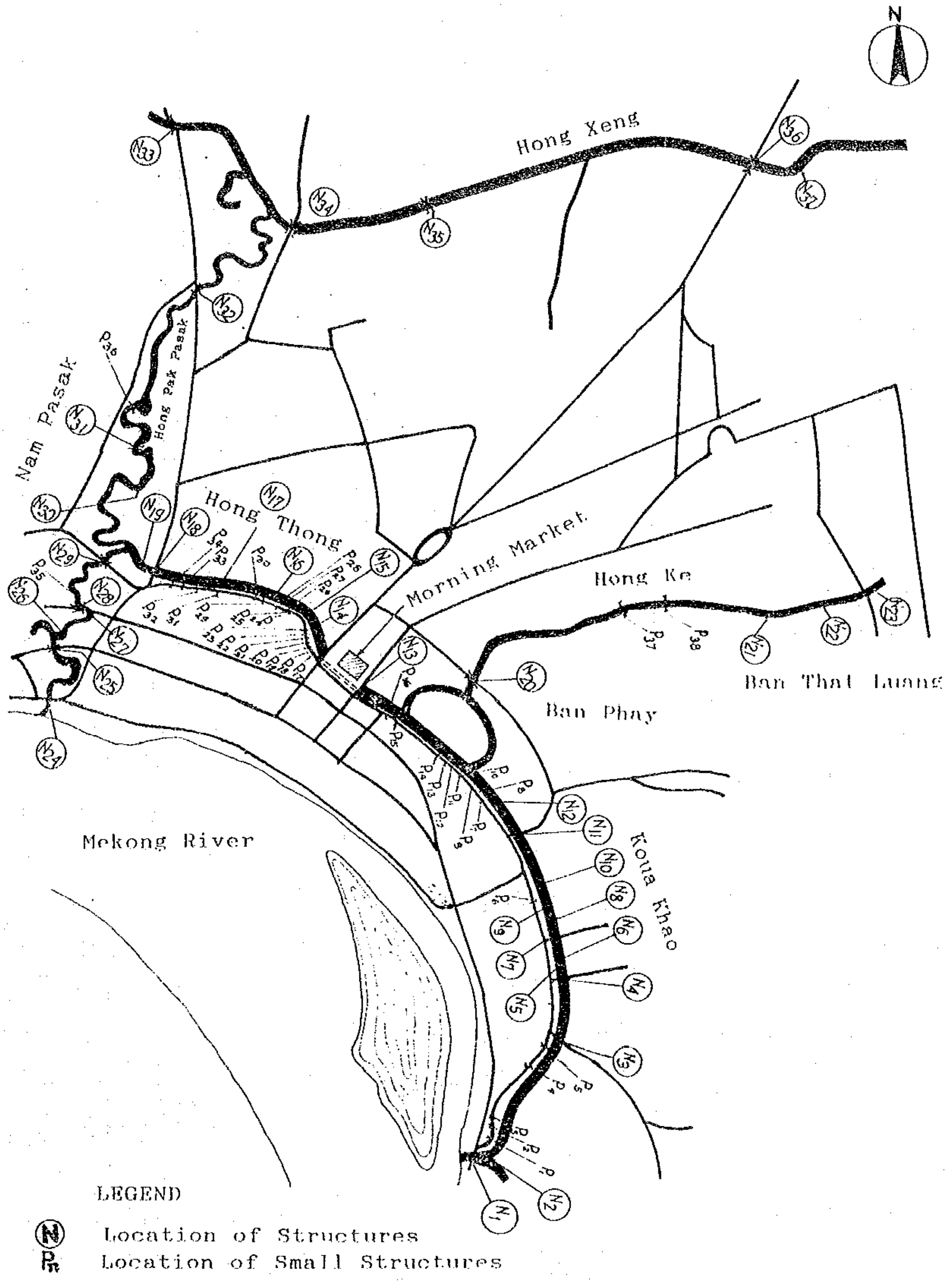
A N N E X

A - 1 Inventory of Structures on the Main Canal



Location of Canal Related Structures

Inventory of Canal Related Structures

Structure No.	Sub-area	Canal Name	Type of Structure	Construction Marerial	Present Condition of Structure: exhaustion	Present Condition of Structure: roughness of inner-surface	Present Condition of Structure: influence on land scape	Flow Condition: reduction of flow area	Flow Condition: sediment condition	Flow Condition: flourishing of weeds
N-1	C	Khoua Kao	box culvert	concrete	A	A	A	A	A	A
N-2	C	"	gate with stop log	brick,wooden	A	A	A	A	A	A
N-3	C	"	box culvert	concrete	B	B	-	B	B	B
N-4	C	"	slab bridge	concrete	A	A	-	B-C	B	C
N-5	C	"	slab bridge	concrete	A	A	A	B	B	B
N-6	C	"	slab bridge	concrete	B	B	A	B	B	B
N-7	C	"	slab bridge	concrete	B	A	A	B	B	C
N-8	C	"	slab bridge	concrete	B	B	A	B	-	C
N-9	C	"	wooden bridge	wood	B	C	B	C	-	C
N-10	C	"	wooden bridge	wood	A	A	A	B	-	C
N-11	C	"	corrugate pipe	steel	A	-	B	B	-	A
N-12	C	"	corrugate pipe	steel	B	-	A	B	-	C
N-13	H	Hong Thong	box culvert	concrete	A	B	A	A	-	A
N-14	H	"	box culvert	concrete	A	A	A	A	A	A
N-15	H	"	box culvert	concrete	A	B	A	A	B	B
N-16	H	"	wooden bridge	wood	B	-	B	A	A	A
N-17	H	"	box culvert	concrete	B	B	A	B	B	A
N-18	H	"	box culvert	concrete	A	B	A	B	B	B
N-19	L	"	box culvert	concrete	A	B	A	B	B	B
N-20	G	Hong Ke	box culvert	concrete	A	A	A	A	-	A
N-21	E	"	culvert(box,pipe)	concrete	B	B	A	B	A	B-C
N-22	F	"	culvert(box,pipe)	concrete	B	A	A	A-B	A-B	A
N-23	F	"	culvert(box,pipe)	conc.,steel	A	B	A	A	A	A
N-24	L	Nam pasak	sluice gate	concrete	A	B	B	B	-	B
N-25	L	"	pipe culvert	concrete	A	B	A-B	B-C	B-C	B
N-26	L	"	box culvert	concrete	A	B	A	A	B	A
N-27	L	"	pipe culvert bridge	concrete	A	A	A	A	A	A
N-28	L	"	box culvert	concrete	B-C	B	A	B	-	B
N-29	L	"	pipe	concrete	B	B	B-C	B	B	B
N-30	L	"	corrugare pipe	steel	B	B	B	B	B	B
N-31	L	"	T-beab bridge	concrete	A	-	A	B	B	B
N-32	L	"	culvert bridge	concrete	A	A	A	A	-	B
N-33	M	"	truss bridge	steel	A	-	A	-	-	A
N-34	J	Hong Xeng	truss bridge	steel	A	-	A	-	-	A
N-35	J	"	wooden bridge	wood	B	-	A	B	-	B
N-36	K	"	box culvert	concrete	A	A	A	A	A	A
N-37	K	"	gated weir	concrete	A	-	A	A	A	B

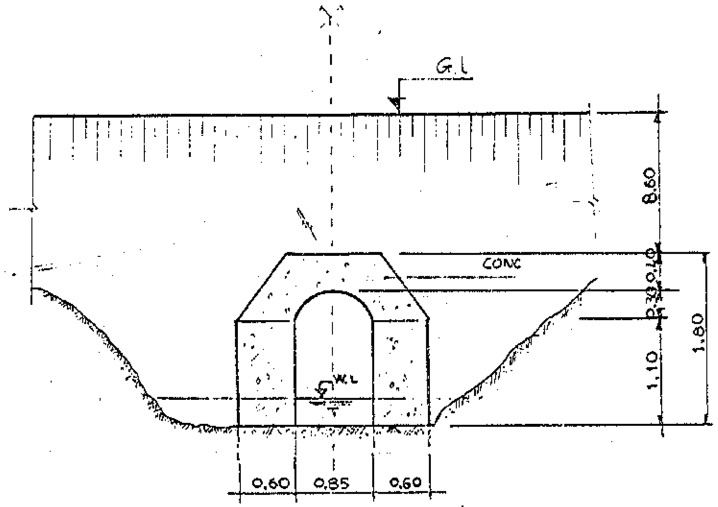
Remarks

A: There are no serious ploblems effecting on the structure and flow capacity and the structure does not produce some unfavorable effecst on the landscape.

B: There are not so sesrious problems but some problems such as follows are observed.
- the structure is outdated for the laps of times and some damages are observesd.
- the flow area is reduced by silting and/or garbage disposal.
- roughness in channel is high due to silting and/or flourishing of weeds and moss.

C: Serious problems such as follows are observed.
- the structure is considerably damaged.
- more than around 50% of flow area is blokaded by silting and garbage and far from being enough to flow water with original capacity.
- the structure produces unfavorable effect on the land scape.

№ 1



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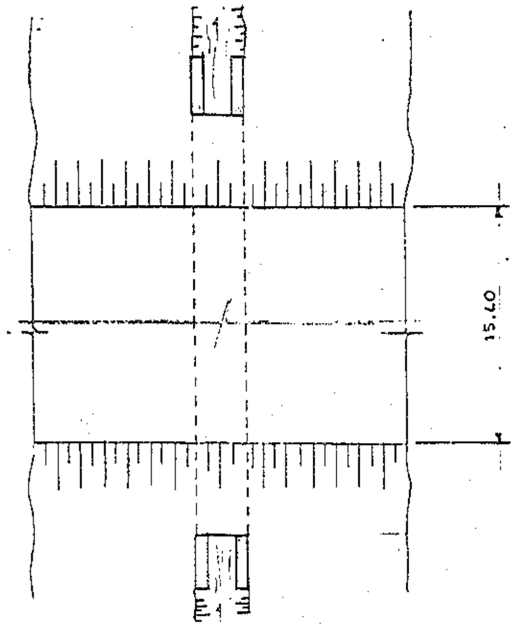

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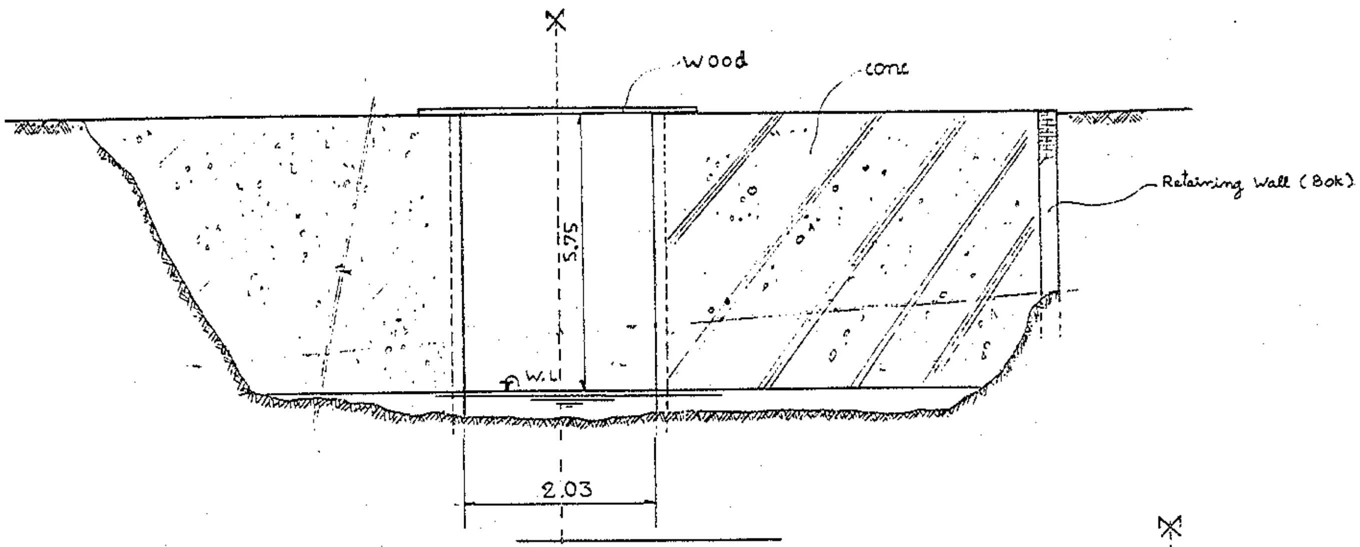

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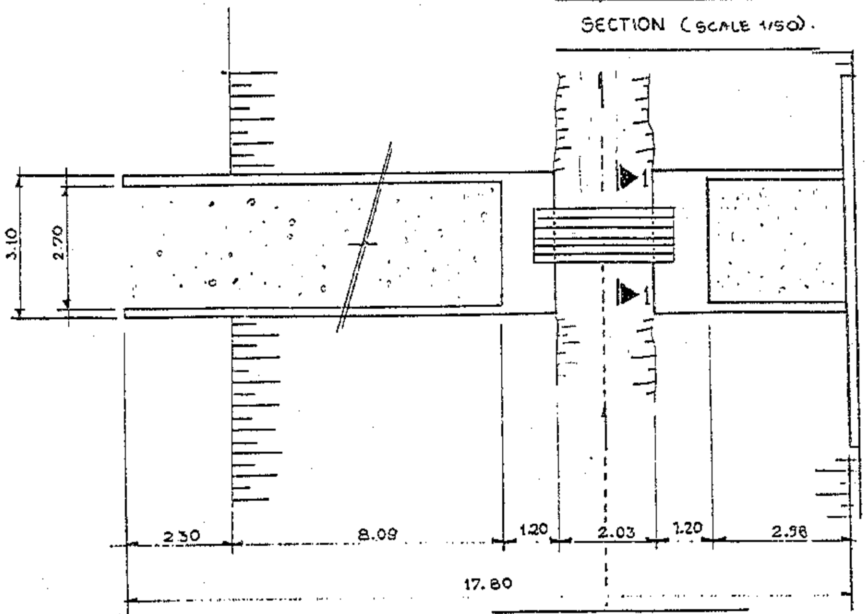

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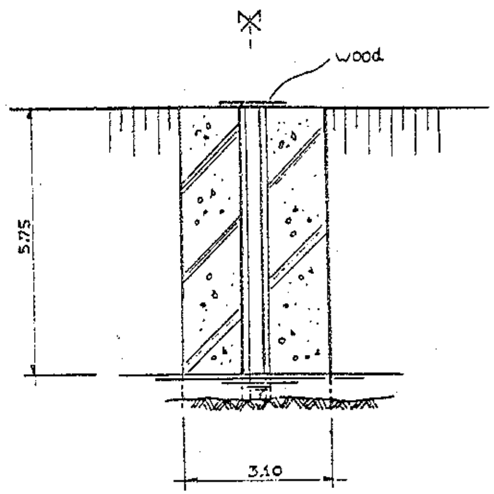

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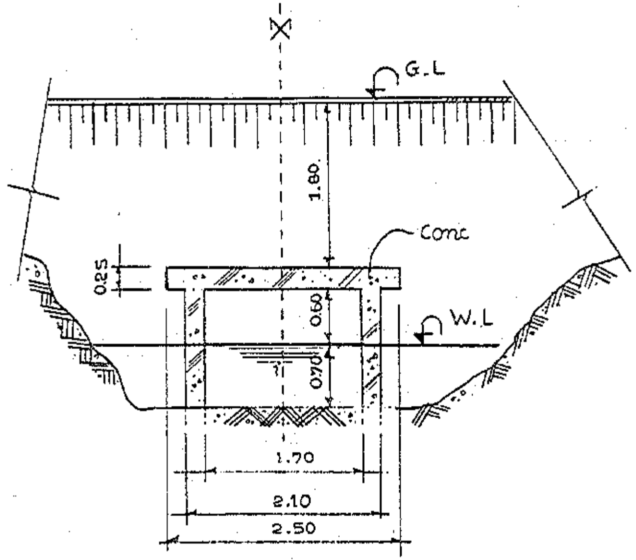

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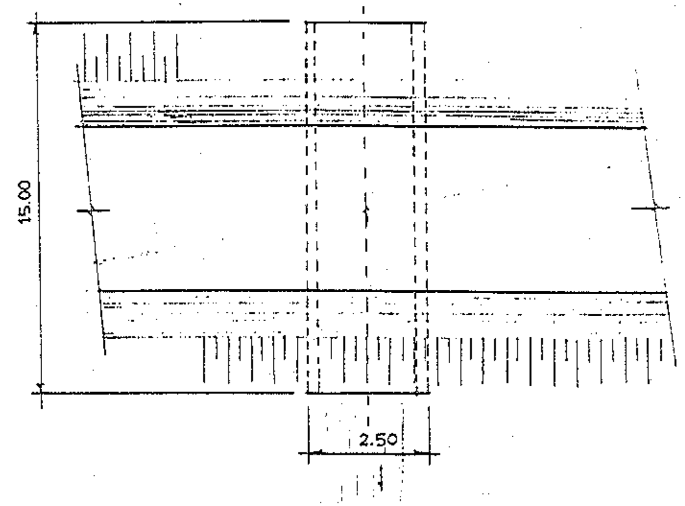

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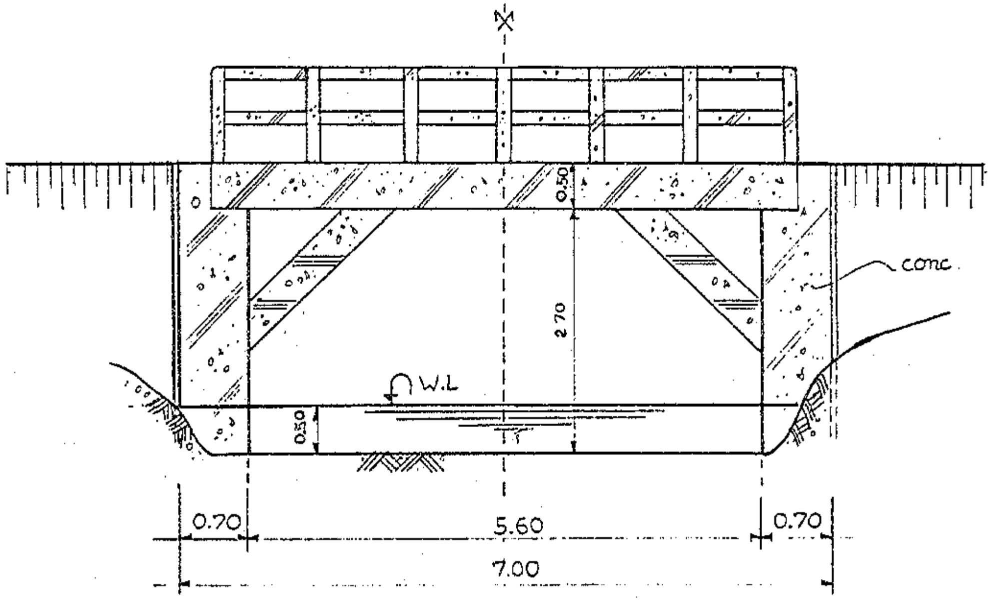

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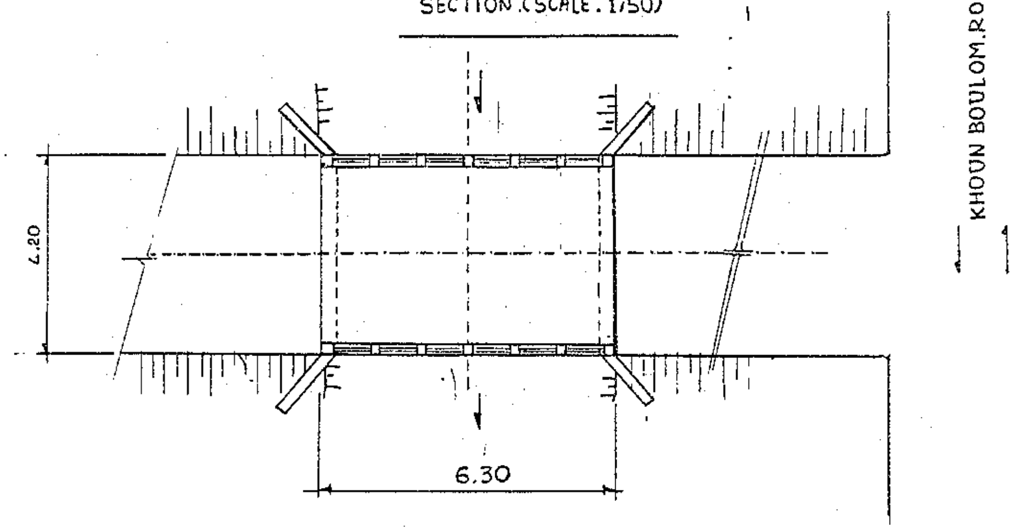

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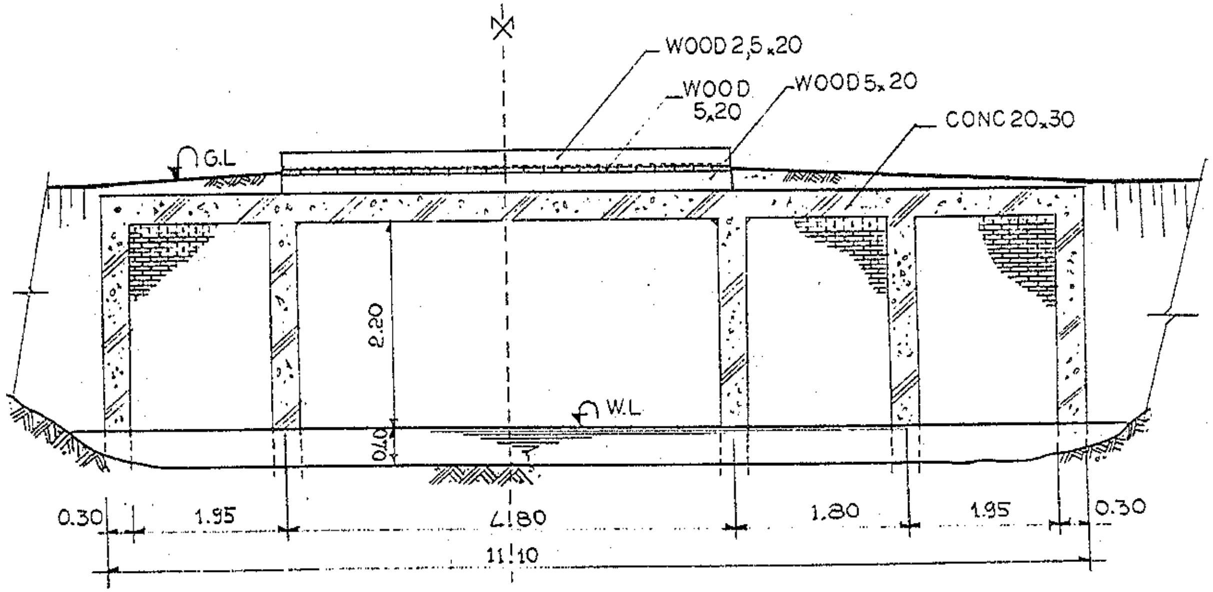

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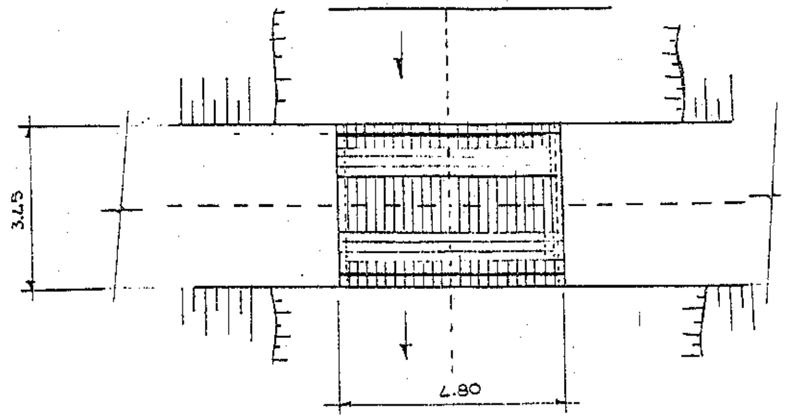

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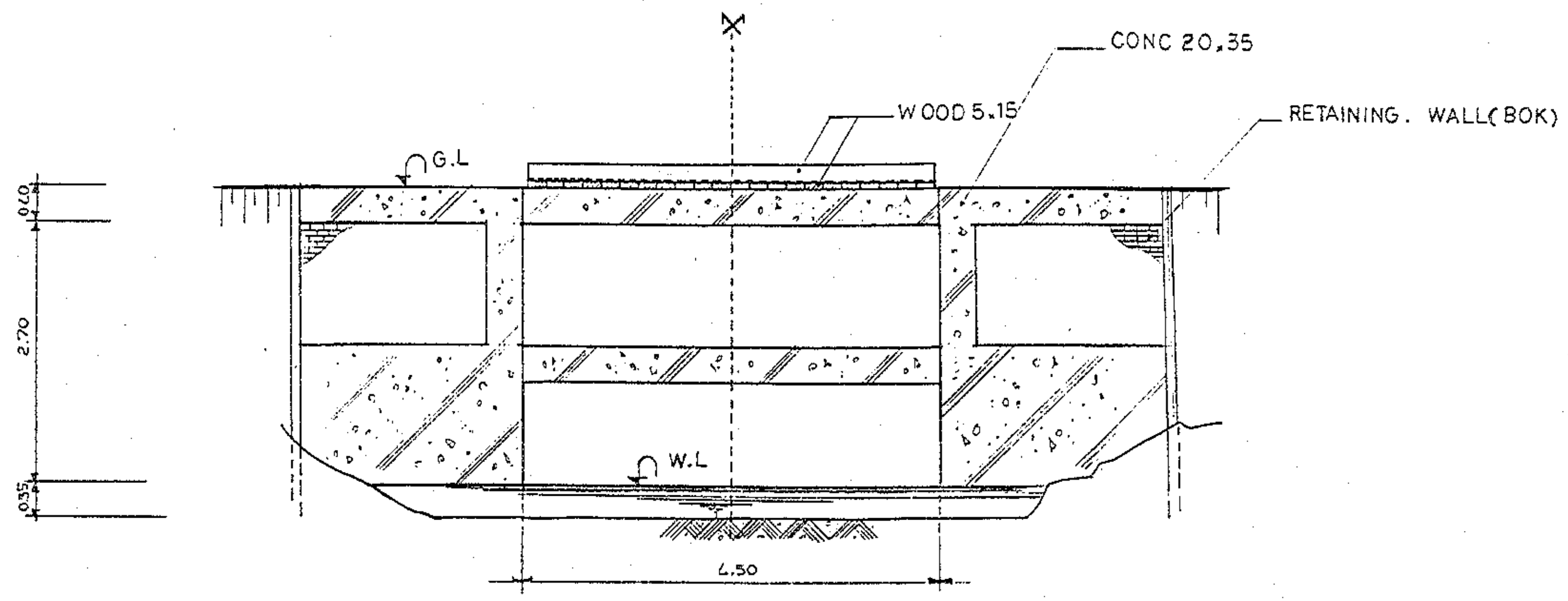

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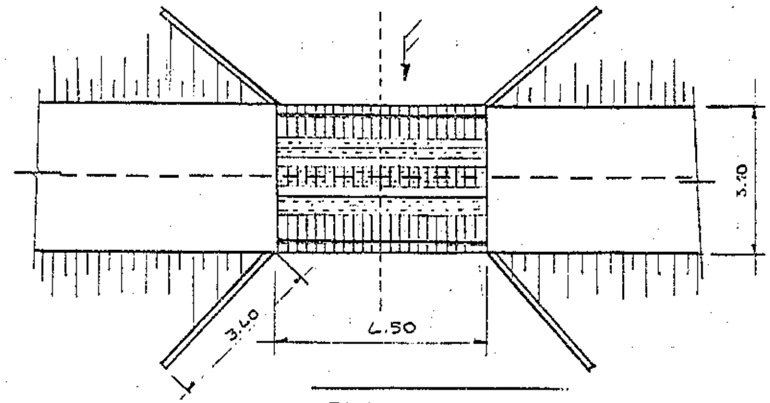

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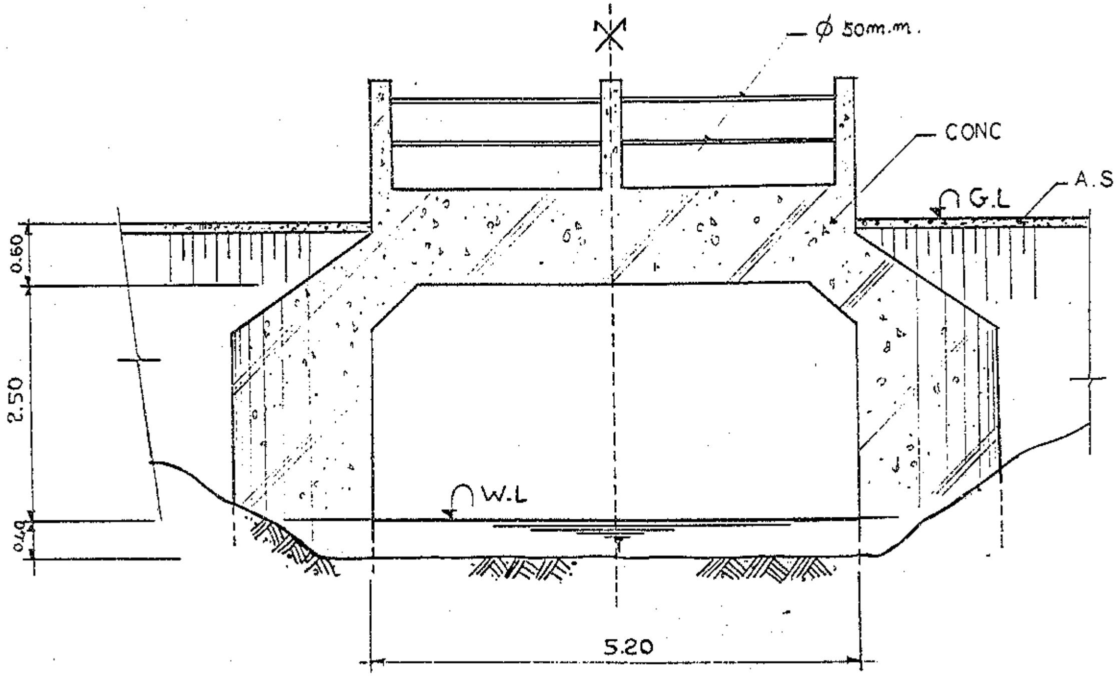

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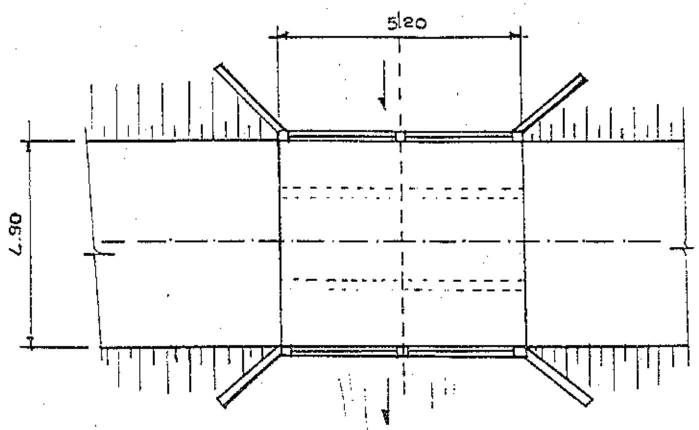

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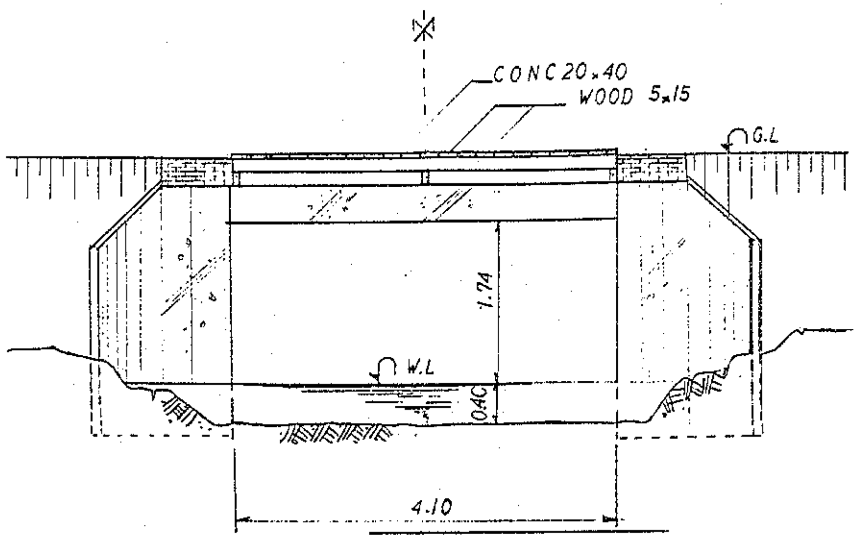

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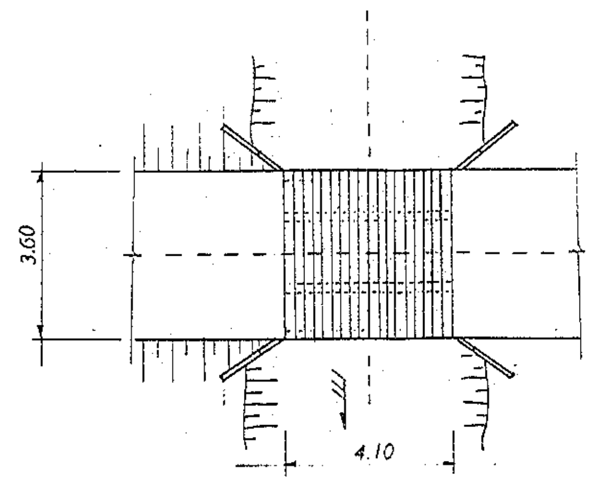

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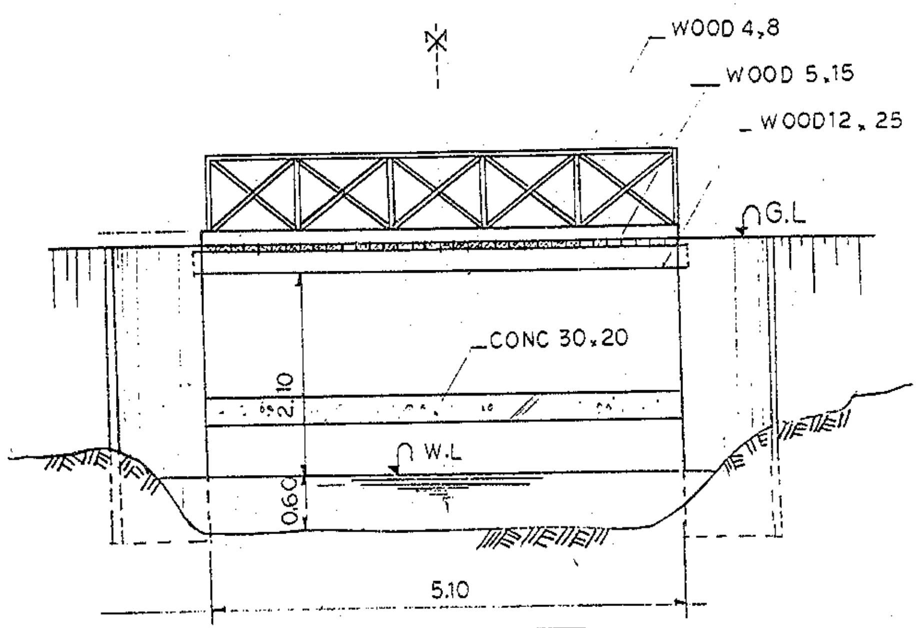

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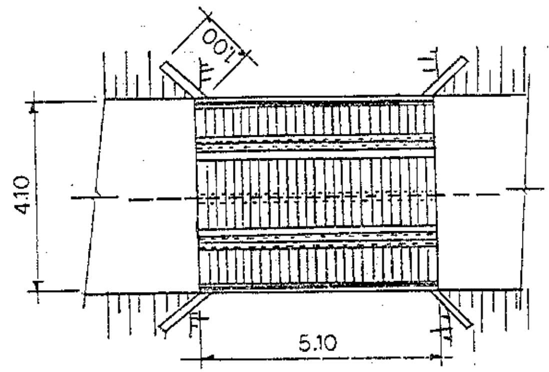

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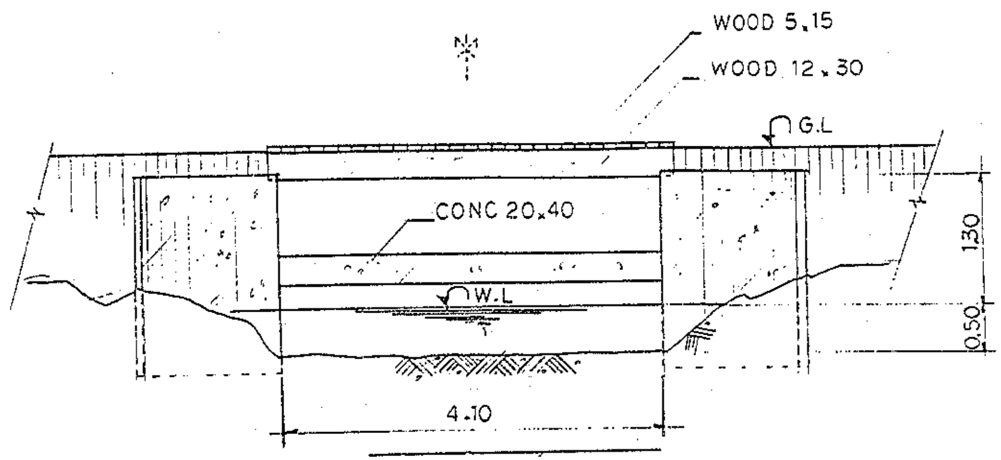

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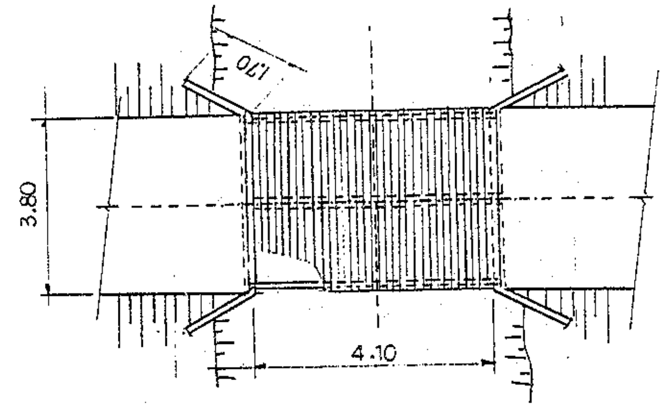

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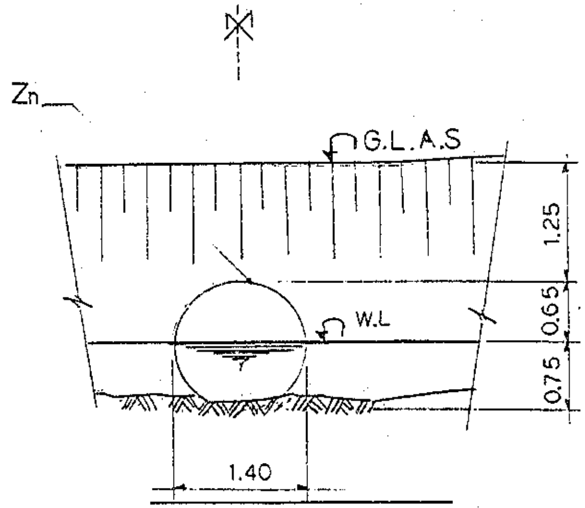

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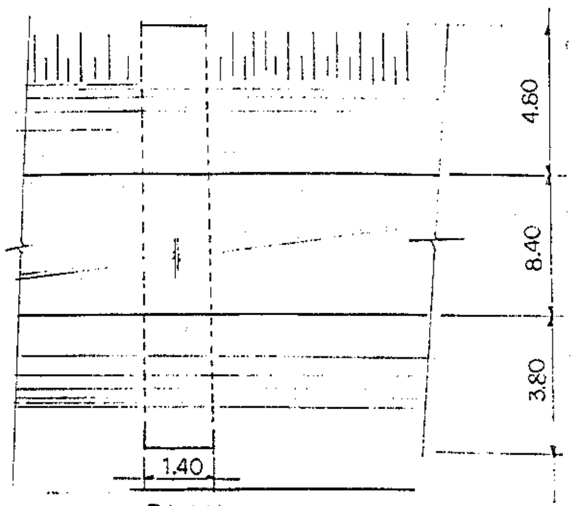

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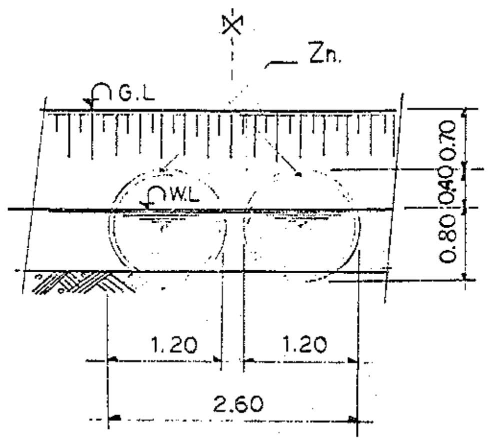

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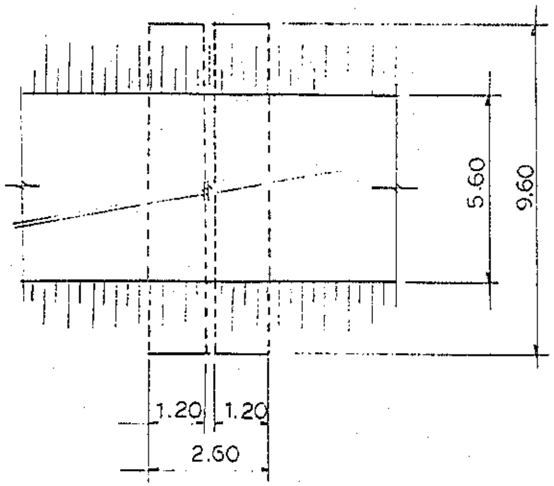

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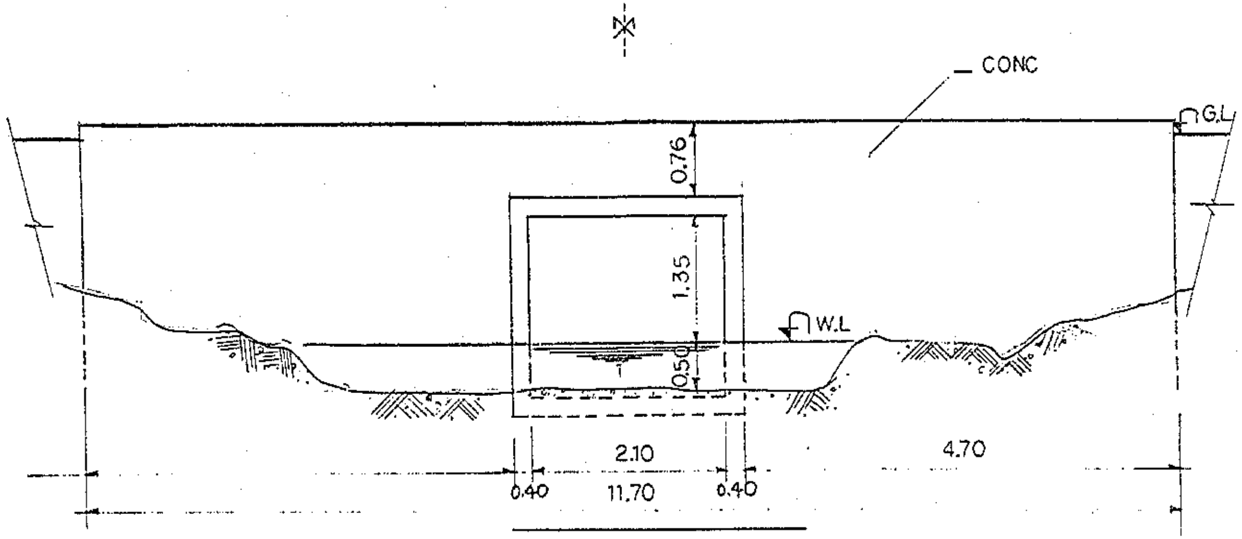
N-13



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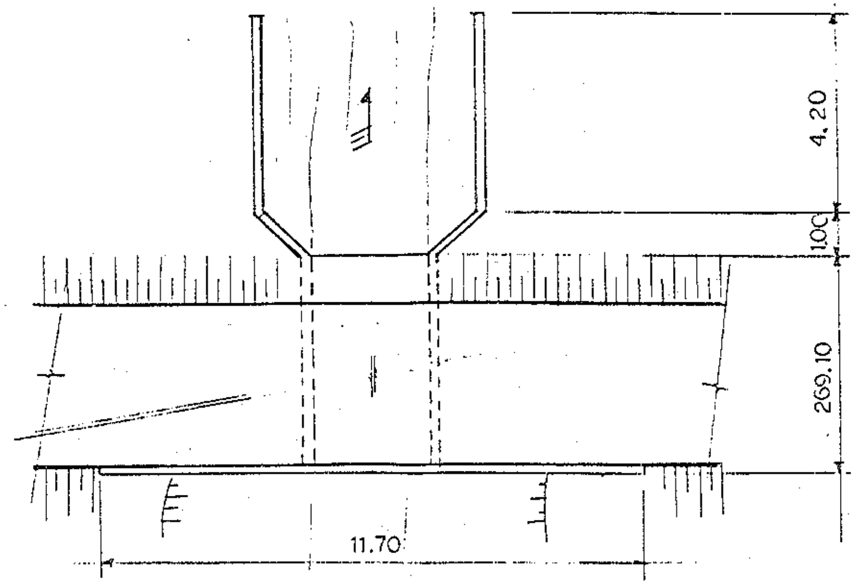

PLAN (SCALE 1/100)

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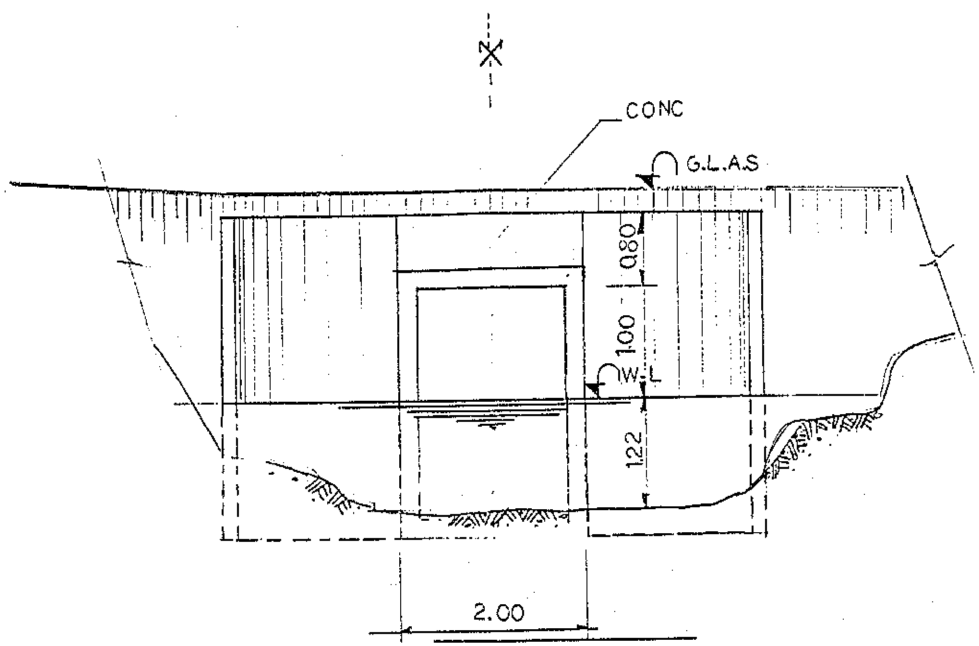

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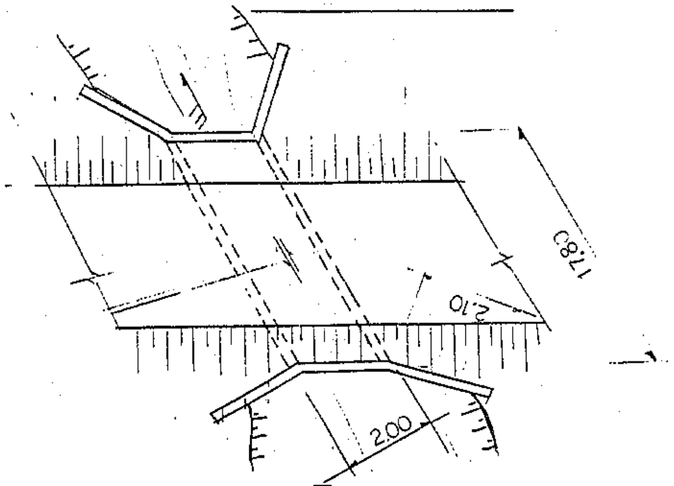

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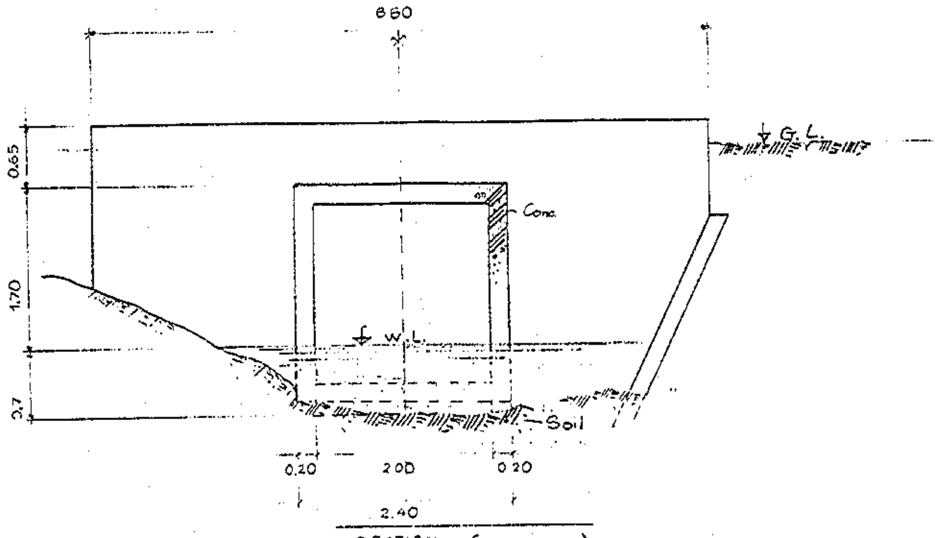

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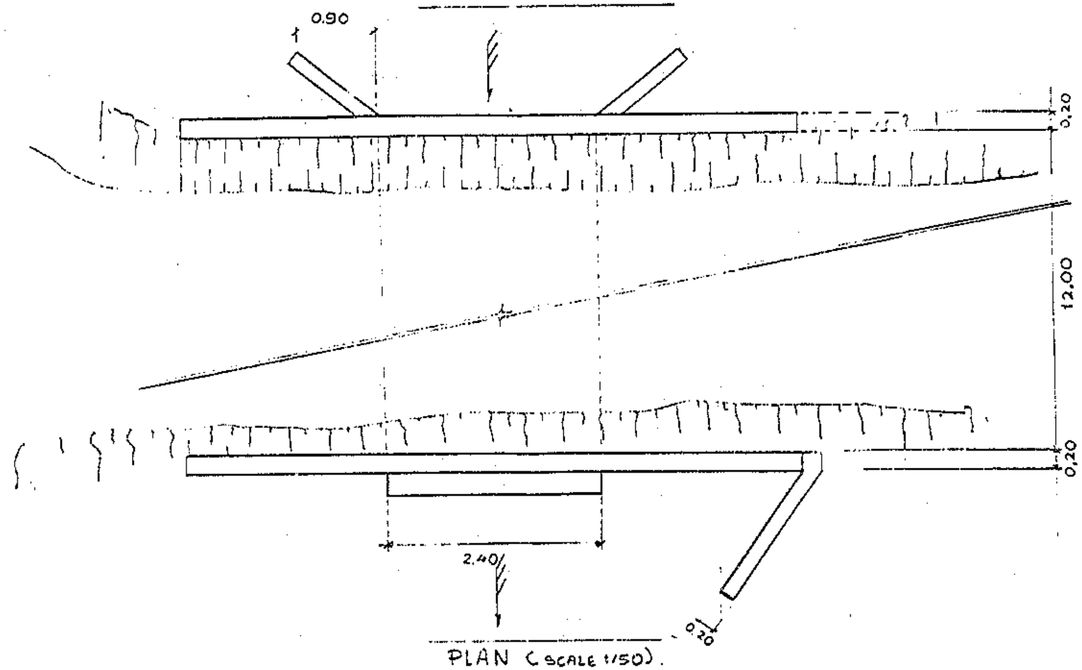

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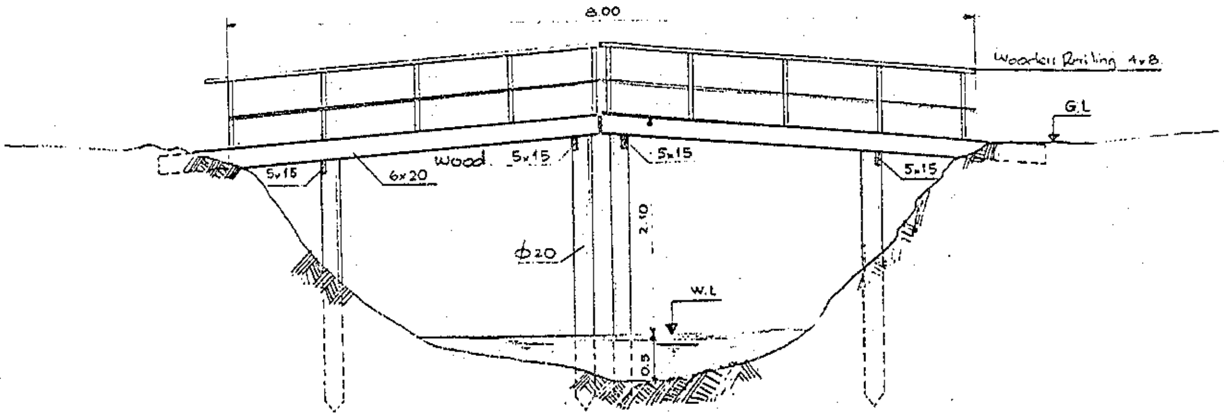

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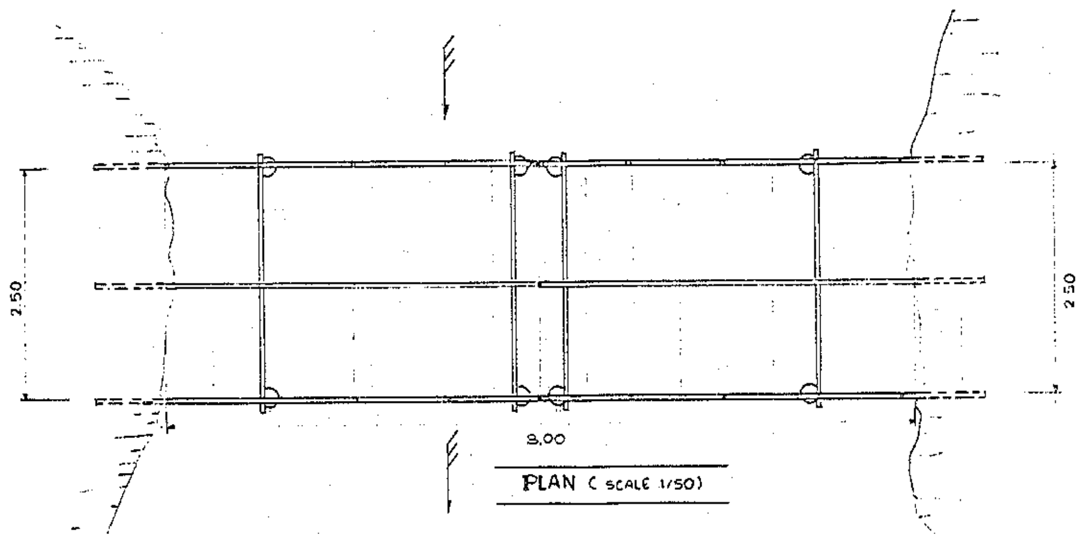

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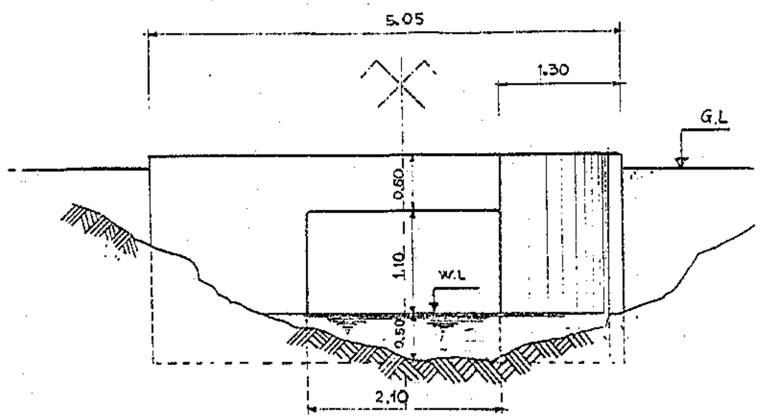
No 17



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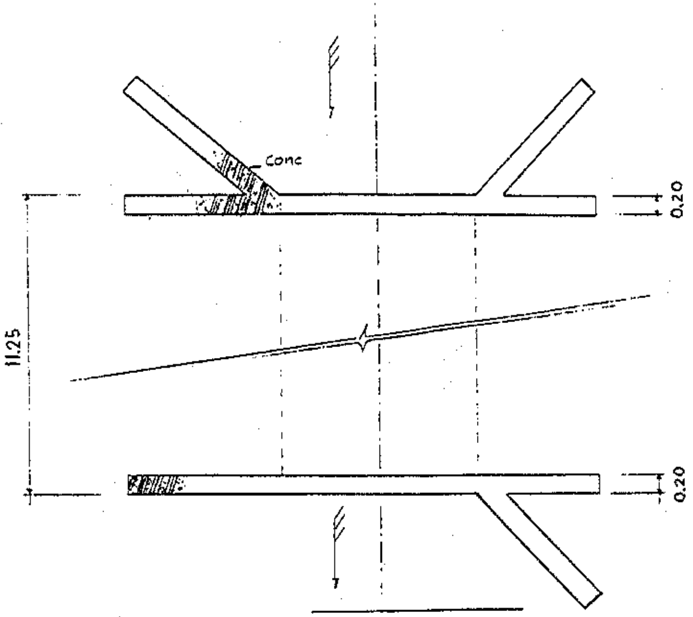
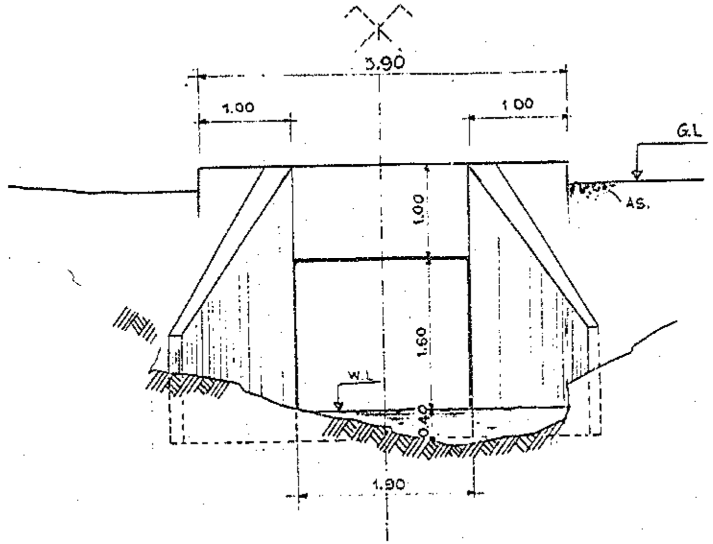


PLAN (Scale 1/50).

Nº 18



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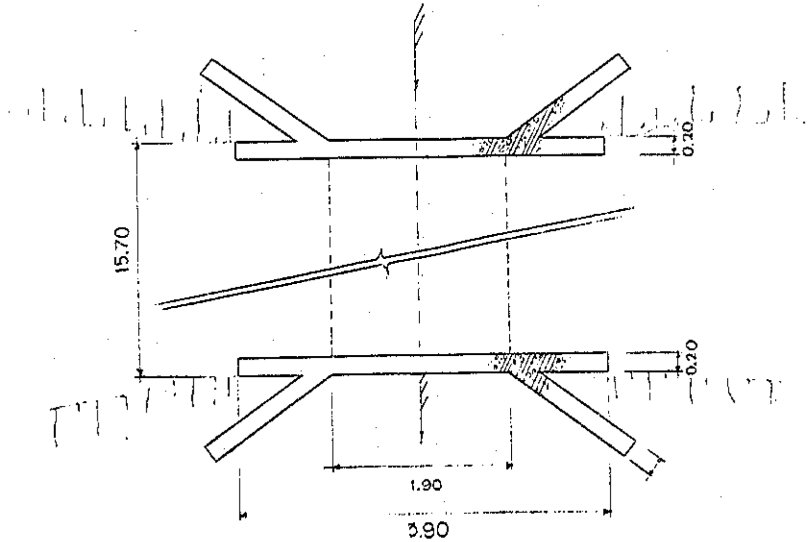
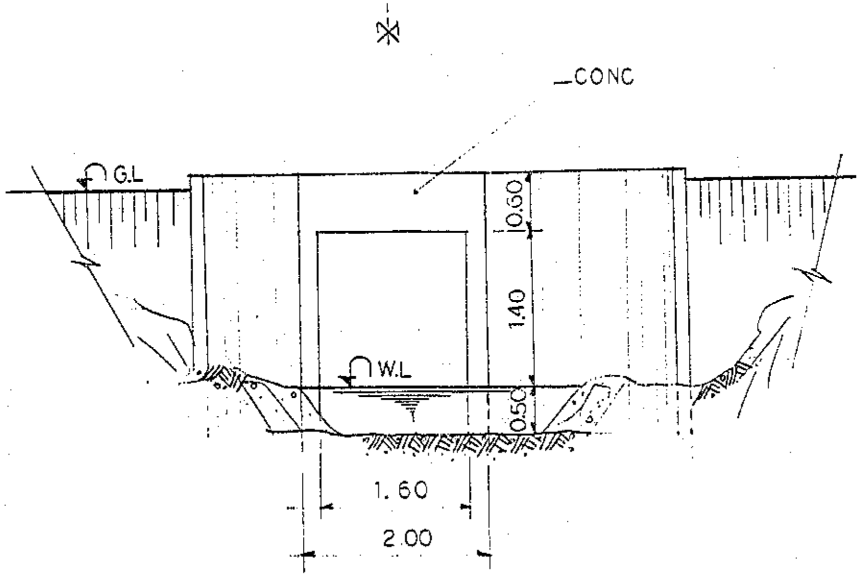


PLAN (SCALE 1/50)

N: 19



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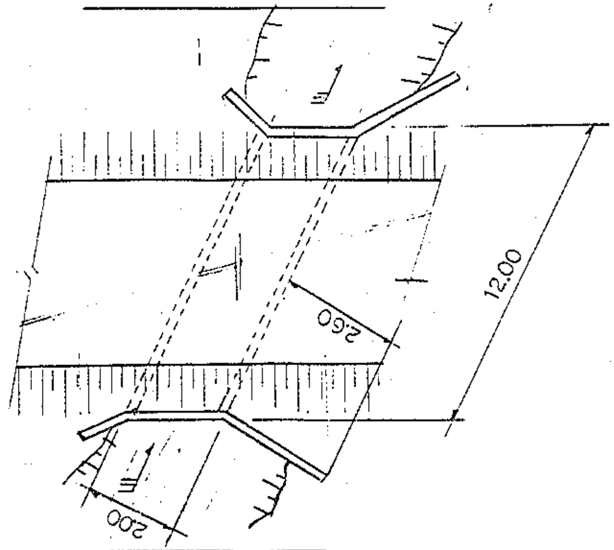

PLAN (SCAL 1/100)

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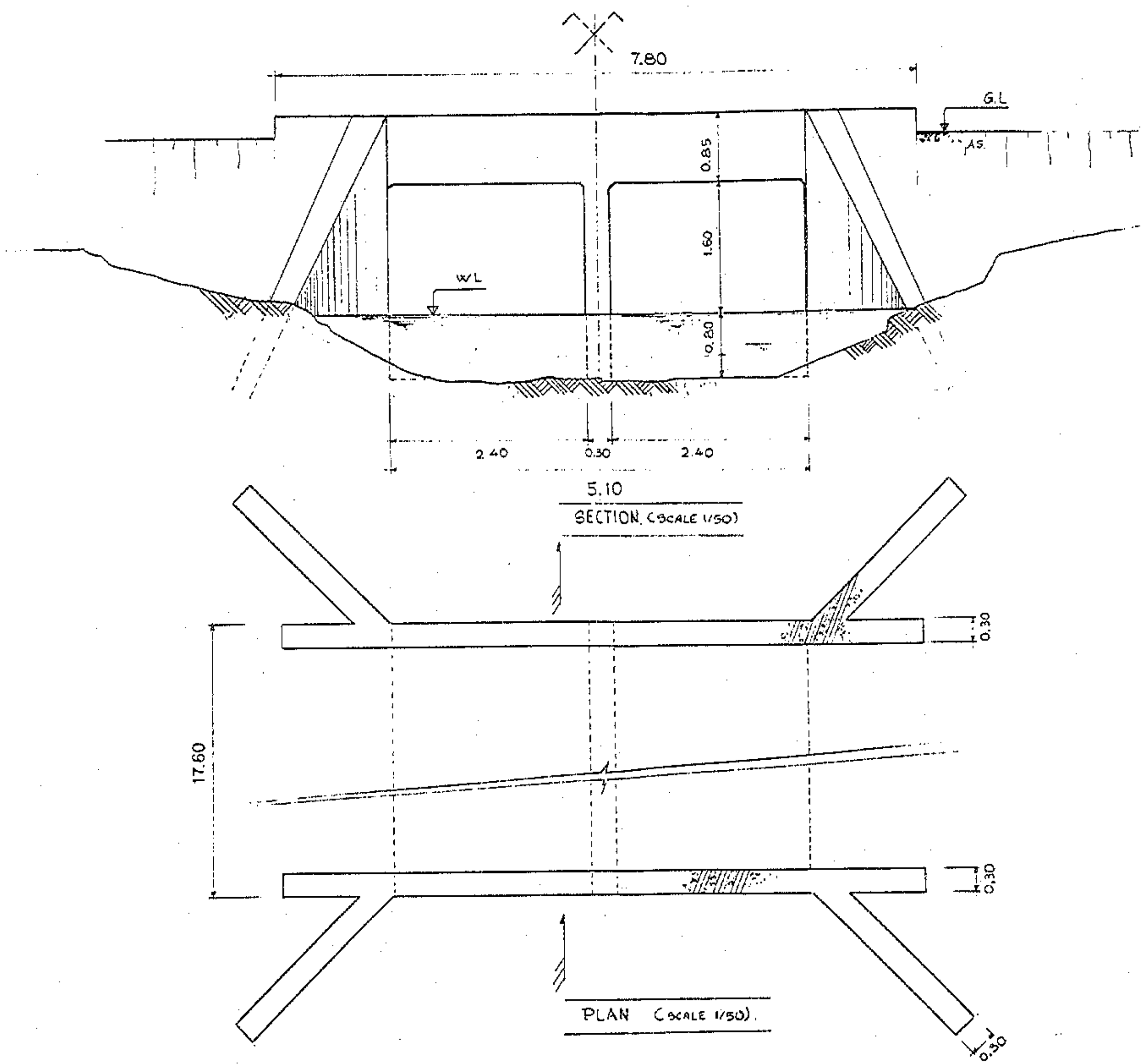
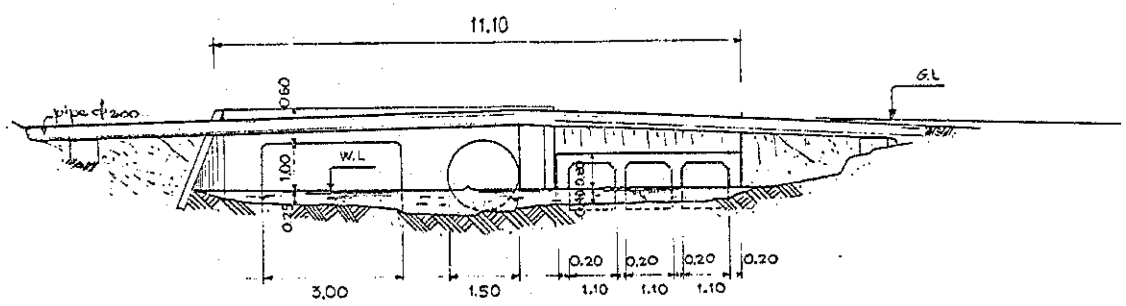


SECTION (SCALE 1/50)

PLAN (SCALE 1/50).

N°21



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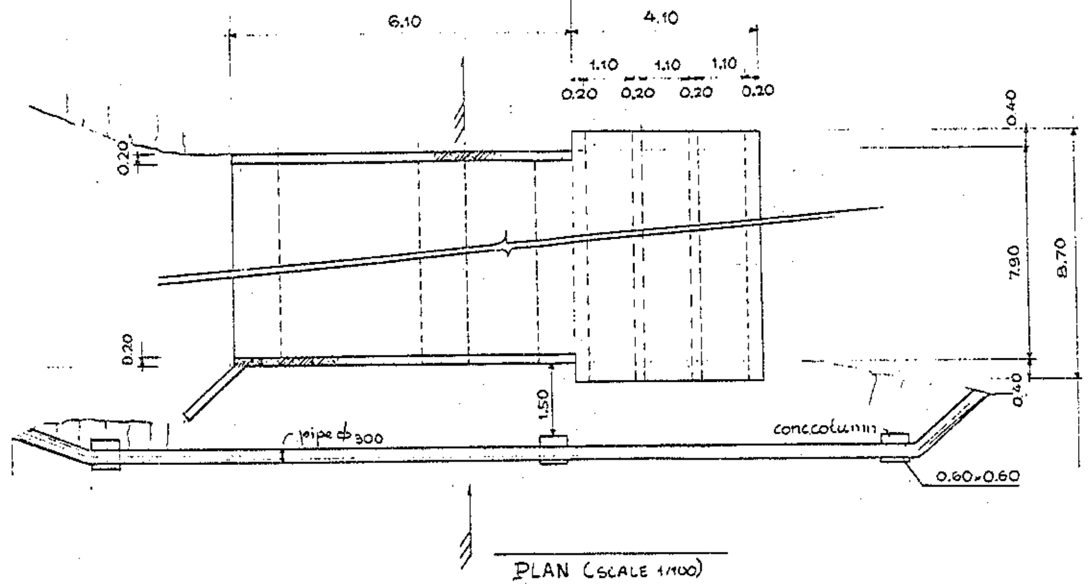

PLAN (SCALE 1/100)

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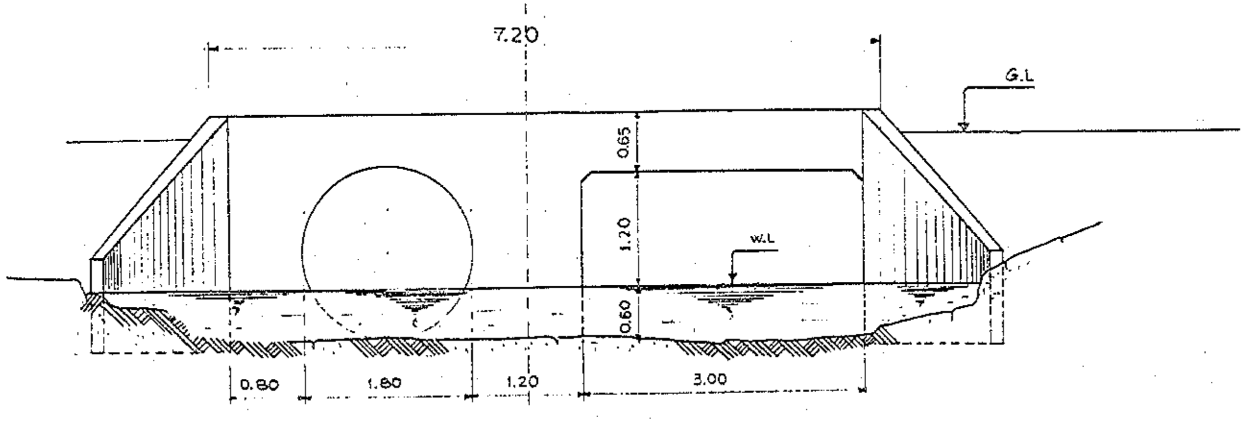

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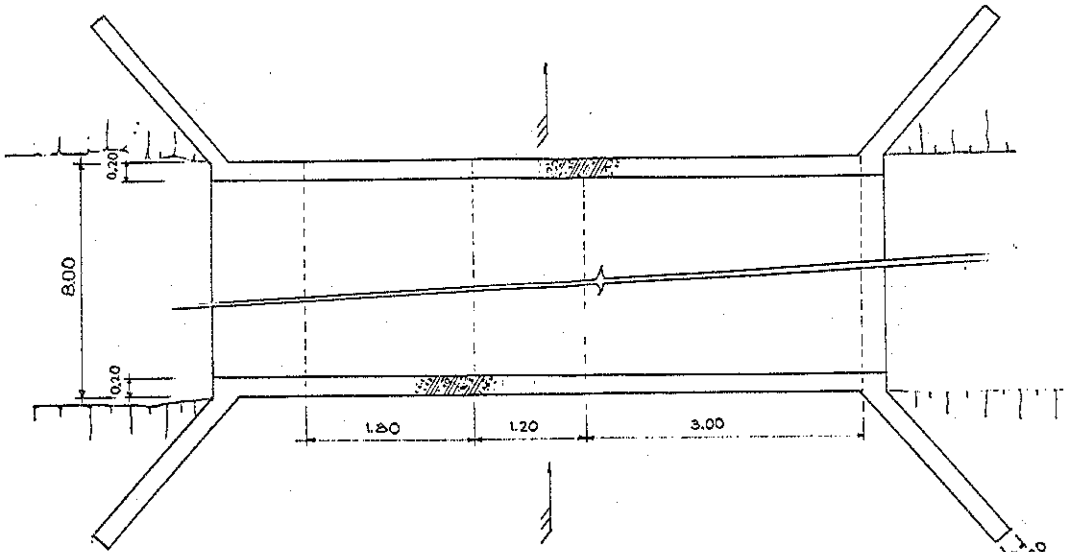

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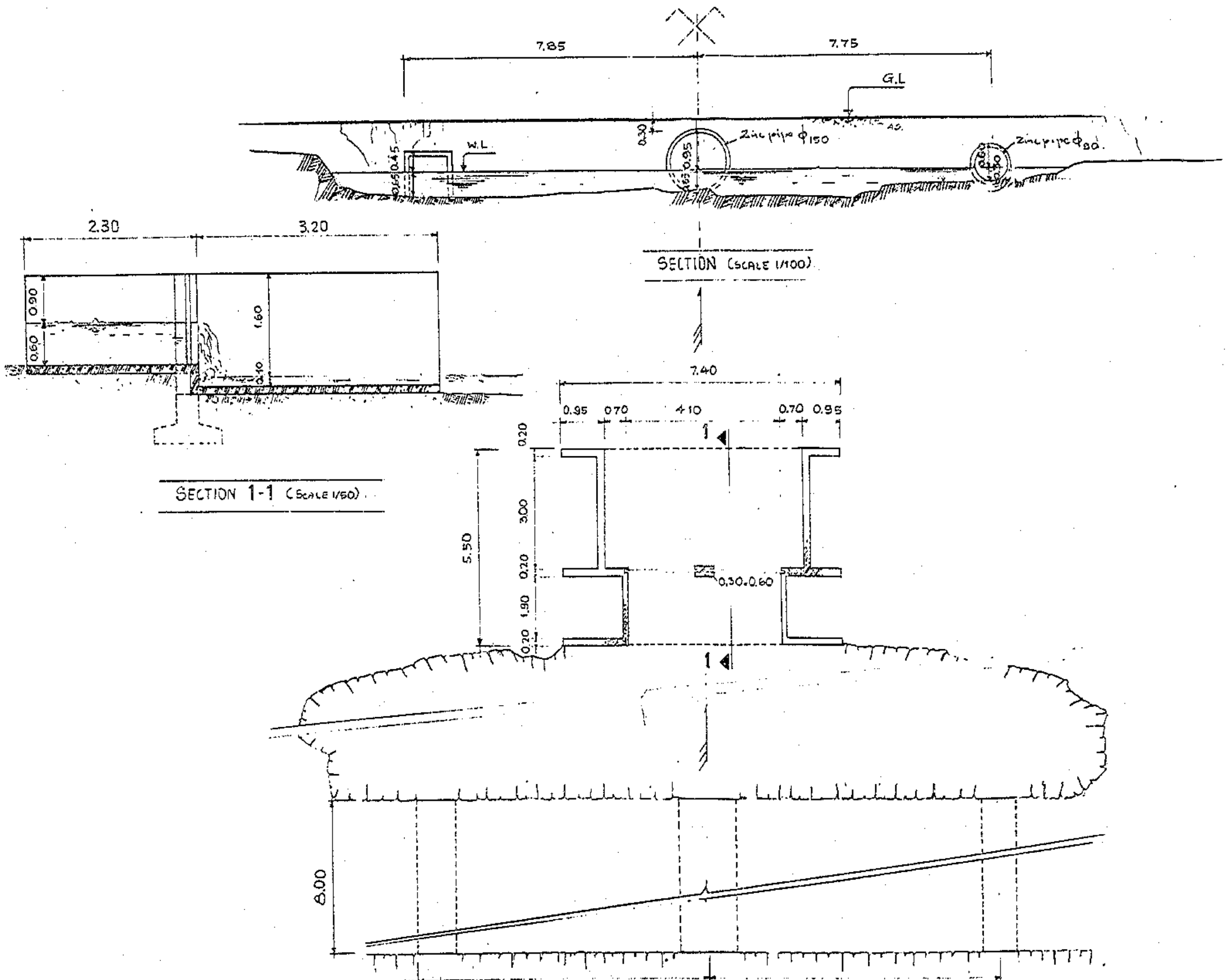
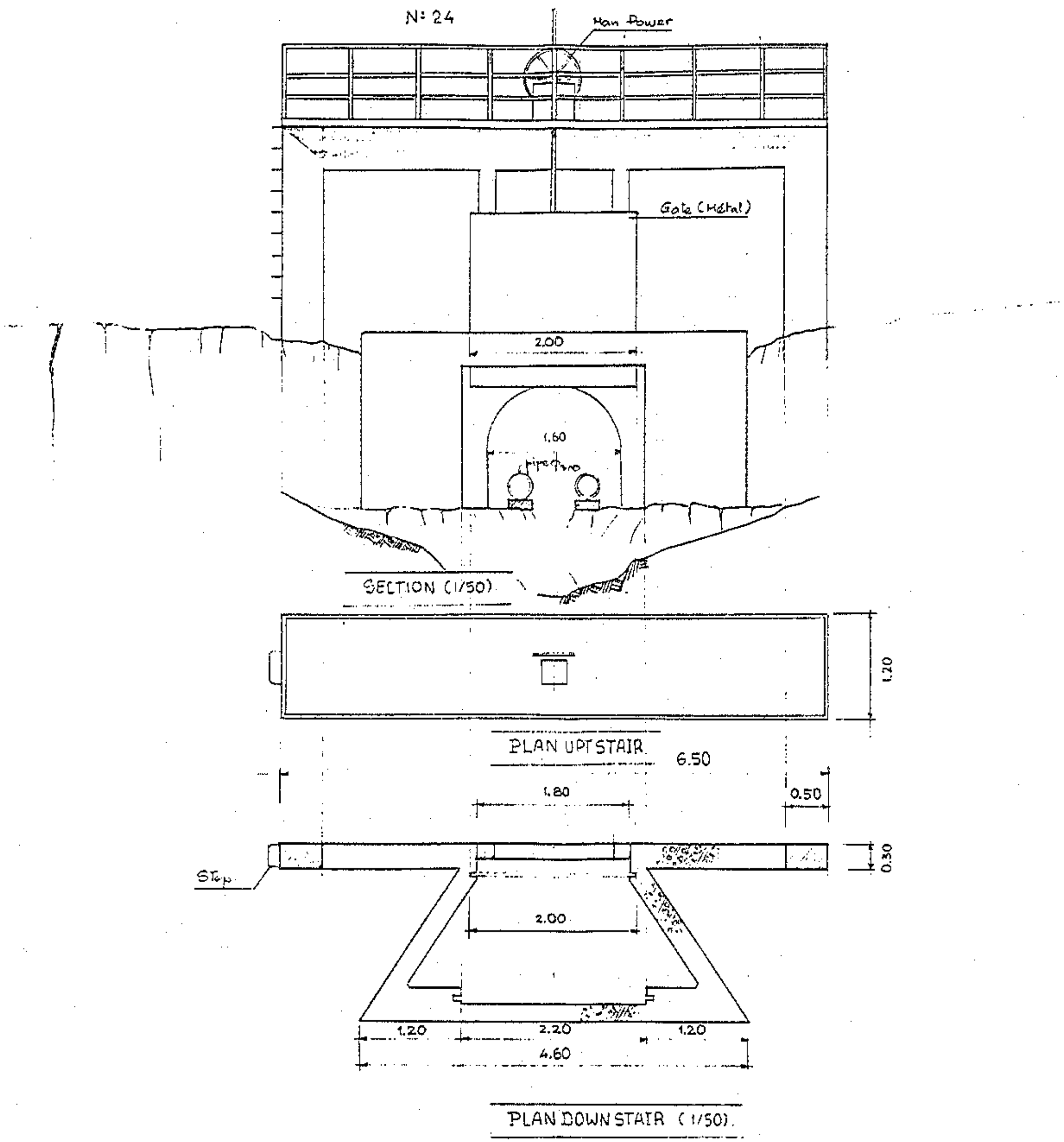


SECTION (SCALE 1/100)

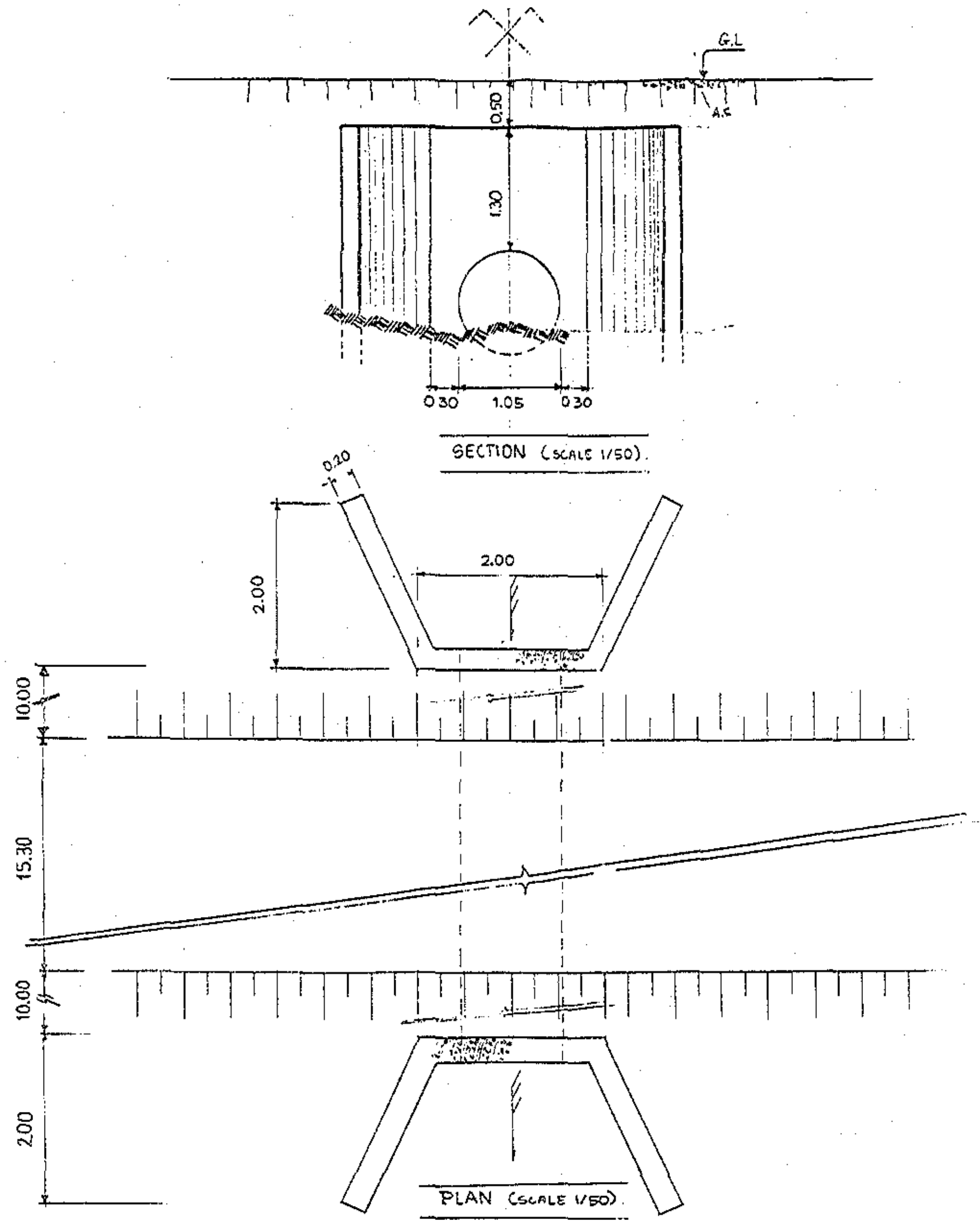
SECTION 1-1 (SCALE 1/50)

PLAN (SCALE 1/100)



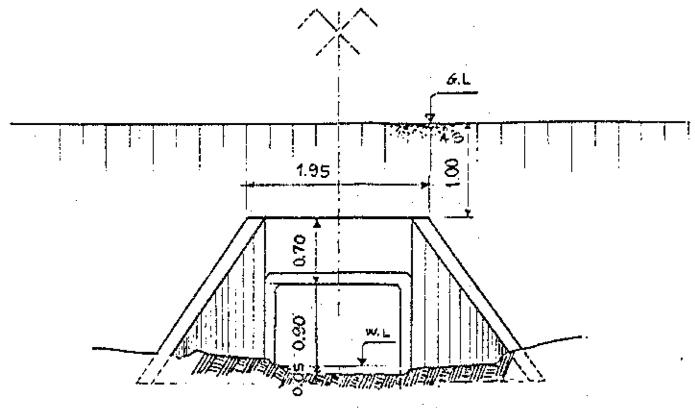
N: 24
Man Power
Gate (Metal)
2.00
1.60
SECTION (1/50)
1.20
PLAN UPTSTAIR
6.50
1.80
0.50
0.30
Step
2.00
1.20
2.20
1.20
4.60
PLAN DOWN STAIR (1/50)

N°25



G.L
A.C
0.50
1.30
0.30
1.05
0.30
SECTION (SCALE 1/50).
0.20
2.00
2.00
10.00
15.30
10.00
2.00
PLAN (SCALE 1/50).

N° 26



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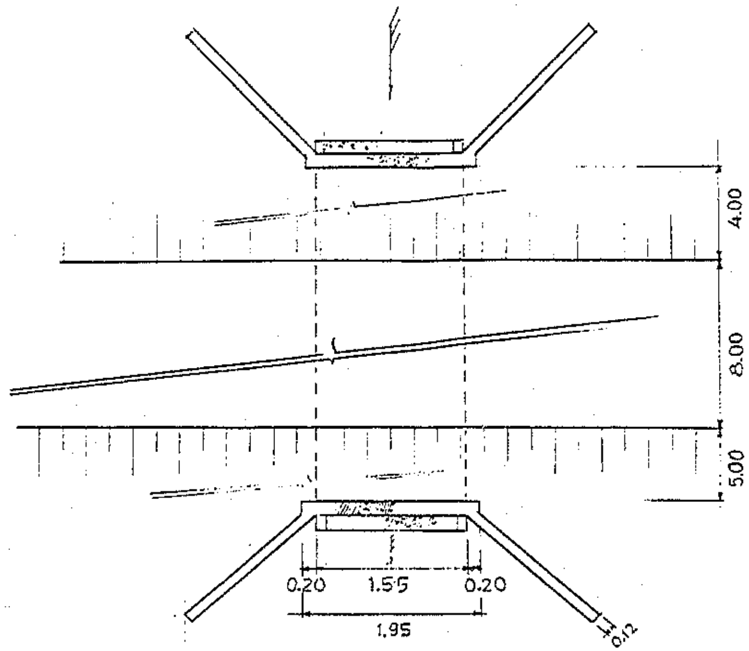

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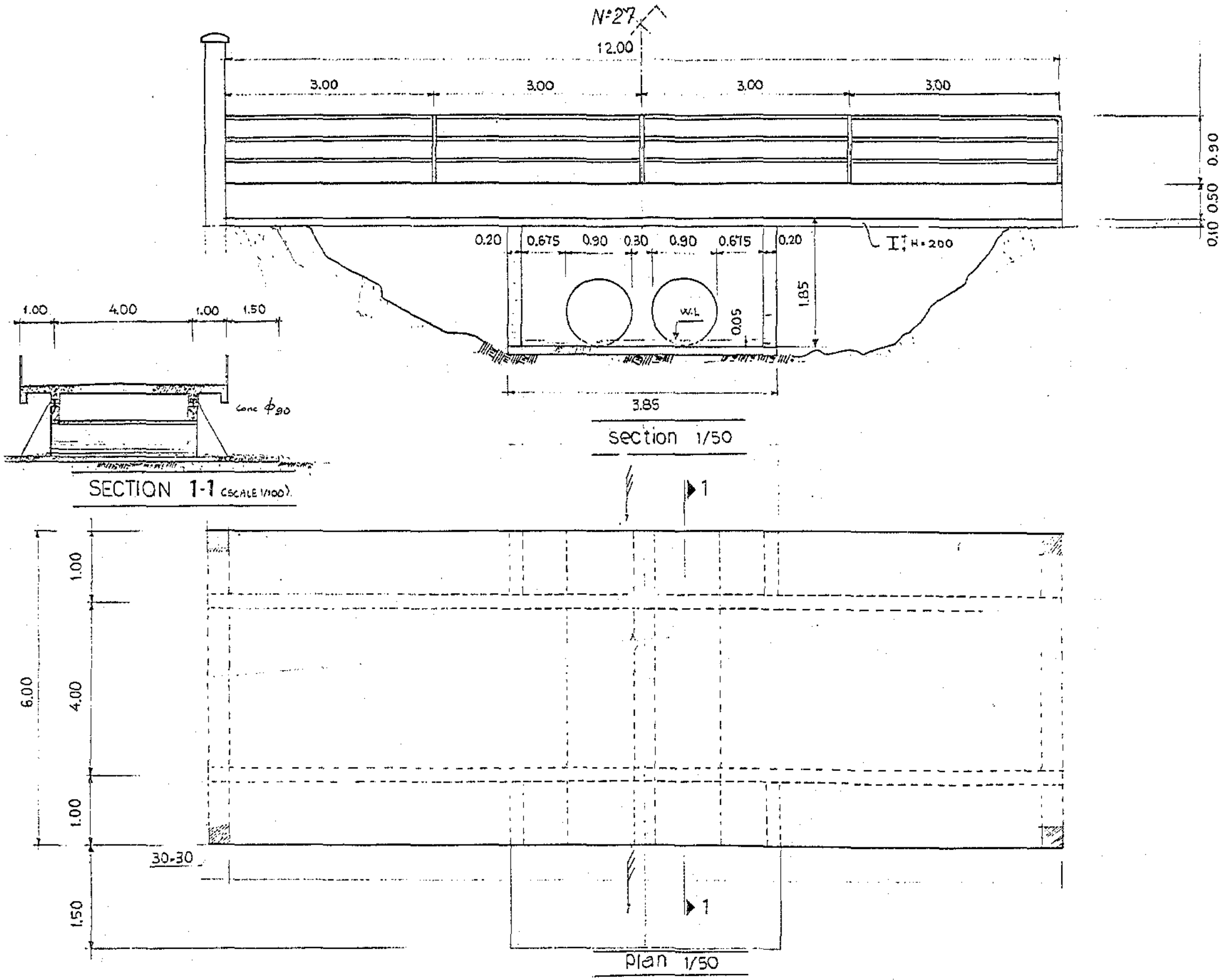

N°27
12.00
3.00
3.00
3.00
3.00
0.90
0.50
0.10
I H=200
0.20
0.675
0.90
0.30
0.90
0.675
0.20
1.85
W.L
0.05
3.85
section 1/50
1.00
4.00
1.00
1.50
conc Φ90
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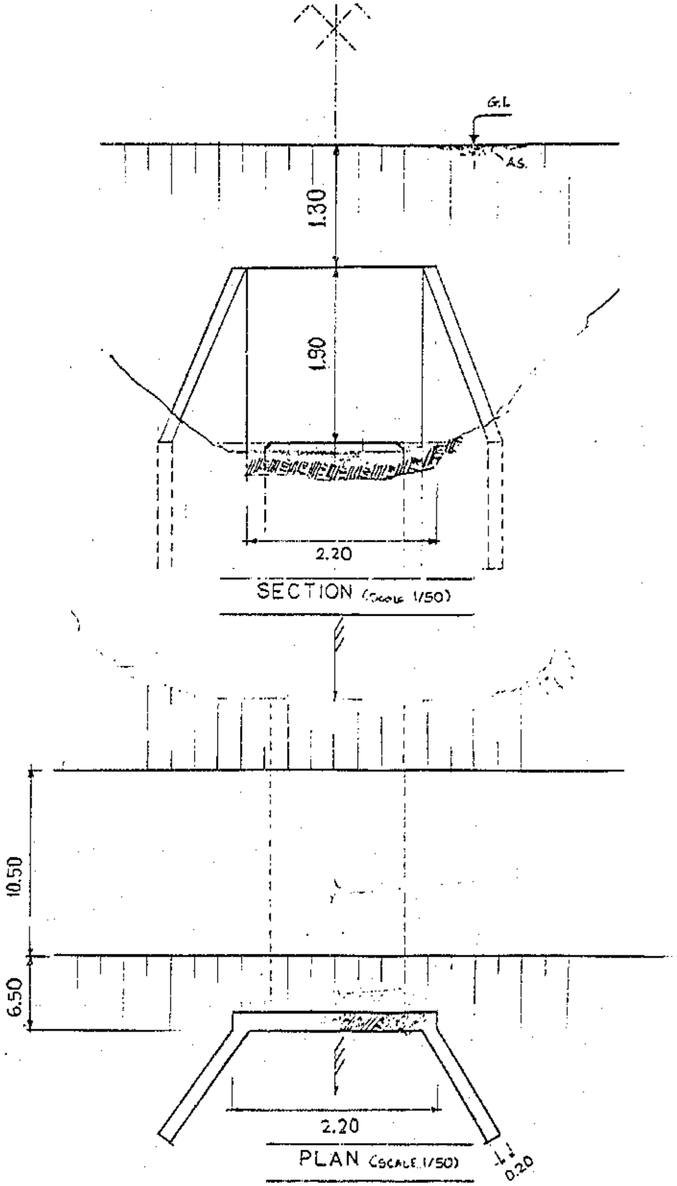
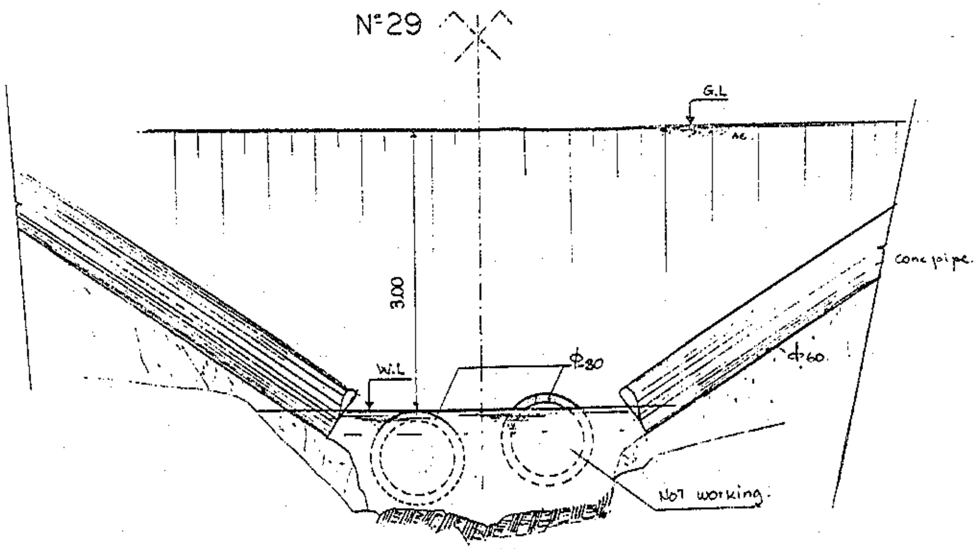
1
1.00
4.00
1.00
6.00
30-30
1.50
1
plan 1/50

Nº 28


G.L
A.S.
1.30
1.90
2.20
SECTION (Scale 1/50)
10.50
6.50
2.20
PLAN (SCALE 1/50)
0.20

N°29



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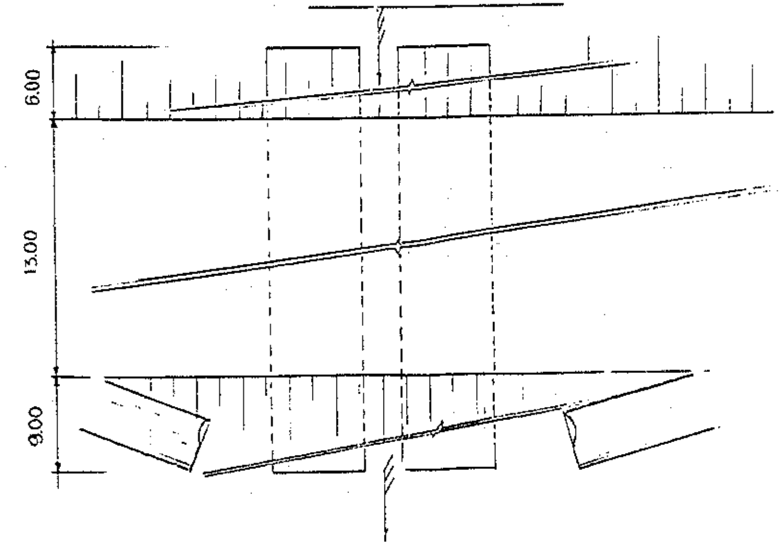
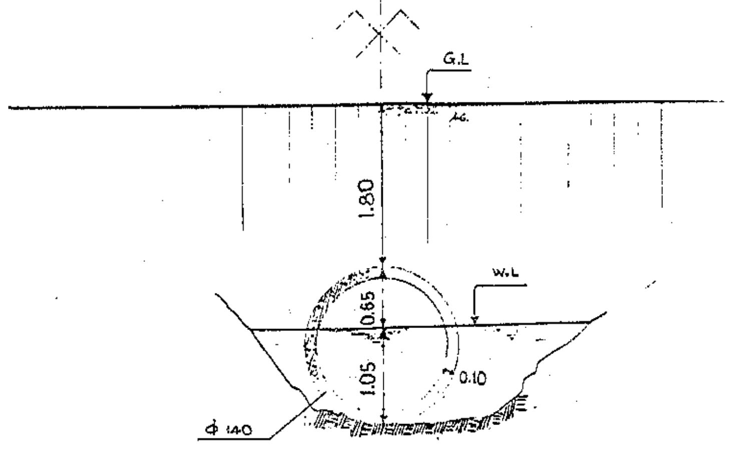
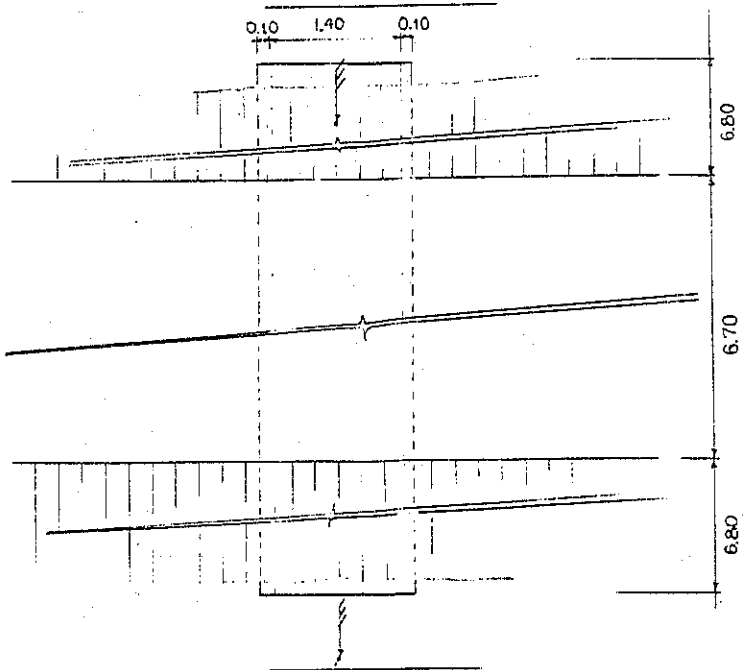


PLAN (SCALE 1/50)

No 30

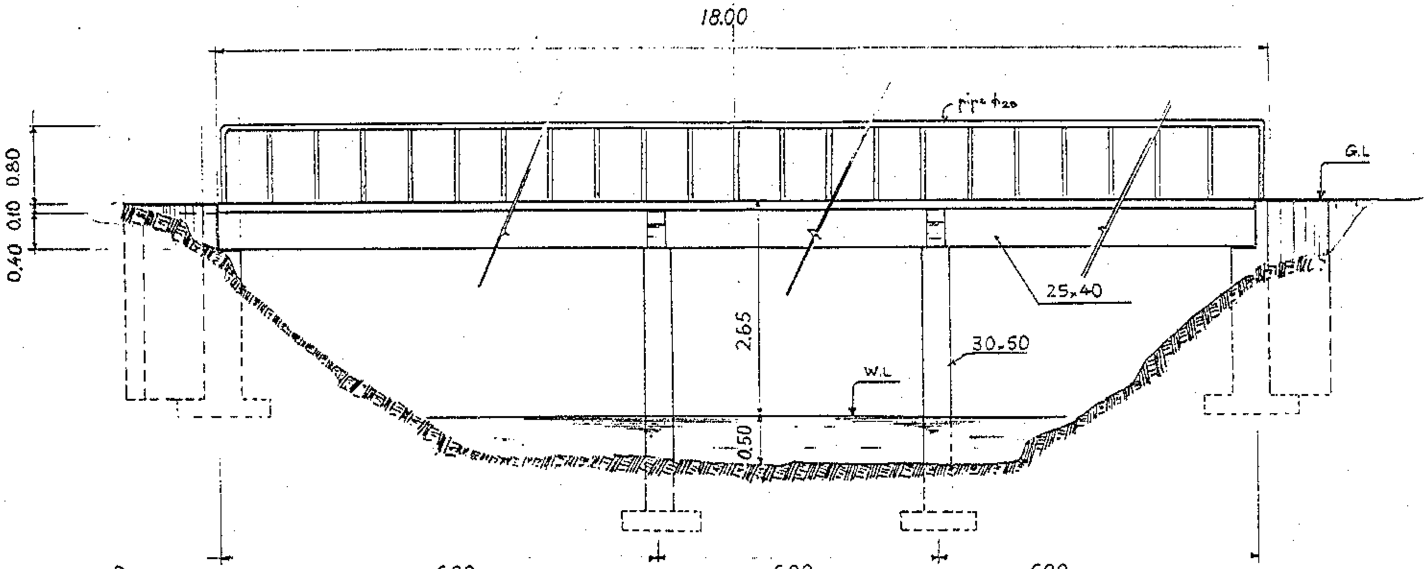


Section (scale 1/50)

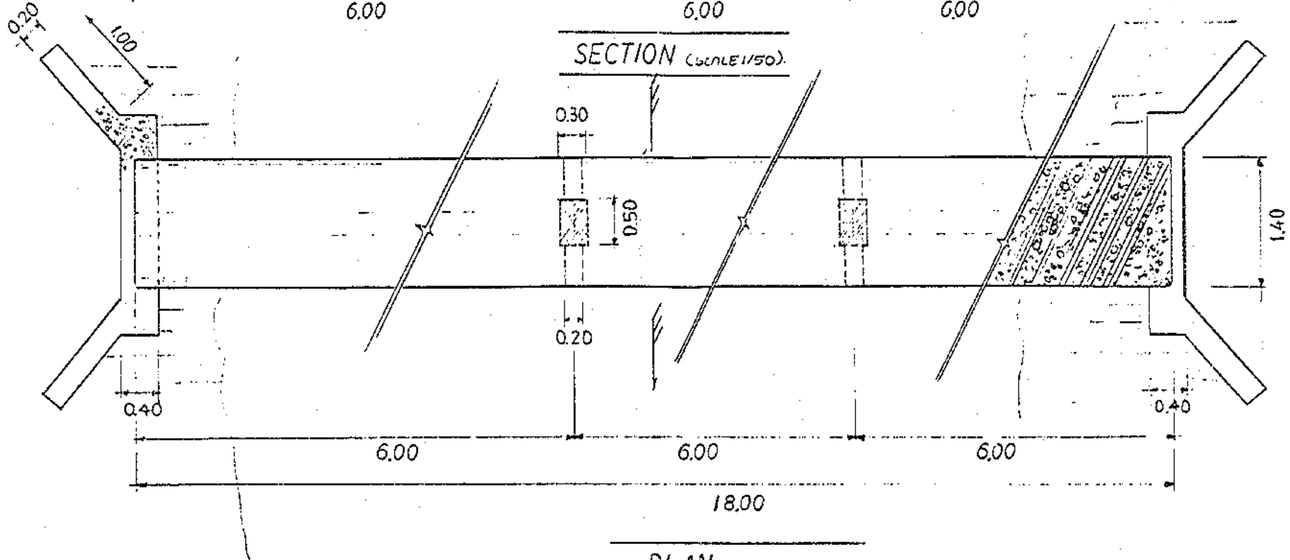


Plan (scale 1/50)

Nº31

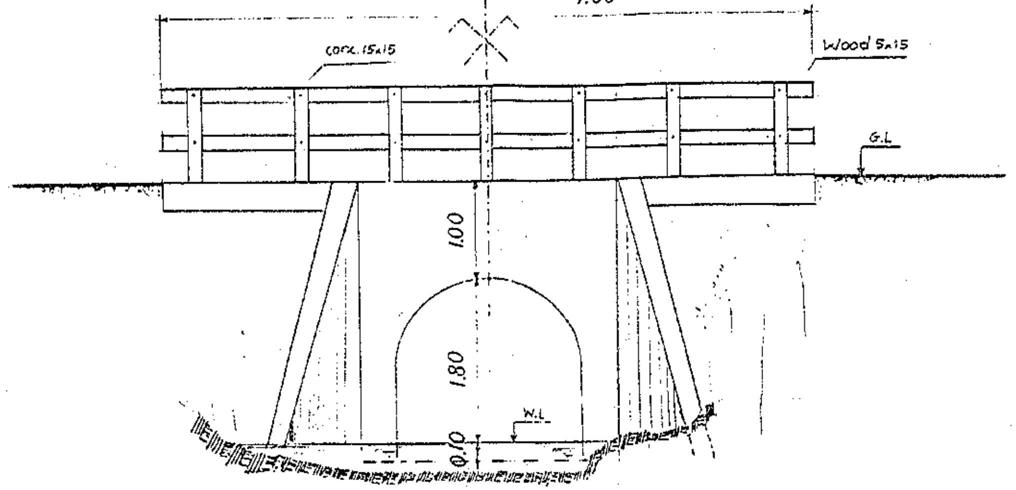


SECTION (SCALE 1/50).

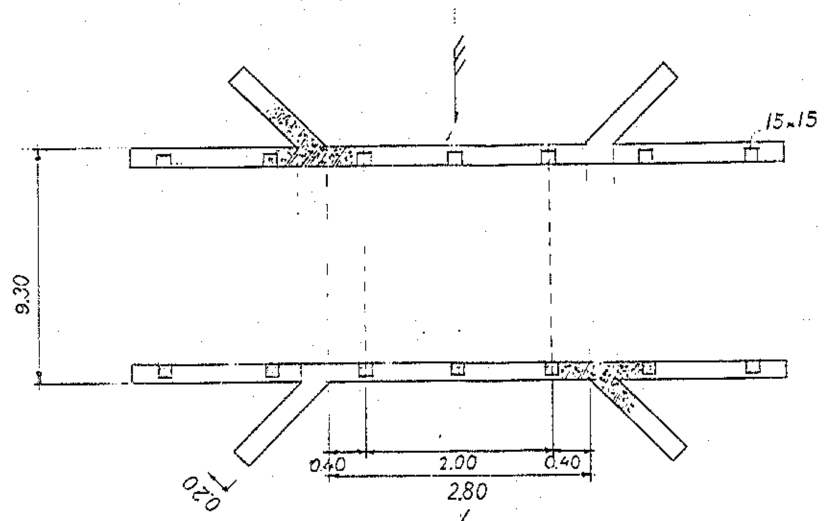


PLAN (SCALE 1/50)

N°32

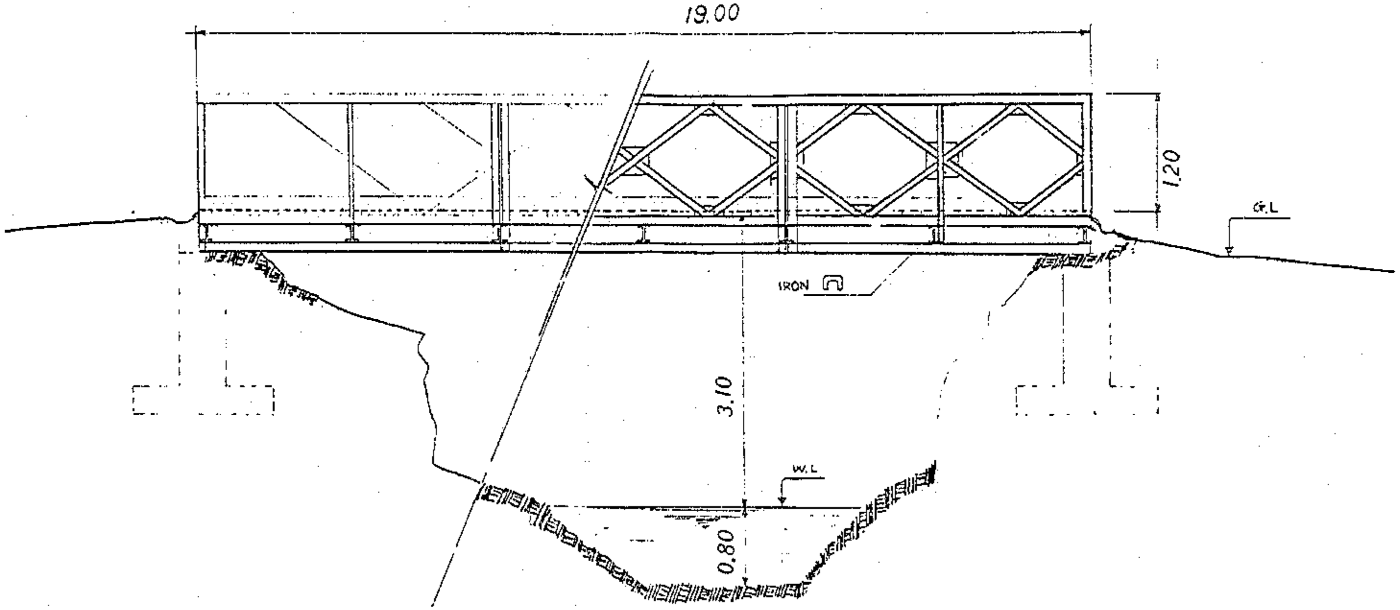


SECTION (SCALE 1/50)

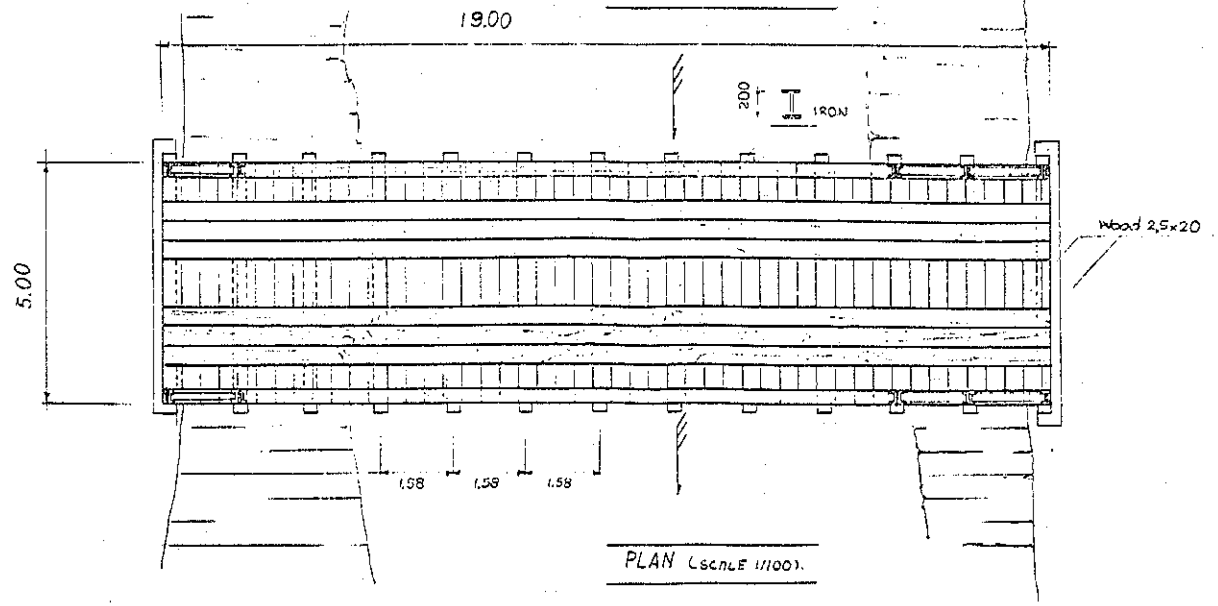


PLAN (SCALE 1/50)

Nº33 Bridge beiley

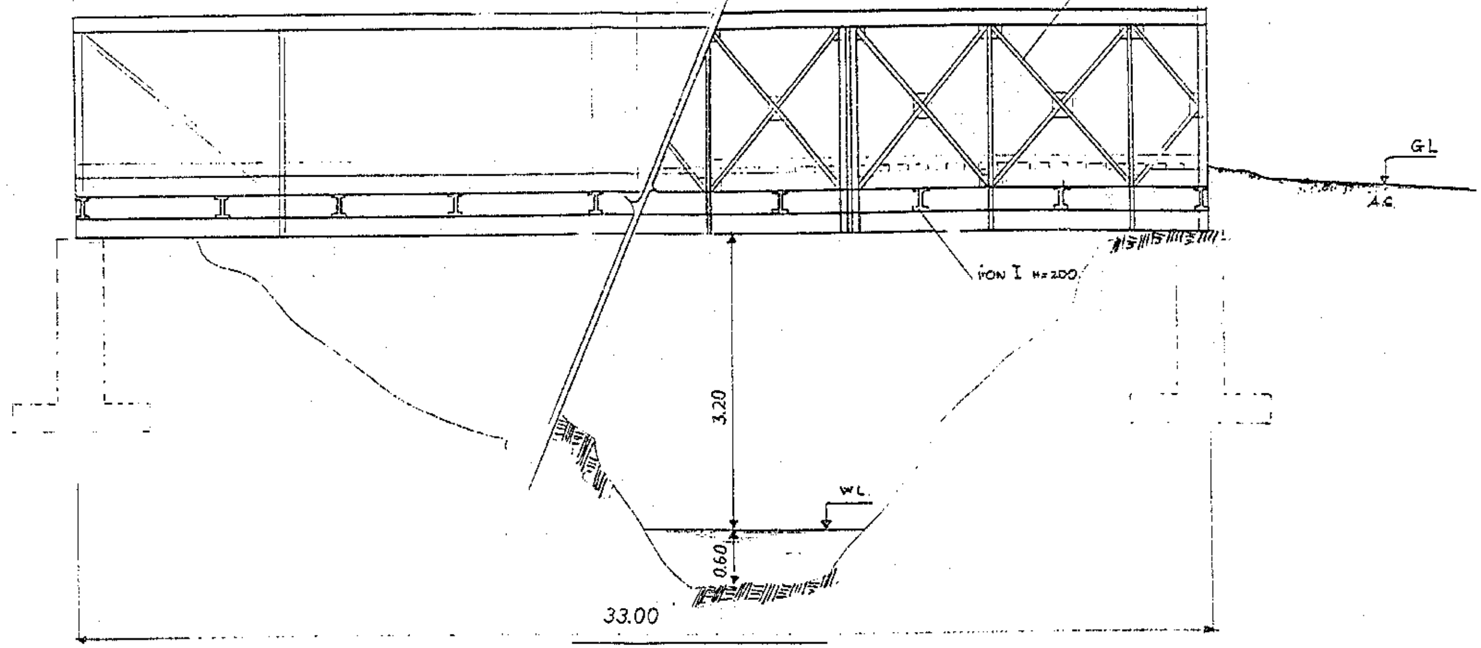


SECTION (SCALE 1/50)

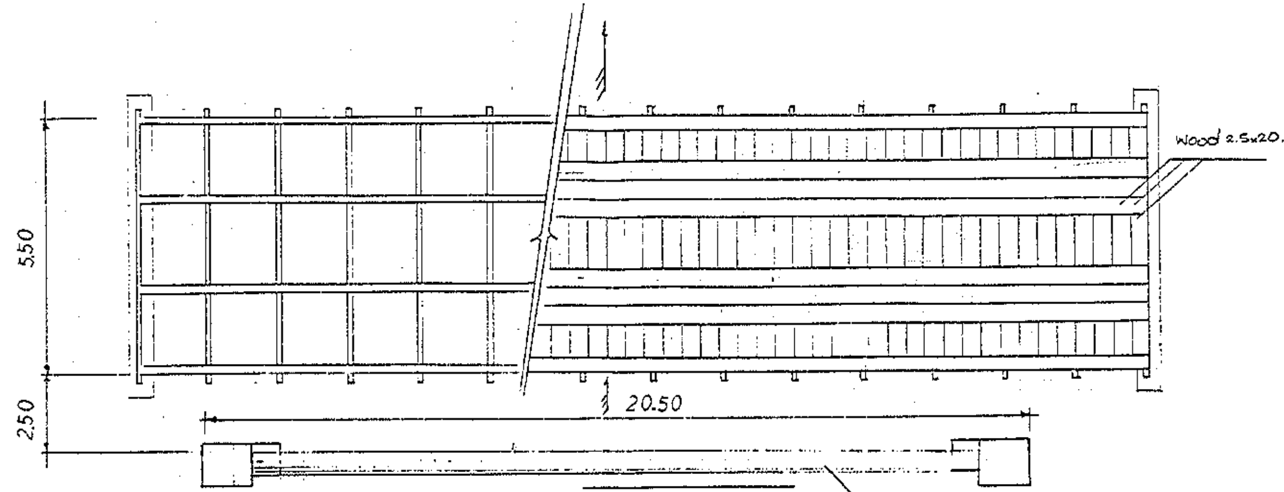


PLAN (SCALE 1/100)

N: 34 Bridge Beiley

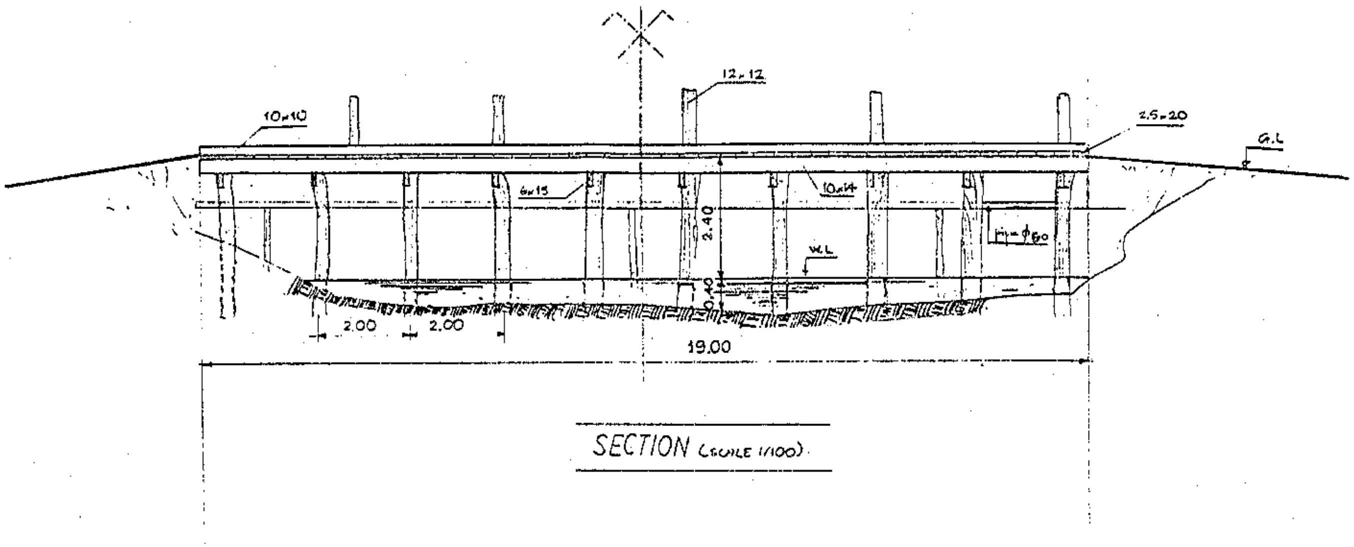


SECTION (SCALE 1/50)

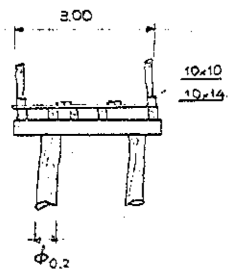


PLAN (SCALE 1/100)

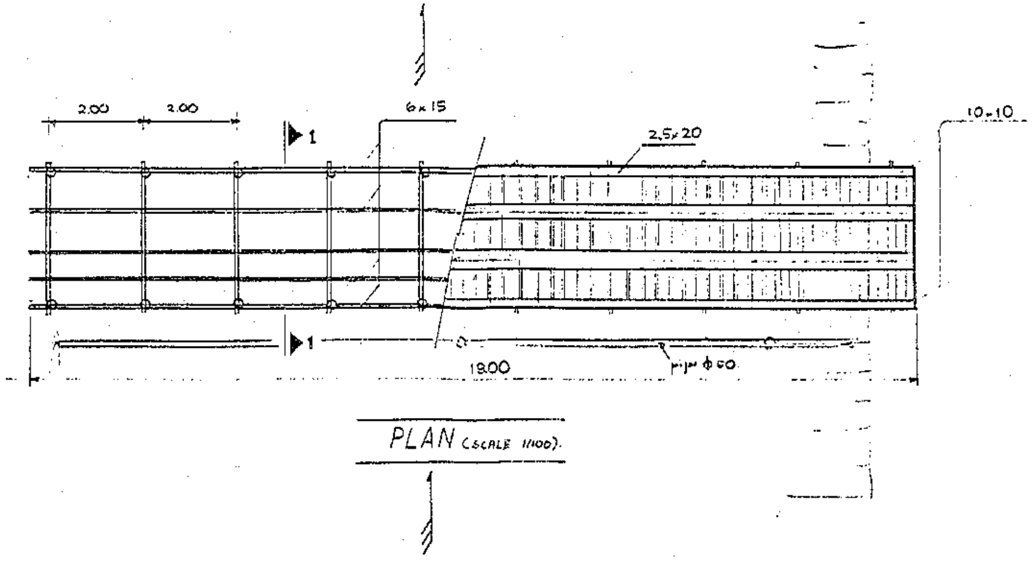
N°35



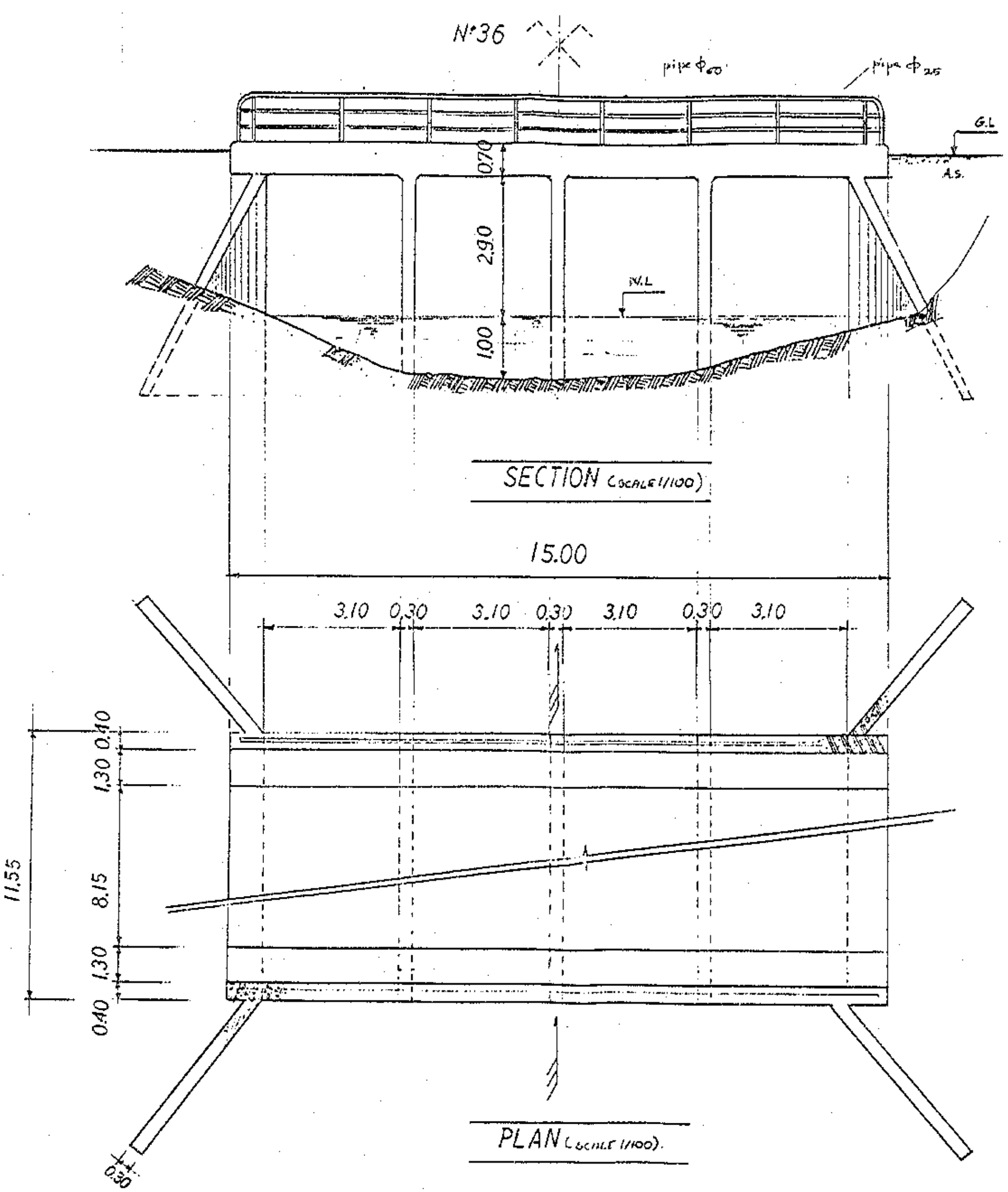
SECTION (SCALE 1/100)



SECTION 1-1 (SCALE 1/100)

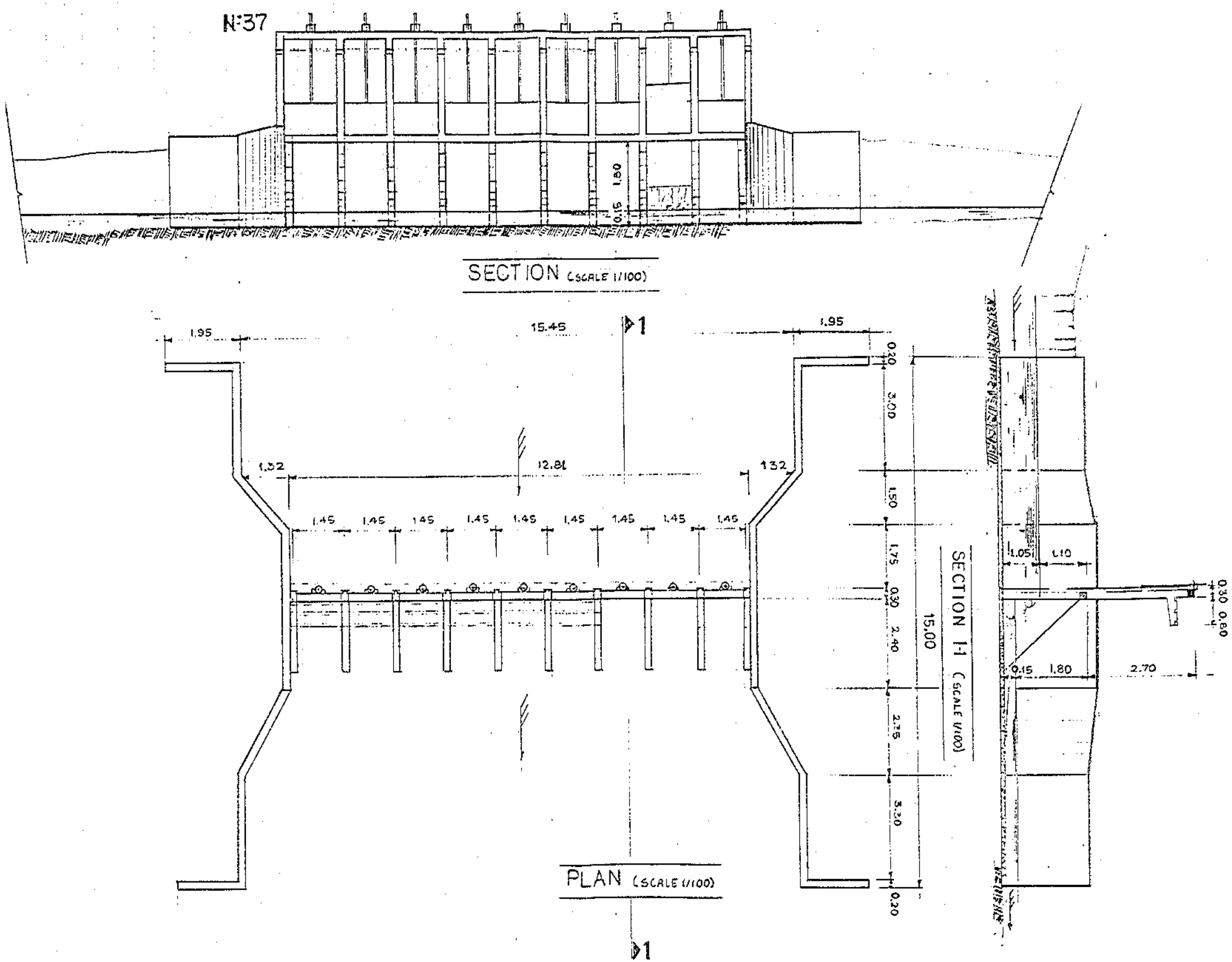


PLAN (SCALE 1/100)



N°36
pipe φ60
pipe φ25
G.L
A.S.
0.70
2.90
1.00
W.L
SECTION (SCALE 1/100)
15.00
3.10
0.30
3.10
0.30
3.10
0.30
3.10
11.55
0.40
1.30
8.15
1.30
0.40
0.30
PLAN (SCALE 1/100)

N:37



1.80
0.15
SECTION (SCALE 1/100)
1.95
15.45
1
1.95
1.32
12.81
1.32
1.45
0.20
3.00
1.50
1.75
0.30
2.40
2.75
3.30
0.20
15.00
SECTION 1-1 (SCALE 1/100)
1.05
1.10
0.30
0.60
0.15
1.80
2.70
PLAN (SCALE 1/100)
1

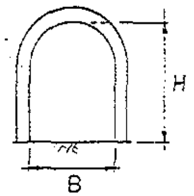
Small Structures on The Main Canals

WOODEN BRIDGE

Structure No.

$P_{1.}$ 5. 7. 8. 10. 11. 12. 13. 14. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 30. 33. 34. 36. 37. 38.

HALFT CYLINDER

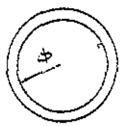


Structure No.

$P_{2.}$ 4. 6. 29.

Number of P	2	4	6	29
B (m)	1.00	1.00	1.40	1.20
H (m)	1.50	1.50	1.90	1.70

CYLINDER

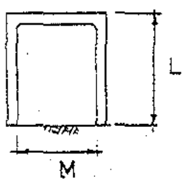


Structure No.

$P_{3.}$ 16. 31. 35.

Number of P	3	16	31	35
ϕ(mm)	100	70	80	100

RECTANGULAR



Structure No.

$P_{9.}$ 15. 32.

Number of P	9	15	32
L (m)	1.40	1.20	1.00
M (m)	1.50	1.90	1.00

A - 2 Inventory of Lateral Canals in Sub-area H

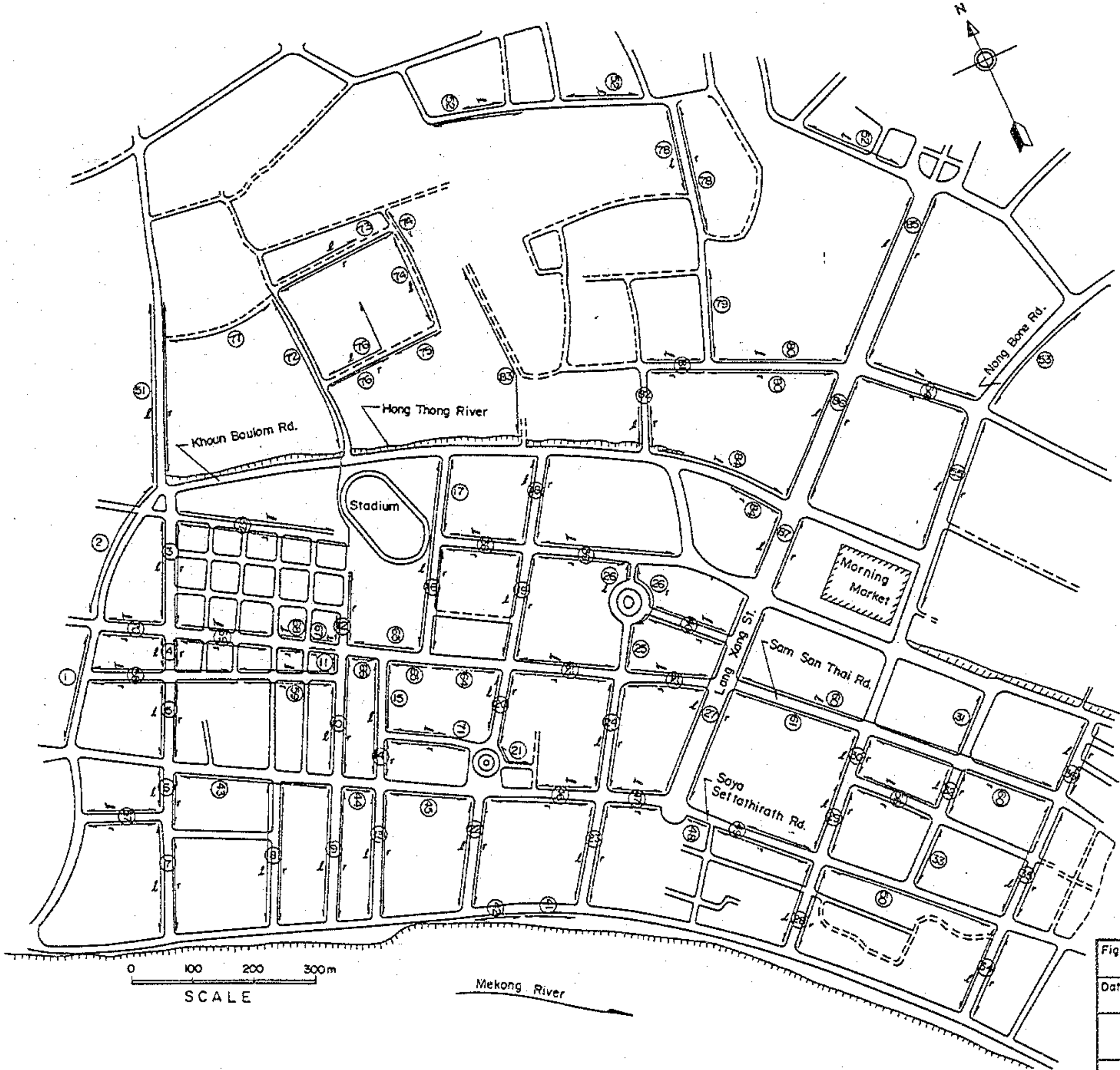


Fig. No.	Distribution Map of Side Ditch
Date:	in Sub-area H

LAO PEOPLE'S DEMOCRATIC REPUBLIC
FEASIBILITY STUDY ON IMPROVEMENT
OF DRAINAGE SYSTEM IN VIENTIANE

JAPAN INTERNATIONAL COOPERATION AGENCY

Inventory of Ditches (South Area of Hong Thong - 1)

Route No.	Section type	Length (m)	Width x depth (m x m)	Dia. (m)	Cover	Interval of side inlet (m)	Present condition: Exhaustion	Present condition: Reduction of flow area	Structures on ditch: Concrete pipe (nos.or m)	Structures on ditch: Steel pipe (nos.or m)	Structures on ditch: Concrete bridge (nos.or m)	Structures on ditch: Wooden bridge (nos.or m)
1	IV	190		0.6	B		B	B				
2	IV	240		0.6	B		B	B				
3-l	I	170	0.4x1.0		B		B	B				10
3-r	I	170	0.6x1.0		B		B	B				
4-l	I	55	0.5x1.0		B		B	B				
4-r	I	55	0.5x1.0		B		B	B				
5-l	I	125	0.7x1.0		B	@10	B	B				
5-r	I	125	0.8x0.8		B	@5	B	C				
6-l	IV	70		0.6	A		B	C				
6-r	I	90	0.4x0.7		A		B	C				
7-l	I	190	0.8x1.0		B		B	C				15
7-r	III	150		0.4	C		B	C				6
8-l	I	230	0.5x0.4		B		B	C				
8-r	III	230		0.5	C		C	C				17
9-l	VI	220	0.4x0.5		C		C	C	1			10
9-r	VI	220	0.4x0.5		C		C	C				20
10-l	II	150	0.6x0.7		B		B	B				33
10-r	II	190	0.6x0.7		B		B	B			5	
11	I	30	0.8x1.0		A		A	B				
12-l	I	60	0.5x0.9		C		B	B				
12-r	I	120	0.5x0.9		C		B	B				
13-l	III	200		0.4	B		C	C			20	
13-r	III	200		0.4	C		C	C			4	
14-l	I	185	0.4x0.3		C		B	C				
14-r	I	65	0.4x0.3		B		B	C				20
15	I	110	0.4x0.3		B		B	C			33	
16-l	II	310	0.8x1.0		A		A	A				
16-r	II	170	0.8x1.0		A		A	A				
17	II	130	0.8x1.0		A		A	A				
18-l	II	140	0.8x1.0		A		A	A				
18-r	II	140	0.8x1.0		A		A	A				
19-l	II	170	0.8x1.0		B		B	C				
19-r	II	170	0.8x1.0		B		B	C				
20-l	I	110	0.8x0.8		A	@11	A	B				
20-r	I	120	0.8x0.8		A	@11	A	B				
21	I	65	0.4x0.4		A		A	B				
22-l	IV	180		0.4	A	@4	A	C				
22-r	I	180	0.6x0.6		A	@6	A	B				
23-l	VI	160	1.0x0.2		C		C	C			1	
23-r	VI	160	1.0x0.2		C		C	C				
24-l	III	170		0.4	C		C	C			50	
24-r	III	170		0.4	C		C	C				

Section type
- I: Rectangular
- II: U-shape flume
- III: Half circular
- IV: Circular
- V: Trapezoidal
- VI: Soil

Cover
- A: all covered
- B: covered but partialy broken
- C: without cover

Exhaustion
- A: no problems
- B: damaged but almost no influence to flow capacity
- C: seriously damaged

Reduction of flow area
- A: almost no influence to flow capacity
- B: flow area is influenced by silting and/or flourishing of weeds.
- C: sectional area is considerably reduced by silting and/or flourishing of weeds.

Inventory of Ditches (South Area of Hong Thong - 2)

Route No.	Section type	Length (m)	Width x depth (m x m)	Dia. (m)	Cover	Interval of side inlet (m)	Present condition: Exhaustion	Present condition: Reduction of flow area	Structures on ditch: Concrete pipe (nos.or m)	Structures on ditch: Steel pipe (nos.or m)	Structures on ditch: Concrete bridge (nos.or m)	Structures on ditch: Wooden bridge (nos.or m)
25	I	70	0.7x0.9		A	@10	A	A				
26-l	I	25	0.7x1.0		A		A	A				
26-r	I	200	0.7x1.0		A		A	A				
27-l	I	340	1.0x1.0		A	@10	A	B				
27-r	I	340	1.0x1.0		A	@10	A	B				
28-l	I	140	0.6x0.6		A	@8	A	C				
28-r	I	140	0.4x0.6		A	@7	A	C				
29-l	I	120	0.4x0.7		C	@4	B	C			5	
29-r	I	120	0.4x0.7		C		B	C			4	
30-l	I	80	0.7x0.8		C	@7	A	A				
30-r	I	65	0.4x1.0		C		B	B			5	
31	VI	110	—		C		-	C				
32-l	VI	70	1.0x0.5		C		B	C				
32-r	VI	70	1.0x0.5		C		B	B				
33	VI	100	1.0x0.5		C		C	C	2			
34-l	VI	145	1.0x0.5		C		C	C				
34-r	III	145		0.3	C		B	C			6	12
35-l	III	200		0.3	C		B	C	1			
35-r	II	200	0.5x0.8		C		A	A	1		30	13
36-l	I	120	0.6x0.6		C		B	C				20
36-r	VI	120	0.4x0.4		C		B	A	1			2
37-l	VI	270	1.0x0.5		C		C	C				
37-r	I	400	0.8x0.9		C	@7	A	B				20
38-l	II	120	0.8x1.0		B	@7	B	B				
38-r	II	120	0.8x1.0		B	@7	B	B				
39-l	I	240	0.6x0.8		B	@7	B	B				
39-r	I	160	0.6x0.8		B	@7	C	B				
40-l	VI	135	1.0x0.5		C	@2.5	B	C	1		15	
40-r	VI	135	1.0x0.5		C		B	C	1		12	
41	I	90	0.4x0.6		A		A	A				
42	V	90	0.6x0.6		C		A	B				
43	I	260	0.8x1.1		A	@10	A	B				
44	I	60	0.8x0.9		A	@12	A	C				
45	I	150	0.8x0.7		A	@8.5	A	B				
46-l	I	100	0.5x0.4		A		A	B				
46-r	I	180	0.3x0.4		A		A	B				
47-l	I	85	0.5x0.4		A		B	B				
47-r	I	85	0.5x0.4		A	@10	A	B				
48	III	35		0.4	C		A	A				
49-l	III	125		0.3	C		C	C				
49-r	I	165	0.4x0.5		C		A	A				

Exhaustion
- A: no problems
- B: damaged but almost no influence to flow capacity
- C: seriously damaged

Reduction of flow area
- A: almost no influence to flow capacity
- B: flow area is influenced by silting and/or flourishing of weeds.
- C: sectional area is considerably reduced by silting and/or flourishing of weeds.

Section type
- I: Rectangular
- II: U-shape flume
- III: Half circular
- IV: Circular
- V: Trapezoidal
- VI: Soil

Cover
- A: all covered
- B: covered but partialy broken
- C: without cover

Inventory of Ditches (South Area of Hong Thong - 3)

Route No.	Section type	Length (m)	Width x depth (m x m)	Dia. (m)	Cover	Interval of side inlet (m)	Present condition: Exhaustion	Present condition: Reduction of flow area	Structures on ditch: Concrete pipe (nos.or m)	Structures on ditch: Steel pipe (nos.or m)	Structures on ditch: Concrete bridge (nos.or m)	Structures on ditch: Wooden bridge (nos.or m)
50	II	290	0.5x0.7		C		A	A			80	
56-l	VI	130	0.5x0.3		C		C	C	2			
56-r	VI	130	0.5x0.3		C		C	C				
57-l	I	120	0.4x0.3		B		C	C	1			
57-r	I	120	0.4x0.3		B		B	A				
58-l	I	240	0.6x0.6		B		A	B				
58-r	I	240	0.6x0.6		B		A	B				
59-l	I	160	0.8x0.8		B	@50	B	C				
59-r	I	160	0.8x0.8		B	@50	B	C				
60-l	I	540	0.6x1.2		A	@8.5	A	B				
60-r	I	320	0.6x1.2		A	@8.5	A	B				
61	I	220	0.4x0.5		A		A	C		1		
62-l	-	140	-		A		A	-				
62-r	I	140	0.5x0.8		A	@5	A	B				
63-l	I	165	0.5x0.5		B		B	C				
63-r	I	165	0.5x0.5		A		B	B				
64	I	70	0.4x0.6		A		A	B				
65-l	I	120	0.6x0.6		A	@5	A	B				
65-r	I	70	0.4x0.6		B		B	C				
66	I	50	0.8x1.0		A		A	B				
67-l	I	45	0.5x0.8		A	@9	A	A				
67-r	I	45	0.5x0.8		A	@9	A	A				
68-l	I	40	0.5x0.8		B		B	B				
68-r	I	40	0.5x0.8		B	@9	A	A				
69-l	I	150	0.5x0.8		B	@9	B	B				
69-r	I	150	0.5x0.8		B	@9	B	B				
70-l	I	100	0.5x0.8		B	@9	B	B				
70-r	I	100	0.5x0.8		B	@9	B	B				
71-l	VI	100	0.5x0.3		C		C	C				
71-r	I	135	0.5x0.4		C		C	C				

Section type
- I: Rectangular
- II: U-shape flume
- III: Half circular
- IV: Circular
- V: Trapezoidal
- VI: Soil

Cover
- A: all covered
- B: covered but partialy broken
- C: without cover

Exhaustion
- A: no problems
- B: damaged but almost no influence to flow capacity
- C: seriously damaged

Reduction of flow area
- A: almost no influence to flow capacity
- B: flow area is influenced by silting and/or flourishing of weeds.
- C: sectional area is considerably reduced by silting and/or flourishing of weeds.

Inventory of Ditches (North Area of Hong Thong)

Route No.	Section type	Length (m)	Width x depth (m x m)	Dia. (m)	Cover	Interval of side inlet (m)	Present condition: Exhaustion	Present condition: Reduction of flow area	Structures on ditch: Concrete pipe (nos.or m)	Structures on ditch: Steel pipe (nos.or m)	Structures on ditch: Concrete bridge (nos.or m)	Structures on ditch: Wooden bridge (nos.or m)
51-l	VI	270	1.0x0.5		C		C	C	7			15
51-r	VI	270	1.0x0.5		C		C	C	5		10	6
52-l	VI	380	1.0x0.5		C		C	C				4
52-r	VI	150	1.0x0.5		C		C	C	4			5
53	I	200	0.3x0.6		A	@7	A	A				
54-l	I	185	0.4x0.8		C	@6.5	A	B				
54-r	I	185	0.8x1.0		A	@6.5	A	B				
55-l	I	240	0.8x1.0		A	@3	A	B				
55-r	I	325	0.4x0.7		B		B	C				
72	VI	270	1.0x0.5		C		C	C	2			22
73-l	VI	150	0.8x0.5		C		C	C				10
73-r	VI	200	0.8x0.5		C		C	C		1		15
74-l	VI	165	0.8x0.5		C		C	C	1			4
74-r	VI	80	0.8x0.5		C		C	C				
75	VI	85	0.8x0.5		C		C	C	2			35
76-l	I	180	0.4x0.7		C		A	C	1			
76-r	I	110	0.4x0.7		C		A	C				
77	VI	200	0.6x0.3		C		C	C	1			5
78-l	VI	130	0.6x0.3		C		C	C	1			10
78-r	VI	210	0.6x0.3		C		C	C	4			10
79	VI	150	0.6x0.3		C		C	C				11
80-l	VI	210	1.0x0.5		C		C	C			20	5
80-r	VI	200	1.0x0.5		C		C	C			15	9
81-l	VI	100	1.0x0.5		C		C	C				
81-r	VI	100	1.0x0.5		C		C	C			20	3
82-l	VI	70	1.0x0.7		C		C	C				27
82-r	IV	70		0.6	A		B	C				
83	VI	300	2.0x1.2		C		A	A	1			5
84-l	VI	240	0.5x0.3		C		C	C			15	20
84-r	VI	100	0.5x0.3		B		C	C			24	
85-l	I	300	0.7x0.6		A	@18	A	C				
85-r	I	300	0.7x0.6		A	@24	A	C				
86-l	I	220	0.9x1.0		A		A	C				
86-r	I	220	0.7x0.6		A	@28	A	C				
87-l	I	120	0.9x1.0		A		A	C				
87-r	I	130	0.7x0.6		A	@28	A	C				

Exhaustion
- A: no problems
- B: damaged but almost no influence to flow capacity
- C: seriously damaged

Reduction of flow area
- A: almost no influence to flow capacity
- B: flow area is influenced by silting and/or flourishing of weeds.
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Section type
- I: Rectangular
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Cover
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APPENDIX F

SOIL MECHANICAL ENGINEERING

APPENDIX F. SOIL MECHANICAL ENGINEERING

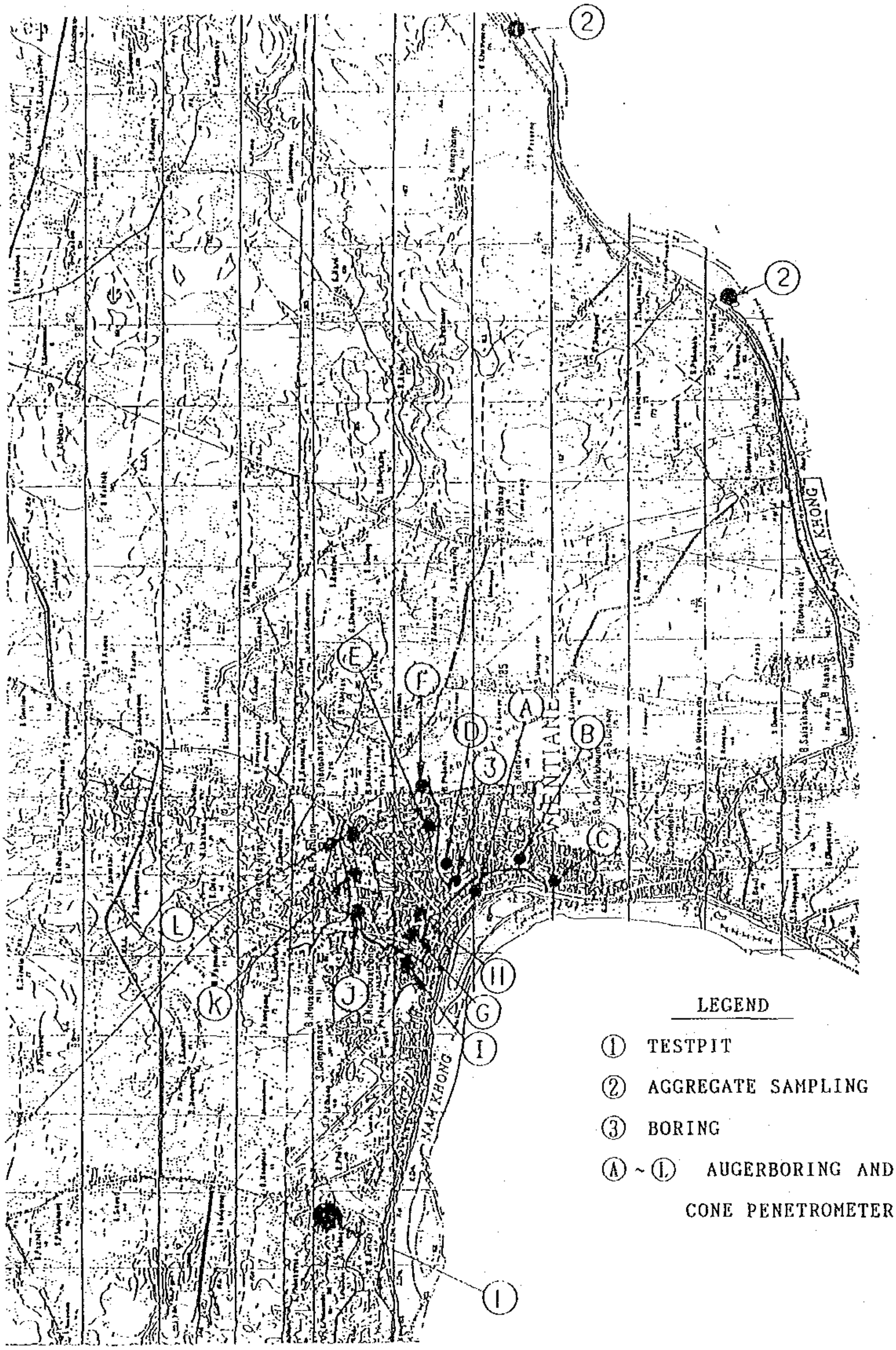
Table of Contents

List of Plate

F.1 RESULT OF SURVEY

F.1.1. PHASE I

F.1.1.1 Location Map of Soil Sampling



F.1.1.2 Auger Boring

Hong Thong

Depth	Hole N.O.				
	A	B	C	G	H
1.0 2.0 3.0	Clay Laterite Loam Gravel	Clay Gravel Clay Loam	Clay Gravel Clay Loam	Silty Clay Clay	Clay Laterite Clay Loam

Hong Ke

Depth	Hole N.O.		
	D	E	F
1.0 2.0 3.0	Clay Loam Clay Laterite	Clay Laterite Gravel Sandy Clay Laom Gravel Clay Loam	Clay Laterite Clay Gravel Gravel Clay Loam

Hong Xeng

Depth	Hole N.O.			
	I	J	K	L
1.0 2.0 3.0	Silt Silty Sand	Silty Clay Clay	Silt Clay	Silt Clay Loam Sandy Clay Loam

GEOLOGIC DEVELOPMENT

HOLE No K, DEPTH : 1.30 - 3.00 m, TYPE OF MATERIAL : CLAY

HOLE No L, DEPTH : 1.00 - 2.20 m, TYPE OF MATERIAL : CLAY LOAM

L, DEPTH : 2.20 - 3.00 m, TYPE OF MATERIAL : SANDY CLAY LOAM

GRAIN SIZE ANALYSIS

TEST ING No	HOLE No	TYPE OF MATERIAL	SEIVE SIZE mm	37.5	19.0	9.5	4.75	2.38	1.18	0.595	0.300	0.149	0.075	0.050	0.037	0.019	0.009	0.005
1	K	CLAY	% PASSING	—	—	—	100	98.9	98.5	98.2	98.0	97.4	96.7	90.6	88.6	86.6	82.6	76.6
2	K	CLAY	% PASSING	—	—	—	100	99.0	98.7	98.5	98.2	97.5	96.8	92.6	90.6	88.6	84.6	78.6
1	K	CLAY	% PASSING	—	—	—	100	99.9	99.8	99.7	99.3	98.1	96.9	92.6	90.6	88.6	84.6	77.6
2	K	CLAY	% PASSING	—	—	—	100	99.9	99.8	99.7	99.2	98.0	96.7	90.6	88.6	86.6	80.6	74.6
1	L	CLAY. L	% PASSING L	—	—	—	—	—	100	99.6	96.6	82.1	68.1	58.6	55.6	49.6	40.6	32.6
2	L	CLAY. L	% PASSING	—	—	—	—	—	100	99.5	96.4	82.0	68.1	56.6	53.6	48.6	39.6	44.6
1	L	S.C.L.	% PASSING	100	99.9	99.8	99.7	96.2	80.4	71.7	54.6	48.6	40.6	32.6	30.6	24.5	16.5	8.0
2	L	S.C.L.	% PASSING	100	99.9	99.8	99.6	96.0	80.4	70.4	55.6	50.6	45.6	34.6	30.6	25.2	17.1	8.0

REMARK: CLAY. L : CLAY LOAM.
S.C.L. : SANDY CLAY LOAM

VIENTIANE. MAY 1989.
D. MATERIAL LABORATORY CHIEF.

HOLE No K, DEPTH : 1.30 - 3.00 m, TYPE OF MATERIAL : CLAY

HOLE No L, DEPTH : 1.00 - 2.20 m, TYPE OF MATERIAL : CLAY LOAM

L, DEPTH : 2.20 - 3.00 m, TYPE OF MATERIAL : SANDY CLAY LOAM

TESTING	HOLE	TYPE OF	ATTERBERG LIMITS			W.C	UNIT WEIGHT g/cm³		SPECIFIC GRAVITY	CONSOLIDATION				UNCONFINED			
No	No	MATERIAL	LL	PL	PI	%	WET	DRY		n	ε	S	E	e	ψ	c	Kg/cm²
1	K	CLAY	48.5	27.8	20.7	22.2	2.08	1.70	2.74	37.9	0.61	0.99	77.0	0.53	12.	1.63	4.06
2	K	CLAY	48.2	27.9	20.3	22.4	2.07	1.67	2.73	-	-	-	-	0.54	13.	1.65	4.16
1	K	CLAY	42.9	25.9	17.0	23.8	2.02	1.63	2.73	40.2	0.67	0.96	134	0.60	14.	1.28	3.30
2	K	CLAY	43.1	25.5	17.6	24.0	2.03	1.64	2.73	40.0	0.66	0.98	134	0.59	15.	0.89	2.86
1	L	CLAY LOAM	25.1	16.0	9.1	15.1	2.05	1.78	2.71	34.3	0.52	0.78	71	0.45	26.	0.36	1.14
2	L	CLAY LOAM	25.6	17.4	8.2	14.2	2.05	1.79	2.72	-	-	-	-	0.46	24.	0.44	1.37
1	L	S.C.L.	24.5	16.5	8.0	20.2	2.06	1.71	2.69	36.3	0.57	0.95	47	0.5	24.	0.32	0.99
2	L	S.C.L.	25.2	17.1	8.1	20.9	2.07	1.71	2.68	36.1	0.56	0.99	55	0.5	22.	0.34	1.04

ATTERBERG LIMITS

LL : LIQUID LIMIT
PL : PLASTIC LIMIT
PI : PLASTIC INDEX
W.C : WATER CONTENT

CONSOLIDATION

n : POROSITY
ε : COEFFICIENT OF POROSITY
S : DEGREE OF SATURATION
E : MODULE OF DEFORMATION

UNCONFINED

C : COHESION
e : VOID RATIO
ψ : ANGLE OF INTERNAL FRICTION.

DATE. MAY 27 - 1989.

D. MATERIAL LABORATORY CHIEF.

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• DIVISION OF MATERIAL LABORATORY.

LAO PEOPLE'S DEMOCRATIC REPUBLIC
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TEST RESULTS

PROJECT : FEASIBILITY STUDY IMPROVEMENT OF DRAINAGE SYSTEM IN VIENTIANE
HOLE No E, DEPTH : 1,00 - 2,50 m, TYPE OF MATERIAL : GRAVEL SANDY CLAY LOAM
E, DEPTH : 2,50 - 3,00 m, TYPE OF MATERIAL : GRAVEL CLAY LOAM
HOLE No F, DEPTH : 1,50 - 2,20 m, TYPE OF MATERIAL : CLAY GRAVEL
F, DEPTH : 2,20 - 3,00 m, TYPE OF MATERIAL : GRAVEL CLAY LOAM

TESTING No	HOLE No	TYPE OF MATERIAL	SIEVE SIZE: mm	GRAIN SIZE ANALYSIS 37.5	19.0	9.5	4.75	2.38	1.18	0.595	0.300	0.149	0.075	0.050	0.037	0.019	0.009	0.005
1	E	G.S.C.L.	% PASSING	100	98.9	81.5	58.3	56.2	55.3	54.2	46.0	33.7	27.7	24.9	23.8	22.0	19.7	15.6
2	E	G.S.C.L.	% PASSING	100	98.9	81.5	58.3	56.2	55.1	54.3	45.7	33.3	27.7	26.1	24.9	22.6	20.2	16.7
1	E	G.C.L.	% PASSING	100	85.7	61.2	43.6	42.6	42.1	41.4	37.0	30.4	26.6	23.3	22.0	21.1	19.0	16.4
2	E	G.C.L.	% PASSING	100	85.7	61.2	43.6	42.5	42.1	41.4	37.0	30.3	26.5	24.2	22.9	22.0	19.4	16.8
1	F	C.G.	% PASSING	100	97.3	83.1	57.4	55.8	53.2	54.7	51.9	48.2	44.5	42.9	40.6	38.3	33.1	30.2
2	F	C.G.	% PASSING	100	97.3	83.1	57.4	55.8	55.2	54.5	52.0	47.6	44.3	42.3	39.5	37.2	32.6	29.1
1	F	G.C.L.	% PASSING	100	98.3	77.9	57.8	55.7	54.6	53.6	49.2	42.9	37.1	32.8	30.5	28.2	23.5	20.6
2	F	G.C.L.	% PASSING	100	98.3	77.9	57.8	55.4	54.5	53.4	49.1	42.7	36.5	33.4	31.7	29.3	24.7	21.2

REMARK : G.S.C.L. : GRAVEL SANDY CLAY LOAM
G.C.L. : GRAVEL CLAY LOAM
C.G. : CLAY GRAVEL.

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TEST RESULTS

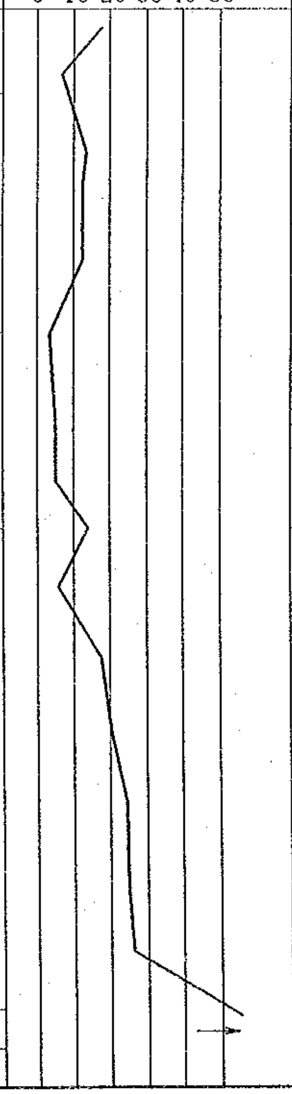
PROJECT : FEASIBILITY STUDY IMPROVEMENT OF DRAINAGE SYSTEM IN VIENTIANE

TESTING	HOLE	DEPTH	TYPE OF MATERIAL	ATTERBERG LIMIT			W.C.	UNIT WEIGHT		SPECIFIC GRAVITY
No	No	m		LL	PL	PI	%	WET	DRY	
1	E	1.00-2.50	GRAVEL SANDY CLAY LOAM	23.5	14.6	8.9	16.9	2.09	1.79	2.69
2	E	1.00-2.50	GRAVEL SANDY CLAY LOAM	23.7	15.4	8.3	17.0	2.08	1.78	2.70
1	E	2.50-3.00	GRAVEL CLAY LOAM	22.0	14.0	8.0	14.7	2.01	1.80	2.69
2	E	2.50-3.00	GRAVEL CLAY LOAM	21.6	14.0	7.6	14.9	2.06	1.79	2.70
1	F	1.50-2.20	CLAY GRAVEL	30.7	18.3	12.4	22.1	2.10	1.72	2.74
2	F	1.50-2.20	CLAY GRAVEL	30.2	18.5	11.7	22.0	2.05	1.68	2.73
3	F	2.20-3.00	GRAVEL CLAY LOAM	23.5	15.0	8.5	20.3	2.03	1.69	2.71
4	F	2.20-3.00	GRAVEL CLAY LAOM	22.4	14.5	7.9	19.7	2.02	1.69	2.71

F.1.1.3 Boring No.3 by S.P.T.

Location③

Depth	Thick-ness	Sym-bol	Name of Soil	Color of Soil	N-Value 0 10 20 30 40 50	Laboratory tests
1	1.22		Clay Laterite	Reddish Brown		
2, 3	1.78		Clay	Dark Brown		SG=2.69 WC=23.5% LL=27.8 PL=18.5 PI= 9.3
4	1.50		Clay Loam	Strong Brown		
5, 6, 7	2.81		Sandy Clay Loam	Brownish		SG=2.67 WC=28.8% LL=25.2 PL=17.8 PI= 7.4
8, 9, 10, 11, 12, 13	6.70		Sandy Loam	Yellowish		
14	0.61		Sandy Gravel			



Remark : S.G. : Specific Gravity

W.C. : Water Content

L.L. :
P.L. : Atterberglimit
P.I. :

BORING LOG

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TEST RESULTS

PROJECT : FEASIBILITY STUDY ON IMPROVEMENT OF DRAINAGE SYSTEM IN VIENTIANE (PHASE I)

BORING : S.P.T. HOLE No-3.

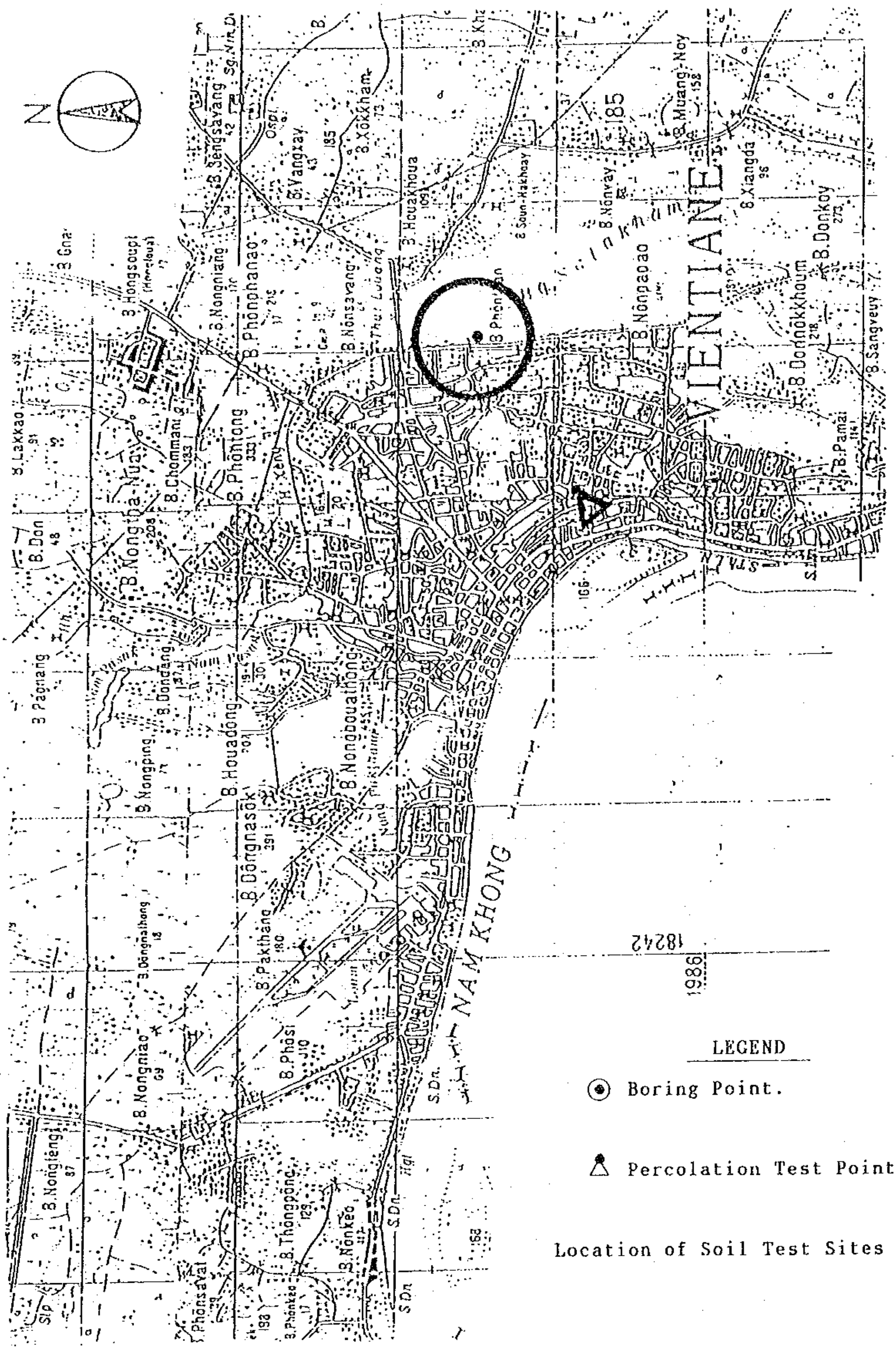
TESTING No	DEPTH (m)	TYPE OF MATERIAL	SIEVE SIZE mm	1.18	0.595	0.300	0.149	0.075	0.05	0.037	0.019	0.009	0.005	Atterberg Li L.L	Atterberg Li P.I	W.C. %	Specific Gravity
			SIEVE ANALYSIS AND HYDROMETER % PASSING SIEVE SIZE mm														
01	3.00	Clay Loam	% PASSING	100.0	99.7	97.3	88.8	73.2	59.2	51.2	45.2	41.2	36.2	29.8	10.7	25.3	2.70
02	3.00	Clay Loam	% PASSING	100.0	99.5	96.3	86.4	70.2	57.2	53.2	47.2	39.2	33.2	27.8	9.3	23.5	2.69
01	6.40-7.31	S.C.L.	% PASSING	100.0	99.9	90.7	50.8	42.7	42.2	40.2	38.2	31.2	25.2	26.6	7.6	31.1	2.68
02	6.40-7.31	S.C.L.	% PASSING	100.0	99.9	91.9	51.7	42.0	40.2	38.2	33.2	28.2	21.2	25.2	7.4	28.8	2.67

REMARK : S.C.L. : SANDY CLAY LOAM.
W.C. : WATER CONTENT.
LI : LIMITS.

VIENTIANE, MAY 22 — 1989.
D. MATERIAL LABORATORY CHIEF.

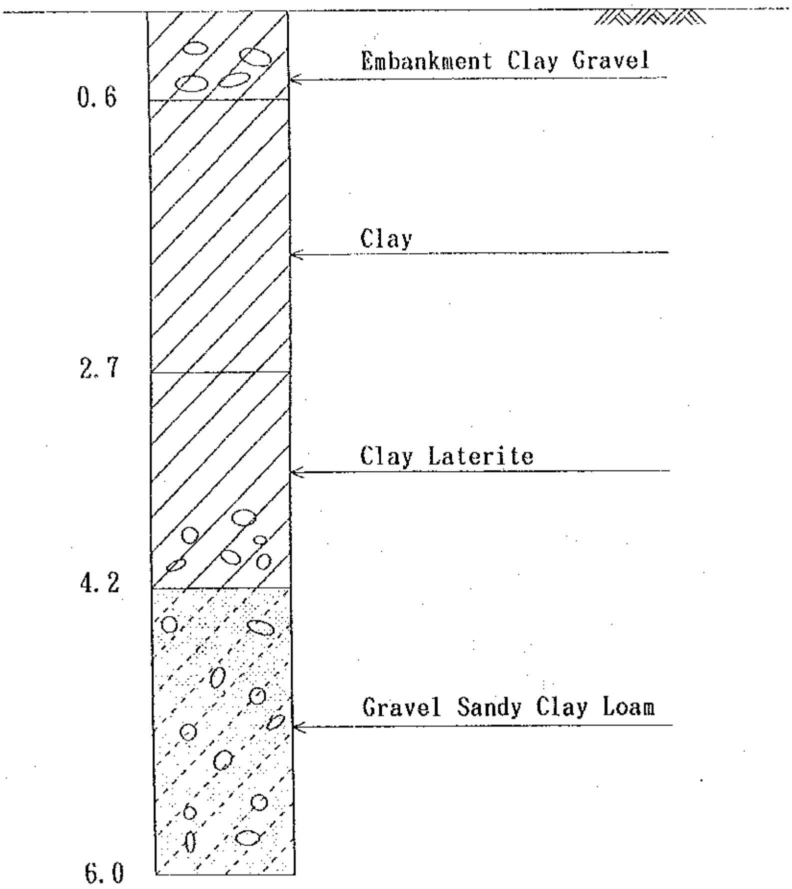
F.1.2 PHASE II

F.1.2.1 Location Map of Soil Test Sites



Location of Soil Test Sites

F.1.2.2 Boring No.1



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TEST RESULTS

PROJECT : SUB SOIL INVESTIGATION FOR VIENTIANE DRAIVAGE SYSTEM PHASE II

HOLE	SAMPLE	DEPTH	TYPE OF MATERIAL	GRAIN SIEVE ANALYSIS																	REMARK
No	No	m		SIEVE SIZE mm	50.0	38.1	19.1	9.5	4.75	2.38	1.18	0.595	0.30	0.149	0.075	0.05	0.037	0.019	0.009	0.005	
1	1	0.60-1.40	CLAY	% PASSING	-	-	-	-	100.0	99.5	99.3	99.2	98.5	95.3	89.4	78.4	76.4	72.4	60.4	50.4	
1	2	1.40-2.10	CLAY	% PASSING	-	-	-	-	100.0	99.5	99.3	99.2	98.5	98.2	97.1	94.4	92.4	90.4	84.4	74.4	
1	3	2.10-2.70	CLAY	% PASSING	-	-	-	-	-	100.0	99.7	99.6	99.3	98.9	98.7	92.4	90.4	88.4	82.4	74.4	
1	4	3.20-4.20	CLAY LATERITE	% PASSING	-	-	100.0	91.2	68.8	66.2	64.0	61.5	57.5	53.3	47.7	41.4	38.6	33.1	30.4	26.3	
1	5	4.20-6.00	GRAVEL SANDY CLAY LOAM	% PASSING	-	100.0	95.4	80.3	67.4	63.7	62.6	60.9	49.5	43.0	39.7	30.0	28.6	25.9	21.9	19.2	

REMARK:

- AUGER BORING HOLE No 1

VIENTIANE, OCTOBER, 9. 89

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SIVISAY NGEUN

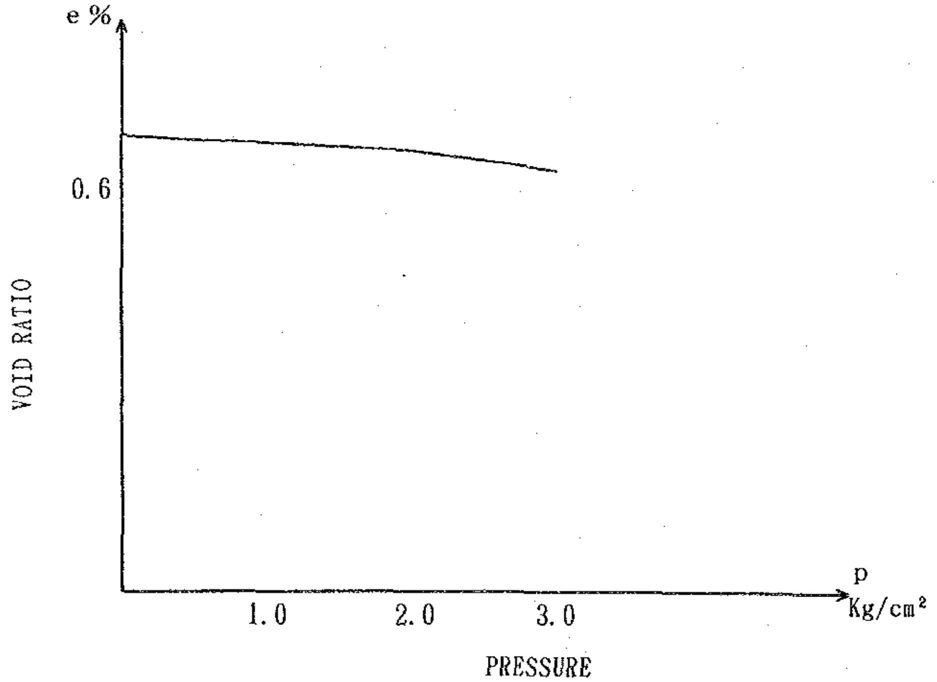
CONSOLIDATION TEST

PROJECT : SUB SOIL INVESTIGATION FOR VIENTIANE SYSTEM PHASE II

BORING No : 1 DEPTH : 1.40m - 2.10m

TYPE OF MATERIAL : CLAY TESTING DATE : SEPTEMBER. 23. 89

DESCRIPTION	CONSOLIDATION TEST		P	e	Cv	mv	Cc
	BEFORE TEST	AFTER TEST			$\times 10^{-4}$		
HEIGHT OF SAMPLE mm	25	24.23	0.5	0.678	–	–	–
DIAMETER OF SAMPLE mm	87.40	87.40	1.0	0.668	4.0	0.011	0.0344
WATER CONTENT %	24.93	23.07	2.0	0.660	8.8	0.005	0.0275
WET UNIT WEIGHT g/cm³	2.00	2.03	3.0	0.646	5.5	0.008	0.0804
DRY UNIT WEIGHT g/cm³	1.60	1.65	–	–	–	–	–
POROSITY %	41.14	39.34	–	–	–	–	–
VOID RATIO %	69.90	64.85	–	–	–	–	–
DEGREE OF SATURATION%	97	97	–	–	–	–	–



CONSOLIDATION TEST

PROJECT : SUB SOIL INVESTIGATION FOR VIENTIANE SYSTEM PHASE II

Soil sample :

Location :

Boring No : 1

Sample No : 2

Sample Depth : 1.40-2.10

Specific gravity: α_s: 2.72

Wet Density : 2.00 g/cm^3

Volume of Solids V_s: 59.11 cm^3

Degree of Saturation S: 97%

Cohesion C : 0.47 kg/cm^2

Soil specimen Measurements :

Diameter : 4.0cm

Initial area : 12,566 cm^2

Initial length : 8 cm

Date : 23. 9.89

Proving Ring No: S 8511

Water Content W: 24.93 %

Dry Density α_d: 1.6 g/cm^3

Volume of Voids V_v: 41.41 cm^3

Void Ration e: 0.699

Angle of Internal Friction ρ : 24°

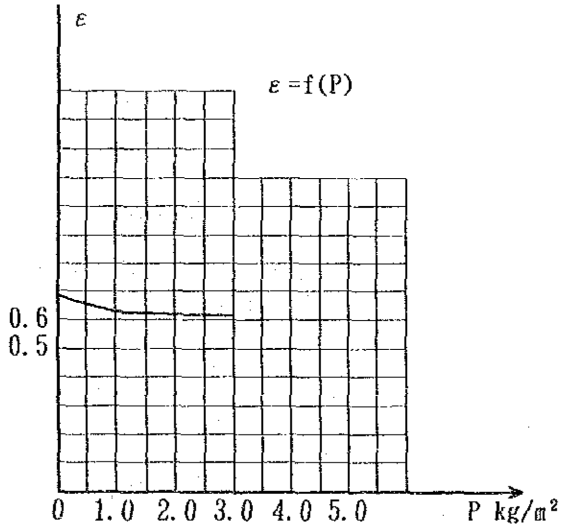
Vertical Dial ΔH 0.001	Strain $\varepsilon = \frac{\Delta H}{H}$	Area $1-\varepsilon$	Corrected Area $A=\frac{A_0}{1-\varepsilon}$	Load Dial in 0.0001"	Axial Load P kg	Stress $\frac{P}{A}$ Kg/cm^2
0.020	0.0063	0.9937	12.6456	31	4.39	0.35
0.040	0.0126	0.9873	12.7276	60	8.48	0.67
0.060	0.0190	0.9809	12.8106	84	11.97	0.93
0.080	0.0253	0.9746	12.8934	98	13.94	1.08
0.100	0.0317	0.9682	12.9787	107	15.15	1.17
0.120	0.0380	0.9619	13.0637	113	16.06	1.23
0.140	0.0444	0.9555	13.1519	134	18.94	1.44
0.160	0.0507	0.9492	13.2385	134	18.94	1.43

CONSOLIDATION TEST

PROJECT : SUB SOIL INVESTIGATION FOR VIENTIANE DRAIVAGE SYSTEM PHASE II.

BORING No : 1 DEPTH : 1.40m - 2.10m

TESTING DATE : SEPTEMBER. 23. 89



P kg/cm²	ε_0	$\frac{\Delta h}{h_0}$	a cm²/kg	E kg/cm²
0.00	0.699			
0.50	0.678	0.0118		
1.00	0.668	0.0182		
2.00	0.660	0.0226	0.0128	75.6
3.00	0.646	0.0308		

Type of material : CLAY

Liquid Limit ; LL : 39.03
Plastic Limit; PL : 24.50
Plastic Index; PI : 14.53
Water Content; W : 24.93
Consistency ; B : 0.02
Unit Weight ; a_0 : 2.00 g/cm³
Specific gravity; a_s : 2.72
Porosity ; n : 41.14 %
Coefficient of Porosity ; : 0.699
Saturation ; S : 0.97
Permeability ; K : $3.81 \cdot 10^{-5}$ m/Day

Sample Sige

- Height : 25.00mm
- Diameter : 87.40mm
- P : Applied Pressure
- $\frac{\Delta h}{h_0}$: Axial strain
- a : Coefficient of Compresibility
- E : Module of Deformation

VIENTIANE, OCTOBER. 9.89

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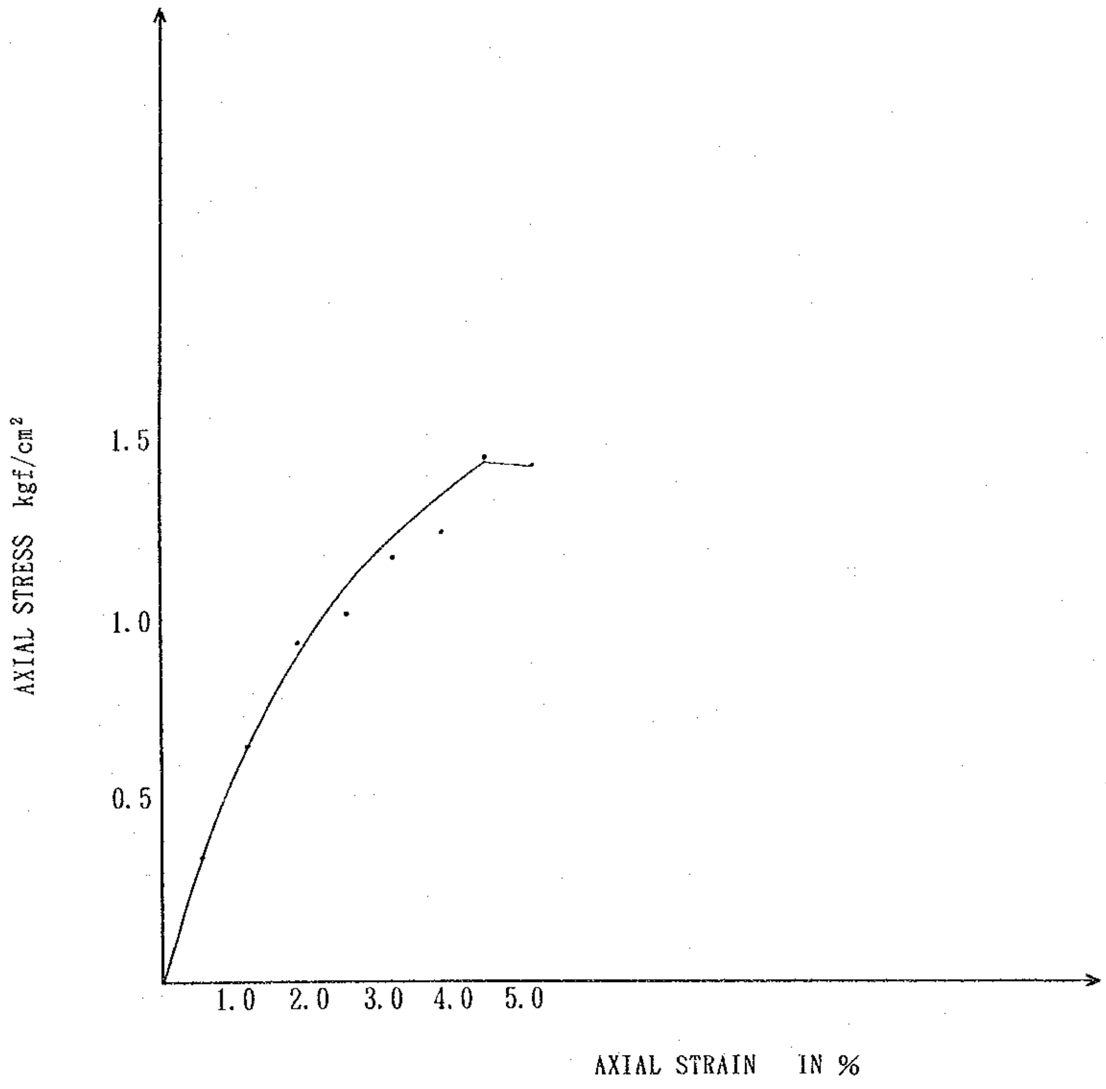
UNCONFINED CONPRESSION TEST

PROJECT : SUB SOIL INVETIGATION FOR VIENTIANE DRAIVAGE SYSTEM PHASE II

BORING No: 1 DEPTH : 1.40-2.10m

TESTING DATE : SEPTEMBER 23.89

TYPE OF MATERIAL: CLAY

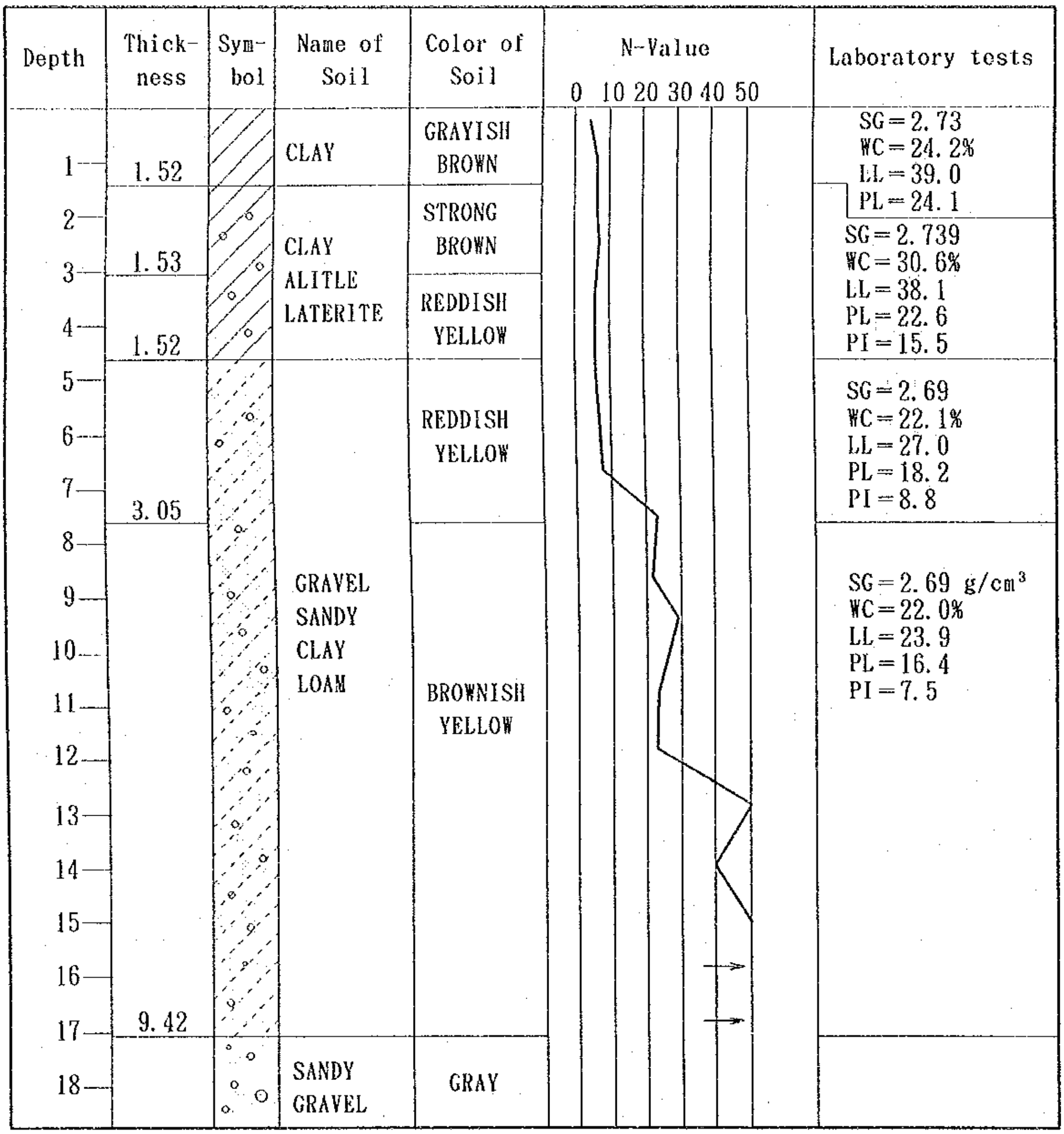


VIENTIANE, OCTOBER 9.89

D.MATERIAL LABORATORY CHIEF.

NGEUN

F.1.2.3 Boring No.2 by S.P.T.



Remark : S.G. : Specific Gravity

W.C. : Water Content

L.L. :
P.L. : Atterberglimit
P.I. :

Fig.2.4.3 Soil Constants of Samples from G.L.0 to G.L.-17.04

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PEACE INDEPENDENCE UNITY SOCIALISM

TEST RESULTS

PROJECT : SUB SOIL INVESTIGATION FOR VIENTIANE SYSTEM PHASE II

HOLE	DEPTH	SIEVE ANALYSIS & HYDROMETER % PASSING SIEVE SIZE IN mm.															ATTERBERG. L.			W C	UNIT-WEIGHT	SPECIFIC GRAVITY	TYPE OF MATERIAL
No	m	25.0	19.0	9.5	4.76	2.38	1.18	0.595	0.300	0.149	0.075	0.050	0.037	0.019	0.009	0.005	LL	PL	PI	%	g/cm³		
2	0.00- 0.90	−	−	−	100.0	99.9	99.3	99.9	97.5	94.5	89.0	82.4	78.4	72.4	62.4	50.4	39.0	24.1	14.9	24.2	−	2.73	CLAY
2	1.83- 2.14	−	100.0	99.9	89.2	84.3	78.9	75.2	70.3	64.9	58.7	50.2	46.6	43.1	39.5	34.2	35.7	21.8	13.9	33.6	−	2.74	CLAY LATERITE
2	3.35- 3.05	−	100.0	99.9	92.7	90.3	99.5	88.7	87.2	84.1	78.1	68.8	66.9	57.7	52.2	44.8	40.5	23.4	17.1	27.6	−	2 2.72	CLAY LATERITE
2	4.87- 5.19	100.0	87.5	74.8	60.0	56.2	53.5	50.3	39.0	35.5	32.9	26.6	25.4	23.0	20.6	15.8	26.4	17.3	9.1	22.4	−	2.69	GRAVEL SANDY CLAY LOAM
2	6.40- 6.70	100.0	96.0	85.5	70.7	64.0	61.0	58.2	44.3	36.5	33.1	29.9	28.5	27.1	20.0	14.4	27.5	18.2	9.3	22.5	−	2.69	GRAVEL SANDY CLAY LOAM
2	7.62- 7.93	100.0	91.3	78.5	64.5	60.2	56.6	53.0	43.6	34.8	30.8	27.3	24.8	23.5	18.3	14.4	27.1	19.0	8.1	21.5	−	2.70	GRAVEL SANDY CLAY LOAM
2	9.45- 9.75	−	100.0	92.8	83.2	79.9	76.6	72.7	57.1	48.9	45.3	38.5	36.8	35.5	25.2	20.2	27.1	18.5	8.6	27.2	−	2.70	GRAVEL SANDY CLAY LOAM
2	10.66-10.36	100.0	92.3	85.9	78.5	74.0	70.4	67.7	50.6	40.6	36.9	31.7	30.1	28.7	22.3	19.1	24.0	16.9	7.1	26.7	−	2.71	GRAVEL SANDY CLAY LOAM
2	12.49-12.79	100.0	89.4	78.1	63.7	59.7	56.1	52.4	44.7	34.1	29.7	25.9	24.6	22.0	18.2	14.3	26.1	16.9	9.2	18.0	−	2.70	GRAVEL SANDY CLAY LOAM
2	14.01-14.31	100.0	92.5	72.5	63.9	60.6	58.8	56.2	31.0	23.4	20.7	17.3	16.0	14.7	11.5	9.0	23.1	16.2	6.9	23.7	−	2.68	GRAVEL SANDY CLAY LOAM
2	15.22-15.54	100.0	93.4	86.1	74.4	70.2	67.4	64.0	47.7	37.3	32.9	32.6	31.1	28.9	22.2	14.8	24.1	16.0	8.1	19.6	−	2.68	GRAVEL SANDY CLAY LOAM
2	16.14-16.44	100.0	99.4	89.9	79.8	69.4	63.7	55.1	30.2	22.3	18.1	17.5	16.7	15.1	11.9	9.5	19.8	13.5	6.3	14.5	−	2.67	GRAVEL SANDY CLAY LOAM
2	16.74-17.04	100.0	89.6	80.8	74.3	70.0	69.9	64.2	31.7	18.8	19.7	14.8	14.1	13.3	11.1	8.1	23.1	16.5	6.6	24.2	−	2.68 2.69	GRAVEL SANDY CLAY LOAM

REMARK
・S.P.T. BORING HOLE No 2

DATE: OCTOBER. 9.89
MATERIAL LABORATORY CHIEF:

F.2.1 PERCOLATION VOLUME AND PERMEABILITY

A permeability volume test was conducted and the following results have been obtained.

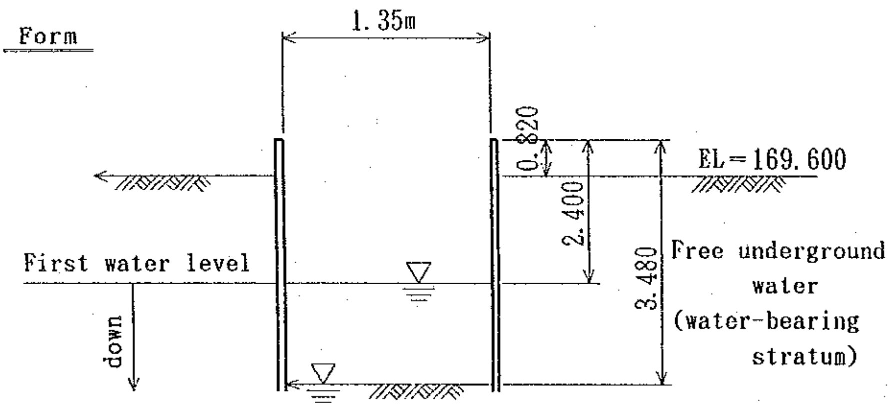
(1) Date October/4/1989

(2) Time A.M. 10,15

(3) Place Well of temple in Ban Dong (Refer to Fig. 2.9.1.)

(4) Form and result of test

Form



Result

No.	Time	Depth
1	10.15	3.480m
2	10.35	2.800
3	10.45	2.640
4	11.00	2.520
5	11.15	2.460
6	11.30	2.430
7	11.45	2.425
8	12.00	2.420

(5) Coefficient of permeability

When the coefficient of permeability is roughly calculated from the permeation volume and time.

$Q=\pi \times r^2=\pi \times (1.35/2)^2 \times (3.480-2.400)=1.546m^3$

$M=Q/A=1.546/2\times \pi \times 1.35\times 1/2=0.365m$

$H=M/hour=0.365/1.75=0.209m/hour$

$k=0.209/(60\times 60/100)=0.0058=5.8\times 10^{-3}cm/s$

(6) A standard for permeability

Coefficient of permeability (k cm/s)

10^2 10 1.0 10^{-1} 10^{-2} 10^{-3} 10^{-4} 10^{-5} 10^{-6} 10^{-7} 10^{-8} 10^{-9}

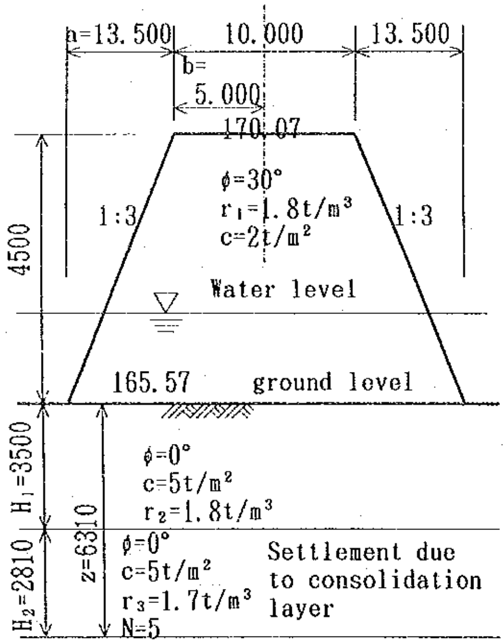
Permeability	large	middle	small	very small	non-permeable

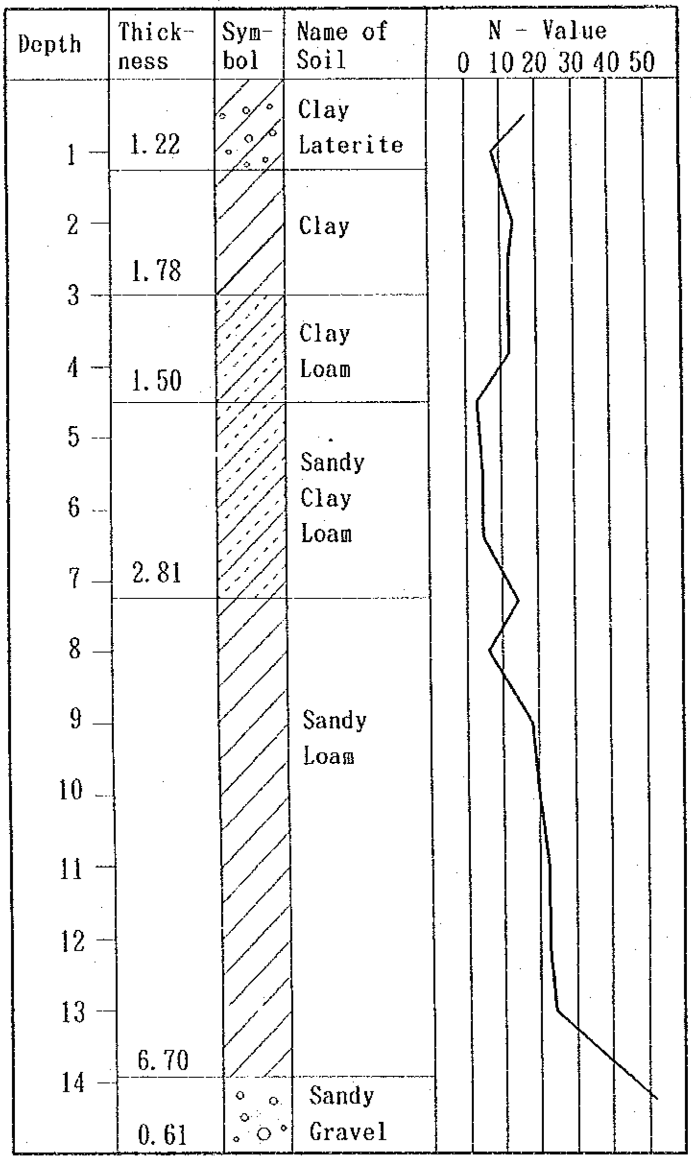
(5.8×10^{-3})
Test result

F.2.2 SETTLEMENT DUE TO CONSOLIDATION

Filling work is planned at Nong chanh marsh, so the settlement volume due to consolidation is examined since a settlement due to consolidation is feared there according to the previous boring results (No.3) which indicate that the sandy clay loam layer at GL-4.5 - GL-7.31 showed an N value of less than 10.

(1) Calculation form





(2) Stress Increase $\Delta \sigma z$ due to Load

$\Delta \sigma z\ max = 0.46 \times (3.5 \times 1.8 + 1.0 \times 0.8) \times 2 = 6.532\ t/m^2$

$a = 13.5m \quad b = 5.0m \quad \frac{a}{z} = \frac{13.5}{6.31} = 2.14 \quad \frac{b}{z} = \frac{5.0}{6.31} = 0.79$

I(Refer to Osterberg diagram)=0.46

(3) Effective pressure p

$P_1 = H_1 \cdot (r_2 - 1) + H_{2/2}(r_3 - 1)$

$= 3.5 \times 0.8 + 2.8_{1/2} \times 0.7 = 3.784t$

(4) Settlement volume

$$\delta = 0.4 \frac{P_1 H_2}{N} \log \frac{P_1 + \Delta \sigma z}{P_1}$$

$$= 0.4 \frac{3.784 \times 2.81}{5} \log \frac{3.784 + 6.532}{3.784}$$

$= 0.851 \log 2.726$

$= 0.851 \times 0.436$

$= 0.371m$

F.2.3 FOUNDATION

F.2.3.1 UNDERSTRUCTURE OF MAIN STRUCTURES

The requirements for the bearing foundation vary according to the size of the load applied to it, but the standard requirements are that the ground with an N value of above 50 is distributed in a continuous 3m or above thickness or that with an N value of above 30 in a continuous 5m or more thickness, and that there is, under this ground, no stratum which may be subject to shearing fracture or settlement due to consolidation.

If no natural settlement is taken into account, a pile foundation may be planned, but if natural settlement can be taken into account, a spread foundation is considered useful judging from the unconfined compression stress and N value of the structure foundation surface.

The construction of embankments and buildings is planned at the ambient areas of Nong chanh Marsh, but when the importance of the structure at issue is considered, a pile foundation is judged better.

The present foundations of the box culvert and bridge are a spread foundation, which can also be judged good when applied under this plan.

F.2.3.2 FOUNDATION OF SHORE PROTECTION

Judging from the previous penetration test results, a spread foundation is considered sufficient as the foundation of the revetments, since the minimum value in the test results is as large as $q\,u=4.04kgf/cm^2$.

However since sludge has been accumulated on the riverbed surface, it will be enough to remove the sludge and then embed the piles at a depth of 50cm (for loam is characterized by that it becomes soft layer when mixed with water, so piles must be embedded into the ground part not affected by water).

F.2.4 STABILITY OF SLOPE

From the cone penetrometer and augerboring test results in Phase I, the measured values of the minimum C (conhesion). stratum and present slope surface were as follows.

	C t/m^2	Layer	Measured Value H= n= (Slope surface & gradient) minimun	maximum
HONG THONG	4	Clay Loam	H=1 n=1:1	H=3 n=1:1.5
HONG KE	6.7	Clay Loam	H=1 n=1:6	H=2 n=1:1
NAM PASAK	14.8	Silt	H=2 n=1:3	H=3 n=1:1
HONG XENG	6.06	Silty Clay	H=2 n=1:3	H=6 n=1:1

Since the test data are insufficient, the design values for each river are determined based on the measured values. In the plan, calculations are made *by substituting the C and r (unit weight) of the test results for the items* in the Tayler's equation.

The slope gradient is mostly 1:1 from the measured values. The design values were calculated as follows on the assumption of the slope gradient being 1:1.

The coefficient of stabilization $Ns=\frac{rHc}{C}$

$$Hc=\frac{Ns \cdot C}{r}$$

$$=\frac{5.5\times4}{1.8}$$

$=12.22m$ (Limit height)

$C=4t/m^2$ (Minimum value in the soil data)

$r=1.8t/m^2$ (Design value in the soil data)

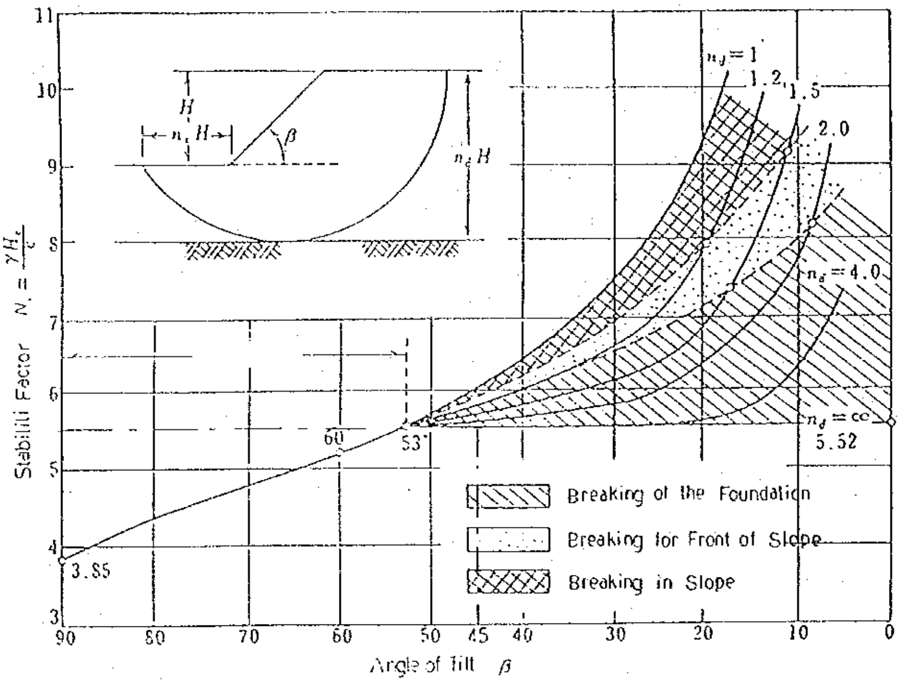


Diagram of Tayler

But the following design value shall be used with the safety coefficient assumed to be 2.

Hc=12.22/2=6.11m≒6.0m

In the assumption that the slope is loaded with motor vehicles, the load was converted into a slope height as follows.

H=1/1.8=0.56≒1.0m

Based on the above calculations, the planned max, allowable height according to the soil data should be:

H=6.00-1.00=5.00m(slope gradient=1:1)

However when the river bank slope is excavated without timbering, the maximum slope gradient of 1:2 should be adopted for stable operation, considering the erosion by water, tropical squalls, the piping and boiling phenomena in the stratum at Lao containing mixed sands and gravels, etc.

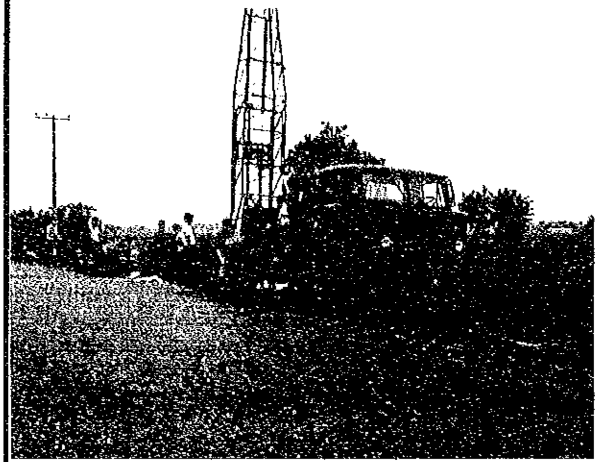
By the way, if a large quantity of sands and gravels are found to be mixed in the ground on the spot, the maximum slope gradient should be 1:3 for the sake of safety.

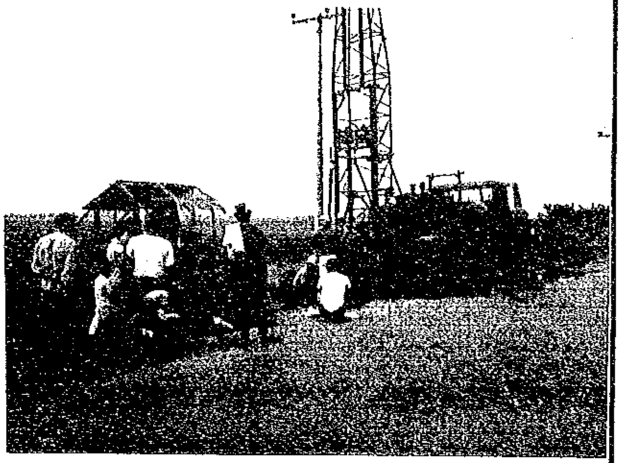
With regard to the bank slope, the present channel banks are mostly constructed using laterite at the slope gradient of 1:1. But the slope surface fracture has occurred at many places due to the phenomena peculiar to Lao. Though no stable slope of filled banks can exactly be determined because no test filling has been done, when the present data available and the actual filling conditions are considered, the slope gradient should be 1:2 when laterite is used, and 1:2 when sand, gravel and clay are used (the design value $\phi = 30°$) for stable operation. Further the filling height should be 5m (the design limit value) as in the case of cutting when the material, of which the soil compaction test results are C=4 t/m^2 or 2 t/m^2 ($\phi = 30$), is used.

PLATE

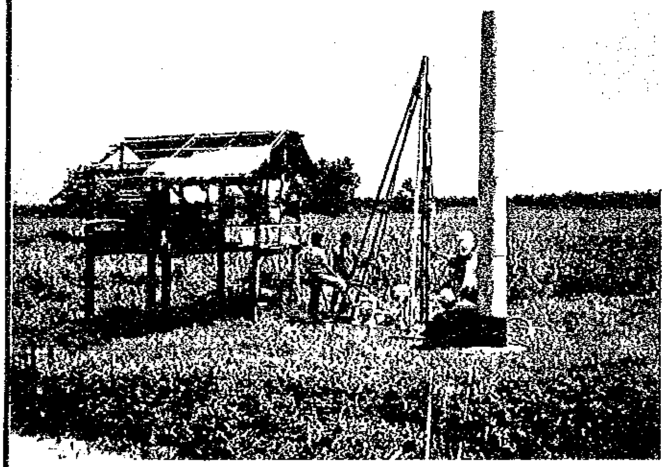
Date: 20 September, 1989
Location: The Hong Ke river at That Luang

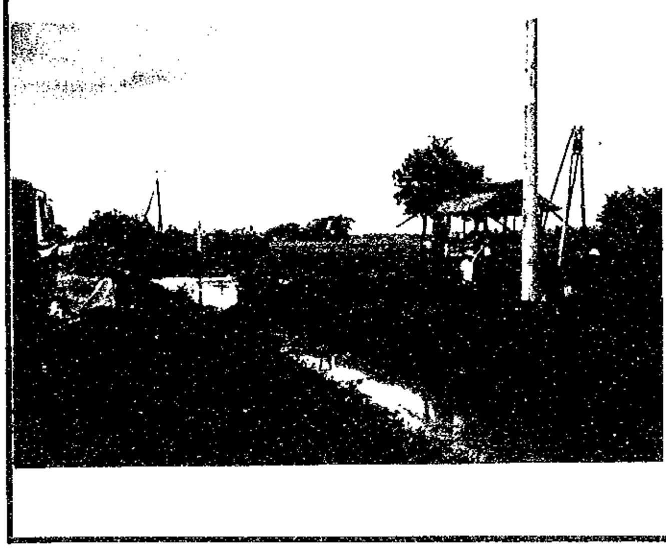
Photographs of Sampling for Phase II





Photographs of Boring for Phase II





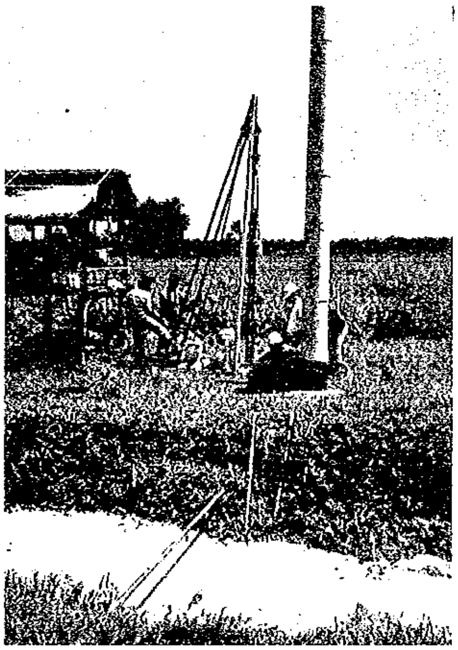


Plate F.1 Soil Survey

LAO PEOPLE'S DEMOCRATIC REPUBLIC
FEASIBILITY STUDY ON IMPROVEMENT
OF DRAINAGE SYSTEM IN VIENTIANE

JAPAN INTERNATIONAL COOPERATION AGENCY

JICA