REPUBLIC OF INDONESIA

REPORT ON JAKARTA CITY TELEPHONE NETWORK PLANNING

VOLUME III

March 1976

JAPAN INTERNATIONAL COOPERATION AGENCY

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Telephone traffic forecast is important for deciding accurately the future management policy of the telephone service organization. Investment in telephone facilities is so great that the number of facilities to construct must be determined exactly and for this purpose the traffic forecast must be carried out at high precision. Although time series data is essential for traffic forecast of high precision, we could not obtain the time series data of Jakarta this time. Therefore, to obtain basic data, we had to measure the present traffic volume in Jakarta and, based on the result of measurement, we carried out the traffic forecast.

3.1 Result of Traffic Measurement

The originating traffic of local exchange offices in Jakarta was measured by the operating-switch count method.

3.1.1 Theoretical Formula of Measurement

$$a = \frac{r_1 + \cdots\cdots\cdots r_n}{n} = \frac{1}{n}\sum_{i=1}^{n} r_i$$

where

a : Total originating traffic of the exchange office concerned (Erlang)

r_i : Number of operating switches in the unit measuring time

n : Number of measurement

Assuming that the total number of subscribers at the exchange office concerned is represented by s, the average originating calling rate per subscriber (CR) is obtained as follows:

$$CR = \frac{a}{s} \text{ Erlang}$$

The calling rate which is used in Chapter 3 and Chapter 4 means average originating calling rate of a subscriber.

3.1.2 Method of Measurement

(1) Prior to the traffic measurement the storage battery discharge in the power room of each exchange office during the past several months was investigated. This was to check traffic fluctuations by months, by days of the week and by hours. The findings were as follows:

Fluctuations by months: No major fluctuations were observed at all exchange offices.

Fluctuations by days of the week: From Monday to Thursday the traffic remained almost constant at all exchange offices and no major fluctuations

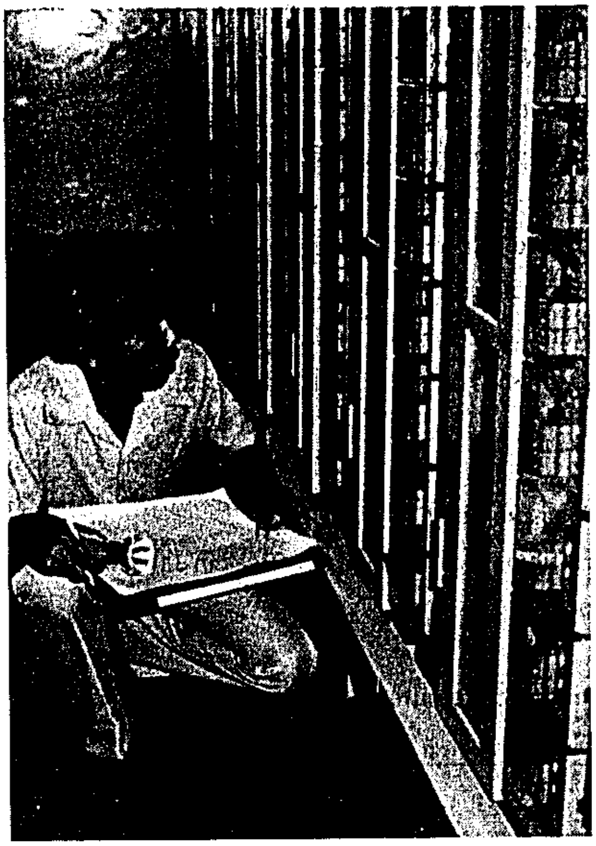


Fig. 3.1.1.(1) Operation Sw. Count (Kebayoran Office)

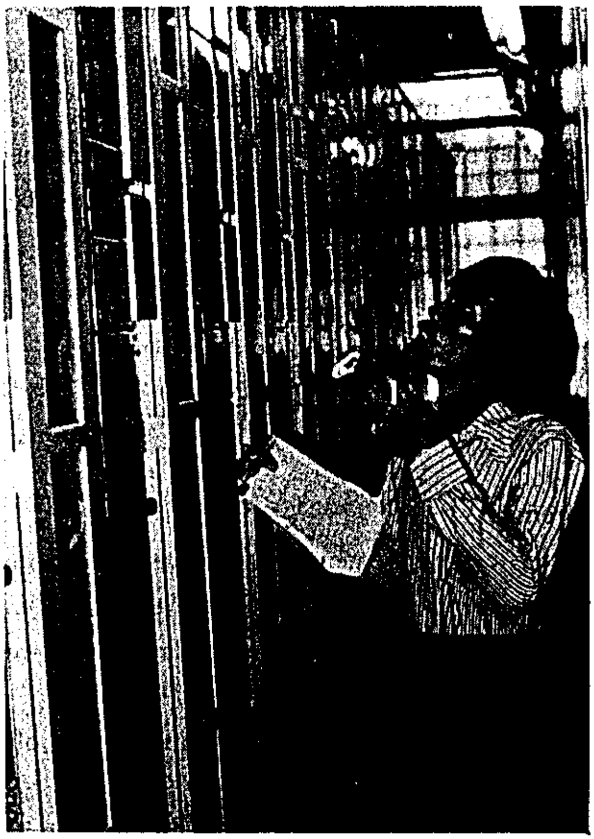


Fig. 3.1.1.(2) Operation Sw. Count (Kebayoran Office)

were observed. On Friday, Saturday and Sunday the traffic was smaller than on other weekdays.

Fluctuations by hours: The busy hour was around 10.00 a.m. at all exchange offices. This busy hour coincided with one testified by the responsible person at each exchange office.

The traffic measurement was carried out for one busy hour chosen for each exchange office, except for Sundays, Fridays and Saturdays, as well as holidays.

(2) Since the total originating traffic was to be measured by 1st GS or AS the total number of circuits was first checked with the working trunking diagram. At the same time the locations, the lighting condition and the obstacles, if any, which might affect the measurement were investigated.

(3) For the purpose of high accuracy of measurement and the uniform quality of measurement the method of measurement was standardized. For the persons in charge of the measurement (five locally employed technical high school graduates) four-hour classroom training and two-hour field practice training were administered. Furthermore, instructions were issued to them so that they would be cleanly dressed when entering the machine room and would never touch equipments without necessity.

(4) The measurement was carried out for one busy hour on ordinary days (excluding Sundays, Fridays, Saturdays and holidays as mentioned in (1) above). The measurement was made 10 times at intervals of six minutes. At the end of each measurement a whistle signal was issued. The persons on duty counted the operating-switches at the designated places and recorded the counts in the designated report format each time.

(5) The average originating calling rate per subscriber at each local exchange office in Jakarta measured by the operating-switch count method is shown in Table 3.1.2.(1).

Table 3.1.2.(1) Measurement Result of Calling Rate

Office	Date		Hour (am)	Calling rate
Kota	30 Jan '74	Wed	9.50~10.50	0.070 Erl
Tg. Priok	10 " "	Thu	10.50~11.50	0.061 "
Gambir	28,29 Jan '74	Mon, Tue	9.50~10.50	0.068 "
Semanggi	8 Jan '74	Tue	9.40~10.40	0.066 "
Slipi	21 " "	Mon	9.00~10.00	0.043 "
Kebayoran	9 " "	Wed	10.30~11.30	0.038 "
Jatinegara	31 " "	Thu	9.30~10.30	0.048 "

3.1.3 Concentration Rate to Busy Hour

3.1.3.1 Method of Forecast

The traffic concentration rate to busy hour in Jakarta was estimated by the following conditions:

(1) Total traffic in each time zone and the current discharge in the power room in the time zone are mutually in proportion.

(2) The midnight minimum discharge is equal to the basic current only to keep switching equipment in operation when traffic is zero.

Therefore, the traffic concentration rate to busy hour at each exchange office was calculated by the following formula:

$$\frac{\text{Maximum discharge ampere-hour} - \text{Minimum discharge ampere-hour}}{\text{Total discharge ampere-hour} - \text{Minimum discharge ampere-hour}} \times 100 = \text{Concentration rate to busy hour (\%)}$$

3.1.3.2 Result of Calculation

The discharge ampere hour measured every hour at each exchange office is shown in Table 3.1.3.2.(1) and the concentration rate to busy hour calculated for each exchange office in Table 3.1.3.2.(2).

The mean value of the concentration rate to busy hour obtained from the concentration rate to busy hour for each exchange office by the weighted average of subscriber number is:

$$16{,}800 + 6{,}690 + 3{,}870 + 1{,}190 = 28{,}550$$

$$\frac{11.39 \times 16{,}800 + 8.9 \times 6{,}690 + 10.42 \times 3{,}870 + 10.56 \times 1{,}190}{28{,}550}$$

$$= 10.64\% \doteqdot 11\%$$

Hence the concentration rate to busy hour in Jakarta is set at 11%.

3.1.4 Fluctuations by Days of the Week

To investigate traffic fluctuations by days of the week the current discharge by days of the week was calculated. Traffic fluctuations by days of the week thus obtained for Gambir Exchange Office (the government office and business office area) and for Kebayoran Exchange Office (the residential and shopping area) are shown in Fig. 3.1.4.(1) and Fig. 3.1.4.(2). In these figures no special traffic variations by days of the week are observed except on Saturday and Sunday. On Sunday the busy hour comes twice, i.e., at midday and in the evening but, on the whole, traffic is light. On Saturday the traffic volume is

TABLE 3-1-3-2-(1)
HOURLY DISCHARGING AMPER HOUR (A.H.)

HOUR \ OFFICE	GAMBIR	KEBAYORAN	JATINEGARA	SLIPI
07	176.48	123.82	39.78	7.62
08	370.21	150.90	82.11	21.62
09	735.53	187.18	122.62	△ 31.52
10	△ 802.72	193.18	△ 127.17	31.28
11	793.30	△ 196.02	122.05	28.91
12	709.67	192.72	114.44	26.31
13	661.36	188.15	106.83	23.87
14	619.40	167.16	97.15	21.84
15	538.34	150.84	82.29	19.24
16	456.49	137.21	68.59	16.85
17	374.77	126.22	62.28	14.44
18	336.41	115.50	61.75	13.65
19	313.61	120.44	65.09	13.42
20	276.95	115.06	63.04	12.63
21	229.33	102.07	51.28	11.16
22	170.41	87.24	37.55	8.96
23	128.37	76.39	28.71	6.69
24	104.27	65.20	23.70	4.43
01	93.55	59.13	20.88	2.72
02	88.29	53.08	18.80	2.21
03	85.74	49.49	o 18.00	o 2.09
04	o 85.47	o 48.48	18.82	2.11
05	89.69	51.64	21.45	2.21
06	105.84	61.39	25.53	3.20
TOTAL	8,346.20	2,818.51	1,479.91	328.98

o MINIMUM DISCHARGE A.H.

△ MAXIMUM DISCHARGE A.H.

TABLE 3-1-3-2-(2) CONCENTRATE RATIO TO BUSY HOUR

ITEM / OFFICE	DATE	SUB'S	WHOLE DISCHARGE AMP. HOUR	MAXIMUM DISCHARGE AMP. HOUR	MINIMUM DISCHARGE AMP. HOUR	CONCENTRATE RATIO TO BUSY HOUR.
			A.H.	A.H.	A.H.	
GAMPIR	JAN - AUG 1974	16,800	8,346.20	802.72	85.47	$\frac{802.72-85.47}{8,346.2-85.47\times 24} \times 100 = 11.39\ \%$
KEBAYORAN	JAN - OCT 1974	6,690	2,818.51	196.02	48.48	$\frac{196.02-48.48}{2,818.51-48.48\times 24} \times 100 = 8.9\ \%$
JATINEGARA	AUG 1973 - JULY 1974	3,870	1,479.91	127.17	18.00	$\frac{127.17-18.00}{1,479.91-18.00\times 24} \times 100 = 10.42\ \%$
SLIPI	MARCH-JULY 1974	1,190	328.98	31.52	2.09	$\frac{31.52-2.09}{328.98-2.09\times 24} \times 100 = 10.56\ \%$

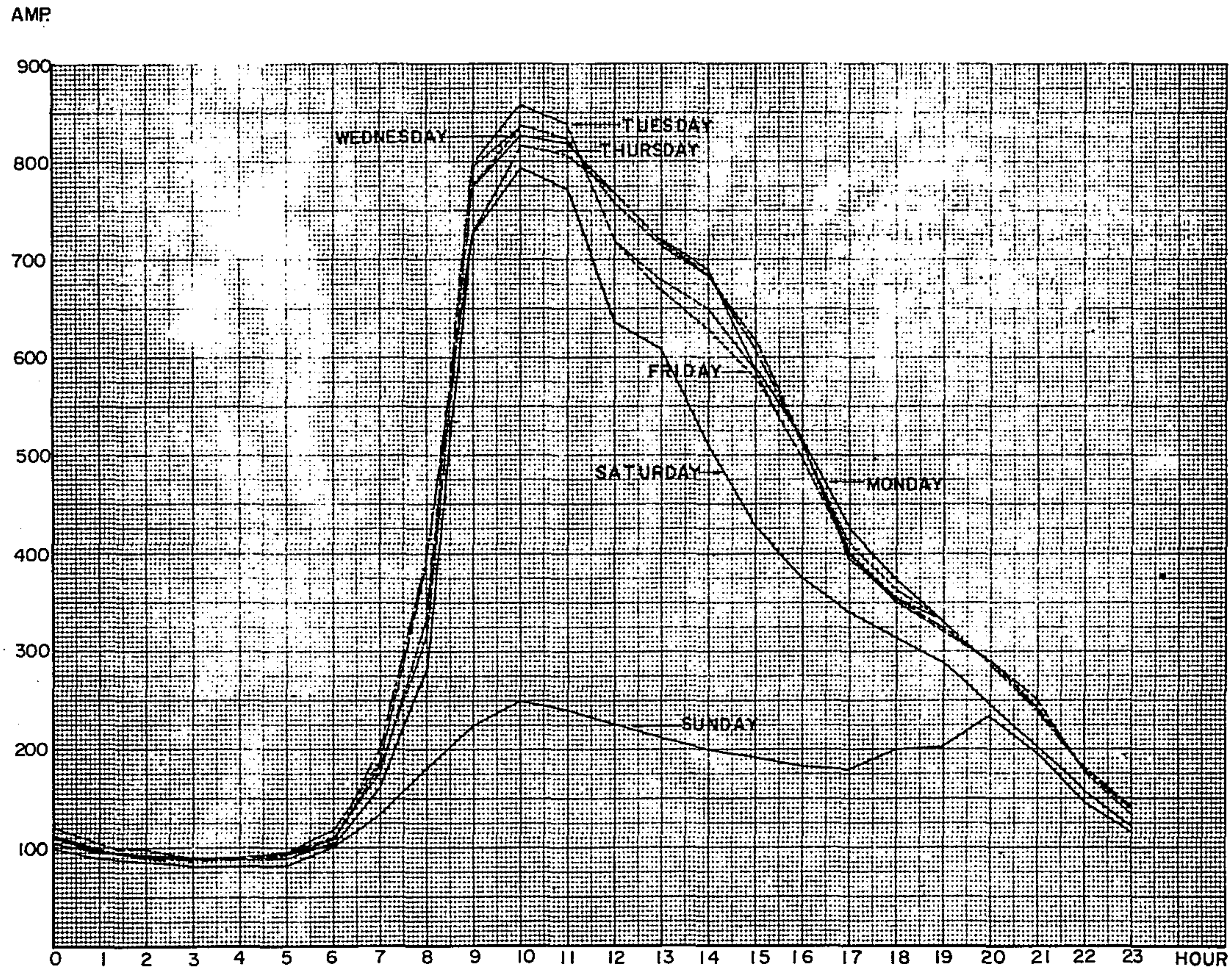


FIG. 3-1-4-(1) GAMBIR OFFICE POWER CONSUMPTION CURVE WEEKLY AVERAGE JUNE 1974 - AUGUST. 1974

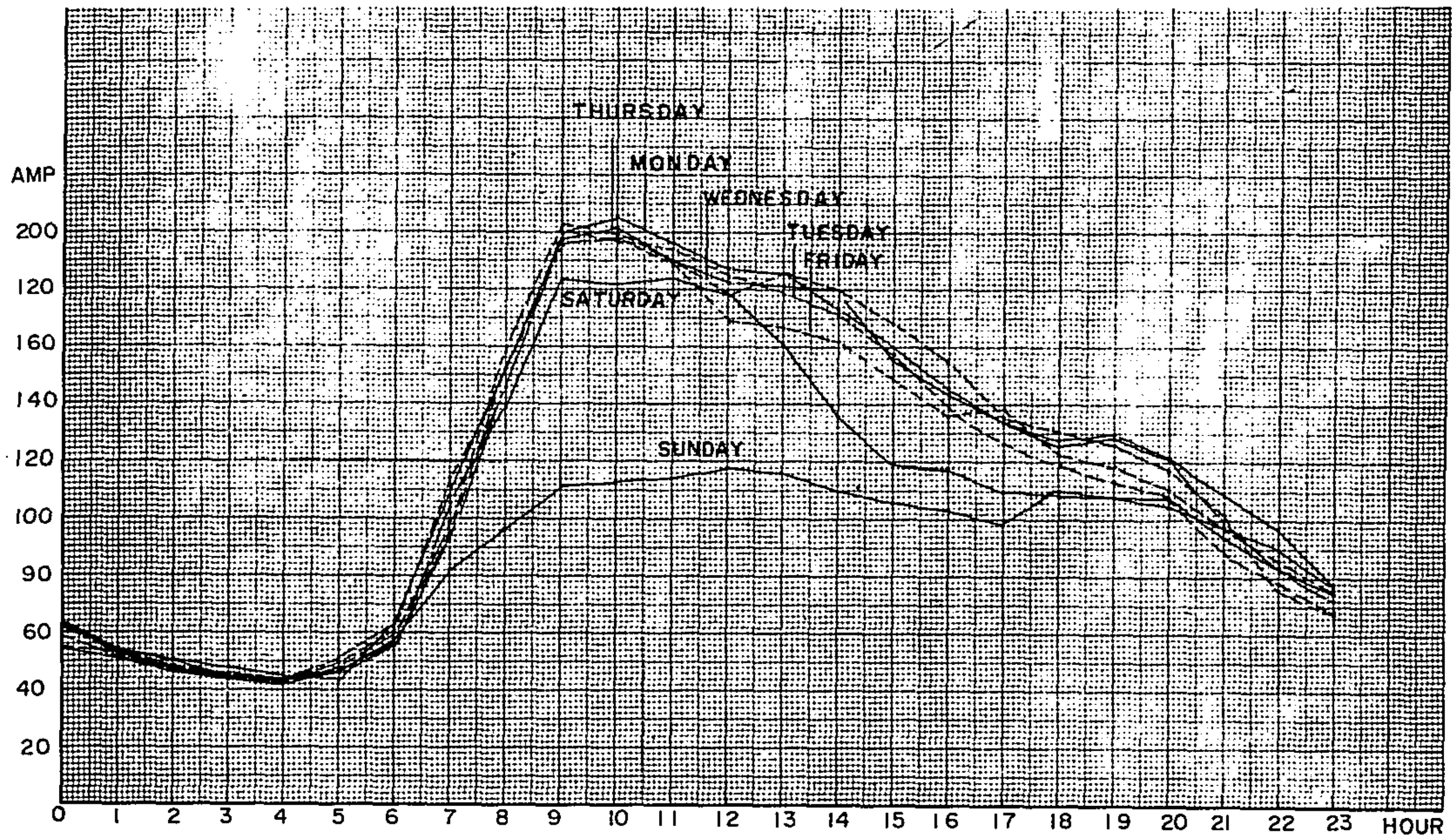


FIG. 3-1-4-(2) KEBAYORAN OFFICE POWER CONSUMPTION CURVE WEEKLY AVERAGE FEB. 1974 - APR. 1974 somewhat smaller than on other weekdays.

3.1.5 Telephone Call Holding Time

The telephone call holding time at each local exchange office in Jakarta was measured as stated hereunder.

3.1.5.1 Exchange Office Where Measurement Was Made and Date/Time of Measurement

The telephone call holding time measurement was made in parallel with the traffic measurement by operating-switch count. Exchange offices where the measurement was made and date/time of measurement are shown in Table 3.1.5.1.(1).

3.1.5.2 *Method of Measurement*

The telephone call holding time was measured by measuring with a stop-watch the operation holding time of C-relay of line finder chosen at radom. Hence the measured time stands for the holding time until the line is released after the dial tone is sent to the calling subscriber.

3.1.5.3 Result of Measurement

The result of telephone call holding time measurement at each exchange office is shown in Table 3.1.5.3.(1).

3.1.5.4 Mean Holding Time

The mean value of each measured time zone is listed in Table 3.1.5.4.(1). When the success call holding time is assumed to be more than 31 sec. it follows that

$$\frac{87{,}455-(5{,}175+7{,}920+2{,}900)}{2{,}227-(1{,}035+528+116)}=\frac{71{,}460}{548}=130.4 \quad \text{sec.}$$

Hence the mean holding time of the success call becomes approximately 130 sec. When the failure call holding time is assumed to be less than 30 sec. it follows that

$$\frac{5{,}175+7{,}920+2{,}900}{1{,}035+528+116}=\frac{15{,}995}{1{,}679}=9.53 \quad \text{sec.}$$

Hence the mean holding time of the failure call becomes approximately 10 sec.

TABLE 3-1-5-3-(1) 1/2

HOLDING TIME OF CALLS IN JAKARTA 1/2

NO.	OFFICE / TIME	KOTA	GAMBIR	SEMA--NGGI	KEBA--YORAN	JATINE--GARA	TOTAL
1	0'.00"~0'.10"	476	228	88	146	97	1,035
2	0'.11"~0'.20"	187	152	79	73	37	528
3	0'.21"~0'.30"	46	29	18	13	10	116
4	0'.31"~0'.40"	40	24	7	8	8	87
5	0'.41"~0'.50"	20	16	6	10	5	57
6	0'.51"~1'.00"	13	5	9	9	4	40
7	1'.01"~1'.10"	17	12	2	9	—	40
8	1'.11"~1'.20"	6	15	1	5	5	32
9	1'.21"~1'.30"	18	7	—	6	2	33
10	1'.31"~1'.40"	6	11	3	—	3	23
11	1'.41"~1'.50"	10	6	1	4	2	23
12	1'.51"~2'.00"	12	6	1	2	—	21
13	2'.01"~2'.10"	8	7	5	4	3	27
14	2'.11"~2'.20"	2	7	1	1	3	14
15	2'.21"~2'.30"	8	3	1	1	2	15
16	2'.31"~2'.40"	6	1	—	1	—	8
17	2'.41"~2'.50"	6	—	—	2	2	10
18	2'.51"~3'.00"	4	1	—	1	—	6
19	3'.01"~3'.10"	7	2	—	1	3	13
20	3'.11"~3'.20"	—	1	1	—	—	2
21	3'.21"~3'.30"	4	1	1	1	2	9
22	3'.31"~3'.40"	2	—	2	—	—	4
23	3'.41"~3'.50"	1	2	1	—	—	4
24	3'.51"~4'.00"	1	2	1	—	1	5
25	4'.01"~4'.10"	2	1	1	—	—	4
26	4'.11"~4'.20"	1	1	—	—	1	3
27	4'.21"~4'.30"	1	1	—	—	1	3
28	4'.31"~4'.40"	—	1	—	—	1	2
29	4'.41"~4'.50"	1	2	1	—	—	4
30	4'.51"~5'.00"	3	4	—	—	—	7

TABLE 3-1-5-3-(1) 2/2
HOLDING TIME OF CALLS IN JAKARTA 2/2

NO.	OFFICE / TIME	KOTA	GAMBIR	SEMA-NGGI	KEBA-YORAN	JATINE-GARA	TOTAL
31	5'01"~5'10"	—	1	—	3	1	5
32	5'11"~5'20"	1	—	1	—	—	2
33	5'21"~5'30"	1	2	—	—	1	4
34	5'31"~5'40"	—	1	—	1	—	2
35	5'41"~5'50"	—	—	—	—	—	—
36	5'51"~6'00"	3	1	—	1	—	5
37	6'01"~6'10"	1	1	—	—	—	2
38	6'11"~6'20"	—	—	1	—	—	1
39	6'21"~6'30"	1	1	—	1	—	3
40	6'31"~6'40"	—	—	—	1	—	1
41	6'41"~6'50"	—	1	—	—	—	1
42	6'51"~7'00"	1	1	—	—	—	2
43	7'01"~7'10"	—	—	—	—	—	—
44	7'11"~7'20"	—	—	—	—	—	—
45	7'21"~7'30"	—	—	—	—	—	—
46	7'31"~7'40"	—	1	—	—	—	1
47	7'41"~7'50"	—	—	—	—	—	—
48	7'51"~8'00"	—	—	—	—	—	—
49	8'01"~8'10"	—	—	—	—	—	—
50	8'11"~8'20"	—	—	—	—	—	—
51	8'21"~8'30"	—	—	—	—	1	1
52	8'31"~8'40"	1	—	—	—	—	1
53	8'41"~8'50"	1	—	—	—	—	1
54	8'51"~9'00"	—	—	—	—	—	—
55	9'01"~9'10"	—	—	—	—	—	—
56	9'11"~9'20"	—	—	—	1	1	2
57	9'21"~9'30"	—	—	1	—	—	1
58	9'31"~9'40"	—	—	—	—	—	—
59	9'41"~9'50"	—	—	—	—	—	—
60	9'51"~10'00"	6	5	2	3	1	17
	TOTAL	924	563	235	308	197	2,227

TABLE 3-1-5-4-(1) HOLDING TIME OF CALLS IN JAKARTA.

NO	TIME H	CALLS N	%	HXN	NO	TIME H	CALLS N	%	NXH	NO	TIME H	CALLS N	%	HXN
1	5	1,035	46.48	5,175	26	255	3	0.14	765	51	505	1	0.05	505
2	15	528	23.71	7,920	27	265	3	0.14	795	52	515	1	0.05	515
3	25	116	5.21	2,900	28	275	2	0.09	550	53	525	1	0.05	525
4	35	87	3.91	3,045	29	285	4	0.18	1,140	54	535	—	—	—
5	45	57	2.56	2,565	30	295	7	0.31	2,065	55	545	—	—	—
6	55	40	1.80	2,200	31	305	5	0.23	1,525	56	555	2	0.09	1,110
7	65	40	1.80	2,600	32	315	2	0.09	630	57	565	1	0.05	565
8	75	32	1.44	2,400	33	325	4	0.18	1,300	58	575	—	—	—
9	85	33	1.48	2,805	34	335	2	0.09	670	59	585	—	—	—
10	95	23	1.03	2,185	35	345	—	—	—	60	595	17	0.76	10,115
11	105	23	1.03	2,415	36	355	5	0.23	1,775	TOTAL		2,227	100 07	87,455
12	115	21	0.94	2,415	37	365	2	0.09	730					
13	125	27	1.21	3,375	38	375	1	0.05	375					
14	135	14	0.63	1,890	39	385	3	0.14	1,155					
15	145	15	0.67	2,175	40	395	1	0.05	395					
16	155	8	0.36	1,240	41	405	1	0.05	405					
17	165	10	0.45	1,650	42	415	2	0.09	830					
18	175	6	0.27	1,050	43	425	—	—	—					
19	185	13	0.58	2,405	44	435	—	—	—					
20	195	2	0.09	390	45	445	—	—	—					
21	205	9	0.40	1,845	46	455	1	0.05	455					
22	215	4	0.18	860	47	465	—	—	—					
23	225	4	0.18	900	48	475	—	—	—					
24	235	5	0.23	1,175	49	485	—	—	—					
25	245	4	0.18	980	50	495	—	—	—					

NO.1 = 1 ~ 10 SEC
NO.2 = 11 ~ 20 "
NO.3 = 21 ~ 30 "
⋮
NO.59 = 581 ~ 590 SEC
NO.60 = 591 ~ ∞

$$\% = \frac{N_i}{\sum_{1}^{60} N_i} \times 100$$

Table 3.1.5.1.(1) Measurement Data for Holding Time of Calls

Office	Date		Hour
Kota	30 Jan '74	Wed	10.00 ~ 11.00
Gambir	29 " "	Tue	10.00 ~ 11.00
Semanggi	8 " "	"	10.00 ~ 11.00
Kebayoran	9 " "	Wed	10.30 ~ 11.30
Jatinegara	31 " "	Thu	9.30 ~ 10.30

3.2 Estimate of Calling Rate in 1976 by Exchange Office

For the purpose of calling rate estimates for 1979, 1983, 1988 and 1993 the calling rate for 1976 at each exchange office in Jakarta was estimated. The following data was used for the estimate:

a. PERUMTEL's estimate data for 1975 and 1976.

b. Late Mr. Atkinson's measurement data (1973).

c. JTP's measurement data (1974) for each exchange office.

These data were studied with emphasis on:

1) Comparison of the estimated calling rate based on the area pattern with the rate given in the above data.
2) Comparison of the estimated calling rate based on the area pattern of a service area with the rate of another service area.
3) Comparison of the calling rate of a service area with the rate of the adjacent service area.

The estimates were made at the unit value of 0.005 Erlang. The originating calling rate estimate per subscriber for 1976 for each exchange office and the data used for the estimate appear in Table 3.2.(1).

3.3 Future Calling Rate

3.3.1 General Tendency

The calling rate continues to vary, depending upon the type of subscriber and the social situation. The calling rate tendency in the future can be estimated, based on the following two factors:

TABLE 3-2-(1)
ORIGINATING AVERAGE CALLING RATE IN JAKARTA (IN ERL)

NO	OFFICE \ YEAR	PERUMTEL FORECAST (1975)	PERUMTEL FORECAST (1976)	MR. ATKINSON AS OF (1973)	J.T.P SURVEY (1974)	J.T.P FORECAST (1976)
1	KOTA. A		0.116	0.074	0.0695	0.085
	KOTA. B, C	0.075	0.079			0.085
2	ANCOL	0.050				0.055
3	PLUIT		0.074			0.055
4	CENGKARENG	0.065				0.045
5	TEGAL ALUR					0.035
6	GAMBIR. A	0.075	0.093	0.077	0.0683	0.085
	GAMBIR. B		0.073			0.085
7	SEMANGGI	0.065	0.076	0.042	0.0263	0.050
8	SLIPI	0.065	0.075	0.046	0.0427	0.050
9	PALMERAH	0.065				0.045
10	KEDOYA					0.040
11	MERUYA					0.040
12	CEMPAKA PUTIH	0.065				0.055
13	RAWAMANGUN					0.045
14	PULOGADUNG	0.065				0.045
15	PENGGILINGAN					0.045
16	TANJUNG PRIOK. A		0.112	0.050	0.0614	0.065
	TANJUNG PRIOK. B	0.065				0.065
17	CILINCING					0.055
18	KEBAYORAN. A		0.073	0.047	0.0382	0.050
	KEBAYORAN. B	0.065				0.050
19	CIPETE	0.065	0.058			0.045
20	KALIBATA	0.065				0.045
21	PASAR MINGGU	0.065				0.040
22	JAGA KARSA.					0.035
23	JATINEGARA. A		0.071	0.050	0.0484	0.055
	JATINEGARA. B	0.065	0.075			0.055
24	CAWANG	0.065	0.079			0.050
25	PASAR REBO	0.065	0.079			0.045
26	KLENDER	0.065				0.040
27	TEBET		0.079			0.050
28	GANDARIA		0.072		0.0531	0.050
	AVERAGE CR.		7,145.2 / 93,000x0.95 = 0.0809		2,384.09 / 40,238 = 0.0593	8,828.7 / 134,920 = 0.0654

3.3.1.1 Calling Rate from Existing Subscriber

The average calling rate from the existing subscriber increases annually and this calling rate is considered to approach a certain fixed value in the future. The reason is that, though the traffic between the existing subscribers will remain almost unchanged, the traffic between the existing and new subscribers will increase gradually in accordance with the increase of new subscribers but this calling rate will saturate in due course.

3.3.1.2 Originating Calling Rate from New Subscriber

The average originating calling rate from the new subscriber at the initial stage is smaller than the average calling rate from the existing subscriber. This is because the residential telephones occupy a great percentage. The originating calling rate from new subscribers will also increase annually and reach a certain value in the future though this saturation value in the future will not be as great as in the case of the originating calling rate from the existing subscribers.

3.3.1.3 Calling Rate Estimate Formula

The calling rate estimate formula based on the conditions given in the preceding paragraphs 3.3.1.1 and 3.3.1.2 is shown below.

Annotations on abbreviations used in the formula follow:

(A) No .... The existing number of subscribers

(B) To .... The existing average originating calling rate per subscriber

(C) Nx .... Number of new subscribers to be installed at x-th year

(D) Tx .... Average originating calling rate from new subscribers installed at x-th year

(E) (Tx)i .... Average originating calling rate from Nx subscribers at (X + i)-th year

The values of Nx, Tx and (Tx)i are expressed as follows:

(F) $$N_x = N_o e^{\frac{g}{10}x} - N_o e^{\frac{g}{10}(x-1)} = N_o \left\{ e^{\frac{g}{10}x} - e^{\frac{g}{10}(x-1)} \right\}$$

g··· onstant

(G) $$T_x = T_o \left(a e^{-\frac{m}{10}x} + b \right)$$

a, b, m······constant

$a + b = 1$

(H) $$(T_x)_i = T_x \left(c - d e^{-\frac{f}{10}i} \right) = T_o \left(a e^{-\frac{m}{10}x} + b \right) \left(c - d e^{-\frac{f}{10}i} \right)$$

c, d, f······consant

$c + d = 1$

Year				
0	$N_o T_o$			
1	$N_o (T_o)_1$	$N_1 T_1$		
2	$N_o (T_o)_2$	$N_1 (T_1)_1$	$N_2 (T_2)$	
3	$N_o (T_o)_3$	$N_1 (T_1)_2$	$N_2 (T_2)_1$	$N_3 (T_3)$
4	$N_o (T_o)_4$	$N_1 (T_1)_3$	$N_2 (T_2)_2$	$N_3 (T_3)_1$
5	$N_o (T_o)_5$	$N_1 (T_1)_4$	$N_2 (T_2)_3$	$N_3 (T_3)_2$
⋮				
i	$N_o (T_o)_i$	$N_1 (T_1)_{i-1}$	$N_2 (T_2)_{i-2}$	$N_3 (T_3)_{i-3}$

Year			
0	$N_o T_o$		
1	$N_o T_o (c - d e^{-\frac{f}{10}})$	$N_1 T_1$	
2	$N_o T_o (c - d e^{-\frac{2f}{10}})$	$N_1 T_1 (c - d e^{-\frac{f}{10}})$	$N_2 T_2$
3	$N_o T_o (c - d e^{-\frac{3f}{10}})$	$N_1 T_1 (c - d e^{-\frac{2f}{10}})$	$N_2 T_2 (c - d e^{-\frac{f}{10}})$
4			
⋮			
i	$N_o T_o (c - d e^{-\frac{if}{10}})$	$N_1 T_1 \left\{ c - d e^{-\frac{(i-1)f}{10}} \right\}$	$N_2 T_2 \left\{ c - d e^{-\frac{(i-2)f}{10}} \right\}$

On condition

$$N_1 = N_o e^{\frac{g}{10}} - N_o e^{\frac{g}{10}(1-1)} = N_o \left(e^{\frac{g}{10}} - 1 \right)$$

$$N_2 = N_o \left(e^{\frac{2g}{10}} - e^{\frac{g}{10}} \right)$$

⋮

$$N_i = N_o \left\{ e^{\frac{gi}{10}} - e^{\frac{g(i-1)}{10}} \right\}$$

$$T1 = To\left(ae^{-\frac{m}{10}} + b\right)$$

$$T2 = To\left(ae^{-\frac{2m}{10}} + b\right)$$

$$\vdots$$

$$Ti = To\left(ae^{-\frac{mi}{10}} + b\right)$$

The total originating traffic, Si, "i" years later:

$$Si = No\,To\left(c - de^{-\frac{fi}{10}}\right) + N1\,T1\left\{c - de^{-\frac{f(i-1)}{10}}\right\} + N2\,T2\left\{c - de^{-\frac{f(i-2)}{10}}\right\}$$

$$+ N3\,T3\left\{c - de^{-\frac{f(i-3)}{10}}\right\}$$

$$\vdots$$

$$+ N_{i-2}\,T_{i-2}\left\{c - de^{-\frac{f\times 2}{10}}\right\} + N_{i-1}\,T_{i-1}\left\{c - de^{-\frac{f}{10}}\right\} + Ni\,Ti\left\{c - de^{-\frac{f\times 0}{10}}\right\}$$

$$= No\,To\left(c - de^{-\frac{fi}{10}}\right)$$

$$+ No\left(e^{\frac{g}{10}} - 1\right) \cdot To\left(ae^{-\frac{m}{10}} + b\right)\left\{c - de^{-\frac{f(i-1)}{10}}\right\}$$

$$+ No\left(e^{\frac{2g}{10}} - e^{\frac{g}{10}}\right) \cdot To\left(ae^{-\frac{2m}{10}} + b\right)\left\{c - de^{-\frac{f(i-2)}{10}}\right\}$$

$$+ No\left(e^{\frac{3g}{10}} - e^{\frac{2g}{10}}\right) \cdot To\left(ae^{-\frac{3m}{10}} + b\right)\left\{c - de^{-\frac{f(i-3)}{10}}\right\}$$

$$\vdots$$

$$+ No\left\{e^{\frac{g(i-2)}{10}} - e^{\frac{g(i-3)}{10}}\right\} \cdot To\left\{ae^{-\frac{(i-2)m}{10}} + b\right\}\left(c - de^{-\frac{2f}{10}}\right)$$

$$+ No\left\{e^{\frac{g(i-1)}{10}} - e^{\frac{g(i-2)}{10}}\right\} \cdot To\left\{ae^{-\frac{(i-1)m}{10}} + b\right\}\left(c - de^{-\frac{f}{10}}\right)$$

$$+ No\left\{e^{\frac{gi}{10}} - e^{\frac{g(i-1)}{10}}\right\} \cdot To\left(ae^{-\frac{mi}{10}} + b\right)\left(c - de^{-\frac{f\times 0}{10}}\right)$$

$$= No\,To\left(e^{\frac{g\times 0}{10}} - 0\right)\left(ae^{-\frac{m\times 0}{10}} + b\right)\left(c - de^{-\frac{fi}{10}}\right)$$

$$+ No\,To\left(e^{\frac{g}{10}} - e^{\frac{g\times 0}{10}}\right)\left(ae^{-\frac{m}{10}} + b\right)\left\{c - de^{-\frac{f(i-1)}{10}}\right\}$$

$$+ No\,To\left(e^{\frac{2g}{10}} - e^{\frac{g}{10}}\right)\left(ae^{-\frac{2m}{10}} + b\right)\left\{c - de^{-\frac{f(i-2)}{10}}\right\}$$

$$+ No\,To\left(e^{\frac{3g}{10}} - e^{\frac{2g}{10}}\right)\left(ae^{-\frac{3m}{10}} + b\right)\left\{c - de^{-\frac{f(i-3)}{10}}\right\}$$

$$\vdots$$

$$+ No\,To\left\{e^{\frac{g(i-2)}{10}} - e^{\frac{g(i-3)}{10}}\right\}\left\{ae^{-\frac{m(i-2)}{10}} + b\right\}\left(c - de^{-\frac{2f}{10}}\right)$$

$$+ No\,To\left\{e^{\frac{g(i-1)}{10}} - e^{\frac{g(i-2)}{10}}\right\}\left\{ae^{-\frac{m(i-1)}{10}} + b\right\}\left(c - de^{-\frac{f}{10}}\right)$$

$$+ No\,To\left\{e^{\frac{gi}{10}} - e^{\frac{g(i-1)}{10}}\right\}\left(ae^{-\frac{mi}{10}} + b\right)\left(c - de^{-\frac{f\times 0}{10}}\right)$$

$$
\begin{aligned}
&= NoToe^{\frac{go}{10}}\left\{ace^{-\frac{mo}{10}}-ade^{-\frac{mo}{10}}\cdot e^{-\frac{fi}{10}}+bc-bde^{-\frac{fi}{10}}-ace^{-\frac{m}{10}}+ade^{-\frac{m}{10}}\cdot e^{-\frac{f(i-1)}{10}}\right. \\
&\quad \left.-bc+bde^{-\frac{f(i-1)}{10}}\right\}+NoToe^{\frac{g}{10}}\left\{ace^{-\frac{m}{10}}-ade^{-\frac{m}{10}}\cdot e^{-\frac{f(i-1)}{10}}+bc\right. \\
&\quad \left.-bde^{-\frac{f(i-1)}{10}}-ace^{-\frac{2m}{10}}+ade^{-\frac{2m}{10}}\cdot e^{-\frac{f(i-2)}{10}}-bc+bde^{-\frac{f(i-2)}{10}}\right\} \\
&\quad +NoToe^{\frac{2g}{10}}\left\{ace^{-\frac{2m}{10}}-ade^{-\frac{2m}{10}}\cdot e^{-\frac{f(i-2)}{10}}+bc-bde^{-\frac{f(i-2)}{10}}-ace^{-\frac{3m}{10}}\right. \\
&\quad \left.+ade^{-\frac{3m}{10}}\cdot e^{-\frac{f(i-3)}{10}}-bc+bde^{-\frac{f(i-3)}{10}}\right\} \\
&\quad + \cdots\cdots\cdots\cdots \\
&\quad + \cdots\cdots\cdots\cdots \\
&\quad +NoToe^{\frac{g(i-2)}{10}}\left\{ace^{-\frac{(i-2)m}{10}}-ade^{-\frac{(i-2)m}{10}}\cdot e^{-\frac{f\times 2}{10}}+bc-bde^{-\frac{f\times 2}{10}}\right. \\
&\qquad \left.-ace^{-\frac{(i-1)m}{10}}+ade^{-\frac{(i-1)m}{10}}\cdot e^{-\frac{f\times 1}{10}}-bc+bde^{-\frac{f\times 1}{10}}\right\} \\
&\quad +NoToe^{\frac{g(i-1)}{10}}\left\{ace^{-\frac{(i-1)m}{10}}-ade^{-\frac{(i-1)m}{10}}\cdot e^{-\frac{f\times 1}{10}}+bc-bde^{-\frac{f\times 1}{10}}\right. \\
&\qquad \left.-ace^{-\frac{im}{10}}+ade^{-\frac{im}{10}}\cdot e^{-\frac{f\times 0}{10}}-bc+bde^{-\frac{f\times 0}{10}}\right\} \\
&\quad +NoToe^{\frac{gi}{10}}\left(ace^{-\frac{im}{10}}+b\right) \\
&= NoToe^{\frac{g\cdot o}{10}}\left\{ac\left(e^{-\frac{m\cdot o}{10}}-e^{-\frac{m}{10}}\right)+bd\left(e^{-\frac{f(i-1)}{10}}-e^{-\frac{fi}{10}}\right)\right. \\
&\qquad \left.+ad\left(e^{-\frac{m}{10}}\cdot e^{-\frac{f(i-1)}{10}}-e^{-\frac{m\cdot o}{10}}\cdot e^{-\frac{fi}{10}}\right)\right\} \\
&\quad +NoToe^{\frac{g}{10}}\left\{ac\left(e^{-\frac{m}{10}}-e^{-\frac{2m}{10}}\right)+bd\left(e^{-\frac{f(i-2)}{10}}-e^{-\frac{f(i-1)}{10}}\right)\right. \\
&\qquad \left.+ad\left(e^{-\frac{2m}{10}}\cdot e^{-\frac{f(i-2)}{10}}-e^{-\frac{m}{10}}\cdot e^{-\frac{f(i-1)}{10}}\right)\right\} \\
&\quad +NoToe^{\frac{2g}{10}}\left\{ac\left(e^{-\frac{2m}{10}}-e^{-\frac{3m}{10}}\right)+bd\left(e^{-\frac{f(i-3)}{10}}-e^{-\frac{f(i-2)}{10}}\right)\right. \\
&\qquad \left.+ad\left(e^{-\frac{3m}{10}}\cdot e^{-\frac{f(i-3)}{10}}-e^{-\frac{2m}{10}}\cdot e^{-\frac{f(i-2)}{10}}\right)\right\} \\
&\quad + \cdots\cdots\cdots\cdots \\
&\quad + \cdots\cdots\cdots\cdots \\
&\quad +NoToe^{\frac{g(i-2)}{10}}\left\{ac\left(e^{-\frac{(i-2)m}{10}}-e^{-\frac{(i-1)m}{10}}\right)+bd\left(e^{-\frac{f}{10}}-e^{-\frac{f\times 2}{10}}\right)\right. \\
&\qquad \left.+ad\left(e^{-\frac{(i-1)m}{10}}\cdot e^{-\frac{f\times 1}{10}}-e^{-\frac{(i-2)m}{10}}\cdot e^{-\frac{f\times 2}{10}}\right)\right\} \\
&\quad +NoToe^{\frac{g(i-1)}{10}}\left\{ac\left(e^{-\frac{(i-1)m}{10}}-e^{-\frac{im}{10}}\right)+bd\left(e^{-\frac{f\times o}{10}}-e^{-\frac{f\times 1}{10}}\right)\right. \\
&\qquad \left.+ad\left(e^{-\frac{im}{10}}\cdot e^{-\frac{f\times 0}{10}}-e^{-\frac{(i-1)m}{10}}\cdot e^{-\frac{f\times 1}{10}}\right)\right\}
\end{aligned}
$$

$$+NoTo\,e^{\frac{gi}{10}}\left(ae^{-\frac{im}{10}}+b\right)$$

$$=NoTo\,e^{\frac{o}{10}}\left\{ac\left(e^{-\frac{o}{10}}-e^{-\frac{m}{10}}\right)+bde^{-\frac{fi}{10}}\left(e^{\frac{f}{10}}-1\right)+ade^{-\frac{fi}{10}}\cdot e^{-\frac{mo}{10}}\left(e^{\frac{f-m}{10}}-1\right)\right\}$$

$$+NoTo\,e^{\frac{g}{10}}\left\{ace^{-\frac{m}{10}}\left(e^{-\frac{o}{10}}-e^{-\frac{m}{10}}\right)+bde^{-\frac{fi}{10}}\cdot e^{\frac{f}{10}}\left(e^{\frac{f}{10}}-1\right)+ade^{-\frac{fi}{10}}\cdot e^{\frac{f-m}{10}}\cdot\left(e^{\frac{f-m}{10}}-1\right)\right\}$$

$$+NoTo\,e^{\frac{2g}{10}}\left\{ace^{-\frac{2m}{10}}\left(e^{-\frac{o}{10}}-e^{-\frac{m}{10}}\right)+bde^{-\frac{fi}{10}}\cdot e^{\frac{2f}{10}}\left(e^{\frac{f}{10}}-1\right)+ade^{-\frac{fi}{10}}\cdot e^{\frac{2(f-m)}{10}}\cdot\left(e^{\frac{f-m}{10}}-1\right)\right\}$$

$$+\ \cdots\cdots\cdots\cdots\cdots\cdots$$

$$+\ \cdots\cdots\cdots\cdots\cdots\cdots$$

$$+NoTo\,e^{\frac{g(i-2)}{10}}\left\{ace^{-\frac{(i-2)m}{10}}\left(e^{-\frac{o}{10}}-e^{-\frac{m}{10}}\right)+bde^{-\frac{fi}{10}}\cdot e^{\frac{f(i-2)}{10}}\left(e^{\frac{f}{10}}-1\right)+ade^{-\frac{fi}{10}}\cdot e^{\frac{(i-2)(f-m)}{10}}\left(e^{\frac{f-m}{10}}-1\right)\right\}$$

$$+NoTo\,e^{\frac{g(i-1)}{10}}\left\{ace^{-\frac{(i-1)m}{10}}\left(e^{-\frac{o}{10}}-e^{-\frac{m}{10}}\right)+bde^{-\frac{fi}{10}}\cdot e^{\frac{f(i-1)}{10}}\cdot\left(e^{\frac{f}{10}}-1\right)+ade^{-\frac{fi}{10}}\cdot e^{\frac{(i-1)(f-m)}{10}}\left(e^{\frac{f-m}{10}}-1\right)\right\}$$

$$+NoTo\,e^{\frac{gi}{10}}\left(ae^{-\frac{im}{10}}+b\right)$$

$$=NoToac\left(e^{-\frac{o}{10}}-e^{-\frac{m}{10}}\right)\left\{1+e^{\frac{g-m}{10}}+e^{\frac{2(g-m)}{10}}+\cdots\cdots+e^{\frac{(i-2)(g-m)}{10}}+e^{\frac{(i-1)(g-m)}{10}}\right\}$$

$$+NoTobde^{-\frac{fi}{10}}\left(e^{\frac{f}{10}}-1\right)\left\{1+e^{\frac{g}{10}}\cdot e^{\frac{f}{10}}+e^{\frac{2g}{10}}\cdot e^{\frac{2f}{10}}+\cdots\cdots+e^{\frac{g(i-2)}{10}}\cdot e^{\frac{f(i-1)}{10}}+e^{\frac{g(i-1)}{10}}\cdot e^{\frac{f(i-1)}{10}}\right\}$$

$$+NoTo\,e^{\frac{gi}{10}}\left(ae^{-\frac{im}{10}}+b\right)$$

$$=NoToac\left(1-e^{-\frac{m}{10}}\right)\frac{e^{\frac{(g-m)i}{10}}-1}{e^{\frac{g-m}{10}}-1}$$

$$+NoTobde^{-\frac{fi}{10}}\left(e^{\frac{f}{10}}-1\right)\frac{e^{\frac{(g+f)i}{10}}-1}{e^{\frac{g+f}{10}}-1}$$

$$+NoToade^{-\frac{fi}{10}}\left(e^{\frac{f-m}{10}}-1\right)\frac{e^{\frac{(g+f-m)i}{10}}-1}{e^{\frac{g+f-m}{10}}-1}$$

$$+NoToe^{\frac{gi}{10}}\left(ae^{-\frac{im}{10}}+b\right)\cdots\cdots(1)$$

The total number of subscribers after "i" years is

$$Noe^{\frac{gi}{10}}$$

Hence the average originating calling rate per subscriber ti after "i" years is

$$ti=\frac{Si}{Noe^{\frac{gi}{10}}}$$

The ratio between ti and To (average originating calling rate per subscriber) is as follows:

$$P=\frac{ti}{To}=\frac{\frac{Si}{Noe^{\frac{gi}{10}}}}{To}=\frac{Si}{NoTo\cdot e^{\frac{gi}{10}}}$$

$$=ac\left(1-e^{-\frac{m}{10}}\right)\cdot\frac{e^{\frac{(g-m)i}{10}}-1}{e^{\frac{g-m}{10}}-1}\cdot e^{-\frac{gi}{10}}$$

$$+bde^{-\frac{fi}{10}}\left(e^{\frac{f}{10}}-1\right)\cdot\frac{e^{\frac{(g+f)i}{10}}-1}{e^{\frac{g+f}{10}}-1}\cdot e^{-\frac{gi}{10}}$$

$$+ade^{-\frac{fi}{10}}\left(e^{\frac{f}{10}}-1\right)\cdot\frac{e^{\frac{(g+f-m)i}{10}}-1}{e^{\frac{g+f-m}{10}}-1}\cdot e^{-\frac{gi}{10}}$$

$$+\left(ae^{-\frac{mi}{10}}+b\right)\cdots\cdots(2)$$

3.3.2 Factors to Exert Influence on Originating Calling Rate

As stated in Paragraph 3.3.1.3 the originating calling rate continues to increase annually but this increase will reach the peak in due time and then turn to the downgrade. There are cases, however, where the originating calling rate estimate cannot be made from such general tendency only. Such cases are divided in two. One is the case where the change in the traffic is slow and continuous. The other is the case where the change is sharp and temporary. Factors involved are described in Paragraphs 3.3.2.1 and 3.3.2.2.

It is difficult to consider such factors for all exchange offices. However, as stated in Paragraph 3.4.2, all necessary factors are considered for six exchange offices where the change in traffic volume is especially conspicuous.

3.3.2.1 Slow and Continuous Traffic Change

(1) Change of Area Pattern

Generally, traffic increases or decreases according to the change of area pattern.

(2) Introduction of PBX and Centrex

When big enterprises and business offices introduce PBX and centrex systems, traffic increases. The reason is that in the case of PBX and centrex the number of extensions per office line is large so that the originating calling rate per office line is higher than that of ordinary subscriber telephones. Therefore, in case where PBX or centrex introduction is scheduled, the contents and scale of subscriber facilities in addition to the number of subscribers must be considered when the traffic estimate is carried out.

(3) Introduction of New Service

Introduction of such new services as mentioned below sometimes exerts an influence on traffic estimate.

a) Weather forecast, market price information, etc.

b) Change from manual switching system to automatic switching system.

(4) Telephone Charge

Telephone charge consists of basic charge and call charge (automatic call charge and manual call charge). The charge raise usually halts the traffic increase or even causes the traffic decrease. However, this trend is temporary in many cases. The traffic returns to the level before the charge raise in due course though this depends upon the social and/or economic situation in general.

The telephone charge discount, i.e., the call charge reduction during small traffic hours (nighttime and holidays) causes the traffic increase during those hours. Therefore, by the good use of this charge discount system can the idle facilities be utilized to the best advantage during small traffic hours and the invested fund recovery effect be improved. (Refer to Fig. 3.3.2.1.(1) dotted line A.)

Attention is necessary, however, because the daytime traffic may be shifted to nighttime in order to take advantage of the discounted call charge, resulting in the nighttime traffic exceeding the daytime busy hour traffic. (Refer to Fig. 3.3.2.1.(1) dotted line B.)

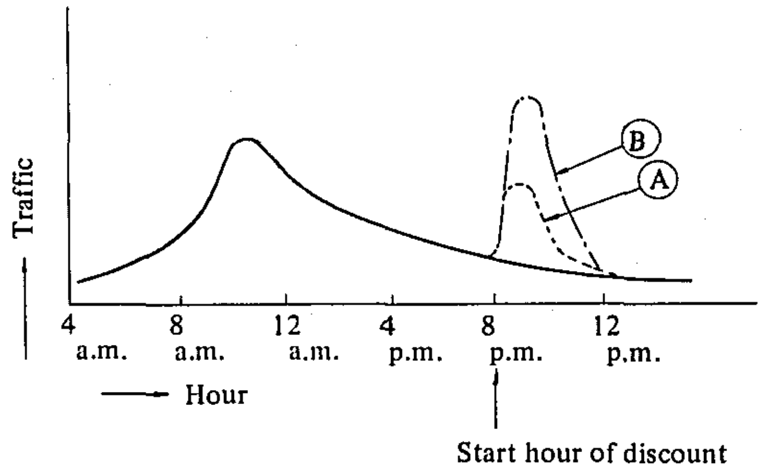


Fig. 3.3.2.1.(1)

(5) Change of Economic Situation

Telephones play a vital role in national economic activities. Therefore, when the economic activities are brisk the telephone traffic increases whereas the recession causes the telephone traffic to decrease. Especially during the times of recession the telephone charge economy may even be a major means of expenditure cutback.

3.3.2.2 Sharp and Temporary Traffic Charge

(1) Influence from Fire and Other Serious Accident

Fire and other serious accident may sometimes cause a sharp increase of telephone traffic. This kind of traffic is impossible to estimate because it takes place regardless of time and place. Traffic congestion will make special service telephones of fire and police stations unavailable. Inter-office junction lines will not operate as they ought due to traffic beyond their capacity and the resultant non-connection of telephones will generate confusion in part of the city. Such abnormal traffic occurrence may sometimes be limited to a specific area and sometimes cover the whole city. Confusion and unrest due to non-connection of telephones may even lead to a kind of social panic. Fig. 3.3.2.2.(1) and 3.3.2.2.(2) are the current discharge records at the exchange office power rooms on the occasion of the state of emergency proclaimed for the whole city of Jakarta on January 15, 1974. These records show that the abnormal traffic occurred about the time the riot took place and as the normal situation was restored at midnight the traffic also returned to the normal level.

(2) Influence from Radio and TV

A sharp increase or decrease of telephone traffic sometimes occurs under the influence of radio and TV programs. For instance, when a quiz program is offered by radio or TV and answers are to be sent by telephone to the braodcasting station, the exchange office that accommodates telephone lines to that broadcasting station has to handle a deluge of answer calls.

On the other hand, during the time a popular radio or TV program is being broadcast the telephone traffic sometimes shows a sharp decrease. On October 30, 1974, the world heavyweight title match between Muhammad Ali and George Foreman was held in Zaire, Africa, and this fight was televised in Jakarta also (from 10.00 to 11.00 a.m., Jakarta time). JTP carried out the telephone traffic survey during this time zone at Kebayoran Exchange Office. Usually this time zone makes the busy hour and the calling rate per subscriber at Kebayoran Exchange Office is 0.040-0.043 Erlang. On that day, however, traffic began to decrease sometime before the start and finally fell to a minimum of 0.021 Erlang though it returned to normal shortly after the fight, as shown in Fig. 3.3.2.2.(3) and Table 3.3.2.2.(4).

3.4 Subscriber Originating Calling Rate Estimate by Exchange Office for 1979, 1983, 1988 and 1993

3.4.1 General Formula for Calling Rate Forecast

In the calling rate forecast in Jakarta the formula (2) of Paragraph 3.3.1.3 was used. The values of coefficients g, f, m, a, b, c and d of the formula (2) were determined in consideration of the situation in Jakarta described below. When these coefficient values are substituted in the formula (2), formula (4) is produced. This formula (4) was used as the general formula for calling rate forecast in Jakarta.

As the telephone demand uptrend in Jakarta can be shown by $No\ e^{\frac{x}{10}}$ as in Fig. 3.4.1.(1), the assumption of $g = 1$ leads to the following expression:

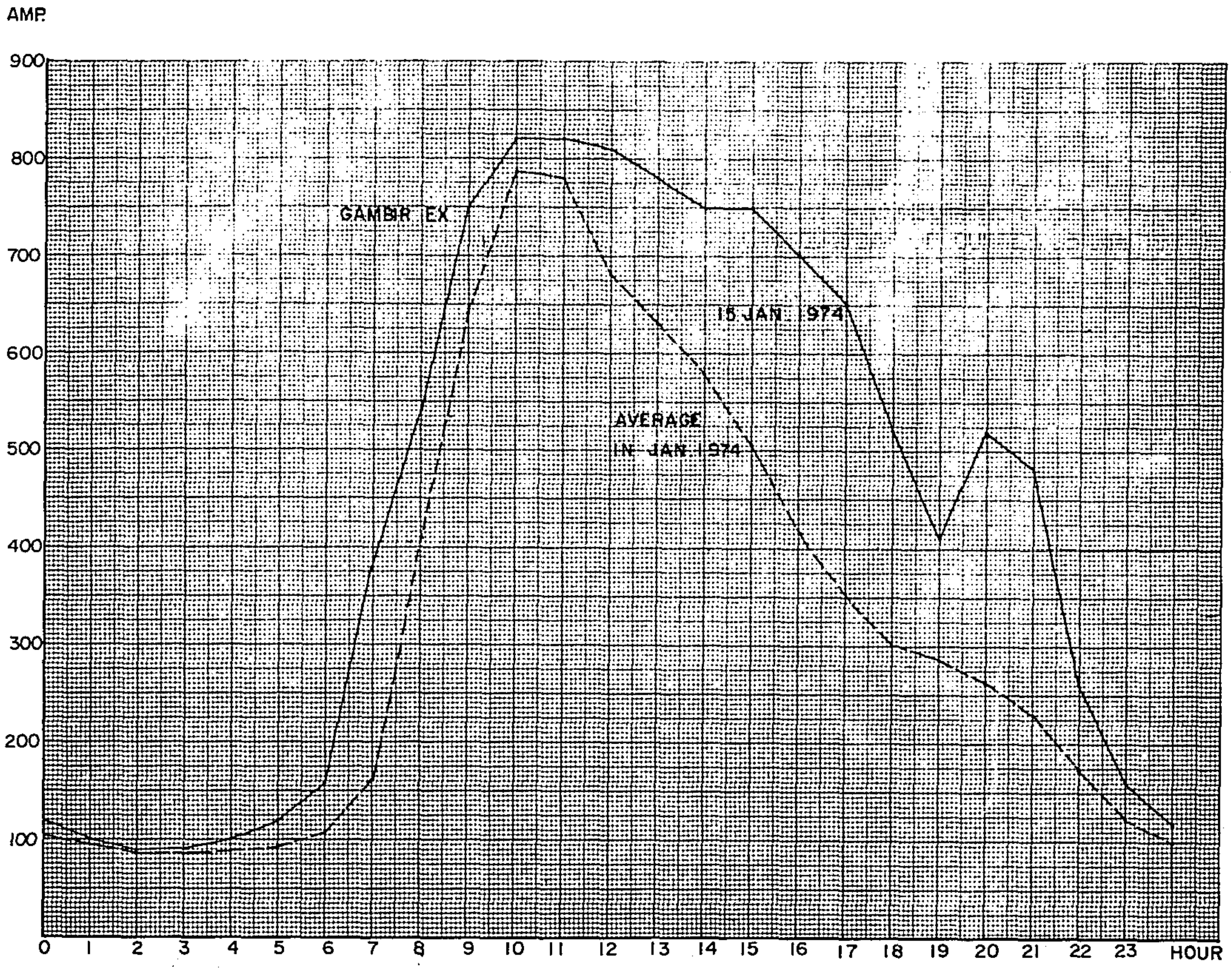


FIG. 3-3-2-2-(1) POWER CONSUMPTION CURVE UNDER THE DAY OF CURFEW (15 JAN. 1974)

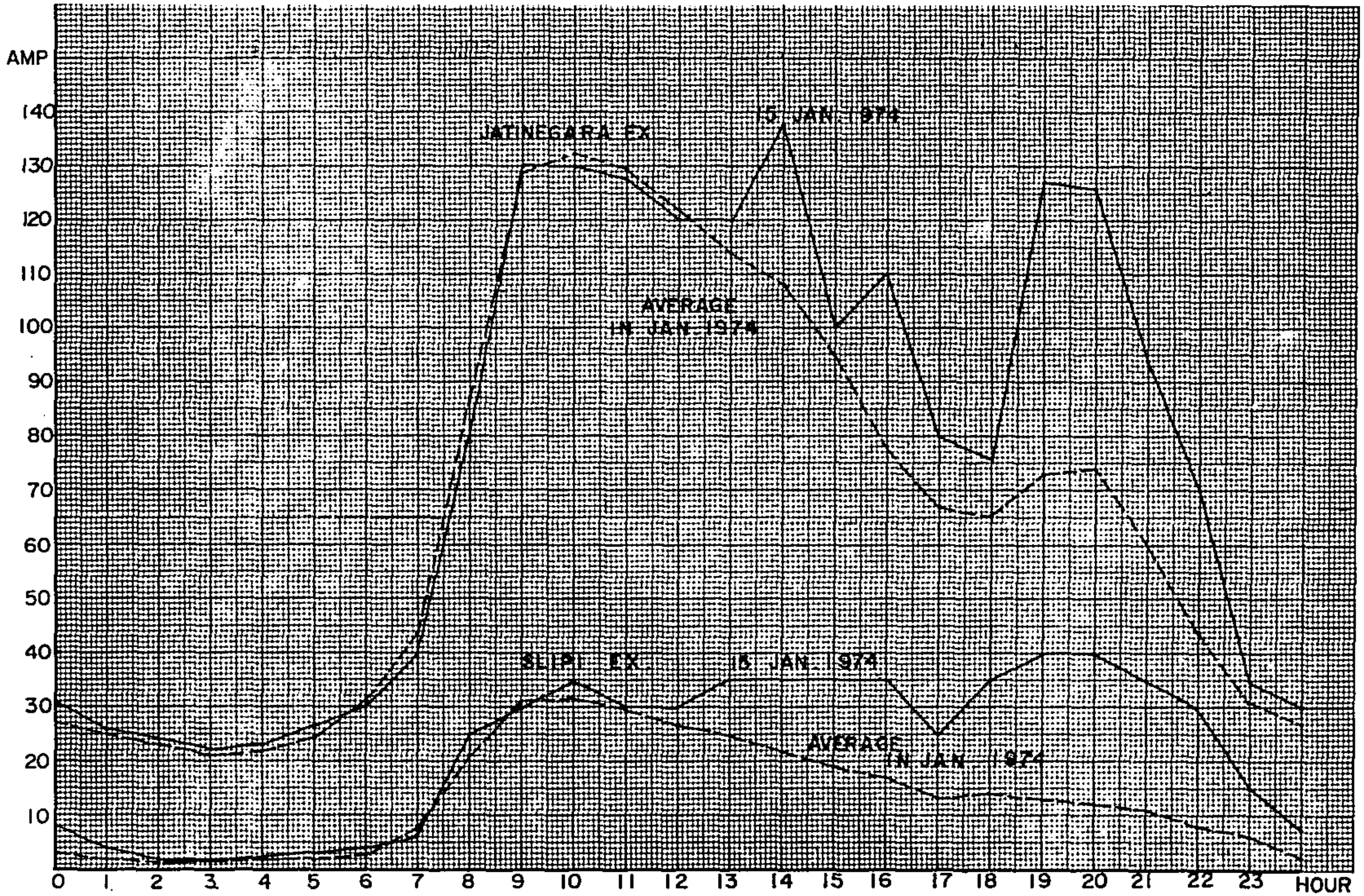


FIG. 3-3-2-2-(2) POWER CONSUMPTION CURVE UNDER THE DAY OF CURFEW (15 JAN. 1974)

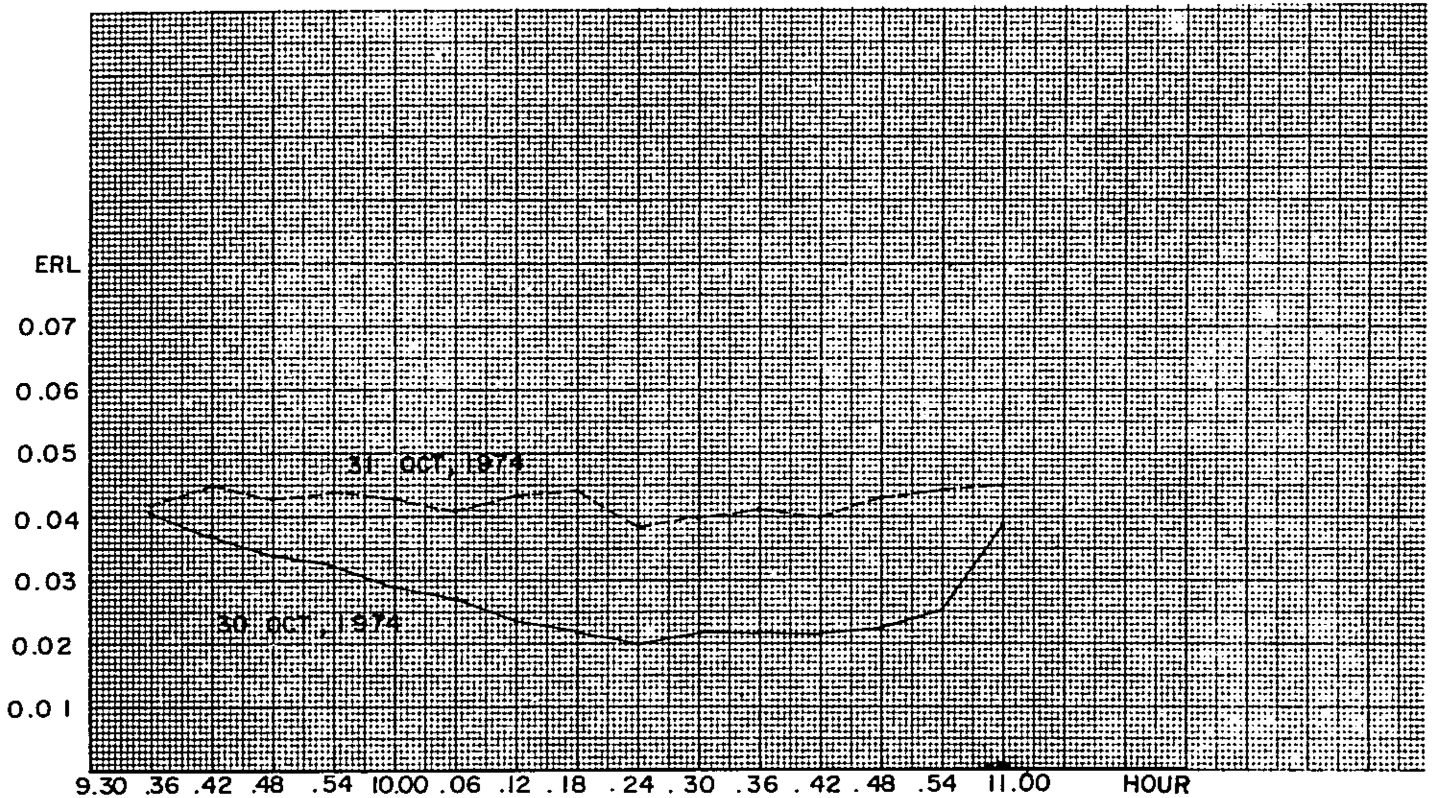


FIG.3-3-2-2-(3) KEBAYORAN OFFICE
AVERAGE ORIGINATING CALLING RATE
31. OCT. 1974

TABLE 3-3-2-2-(4) KEBAYORAN OFFICE

TRAFFIC FRACTUATION BY BOXING TITLE MATCH ON 30TH OCTOBER, 1974.

	1	2	3	4	A TOTAL	A/6,696
1	67	91	75	40	273	0.0408
2	70	82	54	45	251	0.0375
3	68	85	42	37	232	0.0346
4	57	76	52	32	217	0.0324
5	45	63	47	44	199	0.0297
6	46	60	43	34	183	0.0273
7	36	51	37	37	161	0.0240
8	35	50	41	28	154	0.0230
9	27	46	37	27	137	0.0205
10	25	54	37	29	145	0.0217
	476	658	465	353	1,952	0.0292

30 OCTOBER, 1974 ORIGINATING TRAFFIC

$$\frac{1,952}{10} = 195.2$$

$$\frac{195.2}{6,696} = 0.0292 \text{ ERL}$$

	1	2	3	4	B TOTAL	B/6,696
1	74	90	71	47	282	0.0421
2	89	98	68	50	305	0.0456
3	77	91	74	50	292	0.0436
4	75	96	72	53	296	0.0442
5	86	83	74	49	292	0.0436
6	77	76	68	54	275	0.0411
7	77	94	73	50	294	0.0439
8	77	84	75	59	295	0.0441
9	74	85	63	42	264	0.0394
10	76	80	66	47	269	0.0402
	782	877	704	501	2,864	0.04278

31 OCTOBER, 1974 ORIGINATING TRAFFIC

$$\frac{2,864}{10} = 286.4$$

$$\frac{286.4}{6,696} = 0.0428 \text{ ERL}$$

$$P = \left(1 - e^{-\frac{m}{10}}\right) \cdot ac \cdot \frac{e^{\frac{(1-m)i}{10}} - 1}{e^{\frac{1-m}{10}} - 1} \cdot e^{-\frac{i}{10}}$$

$$+ bde^{-\frac{fi}{10}} \left(e^{\frac{f}{10}} - 1\right) \cdot \frac{e^{\frac{(1+f)i}{10}} - 1}{e^{\frac{1+f}{10}} - 1} \cdot e^{-\frac{i}{10}}$$

$$+ ade^{-\frac{fi}{10}} \left(e^{\frac{f-m}{10}} - 1\right) \cdot \frac{e^{\frac{(1+f-m)i}{10}} - 1}{e^{\frac{1+f-m}{10}} - 1} \cdot e^{-\frac{i}{10}}$$

$$+ \left(ac^{-\frac{mi}{10}} + b\right) \quad \cdots\cdots\cdots\cdots\cdots\cdots \quad (3)$$

From the measurement data in Tokyo shown in Figure 3.4.1.(2) the following expression is produced:

$$\begin{cases} 0.8\, e^{-\frac{2}{10} i} + 0.2 \\ 1.3 - 0.3\, e^{-\frac{3}{10} i} \end{cases}$$

Namely,

$$\begin{cases} f = 3 \\ m = 2 \end{cases}$$

$$\begin{cases} a = 0.8 \\ b = 0.2 \end{cases}$$

$$\begin{cases} c = 1.3 \\ d = 0.3 \end{cases}$$

It is considered that the situation in Jakarta in and after 1976 will resemble one observed in Tokyo around 1958. Therefore, based on the originating calling rate trends in Tokyo and, furthermore, in search for greater safety, the coefficients were determined as follows:

[Refer to Fig. 3.4.1.(3).]

$$\begin{cases} 0.7\, e^{-\frac{i}{10}} + 0.3 \\ 1.4 - 0.4\, e^{-\frac{2}{10} i} \end{cases}$$

Namely,

$$\begin{cases} f = 1 \\ m = 1 \end{cases}$$

$$\begin{cases} a = 0.7 \\ b = 0.3 \end{cases}$$

$$\begin{cases} c = 1.4 \\ d = 0.4 \end{cases}$$

In case of m = 1,

$$\frac{e^{\frac{(1-m)i}{10}}-1}{e^{\frac{1-m}{10}}-1} \quad \text{in formula (3) becomes} \quad \frac{0}{0}$$

so that the calculation by $\frac{1-m}{10}=x$ produces:

$$\lim_{x\to 0}\frac{e^{xi}-1}{e^{x}-1}=\lim_{x\to 0}\frac{ie^{xi}}{e^{x}}=i$$

This further produces:

$$P=(1-e^{-\frac{1}{10}})\,acie^{-\frac{i}{10}}+bde^{-\frac{f}{10}i}\,(e^{\frac{f}{10}}-1)\frac{e^{\frac{1+f}{10}}-1}{e^{\frac{1+f}{10}}-1}\cdot e^{-\frac{i}{10}}$$

$$+ade^{-\frac{fi}{10}}(e^{\frac{f-1}{10}}-1)\frac{e^{\frac{f}{10}i}-1}{e^{\frac{f}{10}}-1}\cdot e^{-\frac{i}{10}}+(ae^{-\frac{i}{10}}+b)$$

When f = 2, a = 0.7, b = 0.3, c = 1.4 and d = 0.4 are substituted in the above formula, it follows:

$$P=(1-e^{-\frac{1}{10}})\times 0.7\times 1.4\,ie^{-\frac{i}{10}}+0.3\times 0.4\,e^{-\frac{2}{10}i}\,(e^{\frac{2}{10}}-1)\frac{e^{\frac{3}{10}i}-1}{e^{\frac{3}{10}}-1}\cdot e^{-\frac{i}{10}}$$

$$+0.7\times 0.4\,e^{-\frac{2}{10}i}\,(e^{\frac{1}{10}}-1)\frac{e^{\frac{2}{10}i}-1}{e^{\frac{2}{10}}-1}\cdot e^{-\frac{i}{10}}+(0.7e^{-\frac{i}{10}}+0.3)$$

Hence

$$P=(1-0.905)\times 0.98\,ie^{-\frac{i}{10}}+0.12e^{-\frac{3}{10}i}\,(1.221-1)\frac{e^{\frac{3}{10}i}-1}{1.35-1}$$

$$+0.28e^{-\frac{3}{10}i}\,(1.105-1)\frac{e^{\frac{2}{10}i}-1}{1.221-1}+0.7e^{-\frac{i}{10}}+0.3 \quad \cdots\cdots\cdots\cdots (4)$$

Table 3.4.1.(4) shows the values of Pi in the year i = 0 through the year i = 20 in formula (4).

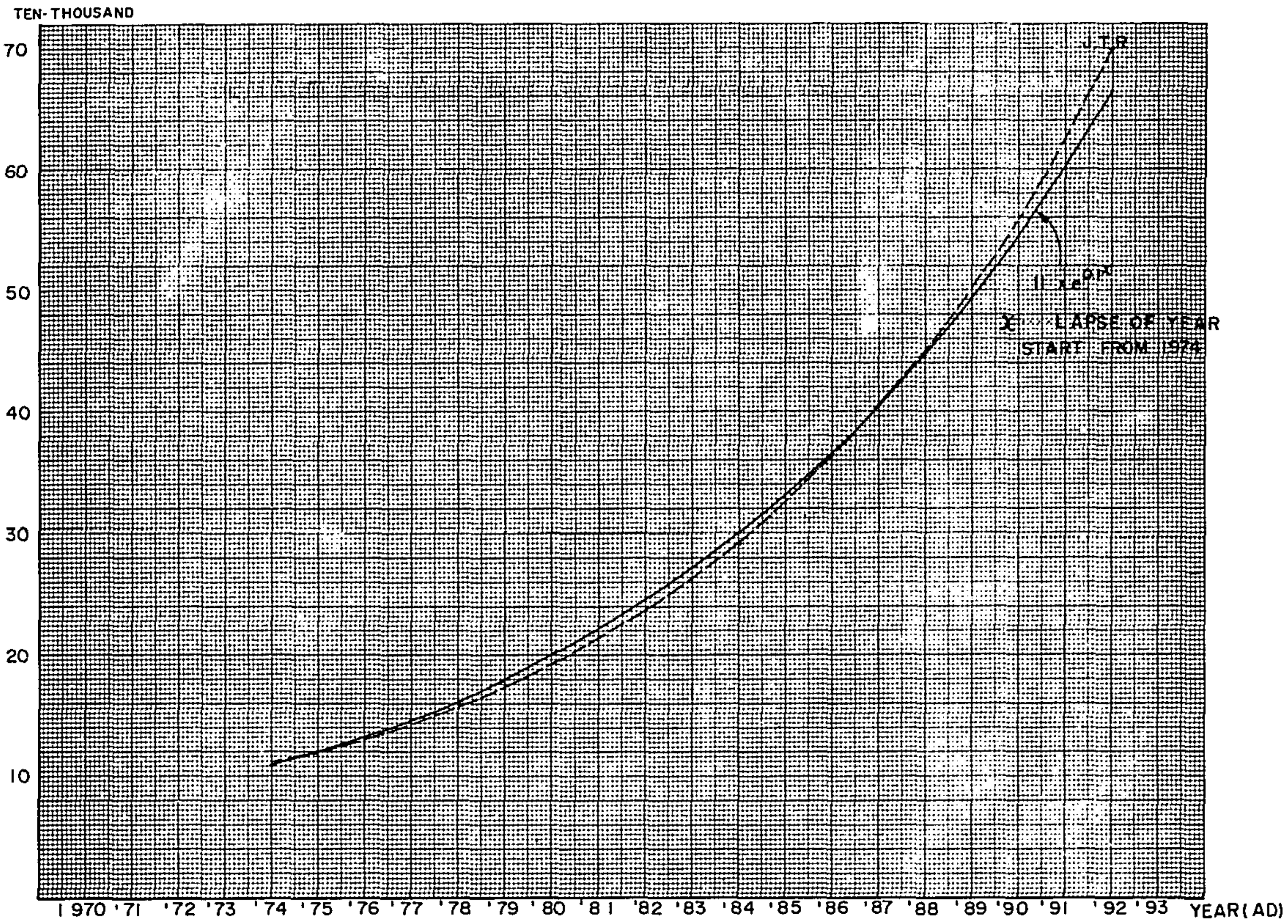


FIG. 3-4-1-(1) DEMAND FORECAST & EXPONENTIAL CURVE

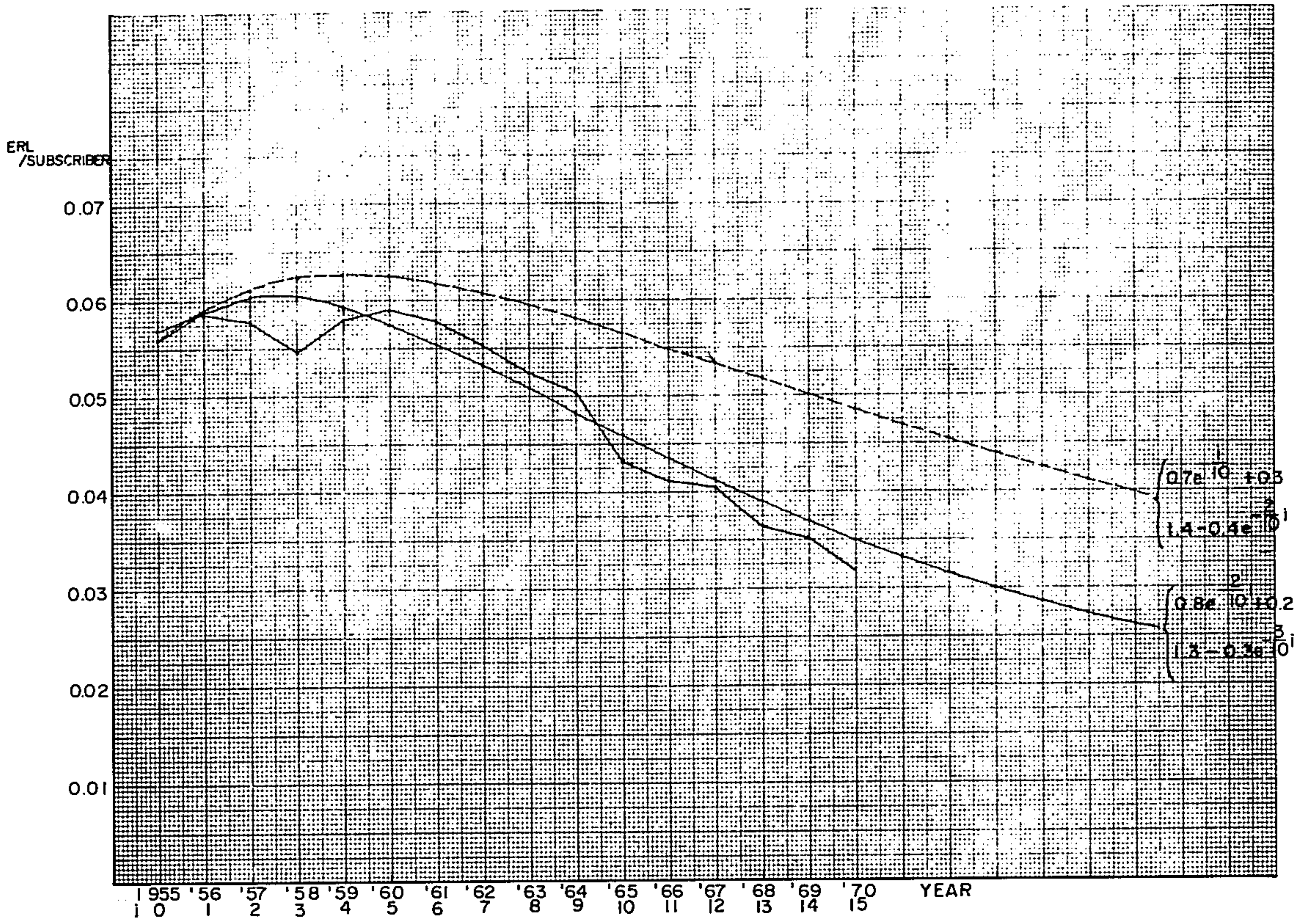


FIG.3-4-1-(2) TRANSITION OF ORIGINATING CALLING RATE PER SUBSCRIBER IN EVERY YEAR IN TOKYO

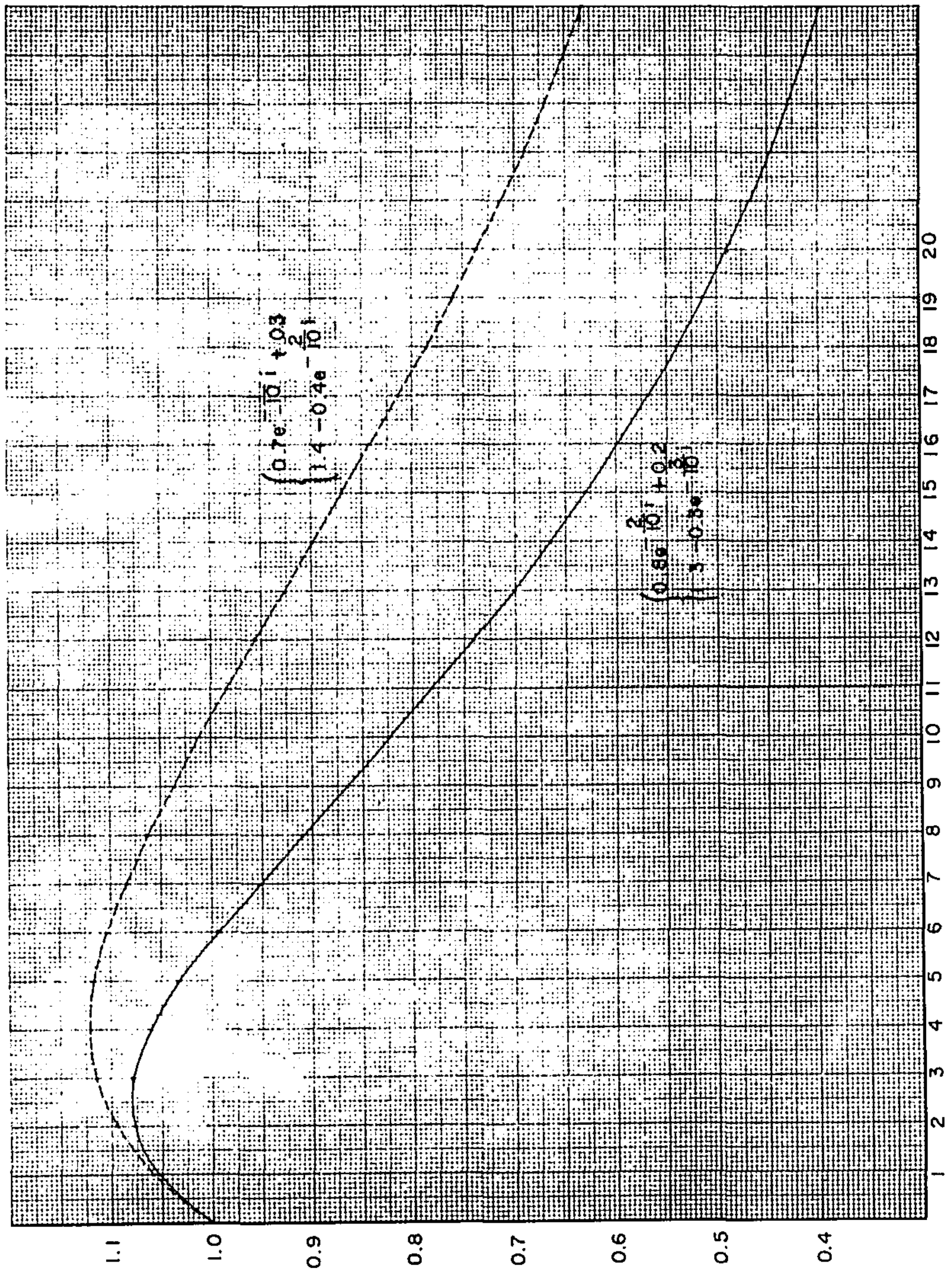


FIG. 3-4-1-(3)

Table 3.4.1.(4) Value of Pi

i	1973 0	1974 1	1975 2	1976 3	1977 4	1978 5	1979 6
Pi	*0.8968 0.99997	0.9499 1.05918	0.9828 1.09587	1.0000 1.115	1.00497 1.12054	1.0022 1.1174	0.9913 1.10531
i	1980 7	1981 8	1982 9	1983 10	1984 11	1985 12	1986 13
Pi	*0.9760 1.08819	0.9554 1.06527	0.9344 1.0418	0.9099 1.01451	0.8846 0.9863	0.8584 0.95708	0.8326 0.9284
i	* 1987 14	1988 15	1989 16	1990 17	1991 18	1992 19	1993 20
Pi	0.8067 0.8995	0.7808 0.87063	0.7561 0.8431	0.7317 0.8158	0.7073 0.78863	0.6855 0.7643	0.6629 0.73908

* Upper : ratio to 1976
Under : value of Pi

Table 3.4.2.(1) Coefficient Table

Year	Coefficient
1976	1.0000
1979	0.9913
1983	0.9099
1988	0.7808
1993	0.6629

TABLE 3-4-2-(2)
AVERAGE ORIGINATING CALLING RATE IN JAKARTA

NO	OFFICE \ YEAR	ESTIMATION 1976	1979	1983	1988	1993
1	KOTA. A	0.085	0.084	0.077	0.066	0.056
	KOTA B, C	0.085	0.084	0.077	0.066	0.056
2	ANCOI	0.055	0.055	0.050	0.043	0.036
3	PLUIT	0.055	0.055	0.050	0.043	0.036
4	CENGKARENG	0.045	0.045	0.041	0.035	0.030
5	TEGAI - AINR	0.035	0.035	0.032	0.027	0.023
6	GAMBIR. A	0.085	0.084	0.077	0.066	0.056
	GAMBIR. B	0.085	0.084	0.077	0.066	0.056
7	SEMANGGI. A	0.050	0.050	0.045	0.039	0.033
	SEMANGGI. B	0.050	0.050	0.045	0.039	0.033
8	SLIPI	0.050	0.050	0.045	0.039	0.033
9	PALMERAH	0.045	0.045	0.041	0.035	0.030
10	KEDOYA	0.040	0.040	0.036	0.031	0.027
11	MERUYA	0.040	0.040	0.036	0.031	0.027
12	CEMPAKAPUTIH	0.055	0.055	0.050	0.043	0.036
13	RAWAMANGUN	0.045	0.045	0.041	0.035	0.030
14	PULOGADUNG	0.045	0.045	0.041	0.035	0.030
15	PENGGILINGAN	0.045	0.045	0.041	0.035	0.030
16	TANJUNG PRIOK. A	0.065	0.064	0.059	0.051	0.043
	TANJUNG PRIOK. B	0.065	0.064	0.059	0.051	0.043
17	CILINCING.	0.055	0.055	0.050	0.042	0.036
18	KEBAYORAN. A	0.050	0.050	0.045	0.039	0.033
	KEBAYORAN. B	0.050	0.050	0.045	0.039	0.033
19	CIPETE	0.045	0.045	0.041	0.035	0.030
20	KALIBATA	0.045	0.045	0.041	0.035	0.030
21	PASAR MINGGU	0.040	0.040	0.036	0.031	0.027
22	JAGA KARSA.	0.035	0.035	0.032	0.027	0.023
23	JATINEGARA. A	0.055	0.055	0.050	0.043	0.036
	JATINEGARA. B	0.055	0.055	0.050	0.043	0.036
24	CAWANG	0.050	0.050	0.045	0.039	0.033
25	PASAR REBO	0.045	0.045	0.041	0.035	0.030
26	KLENBER	0.040	0.040	0.036	0.031	0.027
27	TEBET	0.050	0.050	0.045	0.039	0.033
28	GANDARIA	0.050	0.050	0.045	0.039	0.033
	AVERAGE C.R.	$\frac{8.828.7}{134.920}$ = 0.0654	$\frac{11.602.1}{180.590}$ = 0.0642	$\frac{15.245.18}{265.480}$ = 0.0574	$\frac{21.606.75}{450.450}$ = 0.0480	$\frac{31.708.4}{808.000}$ = 0.0392

3.4.2 Result of Calculation by General Formula

Using the magnification obtained from the value of pi as produced in Paragraph 3.4.1, the calling rate by year and by exchange office was calculated. The magnification for each year, based on the value for 1976, is as given in Table 3.4.2.(1). The value obtained by multiplying the 1976 calling rate of each exchange office by the above magnification appears in Table 3.4.2.(2). For the six exchange offices where the influence on traffic from the structural change of area pattern and the introduction of PBX is especially great the calculation was adjusted by another method.

3.4.3 Calling Rate in 1993 Estimated from Area Pattern

(1) Study of Area Pattern

For the six exchange offices shown in Table 3.4.3.(1) a great change is observed in the area pattern of 1993. For these six exchange offices the calling rate calculation was made by a special method taking the change of area pattern into consideration, without using the result of calculation by the general formula (Table 3.4.2.(2)).

(2) PBX Subscriber Ratio

The PBX subscriber ratio to total subscribers in the 0-1 area is set at approximately 50%. In the Tanjung Priok and Semanggi exchange office areas where very big business offices are not considered to exist the PBX subscriber ratio is set at 30% each.

(3) Calling Rate by Area Pattern

The calling rate in 1993 by each area pattern is determined as shown in Table 3.4.3.(2).

3.4.4 Adjustment of Result of Calculation by General Formula

(1) Calling Rate in 1993 by Area Pattern

The originating calling rates at the six exchange offices in 1993 calculated by area patterns are shown in Table 3.4.4.(1).

(2) Adjustment for 1983 and 1988

Based on the calling rate estimate for 1979 calculated by the general formula as shown in Table 3.4.2.(2) and the calling rate estimate for 1993 by area pattern as shown in Table 3.4.4.(1) the adjusted calling rates for 1983 and 1988 were obtained by the following formula:

Table 3.4.3.(1) Comparison of Demand in Area Pattern

No.	Office	Area pattern	%	
			1976	1993
1	Gambir	0	31.0	68.6
2	Semanggi	0	12.0	36.5
3	Rawamangun	0	2.2	12.0
4	Penggilingan	S.I	49.7	75.8
5	Tg. Priok	0	6.5	29.0
6	Cawang	0	10.7	18.3

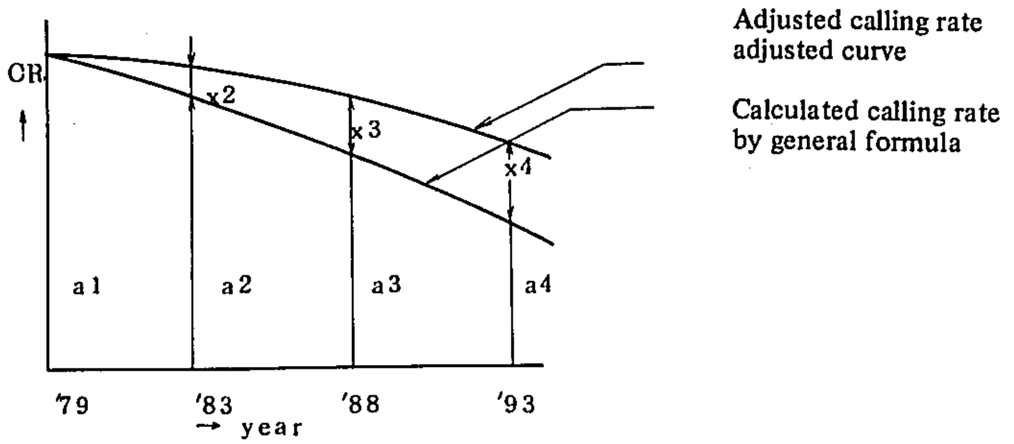
Table 3.4.3.(2) Calling Rate of Each Area Pattern

(in Erl)

Area pattern	Calling rate
0_1 (PBX)	0.223
0_1 (except PBX)	0.06
I_1	0.06
S_1	0.06
R	0.02
A	0.02
Others	0.05

Table 3.4.4.(1) Forecast of Calling Rate by Area Pattern in 1993

No.	Pattern / Office	0_1 C.R. = 0.223		0_1, I_1, S_1. C.R. = 0.06		R C.R. = 0.02		Others C.R. = 0.05		TOTAL C.R.
		%	C.R.	%	C.R.	%	C.R.	%	C.R.	
1	Gambir	19.7	0.044	23.1	0.014	23.3	0.005	33.9	0.017	0.080
2	Semanggi	9.8	0.022	45.8	0.027	35.0	0.007	9.4	0.0047	0.060
3	Rawamangun	5.9	0.013	8.0	0.005	69.6	0.014	16.5	0.008	0.040
4	Penggilingan	-	-	49.0	0.029	24.2	0.005	36.8	0.018	0.052
5	Tg. Priok	7.9	0.018	25.6	0.015	48.2	0.010	18.3	0.009	0.052
6	Cawang	6.7	0.015	6.7	0.004	71.2	0.014	15.4	0.008	0.041



$$x^3 = x^4 \frac{a^1 - a^3}{a^1 - a^4} = \frac{x4}{a^1 - a^4} (a^1 - a^3)$$

$$x^2 = x^3 \frac{a^1 - a^2}{a^1 - a^3} = \frac{x^4 (a^1 - a^3)}{a^1 - a^4} \cdot \frac{a^1 - a^2}{a^1 - a^3} = \frac{x^4}{a^1 - a^4} (a^1 - a^2)$$

$a^3 + x^3 =$ Adjusted calling rate for 1988

$a^2 + x^2 =$ Adjusted calling rate for 1983

(3) Result of Adjustment

The result of adjustment made by the method described in the foregoing is as follows:

Table 3.4.4.(2):	The originating calling rates at the six exchange offices calculated by the general formula.
Table 3.4.4.(3):	The adjusted originating calling rates at the six exchange offices.
Table 3.4.4.(4):	The adjusted originating calling rates (final estimates) by exchange offices and by years.
Fig. 3.4.4.(5):	The mean value comparison curve for the originating calling rate calculated by the general formula and the adjusted originating calling rate.

Table 3.4.4.(2) Calculated Calling Rate by General Equation

Office	1st calculation				
	1976	1979	1983	1988	1993
Gambir	0.085	0.084	0.077	0.066	0.056
Semanggi	0.050	0.050	0.045	0.039	0.033
Rawamangun	0.045	0.045	0.041	0.035	0.030
Penggilingan	0.045	0.045	0.041	0.035	0.030
Tanjung Priok	0.065	0.064	0.059	0.051	0.043
Cawang	0.050	0.050	0.045	0.039	0.033

Table 3.4.4.(3) Amended Originating Calling Rate by Area Pattern

Office	Amended value				
	1976	1979	1983	1988	1993
Gambir	0.085	0.084	0.083	0.081	0.080
Semanggi	0.050	0.050	0.053	0.056	0.060
Rawamangun	0.045	0.045	0.044	0.042	0.040
Penggilingan	0.045	0.045	0.047	0.050	0.052
Tanjung Priok	0.065	0.064	0.061	0.056	0.052
Cawang	0.050	0.050	0.048	0.044	0.041

TABLE 3-4-4-(4) AMENDED FINAL CALCULATION ORIGINATING CALLING RATE IN JAKARTA

NO	OFFICE \ YEAR	ESTIMATION 1976	1979	1983	1988	1993
1.	KOTA. A	0.085	0.084	0.077	0.066	0.056
	KOTA. B, C	0.085	0.084	0.077	0.066	0.056
	ANCOL	0.055	0.055	0.050	0.043	0.036
3	PLUIT	0.055	0.055	0.050	0.043	0.036
4	CENGKARENG	0.045	0.045	0.041	0.035	0.030
5	TEGAL-ALUR	0.035	0.035	0.032	0.027	0.023
6	GAMBIR. A	0.085	0.084	0.083	0.081	0.080
	GAMBIR. B	0.085	0.084	0.083	0.081	0.080
7	SEMANGGI. A	0.050	0.050	0.053	0.056	0.060
	SEMANGGI. B	0.050	0.050	0.053	0.056	0.060
8	SLIPI	0.050	0.050	0.045	0.039	0.033
9	PALMERAH	0.045	0.045	0.041	0.035	0.030
10	KEDOYA	0.040	0.040	0.036	0.031	0.027
11	MERUYA	0.040	0.040	0.036	0.031	0.027
12	CEMPAKAPUTIH	0.055	0.055	0.050	0.043	0.036
13	RAWAMANGUN	0.045	0.045	0.044	0.042	0.040
14	PULOGADUNG	0.045	0.045	0.041	0.035	0.030
15	PENGGILINGAN	0.045	0.045	0.047	0.050	0.052
16	TANJUNG PRIOK. A	0.065	0.064	0.061	0.056	0.052
	TANJUNG PRIOK. B	0.065	0.064	0.061	0.056	0.052
17	CILICING	0.055	0.055	0.050	0.042	0.036
18	KEBAYORAN. A	0.050	0.050	0.045	0.039	0.033
	KEBAYORAN. B	0.050	0.050	0.045	0.039	0.033
19	CIPETE	0.045	0.045	0.041	0.035	0.030
20	KALIBATA	0.045	0.045	0.041	0.035	0.030
21	PASARMINGGU	0.040	0.040	0.036	0.031	0.027
22	JAGAKARSA	0.035	0.035	0.032	0.027	0.023
23	JATINEGARA. A	0.055	0.055	0.050	0.043	0.036
	JATINEGARA. B	0.055	0.055	0.050	0.043	0.036
24	CAWANG	0.050	0.050	0.048	0.044	0.041
25	PASAR REBO	0.045	0.045	0.041	0.035	0.030
26	KLENDER	0.040	0.040	0.036	0.031	0.027
27	TEBET	0.050	0.050	0.045	0.039	0.033
28	GANDARIA	0.050	0.050	0.045	0.039	0.033
	AVERAGE CR.	$\frac{8828.7}{134,920}$ = 0.0654	$\frac{11,602.1}{180,590}$ = 0.0642	$\frac{15,768.2}{265,480}$ = 0.0594	$\frac{23,494.4}{450,450}$ = 0.0521	$\frac{36,539.1}{808,000}$ = 0.0452

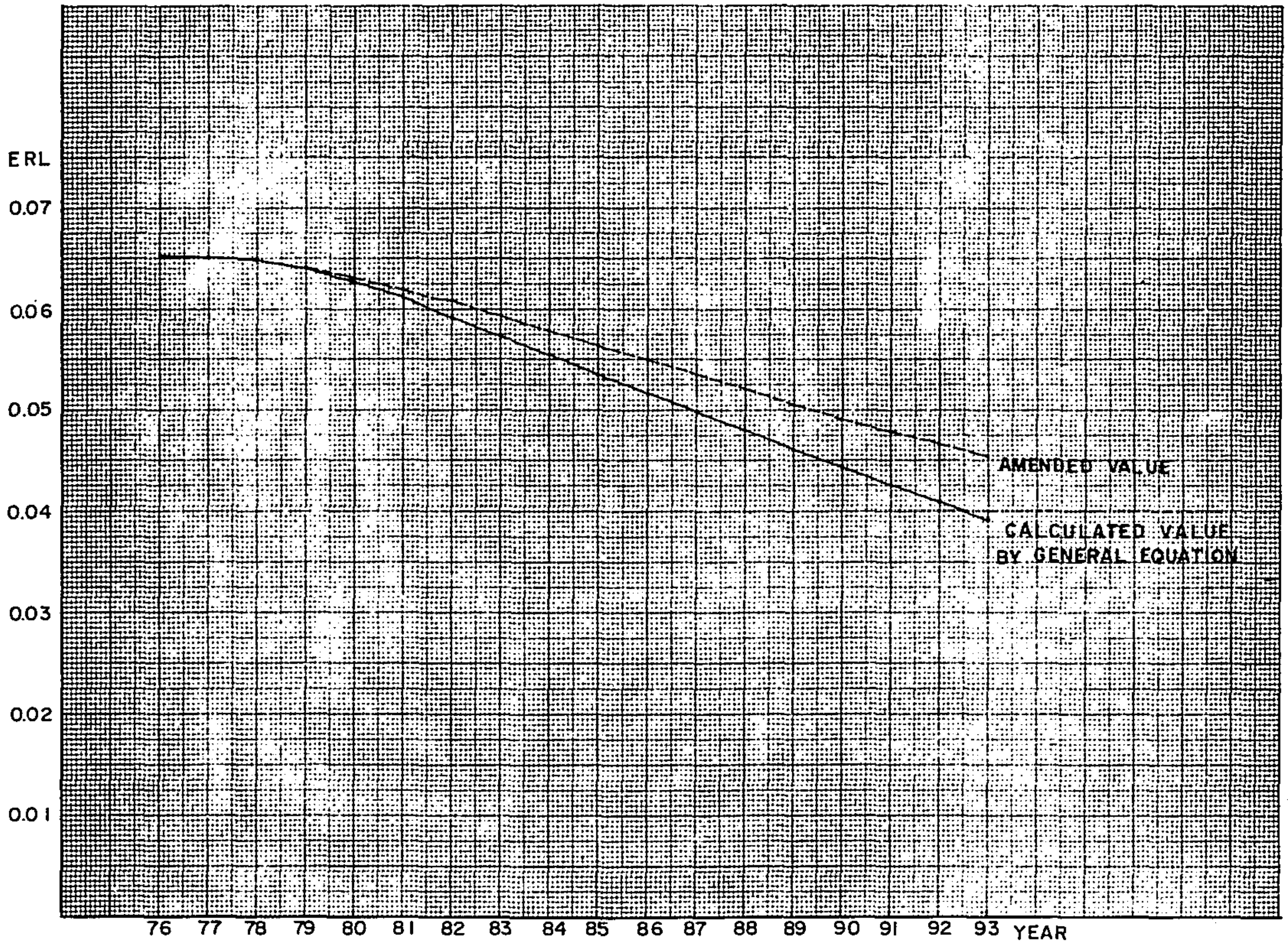


FIG. 3-4-4-(5) AVERAGE ORIGINATING CALLING RATE IN JAKARTA

3.5 Telephone Traffic Management

Traffic management is important for telephone business in establishing various plans. Telephone enterprise must carry out traffic management for the purpose of sound corporate management and provision of service.

3.5.1 Traffic Management Work

The flow of work relevant to traffic management is shown in Fig. 3.5.1.(1).

3.5.2 Traffic Data Formulation

Traffic forecast at high accuracy is extremely difficult. To make reliable traffic forecast the utilization of time series data is necessary. For this purpose it is important to collect data produced at the same standard and keep them in store as time series data. Personnel in charge must be properly trained and educated and the responsible person must be designated. Measuring instruments and necessary papers must be kept in good order so that they can be used whenever necessity arises.

3.5.3 Telephone Traffic Forecast

As stated previously the telephone traffic varies with time, influenced by the social and economic conditions in General. To make reliable traffic forecast a constant study of past investigations and forecast results is essential. A comparative study of recent and past data is also important. When the change of traffic is considered to have occurred the cause of change must be thoroughly investigated so that the finding can be reflected in a new traffic forecast. Based on the traffic forecast thus produced the exchange office and junction line construction plans are made and the construction works are carried out.

3.5.4 Traffic Measurement

Even after the telephone service has started the traffic measurement must be continued and the data obtained must be kept in good custody as time series data. These data must be fully utilized to check whether the working switching facilities and junction lines are carrying traffic at the prescribed service grade or not. When the surplus or deficit condition of facilities against traffic has been detected the remedial action must be taken immediately so as to ensure the satisfactory telephone service.

3.5.5 Evaluation of Forecast

Traffic forecast is carried out to obtain basic data for a long term telephone service planning. The evaluation of data obtained is made generally in the form of comparison between the forecasted value and the real value. Since the forecast errors can be minimized by long-term investigations and accumulated technical experience, the result of traffic

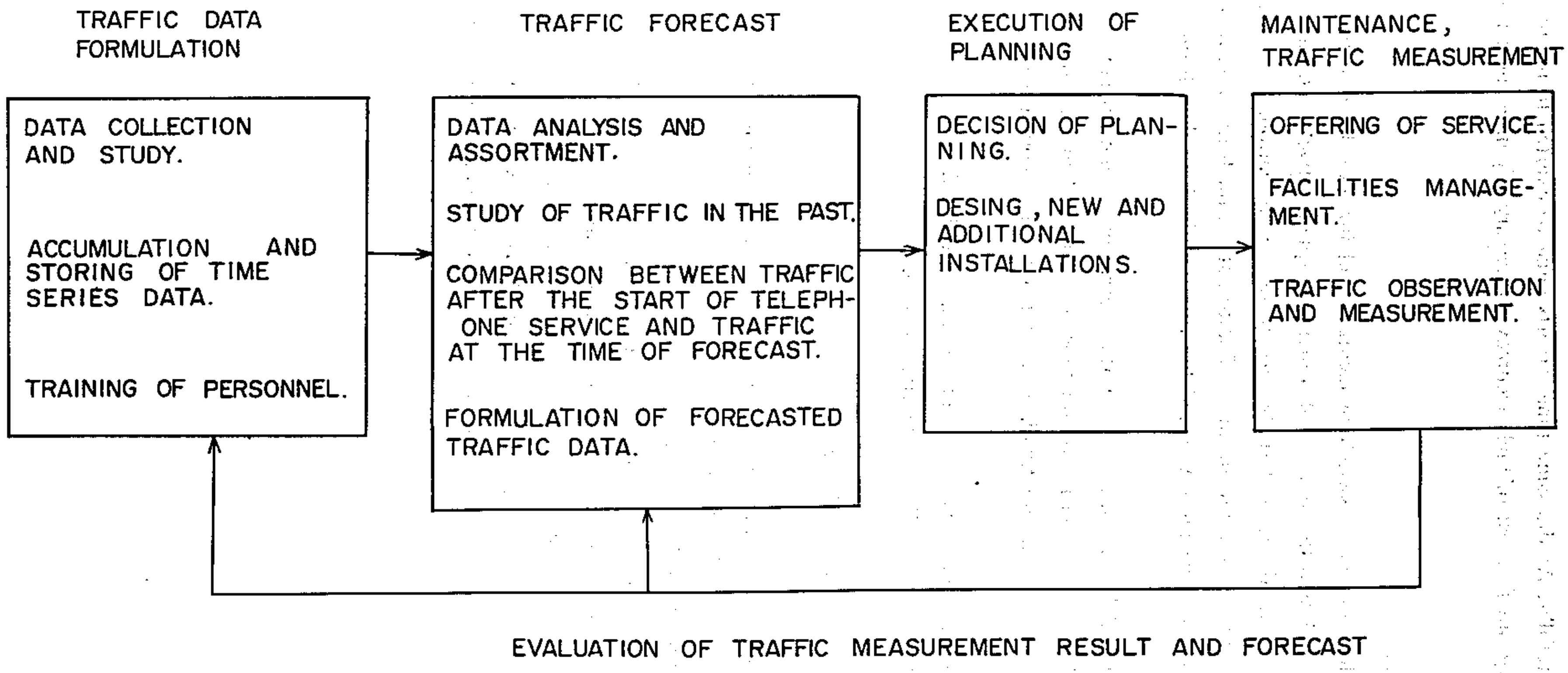


FIG. 3-5-1-(1) TRAFFIC MANAGEMENT WORK

forecast must be studied carefully. At the same time, efforts must be exerted to improve traffic management and carry out forecast of high accuracy. Necessary expenses must not be spared either.

3.6 Introduction of Computer

With the increase in the number of switching facilities and junction lines installed the data collection, analysis and assortment work also increases quantitatively. To handle this large volume of work efficiently it is desirable to introduce the automatic traffic measuring equipment and computer for the purpose of automatic data formulation. By this means the work efficiency can be improved and the time required for data formulation can be reduced.

Measurement data produced by the automatic traffic measuring equipment are automatically processed into perforated information on the tape. The tape is then applied to the computer. The computer processed data are finalized as statistics. Main contents of such statistics are:

a) Traffic volume by time handled by junction lines and switching facilities.

b) Operating efficiency of junction lines and switching facilities.

c) Call completion rate

d) Traffic concentration rate to busy hour.

e) Holding time of calls.

Computerization of traffic measurement work, which has the foregoing merits, nevertheless requires consideration in the following points:

a) A huge amount of fund must be invested.

b) No small number of personnel in charge of traffic management will be idled.

Therefore, it is proposed that the traffic management by manual measurement be adopted and consolidated at the initial stage and the adoption of automatic traffic measuring equipment be considered at a later opportune occasion. It is further proposed that after the coming into full operation of the automatic traffic measuring equipment the introduction of computer be studied.

CHAPTER 4

TELEPHONE TRAFFIC FLOW FORECAST

CHAPTER 4 TELEPHONE TRAFFIC FLOW FORECAST

4.1 Composition of Originating Call

Originating calls by year and by exchange office as forecasted in Chapter 3, Section 4, comprise the following three kinds of calls:

a) Local call

b) SLDD call

c) Special service call

To obtain the calling rate of each of these three kinds of calls we firstly forecasted the average calling rate of SLDD calls and of special service calls and then calculated the average calling rate of local calls by subtracting the average calling rates of SLDD calls and special service calls from the average originating calling rate of each exchange office. That is to say,

Average originating calling rate	−	Average calling rate of SLDD calls	−	Average calling rate of special service calls	=	Average calling rate of local calls

4.1.1 Calling Rate of SLDD Calls

4.1.1.1 Basic Data

SLDD data as shown in Table 4.1.1.1.(1) and Table 4.1.1.1.(2) were obtained from PERUMTEL. From these data the traffic calculation was made, using coefficients mentioned in Paragraphs (1) and (2) below. The mean value of all calculated values was used as basic data. Table 4.1.1.1.(3) contains the basic data.

Table 4.1.1.1.(2) No.2 Data of SLDD Call

Item \ Year	1969	1970	1971	1972	1973	Note
No. of sub's	26,600	30,900	33,800	36,600	38,900	
No. of calls	602,756	953,574	1,278,992	1,624,716	1,979,621	
Calls/sub	22.66	30.86	37.84	44.39	50.89	
Holding time (sec)	200	203	210	219	223	
C.R. (Erl)	0.000503	0.000695	0.000881	0.001079	0.001259	*c/325x11%x HT/3600x1.18

TABLE 4-1-1-1-(1) NO.1 DATA OF SLDD CALL

	YEAR	1970	1971	1972	1973	NOTE
ITEM	NO.OF SUB'S	30,800	33,900	36,600	38,900	
NO. OF CALLS	JKT - BD	773,406	1,060,182	1,271,627	1,617,708	1. JUN'67 S
	" - CBM	——	35,302 x (12/6) = 70,604	142,353	211,023	28. JUN'71 S
	" - SM (JOG)	——	——	183,691 x (12/9)=244,922	549,954	29. MAR'72 S
	" - DPR	——	——	——	61,337 x (12/9.6)=76,672	11. MAR'73 S
	TOTAL	773,406	1,130,786	1,658,902	2,455,357	
PULSE x SEC	JKT - BD	52,299,886x3=156,899,658	73,080,106x3=219,240,318	90,346,276x3=271,038,828	114,138,107x3=342,414,321	
	" - CBM	——	2,980,532x3x(12/6)= 17,883,192	10,209,932x3=30,629,796	15,652,274x3=46,956,822	
	" - SM (JOG)	——	——	22,569,153x2x(12/9) =60,184,408	68,820,697x2=137,641,394	
	" - DPR	——	——	——	7,745,919x2x(12/9.6) =19,364,798	
	TOTAL	156,899,658	237,123,510	361,853,032	546,377,335	
HOLDING TIME (SEC)		203	210	219	223	PULSE x SEC/CALLS
CALLS / SUB		25,1	33,4	45,3	63,1	
CR. (ERL)		0.000565	0.000778	0.001101	0.001561	C/325x11%xHT/3600x 1.18

NOTE. ( ) : AMENDMENT COEFFICIENT TO YEARLY VALUE BECAUSE THIS OFFICE STARTS ON MIDWAY OF THE YEAR.

C/325x11%xHT/3600x1.18

- C — CALLS/SUB
- HT — HOLDING TIME
- 1.18 — AMENDMENT COEFFICIENT FROM EFFECTIVE TRAFFIC TO OFFERED TRAFFIC. (SEE PARA 4-1-1-1)
- 11% — CONCENTRATION RATE OF BUSY HOUR (SEE 3-1-3)
- 325 — AMENDMENT COEFFICIENT FROM YEARLY CALLS TO DAILY CALLS. (SEE PARA 4-1-1-1)

Table 4.1.1.1.(3) Basic data for SLDD

(in Erl)

Table \ Year	1969	1970	1971	1972	1973
4.1.1.1.(1)	-	0.000565	0.000778	0.001101	0.001561
4.1.1.1.(2)	0.000503	0.000695	0.000881	0.001079	0.001259
Average	0.000503	0.00063	0.00083	0.00109	0.00141

(1) Adjustment Coefficient to Convert Annual Number of Calls into Daily Number of Calls

This adjustment coefficient was obtained, using Gambir and Kebayoran exchange offices as pilot cases. First the full day discharge volume for each day of the week minus basic discharge volume was calculated. Then the discharge volume for Saturday, Sunday and holiday, being smaller than that for any other weekday, was adjusted.

Gambir Exchange Office:

Day of Week	Full Day Discharge Volume AH)
Monday	9012.64
Tuesday	8791.56
Wednesday	8904.09
Thursday	8835.76
Friday	8782.49
Total	44326.54
Saturday	7653.16
Sunday	3929.79

Basic discharge volume 86.1 AH

Kebayoran Exchange Office:

Day of Week	Full Day Discharge Volume AH)
Monday	2822.16
Tuesday	2749.64
Wednesday	2830.16
Thursday	2877.61
Friday	2758.91
Total	14038.48
Saturday	2580.39
Sunday	2119.65

Basic discharge volume 44.2 AH

a) Gambir Exchange Office

Monday to Friday:

$$44326.5/5 - (86.1 \times 24) = 6798.9$$

Saturday:

$$7653.2 - (86.1 \times 24) = 5586.8$$

Sunday:

$$3929.8 - (86.1 \times 24) = 1863.4$$

Saturday versus ordinary day ratio:

$$\frac{5586.8}{6798.9} = 0.8$$

Sunday versus ordinary day ratio:

$$\frac{1863.4}{6798.9} = 0.3$$

$$1 \times 5 + 0.8 + 0.3 = 6.1$$

$$365 \times \frac{6.1}{7} = 318.1$$

When eight holidays per year are considered

318.1 - 8 x (1 - 0.3) = 312.5 .... 313 days

b) Kebayoran Exchange Office

Monday to Friday:

$$14038.5/5 - (44.2 \times 24) = 1746.9$$

Saturday:

$$2580.4 - (44.2 \times 24) = 1519.6$$

Sunday:

$$2119.7 - (44.2 \times 24) = 1058.9$$

Saturday versus ordinary day ratio:

$$\frac{1519.6}{1746.9} = 0.9$$

Sunday versus ordinary day ratio:

$$\frac{1058.9}{1746.9} = 0.6$$

$$1 \times 5 + 0.9 + 0.6 = 6.5$$

$$365 \times \frac{6.5}{7} = 338.9$$

When eight holidays per year are considered

338.9 - 8 x (1 - 0.6) = 335.7......336 days

(313 + 336)/2 = 324.5 ....325 days

Hence, 325 was used as a coefficient to obtain the daily number of calls from the annual number of calls.

(2) Coefficient to Convert Effective Traffic into offered Traffic (including failure calls)

This conversion coefficient was calculated from holding time measurement data. Shown below is the offered traffic versus effective traffic ratio on the assumption that the call with holding time of 31 sec. or more is the success call and the call with holding time of 30 sec. or less is the failure call.

	Average Holding Time	Number of Calls	Traffic
31 sec. or more	216.3 sec.	138	8.29 Erl.
30 sec or less	11.2 sec.	481	1.5 Erl.
Total		619	9.79 Erl.

$$\frac{9.79}{8.29} = 1.18$$

Hence 1.18 was used as a coefficient to convert effective traffic into offered traffic.

4.1.1.2 Forecast Method

(1) Long-term Forecast Method

The future SLDD traffic from the long-term angle can be expressed by the logistic curve. The forecast by the logistic curve proves to be successful in not a few cases in Japan and Europe so that the logistic curve is used in our forecast also.

Logistic curve : $y = \frac{K}{1 + me^{-ax}}$

where

x	:	Year
y	:	Calling rate
k	:	0.0063

The result of calculation using the 1970-73 SLDD basic data (Table 4.1.1.1.(3)) as input data is shown in Table 4.1.1.2.(1) and Figure 4.1.1.2.(3).

(2) Short-term Forecast Method

For the short-term SLDD traffic forecast it is more effective to use the regression curve than to use the logistic curve. Here, in the SLDD traffic forecast up to 1980, the regression curve is used.

Regression curve: $y = a\,x^{b}$

where

x : Year

Y : Calling rate

The result of calculation using the 1970-73 SLDD basic data (Table 4.1.1.1.(3)) as input data is shown in Table 4.1.1.2.(2) and Fig. 4.1.1.2.(3).

Hence, in the SLDD calling rate forecast, the short-term forecast method is used for the period up to 1980 and the long-term forecast method is used for the period from 1981. The result of forecast appears in Table 4.1.1.2.(4).

TABLE 4-1-1-2-(1)

IN PUT

YEAR	1970	1971	1972	1973
X	0	1	2	3
Y	0.00063	0.00083	0.00109	0.00141

K = 0.0063

M = 9.0836

A = 0.3178

OUT PUT

YEAR	X	Y
1970	0	0.00063
'71	1	0.00083
'72	2	0.00109
'73	3	0.00141
'74	4	0.00178
'75	5	0.00218
'76	6	0.00261
'77	7	0.00306
'78	8	0.00351
'79	9	0.00396
'80	10	0.00437
'81	11	0.00474
'82	12	0.00509
'83	13	0.00538
'84	14	0.00564
'85	15	0.00584
'86	16	0.00599
'87	17	0.00610
'88	18	0.00618
'89	19	0.00622
'90	20	0.00624
'91	21	0.00627
'92	22	0.00628
'93	23	0.00629
'94	24	0.00631

GRAPHED OUTPUT DATA IS SHOWN ON FIG.4-1-1-2-(3)

TABLE 4-1-1-2-(2)

$Y = a x^b + C$

IN PUT

YEAR	1970	1971	1972	1973
X	0	1	2	3
Y	0.00063	0.00083	0.00109	0.00141

a = 0.000125

b = 0.141405

C = 0.000503

OUT PUT

YEAR	X	Y
1970	0	0.000628
'71	1	0.000837
'72	2	0.001096
'73	3	0.001393
'74	4	0.001724
'75	5	0.002083
'76	6	0.002467
'77	7	0.002875
'78	8	0.003305
'79	9	0.003754
'80	10	0.004225
'81	11	0.004712
'82	12	0.005217
'83	13	0.005737
'84	14	0.006274
'85	15	0.006825
'86	16	0.007391
'87	17	0.007971
'88	18	0.008564
'89	19	0.009171

GRAPHED OUTPUT DATA IS SHOWN ON FIG. 4-1-1-2-(3)

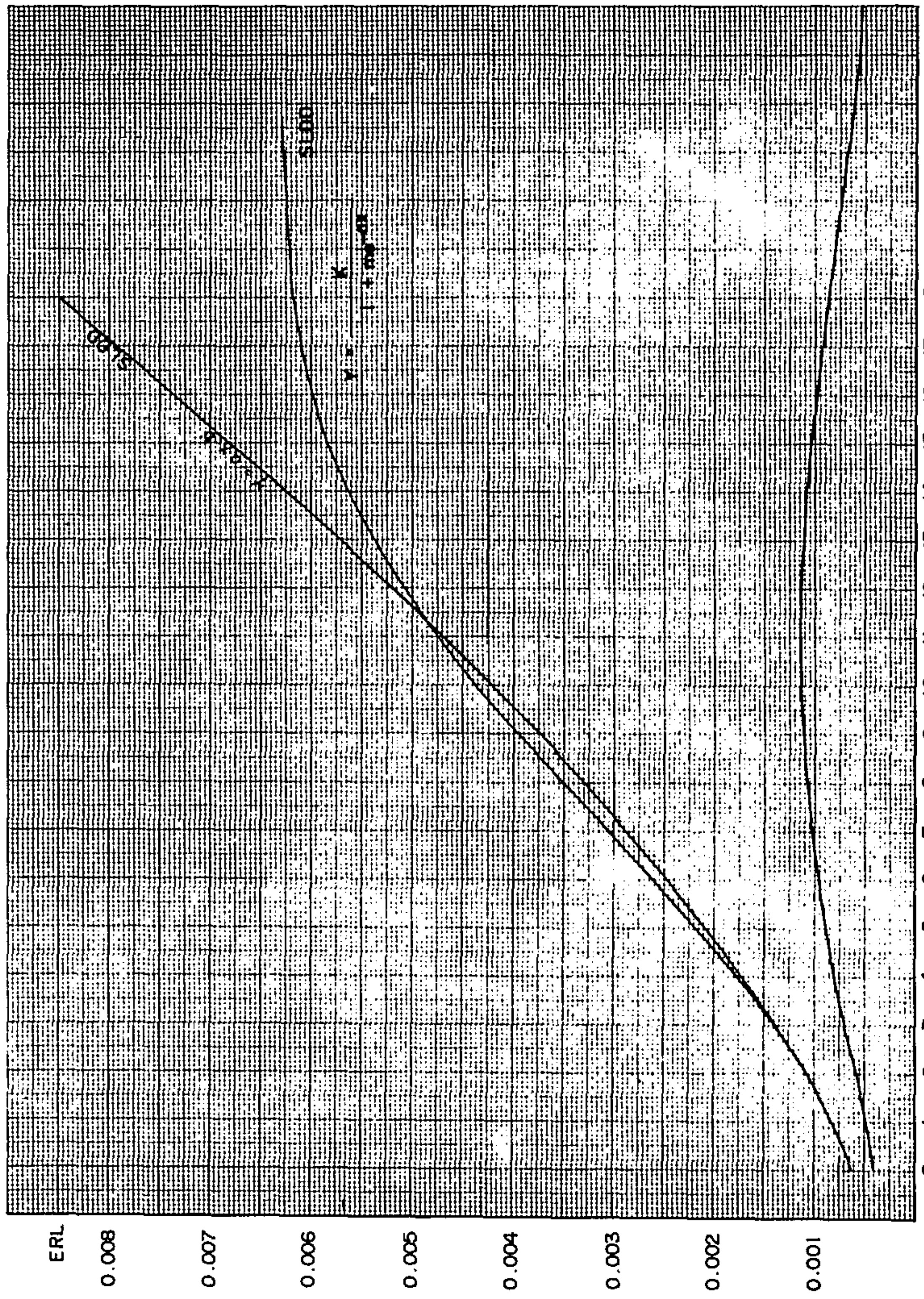

ERL
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
YEAR
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
SL100
SL100

FIG. 4-1-1-2-(3)

Table 4.1.1.2.(4) Forecast of SLDD Calling Rate

(in Erl)

Year	1979	1983	1988	1993
C R	0.00375	0.00538	0.00618	0.00629

4.1.2 Calling Rate of Special Service Calls

4.1.2.1 Basic Data

From special service call data obtained from PERUMTEL (Table 4.1.2.(1)) the basic data (Table 4.1.2.(2)) was prepared.

4.1.2.2 Forecast Method

The special service calling rate in Jakarta will continue a mild increase for the time being. However, with the expansion of SLDD service area the uptrend of special service traffic will halt and then the downtrend will begin. In our forecast it is presumed that the special service calls will reach the peak in 1979 through 1983 at the latest as the result of the SLDD service area expansion. The situation in Jakarta in that year will be similar to that in the government office and commercial districts of Tokyo in or around 1967. Therefore, it was decided that the special service calling rate of 0.0011 Erlang in those districts of Tokyo in 1967 would be applicable to Jakarta in 1979 through 1983. It is further presumed that the special service calling rate in Jakarta in and after 1984 will continue the downtrend to reach 0.0005 Erlang around 1995. This value is determined from the basic data and the calling rate trend in Tokyo. The result of forecast of the special service calling rate in Jakarta is given in Table 4.1.2.(3).

Table 4.1.2.(2) Basic Data of "10X" Calling Rate

(in Erl)

Year	1970	1971	1972	1973
C.R.	0.000400	0.000491	0.000585	0.000699

Table 4.1.2.(3) Forecast of "10X" Calling Rate

(in Erl)

Year	1979	1983	1988	1993
C.R.	0.00111	0.00111	0.000865	0.000592

TABLE 4-1-2-(1) "10X" CALL

	ITEM \ YEAR	1970	1971	1972	1973	
INT. LOCAL	CALLS/YEAR	422,882	492,070	552,324	643,020	
	SUB'S	30,800	33,900	36,600	38,900	
	CALLS / SUB	13.73	14.52	15.09	16.53	C1
	HOLDING TIME	203 SEC	210	219	223	H1
	C R.	0.000309	0.000339	0.000367	0.000409	*1
INT. NATIONAL	CALLS / YEAR	63,515	115,409	178,685	252,052	
	CALLS / SUB	2.06	3.40	4.88	6.48	C2
	HOLDING TIME	404 SEC	404	404	404	H2
	C R.	0.000091	0.000152	0.000218	0.000290	*2
TOTAL		0.000400	0.000491	0.000585	0.000699	

*1 $C1/325 \times 11\% \times H1/3600 \times 1.18$

*2 $C2/325 \times 11\% \times H2/3600 \times 1.18$

4.1.3 Calling Rate of Local Calls

The calling rate of local calls was obtained by the method specified in Section 4.1. That is to say, the SLDD calling rate and special service calling rate obtained as per the foregoing were subtracted from the average originating calling rate (Table 4.1.3.(1)). The forecast of local originating calling rate by year is given in Table 4.1.3.(2).

Table 4.1.3.(2) Local Calling Rate

(in Erl)

Year	1979	1983	1988	1993
C.R.	0.05934	0.05291	0.04506	0.038318

Table 4.1.4.(1) Formation of Calls

(in Erl)

	1979	1983	1988	1993
LOC	0.05934	0.05291	0.04506	0.038318
SLDD	0.00375	0.00538	0.00618	0.00629
"10X"	0.00111	0.0111	0.000865	0.000592
Total	0.0642	0.0594	0.0521	0.0452

Table 4.1.4.(2) Composition of Calling Rate

(in %)

	1979	1983	1988	1993
LOC	92.43	89.07	86.49	84.77
SLDD	5.84	9.06	11.85	13.92
"10X"	1.73	1.87	1.66	1.31
Total	100.00	100.00	100.00	100.00

4.1.4 Calling Rate Composite Ratio

The calling rate composition of each kind of call in each base year is given in Table 4.1.4.(1). From this calling rate composition the calling rate composite ratio was obtained. The composite ratio thus obtained is shown in Table 4.1.4.(2).

4.2 Traffic flow Measurement

For the inter-office traffic flow forecast it is desirable that the time series data on traffic flow of the existing exchange offices are available as basic data. This time, however, such time series data could not be obtained so that we had to measure the inter-office traffic flow

TABLE 4-1-3-(1) 1/4 ORIGINATING AVERAGE CALLING RATE AND TRAFFIC IN JAKARTA (IN ERL)

E : EMD SYSTEM
N : NEW SYSTEM NO.1

	OFFICE	SYSTEM	1979 (PERUMTEL)			1979 (J.T.P)			1983 (J.T.P)			1983 (J.T.P)			1993 (J.T.P)		
			SUB'S	CR.	TRAFFIC	SUB'S	CR.	TRAFFIC	SUB'S	CR.	TRAFFIC	SUB'S	CR.	TRAFFIC	SUB'S	CR.	TRAFFIC
1	KOTA A I	E	9,700	0.084	814.8	8,500	0.084	714.0	8,500	0.077	654.5	8,500	0.056	561.0	8,500	0.056	476.0
2	〃 II	E	–	–	–	–	–	–	2,600	0.077	200.2	6,600	0.066	435.6	12,400	0.056	694.4
3	KOTA B I	E	9,700	0.084	814.8	9,700	0.084	814.8	6,500	0.077	500.5	9,700	0.066	640.2	9,700	0.056	543.2
4	〃 II	E	9,700	0.084	814.8	9,700	0.084	814.8	6,500	0.077	500.5	9,700	0.066	640.2	9,700	0.056	543.2
5	〃 III	E	9,700	0.084	814.8	6,700	0.084	562.8	4,600	0.077	354.2	6,700	0.066	442.2	6,700	0.056	375.2
6	〃 IV	N	–	–	–	–	–	–	1,500	0.077	115.5	7,700	0.066	508.2	22,000	0.056	1,232.0
7	〃 V	N	–	–	–	–	–	–	–	–	–	–	–	–	9,000	0.056	504.0
8	KOTA C I	N	–	–	–	–	–	–	16,200	0.077	1,247.4	18,000	0.066	1,188.0	22,000	0.056	1,232.0
9	〃 II	N	–	–	–	–	–	–	1,800	0.077	138.6	8,400	0.066	554.4	17,400	0.056	974.4
10	〃 III	N	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
11	ANCOL I	E	5,820	0.055	320.1	4,400	0.055	242.0	4,400	0.050	220.0	4,400	0.043	189.2	4,400	0.036	158.4
12	〃 II	N	–	–	–	–	–	–	3,100	0.050	155.0	10,100	0.043	434.3	23,900	0.036	860.4
13	PLUIT I	E	7,760	0.055	426.8	5,700	0.055	313.5	5,700	0.050	285.0	5,700	0.043	245.1	5,700	0.036	205.2
14	〃 II	N	–	–	–	–	–	–	2,300	0.050	115.0	6,500	0.043	279.5	13,100	0.036	471.6
15	CENGKARENG I	E	5,820	0.045	261.9	1,300	0.045	58.5	1,300	0.041	53.3	1,300	0.035	45.5	1,300	0.030	39.0
16	〃 II	N	–	–	–	–	–	–	1,250	0.041	51.3	4,700	0.035	164.5	13,300	0.030	399.0
17	TEGAL ALUR I	E	970	0.035	34.0	730	0.035	25.6	730	0.032	23.4	730	0.027	19.7	730	0.023	16.8
18	〃 II	N	–	–	–	–	–	–	770	0.032	24.6	3,070	0.027	82.9	8,570	0.023	197.1
19	GAMBIR A I	E	9,700	0.084	814.8	9,700	0.084	814.8	9,700	0.083	805.1	9,700	0.081	785.7	9,700	0.080	776.0
20	〃 II	E	9,700	0.084	814.8	8,000	0.084	672.0	8,000	0.083	664.0	8,000	0.081	648.0	8,000	0.080	640.0
21	〃 III	N	–	–	–	–	–	–	4,800	0.083	398.4	13,800	0.081	1,117.8	15,000	0.080	1,200.0
22	〃 IV	N	–	–	–	–	–	–	–	–	–	–	–	–	11,000	0.080	880.0
23	〃 V	N	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
24	GAMBIR I	E	9,700	0.084	814.8	9,700	0.084	814.8	9,700	0.083	805.1	9,700	0.081	785.7	9,700	0.080	776.0
25	〃 II	E	9,700	0.084	814.8	9,500	0.084	798.0	9,500	0.083	788.5	9,500	0.081	769.5	9,500	0.080	760.0

TABLE 4-1-3-(1) 2/4 ORIGINATING AVERAGE CALLING RATE AND TRAFFIC IN JAKARTA (IN ERL)

*1 KEDOYA
*2 MERUYA
*3 PENGGILINGAN NO.2

	OFFICE	SYSTEM	1979 (PERUMTEL)			1979 (J.T.P)			1983 (J.T.P)			1988 (J.T.P)			1993 (J.T.P)		
			SUB'S	CR.	TRAFFIC	SUB'S	CR.	TRAFFIC	SUB'S	CR.	TRAFFIC	SUB'S	CR.	TRAFFIC	SUB'S	CR.	TRAFFIC
26	GAMBIR B III	E	7,760	0.084	651.8	–	–	–	–	–	–	–	–	–	–	–	–
27	〃 IV	N	–	–	–	–	–	–	6,300	0.083	522.9	15,000	0.081	1,215.0	15,000	0.080	1,200.0
28	〃 V	N	–	–	–	–	–	–	–	–	–	1,800	0.081	145.8	15,000	0.080	1,200.0
29	〃 VI	N	–	–	–	–	–	–	–	–	–	–	–	–	3,000	0.080	240.0
30	SEMANGGI A I	E	9,700	0.050	485.0	9,700	0.050	485.0	9,700	0.053	514.1	9,700	0.056	543.2	9,700	0.060	582.0
31	〃 II	E	9,700	0.050	485.0	5,250	0.050	262.5	5,250	0.053	278.3	5,250	0.056	294.0	5,250	0.060	315.0
32	〃 III	E	1,940	0.050	97.0	–	–	–	–	–	–	–	–	–	–	–	–
33	〃 IV	N	–	–	–	–	–	–	5,900	0.053	312.7	7,500	0.056	420.0	21,150	0.060	1,269.0
34	SEMANGGI B I	N	–	–	–	–	–	–	–	–	–	9,700	0.056	543.2	14,900	0.060	894.0
35	SLIPI I	E	9,700	0.050	485.0	*1 9,080	0.050	454.0	9,080	0.045	408.6	9,080	0.039	354.1	9,080	0.033	299.6
36	〃 II	N	–	–	–	–	–	–	3,920	0.045	176.4	12,220	0.039	476.6	26,020	0.033	858.7
37	〃 III	N	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
38	PALMERAH I	E	9,700	0.045	436.5	*2 3,670	0.045	165.2	3,670	0.041	150.5	3,670	0.035	128.5	3,670	0.030	110.1
39	〃 II	N	–	–	–	–	–	–	1,630	0.041	66.8	8,030	0.035	281.1	22,330	0.030	669.9
40	KEDOYA	N	–	–	–	–	0.040	–	1,080	0.036	38.9	3,200	0.031	99.2	10,100	0.027	272.7
41	MERUYA	N	–	–	–	–	0.040	–	1,600	0.036	57.6	4,300	0.031	133.3	11,800	0.027	318.6
42	CEMPAKA PUTIH I	E	9,700	0.055	533.5	9,700	0.055	533.5	9,700	0.050	485.0	9,700	0.043	417.1	9,700	0.036	349.2
43	〃 II	E	4,850	0.055	266.8	1,000	0.055	55.0	1,000	0.050	50.0	1,000	0.043	43.0	1,000	0.036	36.0
44	〃 III	N	–	–	–	–	–	–	4,500	0.050	225.0	13,000	0.043	559.0	29,500	0.036	1,062.0
45	〃 IV	N	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
46	RAWAMANGUN I	E	3,880	0.045	174.6	*3 4,520	0.045	203.4	4,520	0.044	198.9	4,520	0.042	189.8	4,520	0.040	180.8
47	〃 II	N	–	–	–	–	–	–	1,980	0.044	87.1	7,480	0.042	314.2	17,380	0.040	695.2
48	PULOGADUNG I	E	3,880	0.045	174.6	470	0.045	21.2	470	0.041	19.3	470	0.035	16.5	470	0.030	14.1
45	〃 II	N	–	–	–	–	–	–	530	0.041	21.7	2,130	0.035	74.6	6,430	0.030	192.9
50	PENGGILINGAN	N	–	–	–	–	0.045	–	1,150	0.047	54.1	3,100	0.050	155.0	8,300	0.052	431.6

TABLE 4-1-3-(1) 3/4 ORIGINATING AVERAGE CALLING RATE AND TRAFFIC IN JAKARTA (IN ERL)

NO. 3

	OFFICE	SYSTEM	1979 (PERUMTEL)			1979 (J.T.P)			1983 (J.T.P)			1988 (J.T.P)			1993 (J.T.P)		
			SUB'S	CR.	TRAFFIC	SUB'S	CR.	TRAFFIC	SUB'S	CR.	TRAFFIC	SUB'S	CR.	TRAFFIC	SUB'S	CR.	TRAFFIC
51	TG. PRIOK A I	E	5,820	0.064	372.5	8,300	0.064	531.2	7,900	0.061	481.9	8,300	0.056	464.8	8,300	0.052	431.6
52	〃 II	N	-	-	-	-	-	-	-	-	-	7,700	0.056	431.2	24,200	0.052	1,258.4
53	TG. PRIOK B I	N	-	-	-	-	-	-	6,500	0.061	396.5	13,500	0.056	756.0	22,000	0.052	1,144.0
54	〃 II	N	-	-	-	-	-	-	-	-	-	-	-	-	7,000	0.052	364.0
55	CILINCING I	E	970	0.055	53.4	870	0.055	47.9	870	0.050	43.5	870	0.042	36.5	870	0.036	31.3
56	〃 II	N	-	-	-	-	-	-	930	0.050	46.5	3,730	0.042	156.7	10,830	0.036	389.9
57	KEBAYORAN A I	E	9,700	0.050	485.0	9,700	0.050	485.0	7,700	0.045	346.5	9,700	0.039	378.3	9,700	0.033	320.1
58	〃 II	E	9,700	0.050	485.0	6,400	0.050	320.0	5,000	0.045	225.0	6,400	0.039	249.6	6,400	0.033	211.2
59	〃 III	N	-	-	-	-	-	-	2,700	0.045	121.5	4,100	0.039	159.9	9,900	0.033	326.7
60	KEBAYORAN B I	N	-	-	-	-	-	-	5,200	0.045	234.0	9,300	0.039	362.7	15,600	0.033	514.8
61	CIPETE I	E	6,790	0.045	305.6	2,400	0.045	108.0	2,400	0.041	98.4	2,400	0.035	84.0	2,400	0.030	72.0
62	〃 III	N	-	-	-	-	-	-	1,700	0.041	69.7	5,600	0.035	196.0	13,300	0.030	399.0
63	KALIBATA I	E	4,850	0.045	218.3	4,550	0.045	204.8	4,550	0.041	186.6	4,550	0.035	159.3	4,550	0.030	136.5
64	〃 II	N	-	-	-	-	-	-	2,950	0.041	121.0	10,150	0.035	355.3	24,650	0.030	739.5
65	PASAR MINGGU I	E	5,820	0.040	232.8	1,600	0.040	64.0	1,600	0.036	57.6	1,600	0.031	49.6	1,600	0.027	43.2
66	〃 II	N	-	-	-	-	-	-	1,150	0.036	41.4	4 000	0.031	124.0	9 800	0.027	264.6
67	JAGAKARSA I	E	970	0.035	34.0	550	0.035	19.3	550	0.032	17.6	550	0.027	14.9	550	0.023	12.7
68	〃 II	N	-	-	-	-	-	-	500	0.032	16.0	1,900	0.027	51.3	5,250	0.023	120.8
69	JATINEGARA A I	E	3,880	0.055	213.4	3,500	0.055	192.5	3,500	0.050	175.0	3,500	0.043	150.5	3,500	0.036	126.0
70	〃 II	N	-	-	-	-	-	-	2,400	0.050	120.0	6,600	0.043	283.8	14,200	0.036	511.2
71	JATINEGARA B I	E	9,700	0.055	533.5	6,100	0.055	335.5	6,100	0.050	305.0	6,100	0.043	262.3	6,100	0.036	219.6
72	〃 II	E	5 820	0.055	320.1	-	-	-	-	-	-	-	-	-	-	-	-
73	〃 III	N	-	-	-	-	-	-	2,700	0.050	135.0	7,200	0.043	309.6	13,900	0.036	500.4
74	CAWANG I	E	6,790	0.050	339.5	2,300	0.050	115.0	2,300	0.048	110.4	2,300	0.044	101.2	2,300	0.041	94.3
75	〃 II	N	-	-	-	-	-	-	1,900	0.048	91.2	7,700	0.044	338.8	22,300	0.041	914.3

TABLE 4-1-3-(1) 4/4 ORIGINATING AVERAGE CALLING RATE AND TRAFFIC IN JAKARTA (IN ERL)

NO. 4

	OFFICE		SYSTEM	1979 (PERUMTEL)			1979 (J.T.P)			1983 (J.T.P)			1988 (J.T.P)			1993 (J.T.P)		
				SUB'S	CR.	TRAFFIC	SUB'S	CR.	TRAFFIC	SUB'S	CR.	TRAFFIC	SUB'S	CR.	TRAFFIC	SUB'S	CR.	TRAFFIC
76	PASAR REBO	I	E	3,880	0.045	174.6	910	0.045	41.0	910	0.041	37.3	910	0.035	31.9	910	0.030	27.3
77	〃	II	N	–	–	–	–	–	–	790	0.041	32.4	3,890	0.035	136.2	14,490	0.030	434.7
78	KLENDER	I	E	3,880	0.040	155.2	700	0.040	28.0	700	0.036	25.2	700	0.031	21.7	700	0.027	18.9
79	〃	II	N	–	–	–	–	–	–	1,100	0.036	39.6	5,300	0.031	164.3	19,600	0.027	529.2
80	TEBET	I	E	9,700	0.050	485.0	4,950	0.050	247.5	4,950	0.045	222.8	4,950	0.039	193.1	4,950	0.033	163.4
81	〃	II	E	2,910	0.050	145.5	–	–	–	–	–	–	–	–	–	–	–	–
82	〃	III	N	–	–	–	–	–	–	2 950	0.045	132.8	9,750	0.039	380.3	22,750	0.033	750.8
83	GANDARIA	I	E	1,940	0.050	97.0	740	0.050	37.0	740	0.045	33.3	740	0.039	28.9	740	0.033	24.4
84	〃	II	N	–	–	–	–	–	–	810	0.045	36.5	3,110	0.039	121.3	9,060	0.033	299.0
	TOTAL			261,900	0.061	16,001.4	180,590	0.0642	11,602.1	265,480	0.0594	15,768.2	450,450	0.0521	23,494.4	808,000	0.0452	36,539.1

by ourselves. The result of measurement is given in Table 4.2.(1) through Table 4.2.(4). By the study of the measurement data it was found that the traffic flow forecast formula introduced in the following section could be used. Hence this formula was used in the forecast of inter-office traffic flow in Jakarta.

4.3 Traffic Flow Forecast Formula

Local traffic flow between each two local offices in the multioffice area is determined by the inter-office distance and the local economic and social relationship. Shown below is the general formula for traffic flow forecast.

Assume that:

- o "Ti" signifies the local originating traffic from office i;
- o "Tj" signifies the local originating traffic from office j;
- o "Tij" signifies the traffic originating from office i and terminating at office j;
- o "lij" signifies the crow-flight distance (km) between office i and office j;
- o "a" signifies the constant for the city concerned;
- o "bij" signifies the coefficient determined by special relationship between office i and office j:
- o "e-alij" signifies the inter-office coefficient determined by the distance between office i and office j.

Then, Tij is obtained as follows:

$$Tij = Ti \times \frac{Tjbij e^{-a\ell ij}}{T1bi1 \cdot e^{-a\ell i1} + T2bi2 \cdot e^{-a\ell i2} + \cdots\cdots + Tibii + \cdots\cdots + Tnbin \cdot e^{-a\ell in}}$$

$$= Ti \times \frac{Tjbij \cdot e^{-a\ell ij}}{\sum_{x=1}^{n} Txbix \cdot e^{-a\ell ix}}$$

However, since the inter-office special relationship in Jakarta could not be know exactly, the value of bij is set at 1 in the following forecast formula:

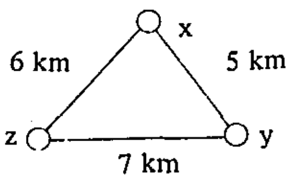
$$Tij = Ti \times \frac{Tj \cdot e^{-a\ell ij}}{T1 \cdot e^{-a\ell i1} + T2 \cdot e^{-a\ell i2} + \cdots\cdots + Ti + \cdots\cdots + Tn \cdot e^{-a\ell in}}$$

$$= Ti \times \frac{Tj \cdot e^{-a\ell ij}}{\sum_{x=1}^{n} Tx \cdot e^{-a\ell ix}}$$

Here the value of a is set at 0.1. The reason is that the future municipal pattern of Jakarta is considered to be similar to that of a big city in Japan. Hence the decision of a, based on the mean value among big cities in Japan. The inter-office coefficient by distance in the case of a = 0.1 is shown in Table 4.3.(1) and Fig. 4.3.(2).

An example of calculation follows:

In the case illustrated below



where

originating traffic	Tx	=	400 Erl.
	Ty	=	300 Erl.
	Tz	=	200 Erl.
furthermore	a	=	0.1
	bij	=	1

the inter-office traffic flow calculated by the formula mentioned above is as shown in Fig. 4.3.(3).

4.4 Inter-office Traffic Flow Forecasts in 1979, 1983, 1988 and 1993

The inter-office traffic flow in each base year was calculated by computer.

4.4.1 Input Data to Computer

1) Number of subscribers and average originating calling rate of each exchange office. (Table 4.1.3.(1).)
2) Composite ratio of each calling rate. (Tabel 4.1.4.(2).)
3) Inter-office crow-flight distance (km). (Table 4.4.1.(1).)

The traffic flow forecast as of 1979 was made in two cases. One was based on the supply plan (completed in 1974) of PERUMTEL and the other on our own demand forecast.

The input data to computer was made according to the following conditions for each exchange office:

1) Traffic flow from new system and that from EMD system are classified as follows:

New system ——→ New system
New system ——→ EMD system
EMD system ——→ New system
EMD system ——→ EMD system

2) Subscriber accommodation rate of each unit is:

New system	100%
EMD system	97%

3) Capacity limit of each unit is:

New system	1250 Erl. + 2%
EMD system	9700 LU., maximum

4.4.2 Output Data from Computer

Traffic flow data made by computer calculation are shown in Table 4.4.2.(1) through Table 4.4.2.(4).

TABLE 4-2-(1) JUNCTION TRAFFIC FLOW

TERMINATING OFFICE	ORIGINATING OFFICE	NUMBER OF JUNCTION	TRAFFIC IN ERL.	NOTE
KOTA.	KOTA (INT)	—	364.5	
	TG. PRIOK	10	3.1	
	TG. PRIOK (ORW)	142	44.6	
	GAMBIR	480	263.4	
	KEBAYORAN	75	26.0	
	JATINEGARA	45	25.6	
	TOTAL	752	727.2	
TG. PRIOK	KOTA	228	61.8	
	TG. PRIOK (INT)	—	26.1	
	TOTAL	228	87.9	
GAMBIR "4"	KOTA	227	152.3	
	TG. PRIOK	16	7.1	
	GAMBIR (INT)	—	491.0	
	SEMANGGI	10	8.7	
	KEBAYORAN	99	72.9	
	JATINEGARA	51	45.1	
	TOTAL	403	777.1	
GAMBIR "5"	KOTA	182	67.1	
	TG. PRIOK	5	0	
	GAMBIR (INT)	—	345.5	
	SEMANGGI	10	6.7	
	KEBAYORAN	51	37.1	
	JATINEGARA	45	27.7	
	TOTAL	293	484.1	

TABLE 4-2-(2) JUNCTION TRAFFIC FLOW

TERMINATING OFFICE	ORIGINATING OFFICE	NUMBER OF JUNCTION	TRAFFIC IN ERL.	NOTE
GAMBIR "35"	KOTA	25	2.2	
	GAMBIR (INT)	—	5.0	
	KEBAYORAN	12	1.4	
	JATINEGARA	6	0.9	
	TOTAL	43	9.5	
GAMBIR "10X"	KOTA	36	6.3	
	TG. PRIOK	8	1.5	
	GAMBIR (INT)	—	12.0	
	SEMANGGI	10	0.9	
	SLIPI	5	0.8	
	KEBAYORAN	15	2.7	
	JATINEGARA	6	2.6	
	TOTAL	80	26.8	
GAMBIR "O" SLDD	KOTA	32	13.5	
	GAMBIR (INT)	—	37.7	
	KEBAYORAN	21	8.6	
	JATINEGARA	11	4.8	
	TOTAL	64	64.6	
GAMBIR ANK.GW	SEMANGGI	90	49.8	
	GANDARIA	12	4.3	
	ISC	26	16.2	
	OUTSIDE JAKARTA (SLDD)	106	46.8	INCLUDING BANDUNG
	TOTAL	234	117.1	
GAMBIR ANK.GW	SLIPI	50	38.9	
	FA	130	54.0	
	BANDUNG (SLDD)	10	5.6	
	TOTAL	190	98.5	

TABLE 4 - 2 - (3) JUNCTION TRAFFIC FLOW

TERMINATING OFFICE	ORIGINATING OFFICE	NUMBER OF JUNCTION	TRAFFIC IN ERL.	NOTE
GANDARIA	GAMBIR.	10	2.1	
	GANDARIA (INT)	—	0.7	
	TOTAL	10	2.8	
SEMANGGI	GAMBIR	106	32.4	
	SEMANGGI(INT)	—	11.7	
	TOTAL	106	44.1	
SLIPI	GAMBIR	48	31.4	
	SLIPI (INT)	—	3.0	
	TOTAL	48	34.4	
KEBAYORAN	KOTA	36	22.1	
	GAMBIR	157	94.2	
	SEMANGGI	10	8.0	
	KEBAYORAN(INT)	—	95.9	
	JATINEGARA	28	16.5	
	TOTAL	231	236.7	
JATINEGARA	KOTA	45	27.7	
	GAMBIR	102	69.7	
	KEBAYORAN	30	14.4	
	JATINEGARA(INT)	—	40.2	
	TOTAL	177	152.0	
G. TOTAL		2,859	2,892.9	

TABLE 4-2-(4) JUNCTION TRAFFIC FLOW AMONG OFFICES IN JAKARTA

FEB. 1974

FROM \ TO		KOTA	TG. PRIOK	GAMBIR	GAMBIR		GANDARIA	SEMANGGI	SLIPI	KEBAYORAN	JATINEGARA	TOTAL	NOTE
					SLDD	"10X"							
KOTA		364.5 —	61.8 228	221.6 434	13.5 32	6.3 36	— —	— —	— —	22.1 36	27.7 45	717.5 811	INCLUDING TANDEM TRAFFIC
TG. PRIOK		47.7 152	26.1 —	7.1 21	— —	1.5 8	— —	— —	— —	— —	— —	82.4 181	
GAMBIR		263.4 480	— —	841.5 —	37.7 —	12.0 —	2.1 10	62.5 106	31.4 48	94.2 157	69.7 102	1,414.5 903	INCLUDING TANDEM TRAFFIC
GAMBIR	ISC	—	—	16.2 26	— —	— —	— —	— —	— —	— —	— —	16.2 26	
	SLDD	— —	— —	52.4 116	— —	— —	— —	— —	— —	— —	— —	52.4 116	
	FA	— —	— —	54.0 130	— —	— —	— —	— —	— —	— —	— —	54.0 130	
GANDARIA		— —	— —	4.3 12	— —	— —	0.7 —	— —	— —	— —	— —	5.0 12	
SEMANGGI		— —	— —	65.2 154	— —	0.9 10	— —	11.7 —	— —	8.0 10	— —	85.8 174	
SLIPI		— —	— —	38.9 50	— —	0.8 5	— —	— —	3.0 —	— —	— —	42.7 55	
KEBAYORAN		26.0 75	— —	111.4 162	8.6 21	2.7 15	— —	— —	— —	95.9 —	14.4 30	259.0 303	
JATINEGARA		25.6 45	— —	73.7 102	4.8 11	2.6 6	— —	— —	— —	16.5 28	40.2 —	163.4 192	
TOTAL		727.2 752	87.9 228	1,486.3 1,207	64.6 64	26.8 80	2.8 10	74.2 106	34.4 48	236.7 231	152.0 177	2,892.9 2,903	

UPPER : TRAFFIC (IN ERL)
UNDER : NO. OF JUNCTIONS

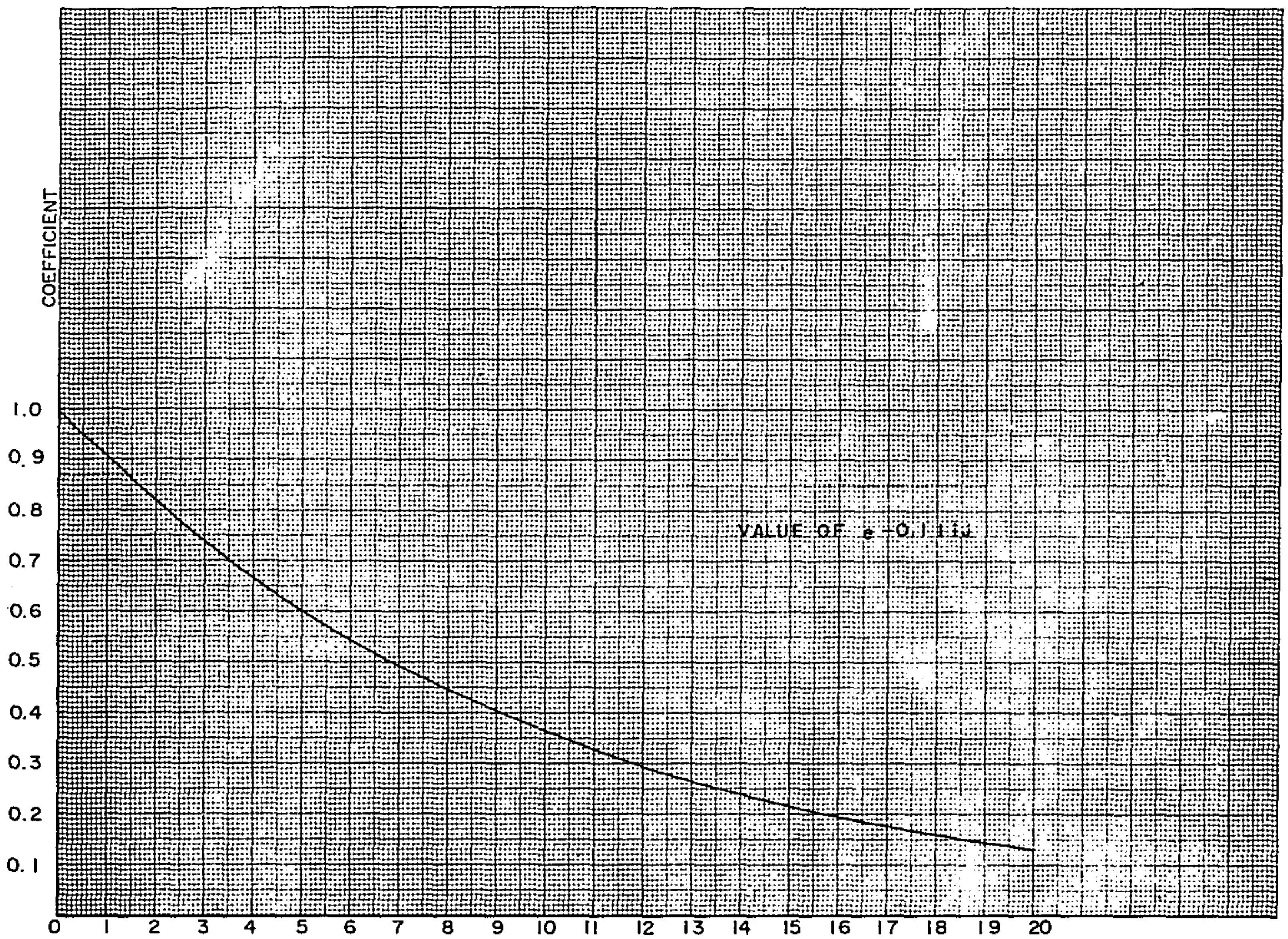


FIG. 4 - 3 - (2) CROW FLIGHT DISTANCE IN KM

Table 4.3.(1) Value of Coefficient

(a = 0.1)

km	e^{-alij}	km	e^{-alij}	km	e^{-alij}
0	1.0000	10	0.36788	20	0.13534
1	0.90484	11	0.33287		
2	0.81873	12	0.30119		
3	0.74082	13	0.27253		
4	0.67032	14	0.24660		
5	0.60653	15	0.22313		
6	0.54881	16	0.20190		
7	0.49659	17	0.18268		
8	0.44933	18	0.16530		
9	0.40657	19	0.14957		

Table 4.3.(3) Traffic Flow

(in Erl)

From \ To	X	Y	Z	TOTAL
X Tx = 400	231.2	105.3	63.5	400
Y Ty = 300	113.3	140.0	46.7	300
Z Tz = 200	77.1	52.7	70.2	200
TOTAL	421.6	298.0	180.4	900

TABLE 4-4-1-(1) CLOW FLIGHT DISTANCE BETWEEN EVERY OFFICE IN JAKARTA (IN Km)

NO.	NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
	OFFICE BUILDING	KOTA A	KOTA B	KOTA C	ANCOL	PLUIT	CENGKARENG	TEG. ALUR	GAMBIR A	GAMBIR B	SEMANGGI A	SEMANGGI B	SLIPI	PALMERAH	KEDOYA	MERUYA	CEM. PUTIH	RAWAMANGUN	PULOGAD.	PENGGIL	TG. PRIOK.A	TG. PRIOK.B	CILINCING	KEBAYOR. A	KEBAYOR. B	CIPETE	KELIBATA	PS. MINGGU	JAGAKARSA	JATINEG. A	JATINEG. B	CAWANG	PS. REBO	KLENDER	TEBET	GANDARIA
1	KOTA A		1.8	3.1	4.0	2.5	7.5	12.5	5.4	6.6	9.0	8.4	4.5	8.0	7.0	11.0	6.5	10.5	10.3	14.5	8.7	10.9	13.5	11.3	12.4	17.0	13.8	18.0	22.5	9.5	11.5	15.4	20.0	15.5	11.2	23.5
2	KOTA B			1.7	3.5	4.2	9.0	14.0	3.7	5.0	7.7	7.2	4.2	7.5	7.5	11.2	4.7	8.7	9.0	12.8	8.2	10.4	13.0	10.0	11.5	16.0	12.0	16.5	21.0	7.5	9.5	13.6	18.3	14.0	9.5	21.9
3	KOTA C				2.6	5.6	10.4	15.5	3.9	4.9	8.0	7.8	5.6	8.6	9.2	12.6	3.6	7.5	7.6	11.3	7.0	8.9	11.6	10.7	12.2	16.3	12.0	16.5	21.1	7.0	9.1	12.9	17.9	13.1	9.0	21.7
4	ANCOL					6.2	11.5	16.4	6.0	7.5	10.2	10.1	7.6	10.7	11.0	14.6	4.9	8.7	6.7	11.7	4.7	7.0	9.6	13.0	14.6	18.6	14.0	18.6	23.2	8.6	10.4	15.0	19.5	13.5	11.0	23.5
5	PLUIT						5.0	10.1	7.3	8.5	10.7	10.0	5.4	8.8	6.5	10.8	9.0	13.0	12.6	17.0	10.5	12.9	15.5	12.5	13.1	18.0	15.3	19.7	23.7	11.7	14.0	17.4	22.0	18.1	13.2	25.5
6	CENGKARENG							5.2	11.0	11.8	13.0	12.1	7.6	9.7	5.5	9.0	13.5	17.3	17.6	21.6	15.5	17.8	20.8	13.8	13.3	18.7	17.7	21.4	24.8	15.5	17.6	20.2	24.7	22.3	16.3	27.5
7	TEGAL ALUR								16.0	16.6	17.7	16.5	12.5	13.9	9.5	11.6	18.5	22.5	22.0	26.8	20.5	22.8	25.7	17.8	16.6	22.0	22.2	25.6	28.4	20.6	22.7	25.0	29.0	27.5	21.2	31.8
8	GAMBIR A									1.2	4.0	3.9	3.7	5.4	7.6	10.0	3.4	6.6	8.6	11.1	10.0	11.9	11.1	6.9	8.7	12.5	8.3	13.0	17.3	4.5	6.7	10.0	14.7	11.4	6.0	18.3
9	GAMBIR B										3.0	3.0	4.1	5.1	8.0	9.8	4.1	6.6	9.4	10.9	11.2	12.8	14.8	5.9	7.9	11.5	7.3	11.8	16.2	4.0	6.2	9.1	13.8	11.4	5.0	17.2
10	SEMANGGI A											1.3	5.5	4.2	8.3	8.9	6.4	7.7	11.2	11.9	13.8	15.5	17.1	3.1	5.4	8.5	4.7	9.0	13.3	4.6	6.0	7.4	11.7	11.0	3.8	14.9
11	SEMANGGI B												4.4	3.0	7.2	7.7	6.9	8.8	12.1	12.9	14.1	15.4	17.7	3.0	4.9	8.8	6.0	10.1	14.1	5.6	7.3	8.7	12.9	12.7	5.1	16.1
12	SLIPI													3.5	4.0	7.1	6.9	6.6	12.0	14.8	12.2	14.3	16.7	7.0	7.5	12.6	10.3	14.4	18.3	8.0	10.2	12.8	17.2	11.4	8.7	20.3
13	PALMERAH														4.5	5.2	8.7	11.3	14.0	15.7	15.2	17.1	19.3	4.1	4.2	9.4	8.3	11.6	15.3	8.4	10.0	11.5	15.3	13.1	8.0	18.0
14	KEDOYA															4.2	10.7	14.3	16.0	18.8	15.5	18.0	20.4	8.5	7.9	13.2	12.7	16.0	19.4	11.8	13.8	15.7	19.8	18.8	12.0	22.5
15	MERUYA																13.5	16.2	19.0	20.7	19.2	21.4	23.9	7.3	5.6	10.7	12.2	14.5	17.0	13.3	15.0	15.5	18.8	20.0	12.5	20.9
16	CEMPAKA PUTIH																	4.0	5.2	8.3	7.5	9.0	11.0	9.5	11.6	14.6	9.2	14.0	18.6	3.8	5.5	10.0	14.6	9.3	6.2	18.5
17	RAWAMANGUN																		4.5	4.5	9.1	9.6	10.5	10.7	13.2	14.7	8.5	12.7	17.4	3.3	3.0	7.7	12.0	5.3	5.4	16.1
18	PULOGADUNG																			5.5	5.3	5.5	6.1	14.4	16.1	20.0	12.8	17.2	31.8	7.3	7.5	12.2	16.2	8.2	9.7	20.5
19	PENGGILINGAN																				10.7	10.2	9.7	14.6	16.9	17.8	11.4	14.7	19.0	7.4	6.0	9.3	12.4	3.1	8.7	16.5
20	TG. PRIOK A																					2.3	5.1	16.8	19.2	22.3	16.7	21.2	26.0	11.0	12.0	16.7	21.2	13.4	13.5	25.3
21	TG. PRIOK B																						3.1	18.3	20.6	23.5	17.8	22.3	27.1	12.1	12.6	17.2	21.5	13.4	14.4	25.8
22	CILINCING																							20.2	22.5	25.0	19.0	23.2	27.8	13.3	13.5	18.0	21.8	13.0	15.6	26.0
23	KEBAYORAN A																								2.5	5.8	4.9	7.8	11.3	7.4	8.5	8.2	11.6	13.3	5.8	14.0
24	KEBAYORAN B																									5.4	6.8	9.0	11.7	9.8	11.0	10.4	13.4	16.0	8.3	15.3
25	CIPETE																										6.5	5.0	6.3	11.4	12.0	9.2	10.2	15.2	9.5	10.8
26	KALIBATA																											4.6	9.7	5.8	5.5	3.3	7.0	9.4	3.3	10.0
27	PASAR MINGGU																												4.6	10.5	9.6	3.4	5.1	12.0	7.8	6.3
28	JAGAKARSA																													15.2	14.3	10.0	7.8	16.2	12.5	6.0
29	JATINEGARA A																														2.2	6.2	10.9	7.0	2.6	14.9
30	JATINEGARA B																															4.5	9.0	5.0	2.6	13.2
31	CAWANG																																4.7	6.7	4.2	8.7
32	PASAR REBO																																	9.3	8.8	4.2
33	KLENDER																																		7.5	16.5
34	TEBET																																			12.6
35	GANDARIA																																			

TABLE 4-4-2(1) TRAFFIC FLOW BETWEEN EXCHANGES IN 1979

(IN ERL)

NO	OFFICE BUILDING	1 KOTA A	2 KOTA B	3 KOTA C	4 ANCOL	5 PLUIT	6 CENGKARENG	7 TEGAL ALUR	8 GAMBIR A	9 GAMBIR B	10 SEMANGGI A	11 SEMANGGI B	12 SLIPI	13 PALMERAH	14 KEDOYA	15 MERUYA	16 CEMPAKA PUTIK	17 RAWAMANGUN	18 PULOGADUNG	19 PENGGILINGAN
1	KOTA A	71.179	182.557		16.171	24.340	2.755	0.730	86.374	83.099	30.296		28.859	7.398			30.627	3.096	0.753	
2	KOTA B	163.550	601.236		46.767	56489	6.522	1.728	281.636	268.262	94.913		81.804	21.394			100.867	23.369	2.357	
3	KOTA C																			
4	ANCOL	17.830	51.557		9.016	6.283	0.690	0.185	30.399	28.382	10.041		7.910	2.110			13.431	3.175	0.403	
5	PLUIT	29.183	75.599		6.832	16.453	1.862	0.488	37.603	36.177	13.456		13.885	3595			12.557	2.909	0.315	
6	CENGKARENG	4.820	12.738		1.095	2.715	0.836	0.217	7.073	7.082	2.911		3.034	0.895			2.181	0.515	0.052	
7	TEGAL ALUR	2.064	5.456		0.474	1.152	0.351	0.258	3.029	3.094	1.285		1.313	0.415			0.933	0.216	0.024	
8	GAMBIR A	72.814	265.012		23.242	26.439	3.408	0.903	260.188	250.323	87.686		54.879	16.842			73.302	18.397	1.566	
9	GAMBIR B	71.648	258.172		22.194	26.017	3.490	0.944	256020	313.126	107.512		68.497	19.254			75.826	20.411	1.604	
10	SEMANGGI A	29.761	104070		8.947	11.024	1.635	0.446	102.104	122490	76.634		26.853	11.125			31.813	9.655	0.707	
11	SEMANGGI B																			
12	SLIPI	28.162	29.108		7.001	11301	1.692	0.453	63.527	66.209	26.677		28.084	7.199			18.259	6.503	0.394	
13	PALMERAH	8.279	26.727		2.142	3356	0.572	0.164	22360	24994	12675		8.256	4.262			6.363	1.696	0.135	
14	KEDOYA																			
15	MERUYA																			
16	CEMPAKA PUTIH	29.705	109200		11.815	10.157	1.209	0.320	84334	85.247	31.412		18.147	5.514			46.899	10.865	1.002	
17	RAWAMANGUN	8.577	31.530		3.480	2.933	0356	0.092	26379	28.614	11.881		8.055	1.831			13.542	6.982	0.463	
18	PULOGADUNG	1.090	3.813		0.530	0.380	0.043	0.012	2.691	2.694	1.043		0.585	0.174			1.497	0.555	0090	
19	PENGGILINGAN																			
20	TG.PRIOK A	33.528	108.229		16.953	12.296	1.392	0.369	61.306	58.982	21.078		15.023	4.049			31.158	9.177	1.095	
21	TG.PRIOK B																			
22	CILINCING	2.661	8.591		1.332	0957	0.105	0.028	7.045	5.279	1.944		1.229	0.345			2.816	1.023	0.165	
23	KEBAYORAN A	30.520	106.725		8.727	11.886	1.947	0.571	98680	118.300	72.549		29.833	14.503			30.117	9.232	0.663	
24	KEBAYORAN B																			
25	CIPETE	3.803	12.907		1.099	1.511	0.263	0.083	12.421	14.891	9.317		3.755	1.881			3.985	1.364	0.082	
26	KALIBATA	6.867	25.244		2.281	2.595	0.381	0.106	24.785	29.713	67.860		6.196	2.753			8.966	3.324	0.225	
27	PASAR MINGGU	2.083	7.432		0.665	0772	0.121	0.035	7.151	8.747	5364		1.898	0914			2.561	1.008	0067	
28	JAGAKARSA	0.609	2.174		0.193	0.237	0.040	0.012	2.133	2.583	1.600		0.590	0.289			0.741	0.289	0.007	
29	JATINEGARA A	7.723	28.963		2.864	2.721	0.347	0.091	26.513	30.235	13.197		5.705	1.994			11.255	4.090	0.285	
30	JATINEGARA B	12.698	47.623		4.804	4.342	0.565	0.148	42732	48.730	23.041		9.195	3412			19070	8.463	0561	
31	CAWANG	3.838	14.110		1.354	1.380	0.195	0.053	13.716	16.280	8.944		3.165	1.311			5.429	2.362	0.157	
32	PASAR REBO	1.314	4.781		0.468	0472	0.067	0.019	4648	5.516	3.155		1.105	0.486			1.858	0.833	0.057	
33	KLENDER	1.085	3.870		0.449	0.367	0.045	0.012	3.405	3.693	1.782		1.039	0.261			1.662	0.857	0.067	
34	TEBET	9.086	33.069		3.142	3266	0.447	0.120	31.823	38.150	19.936		7.418	2.894			12.347	4.623	0.313	
35	GANDARIA	1.090	3.926		0.369	0392	0.060	0.017	0.817	4.622	2.696		0.954	0437			1.480	0.651	0.044	
36	SLDD	41.698	128.035		14.133	18.308	3.416	1.492	86.829	94.182	43654		26.514	9.645			34.368	11.879	1.235	
37	"IOX"	12.352	37.928		4.187	5.424	1.012	0.442	25.722	27.901	12.931		7.854	2.857			10.181	3.519	0.366	
	TOTAL	709.617	2.396382		222.726	265.965	35.824	10.538	1.716513	1827652	767.461		461.634	150039			606.091	175.038	15.554	

NO	OFFICE BUILDING	20 TG.PRIOK A	21 TG.PRIOK B	22 CILINCING	23 KEBAYORAN A	24 KEBAYORAN B	25 CIPETE	26 KALIBATA	27 PASAR MINGGU	28 JAGAKARSA	29 JATINEGARA A	30 JATINEGARA B	31 CAWANG	32 PASAR REBO	33 KLENDER	34 TEBET	35 GANDARIA	36 SLDD	37 "IOX"	TOTAL
1	KOTA A	22.186		1.237	25.924		1.967	5.135	1.055	0.202	7.422	10.590	2.458	0.552	0592	8.050	0.352	41.698	12.352	714.000
2	KOTA B	64.160		3.576	81.213		5.979	16.911	3.371	0.648	24.927	35.582	8.094	1.802	1.894	26.250	1.136	128.035	37.928	2.192400
3	KOTA C																			
4	ANCOL	12.369		0.683	8.173		0.626	1.881	0.371	0.070	3.035	4.418	0.956	0.217	0.270	3.069	0.131	14.133	4.137	242000
5	PLUIT	9.756		0.533	12.104		0.937	2.327	0.468	0.094	3.136	4342	1.059	0.238	0.240	3.470	0.152	18.308	5.424	313.500
6	CENGKARENG	1.611		0.085	2.895		0.238	0.498	0.108	0.023	0.584	0.825	0.218	0.050	0.043	0.693	0.034	3.416	1.012	58.500
7	TEGAL ALUR	0.690		0.037	1.370		0.121	0.224	0.050	0.011	0.248	0.350	0.095	0.023	0.018	0.300	0.016	1.492	0442	25550
8	GAMBIR A	34.198		2.759	70.661		5.414	15.624	3.053	0.597	21.480	30.044	7.403	1.648	1.567	23.771	1.038	86.829	25.722	1.486800
9	GAMBIR B	33.650		2.114	86.636		6.639	9.157	3.818	0.740	25.053	35041	8.987	2.000	1.738	29.145	1.288	94.187	27.901	1.612800
10	SEMANGGI A	13.700		0.888	60.531		4.733	13.119	2.668	0.522	12.458	18.877	5.625	1.303	0.956	17.353	0.855	43654	12.931	747.500
11	SEMANGGI B																			
12	SLIPI	9.701		0.557	24.728		1.895	4.522	0.938	0.191	5.350	7.484	1.978	0.454	0.554	6.414	0.301	26.514	7.854	454.000
13	PALMERAH	2.998		0.179	13.788		1.089	2.304	0.518	0.108	2.140	3.185	0.940	0.229	0.160	2.870	0.158	9.645	2.857	165.150
14	KEDOYA																			
15	MERUYA																			
16	CEMPAKA PUTIH	19.997		1.270	24.811		1.999	6.503	1.258	0.238	10.491	15.426	3.371	0.758	0.880	10.611	0.463	34.368	10.181	588.500
17	RAWAMANGUN	7.340		0.575	9.479		0.852	3.004	0.617	0.116	4.751	8.532	1.828	0.423	0.566	0951	0.254	11.879	3.519	203.400
18	PULOGADUNG	1.337		0.111	0.816		0.061	0.224	0.049	0.003	0.397	0.678	0.145	0.035	0.053	0401	0.020	1.235	0.366	21.150
19	PENGGILINGAN																			
20	TG.PRIOK A	59.540		3.221	16.817		1.302	4.320	0.861	0.160	7.182	11.326	2.426	0.551	0.822	7.192	0.330	31.022	9.190	531.199
21	TG.PRIOK B																			
22	CILINCING	4.587		0.688	1.535		0.127	0.440	0.090	0.017	0.732	1.251	0.273	0.067	0.110	0.748	0.040	2.794	0.828	47.850
23	KEBAYORAN A	13.101		0.840	106.520		8.002	16.598	3.882	0.823	12.153	18.975	6.702	1.698	0.980	18337	1.207	47.012	13.926	805.000
24	KEBAYORAN B																			
25	CIPETE	1.666		0.115	13.142		3.149	3.117	1.132	0.299	1.795	2.947	1.336	0.431	0.179	2.791	0.366	6.307	1.868	108.000
26	KALIBATA	3.823		0.274	18.853		2.155	7.827	1.545	0.279	4.120	7.400	3.161	0.777	0.418	6.802	0.520	11.957	3.542	204.750
27	PASAR MINGGU	1.125		0.085	6.513		1.156	2.281	1.130	0.214	1.189	2.267	1.445	0.434	0.149	2.002	0.348	3.738	1.107	64.000
28	JAGAKARSA	0.319		0.024	2.105		0.466	0.628	0.327	0.156	0.341	0.650	0.342	0.152	0.045	0.574	0.164	1.124	0.333	19.250
29	JATINEGARA A	4.945		0.354	10.742		0.966	1.206	0.626	0.118	5.384	7.530	1.730	0.385	0.389	5.337	0.233	11.242	3.330	192.500
30	JATINEGARA B	8.986		0.697	19.325		1.827	6.635	1.376	0.259	8.677	18.844	4.119	0.935	0.954	10.719	1.365	19.593	5.804	335.500
31	CAWANG	2.508		0.198	8.891		1.079	3.691	1.142	0.178	2.597	5.365	2.884	0.642	0.359	4.078	0.389	6.716	1.989	115.000
32	PASAR REBO	0.867		0.074	3.431		0.529	1.382	0.523	0.120	0.880	1.854	0.977	0.557	0.150	1.396	0.331	2.391	0.708	40.950
33	KLENDER	0.996		0.093	1.524		0.169	0.573	0.138	0.027	0.684	1.457	0.421	0.116	0.200	0.837	0.051	1.635	0.484	28.000
34	TEBET	5.371		0.392	17.578		1.629	5.741	1.144	0.215	5.789	10.089	2.947	0.662	0.516	9.652	0.409	14.454	4282	247.500
35	GANDARIA	0.677		0.057	3.177		0.587	1.205	0.546	0.169	0.694	3.528	0.771	0.431	0.081	1.124	0.592	2.161	0.640	37.000
36	SLDD	31.022		2.794	47.012		6.307	11.957	3.738	1.124	11.242	19.593	6.716	2.391	1.635	14.454	2.161			677.539
37	"IOX"	9.190		0.828	13.926		1.868	3.542	1.107	0.333	3.330	5.804	1.989	0.708	0.484	4.282	0.640			200.707
	TOTAL	382416		25.338	714.220		63.868	164.576	37.649	6.054	188.261	294.254	81.396	20.169	17.007	227.672	15.342	677.539	200.707	12.479502

TABLE 4-4-2 (2) TRAFFIC FLOW BETWEEN EXCHANGES IN 1983

(IN ERL)

NO	OFFICE BUILDING	1 KOTA A	2 KOTA B	3 KOTA C	4 ANCOL	5 PLUIT	6 CENGKARENG	7 TEGAL ALUR	8 GAMBIR A	9 GAMBIR B	10 SEMANGGI A	11 SEMANGGI B	12 SLIPI	13 PALMERAH	14 KEDOYA	15 MERUYA	16 CEMPAKA PUTIK	17 RAWAMANGUN	18 PULOGADUNG	19 PENGGILINGAN
1	KOTA A	75.564	108.603	89.872	22.224	27.541	4.366	1.216	96.214	96.711	39.721		32.977	8.832	1.707	1.695	35.076	8.848	1.294	1.121
2	KOTA B	97.816	201.509	160.214	36.207	36.010	5.824	1.622	176.745	175.889	70.103		52.661	14.064	2.516	2.574	65.081	16.417	2.284	2.080
3	KOTA C	81.615	161.537	180.445	37.644	29.746	4.811	1.327	164.615	168.809	64.644		43.505	11.972	2.018	2.127	69.031	17.589	2.496	2.273
4	ANCOL	23.611	42.731	44.042	15.455	8.869	1.363	0.384	42.238	41.202	16.422		11.275	3.071	0.533	0.551	13.189	4.938	0.864	0.602
5	PLUIT	32.968	47.862	39.212	9.992	19.812	3.141	0.866	44.575	44.806	18.773		16.886	4.465	1.005	0.969	15.304	3.861	0.577	0.483
6	CENGKARENG	7.544	11.174	9.155	2.220	4.533	1.953	0.533	11.617	12.153	5.628		5.112	1.539	0.419	0.438	3.682	0.347	0.132	0.117
7	TEGAL ALUR	3.381	5.007	4.063	1.004	2.012	0.859	0.664	5.206	5.557	22.599		2.315	0.746	0.208	0.243	1.651	0.417	0.062	0.051
8	GAMBIR A	79.711	162.577	150.181	32.936	30.850	5.570	1.550	298.876	300.421	118.546		64.669	20.267	2.911	3.391	86.572	23.656	3.776	2.851
9	GAMBIR B	81.592	164.757	156.831	32.717	31.577	5.934	1.686	305.945	330.320	151.204		71.707	24.100	3.226	3.993	33.158	27.303	2.957	3.356
10	SEMANGGI A	38.139	74.737	68.353	14.842	15.058	3.127	0.896	137.394	172.090	121.285		37.044	14.508	1.782	3.126	43.985	14.534	1.468	1.805
11	SEMANGGI B																			
12	SLIPI	31.956	56.665	46.425	10.284	13.669	2.868	0.801	75.641	82.364	37.386		34.304	8.980	1.528	1.661	22.351	9.668	0.725	0.722
13	PALMERAH	9.581	17.333	14.632	3.208	4.139	0.988	0.298	27.150	31.706	16.748		10.284	5.421	0.618	0.854	7.944	2.305	0.253	0.281
14	KEDOYA	2.283	3.737	2.971	0.972	1.123	0.324	0.100	4.697	5.116	2.484		2.103	0.745	0.203	0.204	1.402	0.368	0.045	0.044
15	MERUYA	2.727	4.599	3.769	0.835	1.302	0.408	0.144	6.586	7.615	5.236		2.757	1.239	0.245	0.552	1.881	0.542	0.059	0.065
16	CEMPAKA PUTIH	32.783	67.535	71.046	16.879	11.948	1.992	0.555	97.664	103.201	42.811		21.560	6.689	0.979	1.097	55.841	14.085	1.790	1.732
17	RAWAMANGUN	10.196	21.004	22.319	5.355	3.716	0.631	0.173	32.904	37.291	17.442		10.307	2.393	0.318	0.388	17.367	9.750	0.891	1.175
18	PULOGADUNG	1.767	3.464	3.754	1.111	0.657	0.104	0.030	4.578	4.788	2.089		1.021	0.311	0.045	0.049	2.617	1.056	0.237	0.181
19	PENGGILINGAN	1.888	3.852	4.217	1.096	0.688	0.114	0.031	5.797	6.703	3.166		1.254	0.426	0.056	0.068	3.121	1.717	0.223	0.509
20	TG.PRIOK A	25.606	46.319	49.217	16.759	10.010	1.587	0.442	49.126	49.381	19.880		12.350	3.398	0.590	0.640	25.671	8.232	1.726	1.326
21	TG.PRIOK B	19.626	35.502	38.872	12.718	7.520	1.204	0.335	38.802	40.190	16.018		9.561	2.685	0.439	0.463	21.103	7.473	1.615	1.331
22	CILINCING	4.090	7.399	8.021	2.659	1.566	0.240	0.068	11.361	8.896	3.690		2.033	0.582	0.093	0.097	4.671	1.847	0.411	0.492
23	KEBAYORAN A	23.000	45.070	39.604	6.514	9.546	2.192	0.675	78.031	97.736	67.516		24.199	12.013	1.384	2.312	24.485	8.171	0.808	1.046
24	KEBAYORAN B	8.206	15.450	13.576	2.889	3.580	0.910	0.302	25.959	31.870	21.366		9.169	4.737	0.585	1.092	7.904	2.535	0.272	0.331
25	CIPETE	5.059	9.618	8.798	1.891	2.142	0.522	0.173	17.334	21.712	15.302		5.376	2.751	0.337	0.640	5.718	2.130	0.178	0.295
26	KALIBATA	2.619	18.169	17.122	3.793	3.554	0.730	0.214	33.402	41.833	28.328		6.566	3.667	0.448	0.697	12.423	5.014	0.466	0.709
27	PASAR MINGGU	2.732	5.462	5.149	1.129	1.078	0.239	0.071	9.644	12.579	8.691		2.680	1.318	0.151	0.261	3.625	1.553	0.412	0.241
28	JAGAKARSA	0.899	1.798	1.678	0.368	0.373	0.086	0.028	3.307	4.182	2.919		938	0.470	0.056	0.105	1.182	0.502	0.017	0.080
29	JATINEGARA A	10.125	21.278	21.082	4.861	3.601	0.681	0.187	36.473	43.455	21.367		8.050	2.872	0.366	0.467	15.919	6.297	0.605	0.790
30	JATINEGARA B	14.197	27.837	29.265	6.953	5.175	0.944	0.261	50.128	59.725	31.813		11.064	11.193	0.513	0.674	23.001	11.113	1.016	1.556
31	CAWANG	5.674	11.687	11.814	2.591	2.174	0.429	0.122	21.271	26.378	16.324		5.036	2.130	0.250	0.379	8.657	4.100	0.376	0.660
32	PAGAR REBO	1.859	3.794	3.721	0.857	0.712	0.142	0.043	6.904	8.561	5.514		1.684	0.756	0.087	0.141	2.838	1.385	0.131	0.251
33	KLENDER	2.103	4.203	4.335	1.127	0.758	0.131	0.036	6.921	7.845	4.262		2.168	0.557	0.069	0.090	3.475	1.953	0.209	0.460
34	TEBET	11.248	22.736	22.526	4.989	4.272	0.820	0.230	40.973	51.316	30.205		9.797	3.903	0.468	0.659	16.345	6.663	0.621	0.905
35	GANDARIA	1.799	3.632	3.493	0.789	0.690	0.148	0.044	6.613	8.365	5.496		1.696	0.793	0.090	0.157	2.638	1.262	0.117	0.229
36	SLDD	77.436	133.244	125.571	33.975	36.240	9.472	4.348	169.195	191.755	100.117		53.001	19.688	3.523	5.219	68.856	25.912	3.715	4.897
37	"IOX"	15.983	27.502	25.918	7.012	7.479	1.955	0.898	34.922	39.578	20.664		10.940	4.064	0.727	1.077	14.211	5.348	0.766	1.011
	TOTAL	853.583	1601.383	1501.263	358.546	343.920	66.817	21.358	2179.006	2432.699	1.137.765		600.358	200.367	30.499	39.155	807.982	258.497	33.594	36.134

NO	OFFICE BUILDING	20 TG.PRIOK A	21 TG PRIOK B	22 CILINCING	23 KEBAYORAN A	24 KEBAYORAN B	25 CIPETE	26 KALIBATA	27 PASAR MINGGU	28 JAGAKARSA	29 JATINEGARA A	30 JATINEGARA B	31 CAWANG	32 PASAR REBO	33 KLENDER	34 TEBET	35 GANDARIA	36 SLDD	37 "IOX"	TOTAL
1	KOTA A	17.849	11.786	2.063	19.792	5.986	2.715	6.839	1.447	0.313	10.087	12.317	5.721	0.835	1.216	10.254	0.588	77.436	15.983	854.700
2	KOTA B	23.062	19.203	3.361	34.932	10.152	4.649	12.691	2.606	0.562	16.449	23.314	7.088	1.530	2.189	18.838	1.070	133.244	27.502	1.470.700
3	KOTA C	31.156	21.190	3.674	30.947	8.994	4.288	12.059	2.476	0.530	19.082	23.057	7.226	1.518	2.277	18.818	1.038	125.571	25.918	1.385.999
4	ANCOL	12.413	8.115	1.420	7.785	2.240	1.078	3.125	0.636	0.136	5.144	6.409	1.855	0.407	0.692	4.877	6.274	33.975	7.012	375.000
5	PLUIT	8.352	5.406	0.946	9.834	3.127	1.377	3.298	0.683	0.155	4.534	5.374	1.753	0.383	0.526	4.703	0.270	36.240	7.479	400.000
6	CENGKARENG	1.311	1.249	0.210	3.258	1.157	0.483	0.979	0.218	0.053	1.170	1.415	0.500	0.110	0.131	1.302	0.083	9.472	1.955	104.550
7	TEGAL ALUR	0.857	0.560	0.095	1.614	0.614	0.257	0.461	0.107	0.027	0.519	0.628	0.228	0.054	0.057	0.590	0.040	4.348	0.898	48.000
8	GAMBIR A	28.372	19.304	4.746	55.630	15.669	7.708	21.459	4.317	0.954	30.104	36.034	11.869	2.565	3.317	31.224	1.791	169.195	34.922	1.867.499
9	GAMBIR B	29.041	20.362	3.784	70.952	19.615	9.832	27.370	5.620	1.228	36.525	43.718	14.988	3.239	3.828	39.825	2.307	191.755	39.578	2.116.497
10	SEMANGGI A	13.306	9.236	1.786	55.786	14.967	7.887	21.094	4.417	0.975	20.440	26.502	10.556	2.373	2.366	26.683	1.825	100.117	20.664	1.105.500
11	SEMANGGI B																			
12	SLIPI	8.343	5.564	1.014	20.179	6.481	2.797	6.439	1.375	0.316	7.772	9.304	3.267	0.733	1.216	8.733	0.537	53.001	10.940	565.000
13	PALMERAH	2.629	1.789	0.326	11.473	3.835	1.638	3.345	0.775	0.181	4.178	4.036	1.592	0.377	0.356	3.985	0.287	19.688	4.064	217.300
14	KEDOYA	0.550	0.353	0.063	1.593	0.571	0.241	0.465	0.108	0.026	0.487	0.596	0.226	0.052	0.054	0.576	0.040	3.523	0.727	38.880
15	MERUYA	0.677	0.447	0.079	3.201	1.281	0.553	0.870	0.223	0.059	0.748	0.941	0.411	0.108	0.084	0.977	0.082	5.219	1.077	57.600
16	CEMPAKA PUTIH	16.724	11.845	2.202	19.632	5.390	2.867	9.003	1.744	0.384	14.822	18.652	5.448	1.189	1.879	14.049	0.807	68.856	14.211	760.000
17	RAWAMANGUN	6.612	5.176	1.074	8.103	2.131	1.317	4.484	0.948	0.201	7.229	11.112	3.182	0.715	1.301	7.062	0.476	25.912	5.348	286.000
18	PULOGADUNG	1.643	1.325	0.284	0.950	0.271	0.131	0.495	0.103	0.008	0.824	1.204	0.345	0.080	0.165	0.780	0.052	3.715	0.766	41.000
19	PENGGILINGAN	1.557	1.347	0.418	1.516	0.407	0.267	0.926	0.215	0.048	1.325	2.275	0.749	0.190	0.448	1.403	0.126	4.897	1.011	54.050
20	TG.PRIOK A	34.459	22.527	3.865	9.236	2.453	1.293	4.139	0.849	0.178	7.021	9.477	2.714	0.598	1.213	6.590	0.398	43.660	9.012	481.900
21	TG.PRIOK B	26.149	27.079	4.708	7.592	2.037	1.095	3.542	0.727	0.153	6.008	8.524	2.465	0.555	1.159	5.752	0.361	35.923	7.415	396.500
22	CILINCING	5.342	5.368	1.661	1.698	0.485	0.254	0.849	0.180	0.038	1.441	2.105	0.616	0.146	0.325	1.479	0.096	8.154	1.683	90.000
23	KEBAYORAN A	7.482	5.298	0.994	57.732	15.162	7.841	15.692	3.780	0.904	1.725	15.667	7.396	1.820	1.427	16.582	1.432	62.786	12.959	693.000
24	KEBAYORAN B	2.344	1.677	0.315	17.906	7.764	3.250	5.169	1.335	0.246	3.673	4.859	2.364	0.605	0.434	5.144	0.501	21.200	4.376	234.000
25	CIPETE	1.679	1.225	0.239	12.570	4.418	5.446	5.200	1.946	0.580	3.057	4.293	2.602	0.814	0.459	4.455	0.767	15.230	3.143	168.100
26	KALIBATA	3.721	2.743	0.552	17.414	4.863	3.599	12.613	2.564	0.523	6.775	10.413	5.945	1.419	1.039	10.484	1.053	27.859	5.750	307.500
27	PASAR MINGGU	1.119	0.825	0.171	6.144	1.840	1.973	3.754	1.855	0.411	1.997	3.259	2.775	0.809	0.376	3.152	0.718	8.970	1.651	99.000
28	JAGAKARSA	0.357	0.263	0.056	2.236	0.725	0.894	1.164	0.624	0.336	0.644	1.052	0.741	0.819	0.128	1.017	0.383	3.045	0.628	33.600
29	JATINEGARA A	4.913	3.622	0.728	10.126	2.690	1.647	5.274	1.060	0.226	9.036	10.816	3.322	0.751	1.241	8.396	0.480	26.727	5.516	295.000
30	JATINEGARA B	7.614	5.900	1.224	15.537	4.086	2.655	9.307	1.988	0.422	12.419	23.081	6.742	1.617	2.062	14.379	1.449	39.264	8.227	440.000
31	CAWANG	2.809	2.198	0.461	9.450	2.541	2.075	6.846	2.181	0.383	4.914	8.686	6.248	1.545	1.026	7.232	0.905	18.265	3.769	201.600
32	PAGAR REBO	0.931	0.743	0.164	3.493	0.985	0.975	2.454	0.956	0.248	1.666	3.128	2.318	1.120	0.411	2.371	0.737	6.315	1.304	69.700
33	KLENDER	1.463	1.203	0.286	2.124	0.548	0.426	1.392	0.345	0.077	1.698	3.093	1.196	0.319	0.750	1.946	0.156	5.871	1.212	64.800
34	TEBET	4.994	3.775	0.754	15.511	4.079	2.598	8.837	1.813	0.384	9.093	13.563	5.296	1.157	1.224	14.211	0.791	32.208	6.647	355.500
35	GANDARIA	0.848	0.664	0.148	3.773	1.118	1.259	2.497	1.163	0.407	1.467	3.820	1.665	1.010	0.274	2.225	1.540	6.319	1.305	69.750
36	SLDD	43.660	35.923	8.154	62.786	21.200	15.230	27.859	8.990	3.045	26.727	39.864	18.265	1.315	5.871	32.208	6.319			1.428.560
37	"IOX"	9.012	7.415	1.683	12.959	4.376	3.143	5.750	1.851	0.628	5.516	8.227	3.769	1.304	1.212	6.647	1.305			294.852
	TOTAL	369.970	272.694	53.708	624.524	184.294	105.738	267.735	62.254	15.345	296.316	400.817	151.657	38.678	42.734	338.949	31.084	1428.560	294.852	17.490.294

TABLE 4-4-2 (3) TRAFFIC FLOW BETWEEN EXCHANGES IN 1988

(IN ERL)

NO	OFFICE BUILDING	1 KOTA A	2 KOTA B	3 KOTA C	4 ANCOL	5 PLUIT	6 CENGKARENG	7 TEGAL ALUR	8 GAMBIR A	9 GAMBIR B	10 SEMANGGI A	11 SEMANGGI B	12 SLIPI	13 PALMERAH	14 KEDOYA	15 MERUYA	16 CEMPAKA PUTIH	17 RAWAMANGUN	18 PULOGADUNG	19 PENGGILINGAN	20 TG PRIOK A	21 TG PRIOK B	22 CILINCING	23 KEBAYORAN A	24 KEBAYORAN B	25 CIPETE	26 KALIBATA	27 PASAR MINGGU	28 JAGAKARSA	29 JATINEGARA A	30 JATINEGARA B	31 CAWANG	32 PASAR REBO	33 KLENDER	34 TEBET	35 GANDARIA	36 SLDD	37 "IOX"	TOTAL
1	KOTA A	69391	129741	88.983	29.101	28.448	6.907	2.047	103.529	104.941	35.590	16.328	36881	12.812	3.430	3.089	37.044	12.281	2.262	2.532	26.137	17.699	3.487	17.720	7.308	3.561	9.014	1.998	0.486	11.694	12.608	6.567	1.583	2.749	13.025	0.999	118.097	16.544	996.600
2	KOTA B	116.505	312.217	205.735	61.493	48.241	11.948	3541	246.659	247.534	81.469	37.005	76.388	27072	6.558	6.088	88.645	29.549	5.178	6.032	55.230	37.399	7.369	40563	16.074	7.911	21.690	4.666	1.132	28.710	30954	15.805	3.771	6.419	31.032	2.353	264.351	37.031	2.230.800
3	KOTA C	80604	207.538	192.138	53013	33 044	8.185	2.402	190.496	196993	62292	27.459	52.323	19.109	4.359	4.170	78.404	26252	4.692	5.522	49.064	34.235	6.678	29.798	11.808	6.048	17088	3.676	0.884	23.782	25.386	13.355	3.089	5.523	25.703	1.891	206.474	28.924	1.742.400
4	ANCOL	30526	71.836	61.391	28.492	12.896	3.039	0.910	63.987	62.742	20.716	9.040	17.752	6.418	1.509	1.415	28.528	9649	2.128	2.198	25.589	17.155	3.380	9.811	3.848	1.991	5.798	1.235	0.296	8398	9.237	4.486	1.094	2.204	8.720	0.654	73885	10.355	623.500
5	PLUIT	33970	64.150	43.560	14.679	22.959	5.575	1.635	53.816	54.547	18.874	8.746	21.187	7.433	2.267	1.982	18.134	6011	1.129	1.239	13.724	9.108	1.795	9.878	4.283	2.026	4.876	1.059	0.270	5.899	6.172	3.380	0.814	1.333	6.704	0.514	62.165	8.709	524.600
6	CENGKARENG	11.761	22.659	15.387	4.931	7.950	5.245	1.523	21.219	22386	8560	4047	9.705	2879	1.430	1.354	6.599	2.232	0.390	0.447	4.751	3.185	0.603	4.950	2.396	1.078	2.200	0.511	0.138	2.303	2.457	1.459	0.408	0.501	2.806	0.240	24.885	3.486	210.000
7	TEGAL ALUR	5.573	10.736	7.216	2.361	3.729	2.436	2.003	10.053	10819	4.179	2.036	4.645	1.990	0.749	0.816	3.128	1.036	0.197	0.208	2.250	1.509	0.288	2.593	1.346	0.605	1.091	0.261	0.075	1.080	1.153	0.704	0.118	0.232	1.343	0.122	12.158	1.703	102.600
8	GAMBIR A	85.324	226384	173320	50.272	37.142	10.269	3.042	374.860	379964	123.811	54034	84.301	35.060	6.816	7.205	106.569	38271	5.637	7.505	48.428	33.790	9.354	58.053	22.325	11.786	32.960	6.951	1.721	40685	42994	23.781	5.674	8.740	46225	3.538	302.352	42.355	2551.500
9	GAMBIR B	87.952	231033	182.266	50.289	38.285	11.019	3.331	386.405	497.908	159.030	68712	94.131	41990	7.611	8.562	115.483	44478	6.071	8.899	49.918	35.892	7.510	74.566	28.106	15.137	42336	9.108	2.234	49.708	52.531	30.242	7.216	10.158	59.375	4.591	345.545	48.406	2.916.000
10	SEMANGGI A	33.778	86.106	65.265	18.743	15.001	4.770	1.457	142.578	180084	104.805	39.763	39.953	18.978	3.466	5.428	44.797	19454	2.476	3.931	18.790	13377	2.913	48.168	17.621	10.026	26.807	5.884	1.459	22.854	26.166	17.500	4.348	6.162	35684	2.822	148.978	20.869	1.257.200
11	SEMANGGI B	15587	39.337	26.936	8.226	6.991	2.269	0.714	62.582	78.259	99.993	19679	19.381	10.990	1.749	2.236	18.517	7.574	0.983	1.546	7.925	5.871	1.192	21.143	8.050	4.207	10.229	2.290	0.585	8.987	9.984	6.678	1.676	1.893	12.472	1.087	64.369	9.017	543.200
12	SLIPI	35.359	81.558	55.380	16.226	17.012	5.465	1.635	98.066	107.580	40362	19.466	46.224	16057	3.700	3.647	28.444	14.494	1.526	1.963	14.720	10.066	2.024	21.768	9.533	4.420	10.221	2.289	0.591	10.859	11.475	6.806	1.673	3.310	13.365	0.839	98.438	13.789	830.700
13	PALMERAH	14.014	32.975	23.075	6.693	6.810	2.409	0.800	46.531	54.798	21.856	12.593	18.319	12.815	1.979	2.480	13.361	5.094	0.702	1.009	6.133	4.279	0.877	16362	7.458	3.423	7.021	1.703	0.448	5.868	6.585	4.360	1.138	1.286	8.062	0.777	48.525	6.797	409.500
14	KEDOYA	4.512	9.606	6.330	1.894	2.496	1.104	0.369	10.899	11.944	4.805	2.410	5.076	2.381	0.904	0.798	3.186	1.099	0.167	0.216	1.733	1.139	0.229	3.070	1.501	0.682	1.318	0.319	0.086	1.217	1.312	0.835	0.211	0.259	1.574	0.145	11.755	1.647	99.200
15	MERUYA	4.882	10.711	7.272	2.131	2.622	1.256	0.473	13.812	16.104	9.034	3.701	6.010	3.583	0.959	1.961	3.887	1.468	0.200	0.288	1.933	11.309	0.260	5.587	3.048	1.413	2.235	0.599	0.178	1.690	1.877	1.374	0.378	0.380	2.417	0.274	15.796	2.213	133.300
16	CEMPAKA PUTIH	34255	91.796	80.033	25.148	14.043	3.584	1.063	119.567	127.412	43.645	17.938	27.431	11.294	2.241	2.275	67.096	22.244	3562	4.450	27.866	20.236	4.234	20.058	7.466	4.282	13.499	2.819	0.676	19.554	21.723	10.656	2.569	4.832	20.303	2.069	120.762	16.917	1019.100
17	RAWAMANGUN	13.168	36.900	32.496	10.314	5.645	1.471	0.427	52.066	69.506	22.962	8896	16.951	5.222	0.937	1.041	26.971	19.899	2291	3.902	14.239	11.429	2.669	10669	3.825	2.541	8.682	1.925	0.459	12327	16.728	8.044	1.998	4.332	13.190	1.186	59.724	8.366	504000
18	PULOGADUNG	2.984	7.606	6.833	2.676	1.248	0.303	0.095	9.054	9.550	3.440	1.359	2.099	0.747	0.168	0.167	5.081	2.695	0.763	0.750	4.423	3.657	0.880	1.565	0.608	0.316	1.200	0.261	0.023	1.755	2.266	1.089	0.279	0.687	1.623	0.163	10.783	1.511	91.000
19	PENGGILINGAN	4.061	10.774	9.777	3.361	1.665	0.421	0.122	14.604	17.028	6.643	2.597	3.284	1.480	0.263	0.292	7.719	5.581	0.912	2.692	5.338	4.735	1.875	3.178	1.162	0.820	2.852	0.693	0.172	3.599	5.451	3.016	0.844	2.369	4.172	0.503	18.367	2.573	155.000
20	TG. PRIOK A	35927	84.542	74.453	33532	15.796	3.833	1.136	80.768	81.869	27.215	11.411	21.102	7.706	1.812	1.681	41.422	17457	4609	4.575	77.098	51.686	10845	12.635	4.575	2.592	8.334	1.793	0.423	12.439	14822	7.127	1.735	4.190	12.788	1.030	106.176	14874	896000
21	TG. PRIOK B	27.965	65.765	59.717	25840	12.052	2.955	0.876	64.783	67665	22.270	9.719	16.591	6.181	1.369	1.309	34.580	16.105	4.382	4.665	59.414	63.095	11.827	10.548	3.858	2.229	7.241	1.558	0.367	10.809	13.539	6.575	1.634	4.064	11.336	0.950	89586	12.550	756000
22	CILINCING	6.485	15.283	13.733	6.002	2.799	0.660	0.198	21.140	16687	5.715	2.326	3.931	1.494	0.324	0.307	8.529	4.434	1.244	2.175	14.692	13.940	4.857	2626	0.961	0.577	1.934	0.429	0.103	2.887	3.728	1.828	0.477	1.273	3029	0.280	22894	3.208	193.200
23	KEBAYORAN A	20256	51.638	37.605	10.693	9.457	3.329	1.088	80.523	101.703	58.018	25.320	25956	17.100	2.667	4.042	24.799	18.877	1.353	2.266	10506	7.631	1.612	49568	17.773	9.865	19.833	5.006	1.345	13037	15.380	12.195	3.315	3.094	20.197	2.330	93355	13.077	787.800
24	KEBAYORAN B	9.808	24.023	17.494	4.924	4.814	1.889	0.663	36.355	45.007	24.917	11.318	13.345	9.150	1.531	8.590	10865	4579	0.619	0.973	4.467	3.277	0.693	20.866	12.335	5.549	8.865	2.401	0.698	5.543	6.474	5.289	1.496	1.277	8.052	1.106	42.980	6.021	362.700
25	CIPETE	6.423	15.890	12.046	3.425	3.060	1.141	0.401	25.794	39.579	18.960	7.950	9.314	5.644	0.936	1.613	8.350	4.089	0.432	0.923	3.399	2.544	0.560	15.563	7.457	9.880	9.477	3.715	1.243	5.002	6.077	6.187	2.139	1.435	7.823	1.799	33.180	4.648	280.000
26	KALIBATA	4.268	30.195	23.585	6.910	6.105	1.607	0.500	50.000	63.152	35.313	13.398	13.329	8.025	1.252	1.768	18.252	9.682	1.137	2.228	7.580	5.729	1.299	21.691	8.258	6.569	23.123	4.926	1.127	10928	14.829	14.216	3.744	3.266	18.524	2.483	60.968	8.541	514.500
27	PASAR MINGGU	3.604	9.373	7.322	2.124	1.601	0.540	0.174	15.214	19.604	11.183	4.329	4.306	2.809	4.380	0.684	5.498	3.097	0.356	0.780	2.354	1.778	0.415	7.901	3.227	3.715	7.106	3.798	0.914	3.325	4.792	6.852	2.208	1.255	5.750	1.750	20.572	2.881	173.600
28	JAGAKARSA	1.328	3.457	2.672	0.775	0.620	0.222	0.076	5.723	7.300	4.206	1.678	1.685	1.122	0.180	0.308	2.007	1.120	0.048	0.293	0.842	0.637	0.151	3.220	1.424	1.886	2.466	1.386	0.837	1.201	1.731	2.048	973	0.465	2.078	1.042	7.839	1.099	66.150
29	JATINEGARA A	11.524	31.508	25.871	7.889	4.868	1.333	0.390	48.640	58445	23.730	9.277	11.161	5.286	0.912	1.054	20.839	10.883	1.311	2.211	8.917	6.740	1.527	11.239	4.071	2.678	8.613	1.817	0.432	12.986	13.723	7.078	1.732	2.762	10.216	1.013	51.464	7.209	434.300
30	JATINEGARA B	14.158	38.707	31.467	9.888	5.803	1.621	0.475	58.578	70.379	30.955	11.744	13.440	6.759	1.119	1.335	26.380	16751	1.928	3.816	12.108	9.621	2.248	15.107	5.417	3.785	13.318	2.982	0.710	15.638	25.658	12.580	3.234	5.062	19.832	2.031	67.771	9.493	571.900
31	CAWANG	9.338	25.026	20.965	6.080	4.025	1.218	0.367	41.026	51.305	26.218	9.947	10.096	5.667	0.902	1.237	16.387	10.200	1.174	2.673	7.373	5.917	1.398	15.166	5.603	4.877	16.167	5.400	1.064	10.212	15.939	19.232	4.991	4.161	16.464	2.750	52.140	7.304	440000
32	PASAR REBO	3.346	8.876	7.216	2.201	1.442	0.442	0.140	14.552	18.196	9.679	3.709	3.690	2.200	0.340	0.505	5.870	3.765	0.447	1.113	2.667	2.184	0.642	6.125	2.356	2.504	6.336	2.586	0.752	3.713	6.077	7.402	3.167	1.820	5.899	2.448	19.908	2.789	168.000
33	KLENDER	4.535	11.794	10.079	3.466	1.840	0.484	0.140	17.495	19.996	8.972	3.271	5.695	1.939	0.325	0.387	8.629	6.360	0.859	2.437	5.029	4.244	1.130	4.467	1.571	1.313	4.309	1.120	0.280	4.623	7.437	4.828	1.420	3.987	5.806	0.618	22.041	3.087	186.000
34	TEBET	13.828	36.687	30.126	8.826	5.960	1.750	0.524	59.649	75.211	36.561	13.871	14.800	7.824	1.271	1.624	23.312	12.490	1.467	2.762	9.878	7.617	1.727	18.757	6.726	4.604	15.729	3.384	0.806	14.241	18.752	12.294	2.964	3.736	24.379	1.813	67.936	9.517	573.300
35	CANDARIA	2.915	7.659	6.103	1.824	1.256	0.412	0.131	12.556	16.018	8.690	3.331	3.347	2.077	0.320	0.505	4.915	3.090	0.359	0.913	2.190	1.757	0.441	5.959	2.409	2.917	5.806	2.837	1.114	3002	5278	5.654	3.386	1.095	4.989	0.605	17.793	2.492	150.150
36	SLDD	118097	264.351	206.474	73.885	62.165	24.885	12.158	302352	345.545	148.978	64.369	98.438	48.525	11.755	15.796	120.762	59.724	10.783	18.362	106.776	89.586	22.894	93.355	42.980	33.180	60.568	20.572	7.839	51.464	67771	52.140	19.908	22.041	67936	17.993			2.784014
37	"IOX"	16.544	37.031	28.924	10.350	8.709	3.486	1.703	42.355	48.406	20.869	9.017	13.789	6.797	1.647	2.213	16.917	8.366	1.511	2.573	14.874	12.550	3.208	13077	6.021	4.648	8.541	2.881	1.099	7.209	9.493	7.308	2.789	3.087	9.517	2.492			389997
	TOTAL	1002.155	2445.468	1.901.245	608.677	457.599	139.484	48645	2998.172	3377.466	1334.535	571.794	868.056	384.615	87.137	93.943	1099898	472.380	75.310	111.072	727.755	556.603	124.989	727.372	294.806	185.641	449.289	116.838	33.066	449228	538.559	350.966	100.193	131.439	562.610	73.100	2784.014	389997	26.667.811

TABLE 4-4-2-(4) TRAFFIC FLOW BETWEEN EXCHANGES IN 1993

(IN ERL)

NO	OFFICE BUILDING	1 KOTA A	2 KOTA B	3 KOTA C	4 ANCOL	5 PLUIT	6 CENGKARENG	7 TEGAL ALUR	8 GAMBIR A	9 GAMBIR B	10 SEMANGGI A	11 SEMANGGI B	12 SLIPI	13 PALMERAH	14 KEDOYA	15 MERUYA	16 CEMPAKA PUTIK	17 RAWAMANGUN	18 PULOGADUNG
1	KOTA A	63.496	144.898	87.795	37.050	28.596	11.225	3.325	110.527	117.098	47.776	20.939	40.069	19.014	7.347	5.754	40.988	16.631	4009
2	KOTA B	129.922	424.960	247.383	95.413	59.099	23.666	7.009	320.924	336.613	133.282	57.831	101.143	48.965	17.119	13.816	120.206	48776	11.185
3	KOTA C	79.173	248.810	203.497	72.452	35.655	14.278	4.188	218.307	235.958	89.764	37.797	61.022	30.442	10.024	8.335	93.122	38.165	8.929
4	ANCOL	38.215	109.762	82.869	49.627	17.734	6.756	2.022	93.460	96089	38046	15.861	26.387	13.033	4.421	3.604	43.187	17.878	5.161
5	PLUIT	34.040	78.462	47.067	20.468	25.275	9.922	2.909	62.918	66.655	27.746	12.282	25.208	12.082	5.317	4.041	21.975	8.915	2.193
6	CENGKARENG	18.743	44.068	26.438	10.935	13.917	14.848	4.311	39.451	43.501	20.011	9.038	18364	10.024	5.334	4.391	12.718	5265	1.207
7	TEGAL ALUR	8.808	20.714	12.301	5.191	6.475	6.840	5.619	18.542	20857	9.693	4.510	8.717	5.104	2.770	2.624	5.977	2.425	0.602
8	GAMBIR A	90.243	292.230	197655	73.979	43.154	19.290	5.714	462.561	490.050	192.104	80.087	105.859	60.142	16.873	15.508	136.291	59905	11.590
9	GAMBIR B	96.914	310.717	216.555	77.103	46.346	21.562	6.515	496.759	669.037	257.074	106.105	123.154	75.040	19.631	19.157	153.871	72.537	12.956
10	SEMANGGI A	44.121	137.276	91.923	34.063	21.525	11.068	3.377	217.286	286.846	200.833	72.787	61.964	41.815	10.759	13.563	70.756	37608	6263
11	SEMANGGI B	19.533	60.172	39.101	14.345	9.625	5.050	1.588	91.508	119.601	73529	34.562	28.840	22.339	5.132	5.703	28.062	14.047	2.387
12	SLIPI	37.964	106.879	64.115	24.238	20.065	10.421	3.137	122.845	140.985	63.573	29.290	58.924	27.961	9.299	7.968	36.927	23.033	3.172
13	PALMERAH	20.317	58.349	36.068	13.499	10.845	6.414	2.059	78.704	96874	48.391	25.585	31.532	30.132	6.717	7.318	23.422	10.931	1.973
14	KEDOYA	9.464	24.595	14.318	5.523	5.753	4.115	1.347	26.624	30.555	15.009	7086	12.644	8.099	4.441	3.409	8.083	3.414	0.680
15	MERUYA	8.861	23.729	14.234	5.382	5.228	4.051	1.525	29.252	35647	22.611	9.415	12.953	10.547	4.075	7.246	8.533	3.943	0.704
16	CEMPAKA PUTIH	37.175	121.594	93.659	37.975	16.742	6.908	2.047	151.399	168.618	69.489	27.283	35.347	19.882	5.691	5.026	88.051	35.725	7.488
17	RAWAMANGUN	17.868	58444	45.469	18.622	8.047	3.387	0.983	78.832	94.165	43.753	16.178	26.119	10.992	2.847	2.751	42.322	38.218	5.759
18	PULOGADUNG	5.023	15.628	12.403	6.266	2.308	0.905	0.286	17.783	19.608	8494	3.204	4.194	2.311	0.662	0.573	10.342	6713	2.489
19	PENGGILINGAN	8.178	26.482	21.231	9.418	3.683	1.505	0.437	34320	41.823	19.628	7.330	7.854	4833	1.239	1.198	18.798	16.638	3.557
20	TG·PRIOK A	49.887	143.279	111.472	64.782	24.096	9.457	2.801	130.846	138.624	55.441	22.206	34.791	17.355	5.889	4.753	69.551	35.874	12.395
21	TG·PRIOK B	40.472	116.240	93.190	52.034	19.160	7.597	2.249	109.387	119.419	47.282	19.712	28.509	14.510	4.636	3.856	60.516	34.498	12.284
22	CILINCING	10.061	28.895	22.934	12.934	4.763	1.814	0.542	38.202	31.518	12.989	5.049	7.229	3.754	1.175	0.968	15.972	10.164	3.730
23	KEBAYORAN A	16.753	52.124	33.535	12.303	8.593	4.883	1.600	77.698	102.573	70.394	29.347	25.488	22.937	5.165	6.803	24.802	13.313	2.173
24	KEBAYORAN B	10.550	31.539	20291	7.370	5.689	3.608	1.266	45.623	59.035	39.318	17060	17.043	15.963	3.855	5.669	14.132	7.289	1.289
25	CIPETE	8.034	24.257	16244	5.959	4.204	2.536	0.890	37.634	49.681	34.784	13.933	12.344	11.448	2.737	4.106	12.628	7.568	1.050
26	KALIBATA	14.221	46512	32.097	12.134	7.078	3.603	1.122	73.625	97.192	65.382	23.696	19.971	16.426	3.698	4.543	27.854	18.084	2.781
27	PASAR MINGGU	4.643	14.737	10.169	3.806	2.265	1.236	0.396	22.865	30794	21.134	7.814	6.586	5867	1.321	1.794	8.565	5.904	0.890
28	JAGAKARSA	1.943	6.168	4.214	1.577	0.998	0.578	0.196	9.765	13.019	9.024	3.438	2.927	2.661	0.618	0.917	3.548	2.422	0.135
29	JATINEGARA A	12.770	42.616	30.912	12.163	5.926	2.622	0.769	62.892	78975	38.588	14.407	14.684	9.501	2.365	2.377	27.921	17.768	2.815
30	JATINEGARA B	13.296	44.371	31.864	12.920	5.988	2.703	0.793	64.183	80.600	42.649	14.457	14.985	10.294	2.462	2.551	29.956	23.283	3.508
31	CAWANG	15.583	50.971	37.721	14.119	7.378	3.609	1.091	79.875	104.396	64.181	23.261	20.001	15.339	3.524	4.200	33.065	25.190	3.795
32	PASAR REBO	6.582	21.314	15.308	6.024	3.116	1.539	0.488	33.401	43.656	27.935	10.226	8.619	7.019	1.564	2.020	13.966	10.963	1.702
33	KLENDER	9.653	30.642	23.135	10.264	4.304	1.830	0.531	43.450	51.902	28.019	9.756	14.396	6.697	1.617	1.676	22.190	20.037	3.543
34	TEBET	16.514	53.474	38.791	14.665	7.819	3.710	1.111	82.966	109.527	64.054	23.214	20.984	15.155	3.552	3.947	33.666	22.075	3.593
35	GANDARIA	4.485	14.376	10.121	3.903	2.123	1.124	0.358	22.530	30.041	19.611	7.179	6.111	5.180	1.154	1.583	9.142	7.034	1.069
36	SLDD	162.919	445.105	307.130	141.817	94.211	10.970	29.775	486.643	581.299	301.507	124.445	161.235	108.576	37.960	44.349	201.450	121.939	28.815
37	"IOX"	15.333	41.888	28.904	13.346	8.866	5.738	2.802	45.798	54.706	28.374	11.711	15.173	10.218	3.572	4.174	18.959	11.475	2.712
	TOTAL	1181.757	3516277	2422.113	1013.669	596.649	301.367	107.178	4139.388	4687.535	2351.472	958081	1221.370	751.657	226.562	232.271	1591.514	855.647	180.383

NO	OFFICE BUILDING	19 PENGGILINGAN	20 TG. PRIOK A	21 TG. PRIOK B	22 CILINCING	23 KEBAYORAN A	24 KEBAYORAN B	25 CIPETE	26 KALIBATA	27 PASAR MINGGU	28 JAGAKARSA	29 JATINEGARA A	30 JATINEGARA B	31 CAWANG	32 PASAR REBO	33 KLENDER	34 TEBET	35 GANDARIA	36 SLDD	37 "IOX"	TOTAL
1	KOTA A	5.493	38.412	27.506	5.923	15.036	8.082	4.667	11.956	2.761	0.763	13.369	12.368	11.731	3.393	6.311	16.182	1.673	162.919	15.333	1170.413
2	KOTA B	15948	98921	70837	15258	41.949	21.663	12638	35065	7.854	2.171	40.003	37005	34.402	9.849	17.963	46.982	4.810	445.105	41.888	3197.600
3	KOTA C	12.859	77.403	57.115	12.178	27.143	14.018	8.511	24.335	5.452	1.491	29.184	26.729	25.606	7.115	15.641	34276	3.406	307.130	28.904	2206.400
4	ANCOL	6.526	51.452	36.477	7.856	11.391	5.823	3.571	10.523	2.335	0.638	13.134	12.396	10.962	3.201	6.922	14.823	1.503	141.817	13.346	1018.800
5	PLUIT	2945	22.085	15.503	3.338	9.181	5.188	2.908	7.084	1.603	0.466	7.386	6.630	6.611	1.911	3.350	9.120	0.943	94.211	8.866	676.800
6	CENGKARENG	1.687	12.160	8.621	1.784	7.317	4.616	2.461	5.058	1.227	0.379	4.586	4.200	4.536	1.325	1.998	6.072	0.701	60.970	5.738	438.000
7	TEGAL ALUR	0.777	5.716	4.052	0.947	3.801	2.572	1.370	2.500	0.625	0.206	2.133	1.954	2.175	0.667	0.920	2.882	0.354	29.775	2.802	213.900
8	GAMBIR A	18.819	82.260	60.699	18.366	56.941	28.536	17.855	50.540	11.100	3.130	53.759	48.747	49.093	14.054	23.194	66376	6.864	486.643	45.798	3496.000
9	GAMBIR B	23.249	88341	67.172	15.361	76.198	37.431	23.894	67.631	15.153	4.229	68.428	62.053	65042	18.621	28.084	88.825	9.277	581.299	54.706	4176.000
10	SEMANGGI A	12.175	39422	29.679	7.064	58.352	27.816	18.666	50.764	11.605	3.271	37.297	36.639	44.620	13.296	16.917	57.962	6.758	301.507	28374	2166.000
11	SEMANGGI B	4.593	15.952	12.498	2773	24.574	12.193	7.553	18.586	4.334	1.259	14.071	13.414	16.336	4.917	5.951	21.221	2.499	124.445	11.711	894.000
12	SLIPI	4.998	25.361	18.356	4.054	21.674	12.370	6.796	15.909	3.710	1.089	14.565	13208	14.266	4.207	8.918	19.482	2.161	161.235	15.173	1158.300
13	PALMERAH	3.469	14.279	10.536	2.363	21.998	13.067	7.109	14.756	3.728	1.116	10.628	10233	12.337	3864	4678	15.866	2.065	108.576	10.218	780.000
14	KEDOYA	1.072	5.841	4.059	0.892	5.972	3.805	2.049	4.006	1.012	0.313	3.188	2.950	3.416	1.038	1.362	4483	0.555	37.960	3572	272.700
15	MERUYA	1.239	5.635	4.035	0.878	9.405	6.688	3.675	5.883	1.642	0.555	3.833	3654	4.869	1.604	1.687	5.956	0.910	44349	4.174	318.600
16	CEMPAKA PUTIH	11.451	48.572	37.304	8.529	20.188	9.818	6.654	21.241	4.618	1.263	26.512	25.274	22.576	6.528	13.156	29.918	3.093	201.450	18.959	1447.200
17	RAWAMANGUN	12006	29.678	25.191	6.431	12.840	5.999	4.724	16.334	3.771	1.022	19.985	23271	20.374	6.071	14.075	23.240	2.820	121.939	11.475	876.000
18	PULOGADUNG	2.993	11.957	10.457	2.751	2.444	1.237	0.764	2.927	0.663	0.066	3.691	4.089	3.580	1.099	2.902	4.166	0.501	28.815	2.712	207.000
19	PENGGILINGAN	12.856	17.267	16.198	7.328	5.935	2.829	2.366	8.345	2.108	0.594	9.056	11.770	11.853	3.982	11.975	11.408	1.850	60.079	5.654	431.600
20	TG·PRIOK A	15.062	171.937	121.888	29.655	16.268	7.678	5.153	16.777	3.758	1.008	21.579	22.063	19.316	5.641	14.602	24.109	2.622	235.248	22.139	1690.000
21	TG·PRIOK B	16.007	138.103	155.098	34.337	14.156	6.749	4.620	15.194	3.404	0.913	19.543	21.006	18.576	5.535	14.760	22.275	2.521	209.914	19.754	1508.000
22	CILINCING	8.350	38.770	39.643	13.966	3.774	1.799	1.282	4.344	1.003	0.274	5.588	6.189	5.528	1.731	4.953	6.368	0.797	58.631	5.517	421.200
23	KEBAYORAN A	4.441	13.956	10.719	2476	38.018	17.766	11.685	23.779	6.251	1.910	13.471	13.638	19.684	6.416	6.424	22679	3.535	119.434	11.240	858000
24	KEBAYORAN B	2.481	7.718	5.987	1.383	20.813	16.036	8.550	13.824	3.898	1.289	7.449	7.465	11.104	3.769	3.447	12.416	2.182	71.660	6.744	514.800
25	CIPETE	2.735	6828	5.404	1.300	18.050	11.272	17.698	17.162	7.015	2.669	7.657	8.148	15.103	6.259	4.505	13.284	4.127	65.563	6.170	471.000
26	KALIBATA	6667	15.365	12.283	3.043	25.386	12.596	11.875	42.307	9.384	2.442	17.230	20.063	35.020	11.061	10.341	31.739	5.746	121.939	11.475	876.000
27	PASAR MINGGU	2.381	4.868	3.891	0.992	9.438	5.023	6.856	13.271	7.387	2.022	5.353	6.616	17.229	6.657	3.961	10.056	4.133	42.845	4.032	307.800
28	JAGAKARSA	1.016	1.978	1.580	0.412	4.366	2.517	3.951	5.231	3.062	2.101	2.195	2.715	5.845	3.336	1.708	4.125	2.796	18.569	1.748	133.400
29	JATINEGARA A	5.810	15.872	12.687	3.142	11.550	5.453	4.249	13.837	3.039	0.823	17.977	16.302	15.307	4.425	7.678	19.886	2.057	88.698	8.348	637.200
30	JATINEGARA B	8499	18.263	15.347	3.917	13.158	6.148	5.090	18.133	4.227	1.145	18.347	25.832	23.074	6.887	11.927	25.288	3.205	100.224	9.432	720.000
31	CAWANG	10.575	19.758	16.770	4.323	23.469	11.300	11.657	39.112	13.606	3.048	21.289	28.513	62.640	18.510	17.417	37.301	8.414	140.397	13.212	1008.600
32	PASAR REBO	5.190	8.429	7.299	1.978	11.177	5.602	7.058	17.777	7.680	2.541	8.987	12.420	26.995	19.197	8.985	15.756	8.830	64.310	6053	462.000
33	KLENDER	12.301	17.196	15.354	4.460	8.818	4.039	4.003	13.298	3.602	1.026	12.297	6.971	20.057	7.083	21.299	16.779	2.413	76296	7.181	548.100
34	TEBET	7.819	18.946	15.449	3.828	20.773	9.707	7.876	27.232	6.101	1.653	21.246	24.007	28.656	8.287	11.196	39.527	3.967	127.242	11.975	914.100
35	GANDARIA	3.330	5.408	4591	1.256	8.500	4.478	6.425	12.947	6.586	2.942	5.769	7.984	16.976	12.195	4.229	10416	12.992	45.017	4.237	323.400
36	SLDD	60.079	235.248	209.914	58.631	119.434	71.660	65.563	121.939	42.845	18.569	88.698	100224	140.397	64.310	76.296	127.242	45.017			5086.211
37	"IOX"	5.654	22.139	19.754	5.517	11.240	6.744	6.170	11.475	4.032	1.748	8.348	9432	13.212	6.053	7.181	11.975	4.237			478.660
	TOTAL	333552	1451.516	1189.955	298670	810.727	430.318	327.992	801.102	222.181	72.144	677.831	706172	859.105	304.114	414.913	930.461	172.334	5086.211	478.660	42.102.891

CHAPTER 5

EXCHANGE OFFICE ESTABLISHMENT PLAN

CHAPTER 5 EXCHANGE OFFICE ESTABLISHMENT PLAN

5.1 Exchange Office Service Area and Wire Centre

5.1.1 General Description

5.1.1.1 Exchange Office Service Area

The exchange office service area must be determined, not only based on the long term demand forecast but also in consideration of the economic conditions in the future.

The CCITT Recommendations do not specify the methodology of establishing the exchange office service area.

Main items to be studied in the exchange office establishment plan are as follows:

a) Size of exchange office service area and number of subscriber terminals to be accommodated

b) Exchange office location

c) Service-in time

In the exchange office many kinds of equipments are installed to accommodate subscribers. Such equipment are classified into two groups. One group includes land and building as well as inside plants, such as switching and power equipment. The other group comprises subscriber lines and outside plants including underground facilities.

Investment required for outside plants is extremely large, compared with that for inside plants. An example in Japan showing annual expenses required for each kind of equipment is given in Fig. 5.1.(1).

According to data of the Municipal Authority of Jakarta (D.K.I.) the city of Jakarta embraces an area of 57,154 hectares. At the time when JTP commenced the long term telephone cable network study for the whole city of Jakarta the Second Five-Year Plan of PERUMTEL (dated March 1, 1973) was already complete.

In this plan the whole city of Jakarta is divided into 28 exchange office service areas. This service area distribution is optimal for the telephone network plan.

The exchange office establishment study is based, in principle, on the Second Five-Year Plan of PERUMTEL.

The size of service area of each exchange office, the telephone demand in 1993 estimated by JTP and the demand density per hectare are shown in Table 5.1.(2).

For the six exchange offices with an asterisk in Table 5.1.(2), i.e., Jakarta Kota, Gambir, Semanggi, Tanjung Priok, Kebayoran and Jatinegara, the estimated telephone demand is extremely large. Consultation was carried out between JTP and PERUMTEL concerning the subdivision of each of the six exchange offices. Decision was made to revise the service area of each exchange office as shown in Table 5.1.(3) and Fig. 5.2.(32).

Wire centre calculation, Key Map designing, junction circuit calculation and other related works were also carried out, based on that revised plan.

5.1.1.2 Local Service Area Classification

PERUMTEL divides the local service area into the ordinary local service area and the special local service area.

This division of local service area is made simply by the distance from the exchange office to the subscriber. The area within 4 km from the exchange office is the ordinary local service area. The area beyond 4 km from the exchange office is the special local service area. New telephone installation tariffs in Jakarta are shown in Table 5.1.(4) and Fig. 5.1.(5).

When deciding the local service area boundary the topographical features, such as road and river should be taken into consideration.

In Japan the Nippon Telegraph & Telephone Public Corporation (NTT) has the local service area regulation similar to the foregoing in force. That is to say, the ordinary local service area boundary is set at about 5 km from the exchange office in principle. Actually, the administrative area and the cluster of houses, as well as the expected city planning in the future and other factors related to the telephone demand, are carefully considered.

In Japan the applicant for new telephone installation who lives inside the ordinary local service area has only to pay the fixed tariff. However, when the applicant lives outside the ordinary local service area he has to pay ¥9,000 per 100 m from the ordinary local service area boundary. A list of new telephone installation tariffs in Tokyo appears in Table 5.1.(6).

5.1.1.3 Wire Centre

Fig. 5.1.(1) shows that the investment in subscriber lines is much larger than that in other equipments. Construction cost economy requires selection of optimum exchange office location.

Wire centre is the point where the calculated annual cost is the minimum. Its location depends upon the pattern of demand distribution.

If the demand density is uniform in the whole service area or the demand is symmetrically distributed to the demand centre the wire centre lies at the same point as the demand centre.

Generally the wire centre can be known after repeated calculations. JTP calculated by computer the wire centre of each of the following 15 exchange offices:

1. Jakarta Kota (C)
2. Ancol
3. Cengkareng
4. Tegal Alur
5. Semanggi (B)
6. Pal Merah
7. Kedoya

8. Meruya
9. Pulo Gadung
10. Penggilingan
11. Tanjung Priok (B)
12. Cilincing
13. Kebayoran (B)
14. Jagakarsa
15. Klender

5.1.1.4 Methodology of Wire Centre Calculation

Cost of installing subscriber lines in the whole service area varies, depending upon the size of service area and the pattern of demand distribution.

When the exchange office is located at the base point of axes X and Y the total cost of subscriber line construction to the demand at points x and y can be obtained as follows:

$$P = \sum_{x} \ell(x, y), D(x, y), Cd$$

where

x : Distribution block area number

The distance from the exchange office to No. x distribution block area is expressed by

$$\ell(x, y) = |Xo - Xi| + |Yo - Yi|$$

D (x, y) signifies the demand in No. x distribution block area in 1983 and 1993.

In the case of Kebayoran (B) Exchange Office the demand is calculated for 1982 and 1992.

Meanwhile, D (x, y) is shown for each ℓ (x, y) as seen in the "In-put and Out-put Data for Wire Centre" diagram.

Cd is expressed by the function of ℓ (x, y) and signifies the cost per pair of subscriber lines. (Refer to Fig. 5.1.(7).)

In this case the annual expenses (A) are expressed by

$$A = P \left\{ \frac{i(1+i)^{N}}{(1+i)^{N_1} - 1} + \mu \right\}$$

where

A : Annual expenses of subscriber lines

P : Total subscriber line construction cost inclusive of civil engineering cost

i : Annual interest rate

N : Service life of plant

μ : Operation and maintenance cost rate

The reference values which JTP used when calculating the wire centres by computer are shown in Table 5.1.(8).

5.1.1.5 Input Data for Wire Centre Calculation

Input data for wire centre calculation are given in the attached drawings, W1 to W15.

5.1.1.6 Output Data for Wire Centre Calculation

Wire centres calculated by computer are shown in the attached drawings, W1 to W15. These calculated wire centres are shown in Fig. 5.2.(32).

5.1.2 Detailed Description of Each Exchange Office

According to the JTP forecast the demand at several exchange offices in 1993 was extremely large. Therefore, the study was made with regard to the subdivision of service areas of those exchange offices. More precisely, investigations were carried out on the following points for the six exchange offices, i.e., Jakarta Kota, Gambir, Semanggi, Tanjung Priok, Kebayoran and Jatinegara:

1) Existing switching room capacity.
2) Main distributing frame (MDF).

Findings in the investigations are as follows:

1) Switching room capacity of each existing exchange office where large demand was forecasted:

	Maximum Subscriber Accommodation Capacity
Jakarta Kota	10,000 line units
Gambir	20,000 "
Semanggi	6,000 "
Tanjung Priok	6,000 "
Kebayoran	10,000 "
Jatinegara	4,000 "

2) The existing MDF comprises two types. One is the type with a protector. The other is without a protector. Capacity per frame varies according to the test room height of each exchange office. MDF with a protector holds an average capacity for 200 terminal pairs per frame. Each frame consists of eight blocks and each block consists of 25 terminal pairs.

In the case of MDF without a protector the average capacity per frame is for 600 terminal pairs. Each frame consists of 12 blocks and each block consists of 50 terminal pairs.

In both cases one frame is 18 cm wide.

In the PERUMTEL plan the latest type MDF is to be used for new installations in and after 1975. This latest type MDF is the protector type with capacity for 800 terminal pairs per frame. Each frame consists of eight blocks and each block consists of 100 terminal pairs.

5.1.2.1 Jakarta Kota

The estimated demand in 1993 in the future service area of this exchange office is 117,400. This number is too large to accommodate for one exchange office. PERUMTEL had plan to construct another exchange office in this area.

JTP recommends that this service area be divided in three in the future. The result of construction cost comparison is given in Table 5.1.(9).

The calculated wire centre of Jakarta Kota (C) Exchange Office is shown in Figure 5.2.(32).

5.1.2.2 Gambir

The estimated demand in 1993 in the future service area of this exchange office is 95,900. As of June 1975, 17,000 subscriber line units are installed in this exchange office. The maximum capacity is for 20,000 subscriber line units.

This exchange office is equipped with toll and international switches, telex, telegraph and toll carrier terminal equipments. This exchange office is located almost at the centre of SLDD and IOX network in the city of Jakarta.

JTP recommends that the service area of this exchange office be divided in two as shown in Fig. 5.2.(32). It is also recommended that the existing exchange office be expanded or a new exchange office be constructed adjacent to the existing exchange office in order to accommodate the toll switches.

Table 5.1.(10) presents the toll office construction cost comparison prepared in February 1975 at the request of PERUMTEL.

Table 5.1.(11) is the subscriber line and switching equipment installation cost comparison.

5.1.2.3 Semanggi

The estimated demand in 1993 in the future service area of this exchange office is 51,000. This is quite a big figure.

A large road, J1 Raya Jenderal Sudirman, traverses north to south the central part of the service area of this exchange office. This road is a suitable service area boundary.

JTP recommends that this service area be divided in two in the future.

The result of construction cost comparison is given in Table 5.1.(12).

The calculated wire centre of Semanggi (B) Exchange Office is shown in Fig. 5.2.(32).

5.1.2.4 Tanjung Prick

The estimated demand in 1993 in the future service area of this exchange office is 61,500. At present, 2,000 subscriber line units are installed. The maximum capcity is for 6,000 subscriber line units.

The existing exchange office is located in the western part of its service area. The J1 Komodor Jos Sudarso expressway traverses north to south the central part of the service area. This expressway is a suitable service area boundary.

JTP recommends that this service area be divided in two in the future.

The result of construction cost comparison is given in Table 5.1.(13).

The calculated wire centre of Tanjung Priok (B) Exchange Office is shown in Fig. 5.2.(32).

5.1.2.5 Kebayoran

The estimated demand in 1993 in the future service area of this exchange office is 41,600.

There are two kecamatans in this service area. They are Kebayoran Baru and Kebayoran Lama. The boundary of these two kacamatans is the Kali Grogol river. This river is a suitable service area boundary.

JTP recommends that this service area be divided in two in the future.

The result of construction cost comparison appears in Table 5.1.(14).

The calculated wire centre of Kebayoran (B) Exchange Office is shown in Figure 5.2.(32).

5.1.2.6 Jatinegara

The estimated demand in 1993 in the future service area of this exchange office is 37,700.

This service area comprises two kecamatans, i.e., Matraman and Jatinegara. The boundary of these two kecamatans is the railway. PERUMTEL planned to establish another exchange office in this area and selected kecamatan Jatinegara for the new exchange office site.

The existing Jatinegara exchange office already has 4,000 subscriber line units installed. There is no surplus space for additional installations.

JTP recommends that this service area be divided in two.

The result of construction cost comparison appears in Table 5.1.(15).

5.2 New Terminal Installation Plan and New Exchange Office Construction Plan by Year

5.2.1 New Terminal Installation Plan

The new terminal installation plan up to 1977 decided by PERUMTEL on 20th January 1975 is shown in Table 5.2.(1).

JTP formulated the new terminal installation plan for and after 1978, based on PERUMTEL.s plan and in consideration of the trend of demand increase. In formulating the plan JTP used the following standards:

a) Four years as an optimum provision period for switching equipment. (Refer to Part III, Chapter 6, Section 8.)

b) 1,000 terminals as a unit of new installation.

Fig. 5.2.(4) through Fig. 5.2.(31) show the new subscriber terminal installation plans for all exchange offices.

5.2.2 New Exchange Office Construction Plan

Table 5.2.(2) and Fig. 5.2.(3) present summaries of new terminal installation plan and new exchange office construction plan for each base year.

The total number of line units given in Table 5.2.(2) exceeds the total demand. This is because the optimum provision period for new/additional subscriber switches is set at four years as aforementioned.

Up to 1978 the total number of line units somewhat exceeds the previously mentioned standard number of installation. This gap can be understood when the following facts are considered:

a) The period mentioned is a transition period in which a large quantity of facilities are additionally installed for the first time in Jakarta.

b) Generally, after the new/additional installation an unexpected demand arises.

c) Since the new/additional installation is to be made by a unit of 1,000 line units the number of switches installed even at the initial stage where the demand increase is mild is moved up to 1,000.

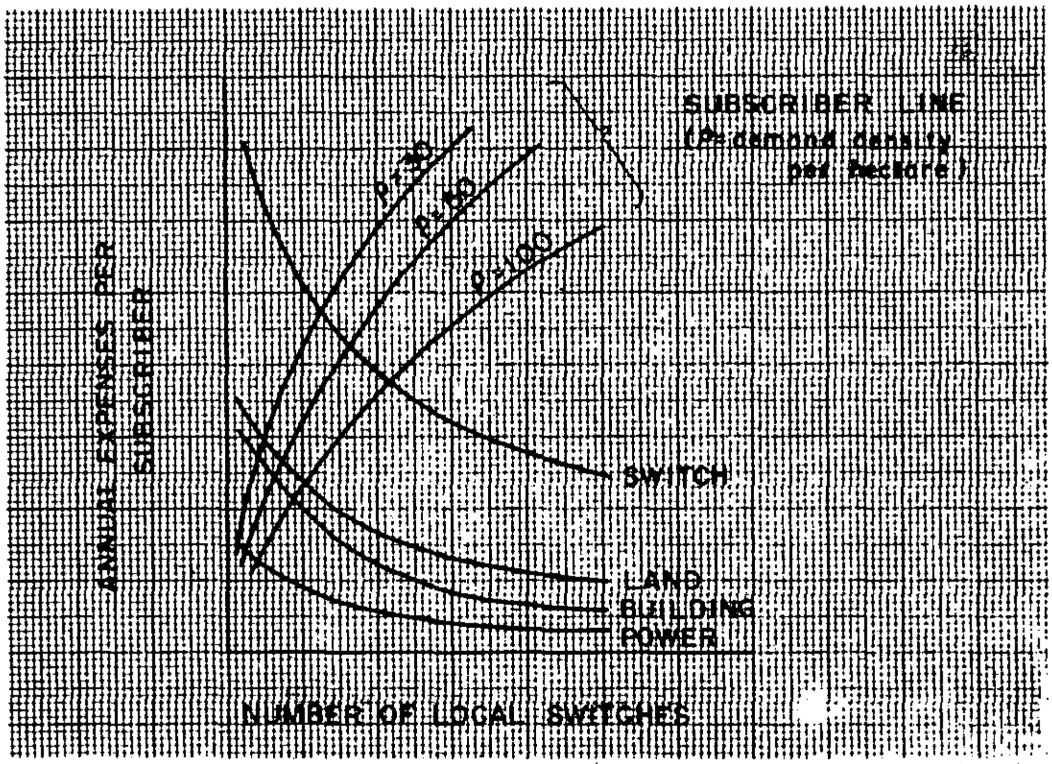


FIG.-5-1(1)

TABLE 5-1-(2)

SERVICE AREA SIZE, DEMAND AND DEMAND DENSITY AS OF 1993 FOR EACH EXCHANGE OFFICE

No	Name of Exchange office	Service area size (ha)	Demand	Demand density /ha
1	*Jakarta Kota	1,576	117,400	74.5
2	Ancol	2,140	28,300	13.2
3	Pluit	1,366	18,800	13.8
4	Cengkareng	3,267	14,600	4.5
5	Tegal Alur	3,108	9,300	3.0
6	*Gambir	2,137	95,900	44.9
7	*Semanggi	1,588	51,000	32.1
8	Slipi	1,481	35,100	23.7
9	Pal Merah	1,505	26,000	17.3
10	Kedoya	1,315	10,100	7.7
11	Meruya	1,882	11,800	6.3
12	Cempaka putih	1,424	40,200	28.2
13	Rawamangun	1,468	21,900	14.9
14	Pulo Gadung	1,692	6,900	4.1
15	Penggilingan	1,529	8,300	5.4
16	*Tanjung Priok	2,441	61,500	25.2
17	Cilincing	1,759	11,700	6.7
18	*Kebayoran	2,070	41,600	20.1
19	Cipete	2,450	15,700	6.4
20	Kalibata	2,289	29,200	12.8
21	Pasar Minggu	2,194	11,400	5.2
22	Jagakarsa	2,064	5,800	2.8
23	*Jatinegara	1,802	37,700	20.9
24	Cawang	2,660	24,600	9.2
25	Pasar Rebo	3,630	15,400	4.2
26	Klender	1,892	20,300	10.7
27	Tebet	1,167	27,700	23.7
28	Gandaria	3,258	9,800	3.0

TABLE 5-1-(3) SERVICE AREA SIZE, DEMAND AND DEMAND DENSITY AS OF 1993 WHICH HAD BEEN DECIDED BY J.T.P. AND PERUMTEL.

No.	Name of Exchange office		Service area size (ha)	Demand	Demad density / ha
1	Jakarta Kota	A	562	20,900	37.2
	,	B	471	57,100	121.2
	,	C	543	39,400	72.6
2	Ancol		2,140	28,300	13.2
3	Pluit		1,366	18,800	13.8
4	Cengkareng		3,267	14,600	4.5
5	Tegal Alur		3,108	9,300	3.0
6	Gambir	A	1,139	43,700	38.4
	,	B	998	52,200	52.3
7	Semanggi	A	871	36,100	4.14
	,	B	717	14,900	20.8
8	Slipi		1,481	35,100	23.7
9	Pal Merah		1,505	26,000	17.3
10	Kedoya		1,315	10,100	7.7
11	Meruya		1,882	11,800	6.3
12	Cempaka Putih		1,424	40,200	28.2
13	Rawamangun		1,468	21,900	14.9
14	Pulo Gadung		1,692	6,900	4.1
15	Penggilingan		1,529	8,300	5.4
16	Tanjung Priok	A	1,214	32,500	26.8
	,	B	1,227	29,000	23.6
17	Cilincing		1,759	11,700	6.7
18	Kebayoran	A	1,107	26,000	23.5
	,	B	963	15,600	16.2
19	Cipete		2,450	15,700	6.4
20	Kalibata		2,289	29,200	12.8
21	Pasar Minggu		2,194	11,400	5.2
22	Jagakarsa		2,064	5,800	2.8
23	Jatinegara	A	672	17,700	26.3
	,	B	1,130	20,000	17.7
24	Cawang		2,660	24,600	9.2
25	Pasar Rebo		3,630	15,400	4.2
26	Klender		1,892	20,300	10.7
27	Tebet		1,167	27,700	23.7
28	Gandaria		3,258	9,800	3.0

TABLE 5-1-(4) INSTALLATION TARIFF IN JAKARTA

(Unit ; Rp.)

Distance (km) from exchange to subscriber		$\ell \leq 4$ km	$4 < \ell \leq 7$ km	$7 < \ell \leq 10$km	$10 < \ell \leq 20$km	$20 < \ell$ km
Basic cost		280	280	280	280	280
Line installation tariff	Basic	500,000	500,000	500,000	500,000	500,000
	Special addition	—	A	B	C	D
	Total	500,000	500,000 + A	500,000 + B	500,000 + C	500,000 + D
Telephone set		2,000	2,000	2,000	2,000	2,000
Technical checking		10,000	10,000	10,000	10,000	10,000
Duty stamp		10	10	10	10	10
Total		512,290	512,290 + A	512,290 + B	512,290 + C	512,290 + D

Note : $4 < \ell \leq 7$ km   A = 12,500/km
$7 < \ell \leq 10$ km   B = A + 12,500 / 100 m
$10 < \ell \leq 20$ km   C = B + 14,000 / 100 m
$20 < \ell$ km   D = C + 16,500 / 100 m

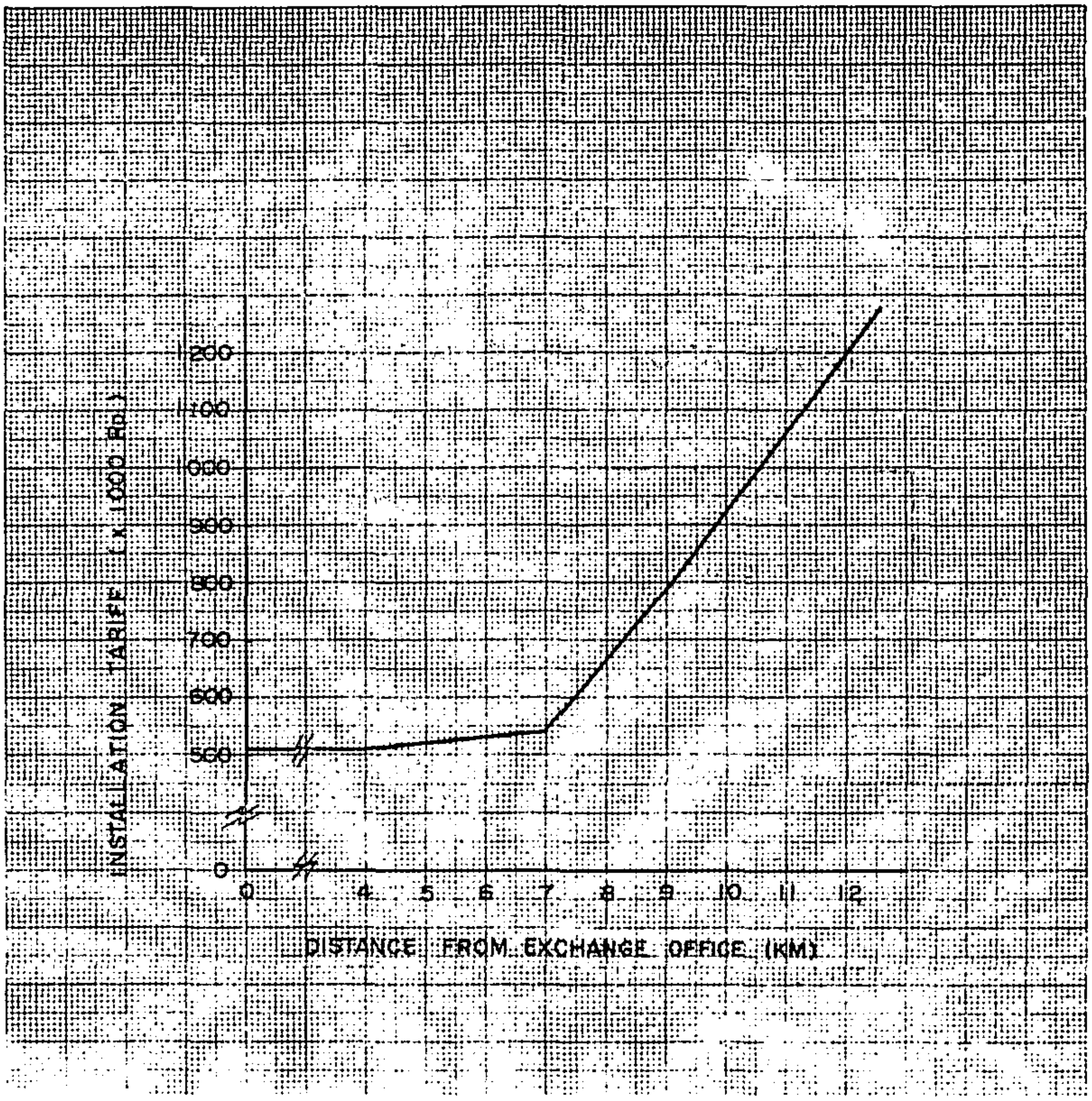


FIG. 5-1-(5)
INSTALLATION TARIFF IN JAKARTA

TABLE 5-1-(6)
INSTALLATION TARIFF IN TOKYO

(Unit : Yen)

	Telephone
Basic cost	300
Installation tariff	50,000
Total	50,300
Telephone Bond	150,000

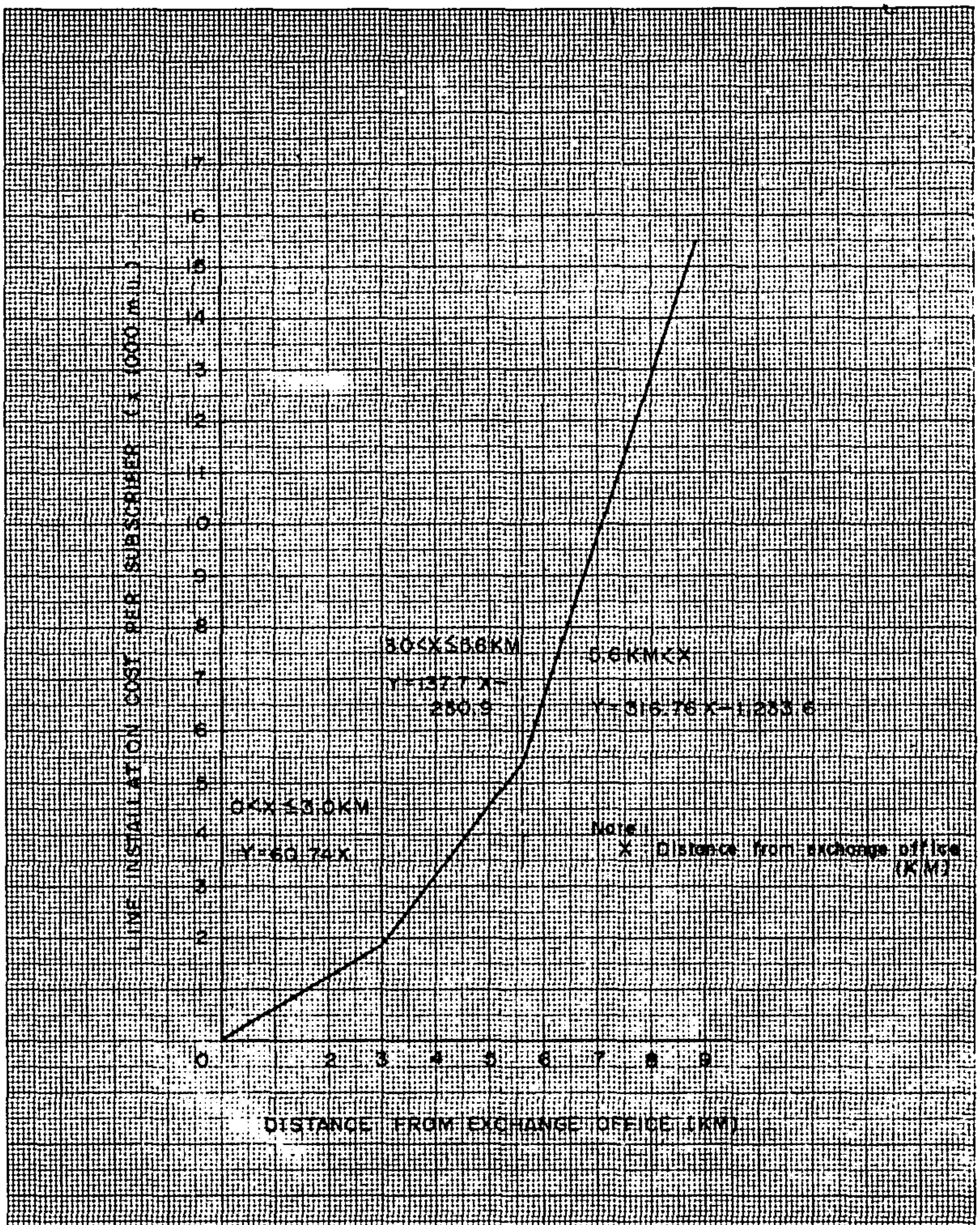


FIG. 5-1-(7)
LINE INSTALLATION COST USED FOR
CALCULATION OF WIRE CENTRE

TABLE 5-1-(8)
EACH FIGURE USED FOR CALCULATION OF WIRE CENTRE

Annual interest rate	i	0.12
Service life of plant	N	25 Years
Annuity from a present amount	$\frac{i(1+i)^N}{(1+i)^N-1}$	0.1275
Operation and maintenance cost rate	μ	0.01
Line installation cost	Cd	See FIG.5-1-(7)

TABLE 5-1-(9) COST COMPARISON BETWEEN PLANS FOR JAKARTA KOTA

Item	Plan 1 (Two Kota service areas)	Plan 2 (Three Kota service areas)
Distance between Kota B to *future Kota C*	—	1.7 km
Number of subscribers as of 1993 beyond future Kota C	0.4 mm ······ 12,101 0.6 mm ······ 8,828	—
Number of necessary junction circuits as of 1993	—	0.4 mm ······ 4,495 0.6 mm ······ 2,014
Installation cost for primary cable including civil work *(Cost difference only)*	(million Rp.) 661	—
Installation cost for junction cable including civil work (Cost difference only)	—	(million Rp.) 249
Installation cost for switch (Cost difference only)	40,875 T.	40,875 T (million Rp.) 94
Total	(million Rp.) 661	(million Rp.) 343
Cost difference		(million Rp.) — 318

TABLE 5-1-(10) COST COMPERISON BETWEEN PLANS FOR TOLL EXCHANGE OFFICE

Item		Plan No. 1 (Existing Gambir)	Plan No. 2 (Gambir B)	Plan No. 3 (Semanggi)
Distance between existing Gambir and new toll exchange office		0 km	3 km	7 km
Number of circuits as of 1993	SLLD	13,631	13,467	15,053
	IOX	1,837	1,837	2,006
Relation between wire centre and toll exchange office location		The same location with wire centre (good)	Distance difference; 3 km (not so good)	Distance difference ; 7 km (very bad)
Effects to circuits between EO and Toll by shifting from wire centre (Increasing rate to Plan No. 1)		Nothing (100 %)	SLDD, IOX – EO Large Difference cost to Plan 1 1,138 million Rp. (116 %)	SLDD, IOX – EO Very large Difference cost to Plan 1 5,233 millon Rp. (172 %)
Effect to increasing loss by using the existing carrier equipment at existing Gambir exchange office (Additional installation cost)		Nothing	Circuit cost X 3 X 3 km 0.6 mm cable (4,097 million Rp.)	Circuit cost X 3 X 7 km 0.6 mm cable (9,559 million Rp.)
Necessary required periods of building construction		*Arrangement of office* building, etc. (1 Year)	*New integrated building* of local and toll circuits (2 Years)	*New toll exchange* building (1 Year)

TABLE 5-1-(II) COST COMPARISON BETWEEN PLANS FOR GAMBIR

Item	Plan 1 (One Gambir service area)	Plan 2 (Two Gambir service areas)
Distance between existing Gambir A to future Gambir B	—	1.8 Km
Number of subscribers as of 1993 beyond future Gambir B	0.4mm ········· 10,164 0.6mm ········· 14,879 0.8mm ········· 1,764	—
Number of necessary junction circuits as of 1993	—	0.4 mm ········· 7,990 0.6 mm ········· 3,373 0.8 mm ········· 59
Installation cost for primary cable including civil work (Cost difference only)	(million Rp.) 1,004	—
Installation cost for junction cable including civil work (Cost difference only)	—	(million Rp.) 451
Installation cost for switch (Cost difference only)	45,830T —	45,830 T 85
Total	(million Rp.) 1,004	(million Rp.) 536
Cost Difference		(million Rp.) — 468

TABLE 5-1-(12) COST COMPARISON BETWEEN PLANS FOR SEMANGGI

Item	Plan 1 (One Semanggi service area)	Plan 2 (Two Semanggi service areas)
Distance between Semanggi A to future Semanggi B	–	2.0 km
Number of subscribers as of 1993 beyond future Semanggi B	0.4 mm ·········· 600 0.6 mm ·········· 5,880 0.8 mm ·········· 200	–
Number of necessary junction circuits as of 1993	–	0.4 mm ········ 851 0.6 mm ········ 1,798 0.8 mm ········ 69
Installation cost for primary cable including civil work (Cost difference only)	(million Rp.) 316	–
Installation cost for junction cable including civil work (*Cost difference only*)	–	(million Rp.) 158
Installation cost for switch (*Cost difference only*)	15,480 T –	15,480 T (million Rp.) 122
Total	(million Rp.) 316	(million Rp.) 280
Cost difference		(million Rp.) – 36

TABLE 5-1-(13) COST COMPARISON BETWEEN PLANS FOR TANJUNG PRIOK

Item	Plan 1 (One TG. Priok service area)	Plan 2 (Two TG. Priok service areas)
Distance between TG. Priok A to future TG. Priok B	—	3.0 km
Number of subscribers as of 1993 beyond future TG. Priok B	0.6 mm ········ 10,885 0.8 mm ········ 6,480	—
Number of necessary junction circuits as of 1993		0.4 mm ········· 687 0.6 mm ········· 800 0.8 mm ········· 1,966
Installation cost for primary cable including civil work (Cost difference only)	(million Rp.) 1,405	—
Installation cost for junction cable including civil work (Cost difference only)	—	(million Rp.) 340
Installation cost switch (Cost difference only)	29,830 T —	29,830 T (million Rp.) 107
Total	(million Rp.) 1,405	(million Rp.) 447
Cost difference		(million Rp.) — 958

TABLE 5-1-(14) COST COMPARISON BETWEEN PLANS FOR KEBAYORAN

Item	Plan 1 (One Kebayoran service area)	Plan 2 (Two Kebayoran service areas)
Distance between Kebayoran A to future Kebayoran B	—	2.8 km
Number of subscribers as of 1993 beyond future Kebayoran B	0.6 mm ········· 10,655	—
Number of necessary junction circuits as of 1993		0.4 mm ········ 943 0.6mm ········ 174 0.8mm ········ 366
Installation cost for primary cable including civil work (Cost difference only)	(million Rp.) 947	—
Installation cost for junction cable including civil work (Cost difference only)	—	(million Rp.) 134
Installation cost for switch (Cost difference only)	15,374 T —	15,374 T (million Rp.) 124
Total	(million Rp.) 947	(million Rp.) 258
Cost difference		(million Rp.) — 689

TABLE 5-1-(15) COST COMPARISON BETWEEN PLANS FOR JATINEGARA

Item	Plan 1 (One Jatinegara service area)	Plan 2 (Two Jatinegara service areas)
Distance between Jatinegara A to Jatinegara B	—	2.8 km
Number of subscriber as of 1993 beyond Jatinegara B	0.6 mm ·········· 5,909 0.8 mm ·········· 6,299	—
Number of necessary junction circuits as of 1993	—	0.4 mm ········ 928 0.6 mm ········ 284 0.8 mm ········ 63
Installation cost for primary cable including civil work (Cost difference only)	(million Rp.) 978	—
Installation cost for junction cable including civil work (Cost difference only)	—	(million Rp.) 101
Installation cost for switch (Cost difference only)	20,823 T —	20,823 T (million Rp.) 123
Total	(million Rp.) 978	(million Rp.) 224
Cost difference		(million Rp.) — 754

TABLE 5-2-(1) INSTALLATION PROGRAM OF TELEPHONE EXCHANGE IN JAKARTA CITY 1975-1977

Issued Jan. 1975 by PLANTEL

No.	Name of Project / Exchange	Existing	1975 KFW project	1975 Pertamina project	1975 PRX project	1976 KFW project	1976 Pertamina project	1976 Mobile exchange project	1976 PRX project	1977 Pertamina project	Total
1	2	3	4	5	6	7	8	9	10	11	12
1	Kota (A)	10,000	–	–	–	–	–	–	–	–	10,000
2	Kota (B)	–	6,000	–	20,000 (T)	–	4,000	–	–	–	30,000
3	Ancol	–	–	–	–	–	–	–	3,500	–	3,500
4	Pluit	–	2,000	1,000	–	–	–	–	–	–	3,000
5	Cengkareng	–	–	–	–	–	–	–	5,000	–	5,000
6	Tegal Alur	–	–	–	–	–	–	–	–	–	–
7	Gambir (A)	17,000	–	–	(T)	3,000	–	–	–	–	20,000
8	Gambir (B)	–	–	–	–	–	–	–	20,000	5,000	25,000
9	Semanggi (A)	2,000	4,000	–	–	–	–	–	10,000	–	16,000
10	Slipi	1,500	2,000	–	–	–	–	–	–	–	3,500
11	Pal Merah	–	–	–	–	–	–	–	5,000	–	5,000
12	Kedoya	–	–	–	–	–	–	–	–	–	–
13	Meruya	–	–	–	–	–	–	–	–	–	–
14	Cempaka Putih	–	–	–	–	–	8,000	–	16,000 (T)	–	24,000
15	Rawamangun	–	–	–	–	–	–	–	6,000	–	6,000
16	Pulo Gadung	–	–	–	–	–	–	–	6,000	–	6,000
17	Penggilingan	–	–	–	–	–	–	–	–	–	–
18	Tanjung Priok	2,000	–	–	4,000	–	–	–	–	–	6,000
19	Cilincing	–	–	–	–	–	–	–	–	–	–
20	Kebayoran	8,000	–	–	–	2,000	–	–	12,000	–	22,000
21	Cipete	600(*)	–	–	–	–	–	–	8,000	–	8,600
22	Kalibata	–	–	–	–	–	–	–	8,000	–	8,000
23	Pasar Minggu	–	–	–	–	–	5,000	–	–	–	5,000
24	Jagakarsa	–	–	–	–	–	–	–	–	–	–
25	Jatinegara (A)	4,000	–	–	–	–	–	–	–	–	4,000
26	〃 (B)	–	–	–	–	–	–	2,000	10,000 (T)	–	12,000
27	Cawang	–	–	–	–	–	–	2,000	8,000	–	10,000
28	Pasar Rebo	–	–	–	–	–	–	1,000	5,000	–	6,000
29	Klender	–	–	–	–	–	–	–	4,000	–	4,000
30	Tebet	–	–	–	–	–	–	2,000	8,000	–	10,000
31	Gandaria	200	–	–	–	–	–	1,000	–	–	1,200
Total		45,300	14,000	1,000	24,000	5,000	17,000	8,000	134,500	5,000	253,800
		45,300	39,000			164,500				5,000	

	Existing	1975 KFW	1975 Pertamina	1975 PRX	1976 KFW	1976 Pertamina	1976 Mobile	1976 PRX	1977 Pertamina	Total
PRX. Project	–	–	–	24,000	–	–	–	134,500	–	158,500
KFW. Project	–	14,000	–	–	5,000	–	–	–	–	19,000
Pertamina Project	–	–	1,000	–	–	17,000	–	–	5,000	23,000
Mobile exchange Project	–	–	–	–	–	–	8,000	–	–	8,000
Existing	45,300	–	–	–	–	–	–	–	–	45,300
Total	45,300	39,000			164,500				5,000	253,800

* : Mobil Exchange

TABLE 5-2-(2) NEW SWITCH AND NEW LOCAL TELEPHONE OFFICE CONSTRUCTION PLAN

(Unit : thousand)

No	Name of Exchange	Existing	'75	'76	'77	'78	'79	'80	'81	'82	'83	'84	'85	'86	'87	'88	'89	'90	'91	'92	'93	Total
1	Jakarta Kota A	10							3				3				5				7	28.0
	〃 B		(26)	4										12				22				64.0
	〃 C							(20)				7				9				15		51.0
2	Ancol			(3.5)		3				5				8				12				31.5
3	Pluit		(3)			5					4				4				7			23.0
4	Cengkareng			(5)											5				10			20.0
5	Tegal Alur										(3)				3				9			15.0
6	Gambir A	17		3			6				8				11				15			60.0
	〃 B			(20)	5							7				8				15		55.0
7	Semanggi A	2	4	10				7								9				17		49.0
	〃 B											(10)				4				5		19.0
8	Slipi	1.5	2			10					6				9				15			43.5
9	Pal Merah			(5)					3				6				12				15	41.0
10	Kedoya										(3)				4				7			14.0
11	Meruya										(4)				4				8			16.0
12	Cempaka Putih			(24)												12				18		54.0
13	Rawamangun			(6)						4				6				9				25.0
14	Pulogadung			(6)																5		11.0
15	Penggilingan								(2)				2				5				6	15.0
16	Tanjung Priok A	2	4			4						6				13				16		45.0
	〃 B							(8)				6				11				16		41.0
17	Cilincing						(2)				2				4				8			16.0
18	Kebayoran A	8		14													4				6	32.0
	〃 B										(9)				4				6			19.0
19	Cipete	0.6		8												6				7		21.6
20	Kalibata			(8)							5				9				15			37.0
21	Pasar Minggu			(5)											4				6			15.0
22	Jagakarsa										(2)				2				4			8.0
23	Jatinegara A	4						3				3				6				8		24.0
	〃 B			(12)											5				7			24.0
24	Cawang			(10)												11				16		37.0
25	Pasar Rabo			(6)													10				12	28.0
26	Klender			(4)										6				15				25.0
27	Tebet			(10)									7				11				16	44.0
28	Gandaria	0.2		1					1				3				5				9	19.2
No. of New exchange offices		–	2	14	–	–	1	2	1	–	5	1	–	–	–	–	–	–	–	–	–	26
Total no. of exchange offices		9	11	25	25	25	26	28	29	29	34	35	35	35	35	35	35	35	35	35	35	
No. of New line units (1000)		–	35	164.5	5	22	8	38	9	9	46	39	21	32	68	89	52	58	117	138	71	
Total no. of line units (1000)		45.3	84.3	248.8	253.8	275.8	283.8	321.8	330.8	339.8	385.8	424.8	445.8	477.8	545.8	634.8	686.8	744.8	861.8	999.8	1070.8	
Total no. of demand		112.7	122.6	134.9	148.6	163.9	180.6	198.5	217.5	240.5	265.5	297.0	332.0	367.0	406.0	452.0	504.0	558.0	626.0	707.8	808.0	

Note : ◯ Mark shows new exchange office service opening time.

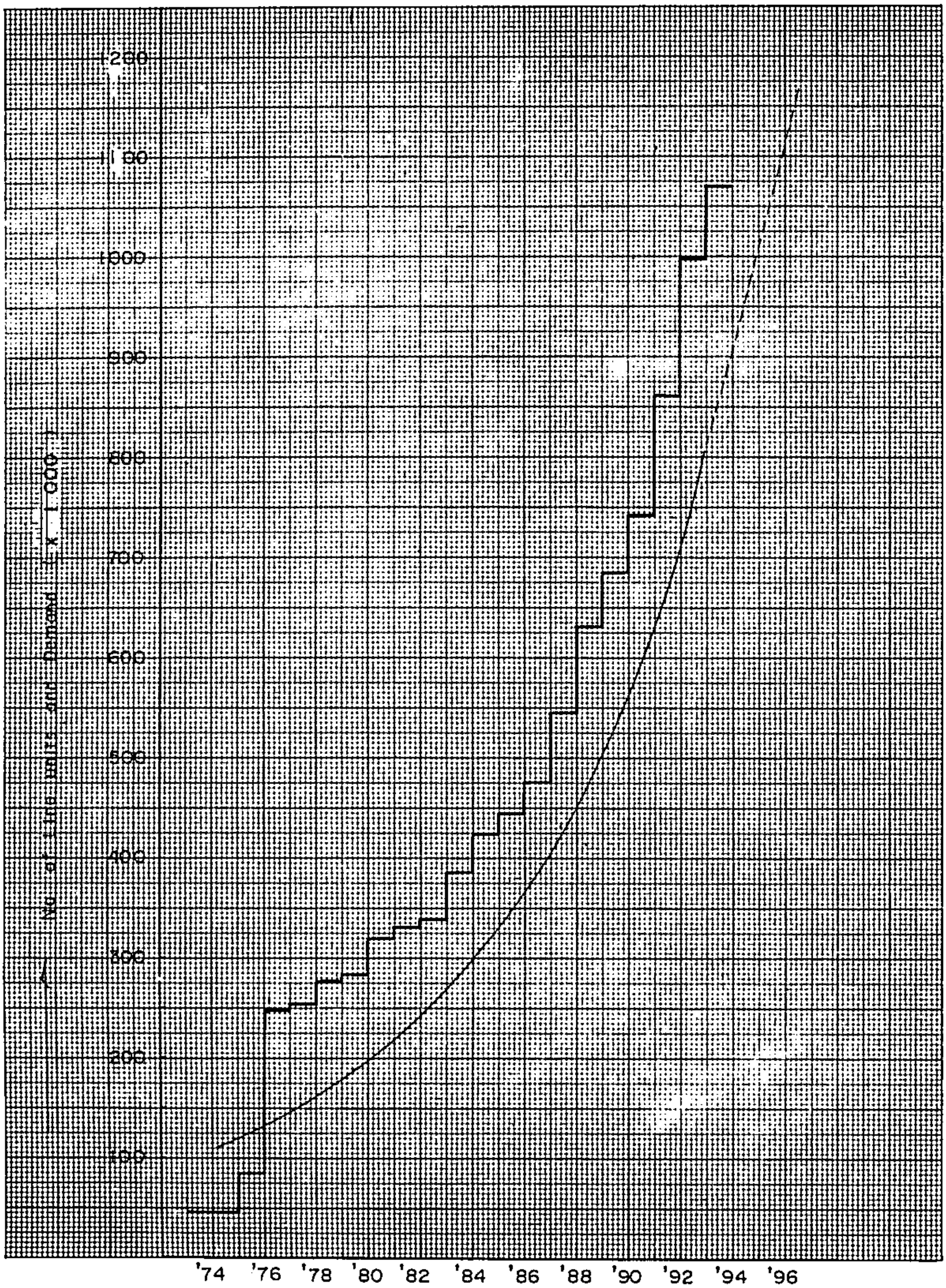


FIG.5-2-(3) NO.OF LINE UNITS AND DEMAND IN JAKARTA

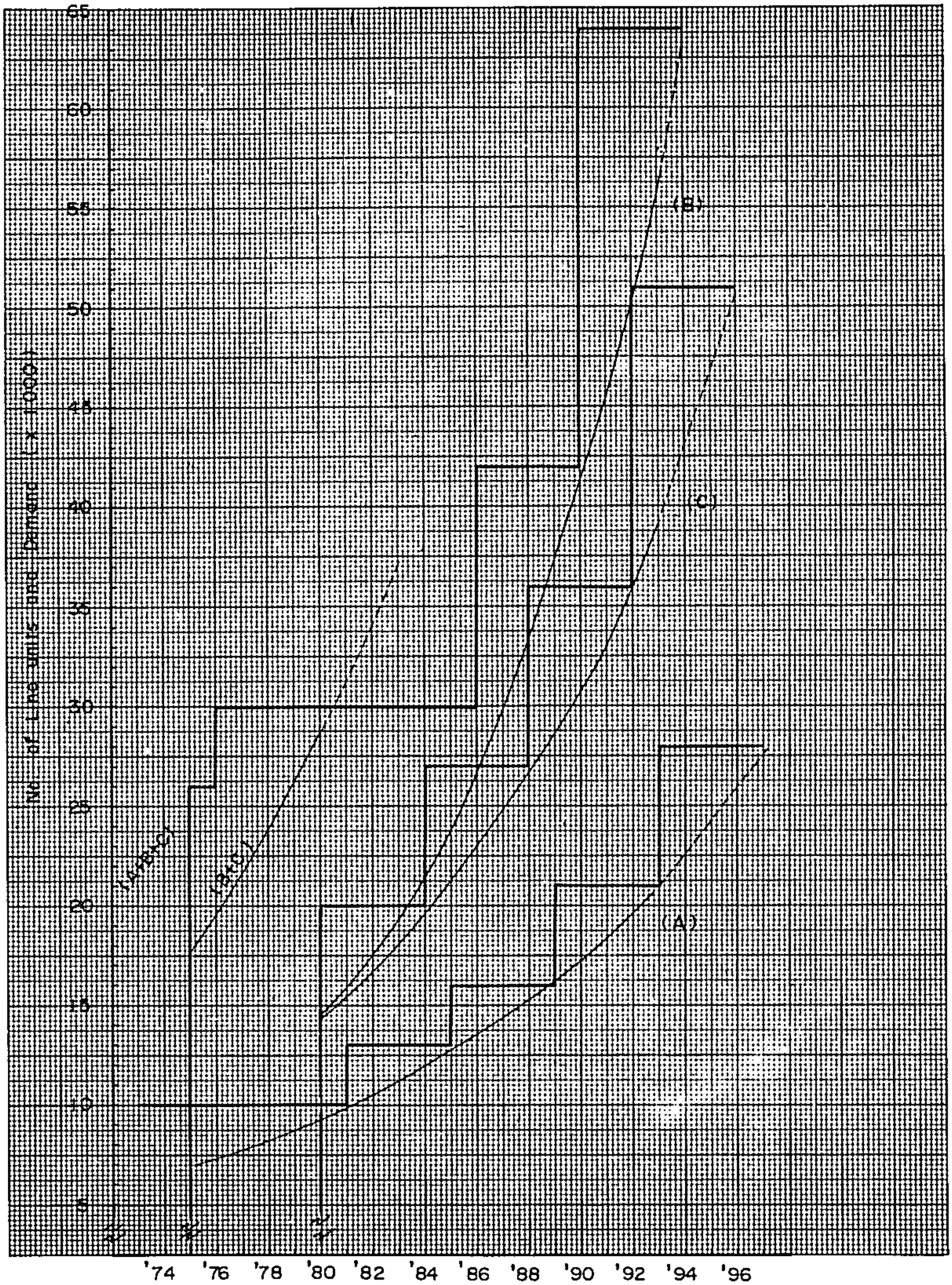


FIG. 5-2-(4) JAKARTA KOTA

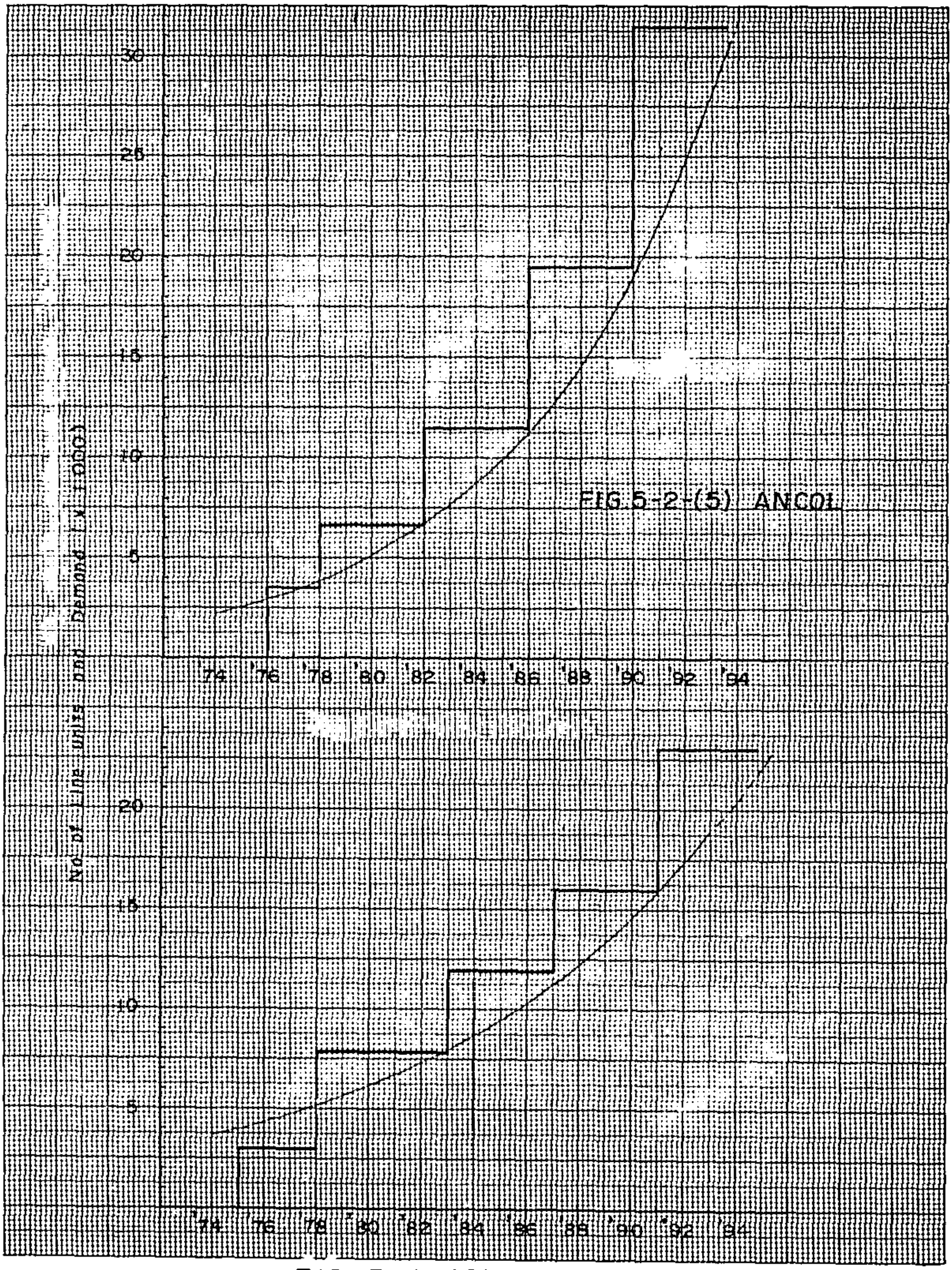


FIG. 5-2-(5) ANCOL

FIG. 5-2-(6) PLUIT

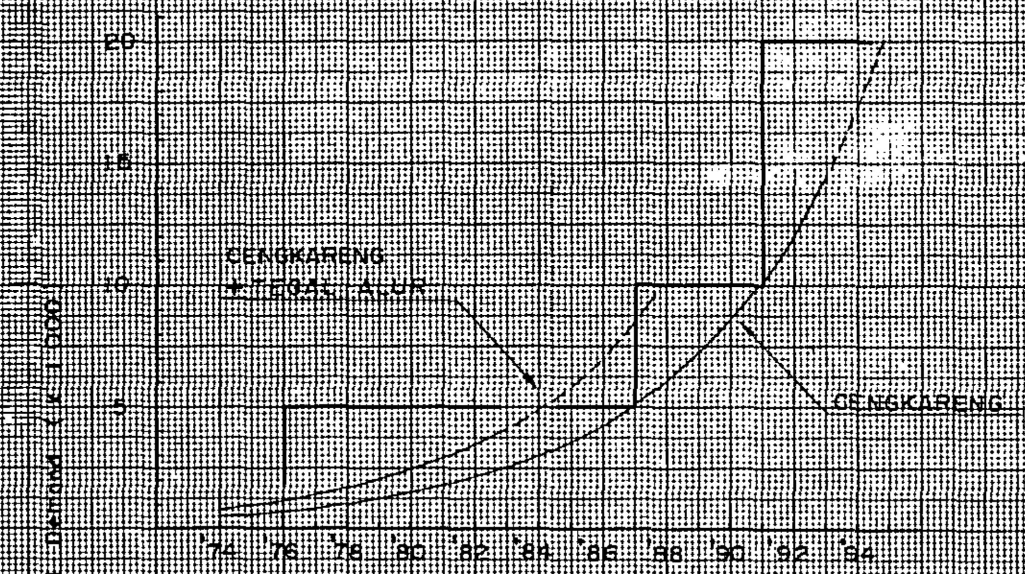


FIG. 5-2-(7) CENGKARENG

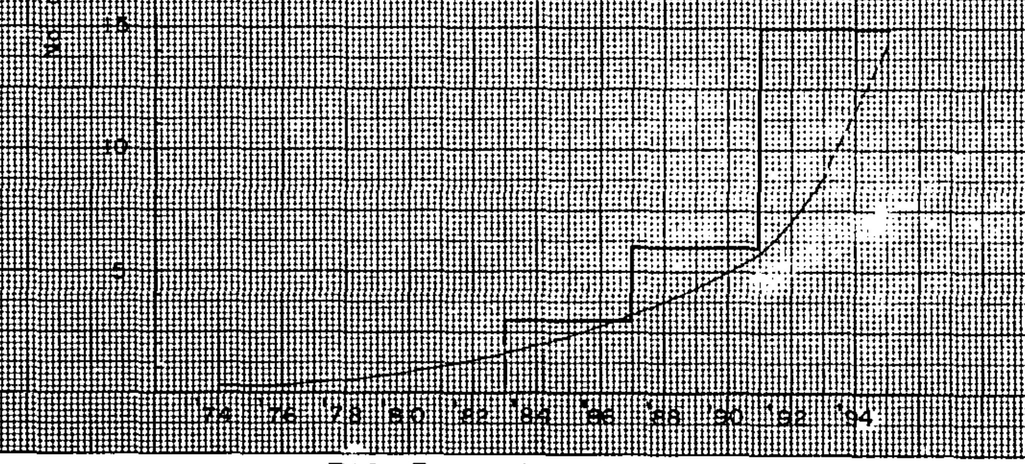


FIG. 5-2-(8) TEGAL ALUR

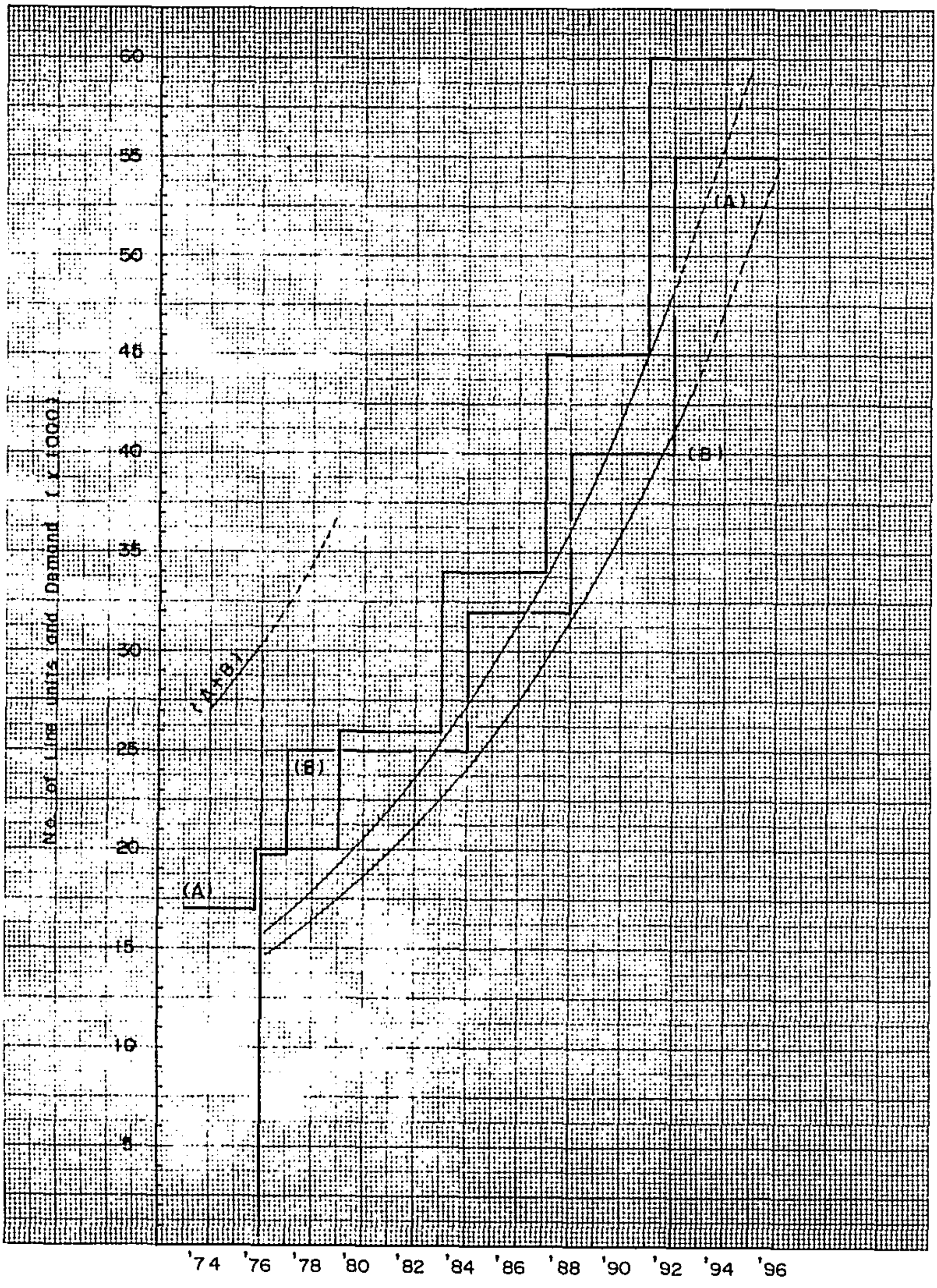


FIG. 5-2-(9) GAMBIR

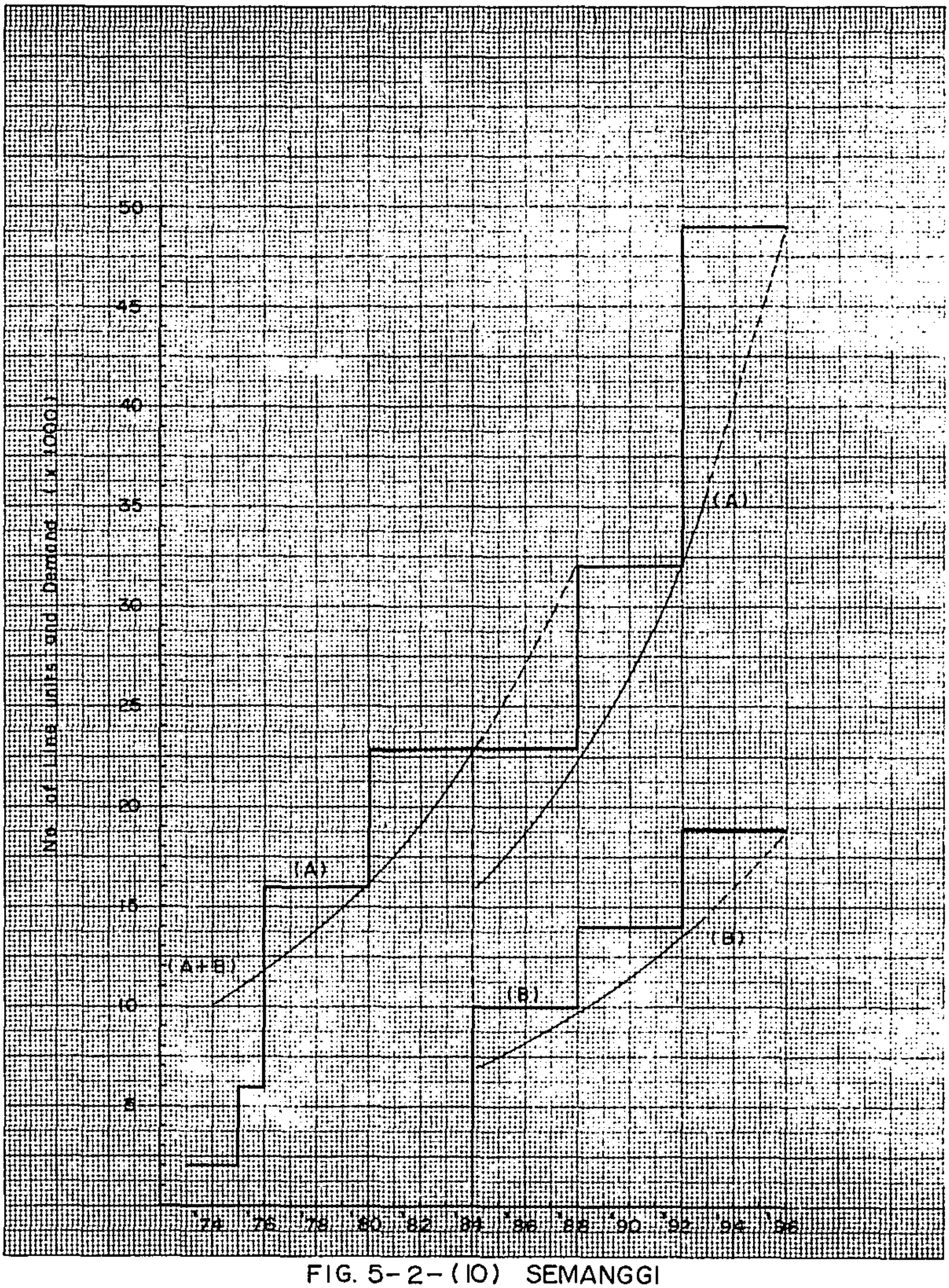


FIG. 5-2-(10) SEMANGGI

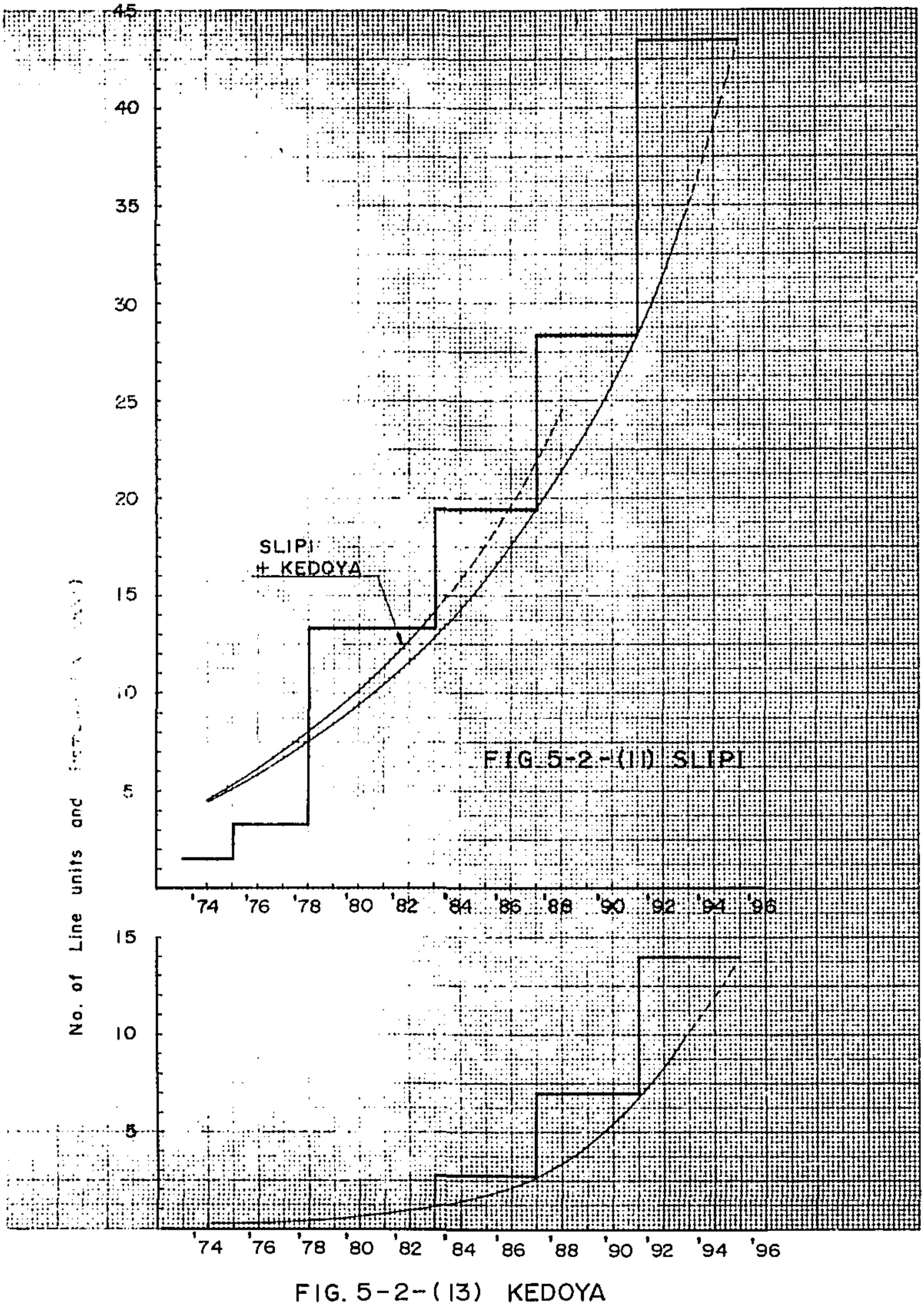


FIG. 5-2-(13) KEDOYA

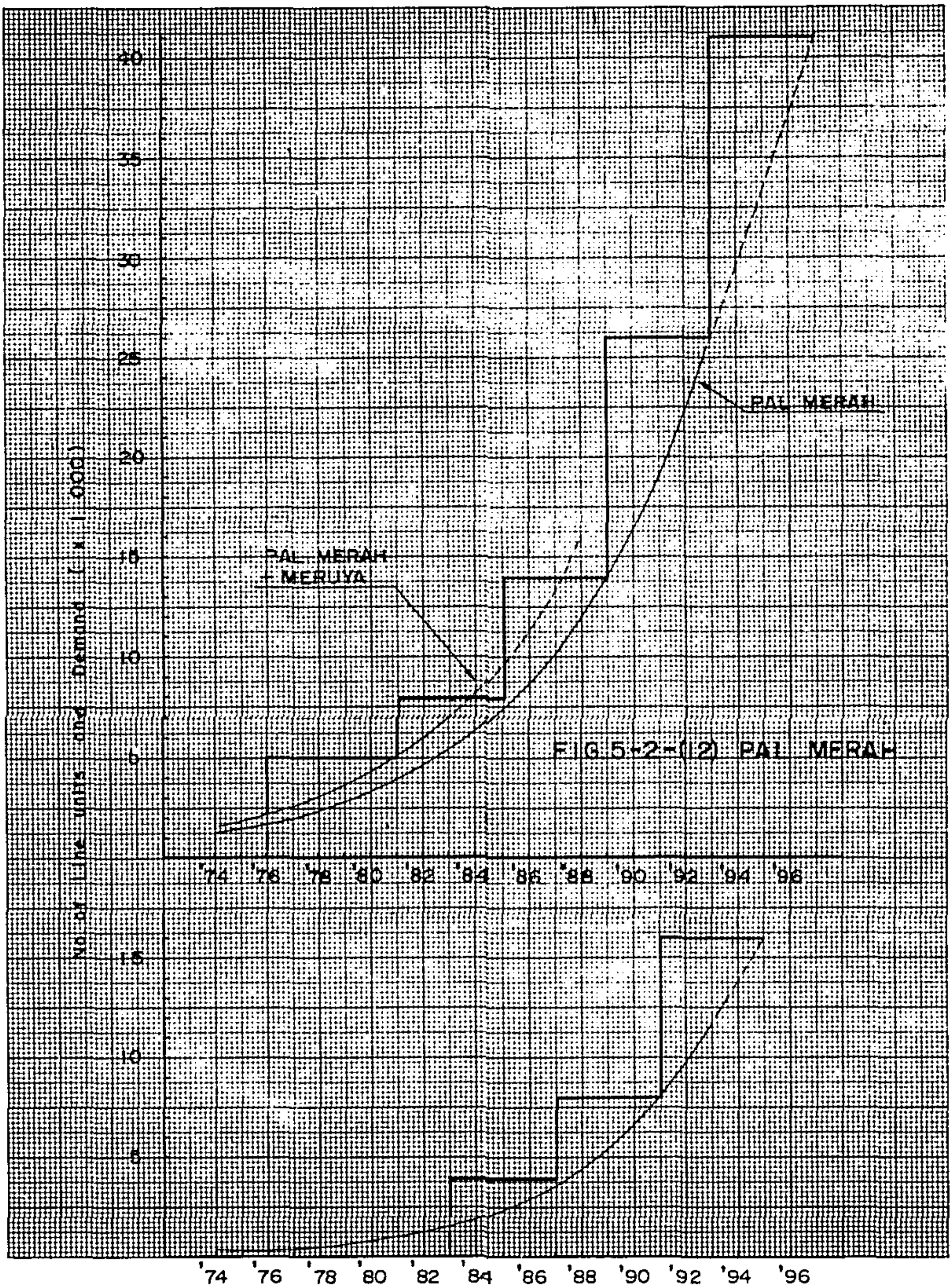


FIG. 5-2-(14) MERUYA

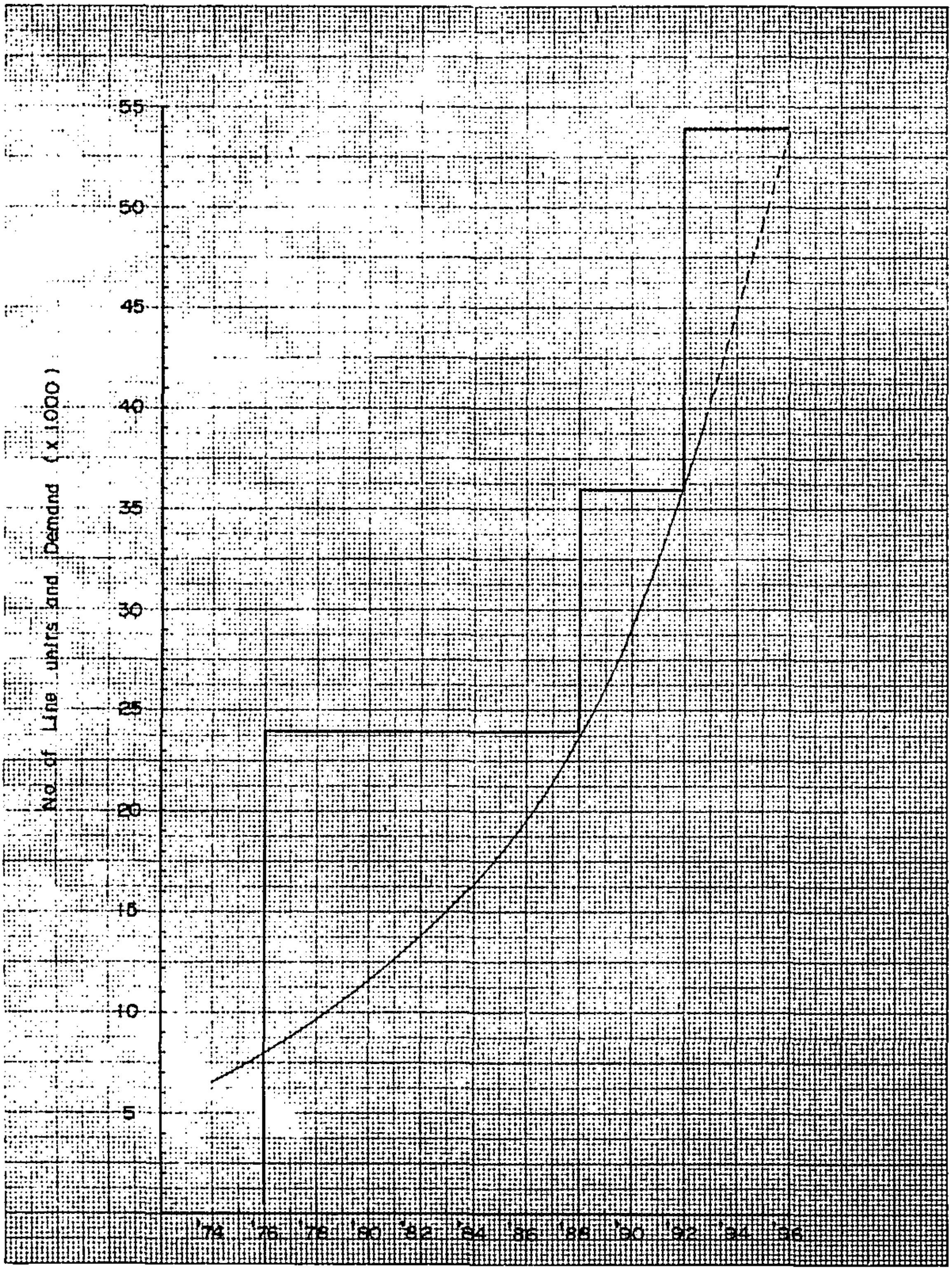


FIG. 5-2-(15) CEMPAKA PUTIH

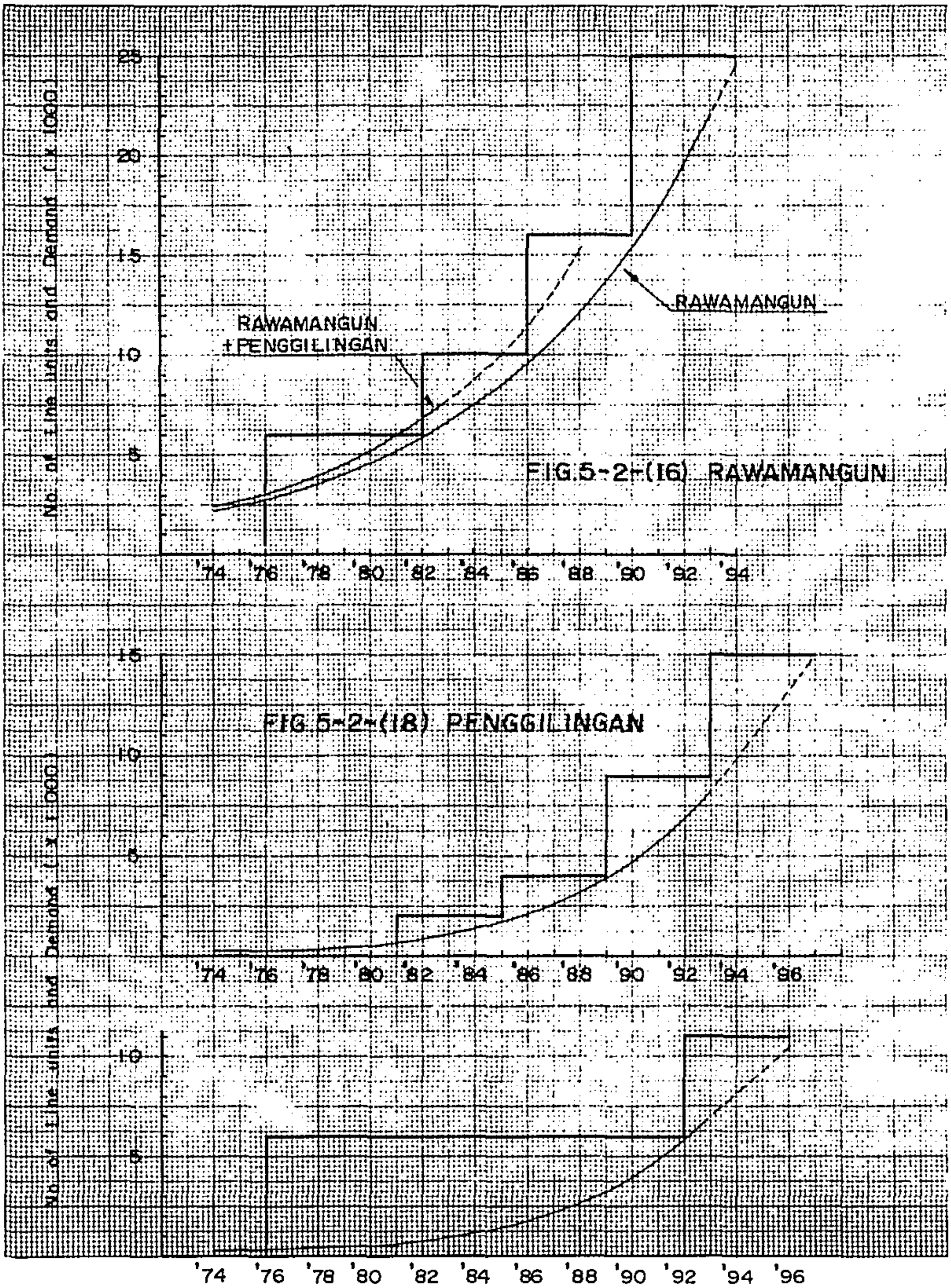


FIG. 5-2-(17) PULO GADUNG

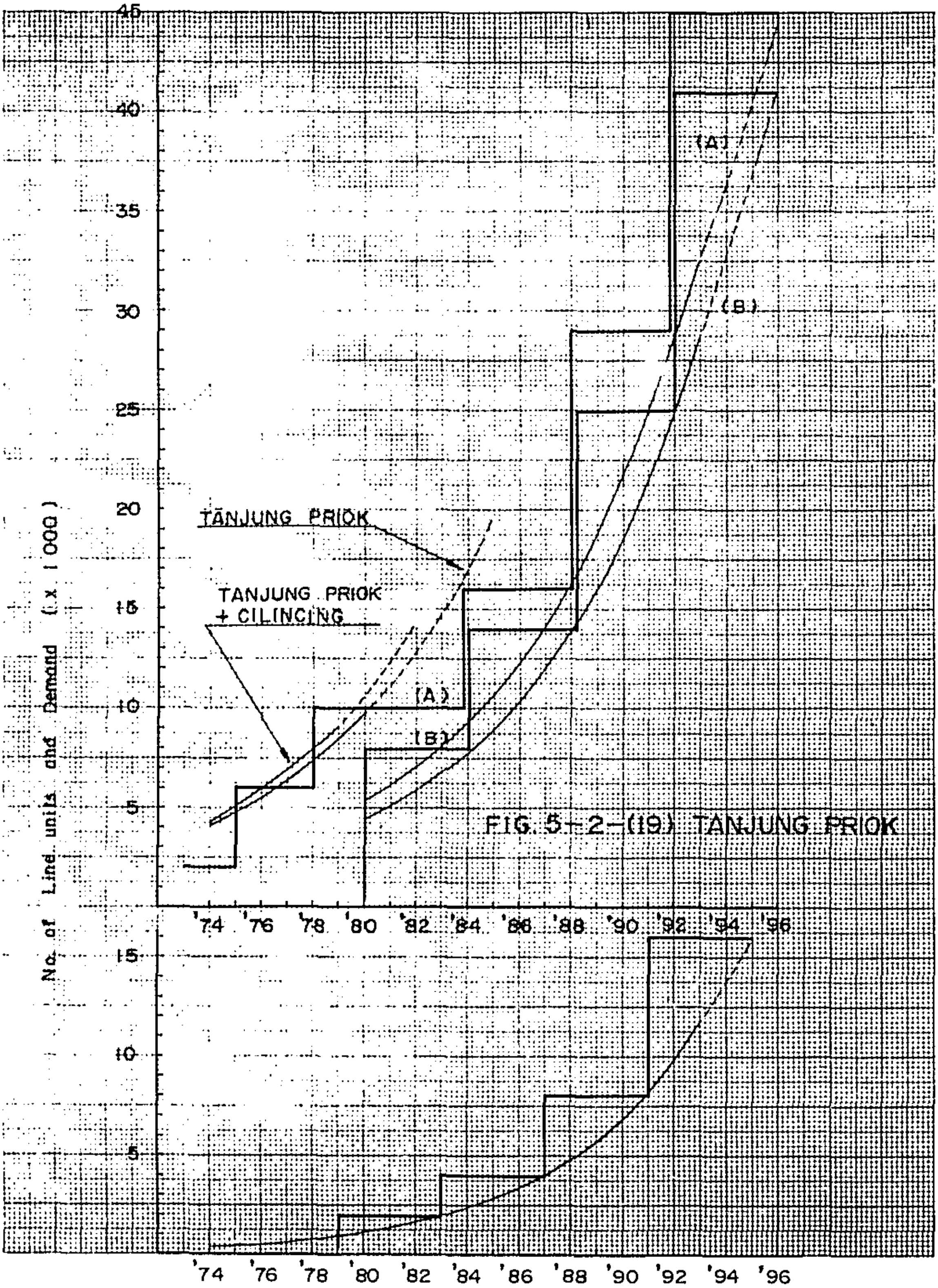


FIG. 5-2-(19) TANJUNG PRIOK

FIG. 5-2-(20) CILINCING

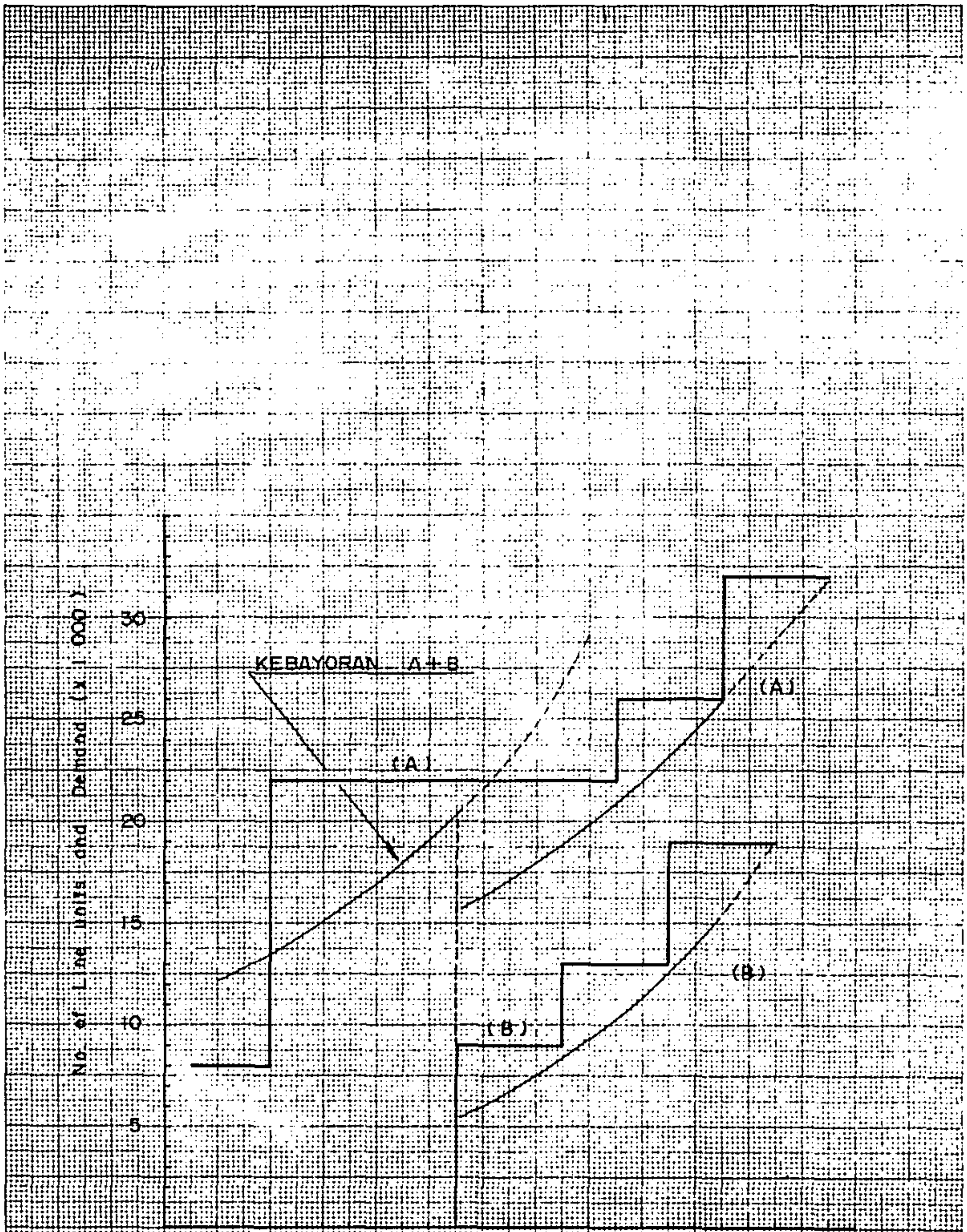


FIG.5-2-(21) KEBAYORAN

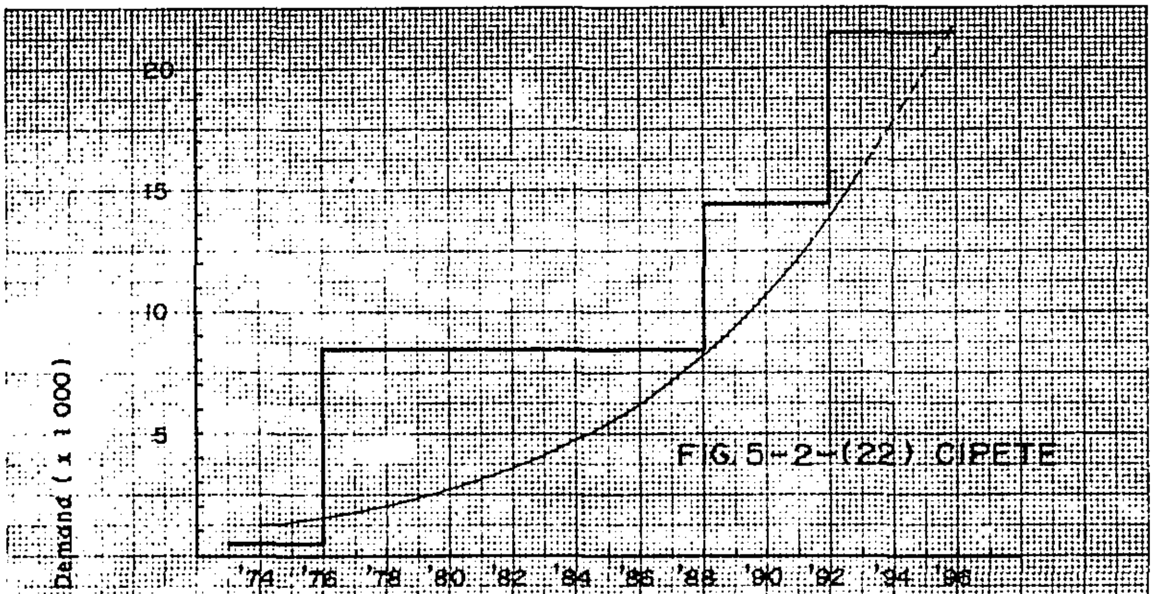


FIG. 5-2-(22) CIPETE

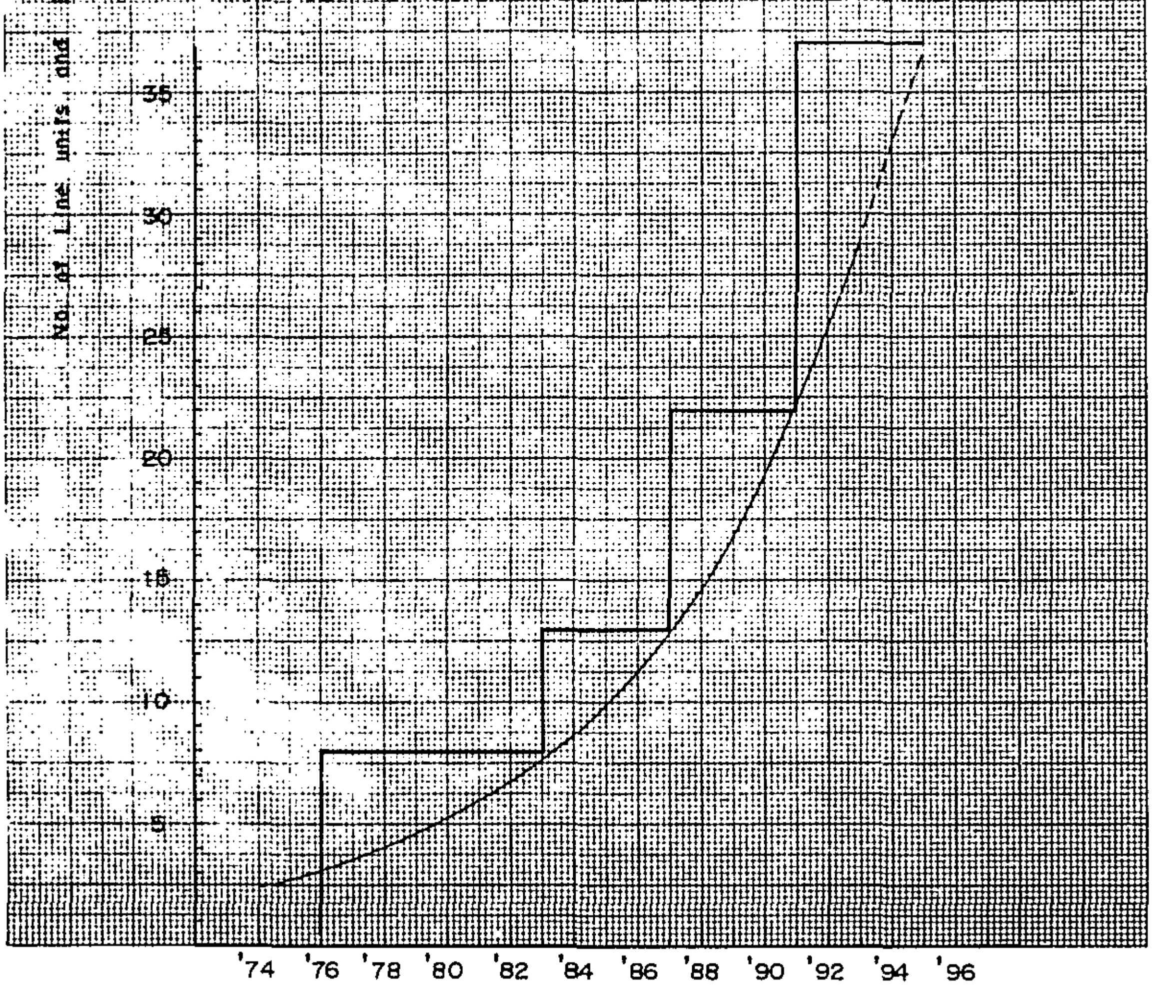


FIG. 5 – 2 –(23) KALIBATA

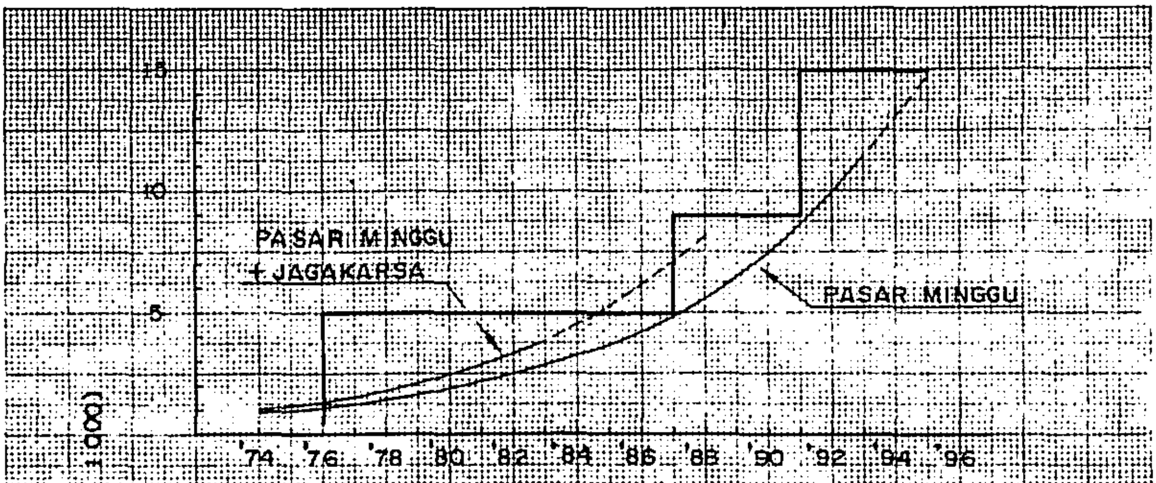


FIG. 5-2-(24) PASARMINNGU

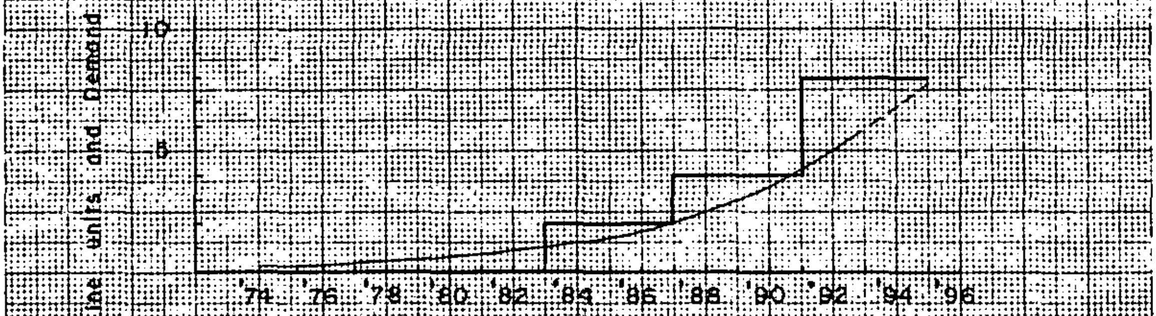


FIG. 5-2-(25) JAGAKARSA

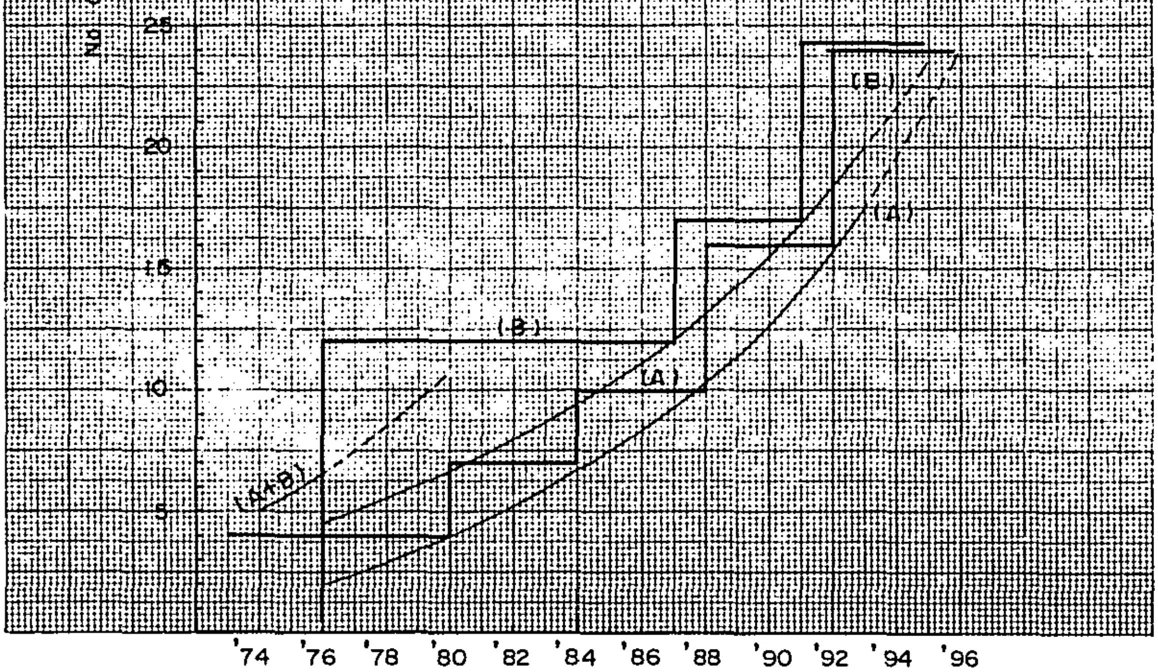


FIG. 5-2-(26) JATINEGARA

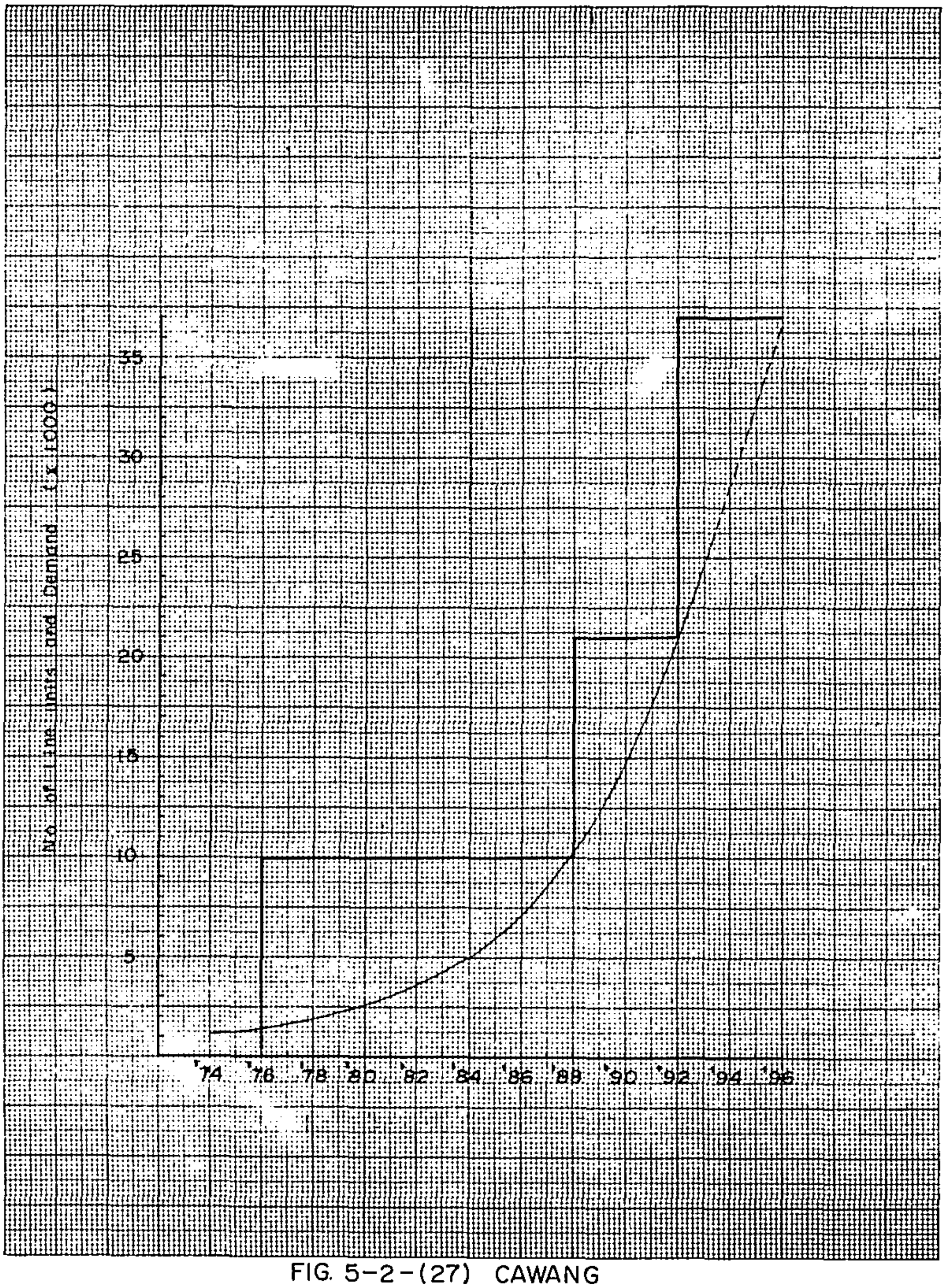
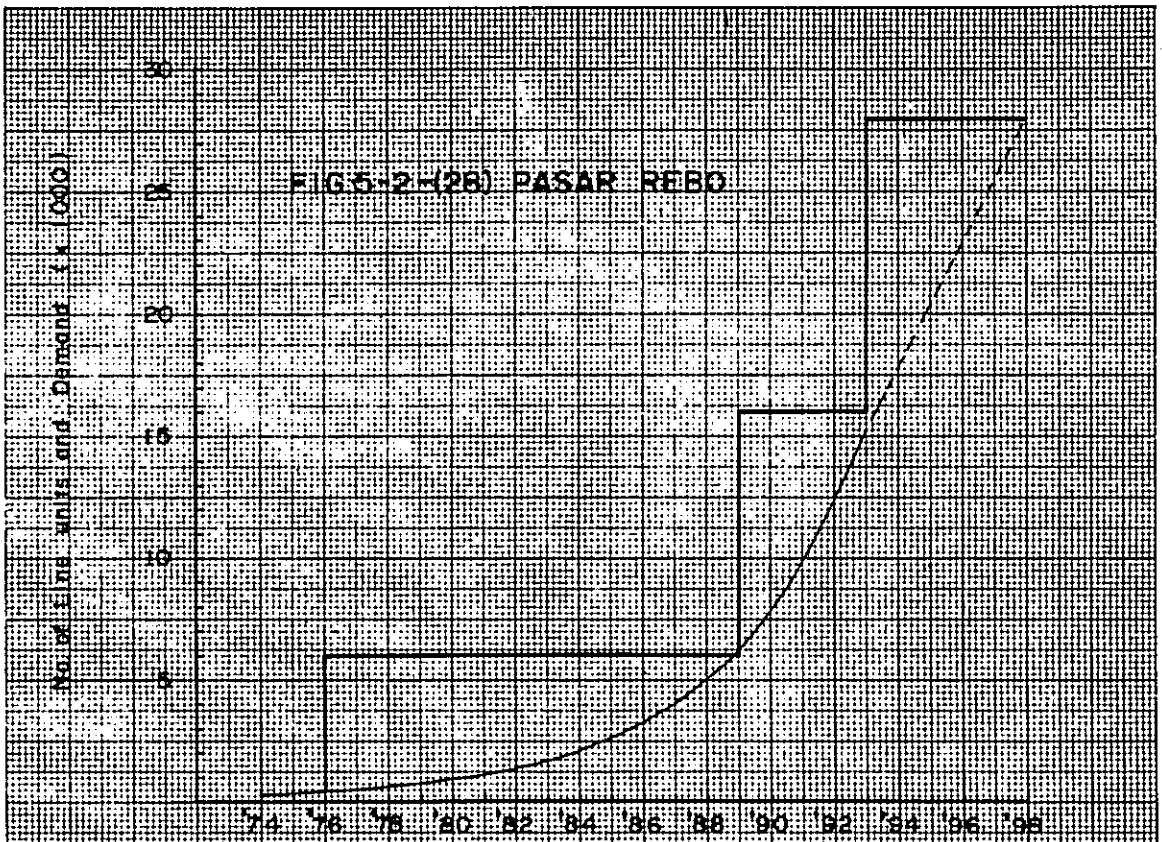


FIG. 5-2-(27) CAWANG



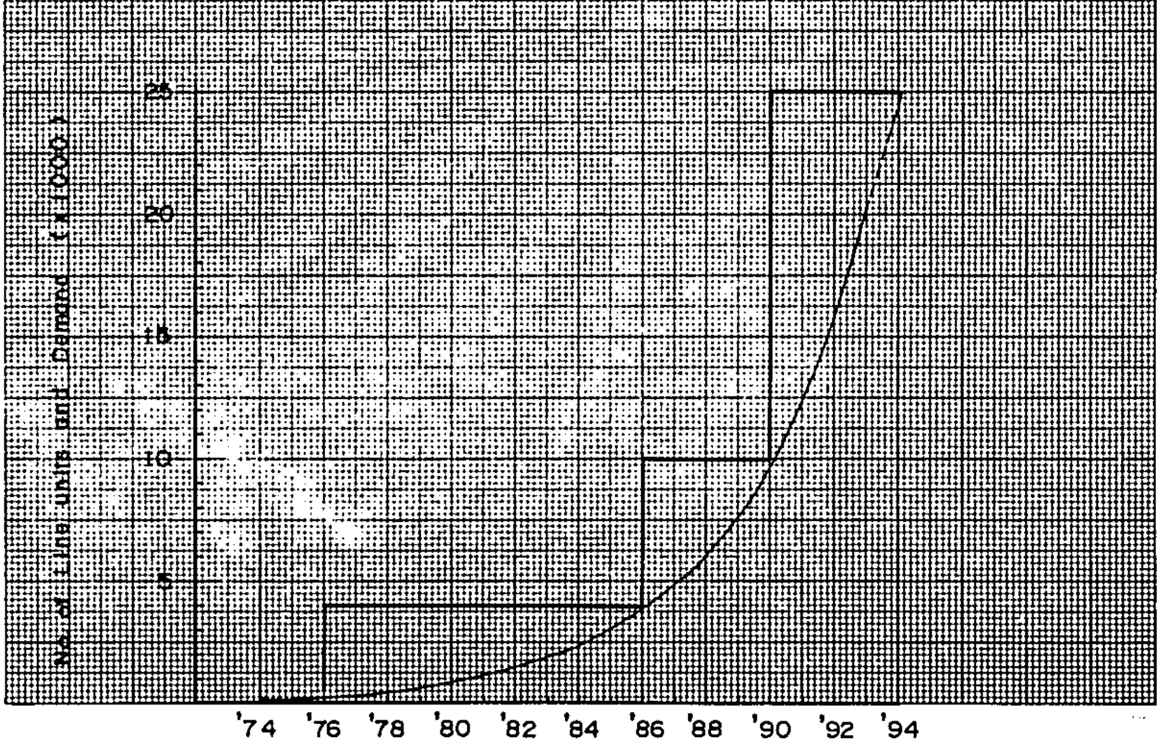


FIG. 5-2-(29) KLENDER

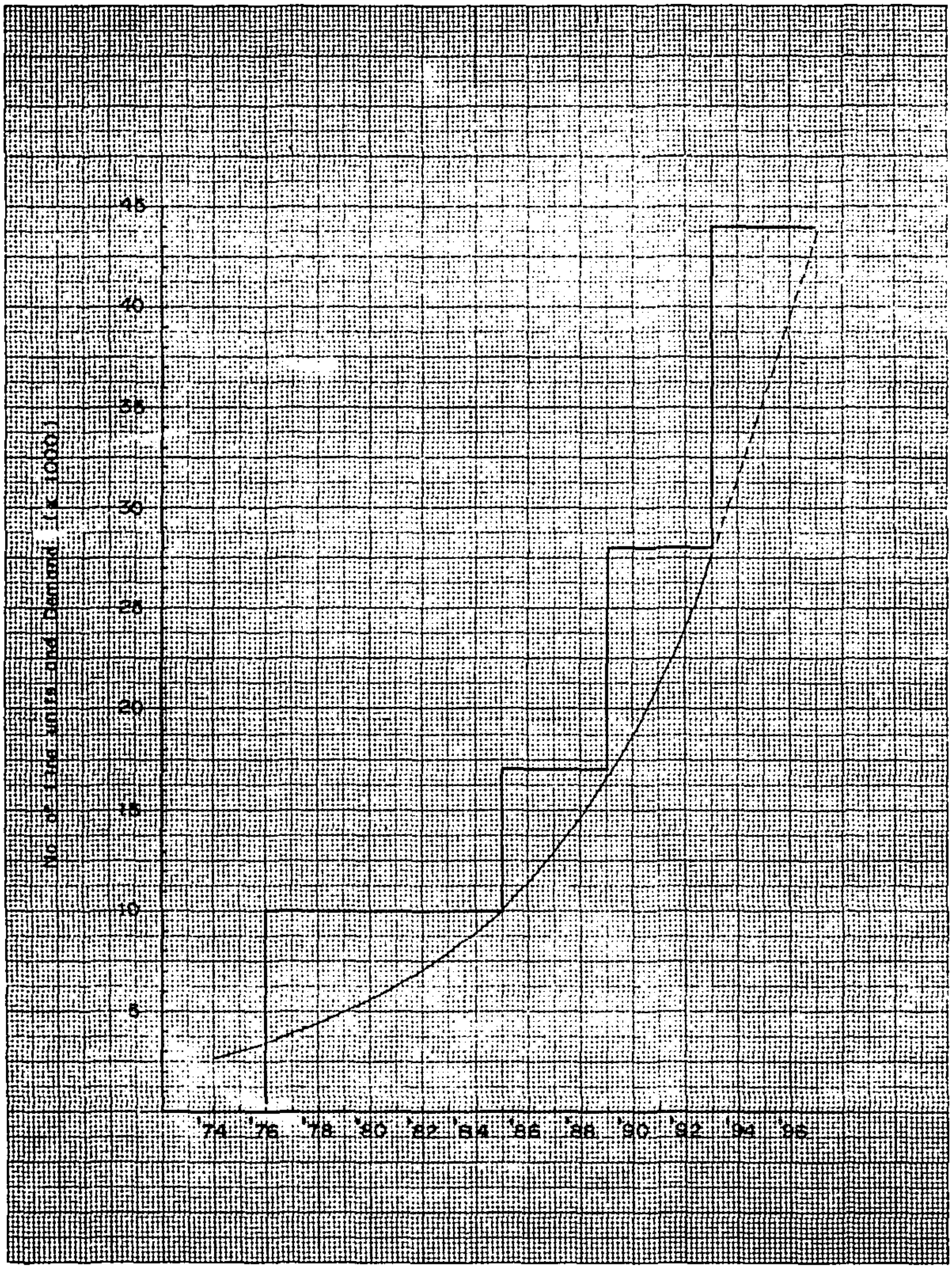


FIG. 5-2-(30) TEBET

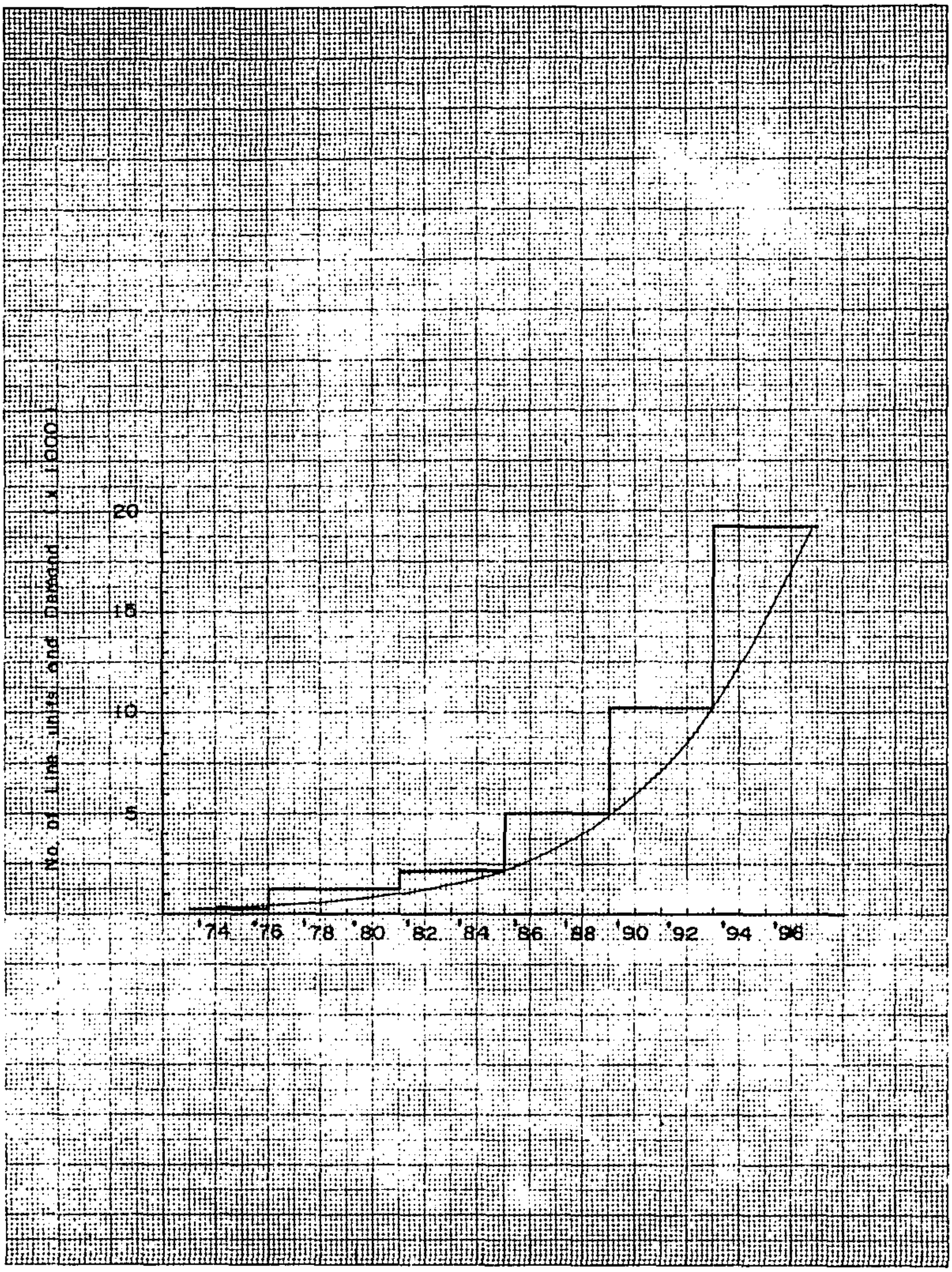
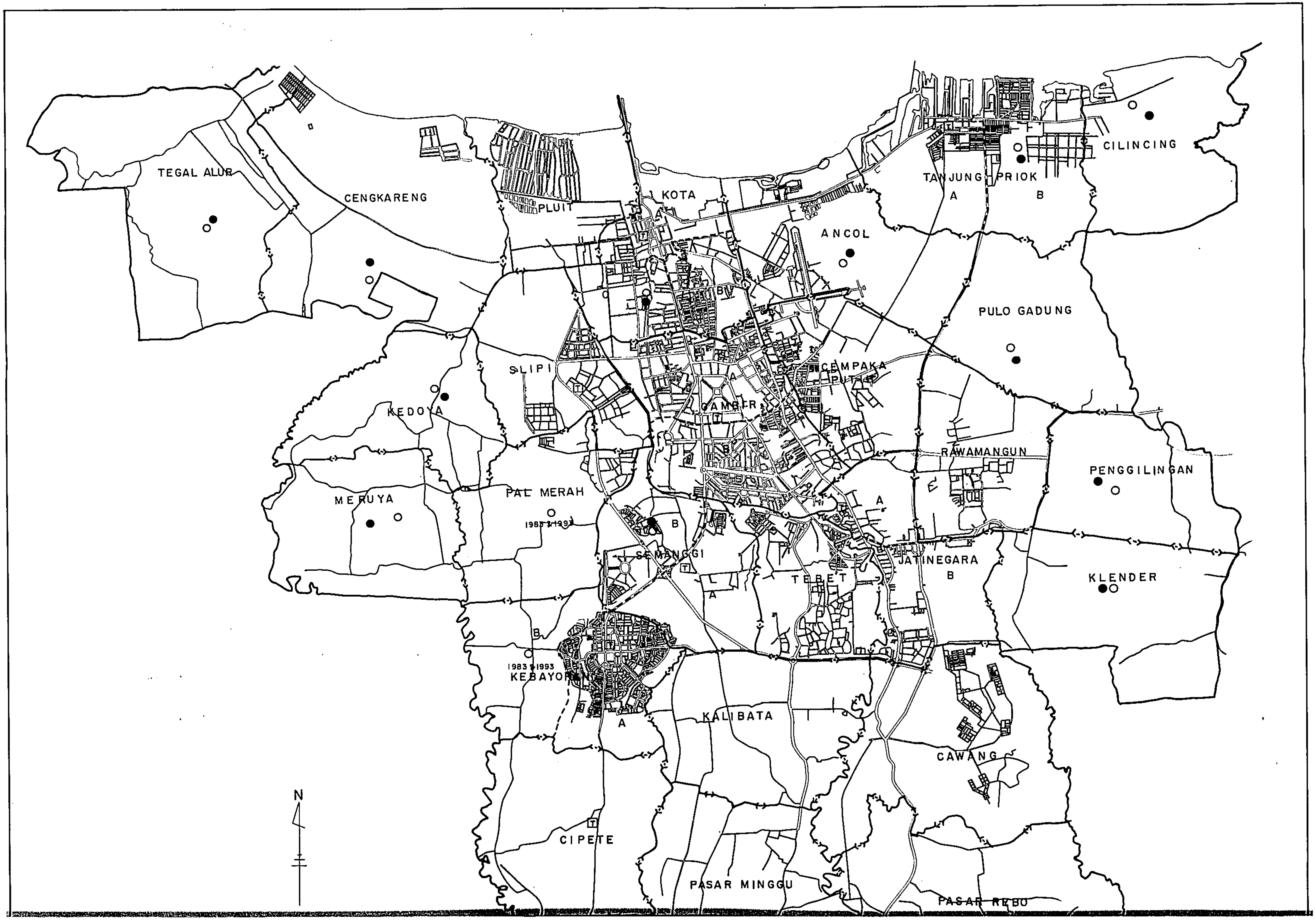


FIG. 5-2-(31) GANDARIA



TEGAL ALUR
CENGKARENG
PLUIT
KOTA
TANJUNG PRIOK
A
B
CILINCING
ANCOL
PULO GADUNG
SLIPI
CEMPAKA PUTIH
KEDOYA
GAMBIR
RAWAMANGUN
PENGGILINGAN
MERUYA
PAL MERAH
1983 - 1993
SEMANGGI
TEBET
JATINEGARA
KLENDER
1983 - 1993
KEBAYORAN
KALIBATA
CAWANG
N
CIPETE
PASAR MINGGU
PASAR REBO

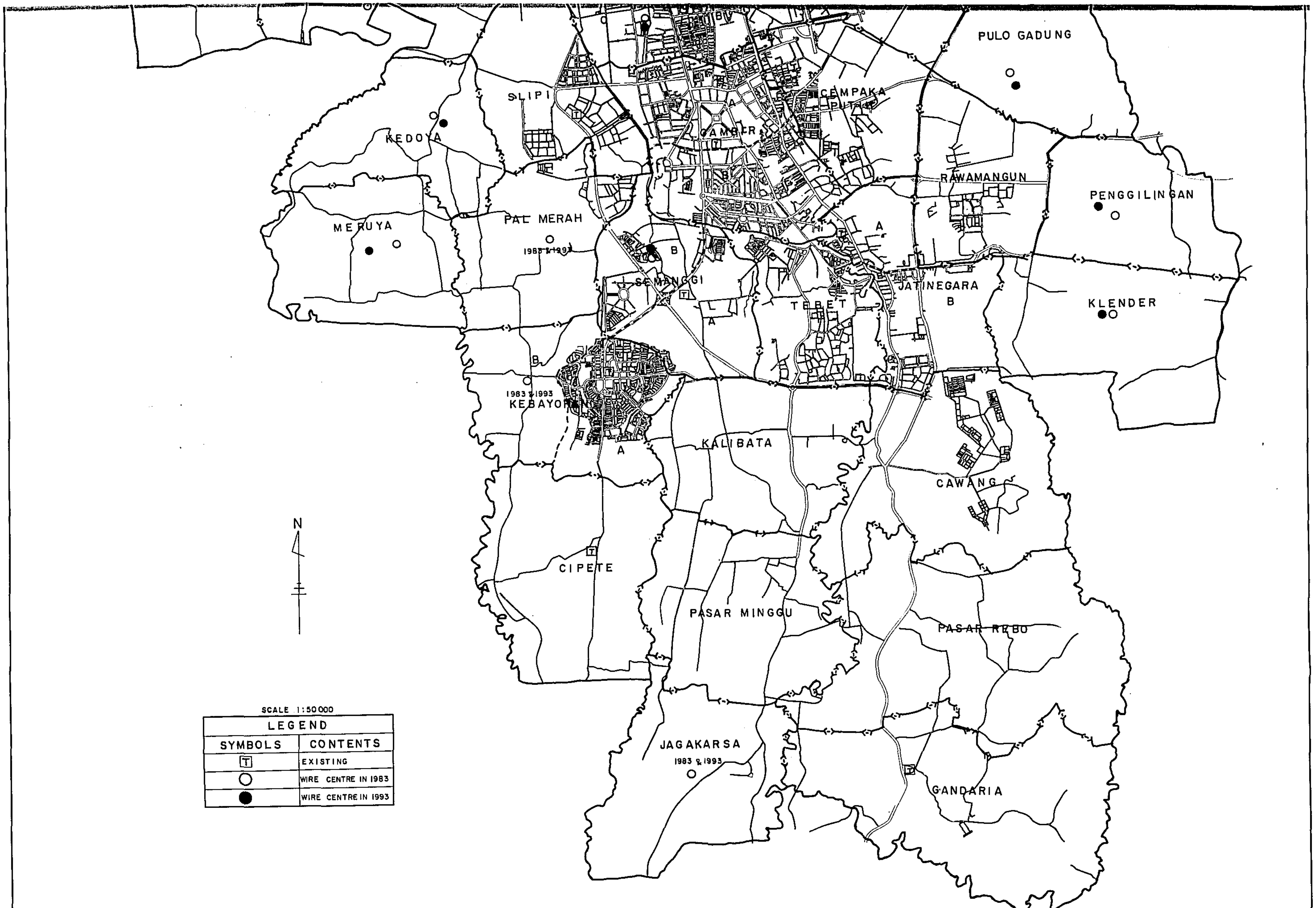


FIG. 5-2-(32)

SERVICE AREA FOR EACH EXCHANGE AND CALCULATED WIRE CENTRE IN JAKARTA

CHAPTER 6

TECHNICAL STANDARD

CHAPTER 6 TECHNICAL STANDARD

6.1 Numbering Plan

According to PERUMTEL's numbering plan the local office code in Jakarta in and after 1975 are to be composed of 2-digits in the case of exchange offices equipped with the EMD system and 3-digits in the case of those equipped with the new switching system. JTP, on the other hand, proposed a different numbering plan. These two numbering plans differ in the method of arranging the exchange office codes. However, judging from the traffic volume, the difference is a mere 0.2% or less. And, from the viewpoint of traffic forecast, this 0.2% difference can be ignored. Thus, in the calculation of junction circuits and the selection of junction cable type, there is no difference between the two numbering plans.

The office code digits for each base year as determined by the two numbering plans are shown in Table 6.1.(1).

Table 6.1.(1) Office Code Comparison for The Both Plans

Plan	Year / Syst	1975	1976	1980	1981
PERUMTEL	EMD	1D,2D	2D	2D	2D
	PRX	3D	3D	3D	3D
JTP	EMD	1D,2D	1D,2D	2D	3D
	PRX	2D	2D	2D	3D

6.1.1 Outline

In the local exchange offices in Jakarta approximately 45,000 LU subscriber circuits are installed as of April 1975. The switching system is the EMD step-by-step system except for Cipete Exchange Office where the crossbar system (NEC - C23MCX) of 600 LU is adopted.

Additional subscriber installations totaling 211,500 LU are planned for and after 1975. This total includes 158,500 LU by the new system, 45,000 LU by the EMD system and 8,000 LU by the MCX system. New subscriber installations by the EMD system, however, are scheduled to be suspended after 1977.

The telephone demand in Jakarta in 1993 is presumed to reach 808,000.

At present, for the numbering system, the terminating tandem system is adopted. Both

1-digit and 2-digit office codes are used. Some of exchange offices which now use the 1-digit office code must change it to the 2-digit code as soon as possible in order that additional subscriber installations may not be obstructed.

In view of the foregoing we studied the local office numbering plan in Jakarta, dividing it in two as follows:

a) The immediate numbering plan for 1975 through 1977.

b) The long-term numbering plan for and after 1978.

6.1.2 Basic Policy of Local Numbering Plan

The basic requirements in connection with the formulation of local numbering plan were as follows:

(1) To take into consideration the future international automatic dialing plan

By the CCITT proposal on the international automatic dialing plan Indonesia is given the country code of "62." CCITT determines the number of digits for international automatic dialing to be 11 digits. On the other hand, Indonesia's national toll numbering plan gives Jakarta and other big cities the 2-digit toll area code ("21" for Jakarta) and the 3-digit toll area code to other cities. Therefore, the maximum digits of local numbers must be 7 or 8.

(2) To adopt pertinent office codes in consideration of future telephone demand

The local office codes must be determined, based on the long-term plan. The alteration of office codes must be avoided unless absolutely necessary. The longer than necessary office codes must also be avoided.

(3) To take switching system performance into full account

The numbering plan is intimately related to the switching system, circuit network formation and tandem system. Therefore, these elements must be taken into full account functionally from the economic viewpoint.

6.1.3 Existing Numbering Plan

The existing numbering plan and number of LU accommodated in Jakarta are shown in Table 6.1.3.(1).

Table 6.1.3.(1) Present Numbering and LU (as of 1974)

Office	Office code	No. of LUs.	System
Kota	2 XXXX 27 XXXX	7,000 3,000	EMD "
Tg. Priok	29 XXXX	2,000	"
Gambir	4 XXXX 5 XXXX 35 XXXX 55 XXXX	10,000 6,000 1,000	" " " PABX
Semanggi	58 XXXX 580 XXXX	2,000	EMD PABX
Slipi	59 XXXX 59 XXX	900 600	EMD "
Gandaria	57 XXX	200	"
Kebayoran	7 XXXX 77 XXXX 78 XXXX	6,000 2,000	" " PABX
Cipete	76 XXXX	600	MCX
Jatinegara	8 XXXX	4,000	EMD
TOTAL		45,300	

"1D" 33,000 "2D" 12,300

6.1.4 Immediate Numbering Plan

At present, in Jakarta, both 1-digit and 2-digit office codes are used. Part of exchange offices that use the 1-digit office code will be unable to fulfill additional subscriber installations in and after 1975 due to the lack of office codes. Therefore, the exchange offices with 1-digit office codes will have to adopt 2-digit office codes sooner or later. What is most important at this time is to accomplish according to schedule the massive installation expansion work now in progress.

Therefore, by so arranging that the work to change the 1-digit office codes to 2-digit codes be kept to the necessary minimum, the numbering plan for the immediate future was formulated. This numbering plan was based on these facts:

(1) The common use of 1-digit and 2-digit office codes is technically possible for the time being.

(2) In the Gambir and Jatinegara areas the work to change the 1-digit office codes to 2-digit codes takes much time to complete because of the deficiency of building space and facilities; it is extremely difficult to effectuate a large-scale installation expansion work in a short period.

(3) Gambir Exchange Office still leaves the accommodation capacity for 2,000 LU.

6.1.4.1. Study of Numbering Plans in Gambir and Jatinegara Areas

The numbering plans for the Gambir and Jatinegara areas are shown in Table 6.1.4.1.(1).

(1) Gambir Area

The merit and demerit comparison table (Table 6.1.4.1.(2)) was made for each of plans 1, 1', 1", 2, 3 - 7 in Table 6.1.4.1.(1). As the result of study based on this comparison table the decision was made that plan 1 would be best fitted for the Gambir area.

Reasons for the above decision are as follows:

(i) Additional building space for installation of switching equipment to realize 2-digit office codes is not necessary.

(ii) Financial investment for installation of switching equipment to realize 2-digit office codes is not necessary.

(iii) The Semanggi office code "58" and Slipi office code "59" had better be used without change.

(2) Jatinegara Area

The undermentioned five plans were drafted and studied. As the result it was decided that Plan 1 or Plan 3 be the first choice provided it was compatible with the PERUMTEL policy and, if not, Plan 2 or Plan 4 would be the substitute.

Plan 1: In the Jatinegara-II area the number of terminals is 12,000 LU. However, the subscriber numbering that can be allocated are only 10,000, i.e., smaller than necessary.

Plan 2: Office code "87" is shared by Jatinegara-II and Gandaria. Therefore, the office code for either one of these two areas has to be changed in the future.

Plan 3: In Jatinegara-II the PRX terminals number 10,000 LU but the subscriber numbering available for allocation are only 8,000.

Plan 4: Office code "87" is shared by Pasarrebo and Gandaria. Therefore, the office code for either one of these two areas has to be changed in the future.

Plan 5: The existing Jatinegara-I Exchange Office requires building expansion for installation of switching equipment to realize the 2-digit office code. The building expansion and additional switching equipment installation take time. Thus the service-in of other exchange offices will also be delayed.

TABLE 6-1-4-1-(1) NUMBERING PLAN IN GAMBIR AND JATINEGARA AREA

	NAME OF EXCHANGE OFFICE	EXPANSION PLAN '74	'75	'76	'77	EXISTING CODE	NUMBERING PLAN (NO.1) RESERVE "4"	(NO.1') "4"	(NO.1") "4"	(NO.2) "4" OR "5"	(NO.3) "4" OR "5"	(NO.4) "5"	(NO.5) "5"	(NO.6) "4"	(NO.7) "5"
GAMBIR	GAMBIR (I)	17	PRX (T)	KFW 3		4-0XXX~9XXX 5-0XXX~6XXX 35-7XXX	NO CHANGE 31-XXXX	〃 〃	〃 〃	4-NO CHANGE ③5-0XXX-6XXX 35-NO CHANGE 〃	〃 〃	③4-0XXX-9XXX 5-NO CHANGE 35-NO CHANGE 31-XXXX	〃 〃	③ 4-XXXX ③ 5-XXXX 〃	〃 〃
GAMBIR	GAMBIR (II)			PRX 20	PRX 5	—	32-XXXX 33-XXXX 36-XXXX	〃	〃	〃	〃	〃	〃	〃	〃
GAMBIR	SEMANGGI (I)	2	KFW 4			58-XXXX	NO CHANGE	38-XXXX	〃	〃	NO CHANGE	③8-XXXX	④7-XXXX	NO CHANGE	③8-XXXX
GAMBIR	SEMANGGI (II)			PRX 10		—	37-XXXX	〃	〃	〃	57 OR 56-XXXX	37-XXXX	46-XXXX	57 OR 56-XXXX	37-XXXX
GAMBIR	SLIPI	1.5	KFW 2			59-XXXX	NO CHANGE	〃	39-XXXX	〃	NO CHANGE	③9-XXXX	④9-XXXX	NO CHANGE	③9-XXXX
GAMBIR	PALMERAH			5		—	38-XXXX	57 OR 58-XXXX	57 OR 58 OR 59-XXXX	51 OR 30-XXXX	〃	48-XXXX	48-XXXX	51-XXXX	48-XXXX
GAMBIR	KEDOYA														
GAMBIR	MERUYA														
JATINEGARA	NAME OF EX. OFFICE	'74	'75	'76	'77	EXISTING CODE	(NO.1)	(NO.2)	(NO.3)	(NO.4)	(NO.5)				
JATINEGARA	JATINEGARA (I)	4				8-1XXX-4XXX	NO CHANGE	〃	〃	〃	85-1XXX~4XXX				
JATINEGARA	JATINEGARA (II)			PRX 10(T) M: 2		—	80-0XXX-9XXX	80-0XXX-9XXX 87-8XXX-9XXX	80-0XXX-7XXX 80-8XXX-9XXX	80-0XXX-9XXX 85-0XXX-1XXX	80-0XXX-9XXX 81-0XXX-1XXX				
JATINEGARA	CAWANG			PRX 8 M: 2		—	86-2XXX-9XXX 86-0XXX-1XXX	〃	〃	〃	〃				
JATINEGARA	PASAR REBO			PRX 5 M: 1		—	85-1XXX-9XXX 85-0XXX	〃	〃	87-1XXX-5XXX 87-0XXX	84-1XXX-5XXX 84-0XXX				
JATINEGARA	KLENDER			PRX 4		—	89-0XXX-3XXX	〃	〃	〃	83-0XXX-3XXX				
JATINEGARA	TEBET			PRX 8 M: 2		—	88-0XXX-7XXX 88-8XXX-9XXX	〃	〃	〃	88-0XXX-7XXX 82-0XXX-1XXX				
JATINEGARA	GANDARIA	0.2		M: 1		57-1XXX	87-0XXX-1XXX	〃	〃	87-8XXX-9XXX	87-0XXX-1XXX				

M: MOBIL

TABLE 6-1-4-1-(2) MERIT GRADE OF NUMBERING PLAN IN GAMBIR AREA.

PLAN	NO. OF CHANGED OFFICE CODE SUBSCRIBERS	TALKIE-SERVICE	TANDEM SW	OFFICE CODE SW	CHANGE OF CODE 5 → 35	CHANGE OF CODE 4 → 34	NOTE
1	0 ◎	0 ◎	EXTENSION OF "3" TANDEM SW.	0 ◎	X BY1985	BY1989	※SERVICE-IN DATE OF KEDOYA AND MEVUYA ARE AFTER 1985.
1'	SEM 2000~6000T O	"58"—"38" "58" O	EXTENSION OF "3" TANDEM SW EXTENSION OF "5" TANDEM SW.	0 ◎	X BY 1985	BY 1989	
1"	SEM 2000~6000T SL I 1500~3500T / 3500~9500T O	"58"—"38" "58" "59"—"39" "59" O	DO. PLAN 1'	0 ◎	X BY 1985	BY 1989	
2	GAM 7000T SEM 2000~6000T SL I 1500~3500T / 10500~16500T Δ	"5"—"35" "50"~"56" "58"—"38" "58" "59"—"39" "59" O	EXTENSION OF "3" TANDEM SW.	GAM 2ND 900 SW'S O	FINISH	BY1989	
3	GAM 7000T O	"5"—"35" "50"~"56" O	DO. PLAN 1'	DO. PLAN2 O	FINISH	BY 1989	
4	GAM 10000T SEM 2000~6000T SL I 1500~3500T / 13500~19500T Δ	"4"—"34" 4XXX "58"—"38" "58" "59"—"39" "59" 1000T IMPOSSIBLE Δ	EXTENSION OF "3" TANDEM SW. NEW INSTALLATION OF "4" TANDEM SW	GAM 2ND 1200 SW Δ	BY1989	FINISH	
5	DO. PLAN4 Δ	"4"—"34" 4XXX "58"—"47" "58" "59"—"49" "59" 4000T IMPOSSIBLE X	EXTENSION OF "3" TANDEM NEW INSTALLATION OF "4" TANDEM	GAM 2ND 1200 SW Δ	BY1989	FINISH	
6	GAM 17000T Δ	"4"—"34" "4" "5"—"35" "50"~"56" O	EXTENSION OF "3" TANDEM EXTENSION OF "5" TANDEM	GAM 2ND 2100 SW X	FINISH	FINISH	
7	GAM 17000T SEM 2000~6000T SL I P I 1500~3500T / 20500~26500T X	"4"—"34" 4XXXX "5"—"35" "50"~"56" "58"—"38" "58" "59"—"39" "59" 1000T IMPOSSIBLE Δ	EXTENSION OF "3" TANDEM NEW INSTALLATION OF "4" TANDEM	GAM 2ND 2100 SW X	FINISH	FINISH	

◎ : BEST Δ : NO GOOD

O : GOOD X : BAD

6.1.4.2 Numbering Plan as of End of 1977

The numbering plan in Jakarta as of the end of 1977 resulting from the foregoing study is presented in Table 6.1.4.2.(1).

TABLE 6-1-4-2-(1) 1/2
OFFICE CODES BY URGENT NUMBERING PLAN

Office	Numbering	
	Present	in 1977
KOTA.A	2-0XXX - 2XXX 2-3XXX - 6XXX 27-0XXX - 2XXX	27-7XXX - 9XXX 27-3XXX - 6XXX no change
KOTA.B		22 - XXXX 23 - XXXX 24 - XXXX
ANCOL		25 - XXXX
PLUIT		28 - XXXX
CENGKARENG		21 - XXXX
GAMBIR.A	35-7XXX 4-0XXX - 9XXX 5-0XXX - 4XXX 5-6XXX	no change
GAMBIR.B		32 - XXXX 33 - XXXX 36 - XXXX
SEMANGGI.A	58- 1XXX - 2XXX	no change
SEMANGGI.B		37 - XXXX
SLIPI	59-0XXX 59- 1XX - 999	59 - XXXX
PALMERAH		38 - XXXX
CEMPAKA PUTIH		61 - XXXX 62 - XXXX (64 - XXXX)
RAWAMANGUN		68 - XXXX
PULOGADUNG		63 - XXXX

( ) for PERUMTEL installation plan.

Table 6.1.4.2.(1) 2/2

Office	Numbering	
	Present	in 1977
Tg. Priok	29 – 0XXX – 1XXX	69 – XXXX
Kebayoran I	7 – 0XXX – 5XXX 77 – 6XXX – 7XXX	77 – 0XXX – 5XXX no change
Kebayoran II		78 – XXXX (71 – XXXX)
Cipete	76 – 0XXX	76 – XXXX
Kalibata		73 – XXXX
Pasar Minggu		79 – XXXX
Jatinegara I	8 – 1XXX – 4XXX	no change
Jatinegara II		80 – XXXX
Cawang		86 – XXXX
Pasar Rebo		85 – XXXX
Klender		89 – XXXX
Tebet		88 – XXXX
Gandaria	57 – 1XX	87 – XXXX

( ) for PERUMTEL installation plan.

6.1.5 Long-term Numbering Plan

The long-term numbering plan for Jakarta which we formulated is introduced below.

6.1.5.1 Area Code

Area Code	Item	Tandem Office
2	Kota area A code	Kota-B
3	Gambir area A code	Gambir-A
4	Spare code	-
5	Gambir area A code	Gambir-A
6	Cempaka Putih area A code	Cempaka Putih
7	Kebayoran area A code	Kebayoran-A
8	Jatinegara area A code	Jitenegara-B
9	Outskirts area A code	-

"O" is the SLDD prefix code. "1" is used for the special service code.

We studied the advisability of using the spare code "4" in the above numbering plan as the local area code.

In the Kota area the 2-digit office code will reach the limit in 1981. And, to do without the alteration to the 3-digit office code the use of "4," together with "2," can be considered. By this arrangement the Kota area office code leaves a margin until 1991. In the Cempaka Putih area and Jatinegara area also the 2-digit office code will reach the limit, the former in 1985 and the latter in 1986. In this case, however, there is no spare area code that can be utilized to save the situation. Therefore, in the two areas mentioned the office code has to be altered to 3 digits in 1985. In this connection, it requires reconsideration to use the spare area code "4" for the Kota area only to delay the introduction of the 3-digit office code for this area for four years until 1985. Even though spare code "4" is used for the Kota area only, the construction work for alteration to the 3-digit code can be postponed only four years, and profits from the saved construction work cost during the postponed period will be as follows, on condition that the absorbing relay group is used to introduce the 3-digit office code and the work cost amounts to US$510,000.

US$510,000 x 12% x 3 years = US$183,600

The disadvantage, however, is that during the four years the subscribers to have their numbers changed will increase by 90,000, i.e., from 200,000 to 290,000.

Also conceivable is a plan to use the spare code "4" not for a specific area only but for any area in Jakarta (as in the new system). In this case, when considered from the EMD system, the tandem system cannot be used, and this proves to be disadvantageous in the cable network formation.

6.1.5.2 Preconditions of Long-term Numbering Plan

The long-term numbering plan was formulated according to the following preconditions:

(1) The construction work in 1975 through 1977 would be carried out as scheduled.

(2) Each office code would conform to the demand forecast by JTP.

(3) As far as possible the tandem area could be discriminated by A code and the exchange building and switching system by B code. (Plan A-II and Plan B-II for Jakarta Kota are excepted.)

(4) The sub-tandem system would not be adopted.

(5) The existing EMD tandem system would remain unchanged and the earlier formulated numbering plan for the immediate future would be succeeded though the necessary consideration would be made of the new switching system.

(6) The 3-digit office code would be introduced in 1981, the year the 2-digit office code in the Kota area would reach the limit.

6.1.5.3 Office Code Allocation by Long-term Numbering Plan

Four long-term numbering plans based on the abovementioned preconditions, i.e., Plan A-I, Plan A-II, Plan B-I and Plan B-II, were formulated as shown in Table 6.1.5.3.(1) through Table 6.1.5.3.(5) and a comparative study was made for these four plans. Their features:

(1) Plan A comprises 2-digit and 3-digit office codes. Plan B uses 3-digit office code only.

(2) For introducing the 3-digit office code Plan B envisages the installation of absorbing relay group or 3rd GS stage as the switching facility. Plan A does not involve such consideration.

(3) Plan A and Plan B are respectively divided into I and II. The former adopts the insertion method and the suffix method for the office code alteration to 3 digits. The latter uses the suffix method only.

6.1.5.4 Methods of Office Code Alteration to 3 Digits

Three methods are available for office code alteration from 2 digits to 3 digits.

Method	Office Code				
	Old		New		
(1) Prefix Method	A	B	ⓧ	A	B
(2) Insertion Method	A	B	A	ⓧ	B
(3) Suffix Method	A	B	A	B	ⓧ

ⓧ: Additional figure

- o Prefix Method

  This method necessitates the tandem change so that it is impossible to practice.

- o Insertion Method

  a. The newly added office code can be allocated to each exchange building so that the relationship between the new office code and the exchange building is clear.

  b. In the case of EMD system the new office code switching stage must be additionally installed.

  c. The inserted figure differs from office to office so that the new office code is difficult to remember. Moreover, the office code change cannot be easily made known to the public.

- o Suffix Method

  a. The figure to be suffixed ("1," for instance) can be unified for the whole of Jakarta so that the rule to realize the 3-digit office code is simple. The office code change can be easily made known to the public.

TABLE 6-1-5-3-(1) 1/2 NUMBERING IN JAKARTA

NO	OFFICE	SYSTEM	PLAN A I 1980	PLAN A I 1993	PLAN A II 1980	PLAN A II 1993	PLAN B I 1980	PLAN B I 1993	PLAN B II 1980	PLAN B II 1993
1	KOTA A	E	27	27	27	27	27	271	27	271
		N	1	249. 248	–	249. 248	–	249. 248	–	249. 248
2	KOTA B	E	22	22	22	22	22	221	22	221
		N	23. 24	233 ~ 237	23. 24	231~234.241	23. 24	233 ~237	23. 24	231~234.241
3	KOTA C	N	–	291 ~ 294	–	291 ~294	–	291 ~294	–	291 ~294
4	ANCOL	N	25	251 ~ 253	25	251 ~ 253	25	251 ~253	25	251 ~ 253
5	PLUIT	E	28	28	28	28	28	281	28	281
		N	20	201. 201	20	201. 202	20	201. 202	20	201. 202
6	CENGKARENG	N	21	211. 212	21	211. 212	21	211. 212	21	211. 212
7	TEGAL ALUR	N	–	261	–	261	–	261	–	261
8	GAMBIR A	E	4. 5. 35. 31	34. 35. 31	4. 5. 35. 31	34. 35. 31	4. 5. 35. 31	341. 351. 311	4. 5. 35. 31	341. 351. 311
		N	–	331 ~ 333	–	531 ~ 533	–	331 ~ 333	–	531 ~ 533
9	GAMBIR B	E	36	36	36	36	36	361	36	361
		N	32. 33	321 ~ 325	32. 33	321~324. 331	32. 33	321 ~ 325	32. 33	321~324. 331
10	SEMANGGI A	E	58	58	58	58	58	581	58	581
		N	37. 39	376 ~379	37. 39	371~373. 391	37. 39	376 ~379	37. 39	371~373. 391
11	SEMANGGI B	N	–	571. 572	–	571. 572	–	571. 572	–	571. 572
12	SLIPI	E	59	59	59	59	59	591	59	591
		N	52	521 ~ 524	52	521 ~524	52	521 ~ 524	52	521 ~ 524
13	PALMERAH	N	38	381 ~ 383	38	381 ~383	38	381 ~383	38	381 ~383
14	KEDOYA	N	–	511. 512	–	511. 512	–	511. 512	–	511. 512
15	MARUYA	N	–	561. 562	–	561. 562	–	561. 562	–	561. 562
16	CEMPAKA PUTIH	E	61	61	61	61	61	611	61	611
		N	62(64)	622~625	62(64)	621~623. 641	62(64)	622 ~625	62(64)	621~623. 641
17	RAWAMANGUN	N	68	681~683	68	681 ~ 683	68	681~683	68	681 ~683
18	PULOGADUNG	N	63	631	63	631	63	631	63	631
19	PENGGILINGAN	N	–	651	–	651	–	651	–	651
20	TG. PRIOK A	E	69	69	69	69	69	691	69	691
		N	60	601 ~604	60	601 ~ 604	60	601 ~604	60	601 ~60[illegible]
21	TG. PRIOK B	N	66	661 ~663	66	661~663	66	661~663	66	661~[illegible]63
22	CILINCING	N	–	671. 672	–	671. 672	–	671. 672	–	671. 67[illegible]

E : END SYSTEM
N : NEW SYSTEM

TABLE 6-1-5-3-(1) 2/2 NUMBERING IN JAKARTA

NO	OFFICE	SYSTEM	A I		A II		B I		B II	
			1980	1993	1980	1993	1980	1993	1980	1993
23	KEBAYORAN A	E	77	77	77	77	77	771	77	771
24		N	78(71)	788. 781	78(71)	781. 711	78(71)	788. 781	78.(71)	751. 711
25	KEBAYORAN B	N	–	751. 752	–	751. 752	–	751. 752	–	751. 752
26	CIPETE	N	76	761. 762	76	761. 762	76	761. 762	76	761. 762
27	KALIBATA	N	73	731~733	73	731~733	73	731~733	73	731~733
28	PASAR MINGGU	E	79	79	79	79	79	791	79	791
		N	–	711	–	701	–	711	–	701
29	JAGAKARSA	N	–	721	–	721	–	721	–	721
30	CIPUTAT	E	–	74	–	74	–	741	–	741
31	JATINEGARA A	E	81	81	81	81	81	811	81	811
		N	82	822. 823	82	821. 822	82	822. 823	82	821. 822
32	JATINEGARA B	N	80	801. 802	80	801. 802	80	801. 802	80	801. 802
33	CAWANG	N	86	861~863	86	861~863	86	861~863	86	861~863
34	PASAR REBO	N	85	851. 852	85	851. 852	85	851. 851	85	851. 852
35	KLENDER	N	89	891~893	89	891~893	89	891~893	89	891~893
36	TEBET	N	88	881~883	88	881~883	88	881~883	88	881~883
37	CANDARIA	E	87	–	87	–	87	–	87	–
		N	87	871	87	871	87	871	87	871

E : EMD SYSTEM
N : NEW SYSTEM

TABLE 6-1-5-3-(2)1/3 NUMBERING PLAN AI 1/3

NO	OFFICE	SYSTEM	1977(INSTALLATION)		1979(DEMAND))		1980(〃)		(PUT IN TO 30' PLAN) 1981 (〃)		1983 (〃)		1988 (〃)		1993 (〃)		
			SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE	
1	KOTA A	E	10.000	27.	8.500	27.	9.100	27	9.500	27	9.800	27	9.800	27	9 800	27	
		N									1.300	249	5.300	249	11.100	249.248	
2	KOTA B	E	10.000	22.	9.000	22.	9.400	22	5.000	22	6.000	22	9.800	22	9.800	22	
		N	20.000	23. 24.	17.100	23. 24	19.000	23.24	10.500	233. 234	13.100	233. 234	24.000	233~235	47.300	233~237	
3	KOTA C	N							15.200	291. 292	18.000	291. 292	26.400	291~293	39.400	291~294	'81 S
4	ANCOL	N	3.000	25	4.400	25.	5.000	25	5.500	251	7.500	251	14.500	251. 252	28.300	251~253	
5	PLUIT	E	3.000	28	2.940	28.	2.940	28	2.940	28	2.940	28	2.940	28	2.940	28	
		N			2.760	20.	3.260	20	3.860	201	5.060	201	9.260	201	15.860	201. 202	
6	CENGKARENG	N	5.000	21	1.300	21	1.500	21	1.750	211	2.550	211	6.000	211	14.600	211. 212	
7	TEGALALUR	N							1.000	261	1.500	261	3.800	261	9.300	261	'81S
	TOTAL		51.000		46.000		50.200		55.250		67.750		111.800		188.400		
8	GAMBIR A	E	20.000	4.5.35.31.	17.700	4.5.35.31	18.800	4.5.35.31.	19.500	34. 35. 31	19.600	34. 35. 31	19.600	34. 35. 31	19.600	34. 35. 31	
		N									2.900	331	11.900	331. 332	24.100	331~333	
9	〃 B	E	5.000	36.	4.000	36.	4.200	36	4.500	36	4.900	36	4.900	36	4.900	36	
		N	20.000	32. 33.	15.200	32.33	16.400	32. 33	17.500	322. 323	20.600	321~323	31.100	321~324	47.300	321~325	
10	SEMAN A	E	6.000	58	5.880	58	5.880	58	5.880	58	5.880	58	5.880	58	5.880	58	
	GGI	N	10.000	37	9.070	37	10.320	37. 39	11.420	377. 379	14.970	377. 379	16.570	377. 379	30.220	376~379	
11	〃 B	N											9 700	571	14.900	571. 572	'88S
12	SLIPI	E	3.500	59	3.430	59	3.430	59	3.430	59	3.430	59	3.430	59	3.430	59	
		N			5.170	52	6.070	52	7.070	521	9.570	521	17.870	521. 522	31.670	521~524	
13	PALMERAH	N	5.000	38	2.950	38	3.400	38	4.000	381	5.300	381	11.700	381. 382	26.000	381~383	
14	KEDA	N											3 200	511	10.100	511. 512	'85S
15	MERUYA	N											4.300	561	11.800	561. 562	'85S
	TOTAL		69.500		63.400		68.500		73.300		87.150		140.150		229.900		

E : EMD SYSTEM (98% ACCOMMODATION)
N : NEW SYSTEM (100% 〃)

TABLE 6-1-5-3-(2) 2/3 NUMBERING PLAN A I 2/3

NO	OFFICE	SYSTEM	1977 (INSTALLATION) SUB	CODE	1979 (DEMAND) SUB	CODE	1980 (〃) SUB	CODE	(PUT INTO "3D PLAN) 1981 (〃) SUB	CODE	1983 (〃) SUB	CODE	1988 (〃) SUB	CODE	1993 (〃) SUB	CODE	
16	CEMPAKA	E	8.000	61	3.500	61	4.000	61	4.500	61	5.000	61	7.840	61	7.840	61	
	PUTIH	N	16.000	62. 64	7.200	62 (64)	7.800	62 (64)	8.300	622 (624)	10.200	622 624	15.860	622 624	32.360	622～625	
17	RAWAMAG	N	6.000	68	4.000	68	4.500	68	5.100	681	6.500	681	12.000	681. 682	21.900	681～683	
18	PULOGADNG	N	6.000	68	470	63	570	63	700	631	1.000	631	2.600	631	6.900	631	
19	PENGGILING										1.150	651	3.100	651	8.300	651	'83 S
20	TG. PKIOK A	E	2.000	69	1.960	69	1.300	69	1.500	69	1.960	69	1.960	69	1.960	69	
		N	4.000	60	6.340	60	4.000	60	4.500	601	5.940	601	14.040	601. 602	30.540	601～604	
21	〃 B	N					4.400	66	5.000	661	6.500	661	13.500	661. 662	29.000	661～663	'80 S
22	CILINCING	N							1.300	671	1.800	671	4.600	671	11.700	671. 672	'81 S
	TOTAL		42.000		23.470		26.570		30.900		400 50		75.500		150.500		
23	KEBAYO A RAN	E	10.000	77	9.000	77	9.000	77	9.000	77	7.000	77	9.500	77	9.800	77	
24	〃 A	N	12.000	78.71	7.100	78 (71)	8.000	78 (71)	9.000	788 (781)	8.400	788 (781)	10.700	788. 781	16.200	788. 781	
25	KEBAYO RAN B	N									5.200	751	9.300	751	15.600	751. 752	'83 S
26	CIPETE	N	8.600	76	2.400	76	2.700	76	3.100	761	4.100	761	8.000	761	15.700	761. 762	
27	KALIBATA	N	8.000	73	4.550	73	5.100	73	6.000	731	7.500	731	14.700	731. 732	29.200	731～733	
28	PASAR	E	5.000	79	1.600	79	1.800	79	2.100	79	2.750	79	4.900	79	4.900	79	
	MINGGU	N											700	711	6.500	711	
29	JAGAKARSA	N									1.050	721	2.450	721	5.800	721	
30	CLPUTAT	E	3.000	74												74	
		N															
	TOTAL		46.600		24.650		26.600		29.200		36.000		60.250		103.700		

E : EMD SYSTEM (98% ACCOMMODATION)

N : NEW SYSTEM (100% 〃)

TABLE 6-1-5-3-(2) 3/3 NUMBERING PLAN AI 3/3

NO	OFFICE	SYSTEM	1977 (INSTALLATION)		1979 (DEMAND)		1980 (〃)		(PUT INTO 3D PLAN) 1981 (〃)		1983 (〃)		1983 (〃)		1993 (〃)	
			SUB	CODE	SUB	CODE	SUB	CODE	SUB	COCE	SUB	CODE	SUB	CODE	SUB	CODE
31	JATINE GARA A	E	4.000	8	3.500	8	3.920	81	3.920	81	3.920	81	3.920	81	3.920	81
		N					180	82	380	822	1.980	822	6.180	822	13.780	822. 823
32	〃 B	N	12.000	80	6.100	80	6.700	80	7.400	801. 802	8.800	801. 802	13.300	801. 802	20.000	801. 802
33	CAWANG	N	10.000	86	2.300	86	2.700	86	3.100	861	4.200	861	10.000	861	24.600	861~863
34	PASAR REBO	N	6.000	85	910	85	1.050	85	1.200	851	1.700	851	4.800	851	15.400	851. 852
35	KLENDER	N	4.000	89	700	89	880	89	1.200	891	1.800	891	6.000	891	20.300	891~893
36	TE BET	N	10.000	88	4.950	88	5.600	88	6.400	881	7.900	881	14.700	881. 882	27.700	881~883
37	GANDARIA	E	200	87	200	87	200	87								
		N	1.000	87	540	87	700	87	1.050	871	1.550	871	3.850	871	9800	871
	TOTAL		47.200		19.200		21.930		24.650		31.850		62.750		135.500	
	GRAND TOTAL		256.300		176.720		193.800		213.300		262.800		450.450		808.000	

E : EMD SYSTEM (98% ACCOMMODATION)
N : NEW SYSTEM (100% 〃)

TABLE 6-1-5-3-(3)1/3 NUMBERING PLAN AII

NO	OFFICE	SYSTEM	1977(INSTALLATION)		1979(DEMAND)		1980(〃)		(PUT INTO 3D PLAN) 1981(〃)		1983 (〃)		1988(〃)		1993(〃)		
			SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE	
1	KOTA A	E	10.000	27	8.500	27	9.100	27	9.500	27	9.800	27	9.800	27	9.800	27	
		N									1.300	249	5.300	249	11.100	249.248	
2	KOTA B	E	10.000	22	9.000	22	9.400	22	5.000	22	6.000	22	9.800	22	9.800	22	
		N	20.000	23.24	17.100	23.24	19.000	23.24	10.500	231.241	13.100	231.241	24.000	231.232 241	47.300	231~234 241	
3	KOTA C	N							15.200	291.292	18.000	291.292	26.400	291~293	39.400	291~294	'81S
4	ANCOL	N	3.000	25	4.400	25	5.000	25	5.500	251	7.500	251	14.500	251.252	28.300	251~253	
5	PLUIT	E	3.000	28	2.940	28	2.940	28	2.940	28	2.940	28	2.940	28	2.940	28	
		N			2.760	20	3.260	20	3.860	201	5.060	201	9.260	201	15.860	201.202	
6	CENGKARENG	N	5.000	21	1.300	21	1.500	21	1.750	211	2.550	211	6.000	211	14.600	211.212	
7	TEGAL-ALUR	N							1.000	261	1.500	261	3.800	261	9.300	261	'81S
	TOTAL		51.000		46.000		50.200		55.250		67.750		111.800		188.400		
8	GAMBIR A	E	20.000	4.5.35.31	17.700	4.5.35.31	18.800	4.5.35.31	19.500	34.35.31	19.600	34.35.31	19.600	34.35.31	19.600	34.35.31	
		N									2.900	531	11.900	531.532	24.100	531~533	
9	〃 B	E	5.000	36	4.000	36	4.200	36	4.500	36	4.900	36	4.900	36	4.900	36	
		N	20.000	32.33	15.200	32.33	16.400	32.33	17.500	321.331	20.600	321.322 331.	31.100	321~323 331	47.300	321~324 331	
10	SEMANGGI A	E	6.000	58	5.880	58	5.880	58	5.880	58	5.880	58	5.880	58	5.880	58	
		N	10.000	37	9.070	37	10.320	37.39.	11.420	371.391	14.970	371.391	16.570	371.391	30.220	371~373 391	
11	〃 B	N											9.700	571	14.900	571.572	'88S
12	SLIPI	E	3.500	59	3.430	59	3.430	59	3.430	59	3.430	59	3.430	59	3.430	59	
		N			5.170	52	6.070	52	7.070	521	9.570	521	17.870	521.522	31.670	521~524	
13	PALMERAH	N	5.000	38	2.950	38	3.400	38	4.000	381	5.300	381	11.700	381.382	26.000	381~383	
14	KEDOYA	N											3.200	511	10.100	511.512	'85S
15	MERUYA	N											4.300	561	11.800	561.562	'85S
	TOTAL		69.500		63.400		68.500		73.300		87.150		140.150		229.900		

E : EMD SYSTEM (98% ACCOMMODATION)
N : NEW SYSTEM (100% 〃)

TABLE 6-1-5-3-(3) 2/3 NUMBERING PLAM AII 2/3

NO	OFFICE	SYSTEM	1977 (INSTALLATION) SUB	CODE	1979 (DEMAND) SUB	CODE	1980 (〃) SUB	CODE	(PUT INTO 3D PLAN) 1981 (〃) SUB	CODE	1983 (〃) SUB	CODE	1988 (〃) SUB	CODE	1993 (〃) SUB	CODE	
16	CEMPAKA	E	8.000	61	3.500	61	4.000	61	4.500	61	5.000	61	7.840	61	7.840	61	
	PUTIH	N	16.000	62. 64	7.200	62(64)	7.800	62 (64)	8.300	621 (641)	10.200	621. 641	15.860	621. 641	32.360	621~623 641	
17	RAWAMANGUN	N	6.000	68	4.000	68	4.500	68	5.100	681	6.500	681	12.000	681. 682	21.900	681 683	
18	PULOGADUNG	N	6.000	63	470	63	570	63	700	631	1.000	631	2.600	631	6.900	631	
19	PENGGILINGAN										1.150	651	3.100	651	8.300	651	'83 S
20	TG. PRIOK A	E	2.000	69	1.960	69	1.300	69	1.500	69	1.960	69	1.960	69	1.960	69	
		N	4.000	60	6.340	60	4.000	60	4.500	601	5.940	601	14.040	601. 602	30.540	601~604	
21	〃 B	N					4.400	66	5.000	661	6.500	661	13.500	661. 662	29.000	661~663	'80S
22	CILINCING	N							1.300	671	1.800	671	4.600	671	11.700	671. 672	'81 S
	TOTAL		42.000		23.470		26.570		30.900		40.050		75.500		150.500		
23	KEBAYORAN A	E	10.000	77	9.000	77	9.000	77	9.000	77	7.000	77	9.500	77	9.800	77	
24	〃 A	N	12.000	78.71	7.100	78 (71)	8.000	78(71)	9.000	781 (711)	8.400	781 (711)	10.700	781. 711	16.200	781. 711	
25	KEBAYORAN B	N									5.200	751	9.300	751	15.600	751. 752	'83 S
26	CIPETE	N	8.600	76	2.400	76	2.700	76	3.100	761	4.100	761	8.000	761	15.700	761. 762	
27	KALIBATA	N	8.000	73	4.550	73	5.100	73	6.000	731	7.500	731	14.700	731. 732	29.200	731~733	
28	PASAR	E	5.000	79	1.600	79	1.800	79	2.100	79	2.750	79	4.900	79	4.900	79	
	MINGGU	N											700	701.	6.500	701	
29	JAGAKARSA	N									1.050	721	2.450	721	5.800	721	
30	CIPUTAT	E	3.000	74												74	
		N															
	TOTAL		46.600		24.650		26.600		29.200		36.000		60.250		103.700		

E : EMD SYSTEM (98% ACCOMMODATION)

N : NEW SYSTEM (100% 〃)

TABLE 6-1-5-3-(3) 3/3 NUMBERING PLAN AII 3/3

NO	OFFICE	SYSTEM	1977 (INSTALLATION)		1979 (DEMAND)		1980 (〃)		(PUT INTO 3D PLAN) 1981 (〃)		1983 (〃)		1988 (〃)		1993 (〃)	
			SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE
31	JATINE GARA A	E	4.000	8	3.500	8	3.920	81	3.920	81	3.920	81	3.920	81	3.920	81
		N					180	82	380	821	1.980	821	6.180	821	13.780	821. 822
32	〃 B	N	12.000	80	6.100	80	6.700	80	7.400	801. 802	8.800	801. 802	13.300	801. 802	20.000	801. 802
33	CAWANG	N	10.000	86	2.300	86	2.700	86	3.100	861	4.200	861	10.000	861	24.600	861~863
34	PASAR REBO	N	6.000	85	910	85	1.050	85	1.200	851	1.700	851	4.800	851	15.400	851. 852
35	KLENDER	N	4.000	89	700	89	880	89	1.200	891	1.800	891	6.000	891	20.300	891~893
36	TEBET	N	10.000	88	4.950	88	5.600	88	6.400	881	7.900	881	14.700	881. 882	27.700	881~883
37	GANDAVIA	E	200	87	200	87	200	87								
		N	1.000	87	540	87	700	87	1.050	871	1.550	871	3.850	871	9.800	871
TOTAL			47.200		19.200		21.930		24.650		31.850		62.750		135.500	
G. TOTAL			256.300		176.720		193.800		213.300		262.800		450.450		808.000	

E : EMD SYSTEM (98% ACCOMMODATION)

N : NEW SYSTEM (100% 〃)

TABLE 6-1-5-3-(4) 1/3 NUMBERING PLAN BI 1/3

NO	OFFICE	SYSTEM	1977 (INSTALLATION)		1979 (DEMAND)		1980 (〃)		(PUT INTO 30° PLAN) 1981 (〃)		1983 (〃)		1988 (〃)		1993 (〃)		
			SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE	
1	KOTA A	E	10.000	27	8.500	27	9.100	27	9.500	271	9.800	271	9.800	271	9.800	271	
		N									1.300	249	5.300	249	11.100	249. 248	
2	KOTA B	E	10.000	22	9.000	22	9.400	22	5.000	221	6.000	221	9.800	221	9.800	221	
		N	20.000	23.24	17.100	23.24	19.000	23.24	10.500	233. 234	13.100	233. 234	24.000	233~235	47.300	233~237	
3	KOTA C	N							15.200	291. 292	18.000	291. 292	26.400	291~293	39.400	291~294	'81 S
4	ANCOL	N	3.000	25	4.400	25	5.000	25	5.500	251	7.500	251	14.500	251. 252	28.300	251~253	
5	PLUIT	E	3.000	28	2.940	28	2.940	28	2.940	281	2.940	281	2.940	281	2.940	281	
		N			2.760	20	3.260	20	3.860	201	5.060	201	9.260	201	15.860	201. 202	
6	CENGKARENG	N	5.000	21	1.300	21	1.500	21	1.750	211	2.550	211	6.000	211	14.600	211. 212	
7	TEGAL-ALUR	N							1.000	261	1.500	261	3.800	261	9.300	261	'81 S
	TOTAL		51.000		46.000		50.200		55.250		67.750		111.800		188.400		
8	GAMBIR A	E	20.000	4.5.35.31	17.700	4.5.35.31	18.800	4.5.35.31	19.500	341.351.311.	19.600	341.351.311	19.600	341.351. 311	19.600	341.351.311	
		N									2.900	331	11.900	331. 332	24.100	331~333	
9	〃 B	E	5.000	36	4.000	36	4.200	36	4.500	361	4.900	361	4.900	361	4.900	361	
		N	20.000	32. 33	15.200	32.33	16.400	32.33	17.500	322. 323	20.600	321~323	31.100	321~324	47.300	321~325	
10	SEMANGGI A	E	6.000	58	5.880	58	5.880	58	5.880	581	5.880	581	5.880	581	5.880	581	
		N	10.000	37	9.070	37	10.320	37.39	11.420	377. 379	14.970	377. 379	16.570	377. 379	30.220	376~379	
11	〃 B	N											9.700	571	14.900	571. 572	'88 S
12	SLIPI	E	3.500	59	3.430	59	3.430	59	3.430	591	3.430	591	3.430	591	3.430	591	
		N			5.170	52	6.070	52	7.070	521	9.570	521	17.870	521. 522	31.670	521~524	
13	PALMERAH	N	5.000	38	2.950	38	3.400	38	4.000	381	5.300	381	11.700	381. 382	26.000	381~383	
14	KEDOYA	N											3.200	511	10.100	511. 512	'85 S
15	MERUYA	N											4.300	561	11.800	561. 562	'85 S
	TOTAL		69.500		63.400		68.500		73.300		37.150		140.150		229.900		

E : EMD SYSTEM (98% ACCOMMODATION)
N : NEW SYSTEM (100% 〃)

TABLE 6-1-5-3-(4) 2/3 NUMBERING PLAN BI 2/3

NO	OFFICE	SYSTEM	1977 (INSTALLATION) SUB	1977 (INSTALLATION) CODE	1979 (DEMAND) SUB	1979 (DEMAND) CODE	1980 (〃) SUB	1980 (〃) CODE	(PUT INTO 3D PLAN) 1981 (〃) SUB	(PUT INTO 3D PLAN) 1981 (〃) CODE	1983 (〃) SUB	1983 (〃) CODE	1988 (〃) SUB	1988 (〃) CODE	1993 (〃) SUB	1993 (〃) CODE	
16	CEMPAKE	E	8.000	61	3.500	61	4.000	61	4.500	611	5.000	611	7.840	611	7.840	611	
	PUTIH	N	16.000	62 . 64	7.200	62 (64)	7.800	62 (64)	8.300	622 (624)	10.200	622. 624	15.860	622. 624	32.360	622~625	
17	RAWAMANGUN	N	6.000	68	4.000	68	4.500	68	5.100	681	6.500	681	12.000	681. 682	21.900	681~683	
18	PULOGADUNG	N	6.000	63	470	63	5.70	63	700	631	1.000	631	2.600	631	6.900	631	
19	PENGGILINGAN										1.150	651	3.100	651	8.300	651	'83S
20	TG. PRIOK A	E	2.000	69	1.960	69	1.300	69	1.500	691	1.960	691	1.960	691	1.960	691	
		N	4.000	60	6.340	60	4.000	60	4.500	601	5.940	601	14.040	601. 602	30.540	601~604	
21	〃 B	N					4.400	66	5.000	661	6.500	661	13.500	661. 662	29.000	661~663	'80S
22	CILINCING	N							1.300	671	1.800	671	4.600	671	11.700	671. 672	'81S
	TOTAL		42.000		23.470		26.570		30.900		40.050		75.500		150.500		
23	KEBAYORAN A	E	10.000	77	9.000	77	9.000	77	9.000	771	7.000	771	9.500	771	9.800	771	
24	〃 A	N	12.000	78. 71	7.100	78 (71)	8.000	78(71)	9.000	788(781)	8.400	788(781)	10.700	788. 781	16.200	788. 781	
25	KEBAYORAN B	N									5.200	751	9.300	751	15.600	751. 752	'83S
26	CILOETE	N	8.600	76	2.400	76	2.700	76	3.100	761	4.100	761	8.000	761	15.700	761. 762	
27	KALIBATA	N	8.000	73	4.550	73	5.100	73	6.000	731	7.500	731	14.700	731. 732	29.200	731~733	
28	PASAR	E	5.000	79	1.600	79	1.800	79	2.100	791	2.750	791	4.900	791	4.900	791	
	MINGGU	N											700	711	6.500	711	
29	JAGAKARSA	N									1.050	721	24.50	721	5.800	721	
30	CIPUTAT	E	3.000	74												741	
		N															
	TOTAL		46.600		24.650		26.600		29.200		36.000		60.250		103.700		

E : EMD SYSTEM (98 % ACCOMMODATION)

N : NEW SYSTEM (100 % 〃)

TABLE 6-1-5-3-(4) 3/3 NUMBERING PLAN BI 3/3

NO	OFFICE	SYSTEM	1977 (INSTALLATION)		1979 (DEMAND)		1980 (,)		(PUT INTO 3D PLAN) 1981 (,)		1983 (,)		1988 (,)		1993 (,)	
			SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE
31	JATINE GARA A	E	4.000	8	3.500	8	3.920	81	3.920	811	3.920	811	3.920	811	3.920	811
		N					180	82	380	822	1.980	822	6.180	822	13.780	822.823
32	〃 B	N	12.000	80	6.100	80	6.700	80	7.400	801.802	8.800	801.802	13.300	801.802	20.000	801.802
33	CAWANG	N	10.000	86	2.300	86	2.700	86	3.100	861	4.200	861	10.000	861	24.600	861~863
34	PASAR REBO	N	6.000	85	910	85	1.050	85	1.200	851	1.700	851	4.800	851	15.400	851.852
35	KLENDER	N	4.000	89	700	89	880	89	1.200	891	1.800	891	6.000	891	20.300	891~893
36	TEBET	N	10.000	88	4.950	88	5.600	88	6.400	881	7.900	881	14.700	881.882	27.700	881~883
37	GANDARIA	E	200	87	200	87	200	87								
	〃	N	1.000	87	540	87	700	87	1.050	871	1.550	871	3.850	871	9.800	871
	TOTAL		47.200		19.200		21.930		24.650		31.850		62.750		135.500	
	GRAND - TOTAL		256.300		176.720		193.800		213.300		262.800		450.450		808.000	

E : EMD SYSTEM (98 % ACCOMMODATION)
N : NEW SYSTEM (100 % 〃)

TABLE 6-1-5-3-(5) 1/3 NUMBERING PLAN BII 1/3

NO	OFFICE	SYSTEM	1977 (INSTALLATION) SUB	CODE	1979 (DEMAND) SUB	CODE	1980 (〃) SUB	CODE	(PUT INTO 3D' PLAN) 1981 (〃) SUB	CODE	1983 (〃) SUB	CODE	1988 (〃) SUB	CODE	1993 (〃) SUB	CODE	
1	KOTA A	E	10.000	27	8.500	27	9.100	27	9.500	271	9.800	271	9.800	271	9.800	271	
		N									1.300	249	5.300	249	11.100	249. 248	
2	KOTA B	E	10.000	22	9.000	22	9.400	22	5.000	221	6.000	221	9.800	221	9.800	221	
		N	20.000	23. 24	17.100	23.24	19.000	23.24	10.500	231. 241	13.100	231. 241	24.000	231. 232 241	47.300	231~234 241	'81S
3	KOTA C	N							15.200	291. 292	18.000	291. 292	26.400	291~293	39.400	291~294	
4	ANCOL	N	3.000	25	4.400	25	5.000	25	5.500	251	7.500	251	14.500	251. 252	28.300	251~253	
5	PLUIT	E	3.000	28	2.940	28	2.940	28	2.940	281	2.940	281	2.940	281	2.940	281	
		N			2.760	20	3.260	20	3.860	201	5.060	201	9.260	201	15.860	201. 202	
6	CENGKARENG	N	5.000	21	1.300	21	1.500	21	1.750	211	2.550	211	6.000	211	14.600	211. 212	
7	TEGAL-ALUR	N							1.000	261	1.500	261	3.800	261	9.300	261	'81S
	TOTAL		51.000		46.000		50.200		55.250		67.750		111.800		188.400		
8	GAMBIR A	E	20.000	4.5.35.31	17.700	4.5.35.31	18.800	4.5.35.31	19.500	341.351.311	19.600	341.351.311	19.600	341.351.311	19.600	341.351.311	
		N									2.900	531	11.900	531. 532	24.100	531~533	
9	〃 B	E	5.000	36	4.000	36	4.200	36	4.500	361	4.900	361	4.900	361	4.900	361	
		N	20.000	32. 33	15.200	32.33	16.400	32.33	17.500	321. 331	20.600	321. 322 331	31.100	321~323 331	47.300	321~324 331	
10	SEMANGGI A	E	6.000	58	5.880	58	5.880	58	5.880	581	5.880	581	5.880	581	5.880	581	
		N	10.000	37	9.070	37	10.320	37. 39	11.420	371. 391	14.970	371. 391	16.570	371. 391	30.220	371~373 391	
11	〃 B	N											9.700	571	14.900	571. 572	
12	SLIPI	E	3.500	59	3.430	59	3.430	59	3.430	591	3.430	591	3.430	591	3.430	591	'88S
		N			5.170	52	6.070	52	7.070	521	9.570	521	17.870	521. 522	31.670	521 524	
13	PALMERAH	N	5.000	38	2.950	38	3.400	38	4.000	381	5.300	381	11.700	381. 382	26.000	381~383	
14	KEDOYA	N											3.200	511	10.100	511. 512	'85S
15	MERUYA	N											4.300	561	11.800	561. 562	'85S
	TOTAL		69.500		63.400		68.500		73.300		87.150		140.150		229.900		

E : EMD SYSTEM (98% ACCOMMODATION)

N : NEW SYSTEM (100% 〃)

TABLE 6-1-5-3-(5)2/3 NUMBERING PLAN BII 2/3

NO	OFFICE	SYSTEM	1977 (INSTALLATION)		1979 (DEMAND)		1980 (〃)		(PUT INTO 30' PLAN) 1981 (〃)		1983 (〃)		1988 (〃)		1993 (〃)		
			SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE	
16	CEMPAKA	E	8.000	61	3.500	61	4.000	61	4.500	611	5.000	611	7.840	611	7.840	611	
	PUTIH	N	16.000	62. 64	7.200	62.(64)	7.800	62(64)	8.300	621.(641)	10.200	621. 641	15.860	621. 641	32.360	621~623 641	
17	RAWAMANGUN	N	6.000	68	4.000	68	4.500	68	5.100	681	6.500	681	12.000	681. 682	21.900	681~683	
18	PULOGADUNG	N	6.000	63	470	63	570	63	700	631	1.000	631	2.600	631	6.900	631	
19	PENGGILINGAN										1.150	651	3.100	651	8.300	651	'83S
20	TG. PRIOKA	E	2.000	69	1.960	69	1.300	69	1.500	691	1.960	691	1.960	691	1.960	691	
		N	4.000	60	6.340	60	4.000	60	4.500	601	5.940	601	14.040	601. 602	30.540	601~604	
21	〃 B	N					4.400	66	5.000	661	6.500	661	13.500	661. 662	29.000	661~663	'80S
22	CILINCINA	N							1.300	671	1.800	671	4.600	671	11.700	671. 672	'81S
	TOTAL		42.000		23.470		26.570		30.900		40.050		75.500		150.500		
23	KEBAYORAN A	E	10.000	77	9.000	77	9.000	77	9.000	771	7.000	771	9.500	771	9.800	771	
24	〃 A	N	12.000	78. 71	7.100	78 (71)	8.000	78(71)	9.000	781 (711)	8.400	781 (711)	10.700	781. 711	16.200	781. 711	
25	KEBAYORAN B	N									5.200		9.300	751	15.600	751. 752	'83S
26	CIPETE	N	8.600	76	2.400	76	2.700	76	3.100	761	4.100	761	8.000	761	15.700	761. 762	
27	KALIBATA	N	8.000	73	4.550	73	5.100	73	6.000	731	7.500	731	14.700	731. 732	29.200	731~733	
28	PASAR	E	5.000	79	1.600	79	1.800	79	2.100	791	2.750	791	4.900	791	4.900	791	
	MINGGU	N											700	701	6.500	701	
29	JAGAKARSA	N									1.050	721	2.450	721	5.800	721	
30	CIPUTAT	E	3.000	74												741	
		N															
	TOTAL		46.600		24.650		26.600		29.200		36.000		60.250		103.700		

E : EMD SYSTEM (98% ACCOMMODATION)
N : NEW SYSTEM (100% 〃)

TABLE 6-1-5-3-(5) 3/3 NUMBERING PLAN BII 3/3

NO	OFFICE	SYSTEM	1977(INSTALLATION)		1979 (DEMAND)		1980 (〃)		(PUT INTO "3D" PLAN) 1981 (〃)		1983 (〃)		1988 (〃)		1993 (〃)	
			SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE	SUB	CODE
31	JATINE GARA A	E	4.000	8	3.500	8	3.920	81	3.920	811	3.920	811	3.920	811	3.920	811
		N					180	82	380	821	1.980	821	6.180	821	13.780	821.822
32	〃 B	N	12.000	80	6.100	80	6.700	80	7.400	801.802	8.800	801.802	13.300	801.802	20.000	801.802
33	COWANG	N	10.000	86	2.300	86	2.700	86	3.100	861	4.200	861	10.000	861	24.600	861~863
34	PASAR REBO	N	6.000	85	910	85	1.050	85	1.200	851	1.700	851	4.800	851	15.400	851.852
35	KLENDER	N	4.000	89	700	89	880	89	1.200	891	1.800	891	6.000	891	20.300	891~893
36	TEBET	N	10.000	88	4.950	88	5.600	88	6.400	881	7.900	881	14.700	881.882	27.700	881~883
37	GANDARIA	E	200	87	200	87	200	87								
		N	1.000	87	540	87	700	87	1.050	871	1.550	871	3.850	871	9.800	871
	TOTAL		47.200		19.200		21.930		24.650		31.850		62.750		135.500	
	GRAND TOTAL		256.300		176.720		193.800		213.300		262.800		450.450		808.000	

E : EMD SYSTEM (98 % ACCOMMODATION)

N : NEW SYSTEM (100% 〃)

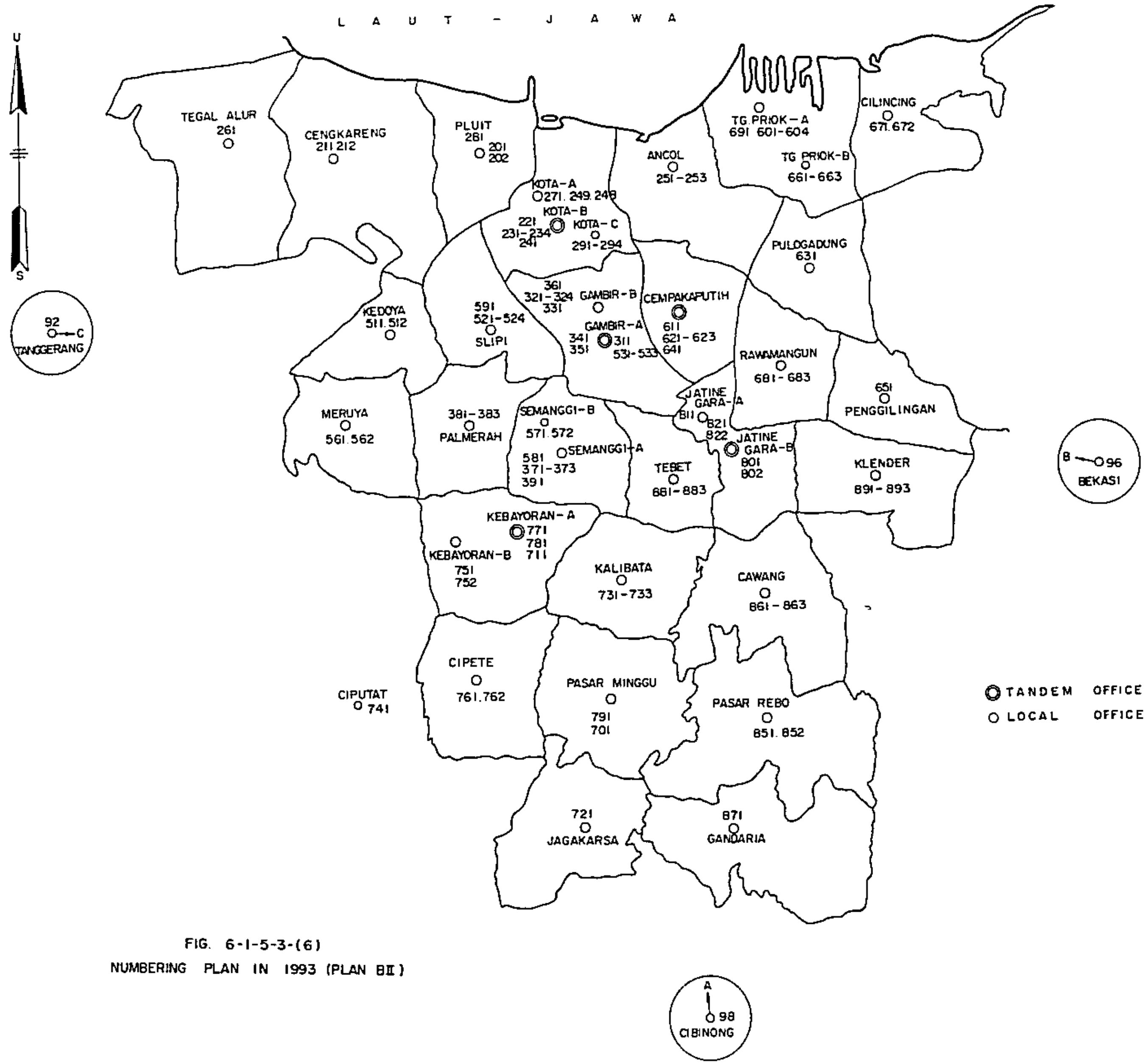


FIG. 6-1-5-3-(6)
NUMBERING PLAN IN 1993 (PLAN BII)

b The introduction of abosrbing relay group eliminates the need for additional installation of 3rd GS stage. This means economy in installation cost.

c. In case the absorbing relay group is introduced C code to be suffixed is one code for each old code.

6.1.5.5 Comparative Study of Long-Term Numbering Plan

Based on the comparison table (Table 6.1.5.5.(1)) we studied the four long-term numbering plans in order to determine the optimum plan for Jakarta. Main points of study were:

(1) In terms of cost to realize the 3-digit office codes Plan A surpasses Plan B. However, when the absorbing relay group is used, Plan B can realize the 3-digit office codes for all exchange offices with a small additional cost.

(2) It seems that the B code unification by means of the insertion method will improve the junction line efficiency per exchange building. Actually, however, such does not hold true. As far as the junction line efficiency is concerned, there is practically nothing to choose between Plan A and Plan B.

(3) For both Plan A and Plan B, Plan I leaves a greater B code surplus than Plan II. However, in the future the common use of B code for exchange buildings will become unavoidable though at that time the new system offices will increase and hence the common use of B code will pose no serious problem. Therefore, in terms of B code surplus no distinction can be recognized between Plan A and Plan B.

(4) The number of subscribers to be affected by the office code change is smaller in Plan A than in Plan B. It depends upon cases whether the inequality of part of subscribers being affected and others not affected by the office code change (Plan A) presents the real question or the equality of all subscribers being affected by the office code change (Plan B) constitutes the vital concern.

(5) In the comparison between the common use of 2-digit and 3-digit office codes and the adoption of 3-digit office codes only Plan B which belongs to the latter is preferable because the new codes can be easily remembered.

(6) As for the method of office code alteration, Plan I method is not only complicated but inconsistent also so that a new office code list must be prepared and distributed among subscribers to familiarize them with new codes. In this case, if the notice to subscribers is incomplete, a serious traffic confusion takes place. And, to minimize such traffic confusion the office code changes, may be made on several occasions according to the item of code change. This series of office code changes, however, involves much trouble to subscribers.

Plan II provides a simple method: the prescribed one figure ("1," for instance) has only to be suffixed after the existing office code. Thus the new office code is easy to remember. The new office code list is necessary only for part of exchange offices in Plan A-II. Hence the traffic confusion will not take place. Moreover, the office code change work can be carried out at a time for the whole of Jakarta.

From the foregoing it can be said that for both Plan A-II and Plan B-II, is preferable.

(7) From the standpoint of subscribers Plan A is inconvenient because of the promiscuity of changed and unchanged numbers. Subscribers must check the office code every time they make a call. Plan B wherein all subscribers have their office code changed relieves them of such inconvenience.

(8) In Plan B the information talkie service for wrong number calls cannot be realized for some of subscribers. This disadvantage can be eliminated by special assignment of personnel for that service for the time being (possibly one month).

Conclusion:

1. As the result of the foregoing study we arrived at a conclusion that if PERUMTEL could develop the absorbing relay group by 1981 and introduce it at each EMD exchange office Plan B-II (which uses the absorbing relay group) would be the optimum plan for Jakarta. Fig. 6.1.5.3.(6) illustrates the B-II numbering plan as of 1993.

2. If the absorbing relay group development is difficult Plan A-II would be the second best.

6.1.5.6 Absorbing Relay Group

(1) Trunking Diagram

The trunking diagram using the absorbing relay group is shown in Fig. 6.1.5.6.(1).

(2) Purpose of Use

When the 2-digit office code of the existing EMD exchange office code is to be changed to 3 digits, the absorbing relay group is used to absorb the 3rd digit impulse instead of installing the new 3rd GS stage for the purpose of cost saving.

(3) Place of Installation

The absorbing relay group is installed preceding the 3rd GS in the EMD exchange office to receive the intra-office call and the terminating calls from the EMD tandem office and the EMD office in its own area. The absorbing relay group is not used on the circuit from the PRX office.

(4) Performance and Composition

The absorbing relay group absorbs the first received 3rd digit impulse but lets the succeeding impulses transit. Because of such simple performance one circuit can be composed of some four ordinary type relays.

TABLE 6-1-5-5-(1)1/2 CHANGE OF OFFICE CODE IN JAKARTA.

ITEM \ PLAN			A I	A II	B I		B II	
OFFICE CODE DIGITS			EMD. 2 D NEW. 3 D MIXED CODE	"	EMD. 3 D NEW. 3 D ALL 3D CODE		"	
AB CODE FOR EACH BUILDING	EMD		ONE (EXCLUDING GAMBIR)	"	"		"	
	NEW		ONE	ONE OR TWO	ONE		ONE OR TWO	
"2D" "3D" AB→[ ]	EMD	SINGLE	NO CHANGE	NO CHANGE	AB①		AB①	
		MULTI						
	NEW	SINGLE	AB①	AB①	AB①		AB①	
		MULTI	A⊗B	AB①	A⊗B		AB①	
EXTENSION OF EMD SWITCH	ABSORB. R/G		NO NEED	"	510.000 $		"	
	OR (3RD GW)		(NO NEED)	(")	(2360.000 $)		(")	
RATIO FOR NUMBER OF JUNCTION LINES (EMD)	FROM OWN AREA		100.0	100.1	100.0		100.1	
	FROM TANDEM		100.0	100.1	100.0		100.1	
B CODE	SPARE	KOTA	ZERO IN 1983	"	"		"	
		GAMBIR	6 IN 1993	4 IN 1993	6 IN 1993		4 IN 1993	
		CEMP	1 IN 1993	ZERO IN 1983	1 IN 1993		ZERO IN 1983	
		KEBAYO	1 IN 1993	ZERO IN 1988	1 IN 1993		ZERO IN 1988	
		JATINE	2 IN 1993	"	"		"	
	OVER WRAP		NO	ONE IN KOTA	NO		ONE IN KOTA	
OFFICE CODE UNDER SERVICE	1981		"2D" 15 CODES "3D" 31 CODES	" "	EMD 15 CODES NEW 31 CODES		" "	
	1991		"2D" 15 CODES "3D" 89 CODES	" "	EMD 15 CODES NEW 89 CODES		" "	
NUMBER OF SPARE CODE			361 CODE	"	ABSORB R/G IS USED	3RD GW IS USED	ABSORB R/G IS USED	3RD GW IS USED
					361	496	361	496
ULTIMATE YEAR OF CODE CAPACITY	KOTA		AD. 2000	"	"	AD.2010	AD.2000	AD.2010
	GAMBIR		AD. 2040	"	"	AD.2060	AD.2040	AD.2060
	CEMP		AD. 2005	"	"	AD.2015	AD.2005	AD.2015
	KEBAYO		AD. 2010	"	"	AD.2035	AD.2010	AD.2035
	JATI		AD. 2004	"	"	AD.2006	AD.2004	AD.2006
NO. OF SUBSCRIBERS OF CHANGED OFFICE CODE.			123.900	"	198.500		"	

TABLE 6-1-5-5-(1) 2/2 CHANGE OF OFFICE CODE IN JAKARTA.

ITEM \ PLAN		A I	A II	B I	B II
INFORMATION TO SUBSCRIBERS	OFFICE CODE CHANGE RULE	COMPLICATED	EASY	COMPLICATED	EASY
	OBJECT SUBSCRIBERS	1/3 NO CHANGE 2/3 CHANGED	"	ALL SUBSCRIBER'S ARE CHANGED	"
TIMES OF CHANGE		AS OFFICE CODE CHANGE RULE IS DIFFICULT SO IT IS BETTER THAT TIMES ARE SEPARATED ACCORDING TO CODE CHANGE PATTERN	CAN BE DONE IN ONE TIME	DO. A I	DO. A II
TALKIE SERVICE	EMD	NO PROBLEM OF B I.	"	IMMEDIATE ANNOUNCEMENT. AFTER EMD OFFICE CODE CHANGE THE IXXX LEVEL IS OUT OF TALKIE SERVICE	" "
	NEW	IMMEDIATE AND TIMED ANNOUNCEMENT	"	"	"
SUBSCRIBERS' OPINION		UNFAIR OPPOSED	"	FAIR APPROVAL	"

(5) Number Required

The number of absorbing relay groups required will be approximately 120 per 1,000 terminals in each EMD exchange office. The exact number depends upon the terminating traffic volume.

(6) Floor Space Required for Installation

The absorbing relay group required will be one-third to one-fourth the size of the ordinary type GS. Therefore the necessary floor space for installation can be small.

(7) Power Consumption

The absorbing relay group holds no speech current supply circuit or other mechanical portion so that the power consumption is extremely small. Work to increase power plant capacity is not necessary.

(8) Unit Cost of Installation

Price per component relay will be US$10 and four relays will be used to make one absorbing relay group. The cost of construction work will be 40% of the material cost. Therefore, the installation cost per absorbing relay group will be

4 x US$10 x 140% = US$56

6.2 Trunking Standard

6.2.1 Basic Network Formula

Following are the general basic items of the local telephone network:

1) Network Type
   - o Mesh type
   - o Star type
   - o Combined type

2) Tandem System
   - a. By type of exchange office formation
     - o Centralized tandem system
     - o Decentralized system
   - b. By type of circuit formation
     - o Originating tandem system
     - o Terminating tandem system

3) Junction Formula
   - a. By call connection type
     - o Direct junction
     - o Tandem junction
   - b. By alternative routing type
     - o Final junction
     - o High usage junction

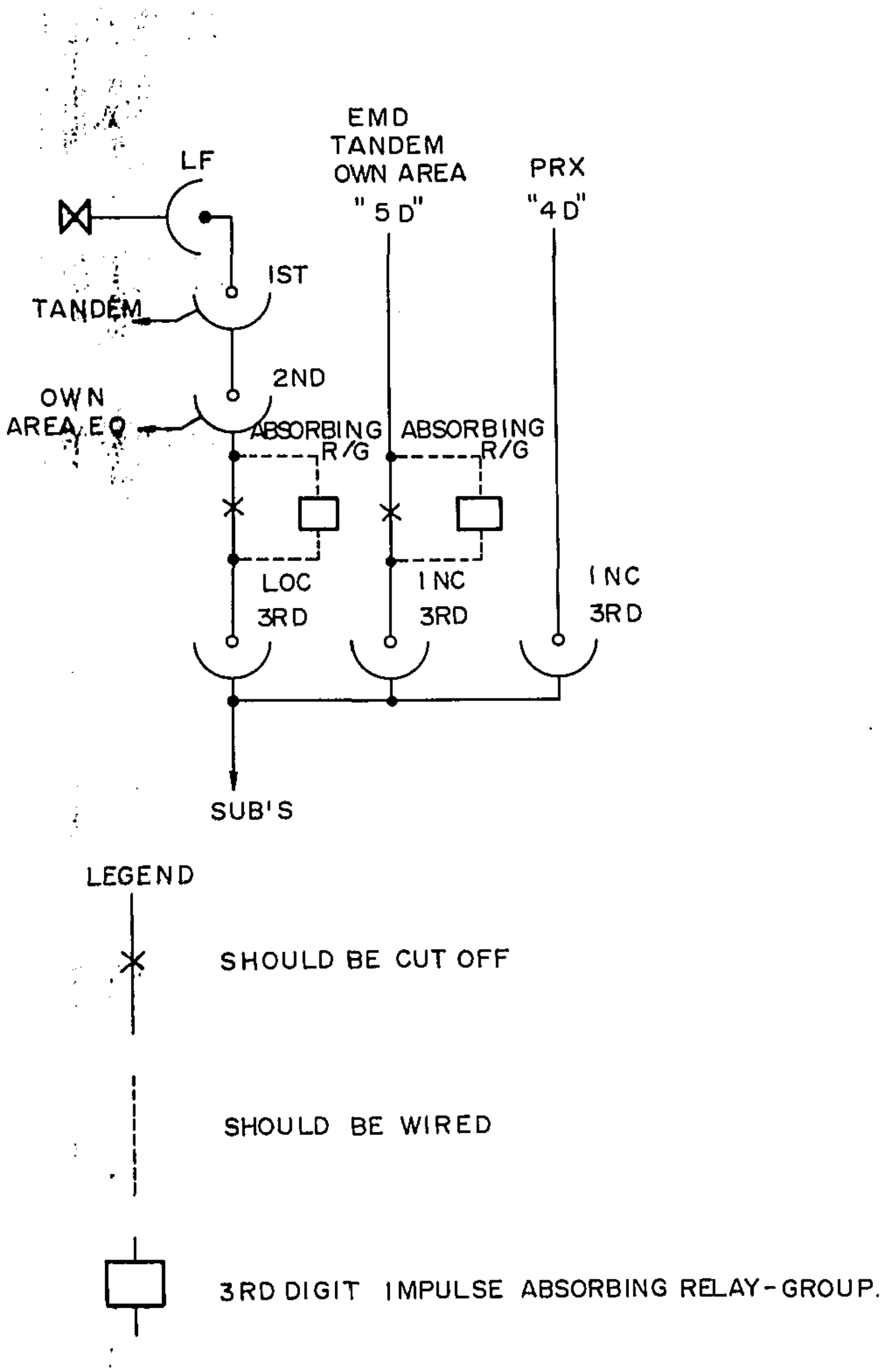


FIG. 6-1-5-6-(1) TRUNKING DIAGRAM.

6.2.2 Existing Local Network in Jakarta

The existing local telephone network in Jakarta is composed of the dispersed terminating tandem system by star type network using the EMD switching equipment. The star type network can improve the network efficiency but it requires the tandem office. If the step by step system is adopted with the EMD switching equipment, establishment of the direct circuit independent of the tandem circuit is impossible, however advantageous it may be. [Tanjung Priok and Semanggi exchange offices have such direct junction established, using ORW (a repeater with alternative routing function).] The existing tandem areas are shown in Table 6.2.2.(1).

Table 6.2.2.(1) Existing Tandem Area

Tandem area	EMD Office	A code	LU
Kota	Kota, Tg. Priok	2	12,000
Gambir	Gambir, Semanggi Gandaria, Slipi	3,4,5	20,700
Kebayoran	Kebayoran, Cipete	7	8,600
Jatinegara	Jatinegara	8	4,000
TOTAL	4		45,300

6.2.3 Network Formation by New Type Switching Equipment

The new type switching equipment to be introduced in and the future is the type which can store the dialled figures. It can be used in whichever tandem system, originating or terminating. The junction circuit can either be the star type or the mesh type; it can even use the star-and-mesh combined type junction. In other words, when traffic exceeds a certain volume and the direct junction is an effective means to carry such traffic, the direct junction is established, whereas the small volume traffic and overflowed traffic from the direct junction are routed via the tandem junction, and by this means the circuit efficiency can be improved. Therefore, the study was made to determine the optimum network formula in Jakarta not only for the present but also for the future after the introduction of the new type switching equipment and its combined operation with the existing EMD equipment.

6.2.4 Local Tandem System in Jakarta

6.2.4.1 Basic Conditions

Following are the basic conditions to determine the local tandem system in Jakarta based on the combined network using both the existing EMD and new type switching equipment:

1) To satisfy at moderate cost the determined transmission loss assignment plan.
2) To adopt one tandem stage.
3) Not to use the sub-tandem system.
4) To take the existing EMD network, as well as its facilities and functions, into full account.
5) To establish a network in which the new type switching equipment can perform to the best advantage, with the adoption of final and high usage junctions where necessary.
6) To ensure that the network by the new type switching equipment can be easily introduced and expanded in the existing EMD network.

6.2.4.2 Local Tandem Plan

Based on the foregoing basic conditions we drafted several plans for local tandem system in Jakarta and carried out a comparative study of those draft plans. Five plans prepared, i.e., P1 through P3 plus PA and PB, are shown in Table 6.2.4.2.(1) and Fig. 6.2.4.2.(2)

Table 6.2.4.2.(1) Tandem Plan

Plan	Contents
P1	5 EMD terminating tandem offices and 5 new system terminating tandem offices will be established.
P2	5 EMD terminating tandem offices and 1 new system concentrated tandem office will be established.
P3	5 EMD terminating tandem offices and 5 new system originating tandem offices will be established.
PA	All overflow calls out of high usage junction from new system offices to EMD offices will be routed via the new system tandem offices.
PB	All overflow calls out of high usage junction from new system offices to EMD offices will be routed via the EMD tandem offices.

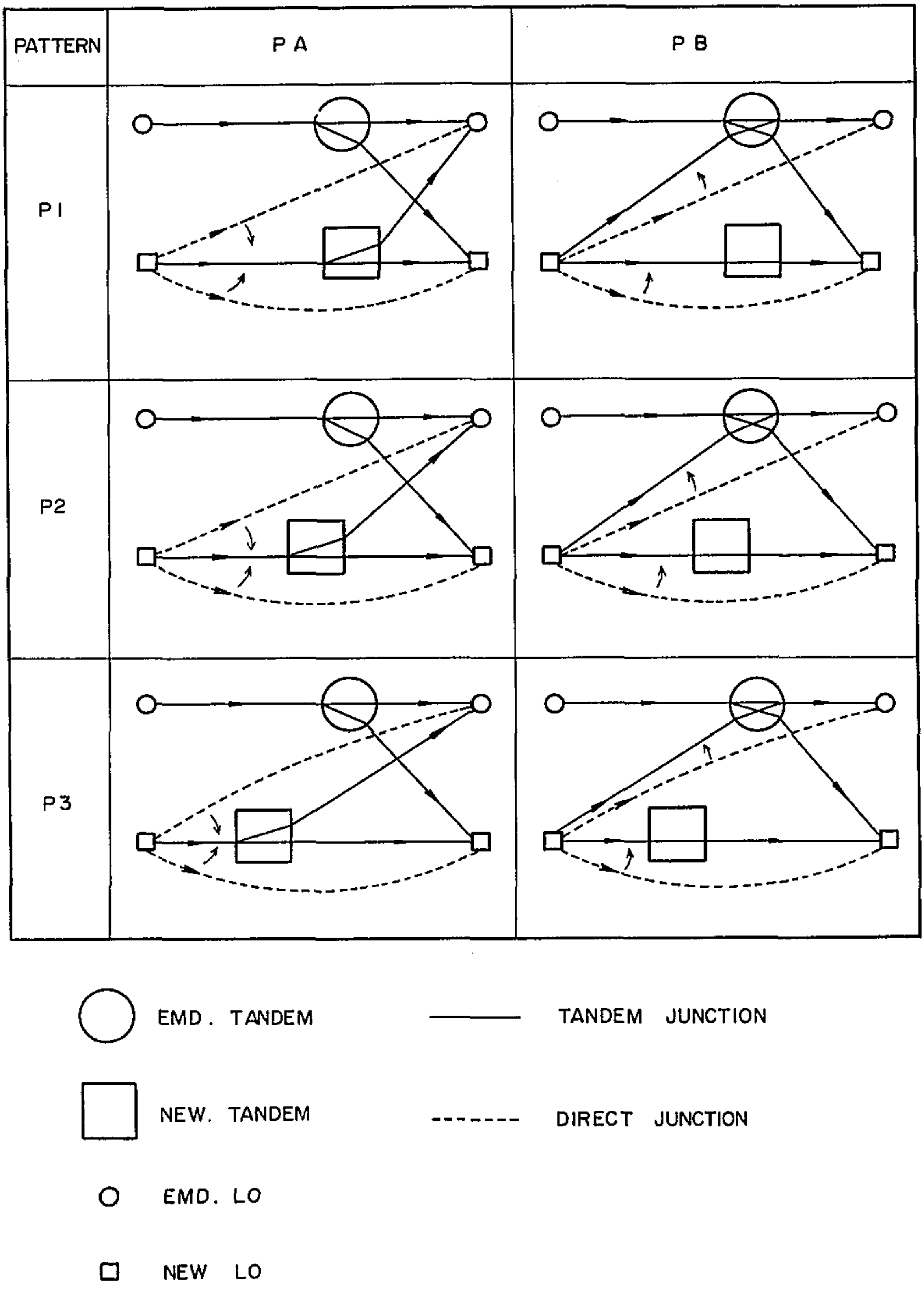


FIG. 6-2-4-2-(2) TANDEM PATTERN

6.2.4.3 Findings in Comparative Study

Study was made on merits and demerits of the foregoing 5 draft plans (refer to Table 6.2.4.3.(1)). Conclusion drawn was that P1-PA would be the fittest for Jakarta. Reasons are:

1) The new system network can be easily introduced in the existing EMD network.
2) The quantity of DP equipment to be used in the new system exchange offices can be limited from the long-range viewpoint.
3) The additional installation of new system switching equipment is easy.
4) The EMD switching equipment will continue to be used at high efficiency.
5) The additional installation of EMD switching equipment can be limited to the necessary minimum.
6) The function of new system switching equipment, i.e., the establishment of final and high usage junctions, is fully considered.

6.2.5 Tandem System Transition

The pattern of tandem system transition from the initial period to the future is shown in Table 6.2.5.(1). This transition pattern is considered to be the best for the telephone network in Jakarta. In this transition pattern:

The 1st stage represents the tandem formula fully based on the EMD system.

The 2nd stage consists of a small number of new system exchange offices introduced in the 1st stage network while the tandem system itself remains unchanged.

In the 3rd stage, due to the increase of new system exchange offices, the establishment of new system tandem offices apart from the EMD system tandem offices is advantageous in the network formation. Thus the tandem offices adopting the new system switching equipment are newly established.

In the 4th stage the overaged EMD switching equipment are withdrawn and the EMD exchange offices decrease. Thus the EMD tandem offices are abolished and the remaining EMD office junctions are routed to the new system tandem offices. Tandem switching are all carried out by the new system tandem office.

In the 5th stage the EMD exchange offices are completely withdrawn with only the new system switching equipment in operation.

6.2.6 Calculation of Junction Lines

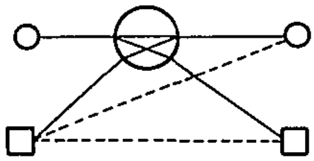
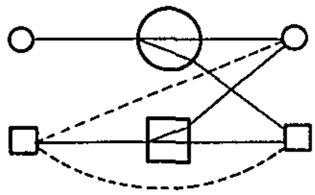
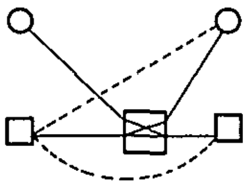
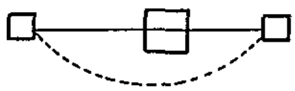
6.2.6.1 Calculation Method

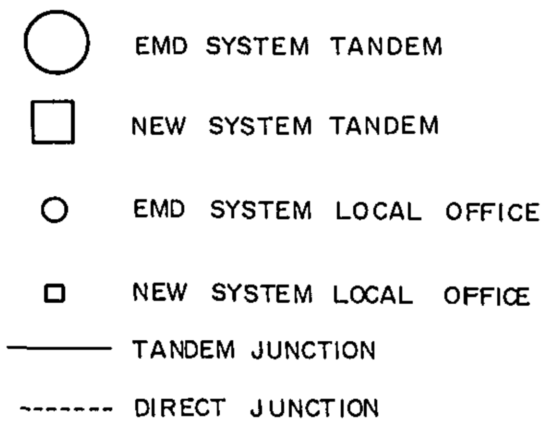
The calculation of junction lines required is based on CCITT Local Telephone Networks, 1968, Chapter IV, provision and the modified Palm-Jacobaens formula using lost call ratio B=0.01.

TABLE 6-2-4-3(1) COMPARISON TABLE OF TANDEM PATTERN.

PATTERN	MAX. POST DIALLING DELAY	EMD. TAMDEM SWITCHING WORK	EMD. LO. SWITCHING WORK	NEW TANDEM DP. SENDER	NEW LO. DP. SENDER	ITEMS
PA PI	SEC 7.5	SMALL	LARGE	NEED	SMALL	1. SUITABLE PATTERN FOR EMD TO INTRODUCE THE NEW SYSTEM. 2. WHEN REFORMING THE EMD OFFICE INTO NEW SYSTEM, JUNCTION WORK IS NOT INCREASED. 3. IDLE SWITCHES NOT OCCURRED IN EMD OFFICE
PA P II	7.2	LARGE	SMALL	NO NEED	LARGE	1. ACCORDING TO INCREASE OF NEW SYSTEM LOCAL OFFICES, EMD TANDEM OFFICE MUST INCREASE SWITCHES MORE THAN THE PA. PI PATTERN.
PB PI	7.5	SMALL	LARGE	NEED	SMALL	1. SAME AS 1 OF PA. PI. PATTERN 2. SAME AS 2 OF PA. PI. PATTERN 3. SAME AS 3 OF PA. PI. PATTERN
PB PII	7.2	LARGE	SMALL	NO NEED	LARGE	1. TRAFFIC LOAD TO EXISTING EMD TANDEM IS LARGER THAN PB. PI. PATTERN
PC PI	7.5	SMALL	LARGE	NEED	SMALL	1. SAME AS 2 OF PA. PI. PATTERN 2. SAME AS 3 OF PA. PI. PATTERN
PC PII	7.2	LARGE	SMALL	NO NEED	LARGE	1. TRAFFIC LOAD TO EXISTING EMD. TANDEM IS LARGER THAN PC. PI. PATTERN

TABLE 6-2-5-(1) CHANGING-PATTERN OF TANDEM

NO	TANDEM PATTERN	NOTE
1		PAST ALL LOCAI OFFICES ADOPT EMD TERMINATING TANDEM SYSTEM ONLY
2		EXISTING ONE NEW SYSTEM END OFFICE ARE INTRODUCED IN EMD TERMINATING TANDEM SYSTEM. (CIPETE OFFICE)
3		AFTER 1976 NUMBER OF NEW SYSTEM OFFICE IS INCREASED, SO TERMINATING TANDEMS BY NEW SYSTEM SWITCH ARE NEWLY INSTALLED.
4		IN FUTURE NUMBER OF EMD SYSTEM OFFICES ARE DECREASED, SO TERMINATING TANDEMS BY EMD SWITCH ARE TAKEN OFF.
5		IN FUTURE ALL LOCAL OFFICES ADOPT NEW TERMINATING TANDEM SYSTEM ONLY.



6.2.6.2 Decision on Final Junction or High Usage Junction

The following criteria are used to decide which, final junction or high usage junction, to adopt in the circuit formation by the new system switching equipment:

1) In case the traffic volume between i and j exchange offices is smaller than 5 Erlang such traffic is to be routed via the tandem office.
2) In case the traffic volume between i and j exchange offices exceeds 5 Erlang the choice between final junction and high usage junction to carry such traffic is made by the formula specified below.

Here,

nij : Number of high usage junctions between i and j exchange offices, calculated by the equivalent random theory.

ndij : Number of final junctions between i and j exchange offices, calculated by the Erlang B formula.

pij : Traffic rejected from nij, the high usage junctions between i and j exchange offices.

Eij : Annual cost ratio of tandem circuits to that of final junctions between i and j exchange offices. This ratio is expressed by

$$Eij = \frac{\text{Annual cost of final junctions}}{\text{Annual cost of tandem circuits}}$$

Now, in the case of $nij + \dfrac{Pij}{Eij\{1-0.3(1-Eij^2)\}} > ndij$

the final junctions will be established.

In the case of $nij + \dfrac{Pij}{Eij\{1-0.3(1-Eij^2)\}} \leq ndij$

the high usage junctions will be established.

In the above formula

$$1-0.3(1-Eij^2) \quad \cdots\cdots\cdots \text{Ⓐ}$$

is the approximate formula to indicate the traffic volume (Erl) which is carried by each tandem route. In this case, Eij is usually 0.1 to 0.9 so that the formula A produces 0.70 to 0.94. Therefore, when Eij is near 1 the traffic volume to be carried by a tandem route becomes large. Hence the establishment of high usage junctions proves to be advantageous. On the other hand, when the Eij value is small the traffic volume to be carried by a tandem route becomes small so that the high usage junctions do not necessarily prove advantageous. In this case the final junctions will prove to be more advantageous.

Also

$$\frac{Pij}{Eij\{1-0.3(1-Eij^2)\}} \quad \cdots\cdots\cdots \text{Ⓑ}$$

gives the number of tandem junctions to carry overflow traffic from high usage junctions, expressed in terms of the number of final junctions.

Further

$$n_{ij} + \frac{P_{ij}}{E_{ij}\,\{1 - 0.3\,(1 - E_{ij}^2)\}} \quad \cdots\cdots\cdots \quad \text{©}$$

presents the total number of circuits required to carry a certain traffic volume by alternative routing, expressed in terms of the number of final junctions.

6.2.6.3 Outlet Utilization in EMD System

1st GS contains outgoing junctions to other tandem area so that 220-pt of high outlet usage is employed for it. For 2nd GS the common 110-pt is used.

The outlet utilization is:

1st GS (220-pt) out .... K = 20

2nd GS (110-pt) out .... K = 10

6.3 Signaling Standard

Decision of signaling system to be used between telephone set and exchange office equipment and between exchange office equipments assumes vital importance. If the signal transmission can be carried out without trouble under (1) and (2) conditions mentioned below, the local telephone network plan for Jakarta which we worked out this time is safe from trouble whichever signaling system is introduced.

(1) *Junction Line Design Conditions*

Transmission loss and d.c. resistance distributions on junction lines in Jakarta are shown in Table 6.3.(1).

(2) Maximum and Minimum Transmission Frequencies

Maximum and minimum transmission frequencies are 3,400 Hz and 300 Hz, respectively, as shown in Fig. 6.3.(2). Both these values comply with CCITT Recommendation G132.

i) Junction cable loading is carried out by the following standard:

Loading inductance	80 mH
Coil spacing	1,500 m (maximu, 106 spans)
Measuring frequency	800 Hz

ii) *Junction cable constants are as follows:*

Primary constant	Refer to Table 7.2.4.(1)
Secondary constant	Refer to Table 7.2.4.(1)

Junction cable transmission frequency range is shown in Fig. 6.3.(2).

Table 6.3.(1) Junction Cable Condition

(at 800 Hz)

Office \ Item	Maximum Loss	Maximum DC-resistance
EO → T	9.5 db	1.900 Ω
T → EO	5.5 db	1.100 Ω
EO → EO	15.0 db	3.000 Ω

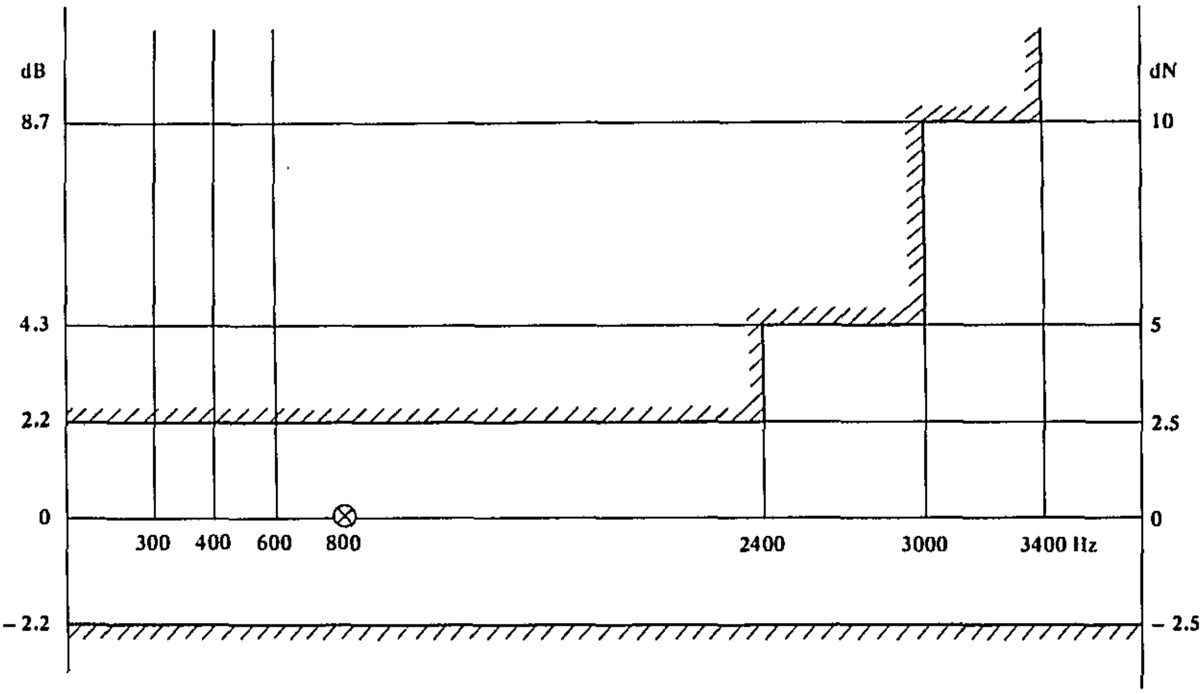


Fig. 6.3.(2)

6.4 Transmission Loss Assignment

6.4.1 Future Desirable Transmission Loss

6.4.1.1 Junction Cable

The reference equivalent in Indonesia is 33 dB, based on the CCITT limit value. The transmission loss on local junction circuits is 19 dB as shown in the PERUMTEL transmission program (Fundamental Plan 1972). In the future, however, the demand for transmission quality improvement will increase gradually in accordance with the progress of the national economy and the elevation of the standard of living among the general public.

(a) For 97% of international telephone connections the reference equivalent should be 36 dB or less.

(b) National sending reference equivalent, i.e., sending reference equivalent (S.R.E.) from the telephone set to the virtual switching points, should not exceed 20.8 dB.

(c) National receiving reference equivalent, i.e., receiving reference equivalent (R.R.E.) from the telephone set to the virtual switching points should not exceed 12.2 dB.

At the initial stage of telephone diffusion the maximum limit prescribed by CCITT can safely apply. For the future, however, we recommend to PERUMTEL to improve the transmission loss assignment. For determination of transmission quality standards in a country, the result of opinion evaluation in the country is usually one of the basic factors.

To our regret we could not obtain data relating to opinion evaluation in Indonesia. However, according to the result of opinion evaluation concerning transmission performance, which was carried out by the Nippon Telegraph & Telephone Public Corporation (NTT), telephone connections at over 33 dB full reference equivalent invite complaints from approximately 80% of subscribers as shown in Fig. 6.4.(2).

As seen in Fig. 6.4.(2) the average evaluation (average score) is generally influenced by line loss, indoor noise, and line noise, etc. These noises will be reduced considerably by the application of new technology including the telephone set improvement. In parallel with such noise reduction the transmission loss by the outside plant must also be reduced.

Following are the methods available for transmission loss improvement:

a) To introduce 4-wire switching system in toll centers.

b) To improve return loss at the 2-wire exchange point.

c) To use the new telephone set with better transmission characteristics.

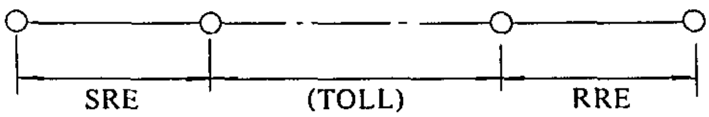
d) To load long distance subscriber lines.

e) To use two-way repeater, etc.

Final decision of transmission loss value is not easy to make as it depends upon the economy, as well as the national policy, of the country concerned. However, considering the aforementioned NTT opinion evaluation, (transmission loss assignment in other countries in Table 6.4.(1)), and the coordination between transmission loss assignment and DC resistance on junction circuit, it is desirable that the local junction circuit transmission performance be improved by 4 dB.

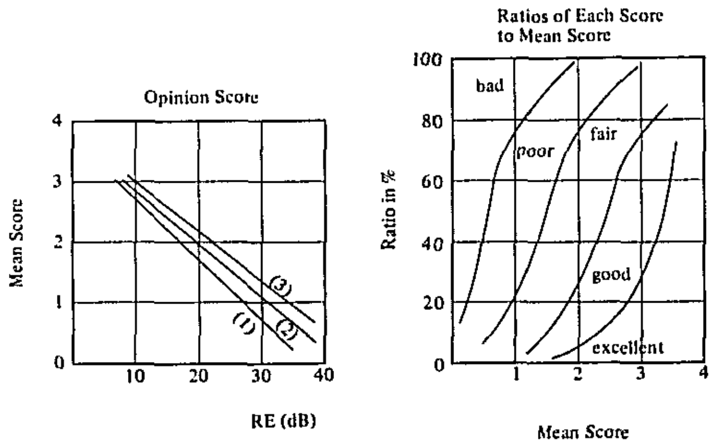
Table 6.4.(1) Transmission Loss Assignment in Other Countries

Country	SRE	RRE	TOLL	Total	Local junction EO - EO	Remarks
Indonesia	10.3	1.7	21	33	19	
Australia	14	6	15	35	15	
France	11	2	16	29		
Holland	17	4	13	34	6	
West Germany	10.3	1.7	19	31	12	
Sweden	13	5	9	27	15	
Japan	7	0.2	10	17.2	13	



Measurement condition:

Office noise:	0.6 mV
Room noise:	60 phones
Line noise:	(1) 3.5 mV
	(2) 1.1 mV
	(3) 0.35 mV



0 ...... bad
1 ...... poor
2 ...... fair
3 ...... good
4 ...... excellent

Fig. 6.4.(2)

6.4.1.2 Subscriber Cables

According to the transmission standards [59/2a/1-(5)] of PERUMTEL, the allowable maximum sending reference quivalent (S.R.E.) the subscriber cable including telephone set is 1.2 Np(10.42dB).

In accordance with this PERUMTEL's standard and the CCITT Handbook "Local Telephone Network", the S.R.E. for only the subscriber lines was calculated as follows:

1) Allowable maximum sending reference equivalent including telephone set = 10.42 dB(1.2 Np)

2) S.R.E. = $\alpha + \beta \cdot L$

α = 0.87 dB (0.1 Np)

L = Line length (km)

$\beta = K \cdot X + Y$

K = Fixed number

Table 6.4.(3)

Cable conductor (mm)	0.4	0.6	0.8
K	1.10	1.00	0.93

$$X = \frac{\sqrt{WRoCo}}{2}$$

W = 2f (f = 800 Hz)

Ro = Loop resistance (Ω/km) of line

Co = Static capacity (F/km) of line

$$Y = \frac{0.5}{1000} \times 8.686 \times Ro$$

3) Maximum line length (km) $= \dfrac{10.42 - 0.87}{\beta} = \dfrac{9.55}{K \cdot X + Y}$

4) Line resistance (Ro) and mutual capacitance (Co)

Table 6.4.(4)

Cable Conductor (mm)	PE Cable		JF Cable	
	Resistance (Ω/loop km)	Mutual Capacitance Co(nf/km)	Resistance (Ω/loop km)	Mutual Capacitance Co(nf/km)
0.4	300	50	300	55
0.6	130	50	130	55
0.8	72	50	72	55

PE cable : Polyethylene insulated cable

JF cable : Jelly filled cable

5) DC resistance and S.R.E. for only Subscriber Line & Maximum Allowable Line Length

Table 6.4.(5)

Kind of Cable		DC Resistance (Ω/loop km)	S.R.E. for only (dB/km)	Maximum Allowable Line Length (km)
0.4	PE	300	3.16	3.0
	JF	300	3.25	2.9
0.6	PE	130	1.68	5.6
	JF	130	1.73	5.5
0.8	JF	72	1.08	8.8

6.4.2 Loss Assignment Comparison

When the junction circuit transmission loss assignment is improved from 19 dB to 15 dB, and the basic conditions (circuit cost, number of tandem circuits, and location of tandem exchange office) are as follows, the optimum transmission loss assignments of EO - T(tandem) and T(tandem) - EO sections of the Plan No.1 are as shown below.

(a) Basic Condition

(a-1) Circuit cost

Table 6.4.(6)

	Index of circuit cost				
Conductor diameter	0.4 mm	0.6 mm	0.8 mm	0.9 mm	1.0 mm
Index	100	196	350	415	465

(a-2) Distribution of tandem circuit by distance

Table 6.4.(7)

in 1993

km	4	6	8	10	12	14	16	18	20	22	24	26	28	30	35
EO → T	1.0	15.7	32.6	41.1	56.4	69.5	76.3	80.0	88.1	91.5	94.4	96.5	98.7	99.5	100 %
T → EO	30.3	46.3	76.4	78.1	78.1	89.7	92.1	96.4	100 %	–	–	–	–	–	–

(b) Total Cost [(1) + (2)]

EO → T: Number of circuits x cost/circuits .... (1)

T → EO: Number of circuits x cost/circuits .... (2)

Table 6.4.(8) Optimum Transmission Loss Assignment

Plan No.	System	Loss assignment	Cable Conductor Diameter 0.4 mm		0.6 mm		0.8 mm		0.9 mm		1.0 mm		Cost
			%	km	%	km	%	km	%	km	%	km	
1	EO → T	12.5dB	47.5	6.38	43.5	15.3	9.0	28.1	–	–	–	–	3,468.7
	T → EO	2.5	14.0	0.7	17.0	2.3	19.5	4.3	8.5	6.0	41.0	13.3	
2	EO → T	11.5	42.5	6.0	45.0	14.0	12.5	27.2	–	–	–	–	3,294.6
	T → EO	3.5	22.5	1.1	24.0	3.6	24.5	6.7	8.5	9.4	20.5	15.2	
3	EO → T	10.5	36.5	5.6	46.5	12.7	16.5	23.9	0.5	32.6	–	–	3,177.2
	T → EO	4.5	30.5	1.5	29.5	4.9	25.0	9.2	6.5	12.8	8.5	17.0	
4	EO → T	10.0	34.5	5.4	46.0	12.1	18.5	22.7	1.0	31.9	–	–	3,155.1
	T → EO	5.0	34.0	1.7	31.5	5.6	20.0	10.4	5.5	14.6	5.0	18.0	
5	EO → T	9.5	31.0	5.2	46.5	11.4	21.0	21.4	1.5	31.1	–	–	3,151.7
	T → EO	5.5	37.5	1.4	33.5	6.2	22.0	11.6	5.0	16.3	2.0	18.9	
6	EO → T	9.0	28.0	5.0	46.0	10.8	23.5	20.2	2.5	30.3	–	–	3,170.5
	T → EO	6.0	41.5	2.1	34.0	6.9	20.5	12.9	4.0	18.2	–	–	
7	EO → T	8.5	25.0	4.8	45.5	10.1	25.5	19.0	3.5	26.6	1.0	32.0	3,217.2
	T → EO	6.5	45.0	2.3	34.5	7.5	18.5	14.1	2.0	18.9	–	–	
8	EO → T	7.5	19.0	4.4	43.0	8.8	28.5	16.5	7.0	23.1	2.5	30.1	3,326.5
	T → EO	7.5	51.0	2.8	30.5	8.8	13.5	16.0	–	–	–	–	
9	EO → T	6.5	12.5	3.9	39.5	7.5	32.0	14.1	7.5	19.7	8.5	28.3	3,578.0
	T → EO	8.5	57.0	3.2	34.0	10.1	9.0	17.0	–	–	–	–	

When the transmission loss assignment on tandem circuits is set at 9.5 dB for EO → T and 5.5 dB for T → EO as seen in the above table, the minimum cost can be attained. (Refer to Fig. 6.4.(9)).

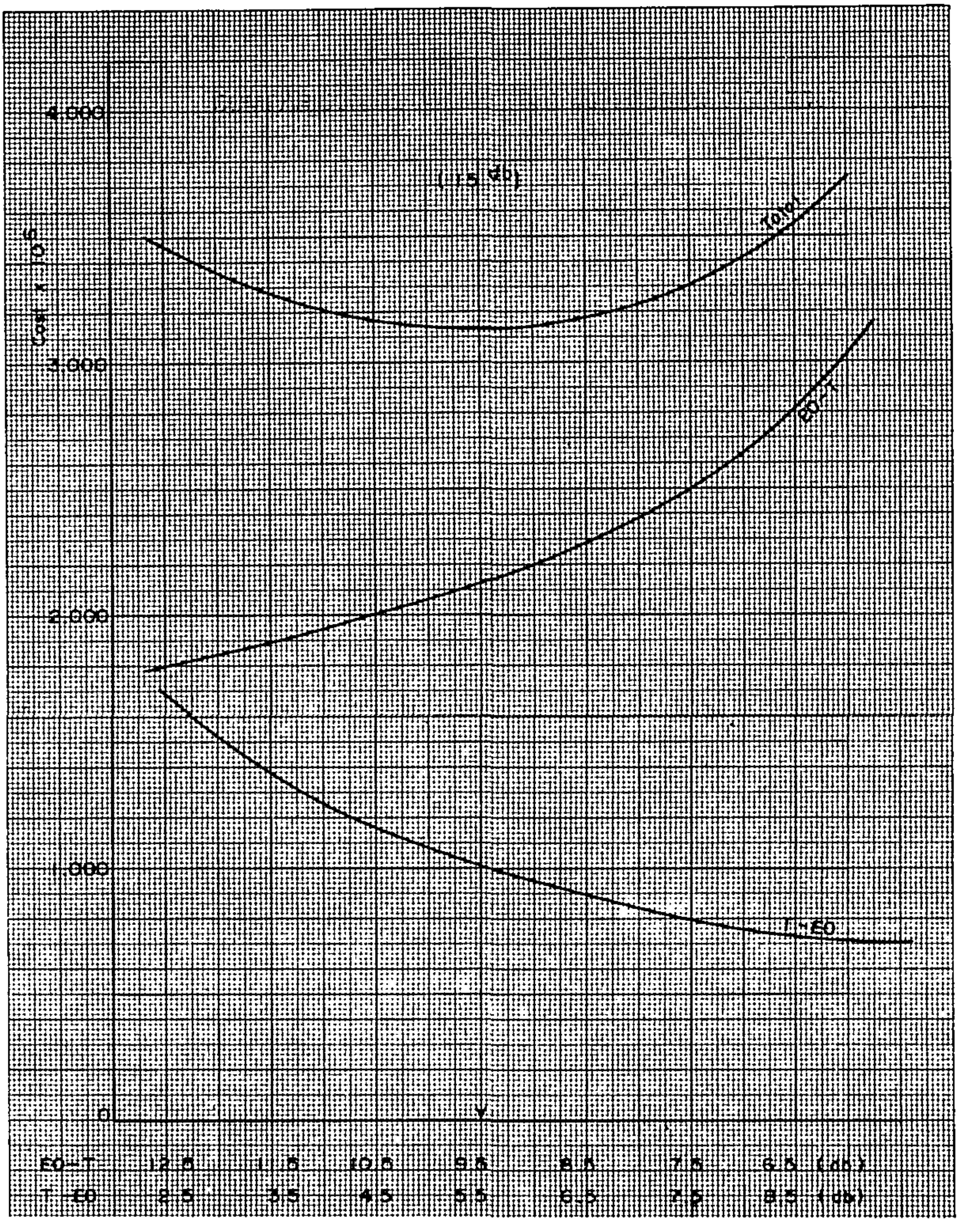


FIG. 6-4 -(9) COMPARISON BETWEEN SEVERAL LOSS ASSIGNMENT

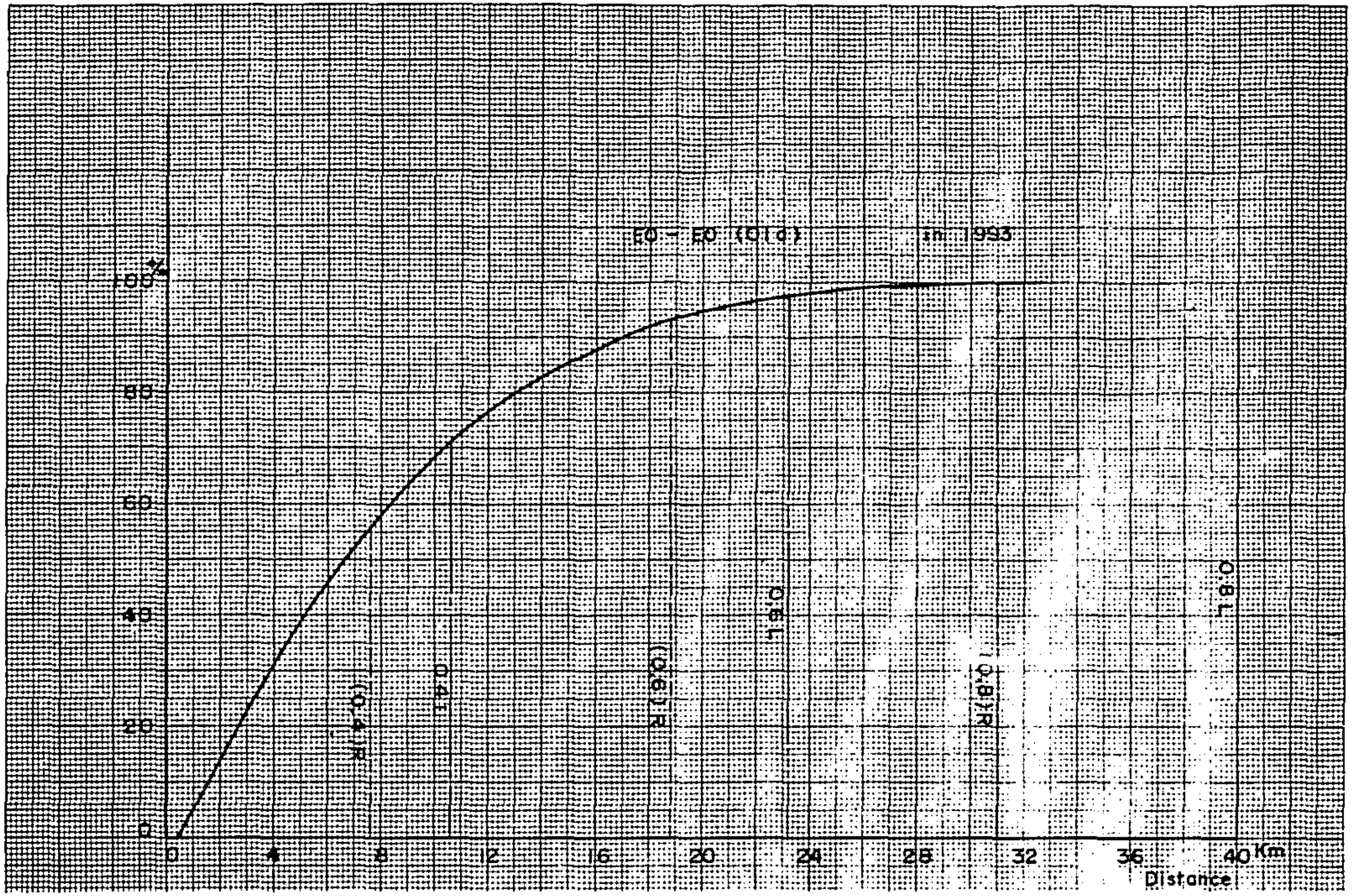


FIG. 6-4-(10) % DISTRIBUTION OF CIRCUITS BY DISTANCE

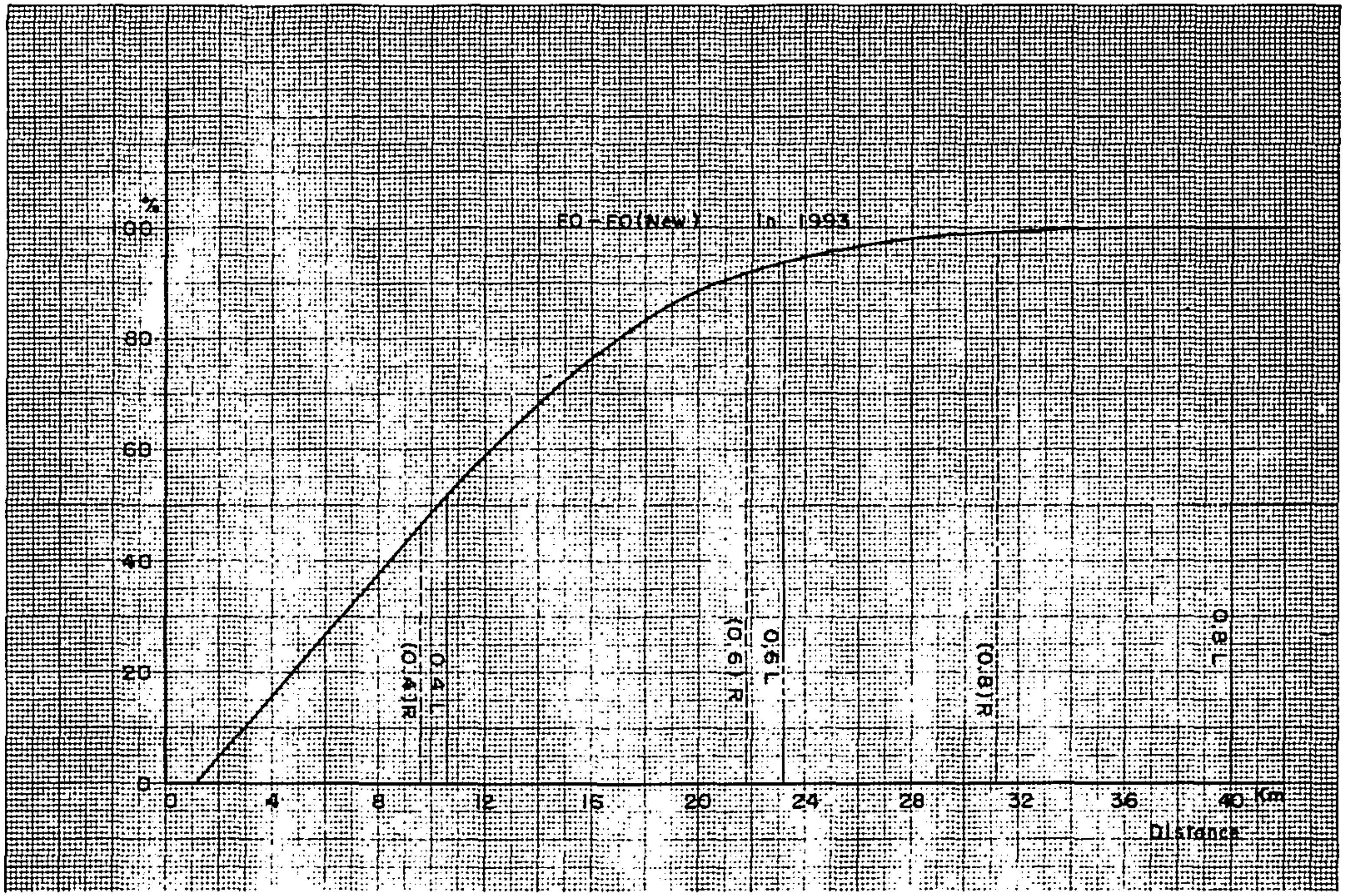


FIG. 6 - 4 - (II) % DISTRIBUTION OF CIRCUITS BY DISTANCE

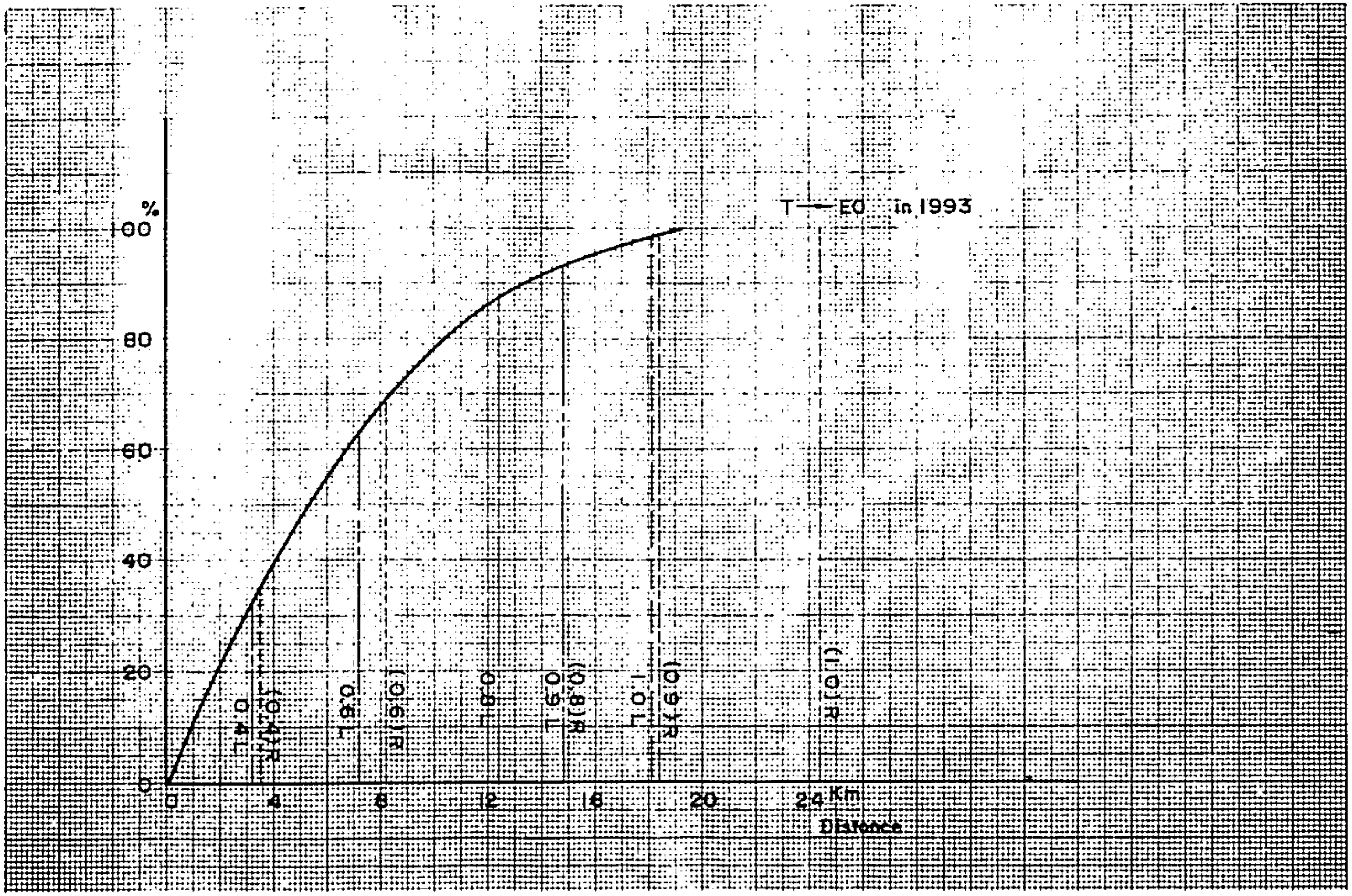


FIG. 6-4-(12) % DISTRIBUTION OF CIRCUIT BY DISTANCE

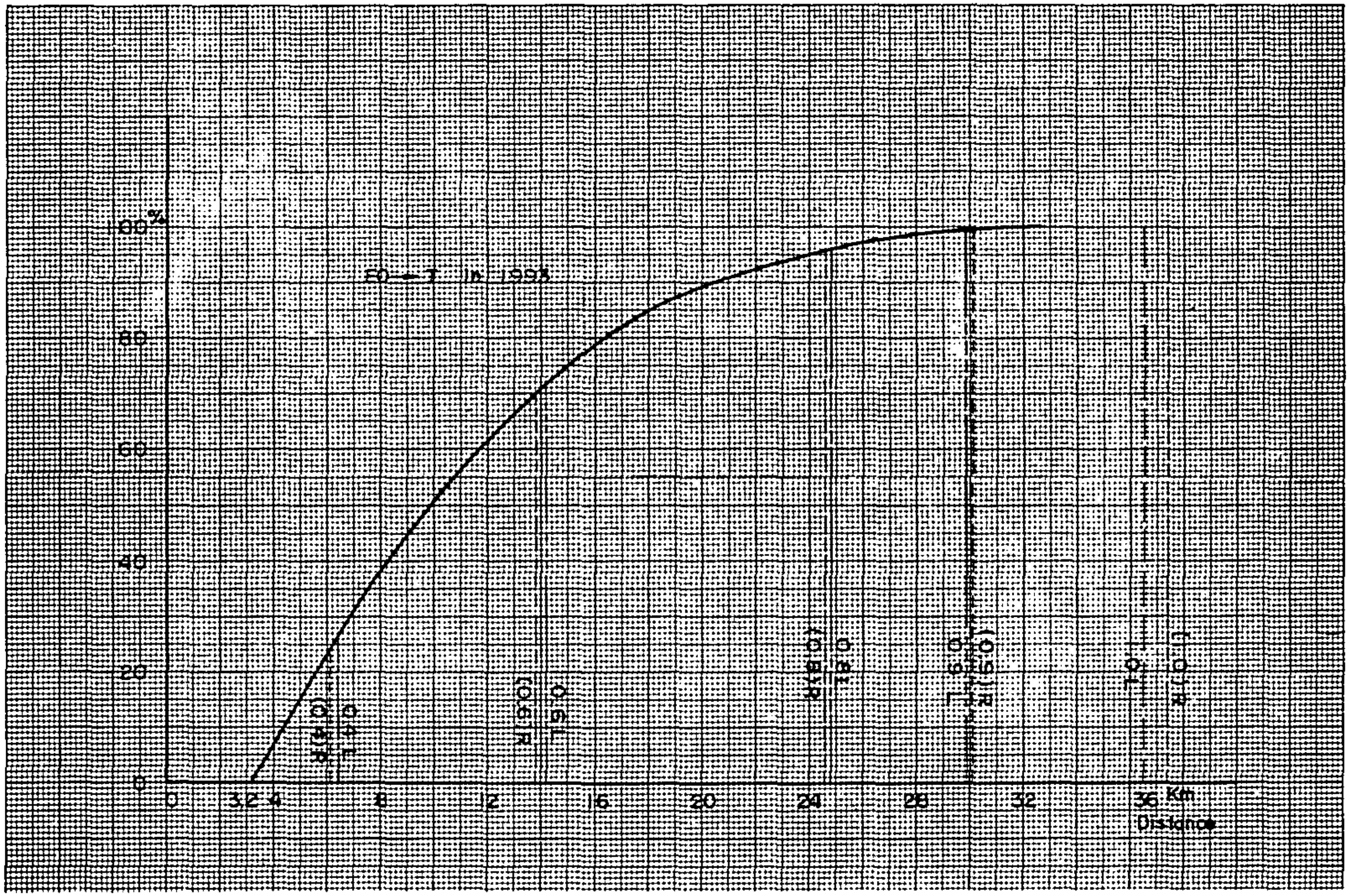


FIG. 6 - 4 - (13) % DISTRIBUTION OF CIRCUIT BY DISTANCE

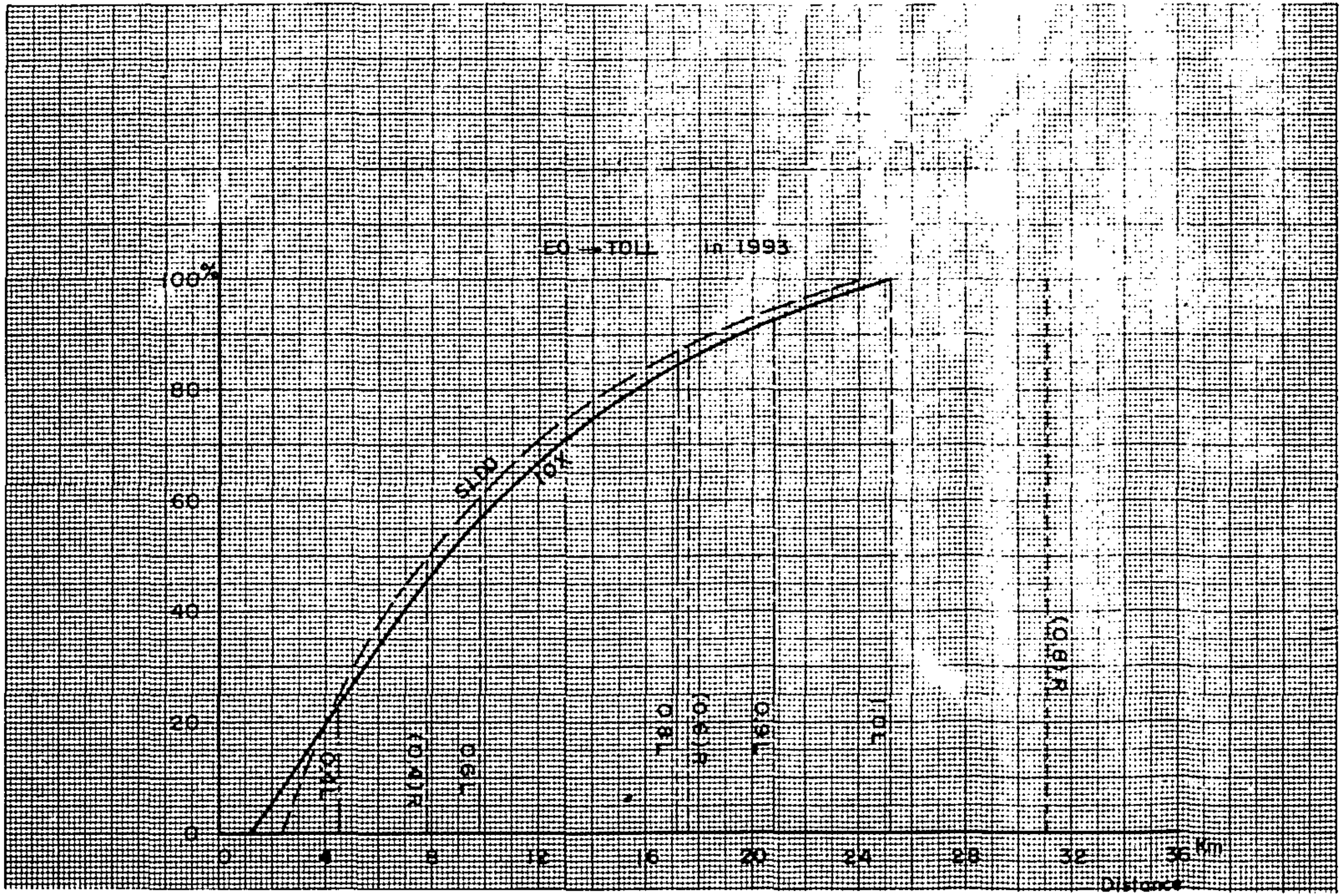


FIG. 6 - 4 - (14) % DISTRIBUTION OF DIRCUITS BY DISTANCE

Table 6.4.(15)

Plan – No. 1

System	% Distribution of Circuit by Circuit Distance and System									
	4 km	8	12	16	20	24	28	30	35	40
EO – EO (O)	2,209	6,132	8,019	9,621	10,428	10,835	10,970	10,971	10,985	10,985
EO – EO (N)	1,649	6,026	9,818	13,351	15,719	17,195	17,791	17,977	18,125	18,147
EO – T	129	4,357	7,540	10,198	11,776	12,624	13,197	13,302	13,373	13,373
T – EO	3,013	7,596	7,762	9,152	9,941	9,941	9,941	9,941	9,941	9,941
SLDD	1,048	7,641	8,903	10,915	12,330	13,484	13,629	13,629	13,629	13,629
1 0 X	204	969	1,157	1,437	1,638	1,811	1,837	1,837	1,837	1,837
TOTAL	8,252	32,721	43,199	54,674	61,832	65,980	67,365	67,657	67,890	67,912
TOTAL (%)	12.2	48.2	63.6	80.5	91.0	97.0	99.2	99.6	99.9	100%

6.4.3 Loading Standard

The existing loading method in the junction cable network in Jakarta is H-type loading. Its inductance is 88 mH and spacing is 1,830 m. In the PERTAMINA Project to be carried out in the near future the 80 mH 1,500 m type loading is to be used.

To shift up the cut-off frequency is as important as the transmission loss improvement. In spite of the loading method improvement from the 88 mH, 1,830 m type to the 80 mH, 1,500 m type the cut-off frequency should nevertheless be shifted up. This is true when the growth of economy and the standard of living elevation in the future with the concomitant upgrading of desires among the people in general are considered. However, the heavy loading cost is greater than the light loading cost.

We recommend that PERUMTEL use the 80 mH, 1,500 m type loading for the time being. As the telecommunication network expansion progresses in the form of quantitative to qualitative improvement, the 80 mH, 1,500 m type loading should be further improved gradually in consideration of optimum investment in telecommunication services.

Table 6.4.(16) Comparison between the Loading Space 1,830 m and 1,500 m

	S = 1.83 km			S = 1.50 km		
Lo	0.7 mH/km			0.7 mH/km		
Co	50 nF/km			50 nF/km		
So	1.83 km			1.50 km		
Ro (Ω/km)	0.4 mm	0.6 mm	0.8 mm	0.4 mm	0.6 mm	0.8 mm
	300	130	72	300	130	72
Lp	88 mH			80 mH		
Rp	7			7		
Go	1 ℧/km			1 ℧/km		
Cut-off Frequency	3,524 Hz			4,083 Hz		
Attenuation (dB/km)	0.4 mm	0.6 mm	0.8 mm	0.4 mm	0.6 mm	0.8 mm
	1.33	0.588	0.33	1.229	0.557	0.322

6.4.4 Two-way Repeater, PCM, etc.

When the conductor diameter is to be determined, not only the transmission loss but the prescribed inter-office DC resistance must also be taken into consideration.

Even in the same cable section the different conductor diameters must be used, depending upon the circuit distance to the destination and in view of the difference in transmission loss assignment according to the type of circuit (EO → T, T → EO, EO ↔ EO).

However, the number of circuits is too small for cable installation by conductor diameter according to the number of circuits for each object year. As the result the number of conduit lines, not to mention the number of cable lines, becomes large and in some cases the conductor utilization efficiency also deteriorates, causing the whole design to be extremely uneconomical. In such cases, the cable conductor diameter must be unified. The most simple way is to install the cable of the maximum diameter conductor among those to be unified. If, however, the number of circuits which require the maximum diameter conductor is very few and the increase of such circuits is not likely to take place in the future, unification of the conductor diameter into the maximum one means extremely uneconomical cable installation.

Therefore, the best realistic design is to use the second largest conductor diameter cable which will be useful in the future also and to insert the two-way repeater in the circuit where the larger conductor diameter is required. By this means the economical design for additional junction cable installation can be realized. Meanwhile, at present, the DC resistance satisfies the prescribed value in many cases so that the method mentioned above poses no problem insofar as the DC resistance is concerned. The circuits where the DC resistance exceeds the prescribed value are listed in the Table 6.4.(17) through Table 6.4.(23).

It is important to realize gradual improvement of transmission loss within the limits of the given budget. Although the PCM system is not adopted in the present junction cable network plan, this system will have to be introduced in the junction cable network of Jakarta in the future. For, the road occupation for civil engineering work will become difficult and hence the additional installation of junction cables will also become difficult.

Furthermore, the number of circuits of exchange offices in the peripheries of Jakarta will increase remarkably in accordance with the greater development of the municipality. In this connection the introduction of PCM system in Jakarta is preferred from the viewpoint of economy as from the angle of remedying the increasing difficulty of civil engineering work.

As the first step the PCM system should be adopted in the toll circuit (between EO and toll exchange office) which is seriously influenced by transmission loss assignment. In case the distance between EO and toll exchange office exceeds 17 km the application of PCM is economically advantageous so as to satisfy the prescribed transmission loss (7 dB).

As seen in Fig. 6.4.(14) the toll circuits, each with a more than 17 km distance between EO and toll exchange office, in 1993 occupy approximately 10% of the total. However, in the initial stage the number of circuits at each exchange office where to introduce PCM is not so large. Thus the introduction of PCM will begin in or after 1983.

Meanwhile, in Tokyo, a big city, the PCM system is already adopted for the reason mentioned in the foregoing.

TABLE 6-4-(17) NUMBER OF EXCESS TRANSMISSION LOSS CIRCUIT

System	1979		1983		1988		1993		Remarks
	Perumtel	JTP	Plan 1	Plan 2	Plan 1	Plan 2	Plan 1	Plan 2	
EO – EO									
EO – T	14	7	24	–	34	–	56	–	
T – EO	388	465	93	56	150	72	236	141	
SLDD	101	58	34	34	68	68	145	145	
IOX	50	32	16	16	22	22	26	26	
MS	–	–	–	1192	–	1921	–	2592	
Total	553	562	166	1298	274	2083	463	2904	

TABLE 6-4-(18) DISTRIBUTION OF CIRCUIT BY EXCESS LOSS

	System	Excess loss												
		0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3
Plan No.1	EO-T	56					(14)							
	T -EO		(45) 161	(15) 75		(308)	(20)							
	SLDD	(46)					(16)				(85) 145			
	IOX	(20)					(10)				(12) 26			(8)
	Total	(66) 56	(45) 161	(15) 75		(308)	(6.0)				(97) 171			(8)
Plan No.2	EO-T													
	T -EO		64	77										
	SLDD										145			
	IOX										26			
	ED-MS					195								
	MS-EO					82								
	Total		64	77		277					171			

( ) : 1979.
Perumtel.

TABLE 6 - 4 - (19)
CIRCUIT SECTION TABLE (EXCESSED THE SPECIFIED LIMIT)

From / To	Item	Cable section No / Distance / Conductor						Total		Plan - No.1			Plan - No.2			Remarks
								D R	Loss	1983	1988	1993	1983	1988	1993	
Gandaria	C. S	35	34	33	15			—	—							0.42db over
	Distance	5.5	9.0	4.3	8.6			27.4K	—							
M S I	Size	1.0	1.0	1.0	0.9			1473	6.42dB				38	99	195	
Gandaria	C. S	60	15					—	—							0.94db over
	Distance	15.5	86					24.1K	—							
SLDD	Size	0.9	0.9					1494	6.44dB	17	32	64	17	32	64	
Gandaria	C. S	60	15					—	—							0.94db over
	Distance	15.5	8.6					24.1K	—							
10 X	Size	0.9	0.9					1494	6.44dB	8	11	13	8	11	13	
SLDD	C. S	15	60					—								0.94db over
	Distance	8.6	15.5					24.1K								
Gandaria	Size	0.9	0.9					1494	6.44dB	17	36	81	17	36	81	
10 X	C.S	15	60					—	—							0.94db over
	Distance	8.6	15.5					24.1K	—							
Gandaria	Size	0.9	0.9					1494	6.44dB	8	11	13	8	11	13	
Tg Priok (B)	C.S	52	19	18	24			—	—							0.04db over
	Distance	3.0	7.0	7.0	11.7			28.7K	—							
Kebayoran T4	Size	0.9	0.9	0.9	0.9			1877	8.04dB	24	34	56				

TABLE 6-4-(20) CIRCUIT SECTION TABLE (EXCESSED THE SPECIFIED LIMIT)

From / To	Item	Cable section No / Distance / Conductor size						Total		Plan — No.1			Plan — No.2			Remarks
								DR	Loss	1983	1988	1993	1983	1988	1993	
M S I	C.S	15	33	34	36			—	—							0.41^{db} over
	Distance	8.6	4.3	9.0	5.5			27.4^{K}	—							
Gandaria	Size	0.9	1.0	1.0	1.0			1473	6.41^{dB}				17	37	82	
Kota (B)	C.S	47	5					—	—							0.21^{db} over
	Distance	14.2	5.0					14.2^{K}	—							
Tegal Alur	Size	1.0	1.0					960	4.21^{dB}	29	46	75	17	21	77	
Cempaka-P T3	C.S	18	19	20				—								0.16^{db} over
	Distance	7.0	7.0	5.0				19.0^{K}								
Cilincing	Size	1.0	1.0	1.0				950	4.16^{dB}	63	104	161	39	51	64	

TABLE 6-4-(21) CIRCUIT SECTION TABLE (EXCESSED THE SPECIFIED LIMIT)

From / To	Item	Cable section No / Distance / Conductor size						Total D R	Total Loss	Perumtel 1979	Perumtel	Perumtel	JTP 1979	JTP	JTP	
Cilincing	C.S	20	19	18	16			—	—							Specified limit 5.5db (0.57db over)
	Distance	5.0	7.0	7.0	4.6			23.6K	—							
SLDD	Size	1.0	0.9	0.9	0.9			1403Ω	6.07dB	8			8			
Cilincing	C.S	20	19	18	16			—	—							(0.57db over)
	Distance	5.0	7.0	7.0	4.6			23.6K	—							
10 X	Size	1.0	0.9	0.9	0.9			1403Ω	6.07dB	5			4			
Pasar - M	C.S	40	29	17				—	—							(0.03db over)
	Distance	5.7	7.0	12.4				20.7K	—							
SLDD	Size	0.9	0.9	0.9				1283Ω	5.53dB	20			9			
Pasar - M	C.S	40	29	17				—	—							(0.03db over)
	Distance	5.7	7.0	12.4				20.7K	—							
10 X	Size	0.9	0.9	0.9				1283Ω	5.53dB	10			5			
Jagakarsa	C.S	28	40	29	48			—	—							(0.58db over)
	Distance	5.5	5.7	7.0	12.4			30.6K	—							
Jatinegara T5	Size	1.0	0.9	0.9	0.8			1852Ω	8.58dB	14			7			
Jagakarsa	C.S	28	40	29	17			—	—							Repeater (1.23db over)
	Distance	5.5	5.7	7.0	8.0			26.2K	—							
SLDD	Size	1.0	0.9	0.9	0.9			1558Ω	6.73dB	7			5			
Jagakarsa	C.S	28	40	29	17			—	—							(1.23db over)
	Distance	5.5	5.7	7.0	8.0			26.2K	—							
10 X	Size	1.0	0.9	0.9	0.9			1558Ω	6.73dB	4			3			

TABLE 6-4-(22)

CIRCUIT SECTION TABLE (EXCESSED THE SPECIFIED LIMIT)

From / To	Item	Cable section No Distance Conductor size						Total D R	Total Loss	Perumtel 1979			JTP 1979			Remarks
Gandaria	C.S	60	15					—	—							Specified limit 5.5db (0.94db over)
	Distance	15.5	8.6					24.1^{K}	—							
SLDD	Size	0.9	0.9					1494Ω	6.44^{dB}	12			7			
Gandaria	C.S	60	15					—	—							
	Distance	15.5	8.6					24.1^{K}	—							
10 X	Size	0.9	0.9					1494Ω	6.44^{dB}	6			4			(0.94^{db} over)
Kota T1	C.S	47	5					—	—							
	Distance	14.2	5.0					19.2^{K}	—							
Tegal Alur	Size	1.0	1.0					960Ω	4.21^{dB}	15			11			(0.21^{db} over)
Cempaka-P T3	C.S	18	19					—	—							
	Distance	7.0	7.0					14.0^{K}	—							
Tj. Priok A	Size	0.8	0.8					1064Ω	4.5^{dB}	308			424			(0.5^{db} over)
Kebayoran T4	C.S	29	40	28				—	—							
	Distance	7.0	5.7	5.5				18.2^{K}	—							
Jagakarsa	Size	0.9	0.9	1.0				1062Ω	4.59^{dB}	20			11			(0.59^{db} over)
Jatinegara T5	C.S	60						—	—							
	Distance	15.5						15.5^{K}	—							
Gandaria	Size	0.9						961Ω	4.14^{dB}	45			19			(0.14^{db} over)
SLDD	C.S	16	18	19	20			—	—							
	Distance	4.6	7.0	7.0	5.0			23.6^{K}	—							
Cilincing	Size	0.9	0.9	0.9	1.0			1403Ω	6.07^{dB}	8			8			(0.57^{db} over)

TABLE 6-4-(23)

CIRCUIT SECTION TABLE (EXCESSED THE SPECIFIED LIMIT)

From / To	Item	Cable section No / Distance / Conductor size						Total D R	Total Loss	Perumtel 1979			JTP 1979			Remarks
10X	C.S	16	18	19	20			—	—							
	Distance	4.6	7.0	7.0	7.0			23.6K	—							0.57db
Cilincing	Size	0.9	0.9	0.9	1.0			1403Ω	6.07	5			4			over
SLDD	C.S	17	29	40				—	—							
	Distance	8.0	7.0	5.7				20.7K	—							0.03db
Pasar-M	Size	0.9	0.9	0.9				1283Ω	5.53dB	26			9			over
10X	C.S	17	29	40				—	—							0.03db
	Distance	8.0	7.0	5.7				20.7K	—							
Pasar-M	Size	0.9	0.9	0.9				1283Ω	5.53dB	10			5			over
SLDD	C.S	17	29	40	28			—	—							Repeater
	Distance	8.0	7.0	5.7	5.5			26.2K	—							1.23db
Jagakarsa	Size	0.9	0.9	0.9	1.0			1558Ω	6.73dB	7			5			over
10X	C.S	17	29	40	28			—	—							Repeater
	Distance	8.0	7.0	5.7	5.5			26.2k	—							1.23db
Jagakarsa	Size	0.9	0.9	0.9	1.0			1558Ω	6.73dB	4			3			over
SLDD	C.S	15	60					—	—							
	Distanco	8.6	15.5					24.1K	—							0.94db
Gandaria	Size	0.9	0.9					1494Ω	6.44dB	13			7			over
10X	C.S	15	60					—	—							
	Distance	8.6	15.6					24.1k	—							0.94db
Gandaria	Size	0.9	0.9					1494Ω	6.44dB	6			4			over

6.5 DC Resistance Limit

6.5.1 Mutual Relation between Transmission Loss Assignment and DC Resistance Limit

A large majority of the junction circuits in Jakarta at present are non-loading circuits using large diamter conductors. However, positive use of loading circuits should be planned in the expansion program for the future Jakarta junction cable network, since the number of junction cables and exchange offices will further increase in line with the development of Jakarta City.

In the case of non-loading circuits, the determination of conductor diameter will be more largely influenced by the transmission loss limit than by the DC resistance limit. On the contrary, in the case of loading circuits the DC resistance limit will have a larger influence.

For example, when using the 0.6 mm conductor loading cable, the distance limits on account of transmission loss (19 dB) and DC resistance (3,000 ohms) are 30.5 Km and 21.9 Km, respectively. This means that the conductor diameter is more largely influenced by the DC resistance limit than by the transmission loss assignment.

The transmission loss to be assigned can be improved automatically to the small value when the cable conductor diameter is determined based on the DC resistance limit which can satisfy the switching equipment operational conditions. Further, the transmission loss can be improved through the use of two-way repeaters, and introduction of new technologies, etc.

First of all, limit of the allowable transmission loss must be studied in order to determine the quality of transmission service in the metropolitan area of Jakarta.

However, in order to make the transmission loss smaller, due consideration must be given to the DC resistance limit of the existing switching equipment. Therefore, it is recommended that, as the first stage, a full study be made of the mutual relation between transmission loss assignement and DC resistance limit by using loading cables, so that a network with more desirable service quality can be set up.

6.5.2 *Improvement of DC Resistance Limit for Future Junction Circuits*

If there were no DC resistance limit, the transmission loss of the junction circuit in the Jakarta metropolitan area can be kept in the specified value (15 dB) by the application of two-way repeaters without the use of 0.9 mm and 1.0 mm conductor cables. As shown in Fig. 6.5.(3), it is assumed that the 100-pair cable conversion of large conductor cables, such as 0.9 mm and 1.0 mm conductor cables, will increase year by year.

The cable cost is in proportion to the amount of copper used and since there will be a shortage in world copper resources in the future, plans for using small conductor cables are very important for reducing the amount of copper required. This will lower not only the

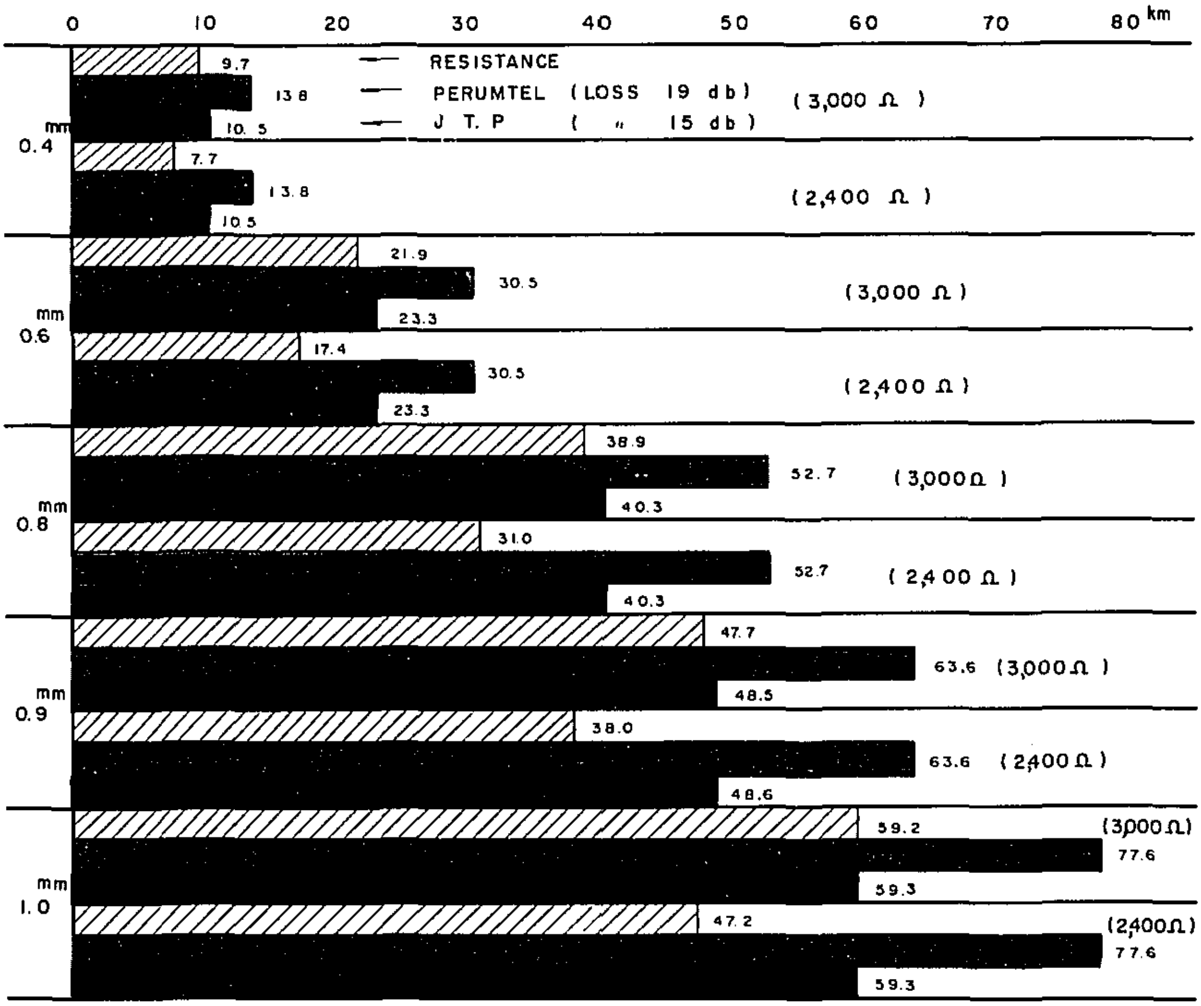


FIG. 6-5-(1)
DISTANCE LIMIT

TABLE 6-5-(2)

DISTANCE LIMIT BY CABLE CONDUCTOR DIAMETER (LOADING)

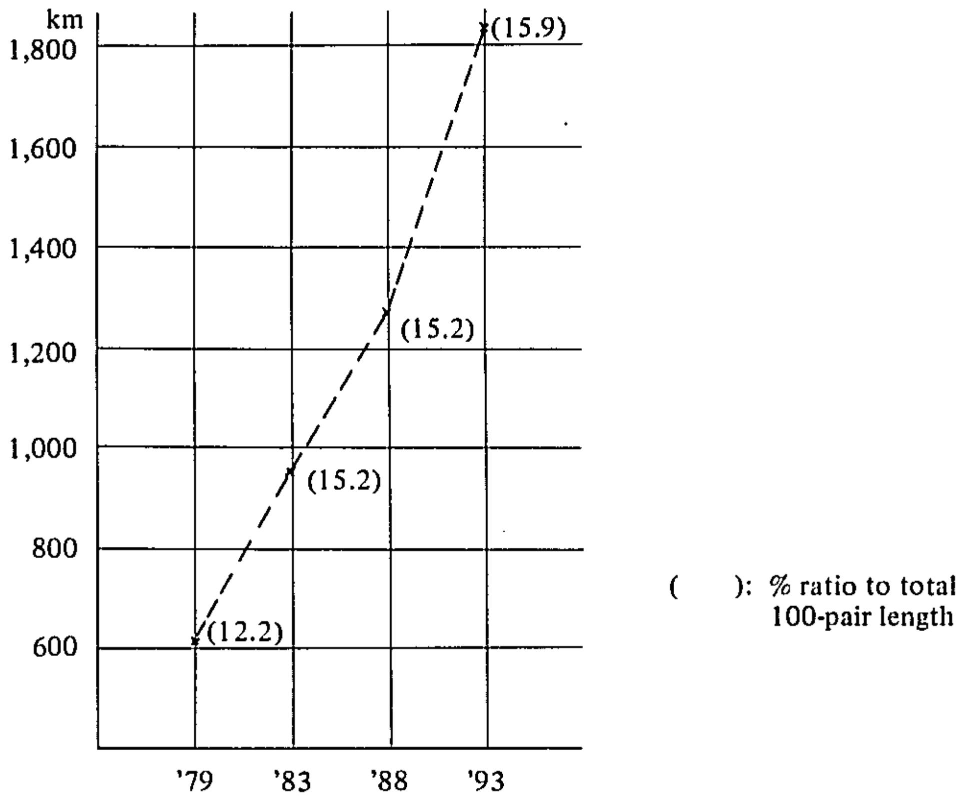
RESISTANCE & LOSS		LINE RESISTANCE LOSS	DISTANCE LIMIT (km)				
			0.4 mm	0.6 m	0.8 mm	0.9 mm	1.0 mm
RESIS-TANCE	3000 Ω	2960 Ω	9.7	21.9	38.9	47.7	59.2
	2400 Ω	2360 Ω	7.7	17.4	31.0	38.0	47.2
LOSS	19 db	17 db	13.8	36.5	52.7	63.6	77.6
	15 db	13 db	10.5	23.3	40.3	48.6	59.3
RESISTANCE /km		—	30.5	13.5	76	62	50
LOSS /km		—	1.229	0.557	0.322	0.267	0.219

cable cost but also the conduit cost. In addition, such troubles as road occupancy and road re-excavation on the occasion of conduit installation can be avoided.

As mentioned previously, the 0.9 mm and 1.0 mm conductor cable lengths account for 17% of the total length. On the other hand, in terms of the cost, these cables comprise 26% of the total cable cost.

Therefore, it is desirable that enlargement of the DC resistance limit be made and the transmission service quality be improved by an economical method.

Fig. 6.5.(3) 100-pair Length 0.9 and 1.0 mm Conductor



6.5.3 Comparison of Various DC Resistance Limit Plans

The DC resistance limit value is important in the design of junction cables, as is the case with the transmission loss assignment. Although 40,000 subscriber lines are served by the present EMD switching system, full studies should be made on how the existing switching equipment or new equipment can be expanded in the future.

Based on the conditions of the DC resistance limit shown in Table 6.5.(4) and Fig. 6.5.(5), and also on the location of the tandem exchange office, number of tandem circuits, and the circuit cost, the optimum DC resistance assignment is calculated. As shown in Table 6.5.(6), DC resistance limit is 1,900 ohms in EO → T, and 1,100 ohms in T → EO section.

Table 6.5.(4) D.C. Resistance Limit (1)

	EMD (EO)	NEW (EO)
EMD (EO)	Direct: 2,400Ω Tandem: 3,000Ω	Direct: 2,400Ω Tandem: 3,000Ω
NEW (EO)	Direct: 2,400Ω Tandem: 3,000Ω	Direct: 3,000Ω Tandem: 3,000Ω

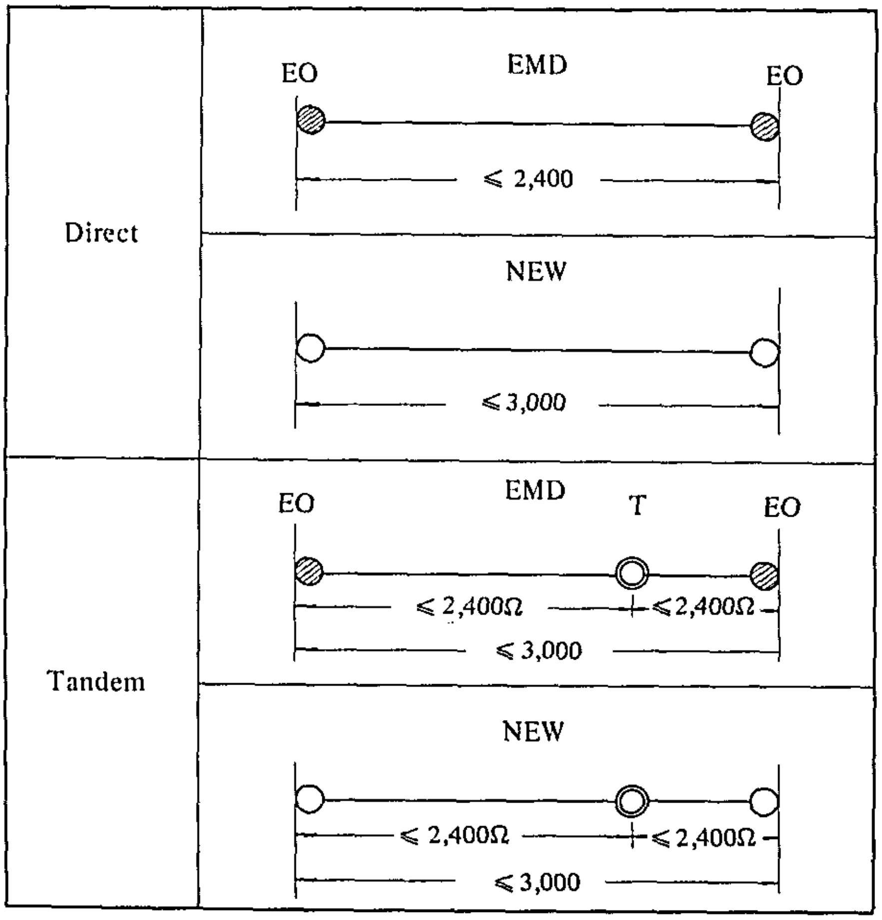


Fig. 6.5.(5) D.C. Resistance Limit (2)

Table 6.5.(6) Optimum D.C. Resistance Combination

Plan No.	System	Resistance allocation	Cable conductor diameter										Cost (m.u.)
			0.4 mm		0.6 mm		0.8 mm		0.9 mm		1.0 mm		
		Ω	%	km	%	km	%	km	%	km	%	km	
1	EO → T	2,500	38.0	5.7	47.0	13.2	15.0	26.7	–	–	–	–	3,617.9
	T → EO	500	15.0	0.8	20.0	2.51	21.0	4.8	9.5	6.9	34.5	13.8	
2	EO → T	2,300	33.0	5.3	48.0	12.1	18.0	23.3	1.0	32.4	–	–	3,443.0
	T → EO	700	22.0	1.1	25.0	3.6	26.0	6.9	8.5	9.8	18.5	15.4	
3	EO → T	2,100	28.5	5.0	47.5	11.1	22.0	21.3	2.0	31.1	–	–	3,379.9
	T → EO	900	28.5	1.4	29.5	4.7	26.5	9.0	7.0	12.7	8.5	17.0	
4	EO → T	2,000	27.0	4.8	46.0	10.5	24.0	20.3	3.0	30.5	–	–	3,376.8
	T → EO	1,000	32.0	1.6	31.0	5.2	25.5	10.0	6.5	14.2	5.0	17.8	
5	EO → T	1,900	24.0	4.7	46.0	10.0	26.0	19.2	3.5	27.4	0.5	32.6	*3,375.2
	T → EO	1,100	35.5	1.8	32.0	5.7	24.5	11.0	5.0	15.7	3.0	18.6	
6	EO → T	1,800	22.0	4.5	45.0	9.5	27.0	18.2	5.0	25.9	1.0	31.8	3,401.7
	T → EO	1,200	38.0	1.9	34.0	6.3	22.0	12.0	5.0	17.1	1.0	19.4	
7	EO → T	1,700	19.0	4.3	44.5	8.9	28.5	17.2	6.0	24.5	2.0	31.0	3,404.0
	T → EO	1,300	40.5	2.1	35.5	6.8	20.5	13.1	3.5	18.6	–	–	
8	EO → T	1,500	13.5	4.0	42.0	7.9	32.0	15.1	8.0	21.5	4.5	29.4	3,558.3
	T → EO	1,500	46.0	2.4	36.0	7.9	18.0	15.5	–	–	–	–	
9	EO → T	1,300	8.0	3.7	38.5	6.8	34.5	13.1	9.0	18.6	10.0	27.7	3,730.8
	T → EO	1,700	53.5	2.9	35.5	9.5	11.0	16.6	–	–	–	–	

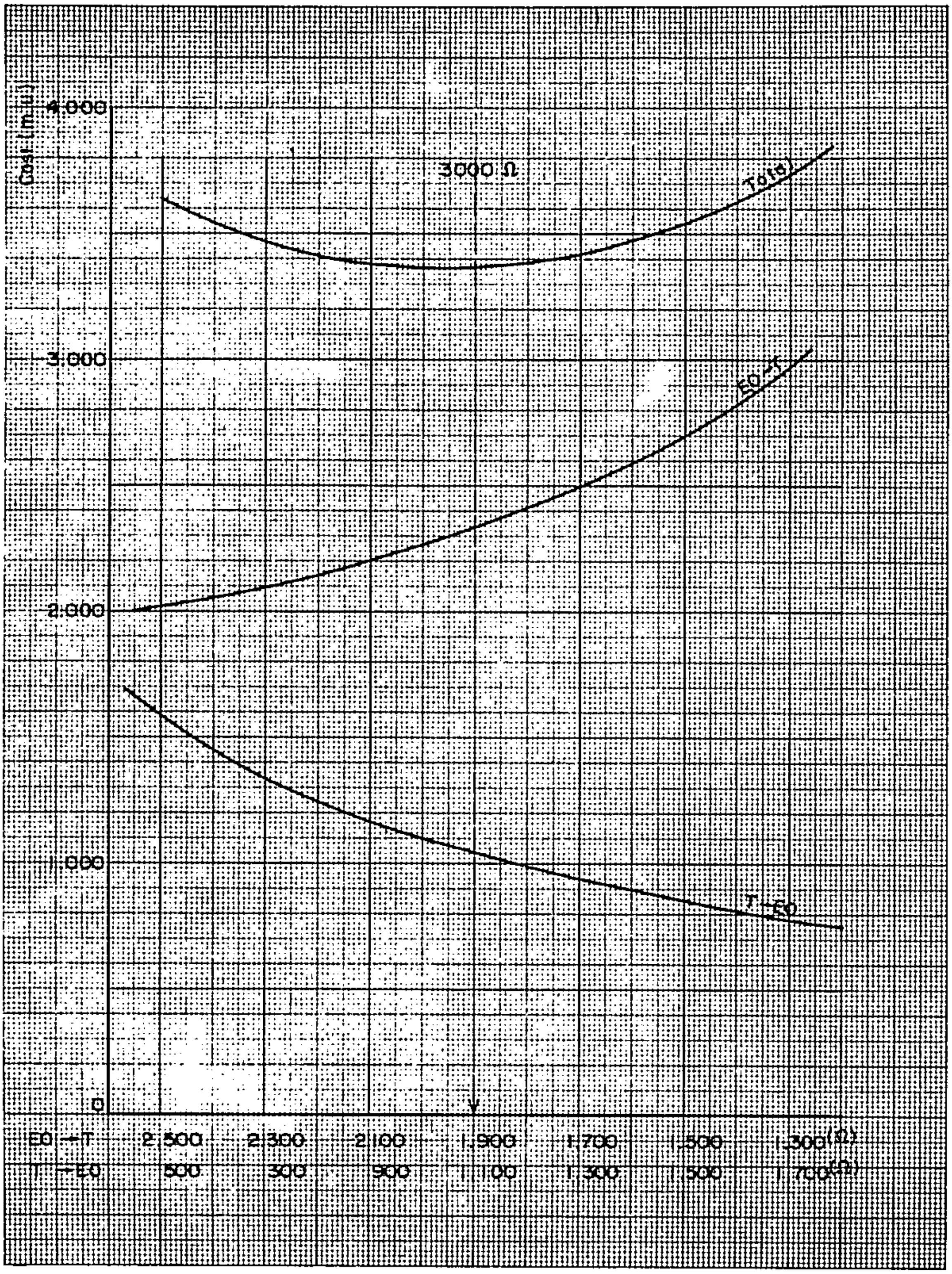


FIG. 6-5-(7)
COMPARISON BETWEEN SEVERAL RESISTANCE ASSIGNMENT

6.6 Kind of Cable

The policy of PERUMTEL hereafter is not to adopt paper insulated cables for both junction and subscriber cables; consequently, in determining the kinds of cables, the object of the study was only for PE insulated cable.

In determining the number of pairs and conductor of the cable, the following items were considered.

(1) Since it is believed that there will be a big increase in future telephone demand, a large number of pair cables were added.

(2) Besides the presently used conductors, cables of 0.9 mm and 1.0 mm conductors were added.

6.6.1 Junction Cable

Junction cables will be conduit cables.

The number of pairs and conductors of the cables are shown in Table 6.6.(1).

6.6.2 Subscriber Cable

6.6.2.1 Primary Cable

Primary cables will be conduit cables.

The number of pairs and conductors of the cables are indicated in Table 6.6.(2). However, small size cables (200 pairs or less) which are branched from the main cable, in the direct service area will be JF cables (See Table 6.6.(3)).

6.6.2.2 Secondary Cable

Secondary cables, when classified, are as follows:

- Secondary cable
  - Underground cable
    - Conduit cable
    - Direct buried cable
  - Aerial cable

(1) Underground Cable (Conduit and Direct Buried Cable)

Underground cables shall be JF cables for both the conduit and direct buried cables.

The kinds of cable size and conductors are as shown in Table 6.6.(3).

(2) Aerial Cable

For aerial cables, the 8-shape self-supporting cable will be used. The number of pairs of the presently used cables is sufficient. The kinds of cable size and conductors of such cables are shown in Table 6.6.(4).

Table 6.6.(1) Junction Cable

No. of Pairs / Diameter (mm)	100	200	300	400	600	800	1200	1600	1800	2400
0.4	—	—	—	△	△	△	△	△	△	△
0.6	—	—	—	◎	◎	◎	◎	—	—	—
0.8	—	○	—	◎	◎	—	—	—	—	—
0.9	○	○	○	○	—	—	—	—	—	—
1.0	○	○	—	—	—	—	—	—	—	—

Note ◎ : Existing
○ : Add after 1975
△ : Add after 1983
— : No use

Table 6.6.(2) Primary Cable

No. of Pairs / Diameter (mm)	200	300	400	600	800	1000	1200	1600	1800	2400
0.4	○	◎	◎	◎	◎	◎	◎	△	△	△
0.6	○	◎	◎	◎	◎	◎	◎	—	—	—
0.8	○	◎	◎	◎	—	—	—	—	—	—

Table 6.6.(3) Secondary Cable

(Conduit, Direct buried) & small pair number branch primary cable in direct service area

No. of pairs / Diameter (mm)	10	20	30	40	50	80	100	150	200
0.4	◎	◎	◎	◎	◎	◎	◎	○	○
0.6	◎	◎	◎	◎	◎	◎	◎	○	○

Note : This cable is jelly filled cable.
Direct buried cables have steel tape armoring.

Table 6.6.(4) Secondary Cable (Aerial)

No. of pairs / Diameter (mm)	10	20	30	40	50	80	100	150	200
0.4	◎	◎	◎	◎	◎	○	○	○	○
0.6	◎	◎	◎	◎	◎	○	○	—	—
0.8	○	○	○	○	○	—	—	—	—

Note : This cable is figure eight shaped self-supporting cable.

6.7 Design Standards for Subscriber Cable Network

6.7.1 Design and Calculation Standards for Key Map

The key map is designed based on the following standards:

(1) The service area of each exchange office is partitioned into the cross connection areas or the direct service areas.

(2) Each cross connection area or direct service area is divided by suitable boundaries, such as rivers, roads, railroads, etc. For the undeveloped areas, provisional boundaries are applied.

(3) Cross Connection Areas

1) The telephone demand as of 1993 in the cross connection area will be 600 as the standard, and 700 at the maximum.

2) In principle, the number of pairs of primary cables in each cross connection area is equivalent to the demand of each area in rounded figures of 100 units.

3) The number of pairs of secondary cables in the cross connection area is the same, in principle, as the number of pairs of primary cables as of 1993. However, when necessary, it is allowable to have the number of secondary cable pairs being up to 1.3 times the number of primary cable pairs.

4) The following two types of cross connection cabinets will be used.

a) 1,600 pairs -- When the telephone demand is 301 to 700 in 1993.

b) 800 pairs -- When the telephone demand is 300 or less in 1993.

(4) Direct Service Area

1) The direct service area will be established in the building area and the area located within as short as 600 m or so from the exchange office.

2) The telephone demand as of 1993 in the direct service area will be 600 as the standard, and 1,800 at the maximum.

3) The number of primary cable pairs is such that can cover 1.3 times the demand in the area. Both demand and pair number are calculated in 100 units, raising to unit factions less than 100.

(5) The sending reference equivalent (S.R.E.) for subscriber line and the DC resistance are calculated for each route, with a view to keeping the values within the limits.

The basic conditions in the calculation are as follows:

1) S.R.E. limit for subscriber line -- 10.42 dB (1.2 Np)

Calculation formula of S.R.E. ..... $\alpha + \beta \ell$

where α : 0.87 dB (0.1 Np)

β : According to type of cable and conductor diameter (Refer to Table 6.7.(1).)

ℓ : Distance (km)

That is, the S.R.E. limit for the subscriber line only, excluding the telephone instrument, is 9.55 dB (1.1 Np).

2) DC resistance limit for subscriber line – 1,200 Ohm (excluding telephone set)

3) In the primary cable section, cable of uni-conductor is used, in principle. That is, the combined use of different diameter conductors is not made in the primary cable section.

In the secondary cable section, the same rule as mentioned above is applied. (Cable conductor diameter of the primary cable section is not always the same as that of the secondary cable section.)

4) The standard values used in calculations for the various kinds of subscriber lines are shown in Table 6.7.(1).

Table 6.7.(1)

Type of cable		D.C. resistance (Ω / km)	S.R.E. (subscriber line only) (dB/km at 800 Hz)
0.4	PE	300	3.16
	JF	300	3.25
0.6	PE	130	1.68
	JF	130	1.73
0.8	PE	72	1.08

5) PE insulated cables is used for primary cables.

6) JF cable is used for secondary underground cable in the developed areas.

7) PE-SS cable is applied for secondary aerial cable in the undeveloped areas.

(6) The primary cable route is determined by consideration of the following conditions:

1) Condition of the existing roads in view of maintenance and economy.

2) In the undeveloped areas, roads proposed in city planning or provisionally assumed roads.

3) Junction cable route and toll cable route.

(7) Location of cross-connection cabinets and feeding point for direct service areas are determined in consideration of the following conditions.

1) Location of cross connection cabinets in developed areas and the feeding point of direct service areas in developed areas are at places where the number of secondary cables in one route is less than three.

2) Location of cross connection cabinets in undeveloped areas is merely selected at places near the exchange office in the cross connection areas.

(8) Others

As the maximum number of pairs for secondary cables, the following numbers of pairs are considered for the future.

a) JF Cable

0.4 mm ...... Maximum 200 pairs

0.6 mm ...... Maximum 200 pairs

b) PF–SS Cable

0.4 mm ...... Maximum 200 pairs

0.6 mm ...... Maximum 100 pairs

0.8 mm ...... Maximum 50 pairs

6.7.2 Design Standards for Subscriber Cable Network in Urgent Areas

As the design standards for the subscriber cable network in urgent areas, the following design standards will be applied in addition to the design standards described in the preceding paragraph 6.7.1. Furthermore, this design was prepared in June to July 1974 based on the request of PERUMTEL.

(1) Provision Period

a) Subscriber primary cables .... 5 years

b) Underground facilities.......................15 years

c) Subscriber secondary cables ....15 years

(2) DC Resistance Limit of Subscriber Line

a) Object area of mobile exchange construction ....1,500 Ohm (excluding telephone set)

b) Other areas ....1,200 Ohm (excluding telephone set)

(3) Kind of Conduit Cable

The polyethylene insulated cable shown in Table 6.7.(2) will be used.

Table 6.7.(2)

Conductor diameter	200	300	400	600	800	1,000	1,200	1,600	1,800	2,400
0.4 mm	O	O	O	O	O	O	O	X	X	X
0.6 mm	O	O	O	O	O	O	O			
0.8 mm	O	O	O	O						

(4) Determination of Number of Ductways

1) Calculation of Number of Ductways

The calculation of the number of ductways will be in accordance with the following.

a) Number of cables required 15 years hence ....N

b) Safe coefficient for demand fluctuation 1.3

c) Calculation formula for number of ductways

N x 1.3 ...... Formula 6.7.(1)

2) Spare Ducts

A certain number of spare ducts must be prepared for use in case where the cable is replaced or the duct is damaged through the affect of other works.

The number of spare ducts is as given in Table 6.7.(3).

Table 6.7.(3)

Number of basic cable ducts	Number of spare ducts
1 – 15	1
16 – 30	2
More than 31	3

3) Decision on Number of Ductways

The number of ductways is determined according to the formula 6.7.(1) and adding the number of spare ducts shown in Table 6.7.(3) to the number of ductways calculated; furthermore, the standard type shown in Fig. 6.7.(4) is applied.

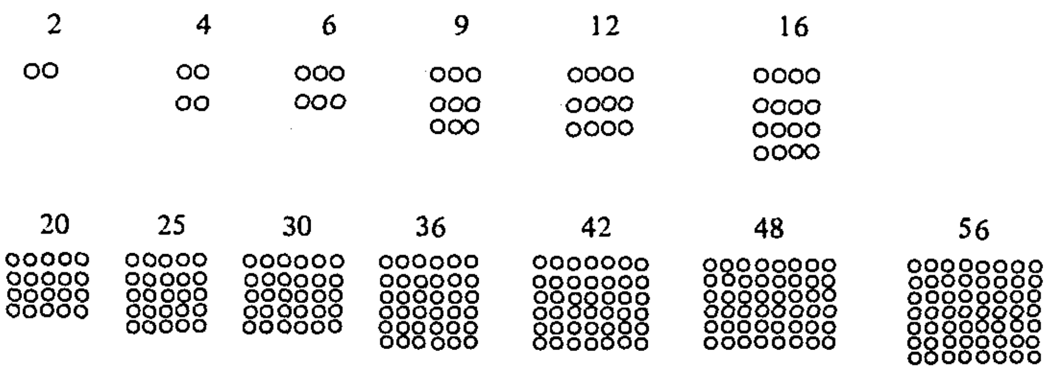


Fig. 6.7.(4)

(5) The following two types of cross connection cabinets are applied.

a) 1,600 pairs .... When the demand is 301 to 700, 15 years after the service-in of the exchange office.

b) 800 pairs .... When the demand is 300 or less, 15 years after the service-in of the exchange office.

6.8 Optimum Provision Period

The optimum provision period varies according to the affect of the various social and economic conditions at the time of the provisions. When there is a rapid increase in telephone demand, the optimum provision period will be short and if the trend in increase is gradual, the optimum provision period will be long.

The provision period for outside plant facilities when expanding the facilities in other countries is shown in Table 6.8.(1). This table was copied from the CCITT "Local Telephone Network" but there is large difference among the countries.

In this section, a study was made of an economic provision period when planning the expansion of facilities.

When there is repeated expansion in facilities, the construction cost can be divided into two parts: the fixed part and the fluctuating part in proportion to the capacity of the facilities.

That is, the construction/installation cost generally can be expressed by the following formula.

$$Y = A + BX \quad \text{..................... Formula 6.8.(1)}$$

where Y : Total construction cost

A : Fixed portion of construction cost

BX : Fluctuating portion of construction cost

B : Fluctuation coefficient

X : Capacity of facilities

When the capacity necessary to satisfy the present demand including the existing subscriber lines is "to" and the required increase in capacity for each year is "t", and if the trend in increase is a straight line, the required facility capacity in N year will be:

$$to + tN$$

Therefore, the necessary construction cost in the initial period will be:

$$Yo = Ao + A + B(to + tN)$$
$$= Ao + A + Bto + BtN \quad \text{......... Formula 6.8.(2)}$$

Where "Ao" is the basic construction cost required only at the time of the initial construction.

The cost of the first expansion work to be carried out after N years, Y_1, is:

$$Y_1 = A + BtN \quad \text{.................... Formula 6.8.(3)}$$

Similarly, the cost of the second construction work to be carried out after 2N years, Y_2, is:

$$Y_2 = A + BtN = Y_1$$

In the same way in the following:

$$Y_1 = Y_2 = Y_3 = \cdots\cdots\cdots\cdots \quad \text{Formula 6. 8.(4)}$$

Present worth coefficient of an annuity $= \dfrac{(1+i)^n - 1}{i(1+i)^n}$

(when $n \to \infty$) $= \dfrac{1}{i}$

From the foregoing, when the coefficient of annual expense is "a", the annual expense of Yo *will be* aYo *and its present worth of an annuity will be* $\frac{a}{i}$ Yo. (when $n \to \infty$).

In the same way, in regard also to Y_1, the present worth of an annual expense after N years is $\frac{a}{i}$ Y_1. This is the amount after N years. The present worth of a future amount for Y_1 is:

$$\frac{1}{(1+i)^N} \cdot \frac{a}{i} \cdot Y_1$$

It is the same in regard to Y_2 after 2N years.

$$\frac{1}{(1+i)^{2N}} \cdot \frac{a}{i} \cdot Y_2$$

The total Z of the present worth in the future of these series of repeated construction works is expressed in the following formula.

$$Z = \frac{a}{i} \cdot Yo + \frac{1}{(1+i)^N} \cdot \frac{a}{i} \cdot Y_1 + \frac{1}{(1+i)^{2N}} \cdot \frac{a}{i} \cdot Y_2 + \frac{1}{(1+i)^{3N}} \cdot \frac{a}{i} \cdot Y_3 + \cdots\cdots\cdots\cdots$$

$$= \frac{a}{i} \cdot Yo + \frac{a}{i} \cdot Y_1 \left\{ \frac{1}{(1+i)^N} + \frac{1}{(1+i)^{2N}} + \frac{1}{(1+i)^{3N}} + \cdots\cdots\cdots\cdots \right\}$$

where if $\dfrac{1}{(1+i)^N} = \alpha$

$$Z = \frac{a}{i} \left\{ Yo + Y_1 (\alpha + \alpha^2 + \alpha^3 + \cdots\cdots\cdots\cdots) \right\}$$

$$= \frac{a}{i} \left(Yo + Y_1 \cdot \frac{\alpha}{1-\alpha} \right)$$

$$= \frac{a}{i} \left\{ Ao + Bto + (A + BtN) \frac{1}{1-\alpha} \right\} \cdots\cdots\cdots\cdots \quad \text{Formula 6. 8.(5)}$$

where since a, i, Ao, Bto are fixed numbers:

$$z = A\left(1 + \frac{Bt}{A} N\right) \cdot \frac{1}{1-\alpha} \quad \cdots\cdots\cdots \text{Formula } 6.8.(6)$$

From formula 6.8.(6), N which makes $\left(1 + \frac{Bt}{A} \cdot N\right) \cdot \frac{1}{1-\alpha}$ the minimum will express the optimum provision period.

Fig. 6.8.(2), shows the optimum porivision period based on the relation between $\frac{Bt}{A}$ and N. However, this figure is a calculation example when the interest rate is 12% per year.

6.8.1 Exchange Office Building

According to PERUMTEL's Construction Program of Exchange Offices in Jakarta (dated January 20, 1975), 18 exchange offices will be constructed from 1975 to 1977. In accordance with this program, several offices are presently under construction.

The new office buildings in Jakarta already decided by PERUMTEL as of June 1975 are as shown in Table 6.8.1.(1).

Table 6.8.1.(1) The Fixed Plan for New Exchange Offices in Jakarta

Name of exchange office	Year of completion	Floors	Building size in m^2			Reference
			Switch and equipment room	Office room	Total	Accommodatable line unit
Pasar Minggu	1975	1	1,194	141	1,335	10.000
Rawamangun	"	"	1,050	197	1,247	"
Cipete	"	"	1,200	112	1,312	"
Cengkareng	"	"	1,200	169	1,369	"
Kalibata	"	"	1,200	152	1,352	"
Pasar Rebo	"	"	750	149	899	"
Pluit	"	"	744	85	829	"
Kebayoran Baru	"	2	1,800	298	2,098	20.000
Jatinegara (B)	"	4	2,602	400	3,002	40.000
Cempaka Putih	"	"	2,826	450	3,276	"
Kota (B)	"	"	3,066	1434	4,500	"
Gambir (B)	"	6	3,409	500	3,909	"

As can be seen in Table 6.8.1.(1), the building sizes are not the same though the number of line units accommodated is the same. It is presumed that this difference is due to the shape of the building site and/or the amount of work handled there.

TABLE 6 - 8 - (1)

PROVISION PERIOD IN YEARS FOR EXTENSION PIANNING

Type of line \ Country	Argentine	Australia (4)	Belgium	Colombia	Congo (Dem. Rep. of)	Denmark	Fed. Republic of Germany (5)	France	Creece	India
Ducts	>20	(1) 20-50	(1)	X	-	20-30	20-30	20	15	-
Conduit cables: Main cables	> 5	8-20	5-10	3-5	-	(3)	5-10	5-8	3-5	-
Distribution cables	>10	20	-	-	-		10-30	-	-	-
Buried cables: Main cables	-	-	7-15		15	4-15	10-20	15	7	6-12
Distribution cables	-	10-20	20-25	long		20-30	30		10-15	15-20
Aerial cables: Main cables	-	-	-	-	X	(2)	-	-	-	-
Distribution cables	>10	10-20	10	3-5			20	5	3-5	-

Type of line \ Country	Japan	Kuwait	Malaysia	Netherlands	New Zealand	Norway	Poland	Sweden	Switzerland	United Kingdom
Ducts	≧15	25	20	-	25	≧30	X	≧10	30-50	ab.20
Conduit cables: Main cables	5	10	5-10	-	8-12	4-5	5-15	4-5	7-10	5-20
Distribution cables	15	-	20	-	-	-		(1)	15-20	ab.20
Buried cables: Main cables	15	5-10	-	5-10	10-20	5-10 (1)	X	4-6	20-40	-
Distribution cables		-	20	(1)		15-20		(1)		20
Aerial cables: Main cables	5	-	-	-	10-20	-	X	-	-	-
Distribution cables	15	5-10	5 (2)	(2)		10-15		5-6	15-20	20

\> = More than ··· years.
≧ = Equal to or more than ··· years.
— = Not in use.
X = No data available.
ab. = About

(1) = Up to ultimate capacity
(2) = As a temporary relief only.
(3) = According to maximum size of cable.
(4) = For junction cables: 4 - 10 years.
(5) = For junction cables: economic provision period.

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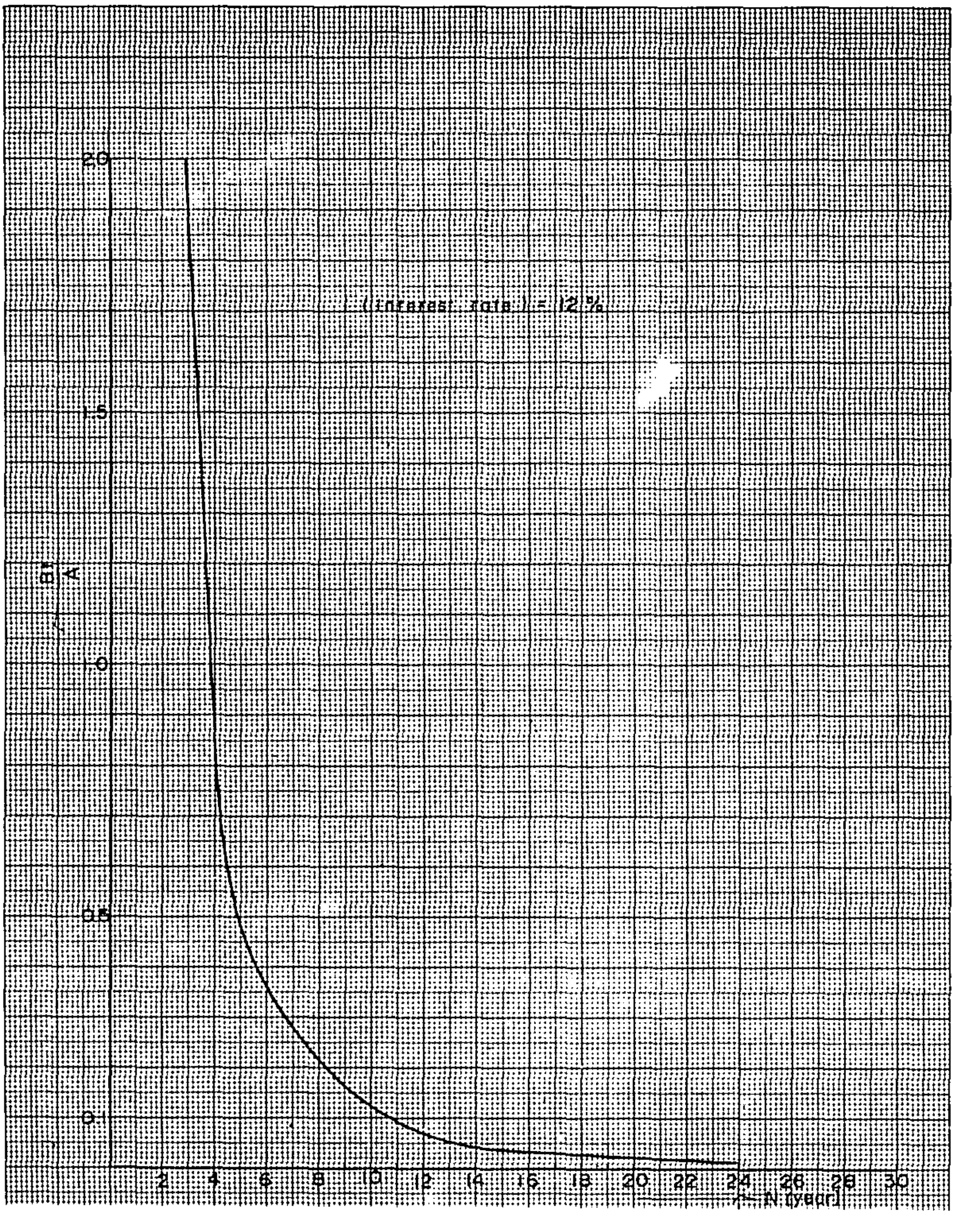

FIG. 6 - 8 - (2)
OPTIMUM PROVISION PERIOD

A study is made here in regard to the relation between the number of line units of the switching equipment and the size of the switching room. If the size of the switching room for accommodating switching equipment of 10,000 line units is 1,200 m^2 and the switching room size for switching equipment of 20,000 line units is 1,800 m^2, the size of the switching room for accommodating switching equipment of the respective number of line units will be as shown in Fig. 6.8.1.(2), and the size of the switching room for accommodating switching equipment of 40,000 line units will be 3,000 m^2.

According to the data for building construction cost as calculated by PERUMTEL the construction cost per 1 m^2 differs with the size of the total construction area. The building construction cost Y is expressed by the following formula.

$$Y = 65 + 115X \ (m \cdot u)$$

where Y : Total construction cost

X : Number of line units of switching equipment (however, the unit is 10,000 line units)

That is, the fixed portion of the construction cost is $A = 65 \ (m \cdot u)$ and the fluctuating coefficient of the construction cost according to scope of facilities is: $B = 115 \ (m \cdot u)$.

On the other hand, from Table 5.2.(2) (New Switching and New Local Exchange Office Construction Plan) in Chapter 5 Section 2, exchange offices in Jakarta can be divided into two kinds based on the number of line units to be accommodated in the future. That is, exchange offices are divided into the two groups of medium and/or small class exchange offices and large class exchange offices. The medium and/or small class exchange offices mean the offices where less than 2,500 line units are installed additionally in one year, and the large class exchange offices mean the offices where more than 2,500 line units are installed additionally.

In the study of the optimum provision period for office buildings based on the number of line units which were already determined by PERUMTEL as shown in Table 5.2.(2), 1976 was chosen as the base year since it is the year when almost all the exchange offices commence the service.

(1) In case of 17 exchange offices in the medium and/or small class.

Total number of line units already determined for 1976..... 48,800

Total number of line units required in 1986 126,800

Total number of line units required in 1991 261,800

According to the above numbers, the average number of line units to be installed additionally in one year for one exchange office is:

For 10 years .... 459 line units; that is, the number of new installations required in one year is: $t = 0.0459$.

For 15 years .... 835 line units; that is, the number of new installations required in one years is: t = 0.0835.

Therefore,

$$\frac{Bt}{A} = \frac{115}{65} \times 0.0459 = 0.081$$

$$\frac{Bt}{A} = \frac{115}{65} \times 0.083 = 0.147$$

The result calculated according to the following condition is shown in Fig. 6.8.1.(3).

That is, $\frac{Bt}{A}$ = 0.08 and 0.15

(However, the interest rate shall be 12% per year.)

From Fig. 6.8.1.(3), the optimum provision period will be 9 - 12 years.

(2) In case the 18 exchange offices are in the large class.

Total number of line units determined for 1976 ------ 200,000

Total number of line units required in 1986 -------- 351,000

Total number of line units required in 1991 -------- 600,000

According to the above numbers, the average number of line units to be installed additionally in one year for one exchange office is:

For 10 years .... 839 line units; that is, the number of new installations required in one year is: t = 0.0839

For 15 years ....1,481 line units; that is the number of new installations required in one year is: t = 0.1481.

Therefore,

$$\frac{Bt}{A} = \frac{115}{65} \times 0.0839 = 0.148$$

$$\frac{Bt}{A} = \frac{115}{65} \times 0.1481 = 0.262$$

The calculated result according to the following condition is shown in Fig. 6.8.1.(3).

That is, $\frac{Bt}{A}$ = 0.15 and 0.25

(However, the interest rate shall be 12% per year.)

Fig.6.8.1.(3) shows that the optimum provisons period is 7 - 9 years.

As the result of the foregoing study, JTP recommends the optimum provision period for office buildings as follows:

a) In case of an exchange office where the demand 15 years hence will be 20,000 or less .... 10 years

b) In case of an exchange office where the demand 15 years hence will exceed 20,000 .... 8 years

6.8.2 Switching Equipment

There are presently switching equipment of 45,000 line units for subscribers in Jakarta. 44,700 line units are in the EMD switching equipment, while the balance of 600 line units are in the crossbar switching equipment.

According to PERUMTEL's Construction Program of Exchange Offices in Jakarta (dated January 20, 1975), the new installation program for the period from 1975 to 1977 has already been determined as shown in Table 6.8.2.(1).

Table 6.8.2.(1)

Kind of switch	New installation	Existing	TOTAL
E.M.D.	42,000	44,700	86,700
X.B	8,000	600	8,600
P.R.X.	158,500	–	158,500
TOTAL	208,500	45,300	253,800

Through the study of the construction costs of the above expansion program, the cost per line unit can be assumed as follows, though there is some difference according to the type of switching equipment.

In case of new installation = 0.0020 – 0.0025

In case of expansion = 0.0025 – 0.0033

where A : Fixed portion of construction cost

B : Fluctuating coefficient of construction cost

The results of the calculation for the optimum provision period according to the following condition and using the above numerical values are shown in Fig. 6.8.2.(2) to Fig. 6.8.2.(4). That is, t = 1,000, 3,000 and 5,000 on condition that the interest rate per year is 12%.

It can be known from Fig. 2.8.2.(2) to Fig. 2.8.2.(4) that in case that the number of line units to be expanded in one year "t" is 5,000 line units or more, the optimum provision period will be 1 to 2 years.

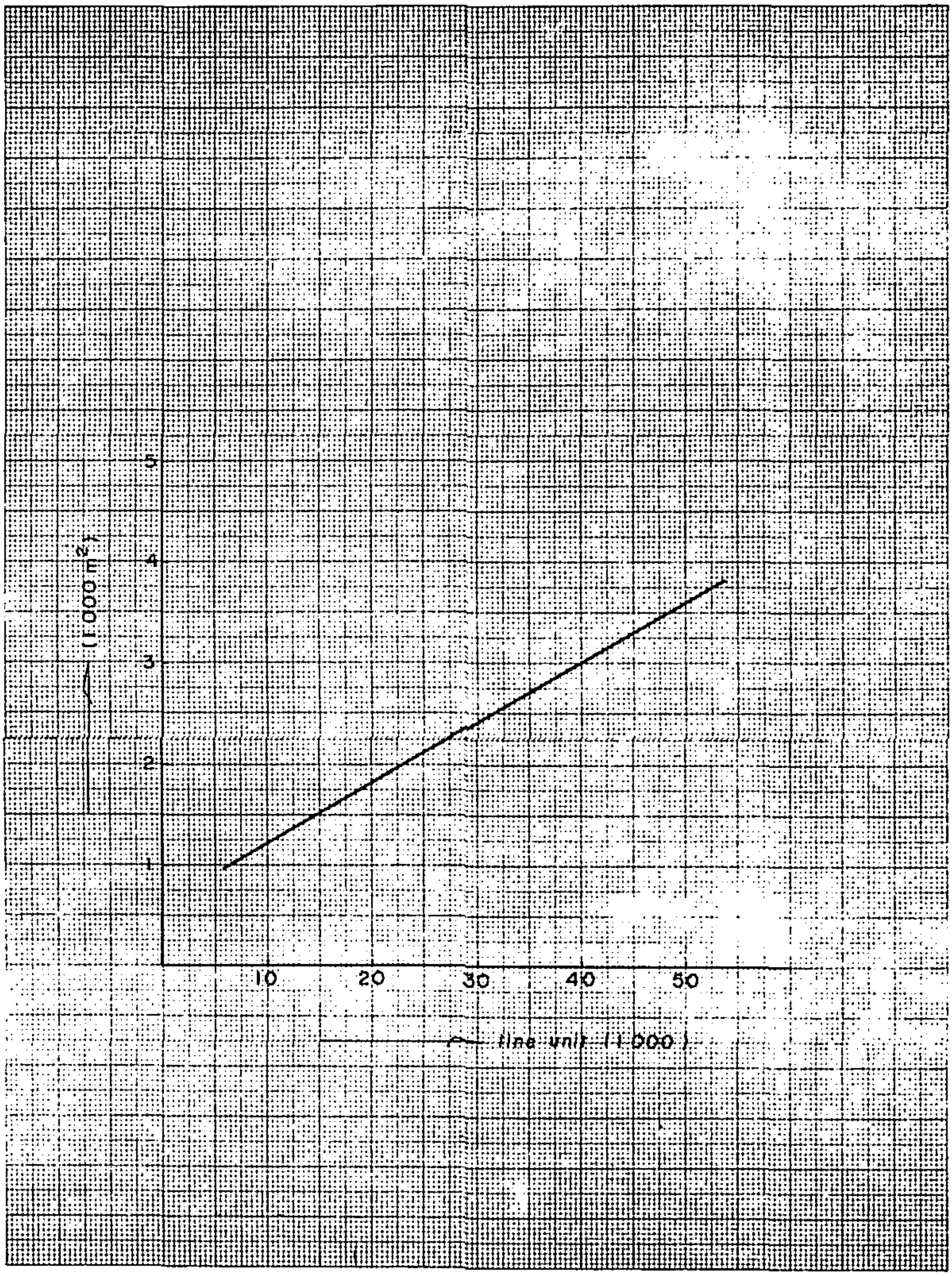

FIG. 6 - 8 - 1 - (2)

BUILDING SIZE FOR SWITCHING ROOM ONLY

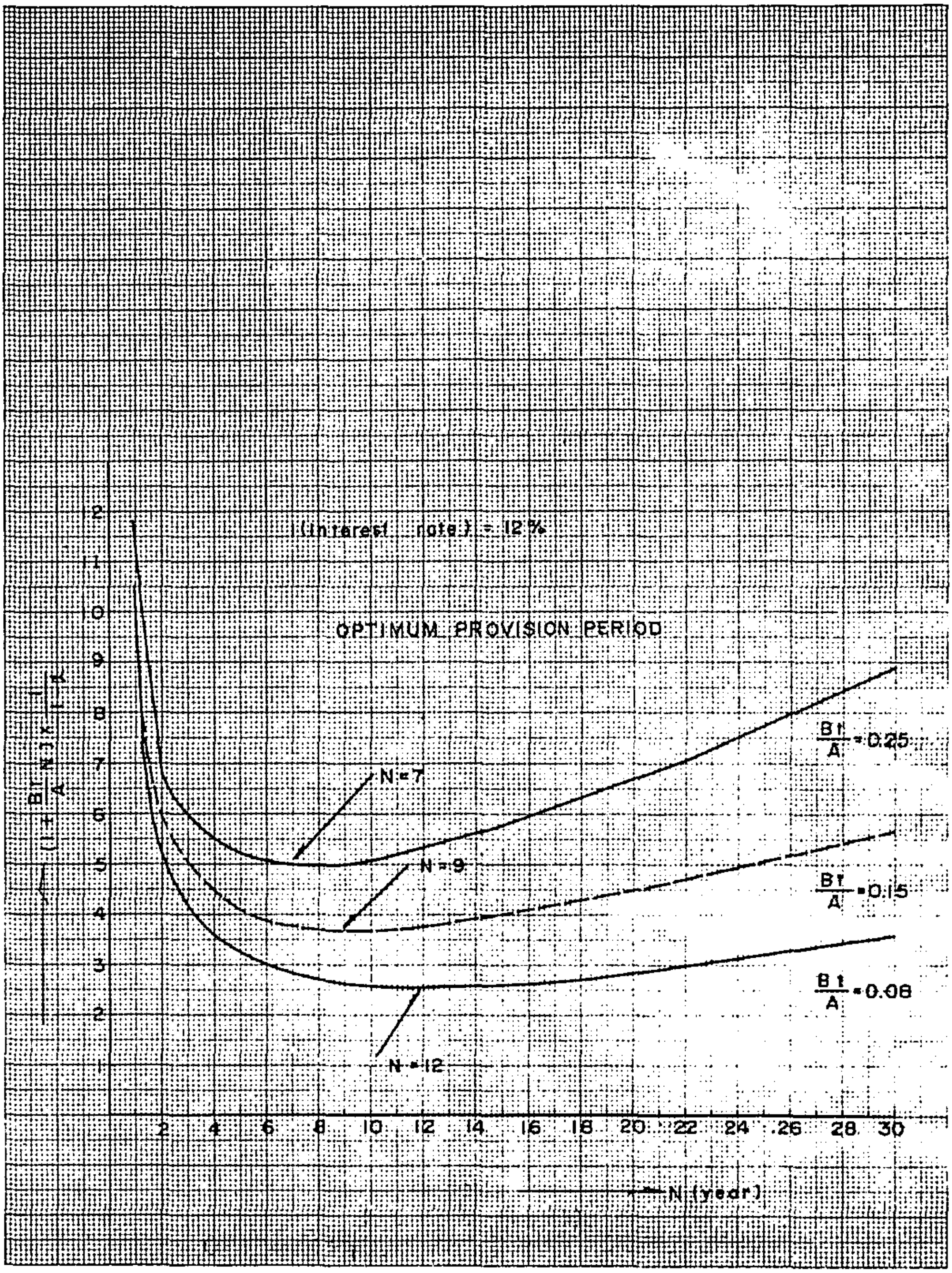

FIG. 6-8-1-(3)
OPTIMUM PROVISION PERIOD FOR BUILDING

When the number of line units to be expanded in one year "t" is 3,000 line units or less, the optimum provision period will be 2 to 3 years.

In the CCITT Recommendation "National Telephone Network for the Automatic Service", the provision period for switching equipment is 3 to 5 years.

In regard to the new expansion of switching equipment for the time being in Jakarta, the following points must be considered:

a) Since the construction funds must be procured by borrowing, it would be better to keep the repeat cycle to every 3 or 4 years, to minimize the troublesome fund procurement procedures.

b) Since the switching equipment must be imported from abroad, it would be inconvenient to repeat the expansion work every two years or so.

c) Since the work will be implemented by international tender, it is believed that a period of about four years would be required from the planning of the expansion project until completion as shown in the following.

Planning	About 4 months	
Discussion	About 1 month	
Tender announcement and tendering	About 4 months	
Evaluation of proposals..................	About 2 months	
Appointment of successful tenderer	About 2 months	
Negotiation and discussion	About 3 months	
Contract conclusion	About 1 month	
L/C opening	About 1 month	
Detail design	About 4 months	
Detail negotiation	About 3 months	Overlapping
Manufacture and transport	About 9 months	period:
Construction and handing-over	About 12 months	3 months
Total	About 43 months	

In consideration of the foregoing conditions, JTP recommends the expansion period for switching equipment be 4 years.

However, it is desirable that efforts be made to shorten the expansion period to 2 to 3 years in th future.

6.8.3 Outside Plant Facilities

6.8.3.1 Underground Facilities

According to the "Fundamental Plan 1972 for the Telephone Network in Indonesia" prepared by PERUMTEL, the provision period for underground facilities is 20 years.

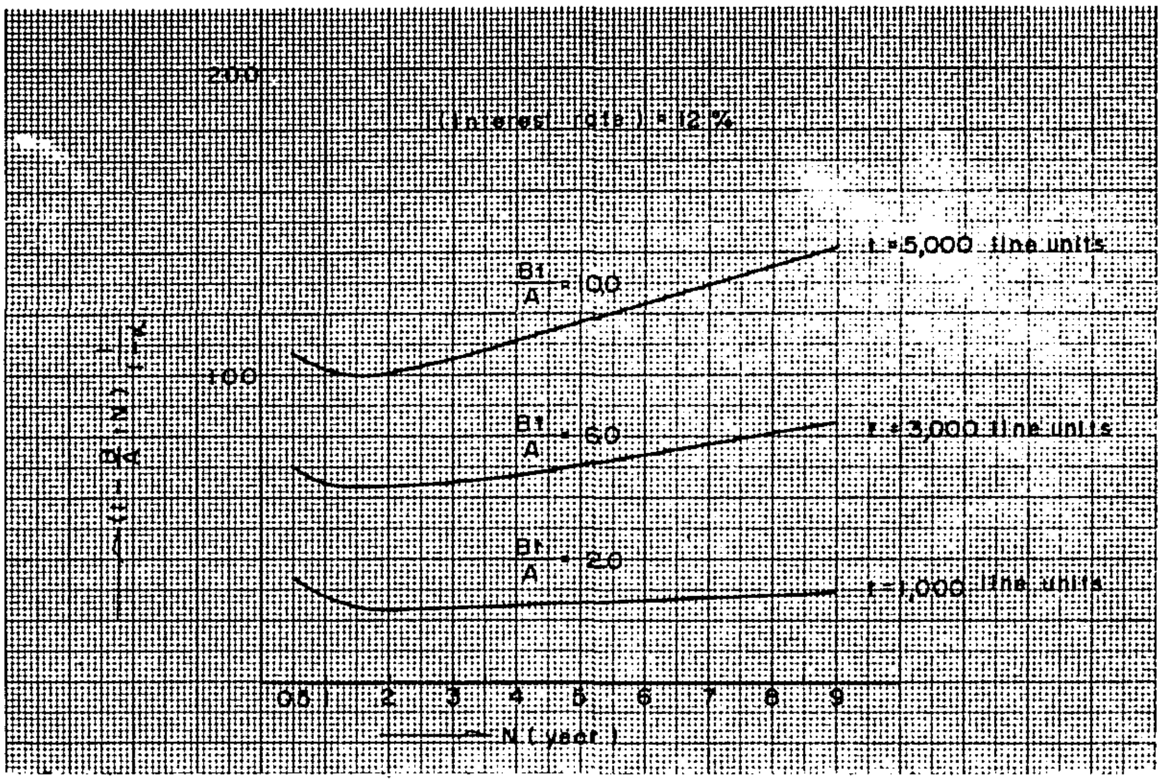

FIG. 6 - 8 - 2 - (2)
OPTIMUM PROVISION PERIOD FOR SWITCHING EQUIPMENT

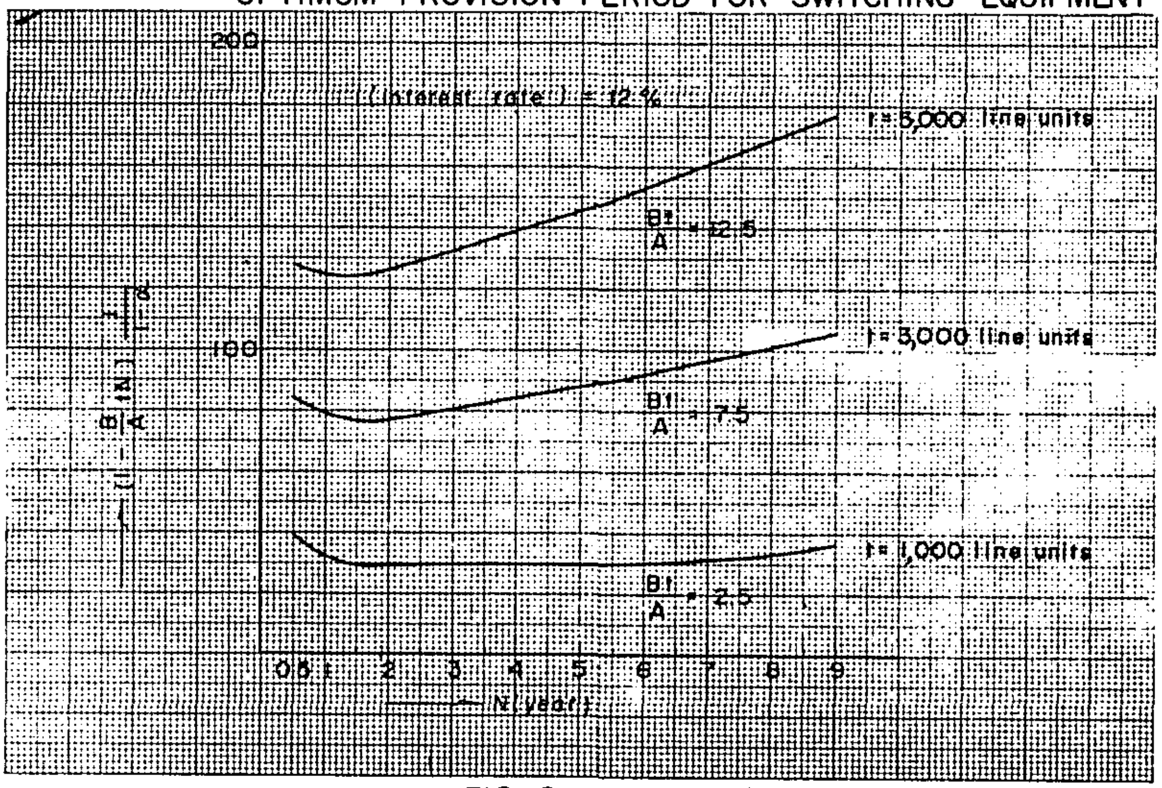

FIG. 6 - 8 - 2 - (3)
OPTIMUM PROVISION PERIOD FOR SWITCHING EQUIPMENT

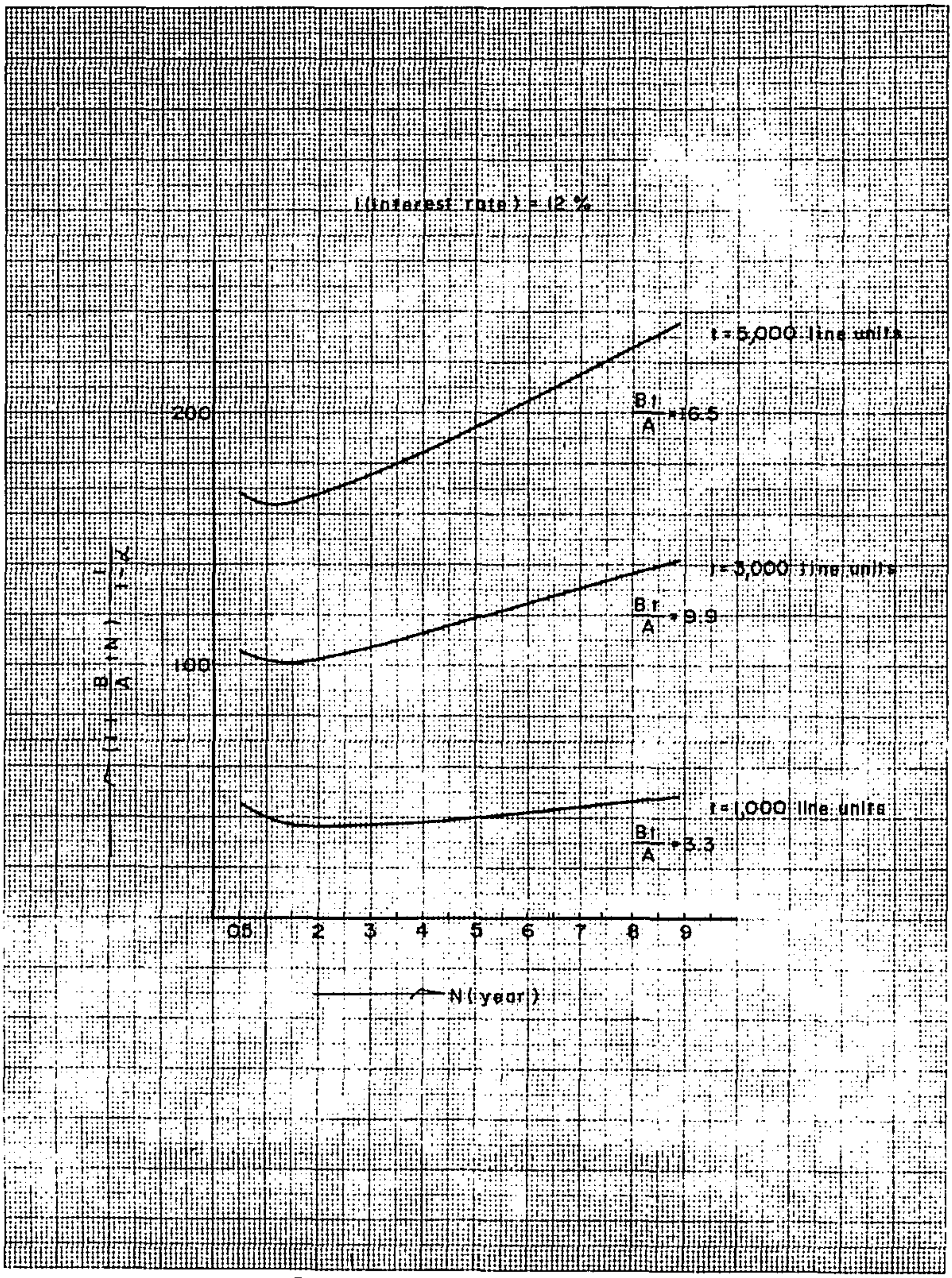

FIG. 6 - 8 - 2 - (4)

OPTIMUM PROVISION PERIOD FOR SWITCHING EQUIPMENT

However, as shown in Table 6.8.(1), there is a large difference in the provision period for underground facilities among countries. In one country, it is about 10 years, while in another country it is set at 30 to 50 years.

The difference in the provision period seen here is due to the variation in the social and ecnomic conditions of different countries, especially in the road conditions.

PERUMTEL has a fixed telephone expansion work program for the period from 1975 to 1977. As the result of the study on the construction cost for underground facilities of this expansion program, the relation between fixed protion "A" of the construction with the fluctuatin portion is as follows:

In case of 9-ductway section —— $\frac{Bt}{A} = 0.1$

In case of 6-ductway section —— $\frac{Bt}{A} = 0.09$

These numerical values were obtained on the assumption that 10% expansion is necessary every year fro each of the above ductway sections.

Fig. 6.8.3.(2) is the result of the calculation of Formula 6.8.(6), with as 0.05 and 0.1.

From Fig. 6.8.3.(2), the optimum provision period is 11 to 13 years. However, JTP recommends that the provision period for underground facilities be 15 years, since the transportation means in Jakarta is limited to bus and motorcar and, therefore, the traffic congestion on the occasion of the underground facilities construction work must be avoided as far as possible. Even at present, the actual situation is that the construction work on the main roads of Jakarta is limited to night work.

6.8.3.2 Junction Cables

According to the "Fundamental Plan 1972" prepared by PERUMTEL, the provision period for junction cables is 3 to 7 years. According to CCITT Recommendation "Local Telephone Network", the provision period applied in different countries is not the same because of the different social and economic policies.

In Japan, the provision period for junction cables differs according to the type of cables, that is, conduit cables, direct buried cables, etc. but the standard is 10 to 15 years.

In general, it can be said that the economic provision period in the case of large cities is shorter than that of the medium and/or small cities. Moreover, in case of a rapid increase in telephone traffic among the exchange offices, the provision period is short and when the increase is gradual, the provision period is long.

JTP used the computer in calculating the number of junction circuits in Jakarta. The calculation results are shown in Table 6.8.3.(1).

On the other hand, a study of the construction cost of the installation program of PERUMTEL for the period from 1975 to 1977, the costs of 0.4 mm and 0.6 mm conductor junction cables are as follows:

Table 6.8.3.(1) Number of Junction Circuits and Circuit Sections in Jakarta

	1979	1983	1988	1993
No. of circuits	22,289	34,205	47,769	67,912
No. of circuits sections	40	53	55	55

In case of 0.4 mm conductor cable $Y = 3{,}590 + 14X$ (m · u)

In case of 0.6 mm conductor cable $Y = 3{,}630 + 22X$ (m · u)

where Y : Total construction cost

X : Number of pairs of cable

When calculation is made based on the theory described in detail in the preceding 6-8, the relation between $\frac{Bt}{A}$ and optimum provision period can be determined from Fig. 6.8.(2). Here, "t" is the required number of pairs to be expanded per year, and the average number of junction cables to be expanded per year in the entire city of Jakarta is 45 circuits. Therefore,

In the case of 0.4 mm conductor cable

$$\frac{Bt}{A} = \frac{14}{3{,}590} \times 45 = 0.175 \fallingdotseq 0.2$$

In the case of 0.6 mm conductor cable

$$\frac{Bt}{A} = \frac{22}{3{,}630} \times 45 = 0.273 \fallingdotseq 0.3$$

Fig. 6.8.3.(3) presents the calculation results when = 0.2 and 0.3, and the interest rate is 12% per year.

As seen in Fig. 6.8.3.(3), in case the provision period is less than 5 years, the loss in construction cost will become very large and when the provision period is more than 5 years, the loss in construction cost is not so large.

Therefore, as the provision period for junction cables, the following is recommended.

a) The number of cable pairs shall meet the required number of circuits for a period at least longer than 5 years. Furthermore, taking into account that Jakarta is a large city, the maximum number of pairs should be laid as a general rule.

b) When the number of cable pairs calculated for 15 years hence is smaller than the maximum number of pairs of the cable, the nearest higher ranking cable should be laid.

6.8.3.3 Subscriber Primary Cable

According to the "Fundamental Plan 1972" prepared by PERUMTEL, the provision period for subscriber primary cables is decided to be 3 to 7 years.

As seen in Table 6.8.(1), the provision period for subscriber primary cables in various foreign countries is about 5 years, excluding Australia and the United Kingdom. It is 8 to 20 years in Australia and 5 to 20 years in the United Kingdom.

On the other hand, as the result of a study of the construction costs of the PERUMTEL's 1975 - 1977 construction program, the construction cost for subscriber primary cables can be calculated as follows:

In the case of 0.4 mm conductor cable

$$Y = 740 + 13X \ (m \cdot u)$$

In the case of 0.6 mm conductor cable

$$Y = 910 + 20X \ (m \cdot u)$$

where Y : Total construction cost

X : Number of cable pairs

According to the demand forecast made by JTP, the telephone demand for the whole city of Jakarta 15 years hence will be equivalent to about 5 times the present demand.

Under these conditions, the following formula can be realized:

$$X = Xo + \frac{4}{15} \cdot Xo \cdot N$$

where Xo : Number of cable pairs equivalent to the telephone demand in the construction period

1) In the case of 0.4 mm conductor diameter

$$A = 740$$

$$B = 13$$

$$t = \frac{4}{15} Xo$$

When the demand in the service area 15 years hence is assumed to be 600 under the foregoing conditions, the demand at the time of construction work is 120 because the demand after 15 years will be 5 times as much.

That is, Xo = 120

$$t = \frac{4}{15} \cdot Xo = \frac{4}{15} \times 120$$

from the above

$$\frac{Bt}{A} = \frac{13}{740} \times \frac{4}{15} \times 120 = 0.56 \fallingdotseq 0.6$$

2) In the case of 0.6 mm conductor cable

$$A = 910$$

$$B = 20$$

$$t = \frac{4}{15} \cdot Xo$$

That is, Xo = 120

$$\frac{Bt}{A} = \frac{20}{910} \times \frac{4}{15} \times 120 = 0.71 \fallingdotseq 0.7$$

Fig. 6.8.3.(4) presents the result of calculation of the optimum provision period when = 0.5 — 0.7, and the interest rate is 12% per year.

Figure 6.8.3.(4) shows that the optimum provision period is 5 years.

In consideration of the examples in the different foreign countries, JTP recommends that the optimum provision period for subscriber primary cables in Jakarta be 5 years.

6.8.3.4 Subscriber Secondary Cable

According to the "Fundamental Plan 1972" prepared by PERUMTEL, the provision period for subscriber secondary cables is 10 to 20 years.

As can be seen in the foregoing Table 6.8.(1), there are different types of cable systems for subscriber secondary cables, for example, conduit cable, direct buried cable, aerial cable, etc., but in nearly all the foreign countries, the provision period for subscriber secondary cables is 10 to 20 years.

The construction cost of the direct buried subscriber secondary cables related to the PERUMTEL's 1975 - 1977 construction program is studied as follows:

In the case of 0.4 mm conductor cable

$$Y = 3{,}650 + 15X \quad (m \cdot u)$$

In the case of 0.6 mm conductor cable

$$Y = 3{,}880 + 24X \quad (m \cdot u)$$

where Y : Total construction cost

X : Number of cable pairs

According to the demand forecast made by JTP, the telephone demand 15 years hence will be nearly 5 times the present demand. Therefore, the following formula can be ralized:

$$X = Xo + \frac{4}{15} \cdot Xo \cdot N$$

where Xo : Number of cable pairs equivalent to the telephone demand at the time of the construction work.

1) In the case of 0.4 mm conductor cable

$$A = 3{,}650$$

$$B = 15$$

$$t = \frac{4}{15} \cdot Xo$$

where, if Xo = 20

$$\frac{Bt}{A} = \frac{15}{3{,}650} \times \frac{4}{15} \times 20 = 0.022 \fallingdotseq 0.02$$

if Xo = 30

$$\frac{Bt}{A} = \frac{15}{3,650} \times \frac{4}{15} \times 30 = 0.033 \fallingdotseq 0.03$$

2) In the case of 0.6 mm conductor cable

$A = 3,880$

$B = 24$

$$t = \frac{4}{15} \cdot Xo$$

where, if $Xo = 20$

$$\frac{Bt}{A} = \frac{24}{3,880} \times \frac{4}{15} \times 20 = 0.033 \fallingdotseq 0.03$$

if $Xo = 30$

$$\frac{Bt}{A} = \frac{24}{3,880} \times \frac{4}{15} \times 30 = 0.049 \fallingdotseq 0.05$$

Fig. 6.8.3.(5) presents the result of calculation of the optimum provision period when = 0.03 and 0.05 and the interest rate is 12% per year.

Fig. 6.8.3.(5) shows that the optimum provision period is 13 to 17 years.

In consideration of the examples in foreign countries, JTP recommends that the optimum provision period for subscriber secondary cables in Jakarta City be 15 years.

6.9 Subscriber Line Structure

6.9.1 Outline

The subscriber line network is composed of aerial cable, conduit cable, direct buried cable, etc. The telephone-tunnel and conduits are constructed to accommodate the conduit cables.

Therefore, these various types of line systems must be applied to correspond with the conditions in the object areas, such as the road situation and developed condition of the cities.

Table 6.9.(2) shows the application examples in the foreign countries as copied from the CCITT Recommendation.

6.9.2 Aerial Cable

The self-supporting type of cable is used as aerial cables which are mainly used as secondary cables in the not too well developed areas. For example, even in the city areas,

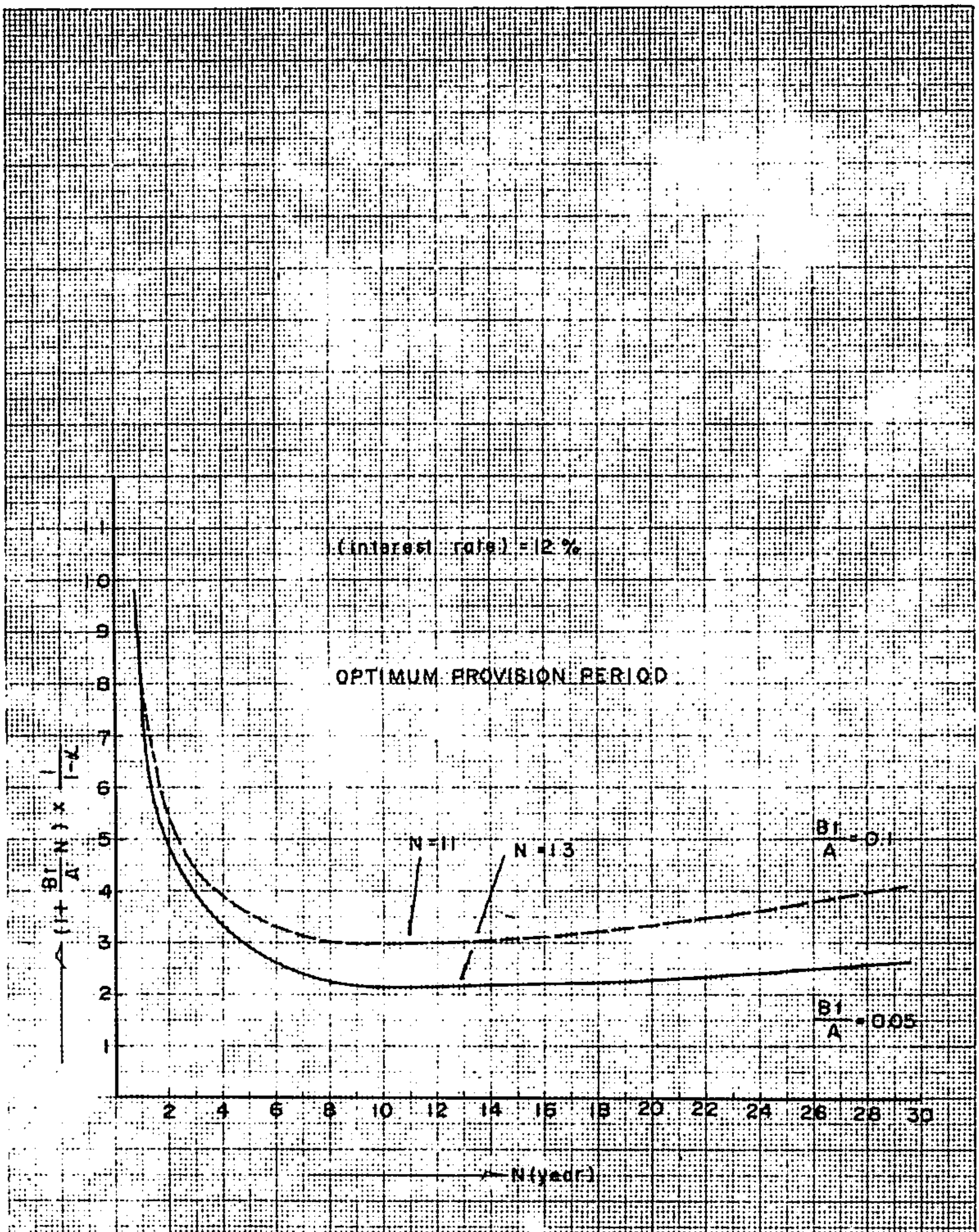

FIG. 6 - 8 - 3 - (2)
OPTIMUM PROVISION PERIOD FOR UNDERGROUND FACILITY

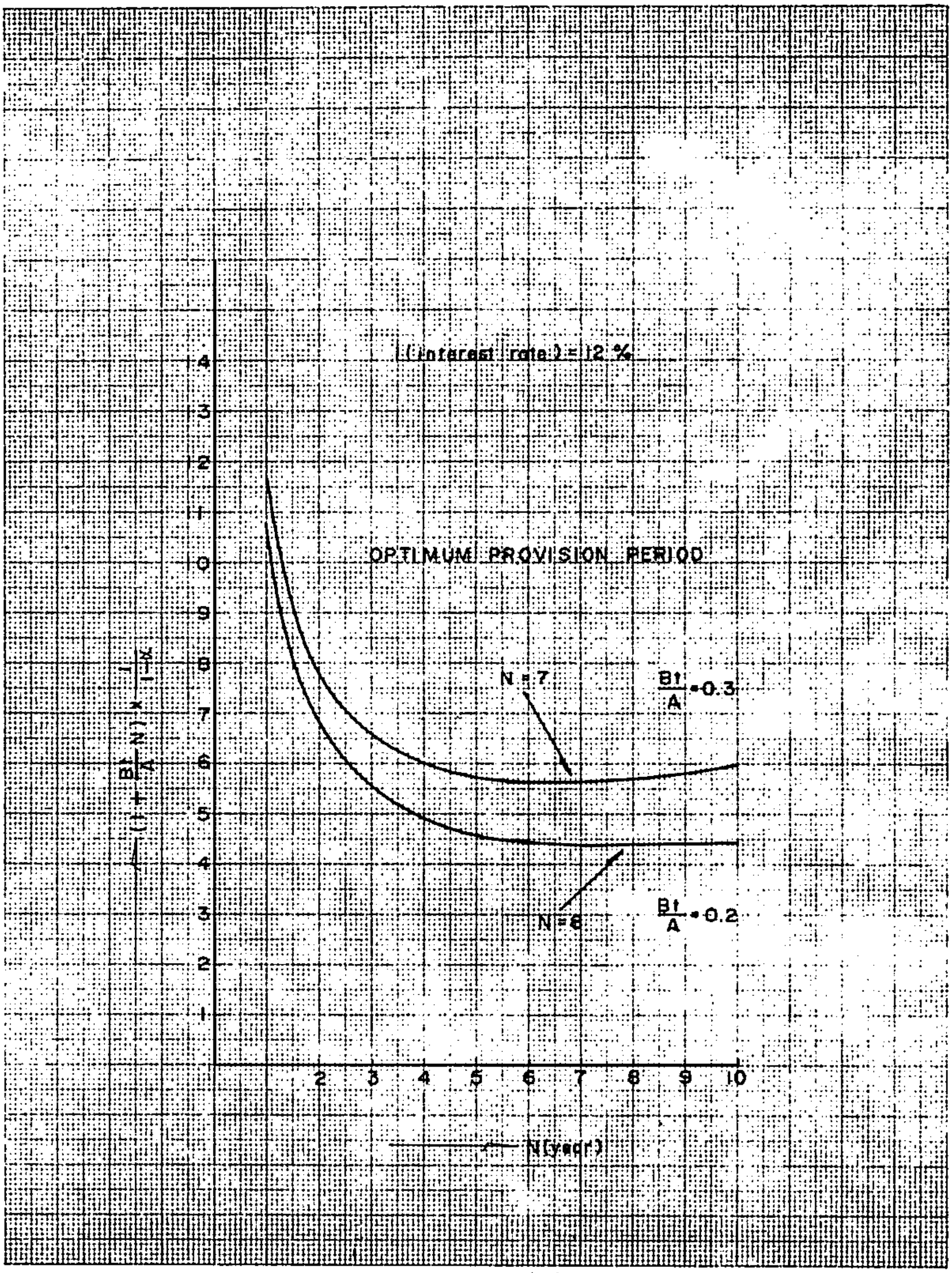

FIG. 6-8-3-(3)
OPTIMUM PROVISION PERIOD FOR JUNCTION CABLE

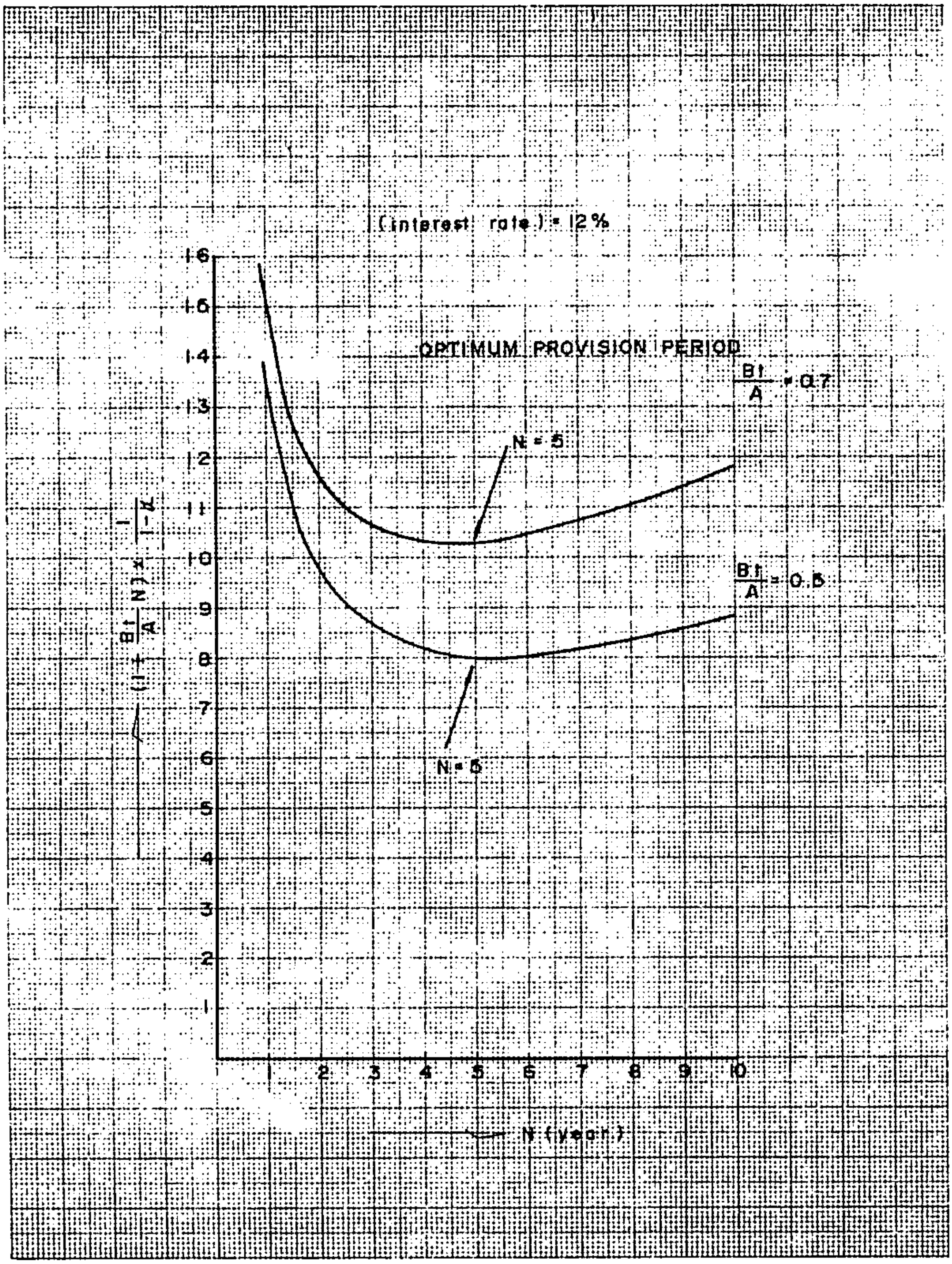

FIG. 6-8-3-(4)
OPTIMUM PROVISION PERIOD FOR SUBSCBER PRIMARY CABLE

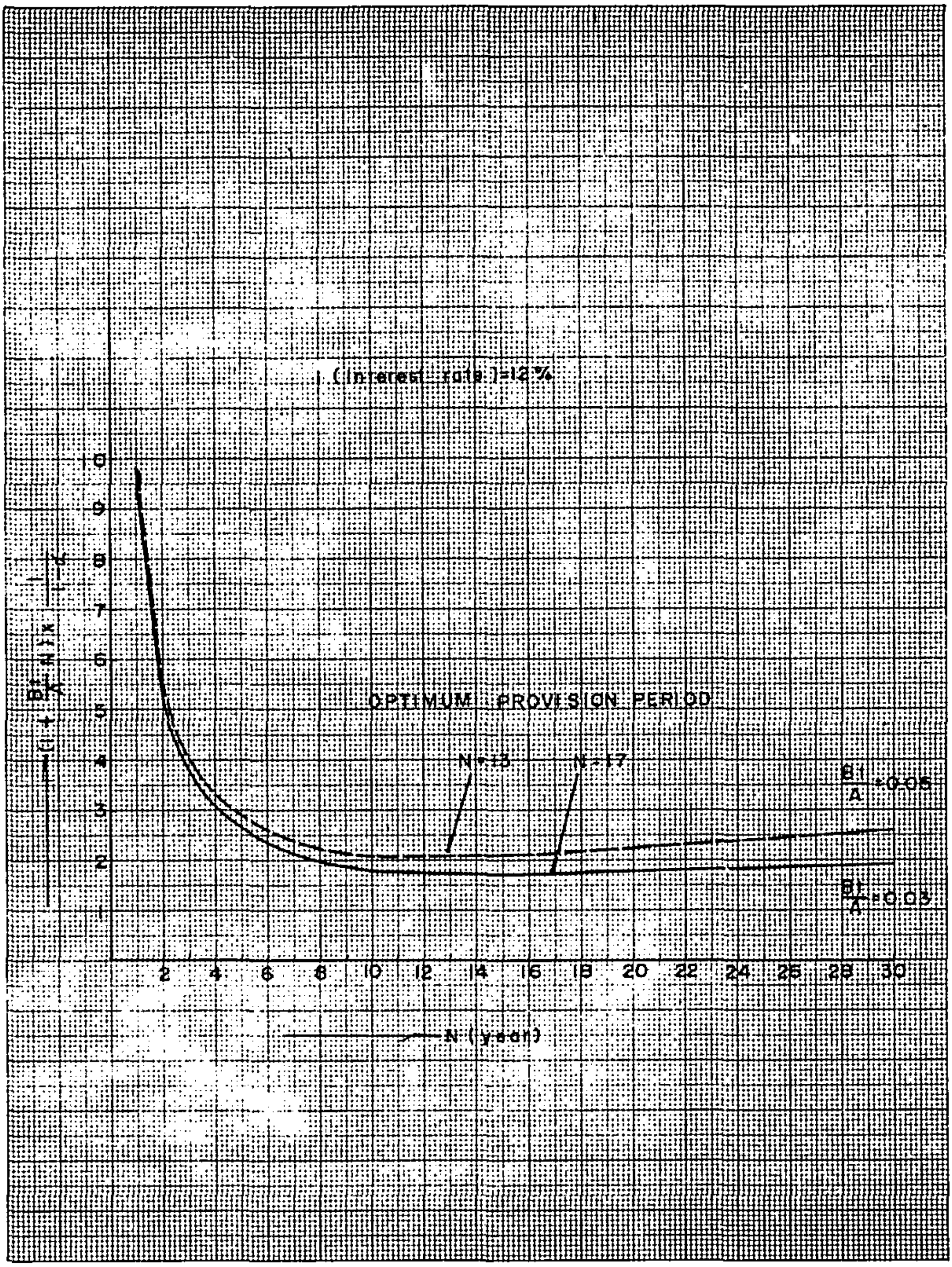

FIG. 6 - 8 - 3 - (5)
OPTIMUM PROVISION PERIOD FOR SUBSCRIBER SECONDARY CABLE

in case the roads are wide and subject to changes according to the city planning or the roads are not suitable for construction of underground facilities, the installation of aerial cables should be considered.

The cable size and conductor diameter of aerial cables are shown in Table 6.9.(1).

Table 6.9.(1) Cable Size and Conductor Diameter of Aerial Cable

	10	20	30	40	50	80	100	150	200
0.4 mm	O	O	O	O	O	X	X	X	X
0.6 mm	O	O	O	O	O	X	X		
0.8 mm	X	X	X	X	X				

X : for the future

The number of aerial cables in one route shall be, in principle, up to two cables. Even in unavoidable cases, it shall be three cables or less. In Japan, in view of the work, the number of aerial cables is limited to three cables or less.

For reference purposes, the necessary height for aerial cables applied in Japan is shown in Table 6.9.(3).

The spacing between the telephone poles when constructing aerial cables shall be 40 m as the standard.

Table 6.9.(3) Necessary Height for Aerial Cable above the Ground in Japan

Condition	Necessary height above the ground	
1. Above the road	minimum	5.0 m
In case of no trouble for traffic		
a) on pedestrian road	minimum	2.5 m
b) on ordinary road	minimum	4.5 m
2. Across the rail road	minimum	6.0 m
3. Across the river	It shall be decided to avoid trouble for ship traffic.	
4. Other area	minimum	3.5 m

6.9.3 Conduit Cable

The conduits for the use of conduit cables shall be as follows:

a) For conduit cable, cable without steel tape amouring is used.

b) Conduit cables are used as primary and secondary cables in already developed city areas or roads developed in accordance with city planning.

TABLE 6-9-(2) USUAL TYPES OF SUBSCRIDER LINE

Type of lines \ Country	Australia	Belgium	Central African Republic	Chile	Colombia	Congo (Dem. Rep. of)	Denmark	Federal Republic of Germany	France	Greece
Main cables	C	C & B	C	C	C	B	C & B	C & B	C & B	C & B
Distribution cables	C, B & A	B	B & A	C & A	B	B	C, B & A (1)	C, B & A	C, B & A	B & A (1)
Subscriber service lead	K, D & O (2)	K & O	K & O	K, D & O	K & O	K & O	K & D (1)	K & O	K, D & O	K, D & O

Type of lines \ Country	Japan	Kuwait	Malaysia	Netherlands	New Zealand	Norway	Sweden	United Kingdom	United states of America
Main cables	C & B	C	C & B (1)	B	X	C & B	C & B	C, B & A (2)	C & B
Distribution cables	C & A	C, B & A	B & A (1)	B	B & A	B & A	C, B & A	C, B & A	B & A
Subscriber service lead	K & D	X	O	K & O (1)	K & O	K, D & O (2)	K, D & O (2)	K & D	K & D

X = No data available
(1) = Only occasionally
(2) = In order to meet transmission requirements
A = Aerial cable
B = Buried cable

C = Cable in duct
D = Dropwire cable
K = Cable (in general)
O = Open-wire line

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Even in the foregoing cases, the secondary cables are direct buried cables if there is sufficient space alongside the road in residential areas and re-excavation is possible.

The cable size and cable conductor of conduit cables are shown in Table 6.9.(4) and Table 6.9.(5).

The standard cable length per 1 drum is shown in Table 6.9.(6).

Table 6.9.(4) Cable Size and Conductor Diameter of Conduit Cable (Primary Cable)

	200	300	400	600	800	1,000	1,200	1,600	1,800	2,400
0.4 mm	O	O	O	O	O	O	O	X	X	X
0.6 mm	O	O	O	O	O	O	O			
0.8 mm	O	O	O	O						

X: for the future

Table 6.9.(5) Cable Size and Conductor Diameter of Conduit Cable (Secondary Cable : Jelly-Filled Cable)

	10	20	30	40	50	80	100	150	200
0.4 mm	O	O	O	O	O	O	O	X	X
0.6 mm	O	O	O	O	O	O	O	X	X

X: for the future

Table 6.9.(6) Standard Length of Cable per Cable Drum

Conductor diameter (mm)	Cable size (pair)	Standard cable length (meter)
0.4	up to 600	500
0.4	800 up to 2400	250
0.6	up to 600	500
0.6	800 up to 1200	250
0.8	up to 400	500
0.8	600	250

6.9.4 Direct Buried Cable

The conditions of use for direct buried cables are as follows:

a) As direct buried cable, steel tape armoured cable is used.

b) As a primary cable route, when the available roads are expected to be improved and there is space for cable laying then, direct buried cable is laid. As secondary cable, direct buried cable is to be used in the developed residential are where re-excavation is possible as described in the preceding paragraph.

The buried depth of direct buried cables, in principle, shall be as in the following. That is, in case of subscriber primary cable, the depth shall be 0.8 m or more and for subscriber secondary cable, 0.6 meter or more.

The cable size and cable conductor of direct buried cable for subscriber primary cable are shown in Table 6.9.(7). The cable size and cable conductor for subscriber secondary cable shall be the same as in Table 6.9.(5).

The standard cable length per one cable drum shall be the same as in Table 6.9.(6).

Table 6.9.(7) Cable Size and Conductor Diameter of Direct Buried Cable (Primary Cable)

	200	300	400	600	800	1,000	1,200	1,600	1,800	2,400
0.4 mm	O	O	O	O	O	O	O	X	X	X
0.6 mm	O	O	O	O	O	O	O			
0.8 mm	X	X	X	X						

X : for the future

6.9.5 Underground Distirbution Method

The following two kinds of systems are applied as underground distribution systems. That is, the system using conduit cables and the system using direct bruied cables.

The applicable standards are as follows:

a) The underground distribution by conduit cables is applied in shopping areas or building areas. Riser cables are installed on the walls of the buildings or inside the buildings.

b) Underground distribution by direct buried cables is applied to the residential areas. The riser cables are installed on the terminal poles.

6.9.6 Telephone-Tunnel

In order to prevent congestion in cable jointing or the laying of cables inside the manholes and to avoid having an extremely large number of ductways, the conduit route is divided into 2 or 3 routes. However, there is limitation in such arrangements.

Therefore, telephone-tunnels are constructed in sections where the number of ductways exceed 60 in order to facilitate cable jointing and cable laying.

However, the construction costs for telephone-tunnels are very much higher than for conduit. Moreover, their re-construction is not easy. Consequently, when constructing telephone-tunnels, the capacity must be determined upon a full study of the telephone demand in the far future.

For referential purpose, the application standards for telephone-tunnels applied by the Nippon Telegraph & TElephone Public Corporation in Japan are shown as follows:

Road Condition	Required Number of Ductways
Ordinary road	Section exceeding 60 ductways
Main road	Section exceeding 40 ductways

Following are the types of the telephone-tunnels adopted:

- Telephone-tunnel
  - Rectangular type tunnel
  - Round type tunnel
    - "Hume" pipe tunnel
    - Tunnel by "Shield" driving method

6.9.7 Conduit

(1) Selection of Conduit Route

When preparing plans for the subscriber cable network and the junction cable network, the selection of the conduit routes must be made upon a full study of the following conditions:

a) The road shall allow the shortest cable length.

b) The road shall be advantageous for subscriber secondary cable distribution.

c) The road shall have as little hindrances in conduit construction, such as bridges, railroad tracks, etc.

d) The road shall be of sufficient width without hindering traffic in conduit construction and maintenance.

e) The road shall be of good soil without any danger of depression, collapse and washing away due to flood. Moreover, the road shall be one which will have no danger of harm to the cables due to vibrations of vehicular traffic.

f) The road shall facilitate conduit construction with little buried objects of other services, such as water work facilities or sewage facilities.

g) The road shall be one with little danger of being abandoned or improved according to city planning.

h) The road shall be one with no possibility of inductive disturbance or chemical corrosion.

(2) Applicable Kind of Pipe

The result of the comparison of the various kinds of pipes is shown in Table 6.9.(8). This table was copied from the CCITT "Local Telephone Network."

In consideration of the capacity for domestic production, JTP recommends the use of PVC pipe. Moreover, PVC pipes are already used in advanced countries.

For subscriber primary cables and junction cables, PVC pipes with a standard inner diameter of 100 mm are used. PVC pipe with a standard inner diameter of 60 mm is used for subscriber secondary cable.

(3) Calculation of Number of Ductways

Refer to Section 7 of Chapter 6.

(4) Manhole Spacing

When constructing 100 mm PVC pipes in straight sections, the maximum spacing between manholes must be 250 m.

(5) Buried Depth

In regard to ducts for subscriber primary cable and junction cable, the buried depth of 0.8 m from the top of the duct to the ground surface must be maintained even after the duct expansion work. In case of subscriber secondary cable, the depth must be 0.6 m.

When the standard buried depth cannot be made because of the nearby bridged or other buried facilities, concrete protection must be made for the PVC pipes.

(6) Required Distance from Buried Facilities of Other Services

The required distance between the conduit and the buried facilities of other services should be determined through discussion with the various competent authorities.

For referential purpose, the allowable distance applied by the Nippon Telegraph & Telephone Public Corporation is shown in Table 6.9.(9).

Table 6.9.(9) Required Distance from Buried Facilities of Other Services

<table>
<tr><th>Relation with other facilities</th><th>Underground power line*</th><th>City gas, waterwork, sewage</th><th>Railroad</th></tr>
<tr><td>Cross</td><td rowspan="2">up to 7 kV AC
30 cm
more than 7 kV AC
60 cm</td><td>15 cm</td><td>1.5 m</td></tr>
<tr><td>Parallel</td><td>30 cm</td><td>1.0 m</td></tr>
</table>

* : In case of power line with direct earth system, the required distance depends on the condition of power line.

TABLE 6-9-(8) CONSIDERATIONS FOR USING DIFFERENT TYPES OF DUCT SYSTEM

		Availability	Economy	Strength	Permeability (gas and water)	Smoothness of inner surface	Protection against cable corrosion	Flexibility	Protection against induction
Pre-fabricated duct units	Concrete	+	+	+	-	O	-	O	-
	Earthen-ware	-	O	O	-	+	+	O	-
Concrete moniliths		+	-	+	+	O	O	-	-
Asbestos-cement ducts		-	-	-	+	+	O	O	-
Fibre ducts		-	-	-	-	+	+	+	-
Plastic ducts		-	-	-	+	+	+	+	-
Cast-iron pipes		-	-	+	+	+	-	O	-
Steel pipes		-	-	+	+	+	-	O	-

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