

Table 3-2-5 Floor Space and Number of Worker

Area Pattern	Number of Floor	Floor Space per Hectare (m ² /ha)	Number of Worker per Hectare (person/ha)
0 - 1	3	7200 - 12000	360 - 600
0 - 2	2	4800 - 8400	240 - 420
	1	3600 - 6000	180 - 300

Table 3-2-6 Demand Density in Office Area

Area Pattern	Number of Floor	Demand per Hectare (No. of Telephone/ha)		
		1985	1995	2005
0 - 1	3	30 - 55	60 - 100	70 - 120
0 - 2	2	20 - 35	35 - 55	45 - 65
	1	15 - 25	25 - 45	35 - 50

Table 3-2-7 Size and Number of Store

Area Pattern	Number of Floor	Size of Estate (m ²)	Number of Store per Hectare (person/ha)
C - 1	4	80 - 180	130 - 300
	3	80 - 180	100 - 225
	2	80 - 180	65 - 150
C - 2	1	80 - 200	30 - 75
C - 3	1	80 - 150	45 - 75

Table 3-2-8 Demand Density in Commercial Area

Area Pattern	Number of Floor	Demand per Hectare (No. of Telephone/ha)		
		1985	1995	2005
C - 1	4	55 - 120	80 - 180	100 - 240
	3	50 - 110	70 - 150	90 - 200
	2	40 - 90	50 - 120	65 - 150
C - 2	1	20 - 55	25 - 65	30 - 80
C - 3	1	15 - 30	20 - 35	25 - 45

Table 3-2-9 Size and Number of Factory

Area Pattern	Size of Factory Estate (m ²)	Number of Factory per Hectare (Factory/ha)
I - 1	2000 - 6000	1 - 3
I - 2	1000 - 1500	4 - 6

Table 3-2-10 Demand Density in Industrial Area

Area Pattern	Demand per Hectare (No. of Telephone/ha)		
	1985	1995	2005
I - 1	1 - 3	2 - 5	3 - 6
I - 2	4 - 6	5 - 7	6 - 8

Table 3-2-11 Demand Forecast in Medan Exchange Area (For each Demand Category)

Pattern	Item	1985			1995			2005		
		Area (Ha)	Demand	Density	Area (Ha)	Demand	Density	Area (Ha)	Demand	Density
Residential Area	R-1	300	2,900	9.7	312	3,430	11.0	312	3,720	11.9
	R-2	3,248	19,860	6.1	5,280	39,810	7.5	9,992	95,520	9.6
	R-3	3,020	6,090	2.0	3,452	15,290	4.4	5,828	31,480	5.4
	R-4	1,480	450	0.3	572	270	0.5	172	180	1.0
Sub Total		8,048	29,300	3.6	9,616	58,800	6.1	16,304	130,900	8.0
Business Area	O-1	24	1,150	47.9	24	1,820	75.8	32	2,880	90.0
	O-2	168	3,750	22.3	260	10,590	40.7	380	17,070	44.9
	C-1	28	1,960	70.0	28	3,650	130.4	28	4,060	145.0
	C-2	416	19,730	47.4	588	35,530	60.4	1,020	69,560	68.2
	C-3	240	4,860	20.3	344	9,160	26.6	652	20,880	32.0
	I-1	36	80	2.2	280	1,010	3.6	568	2,770	4.9
	I-2	556	2,830	5.1	632	3,860	6.1	648	4,970	7.7
Others	288	940	3.3	308	1,180	3.8	388	1,810	4.7	
Sub Total		1,756	35,300	20.1	2,464	66,800	27.1	3,716	124,000	33.4
Non-demand		17,076			14,800			6,860		
Total		26,880	64,600	2.4	26,880	125,600	4.7	26,880	254,900	9.5

Table 3-2-12 Demand Forecast in Semarang Exchange Area (For each Demand Category)

Pattern	Item	1985			1995			2005		
		Area (Ha)	Demand	Density	Area (Ha)	Demand	Density	Area (Ha)	Demand	Density
Residential Area	R-1	548	4,780	8.7	548	5,360	9.8	556	6,610	11.9
	R-2	4,040	14,480	3.6	6,452	34,610	5.4	8,432	65,000	7.7
	R-3	788	1,780	2.3	1,604	5,380	3.4	2,260	12,000	5.3
	R-4	2,500	760	0.3	2,224	1,250	0.6	1,932	1,890	1.0
Sub Total		7,876	21,800	2.8	10,828	46,600	4.3	13,180	85,500	6.5
Business Area	O-1	36	1,720	47.8	40	2,840	71.0	44	3,740	85.0
	O-2	232	6,160	26.6	320	12,770	39.9	444	22,000	49.5
	C-1	4	260	65.0	4	370	92.5	4	440	110.0
	C-2	92	3,180	34.6	252	12,180	48.3	476	27,440	57.6
	C-3	280	6,970	24.9	244	6,810	27.9	280	8,580	30.6
	I-1	276	550	2.0	1,328	4,210	3.2	2,352	9,570	4.1
	I-2	288	1,390	4.8	444	2,410	5.4	552	3,400	6.2
Others	364	1,170	3.2	1,536	3,110	2.0	2,708	5,130	1.9	
Sub Total		1,572	21,400	13.6	4,168	44,700	10.7	6,860	80,300	11.7
Non-demand		29,572			24,024			18,980		
Total		39,020	43,200	1.1	39,020	91,300	2.3	39,020	165,800	4.2

Table 3-2-13 Demand Forecast in Solo Exchange Area (For each Demand Category)

Pattern	Item	1985			1995			2005		
		Area (Ha)	Demand	Density	Area (Ha)	Demand	Density	Area (Ha)	Demand	Density
Residential Area	R-1	84	670	8.0	84	750	8.9	84	930	11.1
	R-2	2,052	5,950	2.9	3,536	14,550	4.1	3,720	25,010	6.7
	R-3	448	810	1.8	316	870	2.8	268	1,340	5.0
	R-4	560	170	0.3	872	430	0.5	820	820	1.0
Sub Total		3,144	7,600	2.4	4,808	16,600	3.5	4,892	28,100	5.7
Business Area	O-1	60	1,910	31.8	144	6,540	45.4	176	10,310	58.6
	O-2									
	C-1	48	1,370	28.5	80	2,380	29.8	100	3,920	39.2
	C-3	184	4,390	23.9	188	4,690	24.9	188	5,450	29.0
	I-1	24	60	2.5	196	510	2.6	224	930	4.2
	I-2	68	340	5.0	268	1,690	6.3	452	3,410	7.5
	Others	40	230	5.8	80	390	4.9	96	680	7.1
Sub Total		424	8,300	19.6	956	16,200	16.9	1,236	24,700	20.0
Non-demand		1,068			1,108			744		
Total		4,636	15,900	3.4	6,872	32,800	4.8	6,872	52,800	7.7

Table 3-2-14 Demand Forecast in Medan Exchange Area (For each Exchange)

Ref. No.	Name of Exchange	Demand									
		1985	1988	1990	1993	1995	1998	2000	2005		
1	Centrum	33,400	38,600	42,100	47,300	50,500	55,500	58,600	65,400		
2	Suka Ramai	8,500	10,700	12,400	15,400	18,000	21,800	24,800	33,400		
3	Pulau Brayan	8,700	10,300	11,900	14,600	15,900	20,700	23,700	33,700		
4	Padang Bulan	2,700	3,900	5,100	7,300	9,400	12,200	14,300	20,500		
5	Cinta Damai	4,700	6,300	7,700	10,400	12,400	16,500	19,700	29,900		
6	Simpang Limun	3,300	4,400	5,500	7,600	9,100	12,900	15,900	26,600		
7	Tanjung Mulia	1,300	1,800	2,300	3,500	3,900	6,800	8,700	17,700		
8	Belawan	1,500	1,900	2,200	2,800	3,300	4,100	4,700	6,100		
9	Tuntungan	100	300	400	900	1,400	3,100	5,100	13,100		
10	Labuhan	400	600	800	1,300	1,700	2,900	4,000	8,500		
	Total	64,600	78,800	90,400	111,100	125,600	156,500	179,500	254,900		

Table 3-2-15 Demand Forecast in Semarang Exchange Area (For each Exchange)

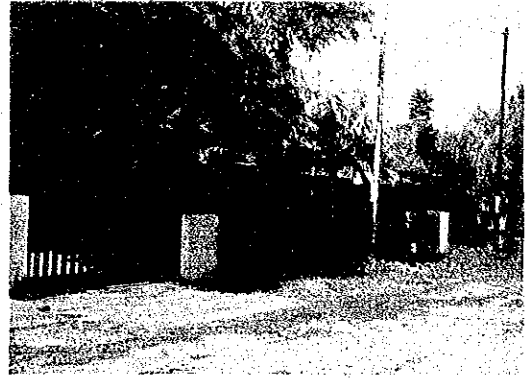
Ref. No.	Name of Exchange	Demand									
		1985	1988	1990	1993	1995	1998	2000	2005		
1	Semarang I	14,800	17,300	19,200	22,400	25,200	28,900	32,000	41,200		
2	Semarang II	10,500	12,400	13,500	15,700	17,800	20,100	22,400	28,800		
3	Tugu	5,220	7,000	8,300	10,600	12,500	15,000	17,100	22,700		
4	Majepahit	3,700	5,700	7,200	9,900	12,400	15,600	18,300	25,900		
5	Banyumanik	5,700	6,700	7,400	8,600	9,900	11,400	12,800	17,100		
6	Genuk	1,300	2,400	3,300	4,900	6,600	8,600	10,400	15,600		
7	Mijen	280	300	400	500	600	700	800	1,100		
8	Gunung Pati	400	400	500	600	700	1,000	1,200	1,900		
9	Mang Kang	1,300	2,400	3,200	4,400	5,600	7,000	8,200	11,500		
	Total	43,200	54,600	63,000	77,600	91,300	108,300	123,200	165,800		

Table 3-2-16 Demand Forecast in Solo Exchange Area (For each Exchange)

Ref. No.	Name of Exchange	Demand									
		1985	1988	1990	1993	1995	1998	2000	2005		
1	Solo I	10,100	11,500	12,500	14,300	15,600	17,800	19,400	24,000		
2	Solo II	5,800	9,100	11,500	14,900	17,200	20,700	23,000	28,800		
	Total	15,900	20,600	24,000	29,200	32,800	38,500	42,400	52,800		



R-1
(High Class Residential Area)



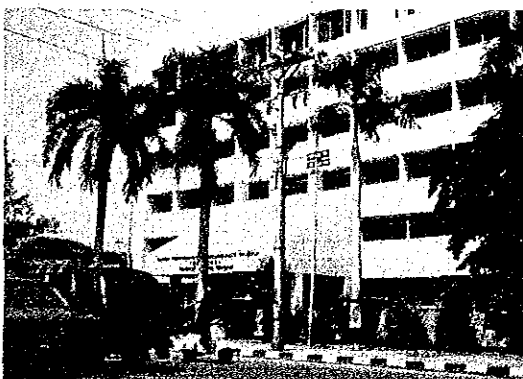
R-2
(Medium Class Residential Area)



R-3
(Low Class Residential Area)



R-4
(Residential Area in Agricultural Area)

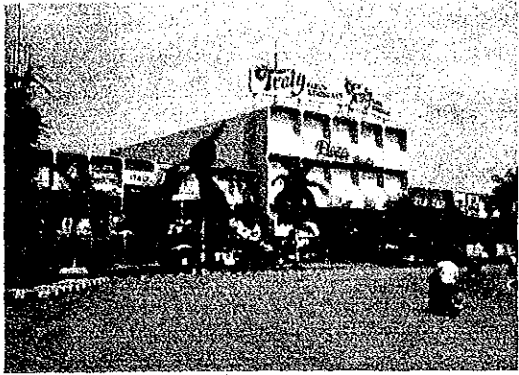


O-1
(Office Area)
(Medium Telephone Demand Area)



O-2
(Office Area)
(Low Telephone Demand Area)

Figure 3 - 2 - 1 Example of Demand Category



C-1
 (Commercial Area)
 (High Telephone Demand Area)



C-2
 (Commercial Area)
 (Medium Telephone Demand Area)



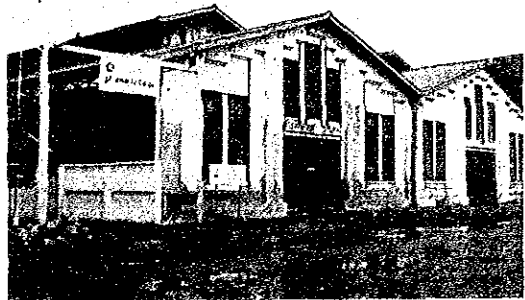
C-3
 (Commercial Area)
 (Low Telephone Demand Area)



I-1
 (Industrial Area of Large Scale
 Fractories)













I-2
 (Industrial Area of Small Factories
 and Workshops)



S-W
 (Warehouse)

Figure 3 - 2 - 2 Example of Demand Category

-  : Sea, River
-  : Commercial Area
-  : Agricultural Area
-  : Industrial Area
-  : Port, Warehouse Area
-  : Military Area
-  : Residential Area
-  : Educational and Social Areas
-  : Office Area
-  : Out of Boundary

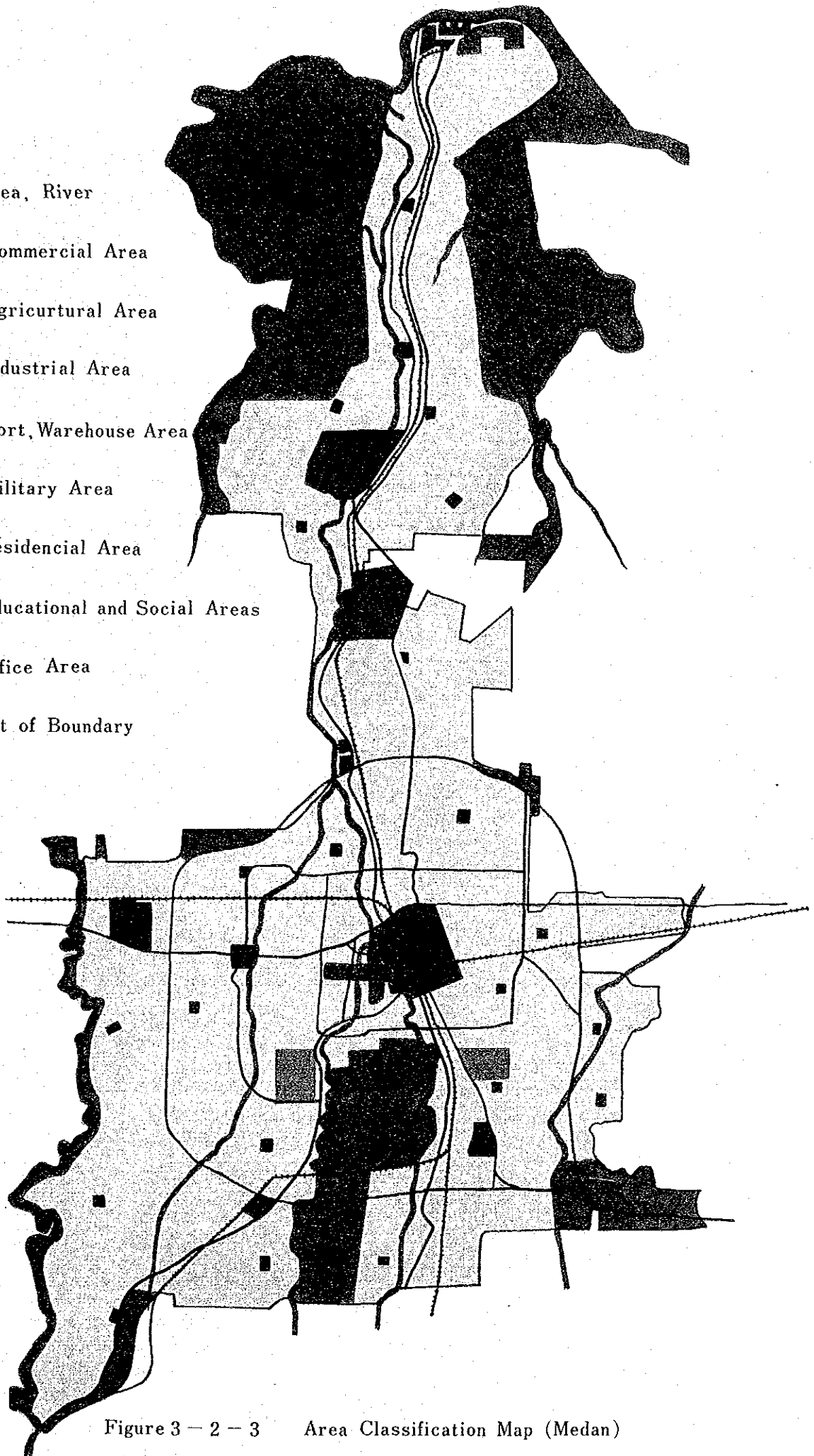


Figure 3 - 2 - 3 Area Classification Map (Medan)

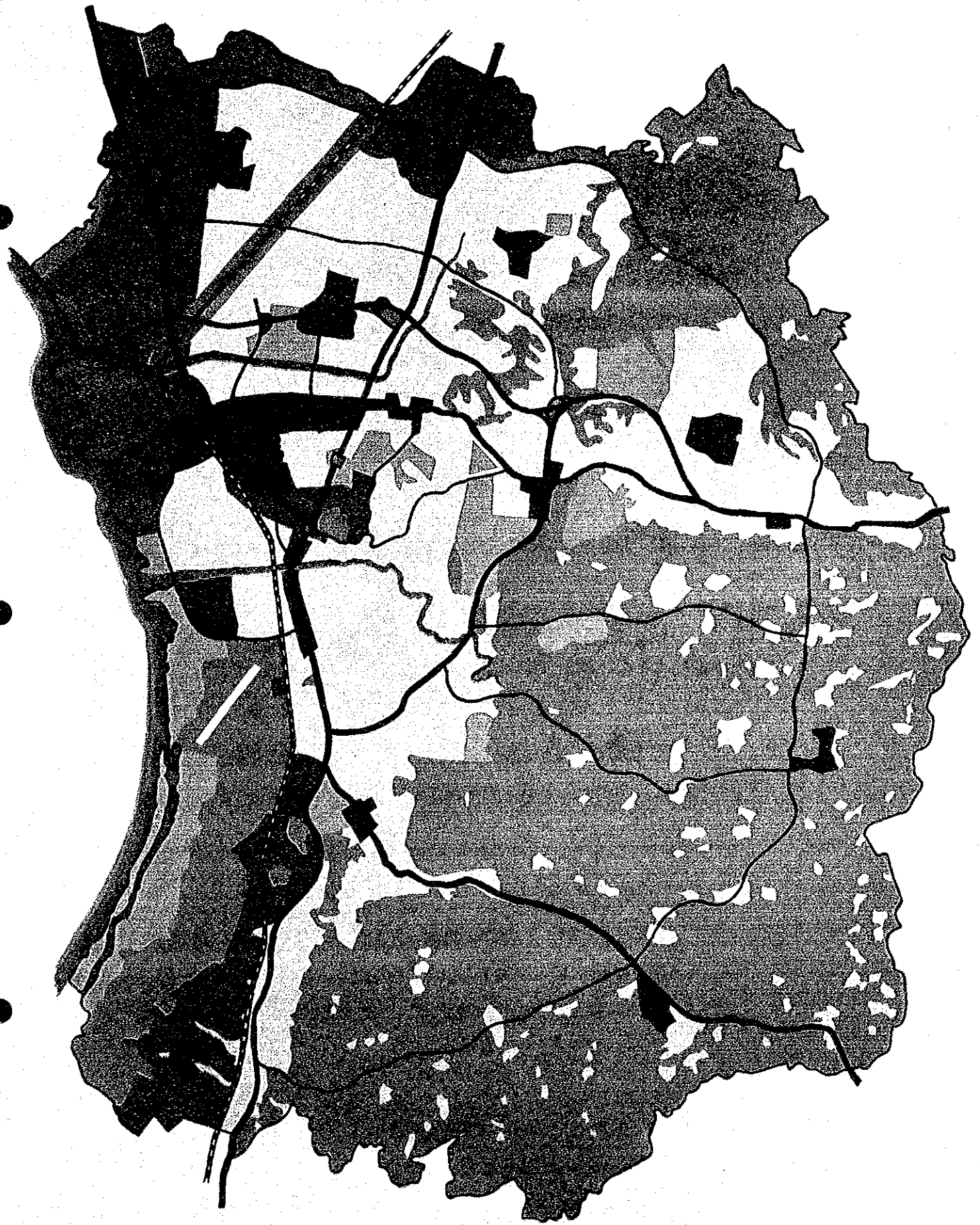


Figure 3 - 2 - 4 Area Classification Map (Semarang)

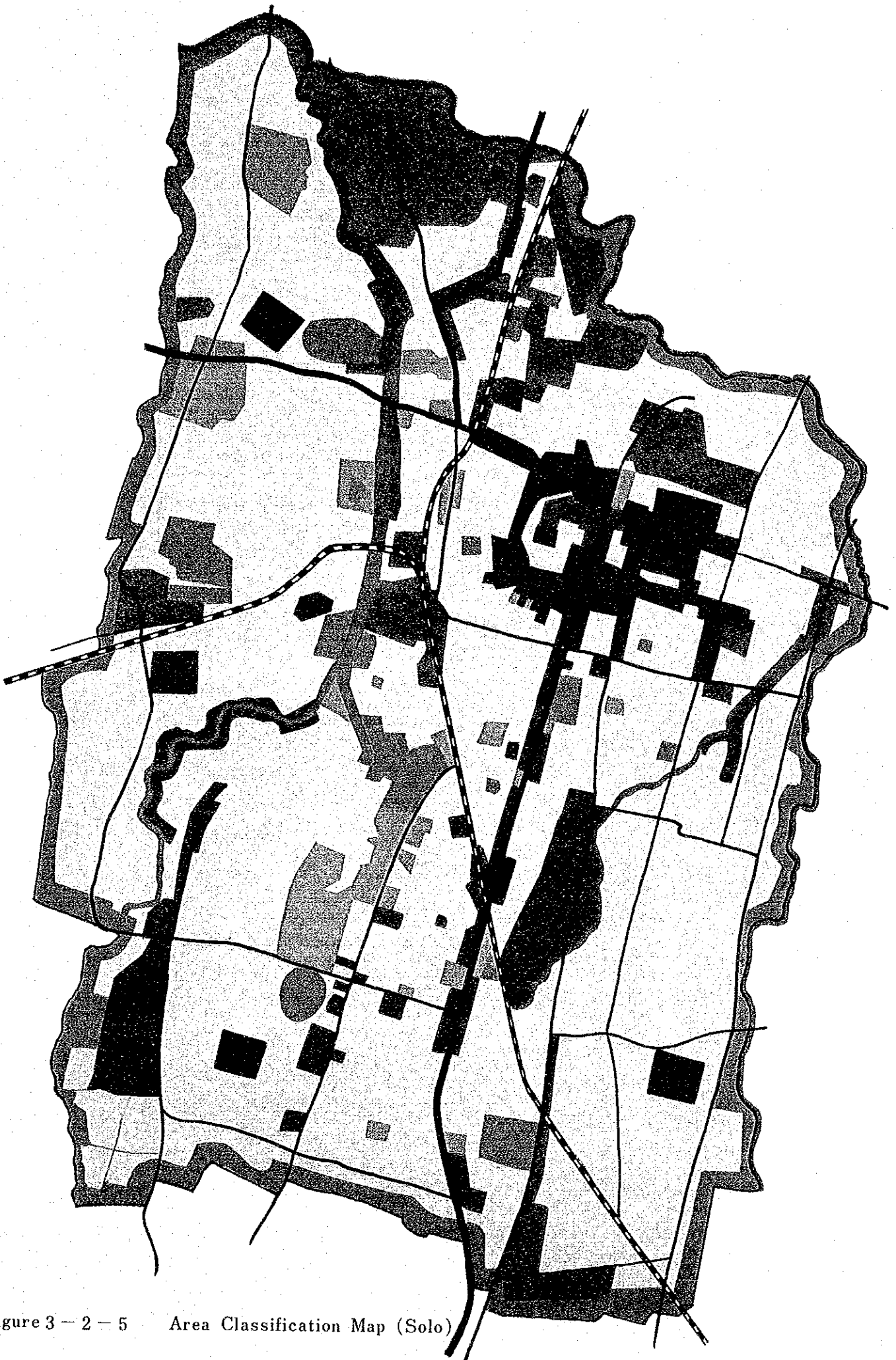


Figure 3 - 2 - 5 Area Classification Map (Solo)

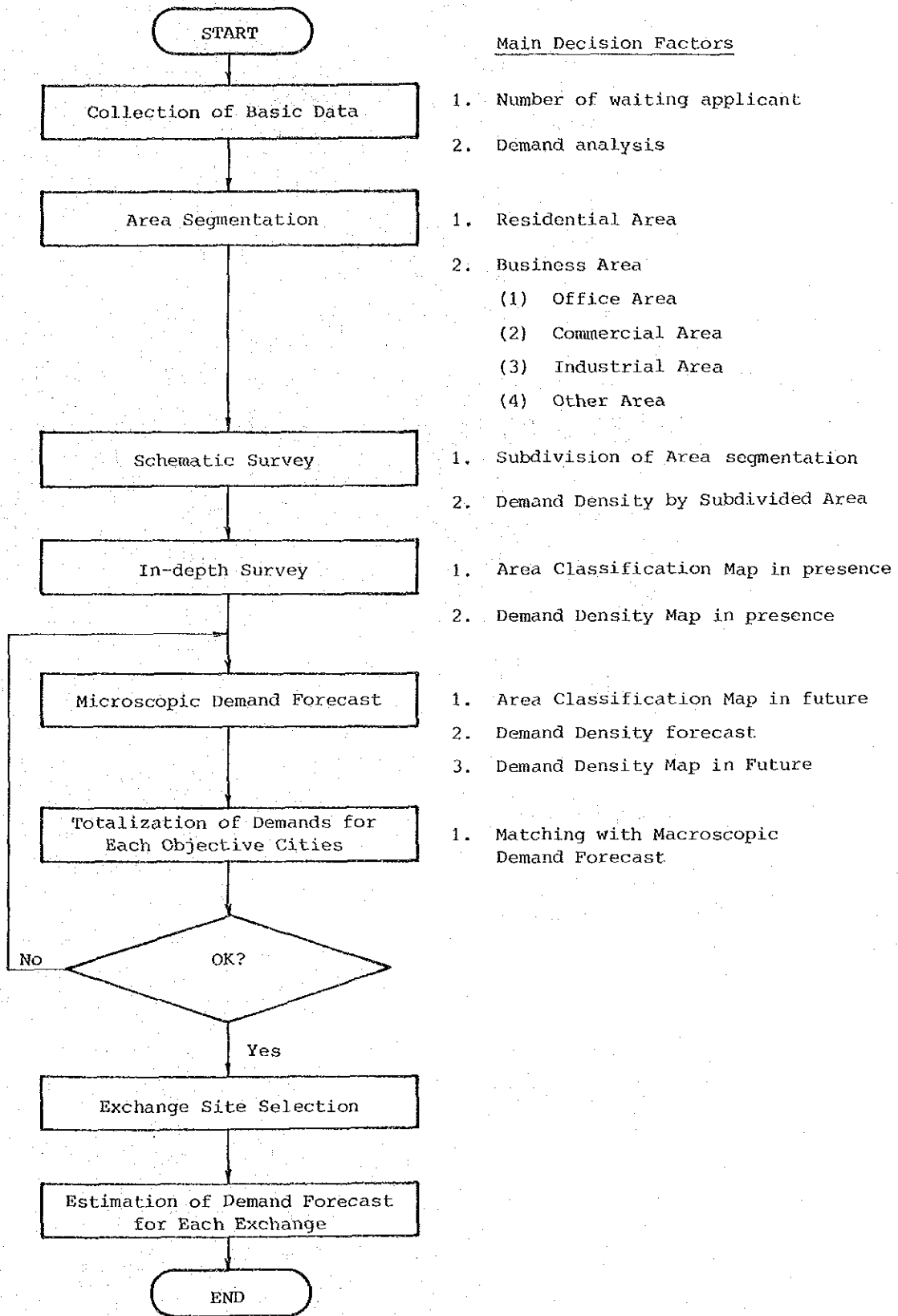


Figure 3-2-6 Microscopic Demand Forecast Procedure

**CHAPTER 4 LONG TERM LOCAL TELEPHONE
NETWORK IMPROVEMENT/
EXPANSION PLAN**

CHAPTER 4 LONG TERM LOCAL TELEPHONE NETWORK IMPROVEMENT/ EXPANSION PLAN

4-1 Objective of Telephone Installation Plan

4-1-1 Long Term Installation Plan Objective

(1) Telephone Exchange Installation Plan

According to PERUMTEL, when on-going REPELITA-IV program terminates successfully in 1988, telephone switching facilities operating in all parts of Indonesia will total 1,613,633 in the number of line units. This figure corresponds to 95% of 1,689,000 as telephone demand forecasted for 1988.

Insofar as PERUMTEL is to achieve demand fulfillment completely in 2000, the prerequisite is that in the case of telephone switching facilities, design period be three years so that in 2000, the number of line units commensurate with demand as of 2003 can already be installed. To attain this objective, design values of installation in final years of prospective five-year plans (REPELITA-V and REPELITA-VI) must be as specified in Table 4-1-1 and Figure 4-1.

Table 4-1-1 Long Term Installation Plan Up to 2005
(National)

Year	Demand Forecast (x 10 ³)	Installation Objective (No. of line units: x 10 ³)
1985	1,404	913.6
1986	1,501	1,167.4
1987	1,578	1,376.1
1988	1,689	1,613.6
1993	2,299	2,397.1
1998	3,089	3,561.1
(2000)	(3,475)	(4,172.0)
2003	4,172	4,985.0 (estimated)
(2005)	4,699	-

If the line unit expansion is to be carried out as shown in the long term installation plan, the number of additional line units to be installed in each prospective five-year plan is as under.

<u>Five-Year Plan</u>	<u>Additional Line Unit Installation</u> (x 10 ³)
i) Initial Plan REPELITA-IV (1984-1988)	750.0
ii) Second Plan REPELITA-V (1989-1993)	783.5
iii) Third Plan REPELITA-VI (1994-1998)	1,164.0
iv) Fourth Plan REPELITA-VII (1999-2003)	1,423.9

Amount of work of second and succeeding five-year plans, when compared with that of initial plan (i.e., REPELITA-IV with amount of work determined by PERUMTEL), is considered to be not excessive to affect adversely the implementation of plan.

(2) Main Telephone Expansion Plan

The number of main telephones operating in all parts of Indonesia is in Table 3-1-1. Average annual expansion rate during 12 years from 1971 to 1983 was 10-11%. The number of main telephones installed by the past five-year plans is as under.

i) REPELITA-II (1974-1978)	91,760
ii) REPELITA-III (1979-1983)	288,128

So as to achieve 100% demand fulfillment by 2000, the number of main telephones must also be expanded at annual rate of at least 10.5%, the past record, or even at higher rate. In other words, the number of main telephones to be installed in the coming 10 years must be 3.5-4.0 times the number installed in the past 10 years.

Thus, for full attainment of installation objective after on-going REPELITA-IV, PERUMTEL as responsible entity for program implementation must further improve its program implementation system ranging from supply of materials to subscriber's premise work and, at the same time, upgrade financial and technical capabilities.

(3) Existing Facilities Replacement

For existing facilities replacement, PERUMTEL's installation guidelines must be fully considered. The guidelines are:

- 1) To introduce digital system for switching facilities and junction line facilities to be newly installed.
- 2) To utilize existing analog facilities not long after installation, to the limit of their useful life, without expansion.
- 3) To replace existing analog facilities near the limit of their useful life with digital facilities in due course.

In Indonesia, no small number of existing facilities are already past the normal depreciation time limit of 20 years. Therefore, in this study, the basic principle is to replace facilities 5-10 years after the designated depreciation period (generally, 20 years), i.e., 25-30 years after installation.

4-1-2 Telephone Installation Plan for Objective Cities of Study

- (1) Table 4-1-2 presents telephone installation objectives for three objective cities of study, i.e., Medan, Semarang and Solo.

These installation objectives are established by the same principle as in Paragraph 4-1-1 (1). That is to say, for switching facilities, design period is set at three years and the number of line units to be installed in each installation period is nearly equal to the number of newly installed telephones after the installation period.

For exchange by exchange installation objectives in comparison with the forecasted demands, refer to ANNEX 3.

- (2) In Table 4-1-3, installation objectives under REPELITA-IV are formulated by this study and presented in comparison with PERUMTEL's installation plan.

- 1) Medan

PERUMTEL plan is such that, at all exchanges in city precincts of Medan, the number of line units installed as of the end of REPELITA-IV, i.e., 1988, exceeds demand forecasted by this study for 1988.

This study aims at complete demand fulfillment in 2000 so that the number of line units installed as of the end of REPELITA-IV, which this study proposes, is 95% or thereabouts of demand, or, more precisely, 75,200 line units.

2) Semarang

For four exchanges to be newly established, i.e., Tugu, Genuk, Banyumanik and Majapahit, PERUMTEL plans to introduce DIC (digital line concentrator) temporarily to relieve urgent demand only. However, at Semarang I and Semarang II exchanges, the number of line units to be installed exceeds forecasted demand.

Result of microscopic demand survey by this study supports judgment that especially in Tugu, Banyumanik and Majapahit areas, independent exchanges must be established during REPELITA-IV period. This is to make installation scale commensurate with demand growth.

3) Solo

PERUMTEL's installation plan must be upgraded to the level of installation objective set by this study.

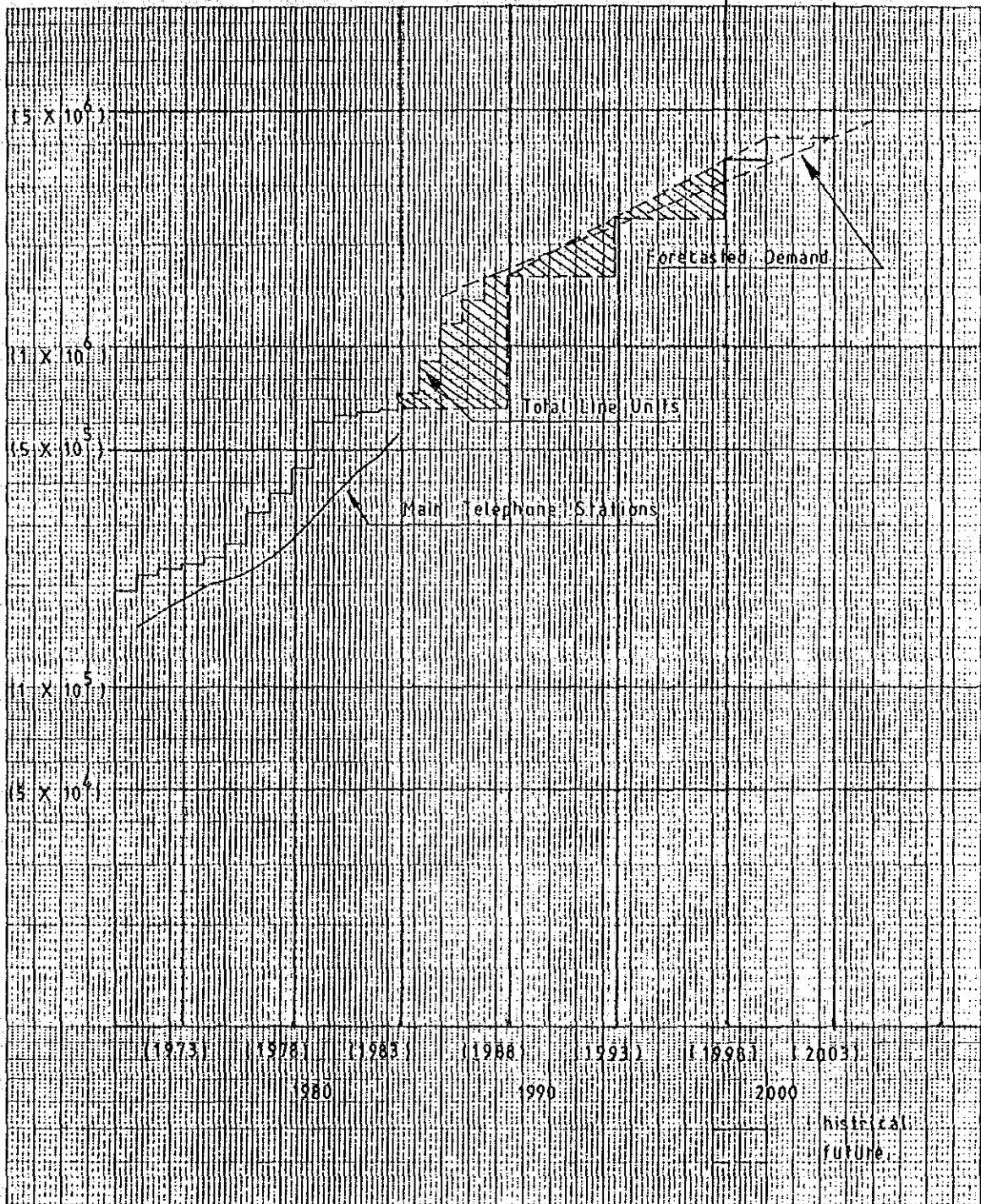


Figure 4-1-1 Long Term Telephone Installation Objective (National)

Table 4-1-2 Long Term Installation Objectives Up to 2005
(for Medan, Semarang and Solo)

No.	Exchange	1988	1991	1994	1997	2000	2003	Remark
1	Centrum	36.9	43.9	50.0	57.0	62.6	65.4	
2	Suka Ramai	10.2	13.5	18.5	23.5	29.8	33.4	
3	Pulau Brayon	9.8	13.0	16.3	22.3	28.7	33.7	
4	Padang Bulan	4.0	6.0	9.6	13.2	17.6	20.5	
5	(Tuntungan)	-	-	1.5	3.3	9.6	13.1	
6	Cinta Damai	6.0	8.4	12.7	17.8	25.2	29.9	
7	Simpang Limun	4.2	6.0	9.3	13.9	21.4	26.6	
8	Tanjung Mulia	1.6	2.4	3.9	6.5	12.6	17.7	
9	Belawan	1.8	2.4	3.4	4.4	5.5	6.1	
10	Labuhan	0.7	1.0	1.6	3.0	6.2	8.5	
	Total (Medan)	75.2	96.6	127.0	164.9	219.2	254.9	
1	Semarang I	16.6	20.9	25.8	31.1	37.4	41.2	
2	Semarang II	11.8	14.7	18.3	21.6	26.3	28.8	
3	Genuk	2.3	3.6	6.8	9.3	13.5	15.6	
4	Tugu	7.0	9.5	13.5	16.2	21.1	22.7	
5	(Mijen)	-	-	-	0.8	1.0	1.1	
6	Banyumanik	6.8	8.6	10.9	12.3	15.2	17.1	
7	(Gunung Pati)	-	-	-	1.0	1.7	1.9	
8	Majapahit	5.4	7.8	12.7	16.8	22.8	25.9	
9	Mang Kang	2.3	3.5	5.7	7.5	10.5	11.5	
	Total (Semarang)	52.2	68.6	93.7	116.6	149.5	165.8	
1	Solo I	11.0	13.6	16.0	19.2	22.1	24.0	
2	Solo II	8.7	12.5	17.6	22.3	27.0	28.8	
	Total (Solo)	19.7	26.1	33.6	41.5	49.1	52.8	
	Grand Total	147.1	191.3	254.3	323.0	417.8	473.5	

Table 4-1-3 REPELITA-IV Installation Objectives
(for Medan, Semarang and Solo)

(No. of line units: 10³)

Exchange	Installation Target	PERUMTEL's Plan	Estimated Demand (1988)
(1) Medan			
Centrum	36.9	45.0	38.6
Suka Ramai	10.2	12.0	10.7
Pulau Brayan	9.8	11.0	10.3
Padang Bulan	4.0	8.0	4.2
Cinta Damai	6.0	7.0	6.3
Simpang Limun	4.2	7.0	4.4
Tanjung Mulia	1.6	3.0	1.8
Belawan	1.8	2.0	1.9
Labuhan	0.7	0	0.6
Total	75.2	95.0	78.8
(2) Semarang			
Semarang I	16.6	25.4	17.3
Semarang II	11.8	15.0	12.4
Genuk	2.3	1.0 (DIC)	2.4
Tugu	7.0	1.0 (DIC)	7.3
Banyumanik	6.8	1.0 (DIC)	7.1
Majapahit	5.4	0.6 (DIC)	5.7
Mang Kang	2.3	0	2.4
Total	52.2	44.0	54.6
(3) Solo I	11.0	13.0	11.5
Solo II	8.7	4.0	9.1
Total	19.7	17.0	20.6

4-1-3 Digitalization Plan for Existing Switching Facilities and Junction Line Facilities

Digitalization plan for existing analog facilities by Paragraph 4-1-1 (3) principle is in Table 4-1-4.

Table 4-1-4 Digitalization Plan for Existing Switching Facilities and Junction Line Facilities

Exchange	Type of Exchange	Line Capacity (L.U.: 10 ³)	Year of Installation	Year of Digitalization (Proposed)
(1) Centrum I	UR-49A	4.0	12-1958	by 1993
	(UR-49A)	4.0	6-1971	(by 1993)
(2) Centrum II	ARF-102	7.0	12-1978	
	MC-10C	10.0	1-1980	
	MC-10C	10.0	-1983	
(3) Semarang I	EMD-F6A	8.0	3-1972	by 1998
	(EMD-F6A)	2.0	6-1976	(by 1998)
	(EMD-F6A)	0.4	-1982	(by 1998)
(4) Semarang II	MC-10C	5.0	1-1978	
	MC-10C	4.0	-1984	
(5) Solo	ARF-101	3.0	12-1957	by 1993
	(ARF-101)	1.0	11-1969	(by 1993)
	(ARF-101)	1.0	8-1976	(by 1993)
	(ARF-101)	2.0	-1982	(by 1993)

Note: Equipment items in () are to be transferred to other exchanges, before useful life termination. Those equipment items are to be installed in group to facilitate maintenance and for effective use of exchange floor space.

4-2 Exchange Site Selection

4-2-1 General

For subscriber's line network in multi-exchange area, main cost determinants are as under.

- (1) Maximum capacity of exchange
- (2) Number of exchanges
- (3) Size of exchange service area
- (4) Locations of exchanges
- (5) Junction network structure

The undermentioned non-economic factors also are intimately related to exchange site selection.

- (6) Signalling limitations and transmission loss limitations on subscriber's lines and junction circuits
- (7) Existing exchange building capacity and building expansion availability
- (8) Subscriber's line network dimension of existing exchange
- (9) Natural boundary conditions, such as rivers, railways and main roads

Therefore, to achieve economically most advantageous exchange site selection, the number and locations of exchanges, as well as the size of each exchange service area, must be so determined as can minimize total cost of local network. In this case, the foregoing non-economic factors must also be duly considered.

4-2-2 Procedures

Exchange site selection procedures are in Figure 4-2-1.

4-2-3 Cost Determinants

For the aforementioned cost determinants, the points of emphasis are as under.

(1) Maximum Capacity of Exchange

In view of capacity limitations of standard local switching equipment EWSD adopted by PERUMTEL, as well as design policy of PERUMTEL for exchange buildings in multi-exchange area, maximum capacity of exchange is set at 40,000 line units.

(2) Number of Exchanges

By the total number of subscriber's lines in exchange service area and subscriber's line capacity per exchange (i.e., maximum capacity of exchange) for each forecast year, necessary minimum number of exchanges can be determined. Also important for this decision is to identify to what extent the service area size of each exchange depends upon the economic and non-economic factors.

(3) Size of Exchange Service Area

For decision of desirable size of exchange service area, geographic and electrical restraints listed as under are duly considered.

- 1) Service areas of existing exchanges
- 2) Natural boundary conditions, such as rivers, railways and main roads
- 3) Administrative area boundary
- 4) Transmission loss and d.c. resistance limitations on subscriber's lines

Economic factors whereby to determine the size of each exchange service area are manifold. In this study, as condition to subscriber's line network design at reasonable cost is used macroscopic judgment as to whether cables with conductor diameters of 0.4 mm and 0.6 mm can be installed for upwards of 90% of subscriber's line network in each exchange area, or not.

(4) Locations of Exchanges

Procedures for decision of exchange locations are as under.

First, to locate theoretical wire center from demand distribution map for final planning year obtained by microscopic demand forecast. Then, to examine whether exchange site is available near the wire center or not, and, if such site is available,

whether primary cable route extension from the site is possible or not. Both these decisions depend upon careful study of field survey results.

(5) Junction Network Structure

Based on requirements resulting from the foregoing items (1) to (4) plus traffic performance and grade of service, decision is made for junction network structure.

4-2-4 Exchange Site Selection in Objective Cities

(1) Medan

At present, in Medan, all local telephone subscribers are accommodated in two exchanges, i.e., Centrum I and Centrum II, located in the central part of the city. These two exchanges are only 400 m apart. No clearcut distinction exists between their respective service areas.

Exchange site selection study for Medan shows that to cater, at economic advantage, for demand spreading toward city periphery and thereby attain REPELITA-IV installation targets, nine exchanges must be established. They are

- 1) Centrum
- 2) Suka Ramai
- 3) Pulau Brayan

- 4) Padang Bulan
(Exchange area includes prospective Tuntungan Exchange area.)
- 5) Cinta Damai
- 6) Simpang Limun
- 7) Tanjung Mulia
- 8) Belawan
- 9) Labuhan

Belawan belongs at present to suburban area but is to be incorporated in Medan local network during REPELITA-IV period.

When future demand growth so necessitates, Tuntungan Exchange is to be newly established in the southern part of Padang Bulan Exchange area. Desirable time for Tuntungan Exchange opening is around 1994 which is within REPELITA-VI period.

Exchange site selection for Medan up to the year 2005 is in Figure 4-2-2.

(2) Semarang

At present, in Semarang, all local telephone subscribers are accommodated in two exchanges, i.e., Semarang I and Semarang II, located in the central part of the city.

Exchange site selection study for Semarang shows that to fulfill demand which is growing along east-to-west seaboard road and along road extending

to south from city center leading to Yogyakarta and Solo, seven exchanges must be in operation or newly established during REPELITA-IV period. They are

- 1) Semarang I
- 2) Semarang II
- 3) Tugu
(Exchange area includes prospective Mijen Exchange area.)
- 4) Majapahit
- 5) Banyumanik
(Exchange area includes prospective Gunung Pati Exchange area.)
- 6) Genuk
- 7) Mang Kang

Prospective Mijen and Gunung Pati exchange areas are now underdeveloped for the most part.

Considering demand growth prospect, establishment of both these exchanges around 1997 is proposed.

Exchange site selection for Semarang up to the year 2005 is in Figure 4-2-3.

(3) Solo

At present, Solo is single-exchange area. City development is mainly in the western part. City planning indicates that there will be no change in such development trend.

To fulfill demand which is growing mainly in the western part of the city, establishment of one more exchange during REPELITA-IV period is necessary. Therefore, operating exchanges in the near future will be

- 1) Solo I
- 2) Solo II

These two exchanges are considered to be sufficient to satisfy demand in Solo even in final project year. Exchange site selection for Solo up to the year 2005 is in Figure 4-2-4.

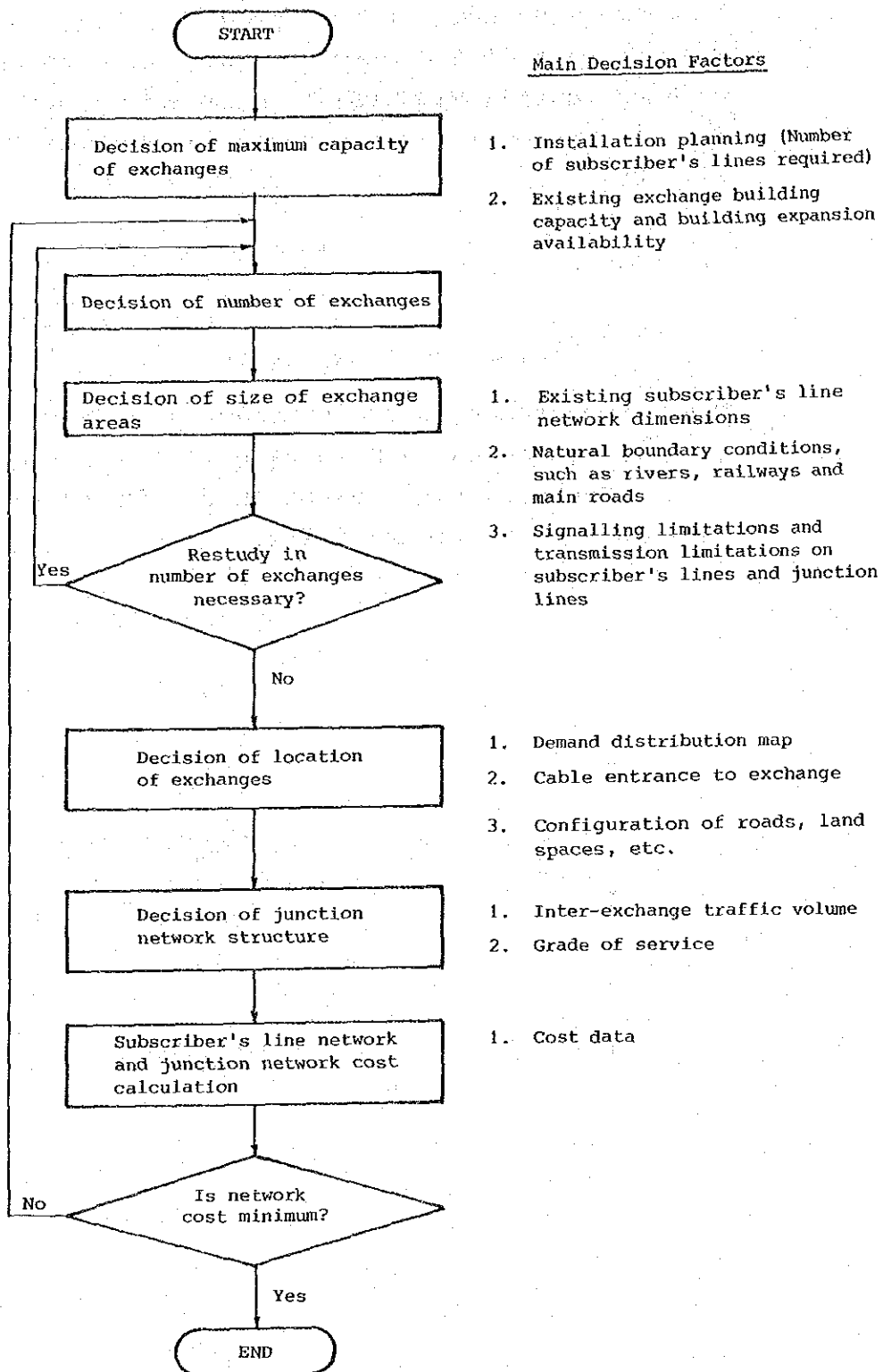


Figure 4-2-1 Exchange Site Selection Procedures

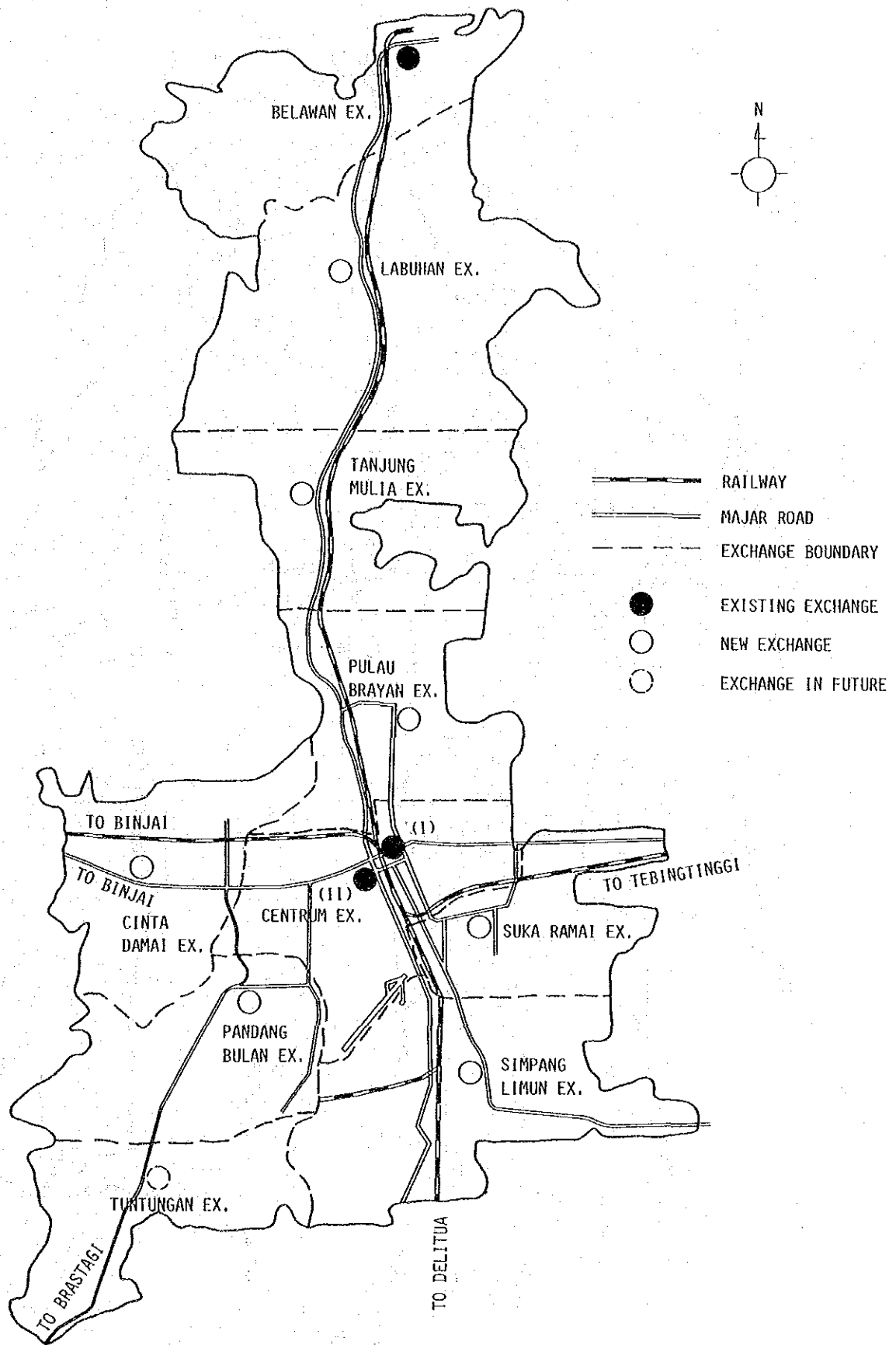


Figure 4-2-2 Exchange Site Selection, Medan

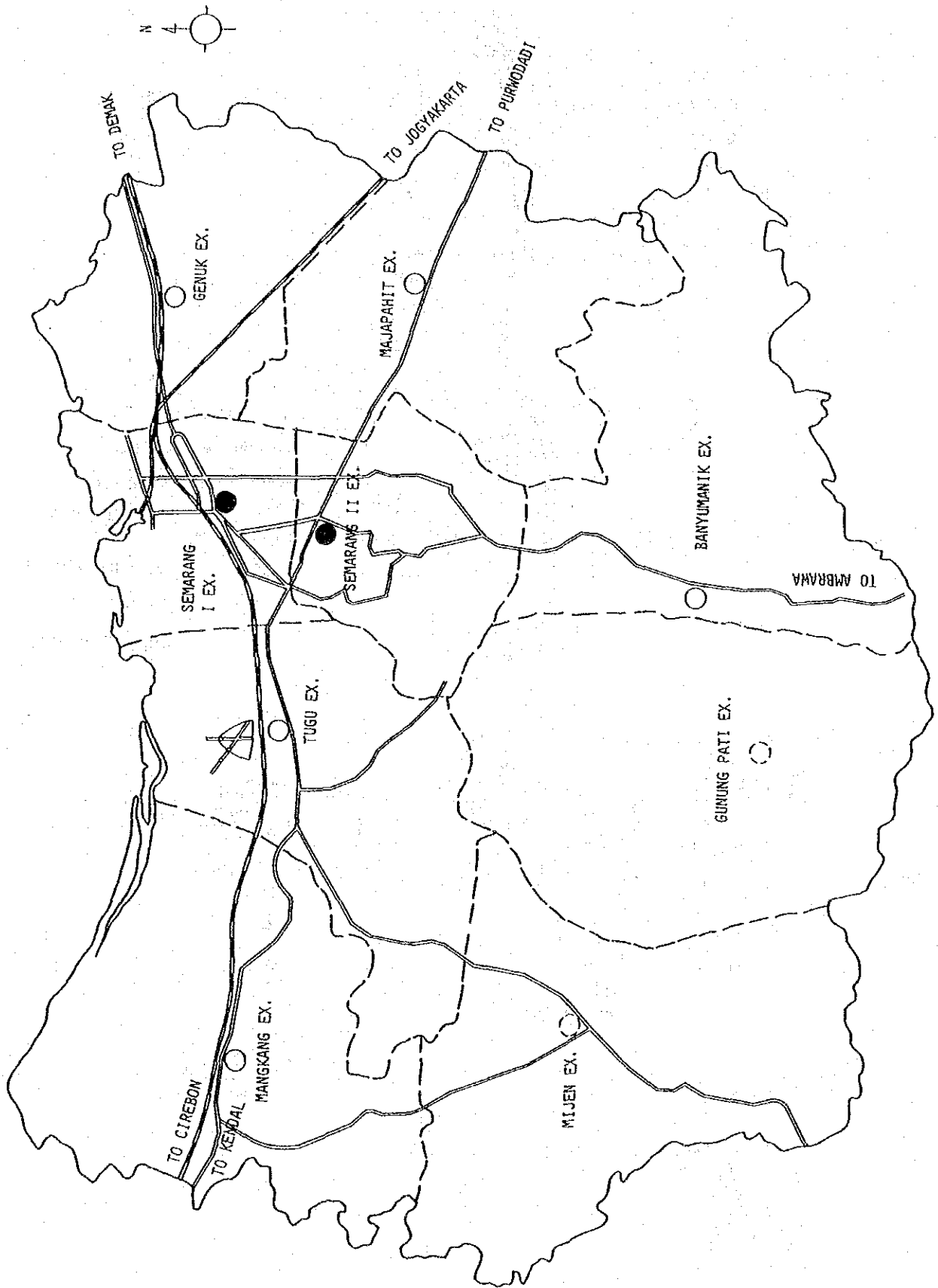


Figure 4-2-3 Exchange Site Selection, Semarang

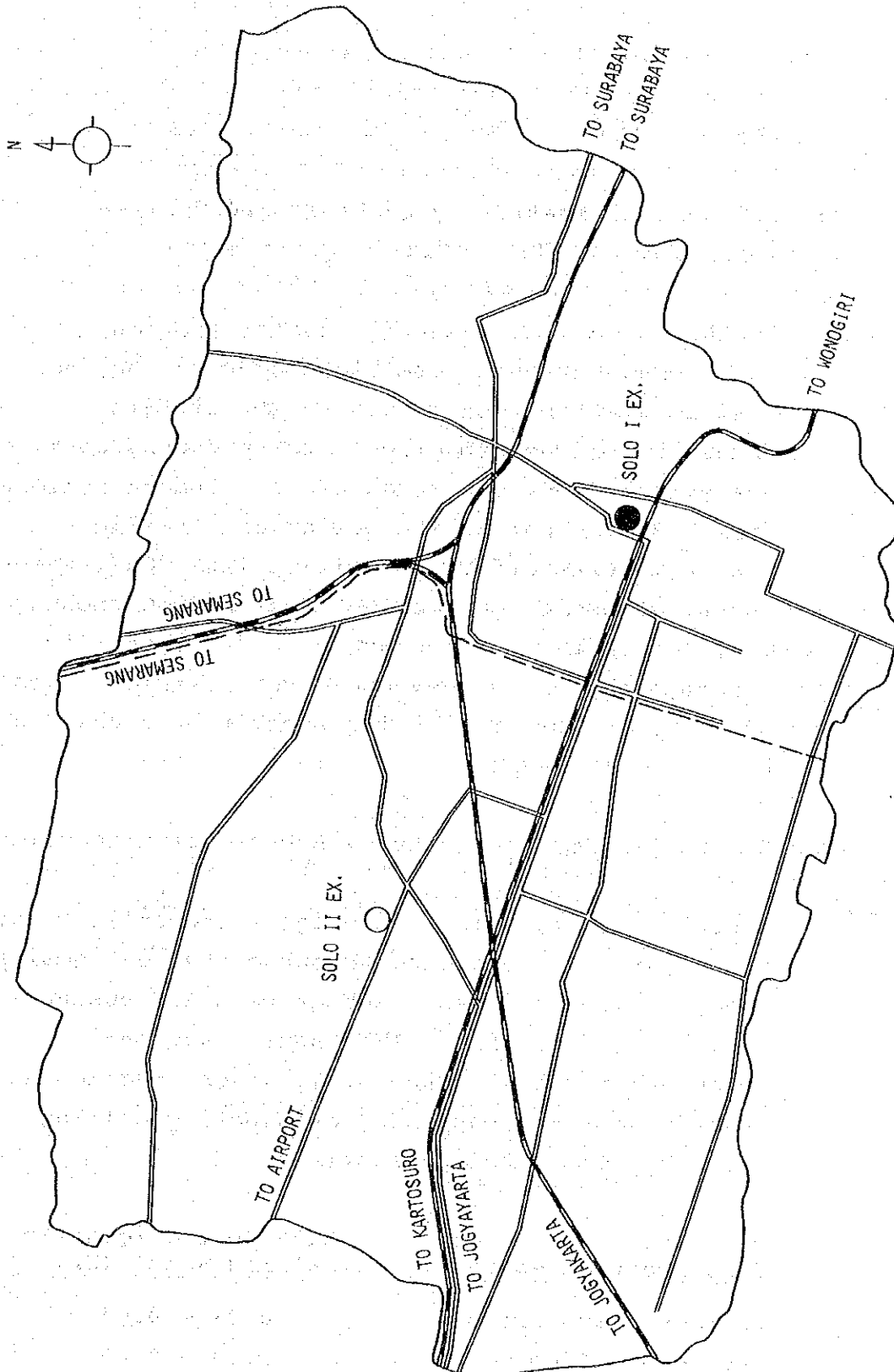


Figure 4-2-4 Exchange Site Selection, Solo

4-3 Traffic Forecast

4-3-1 Basic Data

(1) Originating Traffic by Exchange and Traffic Interflow

In this study, to identify characteristics concerning busy hour traffic concentration and traffic distribution by routes (or traffic interflow) in existing local telephone network, analytical study was made for latest data collected from PERUMTEL out of its periodical traffic measurement records. Especially from "Call Events Distribution MC10-C" collected at MC10-C exchanges, many useful data, including data about traffic interflow by exchanges, could be obtained. Results of analysis for originating traffic by exchanges are in Table 4-3-1.

(2) Originating Calling Rate by Subscriber Categories

A well known fact is that originating calling rate varies greatly according to subscriber categories, i.e., between residence subscribers and business office subscribers. CCITT Manual "National Telephone Network", Chapter 7, gives examples as under concerning busy hour originating calling rates by subscriber categories.

<u>Subscriber Category</u>	<u>Busy Hour Originating Calling Rate (Erl.)</u>
Residence Subscribers	0.01 - 0.04
Business Office Subscribers	0.03 - 0.06
PBX	0.1 - 0.6

In this study, originating calling rates by subscriber categories at the present stage are estimated from residence subscribers versus business office subscribers ratio and busy hour traffic volume at each existing exchange. In this estimate, the above CCITT examples are taken into due consideration. Results obtained are used as basic data for estimation of originating calling rate variations at each exchange according to changes in residence subscribers to business office subscribers ratio as shown in microscopic demand forecast results.

Table 4-3-2 presents originating calling rates by subscriber categories by exchanges obtained by analysis of collected traffic data. After analysis, as shown below, even the calling rate of the same subscriber category varies according to objective cities of study.

<u>Objective City</u>	<u>Residence Subscribers</u>	<u>Business Office Subscribers</u>	(Unit: 10^{-3} Erl.)
			<u>Average</u>
Medan	15.0	50.0	32.8
Semarang	20.0	70.0	46.4
Solo	17.0	58.0	38.2

Note: Business office telephones include PBXs.

(3) Originating Calling Rate by Type of Call

Types of originating traffic are mainly threefold. They are local call, auto-trunk (SLDD) call and special service call. Special service calling rate is considered to make no much change in years to come so that basic data can itself be used for future forecast value. Therefore, when either SLDD originating calling rate or local originating calling rate is forecasted, calculation of originating calling rate by type of call is possible because total originating calling rate is already known. That is,

$$\begin{aligned} \text{Total originating} &= \text{Local originating} + \text{SLDD originating} \\ \text{calling rate} & \quad \text{calling rate} \quad \quad \quad \text{calling rate} \\ & \quad \quad \quad + \text{Special service originating} \\ & \quad \quad \quad \text{calling rate} \end{aligned}$$

1) SLDD Originating Calling Rate

SLDD originating calling rate of each exchange is also considered to depend a great deal upon residence subscribers versus business office subscribers ratio. Therefore, calculation is made separately for residence subscribers and business office subscribers, using the same method as in Paragraph (2). Table 4-3-3 presents SLDD originating calling rates by subscriber categories by exchanges obtained by analysis of collected traffic data. After analysis, as shown below, even the calling rate of the same subscriber category varies according to objective cities of study.

(Unit: 10^{-3} Erl.)

<u>Objective City</u>	<u>Residence Subscribers</u>	<u>Business Office Subscribers</u>	<u>Average</u>
Medan	1.5	6.5	4.0
Semarang	2.5	10.5	6.7
Solo	2.0	9.5	5.9

2) "10X" and "11X" Originating Calling Rates

As the result of traffic data analysis, estimates as under are commonly applicable to Medan, Semarang and Solo.

<u>Type of Call</u>	<u>Mean Calling Rate</u>
	(Unit: 10^{-3} Erl.)
10X	0.9
11X	0.3

3) Local Originating Calling Rate

Local originating calling rate is the remainder after subtraction of toll originating calling rate, "10X" calling rate and "11X" calling rate from gross originating calling rate.

4-3-2 Traffic Forecast Procedures

Traffic forecast results are mainly used as basic data for junction network planning for objective cities of study. Junction circuits are generally installed as individual circuit groups by type of call and by local exchange.

(1) Traffic Forecast by Type of Call

- 1) Local call
- 2) SLDD call
- 3) "10X" call
- 4) "11X" call

As basic data for originating traffic forecast by exchange and by type of call, originating calling rate by exchange and by type of call and number of subscriber circuits by exchange must be given for each forecast year.

(2) Inter-Local Exchange Traffic Forecast

The foregoing 2) - 4) items are established as one junction circuit group for each type of call at each exchange. For item 1), junction circuits to make traffic routing from one local exchange to all other local exchanges possible must be established. That is to say, local call traffic for each forecast year must be further distributed to other local exchanges concerned.

4-3-3 Traffic Forecast by Type of Call

(1) Factors

1) Originating Calling Rate by Exchange and by Traffic Category

a) Total Originating Calling Rate

Total originating calling rate by exchange mainly depends upon residence subscribers versus business office subscribers ratio at each exchange for each forecast year.

b) SLDD Originating Calling Rate

From short term viewpoint, major assumption is that as SLDD service expands regionally, calling rate also grows. Calling rate growth rate is set at 4% for five years from 1988 to 1993 and at 3% for five years from 1993 to 1998, provided that growth will be saturated thereafter. In other words, SDLL network is to be completed by 2005.

c) "10X" and "11X" Originating Calling Rates

With SLDD network expansion, delayed call acceptances, etc., decrease. However, as the number of subscribers increases, calls to directory operators, etc., are bound to increase.

By reason of those mutually conflicting factors, "10X" calling rate in the future is assumed to be at the same level as at present.

For "11X" calls, no change in calling rate is assumed in view of their nature.

d) Local Originating Calling Rate

Local originating calling rate is the remainder after subtraction of SLDD originating calling rate and special service originating calling rate from total originating calling rate.

e) Forecast results for originating calling rates by types of calls are in Table 4-3-4 (1/4) - (4/4).

2) Number of Subscriber Circuits by Exchange

For the number of subscriber circuits by exchange, the number of main telephones for each forecast year, based on subscriber telephone installation plan, is used.

(2) Traffic Forecast by Traffic Category

Local originating traffic, SLDD originating traffic, and "10X" and "11X" originating call volume are respectively expressed by the product of calling rate of each category of call and the number of main stations. Calculation results of originating traffic by category are in Table 4-3-5 (1/4) - (4/4).

4-3-4 Local Traffic Distribution

(1) Distribution Expression

Local traffic is distributed to each exchange. In this study, the expression described in CCITT Manual "General Network Planning", Chapter IX, Annex C, is used for local traffic distribution. The expression is as under.

$$f(i,j) = \frac{C(i,j) \cdot D_i \cdot D_j}{\sum_j C(i,j) \cdot D_j}$$

$$\text{where } C(i,j) = \frac{1}{d^a(i,j)}$$

$f(i,j)$: Originating traffic from Exchange i to Exchange j

D_i : Local originating traffic of Exchange i

D_j : Local originating traffic of Exchange j

d : Crow flight distance between Exchange i and Exchange j

a : Inter-exchange coefficient

(2) Factors

1) Crow Flight Distance

In this study, crow flight distance is not distance between two exchanges but is distance between presumed demand centers of both exchanges.

2) Inter-Exchange Coefficient

Coefficient "a" is for conversion of crow flight distance between two exchanges into social/ economic distance. In many cases, a = 0.03 suffices; however, in some cases, correction is necessary so that the social/ economic distance obtained can reflect the present state of traffic interflow.

(3) Result Local Traffic Distribution Forecast

Local traffic distribution forecast results are in Table 4-3-6 (1/9) - (9/9).

- i) Table 4-3-6 (1/9) - (4/9):
Local traffic distribution, Medan
- ii) Table 4-3-6 (5/9) - (8/9):
Local traffic distribution, Semarang
- iii) Table 4-3-6 (9/9):
Local traffic distribution, Solo

4-3-5 Other Traffic Forecast

Other main types of traffic than the aforementioned traffic by type of call are manual toll call traffic and international call traffic. For these types of traffic, time series forecast is made, based on the past traffic growth data. Forecast results are in Table 4-3-7 and Table 4-3-8.

Table 4-3-1 Analysis of Actual Originating Traffic of Exchange

Ref. No.	Exchange	Local Junction Traffic					10X 11X	SLDD	Total Traffic	No. of Main Lines	Calling Rate Erl.
		EX. I	EX. II	EX. III	EX. IV	Total					
	Medan										
EX. I	Centrum I	52.5	64.0	62.5	36.1	215.1	10.3	254.4	6,754	37.7	
EX. II	Centrum II	62.9	68.8	52.4	25.2	209.3	8.0	249.3	5,531	45.1	
EX. III	Centrum III	62.5	50.9	54.0	24.9	192.3	7.1	228.1	7,295	31.3	
EX. IV	Centrum IV	36.1	25.2	24.9	19.5	105.7	8.3	127.2	6,597	19.3	
	Total	214.0	208.9	193.8	105.7	722.4	33.7	859.0	26,177	32.8	
	Semarang										
EX. I	Semarang I	309.3	105.2			414.5	13.2	498.0	10,236	48.7	
EX. II	Semarang II	103.3	61.5			164.8	6.3	203.0	4,858	41.8	
	Total	412.6	166.7	0.0	0.0	579.3	19.5	701.0	15,094	46.4	
	Solo										
EX. I	Solo I	176.5				176.5	7.3	217.9	5,707	38.2	

Table 4-3-2 Analysis of Actual Originating Calling Rates by Line Category

Exchange	Assumed Calling Rate (1/1000 Erl.)			Estimated Main Lines			Estimated Total Traffic (Erl.)		
	Residence	Business	Average	Residence	Business	Total	Residence	Business	Total
Medan									
Centrum I	15.00	50.00	37.70	2,380	4,374	6,754	35.70	218.70	254.40
Centrum II	15.00	50.00	45.10	779	4,752	5,531	11.70	237.60	249.30
Centrum III	15.00	50.00	31.30	3,904	3,391	7,295	58.50	169.50	228.00
Centrum IV	15.00	50.00	19.30	5,790	807	6,597	86.90	40.40	127.30
Total	15.00	50.00	32.80	12,853	13,324	26,177	192.80	666.20	859.00
Semarang									
Semarang I	20.00	70.00	48.70	4,370	5,866	10,236	87.40	410.60	498.00
Semarang II	20.00	70.00	41.80	2,741	2,117	4,858	54.80	148.20	203.00
Total	20.00	70.00	46.40	7,111	7,983	15,094	142.20	558.80	701.00
Solo									
Solo I	17.00	58.00	38.20	2,758	2,949	5,707	46.90	171.00	217.90

Table 4-3-3 Analysis of Actual SLDD Traffic by Line Category

Exchange	Assumed Calling Rate (1/1000 Erl.)		Estimated Main Lines			Estimated SLDD Traffic (Erl.)			
	Residence	Business	Average	Residence	Business	Total	Residence	Business	Total
Medan									
Centrum I	1.50	6.50	4.70	2,380	4,374	6,754	3.57	28.43	32.00
Centrum II	1.50	6.50	5.80	779	4,752	5,531	1.17	30.89	32.06
Centrum III	1.50	6.50	3.80	3,904	3,390	7,294	5.86	22.04	27.90
Centrum IV	1.50	6.50	2.10	5,790	807	6,597	8.69	5.25	13.94
Total	1.50	6.50	4.00	12,853	13,323	26,176	19.29	86.61	105.90
Semarang									
Semarang I	2.50	10.50	7.10	4,370	5,866	10,236	10.93	61.59	72.52
Semarang II	2.50	10.50	6.00	2,741	2,117	4,858	6.85	22.23	29.08
Total	2.50	10.50	6.70	7,111	7,983	15,094	17.78	83.82	101.60
Solo									
Solo I	2.00	9.50	5.90	2,758	2,949	5,707	5.52	28.02	33.54

Table 4-3-4 (1/4) Originating Calling-Rate by Traffic Category (1988)

(Unit: 0.001 Erlang)

Exchange	Traffic Categories					
	Local	SLDD	10X	11X	Total	Note
1. Medan						
(1) Centrum	32.7	4.9	1.0	0.3	38.9	
(2) Suka Ramai	29.1	4.3	0.9	0.3	34.6	
(3) Pulau Burayan	22.5	3.2	0.7	0.2	26.6	
(4) Padang Bulan	17.1	2.2	0.5	0.2	20.0	
(5) Cinta Damai	27.1	4.0	0.8	0.3	32.2	
(6) Simpang Limun	25.6	3.4	0.8	0.3	30.1	
(7) Tanjung Mulia	27.3	4.0	0.9	0.3	32.5	
(8) Belawan	29.7	4.4	0.9	0.3	35.3	
(9) Tuntungan	0.0	0.0	0.0	0.0	0.0	
(10) Labhan	27.3	4.0	0.9	0.3	32.5	
Average in Medan	29.0	4.3	0.9	0.3	34.5	
2. Semarang						
(1) Semarang I	45.4	8.1	1.1	0.4	55.0	
(2) Semarang II	30.9	5.3	0.8	0.3	37.3	
(3) Tugu	34.1	5.9	0.9	0.3	41.2	
(4) Majapahit	28.3	4.8	0.7	0.2	34.0	
(5) Banyumanik	34.7	6.0	0.8	0.3	41.8	
(6) Genuk	37.3	6.5	0.9	0.3	45.0	
(7) Mijen	0.0	0.0	0.0	0.0	0.0	
(8) Gunung Pati	0.0	0.0	0.0	0.0	0.0	
(9) Mang Kang	39.1	6.8	0.9	0.3	47.1	
Average in Semarang	36.8	6.4	0.9	0.3	44.4	
3. Solo						
(1) Solo I	34.2	6.5	1.0	0.3	42.0	
(2) Solo II	25.9	4.9	0.8	0.3	31.9	
Average in Solo	30.7	5.8	0.9	0.3	37.7	

Table 4-3-4 (2/4) Originating Calling-Rate by Traffic Category (1993)

(Unit: 0.001 Erlang)

Exchange	Traffic Categories					Note
	Local	SLDD	10X	11X	Total	
1. Medan						
(1) Centrum	33.3	5.3	1.1	0.4	40.1	
(2) Suka Ramai	29.1	4.5	0.9	0.3	34.8	
(3) Pulau Burayan	23.1	3.5	0.7	0.2	27.5	
(4) Padang Bulan	16.8	2.3	0.5	0.2	19.8	
(5) Cinta Damai	26.7	4.0	0.8	0.3	31.8	
(6) Simpang Limun	22.7	3.4	0.7	0.2	27.0	
(7) Tanjung Mulia	25.6	4.3	0.8	0.3	31.0	
(8) Belawan	26.1	4.1	0.8	0.3	31.3	
(9) Tuntungan	0.0	0.0	0.0	0.0	0.0	
(10) Labhan	23.4	4.0	0.8	0.3	28.5	
Average in Medan	28.5	4.4	0.9	0.3	34.1	
2. Semarang						
(1) Semarang I	46.4	8.3	1.1	0.4	56.2	
(2) Semarang II	31.7	5.7	0.8	0.3	38.5	
(3) Tugu	34.9	6.0	0.9	0.3	42.1	
(4) Majapahit	29.9	5.4	0.7	0.2	36.2	
(5) Banyumanik	30.8	5.5	0.8	0.3	37.4	
(6) Genuk	38.4	6.9	0.9	0.3	46.5	
(7) Mijen	0.0	0.0	0.0	0.0	0.0	
(8) Gunung Pati	0.0	0.0	0.0	0.0	0.0	
(9) Mang Kang	39.1	6.9	0.9	0.3	47.2	
Average in Semarang	37.0	6.6	0.6	0.3	44.5	
3. Solo						
(1) Solo I	33.3	6.6	1.0	0.3	41.2	
(2) Solo II	27.0	5.4	0.8	0.3	33.5	
Average in Solo	30.2	6.0	0.9	0.3	37.4	

Table 4-3-4 (3/4) Originating Calling-Rate by Traffic Category (1998)

(Unit: 0.001 Erlang)

Exchange	Traffic Categories					Note
	Local	SLDD	10X	11X	Total	
1. Medan						
(1) Centrum	33.8	5.7	1.1	0.4	41.0	
(2) Suka Ramai	29.7	4.9	1.0	0.3	35.9	
(3) Pulau Burayan	24.0	3.8	0.8	0.3	28.9	
(4) Padang Bulan	16.7	2.4	0.5	0.2	19.8	
(5) Cinta Damai	25.4	4.0	0.8	0.3	30.5	
(6) Simpang Limun	22.6	3.5	0.7	0.2	27.0	
(7) Tanjung Mulia	24.2	4.1	0.8	0.3	29.4	
(8) Belawan	23.8	3.8	0.8	0.3	28.7	
(9) Tuntungan	15.6	2.1	0.5	0.2	18.4	
(10) Labhan	20.1	3.5	0.8	0.3	24.7	
Average in Medan	27.5	4.5	0.9	0.3	33.2	
2. Semarang						
(1) Semarang I	47.0	8.6	1.2	0.4	57.2	
(2) Semarang II	32.6	6.0	0.8	0.3	39.7	
(3) Tugu	32.9	5.6	0.9	0.3	39.7	
(4) Majapahit	30.3	5.6	0.8	0.3	37.0	
(5) Banyumanik	28.7	5.3	0.7	0.2	34.9	
(6) Genuk	38.9	7.1	1.0	0.3	47.3	
(7) Mijen	22.3	4.1	0.5	0.2	27.1	
(8) Gunung Pati	28.8	5.3	0.7	0.2	35.0	
(9) Mang Kang	39.7	7.0	0.9	0.3	47.9	
Average in Semarang	36.6	6.6	0.9	0.3	44.4	
3. Solo						
(1) Solo I	33.0	6.7	1.0	0.3	41.0	
(2) Solo II	27.0	5.4	0.8	0.3	33.5	
Average in Solo	29.7	6.0	0.9	0.3	36.9	

Table 4-3-4 (4/4) Originating Calling-Rate by Traffic Category
(2005)

(Unit: 0.001 Erlang)

Exchange	Traffic Categories					Note
	Local	SLDD	10X	11X	Total	
1. Medan						
(1) Centrum	34.3	6.2	1.2	0.4	42.1	
(2) Suka Ramai	30.6	5.4	1.0	0.3	37.3	
(3) Pulau Burayan	25.6	4.4	0.9	0.3	31.2	
(4) Padang Bulan	16.5	2.5	0.6	0.2	19.8	
(5) Cinta Damai	22.7	3.8	0.8	0.3	27.6	
(6) Simpang Limun	22.1	3.7	0.8	0.3	26.9	
(7) Tanjung Mulia	23.3	4.0	0.8	0.3	28.4	
(8) Belawan	21.4	3.6	0.7	0.2	25.9	
(9) Tuntungan	18.0	2.9	0.6	0.2	21.7	
(10) Labhan	21.0	3.6	0.8	0.3	25.7	
Average in Medan	26.2	4.5	0.9	0.3	31.9	
2. Semarang						
(1) Semarang I	48.2	8.9	1.2	0.4	58.7	
(2) Semarang II	33.5	6.2	0.8	0.3	40.8	
(3) Tugu	31.2	5.4	0.9	0.3	37.8	
(4) Majapahit	30.3	5.6	0.8	0.3	37.0	
(5) Banyumanik	25.8	4.8	0.6	0.2	31.4	
(6) Genuk	38.8	7.2	1.0	0.3	47.3	
(7) Mijen	27.6	5.1	0.7	0.2	33.6	
(8) Gunung Pati	33.8	6.2	0.8	0.3	41.1	
(9) Mang Kang	38.6	6.7	0.9	0.3	46.5	
Average in Semarang	36.3	6.6	0.9	0.3	44.1	
3. Solo						
(1) Solo I	31.5	6.5	1.0	0.3	39.3	
(2) Solo II	26.8	5.6	0.8	0.3	33.5	
Average in Solo	29.0	6.0	0.9	0.3	36.2	

Table 4-3-5 (1/4) Originating Traffic Distribution by Category (1988)

Ref. No.	Exchange	No. of Main Lines	Org. CR (mE)	Total Org. (Erl)	SLDD Org. (Erl)	10X Org. (Erl)	11X Org. (Erl)	Local Org. (Erl)
1.	Medan							
EX.1	Centrum I (A)	6,860	38.90	266.86	33.62	6.86	2.07	224.31
EX.2	Centrum II (A)	6,000	38.90	233.40	29.40	6.00	1.80	196.20
EX.3	Centrum III (A)	8,010	38.90	311.58	39.24	8.01	2.40	261.93
EX.4	Centrum IV (A)	8,010	38.90	311.58	39.24	8.01	2.40	261.93
EX.5	Centrum V (D)	8,010	38.90	311.58	39.24	8.01	2.40	261.93
EX.6	Suka Ramai	10,200	34.60	352.92	43.86	9.18	3.06	296.82
EX.7	Pulau Burayan	9,800	26.60	260.68	31.36	6.86	1.96	220.50
EX.8	Padang Bulan	4,000	20.00	80.00	8.80	2.00	0.80	68.40
EX.9	Cinta Damai	6,000	32.20	193.20	24.00	4.80	1.80	162.60
EX.10	Simpang Limun	4,200	31.10	126.42	14.28	3.36	1.26	107.52
EX.11	Tanjung Mulia	1,600	32.50	52.00	6.40	1.44	0.48	43.68
EX.12	Belawan	1,800	35.30	67.07	8.36	1.71	0.57	56.43
EX.13	Tuntungan	0	0.00	0.00	0.00	0.00	0.00	0.00
EX.14	Labhan	700	32.50	22.75	2.80	0.63	0.21	19.11
Total Medan		75,190	34.50	2,590.04	320.60	66.87	21.21	2,181.36
2.	Semarang							
EX.1	Semarang I (A)	9,800	55.00	539.00	79.38	10.78	3.92	444.92
EX.2	Semarang I (D)	6,800	55.00	374.00	55.08	7.48	2.72	308.72
EX.3	Semarang I (A)	0	0.00	0.00	0.00	0.00	0.00	0.00
EX.4	Semarang II (D)	9,000	37.30	335.70	47.70	7.20	2.70	278.10
EX.5	Semarang II	2,800	37.30	104.44	14.84	2.24	0.84	86.52
EX.6	Tugu	7,000	41.20	288.40	41.30	6.30	2.10	238.70
EX.7	Majapahit	5,400	34.00	183.60	25.92	3.78	1.08	152.82
EX.8	Banyumanik	6,800	41.80	284.24	40.80	5.44	2.04	235.96
EX.9	Genuk	2,300	45.00	103.50	14.95	2.07	0.69	85.79
EX.10	Mijen	0	0.00	0.00	0.00	0.00	0.00	0.00
EX.11	Genung Pati	0	0.00	0.00	0.00	0.00	0.00	0.00
EX.12	Mang Kang	2,300	47.10	108.33	15.64	2.07	0.69	89.93
Total Semarang		52,200	36.70	2,321.21	335.61	47.36	16.78	1,921.46
3.	Solo							
EX.1	Solo I (A)	6,200	42.00	260.40	40.30	6.20	1.86	212.04
EX.2	Solo I (D)	5,300	42.00	222.60	34.45	5.30	1.59	181.26
EX.3	Solo II (D)	4,000	31.90	127.60	19.60	3.20	1.20	103.60
Total Solo		15,500	37.70	610.60	94.35	14.70	4.65	496.90

Table 4-3-5 (2/4) Originating Traffic Distribution by Category (1993)

Ref. No.	Exchange	No. of Main Lines	Org. CR (mE)	Total Org. (Erl)	SLDD Org. (Erl)	10X Org. (Erl)	11X Org. (Erl)	Local Org. (Erl)
1.	Medan							
EX.1	Centrum I (A)	0	0.00	0.00	0.00	0.00	0.00	0.00
EX.2	Centrum II (A)	7,000	40.10	280.70	37.10	7.70	2.80	233.10
EX.3	Centrum III (A)	10,000	40.10	401.00	53.00	11.00	4.00	333.00
EX.4	Centrum IV (A)	10,000	40.10	401.00	53.00	11.00	4.00	333.00
EX.5	Centrum V (D)	16,900	40.10	677.69	89.57	18.59	6.76	562.77
EX.6	Suka Ramai	13,400	34.80	466.32	60.30	12.06	4.02	389.94
EX.7	Pulau Burayan	13,700	27.50	376.75	47.95	9.59	2.74	316.47
EX.8	Padang Bulan	6,400	19.80	126.72	14.72	3.20	1.28	107.52
EX.9	Cinta Damai	8,700	31.80	276.66	34.80	6.96	2.61	232.29
EX.10	Simpang Limun	6,200	27.00	167.40	21.08	4.34	1.24	140.74
EX.11	Tanjung Mulia	3,400	31.00	105.40	14.62	2.72	1.02	87.04
EX.12	Belawan	2,400	31.30	75.12	9.84	1.92	0.72	62.64
EX.13	Tuntungan	0	0.00	0.00	0.00	0.00	0.00	0.00
EX.14	Labhan	1,300	28.50	37.05	5.20	1.04	0.39	30.42
Total Medan		99,400	34.10	3,391.81	441.18	90.12	31.58	2,828.93
2.	Semarang							
EX.1	Semarang I (A)	9,800	56.00	550.76	81.34	10.78	3.92	454.72
EX.2	Semarang I (D)	11,100	56.00	623.82	92.13	12.21	4.44	515.04
EX.3	Semarang I (A)	0	0.00	0.00	0.00	0.00	0.00	0.00
EX.4	Semarang II (D)	9,000	38.40	346.50	51.30	7.20	2.70	285.30
EX.5	Semarang II	5,700	38.40	219.45	32.49	4.56	1.71	180.69
EX.6	Tugu	9,500	42.00	399.95	57.00	8.55	2.85	331.55
EX.7	Majapahit	7,800	36.40	282.36	42.12	5.46	1.56	233.22
EX.8	Banyumanik	8,600	36.60	321.64	47.30	6.88	2.58	264.88
EX.9	Genuk	3,600	45.60	167.40	24.84	3.24	1.08	138.24
EX.10	Mijen	0	0.00	0.00	0.00	0.00	0.00	0.00
EX.11	Genung Pati	0	0.00	0.00	0.00	0.00	0.00	0.00
EX.12	Mang Kang	3,500	46.30	165.20	24.15	3.15	1.05	136.85
Total Semarang		68,600	44.50	3,077.08	452.67	62.03	21.89	2,540.49
3.	Solo							
EX.1	Solo I (A)	4,000	41.20	164.80	26.40	4.00	1.20	133.20
EX.2	Solo I (D)	9,600	41.20	395.52	63.36	9.60	2.88	319.68
EX.3	Solo II (D)	12,500	33.50	418.75	67.50	10.00	3.75	337.50
Total Solo		26,100	37.40	979.07	157.26	23.60	7.83	790.38

Table 4-3-5 (3/4) Originating Traffic Distribution by Category (1998)

Ref. No.	Exchange	No. of Main Lines	Org. CR (mE)	Total Org. (Erl)	SLDD Org. (Erl)	10X Org. (Erl)	11X Org. (Erl)	Local Org. (Erl)
1.	Medan							
EX.1	Centrum I (A)	0	0.00	0.00	0.00	0.00	0.00	0.00
EX.2	Centrum II (A)	7,000	41.00	287.00	39.90	7.70	2.80	236.60
EX.3	Centrum III (A)	10,000	41.00	410.00	57.00	11.00	4.00	338.00
EX.4	Centrum IV (A)	10,000	41.00	410.00	57.00	11.00	4.00	338.00
EX.5	Centrum V (D)	28,500	41.00	1,168.50	162.45	31.35	11.40	963.30
EX.6	Suka Ramai	21,800	35.90	782.62	106.82	21.80	6.54	647.46
EX.7	Pulau Burayan	20,700	28.90	598.23	78.66	16.56	6.21	496.80
EX.8	Padang Bulan	12,200	19.80	241.58	29.28	6.12	2.44	203.74
EX.9	Cinta Damai	16,500	30.50	503.25	66.00	13.20	4.95	419.10
EX.10	Simpang Limun	12,900	27.00	348.30	45.15	9.03	2.58	291.54
EX.11	Tanjung Mulia	6,800	29.40	199.92	27.88	5.44	2.04	164.56
EX.12	Belawan	4,100	28.70	117.67	15.58	3.28	1.23	97.58
EX.13	Tuntungan	3,100	18.40	57.04	6.51	1.55	0.62	48.36
EX.14	Labhan	2,900	24.70	71.63	10.15	2.32	0.87	58.29
Total Medan		156,500	33.19	5,195.74	702.38	140.35	49.68	4,303.33
2.	Semarang							
EX.1	Semarang I (A)	0	0.00	0.00	0.00	0.00	0.00	0.00
EX.2	Semarang I (D)	28,900	57.20	1,653.08	248.54	34.68	11.56	1,358.30
EX.3	Semarang I (A)	0	0.00	0.00	0.00	0.00	0.00	0.00
EX.4	Semarang II (D)	9,000	39.70	357.30	54.00	7.20	2.70	293.40
EX.5	Semarang II	11,100	39.70	440.67	66.60	8.88	3.33	361.86
EX.6	Tugu	15,000	39.70	595.50	84.00	13.50	4.50	493.50
EX.7	Majapahit	15,600	37.00	577.20	87.36	12.48	4.68	472.68
EX.8	Banyumanik	11,400	34.90	397.86	60.42	7.98	2.28	327.18
EX.9	Genuk	8,600	47.30	406.78	61.06	8.60	2.58	334.54
EX.10	Mijen	700	27.10	18.97	2.87	0.35	0.14	15.61
EX.11	Genung Pati	1,000	35.00	35.00	5.30	0.70	0.20	28.80
EX.12	Mang Kang	7,000	47.90	335.30	49.00	6.30	2.10	277.90
Total Semarang		108,300	44.40	4,817.66	719.15	100.67	34.07	3,963.77
3.	Solo							
EX.1	Solo I (A)	4,000	41.00	164.00	26.80	4.00	1.20	132.00
EX.2	Solo I (D)	13,800	41.00	565.80	92.46	13.80	4.14	455.40
EX.3	Solo II (D)	20,700	33.50	693.45	11.78	16.56	6.21	558.90
Total Solo		38,500	36.90	1,423.30	131.00	34.40	11.60	1,146.30

Table 4-3-5 (4/4) Originating Traffic Distribution by Category (2005)

Ref. No.	Exchange	No. of Main Lines	Org. CR (mE)	Total Org. (Erl)	SLDD Org. (Erl)	10X Org. (Erl)	11X Org. (Erl)	Local Org. (Erl)
1.	Medan							
EX.1	Centrum I (A)	0	0.00	0.00	0.00	0.00	0.00	0.00
EX.2	Centrum II (A)	7,000	42.00	294.70	43.40	8.40	2.80	240.10
EX.3	Centrum III (A)	10,000	42.10	421.00	62.00	12.00	4.00	343.00
EX.4	Centrum IV (A)	10,000	42.10	421.00	62.00	12.00	4.00	343.00
EX.5	Centrum V (D)	38,400	42.10	1,616.64	238.08	46.08	15.36	1,317.12
EX.6	Suka Ramai	33,400	37.30	1,245.83	180.37	33.40	10.02	1,022.04
EX.7	Pulau Burayan	33,700	31.20	1,051.44	148.28	30.33	10.11	862.72
EX.8	Padang Bulan	20,500	19.80	405.90	51.25	12.30	4.10	338.25
EX.9	Cinta Damai	29,900	27.60	825.24	113.62	23.92	8.97	678.73
EX.10	Simpang Limun	26,600	26.90	715.54	98.42	21.28	7.98	587.86
EX.11	Tanjung Mulia	17,700	28.40	502.68	70.80	14.16	5.31	412.41
EX.12	Belawan	6,100	25.90	157.99	21.96	4.27	1.22	130.54
EX.13	Tuntungan	13,100	21.70	284.27	37.99	7.86	2.62	235.80
EX.14	Labhan	8,500	25.70	218.45	30.60	6.80	2.55	178.50
Total Medan		254,900	31.90	8,160.68	1,158.77	232.80	79.04	6,690.07
2.	Semarang							
EX.1	Semarang I (A)	0	0.00	0.00	0.00	0.00	0.00	0.00
EX.2	Semarang I (D)	36,000	58.70	2,113.20	320.40	43.20	14.40	1,735.20
EX.3	Semarang I (A)	5,200	58.70	305.24	46.28	6.24	2.08	250.64
EX.4	Semarang II (D)	9,000	40.80	367.20	55.80	7.20	2.70	301.50
EX.5	Semarang II	19,800	40.80	807.84	122.76	15.84	5.94	663.30
EX.6	Tugu	22,700	37.80	858.06	122.58	20.43	6.81	708.24
EX.7	Majapahit	25,900	37.00	958.30	145.04	20.72	7.77	784.77
EX.8	Banyumanik	17,100	31.40	536.94	82.08	10.26	3.42	441.18
EX.9	Genuk	15,600	47.30	737.88	112.32	15.60	4.68	605.28
EX.10	Mijen	1,100	33.60	36.96	5.61	0.77	0.22	30.36
EX.11	Genung Pati	1,900	41.10	78.09	11.78	1.52	0.57	64.22
EX.12	Mang Kang	11,500	46.50	534.75	77.05	10.35	3.45	443.90
Total Semarang		165,800	44.10	7,334.46	1,101.70	152.13	52.04	6,028.59
3.	Solo							
EX.1	Solo I (A)	24,000	39.30	943.20	156.00	24.00	7.20	756.00
EX.2	Solo II (D)	28,800	33.50	964.80	161.28	23.04	8.64	771.84
Total Solo		52,800	36.20	1,908.00	317.28	47.04	15.84	1,527.84

Table 4-3-6 (1/9) Local Junction Traffic Distribution in Medan (1988)

From	To	EX.1	EX.2	EX.3	EX.4	EX.5	EX.6	EX.7	EX.8	EX.9	EX.10	EX.11	EX.12	EX.13	EX.14	Total O/G
EX.1 Centrum I	(A)	23.46	20.52	27.39	27.39	27.39	30.20	22.33	6.88	16.33	10.76	4.30	5.48	0.00	1.87	224.30
EX.2 Centrum II	(A)	20.52	17.95	23.96	23.96	23.96	26.42	19.53	6.02	14.29	9.41	3.76	4.79	0.00	1.64	196.21
EX.3 Centrum III	(A)	27.39	23.96	31.99	31.99	31.99	35.26	26.08	8.03	19.07	12.57	5.03	6.40	0.00	2.18	261.94
EX.4 Centrum IV	(A)	27.39	23.96	31.99	31.99	31.99	35.26	26.08	8.03	19.07	12.57	5.03	6.40	0.00	2.18	261.94
EX.5 Centrum V	(D)	27.39	23.96	31.99	31.99	31.99	35.26	26.08	8.03	19.07	12.57	5.03	6.40	0.00	2.18	261.94
EX.6 Suka Ramai	(D)	30.52	26.70	35.64	35.64	35.64	41.75	29.70	9.21	21.74	14.65	5.76	7.35	0.00	2.50	296.80
EX.7 Pulau Brayan	(D)	22.67	19.83	26.47	26.47	26.47	29.86	23.16	6.82	16.30	10.69	4.36	5.53	0.00	1.89	220.52
EX.8 Padang Bulan	(D)	7.02	6.14	8.20	8.20	8.20	9.33	6.87	2.25	5.16	3.39	1.34	1.71	0.00	0.58	68.39
EX.9 Cinta Damai	(D)	16.68	14.59	19.48	19.48	19.48	22.02	16.43	5.16	12.69	7.95	3.20	4.08	0.00	1.39	162.63
EX.10 Simpang Limun	(D)	11.01	9.63	12.86	12.86	12.86	14.87	10.80	3.40	7.97	5.56	2.11	2.69	0.00	0.92	107.54
EX.11 Tanjung Mulia	(D)	4.46	3.90	5.21	5.21	5.21	5.95	4.48	1.37	3.26	2.14	0.93	1.14	0.00	0.39	43.65
EX.12 Belawan	(D)	5.75	5.03	6.72	6.72	6.72	7.71	5.76	1.77	4.22	2.78	1.16	1.58	0.00	0.51	56.43
EX.13 Tuirungan	(D)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EX.14 Labuhan	(D)	1.95	1.71	2.28	2.28	2.28	2.60	1.96	0.60	1.43	0.94	0.40	0.51	0.00	0.18	19.12
Total I/C		226.21	197.88	264.18	264.18	264.18	296.49	219.26	67.57	160.60	105.98	42.41	54.06	0.00	18.41	2,181.41

Table 4-3-6 (2/9) Local Junction Traffic Distribution in Medan (1993)

From	To	EX.1	EX.2	EX.3	EX.4	EX.5	EX.6	EX.7	EX.8	EX.9	EX.10	EX.11	EX.12	EX.13	EX.14	Total O/G
EX.1 Centrum I	(A)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EX.2 Centrum II	(A)	0.00	19.53	27.90	27.90	47.16	31.87	25.70	8.67	18.91	11.30	6.90	4.87	0.00	2.39	233.10
EX.3 Centrum III	(A)	0.00	27.90	38.86	38.86	67.37	45.53	36.72	12.38	27.01	16.14	9.86	6.96	0.00	3.41	331.00
EX.4 Centrum IV	(A)	0.00	27.90	38.86	38.86	67.37	45.53	36.72	12.38	27.01	16.14	9.86	6.96	0.00	3.41	331.00
EX.5 Centrum V	(D)	0.00	47.16	67.37	67.37	113.85	76.95	62.05	20.93	45.65	27.27	16.66	11.76	0.00	5.76	562.78
EX.6 Suka Ramai	(D)	0.00	32.17	45.96	45.96	77.66	55.44	43.10	14.66	31.68	19.39	11.65	8.25	0.00	4.03	389.95
EX.7 Pulau Brayan	(D)	0.00	26.02	37.18	37.18	63.22	43.29	36.68	11.86	25.64	15.44	9.66	6.77	0.00	3.32	316.46
EX.8 Padang Bulan	(D)	0.00	8.83	12.62	12.62	21.33	14.84	11.96	4.27	9.04	5.35	3.25	2.30	0.00	1.12	107.53
EX.9 Cinta Damai	(D)	0.00	19.15	27.36	27.36	46.24	31.82	25.84	8.97	19.76	11.41	7.00	4.94	0.00	2.42	232.27
EX.10 Simpang Limun	(D)	0.00	11.55	16.49	16.49	27.68	19.71	15.62	5.37	11.55	7.34	4.25	3.01	0.00	1.47	140.73
EX.11 Tanjung Mulia	(D)	0.00	7.12	10.18	10.18	17.20	11.99	9.90	3.30	7.17	4.30	2.84	1.90	0.00	0.95	87.03
EX.12 Selawan	(D)	0.00	5.11	7.30	7.30	12.34	8.66	7.08	2.39	5.17	3.12	1.97	1.50	0.00	0.70	62.64
EX.13 Tuntungan	(D)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EX.14 Labuhan	(D)	0.00	2.49	3.55	3.55	6.00	4.20	3.45	1.16	2.51	1.51	0.96	0.69	0.00	0.35	30.42
Total I/C		0.00	234.93	333.63	333.63	567.62	389.83	314.82	106.34	231.30	138.71	84.86	99.91	0.00	29.33	2,824.95

Table 4-3-6 (3/9) Local Junction Traffic Distribution in Medan (1998)

From	To	EX.1	EX.2	EX.3	EX.4	EX.5	EX.6	EX.7	EX.8	EX.9	EX.10	EX.11	EX.12	EX.13	EX.14	Total O/G
EX.1 Centrum I	(A)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EX.2 Centrum II	(A)	0.00	13.27	18.96	18.96	54.04	35.43	27.01	11.00	22.84	15.66	8.74	5.08	2.56	3.06	236.61
EX.3 Centrum III	(A)	0.00	18.96	27.09	27.09	77.19	50.61	38.58	15.71	32.62	22.38	12.48	7.26	3.66	4.37	338.00
EX.4 Centrum IV	(A)	0.00	18.96	27.09	27.09	77.19	50.61	38.58	15.71	32.62	22.38	12.48	7.26	3.66	4.37	338.00
EX.5 Centrum V	(D)	0.00	54.04	77.19	77.19	220.01	144.25	109.96	44.00	92.97	63.78	35.56	20.68	10.44	12.46	962.53
EX.6 Suka Ramai	(D)	0.00	35.66	50.95	50.95	145.20	100.55	73.90	30.33	62.43	43.88	24.06	14.03	7.03	8.44	647.41
EX.7 Pulau Brayan	(D)	0.00	27.31	39.02	39.02	111.21	74.34	59.55	23.25	48.21	33.08	18.89	10.90	5.44	6.59	496.81
EX.8 Padang Bulan	(D)	0.00	11.16	15.94	15.94	45.43	30.67	23.36	10.07	20.30	13.79	7.64	4.46	2.29	2.68	203.73
EX.9 Cinta Damai	(D)	0.00	23.06	32.94	32.94	93.89	62.68	48.12	20.16	42.30	28.05	15.69	9.13	4.64	5.50	419.10
EX.10 Simpang Limun	(D)	0.00	15.94	22.77	22.77	64.90	44.52	33.36	13.84	28.34	20.68	10.92	6.39	3.26	3.84	291.53
EX.11 Tanjung Mulia	(D)	0.00	8.98	12.83	12.83	36.56	24.71	19.29	7.76	16.06	11.05	6.67	3.72	1.83	2.27	164.56
EX.12 Belawan	(D)	0.00	5.31	7.58	7.58	21.61	14.71	11.37	4.62	9.53	6.60	3.80	2.40	1.09	1.37	97.57
EX.13 Tuntungan	(D)	0.00	2.64	3.78	3.78	10.76	7.31	5.57	2.33	4.76	3.31	1.83	1.07	0.58	0.64	48.36
EX.14 Labuhan	(D)	0.00	3.18	4.54	4.54	12.93	8.78	6.81	2.76	5.69	3.93	2.29	1.36	0.65	0.85	58.31
Total I/C		0.00	238.47	340.68	340.68	961.92	649.17	495.46	201.54	418.67	288.57	161.05	93.74	47.13	56.44	4,302.52

Table 4-3-6 (4/9) Local Junction Traffic Distribution in Medan (2005)

From	To	EX.1	EX.2	EX.3	EX.4	EX.5	EX.6	EX.7	EX.8	EX.9	EX.10	EX.11	EX.12	EX.13	EX.14	Total O/G
EX.1 Centrum I	(A)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EX.2 Centrum II	(A)	0.00	8.83	12.62	12.62	48.46	36.68	30.76	11.97	24.26	20.72	14.36	4.46	8.20	6.15	240.09
EX.3 Centrum III	(A)	0.00	12.62	18.03	18.03	69.23	52.40	43.95	17.10	34.65	29.60	20.51	6.37	11.72	8.78	342.99
EX.4 Centrum IV	(A)	0.00	12.62	18.03	18.03	69.23	52.40	43.95	17.10	34.65	29.60	20.51	6.37	11.72	8.78	342.99
EX.5 Centrum V	(D)	0.00	48.46	69.23	69.23	265.85	201.23	168.77	65.68	133.07	113.65	78.77	24.45	44.99	33.72	1,317.10
EX.6 Suka Ramai	(D)	0.00	36.82	52.60	52.60	201.98	161.47	130.55	51.23	102.85	90.01	61.34	19.09	35.18	26.31	1,022.03
EX.7 Pulau Brayan	(D)	0.00	30.99	44.27	44.27	169.98	131.18	115.60	43.14	87.28	74.56	52.93	16.31	23.66	22.55	862.72
EX.8 Padang Bulan	(D)	0.00	12.10	17.28	17.28	66.35	51.71	43.34	17.85	35.12	29.70	20.45	6.37	11.93	8.77	338.25
EX.9 Cinta Damai	(D)	0.00	24.41	34.87	34.87	133.91	103.21	87.16	34.92	71.46	58.99	41.02	12.74	23.61	17.56	678.73
EX.10 Smpang Limun	(D)	0.00	20.97	29.96	29.96	115.04	91.10	75.11	29.79	59.50	54.07	35.47	11.08	20.58	15.24	587.87
EX.11 Tanjung Mulia	(D)	0.00	14.66	20.94	20.94	80.40	62.76	53.90	20.73	41.83	35.86	26.90	8.01	14.33	11.16	412.42
EX.12 Belawan	(D)	0.00	4.63	6.61	6.61	25.38	19.95	16.96	6.59	13.26	11.43	8.18	2.75	4.57	3.60	130.52
EX.13 Tuntungan	(D)	0.00	8.39	11.99	11.99	46.05	36.10	30.29	12.13	24.15	20.86	14.37	4.49	8.82	6.18	235.81
EX.14 Jabuahan	(D)	0.00	6.33	9.05	9.05	34.74	27.23	23.23	9.00	18.11	15.59	11.29	3.57	6.23	5.10	178.52
Total I/C		0.00	241.83	345.48	345.48	1,326.60	1,927.42	863.57	337.23	680.19	584.64	406.10	126.06	231.54	173.90	6,690.04

Table 4-3-6 (5/9) Local Junction Traffic Distribution in Semarang (1988)

FROM	TO	EX.1	EX.2	EX.3	EX.4	EX.5	EX.6	EX.7	EX.8	EX.9	EX.10	EX.11	EX.12	Total O/G
EX.1 Semarang I	(A)	105.60	73.27	0.00	64.57	20.09	54.39	34.60	52.80	19.53	0.00	0.00	20.07	444.92
EX.2 Semarang IA	(D)	79.27	50.84	0.00	44.81	13.94	37.74	24.01	36.64	13.55	0.00	0.00	13.92	308.72
EX.3 Semarang IB	(D)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EX.4 Semarang II	(A)	64.79	44.96	0.00	41.40	12.88	34.22	21.77	33.32	12.17	0.00	0.00	12.59	278.10
EX.5 Semarang II	(D)	20.16	13.99	0.00	12.88	4.01	10.65	6.77	10.37	3.79	0.00	0.00	3.92	86.54
EX.6 Tugu	(D)	55.20	38.30	0.00	34.61	10.77	30.85	18.63	28.82	10.46	0.00	0.00	11.07	238.71
EX.7 Majapahit	(D)	35.35	24.53	0.00	22.17	6.90	18.76	12.73	18.60	6.82	0.00	0.00	6.97	152.83
EX.8 Banyumanik	(D)	54.17	37.59	0.00	34.87	10.60	29.14	18.68	30.47	10.38	0.00	0.00	10.86	236.76
EX.9 Genuk	(D)	19.99	13.87	0.00	12.41	3.86	10.54	6.83	10.35	4.02	0.00	0.00	3.92	85.79
EX.10 Mijen	(D)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EX.11 Gunung Pati	(D)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EX.12 Mang Kang	(D)	20.76	14.41	0.00	12.98	4.04	11.28	7.06	10.96	3.97	0.00	0.00	4.46	89.92
Total I/C		449.29	311.76	0.00	280.70	87.09	237.57	151.08	232.93	84.69	0.00	0.00	87.78	1,922.29

Table 4-3-6 (6/9) Local Junction Traffic Distribution in Semarang (1993)

From	To	EX.1	EX.2	EX.3	EX.4	EX.5	EX.6	EX.7	EX.8	EX.9	EX.10	EX.11	EX.12	Total O/G
EX.1 Semarang I	(A)	83.46	94.53	0.00	51.23	32.45	58.42	40.83	45.84	24.34	0.00	0.00	23.61	454.71
EX.2 Semarang IA	(D)	94.53	107.07	0.00	58.03	36.75	66.17	46.25	51.92	27.57	0.00	0.00	26.75	515.04
EX.3 Semarang IB	(D)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EX.4 Semarang II	(A)	51.41	58.22	0.00	32.97	20.88	36.90	25.79	29.04	15.23	0.00	0.00	14.87	285.31
EX.5 Semarang II	(D)	32.56	36.88	0.00	20.88	13.22	23.37	16.33	18.39	9.64	0.00	0.00	9.42	180.69
EX.6 Tugu	(D)	59.26	67.12	0.00	37.30	23.62	45.01	29.87	33.99	17.70	0.00	0.00	17.69	331.56
EX.7 Majapahit	(D)	41.68	47.21	0.00	26.24	16.62	30.06	22.41	24.09	12.67	0.00	0.00	12.24	233.22
EX.8 Banyumanik	(D)	47.07	53.31	0.00	29.71	18.82	34/40	24.33	29.08	14.21	0.00	0.00	14.05	264.88
EX.9 Genuk	(D)	24.88	28.18	0.00	15.51	9.83	17.84	12.69	14.15	7.89	0.00	0.00	7.27	138.24
EX.10 Mijen	(D)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EX.11 Gunung Pati	(D)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EX.12 Mang Kang	(D)	24.42	27.65	0.00	15.33	9.71	18.03	12.40	14.15	7.36	0.00	0.00	7.82	136.87
Total I/C		459.27	520.47	0.00	287.20	181.90	330.20	230.80	260.65	136.61	0.00	0.00	133.72	2,540.52

Table 4-3-6 (7/9) Local Junction Traffic Distribution in Semarang (1998)

From	To	EX.1	EX.2	EX.3	EX.4	EX.5	EX.6	EX.7	EX.8	EX.9	EX.10	EX.11	EX.12	Total O/G
EX.1 Semarang I	(A)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EX.2 Semarang IA	(D)	0.00	478.43	0.00	101.11	124.70	166.89	158.82	108.66	113.02	5.15	9.51	92.03	1,358.32
EX.3 Semarang IB	(D)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EX.4 Semarang II	(A)	0.00	101.42	0.00	22.39	27.62	36.27	34.52	23.69	24.34	1.12	2.07	19.95	293.39
EX.5 Semarang III	(D)	0.00	125.09	0.00	27.62	34.06	44.74	42.58	29.22	30.02	1.38	2.55	24.60	361.86
EX.6 Tugu	(D)	0.00	189.10	0.00	36.64	45.19	63.99	57.82	40.10	40.91	1.91	3.52	34.31	493.49
EX.7 Majapahit	(D)	0.00	161.59	0.00	35.02	43.19	58.06	58.95	38.62	39.80	1.81	3.37	32.27	472.68
EX.8 Banyumanik	(D)	0.00	111.47	0.00	24.23	29.88	40.60	38.94	28.47	27.27	1.28	2.42	22.62	327.18
EX.9 Genuk	(D)	0.00	115.15	0.00	24.72	30.49	41.14	39.85	27.09	29.57	1.28	2.37	22.88	334.54
EX.10 Mijen	(D)	0.00	5.34	0.00	1.16	1.43	1.96	1.85	1.30	1.30	0.07	0.12	1.11	15.64
EX.11 Gunung Pati	(D)	0.00	9.83	0.00	2.13	2.63	3.59	3.42	2.44	2.41	0.11	0.22	2.01	28.79
EX.12 Mang Kang	(D)	0.00	94.87	0.00	20.50	25.29	34.91	32.70	22.73	23.15	1.10	2.00	20.65	277.90
Total I/C		0.00	1,372.29	0.00	295.52	364.48	492.15	469.45	322.32	331.79	15.21	28.15	272.42	3,863.79

Table 4-3-6 (8/9) Local Junction Traffic Distribution in Semarang (2005)

From	To	EX.1	EX.2	EX.3	EX.4	EX.5	EX.6	EX.7	EX.8	EX.9	EX.10	EX.11	EX.12	Total O/G
EX.1 Semarang I	(A)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EX.2 Semarang IA	(D)	0.00	513.73	74.21	87.33	192.13	201.32	221.64	123.16	171.89	8.42	17.82	123.56	1,735.21
EX.3 Semarang IB	(D)	0.00	74.21	10.72	12.61	27.75	29.06	32.01	17.79	24.83	1.22	2.57	17.85	250.64
EX.4 Semarang II	(A)	0.00	87.60	12.65	15.56	34.23	35.20	38.75	21.60	29.77	1.47	3.12	21.54	301.49
EX.5 Semarang II	(D)	0.00	192.72	27.84	34.23	75.30	77.44	85.26	47.52	65.50	3.24	6.87	47.40	663.32
EX.6 Tugu	(D)	0.00	203.99	29.46	35.55	78.22	86.72	90.65	51.06	69.90	3.52	7.41	51.75	708.23
EX.7 Majapahit	(D)	0.00	225.23	32.53	39.26	86.38	90.91	106.78	56.82	78.57	3.85	8.20	56.24	784.77
EX.8 Banyumanik	(D)	0.00	126.32	18.25	22.09	48.59	51.69	57.35	34.06	43.77	2.21	4.79	32.06	441.18
EX.9 Genuk	(D)	0.00	174.86	25.26	30.19	66.43	70.18	78.65	43.42	63.59	2.96	6.28	43.45	605.27
EX.10 Mijen	(D)	0.00	8.72	1.26	1.52	3.34	3.59	3.92	2.24	3.02	0.16	0.33	2.26	30.36
EX.11 Gunung Pati	(D)	0.00	18.42	2.66	3.21	7.07	7.56	8.33	4.82	6.38	0.33	0.73	4.71	64.22
EX.12 Mang Kang	(D)	0.00	127.29	18.39	22.13	48.68	52.62	57.01	32.20	44.00	2.25	4.69	34.64	443.90
Total I/C		0.00	1,753.09	253.23	303.68	668.12	706.31	780.35	434.69	601.22	29.63	62.81	435.46	6,028.59

Table 4-3-6 (9/9) Local Junction Traffic Distribution in Solo
(1988)

From	To		EX.1	EX.2	EX.3	Total O/G
EX.1	Solo I	(A)	91.35	78.09	42.61	212.05
EX.2	Solo I	(D)	78.09	66.75	36.42	181.26
EX.3	Solo II	(D)	43.78	37.42	22.40	103.60
Total I/C			213.22	182.26	101.43	496.91

(1993)

From	To		EX.1	EX.2	EX.3	Total O/G
EX.1	Solo I	(A)	22.89	54.94	55.37	133.20
EX.2	Solo I	(D)	54.94	131.85	132.89	319.68
EX.3	Solo II	(D)	55.75	133.79	147.96	337.50
Total I/C			133.58	320.58	336.22	790.38

(1998)

From	To		EX.1	EX.2	EX.3	Total O/G
EX.1	Solo I	(A)	15.54	53.63	62.83	132.00
EX.2	Solo I	(D)	53.63	185.01	216.76	455.40
EX.3	Solo II	(D)	62.90	217.01	278.99	558.90
Total I/C			132.07	455.65	558.58	1,146.30

(2005)

From	To		EX.1	EX.2	EX.3	Total O/G
EX.1	Solo I	(A)	0.00	0.00	0.00	0.00
EX.2	Solo I	(D)	0.00	382.86	373.15	756.01
EX.3	Solo II	(D)	0.00	372.97	398.88	771.85
Total I/C			0.00	755.83	772.03	1,527.86

Table 4-3-7 (1/2) Historical Growth of Inter-Local Manual Telephone Traffic

(Unit: 1000 Conversation Minutes)

Item	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	Growth Rate
Whole Indonesia	51,431	48,950	58,719	72,083	75,753	70,316	63,160	64,174	67,621	53,552	(-)5.1%
(1) Medan		293	373	402	342	396	257	287	248		(-)10.1%
(2) Semarang								1,080	1,154		
(3) Solo								1,159	1,256		

Table 4-3-7 (2/2) Inter-Local Manual Telephone Traffic Forecast

(Unit: 1000 Conversation Minutes)

Item	1983	1988	1993	1998	2005	Growth Rate
Whole Indonesia	53,552	41,959	32,876	25,759	18,306	(-)5.0%
(1) Medan	214*	168	132	103	73	
(2) Semarang	1,099*	713	559	438	311	
(3) Solo	1,198*	779	611	478	340	

* Estimated

Table 4-3-8 (1/2) Historical Growth of International Telephone Traffic

(Unit: 1000 Conversation Minutes)

Item	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	Growth Rate
Whole Indonesia	2,299	3,195	4,431	5,427	6,617	7,446	8,864	13,025	16,907	18,793	26.3%
(1) Medan	44	67	171	265	327	320	331	409	475	454	29.6%
(2) Semarang								120	157		
(3) Solo								19	27		

Table 4-3-8 (2/2) International Telephone Traffic Forecast

(Unit: 1000 Conversation Minutes)

Item	1983	1988	1993	1998	2005
Whole Indonesia	18,793	46,763	94,057	151,480	295,190
(Growth Rate %)		20	15	10	10
(1) Medan	454	1,402	2,822	4,544	8,856
(2) Semarang	188*	468	941	1,515	2,952
(3) Solo	28*	70	141	227	443

* Estimated

4-4 Fundamental Telephone Network Plan

4-4-1 Numbering Plan

(1) National Number Composition

In Indonesia, numbering plan consists of universal numbering system. Thus, for national numbers, unique numbers are given to individual subscribers. For call to the same called party, any subscriber can dial the same number to have the call connected. National number is composed of

Trunk prefix "0" + Trunk Code + Local Number

National number (Trunk Code + Local Number) is of nine digits at a maximum. National numbers allocated to objective cities of study during period of this plan are as under.

<u>City</u>	<u>Trunk Code</u>	<u>Local Number</u>
Medan	61	ΔΔ (Δ) XXXX
Semarang	24	ΔΔ (Δ) XXXX
Solo	271	Δ (Δ) XXXX

* Note: Δ: Local exchange number

X: Subscriber number

(Δ): Scheduled to be added in the figure

(2) Numbering Plan Period

Numbering plan must be so arranged that numbering capacity will be large enough to cover expected demand 50 years ahead. In this study, numbering plan for objective cities is considered, assuming twice the telephone demand as of 2005 as final demand 50 years from now.

(3) Local Number Allocation

Local numbering capacity for objective cities of study is as under.

<u>City</u>	<u>Telephone Demand as of 2005</u>	<u>Required Numbering Capacity</u>
Medan	255,000	528,000
Semarang	166,000	340,000
Solo	53,000	106,000

Theoretical numbering capacity by number of digits is as under, due to restriction on the use of first digit.

<u>Number</u>	<u>Numbering Capacity</u>
4-digit number	Up to 7,000 subscribers
5-digit number	Up to 70,000 subscribers
6-digit number	Up to 700,000 subscribers

Use of first digit is restricted as under.

<u>1st Digit</u>	<u>Purpose of Use</u>
0	For trunk prefix
1	For special number
9	For suburban trunk prefix

Thus, for first digit of local number, selection is made out of digits 2 to 8. For this reason, final numbering capacity for each exchange in Medan, Semarang and Solo will require at least 6-digit numbers.

To existing EMD exchanges in Semarang, 5-digit numbers are allocated at present. However, exchanges to be newly established will have 6-digit local numbers allocated. In this case, for Semarang I Exchange, combined 5- and 6-digit numbering plan is proposed to be used temporarily before 1998 when existing EMD switching facilities are to be withdrawn.

Proposed 5- and 6-digit mixed numbering plan is arranged as under.

	<u>Before EMD Withdrawal (- 1988)</u>	<u>After EMD Withdrawal (1988 -)</u>
Existing EMD subscriber	20XXX - 29XXX (excluding 28XXX)	<u>220XXX - 229XXX</u>
New EWSD subscribers	28XXXX	28XXXX
New EWSD subscribers	6XXXX	<u>26XXXX</u>
New EWSD subscribers	7XXXX (reserved)	<u>27XXXX</u>

Numbering plan proposed above is to reserve 40,000 line units including 10,000 spare numbers to meet demand variations against Semarang I Exchange installation plan comprising 29,800 line units as of 1998, i.e., before withdrawal of EMD switches. After withdrawal of EMD switches, Semarang I Exchange will be afforded with 6-digit local numbers that begin with "2". Other exchanges will have 6-digit numbers allocated from the first.

For Solo, 5-digit local number allocation suffices during REPELITA-IV period; however, ultimately, 6-digit numbers only will be used.

Numbering plan based on the foregoing concept is in Table 4-4-1.

(4) Special Service Numbers ("10X" and "11X")

Centralized special service numbers and local special service numbers are as under.

1) Centralized Special Service Numbers ("10X")

- 100: Delayed toll call reception
- 101: Delayed international call reception
- 102: Delayed international call information
- 103: Time announcement
- 104: No-delay international call reception
- 105: No-delay toll call reception
- 106: Toll call information and assistance
- 107: Reserved (for call complaints)

108: Local number directory

109: Telegram consignment

2) Local Special Service Numbers ("11X")

110: Emergency call - Police

111: Spare

112: Reserved (for weather forecast)

113: Emergency call - Fire

114: Revertive call (re-ringing)

115: Spare

116: Spare

117: Fault reception

118: Emergency call - Ambulance

119: Reserved (for duty physician and pharmacy
on holiday)

Table 4-4-1 (1/2) Local Numbering Plan - Medan

Exchange	1984	Until 2005		After 2005	
		Line Unit (N)	Numbering	Line Unit (Nx2)	Numbering
Centrum I	2XXXX	(To be removed)		-	-
Centrum II	32XXXX	7	32XXXX	(To be removed)	
Centrum III	51XXXX	10	51XXXX	10	51XXXX
Centrum IV	52XXXX	10	52XXXX	10	52XXXX
Centrum V	-	40	33XXXX 36XXXX	120	30XXXX 39XXXX 50XXXX 53XXXX
Suka Ramai	-	34	41XXXX 44XXXX	68	41XXXX 47XXXX
Pulau Brayan	-	34	20XXXX 23XXXX	68	20XXXX 26XXXX
Padang Bulan	-	21	61XXXX 63XXXX	42	61XXXX 65XXXX
Cinta Damai	-	30	71XXXX 73XXXX	60	71XXXX 76XXXX
Simpang Limun	-	27	54XXXX 56XXXX	54	54XXXX 59XXXX
Tanjung Mulia	-	18	81XXXX 83XXXX	36	81XXXX 83XXXX 85XXXX
Belawan	(Suburban)	7	88XXXX	14	88XXXX 89XXXX
Tuntungan	-	14	66XXXX 67XXXX	28	66XXXX 68XXXX
Labuhan	-	9	86XXXX	18	86XXXX 87XXXX

Table 4-4-1 (2/2) Local Numbering Plan - Semarang and Solo

Exchange	1984	Until 2005		After 2005	
		Line Unit (N)	Numbering	Line Unit (Nx2)	Numbering
Semarang I	20XXX 29XXX	42	22XXXX 25XXXX 28XXXX	84	21XXXX 29XXXX
Semarang II	311XXX 314XXX	29	31XXXX 33XXXX	58	31XXXX 36XXXX
Tugu	-	23	81XXXX 83XXXX	46	81XXXX 85XXXX
Majapahit	-	26	45XXXX 47XXXX	52	45XXXX 49XXXX
Banyumanik	-	18	51XXXX 52XXXX	36	51XXXX 54XXXX
Genuk	-	16	40XXXX 41XXXX	32	40XXXX 43XXXX
Mijen	-	2	80XXXX	4	80XXXX
Gunung Pati	-	2	50XXXX	4	50XXXX
Mang Kang	-	12	70XXXX 71XXXX	24	70XXXX 72XXXX
Solo I	2XXX 7XXX	24	2XXXX 4XXXX	48	22XXXX 26XXXX
Solo II	-	29	6XXXX 8XXXX	58	33XXXX 38XXXX

4-4-2 Traffic Routing Plan

(1) PERUMTEL's Installation Guidelines

This study is in accordance with PERUMTEL's installation guidelines which are as under.

- 1) To introduce digital system for exchanges to be newly established and for new transmission routes connecting newly established exchange.
- 2) To utilize relatively new analog facilities to the limits of their useful life, without expansion.
- 3) To replace analog facilities near the limits of useful life with digital facilities in due course.

According to those guidelines, changes in the number of junction circuits in networks where analog and digital systems coexist will be as shown in Figure 4-4-2 conceptual diagram. A summary follows:

- 1) Analog-analog inter-exchange junctions will decrease.
- 2) Analog-digital and digital-analog inter-exchange junctions will increase gradually.
- 3) Digital-digital inter-exchange junctions will increase rapidly.

(2) Overlay Junction Network (Refer to Figure 4-4-2)

To achieve transfer from transitional network where analog and digital systems coexist to ultimate fully digitalized junction network according to schedule and at reasonable cost, an effective means is to do successfully with undermentioned strategy, using the aforementioned conceptual diagram as a guideline.

- 1) To restrain additional investment in existing analog junction network to necessary minimum.
- 2) To keep minimum requirements at all times for analog-digital (A/D) converters, which are costly and will ultimately become unnecessary.
- 3) To promote smooth transfer to integrated digital network (IDN) as final objective.

In the network where analog and digital systems coexist, an effective means to realize the above strategy is to keep existing analog system and newly established digital system independent and to connect both by gateway exchange. This network architecture is commonly known as overlay system. By this means, A/D conversion points can be reduced to minimum so that new digital system, maintaining minimum relationship to analog system, continues to grow whereas analog system is gradually digitalized and finally incorporated into IDN. This is the overlay system philosophy.

(3) Traffic Routing Plan in Overlay Network

1) Local Traffic Junction in Local Junction Network

- a) Traffic routing from analog to analog exchanges is via existing route in the future also.
- b) Traffic routing from analog to digital exchanges and from digital to analog exchanges is via gateway exchange. A/D converters are to be installed on existing analog exchange side by reason of cost and from the viewpoint of promoting network digitalization.

Meanwhile, direct route between analog and digital be established as far as economically feasible.

- c) Traffic routing from digital to digital exchanges is always within newly established digital network.

The foregoing arrangement summary is in Figure 4-4-3.

2) SLDD Traffic Junction in Local Junction Network

Concept of SLDD traffic junction in local junction network is in Figure 4-4-4.

a) Local Exchange - SLDD Exchange

- i) SLDD traffic from analog local exchanges is routed solely via outgoing and incoming circuit group from existing analog tandem exchanges.
- ii) SLDD traffic from digital local exchanges is routed solely via outgoing and incoming circuit group from newly established digital tandem exchanges.
- iii) By establishing junction circuits between analog and digital SLDD tandem exchanges, traffic routing between analog and digital systems is to be made possible.

b) SLDD Tandem Exchange - SLDD Tandem Exchange in Other Area

- i) Interface routes wherein SLDD originating traffic from analog and digital tandem exchanges "Ta" and "Td" in objective cities are respectively routed to other tandem exchanges are as under. (Refer to Figure 4-4-4.)

- From digital tandem exchange "Td" to the other digital tandem exchange via "Df".

- From digital tandem exchange "Td" to the other analog tandem exchange via "Ad". In the case of overflow, from analog tandem exchange "Ta" in the same local network to the other analog tandem exchange via "Af".
- From analog tandem exchange "Ta" to the other analog tandem exchange via "Af".
- From analog tandem exchange "Ta" to the other digital tandem exchange via "Dd". In the case of overflow, from digital tandem exchange "Td" to the other digital tandem exchange via "Df".

ii) Terminating traffic from the other tandem exchange is sorted out at the other tandem exchange by the dialed number either to be connected to analog tandem exchange "Ta" or to be connected to digital toll exchange "Td".

3) Suburban Traffic and Special Number Traffic Routing

a) Suburban Traffic

i) Medan Suburbs

At present, Belawan and Binjai Exchanges belong to Medan suburban network. However, in the future, at

least Belawan Exchange is scheduled to be digitalized and incorporated in Medan local network. Binjai Exchange is considered to remain as analog exchange and to be operated as such for some time to come.

In this study, assumption used for suburban traffic routing plan is that Binjai Exchange analog system will continue until 2005 whereas Belawan Exchange will be digitalized during REPELITA-IV period and incorporated in Medan local network. Meanwhile, suburban SLDD traffic of Medan is routed via Medan SLDD tandem exchange.

ii) Assumption used for Semarang and Solo is that suburban exchanges will not be established during the period of this period.

b) Special Number Traffic "10X"

Special number operator's desks to handle traffic from existing analog exchanges and desks to handle traffic from newly established digital exchanges will be separately provided. Handling of traffic from analog exchanges is on existing route and handling of traffic from digital exchanges is via newly established SLDD tandem exchange.