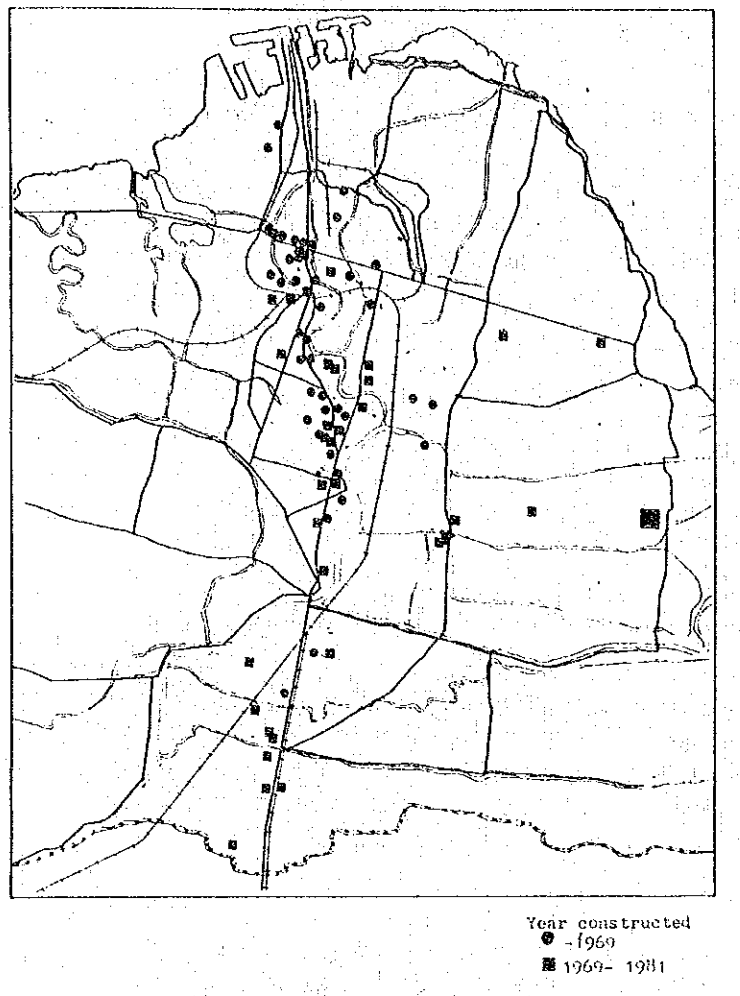


Fig. 2.4.7 DISTRIBUTION MAP OF HIGH-RISE BUILDING (OVER 4 FLOORS)

2.5 TRANSPORT SYSTEM

2.5.1 ROADS AND TRAFFIC

VEHICLE OWNERSHIP

Vehicle ownership in Java island is compared for each of the Java Provinces and GKS Region as shown in Table 2.5.1.

Table 2.5.1 VEHICLE OWNERSHIP IN JAVA AND GKS REGION, 1978

	West Java			Central Java	East Java			Total Java
	DKI JKT	Others	Total		GKS	Others	Total	
1. Passenger Cars (1)	190,566 (46.0)	96,774 (23.3)	287,340 (69.3)	50,358 (12.1)	38,105 (9.2)	38,815 (9.4)	76,920 (18.6)	414,618 (100.0)
2. Trucks	58,449 (27.6)	59,226 (28.0)	117,675 (55.6)	47,932 (22.7)	22,719 (10.9)	23,120 (10.9)	45,839 (21.7)	211,446 (100.0)
3. Buses(2)	17,132 (52.2)	6,100 (18.6)	23,232 (70.7)	4,843 (14.7)	1,782 (5.4)	2,987 (9.1)	4,769 (14.5)	32,844 (100.0)
4. Motorcycles	369,428 (28.2)	241,361 (18.4)	610,789 (46.6)	321,383 (24.5)	181,816 (13.9)	196,265 (15.0)	378,081 (28.9)	1,310,253 (100.0)
Total	635,575 (32.3)	403,461 (20.5)	1,039,036 (52.8)	424,516 (21.6)	244,422 (12.4)	261,187 (13.3)	505,609 (25.7)	1,969,161 (100.0)

Source : "Statistik Indonesia, 1979" Biro Pusat Statistik Jakarta
"GKS Report, JILID IV Transportasi, September, 1979"

Note : (1) Passenger cars include sedan, jeep, station wagon, taxi, oplet, bemo and ambulance
(2) Buses include colt, combi, micro bus.

In terms of the number of registered vehicles in Java island, West Java occupies a dominant share of more than 50% of the Java total. Particularly, DKI Jakarta accounts for more than 30% of the Java total, and among others the passenger cars and buses in DKI Jakarta have a share of nearly 50% of the Java total. Truck ownership in DKI Jakarta and West Java outside DKI Jakarta are relatively higher than that of Central Java and East Java but trucks are generally distributed equally to those regions. Motorcycles in East Java account for the highest percentage among the regions (28.9%) followed by DKI Jakarta, but there is more or less in an equal level of ownership in other regions. GKS Region shows about a half (48.3%) of East Java with respect to the total vehicle ownership, although buses are 37% of those of East Java. Vehicle ownership in each Kabupaten and Kotamadya in GKS Region is compared in Table 2.5.2.

Table 2.5.2 VEHICLE OWNERSHIP IN GKS REGION, 1978

	Surabaya	Sidoarjo	Mojokerto	Gresik	Lamongan	Bangkalan	GKS
1. Passenger Cars	34,476 (90.5%)	1,435 (3.8%)	721 (1.9%)	667 (1.7%)	219 (0.6%)	587 (1.5%)	38,105 (100%)
2. Trucks	19,851 (88.4%)	1,089 (4.8%)	687 (3.0%)	565 (2.5%)	283 (1.2%)	244 (1.1%)	22,719 (100%)
3. Buses	1,719 (96.4%)	19 (1.1%)	28 (1.6%)	5 (0.3%)	7 (0.4%)	4 (0.2%)	1,782 (100%)
4. Motor-cycles	156,455 (86.1%)	9,295 (5.1%)	6,340 (3.5%)	5,913 (3.2%)	2,361 (1.3%)	1,452 (0.8%)	181,816 (100%)
5. Total	212,501 (86.9%)	11,838 (4.9%)	7,776 (3.2%)	7,150 (2.9%)	2,870 (1.2%)	2,287 (0.9%)	244,422 (100%)

Source : "Kumpulan Data Dasar di Wilayah GERBANGKERTOSUSILA Th. 1971-1978, JILID IV Transportasi, Sept. 1979"

The growth of vehicle ownership in Surabaya averages 12.7% per annum and the motorization rate in 1980 was 2.3 times larger than in 1971. Details are given in Table 2.5.3 and 2.5.4.

Table 2.5.3 GROWTH OF VEHICLE OWNERSHIP IN SURABAYA

	Passenger car	Trucks	Buses	Motorcyle	Total
1971	21,133	9,175	968	53,652	84,928
1972	23,308	9,954	984	62,157	96,403
1973	26,474	10,957	1,051	78,182	116,664
1974	26,445	11,393	1,166	91,639	130,643
1975	29,234	12,976	1,076	115,380	158,666
1976	31,665	14,677	1,114	134,042	181,528
1977	34,102	17,524	1,317	155,263	208,206
1978	34,465	19,991	1,398	156,459	212,313
1979	36,972	22,100	1,597	167,085	227,754
1980	40,927	25,484	1,656	184,424	252,491
1981	45,525	27,506	1,678	206,926	281,635

Source : Traffic Police of Surabaya City

Source: Surabaya City Traffic Police

Table 2.5.4 VEHICLE COMPOSITION RATES AND MOTORIZATION RATES IN SURABAYA, 1971 & 1980

	Pass. Cars	Trucks	Buses	M. Cycle	Total	Pop**($\times 10^3$)
1971: Vehicle composition rate (%)	24.9	10.8	1.1	63.2	100.0	1,556
Motorization rate*	13.6	5.9	0.6	34.5	54.6	
1980: Vehicle composition rate (%)	16.2	10.1	0.7	73.0	100.0	2,032
Motorization rate*	20.1	12.5	0.8	90.8	124.3	

Note: * Vehicles per 1000 persons
** National Census 1971 and 1980

As shown clearly in the above Tables, motorcycles in Surabaya are the principal transport means. Growth in ownership and composition rates are both increasing, and motorization rate of motorcycles in 1980 was 2.6 times larger than in 1971.

Ownership and motorization rates of passenger cars grew at an average annual rate of 7.3% and 4.2% respectively during 1971–1980. Share of buses seems to be depressed by an increase of motorcycles. In other words, growth of bus ownership could not keep up with the increasing demand for road transport. From the viewpoint of traffic flows, particularly on main streets in a city, motorcycles weaving in and out of the traffic are an impediment to other traffic which results in reduced capacity and increased traffic accidents. Therefore the rapid increase and higher level of motorcycle ownership is not favourable to safe smooth flow, without counter measures to cope with such problems.

VEHICLE TRAFFIC

(1) Java and Madura

Traffic surveys are conducted by Bina Marga (Directorate General of Highways) every year on traffic flows in Java and Madura. Fig. 2.5.1 compares 1975 and 1980 volumes from which a conceptual traffic flow disgram is derived as shown in Fig. 2.5.2.

Major traffic flows in Java are in the following directions:

- Jakarta–Bekasi–cikampek–Cirebon–Tegal–Semarang
- Jakarta–Bogor–Bandung
- Semarang–Yogyakarta
- Surabaya–Sidoarjo–Malang
- Surabaya–Mojokerto–Jombang–Madiun–Surakarta

Traffic growth between 1975 and 1980 is particularly significant along the above major routes, and around the cities of Jakarta, Bandung, Cirebon, Semarang, Yogyakarta, Malang and Surabaya.

Besides these the connecting routes between Purwokerto and Semarang/Yogyakarta route are noteworthy. Thus 4 traffic influence zones can be conceived in Java centering around the cities of Jakarta/Bandung, Cirebon, Semarang/Yogyakarta and Surabaya/Malang.

(2) East of Semarang–Yogyakarta Corridor

Surabaya–Malang Corridor is a central axis of traffic flows in East Java as can be seen in Fig. 2.5.3. This north-south corridor connect to the west and the east. To the west it connects with the Semarang–Yogyakarta Corridor through either one of the northern or central routes. A larger proportion of westbound traffic from Surabaya–Malang Corridor use the central route, which passes through such local core cities as Mojokerto, Jombang, Madiun and Surakarta.

Another route to the Semarang–Yogyakarta Corridor is the northern route which passes through Lamongan, Bojonegoro/Tuban, Rembang and Semarang.

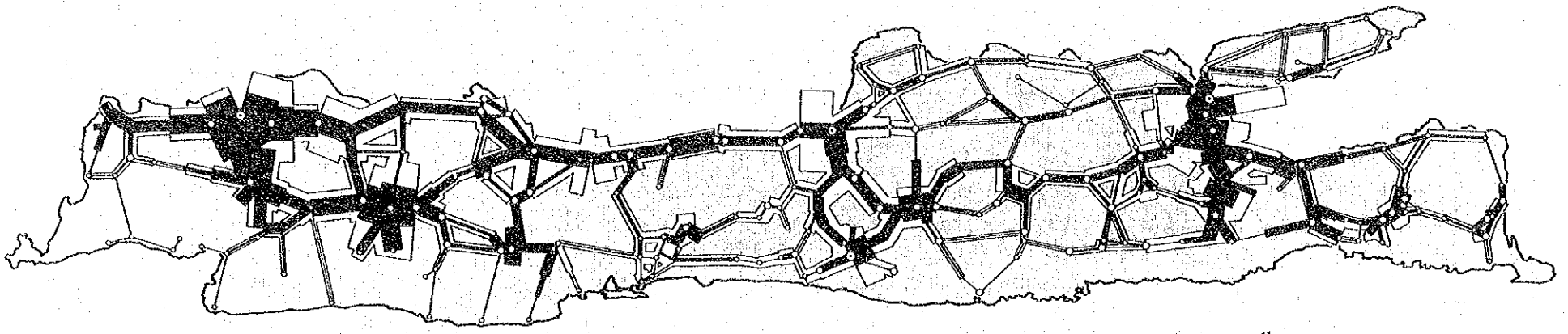
To the east of Surabaya–Malang Corridor, there is a route to connect five local core cities, namely pasuruan, Probolinggo, Lumajang, Jember and Banyuwangi. Particularly, Jember has been developing as a regional core of the eastern area of Surabaya–Malang Corridor. In Madura, Bangkalan and Pamekasan seem to be the regional cores in terms of traffic flows.

(3) GERBANGKERTOSUSILA Region

Average traffic growth in GKS was 17.8% p.a. from 1972 to 1981, as shown in Table 2.5.5. Compared with the vehicle ownership in Surabaya, the growth of traffic flows except for motorcycles, was about two times faster than that of ownership (9.1% p.a.) during the same period as above. This is not only because the economic activities in the region have been encouraged, but also improvement of the road network has been promoted. The implications of this traffic growth in the region may indicate the possibility of enhancing the regional economy by the development of the transport sector. Traffic routes with over the regional average growth rate of 17.8% p.a. are indicated in the right hand side of Table 2.5.5.

Surabaya–Waru–Mojokerto direction exceeded 10,000 A.D.T. in all sections and also exceeds the average growth rate between Surabaya and Mojokerto. Surabaya–Pandaan/Pasuruan directions showed traffic volumes of over 5,000 A.D.T. but traffic growth rates lay below the regional average. Mojokerto–Jombang directions exceeded 10,000 A.D.T. and Mojokerto–Gemekon showed over the regional average growth rate of traffic. Lamongan–Gedeg–Ploso directions had lower traffic flows of 1000–2000 A.D.T. Nevertheless, Lamongan–Gedeg–Ploso sections showed a higher traffic growth of more than 19% p.a. In Madura, traffic volumes are less than 4,000 A.D.T. in all sections and Bangkalan had a lower traffic growth rate than the regional average. In general, Gresik–Lamongan–Babat/Tuban–Jombang sections grew fast but traffic volumes still lie in the lower level.

Waru–Sidoarjo–Pandaan and Waru–Mojokerto directions had the largest traffic in the region, but traffic growth in the former direction was lower than in the latter. The existing road network in GKS Region is presented in Fig. 2.5.5 and traffic volumes and truck composition rates in 1981 are shown in Fig. 2.5.6.



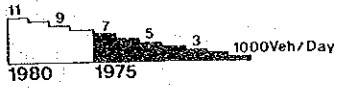


Fig. 2.5.1 COMPARISON OF TRAFFIC FLOWS IN 1975 AND 1980

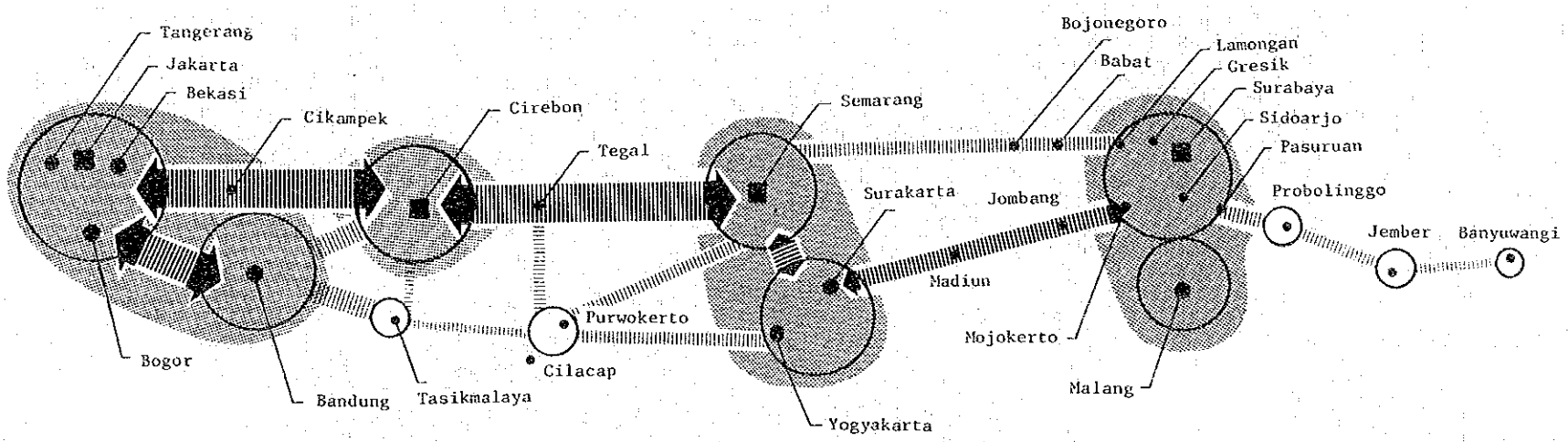


Fig. 2.5.2 CONCEPTUAL DIAGRAM FOR TRAFFIC FLOWS IN 1980

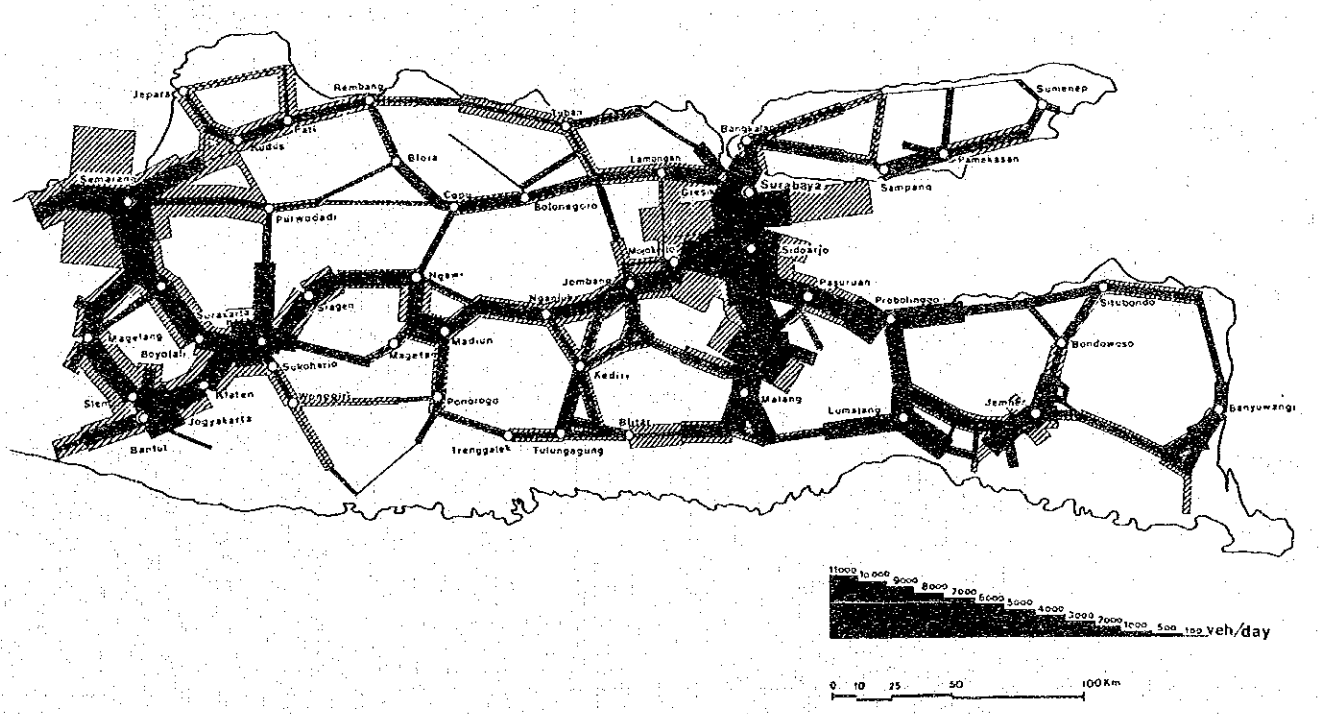


Fig. 2.5.3 DEVELOPMENT OF TRAFFIC FLOWS IN EAST JAVA, 1975 TO 1980

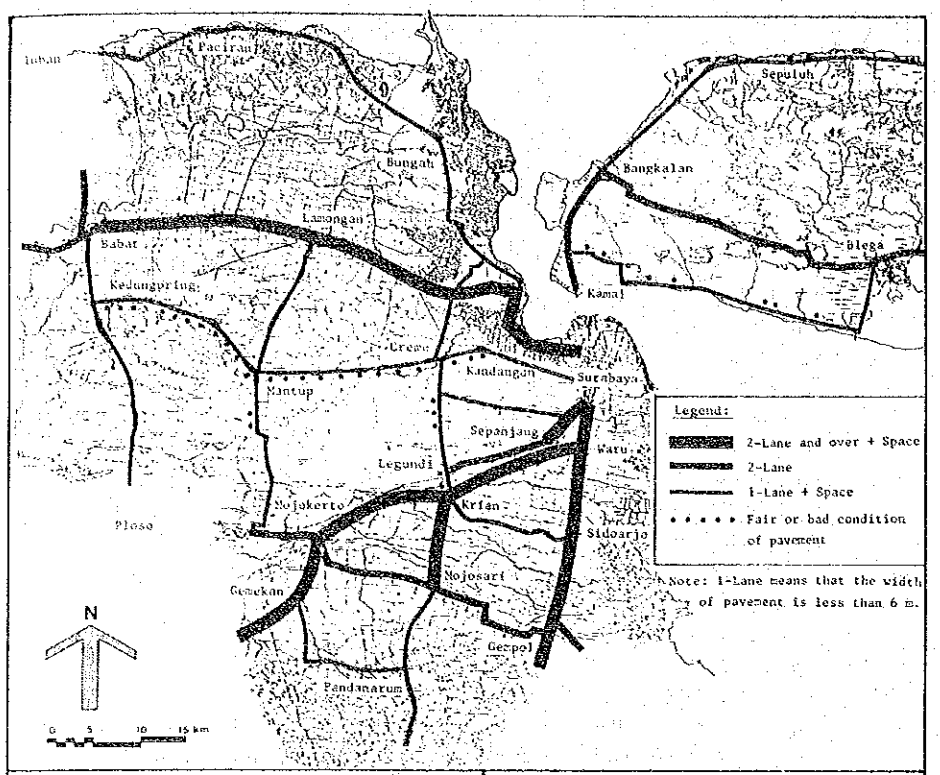
Table 2.5.5 TRAFFIC VOLUMES PER DAY AND GROWTH RATE IN GKS REGION IN 1972 & 1981

Routes and Sections	Code No. of Bina Marga	Year 1972				Year 1981				Av. Ann Growth Rate '72/81(%)
		Type of Vehicle			Total	Type of Vehicle			Total	
		M	B	T		M	B	T		
Surabaya-Bojonegoro-Tuban										
Surabaya - Gresik	C.215	2,358	286	866	3,510	6,692	928	3,910	11,530	14.1
Gresik - Bungah	C.204	849	1	155	1,005	3,551	65	603	4,219	17.3
Bungah - Paciran	C.203	100	-	11	111	524	-	252	776	24.1#
Paciran - Tuban	C.202	265	4	31	300	1,059	10	188	1,257	17.3
Gresik - Lamongan	A.214	717	176	342	1,235	3,872	768	1,737	6,377	20.0#
Lamongan - Babat	C.213	289	161	356	806	2,176	623	1,692	4,491	21.0#
Babat - Bojonegoro	C.212	371	55	276	702	1,199	335	873	2,407	14.7
Babat - Jombang	C.225	569	-	7	576	1,310	-	1,252	2,562	18.0#
Babat - Tuban	C.206	171	75	214	460	1,373	296	924	2,593	21.2#
Surabaya-Mojokerto										
Surabaya - Waru	C.013	7,325	888	3,148	11,361	27,833	3,979	16,470	48,282	17.4
Surabaya - Sepanjang	C.216	2,672	16	889	3,577	10,818	1,062	4,926	16,806	18.8#
Sepanjang - Legundi	C.217	9	1	47	57	4,308	55	4,778	9,141	75.8#
Waru - Krian	C.012	2,442	351	1,583	4,376	11,480	2,304	13,220	27,004	22.4#
Krian - Mojokerto	A.011	1,633	287	794	2,714	6,878	2,007	5,088	13,973	20.0#
Surabaya-Pandaan-Pasuruan										
Waru - Sidoarjo	C.014	4,889	378	1,825	7,092	10,666	2,243	14,209	27,118	16.1
Sidoarjo - Gempol	C.015	3,701	363	1,684	5,748	8,818	1,454	8,606	18,878	14.1
Gempol - Pandaan	C.266	2,463	160	767	3,390	6,834	517	4,226	11,577	14.6
Gempol - Pasuruan	A.016	2,398	186	1,107	3,691	3,239	483	2,124	5,846	5.2
Mojokerto-Jombang-Pandanarum										
Mojokerto - Gemekon	C.010	1,900	333	1,011	3,244	7,584	1,577	6,800	15,961	19.4#
Gemekon - Jombang	C.009	2,389	343	385	3,117	5,314	1,633	3,434	10,381	14.3
Gemekon - Pandarum	C.271	46	-	49	95	1,812	-	2,318	4,130	52.1#
Mojokerto - Mojosari	C.270	1,015	17	152	1,184	3,527	33	1,329	4,889	17.1
Mojosari - Pandanarum	C.269	232	1	134	367	2,473	-	4,354	6,827	38.4#
Mojosari - Gempol	C.267	501	9	303	813	2,093	94	3,027	5,214	22.9#
Mojokerto - Legundi	C.219	46	-	105	151	217	-	392	609	16.8
Mojosari - Krian	C.268	613	-	628	1,241	1,850	11	2,464	4,325	14.9
Lamongan-Gedeg-Ploso										
Lamongan - Ngugrak	C.220	285	-	-	285	992	-	708	1,700	21.9#
Ngugrak - Gedeg	C.221	82	-	28	110	914	-	328	1,242	30.9#
Gedeg - Ploso	C.222	405	6	-	411	993	-	1,017	2,010	19.3#
Bangkalan-Sepuluh-Kamal										
Bangkalan - Kamal	B.312	835	48	214	1,097	2,603	50	502	3,155	12.5
Bangkalan - Blega	C.313	472	46	338	856	2,206	70	846	3,122	15.5
Bangkalan - Sepuluh	C.323	319	-	108	427	1,364	61	216	1,641	16.1
T O T A L		42,361	4,191	17,557	64,109	146,572	20,658	112,813	280,043	17.8

Source : Directorate General of Highways (Bina Marga)

Notes : M-Passenger cars; B-Buses; T-Trucks

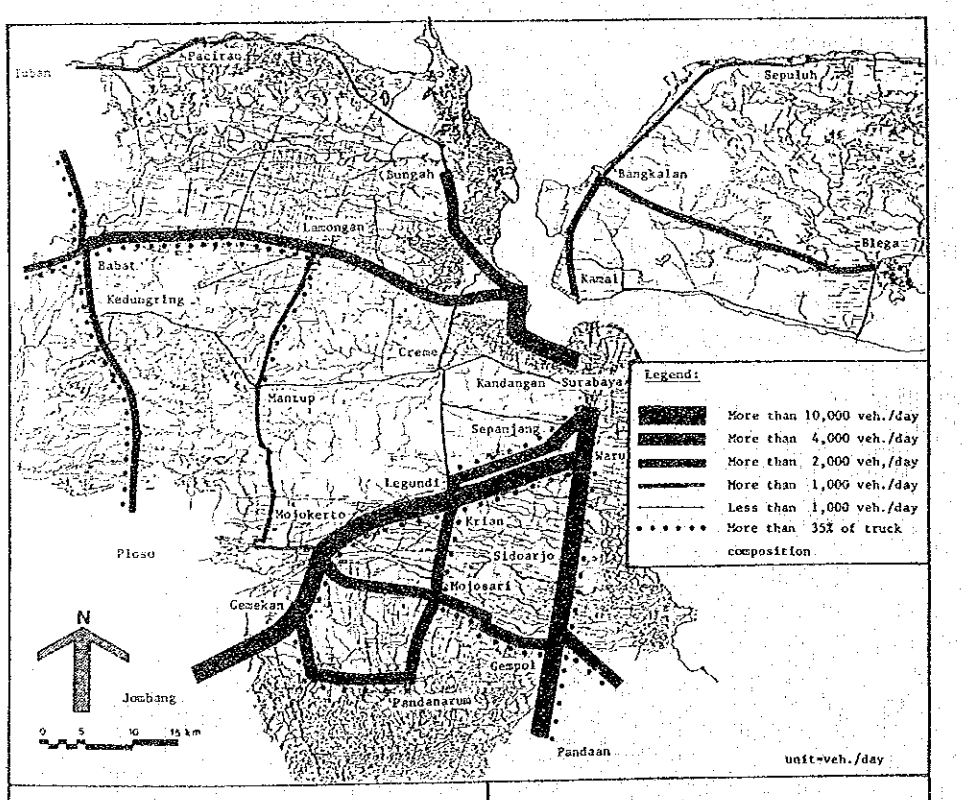
: Over the regional average traffic growth rate of 17.8% p.a. during 1972 to 1981.



URBAN DEVELOPMENT PLANNING STUDY
ON GERBANGKERTOSUSILA
(SURABAYA METROPOLITAN AREA)

Fig. 2.5.5

EXISTING ROAD NETWORK
IN GKS REGION IN JUNE, 1982



URBAN DEVELOPMENT PLANNING STUDY
ON GERBANGKERTOSUSILA
(SURABAYA METROPOLITAN AREA)

Fig. 2.5.6

TRAFFIC FLOWS AND VOLUMES
IN GKS REGION, 1981

Major arterial roads of Surabaya–Porong, Surabaya–Mojokerto–Jombang and Surabaya–Gresik–Babat have been resurfaced recently by the Road Betterment Office and new road construction in these corridors is now in progress as shown below:

- Surabaya–Porong Tollway : Under construction
- Surabaya–Gresik Tollway : Feasibility study was completed in 1980
- Mojokerto Bypass : Completed in July, 1982

Compared with the improvement of the above major arterial roads, collector and local roads are given less road maintenance. Roads in these categories have functions either to support arterial roads or to connect local core cities. Traffic demand on several roads at collector level in particular, has increased and this now requires the improvement of road surface, alignment, bridges and road width. Future traffic demand on the road sections of Taman–Sepanjang–Kalangpilang; Krian–Legundi–Sepanjang; Babat–Plose–Mojokerto; and Lamongan–Gedeg–Mojokerto, are likely to increase.

In addition, with the urban development of Surabaya towards the west, the Surabaya–Kandangan–Cerme road will play an important role in the expansion of urban development of Surabaya towards the west and the rural development of Southern Gresik. The existing road conditions in GKS Region are described in Table 2.5.6. and these were obtained in the inventory survey by the Study Team.

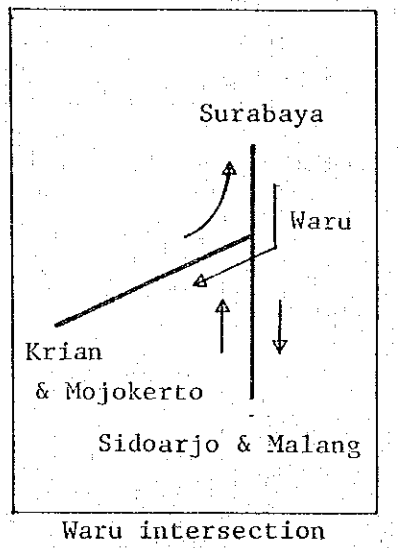
From the survey results, traffic problems are found in major intersections described as follows:

– Waru Intersection

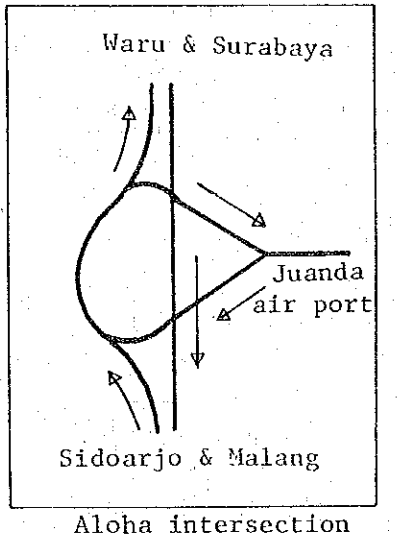
  Two primary arterial roads, Surabaya–Malang and Waru–Mojokerto cross each other at this intersection and traffic jams occur there every day. The former has 4 lanes and the latter 2 lanes, and the intersection needs improvement.

– Aloha Intersection

  This intersection is located at a gate to Juanda Airport on the Surabaya Malang road. Since some traffic from the airport weaves on the Surabaya–Malang road, an improvment is required for the future traffic increase.



Waru intersection



Aloha intersection

– Krian Intersection

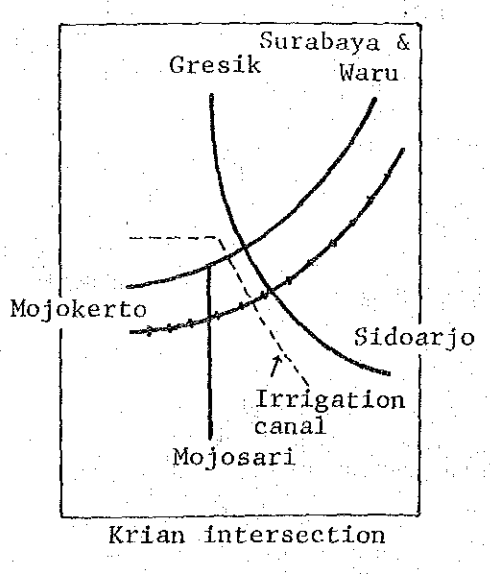
  Krian is an intersection of roads from Waru, Sidoarjo, Gresik, Mojokerto and Mojosari. In addition, the irrigation canal crosses near the intersection and the railroad crosses to the south of the intersection with the roads to Mojosari and Sidoarjo, as shown in the diagram.

Table 2.5.6 ROAD CONDITIONS IN GKS REGION

	No. of Lanes	Condition of Pavement	Travel Speed (km/h)	Traffic Volume & Truck Composition Ratio (%) (1)	Land Use
Surabaya - Gresik	2	Good	48	11,530 (33.9)	Salt field & fish pond
Gresik - Lamongan	2	Good	63	6,377 (27.2)	Rice field & fish pond
Lamongan- Babat	2	Good	83	4,491 (37.7)	Rice field
Gresik - Paciran	1-2	Good	49	-	Partially salt, rice field & fish pond
Paciran - Tuban	1-2	Good	53	1,257 (15.0)	Rice field
Surabaya - Mantup - Kedungpring	1-2	Very Bad	29	-	Unused dry land & dry crop field
Waru - Krian	2	Good	-	27,004 (49.0)	Residential, industrial area & rice field
Sepanjang - Krian	1-2	Good	32	9,141 (52.3)	Residential,industrial area & partially rice field
Krian - Mojokerto	2	Good	60	13,973 (36.4)	Rice field
Surabaya - Waru	4-6	Good	55	48,282 (34.1)	Residential, institutional & industrial area
Waru - Sidoarjo	2-4	Good	49	27,118 (16.1)	Mainly rice field & partially residential area
Sidoarjo - Gempol	2	Good	-	18,878 (45.6)	Mainly rice field & partially residential area
Tuban - Babat	2	Good	59	2,593 (35.6)	Rice field & swampy area
Babat - Jombang	2	Fair	34	2,562 (48.9)	Dry crop field on hilly land
Jombang - Mojokerto	2	Good	62	10,381 (33.1)	Dry crop field
Mojokerto - Mojosari	1-2	Good	58	4,889 (27.2)	Rice & sugarcane field
Mojosari - Gempol	1-2	Good	54	5,214 (58.1)	Rice & sugarcane field
Gresik - Cerme	1-2	Good	44	-	Mainly rice field & partially swampy area
Cerme - Krian	1	Bad	29	-	Dry field and partially forest & rice field
Krian - Mojosari	2	Good	48	4,325 (57.0)	Rice field
Lamongan - Mojokerto	1	Fair	47	1,700 (41.6)	Dry crop field

Note : Source of (1), is the Directorate General of Highways (Bina Marga), 1981.

Krian is thus an important connecting point of major inter-city traffic. The Krian–Mojosari road is connected with the Surabaya–Mojokerto road within 15 meters distance from the junction between Surabaya–Mojokerto road and Krian–Sidoarjo road. This means, a four-leg intersection and a three-leg intersection are immediately adjacent to each other, so that traffic congestion at Krian is observed during most of the day. From the landuse around the intersection, it can be seen that there exists a pasar, shops along the road, and bus/colt/bemo terminal. The improvement of the Krian intersection should therefore be studied and executed as soon as possible, otherwise the urbanization in this area will hamper the inter-city traffic flows.



(4) Surabaya

A road inventory survey was carried out by the Study team in order to understand the present road conditions and to clarify the major road network in Surabaya. The survey results are summarized in Table 2.5.7, Fig. 2.5.7; and the road network is shown in Fig. 2.5.8.

The road network of Surabaya City has been formed under restrictions of the geographical features, the rivers and the railroads. Jl. Raya Jend. Achmad Yani stretching north from Sidoarjo is restricted by the narrow Darmo areas which lies between Kali Surabaya and Gunung Sari Hill.

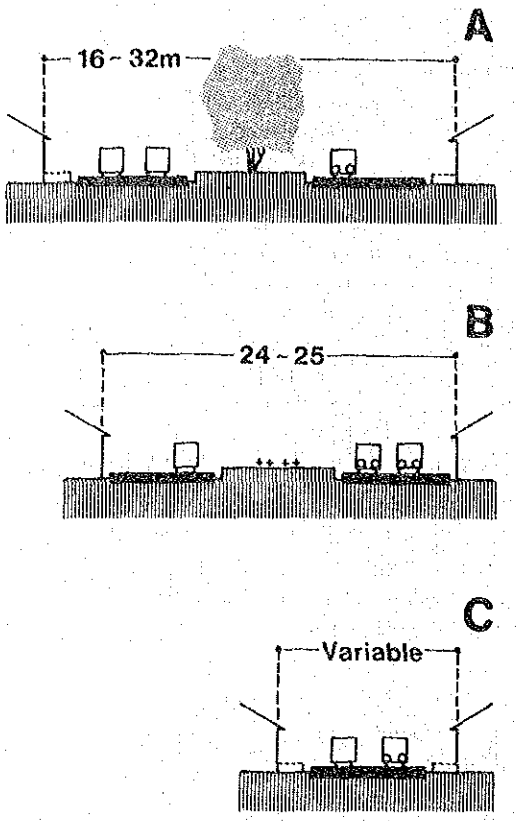


Fig. 2.5.7 TYPICAL CROSS SECTIONS OF MAJOR ROADS IN SURABAYA

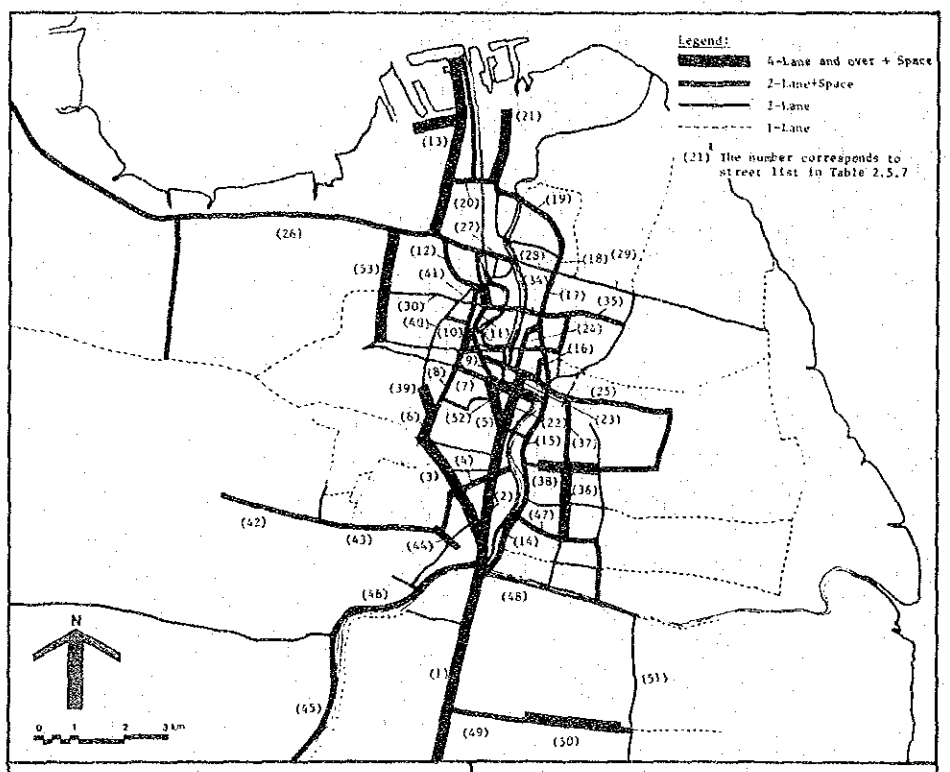
Table 2.5.7 INVESTORY OF MAJOR ROADS IN SURABAYA

No.	Road Name	No. of Lanes	Total Width (m)	Width of Pavement (m)	Width of Median Strip (m)	Width of Shoulder and Open Space (m)	Width of Side Walk (m)	Type of Cross Section	Travel Speed in Peak Period (km/h)
1	Raya Jend. Achmad Yani	6	25.5	21	2.5	1 + 1	-	A	40
2	Raya Darmo	4	21	16	3.0	-	1 + 1	C	30
3	Raya Diponegoro	4	24	18	6	2 + 2	-	B	39
4	Dr. Sutomo	2	18	10	6	2.5 + 2.5	-	A	-
5	Jend. Basuki Rachmat	4	16	12	-	-	2 + 2	C	38
6	Pasar Kembang	4	24	16	8	1 + 1	1.5 + 1.5	B	41
7	Embong Malang	3	15.5	10	-	2.5 + 0.5	2.5	C	16
8	Kedungdoro	2	16-18	12-15	-	3.5 + 2.5	2.5	C	29
9	Tunjungan	4	16	12	-	-	2 + 2	C	40
10	Bubutan	2	15.5	10	3	3 + 3	2.5	A	40
11	Pahlawan	4	20	14	-	-	3 + 3	C	44
12	Indrapura	2	10	8	-	1.5 + 1.5	-	C	16
13	Tanjung Perak	4	32	20	10	4 + 4	-	A	22
14	Ngagel	2	12	10	-	2.5 + 2.5	-	C	35
15	Raya Gubeng	2	14	12	0.2	3.5 + 3.5	-	C	26
16	Kusuma Bangsa	2	15	12	-	2.5 + 2.5	1.5 + 1.5	C	14
17	Kapasari	2	10	7	-	-	1.5 + 1.5	C	24
18	Simokerto	2	12	10	-	1.5 + 1.5	1 + 1	C	22
19	Sidotopo Lor	2	17	11	-	3 + 3	2 + 2	C	22
20	Jakarta	2	11	10	-	1.5 + 1.5	1	C	34
21	Raya Hang Tua	4	25	17	-	2.5 + 2.5	-	C	-
22	Sudirman	6	24	18	-	-	3 + 3	C	47
23	Y. Sudarso	4	22	18	-	2 + 2	1.8 + 1.8	C	47
24	Jaksa Agung Suprapto	2	23	11	10	3 + 3	-	A	-
25	Dharma Husada	2	15	12	-	2.5 + 2.5	1.5 + 1.5	C	-
26	Gresik	2	9-10	6-7	-	2 + 2	-	C	43
27	Kembangjepun	2	16	10	-	4.5 + 4.5	-	C	26
28	Kapasan	2	7	6	-	0.5 + 0.5	-	C	26
29	Kenjeran	2	7	7	-	-	-	C	26
30	Dupak	1	6	6	-	1.3 + 1.3	-	C	14
31	Tebaan	2	7	7	-	-	-	C	14
32	Pasar Besar	2	12	12	-	3 + 2	-	C	15
33	Jagalan	2	12.5	10	-	1.5 + 1.5	1.2 + 1.2	C	15
34	Ngaglik	4	16.5	14	-	-	1.2 + 1.2	C	34
35	Kapas Krampung	2	12	12	-	2.5 + 2.5	-	C	34
36	Pucang Anom Timur	4	27	16	8	2.5 + 2.5	-	A	35
37	Dharmawangsa	4	18	15	-	2 + 2	-	C	44
38	Kertajaya	4	31	20	11	3 + 3	-	A	-
39	Raya Arjuna	4	25	16	8	1.5 + 1.5	-	B	-
40	Semarang	2	7.5	6	-	0.5	-	C	20
41	Pasarturi	2	7	7	-	-	-	C	-
42	Raya Darmo Permai	2	9	8	-	0.5 + 0.5	-	C	34
43	May. Jend. Sungkono	2	7	6	-	0.5 + 0.5	-	C	21
44	Adityawarman	4	20	12	8	1.5 + 1.5	-	A	23
45	Kedurus	2	15	10	-	4.5 + 3.5	-	C	31
46	Gunung Sari	2	10	9	-	1.5 + 1.5	-	C	21
47	Ngagel Jaya Selatan	2	12	10	-	2.5 + 2.5	-	C	29
48	Jagir Wonokromo	2	10	7	-	1.5 + 1.5	-	C	27
49	Jemuranda Yani	2	11	7	-	2 + 2	-	C	27
50	Rungkut Industri	4	28	16	8	1 + 1	2 + 2	A	27
51	Raya Rungkut	2	9	7	-	1 + 1	-	C	36
52	Pemuda	4	17	14	-	-	1.5 + 1.5	C	23
53	Demak	4	25	23	-	1 + 1	4 + 4	C	19

The CBD of Surabaya is located in an area with a width of 3 km along Kali Mas, and surrounded by the north–south bound railroad and the old tramway. Most roads stretch along the major urban rivers (incl. Kali Mas), and they form a complicated network according to the meandering of the rivers. The tracks of the railroad also restrict the alignment and location of the roads so that the traffic concentrates in the flyover roadway over the railroad and in the bridges over the rivers.

All of these situations cause a lot of staggered intersections which lower the traffic efficiency. The overall network system is, excluding a few areas, restricted by the geographical features, the rivers and irrigation water-ways, and it can be pointed out that the original farm villages have developed into the urban area.

Roads leading to Kod. Surabaya from Sidoarjo are Jl. Karangpirang, Pulo Wonokromo, Raya Jend. Achmad Yani and Raya Rungkut. Those from Gresik are Jl. Gresik, Tandes and Menganti, and those from the east are Jl. Kenjerang, Kalikepiting, Keputih and Baratajaka.



URBAN DEVELOPMENT PLANNING STUDY ON GERBANGKERTOSUSILA (SURABAYA METROPOLITAN AREA)

Fig. 2.5.8 EXISTING ROAD NETWORK IN SURABAYA

– North-South Axis

Jl. Raya Jend. Achmad Yani-Jl. Tg. Perak which is a north-south bound trunk line has four lanes. However, there are still traffic jams at many points due to detours caused by the one-way system in the CBD, and lack of traffic sign, lane marks, and level crossings with railroads. Jl. Ngagel-Sidotopo Lor, a road for heavy trucks running along Kali Mas, has many level crossings which cause traffic jams at Wonokromo, Kenjeran and so on. Jl. Kendungsroko–Nginden, located at the east end, cannot be used efficiently because of its narrowness, existence of nearby pasars and a staggered road (Jl. Rungkut) at Kaliwonokromo. The eastern part, with fairly many paddy fields is under development for housing, and construction of a new road will be needed in the future.

– East West Axis

Jl. Kenjeran is the only road which passes through Surabaya from the east on the east–west axis. The east side of Kali Mas is, on the whole, flat level land, while the westside is a mixture of level land and hills. The road network is formed according to this topography. All roads in the eastside are located along irrigation or drainage canals, while the 2 roads in the westside, except for Jl. Gresik, are arranged with one on the flat land and one on hilly land. Every road in the westside has some problems at its access point to the CBD. The ground level crossing at Jl. Gresik and Demak causes a traffic jam. Jl. Tandes also always creates heavy traffic jams, as the road leading to the ground level crossing with Jl. Raya Diponegoro is too narrow to cope with the traffic demand which is generated by housing areas such as Perumnas, developed along the road. Also the many stalls and shops along the road are using the road improperly. Jl. Darmo Permai is a two-lane road on Gunungsari Hill leading to Darmo New Town. Since there have been a lot of housing developments, the capacity of the road is not sufficient. This is mainly due to the 2-lane bottle-neck section near Gunungsari Canal Bridge and several crossings with narrow streets in Darmo district. Jl. Menganti is a narrow two-lane road located at a foot of the hill to the south of Gunungsari Hill and is used by many commuters to Karangpilang and Surabaya. It generates a traffic jam at the crossing with Jl. Gunungsari. It is hard to widen the road, as it lies in between Kali Surabaya and Kali Kedurus.

Jl. Rungkut Industri Raya is a road leading to Rungkut Industrial Estate which is located at 4 km east to Jl. Raya Jend. Achmad Yani. It is desirable to build a flyover at the crossing of the two roads, as the traffic is congested by trucks to and from the Estate. Jl. Raya Rungkut stretches southward from Jl. Raya Wonokromo and runs to the eastern side of Rungkut Industrial Estate and the western side of Juanda Airport. It leads to Mangetan canal, and it is mainly used by traffic from the industrial estate. However, it does not function efficiently as there is an access problem to the north and south areas of Surabaya. A major review of the road network in this area is required, as the area includes important urban facilities.

2.5.2 RAILWAY

RAILWAY LINES

Trunk railway lines connected with Surabaya consist of the Northern Line, Southern Line and Eastern Line as shown schematically in Fig. 2.5.9.

Terminal stations in Surabaya are Pasar Turi on the northern line and Surabaya Kota for both the southern and eastern lines. These two terminal stations are not directly connected by rail but transit passengers between the two lines (northern line – southern line or northern line – eastern line) are carried by bus between Gubeng station and Pasar Turi station.

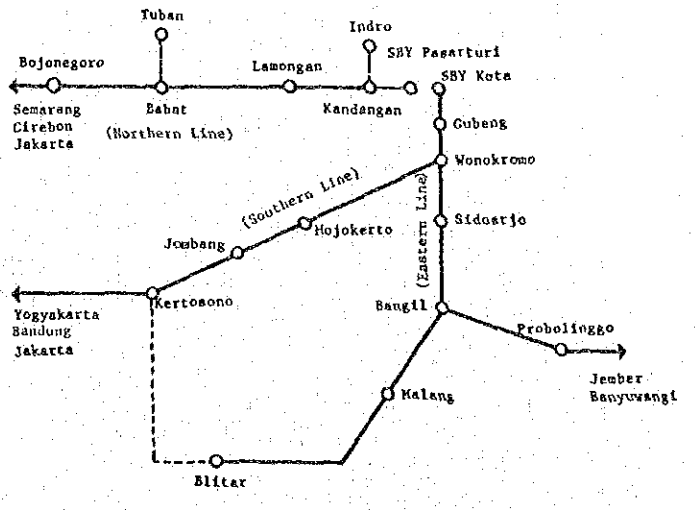


Fig. 2.5.9 SCHEMATIC RAILWAY LINES IN EAST JAVA

PASSENGER AND CARGO TRAFFIC

(1) Passengers

Only data on departing passengers at each station in Surabaya and GKS Region is available and this is shown in Table 2.5.8.

Growth of departing passengers in Surabaya and GKS Region was 7.7% and 8.4% respectively during 1974 – 1980, and in East Java 12.1% during 1978 – 1980. In 1979, a drastic upward growth in traffic was observed throughout East Java and Surabaya, but figures for 1981 appear to show a decline.

The "Gerbangkertosusila Train" operates between Jombang and Surabaya in order to serve commuters to Surabaya. The number of Mojokerto rail passengers experienced a large growth in 1979 and 1980, but traffic seems to be stagnating since then.

Table 2.5.8 DEPARTING PASSENGERS IN SURABAYA AND GKS REGION

(unit : 1000 persons)

Stations	1974	1975	1976	1977	1978	1979	1980	1981*
Surabaya	1,212	1,097	1,151	1,103	1,395	1,794	1,890	1,712
-Semut	347	300	296	292	339	451	549	469
-Gubeng	359	361	380	390	482	582	573	504
-Wonokromo	60	56	44	78	118	226	312	327
-Pasar Turi	446	380	431	343	456	535	456	412
Lamongan	9	8	7	6	9	13	7	6
Babat	84	72	59	56	122	214	225	217
Mojokerto	23	12	15	17	26	80	143	139
Sidoarjo	35	7	8	6	12	12	20	28
Gresik	11	0	-	5	-	11	1	-
Kamal	35	21	-	12	8	-	-	-
GKS Region	1,409	1,217	1,240	1,205	1,572	2,124	2,286	2,090
East Java	-	-	-	-	4,275	5,621	5,370	5,170

Note Estimated based on the monthly data upto November, 1981.
Source PJKA, East Java

(2) Cargo

Cargo volumes handled at the stations in Surabaya and GKS Region are presented in Table 2.5.9.

Cargo tonnage throughout GKS Region showed a downward trend from 1974 to 1976 and then began to increase till 1978. Surabaya cargo traffic accounted for about 90% of the total cargo volumes handled in GKS Region. But it has stagnated at a level of 1 million tons per year since 1978.

Thus, cargo traffic in GKS Region as well as in Surabaya has been fluctuating and the traffic growth has been discouraging. Inbound cargo traffic to Surabaya accounted for about 20 – 30% of the total cargo handled in Surabaya. The rest is bound for outside Surabaya. Major commodities carried out of Surabaya are petroleum, fertilizer and cement, which are loaded at Benteng and Kalimas stations. Total cargoes loaded at these stations accounted for more than 85% of the total cargoes bound for outside Surabaya.

Benteng station is principally for petroleum shipment and distributed about 535,000 tons, 485,000 tons, 407,000 tons of petroleum to East Java in 1978, 1979 and 1980 respectively. Fertilizer is mainly transported from Kalimas station. Of the total outbound fertilizer traffic, 90% was transported to East Java and 10% to Central and West Java. These two major commodities are sea port (Tg. Perak) generated traffic. Thus, railway transport largely relies on the demand from Tg. Perak port.

Destinations of the Surabaya cargo traffic are outlined in Table 2.5.10. According to this table, it is found that petroleum and fertilizer volumes loaded at Benteng and Kalimas stations are gradually decreasing. Therefore, it is likely that marginal petroleum and fertilizer transport to East Java is made by road, namely by truck.

TRIP DISTRIBUTION OF RAILWAY PASSENGERS

A railway passenger survey was carried out by the Team from the 8th till 10th of March, 1982. Departing passengers from the railway stations in GKS Region, as observed from 06:00 to 20:00 on one of these days totalled 4,965 persons. Details are given in Table 2.5.11.

Compared with the bus/bemo/colt passengers in volume, railway plays little role as a means of public transport in the region. As shown in Table 2.5.12, 11.8% of railway passengers generated from the 8 survey stations in GKS Region were estimated to have their destinations in GKS Region, and the remaining 88.2% had destinations outside GKS Region.

With respect to the distribution of departing passengers from the 8 stations surveyed in GKS Region, the following characteristics of those station cities can be found:

- Passengers from Surabaya are mostly medium and long distance travellers, and account for about 92% of the total. Long distance passengers alone, account for about 74% of total departing passengers. However, internal trips are also made in Surabaya to the same extent in number of passengers as those from Sidoarjo and Mojokerto going to Surabaya.
- Sidoarjo and Mojokerto stations show higher proportions of Surabaya bound passengers. In particular, nearly half of the Sidoarjo passengers have their destinations in Surabaya, although the volume is very low.
- Mojokerto station also handles quite a similar volume of passengers to Surabaya as Sidoarjo. A difference can be found not only in the total volume of departing passengers from Mojokerto and Sidoarjo but also in the travel distances of the departing passengers from the two stations. That is, 39% of passengers from Mojokerto have their destinations between Krian and Jombang.
- Babat has less communications with Surabaya than with Tuban. Most of the passengers from Babat use the branch line to Tuban. Passengers trips from Babat dominate the Babat-Tuban section followed by Babat-Lamongan section and Babat-Bojonegoro section.
- Sidoarjo is closely connected with Surabaya but Babat and Mojokerto have rather stronger connections with their surrounding area than with Surabaya. Lamongan has very little passengers compared with other cities.
- Passengers between Surabaya and GKS Region outside Surabaya, number about 440 passengers or 6% of the total railway passengers generated from the station in GKS region. Results are in the following O-D table.

D \ O	Surabaya	GKS Outside SBY	Total
Surabaya	30	210	290
GKS Region Outside SBY	232	64	296
Total	312	274	586

- Trip distribution of railway passengers from Surabaya and GKS Region are shown diagramatically in Fig. 2.5.10 and 2.5.11 respectively.

Table 2.5.9 RAIL CARGO LOADED AND UNLOADED IN SURABAYA AND GKS REGION

(Unit : 1000 ton)

Year	1976			1977			1978			1979			1980			1981 *		
Stations	Ld(1)	Uld(2)	Ttl	Ld(1)	Uld(2)	Ttl	Ld(1)	Uld(2)	Ttl	Ld(1)	Uld(2)	Ttl	Ld(1)	Uld(2)	Ttl	Ld(1)	Uld(2)	Ttl
Surabaya Total	584	193	777	570	222	792	795	280	1,075	770	242	1,012	682	201	883	728	277	1,005
- Pasar Turi	50	101	151	55	107	162	41	110	151	57	90	147	56	87	143	69	100	169
- Kalimas	36	83	119	57	85	142	238	148	385	215	96	311	198	74	272	223	146	369
- Beteng	487	7	494	443	17	460	506	13	519	483	19	502	410	18	428	424	12	436
- Sby. Gudang	4	1	5	9	9	18	3	8	11	10	25	35	5	7	12	-	-	-
- Gubeng	3	0	3	4	0	4	2	0	2	2	3	5	9	10	19	10	17	27
- Wonokromo	1	4	5	2	4	6	5	2	7	3	9	12	4	5	9	2	2	4
Gresik	78	1	79	111	3	114	94	15	109	-	-	249	-	-	294	-	-	-
Babat	11	0	11	13	3	16	10	2	12	9	-	9	8	-	8	11	-	11
Lamongan	0	0	0	0	3	3	1	1	2	-	-	0	-	-	1	-	-	5
Mojokerto	2	1	3	1	1	2	2	3	5	-	-	4	-	-	7	-	-	7
Sidoarjo	0	0	0	2	2	4	5	1	6	-	-	-	-	-	1	-	-	2
GKS Total	675	195	870	697	234	931	907	304	1,211	-	-	1,274	-	-	1,194	-	-	-

Source : PJKA Ekspoitasi Timur, and Stations in Kabupatens

Note : * 1981 figures were estimated based on the monthly data available in 1981

(1) Loaded; (2) Unloaded; Ttl = Total

Table 2.5.10 DESTINATION OF MAJOR COMMODITIES FROM SURABAYA

(unit : 10^3 ton)

Major Commodities Bound For Outside SBY	1978	1979	1980	1981*
Petroleum				
(Benteng - East Java)	534	485	407	315
Fertilizer				
(Kalimas/Benteng - East Java)	235	218	201	157
(" " - West/Central Java)	26	24	22	17
C e m e n t				
(Kalimas/Benteng - East Java)	14	41	37	26
(" " - West/Central Java)	56	166	111	103
O t h e r s				
(Pasar Turi - West/Central Java)	210	149	223	176
(Around East Java)	53	37	56	44

Source : PJKA Exploitasi Jawa Timur

Note * : up to September, 1981

Table 2.5.11 NUMBER OF DEPARTING RAILWAY PASSENGERS

Station Name	Number of Passengers per day
1) Surabaya Kota	752
2) Surabaya Gubeng	984
3) Wonokromo	1,058
4) Sidoarjo	208
5) Mojokerto	416
6) Surabaya Pasar Turi	1,049
7) Lamongan	39
8) B a b a t	459
T o t a l	4,965

Source : Survey Results by the Study Team on the 8th till 10th of March, 1982.

Table 2.5.12 DISTRIBUTION OF PASSENGER'S DESTINATION

Origin / Stat / Dest.	Surabaya*	Sidoarjo	Lamongan	Babat	Mojokerto	Total
SBY	80 (2.1)	97 (46.6)	10 (25.6)	9 (2.0)	94 (22.6)	290 (5.8%)
SMA	90 (2.3)	4 (1.9)	0 (0.0)	3 (0.7)	16 (3.9)	113 (2.3%)
GKS Outside SBY	142 (3.7)	0 (0.0)	10 (25.6)	7 (1.5)	24 (5.8)	183 (3.7%)
Outside GKS (I)	690 (18.0)	54 26.0	7 (18.0)	406 (88.4)	162 (38.9)	1,319 (26.6%)
Outside GKS (II)	2,840 (73.9)	53 (25.5)	12 (30.8)	34 (7.4)	120 (28.8)	3,059 (61.6%)
TOTAL	3,842 (100.0)	208 (100.0)	39 (100.0)	459 (100.0)	416 (100.0)	4,964 (100.0%)

Source : Railway Passenger Survey by the Study Team in March, 1982

Note * : Surabaya consists of 4 stations : Surabaya Kota, Gubeng, Wonokromo and Pasar Turi.

Stat = Station

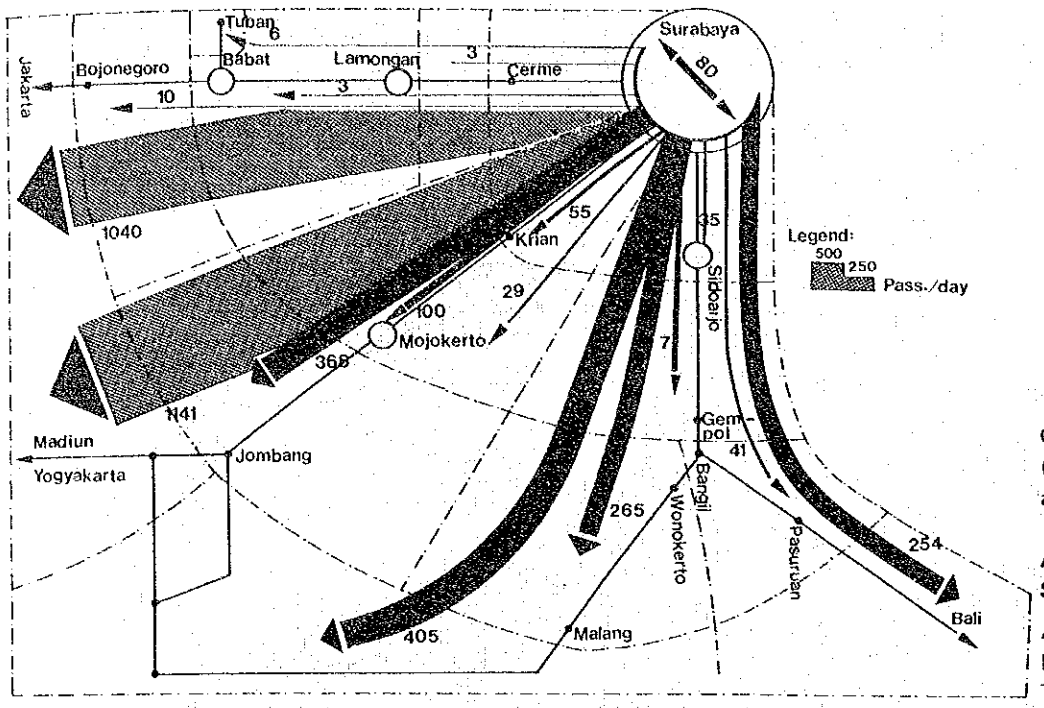


Fig. 2.5.10 TRIP DISTRIBUTION OF RAILWAY PASSENGERS FROM THE STATIONS IN SURABAYA

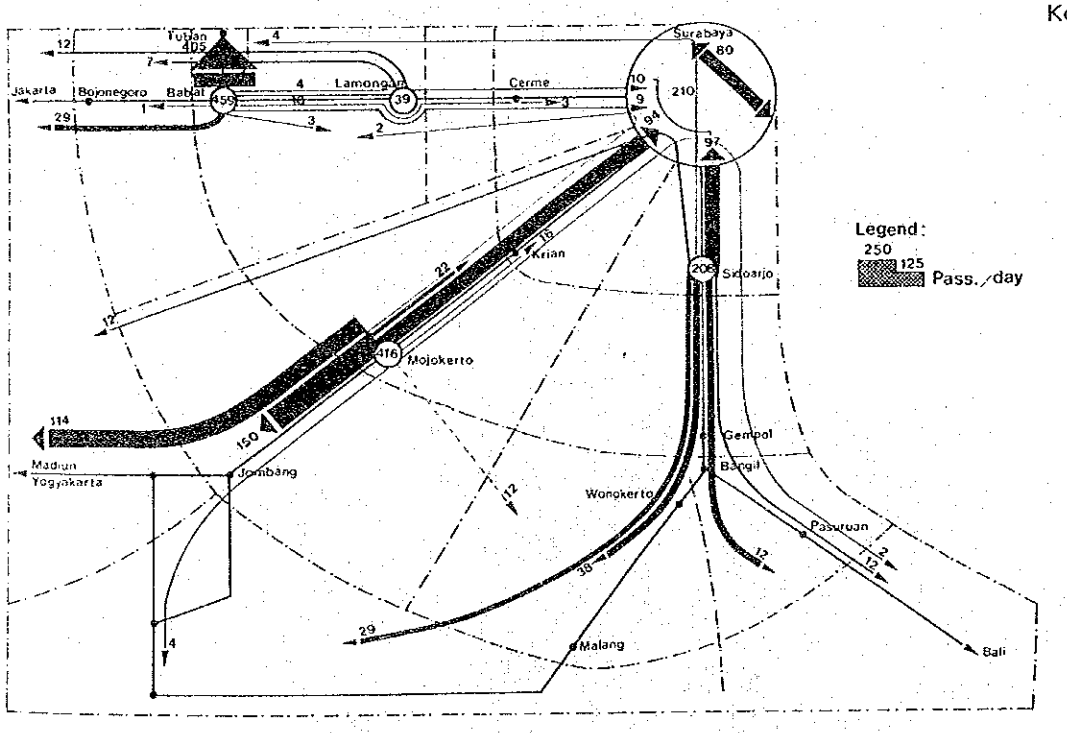


Fig. 2.5.11 TRIP DISTRIBUTION OF RAILWAY PASSENGERS FROM THE STATIONS IN GKS REGION

Table 2.5.13 DISTRIBUTION OF TRIP PURPOSES (RAILWAY)

(Unit : %)

	1 Home to Work	2 Home to School	3 As Part of Work	4 Return Home	5 Others
1. Surabaya	3.3	4.1	9.9	57.3	25.4
2. Sidoarjo	0.0	16.8	35.6	26.9	20.7
3. Mojokerto	1.0	3.4	6.7	62.0	26.9
4. Lamongan	0.0	0.0	37.5	51.0	12.5
5. Babat	1.9	0.0	0.9	90.6	6.6

Considering the locations and number of railway stations and present levels of service (including frequency, capacity, punctuality, etc.), the present railway is not utilized as an urban transportation means.

ACCESS MODES AND INFLUENCE AREA OF RAILWAY STATIONS IN SURABAYA

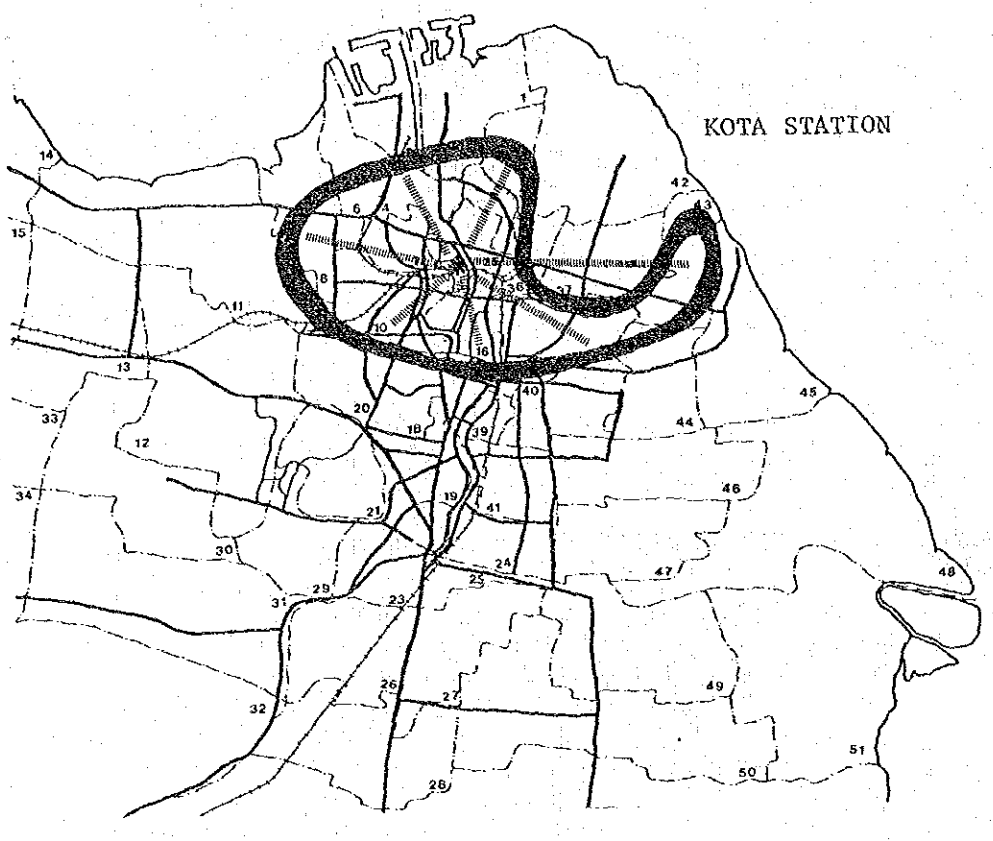
Access modes to the railway stations in Surabaya are generally Becak, Bemo/Colt, and Bus, in that order. However, the composition differs in each station. Gubeng and Pasar Turi station are terminals for the Southern/Eastern Lines and Northern Line respectively. Therefore the proportion of Sedan/Jeep is relatively high compared to other stations, as shown in Table 2.5.14. Pasar Turi and Wonokromo stations are mostly accessed by Bemo/Colt and Buses, while access to Gubeng and Kota Station is mostly by becak. This is because of the difference in accessibility to these stations and also the difference in address area of passengers of these stations. As shown in Fig. 2.5.12, Pasar Turi and Wonokromo stations cover a wider range of passengers' address zones than Gubeng and Kota stations.

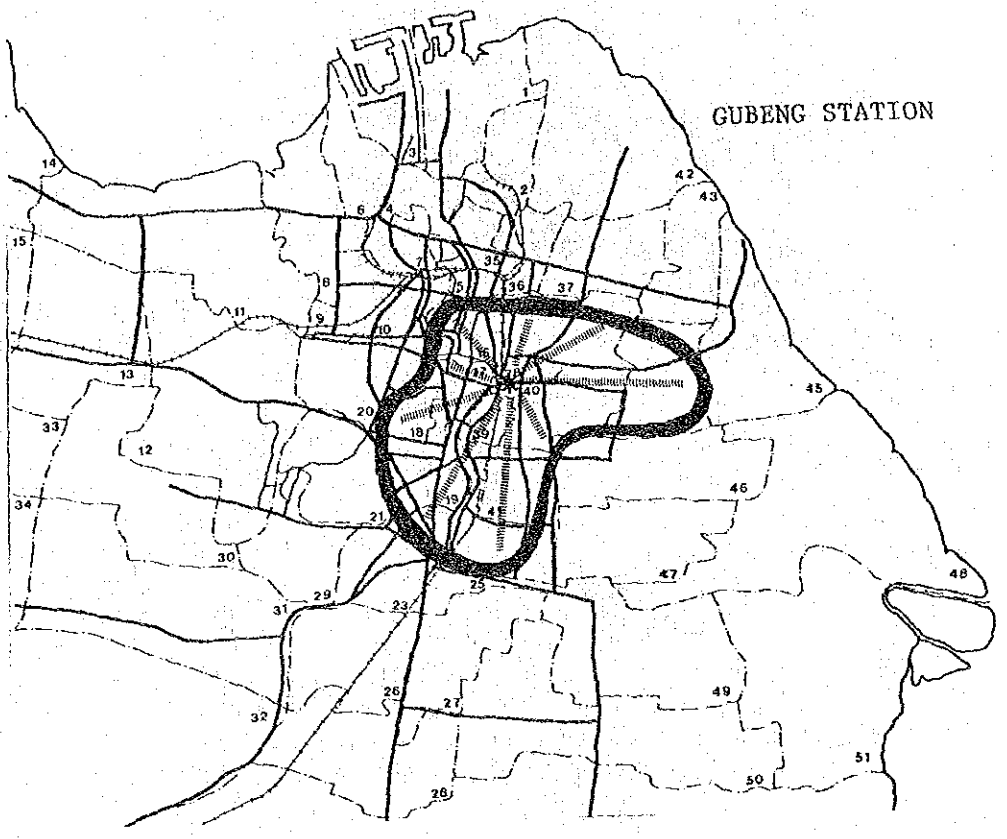
Table 2.5.14 ACCESS MODE TO RAILWAY STATIONS IN SURABAYA

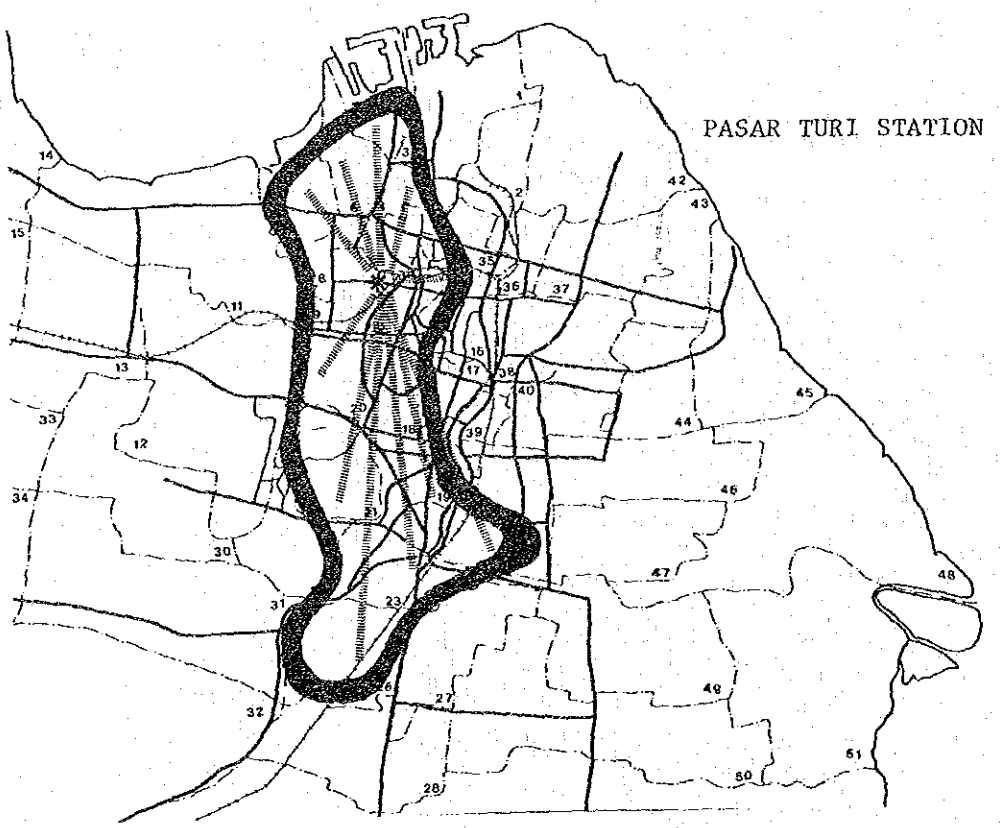
Access Modes	SBY Kota	Gubeng	Wono-kromo	Pasar Turi	SBY Total(%)
1. On foot	48 (6.4)	58 (5.9)	156 (14.7)	19 (1.8)	281 (7.3)
2. Bicycle	0 (0.0)	7 (0.7)	0 (0.0)	3 (0.3)	10 (0.3)
3. Motorcycle	51 (6.8)	91 (9.3)	41 (3.9)	34 (3.2)	217 (5.6)
4. Becak	328 (43.7)	326 (33.1)	207 (19.6)	209 (19.9)	1.070 (27.8)
5. Bemo/colt	125 (16.6)	180 (18.3)	377 (35.6)	307 (29.3)	989 (25.7)
6. Bus	128 (17.0)	58 (5.9)	244 (23.1)	264 (25.1)	694 (18.1)
7. Sedan/Jeep	71 (9.5)	261 (26.6)	28 (2.6)	211 (20.1)	571 (14.9)
8. Truck	0 (0.0)	2 (0.2)	5 (0.5)	3 (0.3)	10 (0.3)
Total	751 (100.0)	983 (100.0)	1.058 (100.0)	1.050 (100.0)	3.842 (100.0)

Source: Survey by the Team

Note : Samples are expanded by the total departing passengers observed at each station.







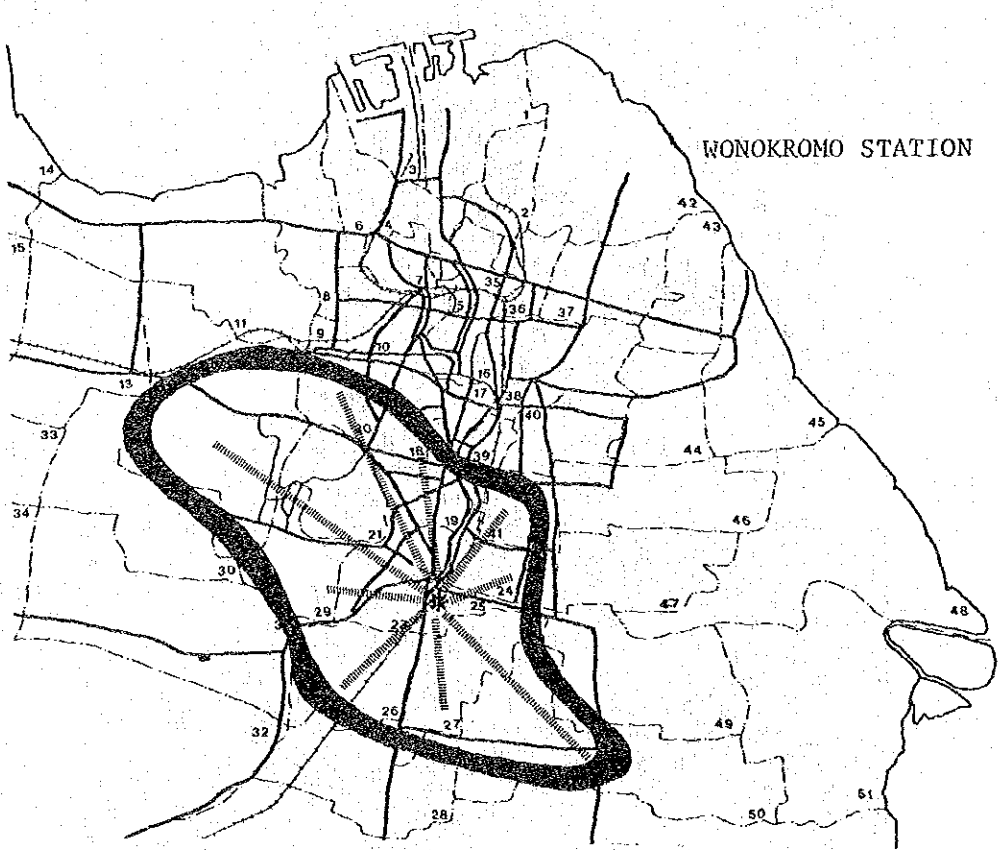


Fig. 2.5.12 DISTRIBUTION OF ADDRESS ZONES OF RAILWAY PASSENGERS ARRIVING AT STATIONS

2.5.3 BUS, BEMO AND COLT

GENERAL

Major public transportation means in Surabaya and GKS Region are buses, bemo and colt. Bemo is a three-wheel or four-wheel motor vehicle with coach. A three-wheeled bemo and four-wheeled bemo have a transport capacity of 8 and 10 persons respectively, including driver, but over-loading is often observed in the streets. Bemo serves for inner-city transport, while a colt with a transport capacity of 9 persons mainly plays a role of inter-city transport. Buses serve for both inner-city and inter-city transport. City bus transport in Surabaya is operated almost entirely by PN DAMRI (Indonesia State Bus Unit) and inter-city transport in East Java, was operated by 156 companies with 1824 buses in 1980. On the whole, bemo supplements the city bus service and colt supplements the inter-city bus for medium distance travel.

CITY BUS AND BEMO IN SURABAYA

City buses running in Surabaya are normally of the regular type with a transport capacity of 48 or 54 persons, but double decker type are now operated in Aloha-Tugu Pahlawan. An express city bus started operation from June, 1982 on the Aloha–Tanjung Perak route. There are 9 city bus routes in Surabaya and these extend in a north-south direction along the main streets. Based on the bus occupancy survey conducted in April 1982 the results were analysed and are summarized in Table 1.4.15.

Total passengers were estimated to be about 290,000 persons per day. Average number of passengers per bus and average trip distance per passenger were estimated to be 50 persons/bus and 5.8 km/trip respectively. The number of boarding passengers averages 8.8 passengers/km from the survey for the survey routes. Comparing the survey routes with other bus routes the average number of passengers per route were estimated and these were applied to derive the total number of passengers as shown in column (7) of Table 2.5.15. Frequency of bus service in Surabaya is presented in Fig. 2.5.13.

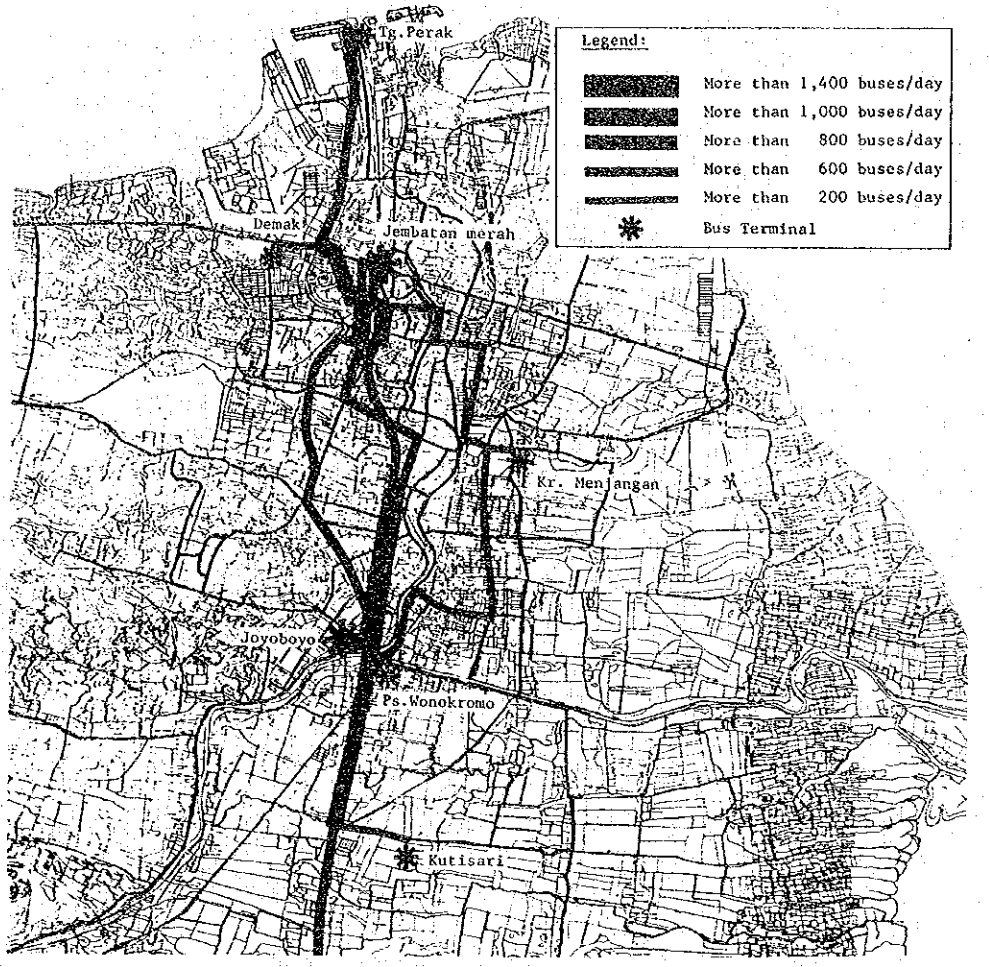


Fig. 2.5.13 FREQUENCY OF CITY BUS SERVICE IN SURABAYA

Table 2.5.15 ANALYSIS OF CITY BUS AND PASSENGERS

	Route Names	(1) Number of Buses	(2) Number of Trips/Bus	(3) Distance of Route (km)	(4) Number of Passengers Trips/Bus	(5) Average Occupants/Bus (Persons)	(6) Average Occupancy Ratio in the Peak Period (%)	(7) Total Number of Passengers (Persons)	(8) Average Trip Dist. per Passenger (Km/Pass)	(9) Average No. of Passengers per Km (Pass./Km)
1*	Wonokromo -Tg. Perak	39	16	13.9	114	47	N-S: 76 S-N:122	69,069	6.0	8.0
2*	Joyoboyo -J. Merah (I) (via Darmo)	37	20	9.0	93	53	N-S: 69 S-N:121	68,801	5.1	10.3
3	Joyoboyo -J. Merah (II) (via Diponegoro)	12	19	10.3	(106)	-	-	24,189	-	(10.3)
4*	Aloha -J. Merah	31	12	18.0	145	51	N-S: 80 S-N:142	53,925	6.4	8.1
5*	Kutisari -Demak	20	8	20.7	189	54	N-S:136 S-N:166	30,250	5.9	9.1
6	Kutisari -Kr. Menjangan	2	12	12.0	(109)	-	-	2,621	-	(9.1)
7	Demak -Kr. Menjangan	2	12	10.0	(91)	-	-	2,184	-	(9.1)
8	Aloha -Tugu Pahlawan	15	13	16.0	(129)	-	-	25,272	-	(8.1)
9	Aloha -Tugu Pahlawan (via Diponegoro)	10	12	16.6	(134)	-	-	16,135	-	(8.1)
	Total/Average	168	14.8	126.5	(119.5)	(102%)	-	292,446	-	

Source : (1), (2) : PN DAMRI SURABAYA July, 1982
(3), (4), (5), (6) : Bus Occupancy Survey results and the estimation by the Study Team

Note : * Survey Routes
(7) and figures in ( ) show the estimation by the Study Team.

Table 2.5.16 COMPARISON OF PASSENGER LOAD IN JAKARTA AND SURABAYA

	(1) DKI JAKARTA (1978)	(2) SURABAYA (1982)
(a) Population (in thousand)	6,090	2,130
(b) City Bus Passengers (1000 pass./day)	1,600	292 (256)
(c) Number of Buses (Bemo)	1,385	168 (2,413)
(d) Bus Passenger Rate (b) / (a)	26.3%	13.7% (12.0%)
(e) Passenger Load per Bus (b)/(c) (Pass/Bus/day)	1,155	1,738 (106)

Source: (1) "Jakarta Harbour Road Feasibility Study" 1981
(2) Estimation by the Study Team

Note : Figures in ( ) show the Bemo operation in Surabaya

Average daily occupancy rate of each route surveyed was not less than 90%. In the morning peak period (06:00–09:00), north bound bus fleet are overcrowded showing occupancy rates of more than 120%. Thus, bus transport in Surabaya is now at full capacity and the increase in bus fleet and the improvement of related facilities such as garage, terminal facility, repair and maintenance work shop, are urgently required. Compared with Jakarta, the existing level of bus service in Surabaya is low in terms of passenger load per bus as shown in Table 2.5.16.

Bemo also plays a major role of public transportation in association with city bus. Bemo are operated in most of the main streets network with 34 routes as shown in Fig. 2.5.14 and Table 2.5.17.

Table 2.5.17 PRESENT CONDITIONS OF BEMO OPERATION IN SURABAYA, 1980

	BEMO ROUTE	Kind of Bemo	Number of Bemo Operated	Number of Round Trips /bemo/day	Total Passengers /day
1	Joyoboyo-Jl. Arjuna-Pasarturi	4-wheel	40	8	5,700
2	Sawahan-Gentengkali-Kr. Menjangan	3 "	60	10	8,000
3	Wonokromo Pasar - Kaliondo	3 "	70	8	7,500
4	Joyoboyo - Sepanjang	4 "	160	7	15,500
5	Joyoboyo - Lakarsantri	4 "	35	7	3,500
6	Karangpilang - Krikilan	4 "	27	4	1,600
7	Sepanjang - Sukodono	4 "	20	6	1,600
8	Joyoboyo - Karang Menjangan	4 "	40	6	3,800
9	Joyoboyo - Sidoarjo	4 "	50	6	5,000
10	Wonokromo - Sidoarjo	4 "	50	6	6,000
11	Pasar Wonokromo - Pagesangan	3 "	19	6	1,600
12	Pasar Wonokromo - Sepanjang	4 "	30	6	3,200
13	Pasar Wonokromo - Sedati	4 "	30	6	3,200
14	Kupang - Benowo	3 "	35	3	2,500
15	Jembatan Merah - Tanjung Perak	3 "	50	20	14,000
16	Jembatan Merah - Joyoboyo	4 "	140	5	16,000
17	Jembatan Merah - Bratang	4 "	95	5	9,500
18	Jembatan Merah - Karang Menjangan	3 "	110	5	7,500
19	Pasar Wonokromo - Karang Menjangan	3 "	40	6	3,400
20	Joyoboyo - Karang Menjangan	3 "	20	6	1,700
21	Jembatan Merah - Joyoboyo	3 "	140	7	13,200
22	Jembatan Merah - Kenjeran	4 "	52	5	4,700
23	Ps. Wonokromo - Bratang	3 "	42	6	3,500
24	Joyoboyo - Sidoarjo	4 "	150	5	15,500
25	Joyoboyo - Sawahan	4 "	80	5	8,000
26	Joyoboyo - Mojoarum	4 "	30	5	3,000
27	Pasar Wonokromo - Rungkut	3 "	42	6	3,500
28	Joyoboyo - Tambakrejo	4 "	70	7	10,000
29	Dukuhkupang - Kapak Krumpung	4 "	97	6	10,000
30	Joyoboyo - Gadongan	4 "	20	5	2,000
31	Jembatan Merah - Benowo	4 "	30	5	3,000
32	Joyoboyo - Perumnas Simomulyo	3 "	45	7	4,500
33	Joyoboyo - Jl. Demak	3 "	75	8	8,400
34	Demak Karang Menjangan	4 "	80	8	12,800
	Total/Average		2,074	6.5	220,400

Source : Unit Terminal Surabaya

"Kijang" is a locally manufactured small bus, utilising certain parts from the Toyota Motor Company. A fleet of 99 such vehicles served a rural area in Surabaya, with 4 routes. The transport demand for bemo was estimated at 220,000 passengers per day in 1980. Bemo fleet increased from 2,074 vehicles in 1980 to 2,237 vehicles in 1981. Therefore, it was estimated that the Bemo fleet and Bemo passengers in 1982, were 2,413 vehicles and 256,000 persons per day, respectively. Together, city transport by bus and bemo totals about 550,000 persons per day, which is 25.7% of Surabaya population.

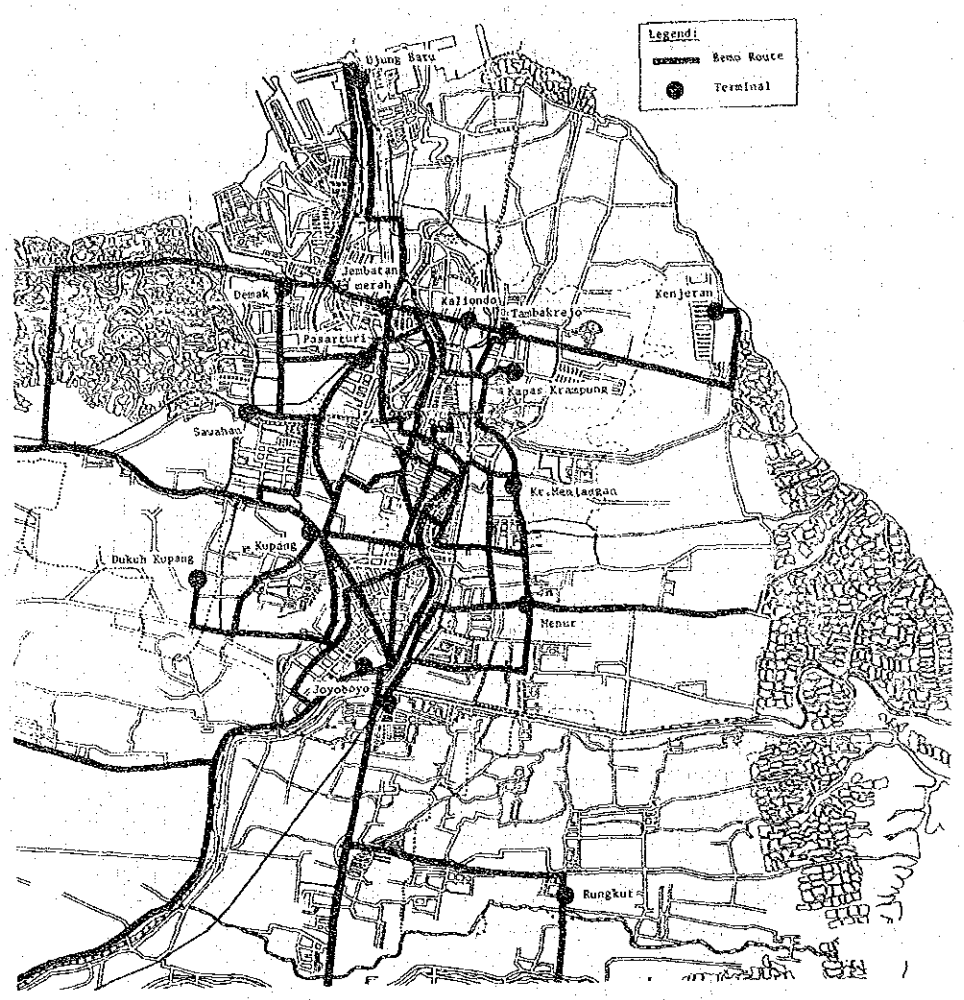


Fig. 2.5.14 BEMO ROUTE NETWORK, 1982

Table 2.5.18 COLT OPERATION IN SURABAYA AND SIDOARJO

	No. of Fleet Operated/day	Directions	Estimated Average Passenger/day
Joyoboyo	About 750	SBY-Mojokerto SBY-Jombang-Kediri SBY-Pasuruan-Probolinggo-etc	13,500
J. Merah	200 - 300	SBY-Gresik SBY-Lamongan-Babat SBY-Malang	5,000
Sidoarjo	50 (colt) 30 (Bemo/Honda) 20 (") 15 (") 20 (")	SID-Krian SID-Surabaya SID-Sepanjang SID-Tulangan SID-Porong	-

Source : DPD Terminal Angkutan Umum KMS, 1981
BAPPEDA Sidoarjo, 9 Juli 1982

COLT AND INTER-CITY BUS

A colt in Surabaya is used for inter-city transport of medium and long distance travel (about 20 km – 100 km). Colt terminals in Surabaya are Joyoboyo and Jembatan Merah, but besides these terminals, colt are often observed in the railway stations such as Gubeng, Wonokromo, Pasar Turi and Semut. Exact number of colts in operation is not known but the data from Joyoboyo, Jembatan Merah terminals and Sidoarjo as shown in Table 2.5.18.

Inter-city transport services rely very much on buses, and inter-city bus terminals are at Joyoboyo and Jembatan Merah. The former serves for eastward, southward, westward and Madura directions and night express, while the latter serves only for northward direction.

According to data from the terminals, buses and passengers departing from Joyoboyo terminal average 790 buses/day and 22,600 passengers/day, while Jembatan Merah terminal is used by 140 buses/day and 5,120 passengers/day. Details are shown in Table 2.5.19. The average occupancy for a bus from Joyoboyo and Jembatan Merah is 30 passengers/bus and 37 passengers/bus respectively.

Table 2.5.19 INTER-CITY BUS OPERATION AT TERMINALS IN SURABAYA, 1982

Directions	Outgoing		Incoming	
	Bus	Pass	Bus	Pass
Joyoboyo Terminal				
1. Wesbound I :				
SBY-Kediri-Tulungagung -Trenggalek	194 5,774	5,493 167,758	193 5,774	5,949 164,817
2. Westbound II :				
SBY-Madiun-Solo-Jogya-Semarang-JKT-Tenanggung -Purwokerto-Cirebon-Bandung	182 5,727	5,103 168,489	182 6,724	5,004 166,846
3. Eastbound :				
SBY-Banyuwangi-Singaraja-Denpasar	183 5,740	5,293 164,658	183 5,741	5,443 167,157
4. Southbound :				
SBY-Malang-Blitar-Tulungagung	182 5,781	5,744 169,508	182 5,773	5,949 169,915
5. SBY-Madura	24 747	1,024 30,571	24 746	982 30,068
6. Total	765 23,769	22,657 700,984	764 23,758	23,327 698,803
Jembatan Merah Terminal				
1. SBY-Gresik-Sembayat	8 190	240 6,044	11 334	275 8,427
2. SBY-Lamongan-Babat	21 463	730 16,858	11 246	295 7,687
3. SBY-Babat-Tuban	42 1,250	1,470 45,203	21 686	630 21,759
4. SBY-Babat-Bojonegoro-Cepu	67 2,217	2,275 83,487	33 1,257	990 39,861
5. SBY-Central Java	6 189	210 7,142	3 95	90 3,198
6. Total	144 4,309	4,925 158,734	79 2,618	2,280 80,932

Source : DLLAJR JATIM

Note : Upper figures are data on March 4, 1982.
Lower figures are monthly totals in March, 1982.

2.5.4 SEAPORT

EXISTING PORT FACILITIES AND CAPACITY

(1) Existing Facilities

The modern port of Surabaya was developed in 1917 with the construction of Jamrud Quay to form the Northern finger of the basin. Additional quays at Nilam, Berlian, Mirah & Perak were subsequently developed to meet the demands on the port. The main commercial port is used by both oceangoing and interisland trade while small Local and Rakyat (sailing) vessels berth along the western frontage of the Kali Mas up as far as the Jl. Jakarta bridge. Approximately 2.7 km of quayage is available on the Kali Mas and this can accommodate vessels up to 3–4 m draught. The Kali Mas operates under a separate management structure from the main port and has its own transit sheds, labour and forwarding arrangements.

The main commercial port facilities provide for general cargo and bulk traffic along some 4,535 m of effective quayage backed up by 111,713 sq.m of transit shed storage and 48,075 sq.m of open storage.

The port is managed by the Port Administration with dock labour provided by YUKA (labour pool agency) and the forwarding of goods by EMKL (shipping companies forwarding and transport agency).

(2) Port Capacity in Tanjung Perak

The cargo handled at the mainport in Tanjung Perak amounted to about 5 million tons, or 3 million tons excluding bulk traffic, in 1979. The absolute limit of port capacity was estimated at 5.9 million tons maintaining the handling method of 1979. However, considering the tolerable berth occupancy levels and eliminating excessive vessel queueing, the practical level of cargo handling capacity is 3.8 million tons[1]. The volume of handled cargoes in 1980 was about 3.5 million tons and this nearly reached the capacity.

Note 1) : "Draft Final Report, Port of Surabaya Phase II Project, Feasibility Study", September 1981.

CARGO TRAFFIC

(1) Port Traffic

The Port of Surabaya is one of the four major ports in the Indonesian regional development strategy. These strategic ports are located in Medan (Sumatera Utara), DKI Jakarta (Jawa Barat), Surabaya (Jawa Timur) and Ujung Pandang (Sulawesi Selatan) and each is assigned as a central port of one of the our development zones of A,B,C, and D as shown in Fig. 2.5.15.

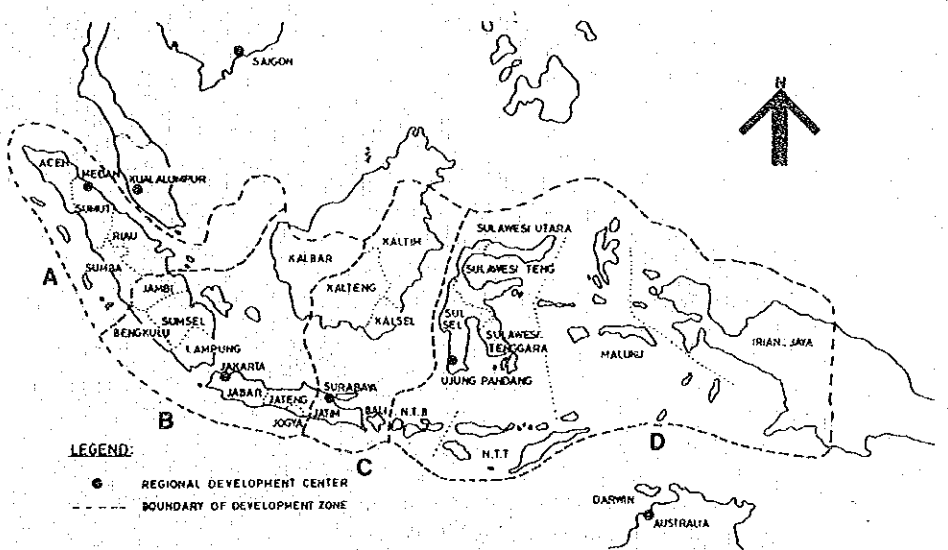


Fig. 2.5.15 REGIONAL DEVELOPMENT ZONES AND CENTRES FOR SEA COMMUNICATIONS

Cargo handling volumes at the major ports in East Java are shown in Table 2.5.20.

Table 2.5.20 CARGO VOLUMES HANDLED AT MAJOR PORTS IN EAST JAVA

Year		Major Ports in East Java (x 10^3 ton)				
		Tg.Perak	Gresik	Probolinggo	Meneng	Kalianget
1978	Ocean-going	2,120				
	Inter-island	2,432 (4,552)	(751)	(177)	(71)	(145)
1979	Ocean-going	2,478				
	Inter-island	2,564 (5,042)	(1,561)	(210)	(141)	(117)
1980	Ocean-going	2,981				
	Inter-island	2,709 (5,690)	(1,832)	(130)	(181)	(192)
1981	Ocean-going	3,005				
	Inter-island	3,175 (6,180)	(530)	(173)	(187)	(78)

Note : ( ) Total of Ocean-going and inter-island cargoes.

Sources : "Laporan Tahunan April 1980/Maret 1981" Kantor Wilayah IV.
"Statistik" Sub bagian statistik dan informasi

Total cargo volume handled at the major ports amounts to 7 million tons, of which Tg. Perak accounts for 86.5% or 6.2 million tons of the total volume in 1981. The traffic of Tg. Perak port in the last 3 years from 1978 to 1981 steadily increased at a rate of 10.7% p.a. and shares of ocean-going and inter-island traffic are more or less equal.

Cargo flows to and from Tg. Perak port since 1969 are presented in Table 2.5.21.

Table 2.5.21 CARGO FLOWS AT TG. PERAK

(unit: 10^3 ton)

Year	Inter-island			Ocean-going			Grand Total
	Inbound	Outbond	Total	Import	Export	Total	
1969	196	365	561	575	509	1,085	1,646
1970	244	556	800	604	668	1,272	2,072
1971	348	606	954	689	848	1,538	2,492
1972	371	723	1,094	876	720	1,597	2,691
1973	405	860	1,265	1,280	694	1,976	3,241
1974	451	937	1,388	1,491	851	2,343	3,731
1975	610	941	1,551	1,764	608	2,372	3,923
1976	653	946	1,599	1,463	585	2,049	3,648
1977	797	1,032	1,829	1,345	552	1,897	3,726
1978	1,195	1,237	2,432	1,484	636	2,120	4,552
1979	1,350	1,214	2,564	1,590	888	2,478	5,042
1980	1,394	1,315	2,709	2,131	850	2,981	5,690
1981	1,619	1,556	3,175	2,248	757	3,005	6,180

Source: Tg. Perak Port statistics Department

Import traffic is the largest volume among the directional flows to and from Tg. Perak. The port can therefore be seen to function as an international port with a bias in traffic to imports which has appeared since 1973. Since 1973 imports have grown at a rate of 7.3% p.a. In contrast, export traffic fluctuates and has shifted downward since 1979.

Regarding the inter-island traffic, outbound traffic was much higher than inbound traffic up to 1977. Since 1978 however, the inbound traffic nearly balanced or slightly exceeded the outbound traffic. Major import commodities handled at Tg. Perak Port are wheat, rice project equipment, iron/steel and chemical goods. These account for 1.4 million tons or 66% of the total imports in 1980.

For domestic trade, major inbound commodities are fertilizer, wood and copra and outbound major commodities are sugar and rice. A characteristic of current cargo flows in Surabaya is a rapid increase in container traffic. The rise in number of TEU's* from 1979 to 1981 appeared to be 58.3% p.a. In terms of cargo tonnage, container cargo increased at 63.1% p.a.

Note: *TEU stands for "Twenty-foot Equivalent Unit", a terminology used to express mixed 20', 30', 40' container movements in terms of a single unit.

(2) Inland Traffic

At present, main items carried out of the port by rail are petroleum, cement and grain, while the main inward traffic to the port is molasses. Port traffic to the hinterland by rail is handled at Beteng and Kalimas stations. Beteng station is mostly used to distribute petroleum from the port to East Java. Relationship between the two rail stations and port traffic is presented in Table 2.5.22. According to this table, land-ward port traffic by rail is estimated at less than 10 percent of the port traffic excluding transshipment and petroleum.

In 1981, total petroleum handled at the port was 3.174 million tons so that overall cargo traffic throughput amounted to 9.045 million tons excluding transhipment between domestic and foreign trade. Total rail traffic handled at Beteng and Kalimas stations was estimated at 0.824 million tons and it therefore accounted for 9.1 percent of the overall port traffic in 1981.

Table 2.5.22 RELATIONSHIP BETWEEN PORT AND RAIL TRAFFIC

(unit : 10^3 ton)

Cargo Traffic	Year			
	1978	1979	1980	1981
Port Traffic :	4,552	5,042	5,690	6,180
Excluding transhipment*	4,324	4,790	5,406	5,871
Petroleum unloaded	-	-	3,250	3,174
Transport by rail from Beteng & Kalimas stns. :	864 (330)	935 (450)	816 (409)	824*** (404)
- Petroleum	534	485	407	(420)***
- Fertilizer	261	243	224	232
- Cement	69	207	185	172
% Share of railway for inland transport of port cargoes :				
Excluding petroleum	7.6%	9.4%	7.6%	6.9%
Including petroleum	-	-	9.4%	9.1%

Note : * Transhipment volume is estimated at 5% of the total port traffic.

** Estimated based on the import/export data in 1981, traffic dept., P.A. Figures in ( ) exclude petroleum.

*** Estimated based on the data from Jan. to Sep. , 1981, PJKA East Java.

Source : PJKA East Java
Traffic Department, Port Administration.

According to the roadside O-D survey conducted by the Study Team in March, 1982 the total cargo volume generated and attracted at the port area was estimated to be 38,000 tons/day excluding ferry traffic, but including truck traffic to and from the warehouses along Jl. Tanjung Perak Timur, Jl. Kalianget and Jl. Kalimas Baru. Total truck flow in this area was estimated at 10,366 trips/day for both inward and outward directions. Based on the roadside O-D survey, the average rate of loaded trucks was estimated to be 57.8% of both inbound and outbound truck traffic in the port area. Accordingly, the average truck load was estimated at 6.4 ton/truck.

Regional distribution of the port related traffic to the inland was obtained based on the O-D interview survey as summarized in Table 2.5.23.

Table 2.5.23 DISTRIBUTION OF PORT RELATED CARGOES BY TRUCK

	Surabaya	GKS outside Surabaya	Outside GKS	Total
Truck (veh/day)	9,112 (87.9%)	700 (6.8%)	554 (5.3%)	10,366 (100%)
Tonnage (ton/day)	23,803 (62.4%)	10,708 (28.1%)	3,630 (9.5%0	38,141 (100.0%)

Source : Estimation by the Study Team

Cargo distribution patterns in Surabaya and GKS Region are presented in Figs. 2.5.16 and 2.5.17.

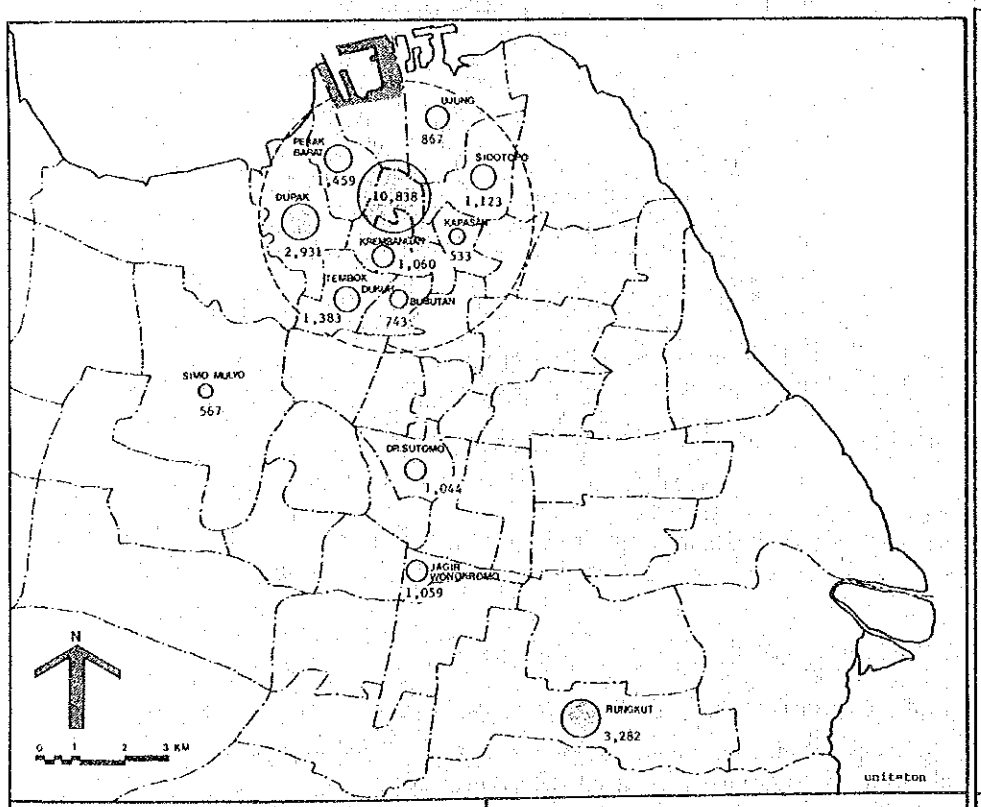
In Surabaya, the port related cargoes are mostly concentrated into Perak Timur (Zone 4) and its adjacent area of about 3 kilometers in radius. This area is a centre of wholesale and trading activities with warehouses, and it handles 51.0% of the total port related cargoes. Inland port traffic in Surabaya is distributed in a north-south direction and another major connection with the port area is the Rungkut industrial area.

In GKS Region, Kebomas, Krian and Sidoarjo are the major areas connecting with the Port area. Kebomas area is shipping a large quantity of limestone through the port to Jakarta. As a whole, port related cargoes are distributed along the three regional corridors at a similar level. That is Surabaya–Gresik corridor (3,072 ton/day), Surabaya–Mojokerto corridor (2,965 ton/day) and Surabaya–Sidoarjo corridor (3,246 ton/day). Eminent feature of the port related traffic outside GKS Region is that the eastern part of East Java occupies a majority of 51% of the total traffic outside GKS Region. This trend was also seen in the Tg. Perak Feasibility Study Report, 1981.

PORT MASTER PLAN

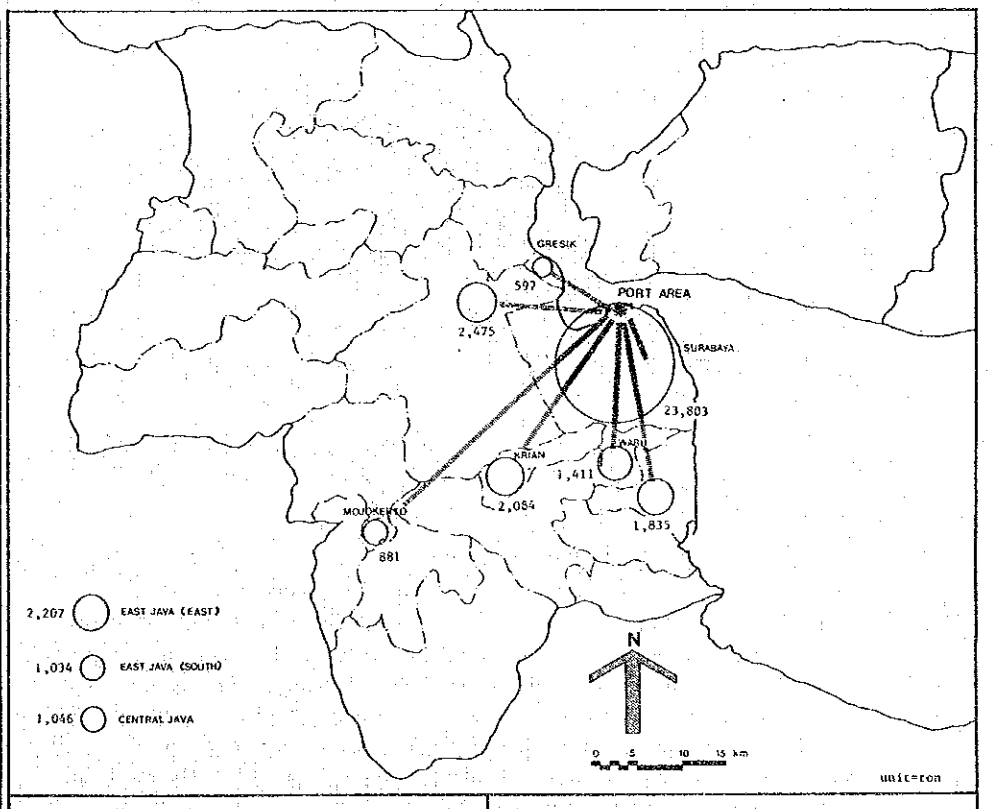
(1) General

The Port Master Plan Study commenced in November 1980 and the Draft Final Report of "Port of Surabaya, Plan 2 Feasibility Study" was finalized in 1982. In the report, the development scheme which involves a new island terminal with two container berths dependent on the airfield CFS (Container Freight Station) and 16 outer harbour inter-island berths, was recommended for the medium term up to 1990. In order to accomodate rapidly rising container traffic the report recommends a short term plan within the existing port. The proposed strategy for long term development beyond 1990 provides for two additional container berths; 45 new inter-island berths; and 12 for ocean-going and Combo vessels, all by 2000. A layout of the existing Tanjung Perak Port is presented in Fig. 2.5.18 showing the proposed location for the medium term master plan.



URBAN DEVELOPMENT PLANNING STUDY ON GERBANGKERTOSUSILA (SURABAYA METROPOLITAN AREA)

Fig 2.5.16
CARGO MOVEMENT BETWEEN SURABYA PORT AREA AND MAIN ZONES (1)



URBAN DEVELOPMENT PLANNING STUDY ON GERBANGKERTOSUSILA (SURABAYA METROPOLITAN AREA)

Fig.2.5.17
CARGO MOVEMENT BETWEEN SURABYA PORT AREA AND MAIN ZONES (2)

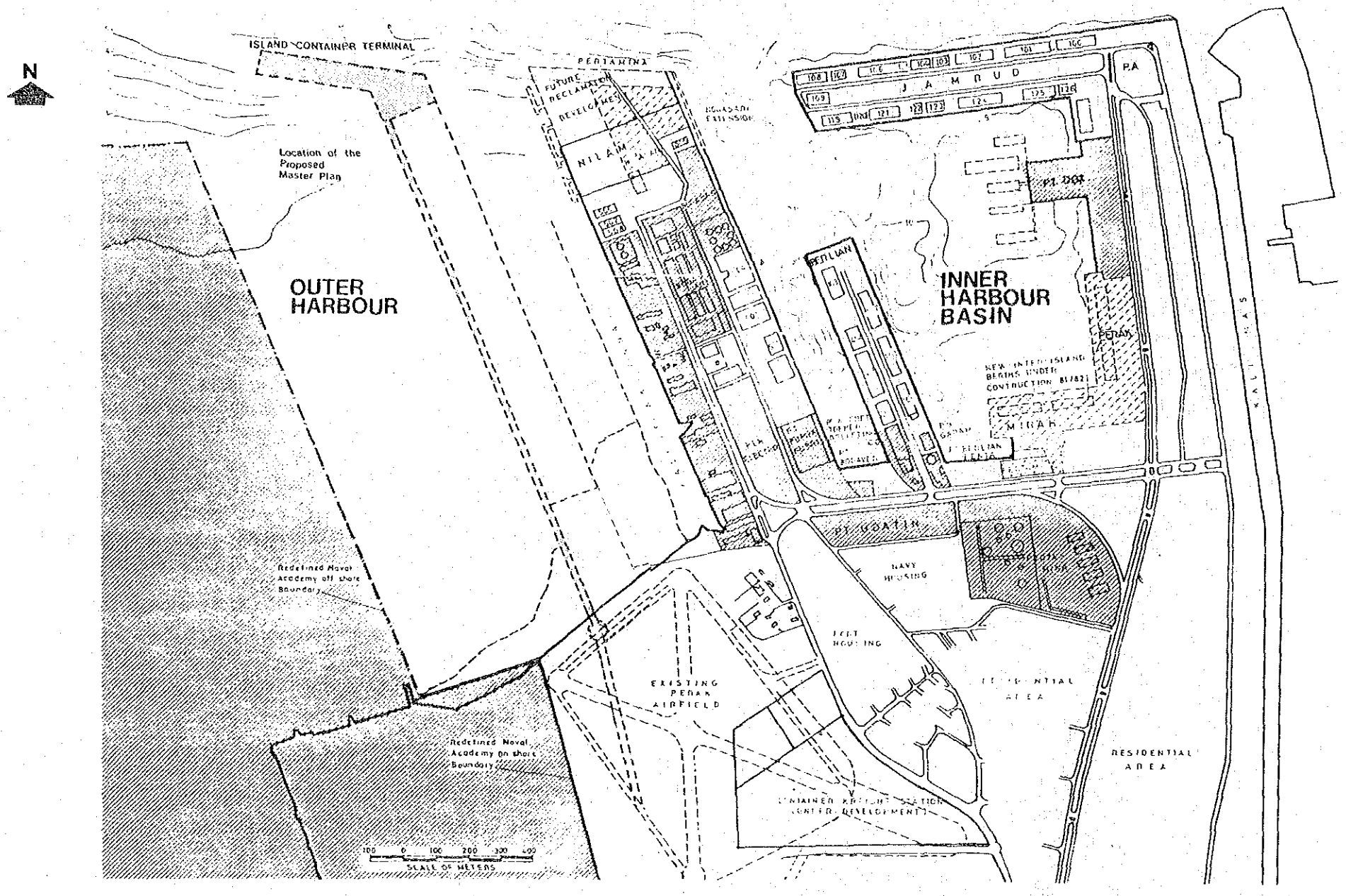


Fig. 2.5.18 TG. PERAK SURABAYA PORT EXISTING PORT LAYOUT

(2) Traffic Demand

Total traffic is forecast to grow by 49 percent to 7.4 million tons in 1985, and by 346 percent to 22.3 million tons in 2000. Little scope exists for further expansion of bulk cargoes in the present port, and significant traffic expansion is foreseen only in the case of wheat (88 percent to 2000); and palm oil (640 percent to 2000) whilst a new jetty is anticipated off Nilam Utara for bulk animal feeds (90 percent to 2000). Other bulk developments are likely to be elsewhere (such as Gresik), and total Surabaya bulk growth will be 8 percent between 1980 and 1985 and 68 percent between 1980 and 2000. Container movements in significant numbers commenced in 1976. By 1979 containerized traffic represented 4.4 percent of all foreign nonbulk tonnage, and by 1980 this had increased to 6.1 percent. In TEU terms, the total 1980 container movements of 19,230 are forecast to increase to 126,850 by 1985 and to 778,000 in 2000. Total containerized cargo in 1985 will be 0.9 m tons, and in 2000 some 5.6 m tons, or 34 percent and 56 percent respectively of total foreign nonbulk movements. For comparison, in 1980 Tanjung Priok handled 9 percent of foreign nonbulk cargoes in containers, and Singapore 42 percent. Kalimas trade by local and rakyat vessels will require additional berthage of 1,008 m in 1985 and 1,945 m in 1990. It is proposed that such berths be constructed at Gresik, to the Northwest of the existing commercial harbour there.

2.5.5 AIRPORT

EXISTING FACILITIES AND TRAFFIC GROWTH

The Juanda Airport is a common facility shared by civil and military authorities. The following facilities are mainly used by the civil service.

– Runway	:	3,000 m length, 60 m width
– Taxiway	:	3,000 m length, 23 m width
– Apron	:	250 m x 100 m, concrete surface
– Passenger Terminal	:	350 m length
– Access Road	:	2 way–2 lane (7 m width), L = 5 km

All the technical buildings, control tower, operations building, power station, fire station, aircraft fuel storage, drinking water storage and distribution, are presently operated by military personnel.

A small workshop, stores and freight warehouse area has been developed to the west of the terminal chiefly under the impulse of Garuda. This area also contains the Met. and Civil Aviation offices and corresponds to a built-up area of about 4,000 to 4,500 m^2.

Air traffic to and from Surabaya grew at an average annual rate of 16.9% and 19.2% for passengers and cargo respectively, between 1974 and 1980. Total passengers in 1980 amounted to 1.3 million and cargo 11,800 tons. Development trends of air passenger and cargo traffic are given in Fig. 2.5.19. Data on air traffic was presented in detail in Progress Report I.

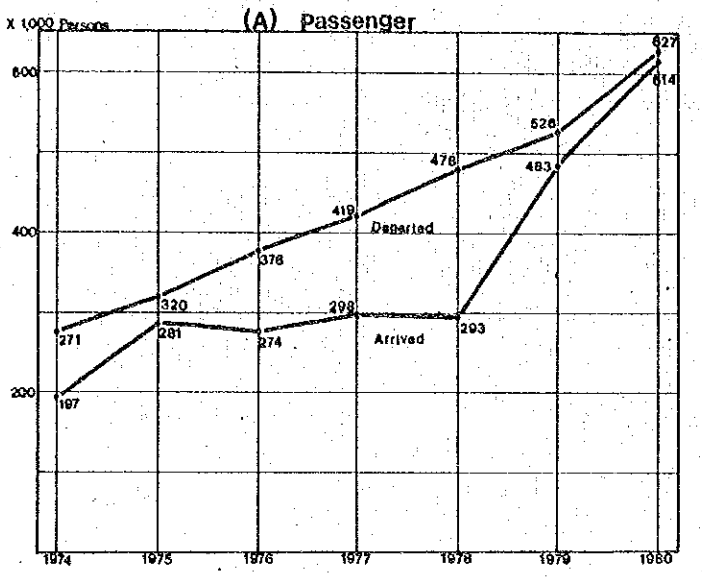


Fig. 2.5.19 TRENDS OF AIR PASSENGERS AND CARGOES THROUGH SURABAYA

DISTRIBUTION OF PASSENGER TRAFFIC

As shown in Table 2.5.24, principal origins and destinations of air passengers through Juanda Airport are Jakarta (44.6%), Banjarmasin (12.6%), Ujung Pandang (12%), Balikpapan (9.9%) and Denpasar (6.9%).

Since Indonesia is an archipelagic nation, passenger movements by aircraft have increased between Surabaya and major cities on other islands. With respect to the growth of air passenger traffic, the connection with Kalimantan and Sulawesi was strengthened drastically at a rate of over 20% p.a. Air traffic between Surabaya and Jakarta showed an outstanding share of air transport through Juanda Airport, and other cities in Java Island such as Bandung, Yogyakarta and Solo formed a minor proportion of the Surabaya air traffic. This is because of the developed road and railway networks in Java and comparatively cheap fares for land transport modes. Semarang, however, is the most growing city in terms of air passengers to and from Surabaya showing an average growth rate of 36.1% p.a. between 1977 to 1980. However, the share of traffic still remains in the lower of total Surabaya air traffic throughput in 1980. Air traffic between Surabaya and Denpasar presented a higher growth rate of 22.7% in the years 1977 to 1980. Tourism development in Bali Island will continue to attract not only domestic visitors but also foreign visitors.

During the Haji season, international flights are despatched from Surabaya for pilgrims to Jeddah, Saudi Arabia. Recent traffic growth of these is also remarkable with a growth rate of 39.2% p.a. This accounts for about 3.6% of the Surabaya air traffic and occurs in a few months of the year. Major origin and destination cities of the Surabaya air-passengers are graphically presented in Figs. 2.5.20 and 2.5.21.

Table 2.5.24 ORIGINS AND DESTINATIONS OF AIR PASSENGERS THROUGH JUANDA AIR PORT, 1980

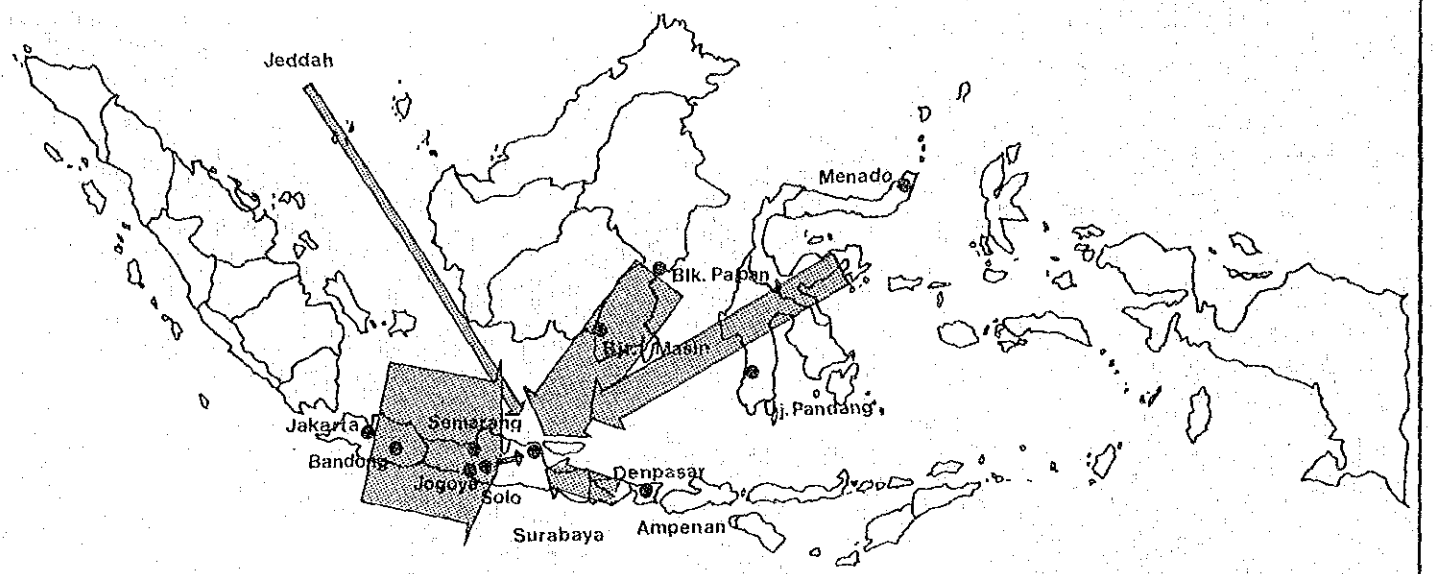
City of Origin and Destination	Air Passengers			Ann. Average growth rate 1974-1980
	Arrived (%)	Departed (%)	Total (%)	
1. Jakarta	275,791 (44.8)	274,682 (44.4)	550,473 (44.6)	12.9%
2. Semarang	35,012 (5.7)	27,861 (4.5)	62,873 (5.1)	36.1%
3. Balikpapan	56,263 (9.1)	66,217 (10.7)	122,480 (9.9)	24.9%
4. Banjarmasin	74,271 (12.1)	80,965 (13.1)	155,236 (12.6)	27.7%
5. Warukin	649 (0.1)	1,618 (0.3)	2,267 (0.2)	-
6. Ujung Pandang	78,447 (12.7)	69.741 (11.3)	148,188 (12.0)	23.6%
7. Menado	3,788 (0.6)	6,669 (1.1)	10,457 (0.8)	-
8. Ampenan	9,532 (1.5)	9,116 (1.5)	18,648 (1.5)	5.9%
9. Denpasar	40,293 (6.5)	44,423 (7.2)	84,716 (6.0)	22.7%
10. Bandung	8,369 (1.4)	6,644 (1.1)	15,013 (1.2)	-
11. Jogya	232 (-)	62 (-)	294 (-)	-
12. Solo	10,886 (1.8)	8,233 (1.3)	19,119 (1.5)	-
13. Jeddah	22,135 (3.6)	22,445 (3.6)	44,580 (3.6)	39.2%
T o t a l	615,668 (100.0)	618,676 (100.0)	1,234,344 (100.0)	16.9%

Source: Kantor Wilayah Perhubungan Udara Juanda

ACCESS TO THE AIRPORT

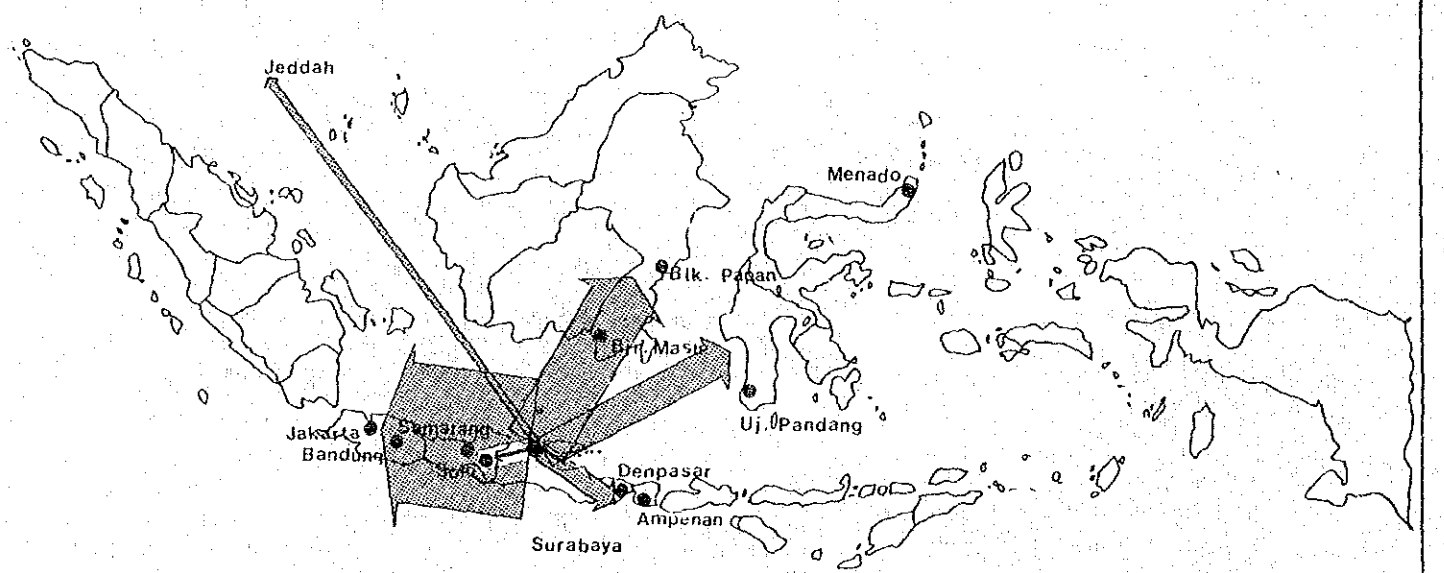
The access to the Airport Juanda is now only by road, mostly by means of car. A city bus is not operated but a smaller capacity of public road transport (colt) is operated in order to serve inhabitants along Jl. Juanda, starting from the junction with Jl. Raya Jend. Achmad Yani.

Most of the passengers are generated in Surabaya and use private or hired cars to the airport. Arriving passengers at the airport also use their private cars or taxis which only serve for those arriving passengers. This taxi company is run by PRIMKOPAL with 181 vehicles in 1981. The access road to the airport branches from Jl. Raya Jend. Achmad Yani and immediately crosses the railway line. Railway operation on this line is not frequent but Jl. Raya Achmad Yani is a very congested road. In the northern vicinity of the airport there exists Rungkut Industrial Estate and this is generating and attracting heavy truck traffic which uses Jl. Raya Achmad Yani. Thus Jl. Raya Achmad Yani is functioning as a trunk regional highway with 4-lane carriageway. Eventually some improvements will be required in the near future at the junction of Jl. Juanda with Jl. Raya Achmad Yani, if the demand of air transport sustains the current rapid growth rate of over 15% p.a. At present, however, serious traffic conflicts at the junction are not observed.



URBAN DEVELOPMENT PLANNING STUDY
ON GERBANGKERTOSUSILA
(SURABAYA METROPOLITAN AREA)

Fig.2.5.20
MAJOR ORIGIN CITIES FOR AIR PASSENGERS ARRIVING AT JUANDA AIRPORT (1980)



URBAN DEVELOPMENT PLANNING STUDY
ON GERBANGKERTOSUSILA
(SURABAYA METROPOLITAN AREA)

Fig 2.5.21
MAJOR DESTINATION CITIES FOR AIR PASSENGERS FROM JUANDA AIRPORT (1980)

2.5.6 TRANSPORT TERMINALS

TRUCK TERMINAL

(1) General

Sidotopo truck terminal is located to the immediate west of Sidotopo marshalling yard in the north of Surabaya. The terminal has been managed as a public cargo terminal under the joint operation of the Government of Surabaya Municipality and PT Margo Rahayu since 1975. The terminal is provided with warehouses and a truck yard for parking and loading/unloading space. The area of the terminal totals 50,000 m^2, of which 8,352 m^2 is for the warehouses (9 units) and 13,666 m^2 for the truck yard and passway.

Commodities flowing in and out of the terminal as derived from the survey are shown in Table 2.5.25. The average truck load of the loaded trucks is also presented in the same table for each of the commodities. Major commodities handled at the terminal are agricultural/forest products and chemical products, and these are mostly bulk cargoes.

Table 2.5.25 DISTRIBUTION OF COMMODITIES THROUGH SIDOTOPO TERMINAL

Commodities	Inflow			Outflow		
	Truck Comp. Rate (%)	Cargo Comp. Rate (%)	Average Cargo Wt. per Truck (ton)	Truck Comp. Rate (%)	Cargo Comp. Rate (%)	Average Cargo Wt. per Truck (ton)
1. Agricultural /Forest Products	30.1	24.9	7.6	31.3	22.4	6.1
2. Fishery Products	2.4	1.8	6.7	3.0	2.3	6.5
3. Mining/ Quarry Products	4.1	3.1	6.9	2.2	3.8	14.3
4. Building Materials	6.5	5.1	7.2	9.7	6.2	5.5
5. Metal/ Machinery	6.5	5.1	7.1	2.2	0.7	2.7
6. Fuels/ Dangerous Goods	-	-	-	-	-	-
7. Chemical Products	26.0	45.5	16.0	29.9	49.4	14.1
8. Products of Med/Small Industry	13.8	8.8	5.8	14.2	8.5	5.1
9. Others	10.6	5.8	5.0	7.5	6.7	7.7
10. Total (Average)	100.0	100.0	(9.1)	100.0	100.0	(8.5)

Source: Survey Results by Study Team

Commodities with the average truck load of more than 14 tons/truck can be transported by truck trailer, such as mining/quarry products and chemical products. Taking this into account an average truck load of the loaded single trucks will fall between 5 tons/truck and 8 tons/truck. Therefore, among the terminal users heavy trucks account for 74.5% of the total trucks as shown in Table 2.5.26.

Table 2.5.26 TRUCK COMPOSITION BY CAPACITY AT SIDOTOPO TERMINAL

(Unit: %)

Class	I (Heavy Truck)	II	III	IIIA	IV	V	Total
%	17.7	56.8	19.1	4.3	0.9	1.2	100%

(2) Distribution of The Traffic

Based on the analysis of the surveyed samples at Sidotopo Terminal, commodities flowing in and out of the terminal are distributed as shown in Table 2.5.27.

Table 2.5.27 DISTRIBUTION OF COMMODITIES THROUGH SIDOTOPO TRUCK TERMINAL

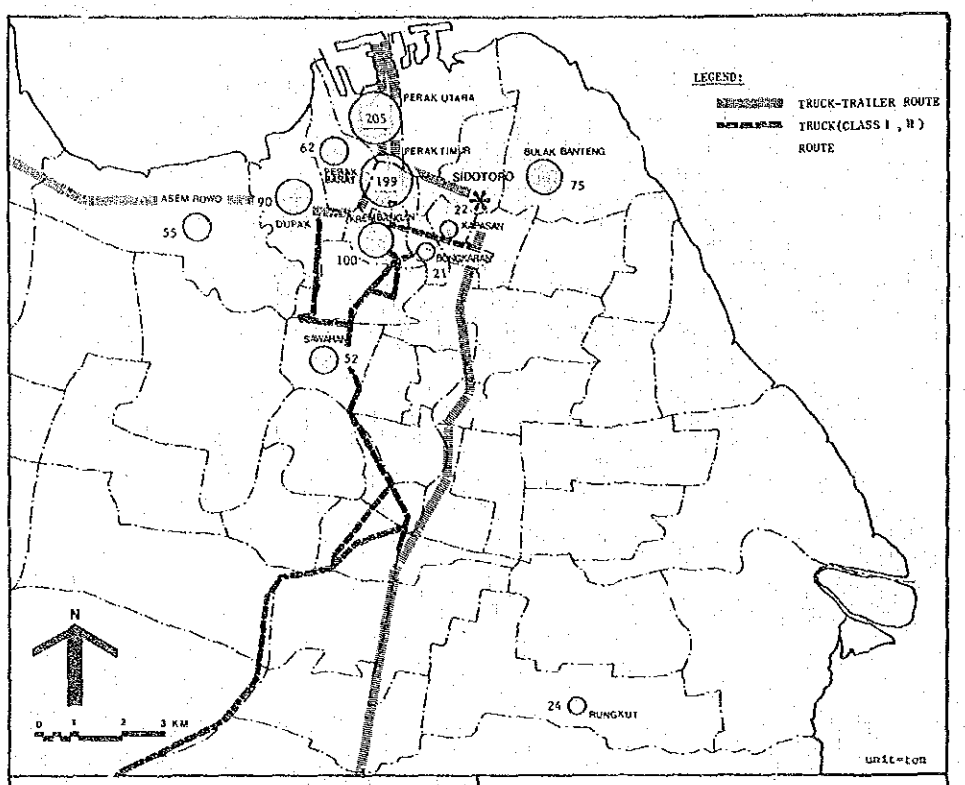
(Unit: %)

Commodities \ Distribution of Comm.	Origin Zones				Destination Zones			
	Surabaya	GKS outside Surabaya	Outside GKS	Total	Surabaya	GKS outside Surabaya	Outside GKS	Total
1. Agricultural/ Forest Products	20.4 33.8	32.9 13.7	36.9 52.5	- 100.0	26.6 73.6	12.5 7.7	9.1 18.7	- 100.0
2. Fishery Product	1.3 31.8	0 0	3.4 68.2	- 100.0	1.6 37.5	0 0	3.5 62.5	- 100.0
3. Mining/ Quarry Products	6.9 69.2	0 0	3.6 30.8	- 100.0	1.4 29.6	0 0	4.4 70.4	- 100.0
4. Building Materials	6.1 41.0	13.7 23.1	6.5 35.9	- 100.0	1.6 14.8	21.1 44.3	5.8 40.9	- 100.0
5. Metals/ Machinery	4.4 42.6	1.5 3.7	6.5 53.7	- 100.0	1.7 100.0	0 0	0 0	- 100.0
6. Fuels/Dangerous Goods	0 0	0 0	0 0	- -	0 0	0 0	0 0	- 100.0
7. Chemical Products	46.7 61.7	38.9 12.9	22.4 25.4	- 100.0	60.2 52.1	60.1 11.6	56.3 36.3	- 100.0
8. Products of Mid/Small Industry	14.2 62.2	13.0 14.3	6.3 23.5	- 100.0	4.3 35.2	0 0	10.7 64.8	- 100.0
9. Others	0 0	0 0	14.8 100.0	- 100.0	2.6 22.4	6.3 11.9	10.2 65.7	- 100.0
10. Total	100.0 44.4	100.0 11.5	100.0 44.1	- 100.0	100.0 53.1	100.0 10.9	100.0 36.0	- 100.0

If only the major flows of commodities are traced, the following can be said for the commodities distributed through Sidotopo terminal.

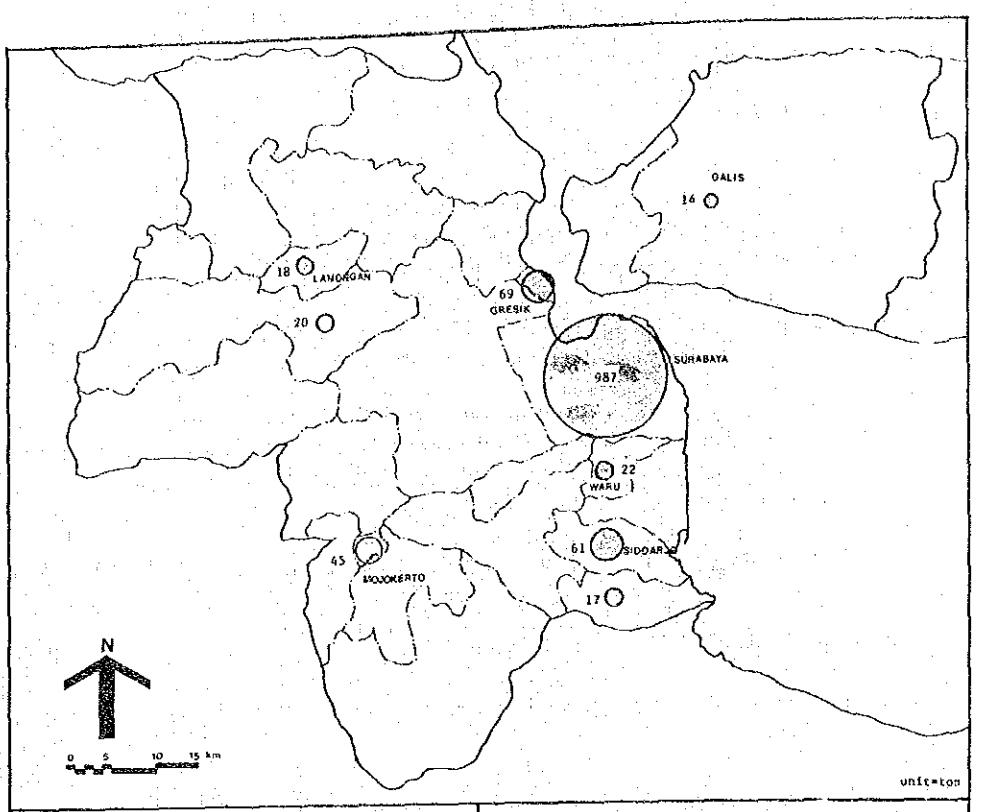
- Agricultural/forest products are generated from outside GKS Region and are attracted to Surabaya.
- Fishery products are collected and distributed to the outside of GKS Region through the terminal.
- Mining/Quarry Products are generated from Surabaya and distributed to the outside GKS Region.
- Building materials are generated from both Surabaya and outside GKS Region and distributed to the same areas.
- Metals/machinery are transported to the terminal from both Surabaya and the outside GKS Region and distributed to the GKS Region outside Surabaya and outside GKS Region.
- Fuels/dangerous goods are not handled at the terminal.
- Chemical products are generated largely from Surabaya and the outside GKS Region, and distributed to those areas.
- Products of medium and small industry are generated from Surabaya and attracted to the outside GKS Region through the terminal.
- Commodity flows which pass through the terminal are mostly made between Surabaya and the outside GKS Region.

The distribution pattern of the total commodities through the terminal is presented in Figs. 2.5.22 through 2.5.24 for Surabaya, GKS outside Surabaya and the outside GKS Region.



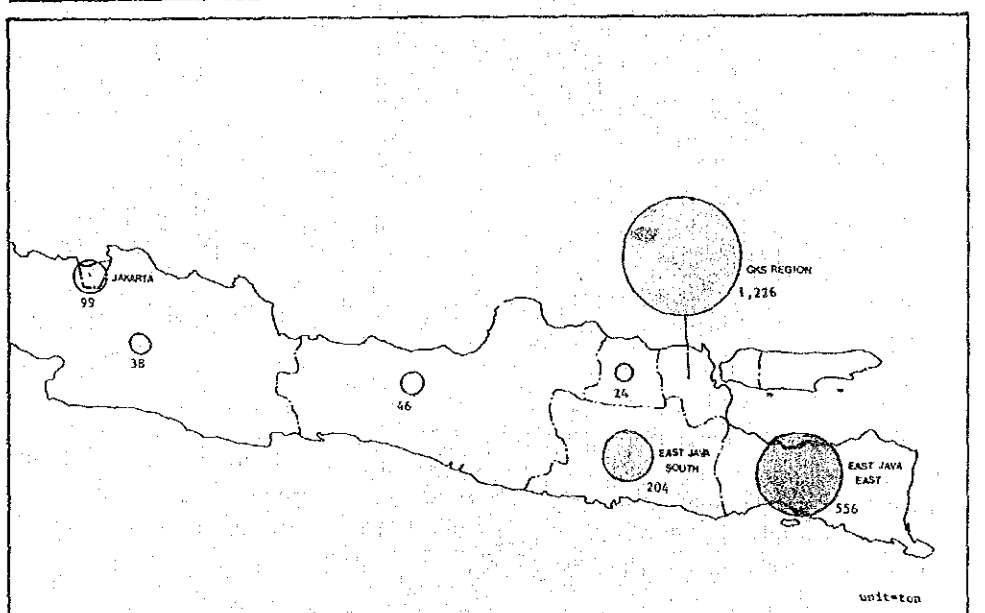
URBAN DEVELOPMENT PLANNING STUDY
ON GERBANGKERTOSUSILA
(SURABAYA METROPOLITAN AREA)

Fig. 2.5.22
CARGO MOVEMENT BETWEEN SIDOTOPO TRUCK TERMINAL AND MAJOR ZONES (1)



URBAN DEVELOPMENT PLANNING STUDY
ON GERBANGKERTOSUSILA
(SURABAYA METROPOLITAN AREA)

Fig. 2.5.23
CARGO MOVEMENT BETWEEN SIDOTOPO TRUCK TERMINAL AND MAJOR ZONES (2)



URBAN DEVELOPMENT PLANNING STUDY
ON GERBANGKERTOSUSILA
(SURABAYA METROPOLITAN AREA)

Fig. 2.5.24
CARGO MOVEMENT BETWEEN SIDOTOPO TRUCK TERMINAL AND MAJOR ZONES (3)

According to Fig. 2.5.22 the origines and destinations for commodities to and from Surabaya through the terminal are in the north of Surabaya and further, this area is along the truck routes and truck trailer routes in particular. Relationship between the port area and the terminal is of great importance and it accounts for 10% of the total cargoes handled at the terminal and 20% of the total cargoes collected and delivered in Surabaya.

(3) Related Traffic Regulations

– Truck Route Regulation

On certain streets in Surabaya City generally on arterial streets (especially: Jl. Raya Darmo, Jl. Urip Somoharjo, Jl. Basuki Rachmat, Jl. Embong Malang/Jl. Tunjungan, Jl. Blauran, Jl. Bubutan, Jl. Pahlawan, Jl. Pasar Besar), heavy trucks are banned. Medium and light trucks can use those streets, however the local government gives the option of applying for a loading/unloading permit if the cargo can not be carried by medium and light trucks.

– Trailer Route Regulation

In Surabaya City, the streets that can be used by trucks with a trailer are shown in Fig. 2.5.22 and except for fuel tankers, these routes can only be used from 22.00 to 05.00. Trucks with trailer that will load/unload in the city, except in the Port, must leave the trailer in Sidotopo Cargo Terminal and the truck can then load/unload in the city.

– Truck Licence

Local government gives loading/unloading dispensation for:

- Fuel transportation.
- Building material transportation for private and government projects.
- Heavy goods transportation that can not be carried by small vehicles.

BUS TERMINAL

There are two bus terminals in Surabaya, they are Joyoboyo and Jembatan Merah. These terminals connect the inter-city transport by bus and colt with the city transport by city bus, bemo and becak. The present situation of these terminals is that demand is greater than capacity and there is a need for expansion or replacement. The terminals access directly to the busy main streets and bring about traffic conflicts in their vicinity.

The present features of the two terminals are summarized in Table 2.5.28.

Table 2.5.28 PRESENT FEATURE OF BUS TERMINALS

	Jembatan Merah Terminal	Joyoboyo Terminal
Area	2,100 m^2	11,135 m^2 + 6,256 m^2 (PJKA)
Parking Space	Bus : 25 Bemo : 50 Colt/taxi : 50 Total : 125	Bus : 110 vehicles Bemo : 200 Colt/Taxi : 50 Total : 360
Operating Routes	Inter-city Bus: 1 directions (5 routes) City Bus : Joyoboyo-Jembatan Merah Colt/taxi : 3 directions Bemo : 7 routes Toyota Kijang : 2 routes	Inter-city Bus : 4 directions City Bus : Joyoboyo-Jembatan Merah Aloha -Jembatan Merah Colt/taxi : 2 directions Bemo : 8 routes (4-wheel Bemo) 2 routes (3-wheel Bemo) Toyota Kijang : 1 route
Traffic and Passengers volume per day (In+Out)	Inter-city Bus : 220 Buses 7,000 pass. City Bus : 1,340 Buses 55,000 pass. Colt/taxi : 250 vehicles 5,000 pass. Bemo : 6,500 vehicles 63,000 pass.	Inter-city Bus : 1,500 Buses 45,000 pass. City Bus : 970 Buses 45,000 pass Colt/taxi : 750 vehicles 13,500 pass Bemo : 15,600 vehicles 105,000 pass.

2.5.7 FERRY

GENERAL

Ferry is only the way to travel to and from Madura Island. Ferry transport is operated by 4 major companies, and they are P.J.K.A., PT. Darma Lautan Utama, PT. Jembatan Madura and K.P.P.B.K. The transport capacity by ferry boats and 5 L.C.M. in 1981 as given by the Inspeksi VIII LLASDP, Surabaya, is as follows:

Ferry boats	:	302 trips/day
Passengers	:	27,858 persons/day
Vehicles	:	4-wheel vehicle (1,052 large size + 326 small size)
		2-wheel vehicle 1,840

Ferry boats berths in Surabaya are located at Ujung Anyar and Ujung Baru, and at Kamal on the Madura side.

TRAFFIC DEMAND

In 1981, passengers from Surabaya to Kamal were about 4 million persons, and vehicles and cargoes loaded were 470,000 vehicles (4-wheeled), and 370,000 tons respectively. From 1977 to 1980, passengers, vehicles and cargo volumes have steadily increased at a rate of 25.8% p.a. and 20.8% p.a. and 29.0% p.a. respectively.

In 1981, passengers declined by 18% from 1980 but vehicle and cargo volumes sustained continuous growth as shown in Table 2.5.29.

As shown in Table 2.5.30, in terms of vehicle composition between Suabaya and Madura the ferry carried motorcycles accounted for more than 50% of the total motor vehicles and showed the highest proportion followed by Colt, Truck/Tanker, and Sedan/Jeep, in that order. An inter-city bus is operated between Joyoboyo Terminal and Madura with a frequency of 24 round trips per day and it carries about 1,000 passengers per day in each direction.

Table 2.5.29 TRAFFIC VOLUME BY FERRY TRANSPORT FROM SURABAYA TO KAMAL

(unit: x 1000)

Year	Passengers	Vehicle Volume		Cargo (ton)	Animal (head)
		4-Wheel	2-Wheel		
1977	2,410	236	-	122	31
1978	3,689	295	129	261	49
1979	4,681	361	281	254	27
1980	4,802	416	375	262	23
1981	3,925	472	339	366	11
Average Annual growth rate (%)	13.0	18.9	38.0	31.6	(22.8)

Source : Seksi L.L.A., Inspeksi VIII L.L.A.S.D.P.
Note : Figures in parenthesis ( ) indicates negative growth.

Table 2.5.30 PERCENTAGE COMPOSITION OF VEHICLE MOVEMENTS BY FERRY IN 1980

(Unit: %)

	Tanker	Truck	Bus	Sedan/ Jeep	Colt	Motor-cycle	Total
Surabaya to Kamal	6.2	13.0	2.7	9.9	17.0	51.2	100.0%
Kamal to Surabaya	5.9	12.4	2.7	8.9	16.0	54.1	100.0%
Total	6.0	12.7	2.7	9.4	16.5	52.7	100.0%

Source: Inspeksi VIII LLASDP, Surabaya.

DISTRIBUTION OF FERRY TRAFFIC (VEHICLES)

Based on the roadside O.D. survey in the port area, the trip distribution between Madura and Surabaya hinterland is shown in Table 2.5.31.

Table 2.5.31 DISTRIBUTION OF VEHICLE TRIPS BETWEEN MADURA AND SURABAYA HINTERLAND

(Unit : Veh./day)

Vehicle Type	Vehicle Trips Between Madura and :			
	Surabaya	GKS Outside Surabaya	Outside GKS Region	Total
Motorcycle	1,438 (95.9)	53 (3.5)	9 (0.6)	1,500 (100.0%)
Sedan/Jeep	213 (78.0)	28 (10.3)	32 (11.7)	273 (100.0%)
Truck	291 (50.7)	159 (27.7)	124 (21.6)	574 (100.0%)

Source : Estimated by the Study Team.

Most of the motorcycle trips by ferry have their origin/distination in Surabaya. Half of the truck traffic is generated/attracted outside Surabaya and is evenly divided between GKS outside Surabaya, and the outside GKS Region.

2.6 PUBLIC FACILITIES

2.6.1 EDUCATIONAL FACILITIES

Table 2.6.1 shows the breakdown the Schools in Surabaya and GKS in relation to East Java and Indonesia. For the educational facilities excluding higher education such as colleges and universities, the following were in existence in GKS region in 1980.

- Elementary School (S.D.) : 16,529
- Junior High School Level (S.L.P.)
  - Junior High School (S.M.P.) : 1,433
  - Junior Technical High School (S.T.) : 67
  - Junior Economic High School (S.M.E.P.) : 0
  - Junior Home Economic High School (S.K.K.P.) : 27
- Senior High School Level (S.L.A.)
  - Senior High School (S.M.A.) : 327
  - Senior Technical High School (S.T.M.) : 128
  - Senior Economic High School (S.M.E.A.) : 108
  - Senior Home Economic High School (S.K.K.A.) : 16
  - Teacher Education (S.P.G.) : 88
  - Physical School (S.G.O.) : 2

Elementary Schools are basically allocated and developed in proportion to the population, even if a little difference appears among regions. Generally about 4–6 units per 10,000 residents are developed. The city of Surabaya has a particular function for the Senior High School level in East Java. The number of Junior High Schools per 10,000 residents is about 0.46 in Surabaya, whilst the average for that of Indonesia is only 0.28. This fact could indicate that Surabaya has a higher educational function serving East Java, as one of its urban functions.

2.6.2 SOCIAL FACILITIES

MEDICAL FACILITIES

The existing condition of medical facilities is summarized in Table 2.6.2. As is understood from this table, the number of hospitals including facilities for child birth, etc. totals about 450 units in GKS Region.

The service level is computed at 7.3 units per 100 thousand residents. Comparing the service level of hospitals by area. Surabaya is 1.39 units per 100 thousand residents, while, that of the other areas in GKS region is only 0.48.

However, the service levels of Public Medical Service Facilities are 2.24 and 9.12 in Surabaya and the Others respectively, so the service level in Surabaya is much lower than the other GKS areas.

OTHER SOCIAL AND CULTURAL FACILITIES

Most of major social and cultural facilities in GKS are accumulated in Kod. Surabaya. Fig. 2.6.1 shows the distribution of major facilities in Surabaya.

Table 2.6.1 EXISTING EDUCATIONAL FACILITIES

	Educational Facilities	GKS Surabaya	GKS Others	GKS Total	Java	INDONESIA
NUMBER OF FACILITIES	Elementary School (SD)	804 (4.9)	2,057 (12.4)	2,861 (17.3)	16,529 (100.0%)	
	Junior High School (SLP)	218 (14.3)	196 (12.8)	414 (27.1)	1,527 (100.0%)	
	Senior High School (SLA)	110 (16.4)	60 (9.0)	170 (25.4)	669 (100.0%)	
	T o t a l	1,132 (6.0)	2,313 (12.4)	3,445 (18.4)	18,725 (100.0%)	
NUMBER OF FACILITIES Per 10,000 persons	Elementary School (SD)	3.39	5.44	4.65	5.66	6.65
	Junior High School (SLP)	0.92	0.52	0.67	0.52	0.63
	Senior High School (SLA)	0.46	0.16	0.28	0.23	0.28
	T o t a l	4.78	6.1	5.60	6.42	7.57

Source : Rencana Pembangunan Di Daerah Jawa Timur Pelita III

Table 2.6.2 NUMBER OF HOSPITALS

Hospital		GKS Surabaya	GKS Others	GKS Total
Number of Hospitals	Hospitals	33	18	51
	Public Medical Service Facilities	53	345	398
	T o t a l	86	363	449
Number of Hospital per 100,000 persons	Hospitals	1.39	0.48	0.82
	Public Medical Service Facilities	2.24	9.12	6.47
	T o t a l	3.63	9.59	7.29

Source : Rencana Pengembangan Di Daerah Jawa Timur Pelita III

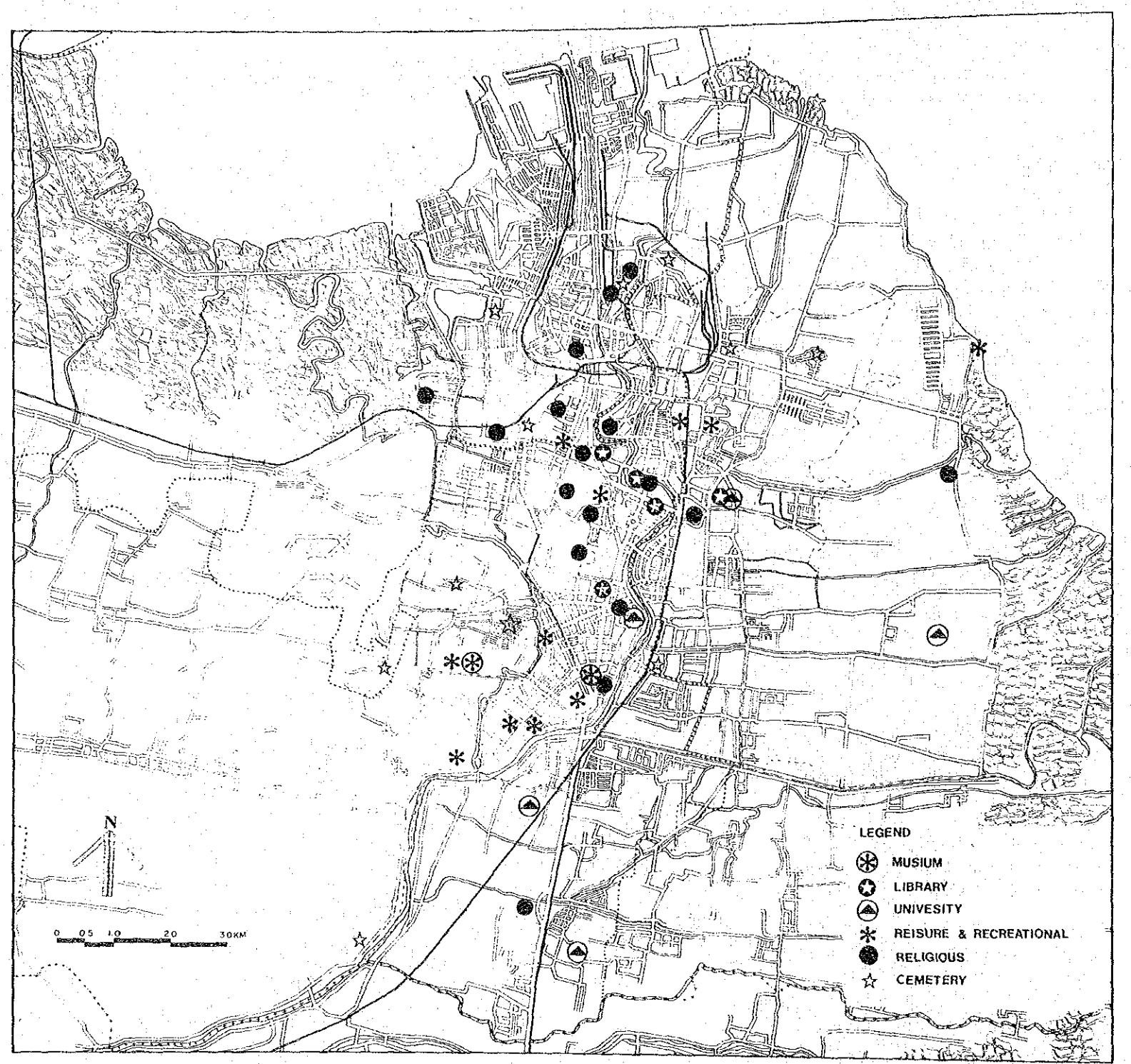


Fig. 2.6.1 DISTRIBUTION OF MAJOR PUBLIC FACILITIES IN SURABAYA CITY

2.7 RIVERS

2.7.1 GENERAL

Rivers and canals are the most basic and principal infrastructure in the urban areas as well as rural areas. Once the rivers and canals are developed, the basic urban structure is strongly controlled for a long time. In accordance with the urban expansion, the requirements on quality and quantity of the waterway systems will be changed. Every rainy season urban areas are innundated as many irrigated agriculture areas remain in the urban area and no conversion to a drainage system has been carried out. Systems should be established to promote improved standards and enhanced urban amenities.

2.7.2 RIVER SYSTEM

Three river systems directly influence the GKS Region; Brantas river from the south, Sala River from the north and Lamong river from the west.

BRANTAS RIVER

The Brantas is the second largest river in Java island. Fig. 2.8.1 shows the whole Brantas basin. The total length of its main stream is about 320 km and the catchment area 12,000 km^2. This corresponds to one quarter of East Java. The annual rainfall in the basin is about 2,000 mm of which about 80% occurs in the rainy season from November to April. The major industry in the basin is agriculture and this employs about 70% of the population. The total farmland occupies 730,000 ha accounting for about 60% of the basin area. The remaining areas are mostly occupied by mountain slopes where the land is not suitable for farming due to topography, thinner soils, and shortage of water. The total area of uplands, estates and orchards amounts to 409,000 ha and this is mostly located at the outskirts of mountain slopes of Mt. Wilis in the west, Mt. Arjuno in the east and Mt. Kelut in the centre of the basin.

At Mojokerto the main stream divides into two rivers, Surabaya river and Porong river. The Porong river was constructed as the relief of the Brantas river many years ago. The Surabaya river receives water from the Brantas river through the Gedeg and Mlirip sluices as well as the Marmojo river, the origin of the Surabaya river.

Mt. Kelut, located at the centre of the Brantas river basin, is an active volcano and erupts at intervals of 15 to 30 years. The volcanic materials produced by an eruption are estimated to be in the order of 100 to 200 million m^3, and for this reason many projects on dredging the river bed have been carried out.

Proyek Kali Brantas office has set up the project schedule up to 2000. The following 9 projects will be executed up to 1989.

- Karangkates Hydro Plant (1986 – 1989)
- Sengguroh Hydro Plant (1982 – 1987)
- Kesamben Hydro Plant (1984 – 1989)
- Development Project of Karangkates upper reach sub-basin and of Selorejo upper reach (Lesti dam and Kepanjen Hydro Plant) (1983 – 1989)
- Brantas middle reach river improvement (1982 – 1989)
- Ngrowo sub-basin development project (1982 – 1989)
- Surabaya river improvement (stage II) (1983 – 1989)
- Widas sub-basin development (1984 – 1989)
- Land conservation, spring water source development and erosion control (1983 – 1989)

A total of 31 dams, including existing, will be constructed by 2000.

SALA RIVER

Sala River is the largest river in Java island and Fig. 2.7.1 shows the whole basin. The river runs about 600 km and drains area of about 16,100 km^2, which is approximately 12% of the total area of Java.

The Sala River has two tributaries, Upper Sala and Madium river. These two rivers originate from the southern mountain range (G. Sewu), and drain areas of 6,072 km^2 and 3,775 km^2 respectively before both join together at Ngawi. From this point, the Sala River flows northward through Kendeng ridges to Cepu and then takes its course eastward in the long extending alluvial flat land to the north of Gresik before finally emptying northward to Java Sea through the straight cut channel. The present river course meanders and has a gentle slope. Actual elevation of the riverbed is only about 100 m above MSL 500 km upstream of the estuary.

Waterhead of the Dengkeng and Woro rivers, flows down the southern slope of G. Merapi, an active volcano, and flushes a large quantity of volcanic debris to the Dengkeng river and then to the Upper Sala River.

Vast marshy and swampy areas occur in Bengawan Jero and Jabung Lawlands in the lower Sala basin. In the basin the farmland occupies 73% (1,148 thousands ha) of the total land. Forest area accounts for only 22% (342 thousands ha) and the others for 5% (72 thousands ha). Direct rainfall in the basin amounts to about 2,100 mm annually or 33.8 billion m^3/year on an average. About 40% (16.7 billion m^3) is estimated to run off as surface water in the stream. The run-off varies from about 65% in the driest year to about 160% in the wettest year. Every year several floods carry most of the yearly run-off into the sea. Such floods are not only losing available water, but also cause severe damage to the surrounding area, especially in the lower basin. The Sala river has too small a flow capacity (500 m^3/sec) to carry floods from the basin. Every rainy season an average of 93,600 ha involving 55,000 houses are damaged by the floods. The river dikes in the Sala lower reach were constructed in the Dutch period, the right bank Babat to Sumbayat 75.6 km and the left bank Rengel to Laren 46.8 km. These dikes have to be repaired every year.

- Jipang Dam:
  Jipang dam is planned to be about 6 km upstream of Cepu and operated for flood control, irrigation and hydropower generation. 1,159 million m^3 and a storage capacity of 740 million m^3 can be distributed to irrigate the farm land of 54,000 ha. The maximum output of 18,000 Kw and total annual generation of 70,800 MWH can be produced.

- Jabung Retarding Pond:
  The Jabung retarding pond is planned as a temporary water reservoir for flood protection and irrigation purposes. At the end of the rainy season, flood water of 216 million m^3 will be reserved in an area of 6,000 ha and will be utilized in the dry season for irrigation.

- Bengawan Jero Swamp:
  Bengawan Jero Swamp is located in Sala River Hilir between Sala River and a provincial road (Gresik – Babat). The Jero Swamp lies in low land with a total area of 10,448 ha ranging from – 1.20 to + 0.60 SHVP and connects the Sala river through Kuro Sluice located at the down stream end of the Blawi river. The swamp consists of three areas depending on the water level as follows:

  Jero Tinggi (Highest Portion) : 1,497 ha
  water level –0.60 – ±0 SHVP

  Jero Tengah (Middle Portion) : 2,806 ha
  water level ±0 – 0.60

  Jero Dalam (Lower Portion) : 6,145 ha
  water level –0.60 – –1.20

  Fish-ponds operate throughout year. The swamp is also managed as rice paddy depending on the water level.

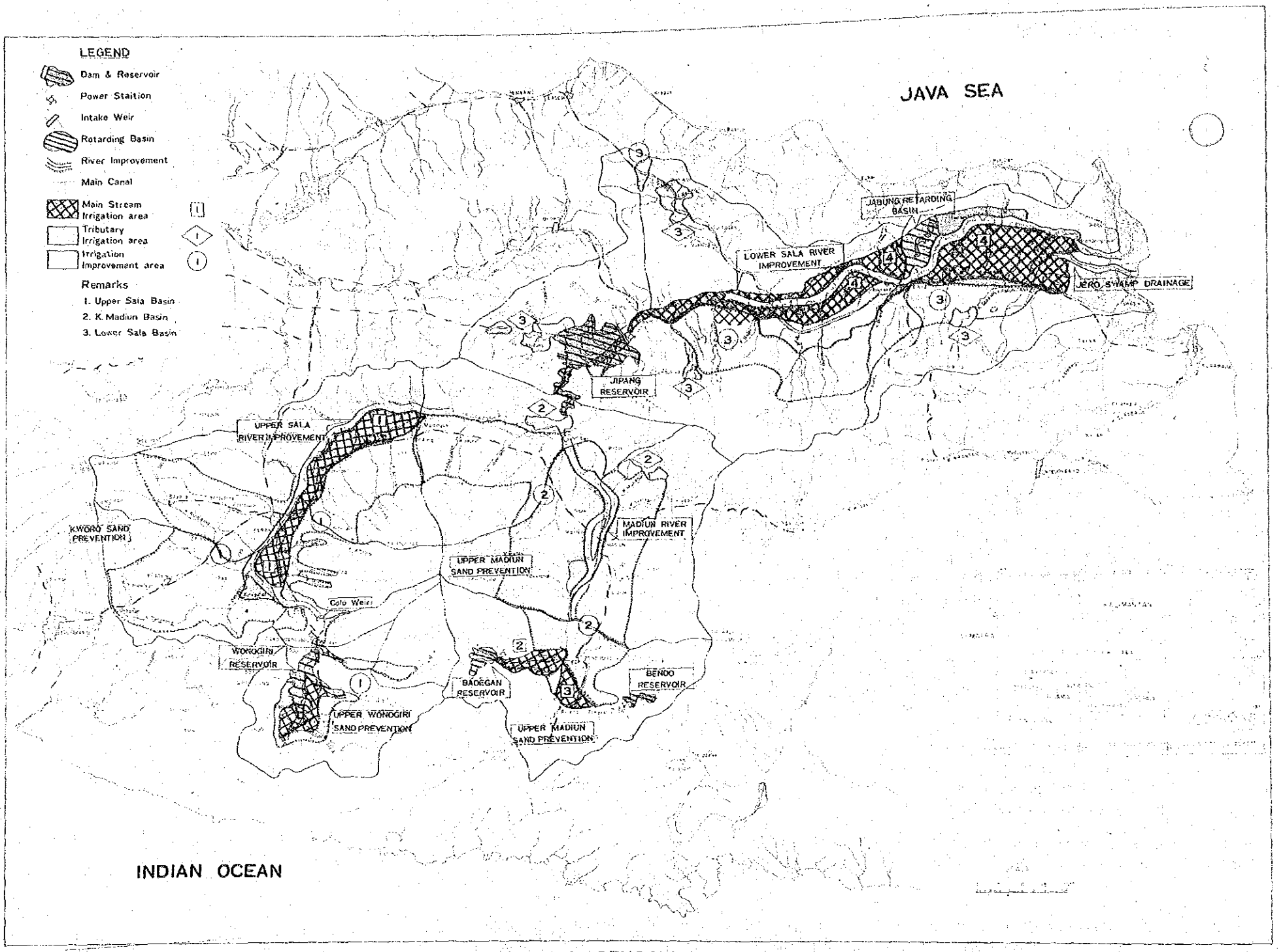


Fig. 2.7.1 BENGAWAN SALA BASIN

The Kuro sluice is the most important water gate to ensure the swamp activities on the paddy/second crop production, fish production, drinking water/bathing water and the local traffic by sailing vessels. The swamp experiences inundation and floods in the wet season and lack of water in the dry season every year. The inundation is brought from five rivers merging from the south into Kali Blawi. The paddy field in the swamp had only low production at 672t in 1979 and 549t in 1980.

Well boring and installation of pumps for the paddy production has been carried out by the Government in the past. Dredging of the Blawi river as well as its tributeries has been executed since Pelita I.

Two major subjects are identified for the Jero Swamp:

- to provide land communication between south and north of Lamongan, through the swamp.
- to expand further facilities for water supply and inundation protection.

– Past and Future Projects in the Sala Basin

Many projects have been completed and others are scheduled as follows:

– Wonogiri Dam	Completed in 1982
Hydro Plant	On-going
Irrigation Canal	On-going (for 22,000 ha)
– Badegan Dam	Pre-feasibility stage
– Bendo Dam	Before pre-feasibility stage

– Jipang Dam	Problem for 13,000 houses to be inundated
– Saboo Project	On-going for Woro river on Mt. Merapi and some projects along Madiwn river
– River Improvement Project	Short cuts and protection work for river dikes being executed in the Sala lower reach. River bank repairing work due to disaster in the up-stream section. Full scale construction to be executed in 1982 on the completion of feasibility study.
– 35 dams construction	on-going and 3 dams completed.

LAMONG RIVER

The Lamong river is located in Lamongan region for the upstream reaches and on the boundary between Gresik and Surabaya in the lower reaches. It has a total catchment area of 830 km^2 and an irrigation area of 4,500 ha. The Lamong river area is a low food producing area in East Java due to its dependance on rainfall. Although there are 53 water reservoirs in Lamongan, these are still insufficient to meet the water demand for irrigation purposes. The government has prepared a plan to construct the Lamong dam based on the geological and topographic survey conducted in 1978 and 1979, but no construction is scheduled yet. It will be located in Kec. Sambeng of Kabupaten Lamongan. On completion of the reservoir, it will serve a 2,500 ha irrigation area using 12.7 x 10^6 m^3 reserved water volume in a 378 ha watershed.

It is reported that Kebomas area in Gresik and the Benowo area in Surabaya are flooded every year. It is assumed that these inundated areas act as retarding ponds in the rainy season. No detailed information is available about this.

SURABAYA/WONOKROMO RIVER

The Surabaya river has a total catchment area of 604.4 km^2, a total length of 100 km and river bed slope ranging from 1/300 in the Marmojo basin to 1/4200 near the Mas river mouth. The Kedung Soro river receives water from the Brantas river through the Gedeg sluice and confluence of the Marmojo river upstream of the Perning gauging station. Every rainy season the Marmojo river floods due to the confluence water of the Kedung Sala river diverted from the Brantas river.

At Wonokromo the Surabaya river divides into two, the Wonokromo river and the Mas river. The upstream of the diversion point there is Gunungsari dam which was constructed in 1981 and maintains water levels for 9 irrigation intakes and industrial water intakes.

Immediately downstream of the dam, the Surabaya river is joined by the Kedurus river. The Jagir dam is located 2.5 km down-stream of Gunungsari dam. The Jagir dam maintains the water level for the Ngagel water treatment plant, and diverts water into the Mas river through Wonokromo sluice. Water passing Jagir dam flows to the sea through the Wonokromo river, which is tidal through its length. The Wonokromo river is primarily a flood relief channel.

2.7.3 LOCAL RIVER/CANAL SYSTEM

SMA consists of four areas; Surabaya, part of Sidoarjo, Gresik and Bangkalan (Kamal).

SURABAYA

(1) Rivers/Major Canal System

– Drainage Area

The drainage areas in Surabaya are divided into 5 basins; Wonocolo–Rungkut, Sukolilo, Central Tandes and Karang Pilang. Each area drains directly to the east sea or to the north sea except the Karang Pilang area which drains to the Wonokromo river through the Surabaya river. There are 13 major drainge rivers or canals and 7 major irrigation canals as shown in Table 2.7.1 and 2.7.2.

Table 2.7.1 DRAINAGE CANALS IN SURABAYA

Name of River/Canal	Length (km)	Outlet Controls
River		
Lamong	68.0	None
Surabaya	28.7	Jagir Dam
Wonokromo	12.3	None
Kedurus	10.8	Jagir Dam
Mas	13.9	Gubeng Dam
Kandangan	40.0	None
Drainage Canal		
Perbatasan	10.0	None
Wonocolo - Wonorejo	14.3	None
Kalidami	6.1	Tide Gate
Tambakwedi	5.7	Tide Gate
Pegirian	8.4	Tide Gate
Greges	4.9	Tide Gate
Anak	3.9	None
Simo	10.6	None
Balong	4.6	None
Semimi	7.9	None
Other Canal		
Lesser Canal	86.0	
Conduits/Pipelines	1,525.0	

Table 2.7.2 IRRIGATION CANALS IN SURABAYA

	Lengths (km)
Main Irrigation Canals	
Menangel	4.8
Kebonagung	13.1
Karah	3.8
Kali Bokor-Keputih	9.0
Kali Kepiting	6.4
Jeblokan	7.7
Gunungsari	21.1
	65.9
Lesser Irrigation System	
Kabonagung	17.9
Kali Bokor-Keputih	5.9
Jeblokan	4.0
Rowo Wyung area	5.7
Others	0.4
	33.9

– Irrigation

Less than 4,000 ha were irrigated in 1981 and these are in 4 zones; Wonocolo–Rungkut, Sukolilo, northern area of Jl. Tandes, and Rowowyung area (Kedurus river basin). These irrigation canals will become drainage canals with urbanization.

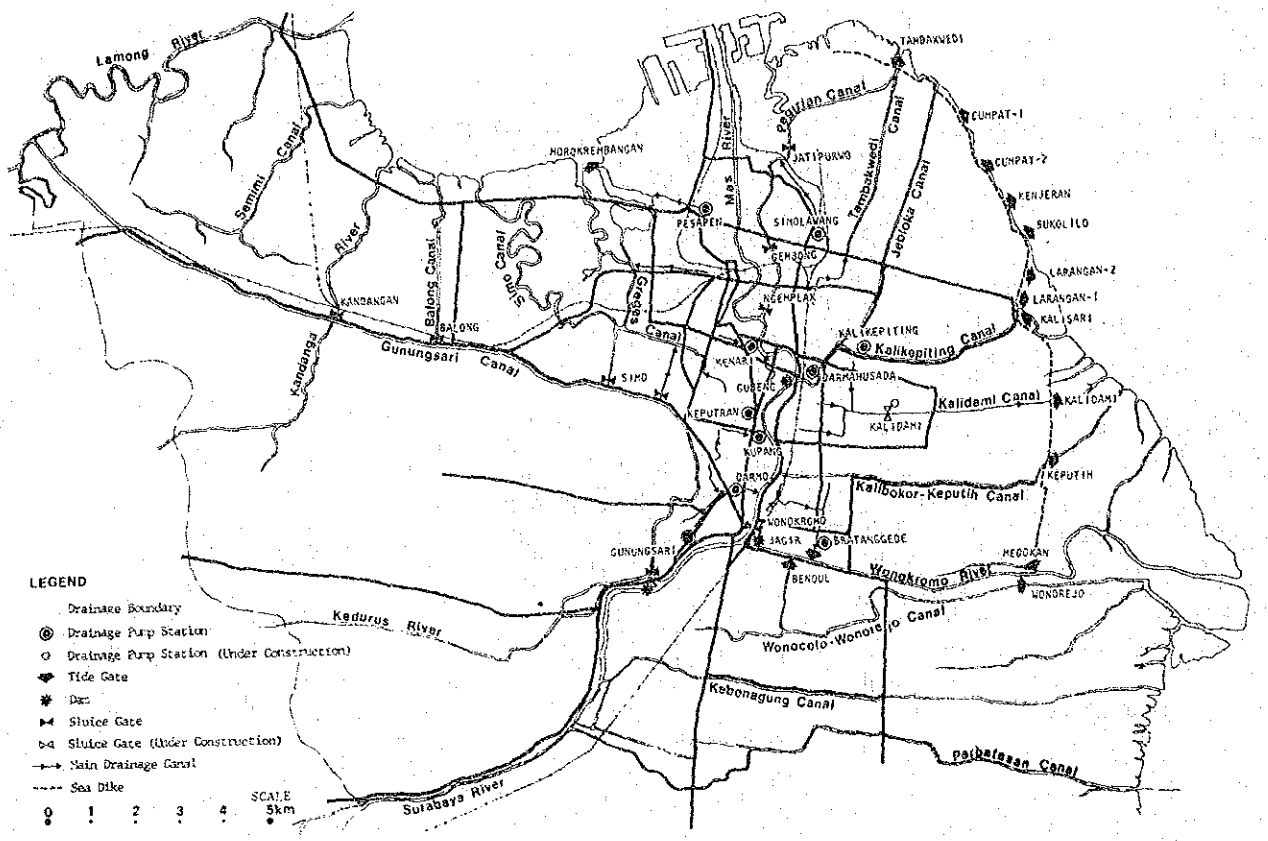


Fig. 2.7.2 EXISTING WATERWAY SYSTEM IN SURABAYA

– Water Reservoir

Two water reservoirs are currently operated; Morokrembangan Boezem and Jeblokan reservoir. The Morokrembangan Boezem has some 83 ha and drains water from the Gregess river by using three mitre gates, 5 m width and 4 m depth which are operated between the Boezen and the sea. The Jeblokan reservoir takes water from Jeblokan canal and drains to the sea through the Tambakwedi mitre gates. In the middle of the reservoir dike a 50 cm diameter pipe with stop logs is installed for the fish-pond along the access canal to the Tambakwedi gate. The reservoir is approximately 5 ha.

– Sea Dike

The sea dike was constructed to prevent saltwater intrusion from the sea. Only 17 km of sea dike is provided for the north to the east coast of Surabaya. No sea dike has been constructed for the western side of the Mas river, and for the south of the Wonokromo river. A total of 12 gates are provided in the sea dike including new 9 gates constructed in 1976/77 by the Brantas Lower Reach Project Office. Many of these flap gates are not successfully operated due to the theft of apparatus required to raise the gate. Due to holding of flood water behind the gate, a large area behind the dike is inundated every year. At almost all dike gates, no gate operators are working.

– Some Problems on Selected Rivers/Major Canals

Mas River

The Mas river is regarded as an urban river from consideration of existing functions, which are drainage for the run-off from its catchment area, the water supply for irrigation/industries, and flushing of its downstream and related canals in the dry season.

The Mas River is controlled by Gubeng dam, located 4.5 km down-stream of the Wonokromo sluice. The dam is used to maintain water levels for the Jeblokan and Kalibokor irrigation offtakes, and for several industrial offtakes. Downstream of the Gubeng dam it is tidal and enters the sea at Tanjung Perak.

Up-stream of the Gubeng dam, the river is heavily silted and has been illegal narrowed. The Gubeng dam now has the important functions and maintains the high water level. This makes it difficult to drain run-off from the surrounding area. It is hoped to lower the water level to allow some natural drainage but this may allow salt water intrusion into the surrounding ground and also water shortage at the surrounding wells, which are used by many people for bathing and washing purposes.

– Kedurus River

The Kedurus river basin, which has a catchment area of 67 km^2, is located between two hills; Gunungsari hill to the north and Kebraon hill to the south. There are however no stream flow records. The river basin suffers habitual inundations every rainy season and it was reported that the inundation in January 1978 was more than 1,030 ha, at about 1 m depth, and lasted about two weeks. This is basically due to the maintenance of a high water level at the Jagir dam and the small capacity of the confluence zone to the Surabaya river. However, gravity drainage is still possible.

– Gregess River

The Gregess river basin also experiences habitual inundations every rainy season. It is reported by Surabaya city that parts of Sawahan, Bubutan, Krembangan and Pabean are affected. The inundation is mainly caused by the low capacity of the minor access rivers and drainage pumps. Garbage, siltation, illegal occupants and flow blockage by bridges and water pipes also aggravate the situation.

– Gunungsari Canal

The Gunungsari canal is an irrigation canal and abstracts water from up-stream of the new Gunungsari dam. The canal receives the whole run-off from Gunungsari hill which is already developed as a residential area. In order to drain the excess water, four spillways were provided at Banyu-urip, Simo, Balong and Kandangan on the canal. However, due to the shortage of spillway capacity, frequent inundation occurs on the left bank, and the right bank of the canal has been cut by inhabitants to relieve their inundated area. This results in the inundation of the Darmo urban area.

– Inundation Problems

Fig. 2.7.3 shows inundated areas in 1981 and observed problems are due to:

- The width of the canal is small continually varying and the downstream section is sometimes narrower than the up-stream.
- Canal planning as an isolated waterway system.
- Inadequate maintenance for siltation and dumped garbage.
- Reduced canal cross-section by bridges, irrigation canals and water pipes crossing over the drainage canals. This indicates no approvals for the construction of these structures by the administrative agency.
- Illegal temporary houses and other structures have been built out from the banks and into the stream or canal.
- Many sluices gates are operated by nearby residents.

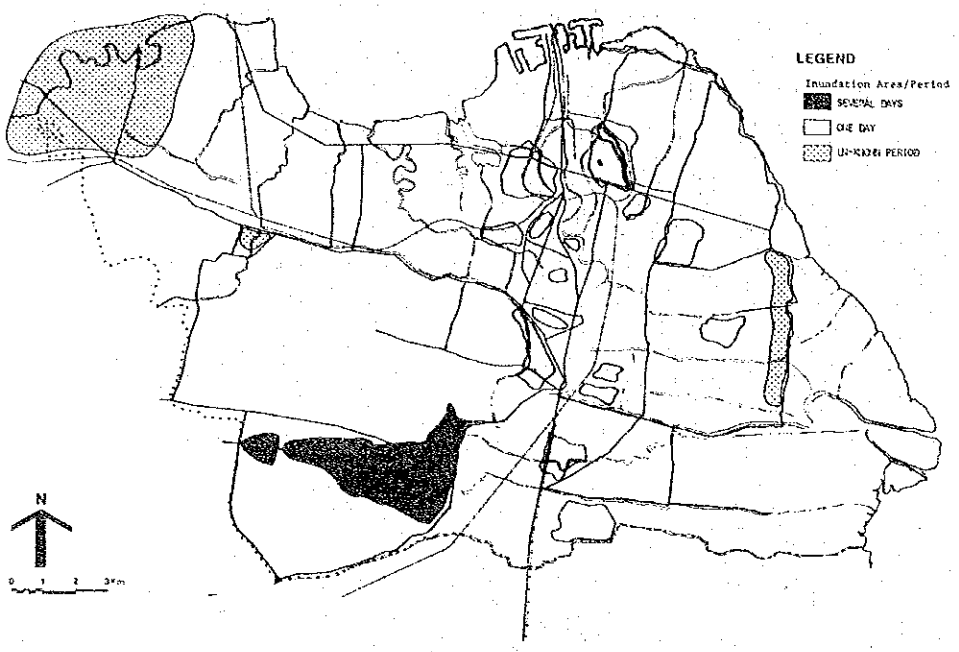


Fig. 2.7.3 INUNDATED AREA IN 1981

(2) Minor Canal

Tertiary and quatery canals except street ditches and gutters are reported to be some 150 km by the studies for SURABAYA WATER, WASTEWATER, DRAINAGE AND SOLID WASTES (CDM Report), Sep. 1976.

Local flooding of the minor canals can be overcome, by first maintaining and cleaning up the canals, and secondly by maintaining the pump stations.

There are 9 pumping stations in operation for local drainage. Based on a site investigation in April 1982, 12 pumps out of a total 30 pumps are out of order. These pumps are shown in Table 2.7.3. Two pump stations in Bratangede and Kalidami are under construction by Surabaya city.

(3) Surabaya Area – Projects of the Related Agencies

The drainage systems in Surabaya, in terms of operation, maintenance and development, are managed by separate agencies such as Surabaya city, Pengairan Tk–1 and the Brantas Lower Reach project office, with overlapping efforts and only limited effective coordination. Brantas Lower Reach project office is the responsible agency for the construction/operation/maintenance work on the primary river system including the Mas river. For the past 10 years the office has executed many projects in Surabaya area as listed below:

Table 2.7.3 EXISTING DRAINAGE PUMP STATION

Station	Existing Pumping Units			
	Pump No.	Rated Capacity m^3/sec	Type of Drive	Total Rated Capacity m^3/sec
1. Kupang	1	0.67	Electric	
	2	0.67	Electric	
	3	0.67	Electric	
	4	0.67	Electric	
	5	0.47	Electric	
	6	0.47	Electric	
				5.62
2. Darmo	1	0.26	Electric	
	2	1.10	Electric	
	3	1.35	Electric	
	4	1.47	Electric	
				4.18
3. Simolawang	1	0.20	Electric	
	2	0.67	Electric	
	3	0.67	Electric	
	4	1.13	Electric	
	5	1.47	Electric	
				4.14
4. Gunungsari	1	1.20	Electric	
	2	2.25	Electric	
	3	0.25	Electric	
				2.65
5. Pesapen	1	0.25	Electric	
	2	0.12	Diesel	
	3	0.12	Diesel	
				1.84
6. Bratang Gede	1	1.30	Diesel	
	2	1.30	Diesel	
	3	1.30	Diesel	
				3.90
7. Keputeran	1	0.20	Diesel	
	2	0.20	Diesel	
				0.24
8. Kalikepiting	1	0.12	Diesel	
	2	0.12	Diesel	
				0.24
9. Darmahusada	1	0.12	Diesel	
	2	0.12	Diesel	

Surabaya/Wonokromo River

– River Course Improvement	
– Section of Spanjang – Gunungsari dam	Completed
– Spanjang – Mlirip Sluice	Waiting for approval
– Mlirip Sluice Construction	Completed in 1979
– Gunungsari Dam Construction	Completed in 1981
– Jagir Dam Improvement Works	50% completed
Mas River (Dredging, Reventment):	80% completed
Morokrembangan Boezam:	
– 17 km embankment and revetment	13.5 km completed will be finished within 1982
– Remaining 3.5 km (Keputih-Medokan)	
– 9 Sluice	Completed in 1980
Appurtenant Facilities (including test facilities, water & rain gauge station and communication station).	Completed in 1980

In 1979 the office proposed the extension projects for the secondary drainage system improvement in the western area of the Mas river as the second stage project. The project has not been implemented yet. The office is currently executing the remaining works for the sea dyke, Jagir dam, and dredging and reventments for the Mas river.

Surabaya city is responsible for the construction, operation and maintenance work for the drainage canals below the secondary system in the urban area. Mainly canal improvement works (excavation and revetment) and construction of pump stations have been executed in the past. In the five year program (Pelita III), Surabaya city is scheduled to improve some 34,600 m of existing canals on a local budget amounting to Rp.981 million, and to maintain about 96,700 m by a local budget amounting to Rp.5,837 million. Out of these projects, canal improvement and expansion projects and construction of pump stations are under-way in 1982/83. Total 9 pumps are replaced in Kupang and

Darmo stations. Two pump station with total 5 pumps are under construction at Bratangede and Kalidami.

Pengairan Tk-1 controls water through the operation of irrigation facilities such as dams/ sluices/gates and canals. Irrigation in Surabaya has no future and it is reported by Pengairan Tk-I that no extension projects for irrigation will be undertaken.

SIDOARJO

(1) General

The Delta Brantas Sidoarjo, enclosing Surabaya and Porong river, is the best rice production area in East Java. The Brantas delta has a total area of approximately 32,600 ha of irrigated sawah. All water for this land is abstracted from the Kali Brantas upstream of Lengkong dam. Beside the rice fields, fish ponds of 10.9 ha lie along the east coast. The elevation of the Delta ranges from about 16.0 m to – 1.0 m and the area has a gentle slope of 1/2000 toward the east. The area with the elevation of less –1.0 m is utilized for fish ponds.

Most of the irrigation water is supplied through two large primary canals, the Magetan canal (17,970 ha) which feeds the north of the delta and the Porong canal (12,505 ha) which supplies the south. The total length of the primary canals is 64 km. There are 263 km of secondary canals, about 800 km of tertiary and about 950 km of quarternary canals. There are 7 drainage basins with the total discharge area of 51,800 ha. The length of secondary drainage canals are shown in Table 2.7.4 and in Fig. 2.7.4.

(2) Inundation

Fig. 2.7.4 shows the inundation area investigated by the Pengairan Brantas Mojokerto office in 1980/81. A total of 265 ha was damaged with more than 30 cm inundation depth for more than one day.

The major causes are:

– Insufficient cross-sectional area of the drainage canal due to siltation.

Table 2.7.4 EXISTING DRAINAGE CANAL LENGTH IN DELTA SIDOARJO

Drainage Canal	Field Area (km)	Pond Area (km)	Total (km)
Tambakoso	10.5	2.0	12.5
Boentoeng	52.0	9.5	61.5
Bulubendo	17.0	1.5	18.5
Tombokogung	11.9	10.0	21.9
Kebetingan	199.7	32.1	231.8
A l o o	47.3	19.2	66.5
Dalong	12.0	11.5	23.5
Total	350.4	85.8	436.2

– Obstruction of flow due to the provision of structures such as water intake weir in the drainage canal.

– No adequate operation of voor canal intake gate during rainy season.

– No drainage due to high tides especially to the east of the highway.

(3) Past and Present Projects

The Delta Brantas office has executed canal improvement projects and construction projects for water control structures for the primary/secondary systems since Pelita – I. For the period of 1982 – 1984 (Pelita – III) the following projects will be executed:

– Improvement of drainage canal	26.55	km
– Strengthening canal embankment	1.95	km
– Improvement of 2 water control structures	2	nos.
– Pilot reclamation project	300	ha
– Lining project for tertiary canals	14,800	m.

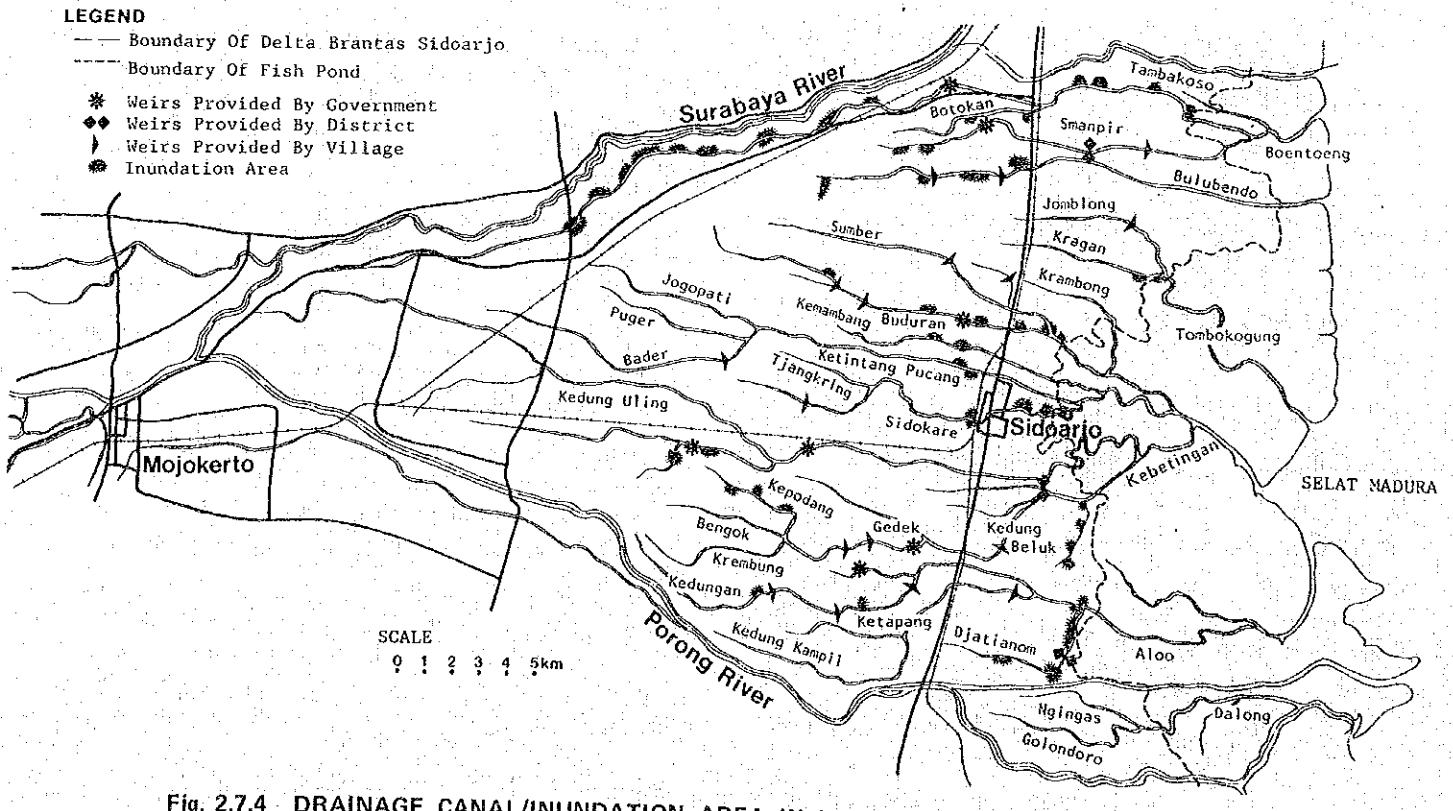


Fig. 2.7.4 DRAINAGE CANAL/INUNDATION AREA IN BRANTAS DELTA SIDOARJO

GRESIK

(1) General

Drainage system develops within the existing city area and has steep gradient due to the development on the slope of the Gresik limestone hill as shown in Fig. 2.7.5. The outline of the urban drainage facilities are summarized in Table 2.7.5.

Tributary canals are around 65 km of Lamang river and 50 km of Surabaya river in the rural area of Kabpaten Gresik.

Table 2.7.5 EXISTING GRESIK DRAINAGE CANAL

Drainage System	Length (km)	Canal Size W x D (m)	Catchment Area (ha)
1. Market-Kali Tutup	0.8	2.0 x (2-2.5)	32
2. Sukorame-JL. Petrokimia	4.1	(1.0-6.0) x (1.0-2.5)	242
3. East Kali Tutup -Jagung Suprapts	3.5	(2-3) x (1.8-2.0)	340
4. P. T Cemen Gresik -Tambak	21.0	2 x 1.0	12
Total	29.4	-	626

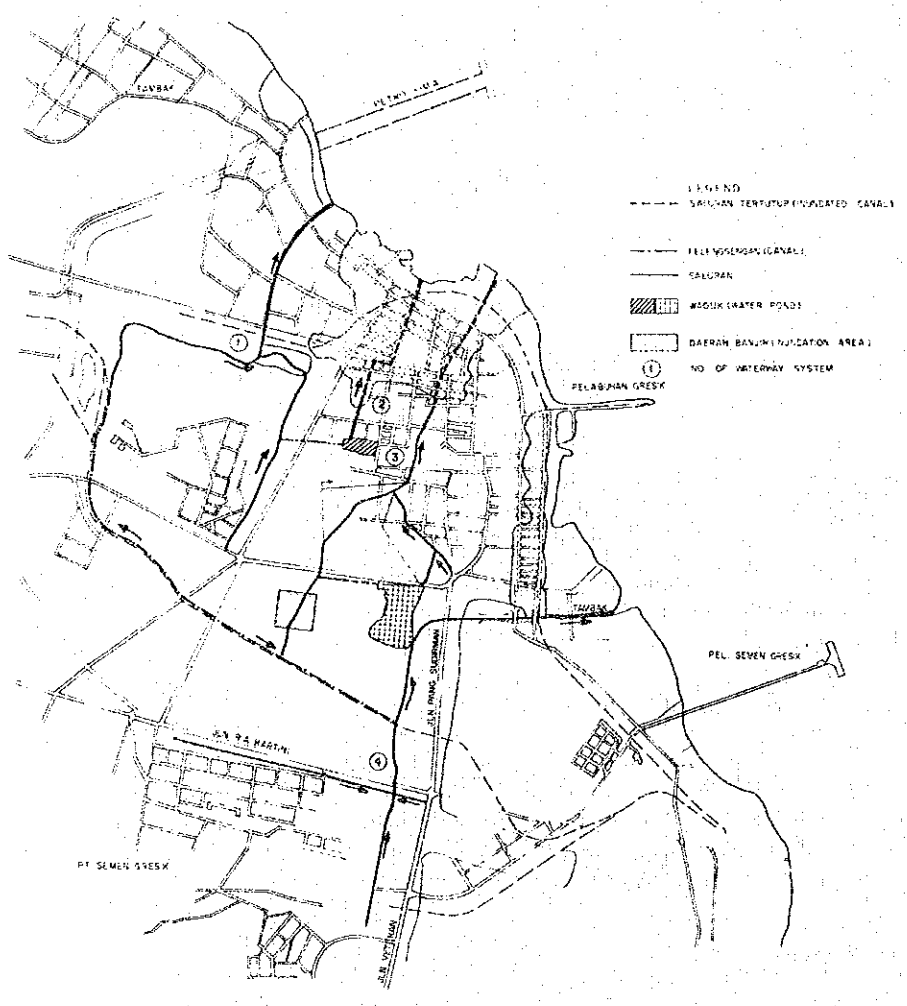


Fig. 2.7.5 EXISTING DRAINAG SYSTEM IN GRESIK

(2) Inundation Problem

Inundation areas are shown in Fig. 2.7.5. The cause of the inundation is:

- Lack and difficulty of maintenance (cleaning) in the drainage system 1 and 3 due to the existence of road and houses on the canals.
- Small canal capacity at the merging point in system 2.
- Broken water gate at Tambak in system 4

The inundation periods of these areas is reported to be about 3 hours.

KAMAL

There are 3 secondary rivers defined in the Kamal area within SMA: namely tellang, Korok and Rebon. The river lengths are approximately 8 km Tellang, 2 km Korok and 1.6 km Rebon. The river bed slopes are steeper than Surabaya and Sidoarjo ranging from 30 to 50 m in the upstream of the rivers. No river improvement has been made in the past.

2.8 UTILITIES

2.8.1 WATER SUPPLY

GENERAL

Water supply is one of the critical resources for urban development and it is necessary to clarify the potential, availability and possibility of various water resources. Data and information were collected from relevant agencies not only from GKS Region but also within East Java. Study reports conducted in the past were reviewed in detail. East Java is in a poor situation for water supply, and little water volume and low water pressures prevail in the piped water system.

WATER SUPPLY SITUATION

This section considers the general supply situation in GKS Region and SMA. The description is given for two categories namely urban water supply (drinking, industry, commercial, etc.) and irrigation water usage.

(1) Urban Water Supply

The direct piped water supply situation in GKS Region is currently at a very low service level as shown in Table 2.8.1. Major water supply features in GKS are summarized as follows:

- In the rural area only Kabupaten Mojokerto has a piped supply system.
- Surabaya is the highest service area in GKS Region and serves 49.4% of the population, 46.5 L/day/capita. Mojokerto city is the lowest service level among the city areas, although the spring sources yield abundant water.
- The water source is mostly from springs except Surabaya and Bangkalan.
- Two new plants are operated in Bangkalan (Tangkel in 1981) and Surabaya (Ngagel-III in 1982). The Babat plant is expected to operate in 1982 for Babat and Lamongan cities.
- The future water supply in Surabaya up to 1985, as scheduled by PDAM Surabaya (Drinking Water Corporation, Surabaya) is shown in Table 2.8.1.

(2) Irrigation Water Supply

In 1981 the irrigated area in GKS Region was approximately 137,000 ha. The development trend (1970–1981) shows a decrease of 4.7%. In the same period, that of Surabaya decreased by more than 40% due to the urban expansion. Only Lamongan increased by 1.4%. Lamongan is however the least developed irrigation area in GKS, while Sidoarjo is the most developed. In Surabaya all irrigation canals are polluted and used as sewerage canals. Table 2.8.2 shows water supply situation from various water resources for GKS irrigation sections in 1980/1981.

Sidoarjo, Mojokerto and Surabaya irrigation sections are highly irrigated. This indicates that water in the Brantas system is abundant. Sala River supplies a small amount of water to the Lamongan irrigation system. No records are available for Lamong river.

(3) Water Use in SMA (1980)

In 1980 the water use situation in SMA was estimated and summarized as follows:

- Residential water was supplied to an estimated 34.3% of the SMA population; piped service was 10.9% and vendor service was 23.4%. Piped water was supplied at 2.5 million m^3/month through 65,300 connections and selling water (vendor) was served at 407,400 m^3/month through 4,000 vendors.
- The other water supply for industrial, commercial and social uses are shown below.

Water Use	Number of Connections	Consumption (m^3/month)
Industrial	731	306,500
Port	2	25,000
Commercial	12,484	608,300
Social	3,087	706,900
Total	16,305	1,646,700

Table 2.8.1 PIPED WATER SUPPLY SITUATION IN GKS REGION

Kabupaten/ Kotamadya	Service Level % ; L/day/Capita		Yield (L/sec), Water Source	Remarks
	City Area	Rural Area		
Lamongan	7% ; 10 L	-	10, Mantup Spring	May, 1982
Bangkalan	14% ; 22	-	35, Bancarang River	May, 1982
Mojokerto	2.4% ; 3[1]	0.5% ; 1.8L	Kab.-115, Jubel, Mojo, Ubalan Springs Kot.-33, Balongsari, Jubel Panggreman Springs	Rural figures are for 1981. City figures are for Feb. 1982.
Sidoarjo	5% ; 3.2L[2]		18-Jubel Spring 75-Umbulan, Pandaan Spring 20-Porong river	May, 1982
	12.1% ; 17.9	-		
Surabaya	49.4% ; 46.5		311-Taman, Umbulan, Springs 2500-Surabaya river	Jan, 1982
Gresik	10.6% ; 19.5	-	12-Suci Spring	Monthly average in 1981

Note : 1) These figures include residential houses, Social use, Hospital use.
2) These figures are for the whole Kabupaten.

PDAM SURABAYA PLAN (UP TO 1985)

Source	Existing (L/sec)	Future (L/sec)
Taman Spring	211	211
Umbulan Spring	100	150
Umbulan New Spring	-	3,000
Ngagel Plant- I	1,000	1,500
- II	1,000	1,000
- III	1,000	1,000
Karangpilang Plant	-	1,000
Mini Plant	-	100
Resource Development	-	100
T o t a l	3,211	8,061

Table 2.8.2 IRRIGATION WATER SUPPLY SITUATION IN GKS REGION

Unit : l./sec

Water Resources	I Apr Jun 4 - 6	II Jly Sep 7 - 9	III Oct Dec 10 - 12	IV Jan Mar 1 - 3
Lamongan Section				
Bengawan Sala	575	930	-	-
Other Rivers	134	46	-	101
Water Reservoir	2,041	1,919	-	1,664
S w a m p	1,185	794	-	3,032
Total	3,935	3,689	-	4,797
Sidoarjo Section				
Brantas river	10,384	5,661	12,653	42,280
Spring/Pump	754	319	931	2,263
Total	11,138	5,980	13,584	44,543
Wonokromo Section				
Surabaya River	2,504	1,679	1,577	3,694
Mojokerto Section				
Brantas River	1,181	492	417	2,374
Marmoyo River	161	63	129	316
Porong River	753	353	806	831
Other Rivers	11,243	6,704	10,351	23,395
Total	13,338	7,612	11,703	26,916
Bangkalan Section				
Bangkalan River	568	1,146	2,160	2,349
Asemtanto River	550	16	823	-
Other Rivers	57	17	583	-
S p r i n g	109	128	909	839
Total	1,284	1,355	5,830	3,188

Source : Pengairan Tk-I Jawa Timur.

EXISTING WATER FLOW IN SURABAYA RIVER

(1) Drainage System in Upper and Middle Reaches

The main features of the Brantas Basin are shown in Fig. 2.8.1. The Brantas Basin is an important agricultural area and many irrigation areas were established during the Dutch Colonial period. Recent extensive development of the Brantas Basin has enlarged the irrigation area, improved drainage and also provided considerable capacity for hydro-electric power production. In respect of the present study it is important to understand the influence, of these developments on dry season Brantas flows. The Brantas Project Office established the project schedule for the river development up to year 2000. There are several projects in the upper/middle Brantas which affect the discharges in the lower reaches and these were taken into account for analysing the distribution of low flows in the river.

There are many planned developments in the basin, the precise effect of which is still uncertain. However since most are on tributaries which contribute little or no water to the main river during the critical low flow periods, it can be assumed there will be no further reductions in flows in the lower Brantas and these projects have been ignored in this report.

(2) Minimum Discharge for the Lower Reach

To determine the availability of water for the Kali Surabaya, it is necessary to analyse flows in the neighbourhood of Mojokerto. For this purpose SURABAYA WATER USE STUDY was conducted by Directorate General Cipta Karya in June 1981.

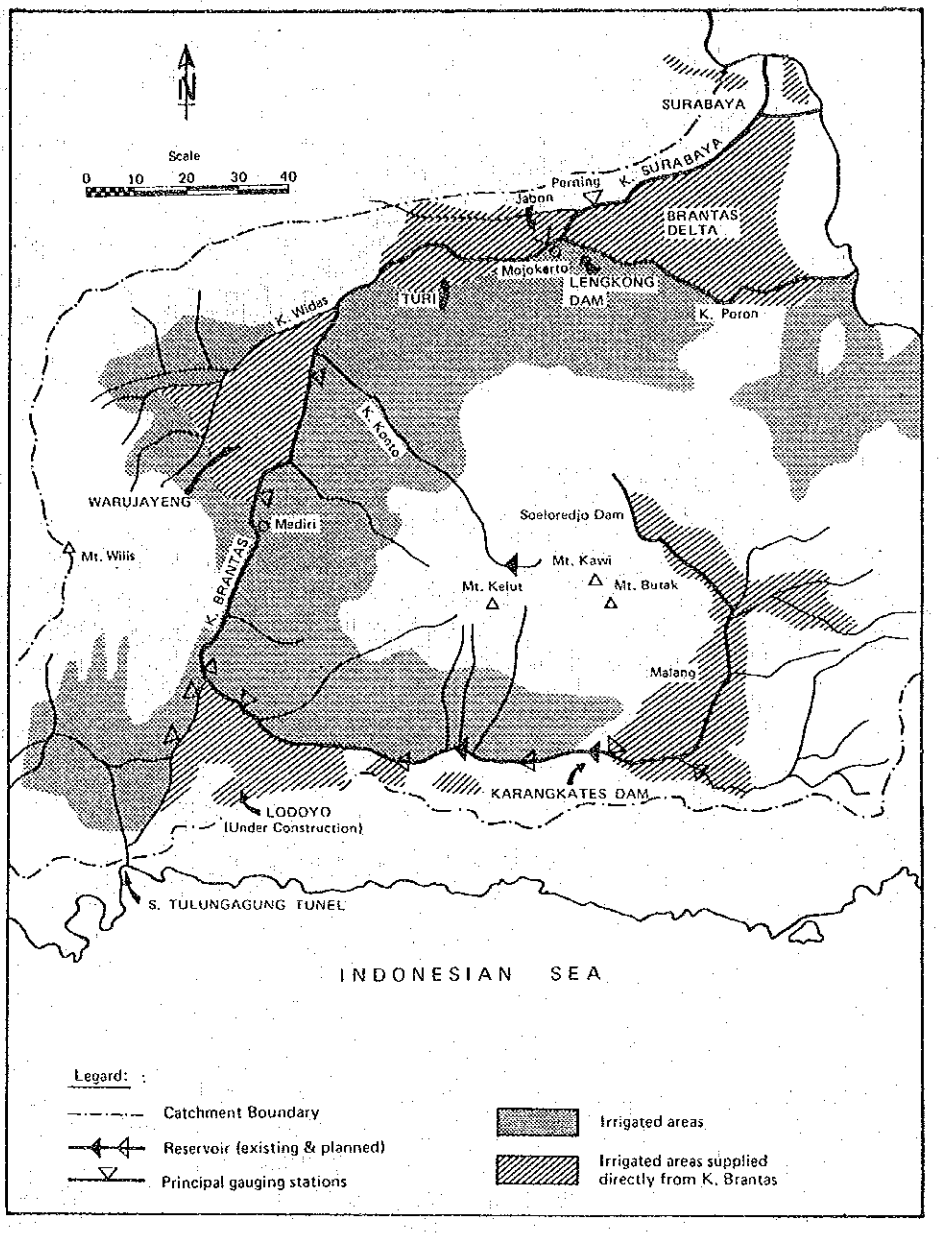


Fig. 2.8.1 BRANTAS BASIN

A schematic river flow in this area is shown in Fig. 2.8.2. The Brantas river flows into Kali Surabaya and Kali Porong through Mlirip Sluice and Lengkong Dam, but the water intake for Brantas delta irrigation area is located before the Lengkong Dam. Kali Kedung Soro diverts before Jabon gauging station and merges with Kali Marmoyo. The Perning gauging station is located downstream of the junction of Kali Surabaya and Kali Marmoyo.

An analysis of flows in the Kali Surabaya at Perning is invalid since these depend primarily on controlled releases from the Kali Brantas, and have increased significantly in recent years. However it is possible to analyse a combination of flows which is independent of the varying pattern of releases to the Kali Surabaya and also includes natural inflows from the Kali Marmoyo and Kali Kedung Sumur, ie., the base flow component in the Kali Surabaya. A low flow frequency analysis on the mean 10-day available Perning discharges was performed for both the naturalized flow series and for flows regulated by Karangkates reservoir.

As the result, a minimum mean 10-day discharge at Perning was established on the basis of the historical record. Since 1973 the mean 10 day flow at Perning has never fallen below 11 m^3/sec. and this figure was proposed as the minimum allowable discharge in the future.

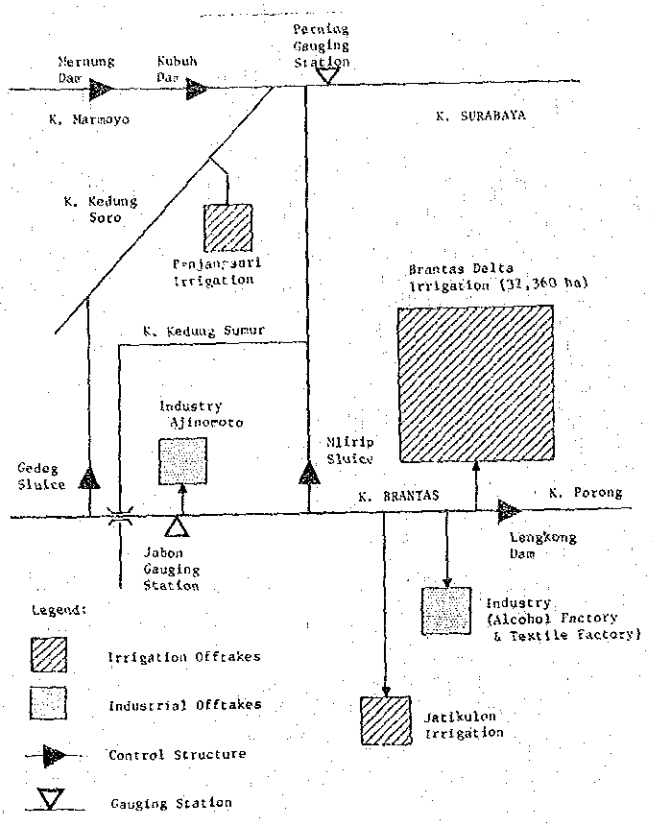


Fig. 2.8.2 RIVER SYSTEM NEAR MOJOKERTO

(3) Existing Water Balance of Surabaya River

The Kali Surabaya is one of two major distributaries of the Kali Brantas, extending from Mlirip sluice, east of Mojokerto (see Fig. 2.8.3.) to Surabaya. There are three significant left bank tributaries, the Kali Kedung Sumur, the Kali Marmoyo and the Kali Kedurus.

The first major structure on the river is Gunungsari dam which was rebuilt in 1981, and maintains water levels for 9 irrigation intakes between Sepanjang and the dam, with a total command area of 2500 ha. Immediately downstream of Gunungsari Dam, the Kali Surabaya is joined by the Kali Kedurus, which has a catchment area of 67 km^2. There are no streamflow records for the Kali Kedurus, but observations during 1980 indicate that dry weather flows are negligible.

The second major structure on the river is Jagir Dam, located 2.5 km downstream of Gunungsari. Jagir dam maintains a head for the Surabaya Water treatment works, and diverts water into the Kali Mas through Wonokromo sluice. During the dry season little or no water is discharged through Jagir Dam, and at such times levels in the Kali Surabaya are in effect controlled by Wonokromo sluice. The dam is used to maintain water levels in the river for the Jeblokan and Kalibokor irrigation offtakes, and for several industrial offtakes. The channel downstream of Gubeng dam is tidal, and enters the sea at Tanjung Perak.

(4) Existing Abstractions

Water is taken from the Kali Surabaya for irrigation, industrial and domestic purposes. The location of the various principal irrigation and industrial areas and the Ngagel water treatment plant is shown on Fig. 2.8.3.

— Irrigation Offtakes:

There are eleven irrigation offtakes (including four for Rowowiyung irrigation area) on the Kali Surabaya and Kali Mas. The irrigation Service estimates the total irrigated area of those systems taking water from the Kali Surabaya and Kali Mas to be 3940

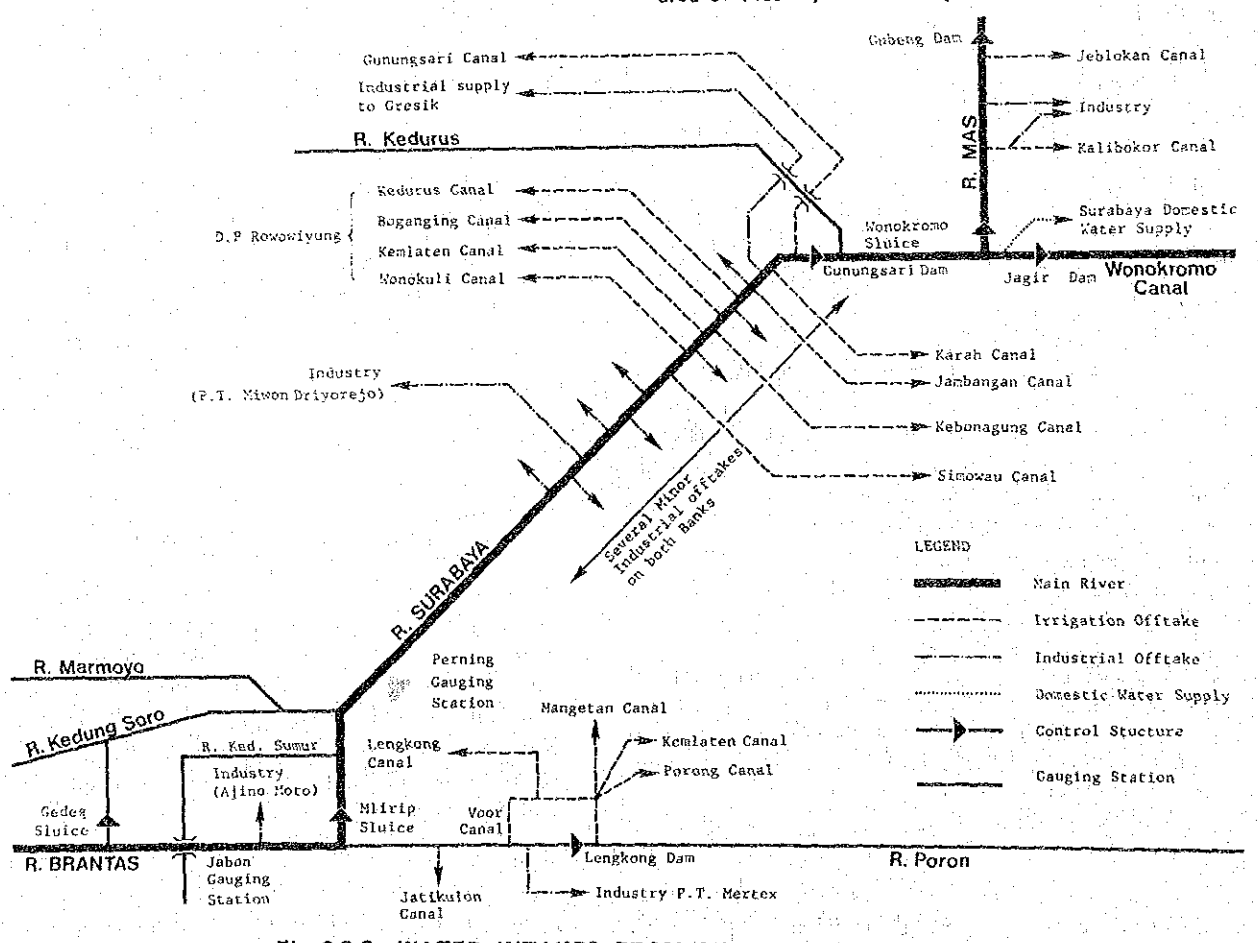


Fig. 2.8.3 WATER INTAKES FROM SURABAYA/MAS RIVER

ha. The area has declined steadily in recent years due to urban expansion in the vicinity of Surabaya. In 1975 it was reported to be 5350 ha and the systems were originally constructed for 7000 ha.

Details of the estimated water requirements and actual recorded canal discharges for the irrigation areas are given in Working Paper No. 4. The total water requirements are estimated as 4.2 m^3/sec to 2.0 m^3/sec from June to November.

– Industrial Abstraction:

There are 23 licenses abstractions for industrial purposes from the Kali Surabaya and its associated canal systems (not including abstractions from the Brantas delta canal system). The total licensed abstractions from the Surabaya river and Mas river amount to 1.0 m^3/sec.

– Surabaya Domestic Water Supply

The largest single licence holder for water abstractions from the Kali Surabaya is the Surabaya Water Supply Authority (PDAM), which can take up to 2 m^3/sec for its Ngagel water treatment. The licensed abstraction is shortly to be increased to 3.3 m^3/sec following full operation of an estention to the treatment works. Due to losses in the treatment works and partial operation of Plant III, the actual abstraction from the river in July 1982 was 2.5 m^3/sec; part of this being returned to the Wonokromo river, just downstream of Jagir Dam, as filter washwater and sludge removed from the clarifiers.

– Summary of Water Balance:

A summary of water requirements and the availability of water is given in Table 2.8.3. From the results, water for dilution and flushing is available in a range of 1.9–4.1 m^3/sec in the dry season, since minimum Perning discharge is 11 m^3/sec.

Table 2.8.3 WATER BALANCE IN KALI SURABAYA

Unit : m^3/sec

Item	Jun	Jul.	Aug.	Sep.	Oct.	Nov.
Domestic	3.3	3.3	3.3	3.3	3.3	3.3
Industry	1.0	1.0	1.0	1.0	1.0	1.0
Irrigation :						
D.P. Rowowiyung[1]						
Simowau canal						
Kebonagung canal	2.2	2.4	2.3	1.7	1.4	1.8
Jambangan canal						
Karah canal						
Canungarri canal						
Kalibokor canal[2]	0.9	1.1	1.1	1.1	0.8	0.0
Jeblokan canal[2]	1.1	0.7	0.7	0.7	0.5	0.2
Leakage, evapotation and other losses	0.6	0.6	0.6	0.6	0.6	0.6
Minimum discharge to meet requirements of water supply, industry and irrigation	9.1	9.1	8.8	8.4	7.6	6.9
Minimum Perning discharge	11	11	11	11	11	11
Available water for dilution and flushing	1.9	1.9	2.2	2.6	3.4	4.1

1. Discharge to D.P. Rowowiyung, the Simowau, Kebonagung, Jambankan, Karah and Canungari canals is based on historical usage.

2. Discharge requirements assessed from the 1980 cropping data.

(5) Delta Irrigation Requirements

A detailed estimate of the water requirements for the delta irrigation system was made by SANYU CONSULTANTS from cropping data for the period 1962/1963 to 1969/1970. Revised estimates of water requirements have been made by Sir M. MACDONALD & PARTNERS, on the basis of 1973–1979 cropping data, to account for the effect of new rice varieties which have been introduced in recent years. The revised optimum water requirements at the head of the system are given in Table 2.8.4.

Table 2.8.4 WATER REQUIREMENTS FOR THE DELTA IRRIGATION AREA (m^3/sec)

June	July	August	September	October	November
40.5	46.7	46.0	36.5	26.7	44.2

ALTERNATIVE WATER SOURCES IN EAST JAVA

For the urban development of SMA, alternative water sources, such as ground water, spring and surface water sources, are studied in this section. The selected sources in this study limited to a radius of 100 km from Surabaya city to allow for economic water transmission.

(1) Ground Water

The Directorate General of Water Resources Development has encouraged deep water development for many years. The areas developed in the past are mainly distributed in the hilly areas or on the mountain slopes of Tuban, Mojokerto, Pasuruan, Probolinggo and Bangkalan regions as shown in Fig. 2.8.4. The following table shows the survey results in these regions. The yields show comparatively high values in Tuban region and rather low values in Pasuruan and Probolinggo. In each region the drilled depth was recorded as less than 100 m in total. The developed water in each well is utilized mainly for irrigation purposes and their yields are less than 70 L/sec as shown below:

Area	Well Depth (M)	Constant Discharge (L/sec)
Tuban	30 – 70	66 – 67
Mojokerto	40 – 95	19 – 60
Pasuruan	20 – 90	9 – 35
Probolinggo	50 – 95	3.5 – 31.5

From these wells, areas of 114 ha in Tuban, 103 ha in Mojokerto, 45 ha in Pasuruan and 87 ha in Probolinggo area are irrigated. It is understood that these water sources are not utilized economically for SMA water supplies.

(2) Spring Water

A total of 8 Kabupaten around GKS region were studied based on the 1980 data from the Proyek Air Bersih Jawa Timur. They are Jombng, Bojonegoro, Tuban, Malang, Pasuruan, Kediri, Probolinggo and Nganjuk as shown in Fig. 2.8.4. Through this study, some indication of the existing water situation around the GKS region can be understood.

Among those spring water sources, some sources with an abundant yield are listed:

Name of Spring Source	Yield (l/sec)	Name of Spring Source	Yield (l/sec)
- Tuban Region		-Malan Region	
Bektiharjo	1,132	Mendit	500
Srunggo	430	Bureng	1,500
Bungkok	520	Kajar	400
Krawak	444	Taman	575
Beron	458	Lenggak Songo	300
Ngerong	693	Umbulan I	981
- Bonjonegoro Region		- Probolinggo Region	
Ngunut	300	Ronggojalu	3,000
Pirang/Arum	583	Kowo	470
Ngerong/Beron	400	- Pasuruan	
- Kediri Region		Umbulan	5,000
Biru	760		

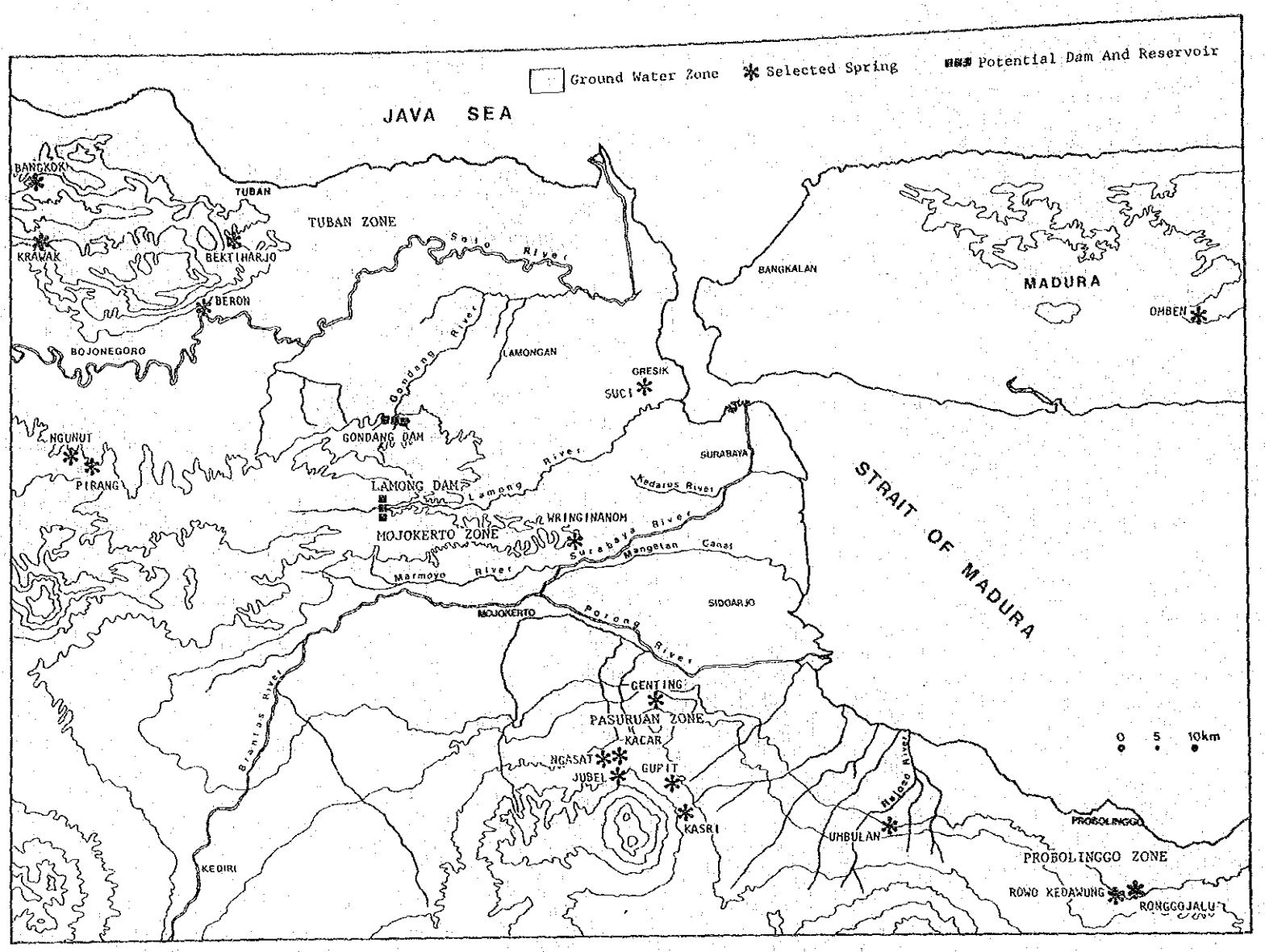


Fig. 2.8.4 ALTERNATIVE WATER SOURCES IN EAST JAVA

Data on the existing water utilization and surplus were however not obtained. Consequently these sources are not included in this study and this provides a task for future study.

(3) Surface Water

Many of the rivers influencing the GKS Region have high water use potential. A large quantity of the high rainfall flows out to sea without utilization, and these water resources should be developed further.

– Brantas River

The annual rainfall in the basin is about 2000 mm of which about 80% occurs in the wet season from November to April. The total surface water potential in the basin amounts to 24 billion m^3. About 50% of the surface water is evaporated and 9 billion m^3 is used for irrigation purpose. The remaining 3 billion m^3 is not utilized and flows into the sea.

– Sala River

The total rainfall is about 2100 mm of which about 80% occurs in the rainy season. Only 10% of the annual rain occurs in the dry season from June to September, the rest falls in the transition periods in October and May. The total surface water potential in the basin amounts 16.7 billion m^3 as surface runoff into the stream, but only 2.6 billion m^3 is utilized for irrigation purposes. The future water demands for irrigation and urban water in the basin were estimated in 1974 to become about 14,340 million m^3.

Despite the large water potential of the basin, the possible surface storage capacity is small, and is expected to be only 2,246 million m^3 in gross total. The prospective availability of water will be far less than the possible demand and only 22% of the incremental demand can expect to be satisfied.

– Lamong River

There are no rain gauge stations in the basin, but there is an automatic flow recording station in Simongagrok, located to the north-west of Mojokerto city. The station records over the period 1950 to 1978 indicate that the average annual discharge in the basin amounts to 800 million m^3, as follows:

Maximum Average Monthly Flow (February): 828.6 m^3/sec.
Minimum Average Monthly Flow (September): 28.1 m^3/sec.

There have been no river improvement plans executed in the basin. However, recently the Lamong dam was planned for irrigation purpose with a storage capacity of 12.7 million m^3 in the upper reaches, but there is no construction schedule yet. The Lamong area is not a good prospect for irrigation. The water use from the dam to SMA is not considered.

– Bancaran River

The Bancaran river is the only river running through Bangkalan city. No general information is available, but the discharge at the Tunjung dam was recorded as 6.7 m^3/sec maximum, and 4.0 m^3/sec minimum. This water source will be utilized for the development in Kamal.

– Results

Unutilized water of 3 billion m^3 in the Brantas river, 14 billion in the Sala River, 300 million m^3 in the Lamong river are identified at this stage. Further efforts in promoting water utilization from existing water potential will be desirable.

2.8.2 WASTE WATER

Todate, there has been no operation of a wastewater treatment system in the GKS Region. The realization of the system is related to conditions such as environmental situation, inhabitants understanding and demands, and budget constraints, etc.

WASTEWATER SYSTEM

There are at present only two small areas in Surabaya city, at Ngaglik and Kalibutuh, that have sanitary sewer systems. The sewers, which are over 50-years old, carry wastewaters from connecting residences to nearby drainage ditches and serve a total of less than 5000 people. Both of these systems are no longer effective.

With the exception of these minor separate collection systems, SMA relies on household septic tanks and cesspools for domestic wastewater disposal. Many homes are without such facilities and simple latrines are constructed directly over waterways. Other residents having no access to private household facilities rely on public toilets or use semi-private lartines located along many principal ditches, rivers and canals. Wastewater from commercial, institutional and industrial activities is also discharged to nearby ditches and canals after passing through on-site septic tanks, cesspools or simple holding basins. Most large industrial establishments are located along the principal river systems and discharge directly to the river.

HOUSEHOLD OPERATION

There is no effective collection, treatment or disposal of household wastewaters in the SMA. In 1980 it was estimated that there were approximately 180,000 private toilets and disposal systems available to 890,000 persons in SMA. It is normal practice for only toilet waste to be flushed into septic tanks while sullage water from bath, laundry and kitchen uses are discharged directly to the nearest drain. Average septic tank capacity is 2 m^3 with a maximum of 4 m^3, and minimum of 1.5 m^3.

Night soil collection is reported to operate in Surabaya. Four private companies operate with an average of 10 trucks, and a total capacity of 30 m^3. The payment made by residents is 5000 Rp. per m^3 in week days and 20% additional payment on holidays. The service is made at a rate of 8 houses/day/truck (200 – 240 houses/month) in the rainy season and 15 houses/day (375 – 450 houses/month) in the dry season. The collected night soil is disposed in the Wonokromo river, just downstream of the Jagir dam.

Most toilets are flushed by water taken from an open water tank that is filled by bucket from wells or the PAM system. Gravity-flush toilets are assumed to be used in only 15 percent of the homes due to higher costs and lack of continuous water pressure to supply tanks. A typical household wastewater collection and disposal system is illustrated in Fig. 2.8.5.

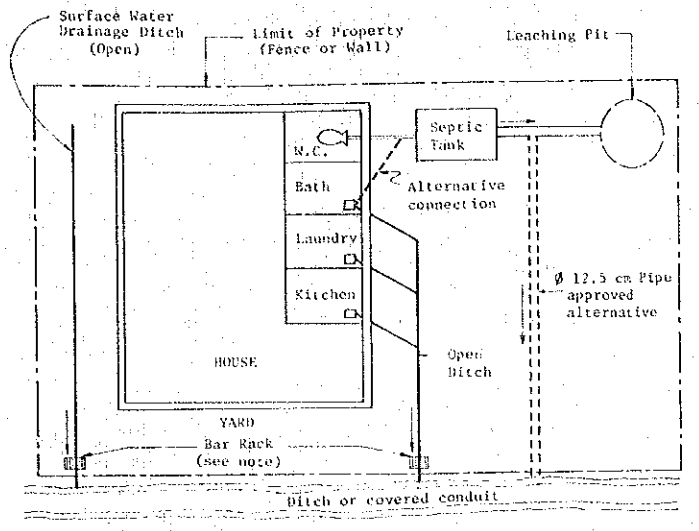


Fig. 2.8.5 HOUSEHOLD WASTEWATER FACILITIES

PUBLIC TOILET FACILITIES

There are presently 300 public toilet facilities reported in Surabaya. These have been constructed by the Public Works Department/Kampung Improvement Project (KIP Project) and many of them are operated by PAM. Of these, 131 toilets were constructed by KIP Project in Urban II (1976–1979) and 66 toilets in Urban III (1979–1982). These toilets in Urban II and III serve 894 ha, about 418,300 persons, and average 2,100 person per public toilet.

The KIP project defined a total of 115 kampungs with total area of 3,795 ha (1,460,000 persons) within 11 old Kecamatans. At the end of the KIP project roughly 700 public toilets will have been constructed.

The facilities are served by piped water and include flush toilets with sub-surface disposal systems, bathing and laundry areas. The public facilities usually contain between two and ten individual toilets and occupy areas of from 100 to 400 sq. meters.

In addition to public toilet facilities there are also many makeshift enclosures used as latrines that are erected on wood poles over waterways. Although these are constructed by individuals and are not "public", it is evident that persons from more than one home use such enclosures. As an indication of the number of these semiprivate facilities there are 33 units along a 1.7 km stretch of Gunungsari canal between Jl. Padmosusastro and Jl. Kembang Kuning.

It has been concluded that about 640,000 people are currently using the public toilet facilities in SMA. There is a need to expand the programme; construct new facilities, improve existing facilities, and provide a better maintenance programme.

INDUSTRIAL OPEATIONS

There is no effective control over the treatment and discharge of wastewaters from industries except in the Surabaya Industrial Estate Rungkut. Industries in SMA discharge untreated liquid wastes directly to nearby rivers or canals. The drainage ditches in areas surrounding most industrial sectors of SMA are unsightly due to waste discharge. During 1975, the municipal water treatment plant was forced to shut down on two occasions as the results of upstream discharges of toxic industrial wastes to the Surabaya River. An industrial survey was made in which questions were asked of major industrial firms as to the quantity and characteristics of their waste discharges. Little quantitative information was made available and only very rough estimates of present and future industrial wastewater flows and loads can be made.

It is anticipated that all large industrial estates which will be developed in the future will be required to provide some form of adequate collection, treatment and disposal of their wastewaters similar to that in use at the Industrial Estate at Rungkut.

Night soil collection is also served by private companies for offices, factories and hotels. The septic tank capacity ranges from 50 to 80 m^3. Five or six septic tanks are served by one company in a month.

2.8.3 SOLID WASTE

GENERAL

Each Kabpaten or Katamadya operates solid waste management only in the city area and operations do not meet the full requirements generated in all their administrative area. The solid waste service is a vital service for urban residents and social activities.

EXISTING SOLID WASTE OPERATION

Serious difficulties are presently experienced in refuse collection and disposal services in Surabaya. While most difficulties are due to budget constraints, it is evident that even with adequate funding, present operations and methods will require significant modification in order to manage the larger solid waste quantities anticipated in 2000.

Within the administrative framework there are three offices immediately concerned with solid wastes management and these are the Departments of Public Works (DPW), District Governments, and Public Health. These departments are responsible for the present operation of the solid wastes system as it pertains to collection, transport, disposal and public safety.

Within the Department of Public Works the City Cleaning Section is most directly responsible for refuse management. Its responsibilities are divided into two categories: street cleaning (including sweeping, trash rack cleaning and berm repairs), and solid wastes management. The latter includes maintenance of disposal bins or other receptacles at public collection centers, systematic pickup and transport of refuse to disposal sites, operation of disposal sites, and administrative control of private contractors and industries engaged in refulse collection and transport to disposal sites. A well-managed solid wastes organization can not keep the city clean without the assistance of the community and associated branches of the city government.

Solid wastes are stored in private bins provided by the solid waste producers ie; households, hotels, meeting halls, hospitals and stores. The solid wastes are collected in hand carts by collectors from the cleaning department or from Rukun Tetangga and Rukun Warga and then stored in trailers and at collecting stations. The solid waste collected in the trailers and at stations are transported by hauling the trailers with tractors, press truck, flat bed trucks and hydraulic trucks to the final disposal sites or the compost plant operated by a private company. Transportation can be carried out at any time so long as it does not cause a nuisance to the residents and does not hinder the flow of traffic.

At the disposal sites, usually landfill areas, bulldozers are operated. The site must be planned not as to cause a negative influence upon the public, living environment, or ground water. The sites are usually located in places remote from the Central Business District but due to the difficulties of obtaining sites, there are some located in open spaces in the urban area.

SOLID WASTE PRODUCTION IN SMA, 1980

(1) Production Volume

The following table shows the solid waste production in 1982 based on information from Katamadya/Kabpaten.

Unit : m^3/day

Kab./Kot.	Residence	Commerce	Industry	Social	Market	Total
Surabaya	4,000	100	300	100	500	5,000
Kota Gresik	-	-	-	-	-	100
Kec. Kebomas	5	3	0.3	0.5	5	13.8
Kota Sidoarjo	-	-	-	-	-	117.2
Krian	-	-	-	-	-	30.5
Taman	-	-	-	-	-	30.6
Waru	-	-	-	-	-	-

This data does not present the actual production and is assumed to be based on the volume actually received.

The actual generated volume must therefore be estimated. The estimate for solid waste production is made using the unit rate surveyed in the study for SURABAYA WATER, WASTEWATER, DRAINAGE AND SOLID WASTE in September 1976 (socalled "CDM Report").

The solid waste production in 1980 was estimated to be as shown Table 2.8.5.

Table 2.8.5 SOLID WASTE PRODUCTION BY CATEGORY IN SMA (1980)

Production / Categories	Volume (m^3/day)	Weight (ton/day)
Residential	9,077	1,366
Seaport	93	25
Naval Base	7	2
Market/Institution	424	113
Industry	934	251
Construction	39	27
Total:	10,504	1,784

The solid waste production in SMA is estimated to be 3.6 L/capita/day and 614 g/capita/day. Compared with the production volume, the handled volume is assumed to be 35% in SMA. The remaining 65% of solid waste is not handled, and disposal is by dumping into convenient areas such as ditches and canals, and by unregulated burning.

(2) Physical Composition

No survey on the physical composition of solid waste has been recently conducted. The composition changes according to the change of society and Table 2.8.6 shows the composition in some countries.

FACILITIES AND EQUIPMENTS

The facilities and equipment used in collection, transportation and disposal work are shown in Table 2.8.7.

The land fill sites currently available are 20 ha Keputih, 8.5 ha Asemrowo in Surabaya, 3 ha Rowa/Kebomas in Gresik, 1.5 ha Sidoarjo, 0.8 ha Krian, and 0.2 ha Taman in Sidoarjo.

P.T. Kurnia's composting plant, a private commercial venture, has been in operation for about 7 years. It has a rated capacity of 475 ton/day of solid waste.

Table 2.8.6 PHYSICAL COMPOSITION COMPARISON

Composition / Waste by Category	Composition (%)		
	Surabaya 1975	Bangkok 1980	Japan 1976
Paper Products	2	18	35.4
Garbage (Market and Yard)	94	36.1	16.0
Glass and Metal	1	10.3	19.0
Plastic	2	10.3	11.2
Chemical and Exotics	1	-	Traces
Construction and Container	Traces	10.3	8.8
Others	Traces	15.0	9.6
Total	100	100	100

Table 2.8.7 EXISTING FACILITY AND EQUIPMENT IN SMA

Facilities and Equipment	Unit	Surabaya	Gresik	Sidoarjo	Kamal	Total
Facilities						
Compost Plant	No	1	-	-	-	1
Land filling Site	No	2	2	3	-	7
Temporary Storage	No	42	6	61	-	109
Container Depot	No	11	-	-	-	11
Trailer Depot	No	33	-	-	-	33
Equipment						
Trailer	No	65	-	-	-	65
Container Truck	No	17	-	-	-	17
Tractor (for trailer)	No	29	-	-	-	29
Press Truck	No	2	-	-	-	2
Flat Bed Truck	No	1	7	5	-	13
Bulldozer	No	2	1	-	-	3
Hand cart	No	150	10	16	-	176
Waste Basket	No	400	-	-	-	400
Broom	No	4,000	-	-	-	4,000
Shovel	No	40	-	-	-	40
Hoe	No	150	-	-	-	150

Temporary storage and container/trailer depots in Surabaya are as follows:

	No.	No. of Trailer/Container	Capacity (m^3)
Temporary Storage	42	--	1,588
Trailer Depot	33	54	1,015
Container Depot	11	42	293
Total:	86	96	2,896

By 1983 four additional container depots will be available.

Capacity and Size of Equipment

Type of Equipment	Capacity
Transport/Handling	
Trailer	—
Press truck	20 m^3
Flat bed truck	3/4 ton
Tractor with trailer	10 m^3
Bulldozer	2 – 4 ton
Container truck	6 m^3
Cart/Tool	
Hand cart	1 – 1.5 m^3 (1 x 1.4 x 0.8 m)

ORGANIZATION/PERSONNEL

In Surabaya three cleaning sections, north, south and east are operated under the control of Solid Waste Urban III sub-project office. As shown in Table 2.8.8, in 1982 a total of 2,010 persons are engaged in cleaning work in SMA.

BUDGET STATISTICS

No budgetary data was available in Gresik, Sidoarjo and Kamal. A total of 1,764 million Rp. was spent for cleaning work in Surabaya in 1981/1982 as shown in Table 2.8.9.

Table 2.8.8 PERSONNEL IN SOLID WASTE, 1982

Kabupatan/Kotamodya	Administration Staff	Cleaning Section Staff	Total
Surabaya			1,798
Head Office	40	-	
Section: North	7	477	
: East	6	412	
: South	7	583	
Special Section	-	366	
Sidoarjo			142
Kota Sidoarjo		91	
Krian		25	
Taman		26	
Gresik			70
Kota Gresik		30	
Kebomas		40	
Bangkalan			-
Kamal			
Total:			2,010

Table 2.8.9 BUDGET OF SURABAYA CLEANING WORK IN 1981/1982

Unit: Million Rp.

Budget \ Fiscal Year	1977/'78	1978/'79	1979/'80	1980/'81	1981/'82
Routine Budget					
Total Routine Budget	599.8	694.3	865.4	1,222.3	1,487.8
Total Special Budget	45.8	72.5	107.0	179.3	200.0
Development					
Equipment for Final Dumping	20.0	45.0	50.0	25.0	-
Kip Urban-III	-	-	308.0	885.4	76.0
Total	665.6	811.8	1,330.4	2,312.0	1,763.8

2.8.4 ELECTRICITY

ELECTRICITY GENERATION

Fig. 2.8.6 shows the electric power system in East Java in 1985 and the generation by category between 1969/70 and 1981/82 is shown in Table 2.8.10.

From 1970 to 1982 the power generated increased by about 5 times. In 1982, 1951 GWH was generated by a total of 30 generating stations. In GKS Region 11 generating stations produced 1,035.9 GWH in 1981/82 as shown in Table 2.8.11.

Around 53 percent of the total generation in East Java was produced in the GKS Region, of which the bulk was produced in SMA.

Table 2.8.10 ELECTRIC GENERATION IN EAST JAVA

Unit: G.W.H.

Year	1969/70	1975/76	1980/81	1981/82
Hydro	128.9	436.7	682.7	833.0
Steam	221.9	140.9	511.9	986.7
Gas	-	-	56.6	41.5
Diesel	35.4	37.5	67.5	89.9
Total	386.3	615.1	1,318.7	1,951.1

ELECTRIC CONSUMPTION

In GKS Region some 214,700 consumers consumed 863 GWH in 1981/82 as shown Table 2.8.12. The Surabaya, Gresik and Sidoarjo share was 91 percent of the total number of consumers and 96 percent of the total consumption in the Region. In Surabaya, Gresik and Sidoarjo average daily consumption per consumer was 3.6 KWH for residential use, 19 KWH for commercial use, 1223 KWH for industrial use and 84 KWH for public use.

TARIFF SYSTEM

Table 2.8.13 shows the tariff on electricity consumption classified into 19 categories. Payment is usually made at PLN accountant offices or a bank contracted with PLN.

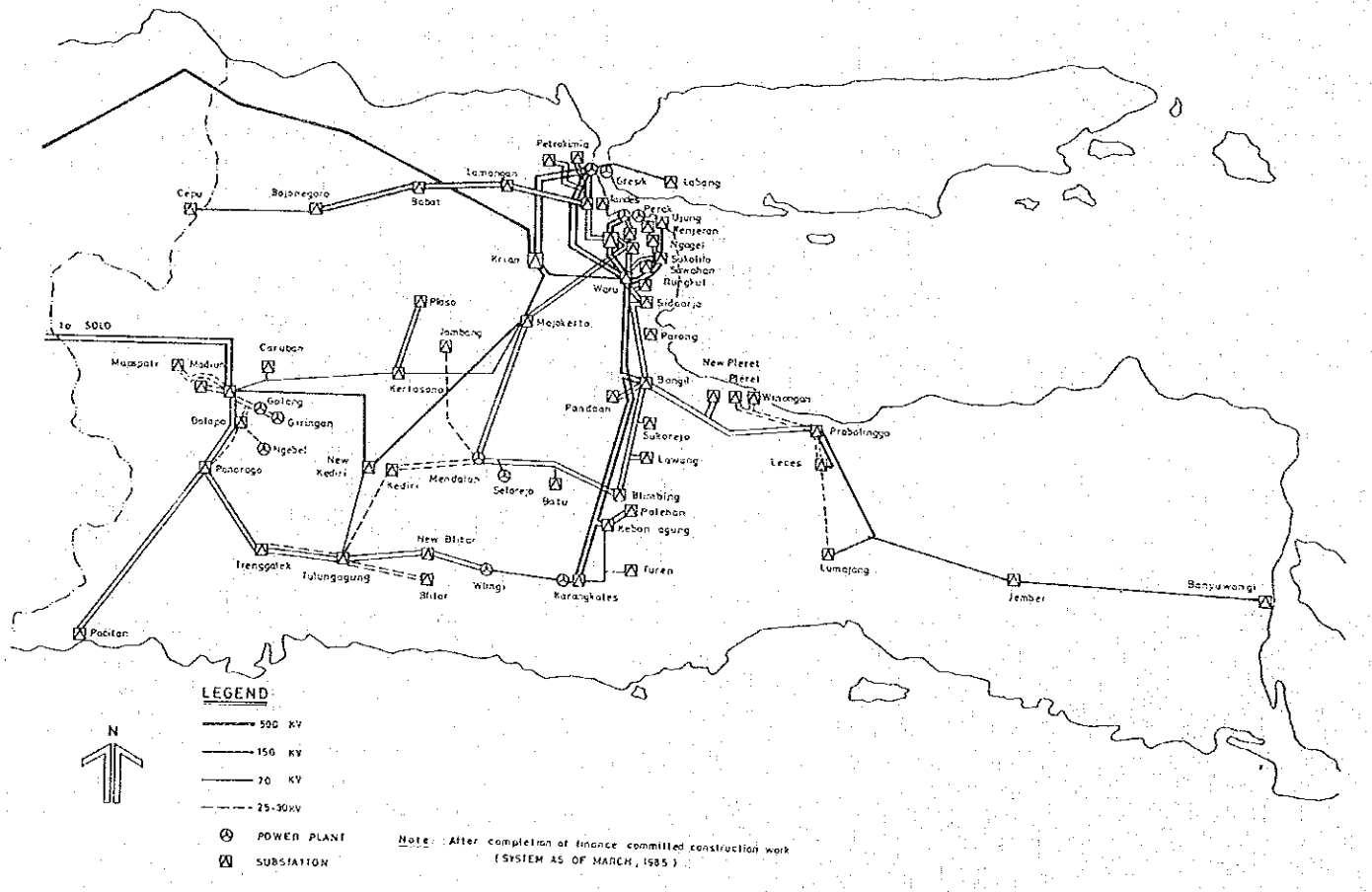


Fig. 2.8.6 EAST JAVA POWER SYSTEM

Table 2.8.11 ELECTRIC GENERATION IN G.K.S. REGION

Unit: GWH

Name of Generator			Production	
STEAM	Perak	I + II	246.9	
	Perak	III + IV	234.3	
	Gresik	I + II	505.5	
				986.7
GAS	Perak		14.0	
	Gresik	I + II	27.5	
				41.5
DIESEL	Lamongan		2.2	
	Bangkalan		4.9	
	Waru Barat		0.2	
	Tanjung Bumi		0.2	
	Kwanyar		0.2	
				7.7
	Total			1,035.9

Table 2.8.13 ELECTRICITY TARIFF (YEAR 1982)

Kabupatan/ Kotamadya	Category	No. of Consumer	Consumption (KWH)
Surabaya/ Gresik Sidoarjo	Resident	181,381	239,803,336
	Commerce	10,345	71,872,734
	Industry	976	435,738,198
	Public Service	2,512	77,318,285
	Sub-total	195,214	824,732,553
Bangialan	Resident	2,961	2,732,558
	Commerce	208	392,824
	Industry	7	71,007
	Public Service	107	649,326
	Sub-total	3,283	3,845,715
Mojokerto	Resident	11,663	11,006,070
	Commerce	780	1,634,014
	Industry	42	15,338,134
	Public Service	347	3,481,878
	Sub-total	12,832	31,460,096
Lamongan	Resident	3,204	2,181,255
	Commerce	94	157,059
	Industry	-	-
	Public Service	83	303,293
	Sub-total	3,381	2,641,607
Total		214,710	862,679,791

Table 2.8.12 ELECTRICITY CONSUMPTION IN GKS REGION (1981/82)

CLASS	DESCRIPTION		FIXED CHARGE RP./KVA	CONSUMPTION CHARGE RP./KVA
S1	Special Tariff for the poor	(60 VA to 200 VA)		
S2	Church, School, Mosque, Hospital	(250 VA to 200 KVA)	1,600	22
R1	Residential use Smallest	(250 VA to 500 VA)	1,600	37.5
R2	Residential use Small	(501 VA to 2200 VA)	1,600	45.5
R3	Residential use Medium	(2001 VA to 6600 VA)	2,800	63.5
R4	Residential use Large	(more than 6601 VA)	2,800	79.5
U1	Commercial use Small	(250 VA to 2200 VA)	2,800	66
U2	Commercial use Medium	(2201 VA to 200 KVA)	2,800	70
U3	Commercial use Large	(more than 201 KVA)	1,750	WBP-74, LWBP-46.5
U4	Temporary Connection	-	-	160
M1	Hotel Small	(250 VA to 200 KVA)	2,800	54.5
M2	Hotel Large	(more than 201 KVA)	1,750	38.5
I1	Industry Small	(3.8 KVA to 99 KVA)	1,750	WBP-49, LWBP-30.5
I2	Industry Medium	(100 KVA to 200 KVA)	1,750	WBP-46.5, LWBP-29.0
I3	Industry Large (Medium Voltage)	(more than 2001 KVA)	1,600	WBP-44.0, LWBP-27.5
I4	Industry Large (High Voltage)	(more than 5000 KVA)	1,500	WBP-40, LWBP-25.5
C1	Government Office	(250 VA to 200 KVA)	2,800	46
C2	Government Office	(more than 201 KVA)	1,500	WBP-46, LWBP-30
J	Street Lighting	-	-	41

Note: 1) Fixed Price by Class 60 VA - 905 Rp., 75 VA - 1,135, 100 VA - 1,465, 125 VA - 1,870, 150 VA - 2,200 Rp.

2) WBP - Hour 18:00 - 22:00, LWBP = Hour 22:00 - 18:00.

2.9 ENVIRONMENT

2.9.1 EXISTING CONDITIONS

GENERAL

Some striking environmental problems are prevailing in SMA. These are inundation, water/solid waste pollution, and the traffic problem. Air pollution and noise from factories are not yet serious problems.

- Inundation

  In the urban area of SMA inundation occurs frequently every rainy season and as stated in the river section of this report, lack of adequate maintenance and reduced waterway capacity are the main causes of this.

- Water Pollution

  Untreated waste water from households and industry are freely discharged into the waterway system and the existing water pollution has reached a serious condition for public health. Household operation gives a large number of coliform and skin diseases and water borne disease like cholera are common. It is reported that the Ngagel plant in Surabaya was shut down in 1971, 1973 and 1975, due to the appearance of many dead and dying fish affected by industrial pollution.

- Solid waste

  The treated volume of solid waste in SMA in 1980 is at a low service level of 35%. Considerable amount of irregular dumping of solid waste affects the majority of the urban area. The scattered solid waste not only makes the sanitary condition worse but also becomes one of the major causes of inundation.

- Traffic problem

  According to the traffic accident data supplied by Surabaya Police office, accident locations in 1981 were distributed over all the urban area. A total of 2,292 accidents occured in 1981 and 292 persons died, 1,393 persons were seriously injured and 1,062 slightly injured.

  The potential for traffic accidents rises according to the traffic conditions (volume and quality) and the street structure. It is an apparent problem that many streets are used for multi-purpose uses and by various transport mades without any defined functional structural provision. Pedestrians are always exposed to traffic hazards and few side-walks and crossing bridges are provided.

Among the problems inundation, solid waste and traffic problems are reported in the relevant sections in this report. Water pollution is therefore the remaining topic, and is discussed in the following section.

WATER POLLUTION

The fundamental problem related to current wastewater practices in SMA, especialy in Surabaya, is that of pollution – a slow but steady deterioration of the quality of the urban and rural environment brought about by inadequate collection and disposal of domestic and industrial wastes. Although this is well recognized occurance, little evaluation of the factors involved and the extent of degradation has been performed.

RIVER WATER

Laboratory tests for chemicl substances were executed by the Provincial Health Agency on the Surabaya and Mas rivers water in 1981. Results showed high values of iron, nitrite and organic substances and that the water is not suitable for drinking purpose. Coliform investigation data reported by the Technical Environment Health Agency is available along the Surabaya and Mas river for October 1980. October is the end of dry season and the number of coliform per 100 ml is shown in the following table.

The table shows that the number of coliform contained in the water starts increasing rapidly from the water intake of Nagagel Plant in Surabaya. The number reaches the maximum at Jembatan Merah bridge. It is understood that the Surabaya piped water supply has a percentible colour and smell due to the high value of excreta.

POLLUTION OF DRAINAGE SYSTEM

The drainage system which carries wastewaters from the city to the sea, receives effluent from septic tanks. The dumping of garbage and lack of hydraulic gradient, in conjunction with the long dry season, aggravates the extensive pollution of the drainage waterways and the Pegirian canal and the Morokrembangan Boezem in Surabaya are particularly affected. The Pegirian canal flows through the central part of the city for a distance of about 5.5 km and a population of 190,000 in a drainage area of about 500 ha, are estimated to contribute wastes to the water. There are many industries also located within this area so that the canal is extremely polluted. Although a sluice gate and pump station are located at the upper end of the canal (on the Mas River), for introduction of flushing water, the facilities no longer operate. The downstream reach of the canal is stagnant and odiferous.

The Morokrembangan Boezem is a storm and wastewater retention basin located to the northwest of the central part of the city. It consists of two shallow ponds with a total area of about 0.82 km^2 connected by a channel under Jl. Gresik. Three drainage canals discharge into the Boezem from an area of about 16.70 km^2 and this is nearly onehalf of the urban area of the city (a contributory population of about 400,000). The capacity of the Boezem is gratly reduced by siltation and this has resulted in extensive shallow areas where vegetation is thick and scum has been trapped along the shores which are odorous and unsightly. Surface water samples from drainage canals, the river system and street ditches within the study area were collected and analyzed for dissolved oxygen (DO) content, biochemical oxygen demand (BOD) and chemical oxygen demand (COD) on two separate occasions in August and September, 1976. Laboratory results from the sampling programme are presented in Table 2.9.1.

Table 2.9.1 MAJOR RIVER/CANAL WATER QUALITY TEST DATA

No. of Samples	General Location	DO	BOD	COD
5	Surabaya River	4.3-8.6	5-10	6-20
5	Upper Mas River	1.1-6.9	5-20	12-70
4	Pegirian and Lower Mas Rivers	nil-4.0	10-100	30-220
6	Drainage ditches*	nil-3.0	25-350	30-700
5	Morokrembangan Boezem	nil-0.6	30-400	135-1095

* : Six sampling sites located throughout the central urban area.

Source: CDM Report in 1975.

The test data illustrates the significant decline in water quality with passage from the Surabaya River area (to the south of the city), through the upper Mas to the lower Mas and Pegirian areas. The high oxygen demands and low dissolved oxygen levels in typical open street drainage ditches and in the northern retention basin of the Morokrembangan Boezem, are evident.

POLLUTION OF GROUNDWATER

Wastewaters of the cities discharge into groundwaters from both septic tank leaching systems and from unlined drainage ditches. The shallow ground water table is subject to direct pollution from these sources. Due to the number of urban inhabitants who still rely on shallow wells for water supply and the high incidence of water-borne disease in the area, the reduction of contamination in groundwaters is the major concern for health authorities.

Shallow ground water wells furnish water supply needs for the majority of the SMA's inhabitants. In general these wells are one meter in diameter, three to five meters deep and the walls constructed of brick masonry. Walls are usually built up to an elevation above danger of being topped by flood waters. It is usual practice to take water from the wells by use of a bucket, however, on higher land, such as Gunungsari Hill, hand pumps and rope winches, are used for wells up to 15 or 20 meters deep. Measurements of ground water surface levels in wells of the Ngaglik area indicates that a 50 to 100 centimeter elevation variation occurs between the dry and rainy season. Many wells are privately owned although a considerable number exist at public sanitation facilities and sometimes along the median strips of the main throughfares. Based on the number of wells in representative areas it is estimated that there are approximately 50,000 ground water wells in Surabaya. Water taken from the wells is primarily used to flush toilets, for bathing and laundry, and for irrigating local grounds. Water is not considered potable unless boiled. The wells have provided a dependable supply of water for many industrial and domestic needs.

In July 1976 water samples from 38 shallow wells were tested by CDM Study. The study reported that coliform organisms were found in 14 (37 percent) of the wells at an average density of 530 colonies per ml. Average chloride level was found to be 505 mg/l, 30 percent of the wells had levels exceeding Ministry of Health permissible limits (600 mg/l) while 87 percent were found to have chloride levels exceeding desirable limits (200 mg/l). Chloride test results are shown as follows:

	Chlorides mg/l
Average	505
Maximum	1,500
Median	360
Minimum	180

From the results, chloride contents around Darmo were about 200 mg/l in 1976, although saline water can be shut out by the Gubeng dam and Jagir dam in the Mas and Wonokrom rivers.

POLLUTION OF MADURA STRAIT

That portion of the Madura Strait located between Surabaya and the island of Madura is primarily used for shipping and fishing. Recreational use is very limited, consisting of some sailing off Kenjeran and very restricted boating and swimming near the port area. There are few areas along the shores which could be considered as potential beach resorts due to the shallow, muddy bottom. The north approach channel must be continually dredged to enable shipping to reach the port area.

Commercial fishing is an important industry in the offshore waters from Surabaya and Fig. 2.9.1 indicates the general location of the principal commercial fishing areas between Surabaya and Madura. The East Java Provincial Fishery Department reports that there is a good potential for increased cultivation of shellfish off Kenjeran if the area can be protected from pollution. Crabs, shrimp and other shellfish are presently caught in areas to the east of Juanda airport and off Gresik and Bangkalan. Bottom dragging is not allowed in the waters between Surabaya and Madura because the practice would disturb natural spawning grounds of shrimp. At one time there were areas off Gresik that were good sources for crustaceans but evidence exists that the resource has been adversely affected by industrial wastes.

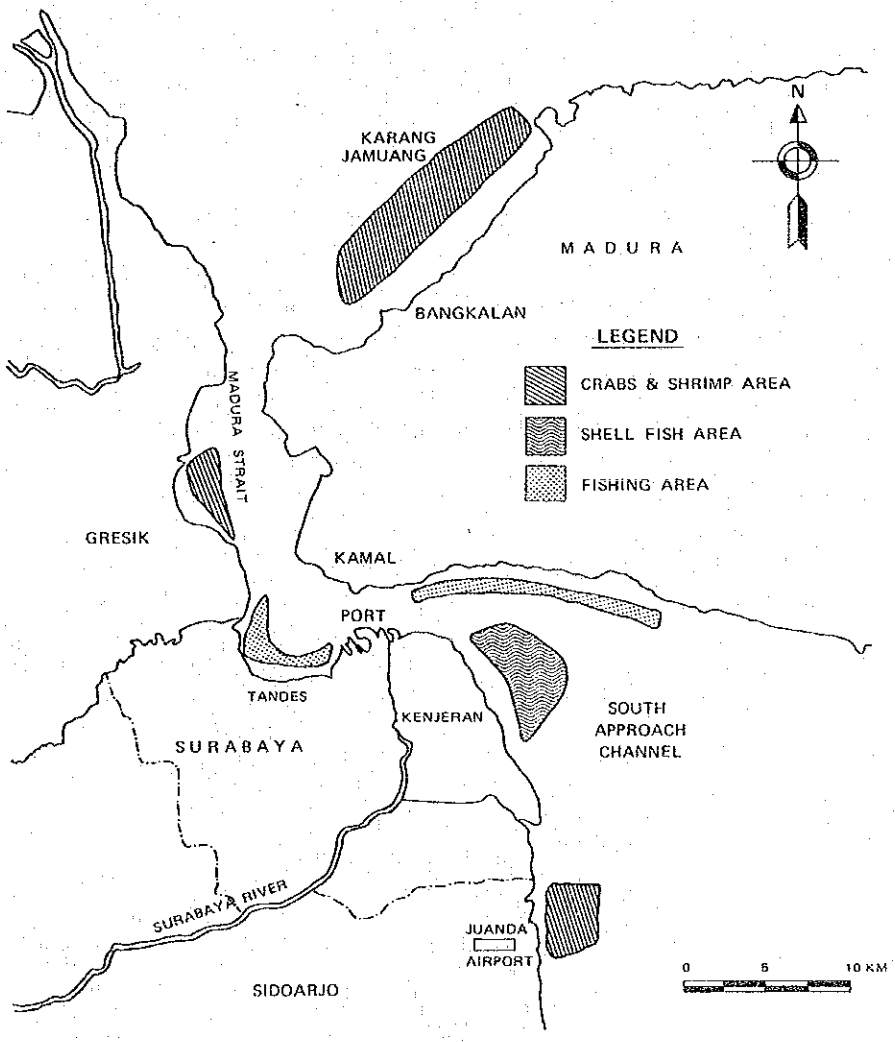


Fig. 2.9.1 FISHERY AREA

Many small fish traps are located near outlets of city drainage canals along the coast. There are also areas off Tandes and the island of Madura where fishing with nets is carried on. The strait is considered a region wherein fish spawn and feed during the juvenile stage. Young fish, caught in the strait, are released in propagation ponds along the eastern shoreline of Surabaya, where, upon rapid growth, they are marketed. Future land use planning excludes development along the coast for about 40 sq. km, so as to be available for fish cultivation. There is evidence that this important resource is being damaged by using polluted water from the Wonokromo River.

2.9.2 INFECTIOUS DISEASE IN SURABAYA

Diseases related to digestive organs are still common in Surabaya and this is related to every day use and contact with ground water/surface water. Data provided by the Health Centres and the Central Hospital in Surabaya is shown in Table 2.9.2.

Table 2.9.2 INFECTIOUS DISEASE

Unit : Person

Diseases \ Year	1970 / 1971	1975 / 1976	1981 / 1982
Cholera	1227 / 104	1610 / 14	1228 / 3
G.E.A	749 / 77	558 / 22	1578 / 9

Note: 1) G.E.A. : Sudden and severe inflamation of the stomach and intestines
2) Figures : Number of patients / Number of deaths

Cholera decreased in number from 1976, while G E A recently increased dramatically. The mortality of both diseases, however, shows a tendency to decrease. The trend by Kecamatan was also studied. In 1970 the majority of patients were from the CBD area such as Wonokromo, Gubeng, Sawahan, and Bubutan, but in 1981 there was a tendency for the patients to be from the remote Kecamatan such as Semampir, Tambaksari and Sakolilo. This is related to the polluted water concentration in the lower reaches of canals which are drained to the peripheral area of Surabaya.