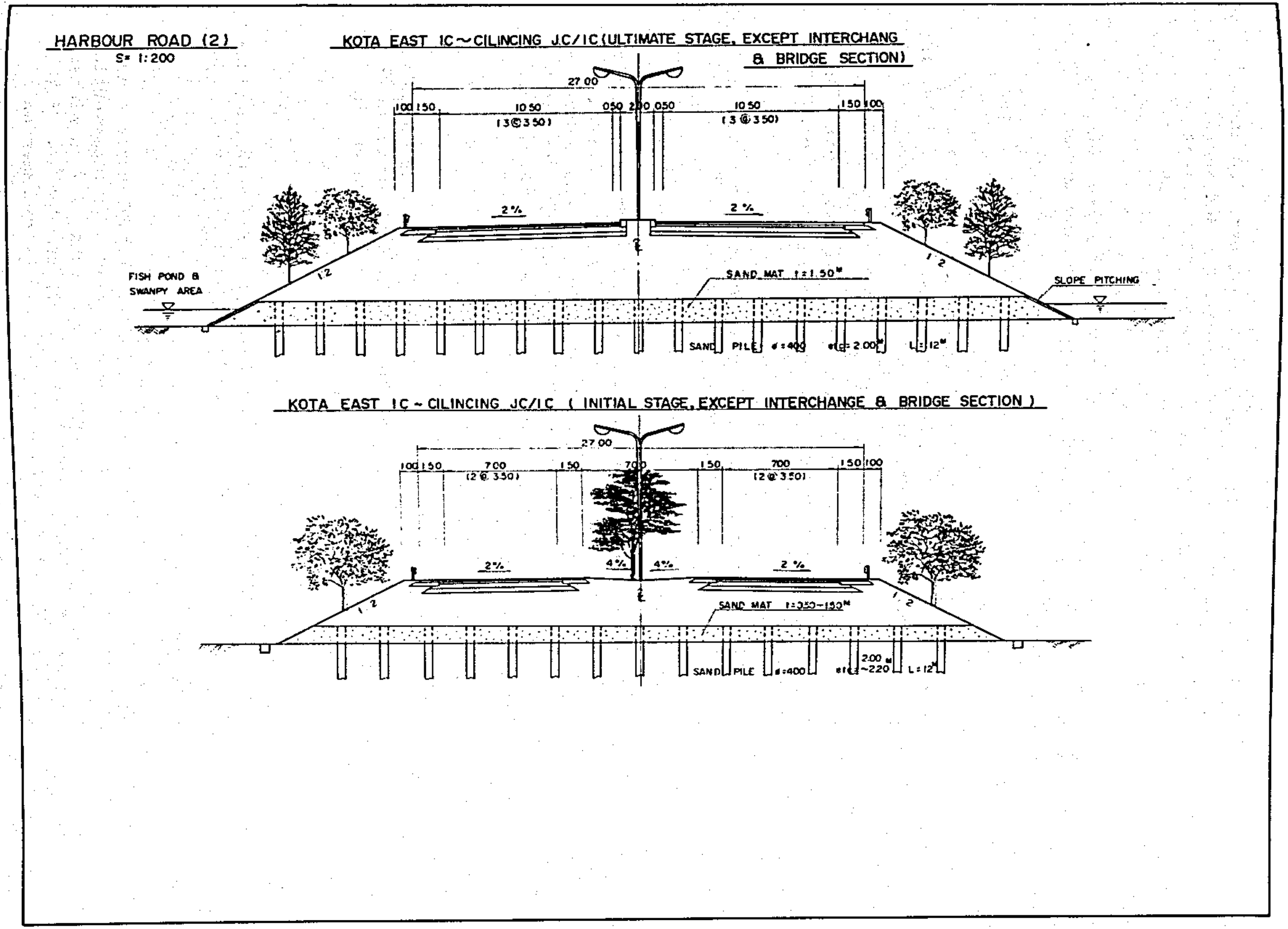


Fig. 8.5 Typical Cross Section of Harbour Road (2)



(2) Tg. Priok Access

The existing street is operated with no controlled access. Upon completion of the related tollways the access road will not meet the traffic demand due to insufficient through lanes capacity, lack of controlled access, and intersections.

An improvement plan should therefore be prepared not only to meet future through traffic demand but also to meet local needs.

1) Type of Road

Tg. Priok Access will mainly serve Tg. Priok Port and its extension ports to the east. The access road should be planned as a major arterial street rather than a part of the tollway as described below:

- Traffic capacity being same as the thruway controlled access from frontage roads and flyover bridges provided for intersections.

- Higher construction cost due to additional grade-separation necessary for the Tg. Priok JC/IC

2) Design Speed

On the urban arterial streets many at-grade intersections are operated. The design speed can therefore usually be lower than that of a road with full access control. It is therefore recommended that the design speed for Tg. Priok Access be a maximum of 60 Km/h as a major arterial street.

3) Lane Width

A lane width of 3.5 m for the throughway is recommended considering the design speed of 60 Km/h and a comparatively high percentage of large trucks, based on the future traffic forecast.

4) Shoulder Width

The minimum width of 0.50 m is adopted for both shoulders since no consideration for parking is necessary.

5) Median Width

Medians are a desirable feature of arterial streets and should be provided where space permits. At intersections where right turns are made, a right turn lane is always desirable from a capacity and safety standpoint. For this purpose a median width of 4.0 m is recommended. The median width of 4.0 m is composed of a raised median of 1.0 m and a right turn lane of 3.0 m at the intersections. This median width of 4.0 m is adopted for the section between Jl. Melati - Raya Pelabuhan. For the section between Tg. Priok Junction - Melati, the existing median width is maintained because the existing width is more than 4.0 m.

6) Cross Slope of Pavement

A pavement cross slope of 2.0 percent is recommended based on the Bina Marga standard.

7) Outer Separator

Outer separators are adopted for the section from Tg. Priok Junction to Jl. Enggano. The width of outer separator adopted is 2.0 m for the Junction - Jl. Melati and 1.0 m for Jl. Melati - Enggano.

8) Frontage Road

There is no controlled access for the traffic generating from local roads. All local roads, therefore have free access to the Jakarta By-pass. In order to promote the safe and efficient operation of the major arterial streets, these local roads should be controlled by the provision of frontage roads.

For the design speed of frontage roads, it is reasonable to adopt less than 40 km/h due to the slow movement of local traffic. A lane width of 3.0 m is adopted considering the predominant usage by passenger vehicles, buses and motorcycles.

The frontage road should be operated as one-way. Two lanes with a shoulder of 0.50 m are provided on both sides of the Access Road.

9) Side Walk

A side walk of 5.0 m is adopted for the entire length of a Tg. Priok Access due to the existing heavy demand.

The side walk is provided outside the frontage roads. It should be a raised type with trees.

10) Other Items

The geometric design standard including other items is summarized in Table 8.3

Typical cross sections are shown in Figs. 8.6 and 8.7.

Table 8.3 Tanjung Priok Access Geometric Design Standard

Design Speed - 60 km/h

Item	Unit	Recommended Standard	Bina Marga Standard	Japanese Standard
Terrain	-	Flat	Flat	Flat
Design Speed	Km/h	60	60	60
Min. R.O.W. Width	m		-	-
Lane Width	m	3.50	3.50	3.50
Outer Shoulder Width	m	0.50	2.50	0.50
Inner Shoulder Width	m	0.50	-	0.50
Median Width	m	4.00 or 6.00	-	1.00
Crossfall of Carriageway	%	2	2	2
Crossfall of Shoulder	%	2	4	2
Maximum Super-elevation	%	10	10	10
Minimum Radii	m	120	115	120
Maximum Gradient	%	7	7	7
Stopping Sight Distance	m	75	75	75
Minimum Vertical Curve Length	m	See Appendix 8.1		50
Minimum Horizontal Curve Length	m	100 or 700/θ	-	100 or 700/θ
Minimum Transition Curve Length	m	50	-	50

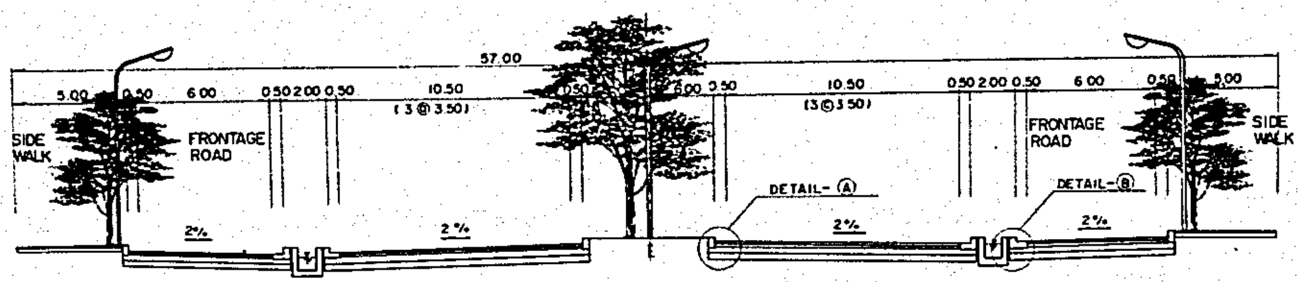
Note: 1. θ shows intersection angle for horizontal curve.

Fig. 8.6 Typical Cross Section of Tg. Priok Access (1)

Tg. PRIOK ACCESS (I)

S = 1 : 200

STA. 0+800~1+800



FLY-OVER APPROACH SECTION AT JL. MELATI

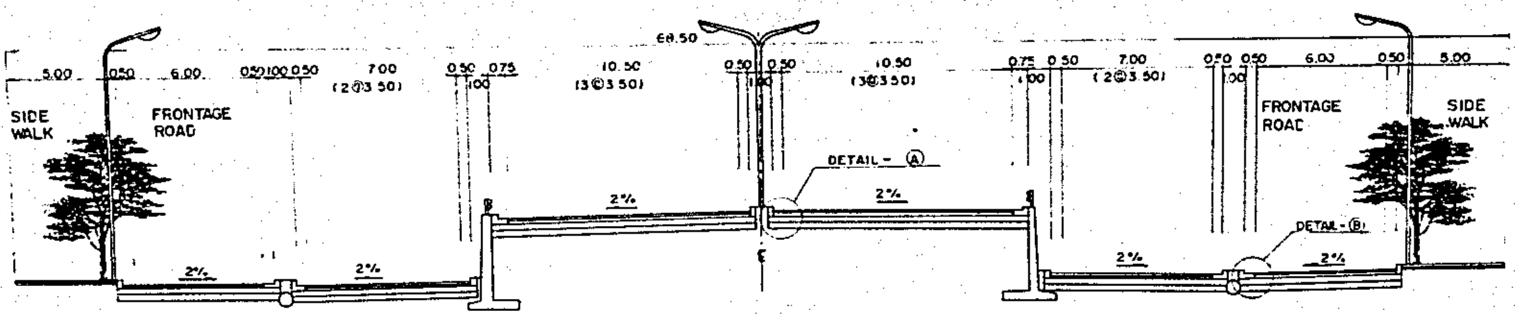
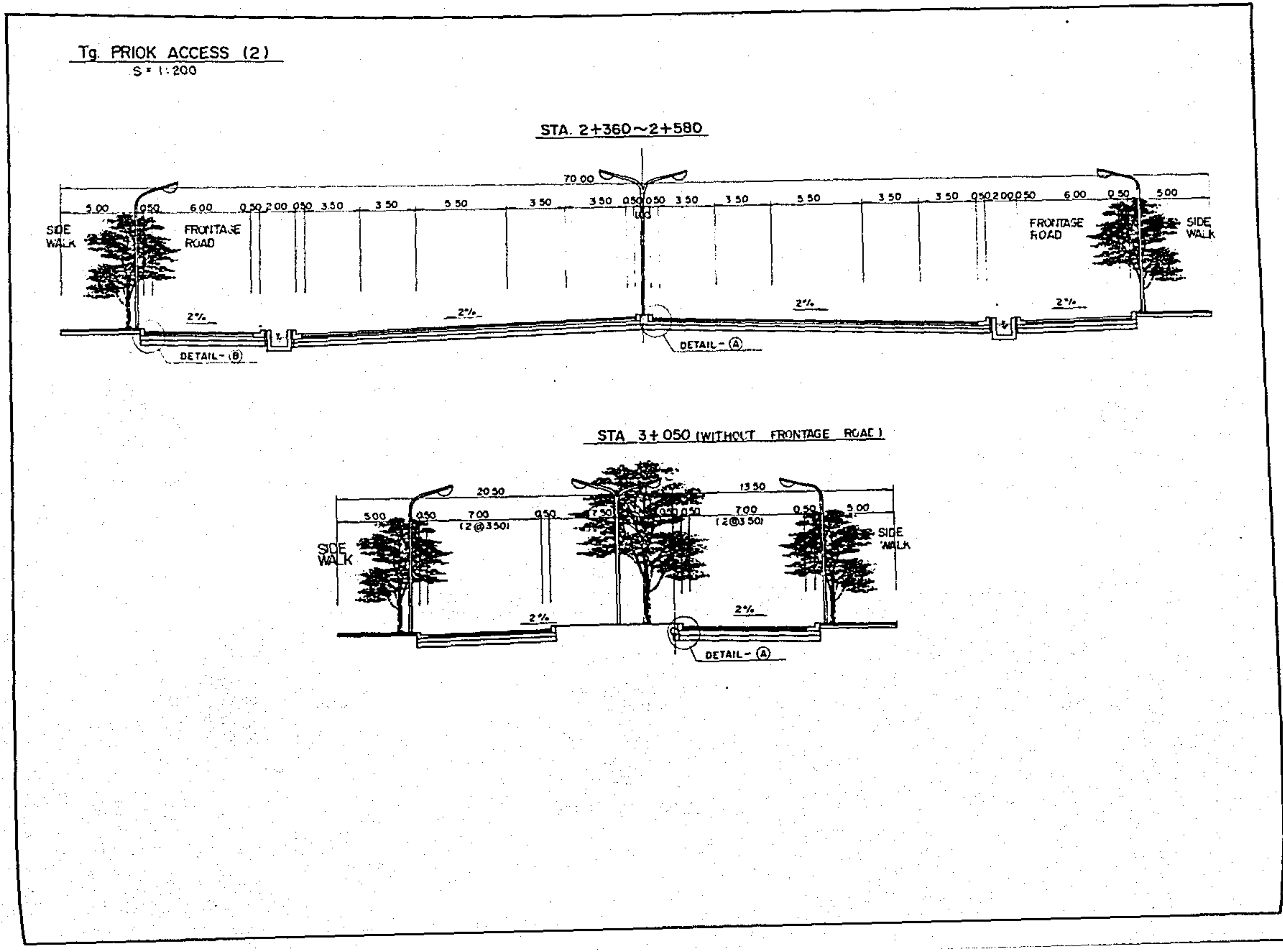


Fig. 8.7 Typical Cross Section of Tg. Priok Access (2)



(3) Junction/Interchange

In this Study a junction is defined as the connecting facility between a tollway and another tollway. An interchange is defined as the connecting facility between a tollway and an arterial street.

1) Design Speed of Rampway

Based on the examination of junctions and interchanges planning carried out in the past in Jakarta, the following design speed for rampway should be basically adopted considering the design speed of the two intersecting throughways and referring to AASHTO Standard.

Type of Intersecting Highway	Design Speed of Highway (Km/h)	Design Speed of Rampway (Km/h)
Freeway-Freeway	120 - 120	60
(Tollway - Tollway)	120 - 100	
	100 - 100	
Ditto	100 - 80	50
	80 - 80	
Freeway (Tollway)	80 - 60	
- Arterial Street	80 - 50	40
	80 - 40	

The design speed of rampways listed above, is that for major rampways since the value to be applied depends on the various conditions and ramp types. For instance, the application of loop design speed should be limited to the value of 40 Km/h.

In the special case of a rampway for speed of 60 Km/h, the design speed is reduced to 40 Km/h where a tollgate is provided.

It is desireable, however, for users to minimize speed down on junction ramps. The following values are recommended for junctions/interchanges on this project.

Intersecting Highway		Recommended Rampway Design Speed (Km/h)
Jakarta Ring Road, and Jakarta Intra Urban Tollway:	Junction	60 (40)
Other Arterial Streets:	Interchange	40

2) Lane Width

A lane width of 3.5 m is adopted for junction ramps and 3.25 m for interchange ramps.

3) Shoulder Width

The left shoulder of a one-lane, one-way ramp of junction ramps and interchange ramps is 2.5 m and 1.5 m respectively. Those for right shoulder are 1.0 m and 0.75 m.

In the case of a two-lane, one-way ramp, 0.75 m shoulders are adopted for both junction and interchange ramps.

4) Ramp Terminal

At the ramp terminals, a speed change lane is provided for the case of the ramp capacity within two-lanes. In the case of a capacity beyond two-lanes, an auxiliary lane is planned to minimize the capacity reduction.

(a) Minimum Length of Speed Change Lane

	One-Lane	Two-Lane
Acceleration Lane	160	240
Taper	50	50
Deceleration Lane	80	120
Taper	1/20	1/20

The speed change lane is lengthend according to the gradient of the throughway.

(b) Auxiliary Lane

The length of an auxiliary lane is a total of 600 m which include 550 m for the auxiliary lane and 50 m for the taper.

5) Other Items

The other items of recommended design standards are presented in Table 8.4 and 8.5.

Typical cross sections for the rampways are shown in Fig. 8.8.

Table 8.4 Rampway Geometric Design Standard

One-Lane One-Way

Design Speed - 60 km /h

Item	Unit	Recommended Standard	Bina Marga Standard	Japanese Standard
Terrain	-	Flat	Flat	Flat
Design Speed	km/h	60	-	60
R.O.W. Width	m		-	-
Lane Width	m	3.50	-	3.50
Outer Shoulder Width	m	2.50	-	2.50
Inner Shoulder Width	m	1.00	-	1.00
Crossfall of Carriageway	%	2	-	2
Crossfall of Shoulder	%	2	-	2
Maximum Superelevation	%	10	-	10
Minimum Radii	m	120	-	120
Maximum Gradient	%	5	-	5
Stopping Sight Distance	m	75	-	75
Minimum Vertical Curve Length	m	See Appendix 8.1		
Minimum Horizontal Curve Length	m	100 or 700/θ	-	100 or 700/θ
Minimum Transition Curve Length	A	50	-	50
Minimum Parameter of Clothoid Curve	-	70	-	70
Value of Superelevation on Curvature		See Appendix 8.1		

Notes: 1. θ shows intersection angle for horizontal curve.

Table 8.5 Rampway Geometric Design Standard

One-Lane One-Way

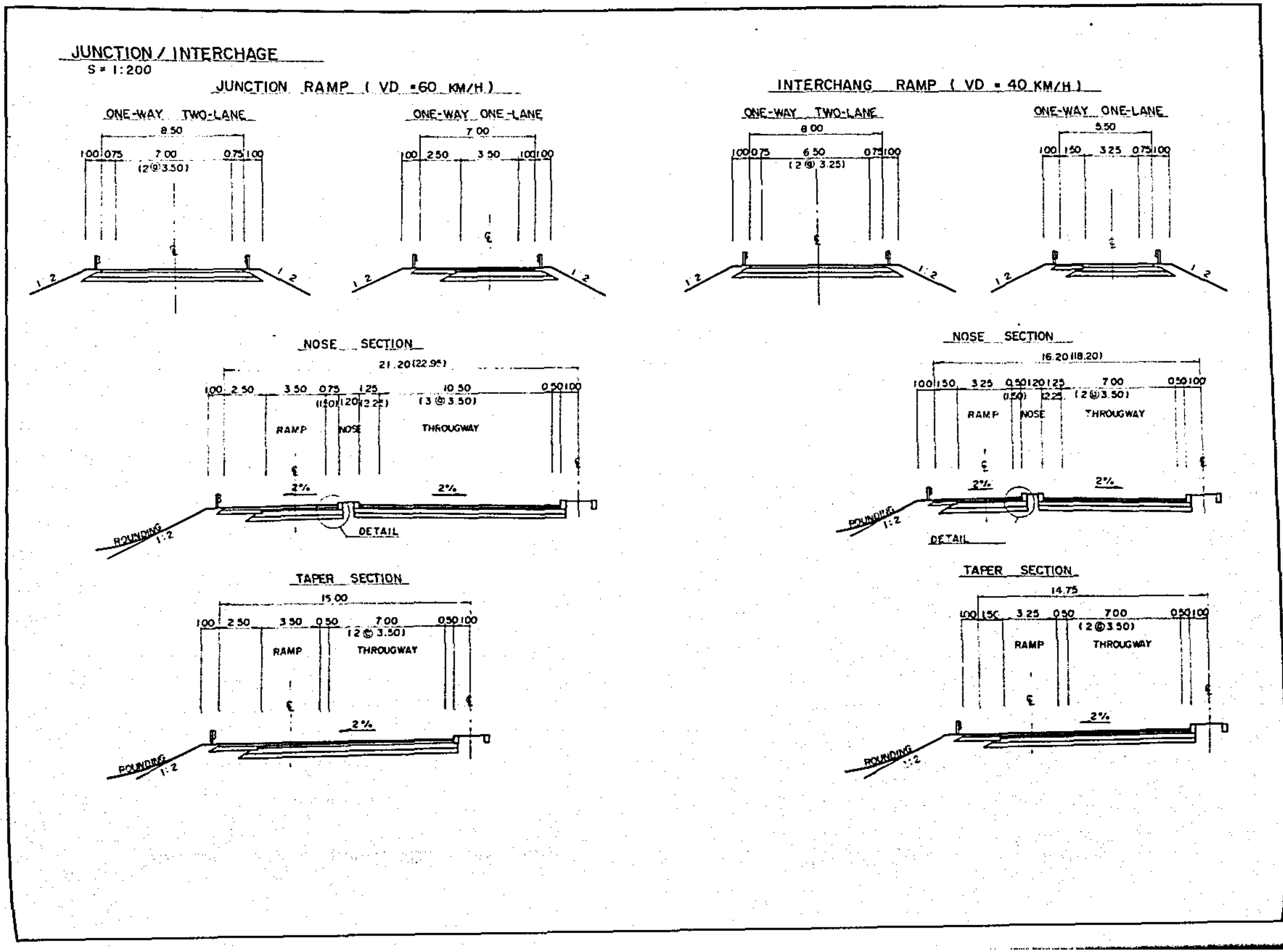
Design Speed - 40 km /h

Item	Unit	Recommended Standard	Bina Marga Standard	Japanese Standard
Terrain	-	Flat	Flat	Flat
Design Speed	km/h	40	40	40
R.O.W. Width	m		-	-
Lane Width	m	3.25	-	3.25
Outer Shoulder Width	m	1.50	-	1.50
Inner Shoulder Width	m	0.75	-	0.75
Crossfall of Carriageway	%	2	-	2
Crossfall of Shoulder	%	2	-	2
Maximum Superelevation	%	10	10	10
Minimum Radii	m	50	50	50
Maximum Gradient	%	6	8	6 (8)
Stopping Sight Distance	m	40	40	40
Minimum Vertical Curve Length	m	See Appendix 8.1		
Minimum Horizontal Curve Length	m	70 or 500/θ	-	70 or 500/θ
Minimum Transition Curve Length	A	35	-	35
Minimum Parameter of Clothoid Curve	A	35	-	35
Value of Superelevation on Curvature	-	See Appendix 8.1		

Notes: 1. θ shows intersection angle for horizontal curve.

2. The figures with bracket show value of absolute maximum.

Fig. 8.8 Typical Cross Sections of Rampways



8.2.3 Bridge Design Standards

(1) Loading Specifications

The design standards for bridges in Indonesia currently in use are adopted for this study. The main specifications are as follows:

- Loading Specifications for Highway Bridges No. 12/1970 published by Bina Marga.

- General Explanation and Interim Guide for Using Loading Specifications for Highway Bridges No. 12/1970, 1974, 1977 by Bina Marga.

For the detailed aspects of design, not covered by the specifications mentioned above, the following specifications are referred to:

- Specifications for Highway Bridge, Japan

- AASHTO (Standard Specifications for Highway Bridges adopted by the American Association of State Highway and Transportation Officials).

(2) Materials for Structures

The materials, concrete, reinforcing steel, prestressing tendon and structural steel, are specified in Appendix 8.2.

(3) Standard Cross Section of Bridges

The standard cross sections of bridges to be adopted for the study are shown in Fig. 8.9.

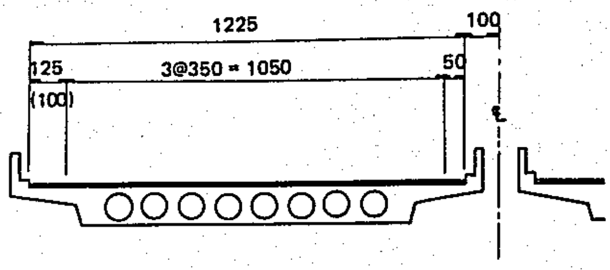
8.2.4 Drainage Criteria

The rational method with peak flow curves is used for this study. A design storm frequency of 25 years is recommended for culverts and 100 year for bridges in compliance with "MASTERPLAN FOR DRAINAGE and FLOOD CONTROL OF JAKARTA".

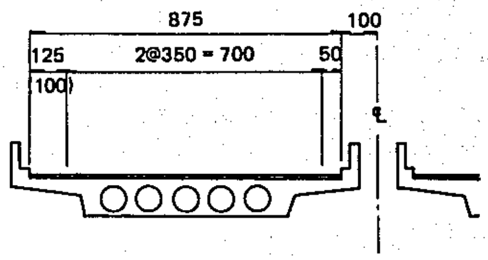
Fig. 8.9 Standard Cross Sections of Bridges

(1) THROUGHWAY BRIDGE

6–LANE (2 x 3–LANES)

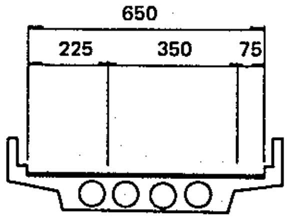


4–LANE (2 x 2–LANES)

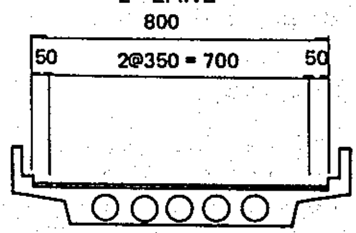


(2) JUNCTION RAMP BRIDGE

1–LANE

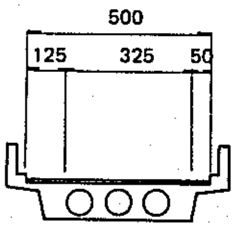


2–LANE

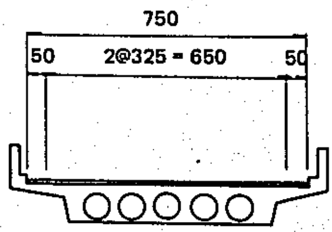


(3) INTERCHANGE RAMP BRIDGE

1–LANE



2–LANE



( ) Shows the width where total bridge length is more than 100 m.

8.3 Alternative Route Study

8.3.1 General

The Project Roads consist of:

- Harbour Road	
Pluit - Cilincing	17.4 km
- Arterial Street	
Tg. Priok Access	3.6 km
Total:	21.0 km

* The preliminary design for the section of Jakarta Airport Cengkareng - Pluit (namely Cengkareng Access) was excluded due to the preparation of detailed design by others. The initial and alternative route studies, however, are conducted in the Project.

These roads are located in the northern part of DKI Jakarta. The Harbour Road is an indispensable component of the Jakarta-West Java Tollway System and runs from Jl. Jembatan Tiga at the west end to Jakarta Ring Road at Cilincing in the east end. The Tg. Priok Access is a major arterial street connecting Tg. Priok Port and Tg. Priok junction/interchange.

8.3.2 Initial Route Study

The corridor of the Harbour Road including Cengkareng Access is considered to run between Cengkareng in the West and Cilincing in the East and is largely expected to be located within five kilometers inland from the shallow offshore area of the Java Sea, and to serve as a major transportation link in the coastal area of DKI Jakarta.

Prior to determination of the sub-corridor, two corridors located on the boundaries of the Project Area were studied. Thus the offshore route located in the shallow portion of the Java Sea and the inland route located more than five kilometer inland were studied as follows:

(1) Study for the Offshore Route

The offshore route, located in the shallow portion of the Java Sea, has many disadvantages as listed below:

- Land development is limited to the southern side of the road, since according to the Jabotabek plan there is no intention to develop a large scale reclamation area.

- The offshore route is located too far from the desire corridor of the traffic generated from the inland area.

- Efficiency for traffic distribution to the existing and future street network is less than that for the inland route.

- Environmental influence to the coastal fish ponds in Kanal Muara and Kapok Muara is unavoidable. Many openings will be required maintain the free flow of brackish water.
- Many bridges are required to provide openings for the numerous rivers and harbours located along the coastal line.

Therefore, the offshore route is not justified.

(2) Study for the Inland Route located more than Five Kilometers from the Coastal Line

The corridor located south of Jl. Pangeran would be very difficult with respect to land acquisition due to the fact that it is a very densely developed area.

This corridor is also too far from the desire corridor of the traffic generated from the many development centers located in the coastal area.

As a result of the study both corridors were not recommended. Therefore, the sub-corridor should be located within the band of five kilometers from the coastal line.

8.2.3 Alternative Route Study

In this study the field investigations using aerial photo mosaics and geographical map, both to the scale of 1 = 5,000, were carried out in detail, to provide a basis for the selection of the best route for the Project Road.

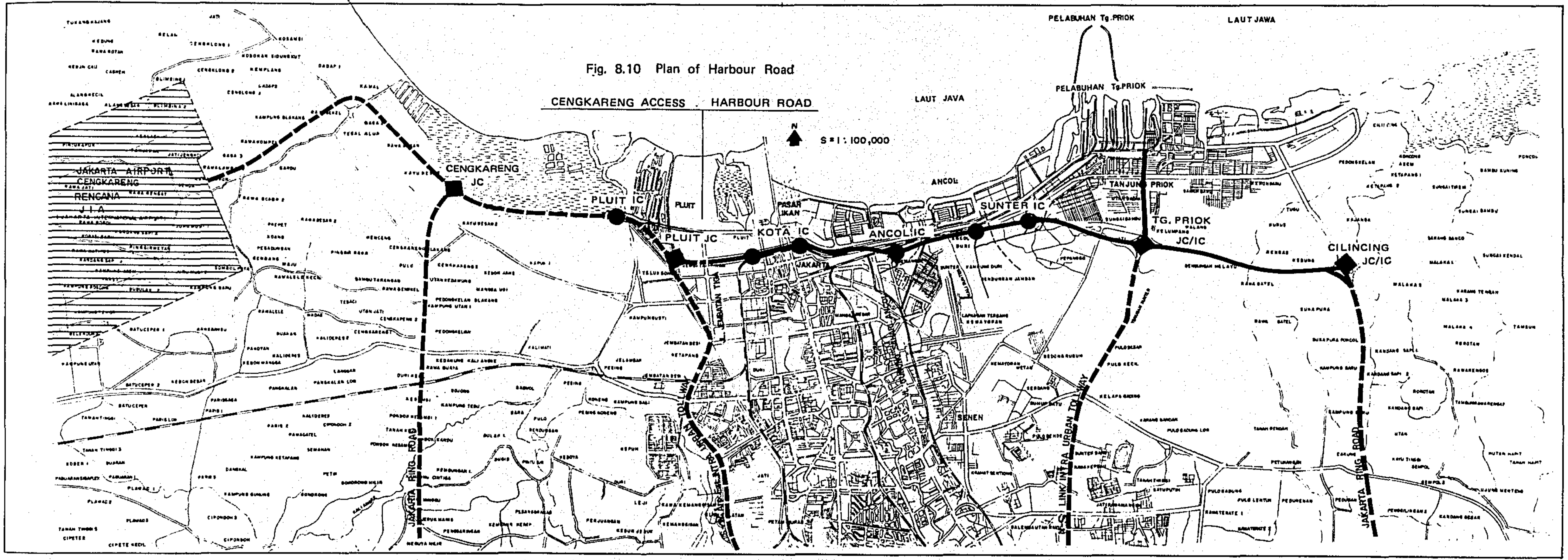
The Study also considered the needs for junctions and interchanges. Tg. Priok Access has no alternative routes, since it is the improvement of existing streets.

The description of alternative routes is made by Cengkareng Access and Harbour Road and their sections as follows:

Cengkareng Access		
Section - I	Cengkareng - Kanal Muara	STA. 0 + 0 - 8 + 0
Harbour Road		
Section - II	Kanal Muara - Kota	STA. 8 + 0 - 17 + 300
Section - III	Kota - Ancol	STA. 17 + 300 - 20 + 400
Section - IV	Ancol - Sunter	STA. 20 + 400 - 22 + 400
Section - V	Sunter - Cilincing	STA. 22 + 400 - 31 + 190

As the result of the study the recommended routes are shown in Fig. 8.10 Alternative routes studied for each section are shown in Fig. 8.11.

Fig. 8.10 Plan of Harbour Road



LEGEND

- PROJECT ROAD
- RELATED TOLLWAY
- INTERCHANGE
- JUNCTION (JUNCTION/INTERCHANGE)

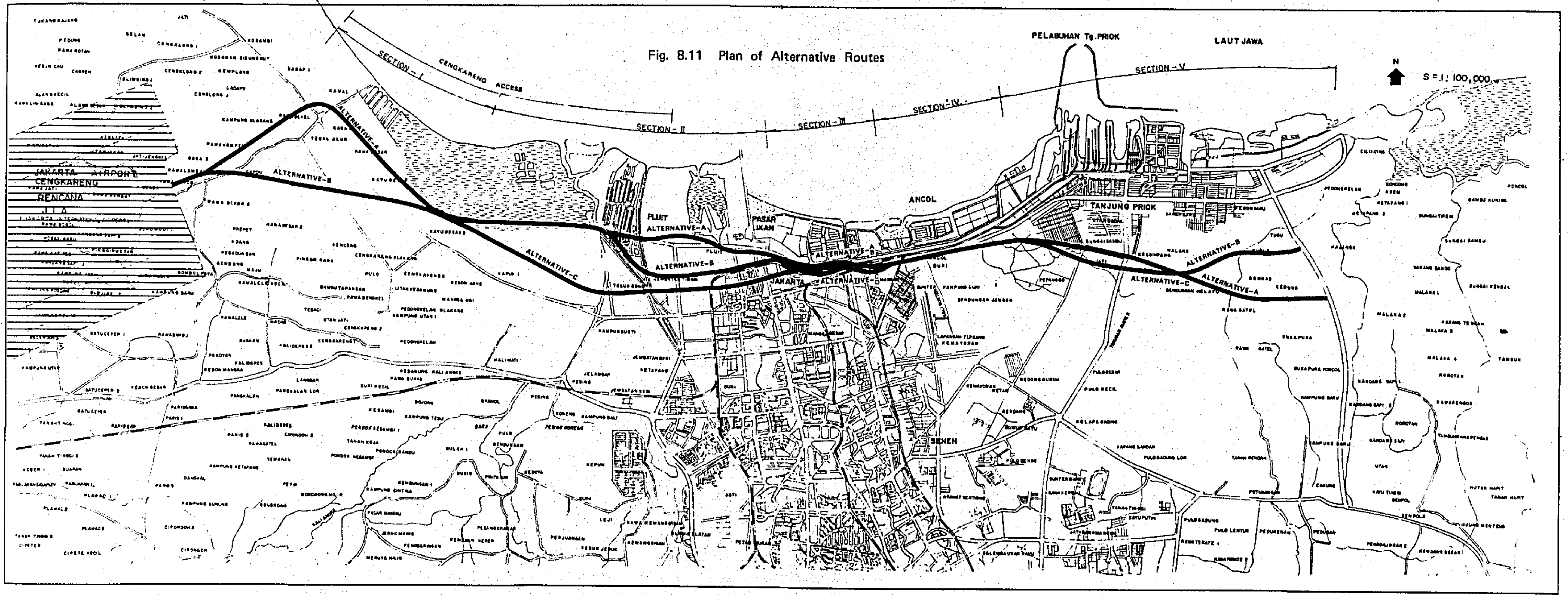


Fig. 8.11 Plan of Alternative Routes

(1) Cengkareng Access

Section - I (Cengkareng - Kanal Muara)

Two alternative routes, A and B, were studied. As a result of this study, Alternative - A (By-pass route) was recommended from the view point of less social problems, since the total cost was almost same as that of Alternative - B (Direct Route).

(a) Alternatives

Two alternative routes were considered in Section - I, with both routes starting from the entrance of the Jakarta Airport Cengkareng.

Alternative - A   By-pass route at Kanal Muara and passing mainly through a rice paddy area.

Alernative - B   Direct route.

(b) Comparison

The comparison for both routes is made in Table 8.6.

(c) Conclusion

Alternative - B was not recommended because it entails more social problems and since the total cost is almost the same as that of alternative - A.

Alternative - A is therefore recommended as the route of Section - I.

(2) Harbour Road

1) Section - II (Kanal Muara - Kota)

Three alternative routes, A, B and C, were studied. As a result of the study, Alternative - B was finally recommended based on some advantages and subject to the DKI's committment to the redevelopment of Kel Penjaringan.

(a) Alternatives

Within the selected sub-corridor, three alternative routes were selected as follows:

Alternative - A   Most northern route using Jl. Raya Pluit Selatan.

Alternative - B   Middle route passing Penjaringan Kampung just north of the Western railway line.

Alternative - C   Most southern route using Jl. Bandungan Utara and Selatan.

(b) Comparison

At first the alternatives were compared based on the condition that the S-W Arc extension of Jakarta Intra Urban Tollway was located on the existing Jl. Latumenten and Jl. Jembatan Tiga. This comparison is shown in Table 8.7.

Alternative - C was not recommended because it entails social problems to the facilities along the existing street and involves a high cost for compensation, land acquisition and Construction.

Also, it is not possible to cross the yard at Kota Station because of the future arrangement of the yard and the direct loading and un-loading of cargo.

Based on this Table 8.7 it is very difficult to choose the best route between alternative - A and - B.

Table 8.6 Comparison of Alternative Routes

SECTION-I STA 0+00—STA 8+300

Item / Alternative	Length (Km)	No., Length and Area of Bridge (No, M, M^2)	Connection with Other Roads	Affected Existing Fasilities				Problem on Traffic Treatment during Constanction	Total Cost
				Factory	School	Sand Stratum (M)	Residence (M)		
Ⓐ 0~8+300	8,30	Br-1 No L=25 M A=5,00 m^2 Box 6×6-1 No 6×5-2 Nos 5×5-1 No 4×4-2 Nos	Modified "Y" Type - 1 No	-	Environmental Influence -5 Nos	L= 900	L= 920	Almost none	almost same as Alternative-Ⓑ
Ⓑ 0~6+670	6.70	Br-4-Nos L=50 m A=1,000 m^2 Box 6×5-4 Nos	Modified "Y" Type - 1 No	Cinema-1 No	Environmental Influence -4 Nos	L= 2,000	L= 1,970	Almost none	

Note : 1. Area of bridges is calculated on the basis of 20 meter width of throughway.

2. Quantities under the columns "Residence" and "sand stratum" give the length of either residential area or sand layer traversed by the planned road.

(c) Further Study of Section - II

Based on the study results discussed in the previous paragraph, the section from Kali Angke to Ciliwung Kota Drain is considered the most difficult to determine the route alignment.

The following additional comparison for the above mentioned section is therefore made based on the Study of the S-W Arc Extension of Jakarta Intra Urban Tollway presented in Appendix 8.3.

- Cost

Table 8.8 shows a comparison for alternatives A and B. Considering the additional cost for the Alternative - A, re-arrangement of intersections and streets, the cost for both Alternatives is almost same.

- Traffic Management

For Alternative - A, it is much more difficult to manage the traffic on Jl. Tongkol - Jl. Pakin intersection due to the additional traffic from the half diamond ramps.

Table 8.7 Comparison of Alternative Routes

Section - II STA. 8+000 ~ STA. 17+300

Item / Alternative	Length (Km)	No, Length and Area of Bridges (No, M, M^2)	Connection with Other Roads	Effected Existing Facilities: Factory.etc	Effected Existing Facilities: Residence (Kampung)(M)	Effected Existing Facilities: Electric Tower	Problems, etc.	Construction Cost of Bridges (Billion Rp.)
(A) STA. 8+0 ~ 17+80	0.91	Throughway Br. L = 3,025 m A = 77,440 m^2 J.C-Br (including street ramps) L = 2,390 m A = 16,730 m^2	Modified "Y" type - 1 No Split Diamond - 1 No	Factory - 4 Nos Ware house - 9 Cinema - 1 Contractor Build - 1 DKI Branch Build. - 1 Hospital - 1	L = 510	—	1) In case of split diamond I.C with Jl. Gedung Panjang and Jl Tongkol both ramps are located close to the existing intersection 2) Pluit Junction. a) Necessary improvement for existing street b) Difficulty of construction c) Enviromental problem for existing Pluit Residential Area d) Juntions toll gate must be located on the extention of S-W Arc.	Throughway Br 31.7 Rampway Br. 14.3 Total 46.0
(B) STA. 8+0 ~ 17+80	0.93	Throughway Br. L = 2,095 m A = 53,632 m^2 J.C-Br (including street ramps) L = 1,840 m A = 12,880 m^2	Ditto	Factory - 5 Nos. Warehouse - 30 Nos. Army - 1 No.	L = 950	1 No	1) Environmental problem for the residential in Kel. Penjaringan 2) Pluit Junction a) Toll gate can be located on the Junction ramp way	Throughway Br. 21.1 Rampway Br. 9.2 Total 30.3
(C) STA. 8+0 ~ 17+80	0.94	Throughway Br. L = 2,465 m A = 63,104 m^2 J.C-Br (including street rampe) L = 1,070 m A = 7,490 m^2	Ditto	Factory. - FOOD - 2 NOS - HOSPITAL - 1 NO. - PLY-WOOD - 2 - SCHOOL - 1 NO. - PLASTIC - 11 - TEMPLES - 1 - LUMBER - 1 - ELECTRIC - 1 - GLASS - 1 - BANK, OFFICE, - MOBIL REPAIR - 2, RESTAURANT - - MANY NOS. - PAINT - 2 - BISCUIT - 1 - SOCKS - 1 - STEEL - 1 - BEER - 1 - PRINTING - 1 - NAIL - 1	L = 1500	—	1) Major problem due the many facilities along the existing streets 2) Almost impossible to locate junction at the Intersection of Jl Jembatan Tiga 3) Effects on for some Historical Buildings 4) Difficulties of Construction	Throughway Br. 32.3 Rampway Br. 5.4 Total 37.7

Note : 1) Area of bridges is calculated on the basis of 25.6 meter width of throughway and 7 meter width of rampway.
2) Quantities under the colum of "Residence" indicate the length of residential area traversed by the planned road.

- Committment on Land Use

  There is open space between Pluit residential area to the north and the industrial area to the south. This space will be used for public buildings and facilities as a buffer zone between the two areas. It will therefore be difficult to implement Alternative - A.

- Re-development of Kel. Penjaringan

  The area consists of a mixed area composed of many warehouses and lowgrade houses. It is apparent that the area lacks infrastructure such as suitable streets supporting commercial/ every day activities and also has a problem of fire safety due to narrow and limited number of existing streets. The re-development plan for the area was therefore prepared by the Study Team.

Finally Alternative - B is recommended subject to the DKI's committment to the re-development of the area along the Alternative - B alignment.

Fig. 8.8 Further Comparison of Section – II

(KALI ANGKE - CILIWUNG KOTA DRAIN)

Item / Alter-native	Length (KM)	Length and Area of Bridges (M, M^2)	Affected Facilities (M^2)	Cost	Remarks
A STA 12 + 0 17 + 200	0.52	L = 2,690 A = 68,344	Land Compensation 311,000 Housing 55,200 Industry & Offices 94,400 Parking 31,800	Almost same	
B STA 12 + 0 17 + 400	0.54	L = 2,650 A = 67,320	Land Compensation 332,300 Housing 71,100 Industry & Office 107,300 Parking -		

2) <u>Section - III</u> (Kota - Ancol)

Four alternative routes, A, B, C and D, were studied. As the result of the study, Alternative - B, which is located in Ancol Canal, was recommended from the view points of the avoidance of P.J.K.A. development plan, less social problems, traffic management during construction and better land utilization.

(a) Alternatives

This section must be located around Ancol Canal since the area to the north of the canal has already been established as the Ancol industrial and residential area and the area to the south of the canal contains two railway lines; Tanjung Priok line and the central line. The alternative routes were also selected based on the necessity of locating Ancol Interchange connecting with Jl. Gunung Sahari Ancol.

Alternative - A	Located to the north of Ancol Canal, using Jl. Lodan.
Alternative - B	Located in Ancol Canal near its south bank.
Alternative - C	Located to the south of Ancol Canal between Jl. Kampung Bandan and the railway to Tg. Priok.
Alternative - D	Located between the railways of Tg. Priok Line and Central line.

For economical reasons, it was desirable to place embankment on the reclaimed land, thus narrowing the existing canal. As a result of the meeting with Directorate General of the Water Resources, the Ministry of Public Works, this alternative was abandoned because narrowing the canal was not considered possible.

Therefore, the alternatives will be mainly constructed as bridge structures.

(b) Comparison

The comparison is shown in Table 8.9.

Table 8.9 Comparison of Alternative Routes (Section III)

Unit: Billion Rp.

Alt. \ Main Item	Construction Cost of Bridge	Land Acquisition and Compensation Cost	Total
Alt. - A	23.9	-	23.9
Alt. - B	20.8	-	20.8
Alt. - C	17.3	1.7	19.0
Alt. - D	17.8	1.0	18.8

According to the Jabotabek Railway Master Plan Study conducted by the Ministry of Communications and Tourism/JICA, there is a necessity to strengthen the western railway (the section between Kampung Bandan and Tg. Priok) and provided a grade separation for the Central railway line. It is therefore not possible to recommend Alternative - C and D since they use the P.J.K.A. land necessary for the above rail improvements. Alternative - D is located entirely in the P.J.K.A. land and Alternative - C uses a part of the land. Furthermore Alternative - C requires relocation of many warehouses and industries.

In connection with traffic management during construction, it is necessary for Alternative - A to control strictly the existing traffic on Jl. Lodan. Alternative - B has less problem with traffic management, due to maintaining traffic on Jl. Kampung Bandan during construction.

Finally Alternative - B is recommended based on fewer traffic problems during construction, less effect of existing commercial facilities and better land utilization.

3) Section - IV (Ancol - Sunter)

In this section no alternative route was studied due to the fact that the area is characterized by fish ponds. The alignment was therefore, established based on controlling the following points:

- Railway to Tg. Priok to the north;
- P.J.K.A. electric transmission station to the north;
- Canal, saluran Sentiong to the south;

- Space required for the Sunter interchange; and
- As close to the railway as possible.

4) Section - V (Sunter - Cilincing)

Three alternative routes, A, B and C, were studied. As the result of the study, Alternative - C (Combination A with B) was recommended mainly on the basis of social problems.

(a) Alternatives

The alternative routes must be located at the south border of the existing residential area, which is within the influence area of Tg. Priok. In this corridor, three alternative routes were selected as described below.

Alternative - A	Located to the south of 150 KV transmission line to Bekasi.
Alternative - B	Passing Kel. Pepanggo, just north of Pertamina and 150 meter north of the triangular intersection at Kel. Tugu.
Alternative - C	Using Alternative - B for the western section and Alternative - A for the eastern section.

(b) Comparison

The three alternatives are compared in Table 8.10.

Alternative - A requires the reloation of many houses located to the south of the 150 KV transmission line in Kel. Sungai - Bambu and Kebon - Bawang.

On the other hand Alternative - B has less problem on re-location of houses in the same Kelurahan due to its location at the border of the housing area and industrial area to the south.

Alternative - B however also has the problem of community separation in Kel. Tugu and it traverses a residential area in Kel. Semper planned by DKI Jakarta.

Alternative - C is recommended as section - V of the Project Road since there are fewer problems related to the relocation of facilities and land separation. It has also requires less construction, land acquisition and compensation cost.

Table 8.10 Comparison of Alternative Route

SECTION - V, STA 22 + 400～STA 31 + 19

Item / Alternative	Length (Km)	No. Length and Area of Bridges (No, M, M²)	Connection With Other Roads	Affected Existing Facilities: Factory	School	Sand Stratum (M)	Electric Tower	Residence (M)	Problem of Traffic Treatment during Construction	Construction Cost
Ⓐ STA 22 + 400 ～31 + 190	8.79	Br - 9 Nos. L = 415 m A = 8,300 m^2	Modified Trumpet Type - 1 No Modified Clover - leaf - 1 No	Factory - 4 No Cinema - 1 No Passar - 1 No Warehouse - 1 No	Environmental Influence - 7 Nos.	L = 2300 + 700 = 3,000	2 Nos.	L = 3,720	Arterial street ramp inter-section of Tg. Priok J.C is located close to the relocated Intersection of Jl. However this is not a major problem.	Most Expensive
Ⓑ STA 22 + 400 ～30 + 440	8.05	Br - 7 Nos. L = 400 m A = 8,000 m^2	Modified Trumpet Type - 1 No Modified Clover - leaf - 1 No	Army - 1 No	Environmental Influence - 8 Nos.	L = 350	2 Nos.	L = 2,400	- Arterial street ramp inter-section of Tg. Priok J.C. is located close to the Jl. Plumpung Semper Intersection. - Passing through Residential area located at Kel. Semper planned by DKI.	Medium
Ⓒ STA 22 + 400 ～30 + 440	8.05	Br - 7 Nos. L = 255 m A = 5,100 m^2	Modified Trumpet Type - 1 No Modified Clover - leaf - 1 No	Army - 1 No	Environmental Influence - 8 Nos.	L = 350 + 700 =1,050	2 Nos.	L = 2,140	- Arterial street ramp inter-section of Tg. Priok J.C. is located close to the Jl. Plumpung Semper intersection.	Cheapest

Note : (1) Area of bridges is calculated on the basis of 20 m width of road.

(2) Quantities under the column of "Residence" indicate the length of residential area traversed by the Planned road.

(3) Quantities under the column of "Sand Stratum" indicate the length of sand stratum traversed by the planned road.

8.3.4 Location Study of Interchanges

(1) General

Interchanges are the vital connecting facilities for the highway system. There should be an adequate number of them in order to attain the maximum traffic efficiency and to aid in future regional development.

In the study a "Junction" defines a facility connecting a tollway and a tollway and an "Interchange" defines a facility connecting a tollway and an arterial street.

In this paragraph junctions and interchanges are studied.

(2) Location of Junction/Interchange

According to the tollway projects in DKI Jakarta, four junctions with other tollways should be located on the Harbour Road and Cengkareng Access.

There are many existing and planned streets traversed by the Harbour Road. Among those streets some arterial streets were selected for connection with the Harbour Road based on consideration of the future urban highway network and the convenience of users.

The locations of junction/interchange and selected arterial streets are listed as follows:

	Name of JC./IC.	Number of Legs	Crossing Road
Cengkareng Access			
1	Cengkareng JC.	3	Jakarta Ring Road
Harbour Road			
2	Pluit IC.	3	Jl. Jembatan Tiga Jl. Raya Pluit Selatan
3	Pluit JC.	3	S-W Arc Extension of Intra Urban Tollway
4	Kota IC. (West, East)	4	Jl. Gedung Panjang Jl. Tongkol
5	Ancol IC.	3	Jl. Gunung Sahari Ancol
6	Sunter IC. (West, East)	4	Jl. Baru Sunter Jl. Martadinata
7	Tg. Priok JC./IC.	4	N-S Link of Intra Urban Tollway (Jakarta By-pass)
8	Cilincing JC./IC.	3	Jakarta Ring Road

The spacing between connecting roads should safely accommodate weaving, diverging, and merging movements on the tollway and should be sufficient to provide good directional signing. The spacing between junctions and interchanges listed above was examined based on AASHTO Standard shown in Table 8.11.

Table 8.11 Suggested Minimum Spacing between Connecting Roads

Type of Highway	Minimum Spacing
Freeway	One mile (1.6 Km)
Other Principal Arterial	1/2 mile (0.8 Km)
Other Principal Arterial (Center Core)	500 feet (0.15 Km)
Minor Arterial	400 feet (0.12 Km)
Collector	300 feet (0.09 Km)

As a result of the study the spacing of junctions/interchanges was determined as follows:

Junction/Interchange	Spacing
Cengkareng	-
Pluit I.C.	3.8 Km
Pluit J.C.	1.6
Kota I.C.	1.6
Ancol I.C.	2.3
Suntur I.C.	1.6
Tg. Priok J.C./I.C.	3.0
Cilincing J.C./I.C.	4.2

8.3.5 General Study for Bridges

(1) General

The structural study is made, among other reasons, for the purpose of estimating the construction cost of the Project.

Type and dimensions of structures, such as bridges, viaducts, box culverts and retaining walls, are determined based on the data collected during the site investigations: topographical survey, soils and materials survey and hydrological study.

The structural study of the Project is characterized as described below:

- The Project Road runs through a highly developed area in DKI Jakarta. Under these conditions long elevated viaducts are considered suitable.

- For junctions/interchanges with other tollways and arterial streets, bridges with small radii and high piers must be planned.

- The construction will therefore be more difficult than a similar project located in a rural area.

(2) Superstructure

1) Functional Requirements

(a) Span Length

The span length is determined by streets, railways and rivers crossed under the highway, and also affected by the soils conditions and the surrounding areas. The bridge span is the most important factor on the selection of bridge type. Once the span is fixed, the type is limited for selection. In the case of bridges with no control for the span, such as standard viaducts, the type and span of the bridges is selected mainly based on economical consideration. Table 8.12 shows the general conditions for selection of the type of superstructure.

(b) Smooth Running Surface

Continuous beam or slab type bridges are recommended to improve the running surface.

2) Environmental Requirements

The environment is an important factor in selection. For example, a concrete bridge is recommended in coastal areas because of its durability. However, a concrete structure having large dead - weight is sometimes disadvantageous in bad ground conditions.

Table 8.12 Type & Nature of Superstructure

(1) BRIDGE TYPE BY SPAN

Type of Superstructure	Bridge Span (M)	10	20	30	40	50	60	70	80	90	100
RC Hollow Slab		—									
PC Hollow Slab		—	—								
PC Simple T-Girder			—	—	—						
PC Simple Box Girder				—	—						
PC Continuous Box Girder					—	—	—	—	—	—	— 200
Steel Simple Composite Girder			—	—	—						
Steel Simple Box Girder				—	—	—					
Steel Continuous Box Girder					—	—	—	—	—	—	—

(2) EVALUATION BY NATURE

		Appearance		Execution Maintenance						Application to Special Types of Bridge				
	Trafficability	Side Elevation	Underside Appearance	Availability of Materials	Reliability of Quality	Construction Period	Degree of Disturbance to Traffic	Ease of Construction	Maintenance	Curved Bridge with Small Radius	High Pier Bridge	Variable Width Bridge	Economy (including substructure)	Total Evaluation
RC Hollow Slab	A	A	A	A	B	B	C	B	A	O		O	A	Suitable for Viaduct
PC Hollow Slab	A	A	A	B	B	B	C	B	A	O			B	Ditto
PC Simple T-Girder	B	B	C	B	B	A	A	B	A				B	Suitable for Bridge Over River
PC Simple Box Girder	B	B	A	B	B	C	C	C	A				B	
PC Continuous Box Girder	A	A	A	B	B	C	A	C	A				B	Suitable for Bridge Over Railway
Steel Simple Composite Girder	B	B	C	C	A	A	A	A	C		O	O	C	Ditto
Steel Simple Box Girder	B	B	B	C	A	A	A	A	C		O		C	Ditto
Steel Continuous Box Girder	A	A	B	C	A	A	A	A	C	O	O	O	C	Suitable to curved bridge with high pier

A : Excellent
B : Normal
C : Inferior

The bridge type which harmonizes best with the environment should be adopted considering the aesthetic point of view. For flyover bridges and viaducts which can be seen from the underside, the structural appearance is very important. Slab bridges and box girder bridges are recommended in these situations.

3) Construction Requirement

(a) Availability of Materials

R.C. and P.C. bridges are recommended in a country where structural steel is imported.

(b) Construction Method

For river or railway crossings or in areas of heavy traffic flow where staging cannot be erected, a bridge type using pre-cast methods or cantilever methods is most suitable.

(c) Construction Period

In cases when the construction period is limited, the selection of bridge type may be determined by speed of construction.

(d) Special Situations

Steel box girder bridges are recommended for curved bridges with small radius and for bridges with high piers.

(e) Economic Considerations

The most economical bridge type is finally selected from the various types which satisfy the above mentioned conditions. When costs are compared, the cost of the bridge itself, maintenance cost during the life of the bridge and the additional cost of the approach to the bridge are considered together. It is easier to maintain R.C. and P.C. birdges and the maintenance cost is lower than that for steel bridges.

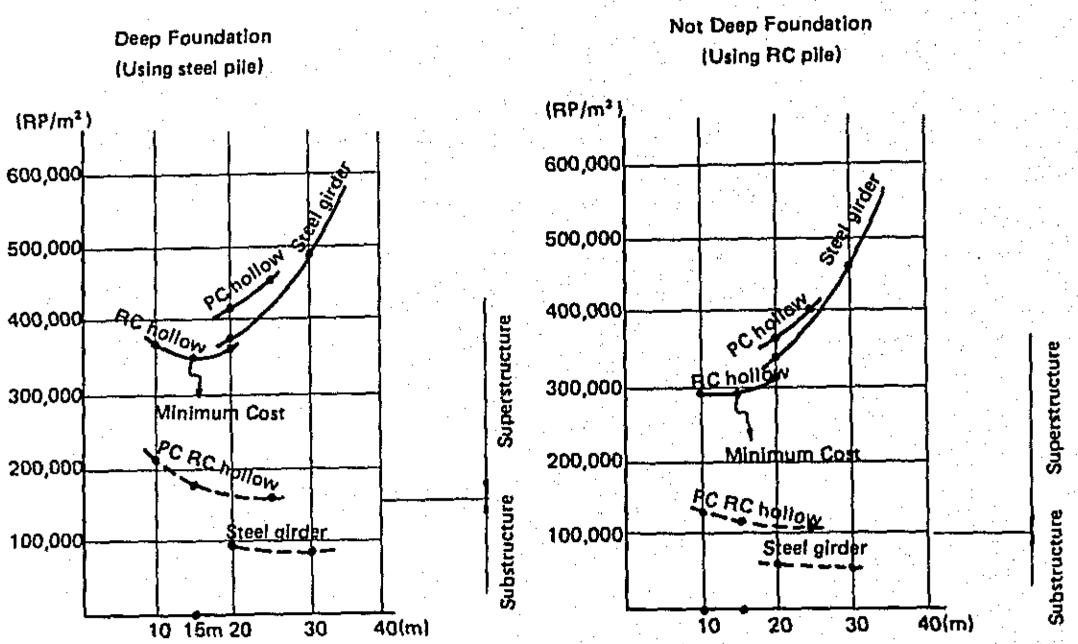
4) Determination of the Type of Superstructure

(a) Viaduct

The standard viaducts are planned in the case of no control for the span. In order to determine the type of viaduct, a cost comparison was made for some types as follows.

Fig. 8.12 Cost Comparison for Standard Viaduct

Unit: m^2



As the result of this comparison a 15 m RC hollow slab is recommended based on mainly economical and aesthetic reasons. In the case of 15 cm RC hollow slab, 4 or 5 span continuous type is usually adopted.

(b) Bridges over Streets, Rivers and Railways

The three spans of continuous PC box girder type or steel box girder type is adopted under the conditions, where the interesecting angle is less than 45 degrees and the main span length is 50 to 70 m.

On the other hand, in the case where the angle is more than 45 degree and the span length is 15 to 40 m, a PC T-beam type is adopted due to its economy and ease of construction. In case the span length is less than 25 m and the underside appearance is important for a street crossing, then a RC or PC slab type is adopted.

(c) Curved Bridges, and Bridges with High Piers

A steel box girder type is the most suitable for curved bridges of small radius with more than a 30 m span. For high piers bridge within interchanges, a steel box girder type is also suitable because of its smaller dead load and simplicity of erection.

(3) Substructure

1) Piers

(a) Piers for Bridges over Steets and for Viaduct

For the developed area and a long viaduct, the side view is very important factor. In such cases T-type with cylindrical column is adopted.

(b) Piers for Bridges over River

In order to minimize the effect on the water flow in a river, a pier of thin wall type is adopted. This type is also economical and easily constructed.

(c) Pile Bent Piers

The bridges with this type of pier prevail in Jakarta. Generally, in a swampy area this type is the most economical and most easily constructed. It however anticipates the problem of large displacement by an earthquake and the inferiority of side appearance. The type is therefore adopted for the height within 5 m from the ground.

2) Abutments

In situations where there is sufficient space to provide an embankment slope at the end of the bridge, the pile bent type abutment is recommended, because of its economy and aesthetic aspects.

In situations where a retaining wall is necessary at the approach to the abutment, the reversed T type abutment, (L) is recommended because of its economy and easy construction.

3) Foundations

The bearing stratum for the Harbour Road is situated in the range of 10 to 35 m depth. Pile foundations should be used.

(a) Steel Pile

At the river bed of old Ciliwung River (STA. 16+0 - STA. 18+380) where the depth is about 35 m, a steel pile is suitable based on extensive experience in Jakarta. Moreover, steel piles are convenient for the revision of the pile length according to the depth of the stratum.

For design purposes the following allowable bearing value for each steel pipe pile is adopted.

	Normal Condition (ton)	Earthquake Condition (ton)
Verticle bearing value	120	180 *-30
Horizontal bearing value	20	30

* Vertical bearing value for negative friction.

(b) Reinforced Concrete Pile

Except the river-bed of old Ciliwung River in this Project, the depth of the stratum ranges from 10 to 15 m.

In Jakarta the regular 40 cm square pile is produced. This is available for the RC pile foundation on the Project.

For design purposes the following allowable bearing value is adopted.

	Normal Condition (ton)	Earthquake Condition (ton)
Vertical bearing value	36	55 *-10
Horizontal bearing value	3	5

* Vertical bearing value for negative friction.

(4) Culverts

Since the Project Road is located in a swampy and fish pond area, many channels for irrigation and brackish water curculation are found along the route. Based on the past experience, it is known that concrete box or pipe culverts will offer the most economical solutions when the span length is smaller than about 7 m.

(5) Stage Construction

The stage construction (4 lanes to 6 lanes) for throughway bridges and viaducts is discussed in this paragraph.

The section to which stage construction is to be applied is from the nose of Kota East IC. to Cilincing. PC, steel and RC type bridges are planned for this section. It is possible to apply the stage construction for all types of bridges. Many problems during and after construction are anticipated as described below.

During Construction

- Decrease of service level as tollway,
- Decrease of toll income,
- Necessary traffic control at tollgates,
- Provision of detour road or frontage road,
- Additional traffic to the local street system,
- Technical problems for during and after construction as shown in the following Table.

Bridge Type	During Construction	After Construction
RC Slab	Necessary high technology for connection of reinforcement bar.	Unequal stress in new and old concrete due to creep. Necessary maintenance of cracking.
PC T-beam	Necessary special joint for PC cable.	- Ditto -
Metal	Necessary careful attention for joint work due to bigger vibration. Necessary adjustment for camber.	Necessary maintenance of cracking.

The additional construction cost was estimated for all planned bridges/viaducts in the section. As the result, the cost saving of bridges applied by the stage construction is estimated to be only 4 percent difference between the initial construction cost for 4-lanes and 6-lanes, since the substructure for 6-lanes should be constructed in the initial stage.

Considering the advantages and disadvantages described above the stage construction for the bridges was not applied for the study.

8.4 Geological Analysis and Soils and Materials Survey

8.4.1 General

The purpose of the survey was to obtain the necessary data for the preliminary design and construction cost estimation for, the pavement, structures, and embankment.

The soils survey was carried out during October, November and December 1980 by a local geotechnical company, P.T. SEECONS, Bandung. The materials survey was conducted during December 1980 by soil and highway engineers accompanied by Indonesian Counterparts. The field work and laboratory testings for the soils survey were planned and supervised by the Team.

8.4.2 Soils Survey and Geological Analysis

(1) Geological Characteristics

The Jakarta area is situated on the delta at the month of the Ciliwung River. The area on both sides of the delta, Tg. Priok area, and Cengkareng area are typical ridged beach planes and are composed of strips of beach ridges. In the Cengkareng area, where new Cengkareng Airport is under construction, the alluvium is deposited widely in old river courses.

The geological composition in Jakarta area is as shown in the following table.

Geological Period	Stratum	Explanation
Quaternary		
Holocene	Alluvium	In a flat plain, the upper layer of Genten Formation, includes a delta, a natural levee, a beach ridge and accumulation from an old river bed.
Pleistoncene	Diluvium	This consists of volcanic ash soil and a southern plateau made of volcanic sediment. To a great extent it is weathered laterite, depending on its depth.
Tertiary		
Pliocene	Genten Formation	Alternation of thin sandstone and mudstone layers

CHAPTER 9

CONSTRUCTION AND MAINTENANCE/OPERATION COSTS

Chapter 9 TECHNICAL ANALYSIS AND PRELIMINARY DESIGN

9.1 General

In this Chapter, a comprehensive analysis and preliminary design related to different engineering aspects for the Project Roads is discussed.

Engineering investigations including topographical and soils and materials survey were undertaken by hiring local consultants.

Based on the engineering investigations and forecast traffic demand, the type, size and dimension of the road facilities were determined in order to make quantity caluculation, estimation of the Project Cost and Construction Schedule.

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Tertiary		
Pliocene	Genten Formation	Alternation of thin sandstone and mudstone layers

The Harbour Road will traverse the delta area of Ciliwung River.

(2) Soils Survey

A soil survey consisting of 12 Bore-holes was conducted at locations shown in Fig. 9.1. Standard penetration tests at 2 m intervals were conducted for selected bore holes. The samples taken with thin-walled tube samplers were tested in the laboratory for specific gravity, moisture content, particle size analysis, liquid limit, plastic limit, unconfined compression and consolidation. The geological profile is shown in Fig. 9.2.

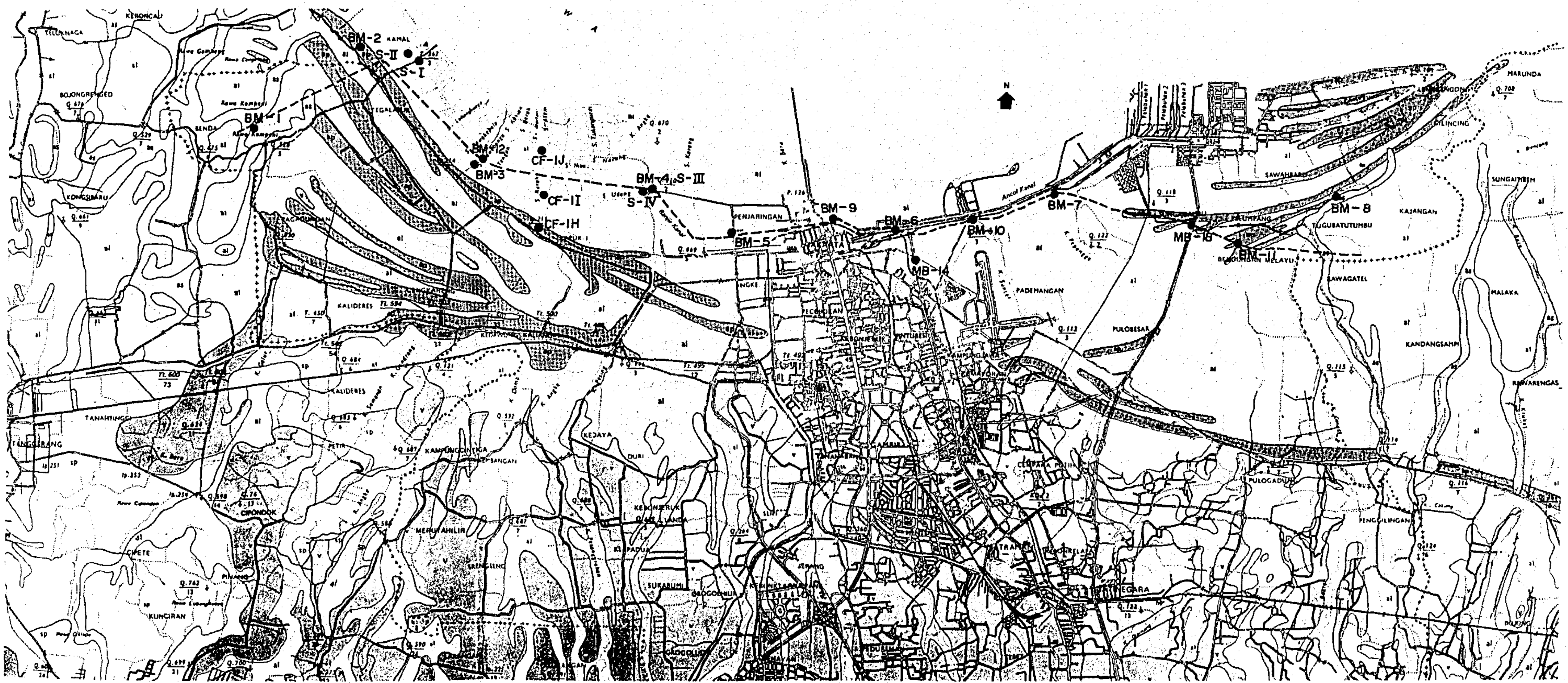
The result of the laboratory tests are summarized in Appendix 9.1. The values of natural water content and wet density of clayly soil show the normal values of 60 - 100% and 1.4kg/cm^2 respectively. The mechanical strength obtained from the unconfine compression and triaxial compression tests are quite low values. The e-log p and log Cv - log $\bar{p}$ curve are shown in Appendix 9.1. Such soft ground may result in the stability problems and large settlement of the sub-surface when a high embankment is planned.

(3) Stability of Embankment

It is vital for the Project Road that the embankment be safely constructed without instability or future ground settlement in excess of the maximum allowable (10 cm) after

Fig. 9.1 Geological Map and Survey Points

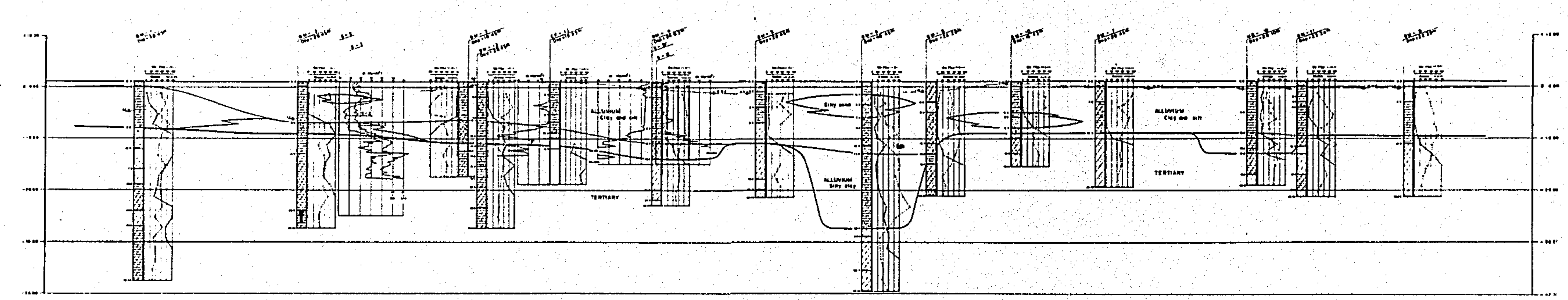
Scale 1: 100,000



LEGEND

BM	:	Boring points conducted in the Project
Others	:	Data collected by the Team
– – –	:	Harbour Road & Cengkareng Access

Fig. 9.2 Geological Profile H = 1 : 100,000 V= 1 : 1,150



opening to traffic.

1) Analysis Conditions

(a) Sub-soil Conditions

As the result of the laboratory test, the soil parameters obtained were as follows:

- Thickness of soft ground 12 M
- Ground water level GL - 1.10 m
- Natural water content 95%
- Wet density 1.5 t/m^3
- Initial cohesion 0.73 t/m^2
- Angle of internal friction 0°
- Yield stress of consolidation assumed to be equal to the embankment load
- Increasing ratio of soil stress 0.3

(b) Embankment Condition

Embankment is loaded on the existing ground in a trapezoid shape and the height was analyzed for 2, 4, 6, 7, 8 and 12 meters.

2) Stability Analysis

In the case of no-treatment for the ground, the critical embankment height was found to be 2.3 m with an allowable safety factor for ground slide (Fs = 1.25). On the other hand, the final settlement was 1.5 - 2.0 m and the remaining settlement was 0.65 - 1.0 m even after the loading period of 180 days.

(a) Treatment Method

There are many treatment methods available for soft ground. Among these methods the sand drain method with sand mat was selected from a practical and economical view point.

The thickness of sand mat placed on the ground is 0.5 m for the developed area and 1.5 m for swampy area. The diameter of sand drain pile is 40 cm.

(b) Interval of Sand Drain Pile & Loading Berm

The relationship between the sand pile intervals and the safety factor analyzed were as follows:

Embankment Height (M)	Interval of Sand Pile Ø 400 (M)	Safety Factor for Ground Slide
H = 2	-	1.74
H = 4	2.0	1.29
H = 6	2.0	1.26
H = 7	2.0	1.25
H = 8	2.0	1.22
H = 12	2.0	1.19

The maximum embankment height was analyzed at 7 m. In order to attain the stability for the high embankment a loading berm is required on both sides of the section of more than 8 m. For the analysis with the berms, the additional right-of-way width was calculated to be as follows:

Embankment Height	Additional R.O.W.
H = 8 M	2 x 10 M
H = 12	2 x 19

Embankment sections of 8 m were planned at several bridge abutment. For these sections the frontage roads or the loading berms should be constructed at the initial stage.

In junctions and interchanges grading should be constructed at the bridge abutment of more than 8 m height.

(4) Analysis for Settlement

The maximum settlement at the center of the embankment section were obtained based on the same conditions analyzed in the stability analysis as follows:

Embankment Height (M)	Interval of Sand Pile Ø 400 (M)	Final Settlement (CM)	Remaining Settlement after loading period of 180 days (CM)
H = 2	-	96	33*
4	2.2	150	Less than 10
6	2.1	193	Less than 10
7	2.0	207	Less than 10
8	2.0	230	Less than 10
12	2.0	283	Less than 10

* Pre-loading is required in order to ensure the settlement of less than 10 cm. The loading period of pre-loading will be required more than one year.

(5) Recommendation

The results of the analysis are summarized as follows:

- Sand mat 0.5 m for developed area
  1.5 m for swampy area

- Sand drain pile

		Interval	Loading berm
H = 2 M	Pre-loading	-	-
H = 4 M	Sand pile Ø 400	2.2 M	-
H = 6	"	2.1 M	-
H = 7	"	2.0 M	-
H ≧ 8	"	2.0 M	10 - 20 M or Rounding

(6) Further Study

1) The boring intervals conducted in this study was too large. In order to confirm the continuity of sand layers and the precise location of the bearing stratum for pile foundations, borings spaced more closely together at the location of high embankment sections and abutment points must be conducted at a future time.

2) Study for Adjacent Facilities

The study for adjacent facilities, such as existing buildings and railways was also considered. In the further study the influence of such facilities will be analyzed.

9.2.3 Materials Survey

Contact with Bina Marga, DKI Jakarta and Department of Mining & Energy, Directorate of Geology Environmental Planning was made and data and information were collected regarding sources of construction materials. Site investigations were also carried out by soil and highway engineers with reference to the topographic and geological maps.

(a) Aggregates & Sand

Fig. 9.3 shows the location of the quarry site and Table 9.1 shows the surveys results.

(b) Embankment Borrow

The volcanic origin soils covering the southern plateau are classified A-2-7 and A-7-5 by AASHTO Soil Classification. The former is coloured light grey and the latter, reddish brown, both being lateritic soils. Both are suitable as embankment materials.

Fig. 9.3 Location of Quarry Sites

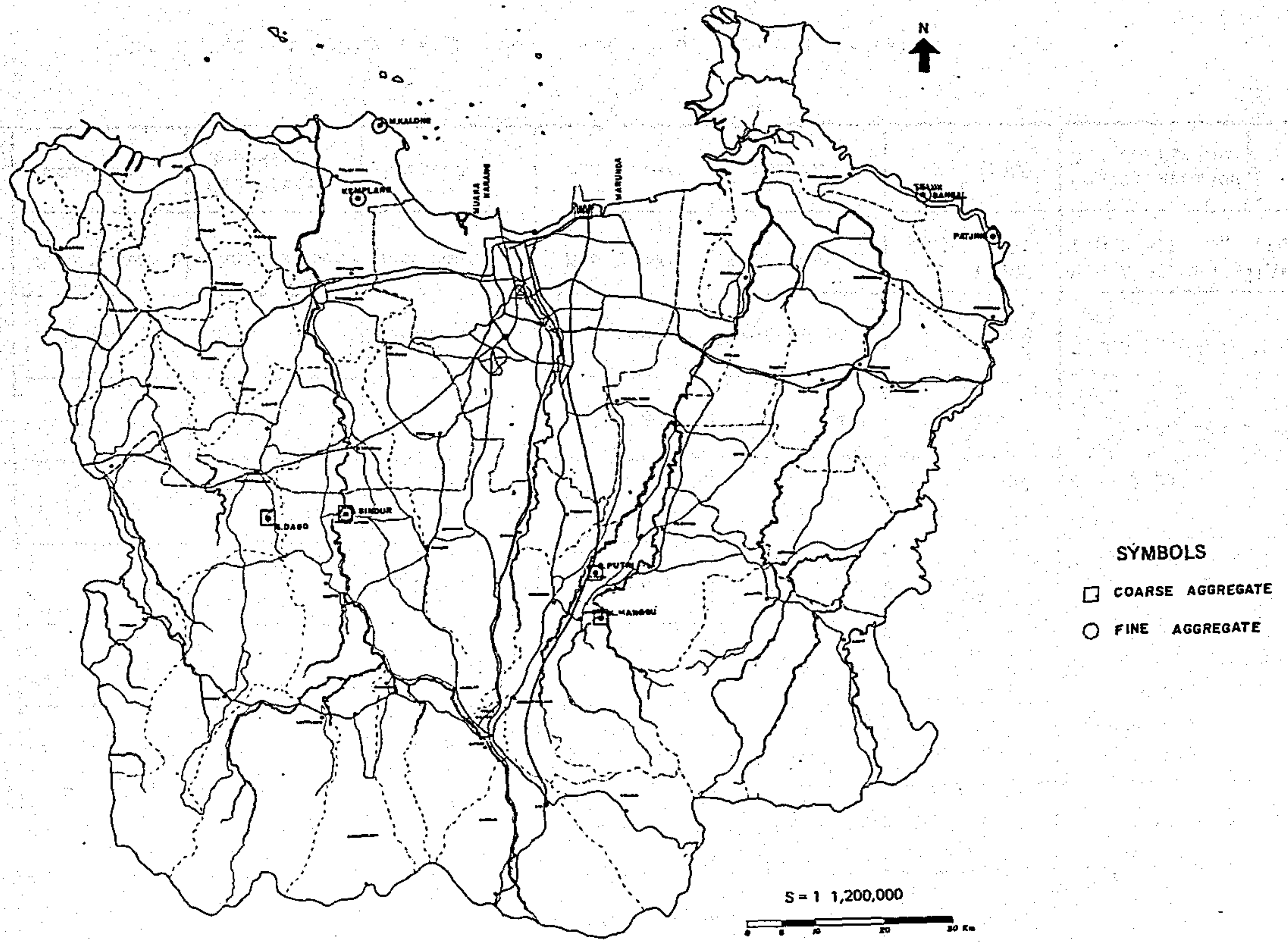


Table 9.1 Survey Results from Quarry Sites

	Site	Material Deposit Feature	Assumed Deposit Volume	Mining Method	Transportation	Price at Quarry (Rp/M^3)	Remarks
Coarse Aggregate	G. Dago	Andesite Hill	Abundant	Blast & Machine	Truck	6,000	Good quality of Crushed stone
	G. Sindur	Terrace Deposit	Abundant	Man Power	Truck & Raft	1,000	Partially mixed soft stone, Necessary road improvement of 15 Km
	G. Putri	Basalt Hill	Limited	Man Power	Truck	4,200	
	K. Manggu	River Bed	Limited	Man Power	Truck	4,000 - 4,200	(Gravel) (Cobbles)
Fine Aggregate	G. Sindur	Terrace Deposit	Abundant	Man Power	Truck & Raft	2,000	Screening excluded in the Price
	Krawang	River Bed	Abundant	Man Power	Truck & Boat	2,000	5,000 Rp/m^3 At Marunda Port
	M. Kalong	Shallow Sea	Abundant	Man Power	Sail Boat	H.Q 1,000 L.Q 600	H.Q 4,500 Rp/m^3 } At M. L.Q 2,500 " } Karang
	Kemplang	Old River Deposit	Limited	Man Power	Truck	3,000	Coarse grained, Bad condition.

Note: H.Q and L.Q mean high quality and low quality respectively.

9.3 Hydrologic Analysis

9.3.1 General

The study was carried out to furnish hydraulic data for the design of the bridges and drainage structures, and to determine the minimum height of embankment at the river basins for the design of road profiles. It also had the purpose of minimizing the hydraulic effects such as the effect of flooding.

For DKI Jakarta, the "MASTERPLAN for DRAINAGE and FLOOD CONTROL OF JAKARTA" was established by the Ministry of Public Works and Electric Power, Directrorate General of Water Resources Development, in December 1973. This is presented in Appendix 9.2. The river plans related to this Project were also established by the MASTERPLAN and its successive studies. These are shown in Fig. 9.4, 9.5 and Table 9.4.

The study focused on the analysis required for the additional openings and the calculation of embankment height.

9.3.2 Hydrologic Analysis

(1) Basic Conditions

1) Rainfall

The "Rainfall Intensity Duration Curves for the Jakarta Area" were analyzed in the preparation of the MASTERPLAN and the data is as shown in Table 9.2.

Table 9.2 One Hou/24 Hours Rainfall Data

Unit: in mm

Return Period (Year)	One-Hour	24-Hours
2	57.2	111.5
5	68.9	151.8
10	76.6	178.5
25	86.0	212.3
50	93.6	237.1
100	100.8	261.8

2) Run-Off Estimation Method

Considering the nature of the project area and the purpose of the study, a rational formula was used in the calculation of flood discharge.

A design storm frequency of 25 years was adopted for additional openings in compliance with the MASTERPLAN.

3) Discharge Capacity

Manning's formula was used to calculate the mean velocity and discharge capacity of each waterflow.

(2) Additional Openings and Embankment Height

1) Additional Openings

The hydrologic analysis for additional openings was conducted in two area of Kel. Pejagaran and Tugu, since the other areas are covered by the MASTERPLAN and have sufficient drainage facilities.

The basic conditions for this calculation were as follows:

- Box culvert	2.0 x 2.0 m
- Catchment area	0.34 km^2
- Slope of existing ground	0.1%
- Spring tide of Java Sea	P.P. + 1.15 m
- Installation height of box culvert	P.P. + 0.0 m

The calculation is shown in Appendix 9.2. As a result, it was found that the capacity of the culvert was sufficient and the back water accompanied with a head loss up-stream was calculated to be less than 12 cm.

The water level increase in the area is not a big problem since the fish ponds dikes are more than 15 cm high.

For the other small area to be drained along the Project Road pipe culverts are provided at the existing waterway and ditches as much as possible.

The drainage facilities for the Project Road are shown in Table 9.3.

2) Free Board

The edge of the throughway shoulder is recommended to be located 1.5 m above the water level based on the back water calculated above.

Fig. 9.4 River/Canal Related to the Project

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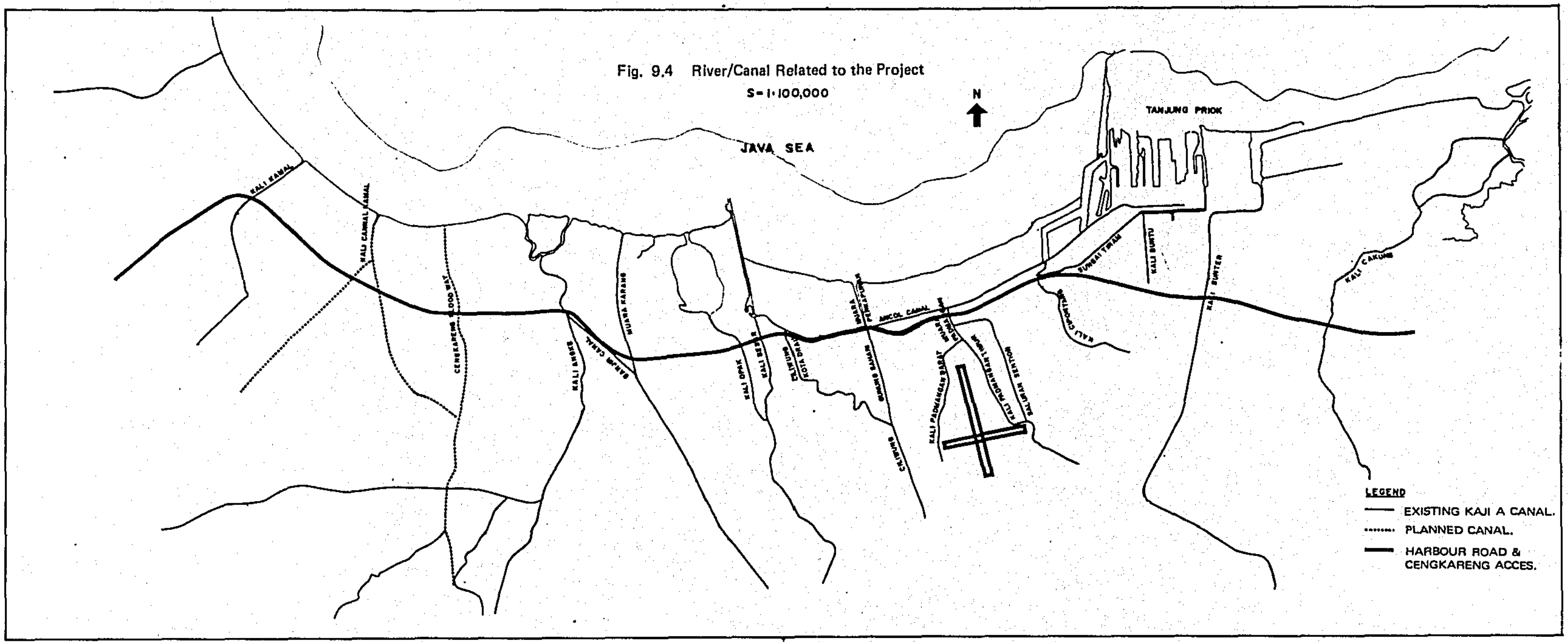
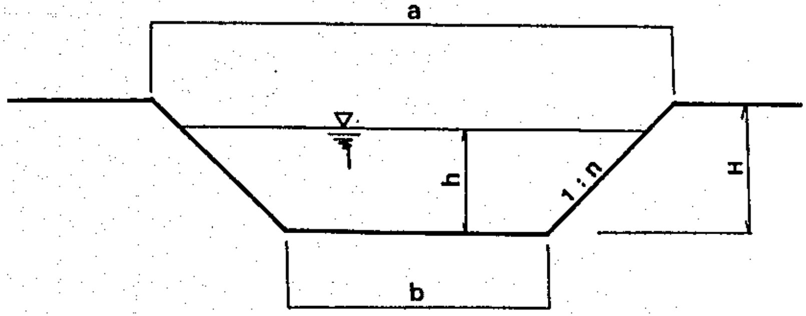


Fig. 9.5 Section of Planned Rivers

A－TYPE



B－TYPE

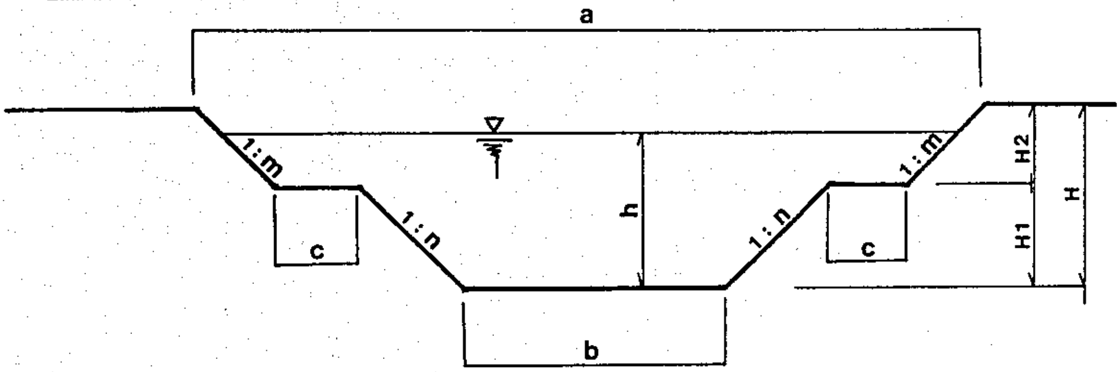


Table 9.4 List of Planned Rivers

STA	RIVER NAME	SECTION TYPE	a	b	c	H	H1	H2	h	n	m
12＋170	KALI ANGKE	A－TYPE	50.0	40.0	－	5 0	－	－	4.8	1	－
13＋760	MUARA KARANG	〃	60.0	40.0	－	4.0	－	－	3.2	2.5	－
16＋90	KALI OPAK	〃	20.0	9.5	－	3.5	－	－	3.5	1.5	－
16＋570	KALI BESAR	〃	36.0	20.0	－	2.0	－	－	2.0	4	－
17＋80	CILIWUNG KOTA DRAIN	〃	28 0	16.0	－	2.0	－	－	2.0	2	－
18＋88	CILIWUNG GUNUNG SAHARI	〃	38.0	18.0	－	2.5	－	－	2.2	2	－
20＋860	MUARA PADEMANGAN	〃	31.3	25.7	－	3.5	－	－	3.13	0.8	－
21＋600	SUNTER WEST DRAIN	〃	29.25	15.0	－	4.75	－	－	3.10	1.5	－
22＋730	KALI CIPONTANG OUT LET	〃	16.25	5.0	－	3.75	－	－	3.25	1.5	－
23＋860	IN LET Ⅱ	〃	17.45	7.5	－	3.31	－	－	3.31	1.5	－
26＋300	TERUSAN SUNTER DRAIN	B－TYPE	44.25	19.0	4.0	5.75	4.25	1.5	4.25	1.5	1.5
27＋550	—	A－TYPE	7.0	4.0	－	1.5	－	－	1.2	1	－
29＋110	KALI CAKUNG	〃	14.0	10.0	－	1.0	－	－	1.0	2	－

Table 9.3 List of Box/Pipe Culverts

Station	Type & Size of Structure	Remarks
(12+600)	BOX 2.0 x 2.0	Out of Project
(13+600)	BOX 2.0 x 2.0	
(14+000)	Ø1.000	
(14+400)	Ø1.000	
15+000	Ø1.000	
15+500	Ø1.000	
19+830	BOX 3@ 1.0 x 1.5	Pademangan Polder Out-let
21+900	BOX 2.0 x 2.0	
22+400	BOX 2.0 x 2.0	
23+600	Ø1.000	
24+250	Ø1.000	
25+800	Ø1.000	
27+800	Ø1.000	
28+400	Ø1.000	
28+900	Ø1.000	
29+745	BOX 3.0 x 3.0	
30+90	BOX 2.0 x 2.0	
30+995	BOX 3.0 x 3.0	

(3) Adjustment with "MASTERPLAN"

The MASTERPLAN should be implemented as soon as possible for the area. In the event it is not implemented in accordance with the Project, extra openings may be required. The schedule can therefore hopefully be adjusted by the related agencies.

It should be noted that the Sunter West and Pademangan Polder should be adjusted according to the alignment of the Project Road.

9.4 Preliminary Design

9.4.1 Throughway and Tg. Priok Access

(1) Description of the Project Road

The recommended route for Harbour Road including Cengkareng Access was designated in 8.3 of Chapter 8. The Cengkareng Access was omitted from the preliminary design due to the preparation of the detailed design by others. The general description for the Harbour Road is described by construction section as follows. That of Tg. Priok Access is not made due to the improvement plan.

Harbour Road

1) Section - I (Pluit - Kota)

The topography in this section is flat dry land and land use is a mixed area of Kampung, warehouse and industry.

Harbour Road starts at Jl. Jembatan Tiga, the east end of Cengkareng Access and passes through the redevelopment area in Kel. Penjaringan by embankment. Within the area three access (one bridge and two box culverts) and frontage roads are planned for the area.

At the end of the section, Kota West I.C. connects to Jl. Gedung Panjan.

2) Section - II (Kota - Ancol)

In this section the route passes over five rivers (Kali Opak, Besar, Ciliwung Kota Drain, Ancol Canal and Culiwung Gunung Sahari), four streets (Jl. Gedung Panjan, Tongkol, Kampung Bandan and Gunung Sahari Ancol) and two railway lines to Tg. Priok. Therefore, the route is planned as long viaduct and bridges for the entire stretch. It runs parallel to the western railway line from Jl. Gedung Panjan, passing over the Ancol Canal and ends to Ancol interchange.

3) Section - III (Ancol - Jakarta By-pass)

The area in this section is characterized by fish ponds and kampung.

The western half of the route is located close and parallelly to the Tg. Priok railway line and the eastern half of the route locates between the kampung and the industrial area in Kel Pepango/Kebon Bawang.

The route starts at Ancol Interchange passing through Sunter Interchange (West/East) and ends at Tg. Priok junction/interchange.

The frontage roads provide for the kampung in Kel. Pepango as well as bridge/culverts for regional traffic.

4) Section - IV (Jakarta By-pass - Cilincing)

The area is characterized by rice paddied and swampy areas. The route starts at the Jakarta By-pass passing the rice paddy area, just south of kampung in Kel. Tugu and ends at Jakarta Ring Road, just north of Cakung warehouse. It is planned to be embankment for the entire length.

(2) Required Number of Lanes

1) Harbour Road

Based on the analysis of throughway capacity, the number of lanes to be constructed by phase are shown as follows.

By 1990 Year

Case-1 & 2 - Four lanes except Seg.- 10 (STA. 19+750 - 21+340) and Seg.- 18

Case 3 - Four lanes except Seg.- 10 (STA. 19+750 - 21+340)

By 2000 Year

Case-1,2 & 3 - Four lanes for Seg.- 2 & 4

- Six lanes for the Sections from Kota East I.C. to Cilincing. (Seg.- 6, 9, 10, 13, 14, 17, 18 & 20)

The construction segments and sections are shown in Fig. 11.1.

2) Tg. Priok Access

The projected traffic volume by section is as shown below.

Unit: Veh./day

Year	Tg.Priok JC/IC - Jl.Melati	Jl. Melati - Jl. Enggano	Jl. Enggano - Jl.Raya Pelabuhan
1990	102,110	64,660	26,500
2000	123,370	110,120	52,290
2010	142,350	128,360	57,640

For the sections of Tg. Priok JC/IC - Jl. Enggano, the traffic volume will reach or exceed the 6-lanes capacity by the year 2000. A 6-lanes carriageway is constructed at the initial stage. For the year 2010, 8 lanes are required, however, due to the established buildings along the section it is not possible to expand the carriageway. The frontage road with total of four lanes is therefore expected to carry a portion of the excessive future traffic.

For the section of Jl. Enggano - Jl. Raya Pelabuhan, the traffic volume will not exceed 4-lane capacity. Therefore a 4-lane carriageway is sufficient up to the year 2010.

As the result, 6-lanes for the section of Tg. Priok JC/IC - Jl. Enggano and 4-lanes for the section of Jl. Enggano - Jl. Raya Pelabuhan are recommended.

(3) Horizontal Alignment

The horizontal alignment was determined considering the geometric design standards and the control points listed as follows:

Control Points for Horizontal Alignment

Section-I

- Remaining land between Kali Angke and the route
- Pluit JC
- Pluit industrial area
- Pluit transformer substation
- Transmission power line to Tg. Priok
- Space for Kota west IC ramp to western railway line

Section-II

- Space for Kota East IC (including frontage road) to western railway line
- Ancol canal
- Syphon structure of Ciliwung Gunung Sahari
- Existing intersection of Jl. Gunung Sahari Ancol - Jl. Martadinata
- Ancol IC.

Section-III

- Transformer substation of Tg. Priok railway line
- Close location parallel to Tg. Priok railway line
- Sunter IC. (West and East)

- Less influence to Sunter development project
- Boundary of kampung and industrial area in Kel. Pepango/ Kebon Bawang

Section-IV

- Pertamina (Oil station)
- South boundary of kampung in Kel. Rawa-Badak/Tugu
- Cakung warehouse

(4) Vertical Alignment

1) Harbour Road

The Preliminary Study for vertical alignment was made simultaneously with the study for horizontal alignment.

The hydrologic analysis and structure study were coordinated with the vertical alignment study.

Basic requirements controlling the engineering aspects of the vertical alignment study were as follows:

- In areas subject to flooding, the finished grade of the roadway is maintained 1.5 m above the water surface;
- Minimum gradient of 0.50% is adopted for roadway surface drainage;
- A combination of horizontal and vertical alignments is considered.

In addition to the basic requirements mentioned above, the following primary control points were considered for the determination of vertical alignment;

Section-I

- STA.14+600	Jl. Jembatan Tiga
- 14+840 15+185 15+720	Kel. Penjaringan Box culverts and Bridge

Section-II

- STA.16+20	Jl. Gedung Panjan
- 16+740	Jl. Tongkol
- 17+630	Jl. Kampung Bandan
- 17+970	Jl. Lodan
- 18+750	Jl. Kampung Bandan

- STA.18+830 Tg. Priok railway line
- 19+100 Tg. Priok railway line

Section-III

- STA.20+380 City planning road
- 20+400 Tg. Priok railway line
- 20+860 Kali Pademangan Barat/Timur
- 21+600 Future plan of Kali Saluran Sentiong
- 22+730 Kali Cipontang out-let
- 24+310 Box culvert
- 25+30 Bridge

Section-IV

- STA.26+230 Tg. Priok Access (Jakarta By-pass)
- 27+550 River
- 28+700 Cibinong freight new line
- 29+115 Kali Cakung
- 29+580 Jl. Tipak Cakung
- 31+930 Jakarta Ring Road

2) Tg. Priok Access

The horizontal alignment study was not conducted, since it is improvement work. For the vertical alignment it is preferable for the existing entrances, intersections and drainage systems to fit the planned alignment and the existing profile.

The planned vertical alignment, therefore, is designed to fit the existing profile as much as possible.

(5) Plan of Frontage Road

The Frontage roads (described in 8.2.2 Design Standard), on both sides of Harbour Road are constructed in this Project for the section, Jl Jembatan Tiga - Jl. Tongkol and STA 23+880 - 25+15.

The frontage roads of Tg. Priok Access will be constructed for the section between Tg. Priok JC/IC and Jl. Eggano. The frontage road between Jl. Enggano and Jl. Raya Pelabuhan is not provided due to non-existence of local roads.

(6) Comparison of Road Structure Types in Kel Penjaringan

The construction cost for the road structure of both embankment and viaduct type are compared. As a result, the embankment was found to be 84 percent cheaper than that of the viaduct as shown in detail in Appendix 9.3.

(7) Alternative Reclamation Plan for Ancol Canal

In connection with the Ancol Canal between Ciliwung Kota Drain and Ciliwung Gunung Sahari as described in 8.3.3.(2).2) Alternative Route Study, the information, indicating that the section of the Ancol Canal could be reclaimed, was obtained at the joint steering committee meeting held to review the Draft Final Report.

The study of the rough cost estimate thereon is discussed below:

Conditions for the reclamation plan:

- Section exists between Jl. Tongkol and Jl. Kampung Bandan (STA 18+840);
- Borrow material to be reclaimed instead of garbage;
- Existing streets and bridges maintained;
- Same unit cost applied as established in the Project; and
- One additional lane of existing streets to be expanded toward the canal.

As a result of this cost comparison (shown in Appendix 9.4), the reclamation plan is 9 percent cheaper than a plan for continuous viaduct.

(8) Coverage of the Project

The coverage of the Project is described as follows:

1) Facilities necessary for the Project itself

- Harbour Road: Jl. Jembatan Tiga ∿ Cilincing (STA 14+574 ∿ 31+930)
- Tg. Priok Access: Tg. Priok JC/IC ∿ Jl. Raya Pelabuhan (STA 0-440 ∿ 3+120)
- 6 Interchanges & 2 Junction/Interchanges

  Pluit IC, Kota IC (West, East)
  Ancol IC, Sunter IC (West, East)
  Tg. Priok JC/IC, Cilincing JC/IC

2) Facilities necessary for maintaining existing functions

- Harbour Road Bridges crossing over existing streets and rivers (See 9.7 in Chapter 9)

- Frontage road (See 9.4.1 - (5) in Chapter 9)
- Drainage facilities Box & Pipe Culvert, Ditches (See 9.3 in Chapter 9)
- Relocation of waterways and roads

3) <u>Specific facilities</u>

- Improvement of Jl. Raya Pluit Selatan

  The section between Kali Muara Karang and Jl. Jembatan Tiga should be improved as the access road for Pluit IC.

- Improvement of existing Intersection

  Existing intersections as described in 9.4.3 of the Main Report should be improved and expanded as shown in Vol.-III Drawings.

  The coverage and extensions to be improved are also shown on the Drawings.

- New streets in Sunter area

  The proposed streets running parallel to Tg. Priok railway line in Sunter area are excluded from the Project. A street established by DKI Jakarta between Jakarta Fair and Sunter is also excluded in the Project.

- Fly-over bridges on Tg. Priok Access

  Two fly-over bridges for the intersections of Jl. Melati and Enggano are included in the Project as shown on the intersection plans in the Drawings.

- Relocation of existing Facilities

  The relocation work for existing power transmission towers, street lighting poles and the oil pipe line as described in 9.6.2 are included in the Project as indicated in Table 10.3.

The construction cost of Tg. Priok Access, however, is excluded from the financial analysis of the Project, but included in the economic evaluation of the Project.

The facilities to be constructed in the Project are indicated by solid lines in the Drawings.

9.4.2 Junctions/Interchanges

In the Study junctions/interchanges including Cengkareng and Pluit junctions are studied. These are planned for the year 2010.

Cengkareng and Pluit junctions however are excluded in the Project cost.

(1) General Consideration for the Junction/Interchange Type

The factors considered in establishing the type of junction or interchange are as follows:

- Type of connecting road and its design speed;
- Characteristics of future intersecting traffic;
- Terrain conditions;
- Existing structure, building and land use;
- Safety and efficiency of traffic; and
- Cost.

The characteristics of an urban junction or interchange vary depending on the type of highways involved. For instance, at crossings with arterial streets, simple and compact forms, such as diamond or partial cloverleaf arrangements involving at-grade ramp terminals on the arterial street are suitable since speeds are relatively low and interrupted flow at other intersections is not uncommon.

Junctions for two tollways nearly always involve some directional or semi-directional ramps for the major turning movements. The layout of a junction for two tollways should be free of any restrictive weaving on the throughways.

Considering the conditions for Harbour Road, the following principles are adopted.

1) For Junctions

Harbour Road is located at the north end of the tollway network in DKI Jakarta and no extension to the north is expected. The following types of junctions are generally expected.

- "T" with directional and semi-directional ramps has an advantage for three leg connections.
- "Cloverleaf" with directional and semi-directional ramps is adopted for four-leg connection located in the outlying area.
- In special cases "Trumpet" is adopted, subject to the following conditions being satisfied:

° Location for tollgate is required;

° Traffic demand on minor rampway is within one-lane capacity of loop ramp.

In this case a design speed of 40 km/h is adopted since vehicles must stop at the tollgate.

2) For Interchange

- "Diamond" type is basically adopted if the traffic demand is within the capacity of the at-grade intersection.

- For Tollway Interchange "Trumpet" and "T" are adopted subject to the following conditions.

  ◦ Trumpet type is adopted when the traffic demand is within the capacity of a one-lane loop ramp.

  ◦ "T" type is adopted if the traffic demand exceeds the capacity of one-lane loop ramp.

- For Arterial Interchange

  If the traffic demand exceeds the capacity of an intersection with streets, other ramp arrangements, such as diamond type are considered.

(2) Preliminary Design of Junctions/Interchanges

The recommended type of JC/IC are shown in Fig. 9.6. The detailed study are as follows:

1) Cengkareng Junction

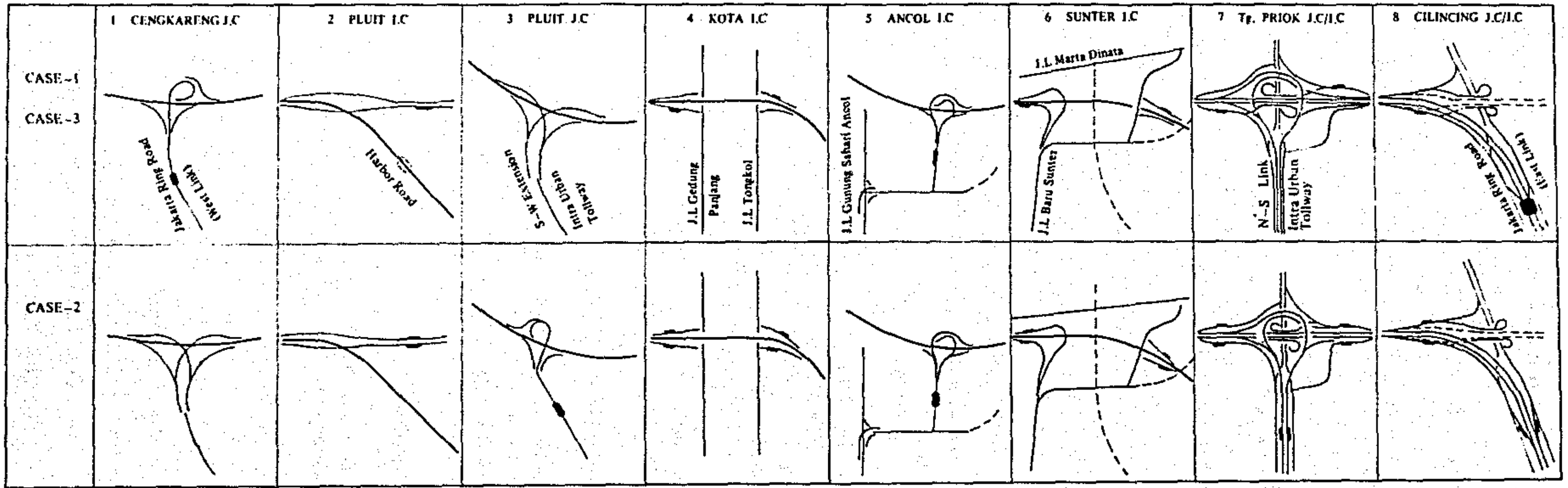
Cengkareng junction is located in Kel. Kanal Muara, and connects Cengkareng Access with the west arc of Jakarta Ring Road. As the result, trumpet type for case-1 & 3 and "T" type for case-2 are recommended.

(a) Type of Junction

The conditions to determine the type of this junction are summarized as follows:

- Terrain and Land use: Flat, rice paddy and fish pond area
- Number of legs : 3 legs
- Design speed
  - Jakarta Ring Road: 100 Km/h
  - Cengkareng Access: 80 Km/h
- Future traffic demand: veh/day in 2010 year

Fig. 9.6 Plan of Junction/Interchange



	Case-1	Case-2	Case-3
Total demand	30,370	62,230	31,570
To and from Pluit	30,370	55,230	31,570
To and from Cengkareng	0	7,000	0

The junction types were recommended as follows by cases.

Case-1 Trumpet type with tollgates

Case-2 "T" type

Case-3 Trumpet type with tollgates

(b) Detailed Location

There are few control points, since the area is rice paddy and fish pond. The junction location was determined considering the approach alignment of Jakarta Ring Road and the factors listed below:

- Minimum affect on the Kampung located along Jl. Kapuk Raya; and

- The approach alignment of Jakarta Ring Road to form a right-angle crossing with Jl. Kapuk Raya.

(c) Tollgates

Tollgates are located on the Jakarta Ring Road, just south of the junction as shown in Fig. 9.6.
The number of lanes required at the tollgate is presented in Table 9.6.

2) Pluit Junction

Pluit junction is located west of Kali Muara Karang, based on the Study of the S-W Arc Extension of Intra Urban Tollway made in Appendix 8.3. As the result, the recommended types are "T" type for case-1 & 3 and trumpet type for case-2.

(a) Type of Junction

The conditions to determine the junction type are listed as follows:

- Terrain & Land Use : Urban area, flat, fish pond area

- Number of legs : 3 legs

- Related roads

  Cenkareng Access : Tollway, 4 lanes
  80 km/h design speed

S-W Arc Extension of Intra Urban Tollway :	Tollway, 4 lanes 80 Km/h design speed

- Future traffic demand: Veh/day in 2010 year

	Case-1	Case-2	Case-3
Total demand	52,090	19,720	71,680
To and from Tj. Priok	33,840	5,217	23,680
To and from Cengkareng	18,250	14,502	48,000

The junction types were recommended as follows by cases.

Case-1	"T" type
Case-2	Trumpet type with tollgates
Case-3	"T" type

(b) Detailed Location

The detailed location of the junction was controlled as following points.

- Kali Muara Karang and Banjir Canal
- Effective land use of the area

(c) Tollgates

The tollgates are required for only case-2 and locates the south of the junction.

3) Pluit Interchange

The interchange serves the traffic to and from Cengkareng and connects with Jl. Jembatan Tiga. This will be used as the east end exit of Cengkareng Access. Prior to the construction of Pluit junction and Seg.- 2 the interchange should be constructed.

(a) Alternative Location

Two alternative locations are compared as follows:

- Alternative - A Wast of Kali Angke access to Jl. Pluit
- Alternative - B Wast of Pluit junction access to Jl. Jembatan Tiga

As the result, alternative-A was selected because the intersection with Jl. Jembatan Tiga could not manage the traffic without a fly-over which could not be located adjacent to Harbour Road, without any affect on the facilities, Pluit industrial area and transformer substation. The traffic analysis of the intersections for both alternatives are shown in 9.4.3 and in Appendix 9.6.

(b) Type of Interchange

A half diamond type is recommended, since the interchange serves the traffic to and from Cengkareng Access.

(c) Tollgates

The tollgates are required for every case on the access road shown in Fig. 9.6.

4) Kota Interchange (Kota West & East IC.)

The interchange was selected to be located based on the convenience of users in relation to long interchange interval of 4.2 km between Pluit JC. and Ancol IC. The type of interchange was recommended to be the split diamond type.

(a) Selection of Access Road

Between Jl. Jembatan Tiga and Jl. Gunung Sahari Ancol there are only two streets, one is Jl. Gedung Panjang and the other is Jl. Tongkol.

The merits and demerits of these two streets are compared for their suitability as an access road, as shown in Table 9.5. As a result, it is not possible to specify access to only one of either Jl. Gedung Panjang or Jl. Tongkol, for the following reasons:

- Service area within each street is highly concentrated.
- Although the existing Jl. Tongkol is a very minor street, it should be an important and a direct access to the CBD.

Therefore, it is recommended that these two streets be mutually connected by frontage roads based on traffic distribution.

(b) Interchange Type

Diamond interchange is recommended based on the following reasons:

- The function of the minor interchange
- Traffic capacity of the access roads
- Densely developed area
- Western Line of PJK run parallelly.

Table 9.5 Access Road Comparison for Kota Interchange

Item \ Jalan	Jl. Gedung Panjang	Jl. Tongkol
Street feature	4-lanes with median. Major arterial (Type-D W = 47 m) in future *	2-lanes with no median. Minor arterial (Type-G W = 30 m) in future *
Clearance for P.J.K.A West - Line	H = 5.0 m	H = 3.3 m
Adjacent Intersection	Jl. Pakin - 400 m Jl. Kopi - 350 m	Jl. Pakin - 350 m Jl. Kunib - 350 m
Distribution Efficiency	Higher street capacity and comparatively higher efficiency for traffic distribution.	Smaller street capacity and lower efficiency for traffic distribution.

Note : * Mark is based on DKI Jakarta Plan

(c) Plan of Related Intersection

The related intersections can be managed by the at-grade intersection analized in 9.4.3.

(d) Tollgates

The tollgates are required for the on-ramps of case-1 & 3 and for on/off-ramps of case-2 as shown in Fig. 9.6.

5) Ancol Interchange

The interchange is located in the area surrounded by Jl. Gunung Sahari Ancol and two railway lines to Tg. Priok. The interchange type was recommended as "T" type.

(a) Interchange Type

The conditions to determine the interchange type are listed as follows:

- Terrain & Land use : Urban area, flat, residential area
- Number of legs : 3 legs
- Related roads

  Harbour Road : Tollway, 6-lanes, 80 Km/h of design speed

Jl. Gunung Sahari Ancol:	Arterial street, 6 lanes, 60 Km/h of design speed
Jl. Trobosan Gunung Sahari-Martadinata:	Arterial street, Planned 6 lanes, 40 Km/h of design speed

- Future Traffic Demand: Veh/day in 2010 year

	Case 1	Case 2	Case 3
Total demand	31,200	60,263	32,700
To and from Tg. Priok	29,390	41,816	20,980
To and from Cengkareng	1,810	18,447	11,720

For the tollway interchange either "T" and trumpet type can be adopted. "T" type was recommended in order to minimize the dead spece between Harbour Road and Tg. Priok railway line, since the construction cost(including throughway bridge) for both types are almost the same.

(b) Interchange Location

The detailed interchange location was controlled by the following points and facilities.

- To take distance from the throughway crest as long as possible;
- To avoid an army complex; and
- To ensure the location of Pademangan Polder (water reservoir).

(c) Tollgates

The tollgates location is as shown in Fig. 9.6.

6) Sunter Interchange (Sunter West & East IC.)

The interchange should have an important role for the related projects and roads. These are Sunter development project, Jakarta Fair, Jl. Mantadinata and a city planning road as described in the Appendix 9.5.
It is also serves the traffic to and from Tanjung Priok.
The interchange type is recommended as a split diamond.

(a) Interchange Type

The conditions to determine the interchange type are listed below:

- Terrain & Land use : Urabn area, flat, fish pond but partially residential area

- Number of legs : 3 or 4 legs

- Related roads:

  Harbour Roads : Tollway, 6 lanes, 80 Km/h design speed

  Jl. Baru Sunter : Arterial street, 4 lanes, 40 Km/h.

  City Planning Road : Arterial street, 4 - 6 lanes, 40 - 60 Km/h.

- Future Traffic Demand : Veh/day in 2010 year

	Case 1	Case 2	Case 3
Total demand	32,000	28,873	30,890
To and from Cenkareng	25,130	20,870	23,390
To and from Cilincing	6,870	8,003	7,500

The type was also controlled by the following conditions:

- The direction of traffic to be served by the interchange and avoidance of a long detour;

- Limited space for rampway arrangement;

- Local service for Sunter and Jakarta Fair planned by others as the extension of main street of Sunter Project area; and

- The tollway connection and arterial connection provided separately.

The interchange type was therefore recommended to be a split diamond on the provision of a new arterial street connecting the tollway and local system. The western ramps connect with Jl. Baru Sunter and the eastern ramps connect with the new arterial street which is one of the direct access to Tg. Priok Port.

(b) Related Intersections

Four intersections on the new arterial street were analyzed in paragraph 9.4.3.

(c) Tollgate

The tollgate locations are shown in Fig. 9.6.

7) Tg. Priok Junction/Interchange

The junction/interchange is located in Kel. Kebon Bawang near PT. Pertamina Oil Station. It is necessary to provide connections for both the Harbour Road - N-S Link of Intra Urban Tollway and Harbour Road - Jakarta By-pass (Tg. Priok Access). The junction/interchange type is recommended to be the "T" plus partial cloverleaf with two intersections.

(a) Junction/Interchange Type

The conditions to determine the interchange type are listed as follows:

- Terrain & Land use : Urban area, flat, residential and industrial area
- Number of legs : 3 legs for junction, 4 legs for interchange
- Related roads :
  - Harbour Road : Tollway, 6-lanes, 80 Km/h design speed
  - N-S link of Jakarta Intra Urban Tollway : Tollway, 6-lanes, 80 Km/h design speed
  - Tg. Priok Access (Jakarta By-pass) : Arterial street 6-lanes, 60 Km/h design speed
- Future Traffic Demand : veh/day/in 2010 year

Junction	Case 1	Case 2	Case 3
Total demand	59,650	28,861	52,700
To and from Cenkareng	37,710	27,383	29,760
To and from Cilincing	21,940	1,478	22,940

Interchange	Case-1	Case-2	Case-3
Total demand	64,780	84,744	57,290
Cengkareng - Tg.Priok	19,460	20,174	20,830
Cengkareng - Halim	1,180	1,948	1,160
Cilincing - Tg.Priok	41,610	54,088	33,490
Cilincing - Halim	2,530	8,534	1,810

For the junction "T" type is adopted since the toll-ways form 3 branches and the service for the Tg. Priok Access is not necessary.

The interchange was 4 branch connections. Many types of interchanges, such as direct connection, turbine, cloverleaf and trumpet types, were considered for the study. The traffic to and from Tg. Priok Port is predominant since the traffic to and from the south is very small. The land available for the interchange/junction was limited according to the information from DKI Jakarta. Under these conditions, trumpet type was not selected due to land limitations and the direct connection and turbine type were also not selected due to the construction cost and design required for such traffic conditions. The cloverleaf was therefore selected for the interchange.

For the combination of the junction ("T" type) and the interchange (cloverleaf type) selected above the possibility of intersections applied to the ramp terminal with the Jakarta By-pass is studied. As a result of the traffic analysis two ramps could be treated with the at-grade intersections.

The final allocation is shown in Fig. 9.6. In Fig. 9.6, the ramp from Cilincing to the South is arranged around the Pertamina Oil Station according to the additional information from DKI Jakarta.

(b) Junction/Interchange Location

The detailed location was controlled by the following facilities:

- Pertamina Oil Station
- A intersection with Jl. Plumpang Semper
- Kali Sunter
- Electric substation of Gardu Induk Plumpang
- Toyota Mobirindo Factory
- Minimum effect on Kampung

(c) Tollgates

The tollgates for the interchange ramps are required to locate the west and east of the JC/IC for case-1 & 3 and barrier tollgates is located on the N-S Link of Intra Urban Tollway for case-2 as shown in Fig. 9.6.

8) Cilincing Junction/Interchange

Cilincing junction/interchange is located north of Cakung warehouse and connects with the east link of Jakarta Ring Road.

Harbour Road connects directly to Jakarta Ring Road. The interchange type recommended is a cloverleaf considering the possibility of extension eastward in the future.

(a) Junction/Interchange Type

The conditions evaluated to determine the junction/ interchange type are listed as follows:

- Terrain & Land use : Outlying area, flat, rice paddy area.

- Number of legs : 4 legs considering for the future extension to the east.

- Related roads

  Harbour Road : Tollway, 6-lanes, 80 Km/h design speed

  Jakarta Ring Road : Tollway, 6-lanes, 100 Km/h design speed

- Future Traffic Demand : Veh/day in 2010 year

For Junction	Case 1	Case 2	Case 3
Tg. Priok - Bekasi	58,440	52,429	40,900
For Interchange			
Total demand	132,500	108,934	143,870
Tg. Priok - Cakung	26,270	29,866	33,130
Tg. Priok - Cilincing	16,960	11,007	23,060
Bekasi - Cilincing	32,220	28,225	44,690
Cakung - Cilincing	57,050	39,836	42,990

The traffic between Tg. Priok and Bekasi is predominant compared to the other traffic demand. This traffic should be treated by the direct connection rather than semi-direct connection. A trumpet and "T" type are not suitable based on the need for the provision of future extension to the east and the point mentioned above.

The traffic demand of the interchange ramps are comparatively small the cloverleaf type is recommended considering the future extension to the east. At the initial stage two loop ramps will be constructed and the remaining ramps will be constructed in the future time.

(b) Detailed Location

The detailed location was controlled by the DKI land use plan and Cakung Warehouse.

(c) Tollgates

For case-1 & 3 one tollgate will be provided at on-ramp to the west and one barrier tollgate be located to the south of the junction/interchange.

For case-2 the tollgates are required to provide every on/off-ramp located to the west and south of the junction/interchange.

(3) Traffic Lanes at Tollgate

The number of traffic lanes to be provided at a tollgate was determined from the traffic volume (interval of arrival), the service time per vehicle, and also the service level provided (planned length of waiting queue).

The above factors were established based on the "Road Design Standard" Japan.

Basic Hourly Traffic Volume (D.H.V.)

D.H.V. = ADT x K x D

where,

ADT : Average Daily Traffic Volume

K : Peak Hour Rate = 9%

D : Single Direction Concentration of Traffic = 55%

Service Time Per Vehicle

For one entry (transit card) - 6 sec.
For one entry (single pay) - 8 sec.
For one exit (double pay) - 14 sec.

Service Level

Length of the average waiting queue - One vehicle

Number of Traffic Lanes Required at Toll Gate

Number of traffic lanes required for 2000 and 2010 year were calculated as shown in Table 9.6.

Table 9.6 Traffic Lanes at Tollgate

Junction/Interchange	Case-1		Case-2		Case-3	
	ON-Ramp	OFF-Ramp	ON-Ramp	OFF-Ramp	ON-Ramp	OFF-Ramp
Cengkareng J.C.	## 4 (7)	* 2 (4)	–	–	## 6 (7)	* 3 (4)
Pluit I.C.	# 6 (9)	–	* 4 (5)	# 5 (7)	# 4 (5)	–
Throughway Barrier	# 3 (6)	# 3 (6)	–	–	–	–
Pluit J.C.	–	–	* 2 (3)	## 4 (5)	–	–
Kota West Ramp	# 2 (2)	–	* 3 (3)	# 3 (4)	# 2 (2)	–
Kota East Ramp	# 4 (5)	–	* 4 (4)	# 4 (5)	# 4 (5)	–
Ancol I.C.	# 4 (5)	–	* 4 (6)	# 4 (8)	# 4 (5)	–
Sunter West Ramp	# 3 (4)	–	* 2 (3)	# 2 (3)	# 3 (4)	–
Sunter East Ramp	# 2 (2)	–	* 2 (2)	# 2 (2)	# 2 (2)	–
Tg. Priok J.C.	–	–	* 3 (3)	## 6 (7)	–	–
Tg. Priok West Ramp	# 3 (3)	–	* 3 (3)	# 4 (4)	# 3 (4)	–
Tg. Priok East Ramp	# 4 (6)	–	* 5 (6)	# 6 (8)	# 4 (5)	–
Cilincing J.C.	## 10 (12)	* 5 (6)	–	–	## 9 (9)	* 5 (5)
Cilincing West Ramp	# 5 (6)	–	* 4 (5)	# 5 (6)	# 5 (7)	–
Cilincing South Ramp	* 3 (4)	# 3 (5)	* 2 (3)	# 3 (4)	* 3 (5)	# 3 (6)

Note: * marks mean the gate for transit card.
marks mean the gate for single pay.
marks mean the gate for double pay.
– marks mean free pass or no tollgate
The figures in the brackets show the number of lanes required in the year of 2010 and the figures without brackets for the year of 2000.

.4.3 Intersections

(1) General

The urban tollway network is closely related to the urban street network. The intersections between the tollway network and the existing street network play an important role for both systems in order to handle smoothly the traffic.

Capacity, speed and safety on most urban arterial streets depends primarily on the number, type and spacing of the intersecting streets. The higher types of arterial streets have occasional grade separations or interchanges where they cross other heavily travelled arteries but for the most part, the layout and traffic control devices used for the intersections at-grade are the key elements for the safe and efficient operation of the arterial streets. Since intersections at-grade play such a vital part in the urban transportation system, the importance of their design and operation should not be under-estimated.

Capacity analysis is one of the most important considerations in the design of signal controlled intersections. The calculations of the capacity and the procedure adopted are in accordance with the recommendations of "Road Design Standard", Japan. The following are the basic elements for the capacity analysis.

The analysis was made for the year of 2000 as well as for the year 2010.

Basic Elements

- Traffic capacity per lane:

Through lanes	= 2,000 veh(PCU)/green hour
Right-turn and left-turn lanes	= 1,800 veh(PCU)/green hour

- Other elements:

Peak factor	= 9%
Percentage of heavy vehicles	= 8%
Rate of direction at peak hour	=55%

(2) Preliminary Design of Intersections

The related intersections with interchanges are analyzed and listed as follows:

Name of Intersection	Name of Intersecting Street
Pluit Intersection	Jl. Jembatan Tiga Jl. Raya Pluit Selatan Jl. Pluit
Kota West/East Inter-section	Jl. Gedung Panjang Jl. Tongkol
Ancol Intersection	Jl. Trobosan Gunung Sahari - Martadinata Jl. Gunung Sahari Ancol
Sunter West/East Inter-section	Jl. Baru Sunter City Planning Road (New Street)
Tg. Priok Access Inter-section	Jl. Melati Jl. Enggano Jl. Raya Pelabuhan
Tg. Priok JC/IC Ramp Intersection	Jakarta By-Pass Interchange Ramps

As a result all intersections can be treated by the signals analyzed in Appendix 9.6.

The improvement cost for streets intersection includes wherever widening is necessary to the end point of improvement.

Among the intersections analyzed, Ancol intersection with Jl. Gunung Sahari Ancol will be grade-separated by the year 2000. The other intersection can be treated as at-grade intersections by the year 2010.

The existing West Railway Line bridge on Jl. Tongkol will be expanded in compliance with the improvement of the intersection with Kota East ramps since the intersection is located close to the railway line.

A fly-over bridge with Jl. Enggano must be constructed in Phase-I as shown in the Drawing. According to the plan of Bina Marga and DKI Jakarta, the construction work (expansion to 4-lanes) will be conducted in the near future. The fly-over bridge will therefore be provided on the premise that the construction work for expansion and extension to the east is carried out by others prior to the construction of the fly-over bridge.

Among the intersections, four major intersections plan, Pluit, Ancol, Enggano and Melati, were made shown in Drawings.

9.4.4 Bridges and Structures

(1) General

The Consultant described the general concept adopted to determine bridge types and the studies conducted for the determination of the type of structures in 8.3.5 of Chapter 8.

In this section the description for specific bridges is made and the summary of the structural planning is presented. The bridge numbers are shown in Fig. 9.7.

(2) Description of Specific Bridges

1) Br-No. 1 (Jl. Jembatan Tiga) and No. 3 (Jl. Gedung Panjan)

The median available for the new bridge pier of Harbour Road exists on two streets. Based on the general concept, a PC hollow slab girder type of 25 m span length is selected.

Regarding the construction method a precast method with temporary erection girder is adopted in order to maintain the existing traffic during the erection.

2) Br-No. 3

(a) STA.16+000 - 17+100

The area is the most developed section in the total length of the Project Road. Many streets and rivers are traversed by the Project Road. The standard viaduct is adopted for the section with no control points mentioned before. The sections with control points are planned based on the general concept.

The steel pipe pile foundations of 35 m length are recommended since the section locates within the old Ciliwung River.

(b) STA.17+100 - 17+500

For this section the pile bent pier type is selected for the following reasons:

- Low height of pier (about 5 m) planned;
- Within the displacement allowance for earthquake; and
- Insignificant side appearance.

12 steel pipe piles are required for the standard section.

(c) STA.17+500 - 18+800

A slab type bridge is selected for this section, since the appearance from both sides of the tollway is important.

(d) Kota Gudang - Tg. Priok Railway Line (STA.18+900)

The span length of 60 m is required for the bridge. A PC continuous box girder type is selected and the erection is accomplished using the cantilever method.

(e) Kota - Tg. Priok Railway Line (STA.19+150)

A span length of 70 m is required for this bridge. A steel continuous box girder is selected contrary to the selection of a PC continuous box girder due to the control of Ancol interchange and the variation of the carriageway width.

3) Connection Railway Line (East Line - Tg. Priok Line, STA.20+400)

A PC T-beam type, 40 m span length and 60 degree skew angle, is adopted since the PC T-beam type is not suitable for an angle of less than 60 degree. The intersecting angle between Harbour Road and the railway is about 45 degrees.

A precast method with erection girders is selected to maintain the railway operation.

4) Ancol Interchange

A PC hollow slab girder type of 25 m span length is selected for the rampways passing over Harbour Road. The cylindrical column type pier is adopted except where the pier is located in the median of Harbour Road. The thin wall type is adopted for the pier in the median.

5) Tg. Priok Junction/Interchange

The steel girder type is superior to a concrete girder type due to the height of piers and small radii. The PC T-beam type of 40 m span length is selected for the parking area of Pertamina Oil Station.

(3) Summary of Bridges/Viaducts

The locations of planned bridges are shown in Fig. 9.7. The bridge list to be constructed in the Project is shown in Table 9.7.

Fig. 9.7 Location Map of Bridges

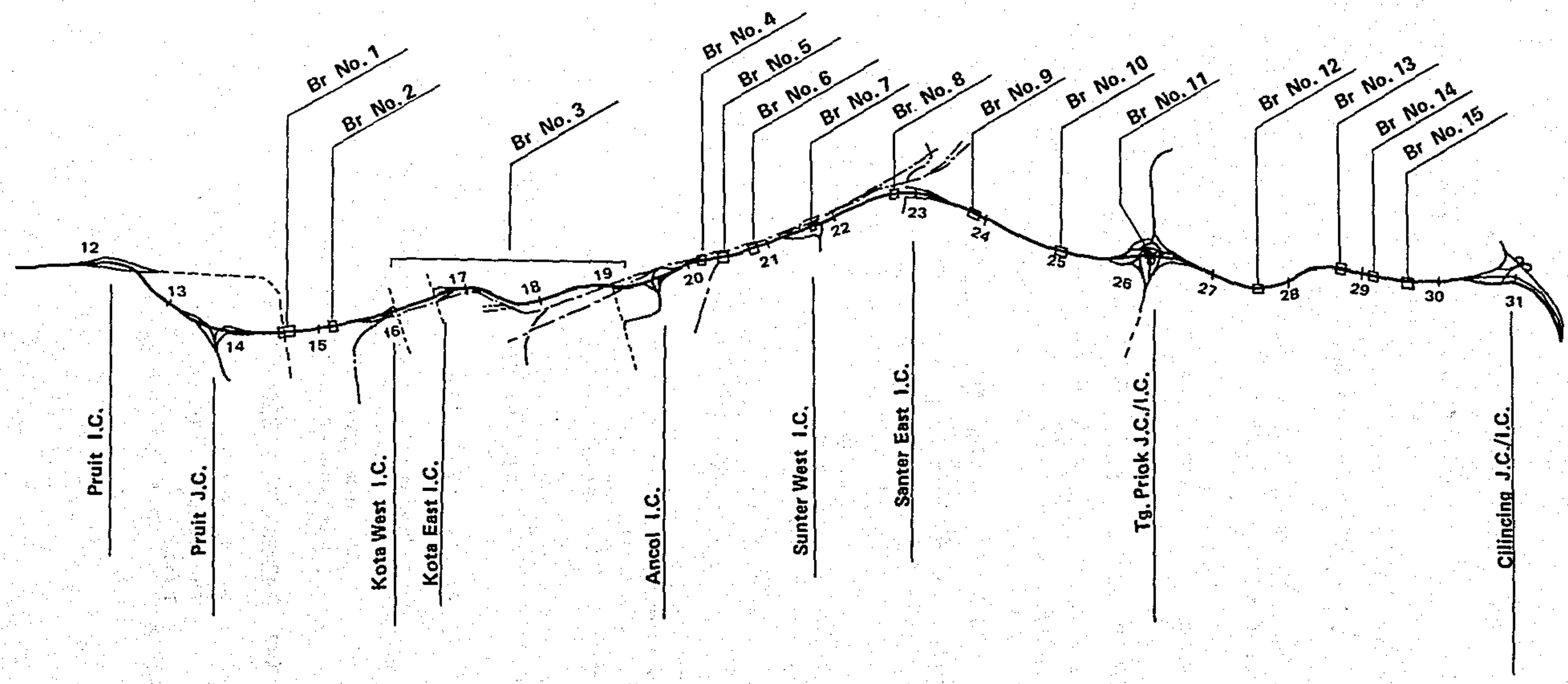


Table 9.7 List of Bridges

(1) THROUGHWAY BRIDGES

Bridge Number	Station	Name	Type	Bridge Length	No. of Lanes	Typical Span
	12+160 *	Kali Angle	P.C. T-beam	92 m	4	40 m
	13+760 *	Kali Muara Karang	P.C. T-beam	92	4	40
1	14+600	Jl. Jembatan Tiga	P.C. Slab	52	4	25
2	15+185		R.C. Slab	16	4	15
3	16+025	Jl. Gedung Panjang	P.C. Slab	52	4	25
	16+050 – 16+080		R.C. Slab	31	4	15
	16+095	Kali Opak	P.C. T-beam	21	4	20
	16+105 – 16+555		R.C. Slab	450	4	15
	16+570	Kali Besar	P.C. T-beam	21	4	20
	16+580 – 16+720		R.C. Slab	140	4	15
	16+735	Jl. Tongkol	P.C. Slab	26	4	25
	16+745 – 17+080		R.C. Slab	335	6	15
	17+095	Ciliwung Kota Drain	P.C. T-beam	26	6	25
	17+110 – 17+610		R.C. Slab	500	6	15
	17+620	Jl. Lodan	P.C. Slab	26	6	25
	17+635 – 17+960		R.C. Slab	325	6	15
	17+980	Jl. Ancol Barat	P.C. T-beam	41	6	40
	18+0 – 18+790		R.C. Slab	790	6	15
	18+800	Jl. Kampung Bandan	P.C. T-beam	41	6	40
	18+880	Railway	P.C. Box	141	6	60
	18+970 – 19+080		R.C. Slab	110	6	15
	19+150	Railway	Steel Box	171	6	70
4	20+185	City Plan Road	P.C. Slab	26	6	25
5	20+400	Railway	P.C. T-beam	41 m	6 m	40 m
6	20+850	Muara Padmangan	P.C. T-beam	52	6	20
7	21+600	Sunter West Drain	P.C. T-beam	52	6	20
8	22+730	Kali Cipontang Outlet	P.C. T-beam	52	6	20
9	23+865	Inlet No. 2	P.C. T-beam	27	6	15
10	25+025		P.C. T-beam	16	6	15
11	26+300		P.C. Slab	77	6	25
12	27+550		P.C. T-beam	16	6	15
13	28+695	Railway	P.C. T-beam	26	6	25
14	29+110	Kali Cakung	P.C. T-beam	16	6	15
15	29+575	Jl. Tipak Cakung	P.C. T-beam	16	6	15
		Outer Ring Road	P.C. Slab	77		25

(2) RAMPWAY BRIDGES

(a) PLUIT I.C.

Ramp	Type	Bridge Length	Width of Bridge	Typical Span
A	R.C. Slab	32 m	7.5 m	15 m
	P.C. T-Beam	93	7.5	40
B	R.C. Slab	78	7.5	15
	P.C. T-Beam	123	7.5	40
	P.C. Box	141	7.5	60

* means bridges excluding from the project.

(b) KOTA EAST I.C.

Ramp	Type	Bridge Length	Width of Bridge	Typical Span
A	R.C. Slab	243 m	5.0 m	15 m
	P.C. T-Beam	26	5.0	25
B	R.C. Slab	212	5.0	15
	R.C. Slab	11	5.0	10
	P.C. T-Beam	26	5.0	25

(c) ANCOL I.C.

Ramp	Type	Bridge Length	Width of Bridge	Typical Span
A	R.C. Slab	122 m	5.0 m	15 m
	P.C. Slab	52	5.0	25
C	R.C. Slab	138	7.5	15
	P.C. Slab	26	7.5	25
Access Road	R.C. Slab	32	10.5	15
	Steel Box	121	10.5	50

(d) SUNTER WEST I.C.

Ramp	Type	Bridge Length	Width of Bridge	Typical Span
A	R.C. Slab	260 m	5.0 m	15 m
	R.C. Slab	16	10.5	15
	P.C. T-Beam	62	5.0	40
B	R.C. Slab	93	5.0	15
	R.C. Slab	11	5.0	10
	P.C. T-Beam	21	5.0	20

(e) SUNTER EAST I.C.

Ramp	Type	Bridge Length	Width of Bridge	Typical Span
A	R.C. Slab	152 m	5.0 m	15 m
B	R.C. Slab	152	5.0	15
C	R.C. Slab	244	13.5	15
	P.C. Slab	52	13.5	25
	P.C. T-Beam	41	13.5	40

(f) Tg. PRIOK J.C. & I.C.

Ramp	Type	Bridge Length	Width of Bridge	Typical Span
A	R.C. Slab	336 m	8.0 m	15 m
	R.C. Slab	76	15.0~8.0	15
	P.C. Slab	26	8.0	25
	Steel Box	141	8.0	60
B	R.C. Slab	441	6.5	15
	R.C. Slab	32	6.5	10
	P.C. Slab	129	6.5	25
	P.C. T-Beam	26	6.5	25
C	R.C. Slab	442	8.0	15
	R.C. Slab	31	15.0~8.0	15
	R.C. Slab	11	8.0	10
	P.C. Slab	78	8.0	25

Ramp	Type	Bridge Length	Width of Bridge	Typical Span
C	P.C. T-Beam	82	8.0	40
	Steel Box	121	8.0	50
	Steel Box	141	8.0	60
D	R.C. Slab	243	6.5	15
F	R.C. Slab	47	5.0	15
	P.C. Slab	26	5.0	25
	P.C. T-Beam	26	5.0	25
G	R.C. Slab	63	5.0	15
	P.C. Slab	78	5.0	25
	P.C. T-Beam	26	5.0	25
H	R.C. Slab	62	7.5	15
	P.C. T-Beam	41	7.5	40
J	R.C. Slab	32	12.5	15
	P.C. Slab	26	7.5	25
	P.C. Slab	26	12.5	25
Tg. Priok Access Road				
A'	R.C. Slab	183	11.25	15
	P.C. Slab	52	11.25	25
B'	R.C. Slab	92	7.75	15
	P.C. T-Beam	82	7.75	40
	Steel Box	242	7.75	50
Street Bridge	P.C. T-Beam	41	16.0 x 2	40

(g) CILINCING J.C. & I.C.

Ramp	Type	Bridge Length	Width of Bridge	Typical Span
B	R.C. Slab	199 m	5.0 m	15 m
	R.C. Slab	16	10.5~9.7	15
	P.C. Slab	26	5.0	25
D	R.C. Slab	76	5.0	15
	R.C. Slab	61	10.5~7.5	15
F	R.C. Slab	32	7.5	15
	P.C. Slab	52	7.5	25
I	R.C. Slab	46	5.0	15
	R.C. Slab	61	7.5~10.5	15
J	R.C. Slab	46	5.0	15
	R.C. Slab	16	9.7~10.5	15
M	R.C. Slab	32	7.5	15
	R.C. Slab	32	7.5~8.9	15
	P.C. Slab	52	7.5	25
	P.C. Slab	52	7.5~8.9	25

(3) OTHER BRIDGES

Name	Type	Bridge Length	Width of Bridge	Typical Span
Street Br. on Pluit I.C. Access Road	P.C.T-Beam	52 m	7.50 m	20 m
Frontage Road Br.				
Kali Opak	P.C.T-Beam	21	10.0 x 2	20
Kali Besar	P.C.T-Beam	21	10.0 x 2	20
Re-construction of Railway Br. on JL. Tongkol	Steel Girder	52	Double Tracking	30

9.4.5 Pavement Design

(1) General

Pavement design was made according to the methodology as described in "AASHTO INTERIM GUIDE FOR DESIGN OF PAVEMENT STRUCTURES, 1972" and Bina Marga publication No. 04/PDBM/1974 as well as its modification in 1978.

The elements of design used are daily traffic volume, serviceability of the pavement, values of soil support and a regional factor. For concrete pavement, which is used only for toll plaza, the elements are daily traffic volume, composite Kc-value on the top of sub-base, working stress in concrete slab and serviceability of the pavement.

Pavement design was made separately for throughway, ramp and frontage road, Tg. Priok Access and toll plaza.

(2) Selection of Pavement Type

The type of pavement was determined by studying the comprehensive factors, such as roadbed and sub-soil conditions, meteorological conditions, economy and experience.

In this Project, the area was defined to be the soft ground with anticipated large and long-term settlements. The construction cost of the flexible pavement and rigid pavement for the initial stage were compared as shown in Appendix 9.7. As a result, the flexible pavement was found to be cheaper than the rigid pavement. Furthermore, the flexible pavement for highways is a more popular type than the others in Indonesia.

Considering these factors the pavement type therefore was determined to be the flexible pavement.

Rigid pavement, however, was adopted for the toll plaza due to many types of oil leaked from vehicles.

(3) Elements of Pavement Design

- Total equivalent 18-kip single axle loads are computed as follows:

Roadway	Design Period	
	10 Year	20 Year
Throughway	3,800,000	9,200,000
Ramp & Frontage Road	2,600,000	6,200,000
Tg. Priok Access	9,600,000	19,200,000
Toll Plaza	-	6,600,000

* 18-kip rate per 1,000 trucks was estimated as 387 for flexible pavement and 413 for rigid pavement based on the truck interview survey conducted in Nov. 1980.

- Soil support value 3.2
- Regional factor 2.5
- Serviceability index 2.5
- Composite Kc-value 160 psi
- Working stress in concrete slab 490 psi

(4) Recommended Pavement Structure

The pavement structure recommended are summarized in Table 9.8.

Table 9.8 Recommended Pavement Structure

Roadway	Throughway		Ramp & Frontage Road		Tg. Priok Access		Toll Plaza	
Design Period in Years	10	20	10	20	10	20	10	20
Required Structural Number	5.32	6.0	5.05	5.75	6.20	6.90	-	-
Concrete Surface	-	-	-	-	-	-	25	25
Asphalt Surface	-	5	-	5	-	5	-	-
Binder	-	-	-	-	5	5	-	-
Base	5	5	5	5	5	5	-	-
Asphalt Treated Base	25	25	25	25	25	25	-	-
Sandy Gravel Subbase	25	25	20	20	30	30	20	20
Total Thickness	55	60	50	55	65	70	45	45
Structure Number of Proposed Pavement	5.30	6.16	5.08	5.95	6.38	7.25	-	-

9.5 Tollway Facilities

9.5.1 Tollway Lighting

(1) General

The objective of the provision of lighting facilities is to reduce the number of traffic accidents occurring during the hours of darkness. In Jakarta, it will also make the tollways more attractive to potential users. Having regard for the predicted volume of traffic, the Consultant recommended that complete lighting facilities be provided for the tollway and its interchanges on Harbour Road.

The installation of lighting facilities for the tollway will be in accordance with the "Design Standard for Lighting Facilities:, established by the Ministry of Construction, Japan. Japanese Standards have been established after much experience with tollway lighting, and so a similar standard was proposed for the lighting facilities for the Project.

(2) Scope of Application

1) Locations for Lighting Installations

The provision of the lighting installations in this project is limited to the following locations.

- Throughways;
- Interchange rampways including toll plazas, and
- Tg. Priok Access Road.

2) Design Illumination Intensities

The average intensities of illumination used in the design of the installations are as follows:

- 15 lux for the throughways and Tg. Priok Access Road;
- 15 lux for the interchanges and rampways; and
- 50 lux for the toll plazas.

These average intensities of illumination can be obtained from high pressure sodium lamps, each 135 - 180 watts.

3) Selection of Lighting Equipment

The mounting position and height of luminaries is determined by the degree of road surface luminance required and the glare tolerated by drivers. In order to keep the level of glare low, the more powerful the light source, the higher it must generally be collected above the road surface. The height and spacing of the columns are clearly interdependent. The type of lighting columns recommended by the Consultant is shown below.

Location	Column Type	Slope Angle (degrees)
Throughways	12 m high tapered type with overhang	Under 5
Rampways	10 m high tapered type with overhang	- ditto -
Toll Plaza	20 m high "high mast lighting"*	-

* High mast lighting is recommended for the large toll-plazas having more than four booths, because glare is relatively small with this method and it is an economical way of lighting large areas.

9.5.2 Traffic Signs

Regulatory signs, warning signs and guide signs are essential to ensure traffic safety and are to be in accordance with Government Standards.

Guide signs convey information to assist drivers, such as destinations with directions and distances, service facilities, and route confirmation information. These signs will play a very important role in informing drivers in advance of the correct traffic lane for making an exit or entry at interchanges and of the location of tollgates. Gantry type signs may be required at certain locations.

9.5.3 Toll Plaza

(1) General

For the preliminary design of the tollgates a study of the necessary construction and furnishing equipment required for the facilities was made.

The location of the tollgates and the number of toll booths required on each rampway were determined and are as shown in Fig. 9.6 and Table 9.6.

The location of the tollgates and the number of toll booths required on each ramway were determined and are as shown in Fig. 9.6 and Table 9.6.

(2) Scope of Tollgate Works

Each tollgate consists of the work items shown below.

- Tollgate structure including columns and roof structure;
- Refuge booth construction;
- Toll booth construction; and
- Equipment installation in booths.
  (Signal, cash machine, fee indicator, speaker, detector)

The detectors are installed in order to check the number of cars (by class) passing through tollgates.

9.6 Relocation of Existing Facilities

9.6.1 General

The Consultant investigated existing utilities likely to be affected by the construction of the Harbour Road and Tg. Priok Access Road, such as the following:

- Power transmission pylons
- Power and communication lines
- Water supply/distribution lines
- Sanitary/storm sewers
- Special utility lines such as oil pipe lines
- Street lighting posts
- Traffic signals
- Existing traffic signs

Many of the facilities were confirmed on site. The Consultant however should inquire with the various Government agencies and other organizations about the accurate location of their utilities and their future development plans within or near the construction limits of the Project during the detailed design stage.

9.6.2 Relocation Works

(1) Power Transmission Pylons

The following pylons, 150 KV, will be relocated:

- STA 16 + 00
- North of Sunter East IC
- Within Cilincing JC/IC

(2) Street Lighting Columns

The existing lighting columns along the major streets are at 35 to 40 m intervals. These are relocated for the section traversed by the planned throughway and interchanges.

(3) Oil Pipe Line

The existing oil pipe line is located along the eastern edge of Tg. Priok Access carriageway from Jl. Enggano to Pertamina Oil Station. It composed of 4 lines, each of 280 mm diameter. Accompanying the extension of the carriageway and the frontage road, they should be relocated or protected suitably where they locate beneath the planned road. The relocation work should be planned in compliance with the regulations of the Government.

9.7 Preliminary Right-of-way Plan

9.7.1 General

The standards to be adopted for the right-of-way will not only be important for the design and operating conditions of the tollways, but will also have a great impact on the communities through which the road passes, their land tenure, investments access facilities, communications and social conditions. Fence should be provided to protect the tollway from illegal occupation and to maintain highway facilities.

The right-of-way width is not same by stations and varies with the embankment height and the speed change lanes at junctions and interchanges.

9.7.2 Preliminary Right-of-Way Plan

The width of right-of-way to be acquired for the Project Road is made based on the drawings of the scale 1:5,000 and is shown in Appendix 9.8.

This was made by the station of 500 m pitches plus some additional stations for the interchanges.

The right-of-way widths designed except interchanges are as follows:

Project Road	Designed Right-of-Way Width
Harbour Road	50 ∿ 80M
Tg. Priok Access	
Tg. Priok JC/IC - Jl. Enggano	51 ∿ 70
Jl. Enggano - Jl. Raya Pelabuhan	34 ∿ 51

9.7.3 Further Coordination

The Consultant established the right-of-way plan within the accuracy of the feasibility study. Further coordination should be made with the agencies and land owners concerned for the assumed items listed below:

Prior to the detailed design of the Project Road, the right-of-way design should be carried out.

The right-of-way design is carried out for determining the right-of-way by stations required for all tollway facilities, based on meetings with agencies concerned and on the provision of a topographic survey. After this the detailed design will be carried out.

(a) Coordination with Agencies concerned

- Future street plan
- Railway (crossing new and existing line)
- River, canal and polder (Ancol canal, Pademangan and Sunter west polder)
- Land use (Development of Kel. Penjaringan, Approved land use along the Project Road)

(b) Region and Land Owner

Frontage Road, Drainage, Compensation, etc.

CHAPTER 10

CONSTRUCTION AND MAINTENANCE/OPERATIONCOSTS

Chapter 10 CONSTRUCTION AND MAINTENANCE/OPERATION COSTS

10.1 General

The Consultant established a unit price for each construction item using basic cost elements such as labour, materials, equipment, overhead, profit etc. The unit prices were computed in accordance with the following criteria.

(1) The estimates were made based on the assumption that all construction works will be contracted to a general contractor by international tender.

(2) The unit prices were computed under the economic conditions prevailing in December, 1980.

(3) The costs were estimated for all alternatives and were classified into foreign currency (indicated in Rupiah) and local currency (indicated in Rupiah) portions.

Foreign currency and local currency components of each unit price were computed based on the following classification of basic cost elements.

The foreign currency component consists of the costs of:

- Imported equipment, materials and supplies;
- Domestic materials of which the country is a net importer;
- Wages of expatriate personnel; and
- Overhead and profit of foreign firms.

The local currency component includes the cost of:

- Domestic materials and supplies of which the country is a net exporter;
- Wages of local personnel;
- Overhead and profit of local firms; and
- Taxes.

(4) The unit price of each work item is obtained by adding the labour cost, equipment cost, material cost, etc. for the item, and the result is checked against recent actual figures for construction work in Indonesia.

(5) Major materials costs include the following items:- Fuel, reinforcing bars, prestressing bars, structural steel, fine aggregate, coarse aggregate, cement, asphalt and steel pipe pile.

(6) The Indonesian tax and duty on equipment and materials imported are also computed separately.

(7) Land acquisition and compensation were based on unit cost data obtained from DKI Jakarta.

(8) For all unit prices a constant allowance of 25% for overhead and profit was added to the direct unit prices.

(9) Physical contingency was assumed to be 15% of the total of construction cost, land acquisition and compensation cost.

(10) The final engineering, supervision fees and administration cost etc. were assumed to be 10% of the total of construction cost, and the breakdowns are as follows:

- Final Engineering; 4%
- Supervision, Administration: 6%

The rates of exchange used to convert the Indonesian Rupiah to Japanese Yen and US Dollar are Rp.628 = US $1.00 = Yen 210.

10.2 Unit Prices

10.2.1 Unit Costs of Materials

The unit cost data of material was collected. The costs of imported materials are based on the CIF Jakarta price whereas those of local materials are based on the market prices in Jakarta. The unit costs of the major material items are as shown in Table 10.1.

Table 10.1 Unit Cost of Major Materials

Unit: Rp.

Major Material	Unit	Unit Cost					
		F.C.	L.C.	Tax	Import Duty	L.C. Total	Subsidy
Fuel (Diesel Oil)	Lit	0	52.5	0	0	52.5	52.5
Reinforcing bar	Ton	58,750	137,083	39,167	0	176,250	0
Prestressing cable	Ton	650,000	0	0	16,250	16,250	0
Structural steel	Ton	900,000	0	0	22,500	22,500	0
Fine aggregate	Cu.M	4,083	1,750	1,167	0	2,917	0
Coarse aggregate	Cu.M	4,375	1,875	1,250	0	3,125	0
Cement	Sack	506	1,181	337	0	1,518	0
Asphalt	Ton	66,667	100,000	33,333	0	133,333	0
Steel pipe pile	Ton	307,250	0	0	16,170	16,170	0

10.2.2 Unit Costs of Labours

The unit labour cost is based on the actual cost prevailing in Jakarta. The following are the costs broken down by major labour classification.

Class I Supervisory Staff	600 Rp./hr.
General Foreman, Foreman, Heavy Equipment Operator, Survey Party Chief, Laboratory Supervisor	
Class II Highly Skilled	500 Rp./hr.
Mechanic, Lubrication Specialist, Parts Man, Grade Man, Electrician, Truck Driver (5 - 15 ton)	
Class III Skilled	400 Rp./hr.
Carpenter, Steel Worker, Mason Labour, Truck Driver (1/2 - 4 ton)	
Class IV Semi-Skilled	350 Rp./hr.
Heavy Labour, Mechanic Helper, Tire Repairman, Clerk	
Class V Unskilled	200 Rp./hr.
Common Labour	

The estimated labour rates include social benefits, insurance, travel costs, sick leave, etc. and are based on the rates provided by Building Information Center, DPU-DKI Jakarta.

10.2.3 Equipment Costs

An assessment of hourly equipment costs was made for the plant that would probably be used in the construction of the Project. These equipment rates are shown in Table 10.2.

That is, the estimated hourly direct costs are calculated based on the estimated CIF unit prices at Tanjung Priok and the operating costs (fuel, lubricant and other expenses) are based on the market prices in Jakarta.

10.3 Unit Cost for Work Items

The unit cost for work items is calculated from the material cost, labour cost, equipment cost, etc. taking into consideration the local conditions in Jakarta, and the unit costs are listed in Table 10.3.

Table 10.2 Equipment Direct Cost per Hour

Unit: in Rupiah

	EQUIPMENT	Direct Hourly Costs					
		F.C.	L.C.	TAX	IMPORT DUTY	L.C. TOTAL	SUBSIDY
1.	Bulldozer 15^t	14,866	5,797	78	2,488	8,363	945
2.	Bulldozer 21^t	22,056	8,309	78	3,691	12,078	1,260
3.	Convertible Excavator 0.7 m^3	11,068	3,934	39	2,158	6,131	630
4.	Clamshell 0.6 m^3	16,517	5,389	39	3,124	8,552	630
5.	Dump Truck 6^t	4,179	1,813	26	-	1,839	368
6.	Flat Bed Truck 6^t	3,190	1,496	26	-	1,522	368
7.	Flat Bed Truck w/2^t Craine	4,339	1,982	26	-	2,008	368
8.	Semi-Trailer Truck 35^t	15,985	6,471	104	3,027	9,602	1,575
9.	Concrete Pump Truck 45 m^3/hr	19,423	5,128	39	3,252	8,419	420
10.	Concrete Mixer Truck 1.6 m^3	5,346	1,992	26	1,137	3,155	315
11.	Water Tank Truck 5500 lit.	4,747	1,764	26	913	2,703	315
12.	Motor Grader 3.7 m	10,090	3,954	52	1,867	5,873	525
13.	Tandem Roller 8 - 10^t	7,354	3,033	33	1,360	4,426	263
14.	Macadam Roller 11 - 14^t	5,267	2,284	33	974	3,291	263
15.	Macadam Roller 8 - 10^t	4,900	2,152	33	906	3,091	263
16.	Tyre Roller 10 - 28^t	6,355	2,858	46	1,175	4,079	394
17.	Sheep's Foot Roller	17,765	6,565	33	3,578	10,176	263
18.	Vibratory Roller Hand Guide 0.5 - 0.6^t	1,556	519	13	288	820	-
19.	Rammer 60 - 100	2,905/Day	1,334/Day	26/Day	583/Day	1,943/Day	-
20.	Aggregate Spreader 2.5 m^3	18,929	6,608	26	3,801	10,435	210
21.	Stone Crushing Plant 40^t/hr.	80,554	15,734	26	10,305	26,065	-
22.	Concrete Plant 45 m^3/hr.	38,784	14,681	46	7,767	22,494	-
23.	Vibrating Screen 1.2 x 2.4	27,283	587	-	356	943	-
24.	Rod Vibrator	1,700/Day	618/Day	8/Day	442/Day	1,068/Day	-
25.	Asphalt Plant 100^t/hr.	165,542	97,414	195	30,543	128,152	44,100
26.	Asphalt Distributor 4000 lit.	13,655	5,052	26	2,903	7,981	315
27.	Asphalt Finisher 3 - 6 m	25,115	8,446	23	4,644	13,113	315
28.	Asphalt Kettle 7500 lit.	20,880/Day	4,463/Day	-	5,674/Day	10,137/Day	-
29.	Mechanical Broom	15,207	4,946	20	3,342	8,308	-
30.	Crawler Crane 127^t	77,142	32,938	104	17,474	50,516	1,575
31.	Truck Crane 10 - 11^t	9,899	3,694	39	1,976	5,709	473
32.	Portable Belt Conveyor 7 m	5,796/Day	2,140/Day	46/Day	1,163/Day	3,349/Day	-
33.	Portable Air Compressor 10.5 m^3/min.	30,818/Day	8,959/Day	43/Day	5,553/Day	14,555/Day	735
34.	Air Compressor 2.0 m^3/min.	10,317/Day	3,603/Day	43/Day	1,859/Day	5,505/Day	735
35.	Electric Generator 70 KVA	10,676/Day	3,684/Day	26/Day	2,600/Day	6,310/Day	473
36.	Electric Generator 35 KVA	8,505/Day	2,764/Day	20/Day	2,072/Day	4,856/Day	210
37.	Pile Driver 3.5^t	47,337	13,787	52	8,545	22,384	420
38.	Diesel Hammer 2.5^t	11,854	3,292	20	2,034	5,346	420
39.	Line Marker	5,416	1,524	7	1,151	2,682	157.5
40.	Welding Machine 300 A w/Diesel Engine	8,256/Day	2,392/Day	7/Day	1,602/Day	4,001/Day	157.5
41.	Grout Mixer 200 lit. x 2	4,827/Day	1,540/Day	-	893/Day	2,433/Day	-
42.	Grout Pump 15 - 30 lit./min.	4,713/Day	1,504/Day	-	872/Day	2,376/Day	-
43.	Concrete Finisher	17,270	7,848	52	3,797	11,697	1,260
44.	Concrete Spreader	20,126	8,902	52	4,425	13,379	1,260
45.	Concrete Cutter, Blade ø25cm	855/Day	1,149/Day	26/Day	598/Day	1,773/Day	-
46.	Water Pump, ø150	2,369/Day	584/Day	-	353/Day	937/Day	-

Table 10.3 Unit Cost for Work Items

Unit: in Rupiah

ITEM NO.	DESCRIPTION	UNIT	UNIT COST F.C	L.C	TAX	IMPORT DUTY	L.C. TOTAL	SUBSIDY
1.	Maintenance and Protection of Traffic	L.S.	-	-	-	-	-	-
2.	Mobilization	L.S.	-	-	-	-	-	-
3.	Clearing and Grubbing	SQ.M.	59	35	0.3	10	45.3	3.8
4.	Removal of Masonry of Concrete Structure	CU.M.	836	6,743	52	0	6,795	74
5.	Removal of Old Pavement	SQ.M.	861	457	4	110	571	56
6.	Relocation of Power Transmission Tower	EACH	38,165,000	26,715,500	7,633,000	-	34,348,500	-
7.	Relocation of Street Lighting Post	EACH	37,645	20,590	260	0	20,850	3,680
8.	Relocation of Oil Pipe Line	L.M.	16,098	10,036	3,254	691	13,981	214
9.	Sand Pile ∅400	L.M.	1,469	769	122	178	1,069	55
10.	Embankment with Borrow Material	CU.M.	3,373	1,867	19	115	2,001	237
11.	Excavation Disposal (A)	CU.M.	860	461	4	113	578	57
12.	Excavation Disposal (B)	CU.M.	624	342	3	74	419	44
13.	Granular Borrow (Sand Mat)	CU.M.	4,169	1,854	1,102	56	3,012	21
14.	R.C. Pipe Culvert D=400	L.M.	21,861	57,170	14,130	342	71,642	79
15.	R.C. Pipe Culvert D=600	L.M.	29,831	68,709	17,544	482	86,735	118
16.	R.C. Pipe Culvert D=1000	L.M.	46,804	102,360	26,001	1,055	129,416	248
17.	R.C. Box Culvert 2.0x2.0	L.M.	428,403	1,658,193	375,470	6,099	2,039,762	619
18.	R.C. Box Culvert 3@1.5 x 1.0	L.M.	487,728	1,786,855	405,188	9,354	2,201,397	1,046
19.	R.C. Box Culvert 3.0 x 3.0	L.M.	721,729	2,732,058	618,104	12,381	3,362,543	1,341
20.	R.C. Box Culvert 6.0 x 4.0	L.M.	930,379	3,123,950	710,091	23,899	3,857,940	2,574
21.	U-Ditch 300	L.M.	7,592	25,038	5,597	252	30,887	29
22.	U-Ditch 800	L.M.	21,575	61,908	13,918	949	76,775	111
23.	U-Ditch 1000	L.M.	29,119	79,566	17,915	1,383	98,864	160
24.	Catch Basin with Cover-A	EACH	22,587	75,908	16,847	614	93,369	73
25.	Catch Basin with Cover-B	EACH	56,364	176,756	39,130	1,754	217,640	217
26.	Subgrade Preparation	SQ.M.	120	99	0.7	22	121.7	7
27.	Subbase Course - B	CU.M.	5,240	3,277	24	189	3,490	321
28.	As. Treated Base Course	TON	9,312	7,856	1,498	640	9,994	788
29.	As. Concrete Surface & Binder	TON	14,729	9,721	2,231	980	12,932	711
30.	Cement Concrete Pavement	SQ.M.	4,964	7,009	1,342	491	8,842	66
31.	Bituminous Prime Coat	Lit	97	118	15	21	154	1
32.	Bituminous Tack Coat	Lit.	97	121	15	21	157	1
33.	Bituminous Seal Coat	Lit.	156	167	20	27	214	3
34.	Bridge & Viaduct	L.S.	-	-	-	-	-	-
35.	Retaining Wall H=4M	L.M.	460,475	1,279,591	265,190	25,385	1,570,166	532
36.	Retaining Wall H=6M	L.M.	836,936	2,169,952	438,396	51,887	2,660,235	833
37.	Stone Masonry	SQ.M.	9,527	10,255	2,658	890	13,803	138
38.	Slope Pitching	SQ.M.	1,428	6,392	618	5	7,015	18
39.	Strip Sodding	SQ.M.	16	87	2	0	89	2
40.	Guard Rail	L.M.	13,057	4,335	756	3,629	8,720	11
41.	Fence	L.M.	9,506	797	34	1,798	2,629	52
42.	Concrete Curb	L.M.	802	1,642	400	30	2,072	3
43.	Concrete Curb & Gutter	L.M.	1,492	2,357	630	58	3,045	6
44.	Road Sign - A	EACH	3,191	66,371	13,173	91	79,635	122
45.	Road Sign - B	EACH	7,696	1,151,196	229,922	197	1,381,315	36
46.	Road Sign - C	EACH	12,899	1,553,496	526,119	336	2,079,951	583
47.	Road Marking	SQ.M.	128	468	83	47	598	6
48.	Road Lighting	EACH	983,350	876,009	157,525	195,298	1,228,832	41
49.	Traffic Signal	EACH	7,499,896	1,780,127	349,781	1,538,505	3,668,413	36
50.	Toll Gate - A	EACH	65,052,650	20,872,920	4,983,580	14,417,050	40,273,550	9,200
51.	Toll Gate - B	EACH	57,828,650	19,241,520	4,802,980	10,805,050	34,849,550	9,200
52.	Operation and Maintenance Office/Facilities	L.S.	-	-	-	-	-	-
53.	Land Acquisition	L.S.	-	-	-	-	-	-
54.	Compensation	L.S.	-	-	-	-	-	-

10.4 Land Acquisition and Compensation Costs

The land acquisition and compensation costs are calculated based on the data on land prices obtained from DKI Jakarta and the costs were computed by road segments.

Land acquisition cost	25,000 Rp./m^2
Land compensation cost	
Parking lot	10,000 Rp./m^2
Residential area	25,000 Rp./m^2
Office, Factory area	25,000 Rp./m^2

10.5 Preliminary Construction Cost Estimates

The construction cost estimate were made for each alternative based on the quantities estimated in the preliminary design and on the unit prices for each work item. The costs are split into foreign and local currency components. The calculation method is summarized in Table 10.4 and a summary of the calculations for cases 1 through 3 is shown in Table 10.5.

The total project cost for Phase-I was estimated based on Dec. 1980 prices for the section from Jl. Jembatan Tiga to Cilincing including junctions and interchanges. The cost for junctions, Tg. Priok JC/IC and Cilincing JC/IC, was calculated to be half of the total cost.

Table 10.5 shows the cost excluding Tg. Priok Access and the total project cost for each of the cases is 230,872, 220,812 and 228,540 million Rupiah respectively. Foreign currency ratio compared with the total cost excluding land acquisition/compensation is as follows.

PROJECT COST FOR PHASE-I (IN 10^6 Rp.)

(Excluding Tg. Priok Access)

	F.C.	L.C.	Total	F.C. Ratio
Case - 1	91,588	84,140	175,728	52.1
Case - 2	86,957	80,795	167,752	51.8
Case - 3	90,973	83,239	174,212	52.2

The breakdown for the Tg. Priok Access is shown in Table 10.6. The cost including Tg. Priok Access is also shown in Table 10.7.

Phase-II Construction costs consisting of expansion of lanes, overlay and grade separation for at-grade intersections are shown below.

PHASE-II PROJECT COST (IN 10^6 Rp.)

F.C.	L.C.	Total	F.C. Ratio
6,121	7,317	13,438	45.5

The costs for each construction segment are shown in Appendix 10.2.

The cost for the alternative implementation schedule. Case-C, is the same amount as shown in Table 10.5 through 10.7 and the cost for the construction Section-I + II is easily obtained by adding the cost of Section-I and II.

Table 10.4 Estimation of Construction Cost

Item	Description	
I	General Earthwork Drainage Structures Pavement Bridge Structures Miscellaneous	Σ (Item 1 ∿ 2)*1) Σ (Item 3 ∿ 13) Σ (Item 14 ∿ 25) Σ (Item 26 ∿ 33) Σ (Item 34 ∿ 36) Σ (Item 37 ∿ 52)
II	Sub-total	Σ (Item 1 ∿ 52)
III	Overhead & Profit	(Item II) x 0.25
IV	Total Construction Cost	(Item II + III)
V	Final Engineering Supervision, Administration and Others	(Item IV) x 0.04 (Item IV) x 0.06
VI	Land Acquisition & Compensation	(Item 53) (Item 54)
VII	Contingencies	(Item IV + VI) x 1.15
	Total Project Amount	(Item IV + V + VI + VII)

Note: *) Detail of each item number is shown in Table 10.3.

Table 10.6 Cost for Tg. Priok Access (in Dec. 1980 Prices)

CASE-1 ∿ 3

Unit: 10^6 RP

DESCRIPTION	F.C.	L.C.	TAX	MPO & PPN	IMPORT DUTY	L.C. TOTAL	TOTAL COST
Seg 15 (Tg. Priok Access)	3,983	3,427	595	360	268	4,651	8,633
Overhead & Profit	996	857	149	90	67	1,163	2,158
Total	4,979	4,284	744	450	335	5,814	10,791
Final Engineering & Supervision	498	428	74	45	34	581	1,079
Land Acquisition & Compensation	0	7,535	0	0	0	7,535	7,535
Physical Contingency	747	1,773	112	118	50	2,053	2,800
Total	6,222	14,020	930	614	419	15,983	22,205

Table 10.5 Project Cost for Phase-1 Construction (in Dec. 1980 Prices) (Excluding TG. Priok Access)

(1) CASE-1

Unit: 10^6 RP

DESCRIPTION	F.C.	L.C.	TAX	MPO & PPN	IMPORT DUTY	L.C. TOTAL	TOTAL COST
Construction Section - I	5,680	4,133	699	473	498	5,803	11,483
Construction Section - II	22,578	11,453	1,875	1,616	1,357	16,301	38,879
Construction Section - III	15,778	11,539	2,015	1,320	1,181	16,055	31,833
Construction Section - IV	14,580	11,526	1,926	1,261	977	15,690	30,270
Sub-Total	58,616	38,651	6,515	4,670	4,013	53,849	112,465
Overhead & Profit	14,654	9,663	1,629	1,168	1,003	13,463	28,117
Total	73,270	48,314	8,144	5,838	5,016	67,312	140,582
Final Engineering & Supervision	7,327	4,831	815	584	502	6,731	14,058
Land Acquisition & Compensation	0	47,951	0	0	0	47,951	47,951
Physical Contingency	10,991	14,440	1,222	876	752	17,290	28,281
Total	91,588	115,536	10,181	7,298	6,270	139,284	230,872

(2) CASE-2

Unit: 10^6 RP

DESCRIPTION	F.C.	L.C.	TAX	MPO & PPN	IMPORT DUTY	L.C. TOTAL	TOTAL COST
Construction Section - I	5,865	4,217	717	486	525	5,945	11,810
Construction Section - II	19,096	9,668	1,603	1,367	1,188	13,826	32,922
Construction Section - III	15,971	11,496	2,045	1,328	1,302	16,171	32,142
Construction Section - IV	14,720	11,500	1,938	1,267	1,062	15,768	30,487
Sub-Total	55,652	36,881	6,303	4,448	4,077	51,709	107,361
Overhead & Profit	13,913	9,220	1,576	1,112	1,019	12,927	26,840
Total	69,565	46,101	7,879	5,560	5,096	64,636	134,201
Final Engineering & Supervision	6,957	4,610	788	556	510	6,464	13,420
Land Acquisition & Compensation	0	46,139	0	0	0	46,139	46,139
Physical Contingency	10,435	13,836	1,182	834	765	16,616	27,051
Total	86,957	110,686	9,849	6,950	6,370	133,855	220,812

(3) CASE-3

Unit: 10^6 RP

DESCRIPTION	F.C.	L.C.	TAX	MPO & PPN	IMPORT DUTY	L.C. TOTAL	TOTAL COST
Construction Section - I	5,381	3,882	675	447	496	5,500	10,881
Construction Section - II	22,560	11,443	1,875	1,615	1,354	16,287	38,847
Construction Section - III	15,778	11,538	2,014	1,320	1,181	16,053	31,831
Construction Section - IV	14,502	11,303	1,882	1,246	1,001	15,432	29,934
Sub-Total	58,221	38,166	6,446	4,628	4,032	53,272	111,493
Overhead & Profit	14,555	9,542	1,612	1,157	1,008	13,319	27,874
Total	72,776	47,708	8,058	5,785	5,040	66,591	139,367
Final Engineering & Supervision	7,278	4,771	806	579	504	6,659	13,937
Land Acquisition & Compensation	0	47,244	0	0	0	47,244	47,244
Physical Contingency	10,916	14,243	1,209	868	756	17,076	27,992
Total	90,970	113,966	10,073	7,232	6,300	137,570	228,540

Note: Tax is for the makers and MPO & PPN is for the contractors.

Table 10.7 Project Cost for Phase-1 Construction (in Dec. 1980 Prices) (Including TG. Priok Access)

(1) CASE-1

Unit: 10^6 RP

DESCRIPTION	F.C.	L.C.	TAX	MPO & PPN	IMPORT DUTY	L.C. TOTAL	TOTAL COST
Construction Section - I	5,680	4,133	699	473	498	5,803	11,483
Construction Section - II	22,578	11,453	1,875	1,616	1,357	16,301	38,879
Construction Section - III	15,778	11,539	2,015	1,320	1,181	16,055	31,833
Construction Section - IV	18,562	14,953	2,522	1,622	1,245	20,342	38,904
Sub-Total	62,598	42,078	7,111	5,031	4,281	58,501	121,099
Overhead & Profit	15,650	10,520	1,778	1,258	1,070	14,625	30,275
Total	78,248	52,598	8,889	6,289	5,351	73,126	151,374
Final Engineering & Supervision	7,825	5,260	889	629	535	7,313	15,137
Land Acquisition & Compensation	0	55,486	0	0	0	55,486	55,486
Physical Contingency	11,737	16,213	1,333	943	803	19,292	31,029
Total	97,810	129,557	11,111	7,861	6,689	155,217	253,027

(2) CASE-2

Unit: 10^6 RP

DESCRIPTION	F.C.	L.C.	TAX	MPO & PPN	IMPORT DUTY	L.C. TOTAL	TOTAL COST
Construction Section - I	5,865	4,217	717	486	525	5,945	11,810
Construction Section - II	19,096	9,668	1,603	1,367	1,188	13,826	32,922
Construction Section - III	15,971	11,496	2,045	1,328	1,302	16,171	32,142
Construction Section - IV	18,702	14,927	2,533	1,627	1,330	20,418	39,120
Sub-Total	59,634	40,308	6,898	4,808	4,345	56,359	115,993
Overhead & Profit	14,909	10,077	1,725	1,202	1,086	14,090	28,999
Total	74,543	50,385	8,623	6,010	5,431	70,449	144,992
Final Engineering & Supervision	7,454	5,039	862	601	543	7,045	14,499
Land Acquisition & Compensation	0	53,745	0	0	0	53,745	53,745
Physical Contingency	11,181	15,620	1,293	902	815	18,630	29,811
Total	93,178	124,789	10,778	7,513	6,790	149,869	243,047

(3) CASE-3

Unit: 10^6 RP

DESCRIPTION	F.C.	L.C.	TAX	MPO & PPN	IMPORT DUTY	L.C. TOTAL	TOTAL COST
Construction Section - I	5,381	3,882	675	447	496	5,500	10,881
Construction Section - II	22,560	11,443	1,875	1,615	1,354	16,287	38,847
Construction Section - III	15,778	11,538	2,014	1,320	1,181	16,053	31,831
Construction Section - IV	18,485	14,730	2,478	1,606	1,268	20,082	38,567
Sub-Total	62,204	41,593	7,042	4,988	4,299	57,922	120,126
Overhead & Profit	15,551	10,398	1,761	1,247	1,075	14,481	30,032
Total	77,755	51,991	8,803	6,235	5,374	72,403	150,157
Final Engineering & Supervision	7,775	5,199	880	624	537	7,240	15,015
Land Acquisition & Compensation	0	54,810	0	0	0	54,810	54,810
Physical Contingency	11,663	16,020	1,320	935	806	19,081	30,744
Total	97,193	128,020	11,003	7,794	6,717	153,534	250,727

10.6 Maintenance & Operation Costs

10.6.1 Maintenance Costs

Maintenance has been defined as "the preserving and keeping of each type of roadway, roadside, structure, and facility as nearly as possible in its original condition as constructed or as subsequently improved, and the operation of road facilities and services to provide satisfactory and safe transportation".

For the Harbour Road, the maintenance costs and the operation costs as a tollway are considered separately. The road maintenance cost is estimated for the following items.

- Road Maintenance Cost
  - Maintenance
    - Electricity Cost (1)
    - Cleaning Cost (2)
  - Repairs - Repair Cost (3)

(1) Electricity Cost

This includes the cost of electricity for lighting and other facilities and services.

(2) Cleaning Cost

This includes the cost of cleaning the road surface, drainage facilities, guard rails, regulatory signs and other services.

(3) Repair Cost

This includes the cost of road surface repairs, overlays, painting of bridges and guard rails etc. inspection of structures, expansion joint repairs and inspection and repair of electric and traffic control facilities.

Existing data on Jagorawi Expressway, past data on the Japanese Metropolitan Expressway and Hanshin Expressway have been used as reference to establish the unit costs in Rupiah, as shown in Table 10.8.

Table 10.8 Road Maintenance Costs per Km per Year

Unit: Rp/Km/Year

Item	Unit	Unit Cost per Km/Year
1) Electricity Cost	Road Length	$7,345 \times 10^3$ Rp.
2) Cleaning Cost	Road Length	$8,233 \times 10^3$ Rp.
3) Repair Cost	Road Length	$30,244 \times 10^3$ Rp.
Total		$45,822 \times 10^3$ Rp.

Notes: 1) The pavement is assumed to be 6 lanes of asphalt concrete which also includes the road surface of bridges.

2) The length of ramps is converted into an equivalent length of 6 lanes of throughway.

3) Maintenance costs for arterials streets are excluded from the total amount.

The maintenance cost for the Harbour Road was calculated to be 1,059 x 10^6 Rp. per year. This was used for all alternatives (case-1 through 3), since the difference in the costs between the cases was negligible.

10.6.2 Operation Costs

The staff required for operation of the tollway are described in Chapter 7. The number needed for alternative cases is summarized in Table 10.9. It should be noted that the site staff for the maintenance work calculated in the previous paragraph is not included in the operation costs, but the office staff is included in these costs.

The cost of purchasing the centralized information and traffic control system described in Chapter 7 is not included in the operation costs. The cost of purchasing vehicles needed for the maintenance and operation of the tollway is excluded in the costs and this will be provided by the operating body.

The annual operation costs in 1980 prices for each alternative case are summarized in Table 10.10.

Table 10.9 Tollway Operation Staff

Staff	Case-1	Case-2	Case-3
A. Toll Booth Staff			
Chief	168	336	156
Collector	210	420	195
B. Operation Office			
Head	1	1	1
Deputy	1	1	1
Chief	5	5	5
Deputy Chief	6	6	6
Sub-chief	5	5	5
Staff	33	33	33
Driver	9	9	9
C. Maintenance Office			
Head	1	1	1
Deputy	1	1	1
Chief	3	3	3
Deputy Chief	5	5	5
Staff	14	14	14
Driver	5	5	5
Total Staff	467	845	440

Table 10.10 Annual Operation Costs in 1980 Prices for Alternative Cases

Alternatives	Unit : x 10^6 Rp./Year
Case-1	941
Case-2	1,636
Case-3	794

CHAPTER 11

IMPLEMENTATION PLAN

Chapter 11 IMPLEMENTATION PLAN

11.1 General

Directorate General of Highways (Bina Marga) will be Government Agency responsible for the execution of the Project.

To complete the construction, it is assumed that the Government will engaged the contractor by international bidding. For the implementation of the Project, the stage construction (Phase-I and II) is adopted and three alternative construction schedules were considered for the Phase-I construction.

11.2 Construction Schedule

11.2.1 Construction Division

In the case of simultaneous construction of the Project Road, it will be impossible to contract the construction work as one single construction section, considering the volume of earthwork and total construction cost which greatly affects the duration of the Project. This will also be controlled by the size of general financial package applied by the international financing agencies. For the convenience of preparing the detailed implementation schedule and construction cost estimates in the engineering stage, the Project Road was divided into four construction sections as shown in Table 11.1 and in Fig. 11.1.

11.2.2 Stage Construction

The construction of the tollway requires a very large investment due to various design requirements. For this reason and to obtain maximum economic benefit it is desirable to consider stage construction instead of completing the final scheme from the initial stage. Stage construction will be considered in such categories as the number of traffic lanes, pavement and grade-separation of at-grade intersection.

(1) Phase-I Construction

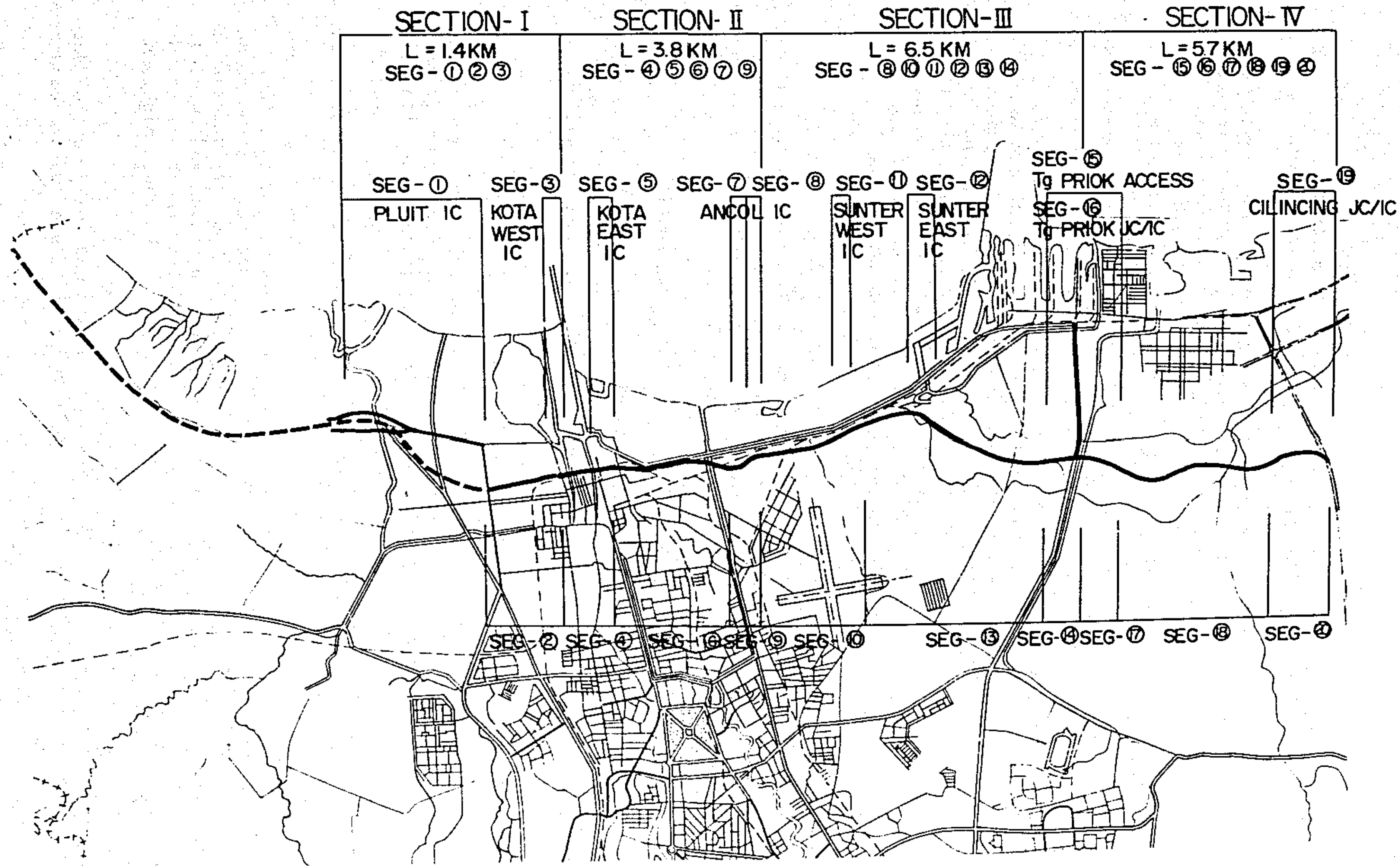
Three alternative construction schedules (Case-A, B and C) were studied for the Phase-I construction. For Case-A and B four construction sections were considered based on traffic demand, efficiency of developing the sorrounding area, construction cost, difficulty of land acquisition, construction progress for the other roads and traffic congestion on existing roads.

For Case-C, three construction sections (I + II, III and IV) are considered.

Table 11.1 List of Segments and Sections

Construction Section	Segment	Total Road Construction Cost in 1980 Prices (x 10^6 Rp)	Quantity of Borrow (m^3)
I	1 (Pluit IC)	6,964	94,930
	2 (Jl. Jembatan Tiga - Jl. Gedung Panjang)	6,085	208,650
	3 (Kota West IC)	1,306	10,210
II	4 (Jl. Gedung Panjang - Kota East IC)	12,892	2,430
	5 (Kota East IC)	2,959	13,350
	6 (Kota East IC - STA.19+250)	30,048	-
	7 (Ancol IC West Ramps)	1,265	35,620
	9 (STA.19+250 - 19+750)	1,435	67,510
III	8 (Ancol IC East Ramps)	4,616	89,370
	10 (STA.19+750 - 22+70)	12,106	444,060
	11 (Sunter West IC)	3,629	100,770
	12 (Sunter East IC)	5,092	104,640
	13 (STA.22+70 - 25+600)	13,053	440,020
	14 (STA.25+600 - 26+214)	1,294	51,840
IV	15 (Tg.Priok Access)	10,792	33,040
	16 (Tg.Priok Access JC/IC)	22,944	293,950
	17 (STA.26+214 - 27+00)	3,441	56,160
	18 (STA.27+00 - 30+400)	11,859	441,250
	19 (Cilincing JC/IC)	13,164	497,150
	20 (STA.30+400 - 31+930)	4,484	151,470

Fig. 11.1 Construction Segments & Sections



The priority for construction sections is III, I, IV II for Case-A and B and III, I + II, IV for Case-C.

Phase-I construction will be completed for the entire length of the Project Road by the year 1990 (Case-A), 1993 (Case-B) and 1990 (Case-C).

(2) Phase-II Construction

Phase-II construction will be completed by the year 2000.

1) Traffic Lanes

As described in Chapter 9, the section from Kota East IC. nose to the end of the Project Road except segments, STA.19+750 - 21+340 & Seg.18 will be expanded to 6 lanes by the year 2000. The segments, STA.19+750 - 21+340 and Seg.-18 will be 6 lanes in the Phase-I construction. The bridges/viaducts are constructed for the ultimate stage in the Phase-I Construction.

2) Pavement

In the analysis of stage construction for the pavement, studies were presented in Chapter 9. It is proposed that the 5 cm surface course of asphalt concrete should be overlaid by the year 2000.

3) Grade Separation of At-Grade Intersection

By 2000 year only Ancol intersection with Jl. Gunung Sahari Ancol will be grade separated. A fly-over bridge directed from the south to the interchange will be constructed.

11.2.3 Implementation Plan

Prior to the construction it will be necessary to carry out such pre-construction preparatory works as topographic survey, soils investigation, detailed design, land acquisition, and financial procurement.

The minimum period required for such preparatory procedures is estimated to be 36 months.

The detailed design will take about eighteen to twenty-four months. During the period required for land acquisition to be completed negotiations on financial procurement are successful and the contract for construction can be approved and awarded. Mobilization for construction can begin after the contract is awarded. It is assumed this process will take about eighteen to twenty-four months.

The construction period for each section was analyzed considering annual working days (see Appendix 11.1) and average construction speed of each work time. The construction periods are shown in Figs. 11.2 through 11.5 and those of Section-I, II, III and IV were estimated to be 2.5, 3, 3 and 4 years and 3 years for Section-(I + II).

The construction schedule of case-A through case-C are shown in Fig. 11.2 through 11.4.

For each case the periods required for detailed design, land acquisition (except the period of pre-negotiation) and construction are same, and the detailed design/pre-negotiation will be started at the same time for all construction sections.

Case-A is an alternative schedule provided by the Government and outlined as follows:

- Detailed design started in the middle of the year of 1982;

- Construction to be completed in 1990; and

- Large investment required in a short term.

Case-B is an alternative schedule characterized by the diversified investment and outlined as follows:

- Detailed design to be started in 1983;

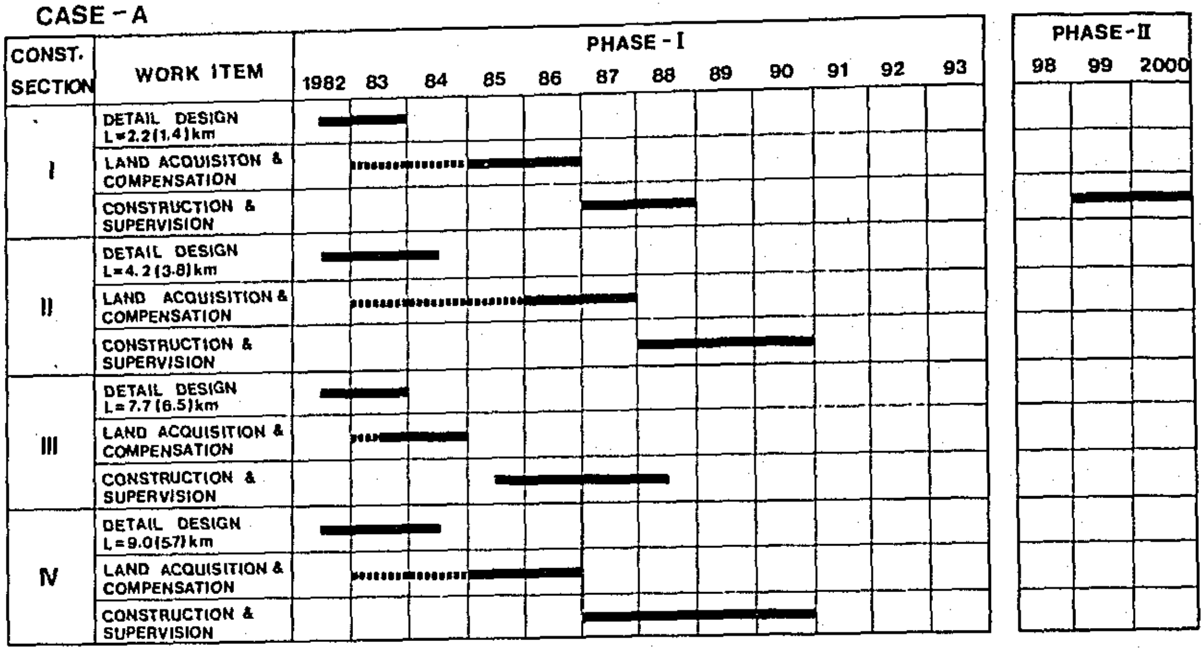
- Construction to be completed in 1993; and

- Maximum two construction sections to be executed at the same time.

Case-C is an alternative schedule that combines construction Section I with II and has the same characteristics as Case-A.

Fig. 11.2 Implementation Schedule

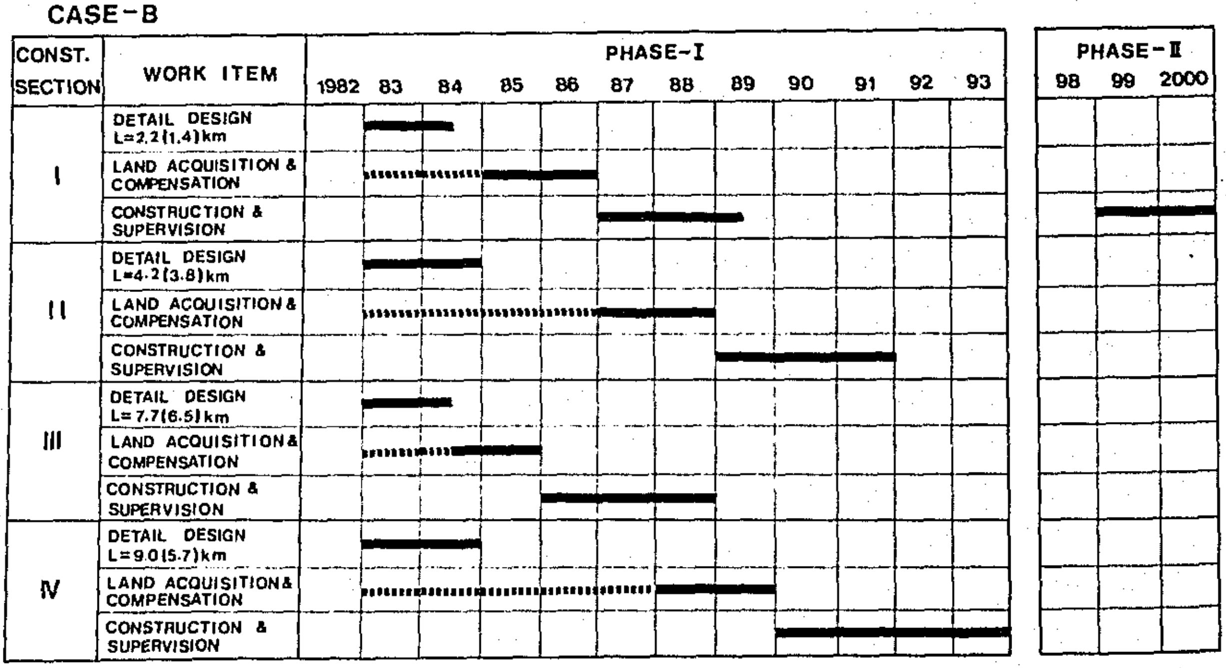
CASE - A



Note: The figures in brackets show the length of the section and the figures without brackt show the converted length of the section including rampways.

Fig. 11.3 Implementation Schedule

CASE - B



Note: The figures in brackets show the length of the section and the figures without brackt show the converted length of the section including rampways.

Fig. 11.4 Implementation Schedule

CASE - C

CONST. SECTION	WORK ITEM	PHASE-I 1982	83	84	85	86	87	88	89	90	91	92	93	PHASE-II 98	99	2000
I + II	DETAIL DESIGN L=6.4(5.2)km															
	LAND ACQUISITION & COMPENSATION															
	CONSTRUCTION & SUPERVISION															
III	DETAIL DESIGN L=7.7(6.5)km															
	LAND ACQUISITION & COMPENSATION															
	CONSTRUCTION & SUPERVISION															
IV	DETAIL DESIGN L=9.0(5.7)km															
	LAND ACQUISITION & COMPENSATION															
	CONSTRUCTION & SUPERVISION															

Note: The figures in brackets show the length of the section and the figures without brackt show the converted length of the section including rampways.

Fig. 11.5 Schedule for Construction Section

CONSTRUCTION SECTION - I
L=1.4 km (2.2)

Seg.①②③

MAIN WORKS	QUANT.	Schedule (bar labels, M.)	PRODUCTION RATE PER MONTH
MOVE ON SITE	-	2	-
CLEARING AND GRUBBING R/W	47,910 M^2	1	47,910
RELOCATION OF OBSTACLES	L.S.	6	-
EMBANKMENT WITH BORROW	313,790 M^3	5, 2	44,830
SUBGRADE PREPARATION	63,420 M^2	1, 0.5	42,280
SUBBASE COURSE	23,410 M^3	2, 1.5	6,690
AS.TREATED BASE	52,690 Ton	3, 2	10,540
A. C. BINDER	11,550 Ton	1.5, 1	4,620
CONCRETE PAVEMENT	1,980 M^2	1	1,980
BREDGES	L.S.	6	-
MISCELLANIOUS	L.S.	1, 6	-
FINISH ROADWAY	-	3	-

CONSTRUCTION SECTION-II
L=3.8(4.2) km

Seg. ④⑤⑥⑦⑨

MAIN WORKS	QUANT.	Schedule (F.YEAR / YEAR, months 2 4 6 8 10)	PRODUCTION RATE PER MONTH
MOVE ON SITE	-	2	-
CLEARING AND GRUBBING R/W	10,852 M^2	1	10,852
RELOCATION OF OBSTACLES	L.S	3	-
EMBANKMENT WITH BORROW	118,910 M^3	3, 2	23,782
SUBGRADE PREPARATION	27,250 M^2	0.6, 0.5	27,250
SUBBASE COURSE	8,500 M^3	1, 0.5	5,667
AS. TREATED BASE	20,830 Ton	1.5, 1	8,332
A. C. BINDER	4,240 Ton	1, 0.5	2,827
CONCRETE PAVEMENT	990 M^2	0.5	1,980
BREDGES	L.S	30	-
MISCELLANIOUS	L.S	2, 8	-
FINISH ROADWAY	-	3	-

CONSTRUCTION SECTION-III
L=6.5(7.7) km

Seg. ⑧⑩⑪⑫⑬⑭

MAIN WORKS	QUANT.	Schedule (F.YEAR / YEAR, months 2 4 6 8 10)	PRODUCTION RATE PER MONTH
MOVE ON SITE	-	2	-
CLEARING AND GRUBBING R/W	125,840 M^2	1	125,840
RELOCATION OF OBSTACLES	L.S	3	-
EMBANKMENT WITH BORROW	1,230,700 M^3	17, 2	64,774
SUBGRADE PREPARATION	183,570 M^2	3, 1	45,893
SUBBASE COURSE	41,960 M^3	4, 2	6,993
AS. TREATED BASE	107,400 Ton	7, 4	9,764
A. C. BINDER	20,170 Ton	3, 1	5,043
CONCRETE PAVEMENT	2,340 M^2	1	2,340
BREDGES	L.S	14	-
MISCELLANIOUS	L.S	6	-
FINISH ROADWAY	-	3	-

CONSTRUCTION SECTION -IV

L=5.7 km (9.0)

Seg. ⑮ ⑯ ⑰ ⑱ ⑲ ⑳

MAIN WORKS	QUANT.	Schedule (bar durations, months)	PRODUCTION RATE PER MONTH
MOVE ON SITE	-	2	-
CLEARING AND GRUBBING R/W	281,680 M^2	2	140,840
RELOCATION OF OBSTACLES	L.S	6, 6	-
EMBANKMENT WITH BORROW	1,473,020 M^3	24, 2	56,655
SUBGRADE PREPARATION	321,800 M^2	3, 2	64,360
SUBBASE COURSE	85,290 M^3	6, 3	9,477
AS. TREATED BASE	191,320 Ton	10, 5	12,755
A. C. BINDER	50,350 Ton	5, 2	7,193
CONCRETE PAVEMENT	2,760 M^2	1	2,760
BREDGES	L.S	10, 18	-
MISCELLANIOUS	L.S	2, 3, 12	-
FINISH ROADWAY	-	3	-

Time scale: F. YEAR / YEAR; months 2 4 6 8 10 (repeated for five years)

CHAPTER 12

ECONOMIC AND FINANCIAL EVALUATION

Chapter 12 ECONOMIC AND FINANCIAL EVALUATION

12.1 Economic Cost and Benefit Analyses

The economic evaluation is to determine whether this project will contribute to the over-all economy of Indonesia based on a comparison of costs and benefits. Although costs represent commitments and consumption of resources (including labour) for the implementation of the project, transfer payments such as taxes and subsidies are not included in the economic cost, since these elements are more institutional than economic attributes. The effects of transfer payments have already been taken into consideration for the financial evaluation of the total financial costs of the project which was presented in Section 10.5.

12.1.1 Economic Costs of the Project

(1) Cost Breakdown

The method of defining economic cost is as follows: The total project costs consisting of land acquisition, construction work and final engineering/supervision services were broken-down and divided into the costs for materials, equipment, labour, overhead/profit and physical contingency components.

In addition, each component was subdivided into the local and foreign portions, and the tax elements for the respective portions were abstracted and the subsidy elements were added. Investment costs for Tg. Priok Access has been included in the economic Project costs.

A summary of these proportions is presented in Table 12.1 along with the subdivided cost elements for the alternative cases of a toll levy system, namely case 1, 2 and 3.

(2) Construction Schedule and Economic Costs

The construction schedule for the Project has been reviewed in Chapter 11, section 11.2, where construction division and stage construction are discussed.

Eventually, the entire length of the Project Road will be divided into four (4) sections and two construction phases will be staged. Based on these analyses two alternative construction plans were considered: Case-A open to traffic in 1991 and Case-B open in 1994.

Case-A requires a larger amount of capital investment than Case-B in the early days of the construction period. Therefore, the adoption of Case-A gives severe circumstances related to the economic feasibility of the Project.

Table 12.1 Economic Cost Breakdown of the Project

(Unit: 10^6 RP.)

Case 1

	F/C	L/C	Taxes	Subsidy	Economic Costs
1. Construction Costs	62,601	42,079	16,422	1,660	106,340
2. Overhead & Profit	15,649	10,520	4,106	415	26,584
3. Final Engineering	3,130	2,104	821	83	5,317
4. Const. Supervision	4,694	3,156	1,231	124	7,974
5. Land Acquisition	0	38,489	0	0	38,489
6. Compensation	0	16,997	0	0	16,997
7. Physical Contingency	11,737	16,213	3,453	311	28,261
8. Total	97,811	129,556	28,262	2,594	229,962

Note: F/C = Foreign component
L/C = Local component

Case 2

	F/C	L/C	Taxes	Subsidy	Economic Costs
1. Construction Costs	59,634	40,308	16,051	1,595	101,537
2. Overhead & Profit	14,908	10,077	4,013	399	25,384
3. Final Engineering	2,982	2,015	803	79	5,076
4. Const. Supervision	4,473	3,023	1,204	119	7,615
5. Land Acquisition	0	37,411	0	0	37,411
6. Compensation	0	16,333	0	0	16,333
7. Physical Contingency	11,182	15,620	3,372	299	27,101
8. Total	93,179	124,787	25,445	2,492	220,458

Case 3

	F/C	L/C	Taxes	Subsidy	Economic Costs
1. Construction Costs	62,203	41,593	16,329	1,634	105,430
2. Overhead & Profit	15,551	10,398	4,083	409	26,358
3. Final Engineering	3,110	2,080	816	82	5,272
4. Const. Supervision	4,666	3,120	1,224	123	7,909
5. Land Acquisition	0	38,214	0	0	38,214
6. Compensation	0	16,596	0	0	16,596
7. Physical Contingency	11,663	16,020	3,432	306	27,989
8. Total	97,193	128,021	25,884	2,551	227,765

Based on this condition for the Project, the total economic investment costs are allocated for the years of construction schedule Case-A.

The costs entailed for the Phase-II construction are incorporated into the maintenance costs in the years 1999 and 2000. Furthermore, construction costs which are estimated for the improvement of Tg. Priok Access during the construction period of Section IV are also included in this economic analysis.

The yearly investment costs required are presented in Tables 12.7 through 12.9 together with yearly economic benefits.

12.1.2 Benefit Measurement

(1) General

Measuring the economic benefits for transport projects is usually much more difficult than measuring their economic costs. There are a number of reasons for this. First, some benefits, even though quite direct - such as the increased comfort and convenience from an improved road - are difficult to express in monetary terms since there are usually no market prices for such benefits. Second, monetary benefits, such as reduced transport costs, affect a great number of people over a long period of time, requiring difficult long-range forecasts. Third, many benefits are indirect, such as the stimulation to the economy from improved transportation: For these benefits to materialize, investments in fields other than transport are frequently necessary.

The most important benefits from transport projects include: (1) reduced operating expenses initially to the users of the new facility and also usually to those who continue to use the existing facilities; (2) lower maintenance costs; (3) fewer accidents and less damage to goods; (4) savings in time for both passengers and freight; (5) increased comfort, convenience and reliability; and (6) stimulation of economic development. Not all of these benefits result from any one single project, and their respective importance differs from project to project. At the present state, those listed near the beginning can frequently be measured in monetary terms more easily than the others.

Considering the data available and the certainty of the benefit which is most likely to be attributed to the Project, that is to say the economic cost savings in vehicle operation costs and time cost of the Harbour Road users, are measured in monetary terms in this Study.

Those who continue to drive the existing road are also beneficiaries, because those who will use the Project Road will reduce the traffic congestion on their original route. However, beneficiaries of the Project are only confined to the Project Road users in this Study.

(2) Vehicle Operating Costs

The vehicle operating costs are calculated for a representative sedan, bus and truck based on the experimental data for vehicles travelling on access controlled paved roads and on normal paved arterial streets at different speeds as well as the survey results for various cost items.

1) Elements of Vehicle Operating Costs

Vehicle operating costs are assumed to consist of "running costs" and "standing costs" for the vehicle.

The term "running costs" are the total of the cost items affected by travel kilometers and times, and "standing costs" are the costs attributable to owning the vehicles. These terms are further detailed into the following cost elements:

(a) Running costs

- fuel consumption
- engine oil consumption
- tyre wear
- maintenance parts and labour costs
- crew costs for commercial vehicles, and
- vehicle depreciation

(b) Standing costs

- interest
- insurance
- overhead and profit

Regarding the above cost components for vehicle operation, interviews with dealers in Jakarta were conducted and the current market prices in September, 1980 were obtained.

2) Representative Types of Vehicles

For the calculation of vehicle operating costs, representative types of vehicles found in Jakarta were selected for analysis.

(a) Sedan

In 1978, about 33 percent of all sedans produced in Indonesia were Toyotas. So, as a representative sedan a medium size Toyota car was chosen:

Medium Type (2000 cc class): TOYOTA CORONA

(b) Bus

Commercial vehicles in Jakarta such as buses and trucks are mainly those with diesel engines and therefore for the representative bus, the Mercedes Benz D 306 was chosen.

(c) Truck

For the representative truck, the diesel powered Mercedes Benz LP 911 with a 5-ton loading capacity was selected.

3) Economic Unit Prices of Vehicle Operating Costs

(a) Vehicle

The current market prices in September, 1980 were determined based on interviews with dealers in Jakarta. In Indonesia, the import duty was changed in 1977 for locally assembled CKD (Completely Knocked Down) vehicles and is now 100% and 0% of the CKD price for sedans and commercial vehicles respectively.

Taking into account further taxes such as M.P.O., sales tax and corporate taxes it is assumed that the average tax portion of the market price is 57.3% for sedans. The tax component for commercial vehicles was obtained directly from dealers. The tax portion of the market price is 6.2% and 10.2% for Buses and Trucks respectively.

(b) Tyre

Taxes of PPN and MPO amount to 7% and a total tax portion, including import duty on tyre materials, is assumed to be 19.4% of the market prices.

(c) Fuel and Oil

Oil prices were increased from May 1980. All the petroleum products marketed inside Indonesia are produced and supplied by PERTAMINA.

Before the increase, it was estimated that the tax component for gasoline was about 45% and diesel was subsidized.

No data base so far has been disclosed regarding the costs or profits of the various petroleum products currently produced by PERTAMINA, and therefore it is extremely difficult to clarify the real economic price of those commodities. On the other hand, a market fuel price of Rp.150 seems very close to the international market price and it is therefore assumed that the economic fuel price is considered to be equal to the market price.

(d) Wages

Wages for each type of job were found by direct inquiry with drivers, maintenance labourers etc.

As shown in the following calculations, it is found that the income tax is small.

- Tax on monthly income of drivers and maintenance labourers.

  Assumption : Taxpayer has a wife and three children.

  Case of Bus Driver

- Monthly gross wages	Rp.120,000
- Reduction according to Article 5 paragraph (2) 10% x Rp.120,000	Rp. 12,000
- Sub-total	Rp.108,000
- Deduction of tax free income according to Article 5 paragraph (8) 1st and 2nd:	
- for taxpayer himself	Rp. 20,000
- for wife	Rp. 20,000
- for three children	Rp. 30,000
- Sub-total	Rp. 70,000
- Monthly balance of taxable income	Rp. 38,000
- Yeraly taxable income 12 x 38,000	Rp.456,000
- The annual income tax for the balance of taxable income of Rp.456,000	Rp. 24,960
- Monthly income tax due	Rp. 2,080
- Monthly tax rate 2,080/120,000 =	1.7%

Economic costs and market prices for the vehicle operating cost elements are compared and summarized in Table 12.2

Table 12.2 Unit Prices and Values

Unit: Rp.

Price of Vehicle (Excluding Tyre)	Financial Price	Economic Price
(Depreciable Value of Vehicle)		
Passenger Car:TOYOTA CORONA 2000 cc	11,725,000	5,003,640
Bus:MERCEDES BENZ D 306	28,806,000	27,024,516
Truck:MERCEDES BENZ 911/42	17,396,000	15,624,516

Price of One Tyre	Financial Price	Economic Price
Passenger Car TOYOTA CORONA 2000 cc (6.45-13)	28,000	22,568
Bus MERCEDES BENZ D 306 (8.25-20)	102,000	82,212
Truck MERCEDES BENZ 911/42 (8.25-20)	102,000	82,212

Fuel and Engine Oil Price (Per Liter)	Financial Price	Economic Price
Gasoline	150	150
Diesel Oil	52.5	105
Engine Oil for Passenger Car & Motorcycle	1,350	1,080
Engine Oil for Bus & Truck	650	520

Time Values (Wage) (Per Hour)	Financial Price	Economic Price
Maintenance Labour	550	550
Driver (Bus)	860	860
Driver (Truck)	500	500
Conductor (Bus)	250	250
Assistant (Truck)	200	200

* Source: Interviews with Dealer in Jakarta, September 1980.

4) Vehicle Operating Cost on a Tollway

In this section the various operating cost items are individually expressed in terms of a vehicle's average running speed in order that costs at different speeds on the Level Tangent Road can be derived.

Usually a tollway is designed to high standards and operated with fully controlled access. Compared with urban arterial streets, vehicles on the tollway can travel more smoothly because of less severe changes of alignment. More important, because of access control and grade separation, tollway vehicles seldom need to stop and re-start.

(a) Fuel Consumption Rate

In this report, most of the data for the fuel consumption rates comes from several experimental surveys in the world including Japan, and from "Quantification of Road User Saving", the paper by Mr. Jan de Weille, and also from "Economic Analysis of Highways" by Rabley Winfery.

Based on the above data, several correlation equations are derived and these were partially amended both in the lower speed and higher speed ranges to take account of the average life of vehicles in Jakarta. The fuel consumption equations adopted in this Study are presented in Appendix 12.4.a.

The fuel consumption rates and the financial and economic costs of fuel consumption are shown in Appendix 12.5 and 12.6.

(b) Engine Oil Consumption, Tyre Wear and Maintenance Costs

The same data sources as above were used for estimating engine oil consumption rates and tyre wear. The correlation equations adopted are shown in Appendix 12.4 b and c.

Maintenance costs consist of the parts cost and labour wages. The correlation equations which were adopted are shown in Appendix 12.4.d.

(c) Depreciation

Vehicle depreciation costs are calculated taking into account the economic life of the vehicle, the total running distance during the vehicle life time, the annual running distance and average running speed. Method of calculation of these costs is shown in Appendix 12.7 and the equations adopted are presented in Appendix 12.4.e.

(d) Interest

The social discount rate of 15% has been recommended by BAPPENAS and thus 15% per annum was adopted as an average rate of interest.

The interest in relation to speed is calculated with the annual running distance. The equations adopted are shown in Appendix 12.4.f.

(e) Insurance Premium

The annual insurance premium figures were found by inquiry to the insurance companies as follows:

Unit: Percent of Vehicle Price/Yr

S e d a n	Bus	Truch
3.7 %	3.65%	4.3%

In the case of a sedan, however, it is not necessarily true that all the cars are insured. Therefore, it is assumed that the insured vehicle rate is 50%. The equation of insurance rates calculated as a percentage of the new value of the vehicle is shown in Appendix 12.4.g.

Tax component is 3% of premium. In this study, economic insurance is, therefore, calculated using 97 percent of a new financial value for the vehicles.

(f) Wages of Crew

The crew of a bus is assumed to consist of one driver and two conductors on an average. The crew of a truck is assumed to consist of one driver and one assitant.

The equations correlating to running speed and crew hours are shown in Appendix 12.4.h.

Finally, the financial and economic vehicle operating costs on a tollway were calculated with respect to speed for the representative vehicles. These results are summarized in Tables 12.3 and 12.4.

5) Vehicle Operating Costs on Arterial Road

A not well maintained surface causes relatively high vehicle running cost as compared to a smooth pavement. From the maintenance policy point of view, Harbour Road must maintain a smooth pavement in order to cope with a high speed drive on a tollway and to secure safe driving.

For the estimation of vehicle operating costs on an arterial road, the method from "An improved Data Base for Estimating Vehicle Operating Cost in Developing Countries" - TRRL supplementary Report 223 US, by H. Hide - is adopted.

Following the above method, the roughness of pavement is given as follows:

	Unit	Tollway	Artery
Roughness	mm/km	2500	3500

Two cost elements of vehicle maintenance and tyre consumption are considered to be affected by the roughness of road pavement.

i) Parts Consumption for Vehicle Maintenance

R = Roughness

PC = parts cost per 1,000 km

VP = Cost of an equivalent new vehicle

LH = number of labour hours per 1,000 km

K = age of the vehicle in cumulative kilometers run

- Passenger Car

$$\frac{PC}{VP} = (-2.03 + 0.0018\ R) \times K \times 10^{-11}$$

- Truck

$$\frac{PC}{VP} = (0.48 + 0.00037\ R) \times K \times 10^{-11}$$

- Bus

$$\frac{PC}{VP} = (-0.67 + 0.0006\ R) \times K^{1/2} \times 10^{-9}$$

ii) Tyre Consumption

Tc : number of Tyres consumed per 1,000 kilometers

L : total weight of the vehicle (ton)

- Passenger Car

$$Tc = (-83 + 0.058\ R) \times 10^{-6}$$

- Medium and heavy vehicles

$$\frac{Tc}{L} = (83 + 0.0112\ R) \times 10^{-7}$$

Difference between tyre consumption on tollway and on arterial road is shown as follows:

		Cost on Arterial/ Cost on Tollway
Maintenance parts: Consumption	Passenger Car	1.73
	Bus	1.27
	Truck	1.26
Tyre Consumption:	Passenger Car	1.94
	Bus	1.10
	Truck	1.10

The above difference in costs for maintenance parts consumption and tyre consumption are added to those obtained for tollway to estimate vehicle operating costs on arterial roads.

In addition, vehicle operating costs on 2-lane streets are assumed to be 30% higher than those on arterial roads.

Consequently, economic and financial vehicle operating costs by speed are calculated for respective road types, that is tollway, arterial roads and 2-lane streets and summarized in Tables 12.3 and 12.4. Sources of data and information for the analysis of vehicle operating costs are listed in the Bibliography below:

BIBLIOGRAPHY

1. International Textbook company "Economic Analysis for Highways" Rabley Winfery.

2. IBRD "Quantification of Road User Savings" Jan de Weille.

3. IBRD "The Economics of Road User Charges" A.A. Walters.

4. TRRL Laboratory Report 674 "Road Transport Investment Model for Developing Countries" R. Robinson, H. Hide, J.W. Hedges, J. Rolt and S.R. Abayanyaka.

5. TRRL Supplementary Report 223 UC "An Improved Data base for Estimating Vehicle Operating Costs in Developing Countries" H. Hide.

6. TRRL Supplementary Report 249 "Road Deterioration Parameters for Estimating Vehicle Operating Costs in Developing Countries" R. Robinson and P.A. Subramaniam.

7. Department of Finance Republic of Indonesia, Directorate General of Customs and Excises "Customs Tariff" 1980.

8. Yayasan Bina Pajak "Pajak-pajak Indonesia" Drs. B. Usman & K. Subroto SH. 1980.

9. Weekly Review "Berita Pajak Jakarta" The Worker's/Employees Income Tax" 1980.

10. Departmen Pekerjaan Umum dan Tenaga Listril Directorat Jenderal Bina Marga" Jakarta - West Java Tollway System Feasibility Study Part A Final Report "Arge Inter-Traffic Lenzconsult.

Table 12.3 Economic Vehicle Operating Cost Related to Speed

(Unit: Rp/km)

Speed	Street (2-way, 2-lane)			Artery (2-way, 4-lane/over			Tollway		
(km/hr)	Sedan	Truck	Bus	Sedan	Truck	Bus	Sedan	Truck	Bus
10	247.7	423.8	630.1	190.5	326.0	484.7	188.0	318.5	466.1
15	188.8	334.4	505.4	145.2	257.2	388.8	142.5	249.5	369.4
20	156.3	284.8	439.7	120.2	219.1	338.2	117.4	211.1	318.0
25	135.1	252.9	399.8	103.9	194.5	307.5	100.9	186.2	286.2
30	119.9	230.4	373.4	92.2	177.2	287.2	89.1	168.6	264.8
35	108.7	214.1	356.1	83.6	164.7	273.9	80.3	155.8	250.3
40	100.1	202.2	344.2	77.0	155.5	264.8	73.4	146.2	240.1
45	93.2	193.6	336.6	71.7	148.9	258.9	67.9	139.2	233.1
50	88.1	188.4	333.7	67.8	144.9	256.7	63.8	134.7	229.6
55	84.5	185.3	333.2	65.0	142.5	256.3	60.8	131.8	227.9
60	82.0	184.1	335.7	63.1	141.6	258.2	58.7	130.4	228.4
65	80.7	185.5	341.0	62.1	142.7	262.3	57.3	130.9	231.0
70	80.2	188.6	348.1	61.7	145.1	267.8	56.7	132.7	235.1
75	80.7	193.4	357.5	62.1	148.8	275.0	56.8	135.7	240.8
80	82.2	199.9	369.5	62.2	153.8	284.2	57.7	140.0	248.4
85	84.4	208.3	382.3	64.9	160.2	294.1	59.1	145.6	256.6
90	87.4	218.4	397.8	67.2	168.0	306.0	61.1	152.7	266.8

Table 12.4 Financial Vehicle Operating Cost Related to Speed

(Unit: Rp/km)

Speed	Street (2-way, 2-lane)			Artery (2-way, 4-lane/over)			Tollway		
(km/hr)	Sedan	Truck	Bus	Sedan	Truck	Bus	Sedan	Truck	Bus
10	419.0	449.2	619.6	345.5	322.3	476.6	339.8	313.9	456.8
15	329.2	341.9	496.5	263.0	253.2	381.9	257.0	244.6	361.1
20	280.5	283.7	433.3	218.2	215.8	333.3	211.9	206.9	311.5
25	250.5	246.4	395.7	189.5	192.7	304.4	182.9	183.5	281.6
30	229.8	220.0	371.8	169.2	176.8	286.0	162.2	167.2	262.0
35	215.2	200.3	356.7	154.1	165.5	274.4	146.8	155.6	249.2
40	204.6	185.3	345.4	142.5	157.4	265.7	134.7	147.0	240.3
45	197.0	173.2	340.6	133.2	151.5	262.0	125.1	140.7	234.4
50	192.7	163.9	338.9	126.1	148.2	260.7	117.5	136.8	231.7
55	189.9	156.9	339.0	120.7	146.1	260.8	111.7	134.1	230.4
60	188.9	151.5	341.8	116.5	145.3	262.9	107.1	132.7	231.1
65	189.9	147.7	347.1	113.6	146.1	267.0	103.7	133.9	233.5
70	192.4	145.1	353.7	111.6	148.0	272.1	101.2	134.0	237.1
75	196.2	143.9	362.1	110.7	150.9	278.5	99.8	136.2	241.9
80	201.1	144.0	372.6	110.8	154.7	286.6	99.5	139.3	248.3
85	207.6	144.8	383.6	111.4	159.7	295.1	99.5	143.4	255.0
90	215.5	146.8	396.8	112.9	165.8	305.2	100.5	148.6	263.4

(3) Time Value

The computation of time value involves many uncertain factors. Generally, it is clear that, as far as the road users' inclinations are concerned, they will use better roads to avoid traffic congestion. It is considered that this kind of inclination can be fundamentally assessed on the basis of the time value of individual road users.

Time value can thus be estimated using the same theory as Herbert Mohring's which is that in deciding which route to select for a trip, road users have an inclination for minimizing the total operating costs of their trips, if enough alternatives are available in urban areas.

The following formula expresses the total trip costs for a vehicle:

$$C = F\ (S^*, N, \bar{Z}) + \frac{P}{S\ (S^*, N, \bar{Z})}$$

where: P = time value for road users (Rp/hour)

F = trip operating costs except time costs (Rp/km)

C = total trip operating costs (Rp/km)

S = actual travel speed (km/hr)

S* = driver's desired travel speed (km/hr)

N = traffic volume

$\bar{Z}$ = other factors

In the case of an urban road network, the growth of traffic volume is followed by the development of the network and the average density of traffic volume will usually not vary on different routes. Under such circumstances it is assumed that there will be little difference between the desired travel speed and the actual travel speed.

Therefore, the result is that S* = S in the formula and that the factors N and $\bar{Z}$ are not really relevant to the actual travel speed. In this case, the above mentioned equation can be simplified as follows:

$$C = F(S) + P/S$$

If an individual road user intends to minimize total trip operating costs then the necessary condition is given as follows:

$$\frac{\partial C}{\partial S} = \frac{\partial F}{\partial S} - \frac{P}{S^2} = 0$$

therefore,

$$\text{Time value/vehicle : } P = S^2 \frac{\partial F}{\partial S} = S^2 \alpha \frac{\partial F'}{\partial S}$$

where: F' = direct running costs, and

α = F/F'

The determinant factors of time value, therefore, consist of direct running costs, vehicle operating costs and a desired travel speed. The desired travel speed is assumed to form a normal distribution curve centering around 65 km/h.

Based on the analysis of vehicle operating costs, time values of sedan, truck and bus are estimated as shown in Table 12.5. The calculation process is presented in Appendix 12.8.

Table 12.5 Time Value at 1980 Prices

(Unit: Rp/Vehicle-hr)

	Time Value	
	Economic	Financial
Sedan	2,800	4,100
Truck	5,760	7,200
Bus	8,460	9,400

(4) Savings in Travel Time and Vehicle Operating Costs

Economic benefits derived from savings in travel time and vehicle operating costs are calculated comparing the traffic assignment results for both "with" and "without" Harbour Road.

In this study, beneficiaries of the Project are only confined to Harbour Road users regardless of other indirect beneficiaries.

Accordingly, at the traffic assignment stage, those who used Harbour Road under "with" Project condition are investigated to determine which routes they would select under "without" Project condition.
The totals of travel distance (vehicle-kms) and travel time (vehicle-hrs) for Harbour Road users, from the traffic assignment results, are derived for each road category of tollway, arterial road and 2-lane street for both "with" and "without" Project.

The total of vehicle operating costs is estimated based on the derived average speed, vehicle-kms on each road category and a table of unit vehicle operating cost related to speed as previously shown in Table 12.3.

The total of time costs was estimated based on the derived vehicle-hrs of Harbour Road users and their time values.

Thus, savings in travel time and vehicle operating costs are calculated based on the difference in vehicle-hrs and vehicle-kms between "with" and "without" Project conditions.

Consequently, the economic benefits for the Project are summarized for each alternative case of toll levy systems as shown in Table 12.6.

11.1.3 Comparison of Economic Cost and Benefit

(1) Cost and Benefit Flows

The staged construction cost has been discussed in Chapter 10. The investment amount for each stage was distributed annually based on the construction schedule.

Economic operation and maintenance costs are estimated to be 87.5% of the respective financial costs.

The costs of Phase II construction in 1999 and 2000 were included in the maintenance costs for those years.

The cost and benefit flows at 1980 prices and at present values discounted at 10% and 15% are presented in Tables 12.7 through 12.9 for each alternative case of toll levy systems.

(2) Sensitivity Analysis and Economic Evaluation

As for the sensitivity analysis, the economic benefit and project life span are varied in order to consider the effects of future unknown factors and to examine the certainty of economic feasibility of the Project.

The time cost saving derived from the Project was considered to be nil, 30% or 50% of the originally estimated time benefit.

Project life span was initially determined to be 20 years after the commencement of Harbour Road operation for its full length.

An alternative project life span of 25 years is also considered to be generally acceptable for road projects.

The above two factors are tested and economic evaluation indicators such as net present value, benefit/cost ratio and internal rate of return are calculated and summarized in Table 12.10 for each alternative case of toll levy systems.

As a result, among the selected alternatives for a toll levy system, Case 1, a flat tariff for Cengkareng Acess and a separate flat tariff for both Harbour Road and Intra Urban Tollway, disclosed the highest marks of any of the evaluation

Table 12.6 Economic Benefits of the Project

(Unit: Rp.10^6/yr.)

(1) Savings in Time Cost and Vehicle Operating Costs

Case No.	Year	Sedan	Truck	Bus	Total
Case 1	2010	71,471	57,524	11,587	140,582
	2000	69,578	44,607	8,376	122,561
	1990	39,103	29,208	7,149	75,460
Case 2	2010	71,506	58,102	12,039	141,647
	2000	63,100	41,527	7,215	111,842
	1990	33,483	26,963	6,293	66,739
Case 3	2010	67,920	55,337	11,500	134,757
	2000	53,096	33,561	6,538	93,195
	1990	27,888	21,812	5,720	55,420

(2) Savings in Vehicle Operating Costs

Case No.	Year	Sedan	Truck	Bus	Total
Case 1	2010	30,655	23,572	4,305	58,532
	2000	26,643	15,191	2,637	44,471
	1990	14,475	7,615	1,546	23,636
Case 2	2010	29,961	21,823	4,618	56,402
	2000	25,955	13,971	2,373	42,299
	1990	13,120	6,277	1,325	20,722
Case 3	2010	31,508	20,590	4,074	56,172
	2000	21,938	11,064	1,998	35,000
	1990	10,920	4,957	1,087	16,964

(3) Savings in Time Costs

Case No.	Year	Sedan	Truck	Bus	Total
Case 1	2010	40,816	33,952	7,282	82,050
	2000	42,935	29,416	5,739	78,090
	1990	24,628	21,593	5,603	51,824
Case 2	2010	41,545	36,279	7,421	85,245
	2000	37,145	27,556	4,842	69,543
	1990	20,363	20,686	4,968	46,017
Case 3	2010	36,412	34,747	7,426	78,585
	2000	31,158	22,497	4,540	58,195
	1990	16,968	16,855	4,633	38,456

Note: Case 1 - Flat tariff for Cengkareng Access and a separate flat tariff available for both Intra Urban Tollway and Harbour Road.
Case 2 - Distance proportional tariff for Cengkareng Access and Harbour Road and flat tariff for Intra Urban Tollway.
Case 3 - Flat tariff available among Cengkareng Access, Intra Urban Tollway and Harbour Road.

Table 12.7 Economic Cost and Benefit Flows for Case 1

(Unit: 10^6 Rp)

	YEAR	COST: CAPITAL	COST: MEINTENANCE	COST: OPERATION	COST: TOTAL	BENEFIT: (A)	BENEFIT: (B)	PRESENT VALUE, DISCOUNTED AT 10%: COST	(A)	(A+.3B)	(A+.5B)	(A+B)	PRESENT VALUE, DISCOUNTED AT 15%: COST	(A)	(A+.3B)	(A+.5B)	(A+B)
0	1980	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1981	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	1982	1139	0	0	1139	0	0	941	0	0	0	0	861	0	0	0	0
3	1983	5217	0	0	5217	0	0	3920	0	0	0	0	3430	0	0	0	0
4	1984	21328	0	0	21328	0	0	14567	0	0	0	0	12194	0	0	0	0
5	1985	23590	0	0	23590	0	0	14648	0	0	0	0	11728	0	0	0	0
6	1986	33379	0	0	33379	0	0	18842	0	0	0	0	14431	0	0	0	0
7	1987	27920	0	0	27920	0	0	14327	0	0	0	0	10496	0	0	0	0
8	1988	44506	0	0	44506	0	0	20762	0	0	0	0	14549	0	0	0	0
9	1989	36638	0	0	36638	0	0	15538	0	0	0	0	10415	0	0	0	0
10	1990	36245	0	0	36245	0	0	13974	0	0	0	0	8959	0	0	0	0
11	1991	0	926	824	1752	25720	54451	614	9015	14740	18557	28099	377	5528	9040	11380	17232
12	1992	0	926	824	1752	27803	57077	558	8859	14315	17952	27045	327	5197	8397	10531	15865
13	1993	0	926	824	1752	29887	59704	507	8657	13845	17304	25951	285	4857	7769	9709	14561
14	1994	0	926	824	1752	31970	62330	461	8419	13343	16625	24832	248	4518	7161	8923	13327
15	1995	0	926	824	1752	34054	64957	419	8152	12817	15927	23702	215	4185	6580	8176	12168
16	1996	0	926	824	1752	36137	67584	381	7864	12277	15219	22573	187	3862	6028	7473	11084
17	1997	0	926	824	1752	38221	70210	347	7562	11729	14507	21452	163	3552	5509	6814	10076
18	1998	0	926	824	1752	40304	72837	315	7249	11179	13799	20349	142	3257	5022	6200	9142
19	1999	0	4339	824	5163	42388	75463	844	6931	10632	13100	19270	363	2978	4569	5630	8281
20	2000	0	8887	824	9711	44471	78090	1443	6610	10093	12414	18218	593	2717	4149	5103	7489
21	2001	0	928	824	1752	45877	78486	237	6199	9381	11502	16805	93	2437	3688	4522	6607
22	2002	0	928	824	1752	47283	78882	215	5809	8716	10654	15499	81	2185	3278	4007	5829
23	2003	0	926	824	1752	48689	79278	196	5437	8094	9864	14291	70	1956	2912	3549	5141
24	2004	0	926	824	1752	50095	79674	178	5086	7513	9130	13175	61	1750	2585	3142	4533
25	2005	0	928	824	1752	51502	80070	162	4753	6970	8448	12144	53	1565	2294	2781	3997
26	2006	0	928	824	1752	52908	80466	147	4439	6465	7815	11191	46	1398	2035	2460	3523
27	2007	0	926	824	1752	54314	80862	134	4143	5993	7227	10311	40	1248	1805	2176	3105
28	2008	0	928	824	1752	55720	81258	121	3864	5554	6681	9499	35	1113	1600	1924	2736
29	2009	0	928	824	1752	57126	81654	110	3601	5145	6175	8749	30	992	1418	1701	2410
30	2010	0	926	824	1752	58532	82050	100	3354	4765	5705	8057	26	884	1256	1504	2123
TOTAL		229962	29930	16480	276372	873001	1465383	125011	126005	193567	238608	351212	90501	56178	87094	107704	159230
31	2011	0	926	824	1752	59938	82446	91	3123	4411	5270	7418	23	787	1112	1329	1870
32	2012	0	926	824	1752	61344	82842	83	2905	4082	4867	6829	20	701	984	1174	1647
33	2013	0	926	824	1752	62750	83238	75	2702	3777	4494	6286	17	623	871	1036	1450
34	2014	0	926	824	1752	64156	83634	69	2511	3493	4148	5785	15	554	771	915	1276
35	2015	0	926	824	1752	65563	84030	62	2333	3230	3828	5323	13	492	682	808	1123
TOTAL		229962	34570	20600	285132	1186752	1881573	125391	139579	212561	261216	382853	90590	59336	91514	112966	166596

Table 12.8 Economic Cost and Benefit Flows for Case 2

(Unit: 10^6 Rp)

YEAR		COST				BENEFIT		PRESENT VALUE									
								DISCOUNTED AT 10%					DISCOUNTED AT 15%				
		CAPITAL	MAINTE NANCE	OPERA TION	TOTAL	(A)	(B)	COST	(A)	(A+.3B)	(A+.5B)	(A+B)	COST	(A)	(A+.3B)	(A+.5B)	(A+B)
0	1980	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1981	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	1982	1107	0	0	1107	0	0	915	0	0	0	0	837	0	0	0	0
3	1983	4983	0	0	4983	0	0	3744	0	0	0	0	3276	0	0	0	0
4	1984	20184	0	0	20184	0	0	13786	0	0	0	0	11540	0	0	0	0
5	1985	23506	0	0	23506	0	0	14595	0	0	0	0	11687	0	0	0	0
6	1986	33019	0	0	33019	0	0	18638	0	0	0	0	14275	0	0	0	0
7	1987	27780	0	0	27780	0	0	14256	0	0	0	0	10444	0	0	0	0
8	1988	42795	0	0	42795	0	0	19964	0	0	0	0	13990	0	0	0	0
9	1989	33998	0	0	33998	0	0	14418	0	0	0	0	9664	0	0	0	0
10	1990	33086	0	0	33086	0	0	12756	0	0	0	0	8178	0	0	0	0
11	1991	0	926	1428	2356	22880	48371	926	8019	13105	16496	24973	506	4918	8037	10116	15315
12	1992	0	926	1428	2356	25137	50723	751	7978	12826	16059	24139	440	4680	7524	9420	14160
13	1993	0	926	1428	2356	27195	53076	682	7877	12490	15565	23252	383	4420	7008	8733	13046
14	1994	0	926	1428	2356	29353	55428	620	7730	12108	15028	22325	333	4148	6498	8065	11982
15	1995	0	926	1428	2356	31511	57781	564	7543	11693	14460	21376	290	3873	6003	7423	10973
16	1996	0	926	1428	2356	33668	60133	513	7327	11253	13870	20414	252	3598	5526	6811	10024
17	1997	0	926	1428	2356	35826	62486	466	7088	10797	13269	19451	219	3329	5071	6232	9136
18	1998	0	926	1428	2356	37984	64838	424	6832	10330	12663	18493	190	3069	4641	5689	8309
19	1999	0	3899	1428	5327	40141	67191	871	6563	9859	12057	17550	374	2821	4237	5181	7542
20	2000	0	7862	1428	9290	42299	69543	1381	6287	9389	11456	16625	568	2584	3859	4709	6834
21	2001	0	926	1428	2356	43709	71113	318	5906	8789	10711	15516	125	2322	3456	4211	6101
22	2002	0	926	1428	2356	45120	72683	289	5543	8221	10007	14472	109	2085	3092	3764	5443
23	2003	0	926	1428	2356	46530	74254	263	5196	7684	9343	13489	95	1869	2764	3361	4852
24	2004	0	926	1428	2356	47940	75824	239	4867	7177	8716	12565	82	1675	2469	2999	4324
25	2005	0	926	1428	2356	49351	77394	217	4555	6698	8126	11698	72	1499	2204	2675	3850
26	2006	0	926	1428	2356	50761	78964	198	4259	6247	7572	10885	62	1341	1967	2384	3427
27	2007	0	926	1428	2356	52171	80534	180	3979	5822	7051	10122	54	1198	1753	2123	3048
28	2008	0	926	1428	2356	53581	82105	163	3715	5424	6562	9409	47	1070	1562	1890	2710
29	2009	0	926	1428	2356	54992	83675	149	3467	5049	6104	8741	41	955	1391	1682	2408
30	2010	0	926	1428	2356	56402	85245	135	3232	4698	5675	8118	36	852	1238	1496	2139
TOTAL		221458	29465	28560	277483	826451	1371361	122322	117966	179660	220789	323612	88169	52306	80301	98964	145623
31	2011	0	928	1428	2356	57912	86815	123	3012	4369	5273	7535	31	759	1101	1329	1899
32	2012	0	926	1428	2356	59223	88385	112	2805	4061	4898	6991	27	676	979	1181	1686
33	2013	0	926	1428	2356	60633	89956	101	2611	3773	4547	6484	23	602	870	1049	1495
34	2014	0	926	1428	2356	62043	91526	92	2429	3503	4220	6011	20	536	773	931	1326
35	2015	0	926	1428	2356	63454	93096	84	2258	3252	3914	5571	18	476	686	826	1176
TOTAL		221458	33105	35700	289263	1129616	1821139	122834	131080	198617	243642	356204	88288	55356	84711	104280	153205

Table 12.9 Economic Cost and Benefit Flows for Case 3

(Unit: 10^6 Rp)

	YEAR	COST: CAPITAL	COST: MEINTENANCE	COST: OPERATION	COST: TOTAL	BENEFIT: (A)	BENEFIT: (B)	PV DISCOUNTED AT 10%: COST	10%: (A)	10%: (A+.3B)	10%: (A+.5B)	10%: (A+B)	PV DISCOUNTED AT 15%: COST	15%: (A)	15%: (A+.3B)	15%: (A+.5B)	15%: (A+B)
0	1980	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1981	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	1982	1127	0	0	1127	0	0	931	0	0	0	0	852	0	0	0	0
3	1983	5190	0	0	5190	0	0	3899	0	0	0	0	3413	0	0	0	0
4	1984	21321	0	0	21321	0	0	14563	0	0	0	0	12190	0	0	0	0
5	1985	23201	0	0	23201	0	0	14406	0	0	0	0	11535	0	0	0	0
6	1986	32991	0	0	32991	0	0	18623	0	0	0	0	14263	0	0	0	0
7	1987	27670	0	0	27670	0	0	14199	0	0	0	0	10402	0	0	0	0
8	1988	43945	0	0	43945	0	0	20501	0	0	0	0	14366	0	0	0	0
9	1989	35767	0	0	35767	0	0	15169	0	0	0	0	10167	0	0	0	0
10	1990	36084	0	0	36084	0	0	13912	0	0	0	0	8919	0	0	0	0
11	1991	0	926	695	1623	18768	40431	569	6578	10829	13663	20749	349	4034	6641	8379	12724
12	1992	0	926	695	1623	20571	42405	517	6555	10608	13310	20066	303	3845	6223	7808	11771
13	1993	0	926	695	1623	22375	44378	470	6481	10338	12909	19336	264	3637	5800	7243	10849
14	1994	0	926	695	1623	24178	46352	427	6367	10029	12470	18573	229	3417	5382	6692	9968
15	1995	0	926	695	1623	25982	48326	389	6220	9691	12004	17789	199	3193	4975	6163	9132
16	1996	0	926	695	1623	27786	50300	353	6047	9331	11520	16994	173	2969	4582	5657	8345
17	1997	0	926	695	1623	29589	52274	321	5854	8957	11025	16196	151	2750	4207	5178	7607
18	1998	0	926	695	1623	31393	54247	292	5646	8573	10525	15403	131	2537	3852	4728	6920
19	1999	0	4707	695	5402	33196	56221	883	5428	8186	10024	14620	380	2333	3518	4308	6283
20	2000	0	9747	695	10442	35000	58195	1552	5203	7798	9528	13853	638	2139	3205	3916	5694
21	2001	0	928	695	1623	37117	60234	219	5016	7457	9085	13155	86	1972	2932	3572	5172
22	2002	0	926	695	1623	39234	62273	199	4820	7115	8645	12470	75	1813	2676	3251	4690
23	2003	0	926	695	1623	41352	64312	181	4618	6773	8209	11800	65	1661	2436	2953	4245
24	2004	0	926	695	1623	43469	66351	165	4413	6434	7781	11150	57	1519	2214	2678	3836
25	2005	0	926	695	1623	45586	68390	150	4207	6101	7363	10520	49	1385	2008	2424	3462
26	2006	0	928	695	1623	47703	70429	136	4003	5775	6957	9912	43	1260	1818	2190	3120
27	2007	0	926	695	1623	49820	72468	124	3800	5458	6564	9328	37	1144	1644	1977	2809
28	2008	0	926	695	1623	51938	74507	113	3602	5152	6185	8768	32	1037	1484	1781	2526
29	2009	0	926	695	1623	54055	76546	102	3408	4855	5820	8233	28	939	1336	1604	2268
30	2010	0	926	695	1623	56172	78585	93	3219	4570	5471	7723	25	848	1204	1442	2035
TOTAL		227296	31158	13900	272354	735284	1187224	123458	101483	154029	189060	276637	89423	44431	68139	83944	123458
31	2011	0	926	695	1623	58289	80624	85	3037	4297	5137	7237	21	766	1083	1295	1824
32	2012	0	926	695	1623	60406	82663	77	2861	4036	4819	6776	19	690	973	1162	1634
33	2013	0	926	695	1623	62524	84702	70	2692	3786	4516	6339	16	621	873	1041	1462
34	2014	0	926	695	1623	64641	86741	64	2530	3549	4228	5925	14	558	783	933	1307
35	2015	0	926	695	1623	66758	88780	58	2376	3323	3955	5535	12	501	701	835	1168
TOTAL		227296	35798	17375	280469	1047902	1610734	123811	114979	173020	211714	308449	89505	47566	72552	89210	130853

Table 12.10 Summary of Economic Evaluation

(1) Case 1

	Project Life Span (PLS = 20 Years)					PLS=25 yrs.
	Discounted at 10%		Discounted at 15%		Internal Rate of Return (%)	Internal Rate of Return (%)
	B-C(10^6Rp)	B/C	B-C(10^6Rp)	B/C		
A	994	1.01	-34,323	0.62	10.08	10.95
A+0.3B	68,556	1.55	-3,407	0.96	14.58	15.11
A+0.5B	113,597	1.91	17,203	1.19	17.00	17.41
A+B	226,201	2.81	68,729	1.76	21.91	22.13

(2) Case 2

	Project Life Span (PLS = 20 Years)					PLS=25 yrs
	Discounted at 10%		Discounted at 15%		Internal Rate of Return (%)	Internal Rate of Return (%)
	B-C(10^6Rp)	B/C	B-C(10^6Rp)	B/C		
A	-4,356	0.96	-35,863	0.59	9.64	10.57
A+0.3B	57,338	1.47	-7,868	0.91	13.98	14.58
A+0.5B	98,467	1.81	10,795	1.12	16.31	16.78
A+B	201,290	2.65	57,454	1.65	21.03	21.30

(3) Case 3

	Project Life Span (PLS = 20 Years)					PLS=25 yrs
	Discounted at 10%		Discounted at 15%		Internal Rate of Return (%)	Internal Rate of Return (%)
	B-C(10^6Rp)	B/C	B-C(10^6Rp)	B/C		
A	-21,975	0.82	-44,992	0.50	8.21	9.39
A+0.3B	30,571	1.25	-21,284	0.76	12.17	12.98
A+0.5B	65,602	1.53	-5,479	0.94	14.32	14.97
A+B	153,179	2.24	34,035	1.38	18.70	19.10

Notes: "A" is saving in vehicle operating costs "B" is time cost saving.

Case 1 - Flat tariff for Cengkareng Access and a separate flat tariff available for both Intra Urban Tollway and Harbour Road.

Case 2 - Distance proportional tariff for Cengkareng Access and Harbour Road and flat tariff for Intra Urban Tollway.

Case 3 - Flat tariff available among Cengkareng Access, Intra Urban Tollway and Harbour Road.

indicators.

Case 1 also indicated more than 17% of internal rate of return even for the condition of 50% reduction of the original time benefit.

Therefore, the Project is considered economically feasible and the toll levy system Case 1 is the most recommended system from the economic point of view.

12.2 Financial Viability

12.2.1 Revenue Calculation

(1) Toll Rate and Tall Levy System

The Indonesian law regulates a toll level to be limited within the financial benefit of a tollway-user trip.

The alternative toll levy systems and toll rates examined in this study are as follows:

Toll Rates: Flat tariff (Rp.400/sedan-trip, Rp.800/truck or bus trip)

Distance proportional tariff (Rp.30/sedan-km, Rp.60/truck - or bus-km)

Toll levy system:

Case 1 - Flat tariff for Cengkareng Access and a separate flat tariff are available for both Intra Urban Tollway and Harbour Road.

Case 2 - Distance proportional tariff for Cengkareng Access and Harbour Road and flat tariff for Intra Urban Tollway.

Case 3 - Flat tariff available for Cengkareng Access, Intra Urban Tollway and Harbour Road.

According to the results of traffic assignment for both "With" and "Without" Harbour Road networks, the financial savings in vehicle operating costs and time costs are derived by a similar method used for the economic analysis. At the same time, the vehicle trips and travel distances on the Harbour Road were obtained for each alternative case of the toll levy systems as shown in Table 12.11.

As can be seen in Table 12.11, the average financial benefit which a Harbour Road user will receive does not exceed the toll rates applied to the alternative cases selected for a toll levy system.

Table 12.11 Financial Benefits for Harbour Road Users in 2010

		Total Financial Benefits* (10^3 Rp./day)	Vehicle-trips (for Cases 1 & 3) Vehicle-kms (for Case 2)	Average Financial Benefit per User
Case 1:	Sedan	249,843	124,600	Rp.2,005/trip
	Truck	155,028	60,132	2,578/trip
	Bus	23,064	8,216	2,807/trip
Case 2:	Sedan	247,500	881,040	Rp. 280/km
	Truck	150,290	380,971	394/km
	Bus	24,147	57,389	420/km
Case 3:	Sedan	245,682	117,942	Rp.2,083/trip
	Truck	142,874	63,431	2,252/trip
	Bus	22,640	7,171	3,157/trip

Note: * Financial benefits include savings in vehicle operating cost and 50% of the time cost estimated originally.

(2) Revenue Calculation

At the traffic assignment stage, different toll levy systems were introduced and incorporated into the assignment technique. The assigned traffic on tollways, as a result, showed clear difference in volume among the alternative toll levy systems.

Revenue calculation for the distance proportional tariff system (Case 2), the toll rate of Rp.30 (Rp.60) for sedan-km (truck or bus-km) was multiplied by assigned traffic volume-kms on each of the tollways. For the flat tariff, however, the number of tollway users are counted and a toll revenue attributable to each tollway is calculated by allocating the total revenue proportionally to the assigned volume-kms on each tollway.

Consequently, the toll revenues for Cengkareng Access, Harbour Road and Intra Urban Tollway are shown in Table 12.12.

Compared with the alternative cases it was found that Case 1 brings about the highest revenue for Harbour Road and for the total of three tollways as well.

Table 12.12 Toll Revenue at 1980 Prices

(Unit: $Rp10^6/Yr.$)

Year	Case No.	Cengkareng Access	Harbour Road	Intra Urban Tollway	Total Revenue
2010	1	18,495.1	27,314.3	43,624.8	89,434.2
	2	15,587.0	20,980.4	41,964.8	78,532.2
	3	16,658.7	24,451.6	40,218.7	81,329.0
2000	1	10,864.0	21,779.3	33,726.5	66,369.8
	2	10,150.3	17,745.8	33,580.8	61,476.9
	3	12,428.3	19,631.0	30,397.5	62,456.8
1990	1	6,354.0	8,306.6	26,917.1	41,577.7
	2	6,234.3	6,962.8	26,657.6	39,844.7
	3	8,823.6	7,314.7	23,653.4	38,791.7

12.2.2 Comparison of Project Cost and Revenue

Construction costs for respective alternatives of toll levy system, Case 1, 2 and 3, have been estimated in Table 10.5 of Chapter 10.

According to the construction schedule-A, these construction costs are allocation to the years from 1982 to 1990.

In order to estimate the project costs at current prices by year, price escalation rates of 7% p.a. and 12% p.a. were adopted for foreign and local currency poritons respectively.

The expected toll revenue at 1980 prices has been estimated as shown in Table 12.12. Toll rate at current prices is assumed to rise at 10% p.a. but to be revised every 5-years.

Based on the above assumptions project cost and revenue flows are calculated as shown in Table 12.13.

For the comparison of the alternative cases from the financial point of view, discounted cost and revenue, cost/revenue ratios and financial internal rates of returns are calculated for the project life span of 25 years and compared as shown in Table 12.14, where the alternative Case 1 retains the highest IRR of 12.8% in this financial comparison as well as in the economic comparison of the alternative cases.

Table 12.13 Financial Project Cost & Revenue Flows at Current Prices

Escalation F/C ... 7% p.a.
Rates: L/C ... 12% p.a.

Toll Rate ... 10% p.a. but only revised every-5 year

(Unit: 10^6 Rp.)

Year	Project Cost			Toll Revenue		
	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3
1980	0	0	0			
1981	0	0	0			
1982	1,476	1,437	1,460			
1983	7,322	6,998	7,283			
1984	33,583	31,775	33,573			
1985	34,356	34,340	33,635			
1986	57,611	56,940	56,804			
1987	55,429	55,292	54,900			
1988	96,024	92,353	94,736			
1989	83,629	77,130	82,606			
1990	88,774	80,212	88,290			
1991	7,349	9,375	6,446	24,135	20,641	21,368
1992	8,230	10,500	7,220	27,503	23,411	24,445
1993	9,218	11,760	8,086	30,873	26,178	27,525
1994	10,323	13,171	9,056	34,240	28,945	30,603
1995	11,563	14,752	10,143	60,172	51,483	53,892
1996	12,950	16,522	11,360	65,560	55,975	58,820
1997	14,504	18,505	12,723	70,948	60,457	63,744
1998	16,245	20,725	14,250	76,340	64,959	68,672
1999	48,330	49,370	49,412	81,728	69,456	73,596
2000	98,609	93,850	104,723	141,564	118,898	127,602
2001	22,823	29,117	20,020	145,165	121,062	130,735
2002	25,561	32,611	22,423	148,759	123,233	133,868
2003	28,629	36,525	25,113	152,360	125,397	137,001
2004	32,064	40,908	28,127	155,955	127,568	140,134
2005	35,912	45,817	31,502	263,880	209,759	236,952
2006	40,221	51,315	35,283	269,825	213,258	242,133
2007	45,048	57,472	39,517	275,781	216,768	247,315
2008	50,454	64,369	44,258	281,725	220,267	252,496
2009	56,508	72,093	49,570	287,681	223,777	300,678
2010	63,290	80,745	55,518	477,995	365,744	427,910
2011	70,884	90,434	62,180	487,690	371,375	436,345
2012	79,390	101,286	69,642	497,368	377,023	444,780
2013	88,917	113,440	77,999	507,063	382,654	453,215
2014	99,587	127,053	87,358	516,740	388,303	461,650
2015	111,538	142,300	97,841	842,296	634,976	752,165

Table 12.14 Comparison of Project Cost and Revenue

	Discounted at 10%			Discounted at 15%			Financial IRR (%)
	Revenue (10^6Rp.)	Cost (10^6Rp.)	R/C	Revenue (10^6Rp.)	Cost (10^6Rp.)	R/C	
Case 1	450,858	323,607	1.4	155,122	201,240	0.8	12.8
Case 2	361,139	333,906	1.1	125,998	201,612	0.6	10.7
Case 3	406,800	313,087	1.3	139,722	196,602	0.7	12.1

12.2.3 Premises for Financial Analysis

(1) General

The alternative Cases 1, 2 and 3 have been analysed and compared and it has been found that Case 1 is superior to the other cases from both the economic and financial points of view.

Therefore, the estimated project costs and revenue attributable to Case 1 are adopted for further financial analyses of the Project.

(2) Basic Categories of Conditions and Alternatives

In order to assess the financial viability of the Project several conditions have to be determined by the Government, while some other conditions must be assumed within a likely range of practicability.

The conditions to be determined or assumed for further financial anayses are classified into 7 categories as stated below:

(a) Construction schedule and price escalation rates,

(b) Financing plan,

(c) Loan conditions and repayment methods,

(d) Liability for loans and bonds,

(e) Equity/owned capital,

(f) Taxation,

(g) Temporary loan.

Some alternatives in one of those categories are also considered to evaluate probable combinations of the alternative conditions. Each of the above categories and alternatives is dicussed below:

(a) Construction Schedule and Price Escalation Rates

The total capital requirement amounts to 175,724 million Rupiah excluding land acquisition costs and compensation at 1980 prices, of which the foreign currency and local currency portions are 52.1% and 47.9% respectively.

The required amount of capital for land acquisition/ compensation and physical contingencies was estimated to be 55,400 million Rupiah at 1980 prices, which account for about 24% of the total cost.

The above investment amount does not include the Tg. Priok Access and the Phase II construction costs. No matter how the cost of Phase II construction is paid the required investment costs were included in the maintenance costs for the years 1999 and 2000.

The total capital requirement at current prices differs based on the conditions of escalation rate and construction schedule for the Project.

So far as the above conditions are concerned, the construction schedule-A applies from 1982 to 1990, and escalation rates of 7% p.a. for foreign currency portion,and 12% p.a. for local currency portion are adopted in this initial stage of the financial analysis.

Incorporating these conditions into a cash flow for the capital requirements the following schedules were obtained and are shown in Table 12.15.

Table 12.15 Schedule of Capital Requirement Flows

Construction Schedule-A, Escalation Rates: F/C - 7% p.a.; I/C - 12% p.a.

(Unit: 10^6Rp.)

	Year	Foreign Currency Portion	Local Currency Portion	Land Acq.* Cost in L/C Portion	Total (F/C + L/C)
0	1980	0	0	0	0
1	1981	0	0	0	0
2	1982	723	753	0	1476
3	1983	2008	5314	3160	7322
4	1984	842	32741	31860	33583
5	1985	5021	29335	22916	34356
6	1986	10744	46917	32538	57611
7	1987	19924	35505	7697	55429
8	1988	41486	54556	0	96024
9	1989	36814	46815	0	83629
10	1990	38752	50022	0	88774
Total		156314	301958	98171	458272

Note: * Including compensation and physical contingency.

(b) Financing Plan

In order to supply the total capital requirement, various financial sources will be considered for this Project. In this Study, however, it was assumed that the foreign currency portion is financed by international financing agencies and the international capital market, and the local currency portion is financed by the Indonesian Government and the domestic capital market.

The proportions allotted to those financial sources have been assumed for each staged construction section and are shown in Table 12.16.

Table 12.16 Financing Plan

	International Finance (Foreign Currency Portion)			Domestic Finance (Local Currency Portion)		
	Agency (A)	Agency (B)	Bond (A)	Bond (A)	Bond (B)	Government
Section I	F/E* +70%	30%	-	60%	-	F/E+L.A.** +40%
Section II	F/E +50%	30%	20%	40%	20%	F/E+L.A. +40%
Section III	F/E +70%	30%	-	60%	-	F/E+L.A. +40%
Section IV	F/E +50%	30%	20%	40$	20%	F/E+L.A. +40%

Notes: * Final engineering costs.

** Land axquisition/compensation costs and their physical contingency of 15%.

(c) Loan Conditions and Repayment Mehods

Loan conditions and repayment methods for the above financial sources are presented in Table 12.17.

Table 12.17 Loan Conditions and Repayment Methods

	International Finance (Foreign currency portion)			Domestic Finance (Local currency portion)		
	Agency(A)	Agency(B)	Bond(A)	Bond(A)	Bond(B)	Government**
Grace Period(Yrs)*	10	7	7	7	7	-
Interest*** Rate (% p.a.)	2.75	6.5	15.5	15.5	10.0	-
Repayment Method	20-ur. equal repayment of the principal	15-yr. equal repayment of the principal	10-yr. equal repayment of the principal and interest	10-yr. equal repayment of the principal and interest	15-yr. equal repayment of the principal	No repayment

Notes: * : As for international financing agencies, a grace period is assumed to start from the year when the loan agreement is made between the borrower and the lender. The year of loan agreement is defined to be the preceeding year from the time when the actual capital requirement accrues.

** : The amount which the Government finances for the Project is regarded as an investment or subsidy which does not require a return in the form of a dividend or interest but tax.

*** : The interest is due even in the grace period.

(d) Liability for Loans and Bonds

During the repayment period, including the grace period, the liability for repayment of the loans or other funds which are financed must be evaluated.

There are three alternatives considered practical for this Project, they are:

Alternative 4-1 : All the liabilities are paid out by the tollway operating body, but the investment by the Government is not repaid.

Alternative 4-2 : During the grace periods for the international loans, the interest is paid out by the Government but thereafter the operating body is liable for the remaining repayment.

Both international and domestic bonds are fully repaid by the operating body.

Alternative 4-3 : The Government subrogates the liability of the international loans, while the operating body repays both international and domestic bonds.

(e) Equity/Owned Capital

The burden of interest on the loan capital is very large particularly before the tollway operation begins. During this pre-operation period, therefore, an additional short term loan is required to balance the payments.

Such a temporary loan generally imposes a higher interest rate (assumed to be 13.5% p.a. in this Study) on the borrower.

In order to avoid such a condition the effect of introducing equity should be considered.

Accordingly, the following alternatives were considered in the financial analyses.

Alternative 5-1 : Equity of 50,000 million Rupiah, which is nearly equal to the pre-operation expenses, is financed aside from the total capital requirement, and also the capital investment for Phase II construction in 1999 and 2000 is financed by the equity.

Alternative 5-2 : No equity for Phase I construction but the capital investment for Phase II construction is financed by the equity.

Alternative 5-3 : No equity.

(f) Taxation

An operating body of the tollway is assumed to be allowed to produce a profit, though usage of the profit may be controlled by the Government.

Therefore, taxation applied to the tollway operation is considered as follows:

Alternative 6-1 : 30% tax on annual profit <u>before</u> annual redemption of long term loans and bonds.

Alternative 6-2 : 30% tax on annual profit after annual redemption of loans and bonds.

Alternative 6-3 : no tax.

(g) Temporary Loan

In order to balance the annual expenditure, a temporary loan is required. A rate of interest on this short term loan is assumed to be 13.5% p.a. However, if all of the temporary loan is repaid then the annual surplus can be assumed to be current-deposited.

Thus, among the above 7 categories, the conditions of 4 categories from (a) through (c) and (g) are assumed to be fixed in this initial stage, while conditions for the other 3 categories, from (d) through (f), are considered with three alternative conditions for respective categories.

12.2.4 Results of Financial Case Study

The possible combinations for the alternative conditions are 27 cases, among which 15 cases were analyzed for the following items and the results are shown in Table 12.18.

i) First year of accumulated surplus (Break-even point) and the Maturity (years) up to break-even point from the start of tollway operation.

ii) Maximum repayment amount for a single year, which is derived from the loan conditions and the repayment methods of the respective financial sources.

iii) Maximum temporary loan which includes the interest on an annual short term loan required to balance the annual expenditure.

iv) Total expenditure of Government which is assigned according to the financing plan and the plan of Government's subrogation for repayment; and shown at 1980 present value using a discount rate of 12% p.a.

v) Accumulated Government income from the tax on tollway operation, which is calculated at 1980 present value using discount rate of 12% p.a. for 25 years from the opening of tollway operation.

vi) Accumulated net profit at 1980 present value discounted at 12% p.a. from the year of break-even point up to 25th year from the opening of tollway operation.

vii) Tax + net profit which are calculated adding the above v) to vi).

Table 12.18 Results of Financial Analysis

Capital Investment	Case No.	Equity/Owned Capital: Nil Equity	Equity/Owned Capital: Equity for Phase II	Equity/Owned Capital: 50 bil. Rupiah + Phase II	Taxation: 30% before loan Repayment	Taxation: 30% after loan Repayment	Taxation: Exempted	Results of Financial Analysis: First Year of Acc. Surplus (Term): Break-even point	Max. Repayment of long term loans and bonds in a single year (Year) (Mil. Rp.)	Max. temporary loan repayment (Year) (Mil. Rp.)	Total expenditure of Gov't at 1980 present value (disc. at 12% p.a.) (Mil. Rp.)	Acc. Gov't Income from tax at 1980 present value (disc. at 12% p.a.) (Mil Rp.)	Acc. Net Profit at 1980 present value (disc. at 12% p.a.) (Mil. Rp.)	Tax + Net Profit (Mil. Rp.)
Operating body is liable for all loan capital but Government investment	01	x			x									
	02	x				x		2006 (16)	38,929 (1997)	328,938 (2000)	34,103	48,042	72,561	120,603
	03	x					x	2004 (14)	38,929 (1997)	289,330 (2000)		0	121,341	121,341
	04		x		x									
	05		x			x		2005 (15)	38,929 (1997)	268,171 (1999)	34,103	51,366	81,478	132,864
	06		x				x				(45,712)**			
	07			x	x									
	08			x		x		2000 (10)	38,928 (1997)	77,705 (1994)	34,103 (81,301)**	51,366	105,077	156,443
	09			x			x	2000 (10)	38,928 (1997)	77,705 (1994)		0	156,613	156,613
Government Subrogates the liability of interest repayment during grace periods of international loans	10	x			x									
	11	x				x		2004 (14)	38,928 (1997)	206,755 (2000)	39,864	48,176	84,532	132,708
	12	x					x	2003 (13)	38,928 (1997)	165,585 (2000)		0	133,176	133,176
	13		x		x									
	14		x			x		2003 (13)	38,928 (1997)	160,521 (1999)	39,864 (51,473)**	51,500	93,247	144,747
	15		x				x	2001 (11)	38,928 (1997)	138,906 (1994)		0	145,092	145,092
	16			x	x									
	17			x		x		1997 (7)	38,928 (1997)	28,012 (1994)	39,864	51,500	114,998	166,498
	18			x			x				(87,062)**			
Government subrogates the liability of repayment for all international loans but bonds	19	x			x									
	20	x				x		2002 (12)	27,197 (1997)	121,122 (1994)	61,556	52,451	98,754	151,205
	21	x					x							
	22		x		x			2003 (13)	27,197 (1997)	193,103 (1999)		70,942	98,861	169,803
	23		x			x		2001 (11)	27,197 (1997)	121,122 (1994)	61,556 (73,165)**	55,934	107,062	162,996
	24		x				x							
	25			x	x			1999 (9)	27,197 (1997)	42,548 (1994)		70,942	112,848	183,790
	26			x		x		1995 (5)	27,197 (1997)	10,493 (1993)	61,556 (108,754)**	55,934	128,224	184,158
	27													

Notes: * 1980 present value of land acquisition cost is 55,466 million Rupiah and it is excluded from the value.

** Figures in parenthesis indicate the case where the equity is provided as Government's cost.

As shown in Table 12.18, the Project is financially viable and the break-even points for the selected cases are attained within 5 to 16 years from the opening of tollway operation.

The Government income from tax for Case 02 exceeds the total Government expenditure and further, this case takes the longest time, that is 16 years, to attain the break-even point among the selected 15 cases. Therefore, the conditions of Case 02 can be disregarded, if the Government would expect the operating body to recover all the debt as soon as possible rather than expect to gain higher return on their investment in the tollway operation.

Without any equity/owned capital in the pre-operation period, the maximum repayment of the temporary loan is more than five-fold compared to that of the long term loan. This is because the repayment of the long term loan due in the pre-operation period incurs a great debt because a temporary loan at a high rate of interest will be necessary.

In order to reduce the burden of loan repayment in the early period of the tollway operation, the introduction of higher proportion of soft loan is of great help to the operating body in their financial condition.

In addition, the preparation of equity/owned capital equivalent to the pre-operation expenses and the taxation that is only applied since annual net profit is produced will be advantageous to the operating body for attaining a sound and favourable financial condition at an early time of operation.

In order to examine the effect of equity/owned capital on the financial condition of the operating body, cases 02, 05, 08, 11, 14, 17, 20, 23 and 26, in which a 30% tax on a profit after loan repayment is imposed, were compared with the following results:

i) The equity for Phase II construction helps to reduce the time to maturity (break-even point) by one year;

ii) The equity of 50 billion Rupiah prepared in the pre-operation period helps to reduce the time to maturity (break-even point) by 5 to 6 years;

iii) The Government's subrogation of interest repayment during grace periods for international loans helps to reduce the time to maturity (break-even point) by 2 to 3 years; and

iv) The Government's subrogation of international loan repayment helps to reduce the time to maturity (break-even point) by 4 to 5 years.

The possibility of introducing the above measures should be studied further in a future detailed study stage considering such factors as a tolerance of Government expenditure on this Project, expected returns to the Government and the operating body, maximum amount of loan repayment, etc.

12.2.5 Other Alternative Conditions for Financial Analysis

(1) General

In the initial stage of the financial analysis, several conditions were classified into 7 categories, 4 of which were assumed to be fixed conditions and the remaining 3 categories were provided with 3 alternatives for the respective categories.

These conditions of the initial stage analysis have been explained in detail in section 12.2.3.

In this section, some alternatives are given to those categories of fixed conditions. The categories to be analyzed at present are as follows:

a) Stage construction (division of construction section and construction priority)

b) Construction schedule

c) Rate of price escalation for foreign currency portion

d) Financing plan

(2) Alternative Conditions

To analyze alternative conditions corresponding to the above categories, Case 03, which conditions have been analyzed previously in financial case studies, sections 12.3.3 and 12.2.4, was taken for a comparison based and several factors of Case 03 are substituted for the following alternative conditions.

Case 03-1 ..... Construction sections I and II are integrated and a construction priority is followed by the alternative construction schedule-C as shown in Fig. 11.4 of section 11.2.3.

Case 03-2 ..... Same construction staging and priority order as Case 03-1 but the following conditions are substituted for the corresponding factors of the comparison basis Case 03.

- Repayment of interest of the international loans is subrogated during a grace period by the Government.
- Equity equivalent to the cost of Phase II construction is financed by the equity for the operating body.
- 30% tax is imposed on the annual profit after loan repayment.

Case 03-3 ..... Construction schedule is changed to Schedule-B, which extends from 1983 to 1993 and takes longer period than Schedule-A.

Case 03-4 (Same as Case 12) ..... This is the case where the Government subrogates the liability of interest repayment during grace periods for international loans.

Case 03-5 ..... This is the case where the above Cases 03-3 and 03-4 are substituted for the equivalent conditions of Case 03.

Case 03-6 ..... Price escalation rate of 10% p.a. is applied to the required foreign currency portion.

Case 03-7 ..... The lower proportion of soft loan (about 32% or 50 billion Rupiah at current prices of the required foreign currency portion) is applied to the financing plan as shown in Table 12.19.

Table 12.19 Alternative Financing Plan

	International Finance (Foreign Currency Portion)			Domestic Finance (Local Currency Portion)		
	Agency (A)	Agency (B)	Bond (A)	Bond (A)	Bond (B)	Government
Section I	F/E* +50%	30%	20%	60%	-	F/E+L.A.** +40%
Section II	F/E +20%	30%	50%	60%	30%	F/E+L.A. +10%
Section III	F/E +50%	30%	20%	60%	-	F/E+L.A. +40%
Section IV	F/E +20%	30%	50%	60%	30%	F/E+L.A. +10%

Notes: * Final engineering costs.

** Land acquisition/compensation costs and their physical contingency of 15%.

12.2.6 Results of the Test for Other Alternative Conditions

Results of the financial analysis are presented in Table 12.20 for the substituted conditions (Case 03-1 ∿ 7) for comparison with Case 03.

Table 12.20 Test for Other Alternative Conditioons

Case No.	Max. Repayment in a Single Year (Million Rp.)	First Year of Surplus, (Term): Break-even Point	Maximum Temporary Loan (Million Rp.)
03 (Comparison basis)	38,929 (1997)	2004 (14)	289,330 (2000)
03-1	36,580 (1997)	2004 (14)	285,619 (2000)
03-2	36,580 (1997)	2002 (12)	153,646 (1998)
03-3	45,151 (2000)	2006 (13)	396,547 (2000)
03-4	38,929 (1997)	2003 (13)	165,585 (2000)
03-5	45,151 (2000)	2005 (12)	276,434 (2000)
03-6	43,520 (1997)	2005 (15)	390,143 (2000)
03-7	51,184 (1997)	2008 (18)	633,442 (2001)

The alternative division of construction section (Case 03-1) does not have an effect of improving the break-even point (maturity).

The Differences in construction Schedule-A and Schedule-B (Case 03-3) only have the advantage to the operating body of hastening the maturity (break-even point) by one year. On the contrary, the maximum loan repayment and the maximum temporary loan increase by 16% and 37% respectively from those of the comparison.

The Government's subrogation of the repayment of international loan interest during the grace periods (Case 03-4), which total about 15 billion Rupiah, brought about a shortening of the period to maturity by one year from that of the comparison. The maximum temporary loan, however, was reduced to about half of the comparison.

Case 03-5, which combines the conditions of Case 03-3 and Case 03-4, hastens the maturity period by 2 years compared with the comparison.

The application of price escalation rate of 10% p.a. (Case 03-6) for the foreign currency portion delays maturity (break-even point) by one year.

As compared in the above table, the introduction of a higher proportion of soft loan (Case 03, comparison basis, accounts for

58% or about 90 billion Rupiah of and Case 03-7 accounts for 32% or about 50 billion Rupiah of the total foreign currency portion) to the financing plan contributes greatly to attaining the maturity (break-even point) much earlier than other cases, namely it is improved from 18 years to 14 years.

Generally, substitutions of alternative conditions for construction schedule, subrogation of interest repayment by the Government and the price escalation rate for the equivalent conditions of the comparison will not contribute greatly to improving the break-even point but a higher proportion of soft loan will considerably.

The computer outputs for the financial case studies conducted so far are presented in Appendices 12.9 through 12.57.

CHAPTER 13

FORESEEABLE ECONOMIC AND SOCIAL IMPACT

Chapter 13 FORESEEABLE ECONOMIC AND SOCIAL IMPACT

13.1 General

Orginally, this Harbour Road was planned based on the requirements the transport sector to serve as one of the urban facilities but since this project will be a large project, it will have various impacts on the area during the construction period as well as after completion of the project.

With regard to the impact during the construction period, it is anticipated that there will be extensive development in the construction sector and supporting sectors because of continuous investment in the sector for more than five years up to a decade.

The important of proper control and adequate policy to achieve economic stability in the area should be considered because of the rapid economic growth resulting from the continuous investment in the sector.

As for the impact after completion of the Harbour Road, the following can be expected.

First, it is considered that the Harbour Road will contribute to the urban development not only in the adjacent area but also in a wide area of influence.

Especially, the function of Harbour Road combining two kinds of major transport facilities i.e. port of Tg. Priok and Cengkareng Airport will present a large impact on the development of various urban facilities and activate economic development in the area accordingly.

Secondly, when Harbour Road is constructed and open to traffic, the access will become easier for the urban redevelopment which is required to achieve targets of the DKI Jakarta Masterplan.

In the residential area near the road, some noise problems can be expected if the area is not planned and developed keeping the conditions moderate.

There will also be another impact on the urban environment, that is the impact on the drainage system.

The Harbour Road runs from east to west in the working part of DKI Jakarta, which means this road crosses all the rivers and canals discharging into the sea. In the planning of the road, the conditions or levels as related to drainage or flood control must be studied in order to maintain the present situation as a minimum requirement.

13.2 Impact on Labour Employment

An new employment opportunity is one of the most beneficial social impacts created by the construction of Harbour Road.

Table 13.1 shows the estimated number of labourers which will be needed during the period of construction. According to this estimation and the construction schedule presented in Chapter 11.2, the maximum average labour intensity, when all sections are constructed at same time in the year of 1988 in construction schedule Case-A, is estimated to be about 5,200 persons per day. While, the minimum labour intensity, when only section 1 is constructed in the year of 1988 in construction schedule Case-B, is estimated to be approximately 430 persons per day.

In either case, two sections are planned to be constructed in parallel, during most of construction period, so that an average number of labourers of at least 2,000 persons per day will be continuously needed.

It is considered that such a social impact as the large number of labour employment required due to the construction of Harbour Road is not temporary but will be continuous during 5 to 10 years.

Table 13.1 Estimation of Labour Employment

Division	Construction Section				Total
	1	2	3	4	
Number of Total labourers [person x day]	253,640	1,206,800	886,730	1,627,140	3,974,310
Average Number of Labourers per day [person]	430	1,720	1,260	1,740	5,150
Number of Working Days for Construction [day]	585	702	702	936	-

13.3 Impact on Urban Development

13.3.1 Characteristics of Harbour Road and Impact on Urban Development

Harbour Road has some characteristics which may influence the urban development in the surrounding area.

Taking into account three main characteristics of Harbour Road, the impacts on the urban development are considered to be as follows:

(1) Impact 1

Harbour Road will contribute to combine two major ports of entry, namely Tg. Priok Port and Cengkareng Airport.

This function will present the impact to increase the potential for development of the hinterland area.

The hinterland area of the prot generally consists of the following facilities.

- Industrial park;
- Free zone (Industrial factories, or warehouses);
- Distribution facilities (warehouse, truck terminal, distribution center, etc.)
- The relevant commercial or service facilities (Financial, commercial, business facilities)

The formation of the hinterland area of a port is very significant to the development of the economic conditions and to the effective investment in the port.

Especially, there exists a great capacity and possibility of development of a hinterland area to the south of Tg. Priok facing Harbour Road.

(2) Impact 2

This Harbour Road will form part of the Ring Road of DKI Jakarta functioning to connect the west part and the east part of the city and also to promote the development of such urban facilities as follows:

- Commercial facilities related to motorization (Shopping center with a large parking area, etc.);
- Urban transportation facilities such as bus terminals or delivery centers of bus, taxi;
- Commercial and business facilities with a wholesale and delivery function;
- Sub-urban housing development;
- Industrial park development;
- Distribution facilities;
- Recreation facilities.

Furthermore, the Harbour Road forms part of Jakarta Intra Urban Tollway and serves for urban trip movement.

(3) Impact 3

Harbour Road will present a long trip service to the housing, commercial, recreation facilities accumulated in the surrounding area.

Harbour Road will contribute to changing the quality of the accumulated urban functions and at the same time, give rise to a high-degree utilization of landuse.

The establishment of Harbour Road would serve as an influence to activate redevelopment or renewal of the mixed, disorderly districts and provide an opportunity for such an enterprise.

13.3.2 Necessity of Redevelopment of Pluit Area

Related to the construction of Harbour Road, it is recommended that Pluit area be redeveloped to make best use of the effects caused by the establishment of Harbour Road and to solve some existing urban problems in this area.

(1) The characteristics of Pluit area, the existing landuse of which is mixed and disorderly, and where the housing area is undeveloped, can easily receive the impact on an urban development of Harbour Road.

In other words, this area has an urgent necessity for redevelopment from an urban planning point of view.

(2) Some warehouses and some factories having a strong relation with Tg. Priok Port have been accumulated here, however, these facilities are planned to be removed or relocated in order to establish the hinterland area for the port.

Therefore, this area will attain a foreseeable change in the near future, and a new land utilization plan after the relocation of these warehouses is expected at present.

(3) Improvement of physical conditions of an area receiving the impacts of Harbour Road should be promoted. Physical planning required for this purpose will include the following components:

- Development of the urban roads network;
- Effective land use and urban facilities development;
- Appropriate allocation of buildings facing Harbour Road in consideration of protection from the noise, air pollution and other environmental problems.

(4) As for the problems of execution, the difficulty of land acquisition is assumed. The construction of Harbour Road in this area should be carried out with a relation-

ship of the redevelopment in order to avoid a social upheaval caused by land acquisition.

The definition of planning area should be decided based on consideration of the following factors:

- The influence area of the construction;
- Masterplan and urban planning roads network;
- Size of neighbourhood unit or formation of community.

Taking account of the above conditions, the recommended planning area would be difined to be approximately 260 hectares including both a part of Kel. Penjaringan and a part of Kel. Pekojan as illustrated on Fig. 13.1.

However, from an urban planning point of view, it is recommended that the defined area of 260 hectares be divided into 2 parts characterized as follows in considering the priority of performance.

(1) The planning area to be developed urgently related to the construction of Harbour Road (Initial Planning Area).

    - This area is assumed to be approximately 170 hectares bounded with Jl. Raya Pluit Selatan, Jl. Gedung Panjang, Jl. Bandengan Utara, and Jl. Jembatan Tiga.

(2) The planning area to be developed in the future in relation to the urban planning roads and the establishment of development in the initial planning area (Secondary Planning Area)

    - This area is assumed to be about 90 hectares bounded with Jl. Bandengan Selatan, Jl. Raya Pejagalan, Jl. Pangeran Tubagusangke, and Jl. Jembatan Dua.

The proposed tentative masterplan in the initial planning area, the development direction of which is to establish the orderly mixed area with housing, commercial and industrial facilities with the population of about 40,000 persons, is shown in Fig. 13.2 and further information is given in Appendix 13.1.

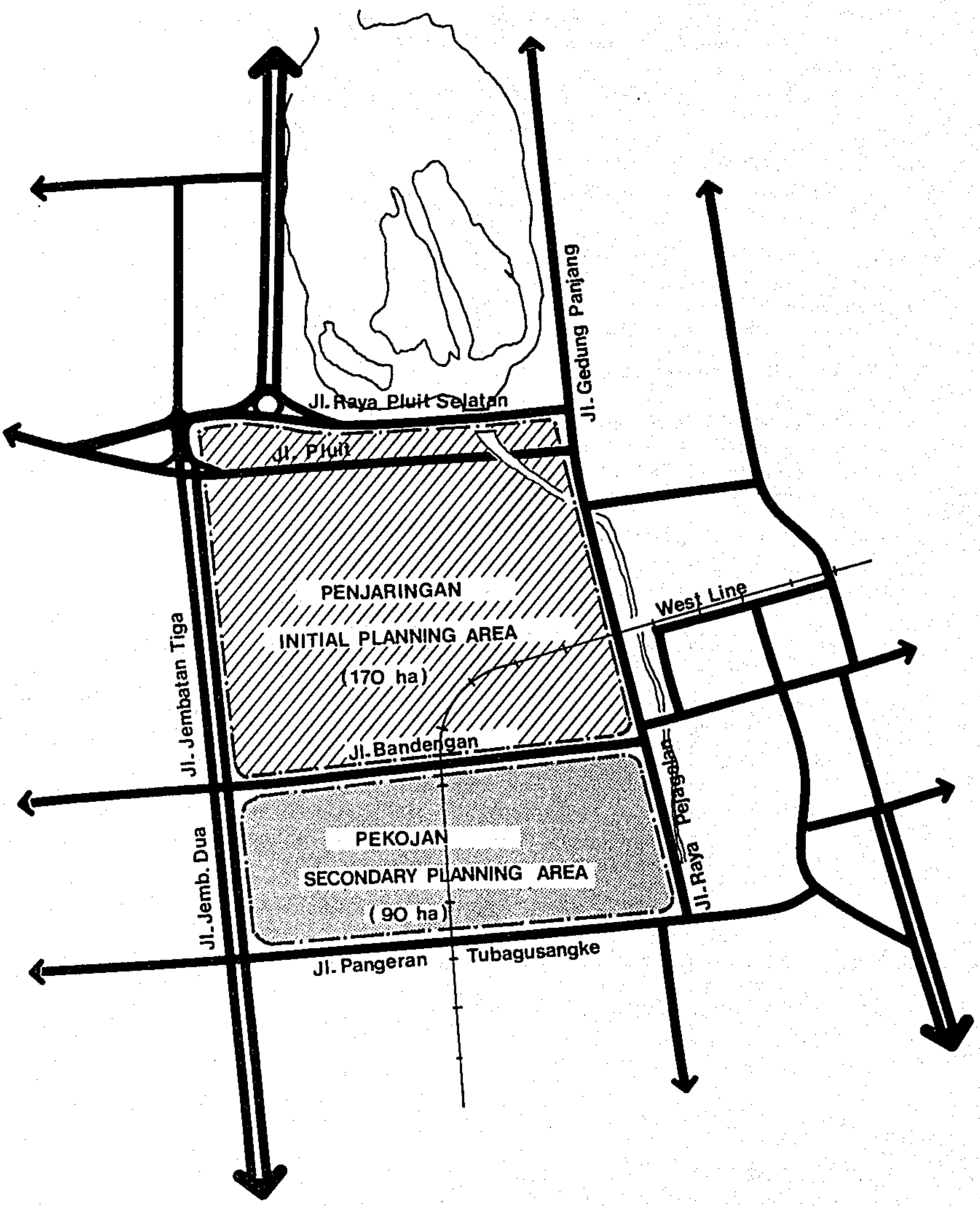


Fig. 13.1 Planning Redeveloped Area

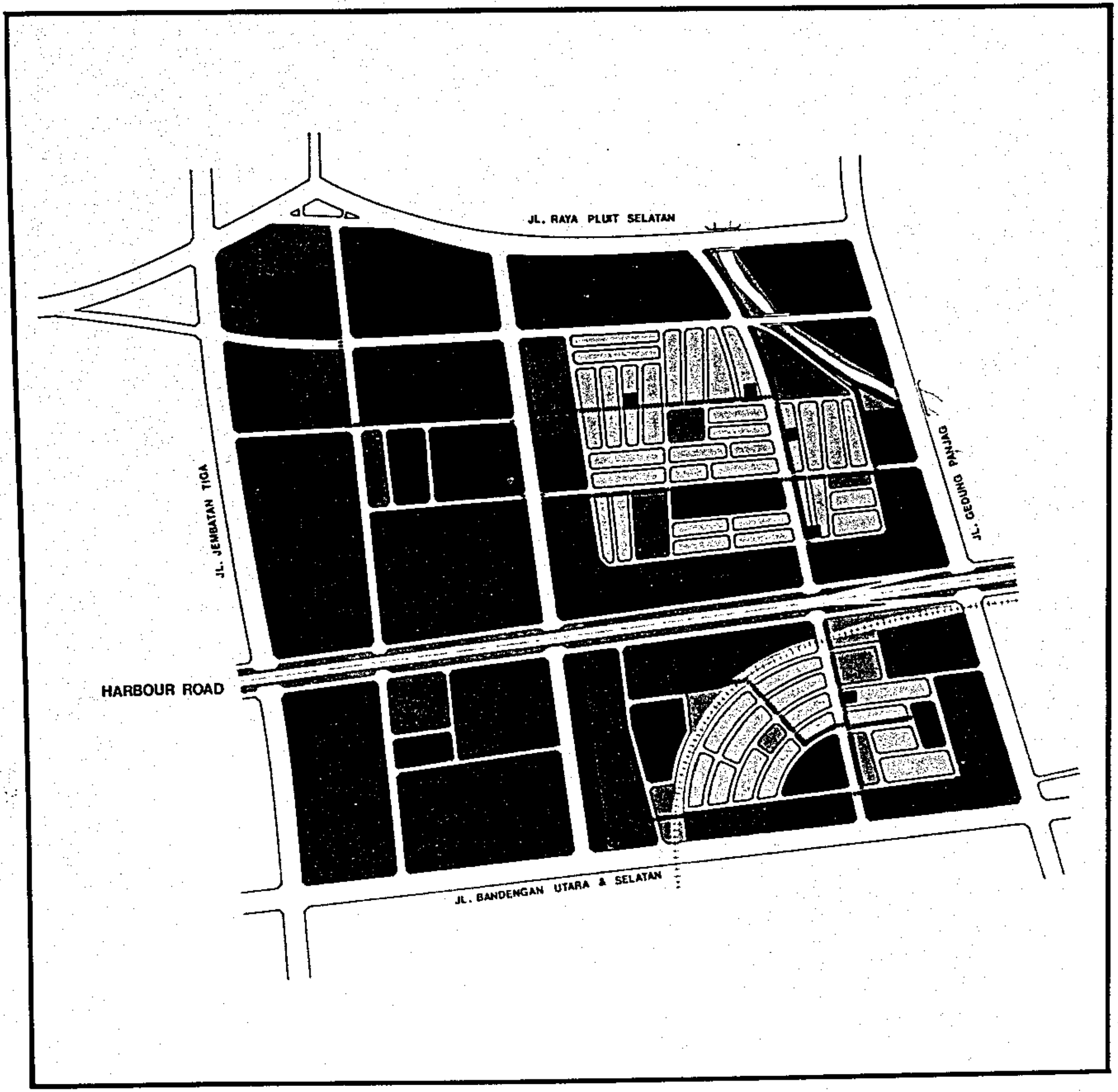


Fig. 13.2
MASTER PLAN
FOR REDEVELOPMENT
IN PENJARINGAN

LEGEND

- COMMERCIAL LAND USE
- INDUSTRIAL LAND USE
- HIGH DENSITY RESIDENTIAL LAND USE
- LOW DENSITY RESIDENTIAL LAND USE
- PUBLIC & SEMI-PUBLIC FACILITIES
- PARK & GREEN
- PEDESTRIAN PATH

N

0 100 500m

JAKARTA
HARBOUR ROAD
PROJECT

13.4 Impact on the Natural Environment

13.4.1 Noise Effects by Traffic on the Road

In the section, the effects of noise from traffic along the frontage area of the road is analyzed. The noise levels caused by the road are shown in Fig. 13.3 with alternative land use of the frontage area as well as alternative cross section of Harbour Road in the form of noise level contour.

Conditions

- Noise Generator — Harbour Road; Frontage Road
- Obstacles — with building (H = 15 m); without building
- Height of Generator — Embankment (H = 5 m); Viaduct (H = 7 m)

Results

	Noise Level at 50 M from R.O.W. dB(A)	
	without Building	with Building
Embankment	62	43
Viaduct	64.5	48

The results indicate that if the proposed road runs in the residential area, it may require some countermeasures to maintain good conditions for the residents.

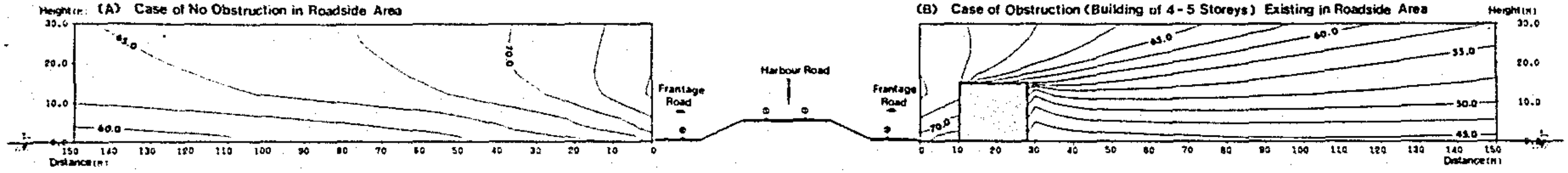
13.4.2 Impact on Existing Drainage System

The "MASTERPLAN for DRAINAGE and FLOOD CONTROL OF JAKARTA" covers the rivers, canals and polders in the Project area. The hydrological study was made in line with the principles and recommendations of the "MASTERPLAN". The influence on the local drainage is therefore minimized or maintained as existing conditions by providing the additional openings analyzed in the Project. The existing drainage situation will therefore not be aggravated by the construction of the Project Road.

13.4.3 Effects on Fish Ponds

Four fish pond areas are defined along the Project Corridor. They are located at Kanal/Kapuk Muara, Penjagalan, Ancol and Sunter and characterized as brackish water ponds connected to the Java Sea through canals.

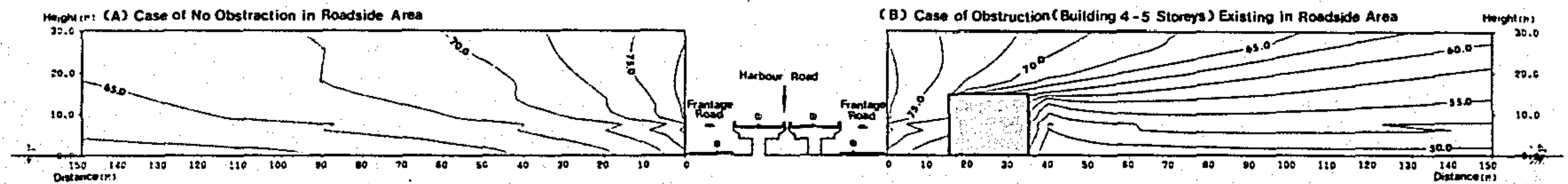
CASE 1 – EMBANKMENT (H = 5 m)



Traffic Condition

	Traffic Volume on Peak Hour	Mixed Ratio of Large Vehicles	Design Speed
1	2,572 (Vhs/Hr)	12.8 (%)	80 (km/Hr)
2	1,308 (〃)	12.2 (〃)	30 (〃)

CASE 2 – VIADUCT (H = 7 m)



Traffic Condition

	Traffic Volume on Peak Hour	Mixed Ratio of Large Vehicles	Design Speed
1	4,937 (Vhs/Hr)	14.9 (%)	80 (km/Hr)
2	2,073 (〃)	18.4 (〃)	30 (〃)

Fig. 13.3 Tentative Noise Study at Peak Time

The species of fishs include milk fish, telopia, shrimp, kakap and mugil. Among these, milk fish accounts for 50 percent of the products. The annual products is estimated at 562 ton per hectar. The product amount is found to be one third lower than the productivity in other fish ponds in Indonesia. This may be due to low water quality caused by pollution from the surrounding area. The area is tending to be converted to other land use approved by DKI Jakarta.

Under these circumstances the drain water from the Project Road can be assumed to have less influence on the existing water quality of fish ponds. The owners and workers should however be firmly compensated for their land/facilities and activities.

13.4.4 Consideration on the Separation of the Existing Community

The construction of a road sometimes results in the separate the existing communities. In some parts, the area can be redeveloped coordinating the construction of the road in the redevelopment. In planning of the road, it is considered desirable to avoid busy communities as much as possible and not to separate them and to provide bridges, viaducts and box culverts as much as possible to maintain the present activities as well as the expected future activities.

ANNEX:

PARTICIPANTS OF THE FEASIBILITY STUDY FOR JAKARTA HARBOUR ROAD

"ANNEX"

PARTICIPANTS OF THE FEASIBILITY STUDY FOR JAKARTA HARBOUR ROAD

(1) DIRECTORATE GENERAL OF HIGHWAYS

1.	Mr. Harun Al Rasyid	(Director of Planning)
2.	Mr. Djuned Djohari	(Secretary of Planning)
3.	Mr. Wiyoto Wiyono	(Sub. Director of Urban Highways)
4.	Mr. Anas Abdul Madjid	(Project Officer of Jakarta Intra Urban Tollway Project)
5.	Mr. Muksin	(Project Manager of Urban Highways)
6.	Mr. Wiharso	(Chief of Highway Engineering, Sub. Directorate of Urban Highways)
7.	Mr. Trihardjo	(Chief of Traffic, Sub. Directorate of Urban Highways)
8.	Mr. Parlindungan	(Project Officer of Jakarta Harbour Road, Urban Highways)
9.	Mr. Arief Budiartono	(Counterpart, Planning Section, Urban Highways)
10.	Miss Apriatini S.	(Counterpart, Planning Section, Urban Highways)
11.	Mr. Sahat S.	(Counterpart, Planning Section, Urban Highways)
12.	Mr. Yanuar M.R.O.	(Counterpart, Sub. Directorate of Highway Engineering)

(2) GOVERNMENT OF DKI JAKARTA

1.	Mr. Ediwan Sukiman	(Bureau of City Planning, DKI)
2.	Mr. Budihardjo	(Regional Development Borad, DKI)
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4.	Mr. Ika Effendi S.	(Counterpart, Bureau of City Planning, DKI)
5.	Mr. Syamsu Ramli	(Bureau of Public Works, DKI)
6.	Mr. Darmanto	(Bureau of Public Works, DKI)

(3) TANJUNG PRIOK PORT AUTHORITY

1. Mr. Sadhu
2. Mr. R.J. Lino
3. Mr. Yadi Manfaat
4. Mr. Suprihat
5. Mr. Setiawan

(4) INDONESIAN STATE RAILWAYS

1. Mr. Soemarbingar
2. Mr. Soeparno

(5) JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

1) SUPERVISORY COMMITTEE

1. Mr. Ichiro Tanahashi	(Chiarman of the Supervisory Committee)
2. Mr. Shunichiro Kamijo	(Member of the Supervisory Committee)
3. Mr. Masamoto Fukami	(Member of the Supervisory Committee)
4. Mr. Takashi Yajima	(Member of the Supervisory Committee)
5. Mr. Hisakazu Oishi	(Member of the Supervisory Committee)

2) JICA OFFICE

1. Mr. Ryonosuke Goto	(Assistant Representative of JICA, Jakarta)
2. Mr. Nobuyoshi Iwasaki	(JICA, Tokyo)

3) EMBASSY OF JAPAN

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4. Mr. Isamu Gunji	(Team Member, Transportation Planning/Economic & Financial Analyses, PCI)

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6. Mr. Nobuhiro Koyama (Team Member, Transportation Planning, PCI)

7. Mr. Tsuneyoshi Jitsuhara (Team Member, Traffic Engineering, PCI)

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JICA