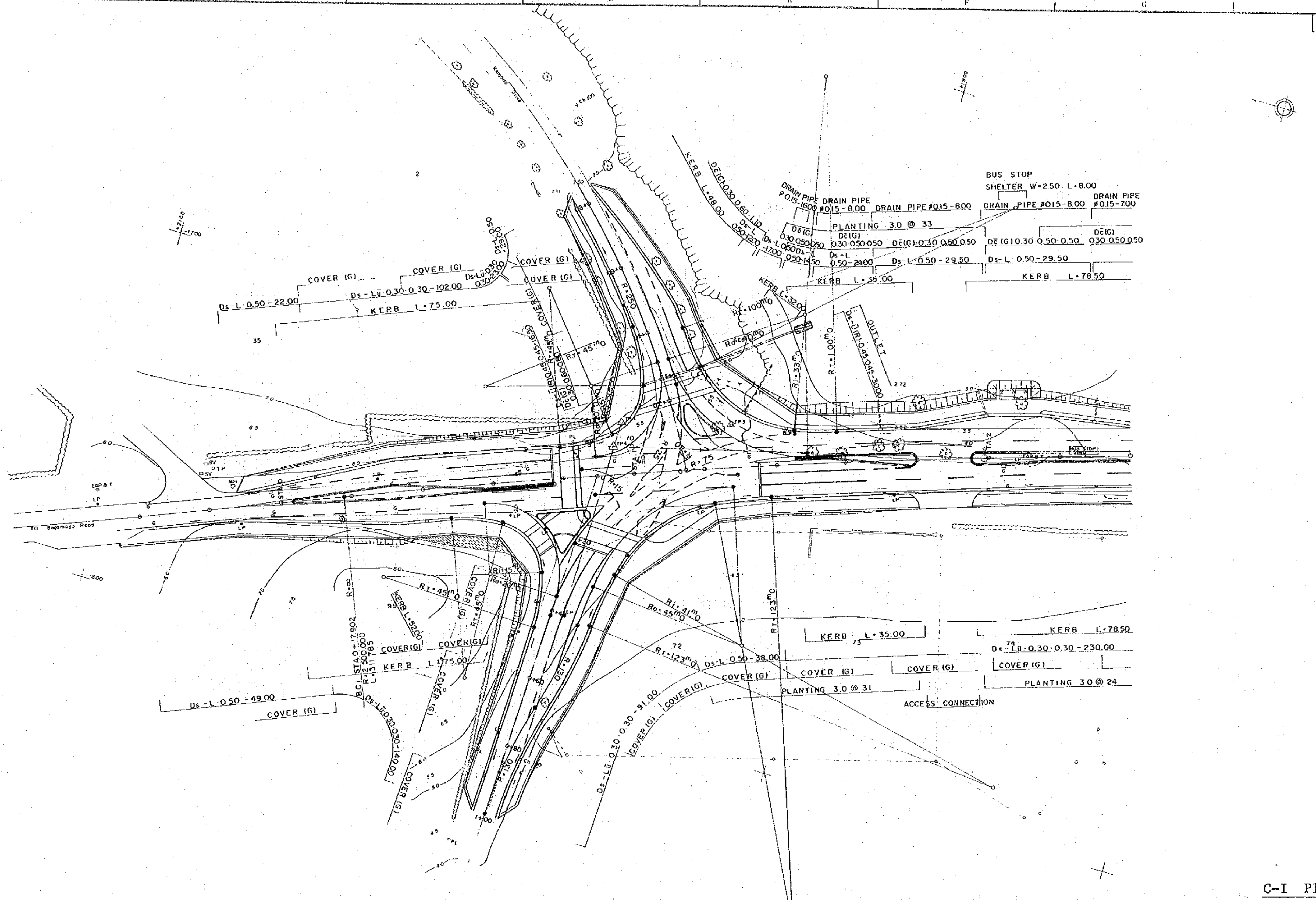
PLATE NO 2



C-I Plan

THE SELANDER BRIDGE EXPANSION PROJECT DAR ES SALAAM	PLAN (1)
MINISTRY OF WORKS	DWG NO.

MINISTRY of WORKS

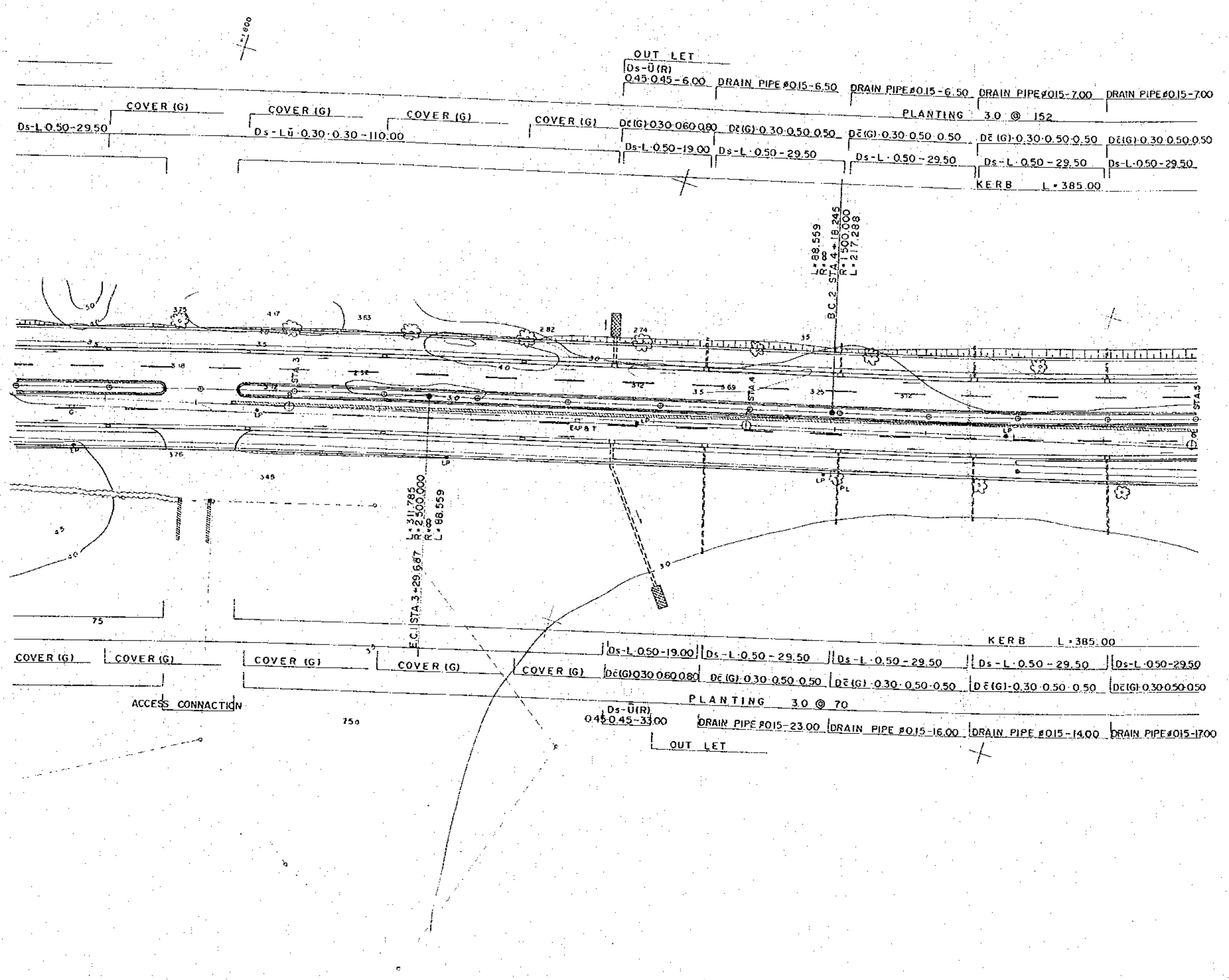
NIPPON KOEI CO., LTD.
CONSULTING ENGINEERS
TOKYO JAPAN

DATE JUNE 30, 1980

SCALE A 0 25 50M (1:500)

SCALE B

REV. NO. | DATE | COORDINATE | REVISION | APPRO | DATE

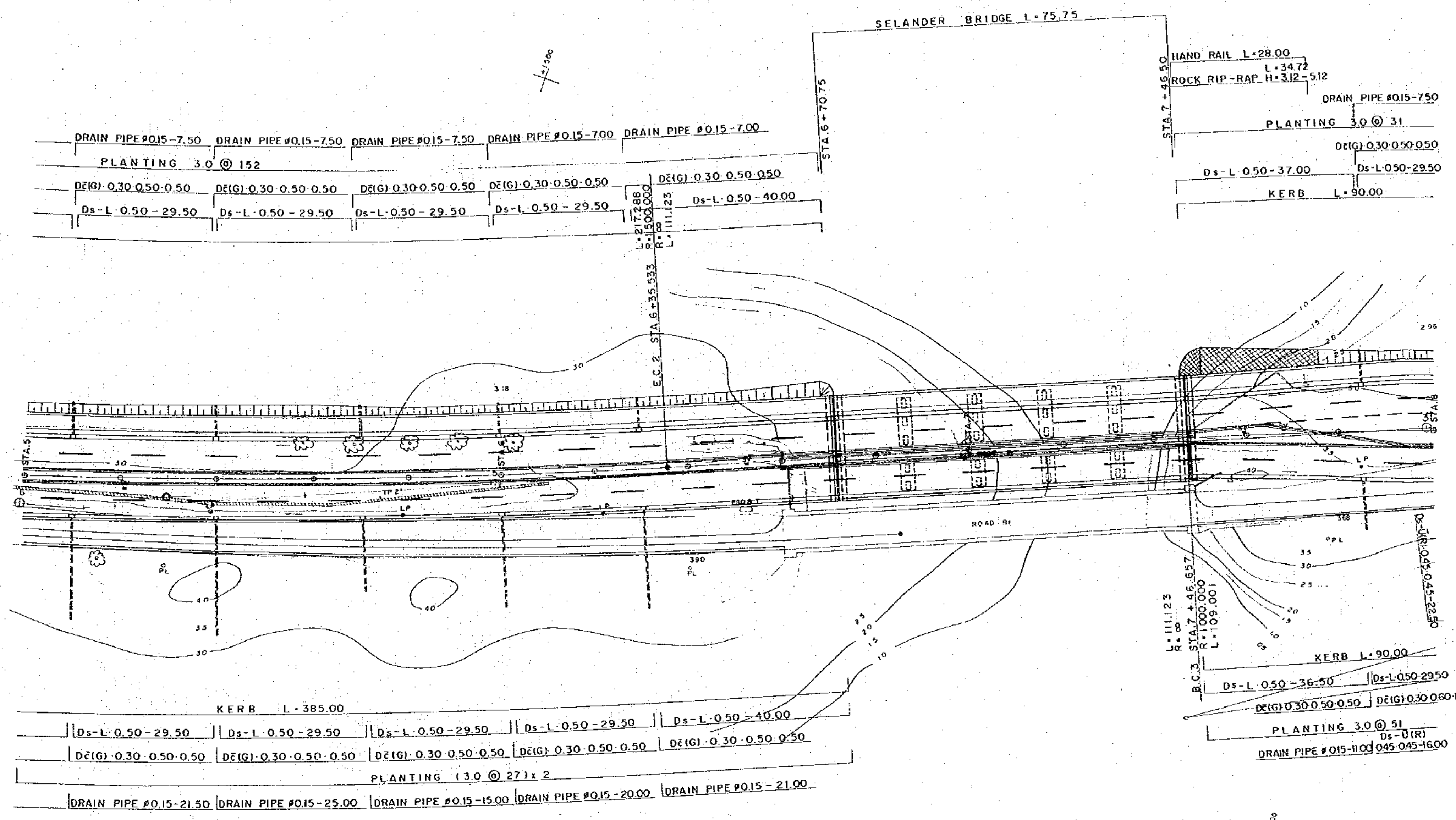


C-I (continued 2)

PLATE NO. 3

THE SELANDER BRIDGE EXPANSION PROJECT DAR ES SALAAM	PLAN (2)
MINISTRY OF WORKS	DWG. NO.
MINISTRY of WORKS	NIPPON KOEI CO. LTD. CONSULTING ENGINEERS TOKYO JAPAN
DATE	JUNE 30, 1980

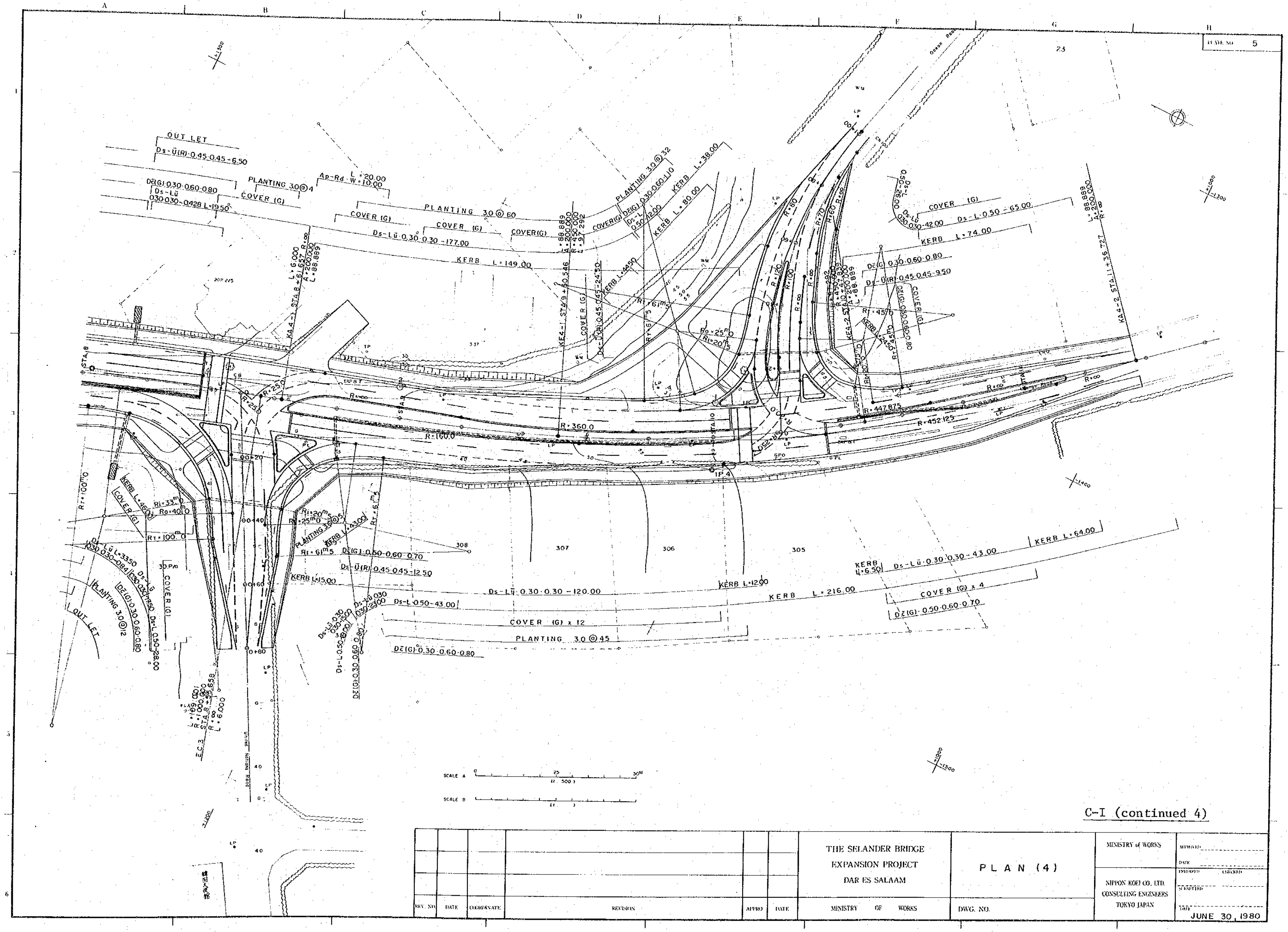
SCALE A 0 25 50M 1 : 500
SCALE B



C-I (continued 3)

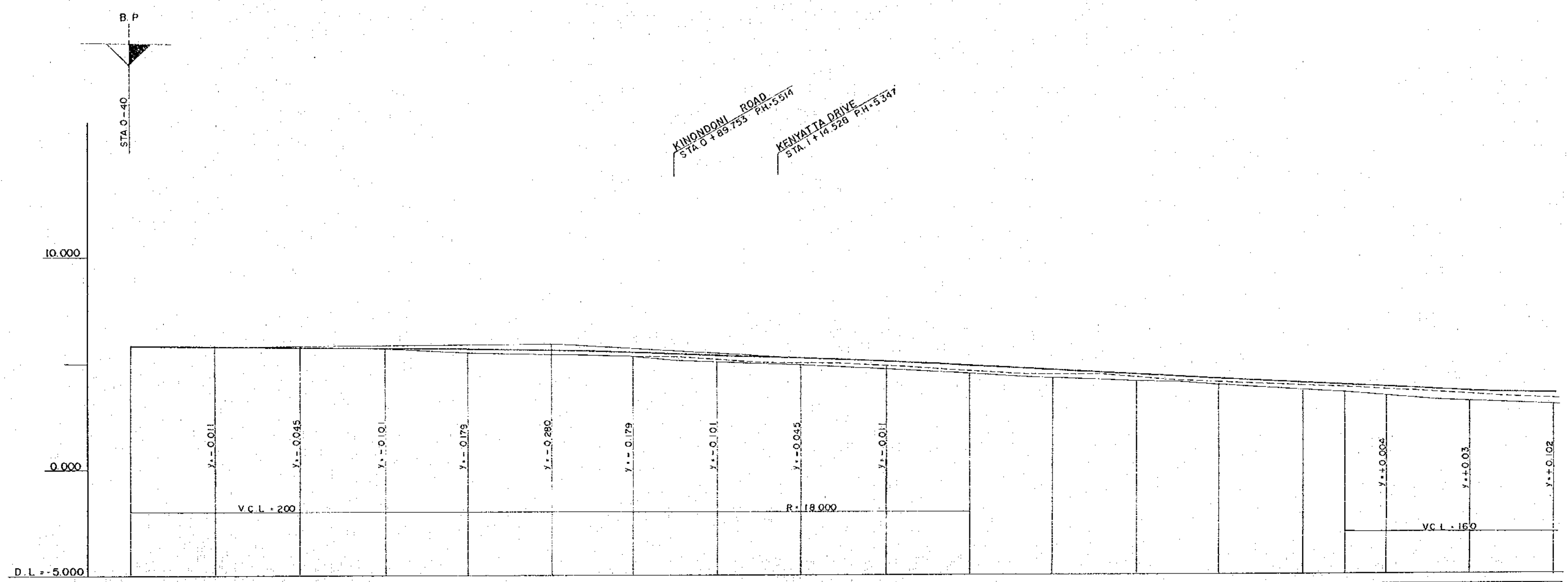
REV NO	DATE	COORDINATE	REVISION	APPRO	DATE	THE SELANDER BRIDGE EXPANSION PROJECT DAR ES SALAAM	PLAN (3)	MINISTRY of WORKS	APPROVED / DATE
						MINISTRY OF WORKS	DWG. NO.	NIPPON KOEI CO. LTD CONSULTING ENGINEERS TOKYO JAPAN	DATE JUNE 30.1980

PLATE NO 4



C-I (continued 4)

PLATE NO. 9



GRADIENT: 5.830 — i=0.120% L=100.000 — 5.950 — i=1.000% L=270.000

EMBANKMENT HEIGHT		0.023	0.043	0.061	0.047	0.140	0.161	0.349	0.305	0.154	0.250	0.290	0.270	0.200	0.300	0.334	0.487	0.462
CUT HEIGHT																		
PROPOSED HEIGHT	5.830	5.843	5.833	5.801	5.747	5.670	5.571	5.449	5.305	5.139	4.950	4.750	4.550	4.350	4.150	3.954	3.787	3.652
GROUND HEIGHT	5.83	5.82	5.79	5.74	5.70	5.53	5.41	5.10	5.00	4.985	4.70	4.46	4.28	4.15	3.85	3.62	3.35	3.19
CUMULATED DISTANCE	-40.00	-20.00	0.00	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	200.00	220.00	240.00	260.00	280.00	300.00
DISTANCE	20.00	20.00	0.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
STATION NO.	-40	-20	0+00	+20	+40	+60	+80	1+00	+20	+40	+60	+80	2+00	+20	+40	+60	+80	3+00

SUPERELEVATION: -2.000% … -2.000%

CURVE BAND: R=∞ — IP1 IA=7°-8'-44.1" R=2500.000, TL=156.095, CL=311.785, SL=4.868

Scale Horizontal = A
Vertical = B

SCALE A: 0 — 25 — 50M (1:500)
SCALE B: 0 — 5 — 10M (1:100)

C-II Profile

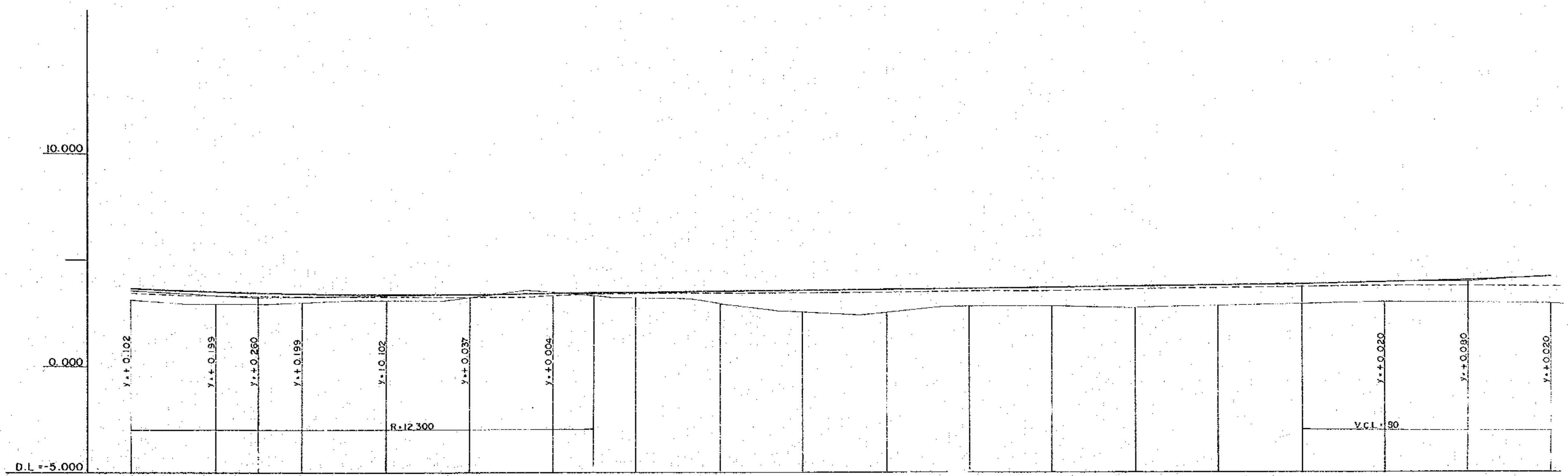
REV. NO.	DATE	COORDINATE	REVISION	APPRO	DATE

THE SELANDER BRIDGE EXPANSION PROJECT
DAR ES SALAAM
MINISTRY OF WORKS

PROFILE
MAIN ROAD (1)
BAGAMOYO ROAD
DWG. NO.

MINISTRY of WORKS
NIPPON KOEI CO., LTD.
CONSULTING ENGINEERS
TOKYO JAPAN

APPROVED
DATE
PREPARED CHECKED
SUBMITTED
DATE JUNE 30, 1980



GRADIENT: (3.250) — i=0.300% L=290000 — (4.120)

STATION NO.	3+00	+20	+40	+60	+80	4+00	+20	+40	+60
EMBANKMENT HEIGHT	0.462	0.630	0.479	0.302	0.177		0.260	0.500	0.590
CUT HEIGHT						0.076			
PROPOSED HEIGHT	3.652	3.610	3.479	3.442	3.437	3.464	3.520	3.580	3.640
GROUND HEIGHT	3.19	2.98	3.00	3.14	3.26	3.54	3.26	3.08	3.05
CUMULATED DISTANCE	300.00	320.00	340.00	360.00	380.00	400.00	420.00	440.00	460.00
DISTANCE	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00

STATION NO.	+80	5+00	+20	+40	+60	+80	6+00	+20	+40
EMBANKMENT HEIGHT	0.120	0.260	0.670	0.780	0.860	0.730	0.760	0.800	0.810
CUT HEIGHT									
PROPOSED HEIGHT	3.700	8.760	3.820	3.880	3.940	4.000	4.080	4.200	4.360
GROUND HEIGHT	3.82	3.50	3.15	3.10	3.08	3.27	3.32	3.40	3.55
CUMULATED DISTANCE	480.00	500.00	520.00	540.00	560.00	580.00	600.00	620.00	640.00
DISTANCE	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00

SUPERELEVATION: 2.000%

CURVE BAND: R=∞ L=88.559 — I.P.2 I.A=8°-17'-59.3" R=1500.000 T.L=108.835 C.L=217.288 S.L=3.943

Scale Horizontal = A
Vertical = B

C-II (continued 2)

SCALE A 0 25 50M (1:500)
SCALE B 0 5 10M (1:100)

REV. NO	DATE	COORDINATE	REVISION	APPRO	DATE

THE SELANDER BRIDGE EXPANSION PROJECT
DAR ES SALAAM

MINISTRY OF WORKS

PROFILE
MAIN ROAD (2)
BAGAMOYO ROAD

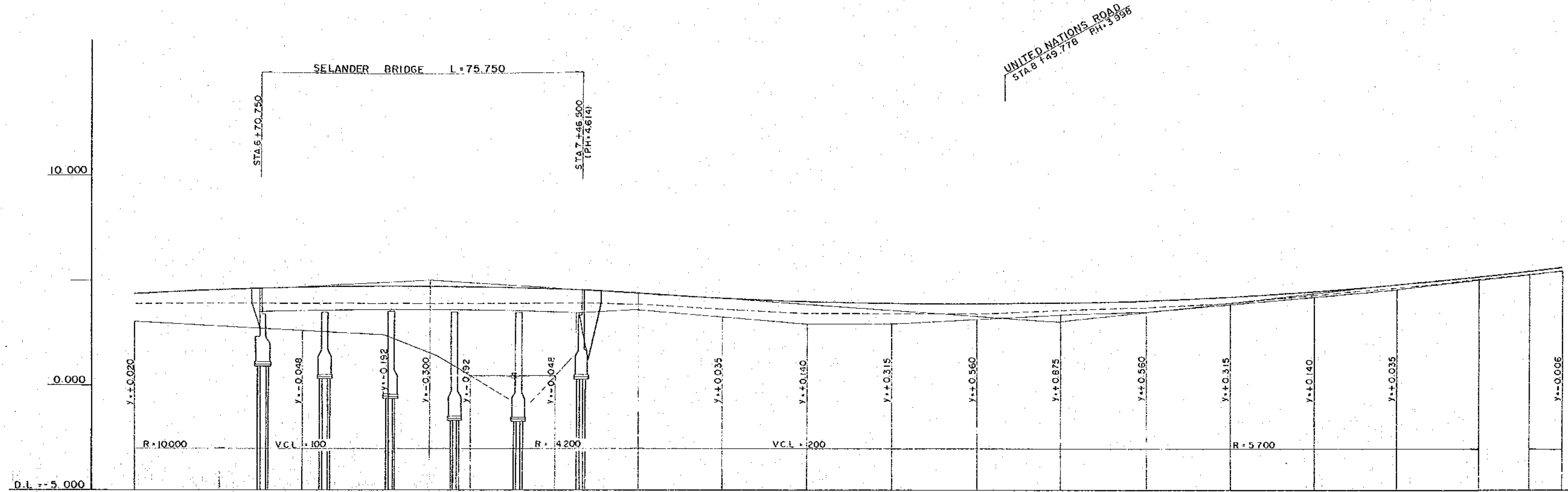
DWG. NO.

MINISTRY of WORKS

NIPPON KOEI CO. LTD
CONSULTING ENGINEERS
TOKYO JAPAN

APPROVED
DATE
PREPARED CHECKED
SUBMITTED
DATE JUNE 30, 1980

PLATE NO. 11



GRADIENT	i=1.100 % L=90.000			5.110				i=1.300 % L=150.000			3.160				i=2.200% L=176.000			
EMBANKMENT HEIGHT	1.810	1.060	2.102	1.948			0.760	0.885	1.010	0.635	0.500	0.485	0.390	0.305	0.270	0.195	0.180	0.254
CUT HEIGHT																		
PROPOSED HEIGHT	4.360	4.560	4.732	4.808	4.788	4.672	4.460	4.235	4.080	3.995	3.980	4.035	4.160	4.355	4.620	4.955	5.360	5.794
GROUND HEIGHT	3.55	3.50	2.63	2.86			3.70	3.38	3.07	3.36	3.48	3.55	3.77	4.05	4.35	4.76	5.18	5.54
CUMULATED DISTANCE	640.00	660.00	680.00	700.00	720.00	740.00	760.00	780.00	800.00	820.00	840.00	860.00	880.00	900.00	920.00	940.00	960.00	980.00
DISTANCE	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	13.580	20.00	20.00	20.00
STATION NO.	6+40	+60	+80	7+00	+20	+40	+60	+80	8+00	+20	+40	+60	+80	9+00	+20	+40	+60	+80
SUPERELEVATION	-2.000 %											2.000 % 40.000 1/154		2.000 %				2.000 %
CURVE BAND	R=∞ L=111.123						I.P.3 IA=6°-14'-43.1" R=1000.000 T.L=54.555 C.L=109.001 S.L=1.487					R=∞ L=6.000	A=200.000 L=88.869				R=450.000	

Scale Horizontal = A
Vertical = B

C-II (continued 3)

SCALE A 0 25 50M (1:500)
SCALE B 0 5 10M (1:100)

REV. NO.	DATE	COORDINATE	REVISION	APPRO.	DATE

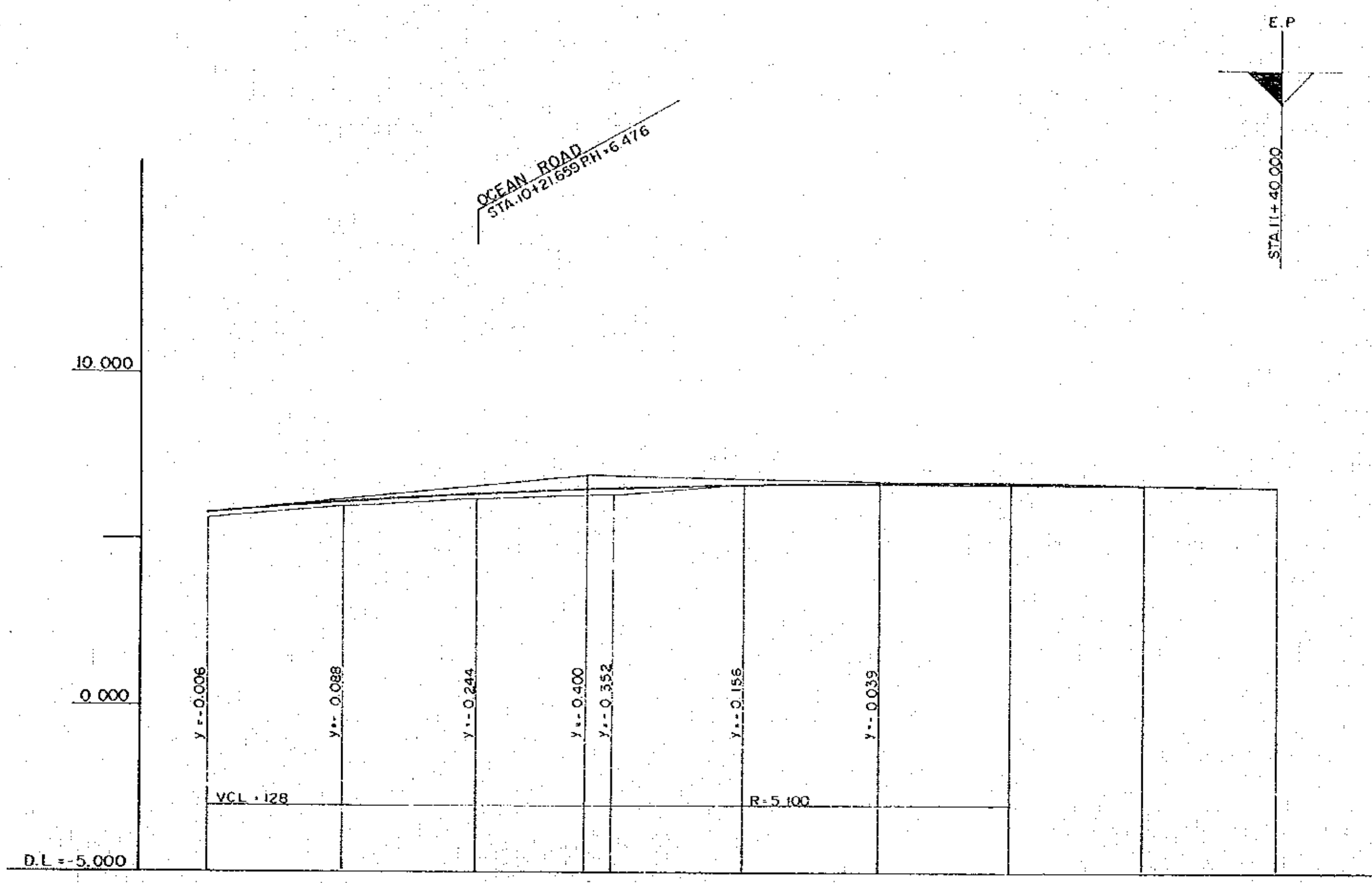
THE SELANDER BRIDGE EXPANSION PROJECT
DAR ES SALAAM
MINISTRY OF WORKS

PROFILE
MAIN ROAD (3)
BAGAMOYO-UPANGA ROAD
DWG. NO.

MINISTRY of WORKS
NIPPON KOEI CO. LTD.
CONSULTING ENGINEERS
TOKYO JAPAN

APPROVED
DATE
DESIGNED CHECKED
SUBMITTED
DATE JUNE 30, 1980

PLATE NO. 12



GRADIENT				7.032			i = 0.300 % L = 104.000		6.720
EMBANKMENT HEIGHT	0.254	0.172	0.216	0.168	0.014	0.041	0.020	0.020	0.000
CUT HEIGHT									
PROPOSED HEIGHT	5.794	6.152	6.436	6.668	6.804	6.861	6.840	6.780	6.720
GROUND HEIGHT	5.54	5.97	6.22	6.50	6.79	6.82	6.82	6.76	6.72
CUMULATED DISTANCE	980.00	1000.00	1020.00	1040.00	1060.00	1080.00	1100.00	1120.00	1140.00
DISTANCE	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
STATION NO.	+80	10+00	+20	+40	+60	+80	11+00	+20	+40
SUPERELEVATION	+2.000 %						2.000 %	40.000 1/153	2.000 %
CURVE BAND	I.P.4 IA = 23°-42'-19.1" R = 450.000 C.L = 97.292					A = 200.000 L = 88.889			

Scale Horizontal = A
Vertical = B

C-II (continued 4)

SCALE A 0 25 50M (1:500)
SCALE B 0 5 10M (1:100)

REV. NO.	DATE	COORDINATE	REVISION	APPRD	DATE

THE SELANDER BRIDGE EXPANSION PROJECT
DAR ES SALAAM
MINISTRY OF WORKS

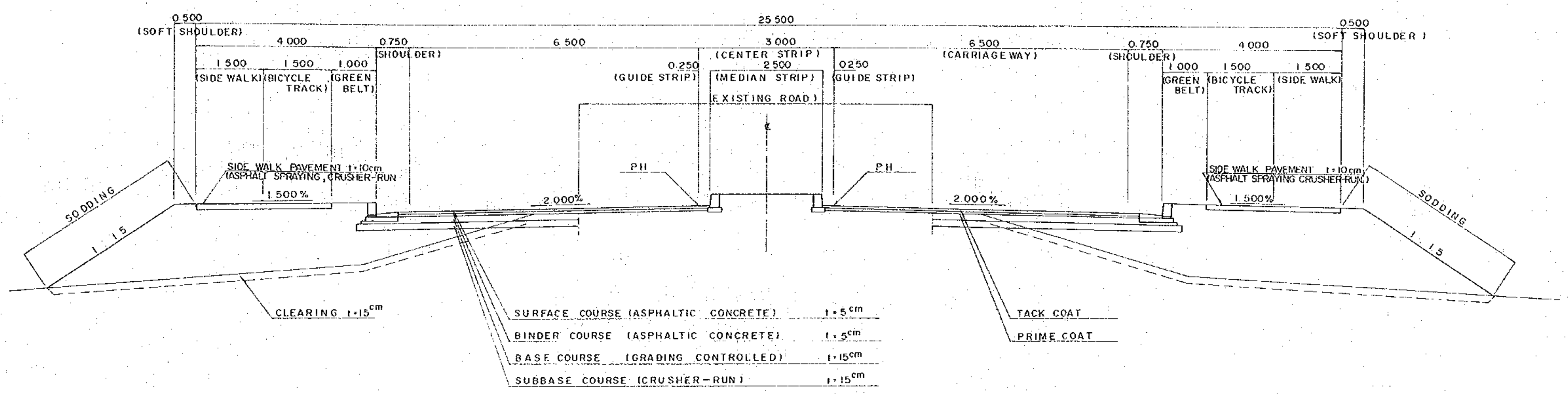
PROFILE
MAIN ROAD (4)
UPANGA ROAD

DWG. NO.

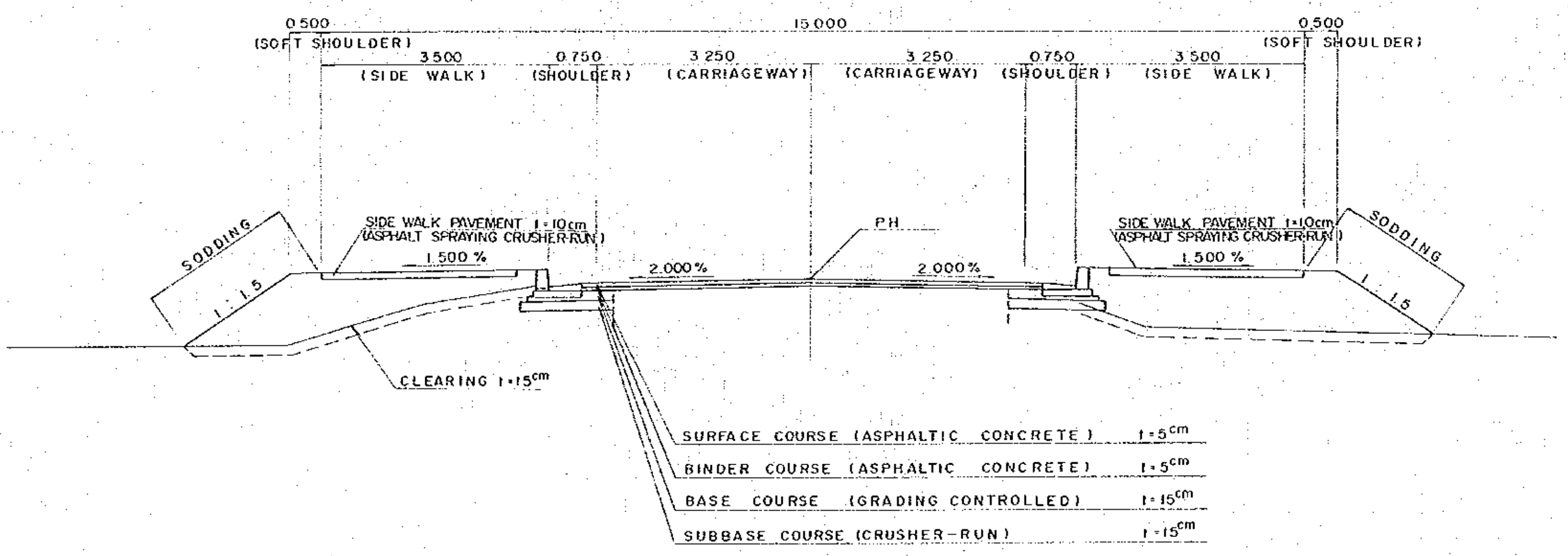
MINISTRY of WORKS

NIPPON KOEI CO. LTD
CONSULTING ENGINEERS
TOKYO JAPAN

APPROVED
DATE
PREPARED CHECKED
SUBMITTED
DATE JUNE 30. 1980



MAIN ROAD



ACCESS ROAD

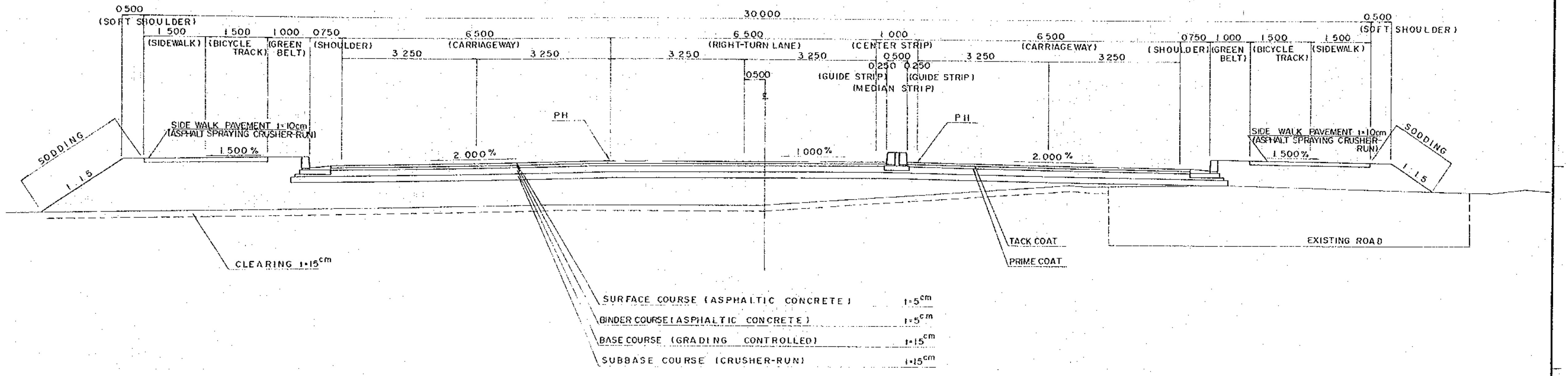
C-III Typical Cross Section

THE SELANDER BRIDGE EXPANSION PROJECT DAR ES SALAAM	TYPICAL CROSS SECTION(I)	MINISTRY of WORKS
MINISTRY OF WORKS	DWG. NO.	NIPPON KOEI CO., LTD. CONSULTING ENGINEERS TOKYO JAPAN
		DATE JUNE 30, 1980

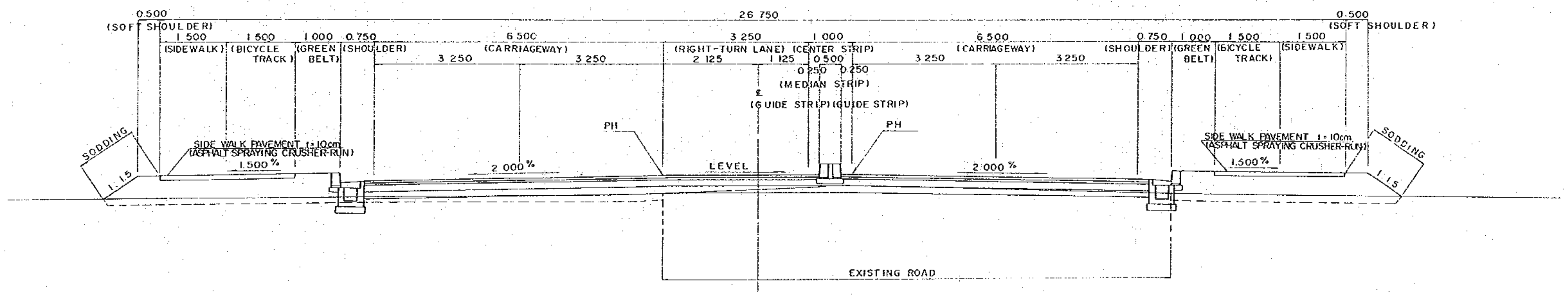
REV. NO. | DATE | CHECKMATE | REVISION | APPRD. | DATE

PLATE NO. 17

PLATE NO. 18



JUNCTION
(RIGHT - TURN TWO LANE)



JUNCTION
(RIGHT - TURN ONE LANE)

C-III (continued 2)

SCALE A 0 2.5 5.0M (1:50)
SCALE B

REV. NO.	DATE	COORDINATE	REVISION	APPRO.	DATE

THE SELANDER BRIDGE EXPANSION PROJECT
DAR ES SALAAM
MINISTRY OF WORKS

TYPICAL CROSS SECTION (2)

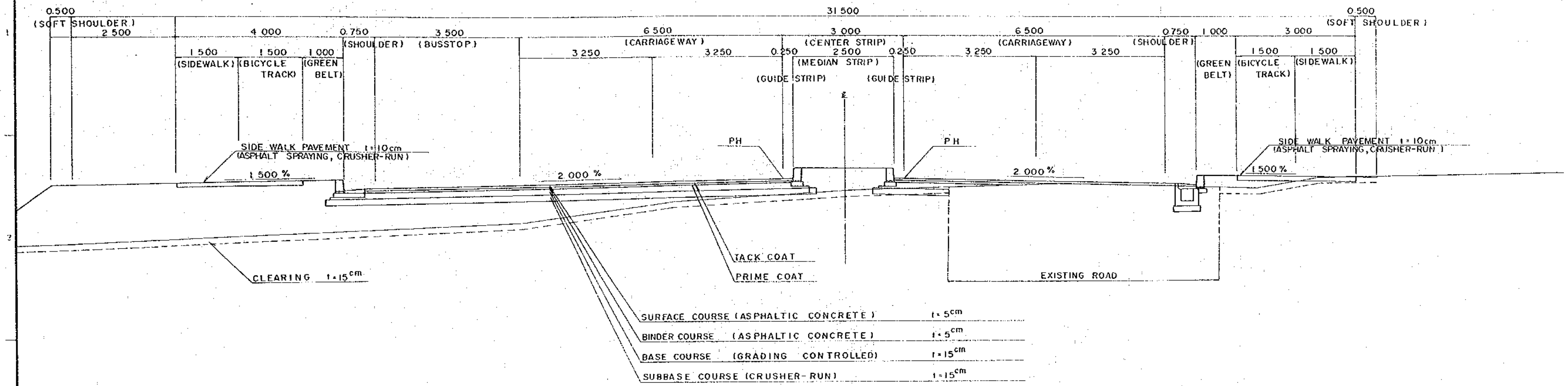
DWG. NO.

MINISTRY of WORKS

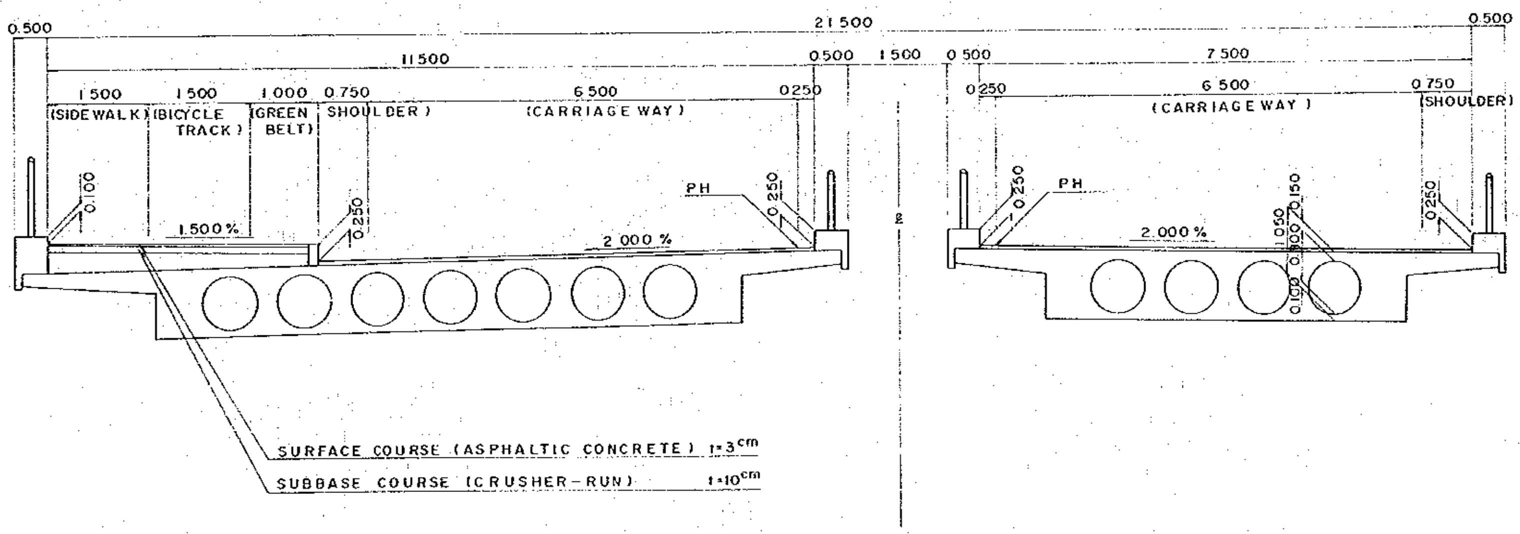
NIPPON KOEI CO. LTD
CONSULTING ENGINEERS
TOKYO JAPAN

APPROVED
DATE
PREPARED
CHECKED
SUBMITTED
DATE JUNE 30, 1980

PLATE NO. 19



BUSSTOP SECTION



BRIDGE SECTION

C-III (continued 3)

REV. NO.	DATE	COORDINATE	REVISION	APPRO.	DATE	THE SELANDER BRIDGE EXPANSION PROJECT DAR ES SALAAM MINISTRY OF WORKS	TYPICAL CROSS SECTION(3) DWG. NO.

MINISTRY of WORKS

NIPPON KOEI CO. LTD
CONSULTING ENGINEERS
TOKYO JAPAN

DATE JUNE 30, 1980

C-IV Calculation of Future Traffic Volume

a) Growth rate

Year	Morning peak hourly traffic of sough direction (7:00 - 8:00 a.m.)	Annual growth	Remarks
1970	*1) 1,277	-	
1971	1,340	5.0	
1972	1,410	5.0	
1973	1,450	2.8	
1974	1,490	"	
1975	1,530	"	
1976	1,620	"	
1977	1,620	"	
1978	1,660	"	
1979	1,700	" *)	*) 1700 vehicles/hr Investigation of JICA Mission
1980	1,800	5.3	
1981	1,890	"	
1982	1,990	"	← Opening year
1983	2,100	"	
1984	2,210	"	
1985	2,330	"	
1986	2,450	"	
1987	2,580	"	← 5 years after opening
1988	2,720	"	
1989	2,860	"	
1990	3,000	"	← Target year

£1) "Traffic Study and Traffic Design data" Sept. 1970 Fig. 12
COWI Consult

b) Annual average of deaily traffic

$$\alpha = \frac{\text{24 hours traffic volume}}{\text{12 hours traffic volume}} = 1.29$$

Heavy direction traffic = 60%

7:00 - 19:00 Daytime traffic volume	*1	13870 vehicles/12 hr
7:00 - 8:00 Peak traffic volume	*2	1277 vehicles/day

therefore Daily traffic volume is 13870 x 1.29 = 17890 vehicles/day

$$\text{Peak rate} = \frac{1277}{17890 \times 0.60} \times 100 = 12\ \%$$

Designing daily traffic volume in target year for pavement design

1987; 2580/(0.60 x 0.12) = 35800 vehicles/day (P.C.U.)

Designing daily traffic volume in target year for junction plan

1990; 3000/(0.60 x 0.12) = 41700 vehicles/day (P.C.U.)

*1)*2) "Traffic Study and Traffic Data" Sep. 1970
COWI Consult.

c) Large vehicle and design traffic volume

Each equivalent rate of passenger car	Large vehicle	3.0
	Motor cycle	0.8
Sharing rate of the total of buses and trucks in ADT		5%
Sharing rate of the motor cycle in ADT		11%

Daily traffic volume in 1987, 1990 is shown below.

Daily Traffic Volume

	Traffic Volume			
Year	Passenger Car	Large Vehicle	Motor cycle and other	Total
1987	27,890	1,660	3,650	33,200
1990	32,500	1,940	4,260	38,700

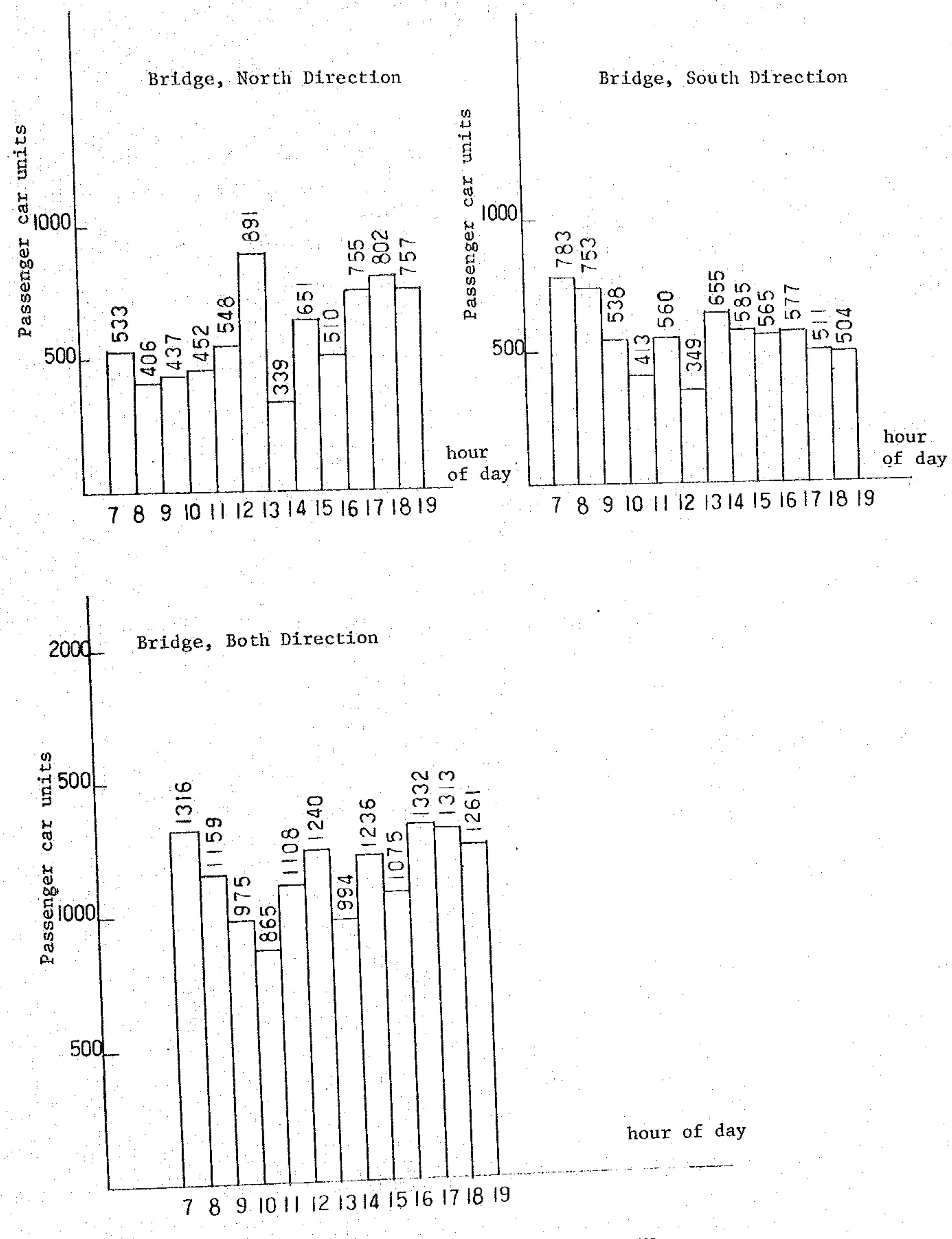


Fig. C-IV.1 HOURLY VARIATIONS IN TRAFFIC VOLUMES ON SELANDER BRIDGE

TRAFFIC COUNT 9TH JULY 1970

Formula for Analysis

For the selection of the analysis a method for by hydrological analysis applicable to the project area, various formulas were reviewed comparatively and the gumbel method was applied.

The result of analysis will be shown below:

1) Calculation for Probability daily rainfall

Order	Daily Rainfall Xi	Xi^2	Date
1	100.1	10,020.01	Jan. 1974
2	94.9	9,006.01	Jan. 1978
3	92.2	8,500.84	Mar. 1976
4	87.5	7,656.25	Nov. 1978
5	86.0	7,396.00	Feb. 1978
6	82.3	6,773.29	Sep. 1977
7	80.1	6,416.01	Sep. 1075
8	75.4	5,685.16	Dec. 1978
9	74.8	5,595.04	Mar. 1971
10	71.0	5,041.00	Jun. 1976
Total	844.3	72,089.61	
Mean	$\bar{X}i=84.43$	$\bar{X}i^2=7,208.96$	

$$\sigma x = \sqrt{\bar{X}_i^{\,2} - (\bar{x}_i)^2} = \sqrt{7208.96 - (84.43)^2} = 8.9741$$

$$\frac{1}{\sigma} = \frac{\sigma x}{\sigma y}$$

$$b = \bar{X}_i - (\frac{1}{\alpha})\ \bar{y}$$

Where $\sigma y = 0.9496$ statistical value determined by sampling number

$\bar{y} = 0.4952$ statistical value determined by sampling number

$$\frac{1}{\alpha} = \frac{8.9741}{0.9496} = 9.450$$

$$b = 84.43 - 9.450 \times 0.4952 = 79.750$$

$$X_T = b + \frac{1}{\alpha} y_T = 79.75 + 9.45\ y_T$$

where X_T : T-years probability daily rainfall

y_T : hereunder

T (year)	y_T	X_T (mm/day)
2	0.3665	83.21
3	0.9027	88.28
5	1.4999	93.92
10	2.2504	101.02

The probability daily rainfall of Side ditches and Culverts in the roadway is generally applied the 3 years probability daily rainfall.

2) Calculation of hourly rainfall

$$\gamma = \frac{X3}{24} \left(\frac{24}{t}\right)^{2/3} \quad \text{(mm/hr)}$$

where γ : Hourly rainfall
X3 : 3 years probability daily rainfall (mm/day)
t : Consecutive rainfall hour (hour)

$$\gamma_1 = \frac{88.23}{24} \times \left(\frac{24}{1}\right)^{2/3} = 30.6 \quad \text{mm/hr}$$

3) Calculation of Design rainfall

The design rainfall is decided by the hourly rainfall and the consecution time.

C-V (continued 3)

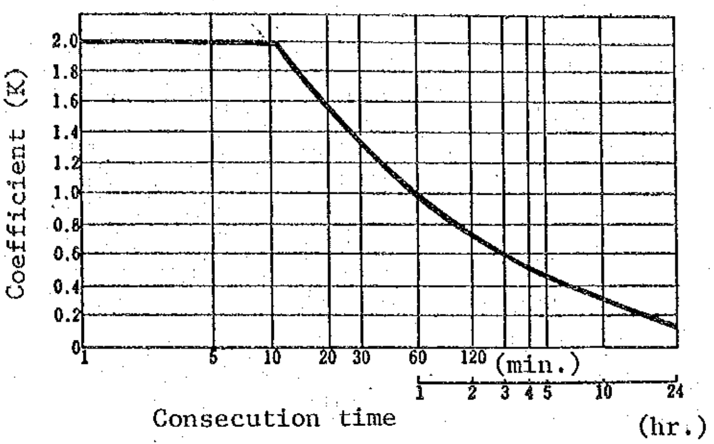


Fig. C-V-1 Coefficient determined according to consecution time.

The consecution time was calculated less than ten minutes.

Vd = 30.6 x 2 = 61.2 → (rounded to 65mm/hr)

Data for : 1971 to 1978
Station : Dar Es Salaam Air Port

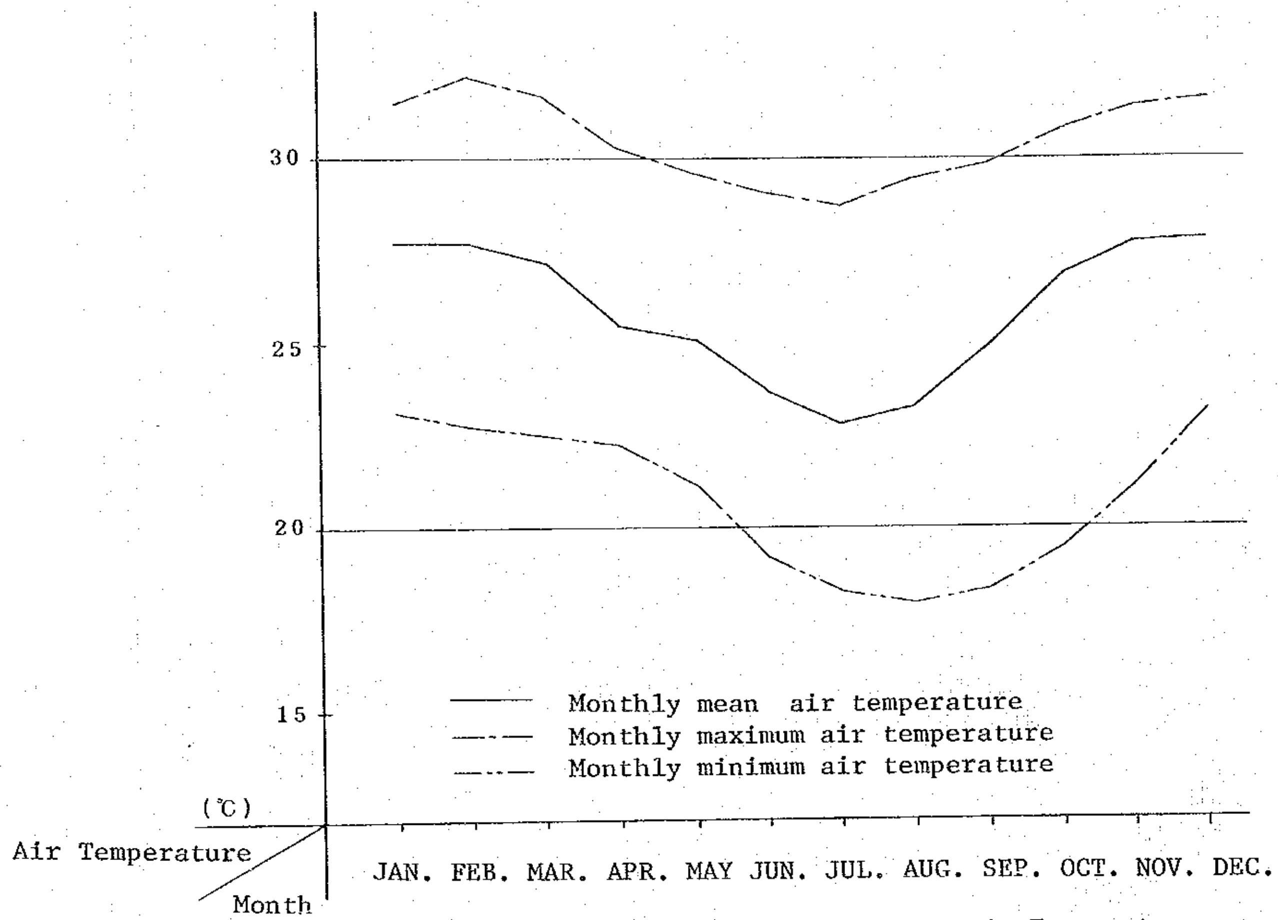


Fig. C-V-2 Variation of Monthly Mean Air Temperature

Data for : 1971 to 1977
Station : Dar Es Salaam Air Port

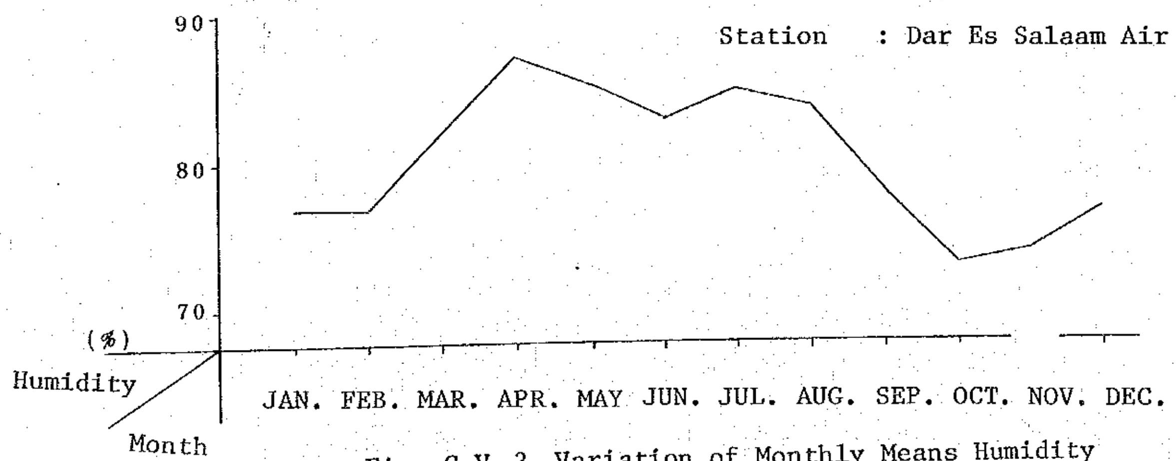


Fig. C-V-3 Variation of Monthly Means Humidity

Data for : 1971 to 1978
Station : Dar Es Salaam Signal Station

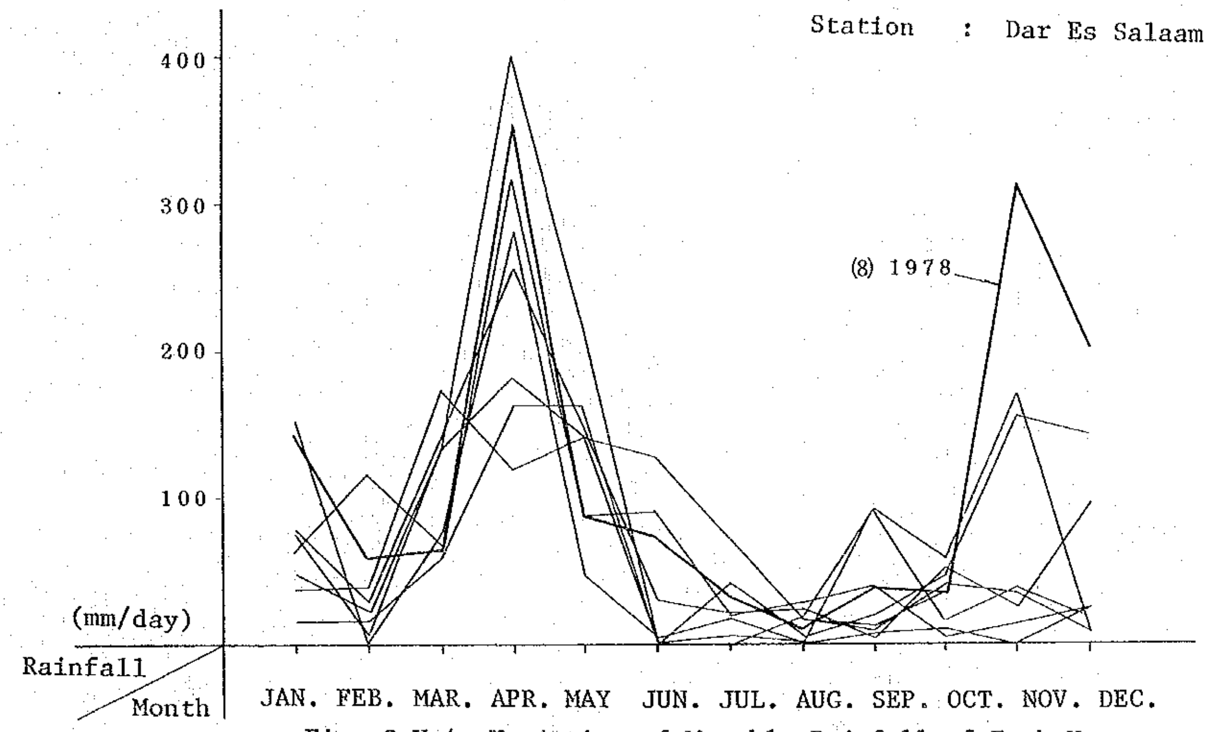


Fig. C-V-4 Variation of Monthly Rainfall of Each Year

Data : 1978 Station : Dar es Salaam Signal Station

Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
Rainfall Days	3	3	6	15	6	7	4	2	2	1	14	5	68

Data for : 1971 to 1978

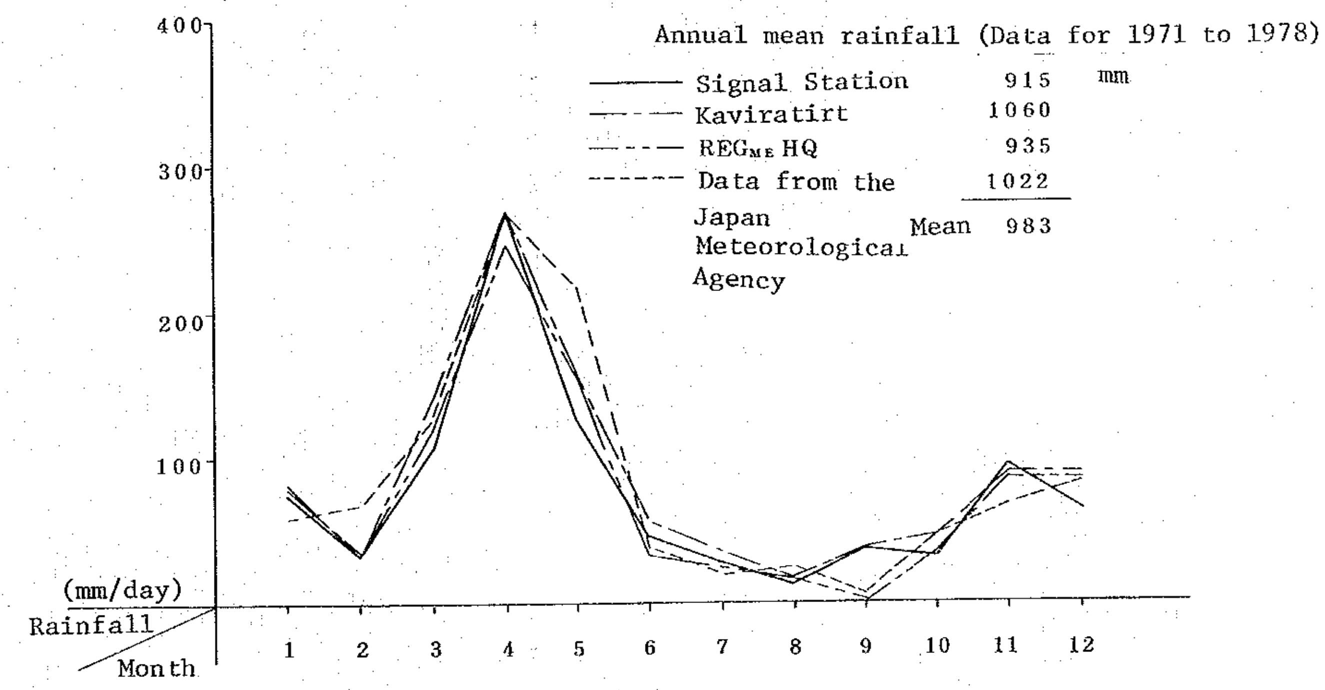
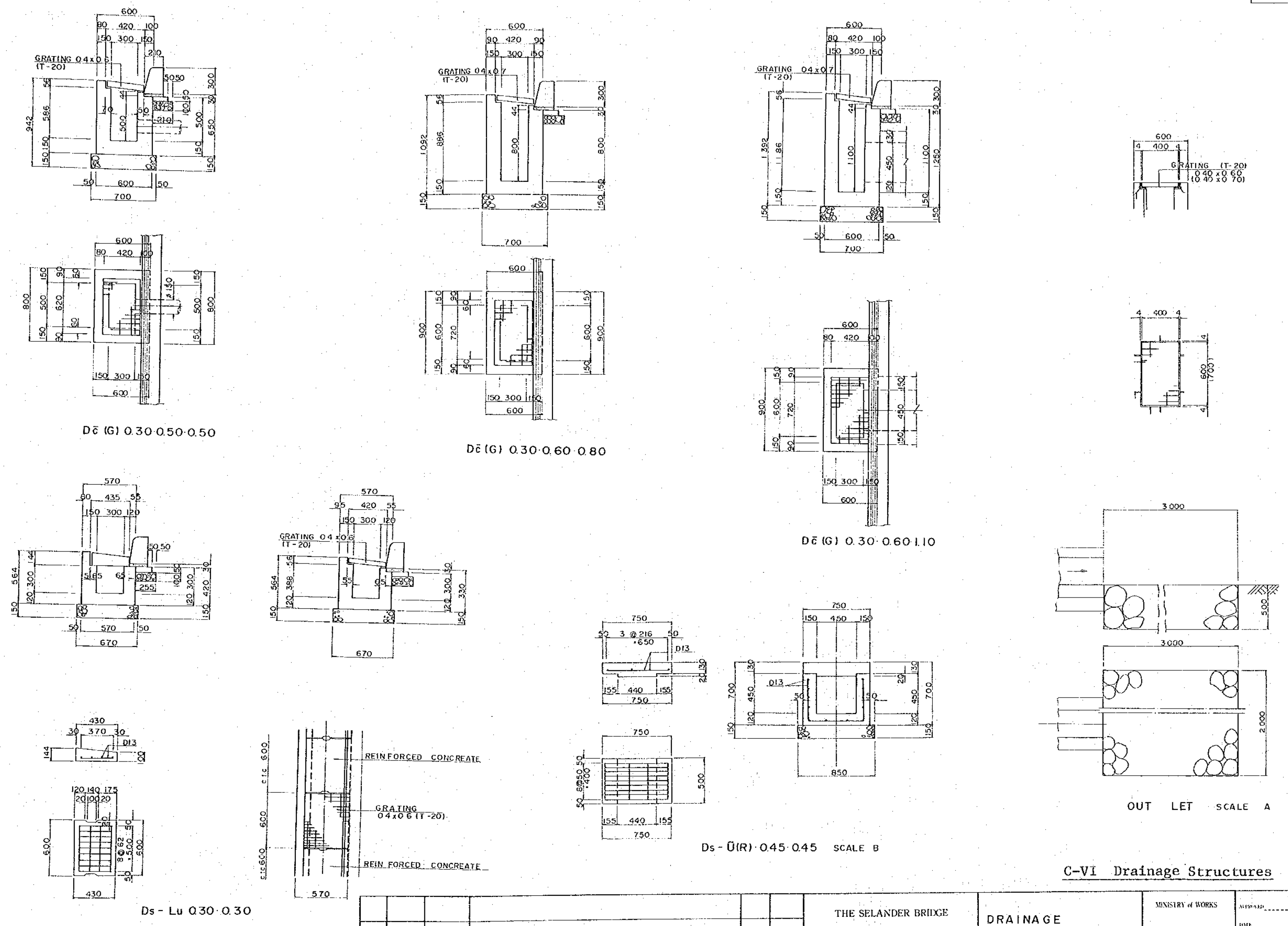


Fig. C-V-5 Variation of Monthly Rainfall of Each Station in Dar Es Salaam



THE SELANDER BRIDGE EXPANSION PROJECT
DAR ES SALAAM

MINISTRY OF WORKS

DRAINAGE STRUCTURE (I)

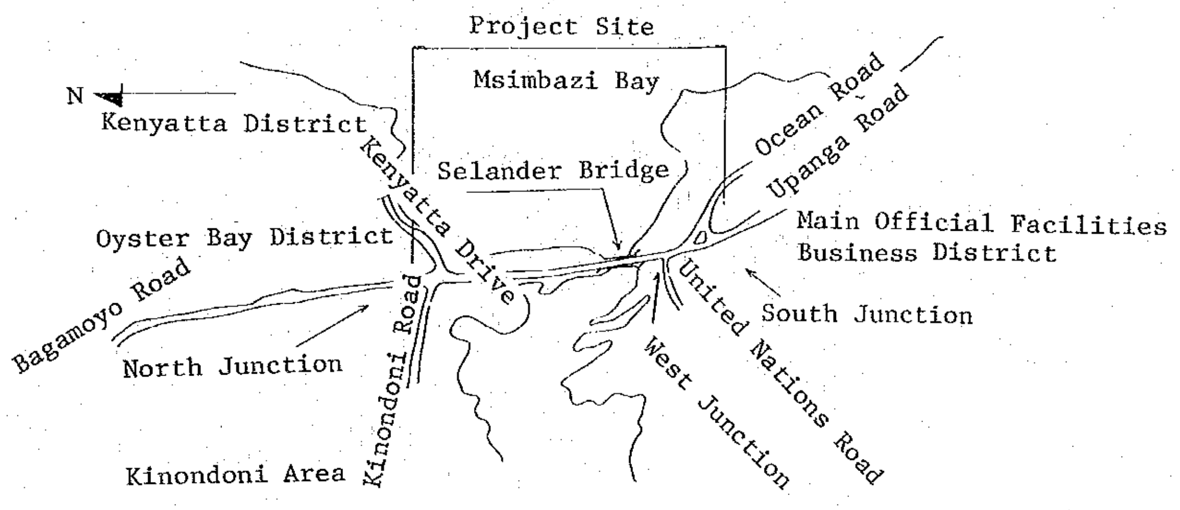
MINISTRY of WORKS

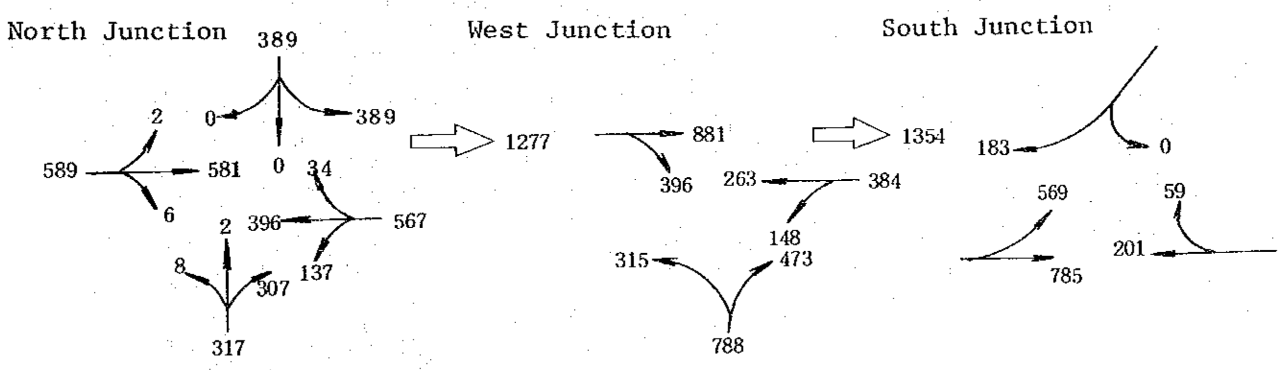
NIPPON KOEI CO. LTD.
CONSULTING ENGINEERS
TOKYO JAPAN

JUNE 30, 1930

C-VII Junction Plans and Signal Indications

(1) Traffic Distribution by Direction 1970

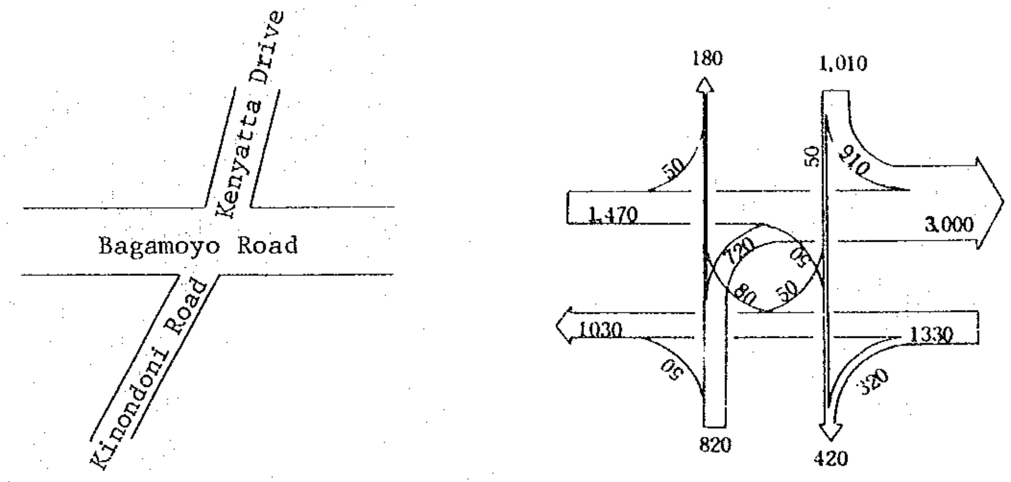




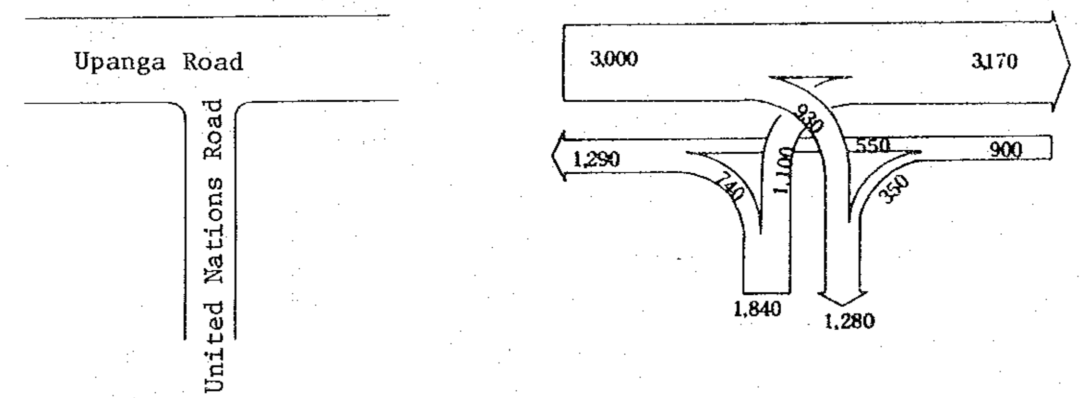
Source : COWI Consult

(2) Design traffic volume (1 9 9 0)

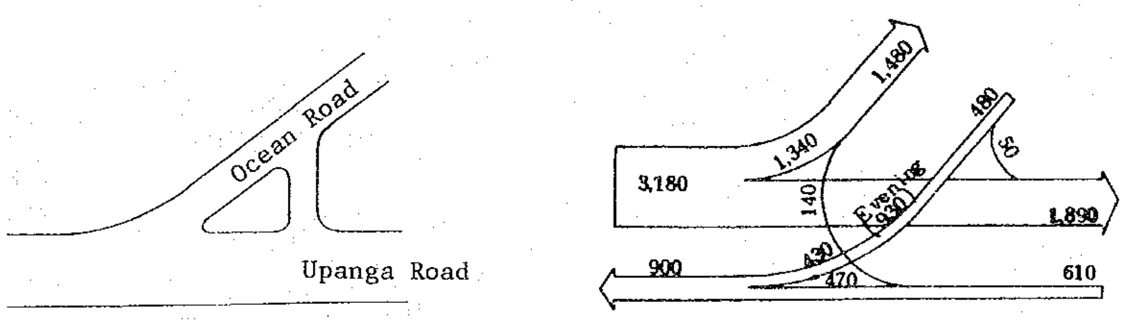
North Junction



West Junction



South Junction

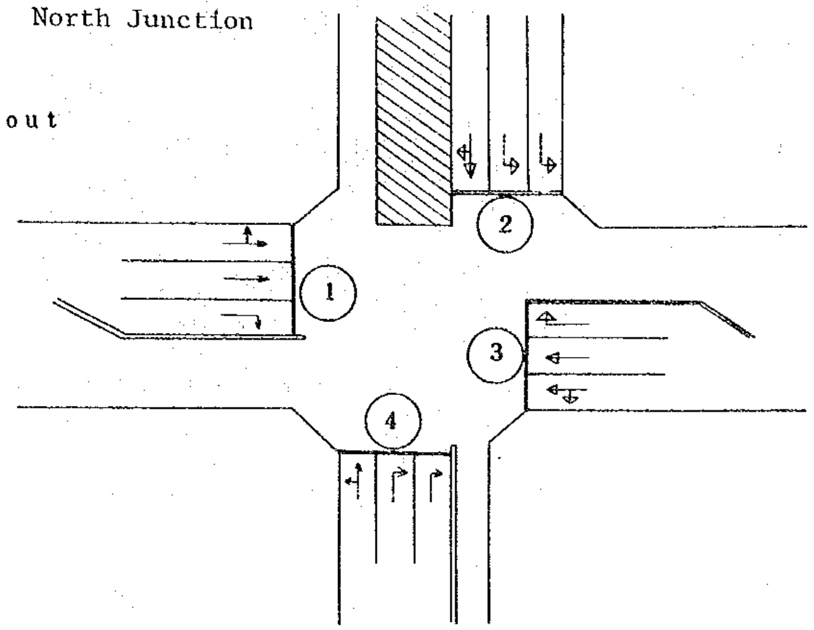


Source : JICA Mission

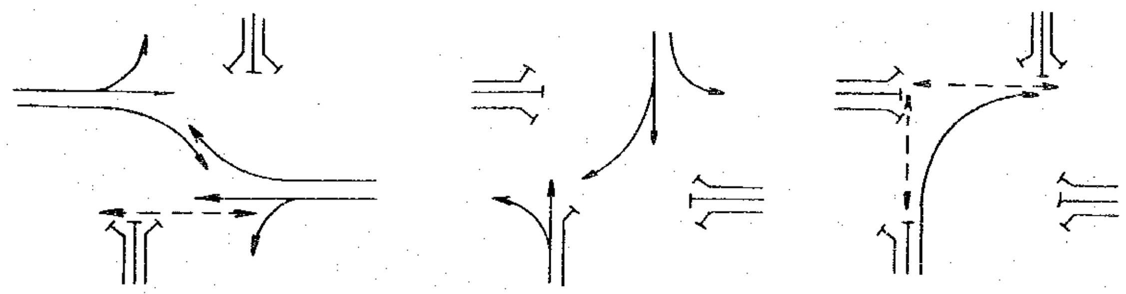
(3) Examination of Traffic Capacity by Traffic Signals

a) North Junction

Layout



Signal Phasing



1φ 32 sec (3 sec) 2φ 32 sec (3 sec) 3φ 17 sec (3 sec)

( ) : Clearance time

Cycle time

$$C = \frac{A}{1-\Sigma y i}$$

$$= \frac{1.5L+5}{1-\lambda}$$

$$= \frac{1.5\times3\times3+5}{1-0.827}$$

107 sec > 80 sec

L ; Loss time (sec)

yi ; Max. necessary phase rate

Design Traffic Capacity

Design Traffic Capacity = Basic Capacity x Adjustment Factor for Right turn/ Left turn x 0.9 x $\frac{\text{Green Signal Time}}{\text{Cycle Time}}$

Phase	Entr.	Exit direction	Design hourly volume	Basic capacity	No. of lanes	Possible capacity	Necessary phase rate Y	Modified phase rate Y	Phase rate	Design capacity	Congestion ratio
1φ	①	50	710	2,000	1	※1. 1,900	0.374	0.452	0.400	684	1.04
1φ	①		710	2,000	1	2,000	0.355		0.400	720	0.99
1φ	①		50	1,800	1	1,800	0.028			※5. 90	0.56
2φ	②		910	3,600	2	3,600	0.253	0.306	0.275	891	1.02
2φ	②	50	100	2,000	1	※2. 1,550	0.065		0.275	384	0.26
1φ	③		80	1,800	1	1,800	0.044			※5. 90	0.89
1φ	③		625	2,000	1	2,000	0.313		0.400	720	0.87
1φ	③	320	625	2000	1	※3. 1,710	0.365		0.400	616	1.01
3φ	④		720	3,600	2	※4 3,600	0.200	0.242	0.213	690	1.04
2φ	④	50	100	2,000	1	1,710	0.058		0.275	423	0.24

$\Sigma Y_i = 0.827 < 0.9$

※1. Left turn 50÷710×100= 7 % 2,000×0.95 =1,900

※2. Right turn 50÷100×100=50 % 2,000×0.795=1,550

※3. Left turn 320÷625×100=51.2% 2,000×0.855=1,710

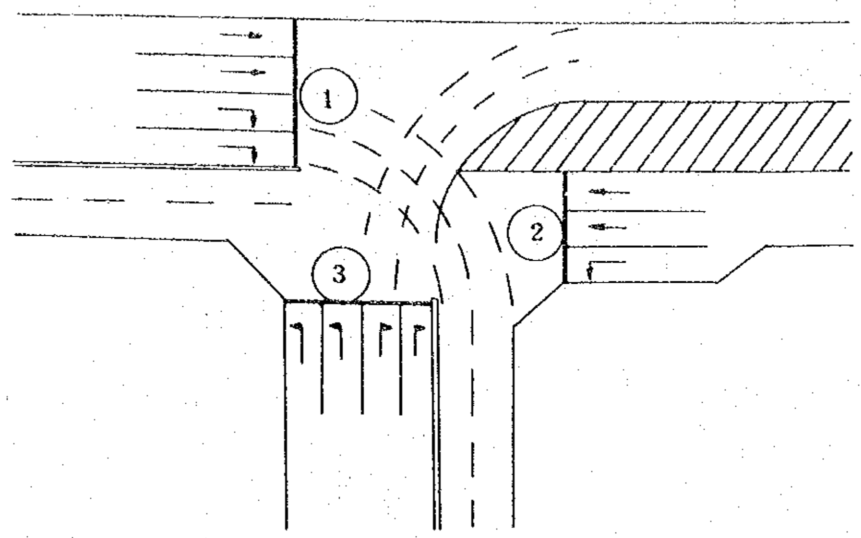
※4. Left turn 50÷100×100=50 % 2,000×0.855=1,710

※5. Passing cars during yellow light : 2 x $\frac{3,600}{80}$ = 90 vehicles

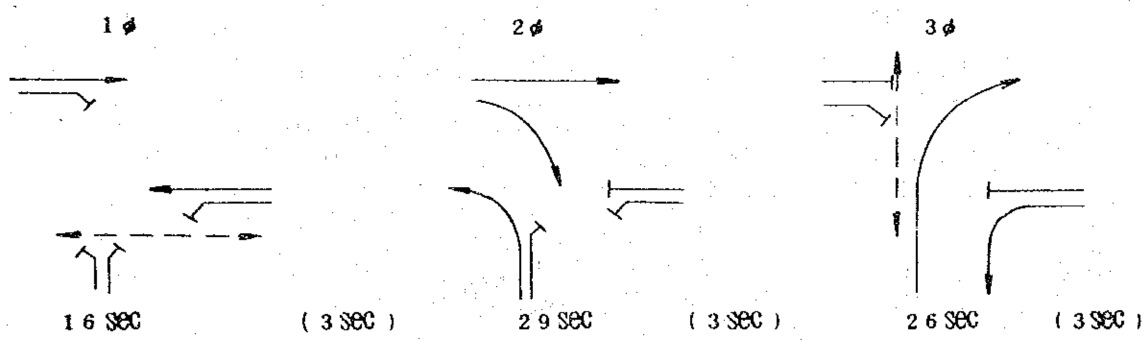
C-VII (continued 3)

b) West Junction

Layout



Signal Phasing



Cycle Time

( ): Clearance time

$$C = \frac{A}{1-\Sigma y_i} = \frac{1.5L+5}{1-\lambda} = \frac{1.5\times3\times3+5}{1-0.824} \doteqdot 105\,\text{sec} > 80\,\text{sec}$$

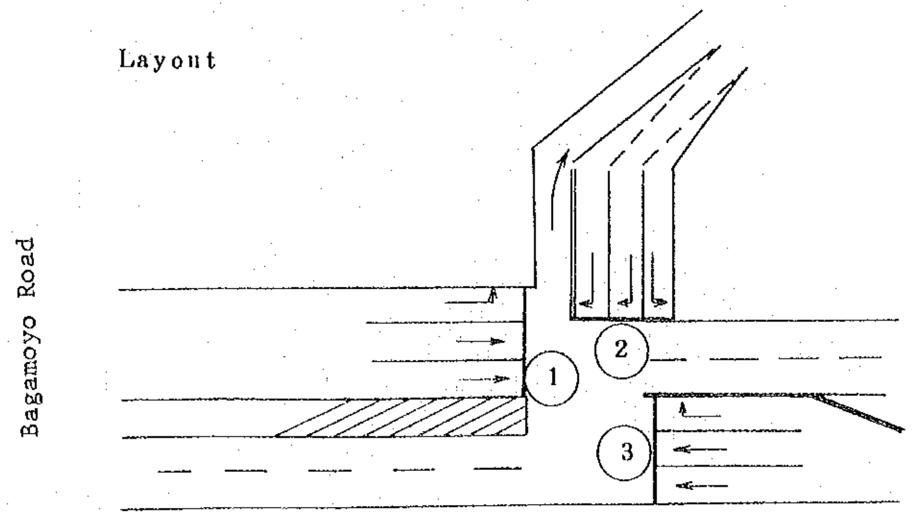
Design Traffic Capacity

Phase	Entr.	Exit direction	Design hourly volume	Basic capacity	No. of lanes	Possible capacity	Necessary phase rate Y	Modified phase rate Y	Phase rate	Design capacity	Congestion ratio
1φ 2φ	①	→	2,070	4,000	2	4,000	[0.518]	0.629	0.563	2,027	1.02
2φ	①		930	3,600	2	3,600	[0.258]	0.313	0.363	1,176	(1.02) 0.79
1φ	②	←	550	4,000	2	4,000	0.138	0.167	0.200	720	0.76
3φ	②		350	1,800	1	1,800,	0.194	–	0.325	527	0.66
2φ	③		740	3,600	2	3,600,	0.206	–	0.363	1,176	0.63
3φ	③		1,100	3,600	2	3,600	[0.306]	0.371	0.325	1,053	1.04

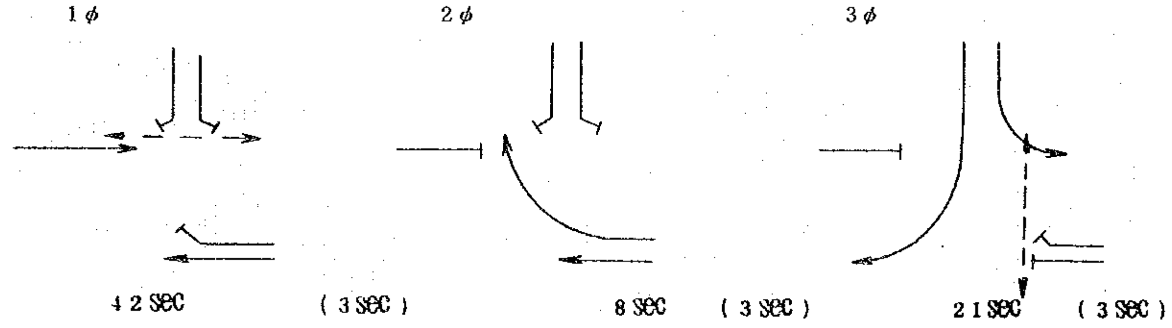
$\Sigma Y_i = 0.824 < 0.9$

c) South Junction

Layout



Signal Phasing



Cycle Time

$$C = \frac{A}{1-\Sigma y_i} = \frac{1.5L+5}{1-\lambda} = \frac{1.5\times3\times3+5}{1-0.779} \doteqdot 83\,\text{sec} > 80\,\text{sec}$$

Design Traffic Capacity

Phase	Entr.	Exit direction	Design hourly volume	Basic capacity	No. of lanes	Possible capacity	Necessary phase rate Y	Modified phase rate Y	Phase rate	Design capacity	Congestion ratio
1φ	①	→	1,840	4,000	2	4,000	[0.460]	0.590	0525	1,890	097
3φ	②		50	1,800	1	1,800	0.028		0263	426	0.12
3φ	②		430	1,800	1	1,800	[0.239]	0.307	0263	426	1.00
2φ	③		140	1,800	1	1,800	[0.08]	0.103	0100	162	0.86
1φ 2φ	③	←	470	4,000	2	4,000	0.118		0625	2,250	0.21

$\Sigma Y_i = 0.779 < 0.9$

D-I Summary of Soil Test Results

PROJECT : SELANDER BRIDGE ORIGINATOR : JAPANESE TEAM.

LABORATORY NO.		7091	
SAMPLE NO.	1	2	3
GRADATION % passing 3 in		Soil	Shore sand
1½ in.	100		
¾ in.	94		
⅜ in.	92		
3/16 in.	91		
B.S. Sieve NO. 7	90	100	100
14	88	99	89
25	75	81	40
36	59	59	8
52	44	40	1
72	36	26	0.3
100	32	16	0.1
200	26	7	0.1
ATTERBERG LIMITS L. L.	40	NP	NP
P. L.	14	NP	NP
P. I.	26	NP	NP
CLASSIFICATION UNIFIED	SC	SAND	SAND
COMPACTION Sta /Mod. FMC	432	0.72	0004
MDD	112	120	127
OMC	16	11	10
C.B.R. At 95/100% M.D.D (Sta./Mod.) Unsoaked			
1 day soaked			
4 days soaked	3 *	21 *	10 *
Specific Gravity	265	265	267

* Average of two test results.

D-II Pavement Design Calculation

a) Design Standards

"A guide for Asphalt Pavement Design" Japan Highway Institute.

b) Traffic volume of Buses and Trucks

1660 ÷ 2 = 830 cars/day · one direction

Traffic Classification

Traffic Classification	Traffic volume of Buses and Trucks
L Traffic	- 100
A Traffic	100 - 250
B Traffic	250 - 1,000
C Traffic	1,000 - 3,000
D Traffic	3,000 -

c) Design CBR

Design CBR of Improved Subgrade : 12% (See ANNEX D-I)

d) Pavement Design and Pavement Formation

i) Design CBR; 12

ii) Traffic Classification ; B traffic

Thickness TA = 17 Total thickness = 26 cm

CBR	Thickness									
	L Traffic		A Traffic		B Traffic		C Traffic		D Traffic	
	TA	Total Thickness	TA	Total Thickness	TA	Total Thickness	TA	Total Thickness	TA	Total Thickness
2	17	52	21	61	29	74	39	90	51	105
3	15	41	19	48	26	58	35	70	45	83
4	14	35	18	41	24	49	32	59	41	70
6	12	27	16	32	21	38	28	47	37	55
8	11	23	14	27	19	32	26	39	34	46
12	-	-	13	21	17	26	23	31	30	36
20-	-	-	-	-	-	-	20	23	26	27

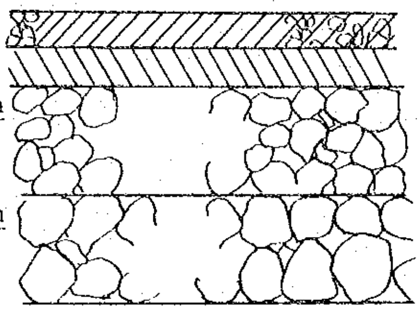
D-II (continued 2)

Assuming the pavement structure illustrated below.

$$TA = 5 \times 1.0 + 5 \times 1.0 + 15 \times 0.35 + 15 \times 0.20 = 18.25 > 17$$

and total thickness is $5 + 5 + 15 + 15 = 40 > 26$

Surface course (Asphaltic concrete) t=5cm
Binder course (Asphaltic concrete) t=5cm
Base course (Grading controlled) t=15cm
Subbase course (Crusher-run) t=15cm



Equivalent Rate used TA Calculation

Used for	Work materials	Condition	Equivalent rate
Surface course & Binder course	Hot mixture asphalt		1.0
Base course	Asphalt treated	Marshall stability value 350 kg min.	0.8
	Grading controlled	CBR 80 min.	0.35
Subbase course	Clusher-run	CRR 20 - 30	0.20

E-I Design Calculation of Lighting

(A)	Kind of road	Trunkroad at town part
(B)	Traffic density on average day	38,700 vehicles/day (1990)
(C)	Construction of road	Width: 6.5m shoulder:0.75W

Design

(D)	Light source used	Fluoresent mercury lamp
(E)	Average horizontal surface illuminance	15ℓx (Average)
(F)	Maintenance facter	0.65
(G)	Deciding the disposition	

1)	Lamp equipment used	H745 (Semi-cut off type)
2)	Position of post erection	0.7 outside from Kerb
3)	Installation height	One side arrangement, 100m (From H≧ 1.2W)
4)	Angle of inclination of installation	5°
5)	Pole used	10-8B
6)	From center of pole to center of lamp equipment	1.3W
7)	Overhang	-0.1(=0.75=0.65+1.3)
8)	Max. installation space	35W (From S≦ 3.5H)
9)	Coefficient of utilization	(On the assumption of using HF400W)

Carriageway side W/H = 6.5 + 0.1/10

= 0.66 --- U_1 = 0.27

(from curve of coefficient of utilization)

Shoulder side W/H = 0.1/10

= 0.01 --- U_2 = 0.01

(from curve of coefficient of utilization)

E-I (continued 2)

$$U = U_1 + U_2$$

$$= 0.26$$

10) Deciding the luminous flux required

$$F = \frac{W.E.S}{U.M}$$

$$= \frac{35 \times 6.5 \times 15}{0.26 \times 0.65}$$

$$= 20.192\ (\ell m)$$

Accordingly, 20.192 HF400W (luminous flux of lamp: 22.000ℓm)

Therefore, Lamp used is HF 400W

11) Calculation of illumunation

$$E = \frac{F.U.M}{S.W}$$

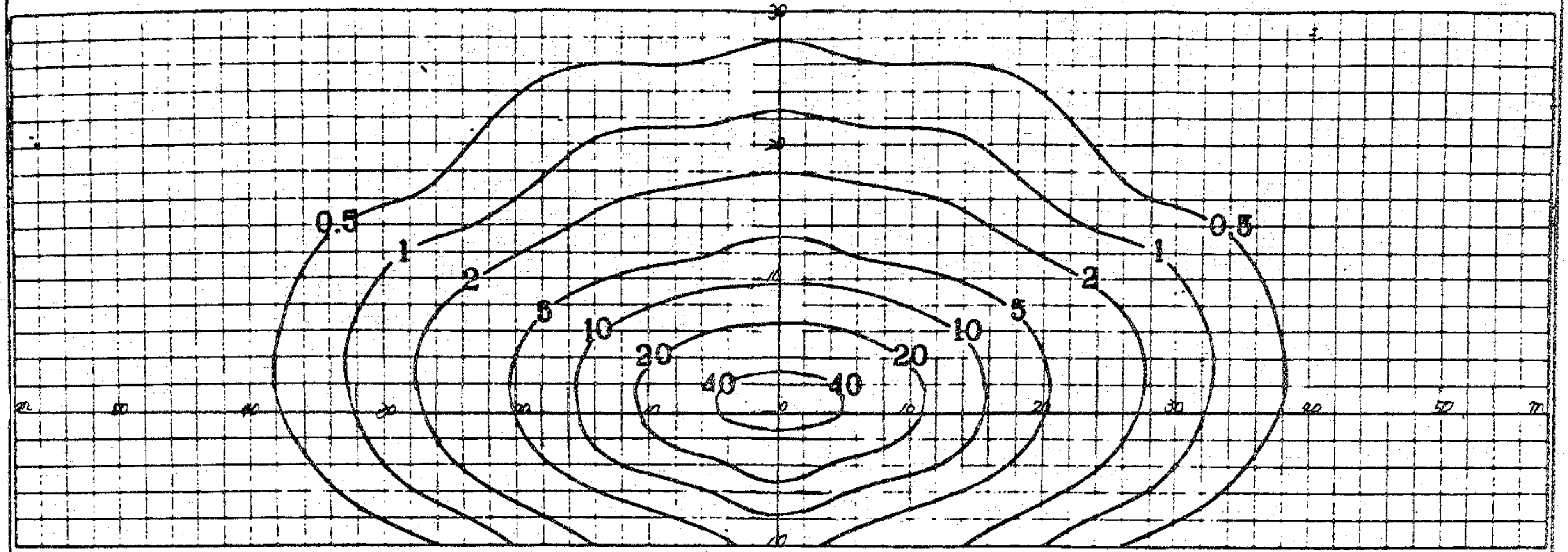
$$= \frac{22.000 \times 0.26 \times 0.65}{35 \times 6.5}$$

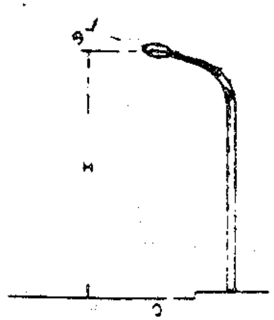
$$= 16.3(\ell x)\ (1.08nt) > 15\ell x(1.0nt)$$

Therefore, lamp equipment space S = 35W

Therefore, height of lamp equipment H = 10m

E-II Isolux Diagram and Illumination Distribution Chart

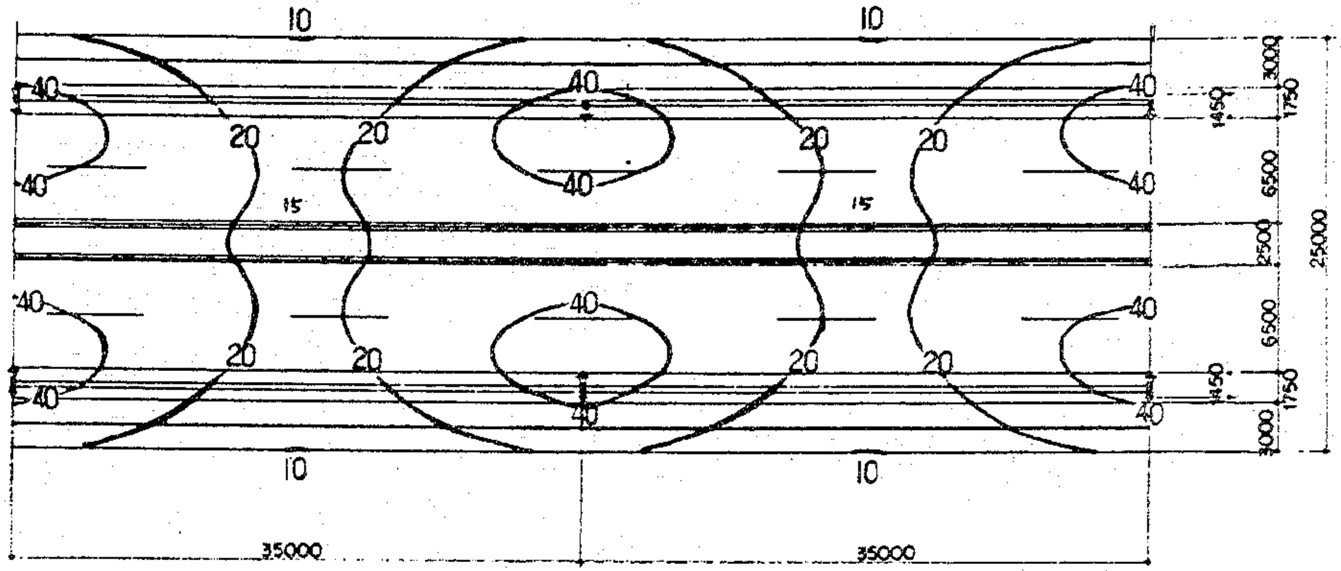




LAMP	400 W
TOTAL LAMP LUMENS	22000 lm
MOUNTING HIGHT (H)	10 m
INCLINATION (θ)	5 °

ISOLUX DIAGRAM (CARRIAGEWAY)	
UNIT : [lx]	SCALE : 1/300

E-II (Continued 2)



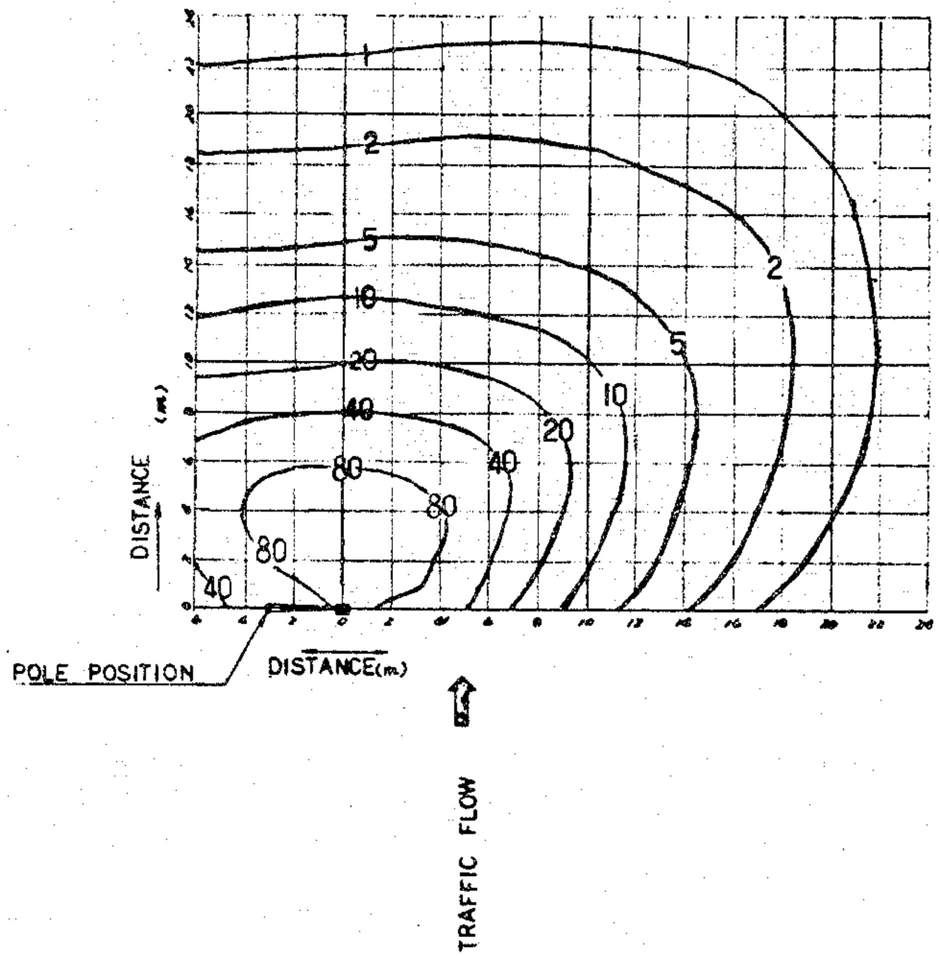
LEGEND

MARK	DESCRIPTION
⊸	LAMP : 400W, HIGHT:10m, 5° POLE [illegible]

NOTE: INITIAL ILLUMINANCE SHALL BE SHOWN THE NUMBER ON THE CURVE. UNIT:[lx]

ILLUMINATION DISTRIBUTION CHART (CARRIAGEWAY)	
UNIT :[lx]	SCALE : 1/300

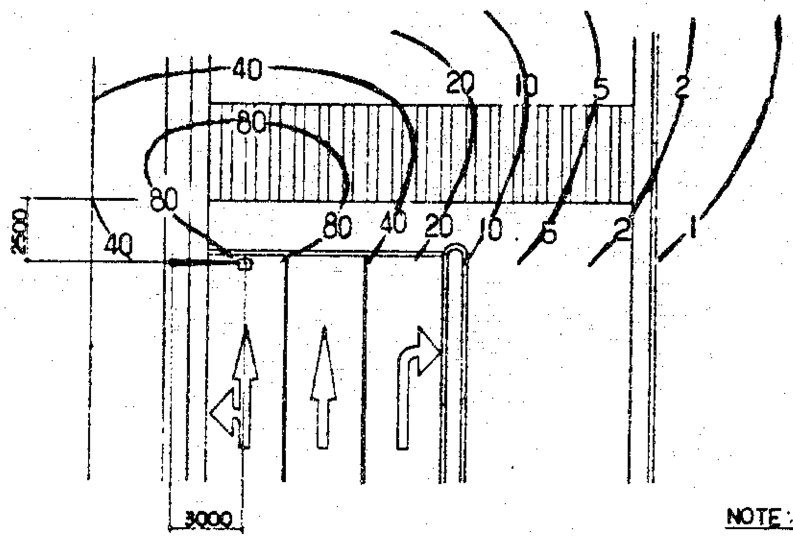
E-II (Continued 3)



NOTE: INITIAL ILLUMINANCE SHALL BE SHOWN THE NUMBER ON THE CURVE. UNIT: [lx]

ISOLUX DIAGRAM (PEDESTRIAN)	
UNIT : [lx]	SCALE : 1/200

E-II (Continued 4)



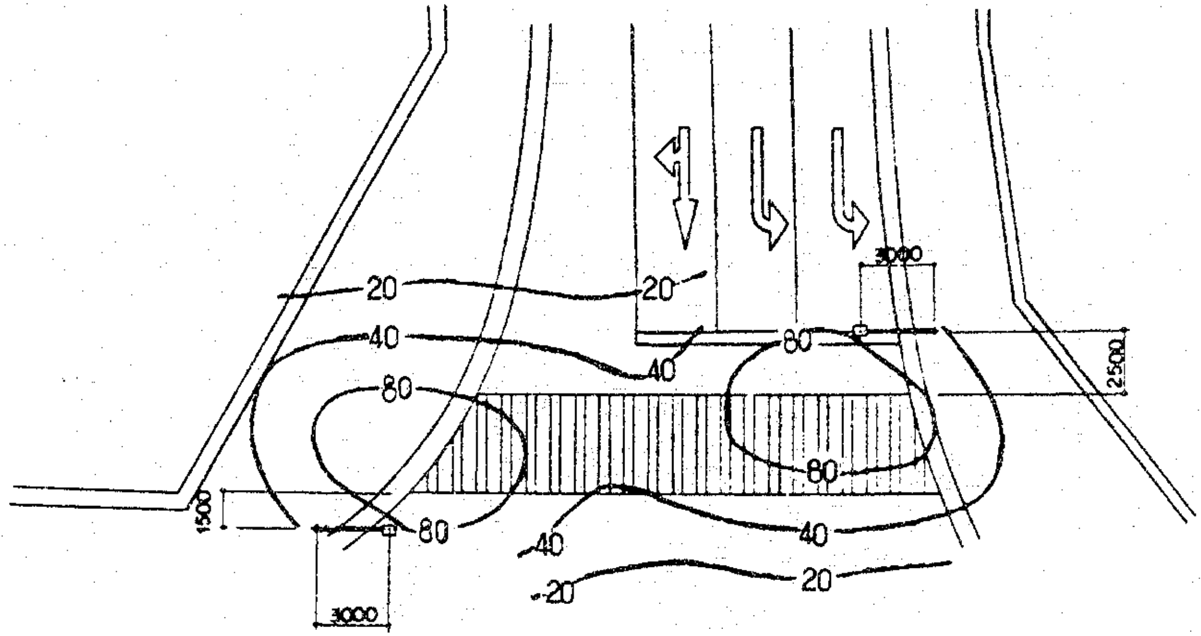
LEGEND

MARK	DESCRIPTION
(lamp symbol)	LAMP : 400 W, HEIGHT H = 6.35m

NOTE: INITIAL ILLUMINANCE SHALL BE SHOWN
THE NUMBER ON THE CURVE.
UNIT : [lx]

ILLUMINANCE DISTRIBUTION CHART OF ONE LAMP (PEDESTRIAN)	
UNIT : [lx]	SCALE : 1/200

E-II (Continued 5)



LEGEND

MARK	DESCRIPTION
(lamp symbol)	LAMP : 400 W, HEIGHT H = 6.35m

NOTE: INITIAL ILLUMINANCE SHALL BE SHOWN THE NUMBER ON THE CURVE.
UNIT : [lx]

ILLUMINANCE DISTRIBUTION CHART OF TWO LAMPS (PEDESTRIAM)	
UNIT : [lx]	SCALE : 1/200

E-III Distribution Panel Load Table and Voltage Drop Calculation

Distribution Panel Load Table

Distribution Panel	Feeder	Connec-tion	Quantity	Phase Amper	Voltage	Load Capacity
A	1	R-N	HF400wx4	9.2(A)	230(V)	2,116 (VA)
		S-N	" x4	"	"	2,116 (VA)
		T-N	" x4	"	"	2,116 (VA)
	2	R-N	HF400wx6	13.8(A)	"	3,174(VA)
		S-N	" x6	"	"	3,174(VA)
		T-N	" x5	11.5(A)	"	2,645(VA)
	3	R-N	HF400wx3	6.9(A)	"	1,587(VA)
		S-N	" x3	"	"	1,587(VA)
		T-N	" x3	"	"	1,587(VA)
	4	R-N	HF400wx4	9.2(A)	"	2,116(VA)
		S-N	" x4	"	"	2,116(VA)
		T-N	" x4	"	"	2,116(VA)
	5	S-N	TRAFFIC SIGNAL			1,800(VA)
TOTAL						28,250(VA)
B	1	R-N	HF400wx4	9.2(A)	230(V)	2,116(VA)
		S-N	" x4	"	"	2,116(VA)
		T-N	" x4	"	"	2,116(VA)
	2	R-N	HF400wx4	9.2(A)	230(V)	2,116(VA)
		S-N	" x4	"	"	2,116(VA)
		T-N	" x4	"	"	2,116(VA)
	3	R-N	HF400wx3	6.9(A)	"	1,587(VA)
		S-N	" x3	"	"	1,587(VA)
		T-N	" x3	"	"	1,587(VA)
	4	R-N	HF400wx4	9.2(A)	230(V)	2,116(VA)
		S-N	" x4	"	"	2,116(VA)
		T-N	" x3	6.9(A)	"	1,587(VA)
	5	S-N	TRAFFIC SIGNAL			3,100(VA)
TOTAL						26,376(VA)

E-III (continued 2)

VOLTAGE DROP CALCULATION

FEEDER NO.	FEEDER		LOAD				LENGTH	CABLE SIZE	VOLTAGE DROP (%)		NOTES
	START	END	MAXIMUM LOAD	VOLTAGE	AMPER	PHASE	(m)	(mm²)	DESIGN	CALCULATION	
			(VA)	(V)	(A)						
B2	9/B2	12/B2	529	230	2.3	1	62.5	8		0.28	
								TOTAL	6	3.08	
B3	Distribution Panel B	MB6	1,587	230	6.9	1	220	14		1.65	
"	MB6	4/B3	1,058	"	4.6	"	27	8		0.44	
"	4/B3	1/B3	529	"	2.3	"	73	"		0.56	
"	MB6	6/B3	1,058	"	4.6	"	33.5	"		0.53	
"	6/B3	9/B3	529	"	2.3	"	104	"		0.81	
								TOTAL	6	3.99	
B4	Distrubtion Panel B	2/B4	2,116	230	9.2	1	83	8		1.46	
"	2/B4	5/B4	1,587	"	6.9	"	85.5	"		1.13	
"	5/B4	8/B4	1,058	"	4.6	"	74.5	"		0.65	
"	8/B4	11/B4	529	"	2.3	"	104	"		0.46	
								TOTAL	6	3.70	

E-III (continued 3)

VOLTAGE DROP CALCULATION

FEEDER NO.	FEEDER		LOAD				LENGTH	CABLE SIZE	VOLTAGE DROP(%)		NOTES
	START	END	MAXIMUM LOAD	VOLTAGE	AMPER	PHASE	(m)	(mm2)	DESIGN	CALCULA-TION	
			(VA)	(V)	(A)						
B1	Distribution Panel B	MB1	2,116	230	9.2	1	20	8		0.35	
"	MB1	31/B1	529	"	2.3	"	55	"		0.25	
"	MB1	MB2	1,587	"	6.9	"	46	"		0.62	
"	MB2	6/B1	529	"	2.3	"	20.5	"		0.09	
"	MB2	MB3	1,058	"	4.6	"	24	"		0.21	
"	MB3	7/B1	529	"	2.3	"	34.5	"		0.16	
"	MB3	9/B1	1,058	"	4.6	"	26.5	"		0.23	
"	9/B1	12/B1	529	"	2.3	"	130.5	"		1.00	
								TOTAL	6	2.91	
B2	Distribution Panel	MB4	2,116	230	9.2	1	35	8		0.62	
"	MB4	4/B2	1,058	"	4.6	"	37	"		0.33	
"	4/B2	1/B2	529	"	2.3	"	118.5	"		0.53	
"	MB4	6/B2	1,587	"	6.9	"	30	"		0.40	
"	6/B2	9/B2	1,058	"	4.6	"	104.5	"		0.92	

E-III (continued 4)

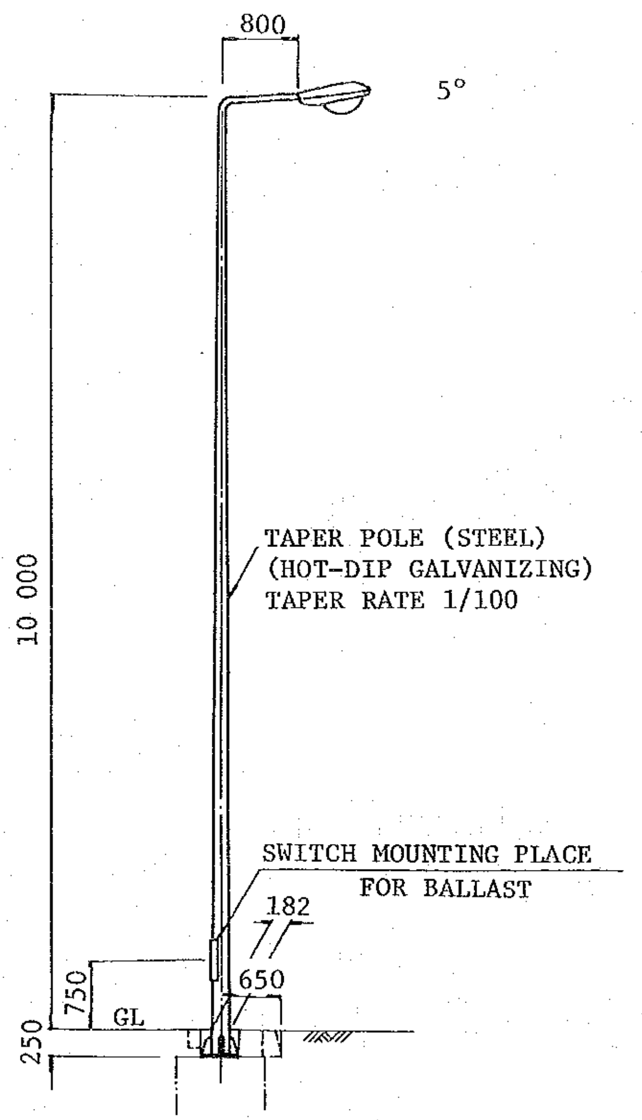
VOLTAGE DROP CALCULATION

FEEDER NO	FEEDER		LOAD				LENGTH	CABLE SIZE	VOLTAGE DROP (%)		NOTES
	START	END	MAXIMUM LOAD	VOLTAGE	AMPER	PHASE	(m)	(mm^2)	DESIGN	CALCULA-TION	
			(VA)	(V)	(A)						
A2	MA5	8/A2	529	230	2.3	1	51	8		0.51	
"	MA5	11/A2	1,587	"	6.9	"	27.5	14		0.20	
"	11/A2	14/A2	1,058	"	4.6	"	99.5	14		0.30	
"	14/A2	17/A2	529	"	2.3	"	117.5	14		0.30	
								TOTAL		3.41	
A3	Distribution Panel A	3/A3	1,587	230	6.9	1	439	14		3.30	
"	3/1A3	5/A3	1,058	"	4.6	"	112.5	"		0.57	
"	6/A3	9/A3	529	"	2.3	"	112.5	"		0.28	
								TOTAL	6	4.15	
A4	Distribution Panel A	3/A4	2,116	230	9.2	1	291.5	14		2.91	
"	3/A4	6/A4	1,587	"	6.9	"	112.5	"		0.84	
"	6/A4	9/A4	1,058	"	4.6	"	112.5	"		0.57	
"	9/A4	12/A4	529	"	2.3	"	112.5	"		0.28	
								TOTAL		4.60	

E-III (continued 5) VOLTAGE DROP CALCULATION

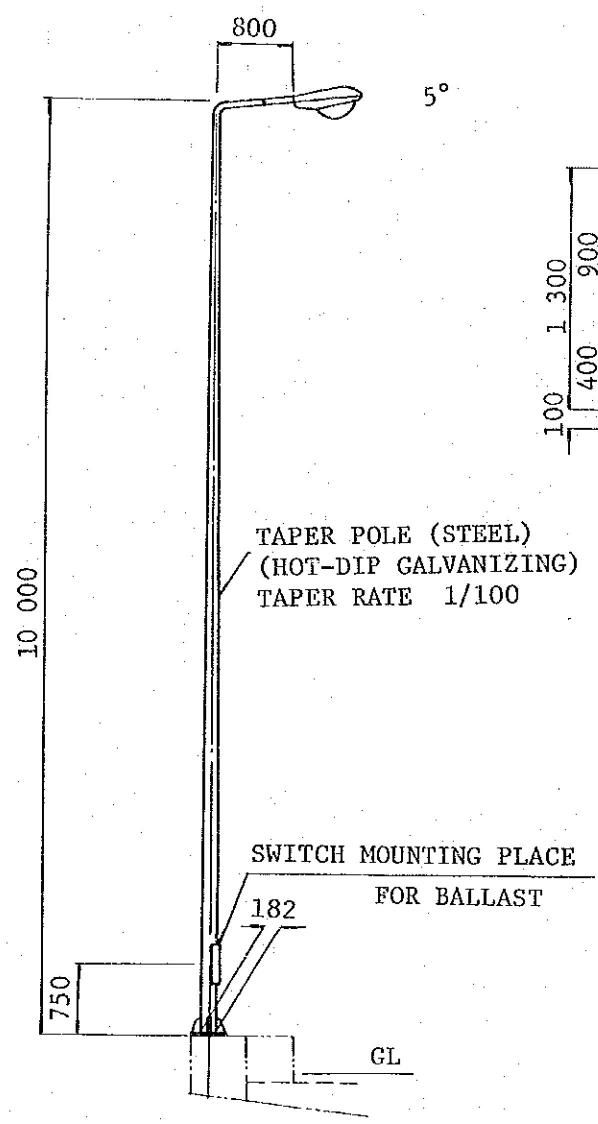
FEEDER NO.	FEEDER START	FEEDER END	LOAD MAXIMUM LOAD (VA)	LOAD VOLTAGE (V)	LOAD AMPER (A)	PHASE	LENGTH (m)	CABLE SIZE (mm^2)	VOLTAGE DROP (%) DESIGN	VOLTAGE DROP (%) CALCULATION	NOTES
A1	Distribution Panel A	MA1	2,116	230	9.2	1	3.0	8		0.05	
"	MA1	1/A1	529	"	2.3	"	49.0	"		0.21	
"	MA1	5/A1	529	"	2.3	"	69.5	"		0.30	
"	MA1	MA2	1,587	"	6.9	"	30.0	"		0.90	
"	MA2	6/A1	529	"	2.3	"	36.0	"		0.16	
"	MA2	9/A1	1,058	"	4.6	"	46.5	"		0.40	
"	9/A1	12/A1	529	"	2.3	"	107.5	"		0.63	
								TOTAL	6	2.15	
A2	Distribution panel A	MA3	3,174	230	13.8	1	34	14		0.51	
"	MA3	1/A2	529	"	2.3	"	79	8		0.35	
"	MA3	5/A2	2,645	"	11.5	"	40.5	14		0.50	
"	5/A2	MA4	2,116	"	9.2	"	9.5	"		0.10	
"	MA2	7/A2	529	"	2.3	"	54.0	8		0.23	
"	MA4	MA5	2,116	"	9.2	"	21.0	14		0.21	

E-IV Foundation of Lighting Pole and Hand Rails



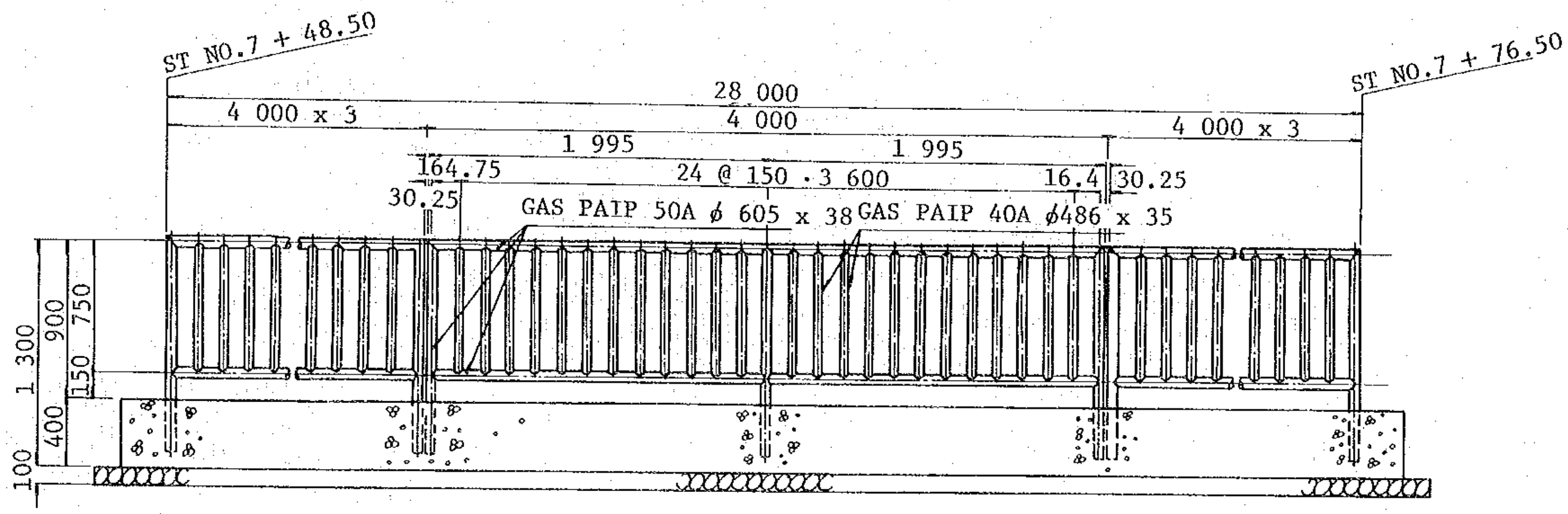
LP-1

ELEVATION OF LIGHTING POLE

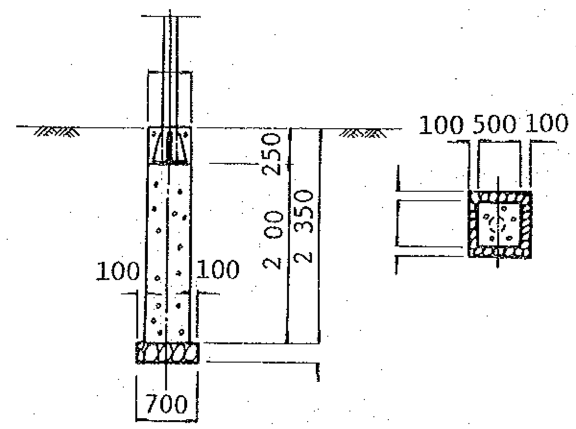


LP-2

ELEVATION OF LIGHTING POLE

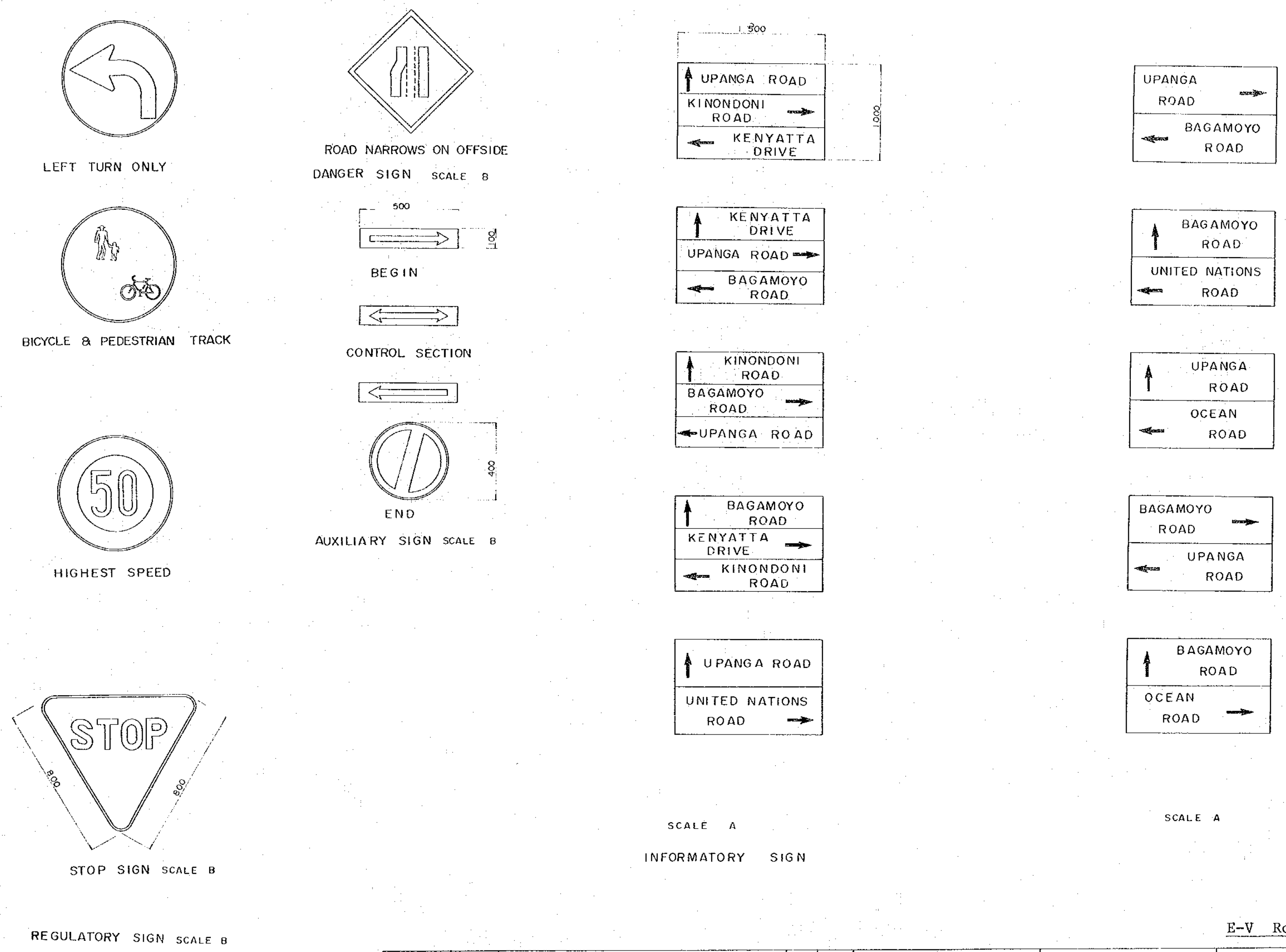


HAND RAI'



BASE CONCRETE OF LIGHTING POLE

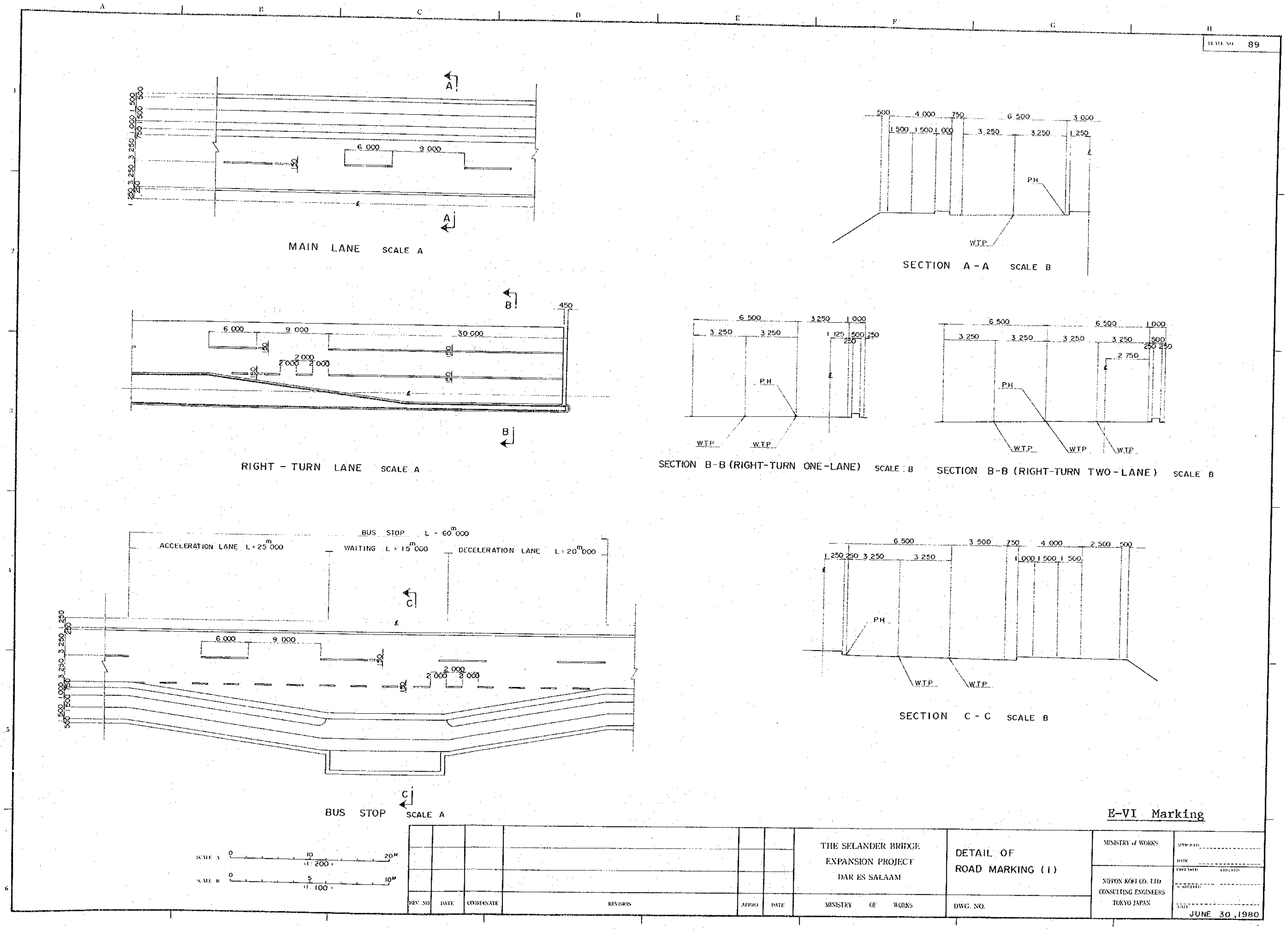
PLATE NO 88

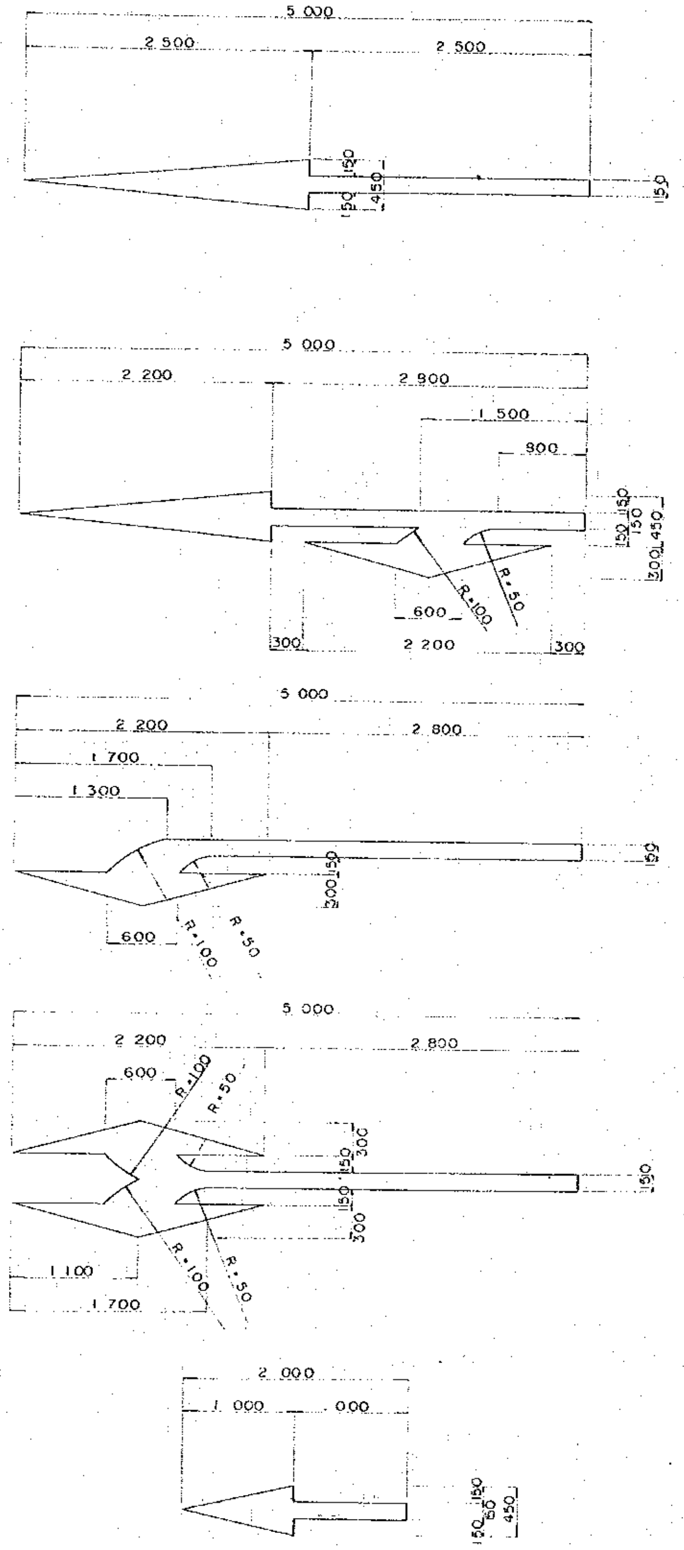


E-V Road Sign

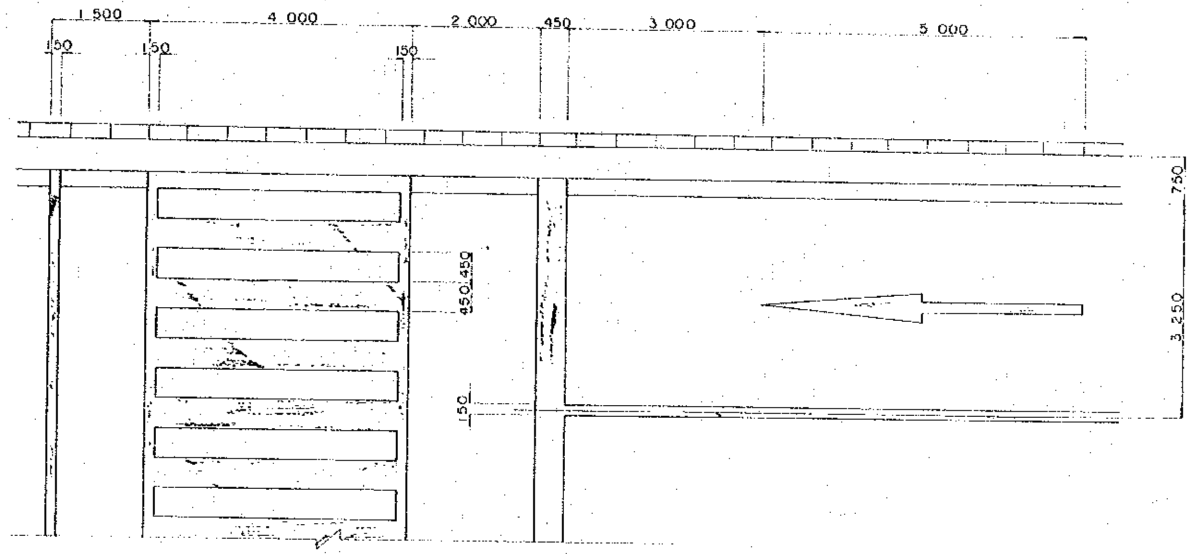
SCALE A 0 — 10 — 20M (1:20)
SCALE B 0 — 0.5 — 1.0M (1:10)

REV. NO	DATE	COORDINATE	REVISION	APPRO.	DATE	THE SELANDER BRIDGE EXPANSION PROJECT DAR ES SALAAM / MINISTRY OF WORKS	DETAIL OF ROAD SIGN / DWG. NO.	MINISTRY of WORKS / NIPPON KOEI CO. LTD. CONSULTING ENGINEERS TOKYO JAPAN	DATE JUNE 30, 1980

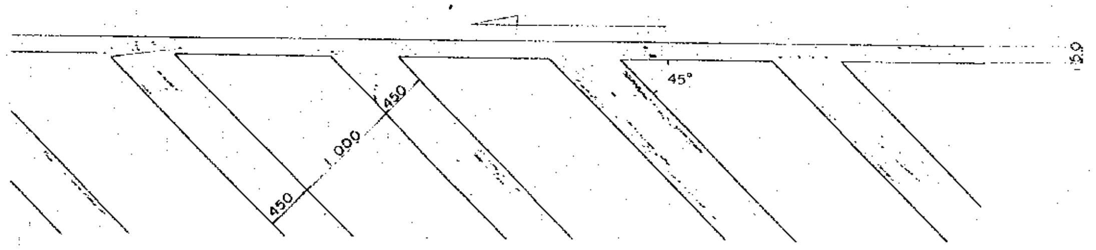

MAIN LANE SCALE A
SECTION A-A SCALE B
RIGHT-TURN LANE SCALE A
SECTION B-B (RIGHT-TURN ONE-LANE) SCALE B
SECTION B-B (RIGHT-TURN TWO-LANE) SCALE B
BUS STOP L = 60m000
ACCELERATION LANE L = 25m000
WAITING L = 15m000
DECELERATION LANE L = 20m000
SECTION C-C SCALE B
BUS STOP SCALE A
P.H.
W.T.P.
SCALE A 0 10 20M 1:200
SCALE B 0 5 10M 1:100
E-VI Marking
THE SELANDER BRIDGE EXPANSION PROJECT DAR ES SALAAM
DETAIL OF ROAD MARKING (I)
MINISTRY of WORKS
NIPPON KOEI CO. LTD CONSULTING ENGINEERS TOKYO JAPAN
JUNE 30, 1980
89



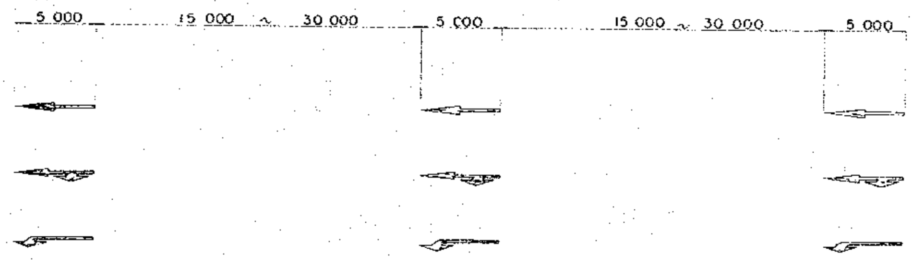
ARROW MARK SCALE C



PEDESTRIAN CROSSING AND STOP-LINE SCALE B



ZEBRA MARK SCALE C



MARKING DISTANCE SCALE A

SCALE A 0 10 20M (1: 200)
SCALE B 0 2.5 5.0M (1: 50)
SCALE C 0 1.5 3.0M (1: 30)

E-VI (continued 2)

REV. NO. / DATE / COORDINATE / REVISION / APPRO / DATE	
THE SELANDER BRIDGE EXPANSION PROJECT DAR ES SALAAM	MINISTRY OF WORKS
DETAIL OF ROAD MARKING (2)	DWG. NO.
MINISTRY of WORKS	NIPPON KOEI CO., LTD. CONSULTING ENGINEERS TOKYO JAPAN
APPROVED / DATE / DESIGNED / CHECKED / SUBMITTED	DATE JUNE 30, 1980

JICA