PART III

STRUCTURE PLAN IN SURABAYA METROPOLITAN AREA

CHAPTER 11

AIMS AND DEVELOPMENT STRATEGY

11.1 AIMS OF THE STRUCTURE PLAN FOR SMA

The aims of the structure plan for SMA are basically derived from the national and regional development context mentioned in the sections 1.1 of Part 1 and 6.1 of Part II.

As described in that section, it is a basic concept in this study that a dual system is established in order to realize the national and regional targets: one is the industrialization system and the other is the distribution system.

This dual system, simultaneously, has to possess a capacity to accommodate the population increase in the urban area.

The aims that can be achieved with the formation of these systems, can be stated as follows:

From a socio-economic point of view, they are;

- to ensure the urban economic growth by making the best use of the economies of agglomeration, and
- to raise the income level and to ensure the social and living stability based on an appropriate distribution of benefits.

In terms of the physical structure,

- to develop urban facilities for industrial, living and communication activities, and
- to develop an orderly physical environment so as to activate the urban facilities developed.

To achieve these aims, the structure plan has to be endowed with the following programme:

In the first step, the availability of development resources such as labour force, materials, transportation facilities, water, financial fund and so on is examined in the direct influence area of the plan and the comprehensive availability checked to find out the "bottle neck" factors.

In the second step, through feasibility examinations, more expensive and much wider area resources are taken into account to prepare the plan. The third step is to try to maintain the higher level of social and individual living standards with environmental conservation. The third step targets should exist beyond the actual structure plan prepared for the comprehensive and balanced sectors.

11.2 PLANNING OBJECTIVES TO COPE WITH PROBLEMS

The objectives of the plan are basically derived from the aims mentioned in the former section 11.1 and simultaneously they have to cope with the existing problems. Based on this recognition, the objectives are identified together with a general observation of the problems existing in study area.

The problems are classified into two categories: socio-economy and physical structure.

11.2.1 OBJECTIVES FOR THE SOCIO-ECONOMIC SECTOR

IDENTIFICATION OF PROBLEMS

Based on the study results of existing conditions, the following problems concerning the urban activities in SMA are generally applicable.

- The growth performance of the economy is low, compared with the national level.
- The incentives for economic investment are slight, because the administrative and management functions are over-accumulated in Jakarta.
- A harmonious constitution is undeveloped between the industrial sectors because of the larger proportion of the population engaged in the tertiary sector.
- Percapita income is comparatively low, and the low income group is in the majority because of high latent unemployment.
- Labour force with suitable skills for a modern industry is in short supply because of lack of vocational training.
- The capability for the formation of domestic capital is immature.

ESTABLISHMENT OF OBJECTIVES

In order to cope with all of the problems above, one of basic objectives is to establish an appropriate industrial structure by an encouragement of the manufacturing sector.

The development of incentives for industrial investments should be given priority for the achievement of this objective, and suitable incentives can be considered as follows:

- Development of infrastructure supporting industrial activities,
- Development of an administrative system integrating the relevant authorities to the industrial-encouragement administration. In terms of this development, a partial localization of administrative decisions as well as simplification of investment procedures is to be considered.
- Aggressive inducement of foregin investment and modern industries, whose purpose is to modernize existing manufacture through a mutual relationship as well as to create employment opportunities.
- Up-grading of production technology through worker training courses.

The other significant objective is to ensure the residents' lives to cope with the problems described in the former paragraph.

There exist various factors influencing the residents' social lives. These factors should be maintained and simultaneously advanced by the opportunities of occupying a dwelling, education, employment, participation in community and so on. Above all, dwellings should be provided for all citizens to ensure their social lives.

- All of the residents must perform a role in the economic activities of the Study Area. The opportunities of employment, therefore, should be provided for all of the persons required, and a minimum wage should be ensured for labourers.
- All citizens must be able to enjoy cultural lives. The urban public services, recreation and the urban amenities should be equally available to all residents.

– Healthy lives should be ensured, free from any fear of diseases, and simultaneously the opportunity to receive medical treatment should be equally available to all residents.

11.2.2 OBJECTIVES FOR PHYSICAL STRUCTURE

IDENTIFICATION OF PROBLEMS

A central problem of the existing physical structure is that the following three significant systems for urbanization are not yet sufficiently developed.

– The system to control and to promote an urban expansion does not yet exist. This fact is found in the disorderly urbanization such as sprawl, illegal occupancy, housing location on unsuitable land, and so on.
– An efficient transportation system does not exist and simultaneously the truck road network in the busy area as well as the peripheral area, is deficient.
– An urban sanitary system is not completed sufficiently. Lack of development of the drainage and sewage system causes not only various obstructions in urban activities, especially in the rainy season, but also promotes the spread of epidemic disease.

ESTABLISHMENT OF OBJECTIVES

In terms of physical structure, it is a basic objective to ensure the development of three urban systems, to establish an efficient urban entity.

(1) To deliberately control the urban growth

This objective includes the following aspects:

– to systemarize the allocation of work places and housing in relation to transport system
– to establish the rules for urbanization such as;

the adjustment between agricultural and urban landuse,

regulations or standards for housing and urban facilities developments,
regulations to control land and landuse,

a standard building code for buildings and structures, and

others to promote planning orderliness.

(2) To establish an efficient transportation system

This is firmly related with socio-economic development, and is classified into the following items:

– To develop the public transportation network system including mass transportation modes,
– To regulate a development standard of roads and streets in accordance with the functional characteristics,
– To establish a functional system for utilization of roads such as primary and secondary systems.

(3) To develop the urban utilities system

Several developments should be executed with high priority for the utilities system. Major developments are:

– Sanitary System,
– Drainage System,
– Water Supply System,
– Solid Waste Treatment System,
– Electricity System and so on.

11.3 PROJECTION OF THE FUTURE SITUATION

11.3.1 GENERAL VIEW OF FUTURE SITUATION OF SMA

A basic planning principle in the urban area of SMA is to form a growth pole aiming at modernization and rationalization of the economic system. It is necessary to plan the future situation in consideration of the multiplier effect of this growth in the rural areas.

Accordingly, SMA should be planned so as to sufficiently possess a functional, as well as physical capability and capacity to perform its particular function.

In this context, the Study Team proposes aggressive industrialization as a planning principle, and plans a functional urban structure in order to support the industrialization.

INDUSTRIALIZATION OF SMA

Standing on the acknowledgement that it is indispensable to aggressively encourage the manufacturing sector in order to achieve the elevation of national income level, Pelita III expects an average growth rate in this sector of 11.0% per annum. Compared with the national total growth rate of 6.5%, the estimated growth rate of the manufacturing sector is considerably higher. From the same understanding as this national concept, the industrialization should be aggressively promoted in SMA as one of the high level industrial development cores in East Java.

Some points of view for discussion on the necessity of industrialization can be prepared as follows;

(1) Nation-wide Industrialization

Since 1968, the Indonesian Government have promoted some big projects based on their own natural and mineral resources in order to form an industrial base as the first step of industrialization. The target of industrial development has been to produce the basic materials and the processing of raw material. The industrial development is now facing the next new step which is to process the basic materials and to produce finished goods with high value added.

On observing the future prospects in this direction from a nation-wide view, it can be found that some development problems exist in the industrial sectors.

First, for the successful achievement of the required high-degree industrialization, the intermediate technology supporting the major production should be accumulated over various sectors.

Second, the efficient transportation and distribution system for new and intermediate materials should be prepared in order to maintain stability of goods supply.

Third, the training of skilled man-power, engineers and managers, should be increased as much as possible.

Fourth, the capital intensive industries and the labour intensive industries should be developed in a good balance in order to form the basis of the industrial structure.

(2) Creation of Employment Opportunities

The increase of employment demand is assumed to be approximately 1.3 million and 2.1 million persons in SMA and GKS region respectively. Including the latent unemployment, employment opportunities for about 2.25 million persons in GKS region should be prepared in GKS region by the year 2000.

The secondary sector has to accommodate about 420 thousand and 610 thousand jobs in SMA and GKS region respectively. Taking into account that generally the tertiary sector depends on the growth of the productive primary and secondary sectors, it is very important to achieve the employment opportunities in the secondary sector, especially the manufacturing portion.

Concerning the argument on the creation of employment opportunities, the quality of employees should be considered. The problems on quality are two: one is the problem of opportunities for the higher-educated persons, and another is the problem of the education or training for the majority of labourers (non-educated group).

A recognition of the necessity for education has prevailed in the nation and the number of people educated to higher grades has increased recently. However, there is a social problem, in that they cannot easily find suitable job opportunities.

The role of the manufacturing sector will therefore important as a receptacle of their knowledge and technology. While, the process of industrialization can be identified to be a process of modernization, efficiency and rationality are premium. It is therefore important to produce men of ability to promote efficient production.

(3) Economic Influence by Effects of Industrialization

Basically, the larger the regional economy becomes, the more regional relationships may be necessary and the regional economy itself will require an efficient relationship with the other areas. For instance, the agriculture of East Java, identified to be the most advanced in Indonesia, should become more valuable through processing and distribution. The functions supporting processing and distribution should be essentially located near the big markets or near the major distribution terminals, such as ports.

Such an inter-regional relationship which can be itself regarded as a part of industrialization, will influence the development of agriculture. Furthermore, the encouragement of manufacturing sector will directly influence the growth of the tertiary sectors through the distribution of goods.

(4) Dominant Key Factors for Industrialization of SMA

Four dominant key factors exist for the industrialization of SMA. The first is the existence of the major port, Tg. Perak, which functions as a distribution core for foreign trading as well as inter-island transport.

The second is the function as a mojor transportation node connecting with major urban areas in East Java.

The third is the accumulation of financial, trading and wholesaling facilities in the distribution sector.

The fourth is the functions of management and administration. These four factors given to SMA should be activated and should be put to the best use in order to assure the development of industrialization. Regarding the industrialization, however, one more important point should be taken into account. That is the point of preservation of the environment. Pollution such as air, water pollution, and disappearance of green areas, should be controlled. It is desirable from this point of view that a planned and controlled development system should be prepared prior to the inducement of factories.

FUNCTIONAL URBAN STRUCTURE

Some countermeasures should be prepared to prevent urban sprawl. It is a basic concept to activate the economies of agglomeration in the urban area and to avoid a loss of agglomeration, by control of surplus urbanization.

A principal way to control urbanization is to make obvious the functional structure and to supervise the re-development of disorderly developments by compulsory measures.

In terms of the functional structure, the following considerations are given:

(1) Ensuring an appropriate extent of urban area

As mentioned in the section 8.1 of Part II, a maximum extent of one unified urban area is generally less than 30 km radius and within 30 minutes travel by vehicle so as not to cause a loss of agglomeration.

For expansion outside this extent, some satellite urban cores are best developed, and it is recommended to re-organize the urban network system.

The urbanization in SMA should accordingly be controlled within this extent.

(2) Internal System for Urban Functions

Traffic comprises cargo flow and passenger flow. Both flows should be separated e.g. the passenger flow is ensured in the central corridor, while the cargo flow is ensured in the outer corridor of the central area, and a grid pattern is a connecting system between both.

(3) Connecting System with Outer Region

It seems clear from the transportation analysis that the encouragement of radial trunk routes is indispensable for ensuring a firm connection with the outer regions.

In consideration of the high development potential of these radial corridors, it will be necessary to develop a dual trunk system.

(4) Allocation System of Facilities

Major industrial facilities such as manufacturing factories, truck terminals and distribution centres, wholesalers, and the port are to be allocated along major trunk routes supporting regional activities. Concurrently, they are to be outside of the central business district but not too far from the residential areas. Moreover, it should be taken into account that these industrial facilities are subject to the economies of agglomeration.

(5) Mass Transportation Network as Urban Structure

A future urban structure is usually based on a network of mass transportation.

The bus system will form this base during the coming decade, however, the inducement of an urban rapid railway system should be taken into account in the future, and simultaneously the urban structure composed by the railway system should be organized.

11.3.2 SCALE OF DEVELOPMENT

It must be a target to achieve the economic growth rate of 6.5% per annum planned in Pelita -- III. However as the economic activity of SMA should support the hinterland of East Java and more, the actual target of economic growth of SMA as a leading city should be set higher than the average rate of 6.5% per annum.

Another target for socio-economic scale is to improve the imbalance of income between the regions. For instance, according to the actual data, the index of income in Surabaya is about 0.8 of Jakarta at present. It will be a basic target to make a balance in income level.

The Study Team considers that an activated industrialization should be given a high priority in order to achieve such a high economic growth as this, and in particular the emphasis should be on the port function at Tanjung Perak and the enlargement of industrial complex related with the port function.

At the initial stage in the process of industrialization, many people will migrate into the SMA from the peripheral area and also outside of GKS. At this stage, the labour forces in the Commercial Service Sector and the Agricultural Sector will be surplus. Therefore this surplus labour force must be strategically supported by the other sectors, especially the manufacturing and construction sectors.

At the ultimate stage, after establishing the development system of inter-sectoral relations and the prosperous co-existence between SMA and the peripheral areas, the imbalance of labour forces will be improved due to the increase of job opportunity in each sector not only in SMA, but also the peripheral rural areas.

The target socio-economic framework in the year 2000 is summarized as shown in Table 11.3.1, based on the study results of Chapter 9 in Part II.

Especially taking a note of the share of SMA in GKS region, the shares of population, employment and households are assumed to increase from 1980 to 2000, while the shares of GRDP by sector are assumed to have a tendency to decrease; the primary sector from 28.5% to 28.2%, the secondary sector from 77.3% to 74.0% and the tertiary sector from 80.9% to 77.4%.

Consequently, the increase of per capita GRDP in SMA is assumed to be less than that in GKS region. This framework shows that the concentration into SMA will advance still more in the social sector, but that the economic development will tend towards an appropriate balance between SMA and the other areas.

Table 11.3.1 SOCIO-ECONOMIC TARGET FOR DEVELOPMENT IN SMA AND GKS IN 2000

ITEMS			SMA		GKS Region		Share of SMA (%)		Magnification 2000/1980		Annual Growth Rate (%)	
			1980	2000	1980	2000	1980	2000	SMA	GKS	SMA	GKS
SOCIAL FACTORS	Population		2,905,414	6,119,400	6,111,935	10,759,700	47.5	56.9	2.10	1.76	3.79	2.87
	(persons)	0 - 14	1,042,447	1,839,500	2,227,198	3,189,300	46.8	57.7	1.76	-	2.88	1.81
		15 - 24	653,567	1,101,300	1,285,451	1,824,800	50.8	60.4	1.69	1.42	2.64	1.77
		25 - 49	890,617	2,374,600	1,869,761	4,203,800	47.6	56.5	2.67	2.25	5.03	4.13
		50 - 64	228,907	532,300	530,286	1,020,000	43.2	52.2	2.33	1.92	4.31	3.32
		65 -years old	89,876	271,700	199,240	521,800	45.1	52.1	3.02	2.62	5.69	4.93
	Employments		1,141,768	2,459,300	2,565,022	4,700,800	43.0	52.3	2.15	1.76	3.91	3.08
	(persons)	Primary	186,593	186,800	1,123,649	1,165,400	16.6	16.0	1.00	1.04	0.01	0.18
		Secondary	162,959	584,800	233,613	847,000	69.8	69.0	3.59	3.63	6.60	6.65
		Tertiary	792,216	1,687,700	1,207,760	2,688,400	65.6	62.8	2.13	2.23	3.85	4.08
	Households (thousand)		597	1,243	1,268	2,236	47.0	55.6	2.08	1.76	3.73	2.88
	Monthly Expenditure Per Household (Rp.)		46,674	92,434	-	-	-	-	1.98	-	3.48	-
ECONOMIC FACTORS	GRDP (million Rp.)		441,843	1,821,500	642,889	2,543,700	68.7	71.6	4.12	3.96	7.34	7.12
		Primary	39,931	65,800	139,870	233,000	28.5	28.2	1.65	1.67	2.53	2.58
		Secondary	107,528	708,200	139,061	956,500	77.3	74.0	6.59	6.88	9.88	10.12
		Tertiary	294,384	1,047,500	363,958	1,354,100	80.9	77.4	3.56	3.72	6.55	6.79
	Per Capita GRDP (thousand Rp.)		152.1	297.6	105.2	236.4	-	-	1.96	2.25	3.41	4.13
	GRDP Per Employment (thousand Rp.)		387.0	740.6	250.6	541.1	-	-	1.91	2.16	3.30	3.92
		Primary	214.0	352.2	124.5	199.9	-	-	1.65	1.61	2.52	2.40
		Secondary	659.8	1,211.0	595.3	1,129.4	-	-	1.84	1.90	3.08	3.25
		Tertiary	371.6	620.6	301.3	503.7	-	-	1.67	1.67	2.60	2.60

NOTE : 1) For monetary terms, Rp. at 1975 Constant Price is applied.

CHAPTER 12

GENERAL STRUCTURE IN SURABAYA METROPOLITAN AREA

12.1 FUNCTIONAL STRUCTURE

12.1.1 GENERAL

First, it must be stated that the Surabya Metropolitan Area means not only Kod. Surabaya but also its regional extent including the peripheral areas such as most of Kab. Gresik and Kab. Sidoarjo, and a part of Kab. Bangkalan. Furthermore, it is defined that SMA is the area to be developed to function as a centre, not only of regional economic activity from an urban planning point of view, but also economic activity covering a wider area in terms of the national development policy. Consequently the development of SMA must be related to the other urban areas, not only in GKS region, but also East Java. The benefits resulting from the development of SMA must be distributed to the whole area through those relations.

The basic concept of equity, which is an ultimate target for developments in Indonesia, should be well considered during the planning. This, however, is not taken to mean similar or the same developments in urban and rural communities, but rather that the development should ensure an equal regional progress based on socio-economic harmony between the urban and the rural. The programme for urban development is basically different from that of the rural development programme, and likewise the quality and quantity of investment for development is also different between the two, so that they can perform their own functions and roles.

The urban development in SMA should therefore be considered as a core composing that harmony, and the central function to be ensured in SMA is to encourage the rural development of the hinterland.

12.1.2 FUNCTIONS TO BE DEVELOPED IN SMA

FUNCTION LEVELS TO BE DEVELOPED

The Surabaya Metropolitan Area must provide three levels of urban function:

Level I: SMA has to function as a centre of extensive economic activities in the wide-reaching hinterland containing East Java, Bali, and the eastern part of Kalimantan. This is achieved through the function of the port, Tg. Perak.

Level II: SMA has to function as a "First Order City" influencing the socio-economic development of East Java Satuan Wilayah Pembangunan (Unit of Development Region).

Level III: SMA has to function as an urban-heart supporting the socio-economic activities and development of GERBANGKERTOSUSILA and its peripheral area.

The function corresponding with Levels I and II, called a regionwide central function, is indispensable for the realization of the conceptual plan for S.W.P., proposed by the central government.

Currently Surabaya has a direct industrial relationship with major cities located within a radius of about 100 km, such as Pasuruan, Probolinggo, Malang, Blitar, Madiun and Kediri. Moreover, through the port of Tanjung Perak, economic relations with the other islands is also maintained. Based on these existing conditions, the Surabaya Metropolitan function should still be more emphasized in order to influence the development of the hinterland and the ensure the benefits of development to the outer areas.

COMPOSITION OF FUNCTIONS

The functions ensuring the socio-economic activities are classified into two categories and nine items as follows;

(1) Industrial Functions

- Administration and Central Management
- Distribution
- Information
- Employment

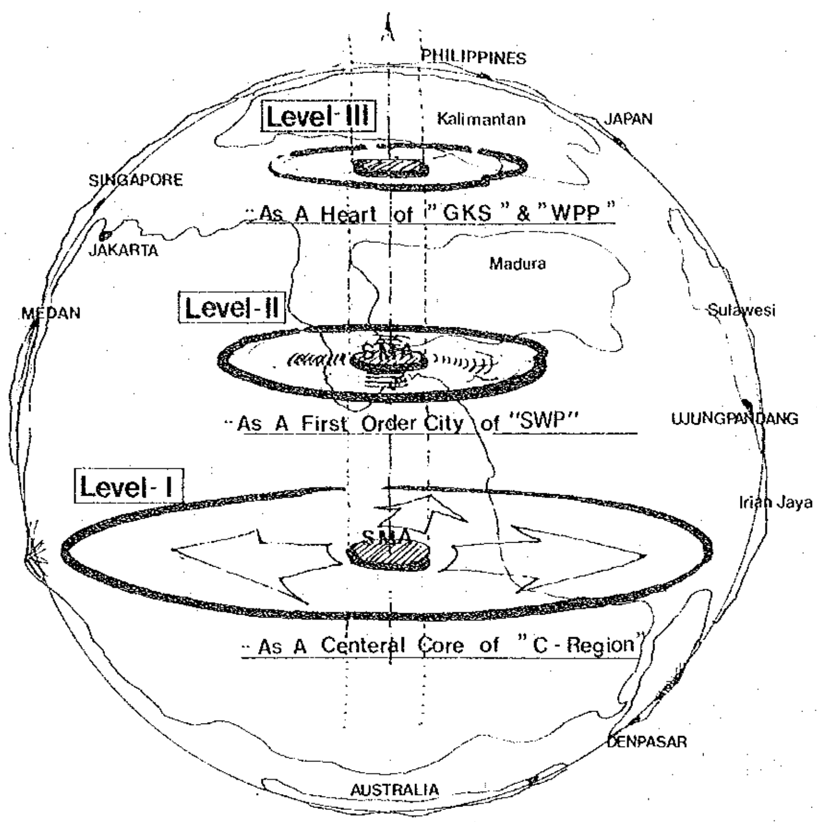


Fig. 12.1.1 CONCEPTUAL SCHEME FOR URBAN FUNCTION OF SURABAYA METROPOLITAN AREA

(2) Social/Cultural Functions

- Consumption
- Social Welfare
- Culture
- Medical Treatment
- Leisure

Basically the development of influence areas such as Mojokerto, Lamongan and Bang-Kalan should also be provided with these functions. However, the functions required in SMA, must be to a higher level in order to serve the wider region, while those in the other areas need not be developed to the same level.

In summary, it is important that a mutually supporting system between the high level functions and the middle and low level functions located in the other areas can be established.

URBAN FUNCTIONS WITH HIGH LEVEL

The urban functions to be especially enhanced in SMA in accordance with Level I and Level II requirements consist of the following factors:

(1) Distribution Function:

The port, Tg. Pevak, is especially important for economic activity in the hinterland. The accumulation of transport and trading businesses as well as the function of collecting and distributing freight & goods is evaluated to become a significant key to regional economic growth.

Centring on the port, an efficient distribution system must be established.

(2) Central Management and Administrative Function

Generally, a central function covers various meanings. The wholesale, trading, banking and financial functions are included in the economic central management function, and the integration of these accumulations with mutual relationships is itself regarded as the central management function.

Especially, in an economic meaning, the areas around Pasar Turi and Surabaya Kota stations should be improved. Furthermore, the areas centring on the Station Wonokromo station and the Joyoboyo bus terminal should be developed as sub-hearts of the city accommodating these additional economic functions.

The accumulation of government agencies administrating the province of East Java is a major central management function. The Study Team considers that these central management functions should be encouraged as one of the significant factors to be ensured in SMA.

(3) Information Function

For the preparation of an informed society, the existing characteristic of an accumulation of information functions in Surabaya should be furthur encouraged. This means not only newspater, printing, advertisement and TV/Radio Stations, but also higher education and institutional facilities.

As an area where social intelligence and scientific technology are fostered, Sukolilo area should be considered as a suitable site.

(4) Employment Function

It is an urban role to accommodate the future population growth. The urban area is a complex in which so many socio-economic activities accumulate and it is especially necessary in the sectors of manufacturing, commerce, and services that opportunities for employment should be prepared to equate with the increase of the labour force. The urban function to be emphasized in SMA corresponding to the function levels is conceptionally summarized in Table 12.1.1.

Table 12.1.1 COMPARISON OF FUNCTION EMPHASIS BETWEEN SMA CENTRAL CORE AND PERIPHERAL URBAN CORES

FACILITY LEVEL TO BE DEVELOPED		LEVEL (I)		LEVEL (II)		LEVEL (III)	
		A	B	A	B	A	B
INDUSTRIAL FUNCTIONS	ADMINISTRATION / CENTRAL MANAGEMENT	■		■			●
	DISTRIBUTION	■		■	○	▨	●
	INFORMATION	■		■	○		●
	EMPLOYMENT			■	○	▨	●
SOCIAL / CULTURAL FUNCTIONS	CONSUMPTION	▨		■	○	▨	●
	SOCIAL WELFARE	▨		■	○	▨	●
	CULTURE	▨		■	○		●
	MEDICAL TREATMENT	▨		■		▨	●
	LEISURE		●	■	○	▨	●

■ Strong
▨ Moderate

● Strong
○ Occasional

A = SMA Central Core
B = Peripheral Urban Cores

A = SMA Central Core B = Peripheral Urban Cores

As mentioned in Chapter 11, the context of development lies in intensive industrialization. The urban functions of support to achieve this target should be given a high level of encouragement in SMA.

12.1.3 CENTRALIZATION AND DECENTRALIZATION

Generally, observing the process of urban growth, some types and urban facilities are likely to be concentrated and some have a tendency to be decentralized. The former are mostly facilities expecting an integrated effect due to concentration in an area, while the latter are the facilities pursuing the merits of relocation, for such reasons as environmental conditions, or reasons of space and growth.

The type of facilities with a need to concentration are commercial facilities with a display function, main offices of commerce and finance, service industries and enterprises, information business, etc.

It is important to make use of the decentralization tendencies and characteristics in the planning of new Urban Centres. Administrative facilities, can function as a core of urbanization and centred on these facilities, the urban structure is formed up to the stage when the urban scale is still small. However, when the urban size becomes large it is sometimes found that these facilities can again be relocated aiming at a new composition of the urban structure.

Besides this, the type of facilities suited to decentralization are as follows: the distribution terminals and facilities, the relevant railway facilities such as marshalling yard and workshop, the higher education facilities, cemeteries, the hospitals for epidemic diseases, the offices and workshops of urban utilities, and so on. Accompanying the increase in car ownership, some shopping centres join this group.

12.2 URBAN PATTERN IN THE FUTURE

12.2.1 CONSIDERATIONS ON A NEW URBAN PATTERN

LIMITATION OF THE URBAN AREA WITH RADIATION PATTERN

The existing urban pattern of SMA is indentified as the well-known radial pattern. Observing the historical urban growth, it is found that the urban area has expanded broadly towards the south and west, centring on the harbour, Tg. Perak in accordance with socio-economic growth of the area. The spreading urban area is located along the trunk roads connecting to major cities in the hinterland in a radial pattern.

Generally, this radial pattern is a natural pattern of urban growth and a lot of cities all over the world have experienced it before the stage of large-scale growth. However, at the metropolitan level stage, this pattern generally comes to possess some urban troubles such as the limitation of development capacity and traffic congestion.

The limitation of urban growth with radial pattern depends on the scale of the city or on the degree of relations between the central function and the peripheral functions. From an urban planning point of view, the limitations of the radial urban development is noted in the following phenomena or problems:

- Lowering of economic efficiency caused by traffic congestion in the central area.
- Physical and spatial limitation for the growth of central function caused by the central area being closed by other uses.
- Disorderly development in the peripheral areas caused by a shortage of infrastructure.

CRITERIA OF BUILDING NEW URBAN PATTERN

Building a new urban pattern in SMA is required in order to solve these problems. In this context, urban planning should satisfy the following features:

- To encourage the accumulated urban functions and to stimulate the existing socio-economic activities,
- To obtain a harmony with the anticipated urban features and the natural environment and to produce as many urban amenities as possible, and
- To accommodate as much investment as possible for the achievement of the future planned socio-economic growth.

Based on the above, generally three urban planning criteria for the composition of new structure are achievable;

- To ensure physical capacity to accommodate the urban functions to be developed in the future,
- To disperse the traffic flow generating by the central area and to promote an efficient transportation system.
- To develop the appropriate network system of infrastructure in the peripheral areas to enlarge the accommodation capacity of the urban facilities.

NEW URBAN PATTERN

In terms of these criteria, the Study Team proposes the following concepts:

(1) To ensure flexibility for the Central Function

Two concepts are proposed to ensure the accommodation of the required central functions:

- One, is to decentralize the central functions into peripheral cores and to interconnect those dispersed functions;
- The other is to promote the redevelopment of the centre so as to increase the capacity of the available land.

If the former is adopted, the proper location of those peripheral cores is in new development and much investment will be needed. In the latter case, a high grade of administrative ability is needed to control the redevelopments and the willingness of the existing residents to finance new investment will be indispensable. Also in the latter case, much time will be necessary to implement the scheme.

Accordingly, in order to meet with the actual urban growth in consideration of the problems, it is proper that both kinds of developments are performed simultaneously. Accordingly, a plan should be prepared such that a part of the central function is decentralized whilst the intensification of landuse inside the central area is promoted by various urban improvement methods.

Urban redevelopment projects are generally the most difficult to implement. Thoughtful laws and regulations for an implementation system should be developed as soon as possible.

(2) Traffic Dispersal Away from the Centre

From a structure planning point of view, it is generally effective to avoid the concentration of traffic into a central area by adding a circular network onto the existing radial pattern.

The addition of a circular network will contribute to the reduction of traffic flow passing through the central area and will give alternative approach routes to a destination. Simultaneously, the circular trunk roads will have an effect on the development of landuse according to the location of the road alignment.

Some examples of this circular pattern can be found in the other cities in the world.

(3) Increase of Development Capacity

The planning of landuse development should be carried out at the same time as that of the infrastructure. Therefore, a key to structure planning is to organically combine the urban functions with the area to be urbanized in the future.

In order to enlarge landuse development capacity, a system to connect the major nodes on the radial trunk roads must be established, because the existing urban corridor-type growth limits the growth of urban areas.

12.2.2 RADIAL/CIRCULAR PATTERN AS A NEW STRUCTURE

The Study Team proposes the radial/circular pattern as the new urban pattern, based on the previous considerations.

The radial/circular pattern has two variants due to the relation between the enlargement of central functions and the development of peripheral areas as shown in Fig. 12.2.1:

- Pattern "A"
  This means to stop the urban growth in the central area and to disperse the required central functions to peripheral cores. By this system, a multi-cored structure will be formed. In this system, it is most important to aggressively develop the major interconnections between all of the dispersed functions.
- Pattern "B"
  This is the system which promotes partial dispersion of central functions whilst activating the existing growth power of the central area, but excludes excessive centralization. In this system, major connectors in the peripheral area will be necessary as same as Pattern A, however, simultaneously the development of an improved street network in the central area should be undertaken as a high priority.

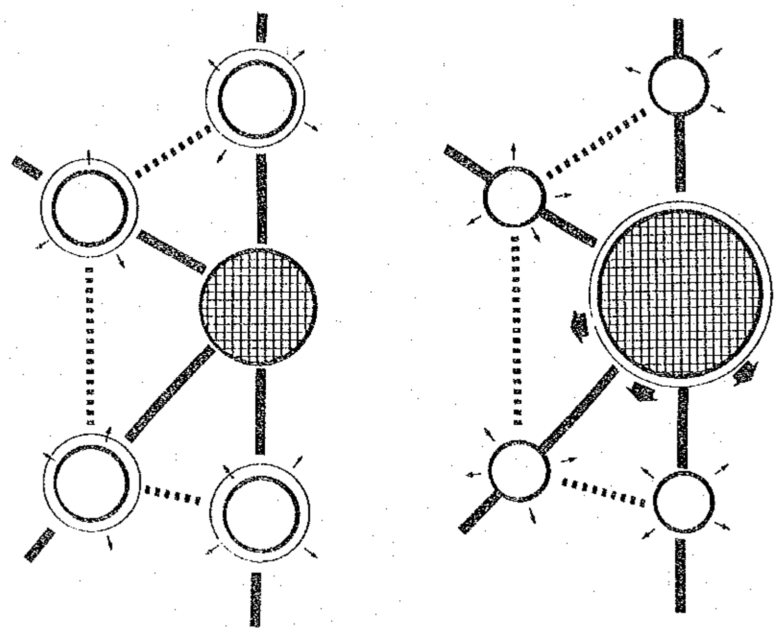


Fig. 12.2.1 VARIATION OF RADIATION CIRCULAR PATTERN

The selection of a suitable urban pattern, should be based on the discussion on how the limited investment for the urban development can be maximized towards the goals. Accordingly, it is important that the activities of the private sector be utilized in developing the planned structure.

The contribution of the private sector theoretically depends on the capital account, and new capital investment is incurred so as to maximize the accumulation of capital. Based on this theory, the growth of central area is supposedly inevitable and should rather be controlled intentionally so as to guide the growth into an appropriate situation.

In this context, the Study Team has decided that the pattern B is suitable, which involves the intentional growth of the central area and simultaneously encouraging the development of peripheral cores.

12.3 SPATIAL FEATURE OF THE PLAN

12.3.1 COMPOSITION OF URBAN LAYOUT

BASIC URBAN STRUCTURE

The basic urban structure in SMA is composed of the two systems of radial/circular pattern as the major system and grid pattern as its supplement.

The existing projections of Surabaya-Malang Tollway and Surabaya-Gresik Tollway are situated as a part of the total system of intra-urban trunk road network involved in the radial/circular pattern.

(1) Radial/Circular Trunk Road System as Major Structure

The Study Team reached the conclusion that the Radial/Circular Road System is the acceptable pattern for the major highway structure of this area as discussed in the section 12.2. The existing pattern is that the regional traffic from all directions, approximately 54,000 vehicles per day, concentrates into the busy area of Surabaya through the radial pattern road network. This attracted traffic includes both goods and passengers. One of the serious problems is that most of the truck traffic destined to the port originates from the southern hinterland, and has to pass through the busy area of Surabaya. A ring road would contribute to the dispersal of this traffic and permit the rehabilitation of the existing road function.

(2) Grid System Supporting Radial/Circular System Activities

A street network based on a grid pattern is recommended to be formed as a fundamental characteristic of the Secondary System in order to promote land development for urban exploitation and to give a diversity of access to the central core area.

This grid pattern can also be recognised as a circular system by the utilization and the structure of intersections. Some of the streets within the grid pattern should function as circular roads in accordance with the particulars of their locations.

The spacing of arterial streets within the grid pattern is recommended to be around 2.0 $\sim$ 3.0 km, based on the following concepts:

- The size of the area enclosed by the arterial streets is assumed to be nearly as large as one community unit.
- The access time from any place to the arterial streets is assumed to be less than 5 minutes by vehicle and 30 minutes on foot. This is assumed to be the maximum walking distance, based on the traffic survey results carried out by the Study Team.
- If the streets at collector level are developed in a relationship with this block and public transportation is available on the collector and arterial level streets, every resident can reach a public transportation mode within 700 meters distance, or 10 minutes walking time. This is considered to be a reasonable distance and is based from the same survey results.

MAJOR ELEMENTS OF THE STRUCTURE

Based on the conceptional structure above, the physical structure planning is performed so as to solve the existing problems as follows:

(1) Development of the East-West Axis Inside of Surabaya City

Some new trunk streets should be encouraged in order to connect the eastern and western areas which are currently divided by Kali Surabaya and the heavy traffic in the central business district. Observing the historical urban growth, the city of Surabaya has been spreading from North to South. Accordingly the major East-West roads are likely to be short.

The following can be expected by the development of East-West trunk roads:

- Enlargement of development potential in the western and eastern areas

– An alternative route for efficient traffic flow and service access to the busy area

(2) Development of Four Ring Roads Centring on Central Business District

– Inner Ring Road

A trunk road encircling the central business district. This will make a physical boundary to the central business district as well ensuring a smoother traffic access.

– Middle Ring Road

The trunk road to mutually connect the developing industrial and residential areas. The significance of this road is especially heightened by its role as the major link between the major industrial areas such as Tandes, Rungkut and Karangpilang and the Port, Tg. Perak.

– Outer Ring Road 1

The trunk road running around the inside of the existing urban area of Surabaya City. This road has the following functions:

- to encourage new developments necessary to accommodate the required urban uses;
- to connect organically with the mutual sub-cores to be developed in future;
- to contribute to the dispersion of central functions due to the establishment of this outer structure;
- to ensure the direct connection between the industrial function of Gresik and the major cities in East Java, as well as between Gresik and Sidoarjo without passing through Surabaya City; and
- to accommodate the traffic trips previously passing through Surabaya City away from the central area.

– Outer Ring Road 2

The road encircling the boundary of Surabaya Metropolitan area. This road will be situated as a connector to link the urban and the rural communities. The most important role of this road lies in mutually inter-connecting the major activity centres in the peripheral area such as Sidoarjo, Krian, Cerme, and Gresik.

The encouragement of this function is indispensable in establishing the mutual growth system of the regional economy, and simultaneously, this ring road will function as a key component of the structure identifying the developed urban areas in SMA.

(3) Encouragement of Radial Trunk Roads

Radial trunk roads have the function of distributing the benefits caused by the development of SMA to every area in East Java, as well as to the GKS Region.

Also, these are the arteries of the united regional economy, giving access for the mutually supporting system of urban functions in SMA with the rural functions.

In this context, four major corridors should be encouraged as follows:

– North-South Axis

This axis is the most important arterial trunk route. In addition to the existing national road and the Surabaya-Malang Highway under construction, the new north-south axis is recommended to be developed to supplement the eastern corridor in consideration of the future traffic demand. This new road has the function of encouraging the development potential is Surabaya-Sidoarjo corridor.

– East-South Axis

This axis guides the central function of SMA upto the capital function of Jakarta. Long-distance trips and the regional trips should be accommodated in this axis. In addition to the existing Surabaya-Mojokerto arterial road, the encouragement of a Local road to the north of Kali Surabaya is recommended.

– North-West Axis

This axis is expected to form the intensive industrial corridor due to the industrial development of Gresik, and the enlargement of the port capacity of Tg. Perak. The existing Surabaya-Gresik road, and the future road being planned are evaluated as industrial trunk roads.

– North Axis

It has already been discussed as to how the Madura Island should be developed and therefore the relationship between Surabaya and Bangkalan must be discussed not in isolation but in consideration of the development of the whole of Madura Island.

At present, there are some connections by ferries between Java and Madura, however, the most important connection from a regional economic point of view is the Surabaya–Kamal route. Especially, as in the near future, Kamal area is assumed to change to an important industrial zone, due to the establishment of a large cement factory and relevant facilities which are now under construction.

The encouragement of a north corridor corresponds to not only the movement in the near future, but also to the long-term development of Madura.

Further study is necessary to determine what connector is appropriate and in particular whether a bridge is necessary and feasible for the encouragement of this corridor.

(4) Development of By Passes

It is found in many cities that a by-pass of arterial road forms a new structure to create development potential. Basically, the by-pass road is effective in the case that the arterial road runs through an intensive and busy area with a large amount of traffic volume.

In this meaning, the Study Team proposes that by-passes be established at four places as follows:

– Sidoarjo (Sidoarjo – Krian – Mojokerto)
– Krian (Sidoarjo – Krian – Mojokerto)
– Krian (Surabaya – Krian – Mojokerto)
– Gresik (Surabaya – Gresik – Lamongan)

Integrating the points discussed above, the structural road shape of SMA is proposed as shown in Fig. 12.3.1.

12.3.2 PRIMARY ROAD NETWORK SYSTEM IN SMA

ALTERNATIVES OF PRIMARY ROAD NETWORK SYSTEM

The primary system and the secondary system are the principal components of the total network system. These two systems, therefore have to be organized to assure the various traffic demand, whatever trip purpose and distance is required.

Roads are thus classified by their functions and require to be connected with each other in accordance with certain rules. In the case of a trip from a residential area to another region, a driver at first uses a local street in the residential area and moves onto a collector street, and then on to an arterial street or urban expressway, before changing on to a regional arterial road. The traffic therefore passes through the secondary and primary road systems and over classified roads of different functions.

A street network with a road classification by function is also required to coordinate area characteristics such as landuse, accumulation of facilities, and the traffic generated from these areas. The streets are required to be allocated at certain intervals and density in order to cope with the concentration of traffic from such area characteristics.

Accordingly, a higher traffic flow efficiency and user satisfaction as well as effective operation of landuses and urban activities, can be achieved in such a continuous hierarchy of road functions, if one road network system is considered as a whole.

The Study Team proposes some alternatives for the primary road network system based on the following conditions:

– to deal with wide variety of regional traffic;
– to serve industrial freight and goods traffic; and
– to serve as an access to major industrial facilities and freight generators.

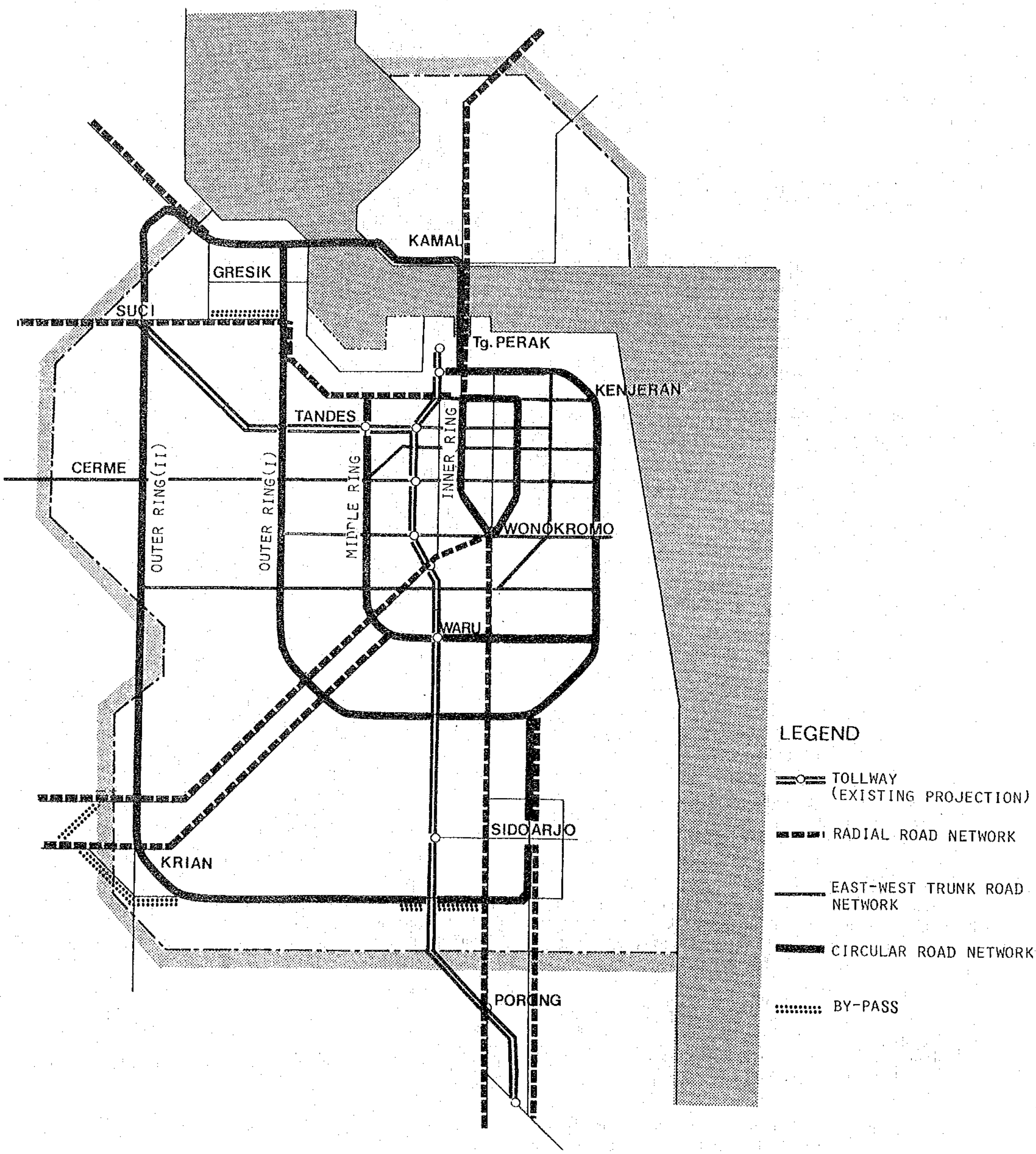


Fig. 12.3.1 PROPOSED BASIC URBAN STRUCTURE

Figs. 12.3.2 to 12.3.4 shows three alternatives for the primary roads network system.

Main differences between these alternatives are as follows:

- Patterns A and B possess the characteristic that the north-south trunk road directly pass through the central area as a primary arterial road.

  In Pattern A, however, the Middle Ring Road is evaluated to be an arterial road, whilst in Pattern B the Outer Ring Road (1) is an arterial road.

- Pattern C stands on the concept that any primary road doesn't pass through the central busy area, but that both of the middle Ring Road and the Outer Ring Road (1) are evaluated as primary arterial roads.

PROPOSED PRIMARY ROAD NETWORK SYSTEM

The Study Team proposes that alternative A is the best system for SMA because of the following:

- The arterial road to substitute the Surabaya-Malang Tollway with the same function as the tollway should be encouraged as a primary arterial road. Accordingly, it is necessary to encourage the North-South artery directly connecting Tg. Perak Port to the hinterland along the tollway. This gives direct Port access to the major axis highway.

- Basically, both the Middle and Outer Ring Road (1) are evaluated as primary roads in consideration of the industrial development function. Especially the middle Ring Road, which forms a significant structure in the near future urban expansion, is remarkably expected to contribute to industrial developments in Tandes and Waru areas.

- The Middle Ring Road had better be developed as an arterial trunk road in consideration of the spacing of arterial roads.

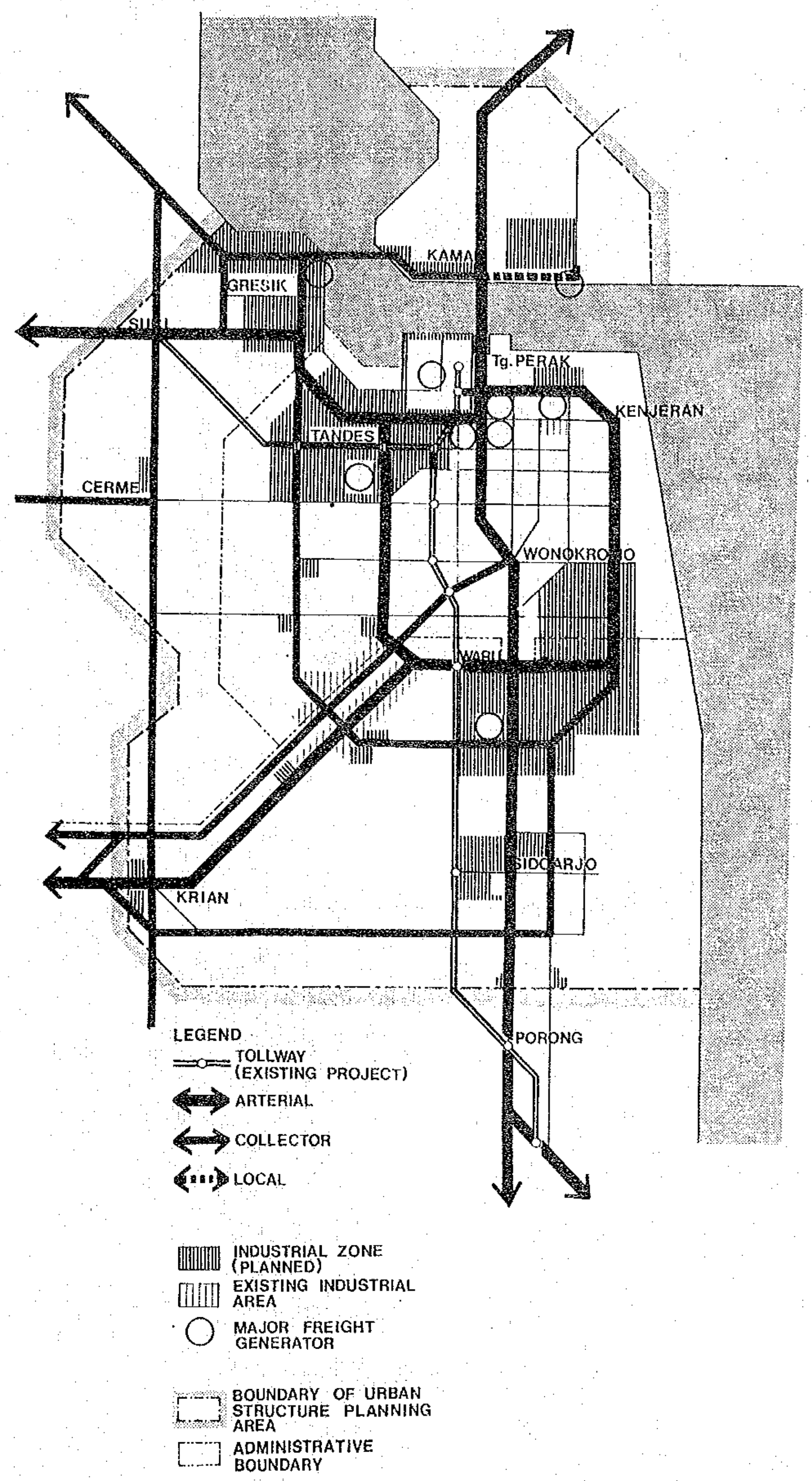


Fig. 12.3.2 ALTERNATIVES OF PRIMARY ROAD NETWORK SYSTEM (PATTERN: A)

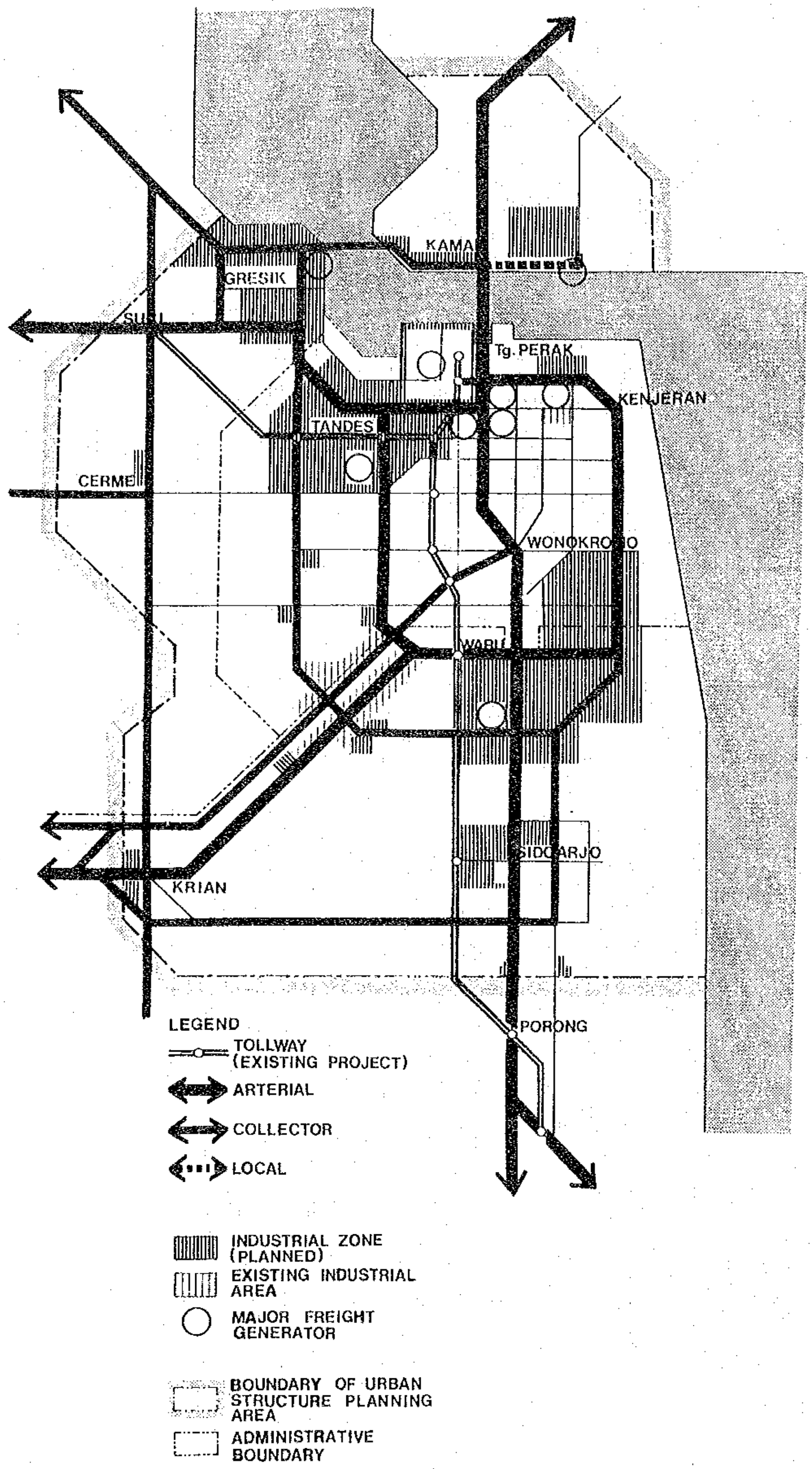


Fig. 12.3.3 ALTERNATIVES OF PRIMARY ROAD NETWORK SYSTEM (PATTERN: B)

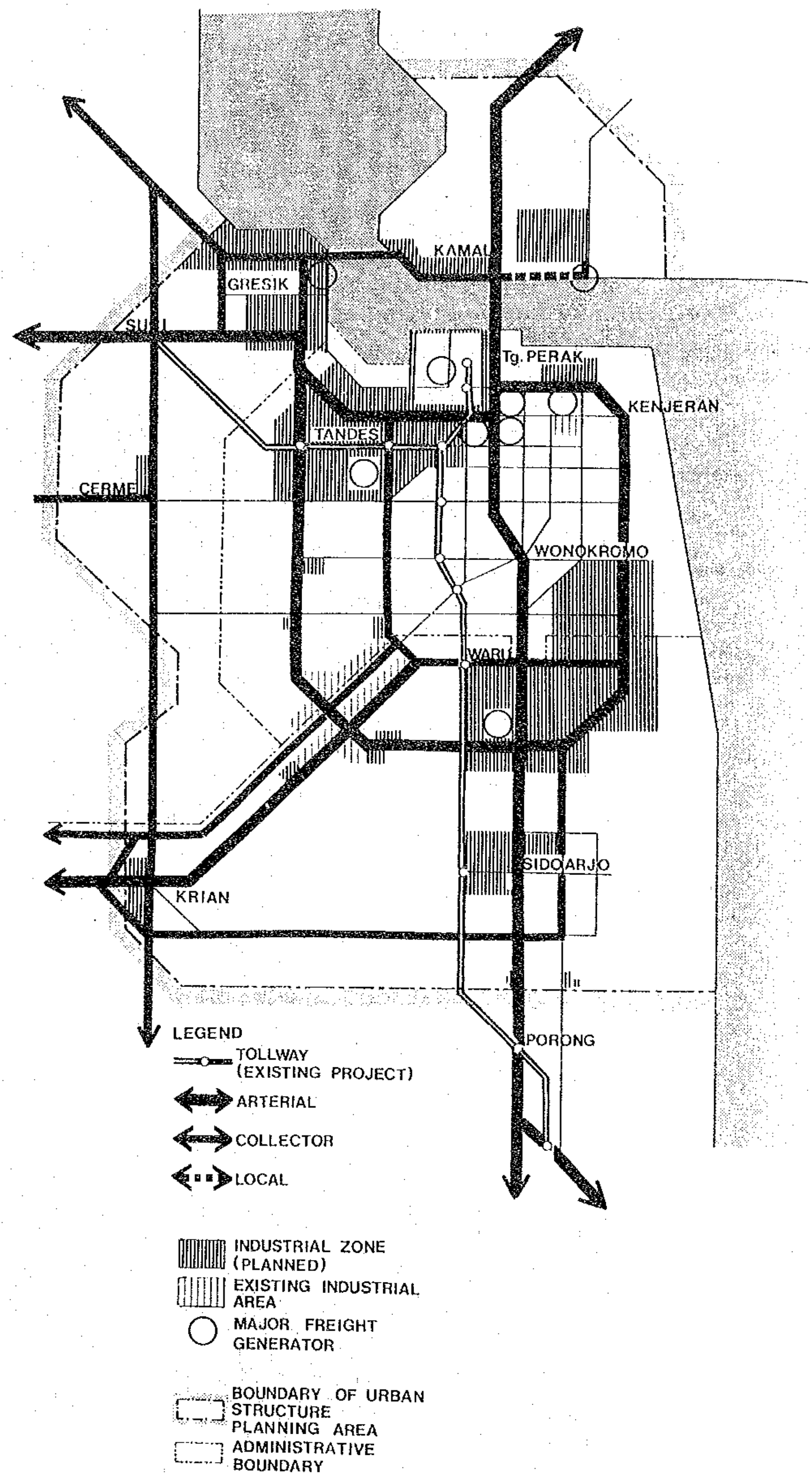


Fig. 12.3.4 ALTERNATIVES OF PRIMARY ROAD NETWORK SYTEM (PATTERN: C)

12.4 LAND AVAILABILITY

12.4.1 CHANGEABLE FACTORS FOR DEVELOPMENT POTENTIAL

Accompanying a change of infrastructure such as roads network, the distribution pattern of high urban development potential will be come changeable in the future. Especially, accessibility is expected to be radically improved.

Based on the same method of physical potential analysis carried out in the section 5.3.3 of Part I, an anticipated urban development potential was assumed.

The changeable factors are:

- Infrastructure and
- Urban accessibility (Time-distance).

The change of infrastructure is in accordance with that of the physical structure proposed in the former section 12.3.

Whilst, natural conditions are an unchangeable factor, these factors are utilized as the present conditions in the analysis.

Fig. 12.4.1 shows the change of "Urban Accessibility" similar to the time-distance to the central area of Surabaya between 1980 and 2000.

12.4.2 EVALUATION OF FUTURE DEVELOPMENT POTENTIAL

The analysis by a mesh method was carried out as follows:

Using 4 constraint factors (natural conditions) and 2 revised promotion factors, the following scoring equation is adopted:

$$E_1(i,j) = An \sum_{n=1}^{6} F(n, i, j)$$

here, $E_1(i, j)$: Total score of the block (i, j)

$F(n, i, j)$: Individual score of the block (i, j) in the factor category (n).

An: Weighting factor for the category (n). (An is assumed 1.)

The reason of adopting the equation and An=1 is that these conditions are found to be most suitable for an evaluation of development potential in the initial trial in the section 5.3.3 of Part I.

The result of ranking evaluation is as shown in Fig. 12.4.2. As is obvious from this figure, the distribution pattern of the blocks with Rank IV and over is widely expanded in the western areas of Surabaya centring on Tandes, Cerme and Gresik, similarly in the surrounding areas of Waru, Krian, Sidoarjo and Kamal.

Based on this result, the evaluation of the suitable area for urban developments in the future was carried out in addition to planning considerations concerning the urbanization pattern. The area bounded by a thick line in this figure indicates the suitable area evaluated by this process.

Basically, the blocks with Rank IV and over are involved in this area, however, the surrounding areas of Krian and Sidoarjo includes a part of Rank III. In this ranking, Rank IV is assumed to be the total score between 24 and 28 points. The blocks of Rank III evaluated to have 22 points and over are also considered suitable.

The result of this evaluation is the basis used for urban development planning in this study.

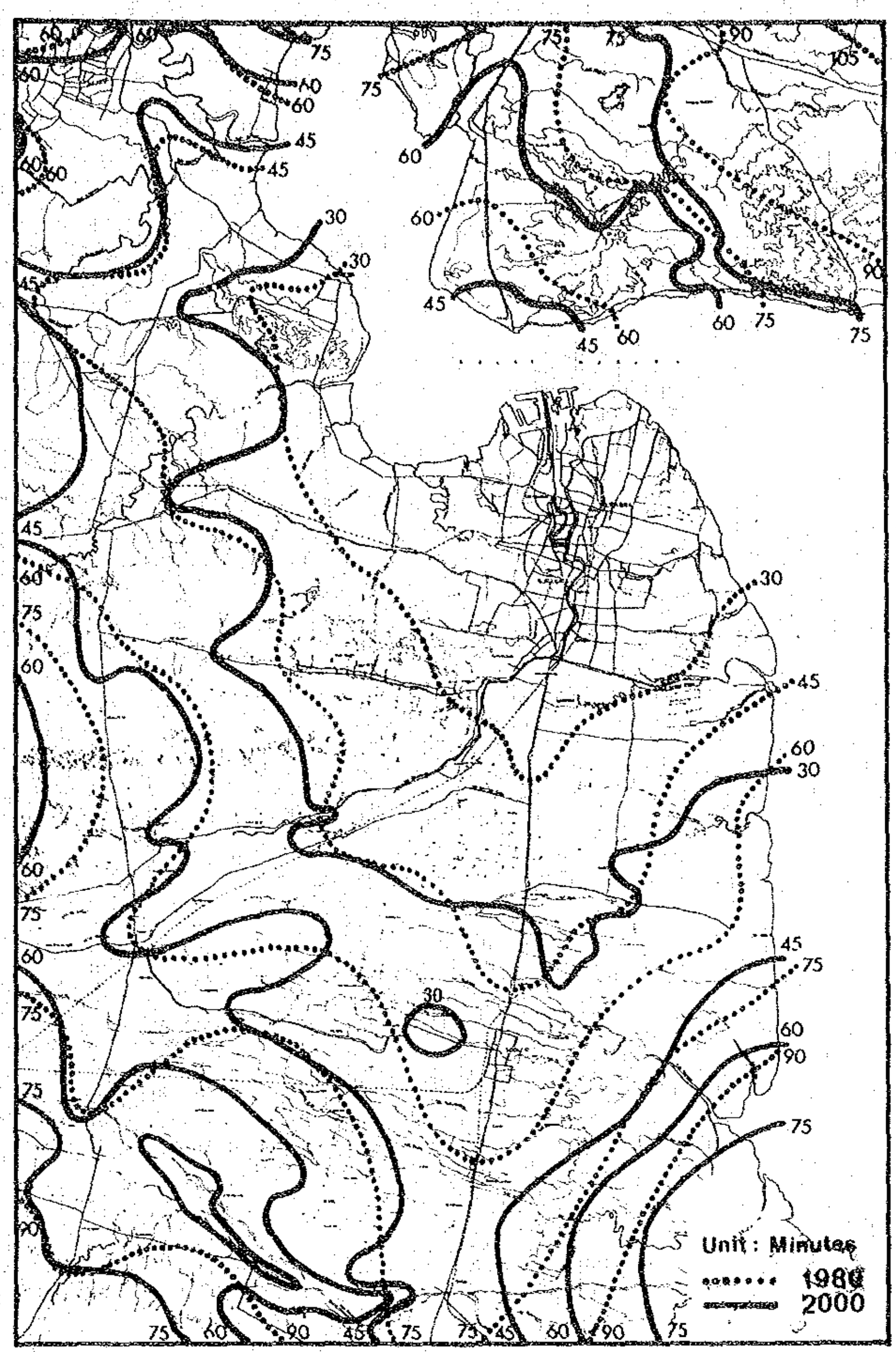


Fig. 12.4.1 CHANGE OF TIME-DISTANCE TO CENTRAL AREA OF SURABAYA BETWEEN 1980 AND 2000

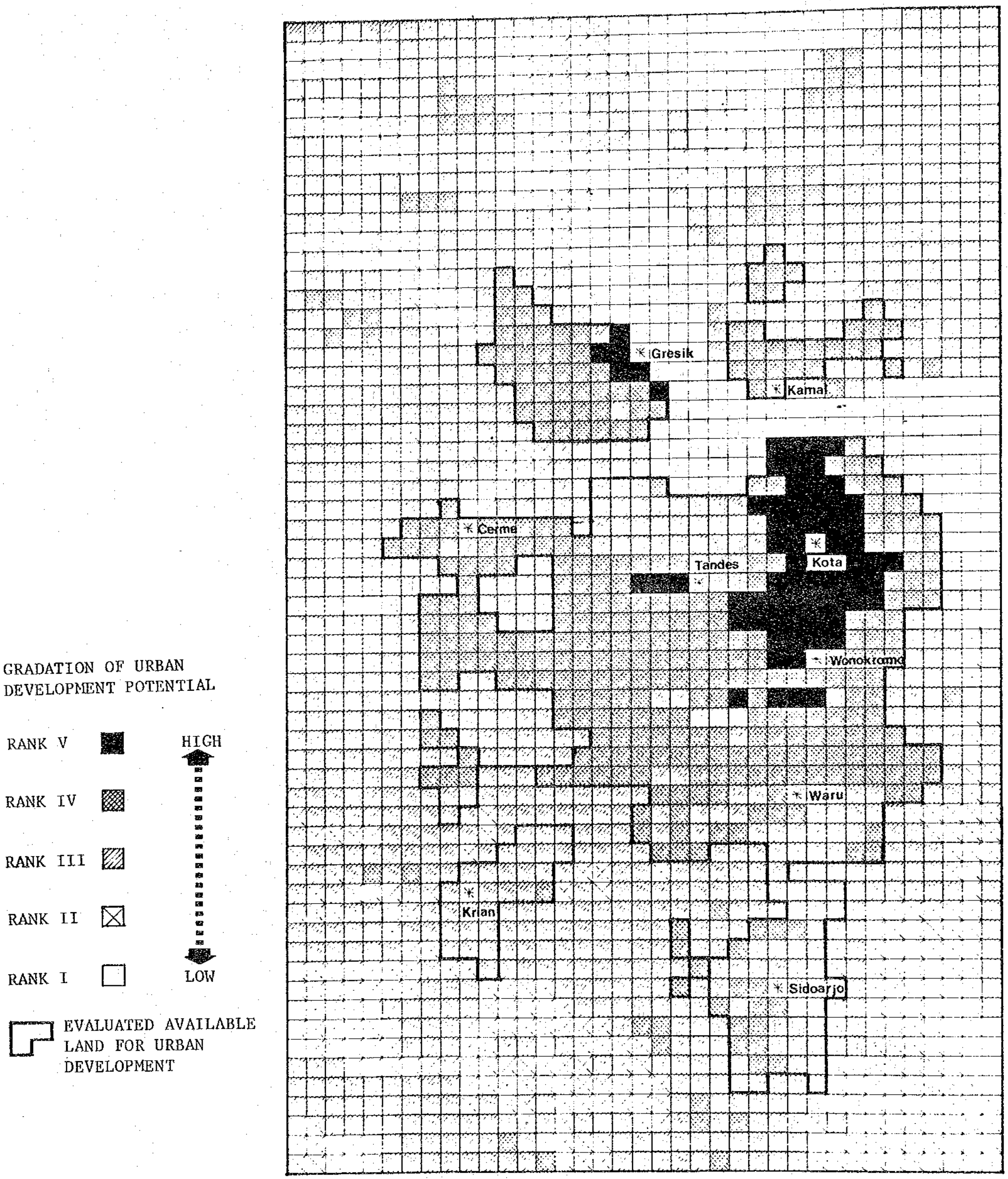


Fig. 12.4.2 LAND AVAILABILITY FOR URBAN DEVELOPMENT IN THE FUTURE

CHAPTER 13

TRAFFIC DEMAND FORECAST

13.1 METHODOLOGY

13.1.1 GENERAL

Several types of traffic surveys were conducted at site in order to analyse the existing patterns of traffic flow in Surabaya as well as GKS Region. The estimated traffic distribution (O-D Matrix) for 1982 is one of the major outputs of the traffic surveys as previously presented in Chapter 3 of Part I. Before entering into the projection of future traffic demand it should be noted that:

- Future traffic demand estimate is based on the 1982 Origin and Destination (O-D) Tables.
- The 1982 O-D Tables were derived mainly from the results of "Home Interview Survey" and "Roadside Interview Survey". The former survey results were used to estimate the present O-D Matrix for zones inside Surabaya in terms of person trips and the latter survey results were used to estimate the present O-D Matrix for zones outside Surabaya in terms of vehicle trips.
- The Roadside interviews were made with vehicle drivers in the vicinity of the boundaries of both Surabaya and GKS Region on radial routes from Surabaya.
- Most of the survey samples, therefore, are for traffic in radial directions. Consequently, the O-D traffic related to Surabaya are sampled and expanded properly for the O-D pairs between Surabaya and outside Surabaya blocks, but those which have their origin and destination in the zones outside Surabaya are not sampled sufficiently to fill out the rest of O-D pair boxes of the Metrix.
- Compared with Jakarta, car ownership rate (cars per population) is in a low level of only 50% of Jakarta. The motorcycle ownership rate of Surabaya is a little higher than that of Jakarta and this is because motorcycles are a substitute for the inadequate public transport service.
- Introduction of urban mass transit (railway) is one alternative for an urban transport system, often in preference to improvement of roads and to increase in buses/bemo.
- Since the existing railway in Surabaya barely provides for urban transport it is difficult to estimate the future traffic diverted to the urban mass transit from other transport means. Nevertheless, considering the levels of car ownership, motorcycle ownership and public transport services in Surabaya, it is most conceivable that the future traffic demand for an urban mass transit will be generated from the future potential owners of motorcycles and potential passengers of buses/bemo, but not necessarily from potential car owners.

Following these considerations about the limitations in the use of the estimated 1982 O-D Metrix and future alternative plans for urban transport system, a flow chart for future traffic demand was prepared as explained in the subsequent section.

13.1.2 ESTIMATING FUTURE O–D MATRICES

Future traffic demand was forecast in terms of person trips because the traffic pattern at present is attributable to personal behaviour rather than vehicle movements. Therefore, it is desirable to prepare person trip O-D tables for each trip purpose separately, if both volume and quality of data and information collected are sufficient. In this Study, a future person trip pattern was estimated by means of "all purposes" as a combined trip purpose. Accordingly, a trip of "all purposes" was so defined to reflect such factors of different trip purposes as trip distance, population, employment level and job oportunity by zone in the primary, secondary and tertiary sectors of industry. Based on the above estimation principle, the following major flow of the work was prepared as shown in Fig. 13.1.1.

13.1.3 ZONE DIVISION

For the analysis of the existing situation within the study area, and to assist in the planning of future development, it was necessary to divide the study area into a number of zones. The careful preparation of the zoning plan is an essential prerequisite of the traffic survey planning and the factors which influenced the final determination of zoning were as follows:

LANDUSE CHARACTERISTICS

Each zone should as much as possible be composed of similar landuse, in order to allow each zone to be treated as a homogeneous unit for the purpose of predicting future activities. Because of the more varied landuse in an urban area, it is therefore necessary to have more zones in an urban area, whilst rural areas can be divided into fewer, larger zones.

ADMINISTRATIVE BOUNDARIES

In order to relate available statistical data to the zones, it is desirable for zones and administrative boundaries to coincide.

ZONE SIZE

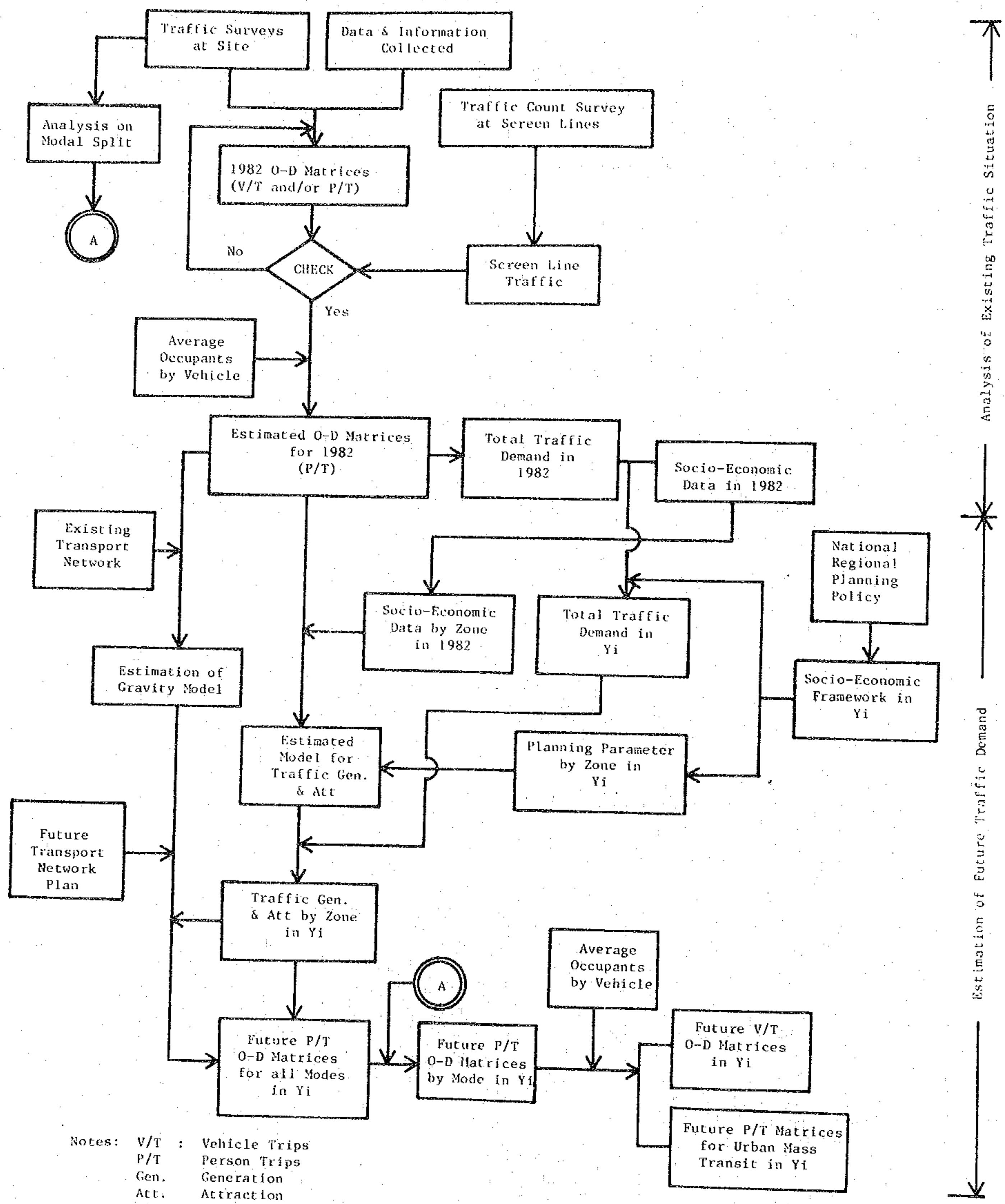
By making the zones small, it is possible to ensure that only similar land uses are contained within each zone but this has to be balanced against the fact that an excessive number of zones will be unmanageable and time-consuming for the purpose of analysis. For the purpose of this study the "Desa" within an urban area, was chosen as the component unit of a zone.

STUDY PURPOSE

For the purpose of preparing a Structure Plan it is usually possible to use fewer but larger zones, as any errors introduced by doing this will not be significant. However when carrying out a feasibility study it is necessary to consider more homogeneous zones, as errors at that level of detail could be significant. To enable the structure plan survey results to be easily incorporated in future feasibility studies, zoning for the traffic surveys was carried out so as to be compatible with a feasibility study. However, following analysis of landuse and traffic survey results, it was found that for some zones this output was deficient in quantity and detail to justify the small zone size selected. When this occured in some areas, zones were regrouped as necessary to fit the level of survey data and to coincide with the planning areas for the Structure Plan, described in section 15.1 of PART III.

CHECK ON SURVEY RESULTS

Traffic count surveys at screen lines and cordons can be used as a check on the estimated O-D Matrix obtained from other surveys such as Home Interview Survey and Roadside Interview Survey. Where features such as rivers or railway lines dictate the location of efficient screenlines and cordons, the zoning should be prepared so as to suit these lines. After consideration of all the factors given above, the zoning for the study was selected as shown in Figs. 13.1.2 and 13.1.3. Zone coding lists are given in Tables 13.1.1 through 13.1.3.



Notes: V/T : Vehicle Trips
P/T Person Trips
Gen. Generation
Att. Attraction
Yi. Future Year Yi

Fig. 13.1.1 ESTIMATING FLOW FOR FUTURE O–D MATRICES

Fig. 13.1.2 ZONE DIVISION IN SURABAYA

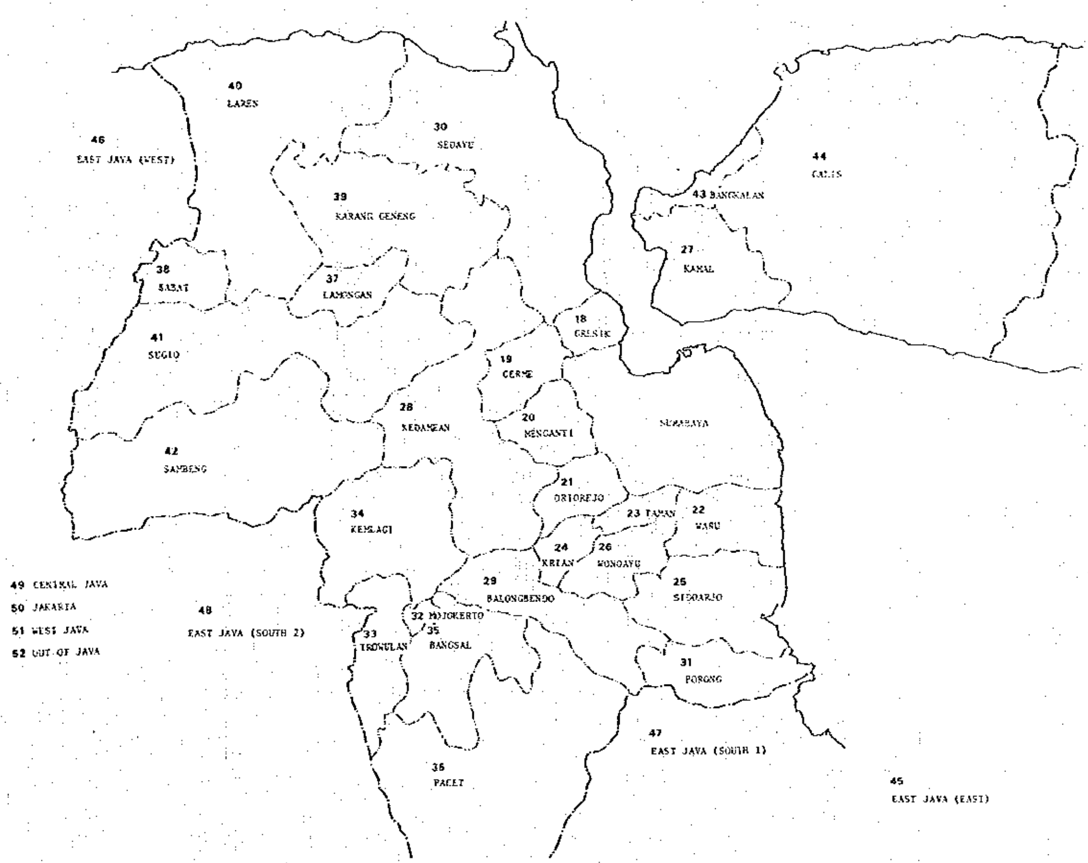


Fig. 13.1.3 ZONE DIVISION IN GKS AND OUTSIDE

Table 13.1.1 ZONE CODE LIST FOR SURABAYA

No.	NAME OF ZONE	KOTAMADYA KABUPATEN	KECAMATAN
18	GRESIK	GRESIK	GRESIK, KEBOMAS
19	CERME	GRESIK	CERME
20	MENGANTI	GRESIK	MENGANTI
21	DRIOREJO	GRESIK	DRIOREJO
22	WARU	SIDOARJO	WARU, GEDANGAN, SEDATI
23	TAMAN	SIDOARJO	TAMAN
24	KRIAN	SIDOARJO	KRIAN
25	SIDOARJO	SIDOARJO	SIDOARJO, CANDI, BUDURAN
26	WONOAYU	SIDOARJO	SUKODONO, WONOAYU
27	KAMAL	BANGKALAN	SOCAH, KAMAL, LABANG
28	KEDAMEAN	GRESIK	DUDUK SAMPEYAN, BENJENG, BALONG PANGGANG, KEDAMEAN, WRINGIN ANOM
29	BALONGBENDO	SIDOARJO	TULANGAN, KREMBUNG, PRAMBON, BALONGBENDO, TARIK
30	SEDAYU	GRESIK	MANYAR, BUNGAH, SEDAYU, UJUNG PANGKAH, PANCENG, DUKUN
31	PORONG	SIDOARJO	TANGGULANGIN, PORONG, JABON
32	MOJOKERTO	KODYA MOJOKERTO	KODYA MOJOKERTO
33	TROWULAN	MOJOKERTO	GEDEG, SOOKO, TROWULAN
34	KEMLAGI	MOJOKERTO	JETIS, KEMLATI, DAWAR BLANDONG
35	BANGSAL	MOJOKERTO	MOJOSARI, BANGSAL, PURI, DELANGGU
36	PACET	MOJOKERTO	PUNGGING, NGORO, KUTOREJO, TRAWAS, PACET, GONDANG, JATIREJO
37	LAMONGAN	LAMONGAN	LAMONGAN
38	BABAT	LAMONGAN	BABAT
39	KARANG GENENG	LAMONGAN	DEKET, TURI, GLAGAH, KARANG BINANGUN, KALITENGAH, KARANG GENENG
40	LAREN	LAMONGAN	PACIRAN, BRONDONG, LAREN, SEKARAN, SUKODONO
41	SUGIO	LAMONGAN	TIKUNG, KEMBANGBAU, SUGIO, KEDUNG PRING, MODO
42	SAMBENG	LAMONGAN	MANTUP, SAMBENG, NGIMBANG, BLULUK
43	BANGKALAN	BANGKALAN	BANGKALAN, SOCAH, KAMAL
44	GALIS	BANGKALAN	KLAMPIS, ARUSBAYA, BURNEH, TRAGAH, LABANG, TANAH MERAH, KWANYAR, GEGER, SEPULU, GALIS, TANJUNG BUMI, KOKOP, KONANG, BLEGAH, MODUNG

Table 13.1.2 ZONE CODE LIST FOR GKS REGION OUTSIDE SURABAYA

No.	NAME OF ZONE	KECAMATAN	DESA
1	TG. PERAK	SEMAMPIR PABEAN CANTIAN KREMBANGAN	UJUNG, PEGIRIAN, AMPEL, WONOKUSUMO, SIDOTOPU PERAK UTARA PERAK BARAT, DUPAK, MORO KREMBANGAN
2	KEDUNG	SUKOLILO	SIDOTOPO WETAN, BULAK BANTENG, TAMBAK WEDI, TANAH KALI KEDINDING, BULAK, KEDUNG COWEK
3	CANTIAN	PABEAN CANTIAN KREMBANGAN SIMOKERTO	PERAK TIMUR, KREMBANGAN UTARA, Nyamplungan BONGKARAN KEMAYORAN, KREMBANGAN SELATAN KAPASAN, SIDODADI, SIMOLAWANG
4	TEGALSARI	BUBUTAN GENTENG TEGALSARI SAWAHAN GUBENG	TEMBOK DUKUH, GUNDIH, JEPARA, BUBUTAN, ALON ALON COTONG PENELEH, GENTENG, KETABANG, KAPASARI EMBONG KALIASIN TEGALSARI, WONOREJO, KEDUNGDORO KUPANG KRAJAN, SAWAHAN, PETEMON GUBENG
5	WONOKROMO	TEGALSARI WONOKROMO	KEPUTRAN, Dr. SUTOMO DARMO, WONOKROMO, SAWUNGGALING
6	SAWAHAN	SAWAHAN KARANG PILANG	PAKIS, PUTAT JAYA, BANYU URIP DUKUH KUPANG, GUNUNG SARI, DUKUH PAKIS
7	GENTING	TANDES	ASEM ROWO, GENTING, KALIANAK, GREGES, TAMBAK LANGON
8	ROMO KALISARI	TANDES	TAMBAKOSO WILANGON, ROWO KALIASIN
9	SIMOMULYO	TANDES KARANG PILANG	SIMO JULYO, TANDES LOR, TANDES KIDUL, GEDANG ASIN, PUTAT GEDE, SONO KWIJENAN, SUKO MANUNGGAL, TANJUNG SAR, TUBANAN, GADEL, KARANG POH, BALONG SARI, BIBIS, MANUKAN WETAN, MANUKAN KULON, BUNTARAN LONTAR, PRADAH KALI KONDAL
10	SEMEMI	TANDES KARANG PILANG	BANJAR SUGIAN, KANDANGAN, KLAKAH REJO, SEMEMI, BABAT JERAWAT, PAKAL, BENOWO, SUMBERJO, TAMBAK DONO SAMBI KEREP, BRINGIN, MADE
11	KARANG PILANG	KARANG PILANG	KEDURUS, JAJAR TUNGGAL, WIYUNG, BABATAN, LIDAH WETAN, LIDAH KULON, KARANG PILANG, KEBRAON, BALAS KLUMPRIK, SUMUR WELUT, BANGKINGAN, WARU GUNUNG, JERUK, LAKAR SANTRI
12	WONOCOLO	WONOKROMO WONOCOLO	JAGIR KARAH, KETINTANG, KEBONSARI, JAMBANGAN, BENDUL MERISI, MARGOREJO, JEMUR WONOSARI, SIDOSERMO, MENANGGAL, GAYUNGAN, PAGESANGAN, SIWALAN KERTO, DUKUH MENANGGAL
13	GUBUNG	WONOKROMO GUBENG	NGAGELRESO, NGAGEL AIRLANGGA, MOJO, BARATAJAYA, KERTAJAYA, PUCANG SEWU
14	TAMBAKSARI	SIMOKERTO	SIMOKERTO, TAMBAKREJO, RANGKAH, GADING, PACARKEMBANG, TAMBAKSARI, PLOSO, PACARKELING
15	NORTH SUKOLILO	SUKOLILO	KOMPLEK KENJERAN, KENJERAN, KALIJUDAN, MULYOREJO, KALISARI, SUKOLILO, DUKUH SUTOREJO
16	SOUTH SUKOLILO	SUKOLILO	MANYAR SABRANGAN, GEBANG PUTIH, NGINDEN JANGKUNGAN, MENUR PUMPUNGAN, KLAMPIS NGASEM, SEMOLO WARU, KEJAWAN PUTIH TAMBAK, MEDOKAN SEMAMPIR, KEPUTIH
17	RUNGKUT	RUNGKUT	KALIRUNGKUT, PANJANG JIWO, TRENGGILIS MEJOYO, KEDUNGBARUK RUNGKUT KIDUL, RUNGKUT TENGAH, RUNGKUT MENANGGAL, PRAPEN, KENDANGSARI, KUTISARI, GUNUNG ANYAR PENJARINGANSARI, WONOREJO, GUNUNG ANYAR TAMBAK, MEDOKAN AYU

Table 13.1.3 ZONE CODE LIST FOR OUTSIDE GKS REGION

NO.	NAME OF ZONE	MAIN CITIES or PROVINCE
45	EAST JAVA (EAST)	PASURUAN, PROBOLINGGO, JEMBER, BANYUWANGI
46	EAST JAVA (WEST)	TUBAN, BOJONEGORO
47	EAST JAVA (SOUTH 1)	MALANG, BLITAR
48	EAST JAVA (SOUTH 2)	JOMBANG, KERTOSONO, KEDIRI, MADIUM
49	CENTRAL JAVA	CENTRAL JAVA
50	JAKARTA	DKI JAKARTA
51	WEST JAVA	WEST JAVA
52	OUT OF JAVA	OUT OF JAVA

13.2 FRAMEWORK OF FUTURE TRAFFIC GENERATION

13.2.1 DEMAND FOR FUTURE PERSON TRIPS

TOTAL PERSON TRIPS IN SURABAYA

Total person trips generated and attracted to Surabaya in 1982 was estimated at 3.7 million trips/day, of which 3.3 million trips were made by Surabaya residents with an average trip rate of 1.85 trips per person.

The level of person trip rate of Surabaya residents in 1982 was relatively low compared with 2.09 trips/person in Jakarta. According to the analytical results of person trip survey, conducted in 1982, factors affecting the person trip rate are as follows:

(1) The number of regularly employed population in secondary and tertiary sectors of industry in Surabaya is well below full employment.

(2) Non-home based trips, which include "Business trip" in particular.

(3) The number of "other trip purposes", which include shopping, private affairs, social and recreational trips

(4) The number of students of such higher education as colleges, universities, graduate schools, and so on

(5) The "out-door trip rate", which is defined to be a percentage of the population who makes at least one trip per day.

The above factors from (1) to (4) are heavily related to the development of the economy and income level and also the development of the transport system. The factor of (5) is a result of other factors of (1) to (4) and shows the percentage change in the number of actual trip makers.

To estimate the future gross trip rate, a net trip rate and an outdoor trip rate (%) were respectively assumed to be 2.5 trips/person and 85%. These are compared in Table 13.2.1 with those derived from the home interview survey for Surabaya, 1982 and from the cases for Jakarta and a Japanese urban area.

Consequently, a future gross trip rate and a trip generation factor were estimated to be 2.1 trips/person and 2.35 trips/person respectively for Surabaya, 2000, as shown in Table 13.2.2.

Table 13.2.1 COMPARISON OF TRIP RATES

Type of Trip Rate	Surabaya, 1982[4]	Surabaya, 2000 (Estimated)	Jakarta, 1980[5]	Average Urban Area in Japan
(1) Gross Trip Rate[1]	1.85	2.1	2.09	2.65
(2) Out-door Trip Rate[2]	75.8%	85%*	86.8%	87.3%
(3) Net Trip Rate[3]	2.44	2.5*	2.41	3.02

Notes: 1) Average trip times per person who lives in Surabaya and is over 6 years of age
2) Percentage population who made at least one trip and are over 6 years of age
3) Average trip times per person who made at least one trip and is over 6 years of age [(3) = (1) ÷ (2)]
* Assumed in comparison with other cases

Source: 4) Home Interview Survey by the Team in 1982
5) Feasibility Study on Jakarta Harbour Road Project, Nov., 1981 by JICA.

Table 13.2.2 TRIP RATE AND TRIP GENERATION FACTORS IN SURABAYA

Trip Rate/Factor	Surabaya, 1982	Surabaya, 2000 (Estimated)
(1) Gross Trip Rate	1.85	2.1
(2) Trips Generated/Attracted in SBY	3,708,600	7,757,300
(3) Population	2,103,800	3,825,000
(4) Percentage Population over 6 Years of Age	85.5%	86.3%
(5) Trip Generation Factor [(2)/(3) x (4)]	2.06	2.35

TOTAL PERSON TRIPS IN SMA OUTSIDE SURABAYA, AND GKS OUTSIDE SMA

In SMA outside Surabaya, development of housing, industries and transportation are planned and it is supposed that urbanization similar to Surabaya will occur and that the residents in the region will have similar travel behavior. Therefore the person trip rate considered in the previous section was adopted in estimating total person trips generated in this region.

Since in the 1982 roadside interview survey by the Study Team, trips in only the radial directions were obtained, the precision of the OD traffic volumes related to GKS outside SMA was limited. Therefore the future total person trips generated in GKS outside SMA for estimating the future OD matrices were given the traffic volume in the radial direction of Surabaya. In practice the future values were obtained by enlarging the total person trips in this region, 1982 by the use of a growth factor for zonal commuting traffic volume derived from the socio-economic framework.

13.2.2 DEMAND FOR FUTURE TRUCK TRAFFIC

EXISTING TRUCK TRAFFIC GENERATED IN SURABAYA

The external truck flows between Surabaya and outside Surabaya were obtained based on the roadside interview survey conducted in the vicinity of boundaries of Surabaya and GKS Region, and the results are summarized in section 3.2.1 of Part I. In order to estimate the existing internal truck flows performed inside Surabaya, a factory and trucking company survey was carried out by sending questionnaires to companies operating trucks. However, insufficient truck trip data was collected to fulfill the required number of O-D pair traffic and therefore a regression equation was prepared by referring to data obtained from similar conditions to Surabaya.

The equation is

$$Y = 0.343X + 47.7 \quad (R = 0.809)$$

where,

Y = ton/the number of jobs in secondary and tertiary sectors of industry

X = Per capita GRDP at 1975 constant price (Rp10,000)

According to the above equation, cargo (ton) generation factor per job (secondary + tertiary sectors) was derived for Surabaya as shown in Table 13.2.3.

Table 13.2.3 CARGO TRAFFIC GENERATION ESTIMATED BY REGRESSION MODEL FOR SURABAYA

	1980	1982
Per Capita GRDP at 1975 Const. Price (Rp 10,000)	18.1	19.2
Cargo Generation Factor (ton/job/year)	53.9	54.3
No. of Jobs (Secondary and Tertiary Sectors)	736,473	791,500
Estimated Cargo (x 1,000 ton/yr)	39,696	42,978
Generation: (ton/day)	132,320	143,260

The external truck traffic generated from Surabaya to outside Surabaya was estimated to be 9,300 trips per day based on the roadside interview survey. At the same time, average truck load and rate of loaded trucks of these external traffic is found to be 6.1 tons per loaded truck and 55%, respectively. Therefore, the internal cargo flows inside Surabaya can be assessed at 112,000 tons/day.

The composition rates of large trucks and small trucks counted at the screen lines in Surabaya are 36% and 64% respectively. Assuming the average truck load and rate of loaded trucks to be 6.5 ton per loaded truck and 55% for large trucks; 2.5 tons per loaded trucks and 55% for small trucks, the internal truck traffic inside Surabaya was estimated at 50,900 trips per day. This internal truck traffic is to be revised after comparison with the screen line truck traffic. Tg. Priok Port is one of the major truck traffic generating facilities, and it handles both foreign and domestic cargoes. The total cargo volume carried by land transport in 1982, excluding transhipment inside the prot area, is estimated at 6.5 million tons and 10% of which is assumed to be transported by rail. An average truck load and a rate of loaded trucks to and from the port were derived to be 6.4 ton/truck and 57.8% respectively from the survey at the port area. Therefore, a total truck traffic generated from the port for 1982 was estimated to be 2,900 truck trips per day assuming actual truck operation of 300 days per year, among which 66.5% or 1,930 trucks have their destinations in Surabaya.

In order to verify the internal truck traffic in Surabaya, (1982) an assumed truck O-D table was checked and adjusted by the screen line truck traffic following the method presented in Fig. 13.2.1. The result of the estimation for generated truck traffic from Surabaya in 1982 was obtained as shown in Table 13.2.4.

Table 13.2.4 ESTIMATED TRUCK TRAFFIC GENERATED FROM SURABAYA, 1982

(Unit: Truck trips/day)

Origin \ Destination	Surabaya	Outside Surabaya	Total
Surabaya outside Port	25,388	8,782	34,170
Tg. Perak Port Traffic	1,933 (x 2)	974	2,907 (4,840)
Surabaya Total	29,254	9,756	39,010

DEMAND FOR FUTURE TRUCK TRAFFIC IN SURABAYA

The existing truck generating factor per job in the secondary sector was calculated to be 0.3 trips/job without port related traffic, and this factor was assumed to be unchanged in future. Therefore, the future truck traffic generated from Surabaya except for port related traffic was estimated as shown in Table 13.2.5.

Table 13.2.5 FUTURE TRUCK TRAFFIC FROM SURABAYA WITHOUT PORT TRAFFIC

	1982	1990	2000
(1) Truck Generating Factor	0.3	0.3	0.3
(2) No. of Jobs in Secondary Sector (Persons)	115,048	167,570	230,953
(3) Truck Traffic Generated from SBY without Port Traffic (veh./day)	34,170	50,271	69,286

Future port traffic was projected based on the results of Tg. Perak Port feasibility study. The economic development framework adopted by the feasibility study is a little lower than that of this Structure Plan and therefore the future cargo traffic in the port was adjusted to be 10,714,000 ton/year and 25,054,000 ton/year for 1990 and 2000 respectively.

Assuming the average truck load at 6.0 ton/loaded truck and a rate of loaded trucks at 55%, the truck traffic generated from the port was estimated to be 5,800 trips and 12,600 trips per day for 1990 and 2000 respectively.

Distribution of this port traffic was assumed to increase in proportion to the growth of zonal jobs in the secondary and tertiary sectors. A summary of the above truck traffic generated from Surabaya and the port, is shown in Table 13.2.6.

Table 13.2.6 ESTIMATED FUTURE TRUCK TRAFFIC GENERATION FOR SURABAYA AND PORT

(Unit:veh. trips/day)

Year	Origin \ Destination	Surabaya	Outside Surabaya	Total
1982	Surabaya outside Port Port related trucks	25,388 1,933 (x 2)	8,782 974	34,170 2,907(4,840)
	Surabaya Total	29,254	9,756	39,010
1990	Surabaya outside Port Port related trucks	35,722 3,202 (x 2)	14,549 2,605	50,271 5,807(9,009)
	Surabaya Total	42,126	17,154	59,280
2000	Surabaya outside Port Port related trucks	45,401 7,033 (x 2)	23,885 5,572	69,286 12,605(19,638)
	Surabaya Total	59,467	29,457	88,924

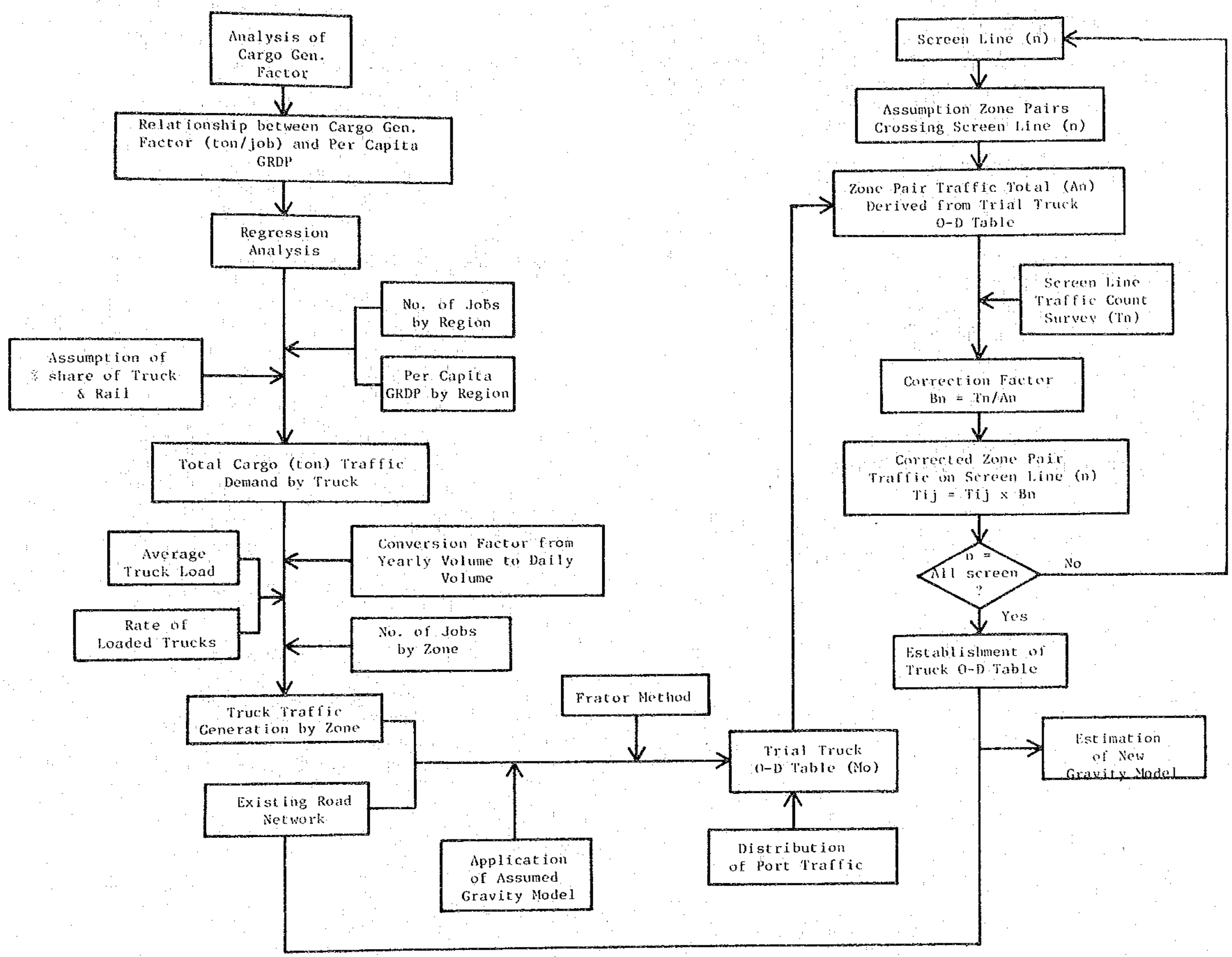


Fig. 13.2.1 ESTIMATING FLOW FOR EXISTING TRUCK O–D MATRIX

DEMAND FOR FUTURE TRUCK TRAFFIC IN SMA OUTSIDE SURABAYA

The existing total truck traffic generated from SMA outside Surabaya was estimated at 8,289 trips/day based on the roadside interview survey. However, the sample traffic obtained from the traffic survey was insufficient to cover all the truck traffic in the area, because of a shortage of survey locations in this area. A very large number is necessary to obtain the required accuracy of information. However, the traffic data to and from Surabaya in radial directions was sufficient to provide significant information about the traffic.

The traffic generating factor of truck flows for Surabaya was estimated at 0.30 trips per job in the secondary sector, but that for SMA outside Surabaya was calculated to be 0.11 trips per job in the secondary sector. This may be considered low because of the lack of truck traffic data. Therefore, a traffic generating factor of truck in the area was assumed to be 0.14 trips per job in the secondary sector for the year 1982. As a result, the total truck traffic generated from SMA outside Surabaya was estimated at 9,374 trips/day.

The future growth of this traffic was estimated using the regression model introduced earlier. In addition, the port traffic to and from Tg. Perak is also related to this area and was taken into consideration in estimating the future truck traffic generated from SMA outside Surabaya as shown in Table 13.2.7.

Table 13.2.7 ESTIMATED FUTURE TRUCK TRAFFIC GENERATION FROM SMA OUTSIDE SURABAYA

(Unit : veh.trips/day)

	1982	1990	2000
(1) Truck Traffic Generated from the Area	9,374	18,461	38,977
(2) Port Traffic from the Area	598	1,931	4,022
Total Truck Traffic Generated from the Area	9,972 (8,289)	20,392	42,999

Note: The figure in ( ) shows the traffic volume derived from the traffic survey.

DEMAND FOR FUTURE TRUCK TRAFFIC IN GKS OUTSIDE SMA

The sample traffic data obtained during the traffic survey was mostly the O-D traffic in a radial direction to and from Surabaya. Considering the study purpose, the existing sample data on the traffic in this area was thought to be sufficient given that the missing data on the O-D traffic has no influence on the radial directions to and from Surabaya.

Therefore, the 1982 estimated truck traffic generation for this area was the base for future truck traffic generation. Growth factors used for the future projection were derived following the method applied for SMA outside Surabaya. The results of the estimation are shown in Table 13.2.8.

Table 13.2.8 ESTIMATED FUTURE TRUCK TRAFFIC GENERATION FROM GKS OUTSIDE SMA

(Unit : veh.trips/day)

	1982	1990	2000
(1) Truck Traffic Generated from the Area	4,104	6,810	11,219
(2) Port Traffic from the Area	64	132	290
Total Truck Traffic Generated from the Area	4,168	6,942	11,509

13.3 ZONAL TRAFFIC GENERATION

13.3.1 ZONAL PERSON TRIP GENERATION

The zonal person trip generation/attraction model was made to break down the total person trips by block (SBY, SMA outside SBY, GKS outside SMA) into zonal trip generation/attraction.

The zonal person trip generation/attraction is the value of all trips by all purposes and all modes. Trip ends by zone was estimated by the use of the number of jobs in secondary and tertiary sectors by zone and employed population in secondary and tertiary sectors by zone without separating trip generation from trip attraction. The zonal person trip generation/attraction model for SBY and the one for Outside SBY were separately built up since the precision of the traffic survey for the two areas was not same. The models and the estimated results are shown respectively in Tables 13.3.1 and 13.3.2.

Table 13.3.1 PERSON TRIP GENERATION/ATTRACTION MODEL

Basic Formula: $T = A \times J + B \times E + C$

where:
- T : Trip End by zone
- J : No. of jobs by zone
- E : Employed population by zone
- A, B, C : Parameter

Applied Block	Value of Parameters		
	A	B	C
Surabaya	0.7174	6.3505	117,511
GKS Outside Surabaya	0.02674	0.4347	-1,593

13.3.2 TRUCK TRAFFIC GENERATION BY ZONE

The same method as that applied to estimate the control total of SBY, SMA outside SBY and GKS outside SMA was also applied to find the truck traffic generation by zone. In practice the generated truck traffic by zone was allocated in proportion to the number of jobs in the secondary and tertiary sectors by zone. The estimated values for truck traffic in the year 1990 and 2000 are shown in Table 13.3.3.

Table 13.3.2 ESTIMATED FUTURE PERSON TRIP ENDS BY ZONE IN 1990, 2000

(Unit: P.T. ends/day)

No.	NAME OF ZONE	1990	2000
1.	TG.PERAK	892,782	934,446
2.	KEDUNG COWEK	228,590	340,112
3.	CANTIAN	665,170	1,042,468
4.	TEGALSARI	1,606,800	1,966,366
5.	WONOKROMO	586,758	747,496
6.	SAWAHAN	573,660	689,576
7.	GENTING	194,630	327,154
8.	ROMOKALISARI	130,686	213,886
9.	SIMOMULYO	606,860	1,037,052
10.	SEMEMI	209,152	814,986
11.	KARANGPILANG	624,913	1,274,256
12.	WONOCOLO	761,952	1,054,646
13.	GUBUNG	781,760	879,870
14.	TAMBAKSARI	891,414	1,105,230
15.	NORTH SUKOLILO	291,494	484,454
16.	SOUTH SUKOLILO	378,750	661,040
17.	RUNGKUT	447,326	752,058
1.	SURABAYA	9,872,702	14,385,098
18.	GRESIK	86,818	157,510
19.	CERME	6,960	110,586
20.	MENGANTI	5,753	101,522
21.	DRIOREJO	13,204	141,218
22.	WARU	52,074	139,240
23.	TAMAN	32,518	62,244
24.	KRIAN	40,130	126,374
25.	SIDOARJO	97,566	231,788
26.	WONOAYU	13,354	28,098
27.	KAMAL	21,530	78,592
2.	S.M.A. OUTSIDE SBY	369,876	1,177,172
28.	KEDAMEAN	9,196	23,416
29.	BALONGBENDO	11,150	17,436
30.	SEDAYU	11,536	26,154
31.	PORONG	7,466	16,302
32.	MOJOKERTO	8,284	10,488
33.	TROWULAN	8,840	17,564
34.	KEMLAGI	7,612	15,174
35.	BANGSAL	11,696	23,126
36.	PACET	15,188	30,036
37.	LAMONGAN	3,910	5,456
38.	BABAT	4,154	5,538
39.	KARANG GENENG	2,850	5,990
40.	LAREN	5,284	10,722
41.	SUGIO	4,788	9,774
42.	SAMBENG	3,652	7,578
43.	BANGKALAN	5,534	5,728
44.	GALIS	11,182	23,002
3.	GKS OUTSIDE SMA	132,322	253,478
45.	EAST JAVA (EAST)	41,331	53,673
46.	EAST JAVA (WEST)	16,208	21,169
47.	EAST JAVA (S-1)	74,969	101,272
48.	EAST JAVA (S-2)	56,481	79,354
49.	GCENTRAL JAVA	16,215	21,047
50.	JAKARTA	11,748	15,273
51.	WEST JAVA	2,472	3,191
52.	OUT OF JAVA	5,333	6,898
4.	OUT OF GKS	224,757	301,877
5.	TOTAL	10,599,657	16,117,625

Table 13.3.3 ESTIMATED FUTURE TRUCK TRAFFIC GENERATED BY ZONE IN 1990, 2000

(Unit : truck trips/day)

No.	NAME OF ZONE	1990	2000
1.	TG. PERAK	8,397	17,678
2.	KEDUNG COWEK	282	943
3.	CANTIAN	12,931	16,808
4.	TEGALSARI	19,126	24,884
5.	WONOKROMO	2,136	3,132
6.	SAWAHAN	1,783	2,048
7.	GENTING	1,783	2,048
8.	ROMO KALISARI	56	591
9.	SIMOMULYO	1,589	2,474
10.	SEMEMI	261	1,188
11.	KARANGPILANG	2,226	4,031
12.	WONOCOLO	2,085	2,863
13.	GUBUNG	1,654	1,907
14.	TAMBAKSARI	4,117	5,352
15.	NORTH SUKOLILO	100	171
16.	SOUTH SUKOLILO	247	540
17.	RUNGKUT	2,071	2,979
1.	SURABAYA	59,280	88,924
18.	GRESIK	7,559	13,394
19.	CERME	148	1,987
20.	MENGANTI	80	954
21.	DRIOREJO	565	1,885
22.	WARU	2,666	5,427
23.	TAMAN	973	1,800
24.	KRIAN	1,567	3,576
25.	SIDOARJO	5,190	8,773
26.	WONOAYU	347	810
27.	KAMAL	1,297	4,393
2.	S.M.A. OUTSIDE SBY	20,392	42,999
28.	KEDAMEAN	23	37
29.	BALONGBENDO	250	398
30.	SEDAYU	15	22
31.	PORONG	383	644
32.	MOJOKERTO	2,005	3,370
33.	TROWLAN	941	1,581
34.	KEMLAGI	24	35
35.	BANGSAL	147	234
36.	PACET	45	67
37.	LAMONGAN	1,268	2,130
38.	BABAT	909	1,528
39.	KARANG GENENGA	19	30
40.	LAREN	37	55
41.	SUGIO	67	99
42.	SAMBENG	18	27
43.	BANGKALAN	720	1,145
44.	GALIS	71	106
45.	EAST JAVA (EAST)	1,296	1,822
46.	EAST JAVA (WEST)	620	872
47.	EAST JAVA (S-1)	3,952	5,554
48.	EAST JAVA (S-2)	937	1,317
49.	CENTRAL JAVA	699	983
50.	JAKARTA	854	1,200
51.	WEST JAVA	100	140
52.	OUT OF JAVA	242	341
4.	OUT OF GKS	8,700	12,229
5.	TOTAL	95,314	155,661

13.4 PLANNING FOR TRANSPORT NETWORK

13.4.1 GENERAL APPRECIATION OF EXISTING TRANSPORT SYSTEM

REGIONAL AND INTER-REGIONAL TRANSPORT

SMA can be characterized as a central urban area in the Indonesian development strategy, accommodating primary services of cultural, social, economic and communication activities. Geographical coverage of these services extends to East Java, part of Central Java, Kalimantan, Sulawesi, Nusatenggara, Maluku and Irian Jaya.

The present activities at Tg. Perak Port and Juanda Airport (movements of goods and people) indicate a delineation of geographical extent to those islands. Land transport in Java is comparatively more developed than other islands. Referring to the 1977 cargo O-D Survey and movements of air passengers it is found that Surabaya is strongly connected with Jakarta, which is provided with central administrative functions as the capital of Indonesia.

Most of the rail cargo is generated from Tg. Perak Port and involves distribution of petroleum and fertilizer to East Java and limited quantities to Central Java. About 90% of the port cargoes are transported and distributed to East and Central Java by truck. Except for such specific cargoes as petroleum, fertilizer and cement from Tg. Perak Port, inbound and outbound rail cargo traffic to and from Surabaya, only amounted to about 200,000 tons each in 1980. Development of rail transport has stagnated and has been substituted with road transport by truck for cargo and intercity bus for passengers.

A movement to containerization of ship cargoes has already started in Surabaya and the Tg. Perak Master Plan elaborates on its realization. Nevertheless, the land transport side is not yet ready to cope with such movement. This is a matter of railway development strategy in order to decide whether the railway will participate in the containerization movement in the future.

To pursue economy of transport by truck it is desirable to enlarge the transport capacity per trip. However, the existing roads are not in a condition to meet this demand. The roads are, generally:

- not wide enough for large traffic
- of poor alignment
- suffer from frequent flooding
- have poor bridges in poor condition
- passing through a succession of small towns and villages, etc.

In addition, heavy truck routes in Surabaya City are limited and their use controlled by time-bands. There is not enough space for parking and transhipment of cargoes. Types of cargoes will increase in variety and destination as the economy develops and commodities in demand will vary widely. For such transport demand, the existing truck yard is not sufficient and the development of a truck terminal system will be required.

URBAN TRANSPORT

Urban transport problems observed in Surabaya are as follows:

(1) Traffic Flow

- More than 50% of road traffic are motorcycles
- Traffic is mixed and composed of large and small vehicles, motorized and non-motorized vehicles, high and low speed vehicles
- Roadside parking
- Indefinite locations of stops for public transport (Bemo/Colt/Becak) and also for city buses

(2) *Transport Facilities*

- Unidentifiable boundary between carriageway and footpaths
- Low standard of road and railway design and maintenance
- Frequent flooding on roads
- Insufficient road capacity and incomplete road network
- Ill-defined function of roads in the network
- Insufficient front yard at rail stations
- Inconvenient access to rail stations
- Level crossings of railway and road
- Impediment of unused rail tracks for road traffic and inefficient use of public land
- Lack of standardization of transport facilities
- Lack of parking space (for cars, trucks and buses)

(3) Public Transport

- Lack of bus fleet and operating routes
- Lack of bus services at night
- Insufficient capacity of bus terminals for intra-city and intercity bus transport
- Lower levels of rail transport services (punctuality, frequency, safety, speed, comfort, etc.)
- No direct connection between northern railway and southern/eastern railway lines

(4) Traffic Management

- Lack of intersection capacity
- Lack of pedestrian facilities
- Lower contribution of one-way system to urban traffic
- Increased traffic accidents
- Control of car parking
- Lack of traffic signals
- Lack of lane marking
- Lack of repair and maintenance of vehicles

(5) Others

- Drivers behaviour
- Illegal operation of public transport (for passengers and cargo)
- Over-loading of trucks

Urban transport problems are not only confirmed to physical problems but are also involved with the quality or variety of transport needs.

The transport sector must form the backbone of a structure plan of Surabaya Metropolitan Area from the viewpoint of both regional and urban development strategies.

13.4.2 PLANNING POLICY FOR TRANSPORT NETWORK

The planning of the transportation network should be carried out on the basis of the development aims and objectives already stated in sections 11.2 and 11.3 Part III. In particular, the transportation plan and other development plans are not in an isolated relationship, but should be mutually effective.

The principles of the allocation plan of population and industries in SMA are summarized as follows:

- To form an urban area which allows continuous expansion of the existing urban area of Surabaya radially and spherically.
- To form sub-areas which are located outside the above area and form independant urban districts of Surabaya in order to reduce the burden of goods and population concentration to the urban Surabaya.

These areas are divided into three categories based on their characteristics, and are named, Central Urban Area; Urban Sub-Centre Area; and Industry and Physical Distribution Facility Area.

The principle of the transportation facility plan is to build the physical framework of the city in consideration of the expected function of these areas and the allocation of fundamental facilities to fulfil those functions as shown in Fig. 13.4.1. Based on this principle and the general appreciation of the existing transport system, planning policy for the transport sector can be proposed as follows:

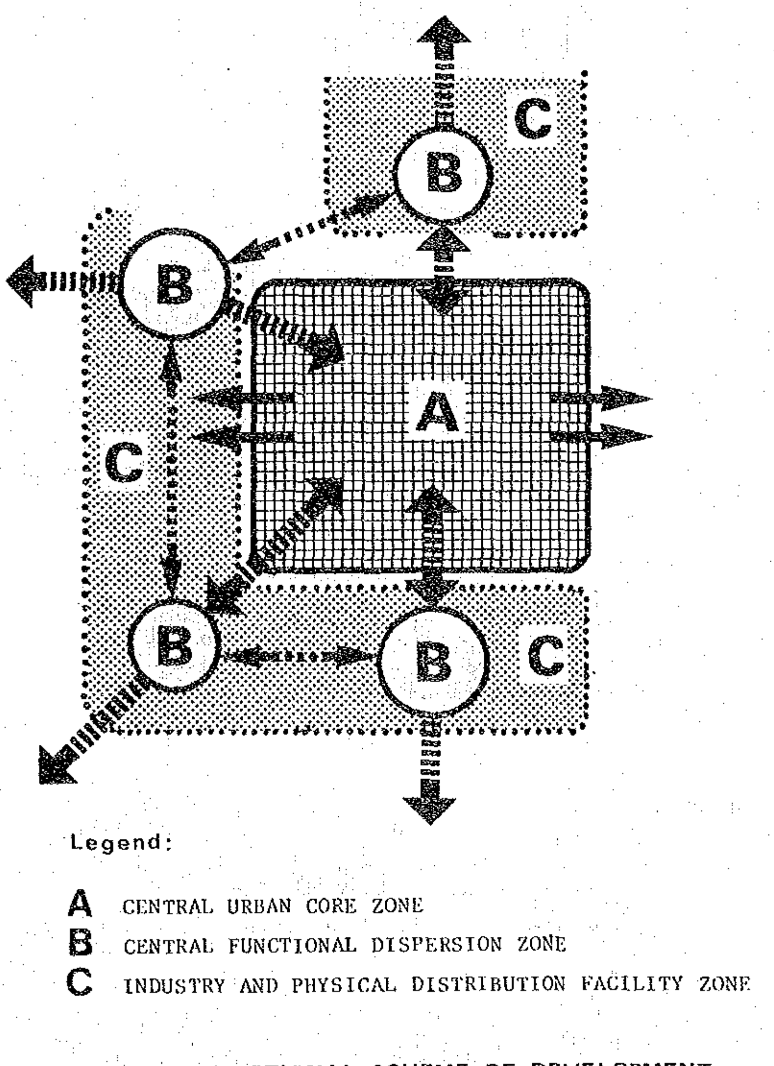


Fig. 13.4.1 CONCEPTIONAL SCHEME OF DEVELOPMENT ZONES AND CONNECTIONS

RE-ORGANIZATION OF ROAD NETWORK SYSTEM

The discussion consists of the following two aspects. One is to study an appropriate composition of the primary road network to ensure the inter-regional road transportation. The other is to study how the secondary system in the city should be composed to secure effective urban transportation and to achieve the development of various urban activities in the area.

- Development of Railway Network System
  The function of railway transportation should be defined and decisions made on how to incorporate the railway into a comprehensive urban transportation system.

- Improvement of Public Transportation System
  The functions of existing modes of public transportation should be defined and decisions made on these modes to the total public transport system.

- Provision of Terminals
  The kind of terminal functions should be studied and decisions made on where they should be placed in the transportation network.

13.4.3 RE-ORGANIZATION OF ROAD NETWORK SYSTEM

GENERAL

In the urban area which is highly developed or expected to be developed, a variety of transport demands are generated such as cargo transport, and passenger transport, each with different trip purposes, distance and speed.

In response to such transport demand there exists many transport means and they must somehow be combined and balanced. However, without well-organized transport facilities (transport network system) traffic conflicts will arise, because of the mixed transport demand and different capacity of supply modes. Therefore, it is necesary to consider how to organize and categorize the road functions in order to meet the traffic demand.

The primary system and the secondary system are the principal components of the total network system. The primary system, being defined by Bina Marga at present as shown in Fig. 13.4.2, is the transportation system for inter-regional traffic and mainly serves the traffic between central cities of the regions. The traffic is therefore characterized as long distance trip, with comparatively high speeds. The secondary system is the one within either urban or rural areas. These two systems, therefore, connected smoothly and should be organized to meet the various traffic demand, whatever trip purpose and distance is required.

RADIAL ROADS IN THE PRIMARY SYSTEM

Considering the analytical results of existing traffic conditions, the following concept with regard to the primary road network in radial directions to and from Surabaya, will be assumed:

- The Mojokerto radial route should be regarded as a major axis to be developed with high priority.

- The Gresik route connecting Surabaya with Jakarta should be intensively developed as a major route supporting wide-regional industrial traffic through Jakarta, Cirebon, Semarang and Surabaya. The development of this northern East-West axis can be expected to have significant impact not only on the development of middle-scale cities but also to the composition of the basic development structure of Java Island.

- Centring on Surabaya, the cities of Sidoarjo and Gresik function as sub-centres, and have strong ties with Surabaya. Mojokerto has relatively high relationships with the other cities as well.

- At Porong, the southward axis from Surabaya is diverted to Malang direction and Pasuruan direction. Both are connecting with major second order cities of Malang, Pasuruan, Probolinggo, Jember and Banyuwangi.

- Surabaya–Bangkalan using ferry transport is a major route connecting East Java and Madura Island.

The planning concept of the primary radial roads is based on these conditions and it can be considered that the composition of regional traffic axes can be proposed as shown in Fig. 13.4.3.

RING ROAD IN THE PRIMARY SYSTEM

As shown in Fig. 13.4.4, the existing traffic pattern is that a large amount of regional and inter-regional traffic from all directions, approximately 60,000 motorized vehicles per day excluding motorcycles, concentrate into the busy area of Surabaya through the radial pattern road network. Both passenger and cargo traffic are mixed using different sizes of vehicles and they are mainly attracted to the central urban area of Surabaya. Through traffic also runs on the same major streets which lead to the central urban area.

In order to avoid traffic conflicts in the urban area, a ring road plan in the area will contribute to the dispersal of the concentrated traffic and the rehabilitation of the existing road functions.

The ring road has an important role not only to connect the regional/inter-regional traffic with the urban Surabaya including Tg. Perak Port, but also to enhance the development potential along this road.

SECONDARY SYSTEM IN THE URBAN AREA

The major arterial streets which form the fundamental bones of the Secondary System promote the land development for urban exploitation and at the same time, give diversity of access to the central urban area.

As mentioned before, the primary road system is basically formed by a combination of radial and ring road patterns. The secondary road system will be basically a grid system although some links in the grid may be part of the primary system.

The grid pattern can be also recognised as ring roads by the utilization and the structure of inter-sections, so that the ring road concept will include 3 rings, the inner, middle and outer rings. The outer and middle rings will be part of the primary road system, but the inner ring will be part of major arterial streets in the secondary system. The grid pattern of major arterial streets should be constructed at intervals of 2.0 to 3.0 km and would bear the major function of the intra-urban transportation situated next to the primary system as shown in Fig. 13.4.5.

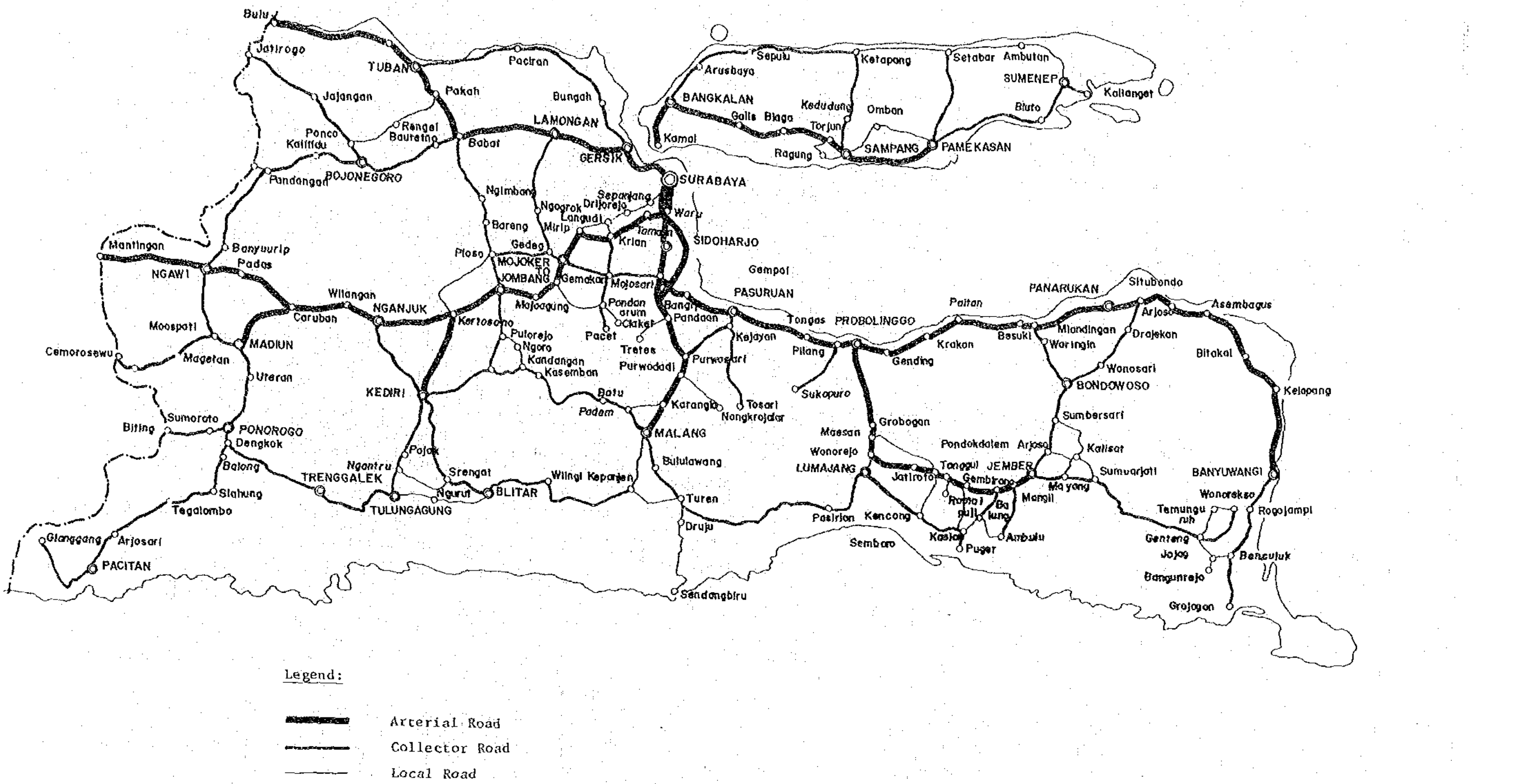


Fig. 13.4.2 EXISTING PRIMARY NETWORK SYSTEM IN EAST JAVA AND MADURA

Scale
KM 0 5 15 25 50 75 100

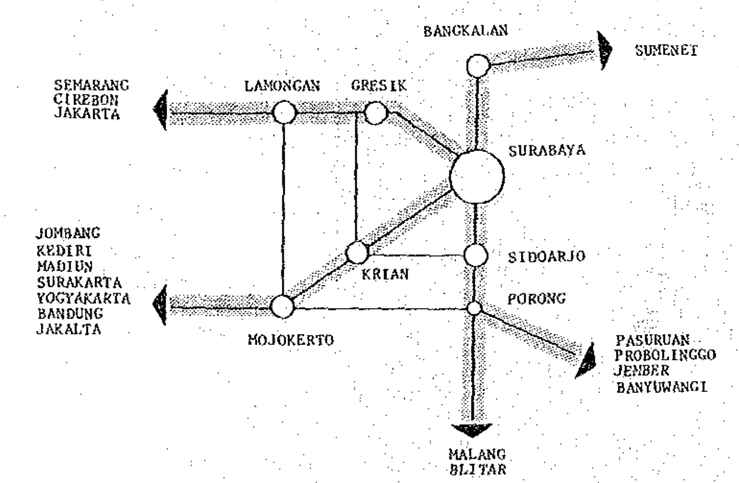


Fig. 13.4.3 PROPOSED PRIMARY RADIAL ROAD NETWORK

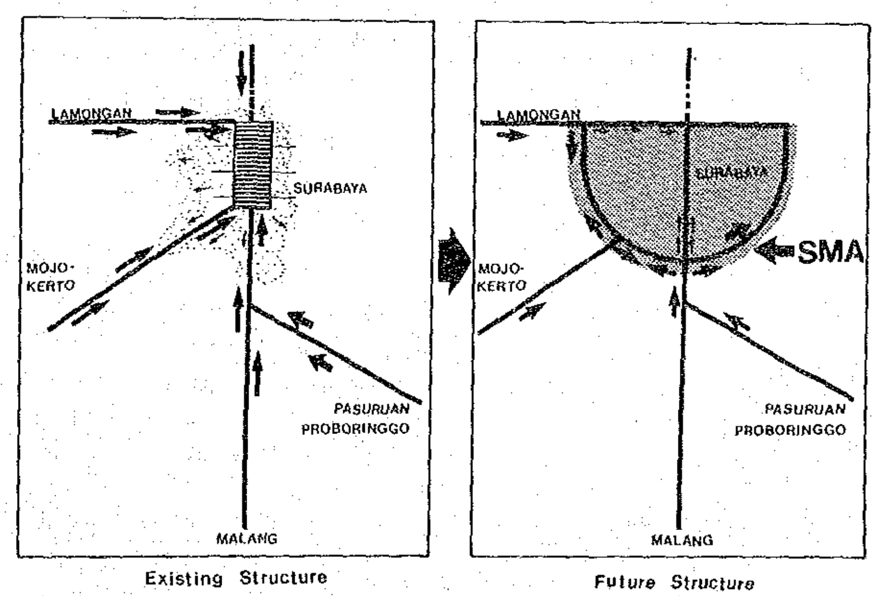


Fig. 13.4.4 CONCEPTIONAL SYSTEM ON RING ROAD TRAFFIC PATTERN

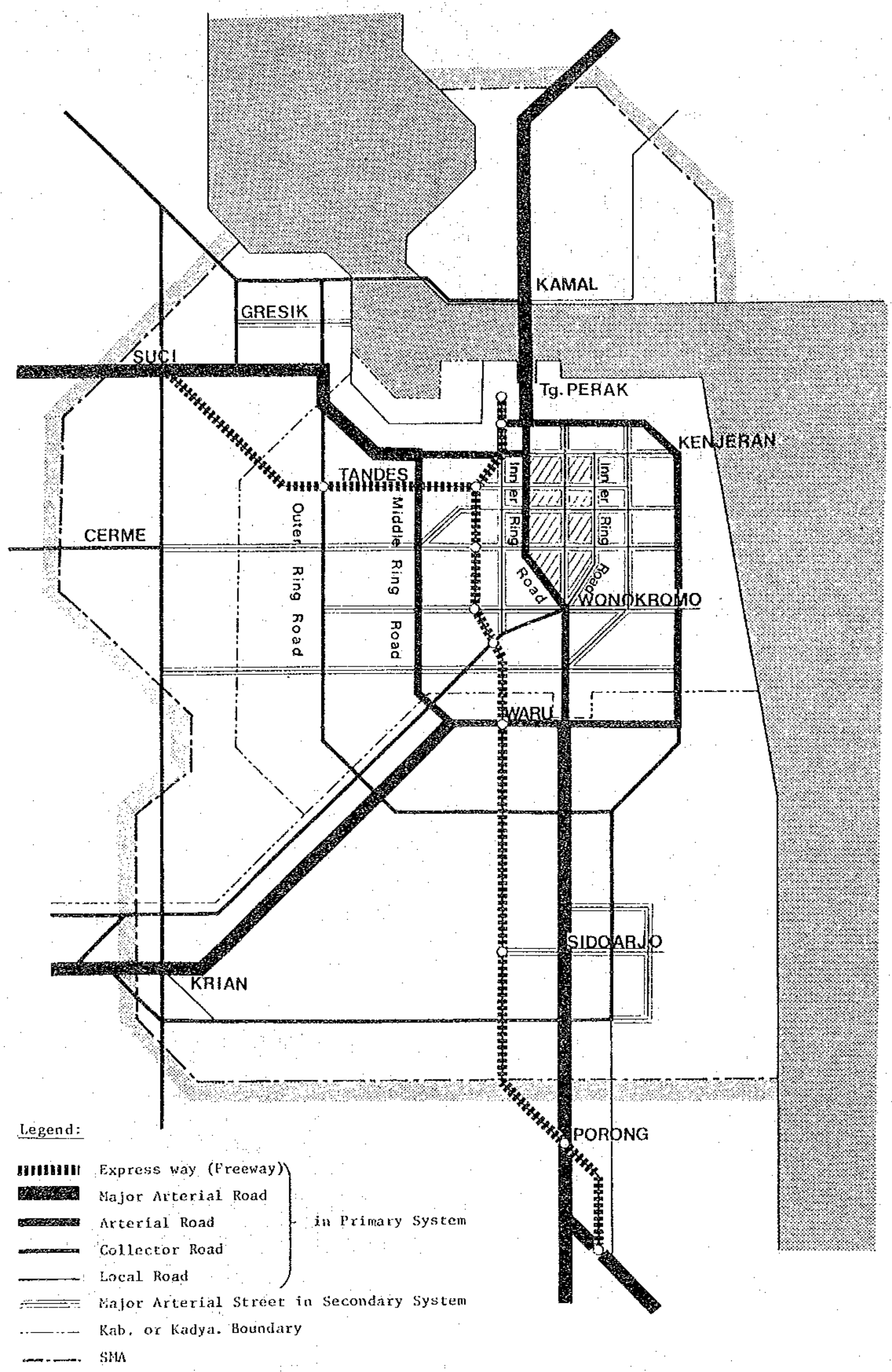


Fig. 13.4.5 PROPOSED COMPOSITION OF URBAN ROAD NETWORK

13.4.4 DEVELOPMENT OF RAILWAY NETWORK SYSTEM

GENERAL UNDERSTANDING OF PRESENT RAILWAYS

Compared with other transportation modes, railway transport has been deteriorating in Indonesia, in accordance with the world trend in rail transport history in the 60's and early 70's. This is particularly true for urban transport, but even for longer trips, rail transport has been partly or largely substituted by road and air transport.

However because of the need for energy savings, a major role for rail transport is now desirable in these days of high energy costs. Generally such demands upon the railway system are not easily satisfied because of the larger initial investment cost than road; the poor operation and maintenance levels; the low engineering standards to meet the required train speeds; and so on.

To strengthen railway transport is in accordance with the national policy to conserve energy. However, this does not mean a continuation of existing practices of railway transport but to develop the railway function as required by the transport sector, and to eliminate as necessary the uneconomical burdens.

Shortages of the present railway transport are:

- No urban/suburban services.
- Standards and maintenance system inadequate.
- Engineering standards (curves, alignment, structures, etc.) unable to support higher speeds.
- Safety, punctuality and comfort are lacking.
- Renewal of tracks, rolling-stocks and other old facilities is required.
- Sufficient area in front of rail stations is not available.
- Access to rail stations is not convenient.

The present railway is not taking a role in urban transport although Gerbangkertosusila trains are operated between Jombang and Surabaya for commuters. Unused rail tracks remain adjacent to roads or pass through areas.

Furthermore, the railway lines at Pasar Turi station and Semut station are not interconnected and transit passengers between the northern line and southern/eastern lines must use buses to make their connection.

In Java and Madura, the average travel distance for rail passengers is about 150 km and for cargoes, about 250 km. To serve for short, medium and long distance passengers the functions of the railway terminal must be strengthened and also the locations have to be considered in the course of transport and urban planning in Surabaya.

EXPECTED ROLES AND OBJECTIVES FOR RAILWAY DEVELOPMENT

The railway is a mode of higher transport efficiency in terms of energy consumption and effective use of land. However, in order to construct and maintain a large scale of facilities traffic demand has to be secured to eliminate managerial and financial problems.

The advantages possessed by rail transport will result in the following major roles for railway transport:

- Inter-City passenger transport
- Large volume cargo transport for medium and long distance travel.
- Commuting service to the work places and schools in the Metropolitan Area.

An advantage of the railway transport is that all the facilities of rail transport are provided specifically for the railway users and are not disturbed by other modes of transport. Therefore, it is much easier to operate trains on schedule and the shorter the operating route, the more easier scheduled operation becomes.

Another advantage of the railway transport is speed and high transport capacity at one time. In order to sustain the large burden of the initial cost and maintenance costs and also to ensure relatively cheap transport, it is quite essential to attract a large demand for rail transport.

The expansion of urban activities and accumulation of business, commercial and institutional facilities in the urban centre will attract the people to the centre area in the daytime. Those who have their jobs there can have their residences within the urban periphery to allow them to commute to their work places and schools.

The advantages of the railway transport, in this sense, will ensure a large transport demand during some peak periods and it will enable the urban activities to grow area-wise. Thus, the railway transport will have characterized its major roles in the urban transport services.

The major role involves urban transport and it was defined that the urban rail transport could encourage the development of urban activities and vice versa. Therefore, to strengthen those advantages and to eliminate obstacles which hamper the advantages of rail transport, should be a major objective for the railway development.

PLANNING POLICY FOR THE RAILWAY DEVELOPMENT

Based on the above considerations, the following planning policies will be proposed:

(1) Radial Lines:

These railway lines will connect the existing urban centres and planned sub-centres with Surabaya radially. That is, North-South direction (Surabaya-Sidoarjo). East-West Direction (Surabaya-Lamongan) and North-Southwest direction (Surabaya-Mojokerto). Such railway network will help to strengthen the traffic flows in these radial directions.

(2) Loop Line:

A loop railway line is planned to cope with the continuous areawise expansion of the existing urban area of Surabaya. It will therefore enable the central urban area to disperse its functions along the loop line and also to ensure that traffic flows among these functions are connected in the same urban area.

(3) New Transit System:

The purpose of the New Transit System is to connect the expanding urban districts and the major facilities such as the port, the airport, the physical distribution facilities, etc. and to actualize a close texture of transportation service supplementing the Mass Transit. Therefore, it can be regarded as the Secondary System of Mass Transit. An introduction plan of the system should be made after careful consideration of the direction of expansion of the urban districts and also of the function of the system which would induce the expansion.

In additon, the plan should be carried out after a careful study on the relationship with other systems. Especially coexistence and/or competition with Bemo, Colt and Bus is very important.

NETWORK ALTERNATIVES

The anticipated network alternatives are shown in Fig. 13.4.6. The items considered in this alternative study are:

- The connection between the Station Gubeng and the Station Pasar Turi through the Station Kota.
- The Rehabilitation and utilization of the Gresik Line and the line between Sidoarjo and Tarik. The former as an urban railway and the latter as a long-distance railway to connect the southern line with the eastern line directly without entering Surabaya. The existing southern line between Mojokerto and Surabaya through Krian is encouraged as a commuting line corresponding with the demand.

- A new transit system to supplement the railways.
- The location of the long-distance train terminals related with the network system.
- The new line (Loop line) as an urban transportation mode and its appropriate length.
- The cargo line network system.

Besides the above, some conditions should be taken into account such as the location of intermediate stations, feeder services system, the relevant facilities and so on.

Consequently, a railway network system is proposed as shown in Fig. 13.4.7 and the main features of the sys*em are described as follows:

(1) Railway

- The long distance train terminals are located at the connections with the radial lines and the loop line; around Waru area for the southern line and around Tandes area for the northern line.
- The commuting line operates into the busy area through a part of the loop line from the directions of Gresik, Lamongan, Mojokerto and Sidoarjo. The origins of commuting lines should be based on the forescast of demand.
- Most sections of the existing railway within SMA are utilized mainly for commuting and urban activity transportation, as well as the loop line.
- The loop line has two types of operating way. One is the inner loop and the other is the outer loop. The length of either loop line is recommended to be less than 40 km.

(2) New Transit System

- The reality and possibility of adoptation of the new transit system should be further studied. Judging from the existing conditions and planning considerations, the North-South line between Wonokromo and Pasar Turi using the track of the old steam tram has a high degree of possibility. As a next step, that line should desirably be extended to Tg. Perak and the Ferry Port.
- The reality of the East-West line depends on the volume of traffic demand.
- The lines connecting with major facilities such as the airport will be realized beyond the year 2000.

(3) Cargo Line

- The study on the utilization of the existing cargo lines serving the port area is continuing, but considering the future industrial development, some new sections of line for cargo transportation from the port area will be needed. It is desirable that the route is located in the western area without passing through the busy section for passenger transportation.

13.4.5 IMPROVEMENT OF PUBLIC ROAD TRANSPORT

GENERAL

Some countries are private transport oriented and others are public transport oriented, but most are various combinations of these two extremes.

Surabaya city lacks transport modes and facilities and lack of public transportation modes and appropriate road link arrangement have caused an increase in the motorcycle ownership. More than 50% occupancy by motorcycle traffic indicates implicitly the feasibility of motorcycle ownership rather than using public transportation modes in terms of the owner's home economy. This means that from an overall evaluation of the existing transport system, the public transport system is generally inferior to motorcycles in its cost and benefit analysis as perceived by the individuals in Surabaya.

Therefore, if the services of public transport are enhanced, the growth in motorcycle ownership will decrease with resulting beneficial effects on total traffic flows and a reduction in economic costs of the region. In this sense, the improvement and strengthening of the existing public transport including urban mass transit should be realized so as to harmonize the various modes of public transport with various transportation demands.

SERVICE AREA OF PUBLIC TRANSPORT MODES

To coincide with the function levels of roads and streets the extent of transport service by each of public transport modes can be defined as follows:

For Primary System

Railway, Inter-city Bus and Colt, including express transit for both railway and inter-city bus.

Colt is, however, only to serve between SMA and adjacent regions of about 50 km in radius.

For Secondary System

Major artery	– Rapid mass transit (railway)
	– New transit (eg. monorail)
	– Bus (including express) and Micro Bus
	– Taxi
Artery	– New transit
	– Bus, Micro Bus
	– Taxi
	– Bemo/Colt
Collector	– Bemo/Colt, Micro Bus
	– Taxi
	– Becak
Local	– Bemo/Colt
	– Taxi
	– Becak

As the traffic demand increases and prices rise, economic efficiency in the transportation sector will be required and therefore transport capacity per vehicle will be increased so as to meet the level of demand in the service area. Thus, future modes of public transport will show an increase in unit transport capacity by substituting for instance, bus for colt, and colt for bemo. However, such a function as becak has today will hardly be subtituted by other existing transportation modes. 85% of the total becak passengers in Surabaya, travel, less than 2.9 km (derived from the Home Interview Survey by the Study Team).
Travel distance by city bus and bemo passengers averages 6.7 km, and this accounts for more than 80% of the total passengers by these modes. Those passengers who travel less than 2.9 km, account for 35% of city bus and bemo passengers. Thus, the role of becak transport has its own position in the transport system. Accordingly, if becak transport can be available it should be utilized in a controlled service area avoiding traffic conflicts with other modes of different speeds.

A substitute for the becak mode would be bicycle or motorcycle. The present traffic pattern of these modes would therefore change to that similar to the becak. As is often observed, becak park at the corner of streets and pasars, and these areas therefore will require parking space for other than car parking, in order to avoid disturbance of through traffic flows.

13.4.6 PROVISION OF TERMINALS

The function of the terminal is to consolidate and distribute the generated traffic. The urban area repeats the concentration and dispersement during its development process. Thus, sub-centres are developed in the periphery of the central urban area, with these sub-centres having various functions.

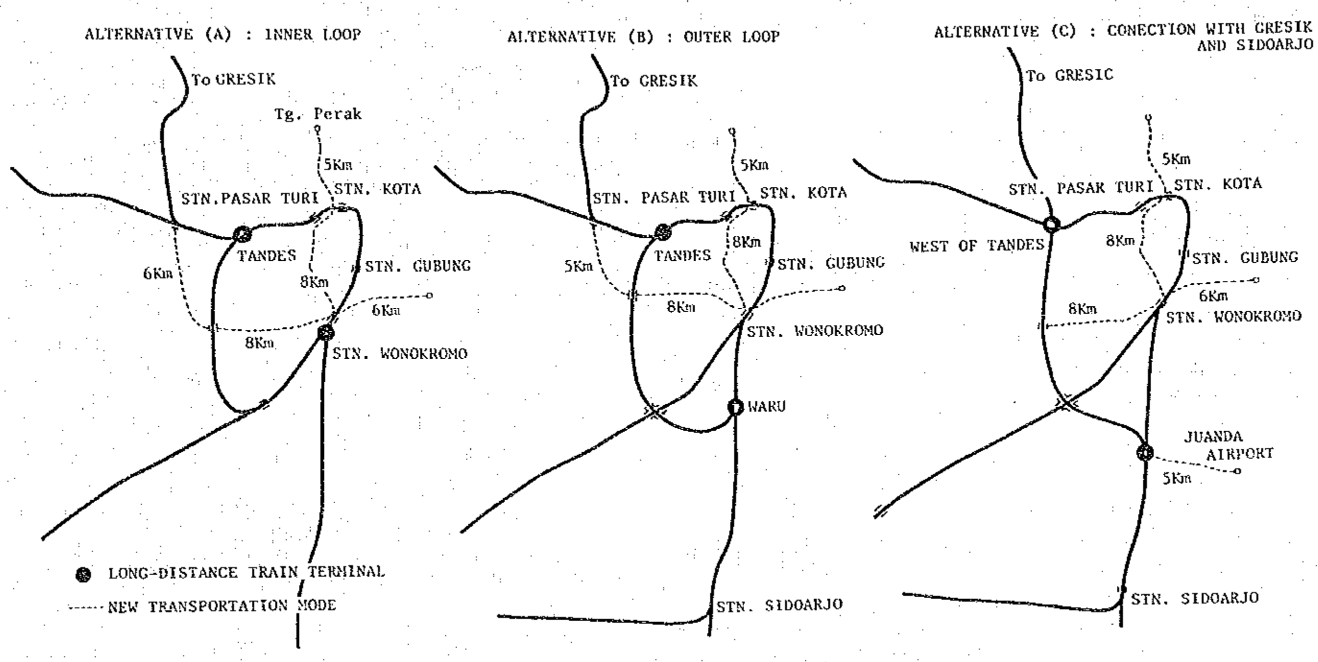


Fig. 13.4.6 ALTERNATIVE RAILWAY NETWORK PLANS

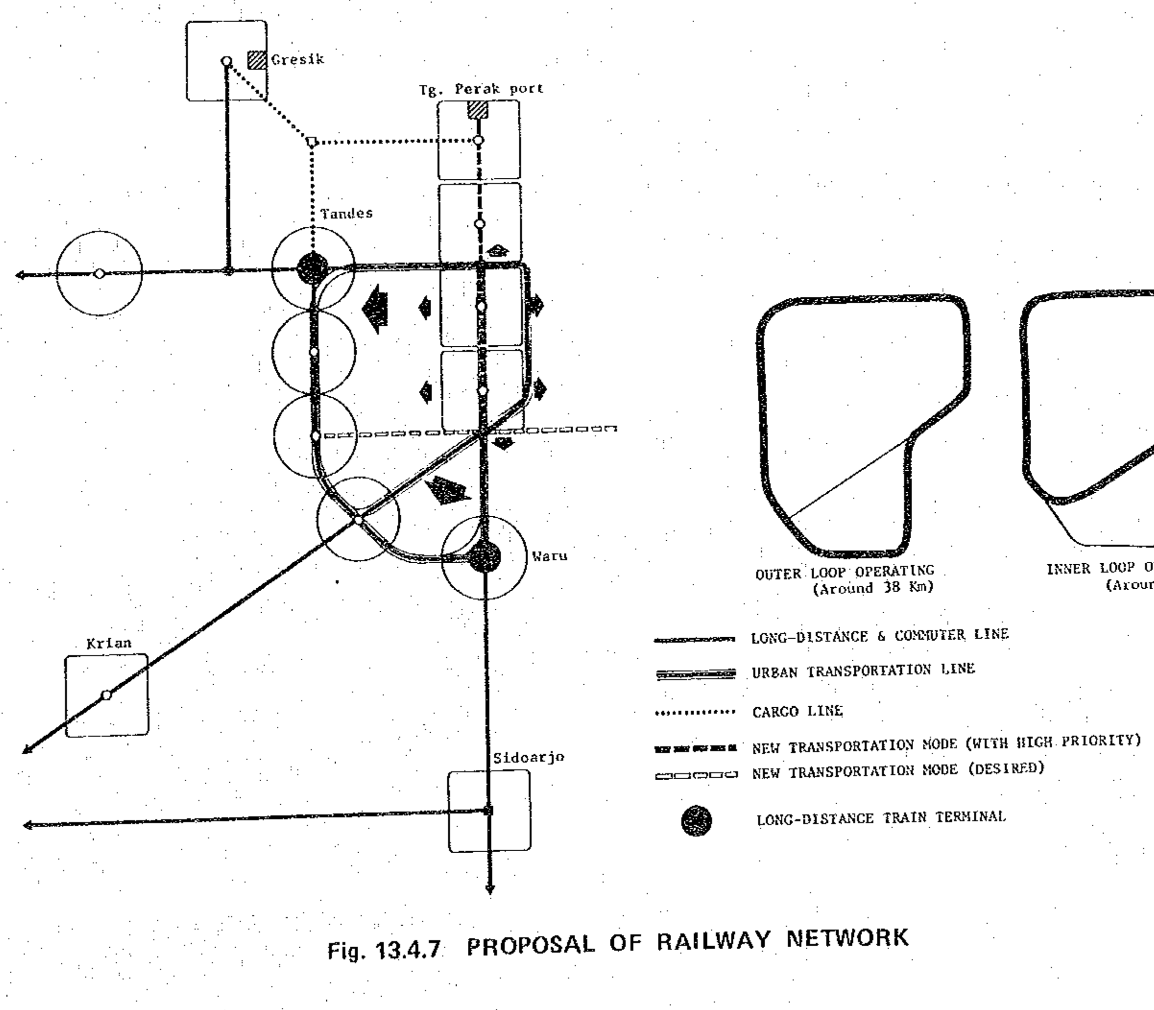


Fig. 13.4.7 PROPOSAL OF RAILWAY NETWORK

In order to reduce intra-urban traffic, such duplicated traffic of cargo from producer outside the urban area sites to wholesalers in the urban area (1st trip in the urban area) and cargo from the wholesaler to retailer (2nd trip in the urban area) should be eliminated by a system such as cargo from producer outside the urban area to the distribution terminal located outside urban area and then distributed to the retailer (1st trip) in the urban area.

The terminal is also a nodal point of the different modes of transport, and functions to provide smooth transfer between the modes.

Such terminal functions are required for both passengers and cargoes. In principle, passenger terminals and cargo terminals should be arranged not to complicate the major axial flow of passengers and cargoes. In this sense, it is proposed that major cargo generating/distribution facilities such as truck terminal, wholesale market, container freight station, major railway cargo station, industrial estate, etc., should be allocated along a ring road. Major axial flow of passengers will be planned in the north-south and east-west directions through the central urban area of Surabaya.

Basically, the passenger terminals for inter-city or long distance transport should be located outside the central urban area in order to avoid unnecessary traffic concentration in the area. These terminals should secure easier access to the urban area, transfer from one to another long distance transport minimizing traffic conflicts and maximizing smooth connection in the urban area.

In this sense, the locations of railstations for the urban mass transit and for long distance transport; and the ring road should be considered in the determination of locations of passenger terminals.

13.4.7 TRANSPORT NETWORK CONDITIONS

Information on the future transport network plan is necessary for estimating future O-D Matrices and traffic assignments. In this section the conditions for transport network (road network and railway network) are summarized.

Road networks in the year 1990 and 2000 were established on the basis of the road network plan described in section 13.4.3 of Part III. The road network and the number of lanes of each road are given in Figs. 13.4.8 through 13.4.11. The conditions of each road link were defined by the following factors:

- the number of lanes
- access controlled or not
- urban area or rural area

The railway development plan was discussed in section 13.4.4 of Part III. Radial lines and loop line where commuter trains operate are planned and the development level (double tracking, electrification and elevation) of each link is to be decided according to the demand of each link.

Therefore in this section the railway network is given for estimating the future person O-D matrices by commuter trains. It is shown in Fig. 13.4.12.

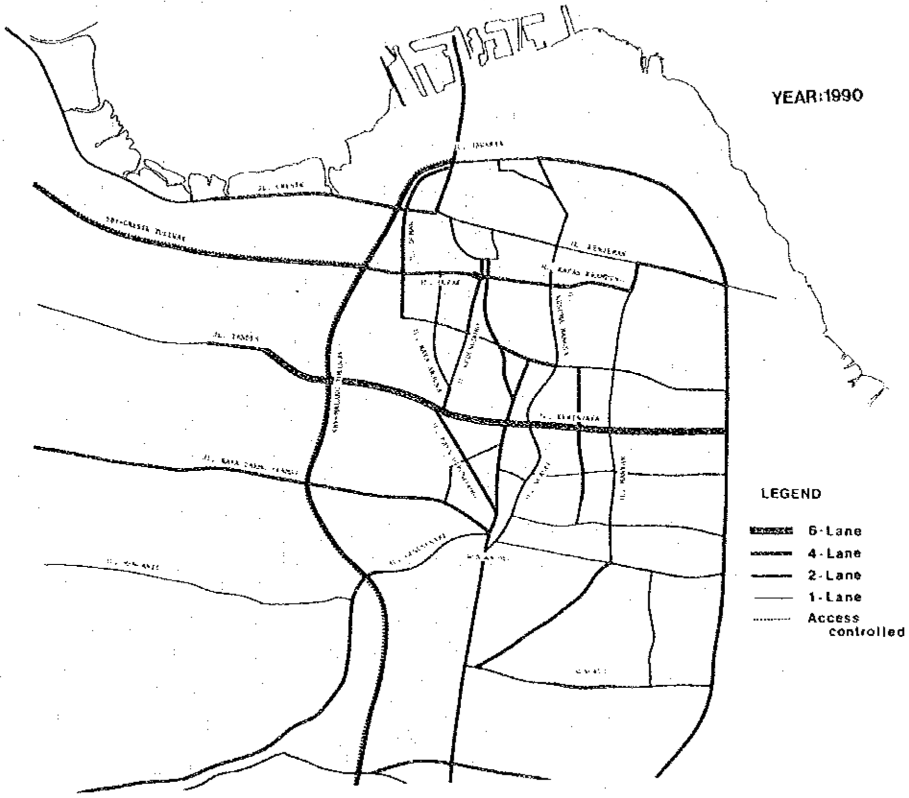


Fig. 13.4.8 ROAD NETWORK FOR TRAFFIC ANALYSIS IN SURABAYA, 1990

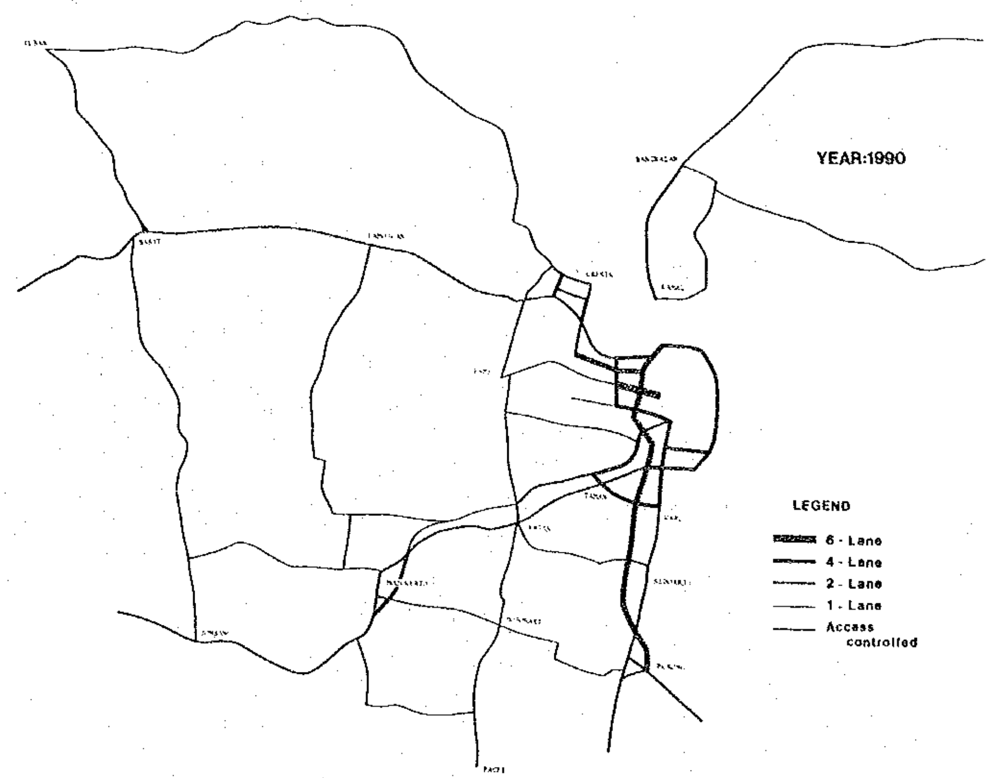


Fig. 13.4.9 ROAD NETWORK FOR TRAFFIC ANALYSIS IN GKS REGION, 1990

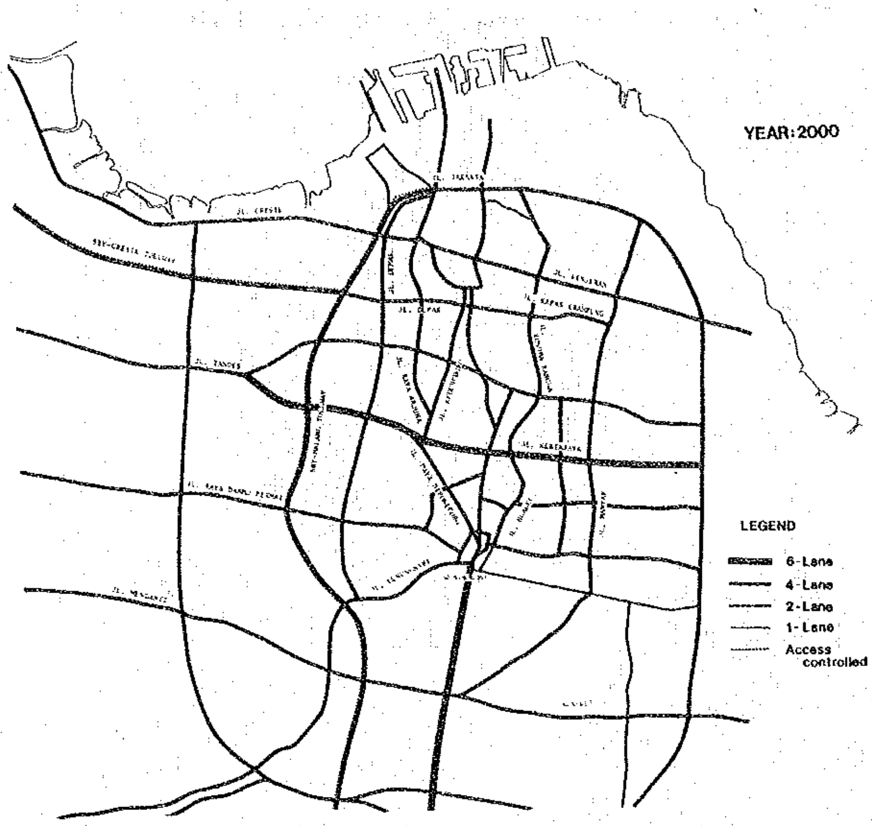


Fig. 13.4.10 ROAD NETWORK FOR TRAFFIC ANALYSIS IN SURABAYA, 2000

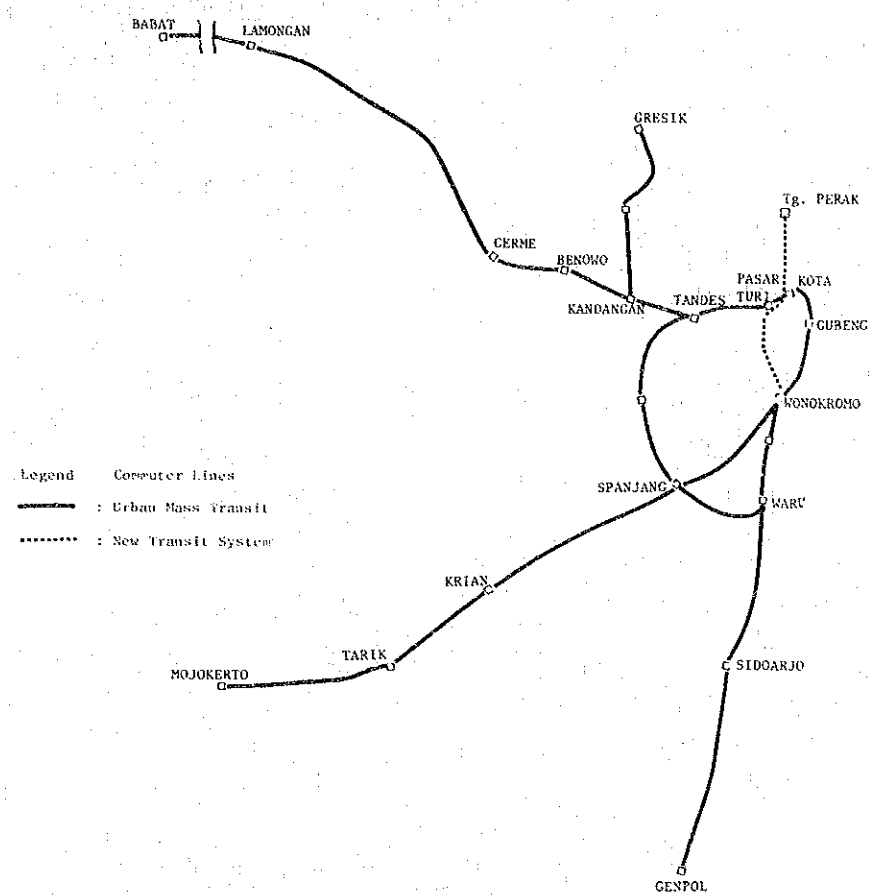


Fig. 13.4.12 NETWORK PLAN FOR URBAN MASS TRANSIT (COMMUTER LINES)

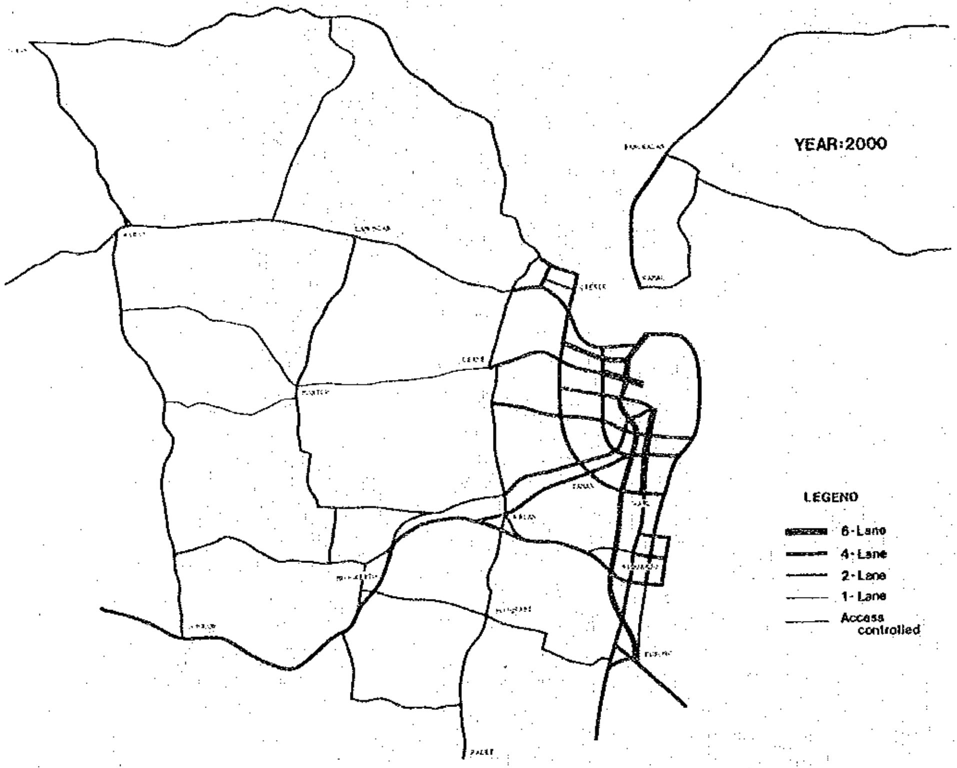


Fig. 13.4.11 ROAD NETWORK FOR TRAFFIC ANALYSIS IN GKS REGION, 2000

13.5 PERSON TRIP DISTRIBUTION MODEL AND FUTURE PERSON TRIP O–D MATRIX

13.5.1 PERSON TRIP DISTRIBUTION MODEL

Future person trip generation/attraction by zone was estimated in Table 13.3.2 of section 13.3.2 of this Part III. In order to estimate a future trip distribution, two types of models, Gravity Model and Growth Factor Method, were applied to the different areas as shown in Fig. 13.5.1. The resulting values derived from the models were so adjusted to meet the previously determined zonal trip generation/attraction totals using Fractor's Method.

The parameters of the Gravity Model applied here were derived from the existing road network conditions and the estimated 1982 O-D Matrix. The formula and the estimated parameters are shown as follows:

$$Tij = K \frac{(Ti \times Tj)^{\alpha}}{Dij^{\beta}}$$

where: Tij : Number of trips in zone i–j
Ti : Trip generation in zone i
Tj : Trip attraction in zone j
Dij : Travel time between zones i–j (minutes)
α = 1.06939
β = 0.68892 (R = 0.909)
K = 0.0045673

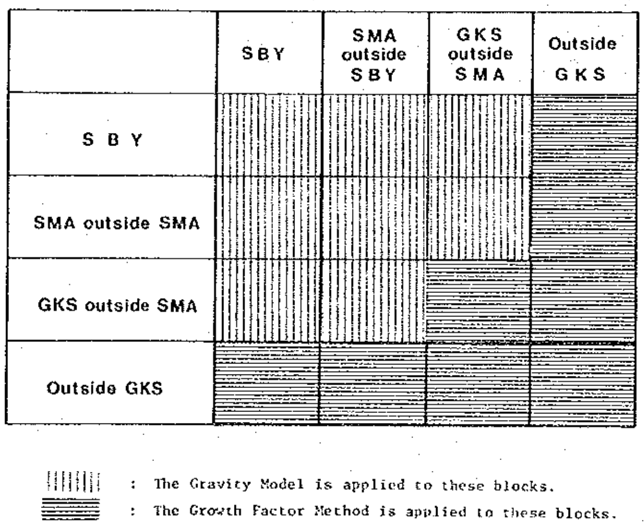


Fig. 13.5.1 TRIP DISTRIBUTION MODELS AND APPLIED AREAS

13.5.2 FUTURE PERSON TRIP O-D MATRIX

Future O-D Matrix on person trip base was calculated by the above-mentioned methods and the results in the year 1990 and 2000 are expressed in Table 13.5.1 as a Block O-D Table and in Figs. 13.5.2 and 13.5.3 as desire line diagram.

Table 13.5.1 ESTIMATED FUTURE PERSON TRIP O-D MATRICES

Name of Block	Year	SBY	SMA outside SBY	GKS outside SMA	Outside GKS	Total
SBY	1990	4,707,294	144,849	21,279	65,738	4,939,160
	2000	6,634,471	427,297	70,122	91,607	7,193,497
SMA outside SBY	1990	144,849	13,961	3,143	24,411	186,364
	2000	427,297	115,116	13,519	33,425	589,357
GKS outside SMA	1990	21,279	3,143	24,797	22,230	71,449
	2000	40,122	13,519	51,618	25,930	131,098
Outside GKS	1990	65,738	24,411	22,230	--	112,379
	2000	91,607	33,425	25,839	--	150,871
Total	1990	4,939,160	186,364	71,449	112,379	5,309,352
	2000	7,193,497	589,357	131,098	150,871	8,064,823

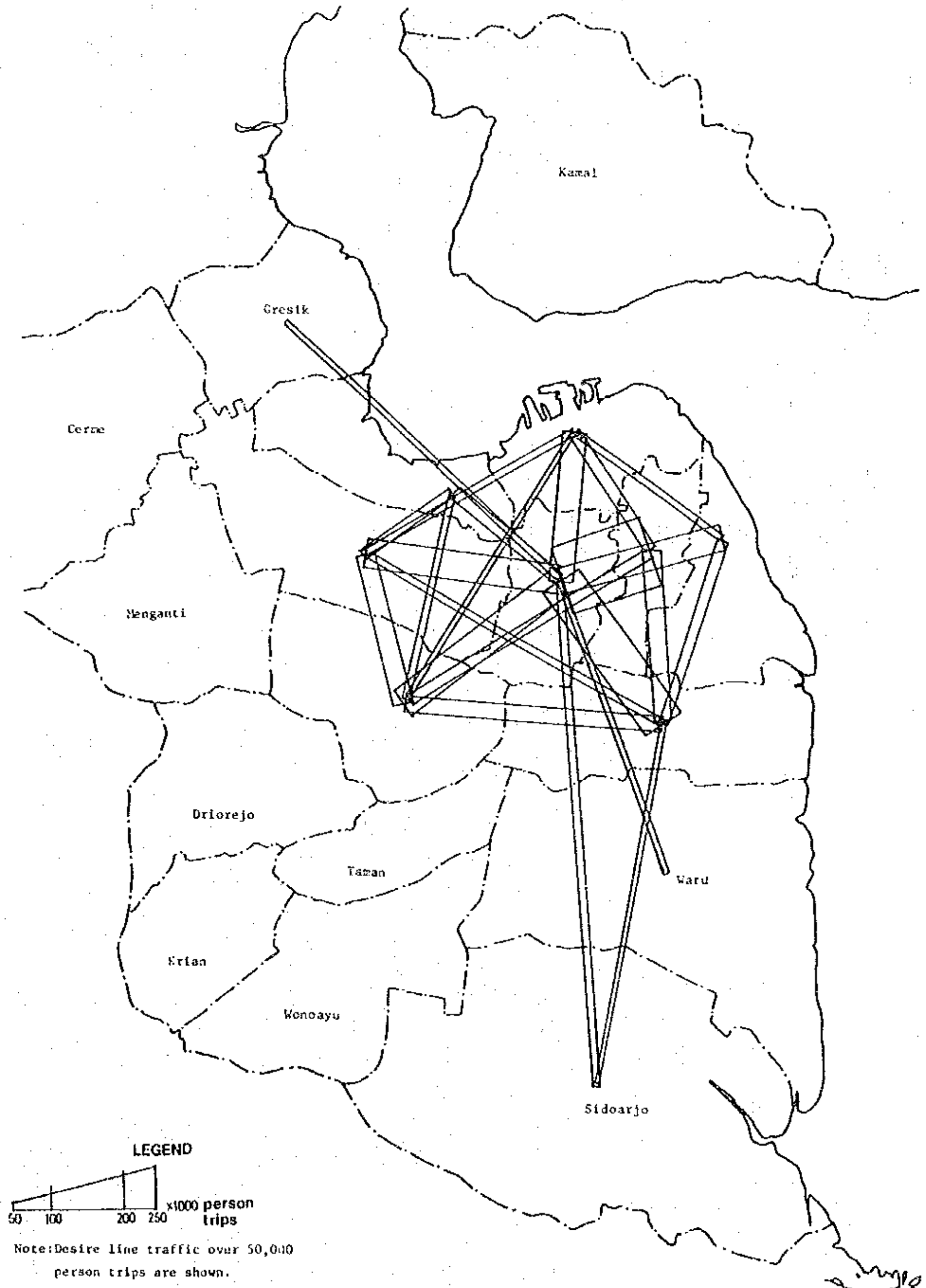


Fig. 13.5.2 DESIRE LINE TRAFFIC FOR SMA IN 2000 (PERSON TRIP)

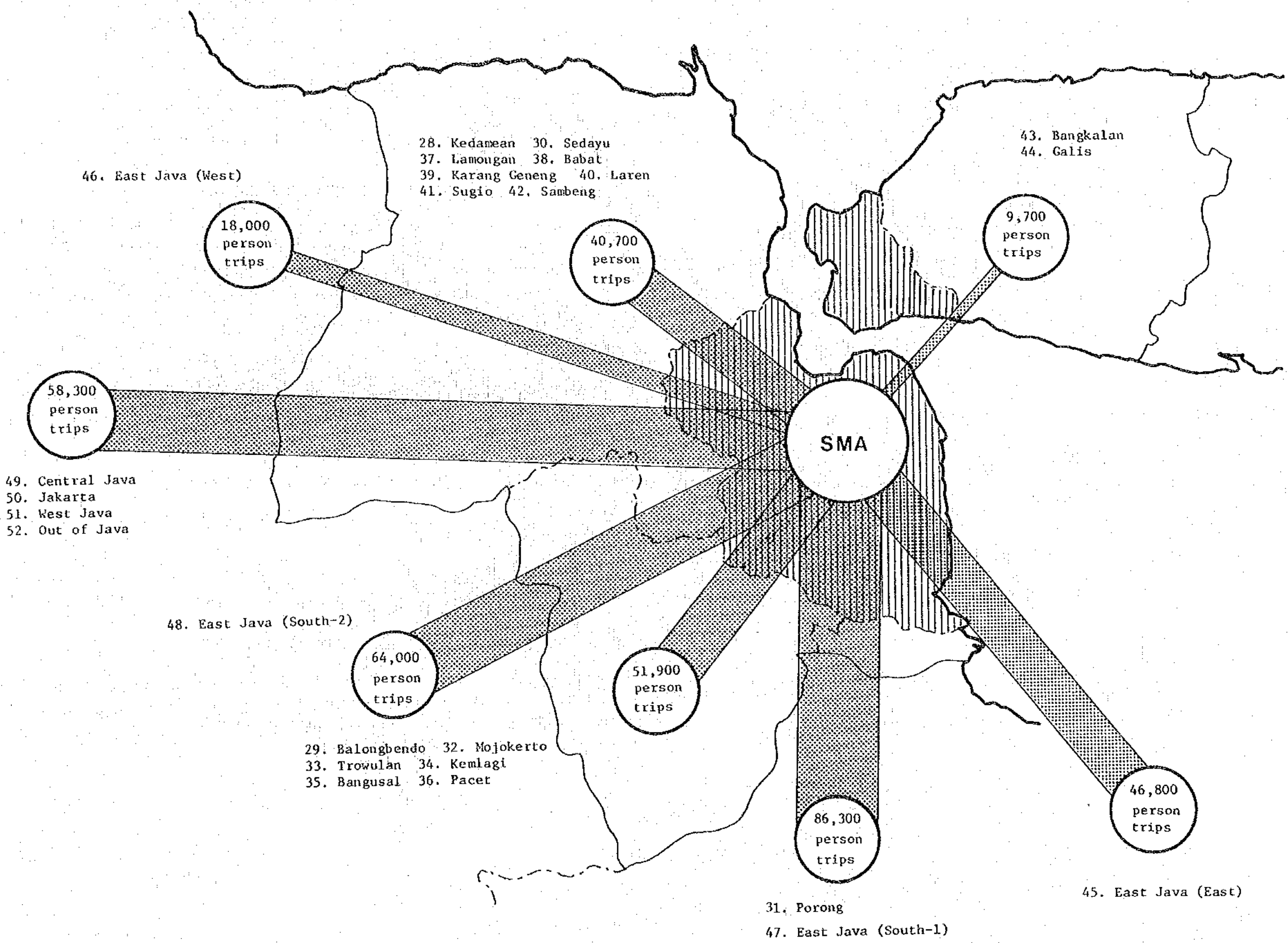


Fig. 13.5.3 DESIRE LINE TRAFFIC FOR OUTSIDE SMA IN 2000 (PERSON TRIP)

13.6 MODAL SPLIT AND TRIP DISTRIBUTION BY MODES

13.6.1 MODAL SPLIT AND SHARES OF TRANSPORT MODES

GENERAL

A flow chart for estimating future O-D tables by mode is shown in Fig. 13.6.1. In this estimation flow, future shares of commuter train (Urban Mass Transit and New Transit System) were assumed for the seven alternative cases described below:

Case 1 : In the year 2000, neither Urban Mass Transit nor New Transit System are available.

Case 2 : In the year 2000, Urban Mass Transit and New Transit System are available at Level I.*

Case 3 : In the year 2000, only Urban Mass Transit is available at Level I.*

Case 4 : In the year 2000, Urban Mass Transit and New Transit System are available at Level II.**

Case 5 : In the year 2000, Urban Mass Transit is available at Level II.**

Case 6 : In the year 1990 neither Urban Mass Transit nor New Transit System are available.

Case 7 : In the year 1990 Urban Mass Transit and New Transit System at Level II.**

Notes: * Level I means the service level which enables the Urban Mass Transit and New Transit System to attract 10% of inter-zonal trip makers within GKS Region. However, if only Urban Mass Transit is prepared on the Level I, it will attract less than 10% of those trip makers within GKS Region.

** Level II, which is defined in the same way as Level I, is the service level that enables Urban Mass Transit and New Transit System to attract 20% of inter-zonal trip makers within GKS Region.

MODAL SPLIT FOR LONG TRIP MODES

Modal Split for Long Distance Train and Inter-City Bus, which are regarded as long distance trips, were decided from the present percentage share of each of the total block O-D traffic. Tables 13.6.1 and 13.6.2 display those for Long Distance Train and Inter-City Bus respectively.

Table 13.6.1 MODAL SPLIT VALUES FOR LONG DISTANCE TRAIN

(Unit: %)

	SBY	SMA outside SBY	GKS outside SMA	Outside GKS
1. SBY	–	–	1.62	15.97
2. SMA outside SBY	–	–	1.02	1.81
3. GKS outside SMA	1.62	1.02	0.40	5.10
4. Outside GKS	15.97	1.81	5.10	–

Table 13.6.2 MODAL SPLIT VALUES FOR INTER-CITY BUS

(Unit: %)

	SBY	SMA outside SBY	GKS outside SMA	Outside GKS
1. SBY	–	–	25	80
2. SMA outside SBY	–	–	10	70
3. GKS outside SMA	25	10	12	60
4. Outside GKS	80	70	60	–

MODAL SPLIT MODEL FOR COMMUTER TRAIN

The modal split model designed for commuter train is shown in Fig. 13.6.2. It was assumed in the model that the share of commuter train between Zone i and j is influenced by the travel distance on rail by the passengers between Zone i and j, and the average access distance to the railway stations in Zone i and Zone j, and finally, by the transport capacity of the commuter train.

MODAL SPLIT CURVE FOR PRIVATE VEHICLES

The modal split curves for sedan and motorcycle were derived from considering the present pattern from the home interview survey and they are shown in Figs. 13.6.3 and 13.6.4 respectively.

FUTURE PERSON TRIPS BY MODE IN GKS REGION

The total person trips by mode in GKS Region are compared with other alternative Cases as shown in Table 13.6.3.

The person trip block O-D tables by mode in all day for Cases 1 and 4 in the year 2000 and Case 6 in the year 1990 are shown in Tables 13.6.4 through 13.6.6.

13.6.2 FUTURE VEHICLE O-D MATRICES

Future person trip O-D tables by transportation mode were converted into vehicle trip O-D tables as described in the preceeding estimation flow. The summarized Vehicle O-D Tables in all day of Cases 1, and 4 in the year 2000 and Case 6 in the year 1990 are shown in Tables 13.6.7 through 13.6.9.

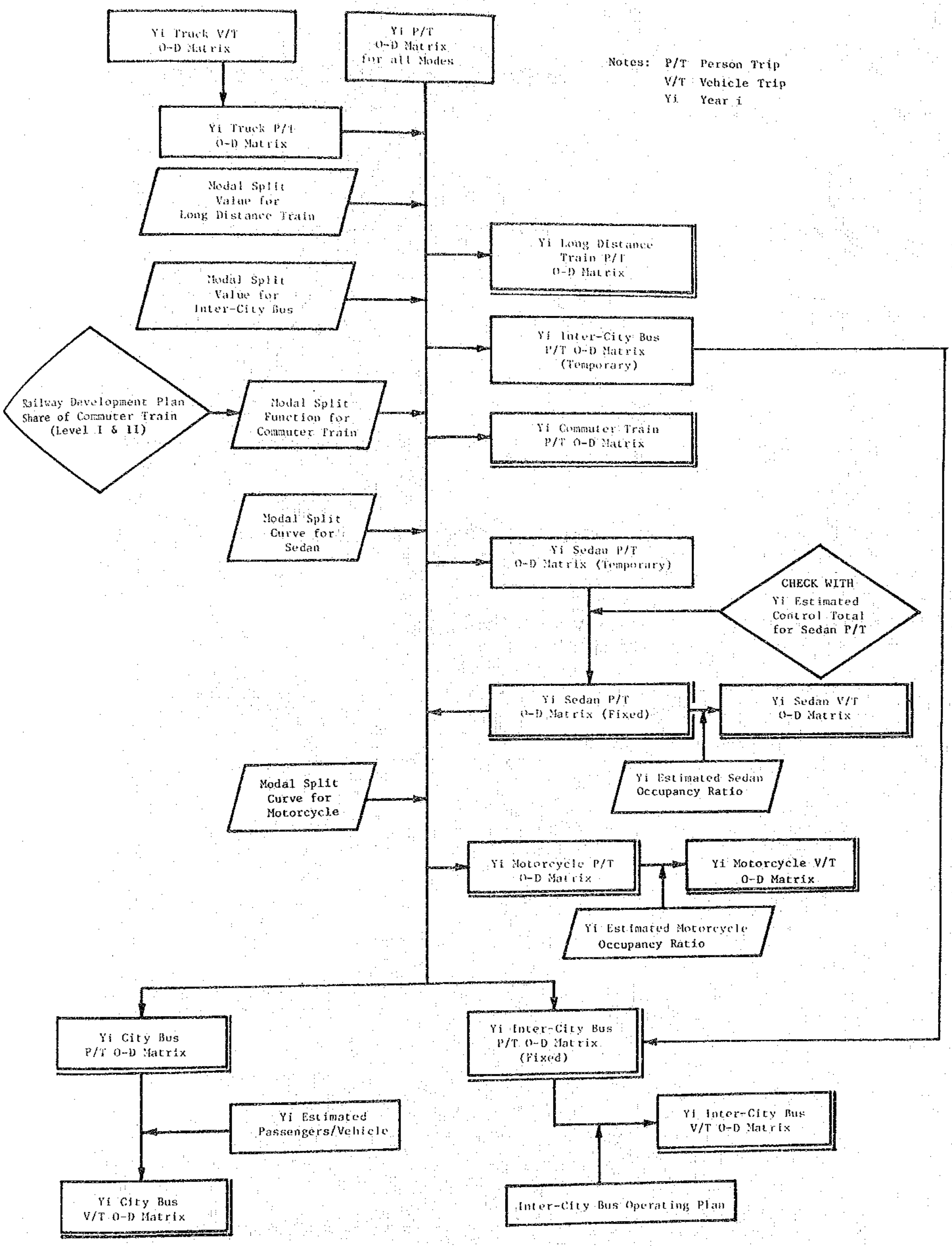


Fig. 13.6.1 ESTIMATING FLOW FOR FUTURE O-D MATRICES BY MODE

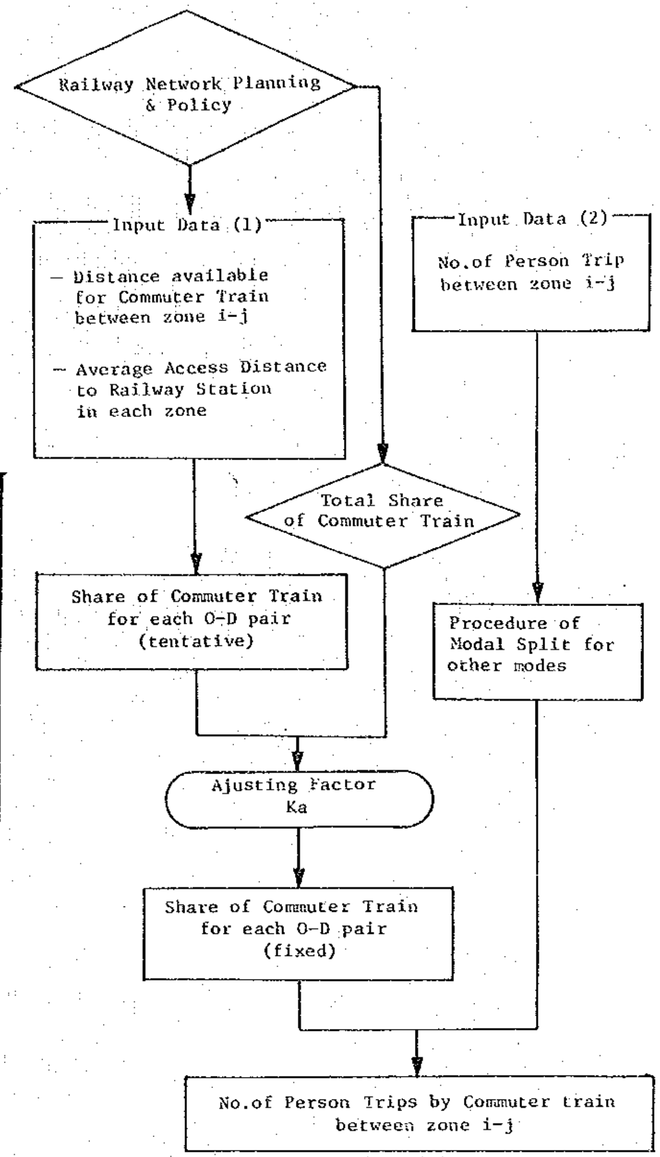


Fig. 13.6.2 MODAL SPLIT MODEL FOR COMMUTER TRAIN

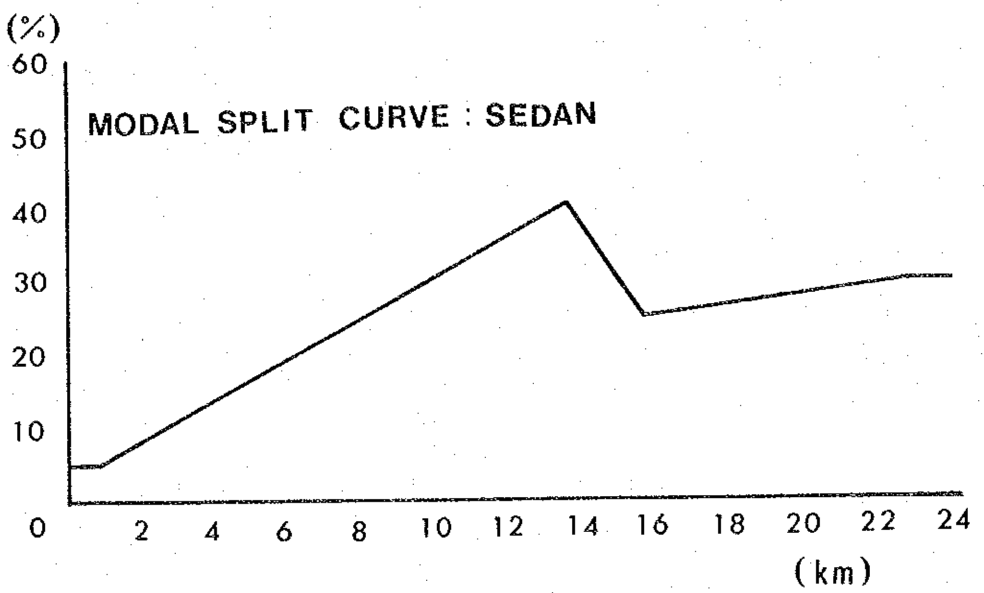


Fig. 13.6.3 MODAL SPLIT CURVE FOR SEDAN P.T.

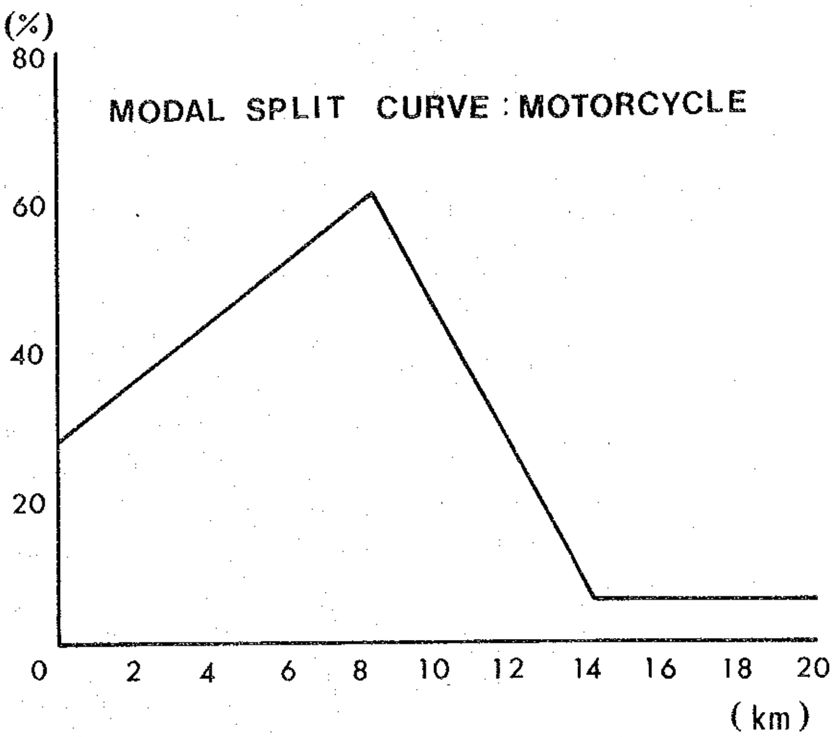


Fig. 13.6.4 MODAL SPLIT CURVE FOR MOTOR CYCLE

Table 13.6.3 COMPARISON OF PERSON TRIPS BY MODE IN GKS REGION FOR ALTERNATIVE CASE 1 THROUGH 7

Unit : Thousand person trips/day

	Year	Truck	Long Distance Train	Sedan	Motorcycle	City Bus	Inter-city Bus	Commuter Train	Total
Case 1	2000	238.2 (5.2)	30.1 (0.7)	1,635.0 (35.5)	793.5 (17.2)	1,578.0 (34.3)	327.2 (7.1)	- (-)	4,602.0 (100%)
Case 2	2000	238.2 (5.2)	30.1 (0.6)	1,632.1 (35.5)	675.2 (14.7)	1,299.2 (28.2)	321.6 (7.0)	405.6 (8.8)	4,602.0 (100%)
Case 3	2000	238.2 (5.2)	30.1 (0.7)	1,632.1 (35.5)	696.7 (15.1)	1,336.0 (29.0)	321.9 (7.0)	347.0 (7.5)	4,602.0 (100%)
Case 4	2000	238.2 (5.2)	30.1 (0.7)	1,629.3 (35.4)	555.8 (12.1)	1,021.8 (22.1)	315.5 (6.9)	811.2 (17.6)	4,602.0 (100%)
Case 5	2000	238.2 (5.2)	30.1 (0.7)	1,629.3 (35.4)	598.4 (12.9)	1,095.5 (23.8)	316.5 (6.9)	694.0 (15.1)	4,602.0 (100%)
Case 6	1990	76.4 (2.7)	23.1 (0.8)	813.8 (28.5)	601.4 (21.1)	1,088.0 (38.1)	252.4 (8.8)	- (-)	2,855.1 (100%)
Case 7	1990	76.4 (2.7)	23.1 (0.7)	812.6 (28.5)	438.6 (15.4)	750.1 (26.3)	247.0 (8.6)	507.3 (17.8)	2,855.1 (100%)

Table 13.6.4 ESTIMATED FUTURE PERSON TRIP O-D BY MODE FOR CASE 1 IN 2000

Unit: Thousand person trips/day

Name of Block	Mode	SBY No. of Trips	SBY %	SMA outside SBY No. of Trips	SMA outside SBY %	GKS outside SMA No. of Trips	GKS outside SMA %	Outside GKS No. of Trips	Outside GKS %	Total No. of Trips	Total %
SBY	Sedan	1,178.8	37.5	183.3	42.9	12.3	30.3	4.8	4.6	1,379.2	37.1
	Motorcycle	728.4	23.2	21.5	5.0	0.7	1.7	0.0	0.0	750.6	20.2
	City Bus	1,143.3	36.4	190.9	44.7	0.0	0.0	0.0	0.0	1,334.2	35.9
	Commuter Train	-	-	-	-	-	-	-	-	-	-
	Inter-city Bus	0.0	0.0	0.0	0.0	22.1	54.4	74.6	71.5	96.7	2.6
	Long Distance Train	0.0	0.0	0.0	0.0	0.6	1.6	12.7	12.2	13.3	0.5
	Truck	91.2	2.9	31.7	7.4	4.9	12.0	12.2	11.7	140.0	3.7
	Total	3,141.7	100.0	427.4	100.0	40.6	100.0	104.3	100.0	3,714.0	100.0
SMA Outside SBY	Sedan	183.3	42.9	26.2	22.7	3.1	22.8	2.1	6.2	214.7	36.4
	Motorcycle	21.5	5.0	17.7	15.4	0.5	3.7	0.0	0.0	39.7	6.7
	City Bus	190.9	44.7	52.9	45.9	0.0	0.0	0.0	0.0	243.8	41.3
	Commuter Train	-	-	-	-	-	-	-	-	-	-
	Inter-city Bus	0.0	0.0	0.0	0.0	7.8	57.4	20.8	61.5	28.6	4.8
	Long Distance Train	0.0	0.0	0.0	0.0	0.1	0.7	0.4	1.2	0.5	0.2
	Truck	31.7	7.4	18.4	16.0	2.1	15.4	10.5	31.1	62.7	10.6
	Total	427.4	100.0	115.2	100.0	13.6	100.0	33.8	100.0	590.0	100.0
GKS Outside SMA	Sedan	12.3	30.3	3.1	22.8	13.2	25.4	2.8	10.4	31.4	23.6
	Motorcycle	0.7	1.7	0.5	3.7	2.0	3.9	0.0	0.0	3.2	2.4
	City Bus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Commuter Train	-	-	-	-	-	-	-	-	-	-
	Inter-city Bus	22.1	54.4	7.8	57.4	34.9	67.2	20.8	77.3	85.6	64.4
	Long Distance Train	0.6	1.6	0.1	0.7	0.2	0.4	1.2	4.5	2.1	1.6
	Truck	4.9	12.0	2.1	15.4	1.6	3.1	2.1	7.8	10.7	8.0
	Total	40.6	100.0	13.6	100.0	51.9	100.0	26.9	100.0	133.0	100.0
Outside GKS	Sedan	4.8	4.6	2.1	6.2	2.8	10.4	-	-	9.7	5.9
	Motorcycle	0.0	0.0	0.0	0.0	0.0	0.0	-	-	0.0	0.0
	City Bus	0.0	0.0	0.0	0.0	0.0	0.0	-	-	0.0	0.0
	Commuter Train	-	-	-	-	-	-	-	-	-	-
	Inter-city Bus	74.6	71.5	20.8	61.5	20.8	77.3	-	-	116.2	70.4
	Long Distance Train	12.7	12.2	0.4	1.2	1.2	4.5	-	-	14.3	8.7
	Truck	12.2	11.7	10.5	31.1	2.1	7.8	-	-	24.8	15.0
	Total	104.3	100.0	33.8	100.0	26.9	100.0	-	-	165.0	100.0
								Total		4,602	

Table 13.6.5 ESTIMATED FUTURE PERSON TRIP O-D BY MODE FOR CASE 4 IN 2000

Unit: Thousand person trips/day

Name of Block	Mode	SBY		SMA outside SBY		GKS outside SMA		Outside GKS		Total	
		No. of Trips	%	No. of Trips	%	No. of Trips	%	No. of Trips	%	No. of Trips	%
SBY	Sedan	1,175.2	37.4	183.6	43.0	13.9	34.2	4.8	4.6	1,377.5	37.1
	Motorcycle	509.1	16.2	13.7	3.2	0.5	1.2	0.0	0.0	523.3	14.1
	City Bus	748.2	23.8	114.9	26.9	0.0	0.0	0.0	0.0	863.1	23.2
	Commuter Train	618.1	19.7	83.5	19.5	3.0	7.4	0.0	0.0	704.6	19.0
	Inter-city Bus	0.0	0.0	0.0	0.0	17.8	43.7	74.6	71.5	92.4	2.5
	Long Distance Train	0.0	0.0	0.0	0.0	0.6	1.5	12.7	12.2	13.3	0.3
	Truck	91.2	2.9	31.7	7.4	4.9	12.0	12.2	11.7	140.0	3.8
	Total	3,141.8	100.0	427.4	100.0	40.7	100.0	104.3	100.0	3,714.2	100.0
SMA outside SBY	Sedan	183.6	43.0	21.8	18.9	2.9	21.3	2.1	6.2	210.4	35.7
	Motorcycle	13.7	3.2	15.5	13.6	0.5	3.7	0.0	0.0	29.7	5.0
	City Bus	114.9	26.9	43.8	38.0	0.0	0.0	0.0	0.0	158.7	26.9
	Commuter Train	83.5	19.5	15.7	13.5	0.8	5.9	0.0	0.0	100.0	16.9
	Inter-city Bus	0.0	0.0	0.0	0.0	7.2	52.9	20.8	61.5	28.0	4.7
	Long Distance Train	0.0	0.0	0.0	0.0	0.1	0.8	0.4	1.2	0.5	0.2
	Truck	31.7	7.4	18.4	16.0	2.1	15.4	10.5	31.1	62.7	10.6
	Total	427.4	100.0	115.2	100.0	13.6	100.0	33.8	100.0	590.0	100.0
GKS outside SMA	Sedan	13.9	34.2	2.9	21.3	12.3	23.7	2.8	10.4	31.9	24.0
	Motorcycle	0.5	1.2	0.5	3.7	1.8	3.5	0.0	0.0	2.8	2.1
	City Bus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Commuter Train	3.0	7.4	0.8	5.9	2.9	5.6	0.0	0.0	6.7	5.0
	Inter-city Bus	17.8	43.7	7.2	52.9	33.0	63.7	20.8	77.3	78.8	59.2
	Long Distance Train	0.6	1.5	0.1	0.8	0.2	3.5	1.2	4.5	2.1	1.7
	Truck	4.9	12.0	2.1	15.4	1.6	3.1	2.1	7.8	10.7	8.0
	Total	40.7	100.0	13.6	100.0	51.8	100.0	26.9	100.0	133.0	100.0
Outside GKS	Sedan	4.8	4.6	2.1	6.2	2.8	10.4	-	-	9.7	5.9
	Motorcycle	0.0	0.0	0.0	0.0	0.0	0.0	-	-	0.0	0.0
	City Bus	0.0	0.0	0.0	0.0	0.0	0.0	-	-	0.0	0.0
	Commuter Train	0.0	0.0	0.0	0.0	0.0	0.0	-	-	0.0	0.0
	Inter-city Bus	74.6	71.5	20.8	61.5	20.8	77.3	-	-	116.2	70.4
	Long Distance Train	12.7	12.2	0.4	1.2	1.2	4.5	-	-	14.3	8.7
	Truck	12.2	11.7	10.5	31.1	2.1	7.8	-	-	24.8	15.0
	Total	104.3	100.0	33.8	100.0	26.9	100.0	-	-	165.0	100.0
								Total		4,602.2	

Table 13.6.6 ESTIMATED FUTURE PERSON TRIP O-D BY MODE FOR CASE 6 IN 1990

Unit: Thousand person trips/day

Name of Block	Mode	SBY No. of Trips	SBY %	SMA outside SBY No. of Trips	SMA outside SBY %	GKS outside SMA No. of Trips	GKS outside SMA %	Outside GKS No. of Trips	Outside GKS %	Total No. of Trips	Total %
SBY	Sedan	68.4	4.3	50.9	35.2	5.4	25.1	2.6	3.4	74.3	4.1
	Motorcycle	583.0	36.2	7.2	5.0	0.4	1.9	0.0	0.0	590.6	32.8
	City Bus	925.2	57.5	78.4	54.3	0.0	0.0	0.0	0.0	1,003.6	55.8
	Commuter Train	-	-	-	-	-	-	-	-	-	-
	Inter-city Bus	0.0	0.0	0.0	0.0	13.1	60.9	61.1	78.2	74.2	4.1
	Long Distance Train	0.0	0.0	0.0	0.0	0.3	1.4	9.8	12.5	10.1	0.6
	Truck	32.5	2.0	7.9	5.5	2.3	10.7	4.6	5.9	47.3	2.6
	Total	1,609.1	100.0	144.4	100.0	21.5	100.0	78.1	100.0	1,800.1	100.0
SMA outside SBY	Sedan	50.9	35.2	2.7	19.9	0.6	19.9	0.5	2.0	54.8	29.4
	Motorcycle	7.2	5.0	1.8	13.2	0.1	3.3	0.0	0.0	9.1	4.9
	City Bus	78.4	54.3	6.0	44.1	0.0	0.0	0.0	0.0	84.4	45.2
	Commuter Train	-	-	-	-	-	-	-	-	-	-
	Inter-city Bus	0.0	0.0	0.0	0.0	1.7	56.5	20.9	82.6	22.6	12.1
	Long Distance Train	0.0	0.0	0.0	0.0	0.01	0.4	0.4	1.6	0.4	0.3
	Truck	7.9	5.5	3.1	22.8	0.6	19.9	3.5	13.8	15.1	8.1
	Total	144.4	100.0	13.6	100.0	3.01	100.0	25.3	100.0	186.6	100.0
GKS outside SMA	Sedan	5.4	25.1	0.6	19.9	5.2	21.8	1.1	4.5	12.4	17.0
	Motorcycle	0.4	1.9	0.1	3.3	1.1	4.6	0.0	0.0	1.6	2.2
	City Bus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Commuter Train	-	-	-	-	-	-	-	-	-	-
	Inter-city Bus	13.1	60.9	1.7	56.5	16.6	69.6	21.2	86.5	52.6	72.1
	Long Distance Train	0.3	1.4	0.01	0.4	0.05	0.2	1.1	4.5	1.5	2.0
	Truck	2.3	10.7	0.6	19.9	0.9	3.8	1.1	4.5	4.9	6.7
	Total	21.5	100.0	3.01	100.0	23.85	100.0	24.5	100.0	73.0	100.0
Outside GKS	Sedan	2.6	3.4	0.5	2.0	1.1	4.5	-	-	4.2	3.3
	Motorcycle	0.0	0.0	0.0	0.0	0.0	0.0	-	-	0.0	0.0
	City Bus	0.0	0.0	0.0	0.0	0.0	0.0	-	-	0.0	0.0
	Commuter Train	-	-	-	-	-	-	-	-	-	-
	Inter-city Bus	61.1	78.2	20.9	82.6	21.2	86.5	-	-	103.2	80.7
	Long Distance Train	9.8	12.5	0.4	1.6	1.1	4.5	-	-	11.3	8.8
	Truck	4.6	5.9	3.5	13.8	1.1	4.5	-	-	9.2	7.2
	Total	78.1	100.0	25.3	100.0	24.5	100.0	-	-	127.9	100.0
								Total		2,187.6	

Table 13.6.7 ESTIMATED FUTURE VEHICLE O-D BY MODE FOR CASE 1 IN 2000

Unit: Vehicle trips/day

Name of Block	Mode	SBY No. of Trips	SBY %	SMA outside SBY No. of Trips	SMA outside SBY %	GKS outside SMA No. of Trips	GKS outside SMA %	Outside GKS No. of Trips	Outside GKS %	Total No. of Trips	Total %
SBY	Sedan	471,638	43.0	73,392	63.4	5,036	48.8	1,962	20.3	552,028	44.8
	Motorcycle	520,426	47.5	15,476	13.4	598	5.8	0	0.0	536,500	43.6
	City Bus	44,096	4.1	7,429	6.3	0	0.0	0	0.0	51,525	4.2
	Inter-city Bus	0	0.0	0	0.0	687	6.7	1,932	20.1	2,619	0.2
	Truck	59,467	5.4	19,545	16.9	3,996	38.7	5,756	59.6	88,764	7.2
	Total	1,095,627	100.0	115,842	100.0	10,317	100.0	9,650	100.0	231,436	100.0
SMA outside SBY	Sedan	73,392	63.4	10,514	26.0	1,288	25.0	853	12.1	86,047	51.1
	Motorcycle	15,476	13.4	12,672	31.4	423	8.2	0	0.0	28,571	17.0
	City Bus	7,429	6.3	2,076	5.1	0	0.0	0	0.0	9,505	5.6
	Inter-city Bus	0	0.0	0	0.0	268	5.3	559	7.9	827	0.5
	Truck	19,545	16.9	15,148	37.5	3,163	61.5	5,646	80.0	43,502	25.8
	Total	115,842	100.0	40,410	100.0	5,142	100.0	7,058	100.0	168,452	100.0
GKS outside SMA	Sedan	5,036	48.8	1,288	25.0	5,362	50.7	1,191	41.7	12,877	44.6
	Motorcycle	598	5.8	423	8.2	1,532	14.5	0	0.0	2,553	8.8
	City Bus	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Inter-city Bus	687	6.7	268	5.3	994	9.4	593	20.7	2,542	8.8
	Truck	3,996	38.7	3,163	61.5	2,684	25.4	1,075	37.6	10,918	37.8
	Total	10,317	100.0	5,142	100.0	10,572	100.0	2,859	100.0	28,890	100.0
Outside GKS	Sedan	1,962	20.3	853	12.1	1,191	41.7	-	-	4,006	20.5
	Motorcycle	0	0.0	0	0.0	0	0.0	-	-	0	0.0
	City Bus	0	0.0	0	0.0	0	0.0	-	-	0	0.0
	Inter-city Bus	1,932	20.1	559	7.9	593	20.7	-	-	3,084	15.7
	Truck	5,756	59.6	5,646	80.0	1,075	37.6	-	-	12,477	63.8
	Total	9,650	100.0	7,058	100.0	2,859	100.0	-	-	19,567	100.0
								Total		1,448,345	

Table 13.6.8 ESTIMATED FUTURE VEHICLE O-D BY MODE FOR CASE 4 IN 2000

Unit: Vehicle trips/day

Name of Block		SBY		SMA outside SBY		GKS outside SMA		Outside GKS		Total	
	Mode	No. of Trips	%	No. of Trips	%	No. of Trips	%	No. of Trips	%	No. of Trips	%
SBY	Sedan	470,182	51.0	73,503	68.4	5,654	53.1	1,962	20.3	551,301	52.5
	Motorcycle	363,762	39.4	9,897	9.2	424	4.0	0	0.0	374,083	35.6
	City Bus	28,904	3.1	4,505	4.2	0	0.0	0	0.0	33,409	3.2
	Inter-city Bus	0	0.0	0	0.0	577	5.4	1,932	20.0	2,509	0.2
	Truck	59,467	6.5	19,545	18.2	3,996	37.5	5,756	59.7	88,764	8.5
	Total	922,315	100.0	107,450	100.0	10,651	100.0	9,650	100.0	1,050,066	100.0
SMA outside SBY	Sedan	73,503	68.4	8,752	23.8	1,193	23.8	853	12.1	84,301	54.0
	Motorcycle	9,897	9.2	11,134	30.3	388	7.8	0	0.0	21,419	13.7
	City Bus	4,505	4.2	1,732	4.7	0	0.0	0	0.0	6,237	4.0
	Inter-city Bus	0	0.0	0	0.0	261	5.2	559	7.9	820	0.5
	Truck	19,545	18.2	15,148	41.2	3,163	63.2	5,646	80.0	43,502	27.8
	Total	107,450	100.0	36,766	100.0	5,004	100.0	7,058	100.0	156,279	100.0
GKS outside SMA	Sedan	5,654	53.1	1,193	23.8	5,016	49.7	1,191	41.7	13,054	45.6
	Motorcycle	424	4.0	388	7.8	1,446	14.3	0	0.0	2,258	7.9
	City Bus	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Inter-city Bus	577	5.4	261	5.2	946	9.4	593	20.7	2,377	8.3
	Truck	3,996	37.5	3,163	63.2	2,684	26.6	1,075	37.6	10,918	38.2
	Total	10,651	100.0	5,005	100.0	10,092	100.0	2,859	100.0	28,607	100.0
Outside GKS	Sedan	1,962	20.3	853	12.1	1,191	41.7	-	-	4,006	20.5
	Motorcycle	0	0.0	0	0.0	0	0.0	-	-	0	0.0
	City Bus	0	0.0	0	0.0	0	0.0	-	-	0	0.0
	Inter-city Bus	1,932	20.0	559	7.9	593	20.7	-	-	3,084	15.7
	Truck	5,756	59.7	5,646	80.0	1,075	37.6	-	-	12,477	63.8
	Total	9,650	100.0	7,058	100.00	2,859	100.00	-	-	19,567	100.00
								Total		1,254,519	

Table 13.6.9 ESTIMATED FUTURE VEHICLE O-D BY MODE FOR CASE 6 IN 1990

Unit: Vehicle trips/day

Name of Block	Mode	SBY No. of Trips	SBY %	SMA outside SBY No. of Trips	SMA outside SBY %	GKS outside SMA No. of Trips	GKS outside SMA %	Outside GKS No. of Trips	Outside GKS %	Total No. of Trips	Total %
SBY	Sedan	273,423	35.6	20,361	52.6	2,172	39.6	1,028	14.8	296,984	36.3
	Motorcycle	416,546	54.3	5,245	13.5	409	7.4	0	0.0	422,200	51.6
	City Bus	35,714	4.6	3,093	8.0	0	0.0	0	0.0	38,807	4.7
	Inter-city Bus	0	0.0	0	0.0	470	8.6	1,592	22.8	2,062	0.2
	Truck	42,126	5.5	10,018	25.9	2,439	44.4	4,349	62.4	58,932	7.2
	Total	767,809	100.0	38,717	100.0	5,490	100.0	6,969	100.0	818,985	100.0
SMA outside SBY	Sedan	20,361	52.6	1,084	12.3	244	12.1	215	5.2	21,904	40.8
	Motorcycle	5,245	13.5	1,336	15.1	104	5.2	0	0.0	6,685	12.5
	City Bus	3,093	8.0	276	3.1	0	0.0	0	0.0	3,369	6.3
	Inter-city Bus	0	0.0	0	0.0	144	7.1	564	13.7	708	1.2
	Truck	10,018	25.9	6,136	69.5	1,528	75.6	3,346	81.1	21,028	39.2
	Total	38,717	100.0	8,832	100.0	2,020	100.0	4,125	100.0	53,694	100.0
GKS outside SMA	Sedan	2,172	39.6	244	12.1	2,088	40.3	442	21.5	4,946	33.5
	Motorcycle	409	7.4	104	5.2	890	17.2	0	0.0	1,403	9.5
	City Bus	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Inter-city Bus	470	8.6	144	7.1	536	10.3	604	29.3	1,754	11.9
	Truck	2,439	44.4	1,528	75.6	1,668	32.2	1,012	49.2	6,647	45.1
	Total	5,490	100.0	2,020	100.0	5,182	100.0	2,058	100.0	14,750	100.0
Outside GKS	Sedan	1,028	14.8	215	5.2	442	21.5	-	-	1,685	12.8
	Motorcycle	0	0.0	0	0.0	0	0.0	-	-	0	0.0
	City Bus	0	0.0	0	0.0	0	0.0	-	-	0	0.0
	Inter-city Bus	1,592	22.8	564	13.7	604	29.3	-	-	2,760	21.0
	Truck	4,349	62.4	3,346	81.1	1,012	49.2	-	-	8,707	66.2
	Total	6,969	100.0	4,125	100.0	2,058	100.0	-	-	13,152	100.0
								Total		900,581	

13.6.3 VERIFICATION OF TRAFFIC DEMAND BY PRIVATE VEHICLE

GENERAL

Premises assumed in the future modal split analysis are as follows:

- Share of long distance trips by inter-city bus and railway is relatively proportional to the total person trips.
- Share of the urban mass transit and the new transit system depends on the transport capacity.
- Share of sedan trips is relatively independent from the development levels of such public transport as the urban mass transit, city bus transport, and also the ownership level of motorcycles. It is, however, dependent on the income level of the inhabitants.
- Using the modal split curve, the percentage shares of motorcycle and city bus trips are determined based on travel distance, which were derived from the "Home Interview Survey in 1982". Accordingly, sedan ownership and average trip times per day were estimated as a prerequisite to assess a future framework of the sedan trips in Surabaya. However, the number of motorcycle trips designed in the modal split analysis will be influenced by the supply level of commuter trains and the travel distance of motorcycle. Therefore, it is also necessary to verify the probable range of motorcycle fleet which will vary corresponding to the alternative development levels of commuter trains. This means conversely to what extent the public transport including commuter trains and city buses should be developed in the future.

FUTURE SEDAN OWNERSHIP AND VERIFICATION OF SEDAN TRIPS

(1) Forecast of Future Sedan Ownership

In order to estimate future sedan ownership, it was intended to complete the factors of motorization level (sedan fleet per 1000 population) and income level (per capita GRDP). However, annual GRDP data was not available even for Surabaya. Therefore, the following method was employed.

- Assuming that one's behaviour to purchase sedan in Surabaya is the same as in Jakarta, data on the levels of income and motorization in Jakarta were used in order to estimate a regression equation to be applied for Surabaya.
- Average annual growth rate was derived from the data on sedan fleet registered in Surabaya and this was applied to project the fleet in the future.
- The future sedan fleet estimated from the above methods were compared and determined.

The resulting future estimates of sedan fleet in Surabaya were compared as shown in Table 13.6.10, and it was eventually assumed to reach 107,145 vehicles for the 1990 and 209,400 for the year 2000.

(2) Estimation of Future Sedan Trips

Based on the "Car-owner Interview Survey in 1982", an average number of trips per sedan was obtained at 2.5 trips/day and the average number of occupants at 2.5 persons/sedan. Assuming that these factors remain unchanged in the future, person trips made by Surabaya's sedan fleet were projected to be 677,700 trips/day in 1990 and 1,324,500 trips/day in 2000.

Table 13.6.10 COMPARISON OF ESTIMATED FUTURE SEDAN FLEET IN SURABAYA

Data Applied for Estimating Future Sedan Fleet in Surabaya					
Year (i)	Sedan Fleet in Surabaya	Per Capita GRDP at 1975 Const. Price in JKT: (1000 X_i)		Motorization Level (Sedan/1000 pop.): (Y_i)	
1971	21,133	--		--	
1972	23,308	--		--	
1973	26,474	--		--	
1974	26,445	--		--	
1975	29,234	195,892		28,227	
1976	31,665	207,508		31,507	
1977	34,102	216,754		32,935	
1978	34,465	223,886		35,264	
1979	36,972	244,719		37,525	
1980	40,927	264,616		41,145	
1981	45,525	--		--	
Estimating Models	Average Annual Growth Rate: 8.0% p.a.	Estimated Regression Equation: $Y_i = 0.1794 X_i - 6.0206$		($r^2 = 0.9773$)	
Future Year (i)	Estimated Sedan Fleet in SBY:	Per Capita GRDP at 1975 Const. Price in SBY: (1000 X_i)	Estimated Motorization Level: (Y_i)	Population (x 1,000) : (Z_i)	Estimated Sedan Fleet in SBY: ($Y_i \times Z_i$)
1990	91,005	242,236	37,437	2,862	107,145
2000	196,472	338,716	54,745	3,825	209,400

The person trips made by sedan in Surabaya were estimated at 805,534 trips/day in 1990 and 1,579,620 trips in 2000, which were computed using the modal split model for sedan presented in section 13.6.1 of Part III. These values do not include the intrazonal trips but include the interzonal trips made not only by the Surabaya's sedan fleet but also by other non-Surabaya sedans.

The average radius of Surabaya zones is about 2.0 km and the percentage share corresponding to the above average distance travelled by sedan was found to be 10% of the total person trips for sedan. Therefore, the inter-zonal person trips made by Surabaya's sedan fleet were assumed to be 610,000 trips/day in 1990 and 1,192,000 trips/day in 2000. These values account for 75.5% and 75.7% of the person trips by sedan in Surabaya being 805,534 trips and 1,579,620 trips for the years 1990 and 2000 respectively. On the basis of these empirical considerations, it was concluded that the estimated future person trips by sedan in Surabaya would fall in the acceptable margine of error for this Study. Therefore, the modal split model applied in this Study was verified for estimating future sedan O-D traffic in terms of person trips.

FUTURE MOTORCYCLE OWNERSHIP AND VERIFICATION OF MODAL SPLIT VALUES

(1) Analysis of Future Motorcycle Ownership

The existing motorcycle fleet in Surabaya numbers 206,926 in 1981 and its ownership rate is 99.7 motorcycles/1000 population. This is a high level of ownership which exceeds that of Jakarta.

A saturation level of motorcycle fleet in Surabaya was estimated using a logistic curve function model as follows:

$$Y = \frac{k}{1 + m e^{-aX}}$$

where, Y : Motorcycle ownership (motorcycles/1000 pop.)

X : Time in sequence starting from 0 to n−1, if the total number of data is n.

m,a : Parameters

k : Saturation level (motorcycle/1000 pop.)

Based on the collected data of motorcycle fleet in Surabaya, two different cases were examined. They are the cases where,

– Saturation level is estimated from the model
– Saturation level is assumed independently

The future motorcycle fleet in Surabaya, 1990 and 2000 were calculated as shown in Table 13.6.11.

Table 13.6.11 MOTORCYCLE OWNERSHIP FORECAST FOR SURABAYA BY DIFFERENT CASES

		Estimated Saturation Level	Assumed Saturation Level	
			CASE I	CASE II
OWNERSHIP (Motorcycle/1,000 population)		103	130	170
No. of Vehicle	1981	206,926	206,926	206,926
	1990	293,841	359,181	437,541
	2000	394,021	496,485	639,042

At the present time motorcycle ownership rate is 99.72 motorcycles per 1000 population and this nearly reaches the estimated saturation level of 103 motorcycles/1000 pop. In other words, there is one motorcycle to every 9.7 persons or 2 households. If the assumed saturation level of 170 motorcycles/1000 pop. was taken, it would mean that one motorcycle is possessed by 5.9 persons, or nearly every household by the year 2000, and this is considered to be a extremely high level of ownership compared with the situation in Jakarta.

Providing the existing service level of the public transport is not improved and per capita income increases about two times, the future motorcycle fleet can be doubled by the year 2000. However, the existing public transport is at a low service level and it is desired to strengthen the role of public transport in the urban transport system from a transport planning viewpoint. Therefore, the future motorcycle fleet in Surabaya should not exceed the saturation level of 130 motorcycles per 1000 population.

The alternative cases for the development levels of commuter trains were examined to analyze a future share of city bus transport and motorcycle transport and conversely, from the possible range of city bus operation and motorcycle ownership, a required level of commuter train development was assessed as discussed in the next section.

(2) Verification of Modal Split Values

According to the alternative cases of development levels of commuter trains (Urban mass transit and New Transit System), total person trips made by motorcycle and city bus in Surabaya for the year 2000 were derived using the modal split curve introduced in section 13.6.1 and the results were presented in Table 13.6.12.

As discussed later in section 14.4.3, a bus transport system cannot be developed only by an increase in bus fleet but it is also required to develop the road network. Taking an example of Case 4, which is the lowest demand for city bus transport among the three alternative Cases for the year 2000, this requires 35 operating routes each of 14 km length and a service headway of 5 minutes in peak-hour operation. Therefore, without commuter trains suitable for the development level of Case 4, demand for bus transport will be overburdened and this will cause an increase in motorcycle traffic towards the motorcycle saturation level of 130, which is considered the maximum level for road transport.

Table 13.6.12 RELATIONSHIP BETWEEN CITY BUS, MOTORCYCLE PERSON TRIPS AND DEVELOPMENT LEVEL OF COMMUTER TRAINS

Alternative Cases for Commuter Train Demand	Estimated P.T. by City Bus in SBY, 2000	Estimated P.T. by Motorcycle in SBY, 2000		
		Inter-Zonal Trip	Intra-Zonal Trip*	Total
Case 1: 0 (Year 2000)	1,525,096	772,860	607,000	1,379,860
Case 2: 395,546 (Year 2000)	1,250,868	655,698	607,000	1,262,698
Case 4: 791,088 (Year 2000)	978,020	537,462	607,000	1,150,462

Notes: Case 1 assumes that no commuter trains are developed in 2000

Case 2 assumes that 10% of the inter-zonal person trips in GKS Region will be made by commuter trains in 2000

Case 4 assumes that 20% of the inter-zonal person trips in GKS region will be made by commuter trains in 2000

* Total intra-zonal trips in Surabaya in the year 2000 were estimated at 3,278,000 trips/day and of these, person trips by walking and bicycles were estimated at 2,671,000 trips/day. Therefore, the remaining intra-zonal person trips, 607,000 trips/day, were considered to be made by motorcycle.

The road public transport in 1982 represents a traffic demand of about 500,000 passengers for both city bus and bemo transport in Surabaya. If the commuter train is not provided in the years 1990 and 2000, demand of another 500,000 passengers per day is assumed to develop every 10 years. In addition, if the road development cannot provide space for such bus transport demand the diversion of the potential bus passengers to motorcycle travellers or vice versa is considered to be insignificant, as the motorcycles also use the same inadequate road network.

Taking the above into consideration, maximum efforts to develop commuter trains as well as city bus transport should be made in order to maximize the use of limited land space for transport infrastructure. Accordingly, the alternative Case 4 is assessed as a goal for the development of the public transport system by both commuter trains and city bus.

The average motorcycle occupancy and average trip times of motorcycles are derived from the "Home Interview Survey in 1982" to be 1.2 persons per motorcycle-trip and 2.5 trips per day, respectively. Therefore, in Case 4, motorcycle fleet in Surabaya was estimated at 383,500 which is quite similar to the estimate derived from the estimated saturation level of 103 for motorcycles in Surabaya.

To summarize, the development of commuter trains with a transport share of 20% of the inter-zonal person trips in GKS Region (Case 4) should be realized and at the same time, a city bus transport which fulfills the transport demand of about 1 million passengers per day in Surabaya is required, together with a road network development fit to receive such bus operations. In case that the road network development can not match the bus transport demand, strengthening of commuter train network will be further required by the year 2000.

13.6.4 FUTURE TRUCK O-D MATRICES

The external truck vehicle O-D between Surabaya and outside Surabaya were derived from the 1982 roadside interview survey by the Study Team. The internal truck vehicle O-D within Surabaya were verified by the estimation procedure presented in Fig. 13.2.1. In order to estimate future truck O-D matrices, the truck O-D matrix in the year 1982 was used as a pattern of trip distribution by the appliciation of Mr. T. J. Frator's method. The estimated results are summarized in the Block O-D tables in the year 1990 and 2000 as shown in Table 13.6.7 through 13.6.9. The desire line diagrams for the truck O-D in the year 1990 and 2000 are shown in Figs. 13.6.10 and 13.6.11.

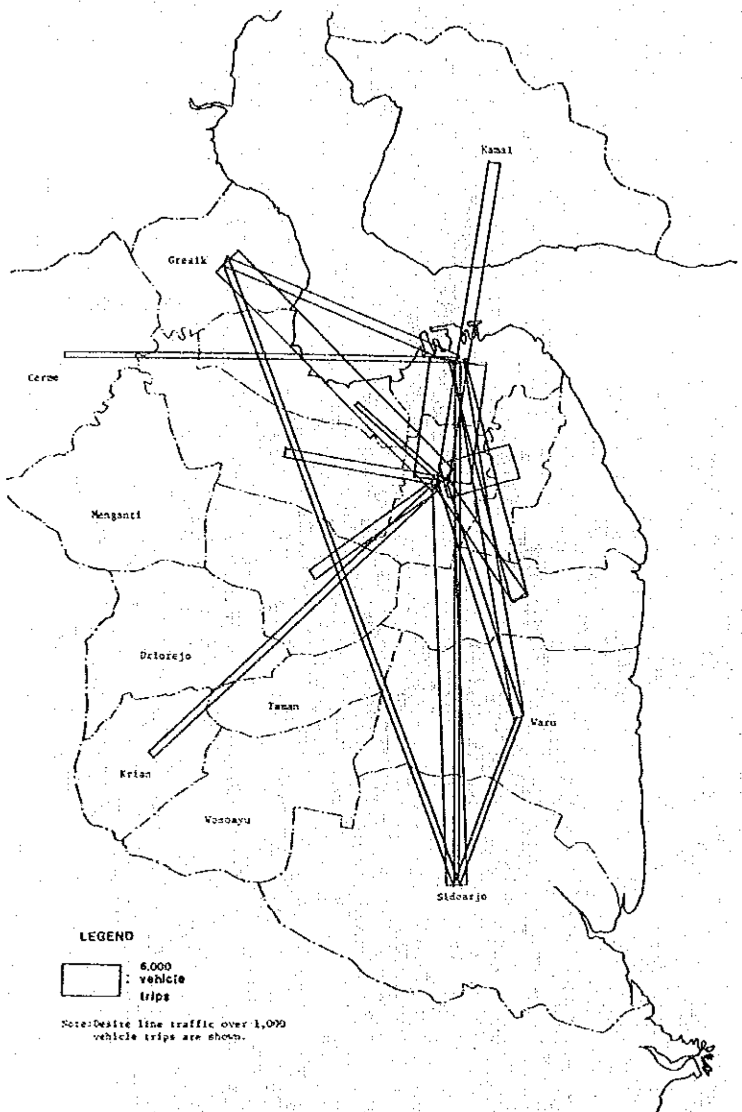


Fig. 13.6.10 DESIRE LINE TRAFFIC FOR SMA IN 2000

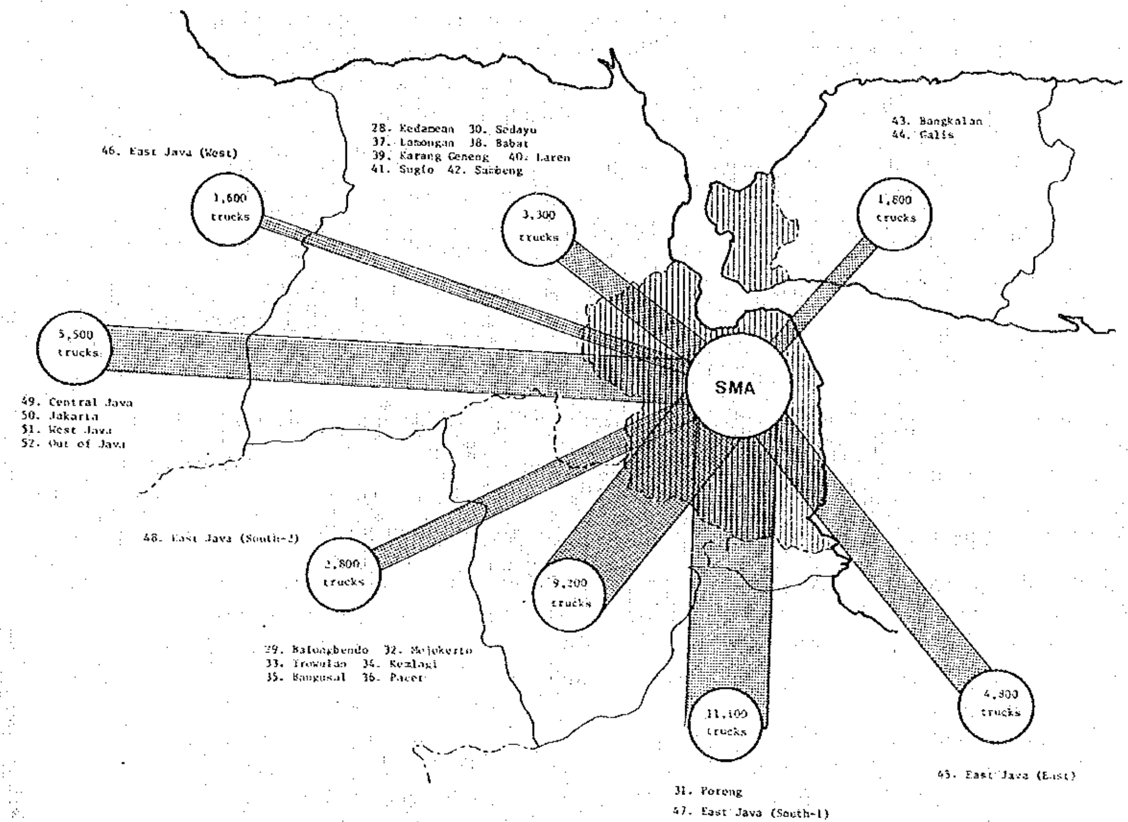


Fig. 13.6.11 DESIRE LINE TRAFFIC FOR SMA OUTSIDE SMA IN 2000 (TRUCK VEHICLE TRIP)

13.7 ASSIGNED TRAFFIC VOLUME ON ROAD AND RAIL NETWORKS

13.7.1 ASSIGNED TRAFFIC VOLUME ON ROAD NETWORK

METHOD OF TRAFFIC ASSIGNMENT FOR ROAD NETWORK

The purpose of traffic assignment is to simulate route choice and to evaluate the road, railway network and service level which are planned in this study. The method is based on traffic limitation (the Q-V) method. Traffic, which is divided into five parts, is assigned to the network in five stages. In each stage, traffic of each O-D pair is assigned to the minimum route reflecting the changes of Q-V conditions for each link.

In traffic assignment, five future vehicle O-D matrices are converted into one O-D matrix in terms of passenger car unit (p.c.u.) by the use of the conversion rates as shown below:

Type of Vehicle	Sedan	Motrocycle	City Bus	Inter-City Bus	Truck
p.c.u.	1	0.3	2	2	2

The road networks for traffic assignment in the year 1990 and 2000 were established after deliberating upon the discussions in Section 13.4.3 of Part III. They are given previously in Figs. 13.4.8 through 13.4.11.

ASSIGNED TRAFFIC VOLUMES ON ROAD NETWORK

Alternative cases for the traffic assignment on the road network were considered for two purposes. One is to evaluate the planned road network system corresponding with the development levels of Urban Mass Transit and New Transit System. The other is to obtain the data for the pre-feasibility study of the Middle Ring Road and the New Transit System (eg. monorail). For the former purpose, the same alternative cases as described in section 13.6.1 were considered. Cases 4 and 6 are recommended as the preferable development level for the transport networks in the year 2000 and 1990 respectively by the Study Team. Case 1, which is the case without Urban Mass Transit and New Transit System, is the "Base Case" for the comparative analysis.

The assigned results are presented in Figs. 13.7.1 through 13.7.6 and summarized in Table 13.7.1.

Table 13.7.1 CHARACTERISTICS OF ASSIGNED TRAFFIC VOLUME

(Unit = thousand)

	Year	Vehicle–km (p.c.u.)	Vehicle–hour (p.c.u.)
Case 1	2000	26,270.8	670.5
Case 4	2000	24,575.4	606.3
Case 6	1990	14,567.9	503.2

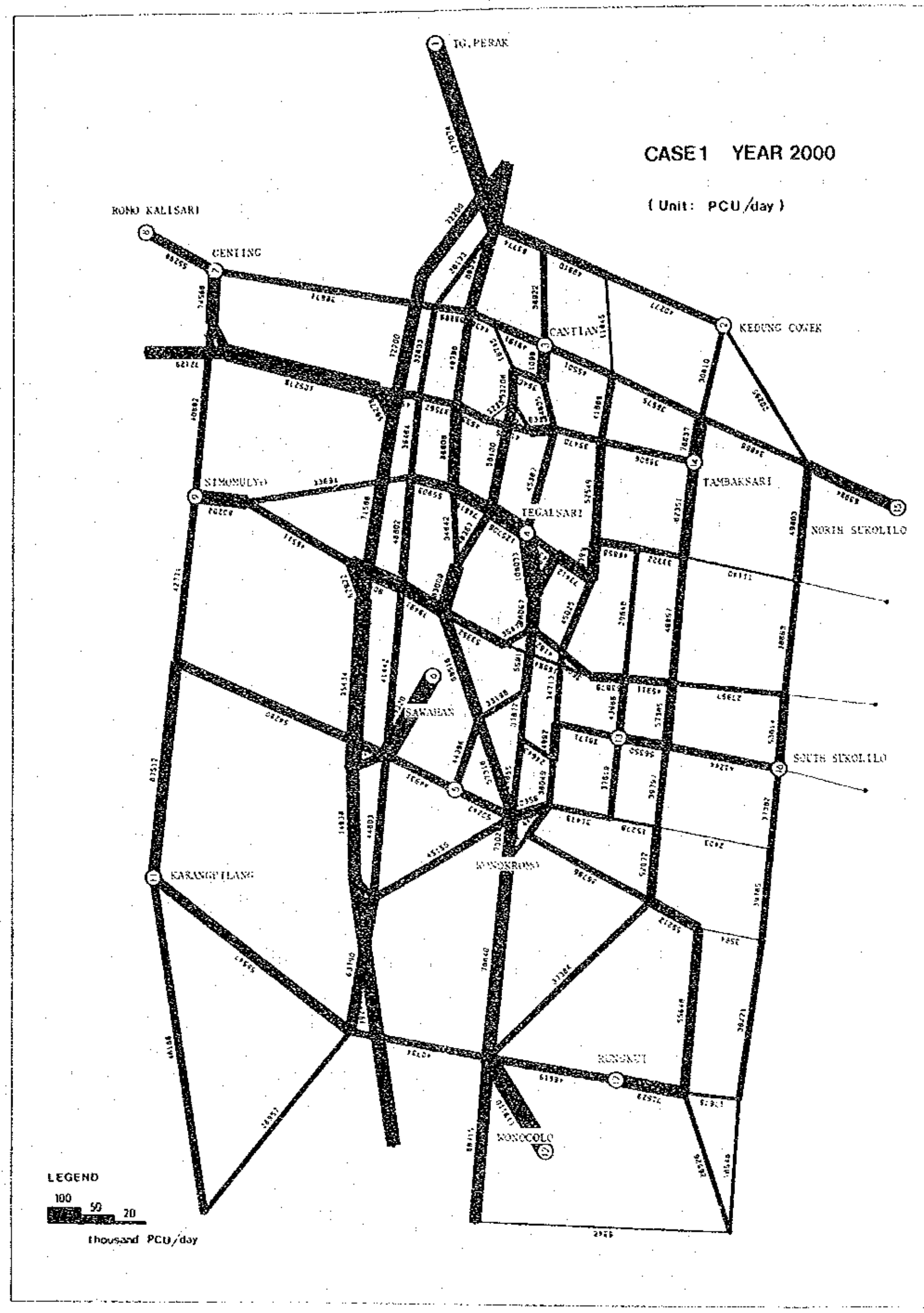


Fig. 13.7.1 ASSIGNED ROAD TRAFFIC FOR CASE 1 IN SURABAYA

13.7.2 ASSIGNED TRAFFIC ON RAILWAY NETWORK

Future person trip O-D traffic by the commuter trains, which were estimated in the proceeding section 13.6 of Part III, were assigned to the railway network shown in Fig. 13.7.7. In order to estimate the demand for the commuter trains by link the traffic volume of each O-D pair was assigned to the minimum route regardless of link capacity at one time. The resulting link loads on the railway network are summarized in Table 13.7.2.

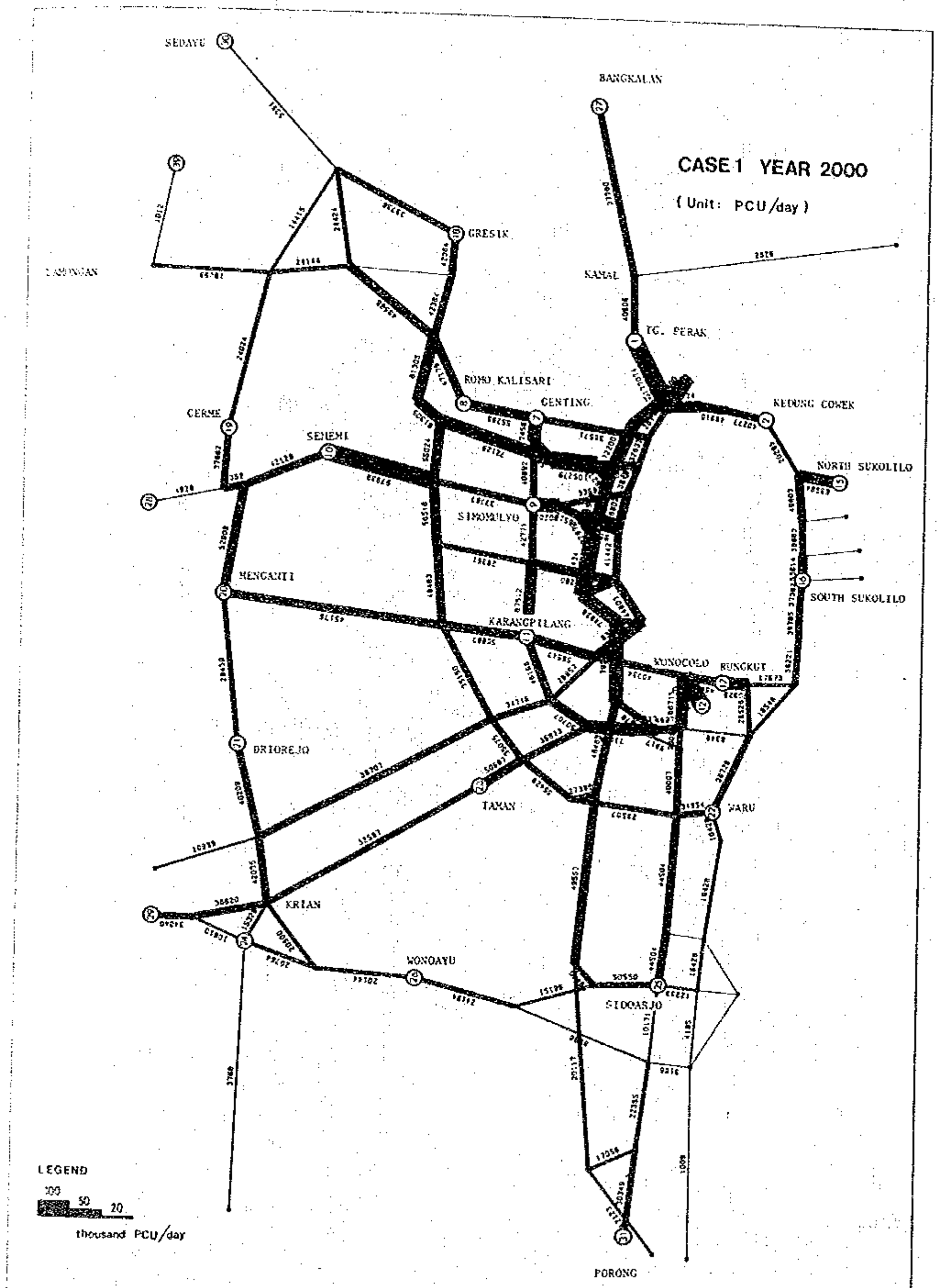


Fig. 13.7.2 ASSIGNED ROAD TRAFFIC FOR CASE 1 IN SMA

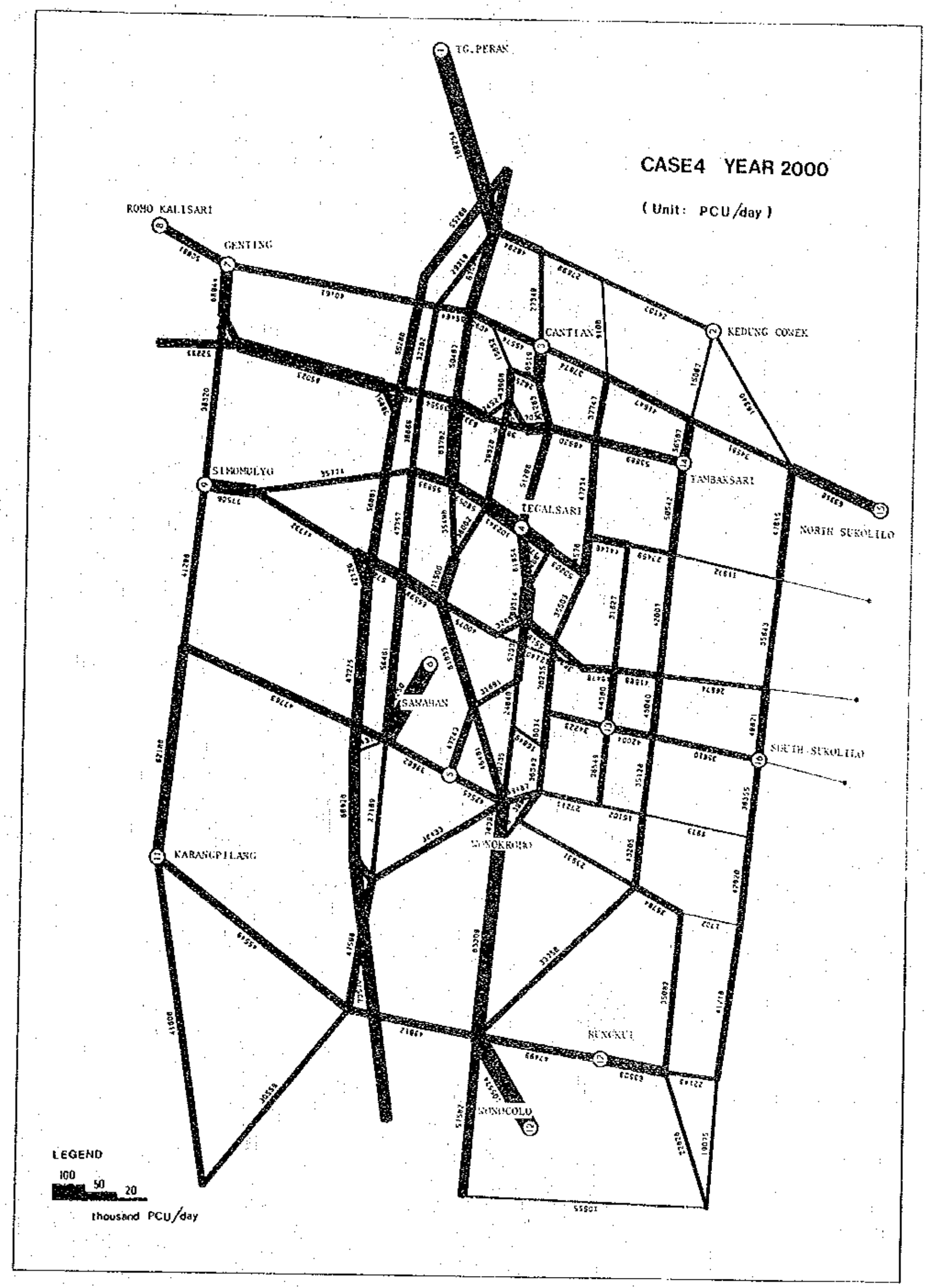
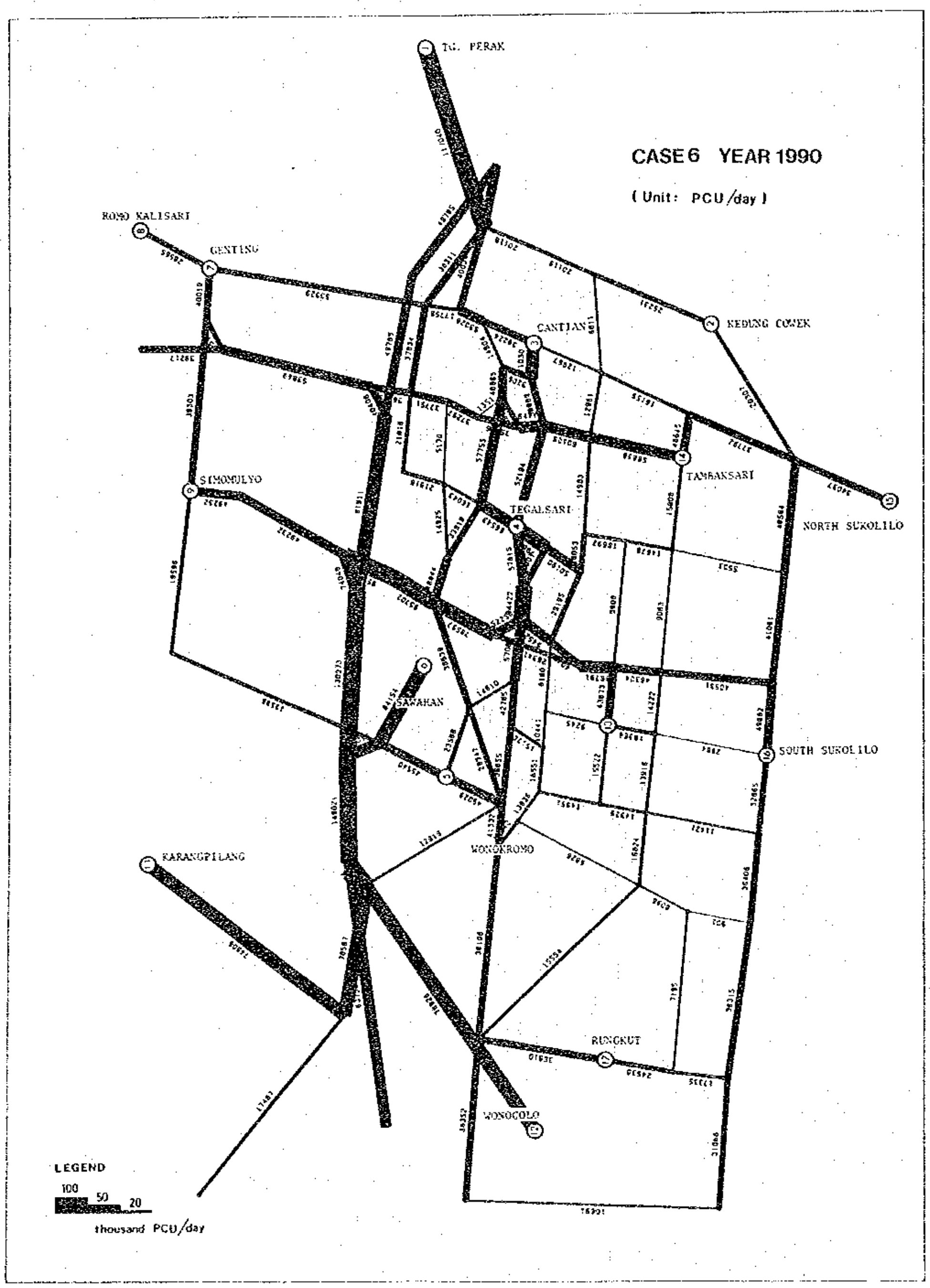


Fig. 13.7.3 ASSIGNED ROAD TRAFFIC FOR CASE 4 IN SURABAYA



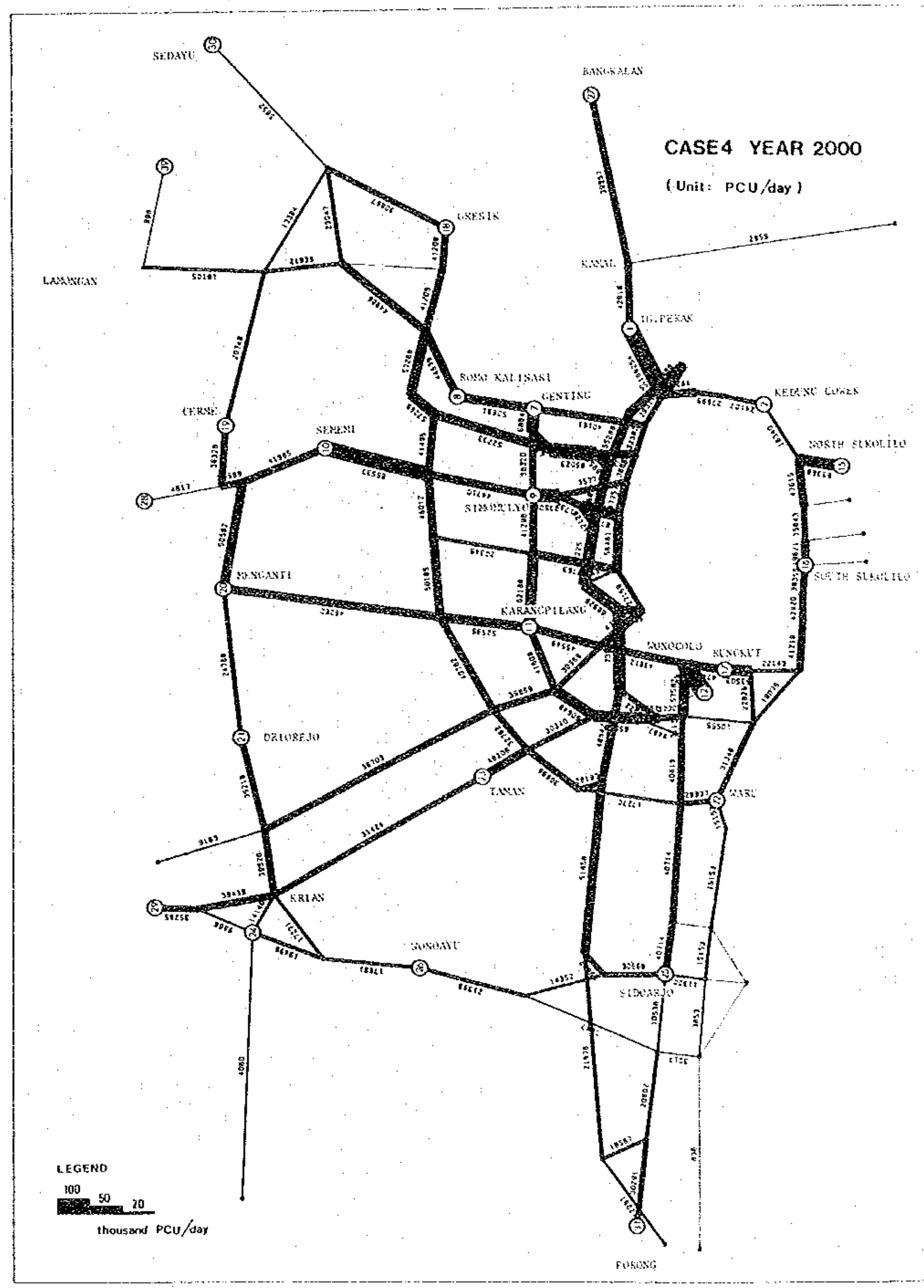


Fig. 13.7.4 ASSIGNED ROAD TRAFFIC FOR CASE 4 IN SMA

Fig. 13.7.5 ASSIGNED ROAD TRAFFIC FOR CASE 6 IN SURABAYA

Table 13.7.2 ASSIGNED TRAFFIC VOLUME OF COMMUTER TRAIN

Link No.	Distance (km)	Sectional Passengers/day	
		Case 7 in the year 1990	Case 4 in the year 2000
3	1.8	110,970	168,434
4	4.0	84,328	136,106
5	2.4	106,681	163,748
6	3.0	106,112	161,658
7	3.0	32,722	82,944
8	10.0	36,707	67,846
9	7.0	19,428	54,698
10	0.1	35,935	78,020
11	7.0	46,317	108,506
12	7.0	57,732	130,552
13	6.8	141,344	243,200
14	4.0	68,878	186,732
15	5.2	36,499	60,518
16	5.8	18,662	31,324
17	4.2	35,008	142,446
18	5.8	4,270	25,722
19	23.0	2,577	2,560
20	28.0	1,902	1,902
21	11.0	17,925	44,560
22	12.0	17,450	61,110
23	8.0	4,612	5,350
24	10.0	3,546	4,282
1	7.4	74,042	73,452
2	0.8	119,581	161,340
27	2.4	137,868	186.146
26	5.0	124,120	156,454

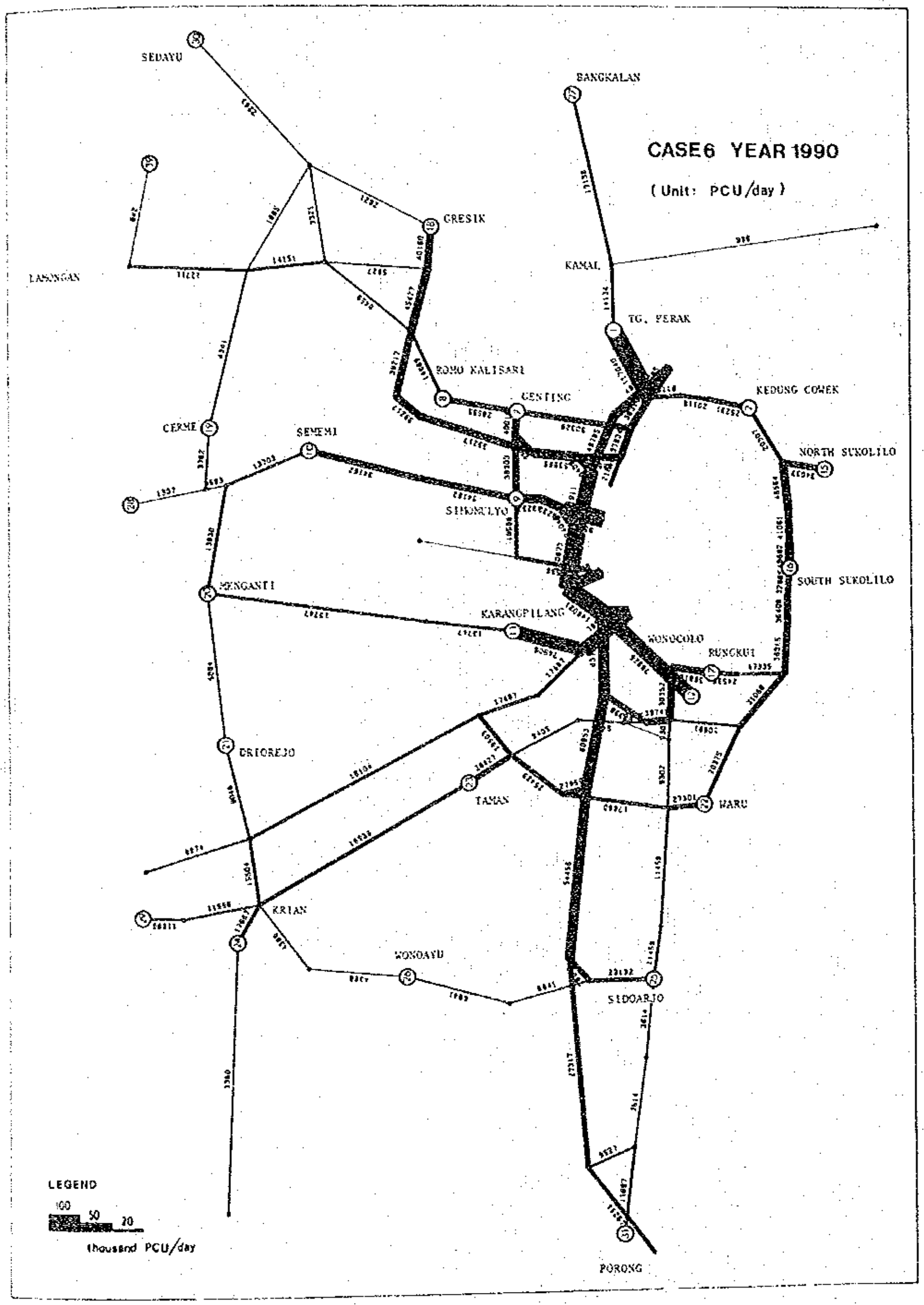


Fig. 13.7.6 ASSIGNED ROAD TRAFFIC FOR CASE 6 IN SMA

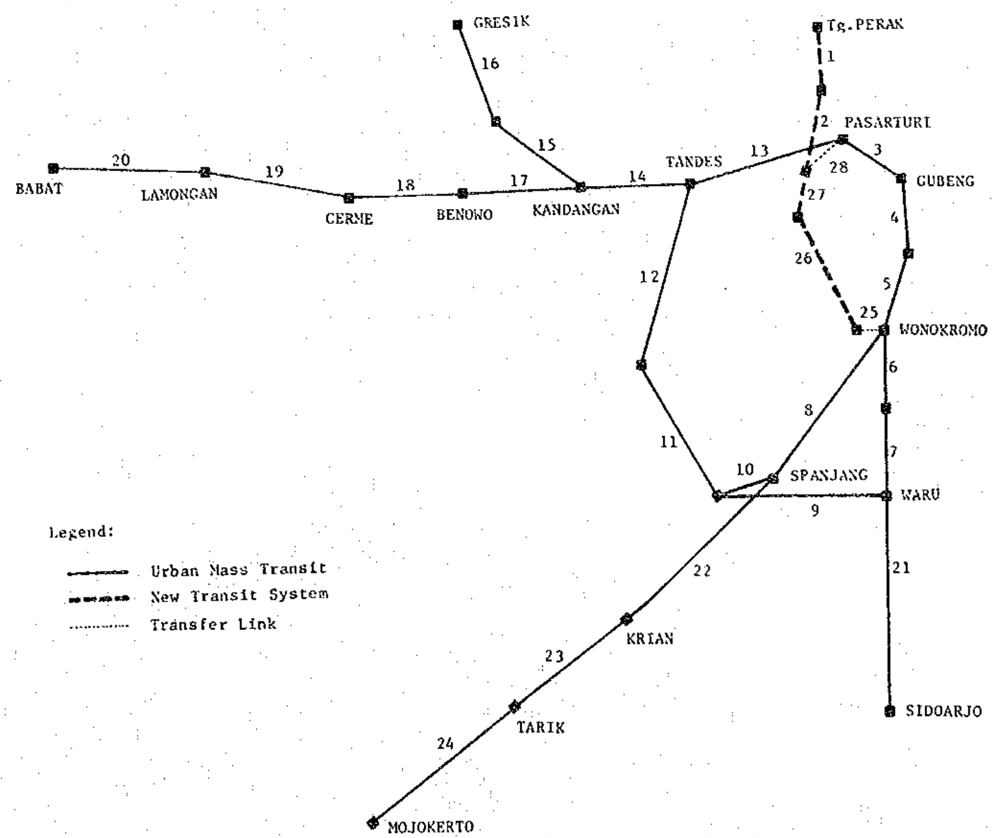


Fig. 13.7.7 RAILWAY NETWORK FOR TRAFFIC ASSIGNMENT