(6) STA 18+750 - STA 20+000

A continuous fly-over is proposed to cross Kali Surabaya River, Jl. Raya Wonokromo, Jl. Ngagel and the railway together with an east bound fly-over. As described above, LRT and CNS Toll Roads also pass through this location. LRT and CNS Toll Roads are north-south oriented and Route-4 is east-west oriented. These facilities are all elevated structures and it must be decided which facility passes at what level. This must be carefully studied and settled with close consultation among the three implementation bodies.

(7) STA 20+000 - STA 27+000

On this section a Busway will be introduced together with a four lanes/two ways road segment. At the intersection crossing Route-5, this Route-4 will fly-over. However the intersection of Route-3 will be at grade because this is a three leg intersection.

After STA 21+000 where the bank of the river is not yet completed, the finished grade has been planned as the same height as the north bank on the opposite side of river where the bank is completed. For this purpose, embankment height will be 2.5 to 3.3 meters. Since this area is near to the river mouth and is a very soft ground area soft ground treatment is required.

12.5.7 Route-5

The basic policies used in selecting Route-1 are described as follows:

- Reinforce east and west connection.
- Give mobility to the West Surabaya and South Gresik development
- Study mass transportation system.
- Study counter measures to solve traffic congestion at the major traffic node of Jemur Sari.
- Connect community split by Kali Surabaya River, the railway and the toll road.
- Apply access control and grade separation as much as possible.

Route-5 is secondary arterial Type II and Class I road with design speed of 60 km/h.

Because so many development permits have been issued and ROW conditions are very limited, access control is not adopted on this route.

From STA 0+300 to STA 16 +000, there is no crossing road except Route-1, and Route-1 crosses Route-5 by fly-over. At both sides of Kali Surabaya River Route-5 intersects Jl. Mastrip and Jl. Jambangan at grade to unify the community split by the river. After STA 19+500 is road widening and overlay of pavement and no grade separation is adopted.

(1) STA 0+300 - STA 16+000

Route-5 connects Kedamean and Driyorejo in southern Gresik, and Kedurus, Jemur Wonosari and Sidosermo in southern Surabaya. The proposed Outer Ring II passes Kedamean which is a center of housing development in southern Gresik. Route-5 starts at the intersection with the existing Gresik-Krian Road. The route goes towards the east along an existing small local road. Along this local road there are many old villages. The Project Road passes in the narrow east west belt between the northern outskirts of these villages and the southern outskirts of planned housing developments scattered over southern Gresik and southern Surabaya areas.

Route-5 has a Busway for public transportation together with four lanes and a side walk. Road width required is thirty five meters.

At STA 7+830 it crosses Route-1. Route-1 toll road and arterial road fly over the Project Road with an access ramp way to the Project Road. Through Route-1, the Project Road connects with Driyorejo Housing Development now underway. According to the developer, another access road is planned to the Project Road.

After coming into Kod. Surabaya administration, at STA 12+800, the route meets with the old ROW of Surabaya-Mojokerto Toll Road and follows this alignment which has been already revised for toll road. From STA. 13+500 to STA 14+850 the route passes the fringe of "Kedurus Retarding Pond" and leads to STA 16+000.

(2) STA 16+000 - STA 19+500

Route-5 crosses Jl. Mastrip and Jl. Jambangan which are on the west and east banks of Kali Surabaya river at grade to unify the community split by river.

Route-5 crosses Sby-Gmp Toll Road, Route-2 North Bound and Route-2 South Bound at STA 16+950, STA 16+650 and STA 17+240 respectively by grade separation. These crossings are a toll road flyover, Jambangan IC and Kebonsari IC. Refer to Figure 12.6.9. and Figure 12.6.10 for these two interchange schemes. After crossing the railway by flyover at STA 17+610 the Project Road runs towards the east to meet with Jl. A. Yani. Ketintang IC is planned for grade separation with Jl. A. Yani and the railway. Refer to Figure 12.6.11 for the interchange scheme.

Besides crossing Jl. A. Yani and the railway, there are LRT by SITNP and the CNS Toll Road by private investor for north and south bound transportation. For LRT Jemur Sari Station is planned at grade combined with a railway station which will be for commuter train in the distant future. For the CNS Toll Road, before and after crossing with Jl. Jemur Sari, On/Off ramps are planned to Jl. A. Yani. Different transportation modes are concentrated at this location. This location is also a very important transportation node similar to Wonokromo on Route-4.

The Project Road and the CNS Toll Road are elevated structures and it must be decided which facility passes at what level. This, together with arrangement of each facility, must be carefully studied and settled with close consultation among the three implementation bodies.

To approach Rungkut Industrial Estate from the Project Road, Rungkut Interchange is provided at STA 19+050. Refer to Figure 12.6.12.

(3) STA19+500 - STA 22+890

From 19+500 to end of the route is Jl. Jemur Sari. This section will be widened and pavement overlay will be carried out for introducing a Busway.

(4) Necessity of ROW Alignment Change for Route-5

The ROW for Route-5 has been established along the existing roads (Jl. Bangkingan, Sumurwelut, Jl. Balas Klumprik and Jl. Kebran II) by Kotamadya Surabaya. However, there are many residential houses continuously along the existing roads and existing road width is only 7 m.

It is important to minimize removal of existing residential houses from the view point of social environmental impact. The alignment established by Kotamadya Surabaya and the alignment proposed by the Study Team are compared by number of houses to be removed. The comparison is shown in Table 12.5.4.

Table 12.5.4 Number of Houses to be Removed

Unit:houses

Description	Established Alignment	Proposed Alignment
Kec. Driyorejo (6.7 km)	460	0
Kec. Lakar Santri (3.4 km)	243	12
Total (10.1 km)	703	12

Source: JICA Study Team

It is recommended that the alignment established by Kotamadya Surabaya is changed to the alignment proposed by the Study Team to minimize the social environmental impact.

12.6 Preliminary Design of Interchange

12.6.1 General

There are three types of interchanges;

1. toll road-to-toll road through artery,
2. toll road-to-artery interchange (On/Off ramp, so called Diamond Type interchange),
3. and artery-to-artery interchange

Interchanges are planned at the connection between the Project Toll Road with Sby-Gre Toll Road and with Sby-Moj Toll Road. In this study direct connection from toll road to toll road is not provided because there are different private investors among these three toll roads with different levy systems. The Project Toll Road is operated by a flat tariff toll levy system because it is planned as intra-urban toll road and its total length is only about 15.5 kilometers. However, Surabaya-Gresik and Surabaya-Mojokerto tolls road are operated by distance proportional toll levy system at these connecting segments. Generally, a toll road to toll road interchange is designed as a direct/high-speed connection without provision of toll gates. But toll gates would be required for toll levy collection for each private investor.

On/Off ramps are planned at the crossings with arterial roads (including planned arterial roads) to collect/distribute the toll road traffic from/to the arterial road network in the Project Area, normally with provision of toll gates.

Interchanges are planned at the crossings with arterial roads (including planned arterial roads) in order to avoid intersecting traffic friction by grade separation. U.R. Design Standard provides for grade separation at the crossing point of each arterial road.

This section describes the preliminary design of the interchanges and On/Off ramps planned on the Project Road.

12.6.2 Toll Levy System

The Project Toll Road will constitute a part of the Surabaya Urban Toll Road System. Therefore, it is understood that basically the Toll Road will be operated under a flat tariff toll levy system. The

Project Toll Road is connected with Sby-Gre Toll Road at the north end and with Surabaya-Mojokerto Toll Road at the south end. It is necessary to provide a mainline toll barrier on the Project Toll Road south of Romo Kalisari Interchange and Driyorejo Interchange respectively.

12.6.3 Location of Interchanges and On/Off Ramps

Two interchanges (toll to toll interchange) , six On/Off ramps and seven interchanges (artery to artery) are planned on the Project Roads. The name of each interchange and On/Off ramps are shown in Table 12.6.1.

12.6.4 Layout of Interchange

(1) Romo Kalisari Interchange

Romo Kalisari interchange connects the existing Sby-Gre Toll Road and the arterial road which leads the Project Toll Road to Jl. Tambak Osowilangon. The design speed of Sby-Gre Toll Road and Romo Kalisari interchange are 80 km/h and 40 km/h respectively. It is not realistic to change or upgrade these fundamental design factors since a part of the structure and land acquisition are ready for future extension. This interchange has been planned based on the original design by modifying the existing single trumpet to a clover leaf type interchange. For future extension, some parts of the structure will be demolished and rebuilt and toll gates reconstructed.

Schematic drawing of this interchange is shown in Figure 12.6.1.

Connection between the Project Toll Road and Sby-Gre Toll Road is through the arterial road which leads the Project Toll Road to NH. Sby-Gre and has been based on the following considerations.

Different private investors are assumed for the Project Toll Road and for Sby-Gre Toll Road. Toll levy collection shall be by toll gate on each toll road.

The Project Toll Road shall apply a flat tariff toll levy system which is a different system from that on the Sby-Gre Toll Road which is operated by a distance proportional toll levy system.

Table 12.6.1 Name of Interchange and On/Off Ramps

Route No.	Name of Interchanges and On/Off Ramps	STA	Distance (km)	Name of Connecting Road	Remarks
1	Benowo IC	1+000		Jl. Tambak Osowilangon	
	Romo Kalisari IC	2+500	1.50	Surabaya Gresik Toll	T to T
	Jl. Sememi On/Off	6+800	4.30	Jl. Sememi from South	
	Route-4 On/Off	9+800	3.00	Route-4 from North	
	Jl. Menganti On/Off	13+400	3.60	Jl. Menganti form South	
	Route-5 On/Off	14+250	0.85	Route-5 from North	
	Kesamben On/Off	15+200	1.30	Route-5 from South	
		16+500		Planned Trunk Road	
	Tenaiu On/Off	18+100	1.60	Surabaya Mojokerto Toll	T to T
	Driyorejo IC	18+920	0.82	Surabaya Mojokerto Toll	
	Torosobo IC	21+015	2.10	NH Surabaya Mojokerto	
2	Kali Anak IC	0+000		Jl. Kali Anak	
4	Kota Satelit IC	15+500		Sby-Gmp Toll	
5	Jambangan IC	16+600	1.10	Route-2	
	Kebonsari IC	17+300	0.70	Route-2	
	Ketintang IC	18+000	0.70	Jl. A. Yani	
	Rungkut IC	18+850	0.85	Jl. Jemur Sari	

(2) Driyorejo Interchange

Driyorejo Interchange has been designed on the Sby-Moj Toll Road as a very local interchange connecting Sby-Moj Toll Road to provincial road Surabaya-Mojokerto. This design is not intended to cross the arterial road nor the toll road. Therefore the shape of the interchange is rather irregular as shown in Figure 12.6.2. It is understood that this type of interchange is not sufficient to meet the proposed traffic assignment.

It is proposed that this interchange shall be modified to be a double trumpet type interchange as shown in Figure 12.6.3. The proposal is not only to modify the shape of the interchange, but also the connecting road shall be changed to National Highway Surabaya-Mojokerto (one of the major arterial roads in GKS region).

The proposed Driyorejo Interchange is a double trumpet type interchange as described above, connecting Sby-Moj Toll Road to an arterial road parallel to the Project Toll Road. Thus, connection between the two toll roads is through the arterial road parallel to the Project Toll Road and is based on the following considerations.

- Different private investors are assumed for the Project Toll Road and the Sby-Moj Toll Road. Toll levy collection shall be by toll gate on each toll road.
- The Project Toll Road shall apply a flat tariff toll levy system which is a different system from that on the Surabaya-Mojokerto Toll Road which shall be operated by a distance proportional toll levy system.

(3) Benowo Interchange

Benowo Interchange is planned at the intersection of NH. Sby-Gre and the access road to Romo Kalisari Interchange. The present intersection is an irregular at grade, three leg intersection as shown in Figure 12.6.4.

Since the Project Toll Road and arterial road are connected to this access road and future traffic projection on the access road to Romo Kalisari Interchange is more than 66,000 pcu/day, it is

necessary that this intersection should be grade separated.

It is proposed that the existing National Highway should be shifted to the south flying-over the existing railway and to provide a single trumpet type interchange at the present location of the toll gate and toll road operation office as shown in Figure 12.6.5.

(4) Torosobo Interchange

Torosobo Interchange is a three leg interchange connecting Route-1 and existing National Highway Surabaya-Mojokerto by a single trumpet type interchange as shown in Figure 12.6.6.

(5) Kali Anak Interchange

Kali Anak Interchange is a three leg interchange connecting Route-2 to Jl. Kali Anak by a single trumpet type interchange as shown in Figure 12.6.7.

(6) Kota Satelit Interchange

The existing Kota Satelit Interchange is a single trumpet interchange with a roundabout. In the roundabout, weaving lengths are not enough even now. Considering future traffic demand on this segment (100,000 pcu/day or more), it is necessary to modify this interchange to a double trumpet type interchange as shown in Figure 12.6.8.

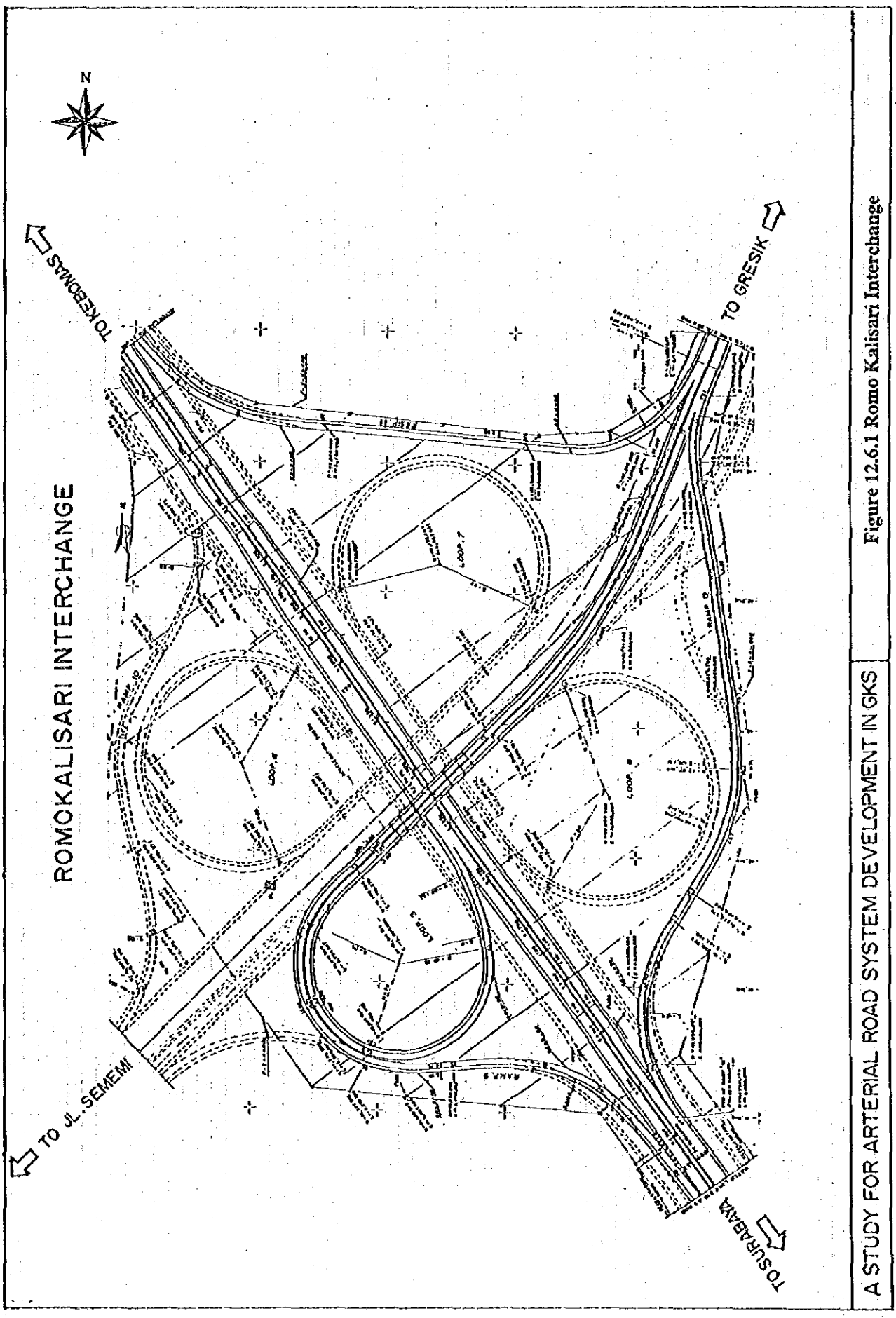
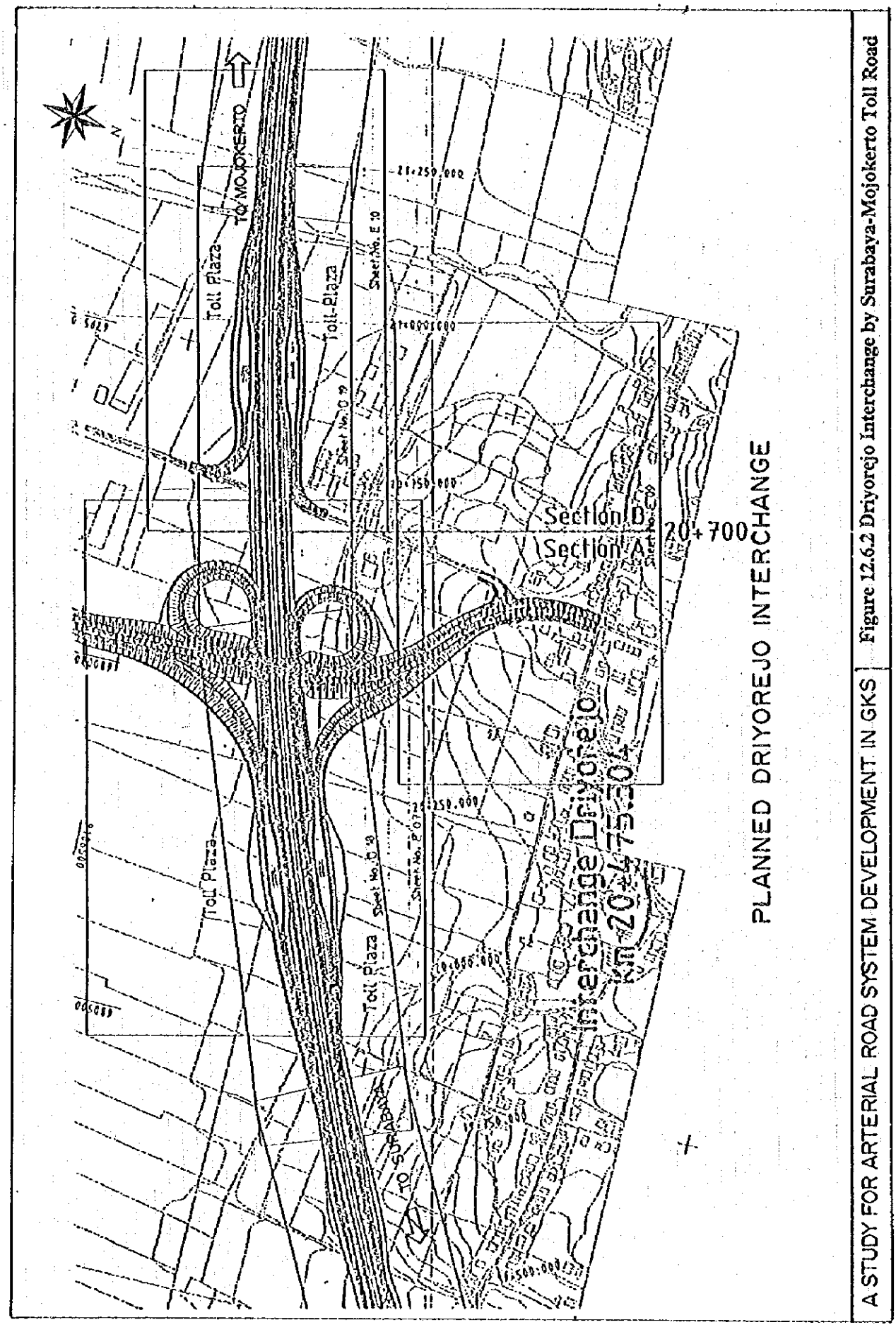


Figure 12.6.1 Romo Kalisari Interchange



A STUDY FOR ARTERIAL ROAD SYSTEM DEVELOPMENT IN GKS | Figure 12.6.2 Driyorejo Interchange by Surabaya-Mojokerto Toll Road

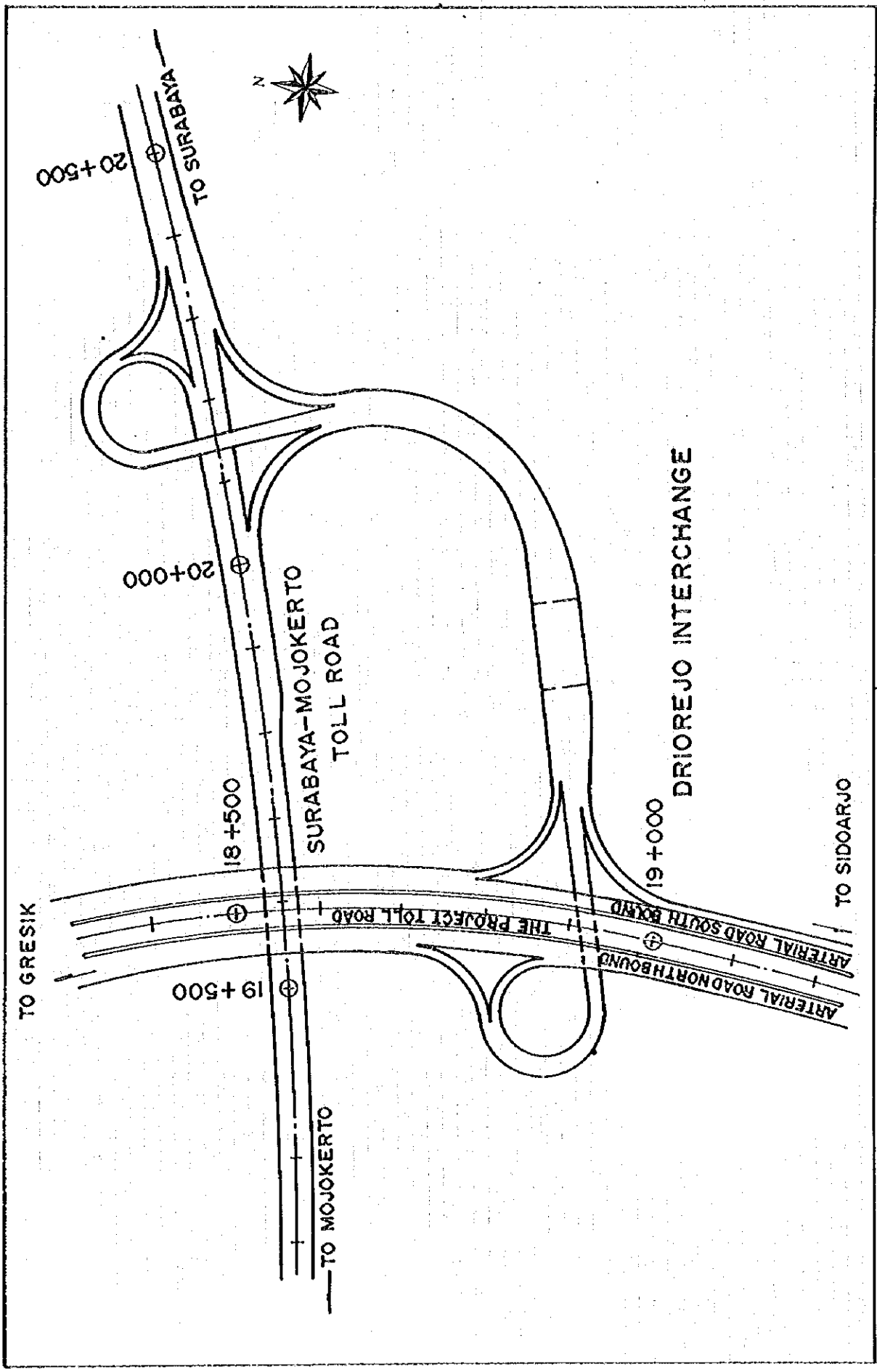


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Figure 12.6.3 Proposed Driyorejo Interchange (Double Trumpet Type)

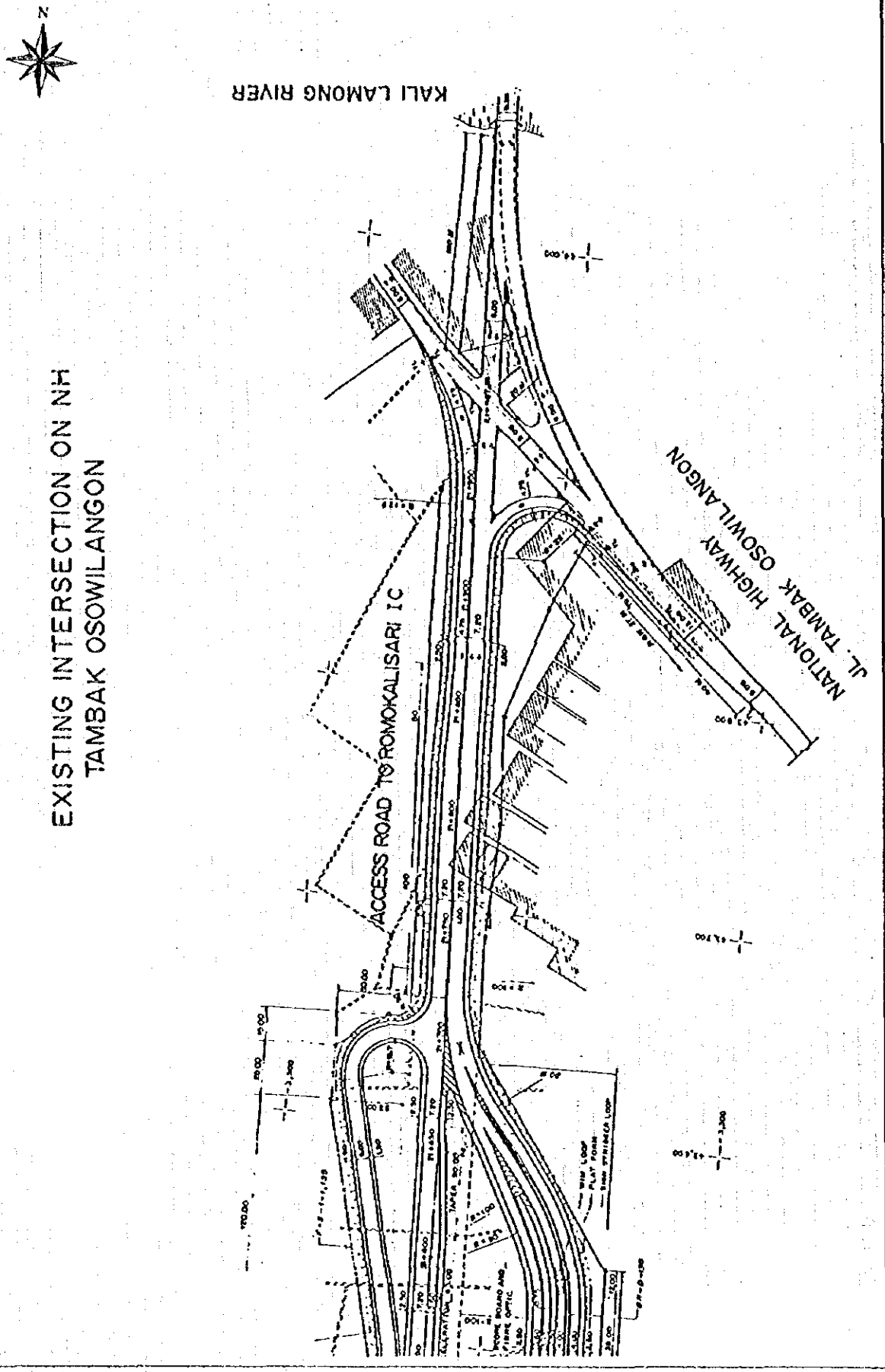

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Figure 12.6.4 Intersection on Jl. Tambak Osowilangon

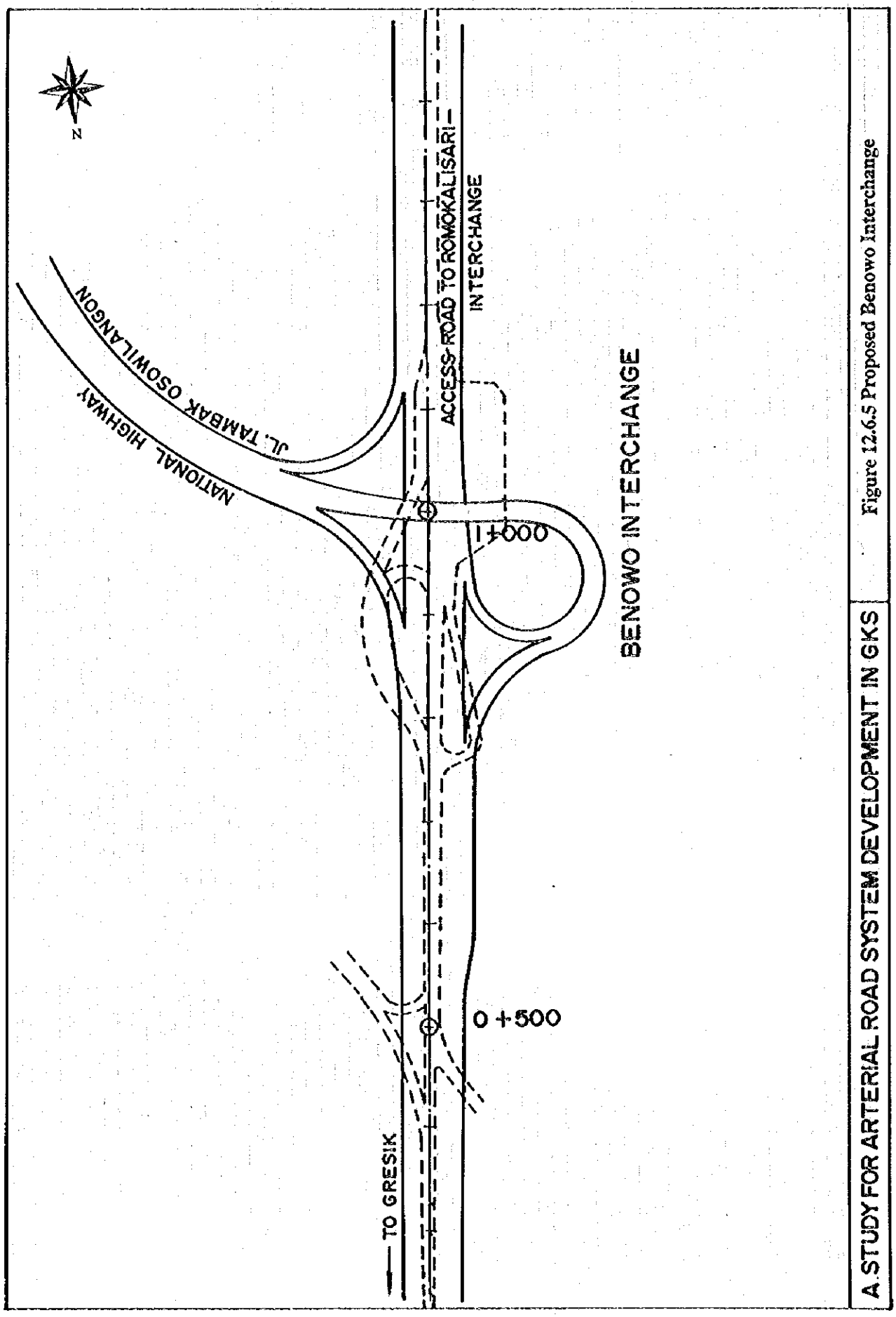

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Figure 12.6.5 Proposed Benowo Interchange

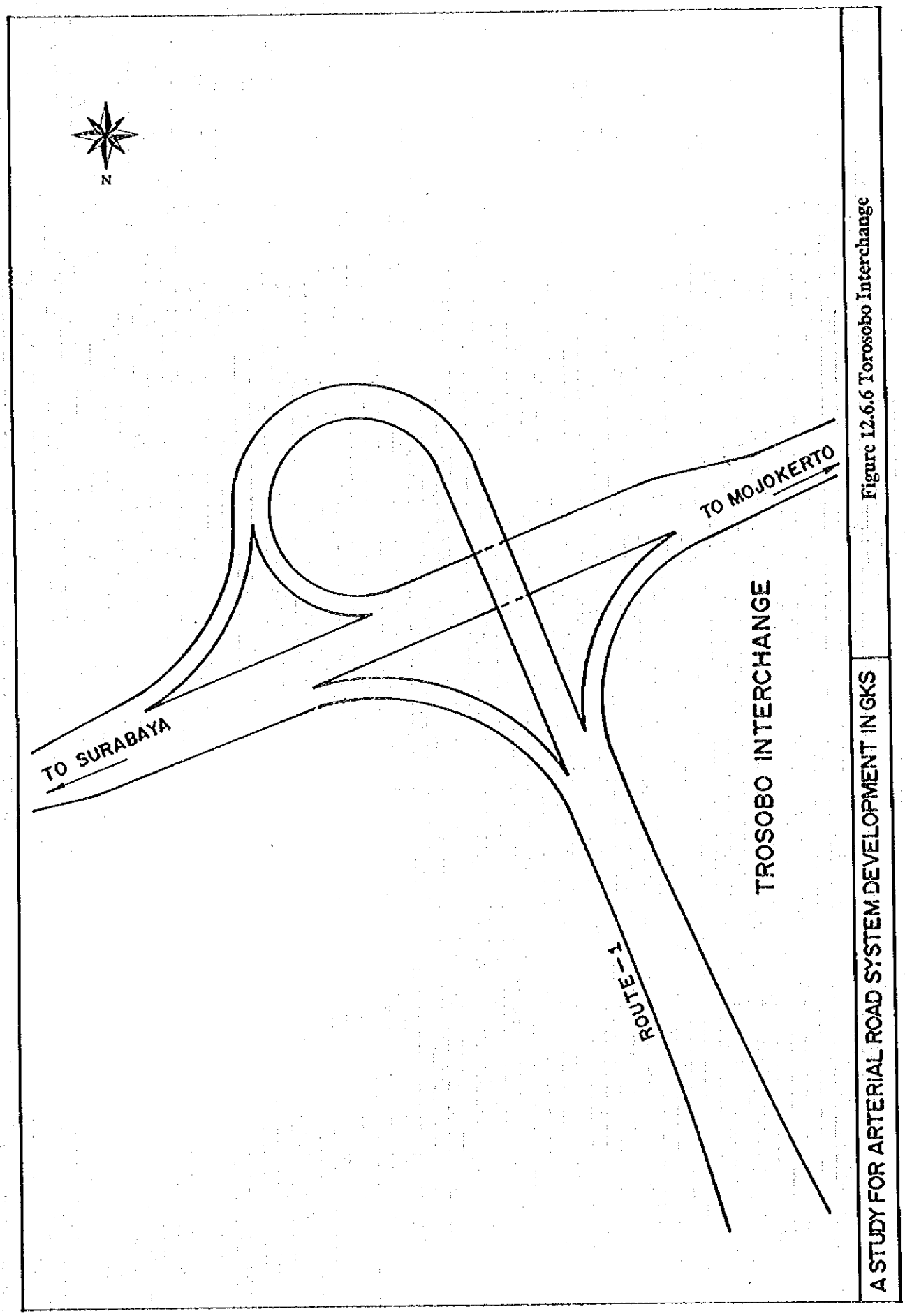

Figure 12.6.6 Torosobo Interchange

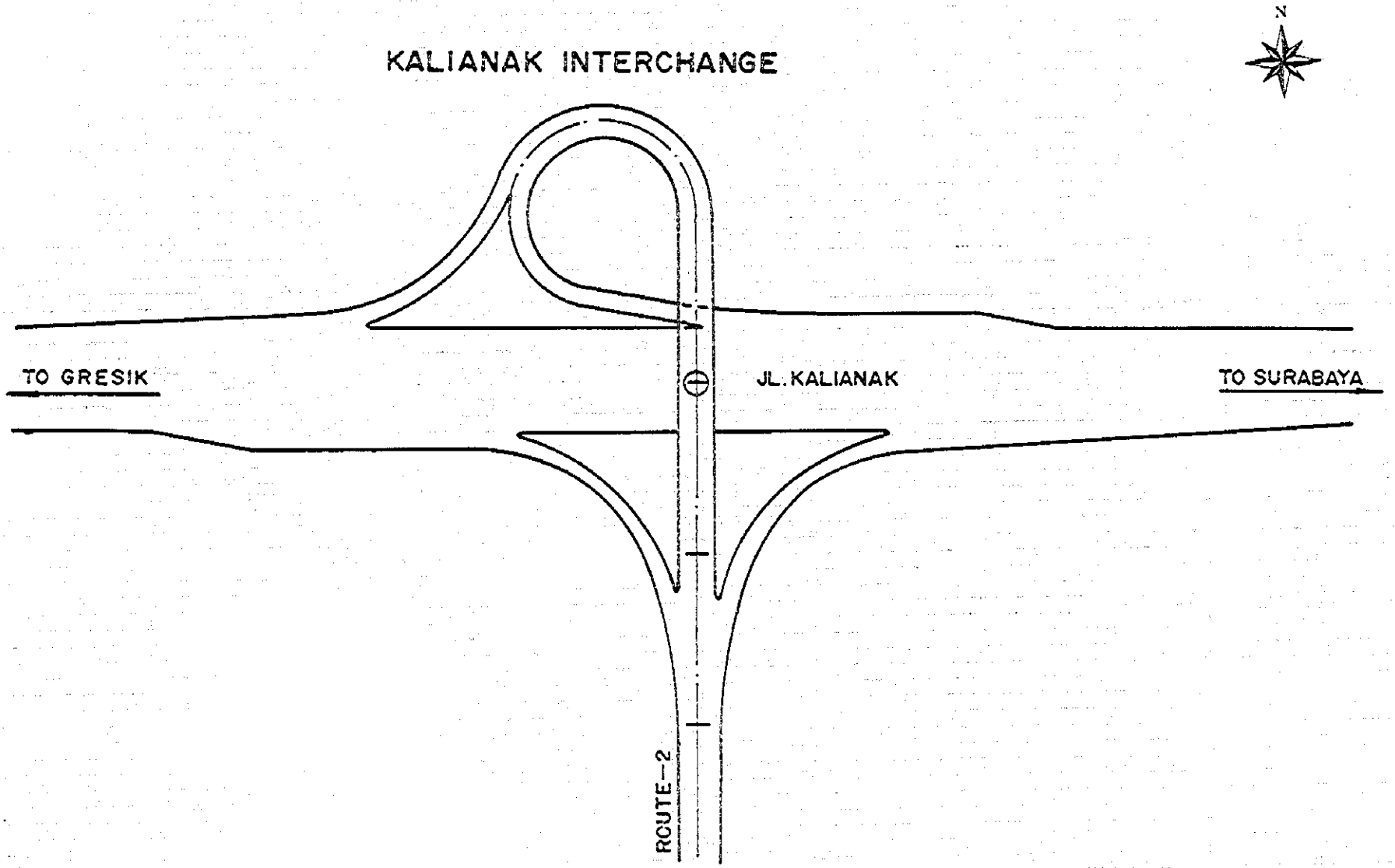

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Figure 12.6.7 Kali Anak Interchange

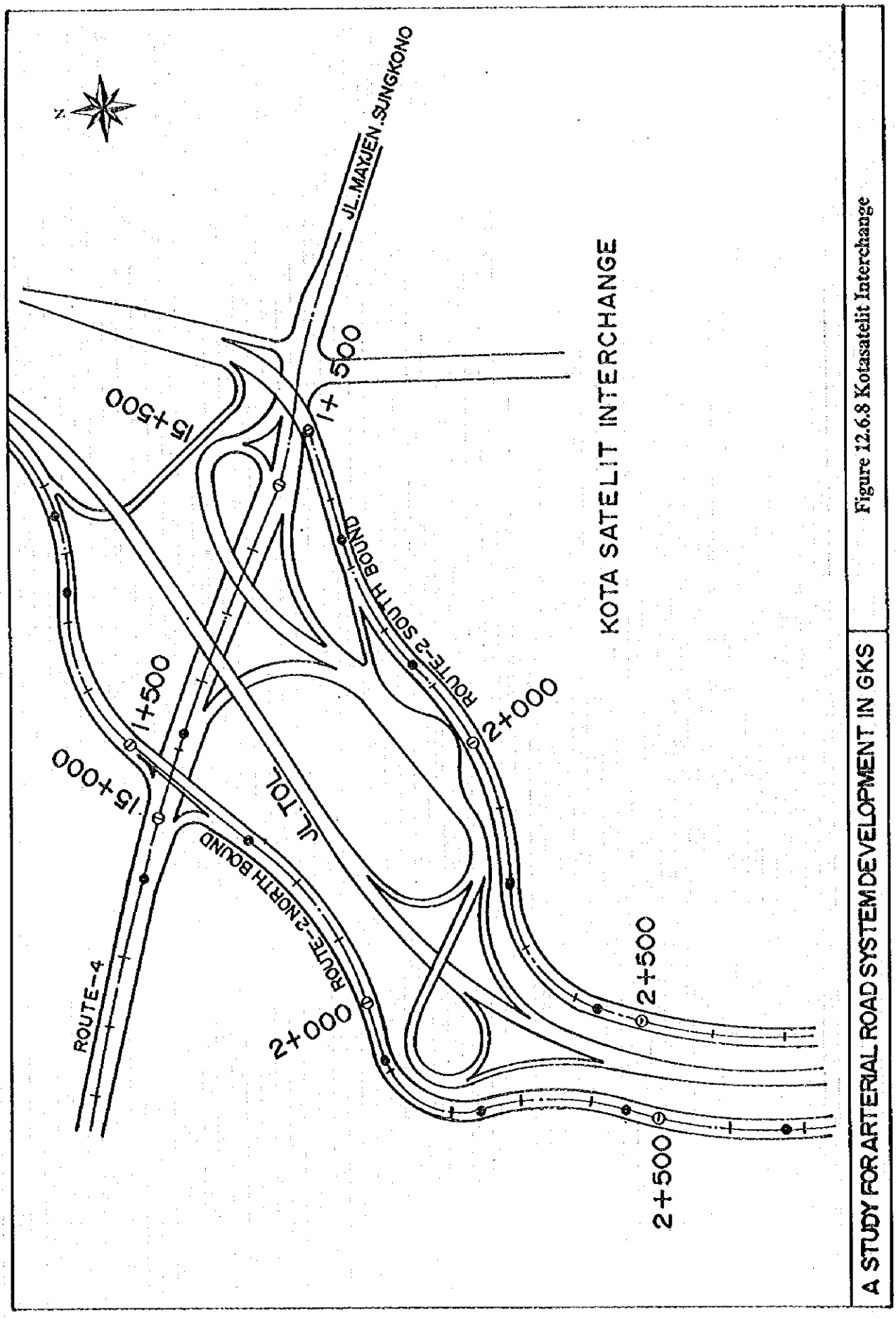

Figure 12.6.8 Kotasatelit Interchange

(7) Jambangan Interchange and Kebonsari Interchange

These are interchanges to connects Route-2, north bound and Route-2, south bound to Route-5. The shape of these interchanges are three leg trumpet type interchanges, but because Route-2 is one way operation, the number of ramp ways is two only for each interchange as shown in Figure 12.6.9 and Figure 12.6.10.

(8) Ketintang Interchange

This interchange connects Route-5 with Jl. A. Yani, the only arterial road coming into Surabaya from the south. On Jl. A. Yani, there is a roundabout and a branch to Jl. Jemur Andayani which crosses the railway at grade. Jl. Jemur Andayani leads to Jl. Jemur Sari and Jl. Rungkut Industri Raya. Because of this railway crossing both roads are congested all day long. The future traffic projection in Route-5 at this segment is 60,000 to 85,000 pcu/day. To solve future congestion and to avoid the railway crossing, this interchange has a very major function. The interchange is a three leg single trumpet type interchange combined with a roundabout on Jl. A. Yani as shown in Figure 12.6.11.

Besides grade separation from Jl. A. Yani and the railway, there is the LRT by SITNP and CNS Toll Road by a private investor for north and south bound transportation. For the LRT, it is planned that Jemur Sari Station at grade combined with the railway station will serve for commuter train in the distant future. For CNS Toll Road, before and after crossing Jl. Jemur Sari On/Off ramps to Jl. A. Yani are planned. Different transportation modes are concentrated at this location which is a very important transportation node, similar to Wonokromo on Route-4.

(9) Rungkut Interchange

This interchange provides access to Rungkut industrial estate from Route-5 and Jl. A. Yani. It is a three leg trumpet type interchange as shown in Figure 12.6.12.

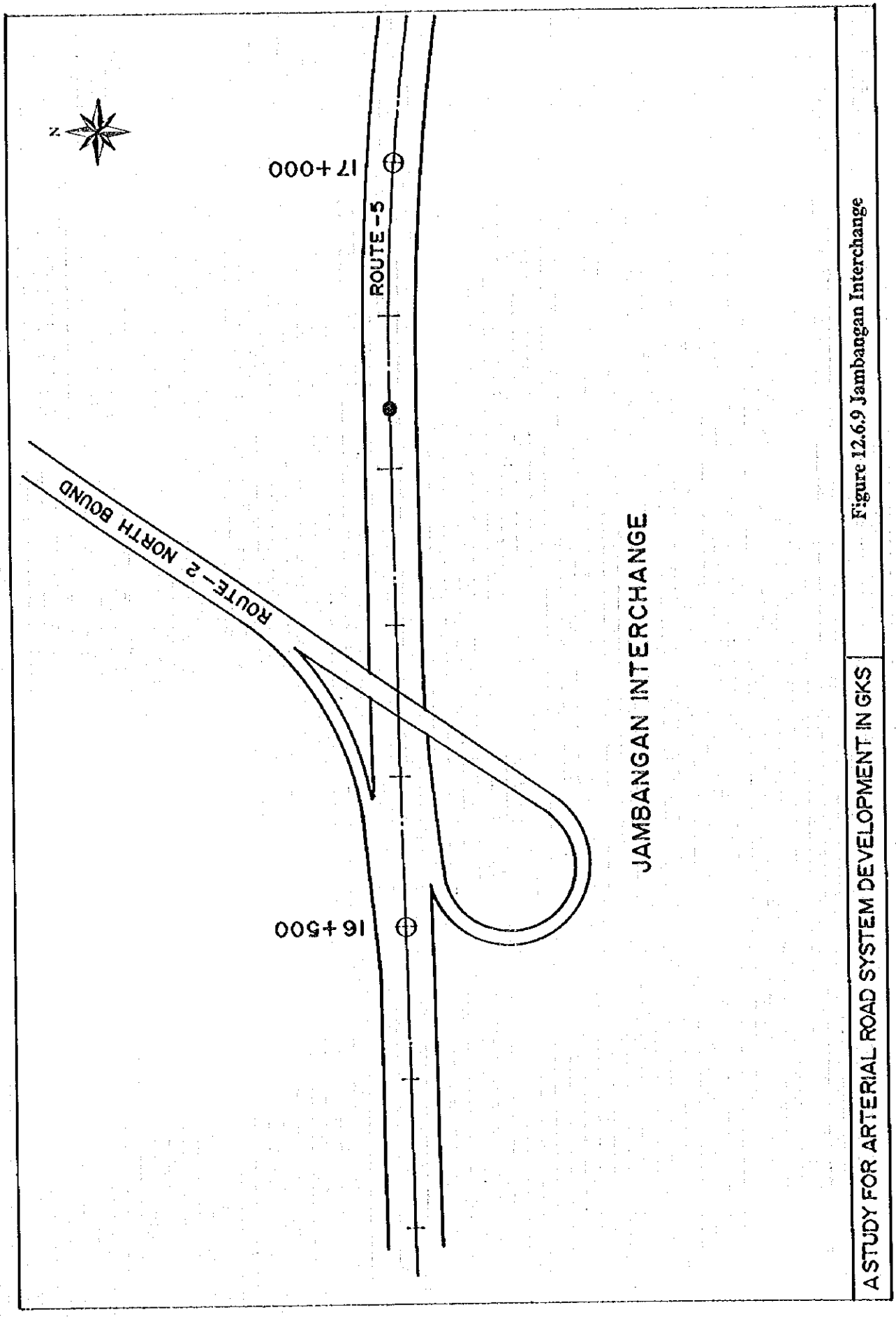

Figure 12.6.9 Jambangan Interchange

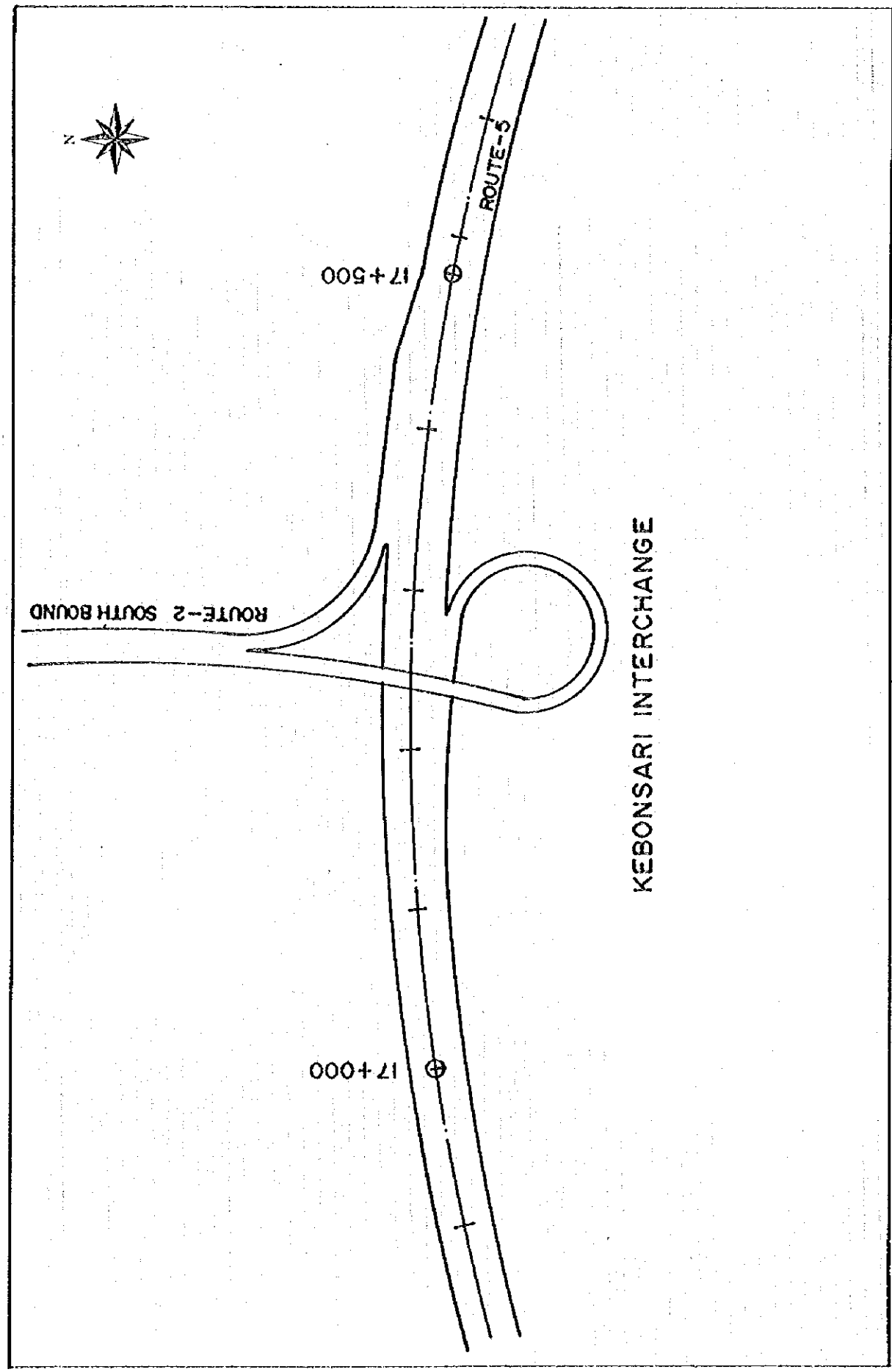

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Figure 12.6.10 Kebonsari Interchange

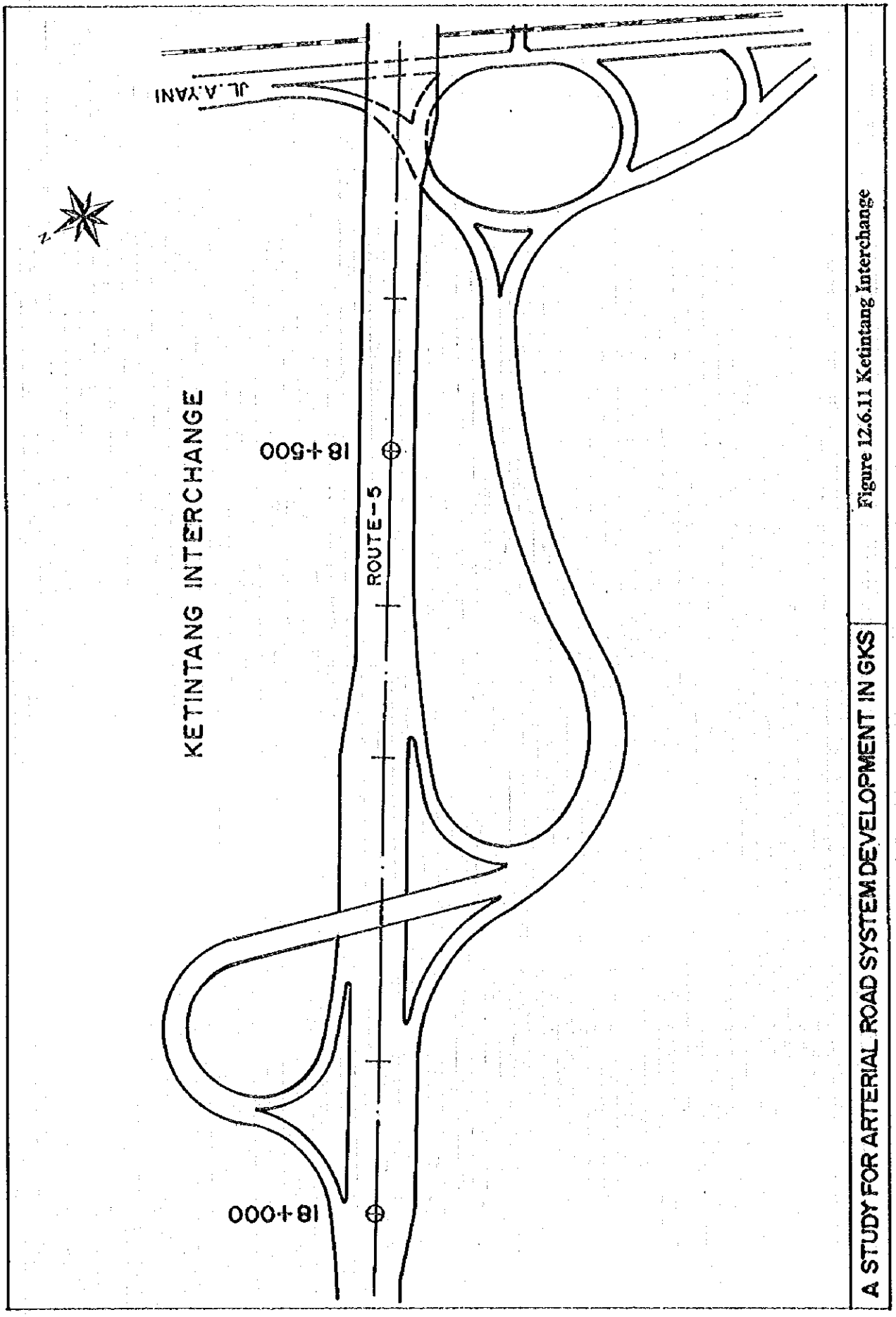

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Figure 12.6.11 Ketintang Interchange

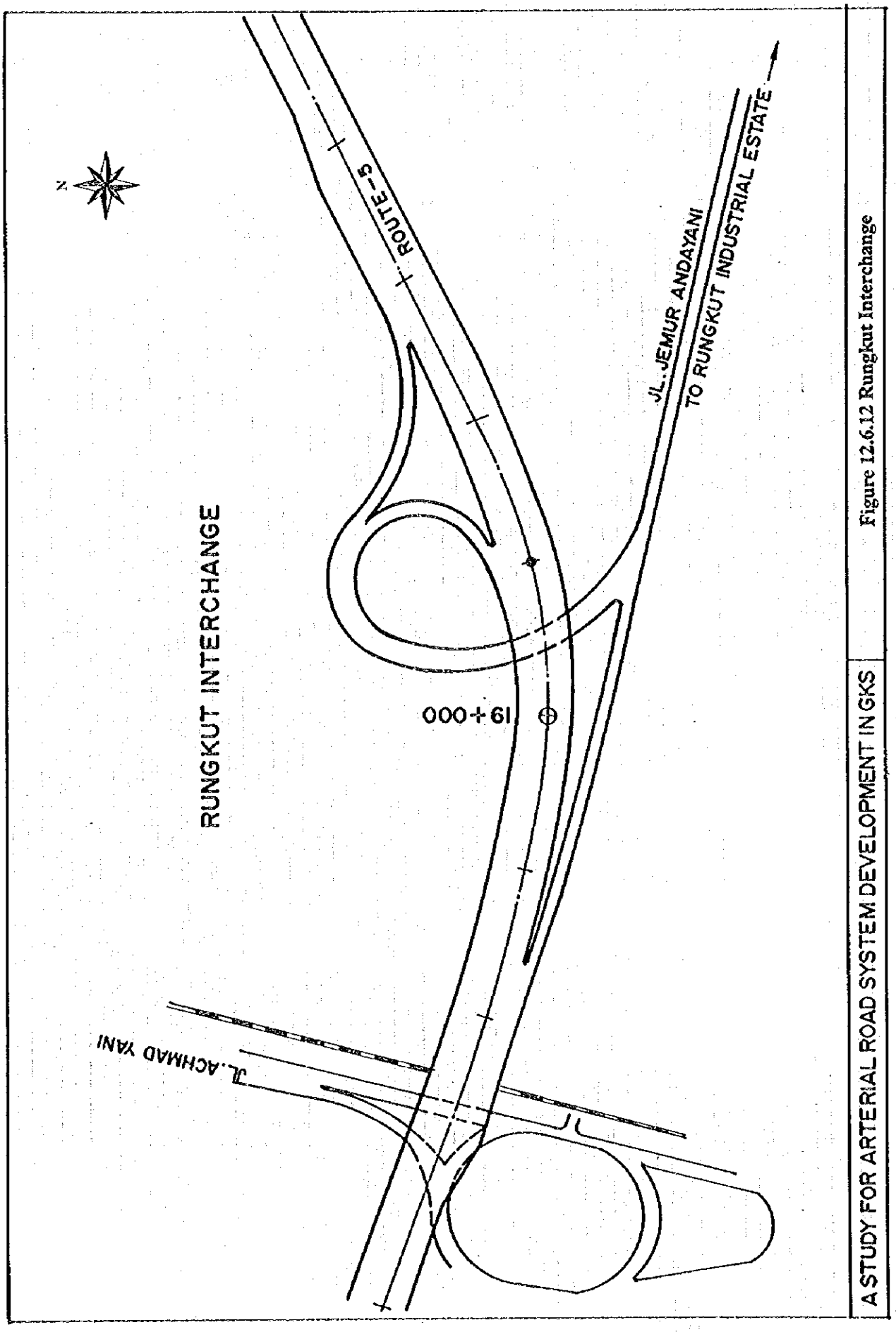

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Figure 12.6.12 Rungkut Interchange

12.7 Preliminary Design of Bridges

12.7.1 General Description of Bridge Types

(1) Superstructure

In general the types of bridges are determined by the surrounding conditions such as the nature of roads, railway lines or rivers which the bridge crosses over, environmental requirements and economic priorities. Special considerations for determination of span length are requirements for future road network and for river improvement plan. Composite PC I-girders are generally adopted in this project, except at Achmad Yani Fly Over and Wonokromo Fly Over on Route-5 and Route-4 respectively, due to heavy traffic and no space for scaffolding over main roads during the construction period.

(a) Span Length

Span length is one of the most important factors in determining a bridge type because once the span length is fixed the choice of bridge type is limited. The general relationship between span length and bridge type is shown in Table 12.7.1.

Table 12.7.1 Relationship Between Span and Bridge Type

Material	Type of Structure	Span length (m) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 200
Reinforced Concrete	Simple T girder	
	Hollow slab	
	Rigid frame	
Prestressed Concrete	Hollow slab	
	Simple I-girder	
	Simple T-girder	
	Simple box-girder	
	Continuous box girder	
	Box girder with hinge	
	Continuous rigid frame	
Steel Bridge	Simple composite girder	
	Simple box girder	
	Continuous box girder	
	Truss girder	

Source: JICA Study Team

(b) Depth Ratio

A beam or girder has a desirable ratio of depth to length of span which will result in minimum construction cost, and this depth ratio is generally adopted.
Standard ratios for main types of girder are shown in Table 12.7.2.

Table 12.7.2 Standard Depth Ratio

Type of Super Structure	Girder Height Ratio (H/L)						Remark
	1/5	1/10	1/15	1/20	1/25	1/30	
PC I-girder							
PC I-girder							
PC Hollow Slab							
PC Box Girder							continuous beam
Steel Composite Girder							simple beam
Steel Box Girder							continuous beam

(c) Environmental Requirements

Careful considerations are necessary to preserve the existing environmental condition (i.e. public facilities, road network, drainage system in residential area) when structural type and construction method are selected.

The type of superstructure including substructure located in urban area should be harmonized aesthetically with the surrounding environment.

(d) Construction and Maintenance Requirement

The construction and maintenance aspects are important in the selection of bridge type. Concrete bridges are generally adopted in this project because of their economical advantages, durability, and freedom from maintenance as well as availability of local products such as cement and reinforcement.

Erection girder and crane erection methods are commonly used for middle length of span less than 40m. In particular over the rivers and for long length viaducts, erection girder method is preferable to enable shorter construction period and easy construction.

(2) Substructure

The substructure of the bridge should be designed to meet the following general requirements as well as soil conditions.

(a) Abutment

Reinforced concrete is normally used for abutments. In general the type of abutment is

shown in Figure 12.7.1.

(b) Pier and columns

Reinforced concrete piers and columns are generally used unless special restrictions are required. Structural type of piers and columns should be determined to meet the surrounding conditions as well as structural requirements. In rivers and canals pile bent piers are generally used for existing bridges, however logs and trash trapped in front of the pier harms the water flow. In addition to the above, bigger displacement of piles due to seismic loading is likely to happen during an earthquake resulting in harmful damage to the superstructure. Therefore in the case of middle and long span bridges pile bent piers are not recommended. Accordingly wall type piers have been adopted for bridges in river or canal.

Abutment Type	Height (m) 10 20 30	Remarks
Reversed T- Type		
Buttress Type		
Rigid Frame Type		
Box Type		
High Embankment Type		

Figure 12.7.1 Type of Abutment

(c) Foundation

Type of foundation is principally determined by subsoil condition, type and size of superstructure and from the economical point of view.

Geological aspects of this project are given in Table 12.7.3.

Based on sub soil conditions as shown in the table pile foundation is adopted for bridges in this project and pile lengths range from 12 meters to 35 meters depending on the locations and subsoil conditions. Concrete spun pile diameter 60 cm is used for the foundation considering penetrating length and availability of local product. Axial capacity of a pile is the sum of the design bearing capacity at the tip of the pile and friction capacity of shift of the pile. Axial capacity of pile of 100 ton at service load is applied.

Table 12.7.3 General Description of Soil Condition in Project Area

Area	Route	Stratigraphy	Deposit and Formation		Depth of Alluvium	N value
North Coastal Area (level terrain)	North part of Route-1 and 2	Alluvium	Cohesive soil	very soft	15 ~ 18m	N = 0
		Diluvium	Cohesive soil			N > 0
Central and East Area (level terrain)	Route-2, 3	Alluvium	Cohesive soil	very soft	15 ~ 20m	N = 0.5
		Diluvium	Cohesive soil	stiff		N > 20
West Hill Top Area	Central and South part of Route-1, west part of Route-4 and 5	Alluvium	Cohesive soil	very soft	0 ~ 9m	
		Diluvium	Tuffaceous	very soft		N > 40

Source: JICA Study Team

Notes

(1) Coefficient of Horizontal Seismic Loading (K_h)

Coefficient of horizontal seismic loading is derived from the following formula. Kh used for the project is calculated for standard type of bridge as shown in the following table.

$K_h = C \cdot S$

Where,

C = Base shear coefficient for appropriate zone, natural period of vibration of structure and soil condition.

S = Structure type factor 1.15 for prestressed concrete hinge zone (partially prestressed)

T = Natural period of vibration

$$T = 2\pi\sqrt{\frac{Wpt}{g \cdot Kp}}$$

g = Acceleration due to gravity (m/s^2)

W = $W_{head} + W_{column}/2 + W_{super}$

W_{head} = Weight of pier head

W_{column} = Half weight of column

W_{super} = Dead load of superstructure (730 t)

Kp = Combined stiffness of bridge pier expressed as horizontal force required to produce a unit deflection at the pier top (Kn/m)

Base Shear Coefficient

Height of Pier	Diameter of Column	$I = \frac{Kd^4}{64}$	$Kp = \frac{3EI}{N^3p}$	Wp	Wpt	Period T	Base scheme C	
Hp (m)	D (m)	(m4)	(t/m)	(t)	(t)	(second)	Medium soil	Soft soil
7.3	2.0	0.7854	15142	57.3	988.6	0.53	0.130	0.150
9.0	2.2	1.1499	11830	85.5	1002.8	0.58	0.124	0.150
11.0	2.4	1.6286	9176	124.4	105.2	0.68	0.110	0.138
13.0	2.6	2.2431	7657	172.6	1076.2	0.76	0.100	0.127
15.0	2.8	3.0170	6704	231.0	1105.5	0.82	0.100	0.118
17.0	3.0	4.1716	6368	300.4	1140.2	0.85	0.100	0.114
20.0	3.2	5.1472	4826	402.1	1191.0	1.00	0.100	0.100

Source: JICA Study Team

Where,

W_{head} = 260 t

W_{super} = 730 t (PC I-girder deck slab and super imposed load)

(2) Pile Axial Capacity Geotechnical Formula

Ultimate pile axial capacity is computed from the following formula by Highway Bridge Design Standard, Volume V Substructure, Japan Road Association.

$$R_u = q_d \times A_p + U\sum l_i f_i$$

Where;

R_u = Ultimate bearing axial capacity of pile (t)

A_p = Cross sectional area of the pile at tip (m^2)

q_d = Ultimate bearing capacity of the soil at tip of pile (t/m^2) which is given by the following figure

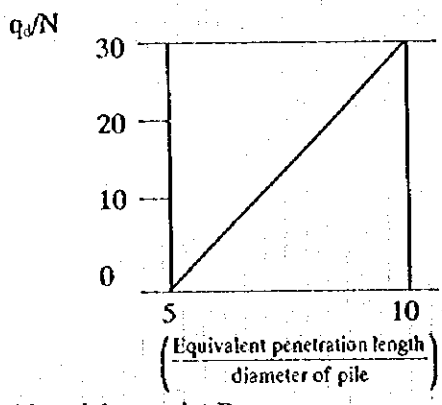
U = The perimeter of the pile (m)

l_i = The depth of soil for which skin friction is considered

f_i = Maximum skin friction stress

{ f_i = C or N (t/m^2) for cohesive soil }

Figure Estimation of q_d



Allowable axial capacity Ra

$$Ra = \frac{1}{n}(Ru - Ws) + Ws - W(t)$$

Ws = Effective weight of soil replaced by the pile

W = Sum of pile weight

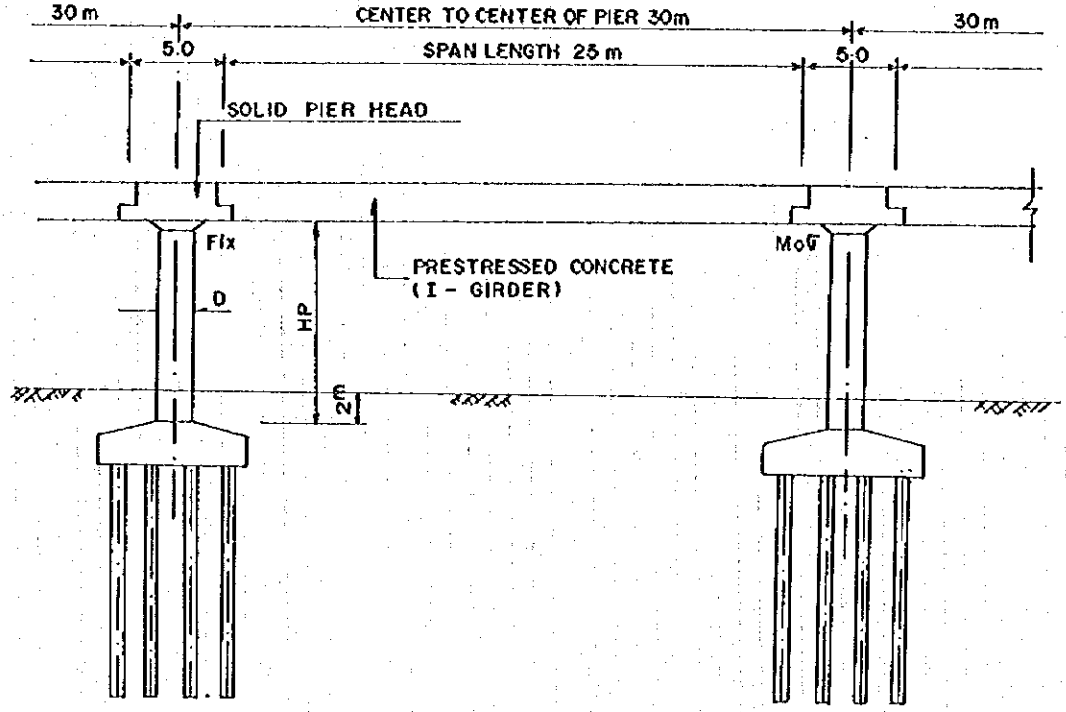
n = Safety factor (for tip bearing pile n = 3, friction pile n = 4)

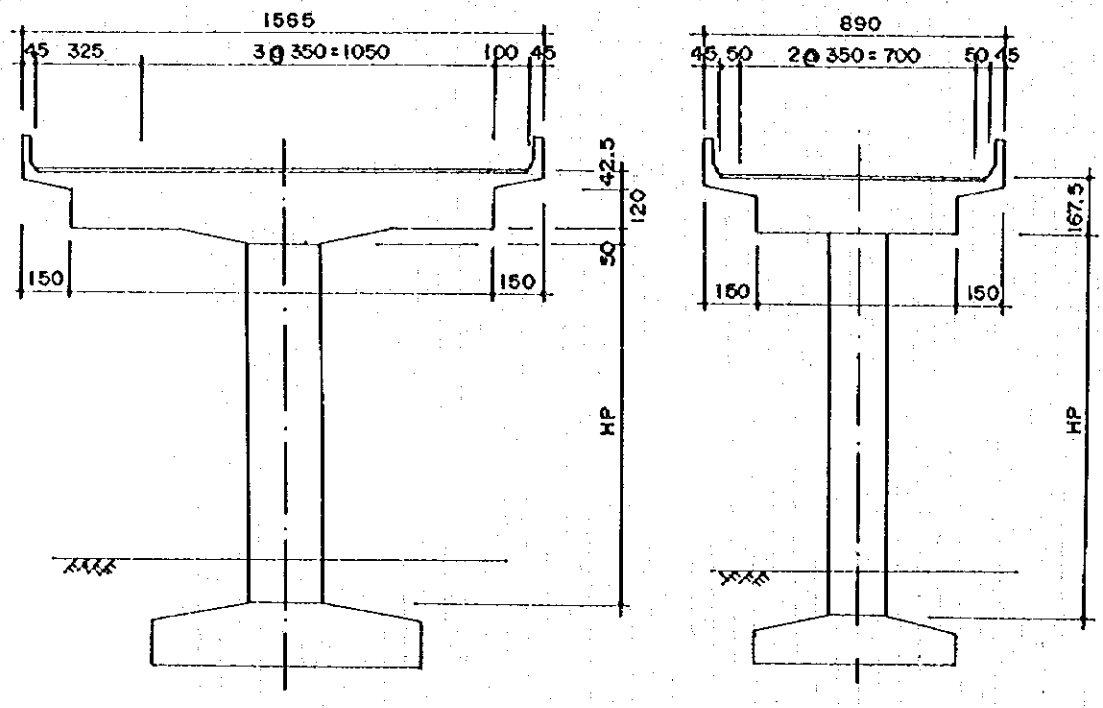
Pile Axial Capacity

Route	Boring No.	Length of Pile L (m)	Diameter of Pile D (cm)	Ru (t/pile)	Ra (t/pile)	Recommended Ra (t/pile)	Remarks
Route-1	No. 1	12m	60	438	109	100	Friction pile
Route-1	No. 2	13m	60	499	169	100	Friction pile
Route-1	No. 3	27m	60	675	225	100	Friction pile
Route-2	No. 8	30m	60	292	73	70	Friction pile
Route-3	No. 5	23m	60	577	143	100	Friction pile
Route-3	No. 7	35m	60	333	121	100	Friction pile
Route-4	No. 4	16m	60	534	132	100	Friction pile
Route-5	No. 6	25m	60	445	111	100	Bearing pile

Note : Boring No. 9 is not used for estimation of pile axial capacity due to shortage of depth of boring log.

Standard span and cross sections of the Project Roads are shown in Figure 12.7.2.





A STUDY FOR ARTERIAL ROAD SYSTEM DEVELOPMENT IN GERBANG KERTOSUSILO REGION	**Figure 12.7.2 Standard Span and Cross Section of the Project Roads**

12.8 Preliminary Design of Pavement

12.8.1 General

The following are Government pavement design standards for flexible pavement and rigid pavement.

- Guide for Flexible Pavement Design (Petunjuk Perencanaan Tebal Perkerasan Lentur Jalan Raya Dengan Metode Analisa Komponen : SKBI – 2.3.26.1987 UDC:625.73(02), Bina Marga)
- Guide for Rigid Pavement Design (Pedoman Perentuan Kaku : Beton Semen, 1985, Bina Marga)

Flexible pavement is recommended to make maximum use of existing flexible pavement.

12.8.2 Conditions for Pavement Design

As described in the previous Chapter and Sections, design factors for pavement design were determined based on the field survey and traffic projections as follows;

Table 12.8.1 Pavement Design Conditions

	Route-1		Route-2	Route-3	Route-4		Route-5
	Toll Road	Arterial			Western Part	Eastern Part	
Number of Lanes	6	4	4	4	6+Busway	4	4+Busway
Opening Year	2004	2004	2004	2004	2004	2004	2004
Design Life (years)	10	10	10	10	10	10	10
CBR on Site (%)	2.36	2.36	1.54	2.98	2.98	2.78	0.71

As described in "Chapter 11.3 Soil Investigation", CBR on the site is about 2 % or more. Due to the poor condition, improvement of sub-grade soil is necessary and it has been determined that 60 cm of sub-grade will be replaced by borrow material.

Axle load model to determined the pavement thickness is shown in Figure 12.8.1.

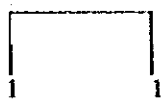
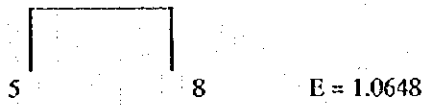
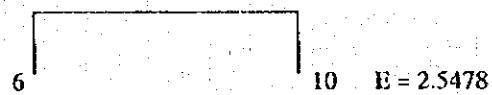
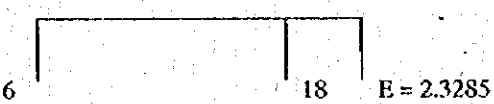
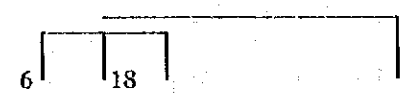
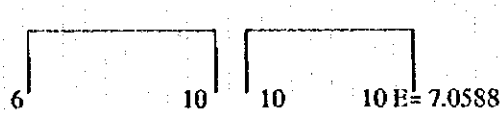
No.	VEHICLE TYPE	MODEL OF LOAD DISTRIBUTIO (TON)
1	PASSENGER CAR	
2	PICK UP	
3	MICROBUS	
4	LARGE BUS	
5	MEDIUM TRUCK	
6	LARGE TRUCK 2 AXLE	
7	LARGE TRUCK 3 AXLE	
8-1	ARTICULATED VEHICLE Type 1	
8-2	Ditto Type 2	
8-3	Ditto Type 3	
8-4	Ditto Type 4	
9	FULL TRAILER COMBINATION	

Figure 12.8.1 Axle Load Model

Pavement design thicknesses for the Project Roads have been determined as shown in Table 12.8.2

Table 12.8.2 Pavement Design Thickness

	Route-1		Route-2	Route-3	Route-4		Route-5	Remarks
	Toll Road	Arterial			Western part	Eastern part		
Surface Course	5	5	5	5	5	5	5	Marshall Stability min. 750 kg
Binder Course	10	10	10	10	10	10	10	Marshall Stability min. 750 kg
Aggregate Base A	25	25	25	20	20	20	25	CBR min. 80 %
Aggregate Base B	30	30	30	20	20	20	35	CBR min. 60 %
Selected Fill (cm)	60	60	60	60	60	60	60	CBR min. 20 %

Source: JICA Study Team

12.9 Toll Road Supporting Facilities

12.9.1 Categories of Supporting Facilities

The objective of road supporting facilities is mainly to maintain smooth and safe traffic flow for the benefit of users. The following supporting facilities are considered to realize these objectives:

- Road furniture such as guardrail and road markings
- Traffic Signs
- Road Lighting

12.9.2 Road Furniture

(1) Guardrail

The major purpose of guardrail is to protect uncontrolled vehicles from running off the Toll Road and to protect the facilities such as bridge piers from damage by such vehicles. Guardrail is planned to be installed at the following locations:

- High embankment sections (H>4.0 m)
- Bridge and box culverts
- Bridge piers and guide sign posts

(2) Road Markings

Markings are particularly important to help control traffic in urban and suburban areas. The standards of Bina Marga/Jasa Marga for marking currently in use are considered. Traffic markings include pavement markings, object markings and reflector markers.

(3) Traffic Signs

The use of three kinds of signs is considered, namely, regulatory signs, warning signs and guide signs to enhance traffic safety and for the convenience of users.

Regulatory signs and warning signs are directly in accordance with the Government's

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

12.9.3 Road Lighting

(1) Objective of Road Lighting

The objective of the provision of lighting facilities is to reduce the number of traffic accidents occurring during the hours of darkness and to make the Toll Road more attractive to potential users.

(2) Location of Lighting Installations

Lighting installations for the Project cover the following locations:

- Junctions and Interchanges including rampways
- On/Off Ramps including toll plazas
- Bridges and viaducts in urban areas, as necessary.

12.10 Current Right of Way Situation and Required Right of Way

The Project Roads cover three administrations which are Kotamadya Surabaya (Kod. Surabaya), Kabupaten Gresik (Kab. Gresik) and Kabupaten Sidoarjo (Kab. Sidoarjo).

Current Right of Way (ROW) situations and requirements are shown in Table 12.10.1 and Figure 12.10.1.

Table 12.10.1 Current ROW Situations and Required ROW

Project Road	Administration	Length (km)	Current ROW (m)	Required ROW (m)	Remarks
Route-1	Surabaya	13.7	55	103	Partly 55 m
	Gresik	6.1	0	103	Agreed by Local Government
	Sidoarjo	1.0	0	103	Agreed by Local Government
Route-2	Surabaya	6.2	20	20	With Sub-Standard
		7.1	2×20	2×20	
Route-3	Surabaya	3.5	25	25	
	Sidoarjo	4.6	0	25	Agreed by Local Government
Route-4	Gresik	6.4	0	40	Agreed by Local Government
	Surabaya	6.2	40	40	With Busway
		6.5	35	35	With Traffic Management
		8.5	25	25	Without Busway
Route-5	Gresik	9.2	0	35	Agreed by Local Government
	Surabaya	6.6	0	35	West Border to Jl. Mastrip
		6.8	35	35	Jl. Mastrip to Jl. Jemur Sari

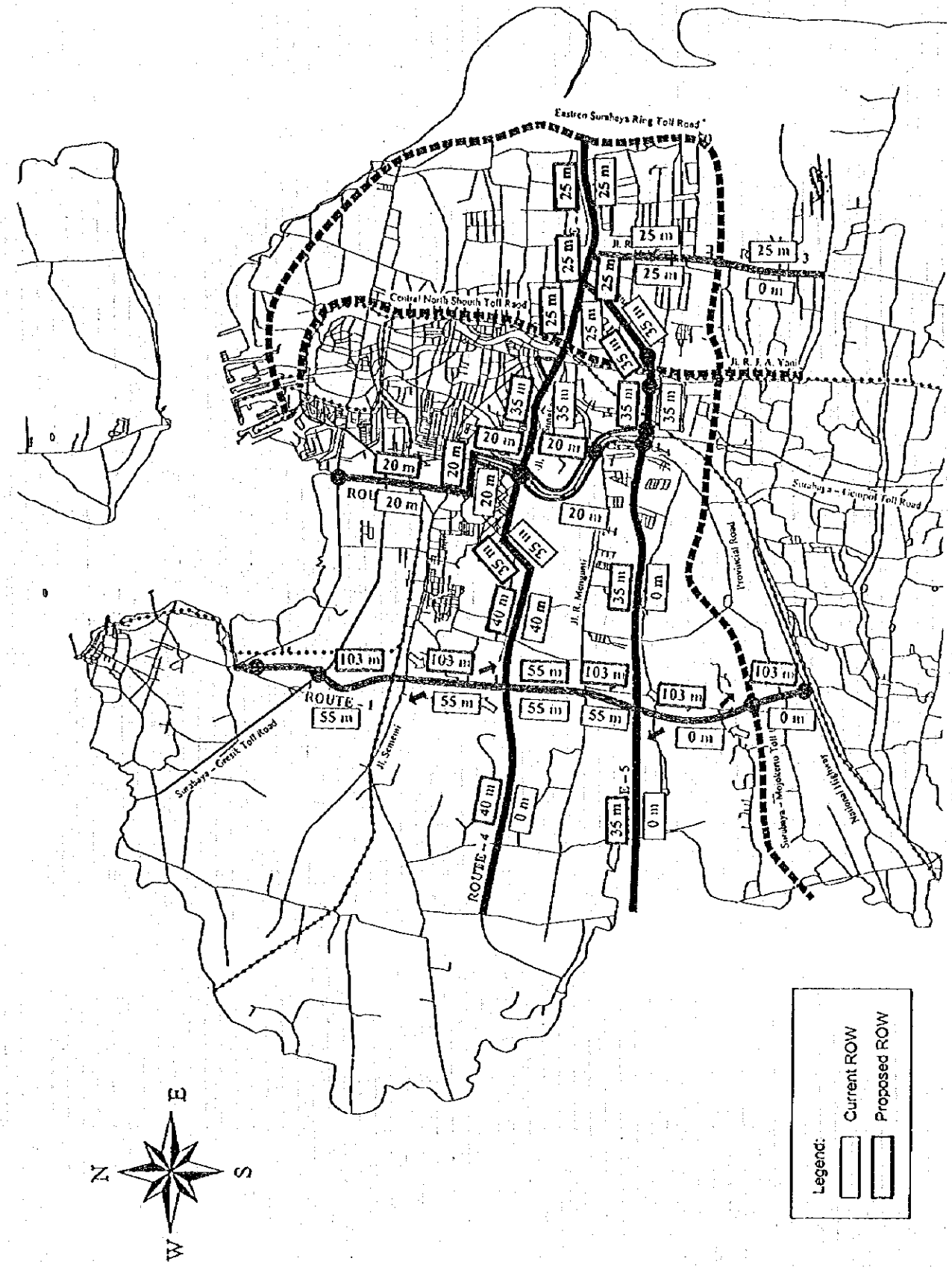


Figure 12.10.1 Current ROW Situation and Requirement for the Project Roads

12.10.1 Route-1

Route-1 covers three administration, i.e. Kod. Surabaya, Kab. Gresik and Kab. Sidoarjo.

(1) STA 0+200 (Boundary of Kod. Surabaya and Gresik) - STA 2+700 (Romo Kalisari IC)

In this area the present land-use is "tambak", that is fish farm and salt farm. In the future, the northern corridor between Kod. Surabaya and Gresik will be industrialized.

There is an access road to Romo Kalisari IC. Along this section, the width of required ROW is 60 meters including the existing access road.

It is also necessary to acquire the land for construction of Benowo IC and the relocation of the existing Toll Gate and Office.

In Romo Kalisari IC area the land has already been prepared for future reconstruction of the interchange. It is therefore not necessary to acquire the land for reconstruction of this interchange.

(2) STA 2+700 (Romo Kalisari IC) - STA 6+550 (Jl. Sememi)

The present land-use is tambak as stated in (1) above. Future land-use will be for industry. However a sports center together with hotel and shopping center are planned for the west side of this route. Future land-use of the area will be industry, commercial and public facilities combined.

Between Romo Kalisari IC and the new toll gate for Route-1 Toll Road is the transition section from Sby-Gre Toll Road to Route-1 Toll Road and is not a Toll Road section. This section requires the same width of 60 m as (1) above except at the toll gate section. Besides the toll gate, land is required for a maintenance and operation office.

(3) STA 6+550 (Jl Sememi) - STA 10+300 (Route-4)

The present land-use in this area is farm land without irrigation. Many villages are scattered over this hilly terrain. As for future land-use, many housing estates are planned. Future land-use is accordingly residential.

This section is the standard section of Route-1. In the middle of the cross section there is the Toll Road and on both sides of the Toll Road there are Arterial Roads with frontage roads for partial access control. The necessary ROW width is 103 meters.

(4) STA 10+300 (Route-4) - STA 12+800 (Jl. Raya Menganti)

The present land-use in this area is farm land. However as mentioned in below, housing estate development is now ongoing and the future land-use will be residential.

Along this section huge scale housing estate development with a golf course (2,000 ha.) is ongoing on both sides of the planned road. The existing ROW is limited to 55 meters. Some parts of the land have already been sold and there is no possibility to widen the existing ROW. Within this ROW the developer is now constructing a trunk road. After completion of development this road will be transferred to Kod. Surabaya administration and it is not

necessary to acquired the land as far as the planned road is within the existing ROW.

The Toll Road is elevated above the arterial road. Because the ROW is limited to 55 meters, an On/Off ramp to Route-4 from the south and an On/Off ramp to Jl. Raya Menganti from north are not provided.

(5) STA 12+800 - STA 13+900 (Boundary of Kod. Surabaya and Gresik)

The present land-use is farm land without irrigation. Since there is no development plan within this area the future land-use will be farm land.

This section is a standard section as (3) above. Required ROW is 103 meters.

(6) STA 13+900 (Boundary of Kod. Surabaya and Gresik)- STA 15+280 (Boundary of Kota Baru Driyorejo)

The present land-use in this area is the same as (5) above , i.e. farm land.

There is no development plan within this section and the local Government has agreed to set out the new ROW.

(7) STA 15+280 - STA 17+450 (Kota Baru Driyorejo)

The present land-use is farm land without irrigation. As described below, a housing development project is ongoing within this area and the future land-use will be residential.

Along this section, Kota Baru Driyorejo Development (1,000 ha.) is ongoing by joint venture of Government agency and state owned construction companies.

It is not a problem that the Project Road will pass through this area, but for the road alignment close co-ordination has been requested by the local Government.

Within this section no land acquisition is required. Required ROW width is 103 meters as a standard section.

(8) STA 17+450 - STA 19+970 (Boundary of Gresik and Sidoarjo)

The present land-use is farm land. Along provincial road Surabaya-Mojokerto industries have developed.

The Project Road crosses the planned Surabaya-Mojokerto Toll Road (hereinafter referred to as Sby-Moj Toll Road) and the Provincial Road Surabaya-Mojokerto. Along this provincial road many factories have been established and the Project Road passes a very narrow ribbon of space (about 105 to 110 meters width) between factories. This is the only open space for the Project Road as this critical control point. The local Government has given a definite promise to set out a ROW of 103 meters at this open space.

(9) STA 19+970 - STA 21+015

The present land-sue on this area is farm land, mostly rice field.

Within Kabupaten Sidoarjo, the local Government has agreed to set out the ROW. The required ROW width is 103 meters as a standard section except at the toll gate area.

12.10.2 Route-2

Route-2 is located within the administration of Kod. Surabaya.

(1) STA 0+000 - STA 6 +160

The present land-use in this section is as follows:
STA 0+000 to STA 2+400 Tambak (future land use will be industry)
STA 2+400 to STA 4+100 Industry
STA 4+100 to STA 6+160 Residential

Route-2 starts from Jl. Kali Anak in the north. At the starting point, for Kali Anak IC, some warehouses and factories are to be removed. From STA. 0+000 to STA 1+200 there is a road which is about 20 meters wide. This road is used as a part of Route-2 and it is necessary to widen to 25 meters.

The Project Road crosses the existing Sby-Gre Toll Road at STA. 1+600. Before and after this toll road many development permits have been issued but are not yet realized. According to the authority of Kod. Surabaya all these development plans are still adjustable and negotiable for the Project Road.

At STA 2+820, the Project Road crosses Jl. Tanjung Sari by an at grade intersection. Before and after this intersection it is necessary to remove some factories. At the crossing of Jl. Raya Tandes at STA 4+100 it is also necessary to remove factories and many existing houses.

Between Jl. Raya Tandes and STA 5+000 is residential area and it is necessary to remove many houses.

From STA 5+000 to STA 6+160 the existing ROW is adequate for the Project Road.

Within these sections required ROW is 25 meters.

(2) STA 0+000 - STA 7+150 (Route-2 North Bound)

The present land-use is as follows:
STA 0+000 - STA 3+500 Residential
STA 3+500 - STA 4+800 Farmland
STA 4+800 - STA 5+700 Residential
STA 5+700 - STA 7+150 Farmland (rice field)

This is a north bound road parallel to the existing Surabaya-Gempol Toll Road (hereinafter called Sby-Gmp Toll Road). Within this section a ROW of 20 meters is set out and is adequate for the Project Road except at the location where the Project Road crosses Jl. May. Jend. Sungkono. At this point resettlement of some houses is necessary.

Required ROW for this section is 20 meters.

(3) STA 0+000 - STA 7+117 (Route-2 South Bound)

The present land-use is as follows:
STA 0+000 - STA 2+500 Residential
STA 2+500 - STA 4+400 Farmland (future residential)
STA 4+400 - STA 6+000 Residential

STA 6+000 - STA 7+117 Farmland (rice field)

This is a south bound road parallel to the existing Sby-Gmp Toll Road. From STA 0+000 to STA 1+400 10 meters width of land for the road has already been prepared on both sides of transmission lines by local Government. Within this section it is not necessary to acquire land.

According to information from the local Government, after crossing Jl. May. Jend. Sunkono, 20 meters of ROW have already set out and this is enough for the Project Road.

Required ROW for this section is 20 meters.

12.10.3 Route-3

Route-3 covers two administrations, i.e. Kod. Surabaya and Kab. Sidoarjo. The present land-use is mixed with industry, residential and farmland uses.

(1) STA 0+000 - STA 3+550 (Boundary of Kod. Surabaya and Sidoarjo)

Route-3 comprises widening of existing Jl. Raya Rungkut with a little improvement of the alignment, but mainly following the existing alignment. Within Kod. Surabaya a ROW of 25 meters has already been set out and is enough for the Project Road.

(2) STA 3+550 (Boundary of Kod. Surabaya and Sidoarjo) - STA 8+125

Within Kabupaten Sidoarjo the ROW is not yet set out. However local Government has agreed to set out a new ROW with 25 meters width.

Required ROW for the Project Road is 25 meters.

12.10.4 Route-4

Route-4 covers two administrations, i.e. Kabupaten Gresik and Kod. Surabaya.

(1) STA 0-600 - STA 5+800 (Boundary of Gresik and Kod. Surabaya)

The present land-use is farmland without irrigation. But in this area many housing estate developments are planned and the future land-use will be residential.

At present there is not a ROW along this section however local Government has agree to set out a new ROW of 40 meters which is enough for the Project Road.

Required ROW for the Project Road including a Busway is 40 meters.

(2) STA 5+800 - STA 7+220 (Crossing point with Route-1)

The present land-use is farmland without irrigation. But in this area many housing estate developments are planned and the future land-use will be residential.

At present there is not a ROW along this section however local Government has agree to set out a new ROW of 40 meters which is enough for the Project Road.

Required ROW for the Project Road including a Busway is 40 meters.

(3) STA 7+220 - STA 12+000

The present land-use is farmland without irrigation. But in this area many housing estate developments are planned and are ongoing so the future land-use will be residential.

Within this section new road construction is ongoing and is partly completed, under construction or at the stage of land acquisition. Established ROW is 40 meters which is adequate for the Project Road.

Required ROW for the Project Road including a Busway is 40 meters.

(4) STA 12+000 - STA 13+060

The present land-use is farmland without irrigation. But in this area many housing estate developments are planned and are ongoing so the future land-use will be residential.

This section is a newly constructed road with 10 meters carriageway and 5.8 meters side walk for each direction on both sides of a transmission line. This is not enough to cover an arterial road and Busway. The Busway will not be provided in this section and the following section to comply with the existing road conditions.

Required ROW for the Project Road without a Busway is 35 meters.

(5) STA 13+060 - STA 18+750

This section is a completely urbanized area. The present land-use is commercial and residential.

This section is the existing Jl. May. Jend. HR Mohamamad and Jl. May. Jend. Sungkono. The existing road width is 35 meters. This area is a newly developing area and along the road there are many offices, shops, hotels and restaurants. It is understood that it would be very difficult to widen the existing road more so to provide a Busway. Therefore a Busway is not provided at this section to comply with today's condition.

Required ROW for the Project Road without a Busway is 35 meters.

(6) Jl. Kutai and Jl. Bengawan

The present land-use is urbanized residential.

To form the Wonokromo Roundabout, it is necessary to widen these two roads to 35 meters without a Busway. Wonokromo Roundabout is intended not only to connect East and West Kod. Surabaya but also to smoothen the traffic flow from North to South. In this way Wonokromo Roundabout is a key strategy of the Project together with the following section.

Required ROW for the Project Road without a Busway is 35 meters.

(7) STA 18+750 - STA 20+000

The present land-use is commercial, residential, public facilities such as bus terminal and public offices.

This section passes a densely inhabited area and requires the relocation of Purabaya Bus Terminal. This is a strategic location on Route-4 which connects West and East Kod. Surabaya

although the social impact by these resettlements is very big.

(8) STA 20+000 - STA 27+000

The present land-use is densely inhabited housing area with some commercial offices.

The Route passes along the southern bank of Wonokromo River where it is densely inhabited. A large amount of resettlement is required. The existing ROW is 25 meters but local Government has agreed to widen this to 35 meters. Since the existing ROW is on the southern bank and there are many housing estate developments on the northern bank, the local Government does not agree to the Project Road being located on the northern bank.

Required ROW for the Project Road without a Busway is 35 meters.

12.10.5 Route-5

Route-5 covers two administration, i.e. Kab. Gresik and Kod. Surabaya.

(1) STA 0+300 - STA 9+530 (Boundary of Gresik and Kod. Surabaya)

The present land-use in this area is farmland without irrigation.

There is no ROW at present. Local Government has agreed to establish a new ROW of 35 meters which is required by the Project Road. The route passes through entirely farm land without irrigation. Only little resettlement is necessary within this section.

Required ROW for the Project Road without a Busway is 35 meters.

(2) STA 9+530 - STA 16+270 (Surabaya River)

The present land-use is as follows:

STA 9+530 - STA 12+500 Farmland without irrigation
STA 12+500 - STA 15+800 Newly developed housing area
STA 15+800 - STA 16+270 Village

There is an existing local road parallel to the Project Road about 300 meters to 200 meters to the South. Along this road a ROW of 35 meters is set out. However along this local road there are many villages and much resettlement is necessary if this ROW is utilized for the Project Road. The Project Road passes the northern belt of these villages and no resettlement is necessary up to STA 15+000. The local Government has agreed to abandon the ROW along this local road and to reset a new ROW of 35 meters.

From STA 12+700 the Route passes through the old Surabaya-Mojokerto Toll Road's ROW. But this ROW has already been abandoned when the route of Surabaya-Mojokerto Toll Road was rerouted towards the south. After rerouting of Surabaya-Mojokerto Toll Road many development permits have been issued but non of them are realized yet. According to the local Government it is still possible to set a new ROW for this section.

From STA 15+000 resettlement of houses is required. In particular around STA 16+000 many houses should be relocated since the route passes through a densely inhabited village.

Required ROW for the Project Road without a Busway is 35 meters.

(3) STA 16+270 (Surabaya River) - STA 19+500 (Jl. Raya Jemur Sari)

The present land-use is as follows:

STA 16+270 - STA 16+600 Village
STA 16+600 - STA 18+100 Farmland (rice field)
STA 18+100 - STA 19+500 Residential

The Project Road meets Route-2 North bound at STA 16+640. Between Surabaya River and Route-2 North bound is a densely inhabited village area and much resettlement is required.

From STA 16+640 to STA 18+120 the Project Road crosses the existing Sby-Gmp Toll Road and the Railway to Mojokerto. This 1.5 km section is rice fields.

From STA 18+120 to STA 19+200 Ketintang IC and Rungkut IC are planned. For Ketintang interchange construction, a village located on the west side of Jl. A. Yani is required to relocate almost entirely. Also for Rungkut interchange construction many houses will be relocated.

From STA 16+160 to STA 18+750 there is a planned road by local Government and 35 meters ROW is set out. Local Government has no objection to utilize this ROW for the Project Road.

Required ROW for the Project Road without a Busway is 35 meters.

(4) STA 19+500 - STA 22+890

The present land-use in this area is residential.

This is a widening and overlay section on the existing Jl. Jemur Sari. Total 35 meters ROW is set and no resettlement is necessary for this section.

CHAPTER 13 CONSTRUCTION PLANNING

CHAPTER 13

CONSTRUCTION PLANNING

13.1 General

The study of construction planning mainly comprises i) establishment of construction method and ii) preparation of construction time schedule. The result of the study will be utilized in the construction cost estimates and will be further reflected in the establishment of a project implementation schedule.

13.2 Outline of the Construction Work

An outline of the construction work for the Project Roads is as follows.

(1) Route – 1 : Toll Road (20.80 km length)

The Toll Road is a new road construction. Notional work of the Toll Road construction for the throughway is shown in Table 13.2.1.

Table 13.2.1 Notional Work for the Toll Road Construction

Description	Length (km)	Remarks (%)
Piled Slab Section	5.35	25.7
Bridge Section	7.15	34.4
(Sub-Total of Structure Section)	(12.50)	(60.1)
Earth Work Section	8.30	39.9
TOTAL	20.80	100

It is noted that the structure section takes up 60.1 % of the total length.

(2) Route – 1 : Arterial Road (15.50 km length)

The arterial road construction consists of a new road construction section and an existing road overlay construction section. Notional work of the Arterial Road construction for the throughway is shown in Table 13.2.2.

Table 13.2.2 Notional Work for the Arterial Road Construction

Description	Length (km)	Remarks (%)
New Road Construction	–	–
Piled Slab Section	1.12	7.2
Bridge Section	1.57	10.1
(Sub-Total of Structure Section)	(2.69)	(17.3)
Earth Work Section	5.37	34.6
(Sub-Total of New Road Construction)	(8.06)	(52.0)
Overlay Section	7.44	48.0
TOTAL	15.50	100

It is noted that the new road construction section and the overlay construction section are approximately the same length.

(3) Route – 2 : Arterial Road (13.30 km length)

The arterial road construction consists of a new road construction section and an existing road overlay construction section. Notional work of the Arterial Road construction for the throughway is shown in Table 13.2.3.

Table 13.2.3 Notional Work for Route – 2 Construction

Description	Length (km)		Remarks (%)	
1. Two-Way Operation Section	–			–
New Road Construction	–			–
Piled Slab Section		1.07		17.3
Bridge Section		0.70		11.3
(Sub-Total of Structure Section)		(1.77)		(28.6)
Earth Work Section		2.33		37.7
(Sub-Total of New Road Construction)		(4.10)		(66.3)
Overlay Section		2.08		33.7
TOTAL of Two-Way Operation Section		6.18		100
2. One-Way Operation Section	North Bound	South Bound	North Bound	South Bound
New Road Construction	–	–	–	–
Bridge Section	0.24	0.22	0.3	4.1
Earth Work Section	5.75	6.86	80.0	96.9
(Sub-Total of New Road Construction)	(5.99)	(7.08)	(83.3)	(100)
Overlay & Widening Section	1.20	0.00	16.7	0.0
TOTAL of One-Way Operation Section	7.19	7.08	100	100

In the one-way operation section (7.19 km, and 7.08 km length) it is noted that new road construction takes up approximately 90 %.

(4) Route – 3 : Arterial Road (8.22 km length)

Route – 3 construction consists of widening and overlay road construction. Notional work of Route – 3 construction for the throughway is shown in Table 13.2.4.

Table 13.2.4 Notional Work for Route – 3 Construction

Description	Length (km)	Remarks (%)
Bridge Section	0.15	1.8
Widening & Overlay Section	8.07	98.2
TOTAL	8.22	100

(5) Route – 4 : Arterial Road (27.60 km length)

Route – 4 construction consists of a new road construction section (earthwork section), an overlay construction section and a widening/overlay construction section. Notional work of Route – 4 construction for the throughway is shown in Table 13.2.5.

Table 13.2.5 Notional Work for Route – 4 Construction

Description	Length (km)	Remarks (%)
Bridge Section	1.51	5.5
Earthwork Section	7.83	28.4
Widening / Overlay Section	18.26	66.1
TOTAL	27.60	100

It is noted that the bridge construction section is only 1.51 km (5.5%) of whole construction length.

(6) Route – 5 : Arterial Road (22.60 km length)

Route – 5 construction consists of a new road construction section (earthwork section) and a widening/overlay construction section. Notional work of Route – 5 construction for the throughway is shown in Table 13.2.6.

It is noted that the earth work construction section takes up 18.51 km (81.9 %) of the whole construction length.

Table 13.2.6 Notional Work for Route – 5 Construction

Description	Length (km)	Remarks (%)
Bridge Section	0.71	3.1
Earthwork Section	18.51	81.9
Widening / Overlay Section	3.38	15.0
TOTAL	22.60	100

13.3 Construction Method

To attain construction economy and to realize the Project Roads with a short construction period, the equipment intensive construction method will be adopted.

No major problems are anticipated in the construction of the Project Roads.

13.3.1 Major Equipment for the Construction

(1) Earthwork

Use of the following major earthwork equipment has been considered in the planning (refer to Table 13.3.1).

Table 13.3.1 Earthwork Equipment

Main Works	Equipment	
	Hauling Distance Less than 100 m	Hauling Distance More than 100 m
Clearing and Grubbing	Bulldozer	
Excavation	Bulldozer	Tractor Shovel
Loading		Tractor Shovel/Payloader
Hauling	Bulldozer	Dump Truck
Spreading	Bulldozer / Motor Grader	
Compaction	Tamping Roller / Tire Roller	

(2) Paving Work

Use of the following major paving work equipment has been considered in the planning (refer to Table 13.3.2).

Table 13.3.2 Paving Work Equipment

Main Work	Equipment
Subgrade Preparation	Motor Grader, Tire Roller, Macadam Roller
Subbase	Motor Grader, Tire Roller, Macadam Roller
Base Course	Motor Grader, Tire Roller, Macadam Roller
Prime / Tack Coat	Asphalt Distributor
Binder / Surface Course	Asphalt Mixing Plant, Asphalt Finisher, Macadam Roller, Tire Roller

(3) Bridge and Viaduct Construction

Use of the following major bridge/viaduct construction equipment has been considered in the planning (refer to Table 13.3.3).

Table 13.3.3 Bridge / Viaduct Construction Equipment

Main Work	Equipment
Foundation	Diesel Pile Hammer, Pile Driver, Truck Crane
Structure Excavation	Clamshell, Power Shovel, Dump Truck
Substructure	Transit Mixer, Concrete Pump Truck
Superstructure	Truck Crane, Erection Girder

13.3.2 Hauling Roads for Construction Materials

Construction of the Project Roads involves hauling large quantities of embankment/pavement/ concrete materials. Basically the Project Area is provided with a sufficiently dense road network (refer to Figure 13.3.1). However, the pavement condition of the existing Desa Roads sometimes lacks enough strength. Pavement strengthening / repair will be necessary but construction of new roads is unlikely.

The National Road and Provincial Roads will be used as major hauling roads for the Project Roads. These roads are currently used as hauling roads for road improvement projects in Surabaya region.

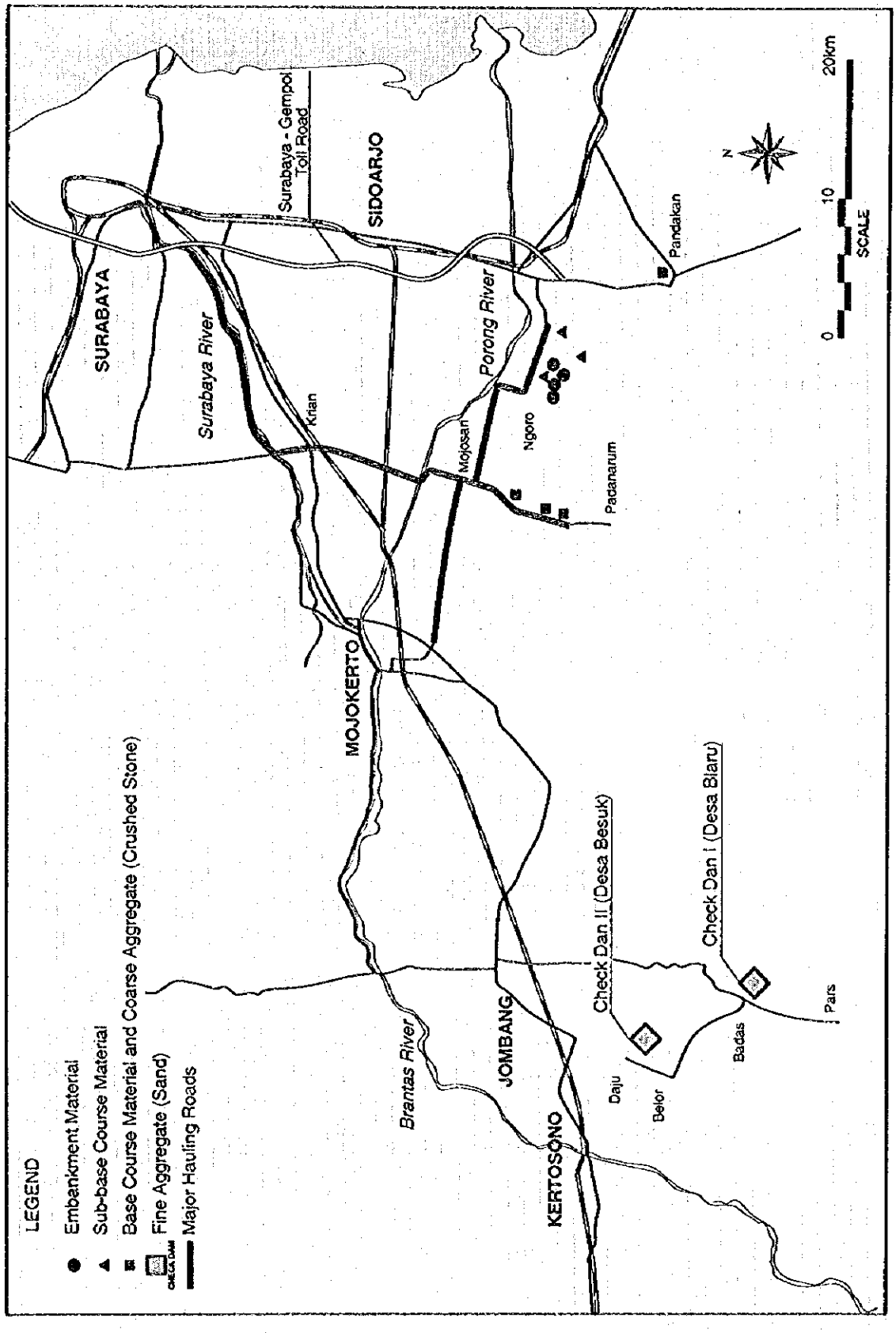


Figure 13.3.1 Material Sources and Major Hauling Roads

13.4 Construction Time Schedule

13.4.1 Conditions for Schedule

(1) Maximum Construction Period

Taking into account the scale of the construction and the number of major equipment and plant required, the maximum possible construction period has been set at 3 years.

(2) Weather Conditions

According to the rainfall data, the number working days for earthwork and the construction of pavement has been estimated as shown in Table 13.4.1.

Table 13.4.1 Number of Working Days

Item	Dry Season May. – Oct. (6 months)	Rainy Season Nov. – Apr. (6 months)	Annual
Number of rainy days	2.9 days/month	13.6 days/month	98.0 days
Working efficiency on a rainy day	65 %	35 %	50 %
Number of holidays	5.0 days/month	5.0 days/month	60.0 days
Number of working days	24.0 days/month	16.2 days/month	241.2 days
Working efficiency	80 %	54 %	67 %

13.4.2 Time Schedule

A construction time schedule for each Project Road has been prepared based on the conditions described in Subsection 13.4.1 above, as shown in Table 13.4.2.

Table 13.4.2 Time Schedule

Description	1 st. year	2 nd. Year	3 rd. year	4 th. year	5 th. year	6 th. year	7 th. year
Final Engineering Design							
Land Acquisition							
Construction							
Opening to Traffic							

Figure 13.3.1 Material Sources and Major Hauling Roads

CHAPTER 14 OPERATION AND MAINTENANCE OF THE PROJECT ROADS

CHAPTER 14

OPERATION AND MAINTENANCE OF THE PROJECT ROADS

14.1 Toll Road Operation and Maintenance

The Government is actively pursuing private sector participation (including foreign investors) in the construction and operation of selected toll roads in order to promote the implementation of toll road development under the limited appropriation of the Government budget. The Toll Road : Route – 1 will be one of the toll roads in which the Government intends to utilize private sector participation.

The participation of P.T. Jasa Marga (Persero, Indonesian Highway Corporation) is an essential requirement in all toll road development and private investor participation should be implemented in the form of a joint venture (JV) or joint operation (JO) with P.T. Jasa Marga. The concession period is generally 30 years, and thereafter the toll road properties will be transferred to the Government.

The Toll Road will be connected with the Surabaya -- Gresik Toll Road and Surabaya – Mojokerto Toll Road both of which are operated by private investors, therefore these toll roads will be operated by three (3) different operators.

14.1.1 Scope of Operation and Maintenance Works

The scope of operation and maintenance works for toll road is broadly divided into the following three major components:

- Toll Road Maintenance
- Traffic Management
- Toll Collection

(1) Toll Road Maintenance

Toll road maintenance together with traffic management has the three basic goals of providing traffic safety, smooth traffic flow and user comfort.

The maintenance function can be divided into routine maintenance, periodic maintenance and incidental maintenance.

Routine maintenance is based on routine (daily) inspection of the condition of the pavement, cut and fill slopes, drainage, bridges and other structures and facilities to monitor any defects or

damage to them. The results of routine inspection should be promptly reported to the regional operation office for follow-up maintenance works as required.

Periodic maintenance is based on detailed inspections to be performed at certain time intervals such as weekly, monthly or yearly depending on the type and kind of facilities, including checking and testing the condition of various structures and facilities. Defects and damage should be reported for repairs or remedies. Periodic maintenance also covers such works as cleaning of pavement, guardrails and sign boards, mowing and maintenance of landscape plantation areas, and road marking and painting.

Incidental maintenance is basically the work to be carried out to restore the toll road and the related facilities to their normal operating conditions after they are damaged by road accident or natural causes.

Maintenance works except for inspections are executed basically by contractors under the supervision of the regional operation office, and will include:

- Cleaning of pavement
- Mowing and maintenance of plantation areas
- Cleaning of drainage facilities
- Pavement repair such as patching and resurfacing
- Repair of expansion joints of bridges and viaducts
- Repair of fill and cutting slopes
- Repair of damage to road facilities caused by traffic accident
- Betterment work including pavement overlay, construction of additional facilities etc.

(2) Traffic Management

Traffic management means traffic control, removal of disable cars which have been involved in accidents, and furnishing users with expressway and traffic information.

Highway patrols are conducted to locate damage to road facilities, traffic accidents, illegal parking, disabled cars and other extraordinary conditions which disturb traffic safety. Information and reports are dispatched to the regional operation office through radio communication installed in the patrol cars.

Such services as rescue, ambulance and emergency treatment to those injured due to traffic accidents, and towing of disabled cars are executed.

Traffic control includes general control of speed, overloading and emergency lane use (under unusual conditions such as traffic accident, adverse weather and operation of maintenance works). Control and prohibition of illegally overloaded trucks are conducted in cooperation with traffic police. Axle load meters will be installed at entries to interchanges for weighing.

Traffic surveillance including information collection and dissemination is also an important part of traffic management especially when the traffic volume is approaching the toll road capacity. Installation of facilities such as CCTV, radio broadcasts, variable message signs and emergency telephones will be programmed in the future.

(3) Toll Collection

The Toll Road will be operated under an open system of toll levy as a regional toll road.

14.1.2 Organization for Operation and Maintenance

The basic organization for operation and maintenance for the Toll Road will be composed of a Head Office, a Regional Operation Office and Toll Gate Offices.

(1) Head Office

The Head Office will be directed by a board of directors of the joint venture company. It will be responsible for overall management of the organization including decision making related to the activities of operation and maintenance of the Toll Road, budgetary control, etc. It will generally have four major departments; technical, administration, operation and finance as shown in Figure 14.1.1. The Head Office will be best located in Jakarta to ensure smooth and easy access to the related Government Agencies, financial institutions and business opportunities.

(2) Regional Operation Office

The Regional Operation Office will be responsible for operation and maintenance works for the Toll Road. Since the total length of the Toll Road is only 15.5 km, the establishment of one office is sufficient as the farthest point from the office can be reached within 20 minutes. It is recommended that the office is located beside the throughway barrier gate.

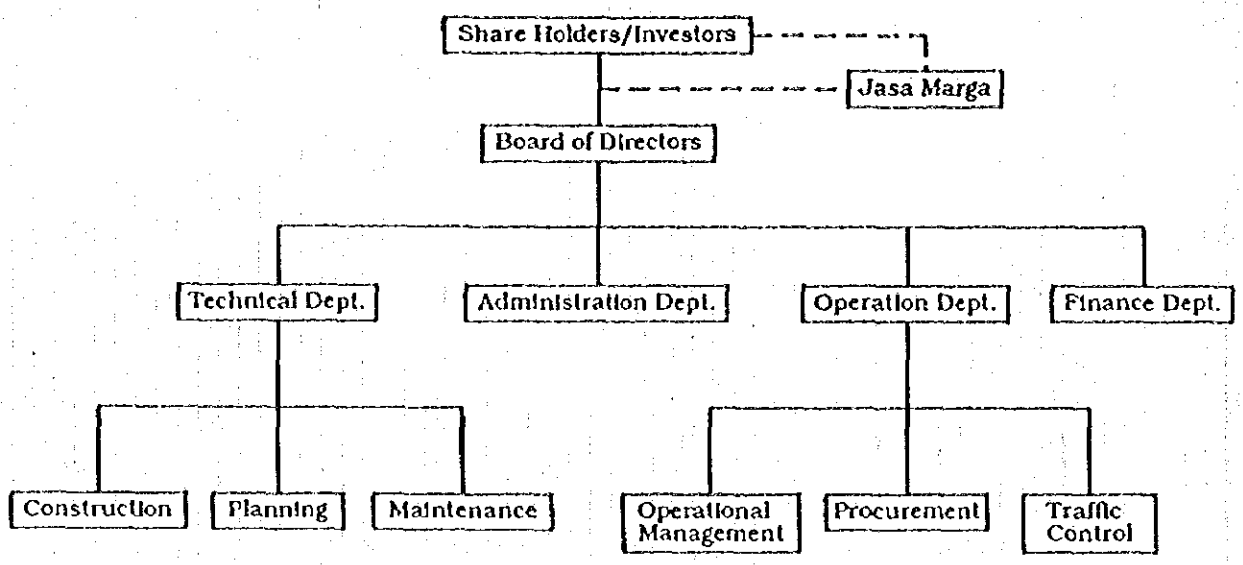
The organization of the Regional Operation Office headed by an Office Manager will generally have 5 sections; administration/employment, finance, supervision of toll collection, maintenance and monitoring/traffic services, as shown in Figure 14.1.1. Policemen from the provincial police will be stationed in the office to cooperate as traffic police.

Maintenance works will be performed mostly by contractors under the supervision of the Regional Operation Office. The office will be provided with the following limited types of equipment for operation and maintenance works under such a system.

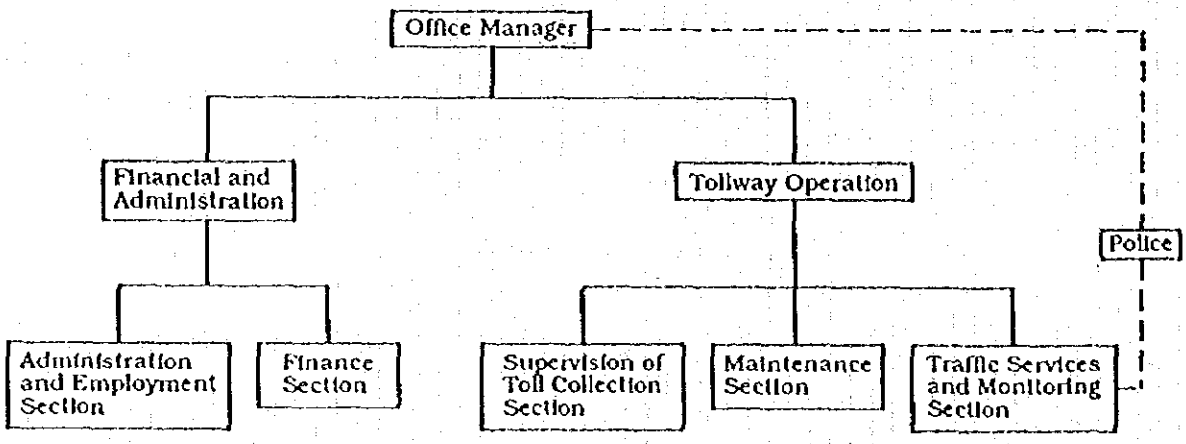
- Communication cars, patrol cars and maintenance vehicles for highway patrol, inspection and supervision of maintenance works being carried out by the contractors.
- Trucks, dump trucks, small crane vehicles, small rollers and tampers, air compressors, breakers, asphalt cutters, etc. for emergency repair works on occasions of accident and disaster.
- Water tankers, grass cutters, etc.
- Ambulance vehicles

(3) Toll Gate Office

A toll gate office will be provided at every on-ramp and at the throughway toll barriers. Toll collectors will work in 3 shifts. The office space provided will be based on the number of toll booths.



Organization of Head Office



Organization of Regional Operation Office

Figure 14.1.1 Organization of Head Office and Regional Operation Office

14.2 Arterial Road Maintenance

The relationship, functional role and administrative status of roads associated with the responsible authorities are shown in Table 14.2.1.

Table 14.2.1 Road Classification and Authorized Development Institution

Road Network System	Functional Classification		Administrative Classification	Authorized Development Institution
Primary System	Arterial		National Road	Ministry of Works
	Collector	Class 1	Provincial Road	Provincial Government
		Class 2		
		Class 3		
		Class 4	District Road (Kabupaten Road)	District Government (Kabupaten / Kotamadya)
	Local			
Secondary System	Arterial Collector Local		Urban Road	Municipal Government (Kotamadya)

Note :
Collector Class 1 : Connecting Provincial Capital to Provincial Capital.
Class 2 : Connecting Provincial Capital to District/Municipal Capital.
Class 3 : Connecting District/Municipal Capital to District/Municipal Capital.
Class 4 : Connecting District/Municipal Capital to Sub-District Capital.

According to the above regulation the Project Roads will be maintained by the following individual agencies.

1) Route – 1 : Primary Arterial Road

The arterial road shall function as a primary arterial road in the Surabaya metropolitan area until construction of Gresik–Krian primary arterial road. It is necessary to be constructed and maintained by the Central Government.

2) Route – 2 : Secondary Arterial Road

Since the arterial road runs only in Kotamadya Surabaya area, it will be maintained by Kotamadya Surabaya.

3) Route – 3 : Secondary Arterial Road

The arterial road runs in Kotamadya Surabaya and Kabupaten Sidoarjo, therefore it will be maintained by Kotamadya Surabaya and Kabupaten Sidoarjo.

4) Route – 4 : Secondary Arterial Road

The arterial road runs in Kotamadya Surabaya and Kabupaten Gresik, therefore it will be maintained by Kotamadya Surabaya and Kabupaten Gresik.

5) Route – 5 : Secondary Arterial Road

Since the arterial road runs in Kotamadya Surabaya and Kabupaten Gresik, it will be maintained by Kotamadya Surabaya and Kabupaten Gresik.