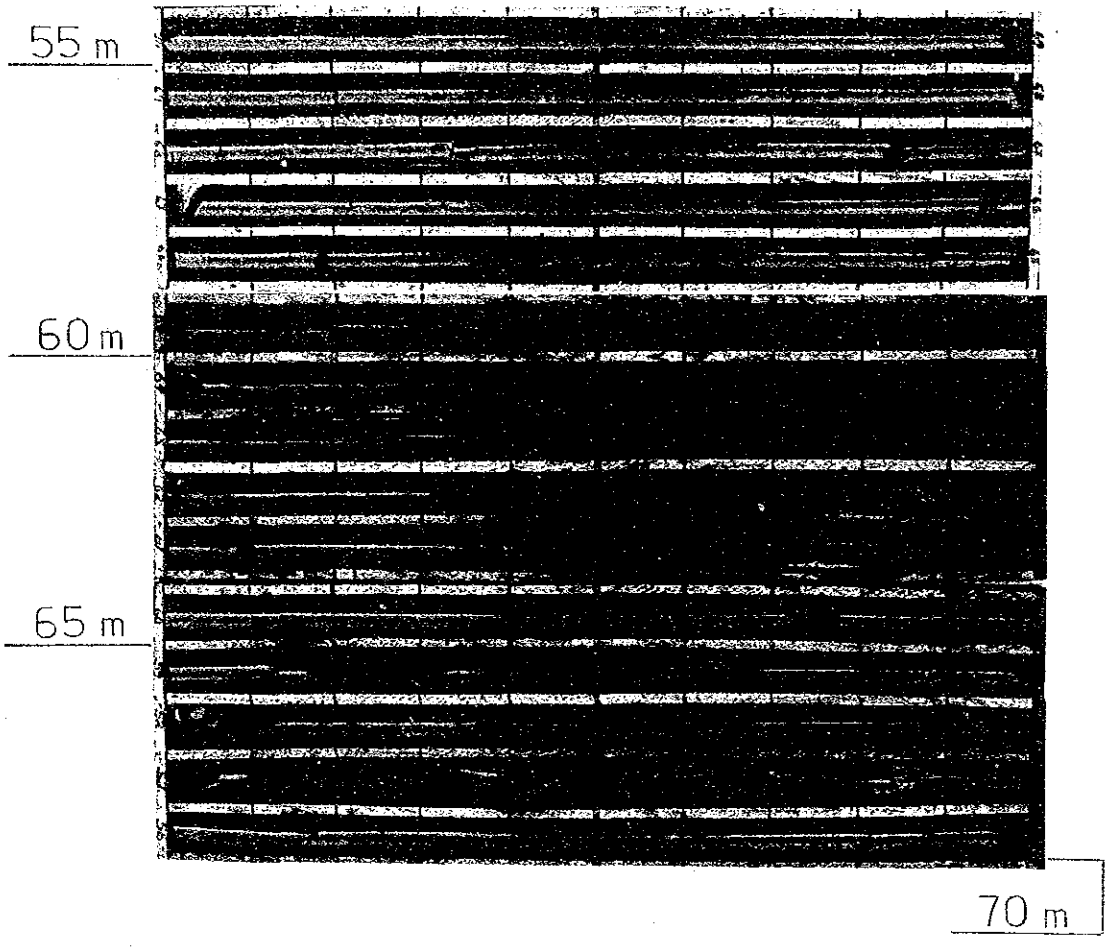
DRILLHOLE LB-2

Sheet (12-21)

DEPTH

From 55 m

To 70 m



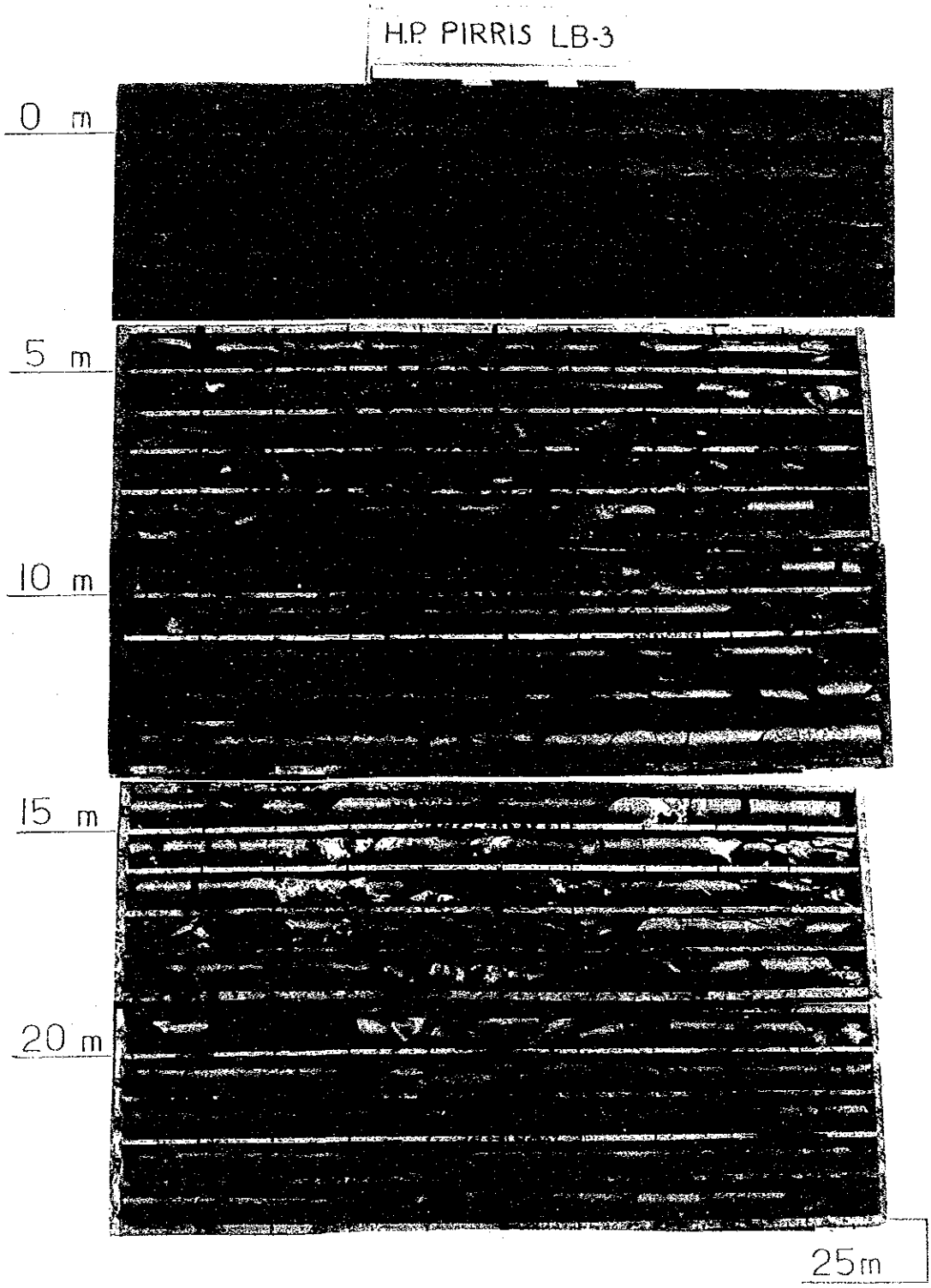
DRILLHOLE LB-3

Sheet (13-21)

DEPTH

From 0 m

To 25 m



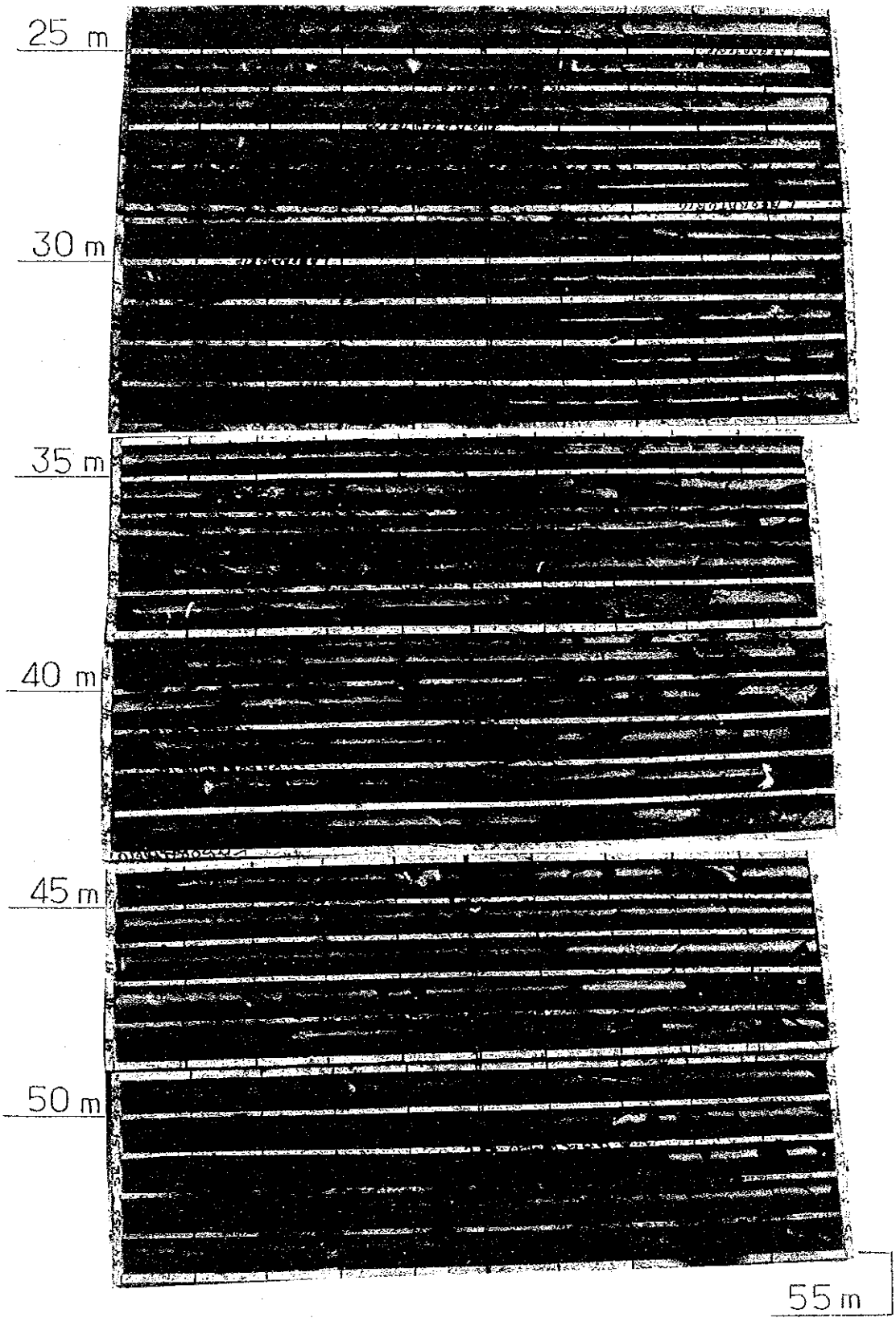
DRILLHOLE LB-3

Sheet (14-21)

DEPTH

From 25 m

To 55 m

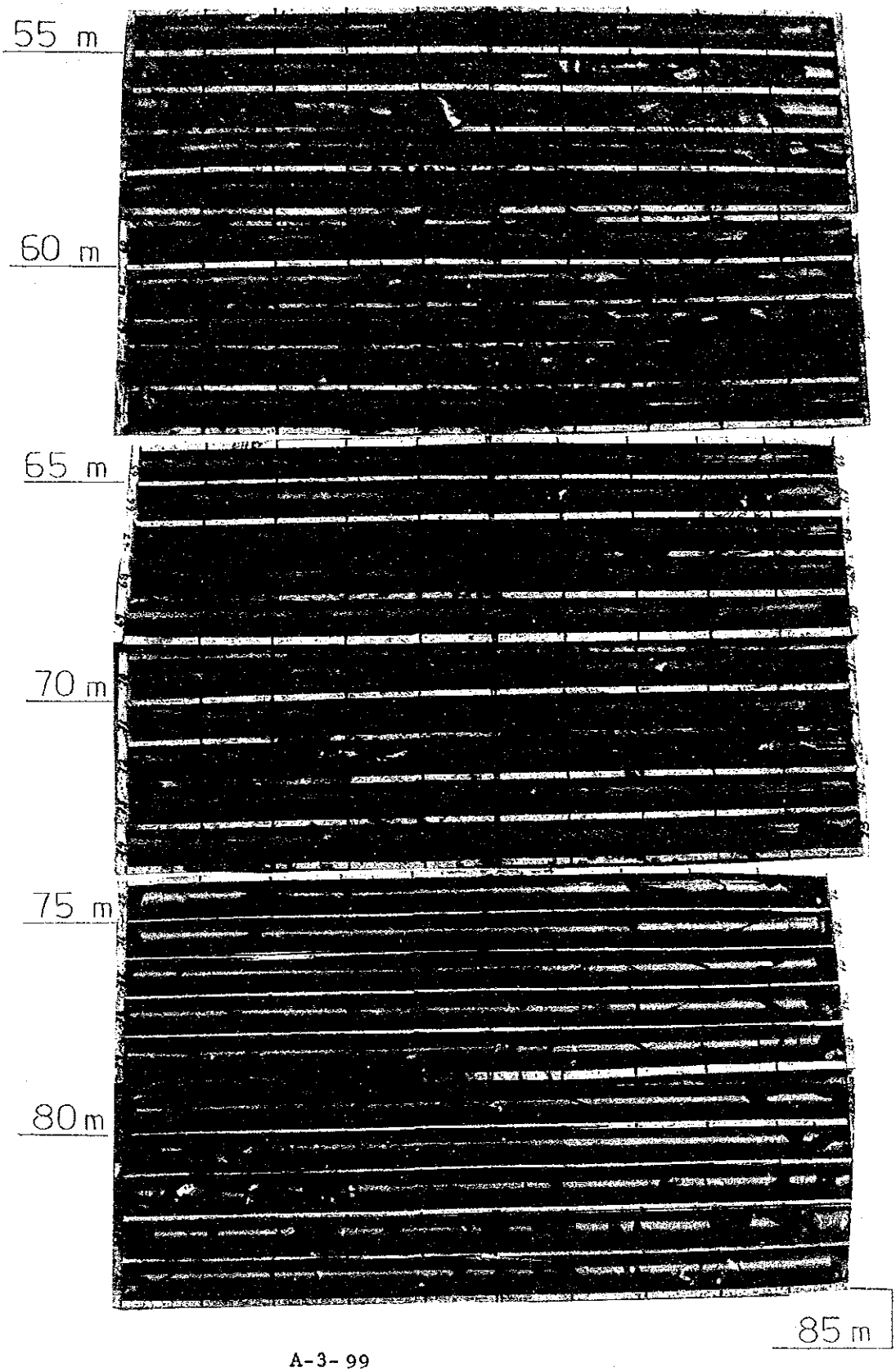


DRILLHOLE LB-3 Sheet (15-21)

DEPTH

From 55 m

To 85 m



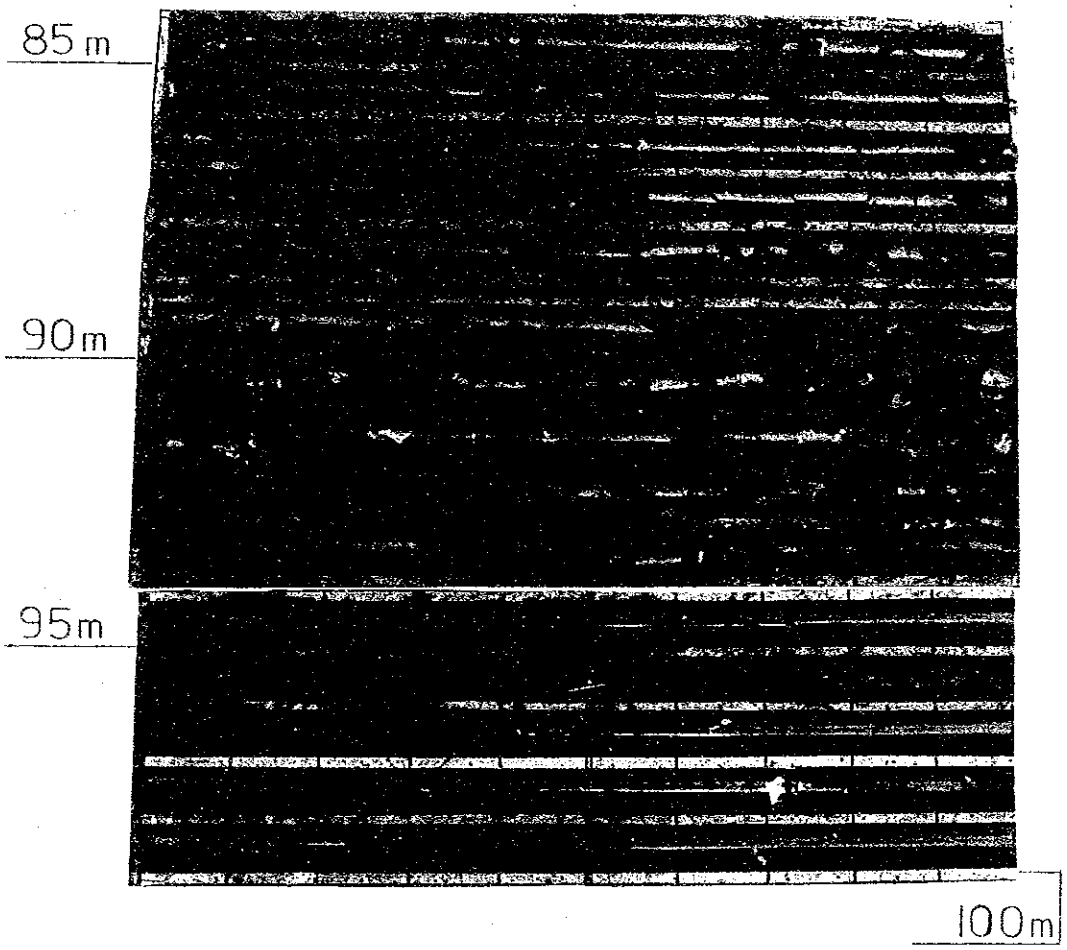
DRILLHOLE LB-3

Sheet (16-21)

DEPTH

From 85 m

To 100 m



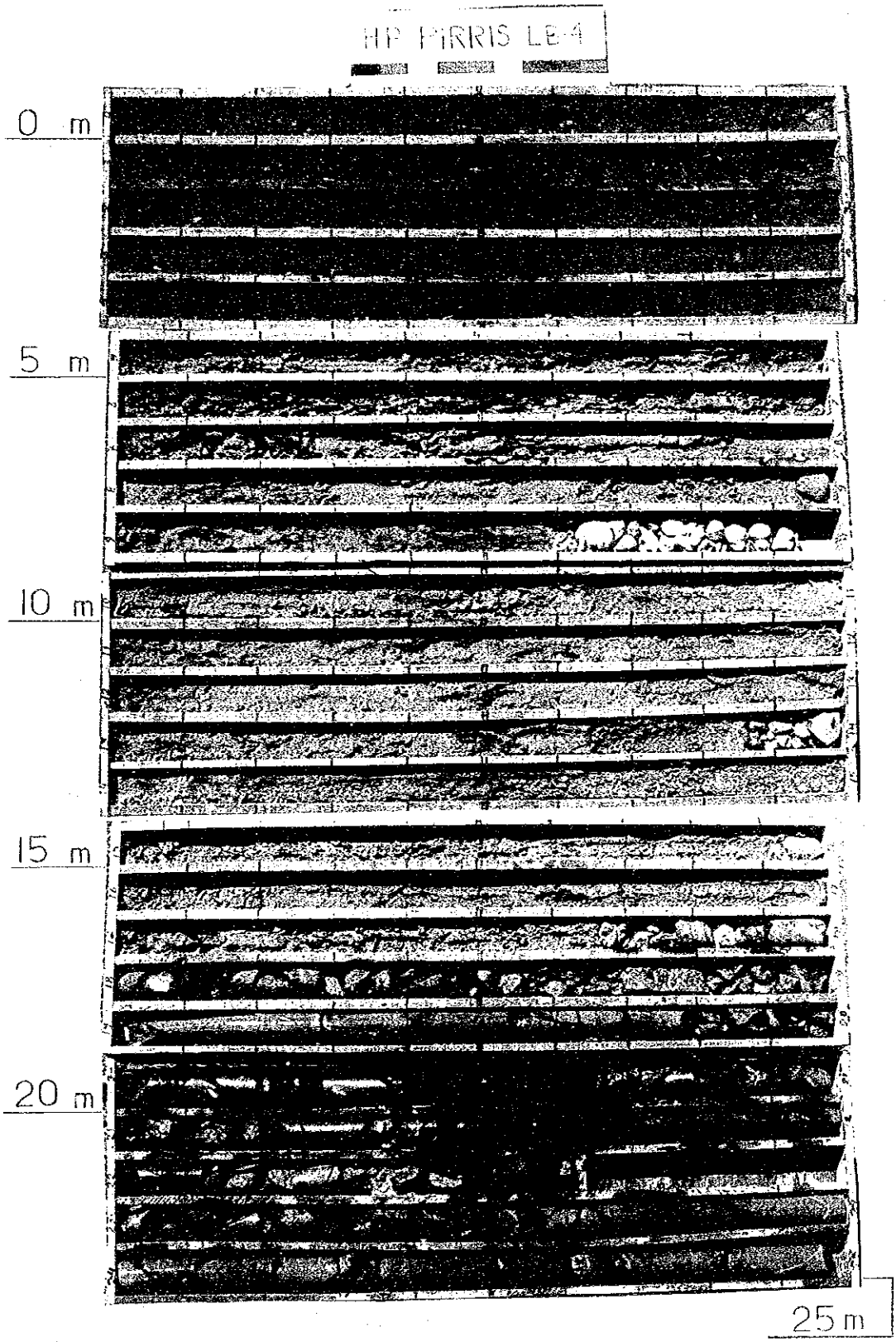
DRILLHOLE LB-4

Sheet (17-21)

DEPTH

From 0 m

To 25 m



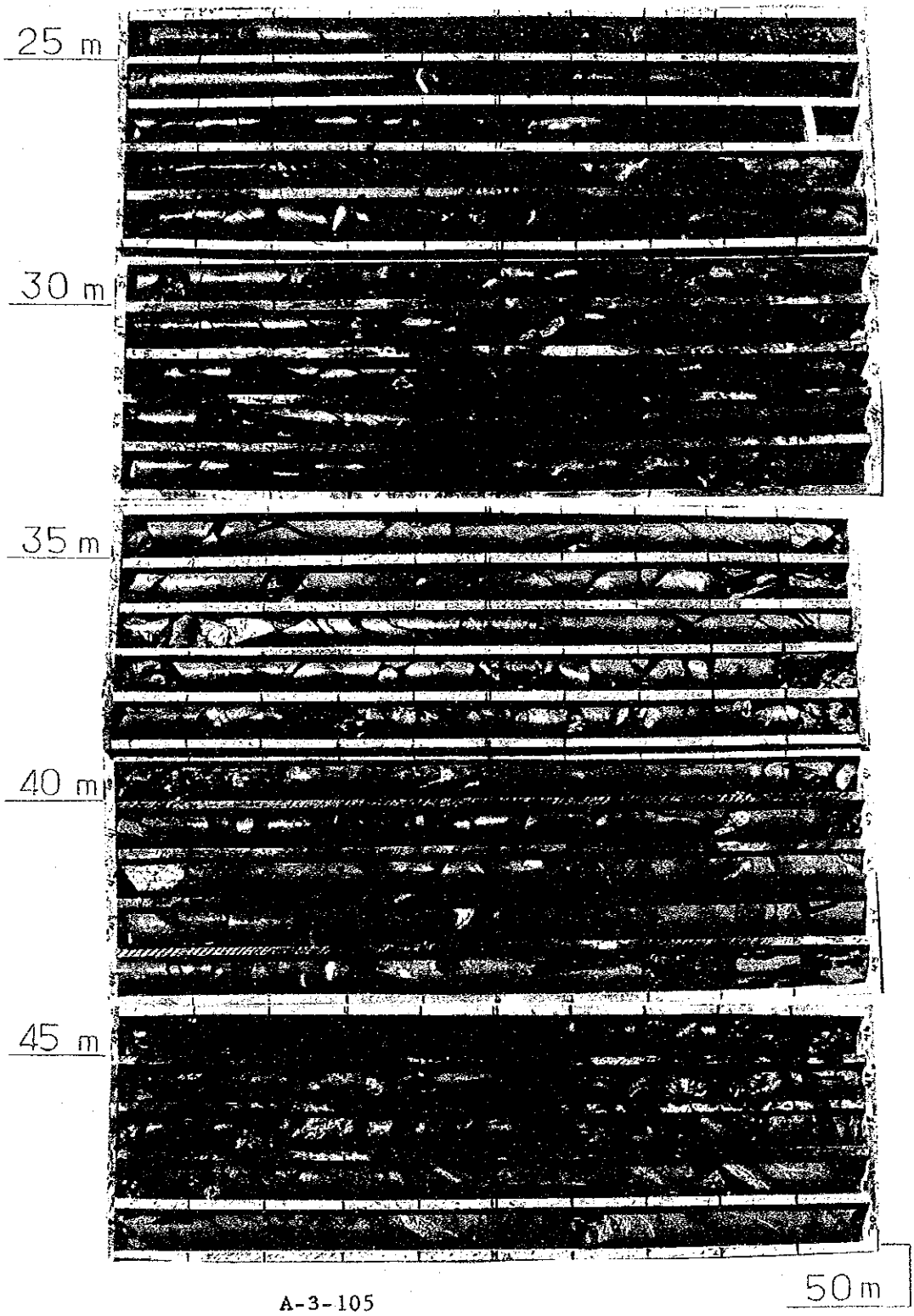
DRILLHOLE LB-4

Sheet (18-21)

DEPTH

From 25 m

To 50 m



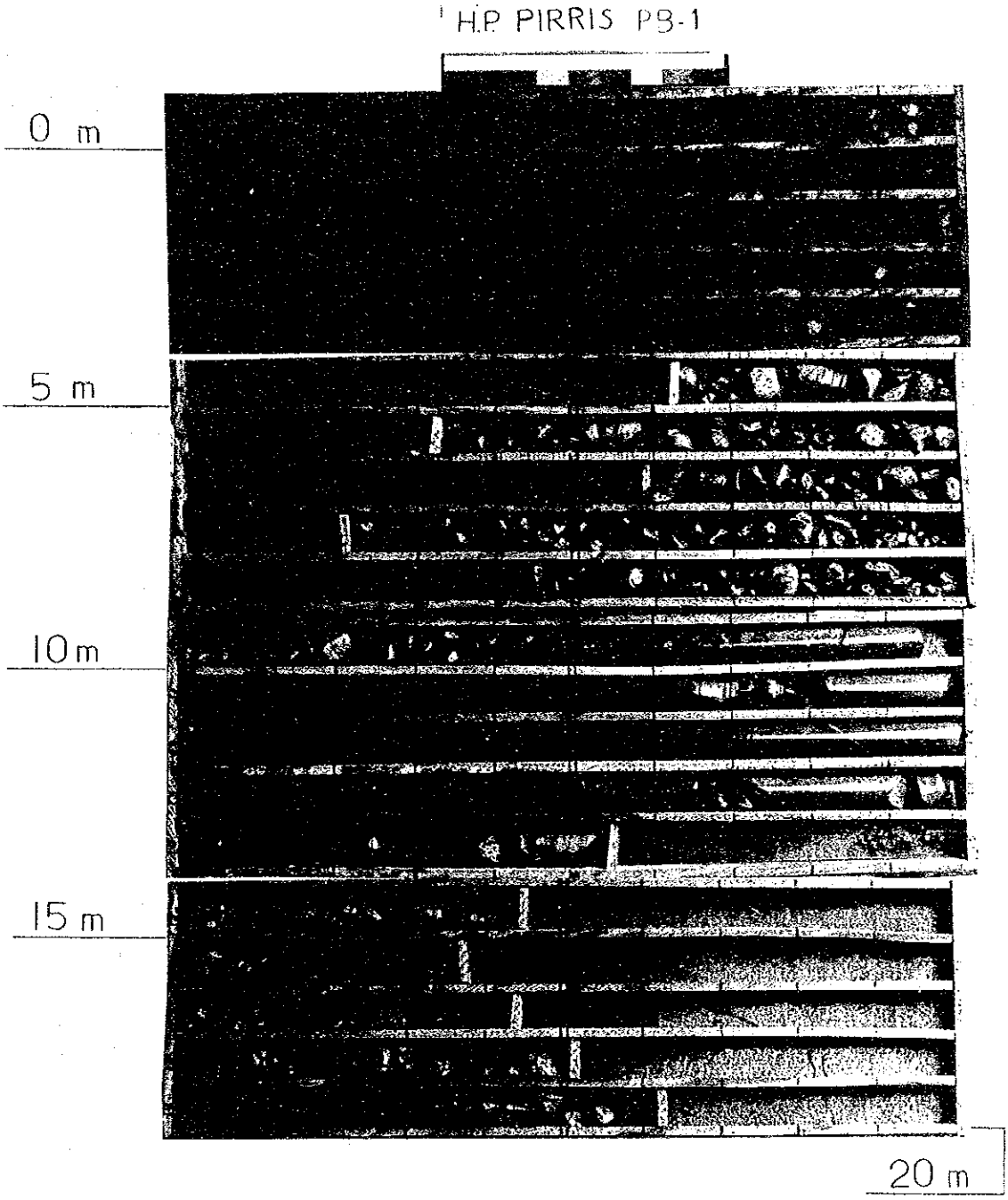
DRILLHOLE PB-1

Sheet (19-21)

DEPTH

From 0 m

To 20 m



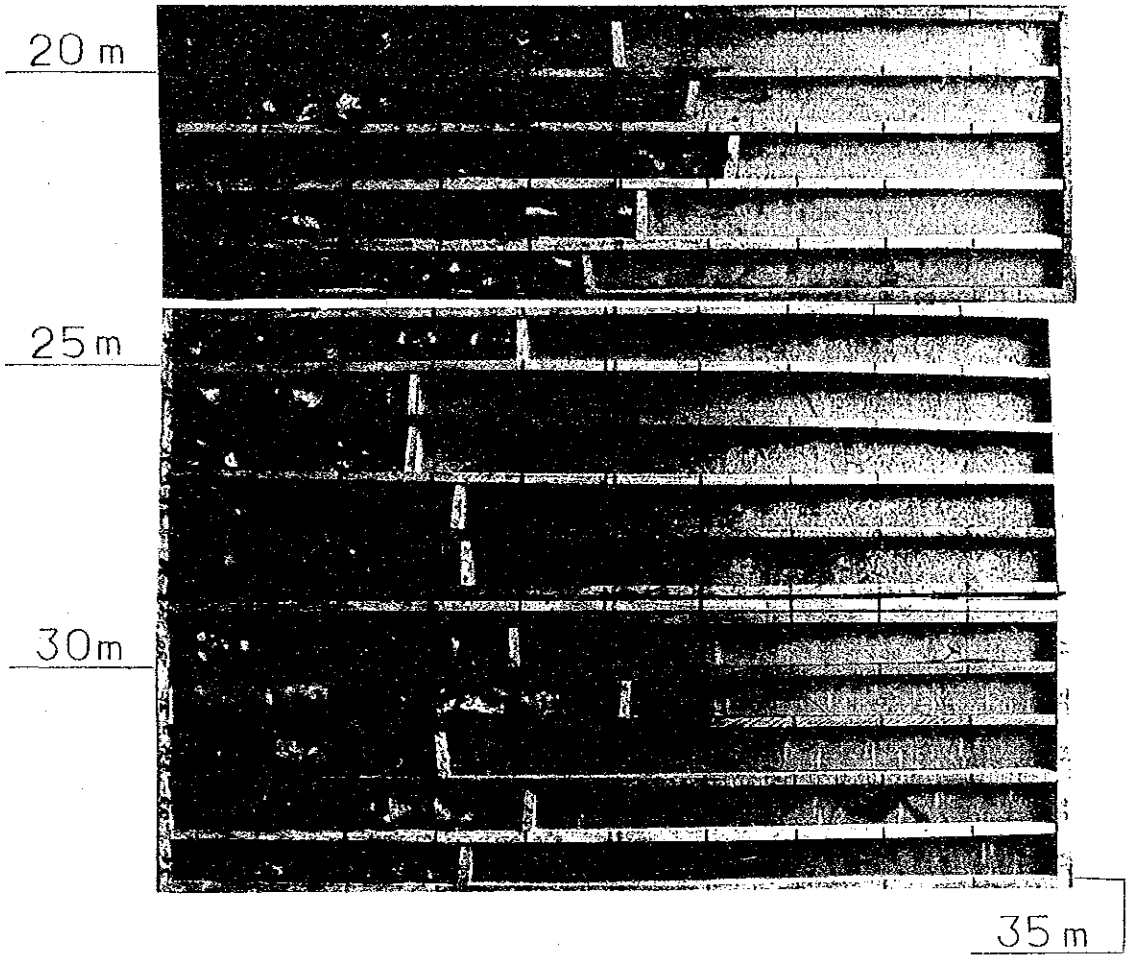
DRILLHOLE PB-1

Sheet (20-21)

DEPTH

From 20 m

To 35 m



DRILLHOLE PB-2

Sheet (21-21)

DEPTH

From 0 m

To 25 m

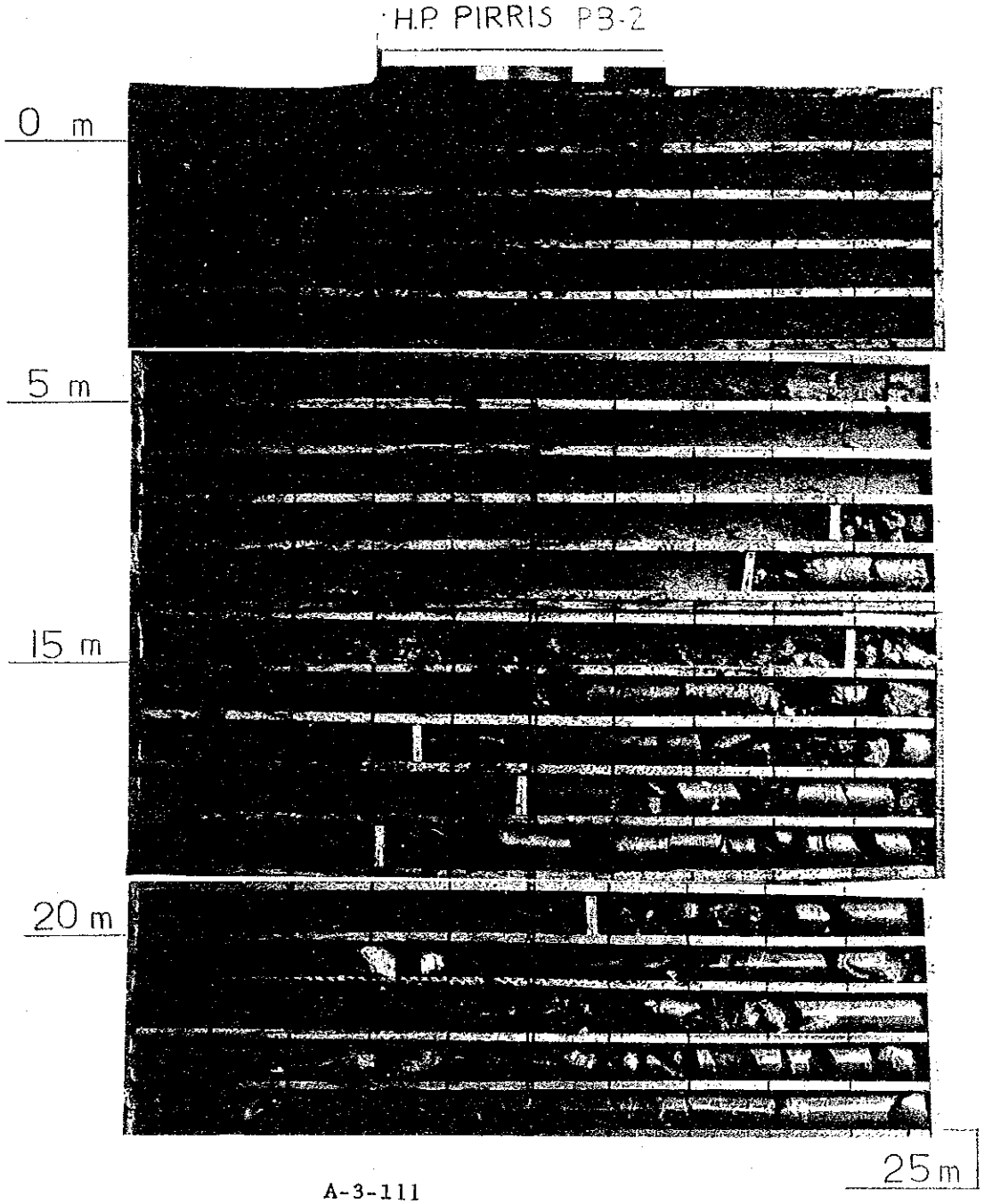


Table A3.7.1 Results of Lugeon Test (Sheet 1-3)

Drill hole No.	Location Tested	Lugeon Value	Maximum Pressure	Water Level when tested	Remarks
	m～m		kg／cm²	m	
UB-1	21.8～25.0	(13.0)	7.5	24.15	
	25.0～30.0	(52.7)	3.8	30.0 <	
	30.0～35.0	1.6	13.3	35.0 <	
	35.0～40.0	0.15	14.0	39.45	
	40.0～45.0	3.3	13.2	31.4	
	45.0～50.0	2.1	13.4	33.6	
UB-2	1.8～ 5.0	(4.2)	5.24	2.3	
	5.0～10.0	(39.0)	5.2	1.57	
	10.0～15.0	8.0	10.16	1.40	
	15.0～20.0	19.5	10.23	2.28	
	20.0～25.0	0.2	10.2	1.95	
	25.0～30.0	0.6	10.24	2.45	
	30.0～35.0	0.95	10.24	2.40	
	35.0～40.0	1.65	10.23	2.30	
	40.0～45.0	0.85	10.23	2.30	
	45.0～50.0	2.2	10.23	2.30	
UB-3	36.5～40.0	(67.0)	4.28	32.0	Packer trouble
	40.0～45.0	(13.6)	9.0	39.0	
	45.0～50.0	(21.0)	9.5	50.0 <	

Note: (1) Lugeon value in parenthises is calculated value when maximum pressure is less than 10kg／cm².

(2) Water Level value in UB-2 shows diagonal length.

Table A3.7.2 Results of Lugeon Test (Sheet 2-3)

Drill hole No.	Location Tested	Lugeon Value	Maximum Pressure	Water Level when tested	Remarks
	m～m		kg／cm²	m	
LB-1	5.8～10.0	(63.0)	3.8	10.0 <	
	11.0～15.0	(7.2)	5.9	9.0	
	15.0～20.0	0.4	11.6	15.9	
	21.0～25.0	0.2	11.5	15.0	
	25.0～30.0	19.0	11.9	18.5	
	30.0～35.0	0.2	11.9	18.5	
	35.0～40.0	0.2	13.2	31.8	
	40.0～45.0	16.0	11.5	36.2	
	45.0～50.0	0.1	14.2	41.6	
	50.0～55.0	0	14.2	41.6	
	55.0～60.0	0	14.9	48.12	
	60.0～65.0	0	14.8	48.12	
	65.0～70.0	0	14.9	48.12	
LB-2	5.8～10.0	(43.0)	3.8	10.0 <	
	11.6～15.0	(7.0)	6.3	13.05	
	15.0～20.0	(34.0)	6.8	20.0 <	
	20.0～25.0	(7.2)	6.9	19.0	
	25.0～30.0	(3.0)	7.1	20.6	
	30.0～35.0	(1.8)	7.4	23.73	
	35.0～40.0	(15.0)	7.3	23.0	
	40.0～45.0	18.0	10.6	26.0	
	45.0～50.0	14.0	13.8	37.37	
	50.5～55.0	0.7	13.8	37.5	
	55.5～60.0	1.2	13.7	37.0	
	60.0～65.0	0.2	13.9	39.0	
	65.0～70.0	0	13.9	39.0	

note: (1) The same as **Table A3.7.1**(Sheet 1-3).

Table A3.7.3 Results of Lugeon Test (Sheet 3-3)

Drill hole No.	Location Tested	Lugeon Value	Maximum Pressure	Water Level when tested	Remarks
	m~m		kg/cm²	m	
LB-3	40.0~45.0	(100.0)	5.5	32.5	
	46.3~50.0	(48.0)	7.9	43.6	
	50.0~55.0	(32.0)	7.9	55.0 <	
	56.0~60.0	(47.0)	6.9	60.0 <	
	61.3~65.0	25.0	11.3	65.0 <	
	65.0~70.0	8.0	16.8	70.0 <	
	71.5~75.0	17.5	13.5	71.0	
	75.6~80.0	18.0	11.3	71.0	
	80.6~85.0	19.0	11.8	85.0 <	
	87.0~90.0	23.0	11.7	90.0 <	
	90.0~95.0	—	—	—	Packer trouble
	95.0~100.0	—	—	—	ditto
LB-4	25.5~30.0	(60.0)	4.4	30.0 <	
	30.0~35.0	—	—	—	Packer trouble
	35.5~40.0	2.5	12.3	26.0	
	40.9~45.0	2.7	12.4	27.0	
	45.0~50.0	(22.0)	3.4	27.0	

Note: (1) The same as Table A3.7.1 (Sheet 1-3).

(2) Water Level value in LB-4 shows diagonal length.

APPENDIX A-4 ROCK FOUNDATION TEST

APPENDIX A-4 ROCK FOUNDATION TEST

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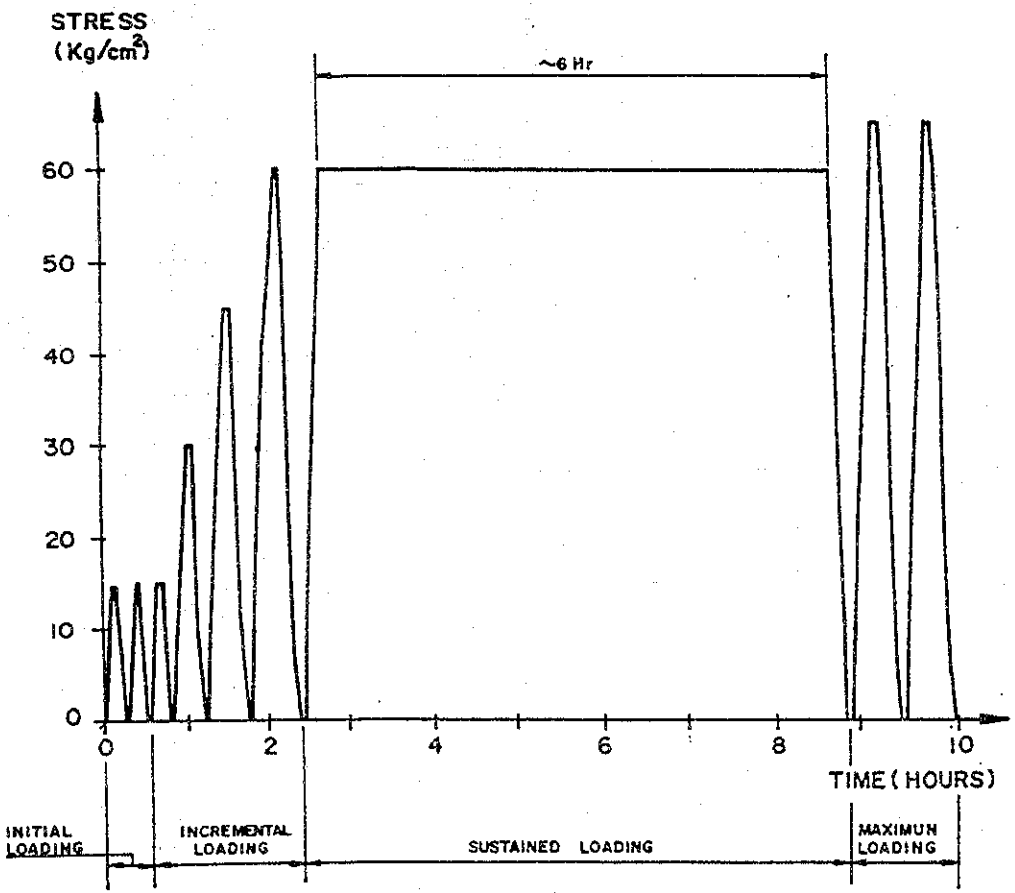
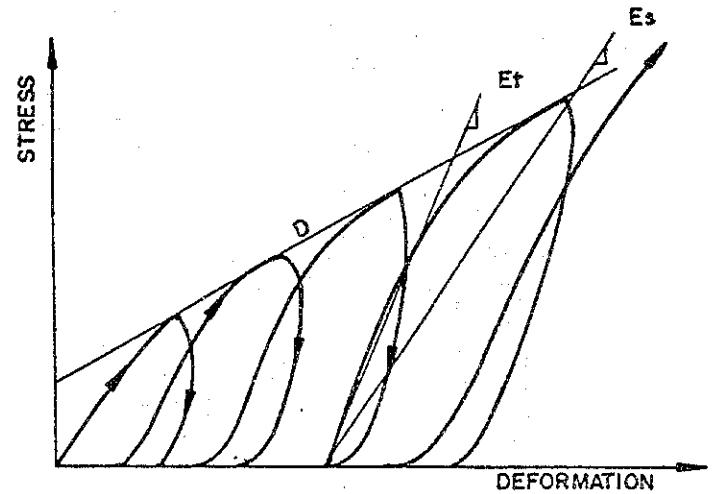
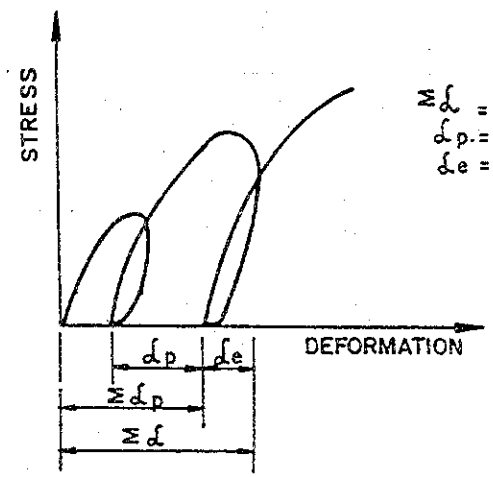
Fig. A-4-1 Loading Diagram





D = Modulus of deformation
Et = Tangential mod. of elasticity
Es = Secant mod. of elasticity



Σδ = Total deformation
δp = Plastic deformation
δe = Elastic deformation

Fig. A-4-2 Plate Bearing Test Apparatus

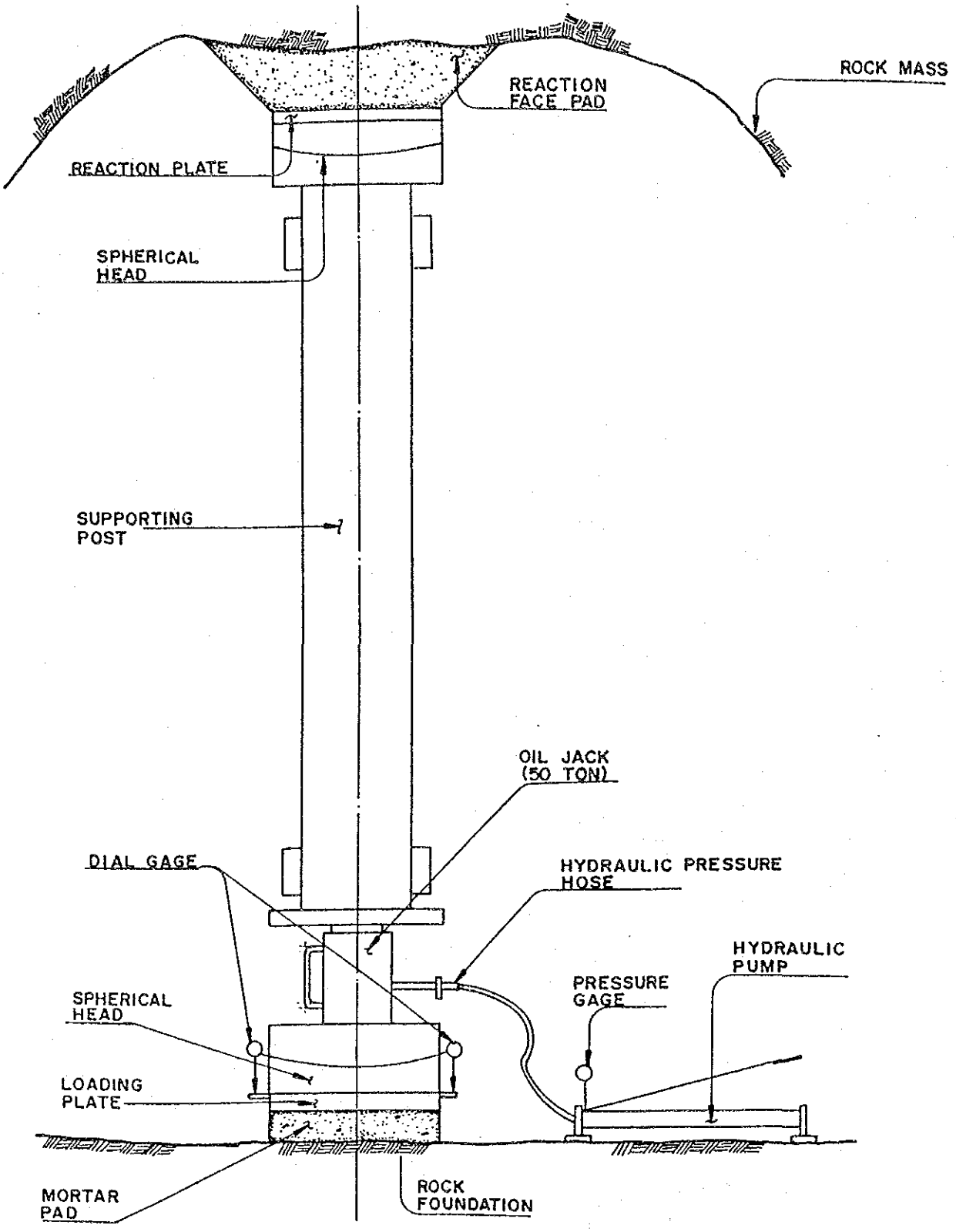


Fig. A-4-3 Modulus Characteristics of Rock Foundation

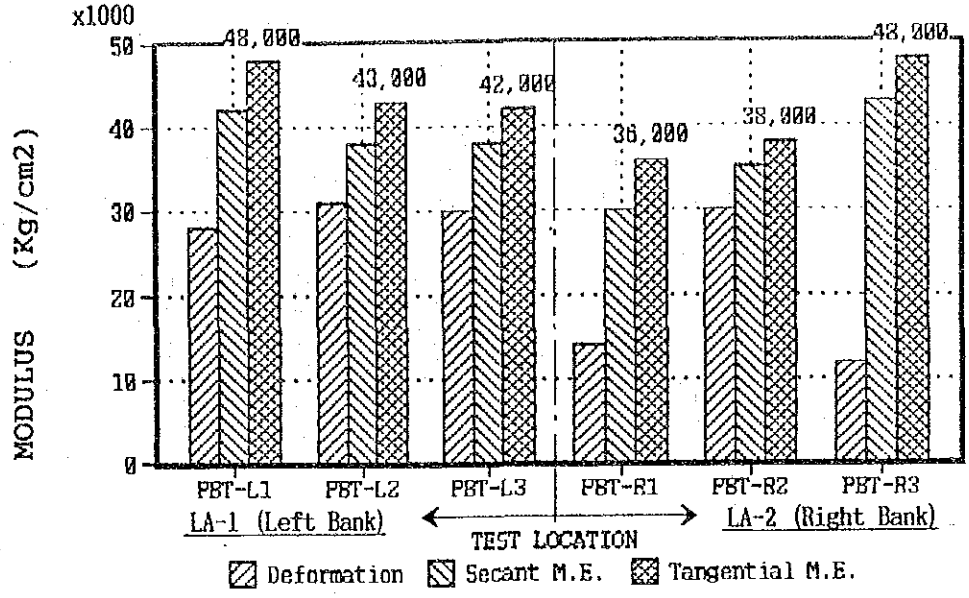


Fig. A-4-4 Deformation Characteristics of Rock Foundation

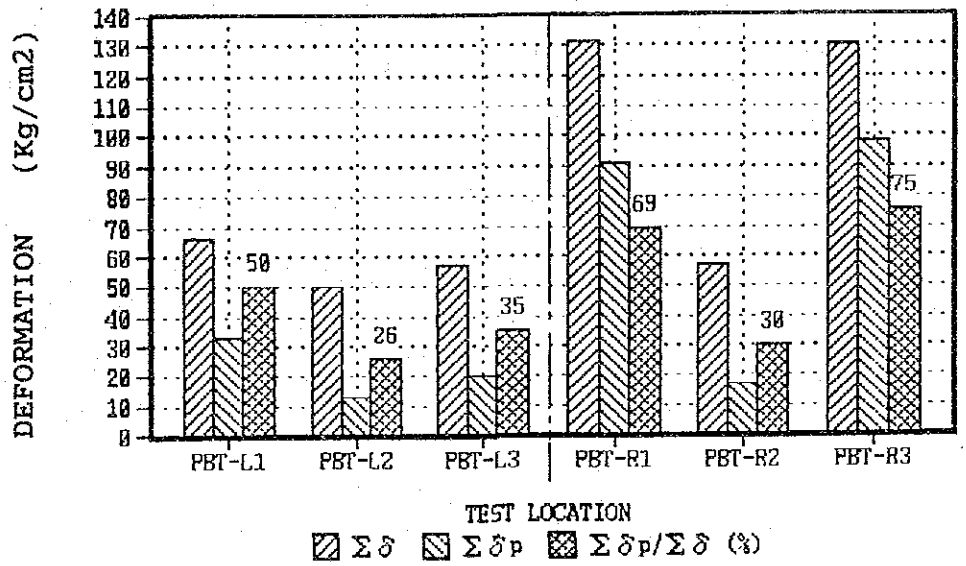


Fig. A-4-5 Creep Characteristics of Rock Foundation

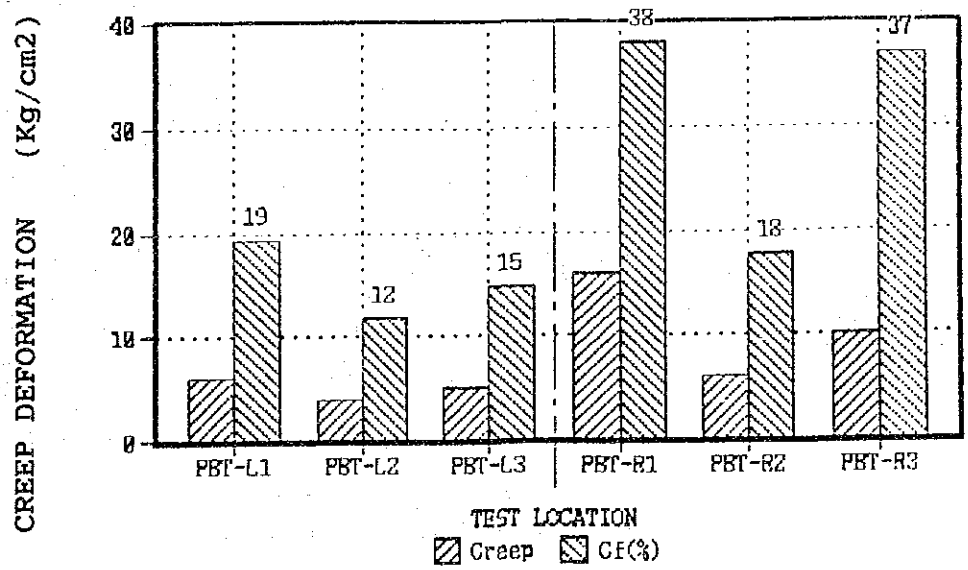


Fig. A-4-6 Geologic Condition of Test Location

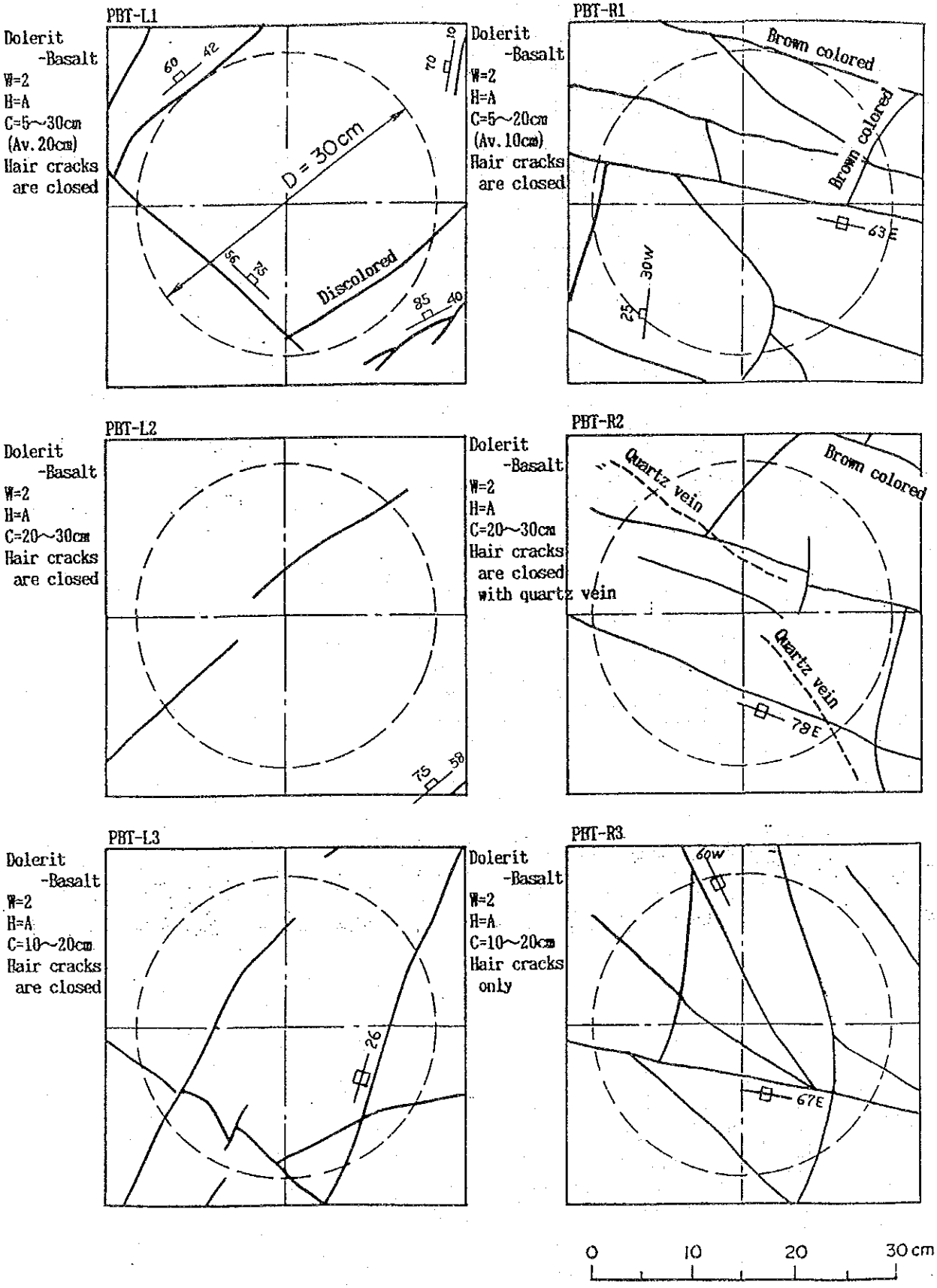
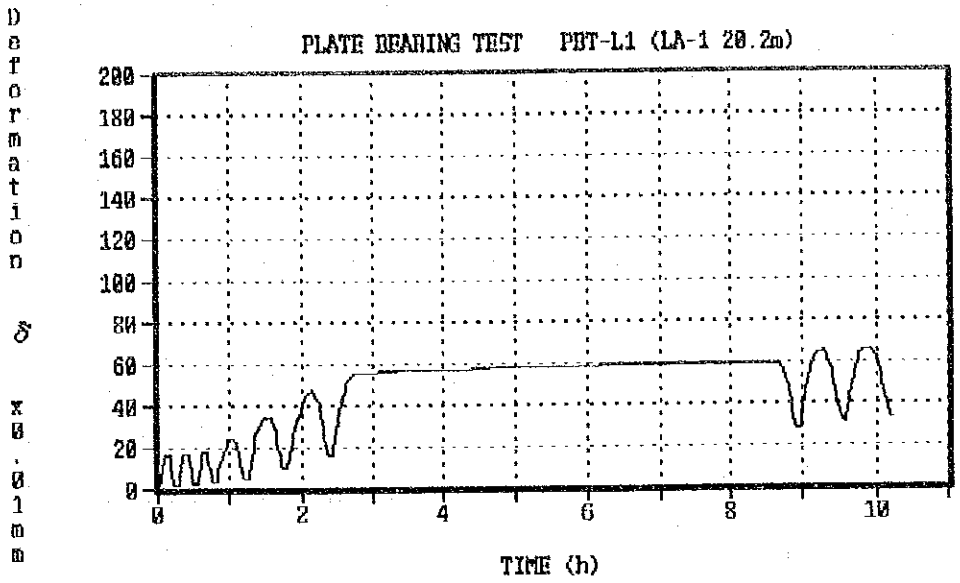
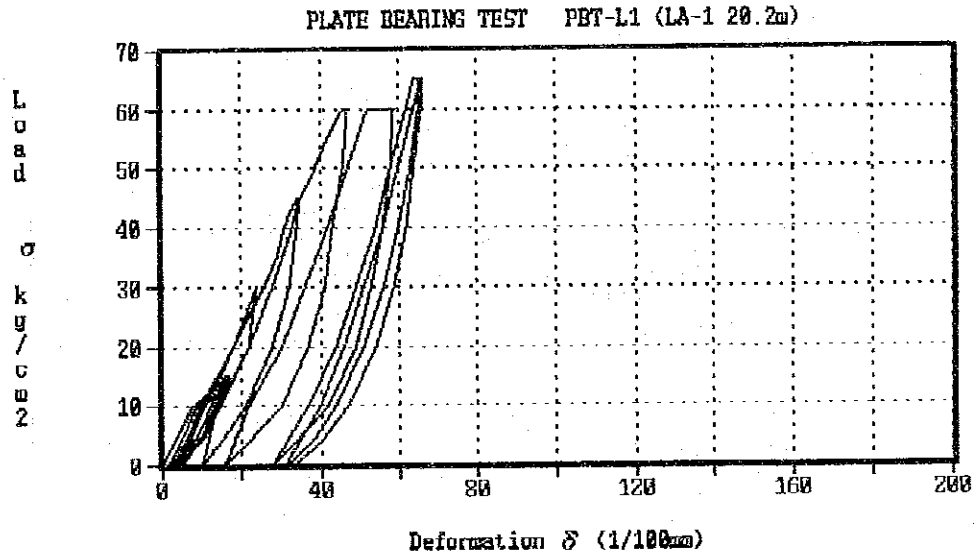


Fig. A-4-7 Load, Time, Deformation of PBT-L1





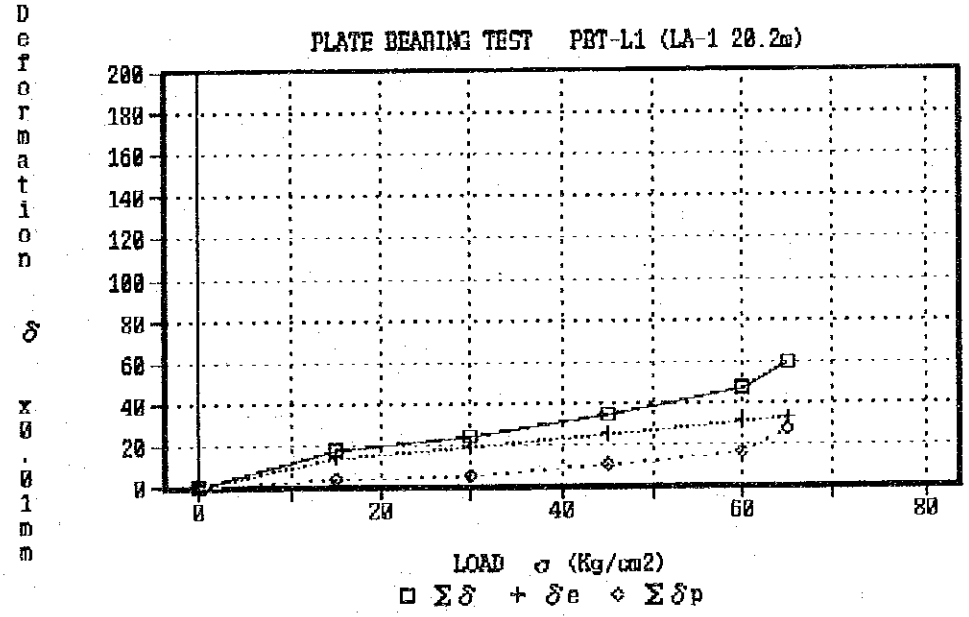
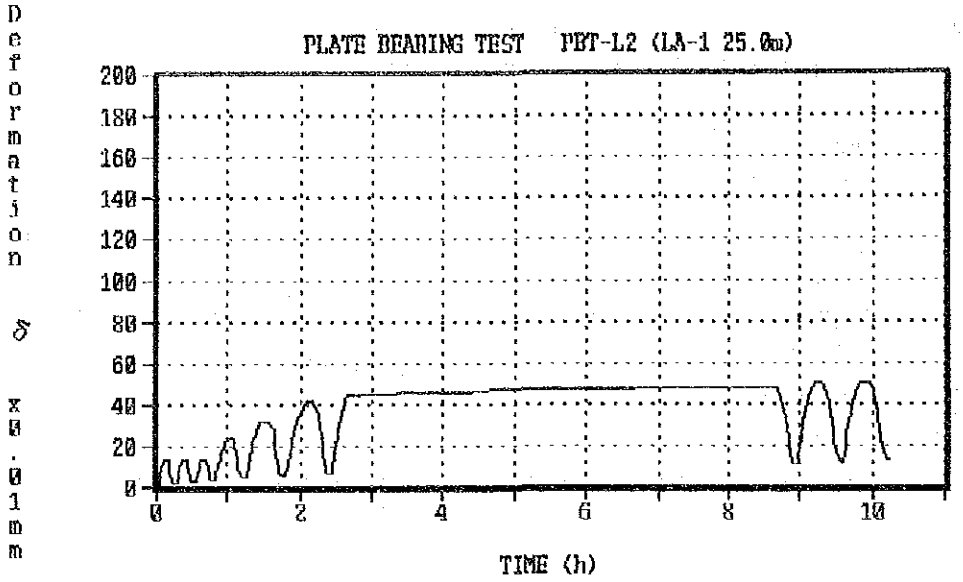
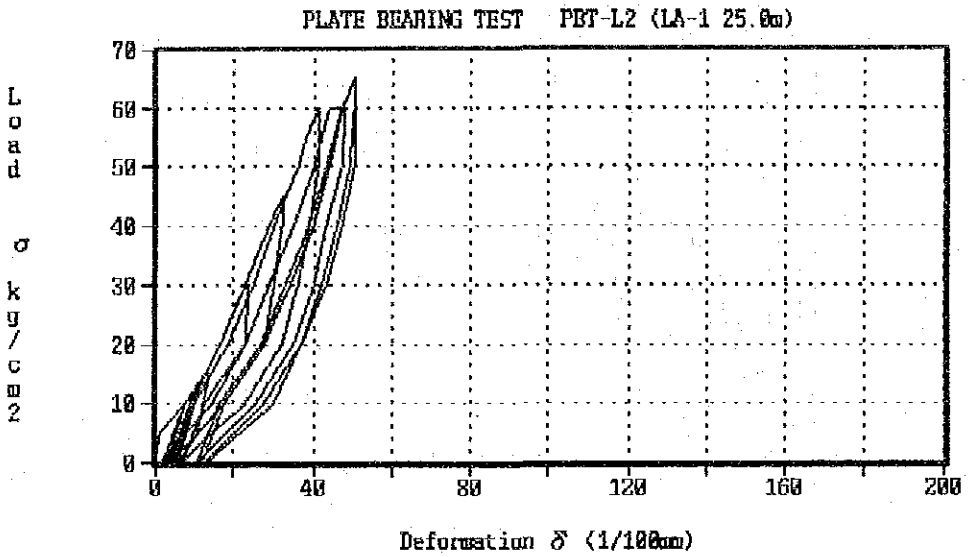


Fig. A-4-6 Load, Time, Deformation of PBT-L2





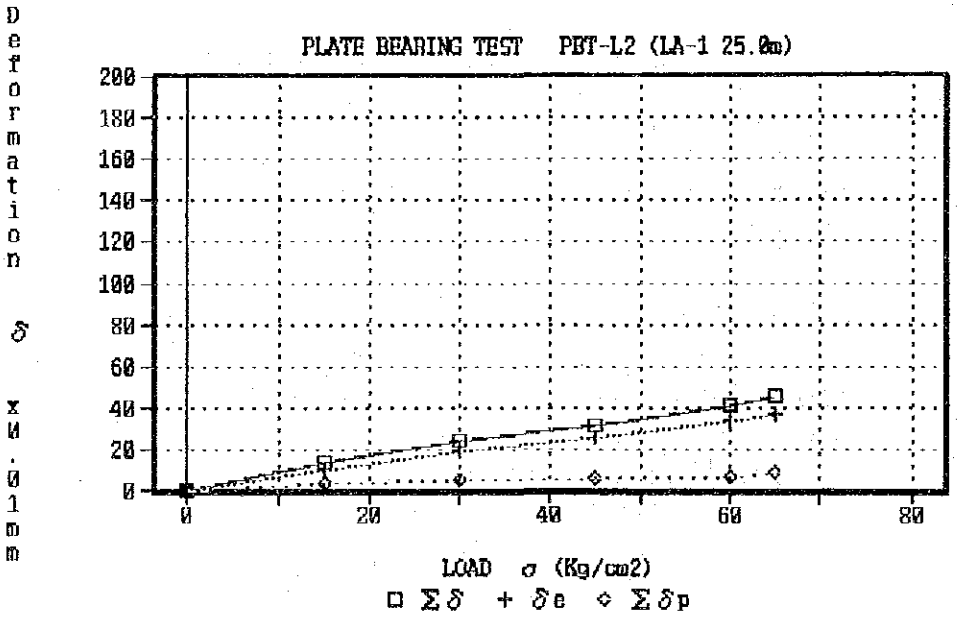
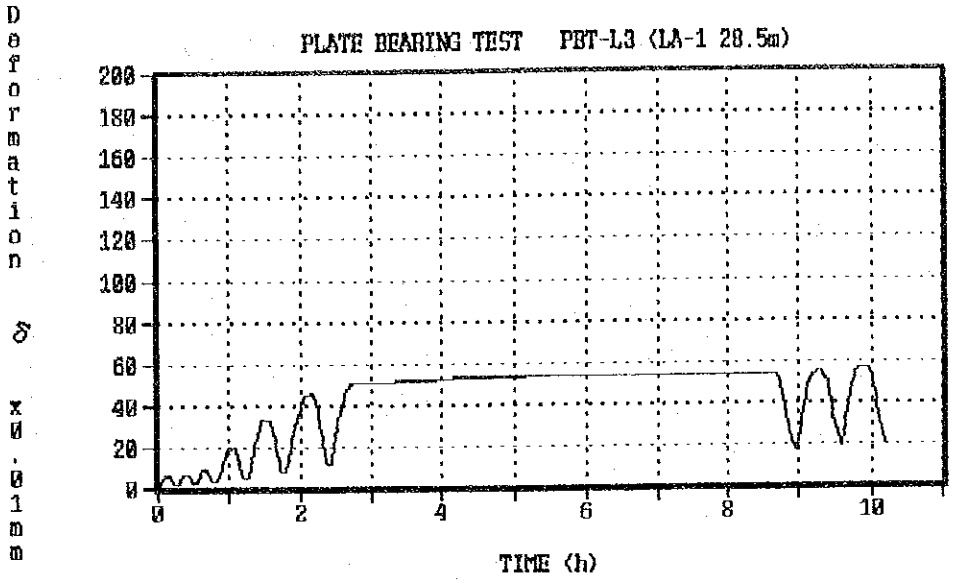
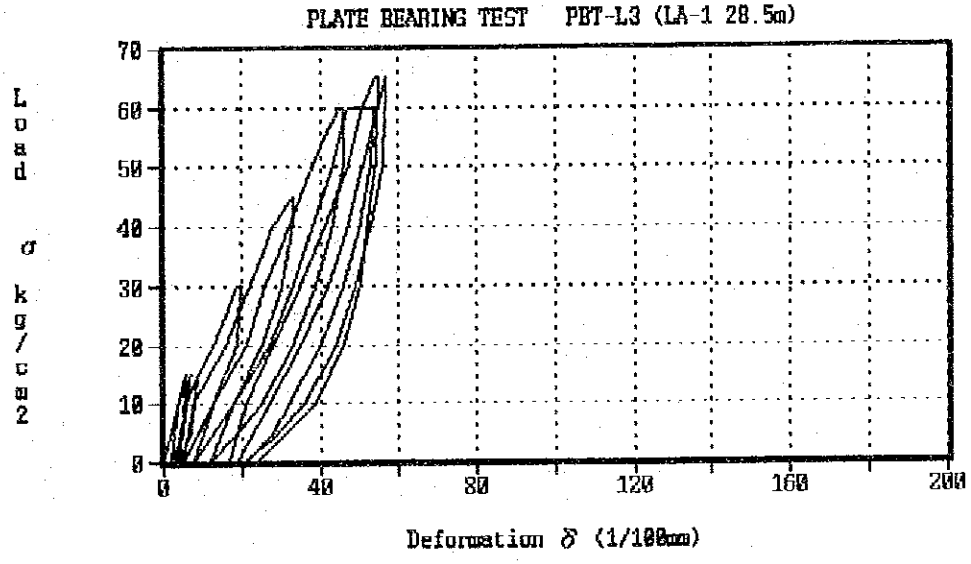


Fig. A-4-9 Load, Time, Deformation of PBT-L3





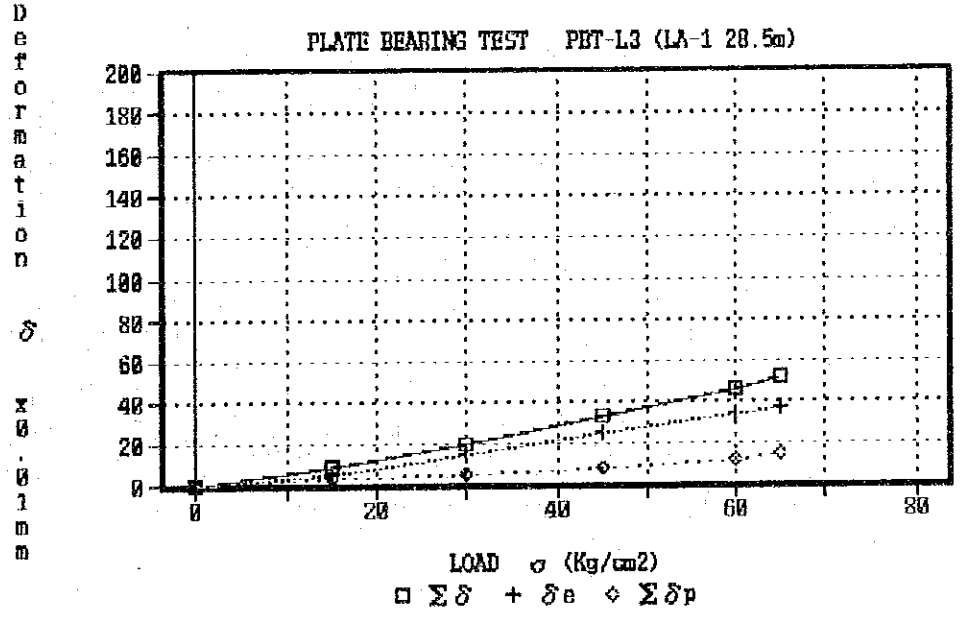
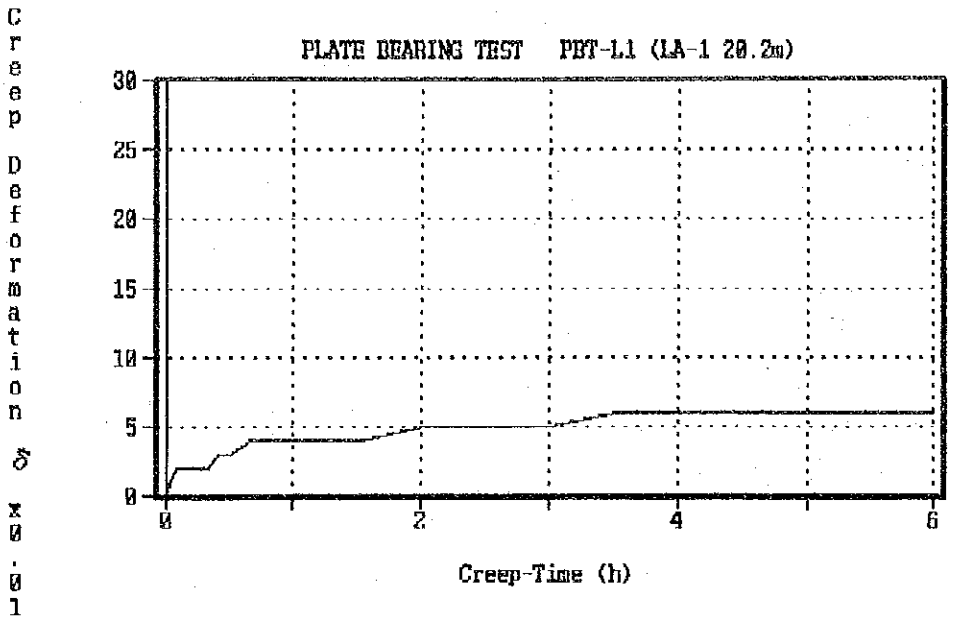
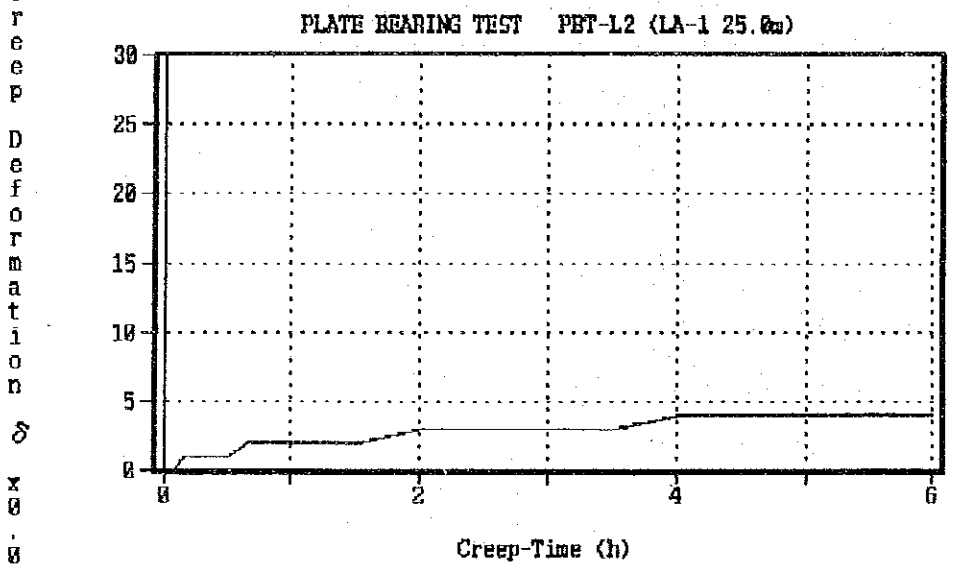


Fig. A-4-10 Creep-Time of PBT-L1, PBT-L2, PBT-L3





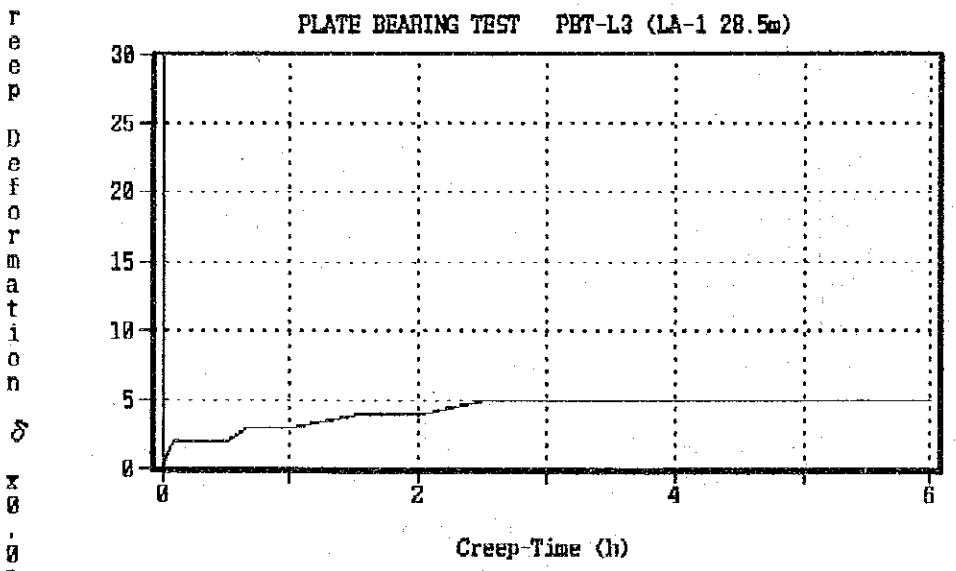
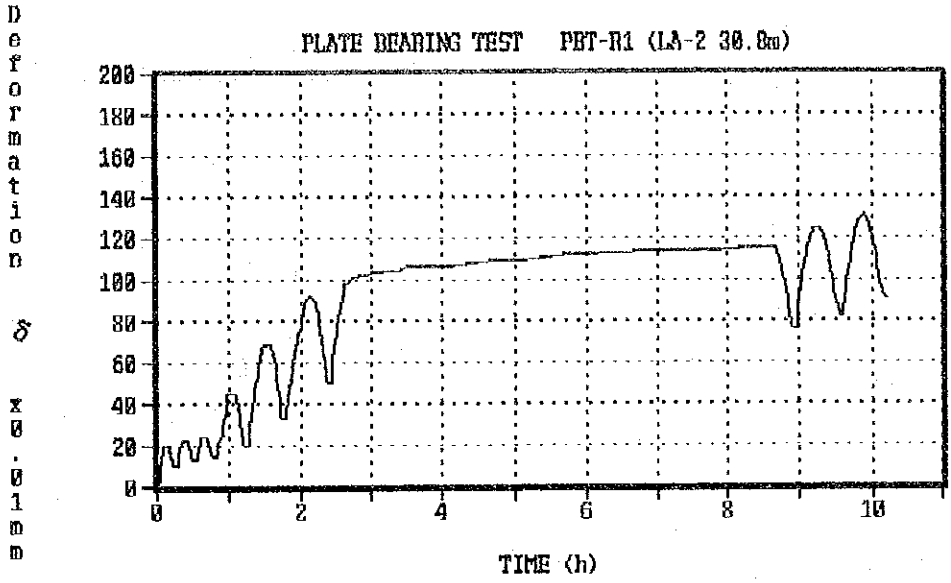
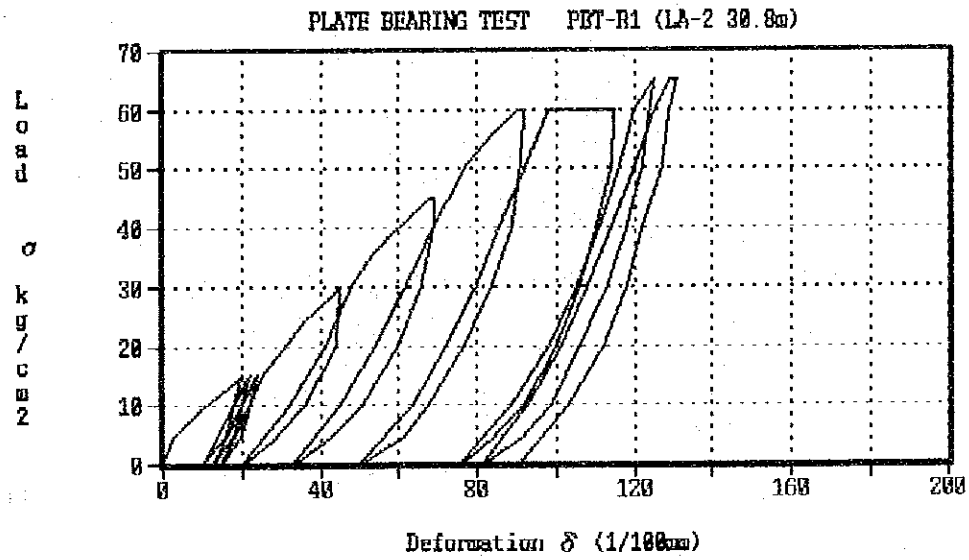


Fig. A-4-11 Load, Time, Deformation of PBT-R1





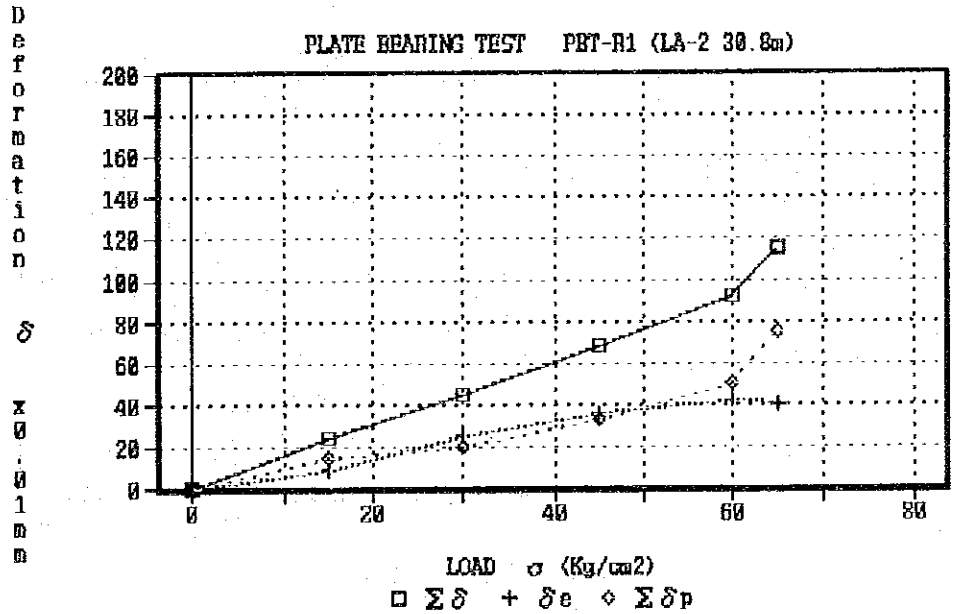
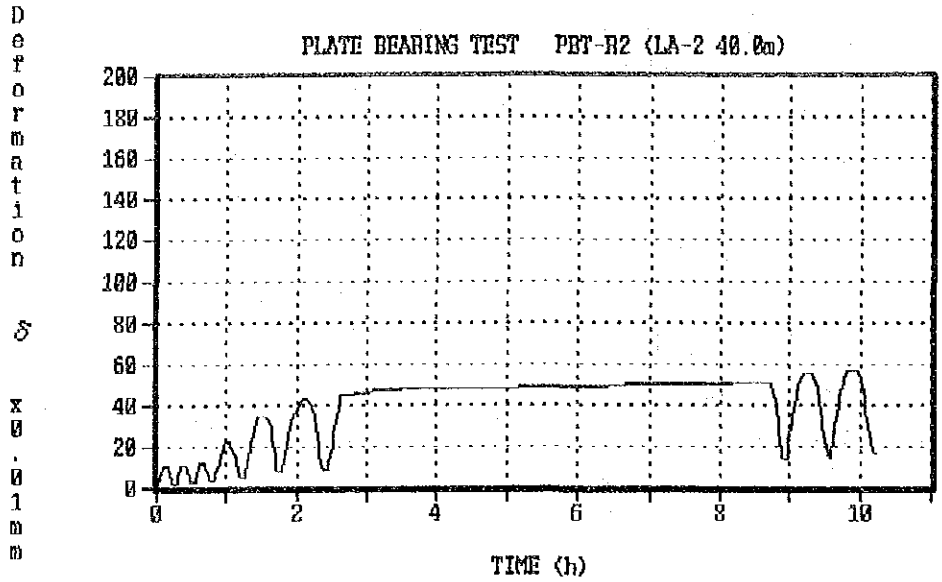
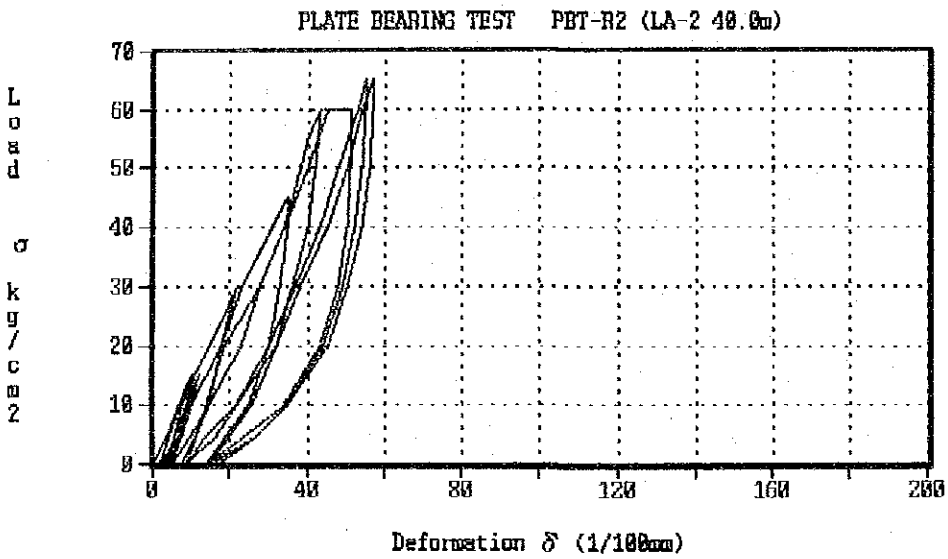


Fig. A-4-12 Load, Time, Deformation of PBT-R2





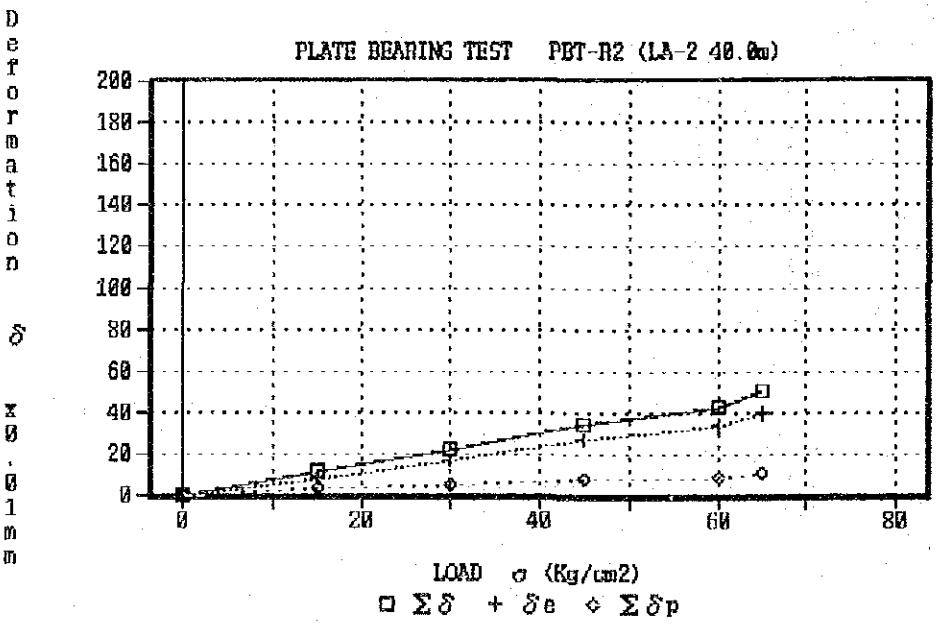
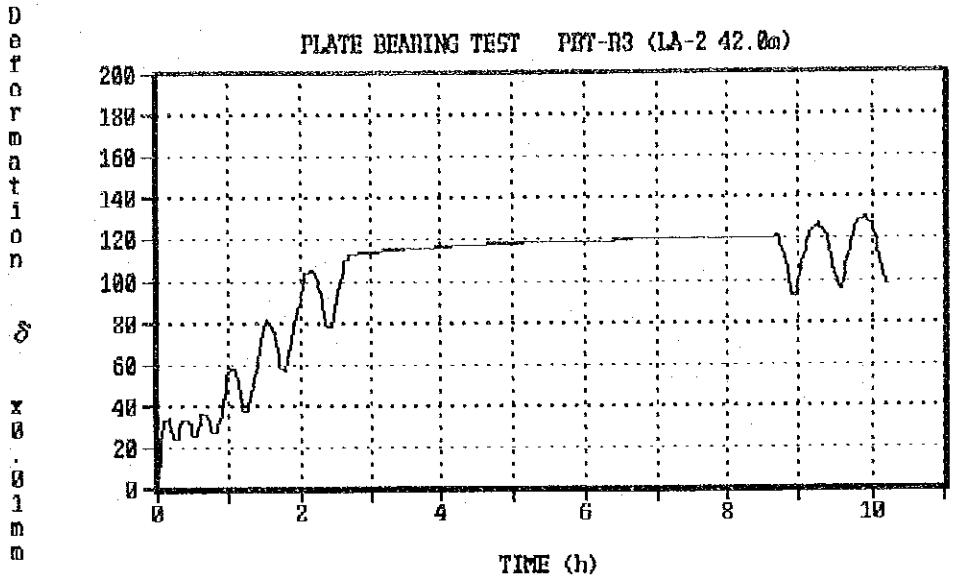
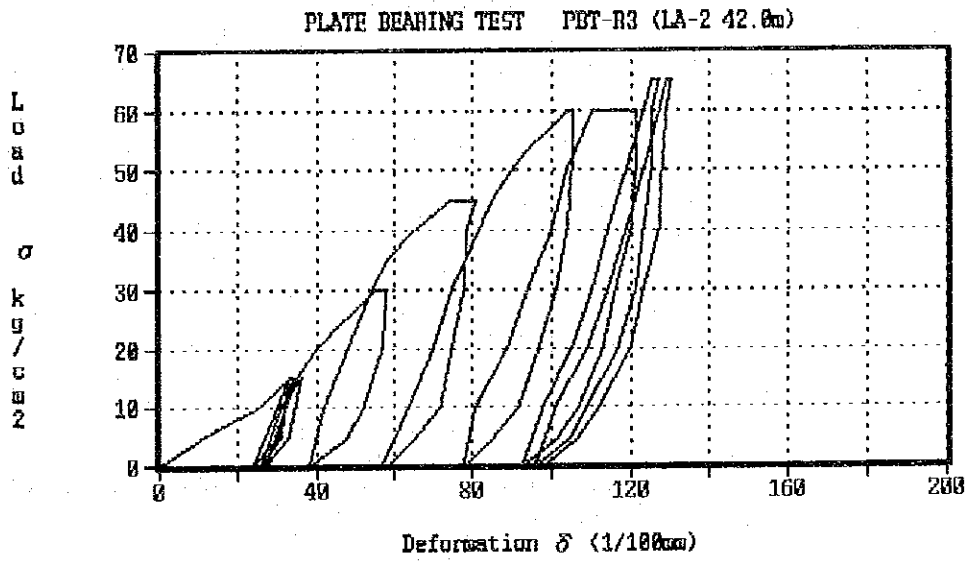


Fig. A-4-13 Load, Time, Deformation of PBT-R3





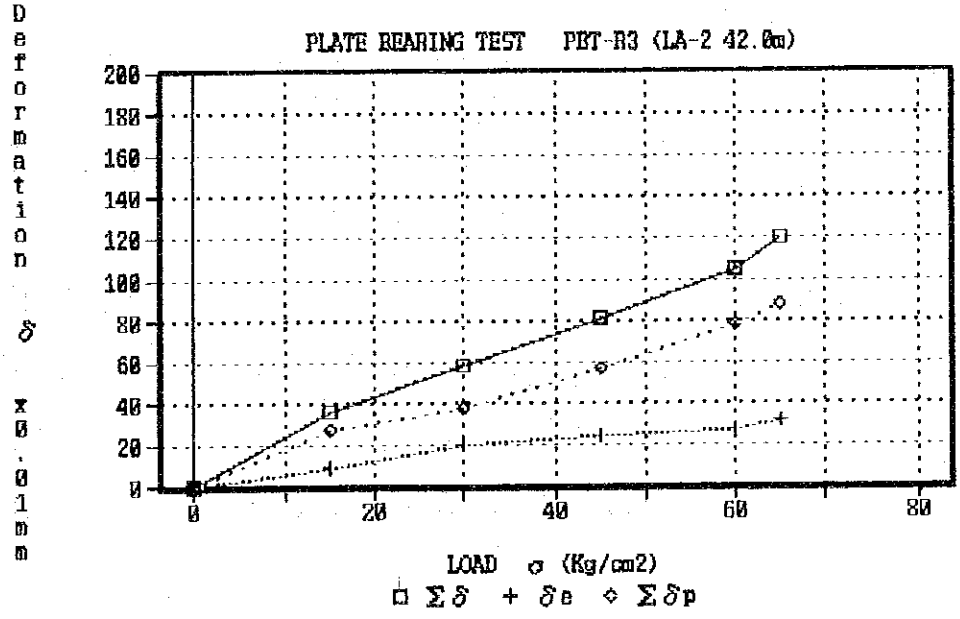
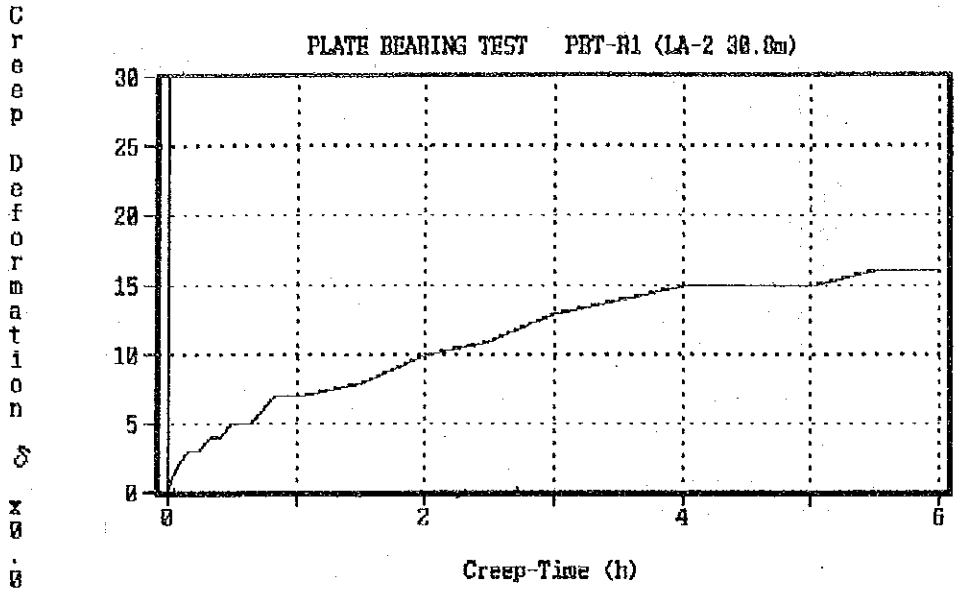
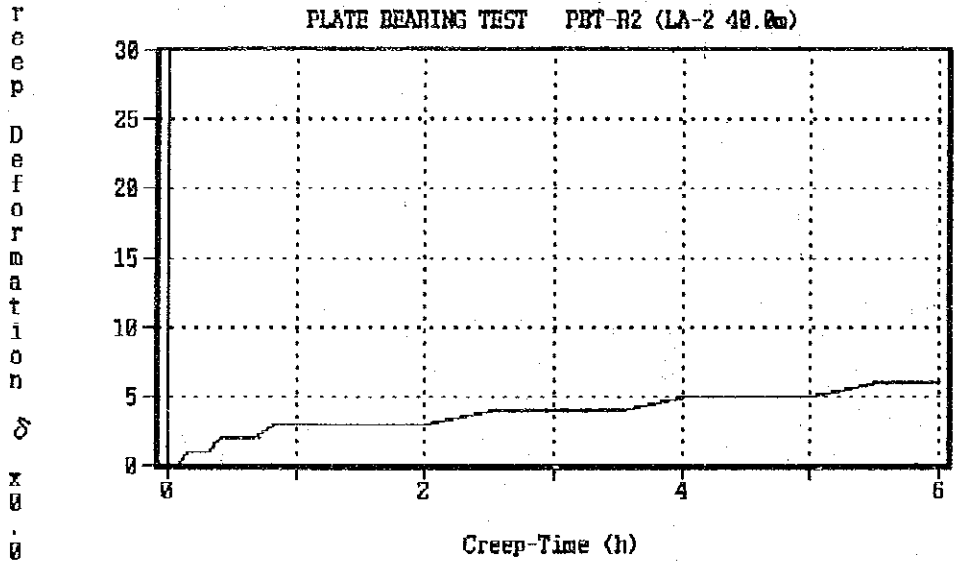


Fig. A-4-14 Creep-Time of PBT-R1, PBT-R2, PBT-R3





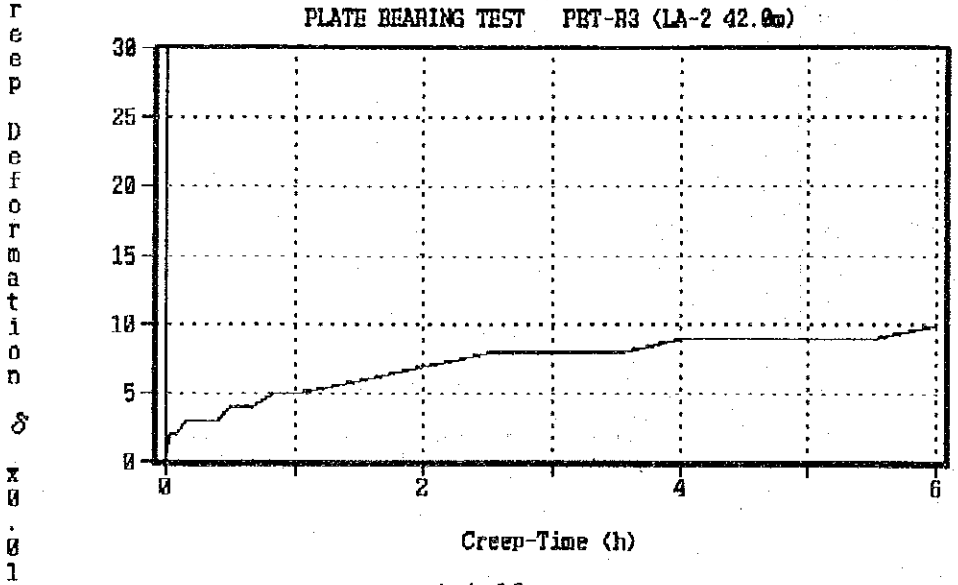


Table A-4-1 Results of Plate Bearing Test

June & July, 1991

Adit	Rock Grade	Measuring Point	Accumulated Distance (m)	Maximum Deformation (1/100mm)	Final Deformation (1/100mm)	$\frac{\Sigma \delta p}{\Sigma \delta}$ (%)	Modulus of Deformation (kg/cm2)	Secant Modulus of Elasticity (kg/cm2)	Tangential Modulus of Elasticity (kg/cm2)	Creep Deformation (1/100mm)	Creep Factor (%)	Remarks
LA-1	CH	PBT-L1	20.20	66	33	50	28,000	42,000	48,000	6	19	Sound. Little cracks and joint, but tight.
	CH	PBT-L2	25.00	50	13	26	31,000	38,000	43,000	4	12	
	CH	PBT-L3	28.50	57	20	35	30,000	38,000	42,000	5	15	Water Nothing.
		Average		58	22	37	30,000	39,000	44,000	5	15	
LA-2	CM	PBT-R1	30.80	131	91	69	14,000	30,000	36,000	16	38	Sound. Many cracks and joint.
	CM	PBT-R2	40.00	57	17	30	30,000	35,000	38,000	6	18	
	CM	PBT-R3	42.00	130	98	75	12,000	43,000	48,000	10	37	Water a little springing.
		Average		106	69	58	19,000	36,000	41,000	11	31	

Table A-4-2 Actual Schedule of In-Situ Rock Foundation Test

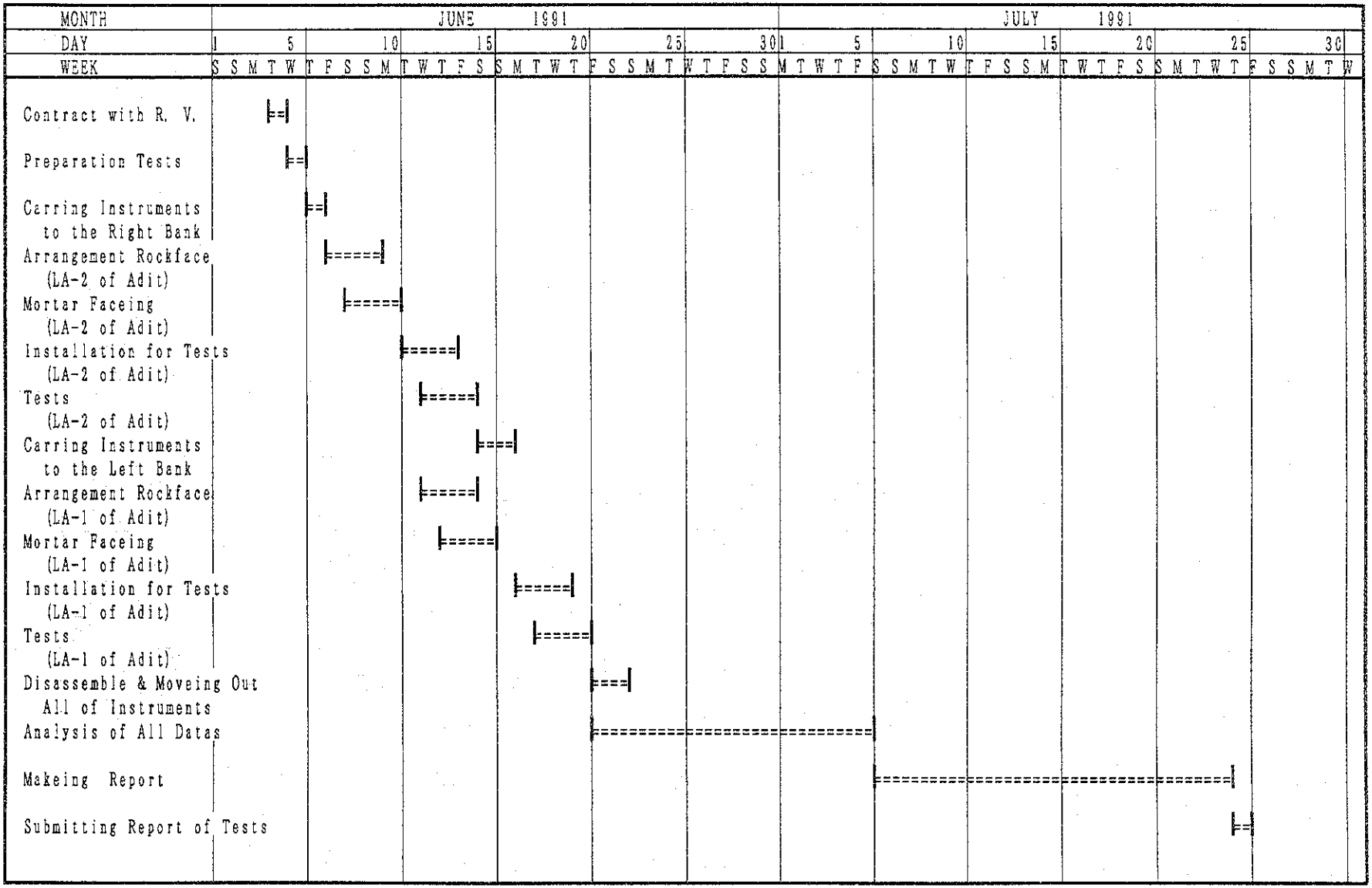


Table A-4-3 Data Sheet of PBT-L1(1) 1991.6-7

PLATE BEARING TEST — Measuring Point PBT-L1 (LA-1 20.2m) — DATA SHEET (1)

Test Location LA-1 (Left Bank)
Loading Plate Radius= 15.00 cm
Loading Plate area = 707 cm2
Jack Ram Diameter = 10.00 cm

Geological Classification: Dolerite - Basalt; CH
Max.Load Stress 78 kg/cm2
Max.Oil Pressur 703 kg/cm2

Date Measured '91/6/20
Measured by M.Rivas V.
J.Capa. 55.2 ton

Time Interval = 00:02 (h:m) Top = 00:04 (h:m) Bottom = 00:04 (h:m)
Load Rate(Virgin) = 5 (kg/cm2/min) Load Rate(Hysteresis) = 10 (kg/cm2/min)

Time (h.m)	Elapse (h.m)	Stress (kg/cm2)	Jack Pressure (kg/cm2)	Deformation (1/100 mm) Dial Gauge Reading of Displacement (1) D.Read	(1) Disp.	(2) D.Read	(2) Disp.		[(1)+(2)]/2	Remarks
05:00	00:00	0.00	0	0	0	0	0		0	Start
05:02	00:02	5.00	45	6	6	2	2		4	
05:04	00:04	10.00	90	11	11	5	5		8	
05:06	00:06	15.00	135	24	24	8	8		16	
05:10	00:10	15.00	135	24	24	8	8		16	Top15
05:12	00:12	5.00	45	13	13	5	5		9	
05:14	00:14	0.00	0	2	2	1	1		2	
05:18	00:18	0.00	0	2	2	1	1		2	Bottom15
05:20	00:20	10.00	90	13	13	4	4		9	
05:22	00:22	15.00	135	25	25	9	9		17	
05:26	00:26	15.00	135	25	25	9	9		17	T15-2
05:28	00:28	5.00	45	14	14	6	6		10	
05:30	00:30	0.00	0	3	3	2	2		3	
05:34	00:34	0.00	0	3	3	2	2		3	B15-2
05:36	00:36	10.00	90	15	15	5	5		10	
05:38	00:38	15.00	135	26	26	10	10		18	
05:42	00:42	15.00	135	26	26	10	10		18	T15-3
05:44	00:44	5.00	45	15	15	7	7		11	
05:46	00:46	0.00	0	4	4	3	3		4	
05:50	00:50	0.00	0	4	4	3	3		4	B15-3
05:52	00:52	10.00	90	16	16	5	5		11	
05:54	00:54	15.00	135	21	21	9	9		15	
05:56	00:56	20.00	180	24	24	11	11		18	
05:58	00:58	25.00	225	28	28	13	13		21	
06:00	01:00	30.00	270	32	32	15	15		24	
06:04	01:04	30.00	270	32	32	15	15		24	T30
06:06	01:06	20.00	180	30	30	14	14		22	
06:08	01:08	10.00	90	20	20	9	9		15	
06:10	01:10	5.00	45	14	14	5	5		10	
06:12	01:12	0.00	0	6	6	4	4		5	
06:16	01:16	0.00	0	6	6	4	4		5	B30
06:18	01:18	10.00	90	14	14	6	6		10	
06:20	01:20	20.00	180	24	24	11	11		18	
06:22	01:22	30.00	270	35	35	16	16		26	
06:24	01:24	35.00	315	40	40	17	17		29	
06:26	01:26	40.00	360	43	43	19	19		31	
06:28	01:28	45.00	405	47	47	21	21		34	
06:32	01:32	45.00	405	47	47	22	22		35	T45
06:34	01:34	40.00	360	46	46	21	21		34	
06:36	01:36	30.00	270	43	43	20	20		32	
06:38	01:38	20.00	180	38	38	18	18		28	

Table A-4-4 Data Sheet of PBT-L1(2)

1991.6-7

PLATE BEARING TEST Measuring Point PBT-L1 (LA-1 20.2m) DATA SHEET (2)

Time (h.m)	Elapse (h.m)	Stress (kg/cm2)	Jack Pressure (kg/cm2)	Deformation (1/ 100 mm) Dial Gauge Reading of Displacement (1) D.Read	(1) Disp.	(2) D.Read	(2) Disp.		[(1)+(2)]/2	Remarks
06:40	01:40	10.00	90	26	26	15	15		21	
06:42	01:42	5.00	45	19	19	12	12		16	
06:44	01:44	0.00	0	11	11	9	9		10	
06:48	01:48	0.00	0	11	11	9	9		10	B45
06:50	01:50	10.00	90	16	16	12	12		14	
06:52	01:52	20.00	180	28	28	16	16		22	
06:54	01:54	30.00	270	35	35	20	20		28	
06:56	01:56	40.00	360	42	42	23	23		33	
06:58	01:58	45.00	405	45	45	25	25		35	
07:00	02:00	50.00	450	50	50	27	27		39	
07:02	02:02	55.00	495	54	54	29	29		42	
07:04	02:04	60.00	540	60	60	32	32		46	
07:08	02:08	60.00	540	61	61	32	32		47	T60
07:10	02:10	50.00	450	60	60	31	31		46	
07:12	02:12	40.00	360	56	56	30	30		43	
07:14	02:14	30.00	270	52	52	29	29		41	
07:16	02:16	20.00	180	47	47	27	27		37	
07:18	02:18	10.00	90	36	36	24	24		30	
07:20	02:20	5.00	45	26	26	20	20		23	
07:22	02:22	0.00	0	17	17	15	15		16	
07:26	02:26	0.00	0	17	17	15	15		16	B60
07:28	02:28	10.00	90	25	25	18	18		22	
07:30	02:30	20.00	180	35	35	24	24		30	
07:32	02:32	30.00	270	43	43	28	28		36	
07:34	02:34	40.00	360	52	52	31	31		42	
07:36	02:36	50.00	450	60	60	34	34		47	
07:38	02:38	60.00	540	68	68	36	36		52	
07:40	02:40	60.00	540	69	69	37	37		53	T60c
07:42	02:42	60.00	540	70	70	37	37		54	Beginning
07:45	02:45	60.00	540	71	71	38	38		55	of Creep
07:50	02:50	60.00	540	71	71	38	38		55	
07:55	02:55	60.00	540	72	72	38	38		55	
08:00	03:00	60.00	540	72	72	38	38		55	
08:05	03:05	60.00	540	73	73	38	38		56	
08:10	03:10	60.00	540	73	73	38	38		56	
08:20	03:20	60.00	540	74	74	39	39		57	
08:30	03:30	60.00	540	74	74	39	39		57	
08:40	03:40	60.00	540	75	75	39	39		57	1 hour
09:10	04:10	60.00	540	75	75	39	39		57	
09:40	04:40	60.00	540	76	76	39	39		58	2 hours
10:10	05:10	60.00	540	76	76	39	39		58	
10:40	05:40	60.00	540	77	77	39	39		58	3 hours
11:10	06:10	60.00	540	77	77	40	40		59	
11:40	06:40	60.00	540	77	77	40	40		59	4 hours
12:10	07:10	60.00	540	78	78	40	40		59	
12:40	07:40	60.00	540	78	78	40	40		59	5 hours
13:10	08:10	60.00	540	78	78	40	40		59	
13:40	08:40	60.00	540	78	78	40	40		59	6 hours
13:42	08:42	50.00	450	77	77	39	39		58	End of Creep

Table A-4-5 Data Sheet of PBT-L1(3)

1991.6-7

PLATE BEARING TEST Measuring Point PBT-L1 (LA-1 20.2m) DATA SHEET (3)

Time (h.m)	Elapse (h.m)	Stress (kg/cm2)	Jack Pressure (kg/cm2)	Deformation (1/ 100 mm) Dial Gauge Reading of Displacement (1) D.Read	(1) Disp.	(2) D.Read	(2) Disp.		[(1)+(2)]/2	Remarks
13:44	08:44	40.00	360	74	74	38	38		56	
13:46	08:46	30.00	270	70	70	36	36		53	
13:48	08:48	20.00	180	64	64	33	33		49	
13:50	08:50	10.00	90	54	54	29	29		42	
13:52	08:52	5.00	45	45	45	25	25		35	
13:54	08:54	0.00	0	36	36	20	20		28	
13:58	08:58	0.00	0	36	36	20	20		28	B60c
14:00	09:00	10.00	90	48	48	25	25		37	
14:02	09:02	20.00	180	57	57	30	30		44	
14:04	09:04	30.00	270	64	64	34	34		49	
14:06	09:06	40.00	360	70	70	38	38		54	
14:08	09:08	50.00	450	75	75	41	41		58	
14:10	09:10	60.00	540	80	80	44	44		62	
14:12	09:12	65.00	585	82	82	46	46		64	
14:16	09:16	65.00	585	83	83	47	47		65	T65-1
14:18	09:18	60.00	540	82	82	47	47		65	
14:20	09:20	50.00	450	80	80	45	45		63	
14:22	09:22	40.00	360	76	76	43	43		60	
14:24	09:24	30.00	270	71	71	41	41		56	
14:26	09:26	20.00	180	65	65	37	37		51	
14:28	09:28	10.00	90	56	56	32	32		44	
14:30	09:30	5.00	45	50	50	28	28		39	
14:34	09:34	0.00	0	39	39	22	22		31	
14:36	09:36	0.00	0	39	39	22	22		31	B65-1
14:38	09:38	10.00	90	52	52	27	27		40	
14:40	09:40	20.00	180	61	61	31	31		46	
14:42	09:42	30.00	270	67	67	35	35		51	
14:44	09:44	40.00	360	72	72	39	39		56	
14:46	09:46	50.00	450	77	77	43	43		60	
14:48	09:48	60.00	540	82	82	46	46		64	
14:50	09:50	65.00	585	84	84	48	48		66	
14:54	09:54	65.00	585	84	84	48	48		66	T65-2
14:56	09:56	60.00	540	84	84	48	48		66	
14:58	09:58	50.00	450	82	82	46	46		64	
15:00	10:00	40.00	360	79	79	44	44		62	
15:02	10:02	30.00	270	75	75	42	42		59	
15:04	10:04	20.00	180	69	69	39	39		54	
15:06	10:06	10.00	90	60	60	34	34		47	
15:08	10:08	5.00	45	52	52	29	29		41	
15:12	10:12	0.00	0	42	42	24	24		33	
15:14	10:14	0.00	0	42	42	24	24		33	B65-2
										The End

Table A-4-6 Data Sheet of PBT-L1(4)

1991.6-7

PLATE BEARING TEST — Measuring Point PBT-L1 (LA-1 20.2m) — DATA SHEET (4)

Test Location LA-1 (Left Bank) — Geological Dolerite - Basalt — Date Measured '91/6/20

Plate Radius (a) = 15.00 cm2 — Classification CH — Measured by M.Rivas V.

Loading Plate area = 707 cm2 — Max.Load Stress 78 kg/cm2 — Capacity 55.2 ton

Deformation Measurement Results

Stress (kg/cm2)	Deformation (1/ 100 mm) δ	δe	δp	Σδ	Σδp
0	0	0	0	0	0
15	16	14	2	16	2
0				2	
15	15	14	1	17	3
0				3	
15	15	14	1	18	4
0				4	
30	20	19	1	24	5
0				5	
45	30	25	5	35	10
0				10	
60	37	31	6	47	16
0 Creep				16	
60 0 h.	(0 %)			53	
60 1 h.	(67 %)			57	
60 3 h.	(83 %)			58	
60 6 h.	(100 %)			59	28
0				28	
65	37	34	3	65	31
0				31	
20 0	0			46	
30 10	5			51	
40 20	10			56	
50 30	14			60	
60 40	18			64	
65	35	33	2	66	33
0				33	

Remarks

δ :Total Deformation
δe :Elastic Deformation
δp :Plastic Deformation
Σδ :Cumulative Total Deformation
Σδp :Cumulative Plastic Deformation

Creep Calculation

Elastic Deformation Just Before Creep δe (1/ 100 mm)	31
Creep Deformation δc (1/ 100 mm)	6
Creep Factor Cf(%) = (δc/δe)*100	19

Modulus of Deformation (D) and Modulus of Elasticity (E) Calculation Formula

$$D \text{ or } E = \frac{\pi a(1-\nu 2)}{2} * \frac{\Delta\sigma}{\Delta\delta}$$

a :Plate radius 15 (cm)
ν :Poisson's ratio 0.2
Δσ :Stress increment (kg/cm2)
Δδ :Deformation increment due to Δσ
πa(1-ν2)/2 = 22.6194 cm

Coefficients Related to Deformation

Modulus of Deformation	D =	28,000	kg/cm2
Tangential Modulus of Elasticity	Et =	48,000	kg/cm2
Secant Modulus of Elasticity	Es =	42,000	kg/cm2

Table A-4-7 Data Sheet of PBT-L2(1) 1991.6-7

PLATE BEARING TEST — Measuring Point PBT-L2 (LA-1 25.0m) — DATA SHEET (1)

Test Location LA-1 (Left Bank) — Geological Classification: Dolerite - Basalt, CH — Date Measured '91/6/19
Loading Plate Radius = 15.00 cm — Max. Load Stress 78 kg/cm2 — Measured by M. Rivas V.
Loading Plate area = 707 cm2 — Max. Oil Pressur 703 kg/cm2 — J. Capa. 55.2 ton
Jack Ram Diameter = 10.00 cm

Time Interval = 00:02 (h:m) — Top = 00:04 (h:m) — Bottom = 00:04 (h:m)
Load Rate (Virgin) = 5 (kg/cm2/min) — Load Rate (Hysteresis) = 10 (kg/cm2/min)

Time (h.m)	Elapse (h.m)	Stress (kg/cm2)	Jack Pressure (kg/cm2)	Deformation (1/100 mm) Dial Gauge Reading of Displacement (1) D.Read	(1) Disp.	(2) D.Read	(2) Disp.		[(1)+(2)]/2	Remarks
06:00	00:00	0.00	0	0	0	0	0		0	Start
06:02	00:02	5.00	45	1	1	0	0		1	
06:04	00:04	10.00	90	10	10	5	5		8	
06:06	00:06	15.00	135	15	15	10	10		13	
06:10	00:10	15.00	135	15	15	10	10		13	Top15
06:12	00:12	5.00	45	9	9	5	5		7	
06:14	00:14	0.00	0	2	2	2	2		2	
06:18	00:18	0.00	0	2	2	2	2		2	Bottom15
06:20	00:20	10.00	90	11	11	4	4		8	
06:22	00:22	15.00	135	16	16	9	9		13	
06:26	00:26	15.00	135	16	16	10	10		13	T15-2
06:28	00:28	5.00	45	9	9	4	4		7	
06:30	00:30	0.00	0	3	3	2	2		3	
06:34	00:34	0.00	0	3	3	2	2		3	B15-2
06:36	00:36	10.00	90	11	11	5	5		8	
06:38	00:38	15.00	135	15	15	10	10		13	
06:42	00:42	15.00	135	17	17	10	10		14	T15-3
06:44	00:44	5.00	45	17	17	5	5		11	
06:46	00:46	0.00	0	4	4	3	3		4	
06:50	00:50	0.00	0	4	4	3	3		4	B15-3
06:52	00:52	10.00	90	11	11	6	6		9	
06:54	00:54	15.00	135	16	16	10	10		13	
06:56	00:56	20.00	180	21	21	13	13		17	
06:58	00:58	25.00	225	24	24	16	16		20	
07:00	01:00	30.00	270	26	26	20	20		23	
07:04	01:04	30.00	270	27	27	20	20		24	T30
07:06	01:06	20.00	180	26	26	19	19		23	
07:08	01:08	10.00	90	19	19	11	11		15	
07:10	01:10	5.00	45	11	11	5	5		8	
07:12	01:12	0.00	0	5	5	4	4		5	
07:16	01:16	0.00	0	5	5	4	4		5	B30
07:18	01:18	10.00	90	11	11	7	7		9	
07:20	01:20	20.00	180	21	21	13	13		17	
07:22	01:22	30.00	270	26	26	19	19		23	
07:24	01:24	35.00	315	29	29	23	23		26	
07:26	01:26	40.00	360	32	32	26	26		29	
07:28	01:28	45.00	405	35	35	29	29		32	
07:32	01:32	45.00	405	35	35	29	29		32	T45
07:34	01:34	40.00	360	35	35	29	29		32	
07:36	01:36	30.00	270	32	32	27	27		30	
07:38	01:38	20.00	180	29	29	27	27		28	

Table A-4-8 Data Sheet of PBT-L2(2)

1991.6-7

PLATE BEARING TEST Measuring Point PBT-L2 (LA-1 25.0m) DATA SHEET (2)

Time (h.m)	Elapse (h.m)	Stress (kg/cm2)	Jack Pressure (kg/cm2)	Deformation (1/ 100 mm) Dial Gauge Reading of Displacement (1) D. Read	(1) Disp.	(2) D. Read	(2) Disp.		[(1)+(2)]/2	Remarks
07:40	01:40	10.00	90	20	20	15	15		18	
07:42	01:42	5.00	45	12	12	9	9		11	
07:44	01:44	0.00	0	6	6	5	5		6	
07:48	01:48	0.00	0	6	6	5	5		6	B45
07:50	01:50	10.00	90	11	11	8	8		10	
07:52	01:52	20.00	180	21	21	17	17		19	
07:54	01:54	30.00	270	27	27	23	23		25	
07:56	01:56	40.00	360	32	32	28	28		30	
07:58	01:58	45.00	405	34	34	31	31		33	
08:00	02:00	50.00	450	37	37	35	35		36	
08:02	02:02	55.00	495	39	39	37	37		38	
08:04	02:04	60.00	540	42	42	40	40		41	
08:08	02:08	60.00	540	42	42	40	40		41	T60
08:10	02:10	50.00	450	42	42	40	40		41	
08:12	02:12	40.00	360	40	40	38	38		39	
08:14	02:14	30.00	270	37	37	35	35		36	
08:16	02:16	20.00	180	33	33	30	30		32	
08:18	02:18	10.00	90	24	24	22	22		23	
08:20	02:20	5.00	45	14	14	13	13		14	
08:22	02:22	0.00	0	7	7	7	7		7	
08:26	02:26	0.00	0	7	7	7	7		7	B60
08:28	02:28	10.00	90	13	13	12	12		13	
08:30	02:30	20.00	180	24	24	22	22		23	
08:32	02:32	30.00	270	30	30	28	28		29	
08:34	02:34	40.00	360	35	35	35	35		35	
08:36	02:36	50.00	450	40	40	40	40		40	
08:38	02:38	60.00	540	44	44	44	44		44	
08:40	02:40	60.00	540	44	44	44	44		44	T60c
08:42	02:42	60.00	540	44	44	44	44		44	Beginning
08:45	02:45	60.00	540	44	44	44	44		44	of Creep
08:50	02:50	60.00	540	45	45	44	44		45	
08:55	02:55	60.00	540	45	45	44	44		45	
09:00	03:00	60.00	540	45	45	44	44		45	
09:05	03:05	60.00	540	45	45	44	44		45	
09:10	03:10	60.00	540	45	45	44	44		45	
09:20	03:20	60.00	540	46	46	45	45		46	
09:30	03:30	60.00	540	46	46	45	45		46	
09:40	03:40	60.00	540	46	46	45	45		46	1 hour
10:10	04:10	60.00	540	46	46	46	46		46	
10:40	04:40	60.00	540	47	47	46	46		47	2 hours
11:10	05:10	60.00	540	47	47	46	46		47	
11:40	05:40	60.00	540	48	48	46	46		47	3 hours
12:10	06:10	60.00	540	48	48	46	46		47	
12:40	06:40	60.00	540	48	48	47	47		48	4 hours
13:10	07:10	60.00	540	48	48	47	47		48	
13:40	07:40	60.00	540	48	48	47	47		48	5 hours
14:10	08:10	60.00	540	48	48	47	47		48	
14:40	08:40	60.00	540	48	48	47	47		48	6 hours
14:42	08:42	50.00	450	47	47	46	46		47	End of Creep

Table A-4-9 Data Sheet of PBT-L2(3)

1991.6-7

PLATE BEARING TEST Measuring Point PBT-L2 (LA-1 25.0m) DATA SHEET (3)

Time (h.m)	Elapse (h.m)	Stress (kg/cm2)	Jack Pressure (kg/cm2)	Deformation (1/ 100 mm) Dial Gauge Reading of Displacement (1) D.Read	(1) Disp.	(2) D.Read	(2) Disp.	.	[(1)+(2)]/2	Remarks
14:44	08:44	40.00	360	44	44	42	42		43	
14:46	08:46	30.00	270	40	40	40	40		40	
14:48	08:48	20.00	180	34	34	35	35		35	
14:50	08:50	10.00	90	27	27	25	25		26	
14:52	08:52	5.00	45	18	18	18	18		18	
14:54	08:54	0.00	0	11	11	11	11		11	
14:58	08:58	0.00	0	11	11	11	11		11	B60c
15:00	09:00	10.00	90	17	17	16	16		17	
15:02	09:02	20.00	180	28	28	26	26		27	
15:04	09:04	30.00	270	34	34	32	32		33	
15:06	09:06	40.00	360	39	39	39	39		39	
15:08	09:08	50.00	450	43	43	43	43		43	
15:10	09:10	60.00	540	46	46	47	47		47	
15:12	09:12	65.00	585	49	49	50	50		50	
15:16	09:16	65.00	585	49	49	50	50		50	T65-1
15:18	09:18	60.00	540	49	49	50	50		50	
15:20	09:20	50.00	450	48	48	49	49		49	
15:22	09:22	40.00	360	45	45	46	46		46	
15:24	09:24	30.00	270	41	41	43	43		42	
15:26	09:26	20.00	180	35	35	38	38		37	
15:28	09:28	10.00	90	28	28	28	28		28	
15:30	09:30	5.00	45	19	19	21	21		20	
15:34	09:34	0.00	0	12	12	12	12		12	
15:36	09:36	0.00	0	12	12	12	12		12	B65-1
15:38	09:38	10.00	90	18	18	17	17		18	
15:40	09:40	20.00	180	29	29	27	27		28	
15:42	09:42	30.00	270	35	35	33	33		34	
15:44	09:44	40.00	360	40	40	40	40		40	
15:46	09:46	50.00	450	44	44	44	44		44	
15:48	09:48	60.00	540	47	47	47	47		47	
15:50	09:50	65.00	585	50	50	50	50		50	
15:54	09:54	65.00	585	50	50	50	50		50	T65-2
15:56	09:56	60.00	540	50	50	50	50		50	
15:58	09:58	50.00	450	49	49	50	50		50	
16:00	10:00	40.00	360	46	46	47	47		47	
16:02	10:02	30.00	270	42	42	44	44		43	
16:04	10:04	20.00	180	36	36	38	38		37	
16:06	10:06	10.00	90	29	29	30	30		30	
16:08	10:08	5.00	45	20	20	22	22		21	
16:12	10:12	0.00	0	13	13	12	12		13	
16:14	10:14	0.00	0	13	13	12	12		13	B65-2
										The End

Table A-4-10 Data Sheet of PBT-L2(4) 1991.6-7

PLATE BEARING TEST — Measuring Point PBT-L2 (LA-1 25.0m) — DATA SHEET (4)

Test Location LA-1 (Left Bank) — Geological Dolerite - Basalt — Date Measured '91/6/19

Plate Radius (a) = 15.00 cm2 — Classification CH — Measured by M.Rivas V.

Loading Plate area = 707 cm2 — Max.Load Stress 78 kg/cm2 — Capacity 55.2 ton

Deformation Measurement Results

Stress (kg/cm2)	Deformation (1/ 100 mm) δ	δe	δp	Σδ	Σδp
0	0	0	0	0	0
15	13	11	2	13	2
0				2	
15	11	10	1	13	3
0				3	
15	11	10	1	14	4
0				4	
30	20	19	1	24	5
0				5	
45	27	26	1	32	6
0				6	
60	35	34	1	41	7
0 Creep				7	
60 0 h.	(	0 %)		44	
60 1 h.	(	50 %)		46	
60 3 h.	(	75 %)		47	
60 6 h.	(	100 %)		48	14
0				11	
65	39	38	1	50	12
0				12	
20 0	0			28	
30 10	6			34	
40 20	12			40	
50 30	16			44	
60 40	19			47	
65	38	37	1	50	13
0				13	

Remarks

δ :Total Deformation
δe :Elastic Deformation
δp :Plastic Deformation
Σδ :Cumulative Total Deformation
Σδp :Cumulative Plastic Deformation

Creep Calculation

Elastic Deformation Just Before Creep δe (1/ 100 mm)	34
Creep Deformation δc (1/ 100 mm)	4
Creep Factor Cf(%) = (δc/δe)*100	12

Modulus of Deformation (D) and Modulus of Elasticity (E) Calculation Formula

$$D \text{ or } E = \frac{\pi a(1-\nu 2)}{2} * \frac{\Delta\sigma}{\Delta\delta}$$

a :Plate radius 15 (cm)
ν :Poisson's ratio 0.2
Δσ :Stress increment (kg/cm2)
Δδ :Deformation increment due to Δσ
πa(1-ν2)/2 = 22.6194 cm

Coefficients Related to Deformation

Modulus of Deformation	D =	31,000	kg/cm2
Tangential Modulus of Elasticity	Et =	43,000	kg/cm2
Secant Modulus of Elasticity	Es =	38,000	kg/cm2

Table A-4-11 Data Sheet of PBT-L3(1) 1991.6-7

PLATE BEARING TEST Measuring Point PBT-L3 (LA-1 28.5m) DATA SHEET (1)

Test Location LA-1 (Left Bank) Geological Dolerite - Basalt Date Measured '91/6/18
Loading Plate Radius= 15.00 cm Classification CH Measured by M.Rivas V.
Loading Plate area = 707 cm2 Max.Load Stress 78 kg/cm2 J.Capa. 55.2 ton
Jack Ram Diameter = 10.00 cm Max.Oil Pressur 703 kg/cm2

Time Interval = 00:02 (h:m) Top = 00:04 (h:m) Bottom = 00:04 (h:m)
Load Rate(Virgin) = 5 (kg/cm2/min) Load Rate(Hysteresis) = 10 (kg/cm2/min)

Time (h.m)	Elapse (h.m)	Stress (kg/cm2)	Jack Pressure (kg/cm2)	Deformation (1/ 100 mm) Dial Gauge Reading of Displacement (1) D.Read	(1) Disp.	(2) D.Read	(2) Disp.		[(1)+(2)]/2	Remarks
06:00	00:00	0.00	0	0	0	0	0		0	Start
06:02	00:02	5.00	45	2	2	2	2		2	
06:04	00:04	10.00	90	4	4	3	3		4	
06:06	00:06	15.00	135	6	6	6	6		6	
06:10	00:10	15.00	135	6	6	6	6		6	Top15
06:12	00:12	5.00	45	4	4	5	5		5	
06:14	00:14	0.00	0	1	1	2	2		2	
06:18	00:18	0.00	0	1	1	2	2		2	Bottom15
06:20	00:20	10.00	90	3	3	4	4		4	
06:22	00:22	15.00	135	7	7	7	7		7	
06:26	00:26	15.00	135	7	7	7	7		7	T15-2
06:28	00:28	5.00	45	5	5	5	5		5	
06:30	00:30	0.00	0	2	2	3	3		3	
06:34	00:34	0.00	0	2	2	3	3		3	B15-2
06:36	00:36	10.00	90	4	4	7	7		6	
06:38	00:38	15.00	135	8	8	9	9		9	
06:42	00:42	15.00	135	8	8	9	9		9	T15-3
06:44	00:44	5.00	45	6	6	7	7		7	
06:46	00:46	0.00	0	3	3	4	4		4	
06:50	00:50	0.00	0	3	3	4	4		4	B15-3
06:52	00:52	10.00	90	5	5	6	6		6	
06:54	00:54	15.00	135	8	8	10	10		9	
06:56	00:56	20.00	180	11	11	15	15		13	
06:58	00:58	25.00	225	13	13	18	18		16	
07:00	01:00	30.00	270	17	17	21	21		19	
07:04	01:04	30.00	270	18	18	22	22		20	T30
07:06	01:06	20.00	180	17	17	21	21		19	
07:08	01:08	10.00	90	12	12	14	14		13	
07:10	01:10	5.00	45	8	8	10	10		9	
07:12	01:12	0.00	0	4	4	6	6		5	
07:16	01:16	0.00	0	4	4	6	6		5	B30
07:18	01:18	10.00	90	8	8	8	8		8	
07:20	01:20	20.00	180	14	14	17	17		16	
07:22	01:22	30.00	270	20	20	23	23		22	
07:24	01:24	35.00	315	23	23	26	26		25	
07:26	01:26	40.00	360	26	26	29	29		28	
07:28	01:28	45.00	405	29	29	36	36		33	
07:32	01:32	45.00	405	30	30	36	36		33	T45
07:34	01:34	40.00	360	30	30	36	36		33	
07:36	01:36	30.00	270	27	27	33	33		30	
07:38	01:38	20.00	180	22	22	28	28		25	

Table A-4-12 Data Sheet of PBT-L3(2) 1991.6-7

PLATE BEARING TEST Measuring Point PBT-L3 (LA-1 28.5m) DATA SHEET (2)

Time (h.m)	Elapse (h.m)	Stress (kg/cm2)	Jack Pressure (kg/cm2)	Deformation (1/ 100 mm) Dial Gauge Reading of Displacement (1) D.Read	(1) Disp.	(2) D.Read	(2) Disp.		[(1)+(2)]/2	Remarks
07:40	01:40	10.00	90	16	16	20	20		18	
07:42	01:42	5.00	45	11	11	14	14		13	
07:44	01:44	0.00	0	6	6	9	9		8	
07:48	01:48	0.00	0	6	6	9	9		8	B45
07:50	01:50	10.00	90	12	12	14	14		13	
07:52	01:52	20.00	180	18	18	23	23		21	
07:54	01:54	30.00	270	24	24	28	28		26	
07:56	01:56	40.00	360	30	30	33	33		32	
07:58	01:58	45.00	405	33	33	36	36		35	
08:00	02:00	50.00	450	36	36	39	39		38	
08:02	02:02	55.00	495	40	40	41	41		41	
08:04	02:04	60.00	540	43	43	46	46		45	
08:08	02:08	60.00	540	45	45	47	47		46	T60
08:10	02:10	50.00	450	45	45	46	46		46	
08:12	02:12	40.00	360	43	43	43	43		43	
08:14	02:14	30.00	270	38	38	40	40		39	
08:16	02:16	20.00	180	30	30	36	36		33	
08:18	02:18	10.00	90	22	22	27	27		25	
08:20	02:20	5.00	45	17	17	20	20		19	
08:22	02:22	0.00	0	11	11	13	13		12	
08:26	02:26	0.00	0	11	11	13	13		12	B60
08:28	02:28	10.00	90	17	17	19	19		18	
08:30	02:30	20.00	180	27	27	26	26		27	
08:32	02:32	30.00	270	33	33	32	32		33	
08:34	02:34	40.00	360	38	38	38	38		38	
08:36	02:36	50.00	450	43	43	43	43		43	
08:38	02:38	60.00	540	47	47	47	47		47	
08:40	02:40	60.00	540	49	49	48	48		49	T60c
08:42	02:42	60.00	540	50	50	49	49		50	Beginning
08:45	02:45	60.00	540	51	51	50	50		51	of Creep
08:50	02:50	60.00	540	51	51	50	50		51	
08:55	02:55	60.00	540	51	51	50	50		51	
09:00	03:00	60.00	540	52	52	50	50		51	
09:05	03:05	60.00	540	52	52	50	50		51	
09:10	03:10	60.00	540	52	52	50	50		51	
09:20	03:20	60.00	540	53	53	51	51		52	
09:30	03:30	60.00	540	53	53	51	51		52	
09:40	03:40	60.00	540	53	53	51	51		52	1 hour
10:10	04:10	60.00	540	53	53	52	52		53	
10:40	04:40	60.00	540	53	53	52	52		53	2 hours
11:10	05:10	60.00	540	54	54	53	53		54	
11:40	05:40	60.00	540	54	54	53	53		54	3 hours
12:10	06:10	60.00	540	54	54	53	53		54	
12:40	06:40	60.00	540	54	54	53	53		54	4 hours
13:10	07:10	60.00	540	54	54	53	53		54	
13:40	07:40	60.00	540	54	54	53	53		54	5 hours
14:10	08:10	60.00	540	54	54	53	53		54	
14:40	08:40	60.00	540	54	54	53	53		54	6 hours
14:42	08:42	50.00	450	53	53	52	52		53	End of Creep

Table A-4-13 Data Sheet of PBT-L3(3)

1991.6-7

PLATE BEARING TEST Measuring Point PBT-L3 (LA-1 28.5m) DATA SHEET (3)

Time (h.m)	Elapse (h.m)	Stress (kg/cm2)	Jack Pressure (kg/cm2)	Deformation (1/ 100 mm) Dial Gauge Reading of Displacement (1) D.Read	(1) Disp.	(2) D.Read	(2) Disp.		[(1)+(2)]/2	Remarks
14:44	08:44	40.00	360	50	50	50	50		50	
14:46	08:46	30.00	270	45	45	47	47		46	
14:48	08:48	20.00	180	38	38	41	41		40	
14:50	08:50	10.00	90	30	30	33	33		32	
14:52	08:52	5.00	45	23	23	26	26		28	
14:54	08:54	0.00	0	16	16	18	18		21	
14:58	08:58	0.00	0	16	16	18	18		17	B60c
15:00	09:00	10.00	90	22	22	26	26		21	
15:02	09:02	20.00	180	31	31	33	33		28	
15:04	09:04	30.00	270	37	37	39	39		35	
15:06	09:06	40.00	360	45	45	44	44		41	
15:08	09:08	50.00	450	50	50	49	49		47	
15:10	09:10	60.00	540	53	53	52	52		51	
15:12	09:12	65.00	585	55	55	54	54		54	
15:16	09:16	65.00	585	55	55	54	54		55	T65-1
15:18	09:18	60.00	540	55	55	54	54		55	
15:20	09:20	50.00	450	54	54	52	52		54	
15:22	09:22	40.00	360	52	52	50	50		52	
15:24	09:24	30.00	270	48	48	47	47		50	
15:26	09:26	20.00	180	42	42	43	43		46	
15:28	09:28	10.00	90	34	34	35	35		39	
15:30	09:30	5.00	45	26	26	27	27		31	
15:34	09:34	0.00	0	17	17	20	20		23	
15:36	09:36	0.00	0	17	17	20	20		19	B65-1
15:38	09:38	10.00	90	25	25	28	28		27	
15:40	09:40	20.00	180	34	34	36	36		35	
15:42	09:42	30.00	270	41	41	42	42		42	
15:44	09:44	40.00	360	47	47	47	47		47	
15:46	09:46	50.00	450	51	51	51	51		51	
15:48	09:48	60.00	540	55	55	54	54		55	
15:50	09:50	65.00	585	57	57	56	56		57	
15:54	09:54	65.00	585	57	57	56	56		57	T65-2
15:56	09:56	60.00	540	57	57	56	56		57	
15:58	09:58	50.00	450	56	56	55	55		56	
16:00	10:00	40.00	360	53	53	52	52		53	
16:02	10:02	30.00	270	49	49	48	48		49	
16:04	10:04	20.00	180	44	44	44	44		44	
16:06	10:06	10.00	90	35	35	37	37		36	
16:08	10:08	5.00	45	28	28	30	30		29	
16:12	10:12	0.00	0	18	18	21	21		20	
16:14	10:14	0.00	0	18	18	21	21		20	B65-2
										The End

Table A-4-14 Data Sheet of PBT-L3(4) 1991.6-7

PLATE BEARING TEST — Measuring Point PBT-L3 (LA-1 28.5m) — DATA SHEET (4)

Test Location LA-1 (Left Bank) — Geological Dolerite - Basalt — Date Measured '91/6/18

Plate Radius (a) = 15.00 cm2 — Classification CH — Measured by M.Rivas V.

Loading Plate area = 707 cm2 — Max.Load Stress 78 kg/cm2 — Capacity 55.2 ton

Deformation Measurement Results

Stress (kg/cm2)	Deformation (1/ 100 mm) δ	δe	δp	Σδ	Σδp
0	0	0	0	0	0
15	6	4	2	6	2
0				2	
15	5	4	1	7	3
0				3	
15	6	5	1	9	4
0				4	
30	16	15	1	20	5
0				5	
45	28	25	3	33	8
0				8	
60	38	34	4	46	12
0 Creep				12	
60 0 h.	(0 %)			49	
60 1 h.	(60 %)			52	
60 3 h.	(100 %)			54	
60 6 h.	(100 %)			54	20
0				17	
65	38	36	2	55	19
0				19	
20 0	0			35	
30 10	7			42	
40 20	12			47	
50 30	16			51	
60 40	20			55	
65	38	37	1	57	20
0				20	

Remarks

δ :Total Deformation
δe :Elastic Deformation
δp :Plastic Deformation
Σδ :Cumulative Total Deformation
Σδp :Cumulative Plastic Deformation

Creep Calculation

Elastic Deformation Just Before Creep δe (1/ 100 mm)	34
Creep Deformation δc (1/ 100 mm)	5
Creep Factor Cf(%) = (δc/δe)*100	15

Modulus of Deformation (D) and Modulus of Elasticity (E) Calculation Formula

$$D \text{ or } E = \frac{\pi a(1-\nu 2)}{2} * \frac{\Delta\sigma}{\Delta\delta}$$

a :Plate radius 15 (cm)
ν :Poisson's ratio 0.2
Δσ :Stress increment (kg/cm2)
Δδ :Deformation increment due to Δσ
πa(1-ν2)/2 = 22.6194 cm

Coefficients Related to Deformation

Modulus of Deformation	D =	30,000	kg/cm2
Tangential Modulus of Elasticity	Et =	42,000	kg/cm2
Secant Modulus of Elasticity	Es =	38,000	kg/cm2

Table A-4-15 Data Sheet of PBT-R1(1) 1991.6-7

PLATE BEARING TEST Measuring Point PBT-R1 (LA-2 30.8m) DATA SHEET (1)

Test Location LA-2 (Right Bank) Geological Dolerite - Basalt Date Measured '91/6/14
Loading Plate Radius= 15.00 cm Classification CM Measured by M.Rivas V.
Loading Plate area = 707 cm2 Max.Load Stress 78 kg/cm2 J.Capa. 55.2 ton
Jack Ram Diameter = 10.00 cm Max.Oil Pressur 703 kg/cm2

Time Interval = 00:02 (h:m) Top = 00:04 (h:m) Bottom = 00:04 (h:m)
Load Rate(Virgin) = 5 (kg/cm2/min) Load Rate(Hysteresis) = 10 (kg/cm2/min)

Time (h.m)	Elapse (h.m)	Stress (kg/cm2)	Jack Pressure (kg/cm2)	Deformation (1/100 mm) Dial Gauge Reading of Displacement (1) D.Read	(1) Disp.	(2) D.Read	(2) Disp.		[(1)+(2)]/2	Remarks
07:15	00:00	0.00	0	0	0	0	0		0	Start
07:17	00:02	5.00	45	2	2	3	3		3	
07:19	00:04	10.00	90	12	12	10	10		11	
07:21	00:06	15.00	135	21	21	18	18		20	
07:25	00:10	15.00	135	21	21	19	19		20	Top15
07:27	00:12	5.00	45	19	19	12	12		16	
07:29	00:14	0.00	0	16	16	4	4		10	
07:33	00:18	0.00	0	16	16	4	4		10	Bottom15
07:35	00:20	10.00	90	20	20	16	16		18	
07:37	00:22	15.00	135	22	22	22	22		22	
07:41	00:26	15.00	135	22	22	22	22		22	T15-2
07:43	00:28	5.00	45	20	20	16	16		18	
07:45	00:30	0.00	0	17	17	8	8		13	
07:49	00:34	0.00	0	17	17	8	8		13	B15-2
07:51	00:36	10.00	90	20	20	20	20		20	
07:53	00:38	15.00	135	23	23	25	25		24	
07:57	00:42	15.00	135	23	23	25	25		24	T15-3
07:59	00:44	5.00	45	20	20	19	19		20	
08:01	00:46	0.00	0	18	18	12	12		15	
08:05	00:50	0.00	0	18	18	12	12		15	B15-3
08:07	00:52	10.00	90	21	21	22	22		22	
08:09	00:54	15.00	135	23	23	26	26		25	
08:11	00:56	20.00	180	29	29	33	33		31	
08:13	00:58	25.00	225	34	34	40	40		37	
08:15	01:00	30.00	270	39	39	50	50		45	
08:19	01:04	30.00	270	40	40	50	50		45	T30
08:21	01:06	20.00	180	38	38	49	49		44	
08:23	01:08	10.00	90	34	34	37	37		36	
08:25	01:10	5.00	45	30	30	28	28		29	
08:27	01:12	0.00	0	23	23	17	17		20	
08:31	01:16	0.00	0	23	23	17	17		20	B30
08:33	01:18	10.00	90	31	31	32	32		32	
08:35	01:20	20.00	180	36	36	45	45		41	
08:37	01:22	30.00	270	41	41	55	55		48	
08:39	01:24	35.00	315	44	44	61	61		53	
08:41	01:26	40.00	360	49	49	70	70		60	
08:43	01:28	45.00	405	55	55	80	80		68	
08:47	01:32	45.00	405	55	55	83	83		69	T45
08:49	01:34	40.00	360	55	55	83	83		69	
08:51	01:36	30.00	270	54	54	78	78		66	
08:53	01:38	20.00	180	51	51	69	69		60	

Table A-4-16 Data Sheet of PBT-R1(2)

1991.6-7

PLATE BEARING TEST Measuring Point PBT-R1 (LA-2 30.8m) DATA SHEET (2)

Time (h.m)	Elapse (h.m)	Stress (kg/cm2)	Jack Pressure (kg/cm2)	Deformation (1/ 100 mm) Dial Gauge Reading of Displacement (1) D.Read	(1) Disp.	(2) D.Read	(2) Disp.		[(1)+(2)]/2	Remarks
08:55	01:40	10.00	90	46	46	55	55		51	
08:57	01:42	5.00	45	42	42	43	43		43	
08:59	01:44	0.00	0	35	35	30	30		33	
09:03	01:48	0.00	0	35	35	30	30		33	B45
09:05	01:50	10.00	90	42	42	48	48		45	
09:07	01:52	20.00	180	46	46	62	62		54	
09:09	01:54	30.00	270	50	50	73	73		62	
09:11	01:56	40.00	360	54	54	83	83		69	
09:13	01:58	45.00	405	56	56	89	89		73	
09:15	02:00	50.00	450	58	58	95	95		77	
09:17	02:02	55.00	495	60	60	105	105		83	
09:19	02:04	60.00	540	63	63	116	116		90	
09:23	02:08	60.00	540	63	63	121	121		92	T60
09:25	02:10	50.00	450	63	63	118	118		91	
09:27	02:12	40.00	360	62	62	115	115		89	
09:29	02:14	30.00	270	60	60	108	108		84	
09:31	02:16	20.00	180	58	58	96	96		77	
09:33	02:18	10.00	90	55	55	81	81		68	
09:35	02:20	5.00	45	53	53	70	70		62	
09:37	02:22	0.00	0	50	50	50	50		50	
09:41	02:26	0.00	0	50	50	50	50		50	B60
09:43	02:28	10.00	90	54	54	73	73		64	
09:45	02:30	20.00	180	57	57	87	87		72	
09:47	02:32	30.00	270	59	59	100	100		80	
09:49	02:34	40.00	360	61	61	111	111		86	
09:51	02:36	50.00	450	63	63	120	120		92	
09:53	02:38	60.00	540	65	65	130	130		98	
09:55	02:40	60.00	540	65	65	133	133		99	T60c
09:57	02:42	60.00	540	65	65	134	134		100	Beginning
10:00	02:45	60.00	540	66	66	135	135		101	of Creep
10:05	02:50	60.00	540	67	67	136	136		102	
10:10	02:55	60.00	540	67	67	137	137		102	
10:15	03:00	60.00	540	67	67	138	138		103	
10:20	03:05	60.00	540	67	67	139	139		103	
10:25	03:10	60.00	540	68	68	140	140		104	
10:35	03:20	60.00	540	68	68	140	140		104	
10:45	03:30	60.00	540	69	69	142	142		106	
10:55	03:40	60.00	540	69	69	143	143		106	1 hour
11:25	04:10	60.00	540	70	70	144	144		107	
11:55	04:40	60.00	540	71	71	146	146		109	2 hours
12:25	05:10	60.00	540	72	72	148	148		110	
12:55	05:40	60.00	540	73	73	150	150		112	3 hours
13:25	06:10	60.00	540	74	74	152	152		113	
13:55	06:40	60.00	540	74	74	153	153		114	4 hours
14:25	07:10	60.00	540	74	74	153	153		114	
14:55	07:40	60.00	540	74	74	154	154		114	5 hours
15:25	08:10	60.00	540	74	74	155	155		115	
15:55	08:40	60.00	540	74	74	155	155		115	6 hours
15:57	08:42	50.00	450	73	73	154	154		114	End of Creep

Table A-4-17 Data Sheet of PBT-R1(3)

1991.6-7

PLATE BEARING TEST Measuring Point PBT-R1 (LA-2 30.8m) DATA SHEET (3)

Time (h.m)	Elapse (h.m)	Stress (kg/cm2)	Jack Pressure (kg/cm2)	Deformation (1/ 100 mm) Dial Gauge Reading of Displacement (1) D.Read	(1) Disp.	(2) D.Read	(2) Disp.		[(1)+(2)]/2	Remarks
15:59	08:44	40.00	360	72	72	148	148		110	
16:01	08:46	30.00	270	71	71	141	141		106	
16:03	08:48	20.00	180	69	69	130	130		100	
16:05	08:50	10.00	90	67	67	117	117		92	
16:07	08:52	5.00	45	65	65	105	105		85	
16:09	08:54	0.00	0	61	61	90	90		76	
16:13	08:58	0.00	0	61	61	90	90		76	B60c
16:15	09:00	10.00	90	64	64	114	114		89	
16:17	09:02	20.00	180	67	67	128	128		98	
16:19	09:04	30.00	270	69	69	140	140		105	
16:21	09:06	40.00	360	71	71	150	150		111	
16:23	09:08	50.00	450	73	73	158	158		116	
16:25	09:10	60.00	540	75	75	165	165		120	
16:27	09:12	65.00	585	78	78	171	171		125	
16:31	09:16	65.00	585	78	78	172	172		125	T65-1
16:33	09:18	60.00	540	77	77	171	171		124	
16:35	09:20	50.00	450	76	76	167	167		122	
16:37	09:22	40.00	360	74	74	162	162		118	
16:39	09:24	30.00	270	72	72	153	153		113	
16:41	09:26	20.00	180	70	70	142	142		106	
16:43	09:28	10.00	90	67	67	130	130		99	
16:45	09:30	5.00	45	66	66	118	118		92	
16:49	09:34	0.00	0	63	63	100	100		82	
16:51	09:36	0.00	0	63	63	100	100		82	B65-1
16:53	09:38	10.00	90	65	65	120	120		93	
16:55	09:40	20.00	180	68	68	133	133		101	
16:57	09:42	30.00	270	70	70	146	146		108	
16:59	09:44	40.00	360	72	72	155	155		114	
17:01	09:46	50.00	450	74	74	166	166		120	
17:03	09:48	60.00	540	76	76	173	173		125	
17:05	09:50	65.00	585	79	79	179	179		129	
17:09	09:54	65.00	585	79	79	182	182		131	T65-2
17:11	09:56	60.00	540	78	78	180	180		129	
17:13	09:58	50.00	450	77	77	176	176		127	
17:15	10:00	40.00	360	75	75	169	169		122	
17:17	10:02	30.00	270	73	73	162	162		118	
17:19	10:04	20.00	180	71	71	152	152		112	
17:21	10:06	10.00	90	69	69	137	137		103	
17:23	10:08	5.00	45	67	67	126	126		97	
17:27	10:12	0.00	0	64	64	117	117		91	
17:29	10:14	0.00	0	64	64	117	117		91	B65-2
										The End

Table A-4-18 Data Sheet of PBT-R1(4)

1991.6-7

PLATE BEARING TEST — Measuring Point PBT-R1 (LA-2 30.8m) — DATA SHEET (4)

Test Location LA-2 (Right Bank) — Geological Dolerite - Basalt — Date Measured '91/6/14

Plate Radius (a) = 15.00 cm2 — Classification CM — Measured by M.Rivas V.

Loading Plate area = 707 cm2 — Max.Load Stress 78 kg/cm2 — Capacity 55.2 ton

Deformation Measurement Results

Stress (kg/cm2)	Deformation (1/100 mm) δ	δe	δp	Σδ	Σδp
0	0	0	0	0	0
15	20	10	10	20	10
0				10	
15	12	9	3	22	13
0				13	
15	11	9	2	24	15
0				15	
30	30	25	5	45	20
0				20	
45	49	36	13	69	33
0				33	
60	59	42	17	92	50
0 Creep				50	
60 0 h.	(	0 %)		99	
60 1 h.	(	44 %)		106	
60 3 h.	(	81 %)		112	
60 6 h.	(	100 %)		115	73
0				76	
65	49	43	6	125	82
0				82	
20 0	0			101	
30 10	7			108	
40 20	13			114	
50 30	19			120	
60 40	24			125	
65	49	40	9	131	91
0				91	

Remarks

δ :Total Deformation
δe :Elastic Deformation
δp :Plastic Deformation
Σδ :Cumulative Total Deformation
Σδp :Cumulative Plastic Deformation

Creep Calculation

Elastic Deformation Just Before Creep δe (1/100 mm)	42
Creep Deformation δc (1/100 mm)	16
Creep Factor Cf(%) = (δc/δe)*100	38

Modulus of Deformation (D) and Modulus of Elasticity (E) Calculation Formula

$$D \text{ or } E = \frac{\pi a(1-\nu 2)}{2} * \frac{\Delta\sigma}{\Delta\delta}$$

a :Plate radius 15 (cm)
ν :Poisson's ratio 0.2
Δσ :Stress increment (kg/cm2)
Δδ :Deformation increment due to Δσ
πa(1-ν2)/2 = 22.6194 cm

Coefficients Related to Deformation

Modulus of Deformation	D =	14,000	kg/cm2
Tangential Modulus of Elasticity	Et =	36,000	kg/cm2
Secant Modulus of Elasticity	Es =	30,000	kg/cm2

Table A-4-19 Data Sheet of PBT-R2(1)

1991.6-7

PLATE BEARING TEST — Measuring Point PBT-R2 (LA-2 40.0m) — DATA SHEET (1)

Test Location LA-2 (Right Bank)
Loading Plate Radius= 15.00 cm
Loading Plate area = 707 cm2
Jack Ram Diameter = 10.00 cm

Geological Classification: Dolerite - Basalt, CM
Max.Load Stress 78 kg/cm2
Max.Oil Pressur 703 kg/cm2

Date Measured '91/6/13
Measured by M.Rivas V.
J.Capa. 55.2 ton

Time Interval = 00:02 (h:m) Top = 00:04 (h:m) Bottom = 00:04 (h:m)
Load Rate(Virgin) = 5 (kg/cm2/min) Load Rate(Hysteresis) = 10 (kg/cm2/min)

Time (h.m)	Elapse (h.m)	Stress (kg/cm2)	Jack Pressure (kg/cm2)	Deformation (1/100 mm) Dial Gauge Reading of Displacement (1) D.Read	(1) Disp.	(2) D.Read	(2) Disp.		[(1)+(2)]/2	Remarks
08:40	00:00	0.00	0	0	0	0	0		0	Start
08:42	00:02	5.00	45	4	4	3	3		4	
08:44	00:04	10.00	90	8	8	6	6		7	
08:46	00:06	15.00	135	12	12	8	8		10	
08:50	00:10	15.00	135	12	12	9	9		11	Top15
08:52	00:12	5.00	45	9	9	6	6		8	
08:54	00:14	0.00	0	2	2	2	2		2	
08:58	00:18	0.00	0	2	2	2	2		2	Bottom15
09:00	00:20	10.00	90	9	9	5	5		7	
09:02	00:22	15.00	135	13	13	8	8		11	
09:06	00:26	15.00	135	13	13	8	8		11	T15-2
09:08	00:28	5.00	45	9	9	5	5		7	
09:10	00:30	0.00	0	3	3	3	3		3	
09:14	00:34	0.00	0	3	3	3	3		3	B15-2
09:16	00:36	10.00	90	10	10	8	8		9	
09:18	00:38	15.00	135	13	13	11	11		12	
09:22	00:42	15.00	135	13	13	11	11		12	T15-3
09:24	00:44	5.00	45	9	9	6	6		8	
09:26	00:46	0.00	0	4	4	4	4		4	
09:30	00:50	0.00	0	4	4	4	4		4	B15-3
09:32	00:52	10.00	90	10	10	6	6		8	
09:34	00:54	15.00	135	13	13	9	9		11	
09:36	00:56	20.00	180	18	18	12	12		15	
09:38	00:58	25.00	225	21	21	16	16		19	
09:40	01:00	30.00	270	24	24	20	20		22	
09:44	01:04	30.00	270	24	24	20	20		22	T30
09:46	01:06	20.00	180	21	21	15	15		18	
09:48	01:08	10.00	90	18	18	11	11		15	
09:50	01:10	5.00	45	13	13	7	7		10	
09:52	01:12	0.00	0	5	5	5	5		5	
09:56	01:16	0.00	0	5	5	5	5		5	B30
09:58	01:18	10.00	90	13	13	7	7		10	
10:00	01:20	20.00	180	21	21	14	14		18	
10:02	01:22	30.00	270	25	25	21	21		23	
10:04	01:24	35.00	315	29	29	25	25		27	
10:06	01:26	40.00	360	32	32	30	30		31	
10:08	01:28	45.00	405	35	35	34	34		35	
10:12	01:32	45.00	405	35	35	35	35		35	T45
10:14	01:34	40.00	360	35	35	35	35		35	
10:16	01:36	30.00	270	33	33	32	32		33	
10:18	01:38	20.00	180	31	31	28	28		30	

Table A-4-20 Data Sheet of PBT-R2(2)

1991.6-7

PLATE BEARING TEST Measuring Point PBT-R2 (LA-2 40.0m) DATA SHEET (2)

Time (h.m)	Elapse (h.m)	Stress (kg/cm2)	Jack Pressure (kg/cm2)	Deformation (1/ 100 mm) Dial Gauge Reading of Displacement (1) D.Read	(1) Disp.	(2) D.Read	(2) Disp.		[(1)+(2)]/2	Remarks
10:20	01:40	10.00	90	24	24	20	20		22	
10:22	01:42	5.00	45	18	18	16	16		17	
10:24	01:44	0.00	0	9	9	7	7		8	
10:28	01:48	0.00	0	9	9	7	7		8	B45
10:30	01:50	10.00	90	17	17	12	12		15	
10:32	01:52	20.00	180	25	25	20	20		23	
10:34	01:54	30.00	270	30	30	25	25		28	
10:36	01:56	40.00	360	35	35	32	32		34	
10:38	01:58	45.00	405	37	37	35	35		36	
10:40	02:00	50.00	450	39	39	37	37		38	
10:42	02:02	55.00	495	41	41	39	39		40	
10:44	02:04	60.00	540	43	43	42	42		43	
10:48	02:08	60.00	540	43	43	42	42		43	T60
10:50	02:10	50.00	450	42	42	42	42		42	
10:52	02:12	40.00	360	40	40	39	39		40	
10:54	02:14	30.00	270	38	38	34	34		36	
10:56	02:16	20.00	180	34	34	30	30		32	
10:58	02:18	10.00	90	24	24	20	20		22	
11:00	02:20	5.00	45	16	16	12	12		14	
11:02	02:22	0.00	0	10	10	8	8		9	
11:06	02:26	0.00	0	10	10	8	8		9	B60
11:08	02:28	10.00	90	13	13	14	14		14	
11:10	02:30	20.00	180	16	16	22	22		19	
11:12	02:32	30.00	270	25	25	30	30		28	
11:14	02:34	40.00	360	32	32	36	36		34	
11:16	02:36	50.00	450	39	39	40	40		40	
11:18	02:38	60.00	540	45	45	45	45		45	
11:20	02:40	60.00	540	45	45	45	45		45	T60c
11:22	02:42	60.00	540	45	45	45	45		45	Beginning
11:25	02:45	60.00	540	45	45	45	45		45	of Creep
11:30	02:50	60.00	540	45	45	46	46		46	
11:35	02:55	60.00	540	45	45	46	46		46	
11:40	03:00	60.00	540	46	46	46	46		46	
11:45	03:05	60.00	540	46	46	47	47		47	
11:50	03:10	60.00	540	46	46	47	47		47	
12:00	03:20	60.00	540	46	46	47	47		47	
12:10	03:30	60.00	540	47	47	48	48		48	
12:20	03:40	60.00	540	47	47	48	48		48	1 hour
12:50	04:10	60.00	540	47	47	48	48		48	
13:20	04:40	60.00	540	47	47	49	49		48	2 hours
13:50	05:10	60.00	540	48	48	49	49		49	
14:20	05:40	60.00	540	48	48	49	49		49	3 hours
14:50	06:10	60.00	540	48	48	50	50		49	
15:20	06:40	60.00	540	49	49	50	50		50	4 hours
15:50	07:10	60.00	540	49	49	50	50		50	
16:20	07:40	60.00	540	49	49	51	51		50	5 hours
16:50	08:10	60.00	540	50	50	51	51		51	
17:20	08:40	60.00	540	51	51	51	51		51	6 hours
17:22	08:42	50.00	450	50	50	51	51		51	End of Creep

Table A-4-21 Data Sheet of PBT-R2(3)

1991.6-7

PLATE BEARING TEST — Measuring Point PBT-R2 (LA-2 40.0m) — DATA SHEET (3)

Time (h.m)	Elapse (h.m)	Stress (kg/cm2)	Jack Pressure (kg/cm2)	Deformation (1/ 100 mm) Dial Gauge Reading of Displacement (1) D.Read	(1) Disp.	(2) D.Read	(2) Disp.		[(1)+(2)]/2	Remarks
17:24	08:44	40.00	360	49	49	50	50		50	
17:26	08:46	30.00	270	48	48	47	47		48	
17:28	08:48	20.00	180	42	42	43	43		43	
17:30	08:50	10.00	90	31	31	36	36		34	
17:32	08:52	5.00	45	21	21	27	27		24	
17:34	08:54	0.00	0	12	12	15	15		14	
17:38	08:58	0.00	0	12	12	15	15		14	B60c
17:40	09:00	10.00	90	22	22	28	28		25	
17:42	09:02	20.00	180	28	28	32	32		30	
17:44	09:04	30.00	270	36	36	38	38		37	
17:46	09:06	40.00	360	43	43	42	42		43	
17:48	09:08	50.00	450	48	48	47	47		48	
17:50	09:10	60.00	540	54	54	51	51		53	
17:52	09:12	65.00	585	56	56	53	53		55	
17:56	09:16	65.00	585	57	57	53	53		55	T65-1
17:58	09:18	60.00	540	57	57	53	53		55	
18:00	09:20	50.00	450	56	56	52	52		54	
18:02	09:22	40.00	360	54	54	50	50		52	
18:04	09:24	30.00	270	50	50	48	48		49	
18:06	09:26	20.00	180	43	43	44	44		44	
18:08	09:28	10.00	90	33	33	36	36		35	
18:10	09:30	5.00	45	24	24	29	29		27	
18:14	09:34	0.00	0	13	13	17	17		15	
18:16	09:36	0.00	0	13	13	17	17		15	B65-1
18:18	09:38	10.00	90	23	23	28	28		26	
18:20	09:40	20.00	180	30	30	34	34		32	
18:22	09:42	30.00	270	38	38	38	38		38	
18:24	09:44	40.00	360	45	45	44	44		45	
18:26	09:46	50.00	450	52	52	48	48		50	
18:28	09:48	60.00	540	56	56	52	52		54	
18:30	09:50	65.00	585	59	59	54	54		57	
18:34	09:54	65.00	585	59	59	54	54		57	T65-2
18:36	09:56	60.00	540	59	59	54	54		57	
18:38	09:58	50.00	450	58	58	53	53		56	
18:40	10:00	40.00	360	56	56	51	51		54	
18:42	10:02	30.00	270	51	51	48	48		50	
18:44	10:04	20.00	180	45	45	44	44		45	
18:46	10:06	10.00	90	34	34	36	36		35	
18:48	10:08	5.00	45	24	24	29	29		27	
18:52	10:12	0.00	0	14	14	19	19		17	
18:54	10:14	0.00	0	14	14	19	19		17	B65-2
										The End

Table A-4-22 Data Sheet of PBT-R2(4)

1991.6-7

PLATE BEARING TEST — Measuring Point PBT-R2 (LA-2 40.0m) — DATA SHEET (4)

Test Location LA-2 (Right Bank) — Geological Dolerite - Basalt — Date Measured '91/6/13

Plate Radius (a) = 15.00 cm2 — Classification CM — Measured by M.Rivas V.

Loading Plate area = 707 cm2 — Max.Load Stress 78 kg/cm2 — Capacity 55.2 ton

Deformation Measurement Results

Stress (kg/cm2)	Deformation (1/100 mm) δ	δe	δp	Σδ	Σδp
0	0	0	0	0	0
15	11	9	2	11	2
0				2	
15	9	8	1	11	3
0				3	
15	9	8	1	12	4
0				4	
30	18	17	1	22	5
0				5	
45	30	27	3	35	8
0				8	
60	35	34	1	43	9
0 Creep				9	
60 0 h.	(	0 %)		45	
60 1 h.	(	50 %)		48	
60 3 h.	(	67 %)		49	
60 6 h.	(	100 %)		51	17
0				14	
65	41	40	1	55	15
0				15	
20 0	0			32	
30 10	6			38	
40 20	13			45	
50 30	18			50	
60 40	22			54	
65	42	40	2	57	17
0				17	

Remarks

δ :Total Deformation
δe :Elastic Deformation
δp :Plastic Deformation
Σδ :Cumulative Total Deformation
Σδp :Cumulative Plastic Deformation

Creep Calculation

Elastic Deformation Just Before Creep δe (1/100 mm)	34
Creep Deformation δc (1/100 mm)	6
Creep Factor Cf(%) = (δc/δe)*100	18

Modulus of Deformation (D) and Modulus of Elasticity (E) Calculation Formula

$$D \text{ or } E = \frac{\pi a(1-\nu 2)}{2} * \frac{\Delta\sigma}{\Delta\delta}$$

a :Plate radius 15 (cm)
ν :Poisson's ratio 0.2
Δσ :Stress increment (kg/cm2)
Δδ :Deformation increment due to Δσ
πa(1-ν2)/2 = 22.6194 cm

Coefficients Related to Deformation

Modulus of Deformation	D =	30,000	kg/cm2
Tangential Modulus of Elasticity	Et =	38,000	kg/cm2
Secant Modulus of Elasticity	Es =	35,000	kg/cm2

Table A-4-23 Data Sheet of PBT-R3(1) 1991.6-7

PLATE BEARING TEST — Measuring Point PBT-R3 (LA-2 42.0m) — DATA SHEET (1)

Test Location LA-2 (Right Bank) — Geological Dolerite - Basalt — Date Measured '91/6/12
Loading Plate Radius= 15.00 cm — Classification CM — Measured by M.Rivas V.
Loading Plate area = 707 cm2 — Max.Load Stress 78 kg/cm2 — J.Capa. 55.2 ton
Jack Ram Diameter = 10.00 cm — Max.Oil Pressur 703 kg/cm2

Time Interval = 00:02 (h:m) — Top = 00:04 (h:m) — Bottom = 00:04 (h:m)
Load Rate(Virgin) = 5 (kg/cm2/min) — Load Rate(Hysteresis) = 10 (kg/cm2/min)

Time (h.m)	Elapse (h.m)	Stress (kg/cm2)	Jack Pressure (kg/cm2)	Deformation (1/ 100 mm) Dial Gauge Reading of Displacement (1) D.Read	(1) Disp.	(2) D.Read	(2) Disp.		[(1)+(2)]/2	Remarks
06:00	00:00	0.00	0	0	0	0	0		0	Start
06:02	00:02	5.00	45	11	11	10	10		11	
06:04	00:04	10.00	90	32	32	17	17		25	
06:06	00:06	15.00	135	42	42	24	24		33	
06:10	00:10	15.00	135	42	42	25	25		34	Top15
06:12	00:12	5.00	45	38	38	22	22		30	
06:14	00:14	0.00	0	36	36	12	12		24	
06:18	00:18	0.00	0	36	36	12	12		24	Bottom15
06:20	00:20	10.00	90	38	38	22	22		30	
06:22	00:22	15.00	135	39	39	26	26		33	
06:26	00:26	15.00	135	39	39	27	27		33	T15-2
06:28	00:28	5.00	45	37	37	24	24		31	
06:30	00:30	0.00	0	35	35	16	16		26	
06:34	00:34	0.00	0	35	35	16	16		26	B15-2
06:36	00:36	10.00	90	38	38	24	24		31	
06:38	00:38	15.00	135	40	40	32	32		36	
06:42	00:42	15.00	135	40	40	32	32		36	T15-3
06:44	00:44	5.00	45	38	38	27	27		33	
06:46	00:46	0.00	0	35	35	19	19		27	
06:50	00:50	0.00	0	35	35	19	19		27	B15-3
06:52	00:52	10.00	90	37	37	27	27		32	
06:54	00:54	15.00	135	39	39	31	31		35	
06:56	00:56	20.00	180	42	42	38	38		40	
06:58	00:58	25.00	225	45	45	48	48		47	
07:00	01:00	30.00	270	50	50	60	60		55	
07:04	01:04	30.00	270	50	50	66	66		58	T30
07:06	01:06	20.00	180	49	49	65	65		57	
07:08	01:08	10.00	90	46	46	57	57		52	
07:10	01:10	5.00	45	44	44	52	52		48	
07:12	01:12	0.00	0	36	36	39	39		38	
07:16	01:16	0.00	0	36	36	39	39		38	B30
07:18	01:18	10.00	90	37	37	47	47		42	
07:20	01:20	20.00	180	39	39	57	57		48	
07:22	01:22	30.00	270	42	42	65	65		54	
07:24	01:24	35.00	315	43	43	73	73		58	
07:26	01:26	40.00	360	45	45	85	85		65	
07:28	01:28	45.00	405	48	48	99	99		74	
07:32	01:32	45.00	405	50	50	111	111		81	T45
07:34	01:34	40.00	360	48	48	110	110		79	
07:36	01:36	30.00	270	46	46	110	110		78	
07:38	01:38	20.00	180	44	44	106	106		75	

Table A-4-24 Data Sheet of PBT-R3(2)

1991.6-7

PLATE BEARING TEST — Measuring Point PBT-R3 (LA-2 42.0m) — DATA SHEET (2)

Time (h.m)	Elapse (h.m)	Stress (kg/cm2)	Jack Pressure (kg/cm2)	Deformation (1/ 100 mm) Dial Gauge Reading of Displacement (1) D.Read	(1) Disp.	(2) D.Read	(2) Disp.		[(1)+(2)]/2	Remarks
07:40	01:40	10.00	90	44	44	99	99		72	
07:42	01:42	5.00	45	41	41	90	90		66	
07:44	01:44	0.00	0	39	39	76	76		58	
07:48	01:48	0.00	0	38	38	76	76		57	B45
07:50	01:50	10.00	90	42	42	85	85		64	
07:52	01:52	20.00	180	45	45	95	95		70	
07:54	01:54	30.00	270	47	47	103	103		75	
07:56	01:56	40.00	360	51	51	112	112		82	
07:58	01:58	45.00	405	52	52	117	117		85	
08:00	02:00	50.00	450	54	54	125	125		90	
08:02	02:02	55.00	495	56	56	136	136		96	
08:04	02:04	60.00	540	59	59	148	148		104	
08:08	02:08	60.00	540	60	60	150	150		105	T60
08:10	02:10	50.00	450	60	60	150	150		105	
08:12	02:12	40.00	360	58	58	149	149		104	
08:14	02:14	30.00	270	55	55	147	147		101	
08:16	02:16	20.00	180	53	53	141	141		97	
08:18	02:18	10.00	90	50	50	133	133		92	
08:20	02:20	5.00	45	47	47	125	125		86	
08:22	02:22	0.00	0	44	44	111	111		78	
08:26	02:26	0.00	0	44	44	111	111		78	B60
08:28	02:28	10.00	90	45	45	117	117		81	
08:30	02:30	20.00	180	49	49	128	128		89	
08:32	02:32	30.00	270	52	52	136	136		94	
08:34	02:34	40.00	360	55	55	144	144		100	
08:36	02:36	50.00	450	58	58	150	150		104	
08:38	02:38	60.00	540	61	61	158	158		110	
08:40	02:40	60.00	540	61	61	161	161		111	T60c
08:42	02:42	60.00	540	62	62	163	163		113	Beginning
08:45	02:45	60.00	540	62	62	163	163		113	of Creep
08:50	02:50	60.00	540	62	62	165	165		114	
08:55	02:55	60.00	540	62	62	165	165		114	
09:00	03:00	60.00	540	62	62	165	165		114	
09:05	03:05	60.00	540	62	62	166	166		114	
09:10	03:10	60.00	540	62	62	167	167		115	
09:20	03:20	60.00	540	62	62	168	168		115	
09:30	03:30	60.00	540	63	63	169	169		116	
09:40	03:40	60.00	540	63	63	169	169		116	1 hour
10:10	04:10	60.00	540	63	63	171	171		117	
10:40	04:40	60.00	540	64	64	172	172		118	2 hours
11:10	05:10	60.00	540	65	65	173	173		119	
11:40	05:40	60.00	540	65	65	173	173		119	3 hours
12:10	06:10	60.00	540	65	65	173	173		119	
12:40	06:40	60.00	540	65	65	174	174		120	4 hours
13:10	07:10	60.00	540	65	65	174	174		120	
13:40	07:40	60.00	540	65	65	175	175		120	5 hours
14:10	08:10	60.00	540	65	65	175	175		120	
14:40	08:40	60.00	540	66	66	176	176		121	6 hours
14:42	08:42	50.00	450	66	66	176	176		121	End of Creep

Table A-4-25 Data Sheet of PBT-R3(3)

1991.6-7

PLATE BEARING TEST — Measuring Point PBT-R3 (LA-2 42.0m) — DATA SHEET (3)

Time (h.m)	Elapse (h.m)	Stress (kg/cm2)	Jack Pressure (kg/cm2)	Deformation (1/ 100 mm) Dial Gauge Reading of Displacement (1) D.Read	(1) Disp.	(2) D.Read	(2) Disp.		[(1)+(2)]/2	Remarks
14:44	08:44	40.00	360	65	65	174	174		120	
14:46	08:46	30.00	270	62	62	170	170		116	
14:48	08:48	20.00	180	59	59	166	166		113	
14:50	08:50	10.00	90	56	56	157	157		107	
14:52	08:52	5.00	45	53	53	151	151		102	
14:54	08:54	0.00	0	50	50	136	136		93	
14:58	08:58	0.00	0	50	50	136	136		93	B60c
15:00	09:00	10.00	90	53	53	143	143		98	
15:02	09:02	20.00	180	56	56	153	153		105	
15:04	09:04	30.00	270	60	60	160	160		110	
15:06	09:06	40.00	360	62	62	165	165		114	
15:08	09:08	50.00	450	65	65	173	173		119	
15:10	09:10	60.00	540	68	68	178	178		123	
15:12	09:12	65.00	585	69	69	181	181		125	
15:16	09:16	65.00	585	70	70	183	183		127	T65-1
15:18	09:18	60.00	540	69	69	181	181		125	
15:20	09:20	50.00	450	68	68	181	181		125	
15:22	09:22	40.00	360	66	66	180	180		123	
15:24	09:24	30.00	270	65	65	176	176		121	
15:26	09:26	20.00	180	62	62	171	171		117	
15:28	09:28	10.00	90	58	58	163	163		109	
15:30	09:30	5.00	45	55	55	155	155		105	
15:34	09:34	0.00	0	52	52	140	140		96	
15:36	09:36	0.00	0	52	52	140	140		96	B65-1
15:38	09:38	10.00	90	55	55	147	147		101	
15:40	09:40	20.00	180	59	59	158	158		109	
15:42	09:42	30.00	270	62	62	165	165		114	
15:44	09:44	40.00	360	65	65	173	173		119	
15:46	09:46	50.00	450	67	67	178	178		123	
15:48	09:48	60.00	540	70	70	184	184		127	
15:50	09:50	65.00	585	71	71	187	187		129	
15:54	09:54	65.00	585	71	71	188	188		130	T65-2
15:56	09:56	60.00	540	71	71	187	187		129	
15:58	09:58	50.00	450	69	69	186	186		128	
16:00	10:00	40.00	360	68	68	185	185		127	
16:02	10:02	30.00	270	65	65	180	180		123	
16:04	10:04	20.00	180	64	64	176	176		120	
16:06	10:06	10.00	90	59	59	165	165		112	
16:08	10:08	5.00	45	56	56	157	157		107	
16:12	10:12	0.00	0	53	53	143	143		98	
16:14	10:14	0.00	0	53	53	143	143		98	B65-2
										The End

Table A-4-26 Data Sheet of PBT-R3(4)

1991.6-7

PLATE BEARING TEST — Measuring Point PBT-R3 (LA-2 42.0m) — DATA SHEET (4)

Test Location LA-2 (Right Bank) — Geological Dolerite - Basalt — Date Measured '91/6/12

Plate Radius (a) = 15.00 cm2 — Classification CM — Measured by M.Rivas V.

Loading Plate area = 707 cm2 — Max.Load Stress 78 kg/cm2 — Capacity 55.2 ton

Deformation Measurement Results

Stress (kg/cm2)	Deformation (1/100 mm) δ	δe	δp	Σδ	Σδp
0	0	0	0	0	0
15	34	10	24	34	24
0				24	
15	9	7	2	33	26
0				26	
15	10	9	1	36	27
0				27	
30	31	20	11	58	38
0				38	
45	43	24	19	81	57
0				57	
60	48	27	21	105	78
0 Creep				78	
60 0 h.	(	0 %)		111	
60 1 h.	(	50 %)		116	
60 3 h.	(	80 %)		119	
60 6 h.	(	100 %)		121	94
0				93	
65	34	31	3	127	96
0				96	
20 0	0			109	
30 10	5			114	
40 20	10			119	
50 30	14			123	
60 40	18			127	
65	34	32	2	130	98
0				98	

Remarks

δ :Total Deformation
δe :Elastic Deformation
δp :Plastic Deformation
Σδ :Cumulative Total Deformation
Σδp :Cumulative Plastic Deformation

Creep Calculation

Elastic Deformation Just Before Creep δe (1/100 mm)	27
Creep Deformation δc (1/100 mm)	10
Creep Factor Cf(%) = (δc/δe)*100	37

Modulus of Deformation (D) and Modulus of Elasticity (E) Calculation Formula

$$D \text{ or } E = \frac{\pi a(1-\nu 2)}{2} * \frac{\Delta\sigma}{\Delta\delta}$$

a :Plate radius 15 (cm)
ν :Poisson's ratio 0.2
Δσ :Stress increment (kg/cm2)
Δδ :Deformation increment due to Δσ
πa(1-ν2)/2 = 22.6194 cm

Coefficients Related to Deformation

Modulus of Deformation	D =	12,000	kg/cm2
Tangential Modulus of Elasticity	Et =	48,000	kg/cm2
Secant Modulus of Elasticity	Es =	43,000	kg/cm2

APPENDIX A-5 SEISMIC PROSPECTING

APPENDIX A-5 SEISMIC PROSPECTING

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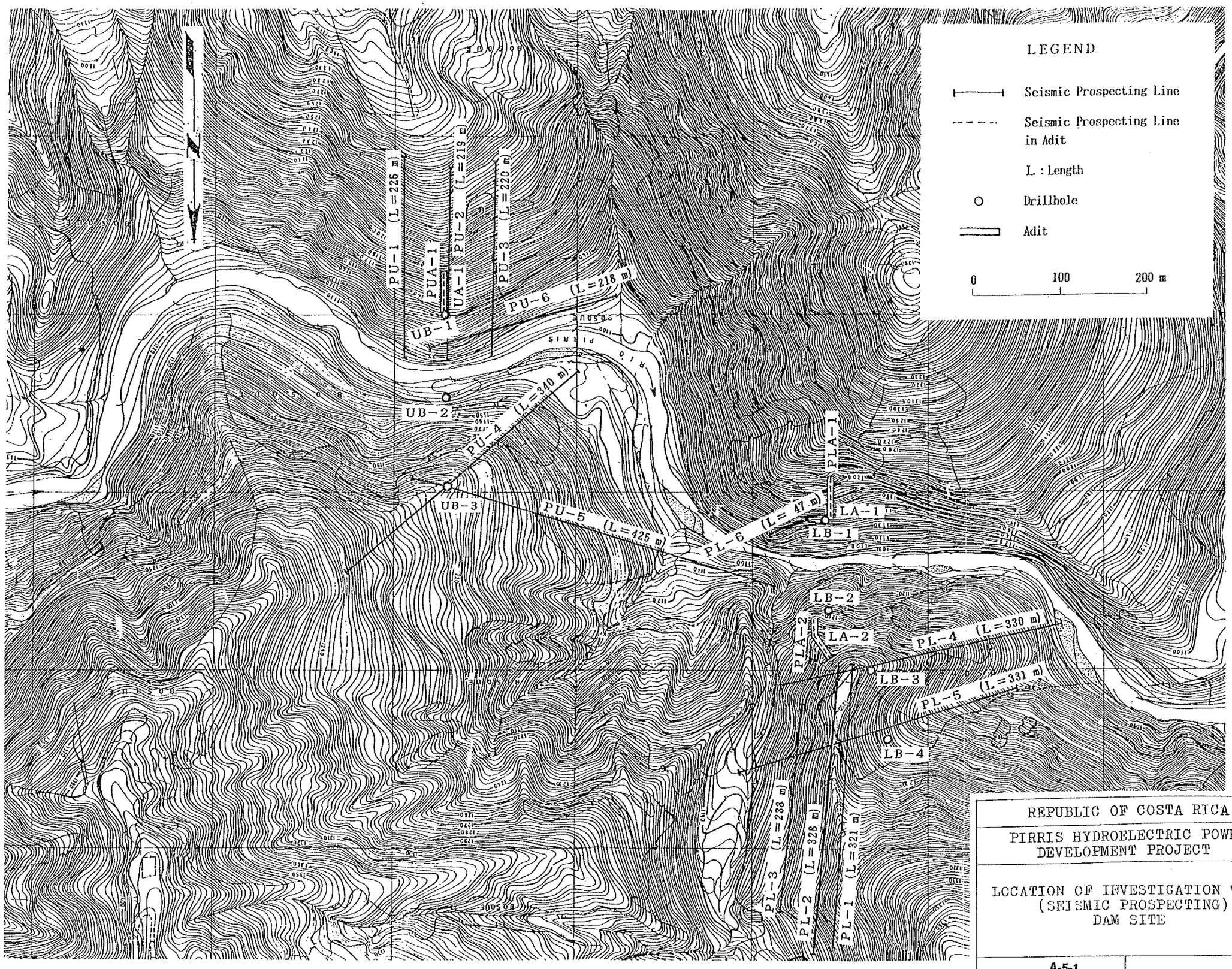
A-5-5	Time-Distance Plot (Sheet No. 1 ~ No. 14)	A-5-39
A-5-6	Result of Seismic Prospecting in Adits (Damsite)	A-5-67

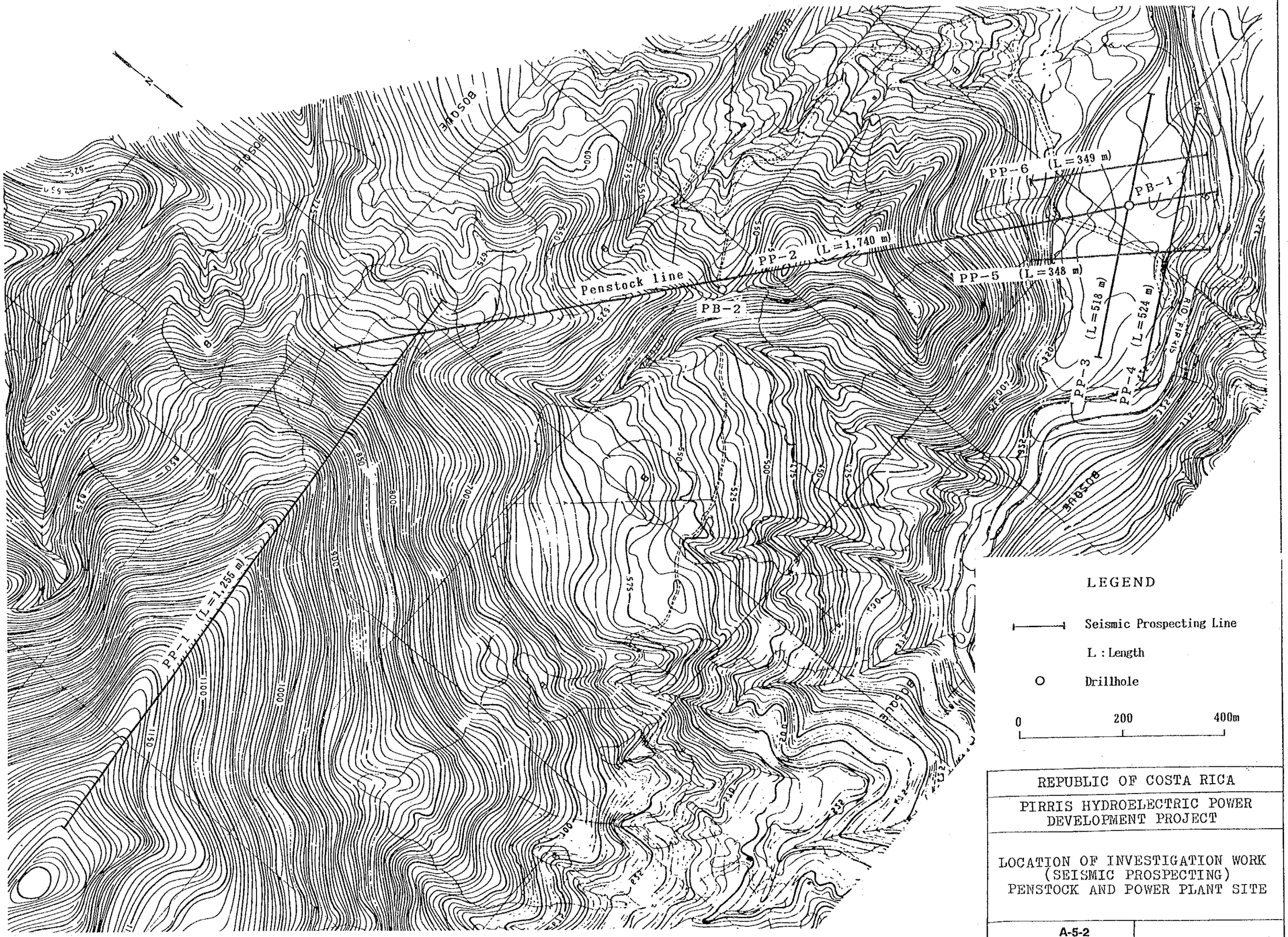


REPUBLIC OF COSTA RICA

PIRRIS HYDROELECTRIC POWER DEVELOPMENT PROJECT

LOCATION OF INVESTIGATION WORK (SEISMIC PROSPECTING) DAM SITE

A-5-1



REPUBLIC OF COSTA RICA

PIRRIS HYDROELECTRIC POWER DEVELOPMENT PROJECT

LOCATION OF INVESTIGATION WORK (SEISMIC PROSPECTING) PENSTOCK AND POWER PLANT SITE

A-5-2

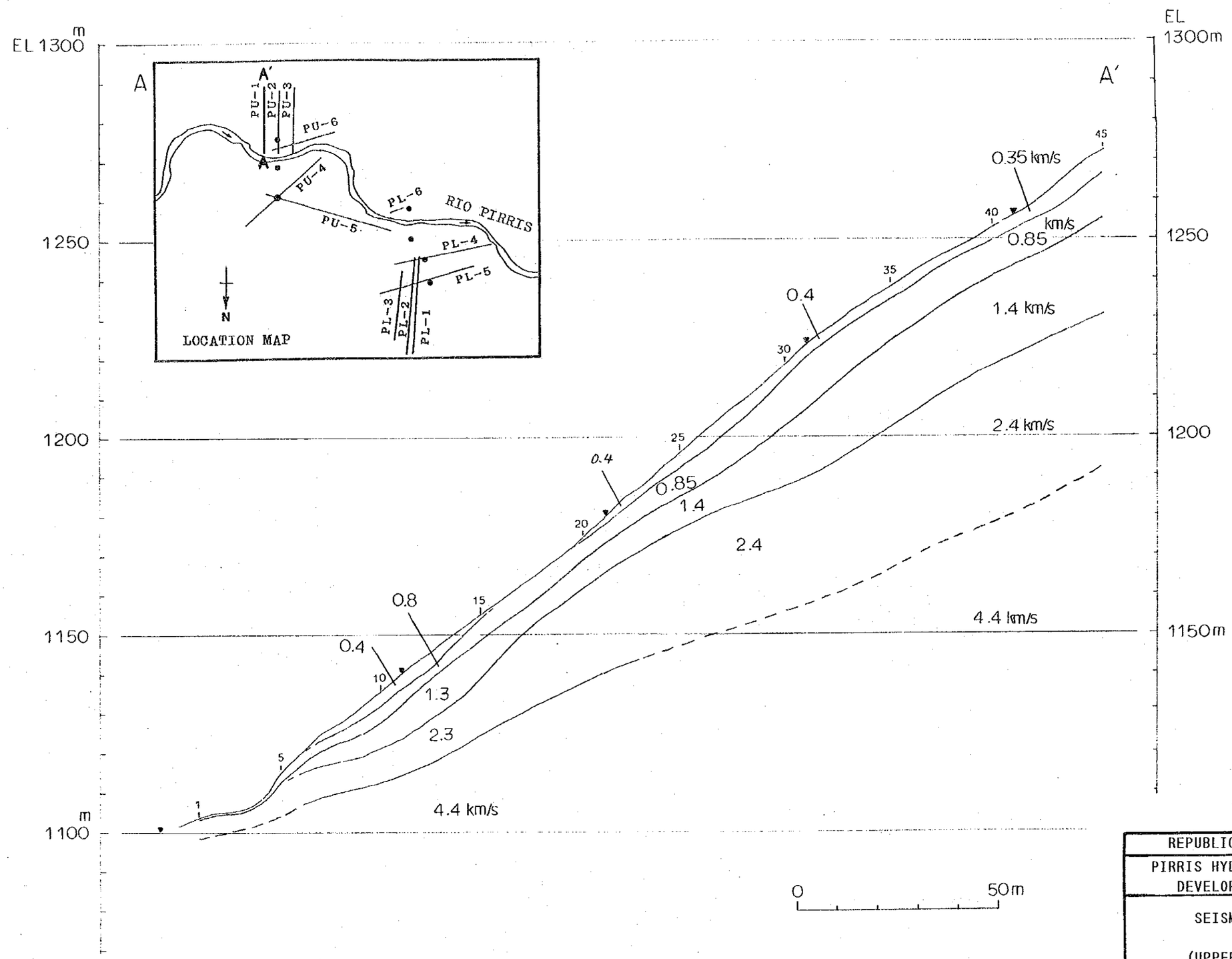
A-5-3 List of Seismic Prospecting Traverse

Location	Line No.	Coordinate		Elevation (m)	Length (m)	Work Period		Remarks
		X	Y			Field Work	Analysis	
Upper (Up-stream) Damsite	PU-1 (B.P.) (E.P.)	399,249.85 399,023.09	451,990.93 451,990.74	1,103.90 1,272.83	226.3	Dec. 1990	Jul. 1991	PS-12 (ICE) S-1 ~ S-45
	PU-2 (B.P.) (E.P.)	399,252.45 399,033.19	451,943.14 451,939.77	1,106.33 1,271.62	219.3	Dec. 1990	Jun. 1991	PS-11 (ICE) S-1 ~ S-45
	PU-3 (B.P.) (E.P.)	399,247.05 399,026.76	451,894.19 451,891.39	1,100.49 1,249.42	220.3	Nov. 1990	Jul. 1991	PS-10 (ICE) S-1 ~ S-45
	PU-4 (B.P.) (E.P.)	399,264.00 399,489.77	451,798.08 452,051.93	1,103.94 1,277.25	339.7	Aug. 1990	Jul. 1991	PS-9 (ICE) S-1 ~ S-35
	PU-5 (B.P.) (E.P.)	399,506.73 399,385.70	451,574.99 451,981.92	1,108.31 1,217.89	424.5	Jun. 1990	Mar. 1990	PS-8 (ICE) S-2 ~ S-45
	PU-6 (B.P.) (E.P.)	399,179.18 399,236.26	451,754.14 451,964.46	1,104.45 1,120.83	217.9	Jun. 1991	Jul. 1991	PS-13 (ICE) S-1 ~ S-45
Lower (Down-stream) Damsite	PL-1 (B.P.) (E.P.)	399,593.23 399,913.66	451,484.93 451,507.11	1,245.88 1,250.25	321.2	Jun. 1990	Jun. 1991	PS-1 (ICE) S-1 ~ S-68
	PL-2 (B.P.) (E.P.)	399,594.43 399,920.88	451,501.58 451,529.24	1,239.69 1,233.11	327.6	Feb. 1990	Mar. 1991	PS-2 (ICE) S-1 ~ S-68
	PL-3 (B.P.) (E.P.)	399,638.32 399,873.90	451,542.59 451,567.94	1,216.87 1,227.31	236.9	Mar. 1990	Jun. 1991	PS-3 (ICE) S-1 ~ S-46
	PL-4 (B.P.) (E.P.)	399,617.64 399,549.58	451,569.64 451,246.74	1,180.87 1,077.83	330.0	Apr. 1990	Jun. 1991	PS-4 (ICE) S-1 ~ S-68
	PL-5 (B.P.) (E.P.)	399,715.68 399,622.95	451,614.95 451,297.45	1,179.93 1,114.85	330.8	Mar. 1990	Jun. 1991	PS-6 (ICE) S-1 ~ S-68
	PL-6 (B.P.) (E.P.)	399,431.80 399,447.22	451,536.68 451,581.39	1,147.91 1,147.86	47.3	Jun. 1990	Jul. 1991	PS-7 (ICE) S-1 ~ S-11
Sub-total	12 Lines				3,241.8			
	PP-2 (B.P.) (E.P.)	398,162.55 397,047.10	441,322.11 442,657.75	292.44 747.66	1,740.2	Feb. 1991	Apr. 1991	P-5 (ICE) S-1 ~ S-175
	PP-3 (B.P.) (E.P.)	397,939.65 398,193.21	441,268.15 441,719.77	324.17 337.66	517.9	Apr. 1991	May 1991	P-3 (ICE) S-2 ~ S-52
	PP-4 (B.P.) (E.P.)	398,023.98 398,289.54	441,227.31 441,700.29	291.38 307.90	542.4	Mar. 1991	Jul. 1991	P-4 (ICE) S-1 ~ S-56
	PP-5 (B.P.) (E.P.)	398,222.80 397,969.76	441,423.94 441,662.67	296.39 392.92	347.9	Apr. 1991	Jul. 1991	P-2 (ICE) S-1 ~ S-36
	PP-6 (B.P.) (E.P.)	398,098.84 397,867.44	441,285.04 441,546.59	294.27 378.94	349.2	Apr. 1991	Jul. 1991	P-1 (ICE) S-1 ~ S-36
Sub-total	6 Lines				4,753.0			
Adits at Damsites	PUA-1 (B.P.)	399,196.82	451,942.40	1,150.00	50	Jun. 1991	Jun. 1991	B.P. AT 0+0.00 E.P. AT0+0.50
	PLA-1 (B.P.)	399,430.75	451,512.99	1,148.76	50	Jun. 1991	Jun. 1991	B.P. AT0+0.00 E.P. AT0+0.50
	PLA-2 (B.P.)	399,540.82	451,528.46	1,160.66	50	Jun. 1991	Jun. 1991	B.P. AT 0+0.00 E.P. AT 0+10.50
Sub-total	3 Lines				150			
Total	21 Lines				8,144.8			

Note: (B.P.): Beginning Point
(E.P.): Ending Point

A-5-4 Seismic Profile (Sheet No. 1 ~ No. 16)

A-5-4-(1)	Seismic Profile	PU-1
A-5-4-(2)	Seismic Profile	PU-2
A-5-4-(3)	Seismic Profile	PU-3
A-5-4-(4)	Seismic Profile	PU-4
A-5-4-(5)	Seismic Profile	PU-5
A-5-4-(6)	Seismic Profile	PU-6
A-5-4-(7)	Seismic Profile	PL-1
A-5-4-(8)	Seismic Profile	PL-2
A-5-4-(9)	Seismic Profile	PL-3
A-5-4-(10)	Seismic Profile	PL-4
A-5-4-(11)	Seismic Profile	PL-5
A-5-4-(12)	Seismic Profile	PL-6
A-5-4-(13)	Seismic Profile	PP-1
A-5-4-(14)	Seismic Profile	PP-2
A-5-4-(15)	Seismic Profile	PP-3, PP-4
A-5-4-(16)	Seismic Profile	PP-5, PP-6



REPUBLIC OF COSTA RICA

PIRRIS HYDROELECTRIC POWER DEVELOPMENT PROJECT

SEISMIC PROFILE
PU-1
(UPPER DAM SITE)

A-5-4-(1)