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No. 52

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

FEASIBILITY STUDY ON THE RESTORATION OF RURAL ROADS

FINAL REPORT

VOLUME Ⅳ

DRAWINGS

JANUARY 1992

JAPAN INTERNATIONAL COOPERATION AGENCY

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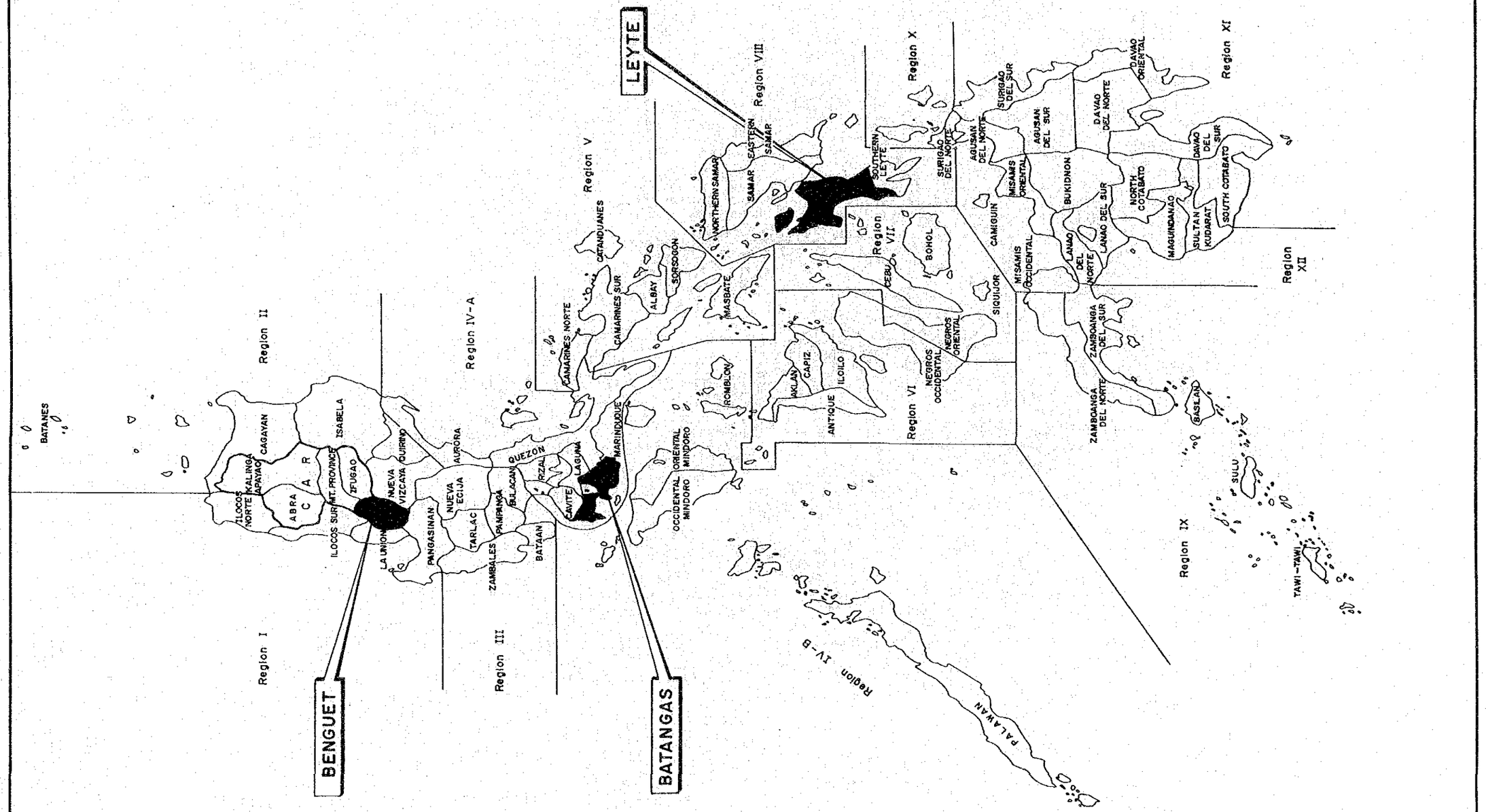
国際協力事業団
23858

INDEX OF DRAWING

1. LOCATION MAP OF PILOT PROVINCE

LOCATION MAP OF PILOT PROVINCE

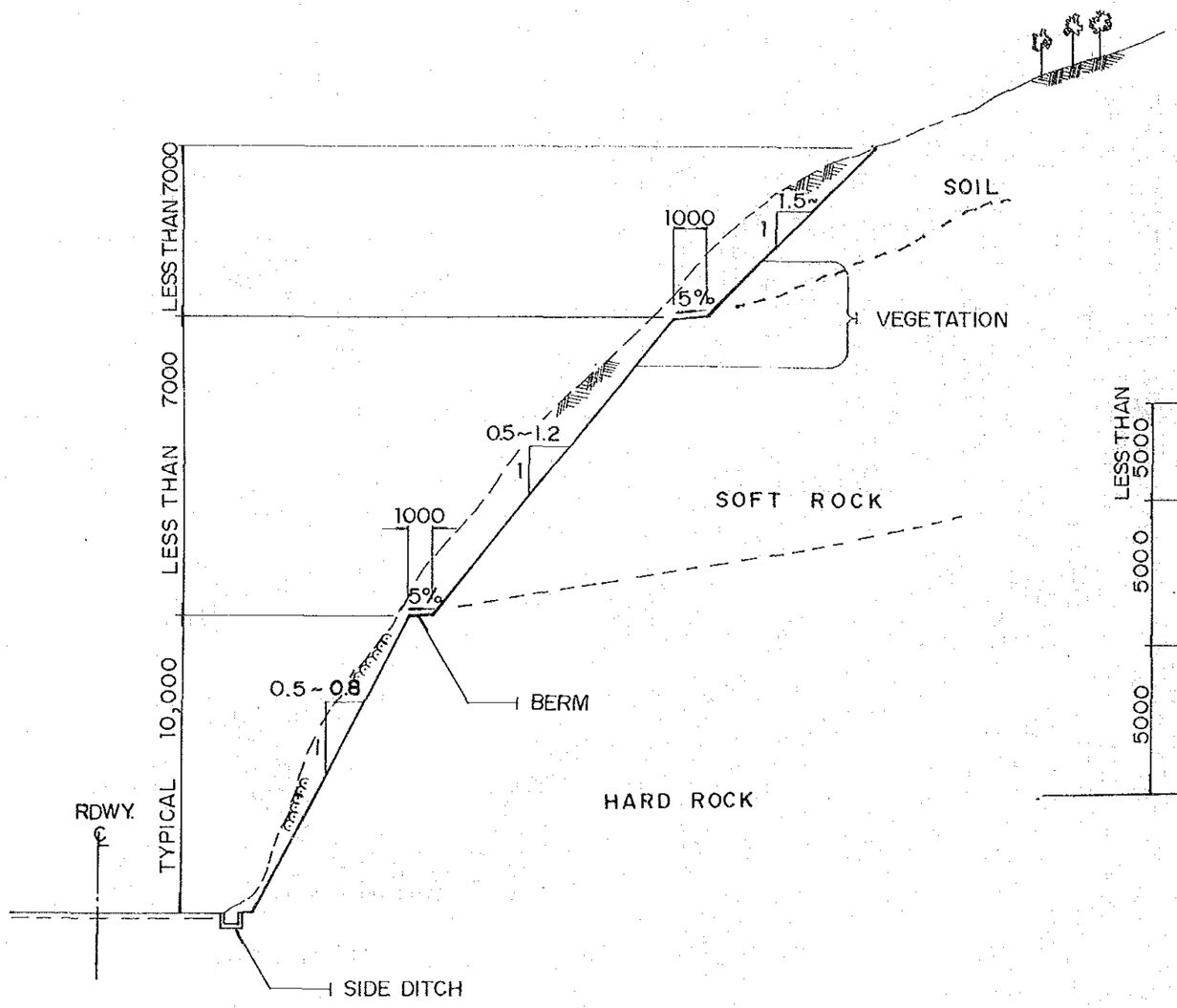
DRAWING NO.
1



2. STANDARD DRAWINGS

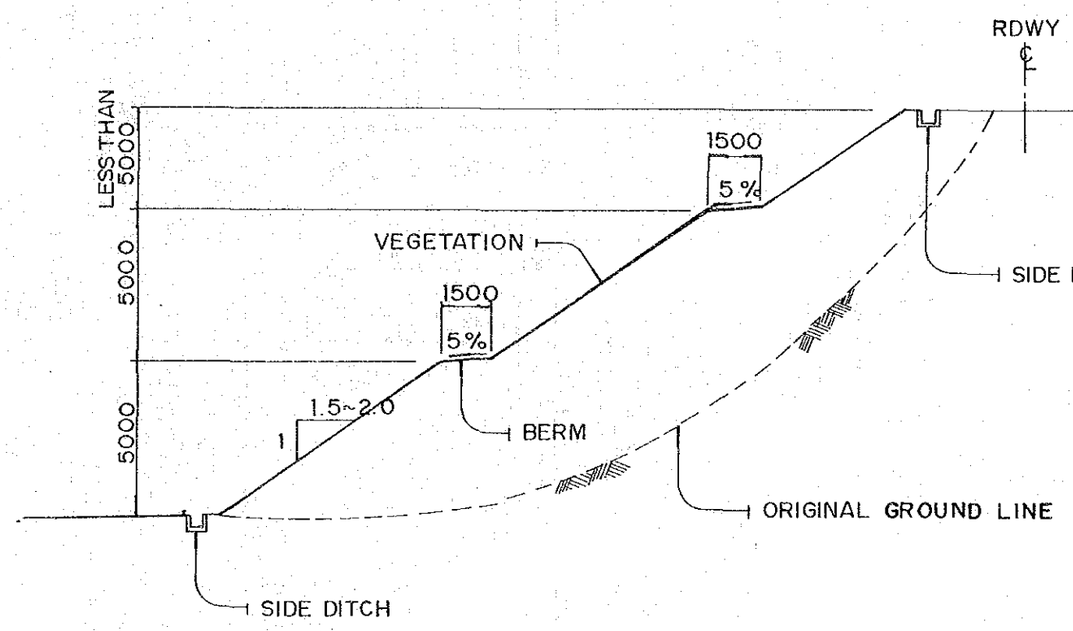
STANDARD DRAWINGS : CUT SLOPE , EMBANKMENT SLOPE

SCALE	DRAWING NO.
1 : 20	2



TYPICAL CROSS SECTION FOR CUT SLOPE
SCALE 1:20

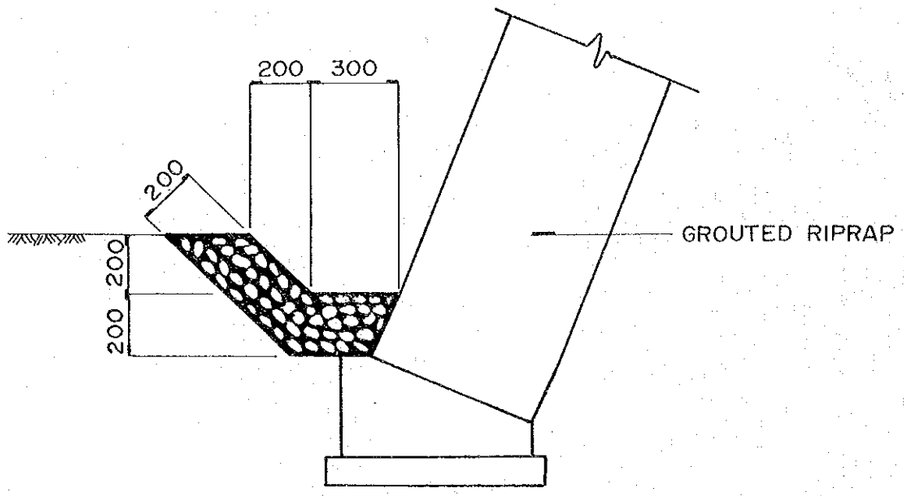
ITEM	KINDS OF ROCKS		
	SAND	SOFT ROCK	HARD ROCK
GRADIENT	MORE THAN 1.5	0.5 ~ 1.2 : 1	0.5 ~ 0.8 : 1
LOCATION OF BERM	LESS THAN 7.0 M	LESS THAN 7.0 M	TYPICAL 10.0 M



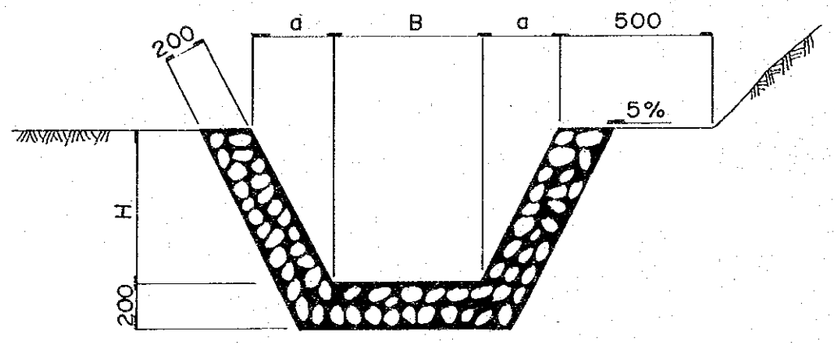
TYPICAL CROSS SECTION FOR EMBANKMENT SLOPE
SCALE 1:20

STANDARD DRAWINGS : SIDE DITCH, CATCH BASIN

SCALE	DRAWING NO.
AS SHOWN	3



SIDE DITCH (TYPE-A)



SIDE DITCH (TYPE-B,C)

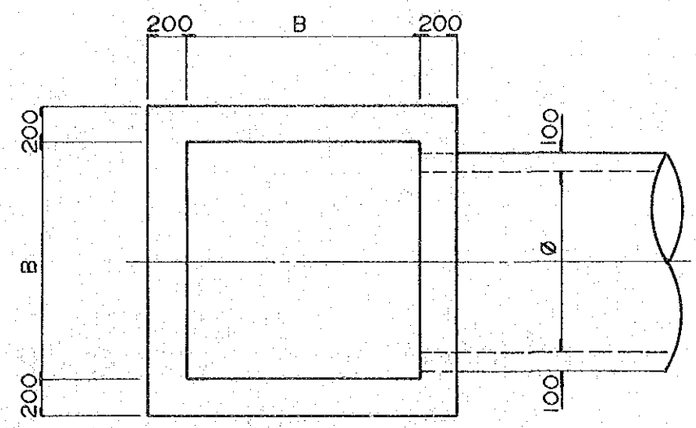
SIDE DITCH
SCALE 1:20

LIST OF UNIT VOLUME PER/M

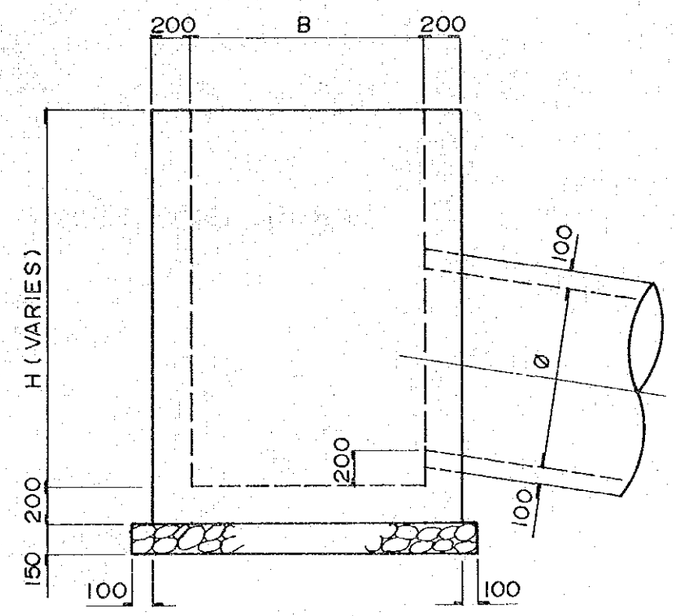
TYPE	A	B	C
VOLUME	0.14 m^3	0.27 m^3	0.40 m^3

LIST OF DIMENSION

TYPE	H	B	a
B	300	300	150
C	500	500	250



PLAN



ELEVATION

CATCH BASIN
SCALE 1:30

LIST OF DIMENSION

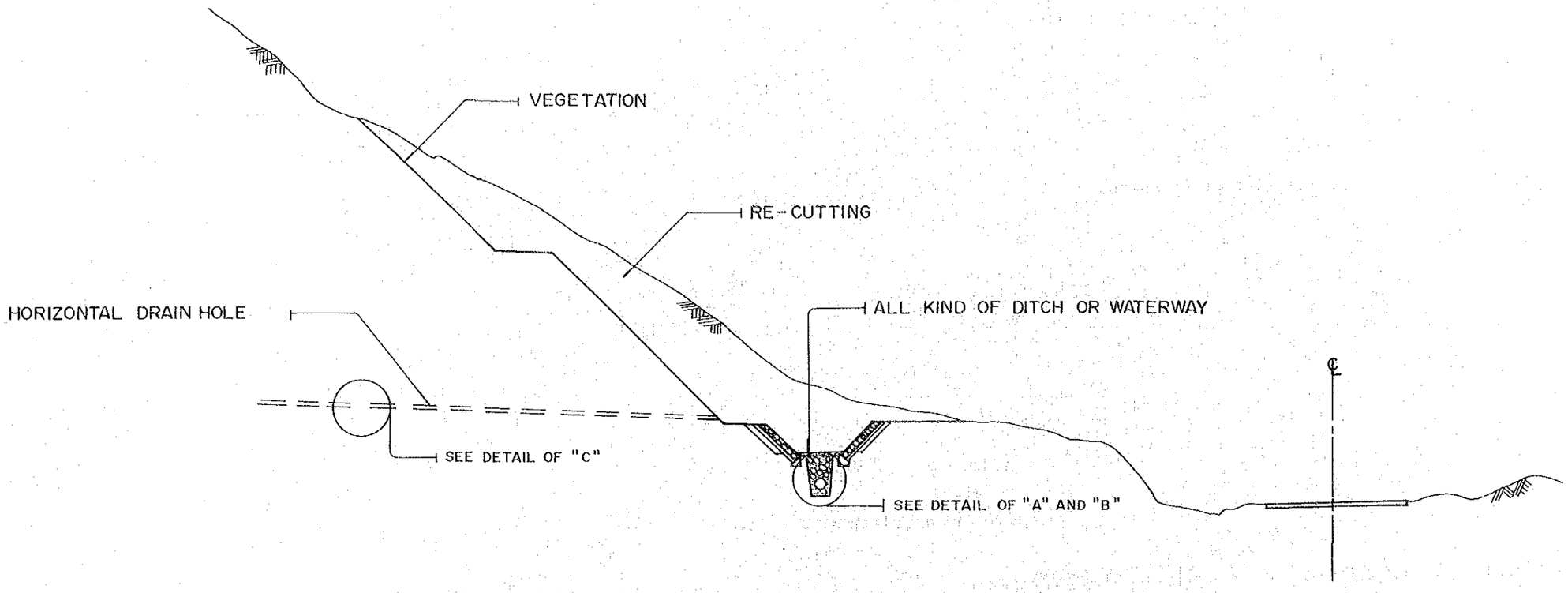
Ø	B
600	900
900	1200
1000	1300
1200	1500

LIST OF VOLUME

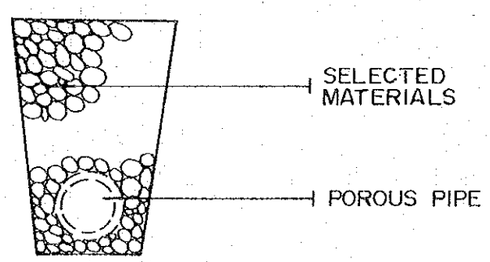
Ø	VOLUME
600	2.10 m^3
900	2.75 m^3
1000	2.98 m^3
1200	3.44 m^3

NOTE: In Case of H=2.0^m

STANDARD DRAWINGS :	SUBSURFACE DRAINER	SCALE —	DRAWING NO. 4

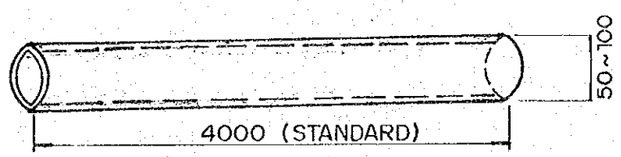


TYPICAL CROSS SECTION SUBSURFACE DRAINER



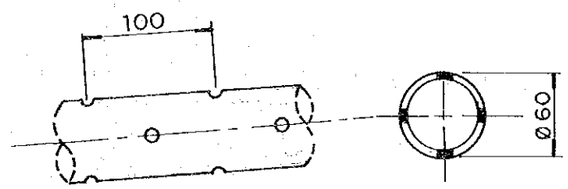
SUBSURFACE DRAINER

DETAIL OF "A"



POROUS PIPE

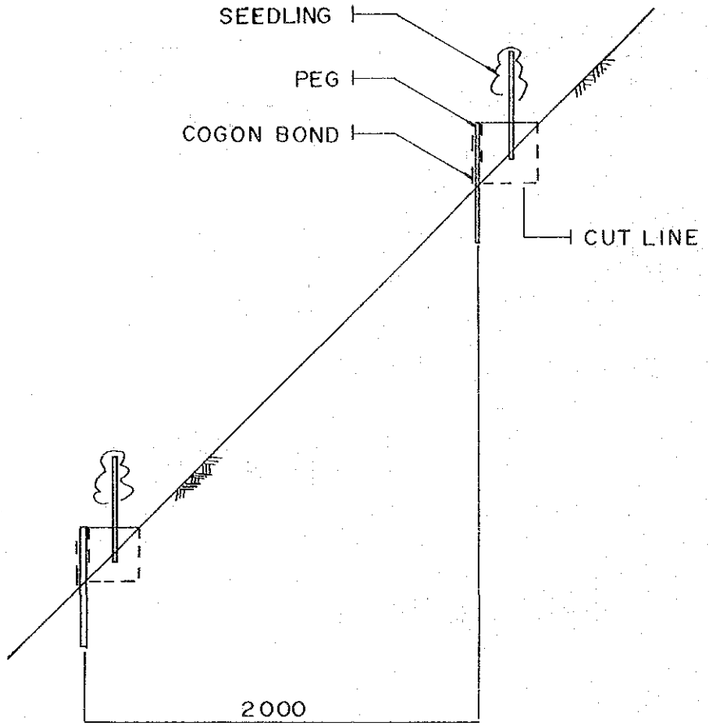
DETAIL OF "B"

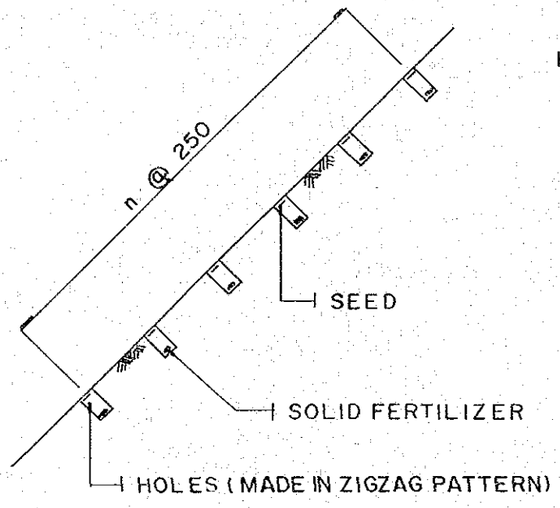


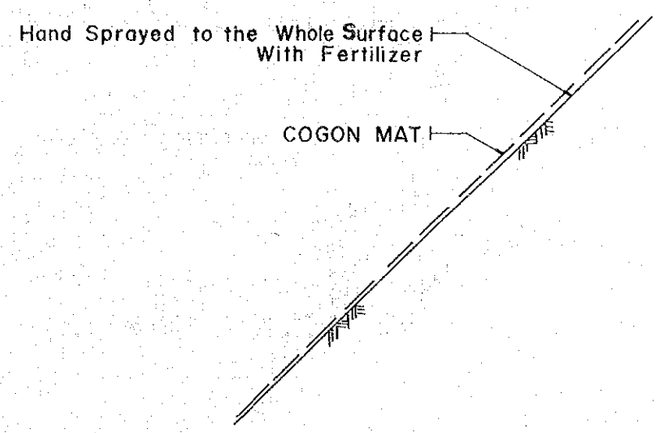
PERFORATED PIPE
(FOR HORIZONTAL DRAIN HOLE)
DETAIL OF "C"

STANDARD DRAWINGS : VEGETATION

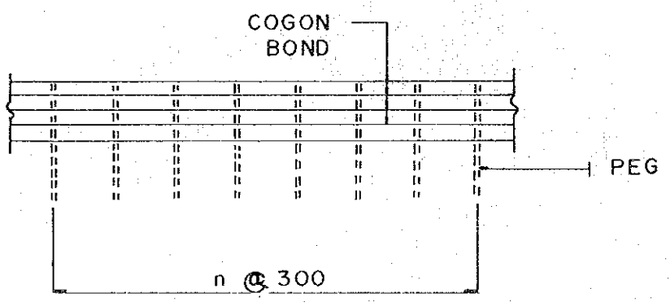
SCALE AS SHOWN | DRAWING NO. 5



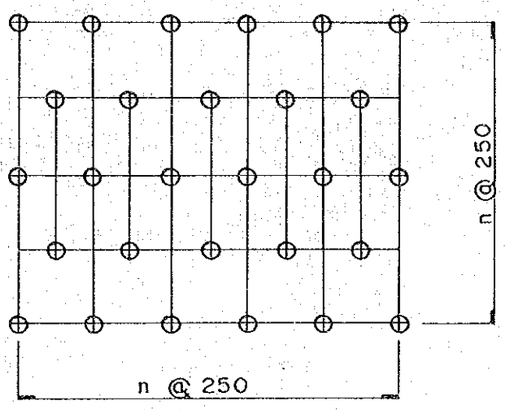




HAND SEEDING & HANDSEEDING WITH MAT

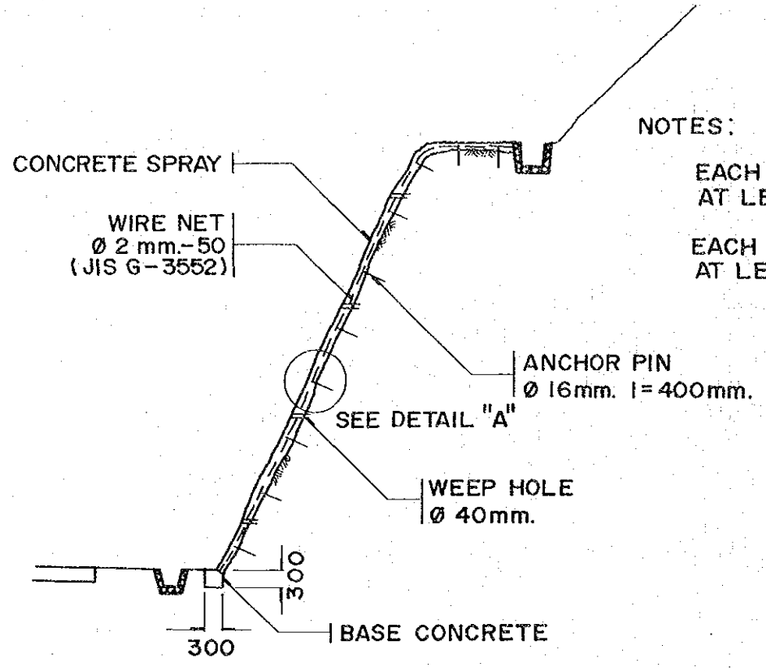


WATTLING
SCALE 1:30



PICK HOLE SEEDING
SCALE 1:20

STANDARD DRAWINGS : CONCRETE SPRAYING , MORTAR SPRAYING	SCALE AS SHOWN	DRAWING NO. 6



CONCRETE SPRAYING

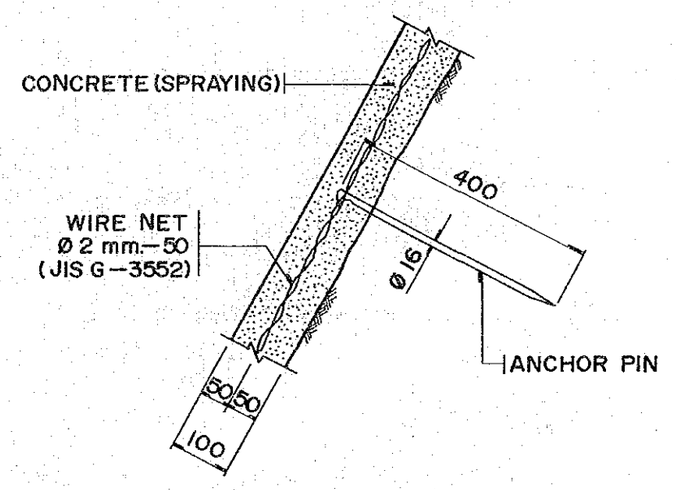
NOTES:

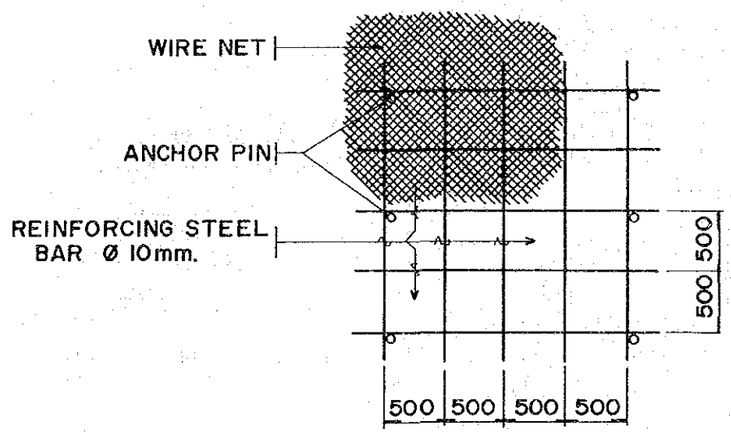
EACH ANCHOR PIN SHALL BE PLACED AT LEAST FOR EVERY 1 SQ.M.

EACH WEEP HOLE SHALL BE PLACED AT LEAST FOR EVERY 2 SQ. M.

LIST OF UNIT MATERIALS PER/10m.²

Thickness (Cm.)	Concrete or Mortar (m²)	Anchor Pin (Each)	Wire Net (m²)	Reinf. Steel (Kg.)	Weep Hole (Each)
15	15	10	10	246	10
10	10	10	10	—	10





BAR ARRANGEMENT
THICKNESS 15 cm.
SCALE 1:50

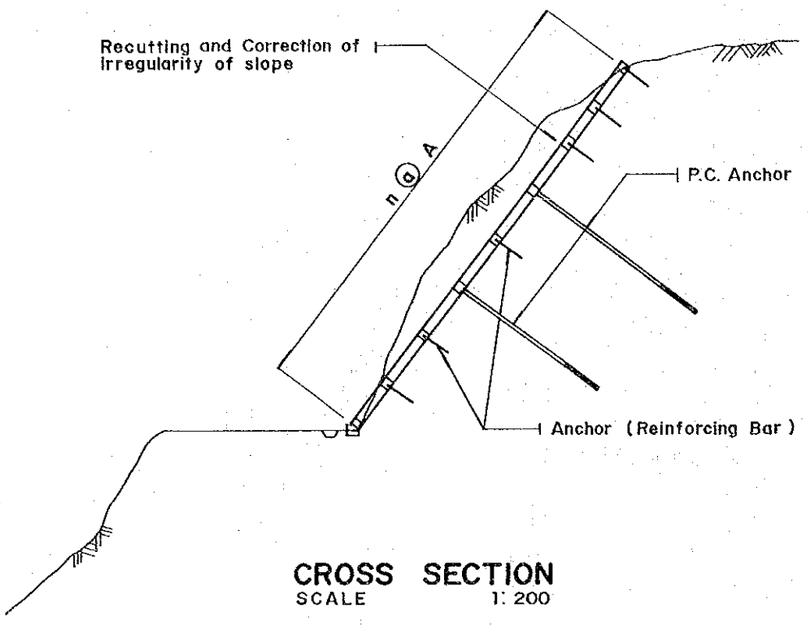
DETAILS OF "A"
THICKNESS 15 cm.
SCALE 1:10

DETAILS OF "A"
THICKNESS 10 cm.
SCALE 1:10

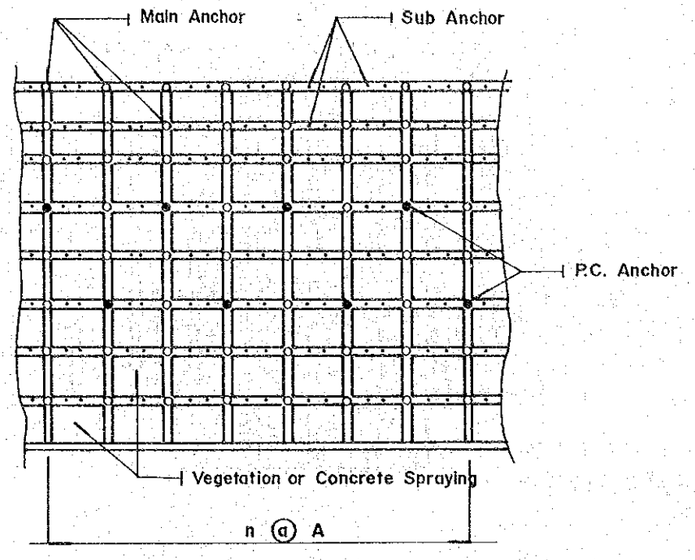
STANDARD DRAWINGS :

CAST - IN - PLACE CONCRETE CRIB

SCALE AS SHOWN | DRAWING NO. 7

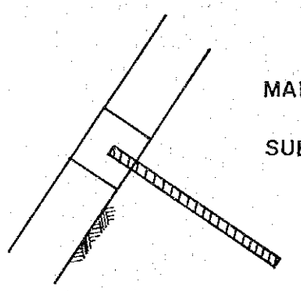


CROSS SECTION
SCALE 1:200



DEVELOPMENT
SCALE 1:200

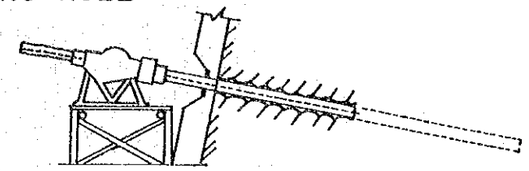
NOTE: 1. If the ground is stable, P.C. Anchor is not required.
2. If the ground is unstable, P.C. Anchor is required.
3. A = 1 500 mm / 2 000 mm / 2 500 mm / 3 000 mm
4. Can be applied to any kind of material for framing.



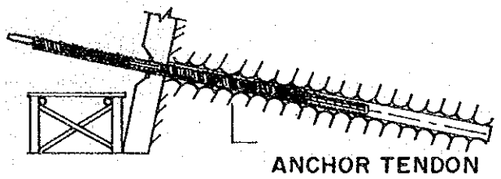
MAIN ANCHOR Ø16 ~ Ø22 L=750 ~ 1500
SUB ANCHOR Ø10 ~ Ø16 L=400 ~ 700

ANCHOR (REINFORCING BAR)
SCALE 1:30

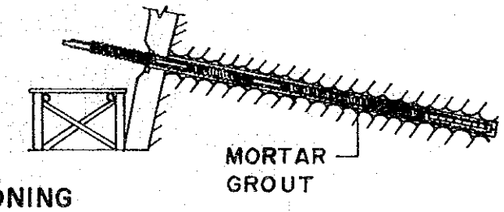
1. BORING HOLE



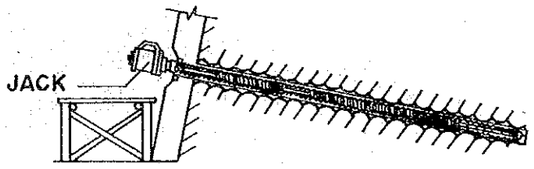
2. INSERTION OF ANCHOR TENDON



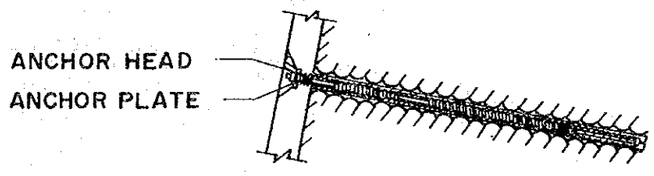
3. INJECTION OF MORTAR GROUT



4. TENSIONING

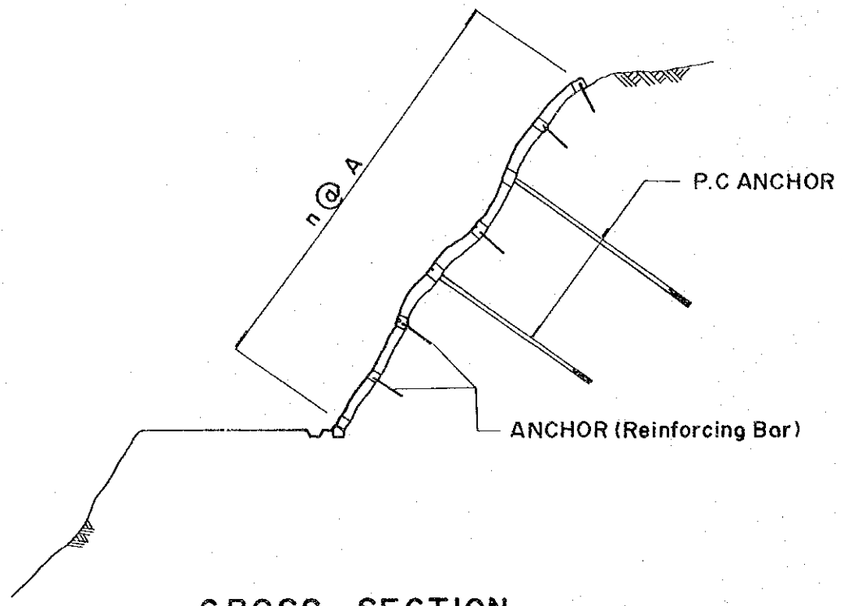


5. FIXING

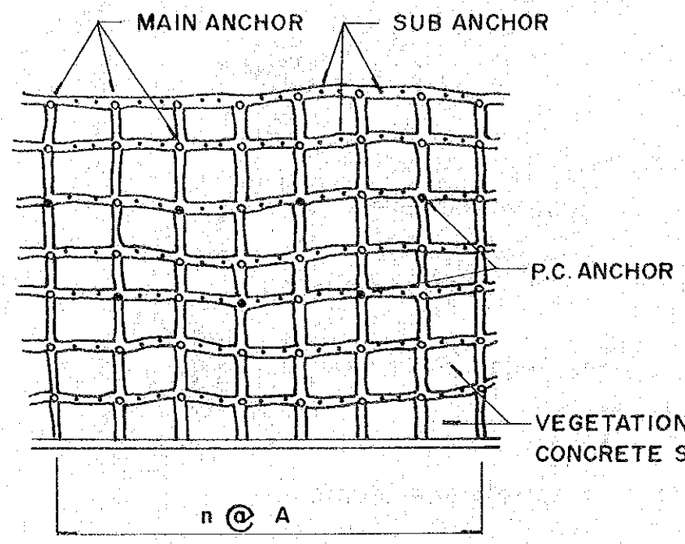


PROCEDURE OF P.C ANCHOR INSTALLATION
SCALE 1:40

STANDARD DRAWINGS : SPRAYED CONCRETE CRIB , P.C. ANCHOR	SCALE AS SHOWN	DRAWING NO. 8

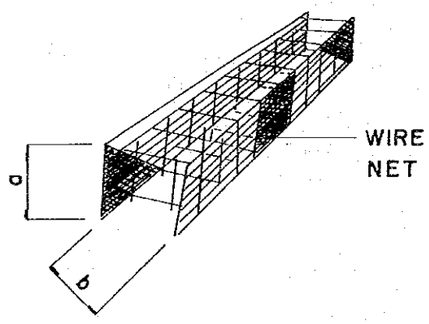


CROSS SECTION
SCALE 1:200



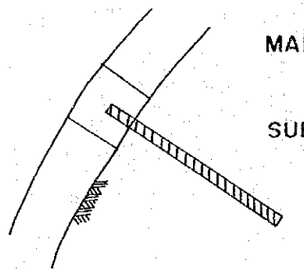
DEVELOPMENT
SCALE 1:200

NOTE: 1. If the ground is stable, P.C. Anchor is not required.
2. If the ground is unstable, P.C. Anchor is required.
3. A = 1500 mm / 2000 mm / 2500 mm / 3000 mm



a x b : 150 x 150
200 x 200
300 x 300
400 x 400
500 x 500

FRAME

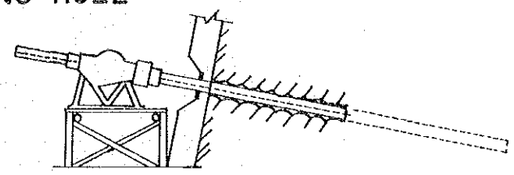


MAIN ANCHOR ø16~ø22
L=750~1500

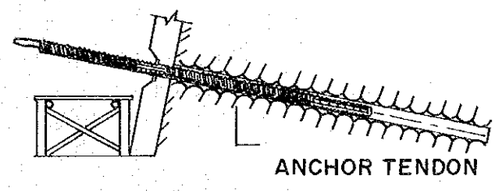
SUB ANCHOR ø10~ø16
L=400~700

ANCHOR (REINFORCING BAR)
SCALE 1:30

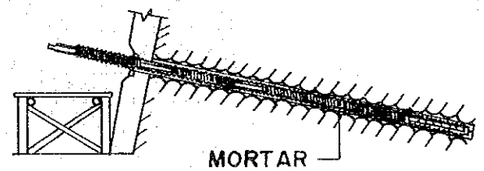
1. BORING HOLE



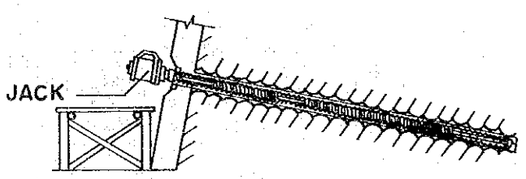
2. INSERTION OF ANCHOR TENDON



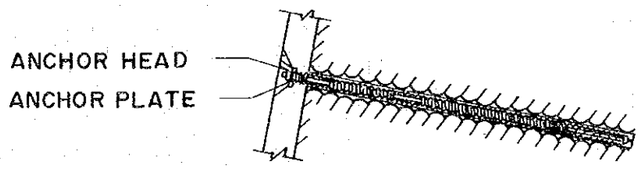
3. INJECTION OF MORTAR GROUT



4. TENSIONING

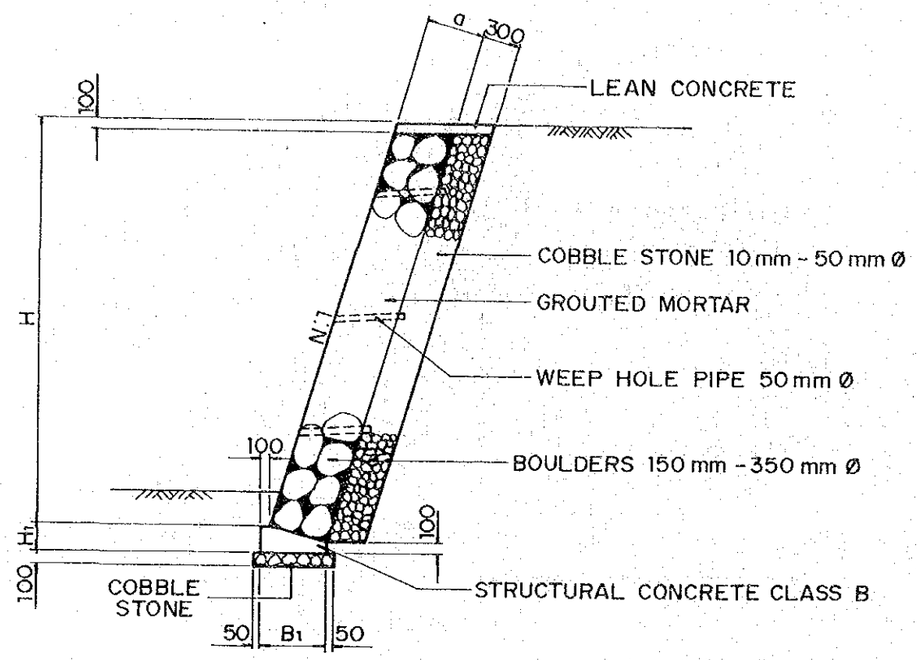


5. FIXING



PROCEDURE OF P.C. ANCHOR INSTALLATION
SCALE 1:40

STANDARD DRAWINGS :	GROUTED RIPRAP	SCALE 1:50	DRAWING NO. 9



GROUTED RIPRAP

LIST OF DIMENSION

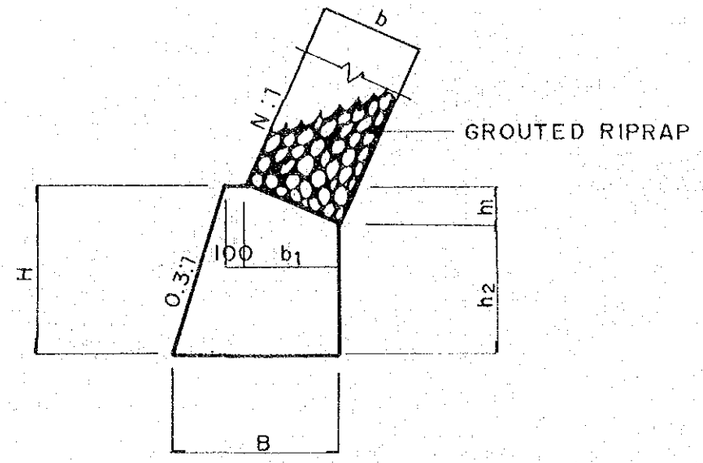
CLASS	H	N	a	B_1	H_1
A	H ≦ 3000	0.3 (0.3)	300	390	180
B	3000 < H ≦ 4000	0.3 (0.4)	500	580 (560)	240 (320)
C	4000 < H ≦ 5000	0.4 (0.5)	600	660 (640)	320 (450)
D	H > 5000	0.5 (0.6)	800	820 (790)	450 (510)

NOTE: 1. (n) = Embankment Slope Factor

LIST OF MATERIALS **PER / 10 M.**

DIMENSION			GROUTED RIPRAP	BACKFILL COBBLE STONE	BASE CONCRETE	BASE COBBLE STONE
H (M)	a (cm)	N	(m^3)	(m^3)	(m^3)	(m^3)
3.0	30	0.3	9.4	9.4	0.59	0.49
4.0	50	0.3	20.9	12.5	1.06	0.68
4.0	50	0.4	21.5	12.9	1.29	0.66
5.0	60	0.4	32.3	16.2	1.50	0.76
5.0	60	0.5	33.5	16.8	1.94	0.74
5.0	80	0.5	44.7	16.8	2.43	0.92
5.0	80	0.6	46.6	17.5	2.61	0.89

STANDARD DRAWINGS :	FOUNDATION FOR GROUTED RIPRAP	SCALE 1:50	DRAWING NO. 10



FOUNDATION FOR GROUTED RIPRAP

LIST OF DIMENSION AND CONCRETE VOLUME

N = 0.3 , b = 300

H	h_1	h_2	B	b_1	CONCRETE (m^3)
2000	90	1910	990	290	1.4
3000	"	2910	1290	"	2.5
4000	"	3910	1590	"	4.0
5000	"	4910	1890	"	5.7

N = 0.4 , b = 600

H	h_1	h_2	B	b_1	CONCRETE (m^3)
2000	220	1780	1260	560	1.9
3000	"	2780	1560	"	3.3
4000	"	3780	1860	"	5.0
5000	"	4780	2160	"	7.0

N = 0.3 , b = 500

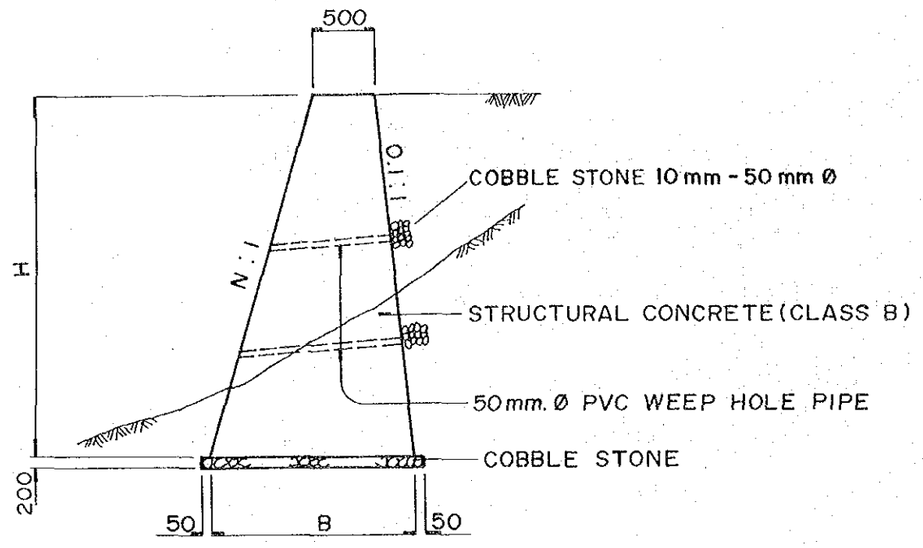
H	h	h	B	b	CONCRETE (m)
2000	140	1860	1180	480	1.7
3000	"	2860	1480	"	3.1
4000	"	3860	1780	"	4.7
5000	"	4860	2080	"	6.6

N = 0.5 , b = 800

H	h	h	B	b	CONCRETE (m)
2000	360	1640	1420	720	2.1
3000	"	2640	1720	"	3.7
4000	"	3640	2020	"	5.6
5000	"	4640	2320	"	7.7

STANDARD DRAWINGS : GRAVITY WALL , GRAVITY TYPE STONE MASONRY WALL

SCALE	DRAWING NO.
1 : 50	11

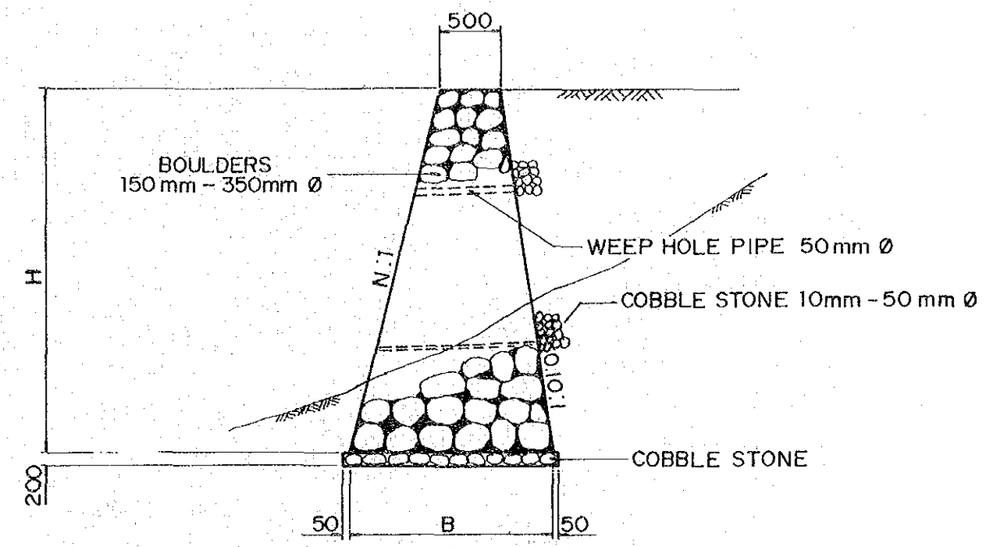


GRAVITY WALL

LIST OF DIMENSION AND MATERIALS PER/M

H	N_1	B	CONCRETE H (m)	CONCRETE V(m^3)	COBBLE STONE (m^3)
H ≦ 2000	0.25	500+H(N+0.1)	2.0	1.7	0.26
2000 < H ≦ 3000	0.30	"	3.0	3.3	0.36
3000 < H ≦ 4000	0.35	"	4.0	5.6	0.48
4000 < H ≦ 5000	0.40	"	5.0	8.8	0.62

NOTE :
1. For Weep hole pipe, Use 1-50 mm. Ø pipe for every 2.0 m^2
2. For base foundation not made of rock, Use concrete base.
3. Cobble Stone must be well compacted



GRAVITY TYPE STONE MASONRY WALL

LIST OF DIMENSION AND MATERIALS PER/M

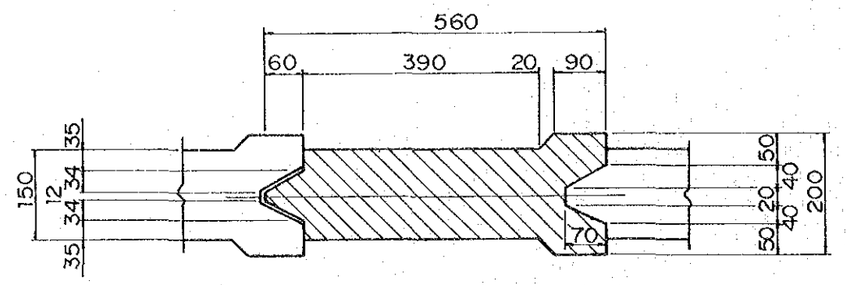
H	N	B	CONCRETE H(m)	CONCRETE V(m^3)	COBBLE STONE (m^3)
H ≦ 2000	0.25	500 + H x (N + 0.1)	2.0	1.7	0.26
2000 < H ≦ 3000	0.30	"	3.0	3.3	0.36
3000 < H ≦ 4000	0.35	"	4.0	5.6	0.48
4000 < H ≦ 5000	0.40	"	5.0	8.8	0.62

NOTE: 1. For Weep hole pipe, Use 1-50 mm. Ø pipe for every 2.0 m^2.
2. For base foundation not made of rock, Use concrete base.
3. Cobble stone must be well compacted.

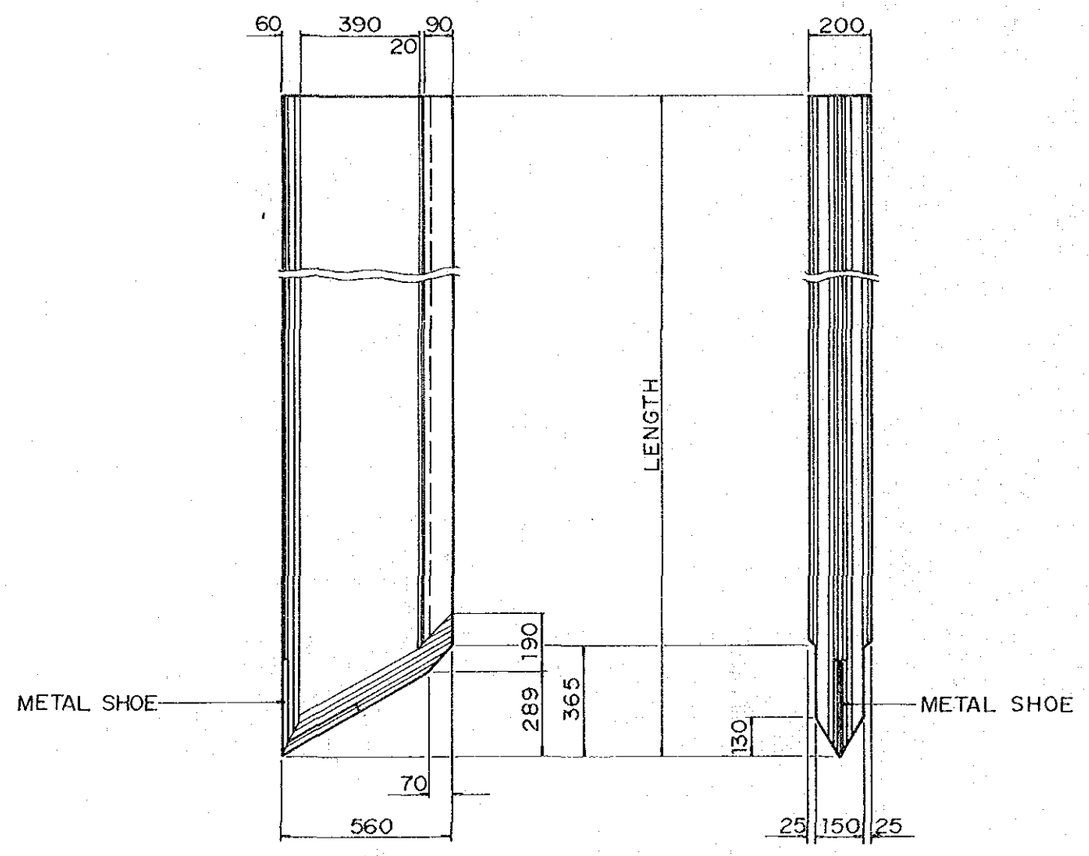
STANDARD DRAWINGS : R.C. SHEET PILE , GRAVITY TYPE SEA WALL

SCALE: AS SHOWN

DRAWING NO. 12

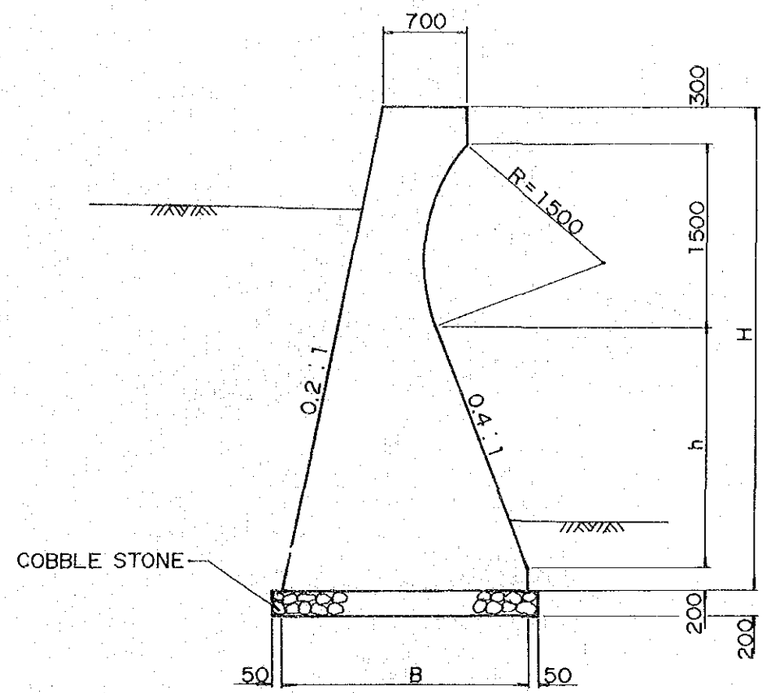


PLAN
SCALE: 1:10



FRONT ELEVATION SIDE ELEVATION

R.C. SHEET PILES
SCALE: 1:20



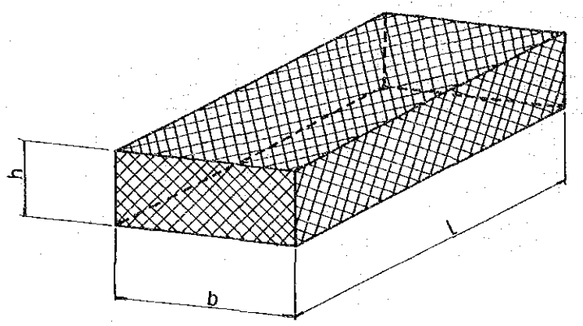
SEAWALL
SCALE: 1:50

LIST OF DIMENSION AND MATERIALS PER/M

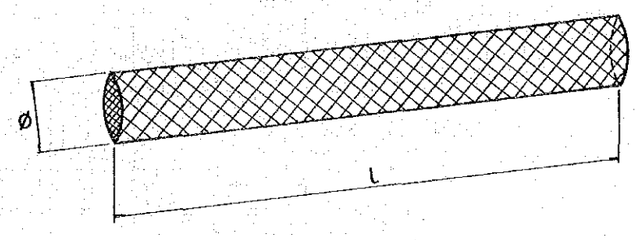
H(m.)	B (m.)	h(m.)	CONCRETE (m^3)	COBBLE STONE (m^3)
3.0	1.48	1.0	2.84	0.32
3.5	1.78	1.5	3.68	0.38
4.0	2.08	2.0	4.68	0.44
4.5	2.38	2.5	5.82	0.50
5.0	2.60	3.0	6.99	0.54

NOTE: R.C. piles or Steel H-pile or Ladder foundation to be used depending on geotechnical condition.

STANDARD DRAWINGS : MAT GABION , CYLINDER GABION	SCALE AS SHOWN	DRAWING NO. 13

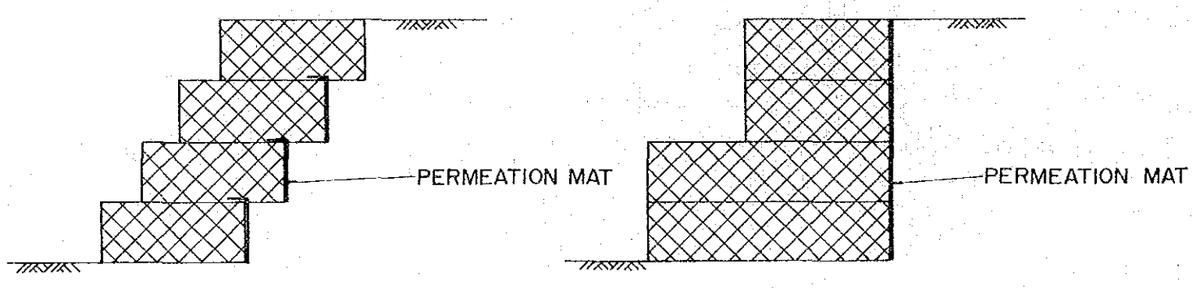


h : 0.40 m, 0.50m, 0.60m
b : 1.2 m
L : 2.0 m ~ 6.0 m (1.0m Pitch)



Ø : 0.45m, 0.60m, 0.90m
L : 3 m ~ 8 m (1.0 m Pitch)

CYLINDER GABION



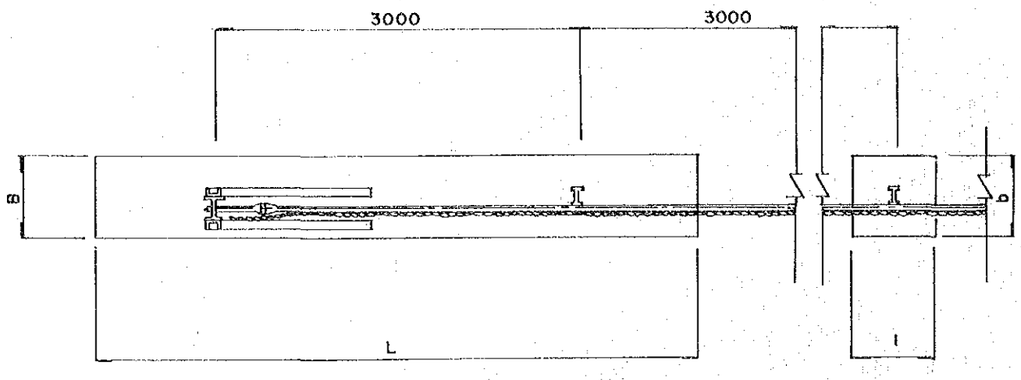
MAT GABION
SCALE: 1: 50

NOTE: Permeation mat was used to protect the backfill from sinking.

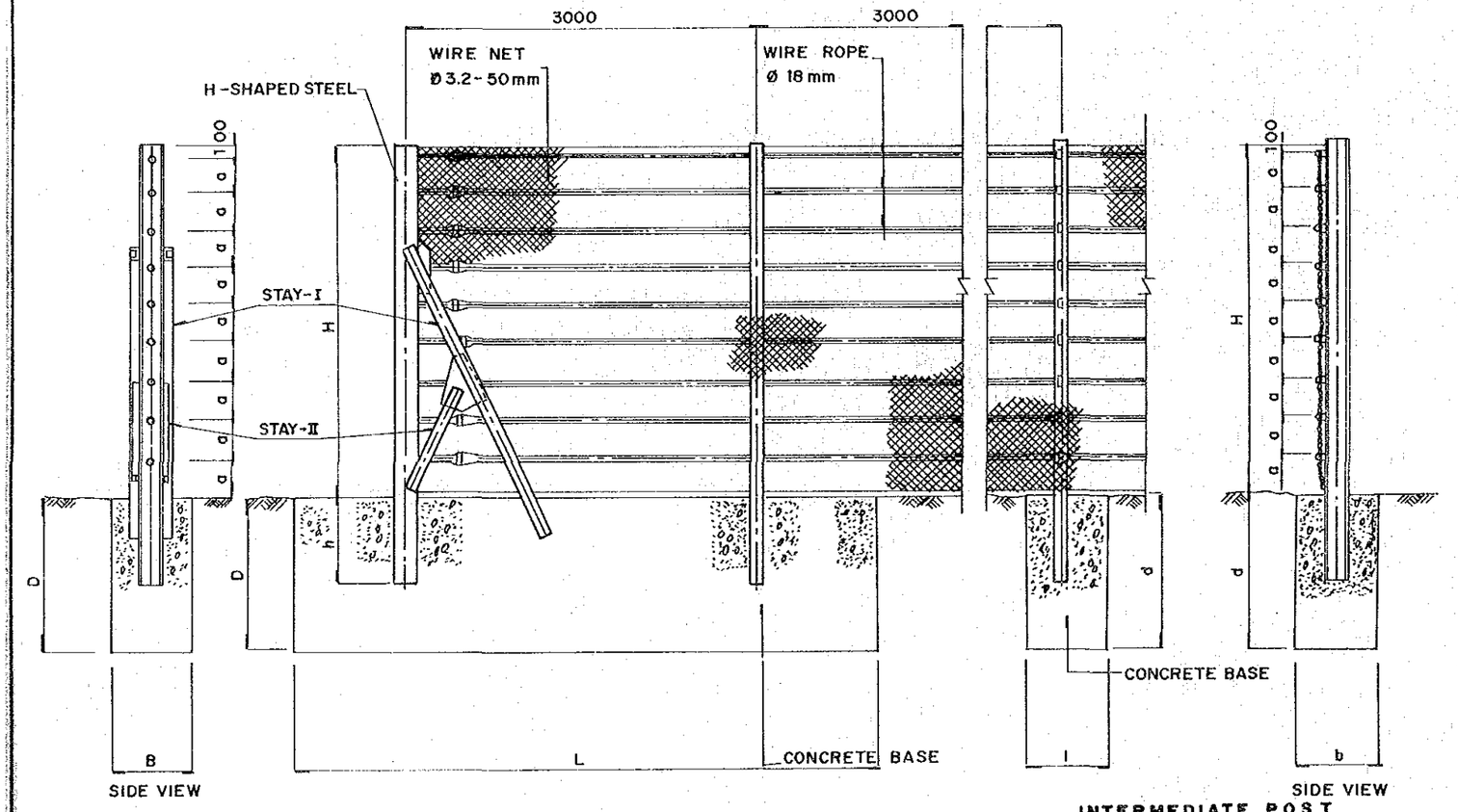
STANDARD DRAWINGS : CATCH FENCE

SCALE 1:500

DRAWING NO. 14



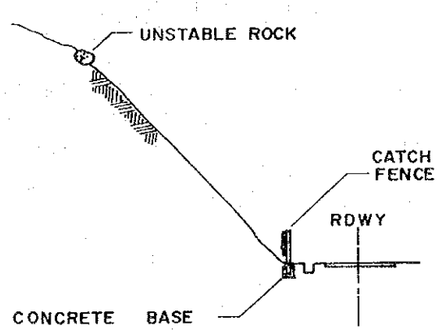
PLAN



ELEVATION

TYPE	HEIGHT H(m)	WIRE ROPE NUMBER EACH	WIRE ROPE SPACING a(mm)	INTERMEDIATE SUPPORT POST SECTION (mm)	INTERMEDIATE SUPPORT POST LENGTH (mm)	INTERMEDIATE SUPPORT POST EMBEDMENT h(mm)	END SUPPORT POST	ABSORPTION ENERGY BY FENCE (t-m)
A	1.00	3	300 ~ 350	H-150x75x5x7	1,500	500	H-125x125x6.5x9-1500 STAY-I H-100x100x6x8	4.6
B	1.25	4	300 ~ 350	H-150x75x5x7	1,800	550	H-125x125x6.5x9-1800 STAY-I H-100x100x6x8	4.3
C	1.55	5	300 ~ 350	H-200x100x5.5x8	2,200	650	H-150x150x7x10-2200 STAY-I H-125x125x6.5x9 PLATE ℓ. -6x50	6.3
D	2.00	6	300 ~ 350	H-200x100x5.5x8	2,750	750	H-175x175x7.5x11-2750 STAY-I H-150x150x7x10 PLATE ℓ. -6x50	5.8
E	2.50	8	300 ~ 350	H-200x100x5.5x8	3,300	800	H-200x200x8x12 STAY-I [-150x75x6.5x10 STAY-II [-100x50x5x7.5	5.6
F	3.00	9	300 ~ 350	H-200x100x5.5x8	3,800	800	H-200x200x8x12 STAY I [-150x75x6.5x10 STAY II [-100x50x5x7.5	5.4

TYPE	INTERMEDIATE POST b (mm)	INTERMEDIATE POST l (mm)	INTERMEDIATE POST d (mm)	END POST B (mm)	END POST L (mm)	END POST D (mm)
A	600	600	1000	600	4000	800
B	600	600	1000	600	4000	1000
C	700	700	1100	600	4000	1300
D	700	700	1100	600	4500	1300
E	700	700	1100	700	5000	1300
F	700	700	1100	700	5000	1400



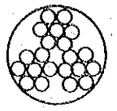
LOCATION OF CATCH FENCE

STANDARD DRAWINGS :

CATCH WIRE NET

SCALE: AS SHOWN

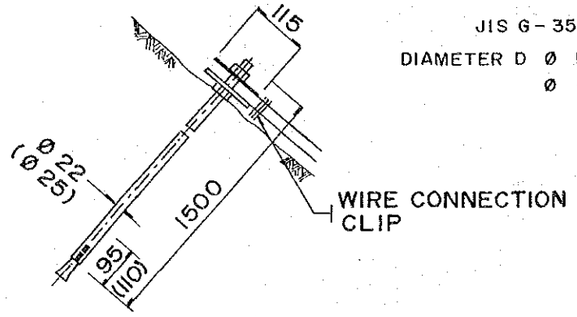
DRAWING NO. 15



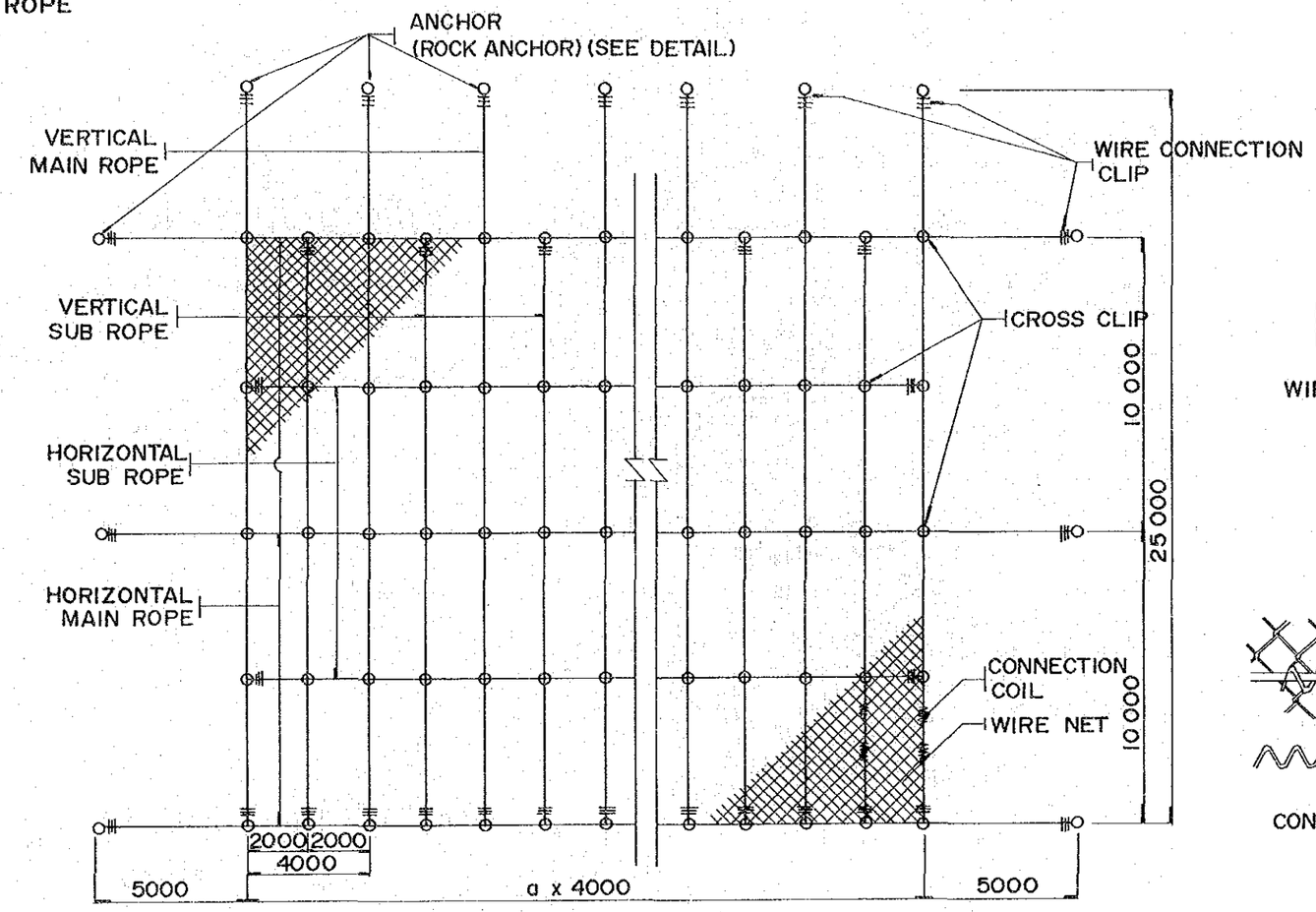
CROSS SECTION OF WIRE ROPE

JIS G-3525

DIAMETER D Ø 12mm.
Ø 16mm.

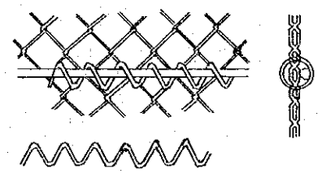


DETAILS OF ROCK ANCHOR

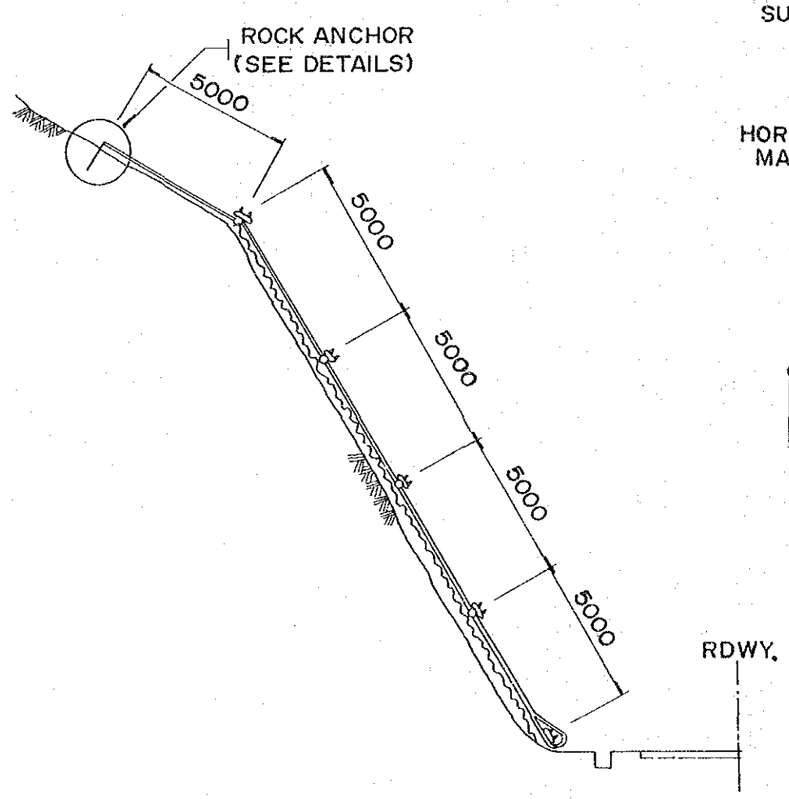


CROSS CLIP

WIRE CONNECTION CLIP



CONNECTION COIL



CROSS SECTION

DIMENSION TABLE OF ROCK NET

ITEM	WIRE NET	WIRE ROPE*1		CONDITION OF SLOPE AND ROCK			ANCHOR
	GALVANIZED WIRE NET	MAIN ROPE	SUB ROPE	MAX. SLOPE LENGTH	MAX SLOPE GRADIENT	ALLOWABLE*2 WT. OF ROCK	ROCK ANCHOR
1500	Ø 4.0mm. x 50x50	Ø 16	Ø 12	50 m.	0.5 : 1	1500 Kg.	Ø 25
1000	Ø 3.2mm. x 50x50	Ø 16	Ø 12	70 m.	0.5 : 1	1000 Kg.	Ø 25
500	Ø 2.6mm x 50x50	Ø 12	Ø 12	70 m.	0.5 : 1	500 Kg.	Ø 22

*1 JIS-G 3525 3x7 G/O TYPE
ULTIMATE TENSILE STRENGTH MORE THAN 7000 Kg. For Ø12mm.
MORE THAN 12000 Kg. For Ø16mm.

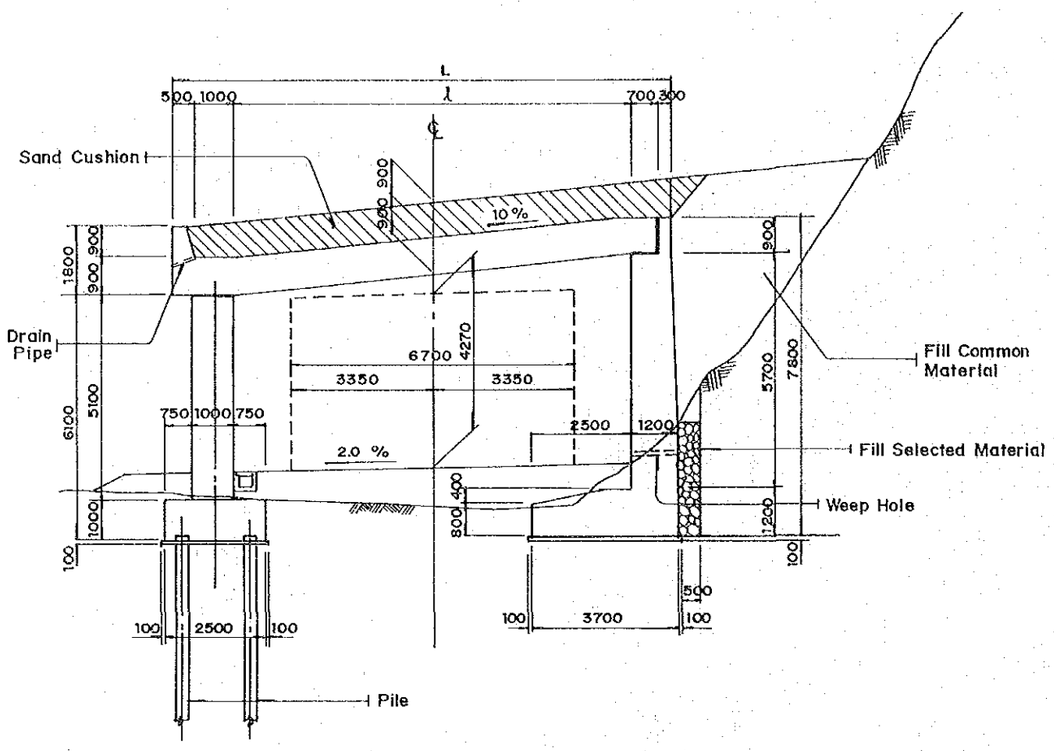
*2 UNIT; PER 40 SQUARE METER (4m. x 10m.)

STANDARD DRAWINGS :

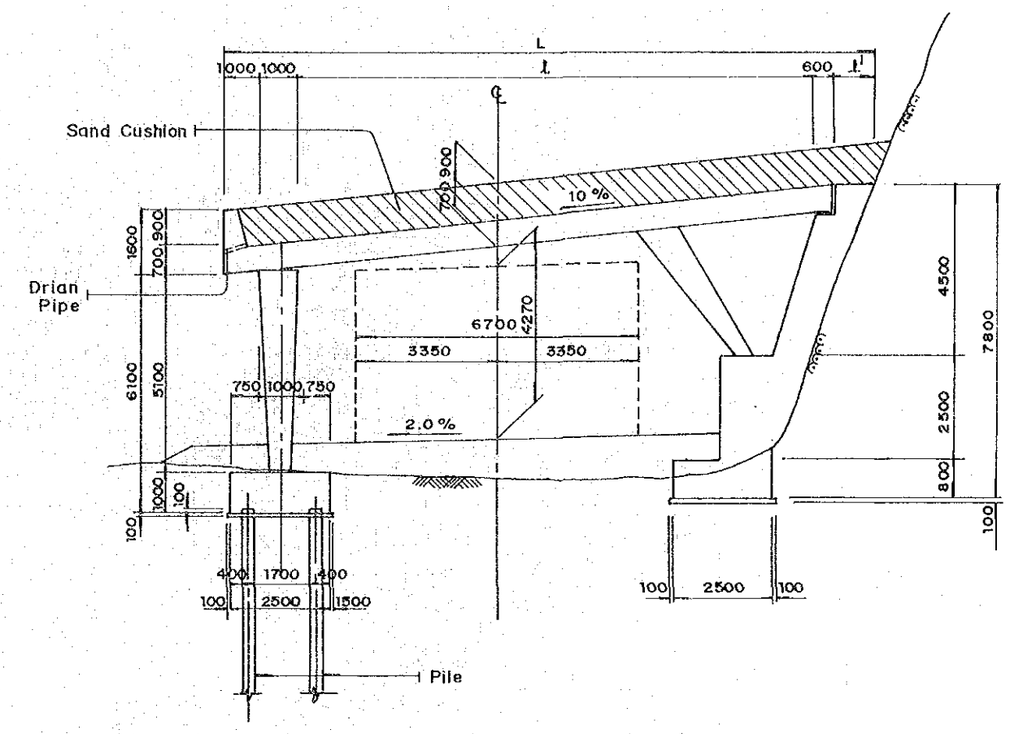
ROCK SHED

SCALE 1 : 150

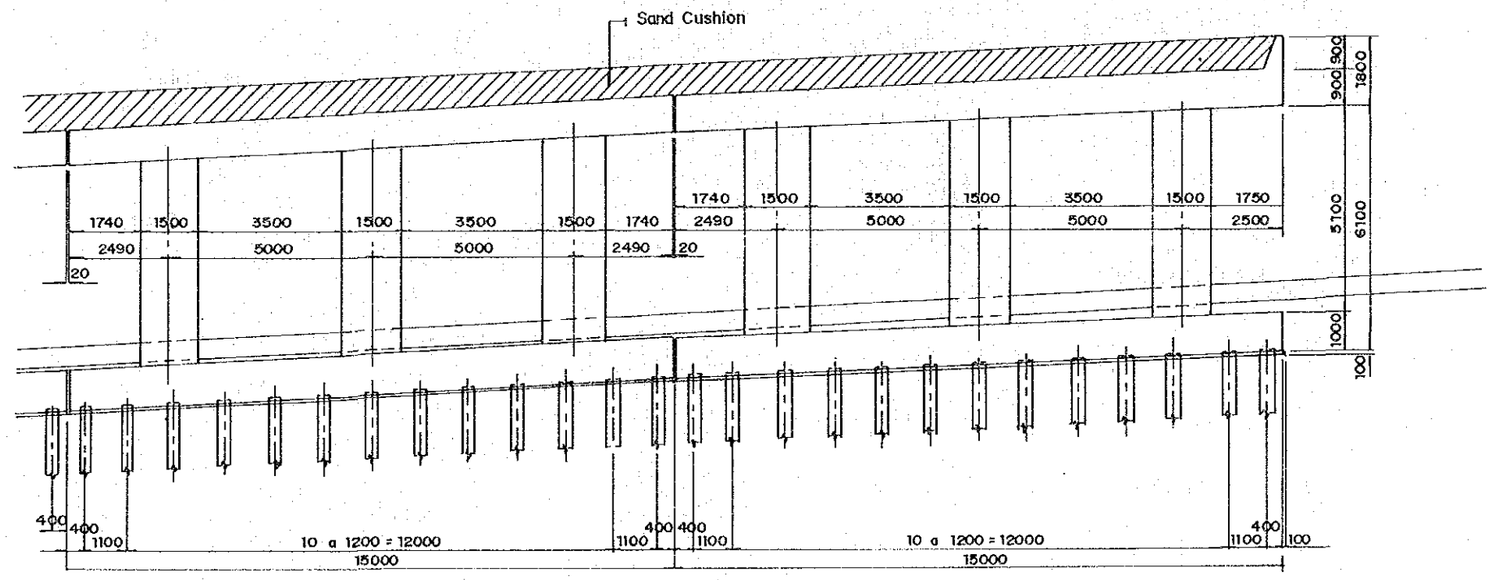
DRAWING NO. 16



CROSS SECTION (R.C.)

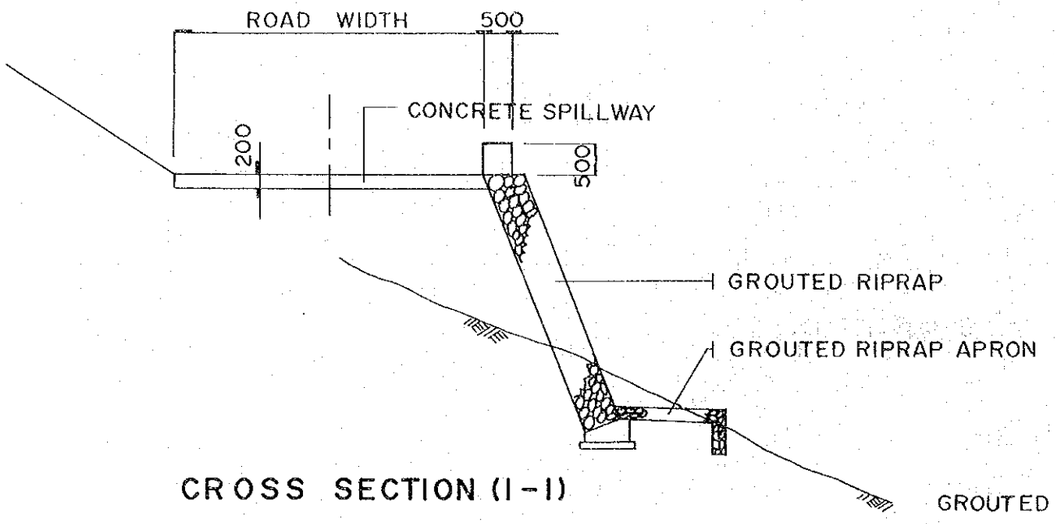


CROSS SECTION (P.C.)

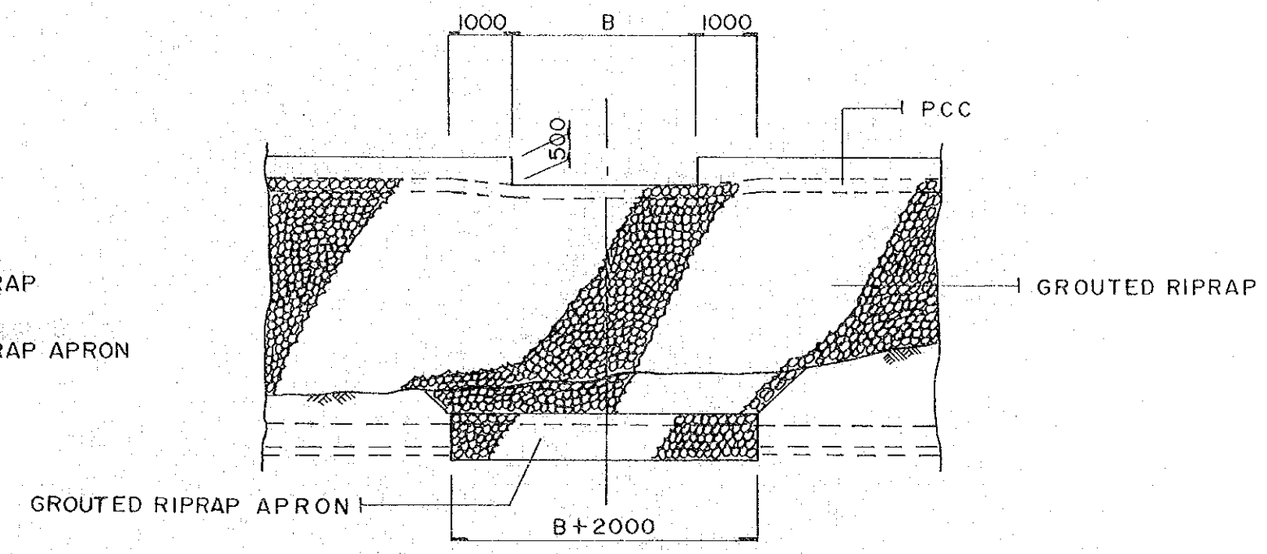


ELEVATION (R.C.)

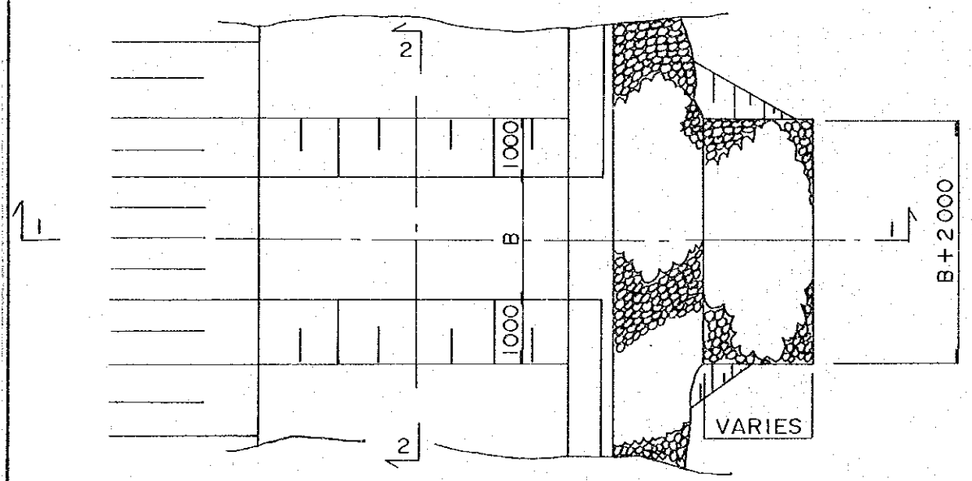
STANDARD DRAWINGS : CONCRETE SPILLWAY, GROUTED RIPRAP APRON	SCALE 1:100	DRAWING NO. 17



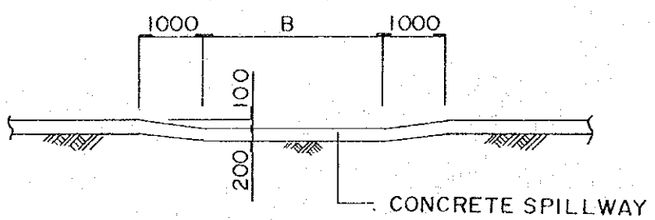
CROSS SECTION (1-1)



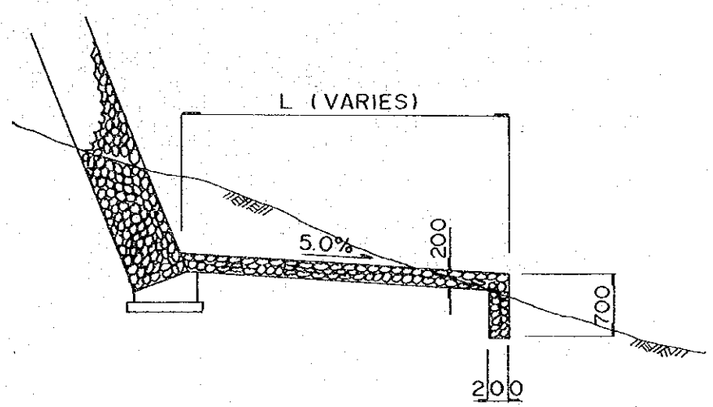
FRONT VIEW



PLAN



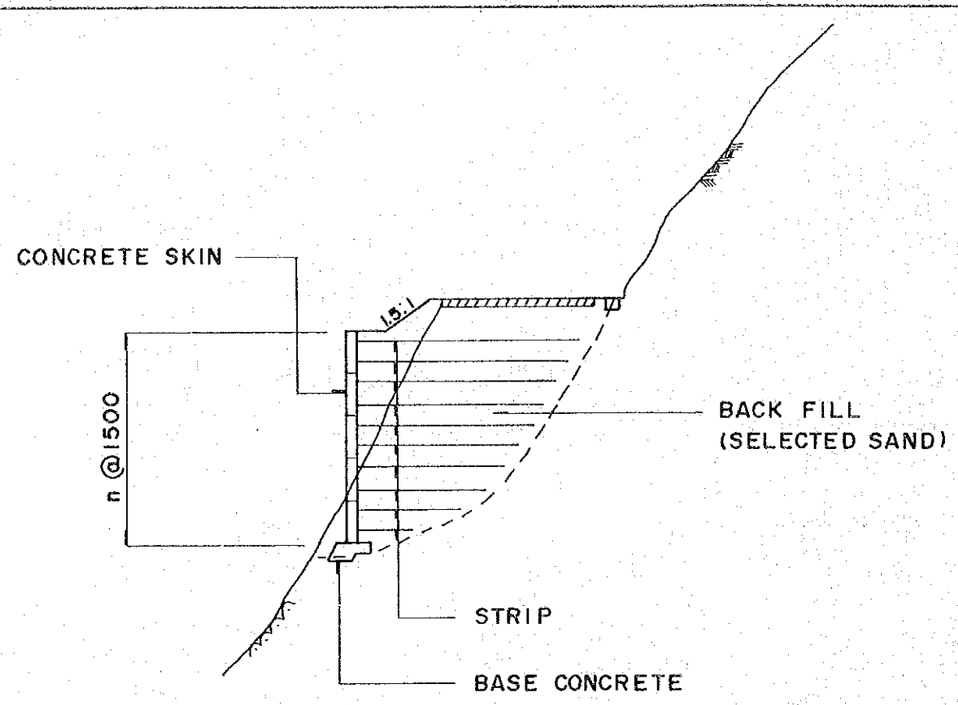
CROSS SECTION (2-2)



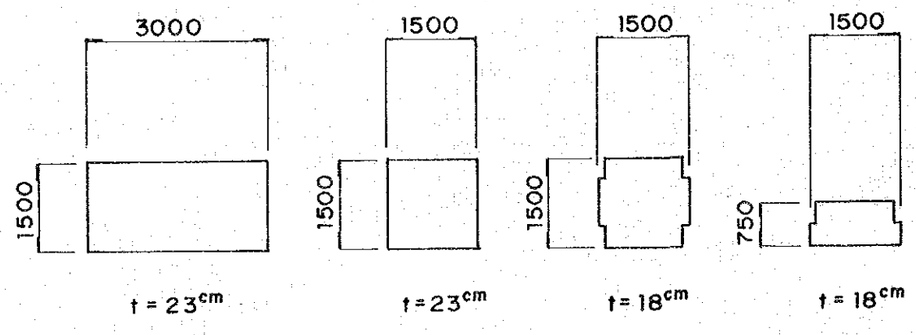
GROUTED RIPRAP APRON

STANDARD DRAWINGS : REINFORCED EARTH WALL

SCALE	DRAWING NO.
AS SHOWN	18



CROSS SECTION
SCALE 1:200



TYPICAL OF CONCRETE SKIN
SCALE 1:100

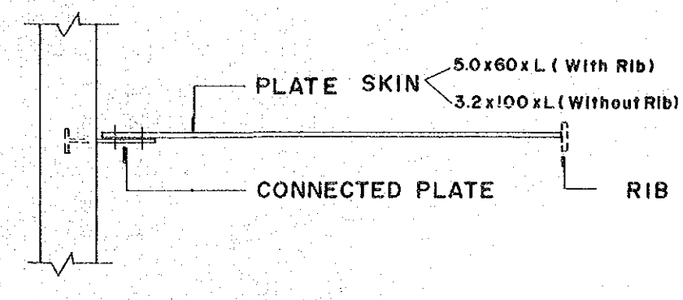
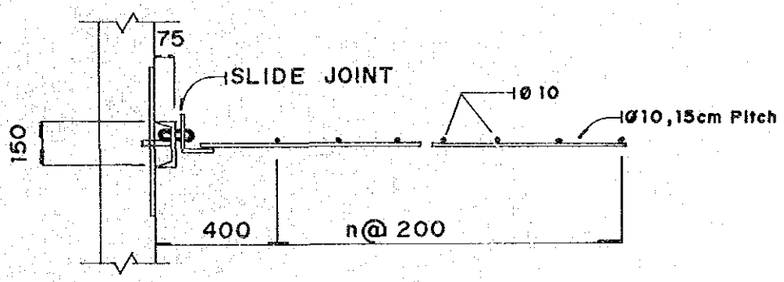
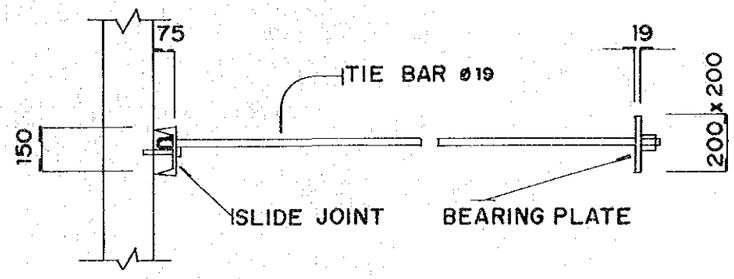


PLATE TYPE



REINFORCING BAR TYPE

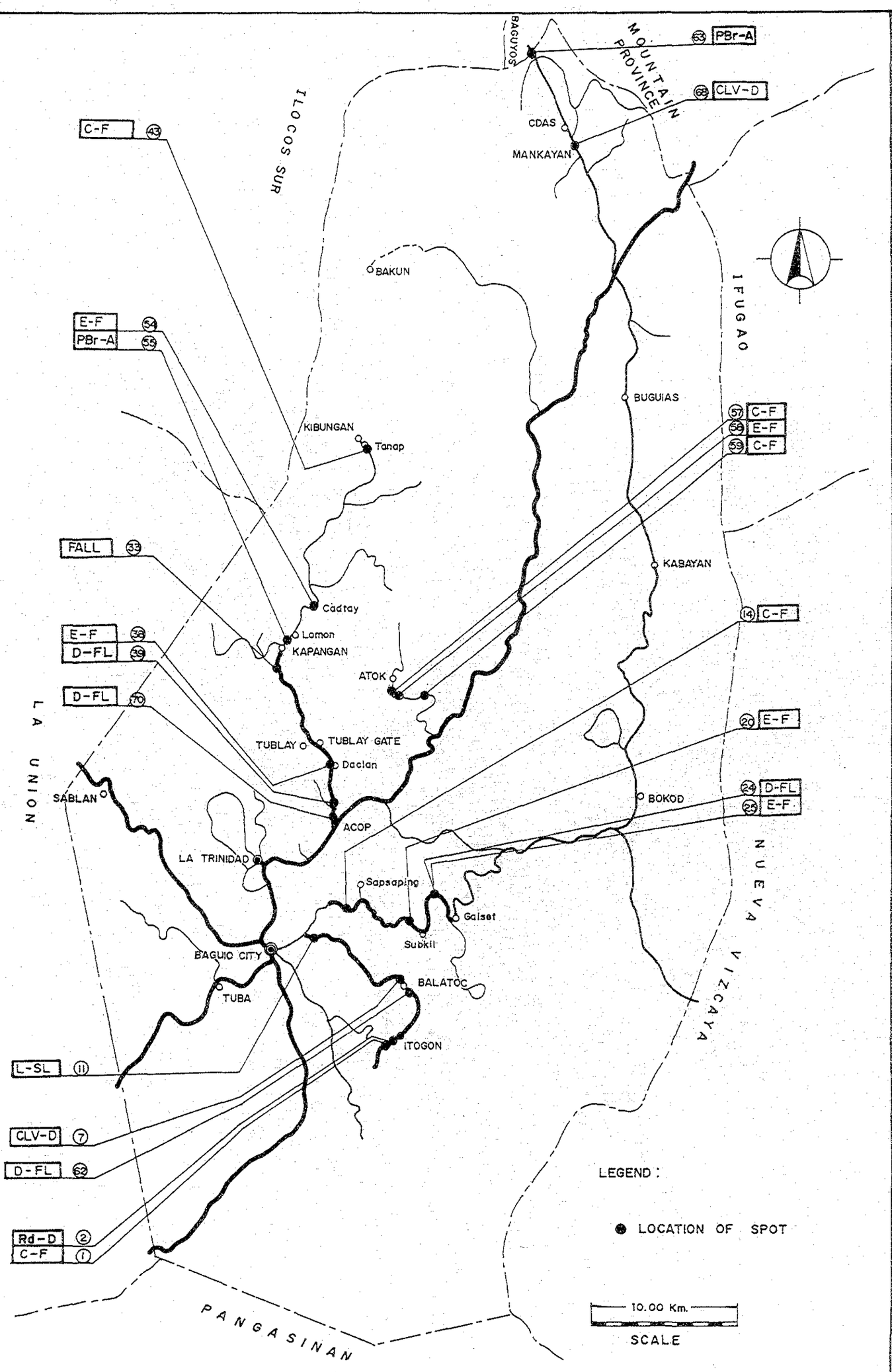


BEARING PLATE TYPE

TYPICAL OF STRIP
SCALE 1:20

3. RESTORATION MEASURES FOR SELECTED SPOTS IN BENGUET

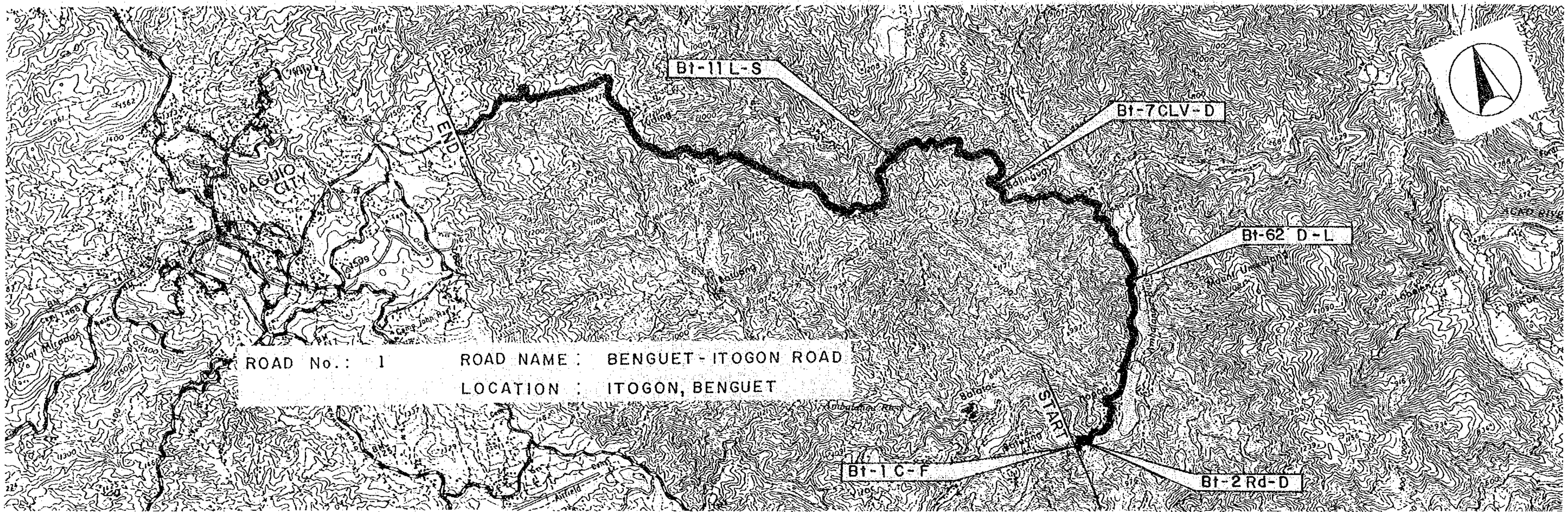
LOCATION OF SELECTED SPOTS IN BENGUET (1/4)

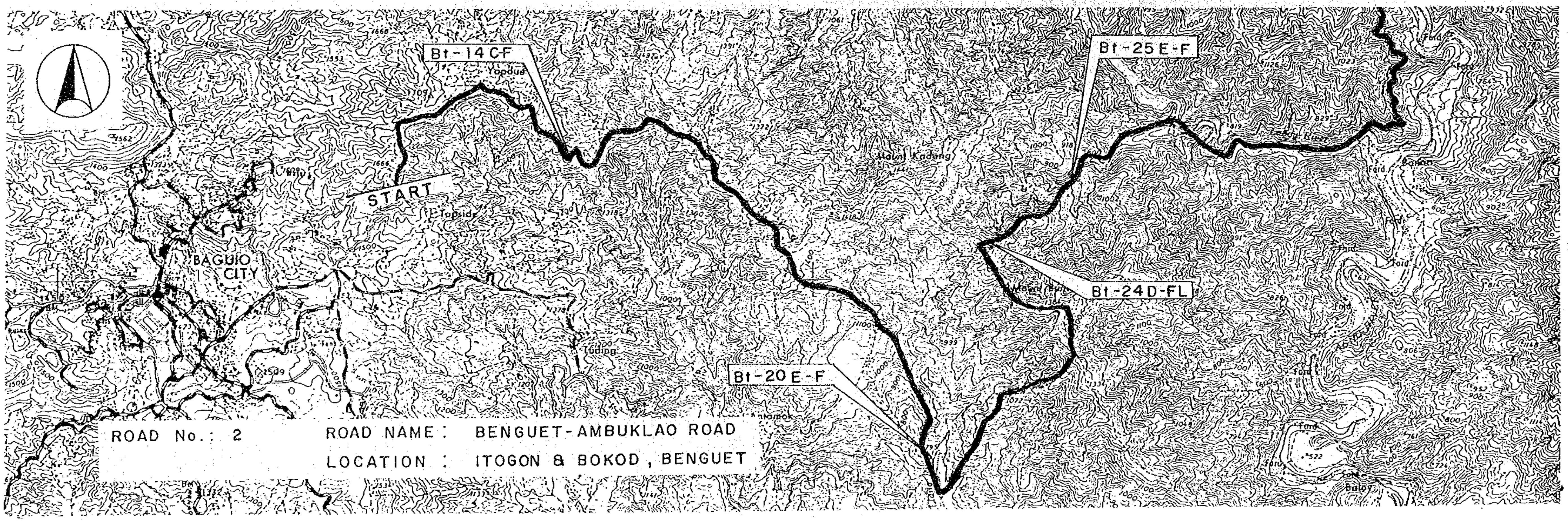


DRAWING NO. 19

LOCATION OF SELECTED SPOTS IN BENGUET (2/4)

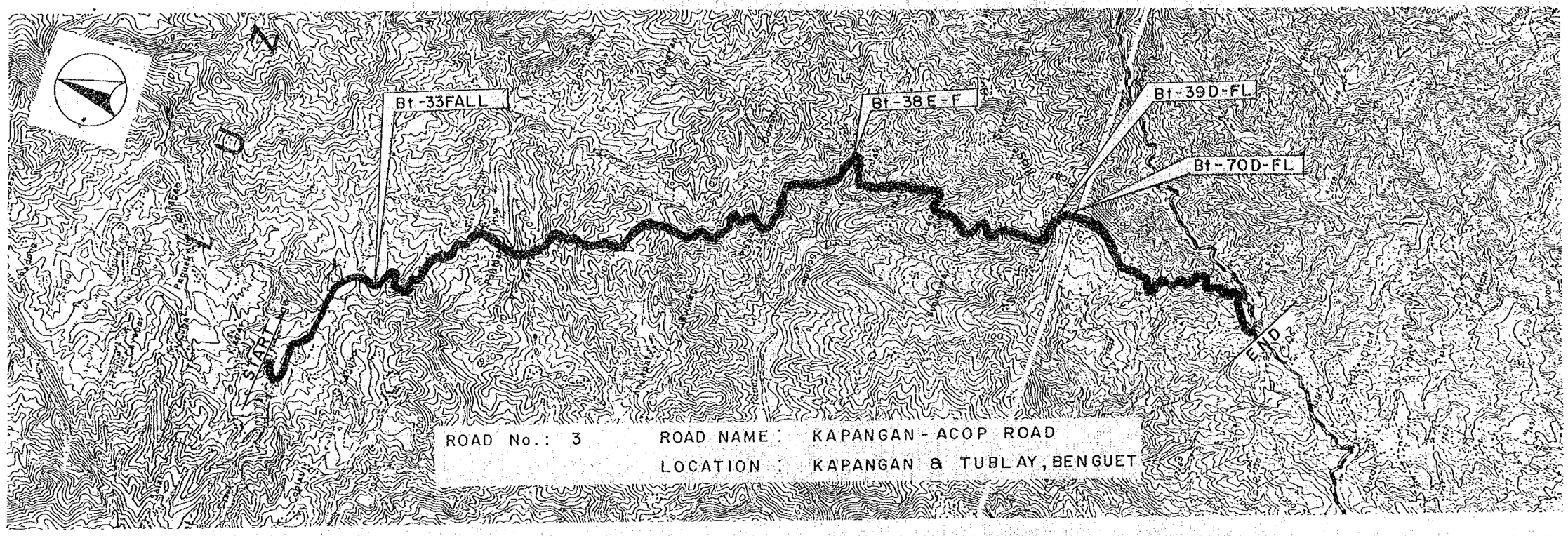
Scale	Drawing No.
1:50,000	20

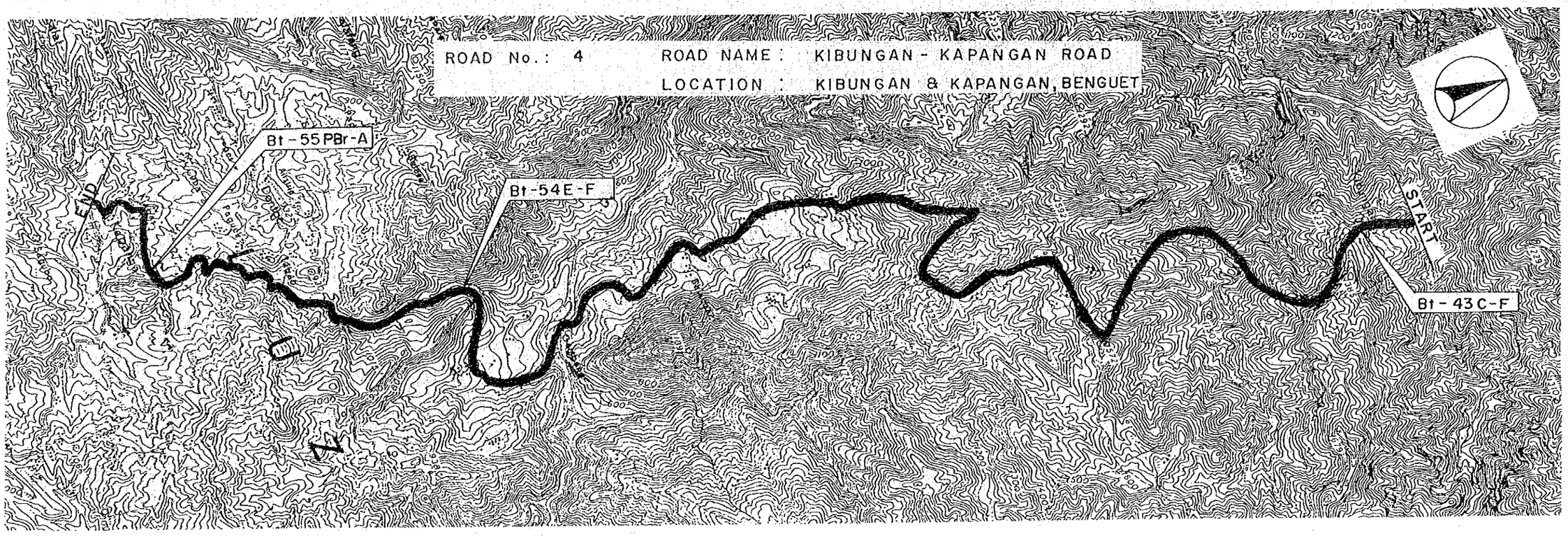




LOCATION OF SELECTED SPOTS IN BENGUET (3/4)

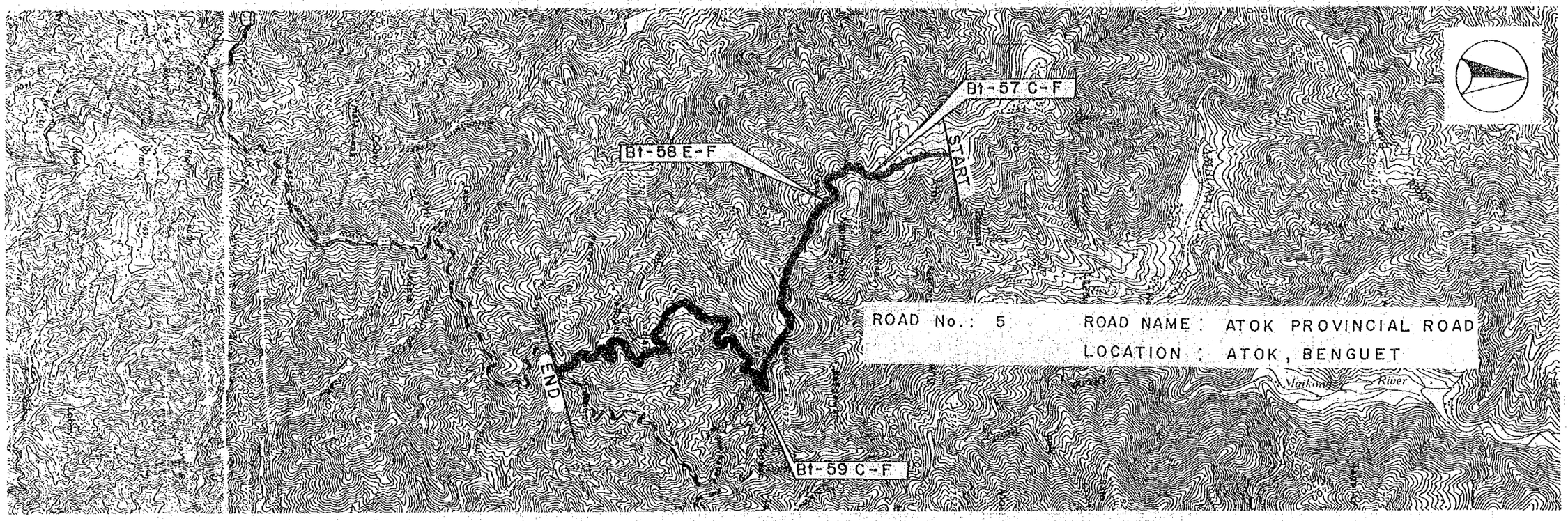
Scale	Drawing No.
1:50,000	21





LOCATION OF SELECTED SPOTS IN BENGUET (4/4)

Scale	Drawing No.
1:50,000	22



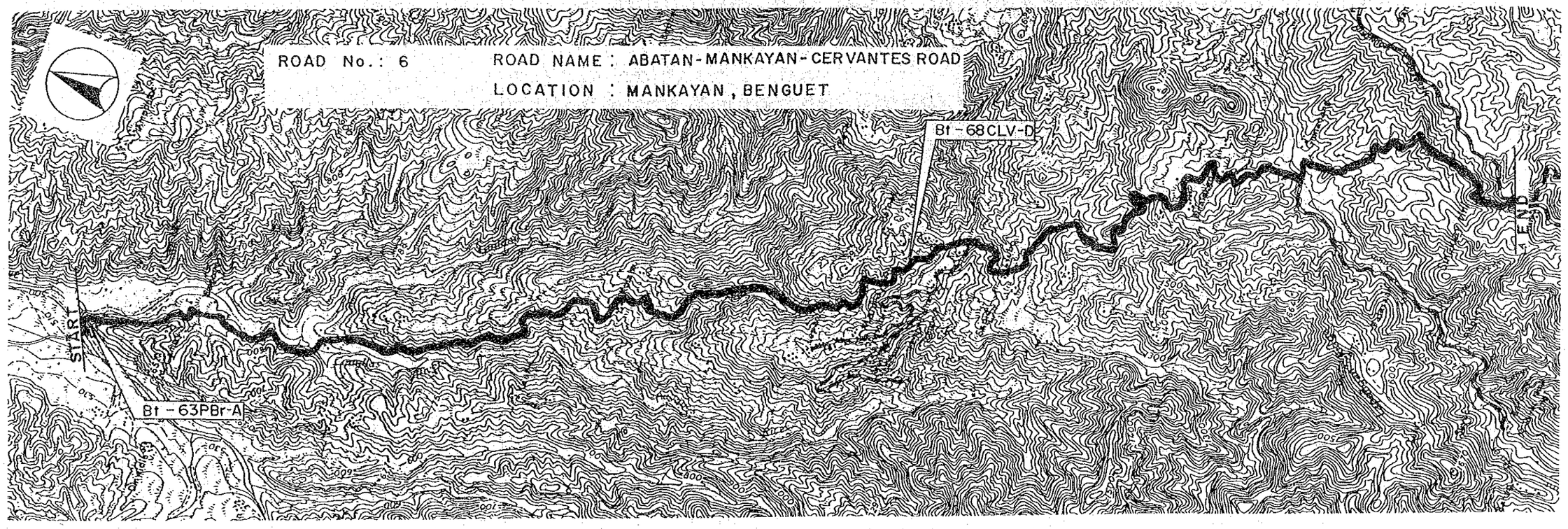


TABLE OF RESTORATION MEASURE APPLIED TO EACH SPOT IN BENGUET

DRAWING NO. 23

TYPE OF RESTORATION MEASURE					SPOT NUMBER	1	2	7	11	14	20	24	25	33	38	39	43	54	55	57	58	59	62	63	68	70
					TYPE OF DISASTER	C-F	Rd-D	CLV-D	L-S	C-F	E-F	D-FL	E-F	FALL	E-F	D-FL	C-F	E-F	PBr-A	C-F	E-F	C-F	D-FL	PBr-A	CLV-D	D-FL
URGENT	U1	Earthwork	U1-1	Removal of Deposit Materials		○		○		○		○		○		○	○			○		○	○			○
			U1-2	Removal of Unstable Materials		○								○						○			○			
			U1-4	Refilling / Embankment							○							○							○	
	U3	Slope Protection	U3-1	Sheet Covering				○		○			○		○						○				○	
			U3-2	Sand Bag Covering							○														○	
	U4	Retaining Work	U4-1	Sand Bag Wall															○						○	
			U4-3	Wooden Fence							○							○								
	U6	Bridge	U6-3	Bailey Bridge																				○		
	U7	Pavement Work	U7-1	Gravel Surfacing					○																	
PERMANENT	P1	Earthwork	P1-1	Recutting	○				○		○		○				○			○						
			P1-3	Refilling / Embankment		○						○		○				○	○							○
			P1-4	Counterweight Fill				○																		
	P2	Surface Drainage	P2-1	Slope Ditch				○																		
			P2-2	Side Ditch	○				○		○	○	○	○		○				○		○				
			P2-4	Culvert																					○	
			P2-5	Catch Basin				○																	○	
	P3	Sub-Surface Drainage	P3-2	Horizontal Drain Hole				○																		
	P4	Slope Protection by Vegetation	P4-2	Hand Seeding with Mdt					○						○											
			P4-6	Pick Hole Seeding										○				○								
			P4-8	Wattling	○															○		○				
	P5	Slope Protection by Structure	P5-3	Stone Pitching					○																	
	P6	Retaining Wall	P6-2	Grouted Riprap	○		○		○	○		○	○	○	○	○		○	○	○	○	○	○	○		
			P6-9	Gabion Wall	○	○	○	○									○									
	P8	Catch Work	P8-2	Catch Gabion Wall							○					○							○			
	P15	Bridge	P15-1	Concrete Bridge															○					○		○
	P16	Foot Protection	P16-1	Concrete Foot Protection								○														
			P16-2	Gabion Foot Protection																	○					
			P16-3	Grouted Riprap Apron			○			○						○					○		○		○	
	P18	Spillway	P18-1	Concrete Spillway			○									○										
	P19	Pavement Work	P19-1	Gravel Surfacing		○																				○
			P19-2	Bituminous Pavement				○																		