carefully discussed with the Army.

3) Third Stage Route Location

In the third stage the route of the new road was finalized. The results are shown on drawings (see the Annex), as well as described in the next section where this information is presented.

8.2.6 Interchange Locations

Under general conditions for rural access-controlled highways, interchanges are allocated at intervals of every 15 to 25 kilometers. Special considerations were taken along Ciawi, Cicurug, Cibadak and the Sukabumi section of the new road, since these areas are quite urbanized. Smaller intervals for interchanges are naturally required there because of the traffic demand. Naturally as the intervals decrease, the increased number of interchanges increases the construction costs. This should also be considered.

With the above considerations in mind as the basic concepts in allocating interchanges, the following points were also considered as prospective locations:

- Both sides of medium to large cities
- Near smaller cities
- At the crossings with main arterial roads
- At the access points to major harbors, airports, resort areas
- At the points where access shall be convenient, considering future development potentials

The cities along the new road route are:

Medium to large cities:		Smaller cities:	
Name	Population	Name	Population (1988)
Cibadak	Approx. 130,000	Cicurug	Approx. 66,000
Sukabumi	Approx. 193,000	Ciranjang	Approx. 100,000
Cianjur	Approx. 175,000		

In view of the above considerations, the following is a list of interchanges selected for establishment at the final stage of construction of the new road.

(1)	Ciawi IC	Sta. 1+200
(2)	Cicurug IC	Sta. 11+800
(3)	Cibadak West IC	Sta. 27+200
(4)	Cibadak East IC	Sta. 32+400
(5)	Sukabumi West IC	Sta. 40+000
(6)	Sukabumi IC	Sta. 46+300
(7)	Sukabumi East IC	Sta. 53+500
(8)	Cianjur West IC	Sta. 65+400
(9)	Cianjur East IC	Sta. 75+500
(10)	Ciranjang IC	Sta. 83+700
(11)	Rajamandala IC	Sta. 92+000

1) Ciawi Interchange (Sta. 1+200)

The new road starts on the existing Jagorawi Toll Road at approximately 600 meters toward the Jakarta side from the main Bogor -

Ciawi arterial road. This point is approximately 6 kilometers south from the Bogor Spur of the Jagorawi Toll Road and there is about a further 12 kilometers until the next interchange to the north near Cicurug.

Demand for this interchange is limited to the local traffic and traffic from the southern areas to Puncak and eastwards. Although the demand would be rather small, services presently provided shall continue as a rule.

2) Cicurug Interchange (Sta. 11+800)

The distance between Ciawi and Cibadak, 30 km, is too long when considered in terms of interchange intervals. Therefore an interchange shall be located north of Cicurug City to provide access to that city. This location also has a high tourist potential due to the location of Lake Lido there.

3) Cibadak West Interchange (Sta. 27+200)

In the existing road network Cibadak forms the connection point to the southern coastal region of West Java Island. Activities such as agriculture, forestry, fishing, and tourism are located in this region. An interchange has been proposed at Cibadak to provide better access to the Jakarta metropolitan area and support the development of these activities. Locating the interchange west of Cibadak will serve the major traffic flow direction in that region.

4) Cibadak East Interchange (Sta. 32+400)

The function of this interchange would be to provide thru traffic along existing roads in the region access to the new road in order to bypass Cibadak City. This would also contribute to mitigating traffic congestion within the city. However at present the traffic volume anticipated does not warrant the construction of this interchange. It may become necessary in the future as the volume increases.

5) Sukabumi West Interchange (Sta. 40+0)

Traffic conditions within Sukabumi City are worsening every year, and it has become necessary to separate traffic bound for Sukabumi from thru traffic. This interchange provides access to the new road to allow thru traffic to bypass the city. Furthermore the traffic generated in Sukabumi is mainly bound for the Jakarta metropolitan area, and shall be served by this interchange which provides it access to the new road.

6) Sukabumi Interchange (Sta. 46+300)

The highlands located at the foot of Mt. Pangrango have a high potential as resort areas. This interchange could support the development of that region as well as serve the Sukabumi City center. However considering the function of this road section between Sukabumi West and East interchanges serving as a bypass of Sukabumi the interval distance will become small if this interchange is constructed. Also the traffic volume projected to use this interchange is low. Therefore at present this interchange is not included in the road plan but should be

considered in the future based on traffic conditions.

7) Sukabumi East Interchange (Sta. 53+500)

The location of this interchange is suitable to realize the function of this section of the new road as the Sukabumi bypass. Furthermore the distance between Sukabumi West interchange and the planned Cianjur West interchange is 28 km, which is rather long in terms of interchange interval and is shortened by the proposed interchange.

8) Cianjur West Interchange (Sta. 65+400)

Within the existing road network the city of Cianjur is the connecting link to the coastal region of Sindang Barang in the south. The high agricultural potential of that area can be supported by this interchange. The interchange also provides access to the new road for Jakarta metropolitan area bound traffic generated in Cianjur as a more attractive alternative than travelling through Puncak.

9) Cianjur East Interchange (Sta. 75+500)

The interval distance between Cianjur West interchange and the interchange to be located at Ciranjang is not so long as to warrant this interchange. The Cianjur city traffic volume that may be served by this interchange is not large to justify the construction of the interchange at this time.

10) Ciranjang Interchange (Sta. 83+700)

This interchange shall along with Cianjur West interchange provide exit and entry points to the Cianjur City bypass for thru traffic. In addition it may be better to shorten the interval distance between Cianjur West interchange and Rajamandala interchange, of 25 km. The interchange shall also serve the town of Ciranjang.

The local road running nearby the interchange shall be used as the access between the existing road and the interchange. This local road has a bottleneck at the point where it crosses a railway and then joins the arterial road. This road should be improved.

11) Rajamandala Interchanges (Sta. 92+00)

The new road utilizes the existing Rajamandala Toll Bridge limiting access by local usage which is available presently. Therefore, the Rajamandala Interchanges are located at both sides of the existing toll bridge. The type of interchange placed here should be a half type one to maintain the function of the existing toll road system used by the local people.

12) End of the Project (Sta. 101+700)

At the end of the project there is a crossing point where the new road crosses the existing road. No interchange is planned by this Study since the subject will be well coordinated by the Cikampek - Padalarang Toll Road Project.

8.3 Design Standard

8.3.1 General

The road's design standards will be set in accordance with its own characteristics, traffic demand, construction cost, operating benefits, etc.

The new road will be a main national highway which will connect the cities of Ciawi, Cibadak, Sukabumi, Cianjur and Bandung. Therefore, the road will be of a high design standard as a toll road for vehicles traveling at high speeds.

Based on standard specifications for the geometric design of expressways and freeways (No. 13A/1976 issued by Bina Marga), the design speed of the highway is 120 km/hour in sparsely developed areas. At present, expressways operated as toll roads have heavy traffic loads and are designed based upon the above standards.

The traffic demand on the new road will be about 14,000-20,000 vehicles/day, so traffic volume is classified in the middle range. The new road will travel along the foot of Mt. Pangrango and other mountains. The type of terrain located here is mountainous and rolling.

Construction costs in rolling or mountainous terrain are usually higher than in flat terrain. The benefits derived from operating the road are normally lower if compared with the construction costs.

Therefore, the standards adopted for design on this new road should be lower than the above standard.

8.3.2 Design Speed

The design speed for the new road shall be set at 80 km/hour which is rather low if compared with standards given in the Standard Specifications for Geometric Design of Expressways and Freeways.

Resulting from the route location, the route sections with design speed of 80 km/hour are limited to the sections with steep vertical gradients. About 80% of the route sections can have a design speed of more than 80 km/hour. Details are described in Section 3.4.2 "Preliminary Geometric Design".

8.3.3 Geometric Design Standard

The geometric design standard on the road is basically determined by the design speed.

Route alignment factors as horizontal curve radius, vertical gradient, and stopping sight distance are directly related with the design speed. The width of carriageway, shoulder, etc., are also influenced by the design speed.

Therefore, the limits of the route alignment factors are directly determined by the design speed in the case of designing the route alignment.

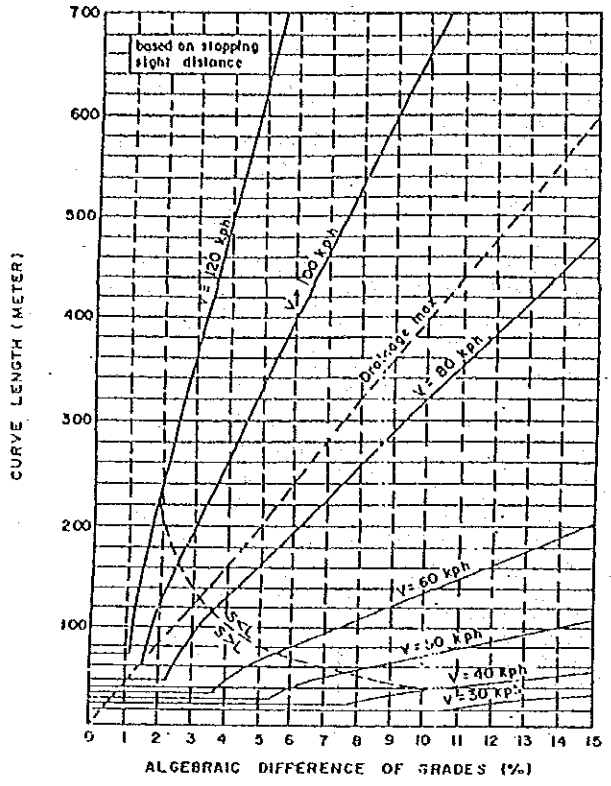
The geometric design standards for the new road are shown in Table-8.3.1 and Fig.-8.3.1. Fig.-8.3.2 shows a full four (4) lane typical cross section.

The geometric design standards satisfy the Highway Classification Secondary IIA in the Standard Specification for Geometric Design of Rural Highways published by Bina Marga.

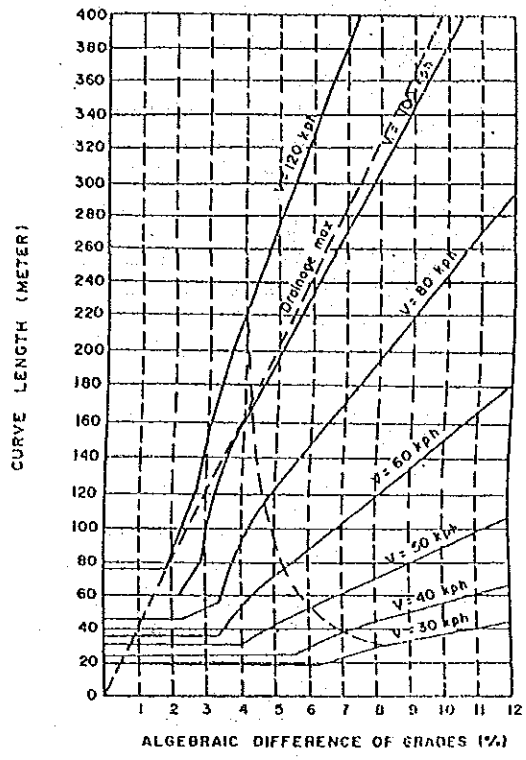
Table-8.3.1 Geometric Design Standards

Item	Unit	Recommended Design Standard
Terrain		Rolling
Design Speed	Km/h	80
Reserved R.O.W width	Meter	as design
Carriageway width	Meter	3.5
Outer shoulder width	Meter	2.5
Inner shoulder width	Meter	1.0
Median width	Meter	5.0, 7.0 1)
Cross slope of pavement	%	2.0
Type of pavement		Cement Concrete
Maximum Superelevation	%	10
Maximum Radius Curve	Meter	210
Maximum Gradient	%	5 2)
Stopping sight distance	Meter	115
Minimum vertical curve Length	Meter	See Fig. 8.3.1

Note :
1) 5.0 meter will be designed in case of full 4 lane construction, 7.0 meter will be designed at widening to final 4 lane on staged construction
2) 5% is maximum gradient without climbing lane



Length of Crest Vertical Curve



Length of Sag Vertical Curve

Fig.-8.3.1 Length of Vertical Curve

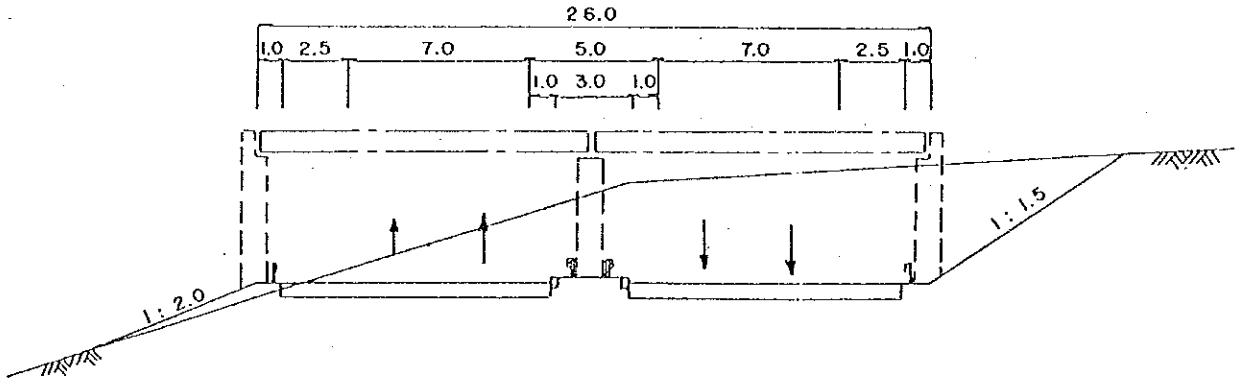


Fig.-8.3.2 Full 4 Lane Typical Cross Section

8.3.4 Design Consideration for Staged Construction

In case of rather low traffic volume, the road should be operated as a provisional 2 lane road.

Two alternatives are considered for a two lane road. One alternative is that work on a four lane road will be constructed and only the pavement will be completed for one (1) lane in each direction (see Fig.-8.3.3).

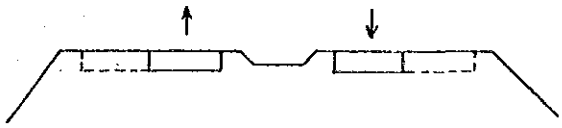


Fig.-8.3.3 Alternative 1 of Staged Construction

The other alternative is shown in Fig.-8.3.4. Half of the final 4 lane construction work will be completed on one side, and the road will be operated as dual direction.

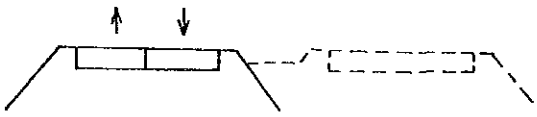


Fig.-8.3.4 Alternative 2 of Staged Construction

Alternative 1 offers the reduction of only 2 lane pavement construction cost which will not contribute much to decreasing the first stage investment.

In the case of alternative 2, serious accidents may occur as head-on collisons will probably take place more frequently.

A simple median strip will be considered between each carriageway to enforce traffic safety if alternative 2 is adopted.

The structure of the simple median strip is shown in Fig.-8.3.5.

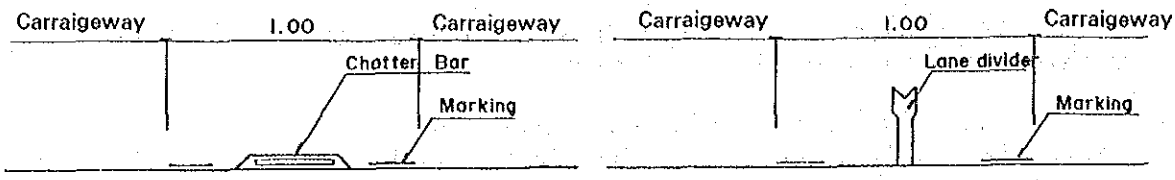


Fig.-8.3.5 Simple Median Strip for 2 Lane Road

The width of the median strip should be 1.0 m. The median strip will consist of two facilities; lane marking set at the edges within the median strip, and a lane divider or chatter bar set at the center.

The lane divider is made of flexible rubber and shaped as shown in Fig.-8.3.5.

The median strip will form a dividing line between the two lanes, however emergency vehicles should not be hindered from crossing into the other direction lane when necessary. The typical provisional two lane cross section is shown in Fig.-8.3.6.

Over-taking will be controlled by this median strip, so normal vehicles will be obliged to travel behind slow speed vehicles. An over-taking (passing) lane should be set at every 6-10 km. The passing lane locations are shown in Fig.-8.3.7.

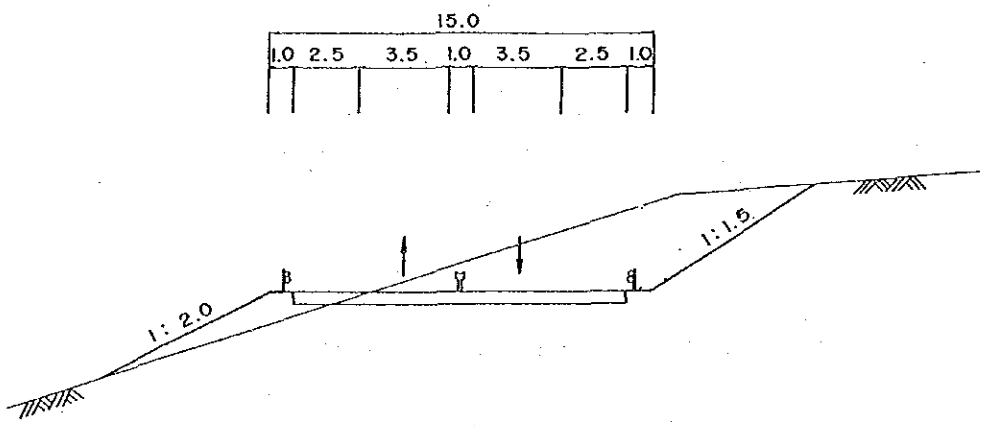


Fig.-8.3.6 Typical Cross Section on Provisional Two Lane Staged Construction

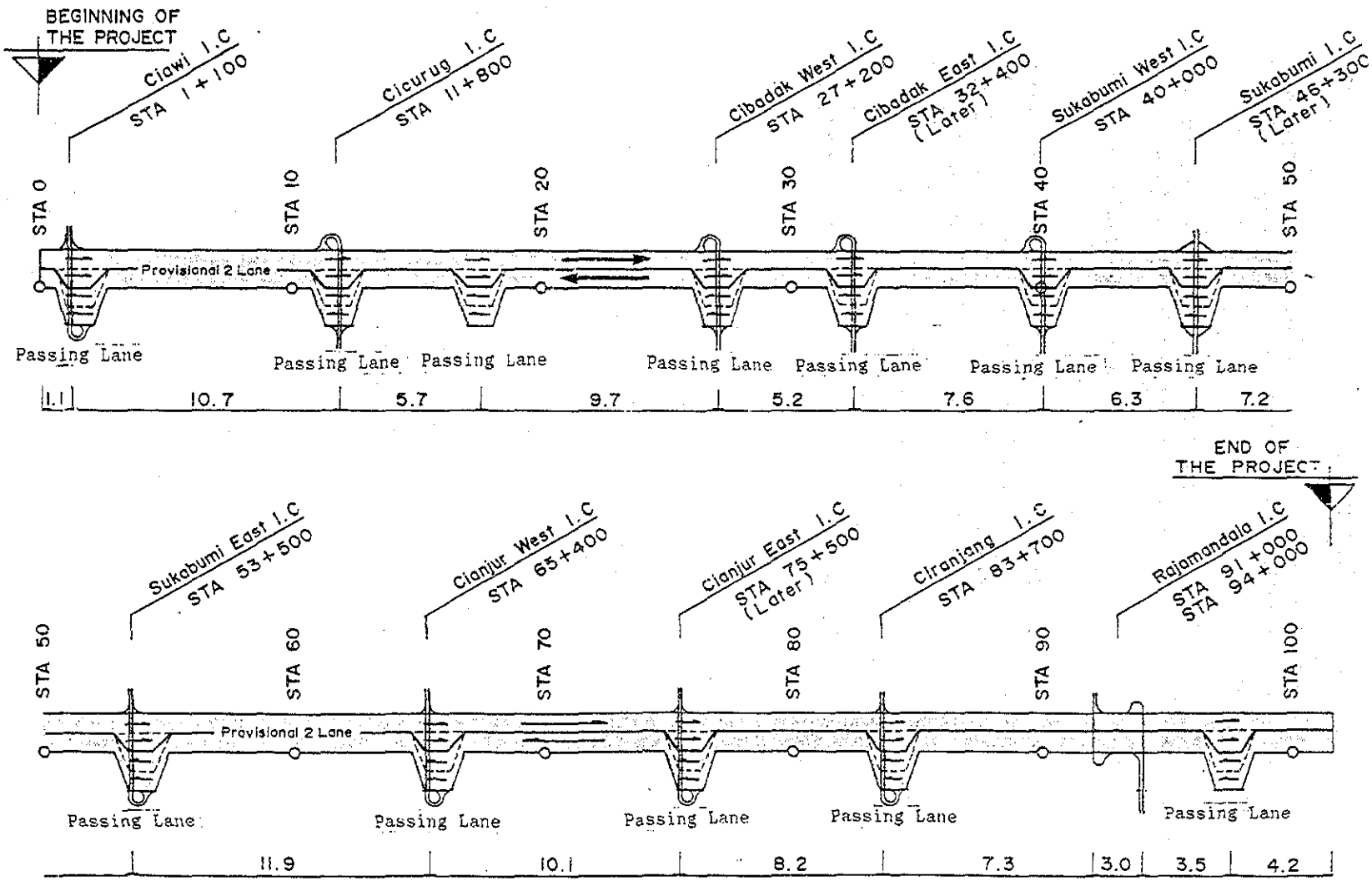


Fig.-8.3.7 Location of Passing Lane

8.3.5 Median Strip Width in Final Stage

The project road will be an access controlled road therefore, over bridges or box culverts should be constructed at crossing points of the existing roads and the new road.

In case of over bridges, abutments and piers should be set behind guardrails as shown in Fig.-8.3.8 in the provisional stage.

An abutment (or a pier) should be used as the center pier of the over bridge in the final stage.

In the final stage, the left side carriageway will be reset beside the left side shoulder. The clearance between the carriageway and the center pier should be 2.0 m as shown in Fig.-8.3.8. The inner shoulder is 1.0 m, clearance from the curb to the guardrail is 0.5 m, and from the guardrail to the pier 0.5 m. The width of the pier is approximately 1.0 m, therefore the median strip width should be 7.0 m in the final stage.

Typical cross sections on staged construction are shown in Fig.-8.3.9 and Fig.-8.3.10.

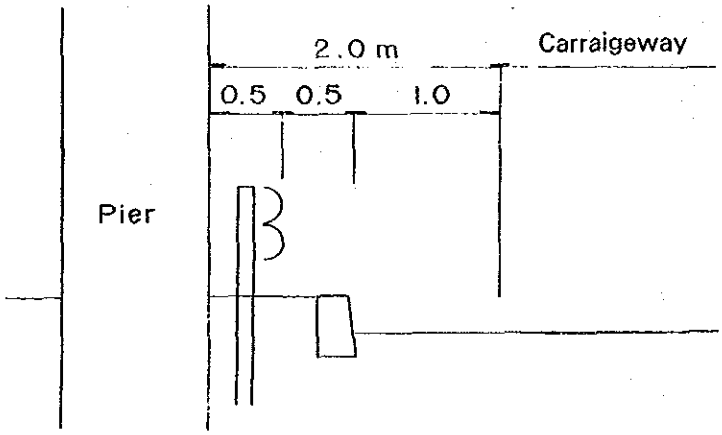


Fig.-8.3.8 Clearance between Carriageway and Pier

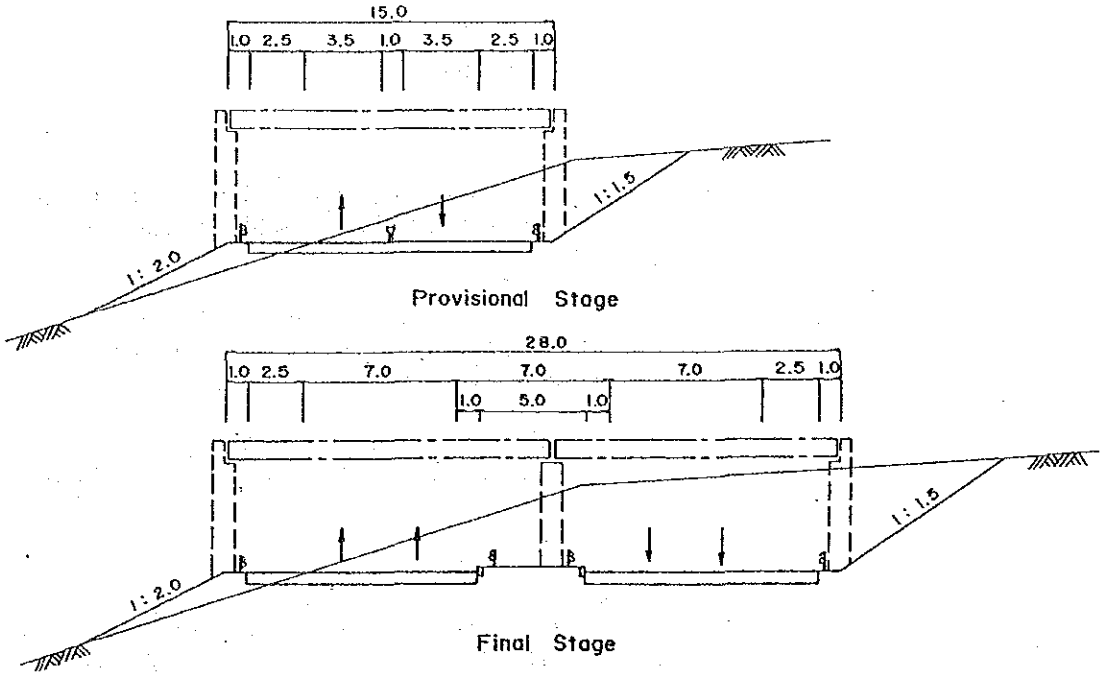


Fig.-8.3.9 Typical Cross Sections on Staged Construction

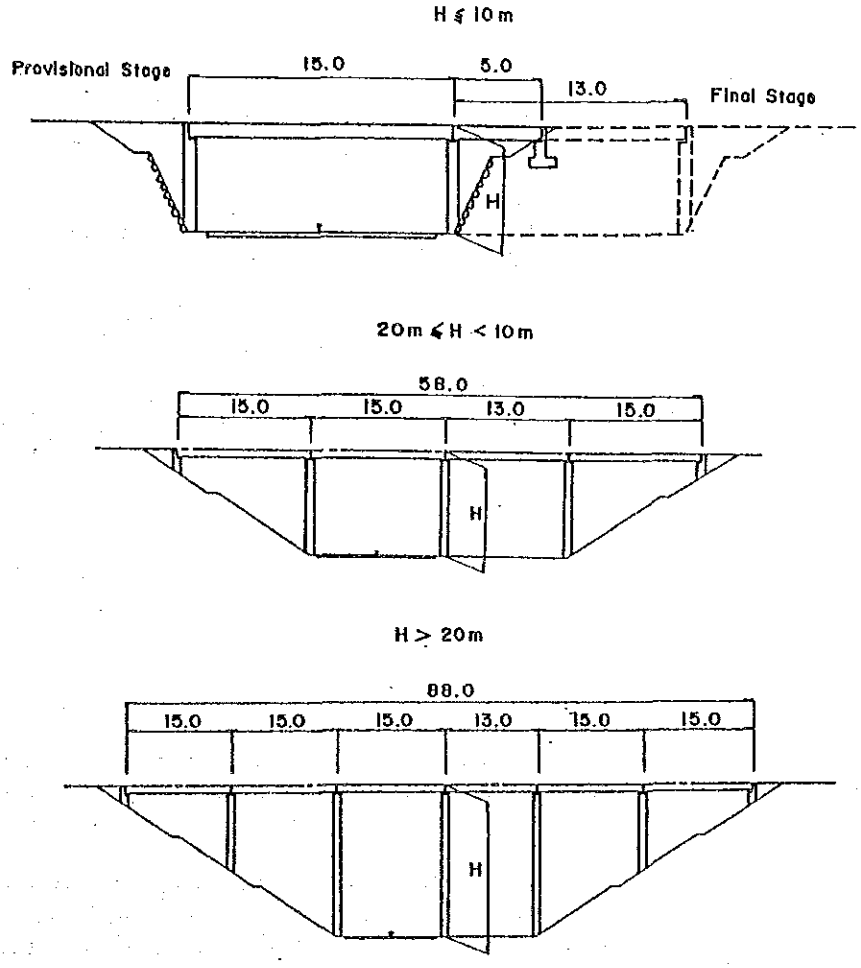


Fig.-8.3.10 Standard Module of Over Bridge on Stated Construction

8.4 Preliminary Design

8.4.1 Engineering Features by Section

1) Ciawi - Cicurug

The starting point of the route will be connected with the end of the Jagorawi Toll Road. The connection point will be located at the end of the Cibalok River Bridge.

This new road will travel along the west side of the intersection crossing the existing Puncak-Bogor road in order to avoid regional facilities such as mosques, schools, etc.

Flat areas are used as paddy fields and hilly areas for farming and cultivation. Residences continuously lie along the existing main road and village roads. Several villages have been developed at the northeast side of Lake Lido.

The route section from its starting point at Sta. 0 to Sta. 7 will be located west of the existing main road. The route will cross Cikereteg River (Sta. 4) and the Cimande River (Sta. 6) if possible at a right angle. After crossing the existing road at Sta. 6+600, the route will travel east of the existing road to avoid control points such as residential areas and regional facilities.

A vast rubber plantation is located southeast of Lake Lido. The plantation is situated at the foot of Mt. Pangrango resulting in higher elevations in the southeast. The route will pass through the northeast edge of Lake Lido to avoid the plantation.

Cicurug city has been developed along the existing main road section from Sta. 17 to Sta. 19. The existing railway runs side by side with the existing main road.

The route will be located so as to avoid Cicurug city and residential areas, and also reduce crossings of power lines. Southeast from the route the terrain is mountainous at the foot of Mt. Pangrango. The route avoids these areas.

At route crossings with existing roads and canals, road structures such as main bridges, over bridges, box culverts and pipe culverts will be constructed. The new road will be of the embankment type at the paddy fields to maintain water supplies flow crossing the road culverts.

2) Cicurug - Cibadak

This section is formed of steep mountain terrain. Land uses are mainly farming and cultivation. The route will be located so as to avoid villages dotting village roads.

The section of the route passing alongside the mountain is located at higher elevations, so it will be difficult to set the gradient within the maximum limit of 5 percent. Vertical alignments in this section take into consideration balancing cutting depth and embankment height. Maximum cutting depth and maximum embankment height are about 30 meters and 20 meters respectively.

3) Cibadak - Sukabumi East

The land use in this section is mainly classified by paddy fields at the foot of Mt. Pangrango.

Geographical features show a gentle climb towards the north. Ground elevations along the route rise from 400 meters to 800 meters. The average inclination is about 1.7 percent.

Residential areas, as a control point of the route, are dotted along the existing main and village roads.

The route will be located so as to avoid residential areas, especially the police academy located north of Sukabumi city.

4) Sukabumi East - Cianjur West

The land use of this section mainly consists of fields, similar to the Cibadak-Sukabumi section.

Ground elevation near Sta. 57 passing by Sukabumi East Interchange is about 850 meters which is the highest elevation throughout the route. The average inclination from the above point to Cianjur West Interchange is about 4 percent which is the steepest gradient through the route. The route location will avoid village areas.

There is a mountain (990 meters above sea level) at Sta. 59. The route will travel south of the mountain as the vertical gradient of the northern route would be too steep.

5) Cianjur West - Ciranjang

The route will be located south of the existing main road to avoid Cianjur City areas.

Ground elevations through the route gradually descend with a 1.4 percent grade to the Ciranjang Interchange.

The land is mainly used for paddy fields. There are several small mountains from Sta. 70 to Sta. 72. The route will avoid these mountainous and village areas. The route will cross the Cilaku and Cisokan Rivers at right angles as much as possible.

Vertical alignment will be set at 1 - 2 meters above the ground surface as land uses are mainly paddy fields.

6) Cianjur - Rajamandala West

Ground elevations are mostly flat and the land is used for paddy fields. The route will travel south of Ciranjang city to avoid the city areas that have developed along the existing main road, and likewise avoid village areas dotting village roads. The route will be located in such a way to minimize number of crossings of power lines.

The proposed height will be kept at 1-2 meters above the paddy field surfaces, and 4-6 meters above the surfaces of existing roads to construct box culverts in order to maintain the road functions.

7) Rajamandala East - Citatah

Geographical features are characterized by rolling terrain. Land uses are paddy fields or farms and cultivated lands. Residential areas continuously lie along the existing main road. Railways, the Cimetak River, and the existing main road are closely located north of the road.

It will be difficult for the route to be located north of the existing main road, therefore, the route will travel south of it.

The route section from Sta. 100 to Sta. 101 will be located close by the existing main road to avoid the army training fields.

The end of the route will be connected with the Cikampek-Padalarang Tollway.

The route location of the new road is shown in Fig.-8.4.1.

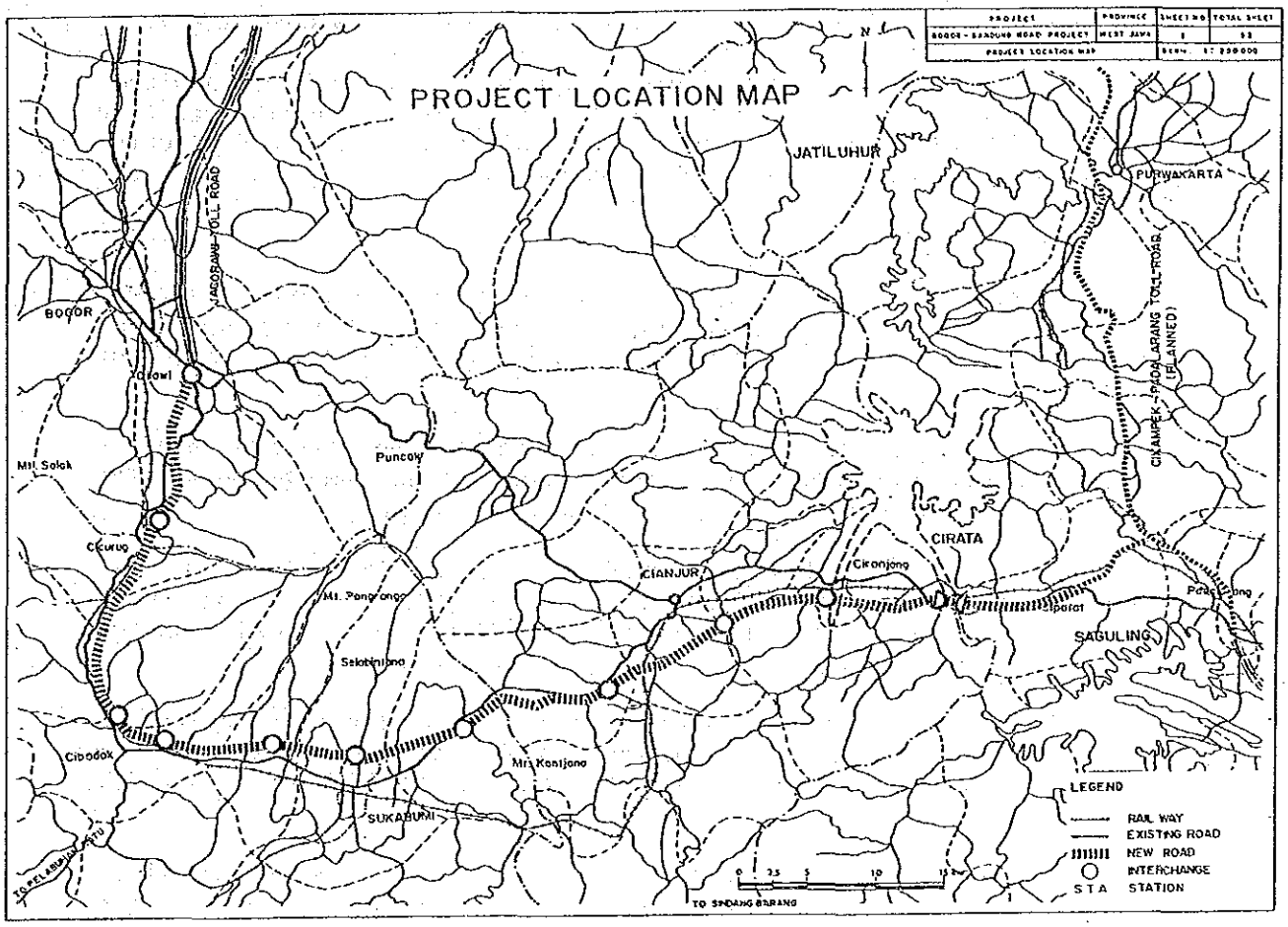


Fig.-8.4.1 Route Location of the New Road

Note: This figure is approximately a 1:20,000 topographic map produced by reducing the 1:5,000 topographic maps prepared by the JICA Study Team.

8.4.2 Preliminary Geometric Design

1) Horizontal Alignment

The minimum radius curve set according to the design speed guarantees a comfortable drive, however cannot totally ensure safety.

Therefore, the minimum radius curve should actually be avoided. It will be desirable to design a horizontal alignment using figures over the desirable minimum radius curve. The desirable minimum radius curve is 400 meters for the design speed of 80 km/hour.

2) Vertical Alignment

Geometric design standard indicates the maximum vertical gradient, however the vertical alignment should be set as gently as possible by considering geographical conditions of features, length of bridges, etc.

Transverse slope will be set for road surface drainage, however a small longitudinal slope should also be set for the same purpose. The minimum gradient of vertical slope will be 0.3 percent.

Minimum vertical curve lengths will be determined by the algebraic difference of two grades. These minimum vertical curve lengths are the minimum figures to lessen the shock between two different slopes and to preserve minimum sight distances.

It will actually be desirable to design vertical curve lengths using over 1.5 to 2.0 times figures of minimum ones, except for unavoidable cases such as steep geographical features or other special reasons.

Vertical alignments throughout the route are shown in Fig.-8.4.2. Vertical gradients from 4 percent to 5 percent are dotted throughout the route, and the total length of these sections is about 20 percent of the route.

3) Relation between Geometric Design and Travel Speed

The route alignment will be actually designed by using higher (lower) figures than those of the geometrical standard. In the sections where horizontal and vertical alignment will be better than the standard, it will be possible to set travel speed at higher speeds than the design speed of 80 km/hour.

From the horizontal alignment standpoint it will be possible to drive at rather high speeds, however the route sections, approximately 20% of the total route, where the vertical gradient is steep, will control the travel speed at the design speed of 80 km/hour.

8.4.3 Major Crossings, Drainage Facilities and Structures

The planned route of the project road passes through steep topography in a mountainous area (Sta. 45), and many main bridges are planned with long and median span lengths in this section. In other sections, most of the bridges are planned with short span length. The average bridge length is 51 m. The average bridge length in the mountainous area is (Sta. 0 - Sta. 45) 79 m.

The numbers of main bridges and over bridges and related data are shown in Table-8.4.1.

Table-8.4.1 Number of Main Bridges and Over Bridges

Structure	Length	Number
Main Bridge	L > 100 m	11
	100 m > L > 50 m	11
	50 m > L > 20 m	7
	20 m > L	30
Over Bridge	L = 88 m	3
	L = 58 m	5
	L = 20 m	54

Major Bridges are shown in Figs.-8.4.3 and 8.4.4.

1) Standardization of Structure

A comprehensive study was made to establish structural standards for main bridges, over bridges and culverts.

The bridge type was determined by span length, construction needs and esthetic requirements. The foundation type was determined as described hereafter.

The structures are as follows :

Superstructure : RC hollow slab
PC simple beam
PC continuous box girder
Steel Truss

Substructure : Wall type
Column type

Foundation : Precast PC pile
Cast in place concrete pile

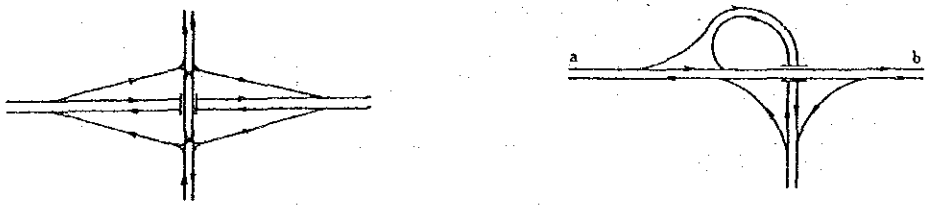
8.4.4 Interchange

1) General

The interchange locations which are already described in Section 8.2.6 of this Chapter, are determined on the basis of future traffic movements and socio-economic conditions in the project area.

The diamond type or trumpet type interchange will generally be designed for access controlled roads. In the case of a tollway, the trumpet type interchange, where it will be possible to gather tollway facilities in one place, will be the typical type used unless otherwise stated.

Fig.-8.4.2 shows the general plan for the diamond type and trumpet type interchanges.



Diamond Type　　Trumpet Type

Fig.-8.4.2 Types of Interchanges

2) Design Standard

Accident rates on access controlled roads are significantly high at interchange sections, so it is not proper to apply the alignment standard of throughway section to interchange sections. The geometric design criteria applied at the interchange sections are shown in Table-8.4.2.

In addition, the geometric design standard for the interchange ramp is shown in Table-8.4.3.

Table-8.4.2 Geometric Design Standards of Throughway for Interchange Section

Item		Design Speed of Throughway 80 km/h
Horizontal-curve Radius (more than m.)	standard	1,100
	special	700
Minimum Vertical-curve Radius Convex Type (more than m.)	standard	12,000
	special	6,000
Minimum Vertical-curve Radius Dent Type (more than m.)	standard	8,000
	special	4,000
Gradient (%)	standard	3
	special	4

Table-8.4.3 Geometric Design Standards for Interchange Ramp

Item	Unit	Recommended Design Standard
Design Speed	Km/h	40
Carriageway width	Meter	3.25
Outer shoulder width	Meter	1.50
Inner shoulder width	Meter	0.75
Minimum Radius	Meter	50
Maximum Gradient	%	6
Acceleration lane length	Meter	160
Deceleration lane length	Meter	80
Taper length	Meter	50

3) Preliminary Design of Interchanges

- Ciawi Interchange (Sta. 1+200)

Ciawi Interchange will be connected with the existing main road about 500 meters from the intersection of Puncak-Bogor road and Ciawi-Cibadak road.

This location was studied on the topographic map (1:5,000). Two concepts were studied among other prospective ideas. One was to utilize the existing Puncak spur as an access road. The traffic flow can be secured by making ramps near Station 0 of the new road. However, this concept was turned down due to the extra crossings (bridges) for the river nearby and high voltage electric lines which are both major

obstacles.

Another concept was to construct a full size interchange at an appropriate location. Even though the area is quite urbanized, the latter concept was adopted.

The interchange will be located so as to avoid residential areas which lie along the existing main road.

The length of the access road to the existing main road will be about 400 meters.

- Cicurug Interchange (Sta. 11+800)

Cicurug Interchange will be connected with the existing main road and located at the northeast edge of Lake Lido.

This interchange will be the trumpet type. The length of the access road of the interchange will be about 400 m.

- Cibadak West Interchange (Sta. 27+200)

The urbanized area of the city expands to the north up to about Station 28 of the new road. The location of the interchange was studied from this point onward, taking into account the control points and other necessary considerations.

The Ciatih river and a railway line lie between the route and the existing main road after Sta. 27. The river and an electric power line are also located between them before Sta. 26. The interchange will be located from about Sta. 26 to Sta. 27.

The access road of the interchange will be crossed at the Ciatih River at a right angle if possible. The length of the access road will be about 900 m.

- Cibadak East Interchange (Sta. 32+400)

Cibadak East Interchange will be located east of Cibadak city and connected with the existing main road between Cibadak and Sukabumi.

Cikolowing River and Ciheulang River flow east of Cibadak city. The interchange will be located at a point after these two rivers.

The length of the access road will be about 800 meters. The road on the way to the existing road, will cross the railway by a bridge.

- Sukabumi West Interchange (Sta. 40+000)

Location of the Sukabumi West Interchange was determined by several factors such as where urbanization along the existing road thins out and where the existing road is very near. A section of suitable land was found near the new road.

The location of the interchange will be suitable at Sta. 40 where the route will come close to the existing main road.

The length of the access road will be 1,000 meters. The route of the access road to the existing main road will avoid the existing fish ponds.

- Sukabumi Interchange (Sta. 46+300)

Sukabumi Interchange will be located at the crossing point of the new road and the existing road which directly travels to Sukabumi city and Salabintana at the foot of Mt. Pangrango.

Residential areas have developed along the road route, therefore a diamond type interchange which needs comparatively small land acquisition and compensation, will be suitable.

Judging from the development conditions of Salabintana, this interchange will be set up later.

- Sukabumi East Interchange (Sta. 53+500)

Sukabumi East Interchange will be located at a point where the route and existing main road will cross east of Sukabumi city.

The point where the access road will connect with the existing main road, will be about the center of the road to avoid sharply curved sections.

- Cianjur West Interchange (Sta. 65+400)

The location of the Cianjur West interchange will be west of Cianjur city where the route comes close to the existing main road and another road traveling to Sindangbarang to support future development in South Java.

- Cianjur East Interchange (Sta. 75+500)

The location of the Cianjur East Interchange will be at Sta. 75+500 where the route will come close to the existing road which travels to the Cianjur city area.

This interchange will be set up later according to the development south of Cianjur. At the time of setting up the interchange, the existing road should be improved.

- Ciranjang Interchange

Ciranjang Interchange will be connected with the existing road which travels to the Ciranjang city area. The existing road from the interchange to the existing main road between Cianjur and Citarum should be improved at the same time the interchange is constructed.

- Rajamandala Interchange (Sta. 91+000 and Sta. 94+000)

Rajamandala Bridge is now operated as a toll road. Two interchanges will be located at both sides of the bridge as the new road will maintain its current function.

These interchanges will be of the half type serving one direction traffic.

8.4.5 Toll Road Facilities and Safety Devices

1) General

The tollway facilities and safety devices for the new road are considered as follows:

- Road lighting
- Traffic signals
- Traffic signs
- Road markings
- Lane divider
- Guard rails
- Toll charge equipment

2) Road Lighting

Road lighting is designed at the interchange areas including ramps, terminals, and access roads.

3) Traffic Signals

Traffic signals are planned to be installed at the intersections of access roads to the interchanges and the existing road.

4) Traffic Signs

Three kinds of signs are planned, namely; regulatory signs, warning signs, and guide signs to promote traffic safety and for the convenience of users.

(1) Regulatory and Warning Signs

Regulatory signs and warning signs are directly connected to the Government's regulations or traffic laws.

(2) Guide Signs

Guide signs convey to drivers information such as destinations and distances, service facilities and route confirmation.

5) Road Markings

Road markings provide traffic safety by lane identification, carriageway edge markings and instructions on the correct lane to use in association with traffic signs and signals. Road markings also identify channelization at the intersections.

6) Lane Divider

In case of a provisional two lane road, serious accidents such as head-on crashes will occur more frequently.

The lane divider will be set up at the center of a simple median strip which will restrict passing vehicles from using the other direction lane. The lane divider will be made of flexible rubber.

7) Guardrails

The major purpose of a guardrail is to protect uncontrolled vehicles from running off the highway and to protect important structures such as bridge piers from damage by such vehicles.

Installation of guardrails are planned at the following locations:

- High embankment sections (H>3.0 m)
- Bridge and box culvert approaches
- Box culvert wing walls and bridge piers
- Guide signs

8) Toll Charge Equipment

The toll charge equipment will be set up at all the interchanges. The equipment will consist of toll gates, toll plaza, and toll office.

The number of booths will be determined on the basis of the traffic demand at the interchange.

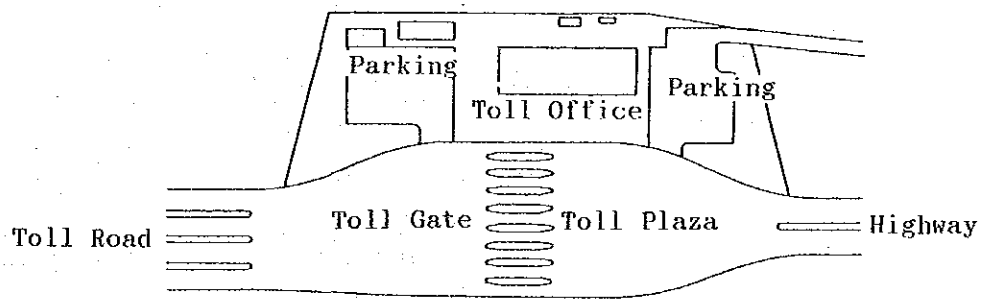


Fig.-8.4.3 Toll Charge Equipment

8.4.6 Construction Aspects

1) Construction

The mechanical plant and equipment to be used in this project, based on experience of past similar road construction projects in Indonesia, are as follows :

(1) Earthworks

The characteristic earthwork items are deep cutting and high embankment formation. The planned maximum cutting depth is 38 m (Sta. 5+600) and maximum embankment height is 20 m (Sta 13+900). Rainfall is heavy in this project area. Therefore, appropriate mechanical plant and equipment should be selected. The major cutting and embankment sections are shown in Table-8.4.4 below.

Table-8.4.4 Major Cutting and Embankment Sections

	STATION	DEPTH AND HEIGHT
Cutting	Sta 5+500 - Sta 5+700	38
	Sta 7+700 - Sta 8+050	20
	Sta 11+100 - Sta 11+900	25
	Sta 22+100 - Sta 22+600	25
	Sta 23+200 - Sta 23+700	25
Embankment	Sta 8+850 - Sta 8+950	18
	Sta 13+450 - Sta 13+550	20
	Sta 13+700 - Sta 13+900	20
	Sta 15+050 - Sta 15+150	17
	Sta 18+500 - Sta 18+650	18
	Sta 99+700 - Sta 100+100	17
	Sta 101+000 - Sta 101+450	17

Table-8.4.5 Earthwork Equipment

Main Works		Equipment		
		Max. Haul 100 m	Max. Haul 500 m	Max. Haul 2000 m
Clearing and grubbing		• Bulldozer		
Excavation			• Bulldozer • Tractor drawn scraper	• Motor scraper
			• Bulldozer • Crawler type loader • Excavation • Dump truck	
Embankment	Scatter	• Bulldozer		
	Levelling	• Motor grader		
Compaction		• Tamping roller • Vibratory roller • Pneumatic type roller • Steel roller		

(2) Pavement Works

Asphalt pavement will be applied to the bridge section, and concrete pavement will be applied to the other sections.

Table-8.4.6 Pavement Equipment

Concrete Pavement	Asphalt Pavement
- Truck mixer	- Dump truck
- Concrete spreader	- Asphalt finisher
- Concrete finisher	- Steel roller
- Concrete plant	- Pneumatic type roller
	- Asphalt mixing plant

(3) Bridge Works

Special equipment will not be utilized, except for a traveler for the cantilevering method in the PC box girder at the bridge over Cikereteg River, and a cable crane for a steel truss bridge (Cisokan River).

Table-8.4.7 Bridge Construction Equipment

Main Works		Equipment		
Sub Structure	Excavation	• Bulldozer	• Excavator	• Dump truck
	Foundation	• Diesel pile hammer • Pile driver	• Truck mixer	• Truck crane • Crawler crane
	Structure	• Crane	• Truck mixer	
Super Structure	Making beam	• Trailer		
	Erection	• Erection girder • Cable crane	• Traveler	

2) Maintenance

Maintenance work is classified into routine maintenance work and periodic maintenance work: Routine maintenance work is required irrespective of traffic volume or road surface condition and includes such work as grass cutting, clearing of ditches, toll and office equipment, traffic sign, lighting and guardrail. Periodic maintenance work is required depending on traffic volume and road surface condition and includes such works as road overlay, patching, sealing, and other road surface repair.

According to Jasa Marga records, periodic maintenance work is required at 5 years interval, after 10 years of operation.

8.4.7 Preliminary Planning of Staged Construction

1) General

In general a staged construction is sought to reduce the capital investment so as to increase the early phase benefits of a project, and be coordinated with the prevailing traffic situation and as a part of the whole project. This method is particularly effective when the demand of a project increases gradually as time passes. There is a 20 year time span from the present until the target year of this Study which is the year 2010. Traffic demand is expected to increase in those years.

In this section, the basic pattern of staged construction to be introduced in the Study is discussed, and will be utilized for cost estimate and final alternatives evaluation and selection.

2) Through Section Construction

Through sections, between interchanges, shall be constructed as either simple 2 lanes, or divided 4 lanes as discussed in Section 8.3 of this chapter. The construction method of each through section shall be determined using economic indicators as explained in Chapter 9.

3) Interchange Construction

All of the interchanges in this project, shall be constructed as four lane full size types at the initial construction stage (in case of staged construction). The reason is explained in the following paragraphs.

The construction of the new road shall be phased which infers that the final 4 lane sections shall for sometime be only 2-lanes. In addition the section of the road between Sukabumi and Rajmandala is designed as 2-lanes. A central medium is also planned and so high speed vehicles will be unable to overtake slower vehicles.

In the case of dual 2 lane high speed roads, the Japanese practice is to provide passing lanes every 5 to 10 kilometers for overtaking vehicles. It is therefore proposed that the interchanges, which are at 10 - 20 kilometer intervals, be constructed as 4 lanes from the initial stage, in order to provide the function of the passing lane as an addition to the interchange function.

Furthermore 4 lane interchanges will decrease the disturbance caused to traffic flow on the new road by the exiting and entering vehicles and reduce the occurrence of accidents.

4) Section-Wise Stages

Sections for formulating alternatives shall be discussed taking interchanges as terminals, although Rajamandala interchange (toll bridge) cannot be used as a terminal and the section between Ciranjang and the end of this project is treated as one.

8.5 Preliminary Information on Environmental Impact

8.5.1 General

Road construction generates various types of impact to both physical and socio-economic environments along the route it passes through. Since the impact may have both favorable and unfavorable effects, the first step is to consider the environmental impacts and identify those effects.

In the Republic of Indonesia, Environmental Impact Assessment (EIA) has just been introduced with the formation of a central committee in accordance with Act No.4/1982 and Regulation No.29/1986. The general guideline for analysis estimation concerning side effects by public works on the living environment was settled, and the guideline for road and bridge projects is also about to be prepared as a technical manual for road projects. According to the draft version of the guidelines, the T.O.R of EIA for the succeeding detailed stage should be prepared at the F/S stage of the Project.

The guidelines are now under review and not yet concluded, therefore the preliminary information on environmental impact are generally arranged based on both the philosophy included in the draft guidelines and physical features of the affected area.

8.5.2 Study Purpose

The purpose of this preliminary environmental consideration is to identify the immediate and long-term effects on the biological, physical and social aspects of the environment affected by the Project during its construction and operation phase.

The following considerations should at least be reflected in this study to achieve the project purpose and to promote the Project effectively and efficiently to serve the society:

Phase of Project Cycle
- Pre-construction Phase
- Construction Phase
- Operation Phase

Information and Evaluation
- Information about the Project
- Information about physical features on the present land use

In this section, the environmental impacts generated by the route, whether favorable or unfavorable, are again studied in order to preliminarily confirm their kinds, and identify and qualify them with the purpose of preparing for future study and analysis of this project.

8.5.3 Environmental Background of the Project

The total length of the project road is 101.8 km, with 14.5 km in Bogor, 53.3 km in Sukabumi, 24.7 km in Cianjur and 9.1 km in Bandung. The road length through residential area is about 10 km, 55 km in paddy field, and about 37 km in other land (forest, plantation area, etc.).

The project involves very large works such as a huge volume of earthworks (deep cuttings and high embankments), bridges, culverts, as well as the disposal of excess cut materials as summarized in Table-8.5.1.

Table-8.5.1 Preparatory and Construction Works of the Project

Items		Unit	Quantity
Earthwork	(Cutting)	X 1,000 m^3	10,856
	(Embankment)	X 1,000 m^3	8,924
	(Transfer)	X 1,000 m^3	1,201
Spoil		X 1,000 m^3	5,584
Drainage		m	4,989
Bridge	(Main Bridge)	Each	59
	(Over Bridge)	Each	52
Culvert	(Box Culvert)	Each	70
	(Pipe Culvert)	Each	135
Interchange		Each	12
Removal of Houses		Each	1,326
Land Acquisition			
Residential Area		m^2	482,857
Industrial Area		m^2	719
Tourism Area		m^2	138
Paddy Field		m^2	3,868,492
Others		m^2	2,952,174

The new road passes through one of the most developed rural areas in Indonesia. This area therefore is well cultivated, inhabited and crisscrossed by large to small roads, railways, canals and other infrastructure. Cities, towns and villages are found scattered everywhere along the route. The new road is also located in plantation areas (rubber, palm-wood, tea and teakwood) and paddy fields. Here too are the facilities and buildings of religious, educational, cultural, etc., activities.

Considering the subject and its environment, the Project will have a large effect on environmental conditions, such as the ecosystem, human life, land-use, socio-economic activities, etc., in a wide area along the new road, during and after construction.

8.5.4 Favorable Effects on Socio-economic Activities

The proposed road effects the various aspects of socio-economic activities such as industry, education, disaster relief, transportation, tourism, etc. Generally, a constructed new road brings about favorable conditions on the socio-economic activities because it shortens the time distance. The proposed road also provides favorable conditions to related areas, particularly developing areas such as Sukabumi and Cianjur.

In this section the remarkably favorable effects on local viewpoints are summarized, analyzing the present condition based on the authorized socio-economic indicators.

1) Social Aspect

(1) Population

According to the statistical data of West Java, there is a little imbalance in the population density among the related Kabupaten and Kotamadya. The population densities of Bogor and Bandung are higher than the average figure of West Java, and this condition is deemed to be mostly caused by the difference in living conditions.

Table-8.5.2 Population Density of Related Kab./Kodya.

Kabupaten/ Kotamadya	Population (x 1000)	Popu. Density (Person/km2)	Ratio to West Java Average
Bogor	3,159	934	1.32
Sukabumi	1,812	65	0.65
Cianjur	1,508	62	0.62
Bandung	30,482	205	2.05
West Java			

The new road construction will gradually distribute the concentrated population in accordance with the development of industrial activities and the improvement of living standards.

(2) Employment

According to the statistical data of West Java in 1987, the number of job seekers were 18,715 in Bogor, 9,906 in Sukabumi, 9,311 in Cianjur and 85,147 in Bandung. The figures show that in particular Bandung has the worst employment condition among the related Kabupaten/Kotamadya.

The new road construction will undoubtedly create job opportunities for job seekers, and many companies will discover the new road's convenience for industrial and commercial activities during and after its construction.

The Project will contribute to the improvement of the employment condition and provide many opportunities and incentives to industrial and commercial activities.

(3) Education

Elementary schools and junior high schools are established in each Kabupaten and Kotamadya to meet the number of students. Meanwhile a large number of high schools are concentrated in Bandung. Although depending on the ratio of students who go on to a higher stage of education, the construction of a new road will, however, provide more advantageous commuting conditions for students who wish to proceed to the next stage of their education.

(4) Medical Treatment

The availability of medical facilities such as hospitals and

clinics is the most important factor among the social factors for human life. The hospitals are concentrated in Bandung (about 32% of the total in West Java), meanwhile in Cianjur there are only 2 hospitals (corresponding to 2% of the total of West Java).

This means that emergency patients are forced to be transported to hospitals in Bandung. Usually there is no moment to lose during an emergency, and depending on the situation the delay of medical treatment can be fatal. The constructed new road will provide greater convenience for the transportation activities, particularly for the people who live in areas adjacent to some interchanges.

(5) Rescue Activity

According to the 1987 statistical data, many storm disasters occurred in Bogor (about 40% of all West Java), and other calamities such as flooding (24% of West Java), fires (30%) and landslides (30%) occurred in Bandung. Generally rescue activities for these disasters require roads with high speed potential.

The proposed road will provide a significantly convenient transportation axis during rescue activities, particularly during flooding and landslide disasters.

(6) Recreation/Resorts

About 33% of the tourists visit Bogor for its panoramic views, and in Bandung 25% of tourists visit for lake views and 20% for panoramic views. Nowadays recreation and resort facilities are becoming increasingly popular in the lives of the Indonesian people. The Puncak in Bogor, Pelabuhan Ratu in Sukabumi, and Lake Cirata in Bandung have good potential for such activities. The West Java Provincial Government's efforts concerning tourism development, particularly in Sukabumi area, is intensive.

The time shortening from/to Jakarta and Bandung will enduce foreign and domestic tourists to visit and stay in Sukabumi and Bandung.

2) Economic Aspect

(1) Local Area Development

According to the proposed route alignment twelve interchanges are planned between Ciawi and Citatah. Most interchanges are located in rural areas however, some are close to the urbanized area. The areas surrounding the interchanges have high potential for industrial development, particularly for storage bases.

Considering the land circumstances, Cicurug Interchange and Rajamandala Interchange (provisional names) have good potential to provide storage functions for the Jakarta Metropolitan Area and Bandung Metropolitan Area respectively. Meanwhile urban functions have already developed behind the planned locations of the Cibadak, Sukabumi, Cianjur and Ciranjang Interchanges and therefore the provision of an intermediate function from/to both big cities will promote the development of the cities.

(2) Fresh Food Transportation

Fresh foods such as vegetable, fruit, meat, milk, eggs, fish, etc., require short transportation times. In the related area, there are many places where fresh foods are produced.

According to the statistical data of West Java the share of fresh food production for each Kabupaten is summarized in Table-8.5.3.

The statistical data shows that, neither Bogor nor Sukabumi have significant fresh food products, while on the other hand, both Cianjur and Bandung have plenty of products, in particular vegetables, fruits and meats. The total production share of vegetables and fruits in both Kabupaten occupies about 50% or more of West Java province's production.

Maintaining the foods fresh is of paramount importance, therefore, the shortening of transportation time will contribute in keeping prices stable and reducing damage rates.

Table-8.5.3 Production Share of Fresh Foods in West Java (%)

Name of Food	Bogor	Sukabumi	Cianjur	Bandung
Vegetable				
Bawang Daun	1	6	47	20
Bawang Merah	0	0	2	29
Kentang	2	1	3	45
Kubis	1	1	4	45
Lobak	0	0	50	35
Petsai Sawi	1	30	18	31
Wortel	1	0	78	12
Buncis	3	3	25	50
Cabe/Lombok	5	4	25	18
Tomat	4	4	20	58
Labu Siam	0	1	74	15
Bawang Putih	0	0	0	60
Fruit				
Alpukat	2	4	17	31
Durian	9	2	16	1
Jambu	2	2	17	6
Pepaya	16	2	5	7
Pisang	2	5	15	5
Meat				
Beef	14	1	2	25
Pork	10	1	0	43
Poultry	21	5	5	9
Milk	7	4	4	61
Egg	22	5	7	6
Fish				
Karamba	18	6	76	0
Kolam Air Deras	54	10	4	13

8.5.5 Negative Effects on Physical and Social Environment

1) General

In order to minimize the negative impact on the environment, criteria for the selection of project route and mitigation measures against the negative impact were established and reflected at the route selection and preliminary study stage by the road planners as follows:

1) Construction work should be done as far as possible away from schools, hospitals and mosques
2) Public institution areas should be avoided
3) Cemetery and grave areas should be avoided
4) Rivers and irrigation channels should be crossed over at the existing location
5) An embankment type road should be applied to the rice field area to allow crossing of small irrigation channels
6) Forest preservation areas should be avoided
7) Water reservation area should be avoided
8) Community separation should be minimized
9) Earthworks should be as small as possible
10) The number of resettlement households should be minimized to as few as possible

By following the above criteria the environmental issues taken into consideration at the F/S stage are almost satisfied, however, many issues assessed for the construction and operation stage still remain unsolved. An EIA study, based on both a detailed field survey and professional judgment following both the Indonesian environmental standards and the guidelines, should be conducted at the detailed design stage.

As the preliminary information on environmental impact, both project information and likely area to be affected are very important for the succeeding EIA. The earthwork volume and some indicators on land use along the proposed road were selected and summarized in Table-8.5.4, as the representative indicators for the basic information.

Based on the above data some preliminary information on environmental issues assessed at the succeeding phase were arranged as described below. The items on environmental impact assessment are manifold, therefore, intensification and summarization of the items are taken into consideration by following the general guideline.

2) Soil/Topography

The soil and topography study is usually directed at the determination of erosion potential caused by wind and water. The change in soil characteristics; vegetation cover and/or topography, the area of land eroding increases, etc., sometimes results in a severe impact.

At the initial opening stage side-tipping of soil and topsoil disposal are likely to be the causes of soil erosion, in particular in areas having slopes greater than 25% and/or through areas covered by natural vegetation that is relatively undisturbed by human activities.

The project road passes mountainous areas at some length, therefore, high embankment and deep cutting sections will naturally appear.

At the setting work of both route alignment and vertical alignment the depth and height has already been considered to be small, however, the project will entail earth cutting more than 30 m deep and filling more than 20 m high, and disposal of about 1,932,000 m^3 of excess material.

According to the F/S the disposal of soil will be mainly produced between Sta.0 and Sta.30, and quarry sites were searched and recommended at Cianjur, Ciranjang, Cipatat, Ciawi and Cicurug. Comparatively large earthworks will appear at the following sections.

Sta.5 -Sta.9 Sta.11-Sta.12 Sta.16-Sta.20 Sta.21-Sta.24
Sta.32-Sta.33 Sta.58-Sta.59

Some areas with unstable soil condition (soft-ground) have been identified between Cibadak and Sukabumi through the field survey. The road built on land with such conditions is likely to cause land subsidence in the adjacent area. In addition, significant intensive rainfall, and drilling and blasting can cause soil erosions.

The study on slope stabilization and recommendation for its measurement should be implemented to secure the slope stabilization whenever required. Identification of adequate locations for material disposal and analysis and possible consequences should be implemented at the detailed design stage.

Table-8.5.4 (1) Land Use in the Area within 100 m of the Proposed Road

STA.	Cut Bank X1000 m3	House	Hospital School Mosque	Monu-ment Grave Cemetery	Planta-tion	Orchard Tree Bamboo	Pond	Crossing Road Crossing Channel	Others
0 - 1	-151	120	No	No	No	Tree(s)	No	1 , 3	
1 - 2	218	20	No	No	No	Tree(s)	3Pond	0 , 1	
2 - 3	-28	5	No	No	No	Tree(s)	No	0 , 4	
3 - 4	300	20	No	No	Rubber(s)	Tree(m)	No	2 , 3	
4 - 5	-314	15	1School	No	Rubber(s)	O(s),T(m)	No	2 , 4	
5 - 6	462	0	No	No	Rubber(s)	O(s),T(l)	No	4 , 0	
6 - 7	-146	60	No	No	No	No	1Pond	2 , 2	
7 - 8	418	10	No	No	No	O(s),T(s)	1Pond	1 , 3	
8 - 9	494	5	No	Grave	Palm(s)	O(s),T(m)	No	1 , 3	
9 - 10	73	15	1School	No	No	Tree(s)	No	3 , 2	
10 - 11	129	15	No	No	No	Tree(s)	2Pond	1 , 3	
11 - 12	1115	20	No	No	Rubber(s)	O(s),T(s)	No	3 , 2	
12 - 13	119	3	No	No	Rubber(s)	O(s),T(s)	No	2 , 4	
13 - 14	87	0	No	No	Rubber(m)	Tree(m)	No	0 , 1	
14 - 15	13	15	No	No	No	O(s),T(s)	No	3 , 2	
15 - 16	-83	10	No	No	Rubber(s)	Tree(s)	4Pond	1 , 3	
16 - 17	327	10	No	No	R(s),P(m)	Tree(s)	No	2 , 1	
17 - 18	230	10	No	No	Palm(s)	Tree(m)	No	0 , 2	
18 - 19	499	10	No	No	Rubber(m)	O(m),T(m)	3Pond	0 , 1	
19 - 20	379	5	No	No	Rubber(m)	Tree(m)	No	1 , 1	
20 - 21	79	3	No	No	No	No	2pond	0 , 1	
21 - 22	512	10	No	No	No	Tree(s)	No	0 , 1	
22 - 23	834	0	No	No	No	O(s),T(m)	No	1 , 1	
23 - 24	854	3	No	No	No	O(m),T(s)	No	1 , 1	Elec. Tower
24 - 25	165	6	No	No	No	Tree(s)	No	1 , 1	
25 - 26	249	5	No	No	Palm(s)	O(s),T(s)	No	0 , 2	
26 - 27	320	10	No	No	Palm(s)	O(s),T(s)	No	1 , 2	
27 - 28	214	8	No	No	No	O(m),T(s)	No	2 , 1	
28 - 29	123	40	No	No	Rubber(s)	O(s),T(s)	No	2 , 3	
29 - 30	197	35	No	No	Rubber(s)	Tree(m)	No	1 , 0	
30 - 31	312	30	1School	No	No	Tree(s)	No	1 , 1	
31 - 32	-111	5	No	No	No	Tree(s)	No	1 , 4	
32 - 33	-482	8	No	No	No	No	No	1 , 3	
33 - 34	-52	12	No	No	No	Tree(s)	No	1 , 2	
34 - 35	-114	6	No	No	No	Tree(s)	No	1 , 3	
35 - 36	144	25	1School	No	Rubber(s)	Tree(s)	No	2 , 2	
36 - 37	127	15	No	No	No	Tree(s)	No	1 , 1	
37 - 38	-62	30	No	No	R(s),P(s)	Tree(s)	4Pond	1 , 2	
38 - 39	-126	50	No	No	Palm(s)	No	2Pond	2 , 4	
39 - 40	-42	15	No	No	No	No	No	1 , 5	
40 - 41	-15	70	4School	No	Rubber(s)	No	5Pond	2 , 1	
41 - 42	-68	35	No	No	No	No	50Pond	1 , 1	
42 - 43	-188	45	No	No	No	Bamboo(s)	10Pond	2 , 3	
43 - 44	-221	30	1School	Grave	No	Tree(s)	2Pond	1 , 4	
44 - 45	-125	35	1School	No	No	Tree(s)	5Pond	1 , 2	
45 - 46	-18	15	1School	Grave	No	Tree(s)	3Pond	2 , 2	
46 - 47	-163	45	1School	No	No	Tree(s)	4Pond	2 , 2	
47 - 48	-113	20	No	No	No	Tree(s)	No	2 , 4	
48 - 49	-21	15	1School	No	No	Tree(s)	No	2 , 4	
49 - 50	-58	20	3School	No	No	Tree(s)	No	1 , 6	

Note : in the item of orchard, tree and bammboo suffix means as follows
S = small m = medium l = large

Table-8.5.4 (2) Land Use in the Area within 100 m of the Proposed Road

STA.	Cut Bank X1000 m3	House	Hospital School Mosque	Monu-ment Grave Cemetery	Planta-tion	Orchard Tree Bamboo	Pond	Crossing Road Crossing Channel	Others
50 - 51	-73	88	1School	Grave	No	Tree(s)	No	1 , 5	
51 - 52	-47	25	1School	No	No	No	2Pond	0 , 6	
52 - 53	46	20	No	No	No	Tree(s)	2Pond	1 , 3	
53 - 54	-133	40	No	No	No	Tree(s)	8Pond	1 , 4	
54 - 55	-182	15	No	No	No	O(s),T)s)	No	2 , 7	Elec. Tower
55 - 56	-186	20	No	No	No	No	1Pond	1 , 0	
56 - 57	72	20	No	No	No	No	2Pond	1 , 1	Elec. Tower
57 - 58	231	20	No	No	No	No	8Pond	1 , 1	
58 - 59	472	25	No	No	No	O(s),T(s)	No	1 , 1	Elec. Tower
59 - 60	10	10	No	No	No	Tree(s)	No	1 , 1	
60 - 61	225	20	No	No	No	Ba(s),T(s)	8Pond	0 , 0	
61 - 62	11	2	No	No	No	Bu(s),T(s)	No	0 , 2	
62 - 63	-206	30	No	No	No	O(s),T(s)	No	1 , 2	
63 - 64	-197	0	No	Grave	No	Tree(s)	No	1 , 2	
64 - 65	-47	15	No	No	No	Tree(s)	No	2 , 2	
65 - 66	-64	40	No	No	No	No	1Pond	1 , 2	
66 - 67	-30	20	No	No	No	No	2Pond	1 , 2	
67 - 68	9	10	No	No	No	No	No	0 , 2	
68 - 69	12	20	1School	No	No	No	No	0 , 1	
69 - 70	-90	15	1School	No	Palm(s)	T(m),Bu(s)	No	1 , 0	Rail-cross
70 - 71	245	8	No	No	No	T(s),Bu(s)	No	0 , 1	
71 - 72	154	25	No	No	No	Tree(s)	1Pond	1 , 2	
72 - 73	144	3	No	No	No	Tree(s)	No	1 , 1	
73 - 74	-45	10	No	No	Palm(s)	No	No	1 , 3	
74 - 75	-92	0	No	No	No	No	No	1 , 4	
75 - 76	-25	25	No	No	Palm(s)	Tree(s)	1Pond	1 , 0	
76 - 77	4	3	No	No	Palm(s)	O(s),T(s)	No	1 , 0	
77 - 78	18	65	1School	No	Palm(s)	O(s),T(s)	No	1 , 2	
78 - 79	63	20	No	No	Palm(s)	Tree(s)	No	1 , 1	
79 - 80	-13	7	No	No	No	T(s),Ba(s)	No	1 , 2	
80 - 81	-8	40	No	No	No	No	2Pond	1 , 1	
81 - 82	-79	13	No	No	No	T(s),Ba(s)	No	1 , 1	
82 - 83	163	9	No	No	No	No	No	0 , 1	
83 - 84	-79	35	No	No	Palm(s)	O(s),Ba(s)	No	1 , 3	
84 - 85	-39	25	No	No	Palm(s)	No	No	1 , 2	Elec. Tower
85 - 86	-33	13	No	No	No	T(s),Ba(s)	No	1 , 1	
86 - 87	-12	10	No	No	No	No	No	0 , 3	
87 - 88	-21	10	No	No	No	No	No	2 , 4	
88 - 89	-15	12	No	No	No	Tree(s)	No	1 , 4	Elec. Tower
89 - 90	-80	65	No	No	No	No	No	2 , 1	
90 - 91	-213	90	2School	No	No	No	No	2 , 2	
91 - 92	-40	110	1School	No	No	T(s),Ba(s)	No	1 , 1	
92 - 93	0	25	No	No	R(s),P(s)	No	No	1 , 1	
93 - 94	-36	70	1School	No	Palm(s)	Orchard(s)	2Pond	1 , 1	
94 - 95	-164	30	No	No	No	No	No	0 , 1	
95 - 96	-158	100	1School	No	R(s),P(s)	No	12Pond	2 , 1	
96 - 97	-99	30	No	Grave	Palm(s)	Tree(s)	3Pond	1 , 2	
97 - 98	6	55	2School	No	Palm(s)	Tree(m)	No	2 , 0	
98 - 99	-203	15	No	No	Palm(s)	Tree(s)	No	0 , 0	
99 - 100	15	45	3School	No	Palm(s)	O(s),T(m)	No	1 , 1	
100 - 101	-175	12	No	No	No	Tree(s)	No	0 , 1	
101 - 102	-387	25	1School	No	No	O(s),T(m)	No	1 , 1	

Note : In the item of orchard, tree and bammboo suffix means as follows
S = small m = medium l = large

3) Water Quality

The impact on water quality can be related to changes in the biological and chemical qualities and/or in the quantity of aquatic resources. The impact should be assessed from the viewpoint of both extent and quality. Causes and effects are as follows.

- Outflow from the temporary supporting facilities (base camp & offices, material stockyards, warehouses, fuel storage areas, staff accommodation, etc.)
- Outflow of hazardous materials (such as fuels, explosives and chemicals) into the natural drainage lines, lakes/reservoirs, irrigation channels, and living activity areas during initial opening, construction and operation
- Change of runoff conditions with the alteration of land shape
- Disruption of water veins with deep cutting earthwork
- Outflow of harmful materials related to vehicle traffic (such as Pb in the exhaust gas, asbestos in asphalt pavement suspended solids in tires, etc.)

There are so many problems concerning water quality impact, however, considering the intensity, magnitude and possibility of measurement, the alteration of rain runoff condition and disruption of water veins are the problems to which careful attention should be paid.

There are many ponds for irrigation, water reservoir and/or fish culture along the proposed road, and 59 river bridges and 135 pipe culverts are planned to maintain the existing functions of these facilities.

Since the following route sections are very susceptible to adverse environmental impact on the water quality as a result of the numerous ponds and crossing channels there, much attention should be paid to the preservation of those water bodies at the detailed design stage based on extensive field survey data.

Sta.3-Sta.4	Sta.7-Sta.13	Sta.25-Sta.29	Sta.40-Sta.42
Sta.57-Sta.58	Sta.60-Sta.61	Sta.71-Sta.75	Sta.87-Sta.89

4) Atmospheric and Noise Quality

Vehicle movement along the new road will likely cause air pollution and annoying noise levels effecting local residents or areas of human congregation during some operating periods. The volume of traffic will increase every year on the new road, and consequently air and noise pollution will also increase. Therefore, these problems will usually become increasingly severe during operating periods.

In addition, the vehicle traffic passing on the temporary access roads and the operation of construction equipments can create the same problems during the construction period.

The effected facilities will not only be limited to residential areas, and schools, hospitals and mosques, where clean air and quiet environment are particularily needed, but also animals and plants will suffer from the effects of this pollution. From the viewpoint of the environmental features, it is considered necessary that almost all areas

along the project road warrant assessment regarding impact on air and noise quality.

Among all the sections, the impact assessment on air and noise quality should be at least conducted at the following areas.

- Areas adjacent to interchanges: 12 locations
- Residential areas: in particular Sta.28-Sta.31 Sta.37-Sta.47 Sta.89-Sta.100
- School area : Sta.40-Sta.52 Sta.90-Sta.101+700

5) Flora and Fauna

Impact on the flora and fauna most often relates to the physical alteration of habitats. The nature and extent of the biotic community are likely to be effected by the land alteration (eg. deforestation) during both construction and operation.

At the F/S stage the habitats of animals and plants are not identified, however, the area which has plenty of trees and grass is likely to be a habitat area or have the potential to become one. Therefore, the following areas should at least be surveyed precisely and the impact should be assessed carefully.

- Forest area : in particular Sta.3 -Sta.5 Sta.8 -Sta.9 Sta.13-Sta.14, Sta.17-Sta.20 Sta.22-Sta.28 Sta.97-Sta.101+700

6) Hazardous Materials

Potentially hazardous materials (such as fuels, explosives and chemicals used in road surfacing) will be stored in large volume within the project.

In particular, the usage of explosives at some quarries and at cutting sections with hard rock, fuels and chemicals at some plants are potentially hazardous materials. Even small amounts of these substances can cause large environmental problems if improperly handled. In addition, the excavation work can cause the exposure and outflow of hazardous materials such as heavy metals into human living environments.

If the storage areas are located near the following areas, the impact assessment should be conducted considering the likelihood of potential hazards, suitability of containment measures, and potential environmental damage.

- populated areas
- natural drainage lines, lakes/reservoirs, irrigation and drainage canals
- social facilities

At the F/S stage the details of construction activities are not yet concluded, therefore based on the accumulation of field survey data and the physical condition of construction works, the likelihood of this impact should be assessed.

7) Social and Economic Issues

(1) Job Opportunity

The Toll Road project would cut across not only human settlements but also productive lands such as paddy fields, plantation areas, etc., and some farmers will lose their jobs. Alternative work opportunities for farmers should be studied as well as the resulting economic loss due to reduced agricultural production.

Almost all the sections of the proposed road pass through land being actively utilized as mentioned above, therefore careful study is necessary based on a precise field survey and the farmers' request.

On the other hand, workers for the project will bring added business to the commercial sector, however project demand for skilled workers could negatively effect other developmental projects in the area.

The employment issues should be assessed carefully with a structural analysis at the detailed design stage.

(2) Resettlement and Shifts in Land Value

According to the F/S the number of resettlement households, namely located within the Project's right-of-way, reaches more than 1,000.

The Project resettlement plan should adequately compensate individuals and families for the period between departing from the right-of-way and full reestablishment in the resettled area. The plan should fully address the impact in and around the resettlement area which could possibly result from the added population.

Shifts in land values should also be assessed as well as such problems as the breaking up of communications and partition of the community due to the Project.

(3) Community Separation

By setting overbridges and box culverts at proper locations the communication function will in most cases be kept as it exists, however community separations may occur depending on circumstances.

If the local community is disturbed by the existence of a new road, appropriate remedial measures should be recommended, which may include rerouting of the road through a less effected area.

(4) Community Support facilities

The number of construction or permanent workers required by the project will cause an increase in demand for public services (such as medical services, education, accommodation, recreational facilities, etc.) which will significantly effect the availability of these services to local residents.

The possibility of the growth of unplanned new settlements along the new road will also put added pressure on community support facilities. In addition, resettled people may also become one of the social pressure factors.

Based on the precise information on the capacities of community support facilities, resettlement plan, land use regulation, etc., a comprehensive analysis should be conducted at the detailed design stage.

(5) Special Areas

Places of special areas of specific value such as historical monuments, archaeologic and religious sites or scenic and aesthetic areas should be identified.

At the F/S stage the route of the project road is selected to avoid such areas, however, some religious sites such as mosques, cemeteries and scenic areas are included in the narrow band along the road. If the above special areas should be effected by the road construction, appropriate remedial measures should be recommended, which may include rerouting of the road through less sensitive areas.

(6) Traffic Congestion and Traffic Accidents

The volume of spoil to be transported by truck will be large enough to require many vehicle trips between cut and fill or disposal areas.

The workers required by the project will sufficiently increase the use of public transport and number of private/project vehicles using public roads to cause traffic congestion or effect availability of public transport for local residents.

Access to or from the new road will likely increase the traffic volume and traffic accidents beyond the handling capabilities of existing feeder roads.

Pedestrian passages across the existing road are improperly located, and the road is improperly fenced to prevent unauthorized pedestrian crossings.

Traffic issues will occur during the various phases and periods, therefore an appropriate assessment should be implemented at the succeeding stage based on a comprehensive survey and analysis.

(7) Study Area

According to general guidelines the extent of the area to be studied for each environmental item is defined as shown in Table-8.5.5.

Table-8.5.5 Extent of Study Area for each Environmental Item

Environmental Components	Suggested Study Area
Flora Fauna Land Compensation Resettlement Archaeology	On-site To include 500 m on each side of the road right-of-way, and any resettlement area, should such be required
Noise Dust Flooding	To include 3 km on either side of the road right-of-way (or further if severe dust problems are anticipated in urbanized areas)
Water Quality	All major downstream user areas and areas of surface waters
	To include all natural and artificial drainage lines, canals and diversions intersected by the proposed road
Socio-economic	Area of human habitation to Kabupaten level within 1-2 km on each side of the road right-of-way
Traffic Public Safety Other Socio-economic Issues	Off-site Areas of human habitation within a 20 km area of the project
Flora and Fauna Land-use	In areas where the natural environment is relatively undisturbed, to include 3 km on either side of the right-of-way

8.5.6 Conclusion and Recommendation

The Republic of Indonesia recognizes the necessity of EIA prior to construction/operation of the project, and is now establishing the guideline for the procedure.

Through this study environmental items (both effected areas and effecting activities) which have a high likelihood of environmental impact are identified at some comparative levels.

Considering the matters mentioned above, EIA for the proposed project should be conducted based on detailed data and expertise from individuals of learning and experience.

This study was made during the F/S stage and therefore the information on the construction plan and the construction management is not complete. More effective and efficient T.O.R. on EIA should be prepared with further supplemented information.

At this time, the time schedule and required staffing deemed necessary are as follows.

The reasonable period for the EIA study is at least 8 months, and 36 man-months of specialists should be sufficient for the work to be completed. A detailed staffing schedule, which will need to be adjusted by the Consultant before starting the study, is recommended below.

Specialist	Man/Month
1. Project Manager	4.0
2. Biologist	5.5
3. Geologist	3.0
4. Agriculturalist	3.5
5. Hydrologist	3.0
6. Sociologist (economist)	4.5
7. Meteorologist/Analyst	2.0
8. Highway Engineer	6.0
9. Structure Engineer	2.5
Total	36.0

8.6 Estimated Construction and Maintenance Cost

8.6.1 Preconditon to Estimation

The estimates were conducted in accordance with the following criteria:

1) The estimates are made on the assumption that all construction works will be contracted to general contractors by international tender

2) The unit costs were computed under the economic conditions prevailing in July 1989

3) The cost was estimated for all alternatives and was classified into foreign currency (indicated in Rupiah) and local currency 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 suppliers;
- 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 cost of each work item is obtained by accumulating the labor cost, equipment cost, material cost, etc. for the item, and the result is checked against recent actual figures for construction works in West Java.

8.6.2 Cost Estimation Method

1) Method

Adopting the generally applied estimation concept, the cost estimation method proceeded as follows. Each construction cost item (e.g. soil cutting, foundation work, pavement, etc.) consisting of materials, machinery, and labor cost components was calculated as the product of unit price and quantity. Subsequently the direct and indirect costs were calculated to which the compensation costs for house and land acquisition, engineering services costs and contingency amount were added (See Fig.-8.6.1).

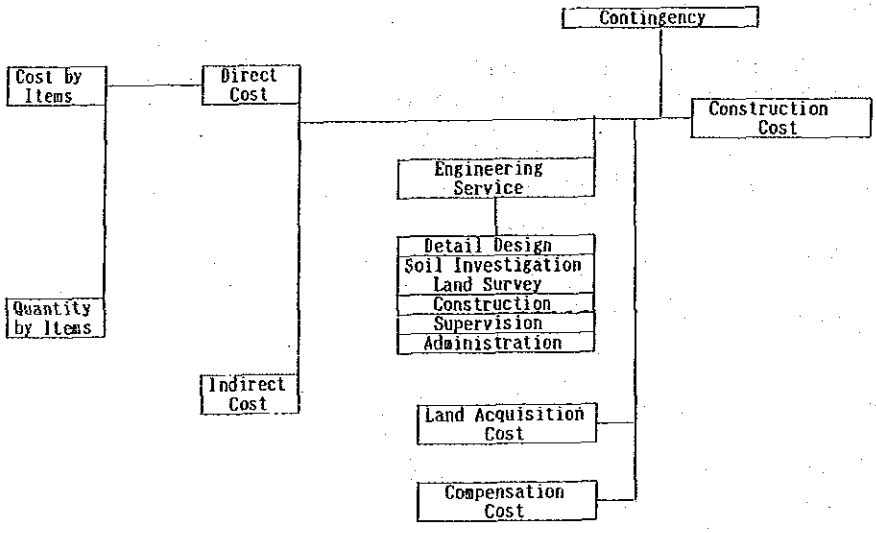


Fig.-8.6.1 Cost Estimation Method

2) Labor Cost

Average unit wages were estimated separately for specialized laborers (carpenters, scaffolders, masons, steel fitters, etc.) as skilled labor, and for unspecialized laborers as unskilled labor, using available price data bulletins (Bulletin Ringkas B.P.S: Biro Pusat Statistik) as reference. Those who drive normal and dump trucks are classified as drivers, and those who drive special equipment and plants, as operators. To the unit cost of the construction labor 43% was added as social charge (Tables-8.6.1 and 8.6.2).

Table-8.6.1 Social Charge and Overhead

Description	Rate per Salary (%)	Remarks
Social Insuarance	8.03	
Retirement Fund	5.00	
Bonus	8.33	1 month/year
Vacation	3.21	10 day/year
National Holidays	3.85	12 day/year
License Fee	2.60	
Overtime	5.26	2 hr/week
Interference by Rain	7.69	24 day/year
Total		

Source: Team Estimate

Table-8.6.2 Labor Cost

No.	Classificationr	Unit	Foreign (US $)	Local (Rp.)
1	Driver	Hr.	0.00	700
2	Foreman	Hr.	0.00	1,000
3	Operator	Hr.	0.00	1,350
4	Skilled Labor	Hr.	0.00	670
5	Unskilled Labor	Hr.	0.00	380

Source: B.P.S. and Team Estimate

3) Machinery Cost

The machinery cost was broken down into rental costs and operation costs. The equipment rental cost was calculated as follows;

$$\text{Rent} = BP \times \frac{(DR + M + MgxT)}{TxHr}$$

where; BP: basic price
DR: depreciation rate
M : annual maintenance rate
Mg: annual management rate
T : operational life
Hr: hour

This estimation method allows the use of some equipment for more than one project, and rental cost is paid only for the hours the equipment was operated. Therefore equipment may be brought into Indonesia for the construction of the project without paying import tax, provided that the equipment is taken out of the country upon the completion of the work (the tax would be paid only if the equipment should be sold in Indonesia) (Table-8.6.3).

4) Materials Cost

The costs of imported materials were estimated by adding the transportation insurance, and custom tariff (reference; Tapip Bea Masuk 1989: Department Keunangan) to the FOB value and adding 10% (Table-8.6.5).

Although most of the materials listed in Table-8.6.4 are available in Indonesia in their raw form or through processing, the foreign currency portion shown in the Table represents costs of equipment and plant used for extraction, transport, and/or processing.

Table-8.6.4 Foreign Currency Portion for Raw Materials

Description	Foreign Currency Portion (%)	Local Currency Portion (%)
Asphalt	100.0	0.0
Cement	60.0	40.0
Sand	60.0	40.0
Crushed Stone	60.0	40.0
Reinforcement	60.0	40.0
Wood	60.0	40.0
Concrete Products	50.0	50.0
Gasoline	60.0	40.0
Diesel Oil	60.0	40.0
Heavy Oil	60.0	40.0
Electricity	40.0	60.0

Table-8.6.3 Machinery Cost

Equipment Name	Basic Price	Operational Life	Resi-dual Value	Annual Operate Hour	Maintenance Rate (%)	Annual Manage Rate (%)	Foreign Financial	Local Financial	Local Economic
Agg. Spreader 2.3m	1500	3	10.00	530	40.00	5.00	1.29	181	45
Apron Feeder 30t	44600	9	10.00	1000	45.00	5.00	8.47	835	50
Asphalt Plant 60t	308200	8	10.00	1500	50.00	7.00	100.65	91748	70909
Asp. Finisher 3m	117950	7	10.00	550	50.00	7.00	54.84	5697	305
Batching Plant	480000	7	10.00	950	60.00	7.00	137.88	25565	9000
Belt Con. 0.35*10m	2400	2	10.00	600	75.00	5.00	3.20	666	128
Belt Con. 0.6*15m	19600	4	10.00	600	75.00	5.00	13.88	2298	140
Bulldozer 11t	73700	5	10.00	2000	65.00	7.00	13.04	2552	796
Bulldozer 21t	80000	5	10.00	2000	65.00	7.00	14.16	3436	1470
Compressor 4.6m3	8000	5	10.00	2000	90.00	5.00	1.50	870	562
Compressor 9.6m3	12000	5	10.00	2000	90.00	5.00	2.24	1425	952
Concrete Cutter 0.3m	5000	3	10.00	680	25.00	5.00	3.06	264	45
Conc. Breaker 30kg	700	2	10.00	960	20.00	5.00	0.42	26	0
Conc. Bucket	1800	5	10.00	560	55.00	5.00	1.02	124	0
Conc. Finisher 5.5m	103000	7	10.00	530	35.00	7.00	46.36	3720	290
Conc. Spreader 2.3m	124000	7	10.00	530	35.00	7.00	55.82	4331	215
Crawler Crane 35t	105000	5	10.00	2000	70.00	7.00	19.01	3242	608
Diesel Hammer 1.26t	44000	5	10.00	800	60.00	7.00	19.03	2310	0
Diesel Hammer 2.5t	65000	5	10.00	800	60.00	7.00	28.11	3413	0
Distributer 4kl	7000	6	10.00	530	40.00	7.00	3.61	377	63
Dump Truck 11t	58000	4	10.00	2000	60.00	10.00	12.91	2171	590
Dump Truck 2t	18000	4	10.00	2000	55.00	10.00	3.92	1088	595
Dump Truck 6t	31000	4	10.00	2000	60.00	10.00	6.90	1329	468
Earth Oager 0.45	60000	4	10.00	2000	90.00	7.00	14.25	2580	197
Engine Pump 4in	1730	6	10.00	740	110.00	5.00	0.81	222	66
Grout Mixer	6800	4	10.00	600	90.00	7.00	5.45	1111	187
Grout Pump	8000	4	10.00	600	90.00	7.00	6.40	1268	187
Hand Hammer 1.1m3	2400	2	10.00	1280	20.00	5.00	1.09	66	0
Hydro-Shovel 0.6m3	40000	5	10.00	2000	90.00	7.00	7.88	2135	796
Line Marker 90kg	4600	4	10.00	1200	30.00	5.00	1.28	500	363
Mac. Roller 12t	25000	5	10.00	2000	65.00	7.00	4.43	1125	505
Motor Grader 3.7m	54300	5	10.00	2000	65.00	7.00	9.61	2038	730
PC Jack	10500	5	10.00	2000	75.00	10.00	2.10	276	0
Road Sweeper 1.8m	80000	4	10.00	2000	90.00	7.00	19.00	4046	814
Soil Compacter 0.05t	600	4	10.00	1000	45.00	5.00	0.22	55	28
Soil Compacter 0.2t	2900	4	10.00	1000	45.00	5.00	1.06	164	45
Soil Mixing Plant 15	157000	6	10.00	1200	50.00	7.00	38.90	8082	3656
Spray Gun	25500	5	10.00	1440	85.00	7.00	6.84	1152	90
Sprayer 0.3kl	2200	3	10.00	1360	25.00	5.00	0.67	82	32
Surf. Vibrater 1.5*0	1800	4	10.00	530	65.00	5.00	1.38	237	40
Tandem Roller 10t	30000	5	10.00	2000	65.00	7.00	5.32	1587	821
Tire Roller 15t	36000	5	10.00	2000	65.00	7.00	6.37	1394	522
Truck 5t	17000	4	10.00	2000	90.00	10.00	4.29	1133	421
Truck 8t	27000	4	10.00	2000	90.00	10.00	6.82	1681	562
Truck Crane 11t	91000	5	10.00	2000	90.00	7.00	17.93	3175	281
Truck Crane 16t	106000	5	10.00	2000	90.00	7.00	20.88	3854	468
Truck Crane 5t	58000	5	10.00	2000	90.00	7.00	11.43	2064	215
Truck Mixer 3m3	25000	4	10.00	2000	90.00	7.00	5.94	1849	786
Watering Cart 5.5kl	11000	5	10.00	1000	50.00	7.00	3.63	900	468
Wheel Loader 1.4m3	83540	5	10.00	2000	60.00	7.00	14.45	2428	612
Truck Crane 40t	120000	5	10.00	2000	90.00	7.00	23.64	4295	468
Truck Crane 70t	250000	5	10.00	2000	90.00	7.00	49.25	8429	504
Truck Crane 90t	350000	5	10.00	2000	90.00	7.00	68.95	11619	540

Table-8.6.5 Material Cost

Material Name	Sales Unit Per	Unit	Unit Price Foreign	Local Financial	Local Economic
Anchor Bolt D28*600	1.00	PCS	4.510	3394	0
Anchor Cap D80*350	1.00	PCS	2.390	1798	0
Asphalt 80-100	1.00	TON	154.000	41773	0
Asphalt Emulsion-2	1.00	L	0.500	136	0
Cat Eye	1.00	PCS	14.250	10723	0
Cement	1.00	TON	32.590	48588	38025
Chair	1.00	PCS	0.150	113	0
Chatter Bar	1.00	PCS	52.800	39732	0
Concrete Pole 10m	1.00	SET	70.600	136000	123500
Concrete Pole 5m	1.00	SET	35.300	68000	62000
Conc. Admixture	1.00	SET	0.900	244	0
Control Box	1.00	SET	195.000	221813	0
Crusher Run	1.00	CUM	4.550	6795	5331
Curing Mat	1.00	SET	1.140	1400	1200
Curing Material	1.00	kg	3.850	1044	0
CV Cable 14A	1.00	LM	0.000	3300	3000
Explosive	1.00	kg	0.000	0	0
Ex-Joint	1.00	LM	6.540	1774	0
Fertilizer	1.00	kg	0.490	133	0
Filler	1.00	CUM	3.180	1169	0
Guard Rail	1.00	LM	13.500	62793	55100
Hard Wood	1.00	CUM	23.490	34250	27400
Joint Material	1.00	SQM	7.520	2040	0
Joint Seajer	1.00	kg	8.850	2401	0
Lamp HH-400	1.00	PCS	30.700	34921	0
Luminaire HWY	1.00	PCS	154.000	175175	0
Pozolis	1.00	kg	1.770	650	0
PC Anchor	1.00	PCS	342.000	257355	0
PC Sheath D65	1.00	LM	2.160	1625	0
PC Steel D12.7	1.00	ton	910.000	684775	0
PVC Conduit	1.00	LM	0.000	18200	16600
Reinforcement	1.00	ton	196.870	294000	230000
Release Material	1.00	lit	2.110	572	0
Rubber Shoe	1.00	SQM	1538.000	2045540	0
RC Pile 0.4*0.4	1.00	LM	22.950	48200	40160
RC Pipe D1000	1.00	LM	73.450	154245	128540
RC Pipe D400	1.00	LM	18.100	37980	31700
RC Pipe D600	1.00	LM	33.740	70900	59100
Sand	1.00	CUM	4.980	7417	5805
Scaffolding	1.00	PCS	6.350	9250	7400
Screened Crusher	1.00	CUM	4.760	7106	5557
Sealing Sheet	1.00	SQM	1.140	309	0
Seed	1.00	kg	10.000	7525	0
Separater	1.00	PCS	63.000	47408	0
Signal-2	1.00	set	11015.900	12530600	0
Soft Wood	1.00	CUM	36.890	32260	25800
Stabilizer	1.00	PCS	61.500	69956	0
Steel Form 0.3*1.5	1.00	PCS	10.680	16500	13200
Steel H300	1.00	ton	332.400	484800	387800
Stone	1.00	CUM	4.980	7417	5805
Taper Pole	1.00	PCS	516.600	753400	602700
Tile	1.00	SQM	5.640	8225	6580
Traffic G-Bead	1.00	Kg	1.420	522	0
Traffic Paint	1.00	lit	2.700	992	0
Traffic Sign 3'	1.00	set	40.170	30228	0
Water Stop	1.00	LM	4.320	4082	0
Wire Mesh	1.00	SQM	1.250	1820	1450

5) Indirect costs

The indirect cost was estimated as 35% of the direct construction cost (foreign and local portions accounting for 20 and 15 percent respectively), and covered the costs of temporary facilities, site offices, maintenance, and overhead (Table-8.6.6). The total direct and indirect cost thus obtained, provided the unit construction price for each cost item.

Table-8.6.6 Indirect Cost Component

Description	Foreign Portion	Local Portion	Total
1. Common Temporary Facilities			
1-1 Transportation	1.06	0.12	1.18
1-2 Mobilization and Demobilization	0.38	1.07	1.45
1-3 Temporary Facilities	0.40	0.60	1.00
1-4 Environment Control	0.20	0.30	0.50
1-5 Safety Facilities	0.12	1.08	1.20
1-6 Public Services Charge	-	1.00	1.00
1-7 Quality Control	0.44	0.44	0.88
1-8 Field Office Maintenance	0.70	0.89	1.59
Subtotal	3.30	5.50	8.80
2. Field Management	5.60	9.20	12.60
3. General Management	11.40	-	11.40
TOTAL	20.30	14.70	35.00

Note: Unit; Percent to the direct cost
Source: Team Estimate

6) Land Acquisition and Compensation

Information for estimating unit cost for land acquisition and compensation for house removal were collected from Kabupatens within the Study Area. Housing compensation unit costs were estimated based on the preliminary market prices.

Compensation costs for land acquisition are shown in Table-8.6.7 and Table-8.6.8.

Table-8.6.7 Land Acquisition

No.	Intersection Station	Paddy Land		Field		Residence		Industry		Tourism		Total	Number of
		Area ㎡	Cost ×10^6Rp.	Area ㎡	Cost ×10^6Rp.	Area ㎡	Cost ×10^6Rp.	Area ㎡	Cost ×10^6Rp.	Area ㎡	Cost ×10^6Rp.	Cost ×10^6Rp.	Removal House
1	STA. 0+000~STA.11+800 Ciavi~Cicurug	320,869	1,169.6	577,955	2,028.2	67,852	698.2	619	14.2			3,910.2	221 1 Factory
2	STA.11+800~STA.27+200 Cicurug~Cibadak(W)	73,184	94.7	344,799	448.5	23,348	29.5			35	0.2	572.9	42
3	STA.27+200~SAT.32+400 Cibadak(W)~Cibadak(E)	216,737	280.3	1,021,135	1,328.3	69,139	87.3			103	0.5	1,696.4	123
4	STA.32+400~STA.40+000 Cibadak(E)~Sukabuni(W)	323,912	680.6	71,594	207.9	31,981	115.0	45	0.1			1,003.6	106 1 Factory
5	STA.40+000~STA.53+500 Sukabuni(W)~Sukabuni(E)	796,889	1,322.9	138,625	354.9	80,449	190.2	55	0.1			1,868.1	198 1 Factory
6	STA.53+500~STA.65+400 Sukabuni(E)~Cianjur(W)	643,600	1,517.3	118,607	172.6	28,382	42.4					1,732.3	89
7	STA.65+400~STA.83+700 Cianjur(W)~Ciranjang	766,888	2,975.9	205,571	785.3	28,145	70.8					3,832.0	103
8	STA.83+700~STA.101+700 Ciranjang~Citatah	726,413	2,449.6	383,888	938.1	173,563	402.1					3,769.8	444 1 Factory
Total			10,490.9		6,263.8		1,635.5		14.4		0.7	18,405.3	1326

Table-8.6.8 Land Acquisition for Interchange

No.	Interchange Station	Paddy Land		Field		Residence		Industry		Tourism		Total	Number of
		Area ㎡	Cost ×10^6Rp.	Area ㎡	Cost ×10^6Rp.	Area ㎡	Cost ×10^6Rp.	Area ㎡	Cost ×10^6Rp.	Area ㎡	Cost ×10^6Rp.	Cost ×10^6Rp.	Removal House
1	STA.11+800 Cicurug			107,983	161.9	1,650	8.3			2,938	14.7	184.9	14
2	STA.27+200 Cibadak(W)	98,800	864.5									864.5	
3	SAT.32+400 Cibadak(E)	123,500	1,080.6									1,080.6	
4	STA.40+000 Sukabuni(W)	17,913	80.6	1,988	8.9	8,200	80.0					169.5	54
5	STA.53+500 Sukabuni(E)	59,963	149.9	17,363	60.8	17,450	61.1					271.8	36
6	STA.65+400 Cianjur(W)	62,975	251.9			3,750	9.4					261.3	
7	STA.83+700 Ciranjang	31,250	125.0	15,150	37.9	4,375	10.9					173.8	41
8	STA.101+700 Rajanandala	27,900	111.6	2,200	5.5	4,713	11.8					128.9	51
Total			2,664.1		275.0		181.5		0.0		14.7	3,135.3	196

7) Engineering Services

The cost of design and construction supervision was estimated as 10% of the total construction cost.

The foreign and local portions of this cost are 80% and 20% respectively.

8) Contingency Cost

Contingency costs were estimated to include two types of contingencies. The first covers unexpected cost resulting during the actual construction such as unexpected rock excavation, or work delay due to unusual weather. The second, price contingency was assumed to be 10% of the total project cost.

8.6.3 Cost Estimation Result

1) Unit Section

The project under study consists of three construction stages. None needs to be implemented as one project in itself. Therefore, each of them is divided into a number of unit sections in the manner described below, for cost estimation purposes. They must not be confused with unit sections for actual construction work execution to be determined with due consideration to project priority, work volume and factors.

(1) Each unit section will be connected with other roads in such a way that it can be opened for service and produce benefit prior to the completion of other sections.

(2) Each unit section will consist of smaller unit elements to enable the formulation of various alternative work programs for project implementation, and the section cost is estimated based on such elements.

2) Total project cost

The costs, disregarding price escalation and price contingency of each unit section were estimated based on July 1989 prices and exchange rate of 1US$ = Rp. 1,750.

8.6.4 Maintenance Cost

Maintenance work is classified into routine operation and maintenance work, and periodic maintenance work. Routine operation and maintenance work includes such works as grass cutting, cleaning of road side ditches and culverts, collection of toll charge, and road patrol. Periodic maintenance work includes such works as overlay, patching, sealing, and other road surface repair.

Table-8.6.9 Result of Construction Cost Estimates

STAGE0 Construction	Length	Construction Foreign	Construction Local	Total	Foreign	Local	Land Aquisition	Compen-sation	Total
Provisional	(Km)	(US$1000)	(Rp10^6)	(Rp10^6)	(%)	(%)	(Rp10^6)	(Rp10^6)	
Section 1 (STA 0 + 0 ~ 11 +800)	11.8	16,453.6	14,646.3	43,440.2	37.88%	62.12%	4,095.2	1,175.0	48,710.4
Section 2 (STA 11 +800 ~ 27 +200)	15.4	24,225.9	19,238.0	61,633.4	39.31%	60.69%	1,437.3	210.0	63,280.7
Section 3 (STA 27 +200 ~ 32 +400)	5.2	6,697.0	6,586.3	18,306.0	36.58%	63.42%	2,777.1	615.0	21,698.1
Section 4 (STA 32 +400 ~ 40 + 0)	7.6	7,457.9	7,702.7	20,754.1	35.93%	64.07%	1,173.1	800.0	22,727.2
Section 5 (STA 40 + 0 ~ 53 +500)	13.5	14,567.7	15,563.9	41,057.3	35.48%	64.52%	2,139.9	1,170.0	44,367.2
Sub Total	53.5	69,402.1	63,737.2	185,191.0			11,622.6	3,970.0	200,783.6
Engineering Fee		8,465.9	3,703.8	18,619.1					
Contingency (10%)		7,786.8	8,303.4	21,930.3			←Local	←Local	
Total	53.5	85,654.8	91,337.0	241,232.9					
Widning									
Section 1 (STA 0 + 0 ~ 11 +800)	11.8	11,934.1	14,359.1	35,243.8	33.86%	66.14%	0.0	0.0	35,243.8
Section 2 (STA 11 +800 ~ 27 +200)	15.4	16,666.4	16,654.4	47,820.8	34.85%	65.15%	0.0	0.0	47,820.8
Section 3 (STA 27 +200 ~ 32 +400)	5.2	5,465.3	6,847.1	16,446.4	33.35%	66.65%	0.0	0.0	16,446.4
Section 4 (STA 32 +400 ~ 40 + 0)	7.6	6,544.9	8,443.0	19,896.6	32.89%	67.11%	0.0	0.0	19,896.6
Section 5 (STA 40 + 0 ~ 53 +500)	13.5	11,958.0	16,338.5	37,265.0	32.09%	67.91%	0.0	0.0	37,265.0
Sub Total	53.5	52,568.7	64,642.2	156,672.4			0.0	0.0	156,672.4
Engineering Fee		7,162.2	3,133.4	15,667.2					
Contingency (10%)		5,975.1	6,777.6	17,234.0			←Local	←Local	
Total	53.5	65,725.9	74,553.2	189,573.6					
2 Lane									
Section 6 (STA 53 +500 ~ 65 +400)	11.9	11,505.3	10,964.9	31,099.1	37.00%	63.00%	1,993.6	445.0	33,537.7
Section 7 (STA 65 +400 ~ 83 +700)	18.3	13,778.4	15,472.1	39,584.3	34.81%	65.19%	4,005.9	720.0	44,310.2
Section 8 (STA 83 +700 ~101 +700)	18.0	11,860.6	9,289.3	30,045.3	39.48%	60.52%	3,918.7	2,475.0	36,439.0
Sub Total	48.2	37,144.2	35,726.3	100,728.8			9,918.2	3,640.0	114,287.0
Engineering Fee		4,604.7	2,014.6	10,072.9					
Contingency (10%)		4,174.9	5,129.9	12,436.0			←Local	←Local	
Total	48.2	45,923.9	56,429.0	136,795.8					
4 Lane									
Section 1 (STA 0 + 0 ~ 11 +800)	11.8	24,503.1	24,485.3	67,365.7	36.37%	63.63%	4,095.2	1,175.0	72,635.9
Section 2 (STA 11 +800 ~ 27 +200)	15.4	34,812.1	31,777.8	92,699.0	37.55%	62.45%	1,437.3	210.0	94,346.3
Section 3 (STA 27 +200 ~ 32 +400)	5.2	9,762.8	10,684.2	27,749.1	35.16%	64.82%	2,777.1	615.0	31,141.2
Section 4 (STA 32 +400 ~ 40 + 0)	7.6	11,363.4	12,897.6	32,783.5	34.66%	65.34%	1,173.1	800.0	34,756.6
Section 5 (STA 40 + 0 ~ 53 +500)	13.5	22,042.0	26,871.1	65,444.6	33.68%	66.32%	2,139.9	1,170.0	68,754.5
Sub Total	53.5	102,483.4	106,696.0	286,041.9			11,622.6	3,970.0	301,634.5
Engineering Fee		13,076.2	5,720.8	28,604.2					
Contingency (10%)		11,556.0	12,800.9	33,023.9			←Local	←Local	
Total	53.5	127,115.5	140,810.4	363,262.6					

The operation and maintenance costs for the proposed tollway are estimated based on the information from Jasa Marga concerning the operation and maintenance costs of several existing tollways, and the average operation and routine maintenance costs per kilometer for the tollway with 4 lanes is estimated to be about 110 million Rp. per annum. The operation and maintenance costs of a tollway with 2 lanes is assumed to be 0.7 times of those with 4 lanes (about 77 million Rp. per annum).

The periodic maintenance cost is estimated to be about 171 million Rp. per kilometer per annum and this cost shall start only after 10 years of operation (Table-8.6.10).

Table-8.6.10 Estimation of Operation and Routine Maintenance Costs

(1) Case of Jagorawi

	O/M Cost (Rp.Mil.)	Length (Km)	O/M Cost per Km	factor of Overhead	O/M Cost per Km (Rp.Mil.)	O/M Cost per Km (Rp.Mil.)
					4 lanes	2 lanes
Op.	3,113.6					
Maint.	911.7					
Total	4,025.3	47.6	85.0	1.2	102.0	71.0

(2) Case of Jakarta-Merak

	O/M Cost (Rp.Mil.)	Length (Km)	O/M Cost per Km	factor of Overhead	O/M Cost per Km (Rp.Mil.)	O/M Cost per Km (Rp.Mil.)
					4 lanes	2 lanes
Op.	2,658.6					
Maint.	808.0					
Total	3,466.6	26.8	129.0	1.2	154.8	108.0

(3) Case of Surabaya-Gempol

	O/M Cost (Rp.Mil.)	Length (Km)	O/M Cost per Km	factor of Overhead	O/M Cost per Km (Rp.Mil.)	O/M Cost per Km (Rp.Mil.)
					4 lanes	2 lanes
Op.	2,614.4					
Maint.	748.3					
Total	3,362.7	43.6	77.0	1.2	92.4	65.0

(Average of Above Tollways)

	O/M Cost (Rp.Mil.)	Length (Km)	O/M Cost per Km	factor of Overhead	O/M Cost per Km (Rp.Mil.)	O/M Cost per Km (Rp.Mil.)
					4 lanes	2 lanes
Op.	8,386.6					
Maint.	2,468.0					
Total	10,854.6	118.0	92.0	1.2	110.4	77.0

Note : Data source of operation and routine maintenance costs of above tollways is from Jasa Marga

These maintenance costs consist of foreign and local portions as shown in Table-8.6.11.

Table-8.6.11 Maintenance Costs in Foreign and Local Portions

Description	Cost (Rp. Mil.)/Year/km		
	Foreign	Local	Total
1. Routine Operation/Maintenance			
1.1 4 lanes	55.2	55.2	110.4
1.2 2 lanes	38.5	38.5	77.0
2. Periodic Maintenance	130.0	41.0	171.0

CHAPTER 9 FORMULATION OF ROAD PROJECT STAGED CONSTRUCTION PLAN

9.1 Determination of Section Priority

1) Determination Methodology

In this chapter the priority ranking of the sections to determine construction sequence shall be examined, and based on this ranking a number of alternative construction plans shall be formulated. In other words, this chapter will examine the construction phasing for the project, the extent of which was determined in Chapter 8, and is scheduled to be completed by the year 2010.

The determination method for the construction priority of the sections shall consider the results of the traffic characteristics analysis in the target year of 2010, and the degree of importance of each section.

The degree of importance of a section shall be determined by the difference in the general vehicle travel distance (veh.km) and vehicle travel time (veh.hour) when the whole route is constructed and those when the route is constructed without the section under examination. The figures obtained in this comparison shall be used as tools for determining the construction phasing priority of the sections (refer to Fig.-9.1.1).

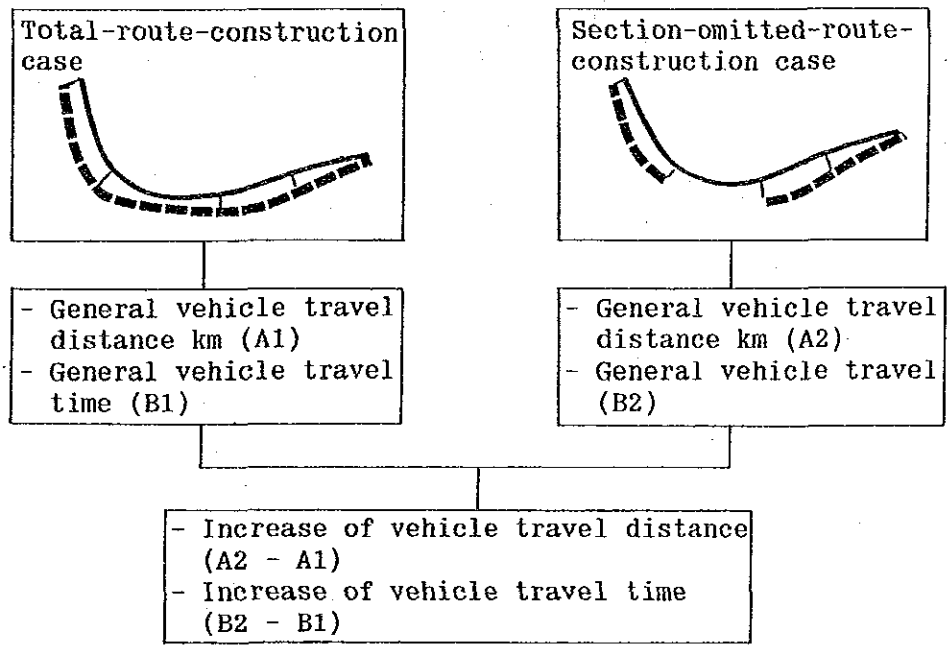


Fig.-9.1.1 Determination of Section Degree of Importance

2) Route Sections

The sections of the project road shall be defined as those sections lying between the cities which the road shall link and shall be as follows:

Section 1: Ciawi - Cibadak
Section 2: Cibadak - Sukabumi
Section 3: Sukabumi - Cianjur
Section 4: Cianjur - Citatah

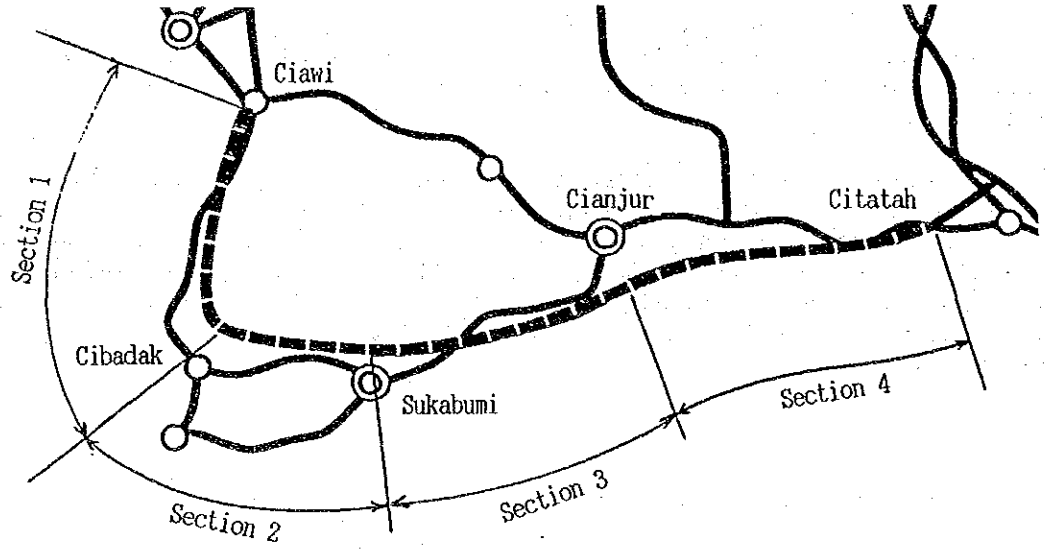


Fig.-9.1.2 Project Road Sections

9.2 Construction Priority Determination by Section

1) Analysis Conditions

The project road to be constructed by the year 2010, in terms of lane number, interchanges location, etc., is described in Chapter 8. As shown in Fig.-9.2.1, from Ciawi up to Sukabumi the road shall have four lanes, after which it will continue eastward to Citatah with only two lanes.

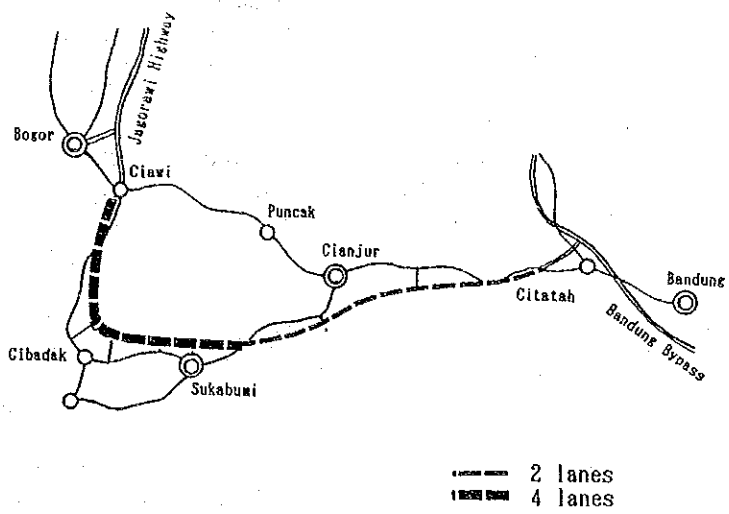


Fig.-9.2.1 Road Project in the year 2010

These conditions shall be the basis for the analysis estimation and the examination of the traffic characteristics.

As a precondition for the estimation analysis the network to be adopted shall be based on that used for the route alternatives investigation in Chapter 6, but with the following two differences:

- The interchanges locations discussed in Chapter 8 shall be considered.
- As a precondition for the operation of the road as a toll road, the toll fares outlined in Chapter 11 (ordinary car 60 Rp./km, heavy truck 90 Rp./km) shall be employed to calculate the conversion rates.

2) Traffic Characteristics by Section

Table-9.2.1 shows the results of the traffic characteristics by section for the year 2010. Fig.-9.2.3 shows the traffic volumes for the region under study.

Table 9.2.1 Traffic Characteristics by Section

Section Number	Section	Traffic Volume Assigned (veh./day)	Heavy Truck Ratio (%)	Average Trip Length (km)
1	Ciawi - Cibadak	21,300	24.9%	107.0
2	Cibadak - Sukabumi	19,800	23.7%	107.9
3	Sukabumi - Cianjur	16,500	18.9%	110.9
4	Cianjur - Citatah	14,000	17.8%	102.5

The daily traffic volume estimated between Ciawi and Sukabumi is about 20,000 vehicles and the corresponding figures for the sections between Sukabumi and Citatah range between 14,000 and 17,000 vehicles.

As in the case of traffic volumes, the estimated heavy truck ratios are higher in the sections between Ciawi and Sukabumi (Sections 1 and 2), with the largest ratio estimated at Section 1 where heavy trucks are forecast to compose a fourth of the total traffic.

In terms of average trip lengths, Section 3 between Sukabumi and Cianjur shall have the longest length and the shortest length shall be in the section between Cianjur and Citatah (Section 4).

The traffic volumes and corresponding average trip lengths for each section are plotted in Fig.-9.2.2.

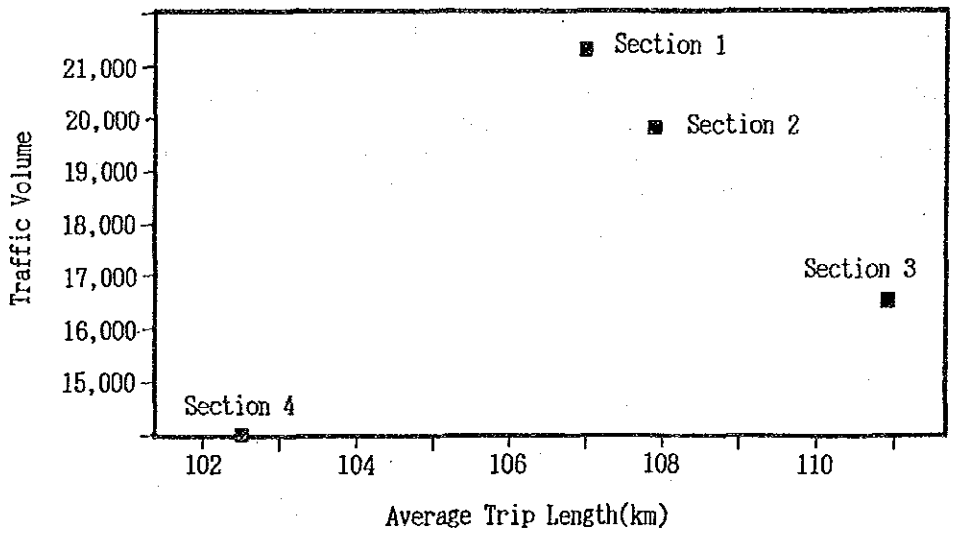


Fig.-9.2.2 Traffic Volume and Average Trip Length by Section

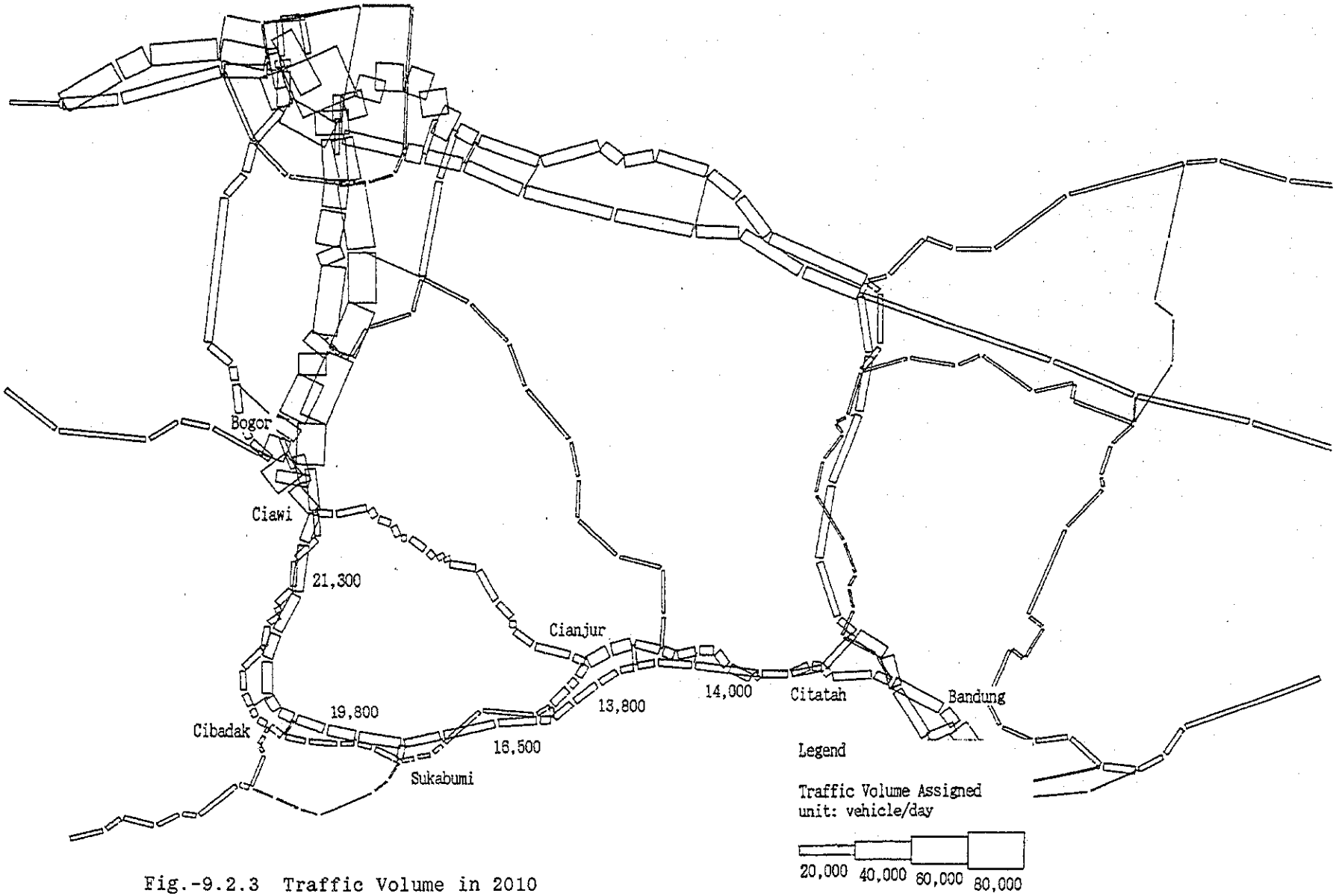


Fig.-9.2.3 Traffic Volume in 2010

When the traffic characteristics of each section are considered it is possible to classify the sections in the following groups:

- Group A (Sections 1 and 2)

The sections of this group have comparatively larger traffic volumes, longer trip lengths and serve a wide region, thereby they may be recognized as major road sections. It is therefore desirable to adopt high standards in order to secure traffic capacity and high traffic speeds. Furthermore these sections have heavy truck ratios which are expected to create congestion. It is therefore considered necessary that the construction be at an early phase in order to secure the traffic capacity.

- Group B (Section 3)

The traffic volume in this section is not so large, however the average trip length is long, and this section can be considered as a major road section serving a wide area. Rather than capacity it is therefore desirable to maintain traffic speed standards. It is considered that this section should be constructed at a comparatively early phase.

- Group C (Section 4)

The traffic volume in this section is comparatively low, and the average trip length is short. This section will be part of a major regional road but its construction priority will be relatively low compared to the other sections.

3) Degree of Importance by Section

As described earlier in the determination methodology, the vehicle travel distance and vehicle travel time values are calculated for the total route construction case and the increases in these values are calculated for the four cases omitting the construction of one of the four sections in each case. The results of this calculation are shown in Table-9.2.2.

The increased values indicate that the travel distance and time would increase if the respective sections are omitted, compared to the case of the total route construction. The importance of the sections corresponds to the increased values, with the section having the highest increase in values considered also having the highest degree of importance and so on in descending order.

Table-9.2.2 Vehicle Travel Distance and Travel Time by Section

Section	Vehicle Distance (1,000 veh.*km)		Vehicle Hour (1,000 veh.*hour)	
	Real Value	Difference	Real Value	Difference
All Constructed	34,249.6		2,142.3	
Ciawi - Cibadak	35,187.7	938.1	2,249.4	107.1
Cibadak - Sukabumi	34,748.7	499.1	2,211.5	69.2
Sukabumi - Cianjur	34,674.2	424.6	2,176.9	34.6
Cianjur - Citatah	34,7771.2	521.6	2,168.1	25.8

As shown in the table, the increased values of vehicle travel distance and travel time are the largest for the Ciawi - Cibadak section, followed by the Cibadak - Sukabumi section. Although the increased value for the vehicle travel distance of the Cianjur - Citatah section is the second highest after the corresponding value for the Ciawi - Cibadak section, the increase in vehicle travel time for that section is low.

4) Construction Priority by Section

In light of the analysis presented in the previous section, and compared with other sections of the route the construction of the Ciawi and Sukabumi component of the route (Sections 1 and 2) should start early, and the priority of the route east of Sukabumi is comparatively low. Accordingly the road project construction plan has been formulated in the following section 9.3.

9.3 Road Project Construction Plan Alternatives

1) Formulation of Alternatives

In order to formulate the road project construction plan alternatives the following policy issues have been considered;

- The construction of the route up to the year 2010 shall be divided into three phases.

  Phase 1: 1991 to 1998
  Phase 2: 1999 to 2005
  Phase 3: 2006 to 2010

- The road project construction plan shall be prepared in such a manner as to facilitate the construction.

- According to the section construction priority, the Ciawi - Cibadak section has the highest priority and the construction shall start at that section.

- Two possibilities shall be considered for the construction of the Ciawi - Sukabumi Section, one having the section constructed as four lanes from the start and the second having the section constructed as two lanes in the preliminary phase.

- As a special case, the section construction phasing shall take into consideration that sections bypassing cities have priority.

In accordance with these basic policies the alternatives for the road project construction plans were formulated as follows;

(1) Alternative A (Fig.-9.3.1)

Phase 1 will cover the construction of the four lane road section between Ciawi and Cibadak, Phase 2 the four lane construction of the Cibadak - Sukabumi section, and Phase 3 the construction of the remaining two lane road section.

(2) Alternative B (Fig.-9.3.2)

Phase 1 will cover the construction of the four lane road section between Ciawi and Sukabumi, Phase 2 the two lane construction of the Sukabumi - Cianjur section, and Phase 3 the construction of the remaining Cianjur - Citatah two lane road section.

(3) Alternative C (Fig.-9.3.3)

Phase 1 will cover the construction of a two lane road section between Ciawi and Sukabumi, Phase 2 the construction of a two lane road section between Sukabumi and Citatah, and Phase 3 the construction of an additional two lanes between Ciawi and Sukabumi.

(4) Alternative D (Fig.-9.3.4)

Phase 1 will cover the construction of the parts of the project road forming bypasses of the cities of Cibadak, Sukabumi, and Cianjur, and construction phases 2 and 3 will be the same as the corresponding phases of Alternative C.

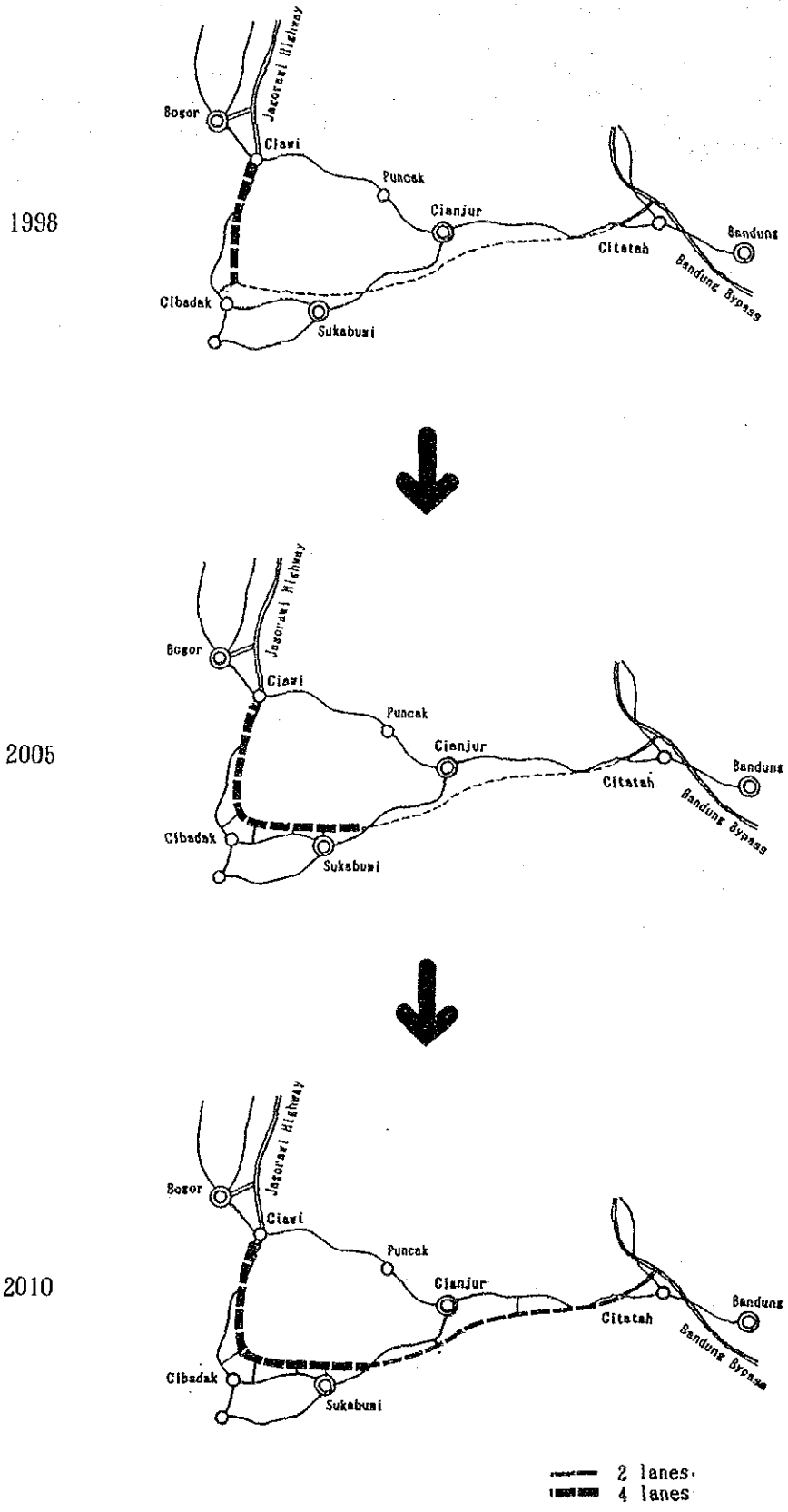


Fig.-9.3.1 Construction Plan Alternative A

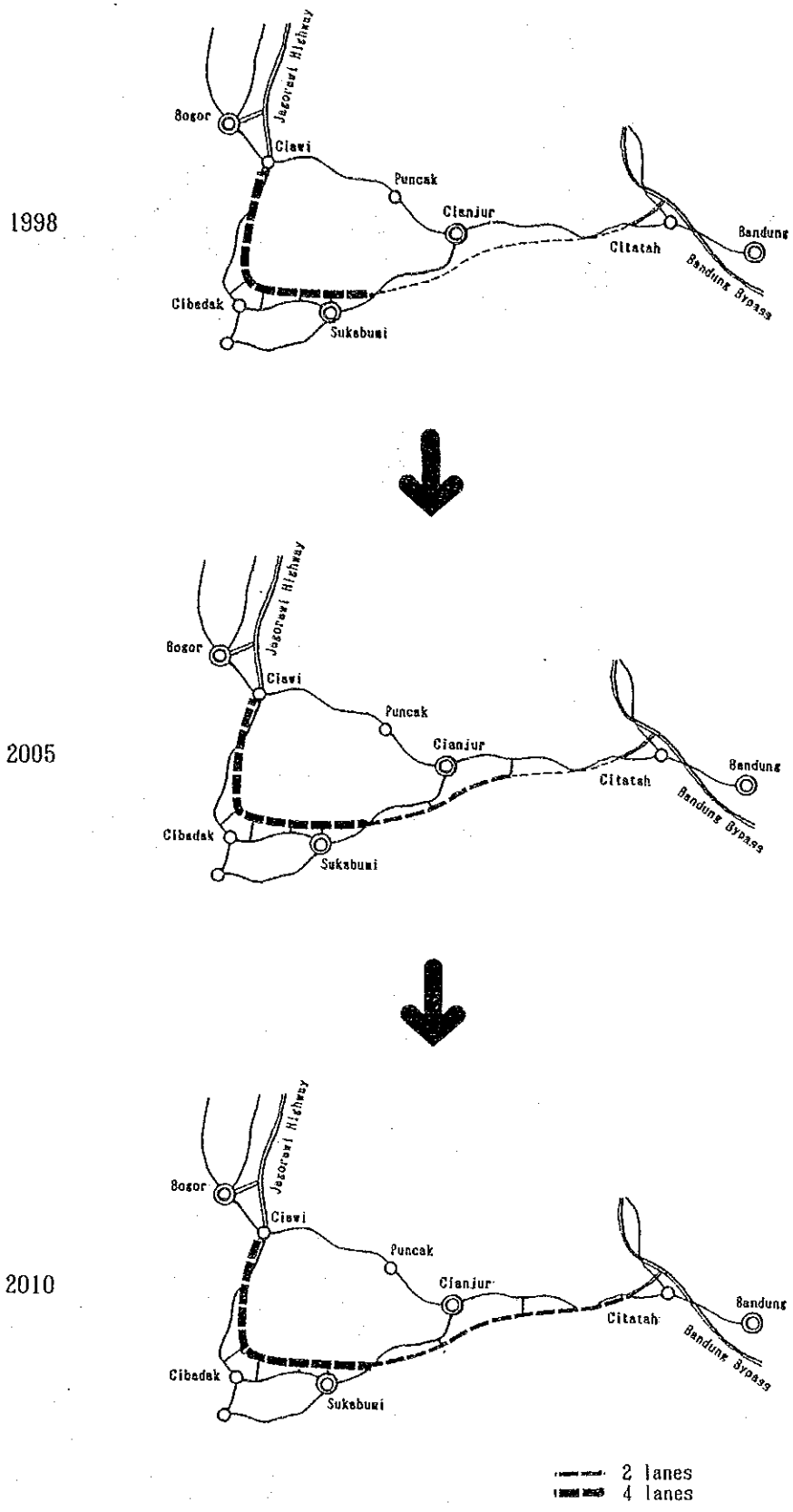
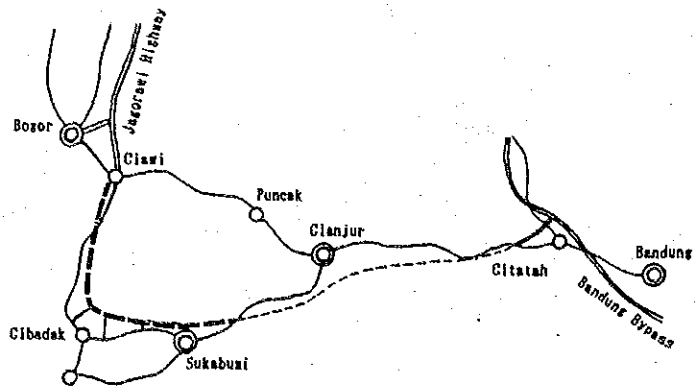
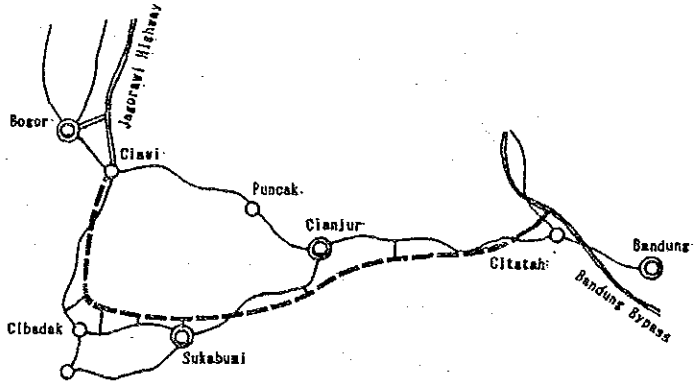


Fig.-9.3.2 Construction Plan Alternative B

1998



2005



2010

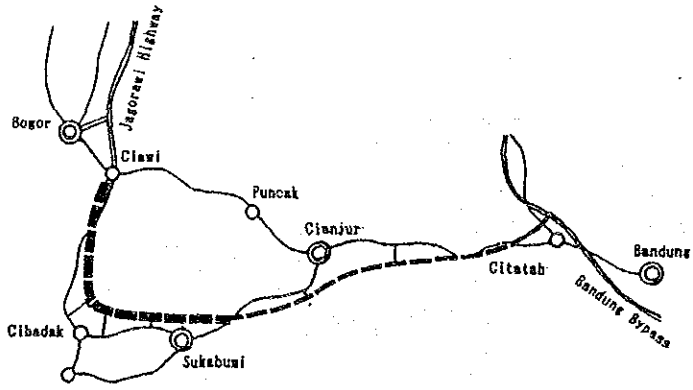


Fig.-9.3.3 Construction Plan Alternative C

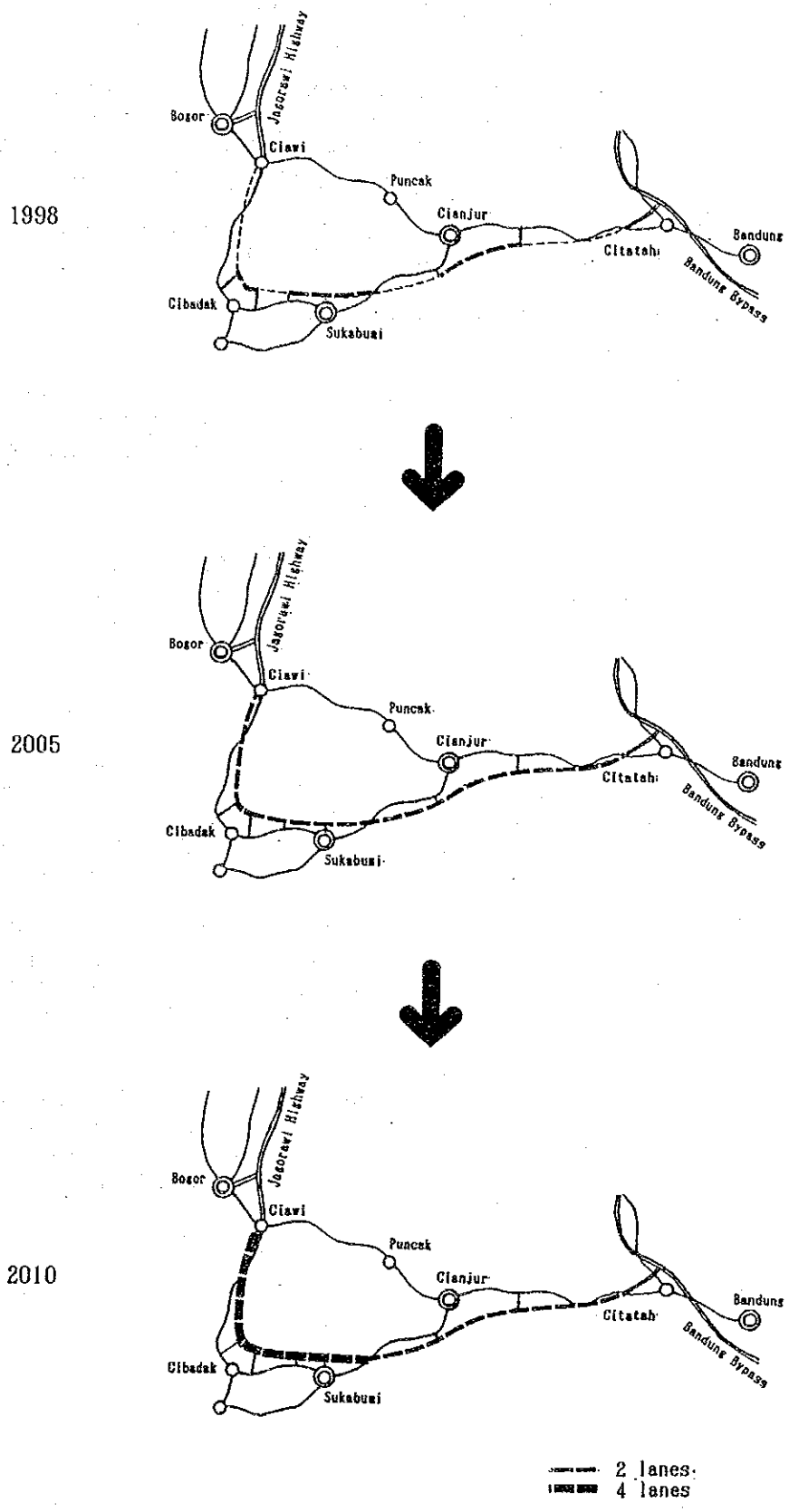


Fig.-9.3.4 Construction Plan Alternative D

2) Reduction of General Vehicle Travel Distance and General Vehicle Travel Time

Table-9.3.1 shows the comparison of each alternative to the without project case in terms of general vehicle travel distance and general vehicle travel time derived from each alternative at the last year of each of the three construction phases, which will be translated into benefits by mutiplying with the vehicle operating cost and vehicle time cost. At the year 2010, the project target year, the reductions produced by all the alternatives shall be equal.

Table-9.3.1 Economic Benefits of the Alternatives

Alternatives	Reduction of General Vehicle Distance (1,000 Veh.km/day)			Reduction of General Vehicle Time (1,000 Veh.hour/day)		
	1988	2005	2010	1998	2005	2010
Alt.A	128.9	214.4	318.8	102.3	159.0	150.3
Alt.B	103.6	201.3	318.8	162.4	165.9	150.3
Alt.C	106.2	209.1	318.8	161.1	162.8	150.3
Alt.D	4.8	209.1	318.8	48.9	162.8	150.3

The analysis of the reductions shows that for phases 1 and 2, Alternative A has the highest reductions of general vehicle travel distance, while the same can be said of Alternative B in the case of general vehicle travel time. Alternative C has high reductions for both vehicle travel distance and vehicle travel time for each phase.

Alternatives A and B serve the heavy traffic between Ciawi and Sukabumi by the provision of a four lane road in the initial phase. On the other hand, phase 2 of Alternative C provides for the construction of the complete length of the road (by two lanes) between Ciawi and Citatah.

Upon the estimation of the economic construction costs in the following Chapter 10, and using the benefits calculated with figures above, a comparison of the economic analysis of the alternatives shall be done and the alternative having the best economic effects shall be adopted to formulate the facilities construction plan.

CHAPTER 10 ECONOMIC ANALYSIS

10.1 Introduction

The basic purpose of the economic appraisal in this chapter is to screen the staged construction alternatives (4 alternatives), which are discussed in Chapter 9, from the economic point of view of the country as a whole. For this purpose cost-benefit analysis is used. The streams of future economic costs and benefits among alternatives are discounted by an appropriate rate. The comparison methods are (a) the net worth of a project or the net present value (NPV), that is, the difference between its discounted costs and benefits; (b) the ratio between costs and benefits or B/C ratio; (c) the economic internal rate of return (EIRR); and (d) the first year rate of return.

10.2 Economic Cost Analysis

1) Construction Costs

The construction cost estimation was already discussed in Chapter 8. Here the cost was converted from financial terms to economic terms by using a cost conversion program developed by the Study Team, which can deduct the transfer items such as import tariff and other taxes.

As for economic cost of land price, the Study Team assumed that the financial cost reflects the opportunity cost of land and proceeded to apply a conversion factor to express it in border prices.

Total economic construction costs of alternatives are summarized in Table-10.2.1.

Table-10.2.1 Summary of Economic Cost for the 4 Alternatives

Unit: Rp Million

Staged Construction Alternatives	Phase 1 (1993-97)	Phase 2 (2000-04)	Phase 3 (2005-09)	Total
Alternative A				
Engineering	14,437.7	11,402.5	9,068.6	34,908.8
Removal of Houses & Land Acquisition	6,225.8	7 807.6	12,202.3	26,235.7
Construction & Others	160,881.0	127,348.8	101,882.7	390,112.5
Total	181,544.5	146,558.9	123,153.6	451,257.0
Alternative B				
Engineering	25,840.2	6,332.3	2,736.3	34,908.8
Removal of Houses & Land Acquisition	14,033.4	6,448.0	5,754.3	26,235.7
Construction & Others	281,229.8	70,934.2	30,948.5	390,112.5
Total	321,103.4	83,714.5	39,439.1	451,257.0
Alternative C				
Engineering	16,646.8	9,068.7	14,119.4	39,834.8
Removal of Houses & Land Acquisition	14,033.3	12,202.4	0.0	26,235.7
Construction & Others	186,182.6	101,882.5	156,725.2	444,790.3
Total	216,862.7	123,153.6	170,844.6	510,860.9
Alternative D				
Engineering	8,857.5	16,858.0	14,119.4	39,834.8
Removal of Houses & Land Acquisition	10,285.1	15,950.6	0.0	26,235.7
Construction & Others	99,346.4	188,718.8	156,725.2	444,790.3
Total	118,488.9	221,527.4	170,844.6	510,860.9

2) Operation and Maintenance Costs

The annual operation and maintenance costs are discussed in Chapter 8. These amounts are also converted to the economic costs by deducting transfer items. The economic operation and maintenance costs are shown in Table 10.2.2. As shown, unit costs are the same for all the alternatives, however, those are distributed according to the staged construction schedule.

Table-10.2.2 Economic Operation and Maintenanace Costs
(Annual costs per km)

Unit: Rp million

	Provisional 2 lane Construction	Widening to final 4 lane Const.	Full 4 lane Construction
Routine	66.2	94.6	94.6
Periodic	159.0	282.7	282.7

Note: The periodic maintenance shall start only after 10 years of operation.

10.3 Economic Benefit Analysis

The economic benefits consist of (a) reduced vehicle operating costs through comparing the with-project case (the staged construction alternatives) to the without-project case from the point of the existing and future road network in the Study Area; and (b) time savings for passengers in the same manner. In order to calculate reduced vehicle operating costs, the model of VOC, representative vehicles, unit prices and components of VOC are studied first. Then, time savings are analyzed.

1) Analysis for Vehicle Operating Costs

(1) Model of the Vehicle Operating Costs

At Bina Marga, the vehicle operating cost is analyzed based on the GENMERRI Model (Generalized Model for the Evaluation of Rural Road Improvement) developed in the 1970's. In principal, this model determines first operating costs of representative vehicles on a straight, level, sealed road in good condition, then applies modifying factors to reflect the effects on operating costs of (a) average drive conditions; (b) congestion; (c) curves; (d) gradients; and (e) imperfect surfaces and pavements.

However, this model is too demanding in terms of input data to be satisfactory for use. In 1986, Bina Marga and World Bank developed a simplified vehicle operating cost model for use screening analysis through modifying the GENMERRI Model. In this Study, this simplified model is adopted because the results of comparison analysis using the Simplified VOC Model and the GENMERRI MODEL show that the differences are within acceptable range.

(2) Representative Vehicles

The following representative vehicle categories and models were selected for calculation of vehicle operating cost in this Study. The selection is based on Bina Marga report - Pembaharuan Perhitungan Biaya Operasi Kendaraan (VOC) Berdasarkan Data Dasar, 1988/1989.

Table-10.3.1 Representative Vehicles

Category	Type	Model
Car	Passenger car	Toyota Corolla (1290cc)
Mini-bus	Mini-bus (Angkutan Kota)	Mitsubishi Colt L300 (1439cc)
H.BUS	Heavy Bus	Mercedes 1113 (5675cc)
L.TRUCK	Light Truck (Pick-up truck)	Mitsubishi Colt L300 (1439cc)
H.TRUCK	Heavy Truck (2 axle)	Mitsubishi Colt FE-114

Of these, the car, mini-bus and light truck are assumed to be petrol driven and the heavy bus and heavy truck are diesel driven. This Study assumes that Mitsubishi Colt FE-114 is a heavy truck although this truck corresponds to a medium one in the Bina Marga definition.

(3) Unit Prices and Components of Vehicle Operating Cost

The unit prices and basic vehicle data are summarized in Table 10.3.2. The economic vehicle costs are estimated by excluding import tax, import/manufacturing sales tax (PPN) and other taxes from its financial cost.

According to the Simplified VOC Model, the components of vehicle operating costs in this Study comprise (a) Fuel costs; (b) Lubricating oil costs; (c) Tyre costs; (d) Repair and maintenance costs; (e) Distance depreciation costs; (f) Time depreciation costs; (g) Interests; and (h) Occupants' and crew wages. Their calculation methods are shown below. The numbers before items correspond to those in Table 10.3.2.

Of these, fuel consumption, oil consumption, repairs and maintenance and distance depreciation vary with the level of utilization in terms of vehicle.kilometers. On the other hand, time depreciation, interest, and crew wages are charged to the time of vehicle utilization in terms of vehicle.hours.

(a) Unit Cost of Fuel (Rp/Litre)

Directly comes from Bina Marga Data in economic terms

(b) Unit Cost of Lubricating Oil (Rp/Litre)

Directly comes from Bina Marga Data in economic terms

(c) Unit Tyre Cost (Rp per mm of tread per 1000 vehicle-km)

Unit tyre costs are calculated as the number of tyres multiplied by the cost of tyres plus retreads divided by tread depth and expressed as cost per mm of tread per 1000 km.

Table-10.3.2 Basic Vehicle Operating Cost Data

No.	Basic Data Items	CAR	MINI-BUS	H.BUS	L.TRUCK	H.TRUCK
R01	Unit petrol cost (Rp/Litre)	341	341	341	341	341
R02	Unit diesel cost (Rp/Litre)	319	319	319	319	319
R03	Petrol engine oil cost (Rp/Litre)	1750	1750	1750	1750	1750
R04	Diesel engine oil cost (Rp/Litre)	1750	1750	1750	1750	1750
R05	Cost of new tyre (Rp)	67200	36500	228500	36500	228500
R06	Cost of retreaded tyre (Rp)	40300	21900	137100	21900	137100
R07	Average number of retreads per tyre	1	1	2	1	2
R08	No. of tyres per vehicle	4	4	6	4	6
R09	No. of spare tyres per vehicle	1	1	1	1	1
R10	Effective tread depth on new tyre (mm)	7.6	7.6	17.8	7.6	17.8
R11	Effective tread depth on retread tyre (mm)	6.4	6.4	14.0	6.4	14.0
R12	Basic repair and maintenance cost (Rp/km)	18.25	20.85	36.25	24.3	33.95
R13	New vehicle price (Rp'000)	38665	16412	60400	12815	50486
R14	Percent tax in new vehicle	54	30	17	23	20
R15	Economic vehicle cost (Rp'000) - EVC	17786	11488	50132	9868	40389
R16	Time depreciation rate (% EVC/year)	5.02	5.2	6.3	3.47	2.27
R17	Distance depreciation rate (% EVC/'000km)	0.34	0.22	0.09	0.22	0.18
R18	Opportunity cost of capital (%/year)	15	15	15	15	15
R19	Vehicle running time (hours/year)	500	2000	3200	1330	1770
R20	Reducible proportion of fleet (%)	10	100	100	40	60
R21	Vehicle actual life (years)	8	4	5	6	6
R22	Drivers/helpers wages (Rp/hour)	590	700	1245	785	1015

Sources: (1)Bina Marga, Perhitungan Biaya Operashi Kendaraan (V.O.C.) Berdasaekan Data Dasar 1988/1989
(2)Bina Marga and IBRD, A Simplified Vehicle Operating Cost Model for Use in Screening Analysis, Technical Advisory Services under Bina Marga-IBRD Highway Betterment Project I, 1986

Note: (1)Heavy Truck (H.TRUCK) in this table corresponds to Medium Truck (M.TRUCK) of Bina Marga Data because of the difference of the representative vehicles.

UTC = 0.001x[(R08+R09)x(R05+R06xR07)/(R10+R11xR07)]

where UTC = Unit Tyre Cost (Rp/mm)
R05 = Cost of new tyre (Rp)
R06 = Cost of retread (Rp)
R07 = Average number of retreads per tyre
R08 = No. of tyres per vehicle
R09 = No. of spare tyres per vehicle
R10 = Effective tread depth on new tyre (mm)
R11 = Effective tread depth on retreaded type (mm)

(d) Unit Repair and Maintenance Cost (Rp/Vehicle-km)

Unit vehicle repair and maintenance costs correspond to basic repair and maintenance costs expressed as Rp per vehicle.km. This cost directly comes from Bina Marga Data.

(e) Distance Depreciation Cost (Rp/Vehicle-km)

Distance depreciation costs are a function of the economic cost of a new vehicle and the distance depreciation rate per vehicle.km.

DDC = [R15x1000-R05x(R08+R09)]x(R17/100)x0.001

where DDC = Distance Depreciation Cost (Rp/Vehicle-km)
R05 = Cost of new tyre (Rp)
R08 = No. of tyres per vehicle
R09 = No. of spare tyres per vehicle
R15 = Economic cost of a new vehicle (Rp'000)
R17 = Distance depreciation rate (per 1000 km)

(f) Time Depreciation Cost (Rp/hour)

Time depreciation costs are a function of the economic cost of a new vehicle and the time depreciation per year and vehicle running time.

TDC = [R15x1000-R05x(R08+R09)]x(R16/100)x(1/R19)x(R20/100)

where TDC = Time Depreciation Cost (Rp/hour)
R05 = Cost of new tyre (Rp)
R08 = No. of tyres per vehicle
R09 = No. of spare tyres per vehicle
R15 = Economic cost of a new vehicle (Rp'000)
R16 = Time depreciation rate (% per annum)
R19 = Vehicle running time (hours per year)
R20 = Reducible proportion of fleet (%)

(g) Interest Cost (Rp/hour)

Interest costs are calculated as follows:

$$INT = [R15x1000-R05x(R08+R09)]x(CRF-1/R21)x(1/R19)x(R20/100)$$

where
- INT = Interest Cost (Rp/hour)
- CRF = Capital Recovery Factor
- R05 = Cost of new tyre (Rp)
- R08 = No. of tyres per vehicle
- R09 = No. of spare tyres per vehicle
- R15 = Economic cost of a new vehicle (Rp'000)
- R18 = Opportunity cost of capital (%/year)
- R19 = Vehicle running time (hours per year)
- R20 = Reducible proportion of fleet (%)
- R21 = Vehicle actual life (years)

$$CRF = 0.01xR18/[1.0-1.0/(1.0+0.01xR18)^{R21}]$$

(h) Wage Cost (Rp/hour)

Wage costs for drivers and helpers directly comes from Bina Marga Data.

(4) Procedure for Estimation of Vehicle Operating Costs

The adopted model in the Study consists of the above components and some adjustment factors. Some of the components of VOC are adjusted for surface condition, gradient and congestion. The components that required adjustment are shown below.

Table-10.3.3 Components and Adjustment Factors

Components	Surface	Gradient	Congestion(V/C)
1. Fuel	o	o	o
2. Oil	o	-	-
3. Tyre	o	o	o
4. Repair & Maint.	o	-	-
5. Distance Depr.	o	-	-
6. Time Depr.	-	-	-
7. Interests	-	-	-
8. Wages	-	-	-

Note: o shows there are corresponding adjustment factors to each component. - means "not applicable".

The model has basic unit cost by speed level of consumption rate of fuel, oil, and tyre wear. Thus, the basic unit costs are modified through the above adjustment factors. Distance depreciation cost, time depreciation cost and interests are calculated according to built-in-equations of the model. Data come from Bina Marga 1988/89 report of vehicle operating cost.

In this Study, the total vehicle operating cost is only sensitive to congestion because in the road network of the Study Area

surface condition (roughness) is assumed to be good and gradient is assumed to be under the same range whether it is with-project case or without-project case.

(5) Results of Vehicle Operating Costs Analysis

Based on the above-mentioned procedures, the vehicle operating costs by type of vehicle, by speed levels and by volume capacity ratio (proxy of congestion) are assumed as shown below.

Table-10.3.4 Vehicle Operating Cost (Rp/km) with V/C Ratio/Car

SPEEDS	<0.6	0.6-0.8	0.8-1.0	1.0-1.2	>1.2
10 - 20	160.7	166.3	169.1	172.0	176.2
20 - 30	138.0	142.9	145.4	147.8	151.5
30 - 40	129.9	134.9	137.4	139.9	143.7
40 - 50	126.7	132.1	134.8	137.6	141.6
50 - 60	126.4	132.6	135.7	138.8	143.5
60 - 70	128.2	135.3	138.9	142.5	147.8
70 - 80	131.5	139.8	143.9	148.0	154.2
80 - 90	135.6	145.1	149.8	154.5	161.6
90 -100	141.7	152.6	158.1	163.5	171.7

Table-10.3.5 Vehicle Operating Cost (Rp/km) with V/C Ratio/L-Bus

SPEEDS	<0.6	0.6-0.8	0.8-1.0	1.0-1.2	>1.2
10 - 20	284.8	298.7	305.6	312.6	323.0
20 - 30	198.9	208.4	213.2	217.9	225.1
30 - 40	165.7	173.8	177.9	182.0	188.1
40 - 50	148.8	156.5	160.3	164.2	169.9
50 - 60	142.0	150.0	154.0	158.0	164.0
60 - 70	141.1	149.8	154.1	158.4	164.9
70 - 80	146.1	156.0	161.0	165.9	173.3
80 - 90	157.1	168.9	174.7	180.6	189.4
90 -100	171.3	185.2	192.1	199.1	209.5

Table-10.3.6 Vehicle Operating Cost (Rp/km) with V/C Ratio/H-Bus

SPEEDS	<0.6	0.6-0.8	0.8-1.0	1.0-1.2	>1.2
10 - 20	475.7	490.3	497.6	504.9	515.2
20 - 30	337.2	348.6	354.4	360.1	368.3
30 - 40	284.5	295.7	301.3	306.9	315.0
40 - 50	260.4	272.5	278.6	284.6	293.4
50 - 60	249.2	262.9	269.8	276.6	286.6
60 - 70	247.3	263.1	270.9	278.8	290.3
70 - 80	254.6	273.2	282.4	291.7	305.3
80 - 90	270.5	292.5	303.5	314.5	330.6
90 -100	292.5	318.6	331.7	344.8	363.8

Table-10.3.7 Vehicle Operating Cost (Rp/km) with V/C Ratio/L-Truck

SPEEDS	<0.6	0.6-0.8	0.8-1.0	1.0-1.2	>1.2
10 - 20	251.9	265.8	272.8	279.8	290.2
20 - 30	179.2	188.7	193.4	198.2	205.3
30 - 40	151.5	159.7	163.8	167.8	173.9
40 - 50	137.8	145.5	149.3	153.1	158.9
50 - 60	133.0	141.0	145.0	149.0	155.0
60 - 70	133.4	142.1	146.4	150.8	157.2
70 - 80	139.5	149.4	154.3	159.3	166.7
80 - 90	151.2	163.0	168.8	174.7	183.5
90 -100	166.0	179.9	186.9	193.8	204.2

Table-10.3.8 Vehicle Operating Cost (Rp/km) with V/C Ratio/H-Truck

SPEEDS	<0.6	0.6-0.8	0.8-1.0	1.0-1.2	>1.2
10 - 20	411.2	425.8	433.1	440.3	450.7
20 - 30	306.5	318.3	324.2	330.1	338.6
30 - 40	268.2	280.1	286.1	292.0	300.6
40 - 50	251.9	265.0	271.6	278.2	287.7
50 - 60	246.3	261.6	269.2	276.8	287.9
60 - 70	247.7	265.4	274.2	283.1	296.0
70 - 80	257.4	278.4	288.9	299.5	314.9
80 - 90	274.8	299.8	312.4	324.9	343.2
90 -100	297.4	327.1	341.9	356.7	378.5

2) Analysis for Time Cost of Passengers

Bina Marga calculated the personal time value of private and commercial trips in economic terms. This amount is the basic unit of time costs for passengers. The following is the summary of the time costs by vehicle type.

Table-10.3.9 Time Costs by Vehicle Type

	Car	Mini-Bus	H.Bus
Personal time value of a private trip (Rp/Hr)	310	170	150
Personal time value of a commercial trip (Rp/Hr)	1000	400	300
% of passenger trips which are private	60	90	90
Average no. of passengers per vehicle	2.6	7.8	30.0
Estimated time costs per vehicle (Rp/Hr)	1523.6	1505.4	4950.0

Source: Bina Marga

3) Results of the Economic Benefit

The total economic benefits, which comprise reduced vehicle operating cost and time savings, are summarized by alternative in Table-10.3.10.

Table-10.3.10 Economic Benefit by Alternative

(Unit: Rp Million/year in economic terms)

Alternatives	Year	VOC	VTC	Total
Alt. A	1998	6,140.7	65,294.8	71,435.5
	2005	9,922.5	81,075.5	90,998.0
	2010	19,023.8	65,777.0	84,800.8
Alt. B	1998	13,633.1	94,149.8	107,782.9
	2005	10,832.9	83,353.2	94,186.1
	2010	19,023.8	65,777.0	84,800.8
Alt. C	1998	13,607.5	93,686.7	107,294.2
	2005	18,807.0	74,843.6	93,650.6
	2010	19,023.8	65,777.0	84,800.8
Alt. D	1998	1,356.8	32,491.8	33,848.6
	2005	10,325.6	82,329.0	92,654.6
	2010	19,023.8	65,777.0	84,800.8

Notes: VOC means the reduced vehicle operating cost.
VTC means the savings of vehicle time cost.

At the first phase, operating cost saving is around 10 percent of the total benefits in every alternative. After the final phase, about 22 percent of the benefits will come from the vehicle operating cost savings. Thus the time savings are much larger than the savings in vehicle operating cost.

10.4 Cost Benefit Analysis

1) Basic Assumptions for Cost Benefit Analysis

The basic assumptions of the economic cost benefit analysis are summarized below.

(a) Base Year : 1989
(b) Project Life : 2010-2040 30 years after completion of the construction in the third phase
(c) Analysis Period : 1993-2040
(d) Investment for Construction : Distributed during 1993 - 1997 (First Phase)
during 2000 - 2004 (Second Phase)
during 2005 - 2009 (Third Phase)
(e) Prices : 1989 prices in economic terms
(f) Residual Value : None

Furthermore, the benefits during 1998-2005 and 2005-2010 are interpolated based on the benefits in 1998, 2000 and 2010. Over the analysis period after 2010, the benefits are assumed to be the same as in 2010.

2) Results of Economic Cost Benefit Analysis

The expected returns are shown in Table-10.4.1. The economic internal rate of return (EIRR) in alternative C is highest although the rates in alternatives A, B and D remain acceptable with the adopted cutoff rate of 15 percent. Taking into consideration the net present value, B/C ratio and the first year rate of return (on the first phase), alternative C shows the most favorable results. Overall, alternative C is most recommendable from the viewpoint of economic analysis.

Table-10.4.1 Results of Cost Benefit Analysis

Unit: Rp Million for NPV

Alternatives	NPV	B/C Ratio	EIRR	FYRR
ALT. A	100,142	1.48	24.65%	39.35%
ALT. B	77,414	1.26	19.82%	32.85%
ALT. C	133,313	1.57	27.02%	49.48%
ALT. D	65,006	1.34	22.45%	28.57%

Note: Net present value and B/C ratio are discounted at 15 percent per year.

10.5 Sensitivity Analysis

Sensitivity analysis of major costs and economic benefits were made. The results are tabulated in Table-10.5.1. The most sensitive factor to influence EIRR is the variation of the economic benefits although the investment cost is also sensitive. A ten percent fall in the economic benefits will cause 2.7%, 2.2%, 2.9% and 2.7% decreases of EIRR for alternatives A, B, C and D, respectively.

Furthermore, in response to advice by the Indonesian counterparts, a more varied range of analysis was made. This is because some actual cases of recent road projects show much higher construction costs comparing to those of feasibility studies. The results are tabulated in Table-10.5.2.

Table-10.5.1 Sensitivity Analysis of the 4 Alternatives

(EIRR %)

	Alt.-A	Alt.-B	Alt.-C	Alt.-D
Investment Cost				
-20%	30.45	24.53	33.25	28.03
-10%	27.32	21.97	29.90	25.03
0%	24.65	19.82	27.02	22.45
+10%	22.34	18.00	24.51	20.20
+20%	20.32	16.43	22.30	18.23
Maintenance Cost				
-20%	24.93	20.19	27.31	22.84
-10%	24.79	20.01	27.16	22.65
0%	24.65	19.82	27.02	22.45
+10%	24.50	19.64	26.87	22.24
+20%	24.35	19.45	26.73	22.03
Economic Benefits				
-20%	18.99	15.23	20.89	16.77
-10%	21.93	17.60	24.08	19.73
0%	24.65	19.82	27.02	22.45
+10%	27.19	21.92	29.75	24.96
+20%	29.57	23.92	32.30	27.29

Table-10.5.2 Additional Sensitivity Analysis of the 4 Alternatives

(EIRR %)

	Alt.-A	Alt.-B	Alt.-C	Alt.-D
Investment Cost				
+30%	18.55	15.06	20.35	16.51
+40%	16.98	13.87	18.61	15.00
+50%	15.59	12.81	17.05	13.66
Maintenance Cost				
+30%	24.20	19.25	26.58	21.82

CHAPTER 11 FINANCIAL ANALYSIS

11.1 Introduction

As a result of economic appraisal in Chapter 10, Alternative C is selected for the most appropriate staged development plan from the national economic point of view. Therefore, financial analysis in this Chapter is focused on this alternative.

For the purpose of a consistent and comprehensive financial analysis, this chapter studied current situations of toll road system at first, and then developed financial projections, analyzed these projections and established cost and benefit streams for the FIRR calculations.

The previous chapter (Chapter 8) discussed the estimation of capital costs and operating costs. Combining revenue projections in this chapter with those costs, annual projected income statements and funds flow statements are developed.

11.2 Analysis of Implementation Body and Toll Rate System

1) Implementation Body

Although there are several bodies/entities possible to implement this project, P.T.Jasa Marga (Persero) seemes to be the most appropriate implementation body. The reasons behind this are that Jasa Marga is the only toll road authority, and the project road is neither a national trunk road, nor an urban road in the metropolitan region. Therefore, the project road may not be so attractive for private investors (regarding this issue, the final section of this chapter discussed the possibility of involving the private sector with Jasa Marga); and furthermore the results of economic analysis can show a high return to the national economy from the project road.

2) Basic conditions for setting up the toll rate

(1) Current situations of toll roads

Jasa Marga was established in 1978 as the only liable toll road authority in Indonesia. As of 1990 Jasa Marga is in charge of 14 toll roads including bridges, in various stages of operation and construction. At present only the North-South Link is being operated jointly by private investors and Jasa Marga.

During 1981-1987, the average daily toll revenue increased at 59 percent per year. In accordance with the length of toll roads, however, the operating cost of Jasa Marga increased at a rate of 26 percent per year in the same period. Also the number of employees in Jasa Marga increased at 32 percent per year.

(2) Current of toll rates condition

Table-11.2.1 shows the current rates of each toll road. Although there are various figures for the toll rates per kilometer, most of them are within certain ranges - that is, Group I (Passenger car, Mini-bus and Pick-up) is within Rp 50-100 per Km and Group II (Bus and Truck) is within Rp 80-120 per Km.

Table-11.2.1 Comparison of Toll Rate by Road (Rp/Km)

	Group I		Group II	
	Toll Rate	Index	Toll Rate	Index
Jagorawi	56.6	100	75.5	100
Jakarta-Tangerang	74.6	132	119.9	148
Surabaya-Gempol	45.9	81	80.3	106
Belmera	58.5	103	102.3	135
Semarang	33.3	59	66.7	88
Ciujung-Serang	64.5	114	64.5	85
Cengkareng	217.4	384	217.4	288
South-West	102.1	180	102.1	135
Jakarta-Cikampek	68.5	121	109.6	145
North-South	120.0	212	120.0	159

Sources: Management Services for the Tollway System Project/ Technical Report No. 3, Nov. 1988
Jasa Marga and Study Team

According to the calculation in the "Management Services for the Tollway System Project (1988)" Report, the average toll rate per Km is Rp 58.3.

(3) Establishing toll rates

In general toll rates are decided based on benefits for toll road users and benefits to the investors. The former means that toll rates should provide road users with sufficient savings on vehicle operating cost (saving on fuel, vehicle spare parts, time and other benefits) in comparison with the use of a non-toll road alternative. The latter means that toll rates should recoup the costs for constructing and operating the toll road system being self-financing over the pay-back period.

According to the interview with Jasa Marga, the rates should be set within 70 percent of the benefits for toll road users. However, in fact the rates are usually far below 70 percent of benefits and are not necessarily decided systematically.

(4) The raise of toll rates

According to Jasa Marga's Corporate Plan (1987), toll rates are expected to increase by 40 percent every 3 year (11.9 percent per year). This ratio does not necessarily correspond to the results in the following Table-11.2.2.

Table-11.2.2 Recent Increase in Toll Rates

		Annual Average Growth Rate (%)	Remarks
Jagorawi	I	14.5	1985-1988
	II	4.6	
Jakarta-Tangerang	I	2.7	1984-1988
	II	2.7	
Bermela	I	15.4	1986-1988
	II	18.3	
Semarang	I	-8.2	1983-1987
	II	-4.3	
Ciujung-Serang	I	15.4	1984-1988
	II	1.6	
Cengkareng	I	3.5	1985-1988
	II	-2.1	
South-West	I	73.2	1987-1989
	II	73.2	

Sources: Management Services for the Tollway System Project/ Technical Report No. 3, Nov. 1988 Jasa Marga and Study Team

Notes: I means Group I (Passenger Car, Mini Bus and Pick-up).
II means Group II (Bus and Truck).

3) Analysis of Optimum Toll Rate

Fig.-11.2.1 shows the relationship between the toll rate and the expected daily revenue of the toll roads, which are located in the forecast area of the future traffic demand model. As shown, the optimum range of the toll rate seems to be within Rp 50-60 per km.

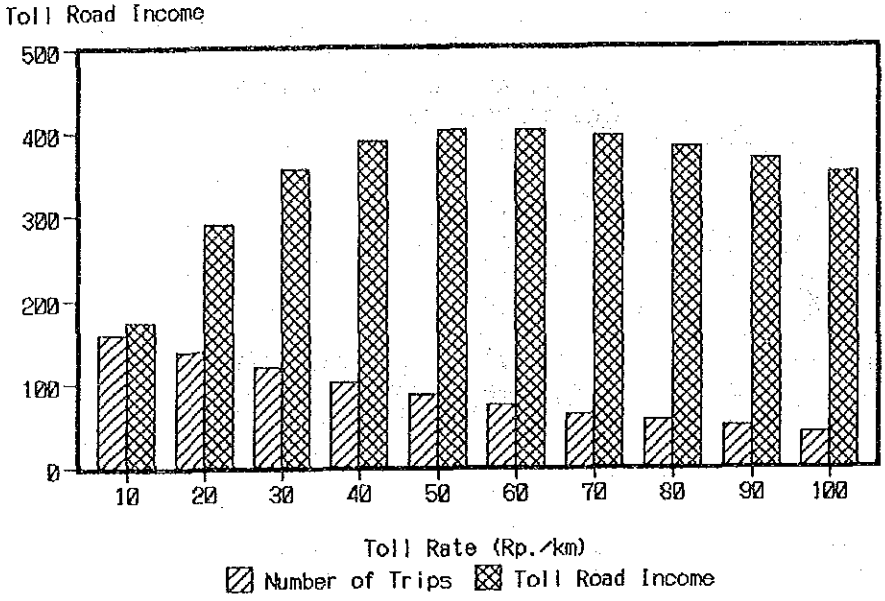


Fig.-11.2.1 Relation between Toll Rate and Toll Revenue
(Unit: Rp million per day)

4) Toll Rate for Financial Analysis

In consideration of the previously described analyses, the toll rates for financial analysis in this study are set up at Rp 60 per km for Group I (passenger cars, pick up and mini-bus) traffic and Rp 90 per km for Group II (truck and bus) traffic in 1989 prices.

Moreover, these toll rates are assumed to increase 3 percent per year. This is because the toll rates are institutionally expected to increase 12 percent per year approximately in nominal terms and this increase can be adjusted to a 3 percent increase in constant terms.

11.3 Estimated Toll Revenue

Based on the traffic demand analysis in accordance with the toll rate discussed above, the toll revenue of the selected staged construction alternative is estimated. The results are summarized below.

Table-11.3.1 Toll Road Revenue Streams

	Unit: Rp Million
1998	14,110.0
1999	17,994.4
2000	22,098.5
2001	26,434.0
2002	31,009.1
2003	35,834.9
2004	40,922.3
2005	46,282.7
2006	49,740.5
2007	53,364.2
2008	57,160.5
2009	61,136.6
2010-	65,299.8

11.4 Estimated Financial Costs

1) Major assumptions for estimation

(1) Date for base cost estimate

This financial analysis is made on a fixed-price basis at 1989, therefore, all investment costs are also estimated at the price levels of that time. The estimated investment costs, however, include physical and price contingencies.

(2) Currency exchange rate

For the purpose of this study, the U.S. Dollar as the standard foreign currency is converted into Indonesian Rupiah (Rp) by the following fixed exchange rate.

One U.S. Dollar = 1,750 Indonesian Rupiah

2) Total Capital Requirement

The financial costs are discussed in Chapter 8 in detail. The estimated capital requirement covers the following items. The components of construction costs are broken down into foreign and local currencies in Table-11.4.1.

(a) Land
(b) Site Preparation Costs including Costs for Removal of Houses
(c) Construction Cost
(d) Interest during construction

Table-11.4.1 Total Construction Costs

Unit: Rp Million

First Phase	Foreign	Domestic	Total
FOREIGN	85,681.6		85,681.6
LOCAL		44,964.5	44,964.5
OTHERS (5%)	4,284.1	2,248.2	6,532.3
SUB TOTAL	89,965.7	47,212.8	137,178.4
INDIRECT COST (35%)	27,847.2	20,165.2	48,012.5
ENGINEERING (10%)	14,815.3	3,703.8	18,519.1
REMOVAL HOUSES		3,970.0	3,970.0
LAND ACQUISITION		11,622.6	11,622.6
TOTAL	132,628.2	86,674.4	219,302.6
CONTINGENCY (10%)	13,262.8	8,667.4	21,930.3
CONSTRUCTION TOTAL	145,891.0	95,341.8	241,232.9

Second Phase	Foreign	Domestic	Total
FOREIGN	45,857.1		45,857.1
LOCAL		25,203.8	25,203.8
OTHERS (5%)	2,292.9	1,260.2	3,553.0
SUB TOTAL	48,150.0	26,464.0	74,614.0
INDIRECT COST (35%)	15,146.6	10,968.3	26,114.9
ENGINEERING (10%)	8,058.3	2,014.6	10,072.9
REMOVAL HOUSES		3,640.0	3,640.0
LAND ACQUISITION		9,918.2	9,918.2
TOTAL	71,354.9	53,005.0	124,360.0
CONTINGENCY (10%)	7,135.5	5,300.5	12,436.0
CONSTRUCTION TOTAL	78,490.4	58,305.5	136,796.0

Third Phase	Foreign	Domestic	Total
FOREIGN	64,924.2		64,924.2
LOCAL		45,603.0	45,603.0
OTHERS (5%)	3,246.2	2,280.1	5,526.4
SUB TOTAL	68,170.4	47,883.1	116,053.6
INDIRECT COST (35%)	23,558.9	17,059.9	40,618.7
ENGINEERING (10%)	12,533.8	3,133.4	15,667.2
REMOVAL HOUSES		0.0	0.0
LAND ACQUISITION		0.0	0.0
TOTAL	104,263.1	68,076.4	172,339.5
CONTINGENCY (10%)	10,426.3	6,807.6	17,234.0
CONSTRUCTION TOTAL	114,689.4	74,884.1	189,573.5

On the other hand, interest during construction is calculated on the debt portion of disbursed capital expenditure in each year for the period from such disbursement time through the end of completion date of each phase.

Table-11.4.2 Interest during Construction

Unit: Rp Million

	Phase 1	Phase 2	Phase 3
Case 1 (Interest=10%)	27,320.3	14,725.7	21,752.3
Case 2 (Interest= 5%)	13,217.9	7,123.5	10,514.6

3) Maintenance and Operation Costs

Maintenance and operation costs are also discussed in Chapter 8, and results are summarized below.

Table-11.4.3 Maintenance and Operating Costs

(Annual cost per km) Unit: Rp million

	Provisional 2 lane Construction	Widening to final 4 lane Const.	Full 4 lane Construction
Routine	77.0	110.0	110.0
Periodic	171.0	304.0	304.0

Note: The periodic maintenance shall start only after 10 years of operation.

11.5 Financial Plan

1) Three Cases for Financial Plan

According to the interest rate for long term loan and other factors, three cases are considered for the financial plan. (15% interest case, and 10% interest rate and bond issue case are not exercised because they could not be paid off within the project life).

Case 1 : 10% Interest Rate for Long Term Loan
Case 2-A : 5% Interest Rate for Long Term Loan
Case 2-B : the same as Case 2-A for Long Term Loan and Issue of Bond in order to reduce the equity capital

2) Financing Term for Long Term Loan

The following conditions are assumed for the long term loan.

Amount of loan	: as shown below
Interest rate	: 10% per year for Case 1
	: 5% per year for Case 2-A and 2-B
Repayment conditions	
Grace period	: full construction period (5 years)
Installment period	: 25 years
Installment term	: equally divided (principal 25 times annual installment)

3) Issue of Bond

In this study, issue of bond is considered only for Case 2-B in order to reduce the burden of the large amount of the equity capital. The total bond issues shall amount to Rp 38,023 million for phase 1, Rp 21,366 million for phase 2, and Rp 35,875 million for phase 3, respectively. This amount is equal to 50 percent of the equity capital of Case 2-A, excluding engineering fee, cost of land acquisition and cost of removal of houses. The interest rate is assumed to be 17 percent per year and maturity period is expected to be 8 years. This assumption is based on the recent terms of issued bond by Jasa Marga.

4) Financing Plan and Debt-Equity Ratio

The total capital requirement as estimated in the above sections is assumed to be financed with the following terms. Basically the portion of foreign currencies including interest during construction is covered by long term debt (Tables-11.5.1 to 11.5.3).

Table-11.5.1 Debt-Equity Ratio - Case 1

Unit: Rp Million

	%	Phase 1	%	Phase 2	%	Phase 3
Debt (Long Term Debt)	64.5	173,211.3	61.5	93,216.1	64.6	136,441.7
Equity	35.5	95,341.8	38.5	58,305.5	35.4	74,884.1
Total	100.0	268,553.1	100.0	151,521.6	100.0	211,325.8

Table-11.5.2 Debt-Equity Ratio - Case 2-A

Unit: Rp Million

	%	Phase 1	%	Phase 2	%	Phase 3
Debt (Long Term Debt)	62.5	159,108.9	59.5	85,613.9	62.6	125,204.0
Equity	37.5	95,341.8	40.5	58,305.5	37.4	74,884.1
Total	100.0	254,450.7	100.0	143,919.4	100.0	200,088.1

Table-11.5.3 Debt-Equity Ratio - Case 2-B

Unit: Rp Million

	%	Phase 1	%	Phase 2	%	Phase 3
Debt (Long Term Debt)	62.5	159,108.9	59.5	85,613.9	62.6	125,204.0
Debt (Bond)	14.9	38,022.7	14.8	21,366.4	17.9	35,875.3
Equity	22.5	57,319.1	25.7	36,939.1	19.5	39,008.8
Total	100.0	254,450.7	100.0	143,919.4	100.0	200,088.1

5) Financing Term for Short Term Debt

A short term loan from local financing institutions is assumed to be made available at an annual rate of 20 percent whenever a deficiency in the annual money flow for the project arises. The repayment of principal and interest payment are assumed to be made in the following year of the borrowing.

11.6 Financial Analysis

1) Financial Projections

Based on the above assumptions, the following financial projections have been prepared.

(1) Financial Analysis for FIRR
(2) Income Statements
(3) Funds Flow Statements
(4) Long Term Debt Repayment Schedule

2) Financial Analysis for FIRR

The results of FIRR are shown below. The FIRROE of Case 2-A is the largest among the three cases.

Table-11.6.1 Results of FIRR

	FIRROI	FIRROE
Case 1	8.83	7.74
Case 2-A	8.83	11.04
Case 2-B	8.83	10.13

Notes: FIRROI means Financial Internal Rate of Return on Total Investment
FIRROE means Financial Internal Rate of Return on Equity

3) Income Statements

Income Statements are projected during the period between 1998 and 2040 in Tables-11.6.2 - 11.6.4. Toll revenue, operation and maintenance cost, and interest of loans are already discussed in the preceding sections. Depreciable assets are assumed to be depreciated for 40 years. The depreciation mode follows the straight line method. Also, salvage value is assumed to be zero percent. Interest during construction is amortized for five years in equal amount. As corporate income tax, 35 percent of the taxable income is assumed to be imposed.

4) Funds Flow Statements

Funds flow statements are projected during the period between 1993 and 2040 in Tables-11.6.2-11.6.4. In the statement, sources of funds comprise profit after tax, depreciation, amortization, equity, long term debt including bond, and short term debt. On the other hand use of funds consist of construction cost, interest during construction, repayment of long term debt and short term debt. Debt-equity ratio and financial terms for loans have been previously discussed.

5) Long Term Debt Repayment Schedule

Repayment Schedule for Case 1 is shown in Table-11.6.5. As shown in the table, long term debts for phase 1 will be paid off in 2022, for phase 2 in 2029, and for phase 3 in 2034, respectively.

Table-11.6.2 Income Statements and Funds Flow Statements for Case 1

INCOME STATEMENTS

Unit: Rp million

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
OPERATING INCOME						14110	17994	22099	26434	31009	35835	40922	46283	49740	53364	57161
OPERATING EXPENSES						15225	15225	15225	15225	15225	9761	9761	19344	19344	19344	28492
OPERATION & MAINTENANCE COST						4120	4120	4120	4120	4120	4120	4120	7677	7677	7677	16825
DEPRECIATION & AMORTIZATION						11105	11105	11105	11105	11105	5641	5641	11667	11667	11667	11667
CONSTRUCTION COST						5641	5641	5641	5641	5641	5641	5641	8722	8722	8722	8722
INTEREST DURING CONSTRUCTION						5464	5464	5464	5464	5464			2945	2945	2945	2945
OPERATING PROFIT (GROSS PROFIT)						-1115	2770	6875	11209	15785	26074	31162	26939	30396	34020	28668
NON-OPERATING EXPENSES						17321	19480	21294	22650	23410	23406	22624	30401	29825	28483	26496
INTEREST ON LONG TERM DEBT						17321	16628	15935	15243	14550	13857	13164	21793	20727	19661	18596
INTEREST ON SHORT TERM DEBT						0	2852	5359	7407	8860	9549	9460	8608	9098	8822	7900
NET PROFIT BEFORE TAX						-18436	-16710	-14419	-11440	-7625	2668	8538	-3462	571	5537	2172
CORPORATE TAX						0	0	0	0	0	934	2988	0	200	1938	760
NET PROFIT AFTER TAX (RETAINED EARNINGS)						-18436	-16710	-14419	-11440	-7625	1734	5549	-3462	371	3599	1412

FUNDS FLOW STATEMENTS

Unit: Rp million

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
SOURCES																
CASH GENERATED	0	0	0	0	0	-7331	-5605	-3314	-335	3480	7375	11190	8205	12038	15266	13079
PROFIT AFTER TAX						-18436	-16710	-14419	-11440	-7625	1734	5549	-3462	371	3599	1412
DEPRECIATION AND AMORTIZATION						11105	11105	11105	11105	11105	5641	5641	11667	11667	11667	11667
FINANCIAL RESOURCES	9260	24852	41424	124273	68745	14259	26793	42072	62894	70380	115200	80397	53324	51943	74282	141422
EQUITY (SHARE CAPITAL)	1852	17445	15209	45627	15209			1007	14565	8547	25640	8547	1567	1567	14350	43050
LONG TERM DEBT	7408	7408	26215	78645	53535			4029	4029	14086	42259	28812	6257	6257	20431	61293
SHORT TERM DEBT						14259	26793	37035	44299	47747	47301	43039	45491	44109	39500	37078
SOURCES TOTAL	9260	24852	41424	124273	68745	6928	21188	38758	62559	73861	122575	91588	61529	63981	89548	154501
USES																
FIXED CAPITAL EXPENDITURE	9260	24852	41424	124273	68745	0	0	5036	18595	22633	67899	37359	7834	7834	34781	104344
CONSTRUCTION COST	9260	24852	41424	124273	41424			5036	18595	22633	67899	22633	7834	7834	34781	104344
INTEREST DURING CONSTRUCTION					27320							14726				
DEBT SERVICES	0	0	0	0	0	6928	21188	33721	43964	51228	54676	54229	53696	56148	54766	50157
REPAYMENT OF LONG TERM DEBT						6928	6928	6928	6928	6928	6928	6928	10657	10657	10657	10657
REPAYMENT OF SHORT TERM DEBT						0	14259	26793	37035	44299	47747	47301	43039	45491	44109	39500
USES TOTAL	9260	24852	41424	124273	68745	6928	21188	38758	62559	73861	122575	91588	61529	63981	89548	154501
CASH INCREASE (OR DECREASE)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BEGINING CASH BALANCE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ENDING CASH BALANCE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table-11.6.2 Income Statements and Funds Flow Statements for Case 1 (continued)

INCOME STATEMENTS

Unit: Rp million

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2025	2030	2035	2040
OPERATING INCOME	61137	65300	67259	69277	71355	73496	75700	77971	80311	82720	85201	87758	101735	117939	136723	158500
OPERATING EXPENSES	28492	36403	36403	36403	36403	36403	39952	39952	39952	39952	39952	47068	47068	47068	47068	41427
OPERATION & MAINTENANCE COST	16825	18591	18591	18591	18591	18591	26491	26491	26491	26491	26491	33607	33607	33607	33607	33607
DEPRECIATION & AMORTIZATION	11667	17812	17812	17812	17812	17812	13461	13461	13461	13461	13461	13461	13461	13461	13461	7820
CONSTRUCTION COST	8722	13461	13461	13461	13461	13461	13461	13461	13461	13461	13461	13461	13461	13461	13461	7820
INTEREST DURING CONSTRUCTION	2945	4350	4350	4350	4350	4350										
OPERATING PROFIT (GROSS PROFIT)	32644	28897	30856	32874	34952	37093	35748	38019	40358	42768	45249	40690	54667	70871	89655	117073
NON-OPERATING EXPENSES	24946	36321	35855	34904	33359	31201	28485	26460	23876	20653	16897	13994	7322	2729	0	0
INTEREST ON LONG TERM DEBT	17530	30108	28497	26885	25274	23663	22051	20440	18828	17217	15605	13994	7322	2729		
INTEREST ON SHORT TERM DEBT	7416	6213	7358	8019	8085	7539	6434	6020	5048	3436	1092	0	0	0	0	0
NET PROFIT BEFORE TAX	7698	-7424	-4999	-2030	1593	5891	7263	11559	16482	22115	28352	26696	47345	68142	89655	117073
CORPORATE TAX	2694	0	0	0	558	2062	2542	4046	5769	7740	9993	9344	16571	23850	31379	40976
NET PROFIT AFTER TAX (RETAINED EARNINGS)	5004	-7424	-4999	-2030	1035	3829	4721	7514	10713	14375	18559	17352	30774	44292	58276	76097

FUNDS FLOW STATEMENTS

Unit: Rp million

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2025	2030	2035	2040
SOURCES																
CASH GENERATED	16671	10388	12813	15781	18847	21641	18182	20975	24175	27836	32020	30814	44236	57754	71737	83918
PROFIT AFTER TAX	5004	-7424	-4999	-2030	1035	3829	4721	7514	10713	14375	18559	17352	30774	44292	58276	76097
DEPRECIATION AND AMORTIZATION	11667	17812	17812	17812	17812	17812	13461	13461	13461	13461	13461	13461	13461	13461	13461	7820
FINANCIAL RESOURCES	87598	36792	40094	40427	37695	32168	30100	25240	17180	5459	0	0	0	0	0	0
EQUITY (SHARE CAPITAL)	14350															
LONG TERM DEBT	42183															
SHORT TERM DEBT	31064	36792	40094	40427	37695	32168	30100	25240	17180	5459						
SOURCES TOTAL	104269	47179	52906	56208	56542	53809	48283	46215	41355	33295	32020	30814	44236	57754	71737	83918
USES																
FIXED CAPITAL EXPENDITURE	56534	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-54978
CONSTRUCTION COST	34781															-54978
INTEREST DURING CONSTRUCTION	21752															
DEBT SERVICES	47735	47179	52906	56208	56542	53809	48283	46215	41355	33295	21574	16115	9186	5458	0	0
REPAYMENT OF LONG TERM DEBT	10657	16115	16115	16115	16115	16115	16115	16115	16115	16115	16115	16115	9186	5458		
REPAYMENT OF SHORT TERM DEBT	37078	31064	36792	40094	40427	37695	32168	30100	25240	17180	5459	0	0	0	0	0
USES TOTAL	104269	47179	52906	56208	56542	53809	48283	46215	41355	33295	21574	16115	9186	5458	0	-54978
CASH INCREASE (OR DECREASE)	0	0	0	0	0	0	0	0	0	0	10446	14699	35049	52296	71737	138896
BEGINING CASH BALANCE	0	0	0	0	0	0	0	0	0	0	0	10446	125455	327116	515841	993052
ENDING CASH BALANCE	0	0	0	0	0	0	0	0	0	0	10446	25145	160505	379412	587579	1136948

Table-11.6.3 Income Statements and Funds Flow Statement for Case 2-A

INCOME STATEMENTS

Unit: Rp million

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
OPERATING INCOME						14110	17994	22099	26434	31009	35835	40922	46283	49740	53364	57161
OPERATING EXPENSES						12404	12404	12404	12404	12404	9761	9761	17624	17824	17824	26972
OPERATION & MAINTENANCE COST						4120	4120	4120	4120	4120	4120	4120	7677	7677	7677	16825
DEPRECIATION & AMORTIZATION						8285	8285	8285	8285	8285	5641	5641	10147	10147	10147	10147
CONSTRUCTION COST						5641	5641	5641	5641	5641	5641	5641	8722	8722	8722	8722
INTEREST DURING CONSTRUCTION						2644	2644	2644	2644	2644			1425	1425	1425	1425
OPERATING PROFIT (GROSS PROFIT)						1706	5590	9695	14030	18605	26074	31162	28459	31917	35541	30188
NON-OPERATING EXPENSES						7955	8503	8383	7511	6683	5364	6046	10009	9519	9030	6540
INTEREST ON LONG TERM DEBT						7955	7637	7319	7001	6683	6364	6046	10009	9519	9030	8540
INTEREST ON SHORT TERM DEBT						0	866	1064	510	0	0	0	0	0	0	0
NET PROFIT BEFORE TAX						-6250	-2913	1312	6519	11922	19710	25116	18451	22398	26511	21648
CORPORATE TAX						0	0	459	2282	4173	6899	8790	6458	7839	9279	7577
NET PROFIT AFTER TAX						-6250	-2913	853	4238	7750	12812	16325	11993	14559	17232	14071
(RETAINED EARNINGS)																

FUNDS FLOW STATEMENTS

Unit: Rp million

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
SOURCES																
CASH GENERATED	0	0	0	0	0	2035	5372	9137	12522	16034	18453	21966	22140	24705	27379	24218
PROFIT AFTER TAX						-6250	-2913	853	4238	7750	12812	16325	11993	14559	17232	14071
DEPRECIATION AND AMORTIZATION						8285	8285	8285	8285	8285	5641	5641	10147	10147	10147	10147
FINANCIAL RESOURCES	9260	24852	41424	124273	54642	4329	5322	7585	18595	22633	67899	29756	7834	7834	34781	104344
EQUITY (SHARE CAPITAL)	1852	17445	15209	45627	15209			1007	14565	8547	25640	8547	1567	1567	14350	43050
LONG TERM DEBT	7408	7408	26215	78645	39433			4029	4029	14086	42259	21210	6267	6267	20431	61293
SHORT TERM DEBT						4329	5322	2549	0	0	0	0	0	0	0	0
SOURCES TOTAL	9260	24852	41424	124273	54642	6364	10694	16723	31117	38667	86351	51723	29973	32539	62160	128562
USES																
FIXED CAPITAL EXPENDITURE	9260	24852	41424	124273	54642	0	0	5036	18595	22633	67899	29756	7834	7834	34781	104344
CONSTRUCTION COST	9260	24852	41424	124273	41424			5036	18595	22633	67899	22633	7834	7834	34781	104344
INTEREST DURING CONSTRUCTION					13218							7124				
DEBT SERVICES	0	0	0	0	0	6364	10694	11686	8913	6364	6364	6364	9789	9789	9789	9789
REPAYMENT OF LONG TERM DEBT						6364	6364	6364	6364	6364	6364	6364	9789	9789	9789	9789
REPAYMENT OF SHORT TERM DEBT						0	4329	5322	2549	0	0	0	0	0	0	0
USES TOTAL	9260	24852	41424	124273	54642	6364	10694	16723	27508	28997	74263	36121	17623	17623	44570	114133
CASH INCREASE (OR DECREASE)	0	0	0	0	0	0	0	0	3609	9670	12088	15602	12351	14916	17590	14429
BEGINING CASH BALANCE	0	0	0	0	0	0	0	0	0	3609	13278	25367	40969	53319	68235	85825
ENDING CASH BALANCE	0	0	0	0	0	0	0	0	3609	13278	25367	40969	53319	68235	85825	100254

Table-11.6.3 Income Statements and Funds Flow Statement for Case 2-A (continued)

INCOME STATEMENTS

Unit: Rp million

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2025	2030	2035	2040
OPERATING INCOME	61137	65300	67259	69277	71355	73496	75700	77971	80311	82720	85201	87758	101735	117939	136723	158500
OPERATING EXPENSES	26972	34155	34155	34155	34155	34155	39952	39952	39952	39952	39952	47068	47068	47068	47068	47068
OPERATION & MAINTENANCE COST	16825	18591	18591	18591	18591	18591	26491	26491	26491	26491	26491	33607	33607	33607	33607	33607
DEPRECIATION & AMORTIZATION	10147	15564	15564	15564	15564	15564	13461	13461	13461	13461	13461	13461	13461	13461	13461	13461
CONSTRUCTION COST	8722	13461	13461	13461	13461	13461	13461	13461	13461	13461	13461	13461	13461	13461	13461	13461
INTEREST DURING CONSTRUCTION	1425	2103	2103	2103	2103	2103										
OPERATING PROFIT (GROSS PROFIT)	34165	31145	33104	35121	37200	39340	35748	38019	40358	42768	45249	40690	54667	70871	89655	111432
NON-OPERATING EXPENSES	8051	13822	13082	12342	11602	10862	10122	9382	8643	7903	7163	6423	3360	1252	0	0
INTEREST ON LONG TERM DEBT	8051	13822	13082	12342	11602	10862	10122	9382	8643	7903	7163	6423	3360	1252		
INTEREST ON SHORT TERM DEBT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NET PROFIT BEFORE TAX	26114	17323	20022	22780	25598	28478	25626	28637	31716	34865	38086	34267	51307	69619	89655	111432
CORPORATE TAX	9140	6063	7008	7973	8959	9967	8969	10023	11100	12203	13330	11993	17957	24367	31379	39001
NET PROFIT AFTER TAX (RETAINED EARNINGS)	16974	11260	13014	14807	16639	18511	16657	18614	20615	22662	24756	22273	33350	45252	58276	72431

FUNDS FLOW STATEMENTS

Unit: Rp million

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2025	2030	2035	2040
SOURCES																
CASH GENERATED	27121	26824	28579	30371	32203	34075	30118	32075	34076	36123	38217	35735	46811	58714	71737	85692
PROFIT AFTER TAX	16974	11260	13014	14807	16639	18511	16657	18614	20615	22662	24756	22273	33350	45252	58276	72431
DEPRECIATION AND AMORTIZATION	10147	15564	15564	15564	15564	15564	13461	13461	13461	13461	13461	13461	13461	13461	13461	13461
FINANCIAL RESOURCES	45296	0	0	0	0	0	0									
EQUITY (SHARE CAPITAL)	14350															
LONG TERM DEBT	30946															
SHORT TERM DEBT	0	0	0	0	0	0	0									
SOURCES TOTAL	72416	26824	28579	30371	32203	34075	30118	32075	34076	36123	38217	35735	46811	58714	71737	85692
USES																
FIXED CAPITAL EXPENDITURE	45296	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-54978
CONSTRUCTION COST	34781															-54978
INTEREST DURING CONSTRUCTION	10515															
DEBT SERVICES	9789	14797	14797	14797	14797	14797	14797	14797	14797	14797	14797	14797	8433	5008	0	0
REPAYMENT OF LONG TERM DEBT	9789	14797	14797	14797	14797	14797	14797	14797	14797	14797	14797	14797	8433	5008		
REPAYMENT OF SHORT TERM DEBT	0	0	0	0	0	0	0	0	0							
USES TOTAL	55085	14797	14797	14797	14797	14797	14797	14797	14797	14797	14797	14797	8433	5008	0	-54978
CASH INCREASE (OR DECREASE)	17332	12027	13781	15574	17406	19278	15321	17278	19279	21326	23420	20938	38378	53705	71737	140670
BEGINING CASH BALANCE	100254	117586	129613	143395	158968	176374	195652	210973	228251	247530	268857	292277	431929	647003	940856	1327016
ENDING CASH BALANCE	117586	129613	143395	158968	176374	195652	210973	228251	247530	268857	292277	313215	470307	700708	1012593	1467685

Table-11.6.4 Income Statements and Funds Flow Statement for Case 2-B

INCOME STATEMENTS

Unit: Rp million

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
OPERATING INCOME	0	0	0	0	0	14110	17994	22099	26434	31009	35835	40922	46283	49740	53364	57161
OPERATING EXPENSES	0	0	0	0	0	12404	12404	12404	12404	12404	9761	9761	17824	17824	17824	26972
OPERATION & MAINTENANCE COST						4120	4120	4120	4120	4120	4120	4120	7677	7677	7677	16825
DEPRECIATION & AMORTIZATION						8285	8285	8285	8285	8285	5641	5641	10147	10147	10147	10147
CONSTRUCTION COST						5641	5641	5641	5641	5641	5641	5641	8722	8722	8722	8722
INTEREST DURING CONSTRUCTION						2644	2644	2644	2644	2644			1425	1425	1425	1425
OPERATING PROFIT (GROSS PROFIT)	0	0	0	0	0	1706	5590	9695	14030	18605	26074	31162	28459	31917	35541	30188
NON-OPERATING EXPENSES	0	0	0	1293	5430	15764	17873	19627	20912	21586	23727	28698	30853	30999	30319	30299
INTEREST ON LONG TERM DEBT						7955	7637	7319	7001	6683	6364	6046	10009	9519	9030	8540
INTEREST ON BOND				1293	5171	6464	6464	6464	6464	6464	7190	8077	4925	3632	3632	4852
INTEREST ON SHORT TERM DEBT					259	1345	3772	5845	7447	8439	10172	14574	15920	17848	17657	16907
NET PROFIT BEFORE TAX	0	0	0	-1293	-5430	-14058	-12283	-9932	-6882	-2981	2347	2464	-2394	918	5222	-111
CORPORATE TAX	0	0	0	0	0	0	0	0	0	0	822	863	0	321	1828	0
NET PROFIT AFTER TAX (RETAINED EARNINGS)	0	0	0	-1293	-5430	-14058	-12283	-9932	-6882	-2981	1526	1602	-2394	596	3394	-111

FUNDS FLOW STATEMENTS

Unit: Rp million

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
SOURCES																
CASH GENERATED	0	0	0	-1293	-5430	-5773	-3998	-1648	1403	5304	7167	7243	7752	10743	13541	10036
PROFIT AFTER TAX	0	0	0	-1293	-5430	-14058	-12283	-9932	-6882	-2981	1526	1602	-2394	596	3394	-111
DEPRECIATION AND AMORTIZATION						8285	8285	8285	8285	8285	5641	5641	10147	10147	10147	10147
FINANCIAL RESOURCES	9260	24852	41424	125565	61365	18860	29223	42271	60791	73494	140771	109355	97073	98119	119315	188630
EQUITY (SHARE CAPITAL)	1852	17445	7605	22814	7605			1007	14565	4273	12820	4273	1567	1567	7175	21525
BOND			7605	22814	7605					4273	12820	4273			7175	21525
LONG TERM DEBT	7408	7408	26215	78645	39433			4029	4029	14086	42259	21210	6267	6267	20431	61293
SHORT TERM DEBT			0	1293	6723	18860	29223	37235	42196	50861	72872	79598	89239	86285	84534	84286
SOURCES TOTAL	9260	24852	41424	124273	55935	13087	25225	40624	62194	78798	147938	116598	104825	106862	132855	198666
USES																
FIXED CAPITAL EXPENDITURE	9260	24852	41424	124273	54642	0	0	5036	18595	22633	67899	29756	7834	7834	34781	104344
CONSTRUCTION COST	9260	24852	41424	124273	41424			5036	18595	22633	67899	22633	7834	7834	34781	104344
INTEREST DURING CONSTRUCTION					13218							7124				
DEBT SERVICES	0	0	0	0	1293	13087	25225	35587	43599	56165	80039	86841	96992	99028	98074	94322
REPAYMENT OF LONG TERM DEBT						6364	6364	6364	6364	6364	6364	6364	9789	9789	9789	9789
REPAYMENT OF BOND											7605	22814	7605			
REPAYMENT OF SHORT TERM DEBT	0	0	0	0	1293	6723	18860	29223	37235	42196	50861	72872	79598	89239	86285	84534
USES TOTAL	9260	24852	41424	124273	55935	13087	25225	40624	62194	78798	147938	116598	104825	106862	132855	198666
CASH INCREASE (OR DECREASE)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BEGINING CASH BALANCE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ENDING CASH BALANCE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table-11.6.4 Income Statements and Funds Flow Statement for Case 2-B (continued)

INCOME STATEMENTS

Unit: Rp million

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2025	2030	2035	2040
OPERATING INCOME	61137	65300	67259	69277	71355	73496	75700	77971	80311	82720	85201	87758	101735	117939	136723	158500
OPERATING EXPENSES	26972	34155	34155	34155	34155	34155	39952	39952	39952	39952	39952	47068	47068	47068	47068	41427
OPERATION & MAINTENANCE COST	16825	18591	18591	18591	18591	18591	26491	26491	26491	26491	26491	33607	33607	33607	33607	33607
DEPRECIATION & AMORTIZATION	10147	15564	15564	15564	15564	15564	13461	13461	13461	13461	13461	13461	13461	13461	13461	7820
CONSTRUCTION COST	8722	13461	13461	13461	13461	13461	13461	13461	13461	13461	13461	13461	13461	13461	13461	7820
INTEREST DURING CONSTRUCTION	1425	2103	2103	2103	2103	2103										
OPERATING PROFIT (GROSS PROFIT)	34165	31145	33104	35121	37200	39340	35748	38019	40358	42768	45249	40690	54667	70871	89655	117073
NON-OPERATING EXPENSES	33419	40242	41296	42426	43121	43412	43333	44593	46081	46968	47335	47280	45195	23318	0	0
INTEREST ON LONG TERM DEBT	8051	13822	13082	12342	11602	10862	10122	9382	8643	7903	7163	6423	3360	1252		
INTEREST ON BOND	8511	9731	9005	8825	8099	8099	8099	4879	1220	0	0	0	0	0	0	0
INTEREST ON SHORT TERM DEBT	16857	16689	19209	23258	25420	26451	27112	30331	36218	39065	40172	40857	41834	22066	0	0
NET PROFIT BEFORE TAX	745	-9097	-8192	-7304	-5921	-4072	-7585	-6574	-5723	-4200	-2086	-6590	9473	47553	89655	117073
CORPORATE TAX	261	0	0	0	0	0	0	0	0	0	0	0	3315	16643	31379	40976
NET PROFIT AFTER TAX (RETAINED EARNINGS)	484	-9097	-8192	-7304	-5921	-4072	-7585	-6574	-5723	-4200	-2086	-6590	6157	30909	58276	76097

FUNDS FLOW STATEMENTS

Unit: Rp million

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2025	2030	2035	2040
SOURCES																
CASH GENERATED	10631	6467	7372	8260	9643	11492	5876	6887	7739	9261	11375	6871	19618	44370	71737	83918
PROFIT AFTER TAX	484	-9097	-8192	-7304	-5921	-4072	-7585	-6574	-5723	-4200	-2086	-6590	6157	30909	58276	76097
DEPRECIATION AND AMORTIZATION	10147	15564	15564	15564	15564	15564	13461	13461	13461	13461	13461	13461	13461	13461	13461	7820
FINANCIAL RESOURCES	128740	96047	116292	127102	132257	135561	151657	181092	195326	200862	204284	212210	197986	70969	0	0
EQUITY (SHARE CAPITAL)	7175															
BOND	7175															
LONG TERM DEBT	30946															
SHORT TERM DEBT	83444	96047	116292	127102	132257	135561	151657	181092	195326	200862	204284	212210	197986	70969		
SOURCES TOTAL	139371	102515	123664	135362	141899	147054	157533	187980	203064	210123	215659	219081	217605	115340	71737	83918
USES																
FIXED CAPITAL EXPENDITURE	45296	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-54978
CONSTRUCTION COST	34781															-54978
INTEREST DURING CONSTRUCTION	10515															
DEBT SERVICES	94075	102515	123664	135362	141899	147054	157533	187980	203064	210123	215659	219081	217605	115340	0	0
REPAYMENT OF LONG TERM DEBT	9789	14797	14797	14797	14797	14797	14797	14797	14797	14797	14797	14797	8433	5008		
REPAYMENT OF BOND		4273	12820	4273			7175	21525	7175							
REPAYMENT OF SHORT TERM DEBT	84286	83444	96047	116292	127102	132257	135561	151657	181092	195326	200862	204284	209172	110331	0	0
USES TOTAL	139371	102515	123664	135362	141899	147054	157533	187980	203064	210123	215659	219081	217605	115340	0	-54978
CASH INCREASE (OR DECREASE)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	71737	138896
BEGINING CASH BALANCE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	156829	539040
ENDING CASH BALANCE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	228566	677936

Table-11.6.5 Long Term Repayment Schedule (Case 1)

Amount of Debt: Phase 1 / Rp 173,211 million Phase 2 / Rp 93,216 million Phase 3 / Rp 136,422 million
Interest Rate :10 percent/year
Repayment :25 year-equal-installment-repayment

Unit: Rp million

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Phase 1																
Principal(1)						6928	6928	6928	6928	6928	6928	6928	6928	6928	6928	6928
Interest(1)						17321	16628	15935	15243	14550	13857	13164	12471	11778	11086	10393
Balance after repayment(1)						166283	159354	152426	145498	138569	131641	124712	117784	110855	103927	96998
Phase 2																
Principal(2)													3729	3729	3729	3729
Interest(2)													9322	8949	8576	8203
Balance after repayment(2)													89487	85759	82030	78302
Phase 3																
Principal(3)																
Interest(3)																
Balance after repayment(3)																
Total																
Principal Total						6928	6928	6928	6928	6928	6928	6928	10657	10657	10657	10657
Interest Total						17321	16628	15935	15243	14550	13857	13164	21793	20727	19661	18596

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2029	2034
Phase 1																
Principal(1)	6928	6928	6928	6928	6928	6928	6928	6928	6928	6928	6928	6928	6928	6928		
Interest(1)	9700	9007	8314	7621	6928	6236	5543	4850	4157	3464	2771	2079	1386	693		
Balance after repayment(1)	90070	83141	76213	69285	62356	55428	48499	41571	34642	27714	20785	13857	6928	0		
Phase 2																
Principal(2)	3729	3729	3729	3729	3729	3729	3729	3729	3729	3729	3729	3729	3729	3729	3729	
Interest(2)	7830	7457	7084	6712	6339	5966	5593	5220	4847	4474	4102	3729	3356	2983	373	
Balance after repayment(2)	74573	70844	67116	63387	59658	55930	52201	48472	44744	41015	37286	33558	29829	26101	0	
Phase 3																
Principal(3)		5458	5458	5458	5458	5458	5458	5458	5458	5458	5458	5458	5458	5458	5458	5458
Interest(3)		13644	13098	12553	12007	11461	10915	10370	9824	9278	8732	8187	7641	7095	3275	546
Balance after repayment(3)		130984	125526	120069	114611	109153	103696	98238	92780	87323	81865	76407	70950	65492	27288	0
Total																
Principal Total	10657	16115	16115	16115	16115	16115	16115	16115	16115	16115	16115	16115	16115	16115	9186	5458
Interest Total	17530	30108	28497	26885	25274	23663	22051	20440	18828	17217	15605	13994	12382	10771	3647	546

6) Analysis for Financial Indicators

Results of financial indicators are summarized below. Case 1, with 10% interest rate, shall have the first year of surplus in income statements in 2003, 5 years after the opening of the first phase of toll road, and shall have the first year of surplus in funds flow statements in 2019. Case 2-A , which has good loan terms with 5% interest rate, shows the most favorite results. The first years of surplus in income statements and funds flow statements are 2000 and 2001, respectively. Also, Debt Service Coverage Ratio (DSCR) is highest among the 3 cases. Case 2-B, where bonds shall be issued, shall have a heavily burdened short term debt. Thus, the paid-off period shall be very late compared with Case 1 or Case 2-A.

Table-11.6.6 Results of Financial Indicators

	Case 1	Case 2-A	Case 2-B
(a) DSCR 1)	0.94	2.49	0.31
(b) First year after reaching BEP ratio not to exceed 80% 2)	2017	2001	2027
(c) First year of surplus in Income Statements	2003	2000	2003
(d) First year of surplus in Funds Flow Statements	2019	2001	2032
(e) Total required amount of Short Term Loan (Rp million)	722,872	12,200	4,278,505

Notes: 1) Debt Service Coverage Ratio;

$$DSCR = \frac{\text{Net Profits + Depreciation + Interest}}{\text{Interest + Principal Due}}$$

2) Break-Even Point Ratio;

$$\text{BEP ratio} = \frac{\text{Break-Even Point Revenue}}{\text{Actual Revenue}}$$