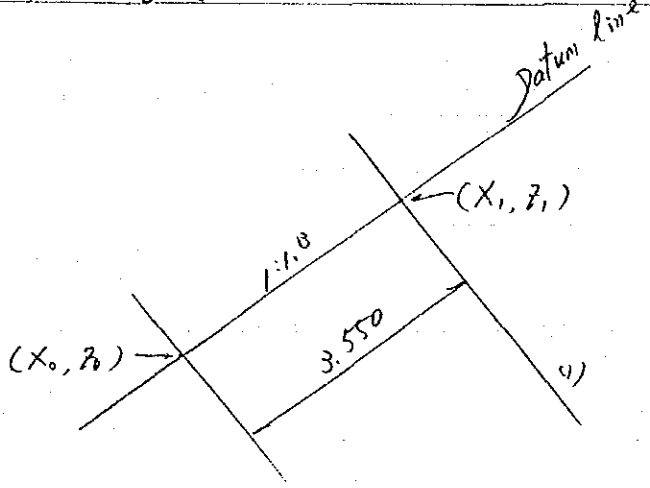
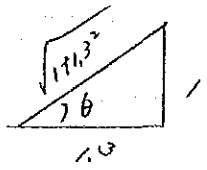
No. 3 Intake





$\theta = \tan^{-1}\frac{1}{1.3} = 37.5886°$

$\cos\theta = \frac{1.3}{\sqrt{1+1.3^2}}$

$\sin\theta = \frac{1}{\sqrt{1+1.3^2}}$

Datum : $Z = \frac{1}{1.3}(X - X_0) + Z_0$

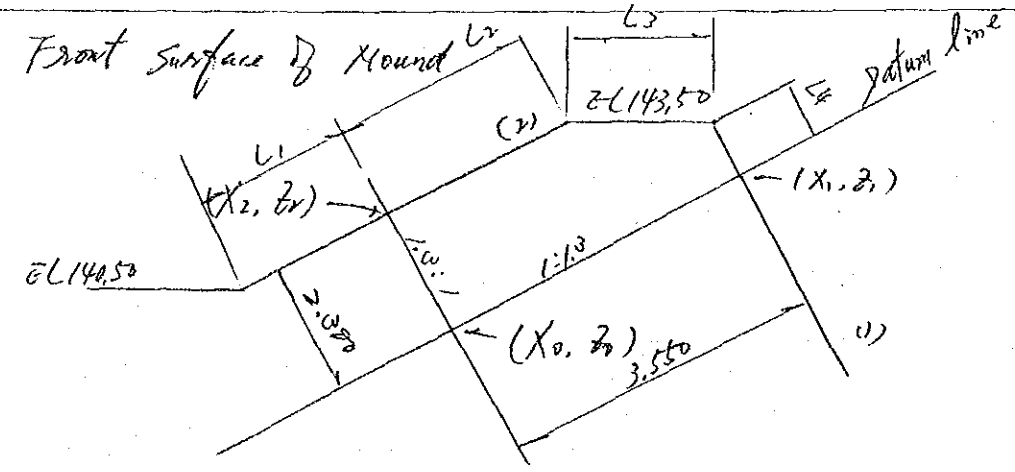
U) : $Z = -1.3(X - X_1) + Z_1$

$X_1 = X_0 + 3.550 \cdot \cos\theta = -1.383$

$Z_1 = Z_0 + 3.550 \cdot \sin\theta = EL\ 142.592$

∴ U) line : $Z = -1.3(X - X_1) + Z_1$

$Z = EL\ 138.0$	$X = 2.1486$
$Z = 138.5$	$X = 1.7634$
$Z = 140.5$	$X = 0.2249$
$Z = 143.5$	$X = -2.0827$



$$X_2 = X_0 - 2.300 \cdot \sin\theta = -5.5998$$

$$Z_2 = Z_0 + 2.300 \cdot \cos\theta = EL\,142.2498$$

$\therefore$ (2) line : $\quad Z = \frac{1}{1.3}(X - X_2) + Z_2$

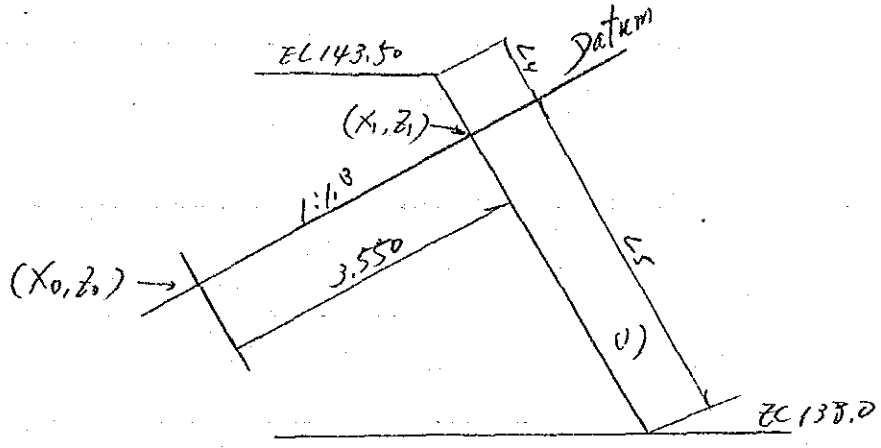
$Z = 140.50 \qquad X = -7.8745$

$Z = 143.50 \qquad X = -3.9745$

$L_1 = \sqrt{1+1.3^2}\,(Z_1 - 140.5) = 2.8698$

$L_2 = \quad " \quad (143.5 - Z_2) = 2.0505$

$L_3 = -2.0827 + 3.9745 = 1.8918$



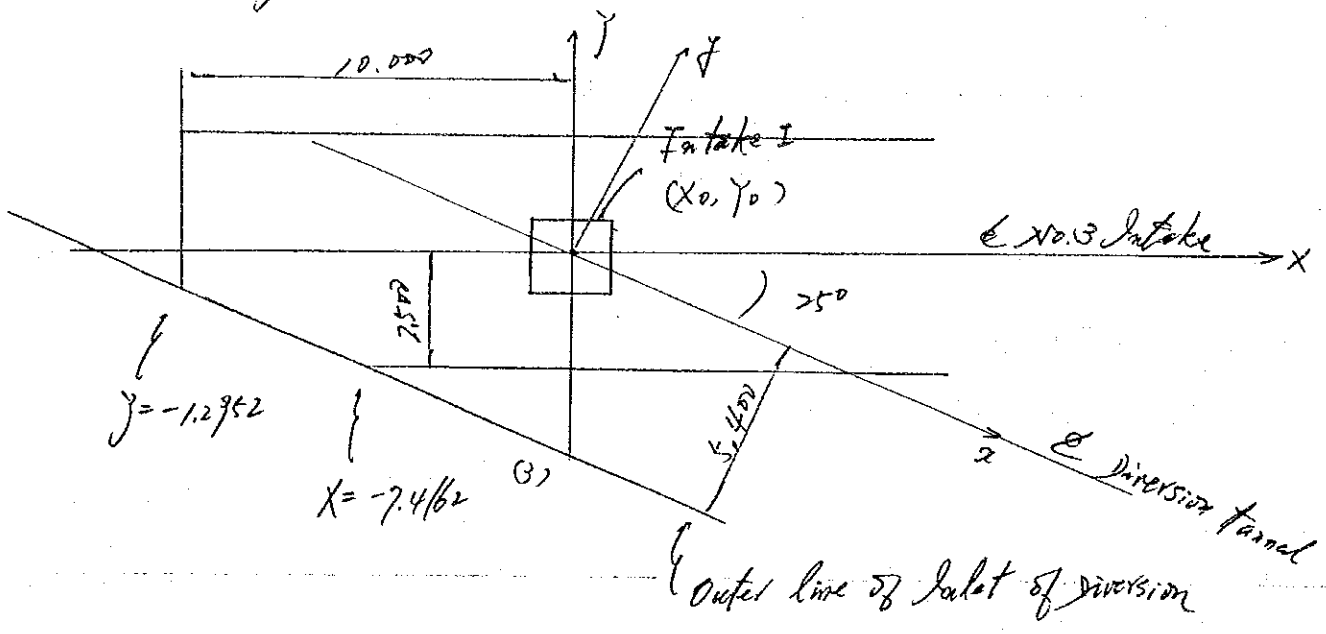
(1) line : $Z = -1.0(X - X_1) + Z_1$ $X_1 = -1.383$

$Z_1 = EL\ 142.5912$

$L_4 = (143.50 - Z_1) \cdot \mathrm{Arc}\theta = 1.1466$

$L_5 = (Z_1 - 138.0) \cdot \mathrm{Arc}\theta = 5.7924$

Plan just on EL 138.0



(3) line : $y = -5.400$

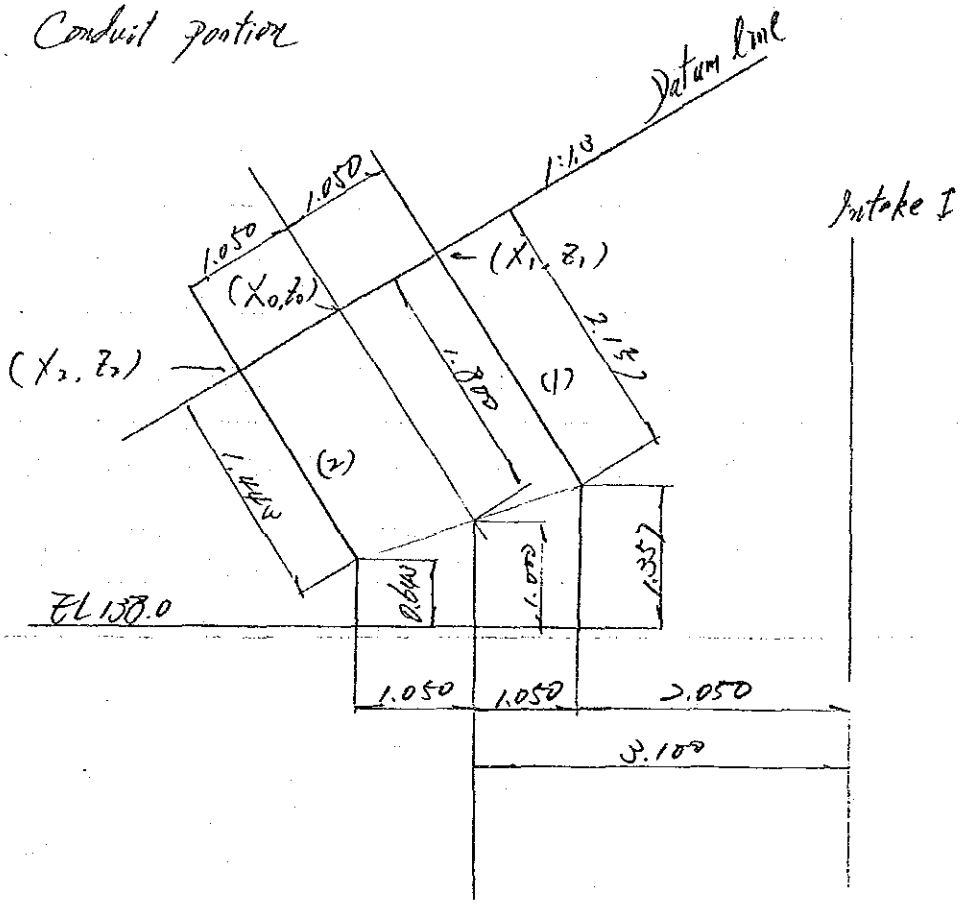
$$\begin{pmatrix} X \\ Y \end{pmatrix} = \begin{pmatrix} \cos 25 & -\sin 25^\circ \\ \sin 25^\circ & \cos 25^\circ \end{pmatrix} \cdot \begin{pmatrix} X \\ Y \end{pmatrix}$$

$$y = \sin 25^\circ X + \cos 25^\circ Y = -5.400$$

$$Y = -\tan 25^\circ X - 5.400 / \cos 25^\circ$$
$$X = -\cot 25^\circ \cdot Y - 5.400 / \sin 25^\circ$$

$X = -10.000 \longrightarrow Y = -1.295\,62$
$Y = -2.500 \longrightarrow X = -7.416\,2$

Conduit portion



$$X_1 = X_0 + 1.050 \cdot \cos\theta = -3.3652$$

$$Z_1 = Z_0 + 1.050 \cdot \sin\theta = EL\ 141.0669$$

$$X_2 = X_0 - 1.050 \cdot \cos\theta = -5.0287$$

$$Z_2 = Z_0 - 1.050 \cdot \sin\theta = EL\ 139.1865$$

∴ (1) line : $Z = -1.3(X - X_1) + Z_1$

(2) line : $Z = -1.3(X - X_2) + Z_2$

$X = -2.050 \longrightarrow Z_{(1)} = 2(138.3571)$

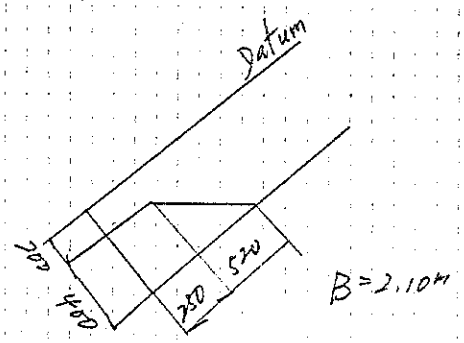
$X = -4.150 \longrightarrow Z_{(2)} = 2(138.6429)$

$$L_{(1)} = \sqrt{(-2.050 - X_1)^2 + (Z_1 - 2(138.3571))^2} = 2.1572$$

$$L_{(2)} = \sqrt{(-4.150 - X_2)^2 + (Z_2 - 2(138.6429))^2} = 1.4428$$

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
	Concrete class C			
	No.3 Intake			
	Block 1"			
	Gross Volume (See Fig on page 18 & 18')			
	$\frac{1}{2}$ (25.860+32.570) x 1.700 = 49.787 m^3			
	$\frac{1}{2}$ (32.570 + 34.098) x 0.934 = 30.778			
	$\frac{1}{2}$ (34.098 +24.636) x 2.586 = 76.237			
	156.797			
	Flow portion (See page 20)			
	$-\frac{1}{2}$ (1.667 +3.082) x 2.10 x 2.10 = -10.476			
	$-\frac{1}{2}$ (5.076 +5.878) x 2.40 x 2.10			
	+ $\frac{1}{2}$ 0.50 x 0.50 x 5.878 x 2			
	+ $\frac{1}{2}$ 0.50 x 0.50 x 5.076 x 2 = -24.868			
	-35.344 m^3			
	121.453 m^3			
	Rail support (See pages 21 ~23)			
	1.140 m^2 x 3.787 m = 4.317 m^3			
	$\frac{1}{2}$ (1.140 + 0.950) x 0.130 = 0.136			
	0.950 x 0.656 = 0.623			
	$\frac{1}{2}$ 0.950 x 0.650 = 0.308			
	5.384 m^3			
	End Sill			
	0.40 x 0.25 x 2.10 = 0.210 m^3			
	$\frac{1}{2}$ 0.40 x 0.520 x 2.10 = 0.218 m^3			
	= 1178 m^3			



Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
	Concrete c			
	No.3 Intake			
	Overhang step (Section C-C)			
	$0.30 \times 0.750 \times 5.223 = 1.175\ m^3$			
	step $3 \times \frac{1}{2} \cdot 0.20 \times 0.76 \times 0.75 = 0.176$			
	path $\frac{1}{2} \cdot 2.883 \times 1.80 \times 0.75 = 1.946\ m^3$			
	$3.297\ m^3$			
	Total (including class A)			
	Block 1' 179.278 m^3			
	Block 1" 121.453			
	Rail support 5.384			
	End sill 0.418			
	Step 3.297			
	$309.830\ m^3$			
	Class A (see page VI-4-49) -5.937			
	Concrete class C $303.891\ m^3$			

Block 1" B = 5.0 m

plane equation of 1:0.15 slope. See Fig. on next page

$$z = \frac{1}{0.15}(x - 3.300) + EL.127.0$$

$$\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} \cos 25^\circ & -\sin 25^\circ & 0 \\ \sin 25^\circ & \cos 25^\circ & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} X \\ Y \\ Z \end{pmatrix}$$

$$x = \cos 25^\circ \cdot X - \sin 25^\circ Y$$
$$y = \sin 25^\circ X + \cos 25^\circ Y$$
$$z = Z.$$

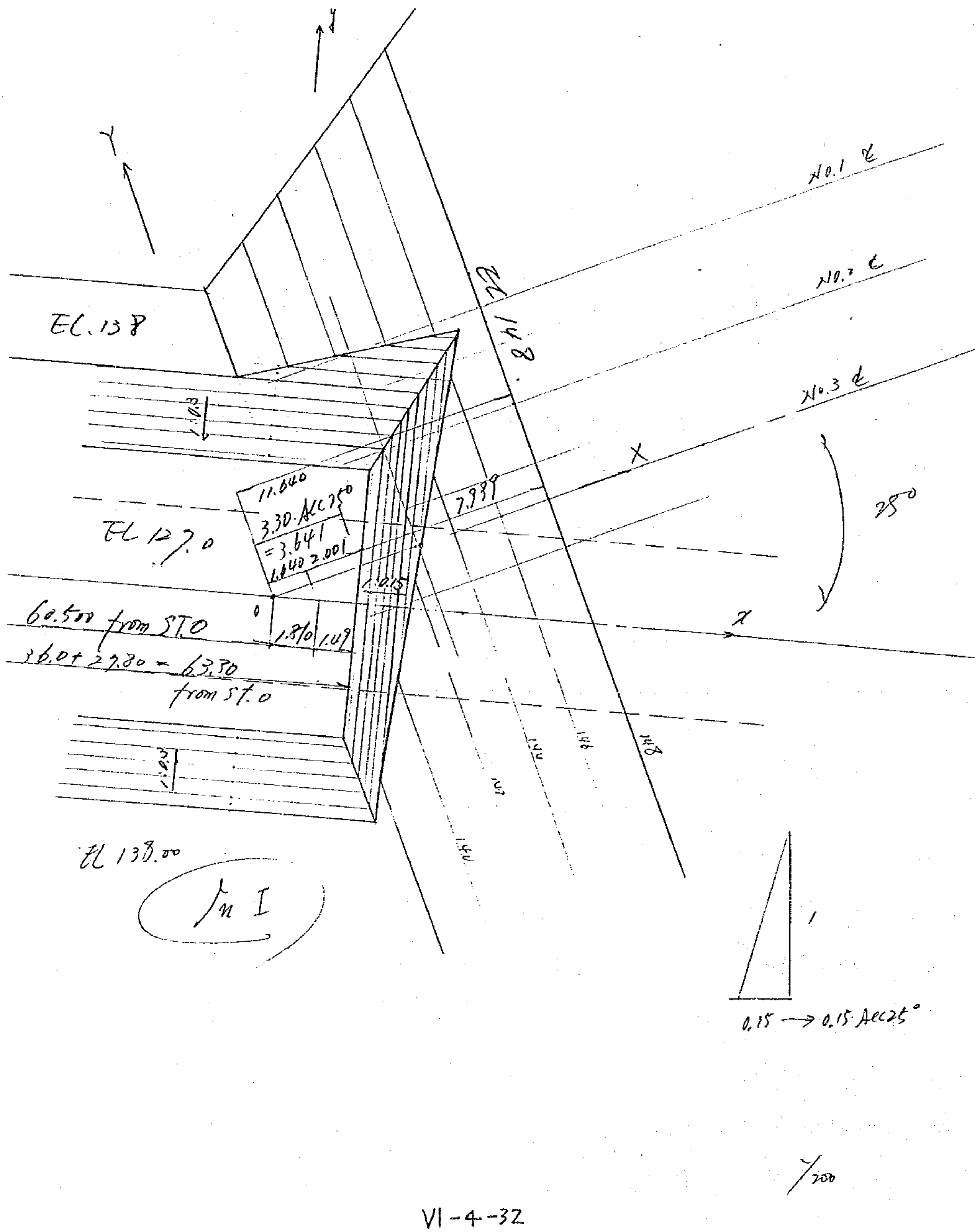
$$Z = \frac{1}{0.15}(\cos 25^\circ X - \sin 25^\circ Y - 3.300) + EL\,127.0$$

Z = EL 138.0

Y = 2.5	X = 6.6274
Y = 0.0	X = 5.4617
Y = -2.5	X = 4.2960

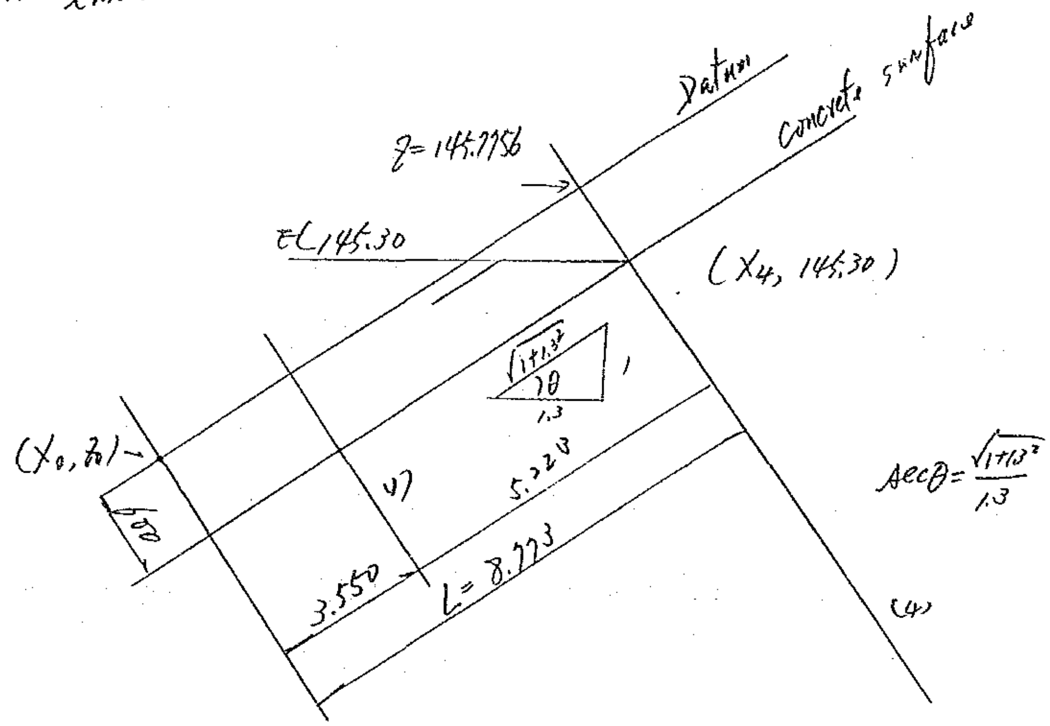
Z = EL 138.5

Y = 2.5	X = 6.7102
Y = 0.0	X = 5.5444
Y = -2.5	X = 4.3787



No.1 ℄
No.2 ℄
No.3 ℄
EL.138
EL 127.0
EL 138.00
148.8
11.040
3.30·Acc25°
=3.641
1.040 2.001
7.939
25°
X
x
Y
y
60.500 from ST.0
36.0+27.30=63.30
from ST.0
1.810
1.49
1:0.15
0.15 → 0.15·Acc25°

(4) line.



concrete surface : $z = \frac{1}{1.3}(X - X_0) + Z_0 - 0.600 \cdot \sec\theta$ (0.7570)

$z = 145.30 \qquad X_4 = 3.1218$ ✓

(4) line $\quad z = -1.3(X - X_4) + EL\,145.30$

$X = X_4 - 0.600 \cdot \sin\theta = 2.7560 \longrightarrow z = EL\,145.7756$

$L = \sqrt{(X - X_0)^2 + (z - z_0)^2} = 8.7728$ ✓

1:0.15 slope equation : $Z = \frac{1}{0.15}(\cos 25^\circ \cdot X - \sin 25^\circ \cdot Y - 3,300) + EL\ 127.0$

(4) plane : $Z = -1.3\,(X - X_4) + EL\ 145.30$

$X_4 = 8.1210$

intersection line of two planes on the XY plane

$$\frac{1}{0.15}(\cos 25^\circ X - \sin 25^\circ Y - 3,300) + EL127.0 = -1.3(X - X_4) + EL\,145.30$$

$$\cos 25^\circ \cdot X - \sin 25^\circ Y - 3,300 = -1.3 \times 0.15\,(X - X_4) + 0.15\,(145.30 - 127.0)$$

$$(\cos 25^\circ + 1.3 \times 0.15)\,X = 1.3 \times 0.15 \cdot X_4 + 0.15\,(145.30 - 127.0) + 3.300 + \sin 25^\circ Y$$

$$X = \frac{1}{1.3 \times 0.15 + \cos 25^\circ}(\sin 25^\circ \cdot Y + 6.6538) \quad \approx Y_0$$

$Y = 2.5 \quad X = 7.0010 \quad Z = EL\ 140.2570$

$Y = 0.0 \quad X = 6.0417 \quad Z = 141.5042$

~~$Y = 2.5 \quad X = 5.0823 \quad Z = 142.7513$~~

1:0.15 slope $Z = \frac{1}{0.15}(\cos 25^\circ X - \sin 25^\circ Y - 3.300) + EL\,127.0$

EL 138.0 ~ EL 148.0 1:1 slope : $Z = X - 1,640 + EL\,138.0$

$$\frac{1}{0.15}(\cos 25^\circ X - \sin 25^\circ Y - 3300) + EL\,127.0 = X - 1,640 + EL\,138.0$$

$$\cos 25^\circ X - \sin 25^\circ Y - 3,300 = 0.15\,(X - 1,640 + 11.0)$$

$$(\cos 25^\circ - 0.15) \cdot X - \sin 25^\circ Y = 0.15\,(11.0 - 1,640) + 3,300$$

$$= 4.7040$$

$(\cos 25° - 0.15)X - \sin 25° Y = 4.104$

$Y = +2.5$	$X = 3.616'$	$Z = EL.\ 143.976'$
$Y = 0.0$	$X = 6.219'$	$Z = 142.529'$
$Y = -2.5$	$X = 4.822'$	$Z = 141.182'$

1:0.15 slope equation : $Z = \frac{1}{0.15}(\cos 75^\circ X - \sin 75^\circ Y - 3.300) + EL\ 137.0$

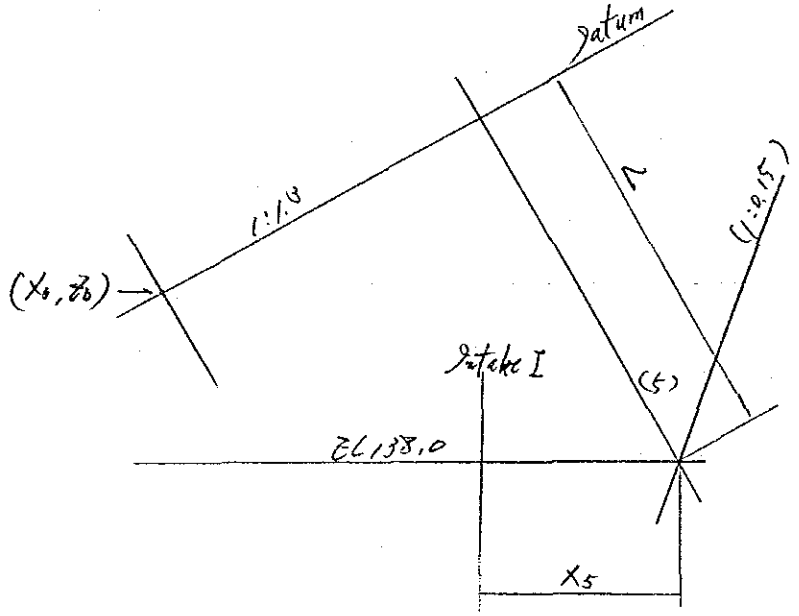
$Z = 138.0$

X_5

~~$Y = +2.5$ $X = 6.6274$~~

$Y = 0.0$ $X = 5.4617$

~~$Y = -2.5$ $X = 4.2960$~~



(5) line : $Z = -1.3(X - X_5) + EL\ 138.0$

Datum : $Z = \frac{1}{1.3}(X - X_0) + Z_0$ $X_0 = -4.1974$, $Z_0 = EL\ 140.4267$

$$\frac{1}{1.3}(X - X_0) + Z_0 = -1.3(X - X_5) + EL\ 138.0$$

$$\left(\frac{1}{1.3} + 1.3\right) X = 1.3 \cdot X_5 + \frac{X_0}{1.3} + EL\ 138.0 - Z_0$$

$\frac{1+1.3^2}{1.3}$

Datum

~~$Y = +2.5$ $X_5 = 6.6274$ $X = 1.4305$ $Z = EL\ 144.7553$~~

$Y = 0.0$ $X_5 = 5.4617$ $X = 0.6982$ $Z = 144.196$

~~$Y = -2.5$ $X_5 = 4.2960$ $X = -0.0342$ $Z = 143.6272$~~

~~$\zeta = 12.5$ $L = (\zeta - 133.0) \times \tan\theta = 8.5234$~~

$\zeta = 0.0$ $L =$ 〃 $= 7.8128$

~~$\zeta = -7.5$ $L =$ 〃 $= 7.1020$~~

(E) plane : $Z = -1.3(X - 5.4617) + EL\ 138.000$

1:0.15 slope : $Z = \frac{1}{0.15}(\cos 25^\circ X - \sin 25^\circ Y - 3.300) + EL\ 127.0$

intersection line of two planes on the X-Y plane

$$\frac{1}{0.15}(\cos 25^\circ X - \sin 25^\circ Y - 3.300) + EL\ 127.0 = -1.3(X - 5.4617) + EL\ 138.000$$

$$\cos 25^\circ X - \sin 25^\circ Y - 3.300 = -1.3 \times 0.15 (X - 5.4617) + 0.15 \times 11.00$$

$$(\cos 25^\circ + 1.3 \times 0.15) X = 1.3 \times 0.15 \times 5.4617 + 0.15 \times 11.00 + 3.300 + \sin 25^\circ Y$$

(A) ... $(\cos 25^\circ + 1.3 \times 0.15) X = \sin 25^\circ Y + 6.0150$ ← Y_0

$Y = 0$	$X = 5.4617$	$Z = 138.000$
~~$Y = 2.5$~~	~~$X = 6.4211$~~	~~$Z = 136.7538$~~
~~$Y = -2.5$~~	~~$X = 4.5024$~~	~~$Z = 139.2471$~~

1:0.15 slope : $Z = \frac{1}{0.15}(\cos 25^\circ X - \sin 25^\circ Y - 3.300) + EL\ 127.000$

EL 138 ~ EL 148 1:1 slope : $Z = X - 1.640 + EL\ 138.0$

Intersection line of two planes on the XY plane (See pages 12 & 13)

(B) ... $(\cos 25^\circ - 0.15) X - \sin 25^\circ Y = 4.7040$

Point of intersection of lines (A) and (B)

$$(\cos 25^\circ + 1.3 \times 0.15) X = \sin 25^\circ Y + Y_0$$
$$(\cos 25^\circ - 0.15) X = \sin 25^\circ Y + 4.704$$

$$(1.3 \times 0.15 + 0.15) X = Y_0 - 4.704 \rightarrow X = 3.8001$$
$$Y = -4.3300$$
$$Z = 140.1601$$

$Y = -2.5 \quad X = 4.5024 \quad Z = 139.2471$

length from cross point of datum line and 15° line

$$L' = \frac{\sqrt{1+1.3^2}}{1.3} (144.1836 - 139.2471) = 6.2384$$

Section at X = 6.042

Intersection line of 1:0.15 slope plane and (4) plane (See page 12)

(A)' ··· $(\cos 25° + 1.3 \times 0.15)X = \sin 25° \cdot Y + 6.6538$

Intersection line of 1:0.15 slope and EL 138 ~ EL 148 1:1 slope (See page 15)

(B) ··· $(\cos 25° - 0.15)X - \sin 25° Y = 4.7104$ O.K.

Point of intersection of line (A)' and (B)

$(\cos 25° + 1.3 \times 0.15)X = \sin 25° Y + 6.6538$
$(\cos 25° - 0.15)X = \sin 25° Y + 4.7104$

$(1.3 \times 0.15 + 0.15)X = 6.6538 - 4.7040 = 1.9498$

$X = 5.6516$
$Y = -1.0166$
$Z = 142.0116$ ⑨

in (A') $Y = +2.5$ $X = 5.0011$ $Z = 140.2570$

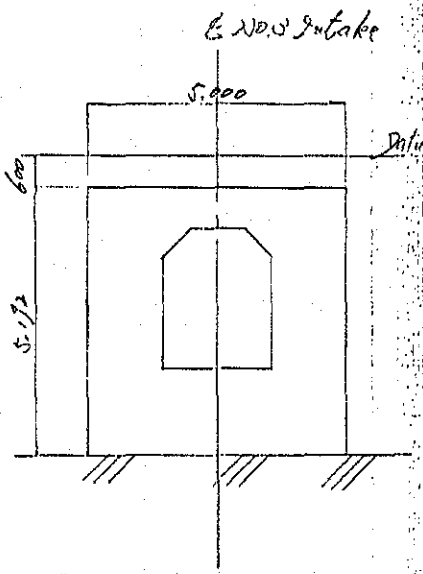
∠ at $Y = 2.5$ $\frac{\sqrt{1+1.3^2}}{1.3}(145.30 - 140.2570) = 6.3624$
∠ at $Y = 0.0$ " (" $- 141.5042$) = 4.7883
∠ at $Y = -1.0166$ " (" $- 142.0116$) = 4.1488

cf See page 12

VI-4-41

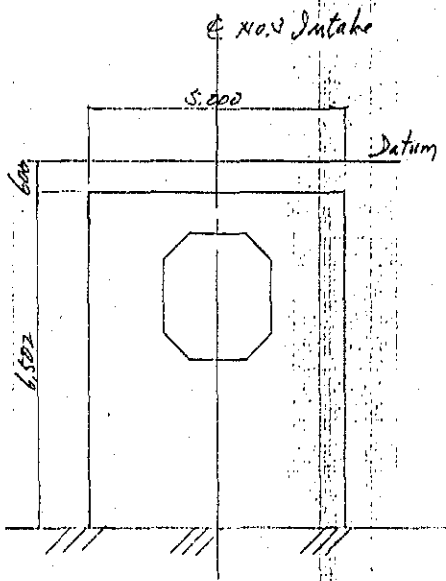
$l = \Delta X \cdot \cos\theta$ $\quad \cos\theta = \frac{1.0}{\sqrt{1+1.63^2}}$

$l = 1.703$ m $\quad l = 0.934$ m



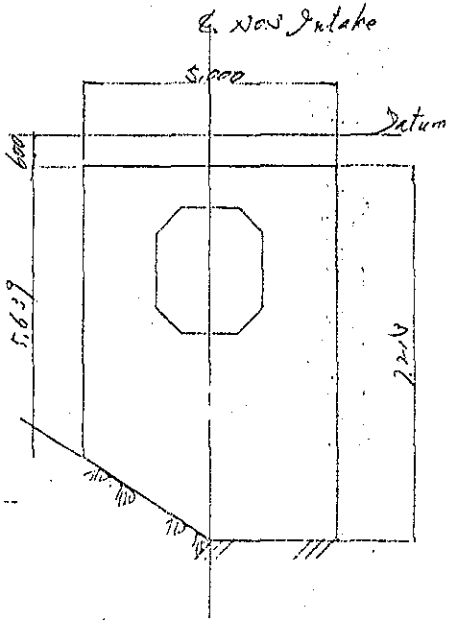
$A_{gross} = 5.172 \times 5.0 = 25.860$ m²

Slant Section at $X = 2.148$



$A_{gross} = 6.502 \times 5.0 = 32.510$ m²

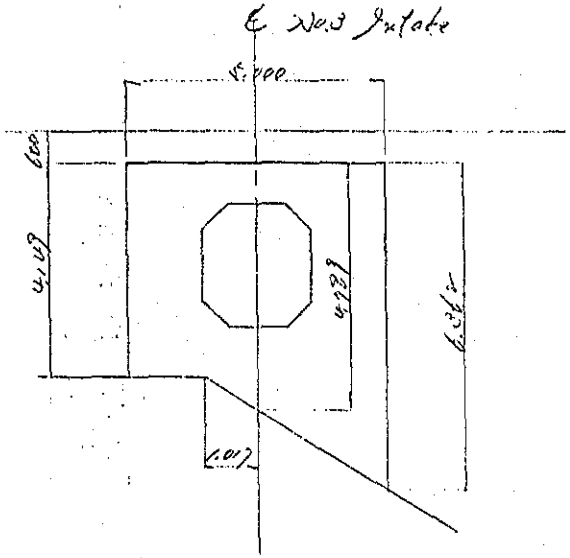
Slant Section at $X = 4.276$



$A_{gross} = \ldots = 14.093$ m²

Slant Section at $X = 6.462$

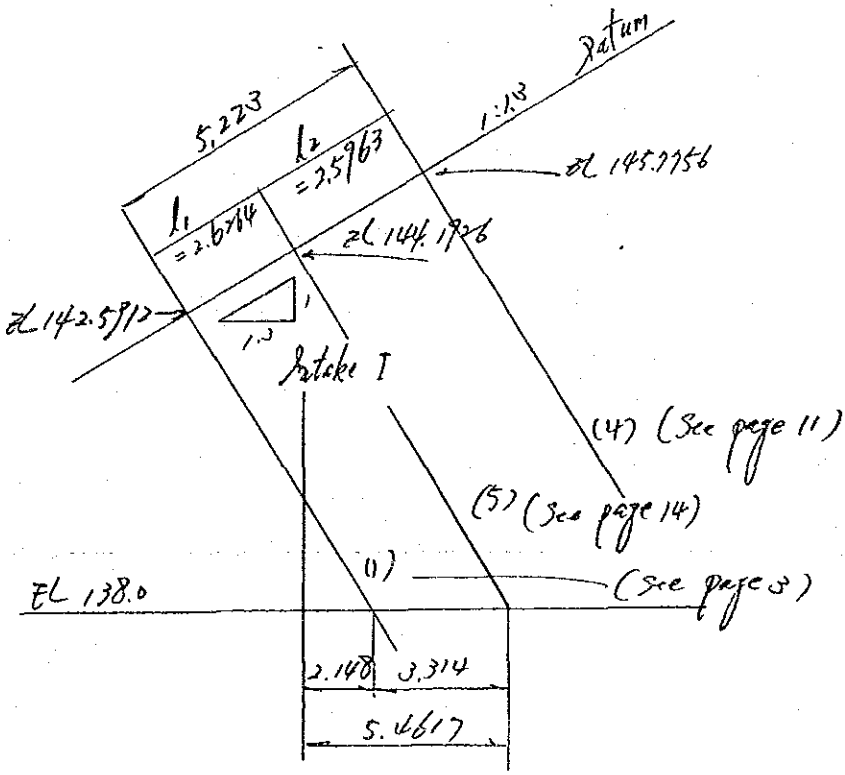
$\ell = 2.596$ m



$A_{gross} = 4.145 \times 1.433 + \frac{1}{2}(4.145 + 6.362) \times 3.517$

$= 24.636$ m²

Slant Section at X = 6.042

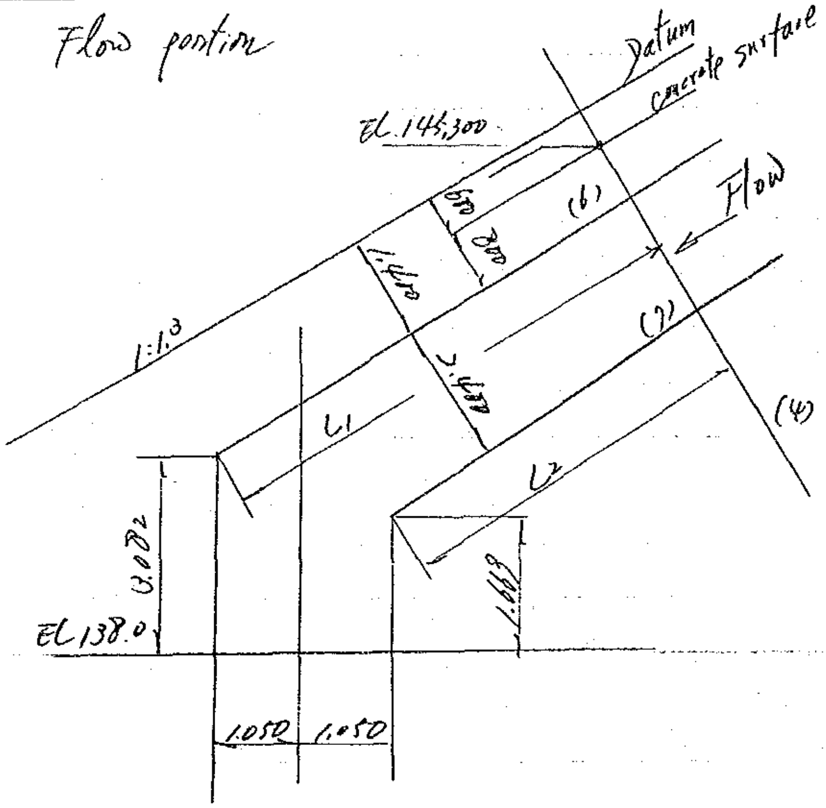


$$l_1 = \sqrt{1+1.3^2} \cdot (144.1926 - 142.5912) = 2.6264$$

$$l_2 = \sqrt{1+1.3^2} \cdot (145.7756 - 144.1926) = 2.5963$$

$$5.2227$$

Flow portion



(6) line : $z = \frac{1}{1.3}(X - X_0) + Z_0 - 1.400 \cdot \sec\theta$ (1.7663)

(7) line : $z = \frac{1}{1.3}(X - X_0) + Z_0 - 3.80 \cdot \sec\theta$ (4.1947)

$X_0 = -4.1994$

$Z_0 = EL\ 140.4267$

(6) and $X = -1.050$ $z = 141.08156$

(7) and $X = 1.050$ $z = 139.6690$

(4) line : $z = -1.3(X - X_4) + EL\ 145.30$

$X_4 = 3.1219$

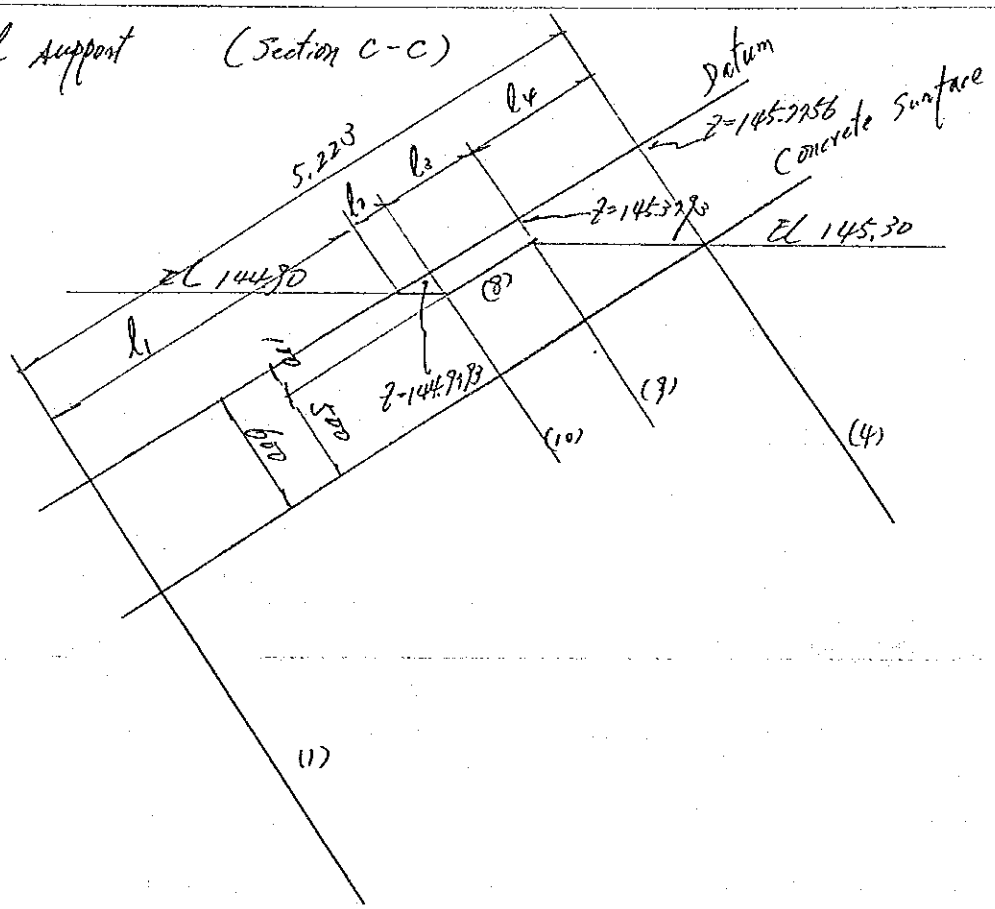
(4) and (6) $X - X_4 = 0.800 \cdot \frac{1}{\sqrt{1+1.3^2}} = 0.4878 \rightarrow z = 144.6659$

(4) and (7) $X - X_4 = 3.200 \frac{1}{\sqrt{1+1.3^2}} = 1.9511 \rightarrow z = 142.7636$

$L_1 = \sqrt{1+1.3^2} \cdot (144.6659 - 141.0816) = 5.8787$

$L_2 = \text{〃} (142.7636 - 139.6690) = 5.0755$

Rail support (Section C-C)



Datum $Z = \frac{1}{1.3}(X - X_0) + Z_0$

$X_0 = -4.1834$

$Z_0 = EL\ 140.4267$

Concrete surface $Z = \frac{1}{1.3}(X - X_0) + Z_0 - 0.7570$

(8) line $Z = \frac{1}{1.3}(X - X_0) + Z_0 - 0.100 \times \text{Sec}\theta$ $\quad \text{Sec}\theta = \frac{\sqrt{1+1.3^2}}{1.3} = 0.1262$

(8) and $Z = EL\ 145.30$ $\quad X = 2.3018$

(8) and $Z = EL\ 144.90$ $\quad X = 1.7818$

(9) line $Z = -1.3 \cdot (X - 2.3018) + EL\ 145.30$

(10) line $Z = -1.3\ (X - 1.7818) + EL\ 144.90$

(9) and Datum

$$z = -1.3(X - 2.3018) + EC\ 145.30$$
$$z = \frac{1}{1.3}(X - X_0) + z_0$$

$$\frac{1}{1.3}(X - X_0) + z_0 = -1.3(X - 2.3018) + EC\ 145.30$$

$$\left(\frac{1}{1.3} + 1.3\right) X = 1.3 \times 2.3018 + EC\ 145.30 + \frac{1}{1.3} X_0 - z_0$$

$$\frac{1 + 1.3^2}{1.3} \qquad X = 2.2408 \qquad z = 145.3793$$

(10) and Datum

$$z = -1.3(X - 1.7818) + EC\ 144.90$$
$$z = \frac{1}{1.3}(X - X_0) + z_0$$

$$\frac{1}{1.3}(X - X_0) + z_0 = -1.3(X - 1.7818) + EC\ 144.90$$

$$\left(\frac{1}{1.3} + 1.3\right) X = 1.3 \times 1.7818 + EC\ 144.90 + \frac{X_0}{1.3} - z_0$$

$$\frac{1 + 1.3^2}{1.3} \qquad X = 1.7208 \qquad z = 144.9793$$

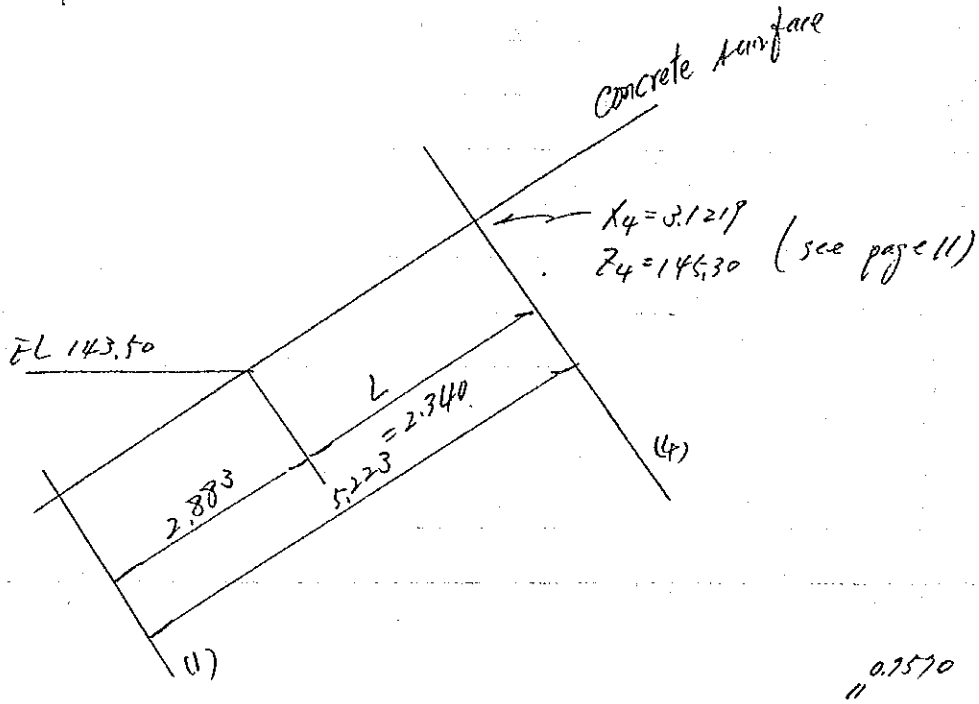
$$l_2 = \sqrt{1 + 1.3^2} \cdot (144.9793 - 144.90) = 0.1801$$
$$l_3 = \quad " \quad \cdot (145.3793 - 144.9793) = 0.6560$$
$$l_4 = \quad " \quad \cdot (145.7556 - 145.3793) = 0.6500$$

$$l_1 = 5.223 - (l_2 + l_3 + l_4) = 3.1869$$

l_1 portion $A = 2 \times 0.95 \times 0.60 = 1.140\ m^2$

l_3 portion $A = 2 \times 0.95 \times 0.50 = 0.950\ m^2$.

Overhang step. (Section C-C)



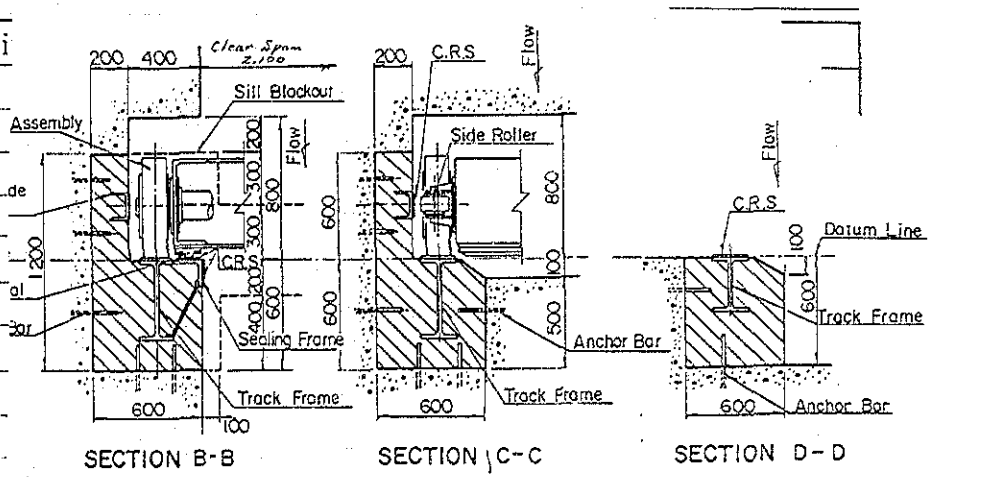
Concrete surface : $Z = \frac{1}{1.3}(X - X_0) + Z_0 - 0.600 \tan\theta$ (0.7570)

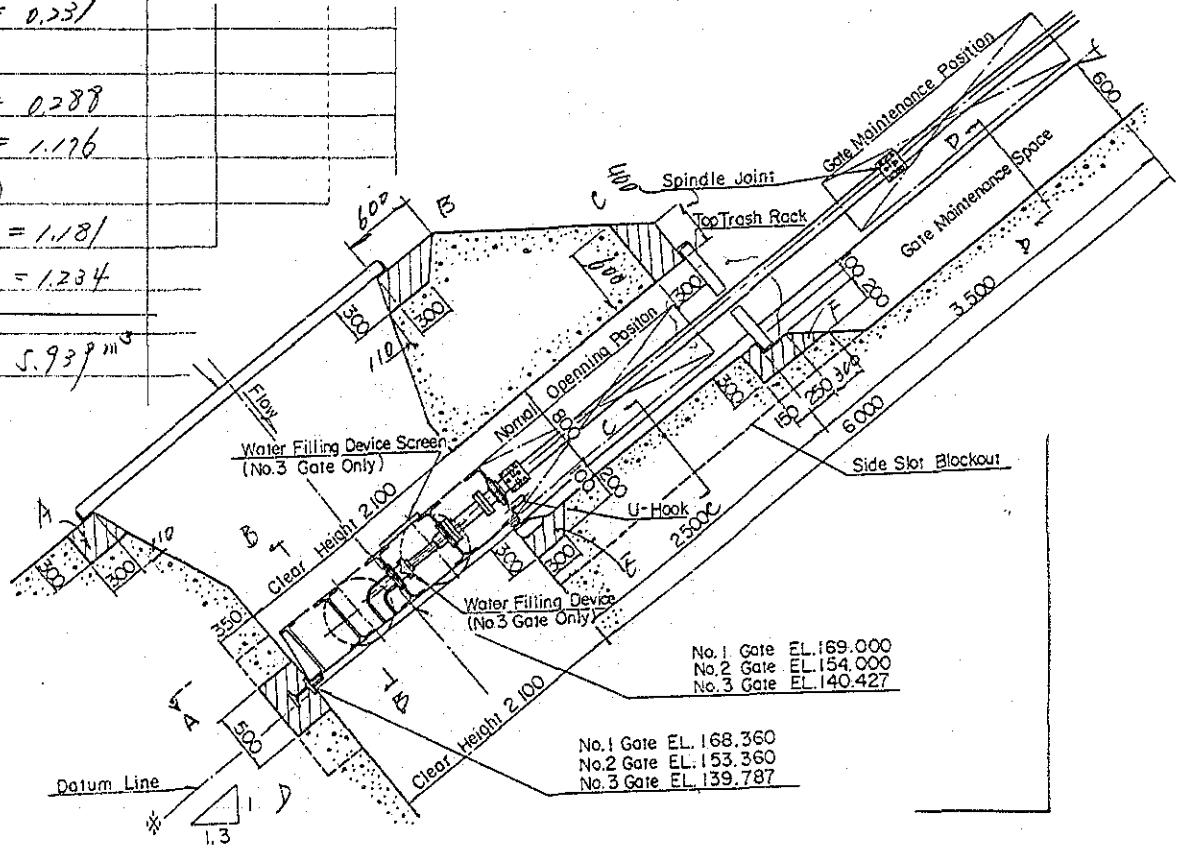
$Z = 143.50 \rightarrow X = 0.1819$

$L = 1.8 \cdot (145.30 - 143.50) = 2.340$

Working Division: E2 Concrete Work

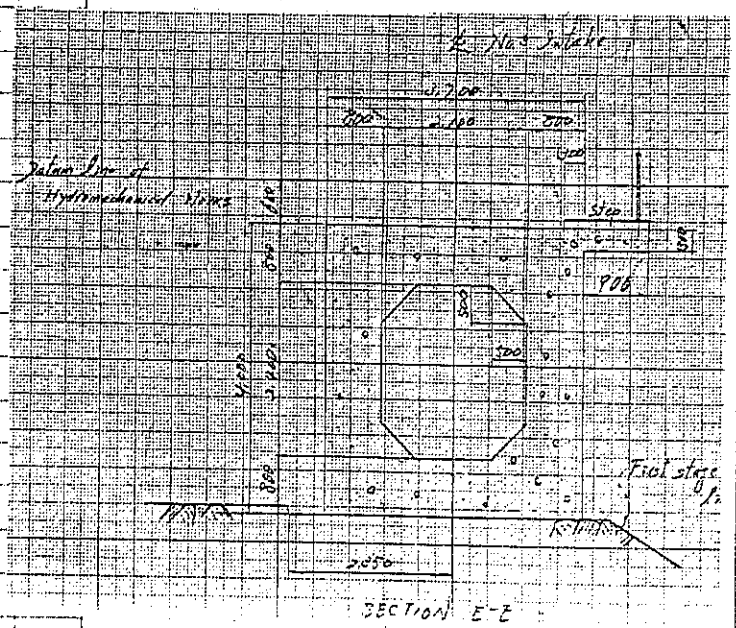
Description	Calculation Details	Uni
01	Concrete class A	
	No.3 Intake.	
	A: $\frac{1}{2}(0.410+0.300)\times0.310\times3.200 = 0.341$	m³
	B: $\frac{1}{2}(0.41+0.60)\times0.30\times3.200 = 0.485$	
	C: $\frac{1}{2}(0.60+0.40)\times0.30\times3.30 = 0.495$	
	D: $0.35\times0.50\times2.80 = 0.508$	
	E: $\frac{1}{2}(0.30+0.20)\times0.10\times2.10$	
	$+\frac{1}{2}(0.31+0.51)\times0.20\times2.10 = 0.231$	
	F: $\{0.15\times0.5+0.25\times0.10$	
	$+\frac{1}{2}(0.3)\times0.2\}\times2.30 = 0.288$	
	Sec B-B: $(0.60\times0.60+0.20\times0.60)\times2.45 = 1.176$	
	" C-C: $(0.60\times0.60+0.20\times0.60-\frac{1}{2}0.10\times0.15)$	
	$\times2.50 = 1.181$	
	" D-D: $(0.60\times0.60-\frac{1}{2}0.10\times0.15)\times3.50 = 1.234$	
	5.939	m³





Working Division: E2 Concrete Work

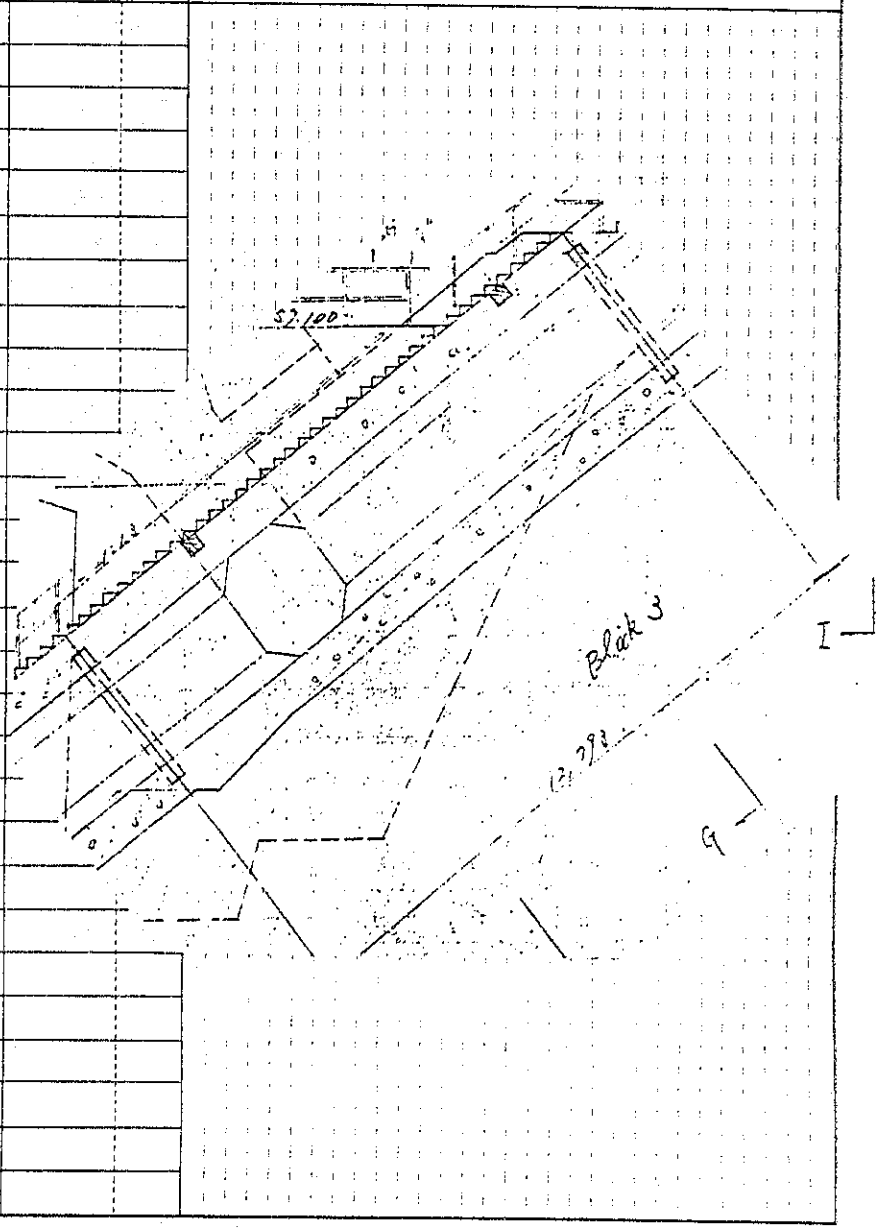
Description	Calculation Details	Unit	Quantity	Remarks
102	Concrete class C			
	No.3 Intake			
	Block 2			
	$\{3.70 \times 4.0 - (2.10 \times 2.40 - 4 \times \frac{1}{2} \times 0.5 \times 0.5)\} 4$			
	$\times 9.513 = 97.603$	m^3		
	hangover step $0.30 \times 0.30 \times 9.513 = 2.568$			
	step $29 \times \frac{1}{2} \times 0.20 \times 0.26 \times 1.20 = 0.905$			
	Base concrete			
	$\frac{1}{2}(3.137 + 0.633) \times 0.337 = 0.634$	m^3		
	$\frac{1}{2} 0.633 \times 0.808 = 0.242$			
	Sec 1~2 $\frac{1}{2} 0.508^2 \times 1.638 = 0.772$			
	" 2~3 $\frac{1}{2}(0.508 + 2.835) \times 1.512 = 2.905$			
	Total 105.689	m^3		



VI-4-50

Working Division: E2 Concrete Work

Description	Calculation Details	Unit	Quantity	Remarks
187	Concrete class C			
	No.3 Intake			
	Block 8			
	$\{3.70 \times 4.0 - (2.10 \times 2.40 - 4 \times \frac{1}{2} 0.5 \times 0.5)\} 4$			
	$\times 12.783 = 181.258\ m^3$			
	Connecting Gateway			
	$-(2.10 \times 2.40 - 4 \times \frac{1}{2} \cdot 0.5 \times 0.5) \times 0.80$			
	$= -3.632\ m^3$			
	Base concrete			
	Sec. 0 ~ 3' $2.835\ m^2 \times 0.448\ m = 1.270\ m^3$			
	" 3' ~ 3" $\frac{1}{2}(2.835 + 2.508) \times 0.360 = 1.034$			
	" 3" ~ 4 $\frac{1}{2}(2.508 + 1.554) \times 0.450 = 0.897$			
	" 4 ~ 5 $\frac{1}{2}(1.554 + 1.556) \times 0.684 = 1.054$			
	" 5 ~ 6 $\frac{1}{2}(1.556 + 4.281) \times 1.846 = 5.446$			
	" 6 ~ 7 $\frac{1}{2} \cdot 4.281 \times 3.192 = 6.832$			
	Total $144.257\ m^3$			



Block 2 $B = 3.70$ m

1:0.15 slope $Z = \frac{1}{0.15}(\cos 25° X - \sin 25° Y - 3380) + EL\ 127.0$

(4) plane $Z = -1.3(X - X4) + EL\ 145.30$

$X4 = 3.1213$ (See page 11)

Intersection line of two planes on the XY plane

$(\cos 25° + 1.3 \times 0.15) X = \sin 25° Y + 6.6538$ (See page 11)

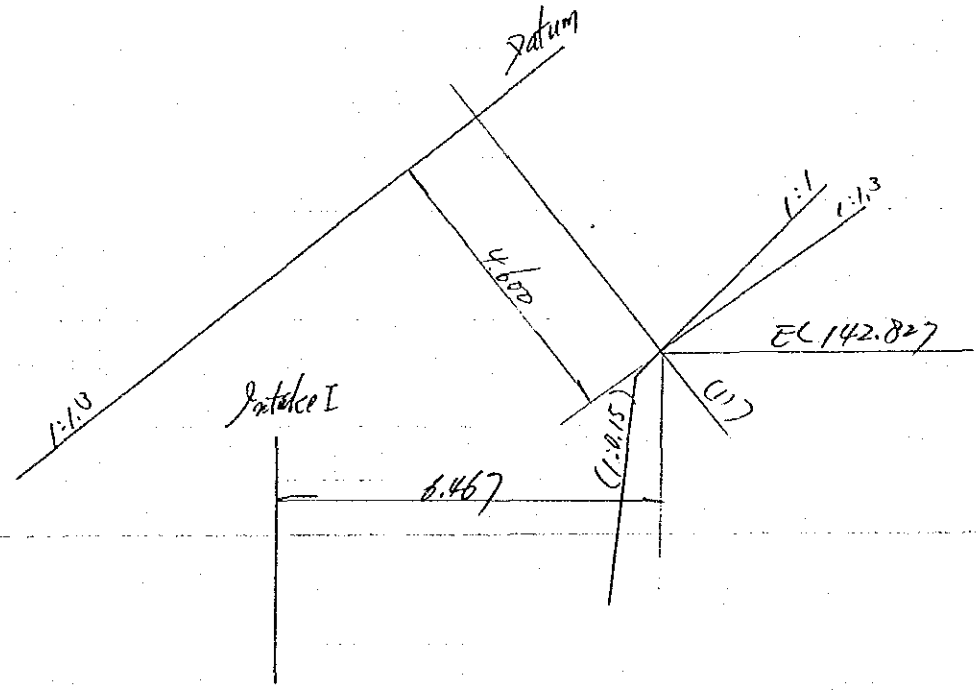
$Y = +1.85$ $X = 6.7516$ $Z = EL\ 140.5813$

$Y = 0.0$ $X = 6.0417$ $Z = EL\ 141.5042$

L at $Y = 1.85$ $L = \frac{\sqrt{1+1.3^2}}{1.3}(145.30 - 140.5813) = 5.3533$

(distance from concrete surface to excavation line)

$X = 6.467$ (See Drawings for excavation)



(11) line $\quad Z = -1.3(X - 6.467) + EL\ 142.827$

Datum $\quad Z = \frac{1}{1.3}(X - X_0) + Z_0$

$X_0 = -4.1874$

$Z_0 = EL\ 140.426$

Cross point : $\frac{1}{1.3}(X - X_0) + Z_0 = -1.3(X - 6.467) + EL\ 142.827$

$\left(\frac{1}{1.3} + 1.3\right) \cdot X = -1.3 \times 6.467 + 142.827 - Z_0 + \frac{X_0}{1.3}$

$\frac{141.3^2}{1.3}$

$X = 3.6624 \qquad Z = EL\ 146.4728$

$L = \frac{\sqrt{141.3^2}}{1.3}(146.4728 - 142.827) = 4.5937 \doteq 4.6$ m

O.K.

1:0.15 slope $Z = \frac{1}{0.15}(\cos 25^\circ X - \sin 25^\circ Y - 3.300) + EL\ 127.0$

(11) plane $Z = -1.3(X - 6.467) + EL\ 142.827$

Intersection line

$$\frac{1}{0.15}(\cos 25^\circ X - \sin 25^\circ Y - 3.300) + EL\ 127.0 = -1.3(X - 6.467) + EL\ 142.827$$

$$\cos 25^\circ X - \sin 25^\circ Y - 3.300 = -1.3 \times 0.15 (X - 6.467) + 0.15(142.827 - 127.0)$$

$$(\cos 25^\circ + 1.3 \times 0.15) X = 1.3 \times 0.15 \times 6.467 + 0.15 \times 15.827 + 3.300 + \sin 25^\circ Y$$

$$\therefore Y_0$$

(A) $\cdots$ $(\cos 25^\circ + 1.3 \times 0.15) X = \sin 25^\circ Y + 6.335$

1:0.15 slope $Z = \frac{1}{0.15}(\cos 25^\circ X - \sin 25^\circ Y - 3.300) + EL\ 127.0$

EL138 ~ EL148 1:1 slope $Z = X - 1.640 + EL\ 138.0$

Intersection line

(B) $\cdots$ $(\cos 25^\circ - 0.15) X = \sin 25^\circ Y + 4.704$

Cross point of (A) and (B)

$$(\cos 25^\circ + 1.3 \times 0.15) X = \sin 25^\circ Y + 6.335$$
$$(\cos 25^\circ - 0.15) X = \sin 25^\circ Y + 4.704$$

$$2.328 X = 6.335 - 4.704$$

$X = 6.467_0$

$Y = 0.442^5$

$Z = EL\ 142.827_0$) O.K.

in (A) $Y = 1.85$ $X = 7.0071$

$Z = 143.1249$

(11)' plane $Z = -1.3 \times (X - 7.0071) + 2C\ 142.1249$

Datum $Z = \frac{1}{1.3}(X - X_0) + Z_0$

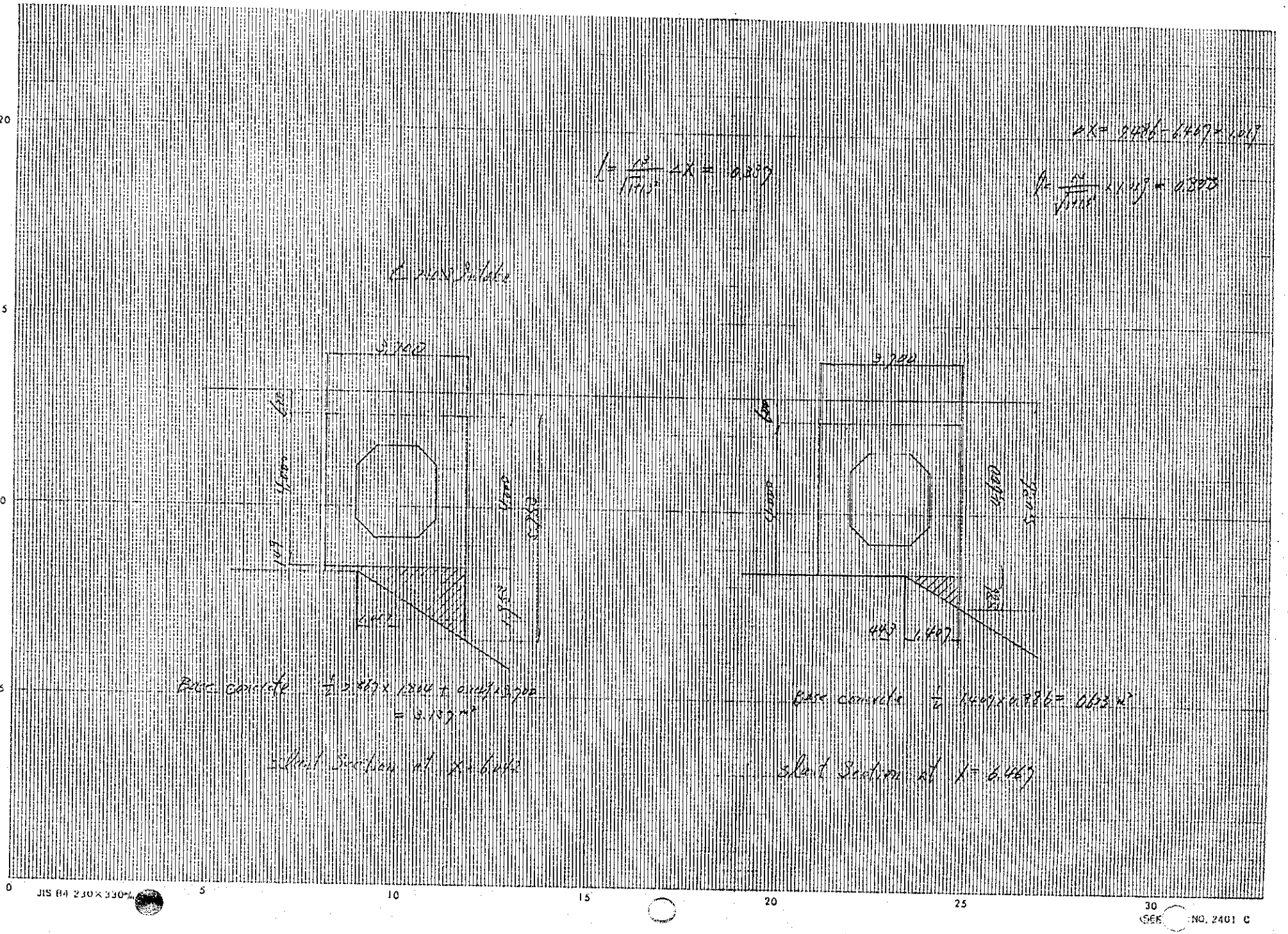
cross point

$$\frac{1}{1.3}(X - X_0) + Z_0 = -1.3(X - 7.0071) + 2C\ 142.1249$$

$$\left(\frac{1}{1.3} + 1.3\right) \cdot X = 1.3 \times 7.0071 + 2C\ 142.1249 - Z_0 + \frac{1}{1.3} X_0$$

$\frac{1+1.3^2}{1.3}$ $X = 3.6625$ $Z = 146.4729$

$$L = \frac{\sqrt{1+1.3^2}}{1.3}\ (146.4729 - 142.1249) = 5.4855$$



No.3 Intake

from now on the Sections of No.3 Intake shall be taken on vertical.

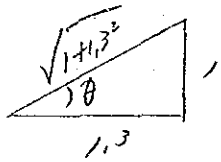
Basic line equation:

Datum line $\quad Z = \frac{1}{1.3}(X - X_0) + Z_0$

$X_0 = -41.874$

$Z_0 = EL\ 140.467$

Concrete surface $\quad Z = \frac{1}{1.3}(X - X_0) + Z_0 - 0.600 \cdot \sec\theta$



$\sec\theta = \frac{\sqrt{1+1.3^2}}{1.3}$

$\sec\theta = 1.26163$

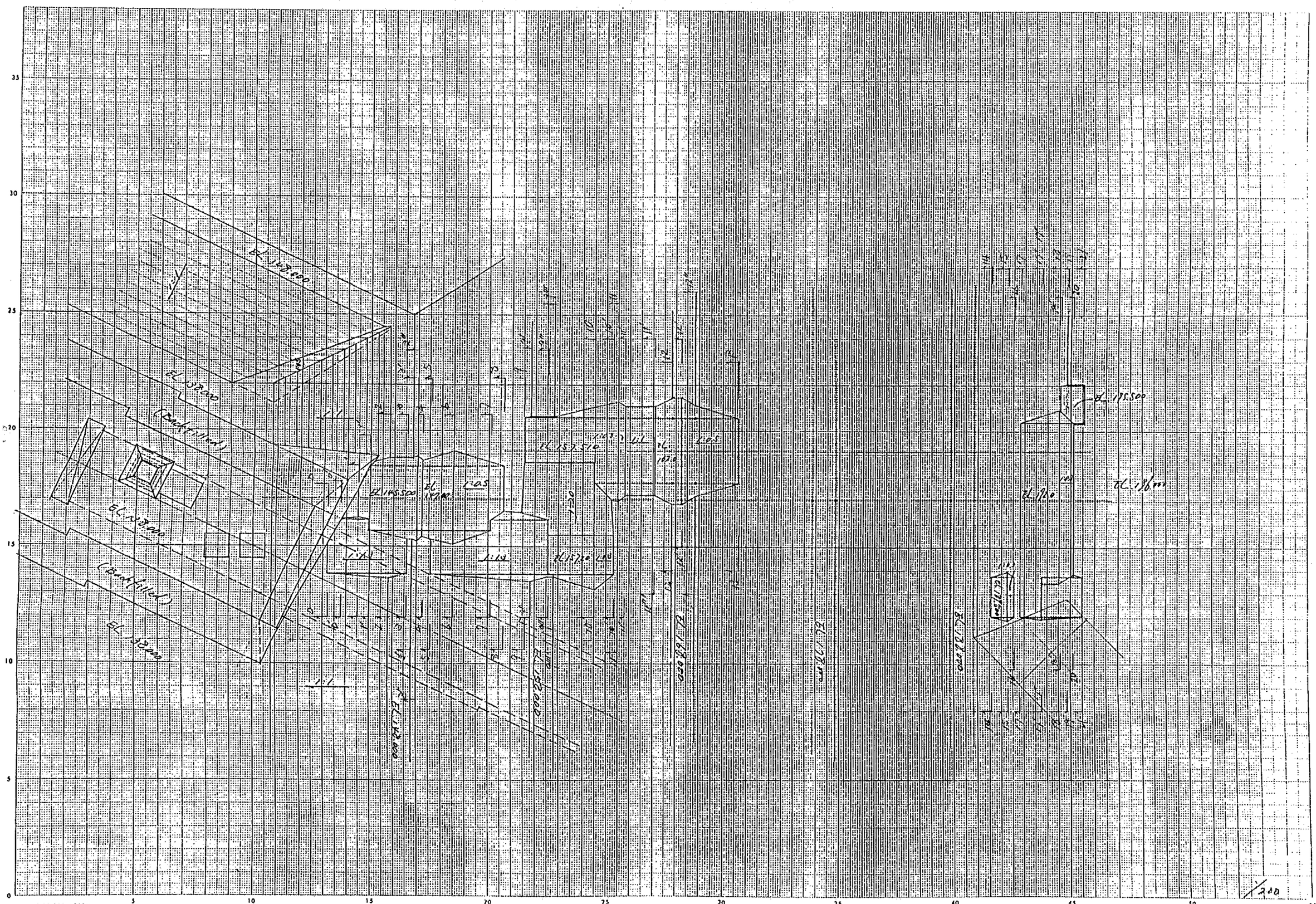
Ceiling of water way $\quad Z = \frac{1}{1.3}(X - X_1) + Z_1 - 1.400 \cdot \sec\theta$

Bottom of water way $\quad Z = \frac{1}{1.3}(X - X_0) + Z_1 - 3.000 \cdot \sec\theta$

Bottom of concrete $\quad Z = \frac{1}{1.3}(X - X_0) + Z_0 - 4.600 \cdot \sec\theta$

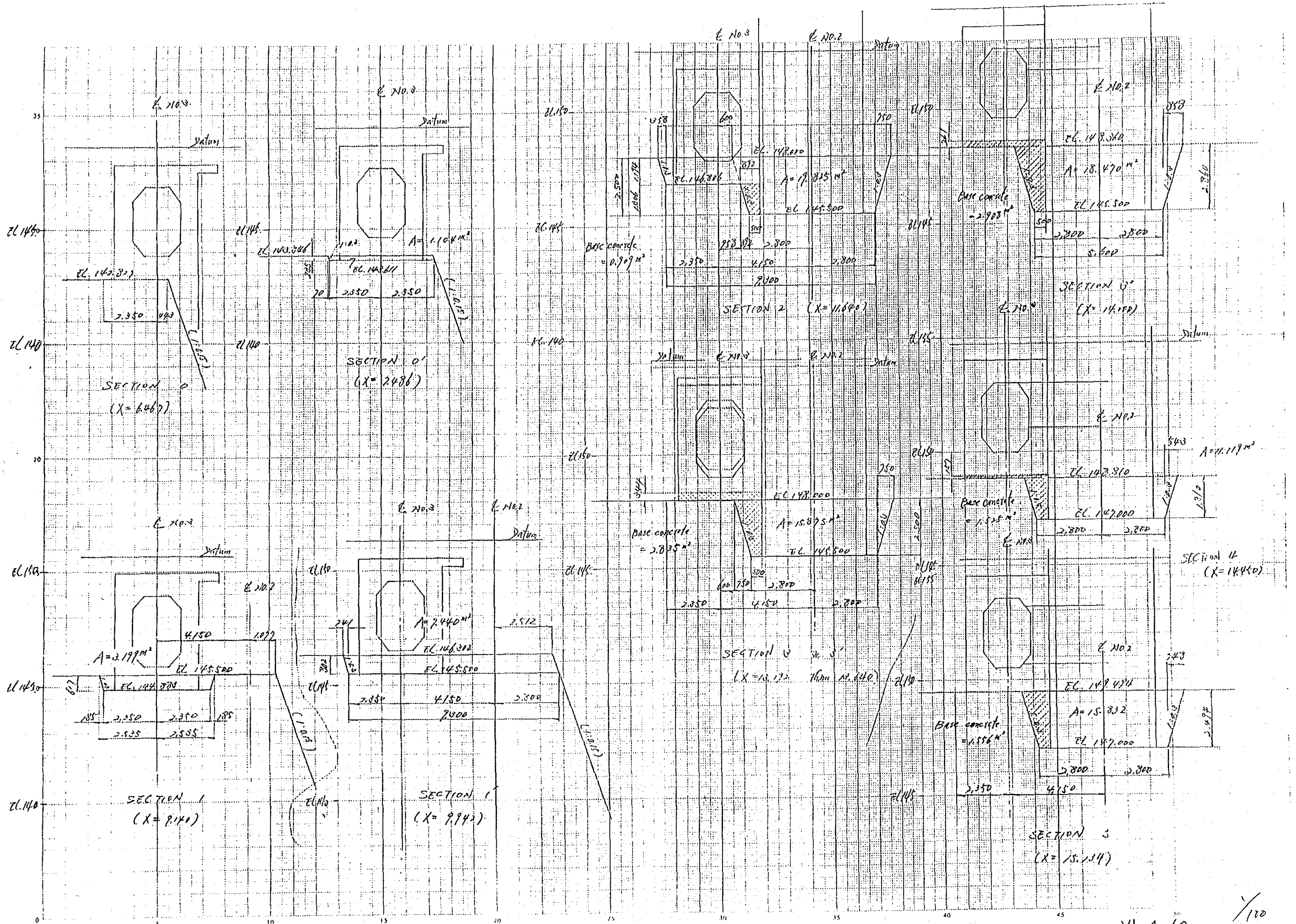
Section No.	X	Datum	Conc. surface	Ceiling	Bottom	Bottom conc.	
0	6.467 m	148.630′	147.873′	146.814	143.836	142.827	
0′	7.486	149.414	148.657	147.648	144.620	143.611	
1	7.140	150.686	149.929	148.920	145.892	144.883	
1′	9.342	151.303	150.546	149.537	146.509	145.500	✓
2	11.640	152.609	151.852	150.843	147.815	146.806	
3	12.192	153.803	153.046	152.037	149.009	148.000	✓
3′	13.640	154.148	153.391	152.382	149.354	148.344	
3″	14.000	154.425	153.668	152.658	149.630	148.621	

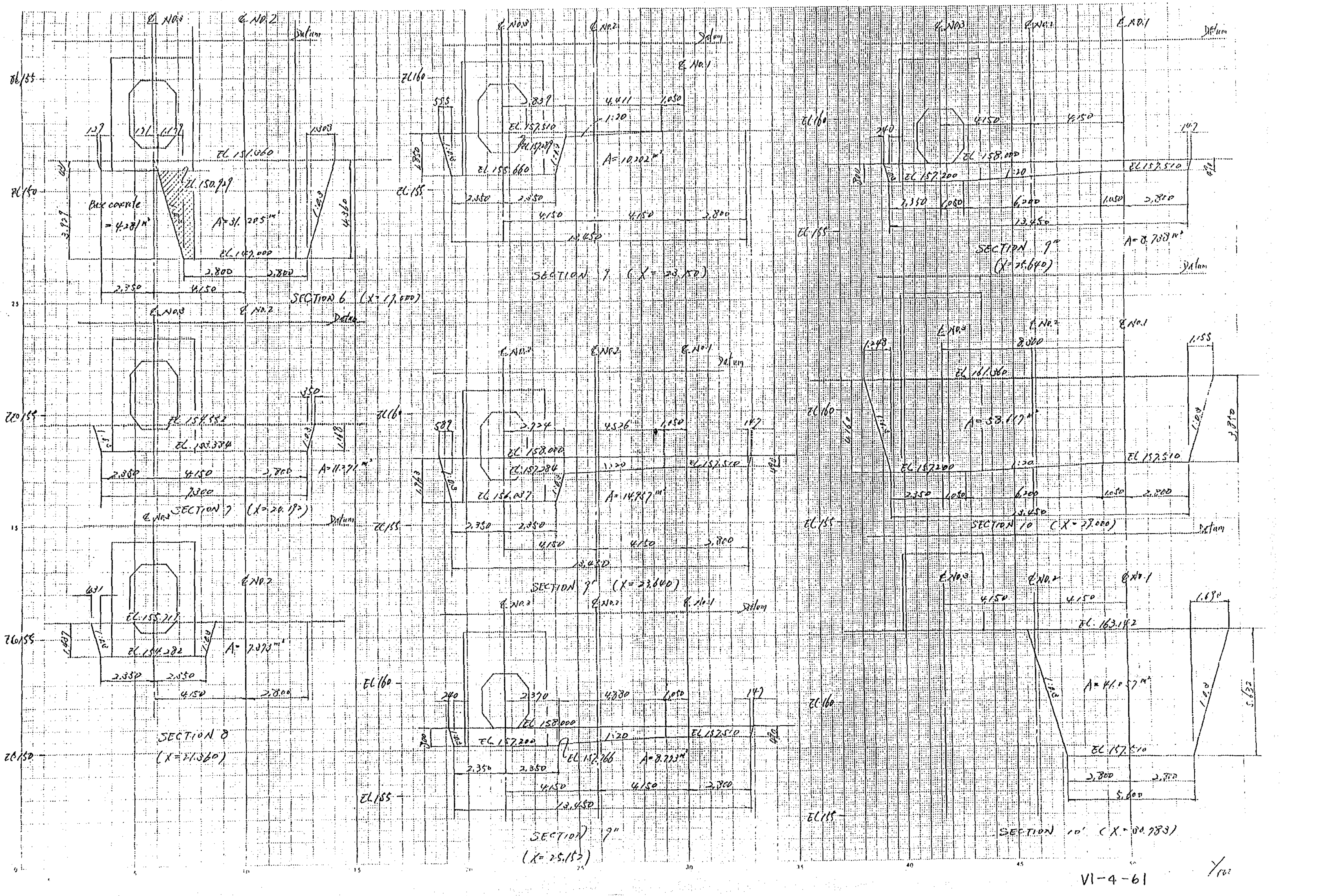
Section No.	X	Datum	Conc. surface	Ceiling	Bottom	Bottom conc.
4	14.450	154.771	154.014	153.005	149.977	148.967
5	15.134	155.297	154.540	153.531	150.503	149.494
6	17.000	156.732	155.975	154.966	151.938	150.929
7	20.192	159.188	158.431	157.422	154.394	153.384
8	21.360	160.086	159.329	158.320	155.292	154.283
9	23.150	161.463	160.706	159.697	156.669	155.660
9'	23.640	161.840	161.083	160.074	157.046	156.037
9"	25.152	163.003	162.246	160.4	158.0	157.20
9'''	25.640	163.379	162.622	"	"	"
10	27.000	165.363	165.206	—	—	157.20
10'	30.383	167.335	166.578	—	—	163.142



JIS A2 380 × 550㎜

VI-4-59


SECTION 0
(X= 6.467)
SECTION 0'
(X= 2.486)
A= 1.104 m²
EL 142.827
EL 143.346
EL 142.611
2.350
(1:0.5)
(1:0.15)
Datum
SECTION 1
(X= 9.140)
A=3.199 m²
EL 145.500
EL 144.880
4.150
2.535
2.505
SECTION 1'
(X= 9.942)
A= 2.440 m²
EL 146.302
EL 145.500
2.512
9.000
SECTION 2
(X= 11.640)
A= 19.825 m²
EL 148.000
EL 146.806
EL 145.500
Base concrete
= 0.909 m³
SECTION 3'
(X= 14.170)
A= 18.470 m²
EL 148.360
EL 145.500
Base concrete
= 2.908 m³
5.600
SECTION 3 & 3'
(X = 13.172 thru 11.640)
A= 15.875 m²
EL 148.000
EL 145.500
Base concrete
= 2.835 m³
SECTION 4
(X= 14.450)
A= 11.119 m²
EL 148.810
EL 147.000
Base concrete
= 1.525 m³
SECTION 5
(X= 15.134)
A= 15.832
EL 149.494
EL 147.000
Base concrete
= 1.556 m³
℄ No.2
℄ No.3
1/120


SECTION 6 (X=17.000)
SECTION 7 (X=20.193)
SECTION 8 (X=21.360)
SECTION 9 (X=23.150)
SECTION 9' (X=23.640)
SECTION 9" (X=25.153)
SECTION 9'" (X=25.640)
SECTION 10 (X=27.000)
SECTION 10' (X=30.783)
Datum
Box concrete = 4.281 m²
A= 31.205 m²
A= 11.371 m²
A= 7.073 m²
A= 10.202 m²
A= 14.957 m²
A= 8.223 m²
A= 8.738 m²
A= 58.117 m²
A= 41.057 m²
EL 151.060
EL 150.939
EL 147.000
EL 154.352
EL 153.334
EL 155.319
EL 154.282
EL 157.510
EL 155.660
EL 158.000
EL 157.384
EL 156.037
EL 157.200
EL 157.266
EL 161.360
EL 163.142
1:20
1:30
2.350
4.150
2.800
13.450
VI-4-61
1/100

Working Division: F2 Concrete Work

Description	Calculation Details	Unit	Quantity	Remarks
F2/02	Concrete class C			
	No.2 Intake			
	Block 4 (Blak 1 & 2 : none)			
	Block 3'			
	B= 4.60 m See Fig. on Page 38			
	EL 145.5 ~ EL 147.0 $\frac{1}{2}$ (3.50+3.375) x 1.500 m^2			
	x 4.60m = 24.444			
	EL 147.0 ~ EL 151.992			
	$\frac{1}{2}$ (6.425 + 8.662) x 4.992			
	x 4.600 = 172.529			
	EL 151.992 ~ 8.000 m high from EL 145.5			
	$\frac{1}{2}$ (8.662 + 7.40) x 1.508			
	x 4.600 = 56.448			
	8.000 ~ EL 1545 { $\frac{1}{2}$ (2.4+2.4+9.0) x 1.0			
	- $\frac{1}{2}$ 2.4 x 0.8 } x 4.60 = 38.824			
	Curb. 0.40 x 0.10 x 4.60 = 0.368			
	EL 145.5 ~ EL 153.1 $\frac{1}{2}$ (7.2 + 1.836)			
	x 2.60 x 4.60 = 54.035			
	Sub-total 347.648 m^3			

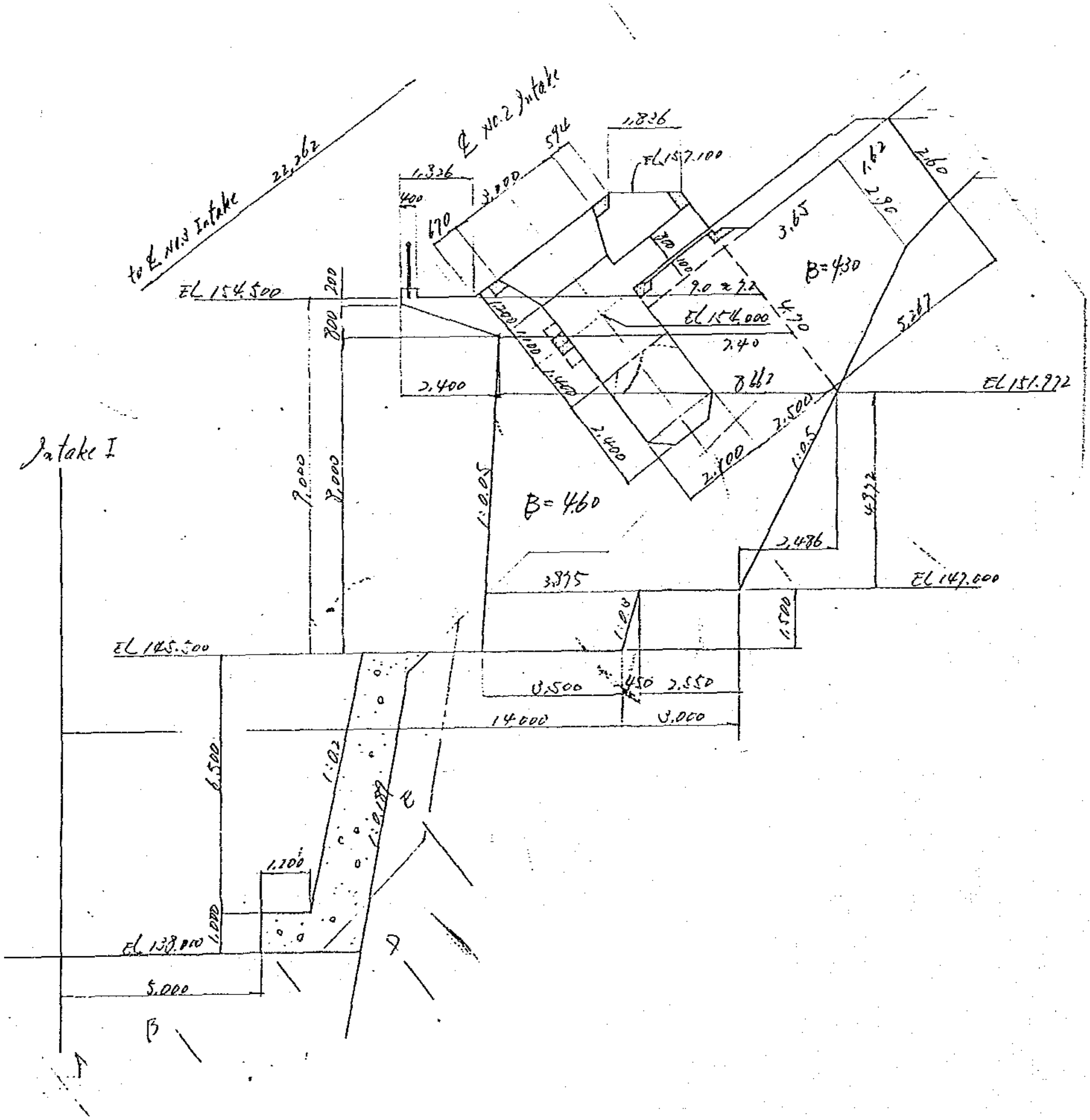
Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
	Waterway			
	$\frac{1.200}{3}(3.20^2+3.0\times2.1+2.1^2) = 7.884\ m^3$			
	$2.1\times2.1\times4.9$			
	$-2\times\frac{1}{2}\times0.5\times0.5\times2.10 = 21.084$			
	$(2.1\times2.4-4\times\frac{1}{2}\times0.5\times0.5)$			
	$\times 1.25 = 5.625$			
	$0.8\times2.5\times2.8 = 6.525$			
	Sub-total $41.168\ m^3$			
	Block 3'			
	Concrete class C (including class A)			
	Gross $345.648\ m^3$			
	Waterway -41.168			
	$304.480\ m^3$			

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
	Concrete class C			
	No.2 Intake			
	Block 3' B= 4.30m (See Taf. on page 36)			
	$\frac{1}{2}(4.70+2.90)\times 4.30\times 3.65 = 58.641$	m^3		
	$\frac{1}{2}(2.90+2.60)\times 4.30\times 1.62 = 19.156$			
	$1.25\times 0.60\times (1.26) = 3.850$			
	$0.95\times 0.60\times 5.26) = 3.002$			
	Base concrete (See page 43)			
	Sec.7 ~ Sec.8 $\frac{1}{2}\times 1.028\times 1.168 = 0.600$	m^3		
	Sec.8 ~ Sec.9 $\frac{1}{2}(1.028+1.212)\times 1.790 = 2.005$			
	Sub-total 88.354	m^3		
	No.2 Intake Block 3 concrete class C			
	Block 3' 306.480	m^3		
	Block 3'' 88.354	m^3		
	class A (page 25) - 5.993	m^3		
	Total 388.835	m^3		

NO.2 Intake



to ℄ NO.3 Intake 22,262
℄ NO.2 Intake
EL 154.500
EL 157.100
EL 154.000
EL 151.972
EL 147.000
EL 145.500
EL 138.000
B=4.30
B=4.60
Intake I
1:0.05
1:0.5
1:0.2
1:0.0
14.000
5.000

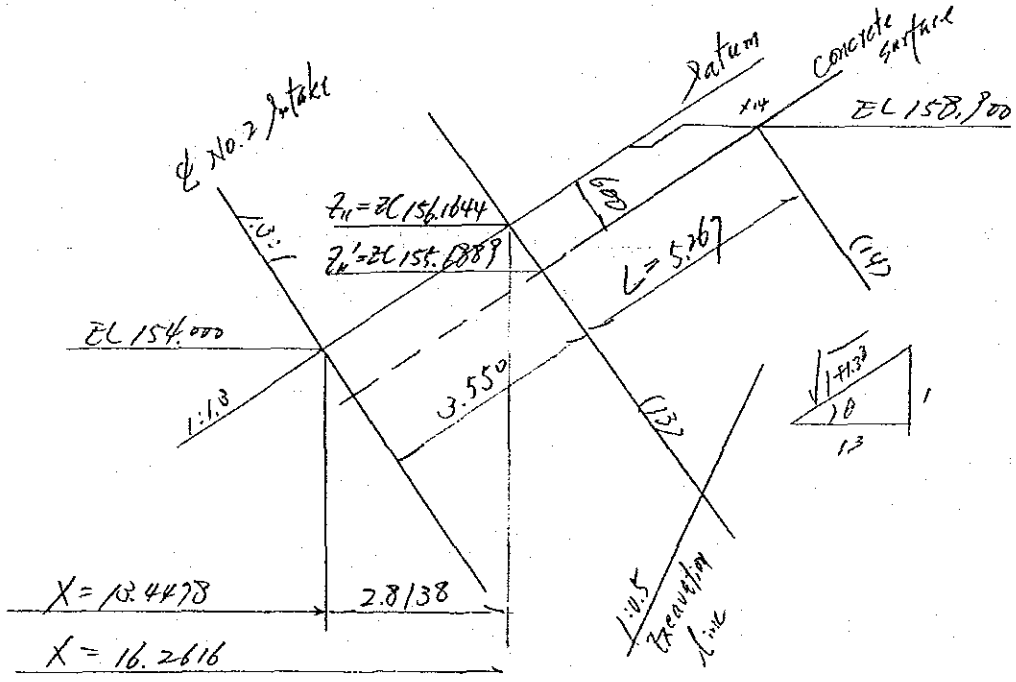
No.2 Intake.

Datum line $\quad z = \frac{1}{1.3}(x - x_0) + z_0$

$x_0 = -41.974$

$z_0 = EL.\ 140.4267$

$z = 154.000 \longrightarrow x = 13.4478$



$z_{11} = EL\ 154.000 + 3.550 \cdot \sin\theta = EL\ 156.1644$

$z_{11}' = z_{11} - 0.600 \cdot \cos\theta = EL\ 155.6889$

$L = \sqrt{1+1.3^2}\ (158.300 - z_{11}') = 5.2666$ O.K.

(13) line $\quad z = -1.3(x - x_{11}) + EL\ 156.1644$

$x_{11} = 13.4478 + 3.550 \cdot \cos\theta = 16.2616$

$\cos\theta = \frac{1.3}{\sqrt{1+1.3^2}} = 0.79362$

1:0.5 Exc. line $\quad z = \frac{1}{0.5}(x - 17.07) + EL\ 147.0$

Cross point of (3) line and 1:0.5 excavation line

$$\frac{1}{0.5}(X-17.00)+EL\,141.0=-1.3(X-X_{11})+EL\,156.1644$$

$$\left(\frac{1}{0.5}+1.3\right)X=1.3\cdot X_{11}+EL\,156.1644+\frac{17.00}{0.5}-EL\,141.0$$

"

3.3 $\quad X=13.4862 \quad Z=EL\,151.9724$

1:0.5 Exc. line $\quad Z=\frac{1}{0.5}(X-17.0)+EL\,141.0$

EL 148.0 ~ EL 158.0 1:1 $\quad Z=X-13.640+EL\,148.0$

Cross point

$$\left(\frac{1}{0.5}-1\right)X=-13.640+EL\,148.0+\frac{17.0}{0.5}-EL\,141.0$$

"

1 $\quad X=21.360$

$$Z=EL\,155.720$$

(14) line :

Z_{14} = EC 158.390

$X_{14} = 13.4478 + 0.60 \cdot \sin\theta + (3.550 + 5.2666) \cdot \cos\theta = 20.8018$

(14) line : $Z = -1.3 (X - X_{14}) + Z_{14}$

EC 148.0 ~ EC 158.0 1:1 $Z = X - 13.640 + EC\,148$

(1+1.3) $X = +13.640 - EC\,148 + 1.3 X_{14} + Z_{14}$

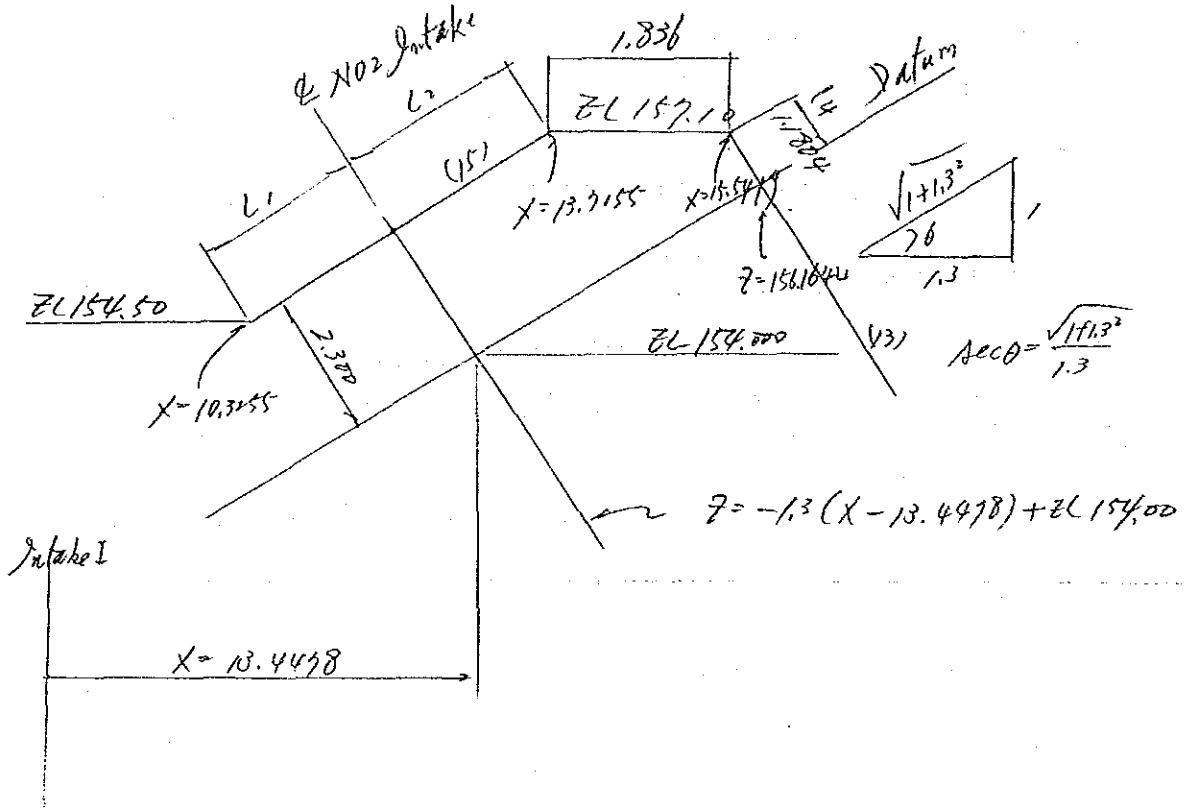
〃 2.3

$X = 22.4272$

$Z = EC\,156.3872$

$L = \sqrt{(22.4272 - X_{14})^2 + (Z_{14} - 156.3872)^2} = 2.6656$

Mound.



(15) line : $Z = \frac{1}{1.3}(X - X_0) + Z_0 + 2.300 \cdot \text{Sec}\theta$

cross point Z ℄ NO.2 and (15) line

$$\frac{1}{1.3}(X - X_0) + Z_0 + 2.300 \cdot \text{Sec}\theta = -1.3(X - 13.4498) + EL\ 154.00$$

$$\left(\frac{1}{1.3} + 1.3\right) X = 1.3 \times 13.4498 + EL\ 154.00 - Z_0 - 2.300 \cdot \text{Sec}\theta + \frac{X_0}{1.3}$$

$\frac{\sqrt{1+1.3^2}}{1.3}$ "

$X = 12.0454$

$Z = EL\ 155.8230$

$L_1 = \sqrt{1+1.3^2}\ (Z - 154.50) = 2.1900$

$L_2 = \quad "\quad (157.10 - Z) = 2.0846$

(15) line $\quad Z = \frac{1}{1.3}(X - X_0) + Z_0 + 2.300 \cdot \text{Acc}\theta$

$Z = 154.50 \rightarrow X = 10.3255$

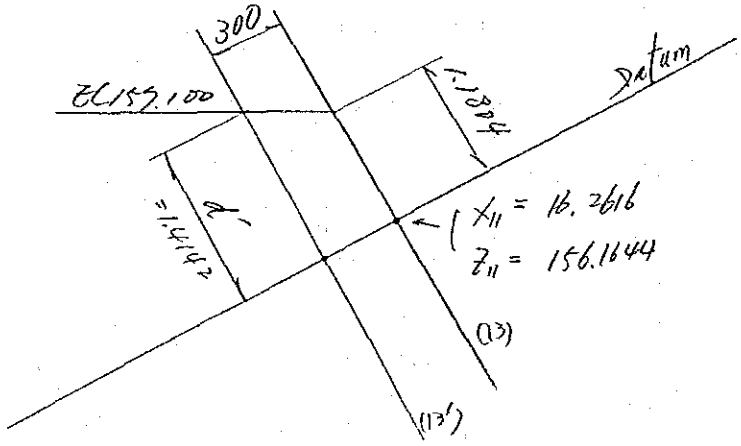
$Z = 157.10 \rightarrow X = 13.7055$

(13) line $\quad Z = -1.3(X - X_{11}) + EC156.1644$

$X_{11} = 16.2616$

$Z = 157.10 \rightarrow X = 15.5419$

$$l_4 = \sqrt{(16.2616 - 15.5419)^2 + (157.10 - 156.1644)^2} = 1.1804$$



$\Delta X = 300 \cdot \cos\theta = 0.2378$, $\Delta Z = 300 \cdot \sin\theta = 0.1824$

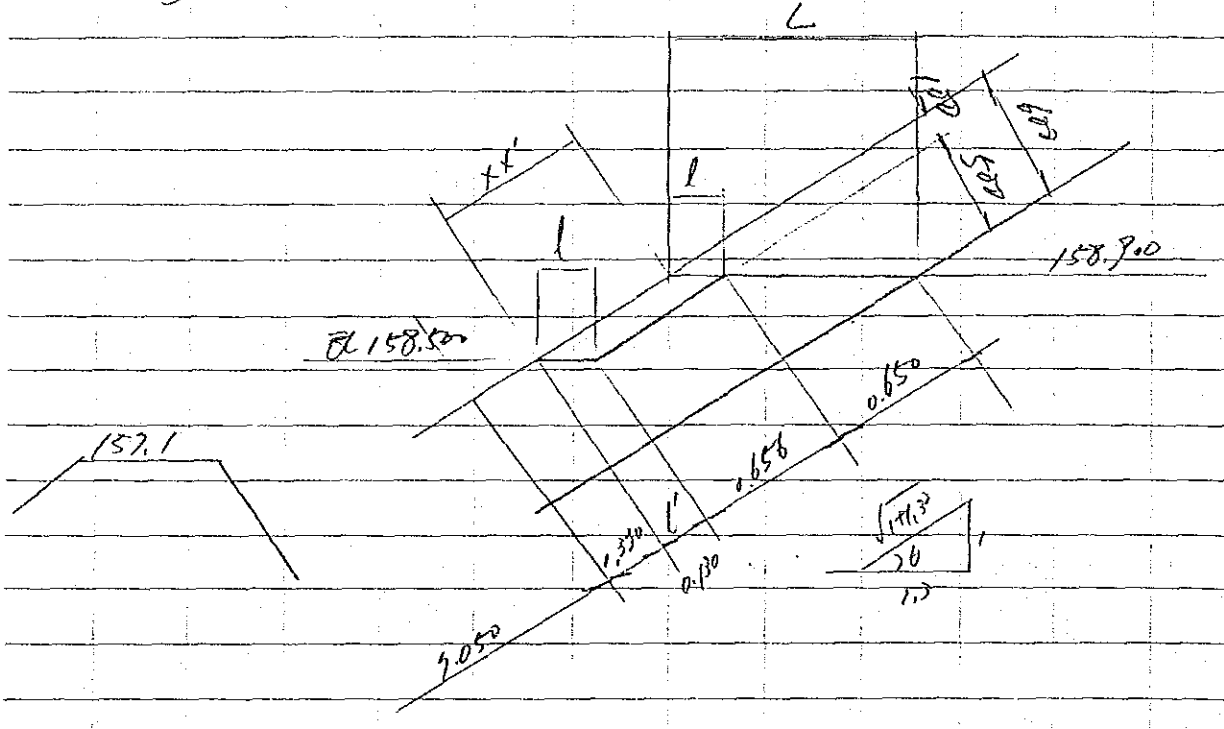
(13') line $\quad Z = -1.3\{X - (16.2616 - \Delta X)\} + 156.1644 - \Delta Z$

$Z = 157.1 \qquad X = 15.1634$

$$d' = \sqrt{\{157.1 - (156.1644 - \Delta Z)\}^2 + \{(16.2616 - \Delta X) - 15.1634\}^2}$$

$= 1.4112$

Datum $Z = \frac{1}{1.3}(X - X_0) + Z_0$



Datum $Z = \frac{1}{1.3}(X - X_0) + Z_0$

$Z = 158.500 \qquad X = 19.2878$

$X' = \frac{\sqrt{1^2+1.3^2}}{1.3}(X - X_0)$

$XX = X' - 22.262 - 3.050 = 0.3304$

$l \cdot \sin\theta = 0.1 \qquad l = \frac{0.1}{\sin\theta}$

$l' = l \cdot \cos\theta = 0.1 / \tan\theta = 0.1 \times 1.3 = 0130$

Datum $Z = \frac{1}{1.3}(X - X_0) + Z_0$

$Z = 158.900$ $\quad X = 19.8178$

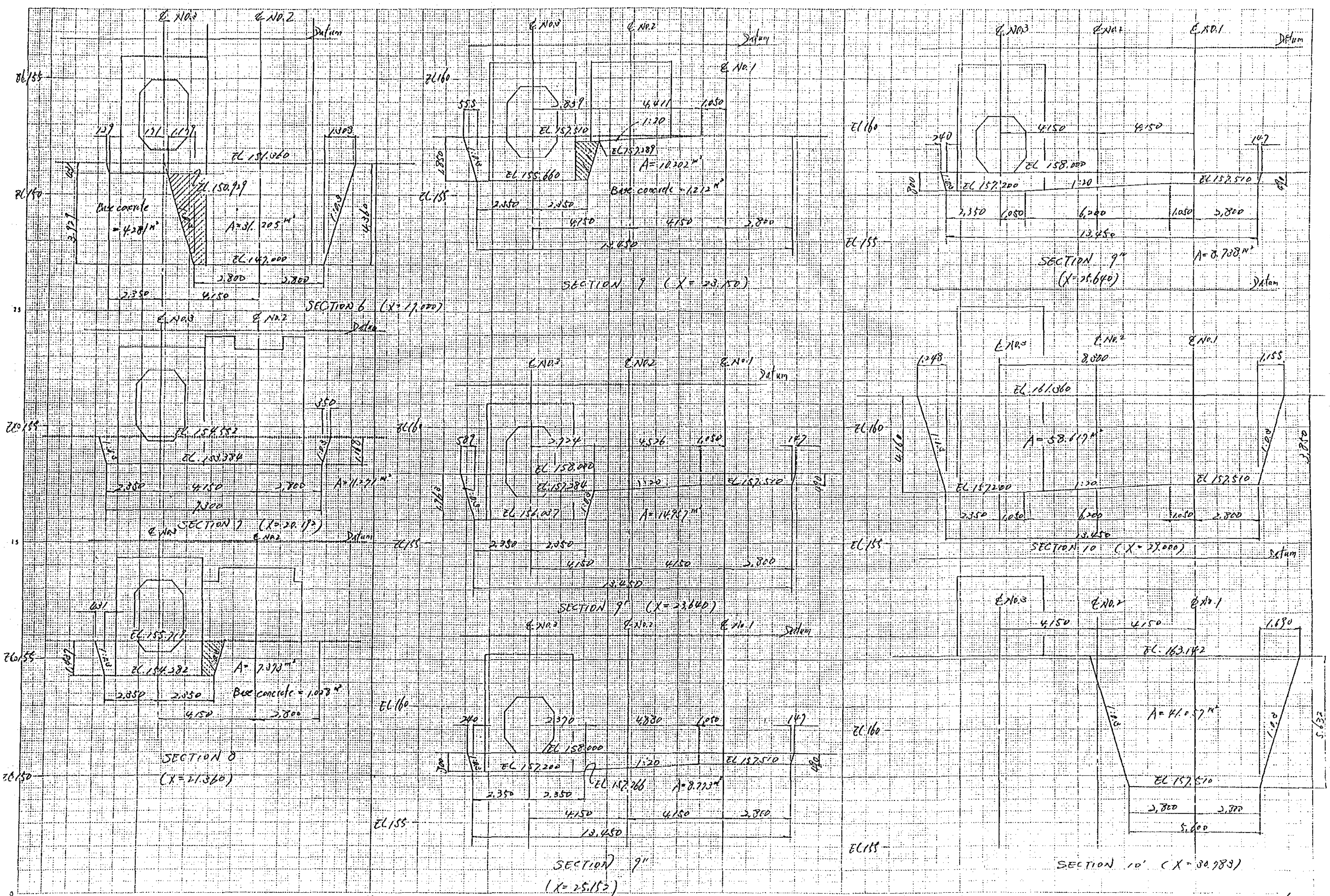
$X' = \frac{\sqrt{1+1.3^2}}{1.3}(X - X_0)$

$XX' = X' - 22.262 - 1.050 - 0.330 = 0.6564 \rightarrow 0657$

$L = 0.6 / \sin\theta = 0.6 \times \sqrt{1+1.3^2} = 0.9840$

$L - l = 0.5 \times \sqrt{1+1.3^2}$

$(L-l)\cdot\cos\theta = 0.5 \cdot \sqrt{1+1.3^2} \cdot \frac{1.3}{\sqrt{1+1.3^2}} = 0.5 \times 1.3 = 0.650$


SECTION 6 (X=17,000)
A=31.205 m²
Base concrete = 4.281 m³
EL 151.360
EL 150.929
EL 147.000
SECTION 7 (X=20.197)
EL 154.582
EL 153.384
A=11.771 m²
SECTION 8 (X=21.360)
EL 155.717
EL 154.382
A=7.373 m²
Base concrete = 1.078 m³
SECTION 9 (X=23.150)
EL 157.510
EL 157.389
EL 155.660
A=10.202 m²
Base concrete = 1.212 m³
SECTION 9′ (X=23.640)
EL 158.000
EL 157.384
EL 156.037
EL 157.510
A=14.957 m²
SECTION 9″ (X=25.153)
EL 158.000
EL 157.200
EL 157.266
EL 157.510
A=8.773 m²
SECTION 9‴ (X=26.640)
EL 158.000
EL 157.200
EL 157.510
A=8.738 m²
SECTION 10 (X=27.000)
EL 161.360
EL 157.200
EL 157.510
A=58.619 m²
SECTION 10′ (X=30.789)
EL 163.142
EL 157.510
A=41.057 m²
Datum
1:20
13.450
4.150
2.350
2.800
1.050
6.200
5.600

1/100

Working Division: E2 Concrete Work

Description	Calculation Details	Unit	Quantity	Remarks
E2/02	Concrete class C			
	No.1 Intake			
	Block 5 (Block 1 ~ 4 : None)			
	Block 5' B= 480" and			
	D= 460" above datum			
	line - 0.60m			
	EL 157.510 ~ EL 159.402			
	$\frac{1}{2}(1.150 + 1.622) \times 1.892 \times 4.80 = 12.587^{m^3}$			
	EL 159.402 - EL 162.0			
	$\frac{1}{2}(1.622 + 4.090) \times 2.598 \times 4.80 = 36.615$			
	EL. 162.0 ~ EL 166.892			
	$\frac{1}{2}(4.090 + 2.335 + 8.663) \times 4.892 \times 4.80 = 180.042$			
	EL 166.892 ~ 2.400			
	$\frac{1}{2}(8.663 + 7.5) \times 1.508 \times 4.80 = 59.273$			
	2.400 ~ EL 169.500			
	$\left\{\frac{1}{2}(2.400 + 7.5 + 1.836 + 7.2) - \frac{1}{2} 2.40 \times 0.80\right\}$			
	$\times 1.0 \times 4.80 = 40.814$			
	Chamb $0.20 \times 0.40 \times 4.60 = 0.368$			
	EL 169.50 ~ EL 172.10			
	$\frac{1}{2}(7.2 + 1.836) \times 2.6 \times 4.80 = 56.385$			
	$-\frac{1}{2} 2.75 \times 2.40 \times 0.20 = -0.708$			
	$-\left\{\frac{1}{2}(2.75 + 2.40 + 4.20 + 1.836)\right.$			
	$\left. - \frac{1}{2} 2.40 \times 0.8\right\} \times 1.0 \times 0.20 = -0.996$			

$+84.380^{m^3}$

Working Division:

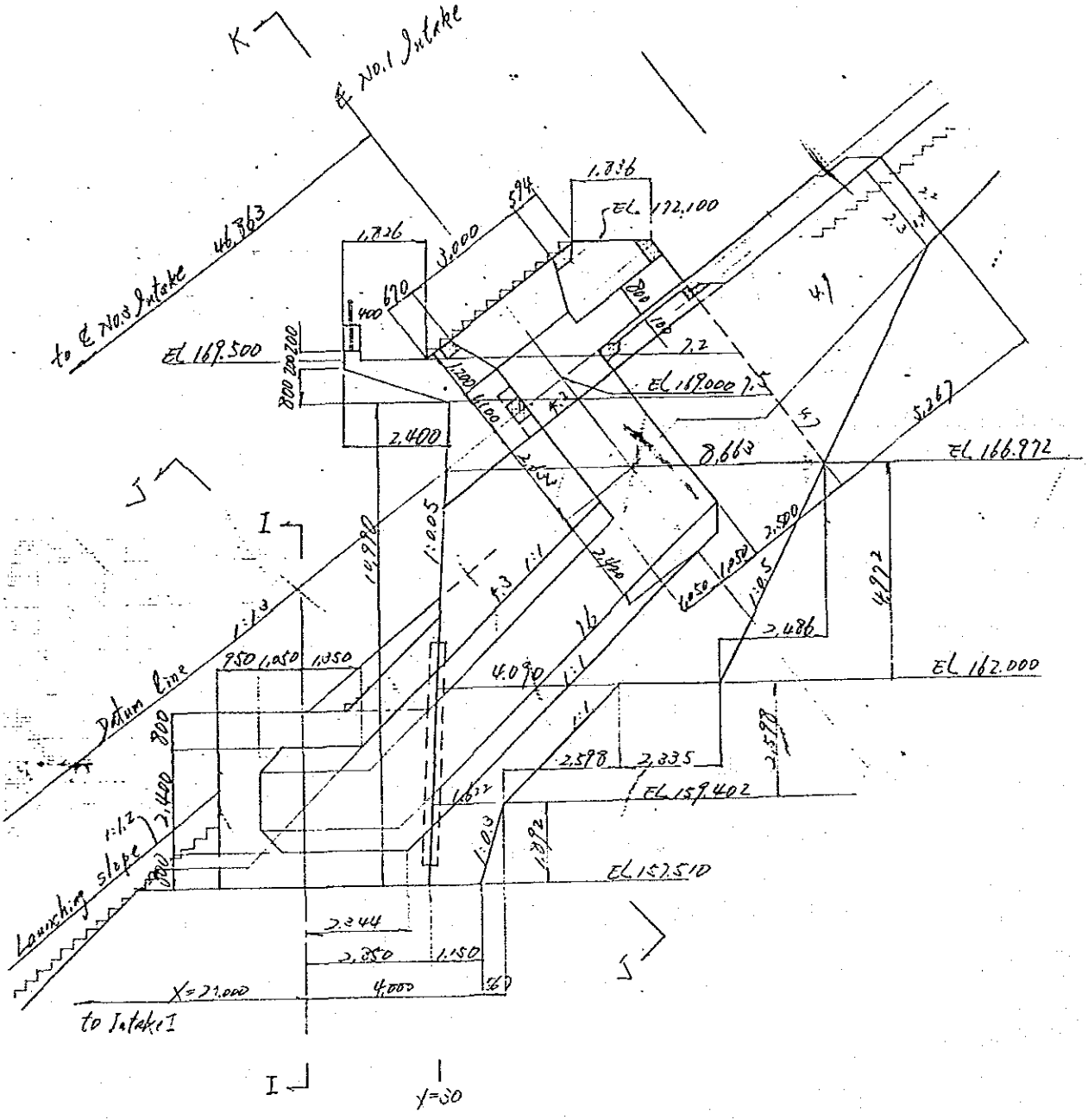
Description	Calculation Details	Unit	Quantity	Remarks
	$-\frac{1}{2}(4.70+4.70)\times1.20\times0.20 = -1.128$			
	$-\frac{1}{2}(4.70+1.836)\times1.40\times0.20 = -0.915$			
Steps	$2\times\frac{1}{2}\times0.217\times0.282\times0.70\times12 = 0.514$			
	Sub total 382.851 m^3			
Waterway				
	$\frac{1.200}{3}(3.0^2+3.0\times2.1+2.1^2) = 1.884\ m^3$			
	$2.10^2\times(1.100+2.633) = 16.462$			
	$2.10^2\times2.420-2\times\frac{1}{2}\times0.5\times0.5$			
	$\times 2.10 = 10.147$			
	$0.8\times2.550\times2.8\text{m} = 6.525$			
	$(2.1\times2.4-4\times\frac{1}{2}\times0.5\times0.5)$			
	$\times\frac{1}{2}(7.6+5.2) = 27.278$			
	Sub-total. 70.301 m^3			
Block E'				
	Gross 382.851 m^3			
	Waterway -70.301			
	Total 312.550 m^3			

Working Division: E2 Concrete Work

Description	Calculation Details	Unit	Quantity	Remarks
E2/02	Concrete class C			
	No. 1 Intake			
	Block 5" B = 450"			
	$\frac{1}{2}(4.7+2.3)\times 4.8\times 4.5$ = 77.175	m³		
	$\frac{1}{2}(2.3+2.2)\times 0.4\times 4.5$ = 4.050			
	$-\ 0.5\times 0.5\times 2.5$ = − 0.688			
	$2\times 0.55\times 0.60\times 5.67$ = 6.004			
	$0.5\times 0.6\times 2.1$ = 0.630			
	$\frac{1}{2}\ 2.0\times 0.85\times 0.35$ = 0.809			
	Sub-total 87.979	m³		
	Block 5 concrete class "C"			
	Block 5' 312.550	m³		
	" 5" 87.979			
	Class A − 5.939			
	Total 394.590	m³		

VI-4-76

No.1 Intake


K
℄ No.1 Intake
to ℄ No.3 Intake
46,363
1,836
EL. 172.100
594
13,000
670
400
EL 169.500
200 200 200
1,200
11,000
EL 169.000
2,400
8,663
EL 166.972
5,267
I
J
1:0.5
1:0.8
1:1.3
1:1
1:1.2
1:0.3
1:0.5
4,422
2,486
EL 162.000
950 1,050 1,050
Datum Line
800
2,400
Launching slope
2,598
2,335
EL 159.402
1,892
EL 157.510
2,344
2,850
1,150
4,000
X=21,000
to Intake I
I
y=50

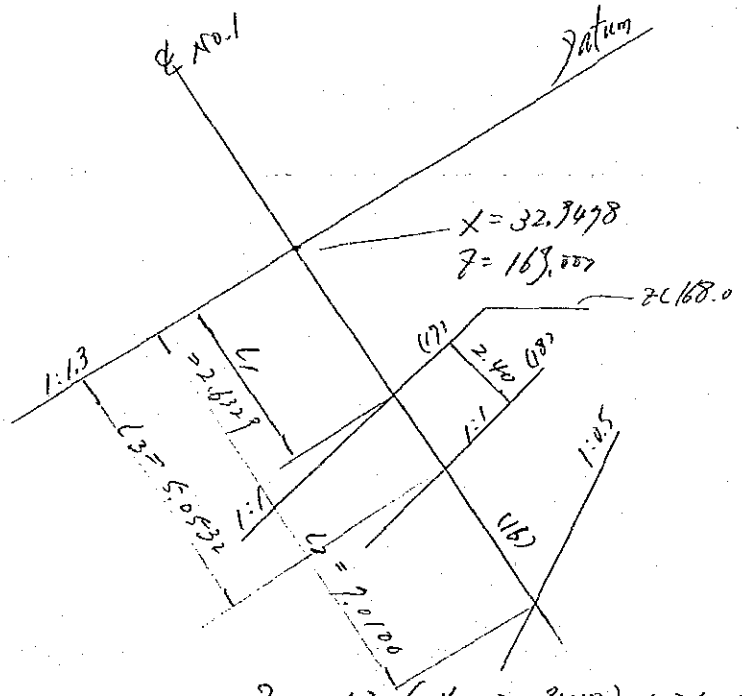
No.1 Intake

Datum line $Z = \frac{1}{1.3}(X - X_0) + Z_0$

$X_0 = -4.1974$

$Z_0 = EL\ 140.4267$

$Z = 163.000 \longrightarrow X = 32.3478$



(17) line $Z = -1.3 \cdot (X - 32.3478) + EL\ 163.000$

EL 158 ~ EL 163 1:1 slope $Z = X - 25.640 + EL\ 158.0$

Cross point

$$X - 25.640 + EL\ 158.0 = -1.3\,(X - 32.3478) + EL\ 163.00$$

$$(1 + 1.3)\,X = 1.3 \times 32.3478 + 163.00 - 158.0 + 25.640$$

$$X = 34.5531$$

$$Z = EL\ 166.9131$$

$$L_1 = \frac{\sqrt{1 + 1.3^2}}{1.3}\,(163.0 - 166.9131) = 2.6327$$

(16) line $z = -1.3(X - 32.3498) + EL\,169.0$

1:0.5 line $z = \frac{1}{0.5}(X - 36.5) + EL\,162.0$

cross point

$$\frac{1}{0.5}(X-36.5) + EL\,162.0 = -1.3(X-32.3498) + EL\,169.0$$

$$(2+1.3)X = +1.3 \times 32.3498 + EL\,169.0 - EL\,162.0 + 2 \times 36.5$$

$$3.3$$

$$X = 37.2218$$
$$z = EL\,163.4437$$

$$l_2 = \frac{\sqrt{1+1.3^2}}{1.3}(169.0 - 163.4437) = 7.0100$$

1:1 lower slope (16) line $z = X - 25.640 + EL\,158.0 - 2.40 \cdot \sec 45^\circ$ ($\sec 45^\circ = \sqrt{2}$)

cross point

$$X - 25.640 + EL\,158.0 - \sqrt{2} \cdot 2.40 = -1.3(X - 32.3498) + EL\,169.0$$

$$(1+1.3)X = 1.3 \times 32.3498 + EL\,169.0 - EL\,158.0 + 25.640 + \sqrt{2} \cdot 2.40$$

$$2.3$$

$$X = 36.0288$$
$$z = 164.9947$$

$$l_3 = \frac{\sqrt{1+1.3^2}}{1.3}(169.0 - 164.9947) = 5.0532$$

(17) line $Z = X - 25.640 + EC\ 158.0$

18) line $Z = X - 25.640 + EC\ 158.0 - \sqrt{2} \cdot 2.400$

$Z = 160.310$ for (17) $X = 28.350$

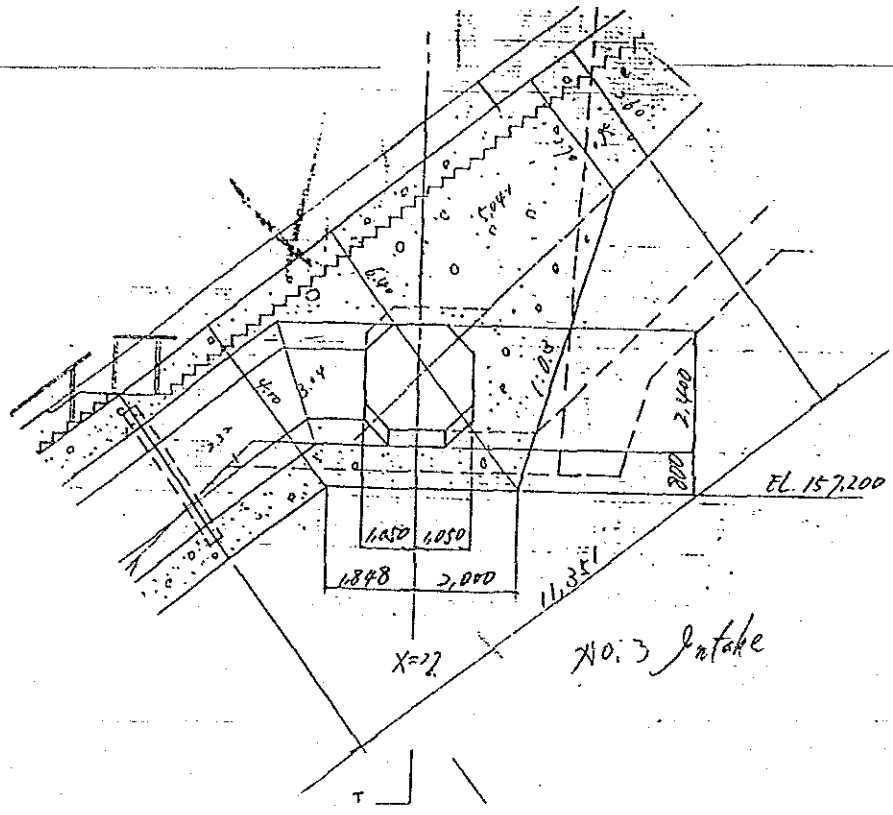
$Z = 158.310$ for (18) $X = 27.3441$

Working Division: E2 Concrete Work

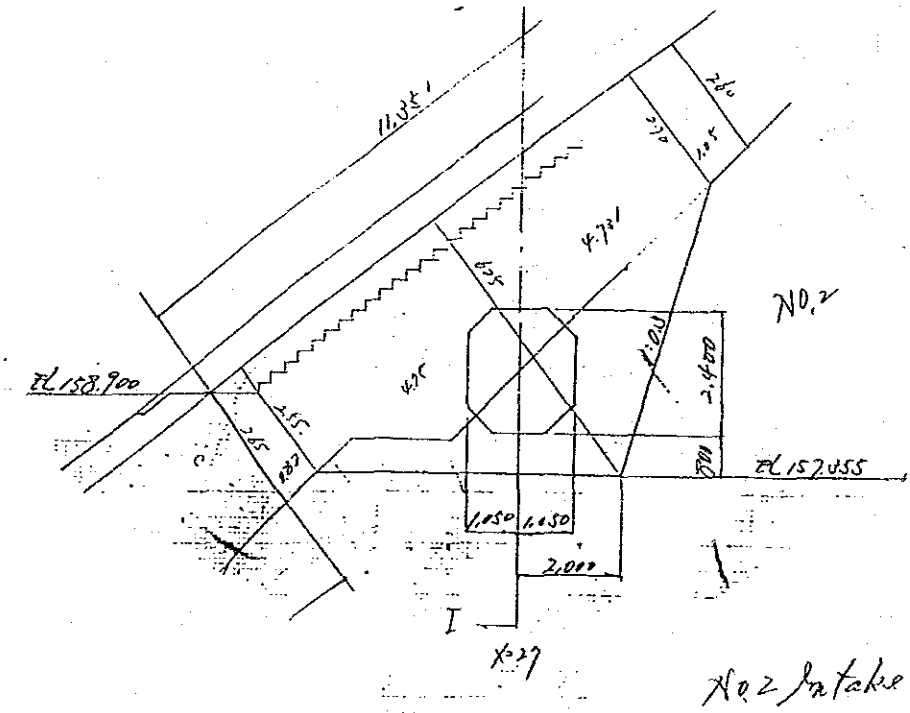
Description	Calculation Details	Unit	Quantity	Remarks
E2/02	Concrete class C			
	No.1, No.2 and No.3 Intake			
	Block 4			
	(No.2 Intake, B = 3.70 m)			
		m^3		
	4.0 × 3.7 × 2.32 = 34.336			
	$\frac{1}{2}$ (4.0 + 6.40) × 3.7 × 3.04 = 58.490			
	$\frac{1}{2}$ (6.40 + 2.70) × 3.7 × 5.041 = 84.865			
	$\frac{1}{2}$ (2.70 + 2.60) × 3.7 × 0.95 = 9.315			
	Sub-total 187.006 m^3			
	(No.2 Intake, B = 3.95 m)			
		m^3		
	$\frac{1}{2}$ (2.65 + 2.55) × 3.95 × 0.82 = 8.421			
	$\frac{1}{2}$ (2.55 + 6.28) × 3.95 × 4.15 = 82.555			
	$\frac{1}{2}$ (6.28 + 2.70) × 3.95 × 4.931 = 83.626			
	$\frac{1}{2}$ (2.70 + 2.60) × 3.95 × 1.05 = 10.891			
	Base concrete			
	Sec.7 ~ Sec.9' $\frac{1}{2}$ (1.212 + 0.857) × 0.49 = 0.507			
	Sec.9' ~ Sec.9" $\frac{1}{2}$ 0.857 × 1.512 = 0648			
	Step part −0.80 × 0.65 × 11.0 = −4.290			
	Sub-total 182.458 m^3			

Working Division:

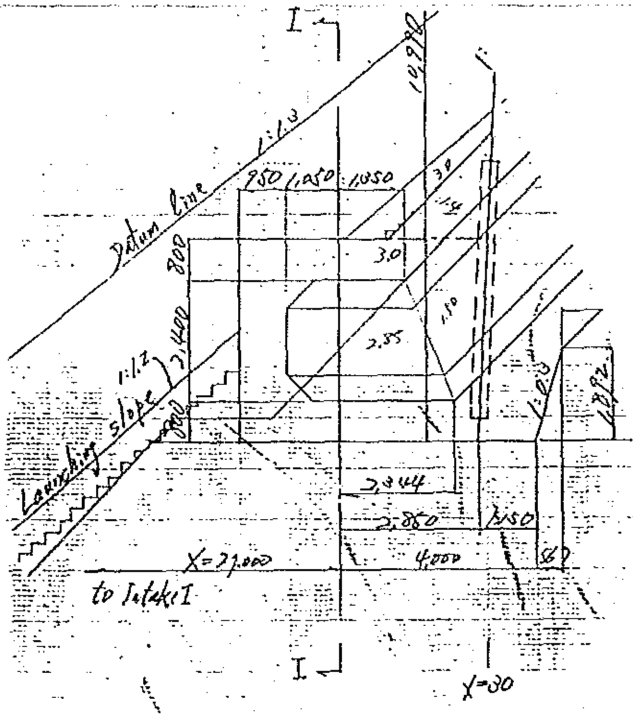
Description	Calculation Details	Unit	Quantity	Remarks
	(No.1 Intake B= 4.35m)			
	$\frac{1}{2}(4.85+5.0)\times 4.0\times 4.35 = 85.695$	m^3		
	$\frac{1}{2}\ 3.0\times 1.4\times 3.7 = 7.770$			
	Sub-total 93.465	m^3		
	Waterway			
	No.3 Intake			
	$(2.40\times 2.10 - 4\times\frac{1}{2}\times 0.5^2)\times 3.0 = 13.620$	m^3		
	$(2.40\times 2.10 - 4\times\frac{1}{2}\times 0.5^2)\times 3.6 = 16.344$			
	lateral			
	$(2.40\times 2.10 - 4\times\frac{1}{2}\times 0.5^2)\times 6.20 = 28.148$			
	No.1 Intake			
	$(2.40\times 2.10 - 4\times\frac{1}{2}\times 0.5^2)\times 2.85 = 12.939$			
	(") $\times 1.50 = 6.810$			
	Sub-total 77.861	m^3		
	Block No.4 Concrete class C			
	No.3 Intake 187.006	m^3		
	No.2 " 182.458			
	No.1 " 93.465			
	Waterway − 77.861			
	Total 385.068	m^3		

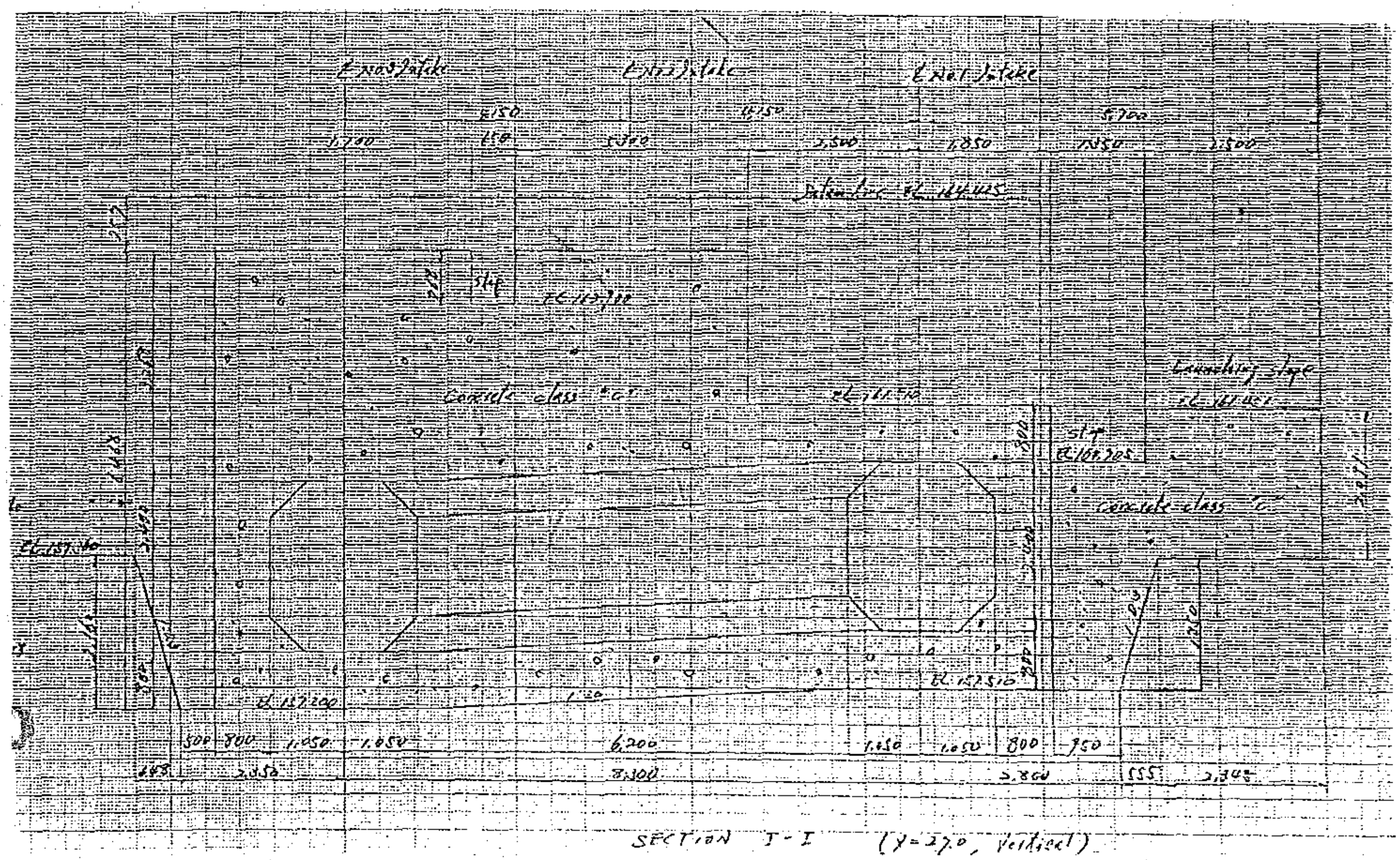


No. 3 Intake



No. 2 Intake





SECTION I - I (X=27.0, Vertical)