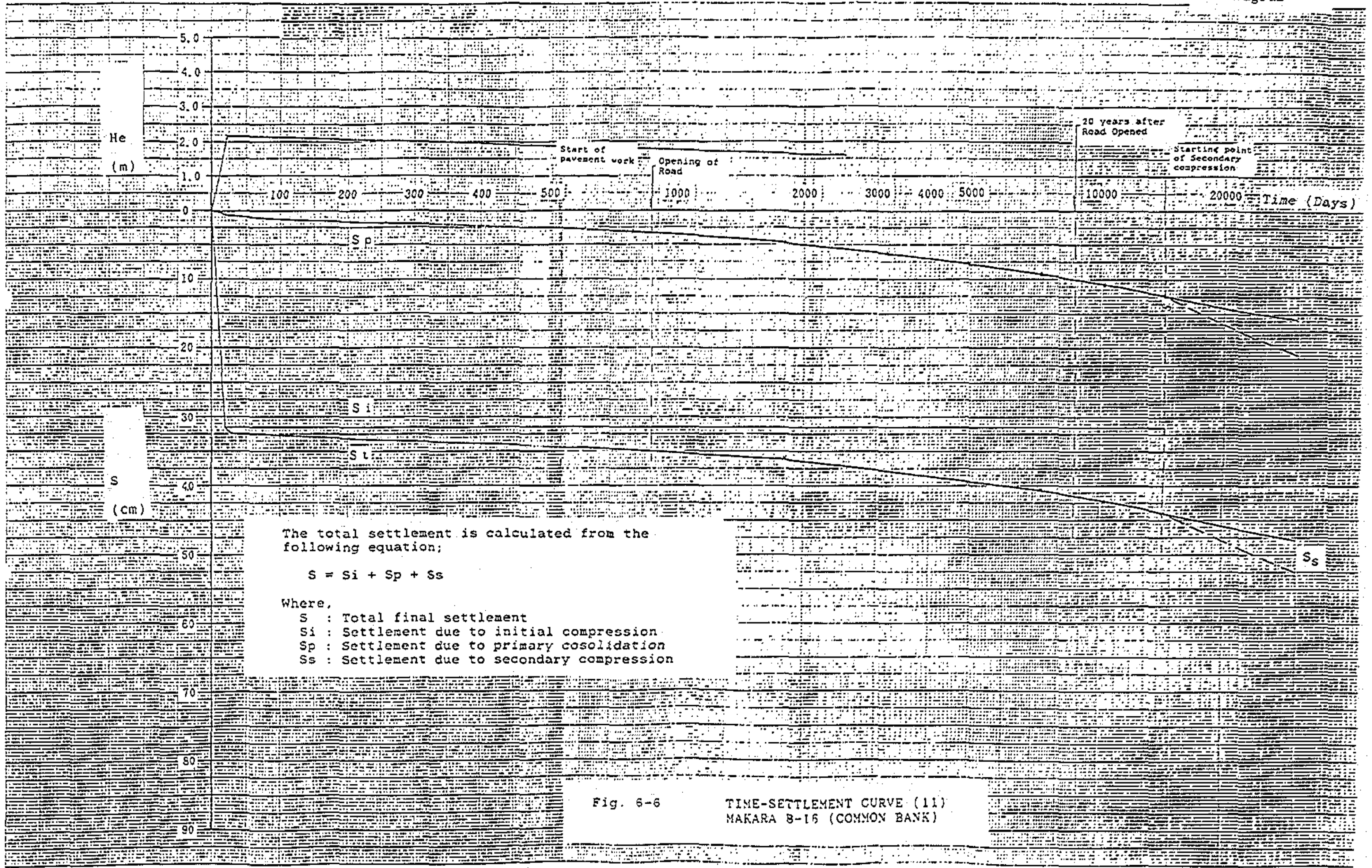


Fig. 6-6 TIME-SETTLEMENT CURVE (11)
MAKARA B-16 (COMMON BANK)

JIS A4 180×250

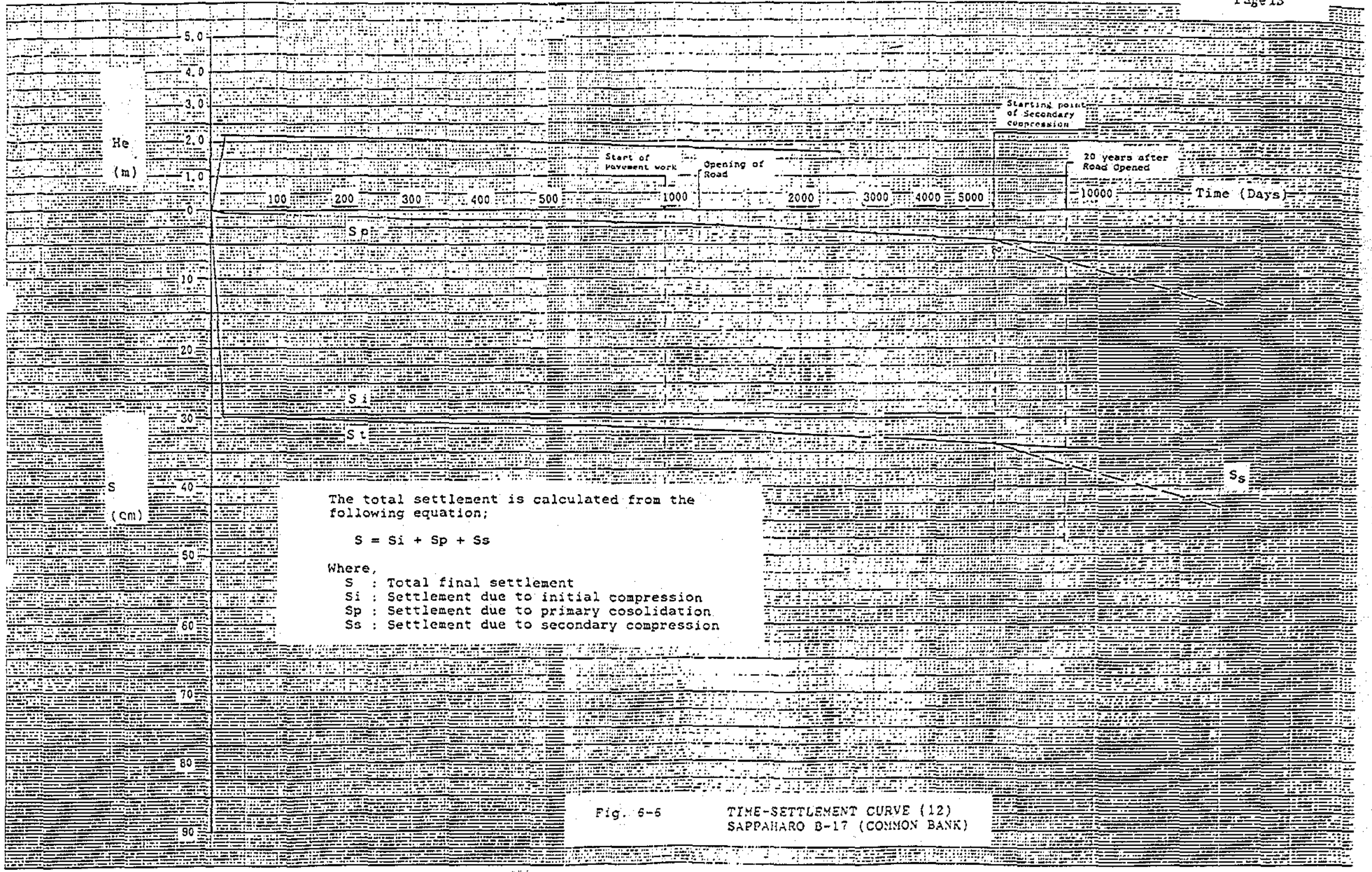
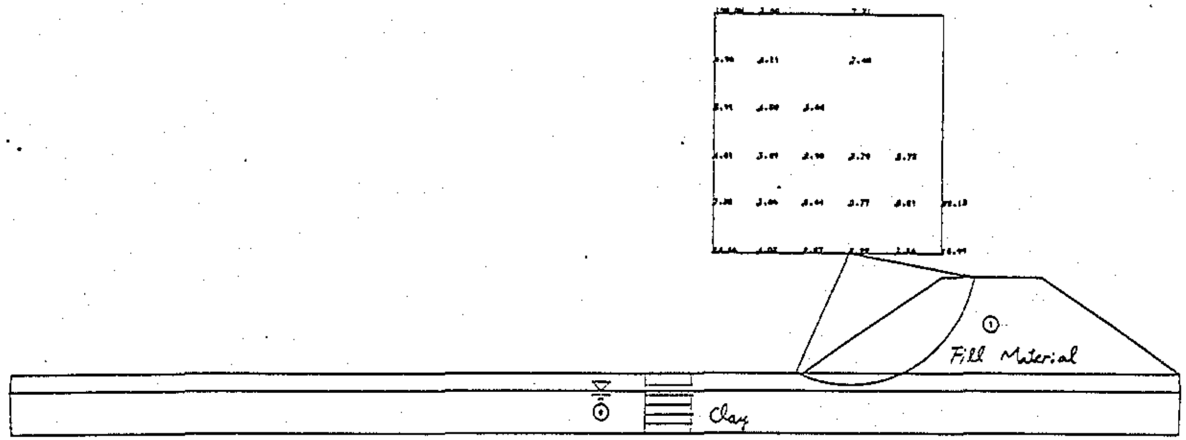


Fig. 6-6 TIME-SETTLEMENT CURVE (12)
SAPPAHARO B-17 (COMMON BANK)

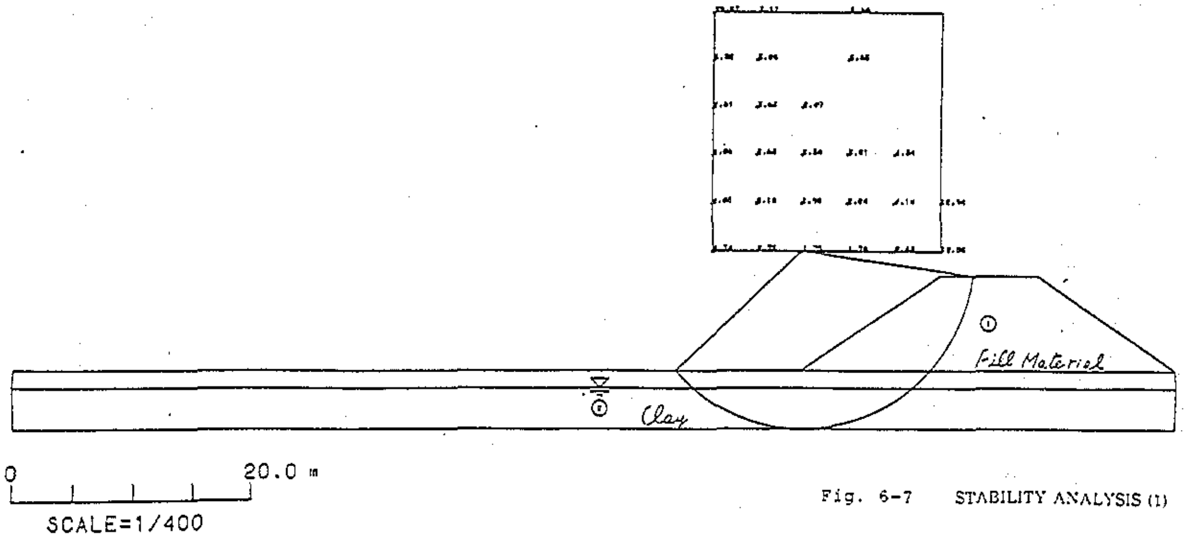
JIS A4 180×250

PNG TRANS ISLAND HIGHWAY BEREINA-MIARU SECTION
STABILITY ANALYSIS



MATERIAL	COHESION (T/m²)	FRICTION (DEG)	W(WET) (T/m³)	W(SAT) (T/m³)	W(SUB) (T/m³)
1	2.60	28.00	1.80	1.90	0.90
2	4.50	0.00	1.73	1.80	0.80
ACCELERATION OF EARTHQUAKE				0.100	

MINIMUM SAFETY FACTOR (NORMAL)		
NORMAL	2.223	
SEISMIC	1.784	



MATERIAL	COHESION (T/m²)	FRICTION (DEG)	W(WET) (T/m³)	W(SAT) (T/m³)	W(SUB) (T/m³)
1	2.60	28.00	1.80	1.90	0.90
2	4.50	0.00	1.73	1.80	0.80
ACCELERATION OF EARTHQUAKE				0.100	

MINIMUM SAFETY FACTOR (SEISMIC)		
NORMAL	2.271	
SEISMIC	1.701	

Fig. 6-7 STABILITY ANALYSIS (1)

PNG TRANS ISLAND HIGHWAY   MIARU RIVER B6
S T A B I L I T Y   A N A L Y S I S

MATERIAL	COHESION (T/m^2)	FRICTION (DEG)	W(WET) (T/m^3)	W(SAT) (T/m^3)	W(SUB) (T/m^3)
1	2.60	28.00	1.80	1.90	0.90
2	1.20	9.00	1.70	1.70	0.70
3	0.00	28.00	1.90	1.90	0.90

MINIMUM SAFETY FACTOR (NORMAL)		
NORMAL	2.109	
SEISMIC		

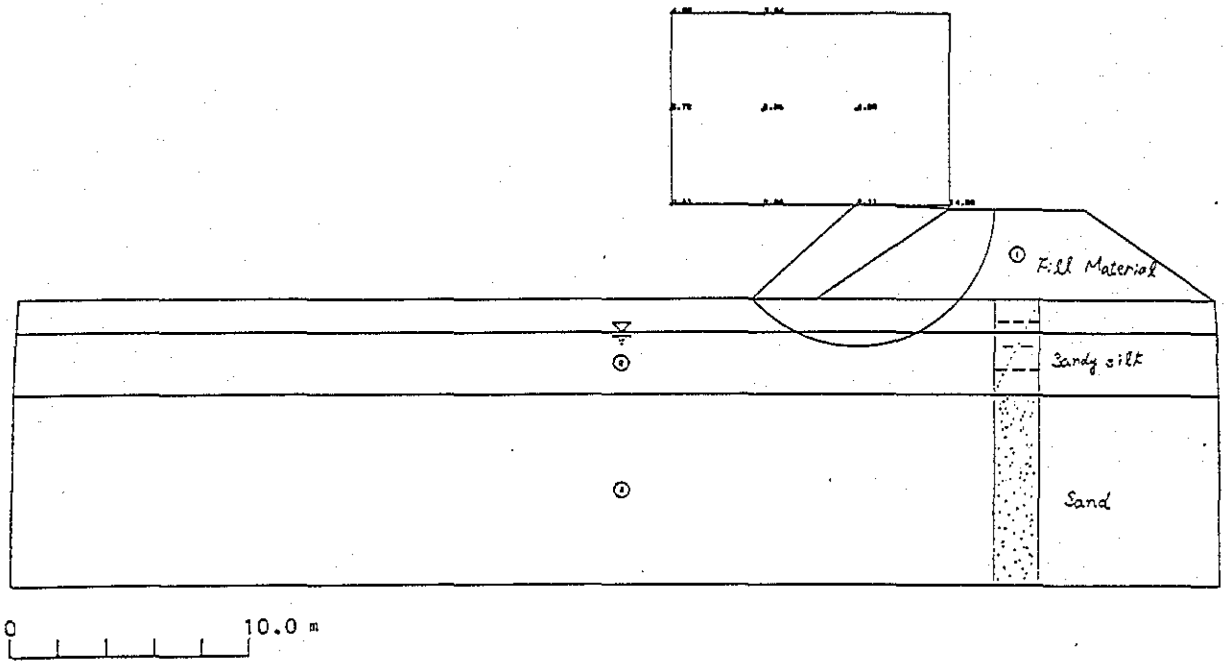
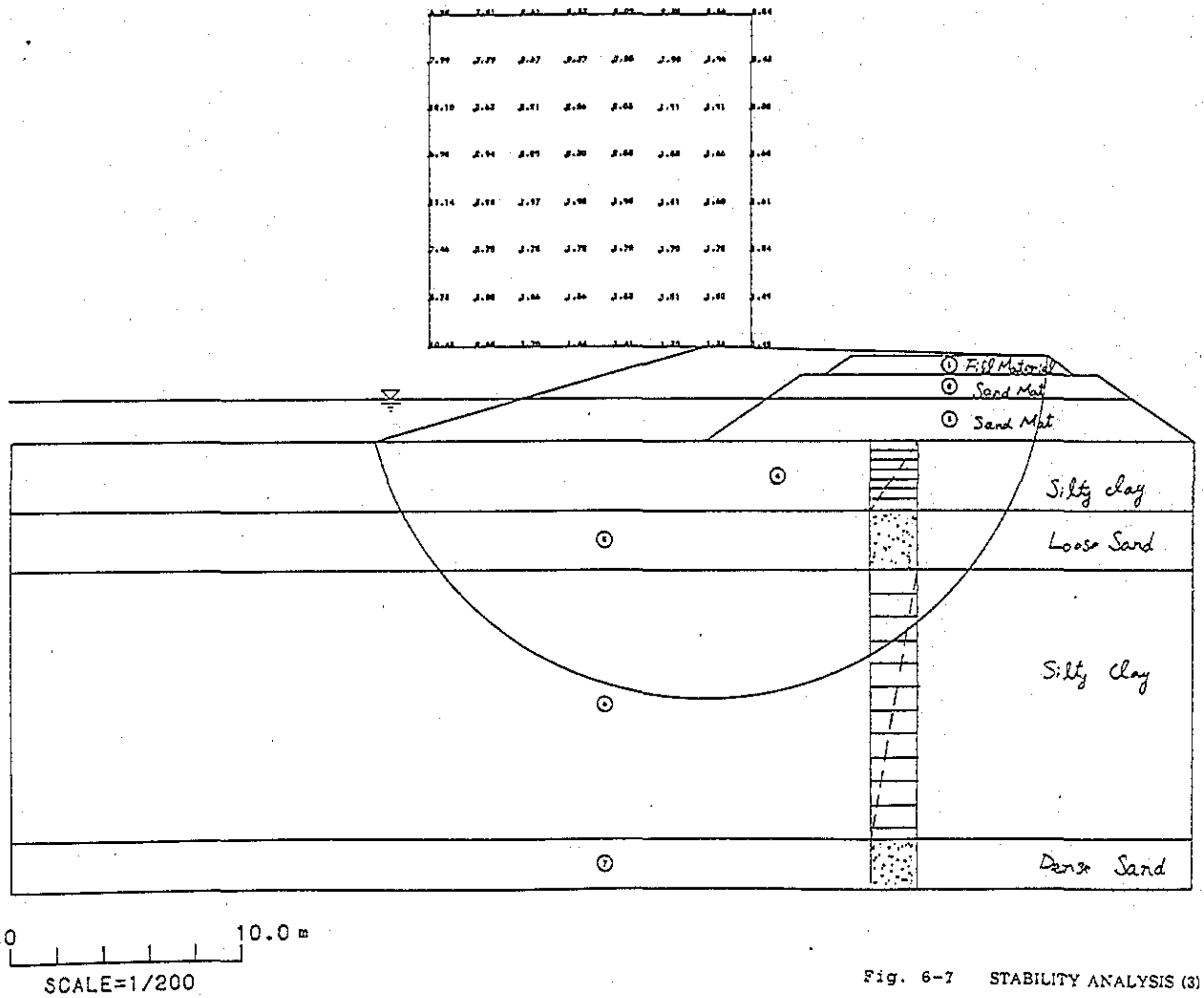


Fig. 6-7 STABILITY ANALYSIS (2)

PNG TRANS ISLAND HIGHWAY ALIKA SWAMP
S T A B I L I T Y   A N A L Y S I S



MATERIAL	COHESION (T/m^2)	FRICTION (DEG)	W(WET) (T/m^3)	W(SAT) (T/m^3)	W(SUB) (T/m^3)
1	2.80	28.00	1.80	1.90	0.90
2	0.00	30.00	1.65	1.70	0.70
3	0.00	27.00	1.65	1.70	0.70
4	2.00	0.00	1.75	1.75	0.75
5	0.00	27.00	1.82	1.82	0.82
6	3.50	0.00	1.75	1.75	0.75
7	0.00	37.00	1.90	1.90	0.90
ACCELERATION OF EARTHQUAKE				0.100	

MINIMUM SAFETY FACTOR (NORMAL)		
NORMAL	1.384	
SEISMIC	0.923	

Fig. 6-7 STABILITY ANALYSIS (3)

PNG TRANS ISLAND HIGHWAY KAPURI RIVER B9
S T A B I L I T Y A N A L Y S I S

MATERIAL	COHESION (T/m^2)	FRICTION (DEG)	W(WET) (T/m^3)	W(SAT) (T/m^3)	W(SUB) (T/m^3)
1	5.20	31.50	1.80	1.90	0.90
2	0.60	6.00	1.50	1.60	0.50
3	1.10	6.00	1.70	1.70	0.70
4	2.00	32.50	1.90	1.90	0.90

MINIMUM SAFETY FACTOR (NORMAL)		
NORMAL	2.788	
SEISMIC		

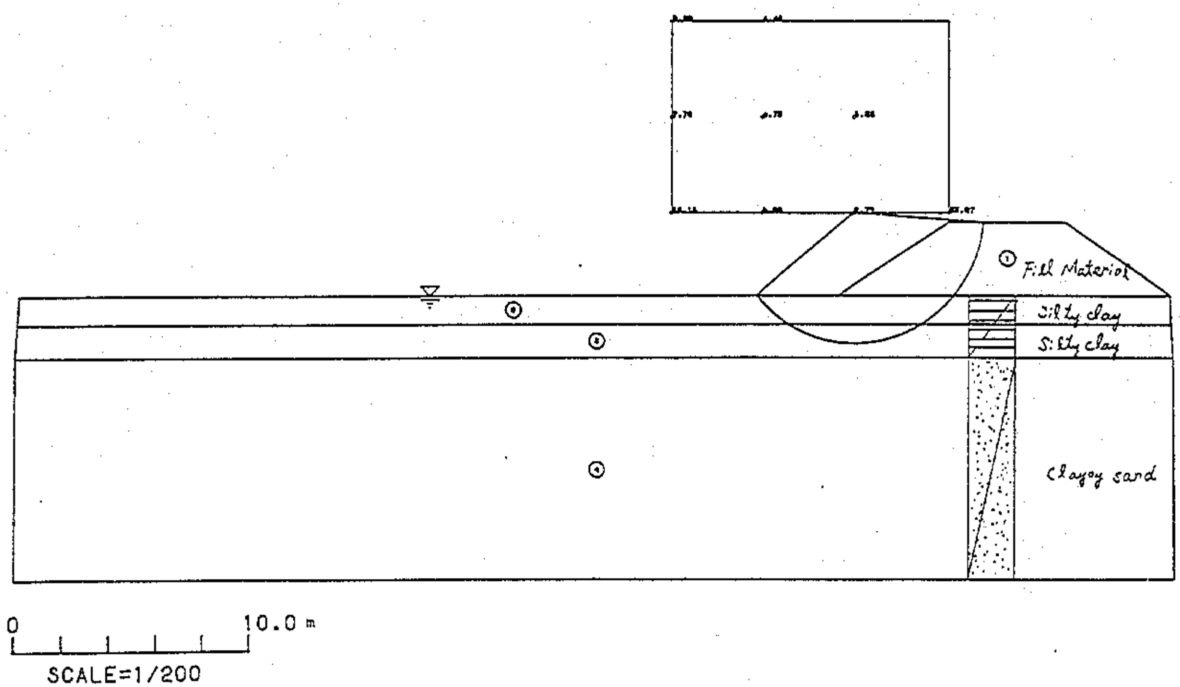
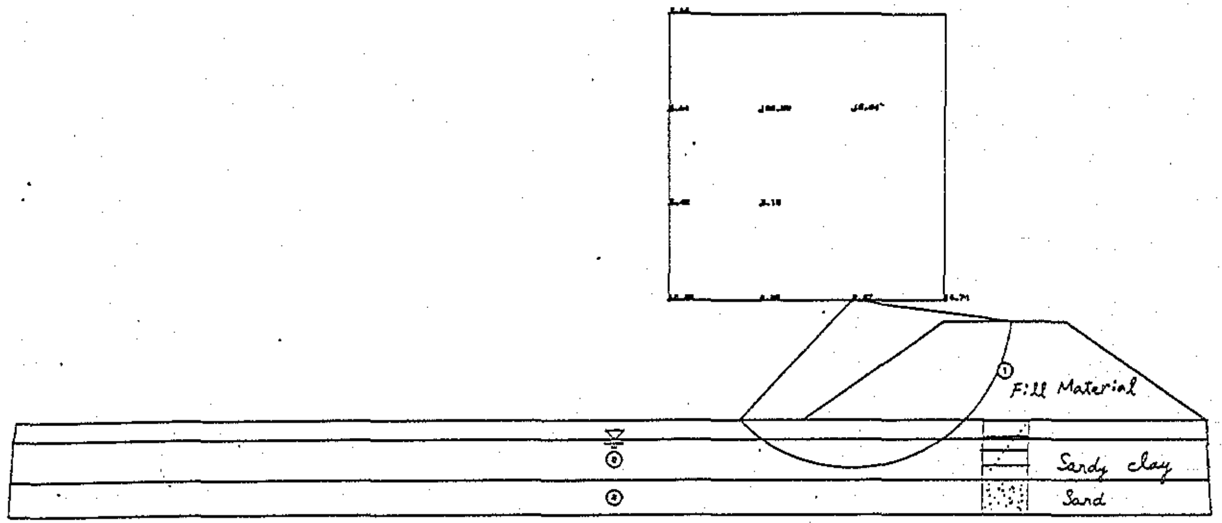


Fig. 6-7 STABILITY ANALYSIS (4)

PNG TRANS ISLAND HIGHWAY LAKEKAMU RIVER B12

STABILITY ANALYSIS

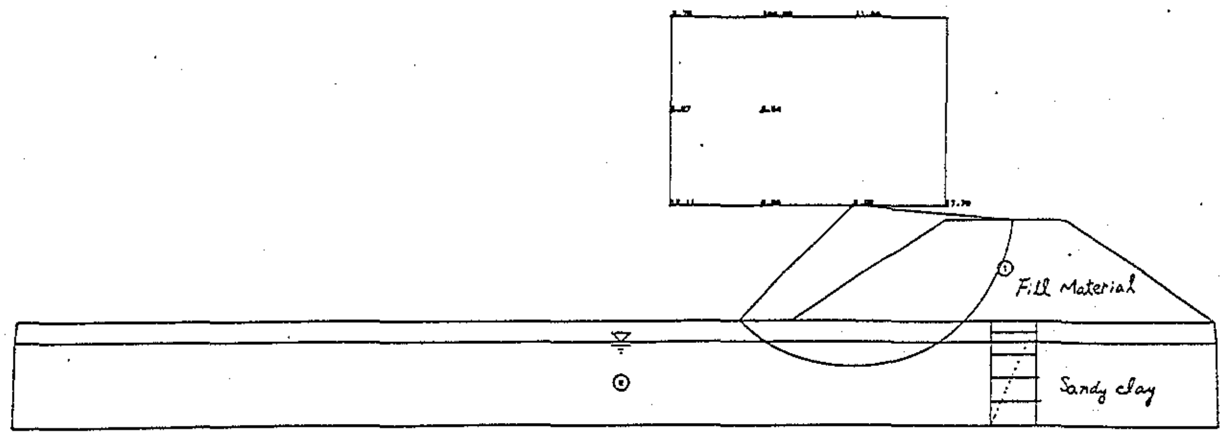


MATERIAL	COHESION (T/m^2)	FRICTION (DEG)	W(WET) (T/m^3)	W(SAT) (T/m^3)	W(SUB) (T/m^3)
1	5.20	31.50	1.80	1.80	0.80
2	0.80	2.50	1.70	1.70	0.70
3	0.00	27.00	1.90	1.90	0.90

MINIMUM SAFETY FACTOR (NORMAL)		
NORMAL	2.073	
SEISMIC		

PNG TRANS ISLAND HIGHWAY TAURI RIVER B13

STABILITY ANALYSIS



MATERIAL	COHESION (T/m^2)	FRICTION (DEG)	W(WET) (T/m^3)	W(SAT) (T/m^3)	W(SUB) (T/m^3)
1	5.20	31.50	1.80	1.90	0.90
2	1.50	6.00	1.60	1.60	0.60

MINIMUM SAFETY FACTOR (NORMAL)		
NORMAL	2.522	
SEISMIC		

0 10.0 m
SCALE=1/200

Fig. 6-7 STABILITY ANALYSIS (5)

PNG TRANS ISLAND HIGHWAY MAKARA RIVER B15

STABILITY ANALYSIS

MATERIAL	COHESION (T/m^2)	FRICTION (DEG)	W(WET) (T/m^3)	W(SAT) (T/m^3)	W(SUB) (T/m^3)
1	5.20	31.50	1.80	1.90	0.90
2	0.00	30.00	1.65	1.90	0.90
3	1.00	7.00	1.70	1.70	0.70
4	0.00	24.00	1.90	1.90	0.90
5	1.50	0.00	1.70	1.70	0.70

MINIMUM SAFETY FACTOR (NORMAL)		
NORMAL	1.705	
SEISMIC		

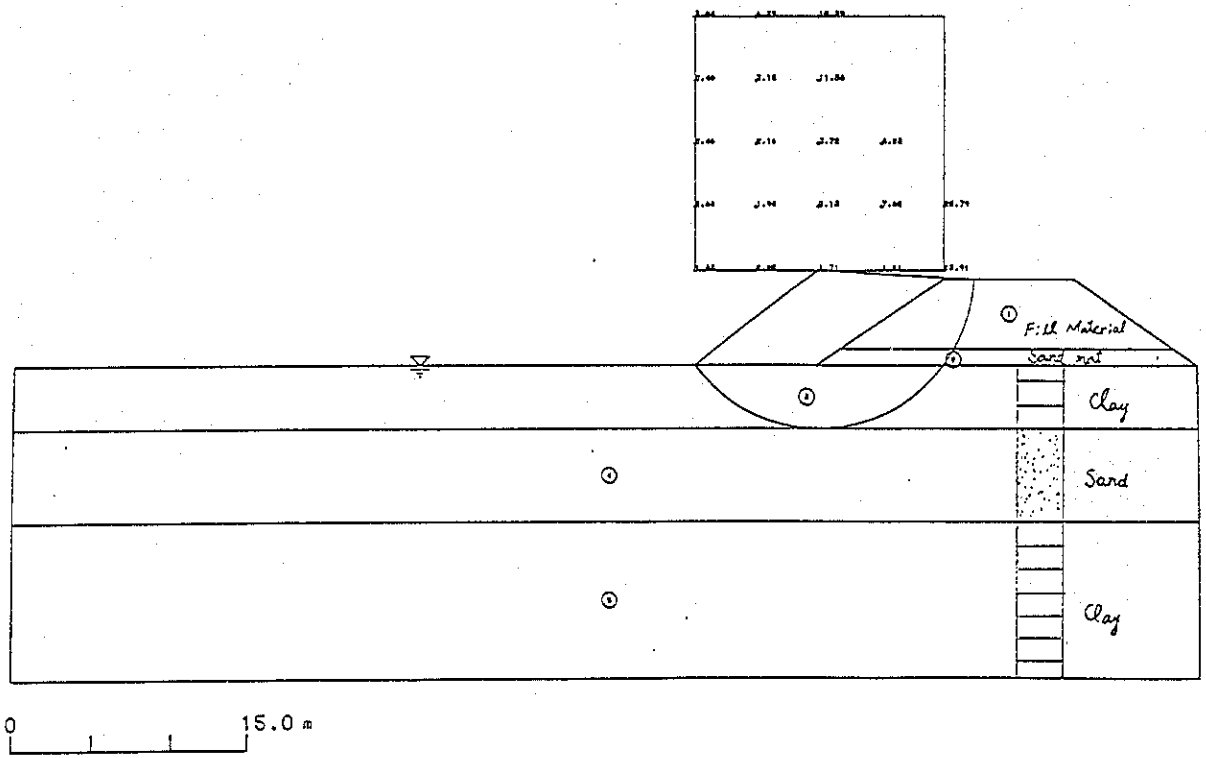


Fig. 6-7 STABILITY ANALYSIS (6)

PNG TRANS ISLAND HIGHWAY SAPPAHARO RIVER B18

STABILITY ANALYSIS

MATERIAL	COHESION (T/m^2)	FRICTION (DEG)	W(WET) (T/m^3)	W(SAT) (T/m^3)	W(SUB) (T/m^3)
1	5.20	31.50	1.60	1.90	0.90
2	0.00	30.00	1.65	1.90	0.90
3	0.00	24.00	1.90	1.90	0.90
4	1.10	0.00	1.70	1.70	0.70
5	0.00	27.00	1.90	1.90	0.90

MINIMUM SAFETY FACTOR (NORMAL)		
NORMAL	1.717	
SEISMIC		

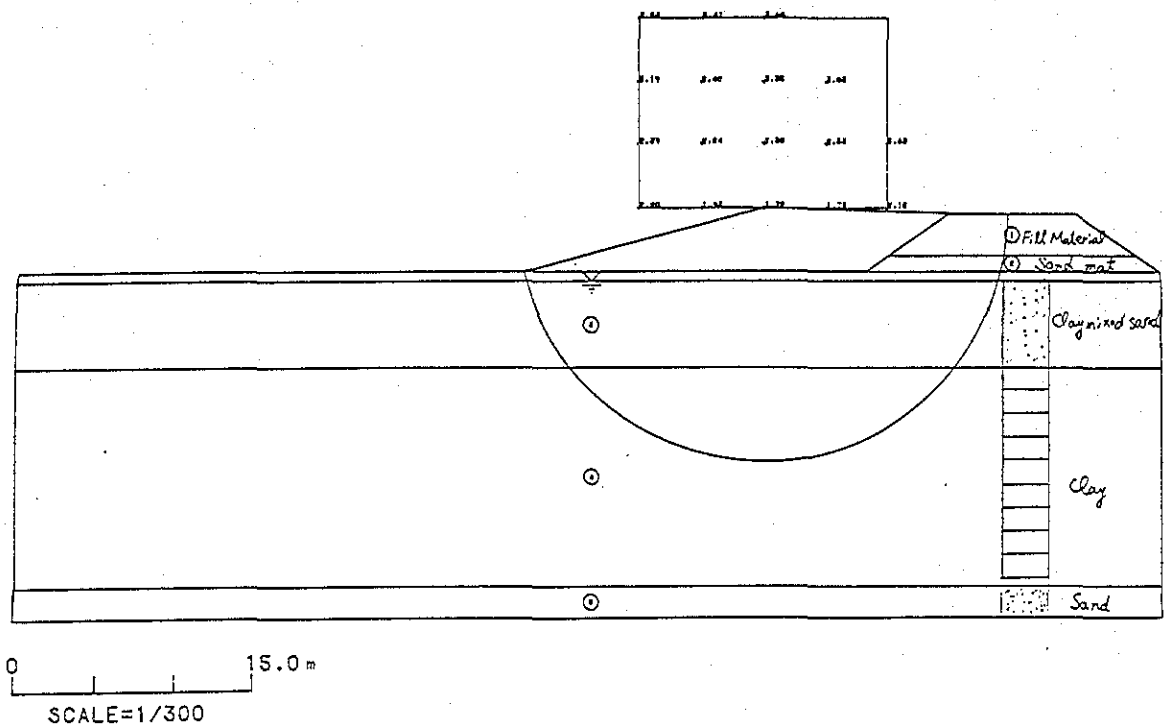


Fig. 6-6 STABILITY ANALYSIS (7)

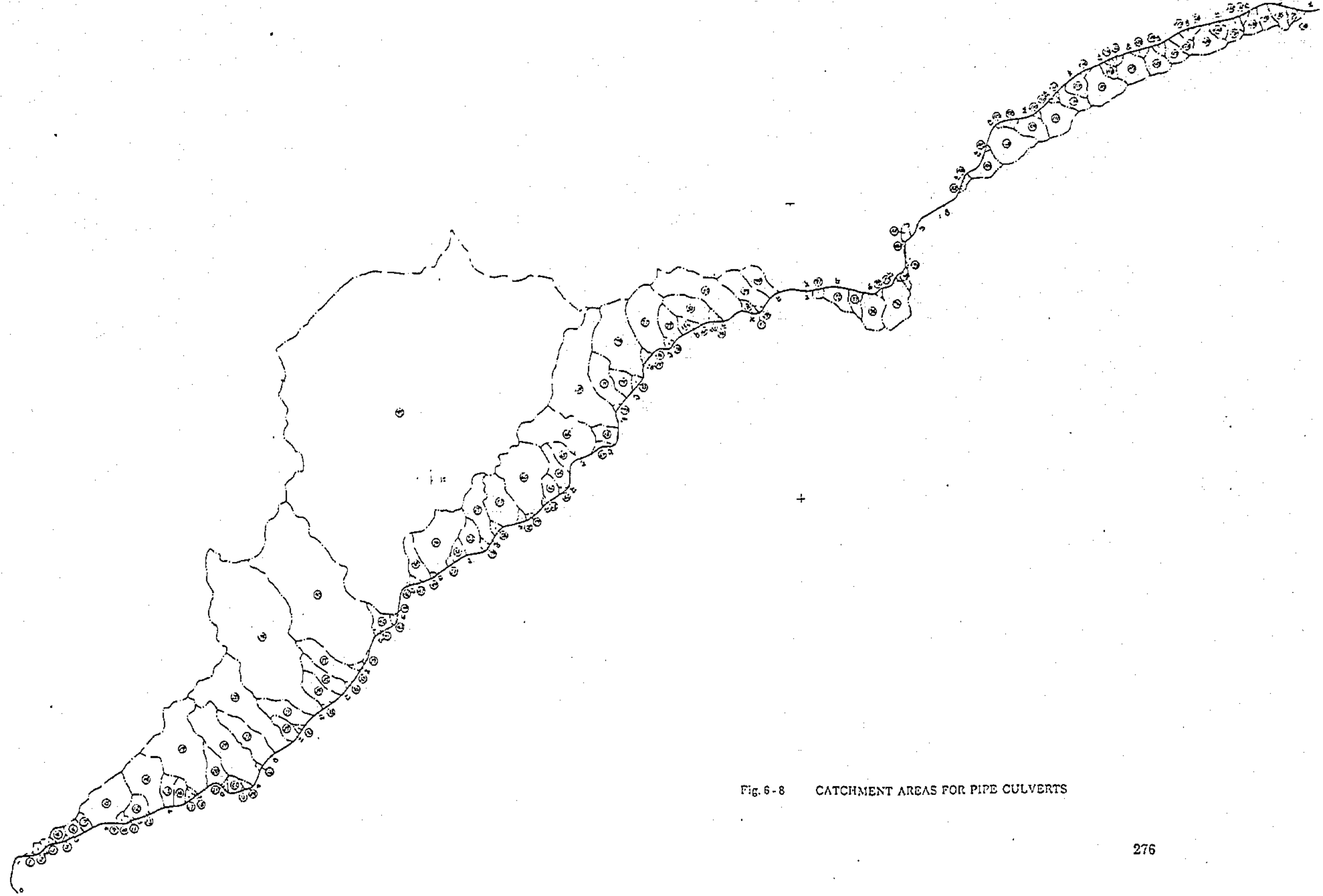
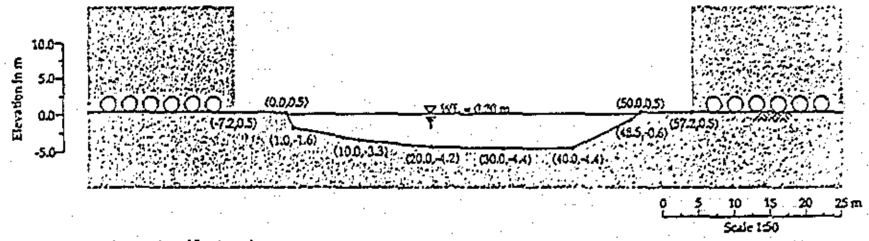


Fig. 6-8 CATCHMENT AREAS FOR PIPE CULVERTS



Assumption of flood routine

Kapuri river	*River bed slope*	s = 0.000 %
	Roughness coefficient	n = 0.025

○ Corrugated metal pipe

Roughness coefficient	n = 0.024
Installation level	EL = 0.5 m
Slope condition	Level

Numbers D900 : 81 nos.
D1200 : 3 nos.
D2100 : 8 nos.

Fig. 6 - 12 ASSUMPTION FOR FLOOD ROUTIN

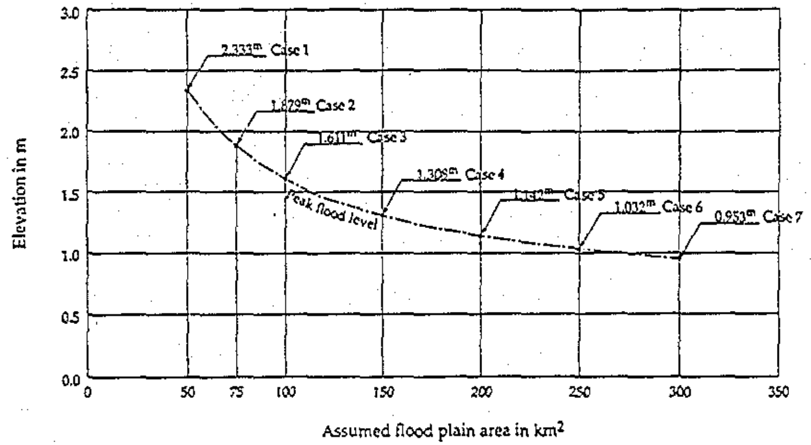


Fig. 6 - 13 RELATIONSHIP BETWEEN ASSUMED FLOOD PLAIN AREA AND PEAK FLOOD LEVEL AT BRIDGE

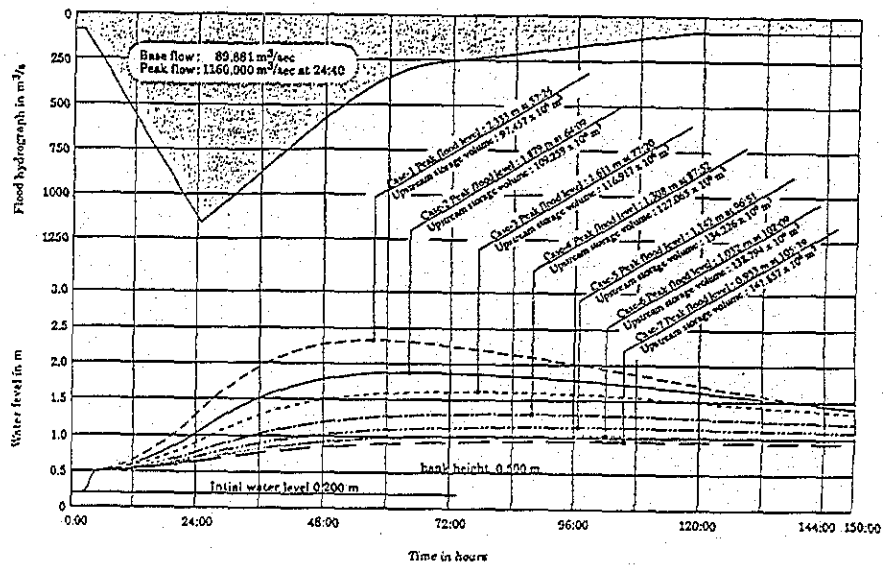


Fig. 6 - 14 TRACE OF WATER LEVEL AT KAPURI RIVER BRIDGE SITE

Table 7 - 1 GIRDER STRESS AND DEFLECTION

BRIDGE	M (kN-m)		SECTION (GRADE 350)	MAX STRESS (MPa)	DEFL (LL + I) (mm)
	NON COMP	COMP			
TAIENA	574	1163	910 x 304 x 224 kg UB	182	16
AGOBINO	805	1436	927 x 308 x 289 kg UB	201	26
UNGONGO	805	1436	"	201	26
MIARU	1518	1400	350 x 16 1100 x 12 350 x 40	193	34
KAPURI	756	926	927 x 308 x 289 kg UB	164	19
LAKEKAMU	-3839 2078	-3473 2730	500 x 28/14 1800 x 14 600 x 36/16	182 166	53
TAURI	3839 2078	-3473 2730	"	182 166	53
MAKARA	756	926	927 x 308 x 289 kg UB	164	16
SAPPAHARO	756	926	"	164	16

Table 7 - 2 PRINCIPAL FEATURES OF SUBSTRUCTURE

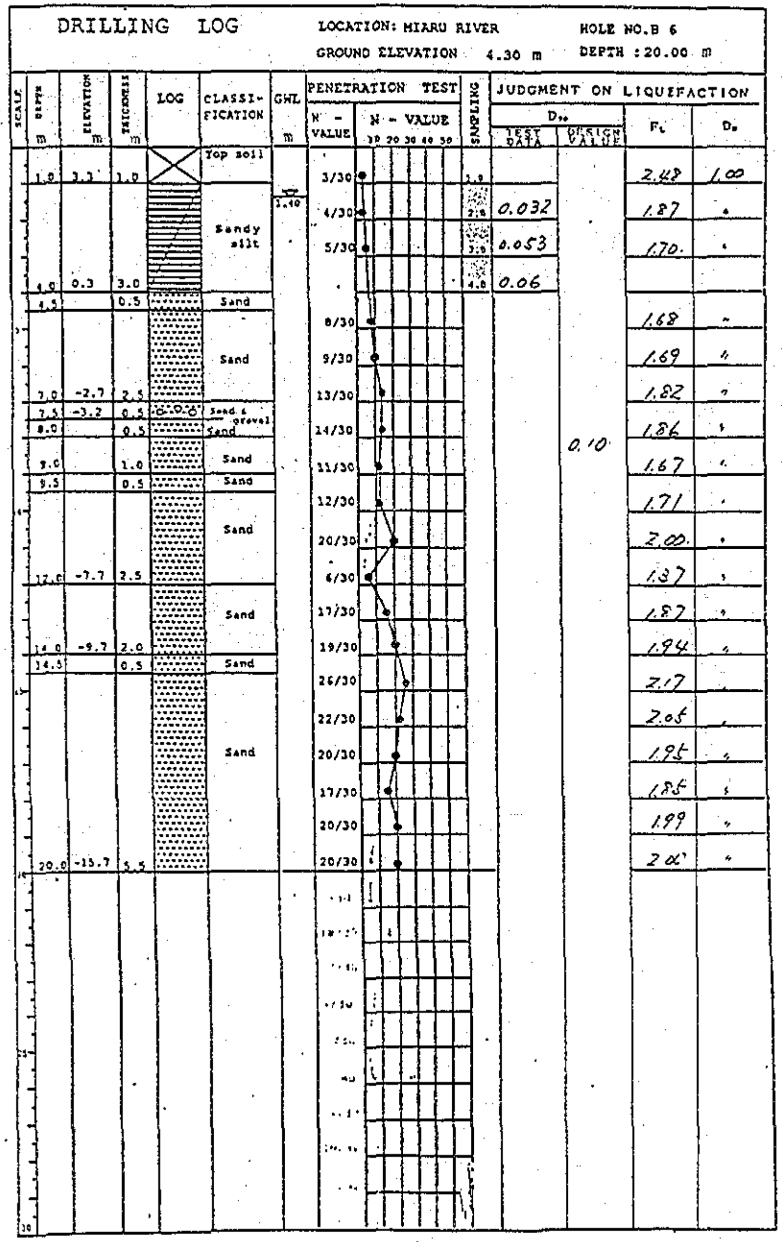
	SUPERSTRUCTURE		PILE DETAILS				HEADSTOCK (m)		
	SPAN (m)	WIDTH (m)	N x D x T	L (m)	b (m)	l(m)	L	B	H
Taiena	17.0	9.2	6/500 x 14	26.3	1.2	2 @ 3.270	9.2	2.5	1.925 1.825
Agobino	20.0	9.2	6/500 x 14	19.2	1.2	2 @ 3.270	9.2	2.5	1.925
Ungongo	20.0	9.2	6/500 x 14	28.5	1.2	2 @ 3.270	9.79	2.5	2.125 2.025
Miaru	3 x 30	5.3	6/600 x 14 4/800 x 12	26.0 38.8	1.5 2.0	2 @ 1.650 3.3	5.3 5.3	3.0 3.5	2.975 1.4
Kapuri	3 x 21.5	5.0	6/500 x 14 4/800 x 12	22.3 36.1	1.5 2.0	2 @ 1.650 3.3	5.3 5.3	3.0 3.5	2.125 1.4
Lakekamu	37 + 46 + 37	5.3	6/800 x 12 4/1000 x 12	6 x 9.3 6 x 5.3 13.5	1.6 2.0	2 @ 1.65 2.7	5.3 5.3	3.5 4.0	4.035 1.4
Tauri	37 + 46 + 37	5.3	6/800 x 12 4/1000 x 12	6 x 5.4 6 x 6.9 13.5	1.6 2.0	2 @ 1.65 2.7	5.3 5.3	3.5 4.0	4.035 1.4
Makara	2 x 20	5.3	6/500 x 14 4/800 x 12	29.4 34.6	1.5 2.0	2 @ 1.65 3.3	5.3 5.3	3.0 3.5	2.125 1.4
Sappaharo	2 x 20	5.3	6/500 x 14 4/800 x 12	6 x 22.1 6 x 27.9 41.7	1.5 2.0	2 @ 1.650 3.3	5.3 5.3	3.0 3.5	2.53 3.76 1.4

Table 7-3 PILE LOADS AND STRESSES

	PILE SECTION				TOTAL LOAD ON PILE GROUP (kN)			PILE LOADS (kN, m)				PILE ULT CAPACITY	MAX PILE STRESS	PILE LAT DEFL
	No.	Dia (mm)	T (mm)	L' (m)	DEAD	DEAD+T44	EQ	DEAD + T44(V)	DEAD + EQ V (COMP)	DEAD + EQ V (TENS)	DEAD + EQ M	(MPa)	(MPa)	(mm)
TAIEHA	6	500	14	26.3	566	1008	1087	170	920	390	155	2,300	104	51
AGOBINO	6	500	14	19.2	666	1121	1188	190	1140	570	168	2,850	122	65
UNGONGO	6	500	14	29.5	666	1121	1188	190	1140	570	168	2,850	122	65
MIARU	6	600	14	26.0	546	1017	1050	170	900	350	304	2,250	117	70
	4	800	12	38.8	1742	2389	800	600	1900	1020	1354	4,750	R.C	121
KAPURI	6	500	14	22.3	378	836	900	140	700	275	193	1,750	109	90
	4	800	12	36.1	1406	2113	710	530	1400	700	1004	3,500	R.C.	79
LAKEKAMU	6	800	12	9.3 5.3	2070	2540	1044	425	1500	710	154	3,750	R.C.	26
	4	1000	12	13.5	2850	3770	1760	950	4500	3000	3875	11,250	R.C.	145
TAURI	6	800	12	5.4 6.9	2070	2540	1044	425	1500	710	154	3,750	R.C.	26
	4	1000	12	13.5	2850	3770	1760	950	4500	3000	3875	11,250	R.C.	145
MAKARA	6	500	14	29.4	378	836	900	140	700	275	193	1,750	109	90
	4	800	12	34.6	1406	2113	710	530	1400	700	1004	3,500	R.C.	79
SAPPAHARO	6	500	14	32.1 27.9	378	836	900	140	700	275	193	1,750	109	90
	4	800	12	41.7	1406	2113	710	530	1400	700	1004	3,500	R.C.	79

Table 7-4 REACTION AND BEARING TYPE

		Reaction (kN) Dead Load	Live Load	Total	Bearing Type (kN)	Remarks
Taiena Creek	External Internal	121 132	381 357	502 489	BP-B103 (Fix) BP-B104 (Mov)	
Agobino Creek	External Internal	147 164	393 369	540 533	" "	
Ungongo Creek	External Internal	147 164	393 369	540 533	" "	
Miaru River	External Internal	182 182	246 223	428 405	BP-B101 (Fix) BP-B102 (Mov)	
Kapuri River	External Internal	126 126	234 212	360 338	" "	
Lakekamu River	Abutment Pier	347 1165	365 737	712 1902	BP-B104 (Mov) BP-B117 (Fix)	Mov on abutment Fix on pier
Tauri River	Abutment Pier	347 1165	365 737	712 1902	" "	" "
Makara River	External Internal	126 126	234 212	360 338	BP-B101 (Fix) BP-B101 (Mov)	
Sappaharo River	External Internal	126 126	234 212	360 338	" "	



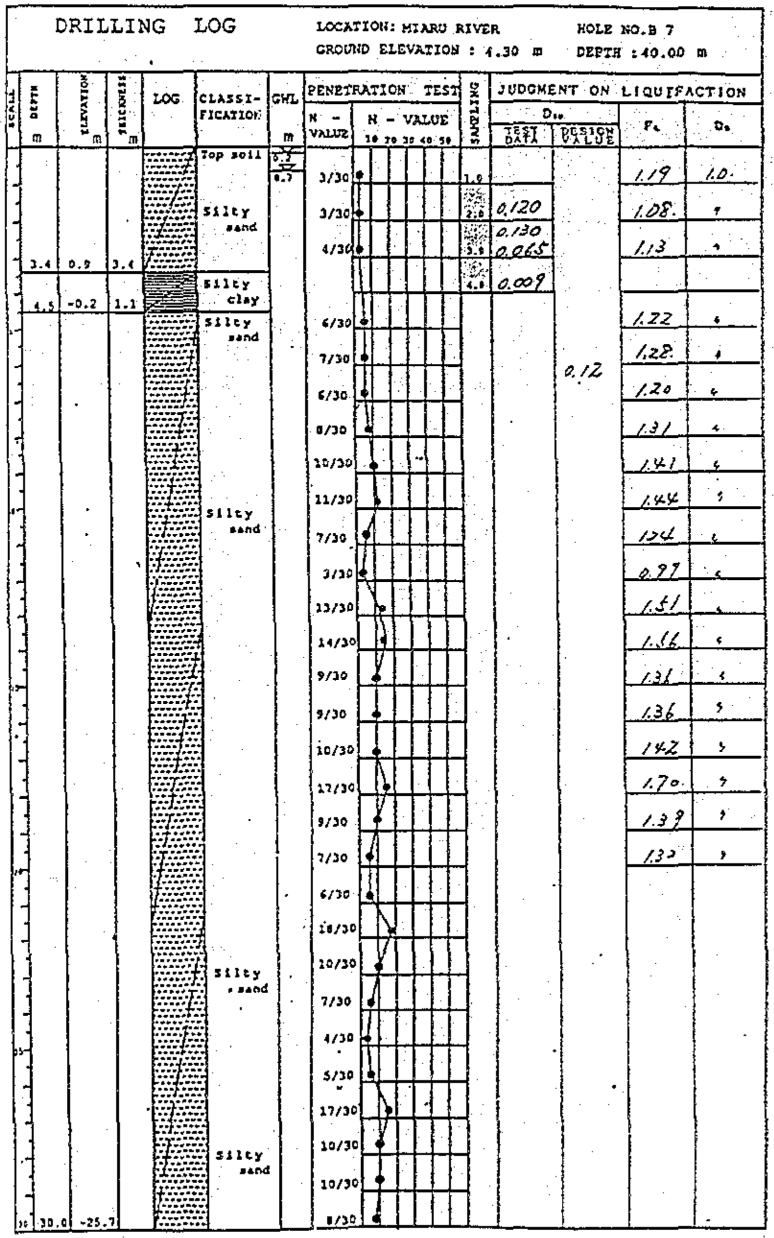
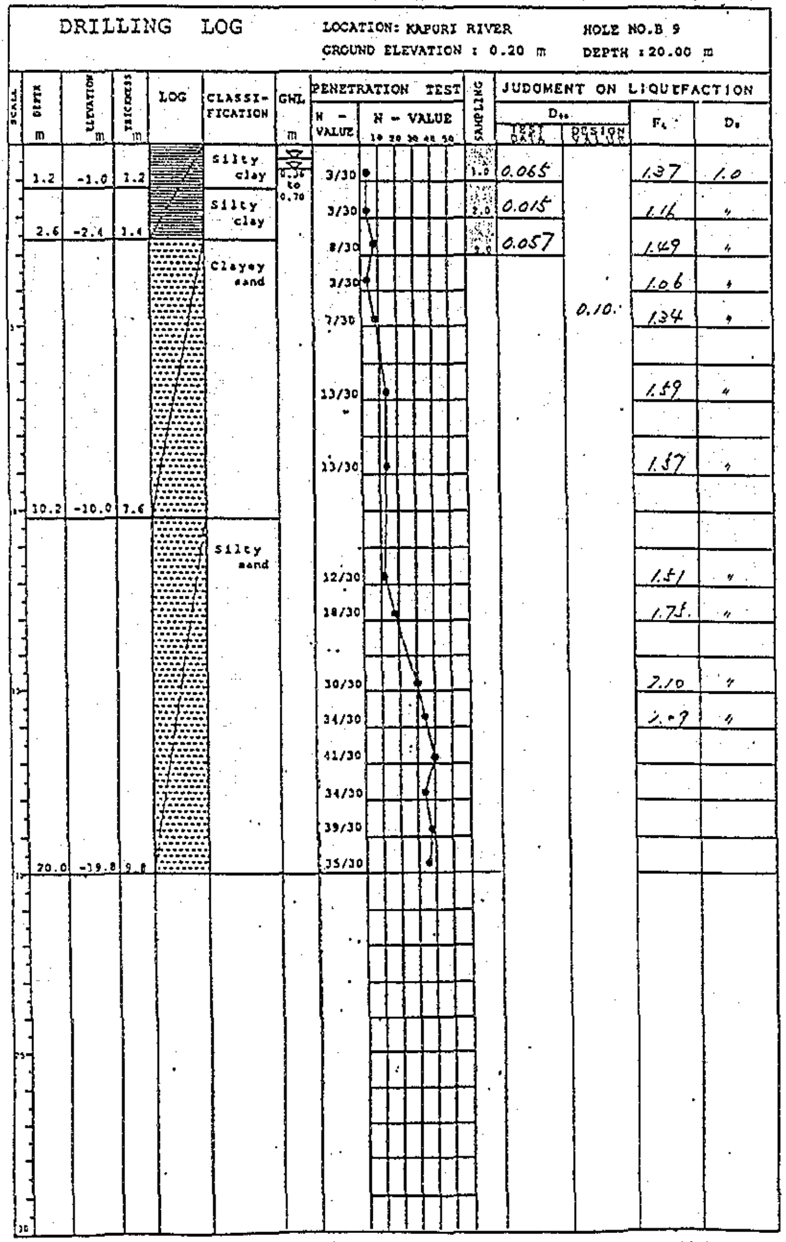


Fig 7-4 LIQUEFACTION ANALYSIS ON MIARU BRIDGE

281



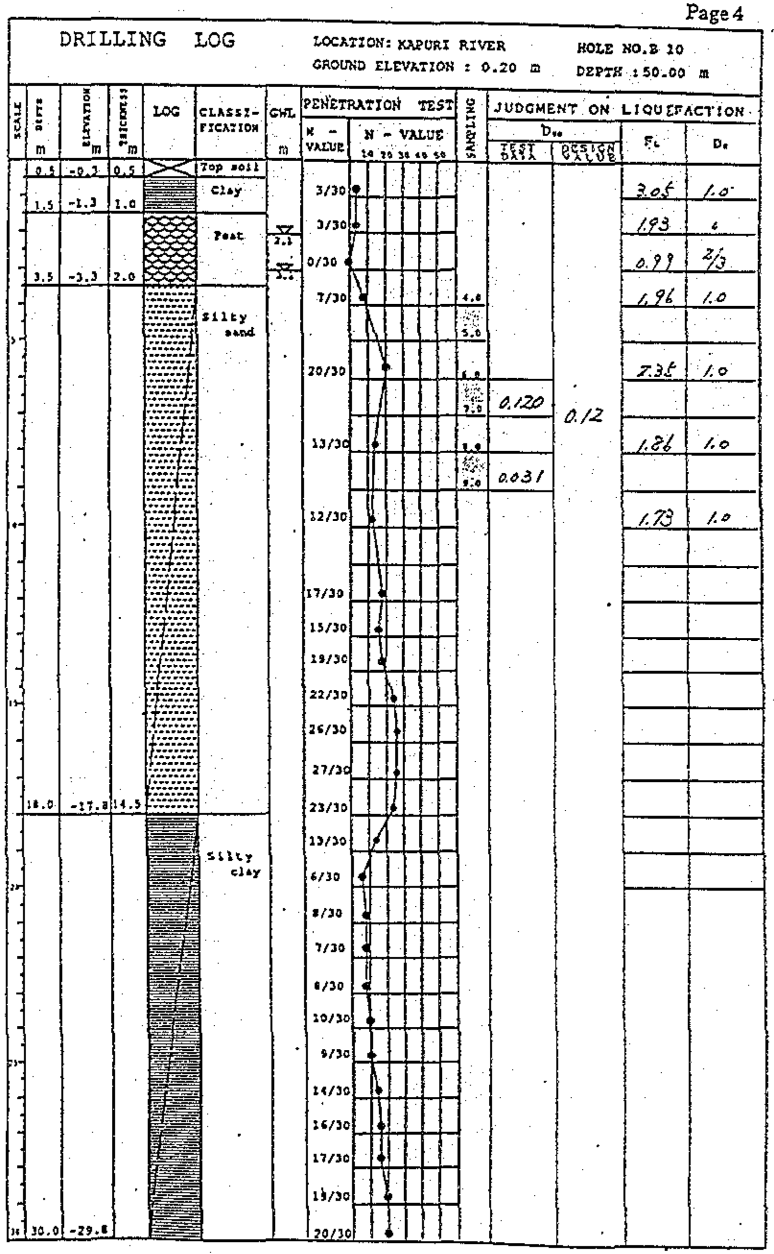
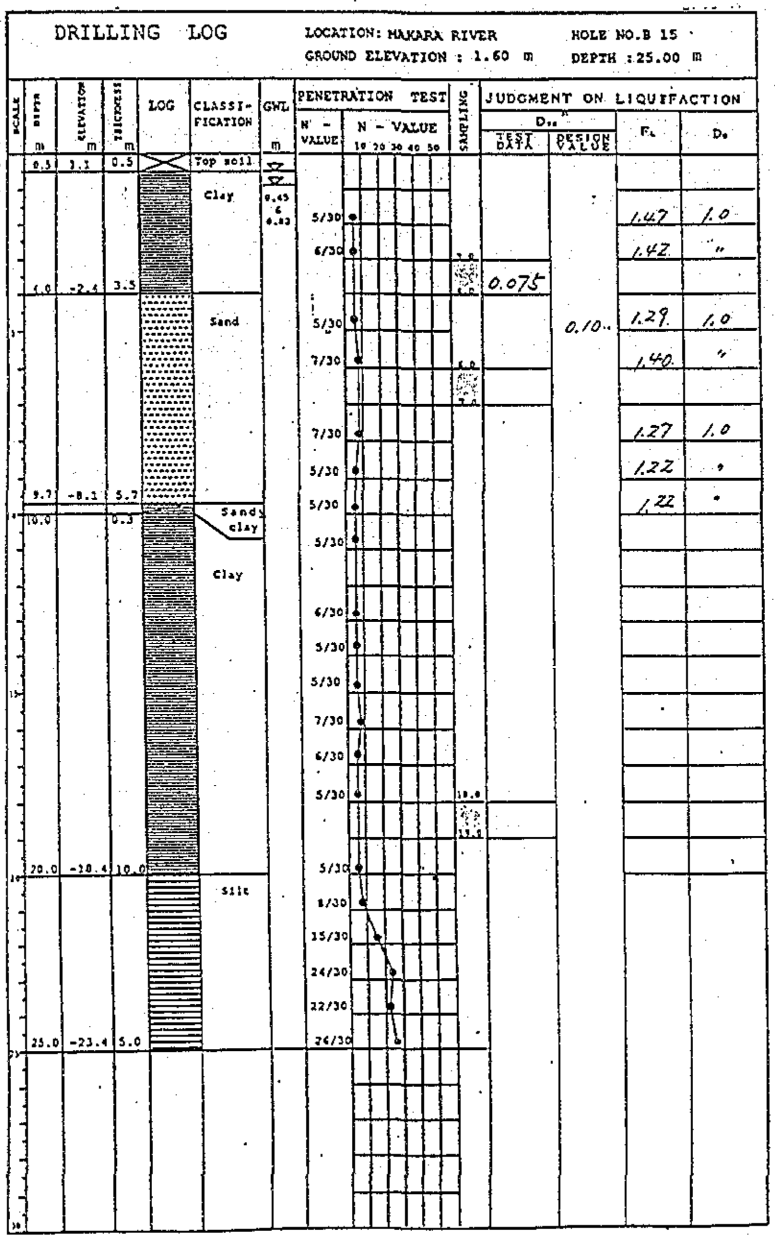


Fig 7-5 LIQUEFACTION ANALYSIS ON KAPURI BRIDGE



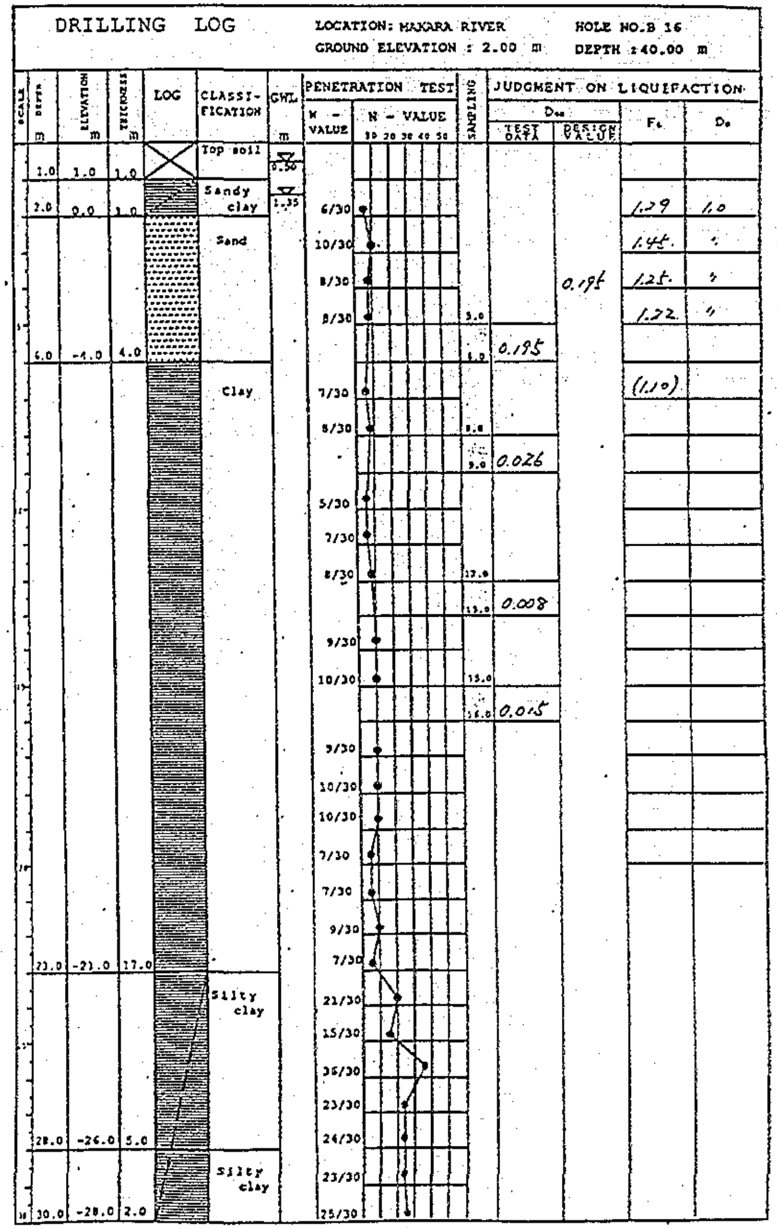
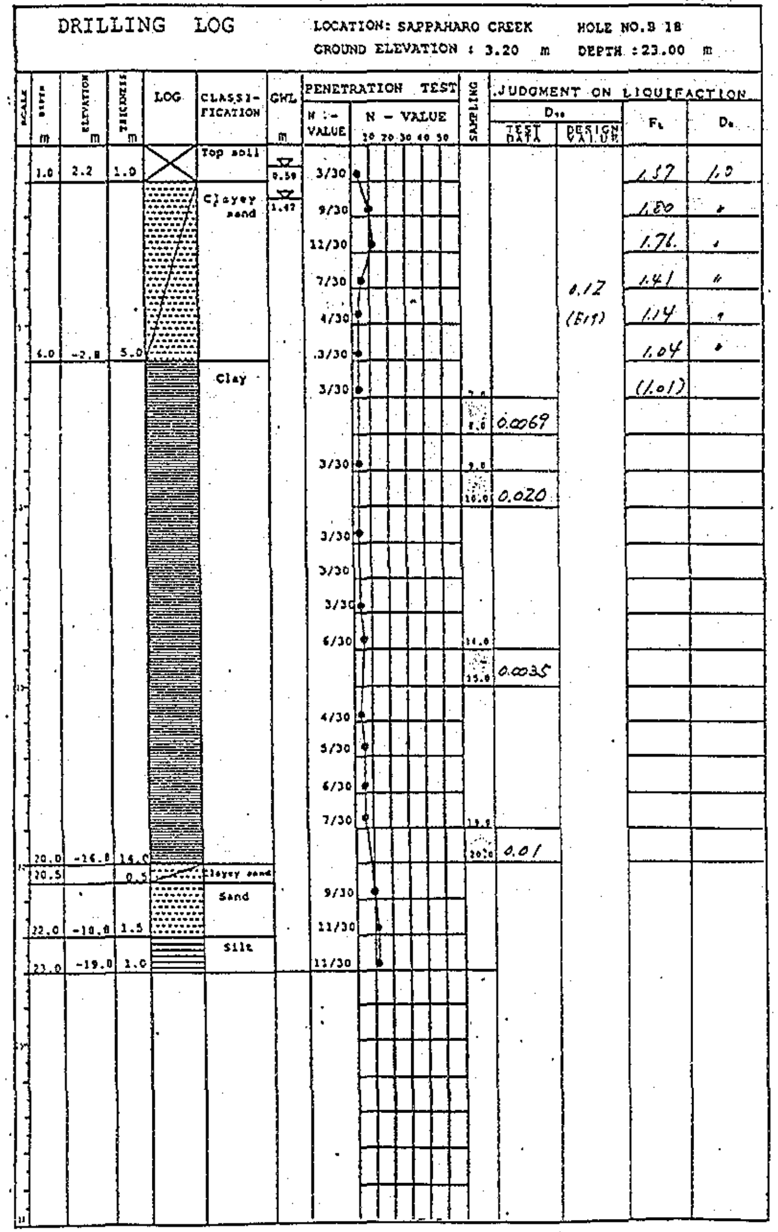


Fig 7-6 LIQUEFACTION ANALYSIS ON MAKARA BRIDGE



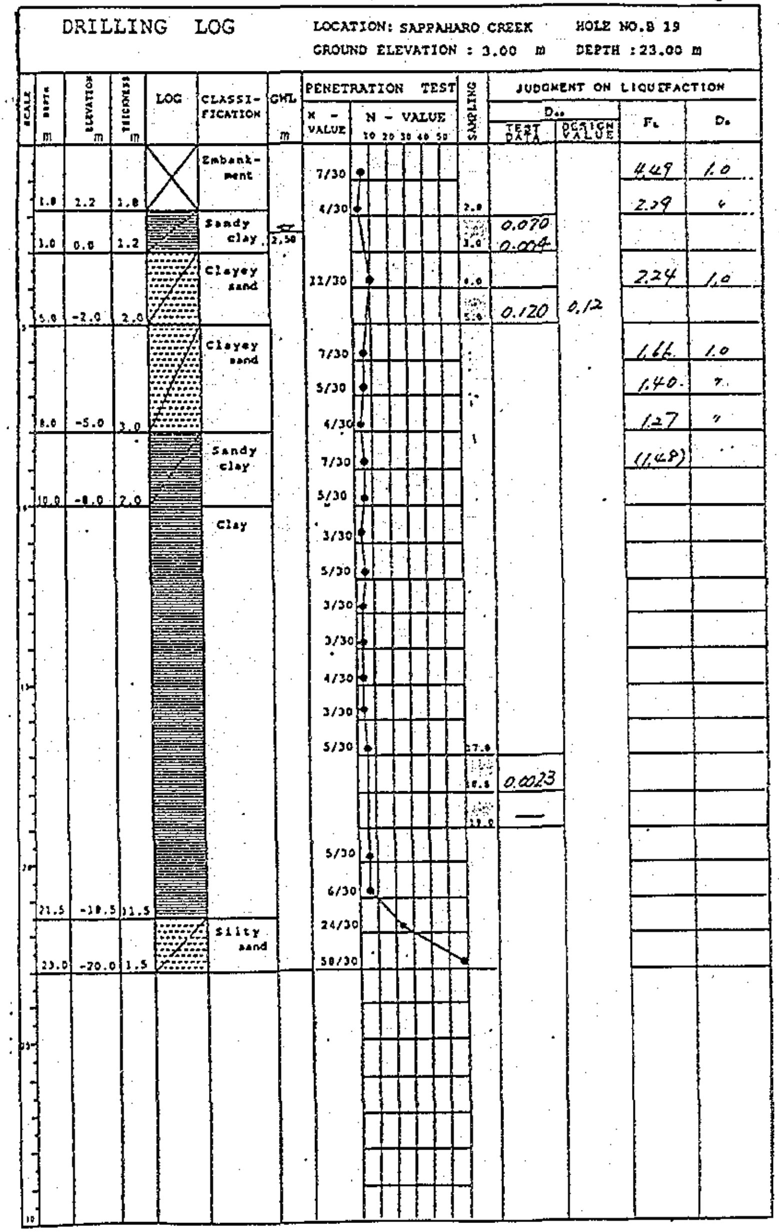


Fig 7-7 LIQUEFACTION ANALYSIS ON SAPPAHARO BRIDGE

Table 7-6 LIQUEFACTION CALCULATION PAPER (1)

MIARU RIVER No. 26

(k_s = 0.14, h_w = 1.4 m)

Z (m)	N (1/?)	D_{50}	γ_{t1}	γ_{t2}	γ_w'	r_d	σ_v	σ_v'	L	R_1	R_2	R	F_L	
1.0	3		1.7	1.8	0.9	0.985	0.166	0.202	0.112	0.158	0.123	0.281	2.49	
2.0	4	0.035 }				0.970	0.346	0.292	0.161	0.178	0.123	0.301	1.87	
3.0	6	0.045 } 0.10				0.955	0.526	0.382	0.184	0.19	0.123	0.313	1.70	[illegible]
5.0	8	0.06 }				0.925	0.886	0.562	0.204	0.22	"	0.343	1.68	
6.0	9					0.910	1.066	0.652	0.208	0.23	"	0.353	1.69	
7.0	13					0.895	1.246	0.742	0.210	0.26	"	0.383	1.82	
8.0	14					0.88	1.426	0.832	0.211	0.27	"	0.393	1.86	
9.0	11					0.865	1.606	0.922	0.211	0.23	"	0.353	1.67	
10.0	17					0.85	1.786	1.012	0.210	0.235	"	0.358	1.71	
11.0	20					0.835	1.966	1.102	0.208	0.295	"	0.418	2.00	
12.0	6					0.82	2.146	1.192	0.207	0.16	"	0.283	1.37	
13.0	17					0.805	2.326	1.282	0.204	0.26	"	0.383	1.87	
14.0	19					0.790	2.506	1.372	0.202	0.268	"	0.391	1.94	
15.0	26					0.775	2.686	1.462	0.199	0.31	"	0.433	2.17	
16.0	22					0.76	2.866	1.552	0.196	0.28	"	0.403	2.05	
17.0	20					0.745	3.046	1.642	0.193	0.255	"	0.378	1.95	
18.0	17					0.73	3.226	1.732	0.190	0.23	"	0.353	1.85	
19.0	20					0.715	3.406	1.822	0.187	0.25	"	0.373	1.99	
20.0	20					0.70	3.586	1.912	0.184	0.245	"	0.368	2.00	

Table 7-6 LIQUEFACTION CALCULATION PAPER (2)

MIARU RIVER No. 27

(k_s = 0.14, h_w = 0.2 m)

Z (m)	N (1/?)	D_{50}	γ_{t1}	γ_{t2}	γ_w'	r_d	σ_v	σ_v'	L	R_1	R_2	R	F_L	
1.0	3		1.7	1.8	0.9	0.985	0.178	0.106	0.232	0.17	0.105	0.275	1.19	[illegible]
2.0	3	0.15				0.970	0.358	0.196	0.248	0.162	"	0.267	1.08	[illegible]
3.0	4	0.12 [illegible]				0.955	0.538	0.286	0.252	0.18	"	0.285	1.13	[illegible]
5.0	6	0.09				0.925	0.898	0.466	0.250	0.20	"	0.305	1.22	
6.0	7					0.91	1.078	0.556	0.247	0.21	"	0.315	1.28	
7.0	6					0.895	1.258	0.646	0.244	0.188	"	0.293	1.20	
8.0	8					0.88	1.438	0.736	0.241	0.21	"	0.315	1.31	
9.0	10					0.865	1.618	0.826	0.237	0.228	"	0.333	1.41	
10.0	11					0.85	1.798	0.916	0.234	0.23	"	0.335	1.44	
11.0	7					0.835	1.978	1.006	0.230	0.18	"	0.285	1.24	
12.0	3					0.82	2.158	1.096	0.226	0.118	"	0.223	0.99	Dz=1.0
13.0	13					0.805	2.338	1.186	0.222	0.23	"	0.335	1.51	
14.0	14					0.790	2.518	1.276	0.218	0.235	"	0.340	1.56	
15.0	9					0.775	2.698	1.366	0.214	0.186	"	0.291	1.36	
16.0	9					0.76	2.878	1.456	0.210	0.18	"	0.285	1.36	
17.0	10					0.745	3.058	1.546	0.206	0.188	"	0.293	1.42	
18.0	17					0.73	3.238	1.636	0.202	0.238	"	0.343	1.70	
19.0	7					0.715	3.418	1.726	0.198	0.17	"	0.275	1.39	
20.0	7					0.70	3.598	1.816	0.194	0.15	"	0.255	1.32	

Table 7-6 LIQUEFACTION CALCULATION PAPER (3)

KAPURI RIVER No. 29

k_s = 0.14
h_w = 0.36 m

x (m)	N (B)	D_{50}	Y_{r1}	Y_{r2}	C_r'	r_d	σ_v	σ_v'	L	R_1	R_2	R	F_L	
1.0	3	0.065	1.5	1.7	0.8	0.925	0.113	0.105	0.213	0.17	0.123	0.291	1.37	
2.0	3	0.015	[illegible]			0.97	0.333	0.185	0.244	0.161	"	0.284	1.16	
3.0	8	0.059	0.10			0.955	0.503	0.265	0.253	0.25	"	0.375	1.48	
4.0	3					0.94	0.673	0.345	0.256	0.15	"	0.274	1.06	Dr=%
5.0	7					0.925	0.843	0.425	0.257	0.22	"	0.343	1.34	
7.0	13					0.895	1.183	0.585	0.253	0.28	"	0.403	1.59	
9.0	13					0.865	1.523	0.745	0.247	0.25	"	0.374	1.51	
12.0	12					0.82	2.033	0.985	0.237	0.235	"	0.358	1.51	
13.0	12					0.805	2.203	1.065	0.231	0.285	"	0.408	1.75	
15.0	20					0.775	2.543	1.225	0.225	0.35	"	0.473	2.10	
16.0	34					0.76	2.713	1.305	0.221	0.34	"	0.463	2.09	
17.0	41													
18.0	34													
19.0	38													
20.0	35													

Table 7-6 LIQUEFACTION CALCULATION PAPER (4)

KAPURI RIVER No. B10

k_s = 0.14
h_w = 2.1 m

x (m)	N (B)	D_{50}	Y_{r1}	Y_{r2}	C_r'	r_d	σ_v	σ_v'	L	R_1	R_2	R	F_L	
1.0	3		.8	1.0	1.0	0.985	0.119	0.248	0.087	0.16	0.105	0.265	3.05	
2.0	3					0.970	0.359	0.368	0.132	0.15	"	0.255	1.93	
3.0	0					0.955	0.559	0.448	0.157	0.05	"	0.155	0.99	
4.0	7					0.940	0.739	0.588	0.171	0.23	"	0.335	1.96	
6.0	20					0.910	1.119	0.768	0.186	0.33	"	0.435	2.35	
8.0	13	0.12	[illegible]			0.880	1.499	0.968	0.191	0.25	"	0.355	1.86	
10.0	12	0.31	(R1)			0.850	1.879	1.168	0.191	0.225	"	0.330	1.73	
12.0	17													
13.0	15													
14.0	19													
15.0	22													
16.0	26													
17.0	27													
18.0	23													
19.0	13													
20.0	6													

Table 7-6 LIQUEFACTION CALCULATION PAPER (5)

MAKARA RIVER No. 815

k_s = 0.14
h_w = 0.55 m

	Z (m)	N 値	D_{50}	γ_{t1}	γ_{t2}	C_w'	γ_d	σ_v	σ_v'	L	R_1	R_2	R	F_L
c	2.0	5		1.7	1.8	0.9	0.970	0.355	0.216	0.334	0.205	0.123	0.328	1.47
c	3.0	6	0.075				0.955	0.535	0.306	0.334	0.210	"	0.333	1.00
	4.0	5					0.925	0.896	0.486	0.319	0.125	"	0.308	1.29
	6.0	7					0.910	1.076	0.571	0.338	0.210	"	0.333	1.00
	8.0	7					0.880	1.436	0.751	0.334	0.175	"	0.298	1.07
	9.0	5					0.865	1.611	0.846	0.331	0.160	"	0.283	1.22
c	10.0	5					0.850	1.771	0.926	0.330	0.155	"	0.272	1.22
c	11.0	5												
c	12.0	6												
c	14.0	5												
c	15.0	5												
c	16.0	7												
c	17.0	5												
c	18.0	5												
c	20.0	5												

Table 7-6 LIQUEFACTION CALCULATION PAPER (6)

MAKARA RIVER No. 816

k_s = 0.14
h_w = 0.50 m

	Z (m)	N 値	D_{50}	γ_{t1}	γ_{t2}	C_w'	γ_d	σ_v	σ_v'	L	R_1	R_2	R	F_L
	2.0	6	[illegible]	1.7	1.8	0.9	0.970	0.355	0.220	0.249	0.225	0.059	0.284	1.29
	3.0	10					0.955	0.535	0.310	0.231	0.275	"	0.334	1.45
	4.0	8					0.940	0.715	0.400	0.235	0.235	"	0.294	1.25
	5.0	8					0.925	0.895	0.490	0.237	0.230	"	0.289	1.22
c	7.0	7					0.895	1.255	0.670	0.235	0.200	"	0.259	(1.10)
c	8.0	8					0.880	1.435	0.710	0.233	0.210	"	0.269	(1.15)
c	10.0	5					0.850	1.795	0.740	0.237	0.155	"	0.214	(0.92)
c	11.0	7												
c	12.0	8	0.008											
c	14.0	9												
c	15.0	10	0.015											
c	17.0	9												
c	18.0	10												
c	19.0	10												
c	20.0	7												

Table 7-6 LIQUEFACTION CALCULATION PAPER (7)

SAPDAHADO CREEK No. 212

$k_s = 0.14$
$h_w = 0.59$ m

	Z (m)	N 1.5	D_{50}	γ_{t1}	γ_{t2}	C_n'	r_d	σ_v	σ_v'	L	R_1	R_2	R	F_L
	1.0	3	(0.12)	1.7	1.8	0.9	0.985	0.174	0.137	0.175	0.17	0.105	0.275	1.57
	2.0	9					0.970	0.344	0.227	[illegible]	0.275	"	0.320	1.40
	3.0	11	–				0.955	0.534	0.317	[illegible]	0.250	"	0.395	1.76
	4.0	7	–(0.10)				0.940	0.714	0.407	0.231	[illegible]	"	0.325	1.41
	5.0	4					0.925	0.894	0.497	0.233	0.160	"	0.265	1.14
	6.0	3					0.910	1.074	0.587	0.233	0.138	"	0.243	1.04
c	7.0	3	0.07				0.895	1.254	0.677	0.232	0.130	"	0.235	1.01
c	8.0	3	0.02											
c	11.0	3												–
c	12.0	3												"
c	13.0	3												"
c	14.0	6	0.04											"
c	16.0	4												"
c	17.0	5												"
c	18.0	6												"
c	19.0	7	0.01											"

Table 7-6 LIQUEFACTION CALCULATION PAPER (8)

SAPDAHADO CREEK No. 210

$k_s = 0.14$
$h_w = 2.50$ m

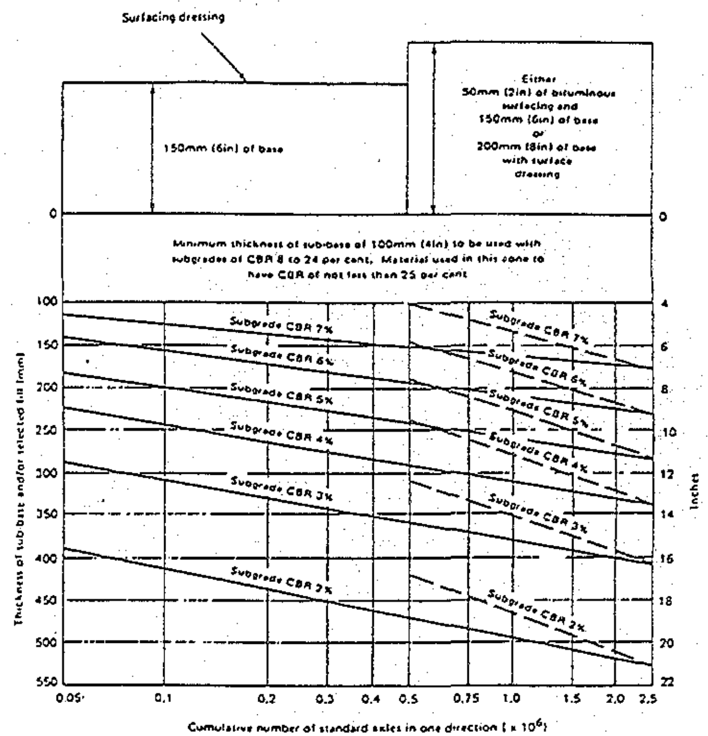
	Z (m)	N 1.5	D_{50}	γ_{t1}	γ_{t2}	C_n'	r_d	σ_v	σ_v'	L	R_1	R_2	R	F_L
	1.0	7	(0.12)	1.8	1.9	1.0	0.985	0.165	0.2[illegible]	0.079	0.235	0.105	0.340	4.29
	2.0	4	0.07, 0.04				0.970	0.355	0.400	0.121	0.170	"	0.275	2.29
	4.0	11	0.12	(0.0[illegible])			0.940	0.735	0.600	0.161	0.285	"	0.360	2.24
	6.0	7					0.910	1.115	0.800	0.178	0.19	"	0.295	1.66
	8.0	5					0.880	1.495	1.000	0.184	0.160	"	0.257	1.40
	9.0	4					0.865	1.685	1.100	0.186	0.130	"	0.235	1.27
c	10.0	7					0.850	1.875	1.200	0.186	0.17	"	0.275	1.48
c	11.0	5												–
c	12.0	3												"
c	13.0	5												"
c	14.0	3												"
c	16.0	3												"
c	11.0	4												"
c	17.0	3	0.04											"
c	18.0	5	–											"

Table 8-1 . CBR OF EMBANKMENT MATERIAL FOR LOT I

Location	Soil Type	Sieve Analysis ; Passing Percent 2.36 mm	0.425	0.151	0.075	Atterberg Limits LL	PI	Compaction MC %	DD t/m³	CBR Soaked %
343	clayey Silt		99	63	48	28	12	16.7	1.74	5.3
350	clayey Silt		87	61	53	35	16			
355	clay		98	71	60	42	23			
358	clay		99	82	74	52	31	18.6	1.30	4.9
366	clayey silt		91	67	57	32	13			
367	clay	99	92	70	59	39	19			
369	clay		89	67	61	37	15	20.1	1.60	7.0
371	clayey silt	99	99	60	38	31	15			
373	clayey silt		95	74	63	29	11	19.5	1.69	3.4
376	clay		93	70	60	43	26			
378	clayey silt		89	69	63	34	12			
380	clay		92	68	61	44	26			
383	clay		99	81	71	37	18			
386	clay		95	78	65	40	22	19.8	1.60	9.0
389	clay		98	91	84	56	19			
391	clay		98	75	63	37	19			
409	clay		97	97	88	76	49	22.3	1.28	1.8

Table 8-3 CBR OF EMBANKMENT MATERIALS FOR LOT II

Section of Route for Pavement Design		Miaru River to Kapuri River	Kapuri River to Tauri River	Tauri River to Malalaua
Fill Material Source and Soil Type		Palipala hill	Ilavala hill	Malalaua exist. Borrow pit.
		Clayey Silt	Silty Sand	Clayey Silt
	9.5 mm			
Sieve	4.75 mm		100	100
Analysis	2.36 mm	100	74	99
Percent by	425 um	80	25	98
wt.passing	150 um	31	13	98
	75 um	25	10	45
Atterberg	LL	29	39	44
Limits	PL	17	22	29
	PI	13	17	32
Std Compaction MDD (t/m³)		1.743	1.770	1.20
	OMC %	16.7	15.8	36.0
Std Soaked CBR %		3.3 6.8 9.4	8.2 5.3	3.7
	x	6.5	6.8	
	s	3.0	2.1	
	x − s	3.5	4.7	



It is desired to provide at the time of construction a pavement capable of carrying more than 0.5 million standard axles, the designer may choose either a 150mm (6in) base with a 50mm (2in) bituminous surfacing or a 200mm (8in) base with a double surface dressing. For both of these alternatives, the recommended sub-base thickness is indicated by the broken line.

Alternatively, a base 150mm (6in) thick with a double surface dressing may be laid initially and the thickness increased when 0.5 million standard axles have been carried. The extra thickness may consist of 50mm (2in) of bituminous surfacing or at least 75mm (3in) of crushed stone with a double surface dressing. The largest aggregate size in the crushed stone must not exceed 19mm (¾in) and the old surface must be prepared by scarifying to a depth of 50mm (2in). For this stage construction procedure, the recommended thickness of sub-base is indicated by the solid line.

Fig. 8-1 PAVEMENT DESIGN CHART (ROAD NOTE 31)

Table 8-2 SUMMARIZED TEST RESULTS OF SUBBASE FOR LOT I

(Subbase Material Test Results
Material : Pitrun Silty Sandy gravel from Inaipi hills)

	Location & Sample No.		Sieve Analysis : Percent by wt. passing								Atterberg Limits		Soaked CBR
			75	37.5	19	9.5	4.75	2.36	0.425	0.075	LL	PI	%
Cardono & Davies Report	Inaipi	S 1	100	87	66	49	39	32	13	6	49*	31*	8*
		S 2	100	86	65	49	37	32	10	2	39*	21*	18*
		S 3	100	71	55	43	35	30	7	2	35*	4	-
		S 4		100	91*	85*	74	62*	17	2	Non	Plastic	-
		S 5	100	76	61	48	40	34	12	3	34*	12*	50
		S 6	100	79	64	48	38	28	8	4	37*	10	-
		S 7	100	85	68	55*	44	37*	15	6	39*	14*	18*
		S 8	100	98	94*	82	68*	53*	22	13*	35*	13*	20*
													-
JICA Study	Inaipi	No.1	100	87	80	57	43	37*	21	14*	37*	16*	35
		No.2	100	88	80	68*	55	46*	24*	15*	41*	22*	30
		No.3	100	82	69	55	42	36*	18	11	38*	20*	30
		No.4	100	91	80	60	44	36*	15	9	39*	14*	15*
		No.5		100	82	59	41	34	17	9	40*	14*	15*
		No.6	100	97	79	55	40	34	18	11	41*	15*	15*
Mean Value		x	100	87	73	56	43	36	15	8	39*	16*	23*
Standard Deviation		s		8	10	10	9	6	5	5	4	6	12
		x + s	100	95	83	66	52	42	20	13	43	22	35
		x - s		79	63	46	34	30	10	3	35	10	11
DOW Specificaiton Type B (75 mm)			100	100 ~60	80 ~40	60 ~30	45 ~20	35 ~15	22 ~8	12 ~3	≤30	≤10	≥25
Preferred Specification	Upper Subbase (Cement treated)		100	100	85	70	55	45	23	15		≤10	≥25
	Lower Subbase (Non treated)			~70	~55	~40	~30	~20	~5	~3			≥ 8

Sample No.1, No.2, No.3 Near Bercina existing borrow pit

Sample No.4, No.5, No.6 Near Babanongo existing borrow pit

S 4 is excluded for computation of x and s

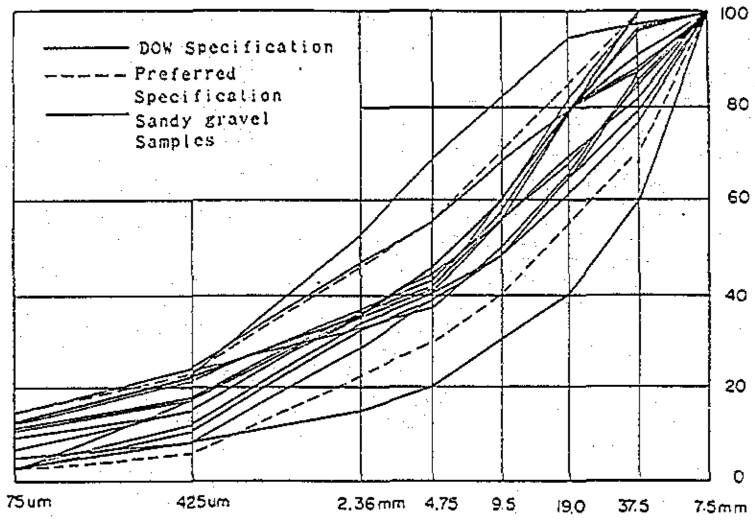
* out of DOW Specification limits

Table 8-4 SUMMARIZED TEST RESULTS OF SUBBASE FOR LOT II

(Subbase Material Test Results
Material : Pit-run Silty Sandy gravel from Malalaua hills)

	Location & Sample No.		Sieve Analysis : Percent by wt. passing								Atterberg Limits		Soaked CBR
			75	37.5	19	9.5	4.75	2.36	0.425	0.075	LL	PI	%
Cardono & Davies Report	Inaipi	S 14	100	91	74	61*	50*	45*	22	6	24	4	35
		S 15		100	76	58*	46*	36*	10	3	Non	Plastic	
		S 16	100	96	79	67*	54*	40*	14	9	34*	4	
		S 17	100	93	80	62*	47*	36*	19	11	35*	11*	40
		S 18	100	94	68	55	45*	37*	19	9	34*	10	25
JICA study	Inaipi	No.7	100	89	82*	66*	53*	45*	18	8	34*	11	23*
		No.8	100	94	89*	75*	60*	51*	26*	13*	28	7	18*,15*
Mean Value		x	100	93	79	64*	52*	42*	20	9	32	7	28
Standard Deviation		s		2	7	8	5	6	4	2	4	4	10
		x + s	100	95	86	72	57	48	24	11	36	11	37
		x - s		~91	~72	~56	~48	~36	~16	~7	28	3	18
DOW Specificaiton Subbase			100	100 ~60	80 ~40	60 ~30	45 ~20	35 ~15	22 ~8	12 ~3		≤10	≥25
Preferred Specification	Upper Subbase (Cement treated)		100	100	90	80	65	50	25	15		≤10	≥25
	Lower Subbase (Non treated)			~80	~65	~50	~40	~30	~10	~3			≥ 8

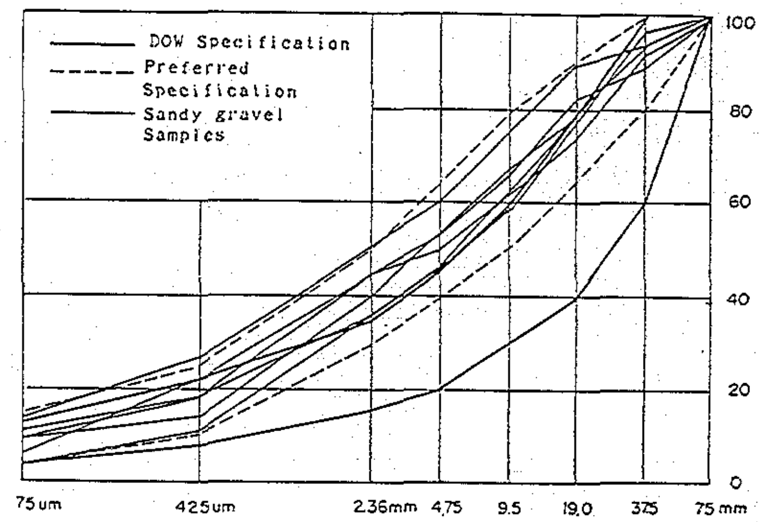
S 15 is excluded for computation of x and s



Preferred Grading Specification Range for the pit-run Sandy gravel subbase (Bereina ~ Miaru River Section)

Sieve Size	Percent by wt. passing: DOW Specification	Percent by wt. passing: Preferred Specification
75 mm	100	100
37.5 mm	60 - 100	70 - 100
19.0 mm	40 - 80	55 - 85
9.5 mm	30 - 60	40 - 70
4.75 mm	20 - 45	30 - 55
2.36 mm	15 - 35	20 - 45
425 um	8 - 22	5 - 23
75 um	3 - 12	3 - 15

Fig. 8-3 PREFERRED GRADING OF SUBBASE FOR LOT I



Preferred Grading Specification Range for the pit-run Sandy gravel subbase (Miaru River ~ Malalaua Section)

Sieve Size	Percent by wt. passing: DOW Specification	Percent by wt. passing: Preferred Specification
75 mm	100	100
37.5 mm	60 - 100	80 - 100
19.0 mm	40 - 80	65 - 90
9.5 mm	30 - 60	50 - 80
4.75 mm	20 - 45	40 - 65
2.36 mm	15 - 35	30 - 50
425 um	8 - 22	10 - 25
75 um	3 - 12	3 - 15

Fig. 8-5 PREFERRED GRADING OF SUBBASE FOR LOT II

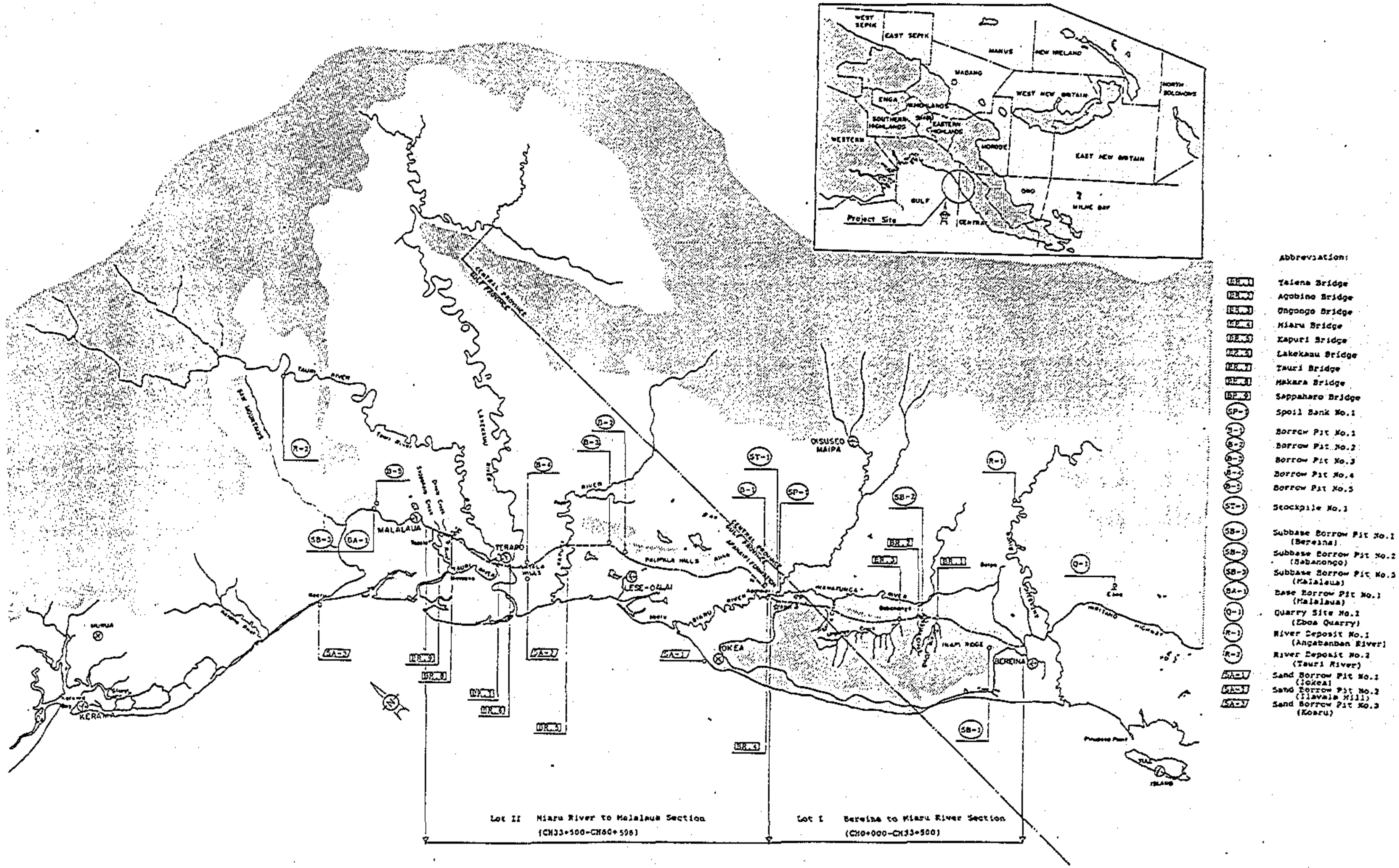


Fig. 11-1 PROJECT LOCATION & MATERIAL SITE

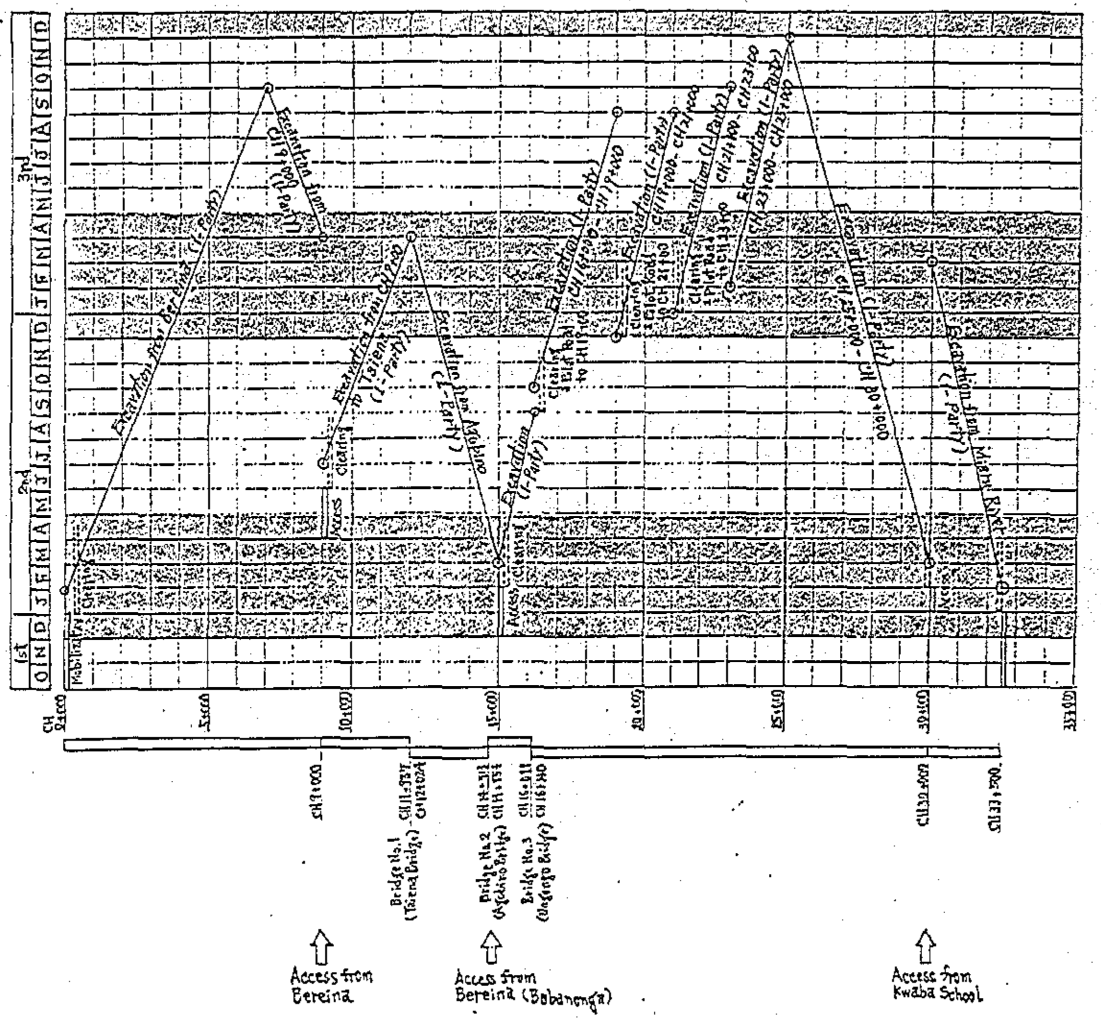
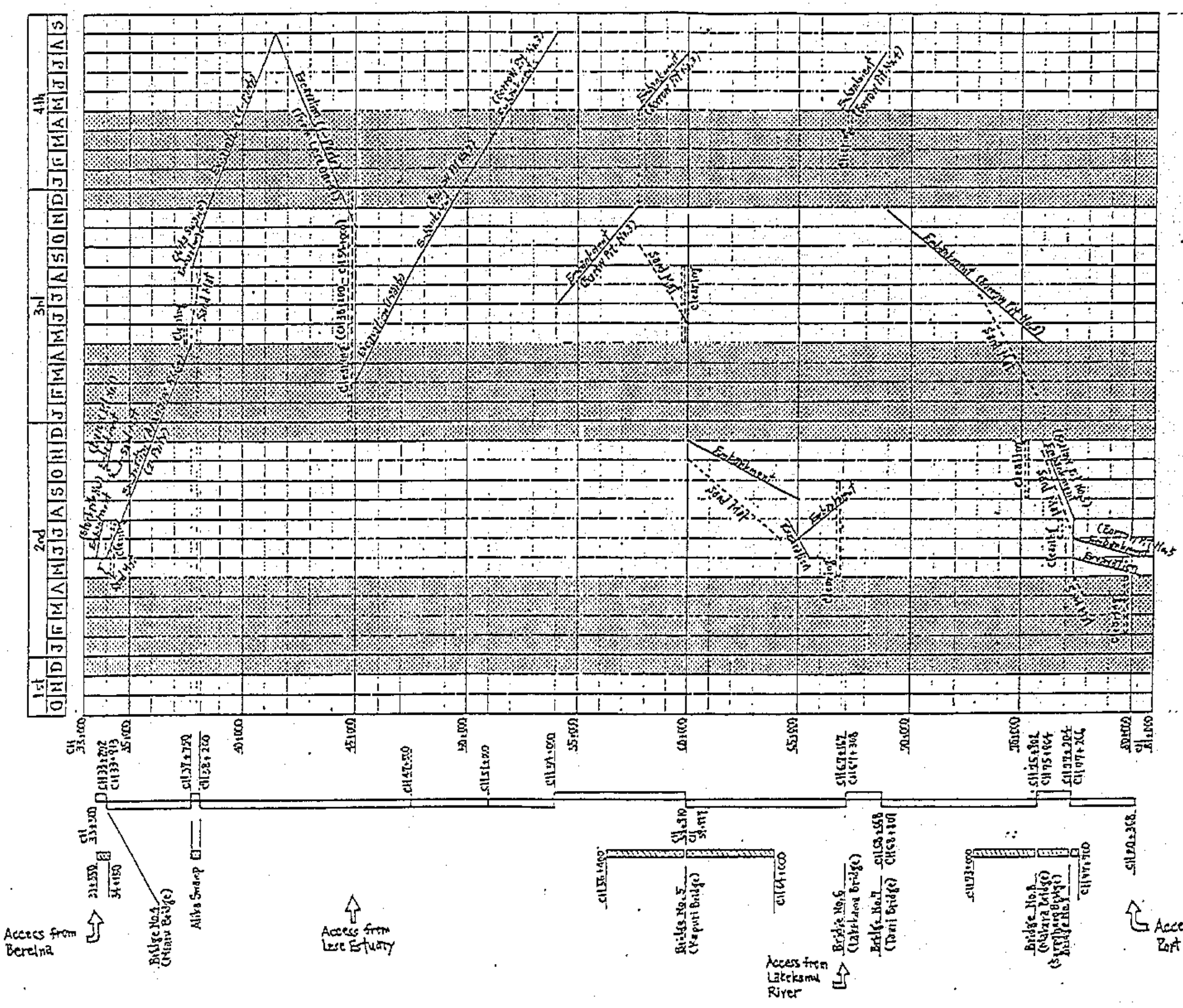


Fig 11-2 EARTHWORK ACCESS DIAGRAM FOR LOT I

Earthwork procedure and schedule are planned based on the following conditions:

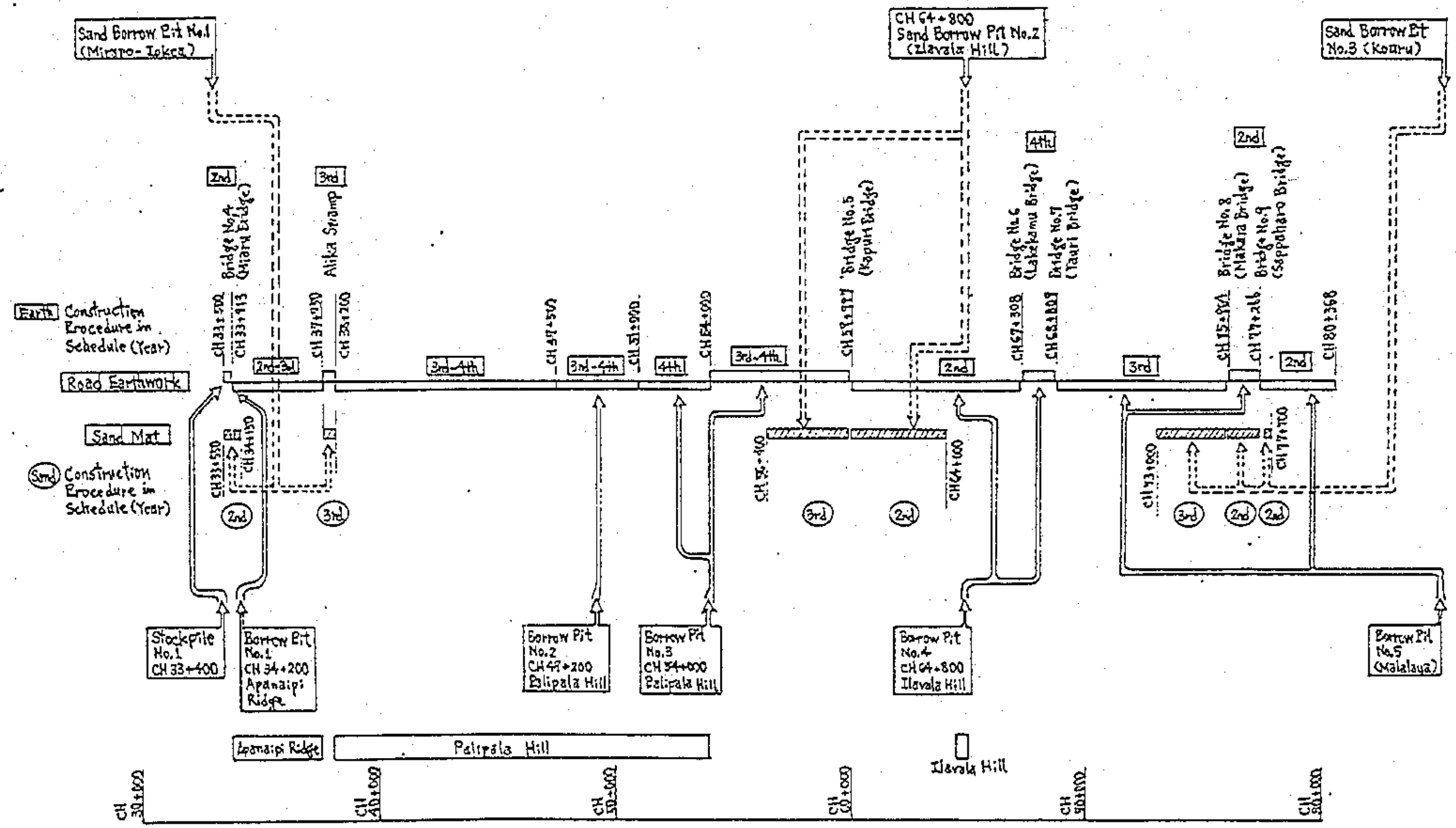
- Workable day 19 days/month (in whole year)
- Daily progress rate 340 m/day
- To repeat the cutting and filling work within 2,000 m road section from mass-curve plan.
- Working width of road cutting section is narrow.
- CH16+099 to CH23+000
  In a view point of topographical conditions, the parallel work will be done after providing pilot road (temporary access).
- CH 23+000 to CH 30+000
  Working site is restricted by steep land.
- Access to the road alignment
  - Bereina
  - CH 9+000
  - Babanenga
  - CH 30+000
  - End point (Miaru River)



Earthwork procedure and schedule are planned based on the following conditions :

- Workable day
  - Land area 19 days/month
  - Swamp area 22 days/month (Dry season)
- Cutting & Filling section
  - Apanaipi Ridge
  - Ealipala Hill
- Embankment Section
  - Miaru Bridge
  - Alika swamp
  - CH 47+500 in Ealipala Hill to CH 54+000
  - CH 54+000 to CH 80+368 Swamp area and soft ground area
- Borrow Pits No.1 to No.5
- Sand Borrow Pit No.1 to No.3
- Access to the road alignment
  - Miar River (Kwaba School)
  - Lese Oarai (Lese Estuary)
  - Lakekamu Bridge Site (Lakekamu River)
  - Malalaua (From Port Kerema)

Fig.11-3 EARTHWORK ACCESS DIAGRAM FOR LOT II



Note : 2nd, 3rd, 4th means fiscal year after commencement

Fig.11-4 EARTH MATERIAL DISTRIBUTION PLAN FOR LOT II

Table 11-1 Major Construction Plant and Equipment, Lot I

Description	Spec.		Required Number
1. Bulldozer w/ripper	21	ton	10
2. Bulldozer	11	ton	7
3. Tractor shovel	2.3	m^3	10
4. Wheel loader	2.0	m^3	1
5. Wheel loader	1.6	m^3	1
6. Backhoe	0.3	m^3	2
7. Crawler drill	10	m^3/min	2
8. Air compressor	13.5	m^3/min	2
9. Dump truck	11	ton	55
10. Dump truck	8	ton	4
11. Dump truck	4	ton	1
12. Crushing plant	60	ton/hr	1
13. Crushing plant	20	ton/hr	1
14. Motor grader	3.7	m	5
15. Vibrating roller	8	ton	7
16. Vibrating roller	4	ton	2
17. Road stabilizer	1.6	m	4
18. Aggregate spreader	3.5	m	1
19. Chip spreader	2.0	m	1
20. Tire roller	15	ton	10
21. Macadam roller	10	ton	5
22. Tandem roller	10	ton	2
23. Sprinkler	5	kl	3
24. Road sweeper			3
25. Asphalt kettle	6,000	litre	2
26. Asphalt distributor	4,000	litre	3
27. Engine sprayer	600	litre	2
28. Pre-coating spray			1
29. Diesel pile driver	2.5	ton	1
30. Truck crane	10	ton	3
31. Crawler crane	35	ton	1
32. Portable mixer	0.6	m^3	1
33. Concrete dumper	0.7	m^3	2

Table 11-2 Major Construction Plant and Equipment, Lot II

Description	Spec.		Required Number
1. Bulldozer w/ripper	21	ton	7
2. Bulldozer	21	ton	2
3. Bulldozer	11	ton	4
4. Bulldozer, low pressure type	10	ton	6
5. Clamshell crane w/pontoon	0.6	m^3	1
6. Amphibious backhoe	0.4	m^3	2
7. Tractor shovel	2.3	m^3	9
8. Backhoe	0.6	m^3	3
9. Backhoe	0.2	m^3	1
10. Wheel loader	2.0	m^3	1
11. Wheel loader	1.6	m^3	1
12. Wheel loader	1.0	m^3	1
13. Dump truck	11	ton	80
14. Dump truck	8	ton	3
15. Dump truck	2	ton	1
16. Soil plant	100	ton/hr	1
17. Crushing plant	20	ton/hr	1
18. Cargo ship	10	m^3	8
19. Motor grader	3.7	m	4
20. Vibrating roller	8	ton	7
21. Vibrating roller	4	ton	2
22. Road stabilizer	1.6	m	2
23. Chip spreader	2.0	m	2
24. Tire roller	15	ton	11
25. Macadam roller	10	ton	4
26. Tandem roller	10	ton	2
27. Sprinkler	5	kl	3
28. Road sweeper			3
29. Asphalt kettle	6,000	litre	2
30. Asphalt distributor	4,000	litre	2
31. Engine sprayer	600	litre	2
32. Pre-coating spray			1
33. Diesel pile driver	2.5	ton	1
34. Diesel pile driver	3.5	ton	1
35. Vibro hammer	60	kw	1
36. Crawler crane	35	ton	2
37. Crawler crane	40	ton	2
38. Truck crane	10	ton	4
39. Bore boring machine	41	kw	1
40. Suction pump	45	kw	1
41. Sand pump	22	kw	1
42. Portable mixer	0.6	m^3	1
43. Concrete dumper	0.7	m^3	2
44. Concrete bucket	0.7	m^3	2

ATTACHMENT-1

1. ROAD CLASSIFICATION AND CROSS SECTION

2. GEOMETRIC STANDARD

1 ROAD CLASSIFICAITON AND CROSS SECTION

1-1 PROJECTED TRAFFIC VOLUME

ADT in initial year --- 200 vehicles per day

ADT after 20 years --- 360* vechicles per day

$$* \text{ADT } (20) = \text{ADT(initial year)} \times (1 + i)^N$$
$$= 200 \times (1+0.03)^{20}$$
$$= 200 \times 1.806$$
$$= 360 \text{ vehicles per day}$$

where: i= Traffic growth rate --- 3 %
N= Design life ---------- 20 years

1-2 TRAFFIC CATEGORY

Judging from the traffic volume,the traffic category is classified as"Medium"from Table2-2 DOW Design Manual,as shown below.

TABLE 2-2
TRAFFIC CATEGORY AND CROSS SECTION DETAILS

Traffic Category	Volume Range (v.p.d)**	Terrain Type ***	Design Speed (kph)	Width of Pavement (m)	Width of Formation (m)
Heavy	400	F/R	80	6.5	8.5
		H	50	6.5	8.0
		M	30	6.0	7.5
Medium	100-400	F/R	70	6.5	7.5
		H	50	6.0	7.0
		M	25	5.5	6.5
Light	< 100	F/R	60	N/A	6.5
		H	40	N/A	6.0
		M	25	N/A	5.5

** The volume range is the anticipated traffic at the end of the design life, assumed to be the same as the pavement design life, of the road.

*** The terrain types are defined as:
F/R Flat and Rolling - less then 10° cross slope
H Hilly - 10° to 30° cross slope
M Mountaiouns - greater than 30° cross slope

1-3 DESIGN SPEED

The Disign Speed adopted is 70km/h considering Flat and Rolling terrain type, refering to the same Table.

1-4 CROSS SECTION

Formation width is amended from 7.5 m to 8.5 m as described in the minutes of meeting, 12 July 1988. The components of the cross section are as follows;

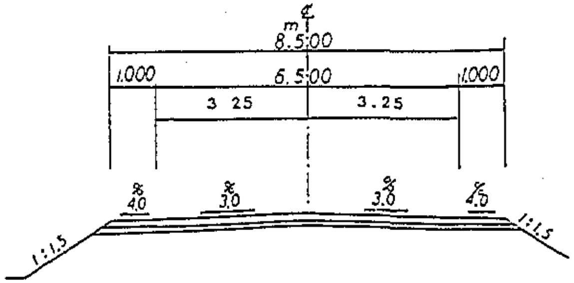
Number of Lanes--- 2
Lane Width ------- 3.25 m
Shoulder Width --- 1.00 m
Crossfall (Refer to Table 3.5.2 in DOW Design Manual)
Pavement --- 3 %
shoulder --- 4 %

TABLE 3.5.2

MINIMUM CROSSFALL

Type of Pavement	Crossfall
Earth or Loan	5 %
Gravel (Shoulder)	4 %
Bitumen (Pavement)	3 %

The typical cross section is shown below.



2 GEOMETRIC STANDARD

2-1 SIGHT DISTANCE

Stopping Distance -------- 90 m
Intermediate Distance ---- 180 m
Overtaking Distance ------ 350 m *
* Intervals of 2 to 2.5 km are desired.

These values are adopted after refering to Table 4.7.1 in DOW Design Manual.

TABLE 4.7.1

SIGHT DISTANCE ON SEALED PAVEMENTS

Design Speed	f	Stopping Distance Ds	Intermediate Distance	Overtaking Distance
30	0.53	30	60	90
40	0.51	40	80	160
50	0.49	55	110	200
60	0.47	70	140	300
70	0.45	90	180	350
80	0.43	115	230	480
100	0.39	170	340	800
Height of eye		1.15	1.15	1.15
Height of object		0.2	1.15	1.15

2-2 HORIZONTAL CURVE

Desirable Radius --------------- 400 m
Minimum Radius ----------------- 155 m
Minumum Length ----------------- 120 m
Minimum Deflection Angle
Superelevation is needed ---- 4.0 Degree
Curve is needed ------------- 1.5 do
Minimum Radius of Horizontal Curve Having Adverse Crossfall --- 1000 m *

$$* \quad R_{min.} = \frac{V^2}{127(e + f)} = \frac{70^2}{127(-0.03 + 0.07)}$$

$= 964 \doteqdot 1000m$

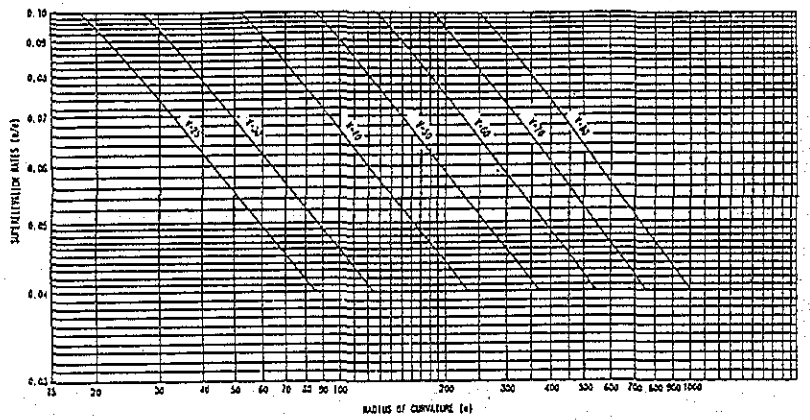
where: $e = -0.03$

$f = 0.07$

Note: f = 0.07 is also adopted in "A GUIDE TO GEOMETRIC DESIGN " OF OVERSEAS UNIT, TRANSPORT AND ROAD RESEARCH LABORATORY-CROWTHORNE, BERKSHIRE, UNITED KINGDOM"

2-3 SUPERELEVATION

Superelevations for each horizontal curve radius in the case of V=70km/h are adopted from Fig.5.2.2. in DOW Design Manual.



DESIGN SUPERELEVATION RATES GRAVELLED PAVEMENT

FIG. 5.2.2

The relations between the horizontal curve radius, the superelevations and the cooefficient of side friction are shown in the table below.

HORIZONTAL CURVE RADIUS(m)	SUPER-EVEVATION e (%)	SIDE FRICTION f
155≦R<188	10	0.149~0.115
180≦R<220	9	0.124~0.085
220≦R<260	8	0.068~0.095
260≦R<320	7	0.078~0.051
320≦R<420	6	0.061~0.032
420≦R<580	5	0.042~0.017
580≦R<880	4	0.027~0.004
R≧880	3	0.014

$$R = \frac{V^2}{127(e + f)}$$

where:

R = Radius of Curve (m)
V = Speed of Vehicle 70 km/h
e = Superelevation
f = Coefficient of side friction

Note: Absolute Minimum Curve Radius

$$R_{min.} = \frac{70^2}{127(0.10 + 0.149)} = 155\ m$$

2-4 SUPERELEVATION TRANSITION

For the maximum relative grade in the development of superelevation is adopted 0.55 from Table 5.7 in DOW Design Mannual.

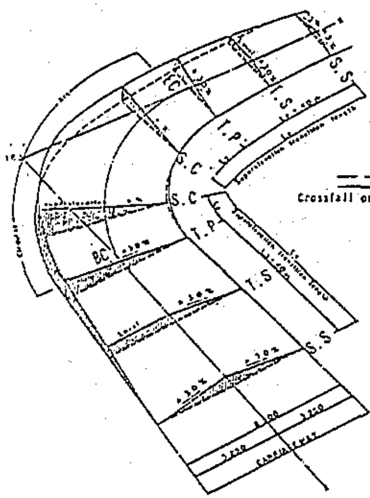
TABLE 5.7

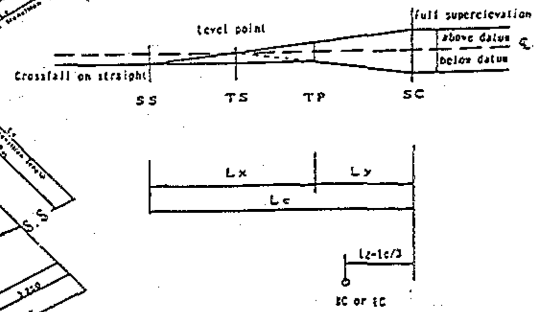
MAXIMUM RELATIVE GRADES IN DEVELOPMENT OF SUPERELEVATION

SPEED km.hr	MAXIMUM RELATIVE GRADE %
25	1.10
30	1.05
40	0.90
50	0.75
60	0.65
70	0.55
80	0.50
100	0.45

(1) STRAIGHT-CURVE-STRAIGHT Alignment.

Considerling safe driving the beginning of the curve (B.C) is located between TP and SC (Lz = Le/3) as shown below.



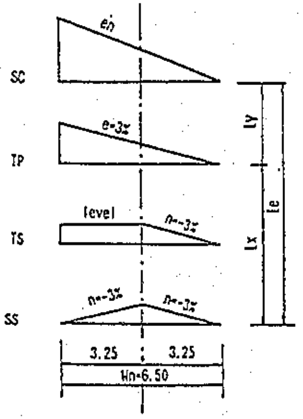


Lx (SS - TP)

$$Lx = \frac{50 \cdot Wn\ (n+e)}{Gr}$$

$$= \frac{50 \times 6.50(0.03+0.03)}{0.05}$$

$$= 35.45 = 40.00\ m$$



Where
Lx = Length of Superelevation Transition(m)
Wn = Width of Two-lane pavement on Tangent(m)
n = Normal Crossfall ------ 3.0 %
Gr = Max. relative grade --- 0.55 %
en = Superelevation Crossfall(m/m)

LY - (TP -SC)

$$LY = \frac{50 \times 6.50(e_n - 0.03)}{0.55}$$

e_n (%)	LY (m)	Gr (%)
4	10	0.3250
5	15	0.433
6	20	0.4875
7	30	0.4333
8	35	0.4643
9	40	0.4875
10	50	0.455

Le = Lx + LY

n~e-en (%)	Le (m)	Lx (m)	LY (m)	Le/3 (m)
-3-3- 4	50	40	10	-
-3-3- 5	55	40	15	-
-3-3- 6	60	40	20	20
-3-3- 7	70	40	30	23
-3-3- 8	75	40	35	25
-3-3- 9	80	40	40	27
-3-3-10	90	40	50	30

The development of superelevation in the case of a 200m radius curve is shown below for clarification.

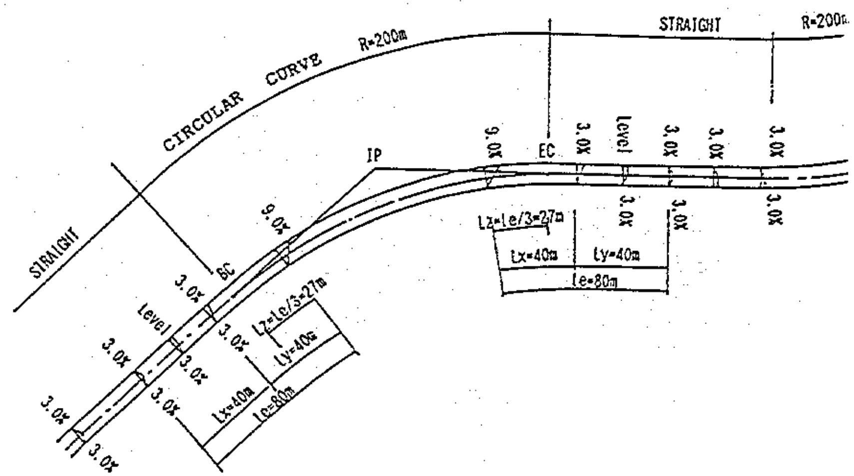
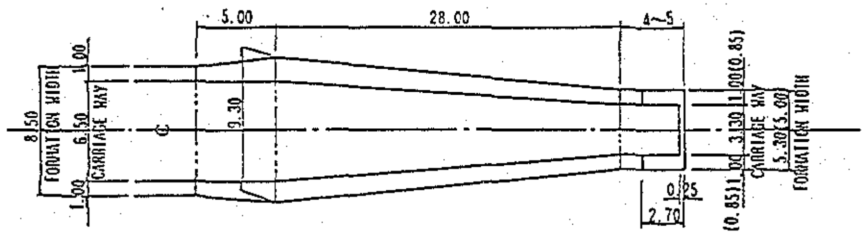


Fig Development of Superelevation in the case of a 200 m radius curve

(2) APPROACH SECTION OF SINGLE LANE BRIDGE

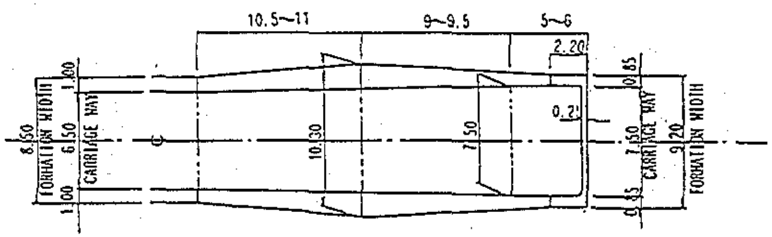
At the approach to single lane bridges, formation width is reduced as below.



Note: Figures in ( ) are for KAPURI BRIDGE.

Single lane bridges where this is to be applied are Miaru, Kapuri, Lakekamu, Tauri, Makara, Sapaharo Bridges.

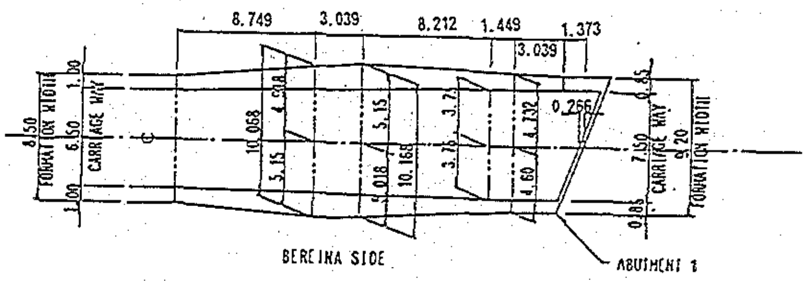
(3) APPROACH SECTION OF TWO WAY BRIDGE

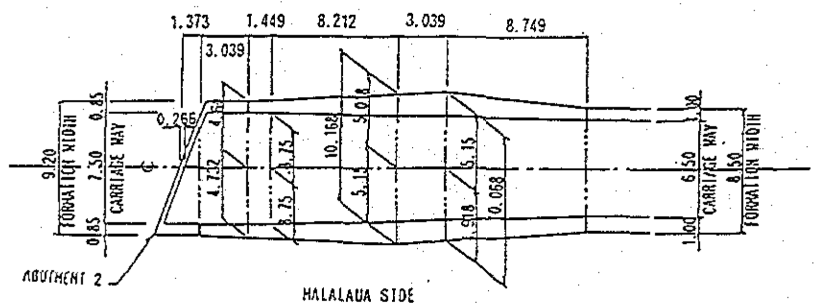


Two Way Bridges where this is to be applied are Taiena, Agobino, Ungongo Bridges.

(4) APPROACH SECTION OF TWO WAY SKEWED BRIDGE

UNGONGO BRIDGE





2-5 GRADIENT

General Maximum ----------- 6 %
Absolute Maximum ---------- 8 % L < 700 m

2-6 VERTICAL CURVES

① Minimum Radius of Crest Curve --- 1755 m

Length of crest curve

$$L = \frac{D^2 \times A}{200(\sqrt{h1} + \sqrt{h2})^2} = \frac{90^2 \times A}{200(\sqrt{1.15} + \sqrt{0.2})^2} = 17.55 \times A$$

Where: L = length of vertical curve (metres)
D = sight distance (metres)
A = algebraic difference in grades (%)
h_1 = height of eye above road (metres) = 1.15 metres
h_2 = height of object above road (metres)
= 1.15 if another vehicle
= 0.2 metres if an object on the ground

$$\text{Therefore } R = \frac{100 \times L}{A} = \frac{100 \times 17.55 \times A}{A} = 100 \times 17.55 = 1755 \text{ m}$$

② Minimum Radius of Sag Curve --- 1740 m

Length of sag curve

$$L = \frac{D^2 \times A}{150 + 3.5 \times D} = \frac{90^2 \times A}{150 + 3.5 \times 90} = 17.40 \times A$$

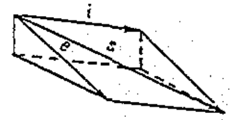
$$\text{Therefore } R = \frac{100 \times L}{A} = \frac{100 \times 17.40 \times A}{A} = 100 \times 17.40 = 1740 \text{ m}$$

2-7 MAXIMUM COMBINED GRADIENT

Smax —— 10.5 %

To avoid the combination of steep gradient and steep superelevation, maximum combined gradient is adopted refering to ROAD STRUCTURE ORDINANCE OF JAPAN.

$$S = \sqrt{e^2 + i^2}$$



Where:
S = Combined Gradient
e = Superelevation
i = Gradient

Relations between Superelevation and Gradient at Mazimum Combined Gradient are shown below.

e %	S %	i %
10	10.5	3.2
9	10.5	5.4
8	10.5	6.8
7	10.5	7.8
6	10.5	8.6

2-8 TAKING OFFSET DISTANCE AT CUTTING SECTION

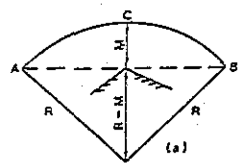
Minimum offset distance should be provided to obtain the stopping sight distance.

Therefor, the minimum offset distance is compared with the width carriageway and lateral clearance at the smallest horizontal curve in the cutting section.

Minimum offset distance (R = 200 m)

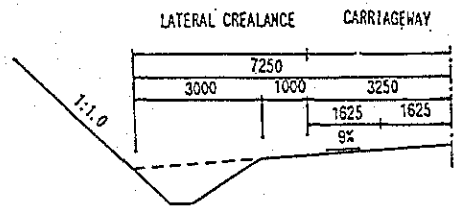
$$M = \frac{D^2}{8(R-1.625)} + 1.625 = \frac{90^2}{8(200-1.625)} + 1.625$$

$$= 5.1 + 1.625 = 6.725 \text{ m} < 7.250 \text{ m}^{1)}$$



Where D = stopping sight distance —— 90 m
R = horizontal curve radius —— 200 m

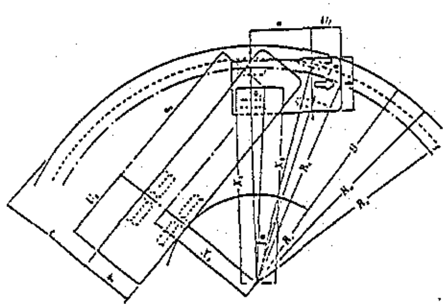
Note 1) As shown below, the width carriageway and lateral clearance is greater than the minimum off set distance.

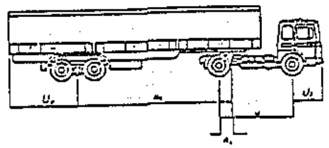


2-9 WIDENING OF CARRIAGEWAY AT SMALL HORIZONTAL CURVE

The carriageway widthis compared with the necessary width for the semi-Trailer at the smallest horizontal curve.

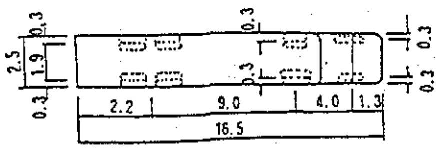
SEMI TRAILER





B = Necessary Width
Rc = Radius of Center line
Rw = Radius of Outer line
Rs = Radius of Front Wheel

a = 4.0 m	b = b_2 = 2.6 m
b = b_2 = 2.5 m	a_2 = 9.0 m
a_2 = 9.0 m	a_o = 0 m
Uf = 1.3 m	U_B = 2.2 m



Derivation of Formula of Necessary Width on Curve

The following equations are found from the figure:

$$B = R_w - R_s \quad \cdots\cdots (1)$$

$$(X_1 + b/2)^2 = R_w^2 - (a + U_f)^2$$

$$X_2^2 = a_o^2 + X_1^2$$

$$X_3^2 = X_2^2 - a_2^2 = X_1^2 + a_o^2 - a_2^2$$

$$B = R_w - X_3 + b_2/2 = R_w + b_2/2 - \sqrt{\{\sqrt{R_w^2 - (a+U_f)^2} - b/2\}^2 - a_2^2 + a_o^2} \quad \cdots (2)$$

$$X_1^2 + (a + U_f)^2 = R_c^2 \quad \cdots\cdots (3)$$

From equations (1) and (3), the following equation is derived:

$$R_w = \sqrt{\{\sqrt{R_c^2 - (a+U_f)^2} + b/2\}^2 + (a+U_f)^2}$$

Combining equation (2) and adove, the following eqution in derived:

$$B = \sqrt{\{\sqrt{R_c^2 - (a+U_f)^2} + b/2\} + (a+U_f)^2} + b_2/2 - \sqrt{R_c^2 - (a+U_f)^2 - a_2^2 + a_o^2}$$

The dimensions of the semi trailer are:

a=4.0, b=b_2=2.5, U_f=1.3, a_2=9.0, a_o=0

Substituting the dimensions of the semi trailer into the equation the following formula is obtained:

$$B = R_w + 1.25 - \sqrt{R_c^2 - 109.09}$$

Where,

$$R_w = \sqrt{(\sqrt{R_c^2 - 28.09} + 1.25)^2 + 28.09}$$

The necessary width calculated by the above formula is smaller than the carriageway width.

Therefore widening is not necessary.

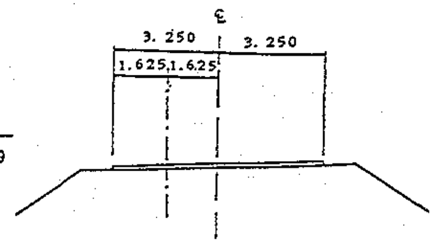
In the case of R=200

R_w = 200 m

$$B = R_w + 1.25 - \sqrt{R_o^2 - 109.09}$$

$$= 200 + 1.25 - \sqrt{198.375^2 - 109.09}$$

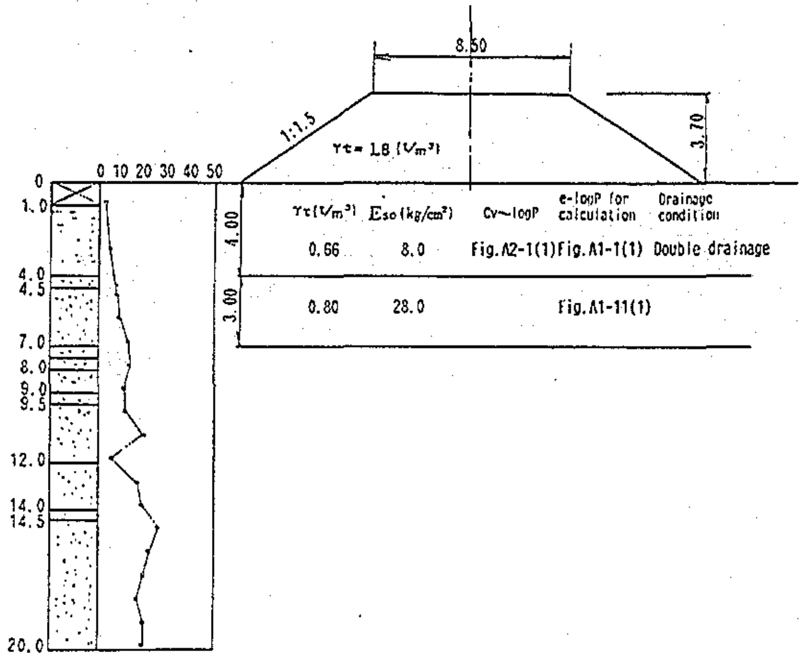
$$= 3.15 < 3.25 \text{ m}$$



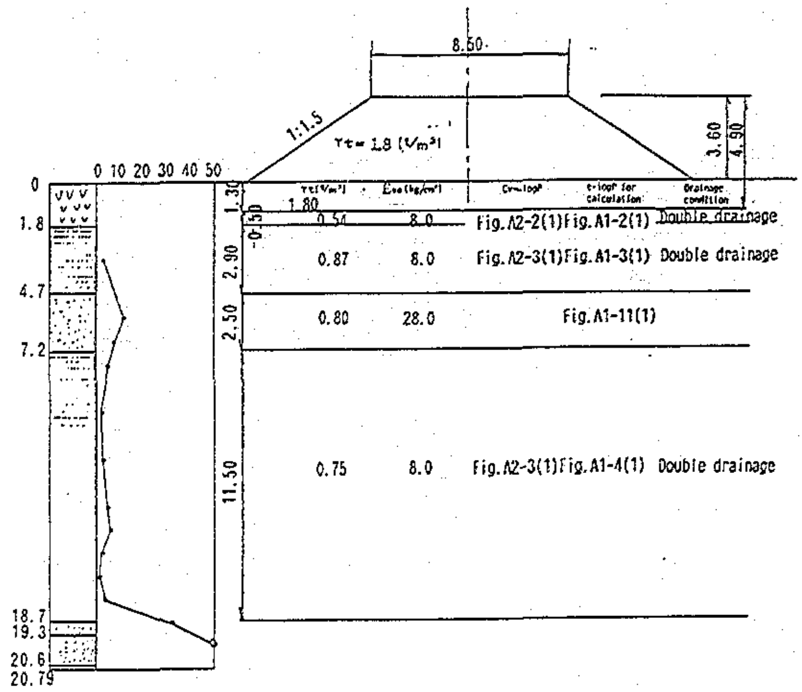
ATTACHMENT-2

Cross Section and Soil Properties
applied to calculation for settlement
and stability of embankment

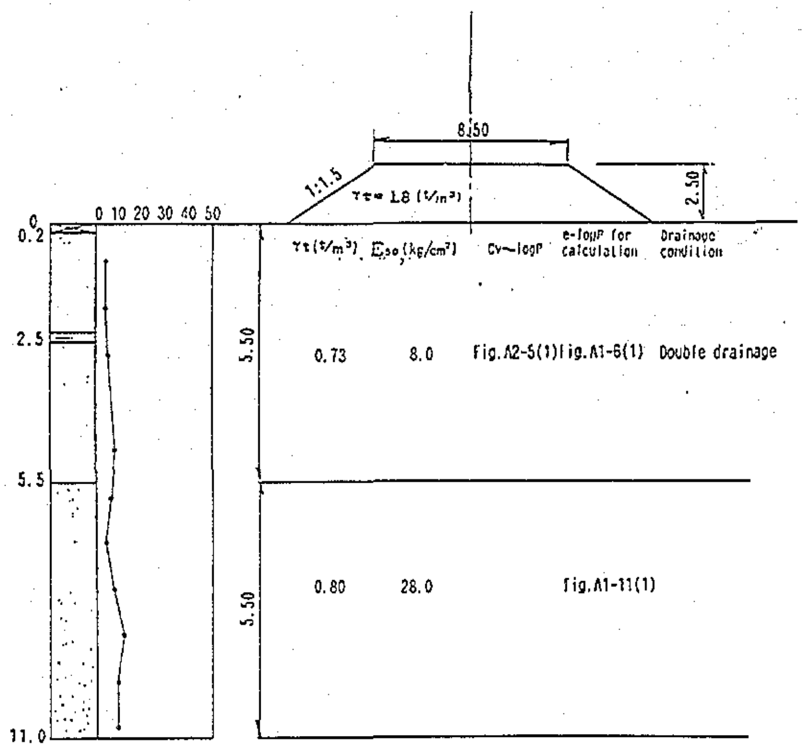
HI(a) Embankment
HIARU with more than 3 m height B-6



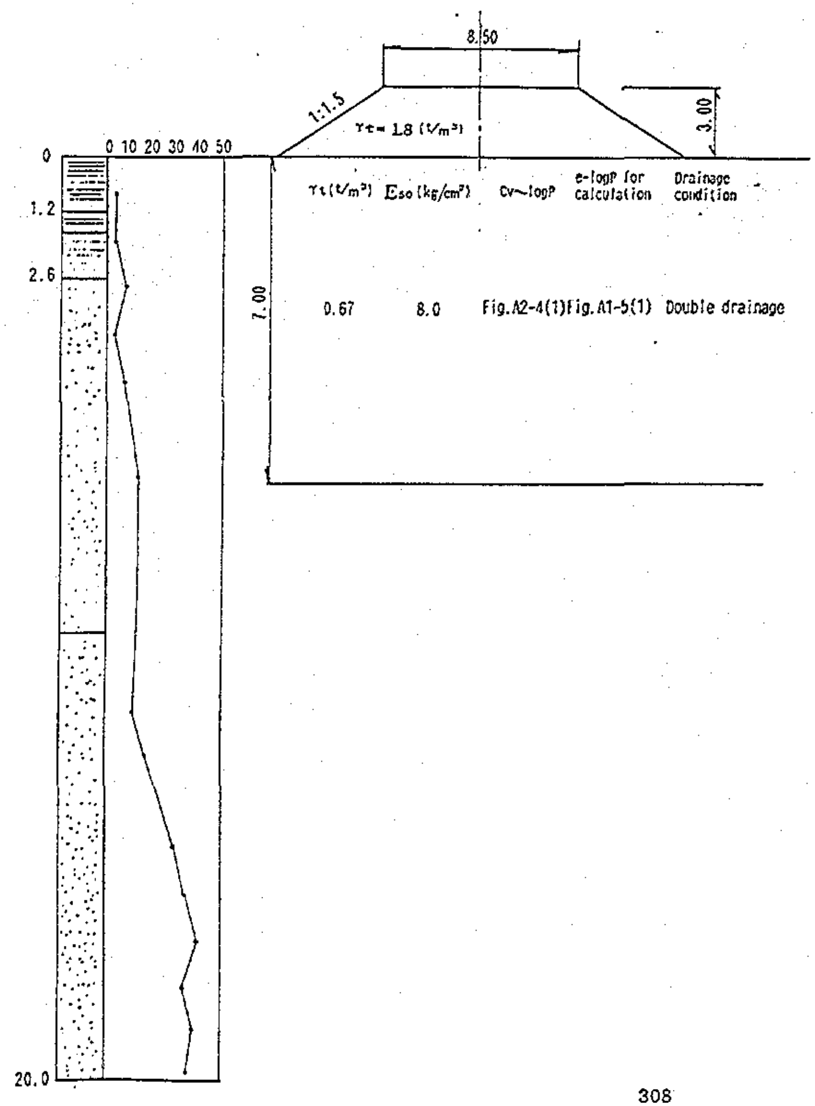
AL(a) Embankment
ALIKA with more than 3 m height B-8



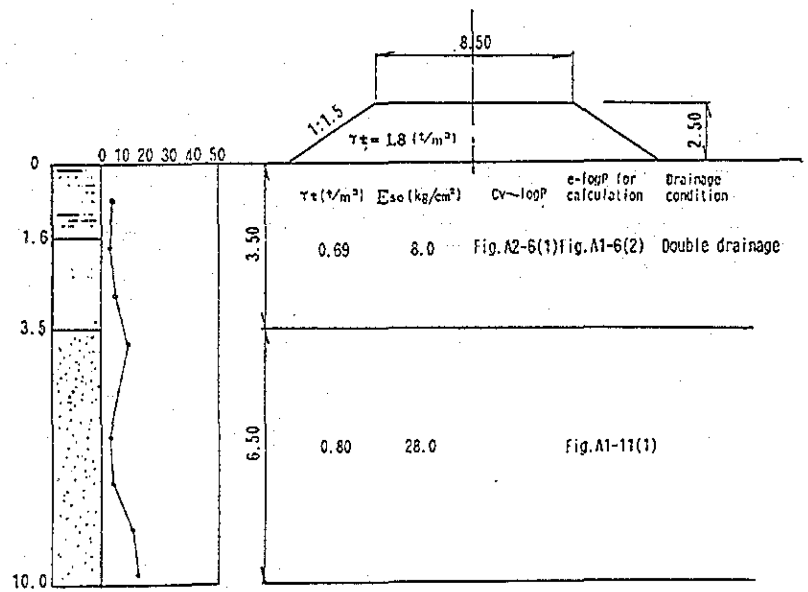
KA(a) Embankment
KAPURI with less than 3 m height S-2



KA(b) Embankment
KAPURI with more than 3 m height B-9

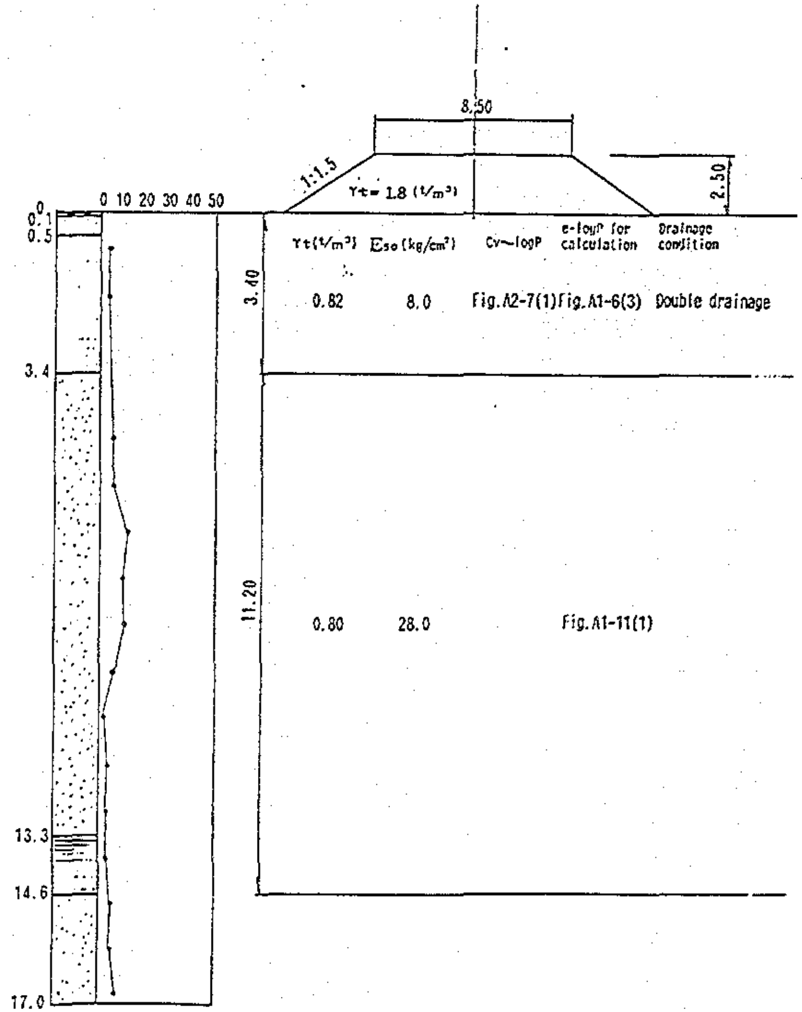


KA(c) Embankment
KAPURI with less than 3 m height S-3



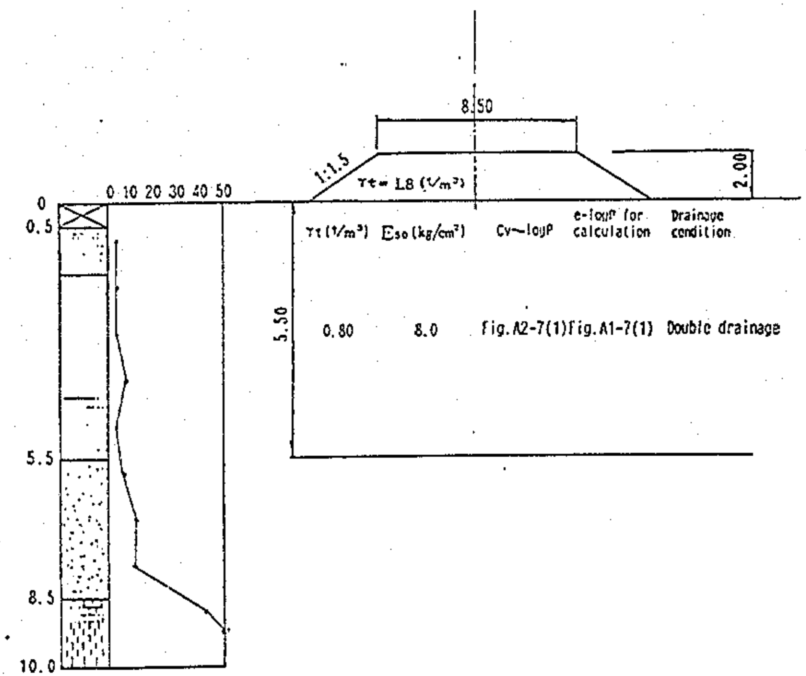
Thickness	γt (t/m³)	E50 (kg/cm²)	Cv~logP	e-logP for calculation	Drainage condition
3.50	0.69	8.0	Fig.A2-6(1)	Fig.A1-6(2)	Double drainage
6.50	0.80	28.0		Fig.A1-11(1)	

KA(d) Embankment
KAPURI with less than 3 m height S-4

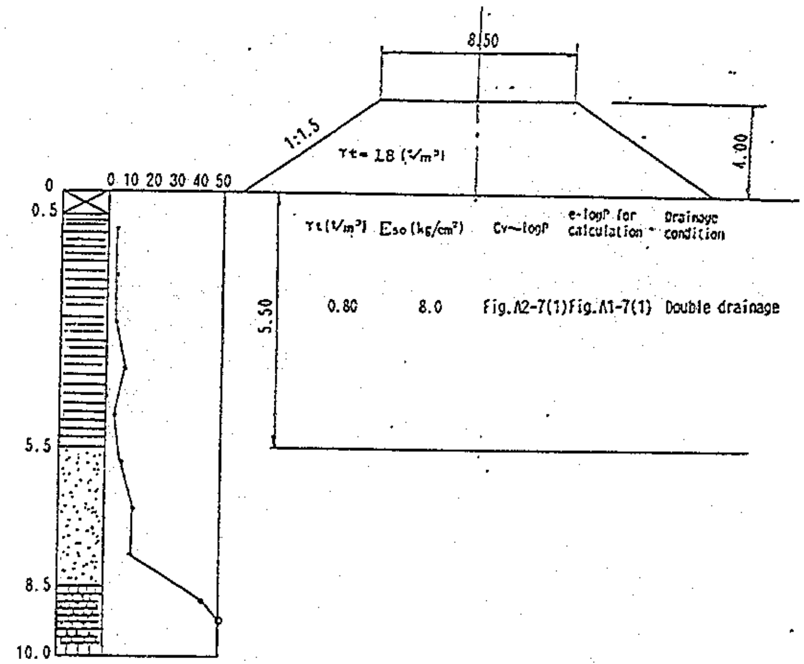


Thickness	γt (t/m³)	E50 (kg/cm²)	Cv~logP	e-logP for calculation	Drainage condition
3.40	0.82	8.0	Fig.A2-7(1)	Fig.A1-6(3)	Double drainage
11.20	0.80	28.0		Fig.A1-11(1)	

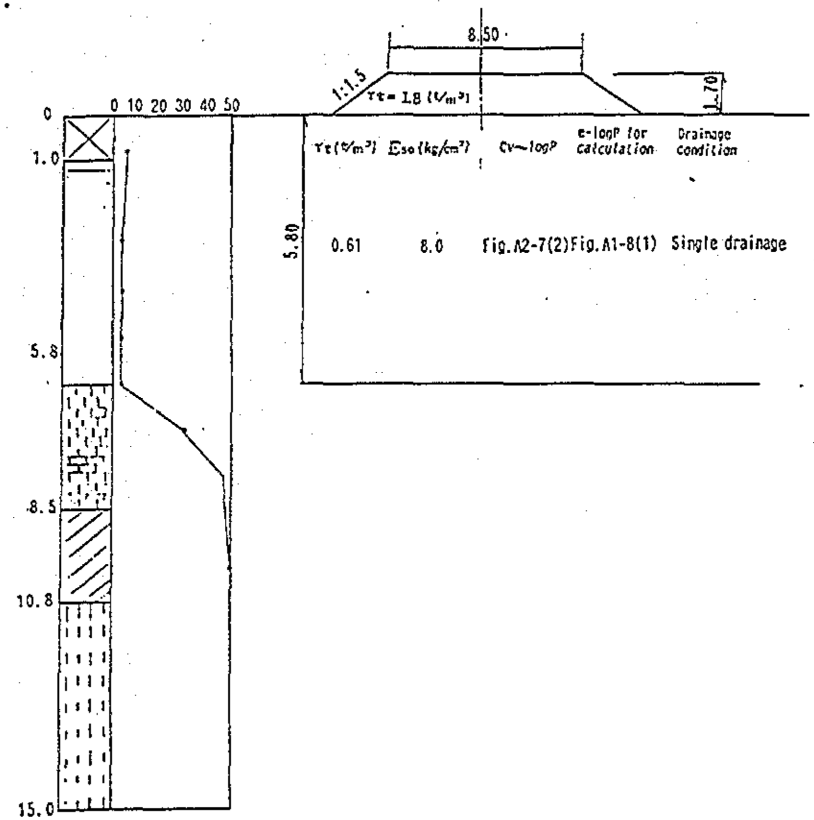
LA(a) LAKEKAHU Embankment with less than 3 m height B-11



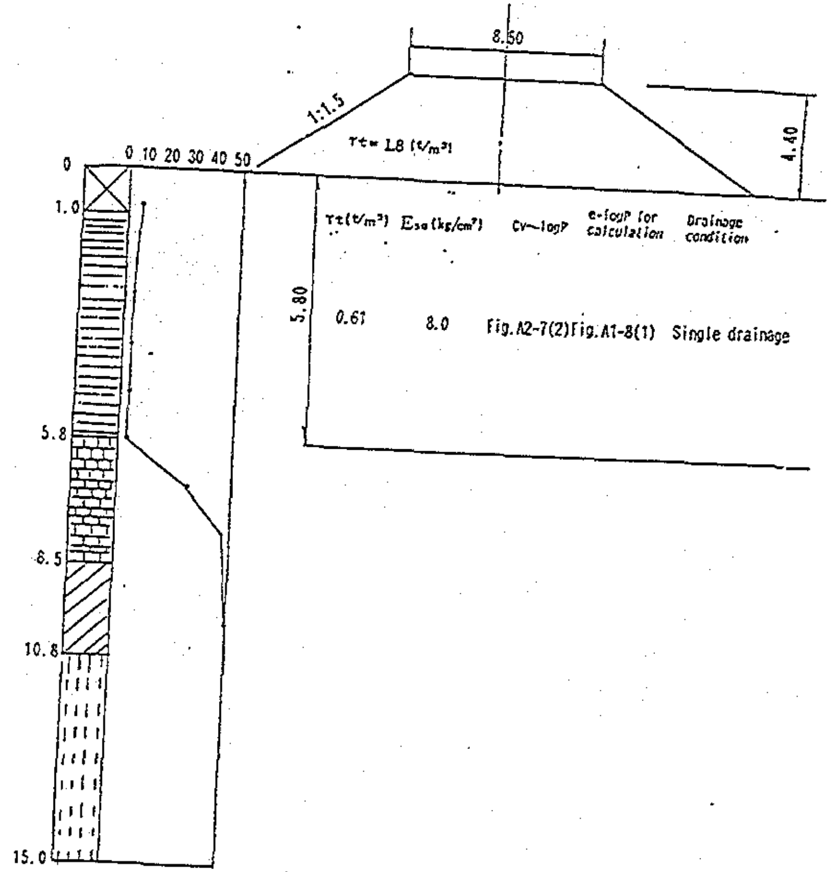
LA(b) LAKEKAHU Embankment with more than 3 m height B-11



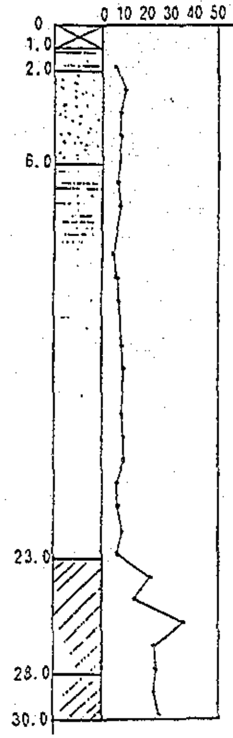
TA(a) & (c) TAURI Embankment with less than 3 m height B-14

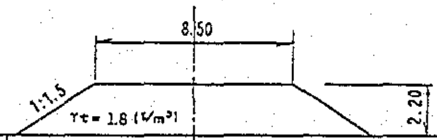


TA(b) TAURI Embankment with more than 3 m height B-14



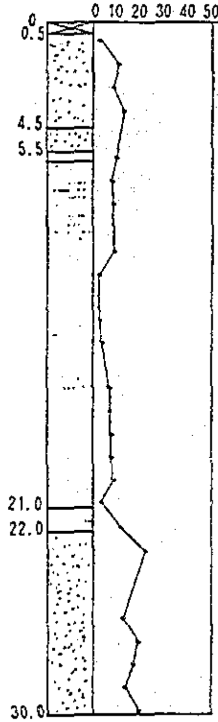
HA(a) HAKARA — Embankment with less than 3 m height — B-16

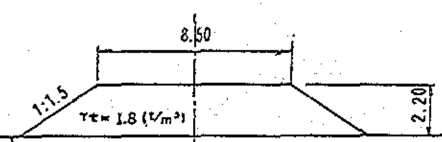




Layer thickness	γ_t (t/m³)	E_{50} (kg/cm²)	Cv~logP	e-logP for calculation	Drainage condition
6.00	0.80	8.0		Fig.A1-1(1)	
17.00	0.73	28.0	Fig.A2-6(1)	Fig.A1-9(1)	Single drainage

SA(a) SAPPAHARO — Embankment with less than 3 m height — B-17





Layer thickness	γ_t (t/m³)	E_{50} (kg/cm²)	Cv~logP	e-logP for calculation	Drainage condition
5.50	0.80	28.0		Fig.A1-11(1)	
15.50	0.94	8.0	Fig.A2-9(1)	Fig.A1-10(1)	Double drainage

CONSOLIDATION TEST
(ESSAI DE CONSOLIDATION)

(e~log P CURVE / (1~log P (COURBE)) — FOR REPORTING (POUR LE RAPPORT)

NAME OF SURVEY & LOCALITY (DÉNOMINATION DE L' ENQUÊTE ET LOCALITÉ)	MIARU RIVER	DATE (DATE)	
SAMPLE NO. & DEPTH (N° DE L' ÉCHANTILLON ET PROFONDEUR)	B6 (m~ m)	TESTED BY (ESSAI PAR)	

* UNDISTURBED OR DISTURBED (INTACT OU REMANIÉ)	* CLASSIFICATION (CLASSIFICATION)	* SPECIFIC GRAVITY Gs (POIDS SPÉCIFIQUE)	* LIQUID LIMIT w_L (%) (LIMIT DE LIQUIDITÉ)	* INITIAL DIMENSION OF SPECIMEN (DIMENSION INITIALE DU SPÉCIMEN): HEIGHT (HAUTEUR) (cm)	DIAMETER (DIAMÈTRE) (cm)
* INITIAL WATER CONTENT w_0 (%) (TENEUR EN EAU INITIALE)	* INITIAL VOLUME RATIO f (INDICE DE VOLUME INITIAL)	* INITIAL VOID RATIO e_0 (INDICE DES VIDES INITIAL)	* DEGREE OF INITIAL SATURATION S_r (%) (DEGRÉ DE SATURATION INITIALE)	COMPRESSION INDEX C_c (INDICE DE COMPRESSION)	YIELD STRESS OF CONSOLIDATION P_c (kg/cm²) (LIMITE D'ÉLASTICITÉ DE CONSOLIDATION)

* THE RECORDING IS NOT NECESSARY IN THE CASE THAT CALCULATION DATA SHEET IS APPENDED.
(LES CHIFFRES NE FIGURENT PAS ICI QUAND LA FEUILLE DES CALCULS DÉTAILLÉS EST ANNEXÉE)

e~log p CURVE
f~log p (COURBE)

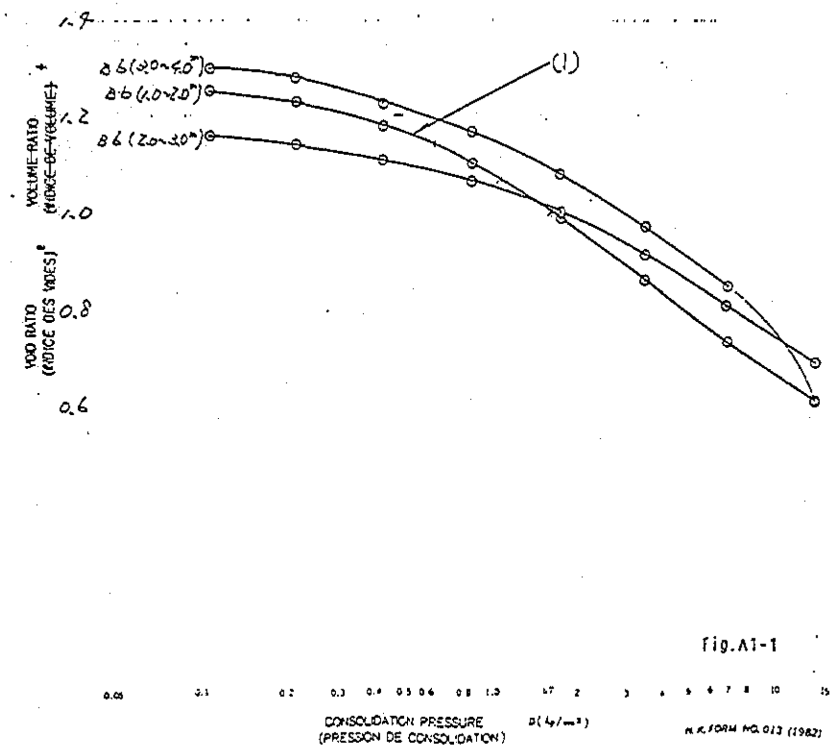


Fig. A1-1

N.K. FORM NO. 013 (1982)

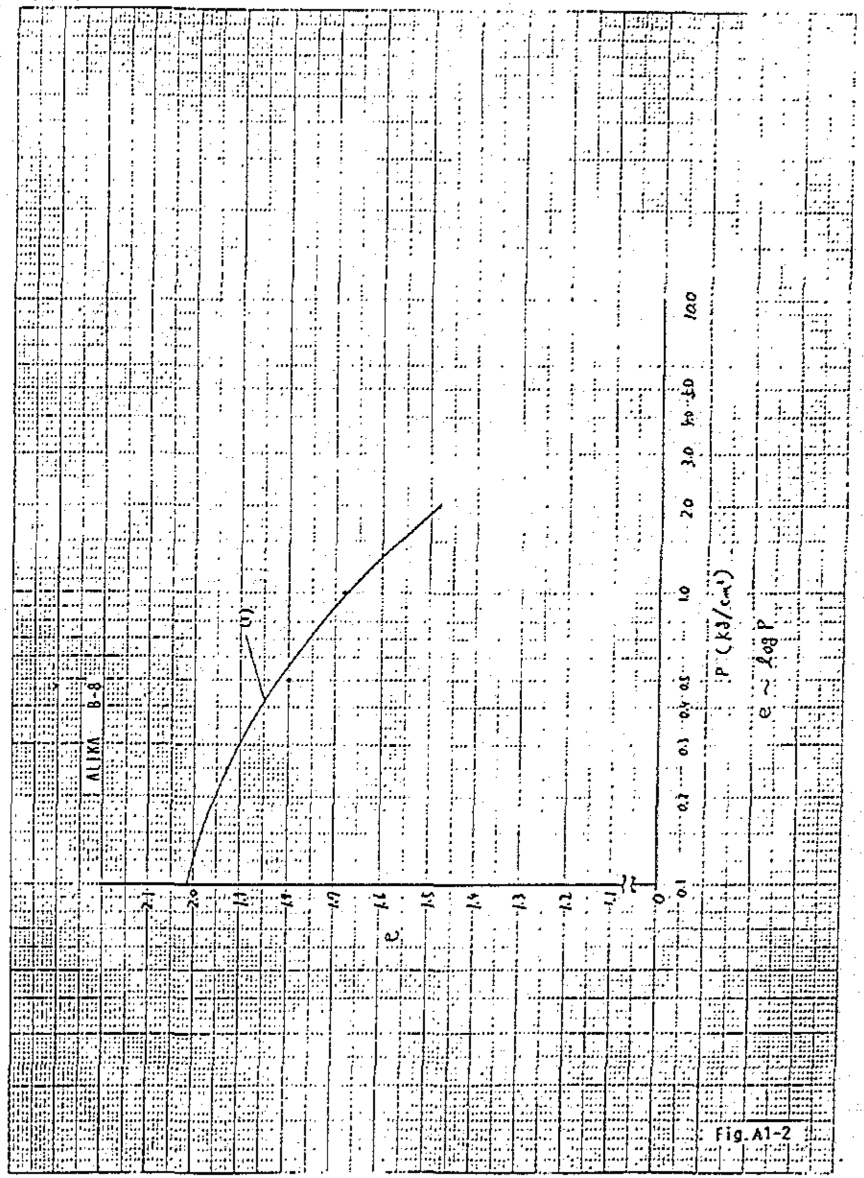


Fig. A1-2

JIS A4 SIZE

CONSOLIDATION TEST (ESSAI DE CONSOLIDATION)

(e−log P CURVE / f−log P (COURBE)) — FOR REPORTING (POUR LE RAPPORT)

NAME OF SURVEY & LOCALITY (DÉNOMINATION DE L' ENQUÊTE ET LOCALITÉ)	Alika swamp	DATE (DATE)	29. 10. 88
SAMPLE NO. & DEPTH (N° DE L'ÉCHANTILLON ET PROFONDEUR)	88/331 B8 (4.0 m − 5.0 m)	TESTED BY (ESSAI PAR)	wK

* UNDISTURBED OR DISTURBED (INTACT OU REMANIÉ)	* CLASSIFICATION (CLASSIFICATION)	* SPECIFIC GRAVITY G_s (POIDS SPÉCIFIQUE)	* LIQUID LIMIT w_L (%) (LIMIT DE LIQUIDITÉ)	* INITIAL DIMENSION OF SPECIMEN (DIMENSION INITIALE DU SPÉCIMEN) HEIGHT (HAUTEUR) (cm)	DIAMETER (DIAMÈTRE) (cm)
		2.599	41.8	2.00	6.00
* INITIAL WATER CONTENT w_o (%) (TENEUR EN EAU INITIALE)	* INITIAL VOLUME RATIO f (INDICE DE VOLUME INITIAL)	* INITIAL VOID RATIO e_o (INDICE DES VIDES INITIAL)	* DEGREE OF INITIAL SATURATION S_r (%) (DEGRÉ DE SATURATURATION INITIALE)	COMPRESSION INDEX C_c (INDICE DE COMPRESSION)	YIELD STRESS OF CONSOLIDATION P_y (t/m²) (LIMITE D'ÉLASTICITÉ DE CONSOLIDATION)
41.8	2.026	1.026	100	0.287	2.03

* THE RECORDING IS NOT NECESSARY IN THE CASE THAT CALCULATION DATA SHEET IS APPENDED.
(LES CHIFFRES NE FIGURENT PAS IOIQUAND LA FEUILLE DES CALCULS DÉTAILLÉS EST ANNEXÉE)

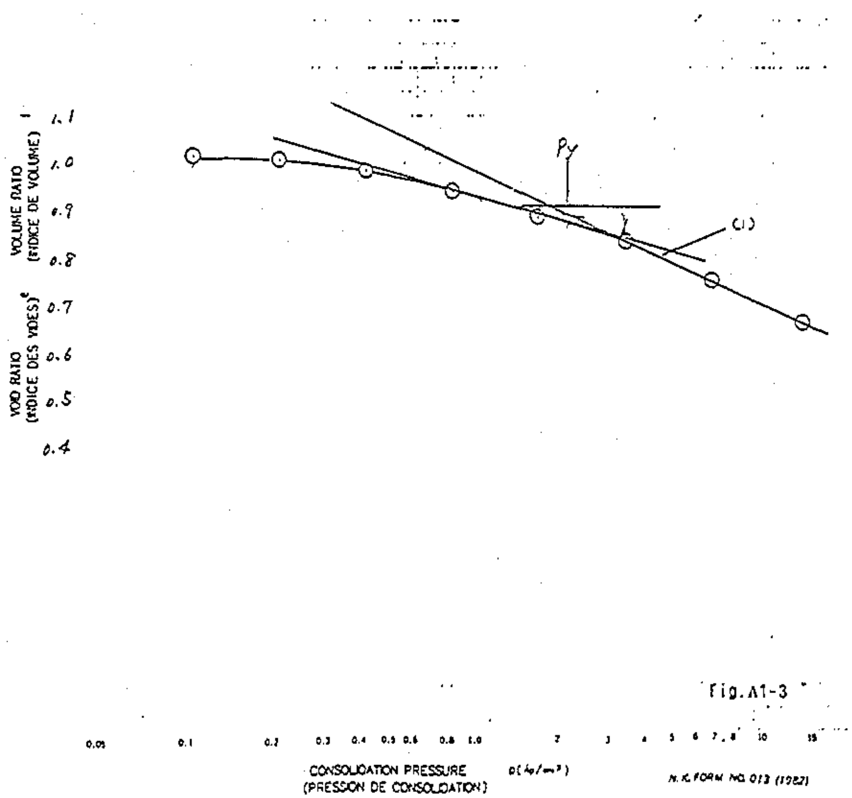


Fig.A1-3

N.K.FORM NO.013 (1982)

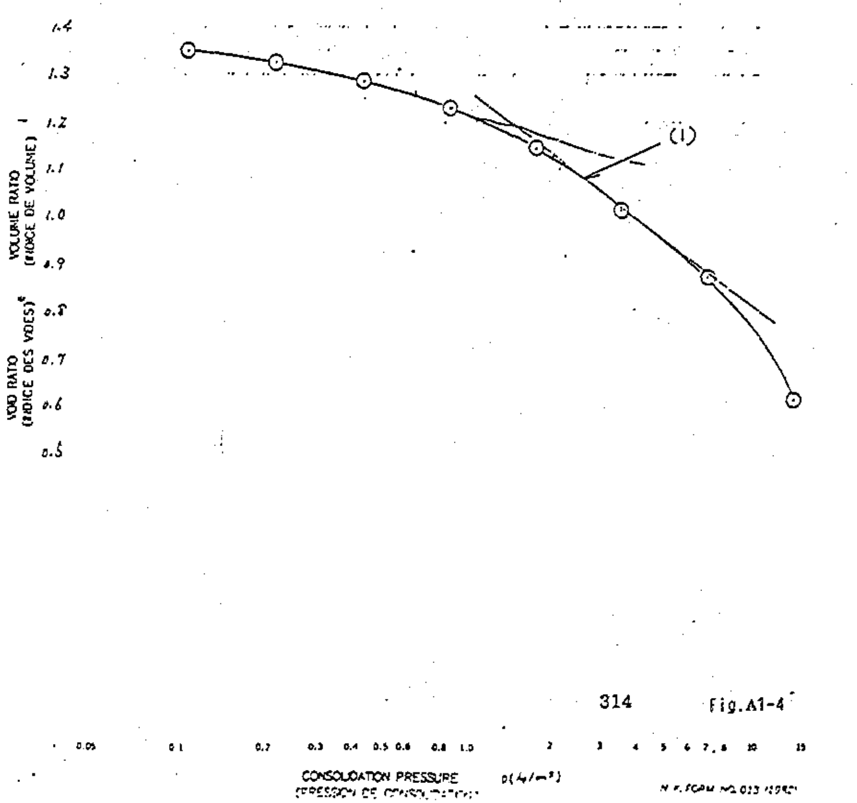
CONSOLIDATION TEST (ESSAI DE CONSOLIDATION)

(e−log P / f−log P (COURBE)) — Page 9 — (POUR LE RAPPORT)

NAME OF SURVEY & LOCALITY (DÉNOMINATION DE L' ENQUÊTE ET LOCALITÉ)	ALIKA SWAMP	DATE (DATE)	1. 11. 88
SAMPLE NO. & DEPTH (N° DE L'ÉCHANTILLON ET PROFONDEUR)	88/334 B8 (12.0 m − 13.0 m)	TESTED BY (ESSAI PAR)	wK

* UNDISTURBED OR DISTURBED (INTACT OU REMANIÉ)	* CLASSIFICATION (CLASSIFICATION)	* SPECIFIC GRAVITY G_s (POIDS SPÉCIFIQUE)	* LIQUID LIMIT w_L (%) (LIMIT DE LIQUIDITÉ)	* INITIAL DIMENSION OF SPECIMEN (DIMENSION INITIALE DU SPÉCIMEN) HEIGHT (HAUTEUR) (cm)	DIAMETER (DIAMÈTRE) (cm)
		2.642		2.00	6.00
* INITIAL WATER CONTENT w_o (%) (TENEUR EN EAU INITIALE)	* INITIAL VOLUME RATIO f (INDICE DE VOLUME INITIAL)	* INITIAL VOID RATIO e_o (INDICE DES VIDES INITIAL)	* DEGREE OF INITIAL SATURATION S_r (%) (DEGRÉ DE SATURATURATION INITIALE)	COMPRESSION INDEX C_c (INDICE DE COMPRESSION)	YIELD STRESS OF CONSOLIDATION P_y (t/m²) (LIMITE D'ÉLASTICITÉ DE CONSOLIDATION)
	2.370	1.370		0.95	—

* THE RECORDING IS NOT NECESSARY IN THE CASE THAT CALCULATION DATA SHEET IS APPENDED.
(LES CHIFFRES NE FIGURENT PAS IOIQUAND LA FEUILLE DES CALCULS DÉTAILLÉS EST ANNEXÉE)



314 Fig.A1-4

N.K.FORM NO.013 (1982)

CONSOLIDATION TEST (ESSAI DE CONSOLIDATION)

(e−log P CURVE / f−log P (COURBE)) FOR REPORTING (POUR LE RAPPORT)

NAME OF SURVEY & LOCALITY (DÉNOMINATION DE L'ENQUÊTE ET LOCALITÉ)	KAPURI RIVER	DATE (DATE)	
SAMPLE NO. & DEPTH (N° DE L'ÉCHANTILLON ET PROFONDEUR)	B9 (m− m)	TESTED BY (ESSAI PAR)	

※UNDISTURBED OR DISTURBED (INTACT OU REMANIÉ)	※CLASSIFICATION (CLASSIFICATION)	※SPECIFIC GRAVITY Gs (POIDS SPÉCIFIQUE)	※LIQUID LIMIT w_L (%) (LIMIT DE LIQUIDITÉ)	※INITIAL DIMENSION OF SPECIMEN (DIMENSION INITIALE DU SPÉCIMEN) HEIGHT (HAUTEUR) (—)	DIAMETER (DIAMÈTRE) (—)
※INITIAL WATER CONTENT w_o (%) (TENEUR EN EAU INITIALE)	※INITIAL VOLUME RATIO f (INDICE DE VOLUME INITIAL)	※INITIAL VOID RATIO e_o (INDICE DES VIDES INITIAL)	※DEGREE OF INITIAL SATURATION S_r (%) (DEGRÉ DE SATURATION INITIALE)	COMPRESSION INDEX C_c (INDICE DE COMPRESSION)	YIELD STRESS OF CONSOLIDATION p_y (t/m²) (LIMITE D'ÉLASTICITÉ DE CONSOLIDATION)

※THE RECORDING IS NOT NECESSARY IN THE CASE THAT CALCULATION DATA SHEET IS APPENDED.
(LES CHIFFRES NE FIGURENT PAS ICI QUAND LA FEUILLE DES CALCULS DÉTAILLÉS EST ANNEXÉE)

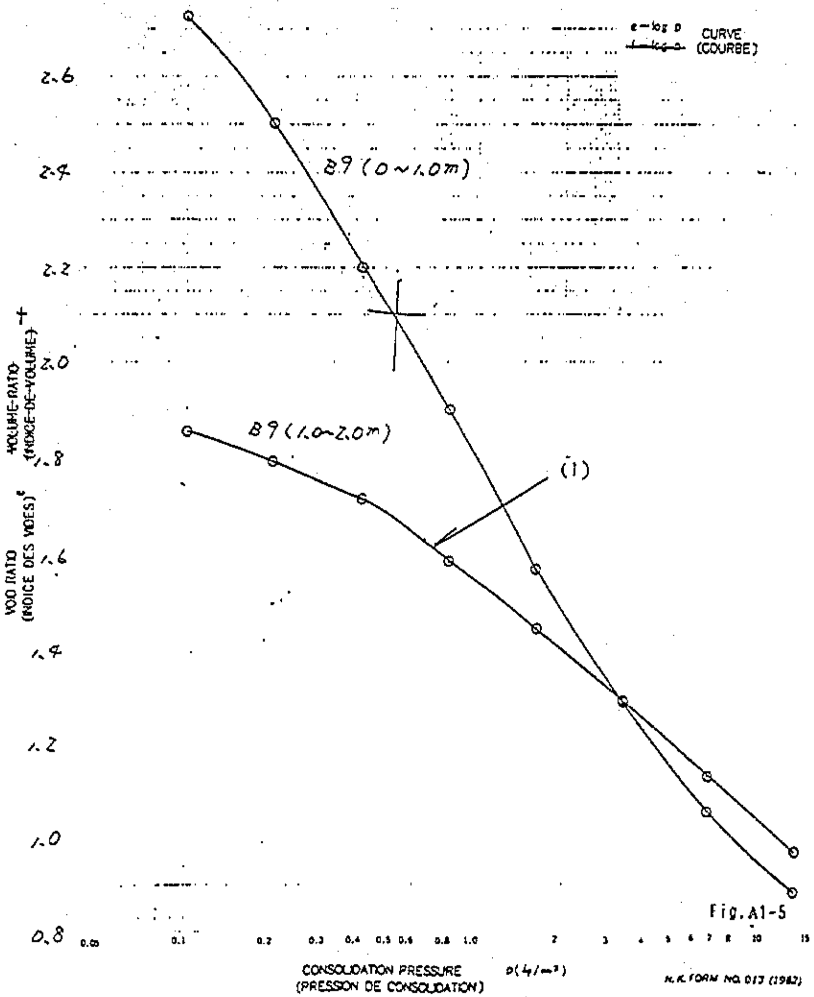


Fig.A1-5

N.K.FORM NO.013 (1982)

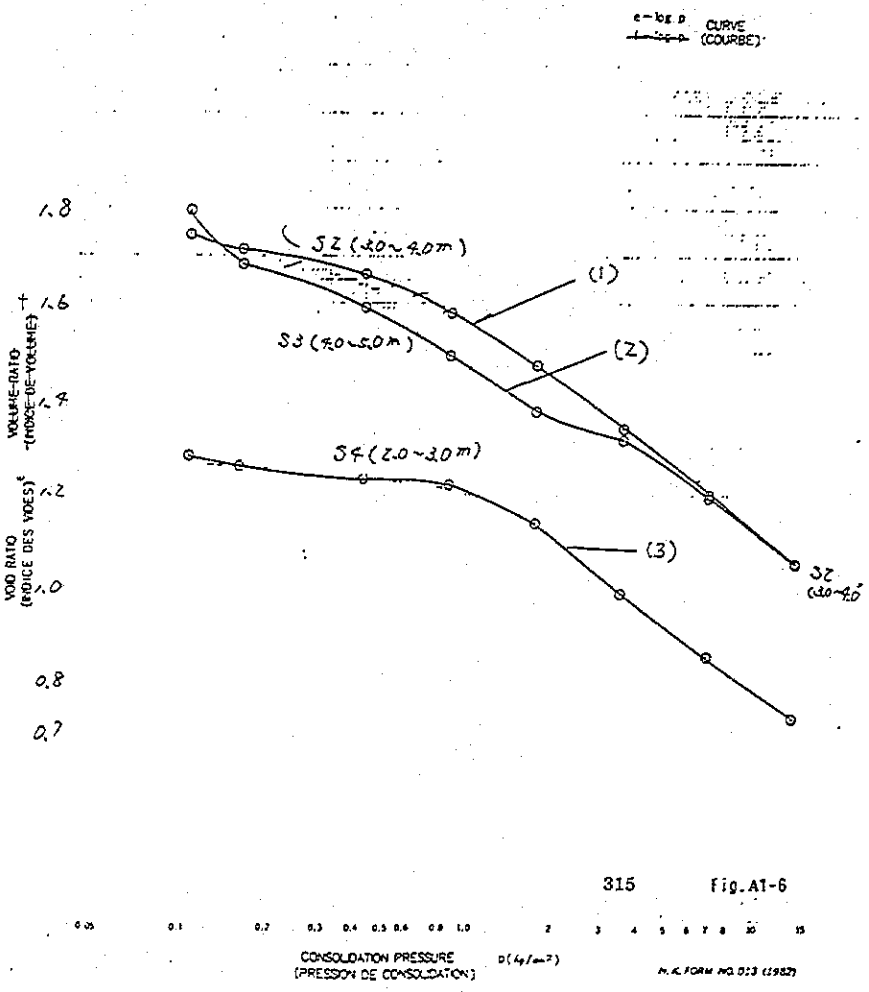
CONSOLIDATION TEST (ESSAI DE CONSOLIDATION)

(e−log P / f−log P (COURBE)) Page 10 (POUR LE RAPPORT)

NAME OF SURVEY & LOCALITY (DÉNOMINATION DE L'ENQUÊTE ET LOCALITÉ)	SWAMP	DATE (DATE)	
SAMPLE NO. & DEPTH (N° DE L'ÉCHANTILLON ET PROFONDEUR)	S2, S3, S4 (m− m)	TESTED BY (ESSAI PAR)	

※UNDISTURBED OR DISTURBED (INTACT OU REMANIÉ)	※CLASSIFICATION (CLASSIFICATION)	※SPECIFIC GRAVITY Gs (POIDS SPÉCIFIQUE)	※LIQUID LIMIT w_L (%) (LIMIT DE LIQUIDITÉ)	※INITIAL DIMENSION OF SPECIMEN (DIMENSION INITIALE DU SPÉCIMEN) HEIGHT (HAUTEUR) (—)	DIAMETER (DIAMÈTRE) (—)
※INITIAL WATER CONTENT w_o (%) (TENEUR EN EAU INITIALE)	※INITIAL VOLUME RATIO f (INDICE DE VOLUME INITIAL)	※INITIAL VOID RATIO e_o (INDICE DES VIDES INITIAL)	※DEGREE OF INITIAL SATURATION S_r (%) (DEGRÉ DE SATURATION INITIALE)	COMPRESSION INDEX C_c (INDICE DE COMPRESSION)	YIELD STRESS OF CONSOLIDATION p_y (t/m²) (LIMITE D'ÉLASTICITÉ DE CONSOLIDATION)

※THE RECORDING IS NOT NECESSARY IN THE CASE THAT CALCULATION DATA SHEET IS APPENDED.
(LES CHIFFRES NE FIGURENT PAS ICI QUAND LA FEUILLE DES CALCULS DÉTAILLÉS EST ANNEXÉE)



315 Fig.A1-6

N.K.FORM NO.013 (1982)

CONSOLIDATION TEST (ESSAI DE CONSOLIDATION)

(e – log P CURVE / f – log P (COURBE)) — FOR REPORTING (POUR LE RAPPORT)

NAME OF SURVEY & LOCALITY (DÉNOMINATION DE L' ENQUÊTE ET LOCALITÉ)	LAKEKAMU RIVER	DATE (DATE)	
SAMPLE NO. & DEPTH (N° DE L'ÉCHANTILLON ET PROFONDEUR)	B/1, B/2 (m – m)	TESTED BY (ESSAI PAR)	

* UNDISTURBED OR DISTURBED (INTACT OU REMANIÉ)	* CLASSIFICATION (CLASSIFICATION)	* SPECIFIC GRAVITY Gs (POIDS SPÉCIFIQUE)	* LIQUID LIMIT w_L (%) (LIMIT DE LIQUIDITÉ)	* INITIAL DIMENSION OF SPECIMEN (DIMENSION INITIALE DU SPÉCIMEN) HEIGHT (HAUTEUR) (cm)	DIAMETER (DIAMÈTRE) (cm)
* INITIAL WATER CONTENT w_o (%) (TENEUR EN EAU INITIALE)	* INITIAL VOLUME RATIO f (INDICE DE VOLUME INITIAL)	* INITIAL VOID RATIO e_o (INDICE DES VIDES INITIAL)	* DEGREE OF INITIAL SATURATION S (%) (DEGRÉ DE SATURATION INITIALE)	COMPRESSION INDEX C_c (INDICE DE COMPRESSION)	YIELD STRESS OF CONSOLIDATION P_y (kg/cm²) (LIMITE D'ÉLASTICITÉ DE CONSOLIDATION)

* THE RECORDING IS NOT NECESSARY IN THE CASE THAT CALCULATION DATA SHEET IS APPENDED.
(LES CHIFFRES NE FIGURENT PAS ICI QUAND LA FEUILLE DES CALCULS DÉTAILLÉS EST ANNEXÉE)

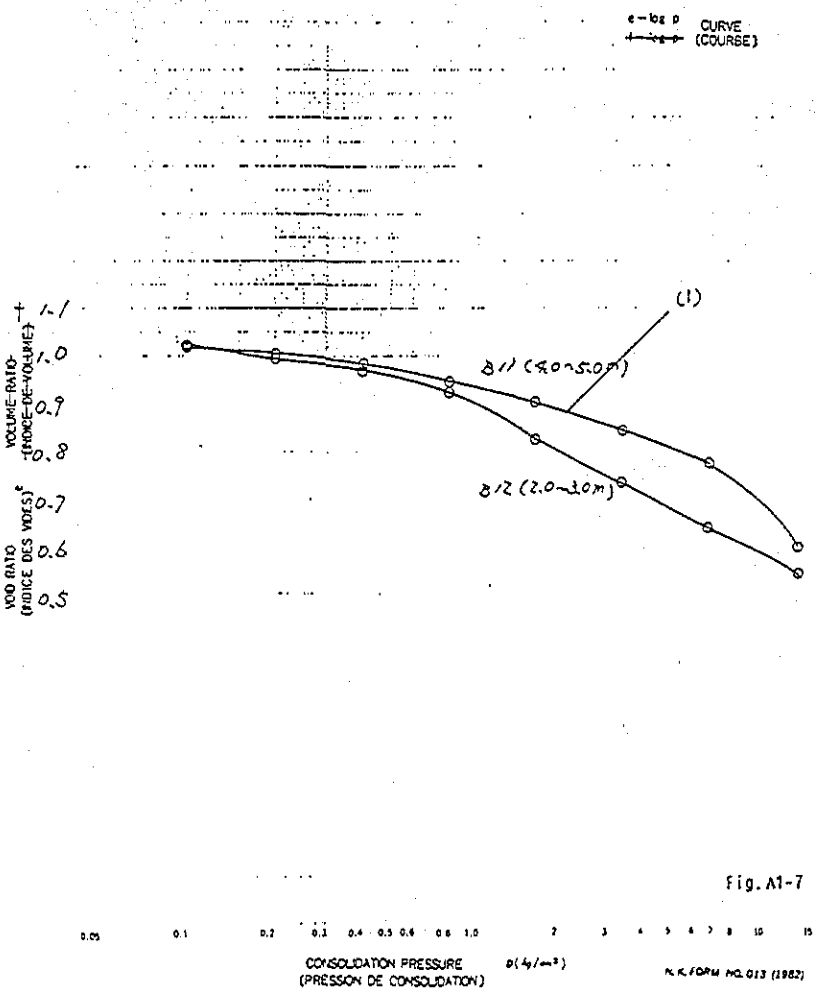


Fig. A1-7

N.K.FORM NO.013 (1982)

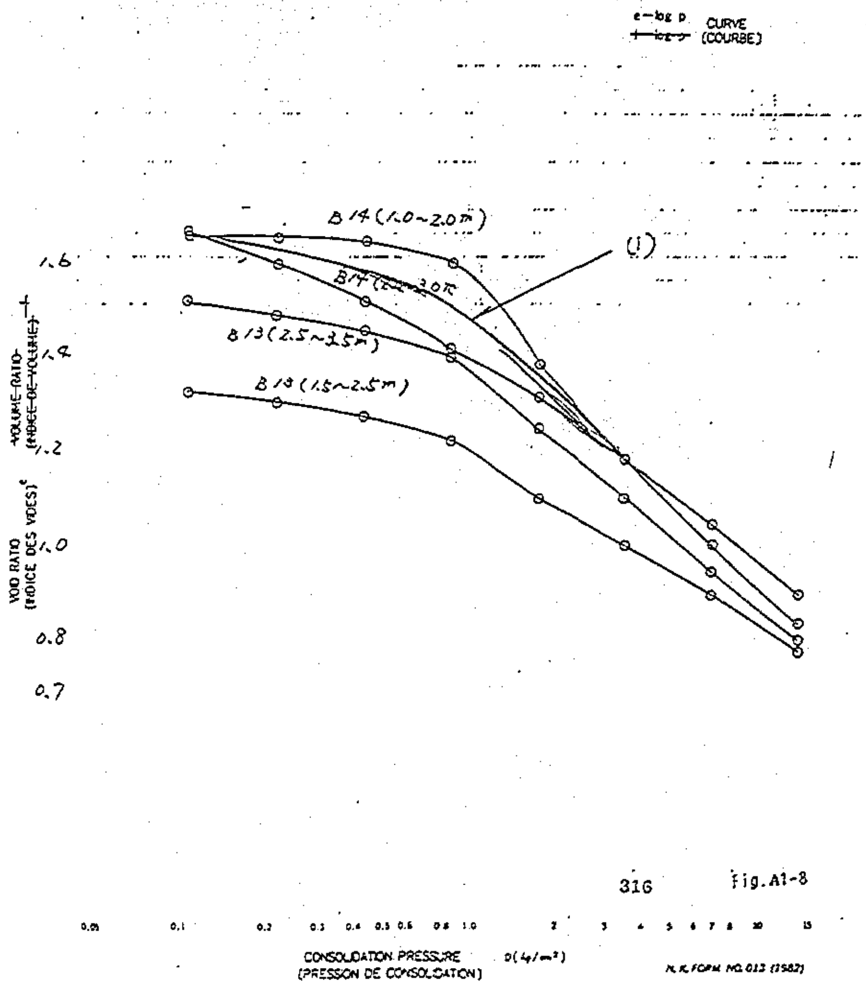
CONSOLIDATION TEST (ESSAI DE CONSOLIDATION)

(e – log P / f – log P (COURBE)) (POUR LE RAPPORT)

NAME OF SURVEY & LOCALITY (DÉNOMINATION DE L' ENQUÊTE ET LOCALITÉ)	TAURI RIVER	DATE (DATE)	
SAMPLE NO. & DEPTH (N° DE L'ÉCHANTILLON ET PROFONDEUR)	B/3, B/4 (m – m)	TESTED BY (ESSAI PAR)	

* UNDISTURBED OR DISTURBED (INTACT OU REMANIÉ)	* CLASSIFICATION (CLASSIFICATION)	* SPECIFIC GRAVITY Gs (POIDS SPÉCIFIQUE)	* LIQUID LIMIT w_L (%) (LIMIT DE LIQUIDITÉ)	* INITIAL DIMENSION OF SPECIMEN (DIMENSION INITIALE DU SPÉCIMEN) HEIGHT (HAUTEUR) (cm)	DIAMETER (DIAMÈTRE) (cm)
* INITIAL WATER CONTENT w_o (%) (TENEUR EN EAU INITIALE)	* INITIAL VOLUME RATIO f (INDICE DE VOLUME INITIAL)	* INITIAL VOID RATIO e_o (INDICE DES VIDES INITIAL)	* DEGREE OF INITIAL SATURATION S (%) (DEGRÉ DE SATURATION INITIALE)	COMPRESSION INDEX C_c (INDICE DE COMPRESSION)	YIELD STRESS OF CONSOLIDATION P_y (kg/cm²) (LIMITE D'ÉLASTICITÉ DE CONSOLIDATION)

* THE RECORDING IS NOT NECESSARY IN THE CASE THAT CALCULATION DATA SHEET IS APPENDED.
(LES CHIFFRES NE FIGURENT PAS ICI QUAND LA FEUILLE DES CALCULS DÉTAILLÉS EST ANNEXÉE)



316

Fig. A1-8

N.K.FORM NO.013 (1982)

CONSOLIDATION TEST (ESSAI DE CONSOLIDATION)

(e−log P CURVE / f−log P (COURBE)) FOR REPORTING (POUR LE RAPPORT)

NAME OF SURVEY & LOCALITY (DÉNOMINATION DE L' ENQUÊTE ET LOCALITÉ)	MAKARA RIVER	DATE (DATE)	
SAMPLE NO. & DEPTH (N° DE L'ÉCHANTILLON ET PROFONDEUR)	B16 (m− m)	TESTED BY (ESSAI PAR)	

* UNDISTURBED OR DISTURBED (INTACT OU REMANIÉ)	* CLASSIFICATION (CLASSIFICATION)	* SPECIFIC GRAVITY Gs (POIDS SPÉCIFIQUE)	* LIQUID LIMIT w_L (%) (LIMIT DE LIQUIDITÉ)	* INITIAL DIMENSION OF SPECIMEN (DIMENSION INITIALE DU SPÉCIMEN) HEIGHT (HAUTEUR) (cm)	DIAMETER (DIAMÈTRE) (cm)
* INITIAL WATER CONTENT w_0 (%) (TENEUR EN EAU INITIALE)	* INITIAL VOLUME RATIO f (INDICE DE VOLUME INITIAL)	* INITIAL VOID RATIO e_0 (INDICE DES VIDES INITIAL)	* DEGREE OF INITIAL SATURATION S_r (%) (DEGRÉ DE SATURATURATION INITIALE)	COMPRESSION INDEX C_c (INDICE DE COMPRESSION)	YIELD STRESS OF CONSOLIDATION P_y (t/m²) (LIMITE D'ÉLASTICITÉ DE CONSOLIDATION)

* THE RECORDING IS NOT NECESSARY IN THE CASE THAT CALCULATION DATA SHEET IS APPENDED.
(LES CHIFFRES NE FIGURENT PAS ICIQUAND LA FEUILLE DES CALCULS DÉTAILLÉS EST ANNEXÉE)

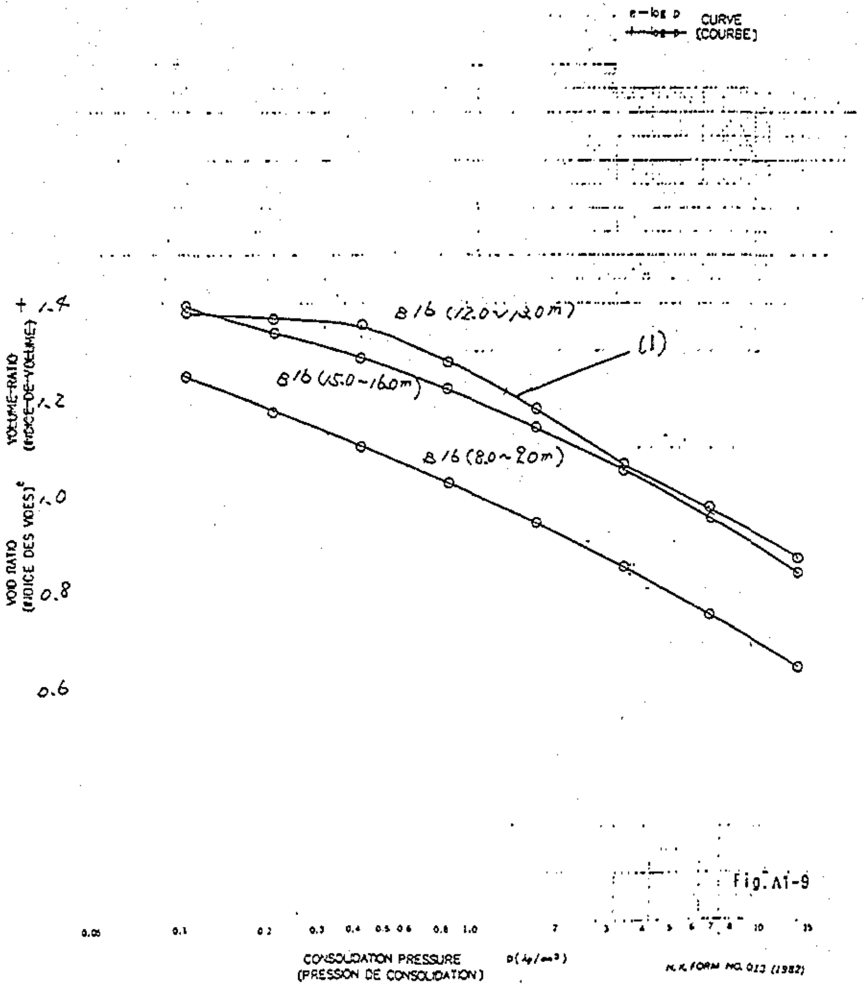


Fig. A1-9

N.K. FORM NO. 013 (1982)

ATTACHMENT 2

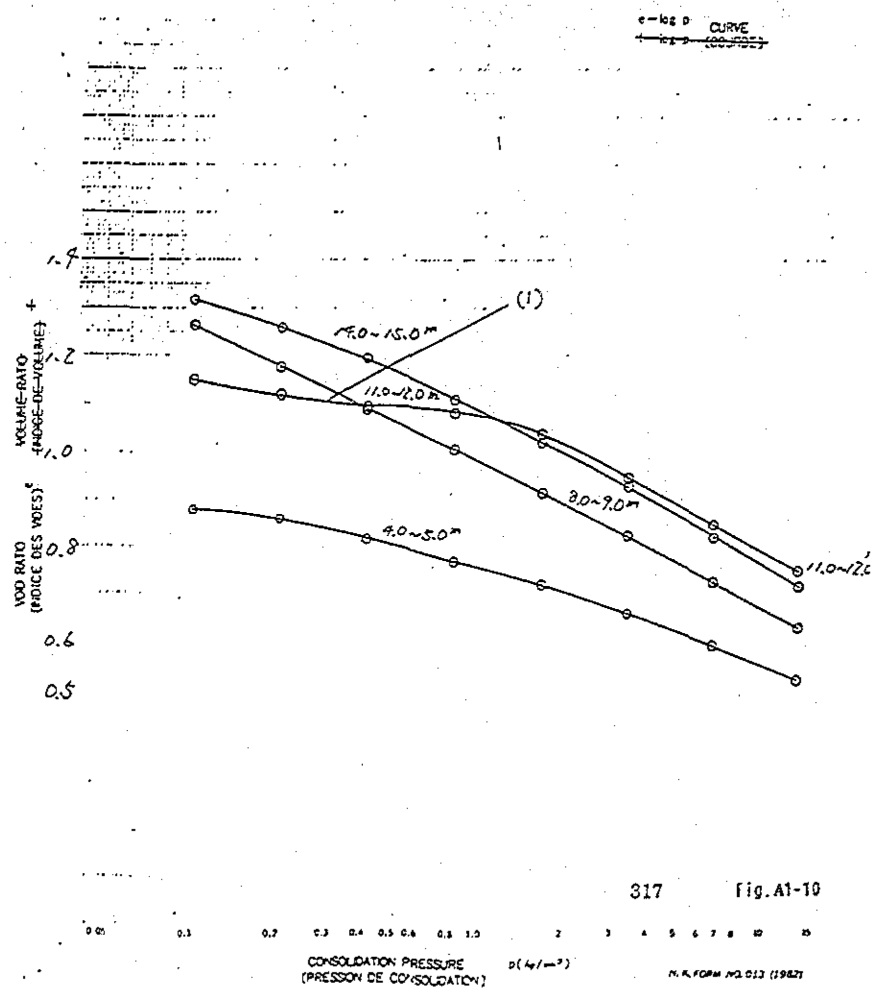
Page 12

CONSOLIDATION TEST (ESSAI DE CONSOLIDATION)

NAME OF SURVEY & LOCALITY (DÉNOMINATION DE L' ENQUÊTE ET LOCALITÉ)	DIVOLA SWAMP	DATE (DATE)	
SAMPLE NO. & DEPTH (N° DE L'ÉCHANTILLON ET PROFONDEUR)	B17 (m− m)	TESTED BY (ESSAI PAR)	

* UNDISTURBED OR DISTURBED (INTACT OU REMANIÉ)	* CLASSIFICATION (CLASSIFICATION)	* SPECIFIC GRAVITY Gs (POIDS SPÉCIFIQUE)	* LIQUID LIMIT w_L (%) (LIMIT DE LIQUIDITÉ)	* INITIAL DIMENSION OF SPECIMEN (DIMENSION INITIALE DU SPÉCIMEN) HEIGHT (HAUTEUR) (cm)	DIAMETER (DIAMÈTRE) (cm)
* INITIAL WATER CONTENT w_0 (%) (TENEUR EN EAU INITIALE)	* INITIAL VOLUME RATIO f (INDICE DE VOLUME INITIAL)	* INITIAL VOID RATIO e_0 (INDICE DES VIDES INITIAL)	* DEGREE OF INITIAL SATURATION S_r (%) (DEGRÉ DE SATURATURATION INITIALE)	COMPRESSION INDEX C_c (INDICE DE COMPRESSION)	YIELD STRESS OF CONSOLIDATION P_y (t/m²) (LIMITE D'ÉLASTICITÉ DE CONSOLIDATION)

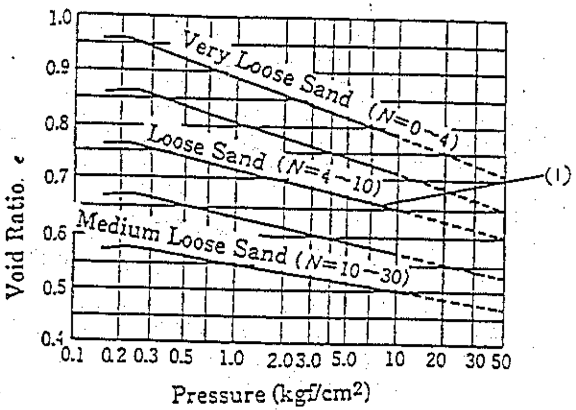
* THE RECORDING IS NOT NECESSARY IN THE CASE THAT CALCULATION DATA SHEET IS APPENDED.
(LES CHIFFRES NE FIGURENT PAS ICIQUAND LA FEUILLE DES CALCULS DÉTAILLÉS EST ANNEXÉE)



317

Fig. A1-10

N.K. FORM NO. 013 (1982)



(B) Pressure versus void ratio curve of sand (B.K.Hough)

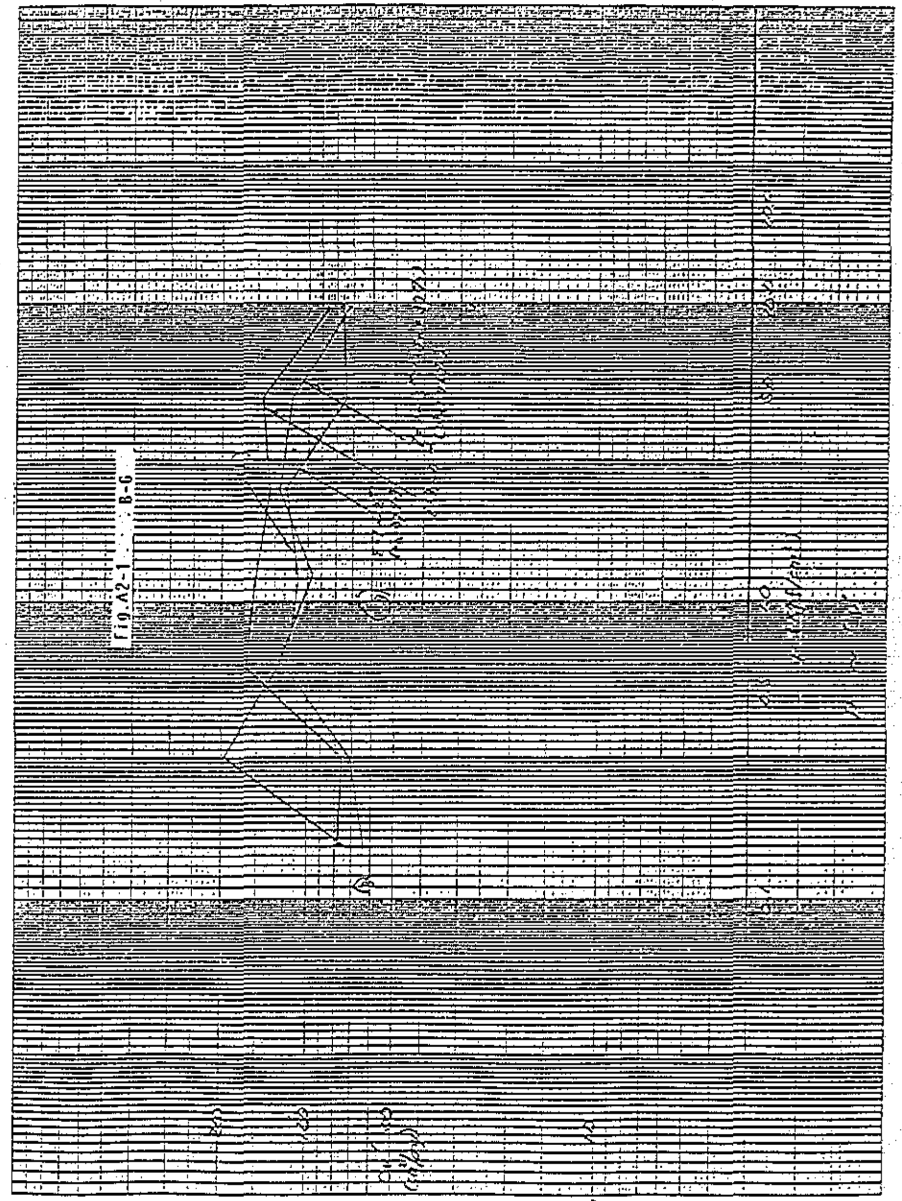


Fig. A1-11

318

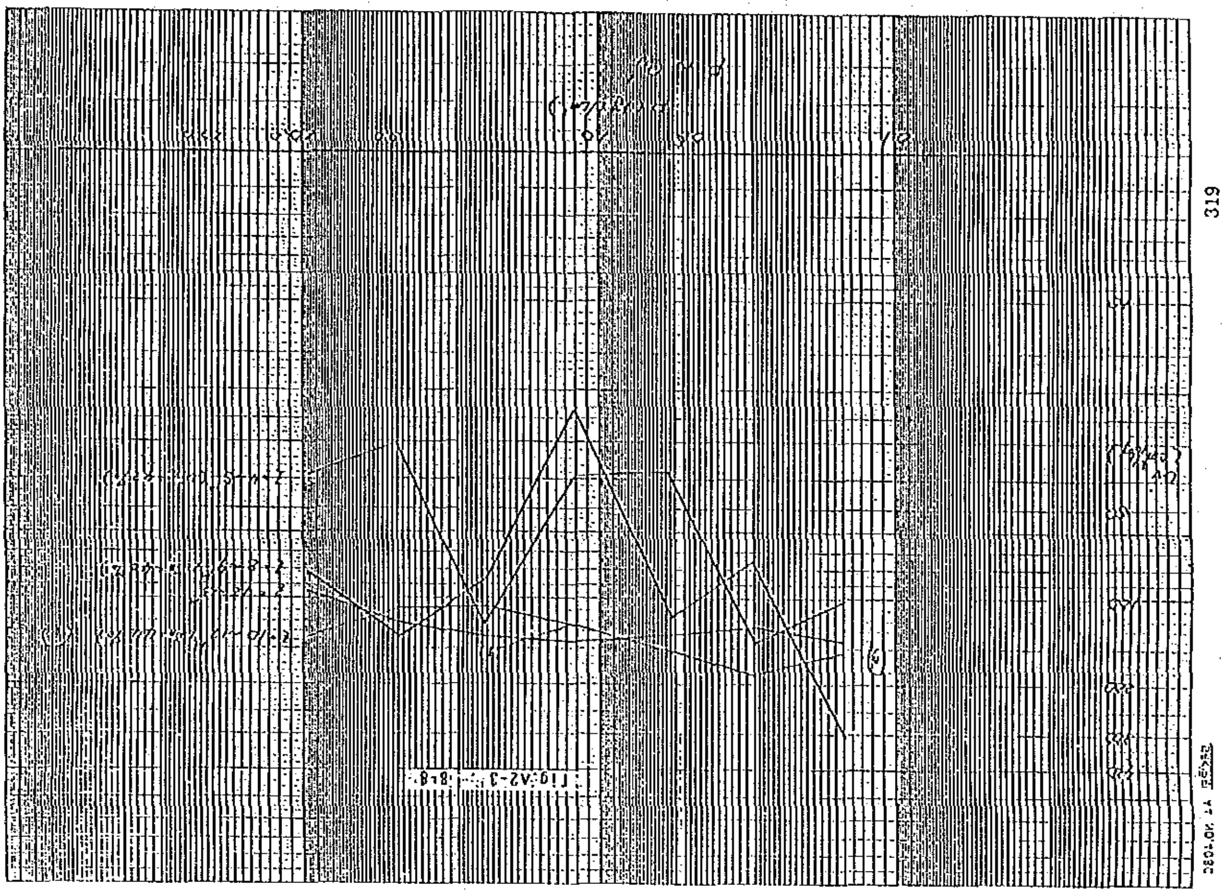


Fig.A2-3 B-8

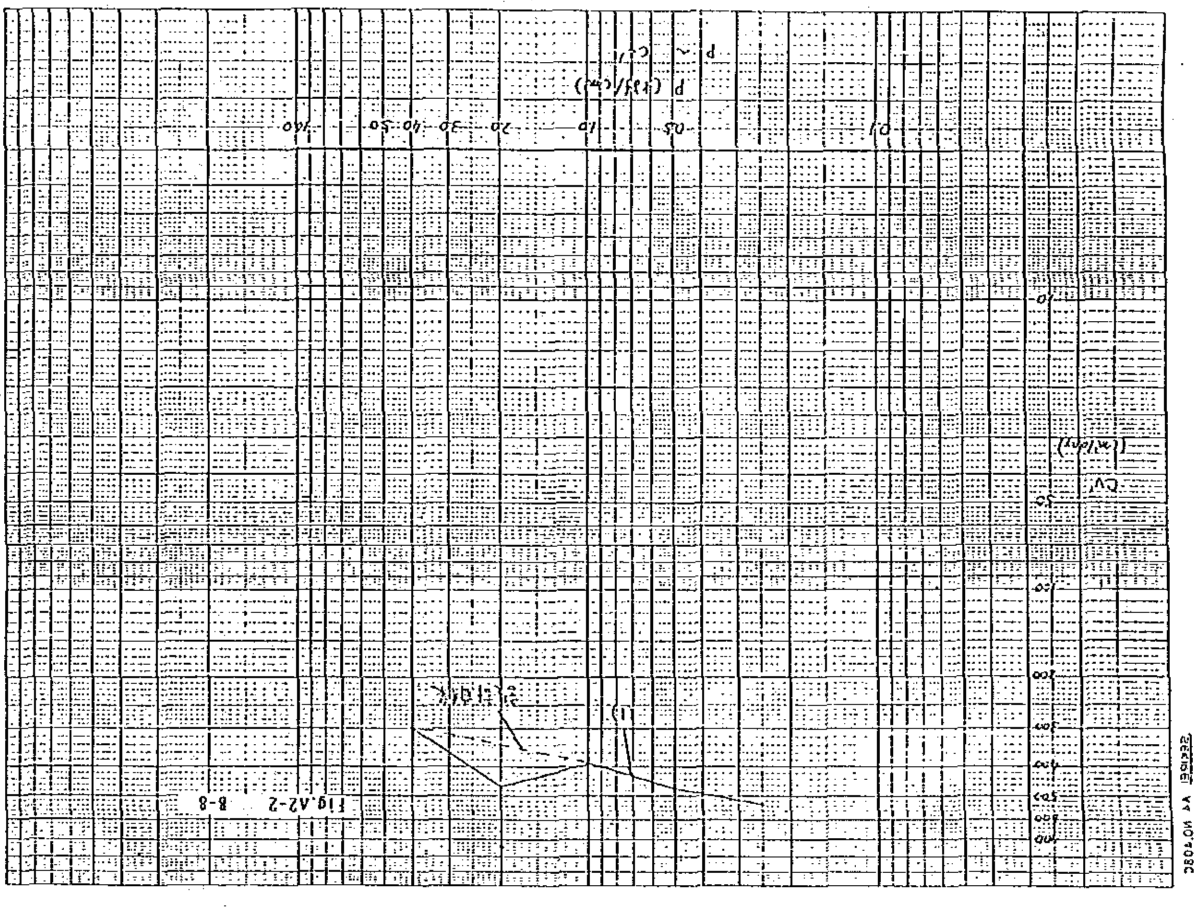
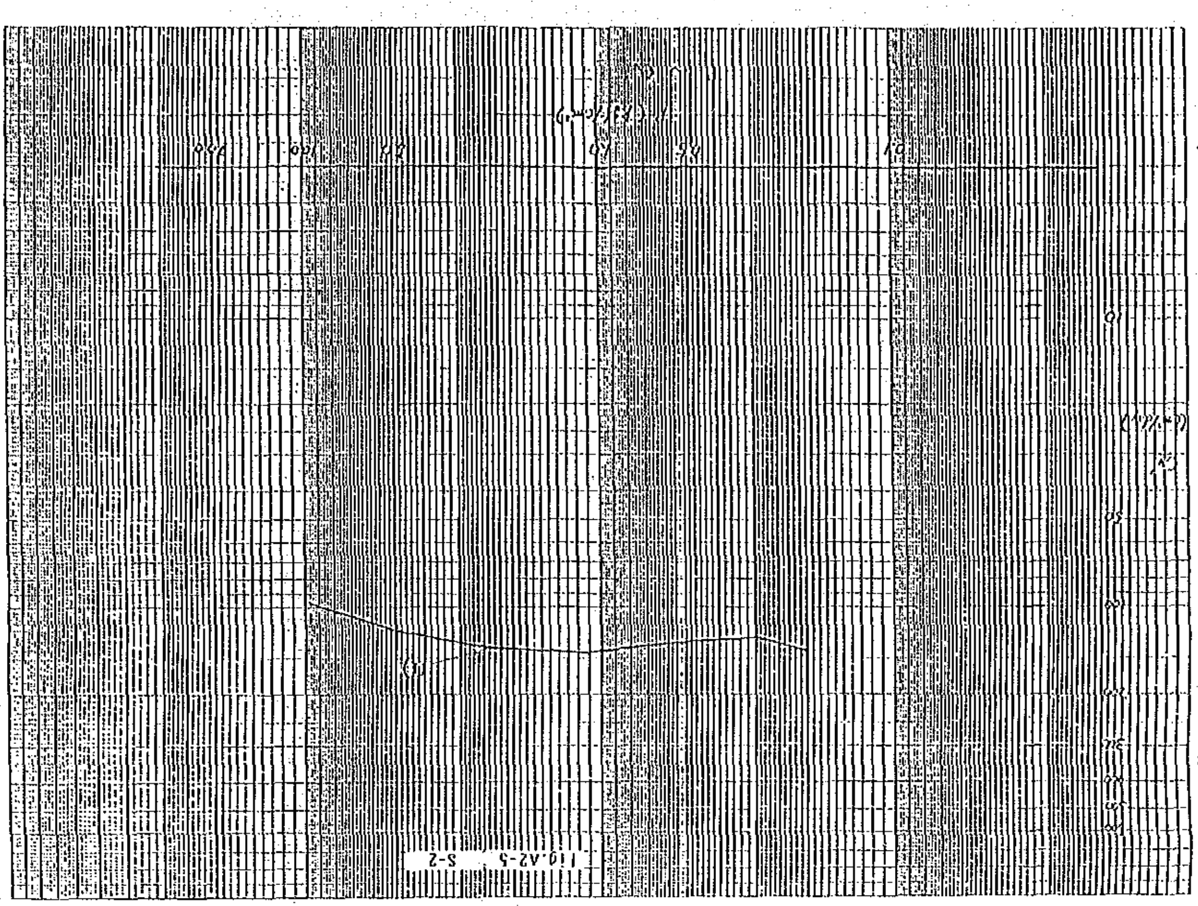
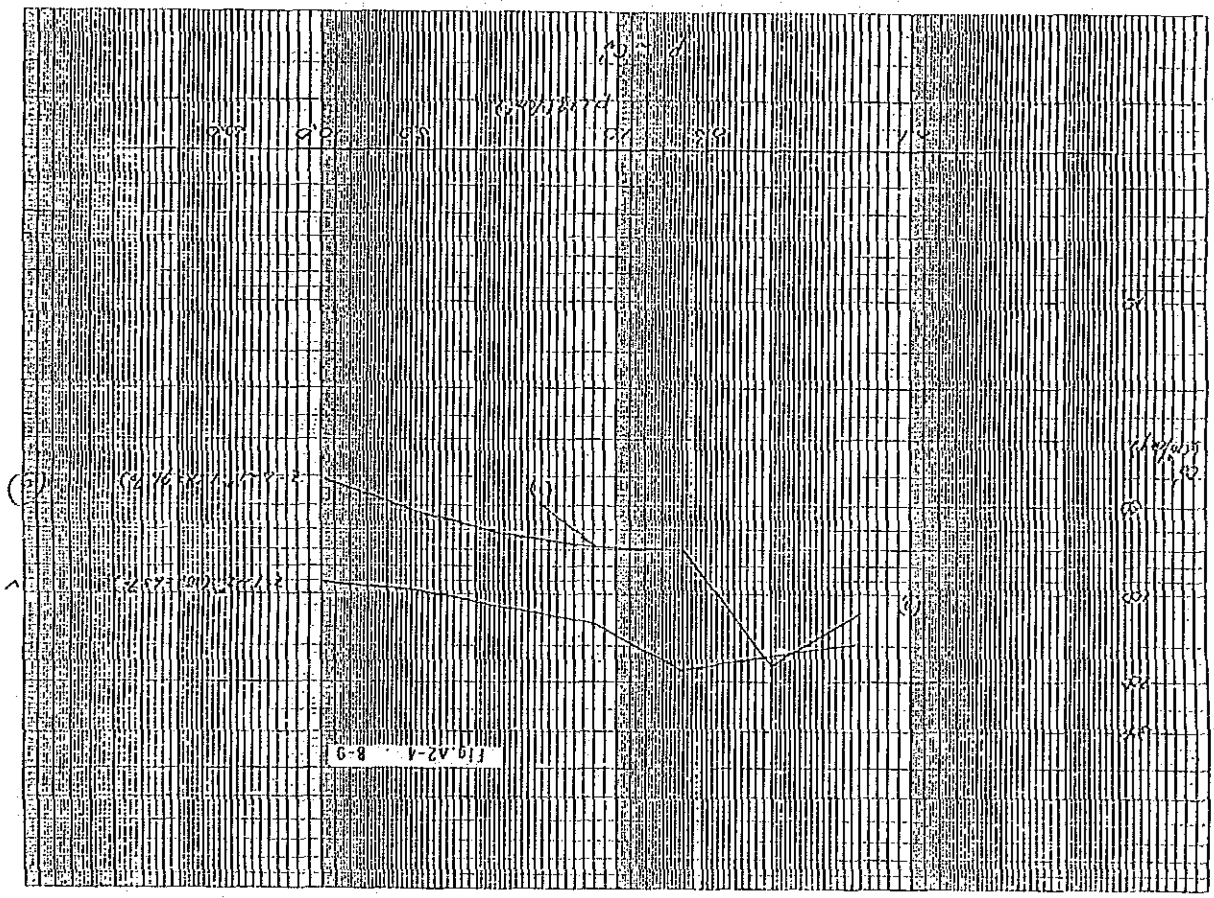


Fig.A2-2 B-8





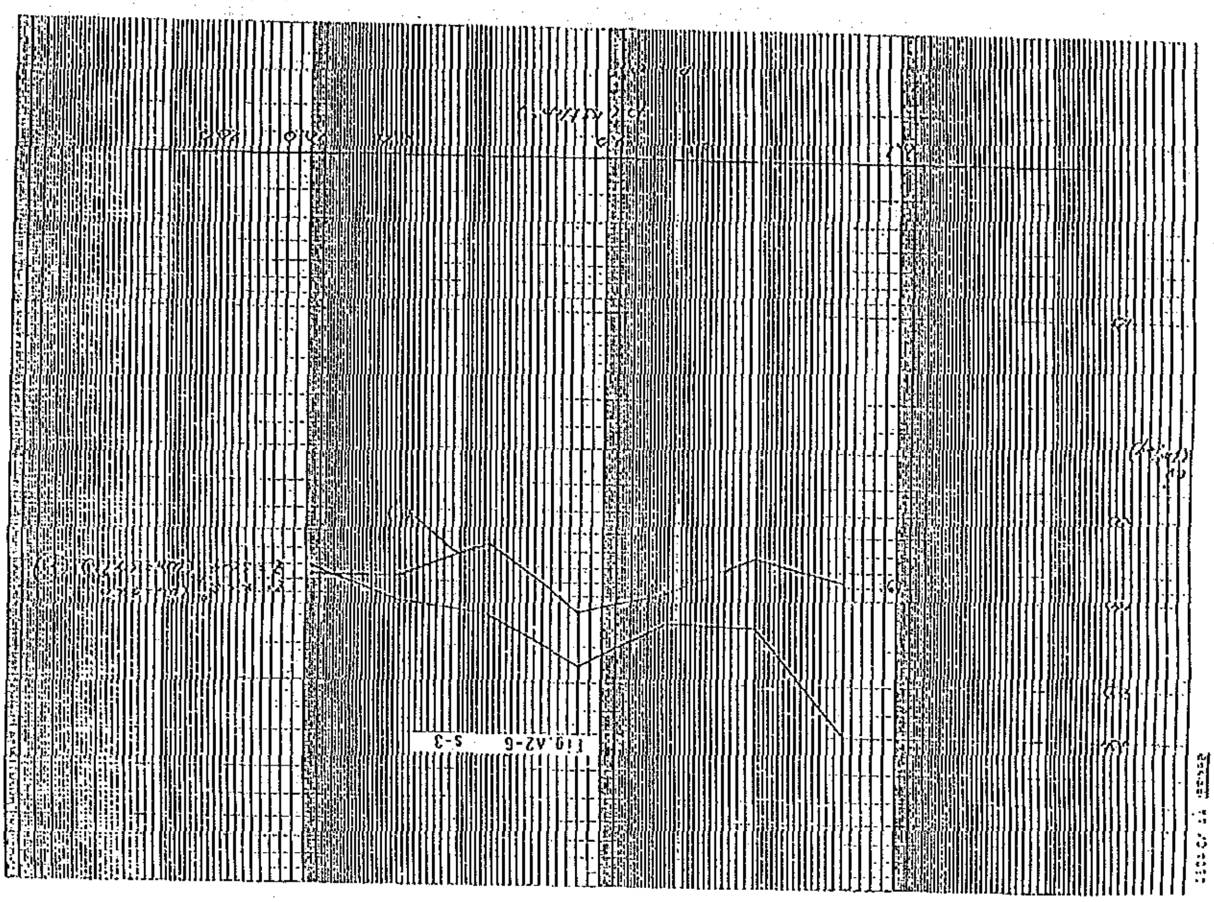


Fig.A2-6 S-3


Fig.A2-7 B-11,B-14,S-4
S4,B11 Curve for calculation

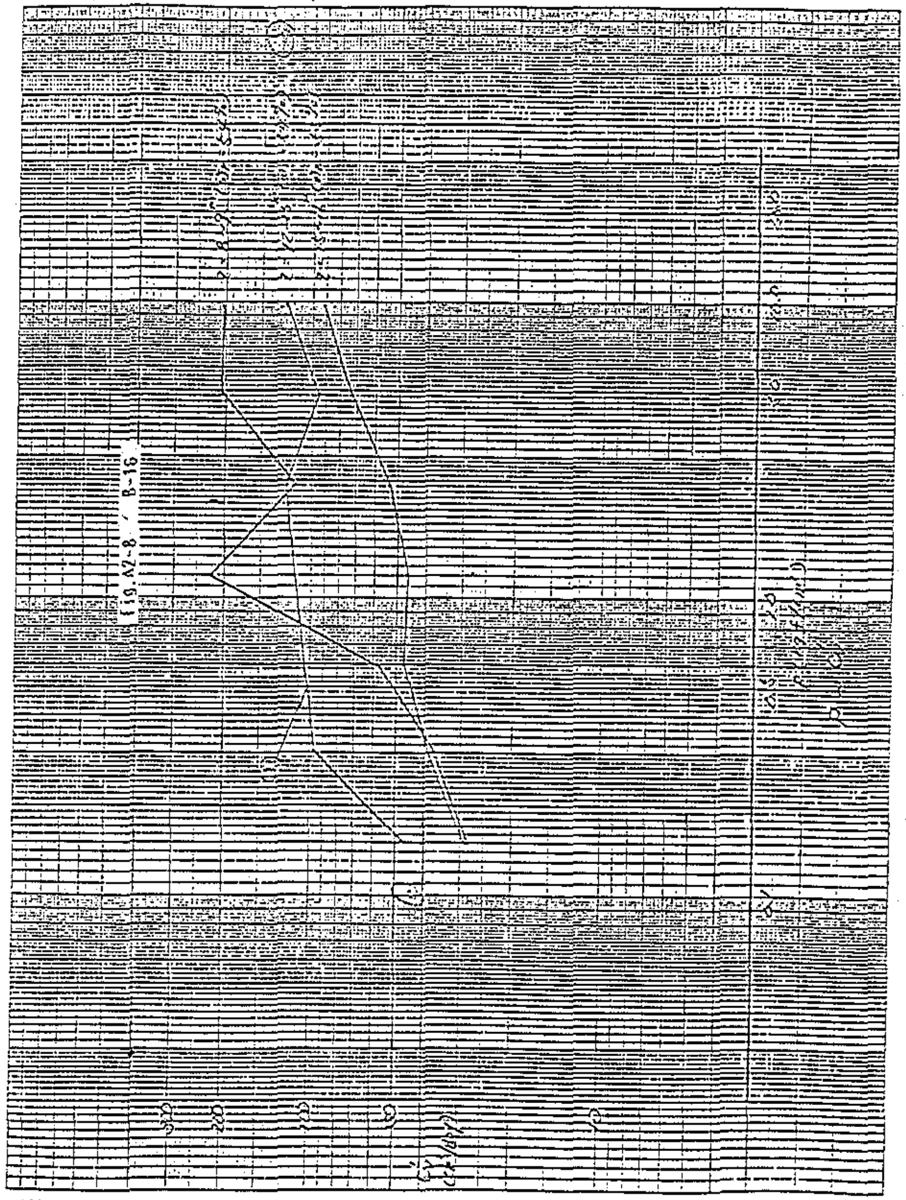


Fig.A2-8 / B-16

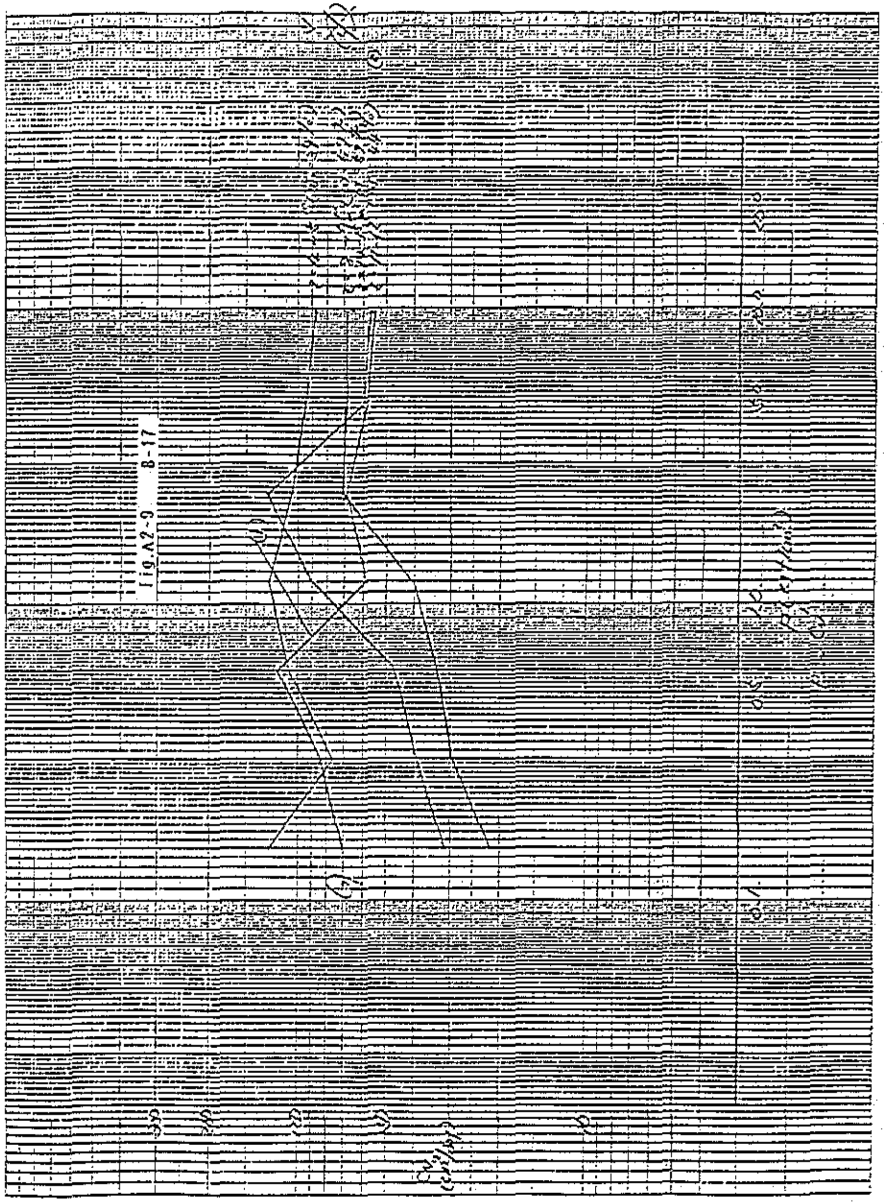


Fig.A2-9 B-17

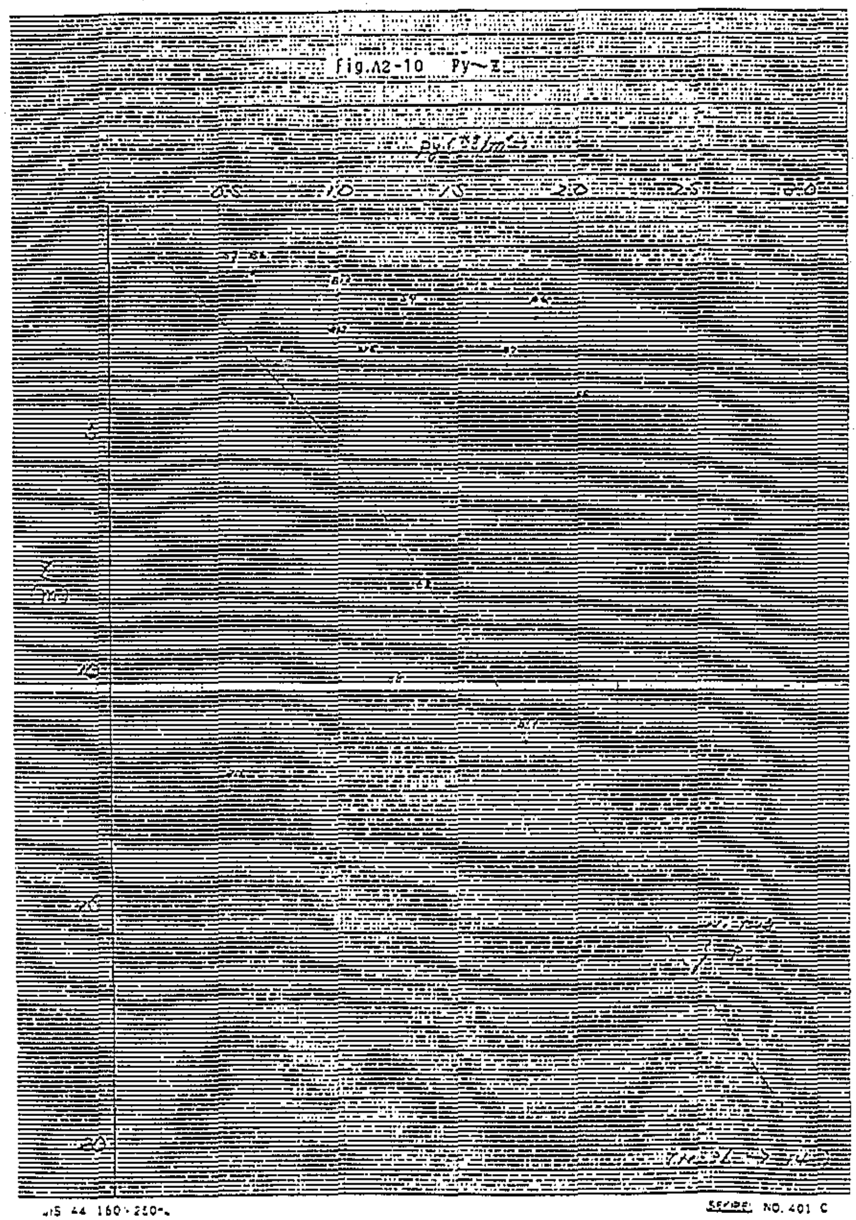


Fig.A2-10 Py~z


Fig.A2-11 qu~z

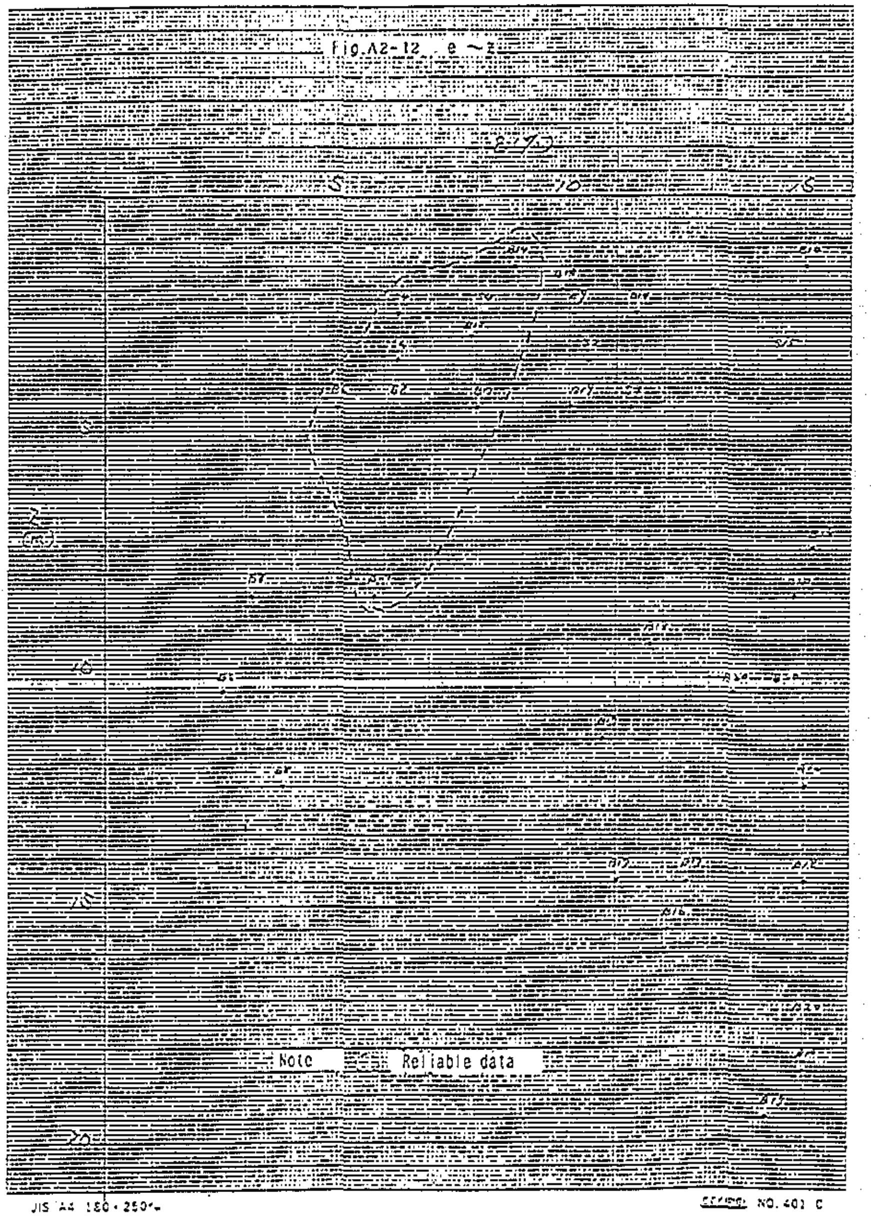


Fig.A2-12 e ~ z

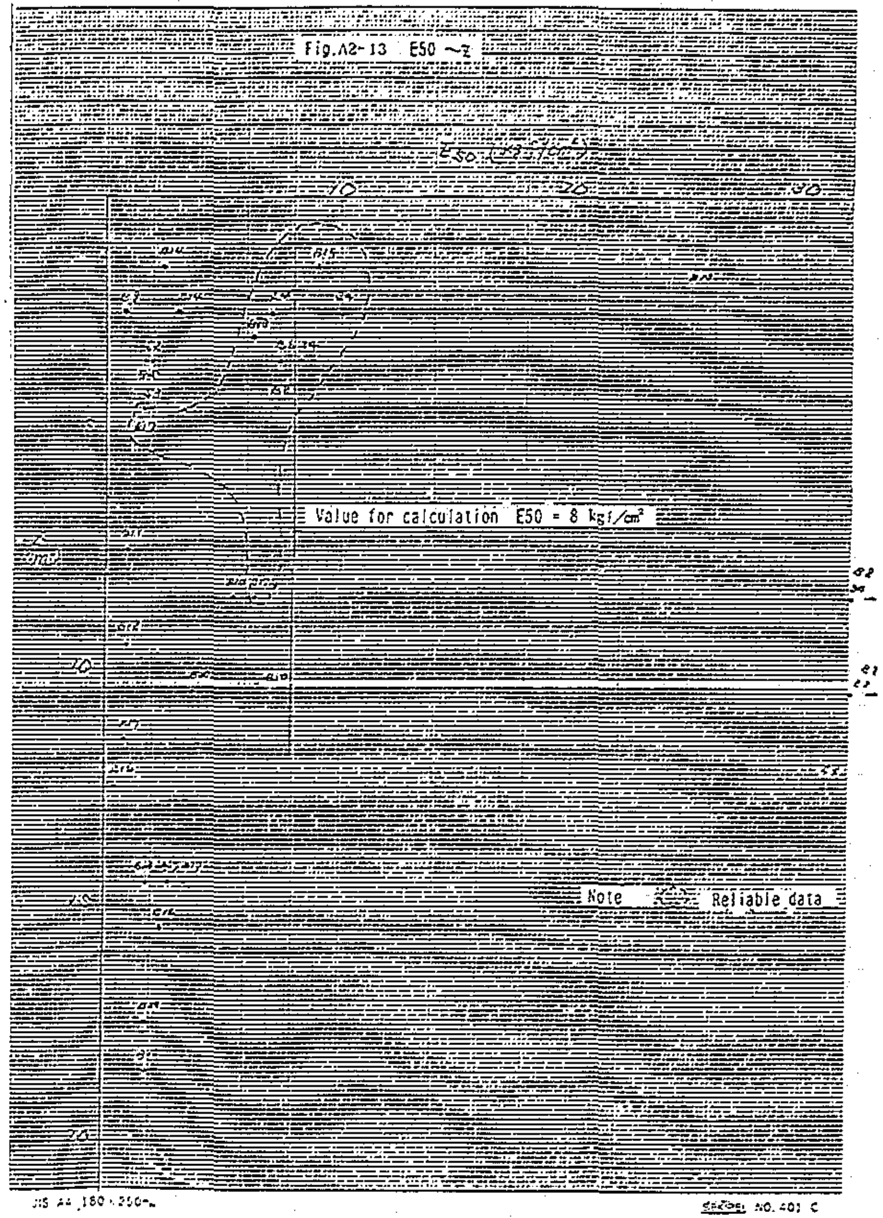


Fig.A2-13 E50 ~ z

324

ATTACHMENT-3

METHOD OF QUANTITY CALCULATIONS

(ROAD WORKS)

METHOD OF QUANTITY CALCULATION

The whole Project area was divided into two lots for contracting. The total quantities were summarized as for Lot-I and Lot-II.

LOT-I	Bereina	TO	Miaru River	Length
	CH. 0+000		CH.33+500	33.500 km
LOT-II	Miaru River	TO	Malalaua	
	CH.33+500		CH.80+596	47.096 km

The calculation area was divided into road work and bridge work for both lots.

For the purpose of calculating quantities on items of 1(Group-3) Clearing and Grubbing, 2(Group-4) Earthworks and 4(Group-7) Drainage, the bridge work includes the earth work within ten (10) metres from both abutments. And Lot-II was subdivided by the type of embankment structures such as borrow embankment and embankment with settlement, sand mat and sand bag.

Lot-I and Lot-II were divided into 34 sections in total.

Sectioning LOT-I : 7 sections
LOT-II : 27 sections

Other items of 3-1(Group-5) Base and Subbase, 3-2(Group-6) Bituminous surfacing and 5(Group-7) Road Furniture and Marking were divided into road work and bridge work except ten (10) metres of earthwork behind the abutments.

Sections in LOT-I

NO. OF SECTION	CHAINAGE	TERRAIN TYPE	ROAD WORK	BRIDGE WORK
1	0+000 TO 11+986	ROLLING/HILLY	○	-
2	11+986 TO 12+025	TAIENA Br. 11+996 TO 12+015	-	○
3	12+025 TO 14+712	ROLLING/HILLY	○	-
4	14+712 TO 14+755	AGOBINO Br. 14+722 TO 14+744	-	○
5	14+755 TO 16+098	ROLLING/HILLY	○	-
6	16+098 TO 16+141	UNGOUNGO Br. 16+109 TO 16+130	-	○
7	16+141 TO 33+500	ROLLING/HILLY	○	-

Sections in LOT-II

NO.OF SECTION	CHAINAGE	TERRAIN TYPE	ROAD WORK	BRIDGE WORK	FORESEEN SETTLE-MENT	SAND MAT (THICKNESS)	SAND BAG
1	33+500 TO 33+800	FLAT	○	–	○	○(0.5m)	–
2	33+800 TO 33+914	MIARU Br. 33+810 - 33+904	–	○	○	○(0.5m)	–
3	33+914 TO 34+150	FLAT	○	–	○	○(0.5m)	–
4	34+150 TO 37+750	ROLLING/HILLY	○	–	–	–	–
5	37+750 TO 38+200	ALIKA SWAMP/W	○	–	○	○	○
6	38+200 TO 47+500	ROLLING/HILLY	○	–	–	–	–
7	47+500 TO 51+200	ROLLING	○	–	–	–	–
8	51+200 TO 54+000	FLAT/ROLLING	○	–	–	–	–
9	54+000 TO 57+100	FLAT	○	–	–	–	–
10	57+100 TO 58+600	KAPURI SWAMP/W	○	–	○	○(0.5m)	–
11	58+600 TO 59+909	KAPURI SWAMP/W	○	–	○	○(1.0m)	○
12	59+909 TO 59+998	KAPURI Br. 59+919 - 59+988	–	○	○	○(1.0m)	–
13	59+998 TO 63+500	KAPURI SWAMP/W	○	–	○	○(1.0m)	○
14	63+500 TO 64+000	KAPURI SWAMP/W	○	–	○	○(0.5m)	–
15	64+000 TO 67+100	FLAT/ILAVALA H.	○	–	–	–	–
16	67+100 TO 67+166	FLAT	○	–	○	–	–
17	67+166 TO 67+308	LAKEKAMU Br. 67+176 - 67+298	–	○	○	–	–
18	67+308 TO 68+667	FLAT	○	–	○	–	–
19	68+667 TO 68+809	TAURI Br. 68+677 - 68+799	–	○	○	–	–
20	68+809 TO 69+000	FLAT	○	–	○	–	–
21	69+000 TO 73+000	FLAT	○	–	–	–	–
22	73+000 TO 75+901	FLAT	○	–	○	○(1.0m)	–
23	75+901 TO 75+965	MAKARA Br. 75+911 - 75+955	–	○	○	○(1.0m)	–
24	75+965 TO 77+204	FLAT	○	–	○	○(1.0m)	–
25	77+204 TO 77+265	SAPPAHARO Br. 77+214 - 77+257	–	○	○	○(1.0m)	–
26	77+265 TO 77+700	FLAT	○	–	○	○(0.5m)	–
27	77+700 TO 80+596	FLAT/EXISTING R.	○	–	–	–	–

1 CLEARING AND GRUBBING (GROUP-3)

-1 Clearing

The area calculated covers an area within 20 metres of the centre line on both sides, and extends to 5 metres outside the top of cutting slope when it exceeds 20 metres. The subject area was classified by vegetations; light, dense and grass, and also by land with and without water. The swamp area is herewith defined as land with water.

-2 Grubbing

An area 2 metres beyond the toe of embankment or the top of cutting slope by is covered. For sections where geotextile fabrications are applied, a further 2 metres is included on both sides.

The limit of the clearing and grubbing area, and the classification with map symbols are shown in figures A3-2, A3-3 and A3-4.

-1 Excavation

- 4 types of soil defined in the DOW Design Standard were adopted for cutting based on the geological data.

TYPE	Depth from ground level
A (Solid Rock)	Deeper than 13m
B (Ripping Soils)	1m — 13m
C (Concrete pier in Sappaharo river N. side)	
D (Common Soil)	0m — 1m

- Summed as solid cut volume calculated by the average end area method.

- Typical cross sections are shown in Figure A3-5.

-2 *Embankment*

i. Embankment
- Summed as compacted volume calculated by the average end area method.
- The compacted fill volume is qualified from cutting earth volume by multiplying by the following conversion factors.

Type D (Common Soil) ... 0.85
Type B (Ripping Soil) ... 0.95
Type A (Solid Rock) ... 1.05

2 EARTHWORKS (GROUP-4)

ii. Settlement for LOT-II only
The settlement was analysed on the soft ground sections listed in Table A3-1. The settlement area of each embankment cross section was calculated employing the cross sectional settlement diagram shown in Figure A3-1. The settlement earth volume of each section was obtained by multiplying the ratio of the settlement area by embankment area of the cross section.

iii. Extra Fill for LOT-II only
In Lakekamu and Turi sections, due to residual settlement of the soft ground during 20 years after opening for traffic, the grade level would settle below the specified level which is 30 cm higher than flood water level Q50. Extra fill with height of 10 cm is planned as a countermeasure.
Extra fill volume is calculated below.

a) Lakekamu section 67+500 - 68+200 (L=700m)
$9.67m * 700.0m * 0.1m = 676.9\ m^3$
b) Tauri section 68+200 - 68+500 (L=300m)
$9.67m * 300.0m * 0.1m = 290.1\ m^3$

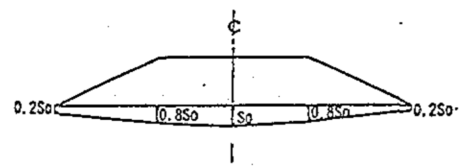


Figure A3-1 SECTIONAL SETTLEMENT DIAGRAM

TABLE A3-1 SOFT GROUND SECTIONS

LOCATION	CHAINAGE	LENGTH (m)	EMBANKMENT HEIGHT (m)	BORING NO.
MIARU	33+550 - 34+150	506	3.70	B- 6
ALIKA	37+750 - 38+200	450	3.60	B- 8
	57+100 - 59+800	2700	2.50	S- 2
KAPURI	59+800 - 60+100	231	3.00	B- 9
	60+100 - 62+400	2300	2.50	S- 3
	62+400 - 64+000	1600	2.50	S- 4
LAKEKAMU	67+100 - 67+500	278	4.00	B-11
	67+500 - 68+200	700	2.00	B-11
	68+200 - 68+550	350	1.70	B-14
TAURI	68+550 - 68+850	178	4.40	B-14
	68+850 - 69+000	150	1.70	B-14
MAKARA	73+000 - 76+300	3256	2.20	B-16
SAPPAHARO	76+300 - 77+700	1357	2.20	B-17
TOTAL		14056		

-3 Surplus material for Lot-II only

- Roadway

Soil volume 10,000 m^3 was planned to be reserved for Lot-II Miaru River Bereina side in the stock pile No.1 16,000 m^3 actually resulted in.

- *Intersections*

11,000 m^3 was Surplus-Soils at Intersection CH.1+450 and spoiled to spoil bank No.1. It was not used for the roadway.

-4 Cut in borrow for Lot-II only

Calculated quantity of borrow to meet fill requirement is based on volume Type-D & B excavation.
Borrow Pits 1--5 were provided accordingly as analyzed mass curve.

LOCATION OF BORROW PITS

Borrow Pits	Chainage	Side	Location
ST-1	33+300	RHS	Apanaipi Bereina side
B -1	34+200	RHS	Apanaipi Malalaua side
B -2	49+200	RHS	Palipala Hill
B -3	54+000	RHS	Palipala Hill
B -4	64+750	RHS	Ilavala Hill
B -5	Over the Project area		Malalaua Existing B.P.

-5 Unsuitable Material

i. Land (Roadway)

Estimates only. Estimated area is as same as grubbing area.

ii. Land (Borrow Pit) LOT-II only

Estimates only.
Calculated volume is the area of borrow pit times each assessed thickness as below.

Borrow pit	No.1	t=0.05m	
Borrow pit	No.2--4	t=0.10m	
Borrow pit	No.5	t=1.00m	...*Analysed from test pit
Sand borrow pit	No.2	t=0.10m	

iii. Swamp (Alika swamp) LOT-II only

The embankment structure for the soft ground in Alika swamp is shown in the typical cross section in Figure A3-6 (b). A layer of peat from the surface to 1.3m below the ground, which continues up to 1.8 m and comprises roots and decayed vegetation, was displaced.
Calculated volume f unsuitable material is the product of the area which was computed (including additional 2m width where sand mat and sand bag are applied) and the depth of 1.3m.

2 EARTHWORKS (GROUP-4)

iv. Land (Base Borrow Pit No. 1 & Subbase Borrow Pit No. 3) LOT-II only

Suitable material for base and subbase is located below 7m from the ground surface, which was analysed by test pit data.
The assessed thickness of the layer is only 2 to 3m. After removing fill material, there is still approx. 350,000 m^3 which is located below the fill materials collected and must be spoiled.

-6 Excavation for Structural Foundation

i. Road work

Volume was calculated by taking account of the areas for the gabions installed at the inlet and outlet of the pipe culverts and of the depth. Calculated at 60% of gabion cubic contents.

ii. Bridge work

The calculated volume is based on foundation levels and dimensions as shown on the drawings.
The volume includes river training.

-7 Filling to Structural Foundations

Bridge section only.
The calculated volume is based on the requirement to the existing surface level from the top of the relieving slabs.
The volume includes back fill materials.

-8 Sand Mat Material for LOT-II only

i. Sand Mat

Calculated by the average end area method.
Sand mat with 1.00m or 0.50m thickness with varying width depending on the embankment height is measured from the cross sections concerned. Volume in Alika swamp is based on the requirement to fill to the elevation 3.20m, which is the usual water level in the dry season.

ii. Sand Bag in Alika Swamp

The calculated volume is based on the required elevation of 3.20m. The width of the top is 1.0m with an outer slope of 1 in 1.5 and an inner slope of 1 in 1; the bags are placed on both sides as shown in Figure A3-6 (b).

iii. Sand Bag in K apuri Swamp

The calculated volume is based on the required elevation of 0.30m, which is the usual water level in the dry season and is measured from the existing ground level with installation on a slope of 1 in 1.5 shown in Figure A3-6 (b).

iv. Replacement in Alika Swamp

Calculated the same as -5.iii above.

v. Settlement

The calculated volume is based on settlement calculations.

2 EARTHWORKS (GROUP-4)

-9 Geotextile for Lot-II only

i. Type A

a) Alika swamp
The calculated volume is based on the slope up to the required elevation of 4.2m, which is flood water level Q100. This goes 1m into thembankment and extends 2m beyond the toe of the slope.

b) Kapuri swamp
The calculated volume is based on the assumption that geotextile is placed on the surface of 1.00m thick sand mat layer and extended 2m from the toe of slope.

ii. Type B

The calculated volume is based on the assumption that geotextile is placed under a 1.00m thick sand mat layer and extended 2m from the toe of the slope.
The layout of geotextile is shown in Figure A3-8.

-10 Subsoil Drain

Subsoil drains with UPVC pipe were provided in the sand mat or the embankment whose material is from Ilavala hills due to increased permeability.
The calculated volume is based on each cross sectional length times an area of 0.5m x 0.5m at 20m intervals.

-11 Reno Mattress

i. Type A for pipe

The calculated volume ibased on the required slope area depending on the culvert barrels times 0.15m thick at the inlet and outlet of the pipe.

ii. Type A for Alika for Lot-II only

The calculated volume is based on the slope up to the required elevation of 4.10m, which is flood water level Q100 and is from the toe of the sand mat. The area of the pipe mouth is deducted.
The thickness of the Reno Mattress is 0.15m.

iii. Type B

The calculated volume is based on the required level from the top of the gabions at TAENA, AGOBINO and UNGONGO Bridges and at MIARU River Malalaua side for river protection.
The thickness of the Reno Mattress is 0.23m.

The Reno Mattress in Alika swamp is shown in Figure A3-9.

-12 Gabion

The calculated volume of Gabions is the required area at the inlet and outlet depending on the culvert barrels times 0.50m thickness (excluding Alika swamp), and also at TAIENA, AGOBINO and UNGONGO Bridges for abutment protection.

2 EARTHWORKS (GROUP-4)

-13 Settlement plate for Lot-II only

The calculated volume of settlement plate is based on the installation at 250m intervals at the centre and both edges of the road in the settlement area.

-14 Displacement Peg for Lot-II only

The calculated volume of displacement peg is based on the installation at 250m intervals on both sides at the same location as the settlement plate installed.
The layout of settlement plate and displacement peg are shown in Figure A3-11.

-15 Excavation for Intersections for Lot-I only

The sum of 3 major intersections as solid cut volume calculated by average end area method. Type D only was assessed.

2 EARTHWORKS (GROUP-4)

-16 Embankment for Intersections

Nominal volume of 125.6 m^3 at each minor intersection. Calculated intersections are as follows;

	MAJOR	MINOR
LOT-I	CH. 0+200 (R), 0+260 (L) CH. 1+450 (L) CH.33+425 (L)	CH.14+200 (R)
LOT-II	-	CH.33+530 (L/R) CH.34+160 (R) CH.49+400 (L) CH.54+100 (R) CH.67+625 (L) CH.67+665 (R) CH.68+500 (L) CH.78+186 (L) CH.79+433 (L) CH.79+780 (L) CH.80+318 (L) CH.80+368 (R) CH.80+446 (R) CH.80+532 (L) CH.80+545 (R) CH.80+586 (L)

3-1 BASE AND SUBBASE (GROUP-5)

ROADWAY

-1 BASE COURSE

The calculated volume of base course layer is based on the length of the construction line minus the length of bridging. Sections of bridge approach winding for two lanes in Lot-I and reducing into single in Lot-II were adjusted. The volume of base course is calculated by the average end area method using 0.15m thickness.

-2 SUBBASE

(a) Upper subbase
The calculated volume is the same area as 3-1-1 above. Summed as base course calculated by the average end area method using 0.10m thickness.

(b) Lower subbase
The calculated volume is the same area as 3-1-1 above. Summed as base course calculated by the average end area method using 0.14m thickness.

3-1 BASE AND SUBBASE (GROUP-5)

INTERSECTIONS

-3 BASE COURSE

The calculated volume of base course layer is based on the length of construction line up to the top of the embankment slope of the main road from approaching existing road, and the road width required with 0.15m thickness at 3 major intersections.
Summed as base course calculated by the average end area method.

-4 SUBBASE COURSE

(a) Upper subbase
The calculated volume of upper subbase is based on the length of construction line minus cutting areas.
Summed as upper subbase calculated by the average end area method using 0.10m thickness.

(b) Lower subbase
The calculated volume of lower subbase is based on the length of construction line minus cutting areas.
Summed as lower subbase calculated by the average end are method using 0.14m thickness.

3-2 BITUMINOUS SURFACING (GROUP-6)

i. Prime Coat

The calculated volume of prime coat is the total area of base course surface and upper subbase surface and includes the 3 major intersections at an application rate of 0.6 litre/m^2.

ii. Blotter Material

The calculated area is the total surface areas of base and upper subbase courses.

iii. Residual Bitumen class 170

The calculated volume of residual bitumen is the length of the construction line excluding the bridge length which is multiplied by 7.10m standard width on the main road first seal at an application rate of 1.45 litre/m^2, and is multiplied by 6.50m width on the carriage way second seal at an application rate of 0.80 litre/m^2.
Calculation includes 3 major intersections.

The width is adjusted in the widened bridge approaches when double lanes are reduced to single lane, and also intersections. The list of tapered points is shown in figure A3-12 for LOT-I and figure A3-13 for LOT-II.

iv. Adhesive Agent

Calculated as 1% of iii. above.

v. 19.0mm cover aggregate

The volume is based on the area of bitumen as calculated under iii. first seal above at a spread rate of 75 m^2/m^3.

vi. 9.5mm cover aggregate

The volume is based on the area of bitumen as calculated under iii. second seal above at a spread rate of 117.5 m^2/m^3.

vii. Precoating material

The calculated volume of precoating material for sealing aggregate is the volume as calculated in v,vi. above at a rate of 9 litre/m^3.

viii. Area calculations

The areas for items i—vi above were calculated.

AREAS CALCULATED

No. Area	Unit	Lot-I	Lot-II
ROADWAY			
A-1 FIRST SEAL	m^2	226,799	330,247
A-2 SECOND SEAL	m^2	210,935	302,297
A-3 PRIME COAT ON BASE COURSE	m^2	284,361	395,611
A-4 PRIME COAT ON SUBBASE	m^2	299,401	416,574
INTERSECTIONS			
B-1 FIRST SEAL	m^2	1,171	-
B-2 SECOND SEAL	m^2	1,131	-
B-3 PRIME COAT ON BASE COURSE	m^2	3,970	-
B-4 PRIME COAT ON SUBBASE	m^2	1,162	-

4 DRAINAGE (GROUP-7)

-1 Corrugated steel pipe culvert

The quantity was determined from the information on the schedule of culverts and culvert detail drawings.

-2 Reno Mattress

Type A

The calculated volume is based on the slope areas required depending on the culvert barrels and a 0.15m thickness at the inlet and outlet pipe.

-3 Gabion

The calculated volume of gabions is the required area at the inlet and outlet taking account of the area required for barrels of 0.50m thickness.

-4 Excavation and backfill of drainage structure foundation

Calculated at 60% of 4-3 above.

Sectional length of pipe for calculation is shown in Figure A3-14.

5 ROAD FURNITURE AND MARKING (GROUP-7)

-1 Road signs

Calculated from the number of road signs shown on the schedule.
Types of road signs are shown in Figure A3-15.

-2 Road edge guide posts

Calculated as the number of road edge guide posts as shown on the schedule.
Layout for road edge guide posts is shown in Figure A3-16.

-3 Guardrails

Quantified on the assumptions that a two lane bridge approach is at 12m and a single lane bridge approach is at 28m on both sides.

Quantity composed of (1) 4m length of guardrail
(2) End section
(3) Post
(4) Fender post for single lane bridge in Lot-II only

Quantities of guardrails per bridge are shown in Table A3-2.

-4 Marking

Calculated as the linear metre of marking as shown on the schedule.

CLEARING AND GRUBBING

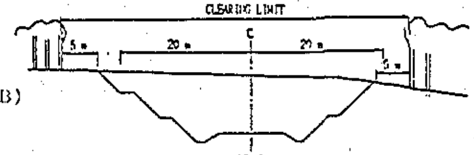
CLEARING

STANDARD LIMIT 20 m. BOTH SIDES OF THE CENTERLINE AS (A).

(A)

INCASE MORE THAN 20 m. FROM THE CENTERLINE TO TOP OF CUTTING SLOPE, A FURTHER 5 m. OUT FROM THE TOP OF CUTTING SLOPE AS (B).

(B)



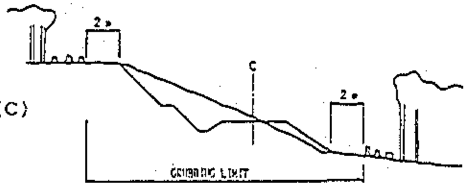
(b)

Figure A3-2 Limit of Clearing

GRUBBING

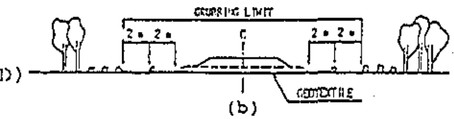
STANDARD LIMIT 2 m. OUT FROM THE TOE OR TOP OF SLOPE AS (C).

(C)



INCASE SETTING GEOTEXTILE SECTION; 2 m. OUT FROM THE EDGE OF SETTING GEOTEXTILE AS (D).

(D)



(b)

Figure A3-3 Limit of Grubbing

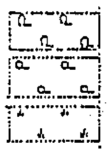
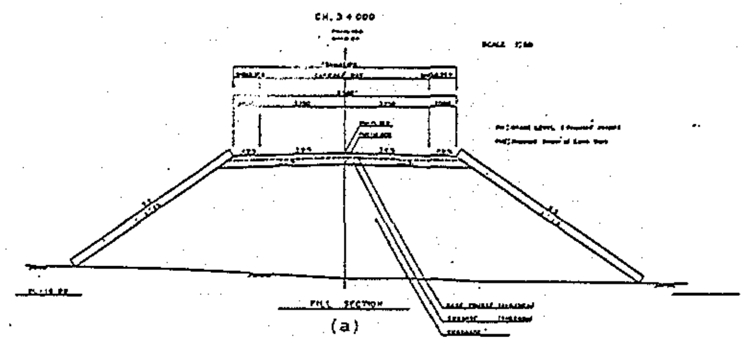
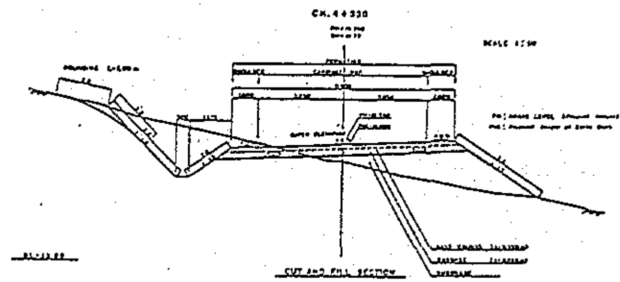
1/1000 TOPOGRAPHIC MAP SYMBOL		CLACIFICATION
	SCATTERED TREES	LIGHT
	FOREST	DENSE
	GRASSLAND	GRASS

Figure A3-4 Classification of Vegetation

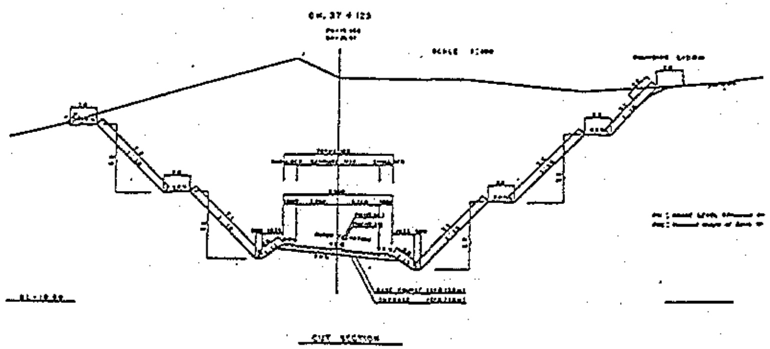
TYPICAL CROSS SECTIONS



(a)



(b)

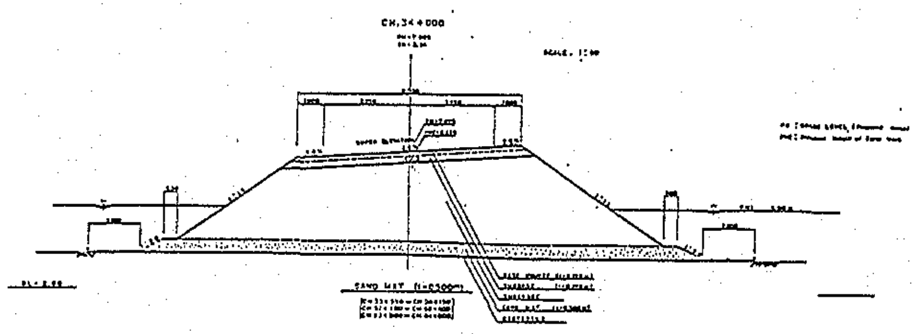


(c)

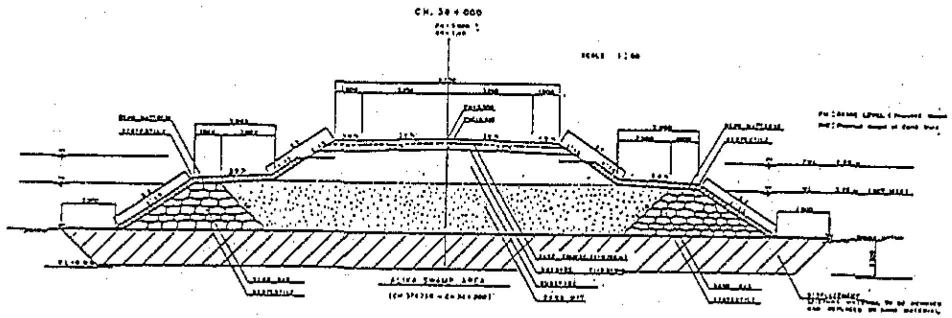
Figure A3-5 Typical Cross Sections in (a)Fill (b)Cut and fill (c)Cut

337

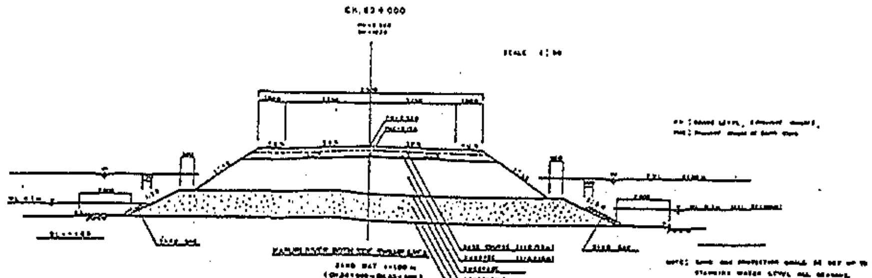
TYPICAL CROSS SECTIONS EMBANKMENT STRUCTURE



(a)Enbamkment with Sand Mat (t=0.50m)



(b)Enbankment in Alika Swamp



(c)Embankment in
Kapuri Swamp (t=1.00m)

Figure A3-6 Typical Cross Sections Embankment Structures

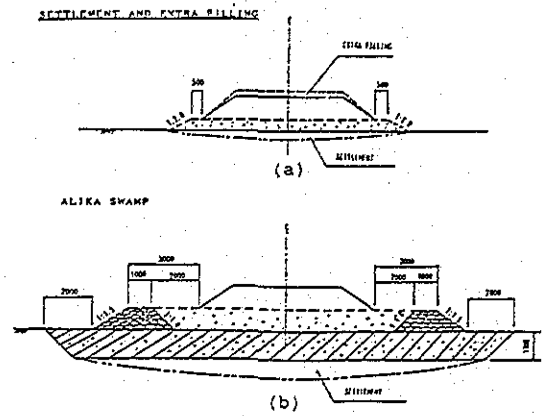


Figure A3-7 Settlement and Extra Filling

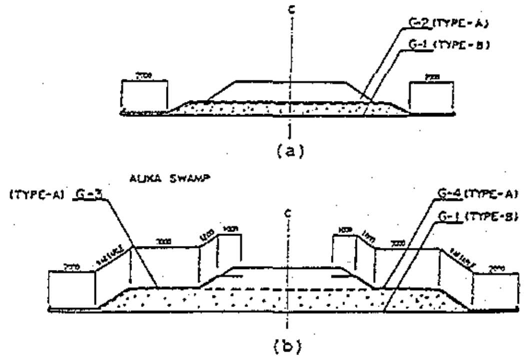
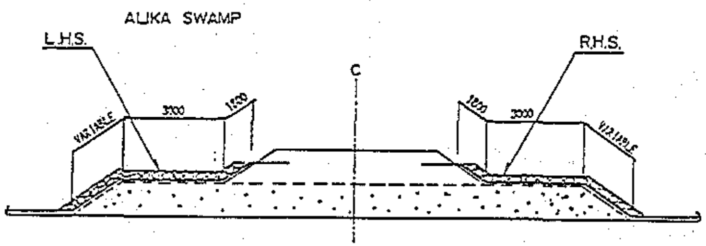


Figure A3-8 Geotextile Setting Type

338

RENO MATTRESS IN ALIKA SWAMP



RENO MATTRESS LOT - 11 SEC.5 ALIKA

DECREASED VOLUME CALCULATION
IN ALIKA RENO-MATTRESS

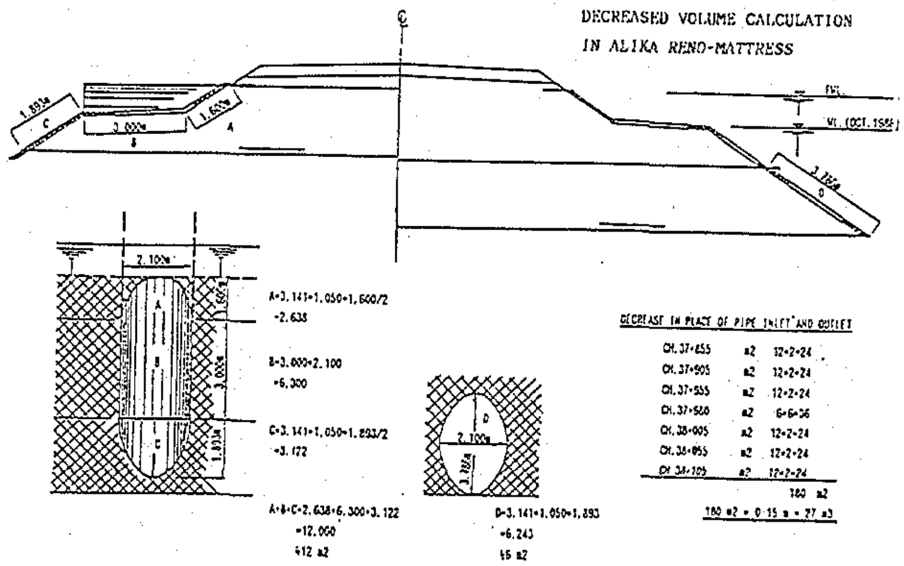


Figure A3-9 Reno Mattress in Alika Swamp

SUBSOIL DRAIN

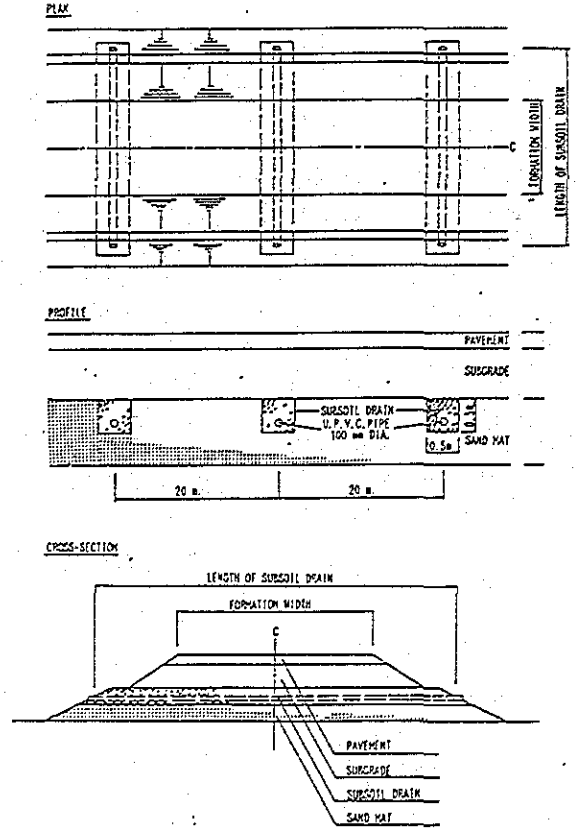


Figure A3-10 Subsoil Drain

SETTLEMENT PLATE AND DISPLACEMENT PEG

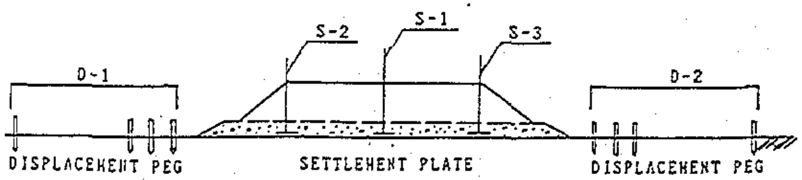
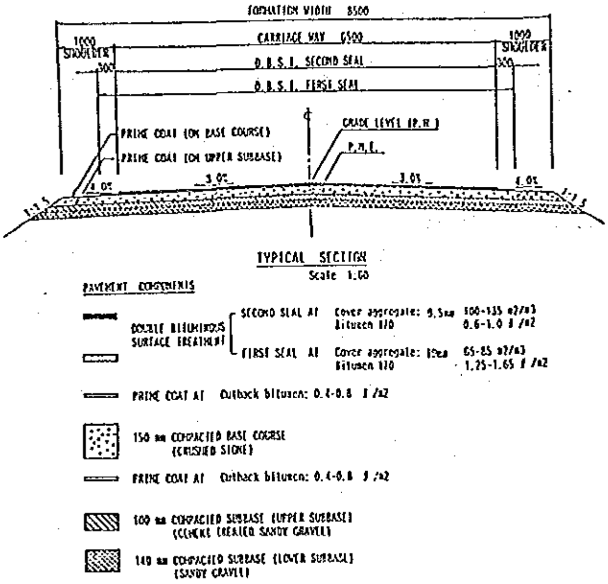
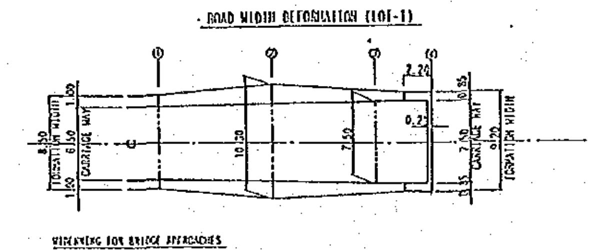


Figure A3-11 Settlement Plate and Dispalacement Peg



PAVEMENT SECTION FOR LOT-I



WIDENING FOR BRIDGE APPROACHES

BRIDGE \ CHAINAGE	ABUTMENT 1				ABUTMENT 2			
	①	②	③	④	④'	③'	②'	①'
TATERA BR.	CH. 11 +971	CH. 11 +981.5	CH. 11 +991	CH. 11 +996.4	CH. 12 +14.6	CH. 12 +20	CH. 12 +29.5	CH. 12 +40
KOSHIRO BR.	CH. 14 +697	CH. 14 +708	CH. 14 +717	CH. 14 +722.9	CH. 14 +744.1	CH. 14 +750	CH. 14 +759	CH. 14 +770

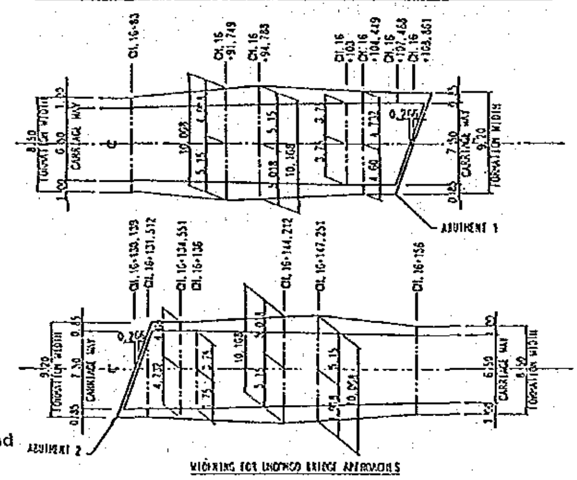
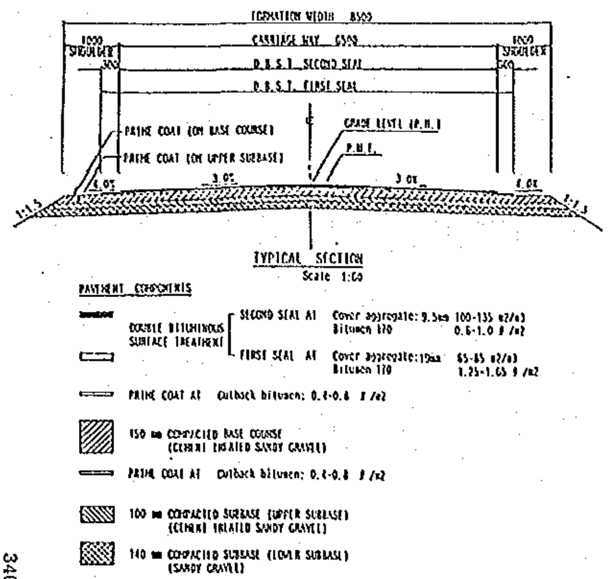
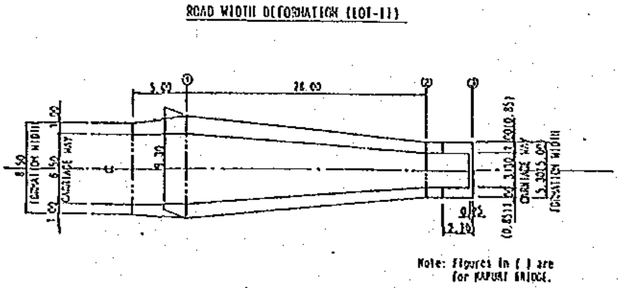


Figure A3-12 LOT-I Pavement Section and Chainage of Width taper





APPROACHES FOR BRIDGES

BRIDGE \ CHAINAGE	ABUTMENT 1			ABUTMENT 2		
	①	②	③	③'	②'	①'
NIARO BR.	CH. 33 +778	CH. 33 +806	CH. 33 +810.25	CH. 33 +903.75	CH. 33 +908	CH. 33 +936
KAPURI BR.	CH. 59 +887	CH. 59 +915	CH. 59 +919.4	CH. 59 +997.4	CH. 59 +992	CH. 60 +20
LAKEWARO BR.	CH. 67 +144	CH. 67 +172	CH. 67 +176.2	CH. 67 +297.8	CH. 67 +302	CH. 67 +330
TAURE BR.	CH. 68 +645	CH. 68 +673	CH. 68 +677.2	CH. 68 +798.8	CH. 68 +803	CH. 68 +831
HAKARA BR.	CH. 75 +879	CH. 75 +907	CH. 75 +911.8	CH. 75 +954.15	CH. 75 +959	CH. 75 +987
SAPPAMARO BR.	CH. 77 +182	CH. 77 +210	CH. 77 +214.1	CH. 77 +256.45	CH. 77 +261	CH. 77 +289

PAVEMENT SECTION FOR LOT-II

Figure A3-13 LOT-II Pavement Section and Point of Road Width Change

340

ATTACHMENT 3
Page 16

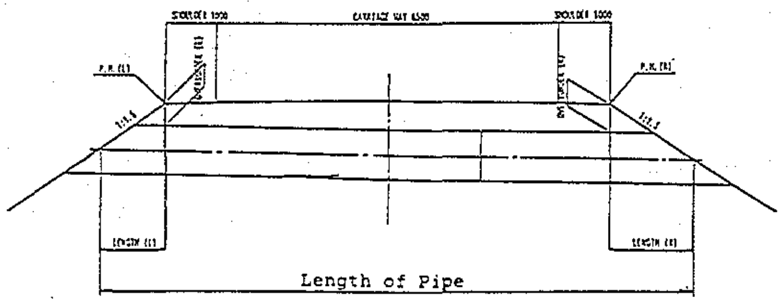
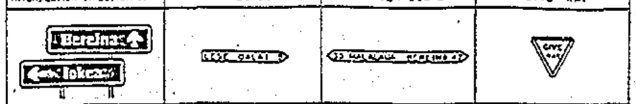


Figure A3-14 Sectional Length of Pipe

ROAD FURNITURE

ROAD SIGN



	INTERSECTION DIRECTION BOARD	FINGER BOARD	FINGER BOARD	GIVE WAY
TYPE	G 2	G3-1	G3-2	R1-2A
SIZE	1920 x 470	1260 x 200	2600 x 200	750
	NO OVERTAKING OR PASSING	GIVE WAY AHEAD	ONE LANE BRIDGE	SCHOOL
TYPE	R6-1A	W3-2A	W4-1A W8-16A	W6-4A
SIZE	750 x 900	750 x 750	600 x 600 (W4-1A) 600 x 400 (W8-16A)	600 x 600

Figure A3-15 Road Signs

ROAD EDGE GUIDE POST

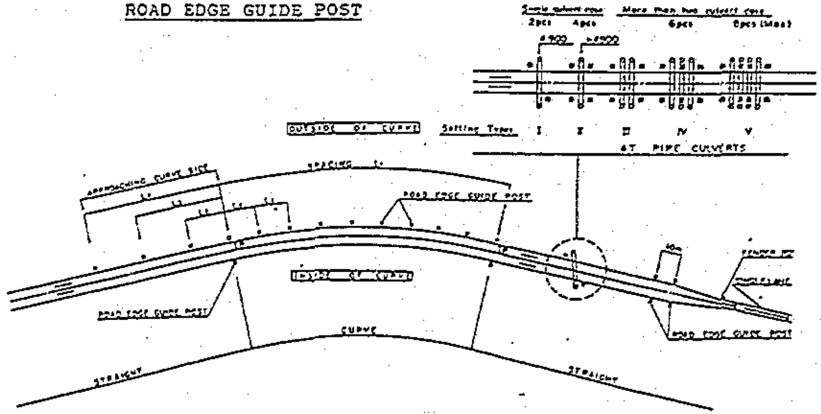


Figure A3-16 Layout for Road Edge Guide Posts

GUARDRAIL

Table A3-2 Quantities of Guardrail

TOTAL QUANTITIES PER BRIDGE

LOT-I
Single Lane Br.

BRIDGE	GUARDRAIL: ONE SECTION LENGTH (m)	TOTAL: POSTS * (NO)	TOTAL: 4m LENGTHS OF GUARDRAIL (NO)	TOTAL: GUARDRAIL END SECTIONS (NO)
TWO WAY BRIDGE	12	34	12	8

LOT-II
Double Lane Br.

BRIDGE	GUARDRAIL: ONE SECTION LENGTH (m)	TOTAL: POSTS * (NO)	TOTAL: 4m LENGTHS OF GUARDRAIL (NO)	TOTAL: GUARDRAIL END SECTIONS (NO)	FENDER POST
SINGLE LANE BRIDGE	26	32	28	8	4

* INCLUDES BLOCKS & M16 BOLTS

ATTACHMENT-4

Proposal on Alternative Construction Schedule

Proposal on Alternative Construction Schedule

Based on the comments expressed by the letter (13-5-2) dated 27 December, 1989 from the OIDA of PNG Government, the JICA study team proposed an alternative construction schedule only from the view point to minimize the annual local currency for the Project.

1. Pre-construction period

   No modification is considered for the pre-construction period of the Project.

2. Lot I construction period

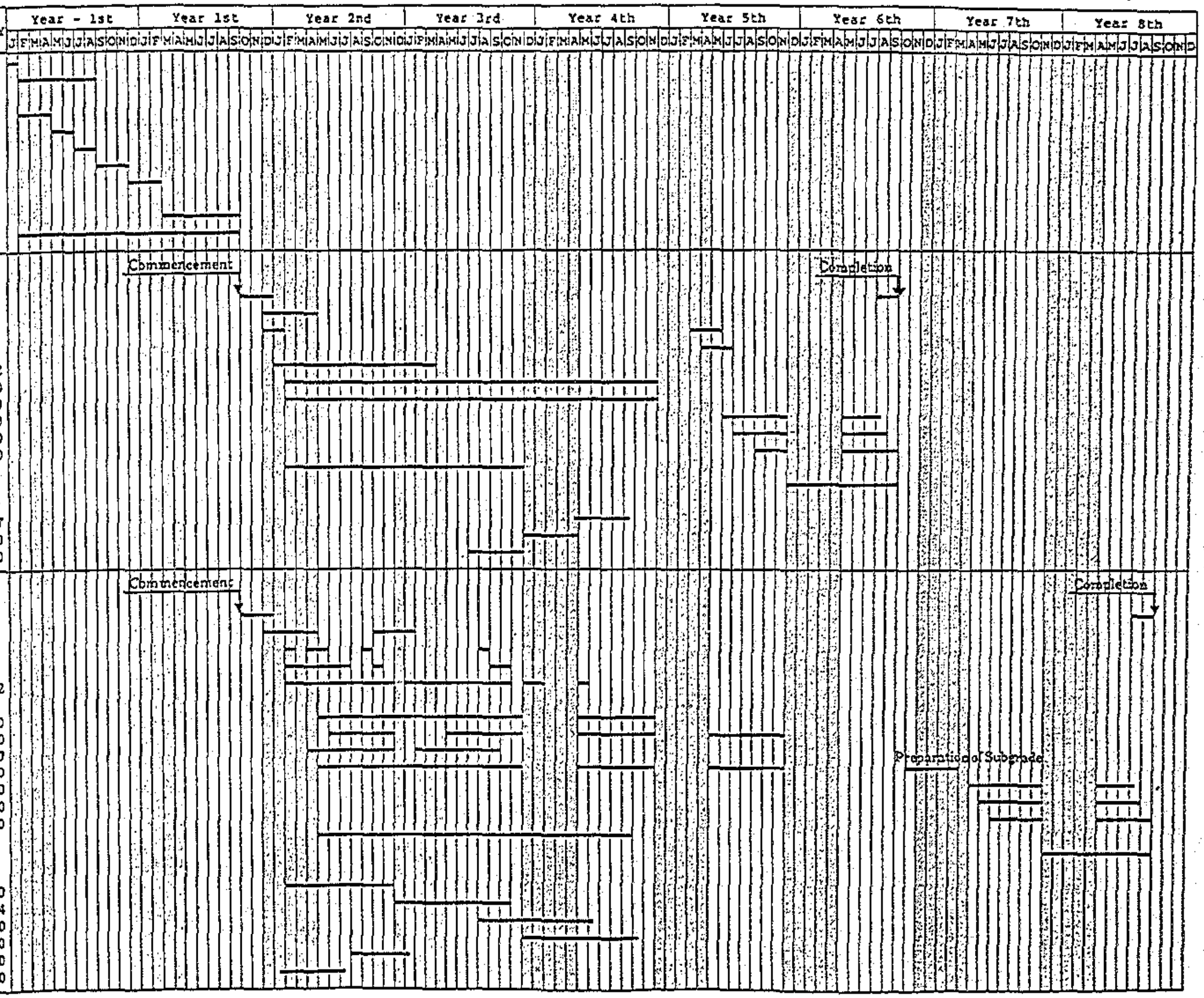
   The commencement of the Project is October of the year 1st as same as the basic schedule, however, the year of completion is to be extended two years (from the total 36 months to the 60 months). The works of Excavation and Embankment are to be extended one year, and the commencement of Pavement works are to be delayed two years.

3. Lot II construction period

   The commencement of the Project is October of the year 1st as same as the basic schedule, however, the year of completion is to be extended three years (from the total 48 months to the total 84 months).
   The works of Excavation including cut in borrow and Embankment is to be extended one year, and the commencement of Pavement works are to be delayed three years. The year 6th will have no works in the site accordingly.

The above alternative schedule is outlined in the Fig. 11-6. The disbursement for the alternative schedule is discussed in the Cost Estimate Report.

DESCRIPTION	UNIT	QUANTITY
Completion of Detailed Design		
Financial Arrangement		
Selection of Consultant		
Proposal		
Evaluation		
Approval of Consultant		
Prequalification		
Tender		
Evaluation		
Award of Contact		
Land Acquisition		
LOT I Bereina to Miaru River Sec.		
1. Preparatory Works		
Mobilization & Demobilizatio		LS
Temporary Building		LS
Access Road		LS
Borrow pit & Quarry site		LS
2. Clearing and Grubbing	ha	142
3. Excavation	m^3	829,000
4. Embankment	m^3	742,000
5. Subbase Course	m^3	75,500
6. Base Course	m^3	44,900
7. Bituminous Surfacing, DBST	m^2	288,300
8. Drainage Work		LS
9. Road Furniture		LS
10. Bridge Work		
(1) Bridge No.1 (Taiena)	m	17
(2) Bridge No.2 (Agobino)	m	20
(3) Bridge No.3 (Ungongo)	m	20
LOT II Miaru River to Malalaua Sec.		
1. Preparatory Works		
Mobilization & Demobilizatio		LS
Temporary Building		LS
Access Road		LS
Borrow Pit		LS
2. Clearing and Grubbing	ha	202
3. Excavation		
Excavation	m^3	261,000
Cut in Borrow	m^3	392,000
4. Sand Mat	m^3	172,000
5. Embankment	m^3	591,000
6. Sub base Course	m^3	104,000
7. Base Course	m^3	60,900
8. Bituminous Surfacing, DBST	m^2	395,000
9. Drainage Work		LS
10. Road Furniture		LS
11. Bridge Work		
(1) Bridge No.4 (Miaru)	m	90
(2) Bridge No.5 (Kapuri)	m	64
(3) Bridge No.6 (Lakekamu)	m	120
(4) Bridge No.7 (Tauri)	m	120
(5) Bridge No.8 (Makara)	m	40
(6) Bridge No.9 (Sappaharo)	m	40



Note : The year - 1st is 1990 in the earlist.

Fig. 11-6 ALTERNATIVE CONSTRUCTION SCHEDULE FOR THE PROJECT

JICA