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STUDY REPORT

ON

THE RURAL DEVELOPMENT WITH SUBMARINE CABLE PROJECT

IN

THE REPUBLIC OF KIRIBATI

(VOLUME I)

August 1982

JAPAN INTERNATIONAL COOPERATION AGENCY

STUDY REPORT

ON

THE SURABAYA-BANJARMASIN SUBMARINE CABLE PROJECT

IN

THE REPUBLIC OF INDONESIA

(VOLUM II)

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Foreward

This mainly contains the undermentioned data and informations on Surabaya-Banjarmasin Optical Fiber Submarine Cable Project.

- Calculation data for required circuits, based on demand and traffic forecasts

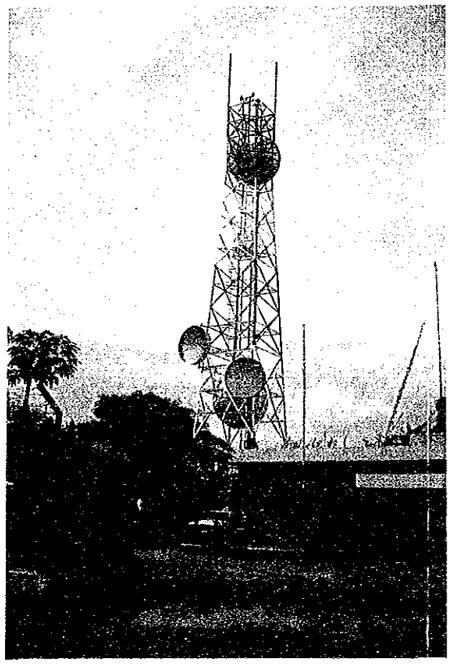
- Calculation bases concerning backhaul system design

Results of demand and traffic forecasts, and the general of backhaul system design are described in Study Report (Volume I).

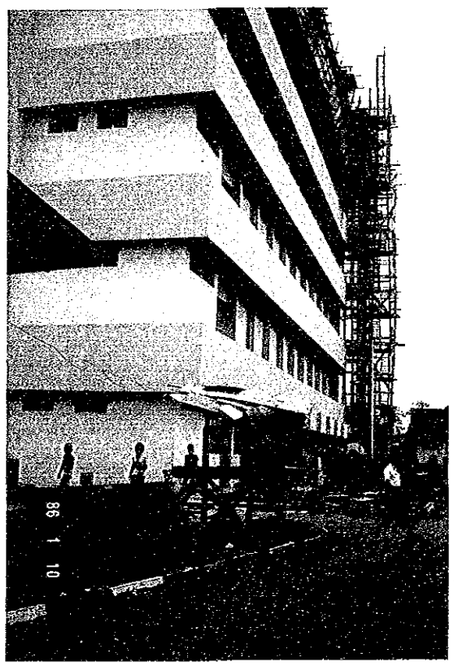
BUMI ANYAR
(CABLE LANDING POINT)

SUBMARINE
CABLE TO
BANJAR-
MASIN

SANDANGAN
(REPEATER STATION)

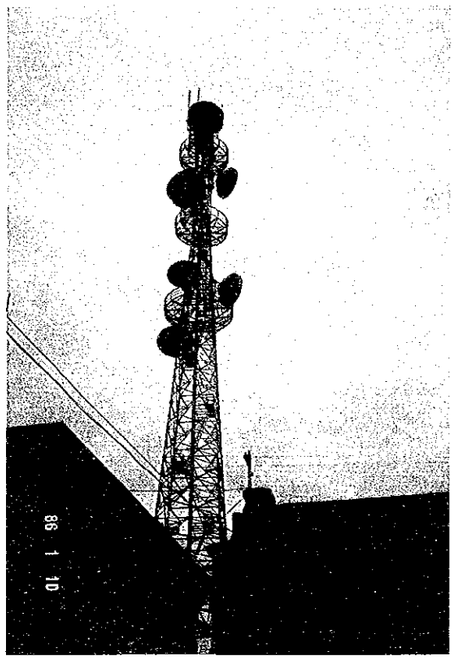


SURABAYA-II

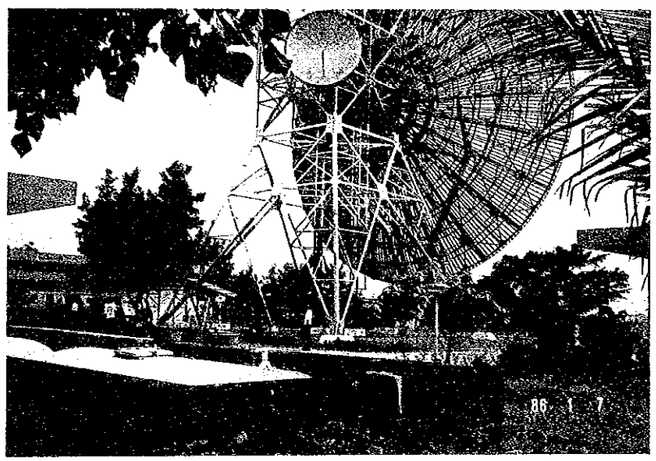


MURBULANGAN
(NEW REPEATER STATION)

FIGURE–SA PLANNED SITES OF BACK-HAUL SYSTEM (SURABAYA SIDE)



BANJARMASIN
(TRUNK EXCHANGE)



KARAMAIAN
(REPEATER STATION)

SUBMARINE CABLE TO SURABAYA

TAKISUNG
(CABLE LANDING POINT)

FIGURE-SB PLANNED SITES OF BACK-HAUL SYSTEM(BANJARMASIN SIDE)

C O N T E N T S

FIGURE/TABLE LIST

CHAPTER 1 CALCULATION DATA FOR REQUIRED CIRCUITS BASED ON DEMAND AND TRAFFIC FORECAST

1.1 Telephone Demand Forecasts Formula

$$\log(MLA_t + NA_t + W_t + S_t)$$

$$= -1.819 - 0.408 \log SF_t + 0.384 \log \frac{GDP_t}{POP_t}$$

$$+ 0.590 \log \frac{ML_{t-1}}{MPS_t} + \log(MPS_t - ML_{t-1})$$

where;

log	:	Natural logarithm operator
ML_t	:	Number of main lines in t year ($\times 10^6$)
ML_{t-1}	:	Number of main lines in t-1 year ($\times 10^{-6}$)
MLA_t	:	$ML_t - ML_{t-1}$ ($\times 10^{-6}$)
NA_t	:	Number of new subscriber applicants in t year ($\times 10^6$)
Wt	:	Number on waiting list in t year ($\times 10^6$)
SF_t	:	Average real subscription fee per main line in t year (by 1975 price level in US$)
GDP_t	:	GDP in t year ($\times 10^6$; by 1975 price level in US$)
POP_t	:	Population in t year ($\times 10^6$)
MPS_t	:	Potential demand population in t year $\approx POP_t \times 0.7$ ($\times 10^6$)
		S_t denotes latent demand in t year ($\times 10^6$)

Estimated Population

(By JICA Report "Fundamental Study on Rural Telecommunicaitons Network", October 1985)

(x 1000)

Year	1989	1990	1995	2000
Population	17,946.2	18,345.8	20,274.9	22,275.3

Estimated GDP

US$ (GDP/CAPITA)

Year	1989	1990	1995	2000
Growth Rate 3%	709	731	847	982
5%	827	868	1,109	1,415
7%	962	1,030	1,444	2,025

Population and GDP after year 2001 up to year 2015 was estimated by using the same method which was applied to the aforementioned JICA Report.

Population

(Unit : x1000)

Year	2005	2010	2015
Population	24,353.6	26,443.2	28,346.8
Growth Rate per Year	1.8%	1.7%	1.5%

For GDP growth rate, 5% was applied.

GDP

(Unit : x1000)

Year	2005	2010	2015
5% Growth Rate	1,806	2,305	2,942

1.2 Telephone Demand Forecast Data

A. Telecommunications Statistics

(SOURCE: TELECOMMUNICATION STATISTICS OF ITU)

YEAR :	MLt (10^6)	MLAt (10^6)	NAt + Wt (10^6)	POPt (10^6)	GDPt (10^6)	SFt (US$)
73 :	0.1834	0.012	0.0752	125.549	27258	440.96
74 :	0.1976	0.0142	0.07856	128.636	30717	311.1
75 :	0.2075	0.0099	0.0747	131.799	30464	1474.02
76 :	0.2194	0.0119	0.08566	135.04	31084	752.71
77 :	0.241	0.0216	0.13153	138.361	34417	1020.7
78 :	0.2751	0.0341	0.11946	141.755	24425	439.5
79 :	0.3171	0.042	0.13144	143.457	28234	290.66
80 :	0.3758	0.0587	0.14322	147.383	26021	200.99
81 :	0.42706	0.05126	0.3338	150.421	37436	188.74
82 :	0.475459	0.048399	0.5244	153	23774	150.83

NOTE: GDP, SUB FEE: US$ IN 1975 PRICE

where;

- MLAt : New subscribers in the year concerned
- NAt+Wt : Sum of new subscribers and waiting subscribers in the year concerned
- POPt : Population
- GDPt : GDP by standard price level in 1975
- SFt : Average subscription fee by standard price level in 1975

B. GDP Data

Table 1 : Trends of Nominal GDP
Table 2 : Real GDP by standard price level in 1973
Table 3 : Gross expenditure on GDP (nominal)
Table 4 : Gross expenditure on GDP (real)

Table-1 Gross Domestic Product at Current Market Prices by Indostrial Origin

(Billion Rupiahs)

1979 - 1983

INDUSTRIAL ORIGIN	1979	1980	1981r)	1982x)	1983x)
(1)	(2)	(3)	(4)	(5)	(6)
1. Agriculture,Livestock,forestry and fishery	8,995.7	11,290.3	13,642.5	15,668.3	18,771.5
1.1. Farm food crops	4,892.0	6,357.6	8,101.8	9,961.0	12,380.9
1.2. Farm non food crops	1,200.9	1,304.9	1,326.5	1,227.3	1,495.6
1.3. Estate crops	589.6	692.6	904.4	1,026.0	1,146.4
1.4. Livestock and products	689.9	990.9	1,257.7	1,418.3	1,520.3
1.5. Forestry	1,048.3	1,141.6	1,140.2	982.9	1,040.0
1.6. Fishery	575.0	802.7	911.9	1,052.8	1,188.3
2. Mining and quarrying	6,979.8	11,672.5	12,970.6	11,707.8	13,823.6
3. Manufacturing industries	3,310.6	5,287.9	5,821.7	7,680.7	8,918.0
4. Electricity, gas and water supply	148.8	225.1	288.2	380.3	503.2
5. Construction	1,789.7	2,523.8	3,117.8	3,507.2	4,433.7
6. Wholesale and retail trade	4,775.1	6,390.9	7,965.7	8,865.1	10,874.6
7. Transport and communication	1,421.5	1,965.3	2,353.2	2,795.2	3,325.0
8. Banking and other financial intermediaries	655.1	752.3	1,404.2	1,603.9	1,840.9
9. Ownership of dwelling	914.2	1,199.5	1,439.4	1,702.6	1,961.8
10. Public administration and defence	2,199.6	3,142.3	3,904.7	4,428.7	5,224.7
11. Services	835.3	995.8	1,119.0	1,292.8	1,537.7
12. Gross domestic product	32,025.4	45,445.7	54,027.0	59,632.6	71,214.7

Table-2 Gross Domestic Product at Constant 1973 Market Prices by Industrial Origin

(Billion Rupiahs)

1979 - 1983

INDUSTRIAL ORIGIN	1979	1980	1981r)	1982x)	1983x)
(1)	(2)	(3)	(4)	(5)	(6)
1. Agriculture,Livestock,forestry and fishery	3,255.6	3,424.9	3,593.5	3,669.8	3,845.6
1.1. Farm food crops	1,908.8	2,073.4	2,261.2	2,294.4	2,412.3
1.2. Farm non food crops	402.1	416.5	429.5	459.2	484.4
1.3. Estate crops	231.1	232.8	243.8	285.3	287.7
1.4. Livestock and products	201.6	212.4	219.8	230.4	241.2
1.5. Forestry	337.7	307.6	245.7	196.4	203.2
1.6. Fishery	174.3	182.2	193.5	204.1	216.8
2. Mining and quarrying	1,046.9	1,034.6	1,069.1	939.8	956.5
3. Manufacturing industries	1,395.3	1,704.6	1,877.8	1,900.7	1,942.5
4. Electricity, gas and water supply	68.6	77.9	89.9	105.5	112.8
5. Construction	562.8	639.3	720.2	757.8	804.5
6. Wholesale and retail trade	1,681.1	1,851.9	2,042.6	2,158.8	2,240.2
7. Transport and communication	559.8	609.4	676.9	716.6	752.5
8. Banking and other financial intermediaries	179.6	207.8	231.4	258.4	276.5
9. Ownership of Dwelling	306.1	335.8	358.7	377.4	400.6
10. Public administration and defence	805.1	971.7	1,075.8	1,114.5	1,176.2
11. Services	304.0	311.3	318.7	326.1	334.3
12. Gross domestic product	10,164.9	11,169.2	12,054.6	12,325.4	12,842.2

Table-3 Expaenditure on Gross Domestic Product at Current Market Prices

(Billion Pupiahs)

1979 - 1983

TYPE OF EXPENDITURE	1979	1980	1981r)	1982x)	1983x)
(1)	(2)	(3)	(4)	(5)	(6)
1. Private consumption expenditure	19.513.7	27.502.9	35.560.0	41.670.3	49.231.0
2. General government consumption expenditure	3.733.4	4.688.2	5.787.9	6.831.7	7.791.3
3. Gross domestic fixed capital formation	6.704.3	9.485.2	11.553.4	13.467.1	17.187.7
4. Export of goods and services	9.628.7	13.849.2	14.927.9	13.345.2	17.732.9
5. Less : Import of goods & services	7.554.7	10.079.8	13.802.2	15.681.7	20.728.2
6. Gross domestic product	32.025.4	45.445.7	54.027.0	59.632.6	71.214.7
7. Net factor income from abroad	-1.484.4	-2.010.7	-1.924.9	-1.957.5	-3.035.9
8. Gross national product	30.541.0	43.435.0	52.102.1	57.675.1	68.178.8
9. Less : Net indirect taxes	1.304.8	1.634.6	1.752.2	2.132.5	2.280.6
10. Less : Depreciation	2.089.4	2.962.1	3.511.8	3.876.1	4.629.0
11. Net national product at factor cost (National income)	27.146.8	38.838.3	46.838.1	51.666.5	61.269.2

a) Residual

Table-4 Expenditure on Guros Domestic Product at Constant 1973 Market Prices

(Billion Rupiahs)

1979 - 1983

TYPE OF EXPENDITURE	1979	1980	1981r)	1982x)	1983x)
(1)	(2)	(3)	(4)	(5)	(6)
1. Private consumption expenditure	7.865.8	8.867.7	10.349.5	10.697.5	11.501.1
2. General government consumption expenditure	1.345.0	1.489.6	1.641.0	1.776.1	1.758.9
3. Gross domestic fixed capital formation	2.436.0	2.896.0	3.218.5	3.636.7	3.921.2
4. Export of goods and services	1.822.0	1.719.3	1.678.2	1.444.3	1.535.0
5. Less : Import of goods & services	3.303.9	3.803.4	4.832.6	5.229.2	5.874.0
6. Gross domestic product	10.164.9	11.169.2	12.054.6	12.325.4	12.842.2
7. Net factor income from abroad	-649.2	-758.7	-673.7	-652.7	-835.1
8. Gross national product	9.515.7	10.410.5	11.380.9	11.672.7	12.007.1
9. Less : Net indirect taxes	495.7	544.3	587.4	600.6	625.8
10. Less : Depreciation	663.5	728.5	786.2	803.9	837.6
11. Net national product at factor cost (National income)	8.356.5	9.137.7	10.007.3	10.268.2	10.543.7

a) Residual

1.3 Traffic Forecast and Data Concerning Calculation of Required Circuits

1.3.1 Traffic Distribution between Terrestrial Transmission Network and Satellite Communication Network

Economic life of submarine cable system is 25 years. Therefore, when designing initial stage installation in the estimated requirement for circuits 25 years after service-in, the following items must be considered for estimation of required circuits:

(1) Policy for traffic distribution between terrestrial transmission network and satellite communication network.

(2) Terrestrial transmission network and satellite communication network expansion plans.

(3) Traffic routing.

(4) Demand forecast in project related areas.

(5) Technical constraints, e.g., channel capacity of existing system and prohibition on double hops via satellite.

All the foregoing items are now being studied by JICA survey team for long term telecommunications network plan of the Republic of Indonesia, and final decision has not yet been reached. This time, for those preconditions, provisional assumptions are used as under.

(1) Traffic Distribution between Terrestrial Transmission Network and Satellite Communication Network.
Both networks hold their respective advantages so that traffic distribution between them cannot be determined by mere economic comparison. Policy is considered to be the deciding factor for traffic distribution between the two networks.

In this study, the guidelines are in accordance with the philosophy used in REPELITA-IV program. That is to say,

(A) In the areas where terrestrial transmission network is fully developed, such network be utilized preferentially. Provided, to secure alternative route, satellite link to carry 10% of traffic be established.

(B) In the areas where terrestrial transmission network exists but its capacity is deficient, traffic be distributed to satellite link by 20%, 40%, 60% or 80%, depending upon the capacity of existing terrestrial transmission network.

(C) In the areas where terrestrial transmission network establishment is difficult, traffic be distributed 100% to satellite link.

Traffic distribution rates by regions used in REPELITA-IV, whereon the above traffic distribution plan is based, appear in table 5.

(2) Terrestrial Transmission Network and Satellite Communication Network Expansion Plans

As regards the long term expansion plan for toll transmission network throughout Indonesia inclusive of satellite communication network, JICA team is making pertinent study at present as mentioned previously, and no conclusion has yet been reached. Therefore, in this study, transmission network expansion plan described as under is assumed.

(A) Terrestrial Transmission Network Expansion Plan

For terrestrial transmission network expansion plan, the guideline is to establish loop network interconnecting main islands. For this purpose, full network digitalization is to

be completed by the year 2000 (refer to "Indonesian Telecommunications Plan for 2000") and, at the same time, microwave radio systems and submarine cable systems are to be constructed were necessary.

This time, project coverage islands are Kalimantan, Sulawesi, Halmahera, Maluku and Irian Jaya.
These islands are to be interconnected by submarine cable systems during REPELITA-IV period.

The existing Eastern Microwave Radio System which links Sulawesi and Jawa-Bali features high quality transmission performance as it functions stably.

For the present, it constitutes the backbone toll transmission route that connects both islands.

However, the Eastern Microwave Ratio System capacity is not greater than 960 CH. Futhermore, when establishing additional system by digital system on the same route, technical infeasibility is foreseen because of more than 170 km by one hop section that exists on the route. For these reasons, Sulawesi island overflow traffic from Eastern Microwave Radio System, as well as trunk traffic to Jawa from Sulawesi islands east of Sulawesi, is bound to proceed by way of Kalimantan, i.e., via Surabaya-Banjarmasin submarine cable system, protected this time.

As for terrestial transmission network on each island, networks in Kalimantan and Sulawesi are to be fully improved by 1990 and networks on islands east of Sulawesi by 2000. This fact signifies that up to 90% of urban traffic on each island will be routed to those terrestrial transmission systems.

(B) Satellite Communication Network Expansion Plan

For satellite communication network, the most important study item is to do without double hops or more. This is because of transmission time lag of about 0.5 sec. per hop.

Even though national calls can do with one hop, international calls sometimes proceed via one more hop of international satellite, causing about one sec. transmission time lag to develop on one way. Thus, in the case of both way communication, about two sec. time lag takes place between "question" and "response". In telephone speech, "hard to converse" inconvenience arises and, in data communication, "unnecessary waiting time" increases.

In spite such disadvantages but by reason of easiness of construction, as well as maintenance and operation, of earth stations, satellite communication system will assume greater importance than heretofore as effective transmission system in the areas where terrestrial transmission system construction is difficult. As such, it will continue to be expanded.

National communication satellites of Indonesia, PALAPA-A and PALAPA-B, hold 12 and 24 transponders, respectively. Satellite to be launched from now foreward is expected to have greater capability than the two now in operation. However, as shown in Table 6, the new satellite is to be used for other communication categories than national public telecommunication also and for overseas communication as well; besides, separate use is scheduled for demand assignment (DA) system and pre-assignment (PA) system. Considering this fact, channel assignment for national public communication is assumed to be about 10,000 CH (approx. 8,000 Erlang) at a maximum.

Table-5 Traffic Distribution Rates by Regions in REPELITA-IV

MATRIK DISTRIBUSI SIRKIT

VIA TRANSMISI TERRESTRIAL VS TRANSMISI SATELIT

FROM \ TO	I	II	III	IV	V	VI	VII	VIII
I	–	40 %	40 %	100 %	100 %	100 %	100 %	100 %
II	40 %	10 %	10 %	80 %	100 %	80 %	100 %	100 %
III	40 %	10 %	10 %	40 %	60 %	60 %	100 %	100 %
IV	100 %	80 %	40 %	40 %	100 %	80 %	100 %	100 %
V	100 %	100 %	60 %	100 %	60 %	60 %	100 %	100 %
VI	100 %	80 %	60 %	80 %	60 %	20 %	100 %	100 %
VII	100 %	100 %	100 %	100 %	100 %	100 %	90 %	100 %
VIII	100 %	100 %	100 %	100 %	100 %	100 %	100 %	90 %

KETERANGAN :

I. PULAU BATAM
II. PULAU SUMATERA
III. P.JAWA+BALI
IV. P.KALIMANTAN
V. KEP.NUSA TENGGARA
VI. P.SULAWESI
VII. KEP.MALUKU
VIII. P.IRIAN JAYA

CATATAN :

1. Elemen matrik menyatakan persentase kanal Satelit sedangkan selisihnya adalah terrestrial.
2. Elemen matrik tersebut di atas dapat diubah disesuaikan dengan kondisi sarana transmisi yang ada di lokasi tersebut.

Table-6 PALAPA Satellite Transponder Arrangement

	PALAPA A2		PALAPA B1		
1.	SCPC／HANKAM－BACKUP	1.	SCPC	1′	SCPC
2.	SCPC／HANKAM－OP	2.	SCPC	2′	SCPC
3.	TV ／PHILIPPINES	3.	FDMA	3′	TDMA
4.	TV ／THAILAND	4.	FDMA	4′	TDMA
5.	TV ／MALAYSIA	5.	FDMA	5′	TDMA
6.	TV ／THAILAND	6.	FDMA	6′	TDMA
7.		7.	FDMA	7′	FDMA
8.		8.	TV	8′	FDMA
9.	SCPC／THAILAND	9.	FDMA	9′	TDMA
10.	SCPC／MAL. PHIL	10.	SCPC／ PA	10′	TDMA
11.	TV ／OCCASIONAL	11.	TV. FDMA －BACKUP	11′	TDMA
12.	TV ／MALAYSIA	12.	FDMA	12′	TDMA

FDMA : 600CH/Tr. TDMA : 900CH/Tr. SCPC : 1000CH/Tr. (VOX)

(3) Telephone Demand Forecast

For telephone demand forecast, in-depth description is made in Study Report Volume I, Chapter 3. Here, forecast results necessary for traffic distribution calculations are shown.

Table-7 Demand Distribution in Urban Areas

(Unit: 1,000)

Year / Demand	1990	1995	2000	2005	2010	2015	(2014)
Jawa	936	1,518	2,195	2,905	3,652	4,428	4,267
Sumatera	205	313	424	527	622	710	694
Kalimantan	45	66	88	105	122	138	134
Sulawesi	72	116	163	209	256	302	293
Others	347	509	664	800	906	992	981
Total	1,605	2,522	3,534	4,546	5,558	6,570	6,369

Table-8 Demand Forecast by Islands in Rural Areas

(Unit: 1,000)

	1990	1995	2000	2005	2010	2015	(2014)
Jawa	460	614	820	1,026	1,232	1,439	1,397
Sumatera	169	226	304	380	457	533	518
Kalimantan	40	52	68	85	102	119	116
Sulawesi	43	58	78	98	117	137	133
Others	53	71	94	118	142	165	160
Total	765	1,021	1,364	1,707	2,050	2,393	2,324

Table-9 Demand Forecast

(Unit: 1,000)

Area		1990	1995	2000	2005	2010	2015	(2014)
Jawa	Urban	936	1,518	2,195	2,905	3,652	4,428	4,268
	Rural	460	614	820	1,026	1,232	1,439	1,397
Sumatera	Urban	205	313	424	527	622	710	694
	Rural	169	226	304	380	457	533	518
Kalimantan	Urban	45	66	88	105	122	138	134
	Rural	40	52	68	85	102	119	116
Sulawesi	Urban	72	116	163	209	256	302	293
	Rural	43	58	78	98	117	137	133
Others	Urban	347	509	664	800	906	992	981
	Rural	53	71	94	118	142	165	160

(4) Traffic Calculation Methodology

Based on national demand forecast in Table 5, calculation is made for satellite communication network traffic and terrestrial transmission network traffic whereby to obtain traffic that proceeds via Surabaya-Banjarmasin submarine cable system projected this time.

(A) Satellite Network and Terrestrial Network Traffic distribution Formulas

Formula whereby to obtain traffic to be distributed to satellite network (T_s) is as under.

T_s = (Demand forecast) x (Satellite communication traffic distribution create) x (Average calling rate per subscriber) x (Toll calling rate) x (demand fulfillment rate) x (Out-of-island coefficient)

Formula whereby to obtain traffic to be distributed to terrestrial network (T_t) is as under.

T_t = (Demand forecast) x (Terrestrial route traffic distribution rate) x (Average calling rate per subscriber) x (Toll calling rate) x (Demand fulfillment rate) x (Out-of-island coefficient)

where

(Demand forecast) : By Table 9

(Satellite communication traffic distribution rate) : To be assumed as in Table 10. Calculation presupposes that the philosophy used in REPELITA-IV program and island by island terrestrial

transmission network expansion plan hold true until 2015.

(Terrestrial route traffic distribution rate) :

by Table 12

(Average calling rate per subscriber) :

52.24×10^{-3} (Erlang)

(Toll calling rate) : 0.16

(Out-of-island coefficient) :

For toll calls, the ratio between traffic to be digested inside the island and traffic to flow out of the island by terrestrial transmission network is to be 4:6. The most part of traffic to flow out of the island concentrates in Jawa. Satellite network handles traffic between intra-island two points also. Hence out-of-island coefficient = 1.

(B) Satellite Communication Traffic Distribution Rate and Traffic

Table 10 presents satellite communication traffic distribution rates. In Kalimantan, urban areas will have terrestrial transmission network completed by 2000. In the most part of other areas, terrestrial transmission network construction will be delayed so that these areas have only to utilize satellite network.

By the earlier introduced calculation formula, satellite communication traffic as in Table 11 can be obtained.

Total traffic of satellite communication is assumed to be about 8,000 Erlang at a maximum as previously stated.

(C) Traffic Propensity by Province

As stated in Study Report, Volume I, Kalimantan Barat out of four Kalimantan provinces holds strong traffic propensity to/from Sumatera so that 80% of traffic from Kalimantan is assumed to proceed via the projected Surabaya-Banjarmasin submarine cable system.

Table-10 Satellite Communication Traffic Distribution Rates

(Unit: %)

Area		1990	1995	2000	2005	2010	2015	(2014)
Jawa	Urban	10	10	10	10	10	10	10
	Rural	40	30	20	10	10	10	10
Sumatera	Urban	20	20	10	10	10	10	10
	Rural	80	60	60	40	20	10	20
Kalimantan	Urban	20	20	10	10	10	10	10
	Rural	80	60	60	40	40	20	40
Sulawesi	Urban	30	30	20	10	10	10	10
	Rural	60	60	60	40	40	40	20
Others	Urban	100	80	60	40	40	20	20
	Rural	100	100	80	80	60	60	60

Table-11 Satellite Communication Traffic

(Unit: Erlang)

Area		1990	1995	2000	2005	2010	2015	(2014)
Jawa	Urban	665.12	1078.69	1559.77	2064.29	2595.11	3146.54	3032.13
	Rural	1307.50	1308.93	1165.38	729.08	875.46	1022.55	992.71
Sumatera	Urban	291.35	444.84	301.29	374.49	441.99	504.53	493.16
	Rural	960.73	963.57	1296.13	1080.11	649.49	378.75	736.18
Kalimantan	Urban	63.95	93.80	62.53	74.61	86.69	98.06	95.22
	Rural	227.39	221.71	289.92	241.60	289.92	169.12	329.72
Sulawesi	Urban	153.49	247.29	231.66	148.52	181.91	214.60	208.21
	Rural	183.33	247.29	332.56	278.56	332.56	194.70	189.02
Others	Urban	2465.78	2893.56	2831.03	2273.92	2575.21	1409.83	1394.20
	Rural	376.62	504.53	534.37	670.81	605.43	703.49	682.18

(D) *Terrestrial Transmission System Traffic Distribution Rate and Traffic*

Table-12 Terrestrial Transmission System Traffic Distribution Rates

(Unit: %)

Area		1990	1995	2000	2005	2010	2015	(2014)
Jawa	Urban	90	90	90	90	90	90	90
	Rural	60	70	80	90	90	90	90
Sumatera	Urban	80	80	90	90	90	90	90
	Rural	20	40	40	60	80	90	80
Kalimantan	Urban	80	80	90	90	90	90	90
	Rural	20	40	40	60	60	80	60
Sulawesi	Urban	70	70	80	90	90	90	90
	Rural	40	40	40	60	60	80	80
Others	Urban	0	20	40	60	60	80	80
	Rural	0	0	20	20	10	40	40

Table-13 Terrestrial Transmission System Traffic

(Unit: Erlang)

Area		1990	1995	2000	2005	2010	2015	(2014)
Jawa	Urban	3590.97	5823.82	8421.13	11145.50	14010.92	16988.05	16370.37
	Rural	1176.53	1832.141	2796.39	3936.25	4726.57	5520.73	5359.60
Sumatera	Urban	699.10	1067.40	1626.68	2021.84	2386.31	2723.92	2662.53
	Rural	144.08	385.36	518.35	971.91	1558.47	2044.86	1766.50
Kalimantan	Urban	153.46	225.07	337.61	402.83	468.05	529.44	514.09
	Rural	34.10	88.67	115.95	217.40	260.881	405.82	296.69
Sulawesi	Urban	214.84	316.14	55.87	801.83	982.15	1158.62	1124.10
	Rural	73.32	98.90	133.00	250.65	299.25	467.20	453.56
Others	Urban	0.00	433.95	1132.20	2046.14	2317.25	3382.95	3315.43
	Rural	0.00	0.00	80.14	100.60	242.13	281.31	272.82

Terrestrial transmission system traffic in Table 13 excludes traffic that originates and terminates in each island. In other words, traffic quoted in the table is inter-island submarine cable system traffic and microwave system traffic.

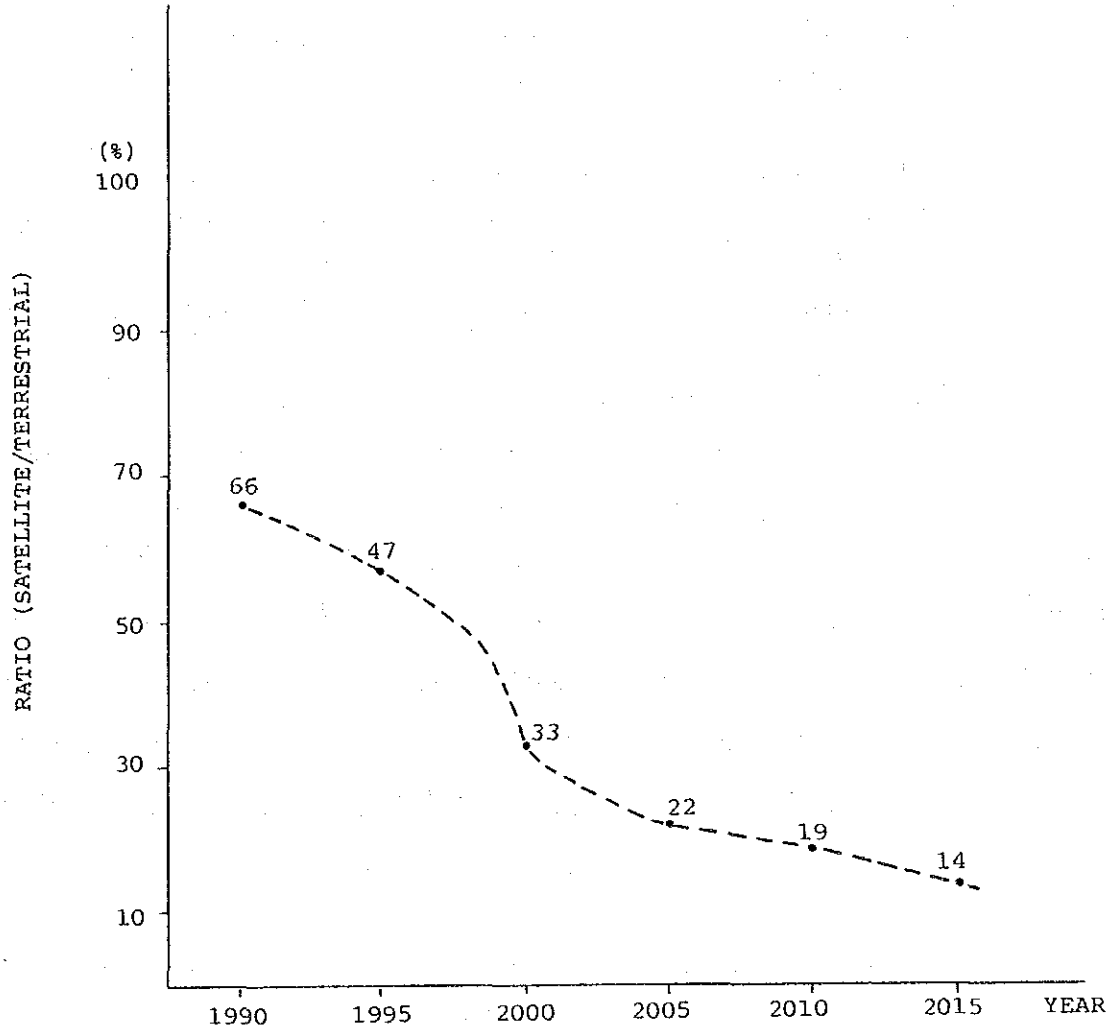


Figure-1 Toll Traffic Distribution between Satellite Network and Terrestrial Transmission Network

Figure 1 shows national toll traffic distribution between satellite network and terrestrial transmission network.

(E) Project Related Areas and Traffic

Table 14 presents traffic breakdown by users in the areas related to this project.

Related areas comprise Kalimantan, Sulawesi and others (Maluku, Halmahera and Irian Jaya). Others include areas not related to this product, such as Bali and Timor so that 60% of others is regarded as being related to this project.

Table-14 Terrestrial Transmission System Traffic in Project Related Areas

Area	1990	1995	2000	2005	2010	2015	(2014)
Kalimantan	187.56	313.74	453.56	620.23	728.93	935.26	810.78
Sulawesi	288.16	445.04	688.87	1052.48	1281.40	1625.82	1577.66
Others(60%)	0.00	260.37	727.40	1288.04	1585.63	2198.57	2170.95
	475.72	1019.15	1249.83	1794.75	3545.96	4759.65	4559.39

(F) Surabaya-Banjarmasin Submarine Cable System Traffic

As regards Sulawesi traffic out of Table 14 traffic, about 900 Erlang is handled by the earlier mentioned Eastern Microwave Radio System (capacity: 960 CH) so that traffic exceeding such limit is considered to flow to Kalimantan route. In other words, in the year 2005 and after, traffic from Sulawesi is to flow to Kalimantan route.
Other islands (Halmahera, Irian Jaya, etc.) are to be interconnected by submarine cable system by 1995 so that the whole traffic to/from those islands is to flow to Kalimantan route; however, Jawa-Irian Jaya submarine cable system is considered to be completed by 2005 so that traffic flow will

be divided in two, i.e., 50% to Kalimantan route and the remaining 50% to Jawa-Irian Jaya route.

Table 15 presents traffic flow estimate by the projected Surabaya-Banjarmaisn submarine cable system.

Table-15 Surabaya-Banjarmasin Submarine Cable System Traffic

(Unit: Erlang)

Area	1990	1995	2000	2005	2010	2015	(2014)
Kalimantan	150	251	363	496	583	748	648
Sulawesi	-	-	-	293	521	866	818
Others(60%)	-	260	727	644	768	1100	1085
	150	511	1090	1433	1872	2714	2551

(5) Calculation of Required Circuits

Given in Table 15 is the telephone traffic forecast. It can be expressed in the number of required circuits as shown in Table 16.

Circuit requirement to cater for other services than telephone, i.e., telex service, leased circuit service and new services, is estimated at 10% of telephone circuits.

Channel allocation to those circuits is by group division, i.e., by originating/terminating circuits from/to Kalimantan and trunk circiuts, and by telephone circuits, telex circuits, leased circuits and other service circuits. Therefore, to cover group division loss, 20% surplus circuits are to be installed.

All the foregoing is considered in final calculation of required circuits. During 2000 through 2005, 140 Mbit/s circuits will be almost completely occupied. In 2015, 140 Mbit/s x 2 (or 280 Mbit/s x 1) circuits will be fully occupied.

Table 16 Number of Required Circuits

Circuit Classification	1990	1995	2000	2005	2010	2015	(2014)
Telephone circuits	170	570	1,210	1,600	2,100	3,000	2,850
Telex circuits, leased circuits, others	20	60	120	160	210	300	290
Sub-total	190	630	1,330	1,760	2,310	3,300	3,140
Total including 20% surplus to cover group division loss	230	760	1,600	2,110	2,780	3,840	3,770
TV circuit (spare for emergency use)	140 Mbit/s x1	140 Mbit/s x1	140 Mbit/s x1	64 Mbit/s x1	64 Mbit/s x1		

1.3.2 Data Used in Originating Calling Rate Analysis : Table 17

Traffic Distribution : Table 18

Table 17 Data Used in Originating Calling Rate Analysis

Name of Province	Subscriber				No. of Pulses (x 1,000 pls)			
	1979	1980	1981	1982	1979	1980	1981	1982
ACEH	1,775	2,266	3,897	5,083	7,306	13,702	17,767	42,944
SUMATERA UTARA	17,003	21,709	25,889	30,864	184,889	244,119	297,193	343,605
SUMATERA BARAT	5,078	5,947	6,080	6,240	39,363	51,188	56,106	67,626
RIAU	2,979	3,488	4,161	4,295	14,765	20,950	30,921	37,476
JAMBI	2,679	2,873	2,872	2,894	22,041	26,599	29,756	30,598
SUMATERA SELATAN	4,505	4,832	5,780	6,880	62,424	82,478	97,976	114,973
LAMPUNG	3,930	4,215	4,802	4,946	29,703	39,641	50,426	57,579
BENGKULU	858	921	927	939	299	710	3,213	5,458
JAKARTA	93,486	122,970	151,560	171,894	1,101,931	1,502,767	1,862,343	2,110,410
JAWA BARAT	29,742	34,421	37,447	40,020	237,223	308,699	399,337	438,068
JAWA TENGAH	21,602	28,013	29,953	31,808	158,681	217,642	316,250	356,408
YOGYAKARTA	2,530	3,281	3,626	3,811	32,410	41,671	48,183	59,125
JAWA TIMUR	45,323	52,361	58,430	65,344	386,420	501,302	615,741	676,277
BALI	3,222	4,164	4,968	5,254	40,709	51,176	63,537	67,734
NUSA TENGGARA BARAT	1,902	2,458	3,083	3,426	4,011	6,192	23,893	25,853
NUSA TENGGARA TIMUR	809	1,046	1,251	1,322	15,204	15,514	8,413	11,470
TIMOR TIMUR	256	330	340	380	-	-	-	-
KALIMANTAN BARAT	972	1,749	1,888	1,891	16,111	21,026	25,302	30,555
KALIMANTAN TENGAH	385	693	830	878	299	643	1,401	2,911
KALIMANTAN SELATAN	1,601	2,883	2,890	3,325	33,265	41,777	50,399	55,534
KALIMANTAN TIMUR	1,357	2,443	4,262	5,333	591	1,288	64,766	89,874
SULAWESI UTARA	2,336	3,106	3,319	3,414	35,713	46,525	57,044	69,932
SULAWESI TENGAH	654	870	930	934	258	616	5,461	11,735
SULAWESI SELATAN	6,331	8,417	9,944	11,990	60,107	81,439	110,147	133,705
SULAWESI TENGGARA	501	666	839	912	60	145	2,749	7,916
MALUKU	1,521	1,507	2,283	2,827	15,646	22,807	30,372	38,264
IRIAN JAYA	359	1,674	3,173	3,614	6,310	12,826	28,228	56,731
TOTAL	253,696	319,303	375,424	410,518	2,505,739	3,353,442	4,296,924	4,942,761

Table 18 Traffic Distribution

No. of Cells, Sep. 1983

Distination	Primary Area		Other Areas	Total
	Primary Center	Other Exchanges		
	3,462 (79.4)	233 (5.3)	669 (15.3)	4,362 (100)
	171 (10.6)	467 (29.0)	922 (57.4)	1,607 (100)
	19 (4.5)	77 (18.1)	329 (77.4)	425 (100)
	1,380 (26.6)	1,835 (35.4)	1,963 (37.9)	5,178 (100)
	599 (16.1)	1,701 (45.8)	1,415 (38.1)	3,715 (100)
	109 (22.0)	333 (67.1)	54 (10.9)	496 (100)
	1,275 (69.4)	112 (6.1)	451 (24.5)	1,838 (100)
	485 (31.6)	103 (6.7)	948 (61.7)	1,536 (100)
	613 (27.0)	18 (0.7)	1,643 (72.3)	2,274 (100)
	407 (69.1)	16 (2.4)	156 (26.5)	589 (100)
	219 (26.7)	0 (0)	601 (73.3)	820 (100)
	299 (19.8)	72 (4.8)	1,137 (75.4)	1,508 (100)
	230 (22.5)	80 (7.7)	683 (66.8)	1,022 (100)
	739 (67.3)	131 (11.9)	228 (20.8)	1,098 (100)
	139 (29.6)	67 (14.2)	264 (56.2)	470 (100)
	1,589 (48.5)	135 (4.1)	1,554 (56.2)	3,278 (100)
	14 (27.1)	0 (0)	37 (72.5)	51 (100)
	466 (27.0)	0 (0)	1,259 (73.0)	1,725 (100)
	833 (44.5)	0 (0)	1,040 (55.5)	1,873 (100)
	327 (65.8)	0 (0)	180 (36.2)	497 (100)
	453 (24.4)	0 (0)	1,403 (75.6)	1,856 (100)
	149 (21.5)	180 (25.9)	365 (52.6)	694 (100)

$\bar{x}$ = 51.24 s = 21.73

Note: Anedatel's Data Traffic

CHAPTER 2 DATA CONCERNING COMMUNICATION NETWORK PROJECT

2.1 Records of Telecommunications Facilities Related to Current Project

2.2 On-going Projects Related to Current Project

(A) Remote Area Telecommunications Network (Phase 1)

Figure 1 is a schematic view of Remote Area Telecommunications Network (Phase 1), a project now in progress. Included in this project is the construction of Sandangan Repeater Station and Bangkalan Exchange in Madura Island, as well as the construction of Surabaya Toll Exchange II and Gresik Exchange in Surabaya area.

(B) Ring Belt Radio Network

Design is being made of Ring Belt Radio Network (6 GHz) to be constructed in Surabaya area. In-depth design contents remain unknown as of May 1981. Scheduled to be used in this system is 6 GHz frequency, the same as one to be used in backhaul system of the projected Surabaya-Banjarmasin submarine cable system. Hence the need to confirm radio frequency to be used in Ring Belt radio Network when implementation work begins for the current Surabaya-Banjarmasin submarine cable system project.

2.3 Local Exchange Expansion Project in REPELETA-IV

Table 26 presents WITEL-IX (whereto Kalimantan are belongs) local exchange expansion plan. This plan constitutes an integral part of the similar project in revised (up-to-date) REPELITA-IV program.

2.4 Terrestrial Transmission Network Expansion Plan in "*Telecommunications As of 2000 Project*"

Figure 2 and 3 present schematic diagrams of terrestrial transmission network expansion plan in "Telecommunications As of 2000 Project" of the Republic of Indonesia.

Figure 4 introduces the terrestrial transmission network construction plan in REPELITA-IV and V Programs, which is now being formulated by JICA study team for long term telecommunications network expansion and improvement.

Table 19 Surabaya II (TP. Office)

1. LOCATION

a.	Address:	Jl. Kebalen Timur No.2, Surabaya
b.	Coordinates	
	Longitude:	E 112° 44' 07"
	Latitude:	S 7° 13' 52"
c.	Elevation:	3 m above sea level

2. ACCESS TO SITE

a. TP. Office is in the central area of the city.

b. No access road construction is required.

3. SITE CONDITION

a.	Site area:	Approx. 5,500 m²
b.	Building coverage:	Approx. 30% to whole area
c.	Existing grade:	Flat
d.	Subsoil:	Sandy clay
e.	Presumed bearing value of soil:	Approx. 5 tons/m²
f.	Underground water table:	Approx. 1.0 m
g.	Others:	New tower construction space for the remote area project is available in this site.

4. PROPAGATION CONDITION

The nearly same as in Surabaya I (Trans. Stn).

5. EXISTING TRANSMISSION EQUIPMENT

CIT Cox. System (Spur Route)

To Mojokerto: 72 ch;	To Madiun: 72 ch;	To Kediri: 36 ch;
To Jombang: 60 ch;	To Sidoarjo: 108 ch;	To Malang: 96 ch;
To Beton: 24 ch;	To Cresik: 72 ch	

6. EXISTING ANTENNA TOWER AND ANTENNA

None.

7. COMMERCIAL POWER SUPPLY

a.	Distribution voltage and wiring system:	220/127 V, 3ø 4 W
b.	Lead-in voltage and wiring system:	220/127 V, 3ø 4 W
c.	Frequency:	50 Hz
d.	Voltage fluctuation:	Stable
e.	Supply time:	24-hour basis supply. Power failure is few a month.

Power supply voltage will be changed to 380/220 V before long.

8. EXISTING POWER EQUIPMENT

a. Engine Generator

Deutz/Selbstregelnder Generator:	185 kVA, 220 V, 50 Hz, 3ø, 4 W x 1 set

b. AVR

None.

c. Rectifier

CIT Alkatel:	48 V x 80 A x 2 sets

d. Battery

Varta:	600 Ah x 24 cells x 1 bank

9. POWER EQUIPMENT TO BE INSTALLED

Present load current from the existing rectifier is 25 A. Therefore, power supply to the telecommunication equipment of the remote area project is available from the existing power supply equipment of the Spur Coaxial Cable System.

10. EXISTING TELEPHONE SWITCH

EMD switch (2 wires): For local switching
BTM MC equipped with 10,000 l.u.

11. BUILDING TO BE USED

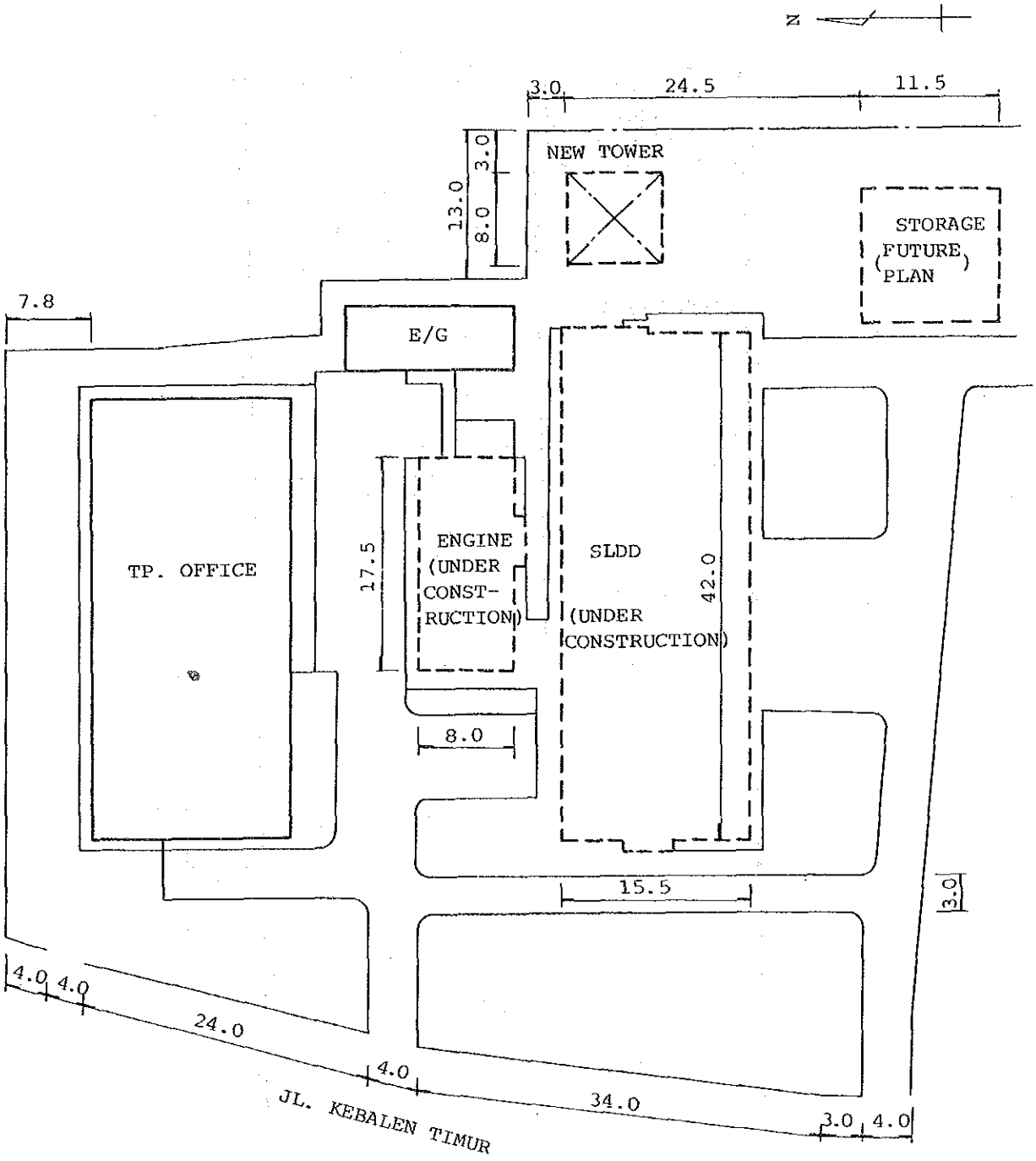
Existing transmission room can be used for the accommodation of the radio and multiplex equipment to the remote area project.

12. NEW TOWER

a. New tower construction is required.

b. When no detailed subsoil data exist, subsoil exploration is necessary for the tower structural design.

c. New tower location in Surabaya II site is more recommendable than that in Surabaya I.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NEW TOWER
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3.0
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STORAGE
(FUTURE
PLAN)
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E/G
TP. OFFICE
ENGINE
(UNDER
CONST-
RUCTION)
17.5
SLDD
(UNDER
CONSTRUCTION)
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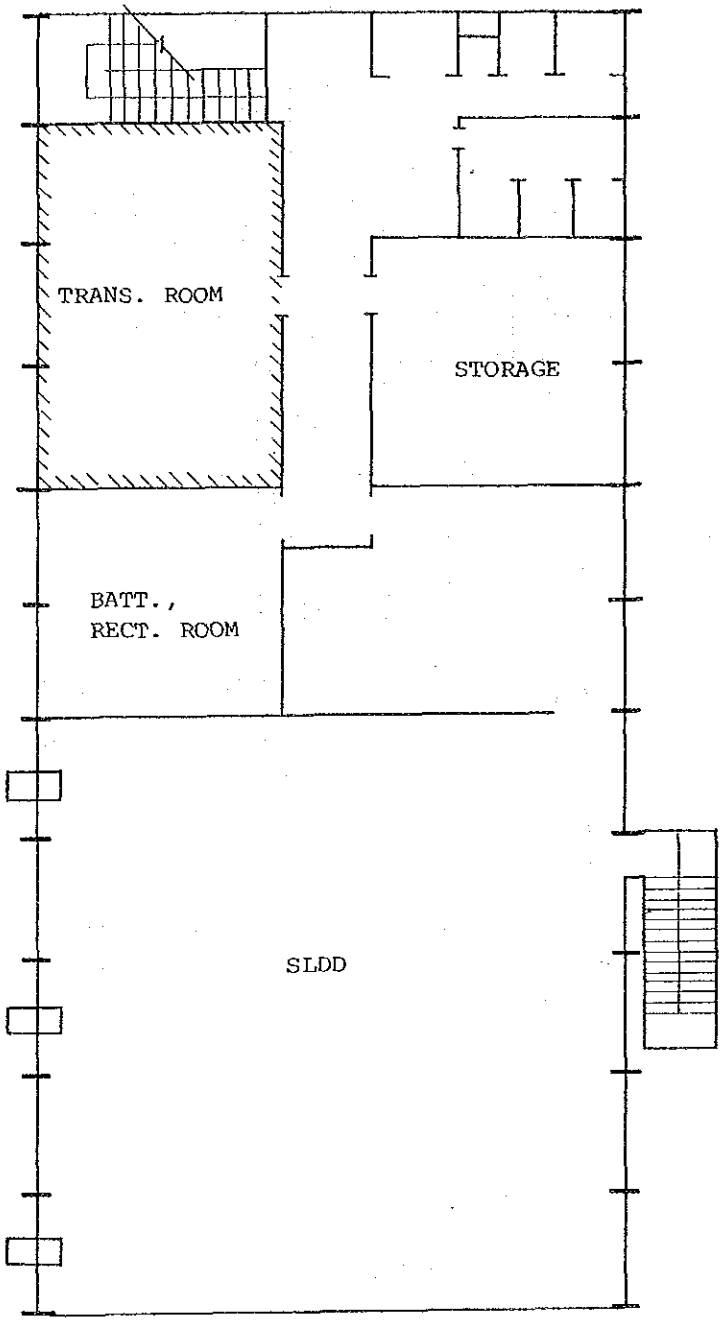
JL. KEBALEN TIMUR



2nd FLOOR

Table 20 Gn. Sandangan (REP. STN)

1. LOCATION

a.	Address:	Pemancar PERUMTEL Jrengik Sandangan
b.	Coordinates	
	Longitude:	E 113° 09' 52"
	Latitude:	S 7° 05' 38"
c.	Elevation:	262 m above sea level

2. ACCESS TO SITE

a. This station is located on the top of Gn. Sandangan.

b. No access road construction is required.

3. SITE CONDITION

a.	Site area:	Approx. 1,750 m²
b.	Building coverage:	Approx. 14% to whole area
c.	Existing grade:	Flat
d.	Subsoil:	Clayey soil with gravel
e.	Presumed bearing value of soil:	Approx. 5 tons/m²
f.	Underground water table:	Deep
g.	Others:	New tower construction space for the remote area project is available in this site.

4. PROPAGATION CONDITION

a. Propagation mode to:

Sampang (TP. Office)	Line of sight
Pamekasan (TP. Office)	Line of sight

b. Reflection point to:

Sampang (TP. Office)	Field
Pamekasan (TP. Office)	Field

c. Distance to:

Sampang (TP. Office)	14.7 km
Pamekasan (TP. Office)	35.9 km

d. Bearing to:

Sampang (TP. Office)	139° 40' 50"
Pamekasan (TP. Office)	102° 27' 22"

5. EXISTING TRANSMISSION EQUIPMENT

a. NEC, 4 GHz, 1,260 ch, 3 W, FM Microwave System

To Surabaya (Tx: 3,940.5, 3,882.5 MHz; Rx: 4,153.5, 4,095.5 MHz)

To Gn. Gerakan Lalang (Tx: 3,940.5, 3,882.5 MHz;
Rx: 4,153.5, 4,095.5 MHz)

Allocated SGs are SG1 and SG2.

b. NEC, 7 GHz, 300 ch, 0.5 W, FM Microwave System

To Pamekasan (Tx: 7,512, 7,561 MHz; Rx: 7,673, 7,722 MHz)

Allocated SGs are SG3 and SG4.

6. EXISTING ANTENNA TOWER AND ANTENNA

a.	Tower height:	24.4 m
b.	Tower shape:	Square type self-supporting
c.	Number of ant:	4
d.	Ant. size and height:	3.3 mø at 22 m (to Surabaya) 3.3 mø at 7 m (to Surabaya) 2 mø at 8 m (to Pamekasan) 2 mø at 7 m (to Gn. Gerakan Lalang)
e.	Others:	Examination of the existing tower strength is requird for the remote area project.

7. COMMERCIAL POWER SUPPLY

Not available.

8. EXISTING POWER EQUIPMENT

a. Engine Generator (Triple Prime Diesel Engine Generator)

Mitsui-Deutz/Nippon Electric Industry:	7.5 kVA, 220/127 V, 50 Hz 1ø, 3 W x 3 sets

b. AVR

None.

c. Rectifier

Sanken Electric:	24 V x 30 A x 2 sets

d. Battery

Yuasa:	130 Ah x 12 cells x 2 banks

9. POWER EQUIPMENT TO BE INSTALLED

Present load current from the existing rectifier is 20 A. Therefore, power supply to the telecommunication equipment of the remote area project is available from the existing power supply equipment of the Jawa - Kalimantan Troposcatter System.

10. EXISTING TELEPHONE SWITCH

None.

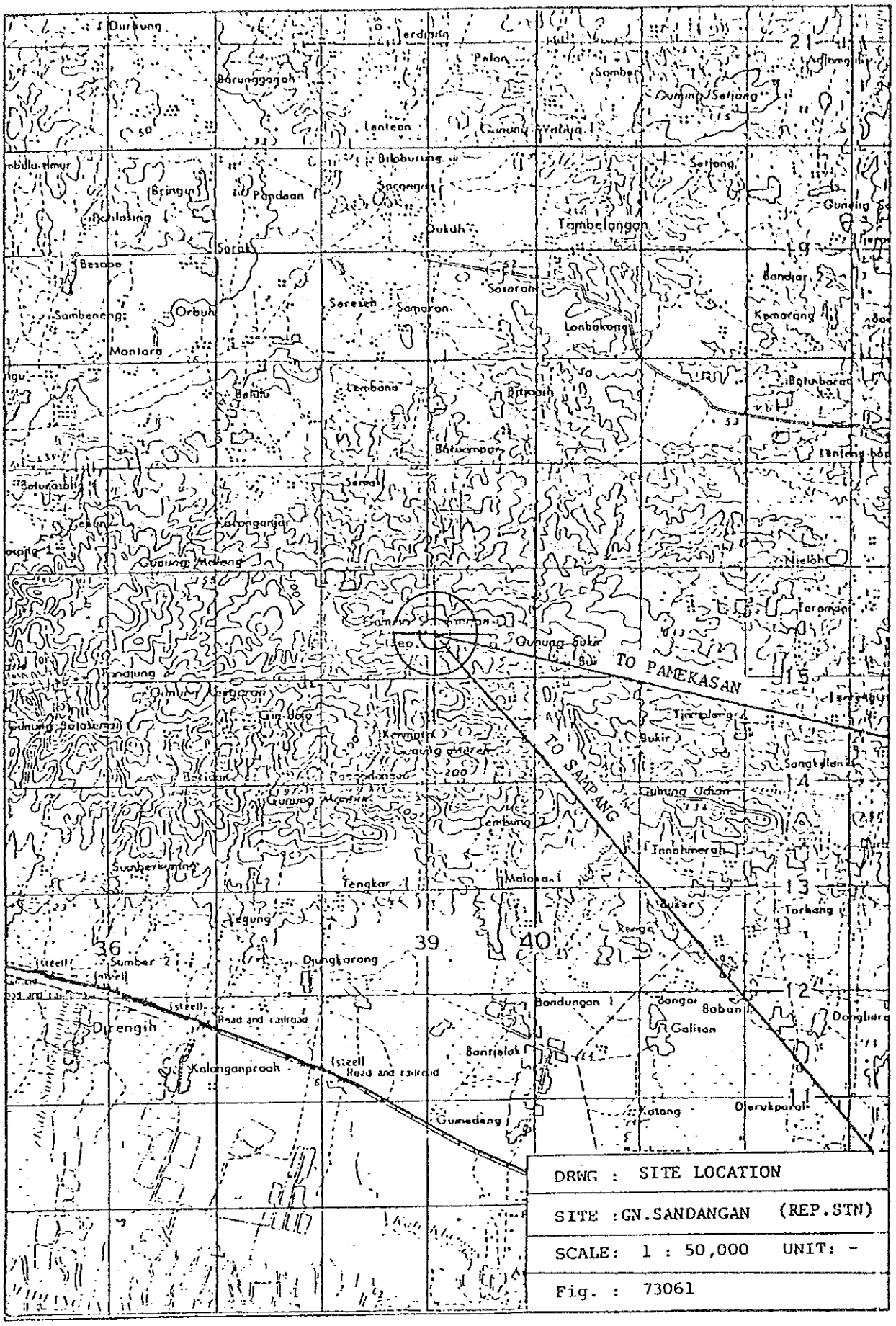
11. BUILDING TO BE USED

Existing radio room can be used for the accommodation of the radio and multiplex equipment to the remote area project.

12. NEW TOWER

a. If the existing tower cannot be used for the remote area project in respect of strength or height, new tower construction is required.

b. When no detailed subsoil data exist, subsoil exploration is necessary for the tower structural design.



DRWG :	SITE LOCATION
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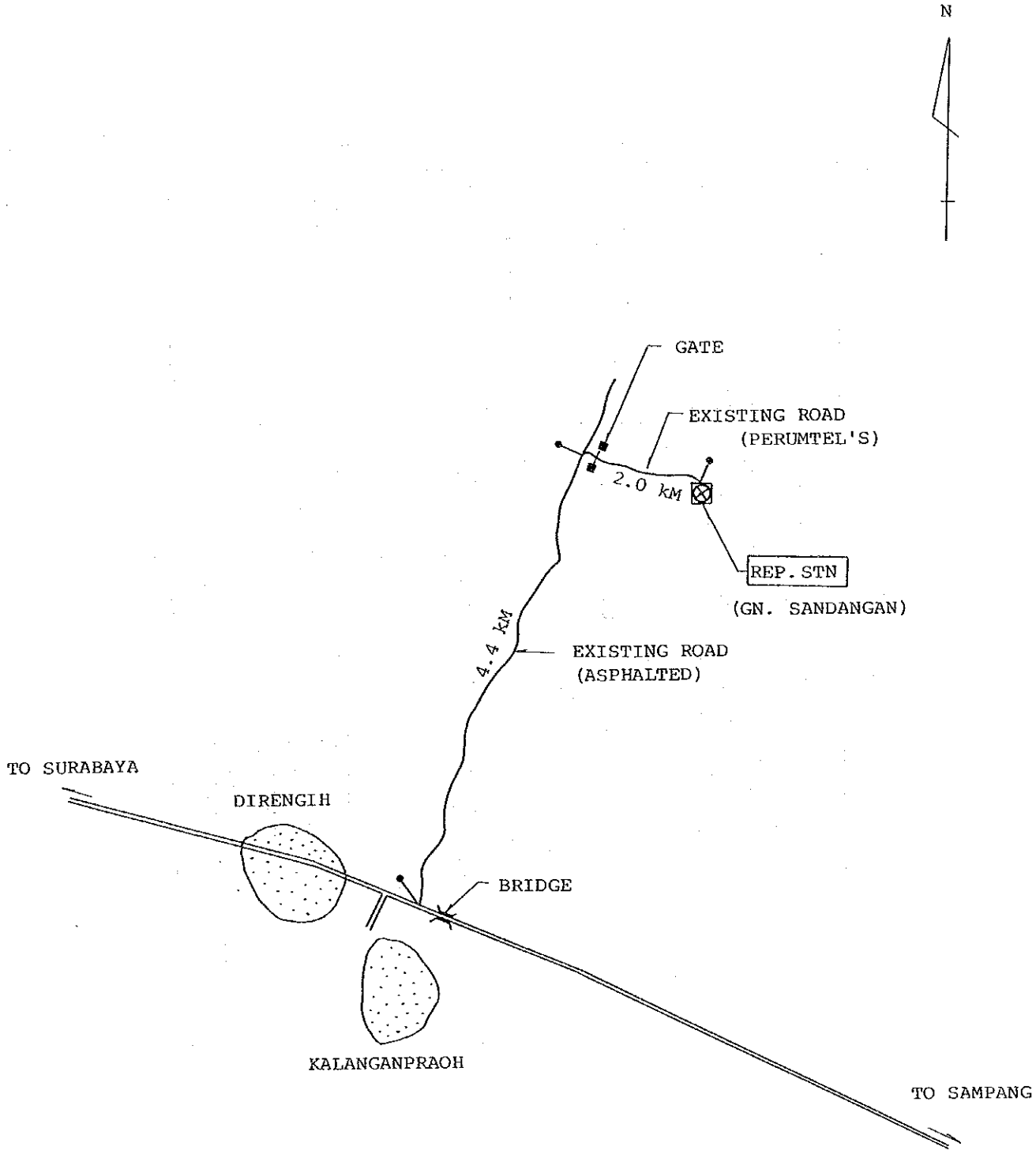
SCALE:	1 : 50,000 UNIT: -
Fig. :	73061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(GN. SANDANGAN)
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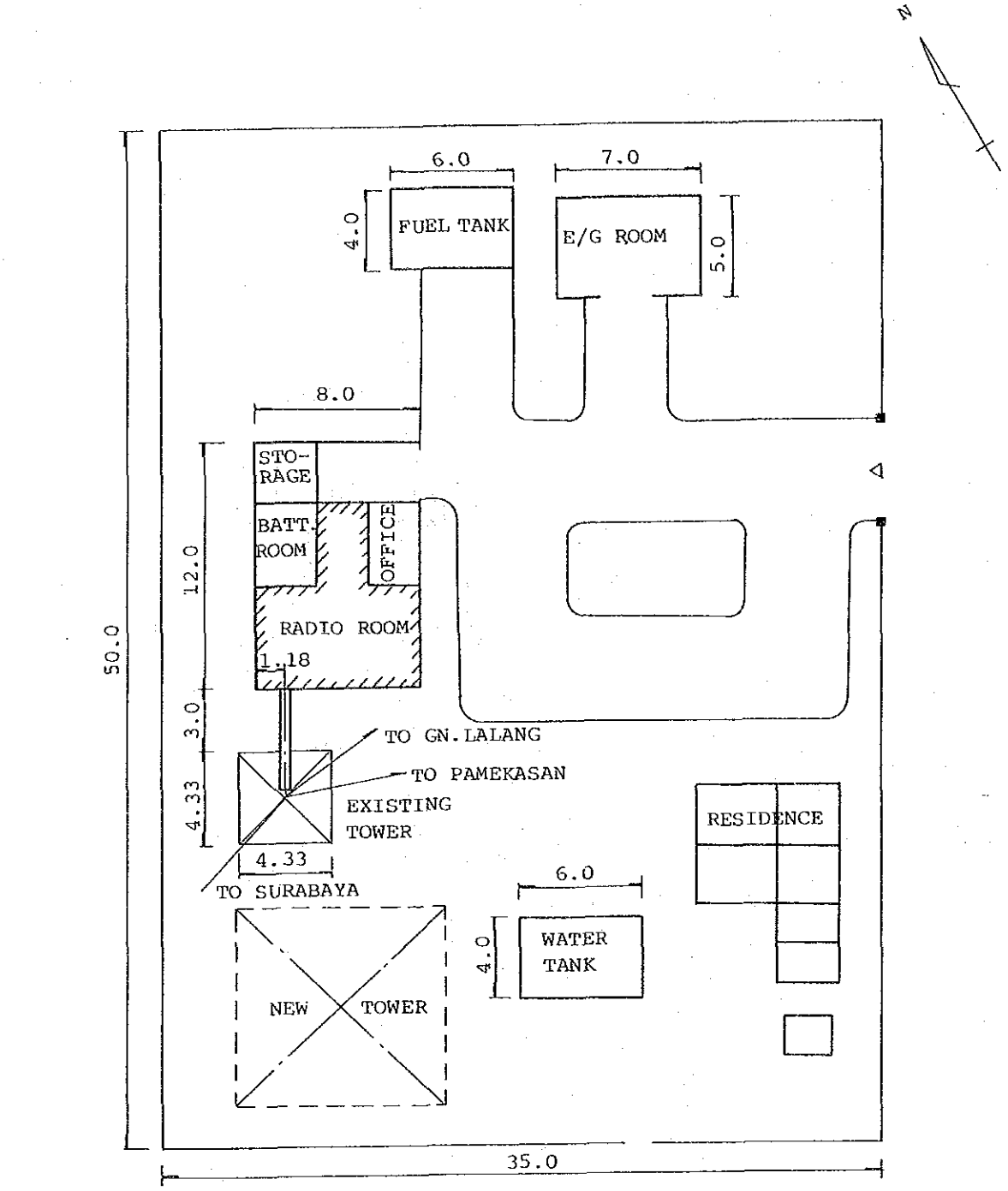
TO SURABAYA
DIRENGIH
BRIDGE
KALANGANPRAOH
TO SAMPANG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RADIO ROOM
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3.0
TO GN. LALANG
TO PAMEKASAN
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TANK
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TOWER
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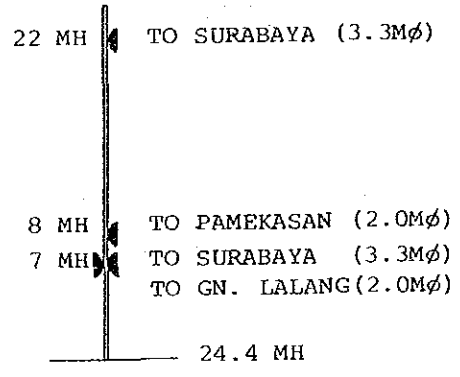
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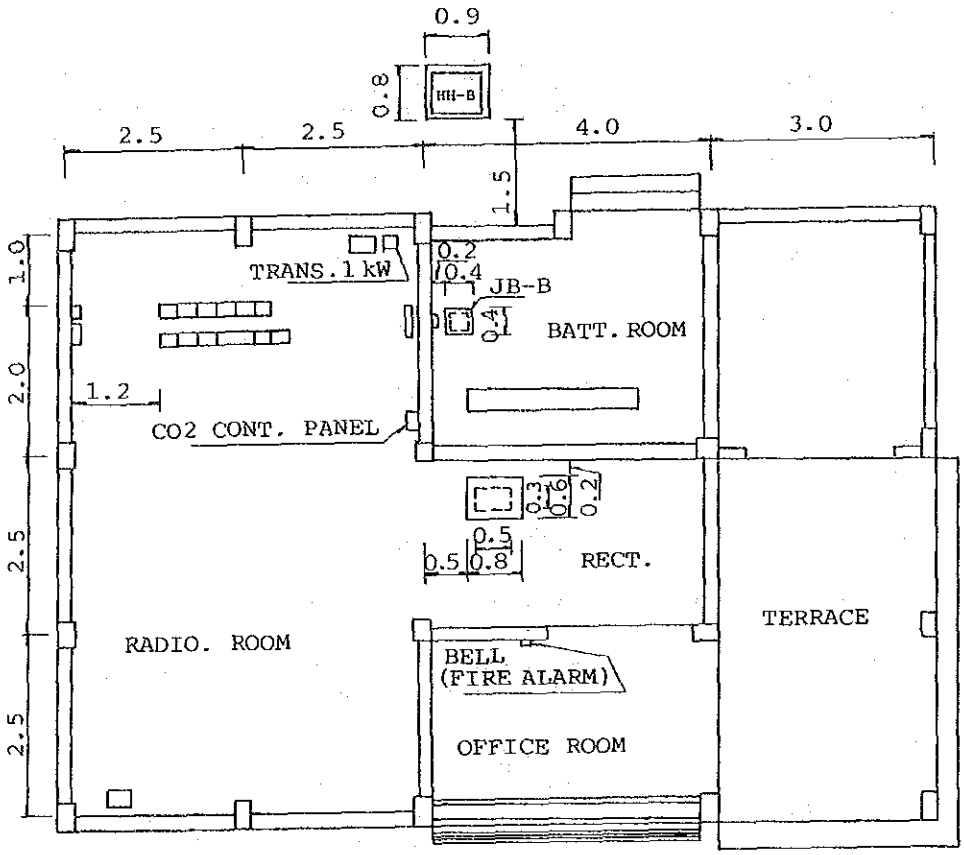
8 MH
TO PAMEKASAN (2.0MØ)
7 MH
TO SURABAYA (3.3MØ)
TO GN. LALANG(2.0MØ)
24.4 MH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HH-B
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2.5
4.0
3.0
1.5
1.0
2.0
2.5
2.5
TRANS. 1 kW
0.2
0.4
JB-B
0.4
BATT. ROOM
1.2
CO2 CONT. PANEL
0.3
0.6
0.2
0.5
0.5
0.8
RECT.
TERRACE
RADIO. ROOM
BELL
(FIRE ALARM)
OFFICE ROOM

Table 21 Gresik (TP. Office)

1. LOCATION — Ref. to Figs. 73031 and 73032

   a. Address: — Jl. J.A. Suprapto, Gresik

   b. Coordinates

      Longitude: — E 112° 39' 01"
      Latitude: — S 7° 09' 40"

   c. Elevation: — 5 m above sea level

2. ACCESS TO SITE

   a. TP. Office is in the central area of the city.

   b. No access road construction is required.

3. SITE CONDITION

   a. Site area: — Approx. 3,380 m²

   b. Building coverage: — Approx. 5% to whole area

   c. Existing grade: — Flat (Backyard part of the site is approx. 30 - 50 cm lower.)

   d. Subsoil: — Clayey soil

   e. Presumed bearing value of soil: — Approx. 5 tons/m²

   f. Underground water table: — Approx. 2 m

   g. Others: — New tower construction space for the remote area project is available in this site.

4. PROPAGATION CONDITION

   a. Propagation mode to:

Surabaya I (Trans. STN)	Line of sight
Lamongan (TP. Office)	Diffraction
Bangkalan (TP. Office)	Radio path on the spherical earth

   b. Reflection point to:

Surabaya I (Trans. STN)	Sea
Lamongan (TP. Office)	Rice field
Bangkalan (TP. Office)	Sea

c. Distance to:

Surabaya I (Trans. STN)	12.5 km
Lamongan (TP. Office)	26.2 km
Bangkalan (TP. Office)	18.7 km

d. Bearing to:

Surabaya I (Trans. STN)	130° 50' 48"
Lamongan (TP. Office)	279° 42' 06"
Bangkalan (TP. Office)	37° 10' 00"

5. EXISTING TRANSMISSION EQUIPMENT

CIT Cox. System (Spur Route)

To Surabaya: 72 ch

6. EXISTING ANTENNA TOWER AND ANTENNA

None.

7. COMMERCIAL POWER SUPPLY

a.	Distribution voltage and wiring system:	380/220 V, 3ø 4 W
b.	Lead-in voltage and wiring system:	380/220 V, 3ø 4 W
c.	Frequency:	50 Hz
d.	Voltage fluctuation:	Stable
e.	Supply time:	24-hour basis supply. Power failure is 3 times a month; the power failure duration is 5 hours each time.

8. EXISTING POWER EQUIPMENT

a. Engine Generator

Benz/AVK: 45 kVA, 400 V, 3ø, 4 W, 50 Hz x 1 set

b. AVR

None.

c. Rectifier

CIT Alkatel:	48 V x 16 A x 2 sets (for CIT Transmission System)

d. Battery

Tudor:	240 Ah x 24 cells x 1 bank (for CIT Transmission System)

9. POWER EQUIPMENT TO BE INSTALLED

Present load current from the existing rectifier is 6 A. Therefore, power supply to the telecommunication equipment of the remote area project is available from the existing power supply equipment of the Spur Coaxial Cable System.

10. EXISTING TELEPHONE SWITCH

Container type EMD switch.

11. BUILDING TO BE USED

a. Existing transmission room can be used for the accommodation of the radio and multiplex equipment to the remote area project.

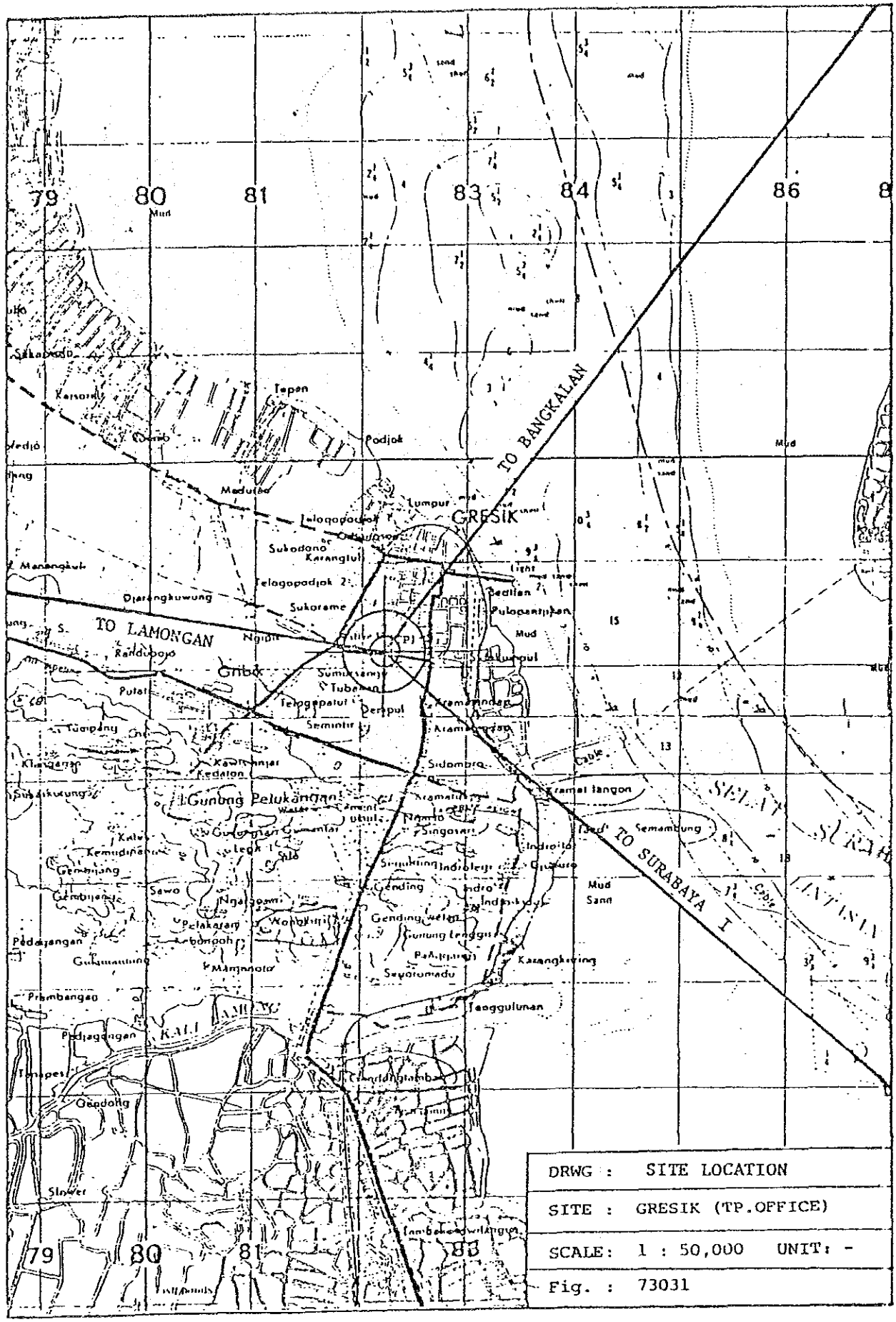
b. Examination of the floor slab strength for existing radio room is necessary.
If the floor slab strength is not sufficient, the reinforcement is required.

12. NEW TOWER

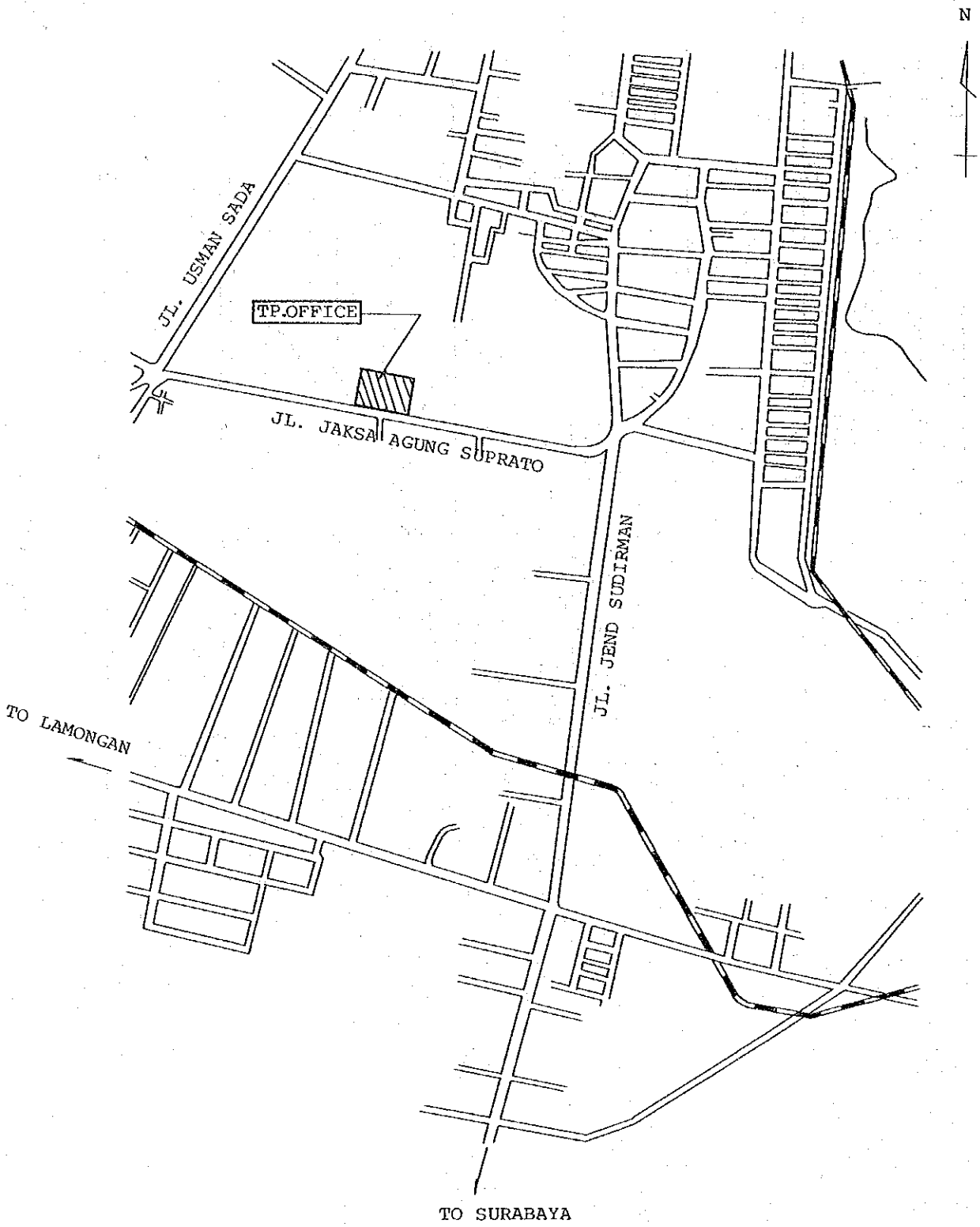
a. New tower construction is required.

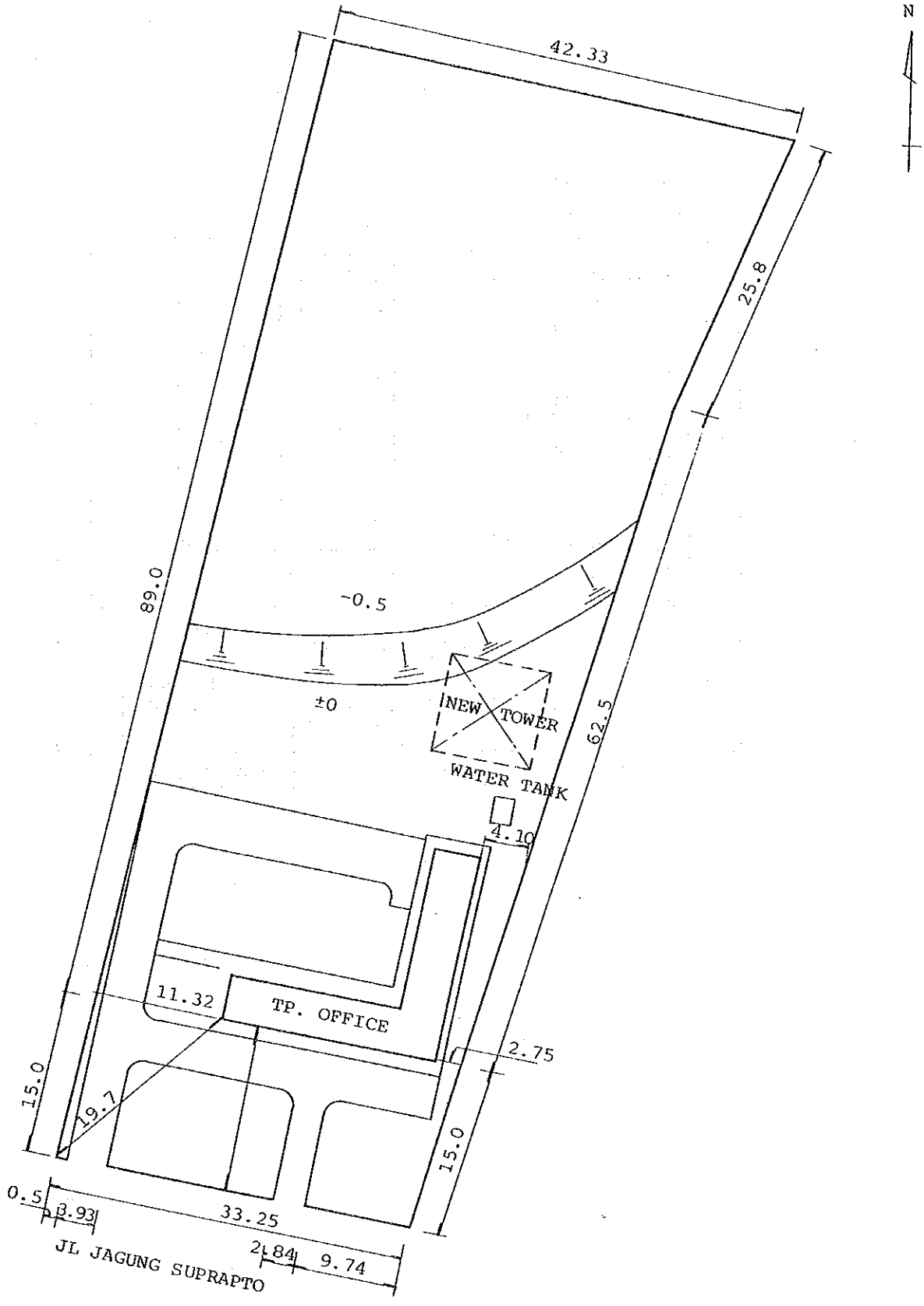
b. When no detailed subsoil data exist, subsoil exploration is necessary for the tower structural design.

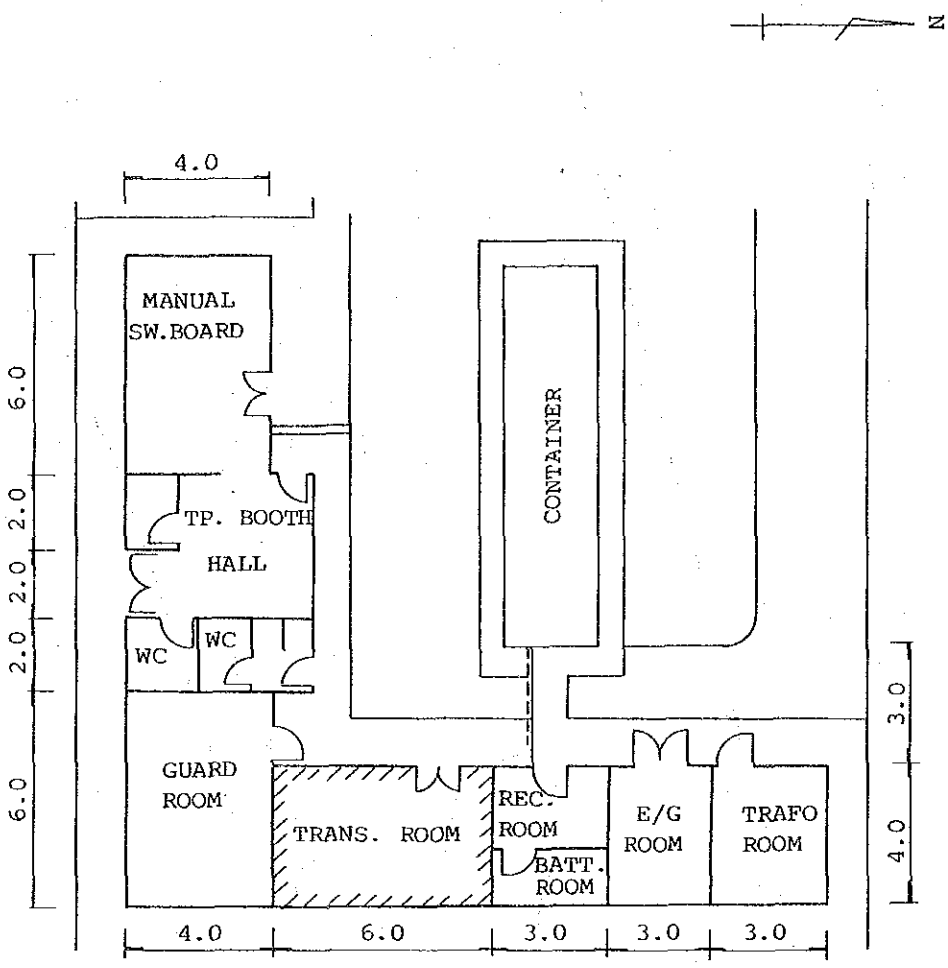
c. 30 - 50 cm high retaining wall construction is recommendable around the tower location.



DRWG :	SITE LOCATION
SITE :	GRESIK (TP.OFFICE)
SCALE:	1 : 50,000 UNIT: -
Fig. :	73031


N
JL. USMAN SADA
TP.OFFICE
JL. JAKSA AGUNG SUPRATO
JL. JEND SUDIRMAN
TO LAMONGAN
TO SURABAYA


N
42.33
25.8
89.0
-0.5
±0
NEW TOWER
WATER TANK
4.10
62.5
11.32
TP. OFFICE
2.75
15.0
19.7
15.0
0.5
3.93
33.25
2.84
9.74
JL JAGUNG SUPRAPTO


N
4.0
MANUAL
SW.BOARD
CONTAINER
TP. BOOTH
HALL
WC
WC
GUARD
ROOM
TRANS. ROOM
REC.
ROOM
BATT.
ROOM
E/G
ROOM
TRAFO
ROOM
6.0
2.0
2.0
2.0
6.0
3.0
4.0
4.0
6.0
3.0
3.0
3.0

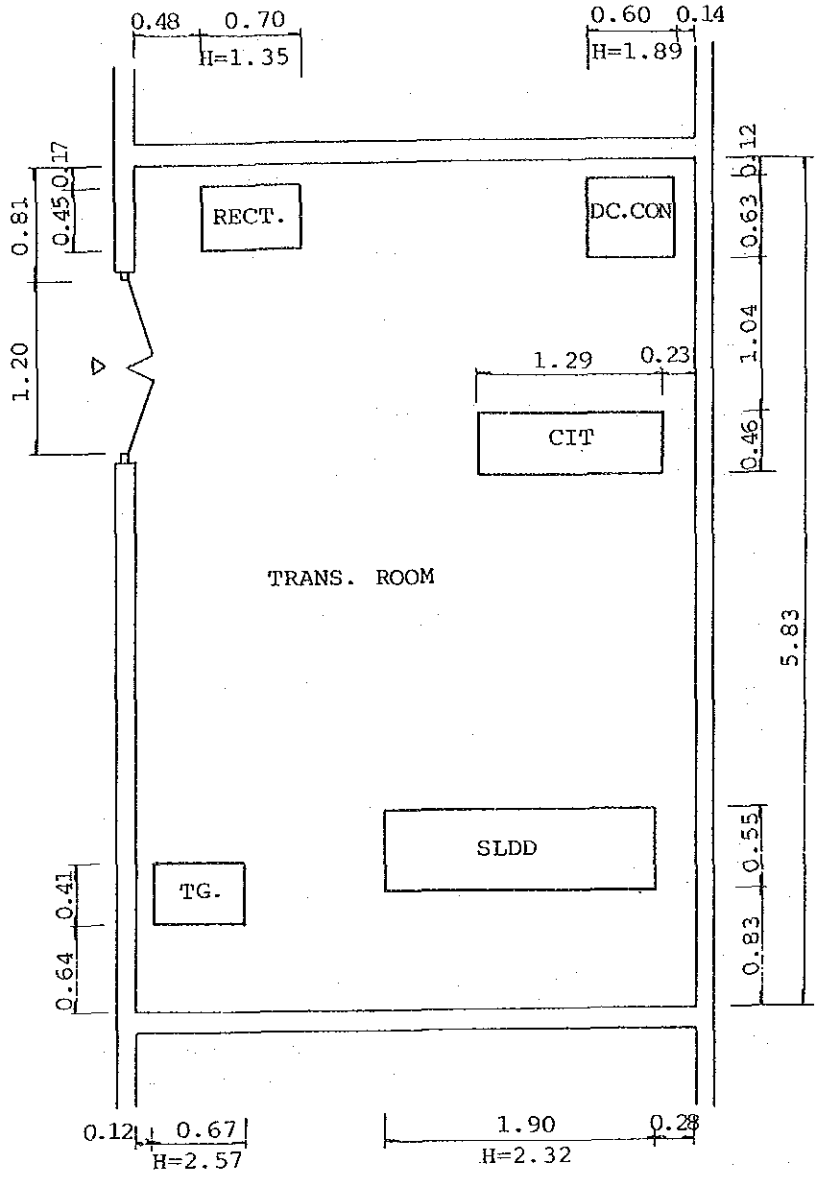

0.48
0.70
H=1.35
0.60
0.14
H=1.89
0.17
0.45
0.81
1.20
RECT.
DC.CON
0.12
0.63
1.04
0.46
1.29
0.23
CIT
TRANS. ROOM
5.83
SLDD
0.55
0.83
TG.
0.41
0.64
0.12
0.67
H=2.57
1.90
0.28
H=2.32

Table 22 Bangkalan (TP. Office)

1.	LOCATION	Ref. to Figs. 73051 and 73052
	a. Address:	Jl. Trunojoyo No. 11, Bangkalan
	b. Coordinates	
	Longitude:	E 112° 45' 09"
	Latitude:	S 7° 01' 35"
	c. Elevation:	3 m above sea level
2.	ACCESS TO SITE	
	a. TP. Office is in the central area of the city.	
	b. No access road construction is required.	
3.	SITE CONDITION	
	a. Site area:	Approx. 2,000 m²
	b. Building coverage:	Approx. 12% to whole area
	c. Existing grade:	Flat
	d. Subsoil:	Clayey soil
	e. Presumed bearing value of soil:	Approx. 5 tons/m²
	f. Underground water table:	Approx. 2 m
	g. Others:	New tower construction space for the remote area project is available in this site.
4.	PROPAGATION CONDITION	
	a. Propagation mode to:	
	Gresik (TP. Office)	Radio path on the spherical earth
	Surabaya I (Trans. STN)	Radio path on the spherical earth
	b. Reflection point to:	
	Gresik (TP. Office)	Sea
	Surabaya I (Trans. STN)	Sea

c. Distance to:

Surabaya I (Trans. STN)	23.1 km
Gresik (TP. Office)	18.7 km

d. Bearing to:

Surabaya I (Trans. STN)	184° 33' 42"
Gresik (TP. Office)	217° 09' 15"

5. EXISTING TRANSMISSION EQUIPMENT

Physical line

To Bangkalan: 2 ch; To Sampang: 3 ch; To Pamekasan: 3 ch;
To Surabaya: 2 ch

6. EXISTING ANTENNA TOWER AND ANTENNA

a.	Tower height:	52 m
b.	Tower shape:	Square type self-supporting
c.	Number of ant.:	None is mounted.
d.	Other:	Examination of the existing tower strength is required for the remote area project.

7. COMMERCIAL POWER SUPPLY

a.	Distribution voltage and wiring system:	380/220 V, 3ø 4 W
b.	Lead-in voltage and wiring system:	380/220 V, 3ø 4 W
c.	Frequency:	50 Hz
d.	Voltage fluctuation:	Stable
e.	Supply time:	24-hour basis supply. Power failure is few a month.

8. EXISTING POWER EQUIPMENT

a. Engine Generator

BISMA/AVK: 15 kVA, 220 V, 3ø x 1 set

b. AVR

None.

c. Rectifier

None. (In the near future, rectifier will be installed.)

d. Battery

None. (In the near future, batteries will be installed.)

9. POWER EQUIPMENT TO BE INSTALLED

For the power supply to the telecommunication equipment of the remote area project, new installation of rectifier and batteries is required.

10. EXISTING TELEPHONE SWITCH

Local battery switch: 400 l.u.

The number of subscribers is 318 as of the end of October, 1983.
The local battery switch will be changed to the common battery switch board in near future.

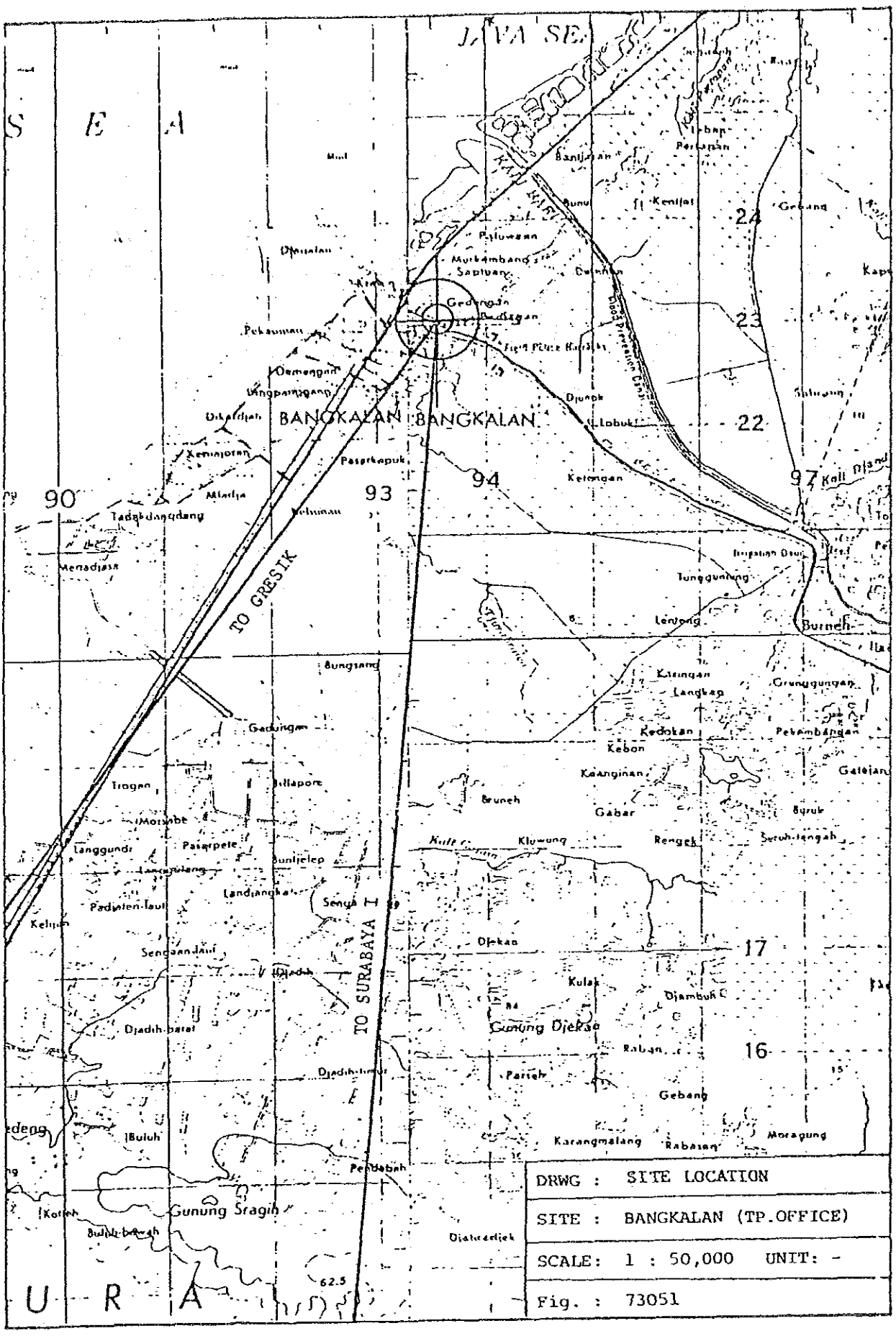
11. BUILDING TO BE USED

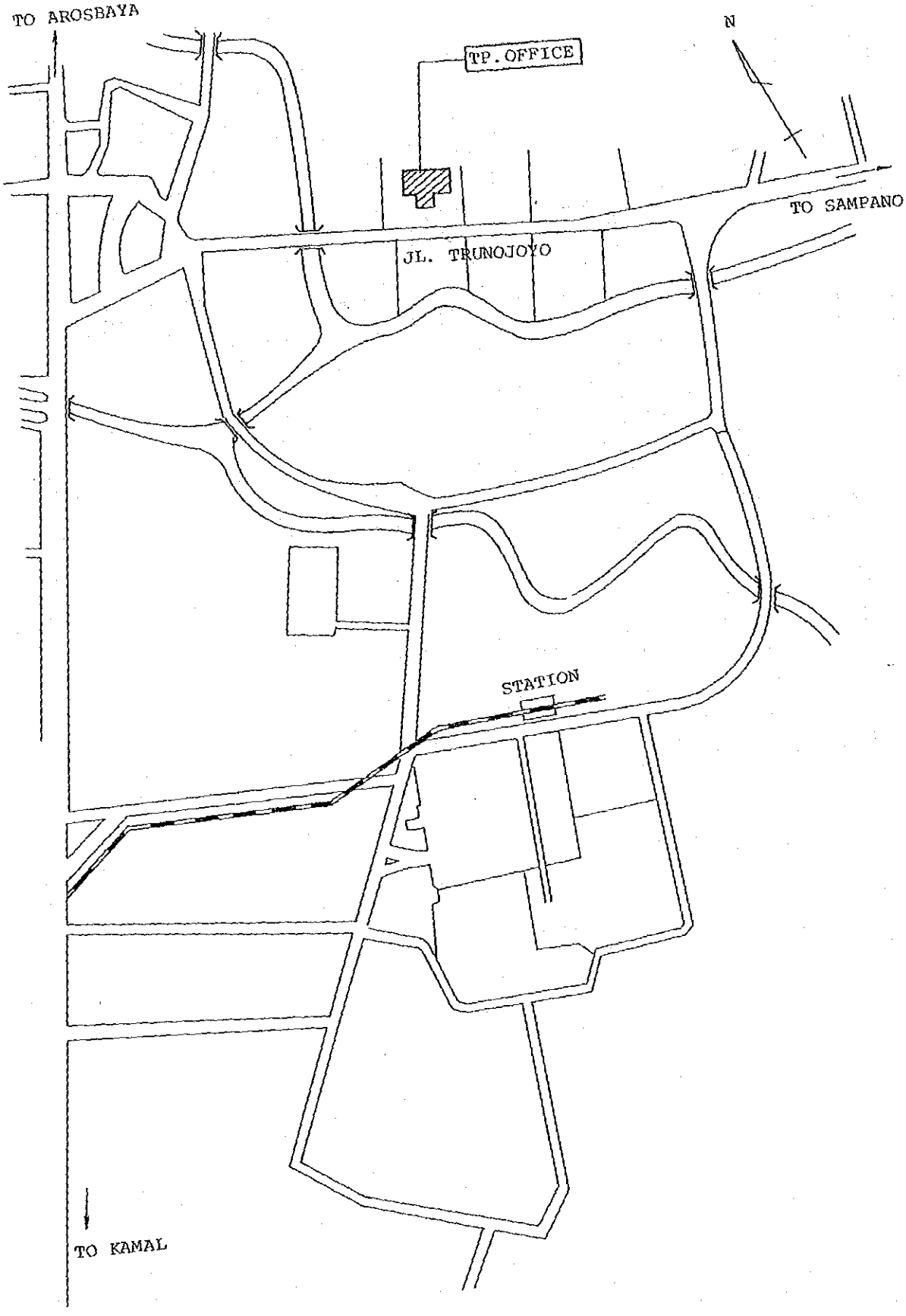
Existing manual board and battery room can be used for the accommodation of the radio and multiplex equipment and batteries of the remote area project.

12. NEW TOWER

a. If the existing tower cannot be used for the remote area project in respect of strength or height, new tower construction is required.

b. When no detailed subsoil data exist, subsoil exploration is necessary for the tower structural design.


JAVA SEA
S E A
BANGKALAN
BANGKALAN
TO GRESIK
TO SURABAYA
Gunung Sragih
Gunung Djeksa
U R A
90
93
94
97
22
23
24
17
16
DRWG : SITE LOCATION
SITE : BANGKALAN (TP.OFFICE)
SCALE: 1 : 50,000 UNIT: -
Fig. : 73051


TO AROSBAYA
N
TP. OFFICE
TO SAMPANO
JL. TRUNOJOYO
STATION
TO KAMAL

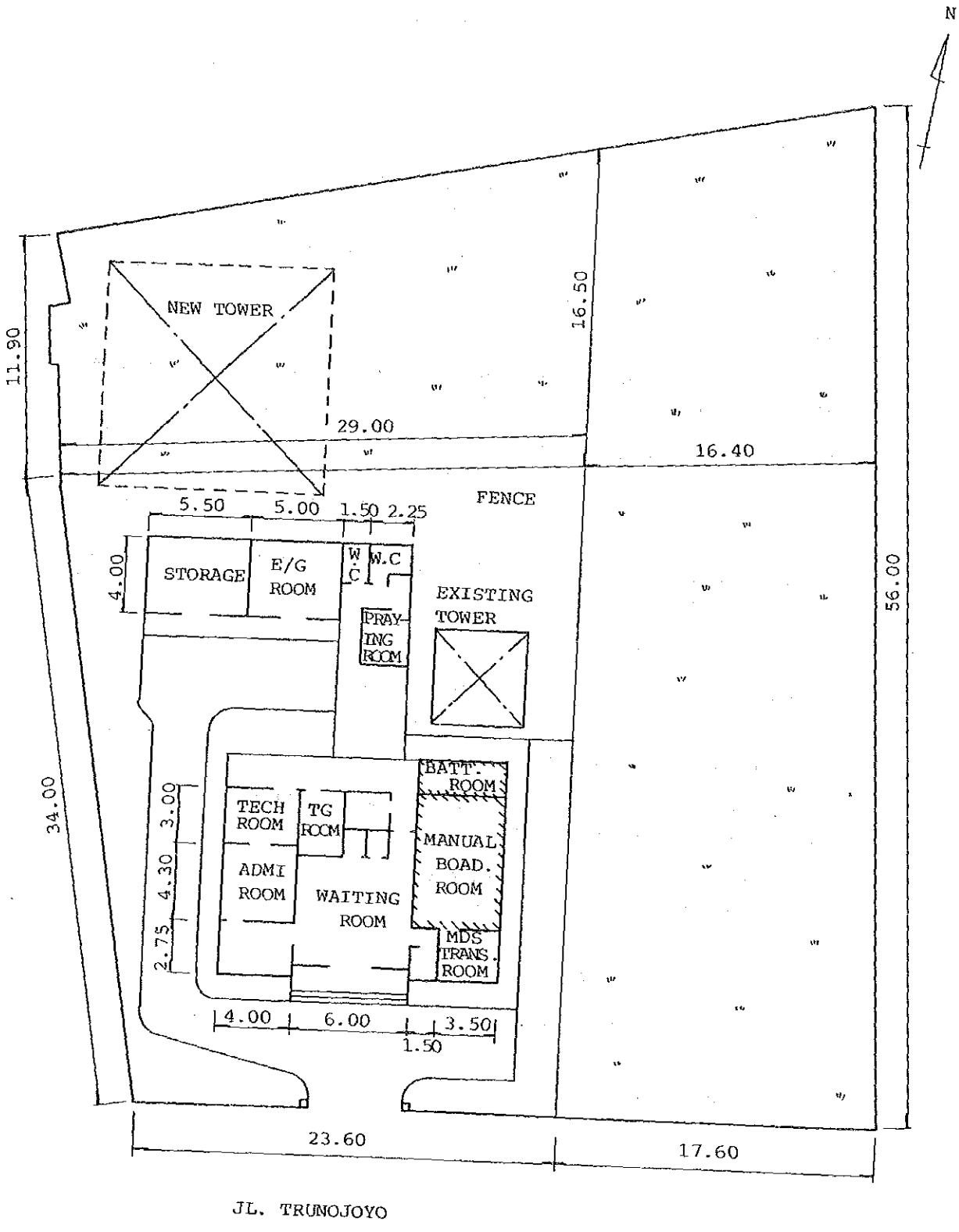

N
NEW TOWER
11.90
16.50
29.00
16.40
FENCE
5.50
5.00
1.50
2.25
4.00
STORAGE
E/G ROOM
W.C
W.C
PRAY-ING ROOM
EXISTING TOWER
56.00
34.00
3.00
4.30
2.75
TECH ROOM
TG ROOM
ADMI ROOM
WAITING ROOM
BATT. ROOM
MANUAL BOAD. ROOM
MDS TRANS. ROOM
4.00
6.00
3.50
1.50
23.60
17.60
JL. TRUNOJOYO

Table 23 Karamaian (REP STN)

1. LOCATION

   a. Coordinates

      Longitude: E 114° 41' 50"
      Latitude: S 3° 45' 00"

   b. Elevation: 305 m above sea level

2. ACCESS TO SITE

   a. This site is microwave repeater station, located on the hilltop. (JAWA-KALIMANTAN Troposcatter)

   b. No need to construct access road.

3. SITE CONDITION

   New tower construction space for this project is available in this site.

4. PROPAGATION CONDITION

   (Propagation mode, distance, bearing, etc.)

5. EXISTING TRANSMISSION EQUIPMENT

   a. NEC 4 GHz, 1,260 ch, 3 W, FM Microwave System (JAWA-KALIMANTAN Troposcatter)

   b. NEC 2 GHz, 120 ch, FM Microwave System (JAWA-KALIMANTAN Troposcatter)

6. EXISTING ANTENNA TOWER AND ANTENNA

   14 m height tower with 2 antennas

7. COMMERCIAL POWER SUPPLY

   None.

   Existing power equipment:

a.	Engine generator:	34 kVA, 220/127 V, 89.3 A, 3ø 4 W, 50 Hz x 3
	Present load:	(July, 1984) 220 V, 50 Hz (u) --- 33 A (v) --- 36 A (w) --- 35 A
b.	Charger:	Charger-inverter for O/H Charger 24 V A x 2
c.	Battery:	140 V 170 Ah x 2 banks for O/H 24 V 60 Ah x 2 banks

8. POWER EQUIPMENT TO BE INSTALLED

The power supply to the telecommunication equipment of this project is available from the existing power supply equipment.

9. BUILDING TO BE USED

Existing equipment room can be used for the accommodation of the radio equipment of this project.

10. NEW TOWER

Since the antenna of troposcatter obstructs the view of the Takisung from the top of existing tower, it is necessary to construct a new tower for this project.

Table 24 Banjarmasin (TP. Office)

1. LOCATION

   a. Coordinates

      Longitude: E 114° 34' 55"
      Latitude: S 3° 19' 34"

   b. Elevation: 2 m above sea level

2. ACCESS TO SITE

   a. This station is in the central area of the city.

   b. The Banjarmasin Microwave station is in this site.

   c. No access road construction is required.

3. SITE CONDITION

   New tower construction space for this project is not available.

4. PROPAGATION CONDITION

5. EXISTING TRANSMISSION EQUIPMENT

   a. NEC 4 GHz, 1,260 ch, 3 W, FM Microwave System (JAWA-KALIMANTAN Troposcatter)

   b. Others

6. EXISTING ANTENNA TOWER AND ANTENNA

   40 m height tower with 4 antennas

7. COMMERCIAL POWER SUPPLY

   a. Voltage: 380/220 V, 50 Hz, 3ø, 50 Hz

   b. Frequency: 50 Hz

   c. Voltage fluctuation: Stable

8. EXISTING POWER EQUIPMENT

a.	Engine generator:	250 kVA, 380/220 V, 3ø x 1 set
b.	AVR:	Present load (July, 1984), R/ph. 5 A, S/ph. 5 A, T/ph. 5 A
c.	Charger:	40 A x 2
d.	Battery:	170 Ah x 2

9. POWER EQUIPMENT TO BE INSTALLED

The power supply to the telecommunication equipment of this system is not available from the existing power supply equipment. Battery and charger should be installed.

10. BUILDING TO BE USED

The next room to the existing radio room is available to install radio and multiplex equipment of this project.

11. NEW TOWER

New tower should be constructed.

Table 25 Antenna Loading Condition of Existing Tower

Station Name	Loading Capacity	Present Conditions	Comment
SURABAYA (1)	Tower height: 60 m Type: Self-supporting UNKNOWN	12 feetø x 1 62.4 m 3.3 m ø x 1 58 m 12 feetø x 1 52.4 m 1.2 m ø x 1 45.5 m 3.3 m ø x 1 44 m 3.3 m ø x 1 43 m 3.3 m ø x 1 36 m	The designed height of the tower is 60 meters. Now one antenna is installed at 62.4 meters high. There is no data of antenna loading capacity nor tower extension record. See Photo 6.2-1.
Gn.SANDANGAN	Tower height: 24.4 m Type: Self-supporting 3.3 m ø x 1 23 m 3.3 m ø x 1 13 m 3.3 m ø x 1 8 m 2.0 m ø x 1 8 m	3.3 m ø x 1 22 m 2.0 m ø x 1 8 m 3.3 m ø x 1 7 m 2.0 m ø x 1 7 m	
Gn.KARAMAIAN	Tower height: 13.5 m Type: Self-supporting 19.0 m ø x 1 12 m 3.3 m ø x 1 12 m 3.3 m ø x 1 7 m	19.0 m ø x 1 12 m --- O/H Grid Antenna 2.4 m ø x 1 12 m	The O/H Grid antenna obstructs the view of the TAKISUNG station. For this reason, new antenna tower should be constructed.
BANJARMASIN	Tower height: 40 m Type: Self-supporting 3.3 m ø x 2 38 m	3.3 m ø x 1 38 m 3.3 m ø x 1 38 m 3.0 m ø x 1 38 m --- Grid Antenna	
BANGKALAN	Tower height: 52 m Type: Self-supporting UNKNOWN	VHF ANTENNAS See Photo 6.2-8 and Photo 6.2-9.	This tower was constructed in 1954. There is no data of loading capacity. New tower construction is required.

Table-26 WITEL-9 Local Exchange Expansion Program

WITEL : IX Banjarbaru

PROPINSI : Kalbar. Kaltim. Kalteng. Kalsel

LOKASI	EXISTING			DAFTAR TUNGGU	DEMAND 1991	CARRY OVER P. III			PROGRAM PEMBANGUNAN (PELITA-IV)						KETERANGAN
	TYPE	KAPS	SISA			LAIN 2	PHASE 1	PHASE 2	84/85	85/86	86/87	87/88	88/89	JUMLAH	
(Auto-Exchange)															
1. Banjarmasin	EMD/HKS	4.000	1.051	3.387	13.000							6.000	—	16.000	1) PROGRAM ARF
2. Pontianak	EMD	2.000	49	1.791	8.000			9.000				10.000			LUAR JAKARTA
3. Samarinda	ARF	3.000	327	1.172	9.000								9.000	9.000	15.000 SS
4. Balikpapan	ARF	2.600	29	1.427	7.000	2.000 1)							7.500	7.500	
5. Banjarbaru	NEC	600	108	218	2.000								2.000	2.000	2) IKK
6. Sampit													2.000	2.000	
7. Pangkalan Bun													2.000	2.000	
8. Buntok													1.000	1.000	
9. Bontang													2.000	2.000	
10. Kualakapuas													1.000	1.000	
11. Sintang	ABK	100	40												
12. Marabikan												600		600	
13. Tanah Grogot												600		600	
14. Tarakan.	ARF	1.000	220	271								—		—	
Sub Total						2.000		9.000				17.200	26.500	43.700	
(Manual Exchange) Manual to Auto : 8 (No.6 - No.13 above) Manual as it is :32 (6520 L.U)															
Sub Total															

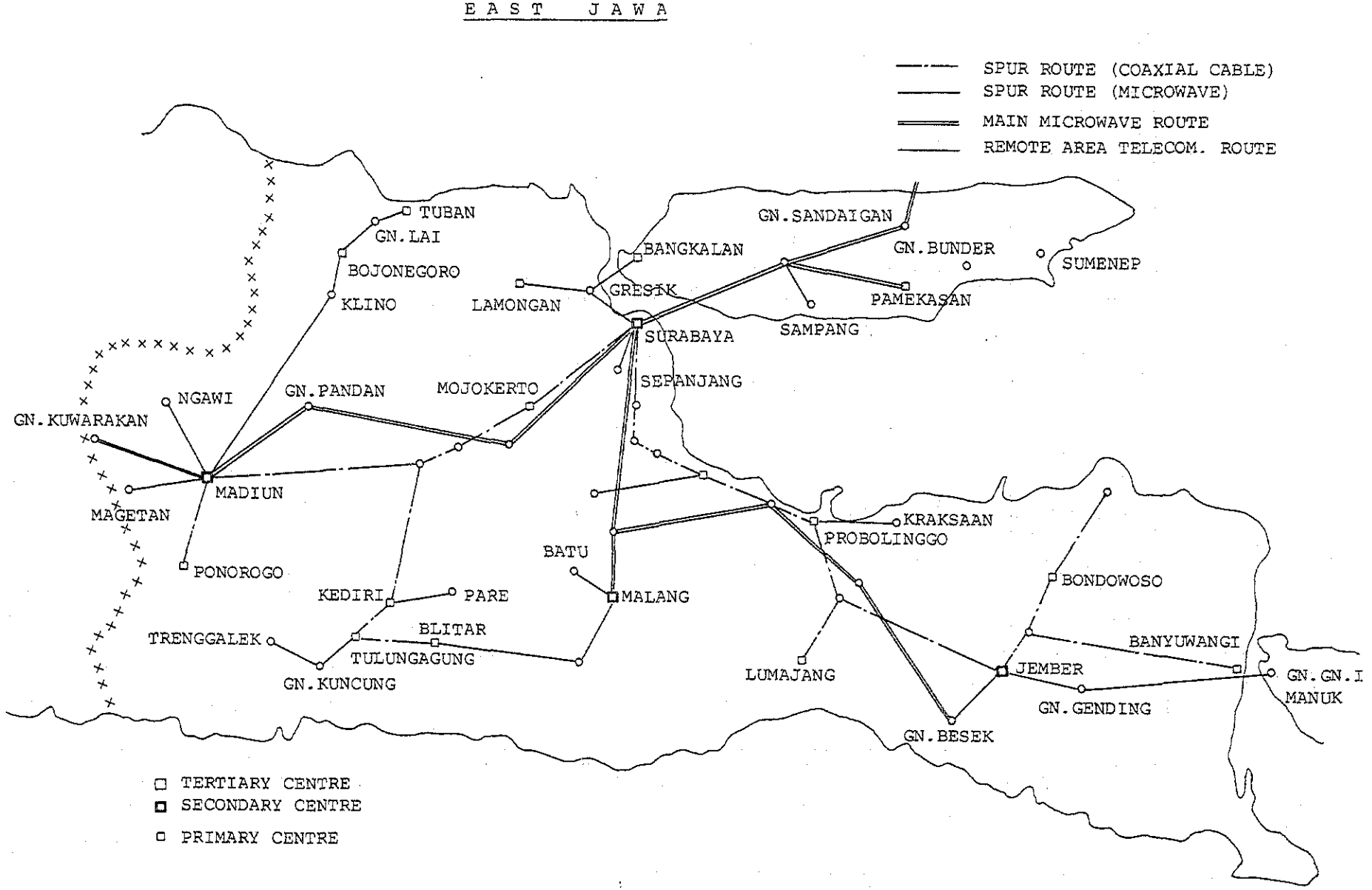


Figure-1 Remote Area Telecommunication Network (PH 1)

Terrestrial Transmission in the Year 2000

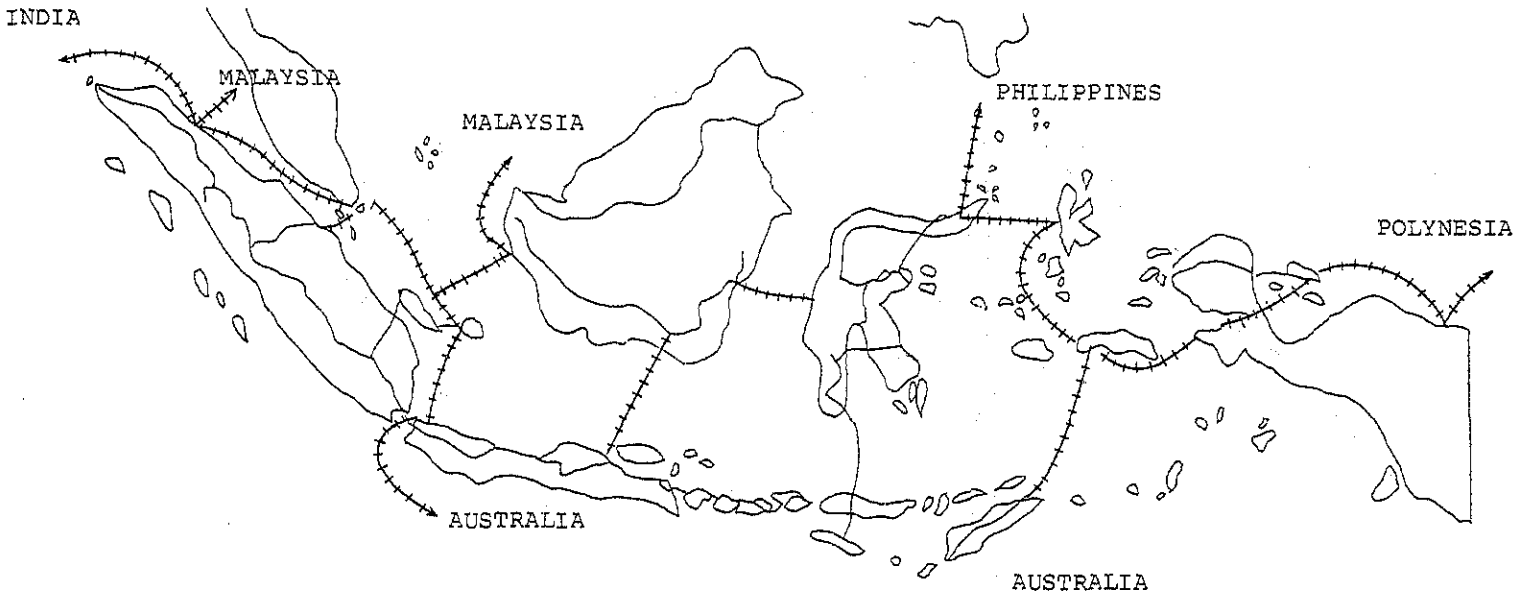
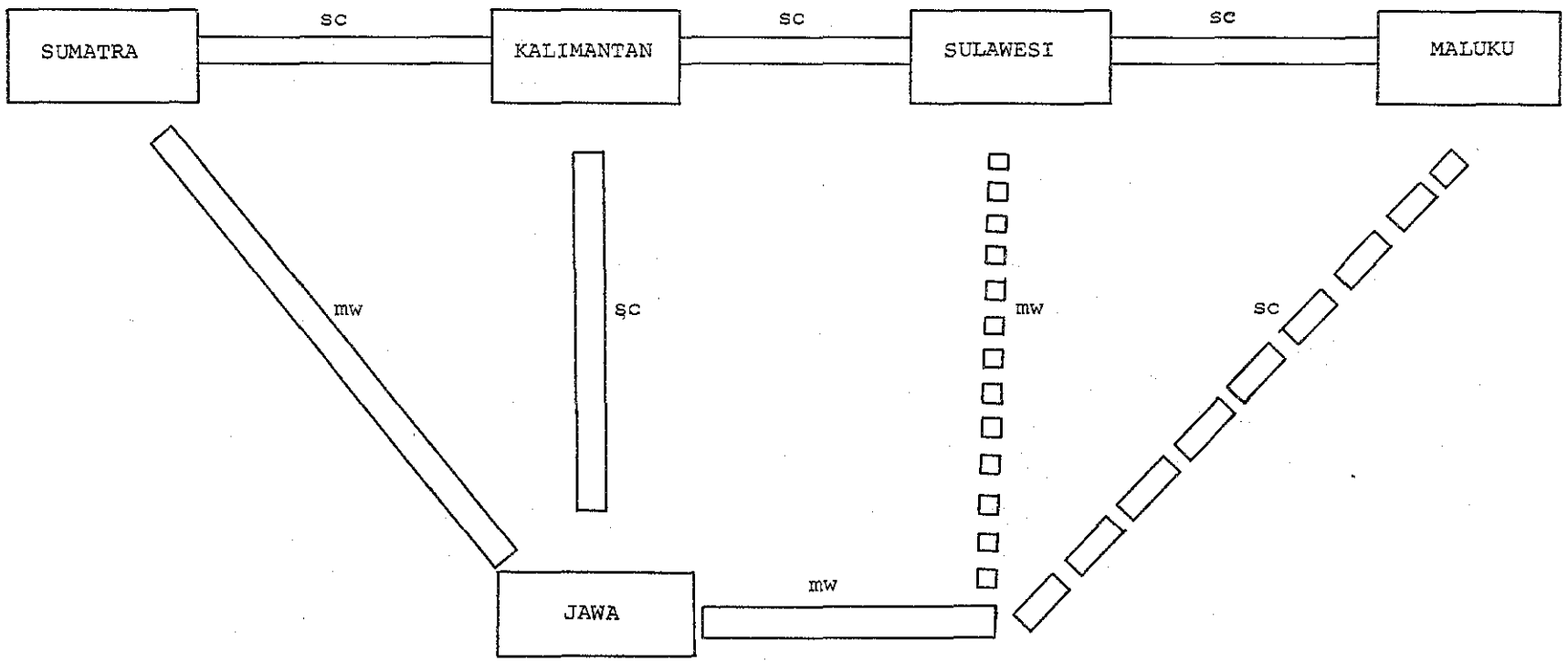


Figure-2 Terrestrial Transmission Network in "Telecomunications As of 2000 Project"

Terrestrial Transmission Pattern



Microwave: mw

Submarine Cable: sc

Figure-3 Main Terrestrial Transmission Systems in "Telecommunications As of 2000 Project"

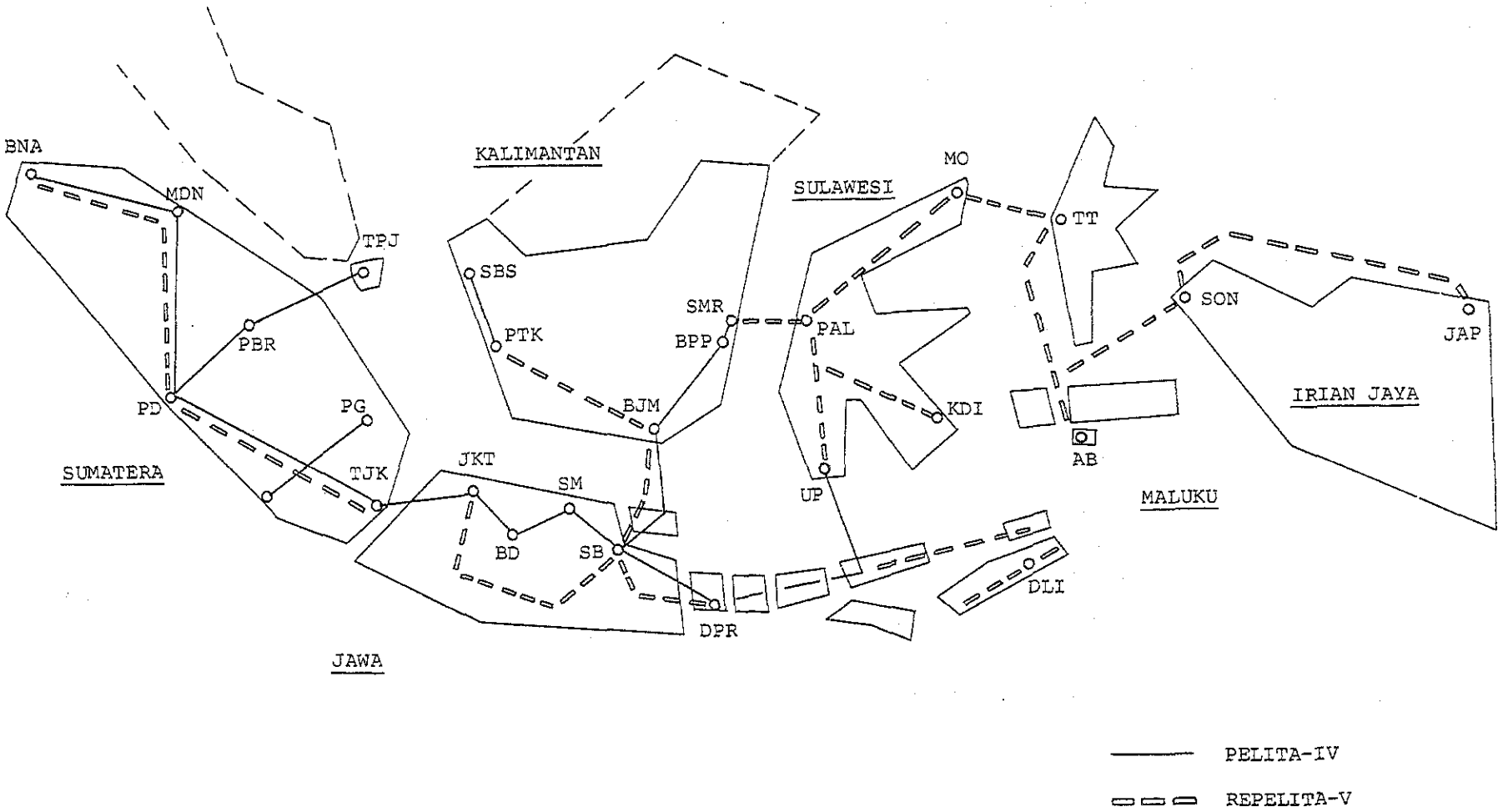


Figure-4 Terrestrial Backbone Transmission System Improvement Plan

CHAPTER 3 BACKHAUL SYSTEM DESIGN RATIONALE

3.1 Backhaul System Route Selection

For microwave radio route, selection must be made for such route where

(A) Initial cost can be minimized;
(B) Technical requirements for transmission system can be satisfied and tower height can be reduced to necessary minimum;
(C) Fading probability is low because the system is 140 Mbit/s high speed digital system;
(D) Existing facilities can be utilized.

This time, for terrestrial microwave radio route on Surabaya side, three alternative plans are prepared for comparative study and, for Kalimantan side, two alternative plans are proposed. Field study results for those alternative routes follow:

(1) Surabaya Side Microwave Radio Route

1) Plan A

49.7 km		18.3 km		4.2 km	
Surabaya	- Sandangan	-	Murbulangan	-	Bumianyar (New)

2) Plan B

12.5 km		18.6 km		20.4 km		25.3 km	
Surabaya	- Gresik	-	Bangkalan	-	Pudjung	-	Bumianyar (New)

3) Plan C

49.7 km		18.3 km		5 km (Bumianyar)
Surabaya	- Sandangan	-	Murbulangan	----- ----- (New) (Submarine cable)

Figure 5 presents Surabaya side route map.

Note: Surabaya-Banjarmasin-Buminayar route was proposed during field study. However, at Bumianyar, tower height was required to be 150 m or even more. Therefore, this route plan was dismissed.

(2) Kalimantan Side Microwave Radio Route

1) Plan A

	16.4 km		48.6 km	
Takisung	-	Karamaian	-	Banjarmasin

2) Plan B

	59.4 km	
Takisung	-	Banjarmasin

Figure 6 presents Kalimantan side route map.

3.2 Radio Station Summary on Each Route

For each proposed site for radio station, investigation was made concerning access road, land building, machine room, and tower/antenna construction plan. findings are summarized in

- Table 27 Surabaya Side Radio Station Summary
- Table 28 Kalimantan Side Radio Station Summary

3.3 Propagation Parameters of Each Radio Station

Table 29 presents propagation parameters of each radio station, including elevation, coordinates longitude and latitude),

propagation distance to/from neighboring station, and azimuth angle to neighboring station.

Given in Table 30 are route by route tower heights and number of antennas required.

3.4 Radio Section Clearance Calculation, Propagation Loss, and Profile Map by Route

Table 31-35 present computer calculation rational for route by route radio section data and profile maps. Conditions of calculation follow:

(1) Frequency: 6,770 MHz
(Center frequency as per CCIR Rec. 384-3)

(2) Equivalent radius of earth coefficient (k) : k = 4/3

(3) Height of obstacle trees : Height of trees in wooded zone is set at 20 m

- Table 31 Plan A, Surabaya Side
  Surabaya - Snadangan, Sandangan - Murbulangan, Murbulanga - Bumianyar

- Table 32 Plan A, Kalimantan Side
  Banjarmasin - Karamaian, Karamaian - Takisung

- Table 33 Plan B, Surabaya Side (1/2)
  Surabaya - Gresik, Gresik - Bangkalan

- Table 34 Plan B, Surabaya Side (2/2)
  Bangkalan - Pudjung, Pudjung - Bumianyar

- Table 35 Plan B, Kalimantan Side
  Banjarmasin - Takisung

3.5 Comparison and Selection of Proposed Routes

(1) Comparison

Table 36 presents comparison between Plans A and B for Surabaya side route. Table 37 presents comparison between Plans A and B for Banjarmasin side route.

(2) Selection

A. Surabaya Side

In the comparison between Plan A and B, Plan A can be judged to be appropriate. This is evident in Table 36.

Plan C shown in Paragraph 3-1 is on the same route as Plan A. It is to install submarine cable (by on-land specifications) from Murbulangan New Repeater Station to Bumianyar and not to establish terminal radio station at Bumianyar. Road between Murbulangan and Bumianyar for (5 km) cable burying route is a footpath between rice fields. Considering that, in this case, road boundary is not clear, road ground is weak, and road itself is unpaved, cable installed is apt to suffer troubles. For such reasons, Plan C was not taken up for comparative study from the outset. (This fact is already understood by POSTEL and PERUMTEL. Refer to Survey Report No. 2.)

B. Banjarmaisn Side

By Table 37, Plan A is judged to be appropriate.

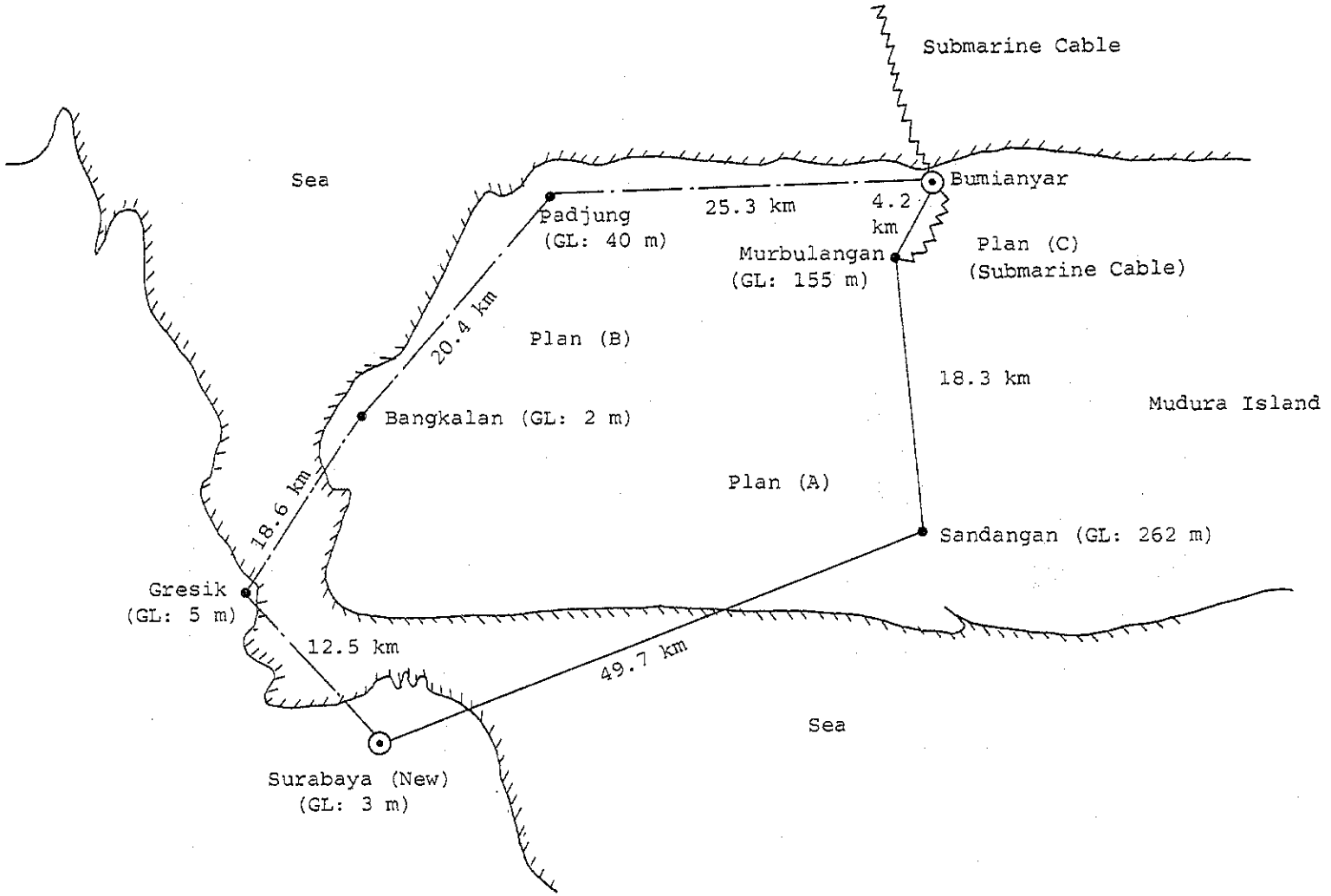


Figure-5 Microwave Radio Route (Surabaya side)

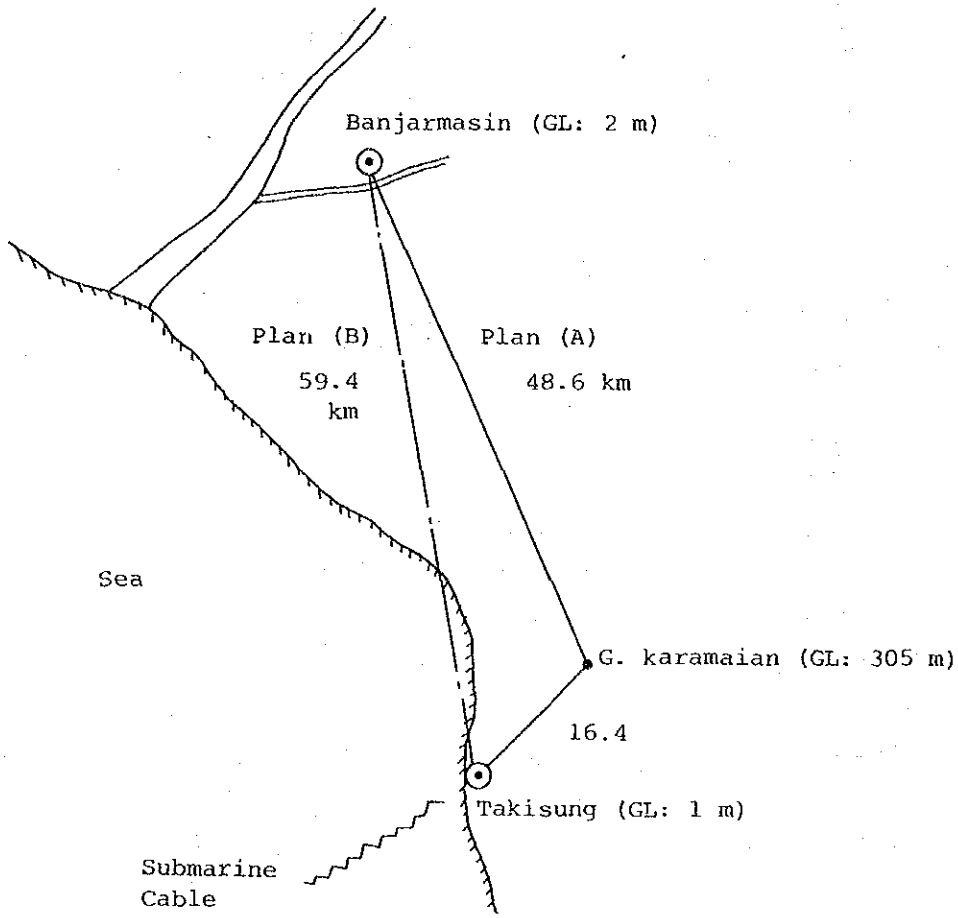


Figure-6 Microwave Radio Route (Banjarmasin side)

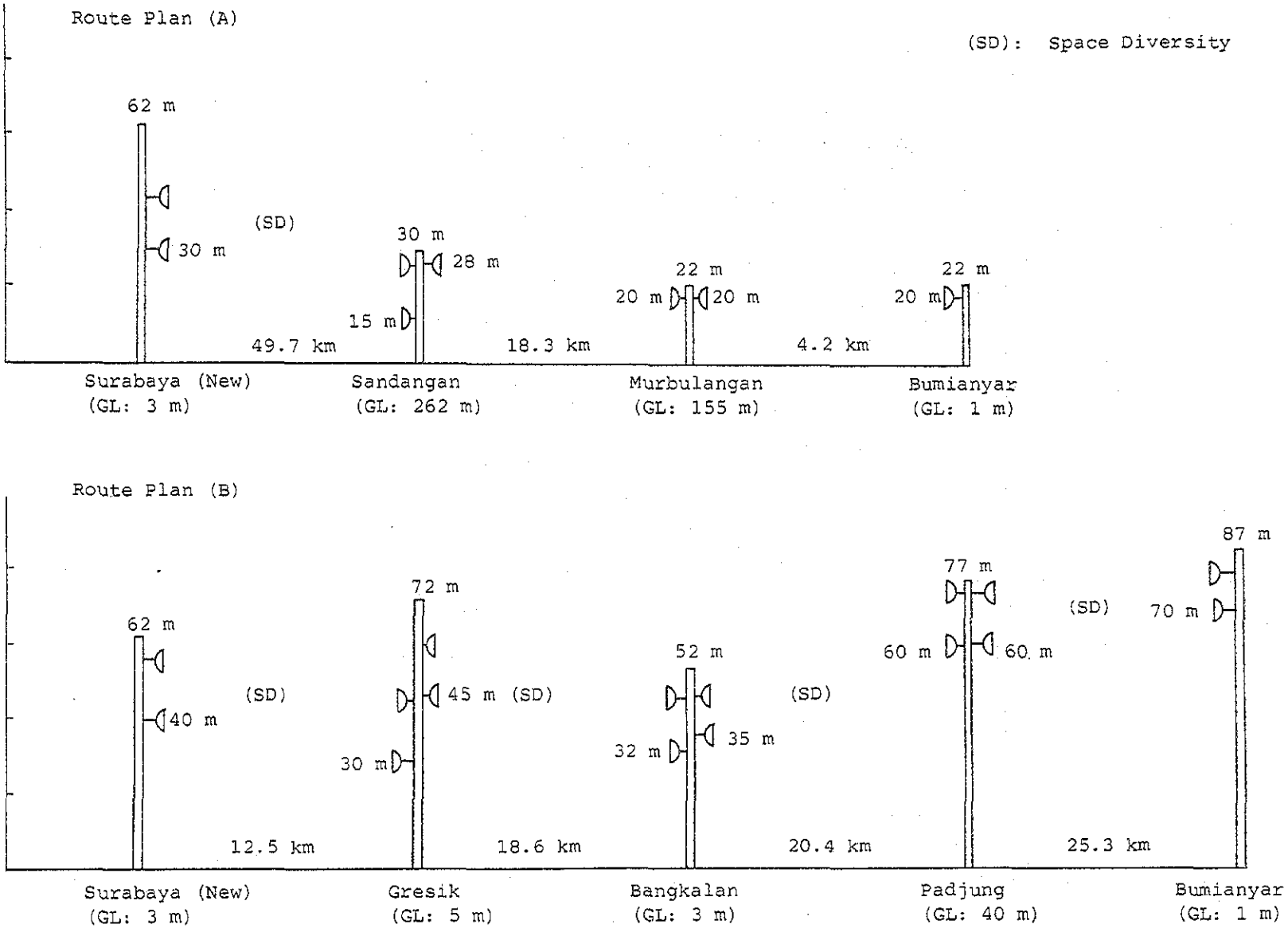
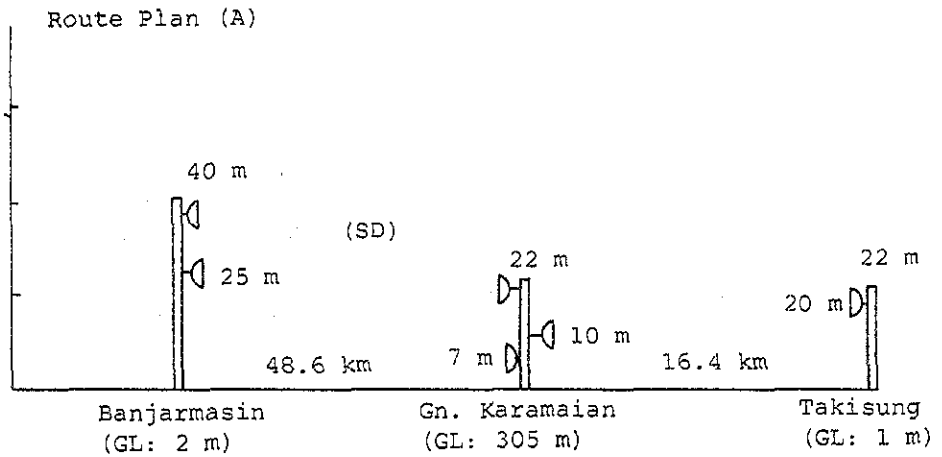


Figure-7 Tower Heights and Antenna Heights (Surabaya Side)



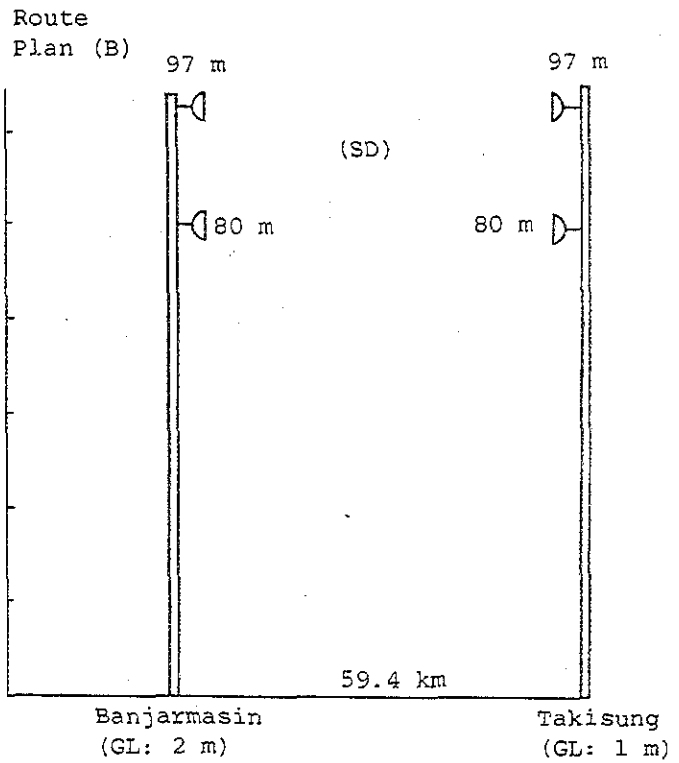


Figure-8 Tower Heights and Antenna Heights (Surabaya Side)

Table 27-A Plan A : Surabaya Side Radio Station Summary

Station Name (1)Station Classification (2)Height above Sea Level	Access Road	Land & Building	Equipment Room	Power Supply System	Tower & Antenna Plan	Remarks
Surabaya-II (1)Microwave terminal station (2)3 m	Located in the city. Hence no need for access road.	Under construction as new telephone office. Scheduled to be completed by 1988. (At present, construction through up to 6th floor.)	2nd floor scheduled to be used for transmission/radio equipment room. Such equipment to share the same floor as R.A.Project equipment. Floor space is large enough. Hence no problem.	Commercial power: 220V/127V E/G output: 185 KVA Power capacity is large enough. Hence no problem.	To use 62m tower to be constructed by R.A. Project. SD system to apply to transmission to/from Sandangan. Two antenna sets to be installed.	In R.A. Project, to accomodate 2GHz band 17MB digital microwave system. In the current project, to accommodate 6GHz band 140 MB digital microwave system.
Gn Sandangan (1)Microwave repeater station (2)262 m	Existing station with access road.	To erect 30m tower on idle land on southern side of existing tower (24.7 m). No problem about land and building.	To install the current project equipment in idle space of existing 4GHz OH system radio equipment room. Floor space is large enough.	No commercial power available. Hence power supply by E/G. Existing E/G capacity is 7.5 kVA 220V which can satisfy project power requirement.	To construct new tower Tower height is to be 30 m. This is to cope with short distance reflection in the direction of Murbulangan by existing tower.	Existing tower lacks capacity to mount three more antennas. Hence new tower to be constructed. SD system to apply to transmission to/from Surabaya.
Murbulangan (1)Micorowave repeater station (2)155 m	7 km from Kabupaten road (Kamal Port 67 km distant from this road) to maitain pass (150 m high) to be rebuilt. New road to be built for about 50m from the pass to the proposed site. At present, trucks and jeeps can go uphill to the pass.	Building scheduled to be shelter type. Land of about 300m, where to erect new tower, to be procured.	To be accommodated in the shelter.	To use solar battery system, accommodating it in the shelter.	New tower to mount three antennas. To construct new tower Tower height is to be 22m, i.e., higher than the surrounding arbor height. New tower to mount two antennas.	The proposed site lies east of the mountain pass (150m high). It is a land of mild slope. Farm lane branching from Kabupaten road (a point 66 km from Kamal Port) is in bad condition. This farm lane (about3 km long), if rebuilt, provides the shortest maintenance road.
Bumianyar (1)Microwave terminal station (2)1 m	Road rebuilding required for about 100 m from Kabupaten road (guidepost showing 65 km point from Kamal Port)	Delta zone between Kabupaten road and cable landing point (30m x 40m = 1200m) scheduled for the proposed site. Building and tower to be constructed in the proposed site.	Equipment room, monitor room, repair room, etc., scheduled to be established in 8 m x 13m = 104m space.	No commercial power available. Hence in-house power generation by E/G. Power source wing, separate from equipments wing, to be newly established.	New tower to be constructed. Tower height is to be 22m, i.e., heigher than the surrounding arbor height. One new antenna to be amounted on new tower.	Residence wing, separate from equipment wing and power source wing, to be newly established.

Table 27-B Plan B : Surabaya Side Radio Station Summary

Station Name (1)Station Classification (2)Height above Sea Level	Access Road	Land & Building	Equipment Room	Power Supply System	Tower & Antenna Plan	Remarks
Surabaya-II (Same as in Table 12)					To use 62m tower to be erected by R.A.Project Transmission to/from Gresik is by oversea propagation. SD system to be adopted. Two antennas necessary.	At three stations (Surabaya-II, Gresik and Bangkalan), new towers are to be constructed by R.A. Project. Surplus capacity of these towers is for two antennas. However, in the case of adopting SD system in both directions at Gresik and Bangkalan stations, mounting of four new antennas become necessary. Hence the need of adjustment with R.A.Project in regard to tower capacity for antenna mounting.
Gresik (1)Microwave repeater station (2)5 m	Existing station in the city. Hence no problem.	Trailer type telephone exchange. Land is large but exchange building is one-storied and small.	Shared use of equipment room for CIT COX system is scheduled. Floor space distribution with R.A. Project equipment is necessary.	Commercial power: 380/220V E/G output: 45kVA Power supply adjustment with R.A.Project is necessary.	Those 72m tower to be erected by R.A.Project Transmission to/from Surabaya and Bangkalan is by oversea propagation SD system to be adopted Four antennas to be newly mounted.	
Bangkalan (1)Microwave repeater station (2)3 m	Existing station in the city. Hence no problem.	Land is large. No transmission/radio equipment room. To accommodate repeater by the current project in the room where open wire carrier (siemens ZF type) is now installed.	Shared use of existing open wire carrier room is scheduled. Floor space distribution with R.A. Project equipment is necessary.	Commercial power: 380/220V E/G output: 15 kVA (220V) New charger and battery installation is necessary. Overall power supply adjustment with R.A. Project is necessary.	Existing HF system tower cannot be used for microwave system antenna. New tower to be erected by R.A. Project that precedes the current project. New tower to mount four new antennas for the current project.	
Pudjung (1)Microwave repeater station (2)40 m	Road rebuilding required for about 1 km from Kabutapen road (a point 38.5km from Kamal Port). New road construction required for about 400m (from almost the center of Toba village.)	Land is flat spotted with farmlands. Shelter type station building scheduled.	To be contained in the shelter.	To use solar battery system accommodated in the center.	Line of sight unavailable to/from Bangkalan and Bumianyar. Tower height thus required to be about 77m. For both sections to/from Bangkalan and Bumianyar, SD system is to be adopted with four antennas newly mounted on the tower.	

Table 27-C Plan C : Surabaya Side Murbulangan Station Summary

Statation Name	Station Classification	Implications as Submarine Cable System Terminal Station	Implications as Microwave System Terminal Station
Murbulangan	Submarine cable system terminal station Microwave system terminal station Manned station at mountain top	1) For about 6 km from L.P. Bumianyar to mountain top microwave terminal station, in-duct cable installation is necessary. 2) Ground where to install cable consists of limestones. For about 1 km down from mountain top, limestones are exposed on the road. High cost of cable installation is unavoidable. 3) Problematical from the viewpoint of maintenance are that land section intervenes in submarine cable section, and that submarine cable system equipment is installed in mountain top microwave station.	1) In Plan A, the station is of shelter type; power supply is by solar battery system; and unmanned repeater system is adopted. Such unmanned station must be changed to manned maintenance station equipped with E/G. 2) Not desirable is to establish manned station at mountain top where to maintain overland microwave terminal station and submarine cable terminal equipment.

Table 28-A Plan A : Kalimantan Side Radio Station Summary

Station Name (1)Station Classification (2)Height above Sea Level	Access Road	Land & Building	Equipment Room	Power Supply System	Tower & Antenna Plan	Remarks
Takisung (1)Microwave Terminal station and submarine cable landing point staion (2)1 m	To be newly built for about 20 m from Kabupaten road to staion	Scheduled for land is 30m x 40m = 1200m in palm grove between Kabupaten road and coastline. Ground level is lower than the road. Hence the need for banking (about 1m).	Equipment room, monitor room, repaiar room, etc., scheduled to be established in 8m x 13m = 104 m land space.	Commercial power unavailable. Power supply is by in-house generation by E/G. Power supply equipment wing, separate from equipment room, to be newly established.	To construct new tower Tower height to be 22m in consideration of surrounding arbor height. To mount one antenna on new tower.	Residence wing to be newly built separately from equipment wing and power supply system wing.
Karamaian (1)Microwave repeater station (2)305 m	Existing station with access road. No problem.	To construct new tower in idle land on eastern side of existing equipment wing.	Shared use of existing OH system station equipment room is scheduled. No problem about floor space.	Commercial power unavailable. Power supply is by in-house generation by E/G. Existing E/G capacity is 34 kVA (220/127V). This capacity is large enough to fill power demand by the current project.	To construct new tower Tower height to be 22m to suit SD system application to trans-mission to/form Banjarmasin and to cope with short distance reflection due to equipment wing. To mount three new antennas on the tower.	There is a plan to extend height of tower for OH system antenna now in use and mount antennas for the current project on the tower. However, tower lack strength to endure additional antennas. Thus the plan is not acceptable
Banjarmasin (1)Microwave Terminal station (2)2 m	Existing station in the city. Hence no problem.	New tower const-ruction scheduled in idle land inside site entrance.	To install the current project equipment in the back of existing 4 GHz microwave system	Commercial power available. E/G capacity is 250 kVA. Battery capacity is deficient to meet power demand by the current project. Hence the need for additional charger and battery installa-tion.	Existing 40m microwave system tower lacks capacity for additio-nal mounting of two antennas. Hence new tower to be const-ructed. To adopt SD system for transmission to/from Karamaian and to mount two antennas on new tower.	

Table 28-B Plan B : Kalimantan Side Radio Station Summary

Station Name (1)Station Classification (2)Height above Ses Level	Differences from Route A Plan	Advantage	Re 100 m High Tower Construciton	Problems Relating to Radio Propagation
Takisung (1) Microwave terminal station and submarine cable landing point station (2) 1 m	To dispense with Karamaian through repeater and connect both terminal stations directry Therefore, at both terminal stations, about 97m tower height is necessary.	One through repeater station can be dispensed with.	For Takisung Station, no problem concerning land availability through ground is weak. Tower construction is possible. For Banjarmasin Station, tower construction space available near station building entrance. However, tower construction at business center in the city and at station building entrance spoils the view. In both cases, construction cost is high.	1) Propagation path is as long as 60km or so. Oversea propagation section and parallel section with overseas circuit exist on propagation path. 2) All antenna heights are below 100m. Hence low-low propagation path. Furthermore, reflection point is in the marsh. 3) Therefore, by reason of circuit failure due to fading, it seems difficult to satisfy CCIR and CCITT standards for 140MB high speed transmission. 4) Propagation test data analysis must precede practicing of propagation.
Banjarmasin (1) Microwave terminal station (2) 2 m				

Table 29 Summary of Site and Path Data

Plan	Side	Site	Latitud	Longitude	Elevation	Path Distance	Path Azimuth TN:Right Rotation
A		Surabaya(New)	7° 13' 52" S	112° 44' 07" E	3m	49.7km	72° 16' 31"
		Sandangan	7° 05' 38" S	113° 09' 52" E	262m		252° 13' 21"
		Sandangan			262m	18.3km	344° 09' 24"
		Murbulangan	6° 55' 57" S	113° 07' 07" E	155m		164° 09' 44"
		Murbulangan			155m	4.2km	356° 09' 34"
		Bumianyar	6° 53' 43" S	113° 06' 58" E	1m		176° 09' 36"
		Takisung	3° 51' 50" S	114° 36' 09" E	1m	16.4km	39° 52' 43"
		Karamaian	3° 45' 00" S	114° 41' 50" E	305m		219° 52' 15"
		Karamaian			305m	48.6km	344° 42' 25"
		Banjarmasin	3° 19' 34" S	114° 34' 55" E	2m		164° 16' 46"
B		Surabaya(New)	7° 13' 52" S	112° 44' 07" E	3m	12.5km	310° 06' 37"
		Gresik	7° 09' 32" S	112° 38' 58" E	5m		130° 07' 15"
		Gresik			5m	18.6km	37° 51' 08"
		Bangkalan	7° 01' 35" S	112° 45' 09" E	3m		217° 50' 28"
		Bangkalan			3m	20.4km	47° 48' 40"
		Padjung	6° 54' 12" S	112° 53' 18" E	40m		227° 47' 38"
		Padjung			40m	25.3km	87° 59' 12"
		Bumianyar	6° 53' 43" S	113° 06' 58" E	1m		267° 57' 35"
		Takisung	3° 51' 50" S	114° 36' 09" E	1m	59.4km	357° 48' 00"
		Banjarmasin	3° 19' 34" S	114° 34' 55" E	2m		177° 48' 05"

Table 30 Route by Route Tower Height and No. of Antennas Required

Route	Surabaya Side					Banjarmasin Side		
Plan (A)	Station Name	Surabaya (new)	Sandangan	Murbulanga	Bumianyar	Takisung	Karamaian	Banjarmasin
	Existing Tower Height	-	24.4 m	-	-	-	14.7 m	40 m
	New Tower Height	62 m	30 m	22 m	22 m	22 m	22 m	40 m
	No. of Antennas Required	2	3	2	1	1	3	2
	Note	To contract new tower by R.A.Project	To contruct new tower by the current project.					
Plan (B)	Station Name	Surabaya (new)	Gresik	Bangkalan	Padjung	Bumianyar	Takisung	Banjarmasin
	Existing Tower Height	-	-	52m(H.F用)	-	-	-	40 m
	New Tower Height	62 m	72 m	52 m	77 m	87 m	97 m	97 m
	No. of Antennas Required	2	4	4	4	2	2	2
	Note	To contract new tower by R.A.Project	To contruct new tower by the current project.					

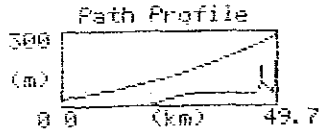
Table 31 Route Pass Clearance, Profile and Span Loss

Plan A (Surabaya Side)

Radius: 1.33333
Surabaya--Sandansan
No. of Data: 11

No.	Dist (km)	Height (m)
1	0.0	3.0
2	5.7	0.0
3	19.2	0.0
4	29.1	50.0
5	45.9	50.0
6	46.0	100.0
7	46.2	150.0
8	46.4	100.0
9	49.0	50.0
10	49.4	100.0
11	49.7	262.0
12	-999.0	-999.0

Max. Height: 262.0 m
Min. Height: 0.0 m



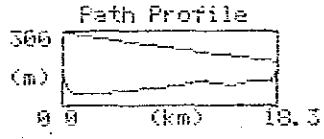
Radius : 1.33333
Surabaya--Sandansan

Ground Hght 1:	3.0 m
Ground Hght 2:	262.0 m
Path Distance:	49.7 km
T. Roughness:	48.6 m
Frequency:	6770 MHz
Ant Height 1:	30.0 m
Ant Height 2:	15.0 m
Critc Point:	5.7 km
Ridge Height:	0.0 m
Tree Height:	20.0 m
Fresnel Dip:	15.0 m
Clearance:	26.2 m
Clearance Fact:	1.8
Free Spc Loss:	143.0 dB
Ridge Loss:	0.0 dB
Total Loss:	143.0 dB

Radius: 1.33333
Sandansan--Murbulansan
No. of Data: 12

No.	Dist (km)	Height (m)
1	0.0	262.0
2	0.1	150.0
3	0.4	100.0
4	0.5	75.0
5	1.2	50.0
6	3.3	50.0
7	10.1	75.0
8	12.0	100.0
9	14.5	75.0
10	16.3	100.0
11	18.0	100.0
12	18.3	155.0
13	-999.0	-999.0

Max. Height: 262.0 m
Min. Height: 50.0 m



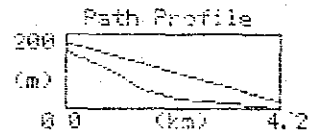
Radius : 1.33333
Sandansan--Murbulansan

Ground Hght 1:	262.0 m
Ground Hght 2:	155.0 m
Path Distance:	18.3 km
T. Roughness:	56.8 m
Frequency:	6770 MHz
Ant Height 1:	28.0 m
Ant Height 2:	20.0 m
Critc Point:	12.0 km
Ridge Height:	100.0 m
Tree Height:	20.0 m
Fresnel Dip:	13.5 m
Clearance:	90.1 m
Clearance Fact:	6.7
Free Spc Loss:	134.3 dB
Ridge Loss:	0.0 dB
Total Loss:	134.3 dB

Radius: 1.33333
Murbulansan--Sumiansar
No. of Data: 6

No.	Dist (km)	Height (m)
1	0.0	155.0
2	0.9	100.0
3	1.2	75.0
4	1.5	50.0
5	2.2	25.0
6	4.2	1.0
7	-999.0	-999.0

Max. Height: 155.0 m
Min. Height: 1.0 m



Radius : 1.33333
Murbulansan--Sumiansar

Ground Hght 1:	155.0 m
Ground Hght 2:	1.0 m
Path Distance:	4.2 km
T. Roughness:	44.7 m
Frequency:	6770 MHz
Ant Height 1:	20.0 m
Ant Height 2:	20.0 m
Critc Point:	0.9 km
Ridge Height:	100.0 m
Tree Height:	20.0 m
Fresnel Dip:	5.6 m
Clearance:	21.8 m
Clearance Fact:	3.9
Free Spc Loss:	121.5 dB
Ridge Loss:	0.0 dB
Total Loss:	121.5 dB

Table 32 Route Pass Clearance, Profile and Span Loss

Plan A (Kalimantan Side)

Radius: 1.33333
Banjarmasin--Karamaian
No. of Data: 9

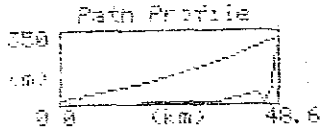
No.	Dist (km)	Height (m)
1	0.0	2.0
2	35.5	20.0
3	44.1	35.0
4	45.6	20.0
5	46.8	50.0
6	47.4	100.0
7	47.9	200.0
8	48.6	305.0
9	-999.0	-999.0

Max. Height: 305.0 m
Min. Height: 2.0 m

Radius: 1.33333
Karamaian--Takisung
No. of Data: 6

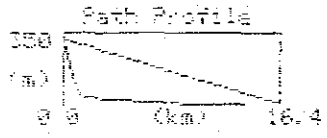
No.	Dist (km)	Height (m)
1	0.0	305.0
2	0.7	200.0
3	1.0	100.0
4	1.5	50.0
5	6.4	25.0
6	16.4	1.0
7	-999.0	-999.0

Max. Height: 305.0 m
Min. Height: 1.0 m



Radius : 1.33333
Banjarmasin--Karamaian

Ground Hght 1:	2.0 m
Ground Hght 2:	305.0 m
Path Distance:	48.6 km
T. Roughness:	63.0 m
Frequency:	6779 MHz
Ant Height 1:	25.0 m
Ant Height 2:	7.0 m
Crit. Point:	35.6 km
Ridge Height:	20.0 m
Tree Height:	20.0 m
Fresnel Dis:	20.5 m
Clearance:	168.5 m
Clearance Fact:	8.2
Free Spc Loss:	142.8 dB
Ridge Loss:	0.0 dB
Total Loss:	142.8 dB



Radius : 1.33333
Karamaian--Takisung

Ground Hght 1:	305.0 m
Ground Hght 2:	1.0 m
Path Distance:	16.4 km
T. Roughness:	103.6 m
Frequency:	6779 MHz
Ant Height 1:	10.0 m
Ant Height 2:	20.0 m
Crit. Point:	6.4 km
Ridge Height:	25.0 m
Tree Height:	20.0 m
Fresnel Dis:	13.2 m
Clearance:	151.5 m
Clearance Fact:	11.5
Free Spc Loss:	133.4 dB
Ridge Loss:	0.0 dB
Total Loss:	133.4 dB

Table 33 Route Pass Clearance, Profile and Span Loss

Plan B (Surabaya Side)

Radius: 1.33333
Surabaya--Gresik
No. of Data: 4

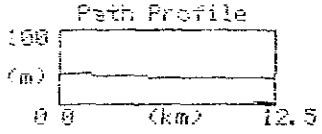
No.	Dist (km)	Height (m)
1	0.0	3.0
2	3.1	0.0
3	10.2	0.0
4	12.5	5.0
5	-999.0	-999.0

Max. Height: 5.0 m
Min. Height: 0.0 m

Radius: 1.33333
Gresik--Banakalan
No. of Data: 4

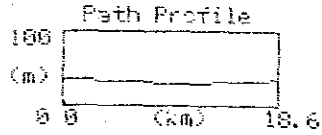
No.	Dist (km)	Height (m)
1	0.0	5.0
2	1.0	9.0
3	9.1	0.0
4	18.6	3.0
5	-999.0	-999.0

Max. Height: 5.0 m
Min. Height: 0.0 m



Radius : 1.33333
Surabaya--Gresik
Ground Hght 1: 3.0 m
Ground Hght 2: 5.0 m
Path Distance: 12.5 km
T. Roughness: 1.4 m

Frequency: 6770 MHz
Ant Height 1: 40.0 m
Ant Height 2: 30.0 m
Critc Point: 10.2 km
Ridge Height: 0.0 m
Tree Height: 20.0 m
Fresnel Dis: 9.1 m
Clearance: 15.1 m
Clearance Fact: 1.7
Free Spc Loss: 131.0 dB
Ridge Loss: 0.0 dB
Total Loss: 131.0 dB



Radius : 1.33333
Gresik--Banakalan
Ground Hght 1: 5.0 m
Ground Hght 2: 3.0 m
Path Distance: 18.6 km
T. Roughness: 2.4 m

Frequency: 6770 MHz
Ant Height 1: 42.0 m
Ant Height 2: 32.0 m
Critc Point: 9.1 km
Ridge Height: 0.0 m
Tree Height: 28.0 m
Fresnel Dis: 14.4 m
Clearance: 18.9 m
Clearance Fact: 0.8
Free Spc Loss: 134.5 dB
Ridge Loss: 0.0 dB
Total Loss: 134.5 dB

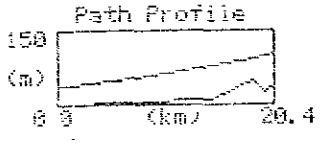
Table 34 Route Pass Clearance, Profile and Span Loss

Plan B (Kalimantan Side)

Radius: 1.33333
Banekalan--Padjuns
No. of Data: 7

No.	Dist (km)	Height (m)
1	0.0	3.0
2	14.4	12.0
3	16.2	25.0
4	18.3	50.0
5	18.6	50.0
6	19.6	25.0
7	20.4	40.0
8	-999.0	-999.0

Max.Height: 50.0 m
Min.Height: 3.0 m



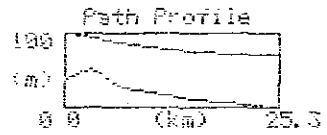
Radius : 1.33333
Banekalan--Padjuns
Ground Hght 1: 3.0 m
Ground Hght 2: 40.0 m
Path Distance: 20.4 km
T.Roughness: 17.6 m

Frequency: 6770 MHz
Ant Height 1: 35.0 m
Ant Height 2: 60.0 m
Critc Point: 18.3 km
Ridge Height: 50.0 m
Tree Height: 20.0 m
Fresnel Dip: 9.1 m
Clearance: 21.4 m
Clearance Fact: 2.3
Free Spc Loss: 135.3 dB
Ridge Loss: 0.0 dB
Total Loss: 135.3 dB

Radius: 1.33333
Padjuns--Bumiayu
No. of Data: 5

No.	Dist (km)	Height (m)
1	0.0	40.0
2	3.3	50.0
3	6.7	25.0
4	15.3	10.0
5	25.3	1.0
6	-999.0	-999.0

Max.Height: 50.0 m
Min.Height: 1.0 m



Radius : 1.33333
Padjuns--Bumiayu
Ground Hght 1: 40.0 m
Ground Hght 2: 1.0 m
Path Distance: 25.3 km
T.Roughness: 15.2 m

Frequency: 6770 MHz
Ant Height 1: 60.0 m
Ant Height 2: 70.0 m
Critc Point: 3.3 km
Ridge Height: 50.0 m
Tree Height: 20.0 m
Fresnel Dip: 11.3 m
Clearance: 21.9 m
Clearance Fact: 1.9
Free Spc Loss: 137.1 dB
Ridge Loss: 0.0 dB
Total Loss: 137.1 dB

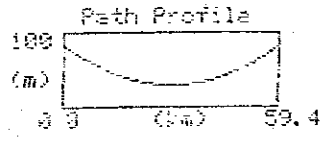
Table 35 Route Pass Clearance, Profile and Span Loss

Plan B (Kalimantan Side)

Radius: 1.33333
Banjarmasin--Takisung
No. of Data: 9

No.	Dist (km)	Height (m)
1	0.0	2.0
2	3.4	1.0
3	31.4	1.0
4	32.9	6.0
5	49.1	3.0
6	59.4	1.0
7	-999.0	-999.0

Max. Height: 2.0 m
Min. Height: 0.0 m



Radius : 1.33333
Banjarmasin--Takisung
Ground Hght 1: 2.0 m
Ground Hght 2: 1.0 m
Path Distance: 59.4 km
T. Roughness: 0.7 m

Frequency: 6770 MHz
Ant Height 1: 50.0 m
Ant Height 2: 80.0 m
Critc Point: 31.4 km
Ridge Height: 1.0 m
Tree Height: 20.0 m
Fresnel Dip: 25.6 m
Clearance: 8.7 m
Clearance Fact: 0.3
Free Spc Loss: 144.5 dB
Ridge Loss: 2.0 dB
Total Loss: 146.5 dB

Table 36 Comparison between Plan A and Plan B, Surabaya Side

	Plan A		Plan B	
No. of Repeater Sections	3	○	4	×
No. of Radio Repeater Stations	4	○	5	×
No. of Towers to be Newly Constructed	3 22 m x 2 30 m x 1	×	2 77 m x 1 87 m x 1	○
No. of Unmanned Repeater stations to be Newly Established	1		1	
Length of Roads to be Newly Built	50 m	○	400 m	×
No. of SD Sections to Cope with Fading	1	○	(All sections) 4	×
No. of Antennas Required	8	○	16	×
Required Waveguide Length	Approx. 160 m	○	Approx. 700 m	×
Radio Propagation Characteristics	There is one oversea propagation section, approx. 50m long. Two other sections are of short distance and propagation paths are considered to be stable.		Two out of four sections are oversea propagation sections. Two other sections are parallel with the coastline. All propagation paths are low-low paths, below 100 m in path clearance. All four sections are considered to require SD countermeasure.	
Judgement	Superior to Plan B in the number of radio repeater stations, the length of roads to be newly built and the number of SD sections.		Inferior to Plan A in terms of initial cost and propagation characteristics.	

Note: ○ - Superior × - Inferior

Table 37 Comparison between Plan A and Plan B, Kalimantan Side

	Plan A	Plan B
No. of Repeater Sections	2	1
No. of Radio Repeater Stations	3	2
No. of Towers to be Newly Constructed	3 — 40 m x 1, 22 m x 1, 20 m x 1	2 — 97 m x 2
No. of SD Sections	1	1
Radio Propagation Characteristics	Propagation distance is less than 50 km and propagation path is high-low path so that, by SD system, the required circuit standard can be satisfied in all likelihood.	Propagation section of about 60 km in distance includes oversea propagation section. Propagation path is low-low path of less than 100 m in height. therefore, to satisfy instantaneous circuit failure standard is considered to be difficult. (Propagation tests are necessary)
Judgement	*Plan A is preferred for adoption.* Reason: No problem is involved in circuit quality maintenance for 140 MB high capacity digital transmission.	*In terms of satisfying instantaneous circuit failure standard and construction cost of two towers, each about 100 m in height* Plan B is inferior to Plan A.

3.6 Comparison of Various Radio Frequency Bands for Backhaul Microwave Link

Radio frequency bands applicable for backhaul microwave system with high transmission capacity are compared in Table 38. However, the frequency bands (3,800 - 4,200 MHz and 5,925 - 6,425 MHz) allocated for INTELSAT and PALAPA Satellite System are excluded.

Table 38 Comparison of Frequency Bands for Backhaul Microwave System

Radio Frequency band	Description
5 GHz (4400 - 5000 MHz)	- 7 go and return 200 or 140 Mbit/s RF channels can be accommodated. - Effect of rain fading may be ignored. - No CCIR recommendation is available but a channeling arrangement is shown on ANNEX IV, CCIR Report 934. - Also to be referred to is ANNEX I, CCIR Report 935 for proposed recommendation (140 Mbit/s digital radio-relay system in 4 GHz band).
6 GHz Upper (6430 - 7110 MHz)	- 8 go and return 140 Mbit/s (16-level/QAM) RF channels can be accommodated as recommended by CCIR Rec. 384-3. - Effect of rain fading may be ignored.
11 GHz (10700-11700 MHz)	- 11 go and return 140 Mbit/s (16-level QAM) RF channels can be accommodated as recommended by CCIR Rec. 387-3. ANNEX III to CCIR Report 782-1 is also to be referred to for medium high and high capacity digital systems. - Rain fading can not be ignored since shortening relay hop length is necessary. - This band is suitable for a short haul but large capacity microwave system provided within or in the suburb of a large city like Surabaya.

Remarks

The 8GHz band may be used for digital system but for medium capacity digital system as shown in ANNEX I to CCIR Rec. 386-2, and ANNEX I and ANNEX II to CCIR Report 934.

CHAPTER 4 BACKHAUL SYSTEM CONFIGURATION

4.1 Digital Microwave System Configuration

Terrestrial transmission system (digital microwave system) is easier to extend than submarine cable system so that digital microwave radio system is to be adopted as backhaul system of the currently projected Surabaya-Banjarmasin Submarine Cable System. Based on the number of cirucits required obtained in Chapter 3, initial stage construction is on 1 + 1 (one working circuit, one standby circuits) basis. As demand increases, system capacity is to be expanded to 2 + 1 (2 working circuits, 1 standby circuit).

4.1.1 Digital Microwave Terminal Equipment Parameters

Following is the digital hierarchy composition for 140 MB digital transmission:

1) Fourth group digital terminal equipment (M 34 MUX)

(1)	No. of system	1
(2)	No. of subsidiary signals/system	4
(3)	Subsidiary signal	34.368 MB (CCITT G.703)
(4)	Multiple signal	139.264 MB (CCITT G.703)

2) Tertiary group digital terminal equipment (M 23 MUX)

(1)	No. of systems	4
(2)	No. of subsidiary signals/system	4
(3)	Subsidiary signal	8.448 MB (CCITT G.703)
(4)	Multiple signal	34.368 MB (CCITT G.703)

3) Secondary group digital terminal equipment (M 12 MUX)

(1)	No. of systems	8
(2)	No. of subsidiary signals/system	4
(3)	Subsidiary signal	2.048 MB (CCITT G.703)
(4)	Multiple signal	8.448 MB (CCITT G.703)

4) Primary group digital terminal equipment (M 30 MUX)

(1)	No. of systems	64 (in case of 1920 CH)
(2)	No. of voice channels/system	30
(3)	Voice signal	(CCITT G.712)
(4)	Multiple signal	2.048 MB (CCITT G.703)

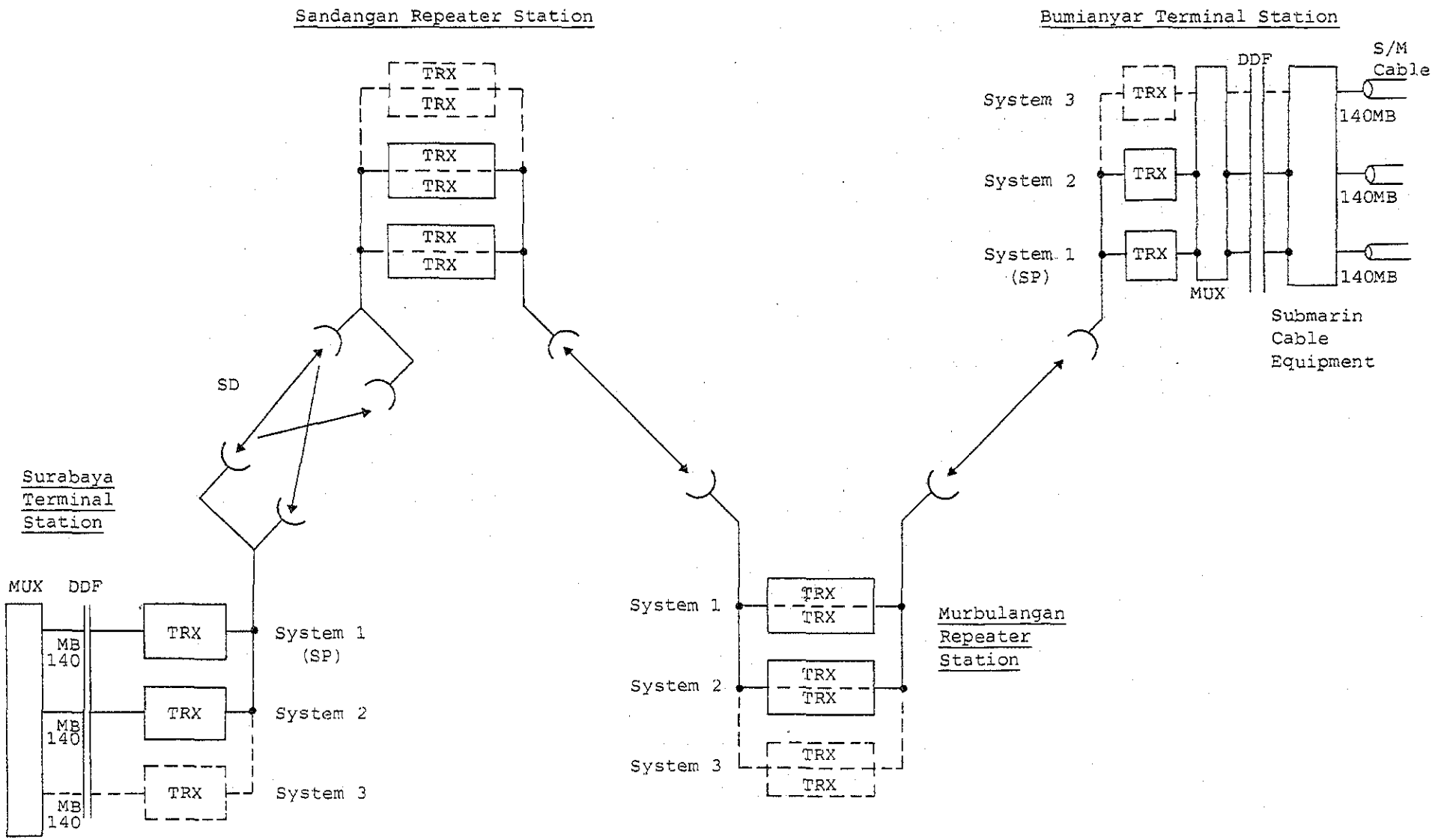


Figure 9 Digital Microwave Radio Link (Surabaya Side)

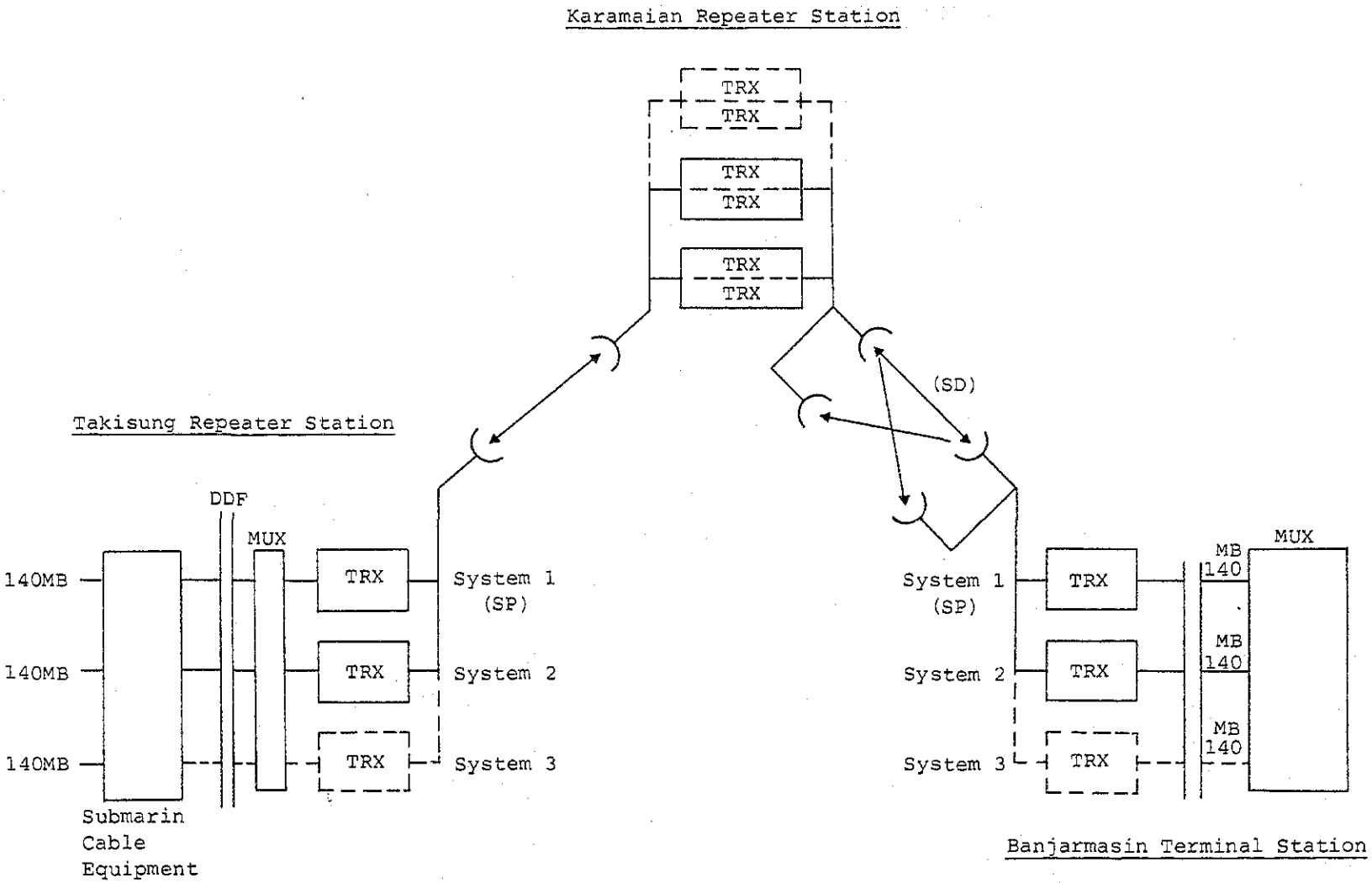


Figure 10 Digital Microwave Radio Link (Banjarmasin Side)

4.2 Cable Landing Point Station, Through Repeater Station Guide Maps

Figure 11 presents Murburangan Repeater Station (Surabaya side) guide map.
Figure 12 presents cable landing point, Tanjungbum (Surabaya side), guide map.
Figure 13 presents cable landing point, Takisung (Kalimantan side), guide map.

4.3 Station Building (New) layout Plans

Figure 14 presents Bumianyar cable landing point station layout plan.
Figure 15 presents Takisung cable landing point station layout plan.

4.4 Existing Station Building Layouts

Figure 16 through 19 present station building layouts of Surabaya Toll Exchange, *Sandangan Repeater Station*, *Karmaian Repeater Station* and Banjarmasin Toll Exchange.

4.5 Power Supply System

Murbulangan Through Repeater Station in Madura Island is a pure repeater station so that power consumption is limited. Thus, for power supply system, solar battery system provides an expadient; however, this time, DEG (diesel engine generator) system is to be adopted. Reasons;

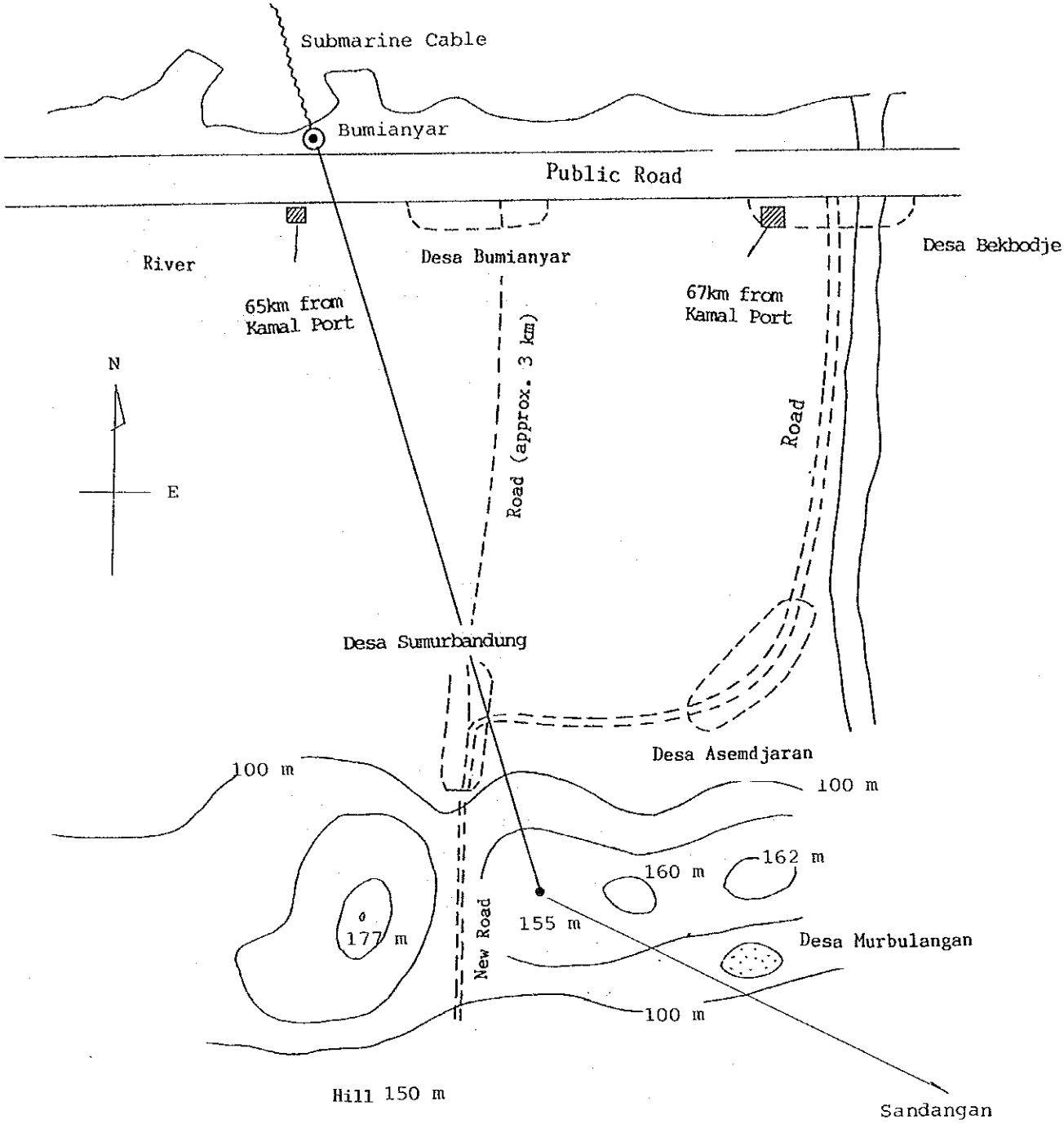
1) Initial cost comparison between DEG system and solar battery system makes the former more advantageous when generation capacity is gareater than 20 kVA.

2) Murbulangan is a repeater station with access road completed so that there is no difficulty in engine oil supply, etc.

3) Solar battery system necessitates large capacity secondary power supply system installation as safety measure against protracted rainy season.

Power supply system details for repeater stations are as under.

Station Name	DEG	Rectifier	Battery	Note
Sandangan	22 kVA x 2	48V 48A	170 AH	
Murbulangan	22 kVA x 2	48V 48A	170 AH	
Bumianyar	30 kVA x 3	48V 200A	800 AH	
Takisung	30 kVA x 3	48V 200A	800 AH	
Karamaian	-	48V 48A	170 AH	
Banjarmasin	-	48V 100A	400 AH	



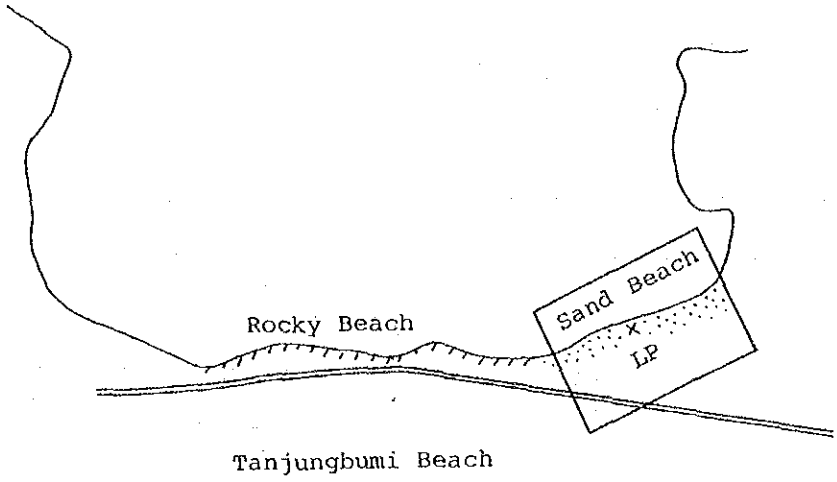
1. Proposed site is at top of mild uphill sloope about 50 m east of mountain pass (elevation: 150 m). Site elevation is 155 m.

2. About 50 m length of access road is to be newly built.

3. Farmland lane 8carriageway) extends about 7 km from Bekbedje Village (67 km from Kamal Port) to proposed site at montain pass (elevation : 150 m). About 1 km section under mountain pass is a limestone road.

4. Farmland lane, about 3 km long, extends from Bumianyar Village to Summurbandung Village. This farmland lane is a bad passage.

Figure 11 Murbualngan Repeater Station Guide Map



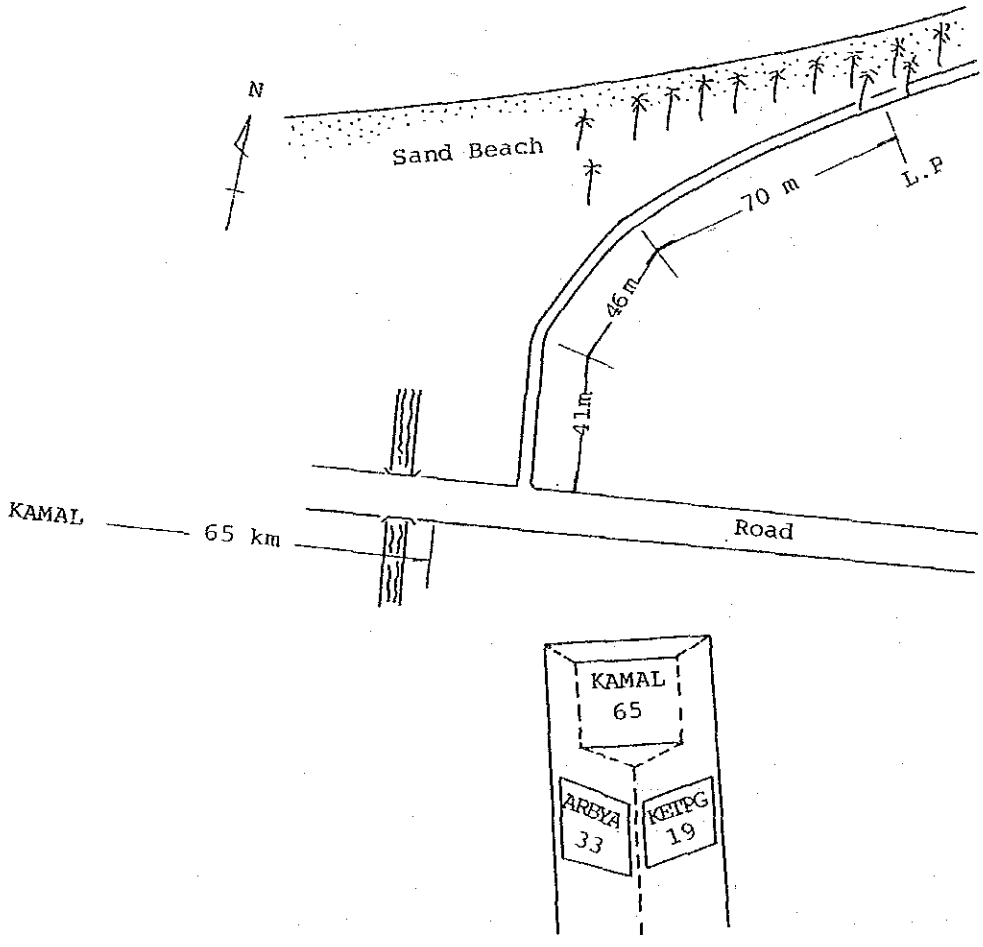


Figure-12 Takisung Terminal Station Site Location Plan

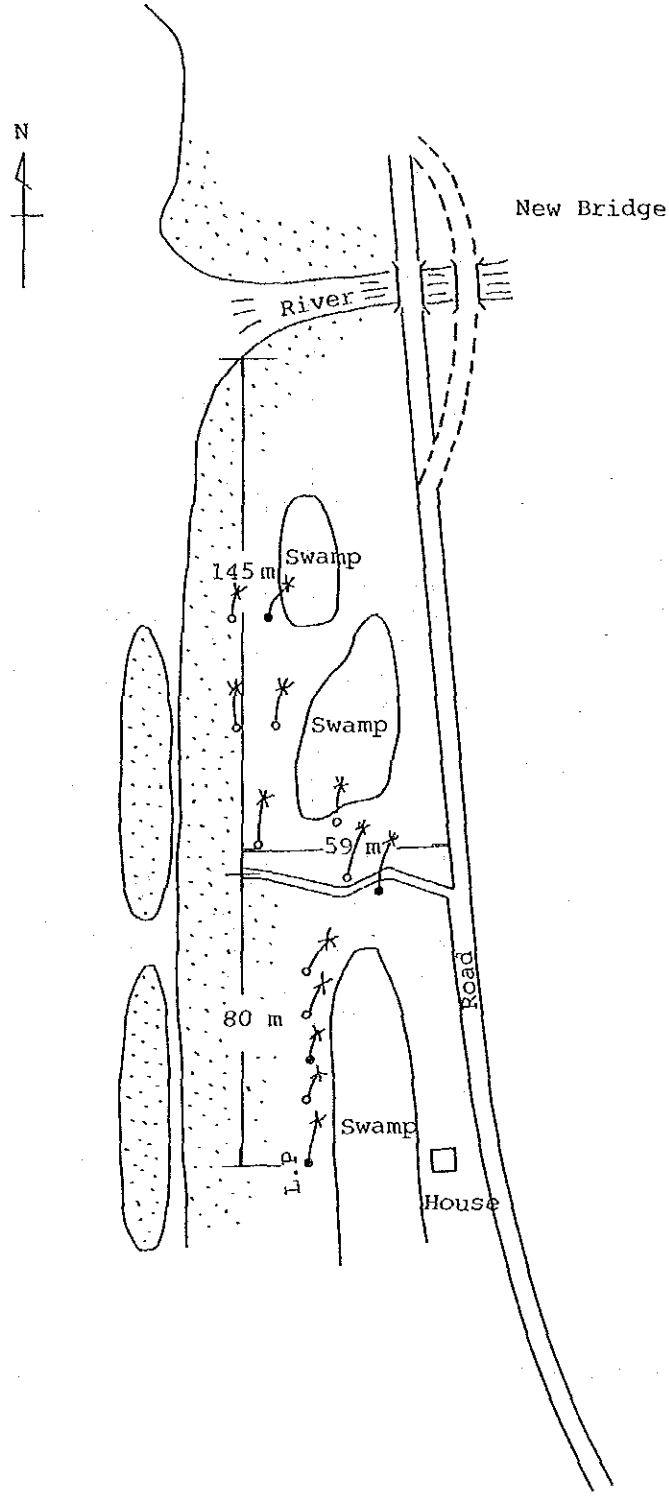


Figure-13 Takisung Beach Landing Point (LP) Guide Map

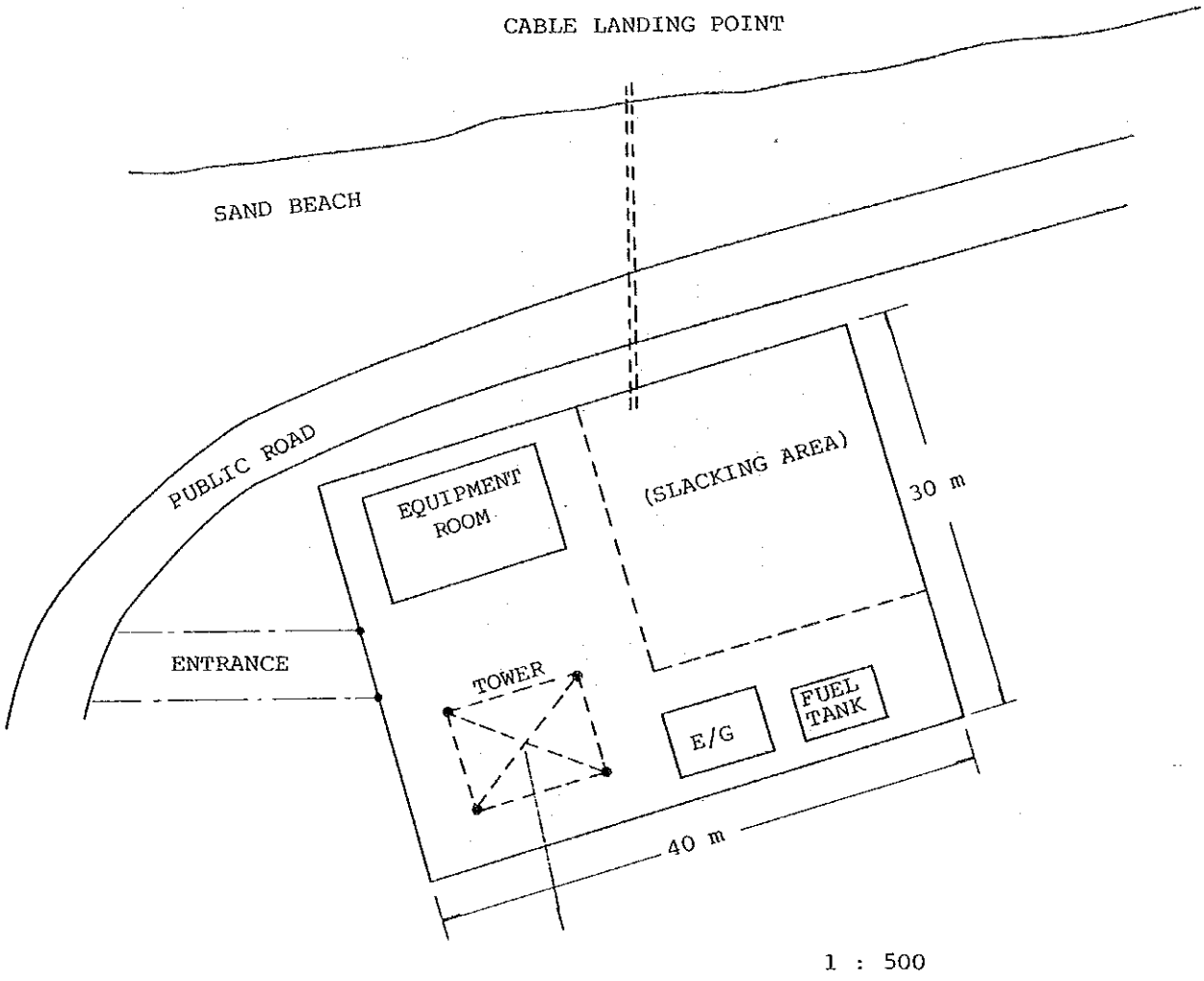


Figure 11 Bumianyar Terminal Station Site Location Plan

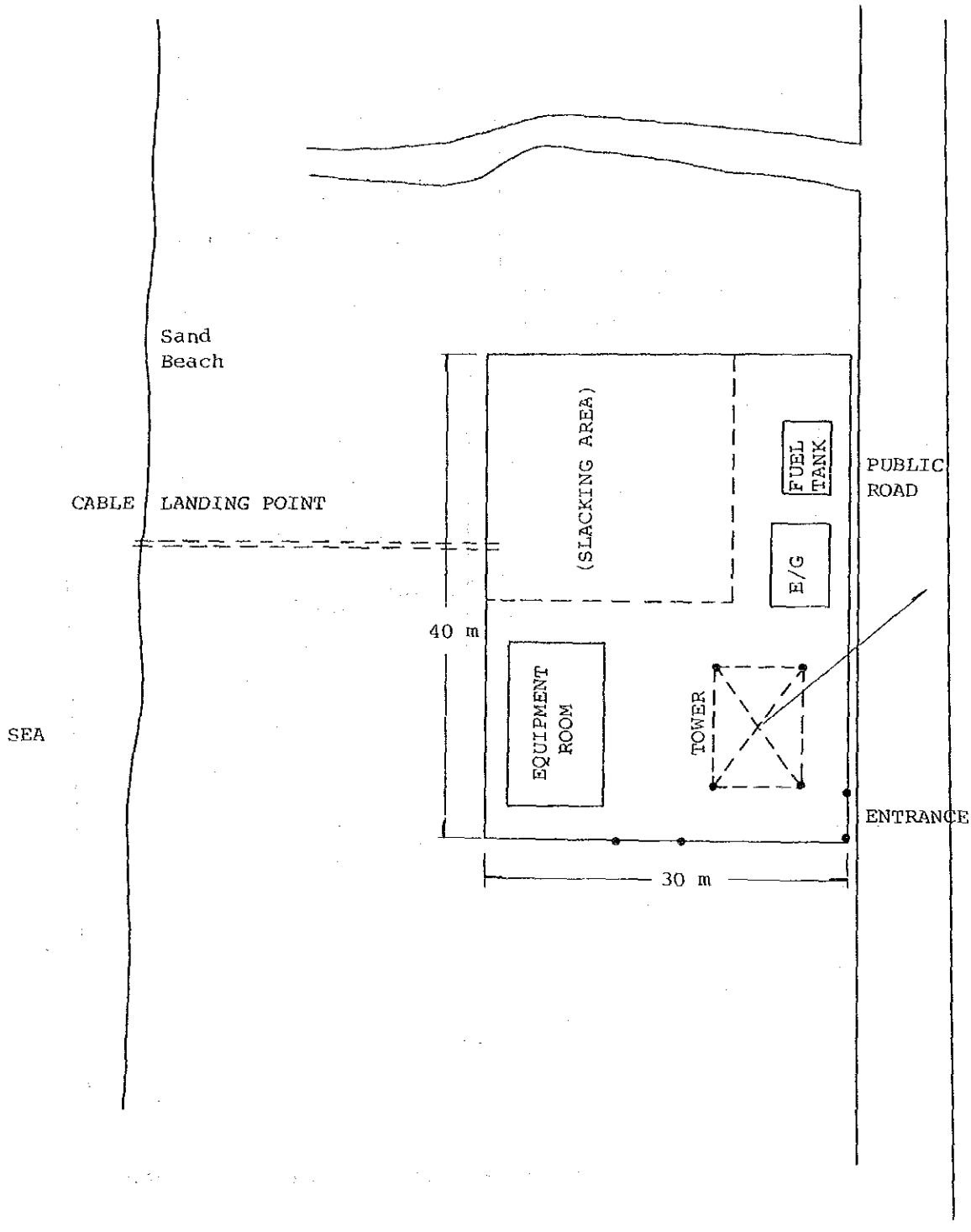


Figure 12 Takisung Terminal Station

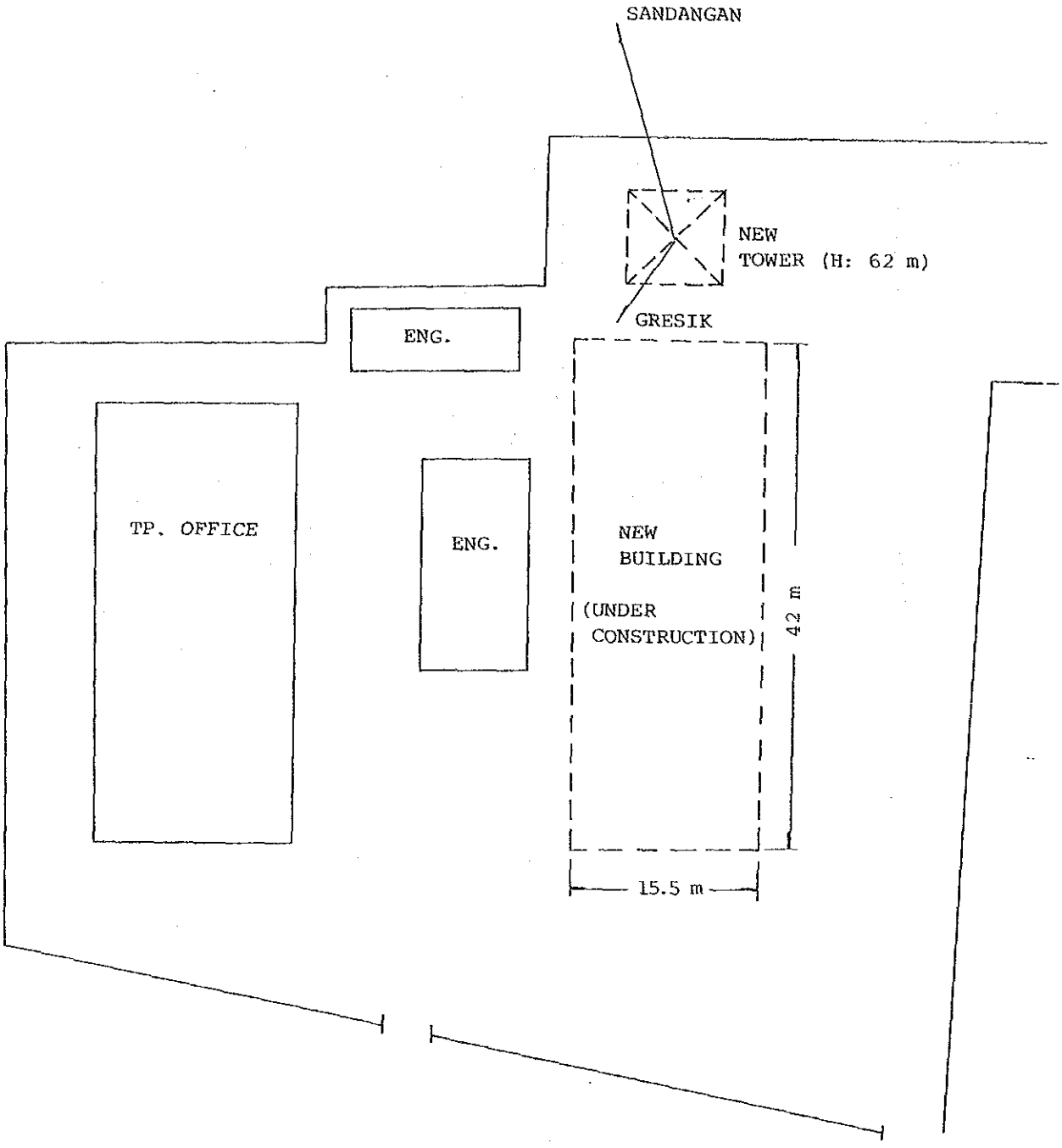


Figure-16 Surabaya Microwave Terminal Station (New) Layout Plan

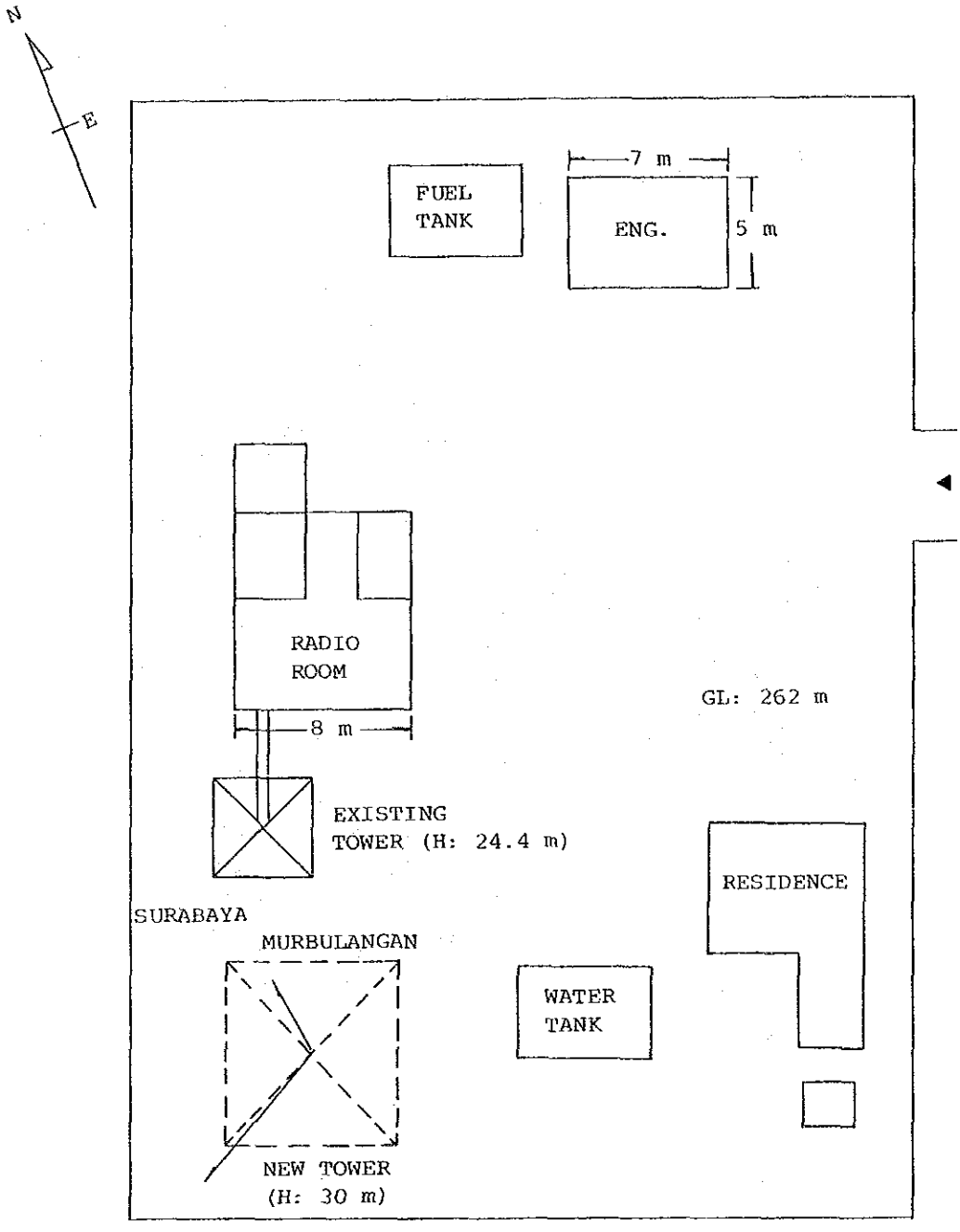


Figure-17 Sandangan Repeater Station Layout Plan

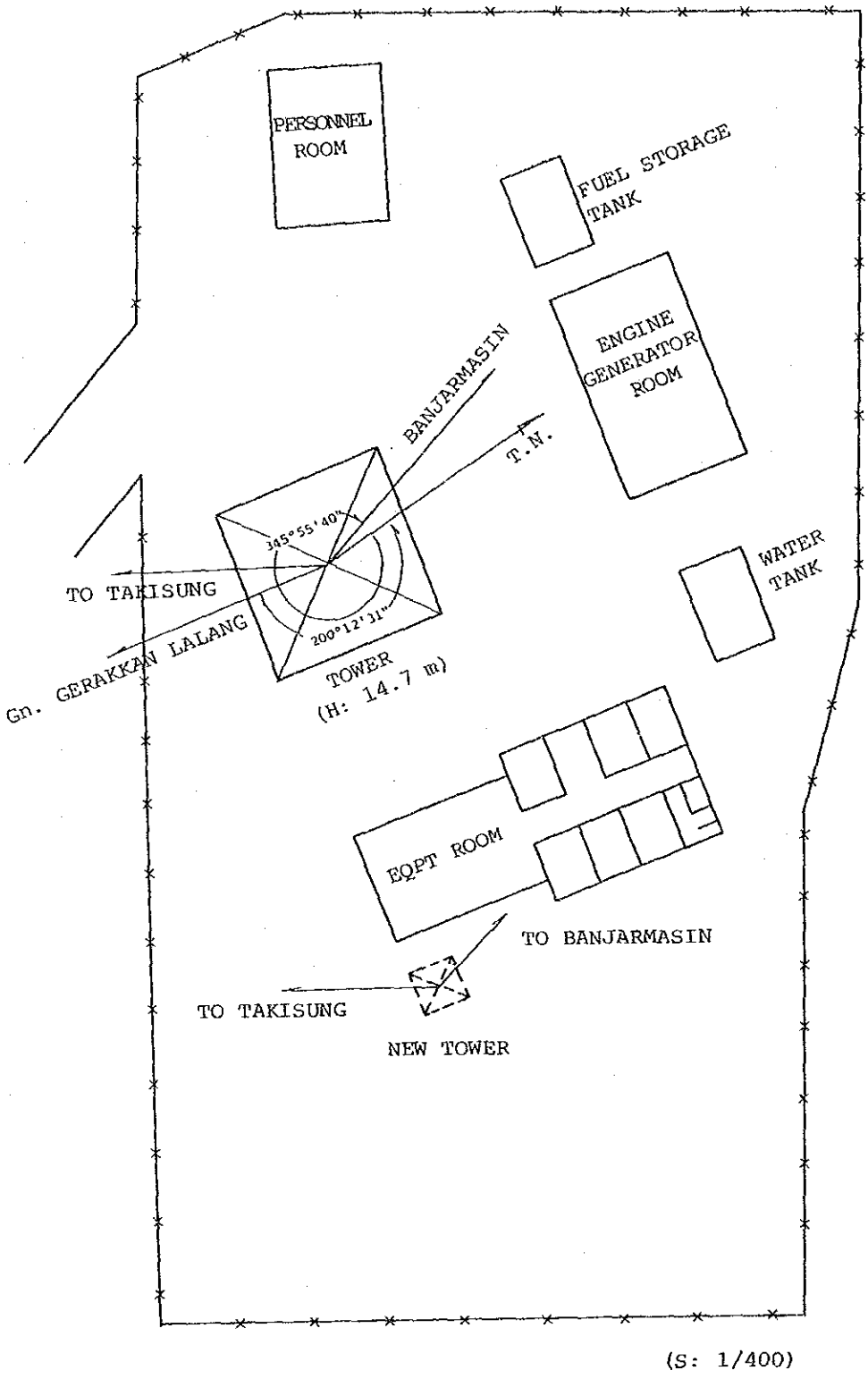


Figure-18 Gn. Karamaian Repeater Station Layout Plan

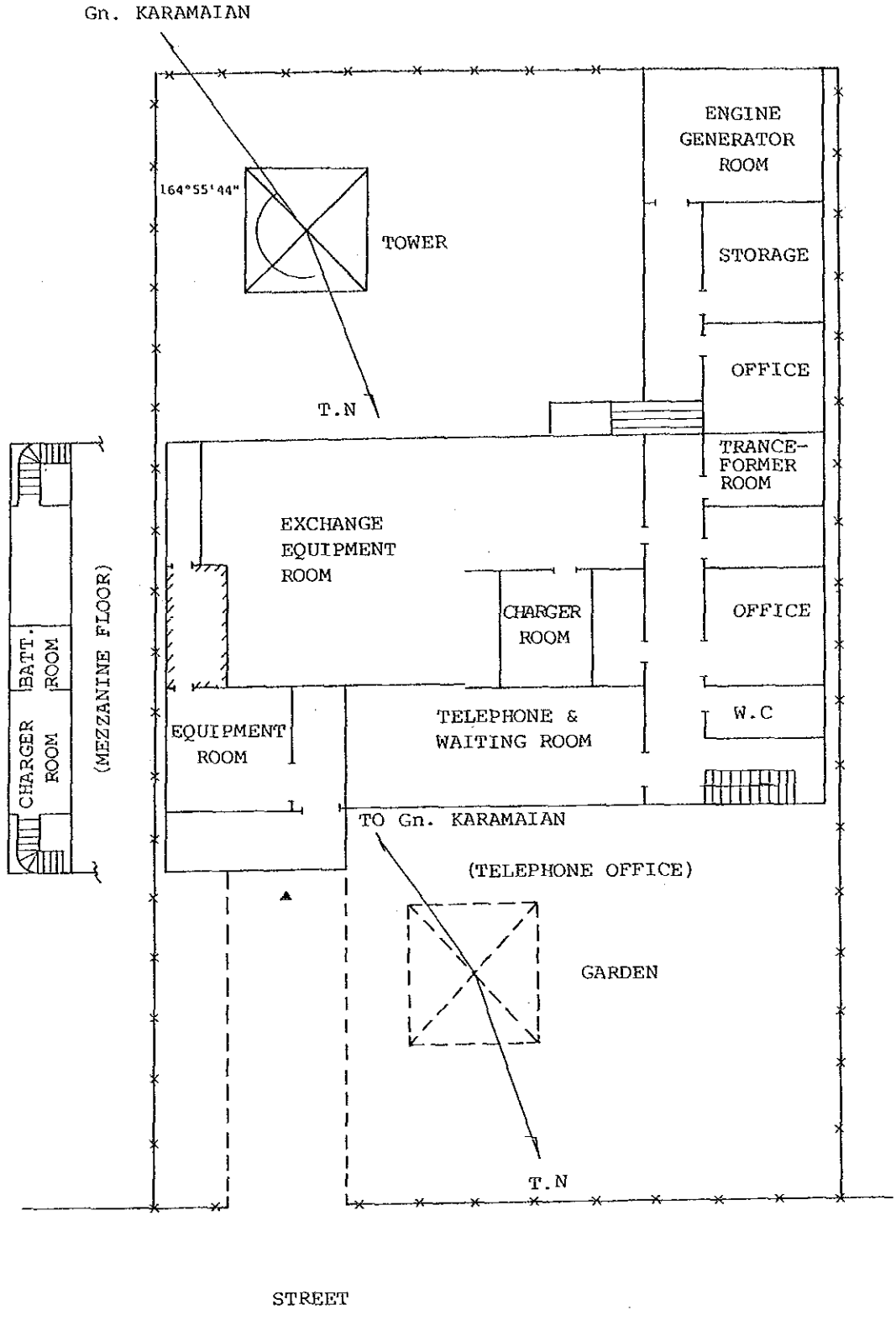


Figure-19 Banjarmasin Station Layout Plan