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REPUBLIC OF INDONESIA
DIRECTORATE GENERAL OF HIGHWAYS
MINISTRY OF PUBLIC WORKS

Feasibility Study on Surabaya–Mojokerto Toll Road Project

EXECUTIVE SUMMARY

OCTOBER 1991

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to a request from the Government of the Republic of Indonesia, the Government of Japan decided to conduct a feasibility study on Surabaya-Mojokerto Toll Road Project and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Indonesia a study team headed by Mr. Akira Shikichi (Mr. Keikichi Yoshida as Successor), Pacific Consultants International, three times between August 1990 and September 1991.

The team held discussions with the officials concerned of the Government of Indonesia, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Indonesia for their close cooperation extended to the team.

October 1991

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

FEASIBILITY STUDY
ON
SURABAYA-MOJOKERTO TOLL ROAD PROJECT

FINAL REPORT

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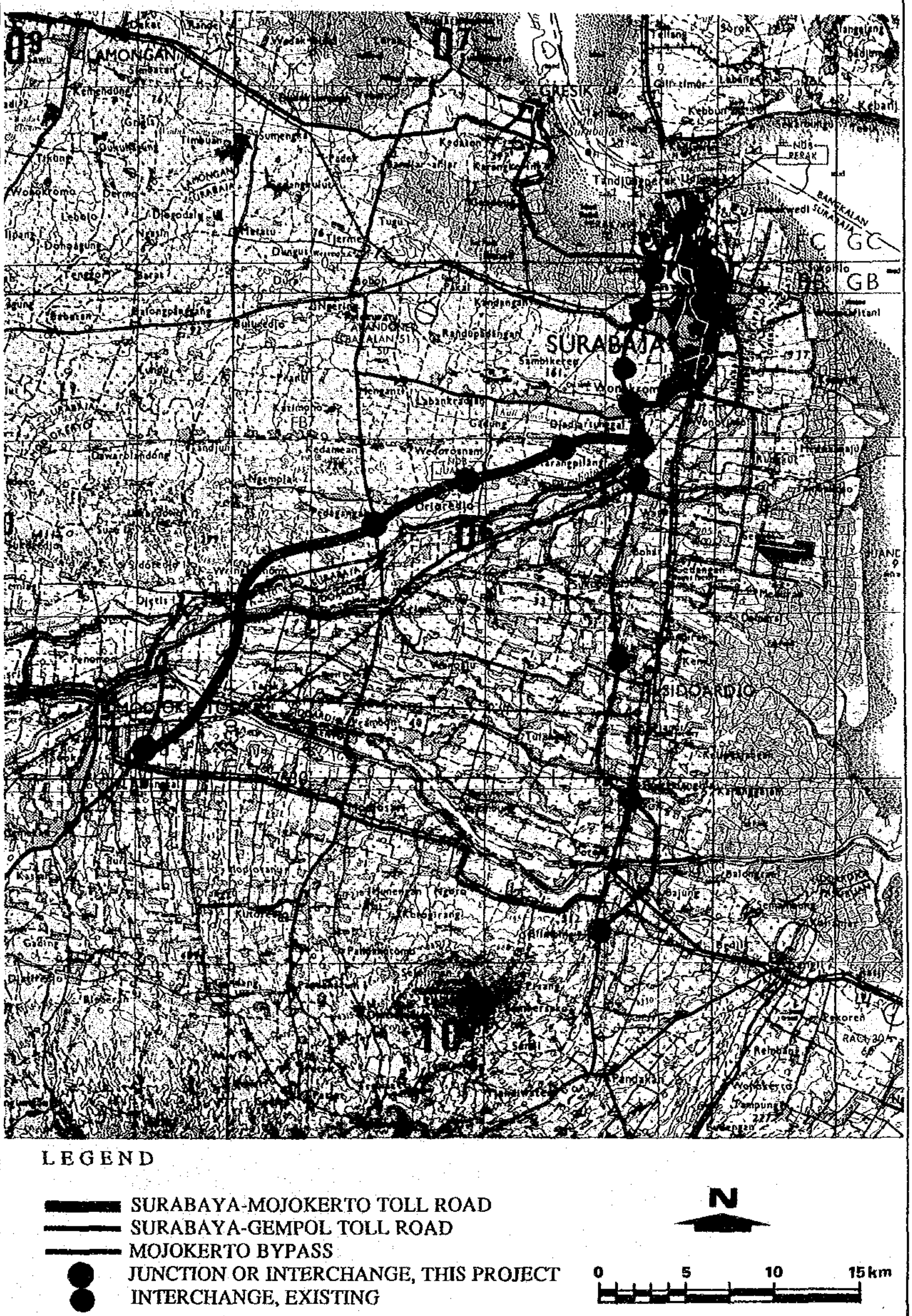


I INTRODUCTION

I-1 Project Background

In realization of the balanced distribution of functions of growth poles to meet the strategic regional development of Java Island, the Trans Java Tollway System and other toll road networks will play an important role.

The necessity to improve the road network in the region of GERBANGKERTOSUSILA (GKS region: Surabaya Metropolitan Region) by providing a toll road network is primarily due to the recent increase in vehicle traffic demand and rapid development in the region.

To cope with this situation, the Government of the Republic of Indonesia decided to develop a toll road system which consists of three radial toll roads in the major transportation and development corridors leading from Surabaya to the northwest (Surabaya-Gresik Toll Road), the southwest (Surabaya-Mojokerto Toll Road) and the south (Surabaya-Gempol Toll Road).

The Surabaya-Gempol Toll Road has been open to the public since July 1986. For the Surabaya-Gresik Toll Road, an agreement of private sector participation was concluded and the review of detailed design has been started. Its construction is scheduled to be completed at the end of 1995.

Under such circumstances, it is urgent to develop the entire section of the Surabaya-Mojokerto Toll Road since traffic congestion in the southwestern corridor (existing national and provincial roads between Surabaya and Mojokerto) could become a major problem in the very near future.

Upon the background mentioned above, the Government of the Republic of Indonesia (hereinafter called the "Government") requested the Government of Japan to implement a feasibility study on the Surabaya-Mojokerto Toll Road Project.

In response to the request of the Government, the Government of Japan decided to proceed with the Feasibility Study on the Surabaya-Mojokerto Toll Road Project (hereinafter called the "Study").

Accordingly, the Japan International Cooperation Agency (hereinafter called "JICA"), the official agency responsible for the implementation of technical cooperation programs of the Government of Japan, dispatched a Preliminary Study Team to Indonesia in November 1989. The scope of work was agreed upon between the Directorate General of Highways, Ministry of Public Works of the Government and the JICA Preliminary Study Team.

In August 1990, the Study was commenced with submission of the Inception Report to discuss and confirm with the Government the approach and methodology of the Study together with the study schedule.

The Study was substantially completed in August 1991 with submission of the Draft Final Report.

I-2 Objective of the Study

The objective of the Study is to examine the feasibility of constructing the Surabaya-Mojokerto Toll Road taking into due consideration the socio-economic conditions of the project area and to evaluate the economic and financial viability of the Project.

I-3 Basic Approach to the Study

The total study period is 15 months from August 1990 to October 1991. Fig. I-1 shows the major work items of the Study and their interrelationship.

The major work in the first 4 months was to select an optimum route from the possible alternative routes taking into account the results of the following studies;

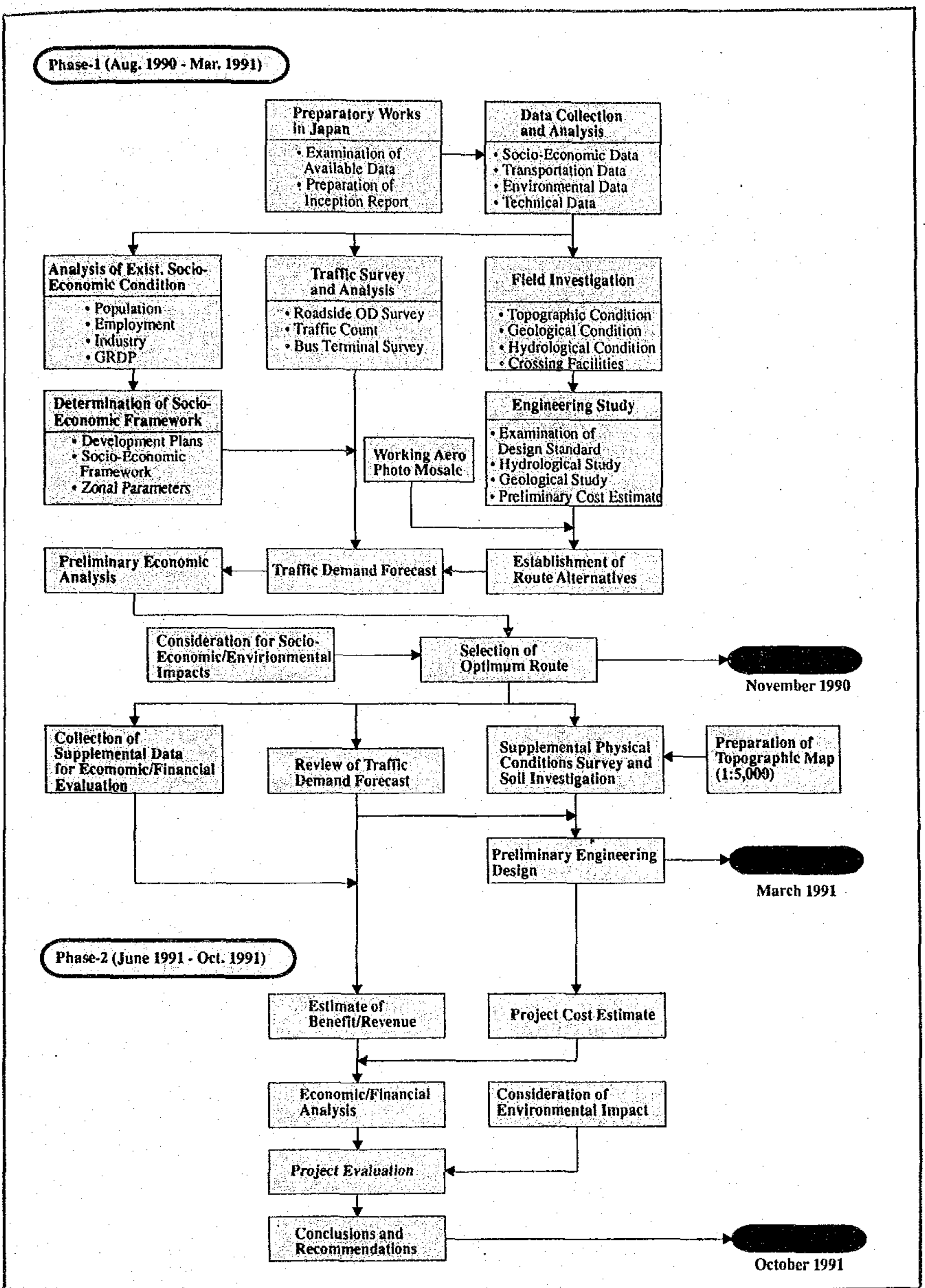
- Analysis of existing socio-economic conditions,
- Determination of socio-economic framework,
- Traffic survey and analysis,
- Engineering survey and investigation and
- Engineering study.

The alternative routes were examined to arrive at the selection of the optimum route comparing from the viewpoints of technical, socio-economic, environmental, transportation and economic aspects.

For the selected optimum route, further studies were carried out including;

- Preliminary engineering design based on the newly prepared 1/5,000 topographic map,
- Consideration of environmental impacts,
- Project cost estimate,
- Estimate of benefits and revenue and
- Economic/financial project analysis.

Based on the results of the above studies, conclusions and recommendations towards the implementation of the Project are prepared.



SURABAYA - MOJOKERTO TOLL ROAD PROJECT

Fig. I-1 Flow of the Study

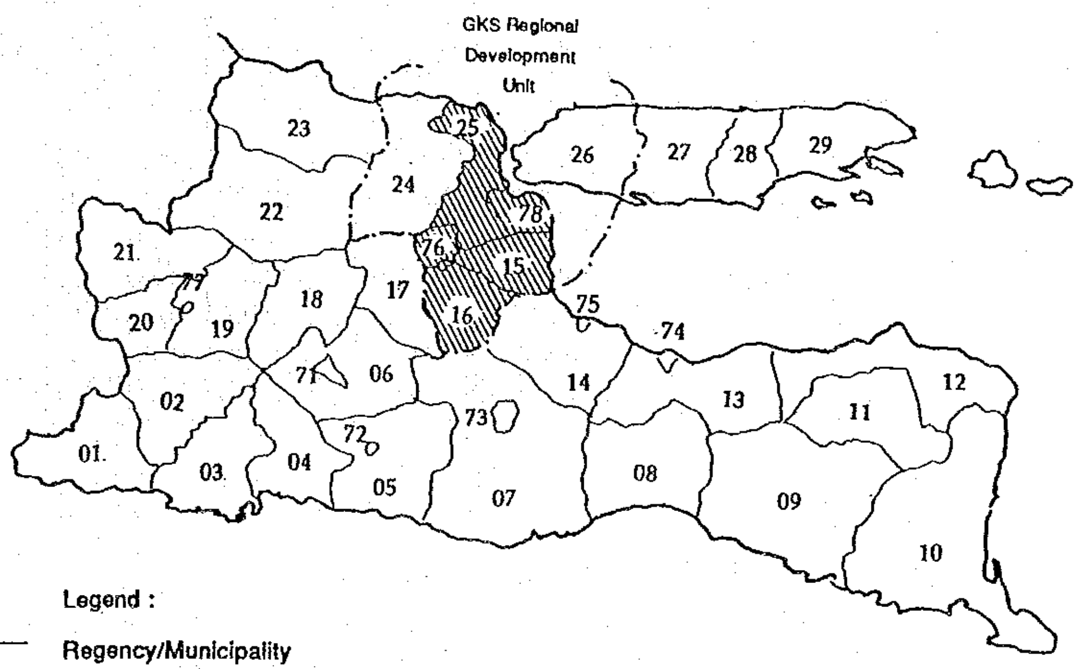
II SOCIO-ECONOMIC CONDITIONS OF THE STUDY AREA AND EAST JAVA

II-1 Administrative Structure and Study Area

East Java Province consists of 29 Kabupatens and 8 Kotamadyas with a total area of about 47,922 square kilometers. The GKS Regional Development Unit includes such administrative districts as Kod. Surabaya, Kab. Sidoarjo, Kab. Gresik, Kod. Mojokerto, Kab. Mojokerto, Kab. Lamongan and Kab. Bangkalan as shown in Fig. II-1.

Surabaya city is defined as the center of not only East Java Province but also the center of the regional development unit of the GKS region in the administrative, social, economic, cultural and educational fields.

As the direct influence area of the Project, the Study Area is defined as covering the GKS region except Kab. Lamongan and Kab. Bangkalan, through which the Surabaya-Mojokerto Toll Road (hereinafter called the "Toll Road") is assumed to pass.



Legend :

Regency/Municipality

GKS Regional Development Unit

Study Area

Code No.	Kabupaten /Kotamadya
78	Kod. Surabaya
15	Kab. Sidoarjo
25	Kab. Gresik
76	Kod. Mojokerto
16	Kab. Mojokerto
24	Kab. Lamongan
26	Kab. Bangkalan

Fig. II-1 Study Area

II-2 Population

In 1990, the population of East Java Province was 33.21 million indicating 18.18% of the total population in Indonesia (182.65 million). The population in the Study Area occupied 16.61% of the total population of East Java Province which is comprised of 29 Kabupatens and 8 Kotamadyas. Kod. Surabaya holds the largest population in East Java Province. Its population, 2.65 million in 1990, occupied 7.98% of the population of East Java Province and 48.07% of the total population in the Study Area. The population growth rate in the Study Area shows 2.55% p.a. during 1980-1985 and 2.14% p.a. during 1985-1990, which are higher than the average in East Java Province (refer to Table II-1).

Population density in East Java Province averaged 7 persons per hectare in 1990. The density in the Study Area, 19 persons per hectare, is higher than that in East Java Province. In the Study Area, Kod. Surabaya shows the highest density of 97 persons per hectare.

Table II-1 Population in the Study Area

Area	Population			Annual Growth(%)		Density Per km
	1980	1985	1990	1985/ 1980	1990/ 1985	1990
Study Area						
- Kab. Sidoarjo	853,685	975,556	1,094,004	2.70	2.32	1,849
- Kab. Mojokerto	705,547	752,646	808,501	1.30	1.44	978
- Kab. Gresik	728,570	800,378	864,003	1.90	1.54	760
- Kod. Mojokerto	68,507	91,956	97,427	6.06	1.16	5,912
- Kod. Surabaya	2,017,527	2,340,311	2,651,394	3.01	2.53	9,675
Total	4,373,836	4,960,847	5,515,329	2.55	2.14	1,938
East Java	29,169,005	31,372,620	33,205,842	1.47	1.14	693

II-3 Landuse in Study Area

The landuse in the Study Area in 1987 is shown in Table II-2.

Table II-2 Landuse in the Study Area (1987)

(Unit : ha)

Land Category	Kab. Sidoarjo	Kab. Mojokerto	Kab. Gresik	Kod. Mojokerto	Kod. Surabaya	Total
Dry Land	33,117	60,739	75,672	825	23,931	194,284
Developed for Building	13,957	13,066	10,626	700	12,703	51,052
Garden/Shift Cultivation	1,186	12,873	31,689	58	1,935	47,741
Swamp/Pond	14,726	27	19,803	0	2,268	36,824
Temporary Utilized	112	0	1,019	0	0	1,131
Forest/Pasture	0	29,434	5,575	0	0	35,009
Plantation	8	363	806	0	0	1,177
Other Dry Land	3,128	4,976	6,154	67	7,025	21,350
Wet land	29,998	37,051	41,733	822	4,775	114,379
Total	63,115	97,790	117,405	1,647	28,706	308,663

Kod. Surabaya (44.25%), Kod. Mojokerto (42.5%) and Kab. Sidoarjo (22.11%) disclose a high percentage of developed area for buildings. While, Kod. Mojokerto (49.91%) and Kab. Sidoarjo (47.53%) have wet land nearly 50% of the total area.

Almost all of the wet land in Kab. Sidoarjo is technically irrigated and it produces a harvest twice or more per year. Accordingly, Kab. Sidoarjo can afford to settle more population than other Kabupatens. Contrary to this, Kab. Gresik is only a little technically irrigated and the harvest frequency is low even in the technical irrigation area. About 40% of the wet land of Kab. Mojokerto is covered by technical irrigation but only half of it can afford a harvest twice or more per year.

II-4 GRDP of East Java

Indonesia's GDP in 1988 is 139,452 Billion Rupiah at current prices and 99,697 Billion Rupiah at 1983 constant prices. The average growth rate of GDP is 6.23% p.a. during 1983-1988.

GRDP in East Java Province in 1989 is 24,569 Billion Rupiah at current prices and 15,457 Billion Rupiah at 1983 constant prices. The real growth rate of GRDP during 1983-1988 is 5.91% p.a.

The industrial structure of East Java Province depends much more on the agricultural sector (30.57%) than the Indonesia average (24.09%) in 1988, in terms of current prices. The share of manufacturing industry in East Java is 18.32% which is almost the same as that in Indonesia (18.52%).

During 1988-1989, the manufacturing industry in East Java seems to accelerate, so that the total GRDP raised by about 1% point and reached nearly 7% p.a. in real economic growth from the previous year.

Assuming that the real growth rate of GRDP in East Java is 7% p.a. during 1989-1990, the GRDP in 1990 was estimated at 16,539 Billion Rupiah at 1983 constant prices, composed of 4,714 Billion Rupiah in the primary sector and 11,825 Billion Rupiah in the secondary and tertiary sectors.

II-5 Vehicle Ownership in East Java

The number of registered vehicles (except for motor cycles) in Indonesia grew from 1,583,000 vehicles in 1982 to 2,427,000 vehicles in 1988, which gives an annual growth rate of 8.9% from 1982 to 1987.

Java has the largest number of vehicle registrations, accounting for 75.0%, 62.4% and 61.2% of 1987 registrations for total passenger cars, buses and trucks respectively throughout Indonesia.

Among the provinces in Java, DKI Jakarta had about 660,000 motor vehicles in 1987 which accounted for 40% of the Java total. East Java provinces had 369,000 vehicles.

In the ratio of registered vehicles to population (motorization ratio), DKI Jakarta completely dominates in Java and amounts to 77.7 vehicles per 1,000 persons in 1987. This figure exceeds West Java having the second highest motorization ratio of 12.0 vehicles per 1,000 person. The motorization of East Java is nearly equal to that of West Java, i.e.11.5 vehicles per 1,000 persons in 1987. The motorization ratio by vehicle type was 6.29, 0.36 and 4.83 vehicles per 1,000 persons for passenger cars, buses and trucks respectively.

III CURRENT TRANSPORTATION PROFILE

III-1 Road Network

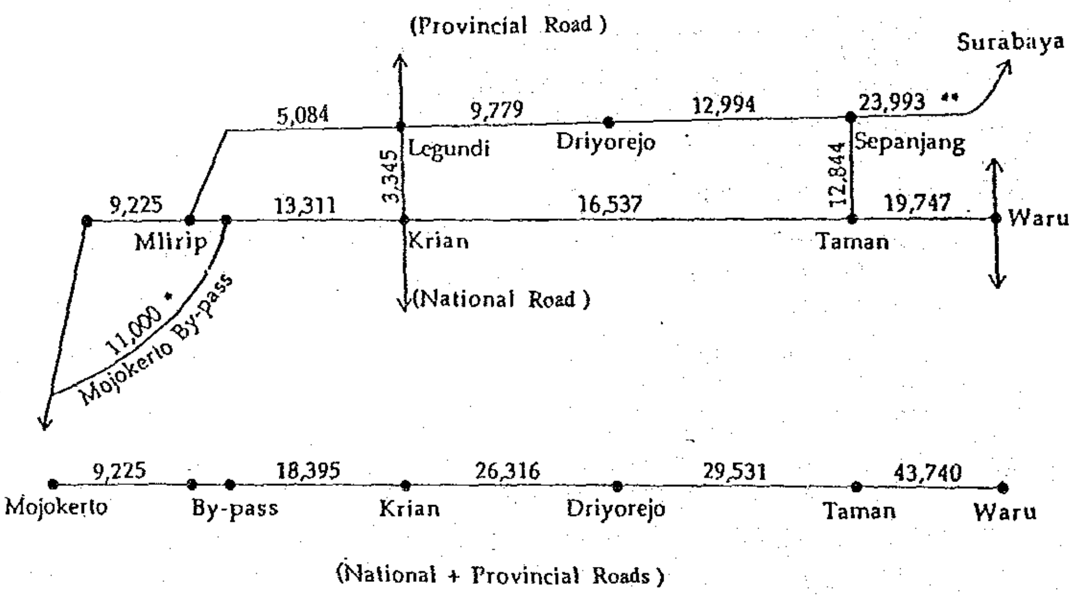
The road network in the Project Area is shown in Fig. III-1. Major road links are in the three major transportation corridors, i) Surabaya-Mojokerto having a national road and a provincial road leading to the southwest from Surabaya, ii) Surabaya-Sidoarjo having a national road and the Surabaya-Gempol Toll Road leading to the south and iii) Surabaya-Gresik having a national road leading to the west.

The national road in Surabaya-Mojokerto corridor situates at the south of the Surabaya river. It leads to Mojokerto via Krian and extends further to the west. A provincial road situates at the north of the river as far as Joyoboyo-Mojokerto.

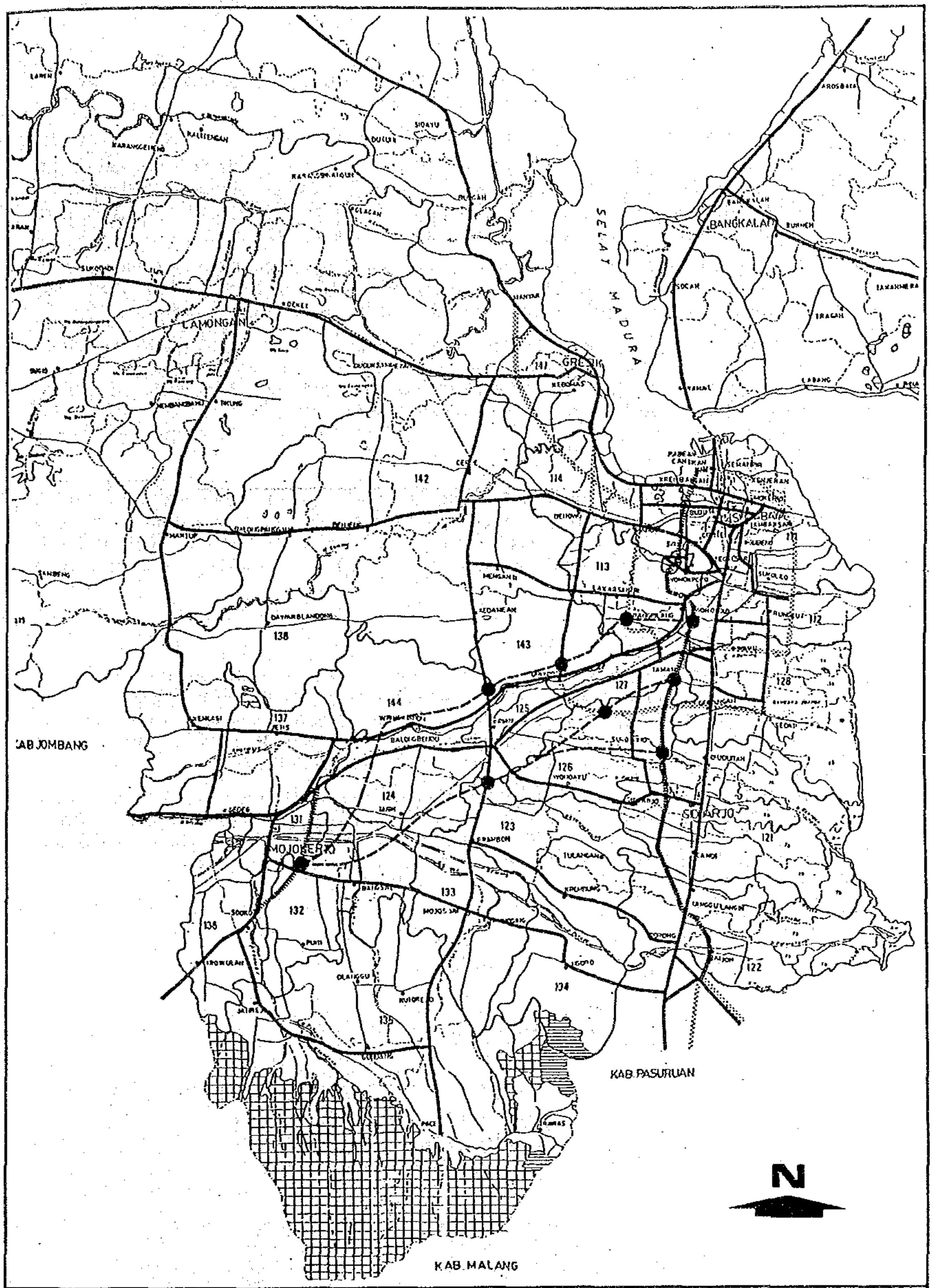
The national road has a paved carriageway width of 6 m and well maintained but is congested especially near Waru and Krian. The provincial road has a paved carriageway width of 5.5 m between Joyoboyo and Krian and has relatively high traffic volume, but surface condition is deteriorated in many locations by heavy trucks. The provincial road between Krian and Mojokerto has a narrow carriageway width of less than 5 m paved.

III-2 Road Traffic

The average daily traffic volume in 1990 on the national and provincial roads in Surabaya-Mojokerto corridor is shown below:



The traffic between Mojokerto and Surabaya gradually increases as it reaches Surabaya, that is about 18,400 vehicles/day near Mojokerto and 43,700 vehicles/day near Surabaya.



SURABAYA - MOJOKERTO TOLL ROAD PROJECT	Fig. III-1 Highway Network in the Study Area

III-3 Other Transportation

(1) Railway

Railway passengers and cargo departed from East Java in 1988 were about 4.0 million persons and 1.7 million tons respectively. Railway stations in East Java are located in such Kabupatens/Kotamadyas as Surabaya, Sidoarjo, Gresik, Lamongan, Mojokerto, Probolinggo, Banyuwangi, Madiun, Jember and Kediri.

The number of railway passengers is dominated by those from Surabaya which accounted for 65% of the total departing passengers in East Java in 1988. The historical increase in passengers has rather stagnated since the year 1985.

The railway cargo is mostly departed from either Surabaya or Gresik which accounted for 58% and 35% of the 1988 total cargo in East Java, respectively. Although the cargo transported in 1987 showed a remarkable increase, the railway cargo volume in East Java is likely to grow steadily.

(2) Seaport

Tg. Perak Port in Surabaya is defined as a primary seaport in Indonesia, where both international and domestic sea freight are handled. The total sea freight loaded and unloaded at Tg. Perak Port was about 3.8 million and 8.1 million tons in 1987, respectively. The total freight volume increased 1.69 times (14.0% p.a.) between 1983 and 1987.

(3) Airport

Juanda Airport is located about 15 kilometers to the south from the center of Surabaya city. Number of passengers was about 1.57 million of which 0.73 million are arriving passengers and 0.84 million are departing passengers in 1987. The total of arriving and departing passengers in 1983 was 1.39 million, so that the total has increased about 3.1% per annum on average during 1983-1987.

Air freight handled at Juanda Airport was about 15,000 tons in 1987. The arriving freight amounted to about 6,800 tons and the departing freight amounted to 8,200 tons. The freight volume at Juanda Airport increased at 7.1% in 1983-1987 period which is more than double the increase in air passengers.

IV FUTURE SOCIO-ECONOMIC FRAMEWORK

IV-1 Fifth Five-Year Development Plan (Pelita V)

The Fifth Five-Year National Development Plan (Pelita V) extends from April 1989 until March 1994. The provincial government of East Java have prepared their Pelita V Regional Development Plan based on the National Development Plan.

IV-2 Population

Based on the results of the 1980 census and 1985 intercensus, the Central Bureau of Statistics estimated the total population in Indonesia to be 231.4 million persons in 2005.

The trend of population growth rates for every five years was applied to extrapolate the future population beyond the year 2005. Table IV-1 shows projection of the future population of Indonesia.

Table IV-1 Future Population of Major Islands in Indonesia

(Unit : 1,000 persons)

Major Islands	1990 1/	1995 2/	2000	2005	2010	2015
Sumatra	37,939	43,356	49,102	55,030	61,320	68,096
	(20.77)	(21.72)	(22.72)	(23.78)	(24.89)	(26.04)
Java	109,235	117,237	124,483	130,655	136,239	141,500
	(59.81)	(58.72)	(57.60)	(56.46)	(55.30)	(54.11)
Nusa Tenggara	10,380	11,307	12,167	12,936	13,649	14,330
	(5.68)	(5.66)	(5.63)	(5.59)	(5.54)	(5.48)
Kalimantan	8,910	10,093	11,346	12,612	13,944	15,403
	(4.88)	(5.06)	(5.25)	(5.45)	(5.66)	(5.89)
Sulawesi	12,724	13,747	14,696	15,505	16,235	16,945
	(6.97)	(6.89)	(6.80)	(6.70)	(6.59)	(6.48)
Maluku/	3,462	3,907	4,322	4,674	4,976	5,230
Irian Jaya	(1.90)	(1.96)	(2.00)	(2.02)	(2.02)	(2.00)
Indonesia	182,650	199,647	216,116	231,412	246,363	261,504
	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)

Note : 1/ Projection by Central Bureau of Statistics, Indonesia
2/ Estimates by JICA Study Team for the population beyond the year 1995

The future population and density of provinces in Java are shown in Table IV-2.

IV-3 Gross Regional Domestic Product (GRDP)

According to Pelita V, target annual GRDP growths are established for the respective provinces, and they are 5.0% p.a. for East Java, 6.8% for DKI Jakarta, 7.2% for West Java, 5.1% for D.I.Yogyakarta and 5.4% for Central Java. As a result, the total GRDP growth of Java comes to 5.94% p.a.

The target growth rates of GRDP established in Pelita V have been employed to estimate the future GRDP of the total of Java and of East Java. The estimated result is presented in Table IV-3 together with the per capita GRDP and its growth rate.

Table IV-2 Future Population and Density of Provinces in Java

(Unit : 1,000 persons)

Provinces	Area (km^2)	1990 1/	1995 1/	2000 2/	2005	2010	2015
DKI Jakarta	590	9,406	10,930	11,505	11,800	11,948	12,095
(Density)	(persons/km^2)	(15,942)	(18,525)	(19,500)	(20,000)	(20,251)	(20,500)
West Java	46,300	34,434	37,548	40,709	43,594	46,271	48,753
(Density)	(persons/km^2)	(744)	(811)	(879)	(942)	(999)	(1,053)
Central Java	34,206	29,017	30,700	32,500	34,071	35,477	36,717
(Density)	(persons/km^2)	(848)	(898)	(950)	(996)	(1,037)	(1,073)
D.I.Yogyakarta	3,169	3,172	3,382	3,605	3,812	4,009	4,196
(Density)	(persons/km^2)	(1,001)	(1,067)	(1,138)	(1,203)	(1,265)	(1,324)
East Java	47,922	33,206	34,677	36,164	37,378	38,534	39,739
(Density)	(persons/km^2)	(693)	(724)	(755)	(780)	(804)	(829)
Java Total	132,187	109,235	117,237	124,483	130,655	136,239	141,500
(Density)	(persons/km^2)	(826)	(887)	(942)	(988)	(1,031)	(1,070)

Note : 1/ Projection by Central Bureau of Statistics, Indonesia

2/ Estimate by JICA Study Team for the population beyond the year 1995

Table IV-3 Future GRDP and GRDP per Capita in Java and East Java (at 1983 constant prices)

Region	Year	Population (x1,000)	GRDP (Bil.Rp)	Per Capita GRDP (x1,000 Rp)	Per Capita GRDP Growth Rate (% p.a.)
Java Total	1990	109,235	58,446.7	535	-
	1995	117,237	78,737.4	672	4.7
	2005	130,655	143,768.9	1,100	5.1
	2015	141,500	264,610.7	1,870	5.4
East Java	1990	33,206	16,539.1	498	-
	1995	34,677	21,108.5	609	4.1
	2005	37,378	34,383.6	920	4.2
	2015	39,739	56,007.1	1,409	4.4
Other Java	1990	76,209	41,907.6	551	-
	1995	82,560	57,628.9	698	4.8
	2005	93,277	109,385.3	1,173	5.3
	2015	101,761	208,603.6	2,050	5.7

IV-4 Future Vehicle Ownership

The growth of future vehicle ownership indicates the magnitude of the growth of traffic demand. In order to relate with the intended classification of future vehicle OD matrices, the future vehicle ownership was estimated by using the data on both registered vehicles and tested vehicles.

The future vehicle ownership in East Java and in the total of Java was analyzed by a regression model using such factors as population, GRDP and GRDP per capita as shown in Table IV-4.

Table IV-4 Future Vehicle Ownership and Growth Factors in East Java and Java

East Java

Year	(Pass.Car+Bus) 1/		(Large/Medium Bus) 2/		(Large/Medium Truck) 3/		(Truck Total) 4/	
	Number	(Growth)	Number	(Growth)	Number	(Growth)	Number	(Growth)
1990	303,071	(100)	5,621	(100)	136,898	(100)	210,061	(100)
1995	435,821	(144)	7,048	(125)	173,669	(127)	296,350	(141)
2005	830,128	(274)	11,048	(197)	276,691	(202)	551,924	(263)
2015	1,484,967	(490)	17,337	(308)	438,678	(320)	975,433	(464)

Java

Year	(Pass.Car+Bus) 1/		(Large/Medium Bus) 2/		(Large/Medium Truck) 3/		(Truck Total) 4/	
	Number	(Growth)	Number	(Growth)	Number	(Growth)	Number	(Growth)
1990	1,313,223	(100)	77,075	(100)	469,548	(100)	700,961	(100)
1995	1,843,083	(140)	101,854	(132)	600,695	(128)	945,047	(135)
2005	3,563,876	(271)	179,266	(233)	1,010,411	(215)	1,724,254	(246)
2015	6,801,481	(518)	318,534	(413)	1,745,517	(372)	3,174,836	(453)

Note:
1/ Total of registered passenger cars and registered buses.
2/ A tested bus is considered to be equivalent to a large/medium bus.
3/ A tested truck is considered to be equivalent to a large/medium truck.
4/ Registered trucks.

IV-5 *Zonal Planning Parameters*

The future population and GRDP of the Study Area are estimated as shown in Table IV-5.

The analysis of the socio-economic framework predicts that in the Study Area, population in 2005 and 2015 will become 1.38 times and 1.64 times of 1990 population respectively and GRDP in 2005 and 2015 will become 2.54 times and 4.64 times of 1990 GRDP respectively.

Table IV-5 Future Socio-Economic Framework

(1) Population

Area	Population (1,000)		
	1990	2005	2015
Study Area			
- Kab. Sidoarjo	1,094	1,544	1,858
- Kab. Mojokerto	809	1,000	1,120
- Kab. Gresik	864	1,089	1,233
- Kod. Mojokerto	97	119	132
- Kod. Surabaya	2,652	3,861	4,720
Total	5,516	7,613	9,063
East Java	33,206	37,379	39,739

(2) GRDP (1983 Constant Prices)

Area	GRDP (Million Rp.)		
	1990	2005	2015
Study Area			
- Kab. Sidoarjo	717,736	1,460,307	2,248,743
- Kab. Mojokerto	336,169	557,935	750,084
- Kab. Gresik	737,501	1,479,136	2,256,045
- Kod. Mojokerto	75,400	200,991	370,584
- Kod. Surabaya	2,362,748	7,046,864	14,003,097
Total	4,229,554	10,745,233	19,628,553
East Java	16,539,098	34,383,601	56,007,100

V TRAFFIC SURVEYS

V-1 Execution of Traffic Survey

In order to update and supplement the existing road traffic data, the following 4 kinds of traffic surveys were conducted by the Study Team on the road links in the Study Area.

- Traffic count survey	:	25 locations
- Roadside OD survey	:	20 locations
- Bus terminal OD survey	:	3 bus terminals
- Travel speed survey	:	26 road links

The results of the traffic survey, in particular, the characteristics of traffic on the existing national and provincial roads in Surabaya-Mojokerto corridor which run in parallel to the Toll Road, are summarized below.

V-2 Results of Traffic Survey

(1) Traffic Volume on Roads

The results of the traffic count survey are illustrated in Fig. V-1.

The traffic counted on Waru-Mojokerto national road exceeded 15,000 vehicles/day at every survey point. Accordingly, in view of potential traffic subject to diversion to the Toll Road, it can be assumed that such traffic is about 12,000 vehicles/day deducting about 20% of short-trip traffic from the above.

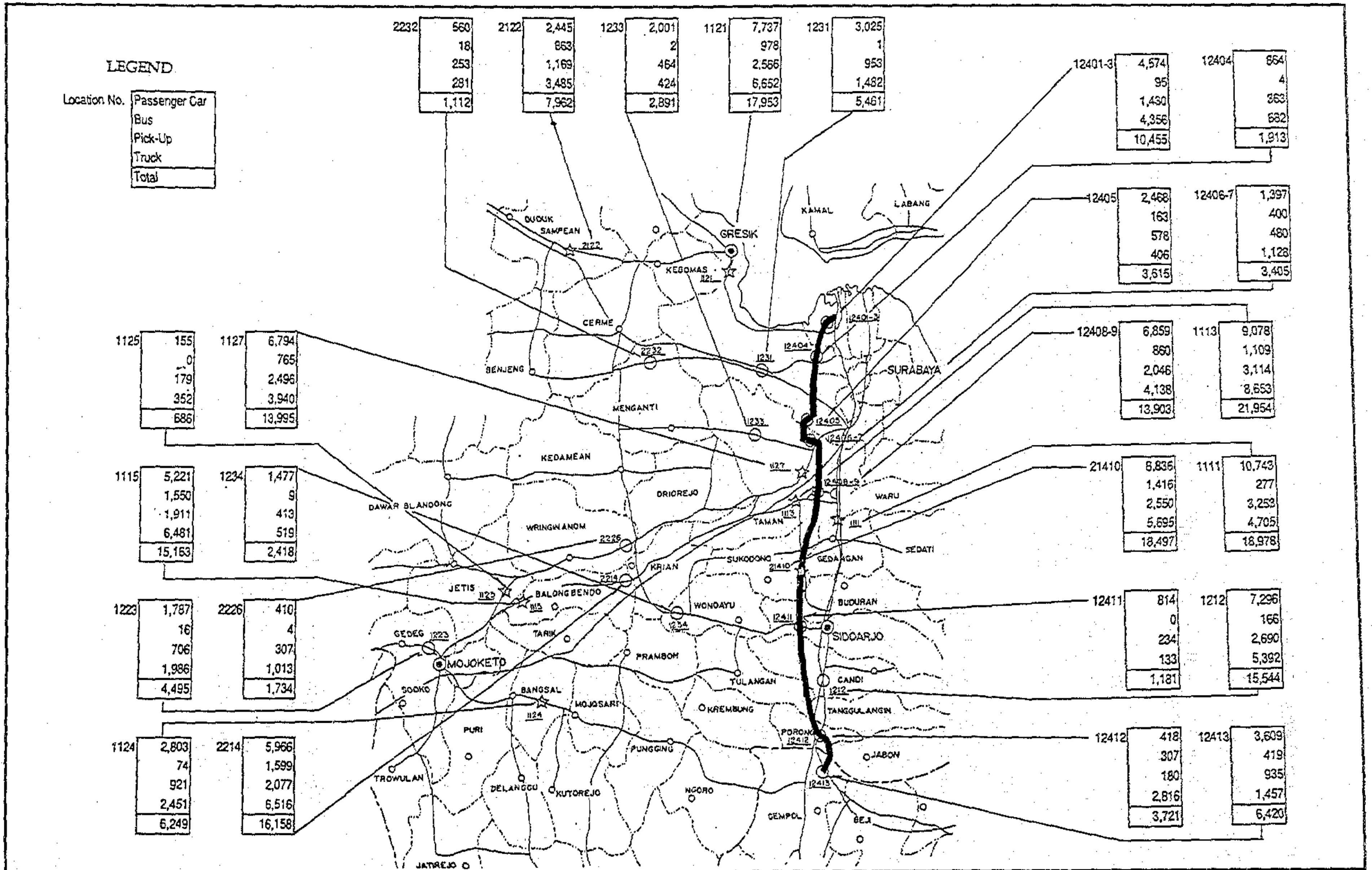
(2) Hourly Fluctuation

On Waru-Mojokerto national road, a higher peak hour ratio is observed in Mojokerto bound traffic at every survey point. At Taman and at the east of Mojokerto city, the peak occurs in the morning with a peak hour ratio of a little less than 8%. At the west of Krian City, the peak also occurs in the morning between 9:00 and 10:00 a.m., but the peak hour ratio is lower, a little more than 6%.

The directional factor (% of peak hour traffic in the heaviest direction) of Mojokerto bound traffic is 59.9% in the peak hour between 11:00 and 12:00 a.m. (peak hour ratio is 7.5%), while that of Surabaya bound traffic is 57.1% in the peak hour between 7:00 and 8:00 a.m. (peak hour ratio is 5.7%), both at the east of Mojokerto city.

(3) Composition of Vehicles (refer to Table V-1)

On Waru-Mojokerto national road, the traffic on its western stretches is characterized by a larger share of Large Bus and Medium Truck (in the west of Krian City and in the east of Mojokerto city) than other road links. Near Waru, the traffic is characterized by a higher share of Large Truck. On the provincial road, the share of Pick-up is high.



SURABAYA - MOJOKERTO TOLL ROAD PROJECT | **Fig. V-1 Daily Traffic Volume in the Study Area in 1990**

Table V-1 Traffic Composition (%)

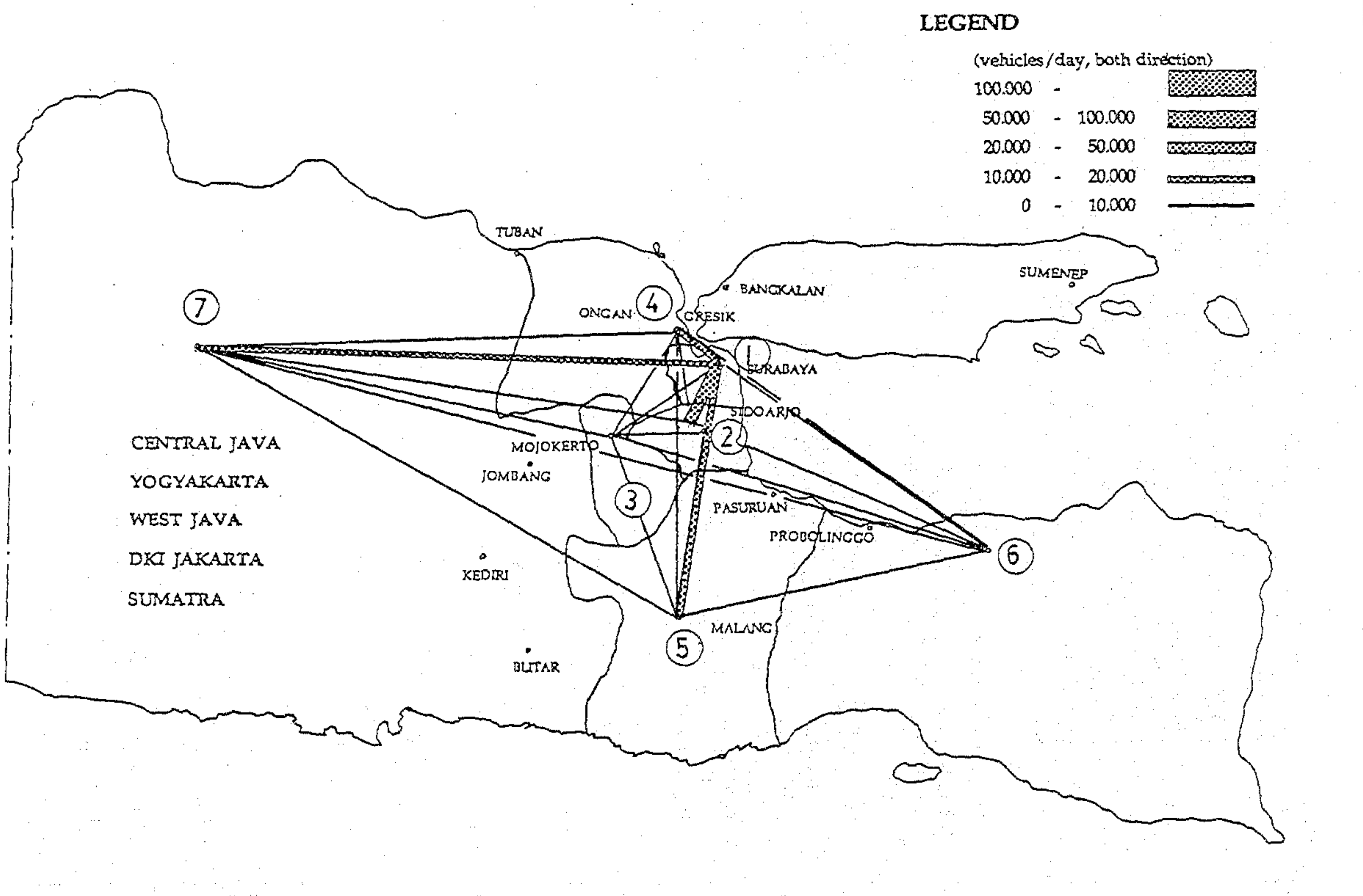
Vehicle Type	National Road		Provincial Road
	West of Krian	Near Waru	West of Joyoboyo
Sedan	13.65	17.96	18.52
Minibus (private)	14.21	13.88	15.73
Minibus (public)	9.07	9.52	14.29
Large Bus	9.90	5.05	5.47
Pick-up	12.85	14.18	17.84
Medium Truck	21.53	15.26	16.08
Large Truck	18.79	24.15	12.07
Total	100.00	100.00	100.00

(4) Trip Distribution (refer to Fig. V-2)

The traffic to and from Zone No. 1 (with Surabaya city as the center) is dominant. It counts for 83,000 trips/day, occupying 72 % of a total inter-regional traffic of 115,000 trips/day.

Among the traffic to and from Zone No. 1, the traffic with Zone No. 2 (with Sidoarjo city as the center) is the largest, counting 23,000 trips/day. The traffic with Zone No. 7 (including Kediri city, Jombang city and westward) counting 18,000 trips/day follows.

The traffic between Zone No. 1 and Zone No. 3 (with Mojokerto city as the center) counts 6,000 trips/day. The total potential traffic subject to diversion to the Toll Road is estimated at about 11,000 trips/day, adding as a conservative estimate 5,000 trips/day to include the traffic between Zone No. 1 and Zone No. 7.



SURABAYA - MOJOKERTO TOLL ROAD PROJECT

Fig. V-2 Trip Distribution Pattern in 1990

VI ENGINEERING SURVEYS

VI-1 Physical Conditions in the Study Area

(1) Topography

The topography is favorable in the Project Area which is divided into 2 terrain conditions, flat and rolling. Flat terrain area is spread out in the Brantas Delta which is enclosed by the Surabaya river and the Porong river with an altitude of less than 25 m. The flat terrain area covers the surroundings of Mojokerto city, all the area of Kab. Sidoarjo and the most part of Kod. Surabaya. The area is mainly used for cultivation of paddy, sugarcane and maize. The rolling terrain area situates in the north of the Surabaya river in Kab. Gresik, with an altitude of less than 70 m.

(2) Geology

Geologically, the flat terrain area is composed of alluvial soil of loam, silt and clay. Soft ground areas are common in the eastern part of the Brantas Delta. The thickness of soft ground layer (N-value less than 4) ranges from 7 to 20 m. The sub-surface soils data indicate that the existence of soft ground area is not common in the east of Krian city. The bearing strata for the construction of pile foundation for bridge structures are situated at 30-50 m deep from the existing ground level, in the flat terrain area.

The rolling terrain area is mainly composed of clay, tuffaceous clay and tuffaceous sandy clay which is unsuitable as embankment material because of its swelling nature even if the dried condition resembles clay stone.

(3) River System and Irrigation System

The Project Area situates downstream of the Brantas river, the second largest river in Java Island, having a total catchment area of about 12,000 km^2 and being about 320 km in main course length. At Mojokerto, the Brantas river branches into the Porong river and the Surabaya river.

The Porong river is the main drainage of the lowermost Brantas which flows into the Madura strait. The Surabaya river is a branch of the Brantas river being separated from the main stream at Mlirip Sluice near Mojokerto and flows into the sea at the north of Surabaya city.

The Brantas Delta is one of the most modernized irrigation areas in Indonesia, with a densely developed irrigation canal and drainage canal network.

(4) Climate

The seasons are influenced by the monsoons which blow in a general direction from the east from May to October and from the west from November to April. During the east monsoon, the average rainfall in Surabaya is around 50 mm per month with August usually the driest. The west monsoon brings heavy rainfalls which average over 235 mm per month. The heaviest rainfalls occur mostly in January and average about 340 mm per month. The average total yearly rainfall in Surabaya is approximately 1,700 mm. In the Project Area, rainfall varies area by area, total yearly rainfall about 1,700 mm in Surabaya, about 1,950 mm in Krian and about 1,680 mm in Mojokerto. The maximum temperature in Surabaya recorded in 1988 was 36.2°C in October and the minimum marked 20.0°C in July. The average humidity is in the range of 65% to 85%.

VI-2 Topographic Survey

Aerial photography was conducted by the Study Team, divided into 2 phases as follows:

- Initially 3 courses were flown for the purpose of preparation of working mosaics (1/10,000) for the preliminary route study; and
- Deliberate aerial photography for the preparation of 1/5,000 scale topographic maps along the optimum route for preliminary design of the Toll Road.

VI-3 Soils and Materials Investigations

Soils and materials investigations were conducted by the Study Team. Machine boring with standard penetration tests was conducted at 5 locations, thin-walled tube sampling was conducted for the soils in soft ground layers and test pit sampling was made at possible sources of embankment/pavement materials and concrete aggregates. Laboratory testing was conducted for the collected samples. The findings are described below:

(1) Properties of Typical Soils (refer to Fig. VI-1)

a) Alluvial Cohesive Soils (Ac1 and Ac2)

Ac1 deposit spreads out in the east and west parts of the Project Area, which is composed of very soft to soft clay and silt with humus soil. The depth of layer is about 15 meters in the west part and about 32 meters in the east part. N-value ranged from 0 to 6 and natural water content from 43.3% to 74.5 %. Ac2 deposit underlies Ac1 and alluvial sandy soils. N-value is rather high, ranged from 11 to 16 and natural water content from 40.2% to 50.4%.

b) Alluvial Sandy Soils (As)

Sandy soils composed of 4% gravel, 65% sand and 31% clay and silt are found in lens status. The thickness of As deposit ranged from 2.8 to 8.0 meters and N-value from 5 to 30.

c) Diluvial Cohesive Soils (Dc1 and Dc2)

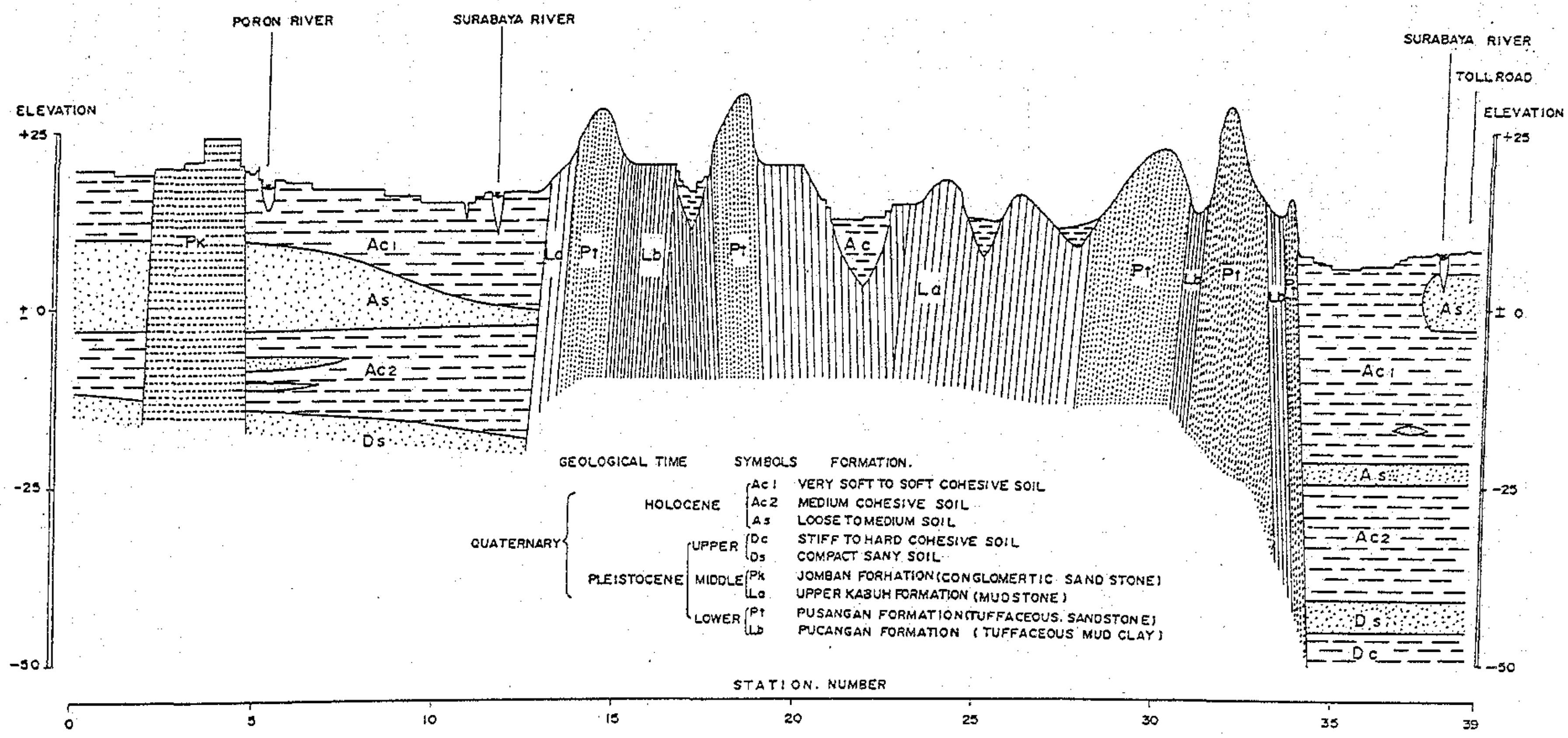
Dc1 deposit is found in the east part of the Project Area and is composed of sandy clay, clay and silt with humus soil. N-value ranged from 19 to 33 and natural water content from 31.6% to 42.4%. Dc2 deposit is distributed in the east and west parts, and is composed of sandy clay and silty clay, situated in the form of lens. N-value ranged from 35 to 50.

d) Diluvial Sandy Soils (Ds)

Ds deposit underlies the fine to coarse sand and silty sand, and is distributed in the east and west parts of the Toll Road corridor. The deposit is situated at a depth of 47 meters in the east part and 32-34 meters in the west part.

(2) Bearing Strata for Piling and Open Caissons

Bearing strata consisting of diluvial sandy soils (Ds, dense) and diluvial cohesive soils (Dc2, very stiff to hard) are found in the formations generally between 30 and 50 meters.



SURABAYA - MOJOKERTO TOLL ROAD PROJECT | Fig. VI-1 Notional Geological Profile along the Project Route

(3) Soft Ground Area

Based on the results of geological investigations, it is judged that soft ground areas exist in the following two locations along the Toll Road route.

	Location	Total Length	Layer Thickness
1.	Near Surabaya river crossing (Sta.9+000 - 13+500)	4.5 km	16 m
2.	Near Mas river crossing (Sta. 34+000 - 38+300)	4.3 km	24 m

For these soft ground areas, treatment by vertical sand drains (40 cm dia., 2.5 m pitch) with 1 m thick sand mat is required according to the results of settlement and stability analysis.

(4) Sources of Materials

a) Embankment Materials

Laterite soils with CBR of approximately 5-6 are available at several potential borrow areas in the southeast of Mojosari. Small scale potential borrow areas are found in the north of the Surabaya river (i.e. silty sand, tuffaceous clay and weathered tuff, with CBR ranging from 5 to 24), but available volume is limited. Excavation of the deposits from the Surabaya and the Porong rivers is not allowed by the Brantas River Basin Development Execution Office.

b) Subbase Materials

Subbase materials of fine to coarse sand, with CBR of approximately 30, are available at several potential borrow areas in the southeast of Mojosari. These materials are not suitable as fine aggregate for concrete due to their grain size distribution characteristics but are highly advantageous for the embankment construction to reduce the total thickness of pavement structure.

c) Coarse Aggregate Materials

The main source of coarse aggregate materials is river gravel (i.e. andesite rocks) from the borrow pits in the south of Mojosari.

d) Fine Aggregate Materials

Abundant fine aggregate materials sources exist in the south of Jombang, sand deposit from eruption of Mount Kelud. Estimated volume of deposits is approximately 5 million m^3.

VI-4 Hydrological Survey

(1) Flood Conditions

The Brantas Delta has had no experience of flooding in the recent decade after implementation of the Porong River and the Surabaya River Improvement Projects. According to the information given by the Sidoarjo Regional Irrigation Office, there are still some small retained water areas, 40 cm depth in maximum, for 2-3 days after heavy rain, which occur because of depressed terrain conditions.

Under such situation, no special considerations against flood will be required for both the Porong and Surabaya rivers if the Toll Road passes over the existing levees securing sufficient headroom for vehicle traffic on the inspection roads on river banks.

(2) Rainfall Analysis

Based on the rainfall data at 11 stations having 20 years daily rainfall records, a rainfall analysis was conducted. Probable daily rainfall of the following return periods was estimated to determine design rainfall intensity.

Return period	Apply to
25 years	Tributaries of the Porong and Surabaya rivers
5 years	Neighboring basin
3 years	Surface water drainage

VII ROUTE SELECTION

VII-1 Procedures

Route study was carried out in the following two steps:

i) To pick up all the possible route alternatives taking into account the socio-economic, environmental and physical conditions in the Project Area and to narrow them down through comparative study to short-listed alternatives.

ii) To compare such short-listed alternatives in more detail in view of technical, environmental, transportation and economic aspects and to select an optimum route.

VII-2 Basic Policies for Route Location

The following basic policies were exercised in locating the alternative routes.

a) To facilitate the future extension of the Toll Road for the formation of the entire Trans Java Tollway System, as well as westward extension from Mojokerto and eastward connection to Pasuruan and Probolinggo via Gempol.

b) To locate the route to enable the construction of the interchanges at the most efficient places for road users. To this end, the route should be selected at the shortest possible distance from the city center of Surabaya, Krian and Mojokerto, which are the major points of traffic generation and attraction in the corridor.

c) To locate the route coordinating with the landuse plan and road network development plan of the regencies of Surabaya, Gresik, Sidoarjo and Mojokerto. Attention was paid to the planned new town development at Driyorejo in Kab. Gresik as a satellite town of Surabaya city, the planned industrial estates at Jetis and at Ngoro in Kab. Mojokerto, and the designated area for future industrial estates development in the north of the provincial road (Wonokromo-Driyorejo-Legundi) in Kab. Gresik.

d) To locate the route which attains to low cost road structures.

e) To pay attention to such primary controls as existing roads, railway lines, large rivers/canals and electric power transmission lines to be crossed.

f) To avoid public facilities such as schools, hospitals, mosques, governmental offices, military facilities (existing military facilities including a maneuvers field near the southwestern boundary of Kod. Surabaya should be avoided), as well as monuments having cultural/ historical values.

g) To avoid as much as possible large factories and housing complexes.

h) To minimize severance of villages and well-developed farmland.

VII-3 Conditions for Route Study

(1) Review of Past Studies

To check the consistency with recent development plans and concepts, the following past studies were reviewed in the route locating process:

- Trans Java Highway Feasibility Study in 1973, the first idea of the Trans Java Tollway System
- Investment Opportunities : Tollroads in Indonesia in 1988, which refined the idea of the Trans Java Highway into the Trans Java Tollway System incorporating the progress of toll roads development. The Surabaya side terminus was planned near Sidoarjo IC on the Surabaya-Gempol Toll Road. The idea of eastward extension from Gempol to Pasuruan appeared.
- Pre-Feasibility Study for the Surabaya-Mojokerto-Kediri Toll Road in 1989, which recommended the route passing south of Mojokerto and Krian and to connect with the Surabaya-Gempol Toll Road at Waru IC.
- Alternative Routes of the Surabaya-Mojokerto Toll Road indicated by the Government of East Java Province. The northern route to connect with the Surabaya-Gempol Toll Road at Kota Satelit IC and the southern route at Waru IC. Both routes start from the northern end of the Mojokerto Bypass.
- GKS Study (i.e. Urban Development Planning Study on Surabaya Metropolitan Area) in 1983, which recommended the development of an arterial ring roads system consisting of the Inner, Middle and Outer Ring Roads together with radial roads development.
- IUIDP (i.e. Integrated Urban Infrastructure Development Project) in 1988 which showed the route of the Inner Ring Road more definitely than the GKS Study, and will be incorporated in the road network development plan of Surabaya municipality in the Pelita VI period.

(2) Extension of the Toll Road in the West of Mojokerto

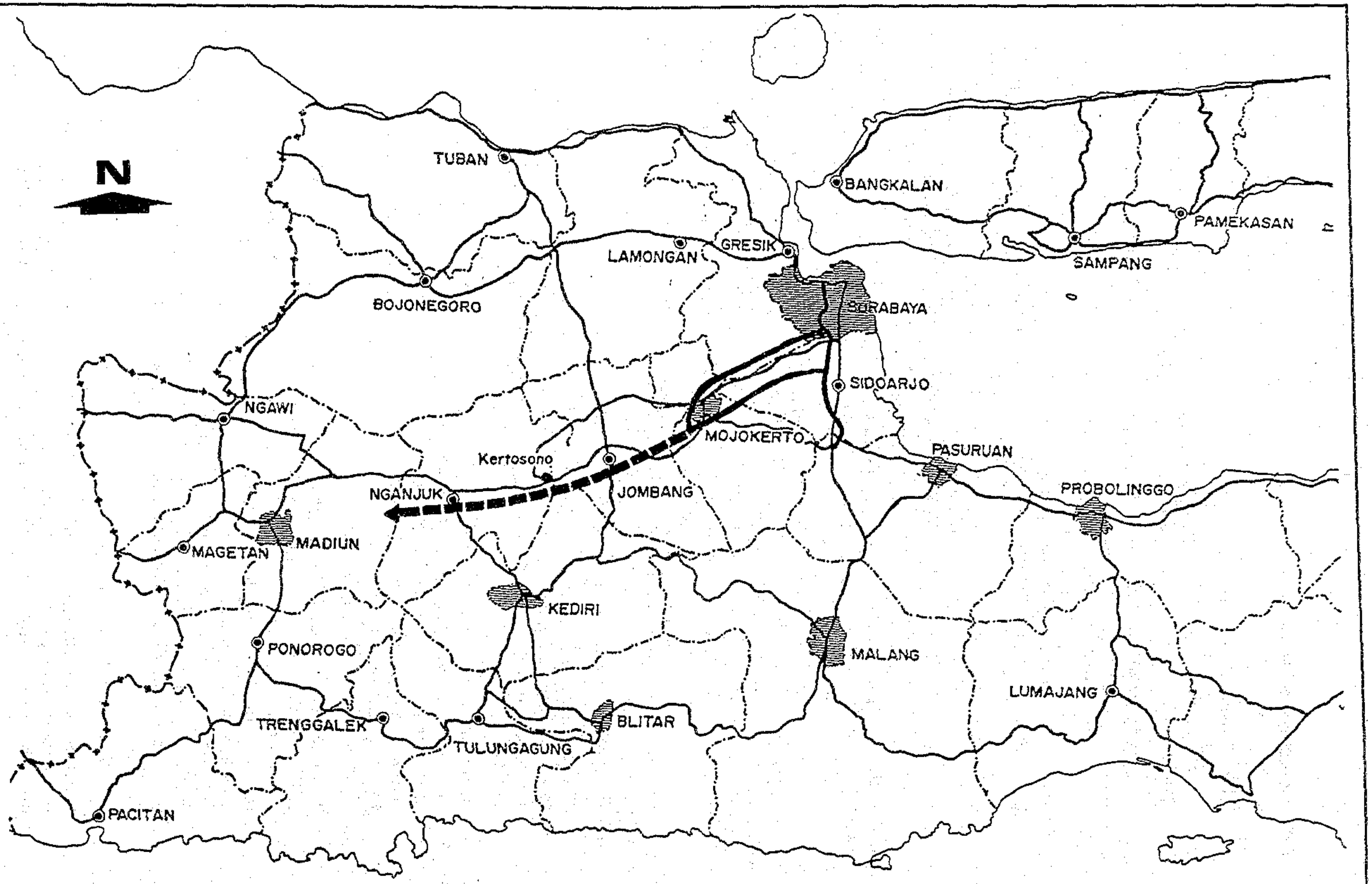
For the future extension of the Toll Road westward from Mojokerto, a general route is understood to follow the route of the existing national road connecting Jombang, Kertosono, Nganjuk and Madiun, keeping the locations of interchanges close to these cities.

In the Jombang-Kertosono-Nganjuk corridor, it is natural to consider that the route of the Trans Java Tollway System will be located south of these cities, since large cities such as Kediri, Tulungagung and Blitar are all located on the south of the national road, while there is no center of large traffic generation and/or attraction in the northern area. This concept is identical to the recommended routes in the past studies (refer to Fig. VII-1).

The alternative route passing north of Mojokerto city (northern route) will therefore join the other alternative route which passes south of the city (southern route) in the section between Mojokerto and Jombang. The northern route from the east will turn to the southwest near Mojokerto city for a shorter route in connection with the crossing of the Brantas river, since the river is in the east-west direction while Jombang city is situated southwest of Mojokerto city. Based on this consideration, it was presumed that both routes meet at about 4.5 km southwest of Mojokerto city, which is the Mojokerto side terminus for route comparison.

(3) Location of Interchanges

Location of interchanges is one of the major governing factors in locating the Toll Road route. Along the corridor, the junction with the Surabaya-Gempol Toll Road and the interchanges for Krian and Mojokerto are the major locations of



SURABAYA - MOJOKERTO TOLL ROAD PROJECT	Fig. VII-1 Basic Route in the West of Mojokerto

interchanges. Once the locations of interchanges are determined, the general route alignment of the Toll Road is almost fixed.

a) Junction with the Surabaya-Gempol Toll Road

The eastern end of the Toll Road is the Junction with the existing Surabaya-Gempol Toll Road. There are two basic considerations. One is to connect the Toll Road directly to the existing interchange (tollway-to-artery interchange) on Surabaya-Gempol Toll Road adding the function as the Junction, and the other is to connect in the stretches between the existing interchanges.

However, direct connection to the existing interchange is not recommended since large reconstruction works disturbing the existing traffic is necessary to modify the existing layout, possibly to a full cloverleaf type or double trumpet type. Waru IC in double trumpet type layout has some possibility of such modification to remodel it to a Junction, however, it is not recommended to connect the Toll Road at this point, since it will cause further concentration of traffic in the future and technical problems regarding alignment, frontage road layout, etc.

The following factors were taken into account in evaluating the possible locations of the Junction between the existing interchanges on the Surabaya-Gempol Toll Road.

- Alignment of the Surabaya-Gempol Toll Road
- Structures on the Surabaya-Gempol Toll Road
- Distance between the Junction and the existing interchange
- Relation with the Ring Road Plan

As a result of the evaluation, the following 3 sites were selected as the proposed locations of the Junction with the Surabaya-Gempol Toll Road.

a.	2 km north of Waru IC	Gunung Sari IC - Waru IC
b.	3 km south of Waru IC	Waru IC - Sidoarjo IC
c.	3 km north of Sidoarjo IC	Waru IC - Sidoarjo IC

b) Interchange for Krian City

At Krian, there are three alternative locations of the interchange, all of which will be connected to the provincial road (Legundi-Krian-Mojosari). The first alternative is in the north of the Surabaya river (3.5 km north of Krian city) and the second alternative is between the Surabaya river and the national road (2 km north of Krian city) just to the north of the planned Krian Bypass. These two locations are intended to serve Krian city and the industrial development area on the north of the Surabaya river in Kab. Gresik and Kab. Mojokerto. The third alternative is 3 km south of Krian city, which is intended to serve Krian and Mojosari. Service to the industrial development area on the north of the Surabaya river is limited.

c) Interchange for Mojokerto City

Direct connection to the existing Mojokerto Bypass or use of the bypass incorporating it into the tollway system for future extension is not recommended because of the following reasons:

- Costly reconstruction for raising the vertical alignment to cross over the national and provincial roads and railway line is required. In addition, widening of the tollway portion (the present bypass is of 2-lane, 2-way) and provision of frontage roads along the tollway portion for local service will become necessary.

- The toll bridge is narrower than the standard width of throughway bridge of a 4-lane toll road.

There are two alternatives of route locations whether the route passes north or south of Mojokerto city.

In the case of the northern route, the suitable location of the interchange is some 5.5 km northwest of Mojokerto city. The approach of the interchange will be connected to the national road about 1 km east from the intersection with the bypass.

One of the significant problems related to the location of the interchange on the northern route is that an additional interchange might be required in the south of Mojokerto after the westward extension of the Toll Road. The interchange selected above can not serve properly the traffic from/to Mojokerto to/from the western area, forcing travel of extra distance.

For the southern route alternative, the connecting road is the Mojokerto Bypass. The interchange is located about 1 km north of the provincial road (Mojokerto-Mojosari) near the existing bus terminal.

d) Other Interchanges

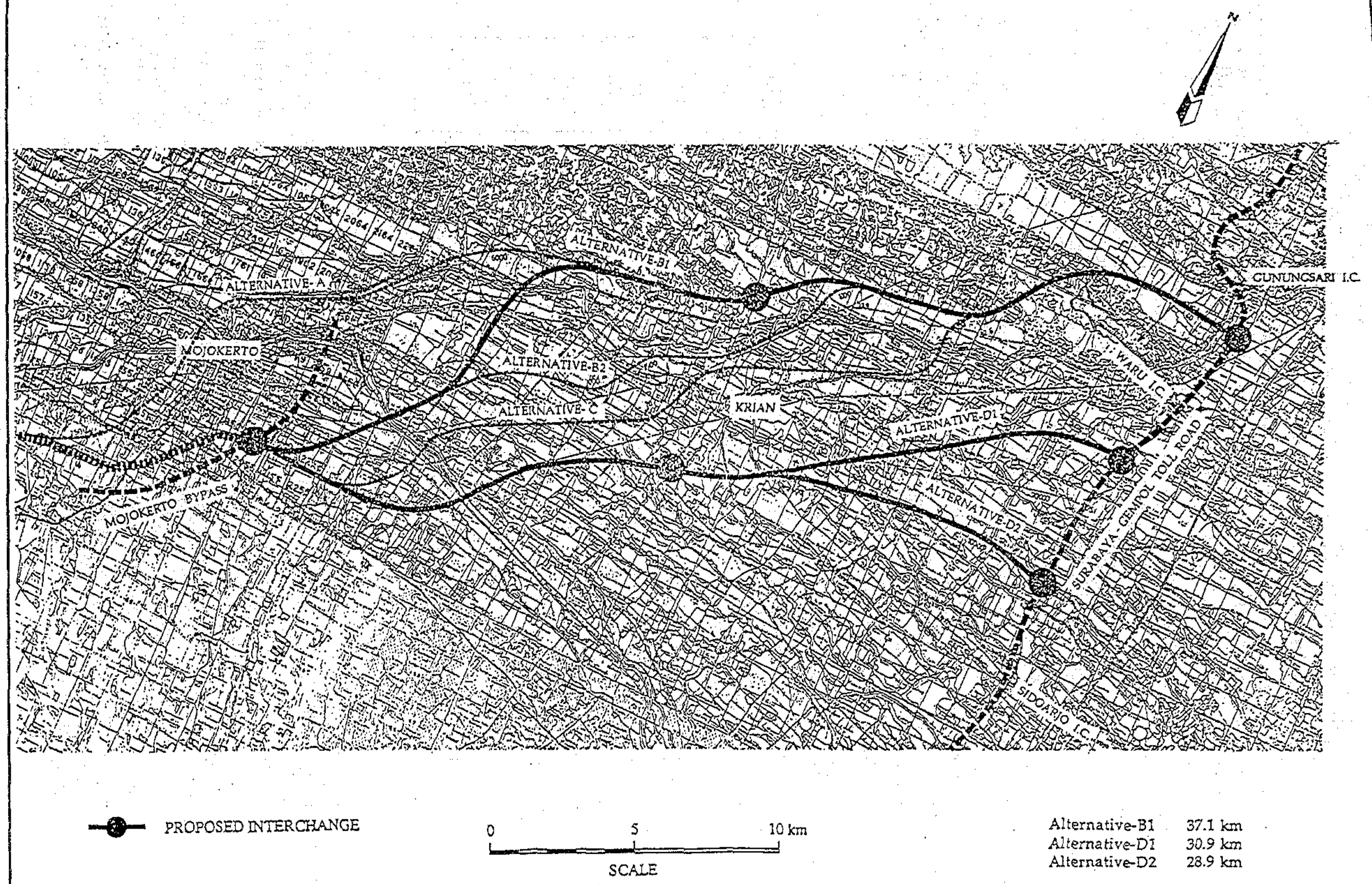
In case that the route is selected to pass north of the Surabaya river and is connected to the Surabaya-Gempol Toll Road north of Waru IC, it crosses the planned Inner and Middle Ring Roads. The connections with these ring roads are other proposed locations to plan additional interchanges.

VII-4 Establishment of Route Alternatives and Screening

A total of 6 route alternatives, divided into 4 basic route alternatives designated Alternative-A, -B, -C and -D, have been established for comparison in the preliminary route study as shown in Fig. VII-2.

The established route alternatives as described above were compared from the viewpoints of technical, environmental, socio-economic and transportation aspects. As a result of the comparison, it was concluded that of the 6 possible alternatives, the 3 route alternatives of Alternative-B1, -D1 and -D2 will be carried forward to the next step of detailed comparison, omitting Alternatives-A, -B2 and -C based on the following considerations

- Alternative-A was omitted since the northern location of the interchange for Mojokerto city is unsuitable being far from the city center and requiring an additional interchange to the south of the city in future.
- Alternative-B2 and -C are almost identical to Alternative-B1 but are less advantageous from the view of construction cost and environmental impact (length passing through inhabited areas).



SURABAYA - MOJOKERTO TOLL ROAD PROJECT	Fig. VII-2 Route Alternatives

VII-5 Selection of the Optimum Route

The 3 short-listed route alternatives of Alternative-B1, -D1 and -D2 were compared based on the results of traffic demand forecast, preliminary cost estimate and preliminary economic analysis from the following viewpoints to select the optimum route.

1) Technical aspects
2) Environmental impact
3) Transportation aspects
4) Economic aspects

(1) Technical Aspects

Technical aspects of each alternative are compared in the form of i) geometric aspects, ii) construction effort and iii) cost for construction and land acquisition and compensation (refer to Table VII-1).

In comparison of the total cost of construction cost and ROW acquisition cost, Alternative-D2 is the lowest (minimum initial investment cost), though the differences among the 3 alternatives are not significant.

Table VII-1 Comparison of Technical Aspects

Description	Unit	Alt-B1	Alt-D1	Alt-D2
A. GEOMETRIC ASPECTS				
1. Total length of the Toll Road	km	37.1	30.9	28.9
(Index)		(1.00)	(0.83)	(0.78)
2. Minimum horizontal curve (Radius)	m	2,000	2,500	2,500
B. CONSTRUCTION EFFORT				
1. Soft ground treatment	km	7.0	16.2	14.1
2. Bridge length	km	2.1	0.7	0.7
C. CONSTRUCTION/ROW ACQUISITION				
1. Construction cost	B.Rp.	223.0	195.4	182.4
(Index)		(1.00)	(0.88)	(0.82)
2. ROW acquisition	B.Rp.	66.7	109.4	95.8
(Index)		(1.00)	(1.64)	(1.44)
3. Total of Construction cost and ROW acquisition	B.Rp.	289.7	304.8	278.2
(Index)		(1.00)	(1.05)	(0.96)
4. Percent of ROW acquisition cost to the total cost of construction and ROW acquisition	%	23.0	35.9	34.4

(2) Environmental Impact

Since there is no significant difference among the 3 alternatives in impacts on natural, man-made and physical environments, the comparison was mainly based on the adverse impacts on the social environment which is comprised of residents displacement and loss of agricultural land.

The residents displacement is measured by the length of the Toll Road which passes through the developed and inhabited areas applying length conversion factors.The quantification of loss of agricultural land is based on the ROW acquisition data applying conversion factors depending on the development of technical irrigation.

The comparison revealed that Alternative-B1 is superior to the other alternatives, as shown in Table VII-2.

Table VII-2 Comparison of Social Impact

Description	Unit	Alt-B1	Alt-D1	Alt-D2
A. RESIDENTS DISPLACEMENT				
1. Developed area	km	0.70	-	-
(Equivalent length f=1.0)		(0.70)		
2. Densely inhabited village	km	1.95	6.75	5.60
(Equivalent length f=1.0)		(1.95)	(6.75)	(5.60)
3. Sparsely inhabited village	km	2.50	-	-
(Equivalent length f=0.5)		(1.25)		
4. Total equivalent length	km	3.90	6.75	5.60
5. Index, population displacement	-	1.00	1.73	1.44
B. LOSS OF AGRICULTURAL LAND				
1. Area in Surabaya city	m^2x10^3	126.5	-	-
(equivalent area f = 1.0)		(126.5)		
2. Area in Gresik regency	m^2x10^3	756.2	-	-
(equivalent area f = 1.0)		(756.2)		
3. Area in Sidoarjo regency	m^2x10^3	362.2	1,157.3	1,104.0
(equivalent area f = 2.0)		(724.4)	(2,314.6)	(2,208.0)
4. Area in Mojokerto regency	m^2x10^3	330.2	406.9	406.9
(equivalent area f = 2.0)		(660.4)	(813.8)	(813.8)
5. Total equivalent area		2,267.5	3,128.4	3,021.8
6. Index, loss of agr. land	-	1.00	1.38	1.33

(3) Transportation Aspects

Based on the results of traffic demand forecast, route alternatives are compared from the viewpoint of traffic demand and impact on regional planning.

a) Road Network Profile

From the road network point of view, Alternative-B1 is preferable to the other alternatives since it connects with both the Inner and Middle Ring Roads, so that the ring road function is fully utilized for the dispersion of radial traffic to/from Surabaya.

b) Traffic Demand

Table VII-3 shows the forecast traffic demand on the alternative routes in terms of the average cross sectional traffic volume and the number of the Toll Road users.

Table VII-3 Cross Sectional Traffic Volume and Toll Road Users

Year	Average Cross Sectional Traffic Volume (Veh./day)			Average Number of Toll Road Users (Veh./day)		
	Alt-B1	Alt-D1	Alt-D2	Alt-B1	Alt-D1	Alt-D2
1995	9,100	10,200	9,300	10,300	11,500	11,200
2005	23,600	26,200	24,200	28,600	28,800	26,600
2015	67,600	69,400	65,300	83,000	75,400	67,200

Note: Number of toll road users is counted as a half of all on and off traffic of the Toll Road.

Alternative-D1 shows the highest average cross sectional traffic volume and it also attracts more traffic than the other alternatives in the early stage of the Toll Road operation. However, the number of the Toll Road users on

Alternative-B1 grows faster than those of the other alternatives, and it finally exceeds Alternative-D1 after the year 2005. From the traffic demand point of view, it can be said that Alternative-D2 is inferior to the other alternatives.

c) Impact on Regional Development

The positive impact of the Toll Road is greatly concerned with the possible and potential number of interchanges. Alternative-B1 will most effectively enhance the future development since it has more potential interchange locations than the others and will encourage the early implementation of ongoing development schemes in the region including a new town development in Driyorejo and the Tandes industrial development.

Overview of the issues discussed above concluded that Alternative-B1 is recommended from the viewpoint of transportation aspects.

(4) Economic Aspects

The results of preliminary economic cost benefit analysis (refer to Table VII-4) indicate that Alternative-B1 has the highest efficiency to the project investment out of the alternatives.

Table VII-4 Summary of Economic Comparison

Description	Alt-B1	Alt-D1	Alt-D2
EIRR	24.8 %	20.9%	18.4%
NPV (Mil. Rp.) at Discount Rate of 15%	201,939	127,526	62,953
B/C Ratio at Discounted Rate of 15%	2.03	1.60	1.33

(5) Summary

As summarized in the table below, Alternative-B1 is superior to the other alternatives in all aspects (Technical Aspect is normally neglected for comparison, since the matters in this item are quantified in the form of cost and benefit and are reflected in item D. Economic Aspects). Thus **Alternative-B1** was selected as the optimum route.

Preferable Priority in Four Major Aspects for Each Route Alternative

Major Aspects for Comparison		Order of Priority to Adopt		
		Alt-B1	Alt-D1	Alt-D2
A.	Technical Aspect	-	-	-
B.	Environmental Impact	1	3	2
C.	Transportation Aspects	1	2	3
D.	Economic Aspects	1	3	2

VII-6 Route Description

From the Mojokerto terminus, the connection with the Mojokerto Bypass at the southeast of Mojokerto city, the route runs in the northeast direction and crosses a railway line and the Porong river. After running through farmland for 5 km, the route changes direction to the north to cross the Surabaya river, then turns easterly to pass through the edge of a gentle hill area along the Surabaya river. After passing 3.5 km north of Krian city, the route turns slightly to the northeast along the Surabaya river passing through a flat area, then turns again easterly to pass through the edge of gentle hills on the south of the planned new town of Driyorejo. It turns to the northeast to avoid the military area then turns again easterly, crosses the provincial road and the Mas river and reaches the junction with the Surabaya-Gempol Toll Road 2 km north from Waru IC.

The route will cross the planned Inner and Middle Ring Roads of Surabaya. From the preliminary design based on 1/5,000 topographic map, the total route length is measured at 38.32 km.

VIII TRAFFIC DEMAND FORECAST

VIII-1 Present Vehicle OD Matrix

The traffic distribution pattern was estimated by using the traffic pattern obtained from the roadside OD survey as well as updating the results of the 1982 nation-wide traffic OD survey (National OD Survey).

The method of estimating the present 1990 vehicle OD matrix includes the following main processes as presented in Fig. VIII-1.

- Establishment of traffic zone system
- Estimation of Partial OD matrix, based on the OD information obtained from the 1990 roadside interview survey
- Updating the 1982 National OD Suivey results
- Consolidation of the updated National OD matrix and the estimated partial OD matrix

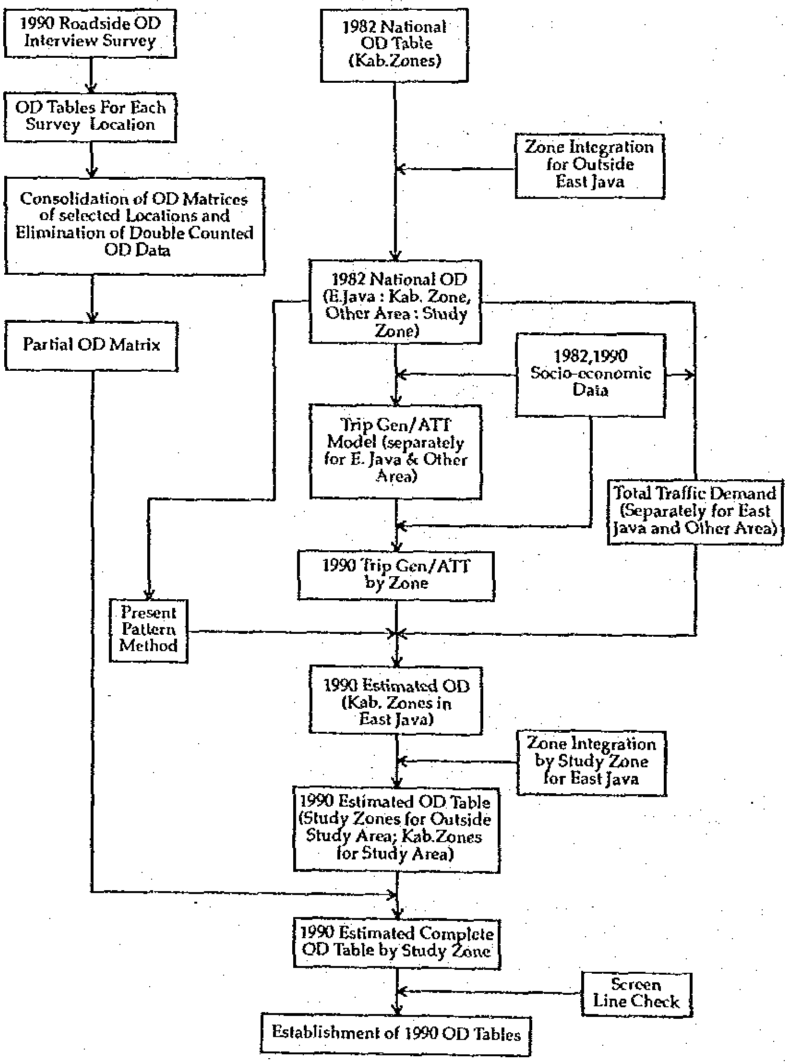


Fig. VIII-1 Flow Diagram for Estimating 1990 OD Matrix

The resulting 1990 OD matrix is presented by consolidating study zones to the East Java and outside East Java blocks as shown in Table VIII-1.

Table VIII-1 Estimated 1990 Block OD Matrix

(Unit: veh./day)

		Block (1) East Java	Block (2) Outside East Java	Total
Block (1)	Pass. Veh.	83,663	6,195	89,858
	Bus	6,896	224	7,120
	Pick-up	27,980	1,196	29,176
	Truck	41,357	3,880	45,237
Block (2)	Pass. Veh.	6,195	25,872	32,067
	Bus	224	31,792	32,016
	Pick-up	1,196	6,158	7,354
	Truck	3,880	14,189	18,069
Total	Pass. Veh.	89,858	32,067	121,925
	Bus	7,120	32,016	39,136
	Pick-up	29,176	7,354	36,530
	Truck	45,237	18,069	63,306

VIII-2 Toll Road Diversion Model

The diversion model was established with the two independent variables of toll rate and difference between travel times through a toll road route and through a non-toll road route, and with the dependent variable of diversion rate, a percentage of diverted traffic to toll road over the total traffic of a specific OD zone pair.

The model formula was calibrated from the data samples of the selected OD pair zones that include a competitive arterial road route against the existing toll road route. Consequently, parameters of the formula were calibrated as follows:

Passenger vehicle : $$p = \frac{100}{1+1.454219 \times 10^{-5} \times T^{2.229036}}$$

Pick-up : $$p = \frac{90}{1+2.623553 \times 10^{-5} \times T^{2.279117}}$$

Truck : $$p = \frac{80}{1+3.330657 \times 10^{-5} \times T^{1.741448}}$$

where, p = Diversion rate (%)
T = Toll/Travel time difference

For buses, the use of toll road is not determined by the preference of a driver but by the operational intention of the bus company. Therefore, the average rate of the existing toll road utilization was derived from the samples obtained from the bus terminal survey.

VIII-3 Future Road Network

The following network components are assumed to exist in the future, in addition to the existing road network.

Name of Trunk Road	Year of opening
Gempol - Malang Toll Road	1998
Surabaya - Gresik Toll Road (East)	1994
Surabaya - Gresik Toll Road (West)	1999
Gempol - Pasuruan Toll Road	1999
Inner Ring Road (East)	1999
Inner Ring Road (West)	2004
Middle Ring Road	2009

Road links incorporated into the network were classified into 9 categories and the Q-V (quantity and velocity) relationship was determined.

VIII-4 Forecast Future Traffic Demand

(1) Future Vehicle OD Matrix

The future OD matrix was based on the growth factors derived from the future vehicle ownership projections in East Java and Java total. As a result, the controlled future traffic generation by OD block was estimated as shown in Table VIII-2. The total generation in 2005 and in 2015 are predicted to be 2.6 times and 4.9 times respectively of that in 1990.

Table VIII-2 Estimated Future Traffic Generation by Zone Block

Block (1) East Java	Block (2) Outside East Java	Total Traffic Generation
M	N	T

(Unit: veh./day)

Year	M	N	T
(1) Passenger Vehicle			
1990	89,858	32,067	121,925
1995	128,878	45,450	174,328
2005	249,676	96,393	346,069
2015	462,700	209,731	672,431
(2) Bus			
1990	7,120	32,016	39,136
1995	9,092	42,626	51,718
2005	14,867	76,158	91,025
2015	24,500	137,240	161,740
(3) Pick-up			
1990	29,176	7,354	36,530
1995	44,596	9,018	53,614
2005	93,044	16,312	109,356
2015	180,384	36,466	216,850
(4) Truck			
1990	45,237	18,069	63,306
1995	57,619	23,368	80,987
2005	94,260	41,966	136,226
2015	156,016	79,319	235,335

In order to estimate the future zonal trip generation/attraction, model equations were calibrated from the established 1990 OD matrix and zonal socio-economic parameters (population and GRDP by Kabupaten) in 1990, based on regression analysis.

Applying future socio-economic parameter by Kabupaten to the above equations, the future trip generation by zone was derived.

(2) Traffic Assignment

The future road traffic volume was estimated by assigning the future OD traffic (matrix) to the future road network as shown in Fig. VIII-2.

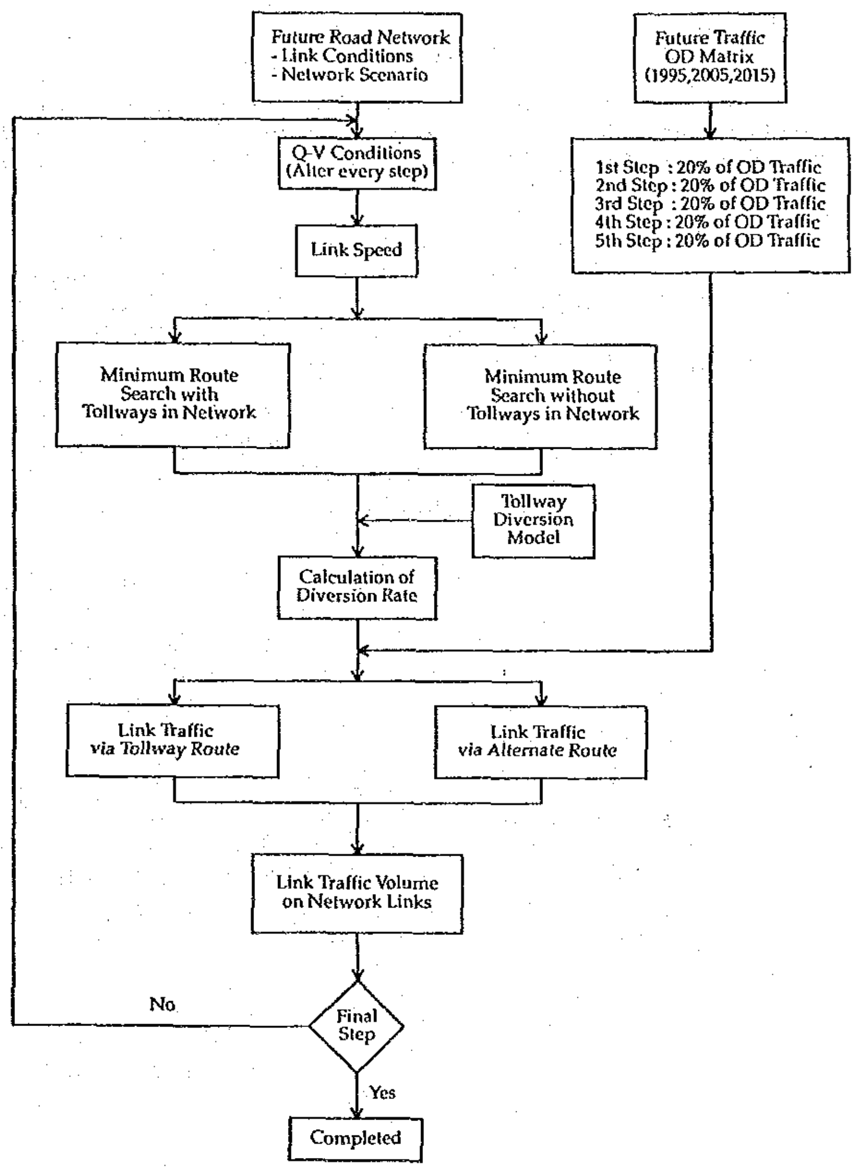


Fig. VIII-2 Flow Diagram for Traffic Assignment

A minimum travel time was adopted as a criterion when selecting possible alternative routes for a particular OD pair traffic. The future OD traffic was divided into 5 steps of 20% of OD traffic and the assigned traffic volume was estimated separately for "via toll road route" and "via non-toll road route". Link conditions (i.e. link speed) of the road network was evaluated after assigning the first 20% OD traffic to the network, and under the altered conditions the second 20% of the OD traffic was assigned to the network based on minimum time travel routings.

The travel time difference between "via toll road" and "via non-toll road" was computed for particular origin-destination traffic under the minimum route search process. The travel distance on the toll road was simultaneously calculated at the route search simulation stage.

Derived travel time difference and the corresponding toll for using toll roads were the basis used to calculate the rate of traffic diversion to the toll roads based on the diversion model.

(3) Estimated Traffic Volume on the Toll Road

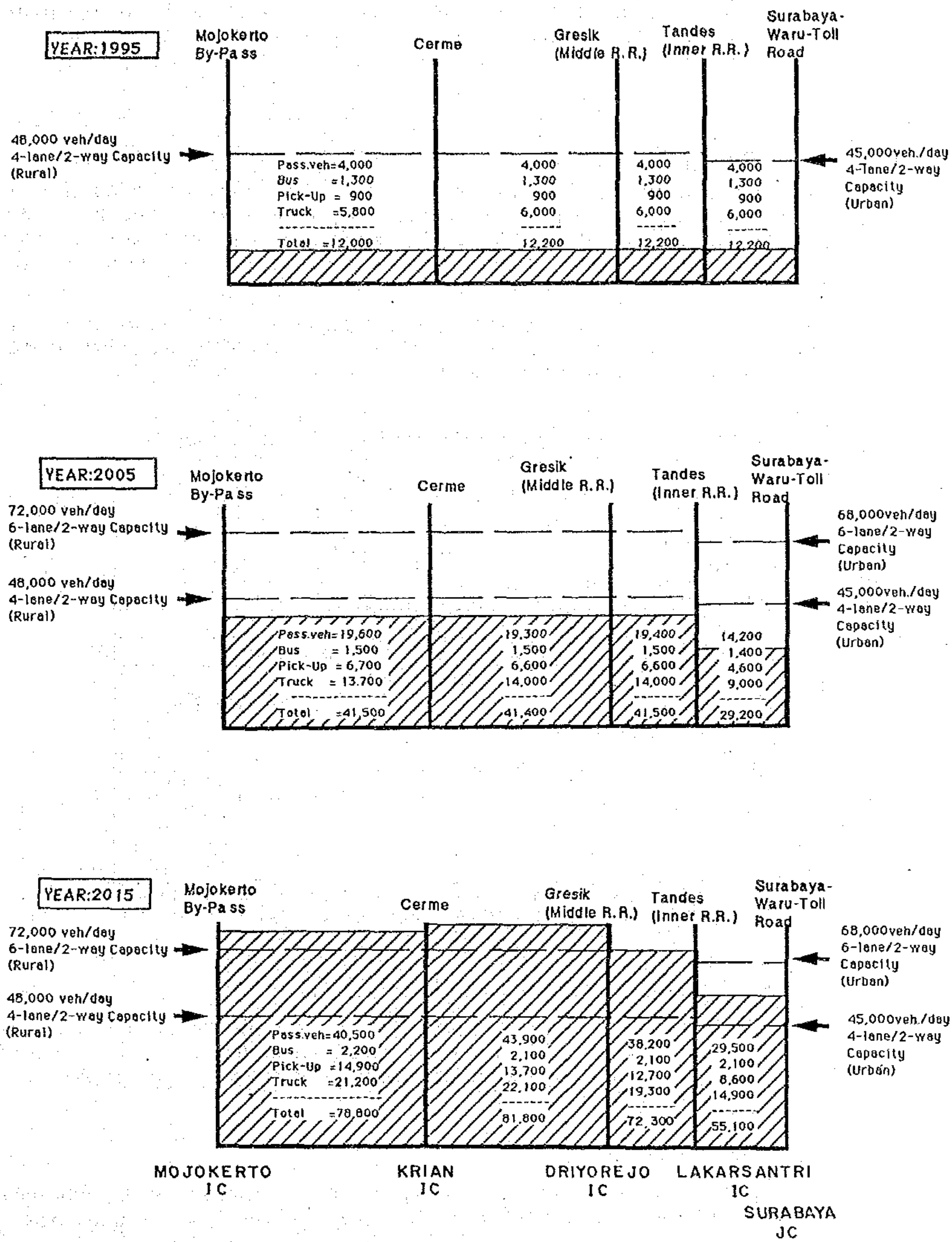
The forecast traffic volume is presented in Fig. VIII-3. The traffic volume in 2005 reaches near the capacity of a 4-lane/2-way toll road. It is, therefore, recommended that the Toll Road should be widened to a 6-lane/2-way toll road before the year 2010.

Decreases in the estimated future traffic volumes on the Toll Road are seen between Driyorejo IC and Surabaya JC. It is observed that these decreases are brought about mainly by the shortage of road capacity of the Surabaya-Waru section of the Surabaya-Gempol Toll Road as well as the openings of the Inner Ring Road and the Middle Ring Road which are assumed toll free.

The existing 4-lane/2-way Surabaya-Gempol Toll Road is estimated to reach its capacity around the year 1997. The road capacity of the Surabaya-Gempol Toll Road influences on the traffic demand on the Surabaya-Mojokerto Toll Road, particularly in the toll road section between the Inner Ring Road and the Junction with the Surabaya-Gempol Toll Road.

The widening of the Surabaya-Gempol Toll Road to a 6-lane/2-way toll road increases the traffic demand on the project Toll Road. The development of the Inner Ring Road is also influential to the Toll Road traffic demand. A total road capacity for the concentrating Surabaya bound traffic is not sufficient to fulfill the future traffic demand. The road network development in Surabaya city is a matter of important and urgent issue.

A ring road as well as a radial road development will soon be required to cope with the future demand for the Surabaya bound inter-city traffic. The Surabaya-Gresik Toll Road is scheduled to start construction soon and the Surabaya-Mojokerto Toll Road is expected to start operation in 1996. The Inner Ring Road development is required thereafter, together with the radial road development inside Surabaya city. Subsequently, the Surabaya-Gempol Toll Road should be widened to strengthen the Surabaya-Gempol corridor.



SURABAYA - MOJOKERTO TOLL ROAD PROJECT

Fig. VIII-3 Estimated Future Traffic Volume on the Toll Road

IX . PRELIMINARY ENGINEERING DESIGN

The preliminary engineering design was prepared for the selected optimum route based on the results of engineering survey and traffic demand forecast.

IX-1 Design Standards

(1) Geometric Design Standard

The geometric design standard for throughway of the Toll Road was established as shown in Table IX-1 referring to the Indonesian standard and the standards actually applied to the designs of Jakarta-Merak Toll Road (Tangerang-Merak Section, under construction) and Cikampek-Cirebon Toll Road (feasibility study completed in early 1990) which constitute parts of the Trans Java Tollway System.

A 120 km/hr design speed will be applied as a regional toll road in a flat terrain, except for the eastern section, east of the planned Inner Ring Road, where a 100 km/hr design speed will be applied as an urban toll road.

Table IX-1 Geometric Design Standard for Throughway of the Toll Road

Description	Unit	Standard
Design Speed	km/h	120/100
Sight Distance	m	225/165
Lane Width	m	3.6
Median Width	m	5.5
Inner Shoulder Width	m	1.5
Outer Shoulder Width	m	3.0
Minimum Radii	m	760(570)/460(380)
Minimum Radius not Requiring Transition Curve	m	4,000/3,000
Minimum Radius not Requiring Superelevation	m	7,500/5,000
Maximum Gradient	%	3.0/4.0
Crossfall of Carriageway	%	2.0
Crossfall of Shoulder	%	4.0
Maximum Superelevation	%	7.0(10.0)/9.0(10.0)

Note : ( ) shows absolute minimum values.

(2) Geometric Design Standard for Interchange Ramps

The geometric design standard for interchange ramps of the Toll Road is shown in Table IX-2 and is based on the Standard Specifications for Geometric Design of Urban Roads, January 1988, except for several items which refer to the Japanese standards and AASHTO standards.

(3) Bridge Design Standard

Basically, the "Loading Specifications for Highway Bridges (No. 12/1970)", published by Bina Marga was followed together with the addenda currently in use in Indonesia.

Table IX-2 Geometric Design Standard for Interchange Ramps

Description	Unit	Standard	
Design Speed	Km/h	40	50
Sight Distance	m	40	55
Lane Width	m	3.6	3.6
Median Width	m	2.5	2.5
Inner Shoulder Width	m	0.75	0.75
Outer Shoulder Width	m	3.0	3.0
Minimum Radii	m	50	90
Minimum Radius for Curve not Requiring Transition Curve	m	140	220
Minimum Radius for Curve not Requiring Superelevation	m	800	1,300
Maximum Gradient	%	6(8)	5.5(7.5)
Minimum Vertical Curve Length	m	40	50
Crossfall of Pavement	%	2	2
Crossfall of Shoulder	%	4	4
Maximum Superelevation	%	10	10

Note : ( ) shows absolute minimum values

(4) *Pavement Design Standard*

The AASHTO Guide 1986 for pavement design was applied. The increased axle load, from 8 ton to 10 ton for single axle load and from 15 ton to 18 ton for tandem axle, was taken into account.

IX-2 Highway Capacity and Number of Lanes

The highway capacity of the Toll Road was examined based on the Highway Capacity Manual (Special Report 209, Transportation Research Council) and was estimated at 48,000 vehicles/day for a 4-lane cross section and 72,000 vehicles/day for a 6-lane cross section. Comparison of the above capacity and the forecast Toll Road traffic suggests a 4-6 lanes stage construction in a 25-year time span of the Project life (presumed opening of the Toll Road is in 1996).

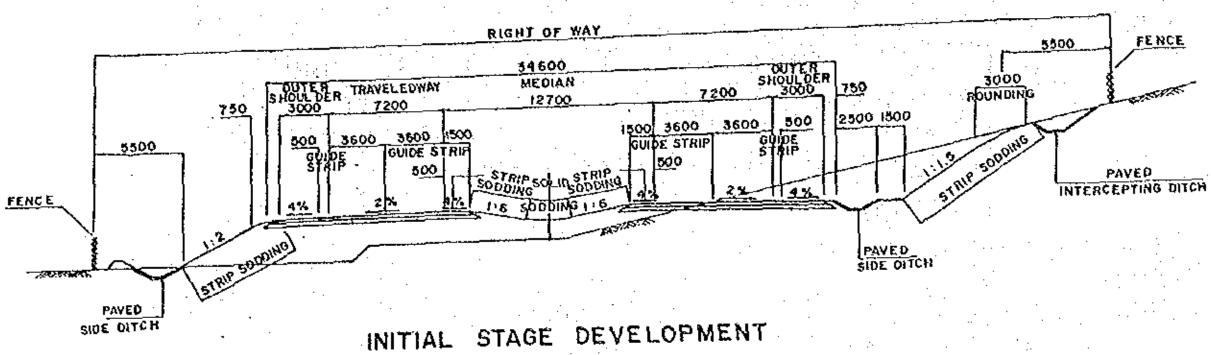
The method of 4-6 lanes stage construction is to construct earthwork for 6-lane with a 4-lane pavement at the outside in the initial stage and to widen the pavement for inner lanes in the ultimate stage construction. Widening to 6-lane will be required in around 2010. Bridges and viaducts will be constructed with full 6-lane width in the initial stage.

Typical cross sections of earthwork section and bridge section are shown in Fig. IX-1.

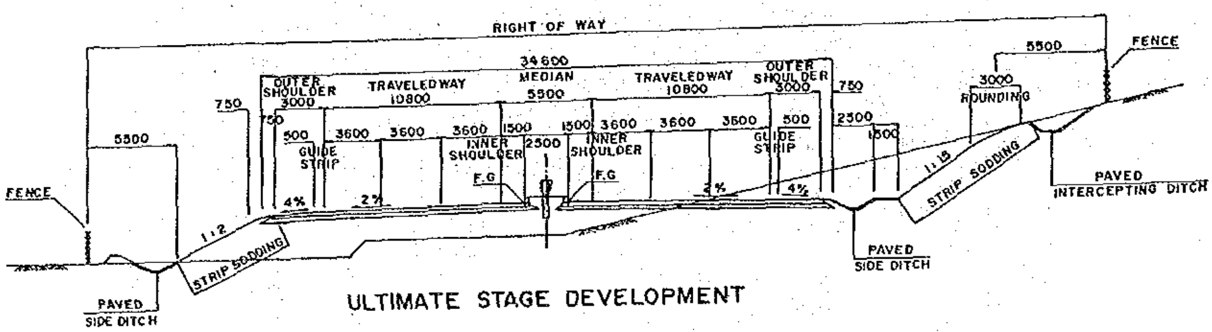
IX-3 Preliminary Geometric Design

The outline of design policies and controls for the determination of horizontal and vertical alignment are described as follows.

Earthwork Section



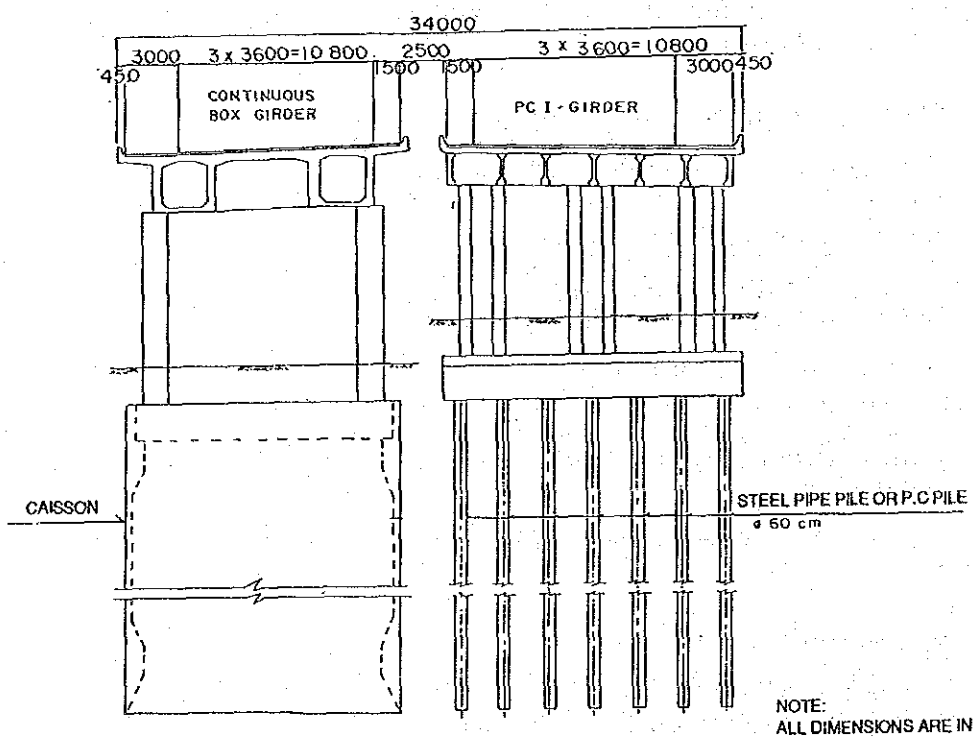
INITIAL STAGE DEVELOPMENT



ULTIMATE STAGE DEVELOPMENT

Bridge Section

LONG SPAN BRIDGE MIDDLE/SHORT SPAN BRIDGE



NOTE:
ALL DIMENSIONS ARE IN MILLIMETERS.

SURABAYA - MOJOKERTO TOLL ROAD PROJECT	Fig. IX-1 Typical Cross Sections

General

- Safe and efficient movement of high volumes of traffic at the specified design speed (i.e. 120 Km/hr and 100 Km/hr) shall be attained by the provision of good roadway alignment.
- Where vertical and horizontal curves occur in combination or in close proximity to each other, consideration should be given to designing a flowing alignment by providing good coordination of these curves.
- Excavation of expansive soils in the north of the Surabaya river shall be avoided if the situations permit.
- Countermeasures shall be provided to maintain the functions of the existing rivers, waterways, irrigation canals/channels and public facilities (i.e. roads., railways and utilities) which will be crossed by the Toll Road.

Horizontal Alignment

- To avoid as much as possible the existing public facilities such as schools, hospitals, mosques and government offices.
- To avoid the military area near Sta. 32.
- To avoid Kedurus retarding pond at Sta. 35+000 - 36+ 000.
- To avoid developing factory areas in the north of the Surabaya river and the existing large factory complex at Sta. 37+600.
- To minimize the demolition of existing housing complexes at Kedurus and Karang Pilang.

Vertical Alignment

- The Porong and the Surabaya rivers and major irrigation canals are provided with inspection roads. Vertical clearance will be maintained as required.
- Existing national and provincial roads are to be overcrossed (i.e. the Toll Road above) to avoid adverse effect to the existing traffic.
- Overcrossing (i.e. the Toll Road under) may be provided for Kab. roads and Desa roads, where it is effective to lessen the embankment requirement of the Toll Road construction.
- Severance of local communities will be avoided by the provision of box culverts.
- A minimum embankment height of 2 m above the existing ground shall be provided in technical irrigation areas to ensure the preservation of the irrigation systems.
- The embankment height shall be kept as low as possible in soft ground areas to reduce treatment effort as well as to shorten the construction period.

As a result of the detailed horizontal alignment design, the total length of the Toll Road is measured at 38.32 km.

IX-4 Preliminary Design of Interchanges

There are two categories of interchanges; i) tollway-to-tollway interchange (Junction : JC) and ii) tollway-to-artery interchange (Interchange : IC). A Junction is planned at the connection between the Toll Road and the Surabaya-Gempol Toll Road which has direct/high-speed connection but without provision of toll gates. Interchanges are planned at the crossings with arterial highways (including planned highways) to collect/distribute the Toll Road traffic from/to the arterial highway network in the Project Area, normally with provision of toll gates.

(1) Toll Levy System

The Toll Road will constitute a part of the Trans Java Tollway System, a system of regional toll roads. Therefore, it is understood that basically the Toll Road will be operated under a distance-proportional toll levy system.

The Toll Road will be connected at Surabaya JC with the Surabaya-Gempol Toll Road which is operated under two different kinds of toll levy system, the section north of Waru IC under a flat tariff toll levy system (as urban toll road section) and the section south of Waru IC under a distance-proportional toll levy system (as regional toll road section). There is a mainline toll barrier on Waru IC at the boundary of these two different systems.

Surabaya JC is located in the section of flat tariff toll levy system of the Surabaya-Gempol Toll Road. Therefore, it is necessary to provide a mainline toll barrier on the Toll Road in the west of Surabaya JC.

The area inside the planned Inner Ring Road is considered as an urban area. Therefore, it is reasonable and recommendable to operate the eastern section of the Toll Road under a flat tariff toll levy system for the convenience of urban toll road users whose trip length is relatively short.

(2) Location and Type of Interchanges

Five interchanges were planned in the stage of route selection (refer to Table IX-3). The shortest interval is 5.6 km between Driyorejo IC and Lakarsantri IC and the longest is 20.7 km between Mojokerto IC and Krian IC.

Table IX-3 List of Interchanges

No.	Name of Interchange	Sta.	Distance (km)	Type of Interchange	Connecting Road
1	Mojokerto IC	0+450		Double Trumpet	Mojokerto Bypass
2	Krian IC	21+150	20.70	Double Trumpet	Kabupaten Road
3	Driyorejo IC	26+900	5.75	Single Trumpet	Planned Middle Ring Road
4	Lakarsantri IC	32+500	5.60	Double Trumpet	Planned Inner Ring Road
5	Surabaya JC	38+320	5.82	Single Trumpet	Surabaya-Gempol Toll Road

These intervals fall in the standard range, referring to toll roads under a distance-proportional toll levy system in Japan and in eastern U.S.A. Therefore, the planned arrangement of interchanges is judged appropriate.

There is no major point of trip generation or attraction in the 20.7 km stretch between Mojokerto IC and Krian IC and no interchange is planned in the present plan. However, there is the possibility to provide an additional interchange in this stretch depending on the growth of traffic demand. Since the alignment of the Toll Road is favorable throughout this stretch, there will be no serious constraints for the provision of such additional interchange.

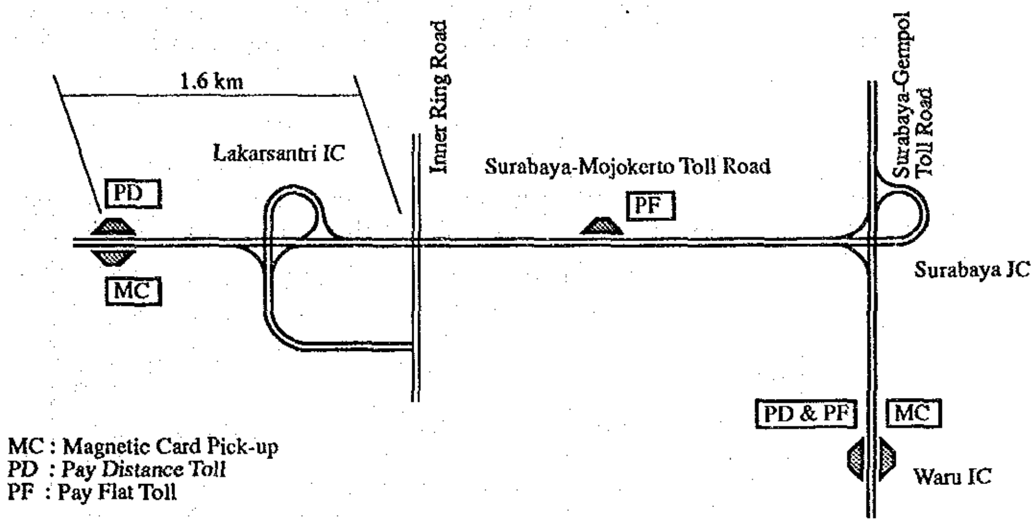
(3) Type of Interchange

For Surabaya JC of a 3-leg interchange, trumpet type was selected because of smaller construction cost in comparison with Y-type.

For interchanges, a trumpet type, single- or double-trumpet depending on the volume of on/off traffic, was selected which allows the provision of integrated on/off ramp gates at one location for economical and efficient tollway operation and management under the distance-proportional toll levy system.

(4) Toll Barrier

It is recommended to locate a mainline toll barrier in the west of Lakarsantri IC at Sta. 30+900 based on the concept that the section in the east of Lakarsantri IC will be operated under a flat tariff system as an urban toll road section, combined with the same tariff section of the Surabaya-Gempol Toll Road. A mainline toll barrier will be located at 1.6 km west of Lakarsantri IC, in the initial stage construction. At the time of the construction of the Inner Ring Road and Lakarsantri IC, another toll barrier for the flat tariff section can be constructed at Sta. 34+800.



IX-5 Preliminary Design of Bridges /Viaducts

The total length of bridge/viaduct sections is 4,060 m which amounts to 10.6% of the total length of the Toll Road.

(1) Superstructure

For the crossings of the Porong and Surabaya rivers, 3-span continuous PC box girder bridges were adopted to minimize disturbance to the existing river flows.

For the other bridges and viaducts, the I-girder bridge was selected from among the precast bridge types of PC I-, U- and T-girders based on its economy and ease of construction. Girders are composite type and a Gerber structure with reinforced concrete cantilevered pier decks was adopted. Span length ranges between 12.5 - 40.0 m and standardization of girders was considered in the design.

(2) Substructure

The height of abutments ranges from 5 to 10 m, therefore the reversed T-type abutment was adopted.

Column type pier was adopted for most bridges and viaducts since the appearance is less clumsy and bulky. However, for the long span bridges for the Porong and Surabaya rivers, wall type pier was adopted to provide smooth flow of water near the piers.

(3) Foundations

Pile foundations are necessary due to adverse sub-surface soil conditions in the Project Area. Precast PC pile (ø 60 cm) was generally adopted except for in the soft ground areas. Steel pipe pile (ø 60 cm) was used in the soft ground areas where the depth of adverse soils is more than 30 m (i.e. Karang Pilang Viaduct, Mas River Bridge and Wonocolo Viaduct).

For the long span bridges over the Porong and Surabaya rivers, open caisson was adopted due to the excessively large external forces at the fixed end. These foundations should be constructed during the dry season when the water level becomes lower to minimize construction cost as well as to mitigate the adverse environmental effect.

IX-6 Preliminary Design of Pavement

Flexible pavement was selected because of lower initial investment cost, suitability in soft ground areas and more comfortable riding condition than rigid pavement.

The thickness design of flexible pavement was made based on the AASHTO Guide for Design of Pavement Structure 1986 and the following conditions.

a) Time Constraints

- Analysis period = 20 years
- Two-stage construction
- Performance period of initial stage = 10 years
- Performance period of second stage = 10 years

b) Axle Load Model

Taking into account the overloaded axle condition and the Government's intention to increase the allowable axle load from 8 ton to 10 ton for single axle and from 15 ton to 18 ton for tandem axle for the important road links, a new axle load model is proposed.

c) Design Sections

Taking into account the condition of roadbed soil and embankment materials, thickness design was prepared for the following two design sections.

Design Sections

Design Section			Design CBR
1	:	Sta. 0+000 - Sta. 25+000 and Sta. 34+000 - Sta. 38+300	10
2	:	Sta. 25+000 - Sta. 34+000	5

The results of thickness design are summarized as shown below.

	Design Section 1	Design Section 2
Initial Stage		
Asphalt Concrete	22 cm	22 cm
Granular Base	25 cm	20 cm
Granular Subbase	-	25 cm
Second Stage		
Asphalt Concrete Overlay	14 cm	15 cm

IX-7 Length by Structural Type and Major Work Quantities

(1) Length by Structural Type

As a result of the preliminary engineering design, the total length of the Toll Road is measured at 38.32 km, out of which 34.26 km (89.4%) is of earthwork sections and the remaining 4.06 km (10.6%) is of bridge/viaduct sections, as shown in Table IX-4.

In earthwork sections, cut sections are limited to the stretches between Sta.14+200 and Sta.14+900 and between Sta.28+600 and Sta.33+900, where the Toll Road passes through hilly areas in the north of the Surabaya river.

Table IX-4 Length by Structure Type

Section		Total Length (km)	Earthwork Section			Bridge Section (km)
			Fill (km)	Cut (km)	Total (km)	
SECTION 1						
Mojokerto IC (Sta. 0+000)	- Krian IC (Sta. 21+000)	21.00	17.62 (83.9%)	1.10 (6.2%)	18.72 (89.1%)	2.28 (10.9%)
SECTION 2						
Krian IC (Sta. 21+000)	- Surabaya JC (Sta. 38+318)	17.32	13.84 (79.9%)	1.70 (9.8%)	15.54 (89.7%)	1.78 (10.3%)
Total		38.32	31.46 (82.1%)	2.80 (7.3%)	34.26 (89.4%)	4.06 (10.6%)

(2) Work Quantities of Major Work Items

Table IX-5 shows the work quantities of major work items for the initial stage construction of the Toll Road.

IX-8 ROW Acquisition and Utility Relocation/Protection

(1) ROW Acquisition

The required ROW acquisition for the construction of the Toll Road was estimated at 2,733,500 m2 as shown in Table IX-6. The ROW width varies from 50 to 80 m depending on the embankment height and cutting depth in earthwork section. A 40 m constant ROW width (3 m from the edge of structure) will be secured for bridge/viaduct sections, except for the sections passing through housing areas. A wider ROW, 10 m from the edge of structure, will be secured along the bridge/viaduct sections passing through housing areas in Surabaya for the provision of a buffer zone of green belt, pedestrian path, etc. in connection with the preservation of the environment.

Table IX-5 Work Quantities

DESCRIPTION	UNIT	Section 1 Mojokerto IC to Krian IC (Sta. 0 - 21)	Section 2 Krian IC to Surabaya JC (Sta. 21 - 38.3)	Total
Clearing & Grubbing	m2	788,200	834,000	1,622,200
Common Excavation	m3	209,000	347,600	556,600
Borrow Material	m3	2,883,100	1,898,600	4,781,700
Sand Mat	m3	142,600	187,400	330,000
Sand Drain Pile, D=40cm	m	365,100	719,500	1,084,600
Continuous Box Girder	m2	8,720	-	8,720
PC I-Girder, S≥30m	m2	57,600	39,100	96,700
PC I-Girder, S<30m	m2	5,310	12,780	18,090
Overbridge	m2	2,860	2,480	5,340
Abutment	m3	9,510	8,030	17,540
Pier	m3	47,970	35,420	83,390
PC Pile, D=0.6m	m	142,730	51,350	194,080
Steel Pipe Pile, D=0.6m	m	-	88,200	88,200
Caisson Foundation	m3	8,410	-	8,410
Paved Ditch	m	43,400	38,600	82,000
Pipe Culvert	m	3,955	2,185	6,140
Box/Portal Culvert	m	2,120	1,496	3,616
Subgrade Preparation	m2	563,200	491,900	1,055,100
Subbase	m3	34,400	75,800	110,200
Granular Base	m3	102,100	80,100	182,200
Prime/Tack Coat	kg	1,380,300	1,208,100	2,588,400
Binder/Surface Course	ton	231,100	202,500	433,600
Asphalt Cement	ton	15,000	13,200	28,200
Concrete Pavement, T=30cm	m2	2,500	9,500	12,000

Table IX-6 ROW Acquisition

(Unit : m2)

Description	Section 1 (Sta. 0 - 21)	Section 2 (Sta. 21 - 38.3)	Total
Developed Area	0	49,800	49,800
Village (Kampung) Area	170,900	89,300	260,200
Farmland	1,185,400	1,049,300	2,234,700
Vacant Land	17,500	171,300	188,800
Total	1,373,800	1,359,700	2,733,500

(2) Relocation/Protection of Utilities

At the crossings with existing PLN electric power transmission lines (70/150 KVA), 11 lines at 5 locations, it is necessary to construct additional 15 pylons on the side(s) of the Toll Road. The existing aerial electric cables and telephone lines crossed by the Toll Road, estimated at 107 locations, will be reconstructed with underground facilities.

X CONSTRUCTION PLANNING

X-1 Basic Conditions of Construction Planning

(1) Construction Sections

For the convenience of construction planning, the Toll Road is divided into the following two sections and work quantities are estimated by section:

Section 1	:	Sta. 0 + 000 - Sta. 21 + 000 (Mojokerto IC - Krian IC, L = 21.00 Km)
Section 2	:	Sta. 21 + 000 - Sta. 38 + 318 (Krian IC - Surabaya JC, L = 17.32 Km)

(2) Equipment Intensive Construction

To attain construction economy and to realize the Toll Road with a shorter construction period, the equipment intensive construction method will be adopted.

(3) Hauling of Materials

The construction involves the hauling of a large quantity of embankment/pavement materials. Basically the Project Area is provided with a sufficiently dense road network (refer to Fig. X-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.

At the job site, the construction should be executed in a sequence to use the mainline of the Toll Road as a pilot as much as possible to enable the transportation of materials on it, without using the parallel national road in order to avoid disturbance to the existing traffic.

X-2 Procurement of Material

(1) Embankment Material

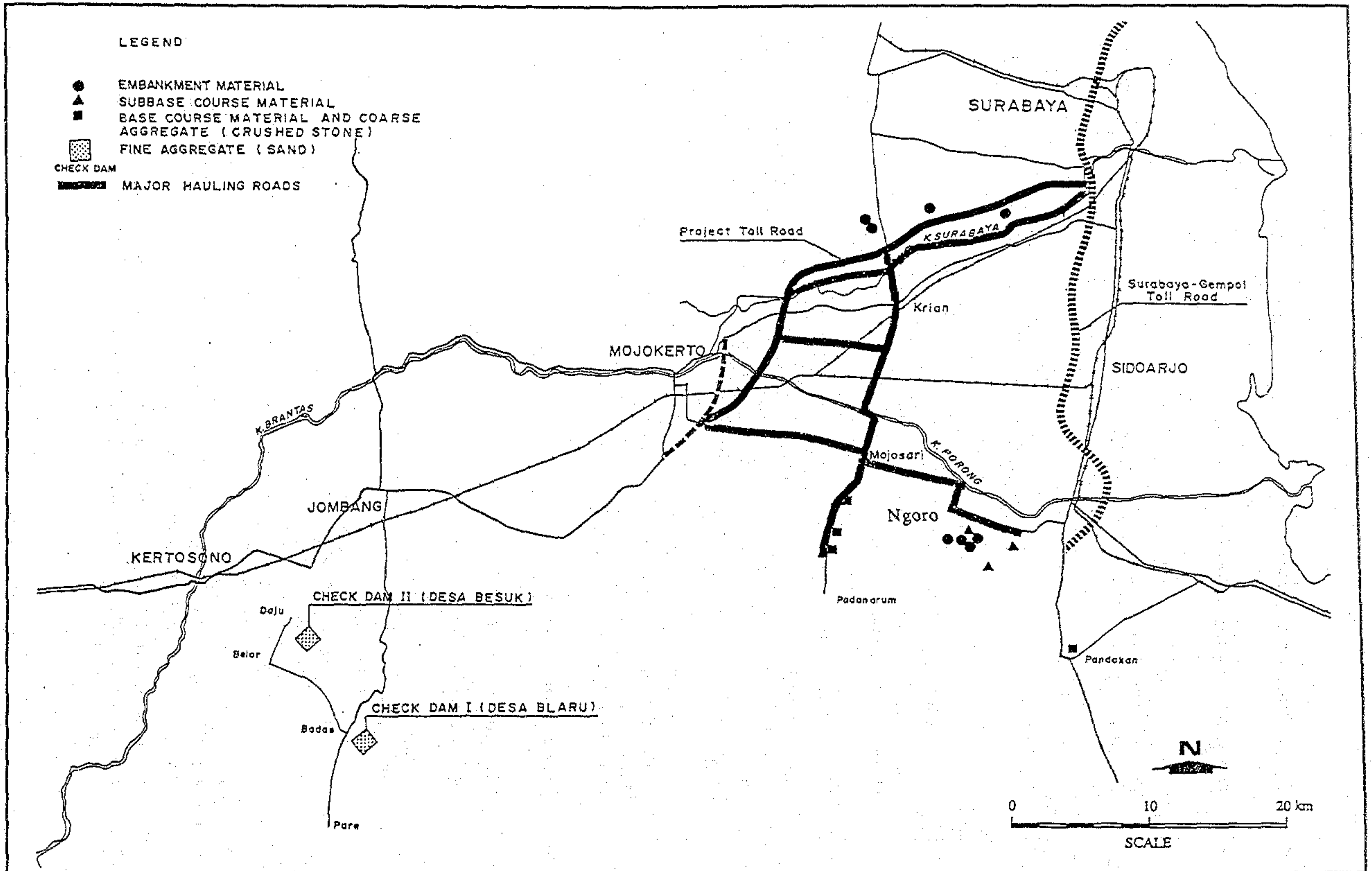
The location of available borrow pits of embankment material is shown below:

Location of Borrow Pits

Borrow Pit Location	Soil Type
- Southeast of Mojosari	Laterite
- Southeast of Mojosari	Fine to Coarse Sand
- Hilly area nearby the Toll Road	Silty Soil, Tuffaceous Clay

Most of embankment materials will be obtained from the borrow pits southeast of Mojosari, except for the middle part of Section 2 which will be constructed with borrow materials available near the site (about 500,000 m^3 in total).

Materials obtained from common excavation (i.e. silty soil) will be utilized for the embankment as much as possible. Excavated topsoil will be stockpiled and later utilized for sodding.



SURABAYA - MOJOKERTO TOLL ROAD PROJECT	Fig. X-1 Material Sources and Major Hauling Roads

(2) Pavement Materials and Aggregates

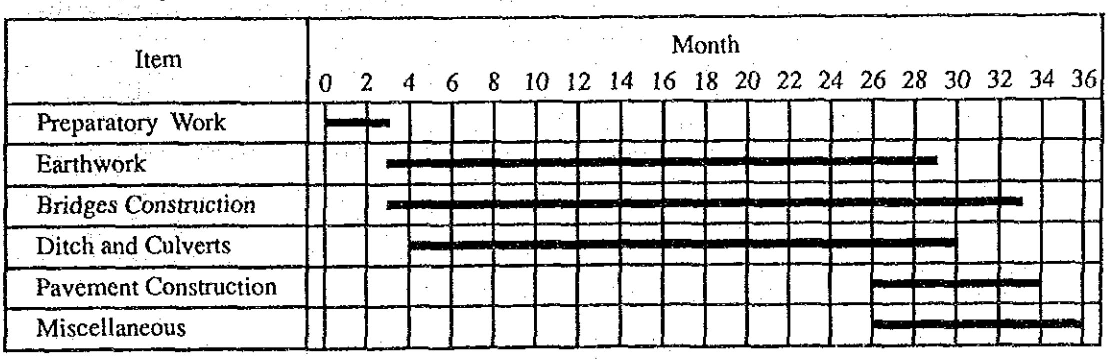
Subbase course materials from southeast of Mojosari will not require processing for gradation control considering the nature of the deposit.

Base course materials and coarse aggregate will be obtained from the south of Mojosari where a number of aggregate producers are in operation. Raw materials are obtained from gravel pits. The contractor will be able to establish his own pit and to operate his own crushing/screening plant. Fine aggregate will be obtained in sand deposits from eruption of Mount Kelud in the south of Jombang.

X-3 Construction Time Schedule

The construction time schedule for each construction section is prepared as a 3-year period, taking into account the scale of the construction works, availability of major equipment and plant and number of working days estimated, as shown in Fig. X-2.

Section 1 (Mojokerto IC - Krian IC : 21.00 km)



Section 2 (Krian IC - Surabaya JC : 17.32 km)

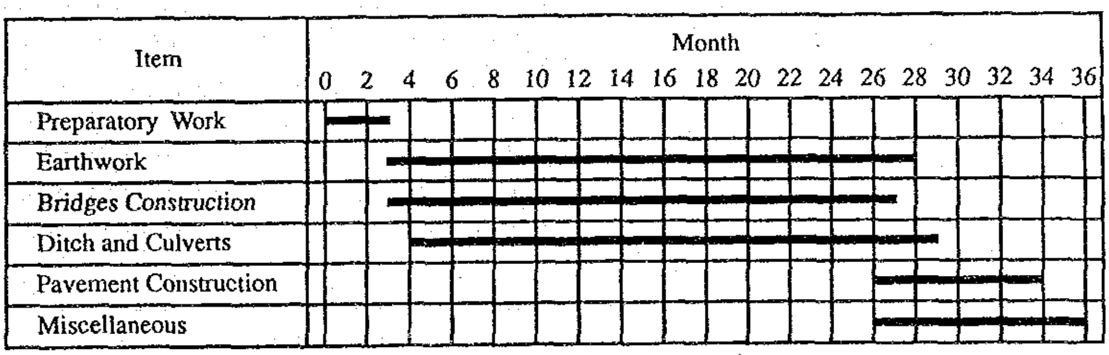


Fig. X-2 Construction Time Schedule

X-4 Implementation Schedule

Based on the fact that the interested private investors have been already invited to submit investment proposals for the implementation of the Project, it is assumed that the final engineering design for the Project will be started by late 1991 for a one year period, and that construction will be executed in 3 years from the beginning of 1993. The opening of the Toll Road to traffic will be at the beginning of 1996 (refer to Fig. X-3).

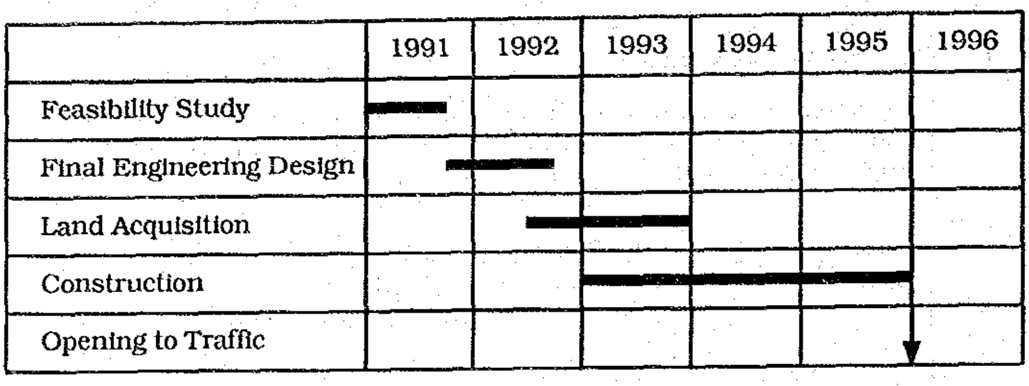


Fig. X-3 Implementation Schedule

XI OPERATION AND MAINTENANCE OF THE TOLL ROAD

XI-1 Tollway Operator

Private sector participation is assumed for the construction and operation of the Toll Road. The participation of P.T. Jasa Marga (Persero, Indonesian Highway Corporation) is an essential requirement in all tollway development and private investor participation should be implemented in the form of a joint venture or joint operation with P.T. Jasa Marga.

The Toll Road will be connected with the Surabaya-Gempol Toll Road operated by P.T. Jasa Marga, therefore, these tollways will be operated by two (2) different operators.

XI-2 Scope of Operation and Maintenance Works

The scope of operation and maintenance works is broadly divided into i) tollway maintenance, ii) traffic management and iii) toll collection.

(1) Tollway Maintenance

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 pavement, cut and fill slopes, drainage, bridges and other structures and facilities to monitor any defects and damages to them. The results of inspection will be promptly reported to a regional operation office for follow-up maintenance works as required.

Periodic maintenance is based on detailed inspection to be performed at certain time intervals such as weekly, monthly or yearly depending on type and kind of facilities, including checking and testing the conditions of various structures and facilities. Defects and damages will be reported for repairs or remedies. Periodic maintenance also covers such works as cleaning of pavement, guardrail and sign board, mowing and maintenance of landscape plantation, and road marking and painting.

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

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

- Cleaning of pavement
- Mowing and maintenance of plantation
- Cleaning of ditches and culverts
- 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, widening, construction of additional rest facilities, etc.

(2) Traffic Management

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

Highway patrol will be conducted to find damage to road facilities, traffic accidents, illegal parking, disabled cars and other extraordinary conditions which disturb traffic safety. Information and reports will be dispatched to a regional operation office through radio communication equipped on the patrol cars.

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

Traffic control includes general control for 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 will be conducted in cooperation with traffic police. Axle load meters will be installed at entries of interchanges for weighing.

(3) Toll Collection

The Toll Road will be basically operated under a distance-proportional toll levy system as a regional toll road. A magnetic card system will be used. Users pick up a magnetic card on entry and pay toll on exit at toll gates at interchanges and at the mainline toll barrier. Totalling and audit of collected toll and recording of traffic data will be also executed at toll gate offices.

XI-3 Organization for Operation and Maintenance

For the assumed private investor participation in the Toll Road, the organization for operation and maintenance should be self-sufficient, separated from that of the Surabaya-Gempol Toll Road. Its basic organization will be composed of a Head Office, a Regional Operation Office and Toll Gate Offices.

1) Head Office

The Head Office 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 be best located in Jakarta to ensure smooth and easy access to the related governmental agencies, financial institutions and business opportunities.

2) Regional Operation Office

The Regional Operation Office will be responsible for execution of operation and maintenance works for the Toll Road. Since the total length of the Toll Road is only 38 km, the establishment of one office is sufficient, as the farthest point from the office can be reached within 30 minutes. It is recommended that the office will be located near the mainline barrier gate, 1.6 km west of Lakarsantri IC.

3) Toll Gate Offices

A toll gate office will be provided at every interchange (Mojokerto IC and Krian IC in the initial stage construction) and at the mainline toll barrier to administer toll transactions, issuance of magnetic cards at entry and collection of toll at exit. Toll collectors will work in 3 shifts.

XI-4 Operation and Maintenance Cost

The annual operation and maintenance costs of the Toll Road in 1991 price are estimated at Rp. 4,677 mil. for 4-lane and Rp. 5,144 mil. for 6-lane, based on the data from the administrative office of the Surabaya-Gempol Toll Road.

XII ENVIRONMENTAL STUDY

XII-1 Study Purpose

The purpose of the environmental study is to ensure that during the planning of the Toll Road, careful consideration has been given to possible environmental effects, so that the plan will, to the extent practicable, minimize adverse effects, and also achieve beneficial effects or enhance environmental values, especially for the purpose of offsetting any unavoidable adverse effects. To this end, the preliminary identification of environmental impacts was carried out by the Study Team.

XII-2 Major Environmental Effects and their Mitigation

The environmental conditions along the Toll Road corridor were examined referring to the totality of human's surroundings: social, manmade, physical and natural. Preserved forest, important vegetation and wildlife are not found in the Toll Road corridor.

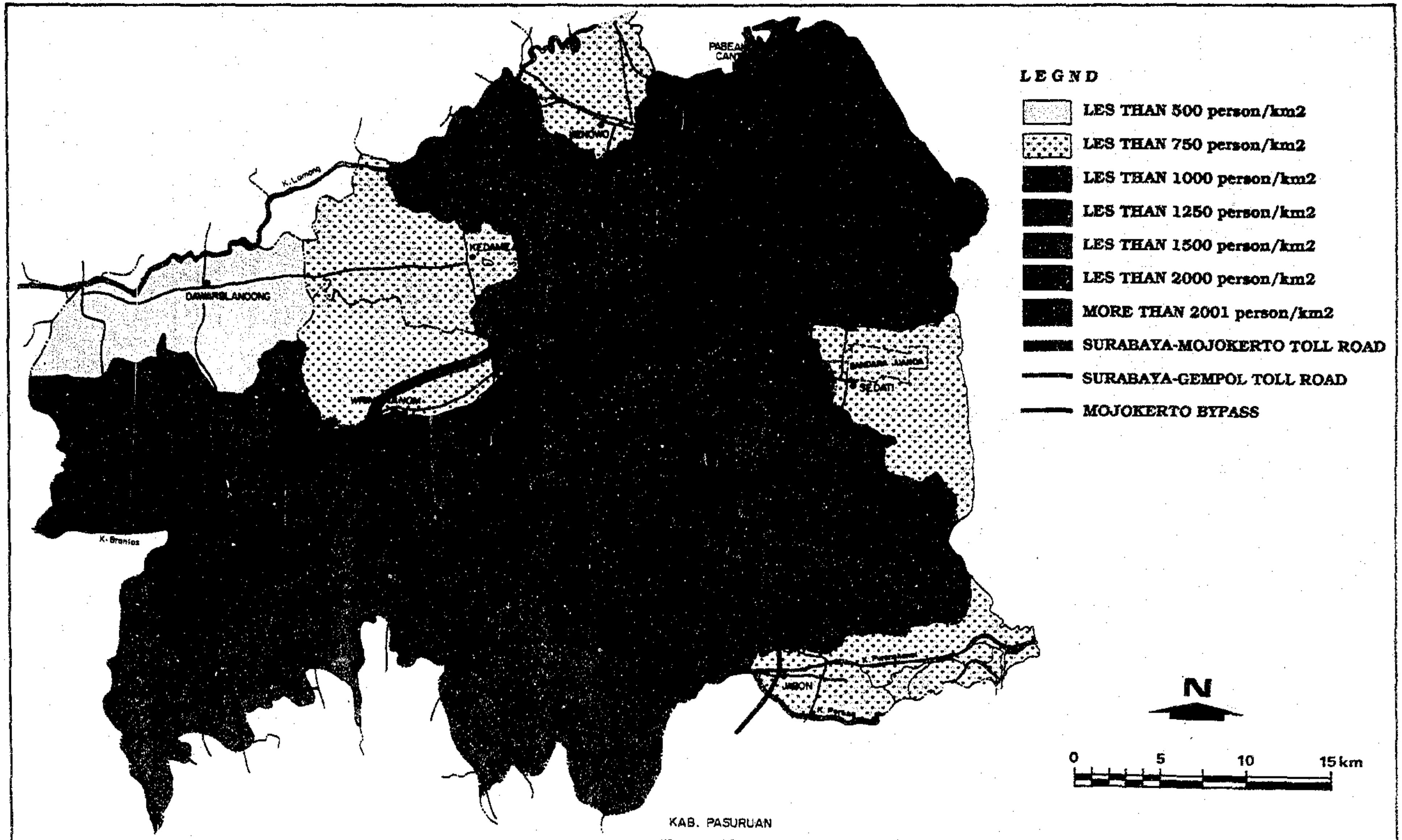
The most significant environmental condition which affects the planning/design of the Toll Road is the social settings especially displacement of residents and loss of agricultural land. The Brantas Delta spread out in Kab. Sidoarjo and Kab. Mojokerto is the most densely populated area (more than 1,000 person/km^2) in the region and irrigation canal networks are maintained by modern agricultural development technology. The selected route runs through this area avoiding as much as possible conditions such as those mentioned above, as shown in Fig. XII-1.

In the construction phase, almost all construction activities will entail environmental impacts associated with transportation matters including air (dust) and noise impact, traffic congestion/accident and damage on existing roads.

To mitigate these matters, certain existing provincial road(s) will be widened to meet the traffic demand and strict traffic management will be enforced to provide smooth traffic flows.

After opening to traffic, the traffic noise/vibration and air quality problems are related to various factors, some of which could be mitigated by proper design for the roadside areas. It is necessary to promote a fundamental condition survey and to establish a monitoring system for these problems.

A full scale environmental impact analysis based on detailed research and examination of the environmental conditions should be conducted and an ANDAL report prepared by the execution body of the Project at the earliest stage as a continuation of this preliminary study.



SURABAYA - MOJOKERTO TOLL ROAD PROJECT

Fig. XII-1 Population Density by Kecamatan

XIII PROJECT COST ESTIMATE

XIII-1 Premises of Cost Estimate

The basic premises in estimating the project cost were as follows:

1) All the construction works will be executed by contractor(s) to be employed by the private investor for the development of the Project.

2) The unit price of each cost component was determined based on the economic conditions prevailing in March 1991. The unit prices of construction works were determined based on the analysis of labor cost, material cost, equipment cost and overhead and profit for major work items. The unit costs of land acquisition and compensation and utility relocation were based on data obtained from the related agencies.

3) For the construction works, Indonesian taxes and duties on import equipment and materials (tax percentage depending on type/kind of equipment and materials) will be imposed. Indonesian value added tax (10%) will be also imposed on the contractor.

4) Engineering cost was assumed to be 5% of construction cost.

5) Physical contingency was estimated to be 10% of the total of construction cost, purchase cost of maintenance equipment, land acquisition and compensation costs, utility relocation cost, and engineering cost.

The project cost was estimated in financial cost and in economic cost. The economic project cost for economic analysis was estimated by deducting such transfer items as taxes and duties from the financial project cost.

XIII-2 Estimated Project Cost

(1) Initial Investment Cost

The estimated initial investment cost is Rp. 391,757 mil. in financial cost and Rp. 354,123 mil. in economic cost, as summarized in Table XIII-1.

In the total construction cost, bridge/viaduct construction takes up the largest part, 47.3% of the total. The remaining 52.7% is taken up by earthwork (24.4%), pavement work (11.5%), ditches and culverts (3.0%), miscellaneous works (4.7%) and general items including mobilization and protection of traffic, strengthening/widening/maintenance of hauling roads (9.1%).

Table XIII-1 Summary of Initial Investment Cost

Description	Financial Cost (mil. Rp.)	Economic Cost (mil. Rp.)
Construction cost	263,194	231,108
Purchase of maintenance equipment	1,141	911
Land acquisition and compensation	75,433	75,433
Utility relocation	3,215	2,923
Engineering	13,160	11,555
Sub-Total	356,143	321,930
Contingency	35,614	32,193
Total	391,757	354,123

(2) Additional Investment Cost

Additional investment cost was estimated as summarized in Table XIII-2.

Table XIII-2 Summary of Additional Investment Cost

Description	Assumed Year of Const.	Financial Cost (mil. Rp.)	Economic Cost (mil. Rp.)
Overlay cost (4-lane)	2005	17,463	14,026
Overlay cost (6-lane)	2015	18,240	14,754
Widening cost	2010	27,408	23,680
Lakarsantri IC	2003	18,796	17,236
Driyorejo IC	2008	5,966	5,310
Krian IC (2nd interchange)	2015	1,944	1,746

XIII-3 Yearly Cash Flow of the Project Cost

A yearly cash flow of the project cost was prepared as shown in Table XIII-3, assuming the following implementation schedule of the initial stage development.

Detailed Design	Late 1991 - Late 1992 (1 year)
Land Acquisition	Mid. 1992 - End 1993 (1.5 years)
Construction	Beginning. 1993 - End 1995 (3 years)

Table XIII-3 Yearly Cash Flow of the Project Cost (Financial Cost)

1) Initial Investment Cost

Description	Year					
	1991	1992	1993	1994	1995	TOTAL
Construction			78,958	105,278	78,958	263,194
Maintenance Equip.					1,141	1,141
Land Acquisition		37,717	37,716			75,433
Utility Relocation		1,608	1,607			3,215
Engineering	1,579	3,685	2,369	3,158	2,369	13,160
SUB-TOTAL	1,579	43,010	120,650	108,436	82,468	356,143
Contingency	158	4,301	12,065	10,843	8,247	35,614
TOTAL	1,737	47,311	132,715	119,279	90,715	391,757

2) Additional Investment Cost

Description	Overlay 2005	Overlay 2015	Widening 2010	L'santri IC 2003	Driyorejo IC 2008	Krian 2nd IC 2015
Construction	15,413	16,099	24,190	12,050	4,850	1,567
Land Acquisition				4,675	428	153
Engineering	462	483	726	362	146	47
SUB-TOTAL	15,875	16,582	24,916	17,087	5,424	1,767
Contingency	1,588	1,658	2,492	1,709	542	177
TOTAL	17,463	18,240	27,408	18,796	5,966	1,944

XIV ECONOMIC PROJECT ANALYSIS

XIV-1 Methodology

The economic analysis followed the conventional discounted cash flow methodology in determining the economic internal rate of return (EIRR), net present value (NPV) and benefit cost ratio (B/C ratio).

XIV-2 Economic Costs

The Project costs were estimated as the economic costs subtracting the portion of transfer payment such as taxes and duties from financial costs, in constant 1991 prices.

The initial investment costs were estimated at Rp. 354,123 million, which will be disbursed in 1991-1995.

The additional investment costs of widening from 4-lane to 6-lane in 2010 and pavement overlays in 2005 and 2015 were also estimated in the economic costs, at Rp. 23,680 million, Rp. 14,026 million and Rp. 14,754 million respectively.

The economic annual operation and maintenance costs were estimated to be Rp. 4,209 million and Rp. 4,630 million for 4-lane and 6-lane highway respectively.

XIV-3 Economic Benefits

The economic benefits quantified for the analysis were the savings in travel costs, composed of vehicle operating cost and vehicle time cost, when comparing the "With" and "Without" Project conditions.

(1) Vehicle Operating Costs

Unit vehicle operating costs were estimated for 7 categories of vehicles, i.e. sedan, minibus (private), minibus (public), pick-up, medium truck, large truck and large bus, based on the analysis of the following cost components of the representative vehicles selected for each category.

- Depreciation cost of vehicle
- Tyre cost
- Fuel cost
- Maintenance cost
- Interest cost
- Insurance cost
- Crew cost
- Overhead cost

The unit vehicle operating costs of 7 vehicle categories were then combined into the 4 vehicle categories of passenger vehicle, pick-up, truck and bus, following the classification for traffic assignment, based on the vehicle composition rate obtained by traffic survey. The unit vehicle operation costs by vehicle category and by travelling speed are summarized in Table XIV-1.

Table XIV-1 Unit Vehicle Operating Costs

(Unit : Rp. /km)

Travelling Speed (km/hr)	Passenger Vehicle	Pick-up	Truck	Bus
10	555	402	766	1,403
15	423	308	604	1,160
20	352	256	519	1,039
25	307	222	467	970
30	275	198	432	928
35	252	180	409	903
40	233	166	392	889
45	220	155	381	884
50	209	147	374	886
55	202	140	370	894
60	196	136	370	906
65	192	133	373	922
70	190	131	378	941
75	190	131	384	864
80	190	132	393	990
85	193	134	403	1,018
90	196	137	416	1,050
95	201	141	430	1,083
100	207	146	446	1,120

Note : Economic costs in 1991 prices

(2) Unit Vehicle Time Costs

Unit vehicle time costs were estimated based on the following toll road diversion equations derived from the traffic survey conducted by the Study.

$$P = \frac{K}{1 + \alpha \cdot T^{\beta}}$$

where,

P : Diversion Rate (%)

T : Toll per travel time difference (Rp./min.) between "via toll road" and "via alternate route"

α, β, K : Parameters of the diversion equation model

The calculated diversion rates using the above equation for differentiated factors of toll per travel time difference produce a probability density distribution. Based on the obtained probability density distribution, the corresponding diversion rate to the median of distribution was estimated at 50% for passenger vehicle, 40% for pick-up and 30% for truck. Applying the above diversion rate, the time values for each vehicle type were estimated for passenger vehicle, pick-up and truck. As for buses, an income approach was adopted to the estimated non-car owners.

The estimated unit vehicle time costs are summarized in Table XIV-2.

Table XIV-2 Unit Vehicle Time Cost

Vehicle Type	Time Cost (Rp./hr.)
Passenger Vehicle	8,880
Pick-up	6,780
Truck	7,980
Bus	7,960

(3) Estimation of Economic Benefits

Based on the daily vehicle-kilometers and vehicle-hours by vehicle type in the "with" and "without" project conditions calculated through the traffic assignment process in traffic forecast and the unit vehicle operating costs and unit vehicle time costs obtained as described above, the economic benefits, the savings in travel costs, were estimated as summarized in Table XIV-3.

Table XIV-3 Estimated Economic User Benefits of Project Toll Road

(Million Rp./Year)

Year	Economic Benefits of Savings in:		Total Benefits
	Vehicle Operating Costs	Time Costs	
1995	13,767	46,671	60,438
2005	78,159	174,144	252,303
2015	216,336	284,481	500,817

XIV-4 Economic Cost-Benefit Analysis

(1) Basic Assumptions

The basic assumptions for the economic cost-benefit analysis were as described below:

Base Year	:	1991
Project Life	:	25 years after the completion of the full length between Surabaya and Mojokerto
Prices	:	Constant 1991 prices
Residual Value	:	None
Discount Rate	:	15%

(2) Results of Economic Cost-Benefit Analysis

Following the conventional discounted cash flow methodology, the efficiency measures were calculated as shown below:

Results of Economic Cost-Benefit Analysis

EIRR	=	27.88%
NPV at 15%	=	457,541 Million Rp. at 1991 constant price
B/C ratio	=	2.68

These results indicate that the Project is economically feasible.

(3) Sensitivity Test

The results show that even the most severe case of -30% benefit and +30% cost still maintains EIRR of 19% (refer to Table XIV-4).

Table XIV-4 Sensitivity Test

(Unit : %)

Cost	Benefit			
	Base	-10%	-20%	-30%
Base	27.88	26.22	24.47	22.59
+10%	26.38	24.80	23.12	21.31
+20%	25.07	23.55	21.93	20.19
+30%	23.91	22.44	20.88	19.19

XV Financial Project Analysis

XV-1 Methodology

This financial project analysis was performed based on the estimations of construction and operation/maintenance costs and toll revenue. For the analysis, financial conditions of required funds were examined and assumed.

Based on the said estimations and assumptions, the profit/loss statement and the cash flow were tabulated, and the first year of continuous annual surplus and continuous accumulated surplus were examined. As the evaluation indicators of financial viability, the financial internal rate of return (FIRR), and net present value (NPV) were demonstrated, according to the conventional discounted cash flow methodology.

For calculation of FIRR, Return on Investment (ROI) and Return on Equity (ROE) were examined. ROI is an indicator which measures a return on the total investment regardless of fund raising conditions, while ROE is an indicator in which a return on equity invested is estimated taking fund raising conditions into account.

XV-2 Assumptions

The following assumptions were made for financial analysis:

1) Project Life

Start of operation	:	1996
Project life	:	25 years after opening to traffic

2) Salvage Value

The project life of 25 years is the period for the purpose of this analysis. The facility of the toll road will continue to have value for a much longer period. Accordingly, the salvage value (undepreciated value) is assumed as a negative cost in the final year of the project life.

3) Investment Cost

The construction and operation of the Toll Road is programmed to be performed by a joint venture or joint operation between Jasa Marga and private investors. According to the legislation of Section 41 in the Government Decree No. 8/1990, costs for land acquisition and compensation of a toll road project in Indonesia are under the government's responsibility, therefore, the investment cost excluding land acquisition and compensation costs was applied for the financial analysis.

4) Prices

For financial analysis, two price bases were assumed as follows:

- Constant 1991 price basis
- Current price basis

In the case of constant price basis, an annual 3% increase of toll rate was assumed according to the targeted growth ratio of Gross Domestic Product (GDP) per capita in Indonesia, while the escalation of investment and operation/ maintenance costs was not considered.

In the case of current price basis, the increase of toll rate by 40% in every three years (about 12% increase per annum) was assumed based on an interview with Jasa Marga. While the annual 8% increase of costs was assumed according to statistical data of the recent trend of consumer prices in Surabaya city.

XV-3 Financial Project Cost

The financial project cost related to the initial investment excluding land acquisition and compensation costs was estimated at Rp. 308,781 million in 1991 constant prices. The estimated financial annual operation and maintenance costs in 1991 constant prices are Rp. 4,676 million and Rp. 5,144 million for 4-lane and 6-lane 2-way respectively.

XV-4 Toll Rate and Revenue

(1) Toll Rate

The toll rates for the revenue estimation for financial analysis were based on the current tariff system of the Surabaya-Gempol Toll Road (i.e. Rp.60 per vehicle-kilometer for passenger vehicle and pick-up and Rp.100 per vehicle-kilometer for bus and truck).

As a result of the traffic assignment, the financial benefit per vehicle-kilometer was obtained for each vehicle type. Then, the obtained financial benefit per vehicle-kilometer and the toll per vehicle-kilometer for each vehicle type were compared, and the ratio of toll to financial benefit in terms of vehicle-kilometer was estimated as shown in Table XV-1. The ratio ranges from 0.13 to 0.51.

Table XV-1 Ratios of Toll and Financial Benefit

(Unit : Rp.)

Year	Vehicle Type	Financial Benefit per Vehicle-Km (a)	Toll per Vehicle-Km (b)	Ratio (b)/(a)
1995	Passenger Vehicle	540	68	0.13
	Bus	222	113	0.51
	Pick-up	365	68	0.19
	Truck	370	113	0.31
2005	Passenger Vehicle	619	91	0.15
	Bus	404	151	0.37
	Pick-up	425	91	0.21
	Truck	482	151	0.31
2015	Passenger Vehicle	652	122	0.19
	Bus	666	203	0.30
	Pick-up	425	122	0.29
	Truck	554	203	0.37

Note : in 1991 prices

(2) Estimated Revenue

Based on the results of traffic assignment and the assumed tariff, toll revenue was estimated as shown in Table XV-2.

Table XV-2 Estimated Toll Revenue

(Unit : Mil. Rp.)

Price Basis	1995	2005	2015
Constant Price	15,483	59,580	153,995
Current Price	19,834	162,299	1,150,591

XV-5 Financial Internal Rate of Return

Table XV-3 shows the FIRR (ROI) and the NPV calculated based on the estimated construction cost, operation/maintenance costs and the toll revenues.

Table XV-3 FIRR (ROI) and NPV

Price Basis	FIRR (ROI) (%)	NPV (Million Rp.)
Constant Price	12.87	-44,752
Current Price	21.95	361,845

XV-6 Cash Flow Analysis

Several cases were examined in the analysis for the combinations of two cases of equity/loan ratio and three cases of loan conditions as shown below:

1) Equity/Loan Ratio

a) Equity 30% : Loan 70%
b) Equity 35% : Loan 65%

2) *Long-Term Loan Condition*

a) Interest rate : 10%
Grace period : 5 years and
Repayment period : 15 years
b) Interest rate : 15%
(Grace period and repayment period is the same as a))
c) Interest rate : 20%
(Grace period and repayment period is the same as a))

A short-term loan was assumed to finance the cash flow deficit of the total financial source against the total financial use, including the interest during the construction period. The repayment of principal and payment of interest was assumed to be made in the year following the borrowing. The interest rate of the short-term loan was assumed to be the same as that applied for the long-term loan used for each above case.

Table XV-4 shows the analysis results for each alternative case, which are summarized below:

Table XV-4 Summary of Financial Analysis Results

Price Bases	Equity /Loan Ratio	Interest Rate (%)	FIRR (ROI) (%)	FIRR (ROE) (%)	First Year of Accum. Surplus in Profit & Loss (Year)
Constant Price Base (a) Toll Rate: 3% up/year (b) Cost: Constant	30%:70%	10	12.87	14.33	2006
		15	12.87	11.68	*
		20	12.87	9.62	*
	35%:65%	10	12.87	14.19	2005
		15	12.87	11.81	2017
		20	12.87	9.90	*
Current Price Base (a) Toll Rate: 40% up/3 years (b) Cost: 8% up/year	30%:70%	10	21.95	26.87	2001
		15	21.95	24.37	2006
		20	21.95	22.37	2011
	35%:65%	10	21.95	26.35	2001
		15	21.95	24.17	2005
		20	21.95	22.37	2010

Note : * denotes null first year of surplus within the project life.

(1) Constant Price Basis

The 30%:70% equity/loan ratio case shows a severe deficit in cash flow. The deficit in cash flow requires the raising of a short-term loan, and this causes a high increase in payment on interest which then leads to a further deficit. Only the 10% interest rate case shows a sound financial condition.

The 35%:65% equity/loan ratio with the 20% interest rate case shows a deficit in cash flow. The 35%:65% equity/loan ratio with the 15% interest rate case shows that the first year of accumulated surplus in the profit and loss statement is 2017, which is 23 years after the opening of the toll road operation.

(2) Current Price Basis

On the other hand, the current price basis shows favorable results which is mainly because of a high level of revenue. There is no considerable difference on calculation of the results between the 30%:70% equity/loan ratio case and the 35%:65% equity/loan ratio case.

In the 35%:65% equity/loan ratio with the 15% interest rate case, the first year of accumulated surplus in the profit and loss statement is 2005, and in the 20% interest rate case is 2010 (10 and 15 years after the opening of the Toll Road respectively).

XV-7 Sensitivity Analysis

1) Sensitivity to Cost and Revenue

In the case of 10% cost overrun and 10% revenue decrease, FIRR (ROI) drops to 19.96%, 1.99% lower than the base case.

2) Sensitivity to Interest Rate of Long-Term Loan

In the interest rate of 22.5% case, for the case of equity/loan ratio of 35%:65% in the current price basis, the first year of accumulated surplus in the profit and loss statement and the first year of annual surplus in the cash flow appear both in 2014 (i.e. 19 years after the opening of the toll road operation).

On the other hand, in the interest rate of 25.0% case, the first year of annual surplus in the profit and loss statement is 2015, however, the first year for the accumulated surplus in the profit and loss statement and the first year of annual surplus in the cash flow do not appear within the period of the project life.

XV-8 Conclusion of Financial Analysis

The FIRR calculations for the current price basis are about 22% for ROI and about 22-27% for ROE varying according to the interest rates of loan. They are similar to or lower than the prevailing level of interest rates on deposit in commercial banks in Indonesia which range from 23% to 28%, and which increased greatly from last year as a result of a financial squeeze in Indonesia.

The above comparison shows that the results of the financial analysis are not very optimistic while the prevailing level of interest rates remains.

Furthermore, the results of sensitivity analysis to interest rate suggest that the interest rate of 22% is the maximum level as the average interest rate of loans applied for the Project in order to maintain a financial viability (the first year of accumulated surplus is 2014, which is 19 years after the opening leaving 6 years in the Project life span).

An effort to introduce loans with lower interest rate wherever possible is therefore advisable to improve the financial viability.

Besides the above measure on the interest rate, the possibility to increase the toll level (such possibility is suggested in section XV-4) should be pursued as another way to improve the financial viability of the Project. According to an interview with Jasa Marga, it was suggested that the guideline for toll structure is recovery of 70% of the benefit which the toll users receive ordinarily from the usage of the toll road.

XVI Recommendations

XVI-1 Implementation of the Project

The results of the Study indicate that the Project is technically sound (no serious technical difficulty is anticipated for the construction) and economically highly feasible. Taking into account the direct and enormous indirect benefits towards regional development other than the quantified savings in travel costs, the Project should be implemented at the earliest opportunity.

However, if the estimated FIRR is compared with the prevailing interest rates on deposit in commercial banks in Indonesia, the financial viability of the Project is not very optimistic. It is necessary to consider the following measures to improve the financial viability:

- To introduce loans with lower interest rate wherever possible. One of the suggested ways is to construct the most costly section (e.g. the stretch in the east of the Inner Ring Road having long bridge/viaduct sections including Surabaya JC) by Jasa Marga alone introducing a soft loan.
- To seek the possibility of increasing the toll level.
- To further examine ways to reduce the construction cost in the final engineering design stage (e.g. to integrate or to abandon the culverts for crossing roads through discussion with the local government, if such measure is effective to lower the embankment height).
- To take favorable taxation measures toward the investor.

XVI-2 Environmental Impact Analysis

In accordance with the requirement of the EIA Guideline, an environmental impact analysis (ANDAL) should be carried out at the earliest stage. In particular, additional data should be collected by thorough investigations at the site to clarify the potential impacts on the social environment including displacement of residents and ROW acquisition problems.

XVI-3 Matters for Further Consideration

(1) Planning of Ring Roads

For effective utilization of the Toll Road, the connections with the planned Inner Ring Road and the Middle Ring Road are quite important. It is recommended to finalize the plan of these ring roads at the earliest time to realize an integrated road network in the region together with the Toll Road.

(2) Westward Extension of the Toll Road

For the westward extension of the Toll Road to complete the Trans Java Tollway System, the route in Kab. and Kod. Mojokerto is already almost fixed. In order to avoid difficulty in ROW acquisition for the extension, it is recommended to freeze land development on the route.

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