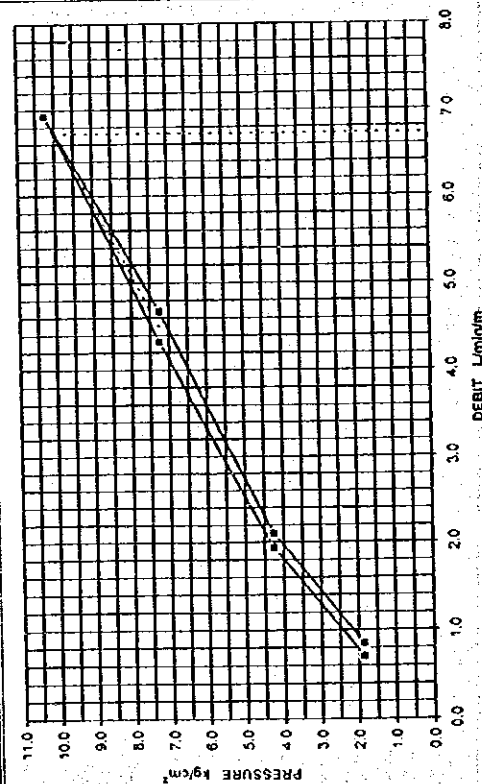
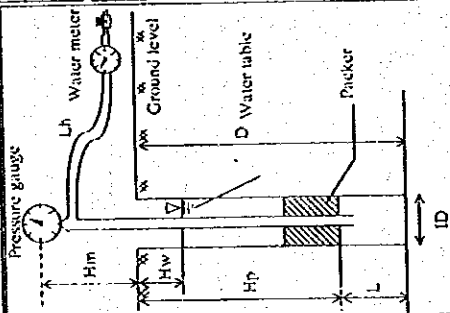


DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

Inclined: 90°

LUGEON PERMEABILITY TEST					TEST No:	HOLE No:	RESULT
					12	BD916D	LUGEON: 6.72
TEST SECTION (m)							
DATE	STARTED AT : 10 H 00						
04/07/99	COMPLETED AT: 11 H 24						
FROM: 70.0 m		TO: 75.0 m		K (cm/s) = 2.65E-05			
D = 75.0 m	ϕ ID = 0.091 m	Lr =	G.W.L.(m): 16.0				
Hp = 70.0 m	Hw = 16.0 m	Lh =	m				
L = 5.0 m	Hm = 1.6 m	ϕ rods =	cm				
PRESSURE (kg/cm ²)				DEBIT	DEBIT		
Applied	Gravity	Head loss	Total	(L/min)	(L/min/m)		
0.10	1.76		1.86	3.52	0.704		
2.50			4.26	9.69	1.938		
5.50			7.26	21.63	4.326		
8.50			10.26	34.67	6.934		
5.50			7.26	23.79	4.678		
2.50			4.26	10.52	2.104		
0.10			1.86	4.24	0.848		
ROCK TYPE: SANDSTONE							

The diagram illustrates the Lugeon Permeability Test setup. A vertical borehole is shown with a packer at depth L. A water meter is connected to the top of the borehole. A pressure gauge is connected to the side of the borehole. The diagram labels various depths: Hm (total depth), Hw (water level), Hp (packer depth), and L (length of test section). The borehole diameter is labeled ID. The diagram also shows a ground level and a water table.



DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

Inclined: 90°

LUGEON PERMEABILITY TEST					TEST No:	HOLE No:	RESULT
					13	BD916D	LUGEON: 5.67
TEST SECTION (m)							
FROM:	75.0 m	TO:	80.0 m	K (cm/s) = 2.22E-05			
D =	80.0 m	ϕ ID =	0.091 m	Lr =	m		
Hp =	75.0 m	Hw =	16.0 m	Lh =	m		
L =	5.0 m	Hm =	1.0 m	ϕ rods =	cm		
PRESSURE (kg/cm ²)					DEBIT (L/min)	DEBIT (L/min/m)	
Applied	Gravity	Head loss	Total				
0.10	1.70		1.80	2.66	0.532		
2.50			4.20	7.69	1.538		
5.50			7.20	19.56	3.912		
8.50			10.20	28.95	5.790		
5.50			7.20	20.58	4.116		
2.50			4.20	9.52	1.864		
0.10			1.80	3.17	0.634		
ROCK TYPE: SANDSTONE							

DATE 04/07/99 STARTED AT : 17 H 00 COMPLETED AT: 18 H 55

Pressure

Lh Water meter

Ground level

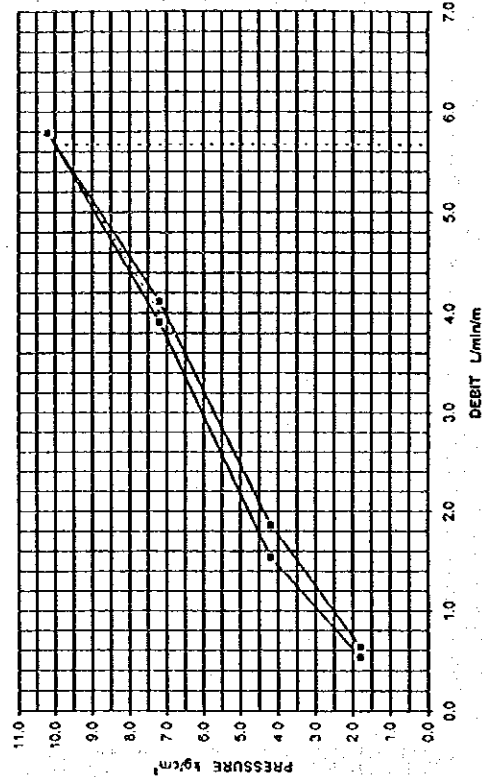
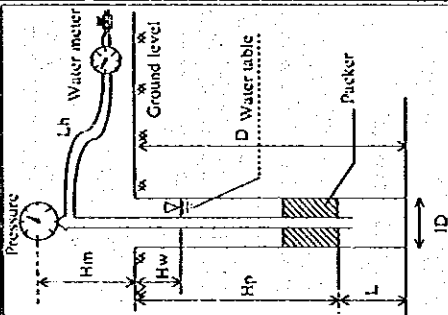
D Watertable

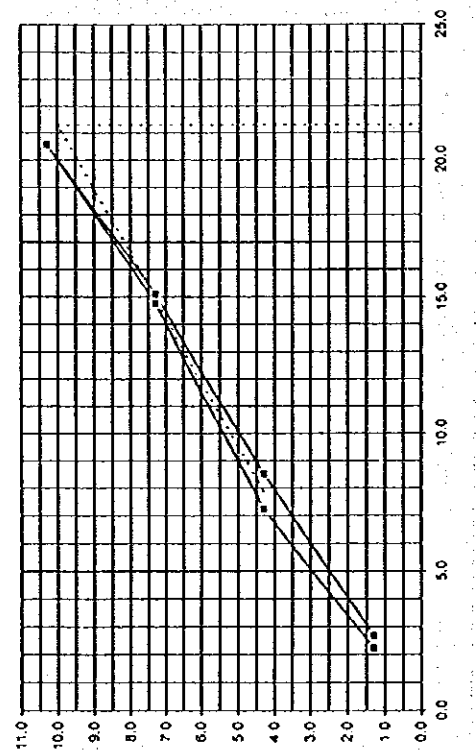
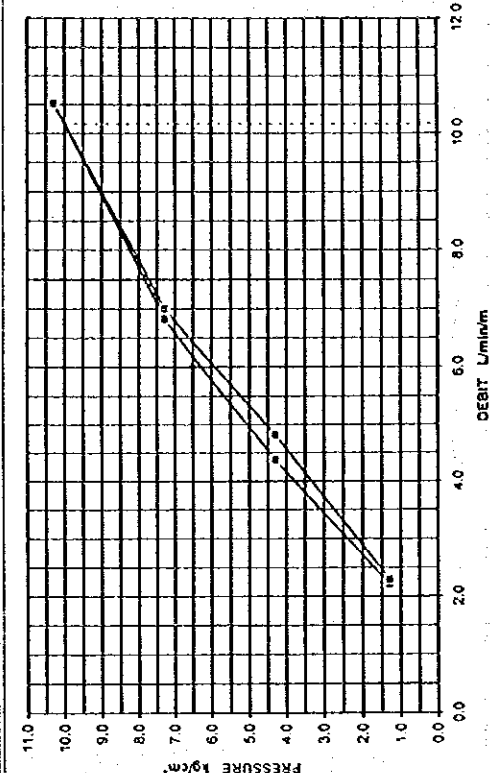
Packer

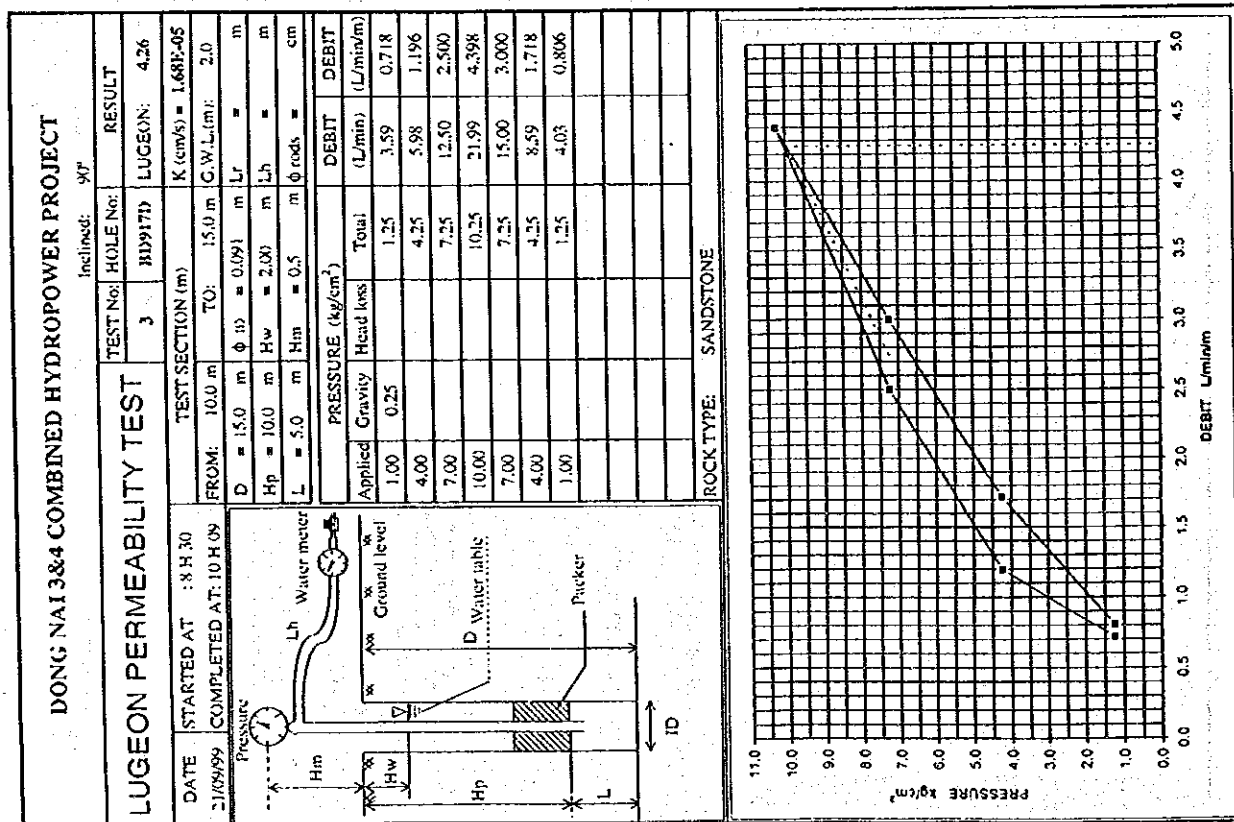
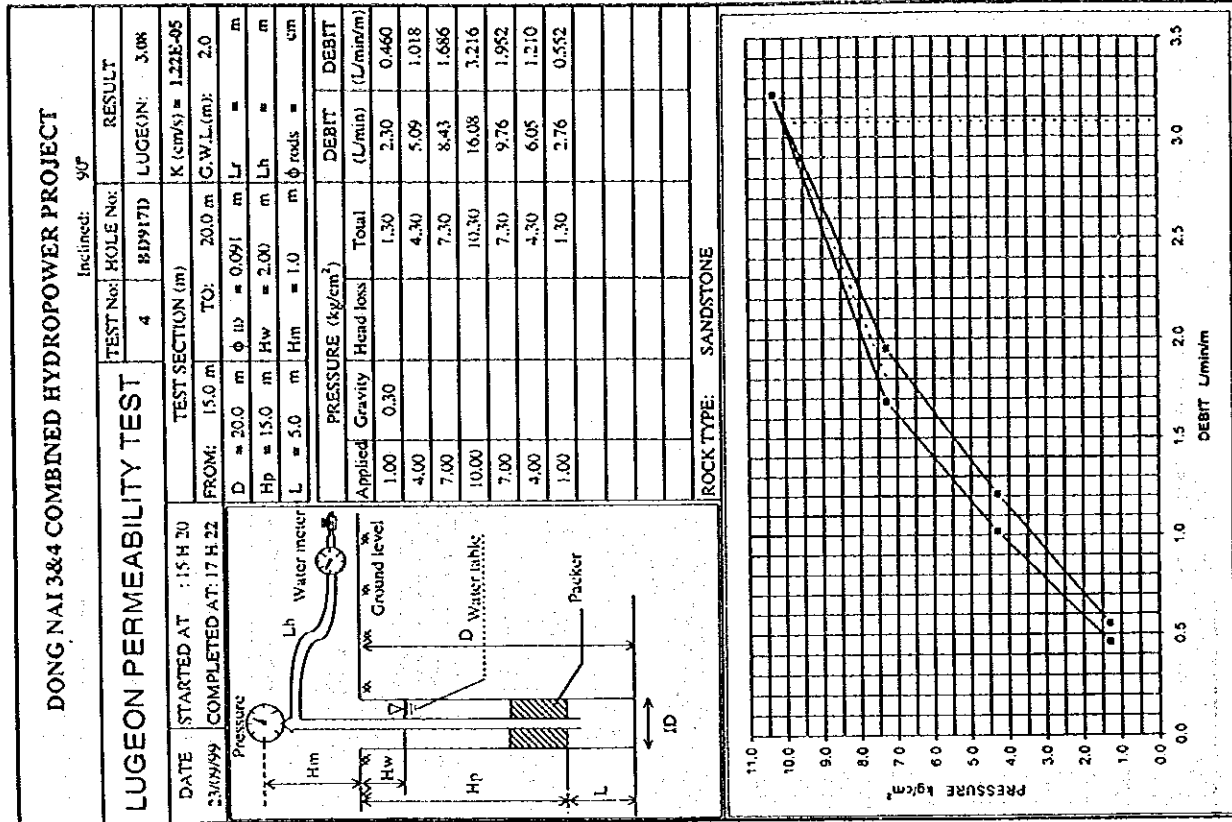
Hp

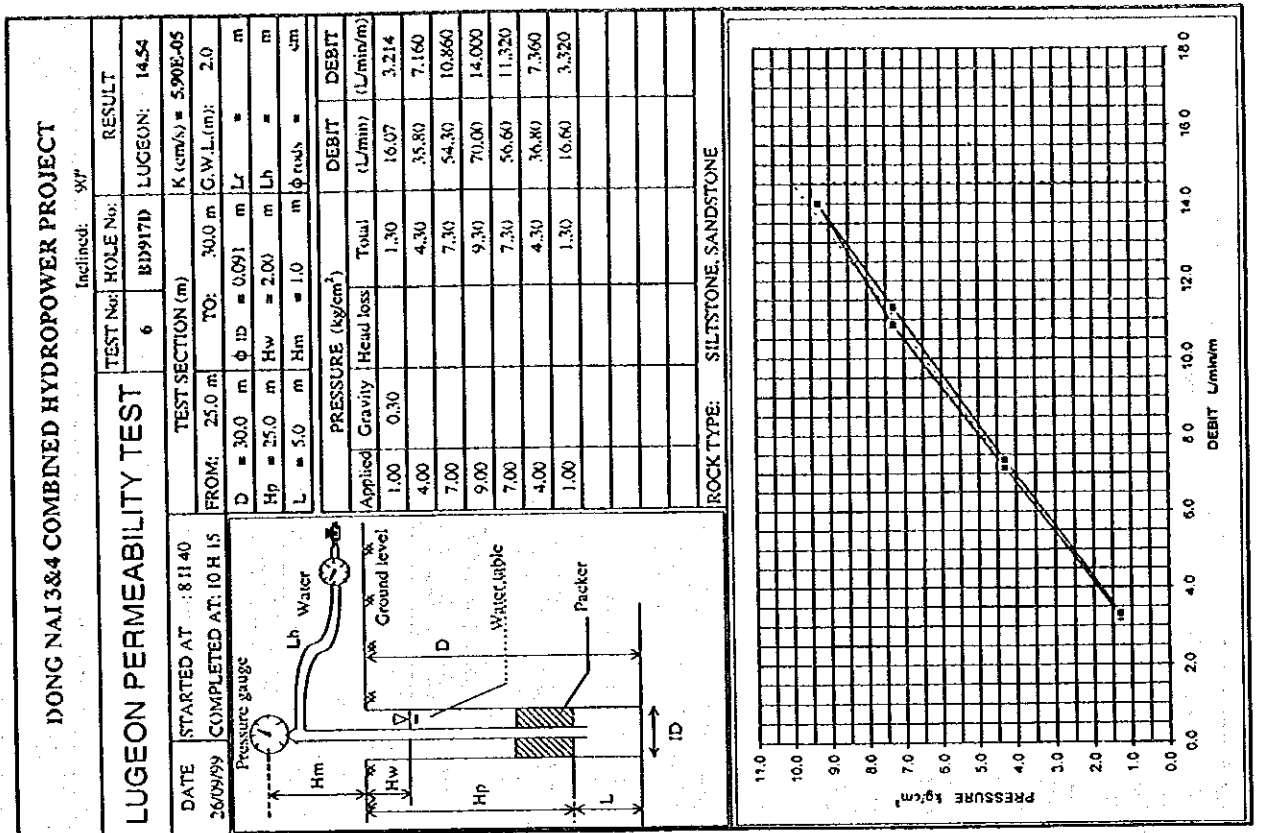
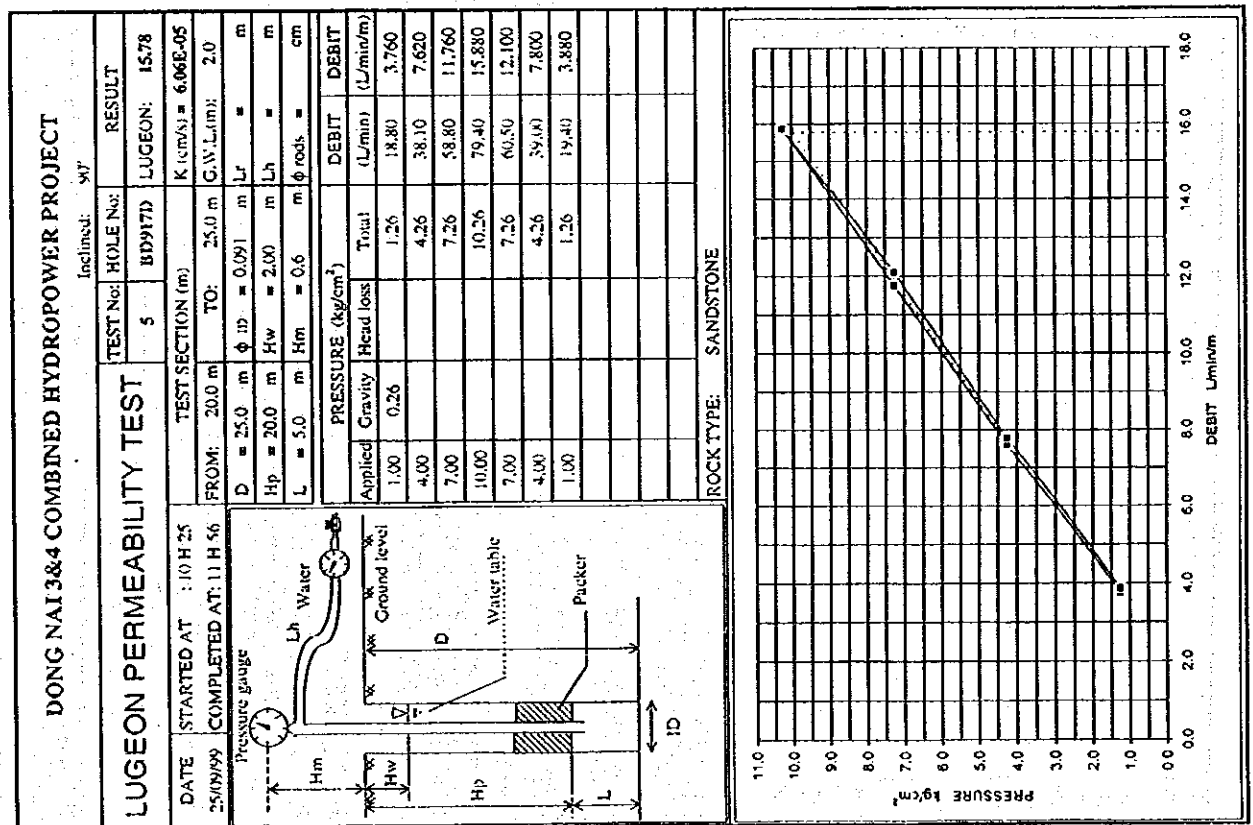
L

ID



[illegible][illegible]

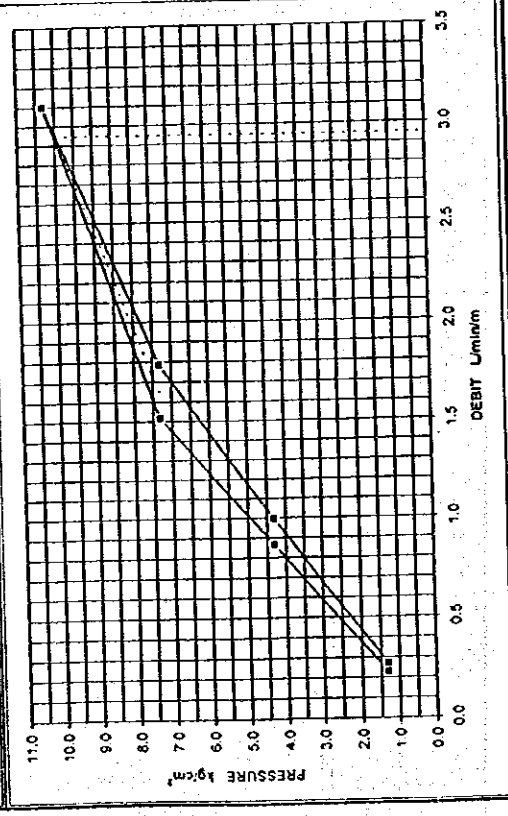
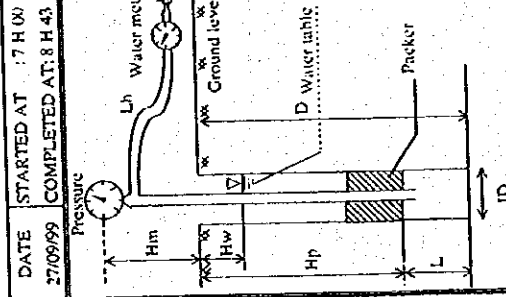




DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

Inclined: 90°

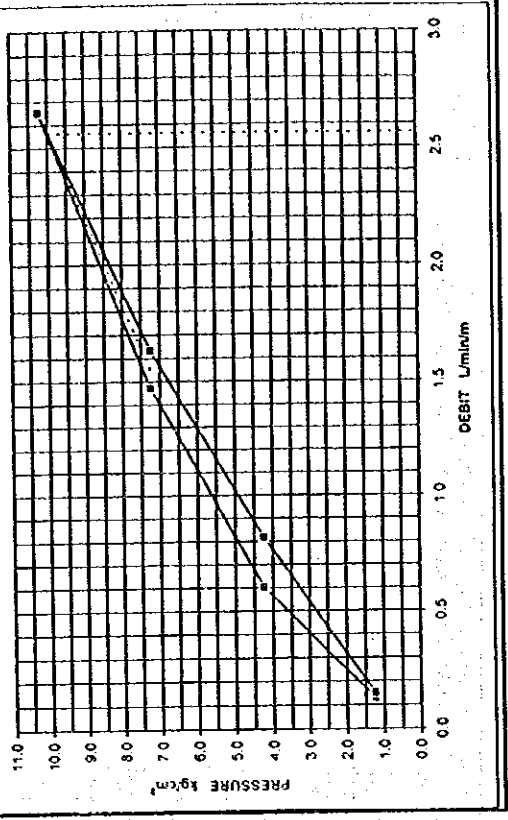
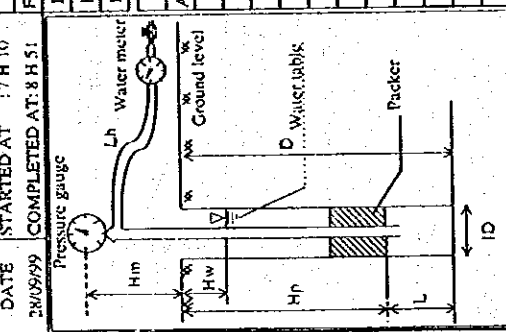
TEST No: HOLE No: RESULT		TEST No: HOLE No: RESULT	
7		8	
LUGEON PERMEABILITY TEST		LUGEON PERMEABILITY TEST	
TEST SECTION (m)		TEST SECTION (m)	
FROM: 30.0 m TO: 35.0 m		FROM: 35.0 m TO: 40.0 m	
D = 35.0 m ϕ ID = 0.091 m		D = 40.0 m ϕ ID = 0.091 m	
H _p = 30.0 m H _w = 2.00 m		H _p = 35.0 m H _w = 1.50 m	
L = 5.0 m ϕ rods = 1.2 m		L = 5.0 m ϕ rods = 1.0 m	
PRESSURE (kg/cm ²)		PRESSURE (kg/cm ²)	
Applied Gravity Head loss Total		Applied Gravity Head loss Total	
1.00 0.32 1.32		1.00 0.25 1.25	
4.00 4.32 8.32		4.00 4.25 8.25	
7.00 7.32 14.32		7.00 7.25 14.25	
10.00 10.32 20.32		10.00 10.25 20.25	
7.00 7.32 14.32		7.00 7.25 14.25	
4.00 4.32 8.32		4.00 4.25 8.25	
1.00 1.32 2.32		1.00 1.25 2.25	
DEBIT (L/min)		DEBIT (L/min)	
1.15 0.230 0.866		0.65 0.170 0.820	
4.33 0.866 5.196		3.01 0.602 3.612	
7.58 1.516 9.096		7.36 1.472 8.832	
15.80 3.100 18.900		13.27 2.654 15.924	
8.93 1.786 10.716		8.17 1.634 9.804	
4.98 0.996 5.976		4.09 0.818 4.908	
1.36 0.272 1.632		0.76 0.152 0.912	
ROCK TYPE: SANDSTONE		ROCK TYPE: SANDSTONE	

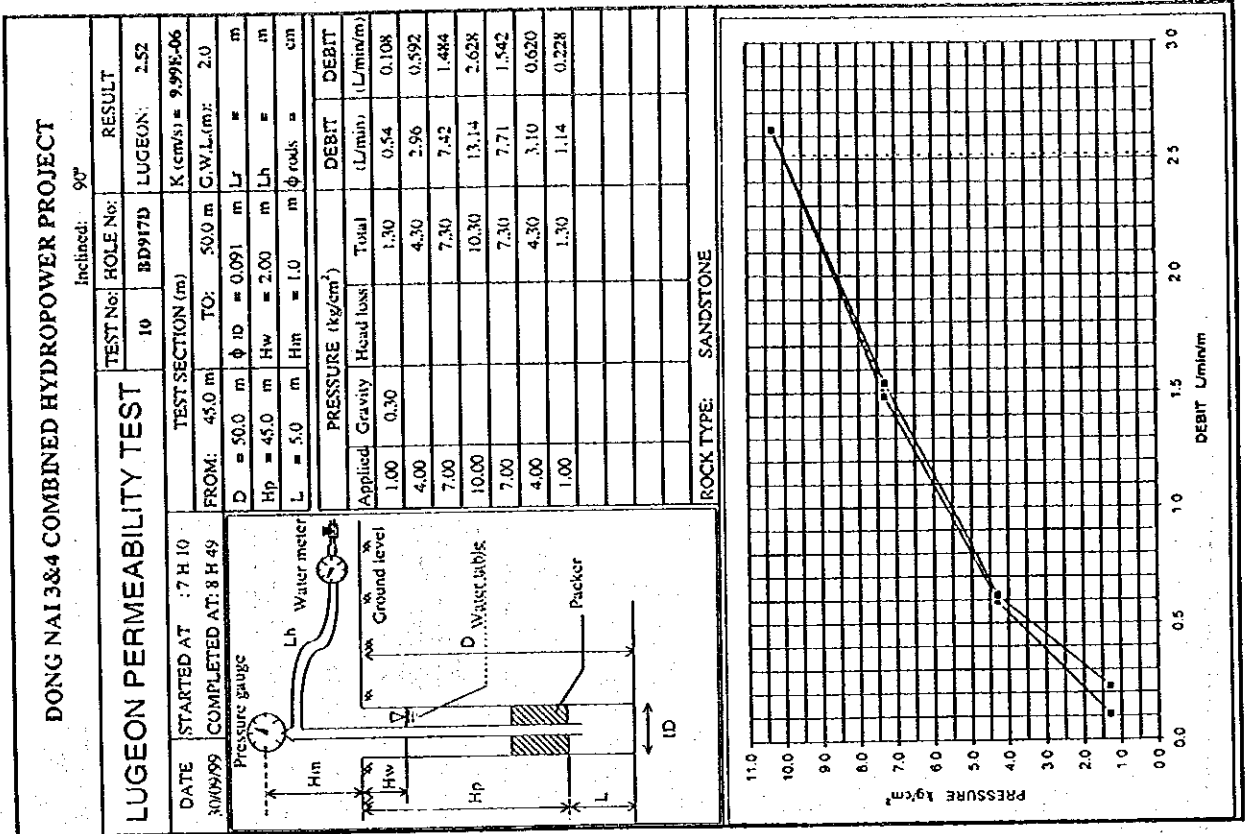
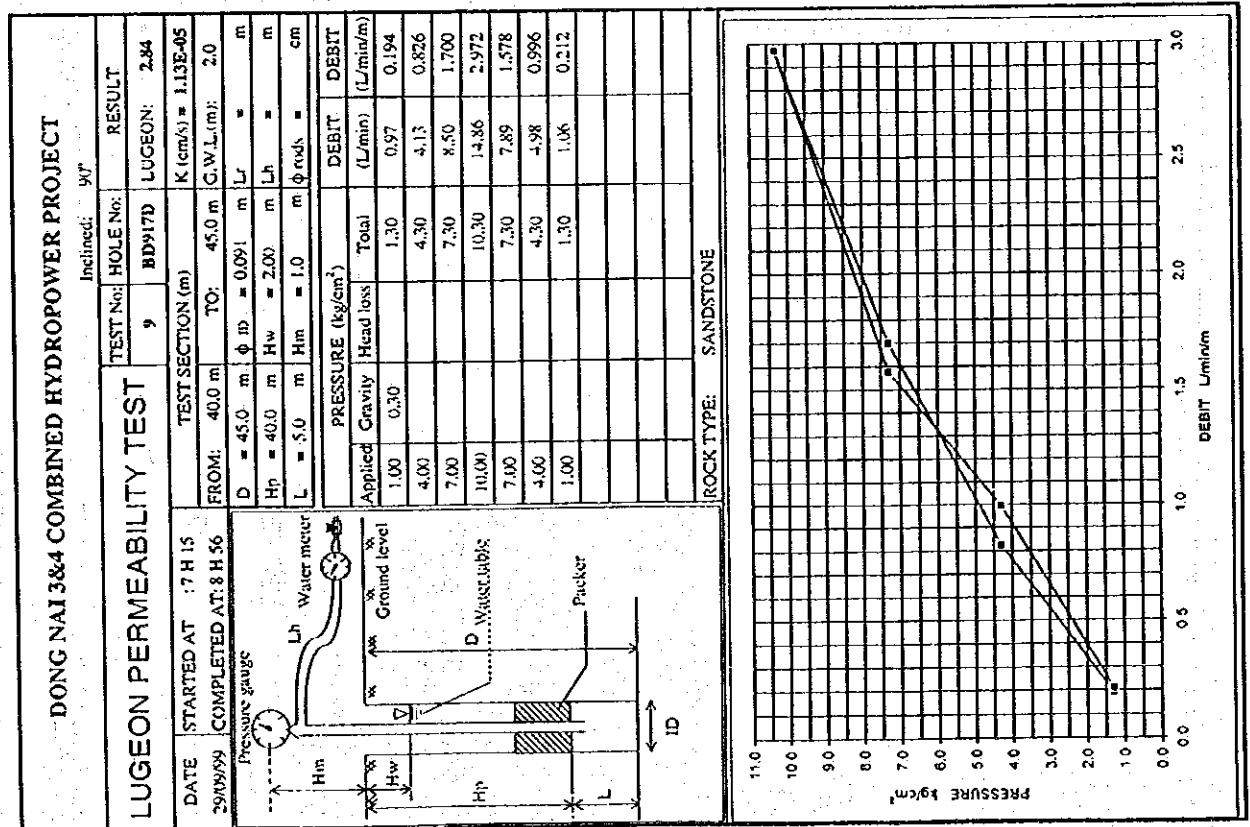


DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

Inclined: 90°

TEST No: HOLE No: RESULT		TEST No: HOLE No: RESULT	
7		8	
LUGEON PERMEABILITY TEST		LUGEON PERMEABILITY TEST	
TEST SECTION (m)		TEST SECTION (m)	
FROM: 30.0 m TO: 35.0 m		FROM: 35.0 m TO: 40.0 m	
D = 35.0 m ϕ ID = 0.091 m		D = 40.0 m ϕ ID = 0.091 m	
H _p = 30.0 m H _w = 2.00 m		H _p = 35.0 m H _w = 1.50 m	
L = 5.0 m ϕ rods = 1.2 m		L = 5.0 m ϕ rods = 1.0 m	
PRESSURE (kg/cm ²)		PRESSURE (kg/cm ²)	
Applied Gravity Head loss Total		Applied Gravity Head loss Total	
1.00 0.32 1.32		1.00 0.25 1.25	
4.00 4.32 8.32		4.00 4.25 8.25	
7.00 7.32 14.32		7.00 7.25 14.25	
10.00 10.32 20.32		10.00 10.25 20.25	
7.00 7.32 14.32		7.00 7.25 14.25	
4.00 4.32 8.32		4.00 4.25 8.25	
1.00 1.32 2.32		1.00 1.25 2.25	
DEBIT (L/min)		DEBIT (L/min)	
1.15 0.230 0.866		0.65 0.170 0.820	
4.33 0.866 5.196		3.01 0.602 3.612	
7.58 1.516 9.096		7.36 1.472 8.832	
15.80 3.100 18.900		13.27 2.654 15.924	
8.93 1.786 10.716		8.17 1.634 9.804	
4.98 0.996 5.976		4.09 0.818 4.908	
1.36 0.272 1.632		0.76 0.152 0.912	
ROCK TYPE: SANDSTONE		ROCK TYPE: SANDSTONE	

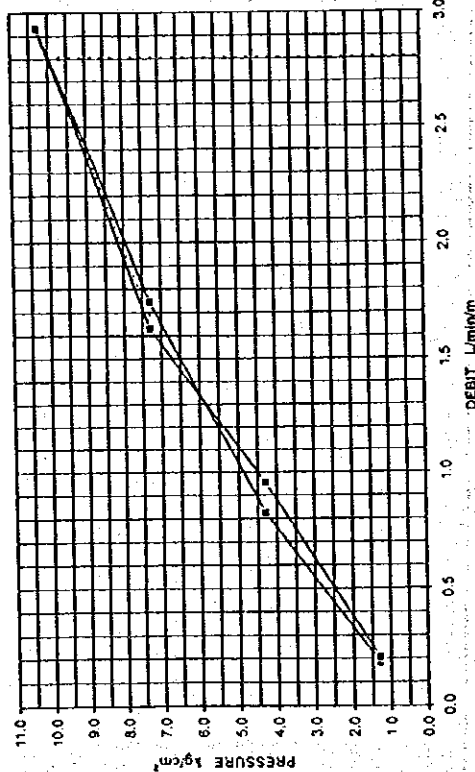
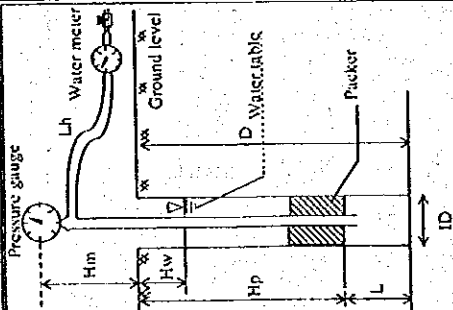




DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

Inclined: 90°

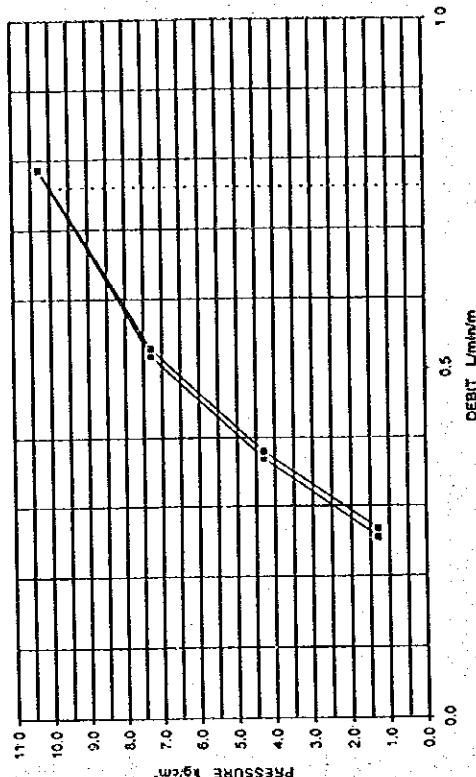
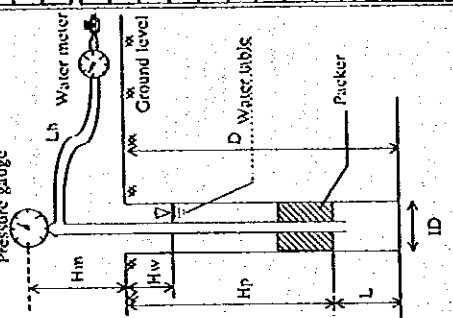
LUGEON PERMEABILITY TEST		TEST No: 11	HOLE No: BD917D	RESULT
LUGEON PERMEABILITY TEST		LUGEON: 2.81		
DATE	STARTED AT	TEST SECTION (m)	K (cm/s) = 1.11E-05	
01/10/99	COMPLETED AT: 8 H 59	FROM: 50.0 m TO: 55.0 m	G.W.L (m): 2.0	
		D = 50.0 m ϕ ID = 0.091 m	Lr =	m
		Hp = 50.0 m Hw = 2.00 m	Lh =	m
		L = 5.0 m Hm = 1.0 m ϕ rock =	cm	
		PRESSURE (kg/cm ²)		DEBIT
		Applied	Head loss	Total
		1.00	0.30	1.30
		4.00		4.30
		7.00		7.30
		10.00		10.30
		7.00		7.30
		4.00		4.30
		1.00		1.30
		DEBIT (L/min)		DEBIT (L/min/m)
		0.92		0.184
		4.13		0.826
		8.73		1.746
		14.66		2.932
		8.16		1.632
		4.78		0.956
		1.03		0.206
		ROCK TYPE: SANDSTONE		

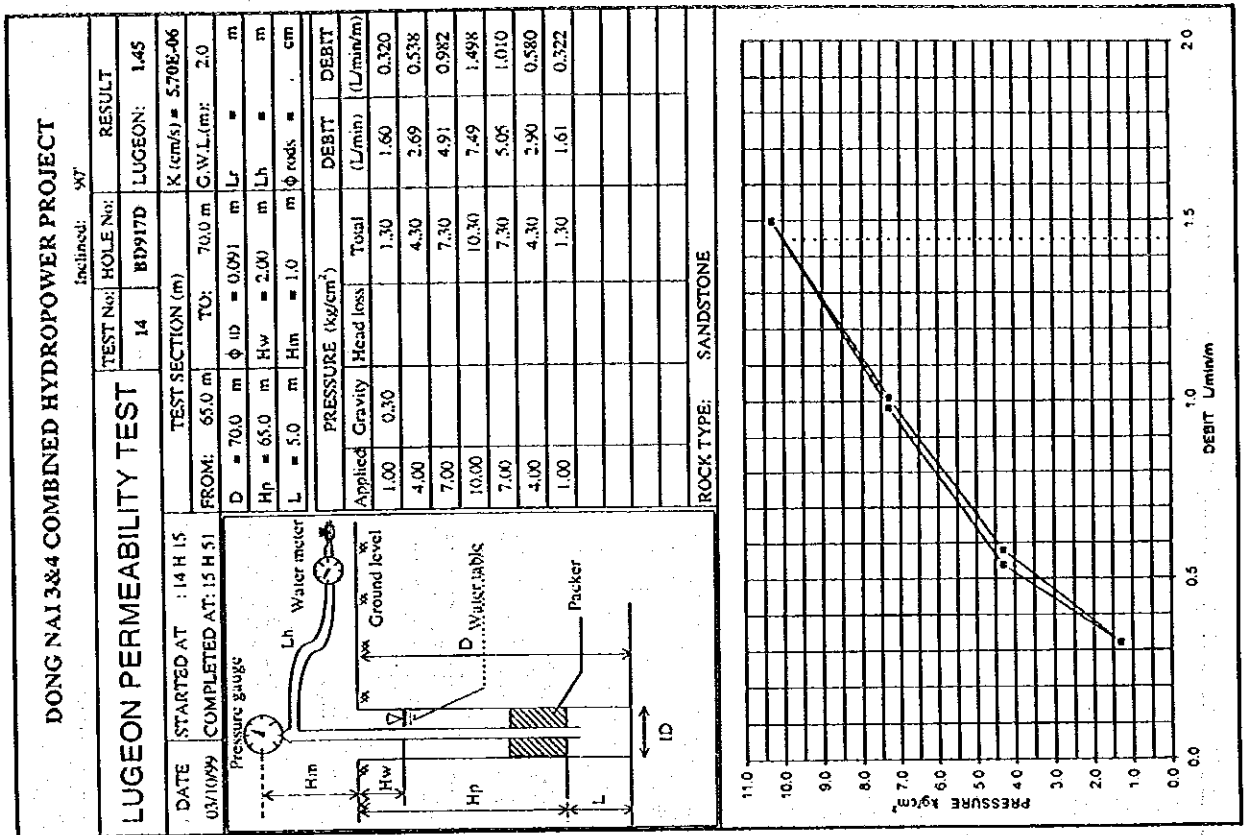
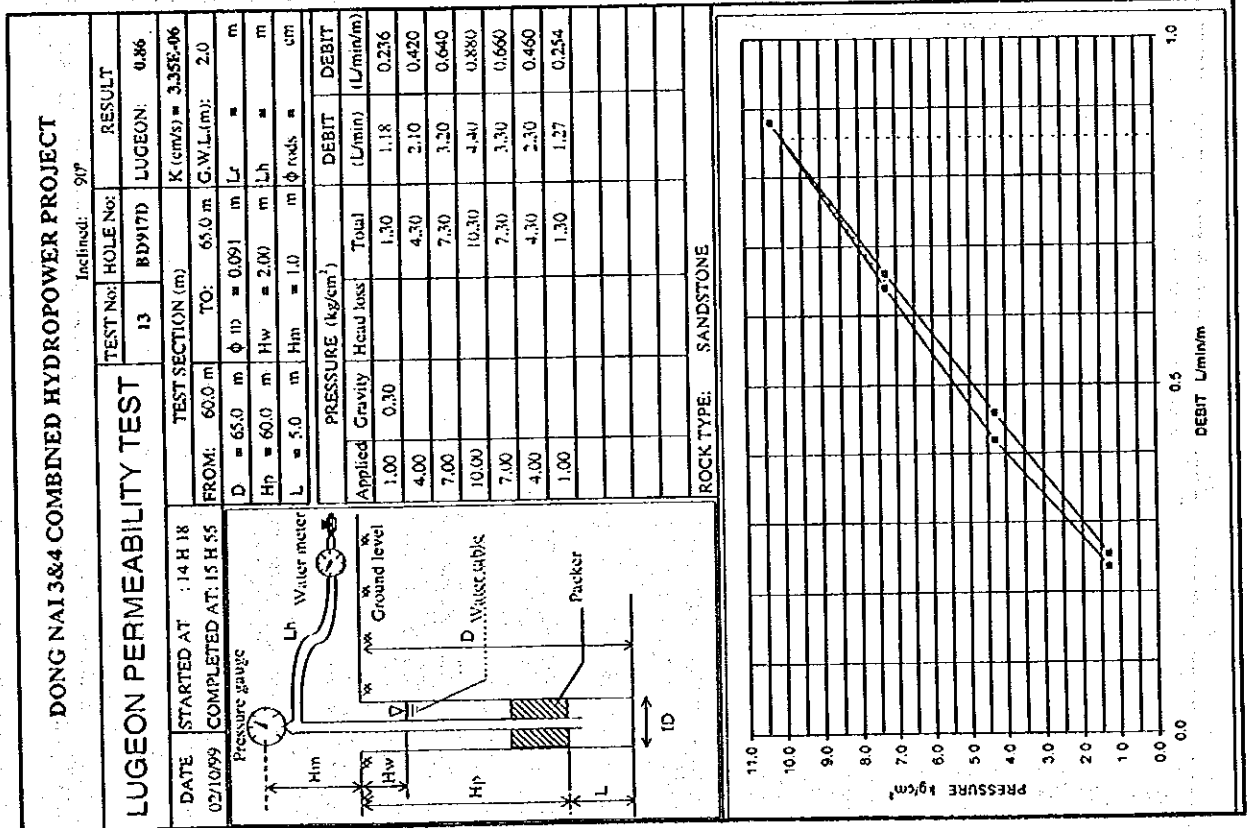


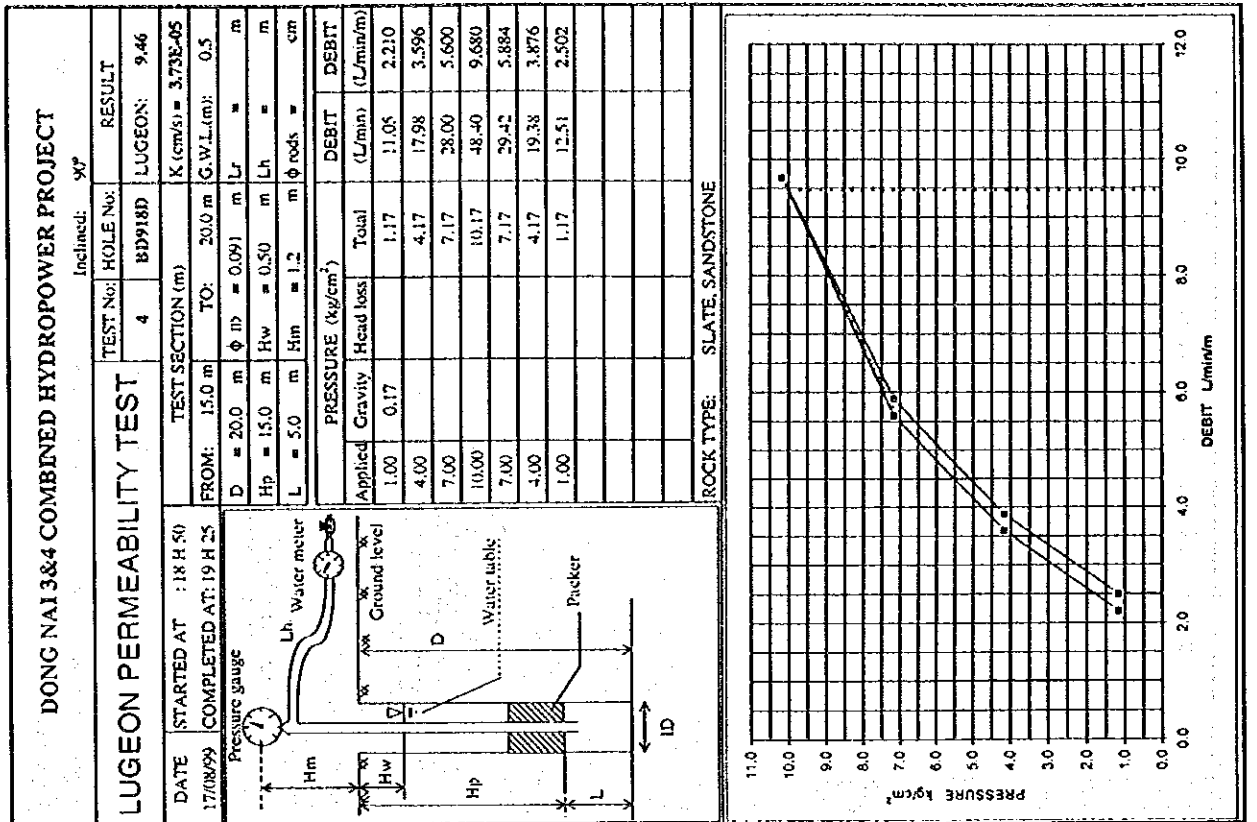
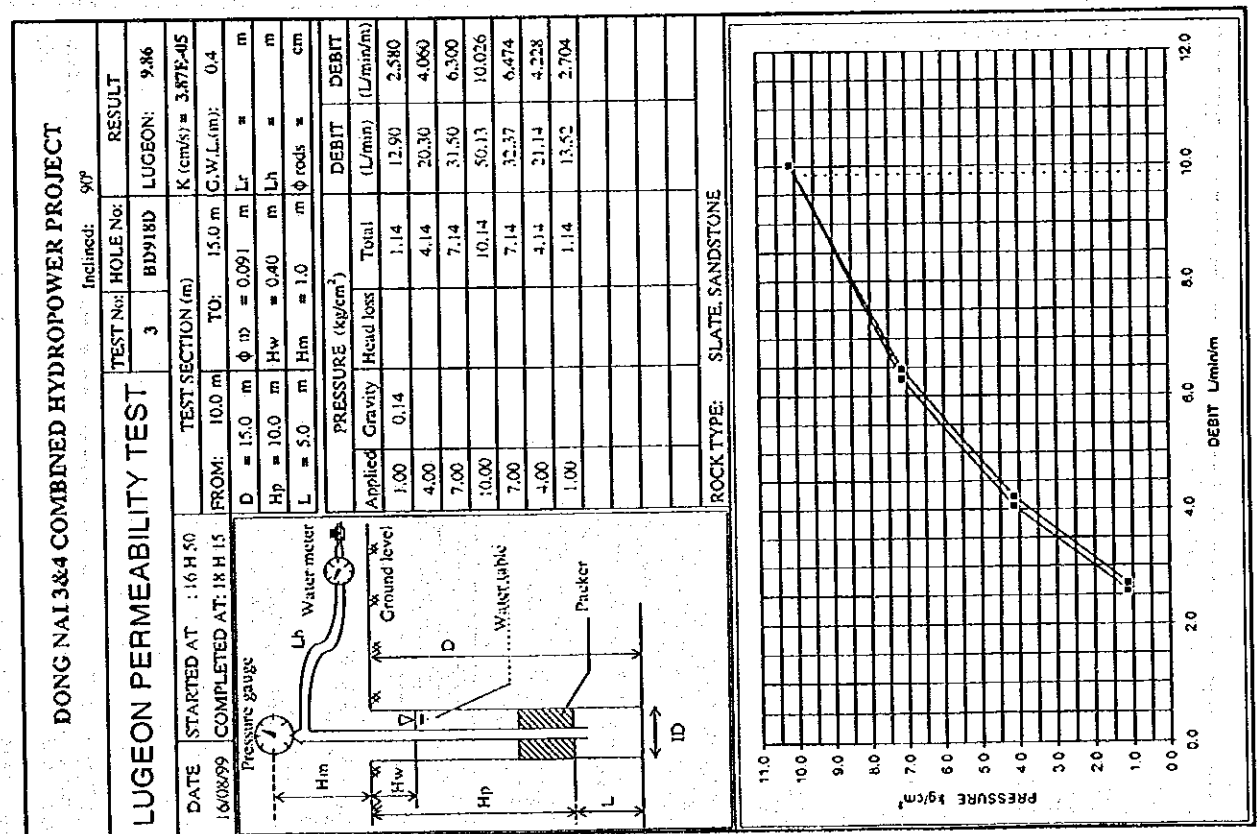
DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

Inclined: 90°

LUGEON PERMEABILITY TEST		TEST No: 12	HOLE No: BD917D	RESULT
LUGEON PERMEABILITY TEST		LUGEON: 0.76		
DATE	STARTED AT	TEST SECTION (m)	K (cm/s) = 2.99E-06	
01/10/99	COMPLETED AT: 17 H 36	FROM: 55.0 m TO: 60.0 m	G.W.L (m): 2.0	
		D = 60.0 m ϕ ID = 0.091 m	Lr =	m
		Hp = 55.0 m Hw = 2.00 m	Lh =	m
		L = 5.0 m Hm = 1.0 m ϕ rock =	cm	
		PRESSURE (kg/cm ²)		DEBIT
		Applied	Head loss	Total
		1.00	0.30	1.30
		4.00		4.30
		7.00		7.30
		10.00		10.30
		7.00		7.30
		4.00		4.30
		1.00		1.30
		DEBIT (L/min)		DEBIT (L/min/m)
		1.28		0.256
		1.85		0.370
		2.60		0.520
		3.93		0.786
		2.65		0.530
		1.90		0.380
		1.34		0.268
		ROCK TYPE: SANDSTONE, SILTSTONE		

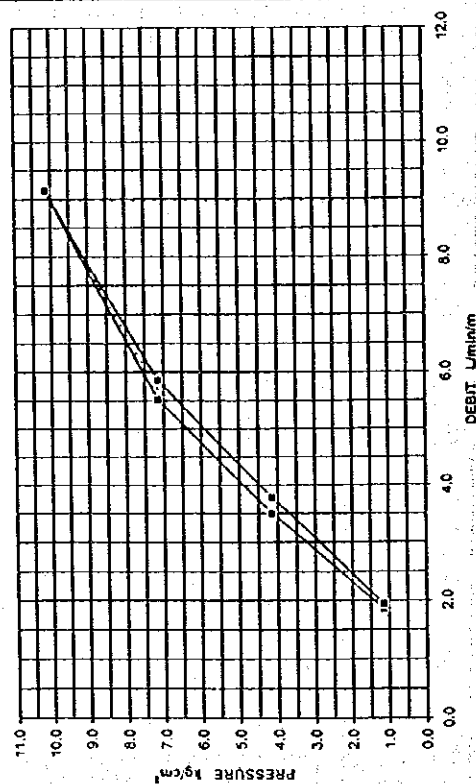






איןפאגלענד:

TEST No:	HOLE No:	RESULT
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[illegible]

ROCK TYPE: SLATE, SANDSTONE

Inclined: 50°

TEST No:	HOLE No:	RESULT
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TEST SECTION (m)		K (cm/s) = 3.04E-05	
FROM:	TO:	30.0 m	30.0 m
D = 30.0 m	ϕ D = 0.091 m	Lr =	m
H _p = 25.0 m	H _w = 0.60 m	Lh =	m
L = 5.0 m	H _m = 1.4 m	ϕ rock =	cm

PRESSURE (kg/cm ²)		DEBIT	
Applied	Gravity	Head loss	Total
1.00	0.20		1.20
4.00			4.20
7.00			7.20
10.00			10.20
7.00			7.20
4.00			4.20
1.00			1.20

PRESSURE (kg/cm ²)		DEBIT	
Applied	Gravity	Head loss	Total
1.00	0.20		1.20
4.00			4.20
7.00			7.20
10.00			10.20
7.00			7.20
4.00			4.20
1.00			1.20

PRESSURE (kg/cm ²)		DEBIT	
Applied	Gravity	Head loss	Total
1.00	0.20		1.20
4.00			4.20
7.00			7.20
10.00			10.20
7.00			7.20
4.00			4.20
1.00			1.20

PRESSURE (kg/cm ²)		DEBIT	
Applied	Gravity	Head loss	Total
1.00	0.20		1.20
4.00			4.20
7.00			7.20
10.00			10.20
7.00			7.20
4.00			4.20
1.00			1.20

PRESSURE (kg/cm ²)		DEBIT	
Applied	Gravity	Head loss	Total
1.00	0.20		1.20
4.00			4.20
7.00			7.20
10.00			10.20
7.00			7.20
4.00			4.20
1.00			1.20

PRESSURE (kg/cm ²)		DEBIT	
Applied	Gravity	Head loss	Total
1.00	0.20		1.20
4.00			4.20
7.00			7.20
10.00			10.20
7.00			7.20
4.00			4.20
1.00			1.20

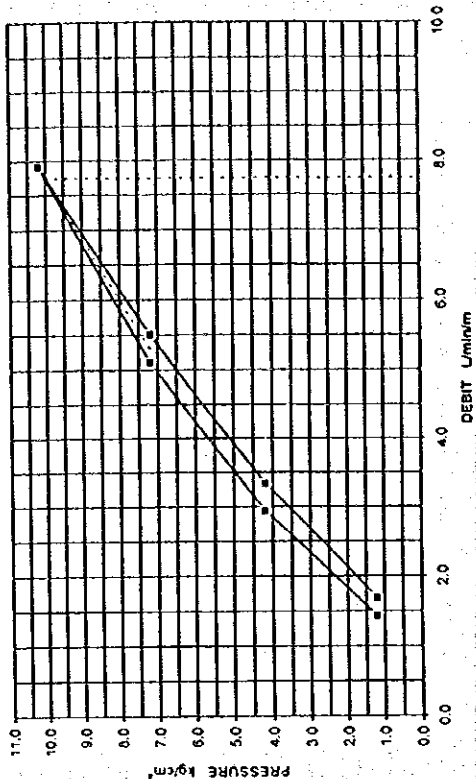
PRESSURE (kg/cm ²)		DEBIT	
Applied	Gravity	Head loss	Total
1.00	0.20		1.20
4.00			4.20
7.00			7.20
10.00			10.20
7.00			7.20
4.00			4.20
1.00			1.20

PRESSURE (kg/cm ²)		DEBIT	
Applied	Gravity	Head loss	Total
1.00	0.20		1.20
4.00			4.20
7.00			7.20
10.00			10.20
7.00			7.20
4.00			4.20
1.00			1.20

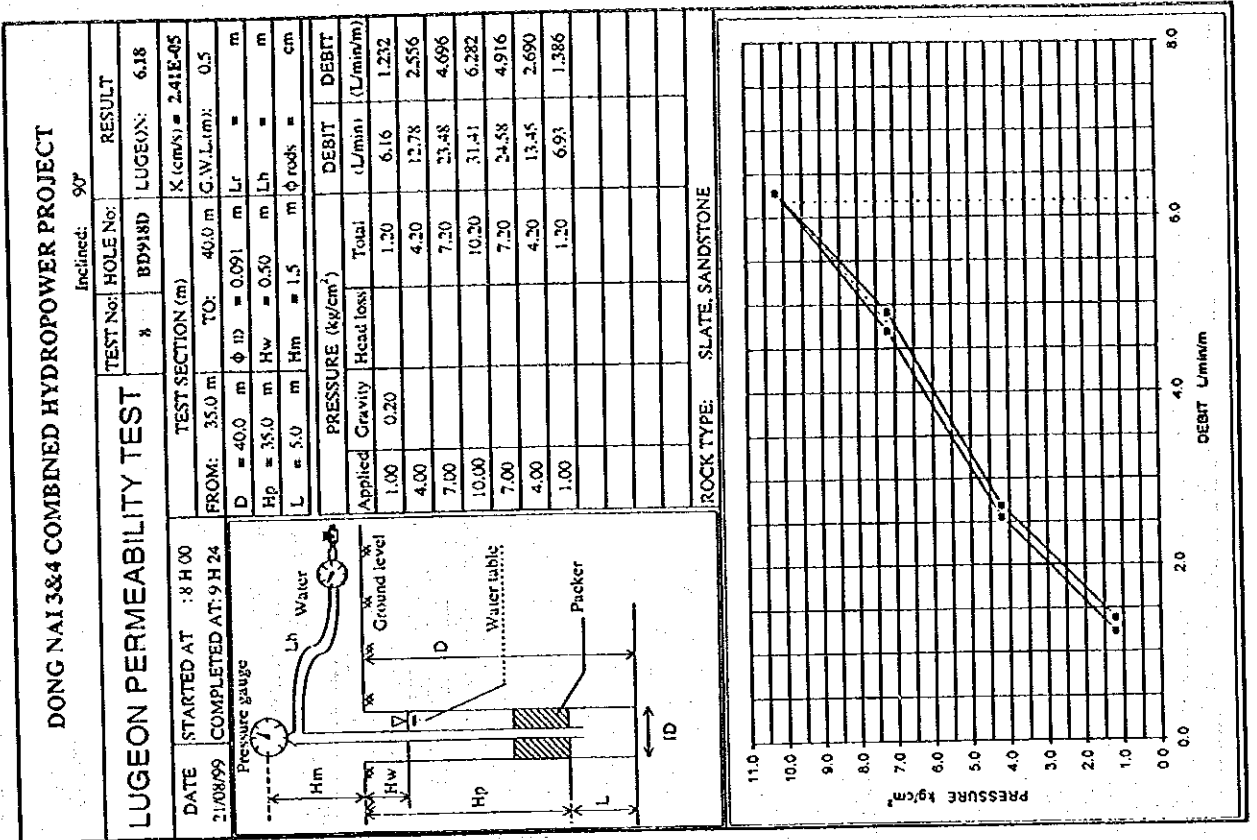
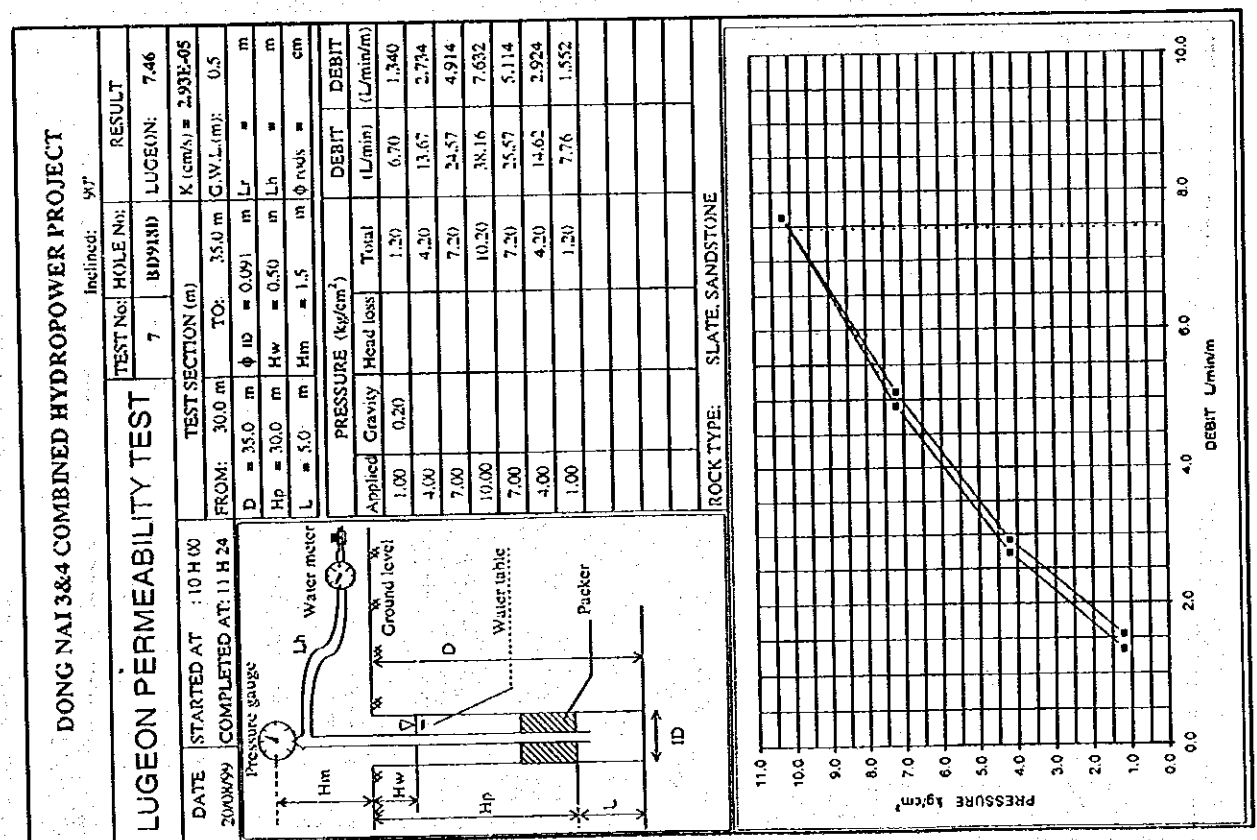
PRESSURE (kg/cm ²)		DEBIT	
Applied	Gravity	Head loss	Total
1.00	0.20		1.20
4.00			4.20
7.00			7.20
10.00			10.20
7.00			7.20
4.00			4.20
1.00			1.20

PRESSURE (kg/cm ²)		DEBIT	
Applied	Gravity	Head loss	Total
1.00	0.20		1.20
4.00			4.20
7.00			7.20
10.00			10.20
7.00			7.20
4.00			4.20
1.00			1.20

PRESSURE (kg/cm ²)		DEBIT	
Applied	Gravity	Head loss	Total
1.00	0.20		1.20
4.0			



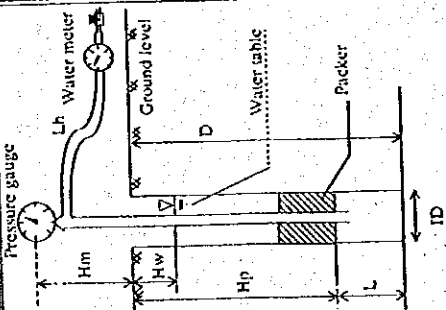
ROCK TYPE: SLATE, SANDSTONE



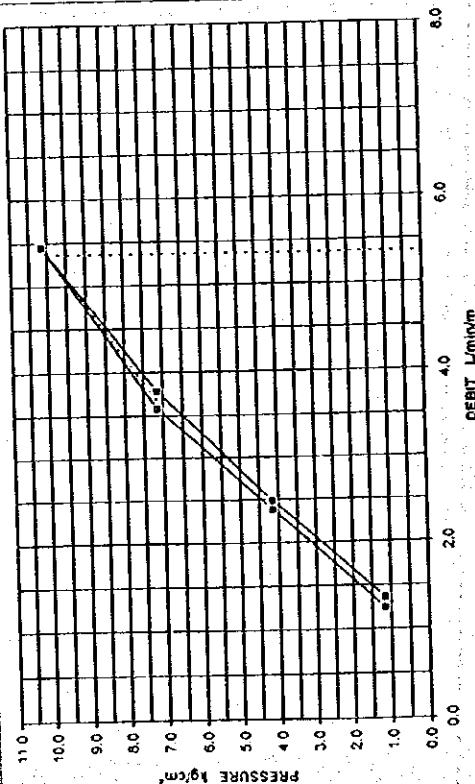
DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

Inclined: 90°

LUGEON PERMEABILITY TEST					TEST No:	HOLE No:	RESULT
					9	BD918D	LUGEON: 5.36
TEST SECTION (m)							
DATE	STARTED AT	18 H 30	TO:	45.0 m			
21/08/99	COMPLETED AT:	19 H 55	FROM:	45.0 m			
PRESSURE (kg/cm ²)							
D	45.0 m	φ ID	0.091 m	Lr	m		
H _p	40.0 m	H _w	0.50 m	Lh	m		
L	5.0 m	H _m	1.0 m	φ rods	cm		
PRESSURE (kg/cm ²)							
Applied	Gravity	Head loss	Total	DEBIT (L/min)	DEBIT		
1.00	0.15		1.15	6.22	1.244		
4.00			4.15	11.92	2.384		
7.00			7.15	17.90	3.580		
10.00			10.15	27.26	5.452		
7.00			7.15	18.91	3.782		
4.00			4.15	12.44	2.488		
1.00			1.15	6.82	1.364		



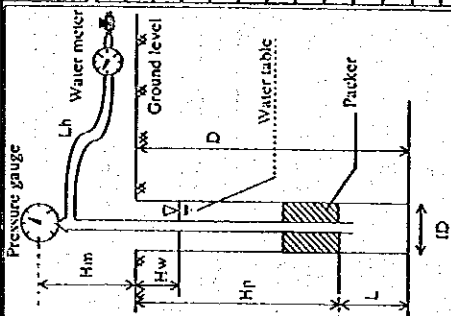
ROCK TYPE: SLATE, SANDSTONE



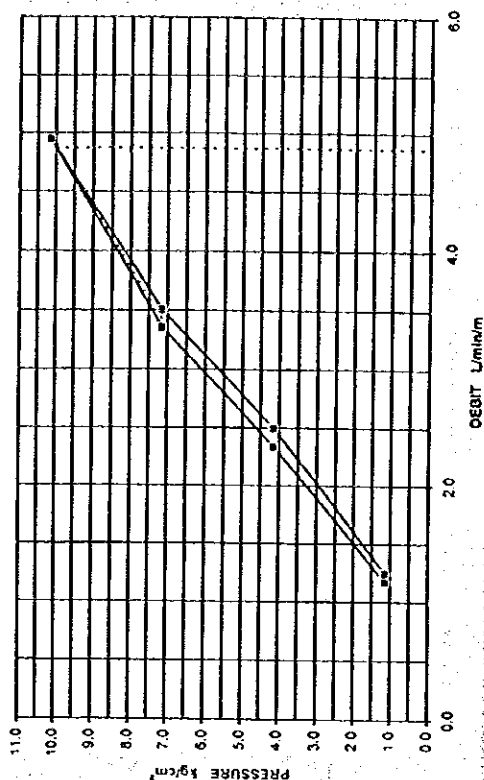
DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

Inclined: 90°

LUGEON PERMEABILITY TEST					
TEST No:		HOLE No:		RESULT	
10		BD918D		LUGEON: 4.87	
TEST SECTION (m)					
FROM: 45.0 m		TO: 50.0 m		K (cm/s) = 1.91E-05	
D = 50.0 m		ϕ ID = 0.091 m		G.W.L.(m): 0.5	
H _p = 45.0 m		H _w = 0.50 m		L _r = m	
L = 5.0 m		H _m = 1.0 m		L _h = m	
		ϕ rods =		cm	
PRESSURE (kg/cm ²)					
Applied		Gravity		Head loss	
1.00		0.15		Total	
4.00				1.15	
7.00				4.15	
10.00				7.15	
7.00				10.15	
4.00				7.15	
1.00				4.15	
				1.15	
				</	



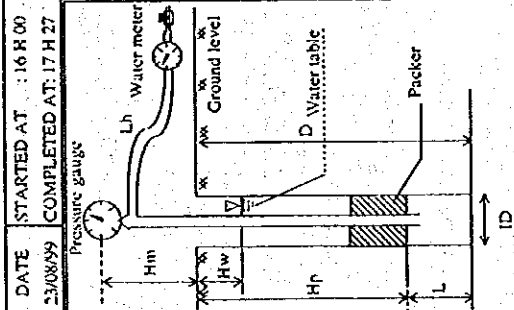
ROCK TYPE: SLATE, SANDSTONE



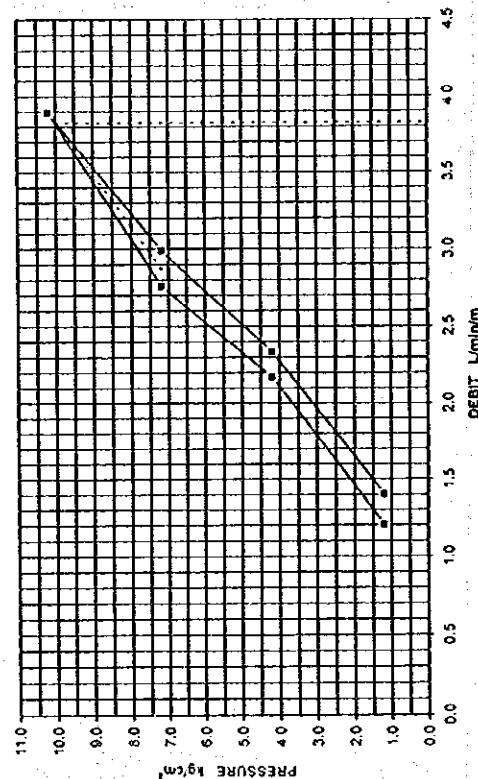
DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

Inclined: 90°

LUGEON PERMEABILITY TEST		TEST No:	HOLE No:	RESULT
		11	BD918D	LUGEON: 3.83
TEST SECTION (m)		K (cm/s) = 1.46E-05		
FROM: 50.5 m		TO: 55.0 m		
D = 55.0 m		φ ID = 0.091 m		
H _p = 50.5 m		H _w = 0.50 m		
L = 4.5 m		H _m = 1.5 m		
		φ rock = cm		
		PRESSURE (kg/cm ²)		
		Applied Gravity	Head loss	DEBIT
		1.00	0.20	Total (L/min)
		4.00		5.42
		7.00		9.78
		10.00		12.42
		7.00		17.52
		4.00		13.46
		1.00		10.52
				2.338
				6.32
				1.404



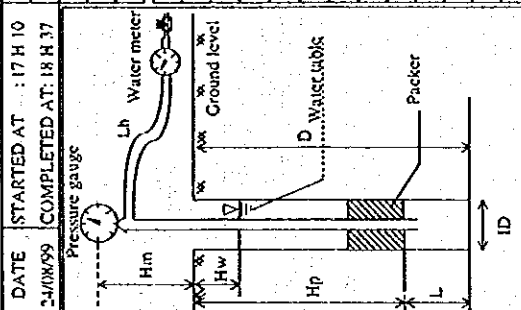
ROCK TYPE: SLATE, SANDSTONE



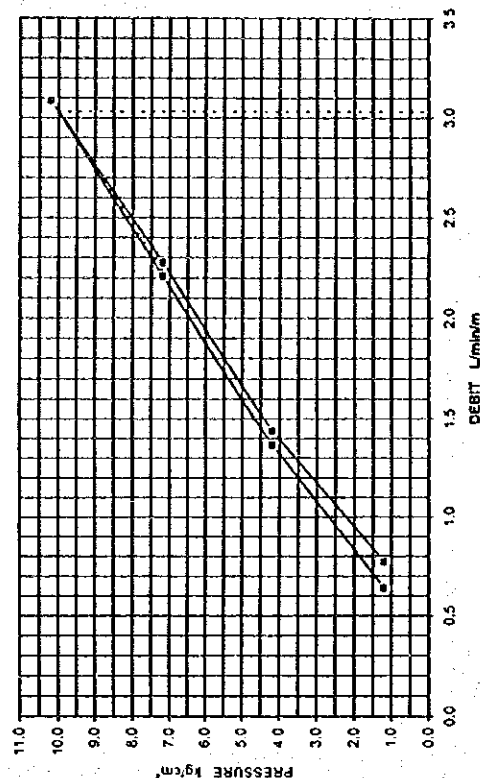
DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

Inclined: 90°

LUGEON PERMEABILITY TEST		TEST No:	HOLE No:	RESULT
		12	BD918D	LUGEON: 3.03
TEST SECTION (m)		K (cm/s) = 1.19E-05		
FROM: 55.0 m		TO: 60.0 m		
D = 60.0 m		φ ID = 0.091 m		
H _p = 55.0 m		H _w = 0.50 m		
L = 5.0 m		H _m = 1.5 m		
		φ rock = cm		
		PRESSURE (kg/cm ²)		
		Applied Gravity	Head loss	DEBIT
		1.00	0.20	Total (L/min)
		4.00		3.20
		7.00		6.84
		10.00		11.05
		7.00		15.44
		4.00		11.38
		1.00		7.19
				1.438
				3.87
				0.774



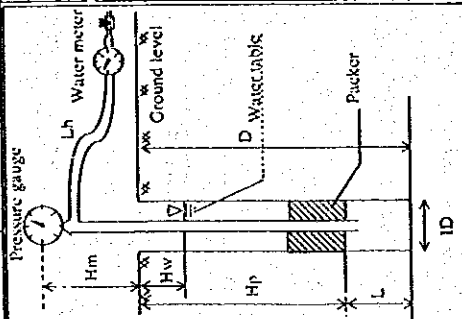
ROCK TYPE: SLATE, SANDSTONE



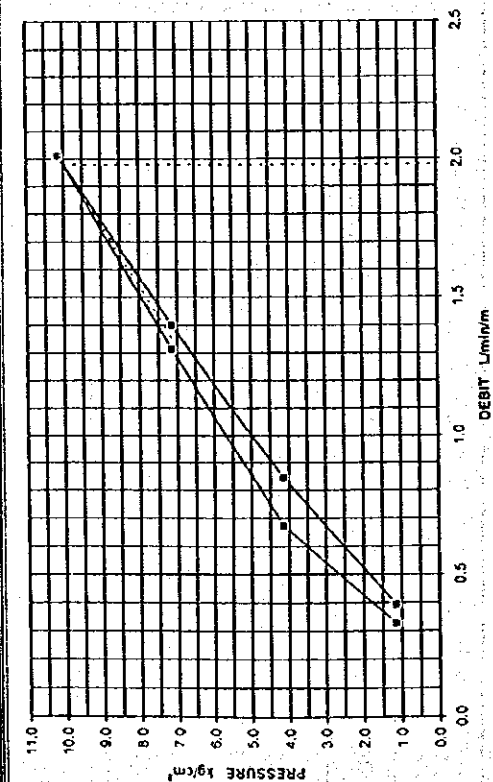
DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

Inclined: 90°

LUGEON PERMEABILITY TEST		TEST No:	HOLE No:	RESULT
		13	BD918D	LUGEON: 1.98
TEST SECTION (m)		K (cm/s) = 7.56E-06		
FROM: 60.0 m		C.W.L. (m): 0.5		
D = 65.0 m		Lr = m		
Hw = 60.0 m		Lh = m		
L = 5.0 m		m ϕ rods = cm		
PRESSURE (kg/cm ²)		DEBIT		
Applied Gravity		Head loss		Total (L/min)
1.00		0.15		1.15
4.00				4.15
7.00				7.15
10.00				10.15
7.00				7.15
4.00				4.15
1.00				1.15
				1.97
				0.394



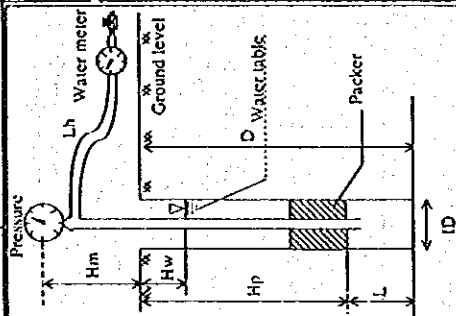
ROCK TYPE: SLATE, SANDSTONE



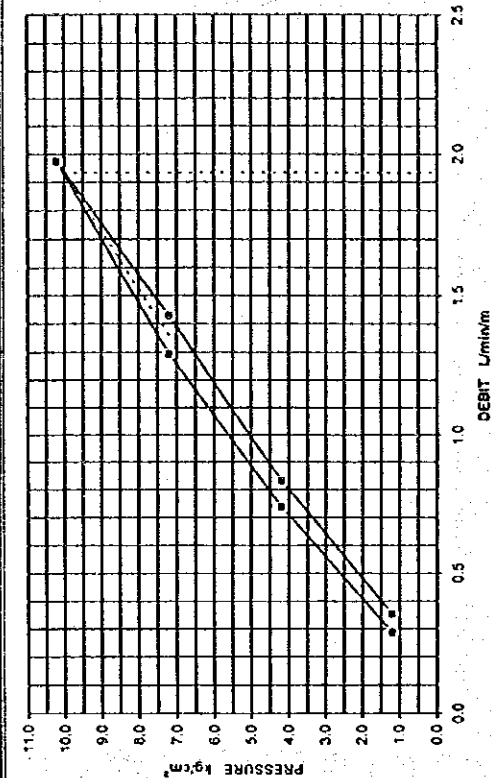
DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

Inclined: 90°

LUGEON PERMEABILITY TEST		TEST No:	HOLE No:	RESULT
		14	BD918D	LUGEON: 1.93
TEST SECTION (m)		K (cm/s) = 7.59E-06		
FROM: 65.0 m		C.W.L. (m): 0.5		
D = 70.0 m		Lr = m		
Hw = 65.0 m		Lh = m		
L = 5.0 m		m ϕ rods = cm		
PRESSURE (kg/cm ²)		DEBIT		
Applied Gravity		Head loss		Total (L/min)
1.00		0.20		1.20
4.00				4.20
7.00				7.20
10.00				10.20
7.00				7.20
4.00				4.20
1.00				1.20
				1.77
				0.354



ROCK TYPE: SLATE, SANDSTONE



DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

OPEN-END CONSTANT-HEAD PERMEABILITY TEST		DATE: STARTED AT : 16 H 35 COMPLETED AT : 16 H 55 20/8/99			
TEST No	HOLE No	PERMEABILITY COEFFICIENT			
1	BD 919D	K = 6.15E-05 cm/s			
TEST SECTION		G.W.L.: DRY m			
DEPTH, m	H, cm	r, cm	Constant: Q, cm ³ /min		
5.0	500.0	6.5	66.00		
Time min.	Volume in V, cm ³	Flow in Q, cm ³ /min	Time min	Volume in V, cm ³	Flow in Q, cm ³ /min
0	0.0		13	2588.0	110.00
1	264.0	264.0	14	2596.0	88.00
2	528.0	264.0	15	2684.0	88.00
3	770.0	242.0	16	2750.0	66.00
4	990.0	220.0	17	2816.0	66.00
5	1210.0	220.0	18	2882.0	66.00
6	1430.0	220.0	19	2948.0	66.00
7	1628.0	198.0	20	3014.0	66.00
8	1804.0	176.0			
9	1980.0	176.0			
10	2134.0	154.0			
11	2266.0	132.0			
12	2398.0	132.0			
SOIL TYPE: Highly weathered zone: CLAY.					

Flow in

Constant water level

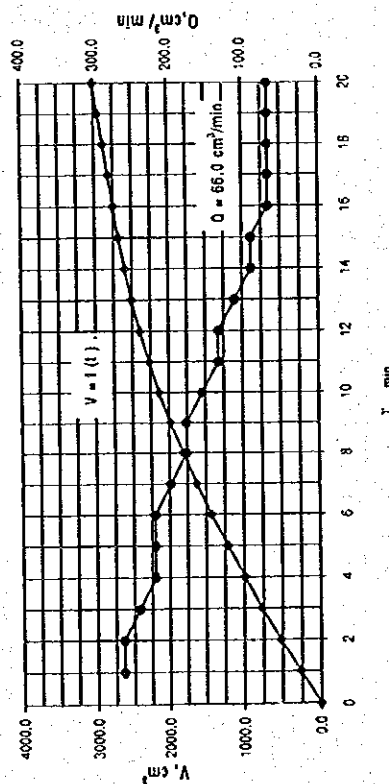
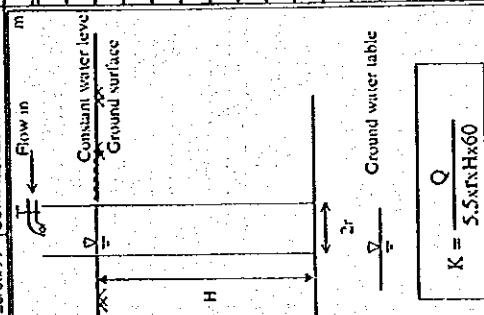
Ground surface

H

2r

Ground water table

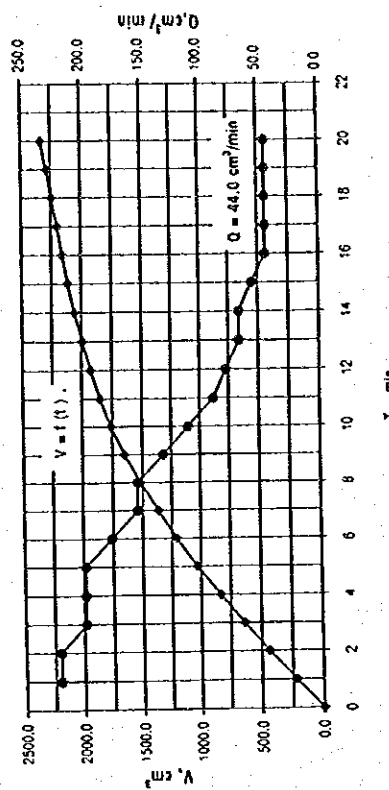
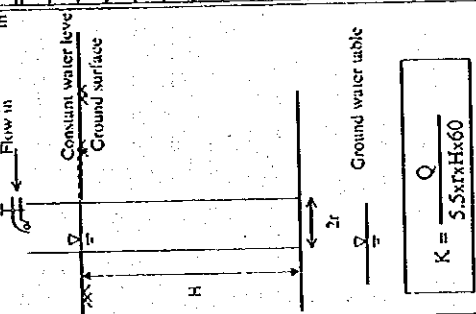
$$K = \frac{Q}{5.5 \pi r H \Delta h}$$



DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

OPEN-END CONSTANT-HEAD PERMEABILITY TEST		
TEST No	HOLE No	PERMEABILITY COEFFICIENT
2	BD 919D	K = 2.05E-05 cm/s
DATE: STARTED AT : 15 H 00		
COMPLETED AT : 15 H 20		
24/8/99		
DEPTH, m	H, cm	r, cm
10.0	1000.0	6.5
G.W.L.: DRY m		
Constant: Q, cm ³ /min		
44.00		
Time min.	Volume in V, cm ³	Flow in Q, cm ³ /min
0	0.0	
1	220.0	220.0
2	440.0	220.0
3	638.0	198.0
4	836.0	198.0
5	1034.0	198.0
6	1210.0	176.0
7	1364.0	154.0
8	1518.0	154.0
9	1650.0	132.0
10	1760.0	110.0
11	1848.0	88.0
12	1925.0	77.0
SOIL TYPE: Highly weathered zone : CLAY, SANDY CLAY.		

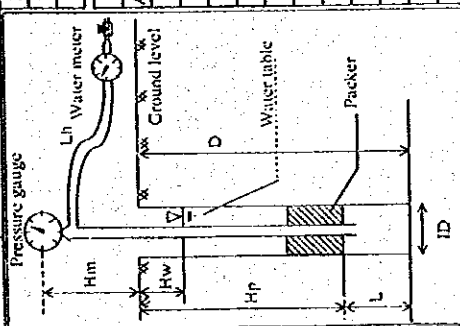
$$K = \frac{Q}{5.5 \pi r H \Delta h}$$



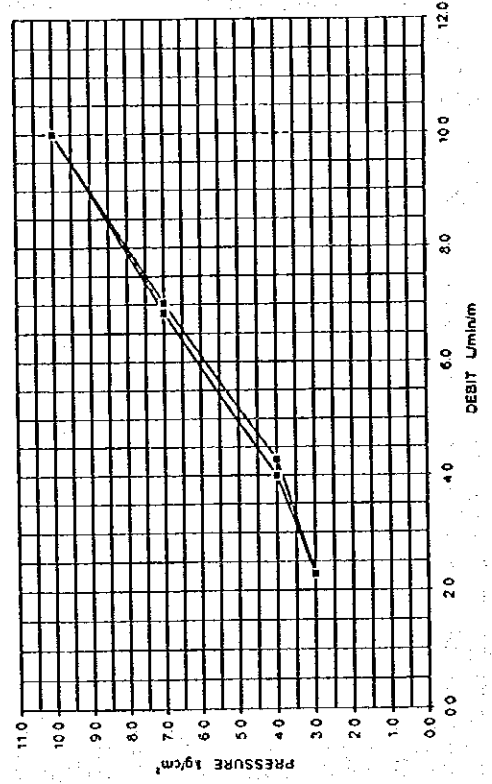
DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

Inclined: 90°

LUGEON PERMEABILITY TEST		TEST No:	HOLE No:	RESULT
		5	BD919D	LUGEON: 10.00
TEST SECTION (m)				
DATE	STARTED AT : 14 H 37			
08/09/99	COMPLETED AT: 16 H 11			
FROM: 25.5 m		TO: 29.0 m		
D = 29.0 m		ϕ ID = 0.110 m	Lr =	m
Hp = 25.5 m		Hw = 23.00 m	Lh =	m
L = 3.5 m		Hm = 2.0 m	ϕ rods =	cm
PRESSURE (kg/cm ²)				
Applied	Gravity	Head loss	Total	DEBIT
0.50	2.50		3.00	(L/min)
1.50			4.00	2.286
4.50			7.00	14.00
7.50			10.00	24.00
4.50			7.00	35.00
1.50			4.00	10.000
0.50			3.00	24.60
				15.00
				4.286
				2.286



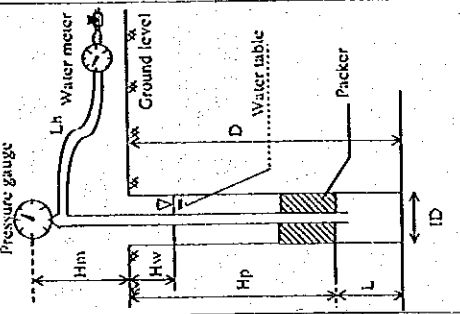
ROCK TYPE: SLATE, SANDSTONE



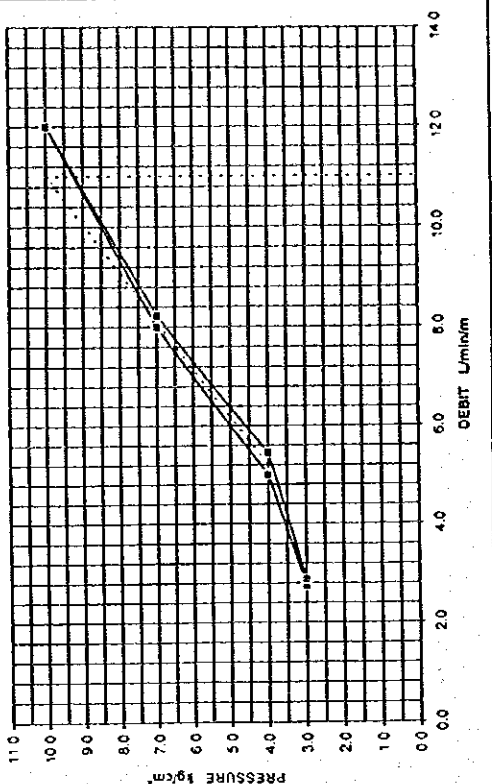
DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

Inclined: 90°

LUGEON PERMEABILITY TEST		TEST No:	HOLE No:	RESULT
		6	BD919D	LUGEON: 11.00
TEST SECTION (m)				
DATE	STARTED AT : 12 H 13			
10/09/99	COMPLETED AT: 13 H 47			
FROM: 29.0 m		TO: 33.0 m		
D = 33.0 m		ϕ ID = 0.110 m	Lr =	m
Hp = 29.0 m		Hw = 23.00 m	Lh =	m
L = 4.0 m		Hm = 2.0 m	ϕ rods =	cm
PRESSURE (kg/cm ²)				
Applied	Gravity	Head loss	Total	DEBIT
0.50	2.50		3.00	(L/min)
1.50			4.00	11.00
4.50			7.00	20.00
7.50			10.00	32.00
4.50			7.00	48.00
1.50			4.00	32.90
0.50			3.00	21.78
				5.445
				11.52
				2.880



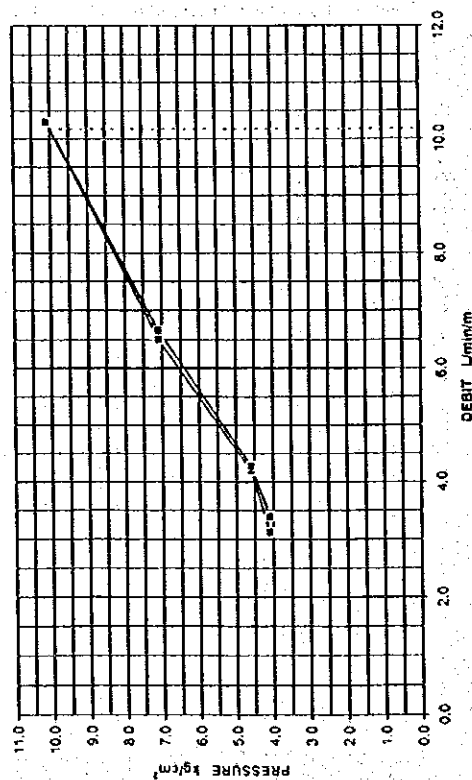
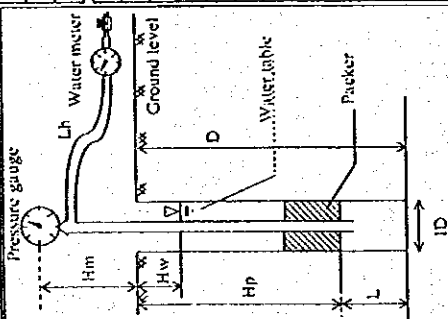
ROCK TYPE: SLATE, SANDSTONE



DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

Inclined: 90°

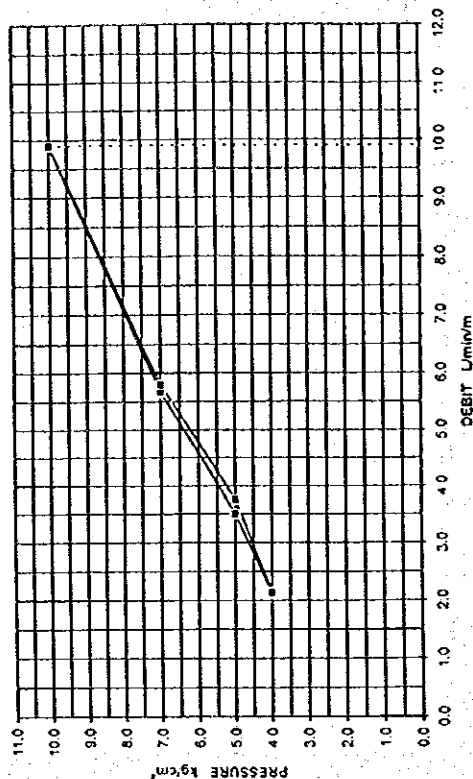
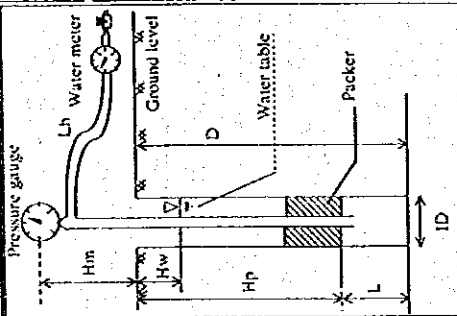
LUGEON PERMEABILITY TEST					TEST No: 7	HOLE No: BD919D	RESULT
LUGEON PERMEABILITY TEST					LUGEON: 10.18		
TEST SECTION (m)					K (cm/s) = 3.64E-05		
FROM: 33.0 m					TO: 37.0 m		
D = 37.0 m					φ ID = 0.110 m		
H _p = 33.0 m					H _w = 34.00 m		
L = 4.0 m					H _m = 2.0 m		
PRESSURE (kg/cm ²)					DEBIT (L/min/m)		
Applied Gravity					Head loss		
0.50					3.60		
1.00					4.60		
3.50					7.10		
6.50					10.10		
3.50					7.10		
1.00					4.60		
0.50					4.10		

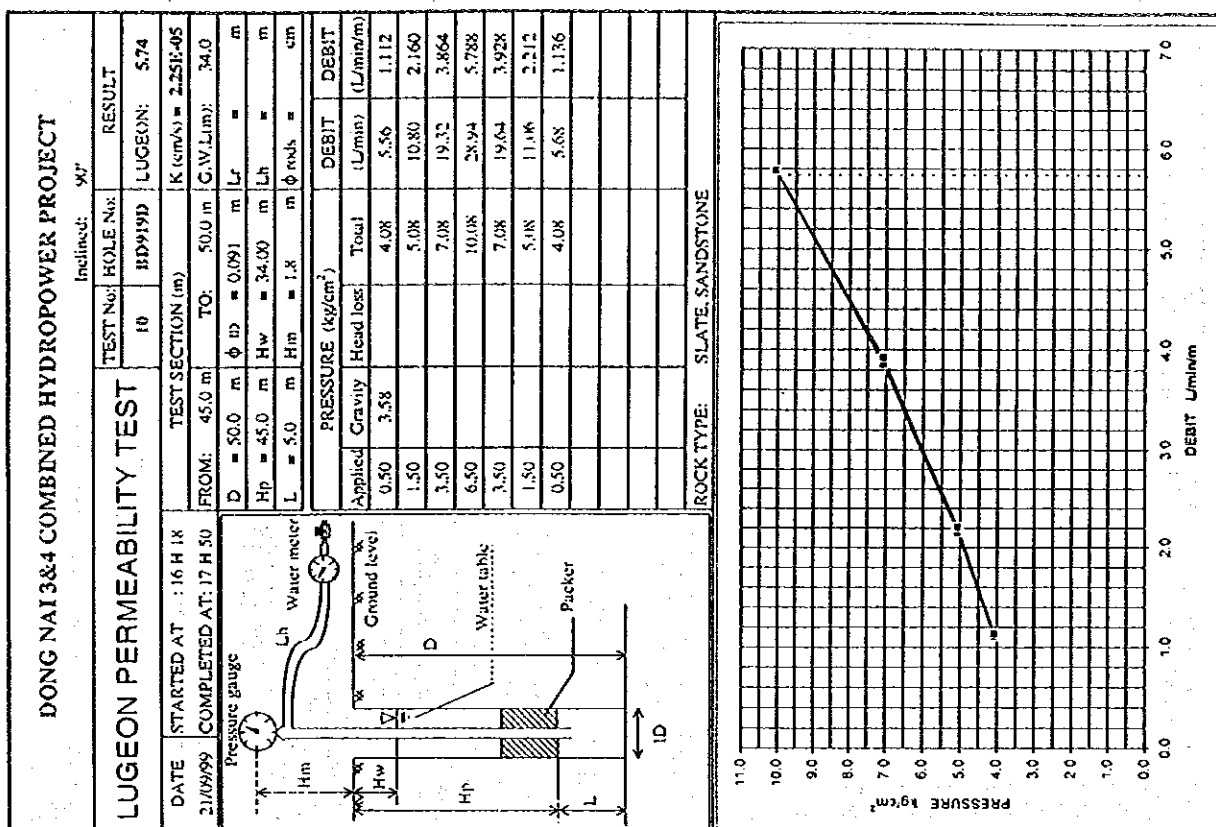
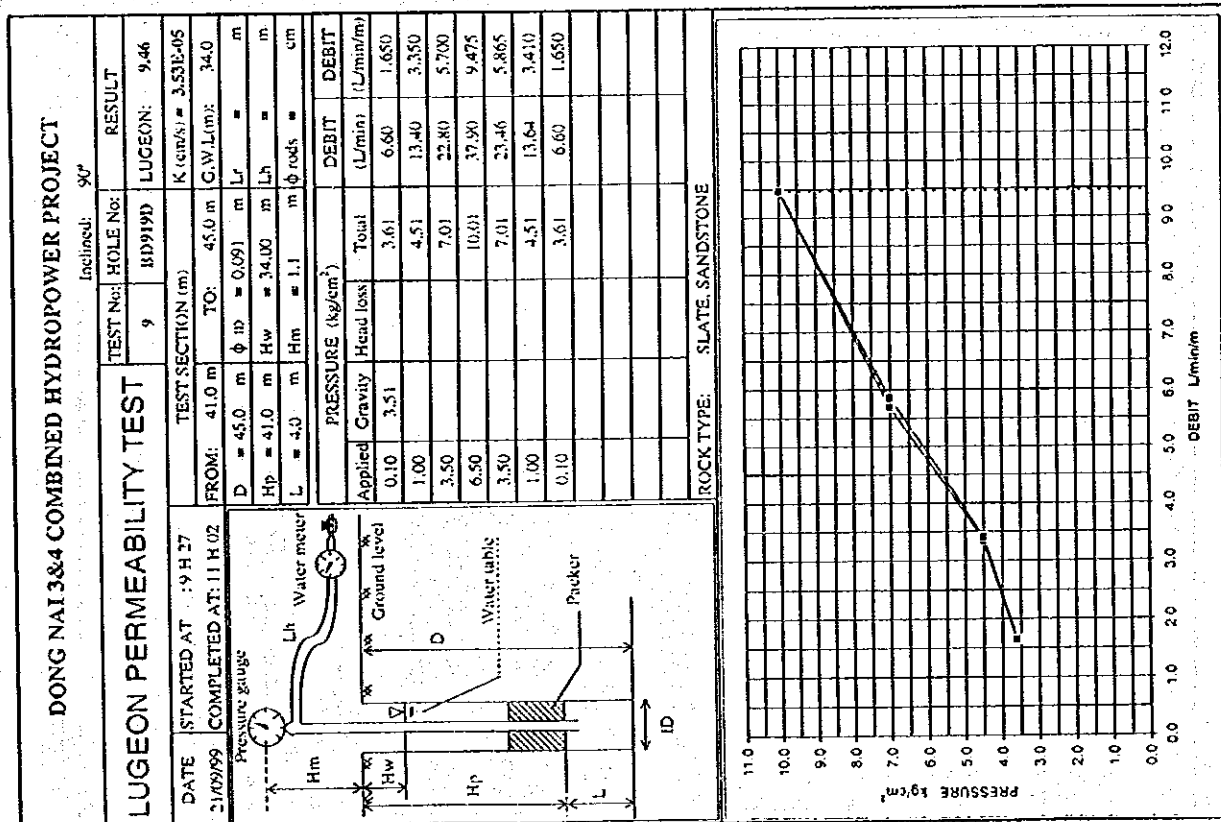


DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

Inclined: 90°

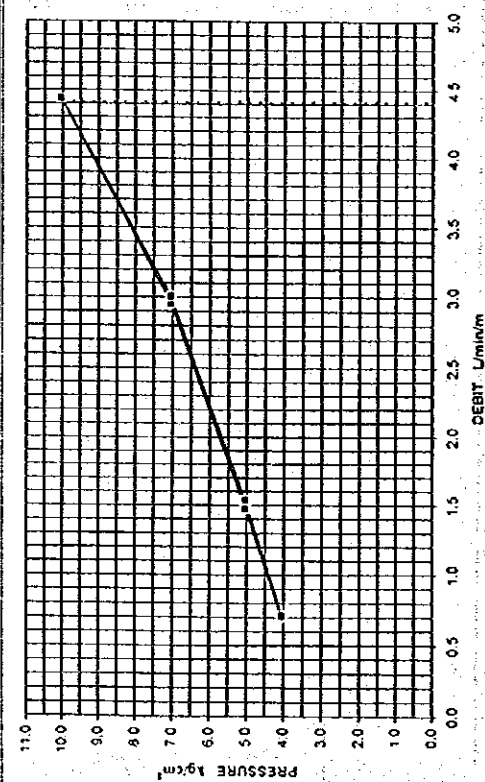
LUGEON PERMEABILITY TEST										TEST No: 8	HOLE No: BD919D	RESULT
LUGEON PERMEABILITY TEST										LUGEON: 9.90		
DATE		STARTED AT : 14 H 55		TEST SECTION (m)		FROM: 37.0 m		TO: 41.0 m		K (cm/s) = 3.69E-05		
20/09/99		COMPLETED AT: 16 H 33		D = 41.0 m		φ ID = 0.091 m		Lr = m		G.V.L (m): 34.0		
				Hp = 37.0 m		Hw = 34.00 m		Lh = m				
				L = 4.0 m		Hm = 1.0 m		φ rods = cm				
				PRESSURE (kg/cm ²)				DEBIT (L/min)				
Applied		Gravity		Head loss		Total		DEBIT		DEBIT		
0.50		3.50				4.00		8.50		2.125		
1.50						5.00		14.00		3.500		
3.50						7.00		22.70		5.675		
6.50						10.00		39.60		9.900		
3.50						7.00		21.20		5.800		
1.50						5.00		15.00		3.750		
0.50						4.00		8.50		2.140		
ROCK TYPE: SLATE, SANDSTONE												





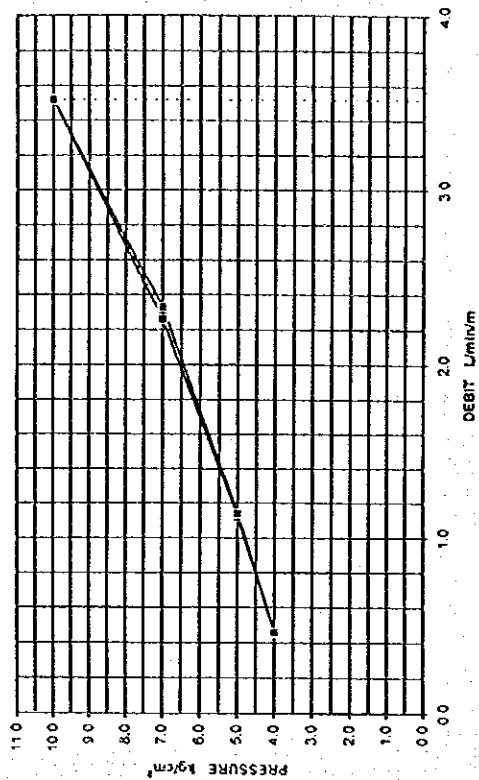
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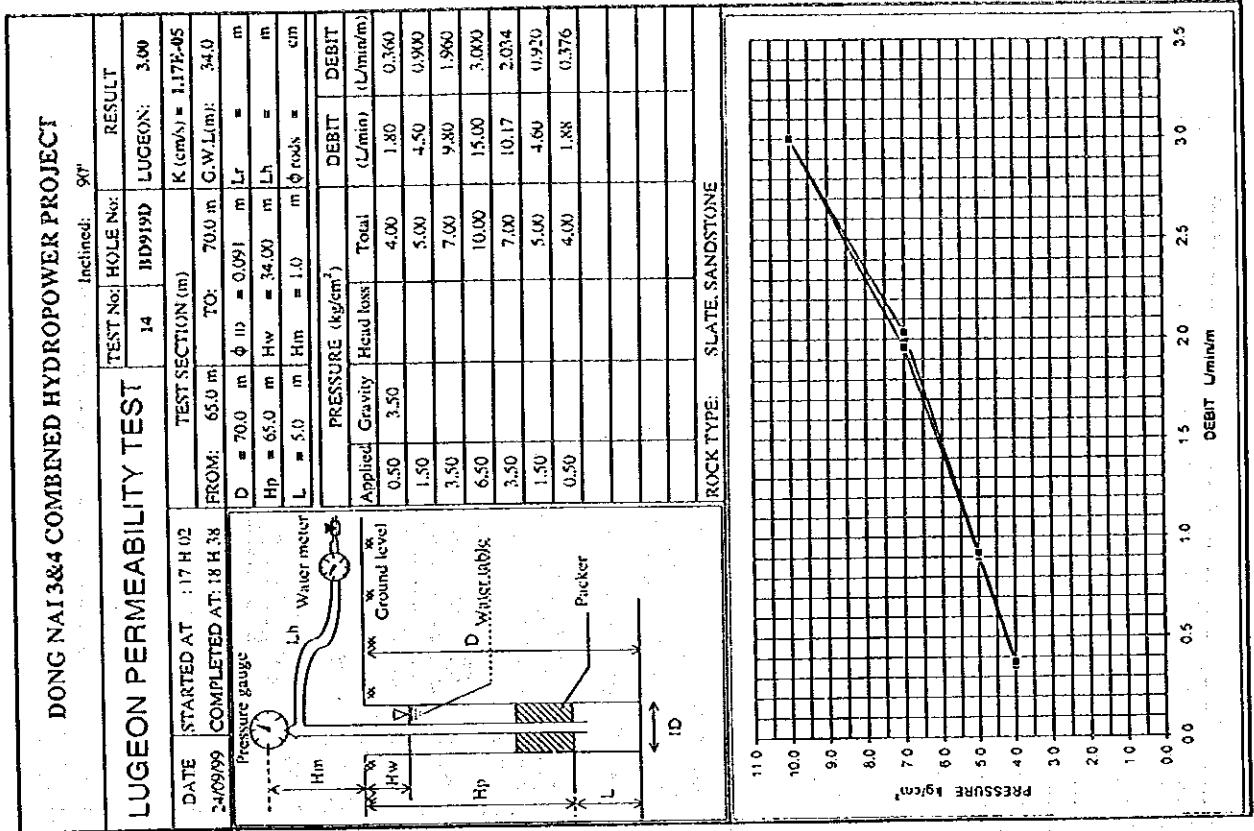
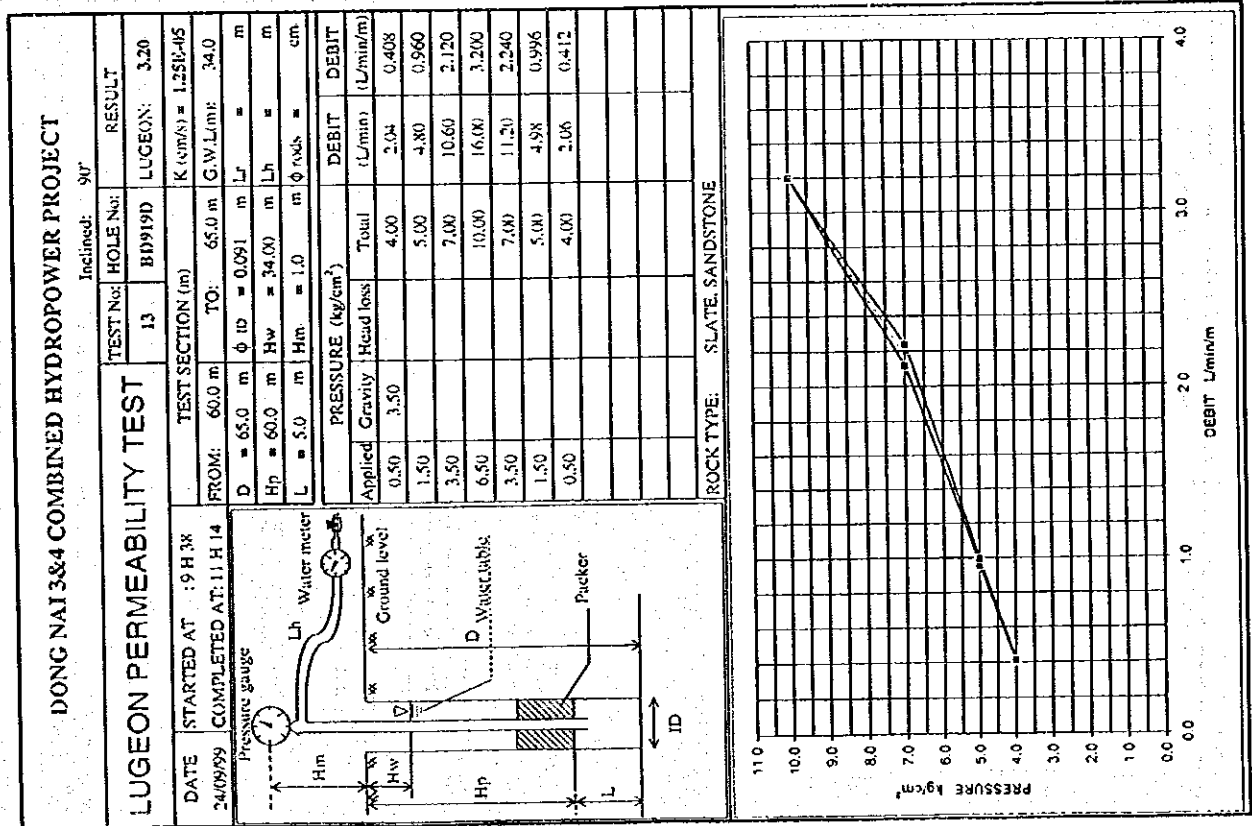
TEST No.:	HOLE No.:
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ROCK TYPE: SLATE, SANDSTONE

4x5: Inclined:

RESULT

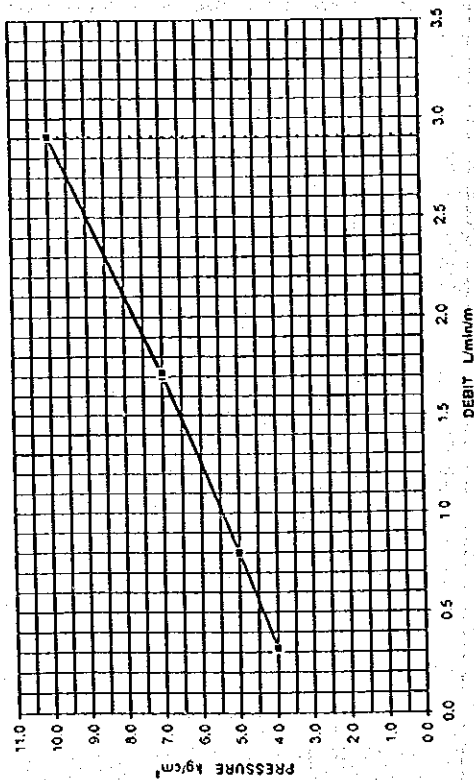
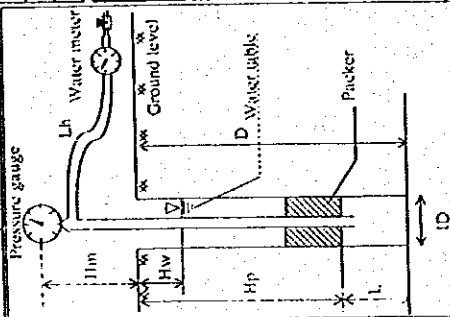
ROCK TYPE: SLATE, SANDSTONE



DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

Inclined: 90°

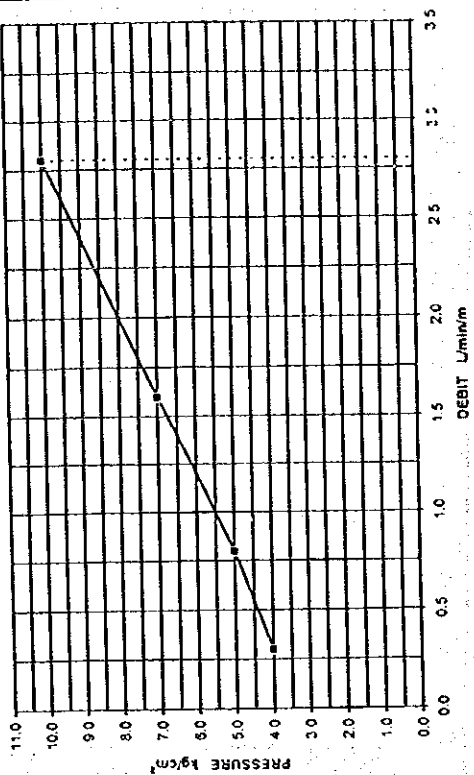
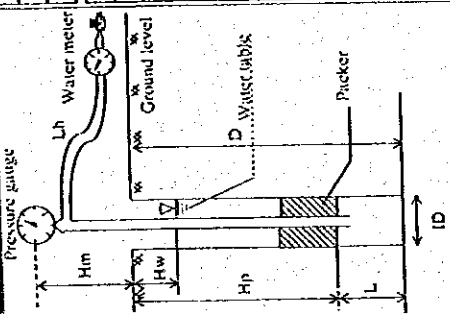
TEST No: 15		HOLE No: BD919D	RESULT
LUGEON PERMEABILITY TEST			LUGEON: 2.91
TEST SECTION (m)			
DATE	STARTED AT : 14 H 44		
26/9/99	COMPLETED AT: 16 H 20		
FROM: 70.0 m TO: 75.0 m G.W. Lm: 34.0			
D	= 75.0 m	ϕ ID = 0.091 m	Lr = m
Hp	= 70.0 m	Hw = 34.00 m	Lh = m
L	= 5.0 m	Hm = 1.0 m	ϕ rods = cm
PRESSURE (kg/cm ²)			
Applied Gravity	Head loss	Total	DEBIT (L/min)
0.50	3.50	4.00	1.60
1.50		5.00	4.00
3.50		7.00	8.50
6.50		10.00	14.55
3.50		7.00	8.60
1.50		5.00	4.00
0.50		4.00	1.60
DEBIT (L/min/m)			
0.50	3.50	4.00	0.320
1.50		5.00	0.800
3.50		7.00	1.700
6.50		10.00	2.910
3.50		7.00	1.720
1.50		5.00	0.800
0.50		4.00	0.320
ROCK TYPE: SLATE, SANDSTONE			



DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

Inclined: 90°

TEST No: 16		HOLE No: BD919D	RESULT
LUGEON PERMEABILITY TEST			LUGEON: 2.80
TEST SECTION (m)			
DATE	STARTED AT : 12 H 17		
26/9/99	COMPLETED AT: 13 H 55		
FROM: 75.0 m TO: 80.0 m G.W. Lm: 34.0			
D	= 80.0 m	ϕ ID = 0.091 m	Lr = m
Hp	= 75.0 m	Hw = 34.00 m	Lh = m
L	= 5.0 m	Hm = 1.0 m	ϕ rods = cm
PRESSURE (kg/cm ²)			
Applied Gravity	Head loss	Total	DEBIT (L/min)
0.50	3.50	4.00	1.50
1.50		5.00	4.00
3.50		7.00	8.00
6.50		10.00	14.00
3.50		7.00	8.00
1.50		5.00	4.00
0.50		4.00	1.50
DEBIT (L/min/m)			
0.50	3.50	4.00	0.300
1.50		5.00	0.800
3.50		7.00	1.600
6.50		10.00	2.800
3.50		7.00	1.600
1.50		5.00	0.800
0.50		4.00	0.300
ROCK TYPE: SLATE, SANDSTONE			



DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

OPEN-END CONSTANT-

HEAD PERMEABILITY TEST

DATE: STARTED AT : 7 H 10

25/08/99 COMPLETED AT : 7 H 30

Flow in

Constant water level

Ground surface

H

2r

Ground water table

$K = \frac{Q}{5.5 \pi H \Delta h \cdot 60}$

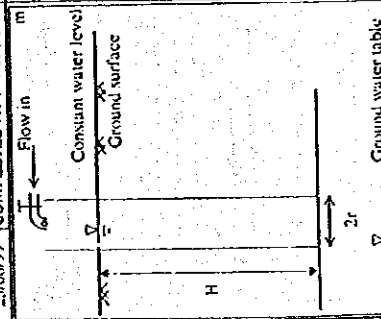
TEST No	HOLE No	PERMEABILITY COEFFICIENT
1	BD 920D	K = 2.05E-05 cm/s

TEST SECTION		G.W.L.: DRY m
DEPTH, m	H, cm	Constant Q, cm ³ /min
10.0	1000.0	6.5
10.0		44.0

Time min.	Volume in V, cm ³	Flow in Q, cm ³ /min	Time min	Volume in V, cm ³	Flow in Q, cm ³ /min
0	0.0		13	1397.0	55.0
1	220.0	220.0	14	1452.0	55.0
2	396.0	176.0	15	1496.0	44.0
3	572.0	176.0	16	1540.0	44.0
4	726.0	154.0	17	1584.0	44.0
5	836.0	110.0	18	1628.0	44.0
6	946.0	110.0	19	1672.0	44.0
7	1034.0	88.0	20	1716.0	44.0
8	1100.0	66.0			
9	1166.0	66.0			
10	1232.0	66.0			
11	1287.0	55.0			
12	1342.0	55.0			

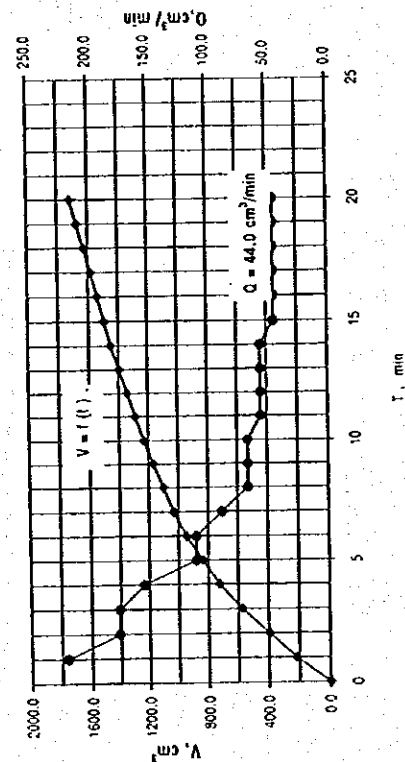
SOIL TYPE:

Highly weathered zone : CLAY



$$K = \frac{Q}{5.5 \pi r H \Delta h}$$

SOIL TYPE: Highly weathered zone : CLAY



DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

OPEN-END CONSTANT- HEAD PERMEABILITY TEST

DATE: STARTED AT : 16 H 40
25/08/99 COMPLETED AT : 17 H 00

Diagram illustrating the setup for an open-end constant-head permeability test. The diagram shows a vertical pipe of length H with a water level at height h from the bottom. The pipe is connected to a constant water level source at the top. The bottom of the pipe is at a distance $2r$ from a ground water table. The diagram shows the flow of water from the constant water level source through the pipe into the ground water table.

$$K = \frac{Q}{5.54rHx60}$$

TEST No. HOLE No. PERMEABILITY COEFFICIENT

2 BD 920D K = 2.24E-05 cm/s

DEPTH, m

16.0 1600.0 H, cm 1600.0 6.5

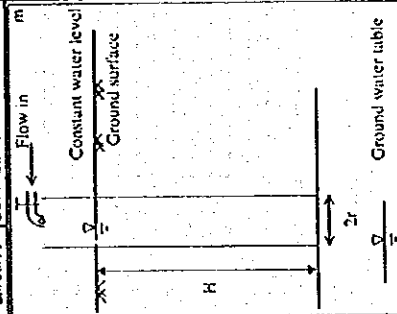
G.W.L.: DRY m

Constant Q, cm³/min

77.0

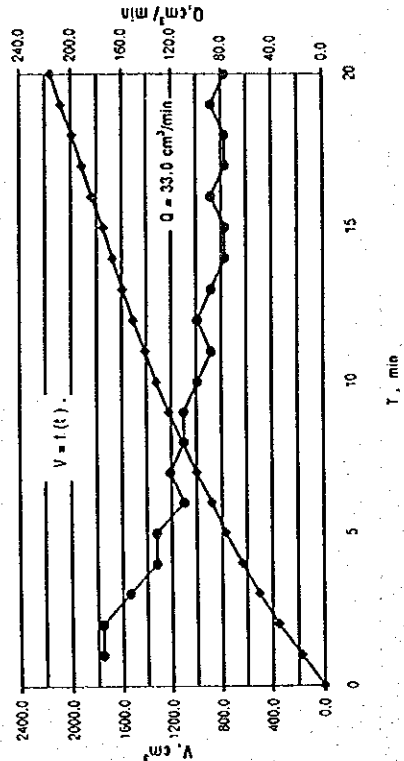
Time min.	Volume in V, cm ³	Flow in Q, cm ³ /min	Time min	Volume in V, cm ³	Flow in Q, cm ³ /min
0	0.0	0.0	13	1595.0	88.0
1	176.0	176.0	14	1672.0	77.0
2	352.0	176.0	15	1749.0	77.0
3	506.0	154.0	16	1837.0	88.0
4	638.0	132.0	17	1914.0	77.0
5	770.0	132.0	18	1991.0	77.0
6	880.0	110.0	19	2079.0	88.0
7	1001.0	121.0	20	2156.0	77.0
8	1111.0	110.0			
9	1221.0	110.0			
10	1320.0	99.0			
11	1408.0	88.0			
12	1507.0	99.0			

SOIL TYPE: Highly weathered zone : CLAY



$$K = \frac{Q}{5.5 \pi r H \Delta h}$$

SOIL TYPE: Highly weathered zone : CLAY

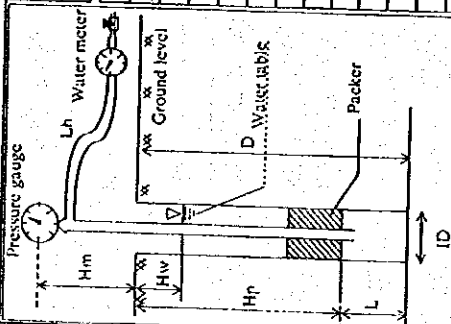


DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

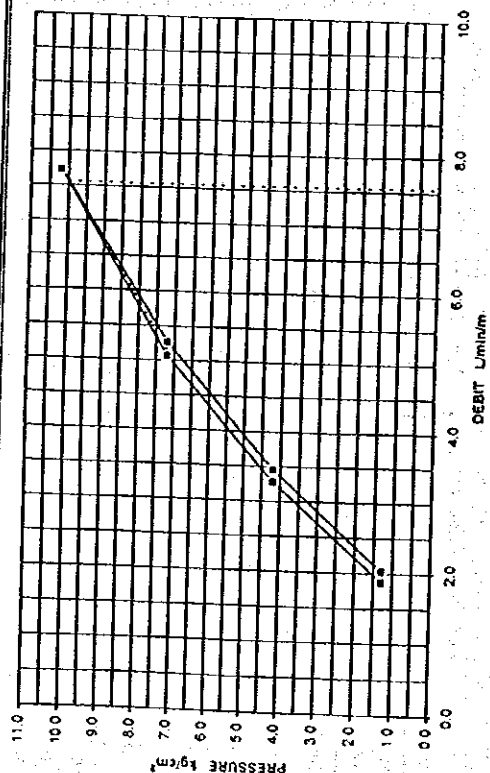
Inclined: 94°

LUGEON PERMEABILITY TEST

TEST No:	HOLE No:	RESULT
3	BD920D	LUGEON: 7.56
TEST SECTION (m)		
DATE	STARTED AT	15 H 10
03/09/99	COMPLETED AT	16 H 34
FROM: 17.5 m TO: 21.0 m		
D = 21.0 m	φ ID = 0.110 m	Lr = 11.5 m
Hp = 17.5 m	Hw = 11.50 m	Lh = m
L = 3.5 m	Hm = 0.5 m	φ rods = cm
PRESSURE (kg/cm ²)		
Applied Gravity	Head loss	Total
0.10	1.20	1.30
3.00		4.20
6.00		7.20
9.00		10.20
6.00		7.20
3.00		4.20
0.10		1.30
DEBIT (L/min)		
		6.58
		11.47
		17.75
		27.04
		18.44
		12.09
		7.10
		2.029
DEBIT (L/min/m)		
		1.880
		3.277
		5.071
		7.726
		5.269
		3.454
		2.029



ROCK TYPE: SANDSTONE, SHALE

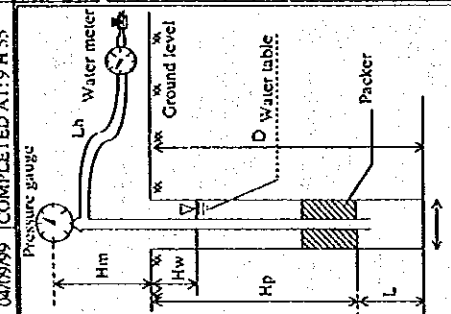


DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

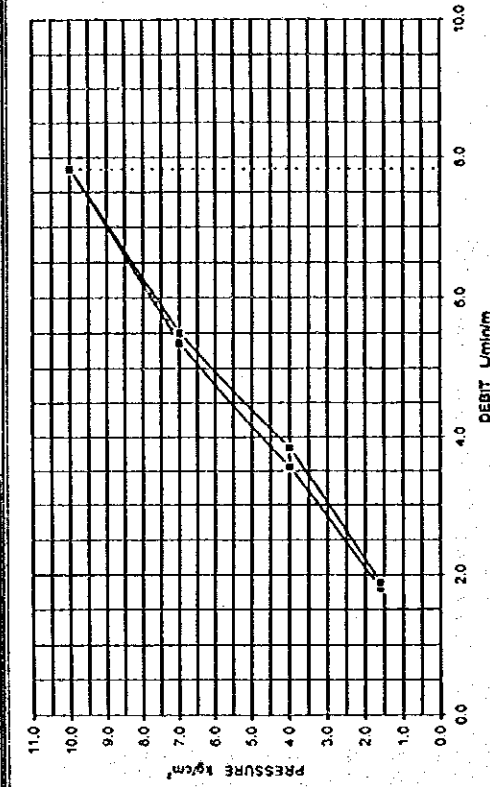
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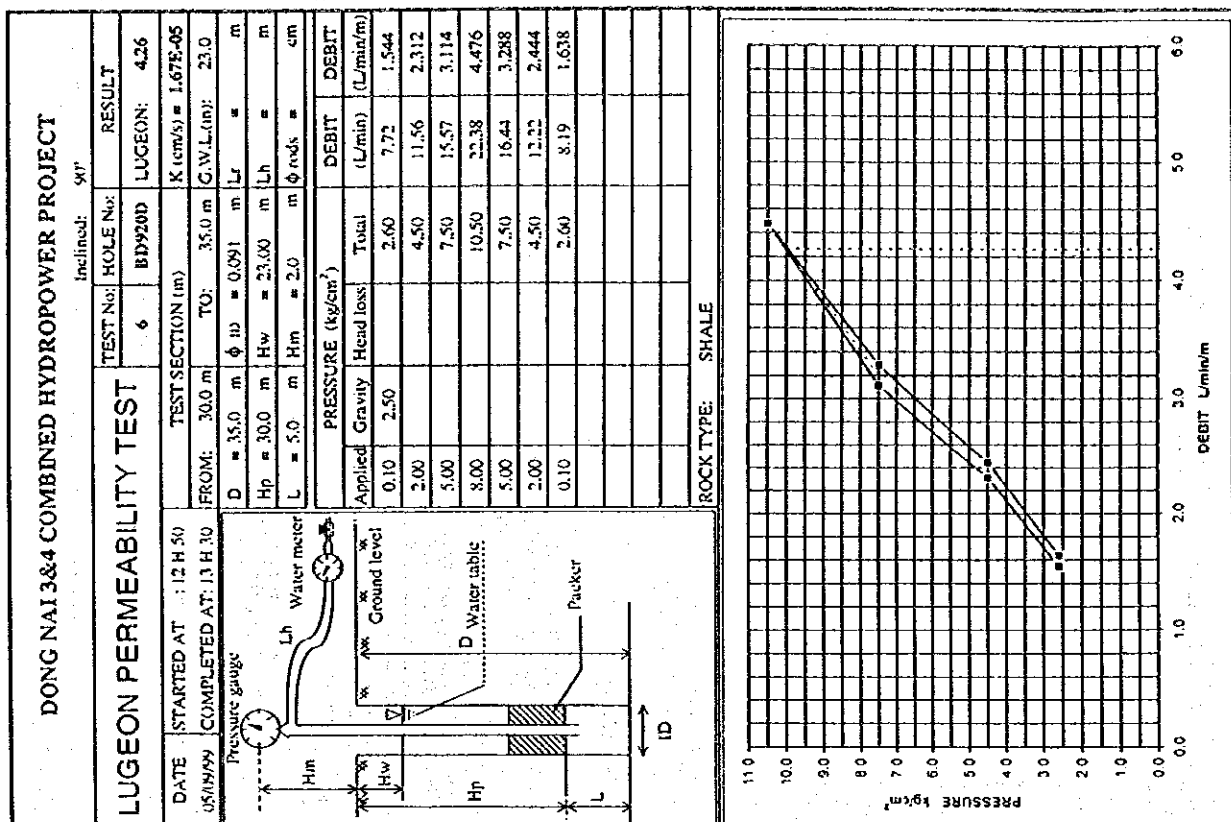
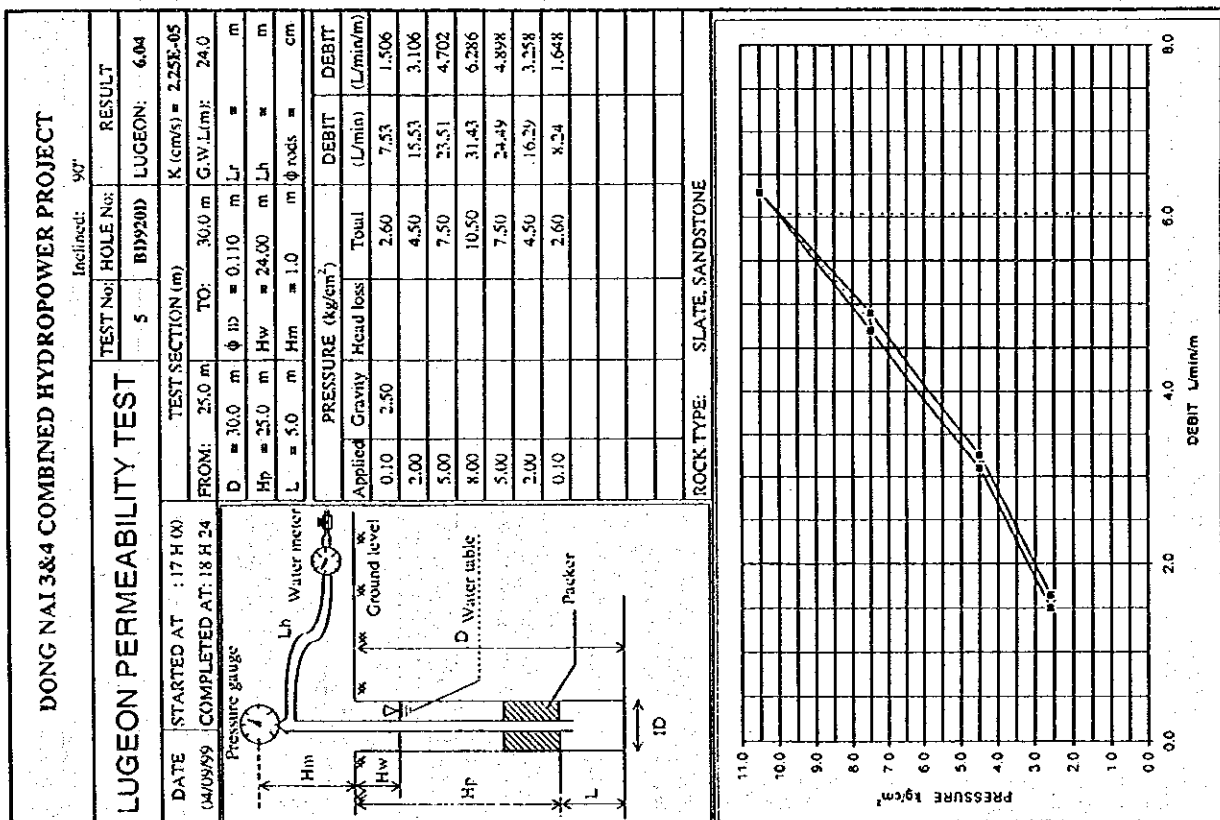
LUGEON PERMEABILITY TEST

TEST No:	HOLE No:	RESULT
4	BD920D	LUGEON: 7.83
TEST SECTION (m)		
DATE	STARTED AT	18 H 30
04/09/99	COMPLETED AT	19 H 55
FROM: 21.0 m TO: 25.0 m		
D = 25.0 m	φ ID = 0.110 m	Lr = 14.0 m
Hp = 21.0 m	Hw = 14.00 m	Lh = m
L = 4.0 m	Hm = 1.0 m	φ rods = cm
PRESSURE (kg/cm ²)		
Applied Gravity	Head loss	Total
0.10	1.50	1.60
2.50		4.00
5.50		7.00
8.50		10.00
5.50		7.00
2.50		4.00
0.10		1.60
DEBIT (L/min)		
		7.25
		14.23
		21.43
		31.33
		22.01
		15.38
		7.58
		1.895
DEBIT (L/min/m)		
		1.813
		3.558
		5.358
		7.833
		5.503
		3.845
		1.895



ROCK TYPE: SANDSTONE, SHALE



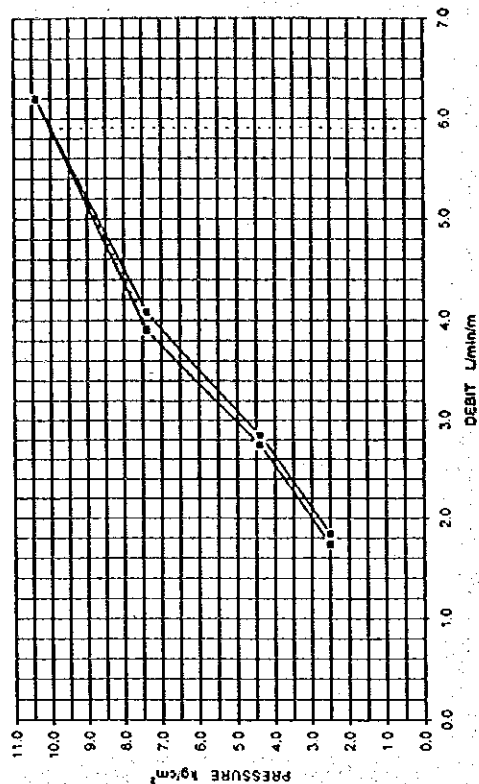


DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

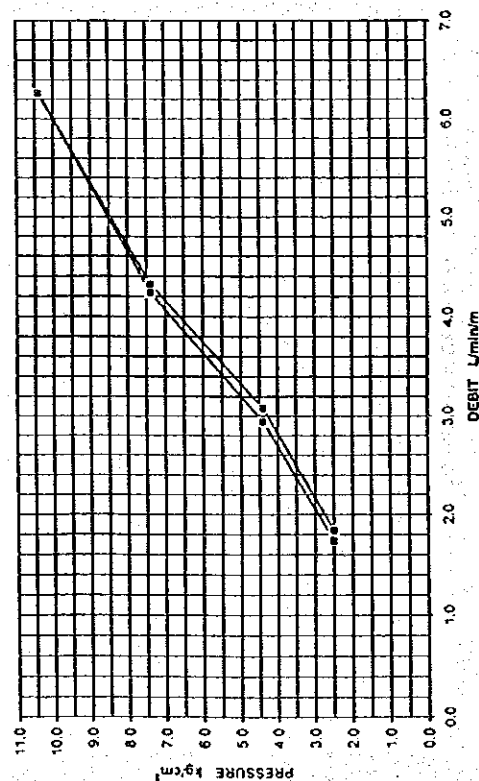
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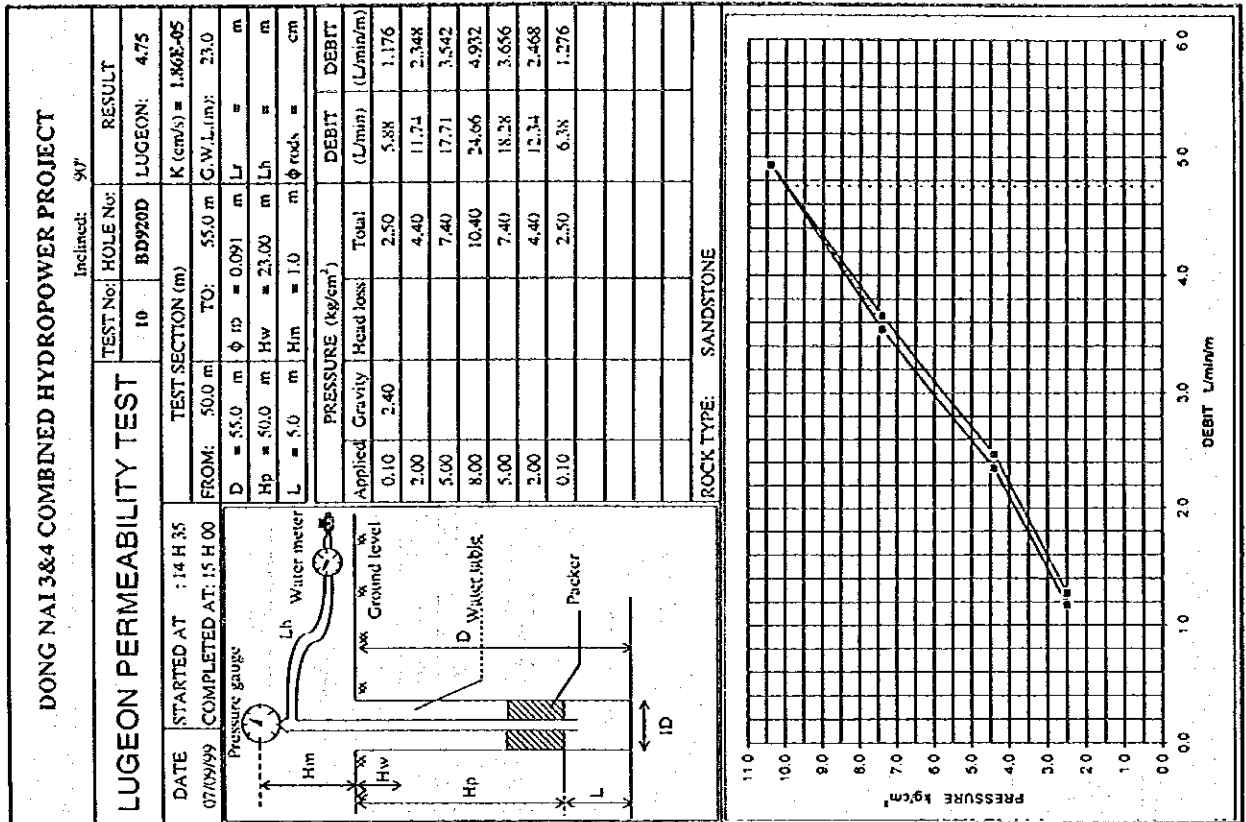
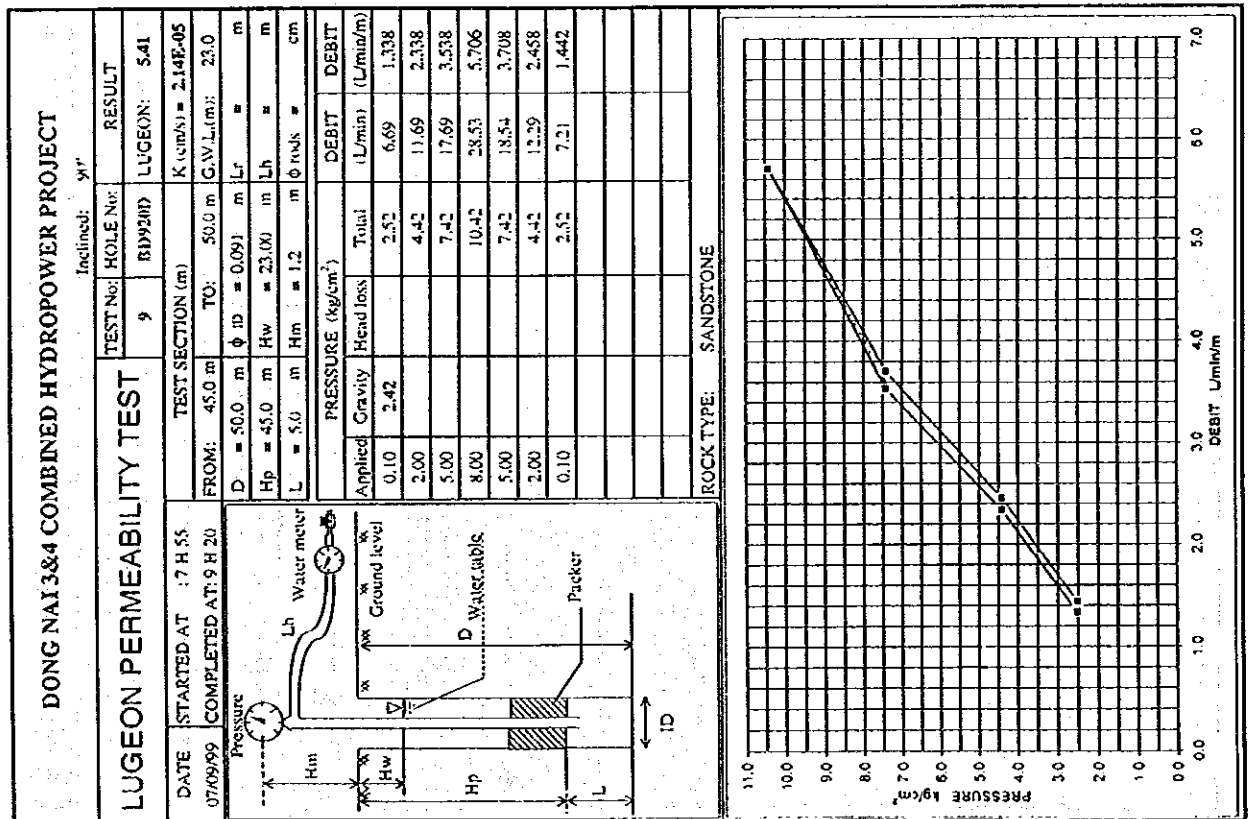
ה'תשנ"ח

LUGEON PERMEABILITY TEST

[illegible]

LUGEON PERMEABILITY TEST

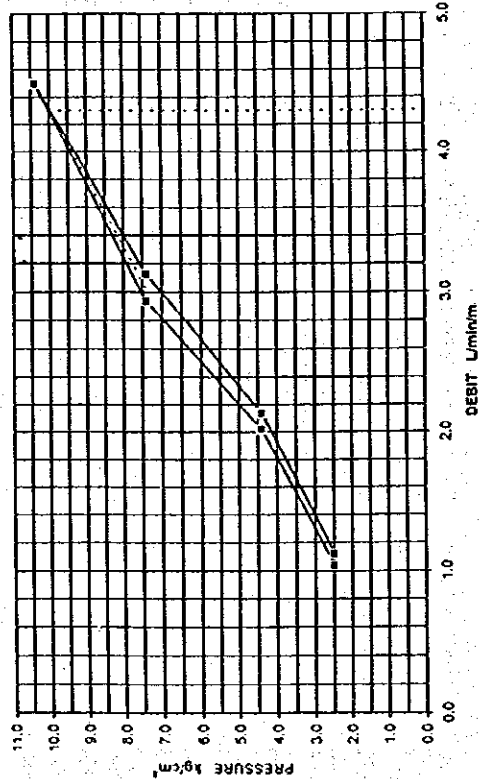
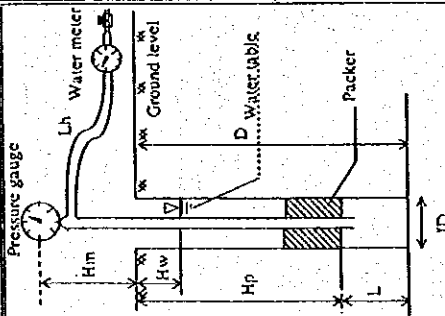
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DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

Inclined: 90°

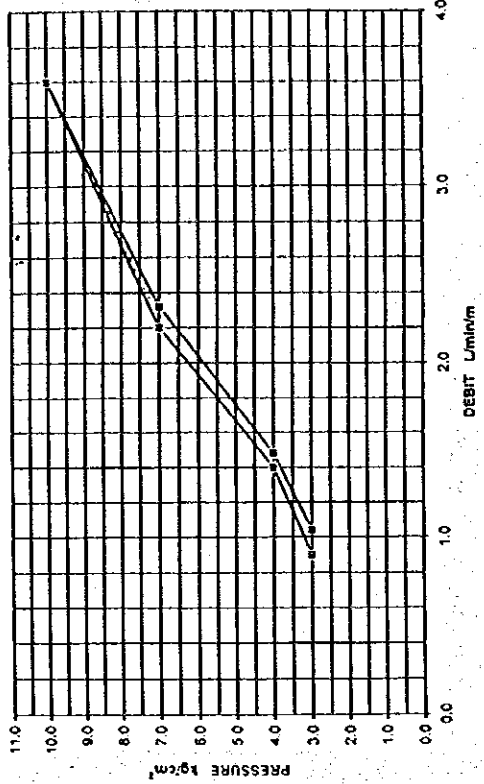
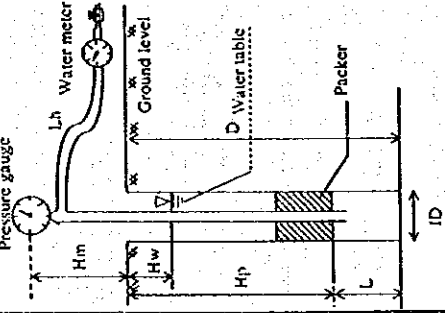
LUGEON PERMEABILITY TEST		TEST No: 11	HOLE No: BD9200	RESULT
DATE: 18/09/99 STARTED AT: 12 H 10 COMPLETED AT: 13 H 35		TEST SECTION (m)		LUGEON: 4.30
FROM: 55.0 m		TO: 60.0 m		K (cm/s) = 1.69E-05
D = 60.0 m		φ ID = 0.091 m		G.W.L (m): 23.0
H _p = 55.0 m		H _w = 23.00 m		L _r = m
L = 5.0 m		H _m = 1.0 m		φ ods = cm
PRESSURE (kg/cm ²)		DEBIT (L/min)		DEBIT (L/min/m)
Applied	Gravity	Head loss	Total	
0.10	2.40		2.50	5.21
2.00			4.40	10.11
5.00			7.40	14.68
8.00			10.40	22.49
5.00			7.40	15.64
2.00			4.40	10.70
0.10			2.50	5.61
ROCK TYPE: SANDSTONE, SLATE				

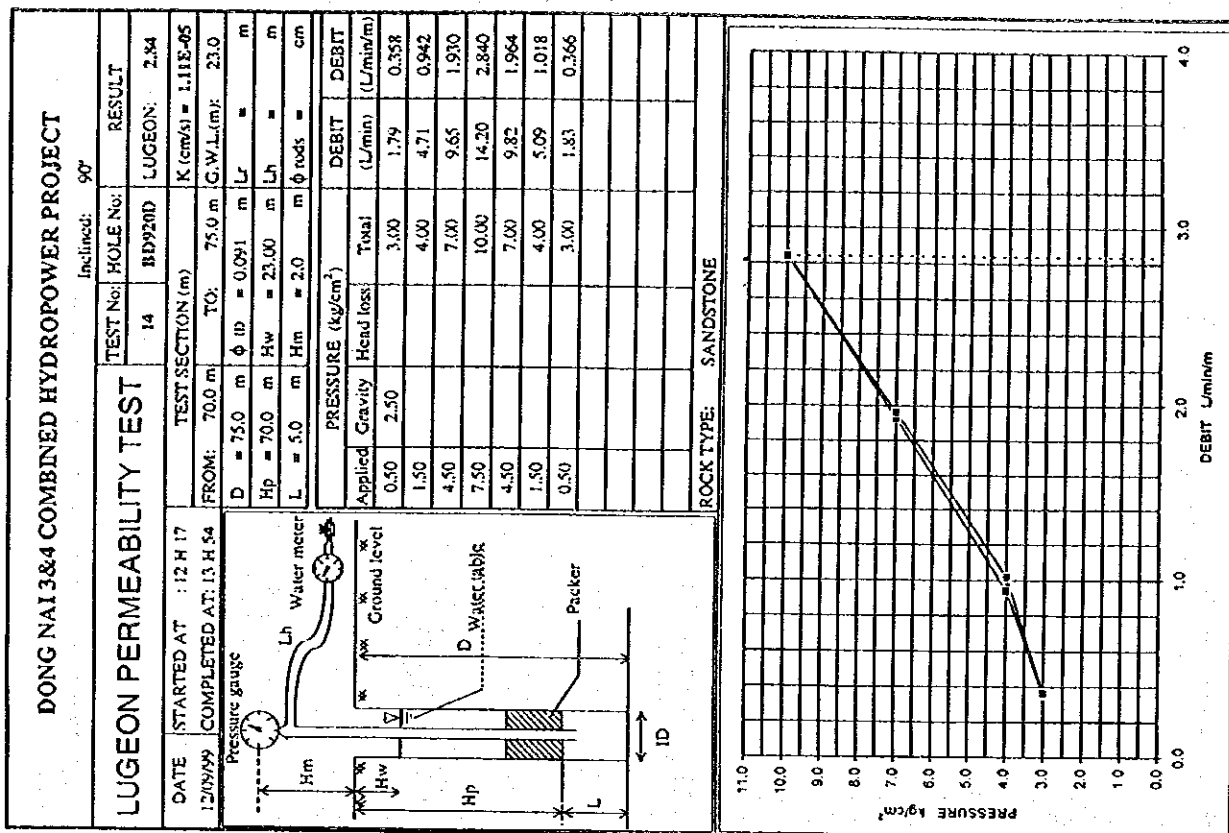
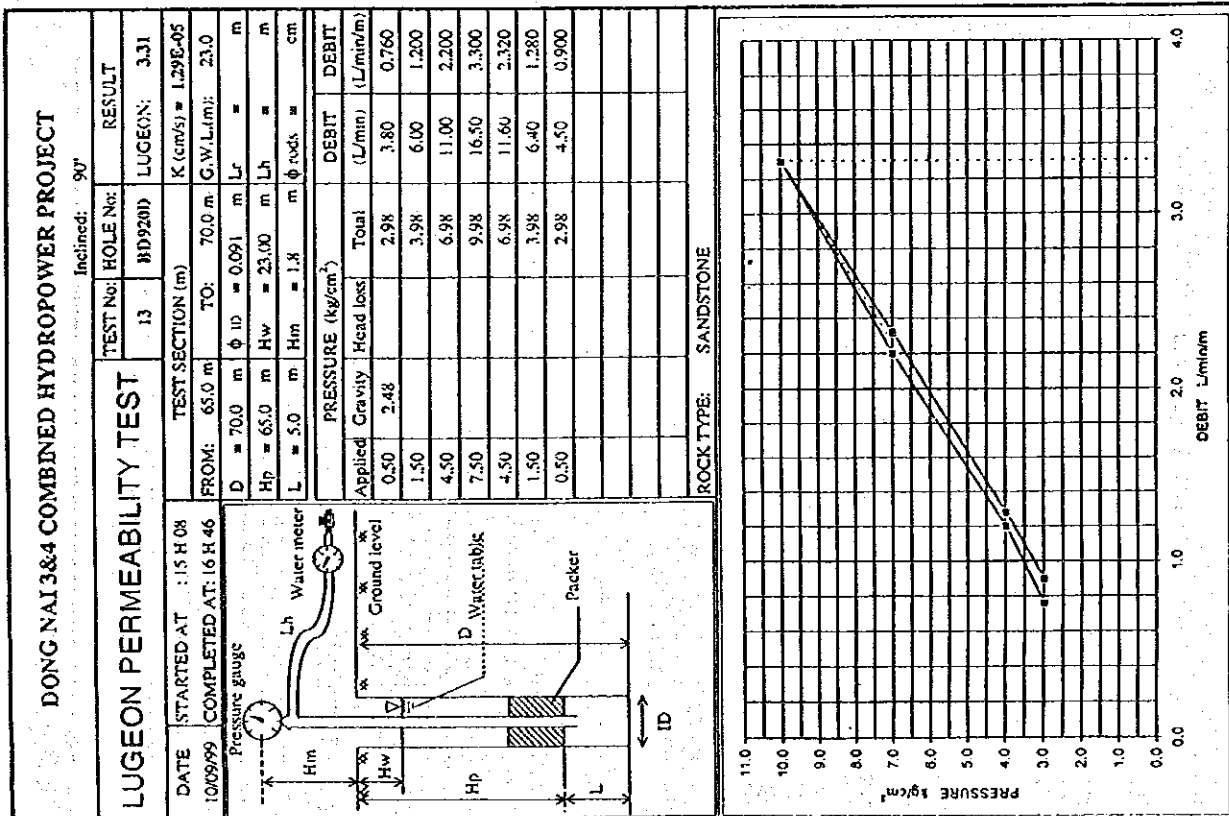


DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

Inclined: 90°

LUGEON PERMEABILITY TEST		TEST No: 12	HOLE No: BD9200	RESULT
DATE: 09/09/99 STARTED AT: 17 H 16 COMPLETED AT: 18 H 55		TEST SECTION (m)		LUGEON: 3.60
FROM: 60.0 m		TO: 65.0 m		K (cm/s) = 1.41E-05
D = 65.0 m		φ ID = 0.091 m		G.W.L (m): 23.0
H _p = 60.0 m		H _w = 23.00 m		L _r = m
L = 5.0 m		H _m = 2.0 m		φ ods = cm
PRESSURE (kg/cm ²)		DEBIT (L/min)		DEBIT (L/min/m)
Applied	Gravity	Head loss	Total	
0.50	2.50		3.00	4.50
1.50			4.00	7.00
4.50			7.00	11.00
7.50			10.00	18.00
4.50			7.00	11.60
1.50			4.00	7.40
0.50			3.00	5.20
ROCK TYPE: SANDSTONE				





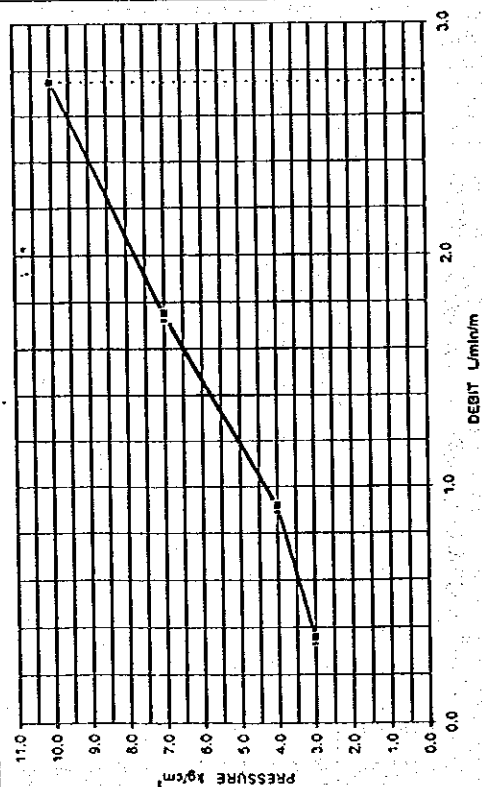
DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

תוצאות: 45%

LUGEON PERMEABILITY TEST

[illegible]

ROCK TYPE: SANDSTONE



Attachment A3

Seismic Refraction Prospecting

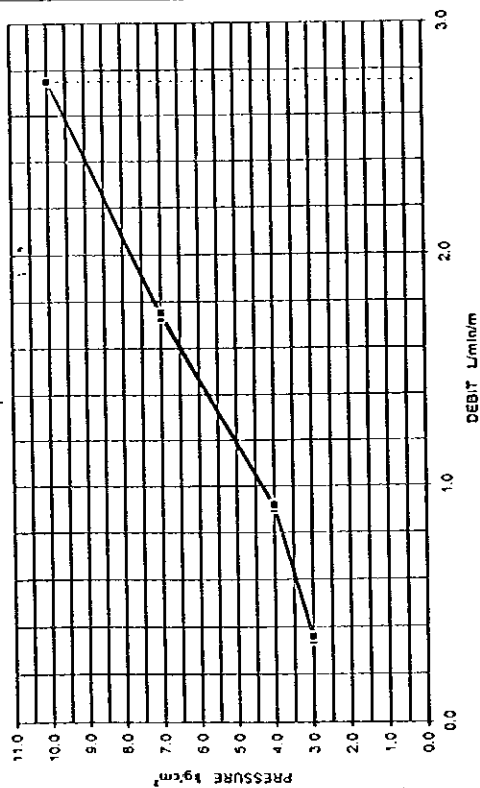
DONG NAI 3&4 COMBINED HYDROPOWER PROJECT

Inclined: 25°

LUGEON PERMEABILITY TEST

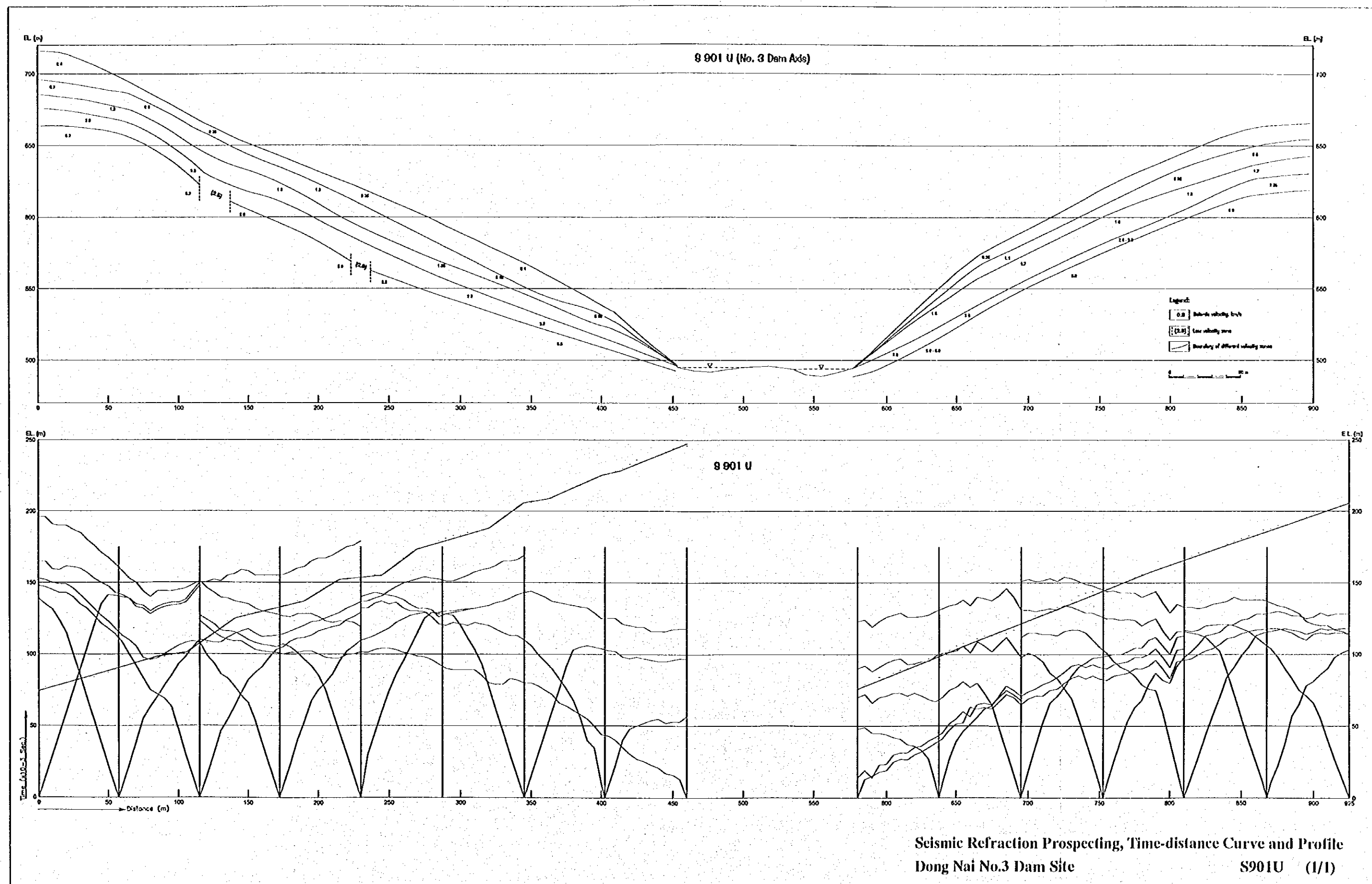
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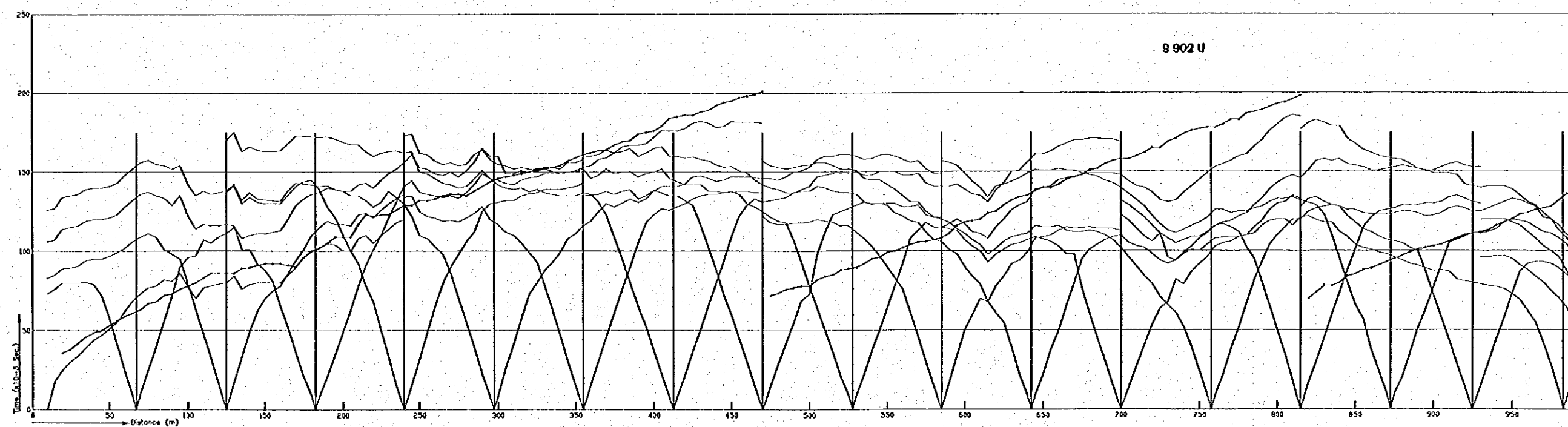
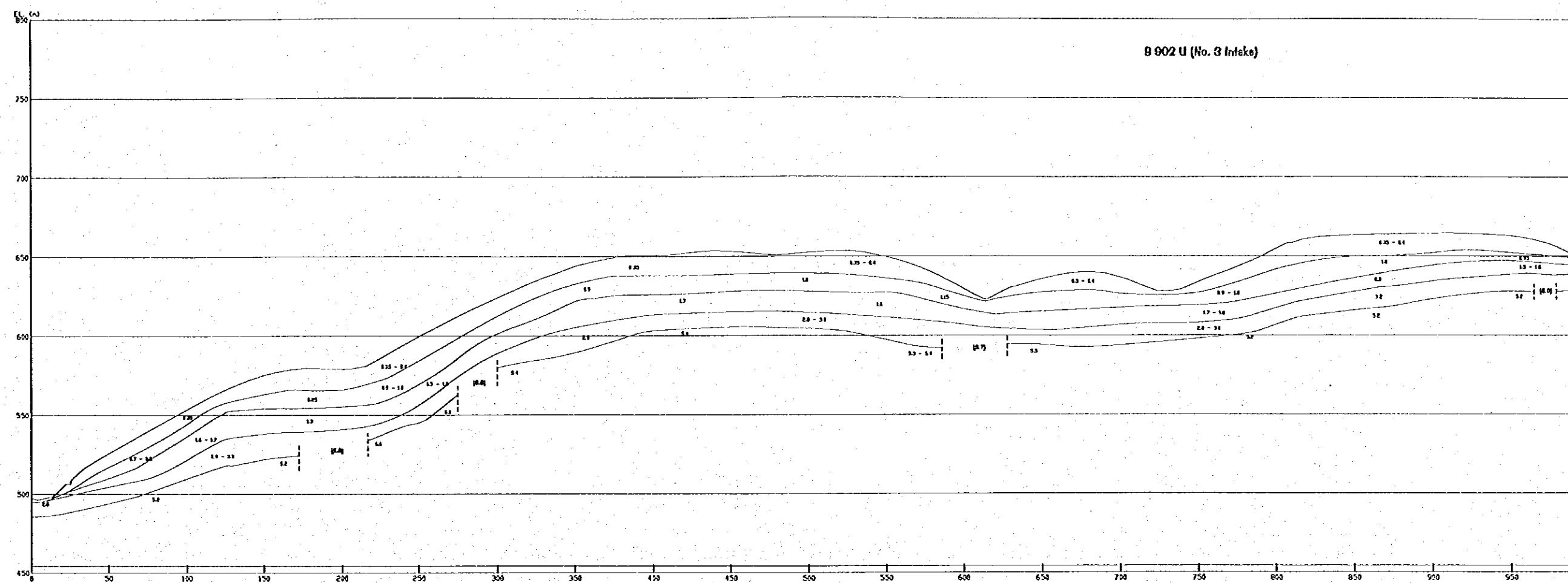
ROCK TYPE: SANDSTONE



Attachment A3

Seismic Refraction Prospecting





Seismic Refraction Prospecting, Time-distance Curve and Profile
Dong Nai No.3 Power Tunnel Intake **S902U** **(1/2)**

