

consequence, it was conceived that the tested bus number implies large and medium sized buses which are generally used for inter-city public transport, and the tested truck number implies large and medium trucks.

2.5.2 Registered Motor Vehicles

The number of registered vehicles (except for motor cycles) in Indonesia grew from approximately 1,580,000 vehicles in 1982 to 2,480,000 vehicles in 1988, which gives an annual growth rate of 7.7% from 1982 to 1988. The annual growth rate of buses over the years 1982-1988 is very high at 15.0%, whilst for the same period the growth rate for passenger vehicles is 7.1% per year and for trucks is 6.8% per year (refer to Table 2.18).

Java has the largest number of vehicle registrations, accounting for 75.0%, 62.4% and 61.2% of 1987 registrations for total passenger vehicles, buses and trucks respectively throughout Indonesia. For passenger vehicles, Java has the highest percentage of cars, however, Java's ratio of vehicle growth from 1982 to 1987 is the lowest ratio in Indonesia (refer to Table 2.19).

Among the provinces in Java, DKI Jakarta had about 660,000 motor vehicles in 1987 which accounted for 40% of the Java total (refer to Table 2.20).

West Java and East Java provinces had nearly the same number of motor vehicles, that is about 390,000 vehicles and 370,000 vehicles respectively, which are about 60% of DKI Jakarta total in 1987.

The ratio of registered vehicles to population (motorization ratio) in Java is shown in Table 2.21 and it is clearly seen that DKI Jakarta completely dominates the ratios for every type of vehicle by very considerable amounts.

In 1987, DKI Jakarta had 44.4 passenger vehicles per 1,000 persons, 14.6 buses per 1,000 persons and 18.8 trucks per 1,000 persons.

The composite DKI Jakarta total is 77.7 vehicles per 1,000 persons and this figure exceeds West Java, which has the second highest motorization ratio of 12.0 vehicles per 1,000 person, by a factor of almost 6.5.

Table 2.18 Historic Pattern, Vehicles Registrations - Indonesia

Type of Vehicle	Year							Growth Rate (% p.a.) 1988/1982
	1982	1983	1984	1985	1986	1987	1988	
Passenger Vehicles (Composition Ratio)	791,019 (50.0%)	862,424 (49.5%)	926,994 (48.5%)	990,651 (48.0%)	1,063,959 (48.3%)	1,170,103 (48.2%)	1,191,231 (48.1%)	7.1
Buses (Composition Ratio)	134,430 (17.0%)	160,260 (18.6%)	191,654 (20.7%)	227,304 (22.9%)	256,574 (24.1%)	303,378 (25.9%)	310,574 (26.1%)	15.0
Trucks (Composition Ratio)	657,104 (41.5%)	717,873 (41.2%)	790,881 (41.4%)	845,338 (41.0%)	882,331 (40.1%)	953,694 (39.3%)	973,704 (39.3%)	6.8
Total (Composition Ratio)	1,582,553 (100.0%)	1,740,557 (100.0%)	1,909,529 (100.0%)	2,063,293 (100.0%)	2,202,864 (100.0%)	2,427,175 (100.0%)	2,475,509 (100.0%)	7.7

Source: Indonesia State Police

Table 2.19 Number of Registered Vehicles in Indonesia

Type of Vehicle	Region	Year						Percent of Total in 1987	Growth Ratio (% p.a.) 1987/1982
		1982	1983	1984	1985	1986	1987		
Passenger Vehicles	Sumatra	95,401	109,971	117,593	127,866	142,278	168,843	14.4	12.1
	Java	616,229	665,354	713,484	756,768	809,258	877,561	75.0	7.3
	Sulawesi	31,743	33,445	37,690	41,818	46,530	50,194	4.3	9.6
	Kalimantan	22,909	24,697	26,315	29,527	30,432	33,068	2.8	7.6
	Others	24,737	28,957	32,066	33,179	35,461	40,437	3.5	10.3
	Indonesia	791,019	862,424	927,148	989,158	1,063,959	1,170,103	100.0	8.1
Buses	Sumatra	31,417	36,290	42,128	49,835	54,986	74,168	24.4	18.7
	Java	82,465	100,895	124,152	147,087	166,780	189,380	62.4	18.1
	Sulawesi	7,991	8,781	10,122	13,452	15,983	18,823	6.2	18.7
	Kalimantan	6,284	6,972	7,445	8,150	8,852	9,747	3.2	9.2
	Others	6,273	7,322	7,807	8,780	9,973	11,260	3.7	12.4
	Indonesia	134,430	160,260	191,654	227,304	256,574	303,378	100.0	17.7
Trucks	Sumatra	143,127	158,577	171,707	182,246	189,793	212,417	22.3	8.2
	Java	412,995	444,985	495,307	523,783	543,896	583,376	61.2	7.2
	Sulawesi	46,551	51,485	57,188	62,529	67,221	71,367	7.5	8.9
	Kalimantan	23,301	26,181	28,320	37,602	38,142	39,301	4.1	11.0
	Others	31,130	36,645	38,359	39,178	43,279	47,233	5.0	8.7
	Indonesia	657,104	717,873	790,881	845,338	882,331	953,694	100.0	7.7
Total	Sumatra	269,945	304,838	331,428	359,947	387,057	455,428	18.8	11.0
	Java	1,111,689	1,211,234	1,332,943	1,427,638	1,519,934	1,650,317	68.0	8.2
	Sulawesi	86,285	93,711	105,000	117,799	129,734	140,384	5.8	10.2
	Kalimantan	52,494	57,850	62,080	75,279	77,426	82,116	3.4	9.4
	Others	62,140	72,924	78,232	81,137	88,713	98,930	4.1	9.7
	Indonesia	1,582,553	1,740,557	1,909,683	2,061,800	2,202,864	2,427,175	100.0	8.9

Source: Statistical Year Book of Indonesia, 1985 and 1989

Table 2.20 Number of Registered Vehicles in Java

Province/Area	Year	Passenger Vehicle	Bus	Truck	Total
DKI JAKARTA	1982	275,139	49,827	112,494	437,460
	1983	299,164	62,515	126,859	488,538
	1984	321,837	81,047	140,562	543,446
	1985	340,177	99,078	149,781	589,036
	1986	356,188	111,147	154,498	621,833
	1987	376,907	123,740	159,344	659,991
WEST JAVA	1982	142,497	16,983	116,113	275,593
	1983	152,496	19,775	117,087	289,358
	1984	152,443	22,904	128,703	304,050
	1985	160,147	25,797	137,293	323,237
	1986	169,281	28,672	140,216	338,169
	1987	190,305	37,430	160,111	387,846
CENTRAL JAVA*	1982	83,226	9,412	91,200	183,838
	1983	83,683	12,015	94,350	190,048
	1984	84,568	12,990	95,691	193,249
	1985	92,289	14,337	98,507	205,133
	1986	99,571	15,521	104,180	219,272
	1987	107,981	16,614	108,680	233,275
EAST JAVA	1982	115,367	6,243	93,188	214,798
	1983	131,758	6,590	106,689	245,037
	1984	154,636	7,211	130,351	292,198
	1985	164,155	7,875	138,122	310,152
	1986	184,218	11,440	145,002	340,660
	1987	202,368	11,596	155,241	369,205
JAVA TOTAL	1982	616,229	82,465	412,995	1,111,689
	1983	668,370	100,895	444,985	1,214,250
	1984	713,484	124,152	495,307	1,332,943
	1985	756,768	147,087	523,703	1,427,558
	1986	809,258	166,780	543,896	1,519,934
	1987	877,561	189,380	583,376	1,650,317

Source : Statistical Year Book of Indonesia, 1985 and 1989

Note : * : Including D.I. Yogyakarta

Table 2.21 Motorization Ratio of Registered Vehicles

(Unit: Veh./1,000 persons)

Type of Vehicle	Region	Year					
		1982	1983	1984	1985	1986	1987
Passenger Vehicles	DKI Jakarta	39.17	40.98	42.42	43.14	43.46	44.35
	West Java	4.96	5.12	5.06	5.19	5.36	5.87
	Central Java*	2.89	2.87	2.87	3.09	3.29	3.49
	East Java	3.84	4.32	5.00	5.23	5.80	6.29
	Java Total	6.48	6.89	7.25	7.55	7.93	8.44
	Indonesia	5.49	5.49	5.77	6.03	6.35	6.80
Buses	DKI Jakarta	7.09	8.56	10.68	12.57	13.56	14.56
	West Java	0.59	0.67	0.76	0.84	0.91	1.16
	Central Java*	0.33	0.41	0.44	0.48	0.51	0.54
	East Java	0.21	0.22	0.23	0.25	0.36	0.36
	Java Total	0.87	1.05	1.26	1.47	1.63	1.82
	Indonesia	0.87	1.02	1.19	1.39	1.53	1.76
Trucks	DKI Jakarta	16.02	17.38	18.53	19.00	18.83	18.75
	West Java	4.04	3.98	4.27	4.45	4.44	4.94
	Central Java*	3.17	3.24	3.24	3.30	3.45	3.52
	East Java	3.10	3.50	4.23	4.40	4.56	4.83
	Java Total	4.34	4.61	5.04	5.23	5.33	5.61
	Indonesia	4.27	4.57	4.93	5.15	5.26	5.54
Total	DKI Jakarta	62.28	66.92	71.63	74.70	75.88	77.66
	West Java	9.58	9.77	10.09	10.48	10.72	11.97
	Central Java*	6.38	6.52	6.50	6.87	7.28	7.54
	East Java	7.14	8.04	9.45	9.89	10.72	11.48
	Java Total	11.69	12.55	13.55	14.25	14.89	15.87
	Indonesia	10.28	11.07	11.89	12.57	13.14	14.11

Source: Statistical Year Book of Indonesia

Note: *Including D.I. Yogyakarta

The motorization of East Java is nearly equal to that of West Java, i.e. 11.5 vehicles per 1,000 persons. A difference is found for passenger vehicles and buses but the motorization ratio of trucks is almost the same.

The motorization ratio of buses in East Java is the lowest compared with other provinces in Java.

2.5.3 Number of Tested Motor Vehicles

The number of tested vehicles, presented in Table 2.22, is compared with that of registered vehicles in Java. The former accounts for about 10% (1987), 35% (1986) and 70% (1987) of the latter for passenger vehicles, buses and trucks, respectively.

The tested passenger vehicle is assumed to include taxi and public minibus and its average annual growth during 1982-1987 for Java is 1.0% p.a., which is very low relatively to the 7.3% p.a. growth of registered vehicles.

In contrast, the number of tested buses/trucks and registered buses/trucks shows similar growth rates such as 15% p.a. for buses and 7% p.a. for trucks in Java, though the tested bus number data in 1987 seem to be something irregular.

Table 2.22 Number of Tested Motor Vehicles in Java

Province/Area	Year	Tested Pass. Veh.	Tested Bus	Tested Truck
DKI JAKARTA	1982	24,262	15,956	76,935
	1983	30,688	15,906	69,628
	1984	25,397	22,113	77,736
	1985	27,129	23,414	87,743
	1986	27,129	23,414	87,743
	1987	27,573	8,706	91,876
WEST JAVA	1982	30,794	7,888	79,553
	1983	33,485	18,583	105,649
	1984	33,485	18,583	105,649
	1985	33,485	18,583	105,649
	1986	33,485	18,583	105,649
	1987	34,561	22,364	116,087
CENTRAL JAVA*	1982	12,856	6,352	57,792
	1983	9,782	9,506	59,856
	1984	7,610	11,281	66,099
	1985	6,573	12,416	74,061
	1986	6,616	12,523	75,057
	1987	8,496	14,063	80,609
EAST JAVA	1982	20,219	3,463	80,571
	1983	20,476	3,769	88,804
	1984	20,747	4,184	100,777
	1985	21,429	4,222	101,919
	1986	21,429	4,222	101,919
	1987	21,872	4,705	111,541
JAVA TOTAL	1982	88,131	33,659	294,851
	1983	94,431	47,764	323,937
	1984	87,239	56,161	350,261
	1985	88,616	58,635	369,372
	1986	88,659	58,742	370,368
	1987	92,502	49,838	400,113

Source : "Vehicle and Length of Road Statistics, 1988",
Central Bureau of Statistics

Note : * including D.I. Yogyakarta

Chapter 3

CURRENT TRANSPORTATION PROFILE

CHAPTER 3

CURRENT TRANSPORTATION PROFILE

3.1 Road Transportation

3.1.1 Road Network

(1) Road network in East Java

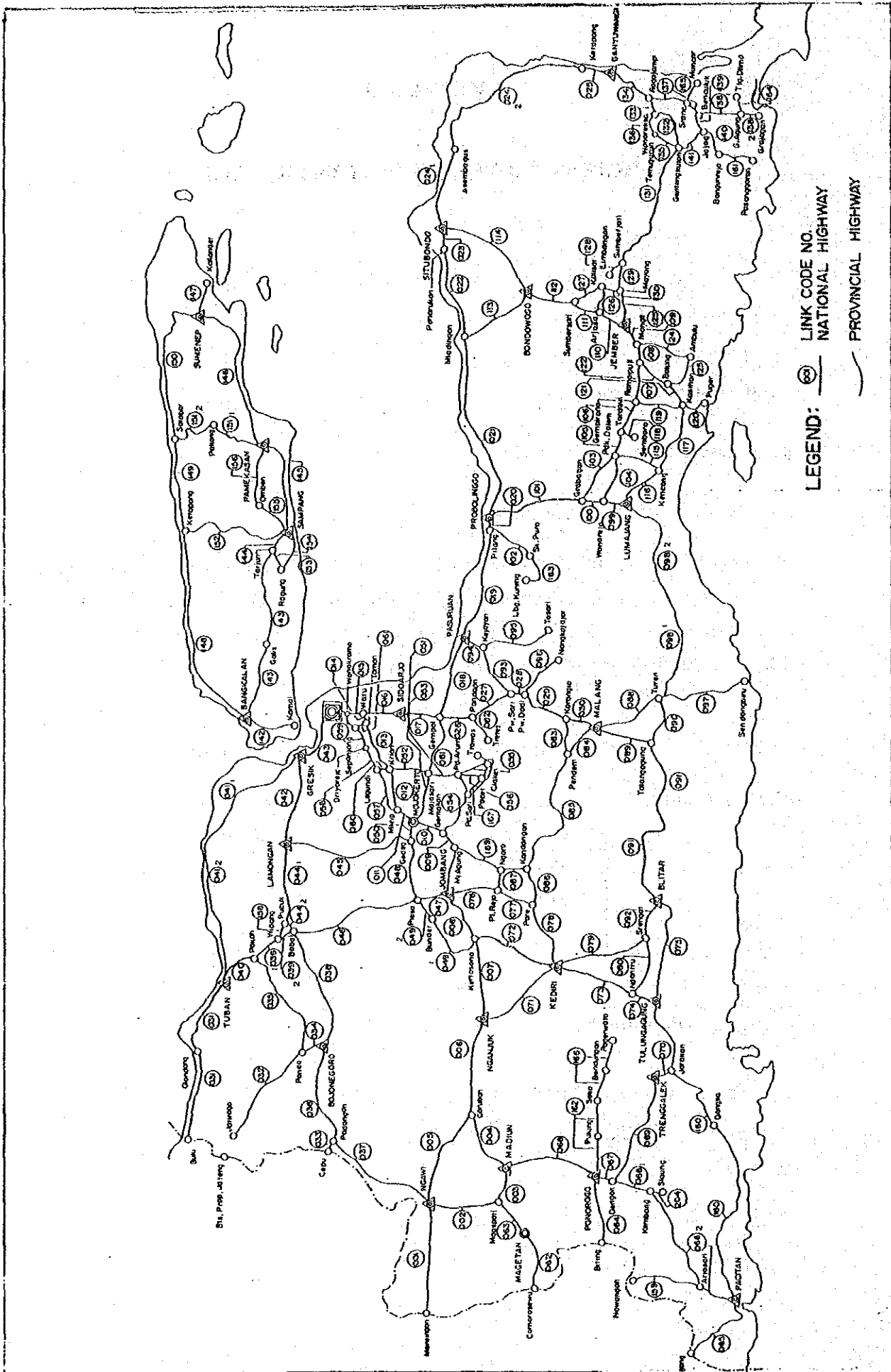
The length of national and provincial roads in East Java is 1,000 kilometers and 2,420 kilometers respectively in 1989. These roads, 3,420 kilometers in total, are asphalt-paved, in which "good" and "fair" surface conditions account for 44.3% and 52.9% respectively. Road length and surface conditions are summarized in Table 3.1.

Table 3.1 Road Length and Surface Conditions in East Java (June 1989)

Surface Condition	National Road		Provincial Road		Total	
	Km	(%)	Km	(%)	Km	(%)
Good	753.0	75.3	760.4	31.4	1,513.5	44.3
Fair	241.4	24.1	1,567.6	64.8	1,809.0	52.9
Damaged	5.6	0.6	90.9	3.8	96.4	2.8
Heavily Damaged	-	-	0.7	0.0	0.7	0.0
Total	1,000.0	100.0	2,419.6	100.0	3,419.6	100.0

Source : "Daftar Kondisi Pada Akhir Bulan", 1989, Bina Marga

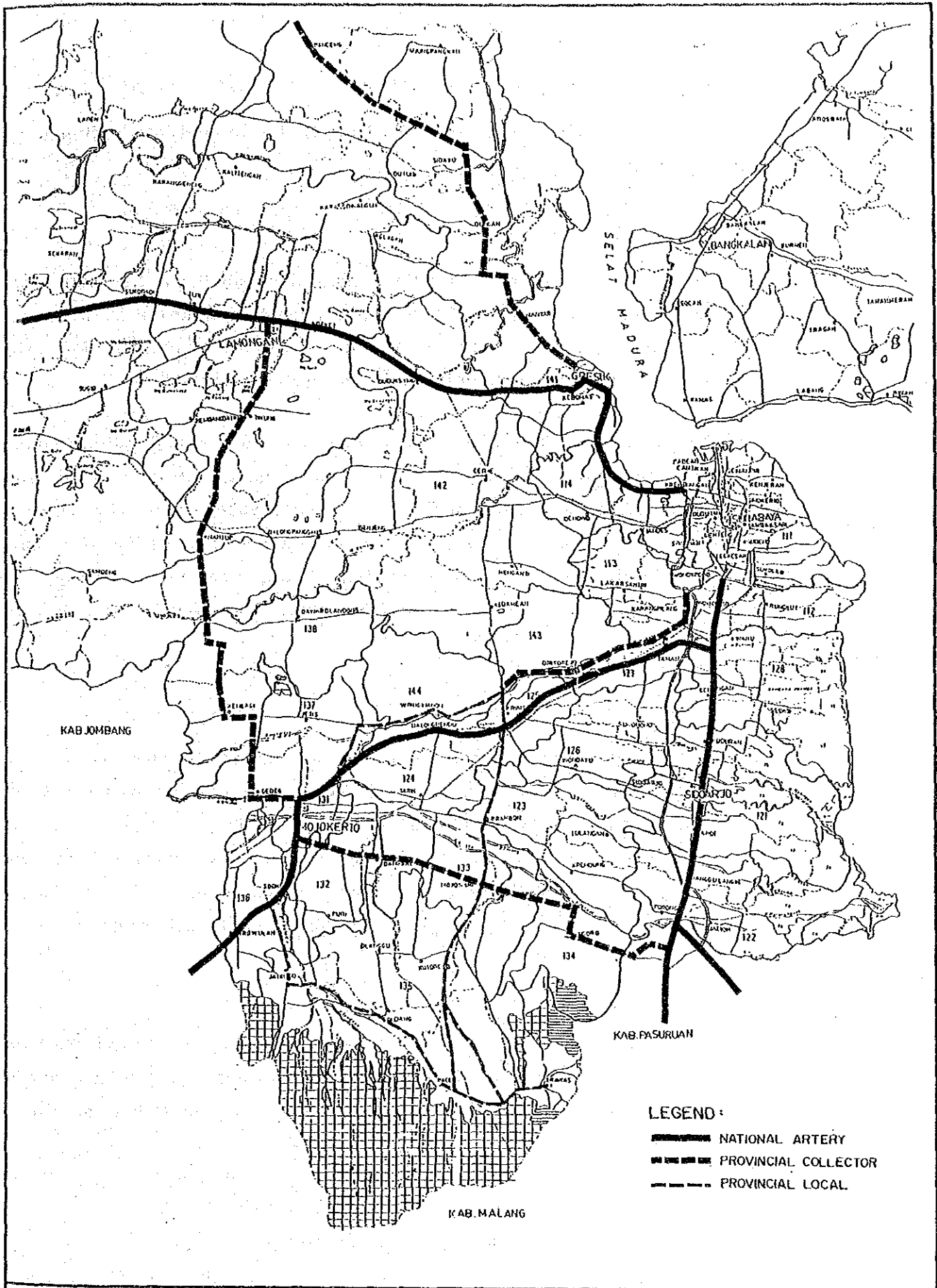
The above national and provincial roads are presented in Fig. 3.1, and more detailed road network in GKS region is shown in Fig. 3.2.



LEGEND: LINK CODE NO. NATIONAL HIGHWAY
 PROVINCIAL HIGHWAY

SURABAYA - MOJOKERTO TOLL ROAD PROJECT

Fig. 3.1 National and Provincial Road Network in East Java



**SURABAYA - MOJOKERTO
TOLL ROAD PROJECT**

Fig. 3.2 Road Network in GKS Region

(2) Major Road Links in the Study Area

The major road links in the Study Area together with present conditions are described as follows:

1) Surabaya - Mojokerto

There are two trunk roads. A national road which situates at the south of the Surabaya river leads to Mojokerto via Krian and extends further to the west. A provincial road which runs in the close proximity of the Surabaya river 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 for light vehicles. Traffic volume is very small.

2) Surabaya - Sidoarjo

There are two major trunk roads, a national road and Surabaya-Gempol Toll Road. They are located parallel to each other keeping a 2-4 km distance and run to the south passing Waru. The national road is 4-lane 2-way and divided in the urban area. To cope with the traffic congestion one-way traffic is enforced near Sidoarjo city center. The carriageways are paved and well maintained. Surabaya-Gempol Toll Road is divided 4-lane with full access control.

3) Surabaya - Gresik

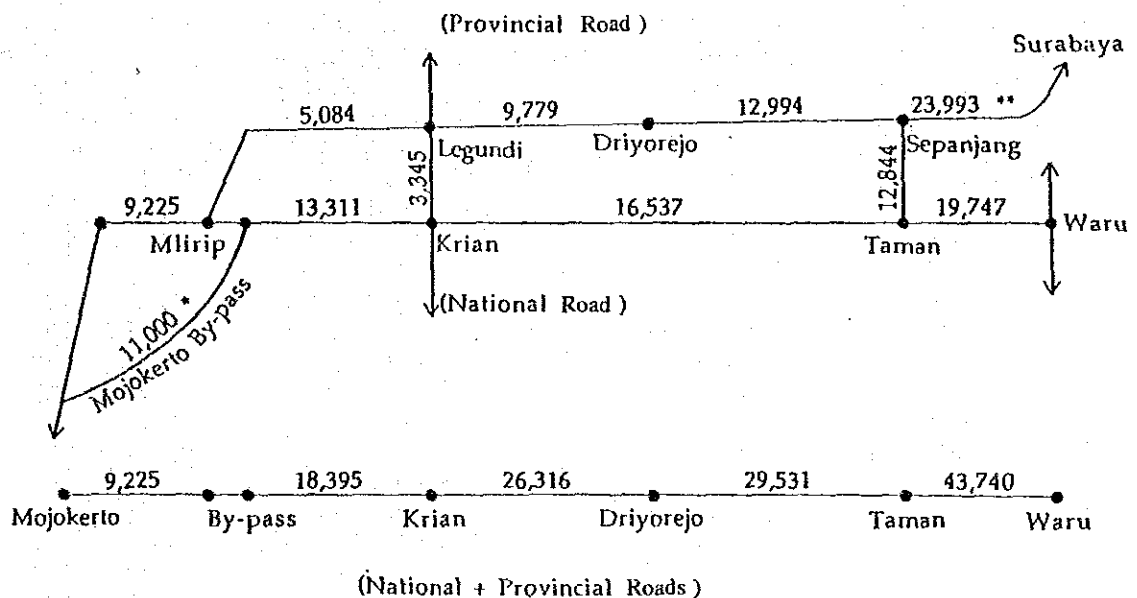
There is a national road leading to the west via Gresik which has a carriageway width of 7 m fully paved and well maintained. Traffic is heavy and occupied largely by heavy trucks, congested in the entire section and serious near Gresik city center.

3.1.2 Road Traffic

(1) National and Provincial Roads

The average daily traffic volume on the national and provincial roads in GKS region in 1990 is listed in Table 3.2, corresponding to the road link codes previously shown in Fig. 3.1.

The existing national and provincial roads which run in parallel to the Toll Road are schematically shown below together with the average daily traffic volume in 1990.



Note : * Data from Mojokerto Toll Bridge
 ** Data from Traffic Survey by the Study Team

The traffic between Mojokerto and Surabaya gradually increases as it reaches Surabaya, that is about 10,000 vehicles in Mojokerto increases up to 44,000 vehicles near Surabaya.

A remarkable decrease in traffic volume between 1985 and 1990 is found in the Surabaya - Waru and Waru - Sidoarjo sections. This is because of the opening of Surabaya - Gempol Toll Road in July 1986.

Table 3.2 Traffic Volume on National and Provincial Roads in the Study Area

Road Link Code	Link Name	Road Length (Km)	Status/ Function	Traffic (veh./day)		
				1985	1990	(1985=100) 1990
010	Mojokerto - Gemakan	6.05	National Artery	8,829	20,571	233
011	Mlirip - Mojokerto	3.45	National Artery	8,679	9,225	106
012	Krian - Mlirip	15.20	National Artery	10,558	13,311	126
013	Taman - Krian	14.00	National Artery	20,815	16,537	79
014	Waru - Taman	4.56	National Artery	11,062	19,747	179
015	Waru - Surabaya	0.82	National Artery	42,259	34,941	83
016	Waru - Sidoarjo	11.61	National Artery	32,462	27,012	83
017	Sidoarjo - Gempol	9.84	National Artery	22,334	26,007	116
041.1	Gresik - Sadang - Tuban	41.27	Provincial Collector	1,753	2,677	153
041.2	Gresik - Sadang - Tuban	32.87	Provincial Collector	921	1,146	124
041.3	Gresik - Sadang - Tuban	11.80	Provincial Collector	3,747	4,679	125
042.1	Gresik - Lamongan	21.55	National Artery	6,713	7,457	111
042.2	Gresik - Lamongan	6.87	National Artery	6,713	7,457	111
043	Surabaya - Gresik	2.81	National Artery	12,911	12,522	97
044.1	Lamongan - Babat	28.81	National Artery	5,829	8,492	146
045.1	Lamongan - Gedek	23.77	Provincial Collector	1,515	2,204	145
045.2	Lamongan - Gedek	18.23	Provincial Collector	2,060	2,204	107
050	Mojokerto - Gedek	4.22	Provincial Collector	8,075	6,584	82
051	Mojosari - Mojokerto	14.36	Provincial Collector	5,201	6,907	133
052	Krian - Mojosari	12.70	Provincial Local	4,965	5,074	102
053	Mojosari - Pandanarum	13.07	Provincial Local	3,721	6,176	166
054.1	Gemekan - Pandanarum	13.34	Provincial Local	3,677	3,491	95
054.2	Gemekan - Pandanarum	7.23	Provincial Local	3,677	3,491	95
055	Pandanarum - Jubel	8.20	Provincial Local	1,479	409	28
056	Pandanarum - Pacet	4.36	Provincial Local	2,371	1,744	74
057.1	Mlirip - Legundi	10.46	Provincial Local	2,886	5,084	176
057.2	Mlirip - Legundi	7.34	Provincial Local	2,886	5,084	176
058	Legundi - Driyorejo	6.00	Provincial Collector	4,297	9,779	228
059	Sepanjang - Driyorejo	4.51	Provincial Collector	12,743	12,994	102
060	Krian - Legundi	2.83	Provincial Collector	2,637	3,345	127
061	Taman - Sepanjang	1.85	Provincial Collector	9,232	12,844	139
Total		364.08		267,007	299,195	112
Vehicles-kms Total (x1000)				2,310	2,662	115

(2) Surabaya-Gempol Toll Road

Surabaya-Gempol Toll Road was opened to traffic in July 1986. The toll road is operated by two different toll levy systems. One is a flat tariff system between Tanjung Perak IC and Waru IC with a service length of 17.0 kilometers. The other is a distance proportional system between Waru IC and Gempol IC with a total length of 26.0 kilometers.

The tariff of the toll road is Rp. 500 per class I (up to 2.5 ton) vehicle and Rp. 1000 per class II (over 2.5 ton) vehicle in the flat tariff section. In the distance proportional section the tariff is set for each section as presented in Table 3.3.

Table 3.3 Tariff System of Distance Proportional Section on Surabaya-Gempol Toll Road, Class I and Class II Vehicles

I/C Name	Waru	Sidoarjo	Porong	Gempol
Waru	-	Rp. 700 (Rp. 1000)	Rp 1200 (Rp. 2000)	Rp. 1500 (Rp. 2500)
Sidoarjo	11.0 km	-	Rp. 500 (Rp. 1000)	Rp. 800 (Rp. 1500)
Porong	20.0 km	9.0 km	-	N/A
Gempol	26.0 km	15.0 km	6.0 km	-

Source : Cabang Tol Surabaya-Gempol, Jasa Marga

Note : Costs in parentheses show the tariff for Class II vehicles.

The number of toll road users in July, 1990 was 27,956 vehicles per day for the flat tariff section and 21,427 vehicles per day for the distance proportional tariff section. The annual growth of the toll road users is summarized in Table 3.4.

Table 3.4 Number of Users on Surabaya-Gempol Toll Road

Description	Tariff System (x1000 veh)			Vehicles Classified (x1000)		
	Flat	Dist. Prop.	Total	Class I	Class II	Total
1987	4,986	3,636	8,622	6,052	2,570	8,622
1988	6,657	4,618	11,275	7,736	3,539	11,275
1989	8,053	5,728	13,781	9,048	4,733	13,781
Growth Rate						
1988/1987	1.34	1.27	1.31	1.28	1.38	1.31
1989/1988	1.21	1.24	1.22	1.17	1.34	1.21

Source : Cabang Tol Surabaya-Gempol, Jasa Marga

Traffic flows on the distance proportional tariff sections are shown diagrammatically in Fig. 3.3. Accordingly, the traffic volume on Surabaya-Gempol Toll Road in 1990 is estimated as shown in Table 3.5.

Table 3.5 Traffic Volume on Surabaya-Gempol Toll Road

Link	Road Length	Traffic (veh/day)	Veh-Km (x1,000)
Surabaya - Waru	0.82 km	14,678	12
Waru - Sidoarjo	11.00 km	20,054	221
Sidoarjo - Porong	9.00 km	19,298	174
Porong - Gempol	6.00 km	14,860	89
Total	26.82 km	68,890	496

Therefore, the growth of traffic between 1985 and 1990 in the Study Area is summarized as shown in Table 3.6.

Table 3.6 Growth of Traffic in the Study Area

Type of Roads	Vehicle-kms (x1,000)		1985=100
	1985	1990	1990
National + Provincial Roads	2,310	2,662	115
Waru-Gempol Toll Road	-	496	-
Total	2,310	3,158	137 (6.5% p.a.)

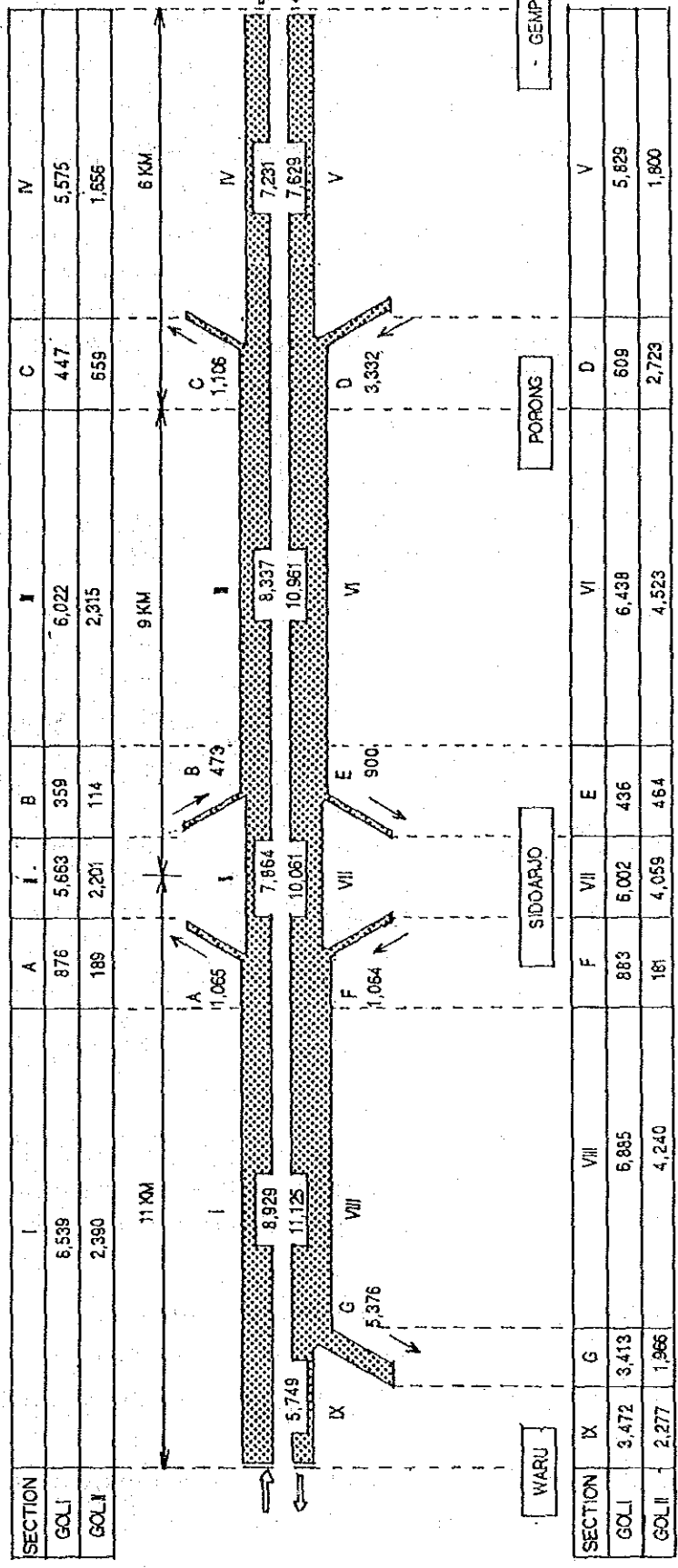


Fig. 3.3 Traffic Flows on Waru-Gempol Toll Road Section in July 1990

3.2 Railway Transportation

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 departing railway passengers and cargo from stations in the above Kab/Kodya are listed in Table 3.7.

Table 3.7 Departing Railway Passengers and Cargo from Stations in East Java

Station in Kab/Kodya	Departing Passengers (x1000)					Departing Cargo (x1000 ton)				
	1984	1985	1986	1987	1988	1984	1985	1986	1987	1988
Surabaya	2,282	2,537	2,501	2,520	2,597	927.6	907.7	865.3	900.0	966.3
Sidoarjo	289	627	434	419	86	3.5	9.3	9.9	2.0	1.5
Gresik	85	66	55	83	-	275.0	350.0	508.8	605.5	585.7
Lamongan	308	286	257	300	60	25.4	17.1	6.6	0.2	0.1
Mojokerto	494	371	616	578	418	0.6	0.3	2.0	0.3	0.2
Probolinggo	20	23	39	25	20	38.2	14.9	9.8	2.6	0.2
Banyuwangi	454	489	584	686	208	0.3	2.1	58.4	95.7	105.4
Madiun	199	215	242	236	239	10.1	4.6	5.3	3.2	10.3
Jember	406	424	556	555	240	23.7	59.7	4.9	100.9	0.3
Kediri	175	172	204	190	118	5.7	0.4	0.3	2.2	0.1
Total	4,712	5,210	5,488	5,592	3,986	1,310.1	1,366.1	1,471.3	1,712.6	1,670.1

Source : "Statistik Perhubungan dan Pariwisata Propinsi Jawa Timur", 1984 - 1988, Statistical Office of East Java Province

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.

3.3 Sea Transportation

Tg. Perak Port is defined as a primary seaport in Indonesia, where both international and domestic sea freight are handled.

The sea freight is transported by the following five types of vessels:

- a) Ocean-going (Samudera)
- b) Interinsular (Nusantara)
- c) Local (Lokal-coastal service)
- d) Special (Khusus)
- e) Traditional (Rakyat)

The freight loaded and unloaded at Tg. Perak Port is shown in Table 3.8. The freight of ocean-going vessel and special vessel accounted for 34% and 39% of the total freight handled at Tg. Perak Port in 1987. Most of the special vessel is used to transport petroleum and natural gas of PERTAMINA.

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 unloaded freight ton is more than double the loaded freight. Excluding the special vessel freight, however, the loaded and unloaded freight are nearly balanced. The total freight volume increased 1.69 times (14.0% p.a.) between 1983 and 1987, or 1.22 times (5.1% p.a.) during the same period excluding special vessel freight.

Besides Tg. Perak Port, there are 6 seaports in East Java. They are Gresik, Banyuwangi, Panarukan, Probolinggo, Pasuruan and Kalianget. Freight volumes in 1987 and transport coverage of the respective seaports are presented in Table 3.9.

Table 3.8 Loaded and Unloaded Freight at Tg. Perak Port

(Unit : 1000 ton)

Type of Vessels	1983	1984	1985	1986	1987	1983=100 1987
Ocean-going (Total)	(3,234)	(2,870)	(2,945)	(3,673)	(4,070)	(126)
Loaded	1,110	1,083	1,123	1,344	1,693	153
Unloaded	2,124	1,787	1,822	2,329	2,377	112
Interinsular (Total)	(1,919)	(2,080)	(2,086)	(2,358)	(2,243)	(117)
Loaded	1,287	1,417	1,305	1,463	1,404	109
Unloaded	632	663	781	895	839	133
Local (Total)	(295)	(330)	(326)	(306)	(386)	(131)
Loaded	183	203	203	207	267	146
Unloaded	112	127	123	99	119	106
Special (Total)	(1,093)	(1,186)	(3,538)	(4,261)	(4,649)	(425)
Loaded	47	18	15	95	55	117
Unloaded	1,046	1,168	3,523	4,166	4,594	439
Traditional (Total)	(497)	(670)	(688)	(588)	(569)	(114)
Loaded	280	352	409	382	362	129
Unloaded	217	318	279	206	207	95
Total	(7,038)	(7,136)	(9,583)	(11,186)	(11,917)	(169)
Loaded	2,907	3,073	3,055	3,491	3,781	130
Unloaded	4,131	4,063	6,528	7,695	8,136	197
Excluding Special	(5,945)	(5,950)	(6,045)	(6,925)	(7,268)	(122)
Loaded	2,860	3,055	3,040	3,396	3,726	130
Unloaded	3,085	2,895	3,005	3,529	3,542	115

Source : "Statistik Perhubungan dan Pariwisata Propinsi Jawa Timur", 1984, 1985-86, 1987, Statistical Office of East Java Province

Table 3.9 Loaded and Unloaded Freight at Other Seaports in East Java, 1987

(Unit : 1000 ton)

Seaport	International			Interinsular			Total		
	Loaded	Un-loaded	Total	Loaded	Un-loaded	Total	Loaded	Un-loaded	Total
1. Gresik	208	1,740	1,948	958	1,046	2,004	1,166	2,786	3,952
2. Banyuwangi	35	-	35	122	324	446	157	324	481
3. Panarukan	3	-	3	2	18	20	5	18	23
4. Probolinggo	117	17	134	108	156	264	225	173	398
5. Pasuruan	-	-	-	17	88	105	17	88	105
6. Kallanget	-	-	-	65	4	69	65	4	69

Source: "Statistik Perhubungan dan Pariwisata Propinsi Jawa Timur 1987", Statistical Office of East Java Province

3.4 Air Transportation

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 departing freight always exceeds the arriving freight. The freight volume in 1983 was 11,400 tons, so that the annual average increase of freight at Juanda Airport is 7.1% in 1983-1987 period which is more than double the increase in air passengers.

Chapter 4

SOCIO-ECONOMIC FRAMEWORK

CHAPTER 4

SOCIO-ECONOMIC FRAMEWORK

4.1 Fifth Five-Year Development Plan (Pelita V)

4.1.1 Pelita V - National Development Plan

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.

(1) Basic Development Policy

Pelita V is the last plan which completes the first 25-year long-term development plan and forms the bases to establish the second 25-year long-term development plan. It is intended at the outset of Pelita V that the success of Pelita V will realize the economic "take-off" during the subsequent Pelita VI.

However, current issues to be tackled in Pelita V are increasing population and the provision of sufficient employment opportunities for them. The population growth rates were 2.3% per annum (p.a.) in 1978 (last year of Pelita II), 2.2% p.a. in 1983 (last year of Pelita III), 2.1% p.a. in 1988 (last year of Pelita IV); and in 1993 (last year of Pelita V) it is expected to be 1.8% p.a. or during the Pelita V period the growth rate is anticipated to average 1.9% p.a.

In order to create job opportunity for the increased population in Pelita V, real economic growth is required to average 5% per annum. To attain such a growth of economy at 5% p.a., the contribution of manufacturing industrial development is expected.

Reflecting the current stagnation of investment in the oil and gas industry, investment capital required for the target economic growth is planned to be derived from the increase in export of non-oil and gas products (about twofold during the 5-

year period) and the increase in general taxes (about threefold during the 5-year period).

Further, the government expects the private sector to supplement the lack of government budget for development. In order to stimulate economic activities of the private sector such institutional improvements as the "deregulation" policy should be emphasized further and continuously.

The remaining shortage of the required investment capital is expected to be obtained from foreign aid which is planned to amount to 239,100 billion Rupiah in total for the 5-year period.

(2) Planned Development Target

The average population growth in Pelita V is projected at 1.9% p.a. and its regional distribution of growth in Java and other regions is estimated as shown in Table 4.1.

Table 4.1 Population Growth in Pelita V

Region	Area (1,000 km ²)	Population (million persons)				Density (person/km ²)	
		1988		1993		1988	1993
Java	132.2	105.8	(60.3%)	114.1	(59.1%)	800	864
Others	1,787.2	69.8	(39.7%)	78.8	(40.9%)	39	44
Total	1,919.4	175.6	(100.0%)	192.9	(100.0%)	91	101

Source : Pelita V, BAPPENAS

The population growth rates are estimated at 1.52% p.a. for Java and 2.46% p.a. for other regions. The growth discrepancy in the regional population is very large, and the population growth in urban areas is assumed to be much higher than in rural areas. The urbanization speed is likely to be enhanced during Pelita V.

The population in 1988 was 175.6 million in the whole country and it is projected to increase to 192.9 million in 1993. The increment during this 5 years is 17.3 million or 3.5 million per year on average.

The labor force is estimated to increase from 74.5 million in 1988 to 86.4 million in 1993. The growth is 11.9 million in total or 2.4 million per year on average.

The age structure of population, as shown in Table 4.2, tends towards the young age group, so that the growth rate of labor force is estimated at 3% per annum. The women's labor force is assumed to grow at 3.9% p.a., which is higher than the men's labor force growth rate of 2.4% p.a. The women's participation in the labor force market seems to play an imperative role in the economic development in Indonesia.

Table 4.2 Age Structure of 1988 and 1993 Population

Age Group (Years)	1988		1993	
	(1,000 persons)	(%)	(1,000 persons)	(%)
0 - 4	23,047.9	13.1	23,019.3	11.9
5 - 9	21,285.3	12.1	22,418.2	11.6
10 - 14	21,553.9	12.3	21,529.0	11.2
15 - 44	79,982.0	45.6	91,770.4	47.6
45 - 64	23,165.0	13.2	26,076.4	13.5
65 and over	6,554.8	3.7	8,122.0	4.2
Total	175,588.9	100.0	192,935.3	100.0

Source : Pelita V, BAPPENAS

The real economic growth during the previous Pelita IV was 4% p.a. on average. The target growth rate of Gross Domestic Product (GDP) is 5% p.a. on average for Pelita V and that of National Income per Capita is 3.1% per annum.

The economic development by industrial sector is targeted as shown in Table 4.3 and the sectoral composition in 1988 and 1993 is projected as shown in Table 4.4.

Table 4.3 Target Economic Growth by Industrial Sector in Pelita V

Industrial Sector	Average Annual Growth Rate (% p.a.) During Pelita V
1. Agriculture	3.6
2. Mining	0.4
3. Manufacturing	8.5
4. Construction	6.0
5. Commerce	6.0
6. Transport/Communication	6.4
7. Others	6.1
GDP	5.0

Source : Pelita V, BAPPENAS

Table 4.4 Target Sectoral Composition of GDP in 1988 and 1993

Industrial Sector	1988	1993
1. Agriculture	23.2	21.6
2. Mining	15.9	12.6
3. Manufacturing	14.4	16.9
4. Construction	5.6	5.8
5. Commerce	15.9	16.7
6. Transport/Communication	5.7	6.0
7. Others	19.3	20.4
GDP	100.0	100.0

Source : Pelita V, BAPPENAS

4.1.2 Pelita V - East Java Provincial Development Plan

A target socio-economic framework is planned by the East Java provincial government for its five years development.

The population in East Java was 32.9 million and the population density 680 persons per square kilometer in 1988. Pelita V projects the East Java population to be 34.6 million and the population density 718 persons per square kilometer in 1993, so that the population growth during Pelita V results in 1.21% per annum. The population in East Java is projected for every year of Pelita V as shown in Table 4.5.

Based on the projected population, the labor force population is estimated to increase from 15.5 million in 1989 to 16.7 million in 1993 at the average annual growth rate of 2.00% as shown in Table 4.5.

Table 4.5 Projection of Population and Labor Force in East Java for Pelita V

Year	Population (x1,000)	Ave. Annual Growth	Labor Force (x1,000)	Ave. Annual Growth
1989	32,945		15,452	
1990	33,380		15,762	
1991	33,770	1.21%	16,077	2.00%
1992	34,166		16,390	
1993	34,565		16,726	

Source : "Repelita V Jawa Timur, Buku I", East Java Provincial Government

The employment opportunity in East Java is also estimated for different industrial sectors as shown in Table 4.6.

Table 4.6 Employment Opportunity by Industrial Sector in East Java for Pelita V

Sector	1989	(%)	1993	(%)
1. Agriculture	8,514	(56.8)	9,713	(58.5)
2. Mining/Quarrying	98	(0.7)	111	(0.7)
3. Manufacturing	1,433	(9.6)	1,567	(9.4)
4. Electricity/Gas/Water Supply	14	(0.1)	15	(0.1)
5. Construction	429	(2.9)	469	(2.8)
6. Trading/Restaurant/ Hotel	2,255	(15.1)	2,373	(14.2)
7. Transportation/ Communication	419	(2.8)	453	(2.7)
8. Banking and other Financial Institutions	64	(0.4)	73	(0.4)
9. Services	1,758	(11.7)	1,842	(11.1)
Total	14,985	(100.0)	16,616	(100.0)

Source : "Repelita V Jawa Timur, Buku I", East Java Provincial Government

The economic development in East Java for Pelita V is estimated at 5% p.a. on average. Sectoral development is also estimated to grow at an average annual rate of 3% for agriculture, 9% for manufacturing, 5% for transportation/communication and 7% for electricity/gas/water supply. The major structure of the East Java economy is, therefore, expected to change by the end of Pelita V as shown in Table 4.7.

Table 4.7 Economic Structure of East Java at the End of Pelita V

Sector	1984	1987	1993
1. Agriculture	32.4	30.7	30.0
2. Manufacturing	16.8	17.2	24.0
3. Transportation/Communication	6.8	6.3	9.0
4. Trading	19.4	21.2	26.0
5. Others	24.6	24.6	11.0
GRDP	100.0	100.0	100.0

Source : "Repelita V Jawa Timur, Buku I", East Java Provincial Government

4.2 Regional Structure Plan

4.2.1 Regional Development Structure

East Java Province is divided into 9 regional development units (SWP - Satuan Wilayah Pembangunan) with development centers for the respective units as shown in Fig. 4.1. In the East Java Pelita V, the development direction of each development unit is defined as follows:

- 1) SWP GERBANGKERTOSUSILA
 - Regional Development Center is Kotamadya Surabaya.
 - Development directions are to such activities as agriculture, manufacturing, transportation/communication, tourism, trading, education, health and living environment.
- 2) SWP Madura and Other Islands
 - Regional Development Center is Sumenep.
 - Development directions are towards agriculture, manufacturing, transportation/ communication, tourism, trading and living environment.

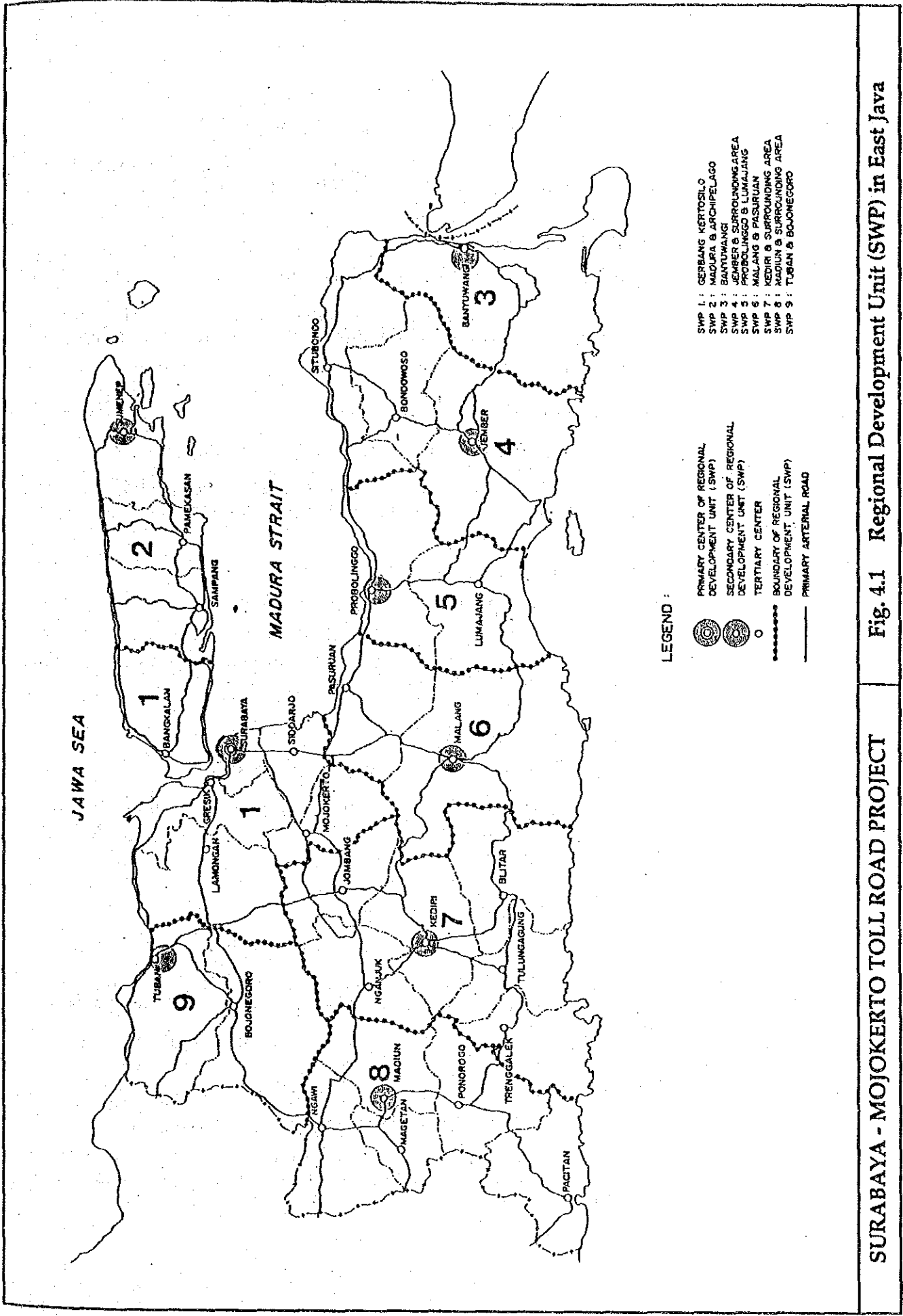


Fig. 4.1 Regional Development Unit (SWP) in East Java

SURABAYA - MOJOKERTO TOLL ROAD PROJECT

- 3) SWP Banyuwangi
 - Regional Development Center is Banyuwangi city.
 - Development directions are towards agriculture, manufacturing, transportation/ communication, trading and tourism.
- 4) SWP Jember and its Environs
 - Regional Development Center is Jember city.
 - Development directions are towards agriculture, manufacturing, mining/quarrying, transportation/ communication, tourism, trading and education.
- 5) SWP Probolinggo
 - Regional Development Center is Kotamadya Probolinggo.
 - Development directions are towards agriculture, manufacturing, transportation/ communication, tourism and trading.
- 6) SWP Malang
 - Regional Development Center is Kotamadya Malang.
 - Development directions are drawn to agriculture, manufacturing, mining/quarrying, transportation/ communication, tourism, trading, education, health and living environment.
- 7) SWP Kediri and its Environs
 - Regional Development Center is Kotamadya Kediri.
 - Development directions are towards agriculture, manufacturing, transportation/communication, tourism, trading, mining/ quarrying and living environment.
- 8) SWP Madiun and its Environs
 - Regional Development Center is Kotamadya Madiun.
 - Development directions are towards agriculture, manufacturing, mining/quarrying, transportation/ communication, tourism, trading and living environment.
- 9) SWP Tuban
 - Regional Development Center is Tuban City.
 - Development directions are drawn to agriculture, manufacturing, transportation/communication, tourism, mining/quarrying, trading and living environment.

In addition to the above regional development units, cities in East Java are ranked due to their functions and influence coverage as follows:

1) Primary Order City : Surabaya

Population : about 3 million

Function : Goods storage, financial services, export-import trading, regional trading and market oriented industries

2) Secondary Order Major City (Population 500,000 to 1,000,000)

City

Function

- | | | |
|-----------|---|--|
| a) Malang | : | Regional trading, industry, education, financial and other services |
| b) Jember | : | Regional trading, industry, exporting, financial services, education and goods storage |
| c) Kediri | : | Regional trading, industry, services and goods storage |
| d) Madiun | : | Regional trading, industry, services and goods storage |

3) Secondary Order Medium City (Population 100,000 to 250,000)

City

Function

- | | | |
|----------------|---|----------------------|
| a) Tuban | : | Trading and Industry |
| b) Sumenep | : | Trading and Industry |
| c) Probolinggo | : | Trading and Industry |
| d) Banyuwangi | : | Trading and Industry |

4) Tertiary Order Cities:

Sidoarjo, Mojokerto, Bangkalan, Gresik, Lamongan, Bojonegoro, Ngawi, Jombang, Nganjuk, Magetan, Ponorogo, Pacitan, Tulungagung, Trenggalek, Blitar, Pasuruan, Lumajang, Situbondo, Bondowoso, Sampang and Pamekasan

4.2.2 Strategic Development Area

According to the East Java Structure Plan 2008, strategic development areas are designated as follows:

1) River Catchment Area (DAS)

Proposed priority development area in the following order:

- DAS Brantas
- DAS Bengawan Solo
- DAS Madura
- DAS Madiun
- DAS Sampean
- DAS Pekalen
- DAS Bondoyudo

2) Tourism Area

Proposed priority in the following order:

- Bromo and Plengkung Zones
- Batu, Tretes, Sarangan and Trowulan Zones

3) Juanda Airport

- Internationalization
- Supporting facilities development
- Planning and control of the relating area

4) Seaport

Proposed development priority is as follows:

- Tg. Perak Port
- Gresik Port
- Meneng Port
- Tuban Port
- Probolinggo Port
- Kalianget Port

5) Dry Port Rambipuji - Jember

- Development of dry port zone
- Upgrading of function for export-import activities
- Banking services

- Planning and control of the related area
- 6) Surabaya - Kamal Bridge
- 7) Northern region industrial zone development

4.2.3 Land Transportation System Development Plan

The East Java Structure Plan 2008 also proposes priority development for the land transportation sector as follows:

(1) Major Road Development Strategy

For collection and distribution of commodities and services a road network should be built to coordinate among various road functions.

The development emphasis is placed on the following routes:

- a) Primary arterial road:
 - Surabaya - Malang route
 - Surabaya - Mojokerto - Madiun up to Ngawi route
 - Surabaya - Pasuruan - Probolinggo - Banyuwangi/Jember route
 - Jember - Banyuwangi route
 - Surabaya - Gresik - Tuban up to Semarang route
 - Kamal - Bangkalan - Sampang up to Sumenep route
 - Kertosono - Kediri route
 - Jombang - Kediri route
- b) Primary collector road:
 - Bojonegoro - Tuban route
 - Babat - Jombang route
 - Madiun - Pacitan route
 - Pacitan - Trenggalek up to Tulungagung and Blitar route
 - Kediri - Tulungagung route
 - Malang - Lumajang route
 - Jember - Bondowoso - Situbondo route
 - Northern route of Madura

- Bondowoso - Besuki

Surabaya - Kamal Bridge construction is also enumerated as a strategic development plan to improve the access to Madura and to reduce the impediment of ferry traffic in the Tg. Perak Port area.

Further, heavy traffic routes will require the construction of express/toll roads. They are:

- Surabaya - Gresik
- Surabaya - Mojokerto
- Gempol - Malang
- Gempol - Pasuruan - Probolinggo

(2) Railway Development Strategy

The major objectives are:

- Improvement of freight transportation by cheap and safe container system
- Relief of such heavy trucks as full and semi trailer trucks from major roads and reduction of road maintenance and repair costs

Safety and functional improvement are expected for the following routes :

- Surabaya - Malang route
- Surabaya - Mojokerto up to Jakarta route
- Babat - Tuban for supporting industrial zone development
- Madiun - Ponorogo route
- Kertosono and Jombang toward Kediri
- Blitar - Malang route
- Surabaya - Jember - Banyuwangi route
- Dampit - Malang route
- Kamal - Pamekasan (and new construction toward Sumenep)
- Surabaya - Babat - Bojonegoro up to Semarang - Jakarta
- Kediri - Tulungagung - Blitar route

Particularly, the Dry Port development in Rambipuji is required to transport container commodities for export and the railway should take an important role in it.

4.3 Future Development Framework

4.3.1 Population of Indonesia and Java

The Central Bureau of Statistics, Indonesia has projected the future population of Indonesia and Provinces, based on the results of the 1980 census and 1985 intercensus surveys.

According to the projection, the total population of Indonesia is estimated to be 231.4 million persons in 2005. A trend of population growth rates for every five years was applied to extrapolate the future population beyond the year 2005.

As a result, the future population of Indonesia was estimated to be 261.5 million in 2015 as shown in Table 4.8.

Table 4.8 Projection of Future Population of Indonesia

Year	Population (x 1,000)	Average Annual Growth Rate
1980 ^{1/}	147,490	-
1985 ^{2/}	164,630	2.22%
1990 ^{3/}	182,650	2.10%
1995 ^{3/}	199,647	1.80%
2000 ^{3/}	216,116	1.56%
2005 ^{3/}	231,412	1.38%
2010 ^{4/}	246,363	1.26%
2015 ^{4/}	261,504	1.20%

Note : ^{1/} 1980 Census Data

^{2/} 1985 Intercensus Data

^{3/} Projection by Central Bureau of Statistics, Indonesia

^{4/} Estimates by JICA Study Team

The provincial future population has been also projected by the Central Bureau of Statistics up to the year 1995.

In order to further extend the projection of provincial population, the population distribution among the major islands of Indonesia was examined. Changes in distribution share, in other words changes in contribution to the increase of total Indonesia population have been traced and extrapolated to estimate the population beyond the year 1995. The estimation result was further checked with growth rates of population for the respective islands so as to avoid the inconsistency of a continuous growth of population. The results are shown in Tables 4.9 and 4.10.

Table 4.9 Future Population of Major Islands in Indonesia

(Unit : 1,000 persons)

Major Islands	1980 ^{1/}	1985 ^{2/}	1990 ^{3/}	1995 ^{3/}	2000 ^{4/}	2005	2010	2015
Sumatra	28,016 (19.00)	32,720 (19.87)	37,939 (20.77)	43,356 (21.72)	49,102 (22.72)	55,030 (23.78)	61,320 (24.89)	68,096 (26.04)
Java	91,270 (61.88)	100,208 (60.87)	109,235 (59.81)	117,237 (58.72)	124,483 (57.60)	130,655 (56.46)	136,239 (55.30)	141,500 (54.11)
Nusa Tenggara	8,487 (5.75)	9,369 (5.69)	10,380 (5.68)	11,307 (5.66)	12,167 (5.63)	12,936 (5.59)	13,649 (5.54)	14,330 (5.48)
Kalimantan	6,723 (4.56)	7,749 (4.71)	8,910 (4.88)	10,093 (5.06)	11,346 (5.25)	12,612 (5.45)	13,944 (5.66)	15,403 (5.89)
Sulawesi	10,410 (7.06)	11,594 (7.04)	12,724 (6.97)	13,747 (6.89)	14,696 (6.80)	15,505 (6.70)	16,235 (6.59)	16,945 (6.48)
Maluku/ Irian Jaya	2,585 (1.75)	2,990 (1.82)	3,462 (1.90)	3,907 (1.96)	4,322 (2.00)	4,674 (2.02)	4,976 (2.02)	5,230 (2.00)
Indonesia	147,491 (100.00)	164,630 (100.00)	182,650 (100.00)	199,647 (100.00)	216,116 (100.00)	231,412 (100.00)	246,363 (100.00)	261,504 (100.00)

- Note :
- 1/ 1980 Census Data
 - 2/ 1985 Intercensus Data
 - 3/ Projection by Central Bureau of Statistics, Indonesia
 - 4/ Estimates by JICA Study Team for the population beyond the year 1995

Table 4.10 Estimated Population Growth of Major Islands of Indonesia

(Unit : % per annum)

Major Islands	1980-85	1985-90	1990-95	1995-2000	2000-05	2005-10	2010-15
Sumatra	3.15	3.00	2.71	2.52	2.31	2.19	2.12
Java	1.89	1.74	1.42	1.21	0.97	0.84	0.76
Nusa Tenggara	2.00	2.07	1.73	1.48	1.23	1.08	0.98
Kalimantan	2.88	2.83	2.52	2.37	2.14	2.03	2.01
Sulawesi	2.18	1.88	1.56	1.34	1.08	0.92	0.86
Maluku/ Irian Jaya	2.95	2.97	2.45	2.04	1.58	1.26	1.00
Indonesia	2.22	2.10	1.80	1.56	1.38	1.26	1.20

The future provincial population is also projected by the Central Bureau of Statistics, Indonesia up to year 1995. In order to further estimate the provincial population beyond 1995, the population density of the provinces in Java Island was examined.

DKI Jakarta, for example, is the most densely inhabited area with gross density of about 160 persons per hectare in 1990. The DKI Jakarta Structure Plan, therefore, plans to control the population increase and sets a target of total population to be 12 million as the utmost limit.

The population density in West Java and Central Java is also high and it was projected not to exceed 10 persons per hectare. As a result, the future population in the provinces in Java Island has been estimated as shown in Table 4.11.

Table 4.11 Future Population and Density of Provinces in Java

(Unit : 1,000 persons)

Provinces	Area (km ²)*	1980 ^{1/}	1985 ^{2/}	1990 ^{3/}	1995 ^{3/}	2000 ^{4/}	2005	2010	2015
DKI Jakarta (Density)	590 (persons/km ²)	6,503 (11,022)	7,913 (13,412)	9,406 (15,942)	10,930 (18,525)	11,505 (19,500)	11,800 (20,000)	11,948 (20,251)	12,095 (20,500)
West Java (Density)	46,300 (persons/km ²)	27,454 (593)	30,940 (668)	34,434 (744)	37,548 (811)	40,709 (879)	43,594 (942)	46,271 (999)	48,753 (1,053)
Central Java (Density)	34,206 (persons/km ²)	25,373 (742)	27,041 (791)	29,017 (848)	30,700 (898)	32,500 (950)	34,071 (996)	35,477 (1,037)	36,717 (1,073)
D.I.Yogyakarta (Density)	3,169 (persons/km ²)	2,751 (868)	2,941 (928)	3,172 (1,001)	3,382 (1,067)	3,605 (1,138)	3,812 (1,203)	4,009 (1,265)	4,196 (1,324)
East Java (Density)	47,922 (persons/km ²)	29,189 (609)	31,373 (655)	33,206 (693)	34,677 (724)	36,164 (755)	37,378 (780)	38,534 (804)	39,739 (829)
Java Total (Density)	132,187 (persons/km ²)	91,270 (690)	100,208 (758)	109,235 (826)	117,237 (887)	124,483 (942)	130,655 (988)	136,239 (1,031)	141,500 (1,070)

- Note :
- 1/ 1980 Census Data
 - 2/ 1985 Intercensus Data
 - 3/ Projection by Central Bureau of Statistics, Indonesia
 - 4/ Estimate by JICA Study Team for the population beyond the year 1995
 - * Data from Statistical Year Book of Indonesia 1989.

4.3.2 Gross Regional Domestic Product

During 1983-1987, GRDP grew at 6.71% in Java and 5.65% in East Java on an annual average. GRDP growth of Java excluding East Java was 7.15% in the same period. This was higher than that of East Java, because of the existence of DKI Jakarta in the area.

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 4.12 together with the per capita GRDP and its growth rate.

Table 4.12 Future GRDP and GRDP per Capita in Java and East Java (at 1983 constant prices)

Region	Year	Population	GRDP	Per Capita GRDP	
		(x1,000)	(Bil.Rp)	(x1,000 Rp)	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

4.3.3 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. However, the data on registered vehicles cannot cover all the intended vehicle classification as discussed previously in Section 2.5.

The growth of vehicle ownership was assumed to determine that of traffic demand in future. Therefore, the future demand of classified vehicle traffic was based on the future ownership growth of the following vehicle groups:

<u>Future Traffic Demand</u>	<u>Future Vehicle Ownership</u>
(1) Passenger Vehicle + Large/Medium Bus	(Registered Passenger Vehicle) + (Registered Bus)
(2) Large/Medium Bus	(Tested Bus)
(3) Pick-up/Mini-truck + Large/Medium Truck	(Registered Truck)
(4) Large/Medium Truck	(Tested Truck)
<hr/>	
(5) Passenger Vehicle = (1) - (2)	
(6) Pick-up/Mini-truck = (3) - (4)	

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 4.13. Based on the data presented in Table 4.13, regression equations which most fit to the estimation of future vehicle ownership were estimated as follows:

1) Registered Passenger Vehicle + Registered Bus (Y_1)

$$\text{East Java} : Y_1 = 0.031X_1 - 6.311 \quad (r = 0.996)$$

$$\text{Java Total} : Y_1 = 0.027X_1 - 2.423 \quad (r = 0.984)$$

2) Registered Truck (Y_2)

$$\text{East Java} : Y_2 = 0.020X_2 - 3.634 \quad (r = 0.969)$$

$$\text{Java Total} : Y_2 = 0.012X_2 - 0.003 \quad (r = 0.996)$$

3) Tested Bus (Y_3)

$$\text{East Java} : Y_3 = 12.861X_3 - 784 \quad (r = 0.948)$$

$$\text{Java Total} : Y_3 = 180.868X_3 - 19689 \quad (r = 0.949)$$

4) Tested Truck (Y_4)

$$\text{East Java} : Y_4 = 331.262X_4 - 28070 \quad (r = 0.948)$$

$$\text{Java Total} : Y_4 = 957.280X_4 - 42597 \quad (r = 0.986)$$

where, Y_1 & Y_2 = Vehicles/1,000 persons

Y_3 & Y_4 = No. of Vehicles

X_1, X_2, X_3 & X_4 = GRDP per Capita (x1,000 Rp.)

The future vehicle ownership was estimated for East Java and Java using the above regression equations and the future socio-economic parameters projected in

Table 4.13 Socio-Economic Data and Vehicle Ownership in East Java and Java

Province / Area	Year	'83 Constant Billion Rp.	Population (1,000 persons)	Per capita GRDP Thousand Rp.	Vehicle Ownership				Tested Bus	Tested Truck
					Passenger Vehicle	Bus	Sub-Total P.C. + Bus	Truck		
EAST JAVA	1982	10,073	30,079	335	115,367	6,243	121,610	93,188	3,463	80,571
	1983	10,846	30,481	356	131,758	6,590	138,348	106,689	3,769	88,804
	1984	11,507	30,924	372	154,636	7,211	161,847	130,351	4,184	100,777
	1985	12,131	31,373	387	164,135	7,875	172,030	138,122	4,222	101,919
	1986	12,894	31,769	406	184,218	11,440	195,658	145,002	4,222	101,919
	1987	13,514	32,168	420	202,368	11,596	213,964	155,241	4,705	111,541
	TOTAL									
JAVA	1982	33,756	95,103	355	616,229	82,465	698,694	412,995	33,659	294,851
	1983	36,586	96,531	379	665,354	100,895	766,249	444,985	47,764	323,937
	1984	40,420	98,352	411	713,484	124,152	837,636	495,307	56,161	350,261
	1985	42,670	100,207	426	756,768	147,087	903,855	523,703	58,635	369,372
	1986	45,223	102,105	443	809,258	166,780	976,038	543,896	58,742	370,368
	1987	47,443	103,984	456	877,561	189,380	1,066,941	583,376	49,838	400,113

Province / Area	Year	VEHICLES PER 1,000 POPULATION			
		Passenger Vehicle	Bus	Sub-Total P.C. + Bus	Truck
EAST JAVA	1982	3.84	0.21	4.04	3.10
	1983	4.32	0.22	4.54	3.50
	1984	5.00	0.23	5.23	4.22
	1985	5.23	0.25	5.48	4.40
	1986	5.80	0.36	6.16	4.56
	1987	6.29	0.36	6.65	4.83
	TOTAL				
JAVA	1982	6.48	0.87	7.35	4.34
	1983	6.89	1.05	7.94	4.61
	1984	7.25	1.26	8.52	5.04
	1985	7.55	1.47	9.02	5.23
	1986	7.93	1.63	9.56	5.33
	1987	8.44	1.82	10.26	5.61

Source : Statistical Year Book of Indonesia, 1985 and 1989
 Vehicle and Length of Road Statistics, 1987 -
 Central Bureau of Statistics

previous Section 4.3.2. The resulting future vehicle ownership is presented in Table 4.14.

Table 4.14 Future Vehicle Ownership and Growth Factors in East Java and Java

East Java

Year	^{1/} (Pass.Vehicle+Bus)		^{2/} (Large/Medium Bus)		^{3/} (Large/Medium Truck)		^{4/} (Truck Total)	
	Number	(Growth*)	Number	(Growth*)	Number	(Growth*)	Number	(Growth*)
1982	121,610	(40)	3,463	(62)	80,571	(59)	93,188	(44)
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	^{1/} (Pass.Vehicle+Bus)		^{2/} (Large/Medium Bus)		^{3/} (Large/Medium Truck)		^{4/} (Truck Total)	
	Number	(Growth*)	Number	(Growth*)	Number	(Growth*)	Number	(Growth*)
1982	698,694	(53)	33,659	(44)	294,851	(63)	412,995	(59)
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 vehicles 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.
* 1990 = 100

4.4 Zonal Planning Parameters

4.4.1 Population

(1) Kabupaten/Kotamadya Population

The East Java Statistical Office has estimated 1990 population of each Kabupaten/Kotamadya in East Java Province.

Furthermore, the future population growth of the respective Kabupatens/Kotamadyas is projected in the East Java Pelita V. The future population of Kabupatens/Kotamadyas was, therefore, based on the Pelita V's growth rate of each Kabupaten/Kotamadya and the previously established population framework of East Java. The resulting estimate is presented in Table 4.15.

(2) Kecamatan Population

Corresponding to the requirement of traffic demand analysis, Kabupatens which are directly influenced by the Toll Road were further divided into traffic zones. The unit area that comprises the traffic zone was defined to be a Kecamatan.

Kabupatens that were broken down into smaller zones are Kotamadya Surabaya, Kabupaten Sidoarjo, Kabupaten Gresik and Kabupaten Mojokerto. The future population of these zones was based on their historical trend of increase and such as the master plan of Driyorejo New Town Development. The total of the estimated Kecamatan population was adjusted eventually to coincide with the relevant Kabupaten population that was estimated previously in above section (1).

4.4.2 GRDP by Kabupaten

Pelita V of East Java introduces the target economic development of its member Kabupatens. However, not all the Kabupatens show their growth target. Therefore, the trend of economic growth in each Kabupaten was analyzed referring to the "Gross Regional Product of East Java and Kabupaten/Kotamadya, 1983-1986, East Java Statistical Office". Derived growth trends were, therefore, applied to their relevant Kabupatens/Kotamadyas that have no specific growth target in Pelita V.

Employing the above growth factors, GRDPs of Kabupaten/Kotamadya in East Java have been estimated, and finally adjusted to be compatible with the previously determined future GRDP in East Java. The estimated future GRDPs by Kabupaten/Kotamadya are presented in Table 4.15.

Table 4.15 Estimated Future Planning Parameters in East Java

Kab./ Kodya	Name	ESTIMATED FUTURE GRDP IN EAST JAVA			ESTIMATED FUTURE POPULATION IN EAST JAVA				
		1990 '83 Constant (Million Rp.)	1995 '83 Constant (Million Rp.)	2005 '83 Constant (Million Rp.)	2015 '83 Constant (Million Rp.)	1990 (1,000)	1995 (1,000)	2005 (1,000)	2015 (1,000)
Kab.	PACITAN	172,719	212,088	311,365	442,313	490	492	493	493
Kab.	PONOROGO	310,496	409,359	693,284	1,135,857	813	818	823	825
Kab.	TRENGGALEK	172,401	206,594	289,059	391,254	627	642	657	663
Kab.	TULUNGAGUNG	336,426	429,805	683,512	1,051,541	898	912	926	931
Kab.	BLITAR	338,234	418,242	623,105	898,048	1,078	1,101	1,124	1,133
Kab.	KEDIRI	474,521	619,685	1,029,707	1,655,245	1,394	1,434	1,474	1,490
Kab.	MALANG	1,396,307	1,500,123	1,687,060	1,835,436	2,279	2,317	2,355	2,370
Kab.	LUMAJANG	440,450	477,902	548,195	608,328	957	976	994	1,001
Kab.	JEMBER	978,854	1,106,914	1,379,167	1,662,360	2,039	2,075	2,111	2,125
Kab.	BANYUWANGI	676,159	815,381	1,155,300	1,583,560	1,611	1,659	1,707	1,727
Kab.	BONDOWOSO	257,790	316,932	466,744	664,962	665	676	688	692
Kab.	SITUBONDO	283,897	355,980	545,342	808,196	577	589	602	607
Kab.	PROBOLINGGO	426,434	550,289	892,855	1,401,448	925	953	980	991
Kab.	PASURUAN	642,909	840,386	1,399,099	2,253,326	1,174	1,221	1,270	1,289
Kab.	SIDOARJO	717,736	917,390	1,460,307	2,248,743	1,094	1,227	1,544	1,858
Kab.	MOJOKERTO	336,169	401,479	557,935	750,084	809	868	1,000	1,120
Kab.	JOMBANG	401,938	511,294	806,129	1,229,545	1,080	1,116	1,152	1,166
Kab.	NGANJUK	343,607	441,083	708,186	1,099,967	993	1,020	1,048	1,059
Kab.	MADIUN	238,464	311,414	517,466	831,820	671	682	692	696
Kab.	MAGETAN	342,961	447,879	744,223	1,196,331	653	663	672	676
Kab.	NGAWI	317,675	413,870	684,445	1,095,011	839	855	871	877
Kab.	BOJONEGORO	277,172	379,532	693,356	1,225,378	1,146	1,183	1,221	1,236
Kab.	TUBAN	313,974	405,359	658,332	1,034,320	1,005	1,039	1,073	1,087
Kab.	LAMONGAN	332,168	423,756	671,961	1,030,809	1,199	1,237	1,276	1,291
Kab.	GRESIK	737,501	938,154	1,479,136	2,256,045	864	933	1,089	1,233
Kab.	BANGKALAN	241,544	316,791	530,929	860,806	737	747	756	760
Kab.	SAMPANG	230,194	258,021	315,856	374,049	673	689	705	711
Kab.	PAMEKASAN	178,455	186,095	197,177	202,107	617	637	656	664
Kab.	SUMENEP	320,075	403,468	624,650	935,554	945	966	987	996
Kodya.	KEDIRI	858,472	1,110,987	1,812,951	2,861,991	274	303	370	435
Kodya.	BLITAR	54,495	61,353	75,772	90,527	123	128	139	148
Kodya.	MALANG	607,953	919,964	2,052,506	4,429,996	682	824	1,203	1,630
Kodya.	PROBOLINGGO	133,894	193,957	396,554	784,341	178	193	228	260
Kodya.	PASURUAN	98,306	127,404	208,499	330,087	165	203	309	431
Kodya.	MOJOKERTO	75,400	105,455	200,991	370,584	97	104	119	132
Kodya.	MADIUN	110,600	143,542	235,582	374,034	183	190	204	216
Kodya.	SURABAYA	2,362,748	3,430,623	7,046,864	14,003,097	2,652	3,005	3,861	4,720
EAST JAVA		16,539,098	21,108,500	34,383,601	56,007,100	38,206	34,677	37,379	39,739

Chapter 5
TRAFFIC SURVEY

CHAPTER 5

TRAFFIC SURVEYS

5.1 Execution of Traffic Surveys

The following 4 kinds of traffic surveys were conducted by the Study Team in order to update and supplement the existing road traffic data.

- Traffic count survey
- Roadside OD survey
- Bus terminal OD survey
- Travel speed survey

The survey objectives, outlines of the surveys, location and period of survey, and survey method and items, are described in the subsequent sections.

5.1.1 Traffic Count Survey

(1) Survey Objective

The traffic count survey aimed at ascertaining the traffic characteristics on the arterial roads which compete with the Toll Road and on Surabaya-Gempol Toll Road, and at obtaining expansion factors to be applied to the data based on the roadside OD survey.

(2) Survey Location and Period

The traffic count survey was conducted at 25 locations, (refer to Table 5.1, Fig. 5.1 and Fig. 5.2), 16 locations on the arterial roads and 9 locations on Surabaya-Gempol Toll Road. The survey on Surabaya-Gempol Toll Road consisted of the counting of the entry traffic at every on-ramp gate of 8 interchanges and the counting of sectional traffic at one location between Waru IC and Sidoarjo IC. The survey was conducted in the period of September 11-20, 1990 for 16 hours (6:00 to 22:00) at 16 locations and 24 hours (6:00 to 6:00 in the next morning) at 9 locations.

Table 5.1 Traffic Count and O/D Survey Conducted

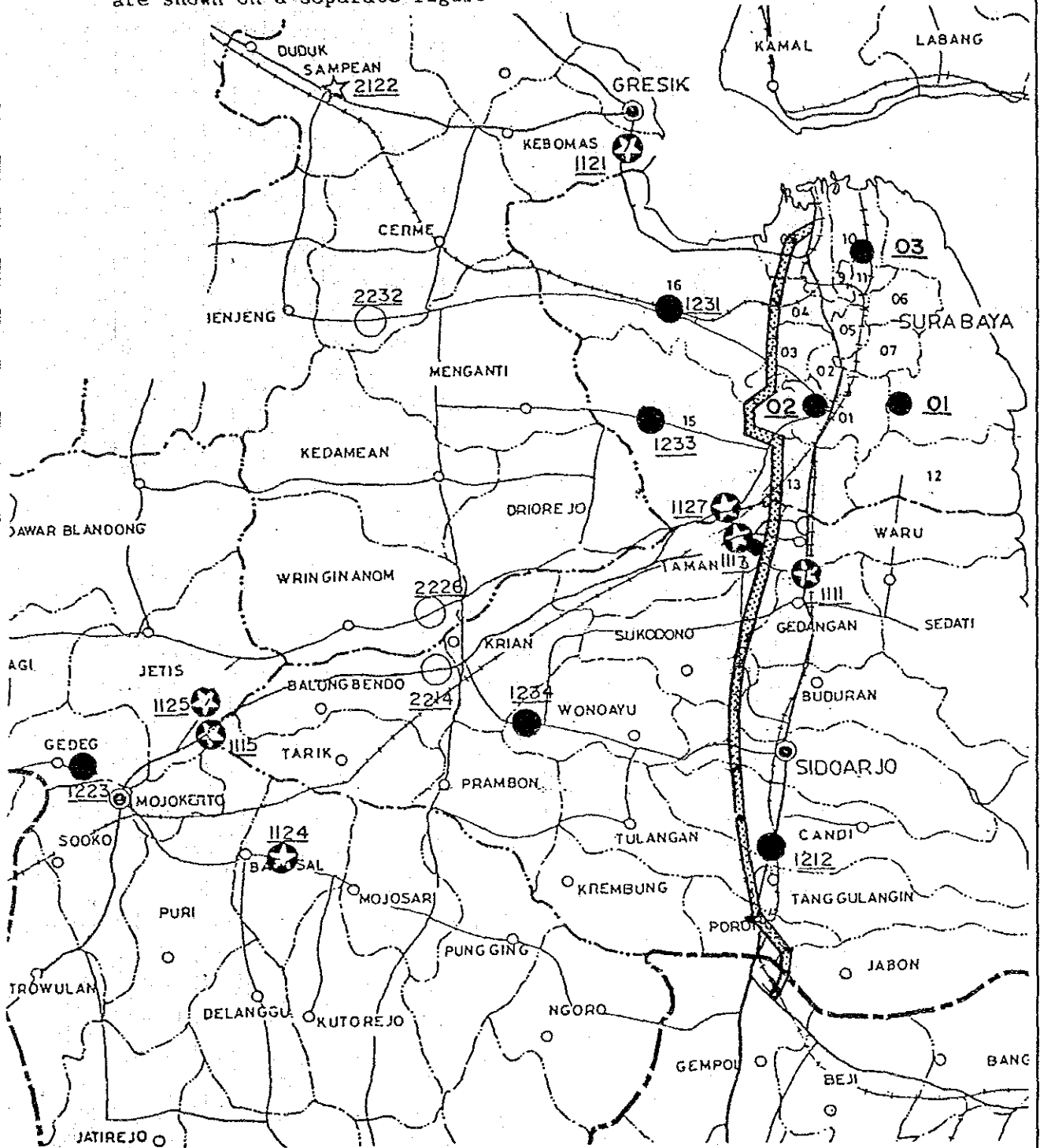
DATE	LOCATION	CODE	SECTION	KECAMATAN	KIND OF SURVEY
SEPT. 11, 1990 (TUESDAY)	TARIK	1115	SURABAYA - MOJOKERTO	TARIK	OD / TC
	GEDEK	1223	MOJOKERTO - LAMONGAN	GEDEK	OD / TC
	PORONG	12412	SURABAYA - GEMPOL	PORONG	OD / TC (TOLL GATE)
	GEMPOL	12413	SURABAYA - GEMPOL	GEMPOL	OD / TC (TOLL GATE)
SEPT. 12, 1990 (WEDNESDAY)	BOLONG BENDO	2214	SURABAYA - MOJOKERTO	KRIAN	TC
	PACING BANGSAL	1124	MOJOSARI - MOJOKERTO	BANGSAL	OD / TC
	WONOAYU	1234	KRIAN - SIDOARJO	WONOAYU	OD / TC
	DUDUK SAMPEAN	2122	LAMONGAN - GRESIK	DUDUK SAMPEAN	TC
SEPT. 13, 1990 (THURSDAY)	JETIS	1125	SURABAYA - MOJOKERTO	JETIS	OD / TC
	KEBRAON	1127	SURABAYA - MOJOKERTO	KARANG PILANG	OD / TC
	TANDES	1231	SURABAYA - GRESIK	TANDES	OD / TC
	WARU I	12408	WARU - GEMPOL		OD / TC (TOLL GATE)
SEPT. 18, 1990 (TUESDAY)	WARU II	12409	WARU - TJ. PERAK		OD / TC (TOLL GATE)
	KEDUNG DURI	21410	SURABAYA - GEMPOL		TC (TOLL ROAD)
	DOROMATU	1121	SURABAYA - GRESIK	KEBON MAS	OD / TC
	GELAM	1212	SURABAYA - SIDOARJO	CANDI	OD / TC
SEPT. 19, 1990 (WEDNESDAY)	DUPAK II	12402	DUPAK - TJ. PERAK		OD / TC (TOLL GATE)
	DUPAK III	12403	DUPAK - GEMPOL		OD / TC (TOLL GATE)
	KOTA SATELIT	12405	KOTA SATELIT - GEMPOL		OD / TC (TOLL GATE)
	GEDANGAN	1111	SURABAYA - SIDOARJO	GEDANGAN	OD / TC
SEPT. 20, 1990 (THURSDAY)	CERME	2232	SURABAYA - LAMONGAN	CERME	TC
	DUPAK I	12401	DUPAK - PASAR TURI		OD / TC (TOLL GATE)
	GUNUNG SARI I	12406	GUNUNG SARI - GEMPOL		OD / TC (TOLL GATE)
	GUNUNG SARI II	12407	GUNUNG SARI - TJ. PERAK		OD / TC (TOLL GATE)
SEPT. 20, 1990 (THURSDAY)	GILANG	1113	SURABAYA - MOJOKERTO	TAMAN	OD / TC
	LIDAH KULON	1233	SURABAYA - MENGANTI	LANKARSANTRI	OD / TC
	BANYU URIP	12404	BANYU URIP - GEMPOL		OD / TC (TOLL GATE)
	SIDOARJO	12411	SIDOARJO - SURABAYA		OD / TC (TOLL GATE)
WRINGINANOM	2226	SURABAYA - MOJOKERTO	WRINGINANOM	TC	

Note: OD : Roadside OD Survey
TC : Traffic Count

LEGEND

- ★ O/D Survey/Traffic Count (24 hours)
- O/D Survey/Traffic Count (16 hours)
- ☆ Traffic Count (24 hours)
- Traffic Count (16 hours)
- Bus O/D Survey (24 hours)

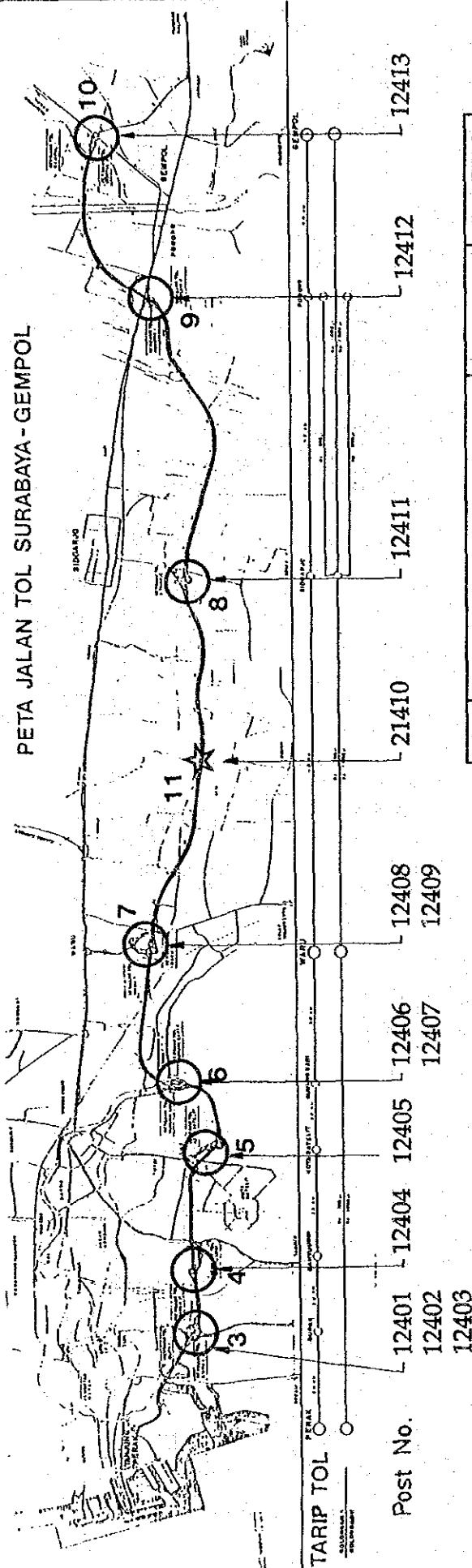
Note : The locations of traffic survey on Surabaya - Gempol Toll Road are shown on a separate figure



**SURABAYA - MOJOKERTO
TOLL ROAD PROJECT**

Fig.5.1 Location of Traffic Survey

PETA JALAN TOL SURABAYA - GEMPOL



NO.	SURVEY LOCATION	O/D AND T.COUNT	TRAFFIC COUNT
3	On-Ramps of Dupak IC	16 HRS	24 HRS
4	On-Rump of Banyu Urip IC	●	
5	On-Rump of Kota Satelit IC	●	
6	On-Rumps of Gunung Sari IC	●	
7	On-Rumps of Waru IC	●	
8	On-Rump of Sidoarjo IC	●	
9	On-Rump of Porong IC	●	
10	On-Ramp of Gempol IC	●	
11	Waru IC-Sidoarjo IC		●

LEGEND

- O/D Survey/Traffic Count (16hours)
- ☆ Traffic Count (24hours)

On Surabaya-Gempol Toll Road, counting of sectional traffic volume was minimized, only at one location for a 24 hours period, since detailed traffic volume data was available from the operation office of Jasa Marga.

(3) Survey Method and Items

Referring to existing traffic volume data (Bina Marga 1979 to 1988) and the results of similar nature of traffic survey, traffic count survey was conducted in the following 8 vehicle classifications:

- Motorcycle
- Sedan (including Jeep and Station Wagon)
- Mini Bus (Private use)
- Mini Bus (Public use)
- Large Bus
- Pick-Up
- Small Truck -- below 5 ton loading capacity
- Large Truck -- more than 5 ton loading capacity (Trailer, Tank Lorry, etc.)

Traffic volumes in the above 9 categories of vehicle types and in each direction were counted with manual counter.

5.1.2 Roadside OD Survey

(1) Survey Objective

The roadside OD survey aimed at determining the distribution pattern and volume of traffic (except bus) related to the Toll Road, and at obtaining data for the analysis of diversion rates to the Toll Road.

(2) Survey Location and Period

Survey locations are the same as those for the traffic count survey except for 5 locations, at a total of 20 locations (refer to Table 5.1, Fig. 5.1 and Fig. 5.2). Survey periods were also the same as those for the traffic count survey.

(3) Survey Method and Items

The interview survey was targeted on the following 7 vehicle types which exclude medium and large buses:

- Motorcycle
- Sedan (including Jeep and Station Wagon)
- Mini Bus (Private use)
- Mini Bus (Public use)
- Pick-Up
- Small Truck -- below 5 ton loading capacity
- Large Truck -- more than 5 ton loading capacity (Trailer, Tank Lorry, etc)

At each survey location, the object vehicles were stopped with traffic police cooperation, and the drivers interviewed at the roadside. It would have been desirable if the drivers of all vehicles could have been interviewed at the roadside, but this was impracticable due to the busy traffic situations. Therefore, a sample survey was conducted with the following target sample rate which secures the survey objective, so as to conduct the survey smoothly and efficiently and to minimize traffic congestion.

<u>Traffic Volume (vehicles/day)</u>	<u>Target Sample Rate (%)</u>
Less than 5,000	100
5,000 - 10,000	50
More than 10,000	25

The roadside interview obtained the following information from drivers (refer to Fig. 5.3 for survey form):

- Type of vehicle
- Weight of cargo (for truck only)
- Origin and destination addresses of the trip
- Trip purpose
- Number of passengers
- Exit ramp (for the survey on Surabaya-Gempol Toll Road)

The attained effective sample rates are shown in Table 5.2.

FORMULIR WAWANCARA ASAL TUJUAN KENDARAAN

NAMA LOKASI :	SHIFT :	TANGGAL :	SURVEYOR :	ARAH :	CUACA : 1. Cerah 2. Hujan 3. Mendung
			Dari : _____		JAM : _____
			Ke : _____		

JENIS KENDARAAN	JENIS (TON)	DATA PERJALANAN			MAKSUD PERJALANAN	JUML PENJUM PANG	HANYA UNTUK JALAN TOLL
		ASAL PERJALANAN	TUJUAN PERJALANAN	KELUAR PIN - TU TOLL			
1 Sepeda Motor Scooter		Kodya/Kab :	Kodya Kab :	1. Dari rumah ke tempat kerja		1 Dupak	1 Dupak
2 Sedan Station Wagon Jeep Taxi		Kecamatan :	Kecamatan :	2 Berdagang/Bisnis Antar, Ambil barang		2 Banyu Urip	3 Kota Satelit
3 <u>KEND. PRIBADI</u> Minibus Kijang Hi - Ace Combi		Desa :	Desa :	3 Pulang kerumah 4 Ke Sekolah		4 Gunung Sari	5 Waru
4 <u>KEND. UMUM</u> Minibus Kijang Hi - Ace Combi		Kodya/Kab :	Kodya/Kab :	5 Belanja/Rekreasi Sosial/Pribadi Lain - lain		6 Sidoarjo	7 Perong
7 Pick - Up Mobil Box		Kecamatan :	Kecamatan :				
8 Micro Truck < 5 ton		Desa :	Desa :				
9 Truck besar Mobil Tangki Trailer		Kodya/Kab :	Kodya/Kab :				
≥ 5 ton		Kecamatan :	Kecamatan :				
		Desa :	Desa :				

FEASIBILITY STUDY ON SURABAYA - MOJOKERTO TOLL ROAD PROJECT

JICA / PT. Wira Nusantarabumi

Table 5.2 Results of Effective Sample Rate of Roadside OD Survey

(Unit : Percentage)

Location No.	Classification of Vehicle							Total-1 (Except Motorcycle)	Total-2 (All)
	Motor-Cycle	Sedan	Minibus (Private)	Minibus (Public)	Pickup	Medium Truck	Large Truck		
11111	36.6	47.0	41.7	46.5	52.0	58.4	60.2	49.7	45.0
11113	28.5	50.6	41.5	35.2	43.6	55.8	46.6	44.5	39.5
1111	32.4	49.0	41.6	39.9	47.2	56.9	51.7	46.7	41.9
11132	43.9	54.7	40.2	55.3	47.0	54.6	57.5	51.6	49.9
11134	34.5	44.2	43.8	38.7	37.5	41.8	45.2	42.4	40.7
1113	38.5	48.8	41.9	45.6	41.5	46.2	50.2	46.3	44.5
11152	42.5	56.4	52.5	50.3	53.0	59.9	50.2	54.4	52.3
11154	32.9	49.2	45.3	38.8	42.0	54.1	50.7	48.3	45.7
1115	37.9	52.9	49.0	44.5	47.5	57.1	50.5	51.4	49.1
11211	32.6	44.1	41.3	36.6	46.6	58.4	44.5	45.0	41.9
11213	37.8	52.3	52.3	59.8	55.8	49.4	50.4	52.7	49.2
1121	35.0	48.1	46.3	48.0	50.9	53.8	47.1	48.6	45.3
11242	41.4	66.6	51.8	51.5	62.9	70.9	83.3	64.8	55.0
11244	37.4	66.2	64.4	61.9	65.5	72.2	71.2	67.3	55.8
1124	39.5	66.4	58.3	56.7	64.3	71.6	77.1	66.1	55.4
11252	58.5	90.3	85.4	93.8	73.7	94.0	100.0	87.3	66.0
11254	81.7	95.2	93.9	100.0	83.3	98.9	100.0	94.3	85.4
1125	68.8	92.3	89.2	96.6	78.2	96.5	100.0	90.7	74.8
11272	26.8	41.5	40.5	30.2	37.3	47.5	37.8	39.7	34.7
11274	21.9	51.4	54.5	44.3	55.4	58.5	50.4	52.4	38.2
1127	24.1	46.7	48.0	37.9	45.8	51.8	42.7	45.8	36.5
12121	36.5	49.3	48.5	33.8	42.9	75.4	56.1	48.8	44.1
12123	22.5	47.0	32.6	32.7	49.0	54.5	32.5	41.7	36.0
1212	30.3	48.0	40.5	33.3	45.9	63.4	40.1	45.0	40.0
12232	36.6	56.6	67.2	53.9	62.0	54.2	56.4	57.7	45.5
12234	42.7	68.2	45.7	38.6	62.7	56.9	75.9	55.7	50.0
1223	38.8	63.5	58.0	46.5	62.3	55.6	65.2	56.7	47.4
12312	31.8	68.7	48.7	44.5	69.4	60.6	57.6	58.1	42.0
12314	43.9	52.4	71.0	64.1	49.2	72.7	52.3	60.2	51.8
1231	36.6	61.3	60.5	53.8	59.2	66.9	54.9	59.1	46.2
12332	51.7	83.4	78.4	62.4	80.2	88.0	78.3	72.5	60.5
12334	55.2	89.7	92.2	66.5	89.0	98.3	92.5	80.3	65.6
1233	53.5	86.0	84.7	64.4	84.5	94.7	87.3	76.4	63.1
12342	52.9	76.9	79.4	78.8	81.9	89.6	77.5	80.7	65.4
12344	41.2	72.8	75.8	58.5	85.2	89.8	90.2	73.5	56.8
1234	47.4	74.5	77.8	68.6	83.5	89.7	84.6	77.1	61.2
12401	-	54.7	51.6	100.0	56.3	67.4	46.8	53.3	53.3
12402	-	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
12403	-	31.5	33.6	92.1	36.4	41.0	34.5	34.9	34.9
12401-3	-	40.4	42.4	93.2	42.3	53.7	42.3	43.4	43.4
12404	-	68.3	59.1	100.0	66.0	70.0	58.6	64.7	64.7
12405	-	48.8	49.1	90.0	47.1	50.0	58.1	49.2	49.2
12406	-	93.9	84.7	66.7	95.0	103.2	65.8	89.2	89.2
12407	-	49.0	49.4	66.7	55.4	59.6	51.3	52.8	52.8
12406-7	-	58.2	58.8	66.7	60.7	62.2	52.5	58.5	58.5
12408	-	36.1	36.1	33.3	36.8	46.8	38.6	37.4	37.4
12409	-	44.5	49.0	75.0	51.6	55.0	36.6	45.8	45.8
12408-9	-	39.4	40.9	51.4	43.5	51.5	37.5	41.2	41.2
12411	-	90.5	85.3	100.0	84.4	94.9	84.2	87.8	87.8
12412	-	36.1	55.6	33.3	50.3	36.1	25.9	32.0	32.0
12413	-	35.1	36.1	60.4	36.2	51.3	40.4	38.3	38.3

Note : Number of Samples/Traffic Volume X 100
 " - " stands for no traffic volume

5.1.3 Bus Terminal OD Survey

(1) Objective

The bus terminal OD survey aimed at determining the distribution pattern and the volume of inter-city bus traffic in the Study Area.

(2) Survey Location and Period

The bus terminal OD survey was conducted at 3 bus terminals in Surabaya city, at Bratang, Joyoboyo and Jembatan Merah, in a period of September 25-27, 1990.

(3) Survey Method and Item

Interviews targeted to all the buses were conducted at the entrance and exit of bus terminals for 24 hours.

Since all the routes of inter-city buses have their origin/destination or transit point at the above 3 terminals in Surabaya, this survey can cover most of the bus OD in the Study Area.

The bus terminal OD survey obtained the following information from drivers

- Departing and arrival time of buses
- Origin and destination
- Transit points
- Number of passengers
- On/Off interchanges in case of travel on Surabaya-Gempol Toll Road

5.1.4 Travel Speed Survey

(1) Objective

The travel speed survey aimed at determining the travel speed and travel situation in each road section. Travel speed data are especially important for analyzing diversion rates for the Toll Road and for traffic assignment.

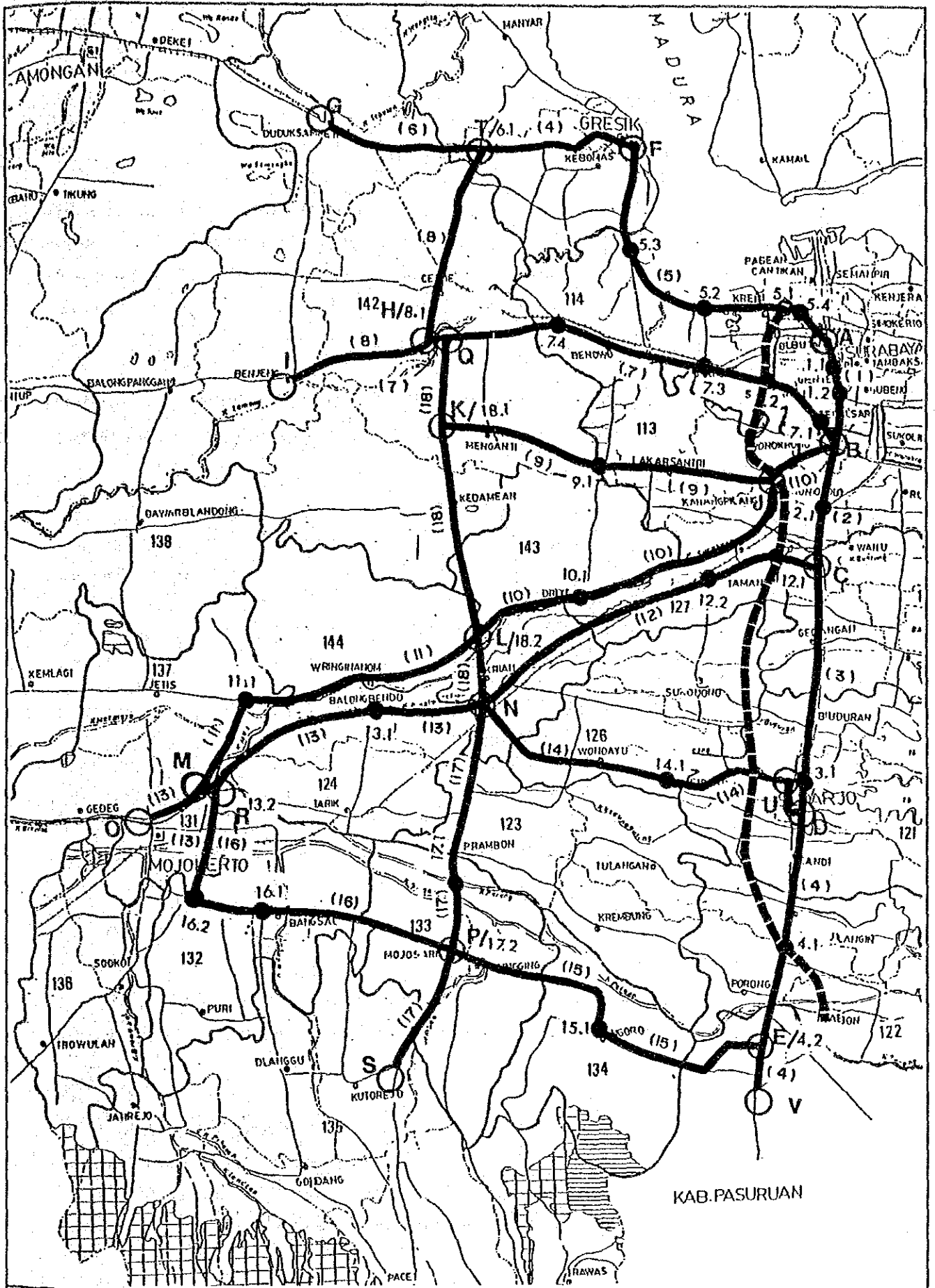
(2) Survey Location and Period

The travel speed survey was conducted for 26 road links as shown in Fig. 5.4, in the period of September 25-27, 1990.

(3) Survey Method

The travel speed survey was carried out during a weekday on the arterial roads and on Surabaya-Gempol Toll Road in the following manner:

- The distance and the time taken between each check point from the starting point were observed.
- The driver of the travel speed survey vehicle was instructed to travel at the normal speed in each road section, and the time taken was recorded.



**SURABAYA - MOJOKERTO
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Fig. 5.4 Location of Travel Speed Survey

5.2 Results of Traffic Surveys

5.2.1 Traffic Volume on Roads in the Study Area

The results of the traffic count survey are shown in Table 5.3 and are also illustrated in Fig. 5.5 (Table 5.3 in 8 vehicle classifications according to the actual survey and Fig. 5.5 in 4 vehicle classifications grouped for traffic demand forecast described in Chapter 8). The data at 16-hour survey location are expanded to 24-hour traffic volume.

The survey locations which observed heaviest traffic (excluding motorcycle) are on 3 national roads radially extended from Surabaya city and on Surabaya-Gempol Toll Road as follows:

<u>Location</u>	<u>Code No.</u>	<u>Traffic Volume</u> (Vehicles/24 hours)
<u>National Roads</u>		
Waru-Mojokerto Section		
Taman	1113	22,000
West of Krian City	2214	16,000
East of Mojokerto City	1115	15,000
Surabaya-Gempol Section		
South of Waru	1113	19,000
South of Sidoarjo	1212	16,000
Surabaya-Gresik Section		
South of Gresik	1121	18,000
<u>Surabaya-Gempol Toll Road</u>		
South of Waru IC	21410	18,000

The interchanges on Surabaya-Gempol Toll Road which have heaviest on-ramp traffic are Waru IC (No. 12408-9, 14,000 vehicles/day) and Dupak IC (No. 12401-3, 10,000 vehicles/day)

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.

Table 5.3 Results of Traffic Count Survey

(Unit : Number of Vehicles in 24 hours)

Location No.	Classification of Vehicle								Total-1 (Except Motorcycle)	Total-2 (All)
	Motor-Cycle	Sedan	Minibus (Private)	Minibus (Public)	Large Bus	Pickup	Medium Truck	Large Truck		
11111	4,521	1,444	1,308	2,035	156	1,391	1,109	728	8,171	12,692
11113	4,921	1,814	1,248	2,894	121	1,862	1,666	1,202	10,807	15,728
1111	9,442	3,258	2,556	4,929	277	3,253	2,775	1,930	18,978	28,420
11132	2,583	1,704	1,620	863	635	1,304	1,148	2,154	9,428	12,011
11134	3,482	2,238	1,427	1,226	474	1,810	2,202	3,149	12,526	16,008
1113	6,065	3,942	3,047	2,089	1,109	3,114	3,350	5,303	21,954	28,019
11152	1,488	1,010	1,081	539	737	951	1,798	1,499	7,615	9,103
11154	1,366	997	1,047	547	813	960	1,694	1,490	7,548	8,914
1115	2,854	2,007	2,128	1,086	1,550	1,911	3,492	2,989	15,163	18,017
11211	2,960	1,833	1,363	836	490	1,366	943	2,593	9,424	12,384
11213	2,503	1,759	1,133	813	488	1,220	993	2,123	8,529	11,032
1121	5,463	3,592	2,496	1,649	978	2,586	1,936	4,716	17,953	23,416
11242	2,161	356	475	550	42	434	685	508	3,050	5,211
11244	1,995	367	509	546	32	487	731	527	3,199	5,194
1124	4,156	723	984	1,096	74	921	1,416	1,035	6,249	10,405
11252	1,013	31	41	16	0	95	167	5	355	1,368
11254	803	21	33	13	0	84	176	4	331	1,134
1125	1,816	52	74	29	0	179	343	9	686	2,502
11272	4,466	1,236	1,021	911	285	1,319	1,376	1,036	7,184	11,650
11274	5,532	1,356	1,181	1,089	480	1,177	875	653	6,811	12,343
1127	9,998	2,592	2,202	2,000	765	2,496	2,251	1,689	13,995	23,993
12121	4,067	752	880	2,215	92	1,385	1,364	738	7,426	11,493
12123	3,104	936	806	1,707	68	1,305	1,781	1,509	8,112	11,216
1212	7,171	1,688	1,686	3,922	160	2,690	3,145	2,247	15,538	22,709
12232	2,646	236	279	408	4	348	884	154	2,313	4,959
12234	1,514	268	218	378	12	358	808	140	2,182	3,696
1223	4,160	504	497	786	16	706	1,692	294	4,495	8,655
12312	3,969	570	330	661	0	488	414	329	2,792	6,761
12314	2,612	467	357	640	1	465	392	347	2,669	5,281
1231	6,581	1,037	687	1,301	1	953	806	676	5,461	12,042
12332	1,831	194	181	661	2	245	122	36	1,441	3,272
12334	1,907	131	145	689	0	219	202	64	1,450	3,357
1233	3,738	325	326	1,350	2	464	324	100	2,891	6,629
12342	1,344	132	185	385	9	211	187	67	1,176	2,520
12344	1,165	246	138	391	0	202	187	78	1,242	2,407
1234	2,509	378	323	776	9	413	374	145	2,418	4,927
21222	1,464	427	530	242	442	581	549	1,268	4,039	5,503
21224	1,321	427	558	261	421	588	448	1,220	3,923	5,244
2122	2,785	854	1,088	503	863	1,169	997	2,488	7,962	10,747
22142	2,250	1,093	1,132	750	771	1,030	1,790	1,402	7,968	10,218
22144	2,236	1,112	1,164	715	828	1,047	1,689	1,635	8,190	10,426
2214	4,486	2,205	2,296	1,465	1,599	2,077	3,479	3,037	16,158	20,644
22262	1,755	63	67	62	2	143	361	132	830	2,585
22264	1,929	71	73	74	2	164	363	157	904	2,833
2226	3,684	134	140	136	4	307	724	289	1,734	5,418
22322	1,852	36	74	136	10	145	128	11	540	2,392
22324	1,839	37	86	191	8	108	113	29	572	2,411
2232	3,691	73	160	327	18	253	241	40	1,112	4,803
12401	0	987	660	4	73	382	578	1,621	4,305	4,305
12402	0	45	35	2	1	13	18	64	178	178
12403	0	1,881	922	38	21	1,035	692	1,383	5,972	5,972
12401-3	0	2,913	1,617	44	95	1,430	1,288	3,068	10,455	10,455
12404	0	512	347	5	4	363	296	386	1,913	1,913
12405	0	1,539	919	10	163	578	255	151	3,615	3,615
12406	0	176	142	3	381	64	34	44	844	844
12407	0	680	393	3	19	416	543	507	2,561	2,561
12406-7	0	856	535	6	400	480	577	551	3,405	3,405
12408	0	2,401	1,806	21	705	1,131	545	1,237	7,846	7,846
12409	0	1,563	1,052	16	155	915	746	1,610	6,057	6,057
12408-9	0	3,964	2,858	37	860	2,046	1,291	2,847	13,903	13,903
12411	0	511	302	1	0	234	66	67	1,181	1,181
12412	0	248	167	3	307	180	783	2,033	3,721	3,721
12413	0	1,947	1,571	91	419	935	584	873	6,420	6,420
214101	0	2,523	1,950	26	719	1,313	1,206	2,507	10,244	10,244
214103	0	2,787	1,540	10	697	1,237	542	1,440	8,253	8,253
21410	0	5,310	3,490	36	1,416	2,550	1,748	3,947	18,497	18,497

Note : Data of 16 hours survey were converted into 24 hours traffic volume based on the analysis results of the existing traffic data.

5.2.2 Hourly Fluctuations of Traffic Volume

Fig. 5.6 shows the hourly fluctuations of total traffic at 8 major survey points. The following are the observations from these figures.

- 1) Peak hour ratio is about 8% at most survey points. The occurrence of the peak varies in the morning at some points and in the afternoon at others.
- 2) On Surabaya-Gempol Toll Road, the peak of Surabaya bound traffic occurs at around 2:00 p.m. while the peak of Gempol bound traffic is at around 10:00 a.m. The peak hour ratio is about 8% for both directions.
- 3) On Waru-Mojokerto national road which runs parallel to the Toll Road, a higher peak hour ratio is observed in Mojokerto bound traffic at every survey point. At Taman (No. 1113) and at the east of Mojokerto city (No. 1115), the peak occurs in the morning with a peak hour ratio of a little less than 8%. At the west of Krian City (No. 2214), 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%.
- 4) 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 (No. 1115).

5.2.3 Composition of Vehicles

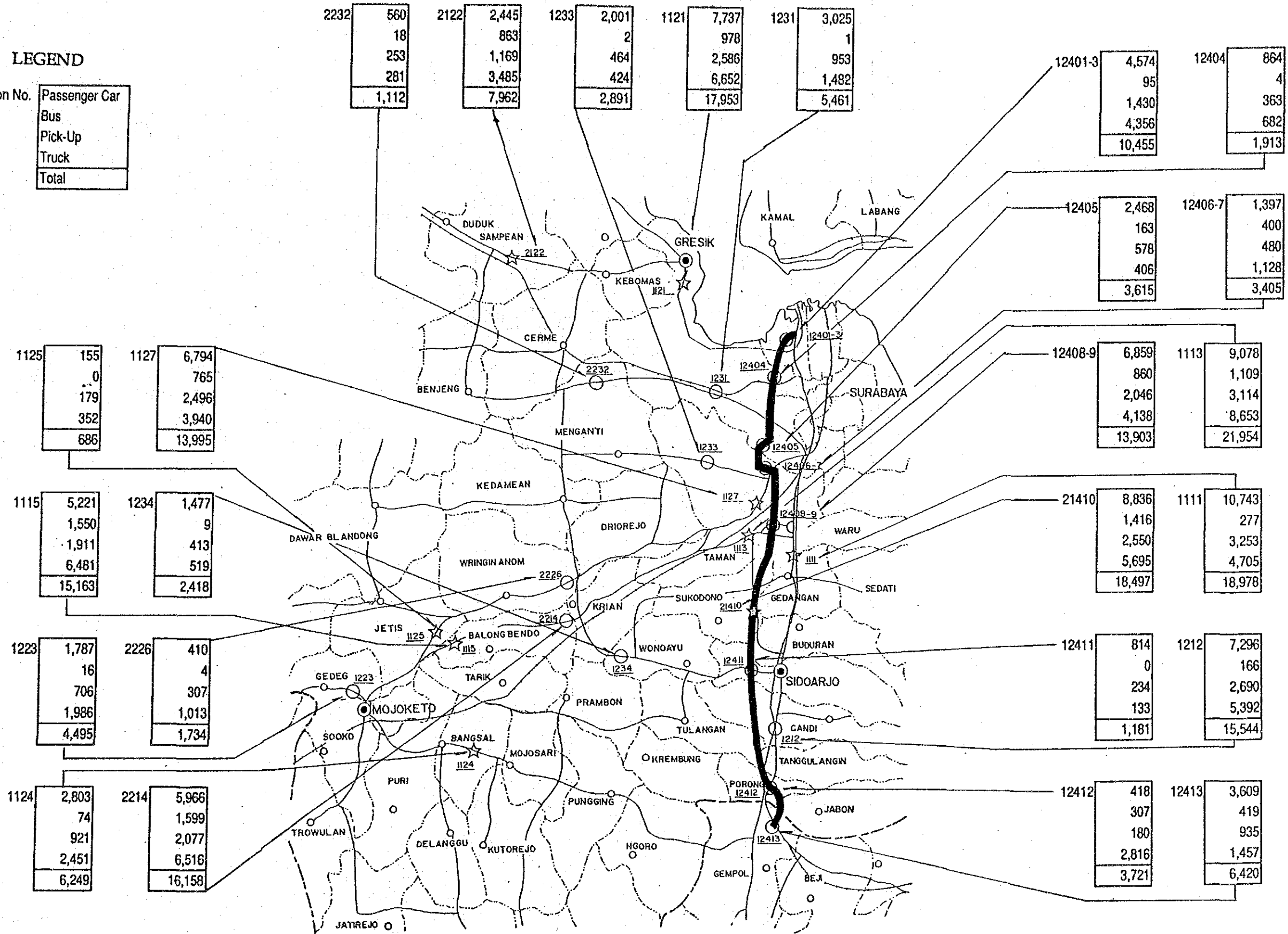
Fig. 5.7 shows the compositions of traffic at 8 major survey points. The following characteristics are observed from these diagrams.

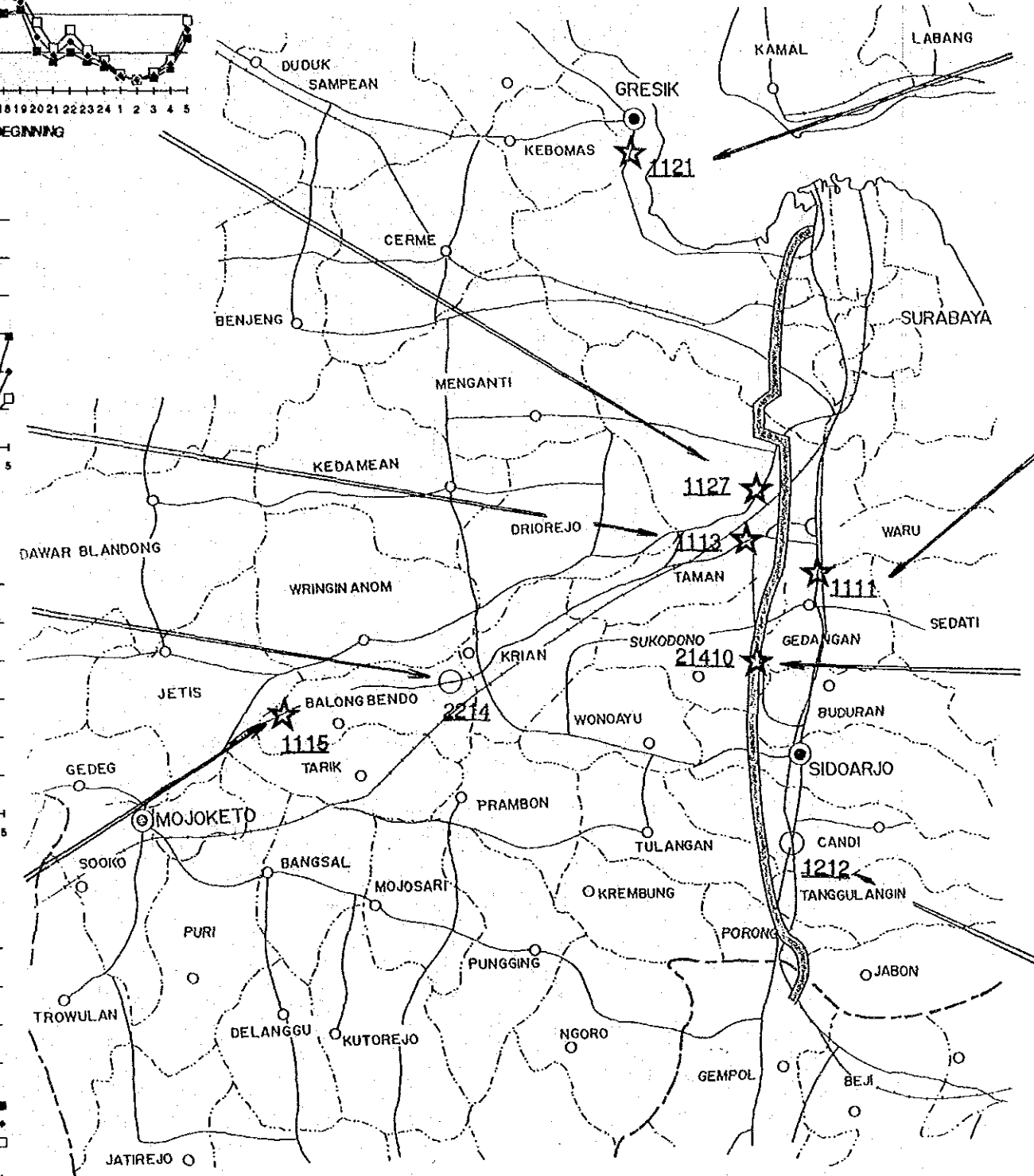
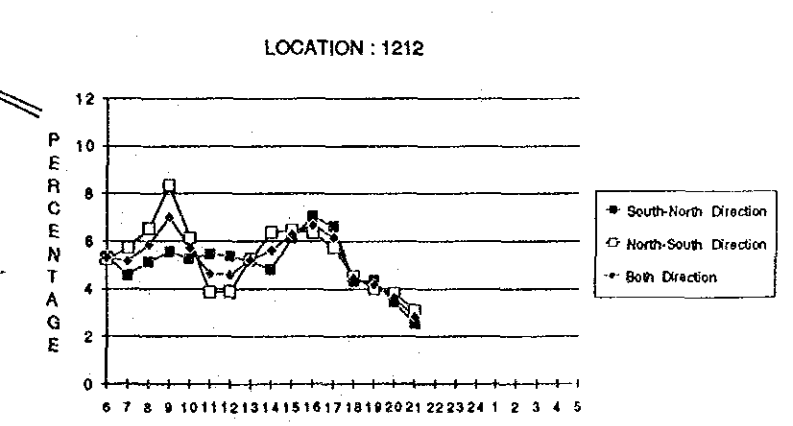
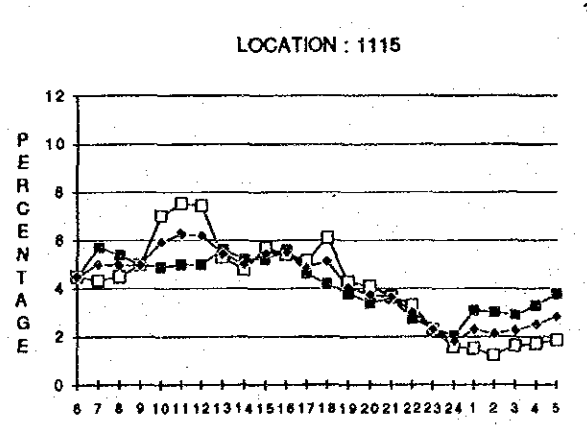
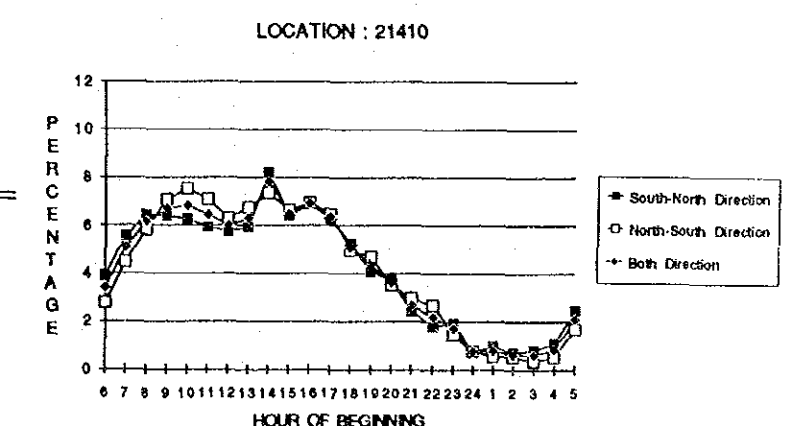
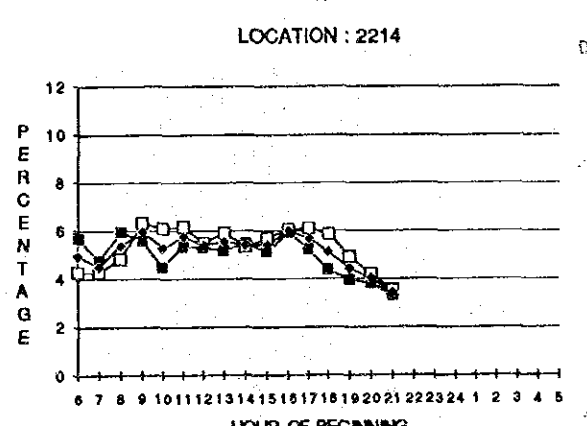
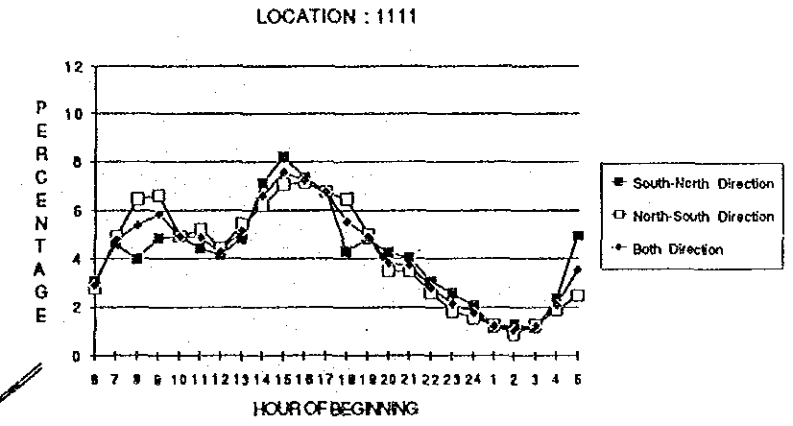
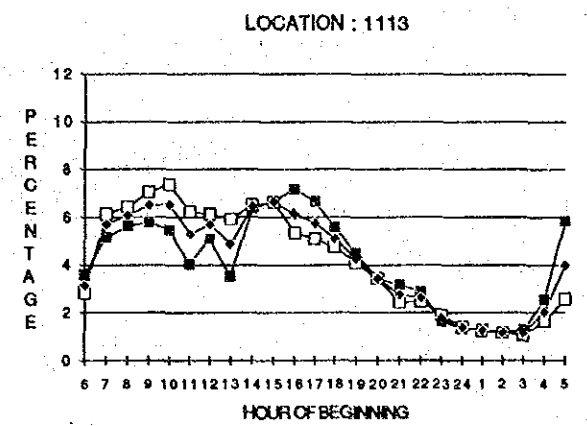
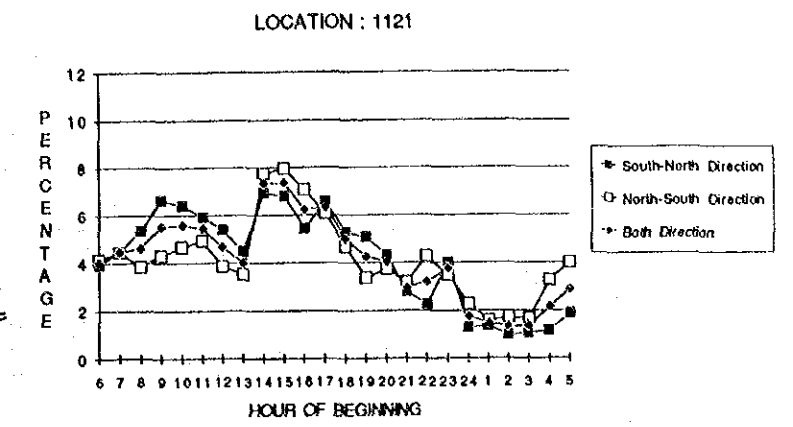
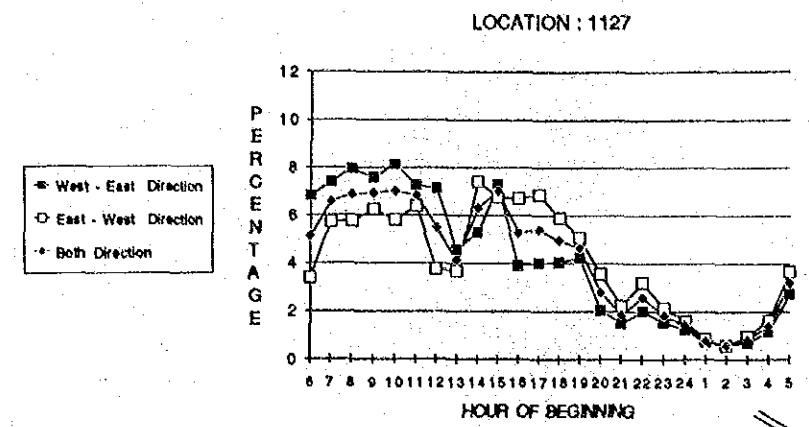
(1) Characteristics by Road Link

- 1) On Surabaya-Gempol Toll Road, Sedan occupies the largest percentage at 28.7% followed by Large Truck at 21.3% and Minibus (private) at 21.3%, while, Minibus (public) occupies the smallest percentage at 0.2% at the south of Waru IC (No. 21410). At this survey point, the share of Sedan and the share of Minibus are the largest and the shares of Minibus (public) and Medium Truck are the smallest among all the survey points.

LEGEND

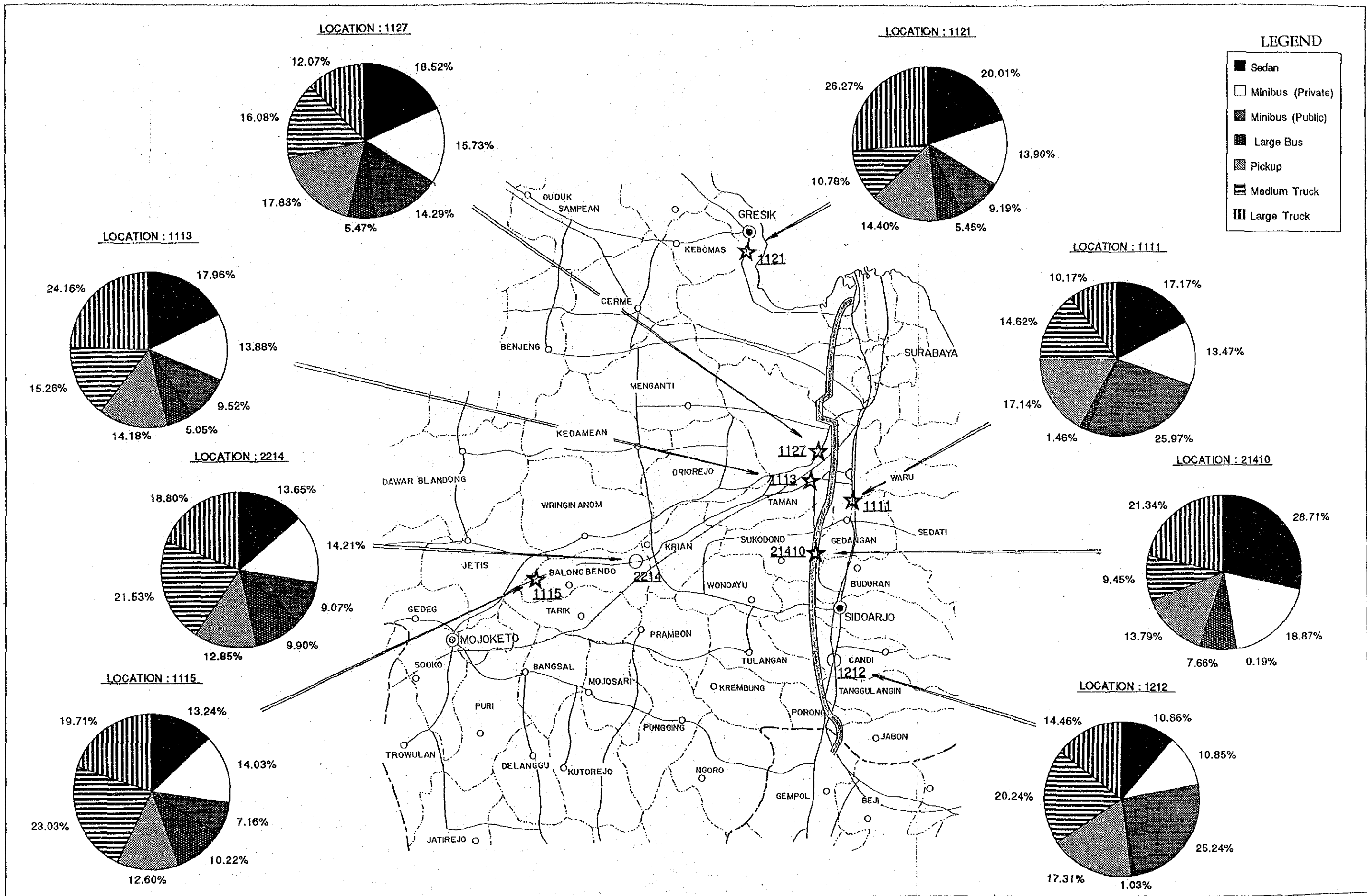
Location No.	Passenger Car	Bus	Pick-Up	Truck	Total
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SURABAYA-MOJOKERTO TOLL ROAD PROJECT

Fig. 5.6 Hourly Fluctuations of Traffic Volume



- 2) At the south of Waru (No. 1111) and at the south of Sidoarjo (No. 1212) on the national road which runs parallel to Surabaya-Gempol Toll Road, the share of Minibus (public) is larger than at the other survey points, while the shares of Large Bus, Sedan and Minibus (private) are smaller.
- 3) On Waru-Mojokerto national road running parallel to the Toll Road, the traffic on its western stretches is characterized by a larger share of Large Bus and Medium Truck (at No. 2214 in the west of Krian City and No. 1115 in the east of Mojokerto city). Near Waru (No. 1113), the traffic is characterized by a higher share of Large Truck. At survey point No. 1127 on the provincial road, the share of Pick-up is high.
- 4) At survey point No. 1121 in the south of Gresik on the national road, Large Truck and Sedan show higher shares.

(2) Characteristics by Vehicle Type

- 1) Sedan generally occupies a higher percentage among the total traffic with a comparatively wide range of 10.9% at survey point No.1212 on Surabaya-Gempol national road to 28.7% at survey point No. 21410 on Surabaya-Gempol Toll Road. The maximum share on the toll road and the minimum share on the national road, which are situated in competitive locations, suggest Sedan's high preference for the toll road.
- 2) The share of Minibus (private) varies from 10.9% (No. 1212) to 18.9% (No. 21410). As the Sedan, Minibus (private) has also high preference for the toll road.
- 3) The share of Minibus (public) widely varies from 0.2% (No.21410) to 25.2% (No. 1212). Different from Sedan and Minibus (private), the minimum share occurs on the Surabaya-Gempol Toll Road while the maximum is on the parallel national road. This suggests low preference for the toll road due to local service characteristic inherent to this type of vehicle.
- 4) The share of Large Bus is generally low in the total traffic with a comparatively wide range of 1.0% (No. 1212) to 10.2% (No.1115). The higher share on Surabaya-Gempol Toll Road (7.7%, No. 21410) suggests high preference for the toll road.

- 5) The share of Pick-up is in a smaller range of 12.6% (No. 1115) to 17.8% (No. 1127).
- 6) The share of Medium Truck ranges between 9,5% (No. 21410) to 23.0% (No. 1115).
- 7) The share of Large Truck ranges between 12.1% (No. 1127) to 26.3% (No. 1121).
- 8) A high percentage of heavy vehicles (Large Bus plus Large Trucks) was observed in the following survey points:

- South Gresik City (No.1121)	31.7%
- East of Mojokerto City (No. 1115)	29.9%
- Taman (No.1113)	29.2%
- Surabaya-Gempol Toll Road (No. 21410)	29.0%
- West of Krian City	28.7%

5.2.4 Trip Distribution

The distribution pattern of traffic in the Study Area was analyzed based on the results of the traffic count survey, roadside OD survey and bus terminal OD survey.

The characteristics of the trip distribution pattern are explained by the desirable linkages between places of trip generation and attraction. Fig. 5.8 shows the desire lines of 1990 vehicular traffic. They were prepared based on the results of the traffic survey by the Study Team and supplemented by the data of the 1982 National OD Survey for the trips having trip ends outside the survey area.

The following are the observations regarding the outline trip distribution pattern:

- 1) The traffic to and from Zone No. 1 (with Surabaya city as the zone center) is dominant. It counts for 83,000 trips/day, occupying 72 % of a total inter-regional (inter-zonal) traffic of 115,000 trips/day (excluding intra-zonal traffic).
- 2) Among the traffic to and from Zone No. 1, the traffic with Zone No. 2 (with Sidoarjo city as the zone center) is the largest, counting 23,000 trips/day. The traffic with Zone No. 7 (Kediri city, Jombang city and westward)

counting 18,000 trips/day and the traffic with Zone No. 5 (with Malang city as the zone center including Pasuruan city) counting 17,000 trips/day follow.

- 3) The traffic between Zone No. 1 and Zone No.3 (with Mojokerto city, the eastern terminus of the Toll Road, as the zone center) counts 6,000 trips/day.
- 4) The total potential traffic subject to diversion to the Toll Road is estimated at about 11,000 trips/day, adding 5,000 trips/day which are included in the traffic between Zone No.1 and Zone No.7 and passes through Surabaya-Mojokerto corridor in a conservative estimate, to the above number.
- 5) Apart from the traffic to and from Zone No.1, a large number of trips are observed between Zone No. 7 and Zone No. 5 and between Zone No. 7 and Zone No. 6 (with Probolinggo city as the zone center, including Bali Island), which counts 11,000 trips/day in total.

5.2.5 Travel Speed

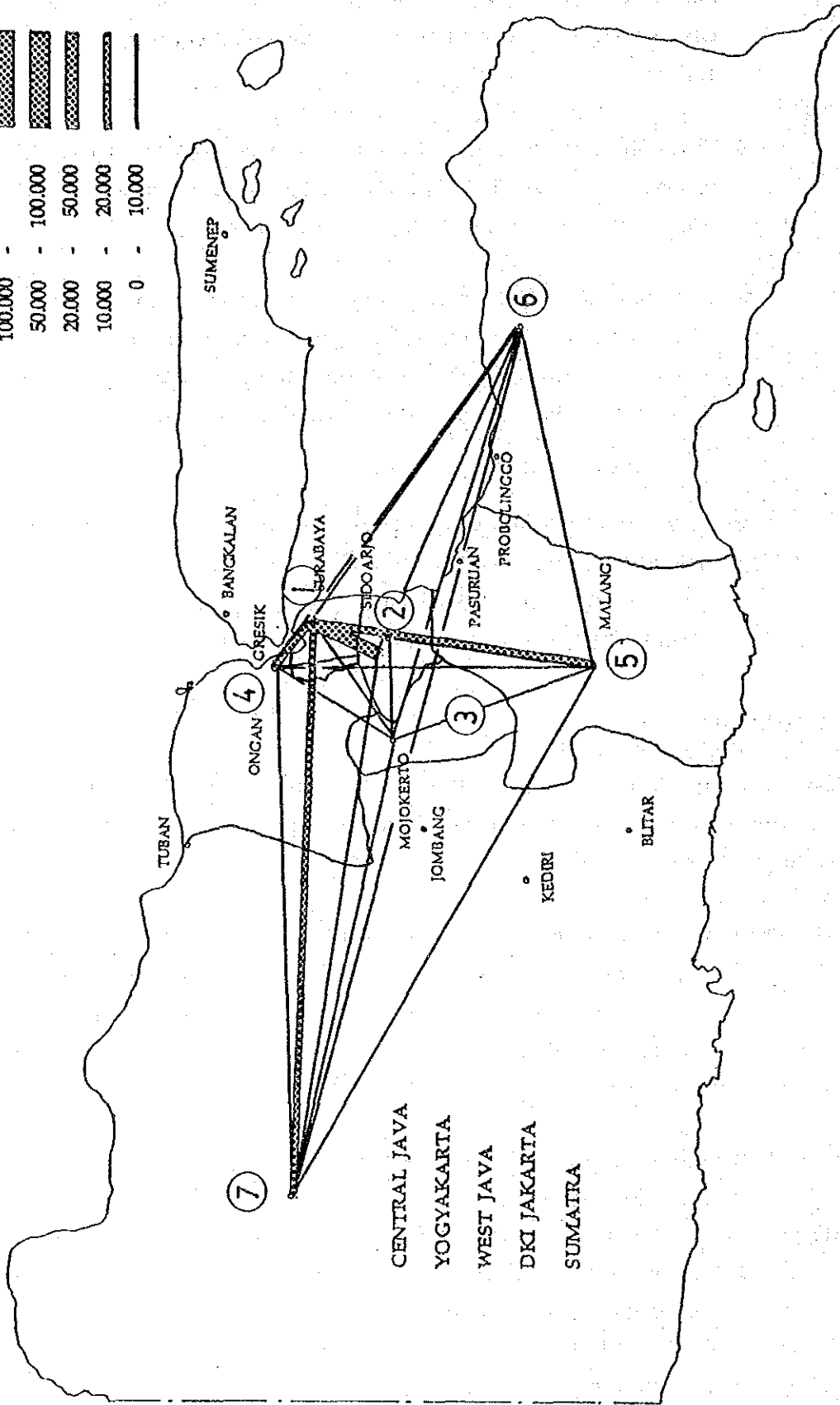
Fig. 5.9 shows the estimated average travel speed by road link based on the results of the travel speed survey. The following characteristics of travel speed are observed from the figure.

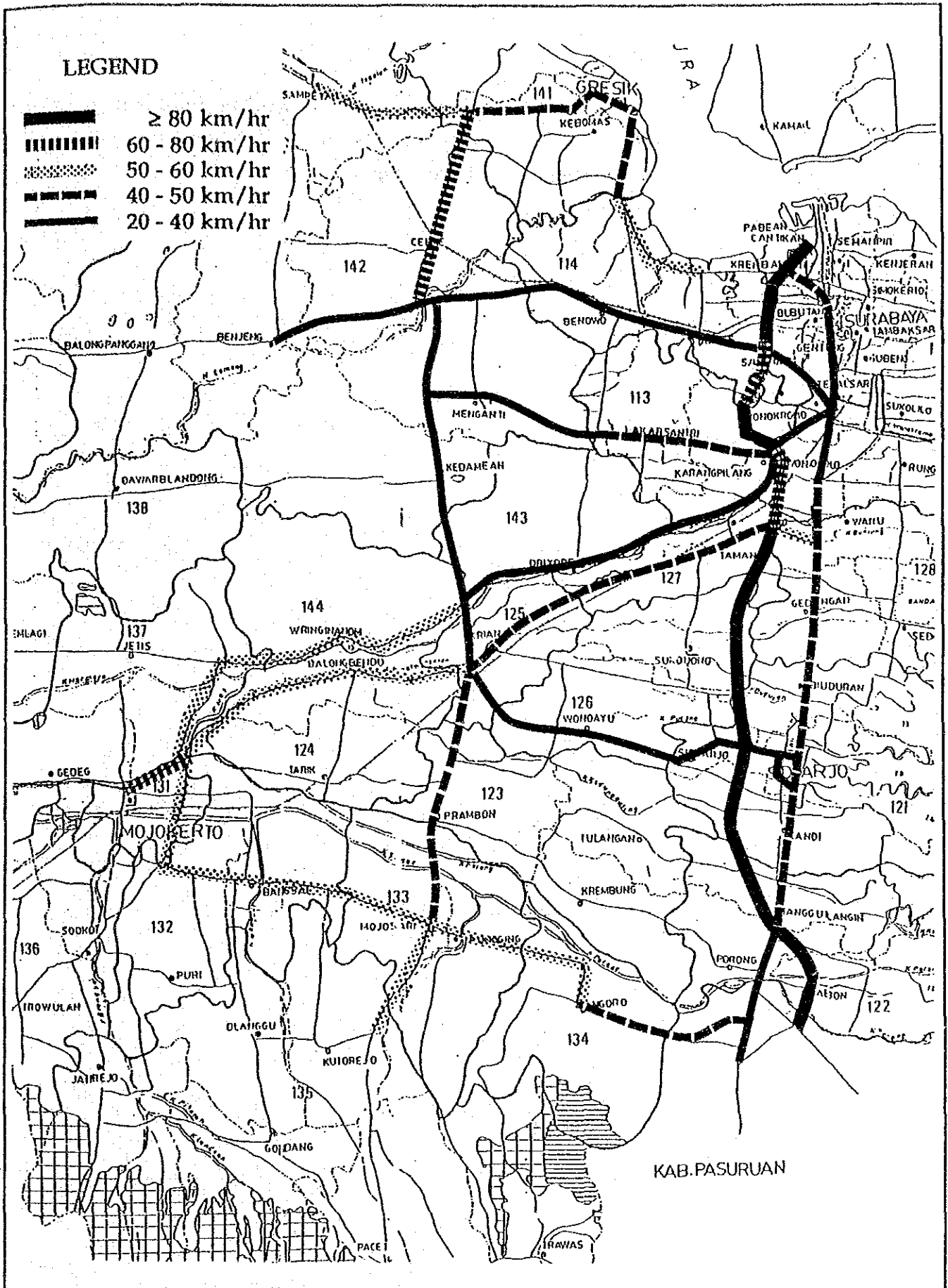
- 1) Travel speed is high on the road links near the city center of Surabaya and low in its suburban area. In road administrative classification, the travel speed is the lowest on Kabupaten roads followed by national/provincial roads. The highest travel speed is on the existing toll road.
- 2) The average travel speed on Kabupaten roads is 34.1 km/hr, with the lowest of 29.4 km/hr.
- 3) The average travel speed on provincial roads is 43.5 km/hr and that on national roads is 45.9 km/hr.

LEGEND

(vehicles/day, both direction)

100,000 -	[Dense cross-hatch pattern]
50,000 -	[Medium cross-hatch pattern]
20,000 -	[Sparse cross-hatch pattern]
10,000 -	[Dotted pattern]
0 -	[Solid line]





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Fig. 5.9 Results of Travel Speed Survey

- 4) The average travel speed on Surabaya-Gempol Toll Road is 97.0 km/hr with the lowest 63.5 km/hr. It can be said that high-speed services of the said toll road are secured at present.

Chapter 6
ENGINEERING SURVEY

CHAPTER 6

ENGINEERING SURVEY

6.1 Physical Conditions of the Study Area

6.1.1 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 the Sidoarjo regency and the most part of Surabaya city. 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 Gresik regency, with an altitude of less than 70 m.

6.1.2 Geology

Geologically, the flat terrain area is of Alluvium Formation of Holocene Age composed of alluvial soil of loam, silt and clay. Soft ground areas are common in the eastern part of the Brantas Delta. According to the construction record of the Surabaya-Gempol Toll Road, 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 of Pucangan and Kabuh Formation in Middle to Lower Pleistocene Age. The soils in the Pucangan Formation are composed of clay, tuffaceous clay and tuffaceous sandy clay classified as CH according to the AASHTO soil classification. This soil is unsuitable as embankment material because of its swelling nature even if the dried condition resembles clay stone.

The sources for embankment materials are found in the hilly areas from the south of Gempol to Mojoagung. Excavation of the deposits from the Surabaya river and the Porong river is not allowed since both rivers are under the control by the Brantas River Basin Development Execution Office (BRBDEO).

6.1.3 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 km² and being about 320 km in main course length. At Mojokerto, the Brantas river branches into the Porong river and the Surabaya river.

The main tributaries of the Brantas river are the Lesti, Ngrowo, Konto and Widas rivers. 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 Mirip Sluice near Mojokerto and flows into the sea at the north of Surabaya city.

The Porong and Surabaya rivers flow through a very flat plain lower than the elevation of 20 m SHVP (Surabaya Haven Vloed Peil). The Surabaya river acts as a water supply canal to Surabaya city and as a main drain of the city. As shown in Fig. 6.1, major tributaries of the Porong river are the Sadar and Kambing rivers while the Marmoyo river is a tributary of the Surabaya river.

The Brantas Delta is one of the most modernized irrigation areas in Indonesia, with a densely developed irrigation canal and drainage canal network. The irrigation area is operated by the Sidoarjo Regional Irrigation Office of DPU in Sidoarjo regency.

6.1.4 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

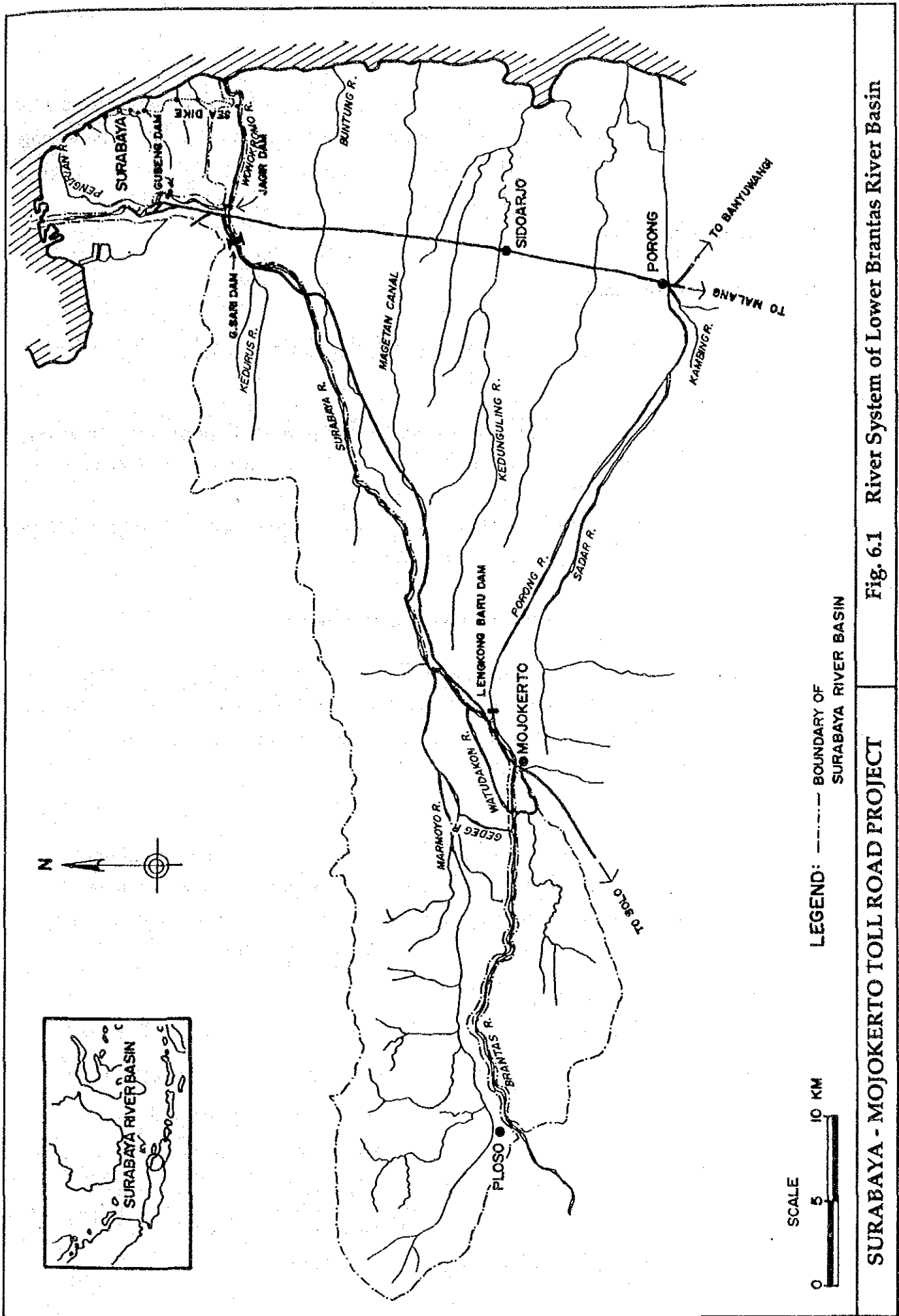


Fig. 6.1 River System of Lower Brantas River Basin

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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%.

6.2 Topographic Survey

6.2.1 Aerial Photography

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 for the preliminary route study on 22 September 1990; and
- Deliberate aerial photography was conducted during 12-15 October 1990 (5 courses, refer to Appendix A-6.1).

6.2.2 Preparation of Uncontrolled Aerial Photo Mosaics

Uncontrolled aerial photo mosaics of the Project Area to a scale of 1:10,000 (flown during 12-15 October 1990) were provided by the Study Team to prepare the bases for the route selection of the Toll Road (refer to Appendix A-6.2).

6.2.3 Ground Survey

A satellite geodesy survey was adopted by means of the Global Positioning System (GPS), and the coordinates of each point were referred to the existing satellite geodesy point, D1060 for planimetric positioning and three existing bench marks (national vertical control network), TTG-1035, TTG-1042 and TTG-1043.

Datum Point (D1060)

Ellipsoid Datum:	Latitude =	7° 20' 12.61610" S
	Longitude =	112° 40' 16.15730" S
UTM Coordinate:	Major axis	6,378,160 m
	Ellipticity	1/298,247
	Easting =	684,489.59557
	Northing =	9,188,668.12661
Geodetic coordinate system:	UTM (49 zone)	

Existing TTG Bench marks

Elevation (Datum height at mean sea level):

TTG 1035 = +5.218 m

TTG 1042 = +15.905 m

TTG 1043 = +16.770 m

6.2.4 Mapping

Careful attention was paid to the identification of the following objects:

- Main roads, railways, rivers, irrigation canals and electric power transmission lines;
- Paddy fields, cultivated land, plantations, cemeteries and factories;
- Public buildings such as mosque, church, hospital, school, etc.; and
- Afforestation area, development/conservation areas and restricted areas

Map sheet format is unified with the standard of the Directorate General of Highways, Ministry of Public Works.

6.2.5 Execution of Work and Accuracies

(1) Execution of Work

a) Aerial Photography

Aerial photography including preparation of uncontrolled aerial photo mosaics was executed as follows:

Work Period : September 17, 1990 - October 28, 1990

Work Volume : Photo signals and setting of concrete monuments 27 points

Aerial photography 7 runs, 147 sheets (450 km²)

Uncontrolled mosaic 15 sheets (450 km²)

b) GPS Survey (Ground Survey)

Work Period : October 18, 1990 - October 27, 1990

Work Volume : New control point 26 points, monumented

Existing control point 1 point (D1060)

c) Leveling (Ground Survey)

Work Period : September 26, 1990 - October 13, 1990

Work Volume : 150 km

d) Field Verification (Ground Survey)

Work Period : October 15, 1990 - October 30, 1990

Work Volume : 200 km²

e) Aerial Triangulation

Work Period : October 25, 1990 - November 10, 1990

Work Volume : 90 models

f) Machine Plotting

1/5,000 scale plotting work was executed as shown in Appendix A-6.3.

Work Period : November 21, 1990 - December 22, 1990

Work Volume : 200 km², 90 models

g) Compilation

Work Period : December 10, 1990 - December 22, 1990

Work Volume : 200 km², 34 sheets

h) Field Supplemental Survey

Work Period : January 13, 1991 - January 17, 1991

Work Volume : 200 km², 34 sheets

i) Drawing

Work Period : December 20, 1990 - January 25, 1991

Work Volume : 200 km², 34 sheets

(2) Accuracies

a) Aerial Photography

Aerial photography was performed covering the whole area without any cloud influence. All photographs were checked and passed for stereo machine plotting purposes.

b) GPS Survey

Three (3) GPS stations were observed simultaneously, using the differential method and each point was fixed by 3 dimensional coordinates which were related to existing control point D1060. Closure error of each triangle formed by 3 GPS points satisfied the following limits:

Horizontal: $\pm 2 \text{ ppm} \times \text{Distance}$

Vertical: $\pm 5 \text{ ppm} \times \text{Distance}$

c) Leveling

Error of all leveling fell within the following limit:

Error limit = $3 \text{ cm} \times \sqrt{S}$ (S in km)

d) Aerial Triangulation

Aerial triangulation computations were carried out using the PATMR program. Standard deviation and maximum difference between original control points and adjusted control points satisfied the limit of JICA regulations.

e) Machine Plotting

Scaling errors of model orientation (tie point and control point) are less than 0.3 mm on the map and their elevation errors are less than 1.0 m.

6.2.6 River Cross Section Survey

A river cross section survey was conducted by the Study Team for 7 major rivers. In comparison with the cross sections in the river improvement plan of the Brantas River Basin Development Execution Office, it was found that some sections are deeply scoured or sedimented. For the preliminary bridge design, safe side cross sections were used particularly in determining the depth of pier footing.

It is to be noted that the datum level used by the Brantas River Basin Development Execution Office is based on SHVP, which was measured to be 1.27 m higher than the datum level of national vertical control network used for the ground survey described in Subsection 6.2.3.

6.3 Soils and Materials Investigations

6.3.1 Geological Descriptions of the Project Area

(1) Geographical Background

The geographical features of the area along the Toll Road route are generally flat with the altitude ranging between 5 to 30 meters above mean sea level. The Porong river and the Surabaya river are crossed by the Toll Road.

(2) Geology

Geologically, the Project Area is formed mainly of sedimentary formations of Quaternary Age (refer to Fig. 6.2). The geological sequence found in the Area is as shown in Table 6.1.

Table 6.1 Geological Formation

Geological Age		Stratigraphy	Deposit and Formation	Soil Symbol
Quaternary	Holocene	Alluvium	- Cohesive soil, very soft to soft	Ac1
			- Cohesive soil, medium	Ac2
			- Sandy soil, loose to medium	As
	Pleistocene	Diluvium (Upper layer)	- Cohesive soil, very stiff to hard	Dc
- Sandy soil, dense			Ds	
- Jombang formation - Upper Kabuh formation			Pk La	
Tertiary	Pliocene	Diluvium (Lower layer)	- Pusangan formation - Pucangan formation	Pt Lb
			- Upper Kalibeng formation	Na

(3) Characteristics of Deposit and Formation along the Toll Road

a) Alluvium Deposit

Alluvium deposit is widely distributed in the delta area (Sta. 0+000 - 2+000, 4+000 - 18+000 and 34+000 - 38+000) and is mainly composed of cohesive soils (Ac1, Ac2) and sandy soils (As). These deposits are situated at a depth of 32 to 33.5 meters in the west part and 32 meters in the east part.

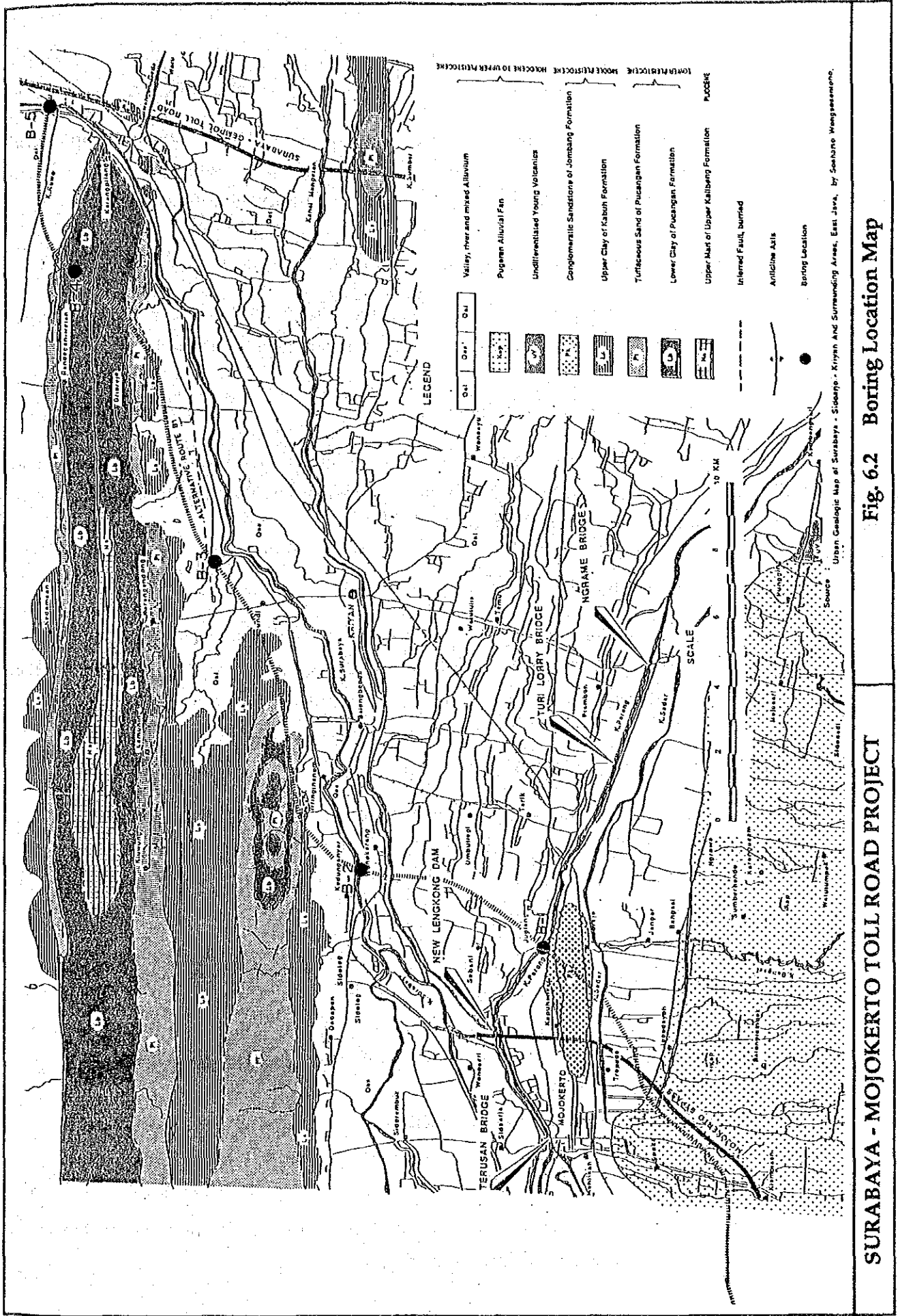


Fig. 6.2 Boring Location Map

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b) Upper Diluvium Deposit

Upper diluvium deposit is overlaid by alluvium deposit and is composed of cohesive soils (Dc1, Dc2) and sandy soil (Ds). The deposit is situated at a depth of 34.7 meters in the west part and 32 to 48.5 meters in the east part.

c) Jombang Formation

Jombang formation is distributed between Sta. 2+000 - 4+500 in the east part of Mojokerto. The formation is composed of conglomerated sandstone.

d) Upper Kabuh Formation

Upper Kabuh formation is found between Sta. 19+000 - 28+000 in the lower part of hills. The formation is composed of clay, intercalated with tuffaceous sand, marly clay and sand lenses.

e) Pusangan Formation

Pusangan formation (Pt) is distributed in the area between Sta. 13+800 - 15+000, 17+600 - 18+600 and 28+000 - 31+000 on the top of hills. The formation is composed of tuffaceous sandstone, intercalated with thin tuff and mudstone.

f) Pucangan Formation

Pucangan formation (Lb, expansive clay) is distributed in the areas between Sta. 15+000 - 17+000 and 31+000 - 34+000. The formation is composed of tuffaceous clay of high slaking property (test result showed 100% slaking ratio).

g) Upper Kalibeng Formation

Upper Kalibeng formation is distributed in the west part in hilly areas to the north of the Toll Road. The formation is mainly composed of marl.

6.3.2 Scope of Soils and Materials Investigations

(1) Purpose of the Investigations

The purpose of the investigations is to obtain data for the preliminary design of embankment, pavement, bridges and other structures.

(2) Field Work and Laboratory Testing

The field work and laboratory testing was executed by a local consulting firm, P.T. Wira Nusantara, Bandung. The Study Team planned and supervised the investigations. Machine boring with standard penetration tests (2 m interval) was conducted at 5 locations (Boring logs are shown in Appendix A-6.4). Thin-walled tube sampling was conducted for the soils in soft ground layers. Test pit sampling was made at possible sources of embankment materials, pavement materials and concrete aggregates.

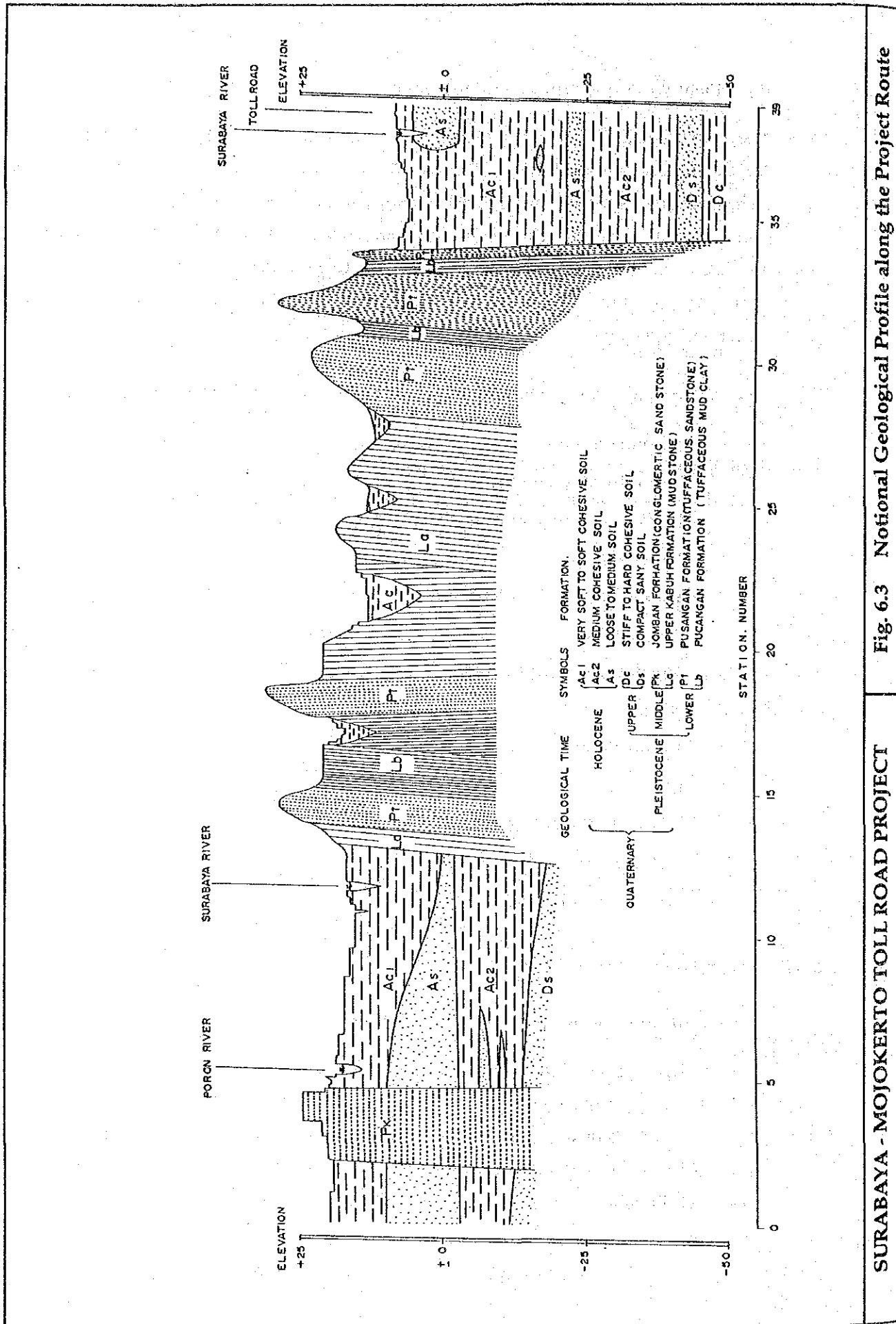
The following laboratory testings were conducted for the collected samples.

- Specific gravity
- Natural water content
- Particle size distribution
- Liquid limit
- Plastic limit & plasticity index
- Wet density
- Unconfined compression
- Consolidation
- Compaction
- CBR
- Apparent specific gravity
- Absorption
- Grain size analysis

6.3.3 Properties of Typical Soils

(1) Alluvial Cohesive Soils (Ac1 and Ac2)

Ac1 deposit spreads out in the east and west parts of the Project Area (refer to Fig. 6.3), 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 % according to the result of the laboratory tests.



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Fig. 6.3 Notional Geological Profile along the Project Route

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%.

(2) Alluvial Sandy Soils (As)

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

(3) 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.

(4) 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.

(5) 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.

(6) Soft Ground Area

The term "Soft Ground Layer" depends on the type of facilities to be constructed (i.e. highways, railways, buildings, etc.), but in the case of the development of the Toll Road, soils layers which have the characteristics shown in Table 6.2 are generally called "Soft Ground Layer".