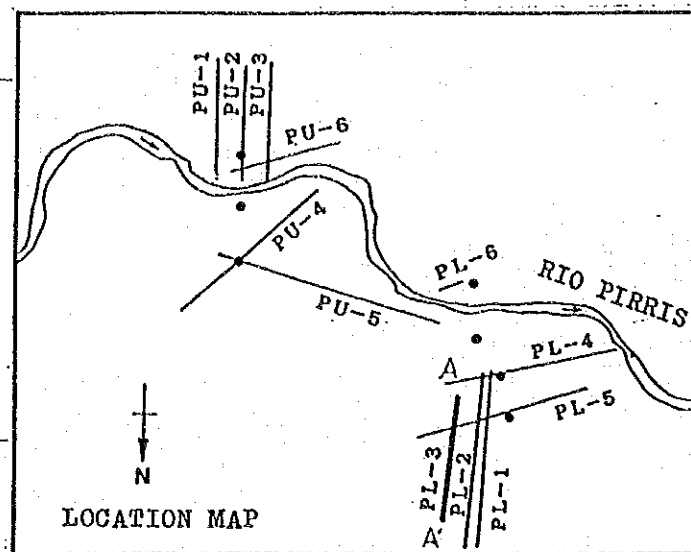


EL 1300
m

A



1250

1200

1150

1100
m

RIO
PIRRIS



3.8 km/s

3.8 km/s

0.4

PL-5

15

0.5

1.1

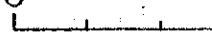
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0.5

0.2 km/s

35

0



1.2

2.1

5

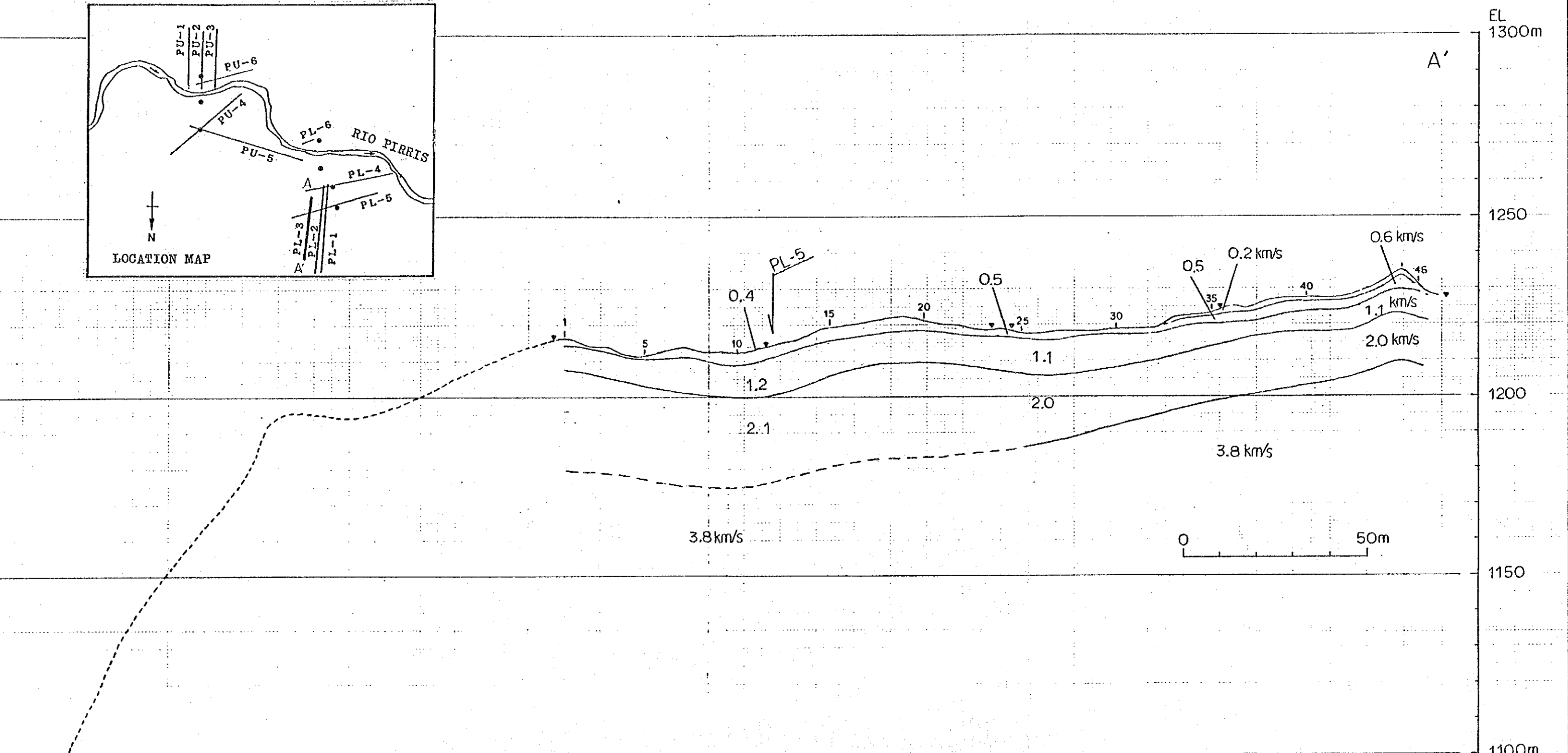
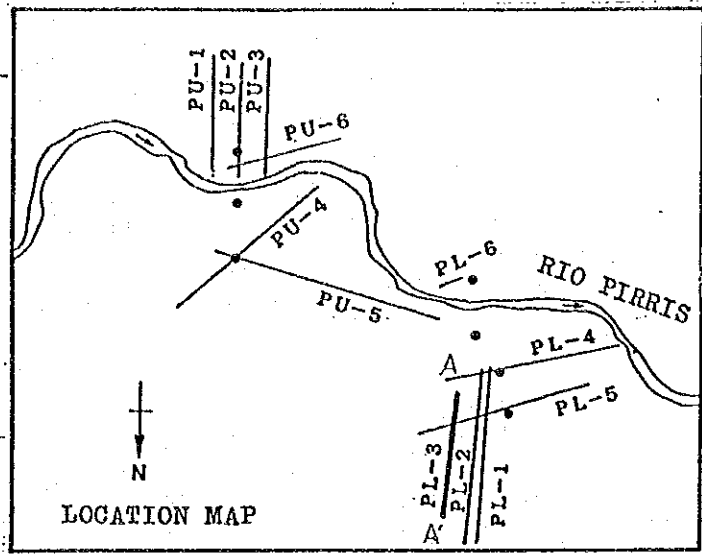
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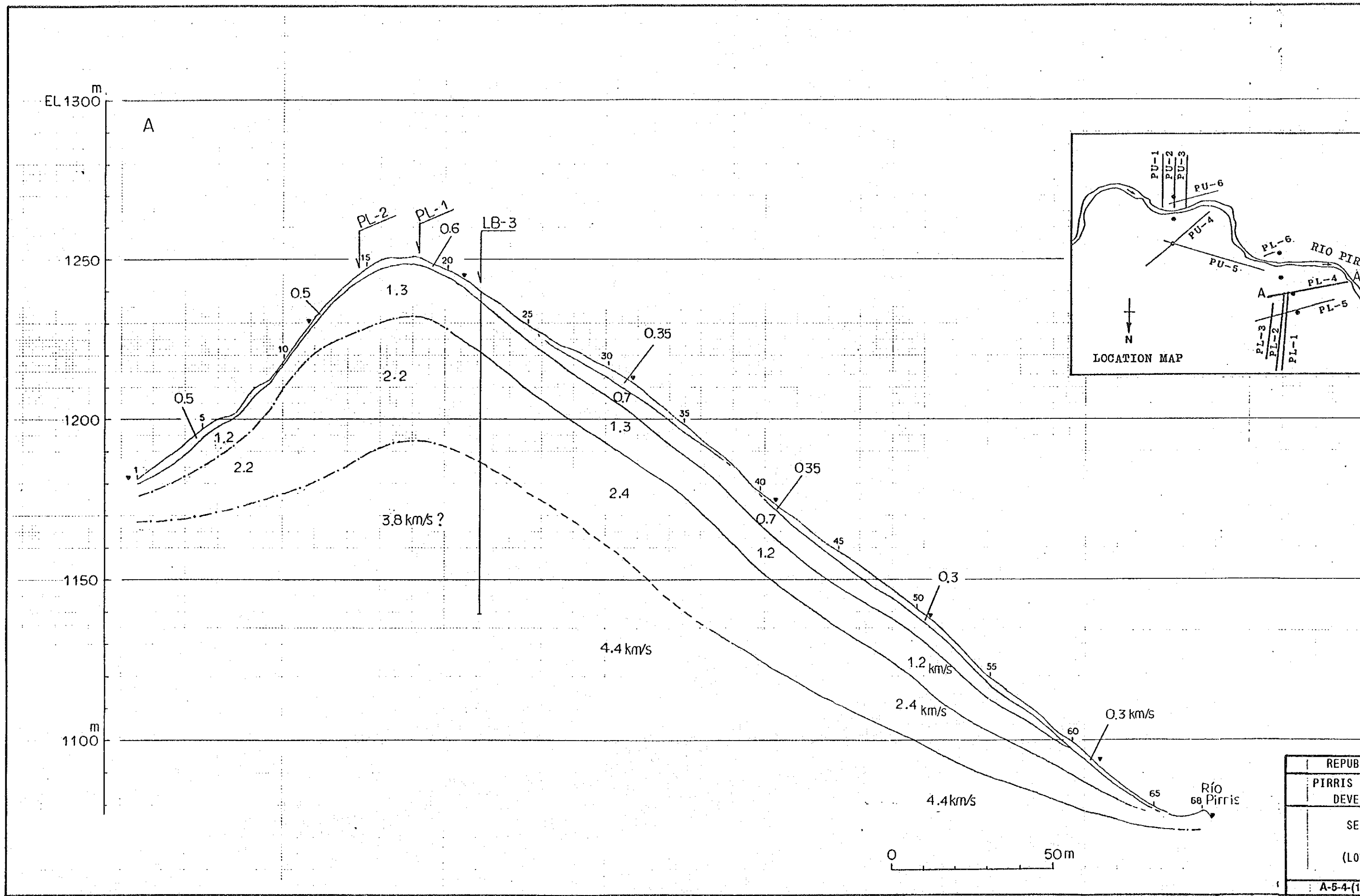
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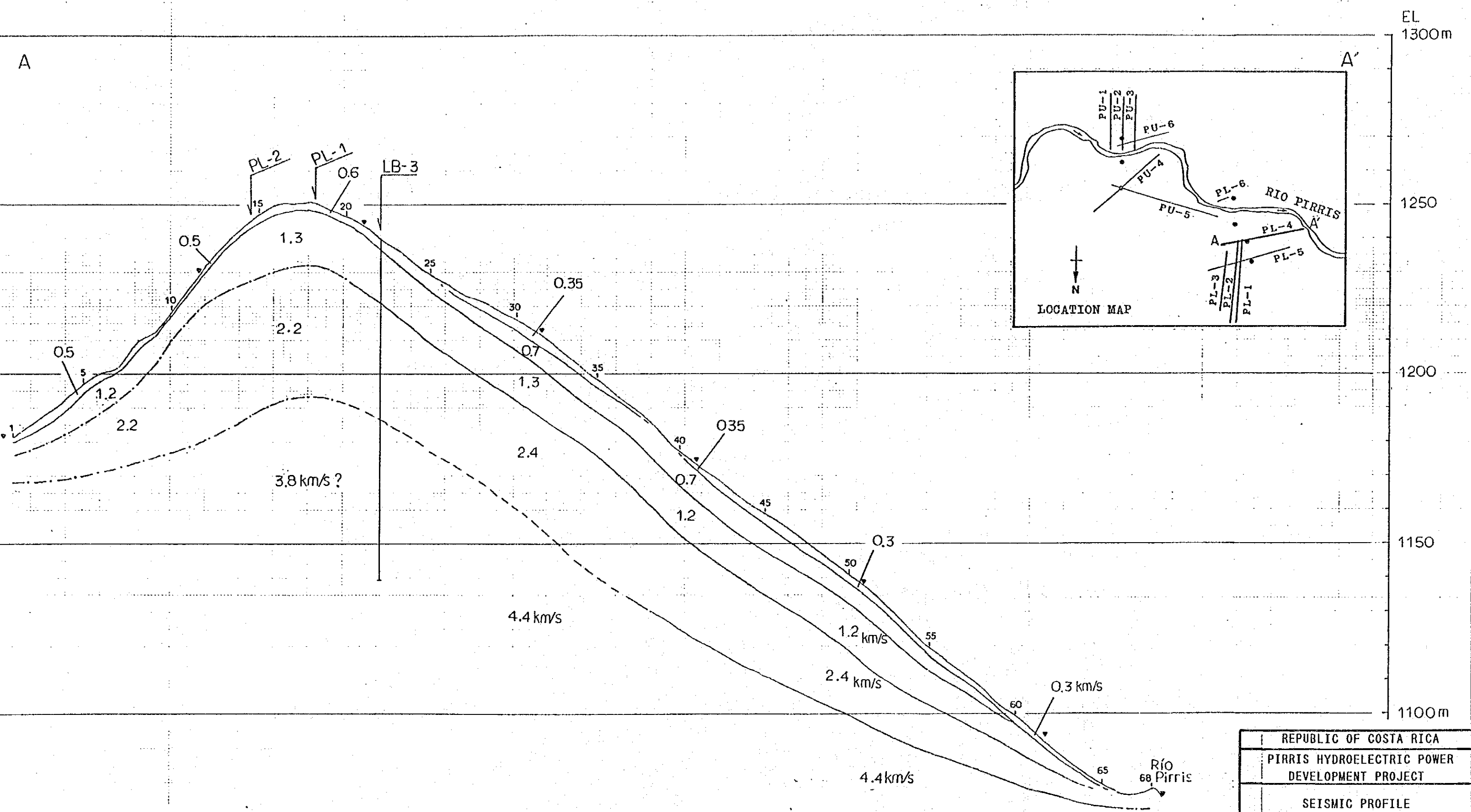
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REPUBLIC OF COSTA RICA	
PIRRIS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
SEISMIC PROFILE PL-3 (LOWER DAM SITE)	
A-5-4(9)	

APPENDIX





REPUBLIC OF COSTA RICA
PIRRIS HYDROELECTRIC POWER DEVELOPMENT PROJECT
SEISMIC PROFILE PL-4 (LOWER DAM SITE)
A-5-4-(10)

EL 1300 m

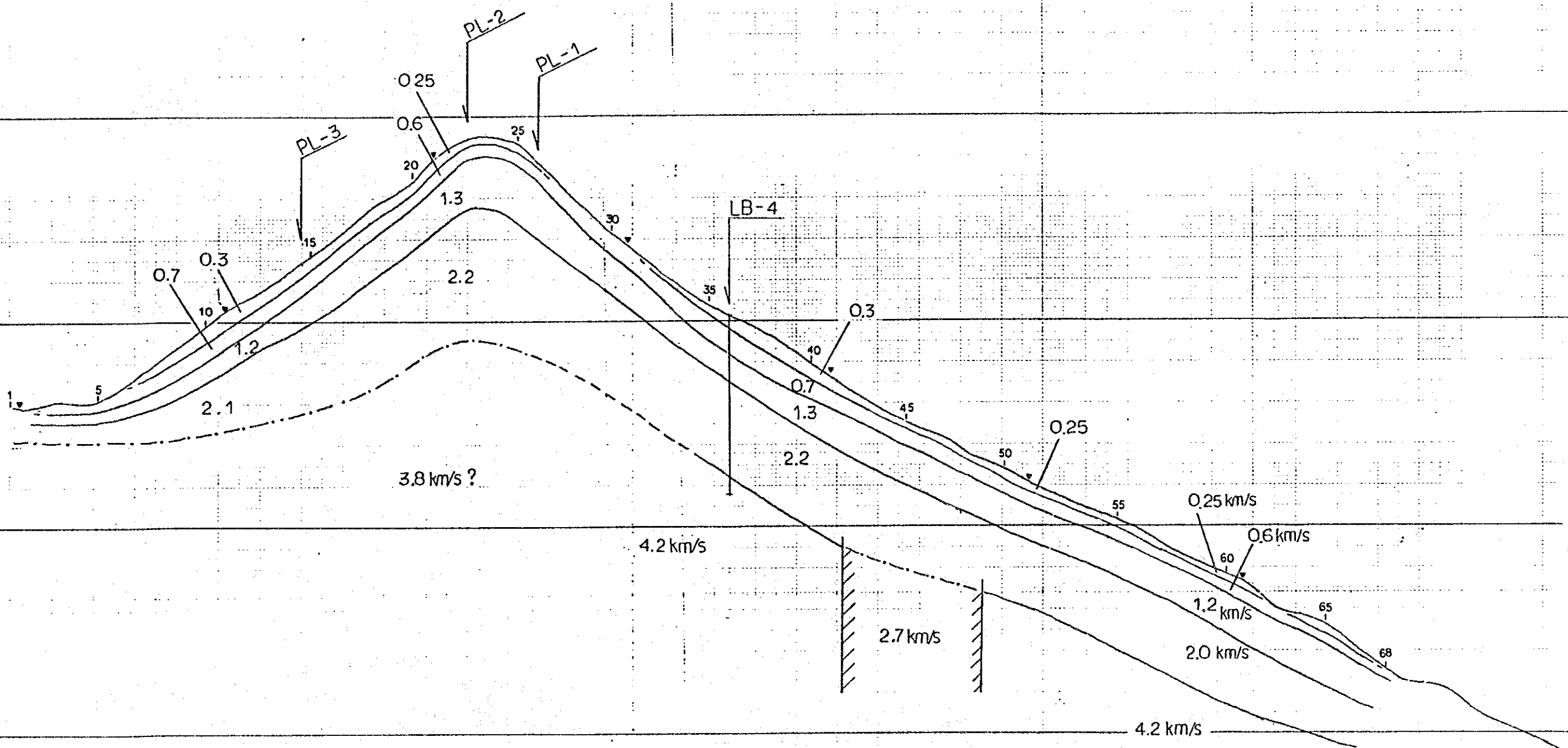
A

1250

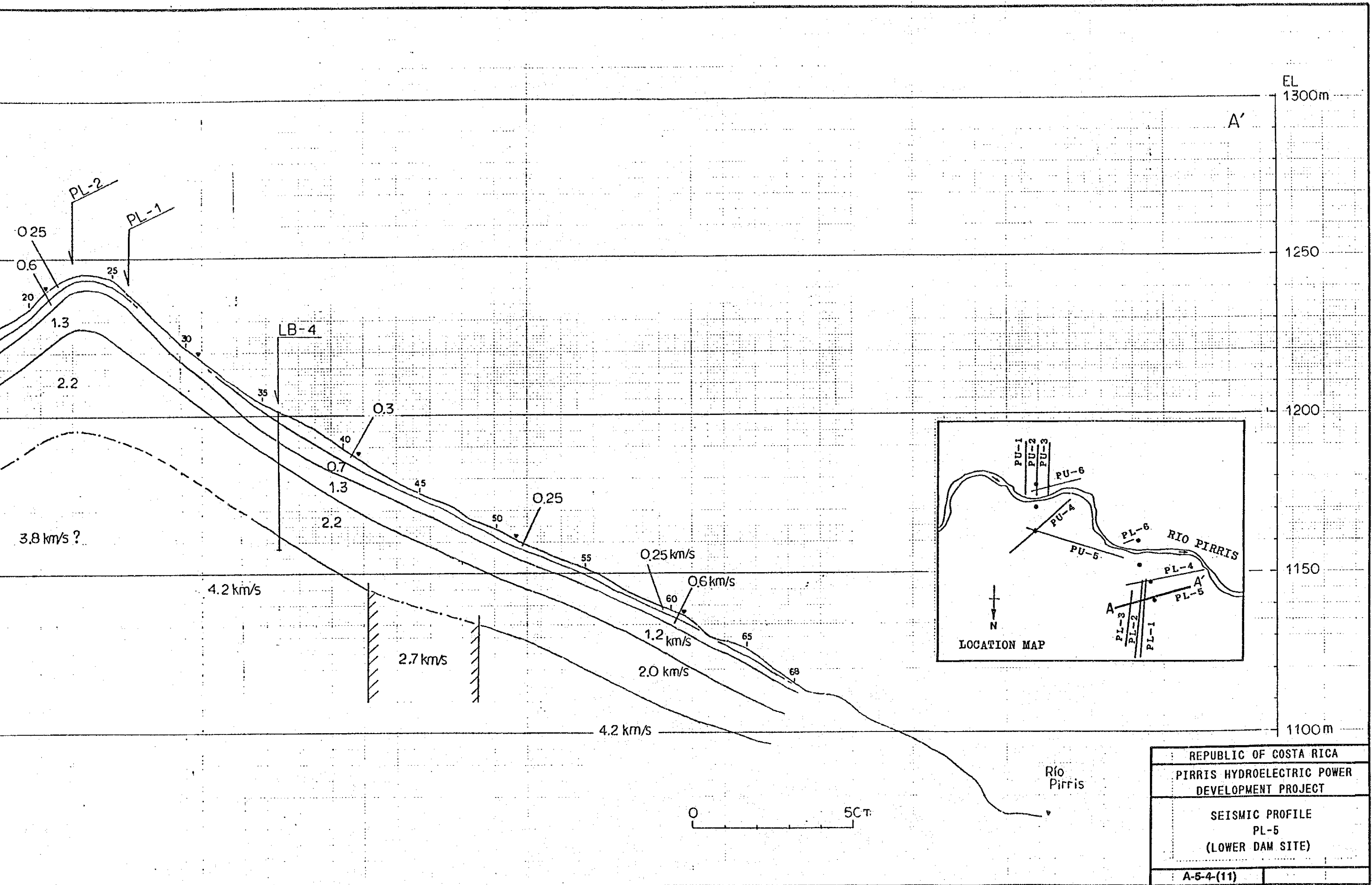
1200

1150

1100 m



0 50



A'

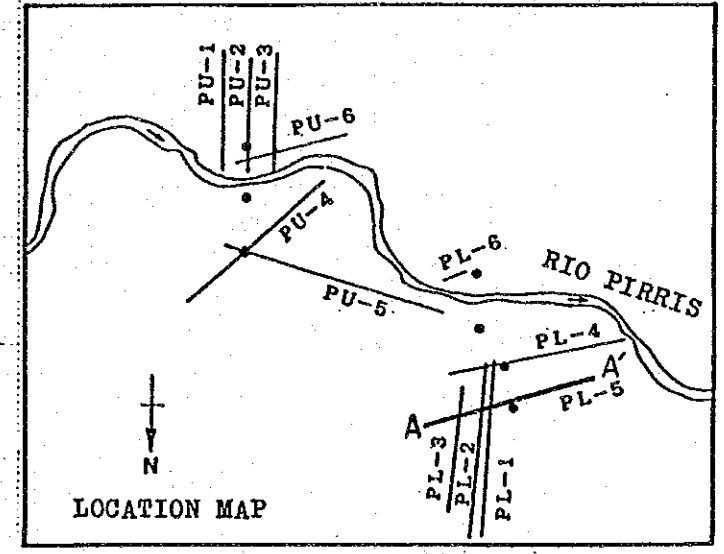
EL 1300m

1250

1200

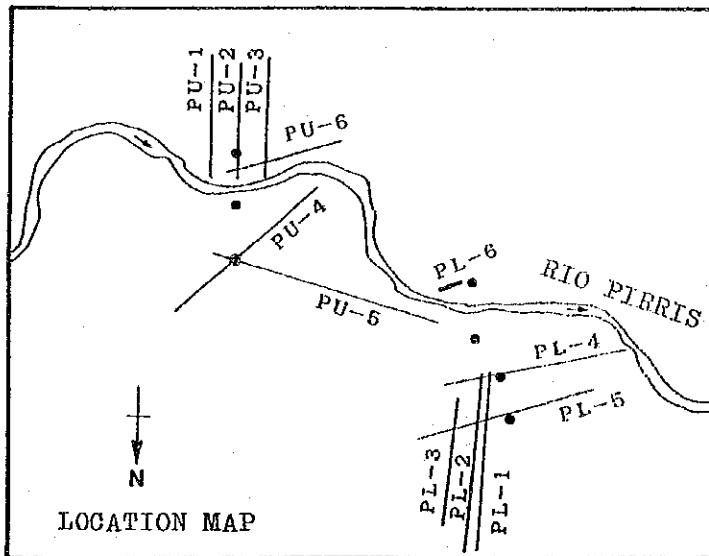
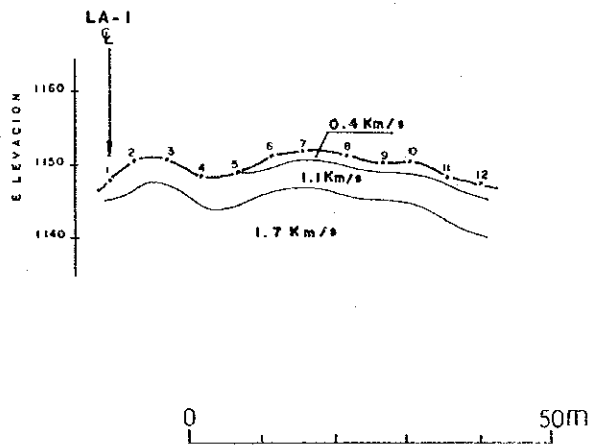
1150

1100m

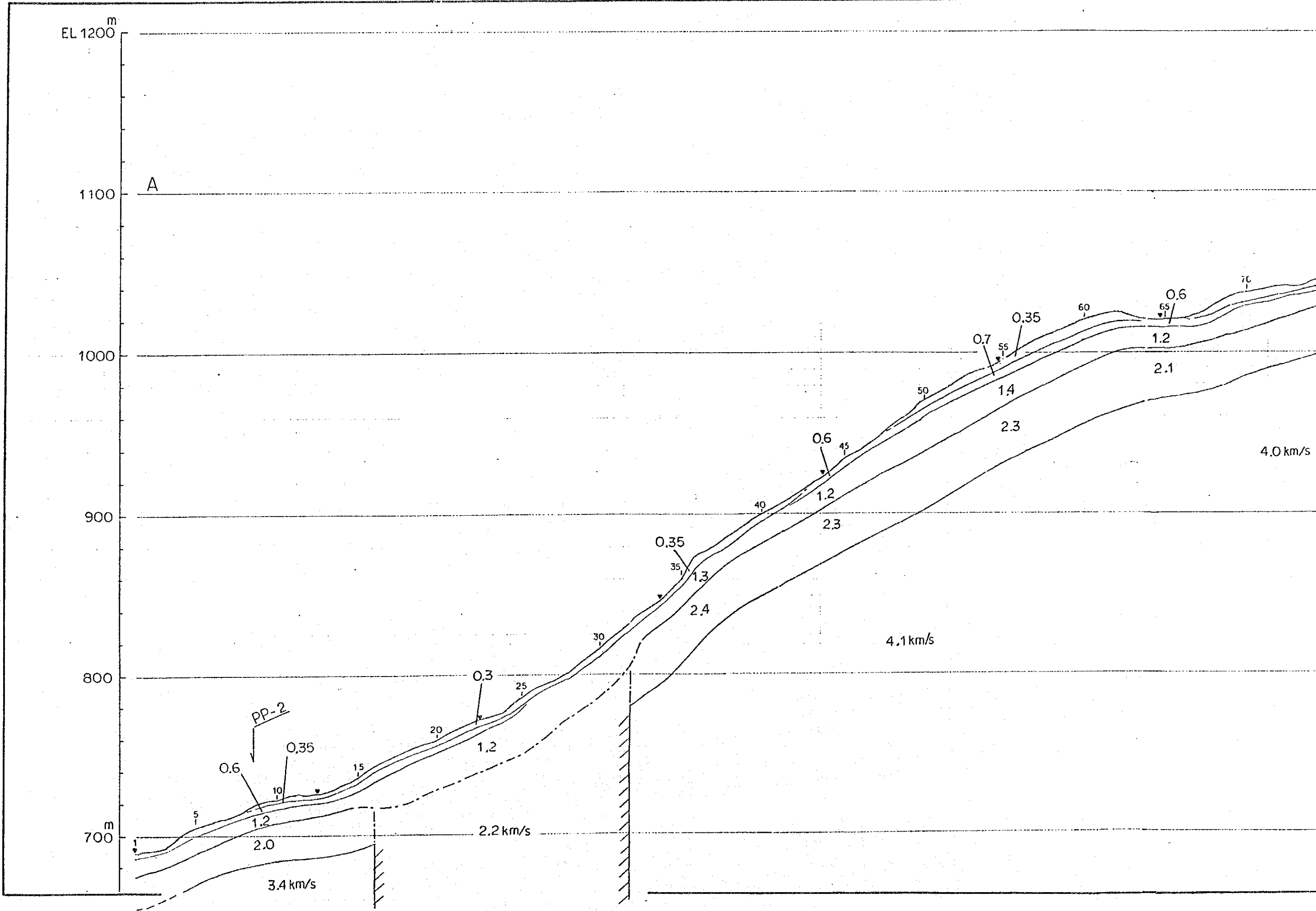


Río Pirris

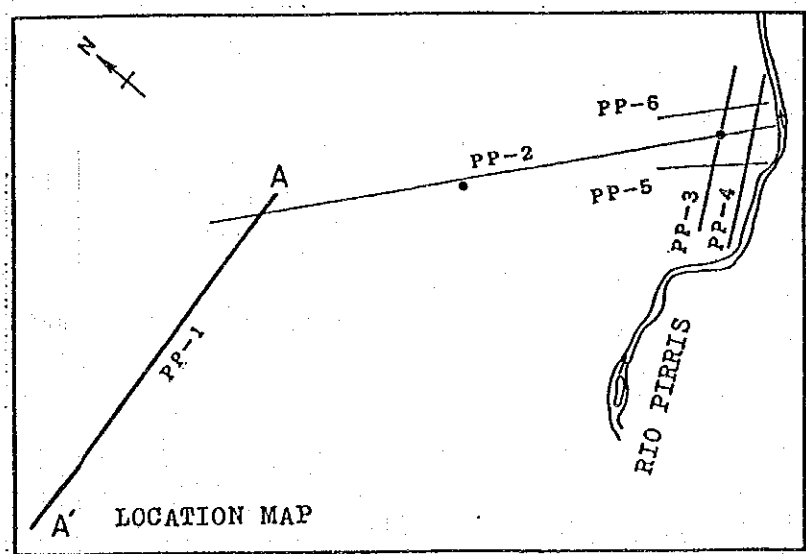
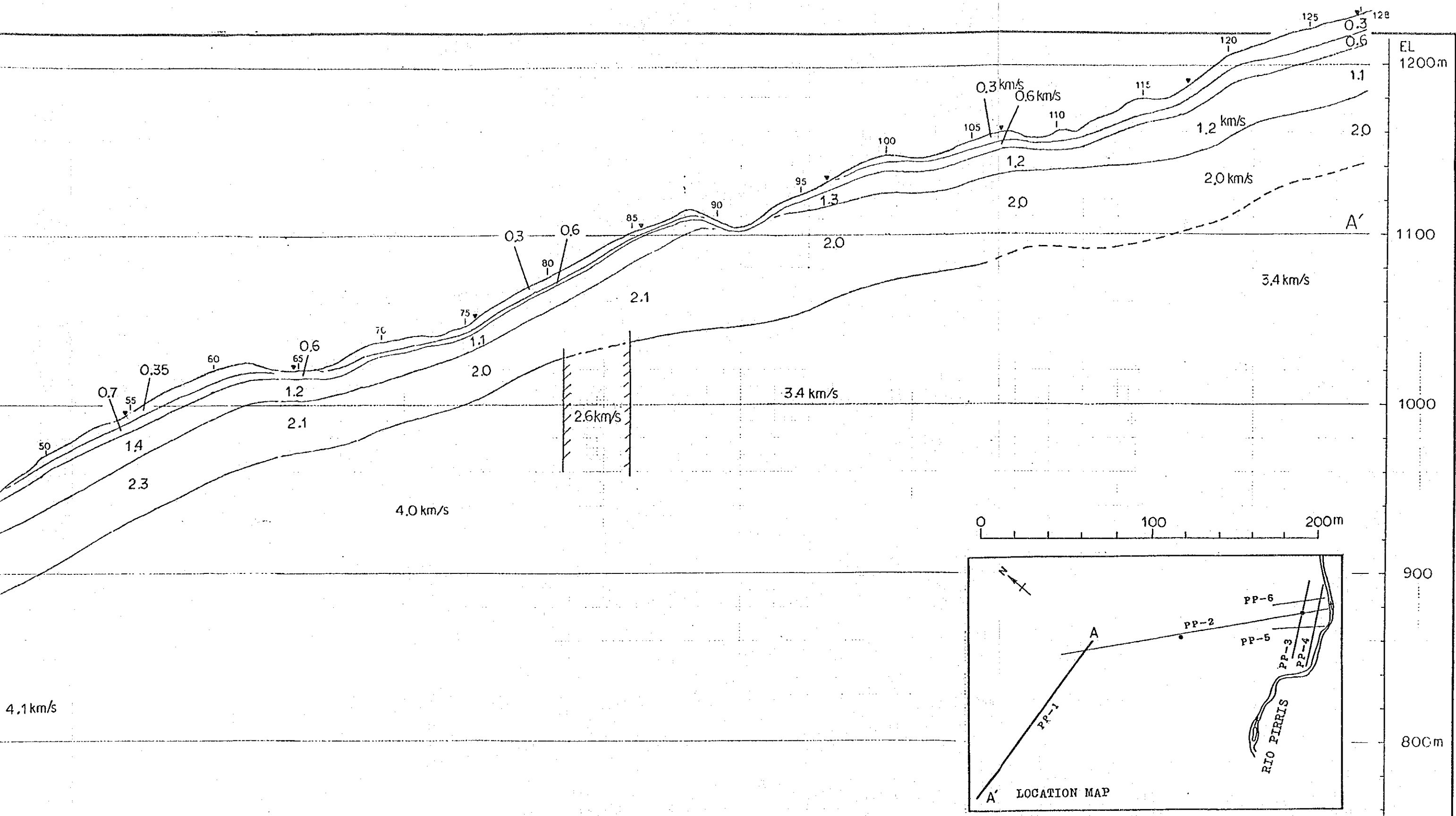




REPUBLIC OF COSTA RICA	
PIRRIS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
SEISMIC PROFILE PL-6 (LOWER DAM SITE)	
A-5-4-(12)	

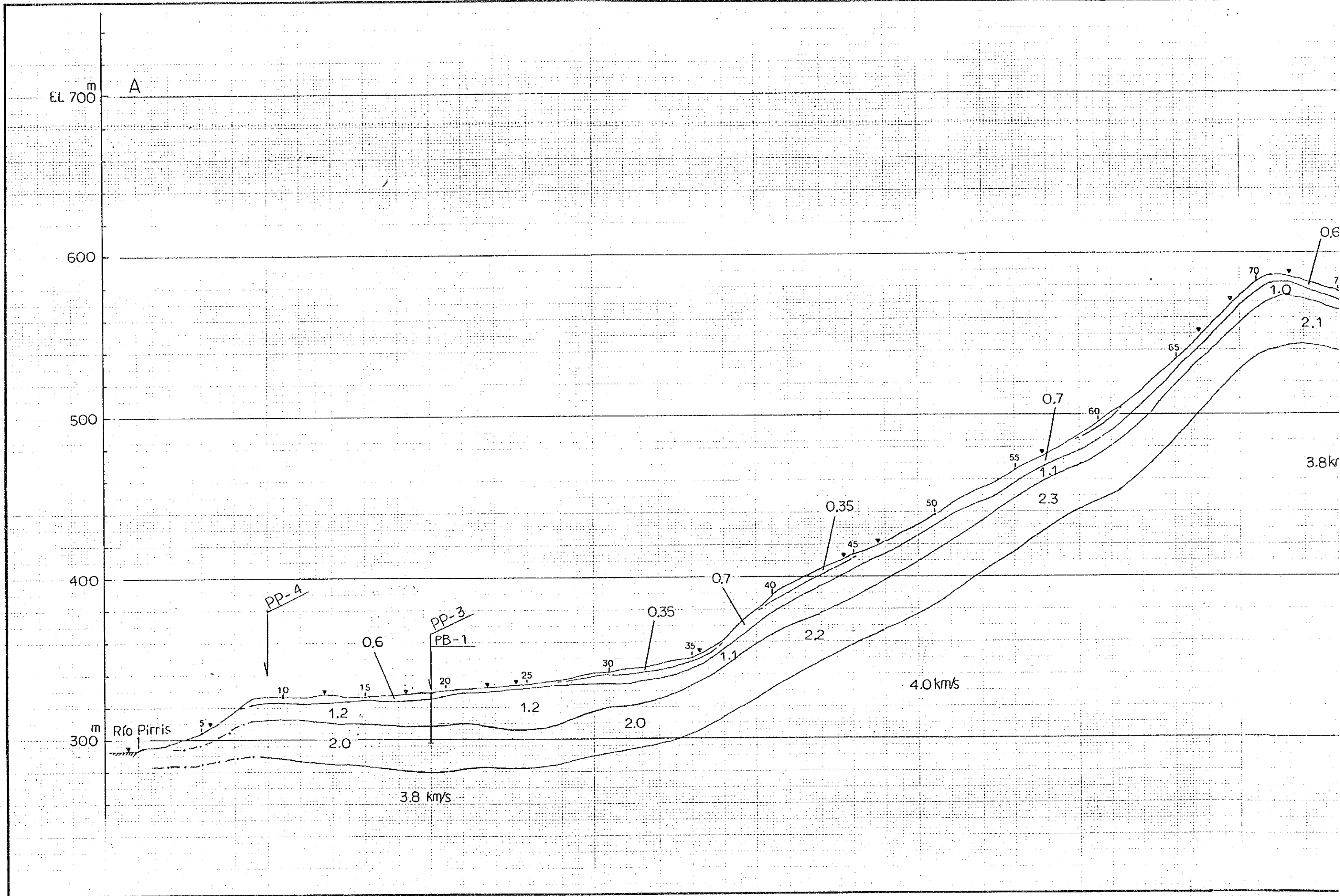


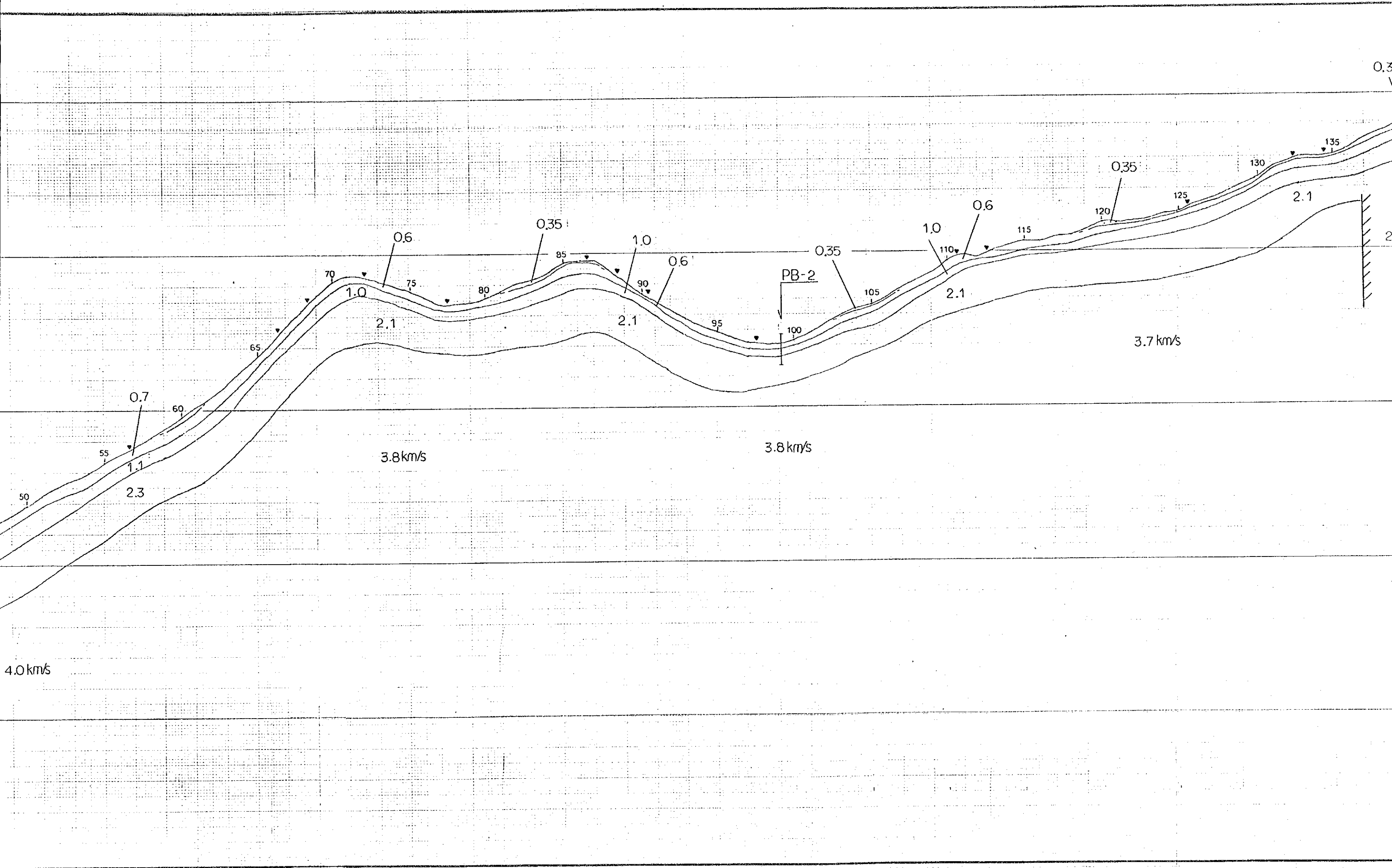
APPENDIX

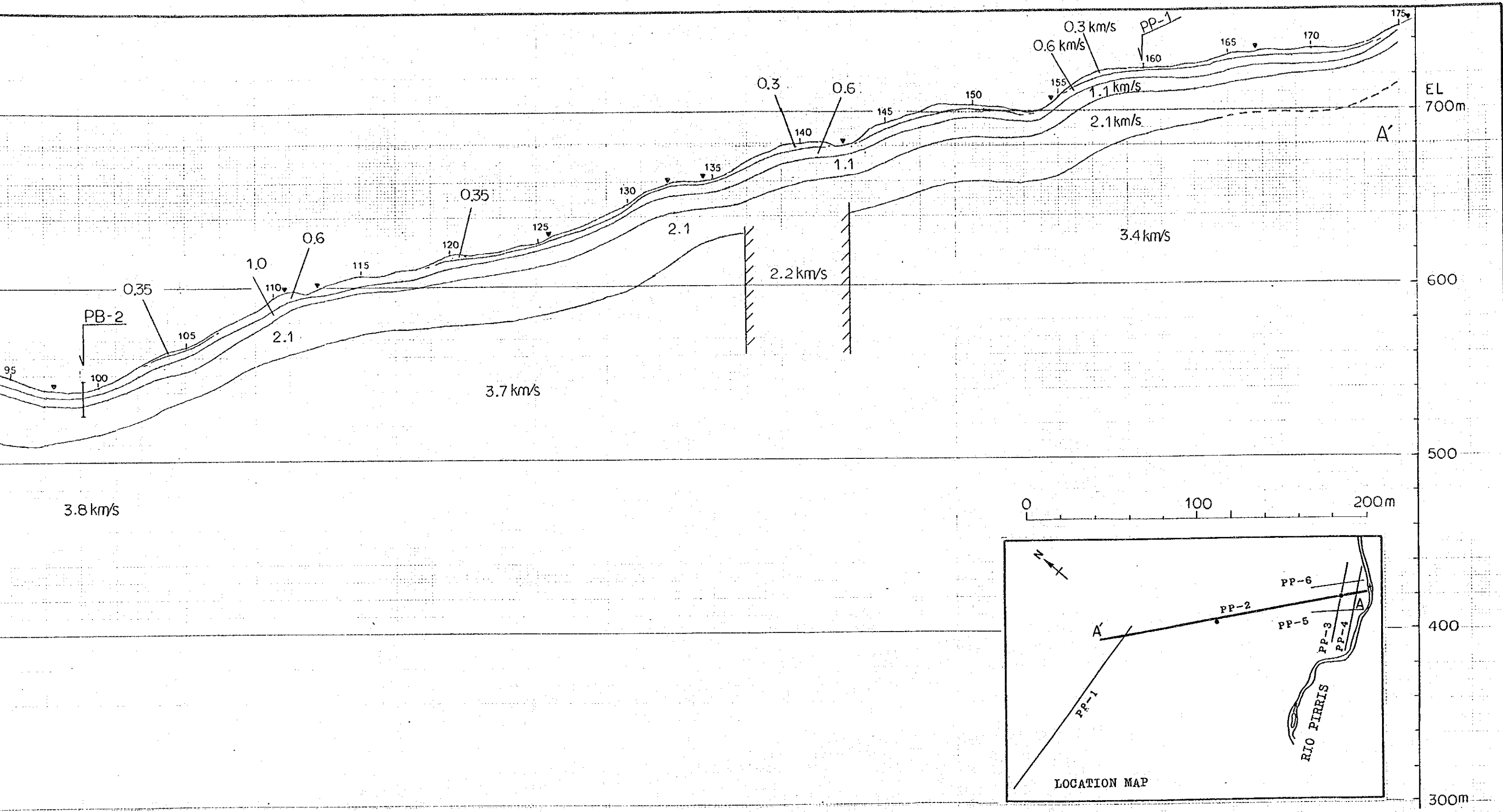


REPUBLIC OF COSTA RICA	
PIRRIS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
SEISMIC PROFILE	
PP-1	
(PENSTOCK AND POWER PLANT SITE)	
A-5-4-(13)	

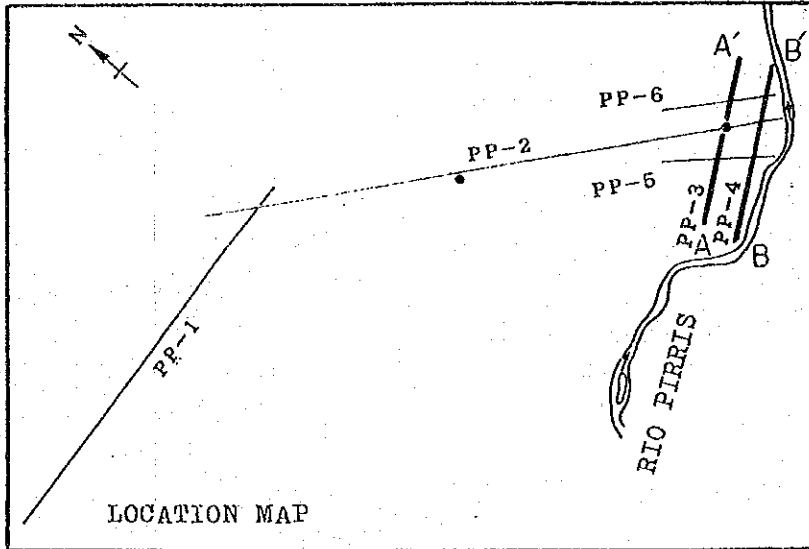
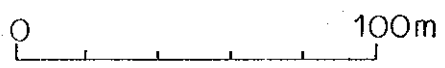
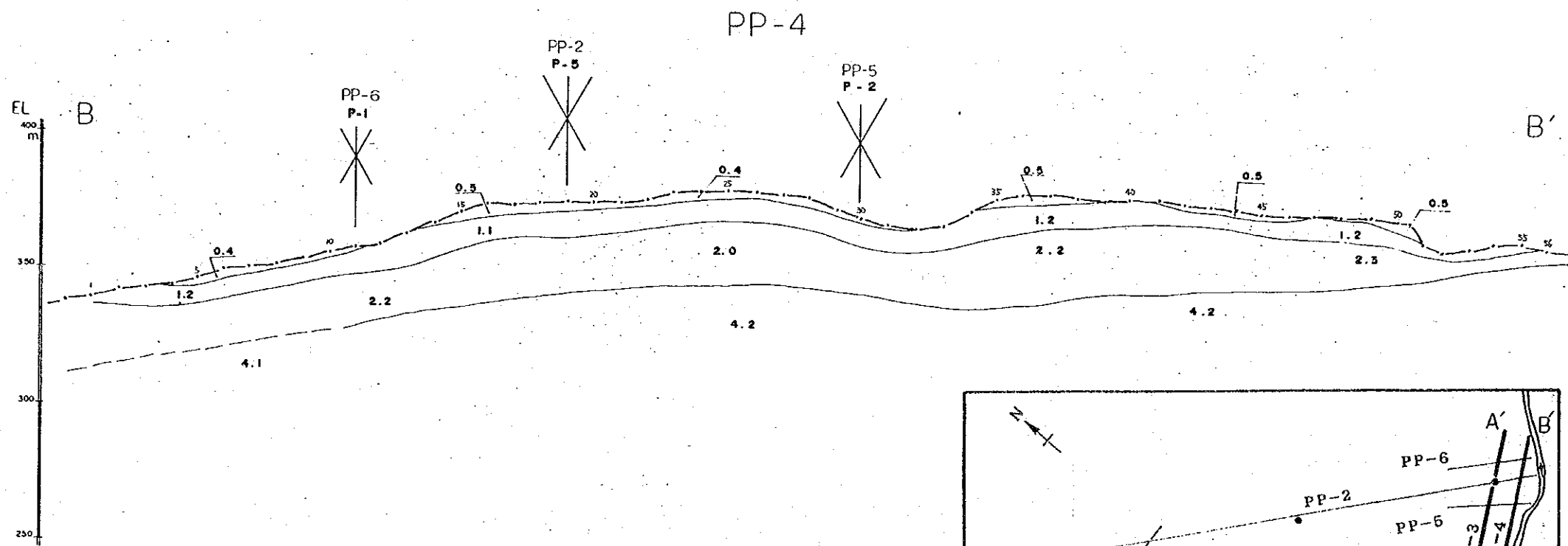
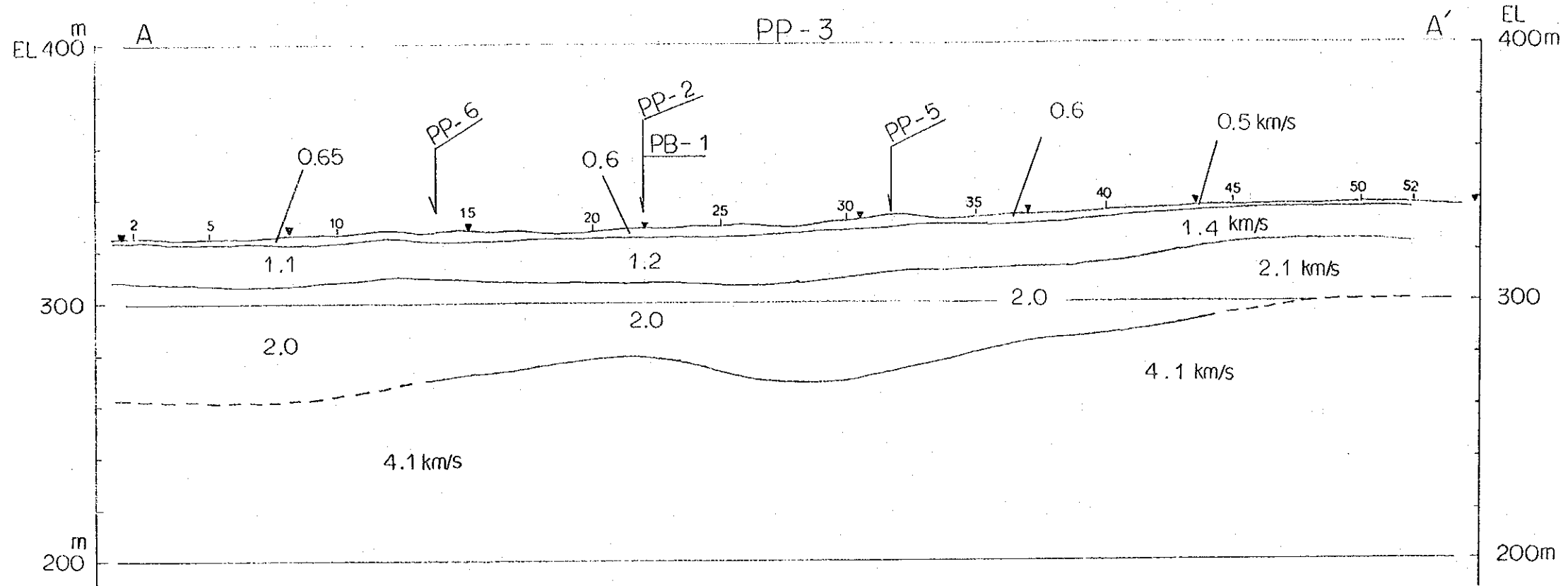
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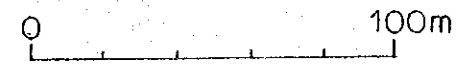
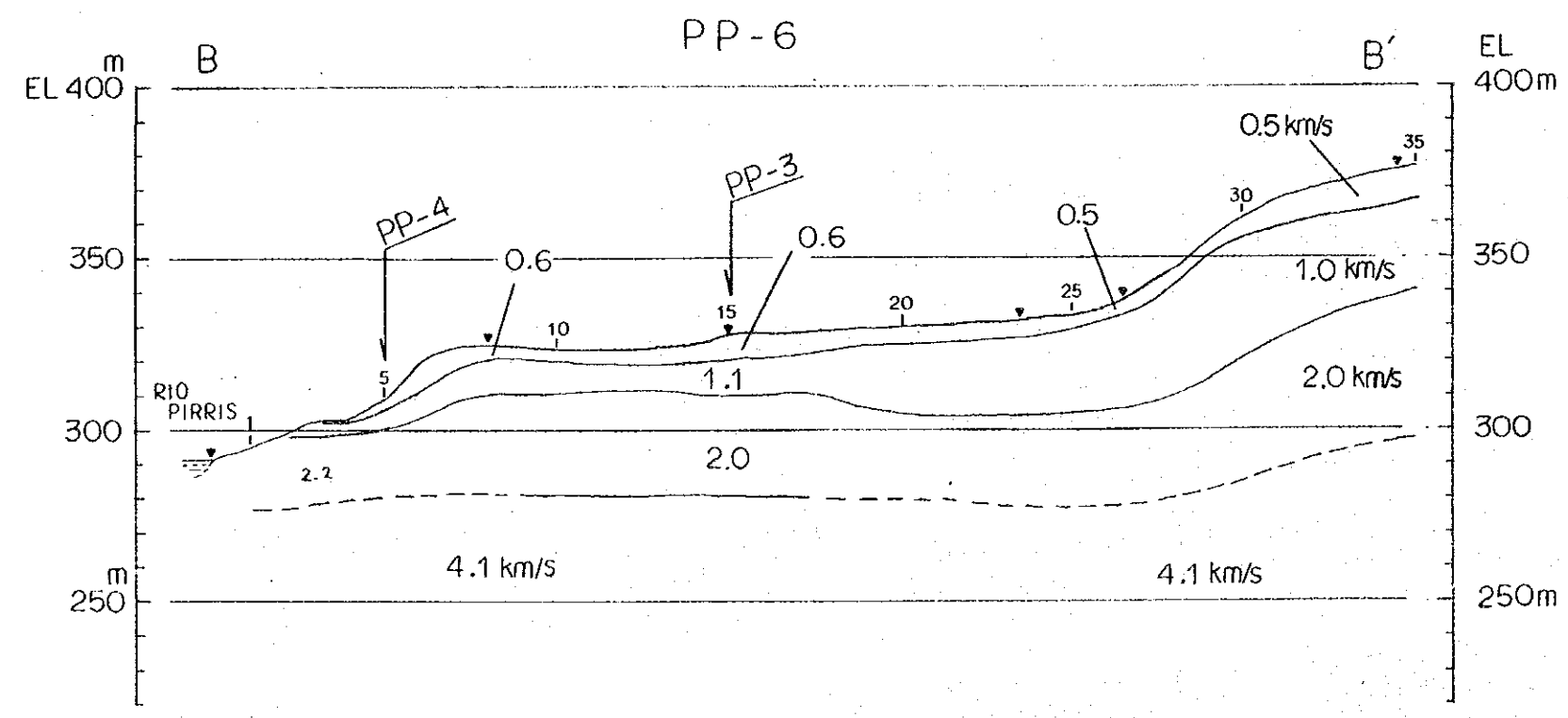
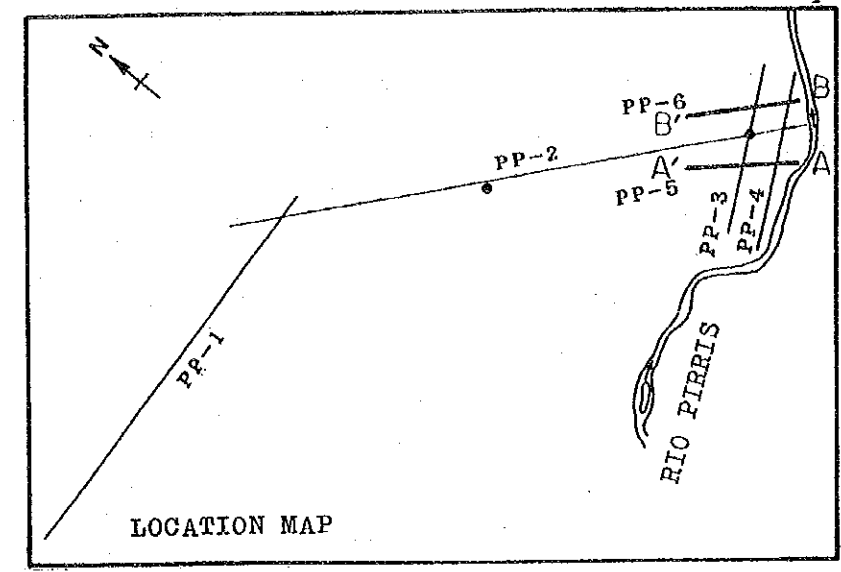
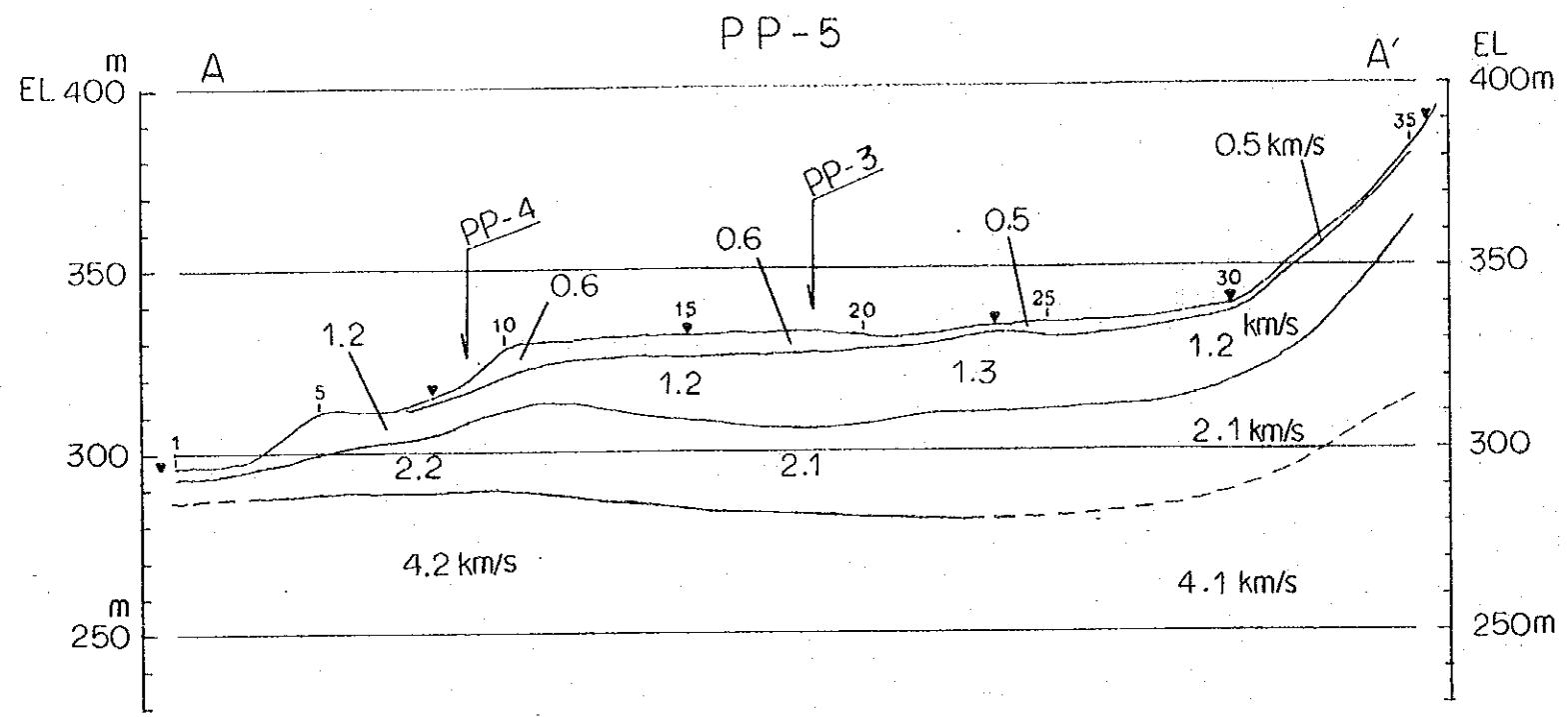




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PIRRIS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
SEISMIC PROFILE PP-2 (PENSTOCK AND POWER PLANT SITE)	
A-5-4-(14)	



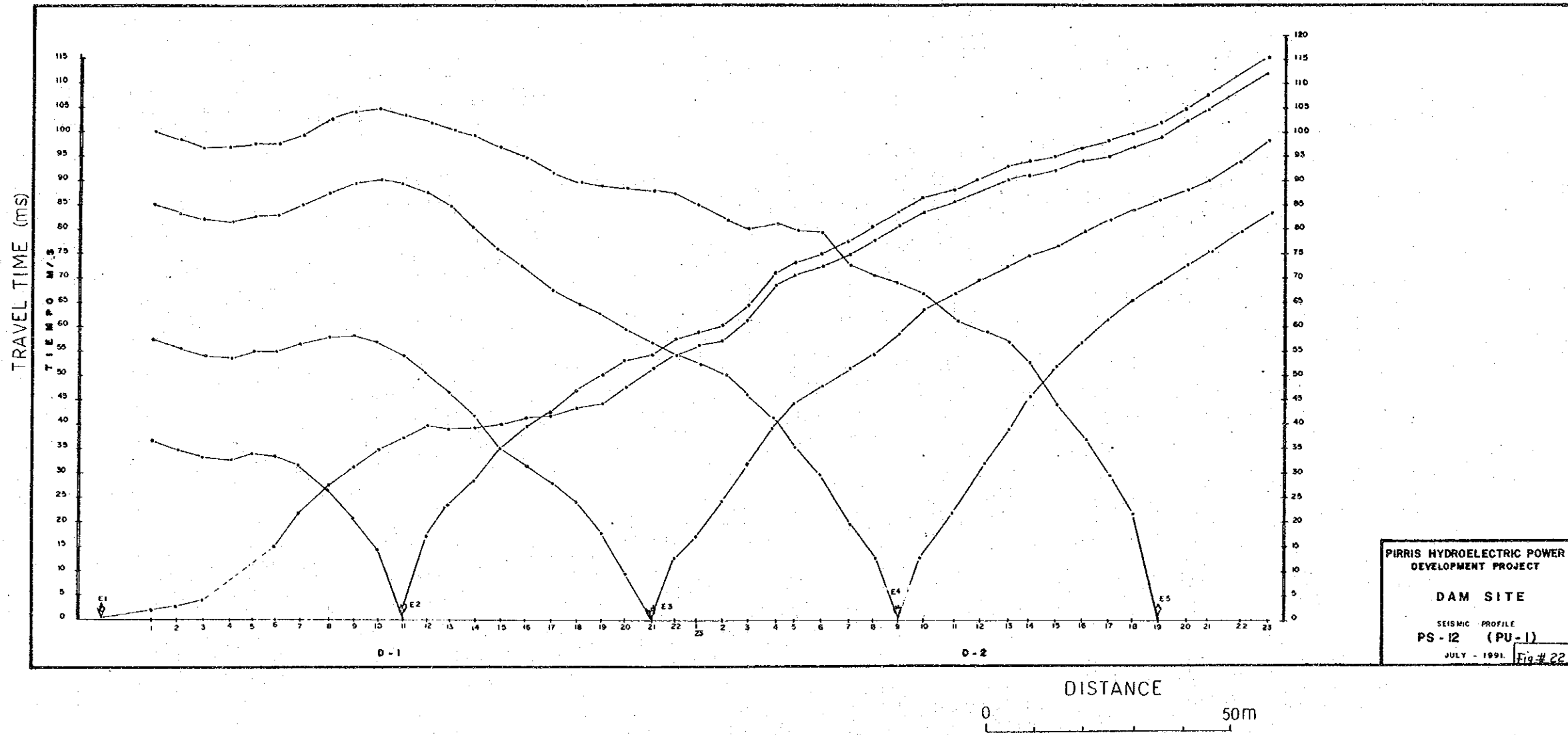
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PIRRIS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
SEISMIC PROFILE PP-3, PP-4 (PENSTOCK AND POWER PLANT SITE)	
A-5-4-(15)	



REPUBLIC OF COSTA RICA	
PIRRIS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
SEISMIC PROFILE PP-5, PP-6 (PENSTOCK AND POWER PLANT SITE)	
A-5-4-(16)	

A-5-5 Time-Distance Plot (Sheet No. 1 ~ No. 14)

A-5-5-(1)	Time-Distance Plot	PU-1
A-5-5-(2)	Time-Distance Plot	PU-2
A-5-5-(3)	Time-Distance Plot	PU-3
A-5-5-(4)	Time-Distance Plot	PU-4
A-5-5-(5)	Time-Distance Plot	PU-5
A-5-5-(6)	Time-Distance Plot	PU-6
A-5-5-(7)	Time-Distance Plot	PL-1
A-5-5-(8)	Time-Distance Plot	PL-2
A-5-5-(9)	Time-Distance Plot	PL-3
A-5-5-(10)	Time-Distance Plot	PL-4
A-5-5-(11)	Time-Distance Plot	PL-5, PL-6
A-5-5-(12)	Time-Distance Plot	PP-1, PP-2
A-5-5-(13)	Time-Distance Plot	PP-3, PP-4
A-5-5-(14)	Time-Distance Plot	PP-5, PP-6



PIRRIS HYDROELECTRIC POWER
DEVELOPMENT PROJECT

DAM SITE

SEISMIC PROFILE
PS-12 (PU-1)

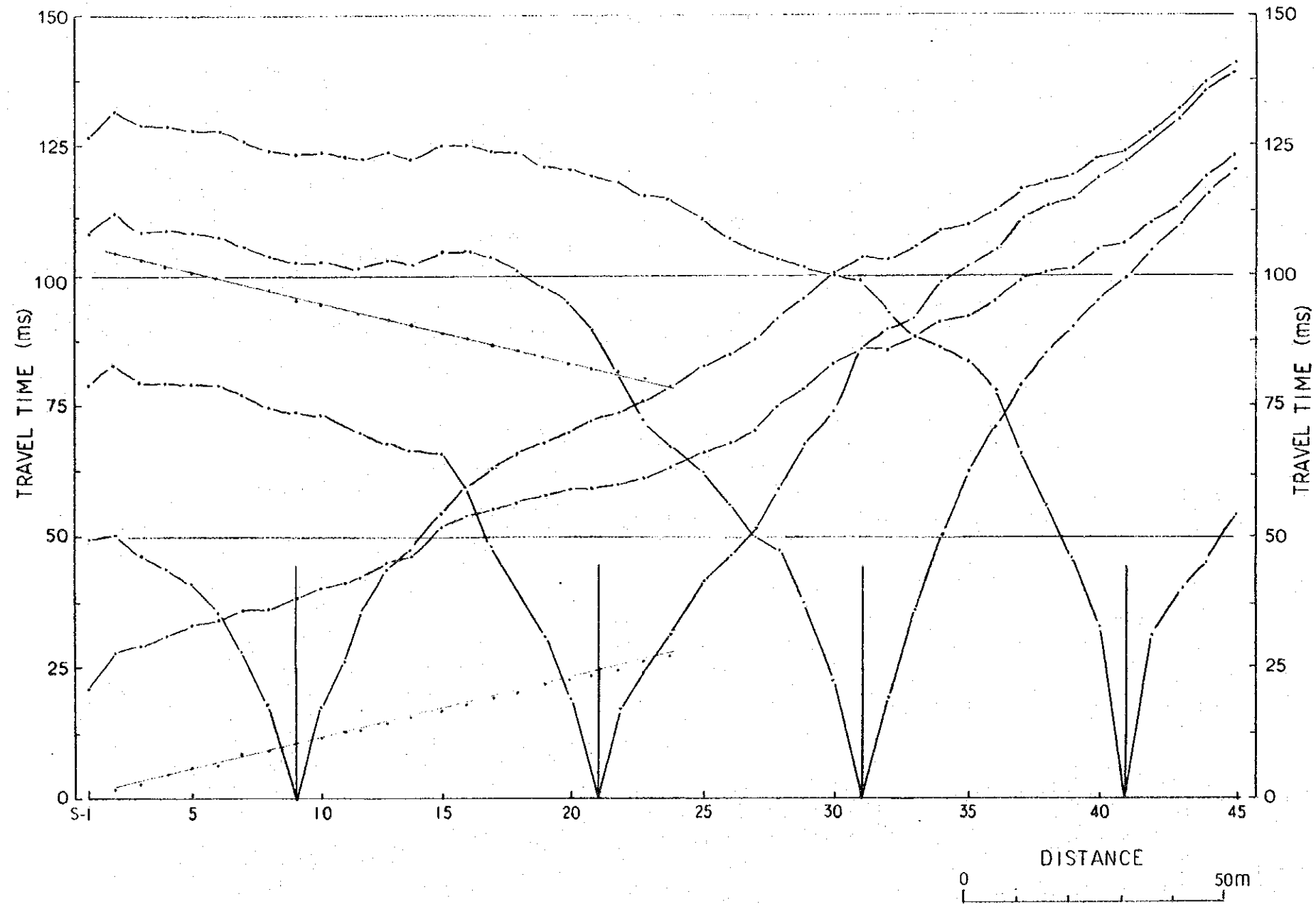
JULY - 1991 Fig # 22

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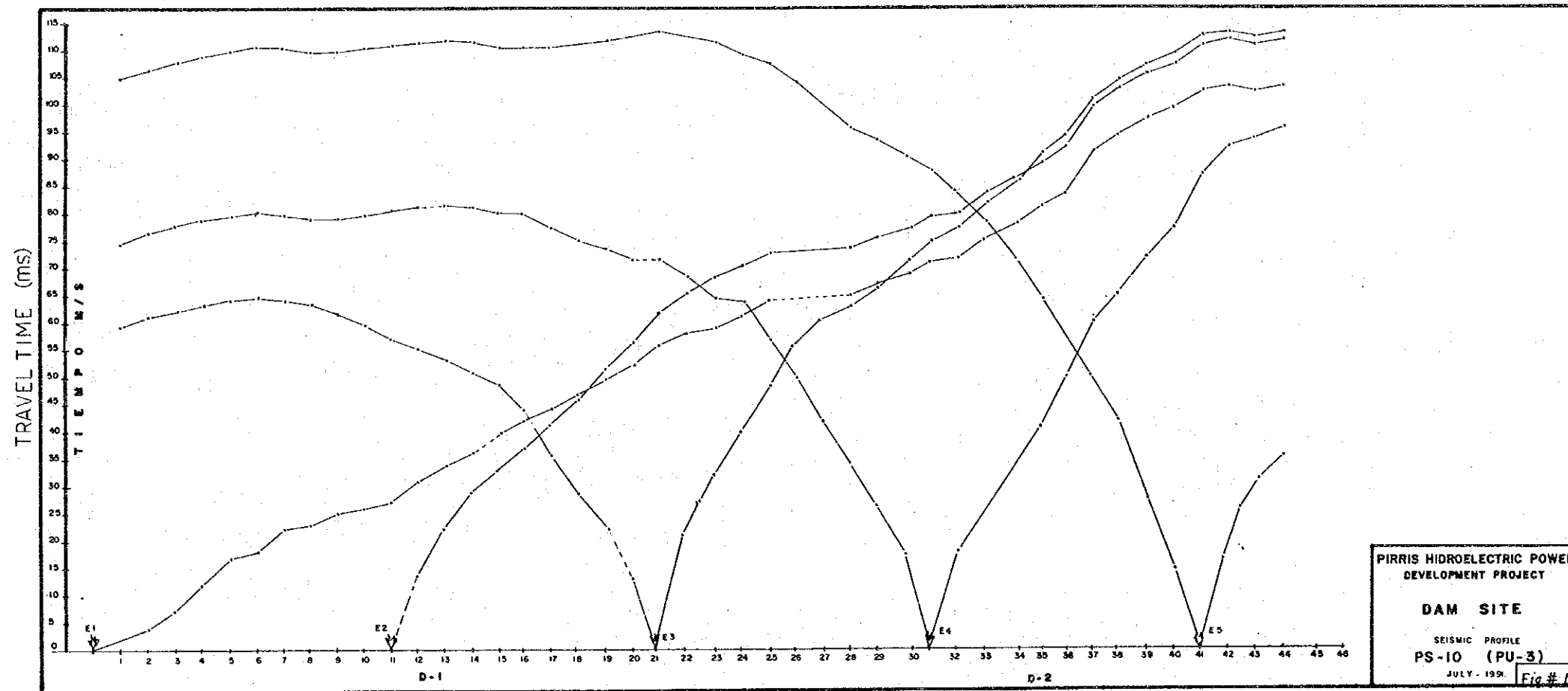
PIRRIS HYDROELECTRIC POWER
DEVELOPMENT PROJECT

TIME-DISTANCE PLOT
PU-1
(UPPER DAM SITE)

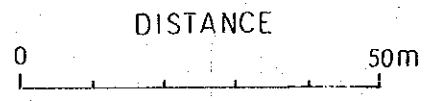
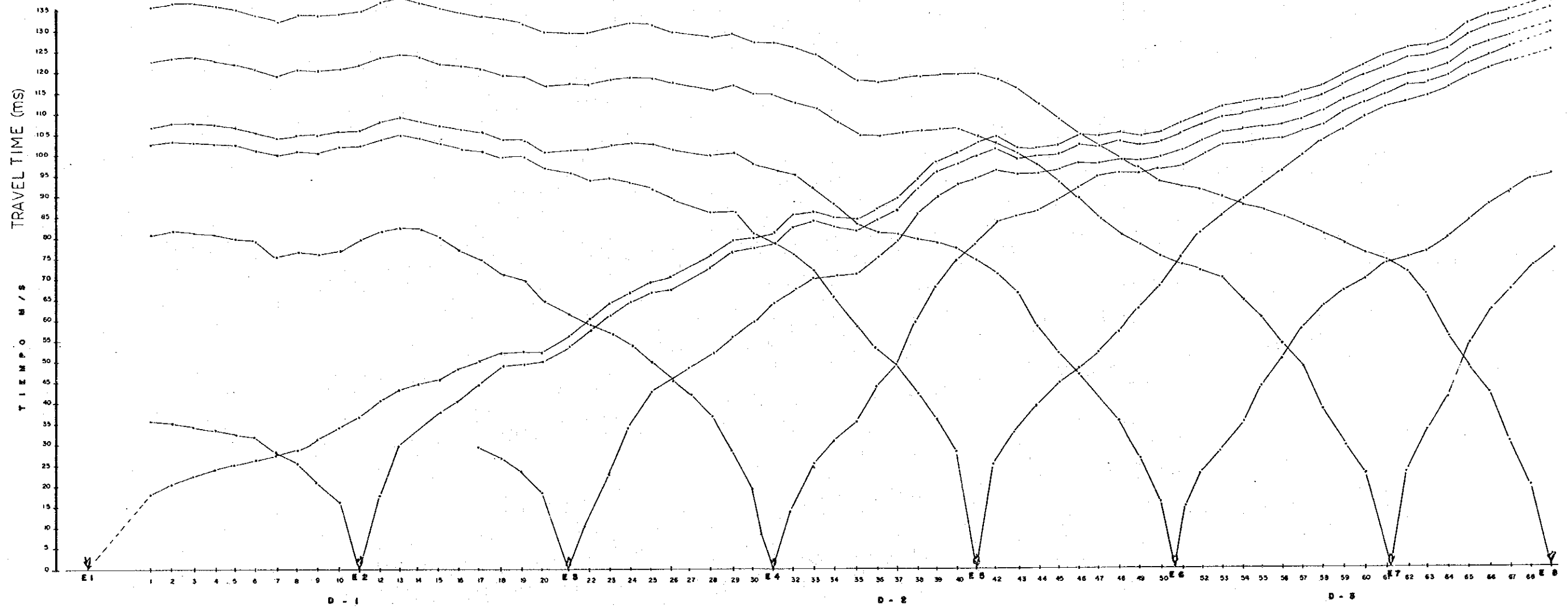
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PIRRIS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
TIME-DISTANCE PLOT PU-2 (UPPER DAM SITE)	
A-5-5-(2)	



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PIRRIS HYDROELECTRIC POWER DEVELOPMENT PROJECT
TIME-DISTANCE PLOT PU-3 (UPPER DAM SITE)
A-5-5-(3)



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PIRRIS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
TIME-DISTANCE PLOT PU-4 (UPPER DAM SITE)	
A-5-5-(4)	

TRAVEL TIME (ms)

150
125
100
75
50
25
0

S-1

5

10

15

20

25

30

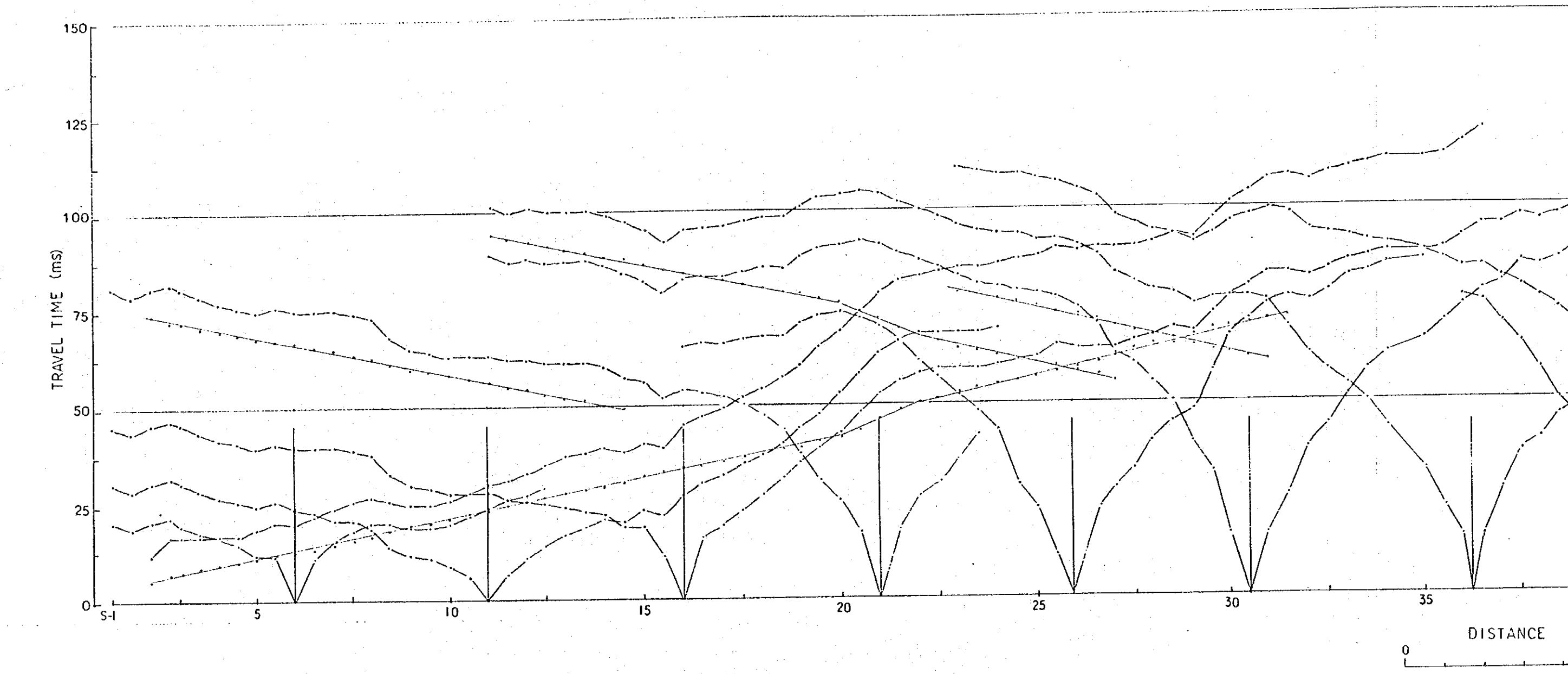
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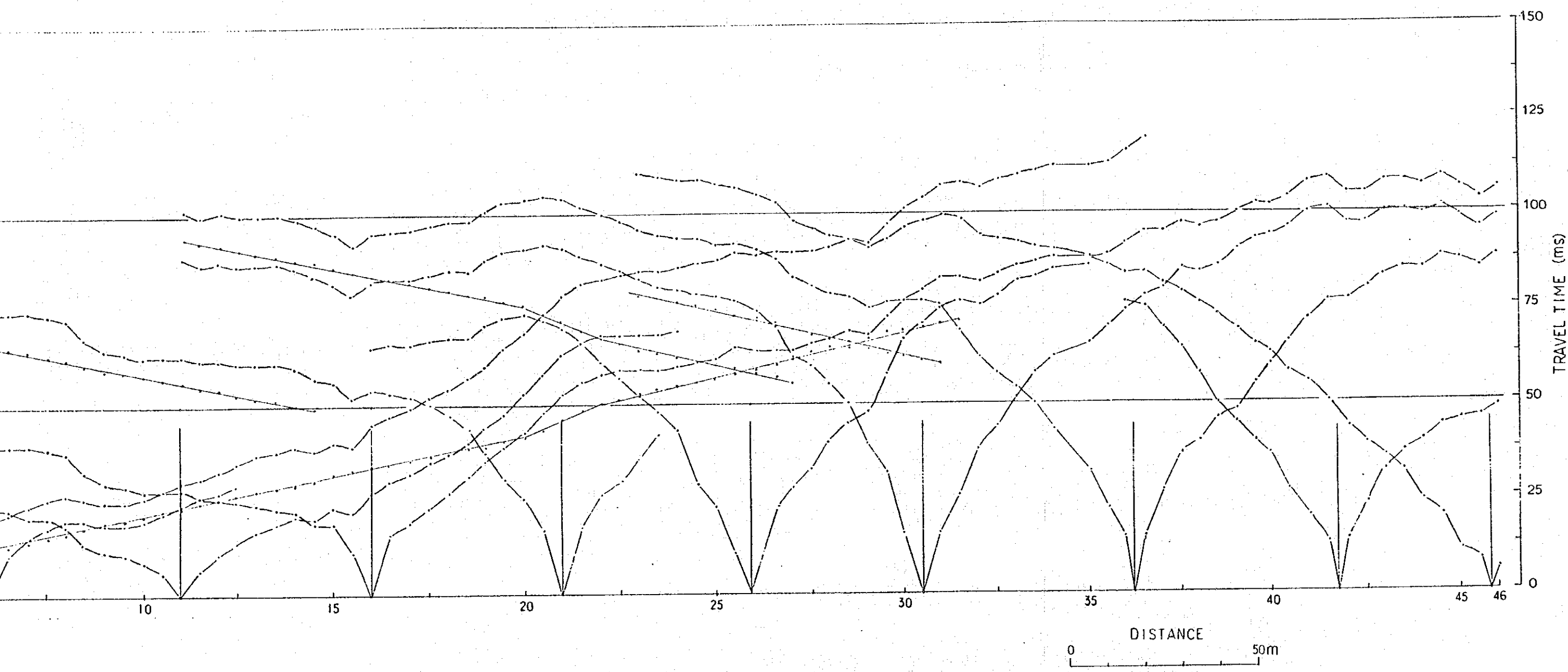
DISTANCE

0

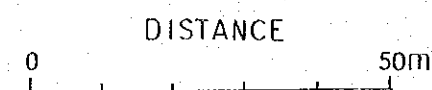
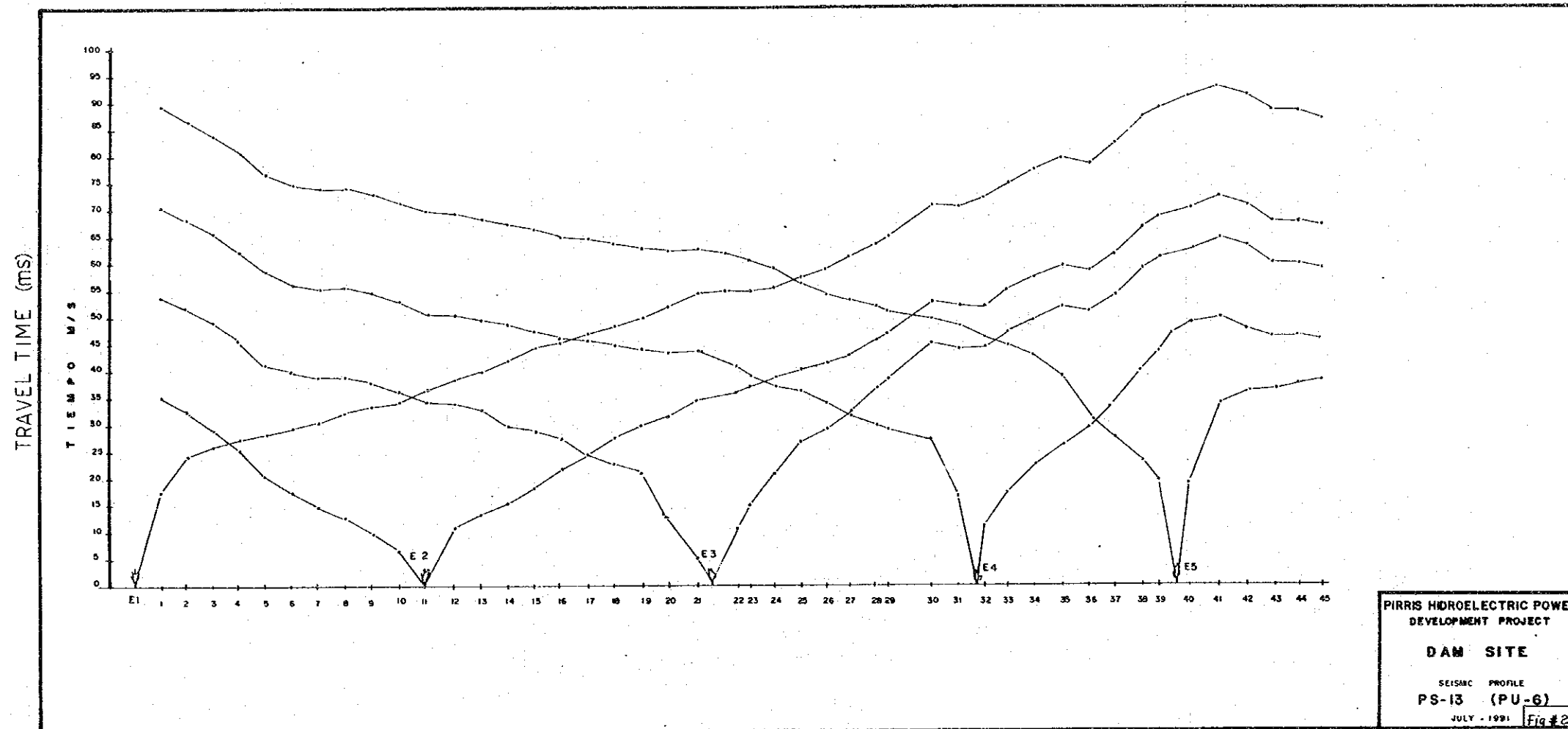
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APPENDIX

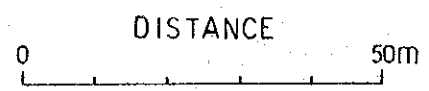
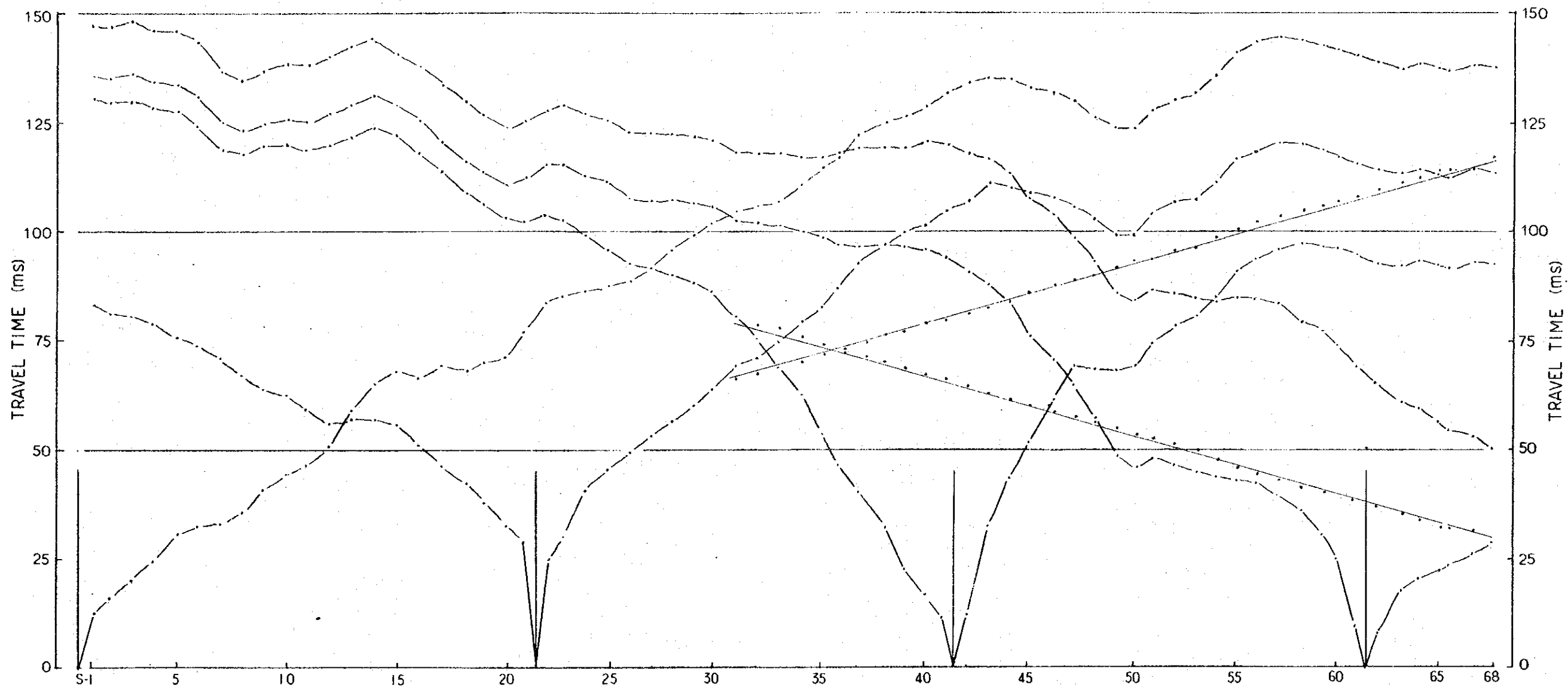




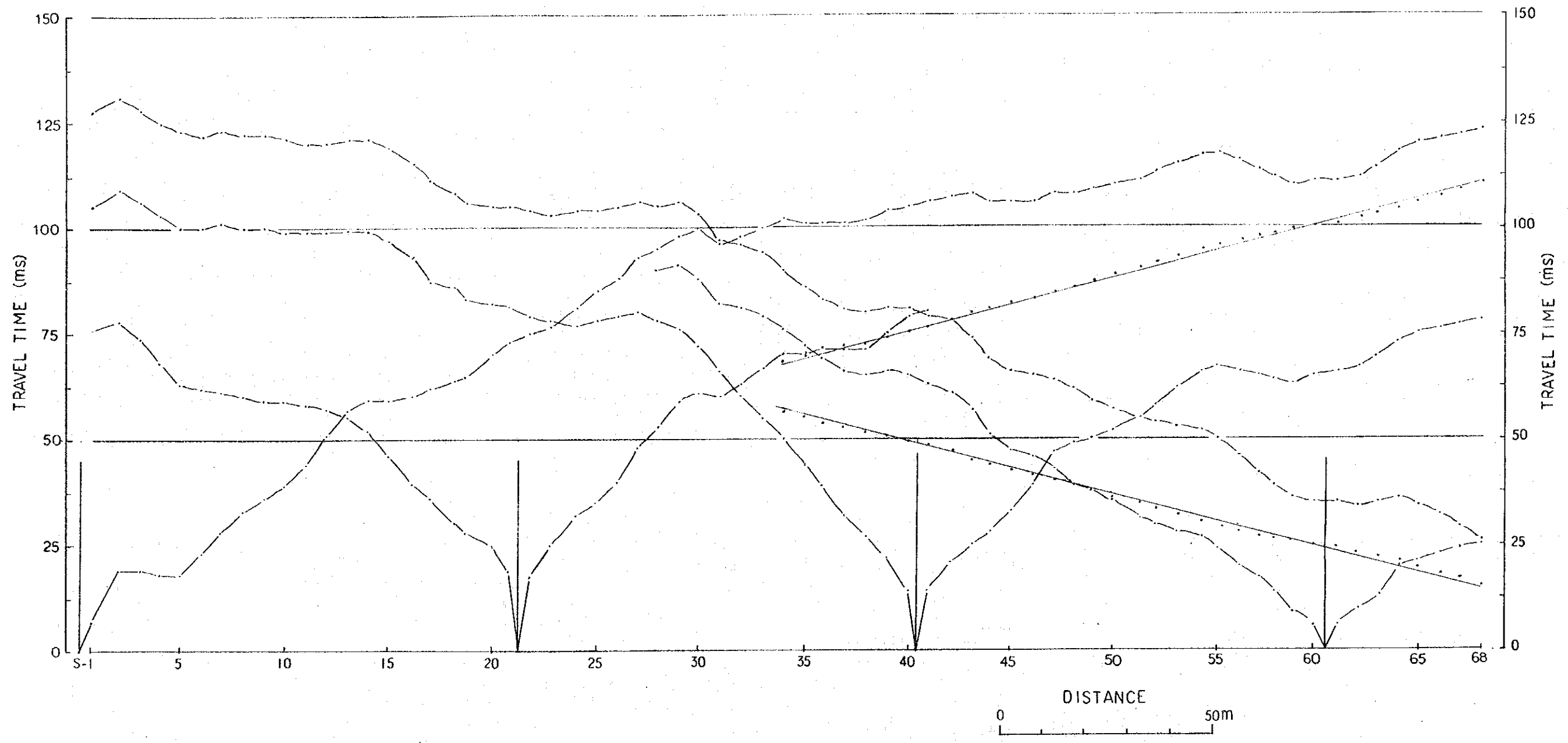
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TIME-DISTANCE PLOT PU-5 (UPPER DAM SITE)	
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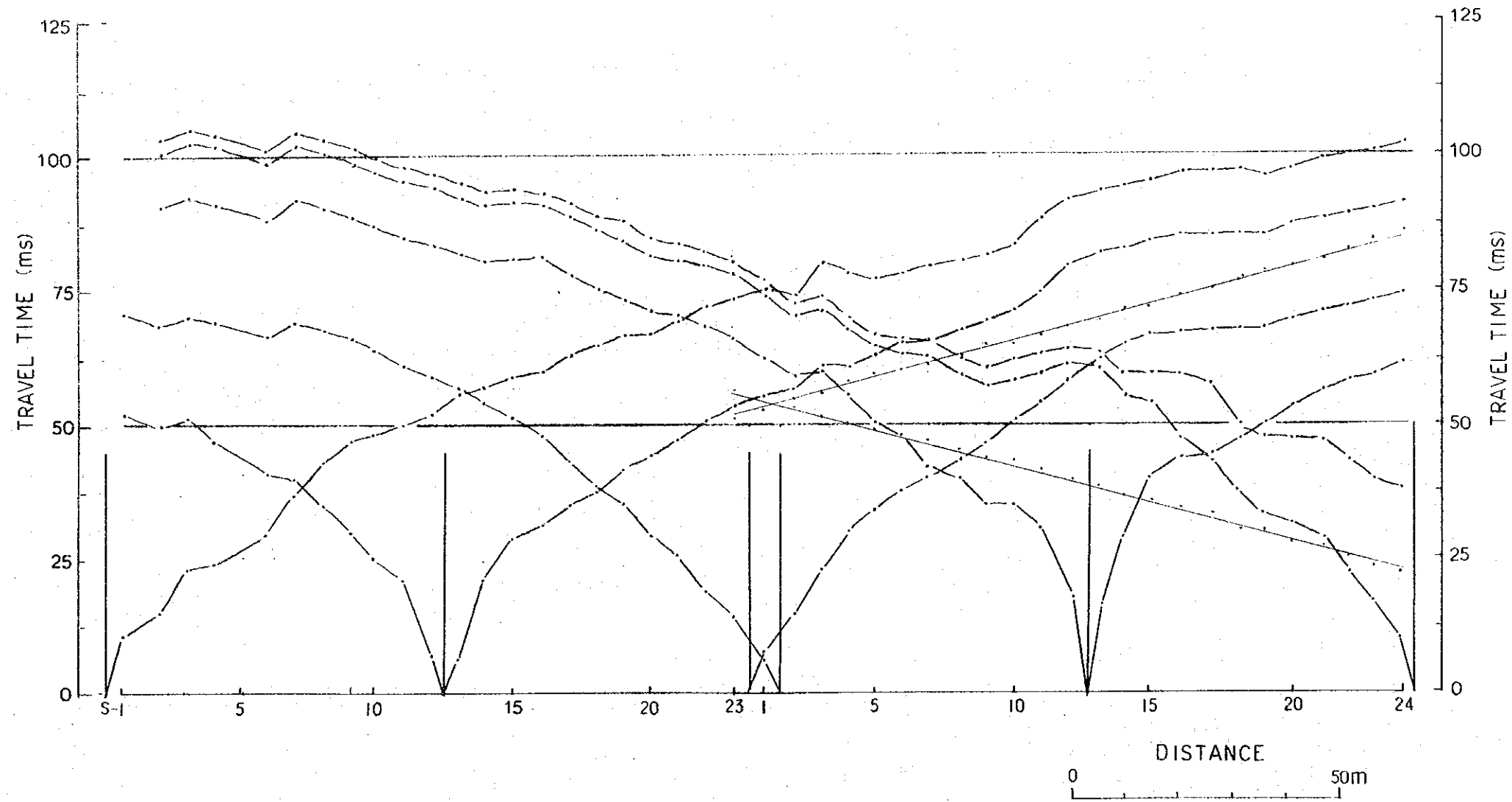
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TIME-DISTANCE PLOT PU-6 (UPPER DAM SITE)	
A-5-5-(6)	



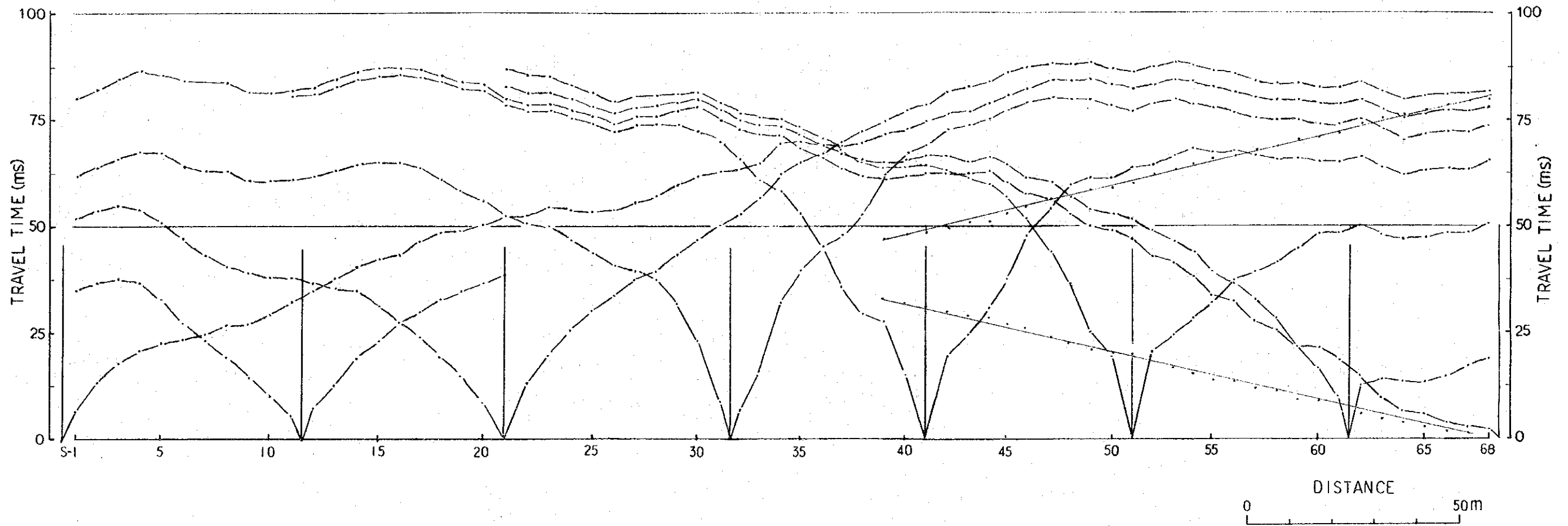
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PIRRIS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
TIME-DISTANCE PLOT PL-1 (LOWER DAM SITE)	
A-5-5-(7)	



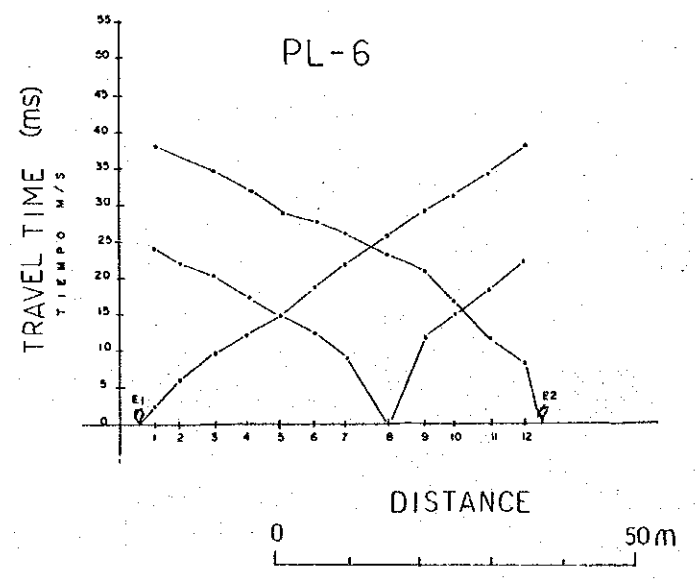
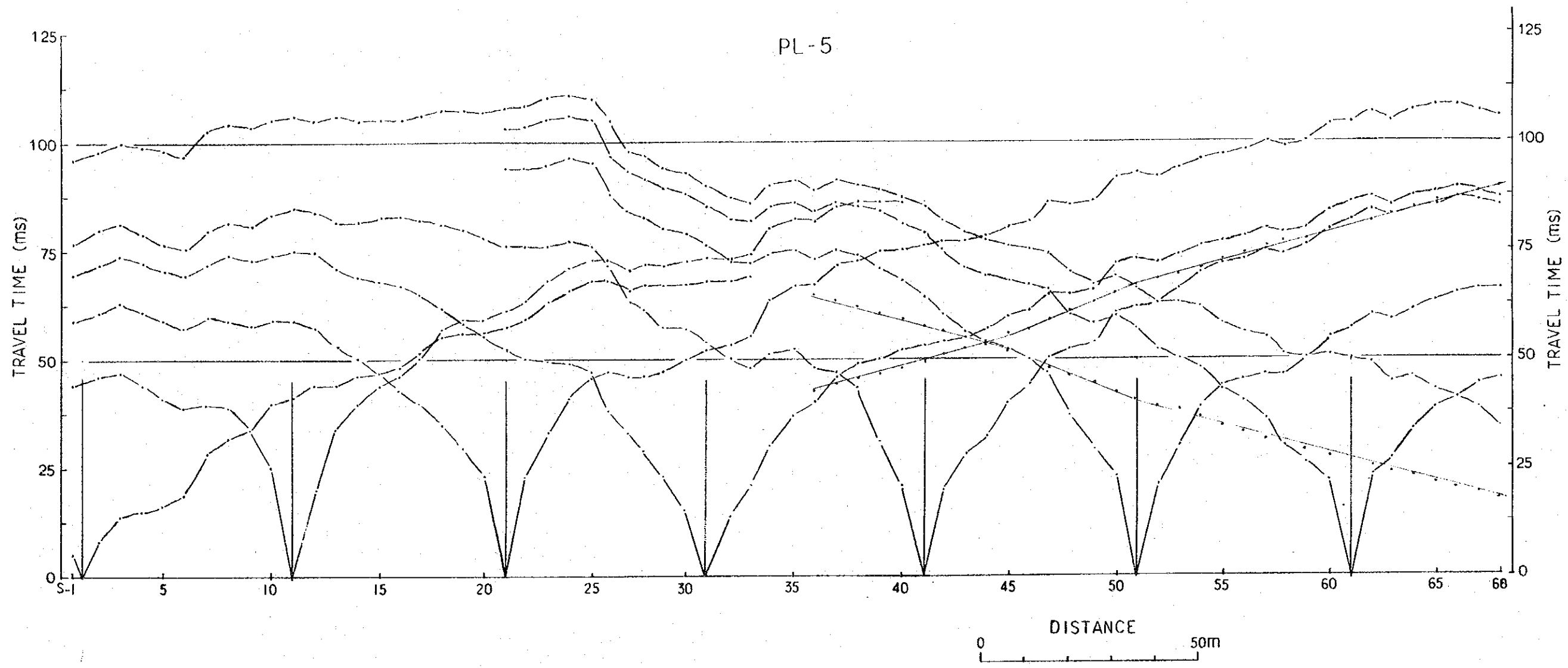
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PIRRIS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
TIME-DISTANCE PLOT PL-2 (LOWER DAM SITE)	
A-5-5-(8)	



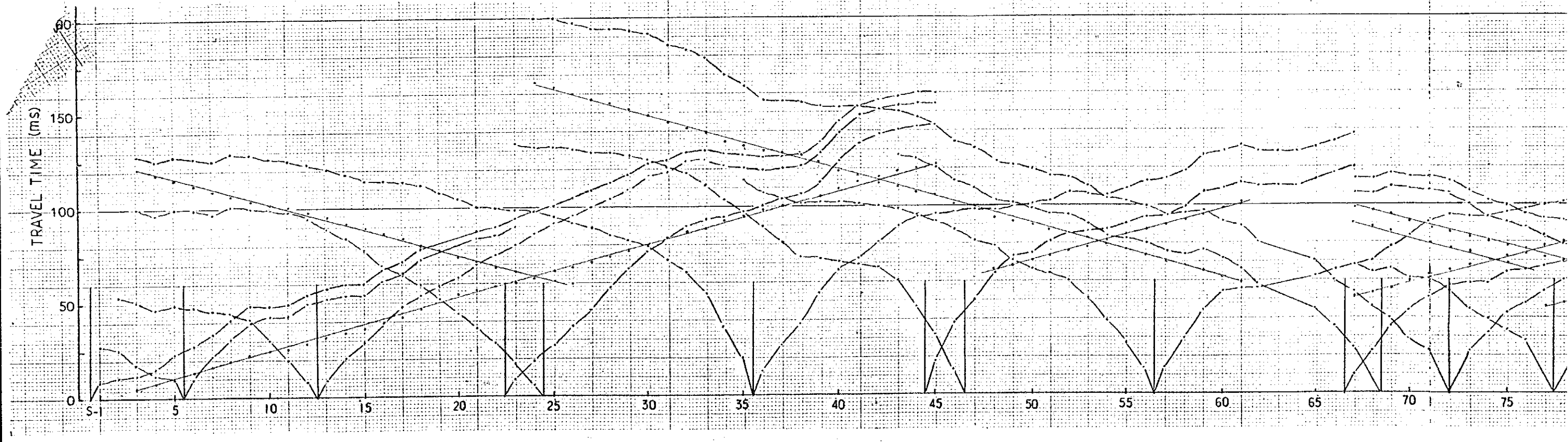
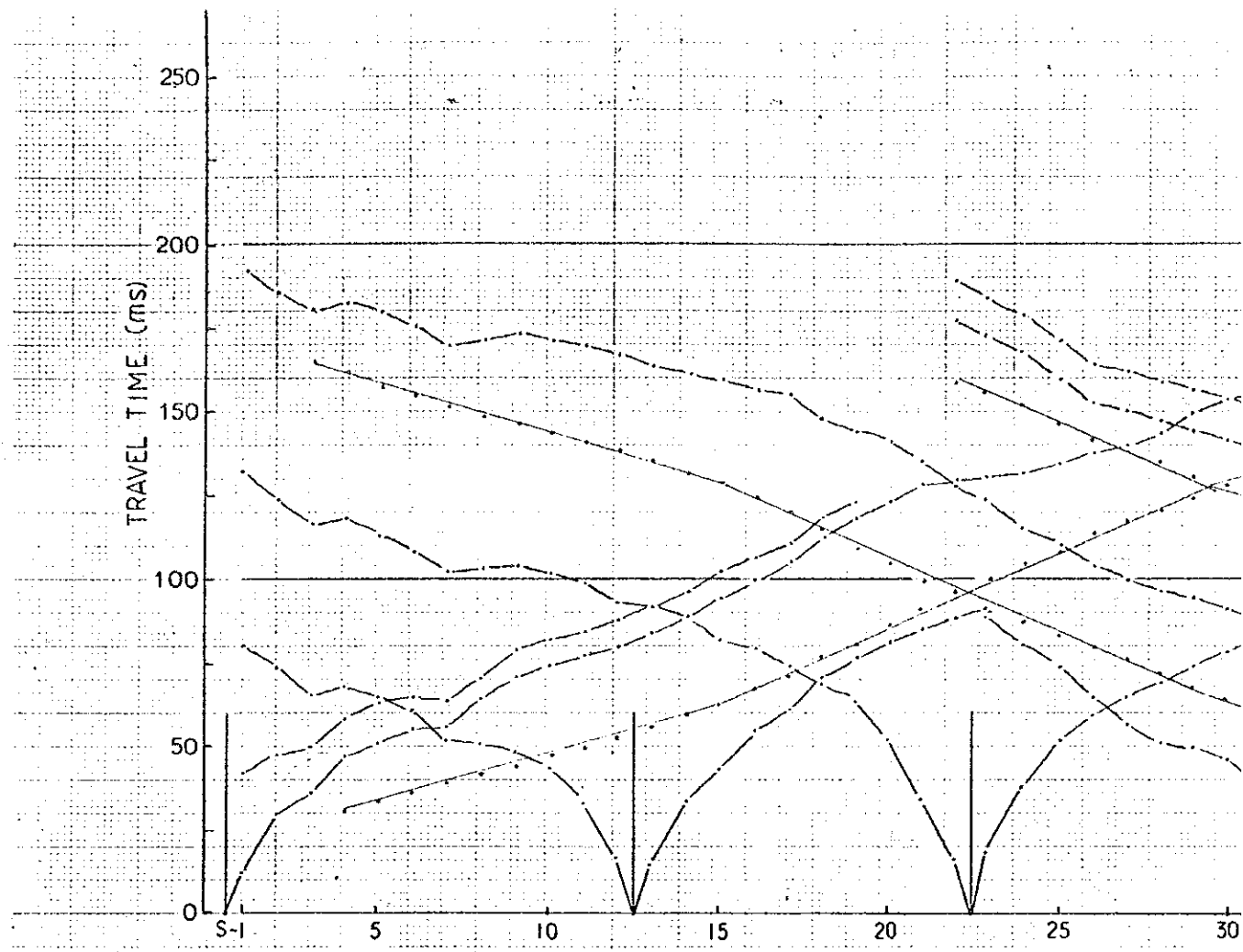
REPUBLIC OF COSTA RICA	
PIRRIS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
TIME-DISTANCE PLOT PL-3 (LOWER DAM SITE)	
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REPUBLIC OF COSTA RICA	
PIRRIS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
TIME-DISTANCE PLOT PL-4 (LOWER DAM SITE)	
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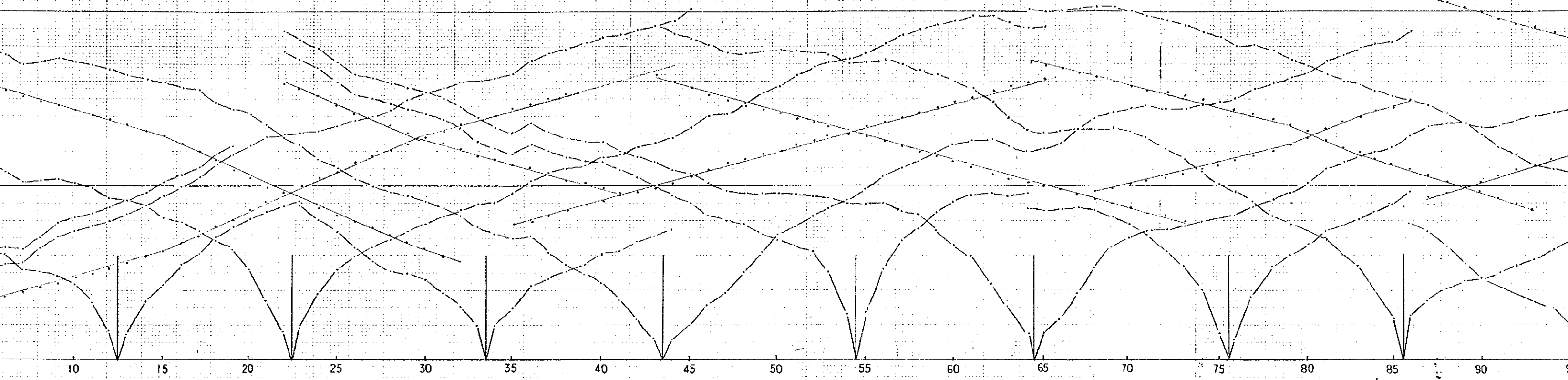


REPUBLIC OF COSTA RICA	
PIRRIS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
TIME-DISTANCE PLOT PL-5, PL-6 (LOWER DAM SITE)	
A-5-5-(11)	

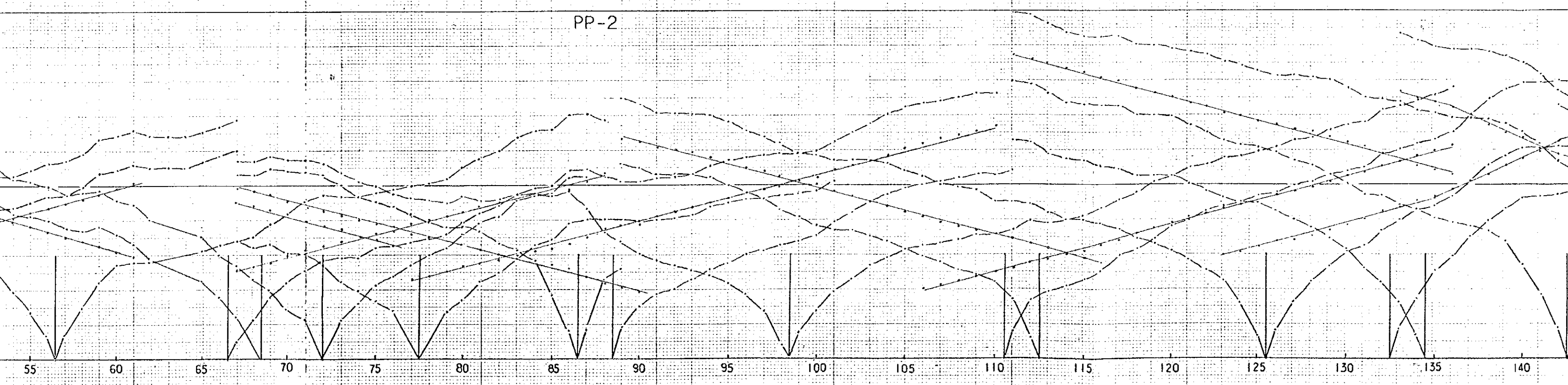


APPENDIX X

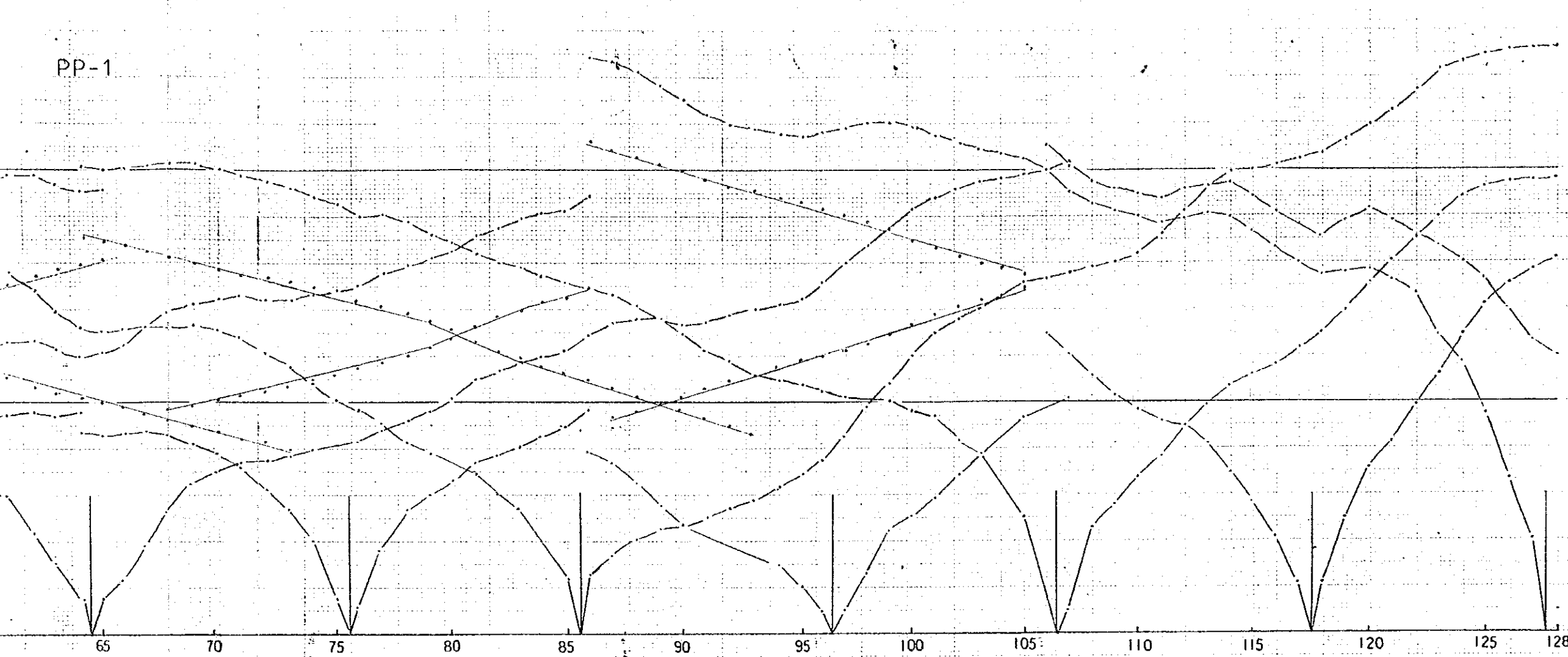
PP-1



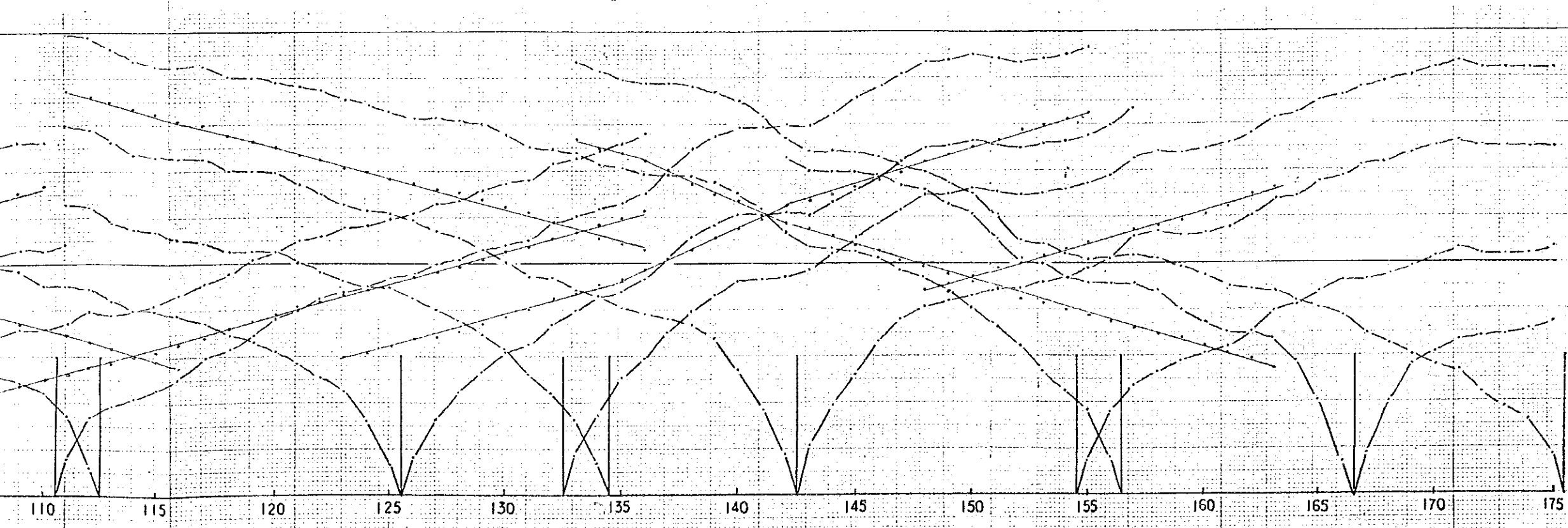
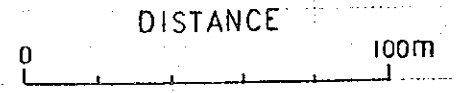
PP-2



PP-1

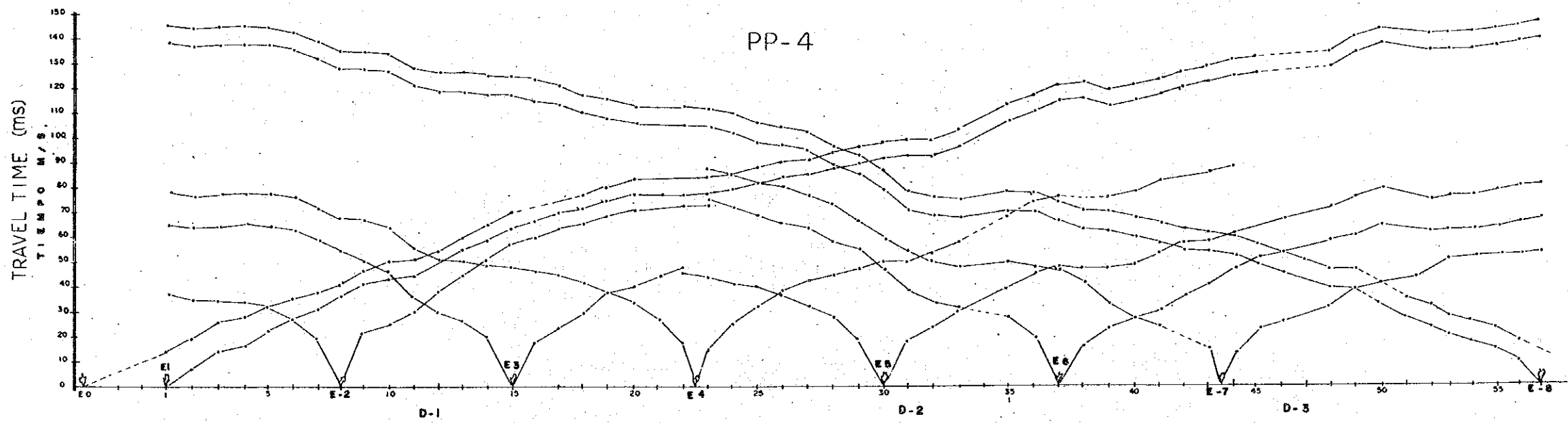
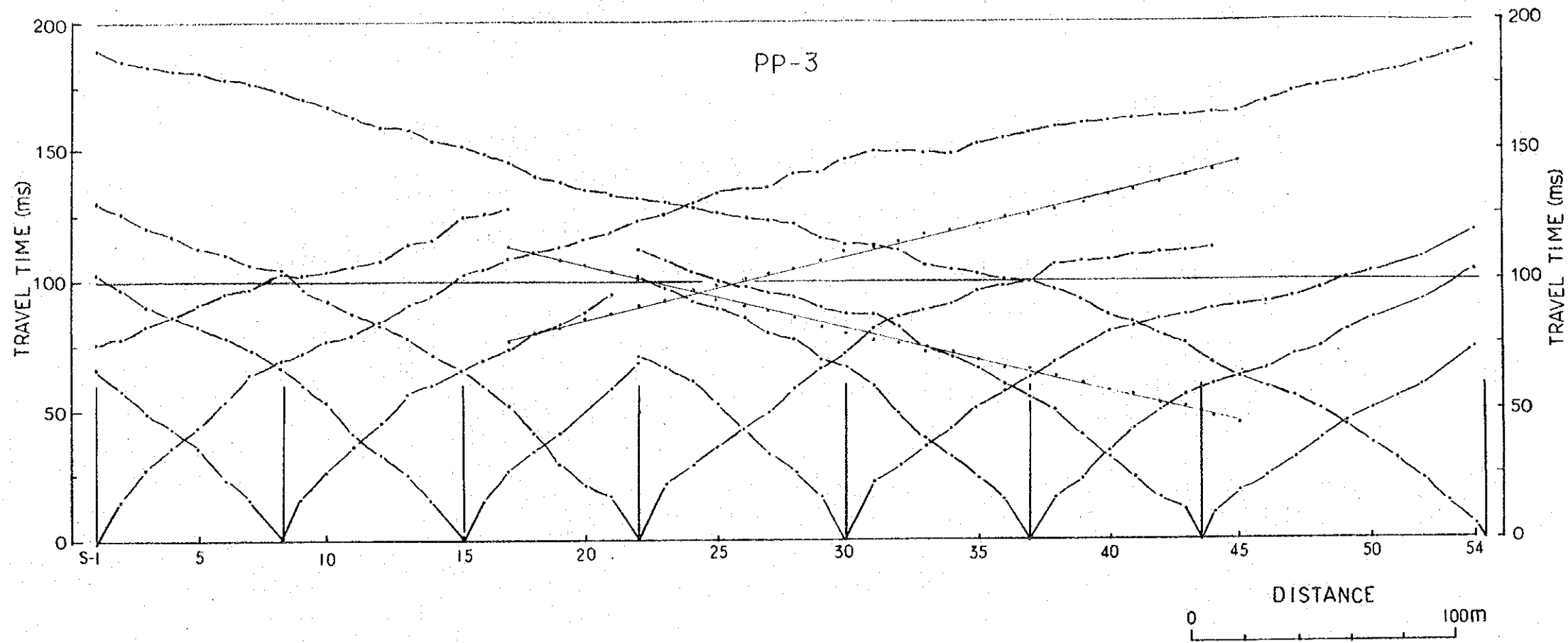


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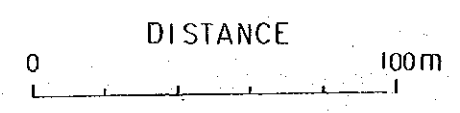
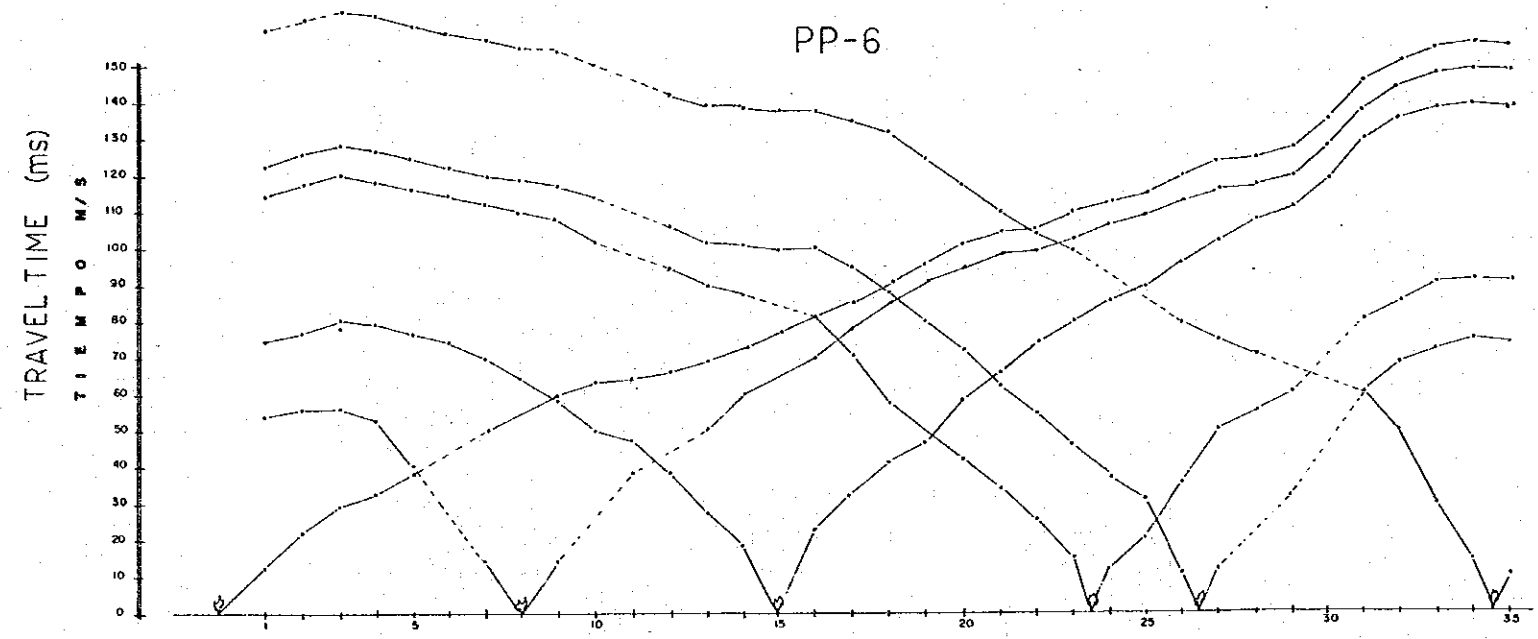
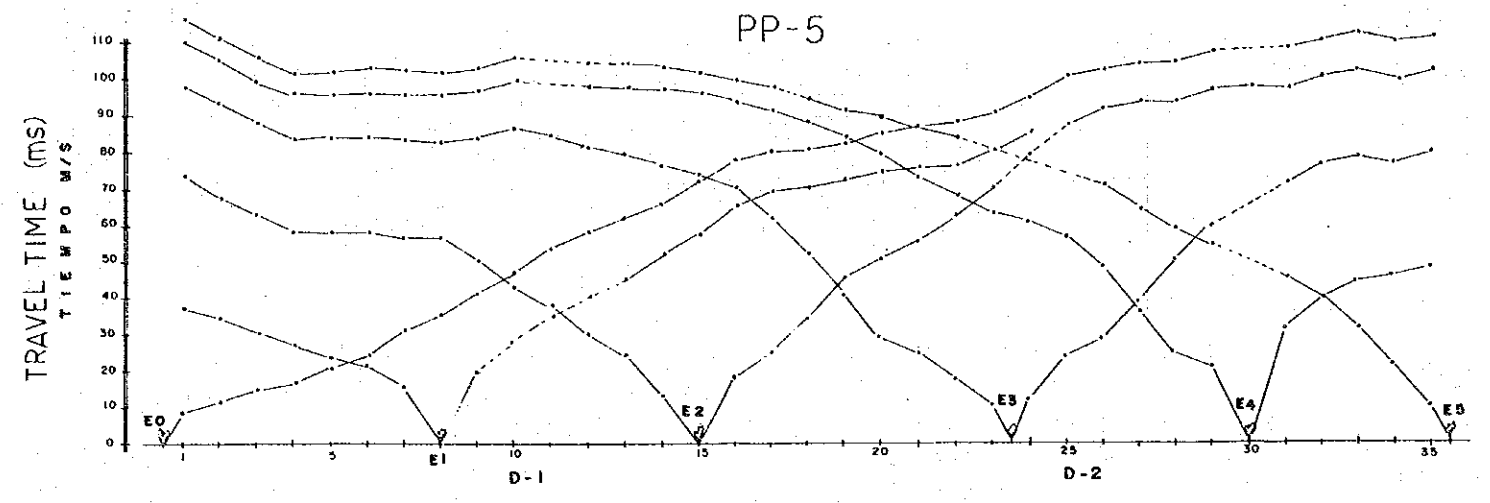


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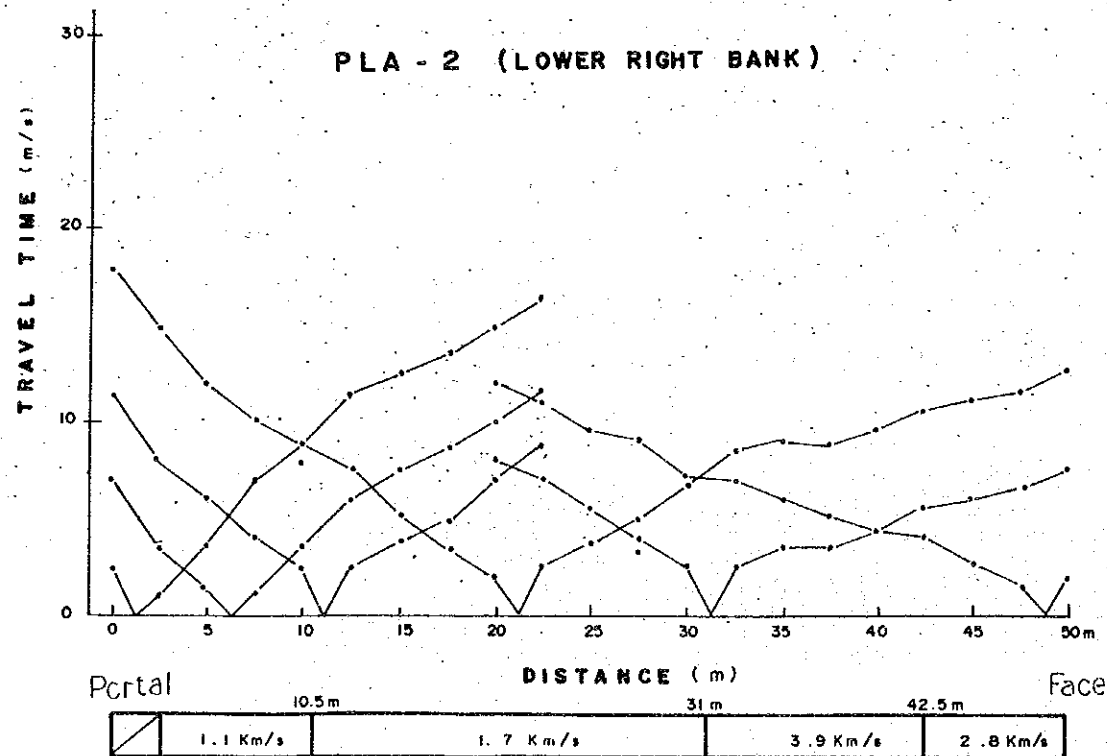
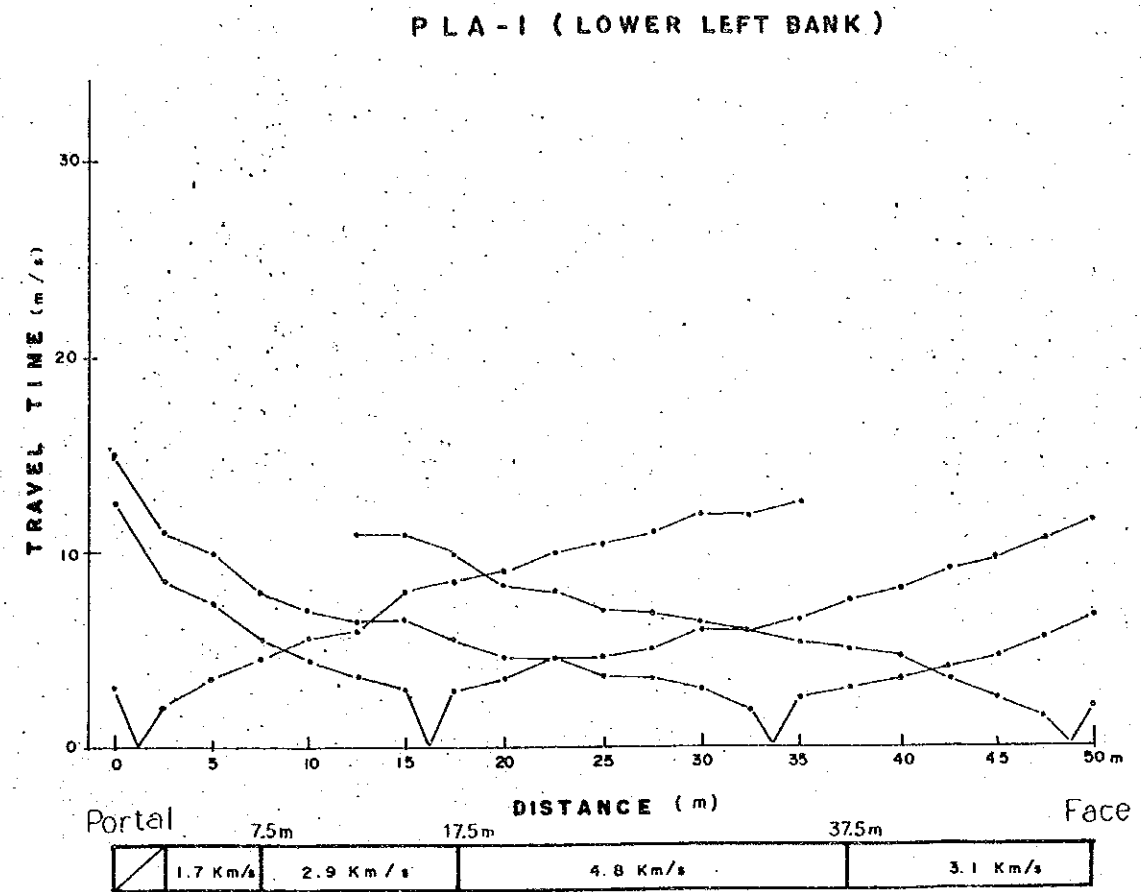
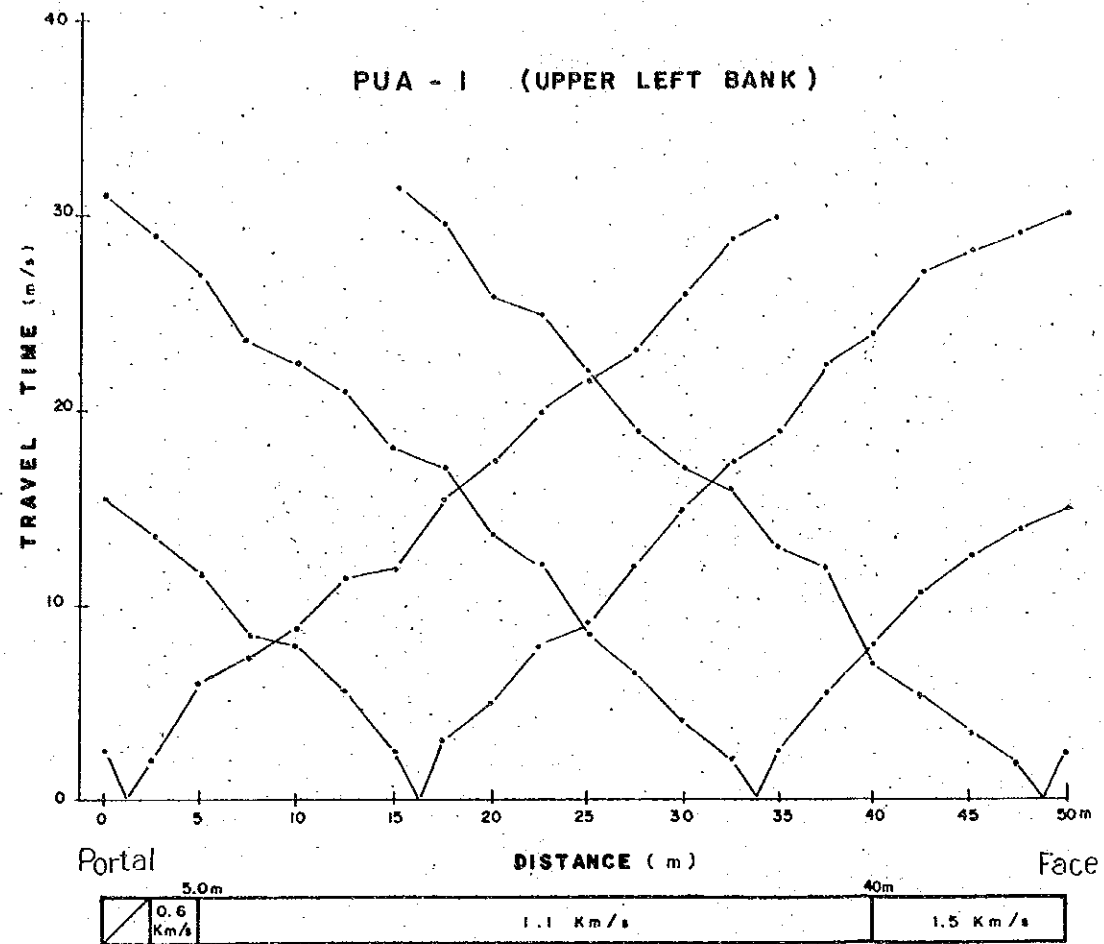
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PIRRIS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
TIME-DISTANCE PLOT PP-1, PP-2 (PENSTOCK AND POWER PLANT SITE)	
A-5-5-(12)	



REPUBLIC OF COSTA RICA	
PIRRIS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
TIME-DISTANCE PLOT PP-3, PP-4 (PENSTOCK AND POWER PLANT SITE)	
A-5-5-(13)	



REPUBLIC OF COSTA RICA	
PIRRIS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
TIME-DISTANCE PLOT PP-5, PP-6 (PENSTOCK AND POWER PLANT SITE)	
A-5-5-(14)	



REPUBLIC OF COSTA RICA	
PIRRIS ELDROELECTRIC POWER DEVELOPMENT PROJECT	
RESULT OF SEISMIC PROSPECTING IN ADITS (DAM SITES)	
A-5-6	

**APPENDIX A-6 LABORATORY TESTS OF CONSTRUCTION
MATERIALS**

APPENDIX A-6 LABORATORY TESTS OF CONSTRUCTION MATERIALS

Contents

		<u>Page</u>
Fig. A-6-1	Alkali Aggregate Reaction Tests of Quarry Site and LA-2 Adit	A-6-1
Fig. A-6-2	Strain Curve of Unconfined Compression Strength Tests	A-6-2
Fig. A-6-3	Compression Strength and Modulus of Elasticity of UB-3 Boring Cores	A-6-8
Fig. A-6-4	Location of Borrow Area (CP-1, CP-2, CP-3)	A-6-9
Fig. A-6-5	Grain-size Analysis Test of CP-1	A-6-10
Fig. A-6-6	Plasticity Chart of Liquid Limit, Plasticity Index of CP-1	A-6-11
Fig. A-6-7	Grain-size Analysis Test of CP-2	A-6-12
Fig. A-6-8	Plasticity Chart of Liquid Limit, Plasticity Index of CP-2	A-6-13
Fig. A-6-9	Grain-size Analysis Test of CP-3	A-6-14
Fig. A-6-10	Plasticity Chart of Liquid Limit, Plasticity Index of CP-3	A-6-15
Fig. A-6-11	Compaction Test of CP-1, CP-2, CP-3, CP-M	A-6-16
Fig. A-6-12	Mohr Stress Circles of CP-1, CP-2, CP-3	A-6-17
Fig. A-6-13	Strain - Stress History of Triaxial Compression Test of CP-1	A-6-18
Fig. A-6-14	Strain - Stress History of Triaxial Compression Test of CP-2	A-6-19
Fig. A-6-15	Strain - Stress History of Triaxial Compression Test of CP-3	A-6-20
Table A-6-1	Quantity and Sampling Location of Laboratory Tests .	A-6-21
Table A-6-2	Result of Concrete Aggregate and Boring Core on Laboratory Tests	A-6-22
Table A-6-3	Result of Rock and Soil Materials on Laboratory Tests	A-6-23
Table A-6-4	Specific Gravity, Absorption and Crushing Tests of Quarry Site	A-6-24

Table A-6-5	Specific, Absorption, Ultrasonic, Modulus of Elasticity and Compression Strength Tests of Boring Cores	A-6-25
Table A-6-6	Tensile Strength Tests of Boring Cores	A-6-28
Table A-6-7	Specific, Absorption, Optimum Moisture, Liquid Limit, Plasticity Index, and Compaction Tests of Borrow Area	A-6-29
Table A-6-8	Geologic Column of CP-1	A-6-30
Table A-6-9	Geologic Column of CP-2	A-6-31
Table A-6-10	Geologic Column of CP-3	A-6-32
Table A-6-11	Data Sheets of Triaxial Compression Test of CP-1 ($P_3' = 2.0$)	A-6-33
Table A-6-12	Data Sheets of Triaxial Compression Test of CP-1 ($P_3' = 4.0$)	A-6-34
Table A-6-13	Data Sheets of Triaxial Compression Test of CP-1 ($P_3' = 8.0$)	A-6-35
Table A-6-14	Data Sheets of Triaxial Compression Test of CP-2 ($P_3' = 2.0$)	A-6-36
Table A-6-15	Data Sheets of Triaxial Compression Test of CP-2 ($P_3' = 4.0$)	A-6-37
Table A-6-16	Data Sheets of Triaxial Compression Test of CP-2 ($P_3' = 8.0$)	A-6-38
Table A-6-17	Data Sheets of Triaxial Compression Test of CP-3 ($P_3' = 2.0$)	A-6-39
Table A-6-18	Data Sheets of Triaxial Compression Test of CP-3 ($P_3' = 4.0$)	A-6-40
Table A-6-19	Data Sheets of Triaxial Compression Test of CP-3 ($P_3' = 8.0$)	A-6-41

Fig. A-6-1 Alkali Aggregate Reaction Tests of Quarry Site and LA-2 Adit

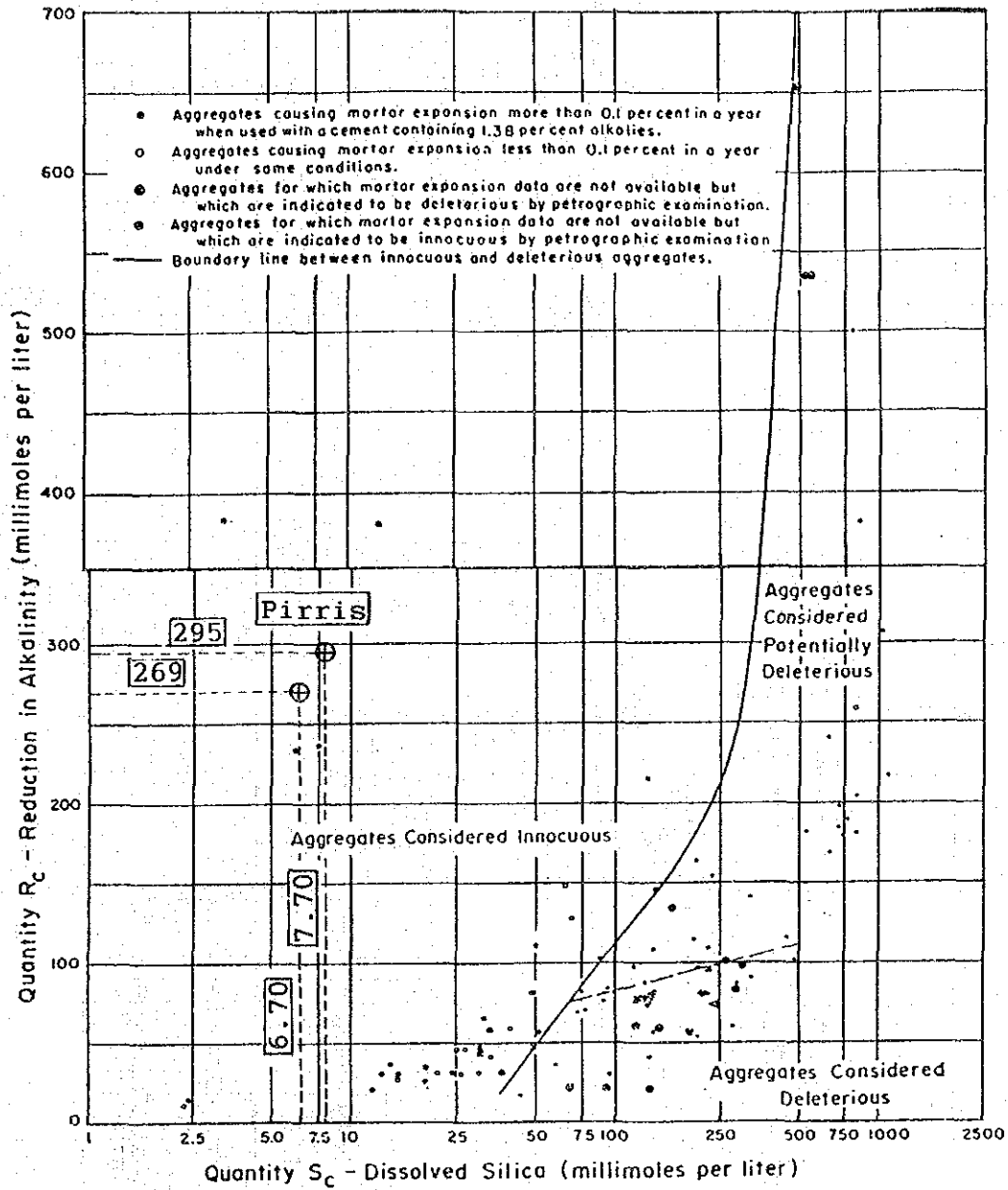


Illustration of Division Between Innocuous and Deleterious Aggregates on Basis of Reduction in Alkalinity Test

Fig. A-6-2 Strain Curve of Unconfined Compression Strength Tests

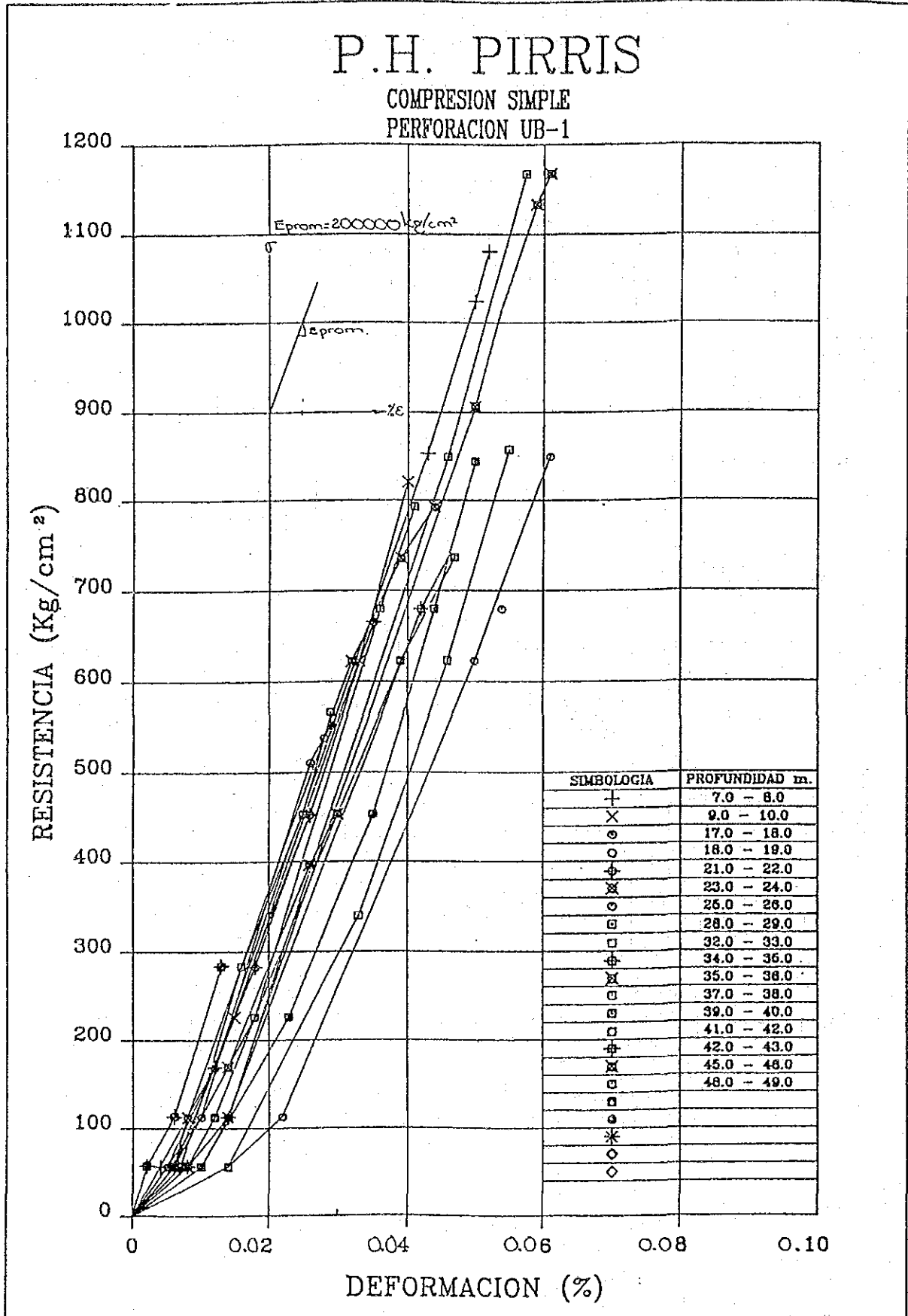


Fig. A-6-2 Strain Curve of Unconfined Compression Strength Tests

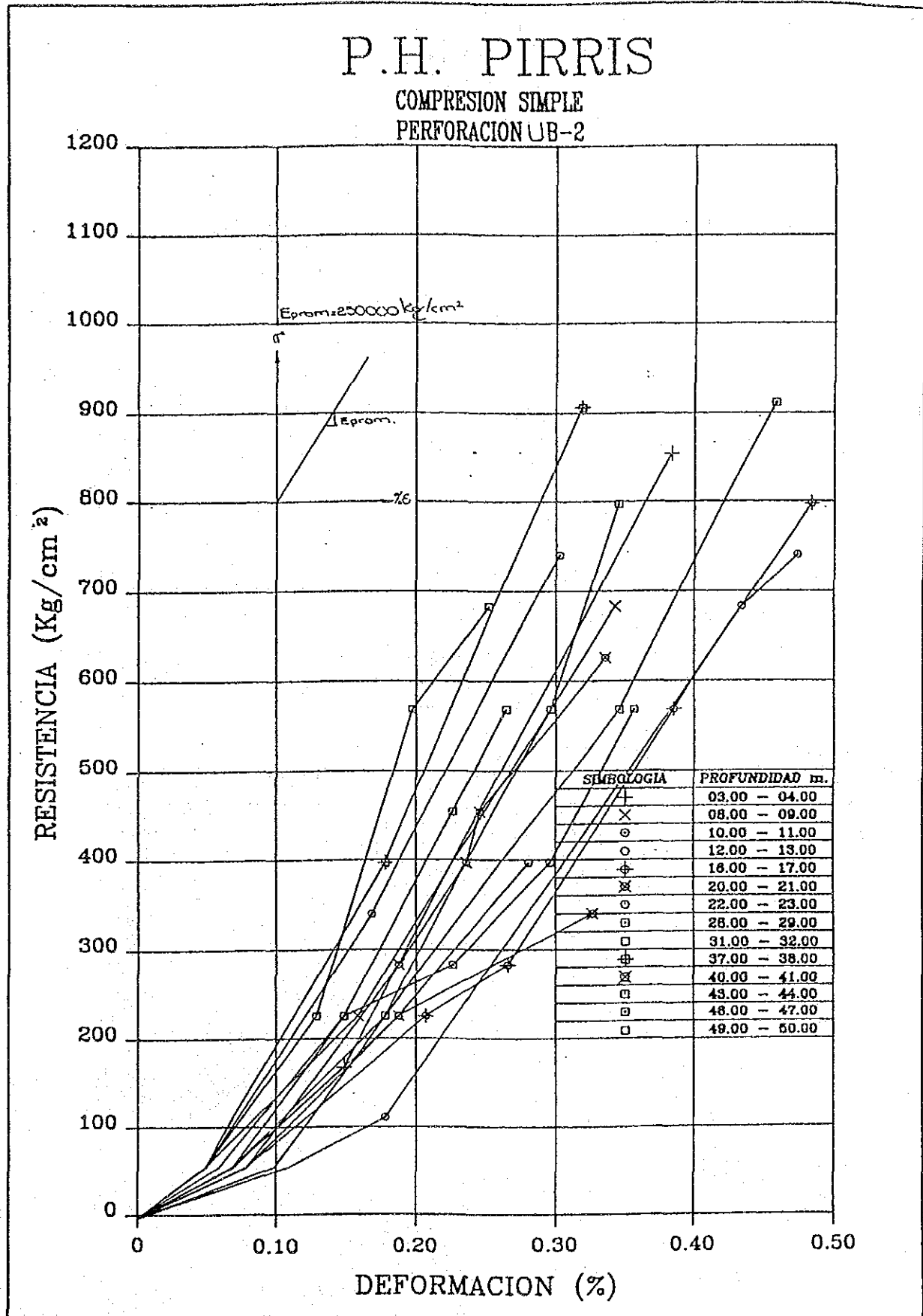


Fig. A-6-2 Strain Curve of Unconfined Compression Strength Tests

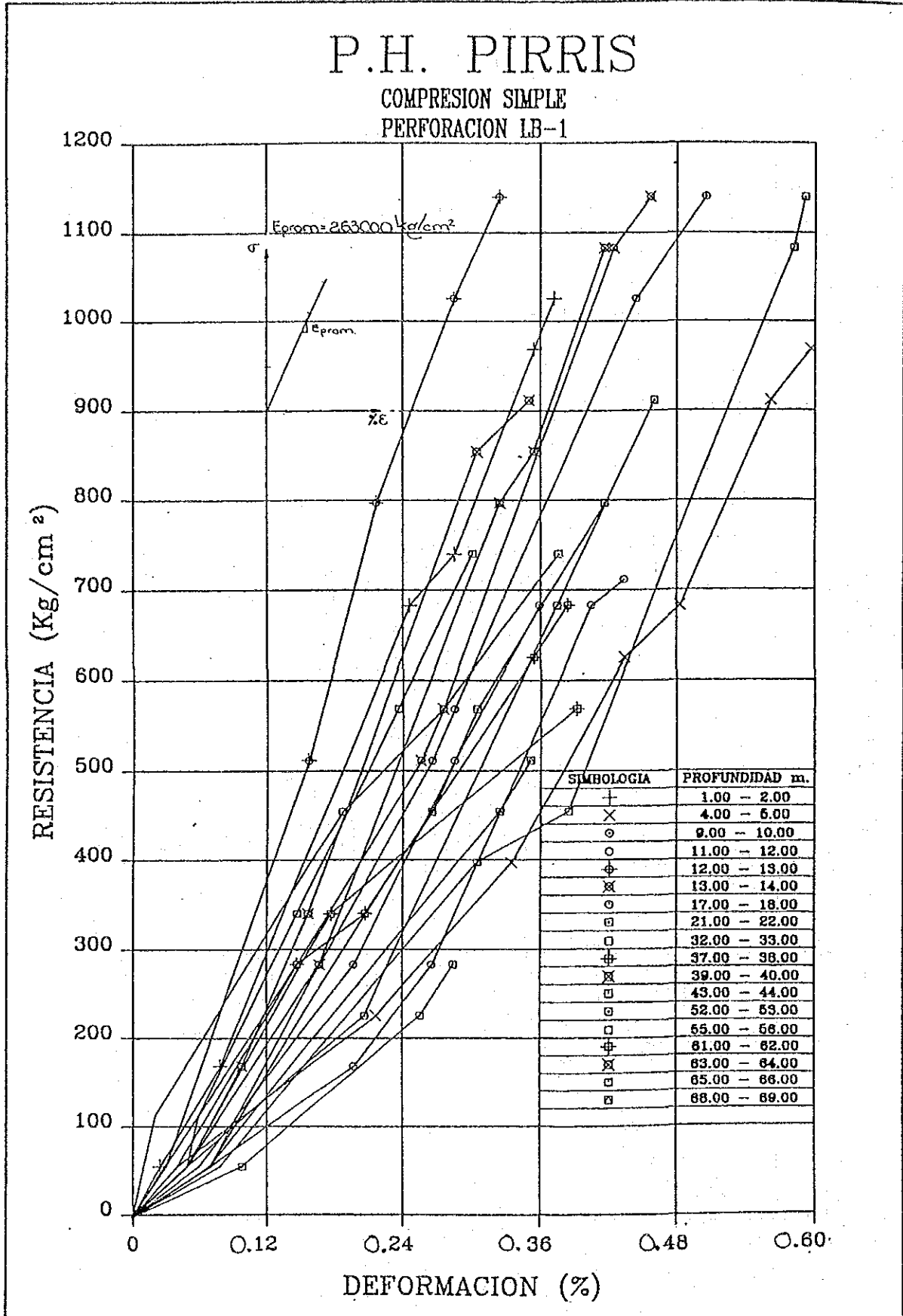


Fig. A-6-2 Strain Curve of Unconfined Compression Strength Tests

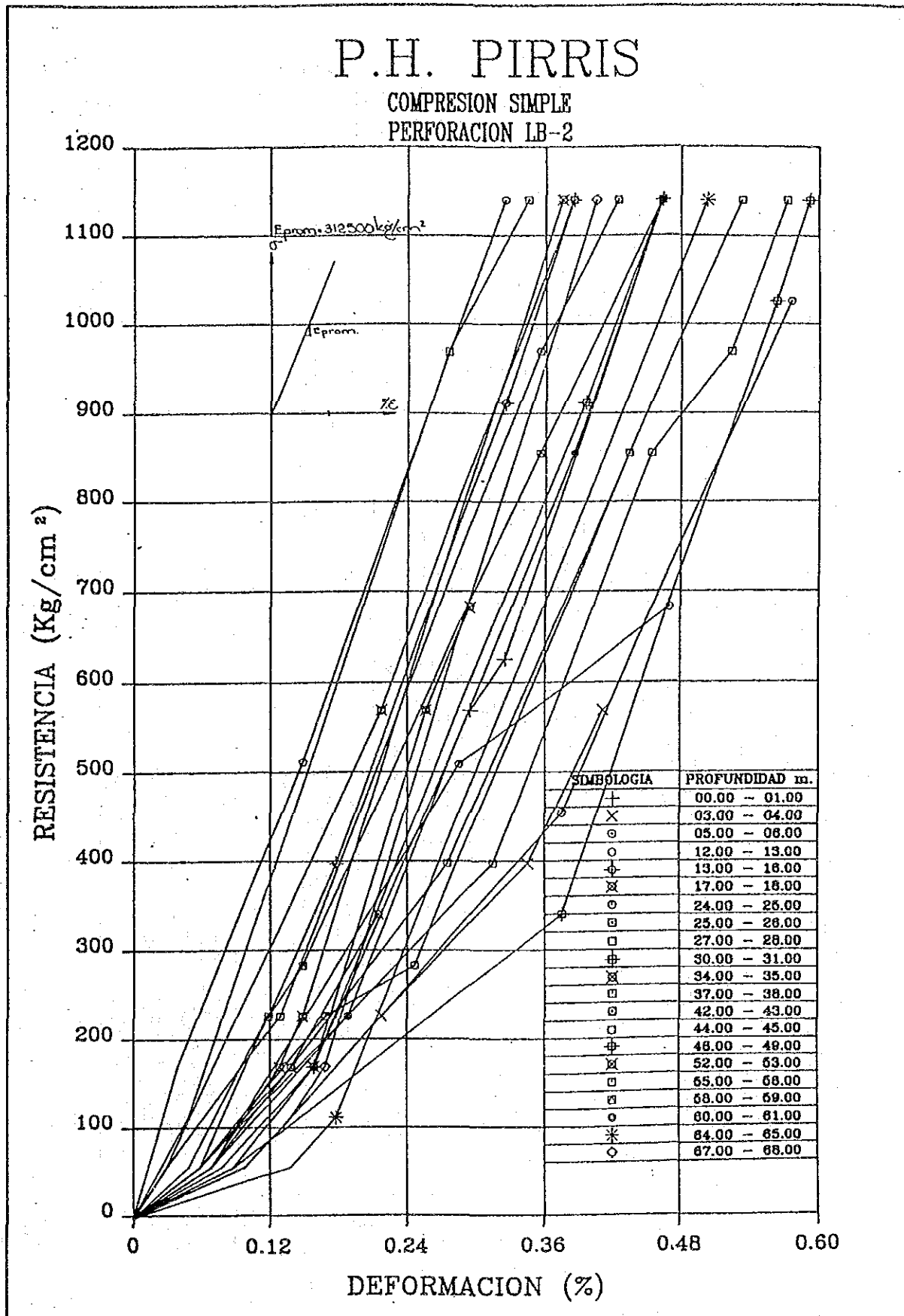


Fig. A-6-2 Strain Curve of Unconfined Compression Strength Tests

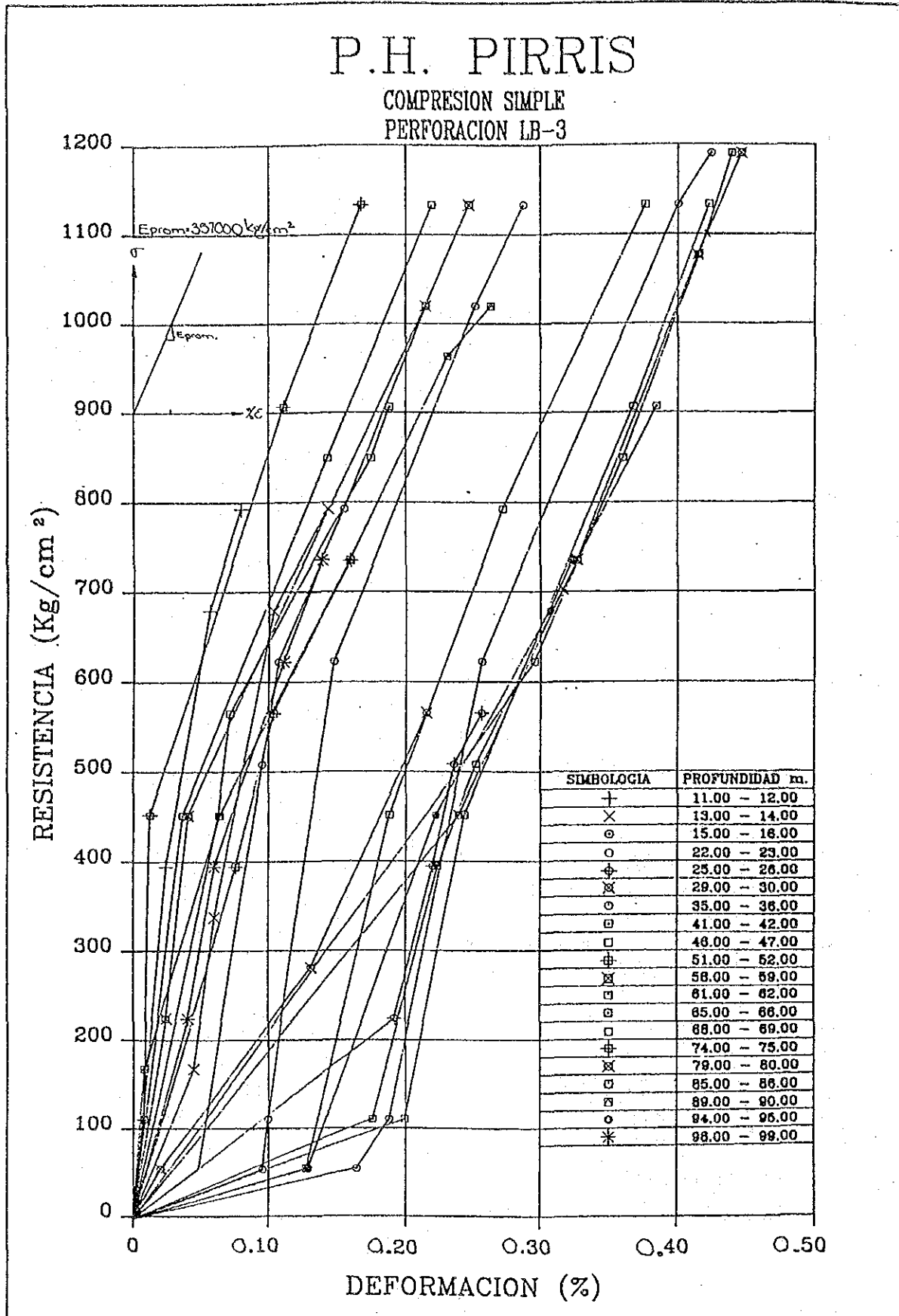


Fig. A-6-2 Strain Curve of Unconfined Compression Strength Tests

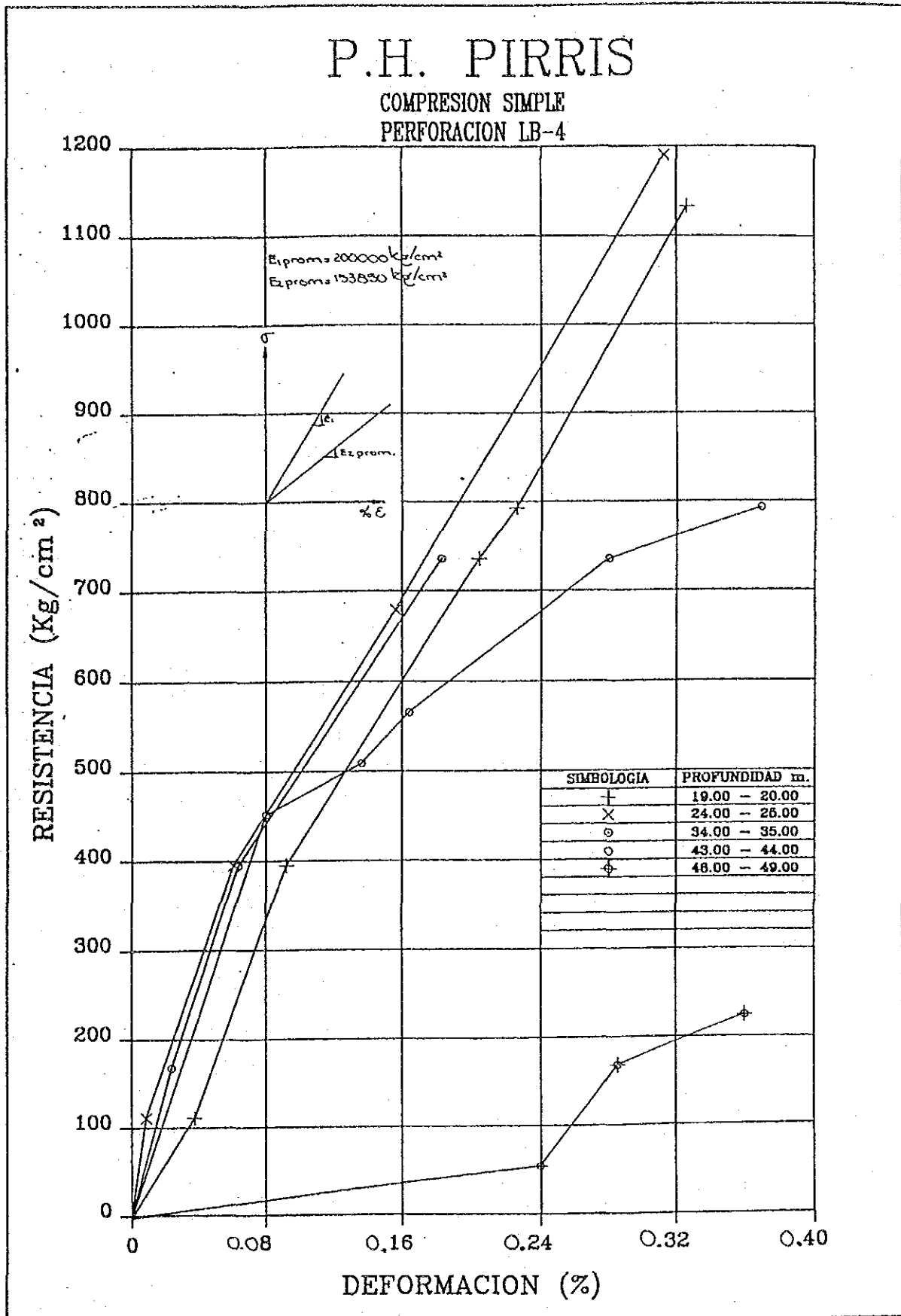
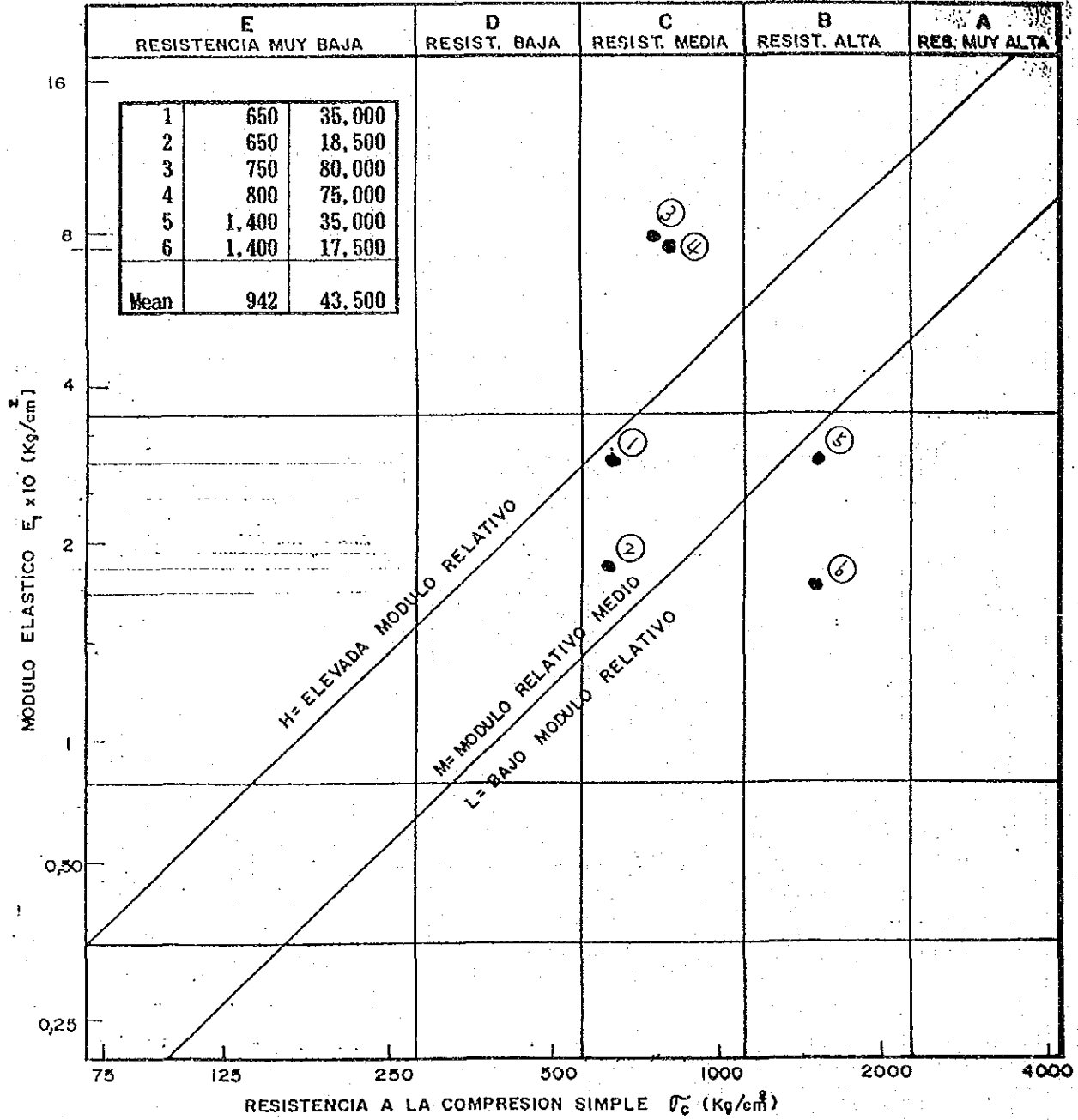


Fig. A-6-3 Compression Strength and Modulus of Elasticity of UB-3 Boring Cores



• Perforación UB-3

CLASIFICACION DE LA ROCA INTACTA
SEGUN DEEAE.

Fig. A-6-4 Location of Borrow Area (CP-1, CP-2, CP-3)

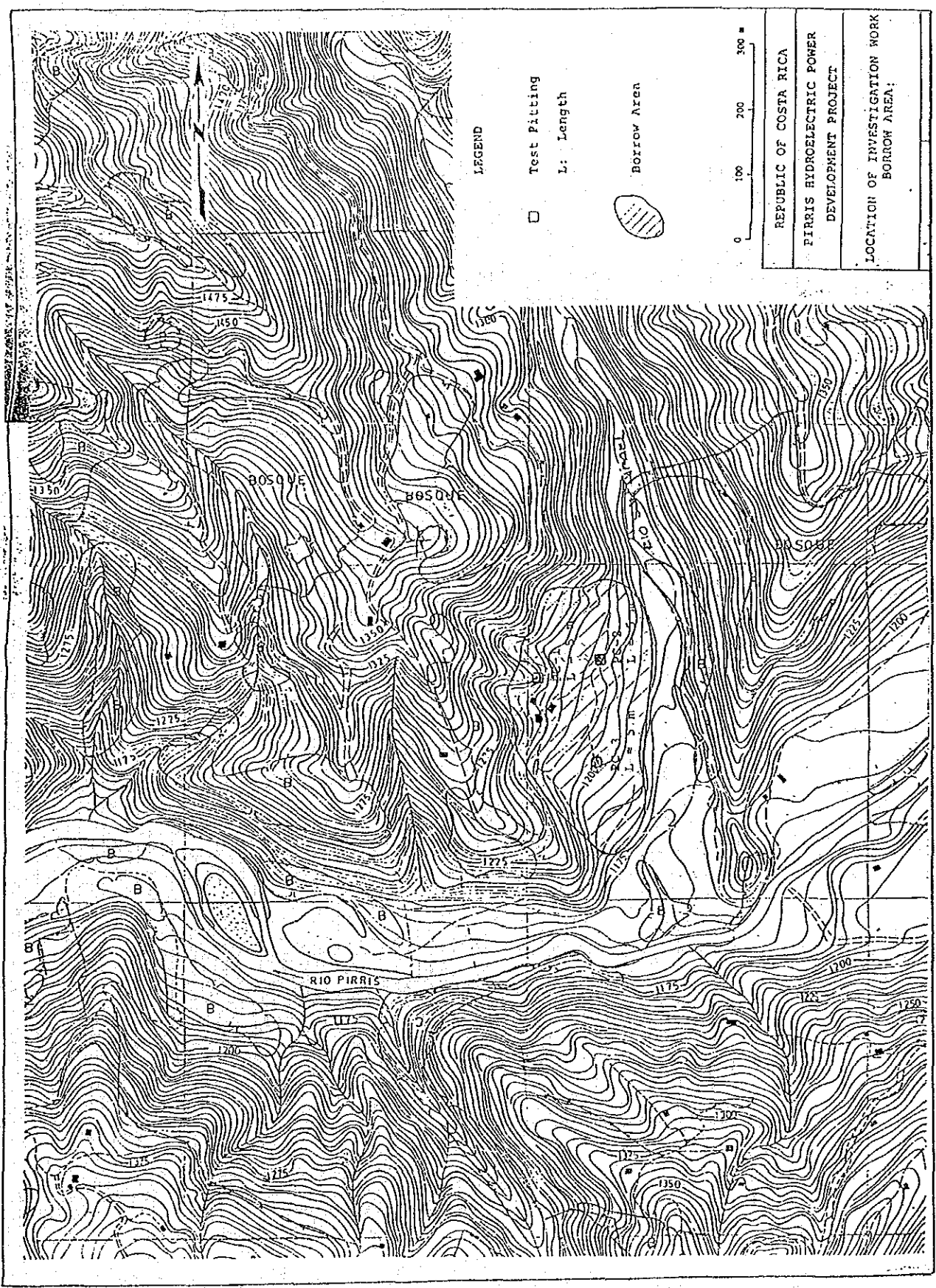


Fig. A-6-5 Grain-size Analysis Test of CP-1

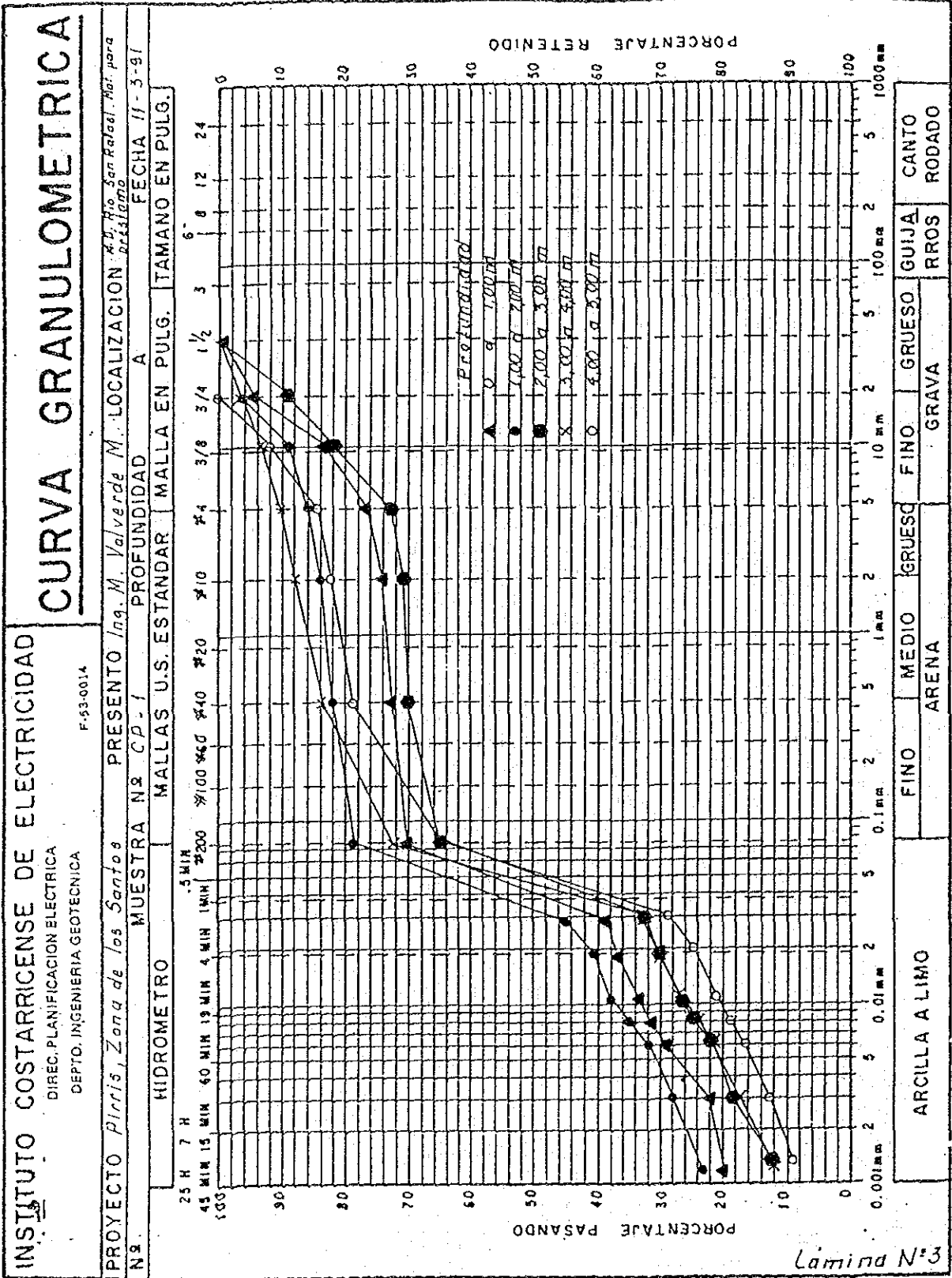


Fig. A-6-6 Plasticity Chart of Liquid Limit, Plasticity Index of CP-1

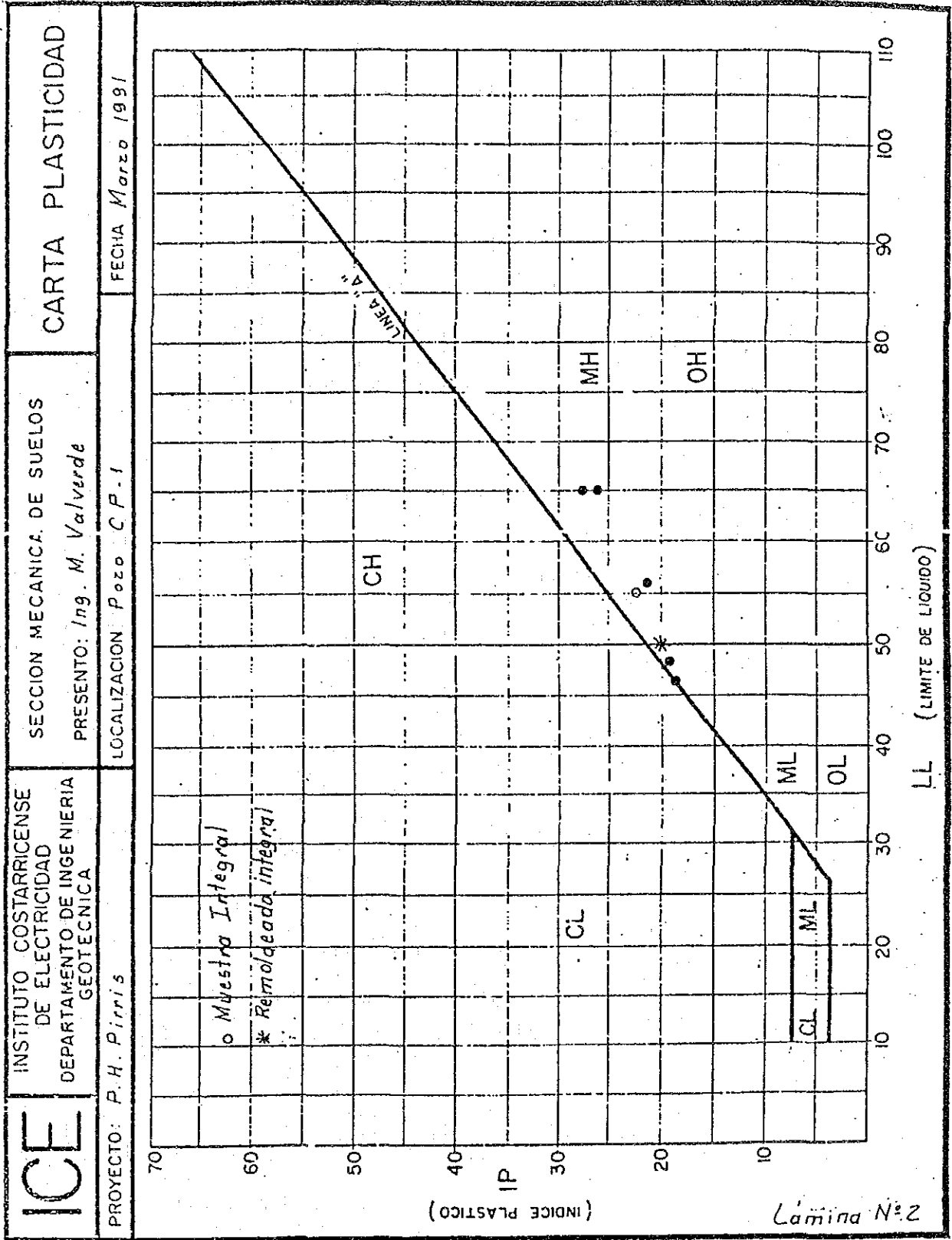


Fig. A-6-7 Grain-size Analysis Test of CP-2

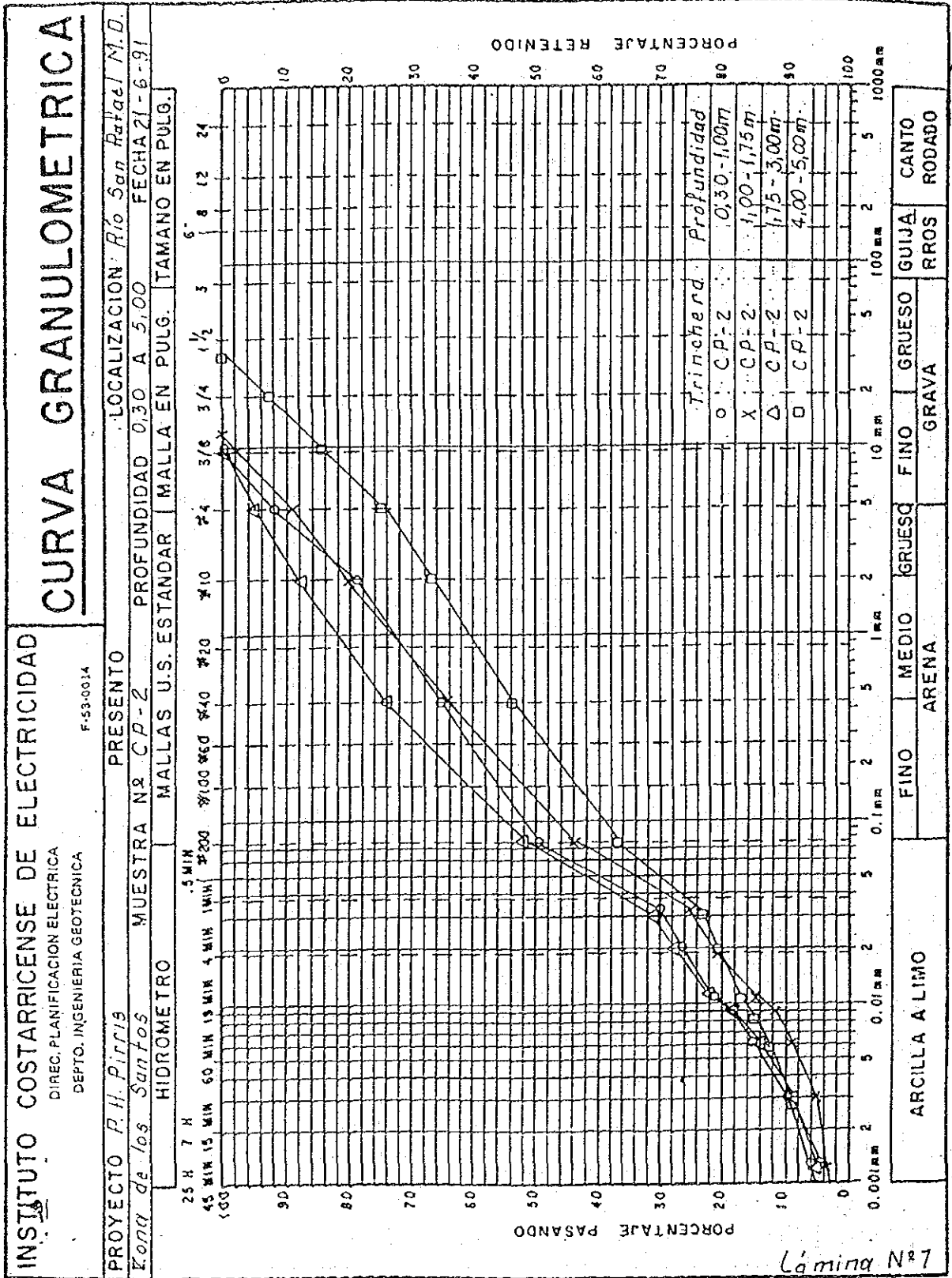


Fig. A-6-8 Plasticity Chart of Liquid Limit, Plasticity Index of CP-2

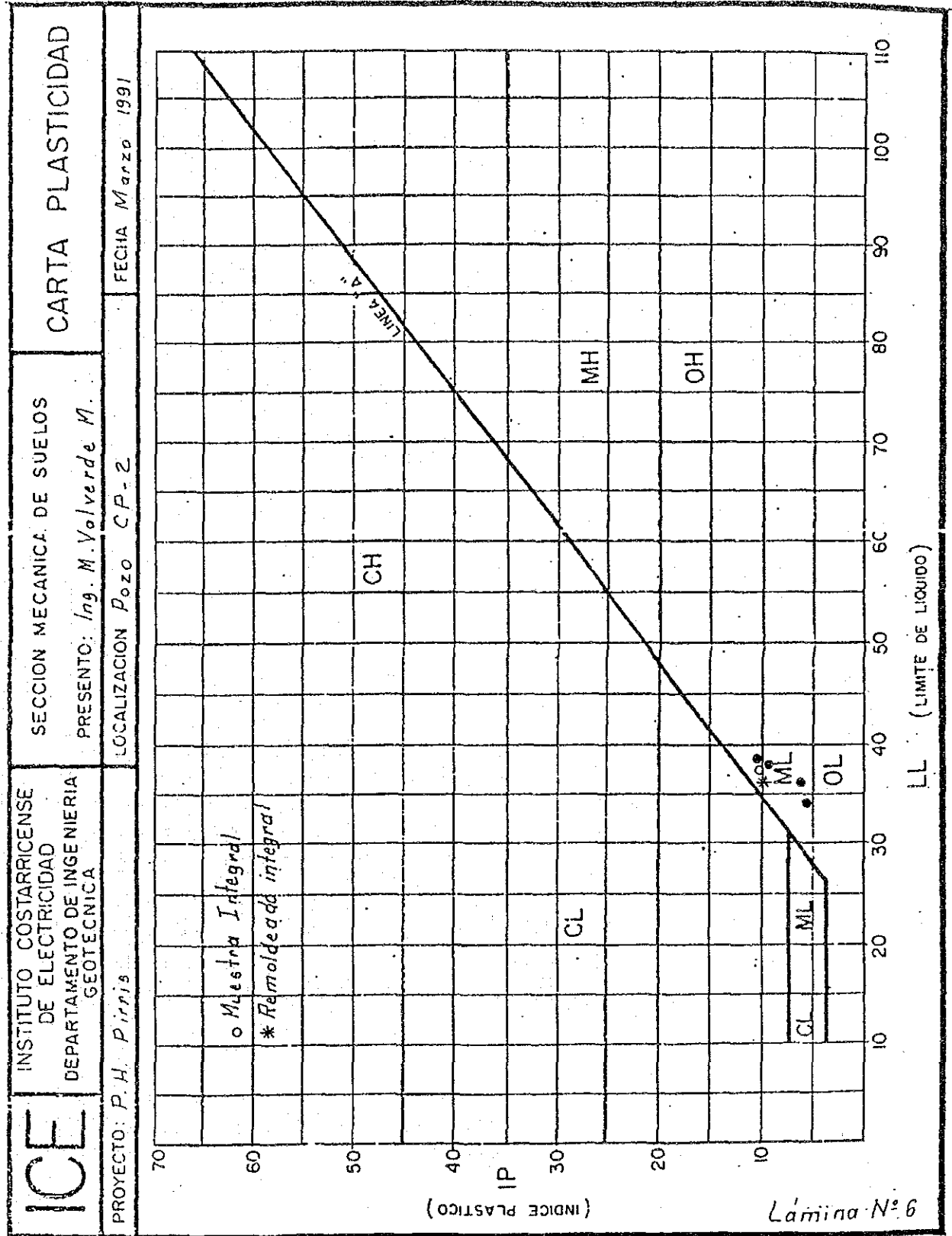


Fig. A-6-9 Grain-size Analysis Test of CP-3

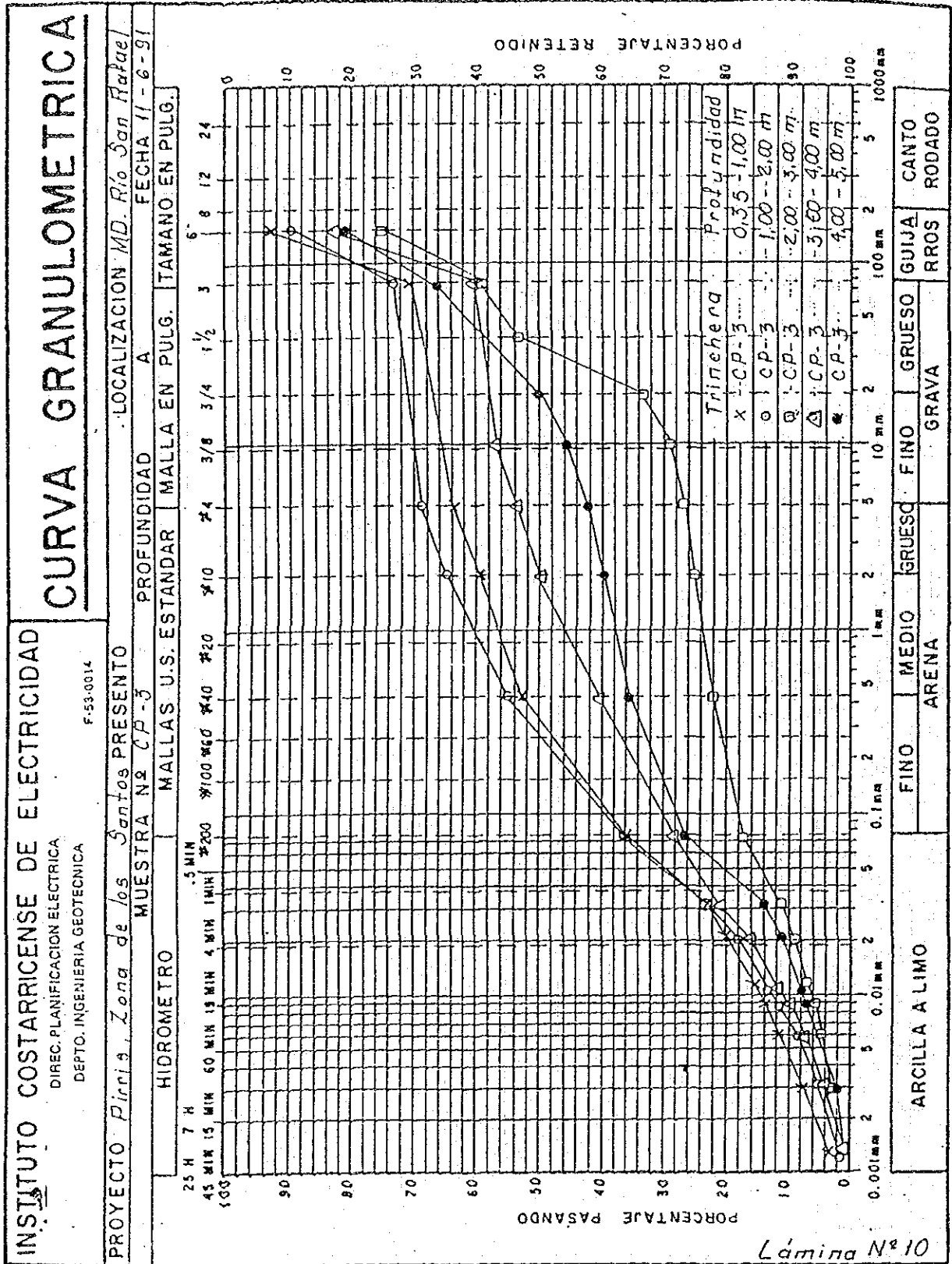


Fig. A-6-10 Plasticity Chart of Liquid Limit, Plasticity Index of CP-3

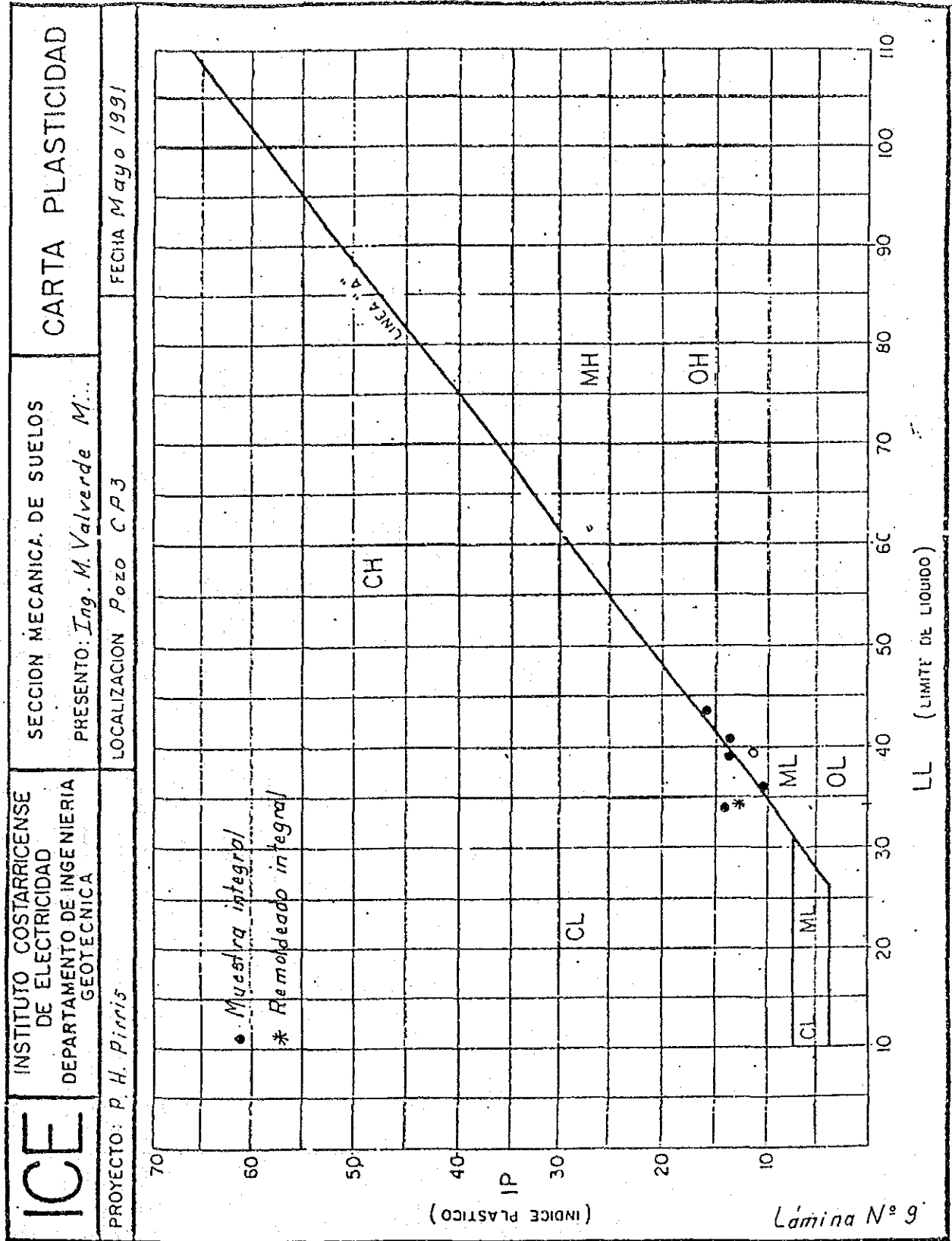


Fig. A-6-11 Compaction Test of CP-1, CP-2, CP-3, CP-M

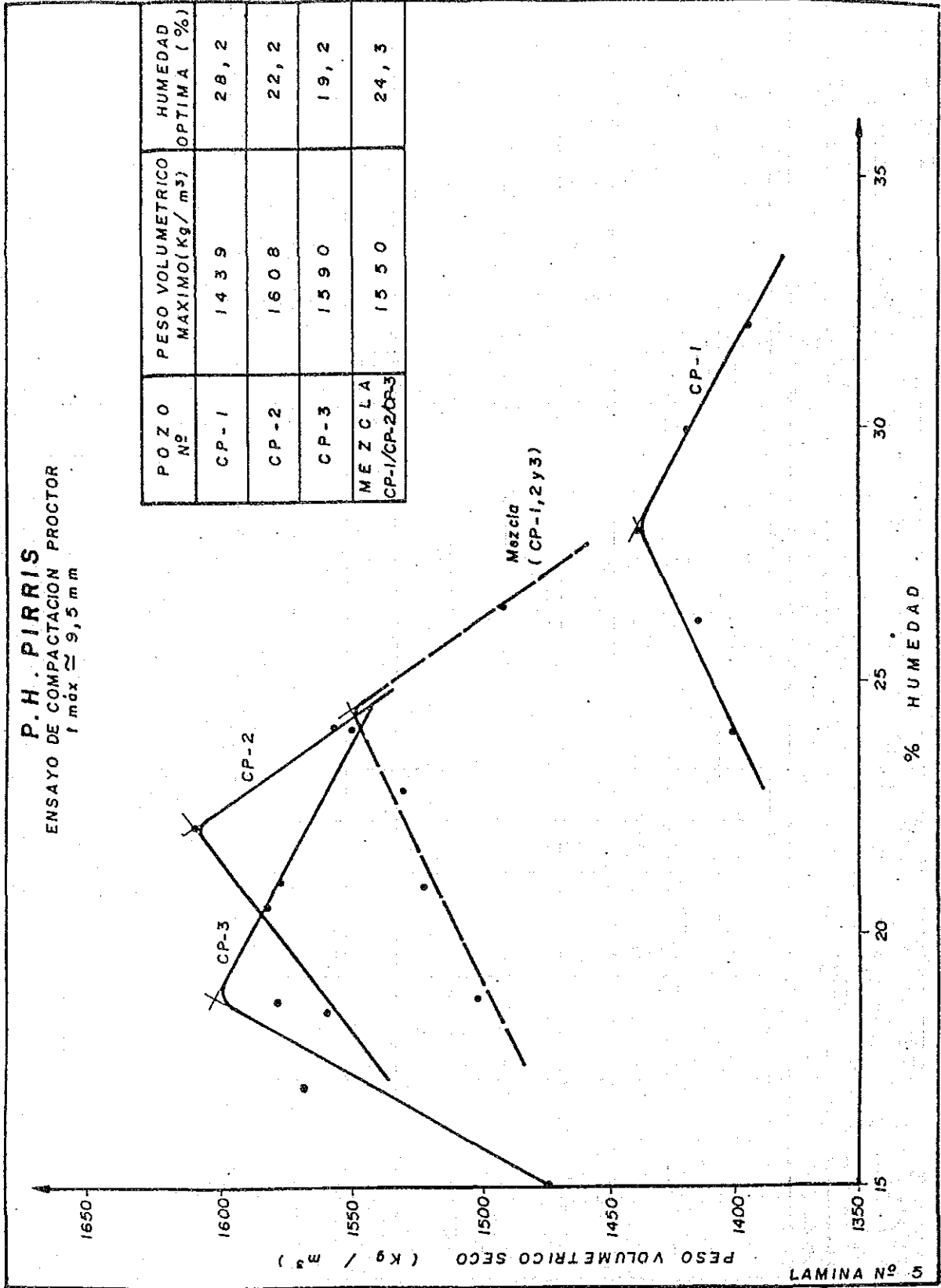
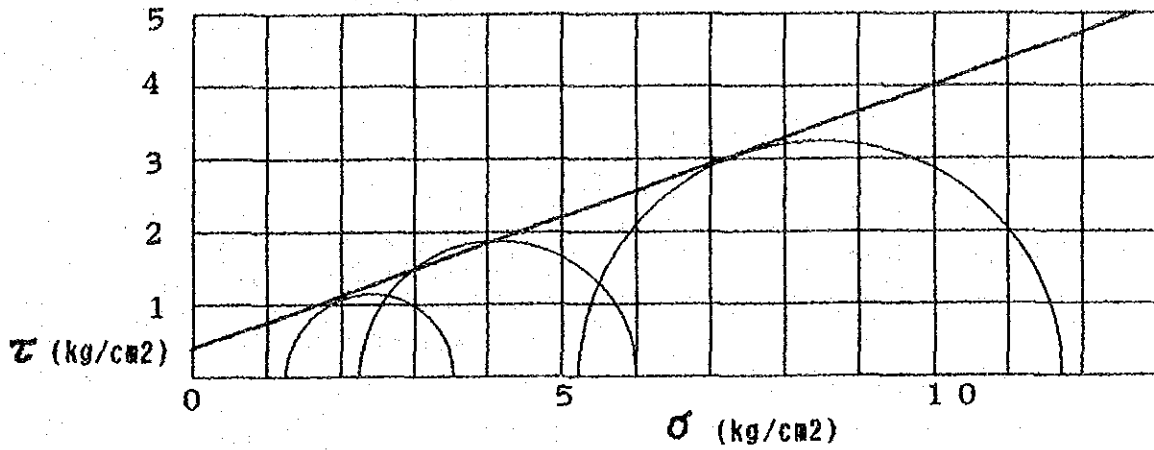
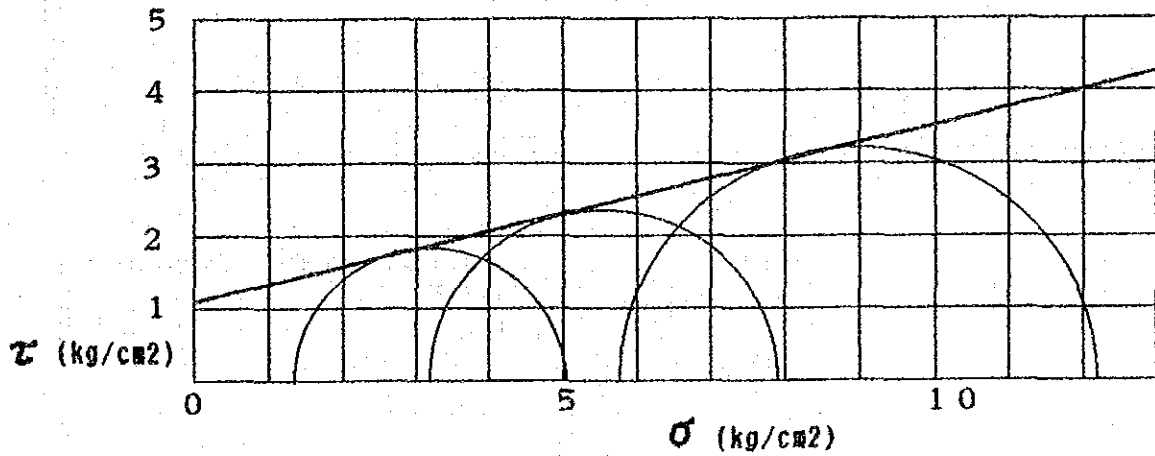


Fig. A-6-12 Mohr Stress Circles of CP-1, CP-2, CP-3

CP-1 $\tau = 0.40 + \sigma n \tan 19^\circ 30'$ $\epsilon = 2\%$



CP-2 $\tau = 1.12 + \sigma n \tan 13^\circ 25'$ $\epsilon = 2\%$



CP-3 $\tau = 1.20 + \sigma n \tan 12^\circ 00'$ $\epsilon = 2\%$

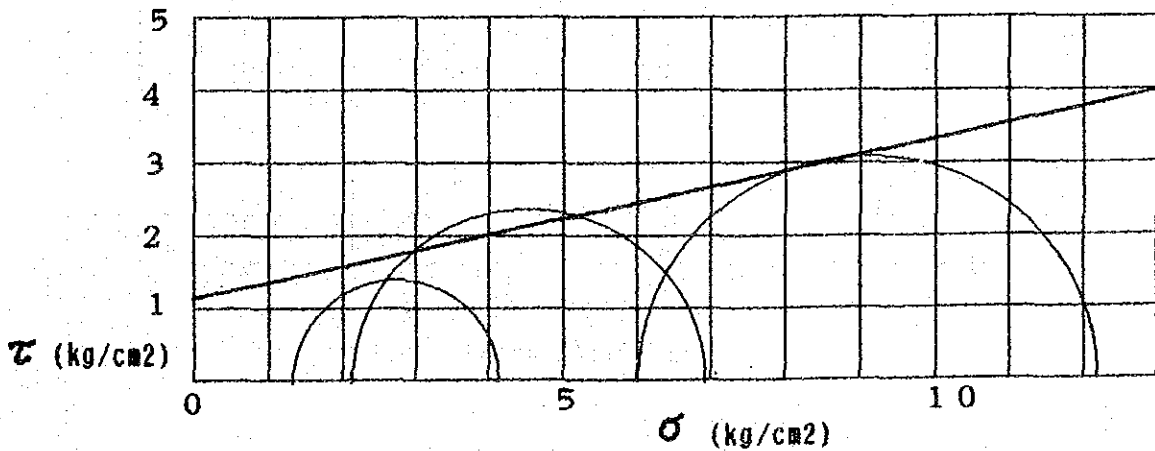


Fig. A-6-13 Strain - Stress History of Triaxial Compression Test of CP-1

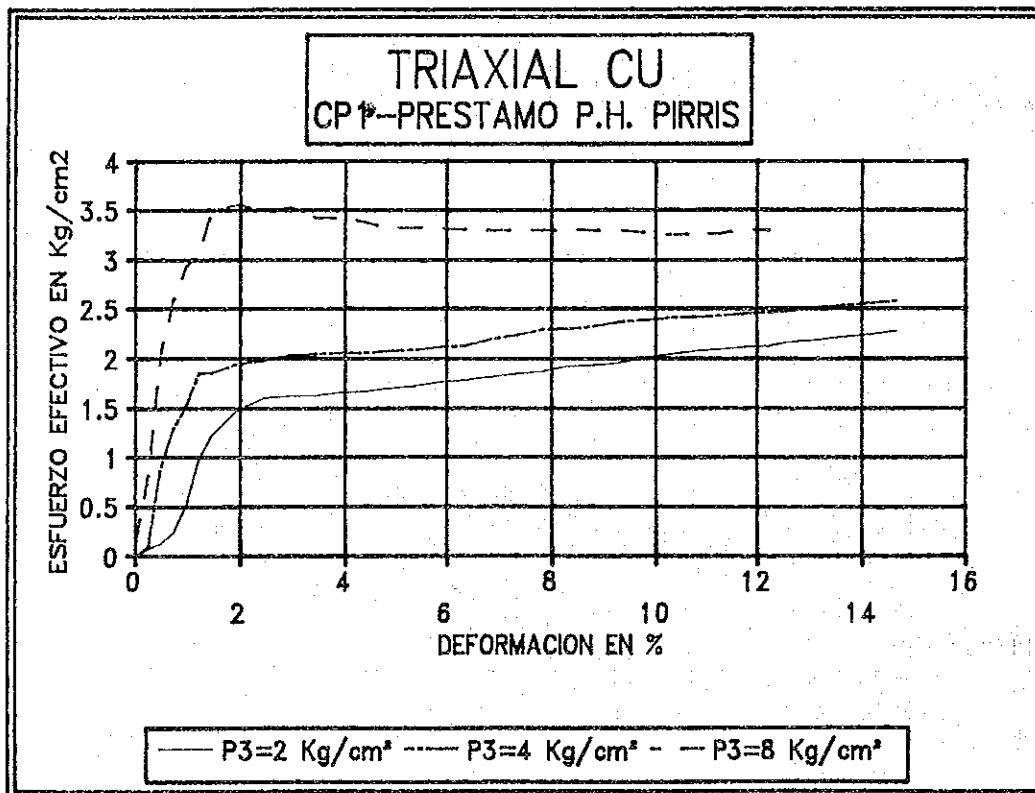
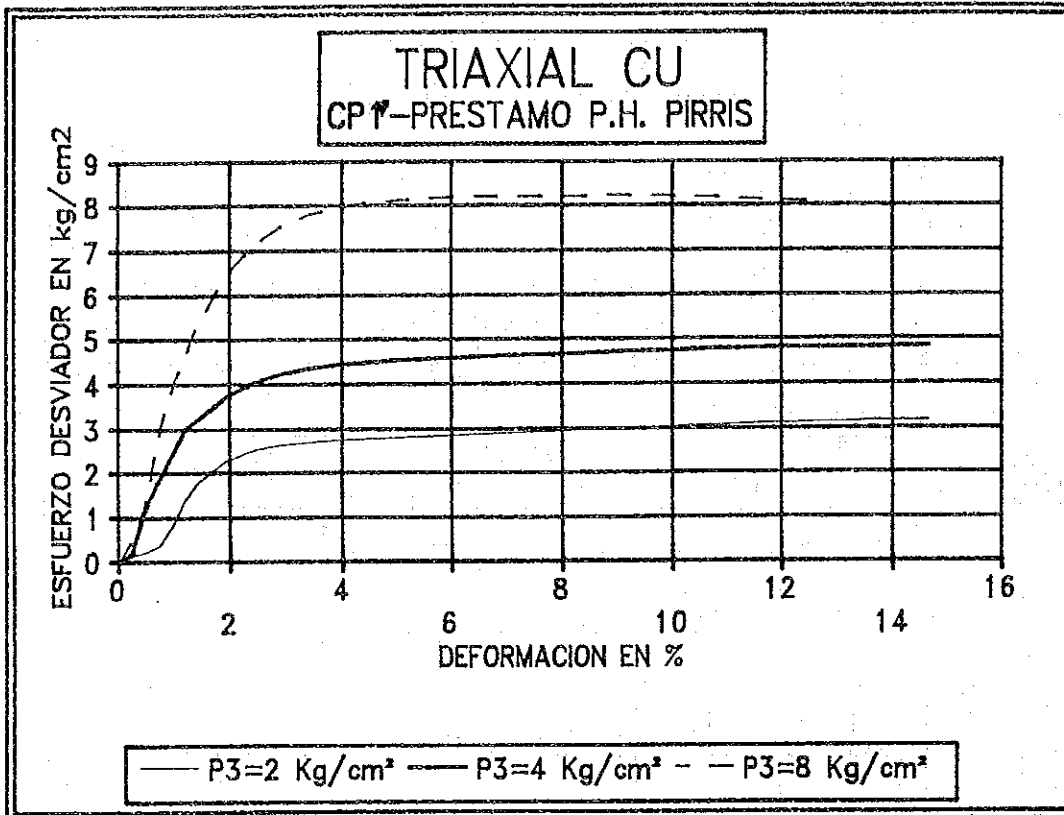


Fig. A-6-14 Strain - Stress History of Triaxial Compression Test of CP-2

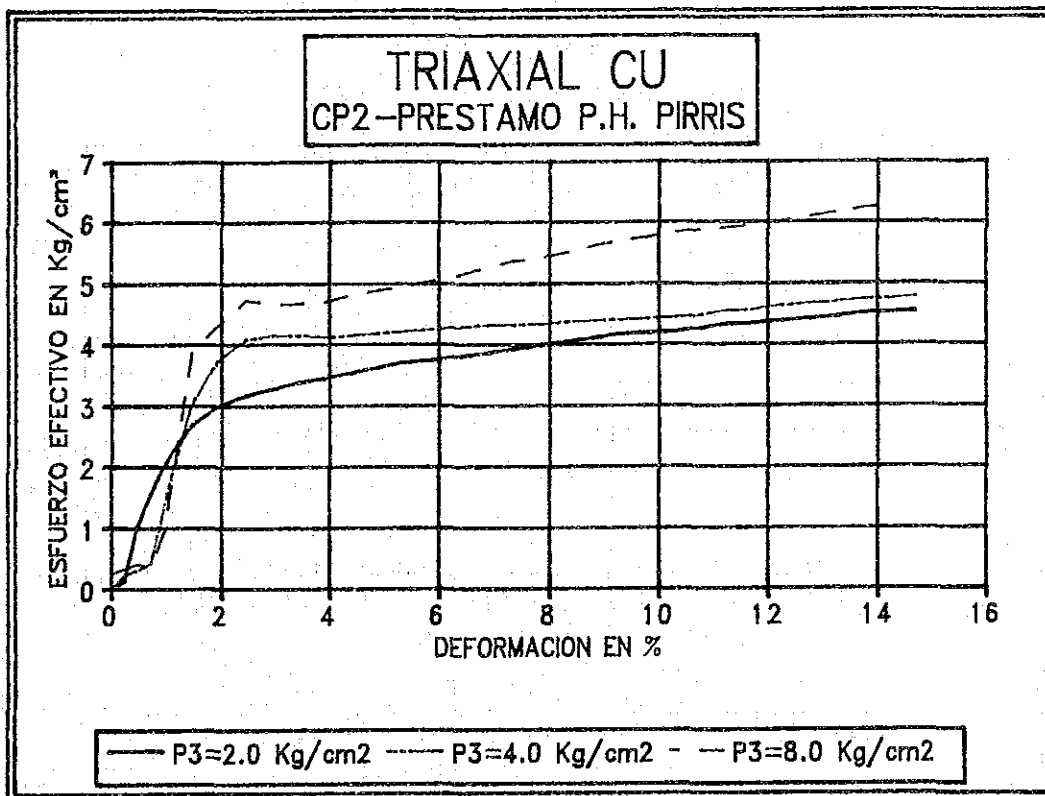
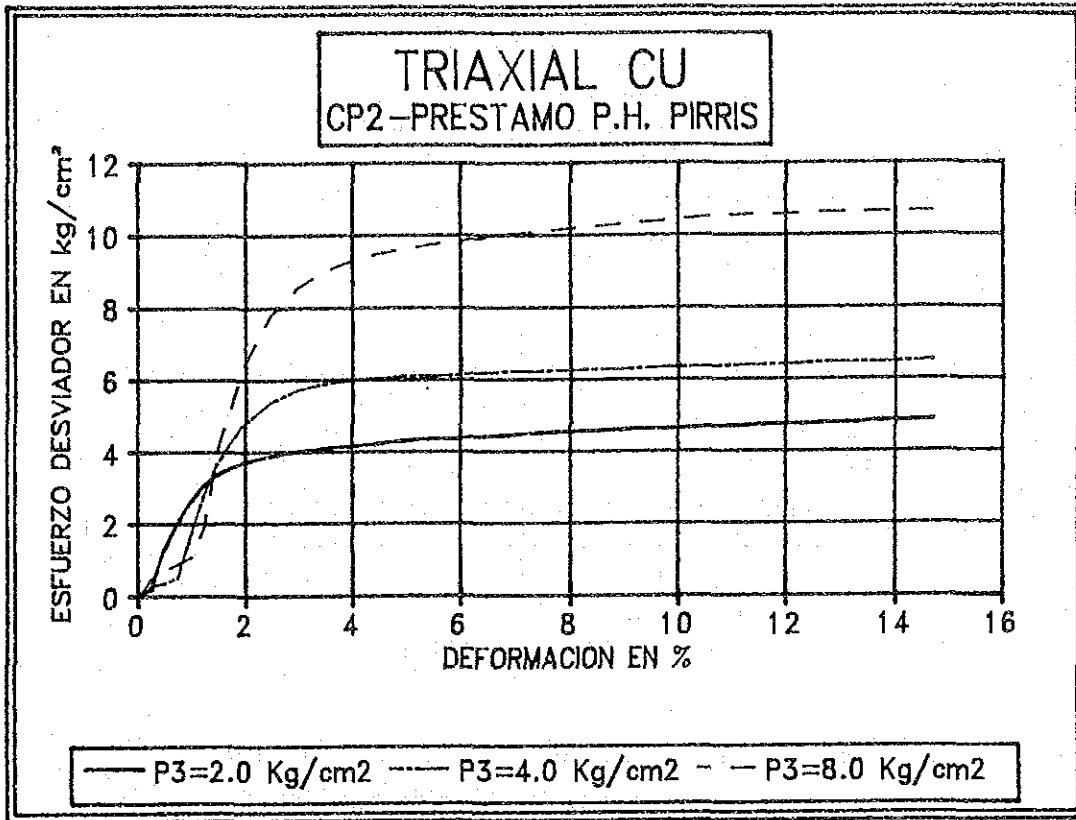


Fig. A-6-15 Strain - Stress History of Triaxial Compression Test of CP-3

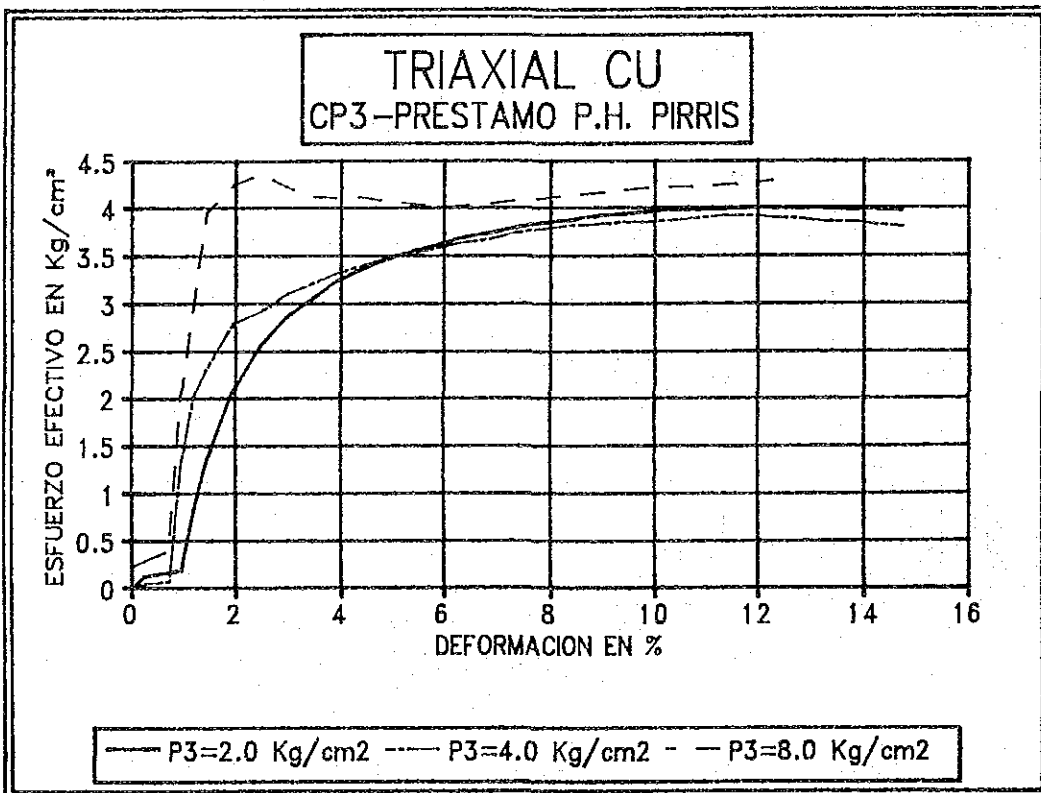
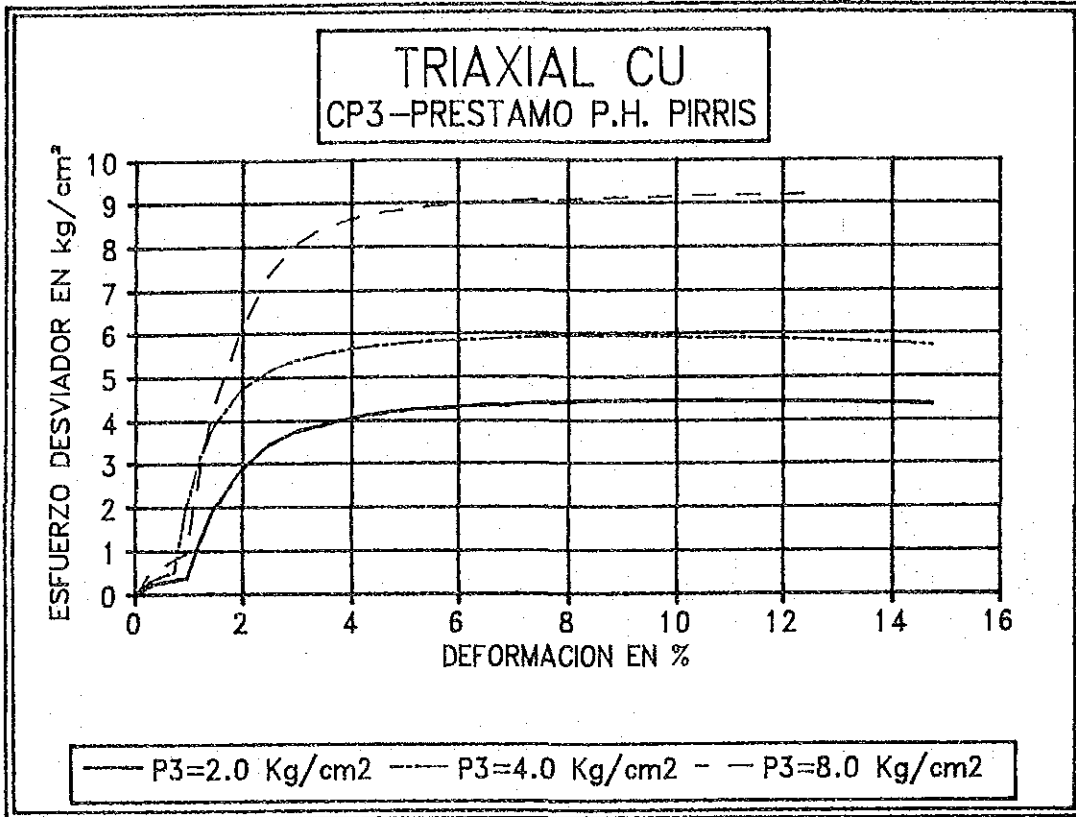


Table A-6-1 Quantity and Sampling Location of Laboratory Tests

Test Item	ASTM	Quantity	Sampling Location
1. Concrete Aggregate			
(1) Specific gravity and absorption	C 127-84	2	Quarry Site (Right Bank of Upstream Dam site) and Right Bank Adit of Downstream Dam site. (LA-2 Adit)
(2) Soundness test	C 128-84 C 88-83	2	
(3) Abrasion Loss Test	C 131-81	2	
(4) Slake Durability Test	D 4644-87	2	
(5) Alkali Aggregate Reaction Tests	C 289-81 C 227-81	2	
(6) Crushing Test	T.S-L.T	2	
2. Laboratory Test of Boring Core			
(1) Specific gravity, absorption Tests	C 127-84 C 128-84	7	UB-1,UB-2,UB-3
(2) Ultrasonic Test	D 2845-83	7	and
(3) Unconfined Compression Test	D 2938-79	7	LB-1, LB-2, LB-3, LB-4
(4) Tensile Test	D 3967-81	7	
3. Rock Materiales			
(1) Specific gravity and absorption	C 127-84 C 128-84	1	Right Bank Adit of Downstream Dam site. (LA-2 Adit)
(2) Unconfined Compression Test	D 2938-79	1	
4. Soil Materiales			
(1) Specific gravity Test	C 127-84 D 854-83	4	CP-1,CP-2,CP-3 and CP-M (Mixture CP-1, -2, -3)
(2) Moisture Test	D 2216-80	4	
(3) Grain-size Analysis Test	D 422-63	4	
(4) Liquid Limit & Plastic Limit Test	D 4318	4	
(5) Compaction Test	D 698-78	4	
(6) Permeability Test	T.S-L.T	4	
(7) Triaxial Compression Test	T.S-L.T	4	

Table A-6-3 Result of Rock and Soil Materials on Laboratory Tests

Sampling Location	Test Item	Specific Gravity		Absorption (%)			Unconfined Compression (kg/cm ²)					Remarks	
		Specific Gravity	Optimum Moisture (Natural) (%)	-0.005 (mm)	-0.074 (mm)	-4.8 (mm)	Liquid Limit (%)	Plasticity Index PI (%)	Compaction (kg/m ³)	Permeability x10 ⁻⁶ (cm/sec)	Triaxial Compression C (kg/cm ²)		Classification of Soils
3. Rock Materials LA-2 Adit (Right bank of Downstream Dam site)			2.88	1.03									
4. Soil Materials	CP-1 (Right bank of Upstreamward)	2.73	28.2 (30.8)	16-31	65-79	73-90	46-65	19-27	1,439	0.095	0.40	19° 30'	MH
	CP-2 (' of ')	2.68	22.2 (23.5)	8-14	37-52	75-95	34-38	6-11	1,608	0.340	1.12	13° 25'	SM
	CP-3 (' of ')	2.68	19.2 (23.0)	4-11	17-36	27-69	34-38	6-11	1,590	-----	1.20	12° 00'	SM
	CP-W (' of ')	---	24.3 (-----)	---	---	---	---	---	1,550	---	---	---	---

Table A-6-4 Specific Gravity, Absorption and Crushing Tests of Quarry Site

Este ensayo se realizó bajo el procedimiento de la norma ASTM C127-88 y C128-88, y fue ejecutado para 8 tamaños por separado según el siguiente cuadro:

	TAMAÑO MUESTRA					
MALLA	2-1 1/2	1 1/2-1	1-3/4	3/4-5/8	5/8-3/8	3/8-4
DIAMETRO	51-38	38-25	25-19	19-16	16-9	9-5
Gb (*)	2.27	2.65	2.60	2.56	2.51	2.44
Abs %	4.9	1.7	2.5	5.0	3.4	4.9

(*) Gravedad específica bruta seca.

ENSAYO DE QUEBRADO

Para este ensayo se utilizò el quebrador del laboratorio de muelas, el cual tiene una abertura máxima de 80 mm y se le fijò su abertura mínima en 25 mm.

Seguidamente se escogió una muestra de 40 kg de material entre 60 y 120 mm de tamaño y se procedió a quebrarla en su estado natural. La granulometría resultante fue la siguiente:

MALLA	1 1/2	1	3/4	5/8	3/8	4	8	16	30	50	100	200
DIAMETRO	38	25	19	16	9	5	2	1.2	0.6	0.3	0.15	0.079
% Pas.	93	59	36	29	19	11	10	7	5	3	2	1

Utilizando este mismo material se realizó un segundo quebrado resultando la siguiente granulometría:

MALLA	1 1/2	1	3/4	5/8	3/8	4	8	16	30	50	100	200
DIAMETRO	38	25	19	16	9	5	2	1.2	0.6	0.3	0.15	0.079
% Pas.	-	-	-	99	95	45	22	20	14	10	6	2

Con el propósito de cuantificar la forma geométrica del producto quebrado se listan a continuación por tamaño 30 determinaciones de tamaño.

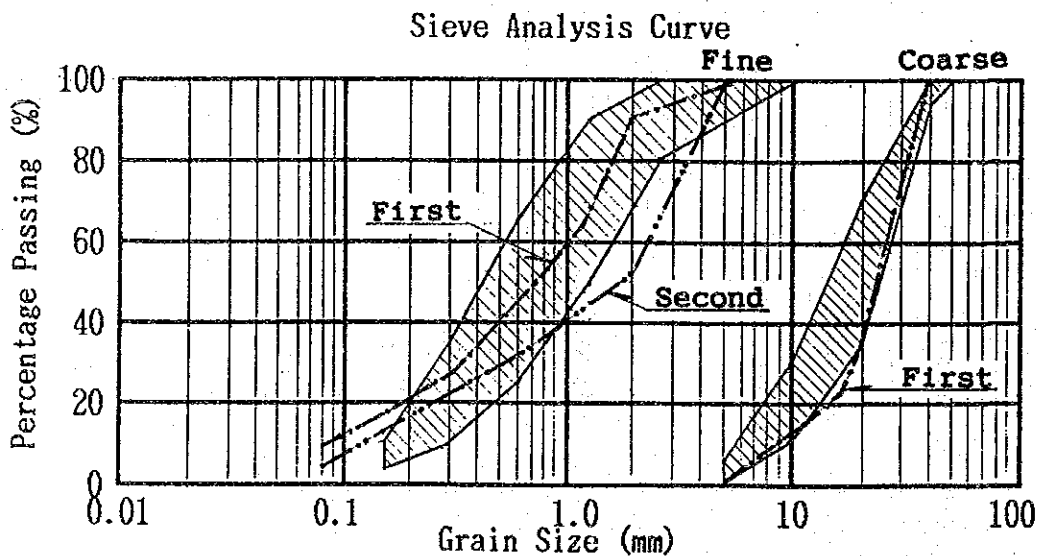


Table A-6-5 Specific, Absorption, Ultrasonic, Modulus of Elasticity and Compression Strength

Tests of Boring Cores

PERFORACION UB - 1

MUEST #	PROF m.	LONG (mm)	DIAM. (mm)	γ_d (kg/m ³)	Q_u (kg/cm ²)	G_s (bruta)	Abs (%)	V_p (km/seg)	V_s (km/seg)	μ	MED (T/cm ²)	GD (T/cm ²)
1	7-8	124.9	47.3	2703.8	1081.3	2.60	0.47	4.53	3.02	0.10	497.5	251.3
2	9-10	124.8	47.4	2693.6	821.7	2.71	0.46	4.67	3.09	0.11	518.3	262.4
3	17-18	125	47.4	2721.1	552.5	2.73	0.63	5.53	3.25	0.24	532.8	292.9
4	18-19	124.8	47.4	2700.0	538.4	2.72	0.61	5.29	3.01	0.26	467.3	250.5
5	21-22	125	47.4	2689.8	665.9	2.70	0.42	5.17	3.11	0.22	506.3	265.5
6	23-24	125	47.4	2720.2	835.9	2.74	0.72	4.88	3.26	0.10	532.7	294.3
7	25-26	125	47.4	2737.4	850.1	2.75	0.20	5.43	3.09	0.26	498.9	267.6
8	28-29	125	47.4	2718.3	1164.6	2.73	0.55	5.39	3.08	0.26	491.3	263.1
9	32-33	115.3	47.4	2696.4	855.7	2.71	0.24	4.43	2.59	0.24	346.3	194.0
10	34-35	125	47.4	2693.0	850.1	2.71	0.35	5.53	2.84	0.32	398.1	221.9
11	35-36	125	47.4	2684.8	1388.4	2.70	0.89	5.53	2.89	0.31	414.4	229.5
12	37-38	124.3	47.4	2714.5	793.4	2.73	0.55	5.36	2.76	0.32	379.9	211.5
13	39-40	125	47.4	2699.8	844.4	2.72	0.39	5.39	2.95	0.29	439.9	239.6
14	41-42	122.4	47.4	2690.0	566.7	2.70	0.24	5.67	3.01	0.30	453.5	249.6
15	42-43	124.8	47.4	2670.0	283.4	2.68	0.70	5.43	3.03	0.27	462.8	250.1
16	45-46	125	47.4	2694.8	453.4	2.71	0.42	5.53	2.95	0.30	434.8	239.1
17	48-49	124.1	47.4	2686.5	736.7	2.70	0.63	5.44	3.17	0.24	517.0	274.9

PERFORACION UB - 2

MUEST #	PROF m.	LONG (mm)	DIAM. (mm)	γ_d (kg/m ³)	Q_u (kg/cm ²)	G_s (bruta)	Abs (%)	V_p (km/seg)	V_s (km/seg)	μ	MED (T/cm ²)	GD (T/cm ²)
1	3-4	121.0	47.2	2705.5	857.3	2.70	1.15	5.31	2.87	0.29	415.0	227.1
2	8-9	121.0	47.2	2717.3	685.8	2.71	0.68	5.35	2.92	0.29	434.7	237.0
3	10-11	120.8	47.2	2706.2	743.0	2.69	0.51	5.44	2.96	0.29	443.8	242.2
4	12-13	121.0	47.2	2719.6	400.1	2.72	0.36	5.17	2.94	0.26	446.2	239.5
5	16-17	120.9	47.2	2703.9	971.6	2.70	1.22	5.35	2.98	0.28	452.4	244.8
6	20-21	121.0	47.2	2712.6	628.7	2.71	0.52	5.40	2.92	0.29	432.5	236.6
7	22-23	108.5	47.2	2707.4	685.8	2.69	0.62	4.89	2.61	0.30	342.0	189.0
8	28-29	120.9	47.2	2721.9	914.4	2.71	0.83	5.35	2.98	0.28	455.5	246.4
9	31-32	120.9	47.2	2694.5	571.5	2.71	0.98	5.26	3.01	0.26	464.9	248.8
10	37-38	120.8	47.2	2702.9	857.3	2.71	0.72	5.44	2.92	0.30	428.1	235.0
11	40-41	121.0	47.2	2673.8	342.9	2.68	0.64	5.45	2.91	0.30	420.1	231.0
12	43-44	120.1	47.2	2726.7	800.1	2.71	0.77	5.18	2.92	0.27	439.2	236.6
13	46-47	120.5	47.2	2706.3	571.5	2.71	0.70	5.29	2.95	0.27	446.1	241.0
14	49-50	120.8	47.2	2696.7	685.8	2.70	0.93	5.49	2.98	0.29	445.9	243.7

γ_d = Peso Volumetrico seco.
 Q_u = Resistencia.
 G_s = Gravedad Especifica.
 Abs = Absorción.
 V_p = Velocidad de Onda.
 V_s = Velocidad de Onda.
 MED = Módulo Elástico Dinámico.
 GD = Módulo de Cizalle.
 μ = Relación de Poisson.

Table A-6-5 Specific, Absorption, Ultrasonic, Modulus of Elasticity and Compression Strength

Tests of Boring Cores

PERFORACION LB - 1

MUEST #	PROF m.	LONG (mm)	DIAM. (mm)	γ_d (kg/m ³)	Q_u (kg/cm ²)	G_s (bruta)	Abs (%)	V_p (km/seg)	V_s (km/seg)	μ	MED (T/cm ²)	GD (T/cm ²)
1	1-2	120.6	47.2	2881.7	1028.7	2.88	0.49	5.69	3.17	0.27	548.2	296.4
2	4-5	120.7	47.2	2884.1	971.6	2.90	0.30	4.99	3.08	0.19	537.7	279.2
3	9-10	120.6	47.2	2866.1	685.8	2.89	2.12	4.98	2.90	0.24	462.5	245.9
4	11-12	120.6	47.2	2932.4	714.4	2.93	0.76	4.98	2.96	0.23	495.8	261.6
5	12-13	120.6	47.2	2868.5	1257.3	2.87	1.72	5.74	3.05	0.30	492.9	271.6
6	13-14	120.9	47.2	2867.5	1143.0	2.88	0.54	5.65	3.18	0.27	550.2	296.4
7	17-18	120.9	47.2	2866.1	1143.0	2.88	1.19	5.26	2.95	0.27	471.7	254.4
8	21-22	120.8	47.2	3022.7	800.1	2.97	0.64	5.54	3.13	0.27	561.8	302.3
9	32-33	120.8	47.2	2834.4	743.0	2.84	0.53	5.30	2.76	0.31	396.8	220.1
10	37-38	120.9	47.2	2855.9	571.5	2.90	0.74	5.60	2.92	0.31	453.3	251.3
11	39-40	120.9	47.2	2853.8	914.4	2.87	0.68	5.30	2.89	0.29	447.0	243.8
12	43-44	120.9	47.2	2607.5	285.8	2.63	2.88	4.23	2.86	0.06	434.6	218.5
13	52-53	121.0	47.2	2842.9	914.4	2.86	1.38	5.55	3.06	0.28	498.7	271.0
14	55-56	121.0	47.2	2862.3	1200.2	2.87	2.97	5.99	3.07	0.32	494.2	275.6
15	61-62	120.8	47.2	2881.2	685.8	2.89	0.10	5.44	3.00	0.28	489.4	265.6
16	63-64	120.8	47.2	2743.5	1065.9	2.75	3.04	5.21	2.82	0.29	408.2	223.1
17	65-66	120.9	47.2	2885.5	743.0	2.91	2.42	5.35	2.98	0.28	482.8	261.2
18	68-69	120.5	47.2	2871.8	514.4	2.89	0.05	5.63	3.01	0.30	484.4	266.1

PERFORACION LB - 2

MUEST #	PROF m.	LONG (mm)	DIAM. (mm)	γ_d (kg/m ³)	Q_u (kg/cm ²)	G_s (bruta)	Abs (%)	V_p (km/seg)	V_s (km/seg)	μ	MED (T/cm ²)	GD (T/cm ²)
1	0-2	119.7	47.2	2902.4	1143.0	2.88	0.97	5.25	2.80	0.30	421.3	231.8
2	3-4	120.0	47.2	2940.4	571.5	2.92	0.40	5.66	3.11	0.28	533.5	290.2
3	5-6	120.0	47.2	2932.8	1257.3	2.92	0.42	5.31	3.06	0.25	525.8	280.6
4	12-13	116.8	47.2	2975.0	1257.3	2.89	0.41	5.31	3.04	0.26	525.3	281.0
5	13-16	119.3	47.2	2848.5	1257.3	2.89	0.24	5.97	2.97	0.34	454.6	256.1
6	17-18	119.6	47.2	2873.8	342.9	2.89	1.46	4.56	2.89	0.17	476.3	244.9
8	24-25	119.6	47.2	2865.7	685.8	2.86	1.18	5.54	2.87	0.32	435.6	241.8
9	25-26	120.0	47.2	2886.1	1257.3	2.88	0.86	5.71	2.94	0.32	457.7	254.9
10	27-28	120.0	47.2	2929.0	1257.3	2.91	0.46	5.88	3.06	0.31	505.1	280.2
11	30-31	120.0	47.2	2881.4	1257.3	2.87	1.02	5.77	3.02	0.31	482.8	267.4
12	34-35	119.9	47.2	2920.5	914.4	2.90	0.08	5.40	2.97	0.28	483.0	262.6
13	37-38	120.0	47.2	2908.0	1257.3	2.90	0.69	5.71	2.96	0.32	466.5	259.4
14	42-43	120.0	47.2	2901.9	1257.3	2.91	0.74	5.56	2.91	0.31	454.2	251.3
15	44-45	120.3	47.2	2875.1	1257.3	2.89	0.56	5.84	2.99	0.32	468.5	261.6
16	48-49	120.2	47.2	2870.9	1257.3	2.88	0.65	5.51	3.11	0.27	528.3	284.2
17	52-53	120.3	47.2	2896.0	685.8	2.90	0.28	5.42	2.96	0.29	476.5	259.6
18	55-56	120.5	47.2	2912.1	914.4	2.92	0.52	5.58	3.11	0.28	530.0	286.8
19	58-59	120.5	47.2	2925.9	1257.3	2.93	0.24	5.79	3.07	0.30	512.4	282.3
20	60-61	120.4	47.2	2888.9	1257.3	2.89	0.26	5.56	2.97	0.30	471.7	259.4
21	64-65	120.7	47.2	2930.0	1257.3	2.93	0.29	5.92	2.93	0.34	453.0	256.8
22	67-68	120.6	47.2	2932.8	1257.3	2.93	0.43	5.64	3.02	0.30	498.9	274.1

γ_d = Peso Volumetrico.
 Q_u = Resistencia.
 G_s = Gravedad Especifica.
 Abs = Absorción.
 V_p = Velocidad de Onda.
 V_s = Velocidad de Onda.
 MED = Módulo Elástico Dinámico.
 GD = Módulo de Cisalle.
 μ = Relación de Poisson.

Table A-6-5 Specific, Absorption, Ultrasonic, Modulus of Elasticity and Compression Strength

Tests of Borling Cores

PERFORACION LB-3

MUEST #	PROF m.	LONG (mm)	DIAM. (mm)	γ_d (kg/m ³)	σ_u (kg/cm ²)	G_s (bruta)	Abs (%)	V_p (km/seg)	V_s (km/seg)	μ	MED (T/cm ²)	GD (T/cm ²)
1	11-12	123.3	47.4	2911.2	850.1	2.92	0.32	5.82	2.94	0.33	456.9	256.2
2	13-14	123.3	47.4	2814.2	793.4	2.82	1.00	—	—	—	—	—
4	15-16	123.2	47.4	2779.2	1190.1	2.80	1.89	5.40	2.91	0.30	437.3	239.6
5	22-23	123.5	47.4	2867.9	1246.7	2.89	0.03	5.56	3.07	0.28	509.2	276.4
7	25-26	123.2	47.4	2800.4	566.7	2.81	1.08	—	—	—	—	—
9	29-30	123.6	47.4	2857.8	566.7	2.88	0.34	4.79	2.99	0.18	502.8	260.1
12	35-36	123.7	47.4	2842.2	1020.1	2.85	1.00	5.38	3.16	0.24	545.3	289.0
14	41-42	110	47.4	2823.2	906.7	2.84	1.09	—	—	—	—	—
15	46-47	123.6	47.4	2812.4	1586.8	2.83	1.34	5.28	2.78	0.31	402.9	222.5
18	51-52	123.4	47.4	2827.5	736.7	2.85	0.11	5.51	3.21	0.24	561.3	298.1
19	58-59	123.9	47.4	2849.5	1360.1	2.88	0.35	—	—	—	—	—
20	61-62	123.3	47.4	2868.9	1303.4	2.89	0.42	5.41	3.19	0.23	565.6	298.9
22	65-66	123.3	47.4	2875.3	906.7	2.90	0.38	—	—	—	—	—
23	68-69	123.6	47.4	2879.8	1360.1	2.90	0.30	5.78	2.99	0.32	471.2	262.1
25	74-75	123.8	47.4	2915.9	1473.4	2.93	0.24	—	—	—	—	—
27	79-80	123.7	47.4	2862.4	1416.8	2.89	0.14	5.52	2.92	0.31	450.8	248.7
30	85-86	123.4	47.4	2891.4	1530.1	2.93	0.19	—	—	—	—	—
31	89-90	123.7	47.4	2904.1	1020.1	2.94	0.49	5.95	3.14	0.31	529.5	292.3
33	94-95	122.1	47.4	2888.3	736.7	2.90	0.29	—	—	—	—	—
35	98-99	123.8	47.4	2904.9	736.7	2.94	0.74	5.90	3.28	0.28	587.5	318.1

PERFORACION LB-4

MUEST #	PROF m.	LONG (mm)	DIAM. (mm)	γ_d (kg/m ³)	σ_u (kg/cm ²)	G_s (bruta)	Abs (%)	V_p (km/seg)	V_s (km/seg)	μ	MED (T/cm ²)	GD (T/cm ²)
1	19-20	118.0	47.4	2880.1	1246.7	2.90	0.30	5.27	2.86	0.29	441.8	241.2
2	24-25	113.6	47.4	2897.4	1530.1	2.92	0.10	4.98	2.67	0.30	383.0	210.4
5	34-35	123.8	47.4	2875.2	736.7	2.88	1.02	4.91	2.93	0.22	480.2	252.6
7	43-44	123.2	47.4	2887.3	793.4	2.93	0.13	—	—	—	—	—
8	48-49	123.5	47.4	2802.3	226.7	2.82	0.88	4.06	2.74	0.08	428.2	215.5

γ_d = Peso Volumetrico.
 σ_u = Resistencia.
 G_s = Gravedad Especifica.
 Abs = Absorción.
 V_p = Velocidad de Onda.
 V_s = Velocidad de Onda.
 MED = Módulo Elástico Dinámico.
 GD = Módulo de Cizalle.
 μ = Relación de Poisson.

Table A-6-6 Tensil Strength Tests of Boring Cores

PERF.No.	PROF. (m)	Do. (mm)	Lo (mm)	Ws (gr)	P. (kg)	&d (k/m3)	TRACCION*
LB 1	1.0 - 2.0	47.2	126.0	647.2	9500	2935	101
LB 1	12 - 13	47.3	103.4	573.4	6875	3155	89
LB 1	17 - 18	47.2	116.0	589.2	6000	2902	69
LB 1	37 - 38	47.3	110.0	567.5	8400	2936	102
LB 1	43 - 44	47.2	99.0	458.5	3000	2646	40
LB 2	5 - 6	47.5	110.0	580.0	6400	2975	77
LB 2	12 - 13	47.7	116.0	577.5	7900	2785	90
LB 2	24 - 25	47.5	113.5	574.0	10000	2853	118
LB 2	44 - 45	47.2	120.6	609.4	8000	2887	89
LB 2	67 - 68	47.4	94.0	499.0	7500	3008	107
LB 3	3 - 4	47.4	115.0	541.0	6560	2665	76
LB 3	8 - 9	47.5	81.0	384.3	4920	2677	81
LB 3	16 - 17	47.5	87.4	428.0	8000	2763	122
LB 3	20 - 21	47.5	108.0	515.0	6460	2690	80
LB 3	30 - 31	47.3	112.0	536.8	9000	2727	108

Tensil Strength

LB-1 80.2 +- 23.4 kg/cm2
 LB-2 96.2 +- 14.5 kg/cm2
 LB-3 93.4 +- 18.3 kg/cm2

* Resistencia a la traccion en Kg/cm2

Table A-6-7 Specific, Absorption, Optimum Moisture, Liquid Limit, Plasticity Index, and Compaction Tests of Borrow Area

INSTITUTO COSTARRICENSE DE ELECTRICIDAD		DIRECCION INGENIERIA CIVIL		DEPARTAMENTO INGENIERIA GEOTECNICA		PROYECTO: P.H. Pircis																
NOMBRE DEL AREA DE PRESTAMO: M.D. Rio San Rafael		ELEVACION: Muy variable		ACCESIBILIDAD: Mala		FECHA: Marzo 91																
LOCALIZACION GENERAL:		TIPO DE MATERIAL: Pasa meteorizada coluvio- aluvion		AREA DE PRESTAMO:		REVISION:																
COORDENADAS LIMITES:		GRANULOMETRIA		IN SITU		PRUEBA DE COMPACTACION																
Pozo No	Coord.	Elevacion (m)	Prof. (m)	N.F. (m)	> 3% %	M ₆₀ %	M ₄₀ %	D ₁₀ (mm)	D ₆₀ (mm)	C _u	LL %	IP %	G _s	W _{nat} %	SUCS	δ _{max} Kg/m ³	W %	S %	G _s	e _{min}	OBSERVACIONES	
CP-1	E		1 00-10	No Hay	70	30	-	-	0,055	-	65	26	2,74	31,4	MH							
	N		2 10-20	"	79	21	-	-	0,045	-	65	27	2,89	32,2	MH							
	E		3 20-30	"	65	35	-	-	0,070	-	56	22	2,72	31,3	MH							
	N		4 30-40	"	73	27	-	-	0,060	-	48	19	2,76	32,3	ML							
	E		5 40-50	"	64	36	-	0,0015	0,070	47	47	19	2,73	26,8	ML-CL							
	N		I 10-50		71	29	-	-	0,06	-	55	22	2,81	-	MH	1439	282	-	281	-		
CP-2	E		1 03-10	No Hay	50	50	-	0,002	0,27	135	36	7	2,70	23,0	SM							
	N		2 10-175	"	44	56	-	0,007	0,30	43	38	9	2,67	25,0	SM							
	E		3 175-30	"	52	48	-	0,003	0,15	50	34	6	2,70	2,50	ML							
	N		4 40-50	"	37	63	-	0,004	1,00	250	38	11	2,65	2,10	SM							
	E		I 03-50		52	48	-	0,006	0,45	75	37	10	-	-	ML	1608	222	-	-	-		
CP-3	E		1 03-10	No Hay	39	24	30	0,006	2,0	333	36	7	2,70	2,3	SM							
	N		2 10-175	"	36	33	28	0,005	0,95	190	38	9	2,67	2,5	SM							
	E		3 175-30	"	17	10	39	0,022	7,5	340	34	6	2,70	2,5	SM							
	N		4 40-50	"	29	25	40	0,008	0,25	28	38	11	2,65	2,1	SM							
	E		I 03-50		-	-	-	-	-	-	38	11	-	-	GM	1530	19,2	-	-	-		
	N																					

TABLA N: 1

Table A-6-8 Geologic Column of CP-1

INSTITUTO COSTARRICENSE DE ELECTRICIDAD DEPARTAMENTO DE INGENIERIA GEOTECNICA DESCRIPCION DE POZOS DE EXPLORACION TRINCHERAS Y PERFORACIONES					
PROYECTO: P.H. PIRRIS			POZO: C P - 1		
UBICACION: Marqen derecha, Rio San Rafael			ELEVACION:		
COORDENADAS N:		E:	FONDO:		
FECHA INICIO: 19/2/91			NIVEL FREATICO: No hay		
FECHA FINALIZACION: 21/2/91					
METODO EXCAVACION: Manual					
PRO-FUN-DIDAD (m)	ESTRA-TIGRA-FIA	DESCRIPCION TIPO SUELO, COLOR, CONSISTENCIA, ESTRUCTURA, CONTENIDA HUMEDAD, PLASTICIDAD	CLASI-FICA-CION SUCS	% HUNE-DAD NATURAL	GRAVE-DAD ES-PECIFI-CA (GS)
1.0	~~~~~	Limo arcilloso color rojizo con muy poco bloque. Los bloques son rojizos y en su mayoría angulosos, en general muy meteorizados, fáciles de disrregar con la mano. Se estima que por volumen hay un 15% de bloques.	MH	31.4	2.74
2.0	~~~~~	Limo arcilloso color rojizo, similar anterior, con un poco mas de bloques. Los bloques poseen las mismas características que en el tramo anterior. Se estima que por volumen hay un 20% de bloques y en general menores de 7.6.7 cm (3plq)	MH	32.2	2.69
3.0	~~~~~	Limo arcilloso color rojizo con bloques. Bloques con meteorización esferoidal, con predominio de los angulosos. T max= 7 plq. Se estima que por volumen el material posee un 25 % de bloques, en general menores a 3 plq	MH	31.3	2.72
4.0	~~~~~	Limo arcilloso color rojizo con bloques de hasta 7plq. Algunos presentan meteorización esferoidal. Predominan bloques angulosos. A partir de 3.5m se nota menos meteorización y aparecen más bloques. Se estima un 35% por volumen de bloques	ML	32.3	2.76
5.0	~~~~~	Limo arcilloso color rojizo con bloques de hasta 8 plq. En general, fáciles de disrregar a mano. Se estima que el material posee por volumen un 40 % de bloques, menores en general a 3 plq.	ML-CL	26.8	2.73
OBSERVACIONES: 1- No hay cobertura vegetal. 2- De acuerdo a lo observado luego de concluido el pozo, se estima que por volumen, tiene un 95% de material menor a las 6 plq; y un 90% menor a las 3 plq.					
INSPECTOR: A. Torres			FECHA: Marzo 1991		
DESCRITO POR: Inq. M. Valverde/ A. Torres			APROBADO POR:		

Table A-6-9 Geologic Column of CP-2

INSTITUTO COSTARRICENSE DE ELECTRICIDAD DEPARTAMENTO DE INGENIERIA GEOTECNICA DESCRIPCION DE POZOS DE EXPLORACION TRINCHERAS Y PERFORACIONES					
PROYECTO: P.H. PIRRI			POZO: C P - 2		
UBICACION: Marqen derecha, Rio San Rafael			ELEVACION:		
COORDENADAS N:		E:	FONDO:		
FECHA INICIO: 30/1/91			NIVEL FREATICO: No hay		
FECHA FINALIZACION: 7/2/91					
METODO EXCAVACION: Manual					
PRO-FUN-DIDAD (m)	ESTRATIGRAFIA	DESCRIPCION TIPO SUELO, COLOR, CONSISTENCIA, ESTRUCTURA, CONTENIDA HUMEDAD, PLASTICIDAD	CLASIFICACION SUCS	% HUMEDAD NATURAL	GRAVEDAD ESPECIFICA (GS)
		Orgánico			
1.0	*****	Material limo arenoso color café claro con bloques 1ax ≈ 8 plq, meteorizados inclusive esferoidalmente. Se estima que posee por volumen 30% de bloques en general menor de 3 plq.	SM	23	2.70
	*****	Material limo arenoso color café claro con mayor cantidad de bloques que poseen las mismas características del tramo anterior. Se estima que posee por volumen 40%, en qrl menor 3plq	SM	25	2.67
2.0	*****	Limo arenoso café claro, bloques café oscuro, blancuzcos y anulosos. Algunos son redondeados y hay meteorización esferoidal. En general los bloques se disgregan a mano y se estima que por volumen posee un 30 %, en general menores a 3 plq.	ML	25	2.70
3.0	*****	Limo arenoso color café claro, bloques café oscuro y blancuzcos, tanto anulosos como redondeados. Algunos presentan meteorización esferoidal y en general estan meteorizados. Se estima que hay un 40% por volumen, en general menores de 3plq			
4.0	*****	Limo arenoso color café claro con bloques. La condición de los bloques similar tramo anterior. Se estima que por volumen hay un 30 % de bloques que en general son menores a las 3 plq.	SM	21	2.65
5.0	*****				
OBSERVACIONES:					
1- De acuerdo a lo que se observa en las paredes del pozo concluido, se estima que un 98 % de los bloques son inferiores a las 6 plq; y un 95% inferiores a las 3 plq.					
INSPECTOR: A. Torres			FECHA: Marzo 1991		
DESCRITO POR: Inq. M. Valverde/ A. Torres			APROBADO POR:		