

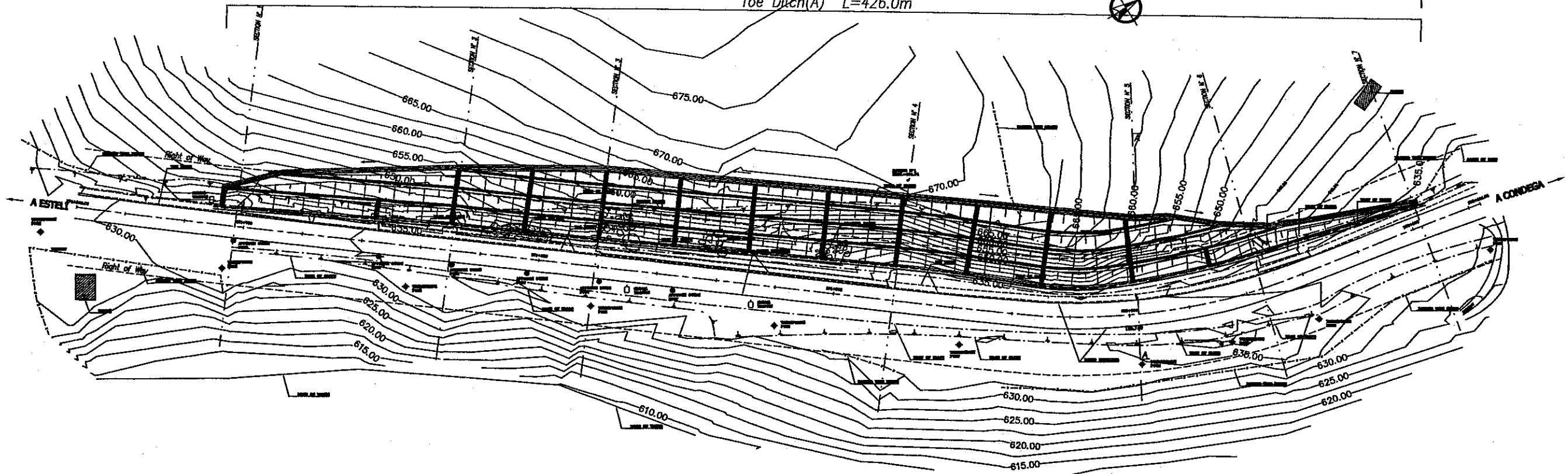
ORIENTAL CONSULTANTS CO., LTD.
JAPAN ENGINEERING CONSULTANTS
CO., LTD.

CONTENIDO: LEVANTAMIENTO TOPOGRAFICO
SECCIONES TRANSVERSALES
UBICACION: KM 175+450 CARRETERA TELICA - SAN ISIDRO
SITE: N026A006

PROYECTO: STUDY OF VULNERABILITY REDUCTION FOR MAJOR ROADS
IN THE REPUBLIC OF NICARAGUA

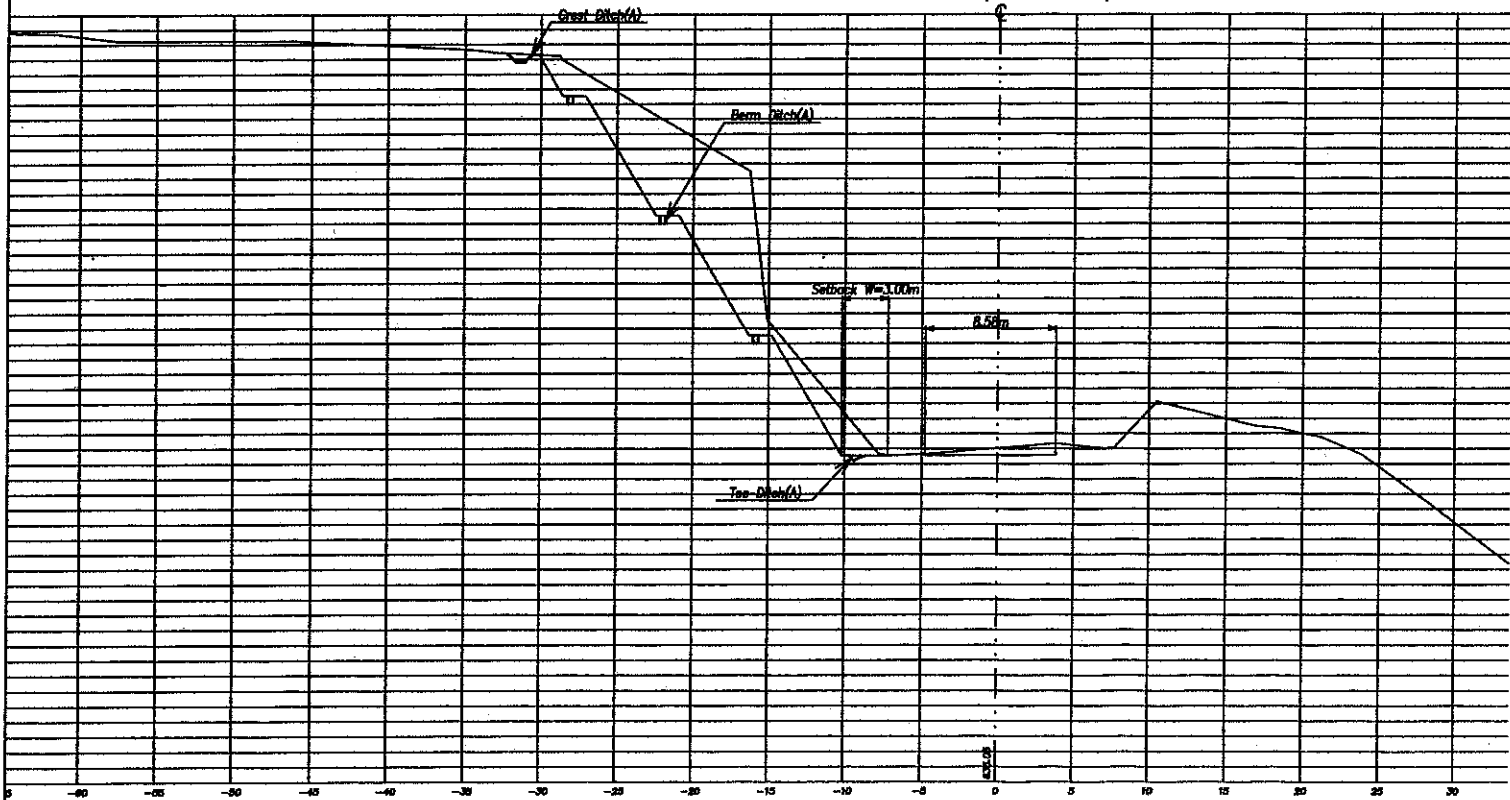
CALCULO: DIBUJO: HOJA N°
LEVANTO: FECHA: 1
RESPONSABLE TECNICO: ESCALA: November 2002
Illustration 16

Crest Ditch(A) L=426.0m
 Berm Ditch(A) L=1065.0m
 Vertical Ditch L=364.0m
 Toe Ditch(A) L=426.0m

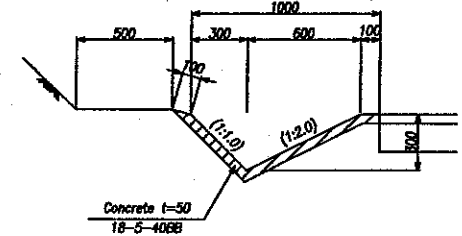


Plan S=1:1500

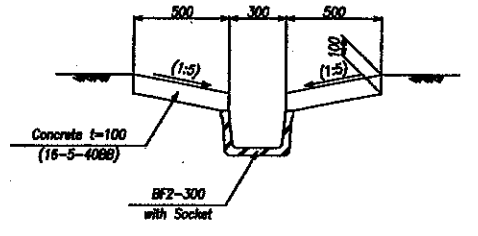
A - A
 172+003 (SECTION N°5)



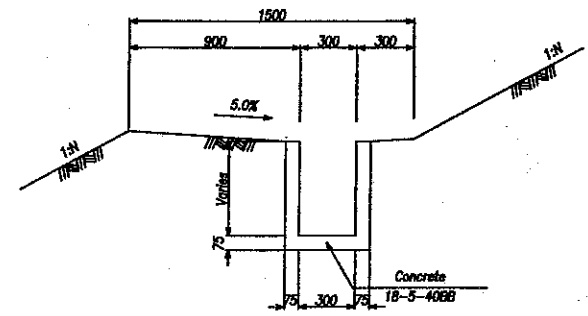
Cross Section S=1:500



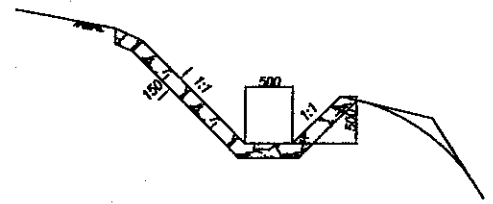
Toe Ditch(A) S=1:40
 *For Cut



Vertical Ditch S=1:40



Berm Ditch(A) S=1:40
 *For Cut of Soft Rock



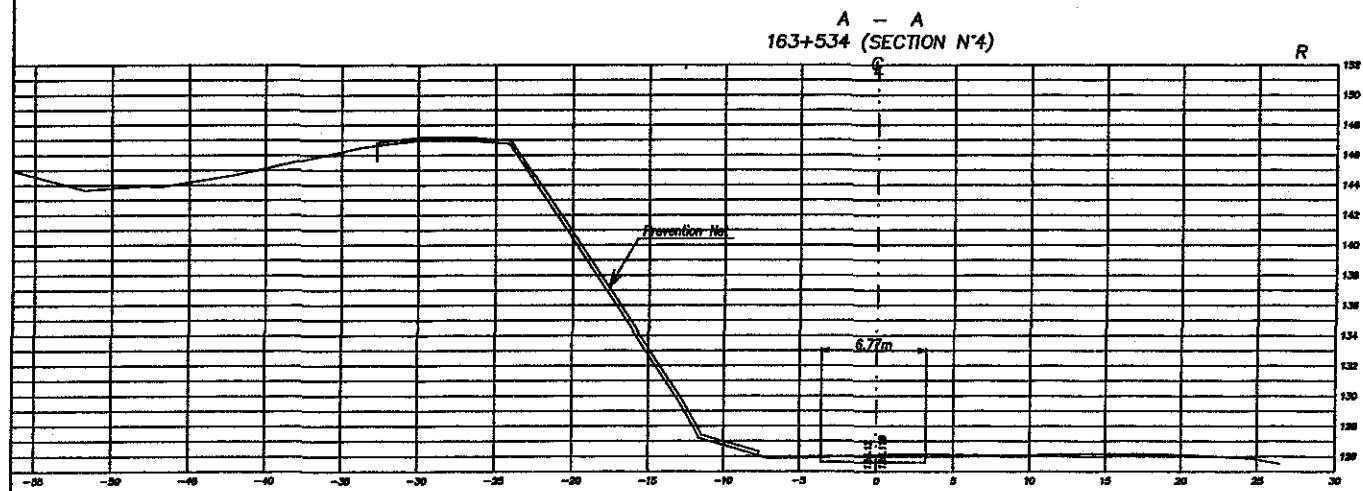
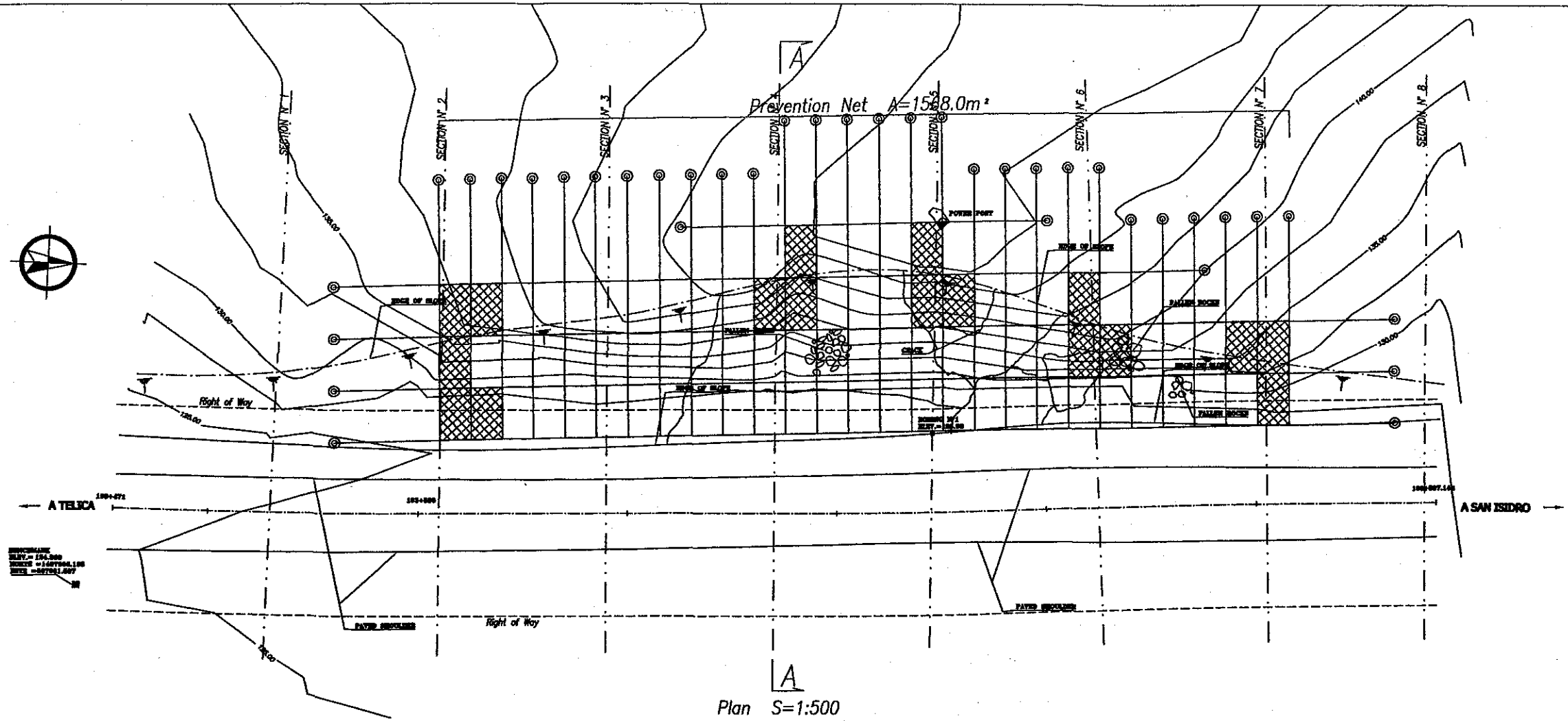
Crest Ditch(A) S=1:80

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 CO., LTD.

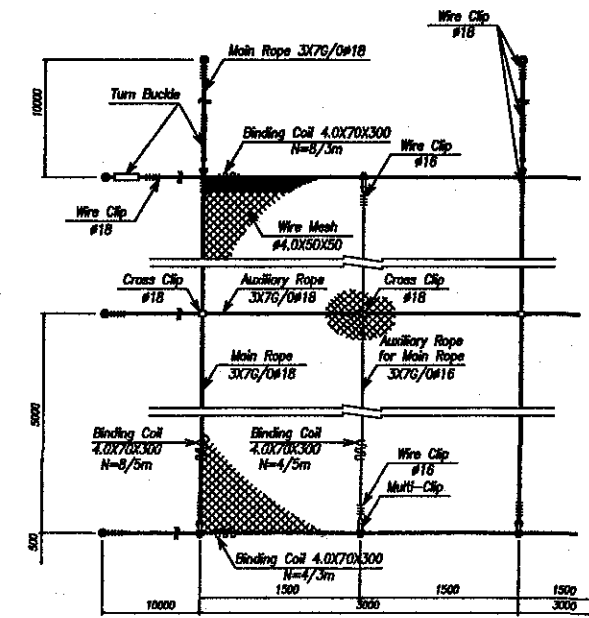
CONTENIDO: LEVANTAMIENTO TOPOGRAFICO SECCIONES TRANSVERSALES
 UBICACION: KM 171+643.95 CARRETERA MANAGUA - EL ESPINO
 SITIO: N001B170

PROYECTO: STUDY OF VULNERABILITY REDUCTION FOR MAJOR ROADS IN THE REPUBLIC OF NICARAGUA

CALCULO: DEBAJO: HOJA N°
 LEVANTO: FECHA: November 2002 2
 RESPONSABLE TECNICO: ESCALA: Illustration 16

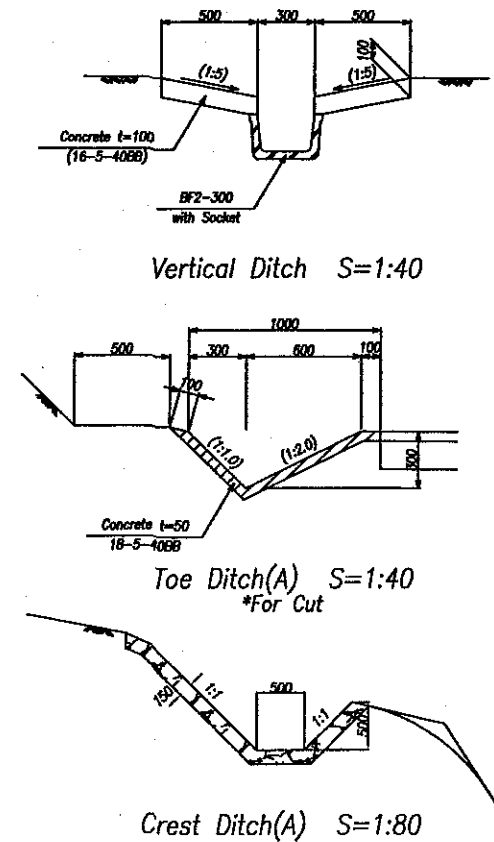
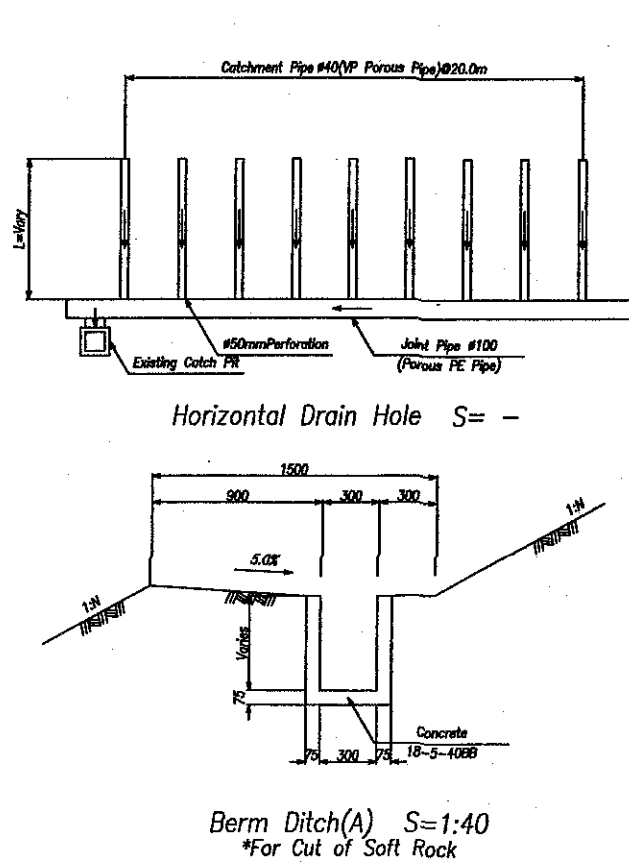
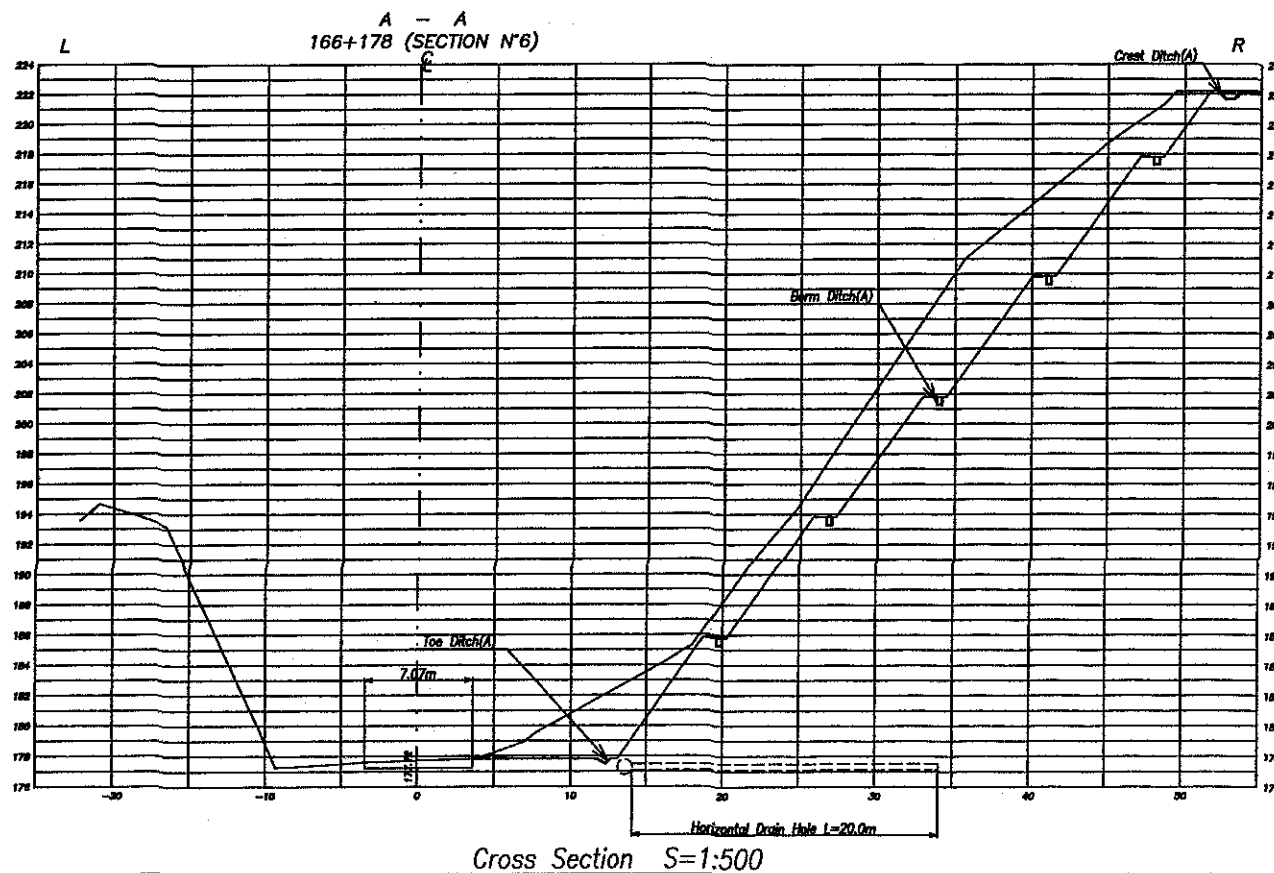
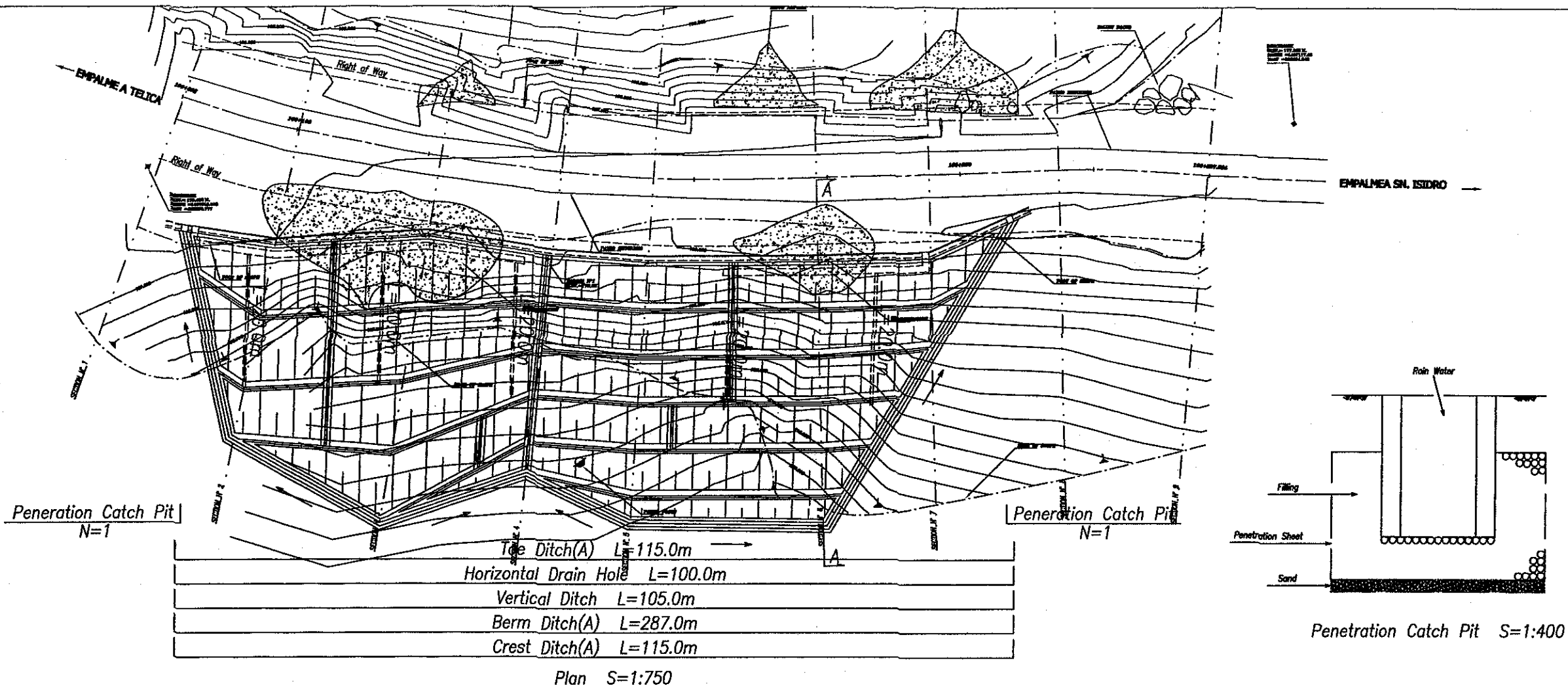


Cross Section S=1:500



General Layout of Prevention Net S=Non Scale

ORIENTAL CONSULTANTS CO., LTD. JAPAN ENGINEERING CONSULTANTS CO., LTD.	CONTENIDO: LEVANTAMIENTO TOPOGRAFICO SECCIONES TRANSVERSALES	PROYECTO: STUDY OF VULNERABILITY REDUCTION FOR MAJOR ROADS IN THE REPUBLIC OF NICARAGUA	CALCULO:	DIBUJO:	HOJA N°
	UBICACION: KM 163+471 CARRETERA TELICA - SAN ISIDRO		LEVANTO:	FECHA: November 2002	3
	SITIO: N026B160		RESPONSABLE TECNICO:	ESCALA: Illustration	16



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JAPAN ENGINEERING CONSULTANTS
CO., LTD.

CONTENIDO: LEVANTAMIENTO TOPOGRAFICO
SECCIONES TRANSVERSALES
UBICACION: KM 166+300 CARRETERA TELICA - SAN ISIDRO
SITE: N0268140

PROYECTO:

STUDY OF VULNERABILITY REDUCTION FOR MAJOR ROADS
IN THE REPUBLIC OF NICARAGUA

CALCULO:

LEVANTO:

RESPONSABLE
TECNICO:

DEBIDO:

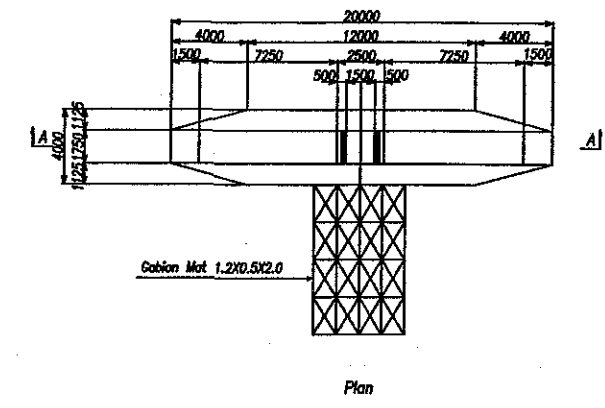
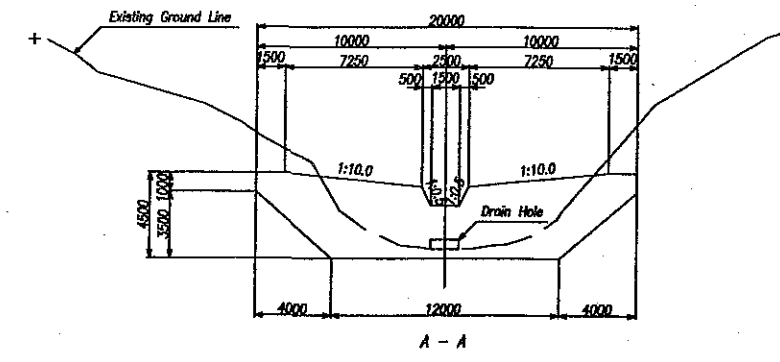
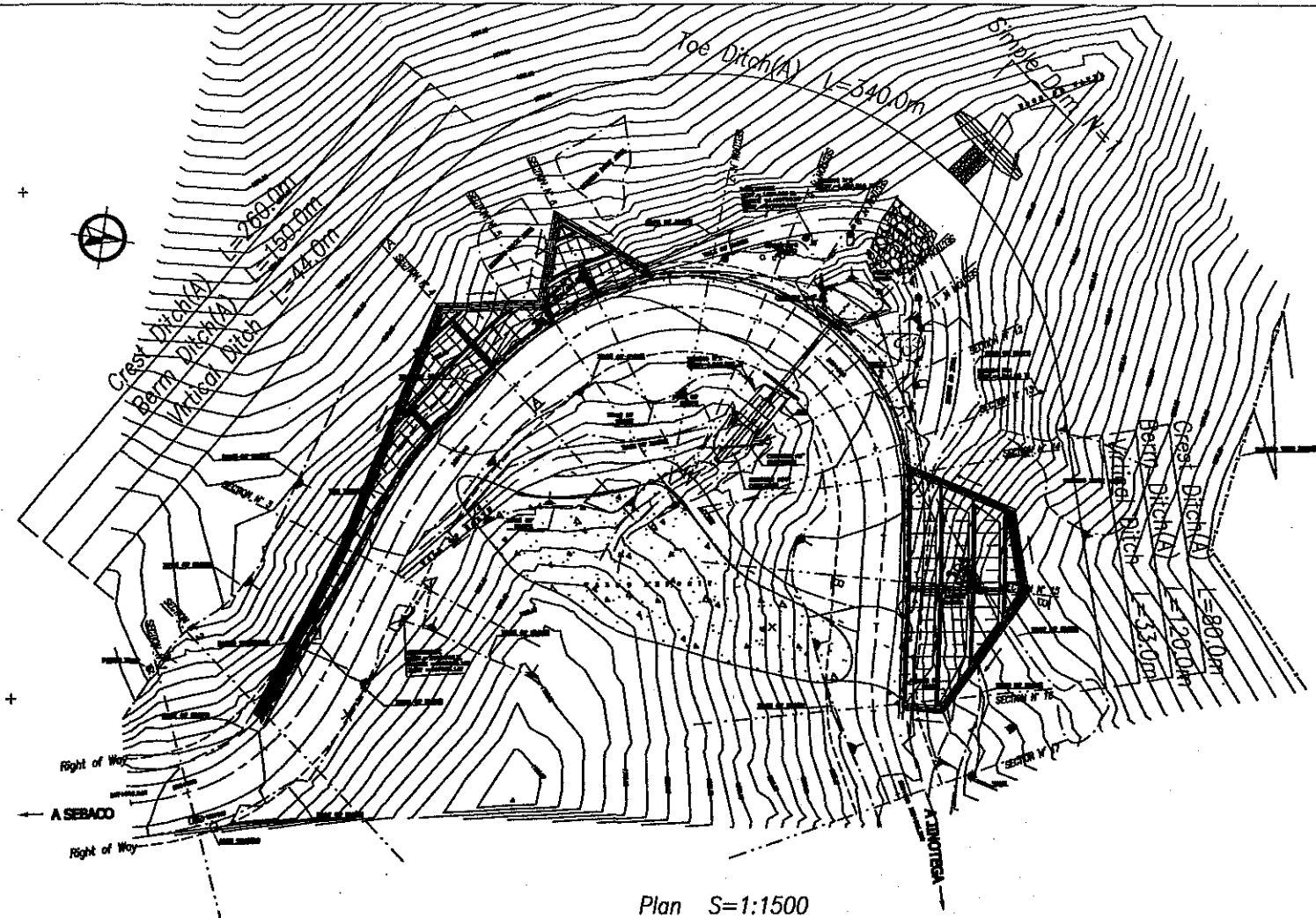
FECHA:

ESCALA:

HOJA N°

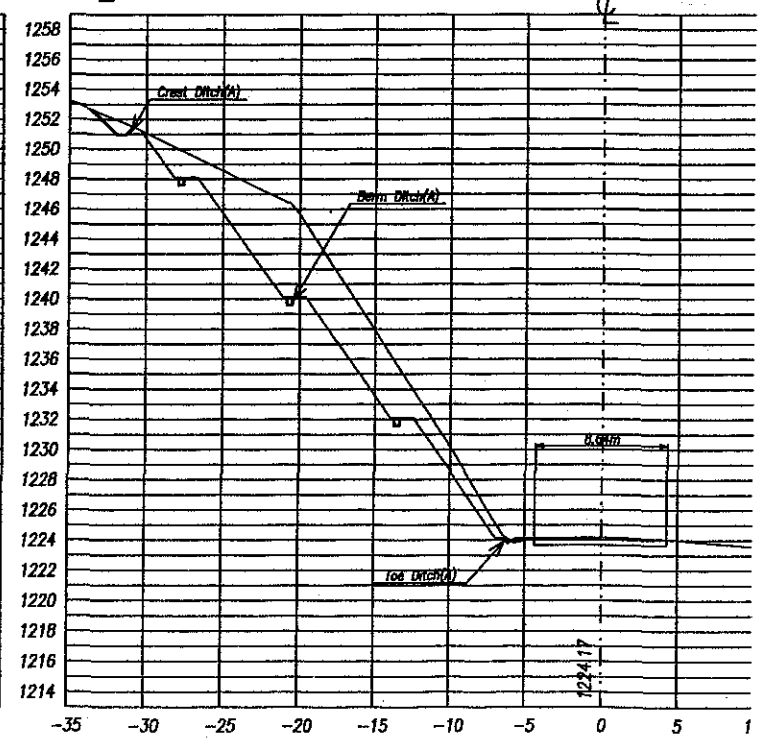
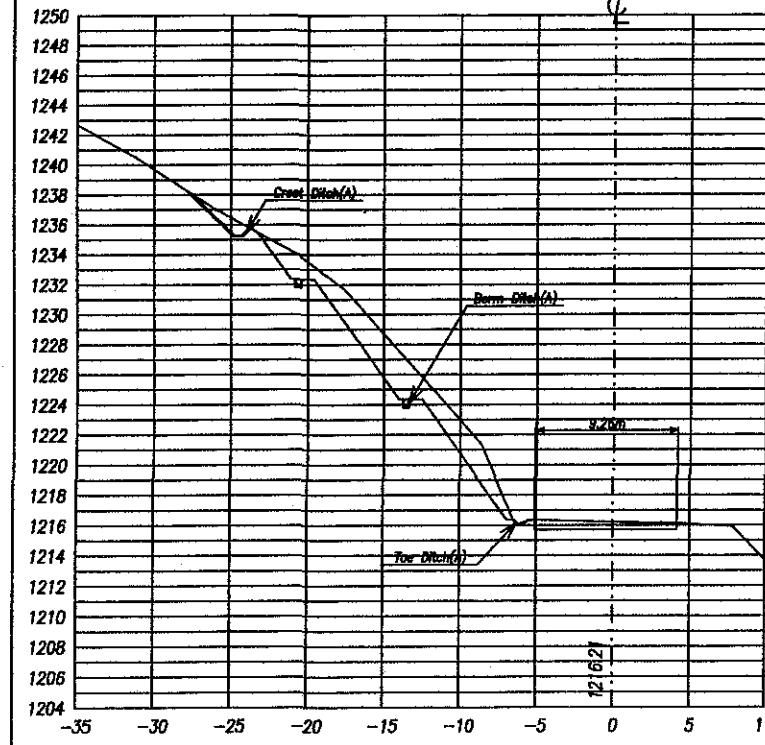
4

16

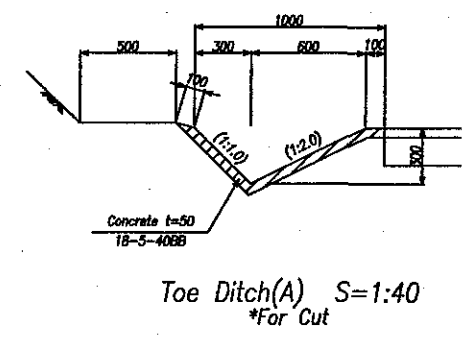


A - A
138+119 (SECTION N°4)

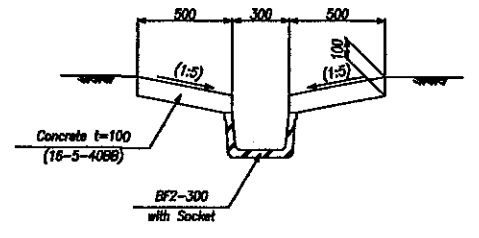
B - B
138+250 (SECTION N°15)



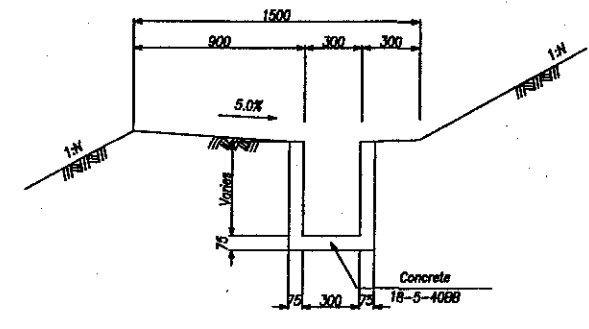
Cross Section S=1:500



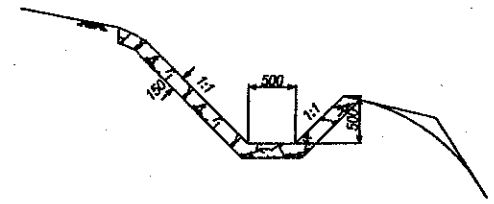
Toe Ditch(A) S=1:40
*For Cut



Vertical Ditch S=1:40



Berm Ditch(A) S=1:40
*For Cut of Soft Rock



Crest Ditch(A) S=1:80

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CO., LTD.

CONTENIDO: LEVANTAMIENTO TOPOGRAFICO
SECCIONES TRANSVERSALES
UBICACION: KM 138+000 CARRETERA SEBACO - JINOTEGA
SITO: N003E170

PROYECTO: STUDY OF VULNERABILITY REDUCTION FOR MAJOR ROADS
IN THE REPUBLIC OF NICARAGUA

CALCULO: LEVANTO: RESPONSABLE TECNICO:
DIBUJO: FECHA: November 2002
ESCALA: Illustration

Typical Cross Section

For Cut

Cut Slope Standard in Nicaragua

Functional Classification	Minor Collector	Major Collector	Minor Arterial	Principal Arterial	Special Arterial
Number of Lane	2	2	2	2	4
Future Average Daily Traffic (vpd)	-400	400 - 1,800	1,800 - 3,000	-3,000	Over 3,000
Side-slope	On Sound Rock	0-1/2:1	0-1/2:1	0-1/2:1	0-1/2:1
	Unknown Soil	1:1	1 1/2:1	1 1/2:1	2:1
	Well Compacted Soil	1:1	1 1/2:1	1 1/2:1	2:1
	Not Well Compacted Soil	1 1/2:1	1 1/2:1	2:1	2:1

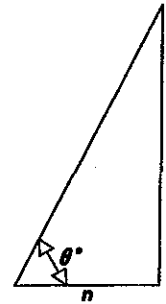
For Embankment

Cut Slope Standard in Nicaragua

Functional Classification	Minor Collector	Major Collector	Minor Arterial	Principal Arterial	Special Arterial
Number of Lane	2	2	2	2	4
Future Average Daily Traffic (vpd)	-400	400 - 1,800	1,800 - 3,000	-3,000	Over 3,000
Side-slope	H < 1.2m	3:1	3:1	4:1	4:1
	H > 1.2m	1 1/2:1	1 1/2:1	2:1	2:1

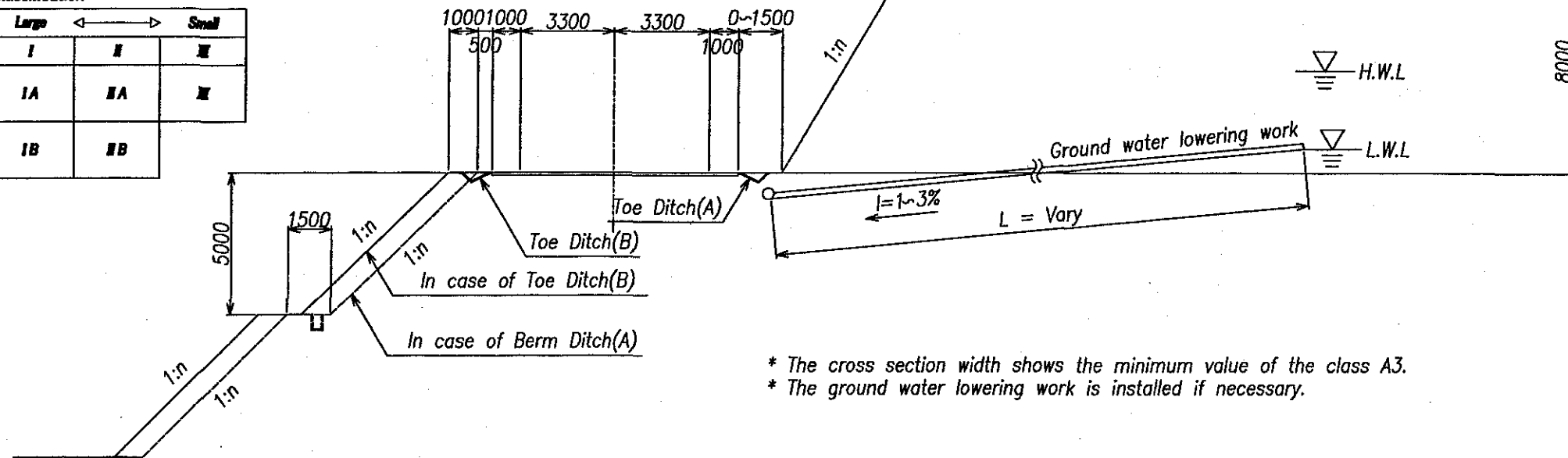
Recommendable Cut Slope Standard in Nicaragua

Classification	Height of cut (m)	Degree of Cut θ (°)	1/tan θ	n	:	1
hard rock	$10 \geq H$	80	0.1763	0.2	:	1
	$10 < H \leq 20$	80	0.1763	0.2	:	1
	$20 < H \leq 30$	80	0.5774	0.6	:	1
	$H > 30$	80	0.5774	0.6	:	1
soft rock	$10 \geq H$	65	0.4663	0.5	:	1
	$10 < H \leq 20$	65	0.4663	0.5	:	1
	$20 < H \leq 30$	55	0.7002	0.8	:	1
	$H > 30$	55	0.7002	0.8	:	1
soil/sand	$10 \geq H$	60	0.5774	0.8	:	1
	$10 < H \leq 20$	60	0.5774	0.8	:	1
	$20 < H \leq 30$	50	0.8391	1.0	:	1
	$H > 30$	50	0.8391	1.0	:	1
soil/sand	$10 \geq H$	55	0.7002	0.8	:	1
	$10 < H \leq 20$	55	0.7002	0.8	:	1
	$20 < H \leq 30$	45	1.0000	1.0	:	1
	$H > 30$	45	1.0000	1.0	:	1
soil/sand	$10 \geq H$	45	1.0000	1.0	:	1
	$10 < H \leq 20$	40	1.1918	1.2	:	1
	$20 < H \leq 30$	35	1.4281	1.5	:	1
	$H > 30$	30	1.7321	1.8	:	1



Concept for Rock Classification

Rock Quality Classification according to Hardness	Large ← → Small		
	I	II	III
Rock Quality Classification according to Decrease in Strength	A	IIA	III
Large	B	IB	IIIB
Small			



* The cross section width shows the minimum value of the class A3.
 * The ground water lowering work is installed if necessary.

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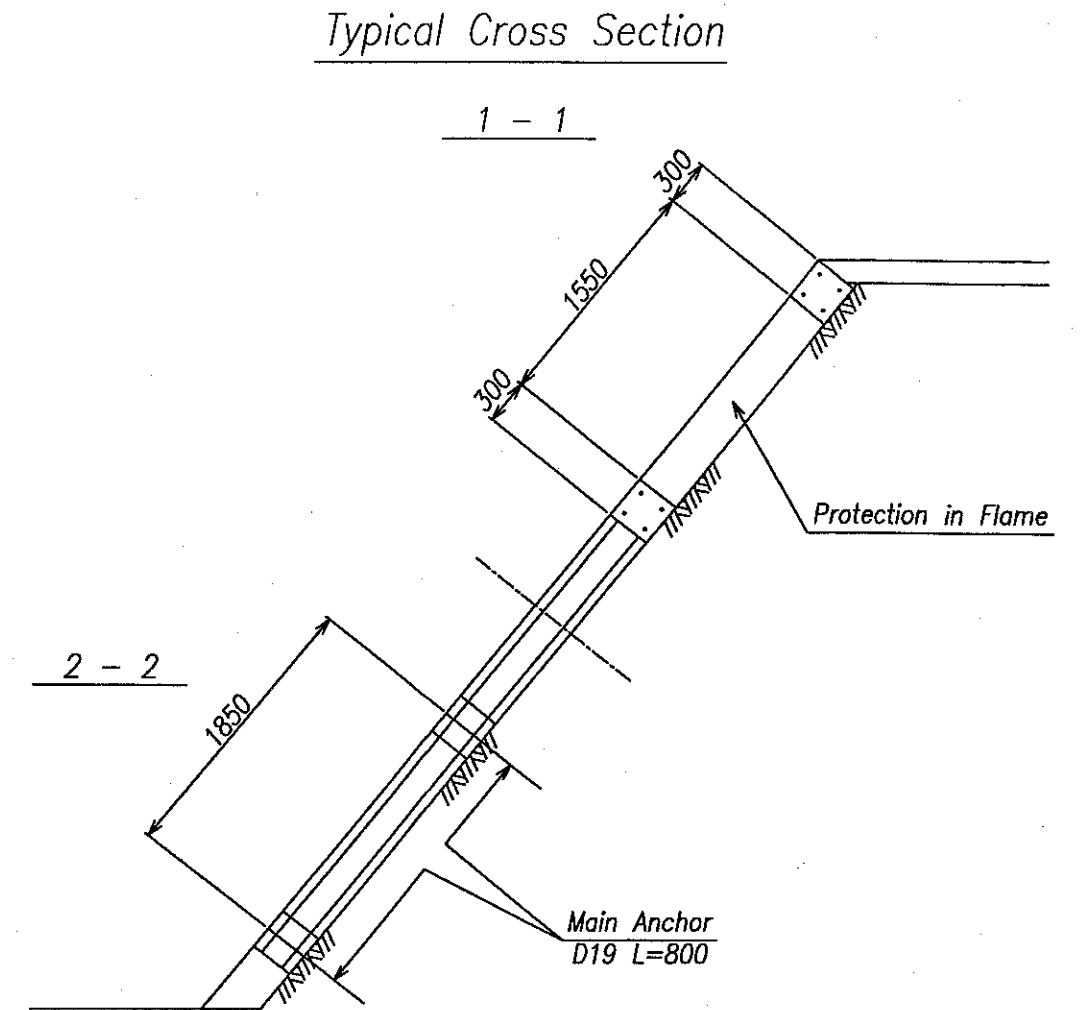
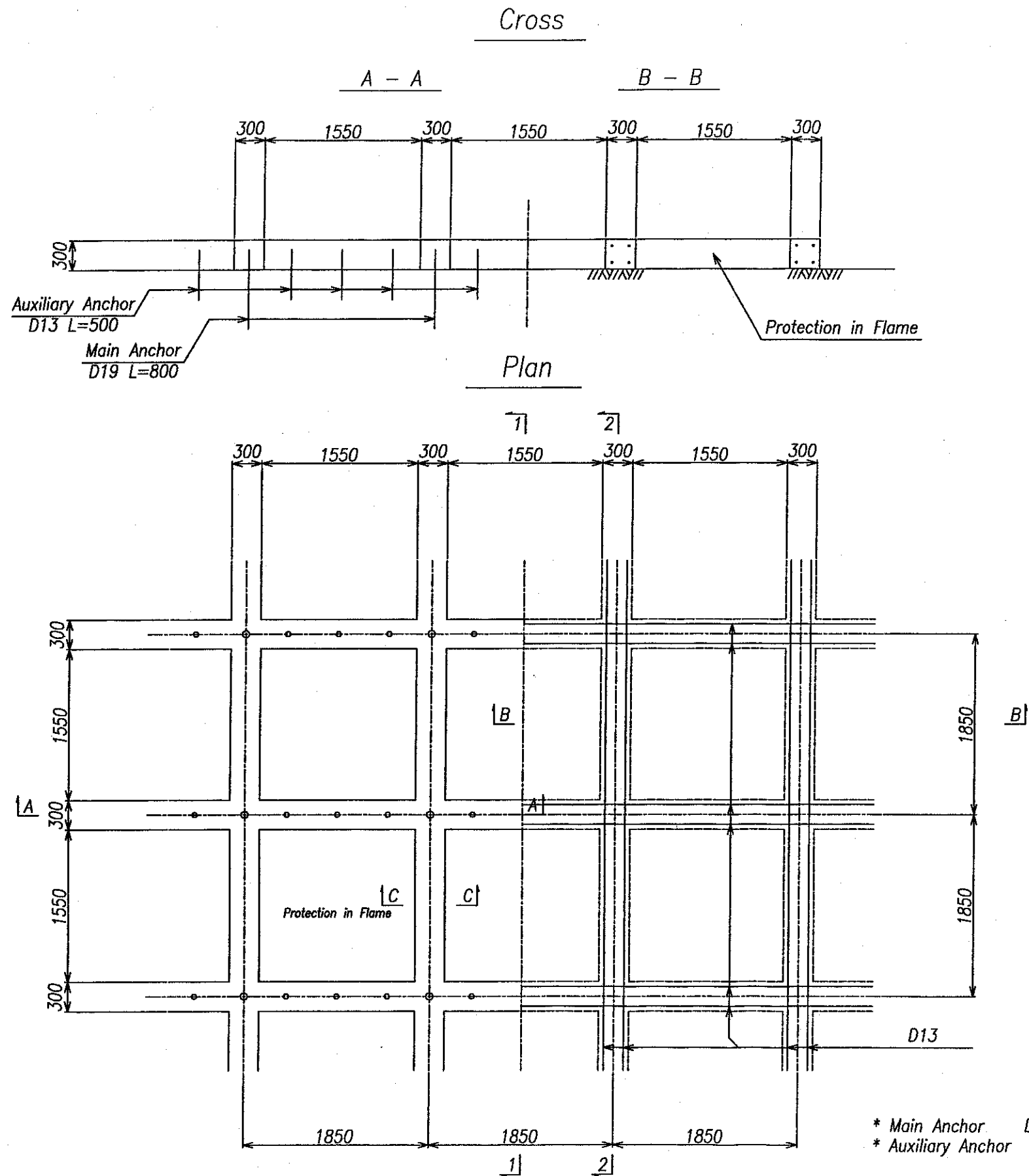
CONTENIDO:
 UBICACION:
 SITIO:

PROYECTO:
 STUDY OF VULNERABILITY REDUCTION FOR MAJOR ROADS
 IN THE REPUBLIC OF NICARAGUA

CALCULO:
 LEVANTO:
 RESPONSABLE TECNICO:

DEBIDO:
 FECHA:
 ESCALA:

General Layout of Concrete Cribwork



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JAPAN ENGINEERING CONSULTANTS
CO., LTD.

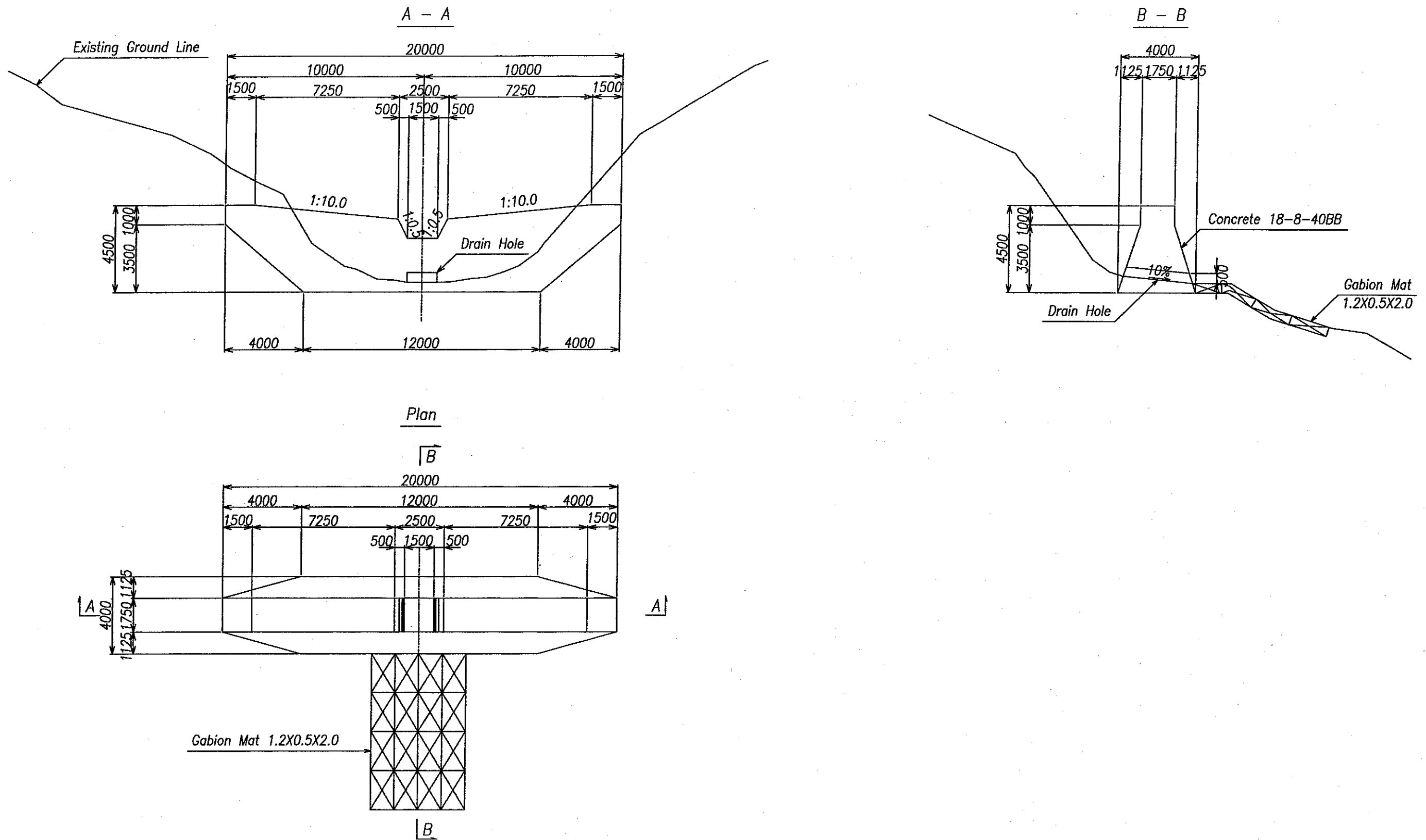
CONTENIDO:	
UBICACION:	
SITIO:	

PROYECTO:

**STUDY OF VULNERABILITY REDUCTION FOR MAJOR ROADS
IN THE REPUBLIC OF NICARAGUA**

CALCULO:	DIBUJO:	Hoja N°
LEVANTO:	FECHA: November 2002	7
RESPONSABLE TECNICO:	ESCALA: S = 1:50	16

General Layout of Simple Dam



ORIENTAL CONSULTANTS CO., LTD.
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CONTENIDO:
UBICACION:
SITIO:

PROYECTO:

STUDY OF VULNERABILITY REDUCTION FOR MAJOR ROADS
IN THE REPUBLIC OF NICARAGUA

CALCULO:
LEVANTO:
RESPONSABLE TECNICO:

DIBUJO:
FECHA:
ESCALA:

November 2002
Illustration

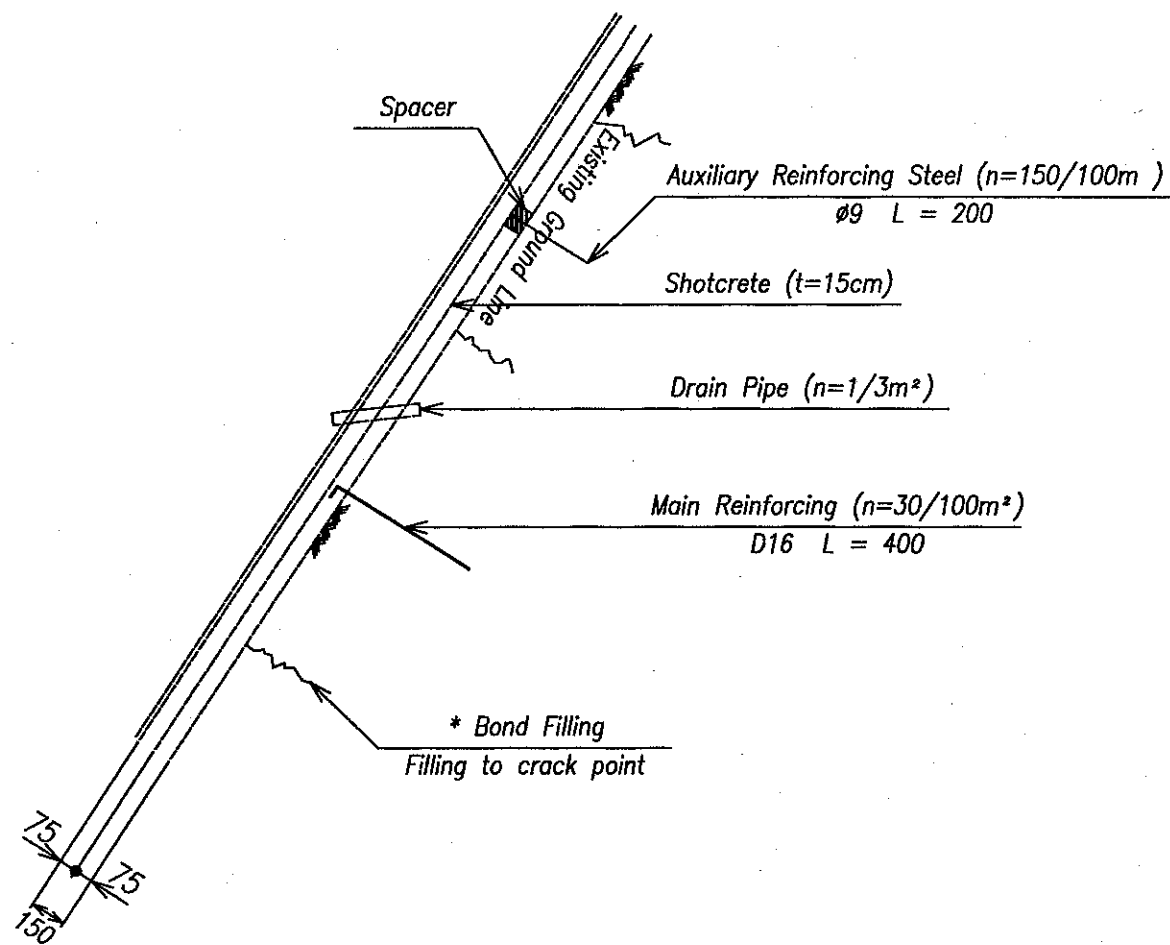
HOJA N°

8

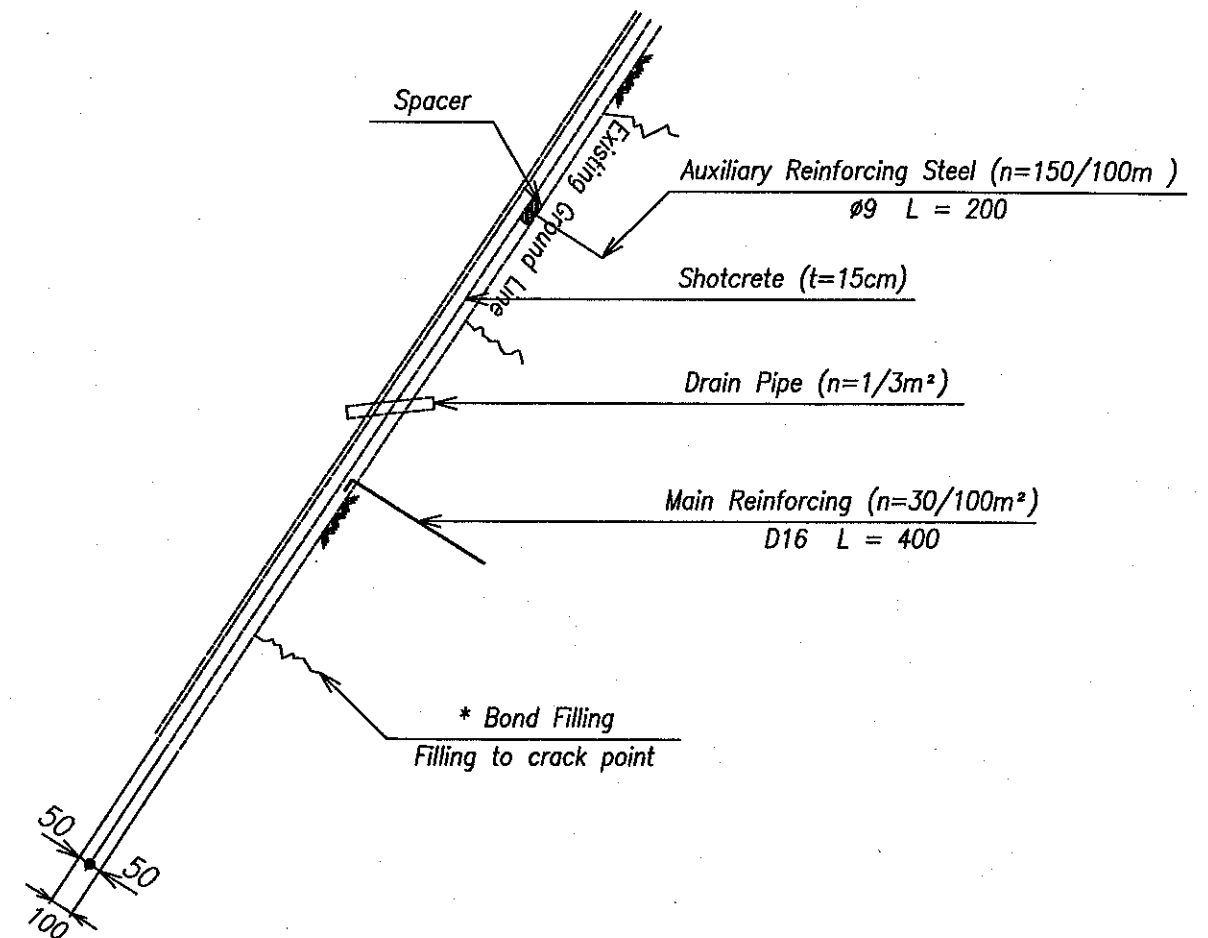
16

General Layout of Shotcrete

Shotcrete(Unevenness Point)



Shotcrete(Flatness Point)



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CO., LTD.

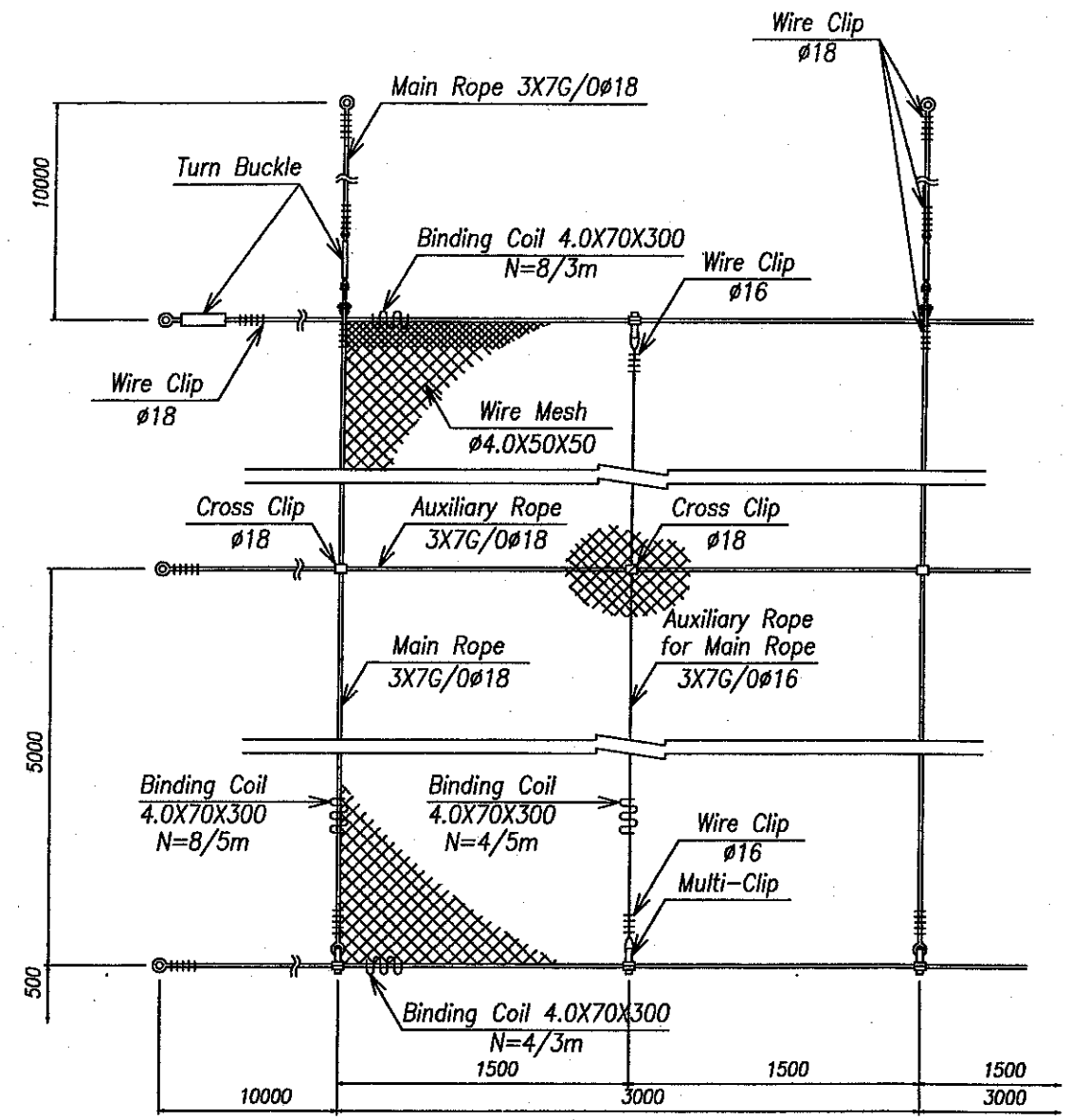
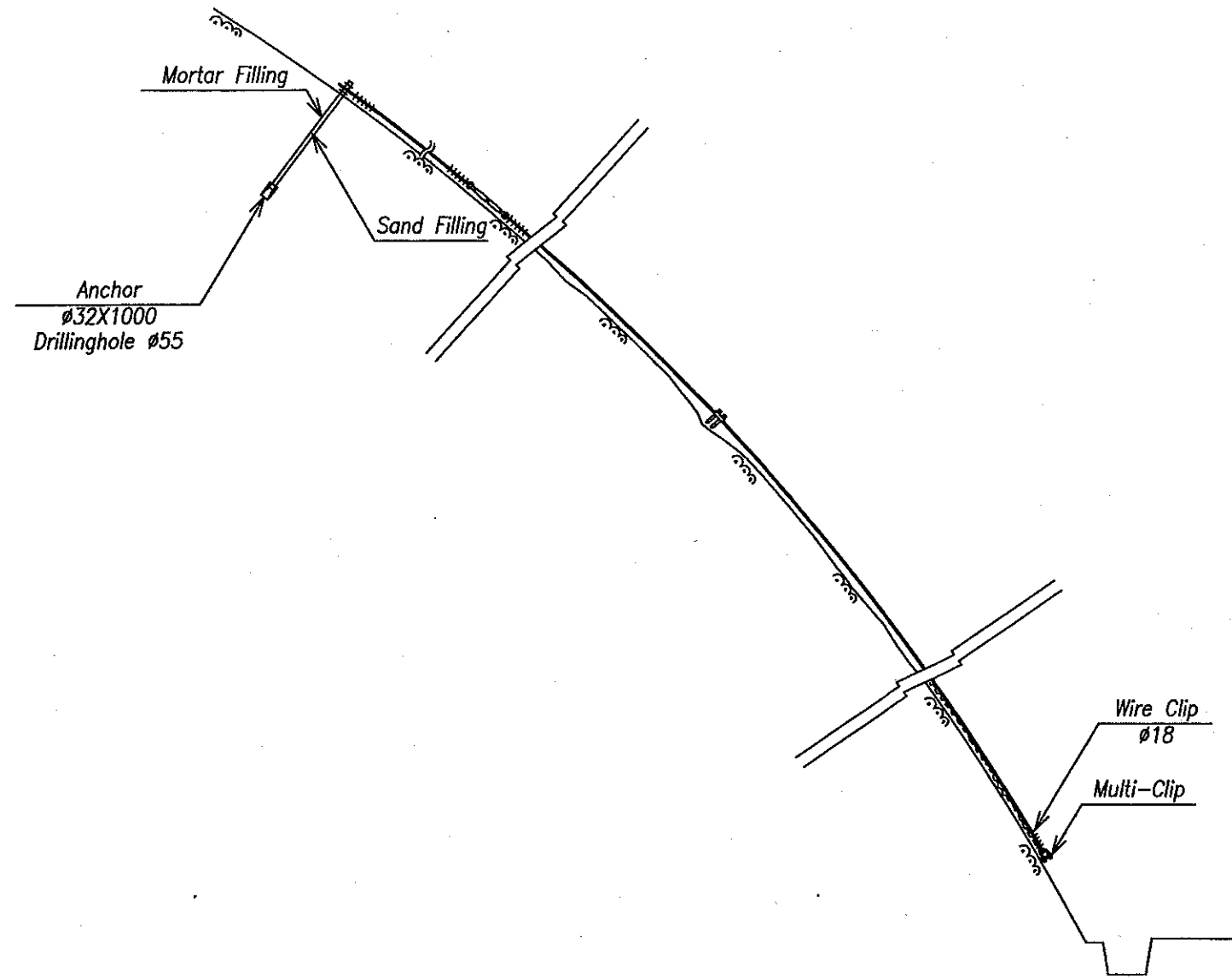
CONTENIDO:	
UBICACION:	
SITIO:	

PROYECTO:

STUDY OF VULNERABILITY REDUCTION FOR MAJOR ROADS
IN THE REPUBLIC OF NICARAGUA

CALCULO:	DEBIDO:	HOJA N°
LEVANTO:	FECHA: November 2002	9
RESPONSABLE TECNICO:	ESCALA: S = 1:30	16

General Layout of Prevention Net



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CONTENIDO:	PROYECTO:
UBICACION:	
SITIO:	

STUDY OF VULNERABILITY REDUCTION FOR MAJOR ROADS
IN THE REPUBLIC OF NICARAGUA

CALCULO:	DISEÑO:	HOJA N°
LEVANTO:	FECHA:	10
RESPONSABLE TÉCNICO:	ESCALA:	16

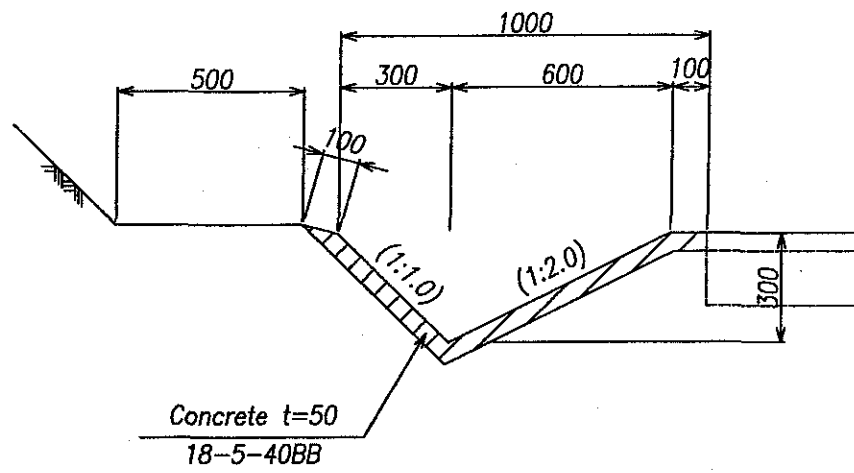
November 2002

S = 1:200

General Layout of Drainage Work (1/2)

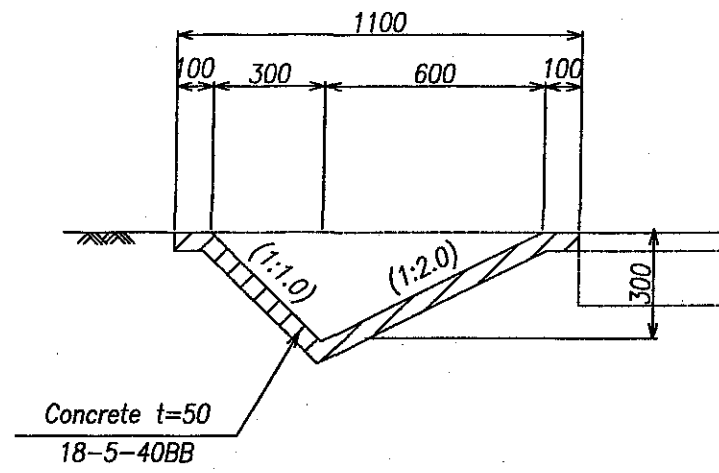
Toe Ditch(A)

S=1:20
*For Cut



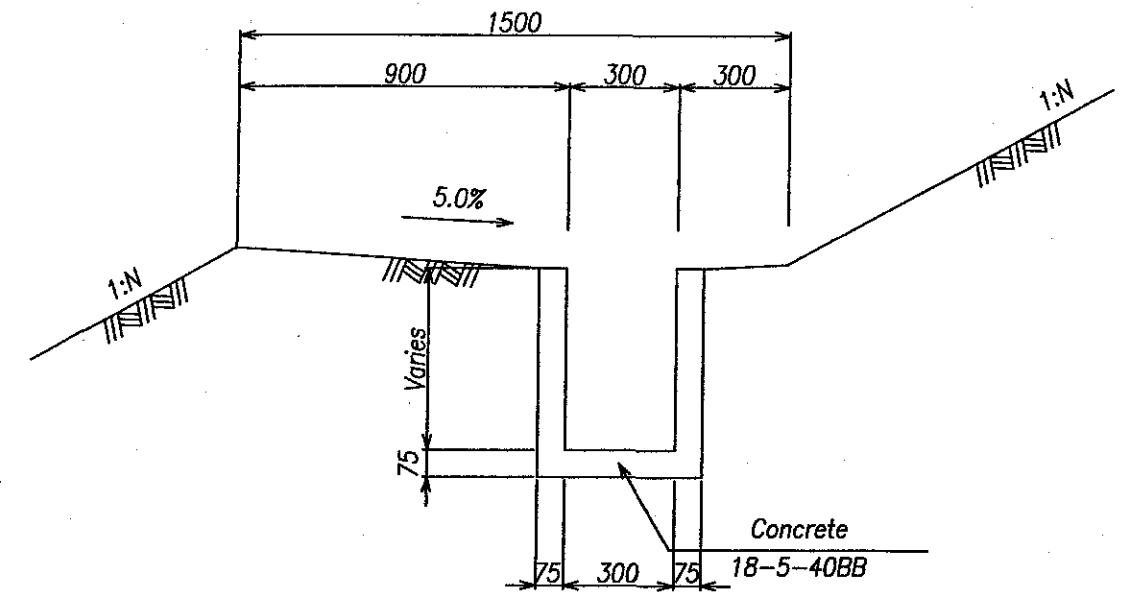
Toe Ditch(B)

S=1:20
*For Embankment



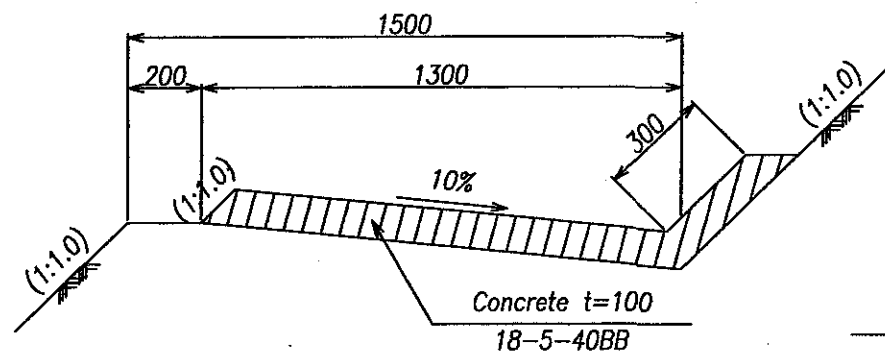
Drainage Ditch on Berm(A)

S=1:20
*For Cut of Soft Rock



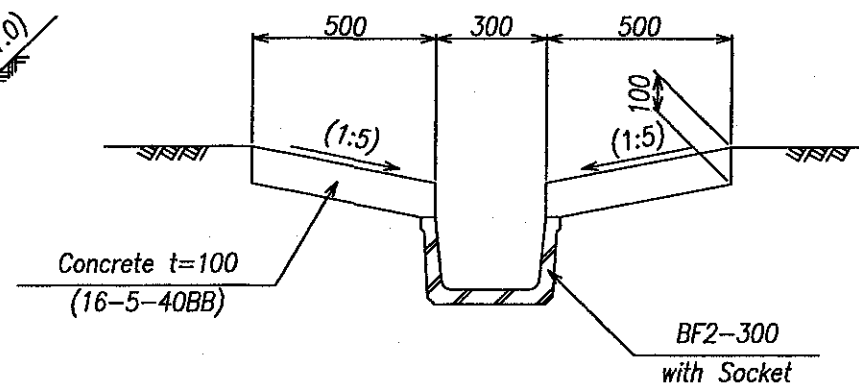
Drainage Ditch on Berm(B)

S=1:20
*For Cut for Hard Rock



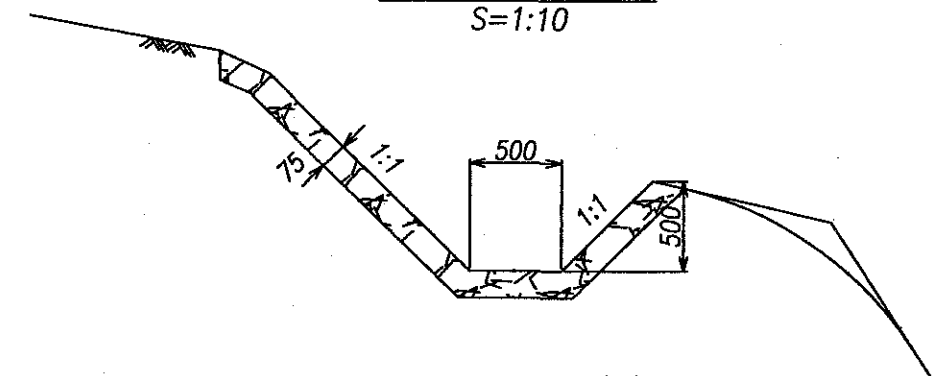
Vertical Ditch

S=1:20



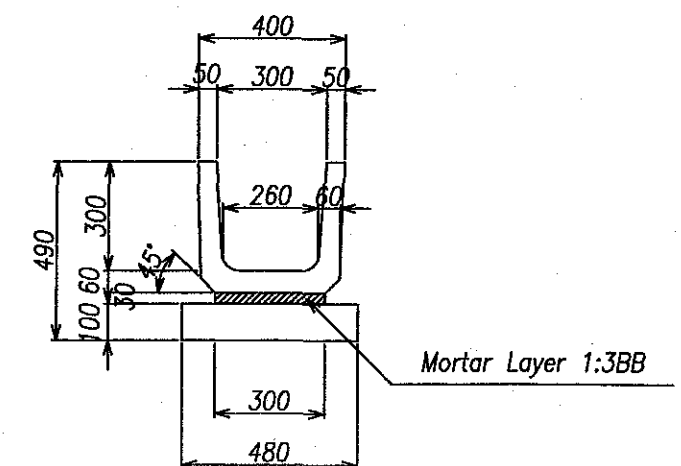
Crest Ditch(A)

S=1:10



Crest Ditch(B)

S=1:20



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CONTENIDO:
UBICACION:
SITIO:

PROYECTO:

STUDY OF VULNERABILITY REDUCTION FOR MAJOR ROADS
IN THE REPUBLIC OF NICARAGUA

CALCULO:

LEVANTO:
RESPONSABLE
TECNICO:

DEBUIO:

FECHA:
November 2002

ESCALA:
Illustration

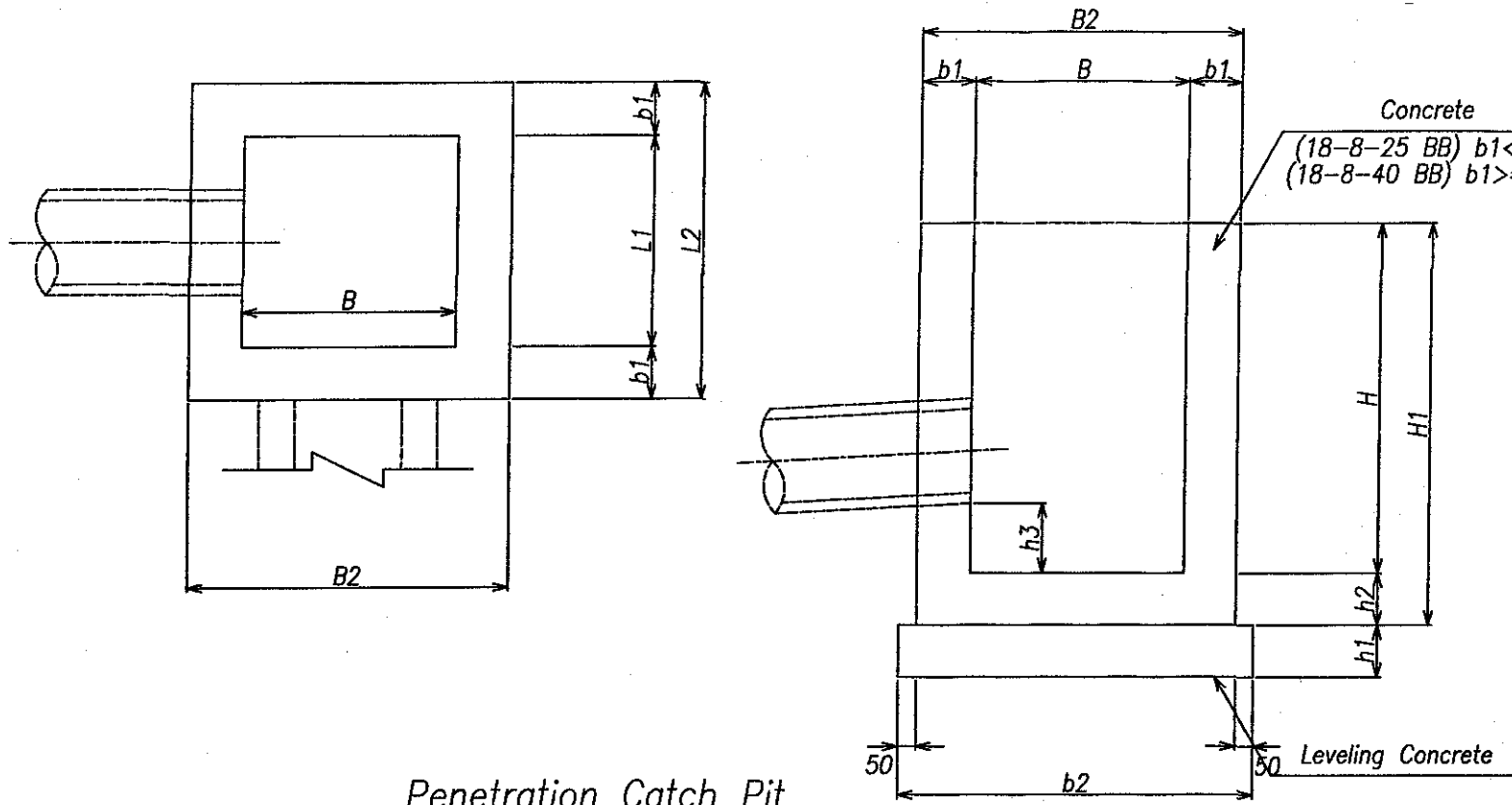
HOJA N°

11

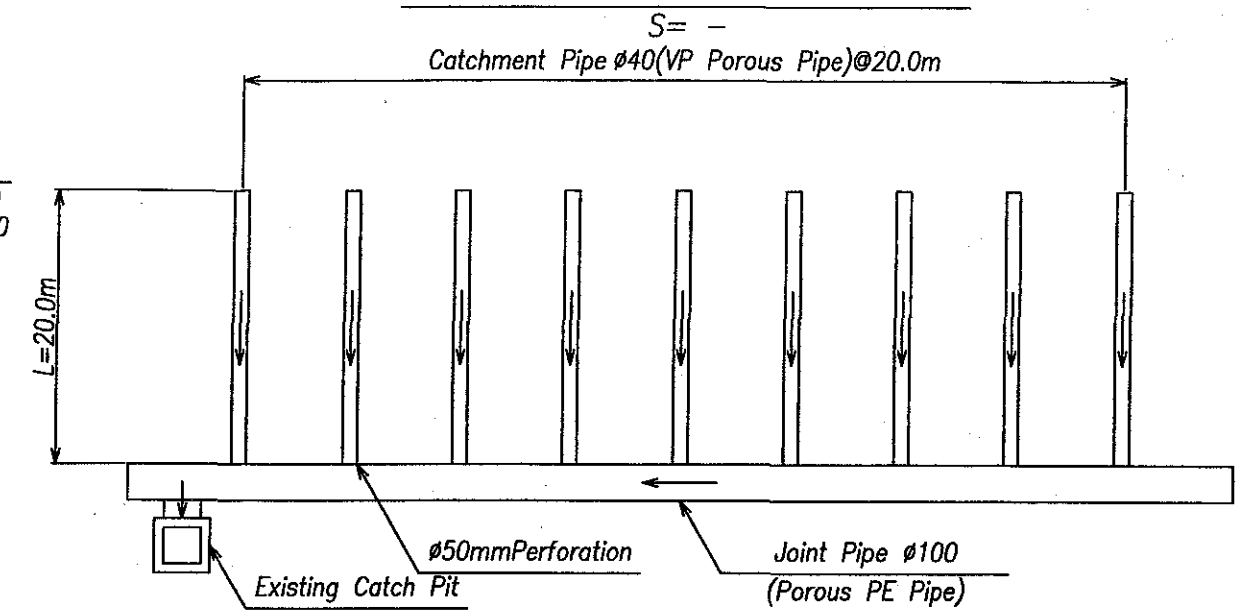
16

General Layout of Drainage Work (2/2)

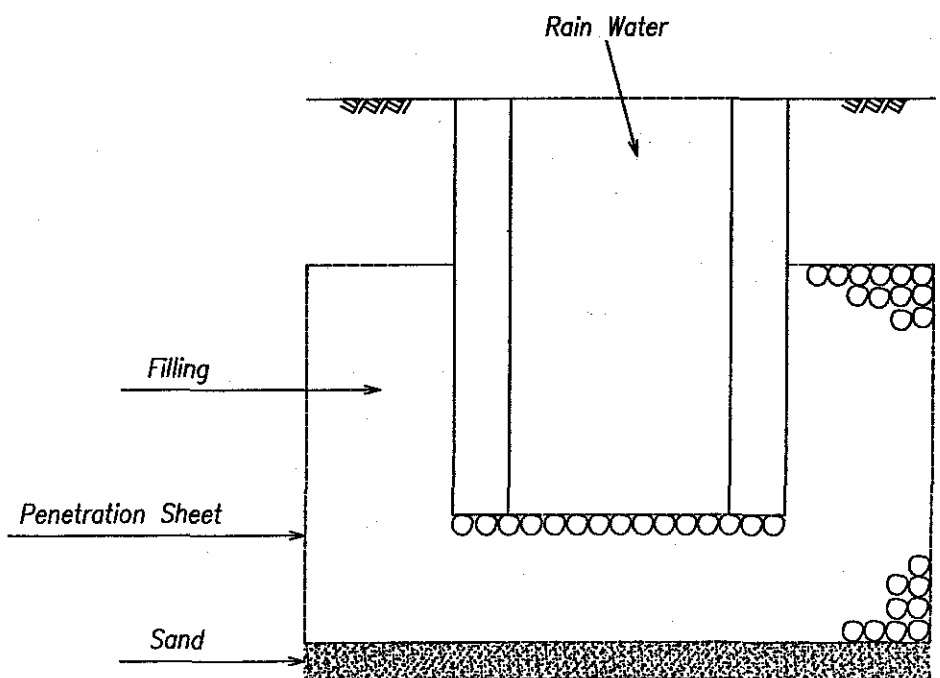
Catch Pit
S=1:20



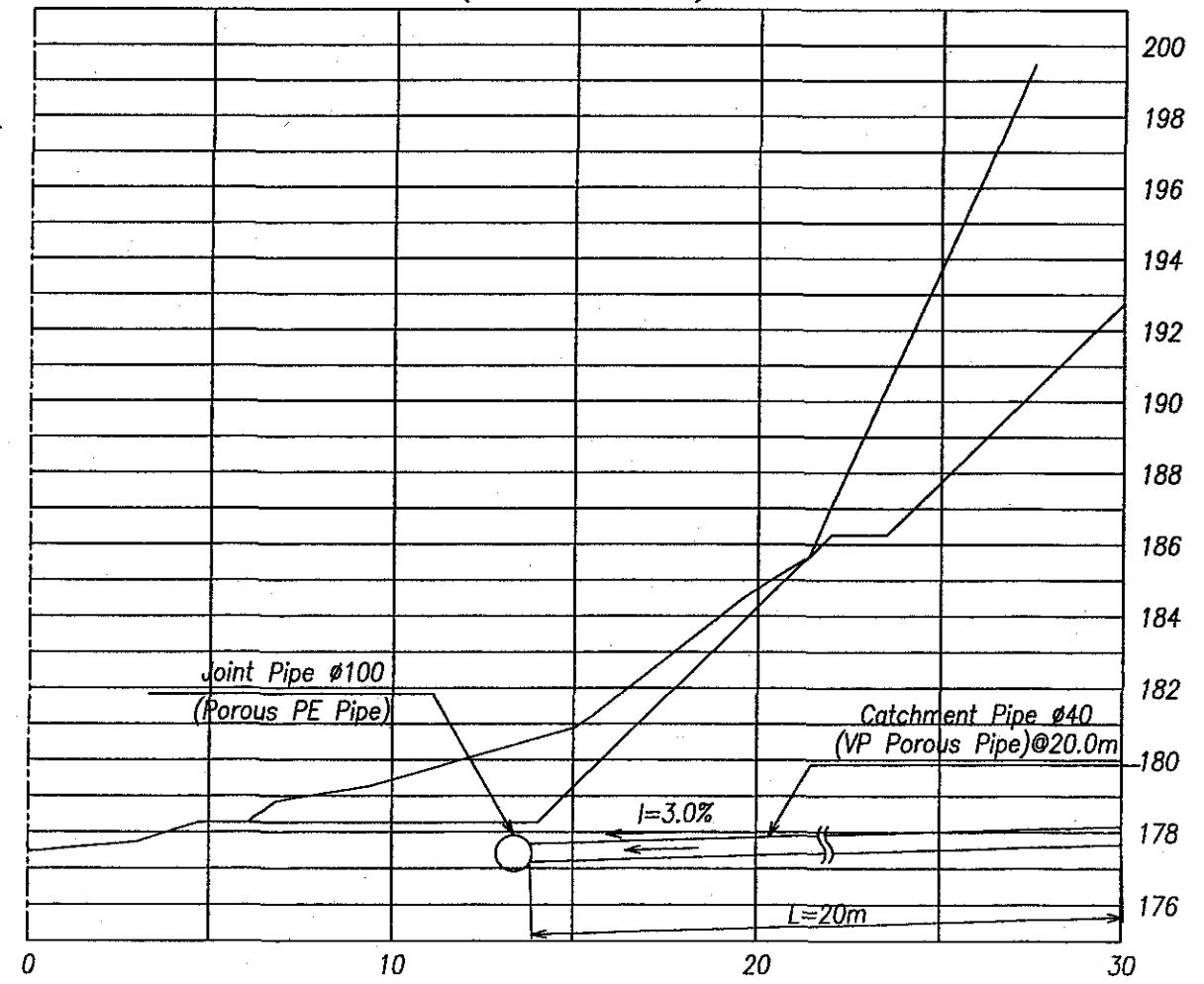
Horizontal Drain Hole



Penetration Catch Pit
S=1:20



166+122 (SECTION N°3) S=1:10



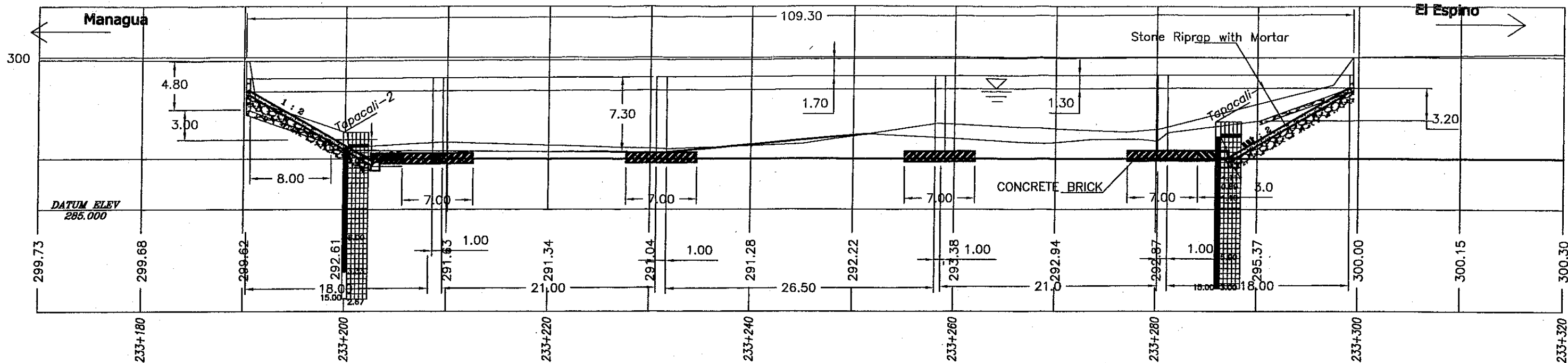
ORIENTAL CONSULTANTS CO., LTD.
JAPAN ENGINEERING CONSULTANTS
CO., LTD.

CONTENIDO:	PROYECTO:
UBICACION:	
SITIO:	

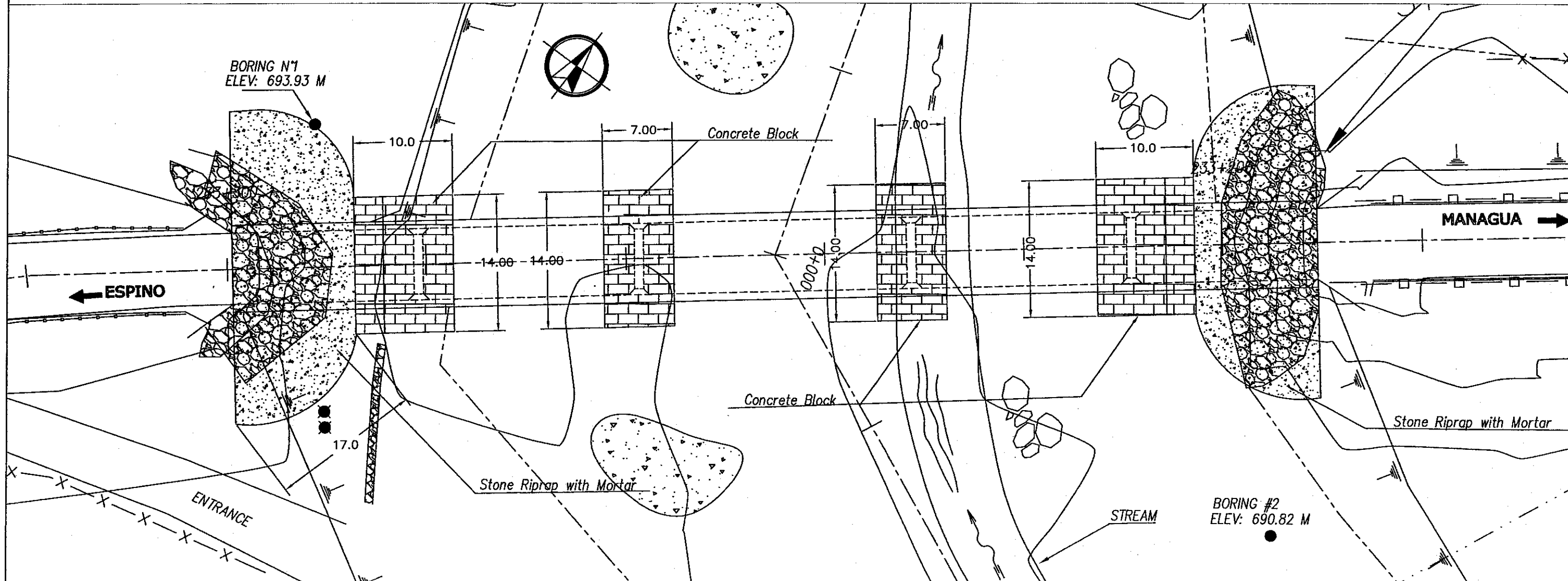
STUDY OF VULNERABILITY REDUCTION FOR MAJOR ROADS
IN THE REPUBLIC OF NICARAGUA

CALCULO:	DEBIDA:	HOJA N°
LEVANTO:	FECHA:	12
RESPONSABLE TECNICO:	ESCALA:	16
	Illustration	

Tapacali bridge



CROSS SECTION ALONG CENTER LINE OF HIGHWAY
SCALE HOR: 1:400 ; VER: 1:400



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 CO., LTD.

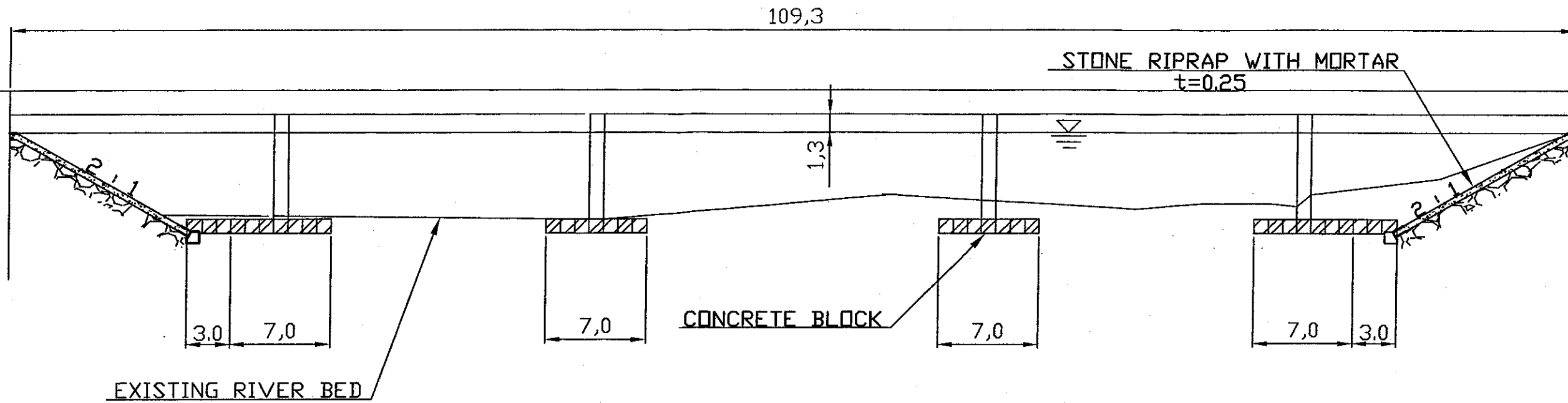
CONTENIDO: LEVANTAMIENTO TOPOGRAFICO
 UBICACION: KM 233+245 CARRETERA MANAGUA - EL ESPINO
 SITIO: PUENTE TAPACALI (NIC 1)

PROYECTO: STUDY OF VULNERABILITY REDUCTION FOR MAJOR ROADS
 IN THE REPUBLIC OF NICARAGUA

CALCULO: Ch. Rivera, C.
 LEVANTO: Mauricio Méndez
 RESPONSABLE TECNICO:

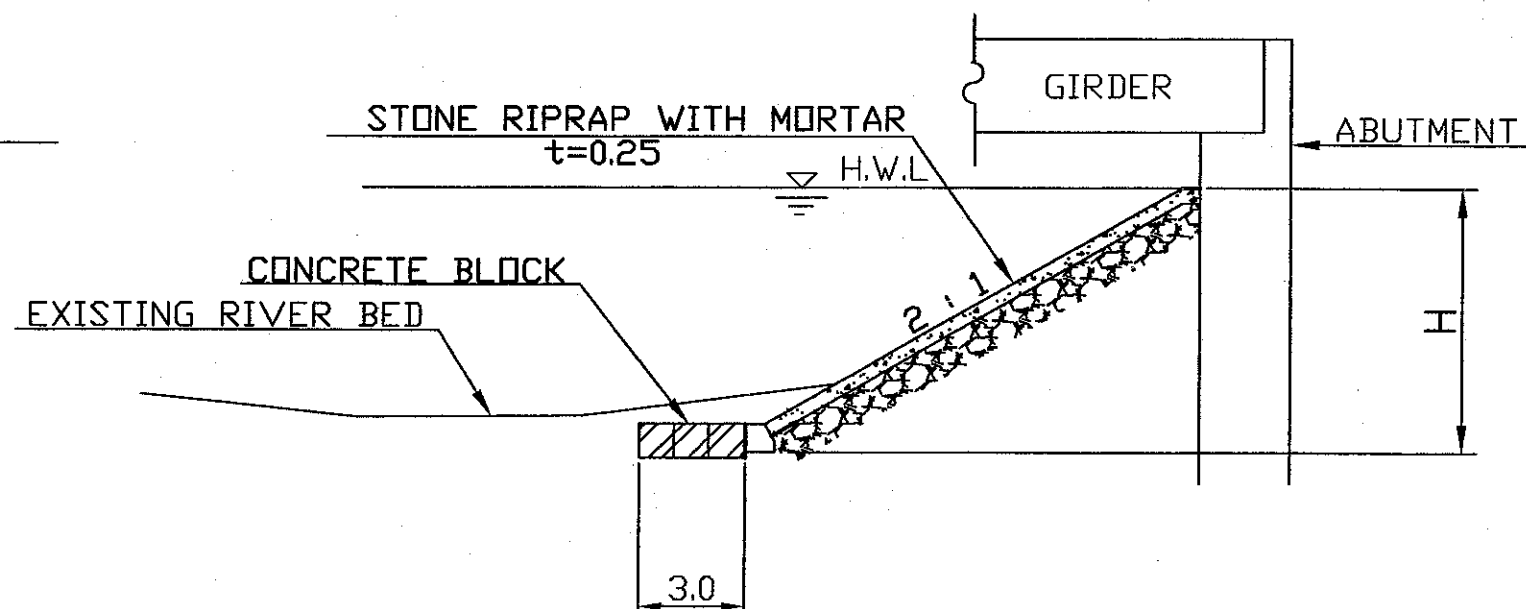
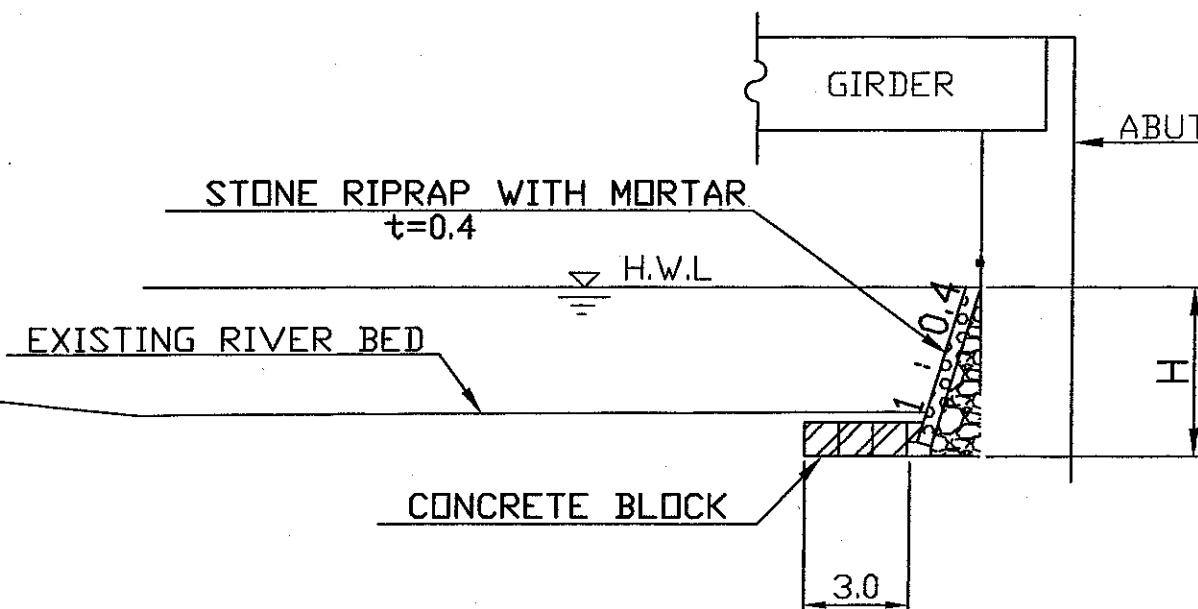
DIBUJO: Ch. Rivera, C.
 FECHA: 13
 ESCALA: 1:200
 HOJA N°: 16

General Layout of Protection for Scouring



$H \leq 5m$

$H > 5m$



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CONTENIDO:
UBICACION:
SITIO:

PROYECTO:

STUDY OF VULNERABILITY REDUCTION FOR MAJOR ROADS
IN THE REPUBLIC OF NICARAGUA

CALCULO:

LEVANTO:
RESPONSABLE
TECNICO:

DEBIDO:
FECHA:
ESCALA:

HOJA N°

14

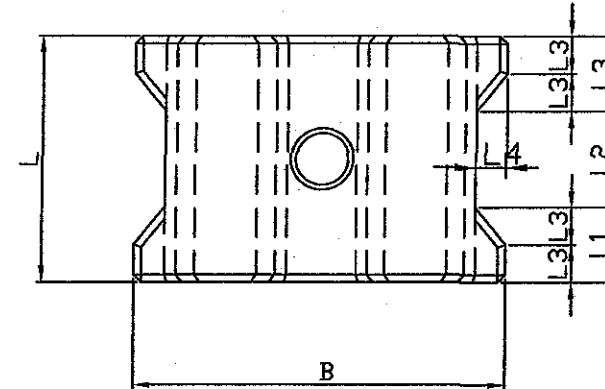
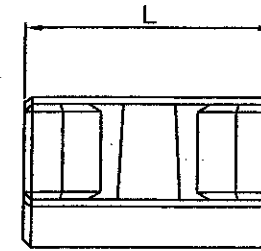
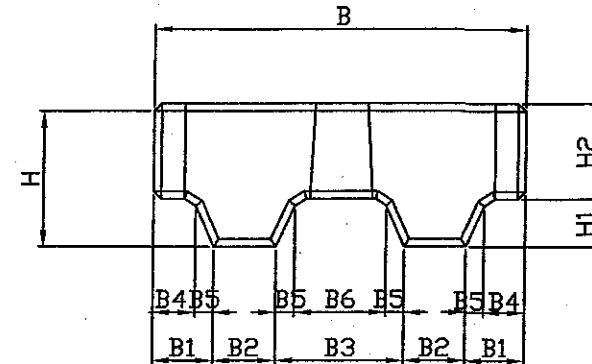
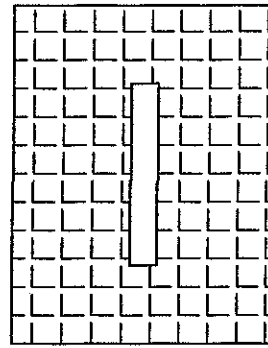
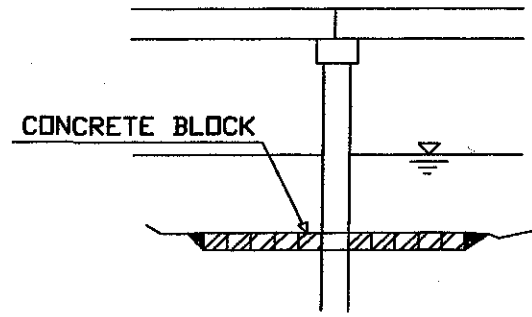
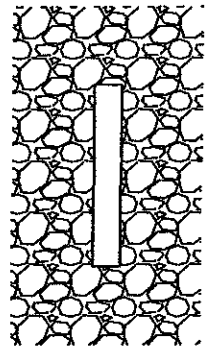
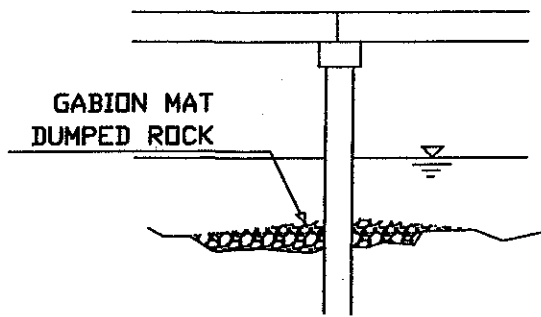
16

General Layout of Protection for Scouring Around Pier

Flow Velocity ≤ 2 m/sec

Flow Velocity ≤ 2 m/sec

Detail of Concrete Block



Size of Concrete Block

	1t	2t	3t	4t	6t
B	1250	1550	1800	1950	2250
B1	200	250	290	315	360
B2	210	260	300	325	380
B3	430	530	620	670	770
B4	125	160	180	200	235
B5	75	90	110	115	125
B6	280	350	400	440	520
L	850	1050	1210	1330	1500
L1	260	320	370	410	460
L2	330	410	470	510	580
L3	130	160	185	205	230
L4	100	130	145	160	190
H	520	650	750	820	940
H1	160	200	240	260	300
H2	360	450	510	560	640

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CONTENIDO:
UBICACION:
SITIO:

PROYECTO:

STUDY OF VULNERABILITY REDUCTION FOR MAJOR ROADS
IN THE REPUBLIC OF NICARAGUA

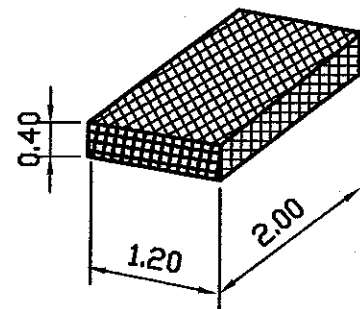
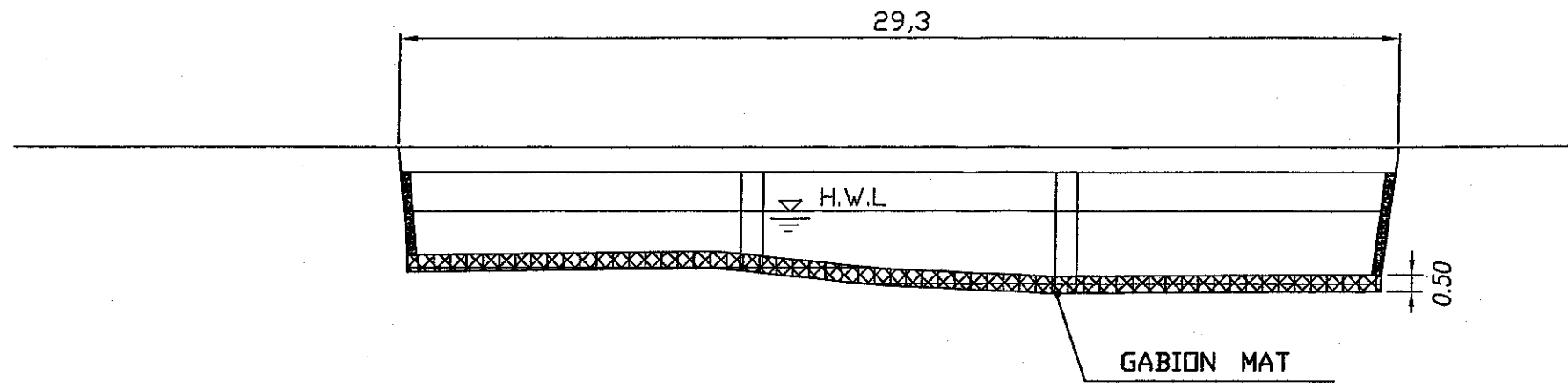
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DIBUJO:
LEVANTO:
RESPONSABLE TECNICO:

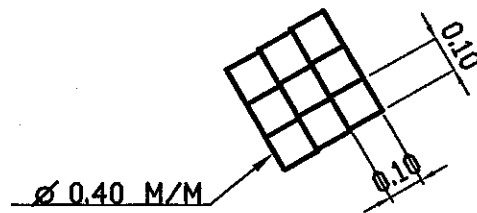
FECHA:
ESCALA:

HOJA N°
15
16

General Layout of Protection for Scouring by Gabion Mat



GABION MAT



DETAIL OF WIRE MESH

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UBICACION:	
SITIO:	

PROYECTO:

STUDY OF VULNERABILITY REDUCTION FOR MAJOR ROADS
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CALCULO:

LEVANTO:	DIBUJO:	HOJA N°
RESPONSABLE TECNICO:	FECHA:	16
	ESCALA:	16

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