

§ 7. *Earth work and Miscellaneous work*

7-1 Earthworks

A. Abutment

Excavation

$$V = \frac{3.20}{6} \cdot [3.50 \cdot 10.962 + (1.70 + 3.50) \cdot (14.162 + 10.962) + 1.70 \cdot 14.162]$$

$$= 103.0 \text{ m}^3$$

Selected Material

$$V = \frac{1}{2} \cdot (0.60 + 2.10) \cdot 2.70 \cdot 9.028 = 32.9 \text{ m}^3$$

fillter

$$V = 2.0 \cdot 0.50 \cdot 9.028 = 9.0 \text{ m}^3$$

A. Abutment

Excavation

$$V = \frac{3.20}{6} \cdot [3.40 \cdot 10.962 + (3.40 + 2.00) \cdot (10.962 + 14.162) + 2.0 \cdot 14.162]$$

$$= 107.3 \text{ m}^3$$

Selected Material

$$V = \frac{1}{2} \cdot (0.60 + 2.10) \cdot 2.70 \cdot 9.028 = 32.9 \text{ m}^3$$

fillter

$$V = 2.00 \cdot 0.50 \cdot 9.028 = 9.0 \text{ m}^3$$

A. Abutment

Excavation

$$V = 3.20/6 \cdot [(1.20 \cdot 18.717 + (1.20 + 3.00) \cdot (15.517 + 18.717)) + 3.0 \cdot 15.517]$$

$$= 113.5 \text{ m}^3$$

Selected Material

$$V = \frac{1}{2} \cdot (0.60 \cdot 2.10) \cdot 2.40 \cdot 13.597$$

$$= 44.1 \text{ m}^3$$

fillter

$$V = 2.00 \cdot 0.5 \cdot 13.597$$

$$= 13.6 \text{ m}^3$$

A₂ Abutment

Excavation

$$V = 4.20/6 \cdot [(2.20 \cdot 19.717 + (2.20 + 4.50) \cdot (15.517 + 19.717)) + 4.50 \cdot 15.517]$$

$$= 249.5 \text{ m}^3$$

Selected Material

$$V = \frac{1}{2} \cdot (0.7 \cdot 3.50) \cdot 3.80 \cdot 13.597$$

$$= 108.5 \text{ m}^3$$

fillter

$$V = 3.25 \cdot 0.5 \cdot 13.597$$

$$= 22.1 \text{ m}^3$$

A₁ Abutment

Excavation

$$V = \frac{3.00}{6} \cdot [1.50 \cdot 12.491 + (1.50 + 3.20) \cdot (12.491 + 9.491) + 3.20 \cdot 9.491]$$

$$= 76.0 \text{ m}^3$$

Selected Material

$$V = \frac{1}{2} \cdot (0.70 + 2.00) \cdot 2.50 \cdot 7.524 = 25.4 \text{ m}^3$$

fillter

$$V = 2.00 \cdot 0.50 \cdot 7.524 = 7.5 \text{ m}^3$$

A₂ Abutment

Excavation

$$V = \frac{3.70}{6} \cdot [1.70 \cdot 13.191 + (1.70 + 3.50) \cdot (13.191 + 9.491) + 3.50 \cdot 9.491]$$

$$= 107.0 \text{ m}^3$$

Selected Material

$$V = \frac{1}{2} \cdot (0.60 + 2.50) \cdot 3.20 \cdot 7.524 = 38.5 \text{ m}^3$$

fillter

$$V = 2.50 \cdot 0.50 \cdot 7.524 = 9.8 \text{ m}^3$$

A1 Abutment

Excavation

$$V = 4.20/6 \cdot [4.20 \cdot 7.70 + (4.20 + 4.20) \cdot (7.70 + 11.90) + 4.20 \cdot 11.90]$$

(Common 51.9 + rock 121.0)
0.3 : 0.7

$$= 172.9 \text{ m}^3$$

Selected Material

$$V = \frac{1}{2} \cdot (0.70 + 3.60) \cdot 3.30 \cdot 5.5 = 44.9 \text{ m}^3$$

fillter

$$V = 3.00 \cdot 0.5 \cdot 5.50 = 8.3 \text{ m}^3$$

A2 Abutment

Excavation

$$V = 4.20/6 \cdot [2.80 \cdot 11.90 + (2.80 + 4.6) \cdot (11.90 + 7.70) + 4.60 \cdot 7.70]$$

(Common 44.9 + rock 104.7)
0.3 : 0.7

$$= 149.6 \text{ m}^3$$

Selected Material

$$V = \frac{1}{2} \cdot (0.70 + 3.50) \cdot 3.70 \cdot 5.50 = 42.7 \text{ m}^3$$

fillter

$$V = 3.00 \cdot 0.5 \cdot 5.50 = 8.3 \text{ m}^3$$

*A₁ Abutment**Excavation*

$$V = 2.00/6 \cdot [2.40 \cdot 9.70 + (2.40 + 3.40) \cdot (9.70 + 7.70) + 3.40 \cdot 7.70] \\ = 50.1 \text{ m}^3$$

Selected Material

$$V = \frac{1}{2} \cdot (0.60 + 1.80) \cdot 2.00 \cdot 5.50 = 13.2 \text{ m}^3$$

$$\frac{1}{2} \cdot \frac{1}{2} \cdot (1.80 + 2.80) \cdot 0.65 \cdot 5.50 = 8.2 \text{ m}^3$$

$$\Sigma V = 21.4 \text{ m}^3$$

fillter

$$V = 2.00 \cdot 0.50 \cdot 5.50 = 5.50 \text{ m}^3$$

*A₂ Abutment**Excavation*

$$V = 4.00/6 \cdot [1.60 \cdot 11.72 + (1.60 + 3.50) \cdot (11.70 + 7.70) + 3.50 \cdot 7.70] \\ = 96.4 \text{ m}^3$$

Selected Material

$$V = \frac{1}{2} \cdot (0.60 + 2.70) \cdot 3.4 \cdot 5.50 = 30.9 \text{ m}^3$$

fillter

$$V = 2.50 \cdot 0.50 \cdot 5.50 = 6.9 \text{ m}^3$$

[illegible]

7-2 Demolition

Concrete structure

	Pailles OV.	Coromandel OV.	AI-ROAD	Total
R.C. Slab	44.6	14.7	54.3	113.6
Abutment	530	350	1350	2230

PAILLES Ov.

Demolition

Concrete structure

1) Superstructure

$$V_1 = 0.35 \times 1.31 \times 12.25 \times 2 = 11.2 \text{ m}^3$$

$$V_2 = 5.50 \times 0.30 \times 12.25 = 20.2$$

$$V_3 = 0.70 \times 0.70 \times 12.25 \times 3 = 13.2$$

$$\Sigma = 44.6 \text{ m}^3$$

2) Sub structure

$$\text{Abutment } A_1 \quad 6.5 \times 10.0 \times 1.0 = 250 \text{ m}^3$$

$$\text{" } A_2 \quad 6.5 \times 10.3 \times 1.0 = 270$$

$$\Sigma = 530 \text{ m}^3$$

A1 - ROAD Ov.

Demolition

Concrete structure

1) Superstructure

$$V_1 = 19.3 \times 5.5 \times 0.46 = 48.8 \text{ m}^3$$

$$V_2 = 0.35 \times 1.3 \times 6.0 \times 2 = 5.5$$

$$54.3 \text{ m}^3$$

2) Sub structure

$$\text{Abutment } A_1 \quad 19.3 \times 8.50 \times 1.0 = 164 \text{ m}^3$$

$$\text{" } A_2 \quad 19.3 \times 9.0 \times 4.0 = 695$$

$$1350 \text{ m}^3$$

COROMANDEL DV.

Demolition

Concrete structure

1) Superstructure

$$V_1 = 4.15 \times 0.45 \times 5.3 = 9.9 \text{ m}^3$$

$$V_2 = 0.35 \times 1.30 \times 5.3 \times 2 = 4.8$$

$$14.7 \text{ m}^3$$

2) Sub structure

Abutment A, A₂

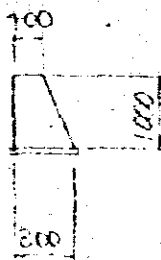
$$V = 8.0 \times 5.5 \times 4.0 \times 2 = 352 \text{ m}^3$$

7-3 Gravity-Type Retaining wall.

(1) PAILLES Ov. Br.

(A1) side

Concrete Volume



$$\begin{aligned} \text{(left)} \quad V &= \frac{1}{2} \times (0.4 + 0.8) \times 1.0 \times 1.0 = 0.6 \, \text{m}^3 \\ \text{(right)} \quad V &= \quad \quad \quad = \quad \quad \quad \\ \hline &= 1.2 \, \text{m}^3 \end{aligned}$$

Formwork Area

$$\text{(left)} \quad A_1 = \frac{1}{2} \times (0.4 + 0.8) \times 1.0 + 1.0 \times 1.0 = 1.6 \, \text{m}^2$$

$$A_2 = \sqrt{0.4^2 + 1.0^2} \times 1.0 = 1.1 \, \text{m}^2$$

$$\text{(right)} \quad A_1 = \quad \quad \quad = 1.6 \, \text{m}^2$$

$$A_2 = \quad \quad \quad = 1.1 \, \text{m}^2$$

$$\Sigma A_1 = 3.2 \, \text{m}^2 \quad (\text{Fair Finish})$$

$$\Sigma A_2 = 2.2 \, \text{m}^2 \quad (\text{Rough Finish})$$

$$\text{for blinding } (1.0 + 1.0) \times 2 \times 0.1 \times 2 = 0.8 \quad (\text{Rough Finish})$$

(A2) side

Concrete Volume

$$\Sigma V = 1.2 \, \text{m}^3$$

Formwork Area

$$\Sigma A_1 = 3.2 \, \text{m}^2 \quad (\text{Fair Finish})$$

$$\Sigma A_2 = 2.2 \, \text{m}^2 \quad (\text{Rough Finish})$$

$$\text{for blinding } A = 0.8 \, \text{m}^2 \quad (\quad)$$

blinding concrete volume

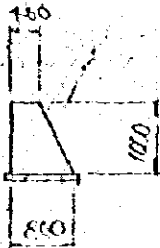
left and right

$$\text{(A1) side } 1.0 \times 0.1 \times 1.0 \times 2 = 0.2 \, \text{m}^3$$

$$\text{(A2) " } \quad \quad \quad = 0.2 \, \text{m}^3$$

(2) A1- ROAD. Over. Br.

(A1) side



Concrete Volume

$$(Right) V = \frac{1}{2} \times (0.4 + 0.8) \times 1.0 \times 1.0 = 0.6 \text{ m}^3$$

blinding concrete Volume

$$V = 0.1 \times 1.0 \times 1.0 = 0.1 \text{ m}^3$$

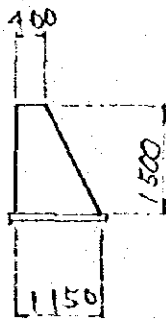
Formworks Area

$$A_1 = 1.6 \text{ m}^2$$

$$A_2 = 1.1 \text{ m}^2$$

$$\text{Form for blinding} = (1.0 + 1.0) \times 2 \times 0.1 = 0.4$$

(A2) side



Concrete Volume

$$(Right) V = \frac{1}{2} \times (0.4 + 1.15) \times 1.5 \times 1.3 = 1.5 \text{ m}^3$$

$$(Left) V = 1.5 \text{ m}^3$$

Blinding concrete Volume

$$(Right) V = 1.35 \times 0.1 \times 1.4 = 0.2 \text{ m}^3$$

$$(Left) V = 0.2 \text{ m}^3$$

Formwork Area

$$(Right) A_1 = \frac{1}{2} \times (0.4 + 1.15) \times 1.5 + 1.5 \times 1.3 = 3.1 \text{ m}^2$$

$$A_2 = \sqrt{0.75^2 + 1.5^2} \times 1.3 = 2.2 \text{ m}^2$$

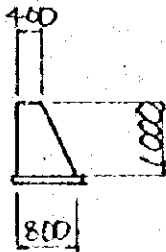
$$(Left) A_1 = 3.1 \text{ m}^2$$

$$A_2 = 2.2 \text{ m}^2$$

$$\text{form for blinding} (1.35 + 1.4) \times 2 \times 0.1 \times 2 = 1.1 \text{ m}^2$$

(3) COROMANDEL Ov. Br.

(A1) side



Concrete Volume

$$\text{Right } V = 0.6 \text{ m}^3$$

$$\text{Left } V = 0.6 \text{ m}^3$$

Blinding concrete

$$\text{Right } V = 0.1$$

$$\text{Left } V = 0.1$$

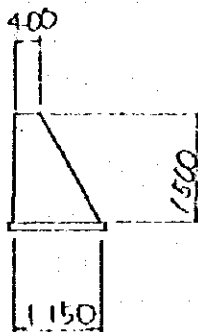
Formwork Area

$$\text{Right } A_1 = 1.6 \text{ m}^2 \quad A_2 = 1.1 \text{ m}^2$$

$$\text{Left } A_1 = 1.6 \quad A_2 = 1.1 \text{ m}^2$$

$$\text{Form for blinding } 0.8 \text{ m}^2$$

(A2) side



Concrete Volume

$$\text{Right } V = \frac{1}{2} \times (0.4 + 1.15) \times 1.5 \times 1.5 = 1.17 \text{ m}^3$$

$$\text{Left } V = 0.6 \text{ m}^3$$

Blinding concrete

$$\text{Right } V = 0.1 \times 1.35 \times 1.5 = 0.2 \text{ m}^3$$

$$\text{Left } V = 0.1 \text{ m}^3$$

Formwork Area

$$\text{Right } A_1 = \frac{1}{2} \times (0.4 + 1.15) \times 1.5 + 1.5 \times 1.5 = 3.4 \text{ m}^2$$

$$\text{Left } A_2 = \sqrt{0.75^2 + 1.5^2} \times 1.5 = 2.5 \text{ m}^2$$

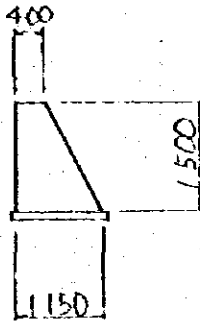
$$\text{Left } A_1 = 1.6 \text{ m}^2$$

$$A_2 = 1.1 \text{ m}^2$$

$$\text{Form for blinding } (1.35 + 1.5) \times 2 \times 0.1 + 0.4 \text{ m}^2 = 1.0 \text{ m}^2$$

(4) Cor. Int. H-Rp Ov. Br.

① Side



Concrete Volume

$$(Right) V = \frac{1}{2} \times (0.4 + 1.15) \times 1.5 \times 2.2 = 2.6 \text{ m}^3$$

$$(Left) V = \frac{1}{2} \times (0.4 + 1.15) \times 1.5 \times 2.7 = 3.1 \text{ m}^3$$

Blinding concrete

$$(Right) V = 0.1 \times 1.35 \times 2.3 = 0.3 \text{ m}^3$$

$$(Left) V = 0.1 \times 1.35 \times 2.8 = 0.4 \text{ m}^3$$

Formwork Area

$$(Right) A_1 = \frac{1}{2} \times (0.4 + 1.15) \times 1.5 + 2.2 \times 1.5 = 4.5 \text{ m}^2$$

$$A_2 = \sqrt{0.75^2 + 1.5^2} \times 2.2 = 3.7 \text{ m}^2$$

$$(Left) A_1 = \frac{1}{2} \times (0.4 + 1.15) \times 1.5 + 2.7 \times 1.5 = 5.2 \text{ m}^2$$

$$A_2 = \sqrt{0.75^2 + 1.5^2} \times 2.7 = 4.5 \text{ m}^2$$

$$\text{Form for blinding} = \frac{(1.35 + 2.3) \times 2 \times 0.1}{2} + \frac{(1.35 + 2.8) \times 2 \times 0.1}{2} = 1.6 \text{ m}^2$$

② side

Concrete Volume

$$(Right) V = \frac{1}{2} \times (0.4 + 1.15) \times 1.5 \times 1.8 = 2.1 \text{ m}^3$$

$$(Left) V = 2.1 \text{ m}^3$$

Blinding concrete

$$(Right) V = 0.1 \times 1.35 \times 1.9 = 0.3 \text{ m}^3$$

$$(Left) V = 0.3 \text{ m}^3$$

Formworks.

$$(Right) A_1 = \frac{1}{2} \times (0.4 + 1.15) \times 1.5 + 1.8 \times 1.5 = 3.9 \text{ m}^2$$

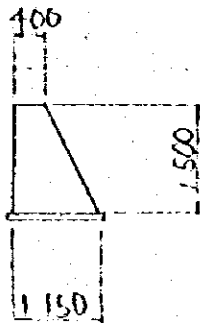
$$A_2 = \sqrt{0.75^2 + 1.5^2} \times 1.8 = 3.0 \text{ m}^2$$

$$(Left) A_1 = 3.9 \text{ m}^2 \quad \text{form for blinding} = \frac{(1.35 + 1.9) \times 2 \times 0.1 \times 2}{2} = 1.3 \text{ m}^2$$

$$A_2 = 3.0 \text{ m}^2$$

(5) STA. 22 Ov. Br.

(A1) side



Concrete Volume

$$\text{(Right)} \quad V = \frac{1}{2} \times (0.4 + 1.15) \times 1.5 \times 2.5 = 2.9 \text{ m}^3$$

$$\text{(Left)} \quad V = 2.9 \text{ m}^3$$

Blinding concrete

$$\text{(Right)} \quad V = 0.1 \times 1.35 \times 2.6 = 0.4 \text{ m}^3$$

$$\text{(Left)} \quad V = 0.4 \text{ m}^3$$

Formwork Area

$$\text{(Right)} \quad A_1 = \frac{1}{2} \times (0.4 + 1.15) \times 1.5 + 1.5 \times 2.5 = 4.9 \text{ m}^2$$

$$A_2 = \sqrt{0.75^2 + 1.5^2} \times 2.5 = 4.2 \text{ m}^2$$

$$\text{(Left)} \quad A_1 = 4.9 \text{ m}^2$$

$$A_2 = 4.2 \text{ m}^2$$

$$\text{form for blinding} = (1.35 + 2.6) \times 2 \times 0.1 \times 2 = 1.6 \text{ m}^2$$

(A2) side

Concrete Volume

$$\text{(Right)} \quad V = \frac{1}{2} \times (0.4 + 1.15) \times 1.5 \times 1.5 = 1.7 \text{ m}^3$$

$$\text{(Left)} \quad V = 1.7 \text{ m}^3$$

Blinding concrete

$$\text{(Right)} \quad V = 0.1 \times 1.35 \times 1.6 = 0.2 \text{ m}^3$$

$$\text{(Left)} \quad V = 0.2 \text{ m}^3$$

Formwork Area

$$\text{Right} \quad A_1 = \frac{1}{2} \times (0.4 + 1.15) \times 1.5 + 1.5 \times 1.5 = 3.4 \text{ m}^2$$

$$A_2 = \sqrt{0.75^2 + 1.5^2} \times 1.5 = 2.5 \text{ m}^2$$

$$\text{Left} \quad A_1 = 3.4 \text{ m}^2$$

$$A_2 = 2.5 \text{ m}^2$$

$$\text{form for blinding} = (1.35 + 1.6) \times 2 \times 0.1 \times 2 = 1.2 \text{ m}^2$$

7-4 Stone Masonry

(1) PAILLES Ov. Br.

$$\textcircled{P_1} \text{ side} \quad \text{Area} \quad A = 8.5^m \times 14.0 = 119^m{}^2$$

$$\text{Length} \quad L = 14.0^m$$

$$\textcircled{P_2} \text{ side} \quad \text{Area} \quad A = 12.0^m \times 14.5 = 174^m{}^2$$

$$\text{Length} \quad L = 14.5^m$$

(2) A1-ROAD Ov. Br.

$$\textcircled{P_1} \text{ side} \quad \text{Area} \quad A = 7.0 \times 17.0 = 119^m{}^2$$

$$\text{Length} \quad L = 17.0^m$$

$$\textcircled{P_2} \text{ side} \quad \text{Area} \quad A = 12.0 \times 18.0 = 216^m{}^2$$

$$\text{Length} \quad L = 20.0^m$$

(3) COROMANDEL Ov. Br.

$$\textcircled{P_1} \text{ side} \quad \text{Area} \quad A = 8.0 \times 12.0 = 96^m{}^2$$

$$\text{Length} \quad L = 12.0^m$$

$$\textcircled{P_2} \text{ side} \quad \text{Area} \quad A = 9.5 \times 14.0 = 133^m{}^2$$

$$\text{Length} \quad L = 14.0^m$$

(4) Cor. Int. H-Rp Ov. Br.

$$\textcircled{A_1} \text{ side} \quad \text{Area} \quad A = 5.5 \times 8.0 = 44^m{}^2$$

$$\text{Length} \quad L = 8.0^m$$

$$\textcircled{A_2} \text{ side} \quad \text{Area} \quad A = 7.0 \times 8.5 = 60^m{}^2$$

$$\text{Length} \quad L = 8.5^m$$

(5) STA. 22 Ov. Br.

$$\textcircled{P_1} \text{ side} \quad \text{Area } A = 7.0 \times 10.0 = 70 \text{ m}^2$$
$$\text{Length } L = 10.0 \text{ m}$$

$$\textcircled{P_3} \text{ side} \quad \text{Area } A = 10.5 \times 10.0 = 105 \text{ m}^2$$
$$\text{Length } L = 10.0 \text{ m}$$

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4. G.R.N.W. Bridge and St. Louis River Bridge

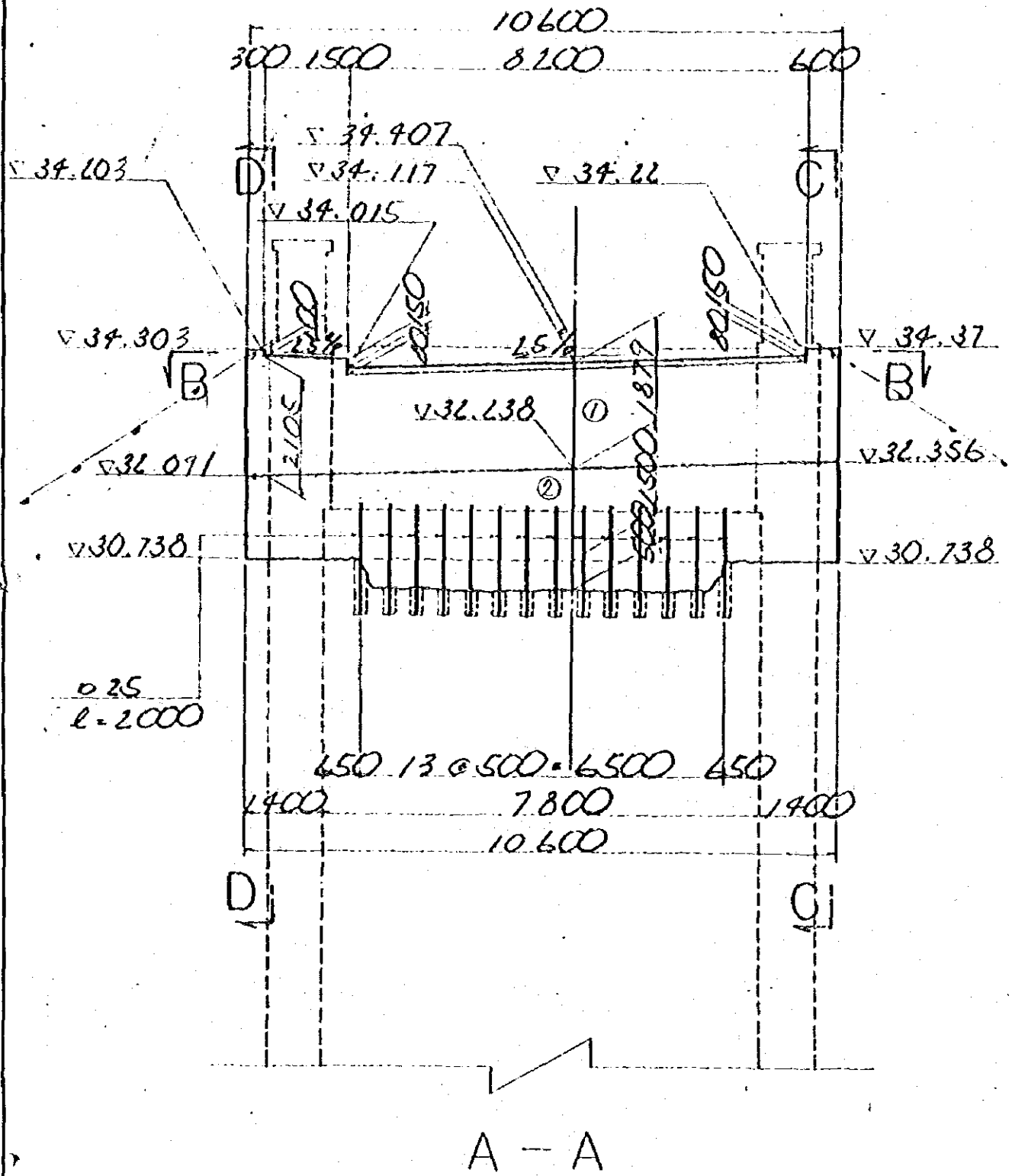
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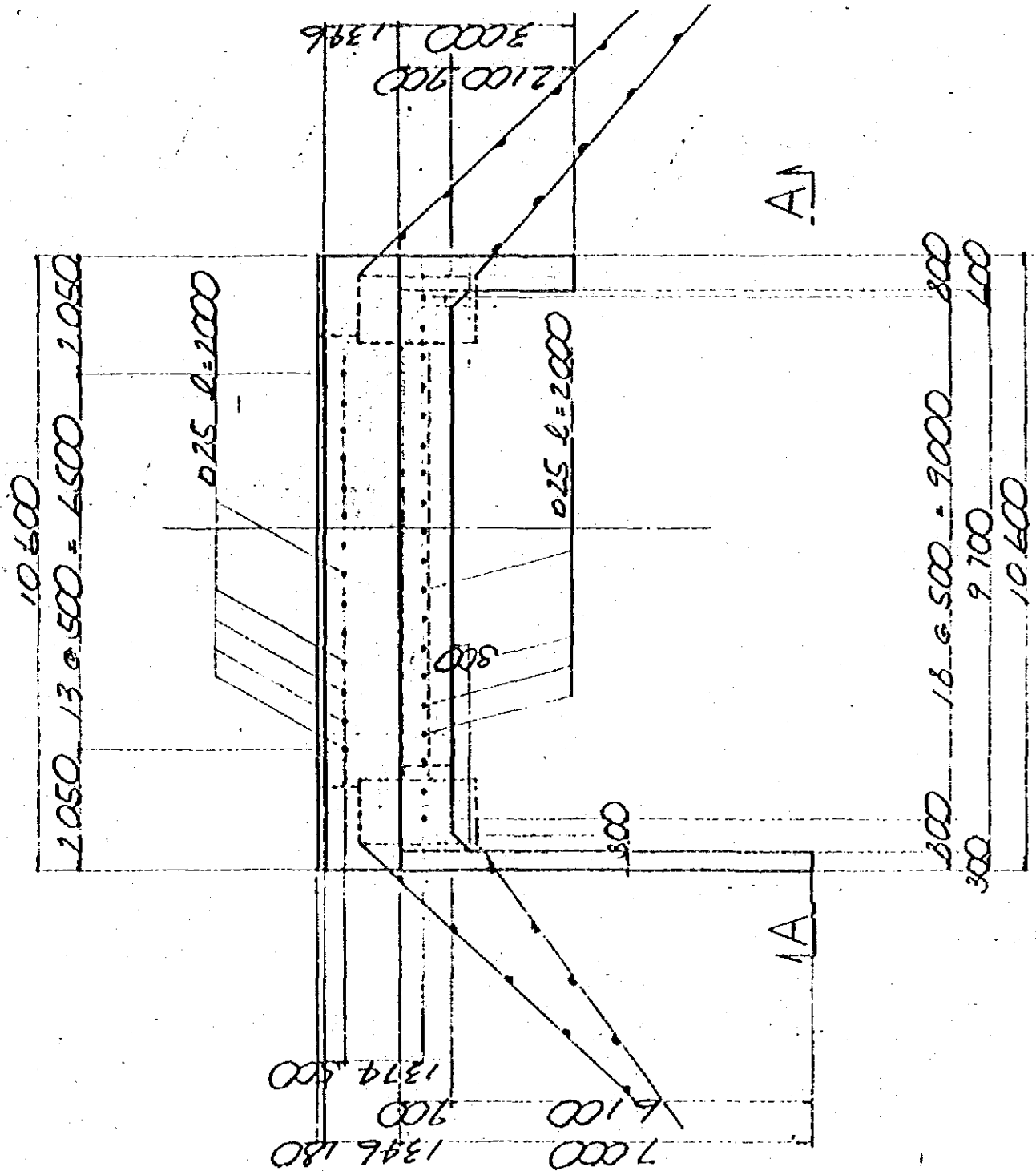
§ §	1.	LIST OF MATERIALS	———	1
§ §	2.	A - LINE	B.R. ———	3
		St. LOUIS	B.R. ———	4
		G.R.N.W.	B.R. ———	22
§ §	3.	B - LINE	B.R. ———	50
		St. LOUIS	B.R. ———	51
		G.R.N.W.	B.R. ———	89
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§§ 2 A-LINE B.R.

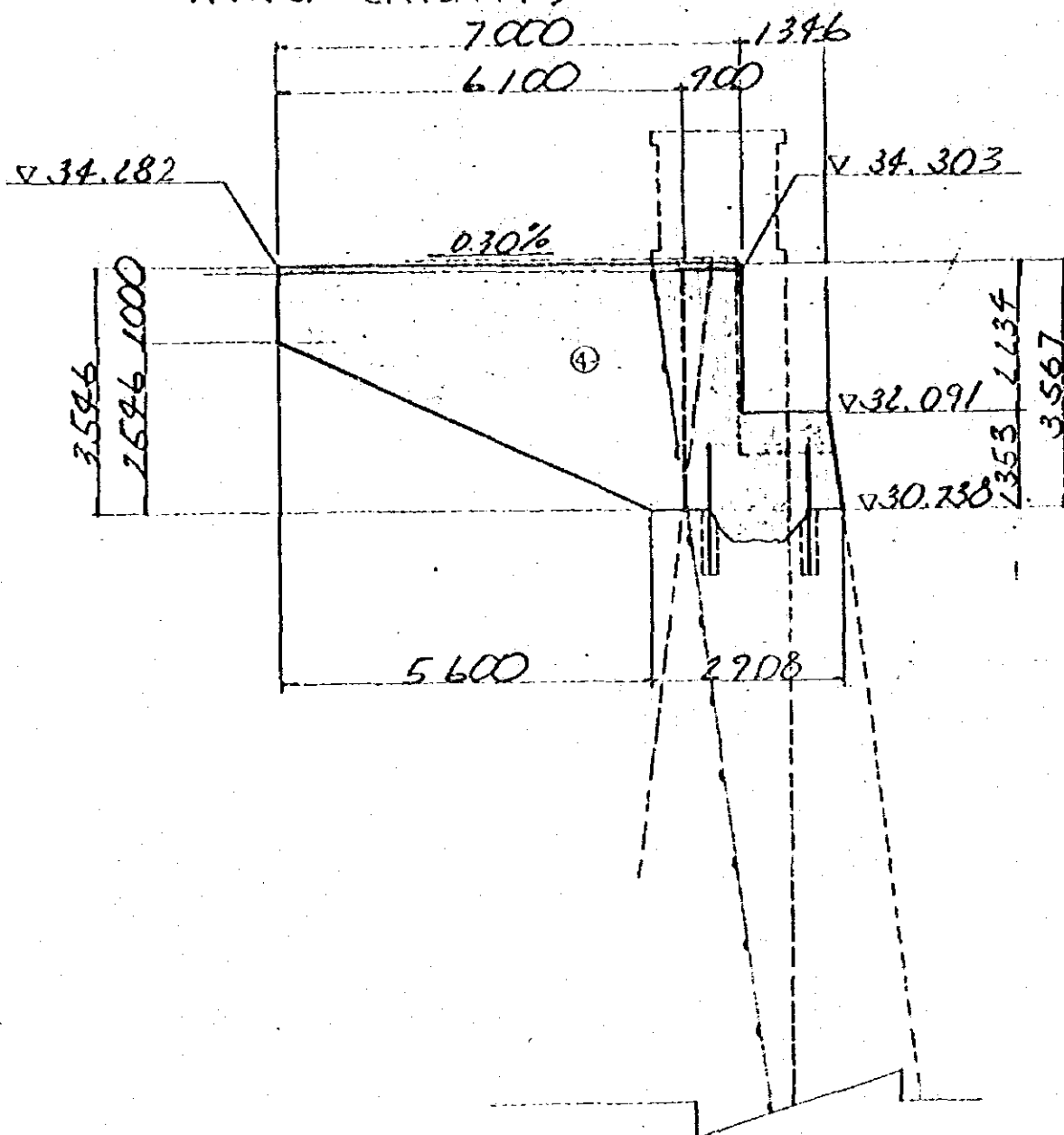
st. LOUIS
A1 - ABUTMENT

§ 1 STRUCTURAL FIGURE





WING (RIGHT)



D - D

§ 2 concrete volume

palapet

$$\begin{aligned}
 \textcircled{1} \quad & \frac{1}{2} \times (2.212 + 2.205) \times 0.30 \times 0.90 = 0.596 \\
 & \frac{1}{2} \times (2.105 + 2.029) \times 1.50 \times 0.90 = 2.79 \\
 & 1.799 \times 8.20 \times 0.90 = 13.277 \\
 & \frac{1}{2} \times (2.029 + 2.014) \times 0.60 \times 0.90 = 1.092 \\
 & \frac{1}{2} \times (0.30 + 0.60) \times 0.30 \times 8.20 = 1.107
 \end{aligned}$$

wall

$$\begin{aligned}
 \textcircled{2} \quad & \frac{1}{2} \times (1.353 + 1.618) \times 10.60 \times \frac{1}{2} \\
 & \times (2.246 + 2.374) = 36.374 \\
 & 0.50 \times 1.374 \times 6.50 = 4.466
 \end{aligned}$$

wing (left)

$$\begin{aligned}
 \textcircled{3} \quad & \frac{1}{2} \times (1.00 + 3.63) \times 1.50 \times 0.60 = 2.084 \\
 & \frac{1}{2} \times (3.63 + 3.631) \times 0.652 \times 0.60 = 1.42
 \end{aligned}$$

wing (right)

$$\begin{aligned}
 \textcircled{4} \quad & \frac{1}{2} \times (1.00 + 3.563) \times 5.60 \times 0.30 = 3.833 \\
 & \frac{1}{2} \times (3.563 + 3.564) \times 0.552 \times 0.30 = 0.59
 \end{aligned}$$

haunch

$$\frac{1}{2} \times 0.30 \times 0.30 \times (3.464 + 2.402) = 0.264$$

$$\Sigma V = 47.893 \text{ m}^3$$

grand total

$$V = 47893 \text{ m}^3$$

{ 3 form area

: parapet.

$$\begin{aligned}
 \textcircled{1} \quad & \frac{1}{2} \times (2.212 + 2.205) \times 0.30 & = 0.663 \\
 & \frac{1}{2} \times (2.105 + 2.029) \times 1.50 & = 3.101 \\
 & \frac{1}{2} \times (2.090 + 2.029) \times 1.20 & = 2.471 \\
 & 1.799 \times 8.20 & = 14.752 \\
 & 1.799 \times 7.90 & = 14.212 \\
 & \frac{1}{2} \times (2.029 + 2.014) \times 0.60 & = 1.213 \\
 & (2.212 + 2.014) \times 0.90 & = 3.803 \\
 & (0.25 \times 2 + 0.10) \times 0.90 & = 0.504 \\
 & -0.60 \times 8.20 + 0.30 \times 1.029 & = -5.229 \\
 & 0.30 \times 8.20 & = 2.46 \\
 & 0.30 \times 1.2 \times 8.20 & = 3.479 \\
 & \frac{1}{2} \times (0.30 + 0.60) \times 0.30 & = 0.135 \\
 \textcircled{2} \quad & \frac{1}{2} \times (1.363 + 1.63) \times 10.60 & = 15.863 \\
 & \frac{1}{2} \times (1.368 + 1.596) \times 9.10 & = 13.486 \\
 & \frac{1}{2} \times (2.246 + 2.44) \times 1.618 & = 3.791 \\
 & \frac{1}{2} \times (2.246 + 2.408) \times 1.353 & = 3.148
 \end{aligned}$$

wing

$$\begin{aligned}
 \textcircled{3} \quad & \frac{1}{2} \times (1.00 + 3.63) \times 1.50 \times 2 & = 6.945 \\
 & \frac{1}{2} \times (3.63 + 3.632) \times 0.589 & = 2.139
 \end{aligned}$$

$$\frac{1}{2} \times (3.63 + 3.631) \times 0.389 = 1.412$$

$$\begin{aligned} & (1.00 + \sqrt{1.50^2 + 2.625^2} + 0.589) \\ & \times 0.60 = 2.767 \end{aligned}$$

wing (right)

$$\textcircled{4} \frac{1}{2} \times (1.00 + 3.563) \times 5.60 \times 2 = 25.553$$

$$\frac{1}{2} \times (3.563 + 3.565) \times 0.50 = 1.782$$

$$\frac{1}{2} \times (3.563 + 3.564) \times 0.20 = 0.713$$

$$\begin{aligned} & (1.00 + \sqrt{2.546^2 + 5.60^2} + 0.50) \\ & \times 0.30 = 2.295 \end{aligned}$$

haunch

$$0.30 \times \sqrt{2} \times (3.458 + 2.402) = 2.486$$

$$\Sigma A = 123.944$$

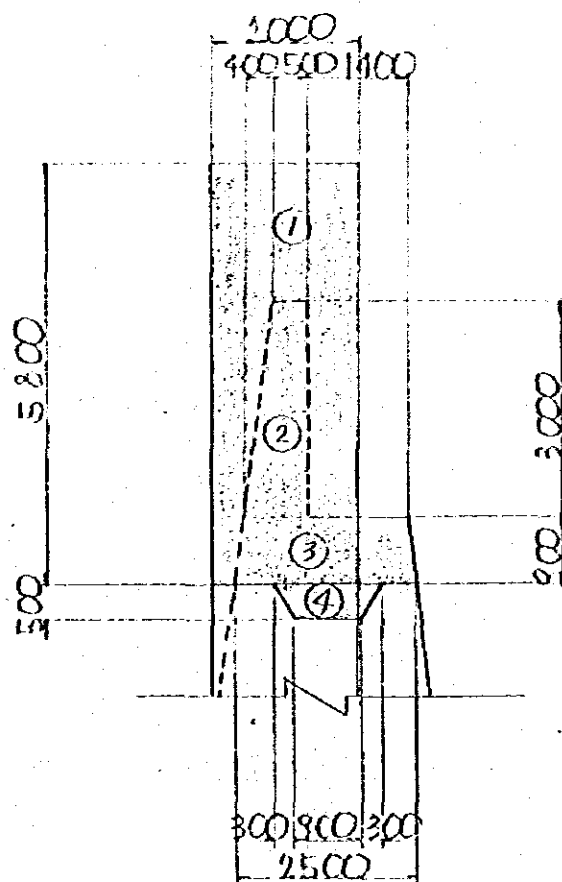
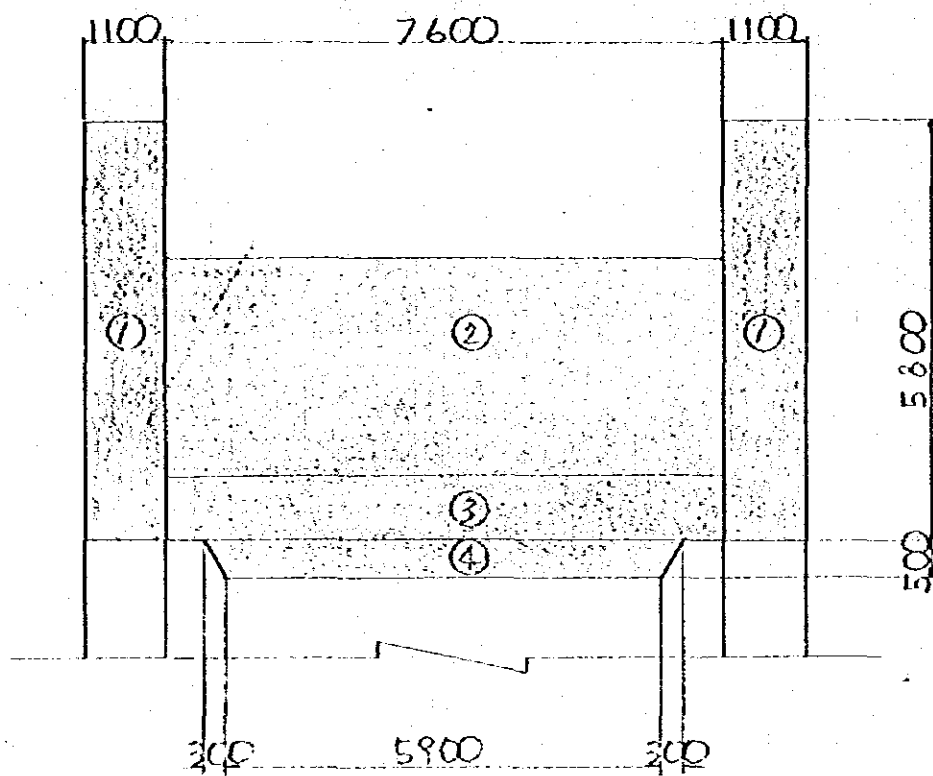
grand total

type-A (plane formworks)

$$A = 123.944 \text{ m}^2$$

A,

§ 4 DEMOLITION



$$\textcircled{1} \quad 1.10 \times 5.80 \times 2.00 \times 2 = 25.52$$

$$\textcircled{2} \quad \frac{1}{2} \times (0.50 + 0.90) \times 3.00 \times 7.60 = 15.96$$

$$\textcircled{3} \quad \frac{1}{2} \times (2.30 + 2.50) \times 0.90 \times 7.60 = 16.416$$

$$\textcircled{4} \quad \frac{1}{6} \times 0.50 \times [6.50 \times 1.50 + (6.50 + 5.90) \times (1.50 + 0.90) + 5.90 \times 0.90] = 3.735$$

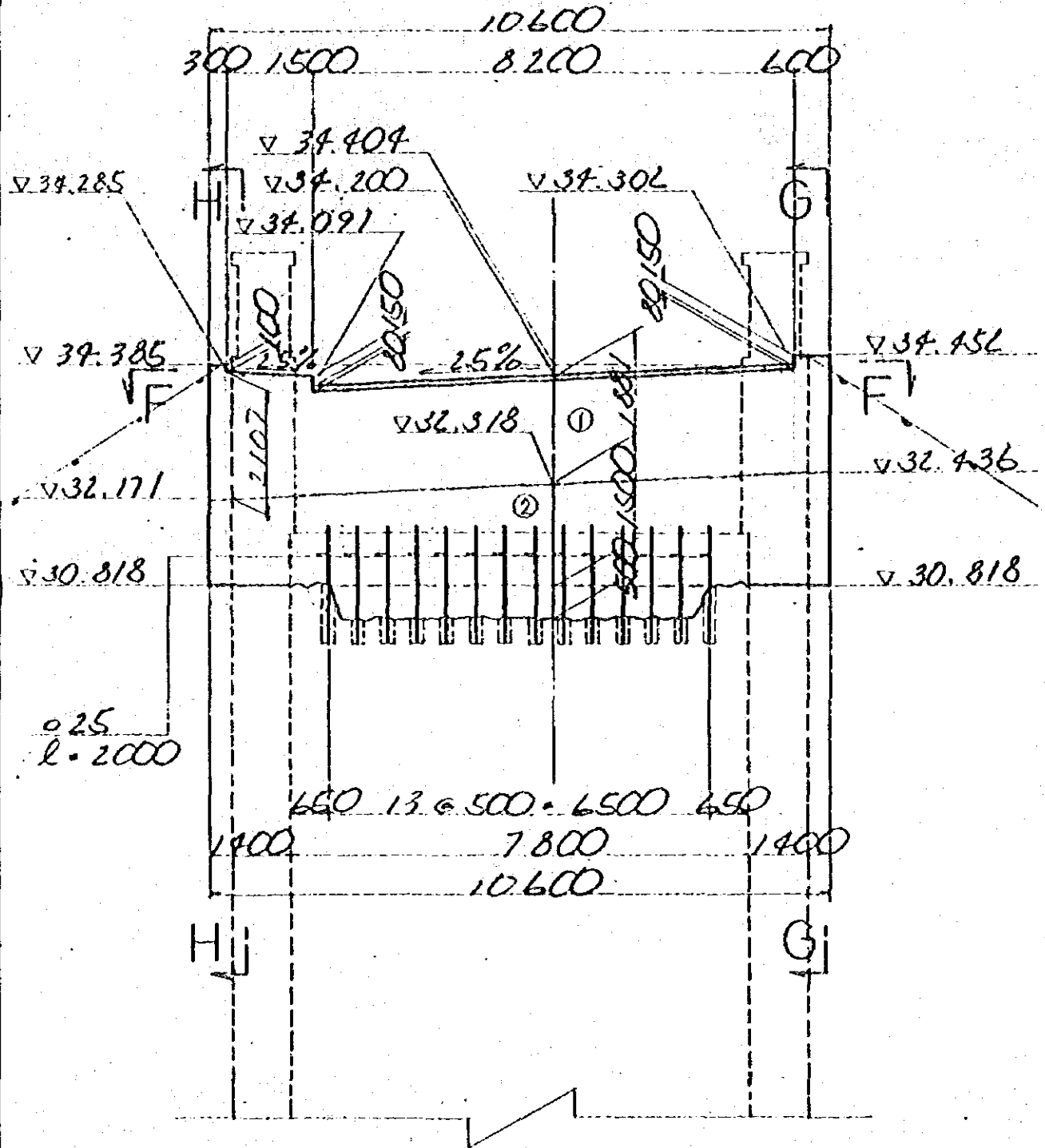
$$\Sigma V = 61.631 \text{ m}^3$$

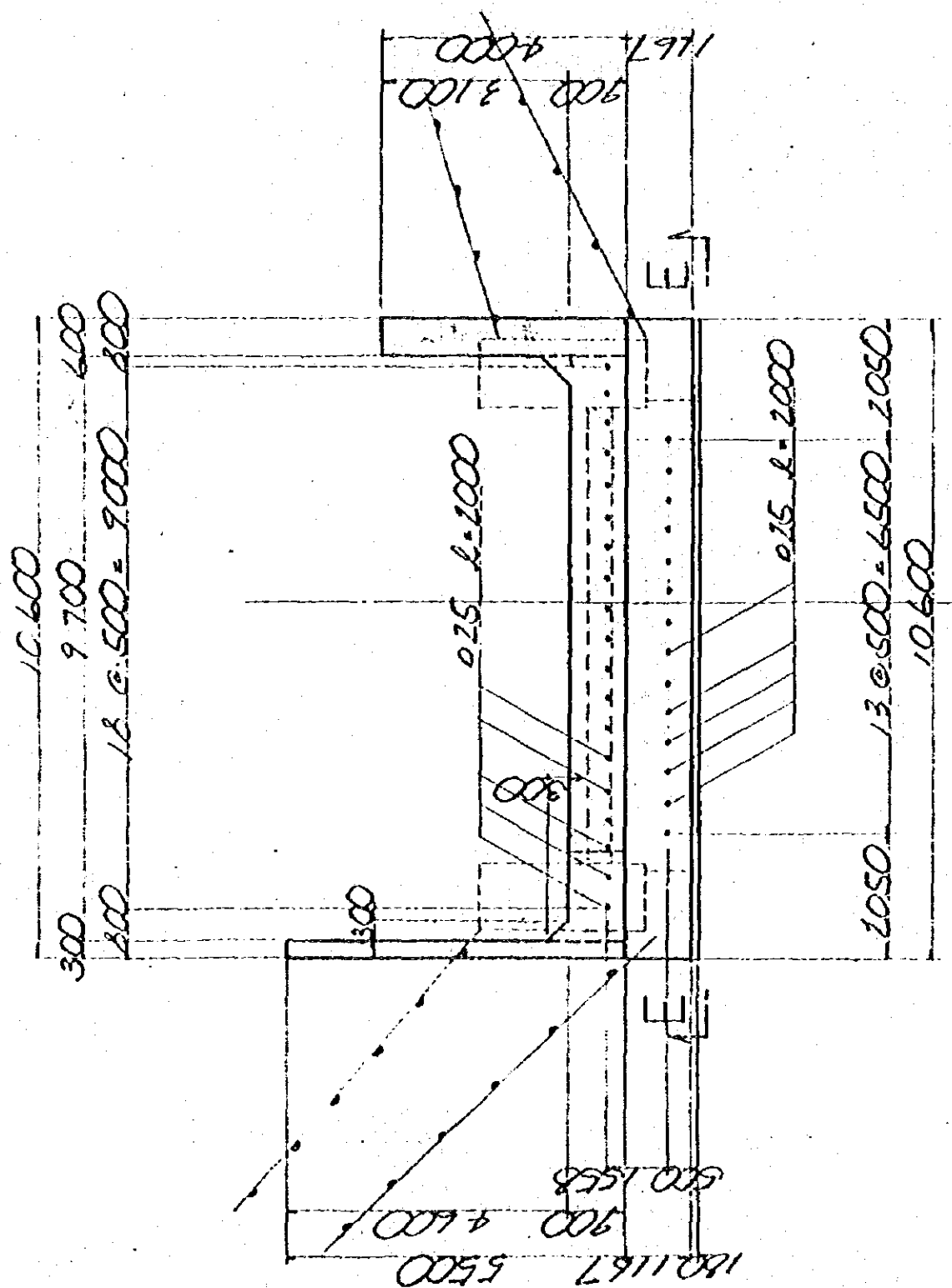
grand total

$$\Sigma V = 61.631 \text{ m}^3$$

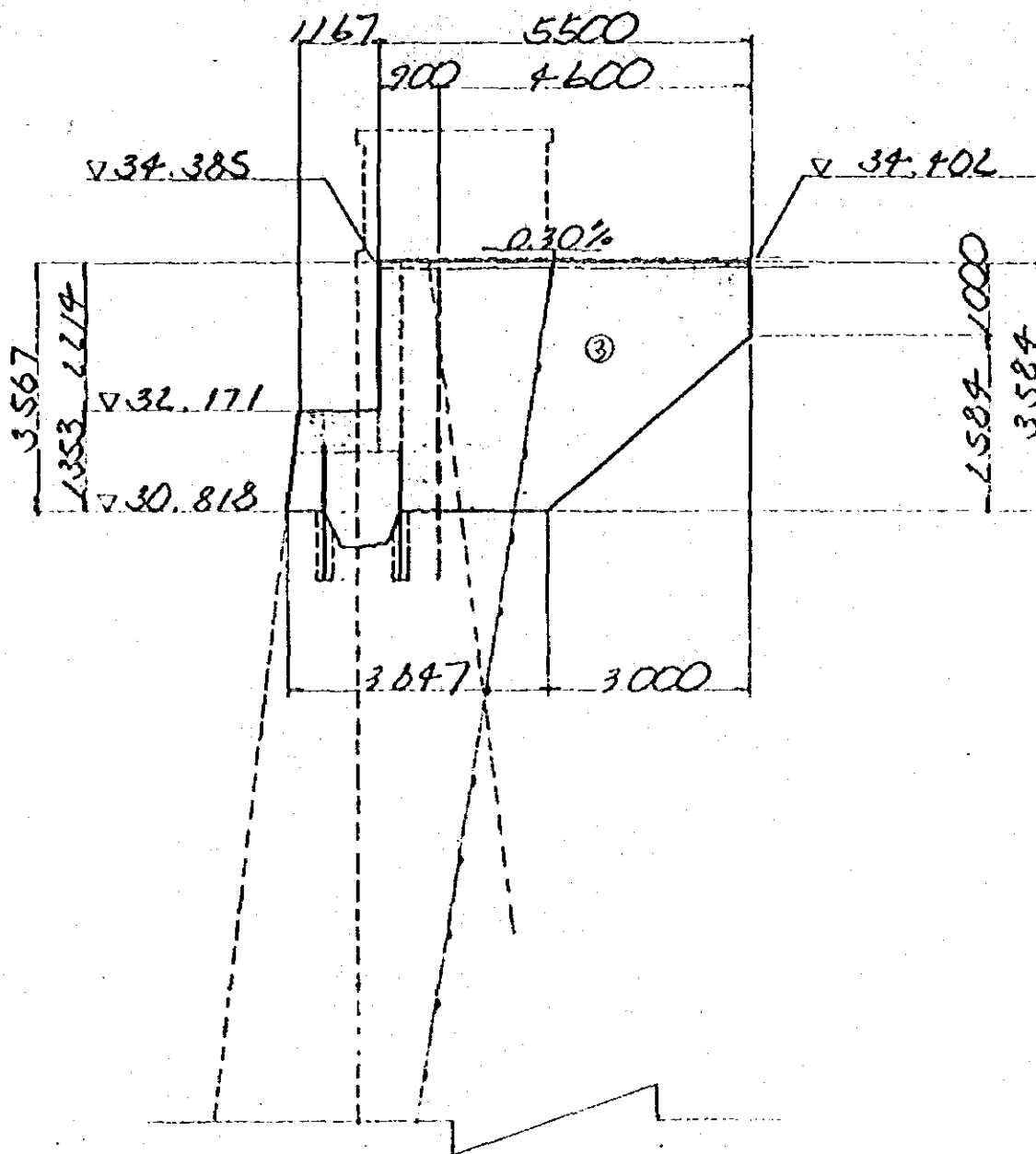
S.T. LOUIS
A₂ - ABUTMENT

§ 1 STRUCTURAL FIGURE

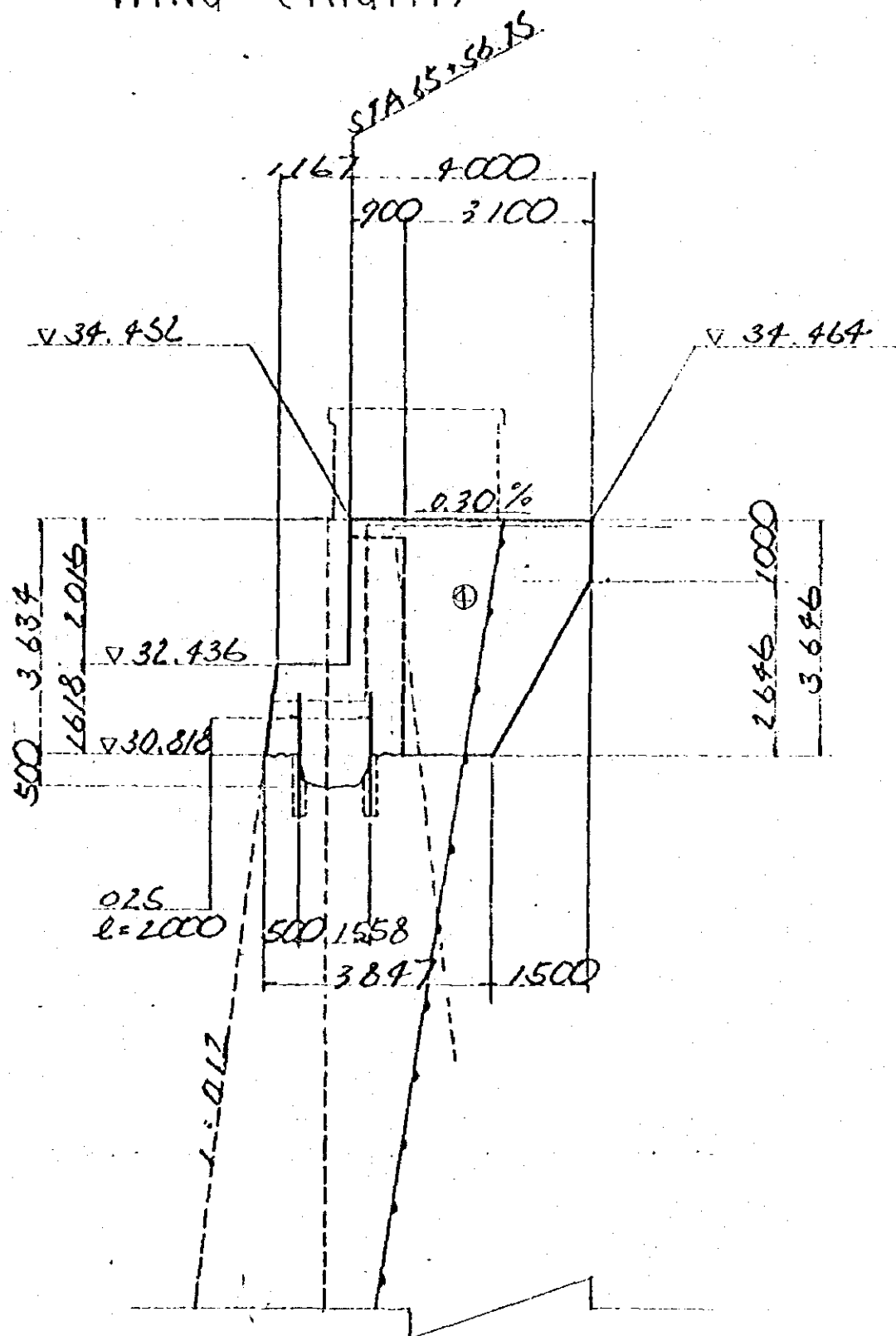




WING (LEFT)



WING (RIGHT)



§ 2 concrete volume

palapet

$$\begin{aligned}
 \textcircled{1} \quad & \frac{1}{2} \times (2.214 + 2.207) \times 0.30 \times 0.90 = 0.597 \\
 & \frac{1}{2} \times (2.107 + 2.031) \times 1.50 \times 0.90 = 2.793 \\
 & 1.801 \times 8.10 \times 0.90 = 13.291 \\
 & \frac{1}{2} \times (2.031 + 2.016) \times 0.60 \times 0.90 = 1.093 \\
 & \frac{1}{2} \times (0.30 + 0.60) \times 0.30 \times 8.10 = 1.107
 \end{aligned}$$

wall

$$\begin{aligned}
 \textcircled{2} \quad & \frac{1}{2} \times (1.353 + 1.618) \times 10.60 \times \frac{1}{2} \\
 & \times (2.067 + 2.261) = 34.075 \\
 & 0.50 \times 1.374 \times 6.50 = 4.466
 \end{aligned}$$

wing (left)

$$\begin{aligned}
 \textcircled{3} \quad & \frac{1}{2} \times (1.00 + 3.575) \times 3.00 \times 0.30 = 2.059 \\
 & \frac{1}{2} \times (3.575 + 3.561) \times 1.60 \times 0.30 = 1.713
 \end{aligned}$$

wing (right)

$$\begin{aligned}
 \textcircled{4} \quad & \frac{1}{2} \times (1.00 + 3.642) \times 1.50 \times 0.60 = 2.089 \\
 & \frac{1}{2} \times (3.642 + 3.637) \times 1.60 \times 0.60 = 3.494
 \end{aligned}$$

haunch

$$\frac{1}{2} \times 0.30 \times 0.30 \times (3.575 + 3.012) = 0.296$$

$$\Sigma V = 67.073 \text{ m}^3$$

grand total

$$V = 67.073 \text{ m}^3$$

form area

parapet

$$\begin{aligned}
 \textcircled{1} \quad & \frac{1}{2} \times (2.214 + 2.207) \times 0.50 = 0.663 \\
 & \frac{1}{2} \times (2.107 + 2.013) \times 1.50 = 3.104 \\
 & \frac{1}{2} \times (2.092 + 2.031) \times 1.20 = 2.474 \\
 & 1.801 \times 8.20 = 14.768 \\
 & 1.801 \times 7.90 = 14.228 \\
 & \frac{1}{2} \times (2.031 + 2.016) \times 0.60 = 1.214 \\
 & (2.214 + 2.016) \times 0.90 = 3.807 \\
 & (0.23 \times 2 + 0.10) \times 0.80 = 0.504 \\
 & -0.60 \times 8.20 + 0.30 \times 10.31 = -5.229 \\
 & 0.30 \times 8.20 = 2.46 \\
 & 0.30 \times \sqrt{2} \times 8.20 = 3.479 \\
 & \frac{1}{2} \times (0.30 + 0.60) \times 0.30 = 0.135 \\
 \textcircled{2} \quad & \frac{1}{2} \times (1.353 + 1.618) \times 10.60 = 15.746 \\
 & \frac{1}{2} \times (1.368 + 1.596) \times 9.10 = 13.486 \\
 & \frac{1}{2} \times (2.067 + 2.229) \times 1.35 = 2.90 \\
 & \frac{1}{2} \times (2.067 + 2.261) \times 1.618 = 3.501
 \end{aligned}$$

wing (left)

$$\begin{aligned}
 \textcircled{3} \quad & \frac{1}{2} \times (1.00 + 3.575) \times 3.00 \times 2 = 13.725 \\
 & \frac{1}{2} \times (3.575 + 3.561) \times 1.60 = 5.709
 \end{aligned}$$

$$\frac{1}{2} \times (3.575 + 3.571) \times 1.30 = 4.645$$

$$\frac{(1.00 + \sqrt{2584^2 + 3.00^2} + 1.60)}{2} \times 0.30 = 1.968$$

wing (right)

$$\textcircled{4} \frac{1}{2} \times (1.00 + 3.642) \times 1.50 \times 2 = 6.963$$

$$\frac{1}{2} \times (3.642 + 3.637) \times 1.60 = 5.823$$

$$\frac{1}{2} \times (3.642 + 3.638) \times 1.30 = 4.732$$

$$\frac{(1.00 + \sqrt{1.50^2 + 2.646^2} + 1.60)}{2} \times 0.60 = 3.385$$

haunch

$$0.30 \times \sqrt{2} \times (3.575 + 3.012) = 1.795$$

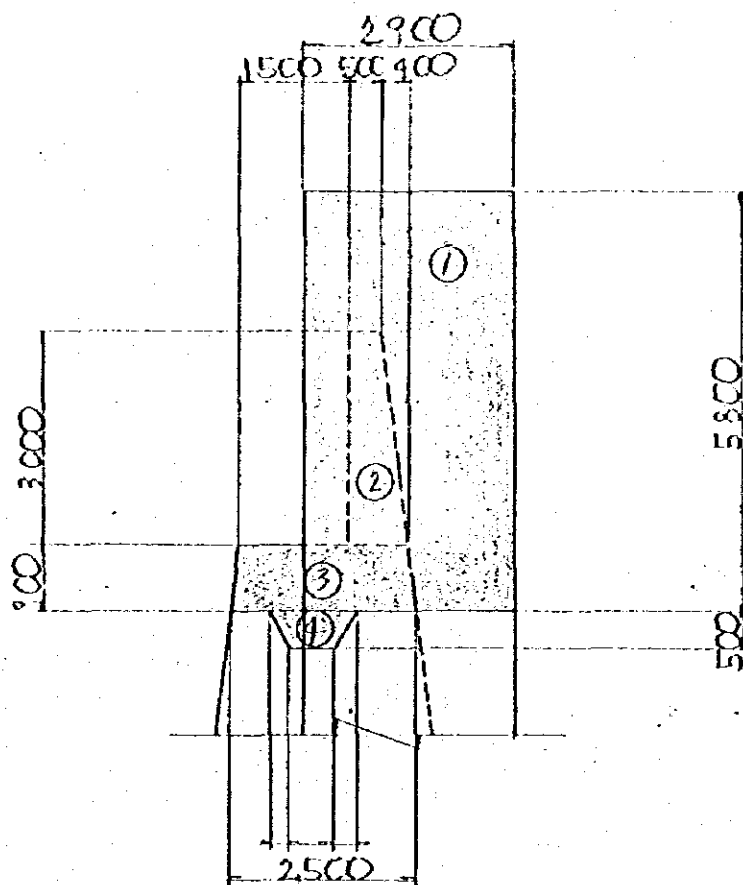
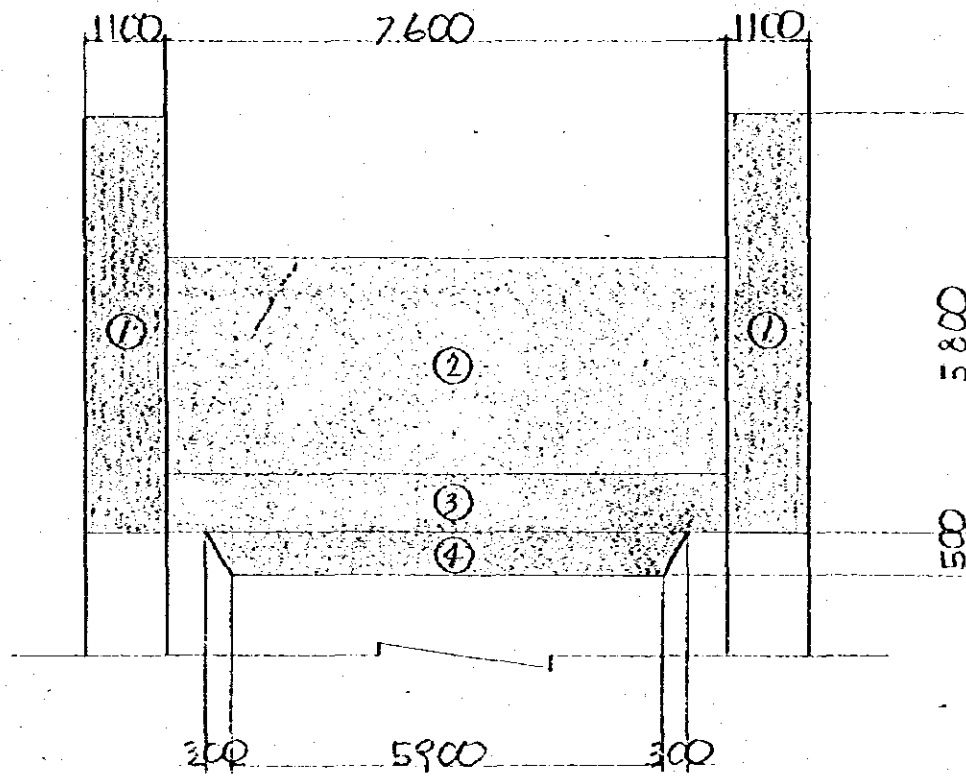
$$\Sigma A = 126.985 \text{ m}^2$$

grand total

type-A (plane formworks)

$$A = 126.985 \text{ m}^2$$

§ 4. DEMOLITION



$$\textcircled{1} \quad 1.10 \times 5.80 \times 2.90 \times 2 = 37.004$$

$$\textcircled{2} \quad \frac{1}{2} \times (0.50 + 0.90) \times 3.00 \times 7.60 = 15.96$$

$$\textcircled{3} \quad \frac{1}{2} \times (2.30 + 2.50) \times 0.90 \times 7.60 = 16.416$$

$$\textcircled{4} \quad \frac{1}{6} \times 0.50 \times [6.50 \times 1.50 + (6.50 + 5.90) \times (1.50 + 0.90) + 5.90 \times 0.90] = 3.735$$

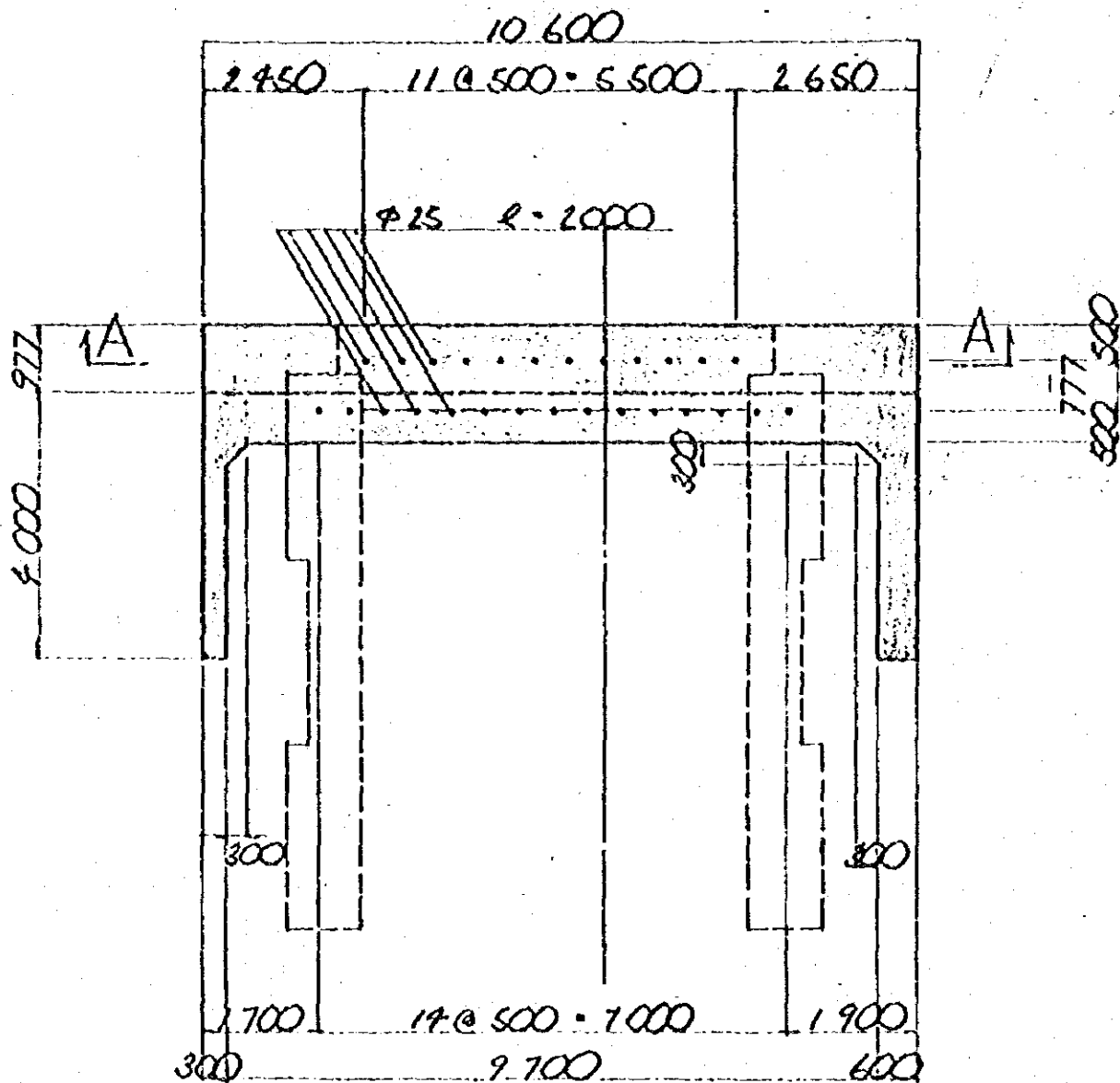
$$\Sigma V = 73.115 \text{ m}^3$$

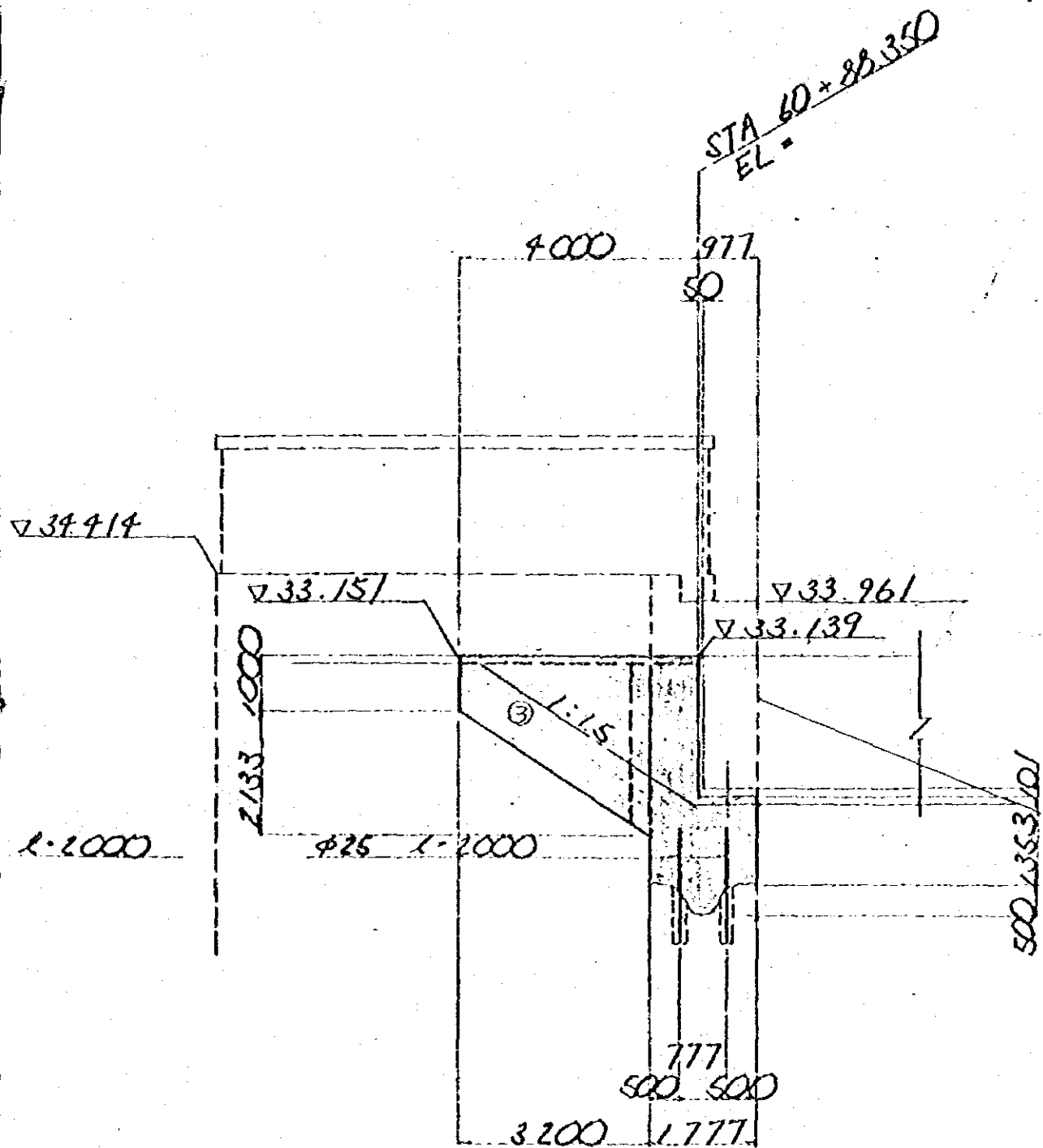
grand total

$$\Sigma V = 73.115 \text{ m}^3$$

G. R. N. W.

A₁ - ABUTMENT





B - B

§ 2 concrete volume

parapet

$$\begin{aligned}
 \textcircled{1} \quad & \frac{1}{2} \times (2.239 + 2.232) \times 0.30 \times 0.80 = 0.537 \\
 & \frac{1}{2} \times (2.132 + 2.031) \times 1.50 \times 0.80 = 2.498 \\
 & 1.801 \times 8.20 \times 0.80 = 11.815 \\
 & \frac{1}{2} \times (2.031 + 2.016) \times 0.60 \times 0.80 = 0.971 \\
 & \frac{1}{2} \times (0.30 + 0.60) \times 0.30 \times 8.20 = 1.107
 \end{aligned}$$

$$\begin{aligned}
 \textcircled{2} \quad & \frac{1}{2} \times (1.353 + 1.618) \times 10.60 \times 1.777 = 27.981 \\
 & 0.50 \times 0.777 \times 7.000 = 2.72
 \end{aligned}$$

wing (left)

$$\textcircled{3} \quad \frac{1}{2} \times (1.00 + 3.123) \times 3.20 \times 0.30 = 1.979$$

wing (right)

$$\textcircled{3} \quad \frac{1}{2} \times (1.00 + 3.123) \times 3.20 \times 0.60 = 3.958$$

haunch

$$\frac{1}{2} \times 0.30 \times 0.30 \times 3.492 = 0.157$$

$$\frac{1}{2} \times 0.30 \times 0.30 \times 2.404 = 0.108$$

grand total

$$V = 53.831 \text{ m}^3$$

$$\Sigma V = 53.831 \text{ m}^3$$

§ 3 form area
parapet

$$\begin{aligned}
 \textcircled{1} \quad & \frac{1}{2} \times (2.239 + 2.232) \times 0.30 & = & 0.671 \\
 & \frac{1}{2} \times (2.132 + 2.031) \times 1.50 & = & 3.122 \\
 & \frac{1}{2} \times (2.117 + 2.031) \times 1.20 & = & 2.489 \\
 & 1.801 \times 8.20 & = & 14.768 \\
 & 1.801 \times 7.90 & = & 14.228 \\
 & \frac{1}{2} \times (2.031 + 2.016) \times 0.60 & = & 1.214 \\
 & 0.80 \times (1.353 + 1.618) & = & 2.377 \\
 & -0.60 \times 8.20 + 0.30 \times 1.401 & = & -5.34 \\
 & 0.30 \times 8.20 + 0.30 \times \sqrt{2} \times 8.20 & = & 5.939 \\
 & \frac{1}{2} \times (0.30 + 0.60) \times 0.30 & = & 0.135 \\
 \textcircled{2} \quad & \frac{1}{2} \times (1.353 + 1.618) \times 10.60 & = & 15.746 \\
 & \frac{1}{2} \times (1.361 + 1.603) \times 9.70 & = & 14.375 \\
 & 1.777 \times (1.353 + 1.618) & = & 5.279
 \end{aligned}$$

wing (left)

$$\begin{aligned}
 \textcircled{3} \quad & \frac{1}{2} \times (1.00 + 3.123) \times 3.20 & = & 6.597 \\
 & \frac{1}{2} \times (1.00 + 3.142) \times 2.90 & = & 6.006 \\
 & (1.00 + \sqrt{3.20^2 + 2.133^2}) \times 0.30 & = & 1.454
 \end{aligned}$$

wing (right)

$$\textcircled{3} \quad \frac{1}{2} \times (1.00 + 3.123) \times 3.20 = 6.597$$

$$\frac{1}{2} \times (1.00 + 3.142) \times 2.90 = 6.006$$

$$(1.00 + \sqrt{3.20^2 + 2.133^2}) \times 0.60 = 2.907$$

haunch

$$0.30 \times \sqrt{2} \times 3.492 = 1.482$$

$$0.30 \times \sqrt{2} \times 2.404 = 1.02$$

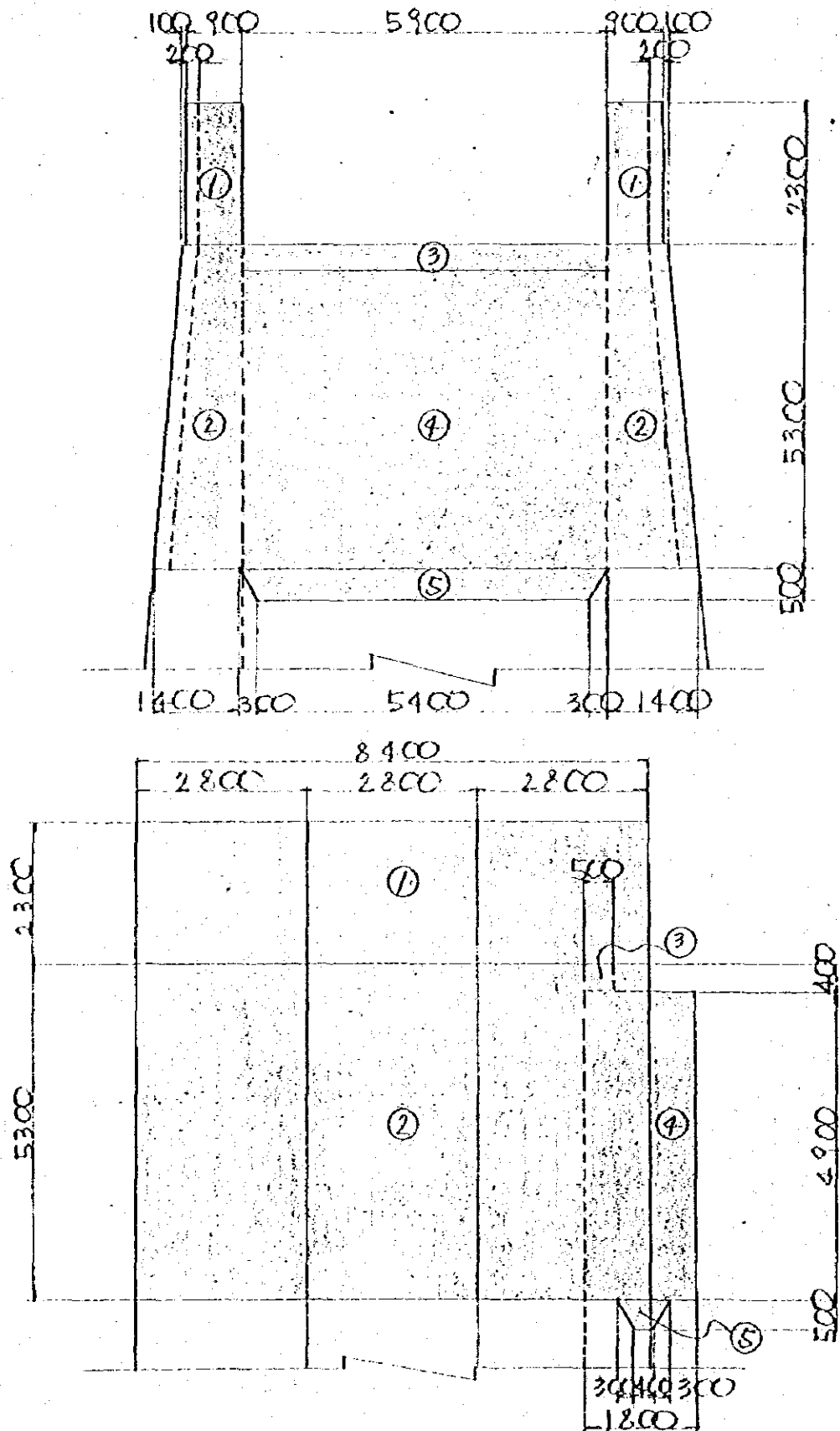
$$\Sigma A = 107.072 \text{ m}^2$$

grand total

type-A (plane formwork)

$$A = 107.072 \text{ m}^2$$

§ 4. demolition



$$\textcircled{1} \quad 0.90 \times 2.30 \times 8.40 \times 2 = 34.776$$

$$-2.80 \times 2.30 \times 0.20 \times 2 = -2.576$$

$$\textcircled{2} \quad \frac{1}{2} \times (1.00 + 1.40) \times 5.30 \times 8.40 \times 2 = 106.848$$

$$-2.80 \times 5.30 \times 0.30 \times 2 = -8.904$$

$$\textcircled{3} \quad 0.40 \times 0.50 \times 5.90 = 1.180$$

$$\textcircled{4} \quad 1.80 \times 4.90 \times 5.90 = 52.038$$

$$\textcircled{5} \quad \frac{1}{6} \times 0.50 \times [6.00 \times 1.00 + (6.00 + 5.40) \times (1.00 + 0.40) + 5.40 \times 0.40] = 2.010$$

$$\Sigma V = 185.372 \text{ m}^3$$

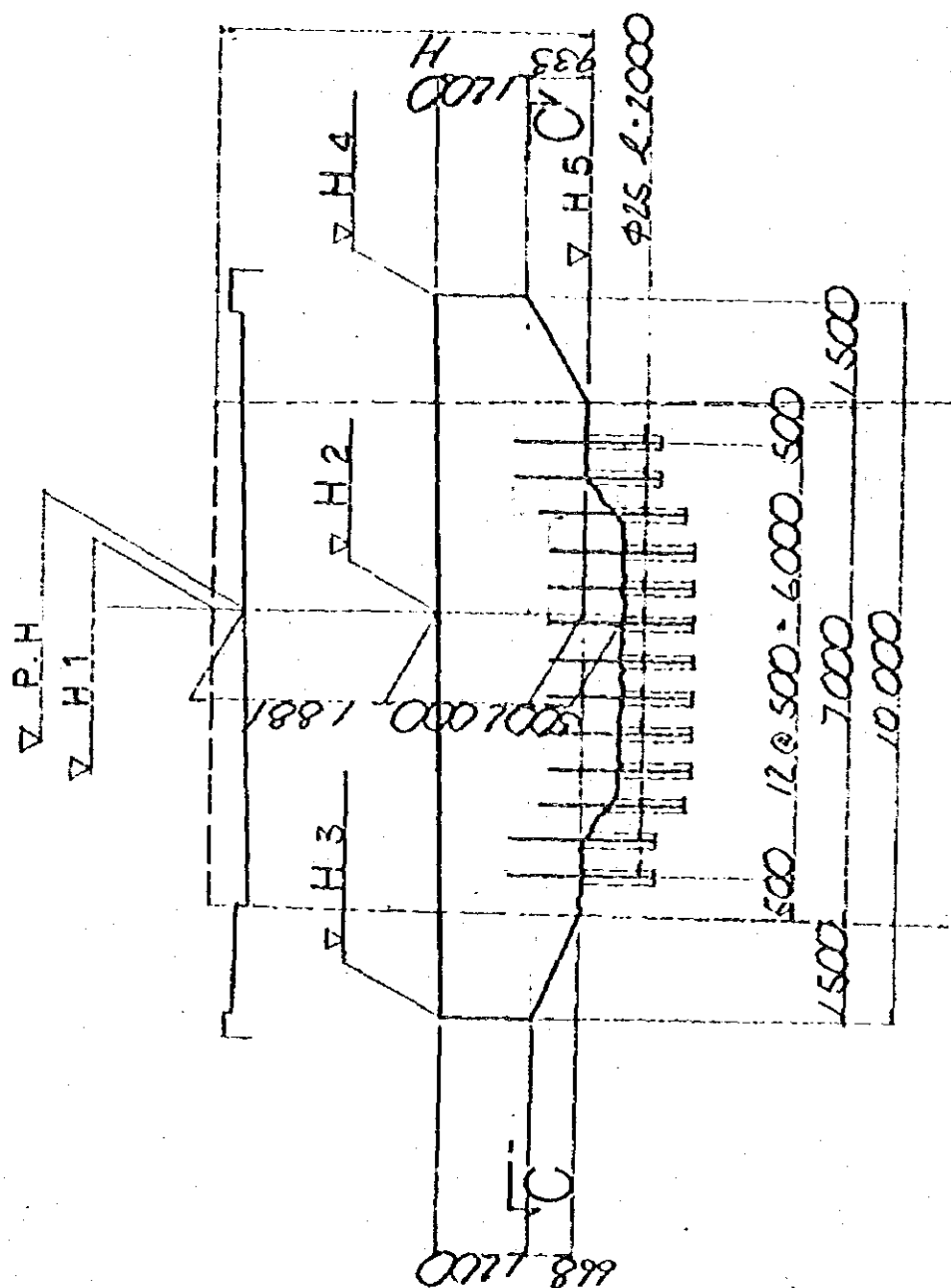
grand total

$$\Sigma V = 185.372 \text{ m}^3$$

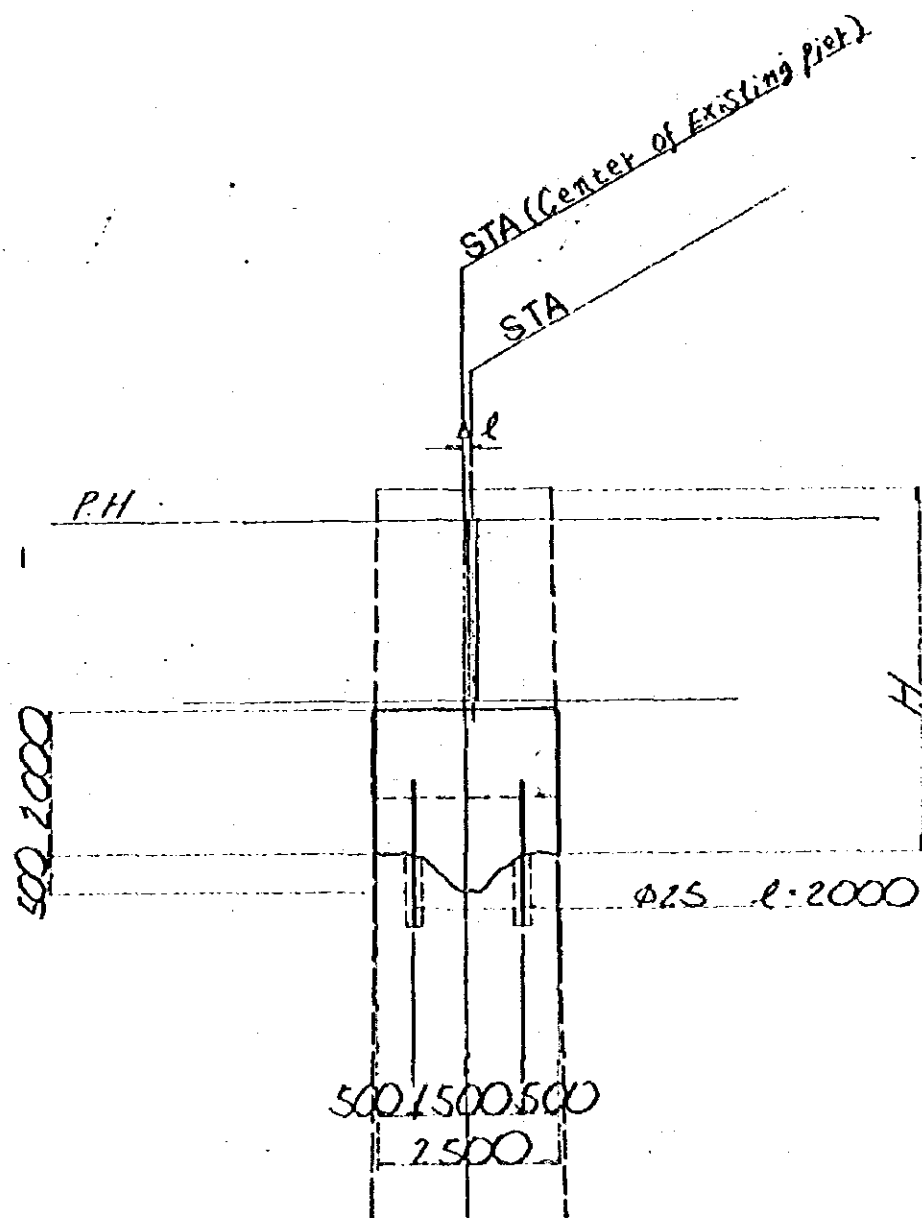
G. R. N. W.

$P_1 \sim P_6$ - PIER.

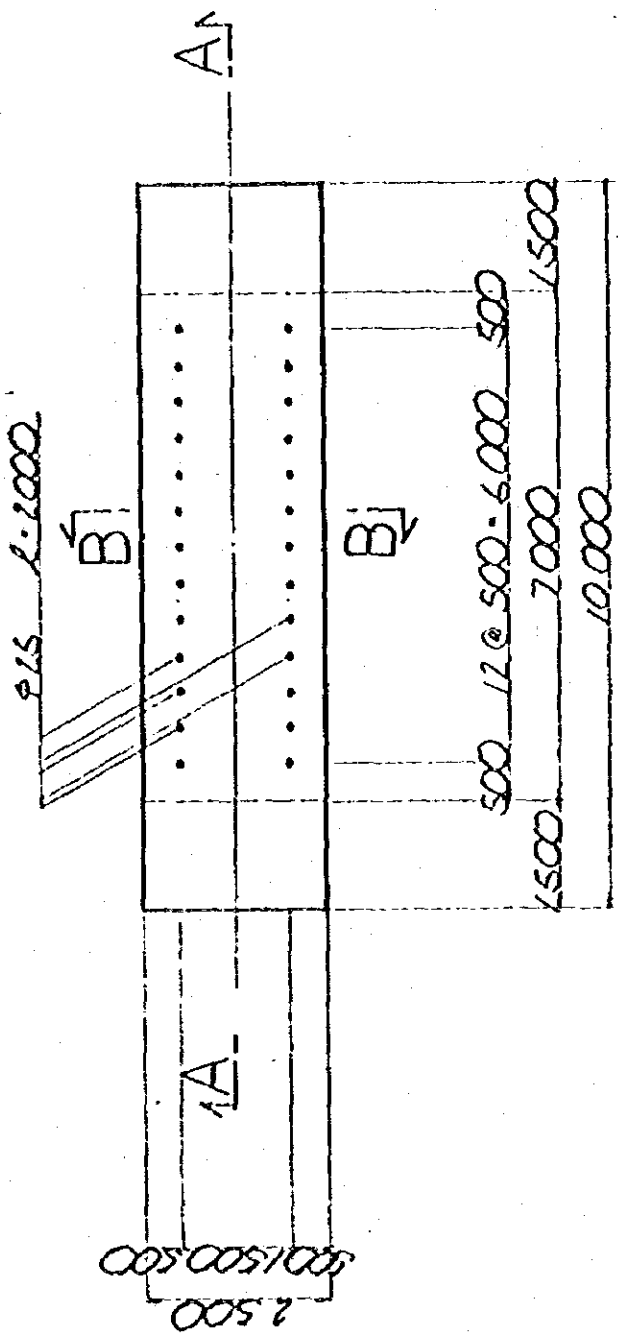
§ 1 STRUCTURAL FIGURE



A-A



B-B



C-C

	P1	P2	P3	P4	P5	P6
STA center of existing pier	61 - 15.737	61 - 43.269	61 - 70.841	61 - 98.361	62 - 25.911	62 - 53.501
STA	61 - 15.925	61 - 43.475	61 - 71.025	61 - 98.575	62 - 26.125	62 - 53.675
P.H	32.900	32.960	33.043	33.126	33.208	33.291
H	4.955	4.885	4.802	4.726	4.618	4.569
H1	33.959	33.948	33.949	33.956	33.931	33.965
H2	31.007	31.063	31.147	31.230	31.313	31.396
H3	30.872	30.931	31.015	31.098	31.181	31.264
H4	31.137	31.196	31.280	31.363	31.446	31.529
H5	29.007	29.063	29.147	29.230	29.313	29.396
Δl	118	206	184	214	214	174

§ 2 concrete volume
beam

$$1.20 \times 10.00 \times 2.50 = 3.00$$

$$\frac{1}{2} \times (10.00 + 7.00) \times 0.801 \times 2.50 = 17.021$$

$\lambda = 0.668 + 0.933$

$$0.50 \times 1.50 \times 6.00 = 4.50$$

$$\Sigma V = 24.521 \text{ m}^3$$

grand total

$$V = 24.521 \text{ m}^3$$

§ 3 form area
beam

$$(2.50 + 10.60) \times 2 \times 1.20 = 31.44$$

$$\frac{1}{2} \times (7.00 + 10.60) \times 0.801 \times 2 = 14.098$$

$$\sqrt{0.668^2 + 1.50^2} \times 2.50 = 4.105$$

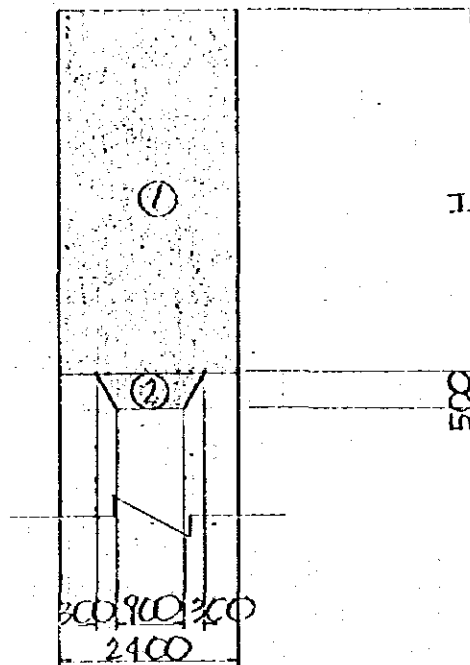
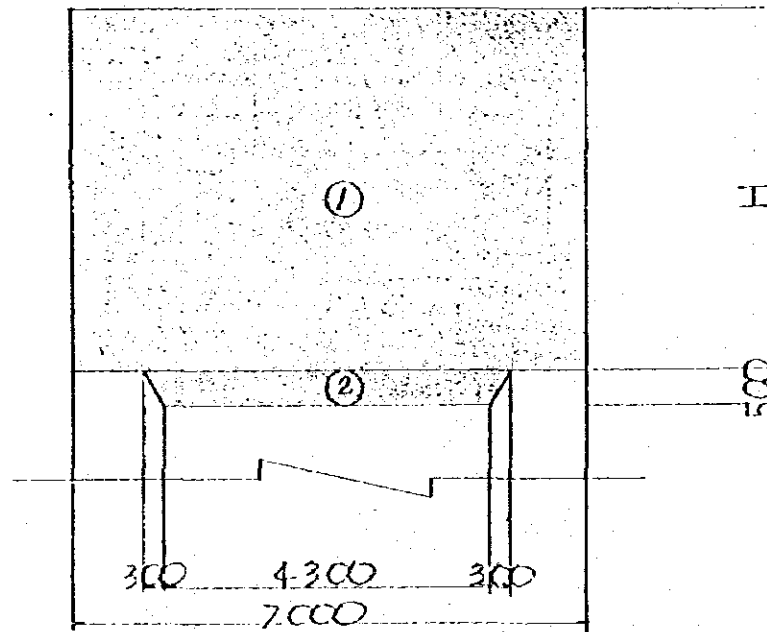
$$\sqrt{0.933^2 + 1.50^2} \times 2.50 = 4.416$$

$$\Sigma A = 54.059 \text{ m}^2$$

grand total

$$A = 54.059 \text{ m}^2 \text{ (type-A)}$$

§ 4. demolition



	m					
	P ₁	P ₂	P ₃	P ₄	P ₅	P ₆
H	4.955	4.885	4.802	4.726	4.618	4.569

$$P_1 \quad 2.40 \times 7.00 \times 4.955 = 83.244$$

$$\frac{1}{6} \times 0.50 \times [4.90 \times 1.50 + (4.90 + 4.30) \times (1.50 + 0.90) + 4.30 \times 0.90] = 2.775$$

$$\Sigma V = 86.019 \text{ m}^3$$

$$P_2 \quad 2.40 \times 7.00 \times 4.885 = 82.068$$

$$= 2.775$$

$$\Sigma V = 84.843 \text{ m}^3$$

$$P_3 \quad 2.40 \times 7.00 \times 4.802 = 80.674$$

$$= 2.775$$

$$\Sigma V = 83.449 \text{ m}^3$$

$$P_4 \quad 2.40 \times 7.00 \times 4.726 = 79.397$$

$$= 2.775$$

$$\Sigma V = 82.172 \text{ m}^3$$

$$P_5 \quad 2.40 \times 7.00 \times 4.618 = 77.582$$

$$= 2.775$$

$$\Sigma V = 80.357 \text{ m}^3$$

$$P_6 \quad 2.40 \times 7.00 \times 4.569 = 76.759$$

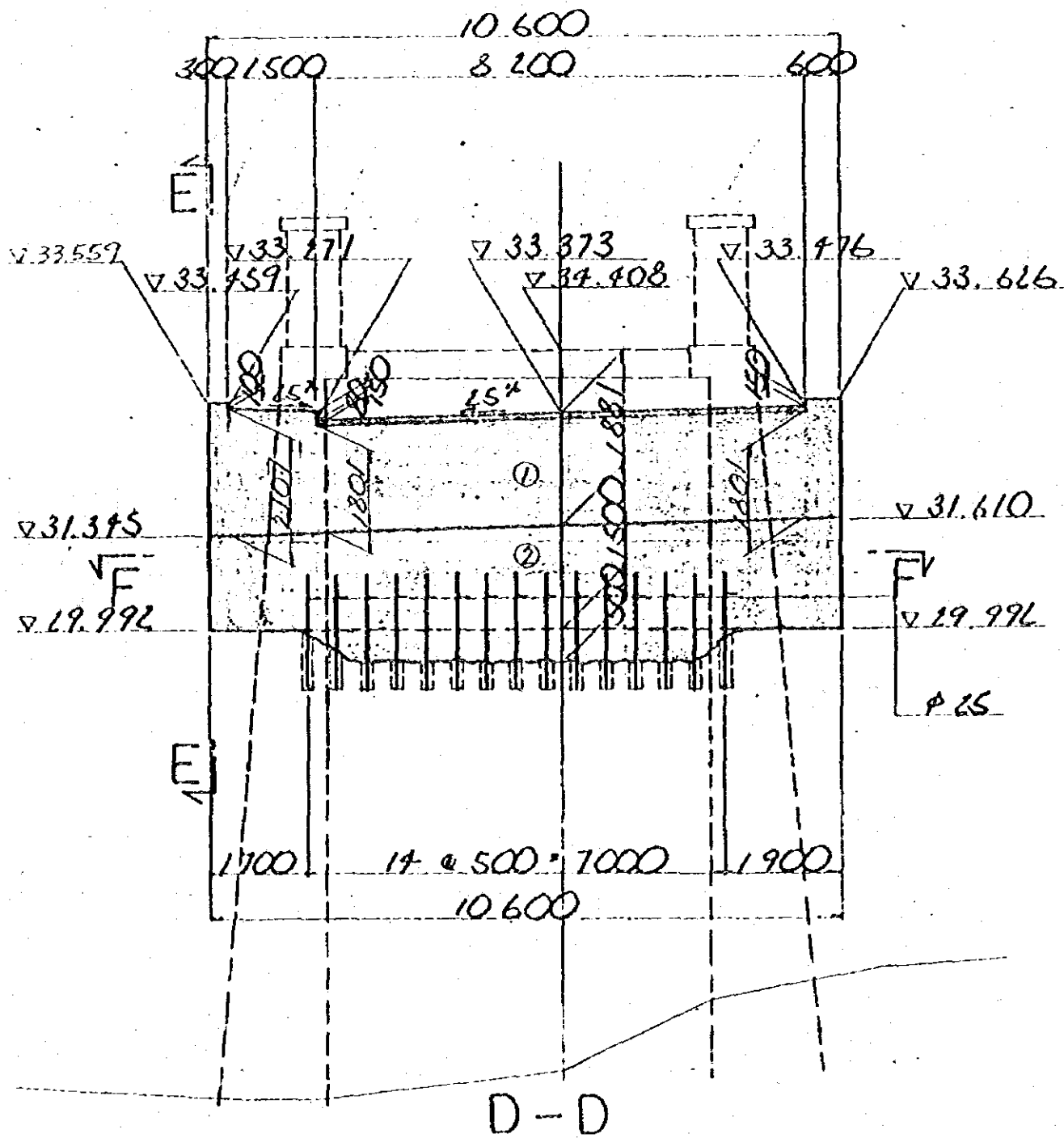
$$= 2.775$$

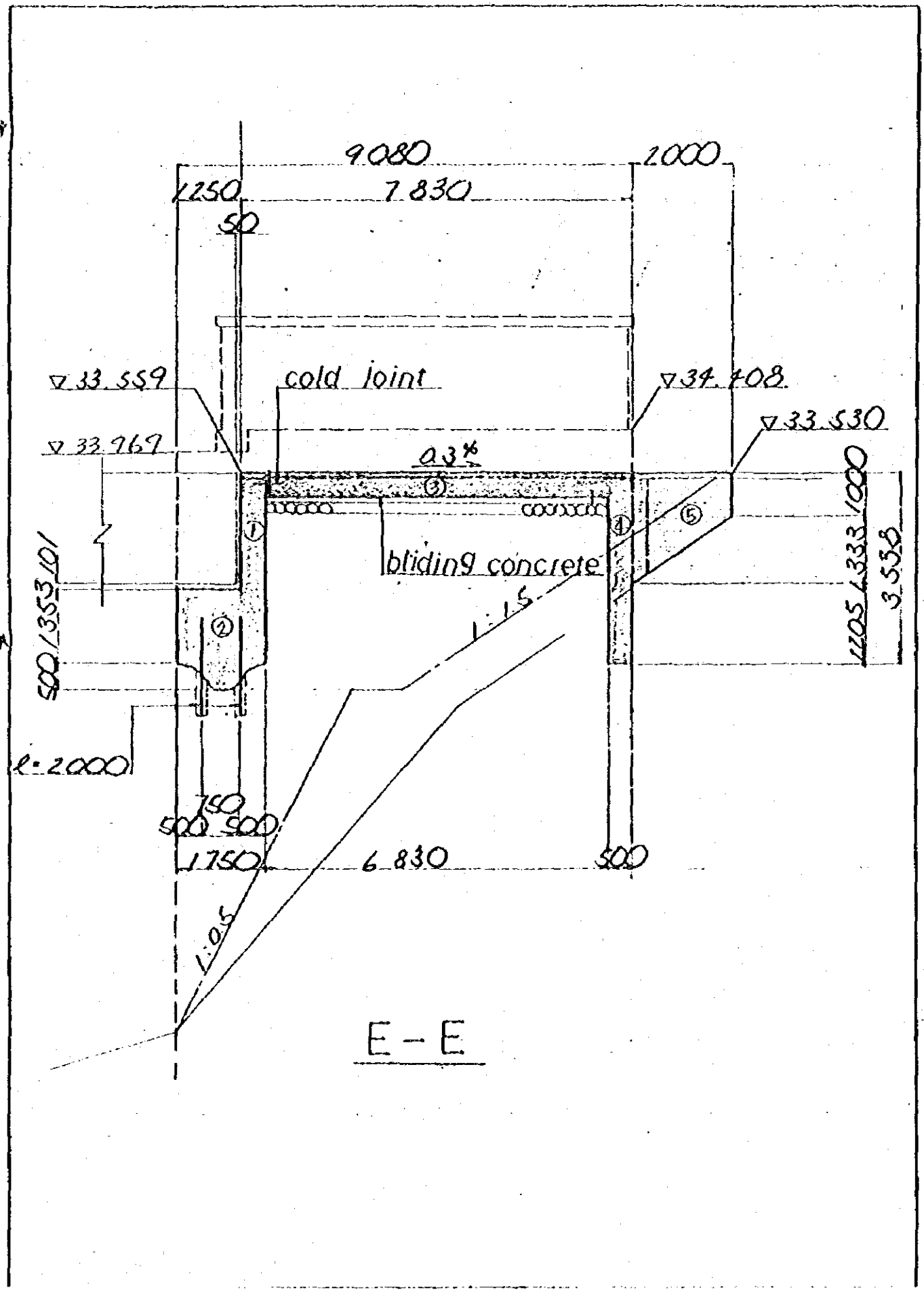
$$\Sigma V = 79.534 \text{ m}^3$$

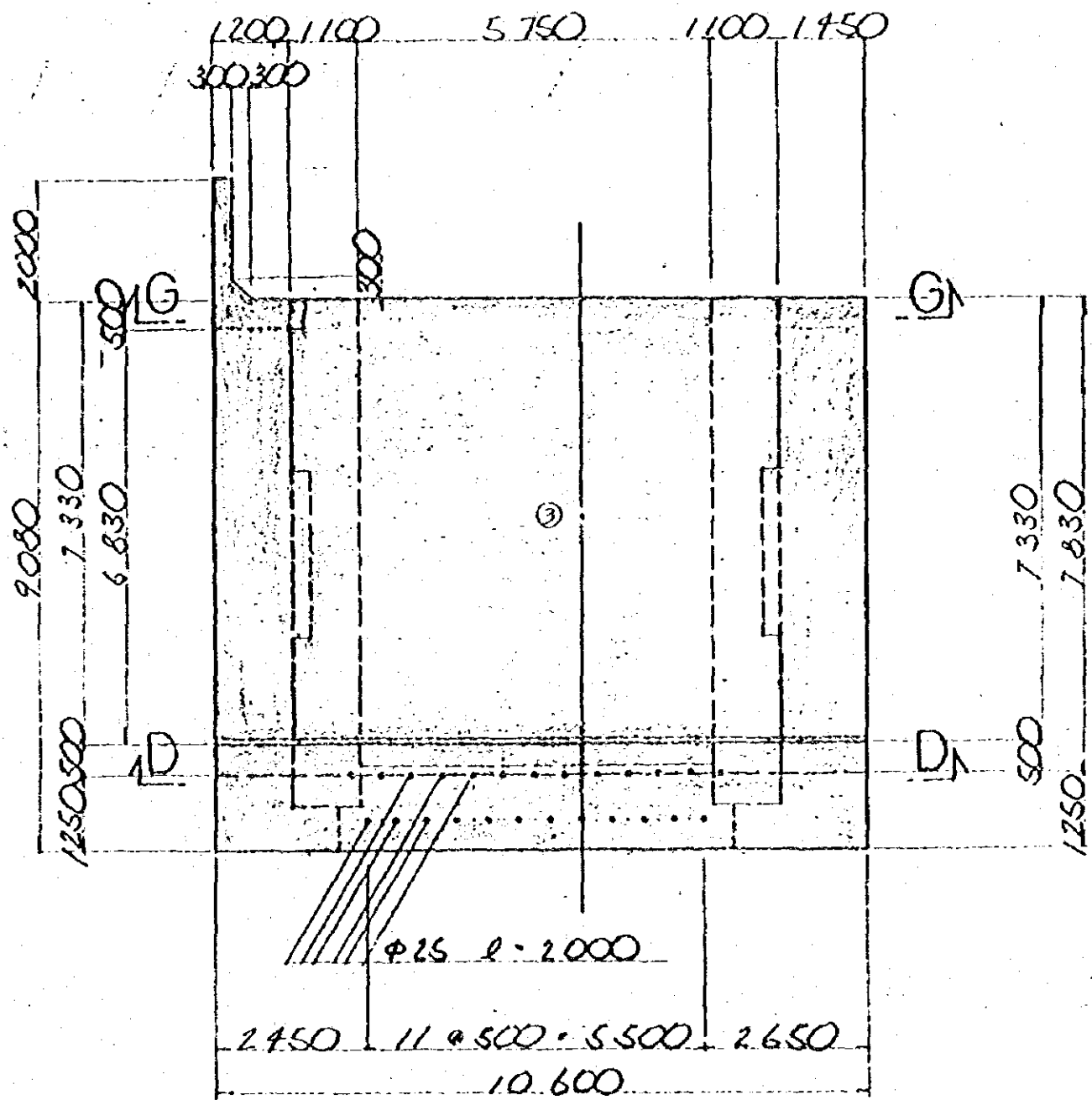
G. R. N.W.

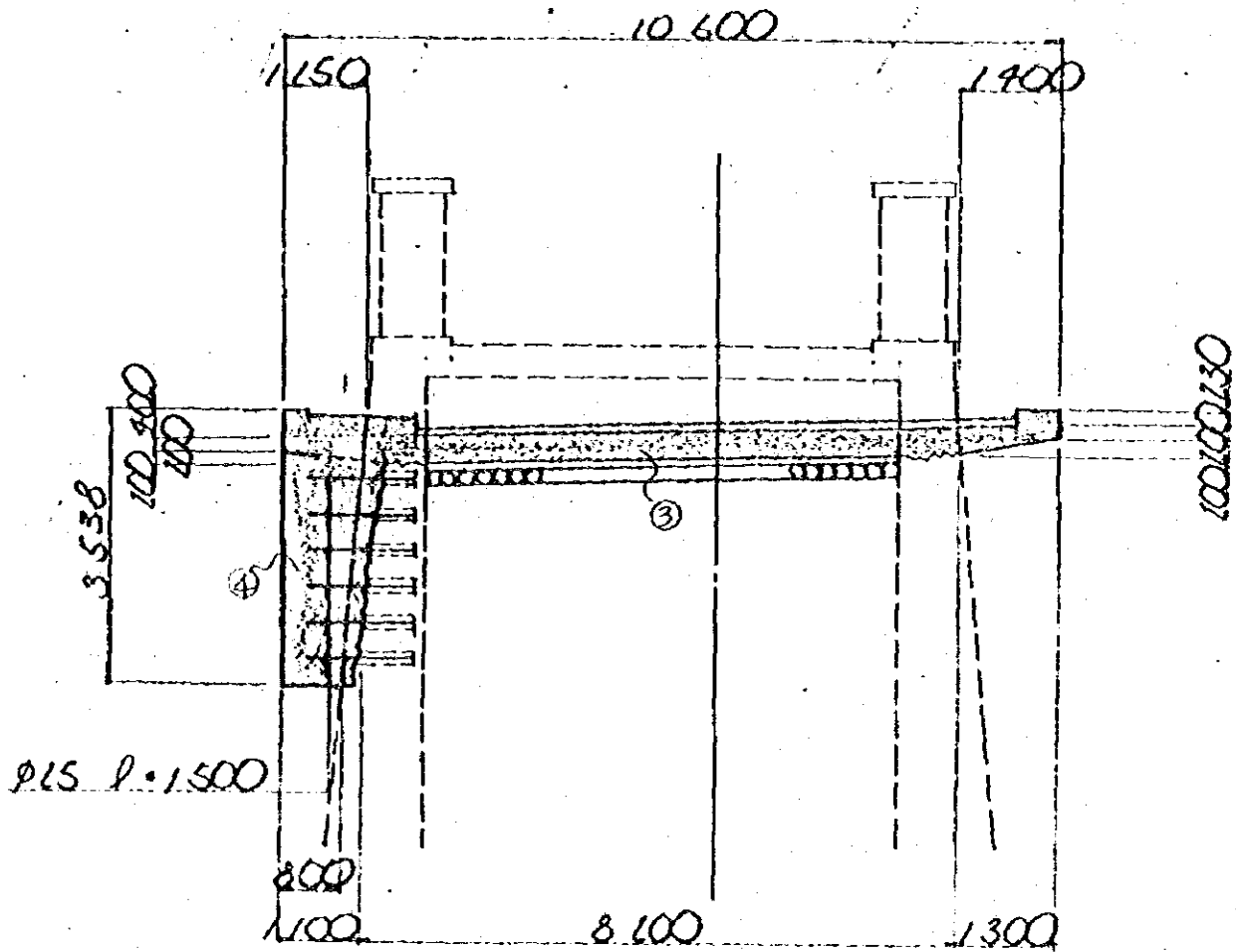
A₂ - ABUTMENT

§ 1 STRUCTURAL FIGURE









§ 2 concrete volume

parapet

$$\textcircled{1} \frac{1}{2} \times (2.214 + 2.207) \times 0.30 \times 0.50 = 0.332$$

$$\frac{1}{2} \times (2.107 + 2.031) \times 1.50 \times 0.50 = 1.552$$

$$1.801 \times 0.20 \times 0.50 = 0.384$$

$$\frac{1}{2} \times (2.031 + 2.016) \times 0.60 \times 0.50 = 0.607$$

wall

$$\textcircled{2} \frac{1}{2} \times (1.353 + 1.618) \times 10.60 \times 1.75 = 27.556$$

$$0.50 \times 0.750 \times 7.00 = 2.625$$

slab

$$\textcircled{3} \frac{1}{2} \times (0.40 + 0.368) \times 0.30 \times 7.32 = 0.843$$

$$\frac{1}{2} \times (0.268 + 0.23) \times 1.50 \times 7.32 = 2.734$$

$$0.23 \times 0.60 \times 7.32 = 1.010$$

$$0.20 \times 10.60 \times 7.32 = 15.518$$

$$\frac{1}{2} \times (10.60 + 7.95) \times 0.20 \times 7.32 = 13.579$$

$$\textcircled{4} \frac{1}{2} \times (1.00 + 1.20) \times 2.838 \times 0.50 = 1.616$$

wing

$$\textcircled{5} \frac{1}{2} \times (1.00 + 2.327) \times 2.00 \times 0.30 = 0.998$$

haunch

$$\frac{1}{2} \times 0.30 \times 0.30 \times 2.339 = 0.105$$

$$\Sigma V = 76.459 \text{ m}^3$$

grand total

$$V = 76.459 \text{ m}^3$$

§ 3 form area

parapet

$$\begin{aligned} \textcircled{1} \quad \frac{1}{2} \times (2.214 + 2.207) \times 0.30 \times 2 &= 1.326 \\ \frac{1}{2} \times (2.107 + 2.031) \times 1.50 \times 2 &= 6.207 \\ 1.801 \times 8.20 \times 2 &= 29.536 \\ \frac{1}{2} \times (2.031 + 2.016) \times 0.60 \times 2 &= 2.428 \\ 0.50 \times (2.214 + 2.016) &= 2.115 \\ 0.50 \times (0.23 \times 2 + 0.10) &= 0.28 \end{aligned}$$

wall

$$\begin{aligned} \textcircled{2} \quad \frac{1}{2} \times (1.358 + 1.618) \times 10.60 \times 2 &= 31.546 \\ (1.358 + 1.618) \times 1.75 &= 5.208 \end{aligned}$$

slab

$$\begin{aligned}
 \textcircled{3} \quad & \frac{1}{2} \times (0.40 + 0.368) \times 0.30 & = & 0.115 \\
 & (0.60 + 0.10) \times 7.32 & = & 5.124 \\
 & \frac{1}{2} \times (0.268 + 0.23) \times 1.50 & = & 0.374 \\
 & 0.23 \times 2 \times 7.32 & = & 3.367 \\
 & 0.23 \times 0.60 & = & 0.138 \\
 & 0.43 \times 7.32 & = & 3.148 \\
 & 0.20 \times 10.60 & = & 2.12 \\
 & \frac{1}{2} \times (10.60 + 7.95) \times 0.20 & = & 1.855 \\
 & \sqrt{1.30^2 + 0.20^2} \times 7.32 \times 2 & = & 19.256
 \end{aligned}$$

$$\begin{aligned}
 \textcircled{4} \quad & \frac{1}{2} \times (1.00 + 1.20) \times 2.938 \times 2 & = & 6.464 \\
 & (2.938 + 0.80) \times 0.50 & = & 1.869
 \end{aligned}$$

wing

$$\begin{aligned}
 \textcircled{5} \quad & \frac{1}{2} \times (1.00 + 2.327) \times 2.00 \times 2 & = & 6.678 \\
 & (1.00 + \sqrt{1.333^2 + 2.00^2}) \times 0.30 & = & 2.033
 \end{aligned}$$

haunch

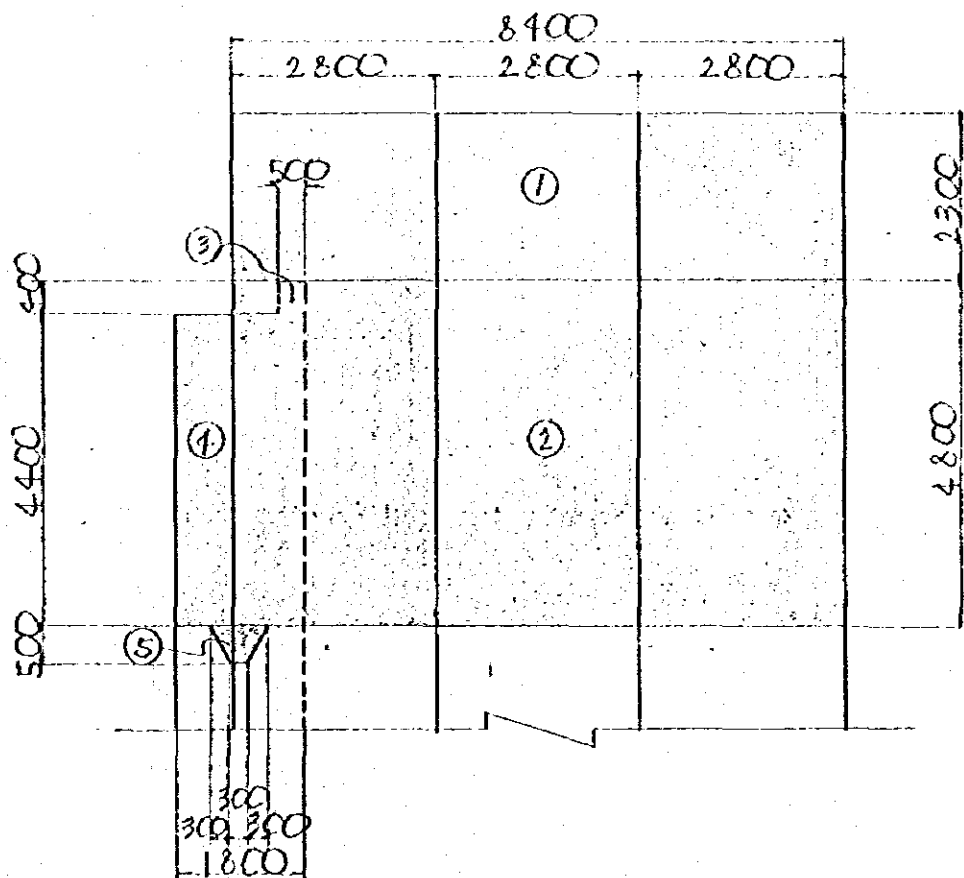
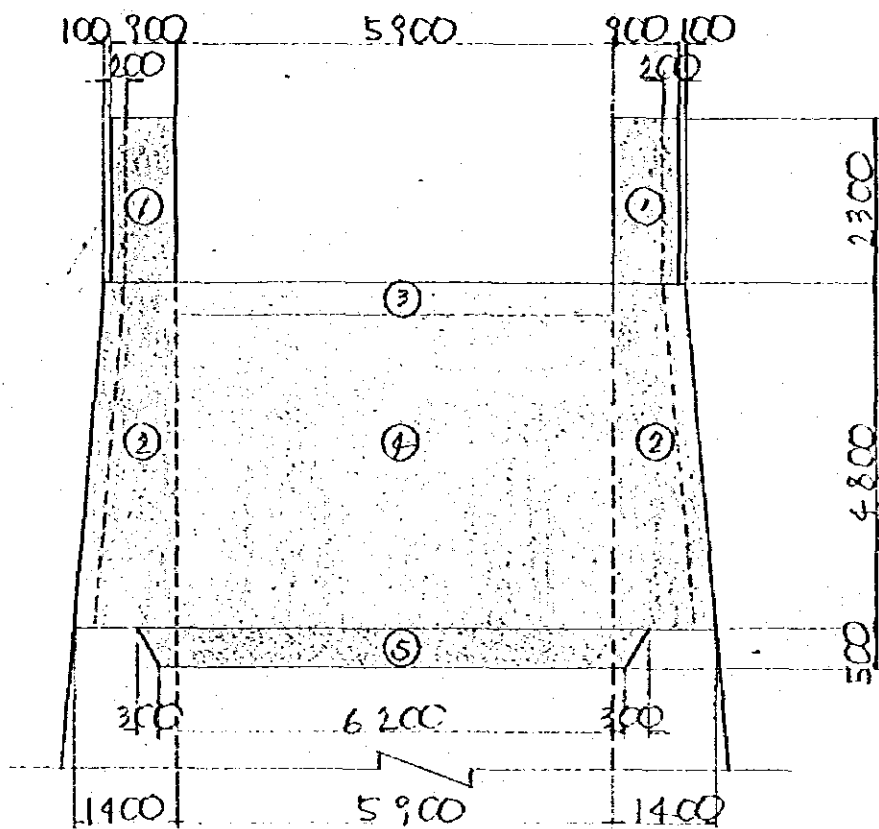
$$0.30 \times \sqrt{2} \times 2.339 = 0.992$$

$$\Sigma A = 132.179 \text{ m}^2$$

grand total

type - A (plane formworks)

$$A = 132.179 \text{ m}^2$$



$$\textcircled{1} \quad 0.90 \times 2.30 \times 8.40 \times 2 = 34.776$$

$$- 2.80 \times 2.30 \times 0.20 \times 2 = - 2.576$$

$$\textcircled{2} \quad \frac{1}{2} \times (1.00 + 1.40) \times 4.80 \times 2 = 11.52$$

$$- 2.80 \times 4.80 \times 0.30 \times 2 = - 8.064$$

$$\textcircled{3} \quad 0.40 \times 0.50 \times 5.90 = 1.18$$

$$\textcircled{4} \quad 1.80 \times 4.40 \times 5.90 = 46.728$$

$$\textcircled{5} \quad \frac{1}{6} \times 0.50 \times [6.80 \times 0.90 + (6.80 + 6.20) \times (0.90 + 0.30) + 6.20 \times 0.30] = 1.965$$

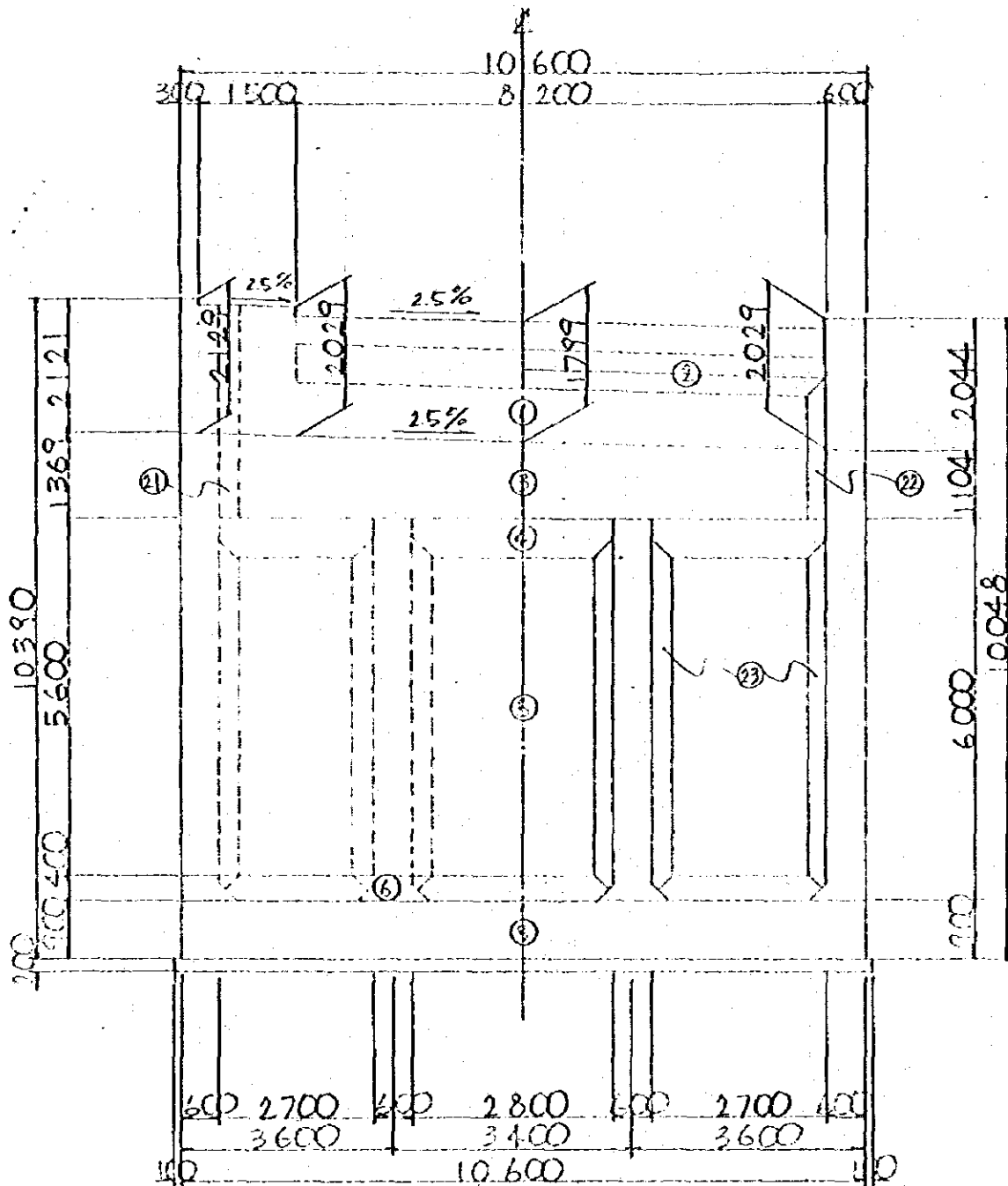
$$\Sigma V = 85.529$$

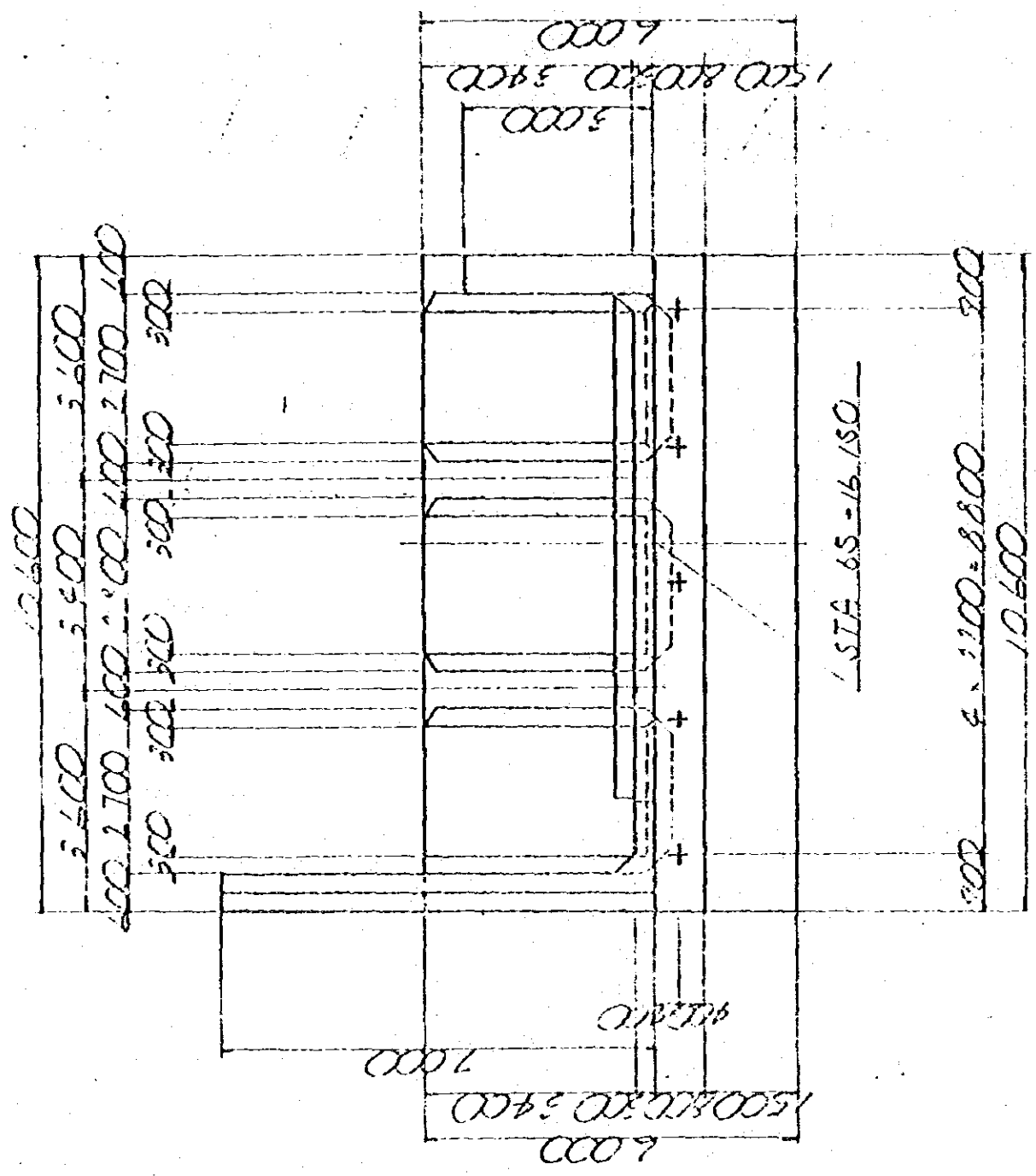
grand total

$$\Sigma V = 85.529 \text{ m}^3$$

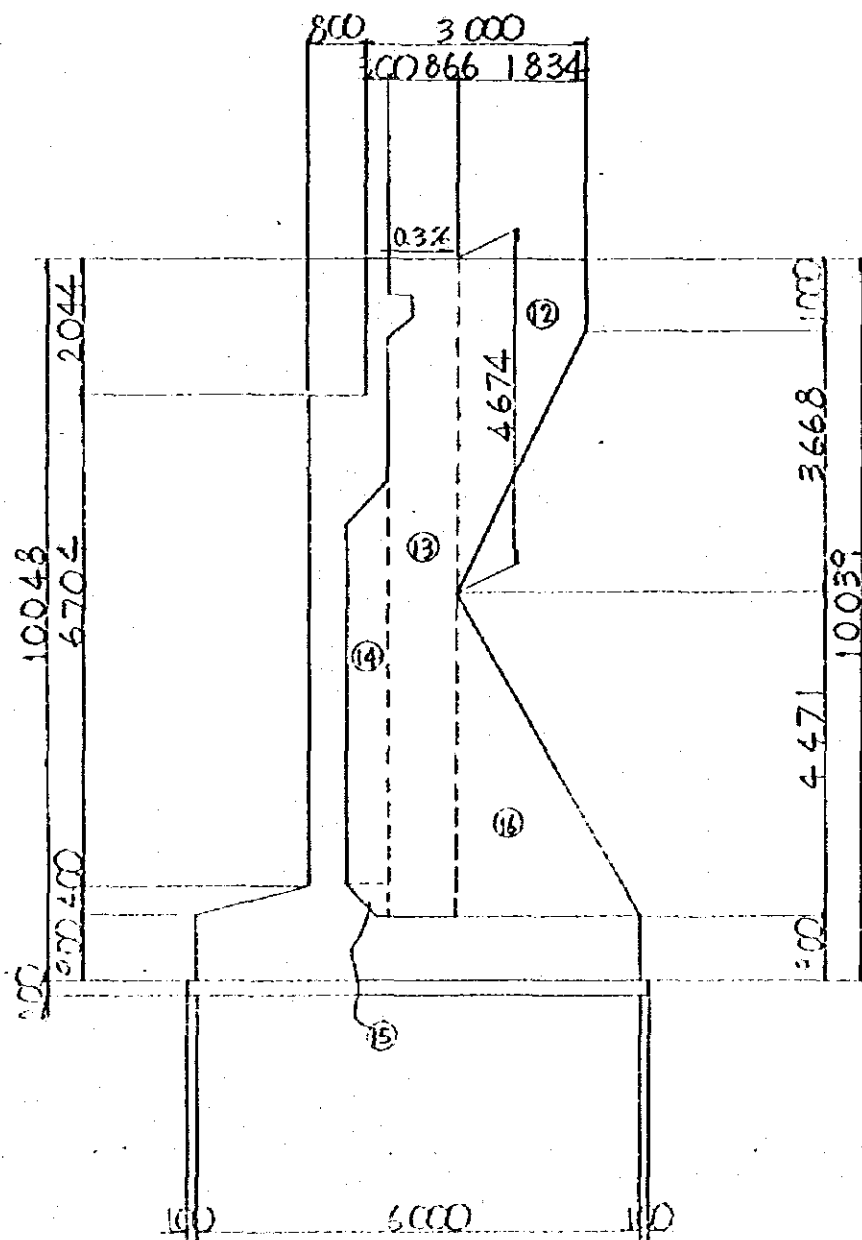
§§ 3. B-LINE B.R.

St. LOUIS
A1 - ABUTMENT

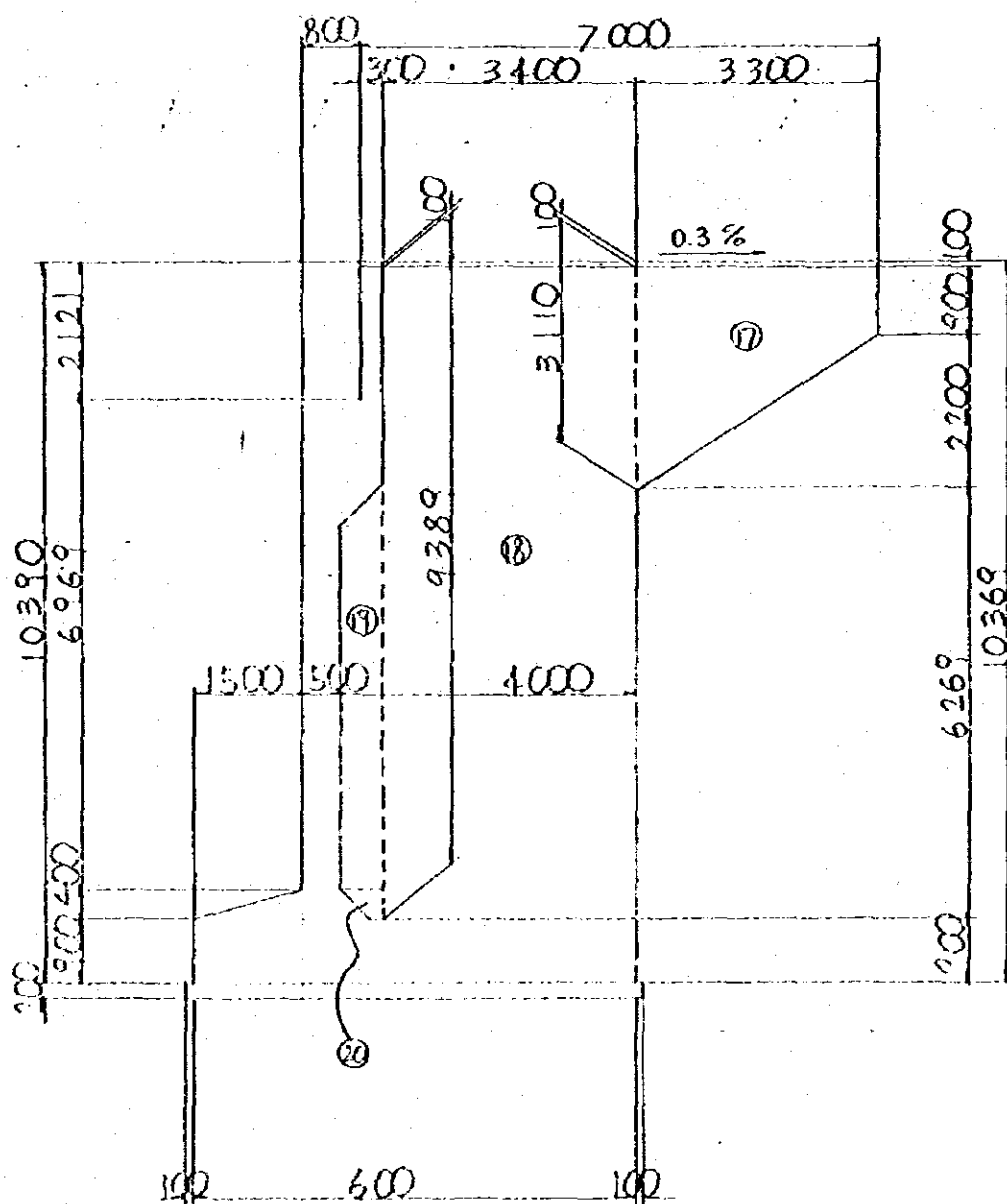




WING (RIGHT)



WING (LEFT)



§ 2 concrete volume

Parapet

- ① $\frac{1}{2} \times (2.121 + 2.129) \times 0.30 \times 0.30 = 0.191$
- $2.029 \times 1.50 \times 0.30 = 0.913$
- $1.799 \times 8.20 \times 0.30 = 4.426$
- $\frac{1}{2} \times (2.029 + 2.044) \times 0.60 \times 0.30 = 0.367$
- ② $\frac{1}{2} \times (0.30 + 0.60) \times 0.30 \times 8.20 = 1.107$

Wall

- ③ $\frac{1}{2} \times (1.369 + 1.104) \times 1.10 \times 10.60 = 14.418$
- ④ $\frac{1}{2} \times 0.60 \times 0.60 \times 10.60 = 1.908$
- ⑤ $6.00 \times 0.50 \times 10.60 = 31.8$

footing

- ⑥ $\frac{1}{2} \times 1.50 \times 0.40 \times 10.60 = 3.18$
- ⑦ $\frac{1}{2} \times 0.40 \times 0.40 \times 10.60 = 0.848$
- ⑧ $0.90 \times 6.00 \times 10.60 = 57.4$

buttress

- ⑨ $\frac{1}{2} \times 6.00 \times 3.40 \times 0.60 \times 2 = 12.24$
- ⑩ $\frac{1}{2} \times (5.00 + 5.60) \times 0.60 \times 0.60 \times 2 = 3.816$
- ⑪ $\frac{1}{2} \times (0.60 + 0.20) \times 0.40 \times 0.60 \times 2 = 0.192$

Wing (Right)

- ⑫ $\frac{1}{2} \times (1.00 + 4.674) \times 1.834 \times 0.60 = 3.122$

$$\textcircled{13} \quad \frac{1}{2} \times (9.145 + 9.148) \times 0.866 \times 0.60 = 4.753$$

$$\textcircled{14} \quad \frac{1}{2} \times (5.00 + 5.60) \times 0.60 \times 0.60 = 1.908$$

$$\textcircled{15} \quad \frac{1}{2} \times (0.20 + 0.60) \times 0.40 \times 0.60 = 0.096$$

$\textcircled{16}$

Wing (left)

$$0.30 \times 0.10 \times 6.70 = 0.201$$

$$\textcircled{17} \quad \frac{1}{2} \times (0.90 + 3.11) \times 3.30 \times 0.60 = 3.97$$

$$\textcircled{18} \quad \frac{1}{2} \times (9.389 + 9.379) \times 3.40 \times 0.60 = 19.143$$

$$\textcircled{19} \quad \frac{1}{2} \times (5.00 + 5.60) \times 0.60 \times 0.60 = 1.908$$

$$\textcircled{20} \quad \frac{1}{2} \times (0.20 + 0.60) \times 0.40 \times 0.60 = 0.096$$

haunch

$$\textcircled{21} \quad \frac{1}{2} \times 0.30 \times 0.30 \times 3.376 = 0.152$$

$$\textcircled{22} \quad \frac{1}{2} \times 0.30 \times 0.30 \times 1.903 = 0.086$$

$$\textcircled{23} \quad \frac{1}{2} \times 0.30 \times 0.30 \times 5.30 \times 6 = 1.431$$

$$\textcircled{24} \quad \frac{1}{2} \times 0.30 \times 0.30 \times 3.90 \times 6 = 1.053$$

$$\Sigma V = 170.725 \text{ m}^3$$

grand total

$$V = 170.725 \text{ m}^3$$

blinding concrete volume.

$$6.20 \times 10.80 \times 0.20 = 13.392 \text{ m}^3$$

§ 3. form area

Parapet

$$\begin{aligned}
 \textcircled{1} \quad & \frac{1}{2} \times (2.121 + 2.129) \times 0.30 & = & 0.638 \\
 & 2.029 \times 1.50 & = & 3.044 \\
 & 1.799 \times 8.20 \times 2 & = & 29.504 \\
 & \frac{1}{2} (2.029 + 2.044) \times 0.60 & = & 1.222 \\
 & 2.029 \times 0.90 & = & 1.826 \\
 & -0.60 \times 8.20 & = & -4.92 \\
 & -0.30 \times 0.719 & = & -0.216 \\
 & 0.30 \times (2.121 + 2.044) & = & 1.25
 \end{aligned}$$

$$\begin{aligned}
 \textcircled{2} \quad & 0.30 \times 8.20 & = & 2.46 \\
 & 0.30 \times \sqrt{2} \times 8.20 & = & 3.479 \\
 & \frac{1}{2} \times (0.30 + 0.60) \times 0.30 & = & 0.135
 \end{aligned}$$

wall

$$\begin{aligned}
 \textcircled{3} \quad & \frac{1}{2} \times (1.369 + 1.104) \times 10.60 & = & 13.107 \\
 & \frac{1}{2} \times (1.347 + 1.127) \times 8.80 & = & 10.886 \\
 & (1.369 + 1.104) \times 1.10 & = & 2.72 \\
 \textcircled{4} \quad & 0.30 \times \sqrt{2} \times (2 \times 2.70 + 2.80) & = & 3.479 \\
 & \frac{1}{2} \times (2.10 + 2.70) \times 0.30 \times \sqrt{2} \times 2 & = & 2.036 \\
 & \frac{1}{2} \times (2.20 + 2.80) \times 0.30 \times \sqrt{2} & = & 1.06 \\
 & \frac{1}{2} \times 0.60 \times 0.80 \times 2 & = & 0.36 \\
 \textcircled{5} \quad & 6.00 \times 10.60 & = & 63.60 \\
 & 5.00 \times (2.10 \times 2 + 2.20) & = & 32.0
 \end{aligned}$$

$$0.50 \times 6.00 \times 2 = 6.00$$

footing

$$\textcircled{6} \quad \frac{1}{2} \times 1.50 \times 0.40 \times 2 = 0.60$$

$$\textcircled{7} \quad 0.40 \times \sqrt{2} \times (2 \times 2.40 + 2.50) = 4.13$$

$$\frac{1}{2} \times 0.40 \times 0.40 \times 2 = 0.16$$

$$\textcircled{8} \quad 0.90 \times (6.00 + 10.60) \times 2 = 29.88$$

buttress

$$\textcircled{9} \quad \frac{1}{2} \times 5.70 \times 3.23 \times 2 \times 2 = 36.882$$

$$\textcircled{10} \quad \frac{1}{2} \times (5.70 + 5.40) \times 0.30 \times 2 \times 2 = 6.66$$

$$\sqrt{6.00^2 + 3.40^2} \times 0.60 \times 2 = 8.276$$

Wing (right)

$$\textcircled{12} \quad \frac{1}{2} \times (1.00 + 4.674) \times 1.834 \times 2 = 10.406$$

$$(1.00 + \sqrt{1.834^2 + 3.668^2}) \times 0.60 = 3.061$$

$$\textcircled{13} \quad \frac{1}{2} \times (9.145 + 9.148) \times 0.866 \times 2 = 15.842$$

$$-0.30 \times (2.423 + 0.866) = -0.987$$

$$\textcircled{14} \quad \frac{1}{2} \times (5.00 + 5.60) \times 0.60 = 3.18$$

$$\frac{1}{2} \times (5.70 + 5.40) \times 0.30 = 1.665$$

$$\textcircled{15} \quad \frac{1}{2} \times (0.20 + 0.60) \times 0.40 = 0.16$$

$$\textcircled{16} \quad \frac{1}{2} \times 4.471 \times 2.534 + \frac{1}{2} \times 4.171 \times 2.364 = 10.595$$

$$\sqrt{4.471^2 + 2.534^2} \times 0.60 = 3.083$$

Wing (left)

$$\begin{aligned}
 & (6.70 \times 2 + 0.30) \times 0.10 & = & 1.37 \\
 \textcircled{17} & \frac{1}{2} \times (0.90 + 3.11) \times 3.30 \times 2 & = & 13.233 \\
 & (0.90 + \sqrt{2.20^2 + 3.30^2}) \times 0.60 & = & 2.92 \\
 \textcircled{18} & \frac{1}{2} \times (9.379 + 9.389) \times 3.40 \times 2 & = & 63.811 \\
 & - 0.30 \times (3.376 + 3.40) & = & - 2.033 \\
 & 6.269 \times 0.60 & = & 3.761 \\
 \textcircled{19} & \frac{1}{2} \times (5.00 + 5.60) \times 0.60 & = & 3.18 \\
 & \frac{1}{2} \times (5.70 + 5.40) \times 0.30 & = & 1.665 \\
 \textcircled{20} & \frac{1}{2} \times (0.20 + 0.60) \times 0.40 & = & 0.16
 \end{aligned}$$

haunch

$$\begin{aligned}
 \textcircled{21} & 0.30 \times \sqrt{2} \times 3.376 & = & 1.432 \\
 \textcircled{22} & 0.30 \times \sqrt{2} \times 1.903 & = & 0.807 \\
 \textcircled{23} & 0.30 \times \sqrt{2} \times 5.30 \times 6 & = & 13.492 \\
 \textcircled{24} & 0.30 \times \sqrt{2} \times 3.90 \times 6 & = & 9.928 \\
 & \frac{1}{2} \times 0.30 \times 0.30 & = & 0.045 \\
 & \frac{1}{2} \times 0.30 \times 0.345 \times 5 & = & 0.259
 \end{aligned}$$

$$\Sigma A = 421.293 \text{ m}^2$$

blinding concrete form area

$$(6.20 + 10.80) \times 0.20 \times 2 = 6.80 \text{ m}^2$$

grand total

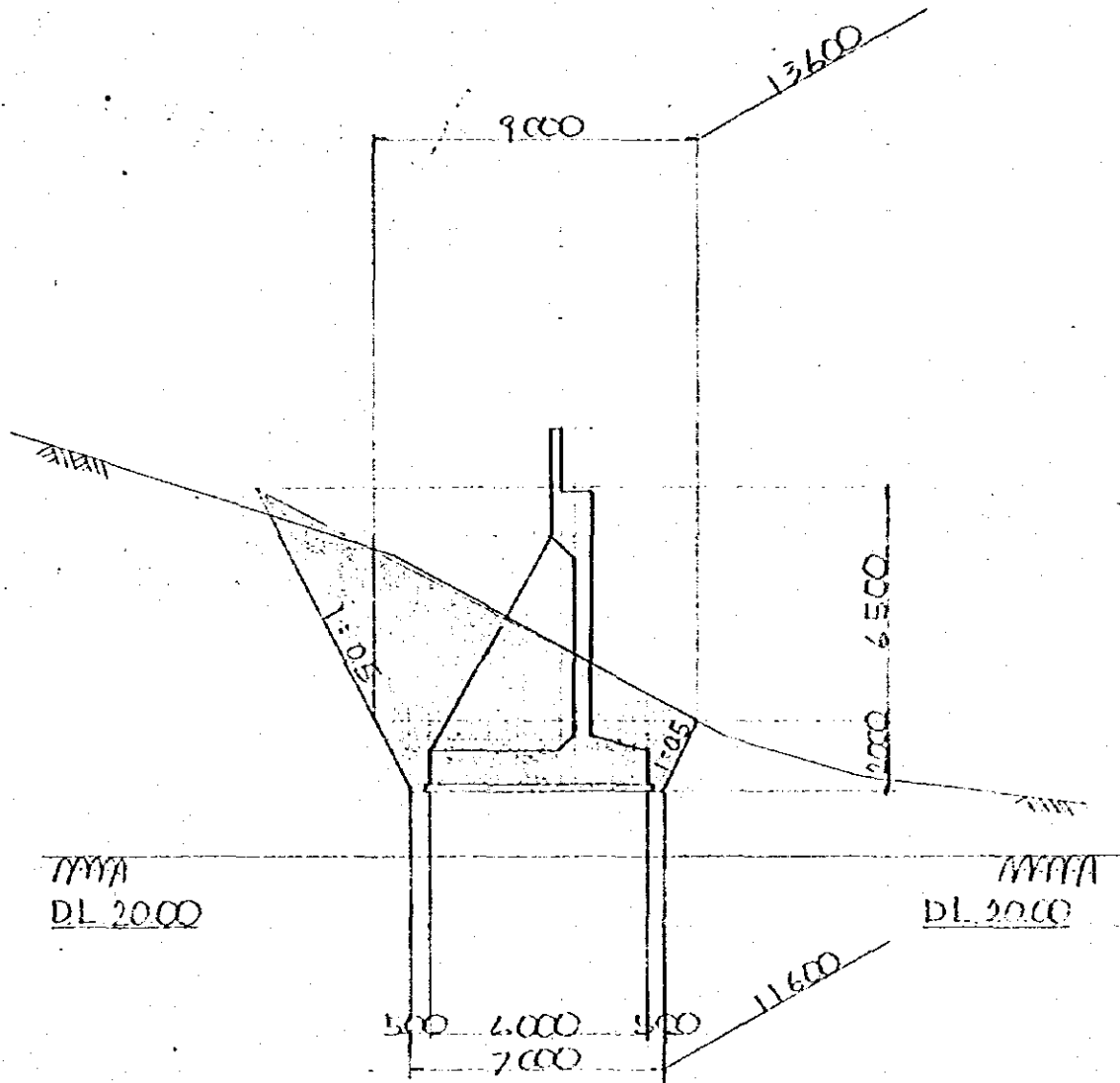
type - A (plane formworks)

$$A = 386.523 \text{ m}^2$$

type - E (rough finish formworks)

$$A = 41.57 \text{ m}^2$$

§ 4 EARTH WORKS



(1) EXCAVATION

common

$$\frac{1}{6} \times 2.00 \times (9.00 \times 13.60 + (9.00 + 7.00) \times (13.60 + 11.60) + 7.00 \times 11.60) = 202.267$$

$$\frac{1}{6} \times 9.00 \times 4.50 \times (20.10 + 2 \times 13.60) = 461.175$$

$$\Sigma V = 663.442 \text{ m}^3$$

wall

$$0.50 \times 2.20 \times 10.60 = 11.66$$

buttress

$$\frac{1}{2} \times (1.903 + 4.00) \times 3.70 \times 0.60 \times 2 = 19.657$$

$$4.00 \times 3.70 \times 0.60 = 8.88$$

$$- \frac{1}{2} \times 0.40 \times 0.40 \times 0.60 \times 4 = -0.192$$

haunch

$$\frac{1}{2} \times 0.30 \times 0.30 \times 2.60 \times 6 = 0.702$$

$$= 1.08$$

footing

$$= 61.428$$

blinding concrete

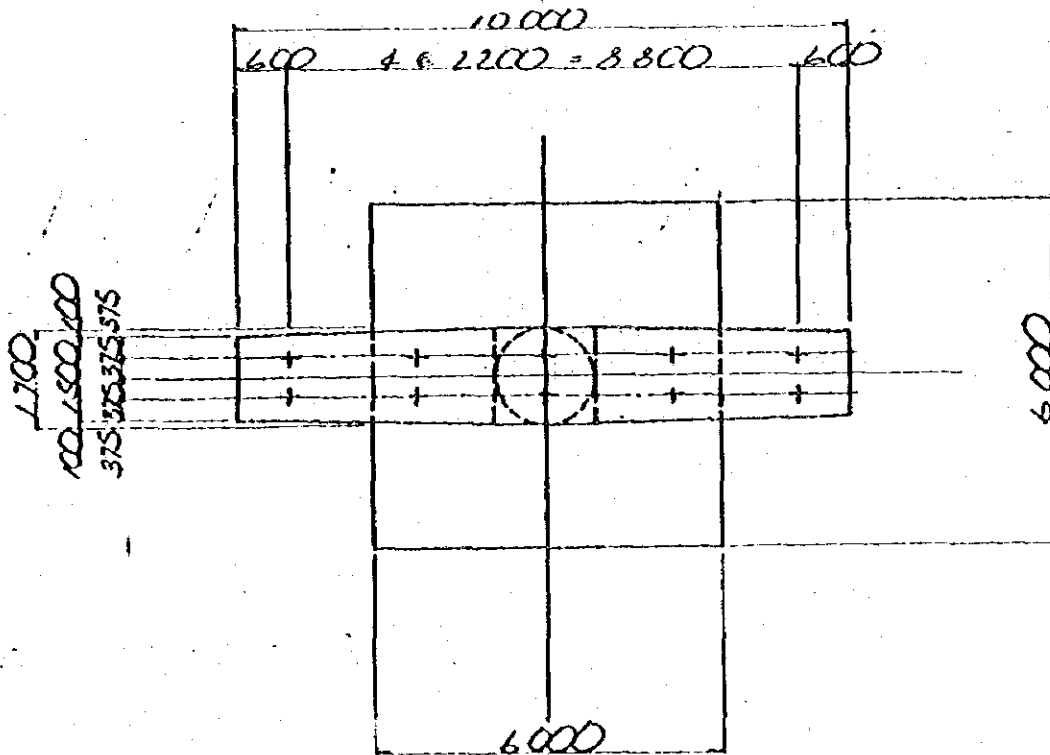
$$= 13.392$$

$$\Sigma V = 116.607 \text{ m}^3$$

(2) BACK FILL

$$663.442 - 116.607 = 546.835 \text{ m}^3$$

St. LOUIS
 $P_1 \sim P_2 - \text{PIER.}$


PLAN

	P. 1	P. 2
STA	65+13.115	65+11.115
P. H	34.089	34.187
EL 1	32.077	32.194
2	32.222	32.317
3	32.347	32.444
4	30.100	30.278
5	19.116	19.320
6	17.516	17.620

§ 2 concrete volume

beam

$$\textcircled{1} \quad \frac{1}{2} \times (2.00 + 2.042) \times 1.70 \times 1.70 = 5.841$$

$$\textcircled{2} \quad \frac{1}{2} \times (1.50 + 1.70) \times 4.15 \times 1.20 \times 2 = 15.936$$

$$\textcircled{3} \quad \frac{1}{6} \times 0.80 \times 4.15 \times (2 \times 1.70 + 1.50) = 2.711$$

$$\textcircled{4} \quad \frac{1}{6} \times 0.842 \times 4.15 \times (2 \times 1.70 + 1.50) = 2.854$$

column

$$\textcircled{5} \quad \frac{1}{4} \times \pi \times 1.70^2 \times 10.978 = 24.918$$

footing

$$\textcircled{6} \quad 6.00 \times 1.70 \times 6.00 = 61.20$$

$$\Sigma V = 113.46 \text{ m}^3$$

grand total

$$V = 113.46 \text{ m}^3$$

blinding concrete volume

$$6.20 \times 6.20 \times 0.20 = 7.688 \text{ m}^3$$

§ 3 form area

beam

$$\textcircled{1} \quad \frac{1}{2} \times (2.00 + 2.042) \times 1.70 \times 2 = 6.871$$

$$1.70 \times 1.70 - \frac{\pi}{4} \times 1.70^2 = 0.62$$

$$\textcircled{2} \quad \sqrt{4.15^2 + 0.10^2} \times 1.20 \times 2 \times 2 = 19.926$$

$$1.50 \times 1.20 \times 2 = 3.60$$

$$\textcircled{3} \quad \frac{1}{2} \times \sqrt{4.15^2 + 0.10^2} \times 0.80 \times 2 = 3.321$$

$$\frac{1}{2} \times (1.50 + 1.70) \times \sqrt{0.697^2 + 4.15^2} = 6.733$$

$$\textcircled{4} \quad \frac{1}{2} \times \sqrt{4.15^2 + 0.10^2} \times 0.842 \times 2 = 3.495$$

$$\frac{1}{2} \times (1.50 + 1.70) \times \sqrt{0.947^2 + 4.15^2} = 6.811$$

column

$$\textcircled{5} \quad \pi \times 1.70 \times 10.978 = 58.63$$

footing

$$\textcircled{6} \quad 6.00 \times 4 \times 1.70 = 40.80$$

$$\Sigma A = 150.807 \text{ m}^2$$

blinding concrete form area

$$6.20 \times 4 \times 0.20 = 4.96 \text{ m}^2$$

grand total

type - A (plane formworks)

$$A = 51.377 \text{ m}^2$$

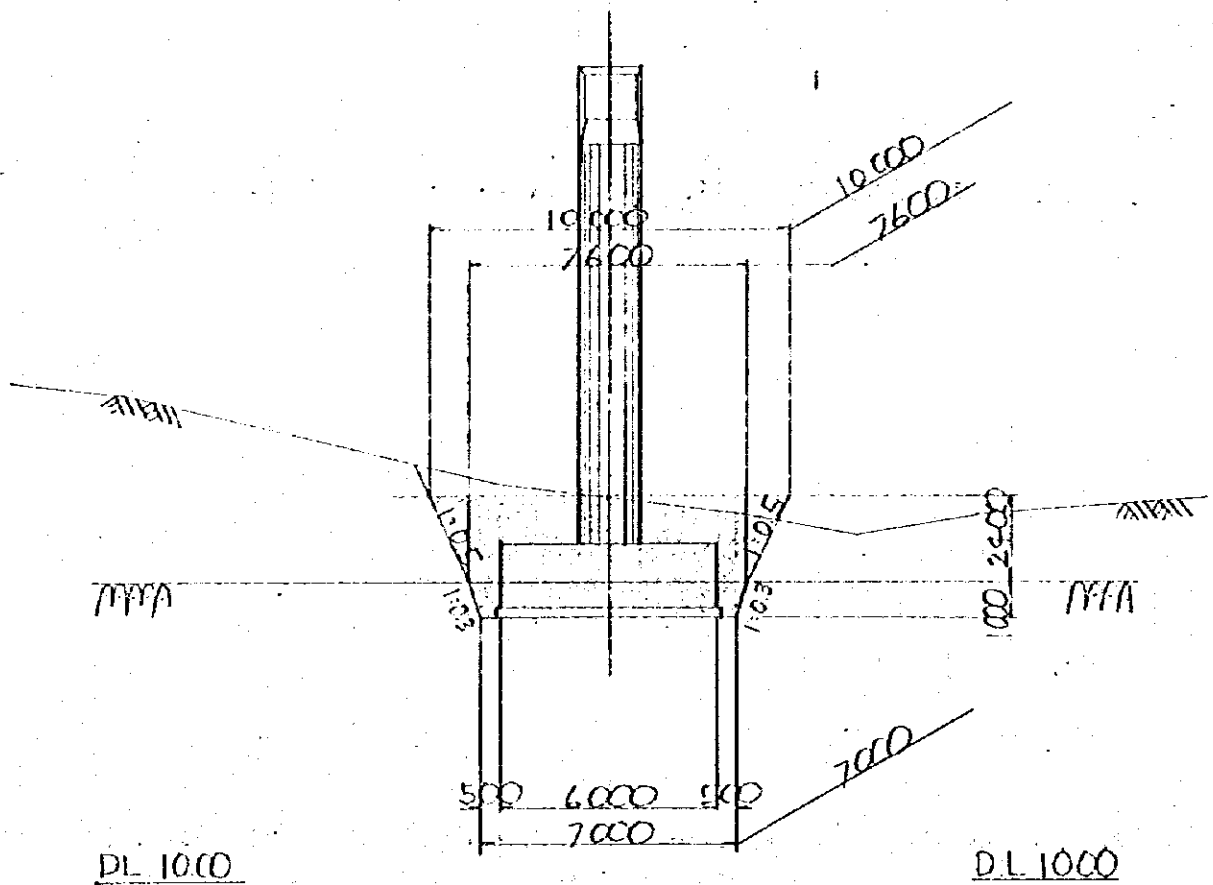
type - B (curved formworks)

$$A = 58.63 \text{ m}^2$$

type - E (rough finish formworks)

$$A = 45.76 \text{ m}^2$$

§ 4 EARTH WORKS (P₁)



(1) EXCAVATION

common

$$\frac{1}{6} \times 240 \times \{ 10.00 \times 10.00 + (10.00 + 7.60) \\ (10.00 + 7.60) + 7.60 \times 7.60 \} = 187.008 \text{ m}^3$$

rock

$$\frac{1}{6} \times 100 \times \{ 7.60 \times 7.60 + (7.60 + 7.00) \\ (7.60 + 7.00) + 7.00 \times 7.00 \} = 53.32 \text{ m}^3$$

$$\Sigma V = 240.328 \text{ m}^3$$

column

$$\frac{1}{4} \times \pi \times 1.70^2 \times 1.50 = 3.405$$

footing

$$= 61.20$$

blinding concrete

$$= 7.688$$

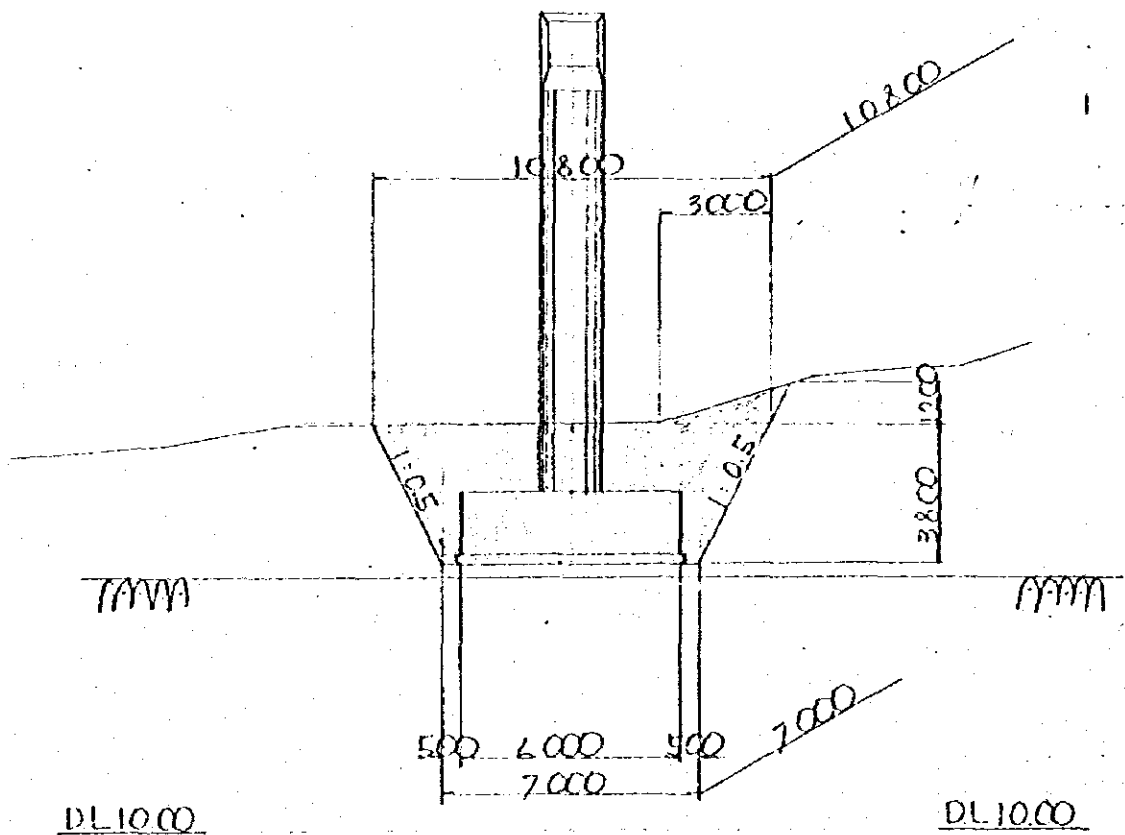
$$\Sigma V = 72.293 \text{ m}^3$$

(2) BACK FILL

$$240.328 - 72.293$$

$$= 168.035 \text{ m}^3$$

EARTH WORKS (P₂)



(1) EXCAVATION

common

$$\frac{1}{6} \times 3.80 \times \{ 10.80^2 + (10.80 + 7.00)^2 + 7.00^2 \} = 305.571$$

$$\frac{1}{6} \times 3.00 \times 1.20 \times (12.00 + 2 \times 10.80) = 20.16$$

$$\Sigma V = 325.731 \text{ m}^3$$

column

$$\frac{1}{4} \times \pi \times 1.70^2 \times 1.90 = 4.313$$

$$\text{footing} = 61.20$$

$$\text{blinding concrete} = 7.688$$

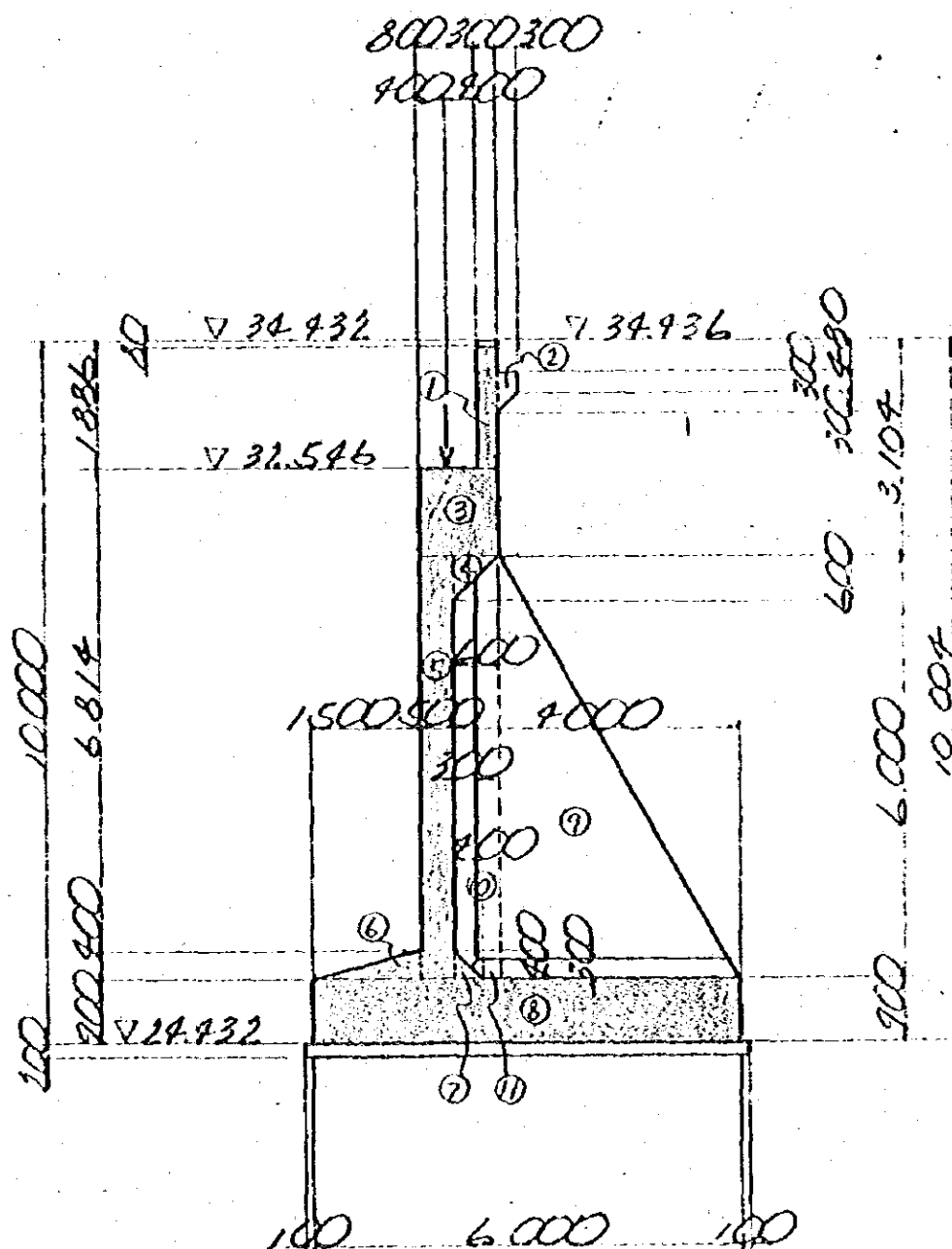
$$\Sigma V = 73.201 \text{ m}^3$$

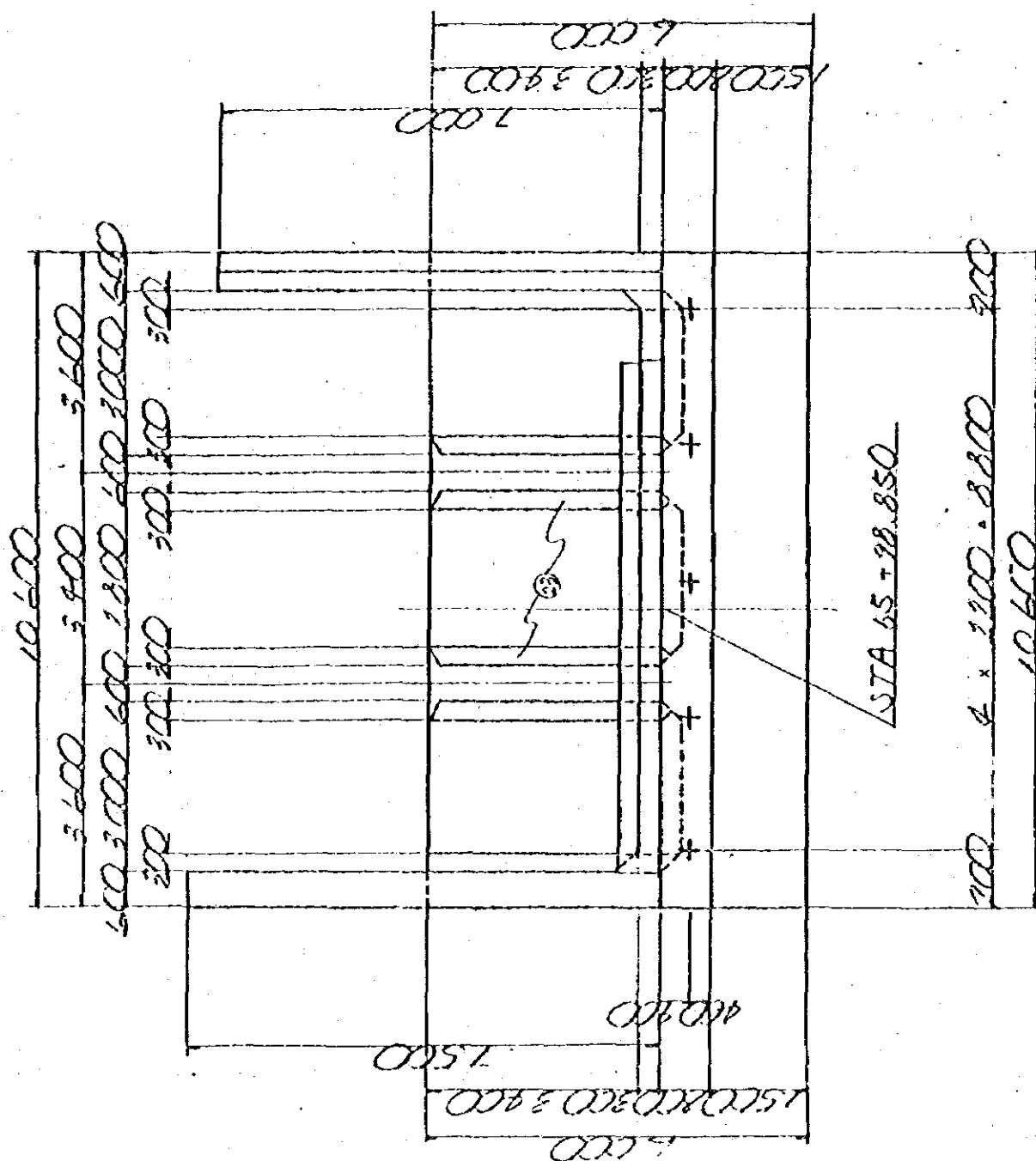
(2) BACK FILL

$$325.731 - 73.201 = 252.53 \text{ m}^3$$

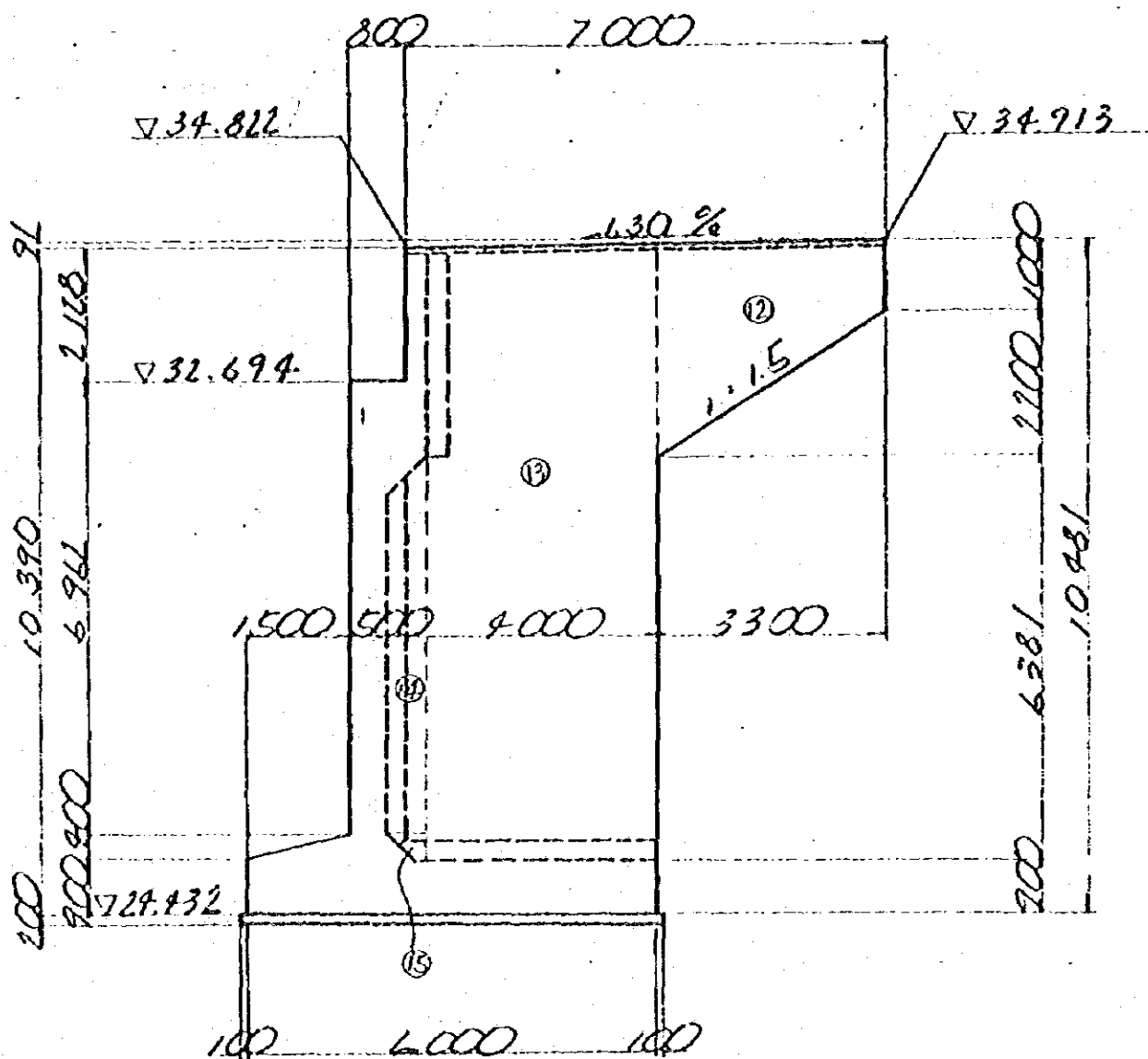
St. LOUIS
A₂ - ABUTMENT

§ 1 STRUCTURAL FIGURE

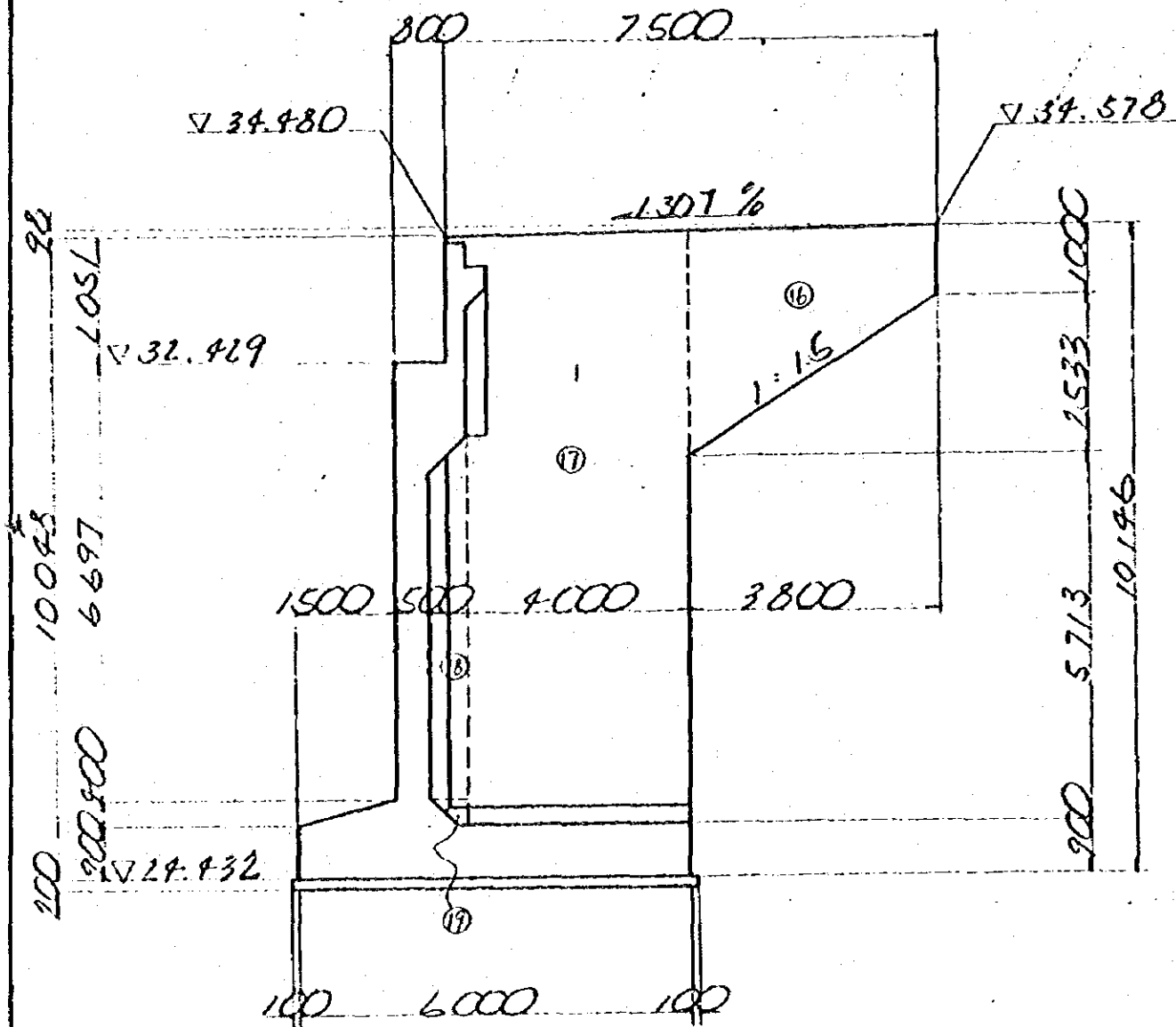




WING (RIGHT)



WING (LEFT)



§ 2 concrete volume

Parapet

- ① $\frac{1}{2} \times (2.051 + 2.036) \times 0.60 \times 0.30 = 0.368$
 $1.806 \times 8.20 \times 0.30 = 4.443$
 $2.036 \times 1.50 \times 0.30 = 0.916$
 $\frac{1}{2} \times (2.136 + 2.128) \times 0.60 \times 0.30 = 0.384$
- ② $\frac{1}{2} \times (0.30 + 0.60) \times 0.30 \times 8.20 = 1.107$

Wall

- ③ $\frac{1}{2} \times (1.097 + 1.362) \times 1.10 \times 10.60 = 14.336$
 ④ $\frac{1}{2} \times 0.60 \times 0.60 \times 10.60 = 1.908$
 ⑤ $6.00 \times 0.50 \times 10.60 = 31.8$

footing

- ⑥ $\frac{1}{2} \times 1.50 \times 0.40 \times 10.60 = 3.18$
 ⑦ $\frac{1}{2} \times 0.40 \times 0.40 \times 10.60 = 0.848$
 ⑧ $0.90 \times 6.00 \times 10.60 = 57.4$

buttress

- ⑨ $\frac{1}{2} \times 6.00 \times 3.40 \times 0.60 \times 2 = 12.24$
 ⑩ $\frac{1}{2} \times (5.00 + 5.60) \times 0.60 \times 0.60 \times 2 = 3.816$
 ⑪ $\frac{1}{2} \times (0.60 + 0.20) \times 0.40 \times 0.60 \times 2 = 0.192$

Wing (Right)

- $0.10 \times 0.30 \times 6.70 = 0.201$
 ⑫ $\frac{1}{2} \times (0.90 + 3.057) \times 3.30 \times 0.60 = 3.917$

$$\begin{aligned}
 (13) \quad & \frac{1}{2} \times (9.438 + 9.394) \times 3.40 \times 0.60 = 19.209 \\
 (14) \quad & \frac{1}{2} \times (5.00 + 5.60) \times 0.60 \times 0.60 = 1.908 \\
 (15) \quad & \frac{1}{2} \times (0.20 + 0.60) \times 0.40 \times 0.60 = 0.096
 \end{aligned}$$

Wing (left)

$$\begin{aligned}
 (16) \quad & \frac{1}{2} \times (1.00 + 3.483) \times 3.80 \times 0.60 = 5.111 \\
 (17) \quad & \frac{1}{2} \times (9.196 + 9.152) \times 3.40 \times 0.60 = 18.715 \\
 (18) \quad & \frac{1}{2} \times (5.00 + 5.60) \times 0.60 \times 0.60 = 1.908 \\
 (19) \quad & \frac{1}{2} \times (0.20 + 0.60) \times 0.40 \times 0.60 = 0.096
 \end{aligned}$$

haunch

$$\begin{aligned}
 (20) \quad & \frac{1}{2} \times 0.30 \times 0.30 \times 3.398 = 0.153 \\
 (21) \quad & \frac{1}{2} \times 0.30 \times 0.30 \times 1.903 = 0.086 \\
 (22) \quad & \frac{1}{2} \times 0.30 \times 0.30 \times 5.30 \times 6 = 1.431 \\
 (23) \quad & \frac{1}{2} \times 0.30 \times 0.30 \times 3.90 \times 6 = 1.053
 \end{aligned}$$

$$\Sigma V = 186.822 \text{ m}^3$$

grand total

$$V = 186.822 \text{ m}^3$$

blinding concrete volume

$$6.20 \times 10.80 \times 0.20 = 13.392 \text{ m}^3$$

§ 3. form area

Parapet

$$\begin{aligned}
 \textcircled{1} \quad & \frac{1}{2} \times (2.051 + 2.036) \times 0.30 & = & 0.613 \\
 & 1.806 \times 8.20 \times 2 & = & 29.618 \\
 & 2.036 \times (1.50 + 0.90) & = & 4.886 \\
 & \frac{1}{2} \times (2.136 + 2.128) \times 0.30 & = & 0.64 \\
 & 0.30 \times (0.23 \times 2 + 0.10) & = & 0.168 \\
 & -0.60 \times 8.20 & = & -4.92 \\
 & -0.30 \times 0.806 & = & -0.242 \\
 & 0.30 \times (2.051 + 2.128) & = & 1.254 \\
 \\
 \textcircled{2} \quad & 0.30 \times 8.20 & = & 2.46 \\
 & 0.30 \times \sqrt{2} \times 8.20 & = & 3.479 \\
 & \frac{1}{2} \times (0.30 + 0.60) \times 0.30 & = & 0.135
 \end{aligned}$$

wall

$$\begin{aligned}
 \textcircled{3} \quad & \frac{1}{2} \times (1.097 + 1.362) \times 10.60 & = & 13.033 \\
 & \frac{1}{2} \times (1.120 + 1.340) \times 8.80 & = & 10.82 \\
 & (1.097 + 1.362) \times 1.10 & = & 2.705 \\
 \textcircled{4} \quad & 0.30 \times \sqrt{2} \times (2 \times 2.70 + 2.80) & = & 3.479 \\
 & \frac{1}{2} \times (2.10 + 2.70) \times 0.30 \times \sqrt{2} \times 2 & = & 2.036 \\
 & \frac{1}{2} \times (2.20 + 2.80) \times 0.30 \times \sqrt{2} & = & 1.06 \\
 & \frac{1}{2} \times 0.60 \times 0.60 \times 2 & = & 0.36 \\
 \textcircled{5} \quad & 6.00 \times 10.60 & = & 63.60 \\
 & 5.00 \times (2.10 \times 2 + 2.20) & = & 32.0
 \end{aligned}$$

$$0.50 \times 6.00 \times 2 = 6.00$$

footing

$$\textcircled{6} \quad \frac{1}{2} \times 1.50 \times 0.40 \times 2 = 0.60$$

$$\textcircled{7} \quad 0.40 \times \sqrt{2} \times (2 \times 2.40 + 2.50) = 4.13$$

$$\frac{1}{2} \times 0.40 \times 0.40 \times 2 = 0.16$$

$$\textcircled{8} \quad 0.90 \times (6.00 + 10.60) \times 2 = 29.88$$

buttress

$$\textcircled{9} \quad \frac{1}{2} \times 5.70 \times 3.23 \times 2 \times 2 = 36.882$$

$$\textcircled{10} \quad \frac{1}{2} \times (5.70 + 5.40) \times 0.30 \times 2 \times 2 = 6.66$$

$$\sqrt{6.00^2 + 3.40^2} \times 0.60 \times 2 = 8.276$$

Wing (right)

$$(6.7 \times 2 + 0.30) \times 0.10 = 1.37$$

$$\textcircled{12} \quad \frac{1}{2} \times (0.90 + 3.057) \times 3.30 \times 2 = 13.058$$

$$(1.00 + \sqrt{3.30^2 + 2.20^2}) \times 0.60 = 2.92$$

$$\textcircled{13} \quad \frac{1}{2} \times (9.438 + 9.394) \times 3.40 \times 2 = 64.029$$

$$-0.30 \times (3.398 + 3.40) = -2.039$$

$$6.381 \times 0.60 = 3.829$$

$$\textcircled{14} \quad \frac{1}{2} \times (5.00 + 5.60) \times 0.60 = 3.18$$

$$-\frac{1}{2} \times (5.40 + 5.70) \times 0.30 = -1.665$$

$$\textcircled{15} \quad \frac{1}{2} \times (0.20 + 0.60) \times 0.40 = 0.16$$

Wing (left)

$$\begin{aligned}
 (16) \quad & \frac{1}{2} \times (1.00 + 3.483) \times 3.80 \times 2 & = & 17.035 \\
 & 0.00 + \sqrt{3.80^2 + 2.533^2} \times 0.60 & = & 3.34 \\
 (17) \quad & \frac{1}{2} \times (9.196 + 9.152) \times 3.40 \times 2 & = & 62.383 \\
 & -0.30 \times (1.903 + 3.40) & = & -1.591 \\
 & 5.713 \times 0.60 & = & 3.428 \\
 (18) \quad & \frac{1}{2} \times (5.00 + 5.60) \times 0.60 & = & 3.18 \\
 & \frac{1}{2} \times (5.40 + 5.70) \times 0.30 & = & 1.665 \\
 (19) \quad & \frac{1}{2} \times (0.20 + 0.60) \times 0.40 & = & 0.16
 \end{aligned}$$

haunch

$$\begin{aligned}
 (20) \quad & 0.30 \times \sqrt{2} \times 3.398 & = & 1.442 \\
 (21) \quad & 0.30 \times \sqrt{2} \times 1.903 & = & 0.807 \\
 (22) \quad & 0.30 \times \sqrt{2} \times 5.30 \times 6 & = & 13.482 \\
 (23) \quad & 0.30 \times \sqrt{2} \times 3.90 \times 6 & = & 9.928 \\
 & \frac{1}{2} \times 0.30 \times 0.30 \times 2 & = & 0.09 \\
 & \frac{1}{2} \times 0.30 \times 0.345 \times 4 & = & 0.207
 \end{aligned}$$

$$\Sigma A = 463.51 \text{ m}^2$$

blinding concrete form area

$$(6.20 + 10.80) \times 0.20 \times 2 = 6.80 \text{ m}^2$$

grand total

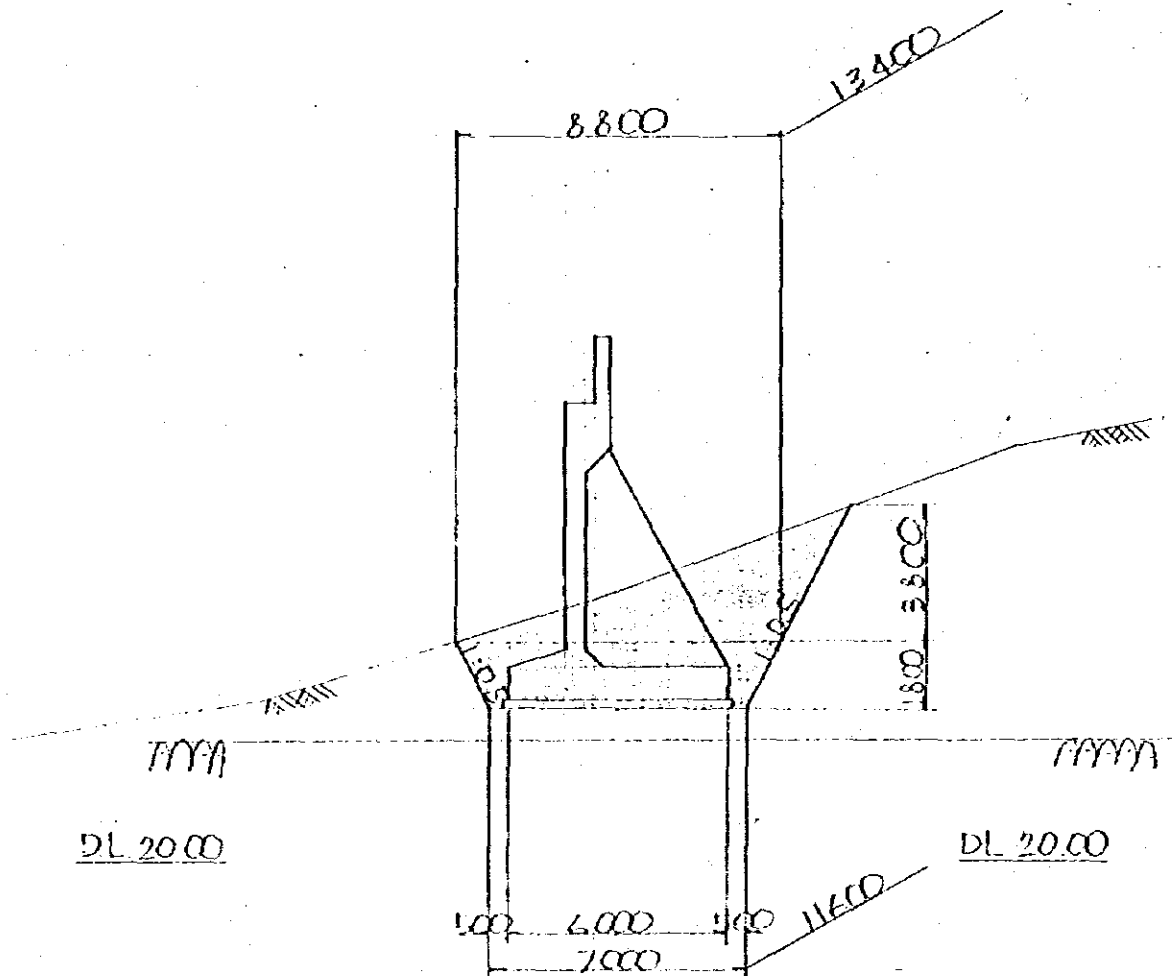
type - A (plane formworks)

$$A = 428.74 \text{ m}^2$$

type - E (rough finish formworks)

$$A = 41.57 \text{ m}^2$$

§ 4 EARTH WORKS



(1) EXCAVATION

common

$$\frac{1}{2} \times 1.80 \times \{ 8.80 \times 13.40 + (8.80 + 7.00) \times (13.40 + 11.60) + 7.00 \times 11.60 \} = 178.236$$

$$\frac{1}{6} \times 8.80 \times 3.80 \times (17.20 + 2 \times 13.40) = 245.227$$

$$\Sigma V = 423.463 \text{ m}^3$$

wall

$$1.70 \times 0.50 \times 10.60 = 9.01$$

buttress

$$\frac{1}{2} \times (2.725 + 4.00) \times 2.25 \times 0.60 \times 2 = 9.079$$

$$2.25 \times 4.00 \times 0.60 \times 2 = 10.80$$

$$-\frac{1}{2} \times 0.40 \times 0.40 \times 0.60 \times 4 = -0.702$$

haunch

$$\frac{1}{2} \times 0.30 \times 0.30 \times 1.70 \times 6 = 0.459$$

$$= 1.08$$

footing

$$= 61.428$$

blinding concrete

$$= 13.392$$

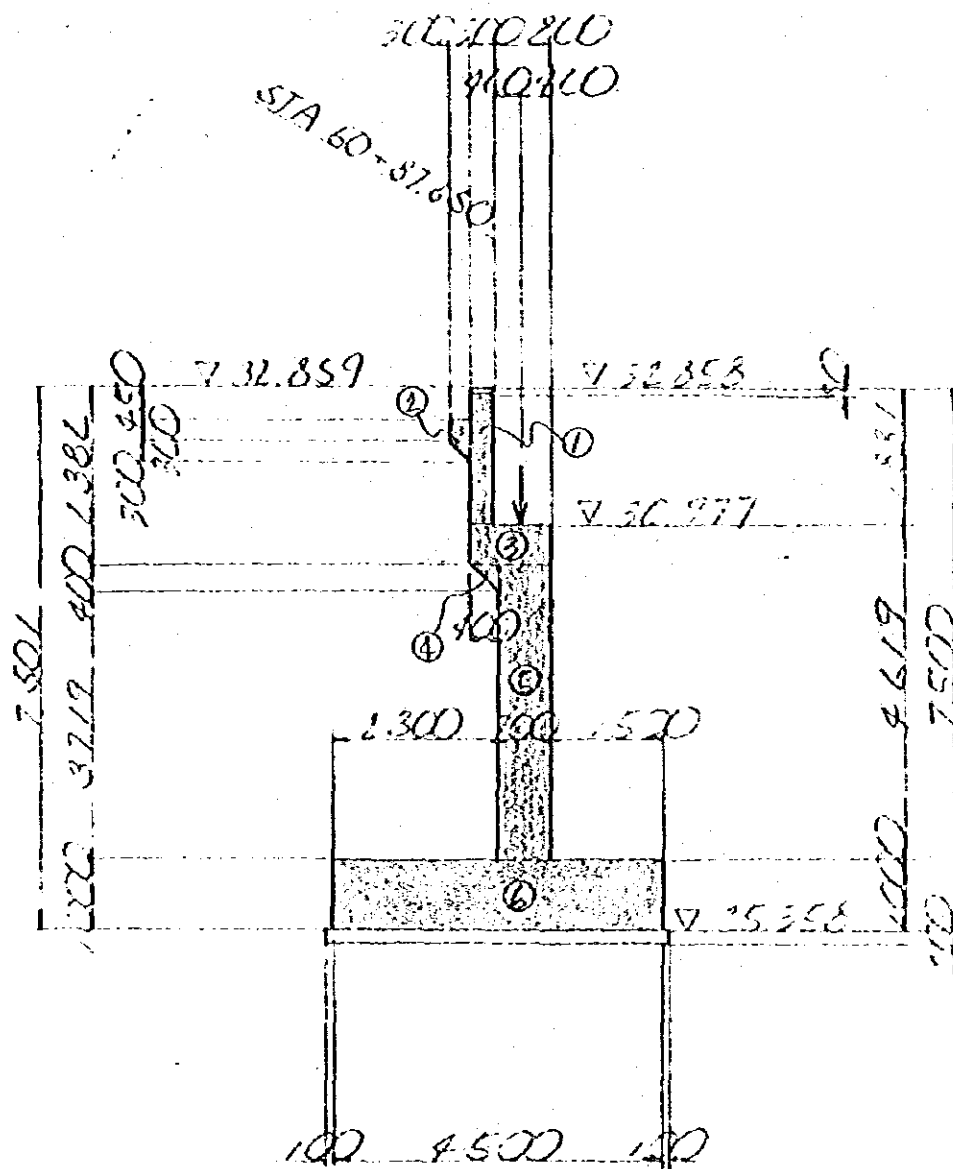
$$\Sigma V = 104.546 \text{ m}^3$$

(2) BACK FILL

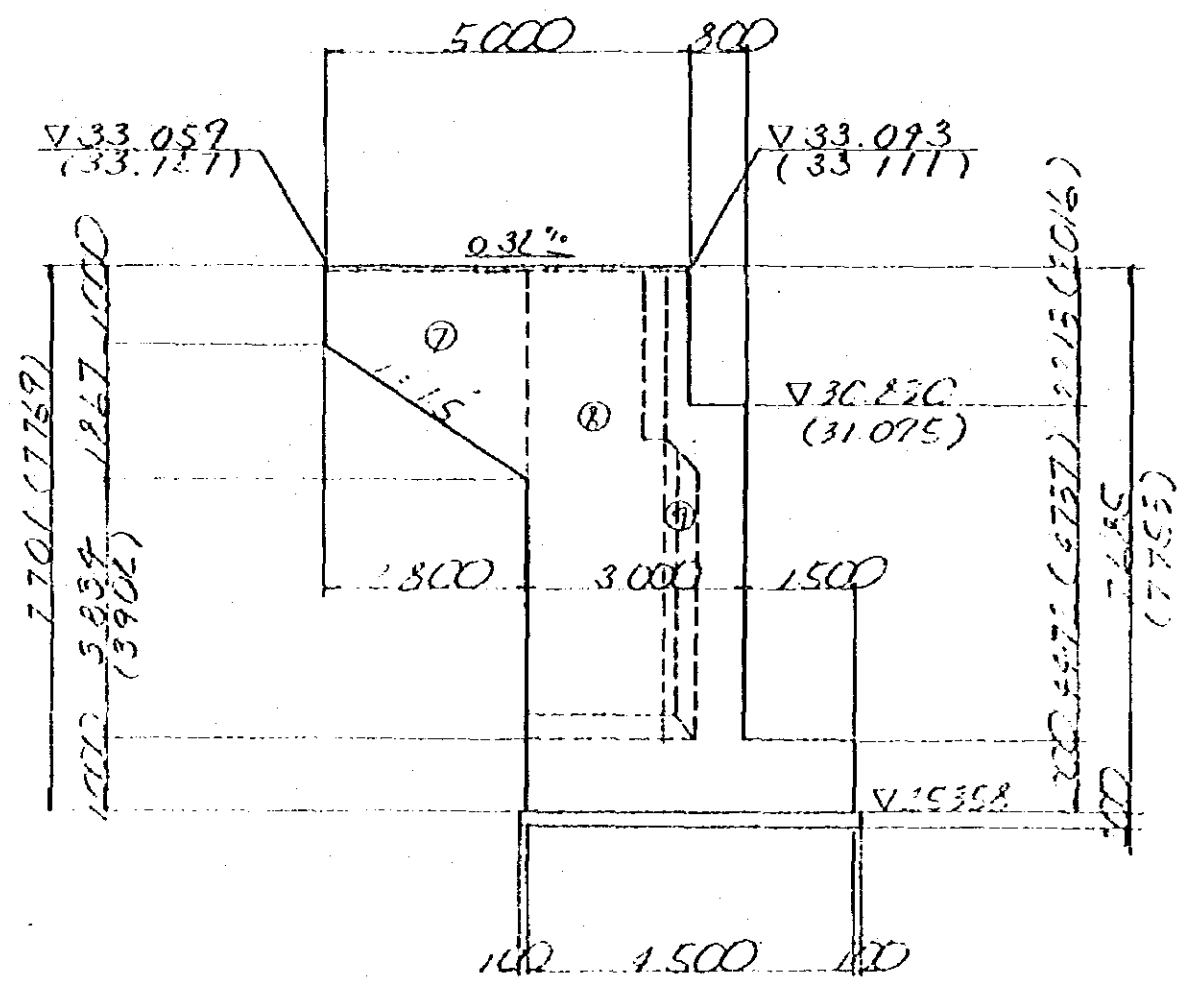
$$423.463 - 104.546 = 318.917 \text{ m}^3$$

G. R. N. W.
A1 - ABUTMENT.

§ 1 STRUCTURAL FIGURE



WING LEFT (RIGHT)



§ 2 concrete volume

parapet

- ① $\frac{1}{2} \times (2.213 + 2.206) \times 0.30 \times 0.30 = 0.199$
 $\frac{1}{2} \times (2.106 + 2.031) \times 1.50 \times 0.30 = 0.931$
 $1.801 \times 8.20 \times 0.30 = 4.43$
 $\frac{1}{2} \times (2.031 + 2.016) \times 0.60 = 1.214$
 ② $\frac{1}{2} \times (0.30 + 0.60) \times 0.30 \times 8.20 = 1.107$

wall

- ③ $\frac{1}{2} \times (0.353 + 0.618) \times 10.60 \times 1.10 = 5.661$
 ④ $\frac{1}{2} \times 0.40 \times 0.40 \times 10.60 = 0.848$
 ⑤ $0.50 \times 4.119 \times 0.70 = 1.442$

footing

- ⑥ $4.50 \times 10.60 \times 1.00 = 47.70$

wing. (right)

- ⑦ $\frac{1}{2} \times (1.00 + 2.858) \times 2.80 \times 0.60 = 3.241$
 ⑧ $\frac{1}{2} \times (6.76 + 6.754) \times 1.90 \times 0.60 = 7.703$
 ⑨ $\frac{1}{2} \times (4.119 + 3.719) \times 0.40 \times 0.60 = 0.941$

wing (left)

$$4.70 \times 0.10 \times 0.30 = 0.141$$

$$\textcircled{7} \quad \frac{1}{2} \times (0.90 + 2.758) \times 2.80 \times 0.60 = 3.073$$

$$\textcircled{8} \quad \frac{1}{2} \times (6.592 + 6.584) \times 1.90 \times 0.60 = 2.511$$

$$\textcircled{9} \quad \frac{1}{2} \times (4.119 + 3.719) \times 0.40 \times 0.60 = 0.941$$

haunch

$$\textcircled{10} \quad \frac{1}{2} \times 0.30 \times 0.30 \times 0.801 = 0.036$$

$$\textcircled{11} \quad \frac{1}{2} \times 0.30 \times 0.30 \times 2.459 = 0.111$$

$$\textcircled{12} \quad \frac{1}{2} \times 0.30 \times 0.30 \times 4.019 \times 2 = 0.362$$

$$\textcircled{13} \quad \frac{1}{2} \times 0.30 \times 0.30 \times 2.30 \times 2 = 0.207$$

$$\Sigma V = 87.799 \text{ m}^3$$

grand total

$$V = 87.799 \text{ m}^3$$

blinding concrete volume

$$4.70 \times 10.80 \times 0.20 = 10.152 \text{ m}^3$$

§ 3. form area

parapet

$$\begin{aligned}
 \textcircled{1} \quad & \frac{1}{2} \times (2.213 + 2.206) \times 0.30 & = & 0.663 \\
 & \frac{1}{2} \times (2.106 + 2.031) \times 1.50 & = & 3.103 \\
 & \frac{1}{2} \times (2.069 + 2.031) \times 0.90 & = & 1.845 \\
 & 1.801 \times 8.20 \times 2 & = & 29.536 \\
 & - 0.60 \times 8.20 + 0.30 \times 0.801 & = & - 5.16 \\
 & \frac{1}{2} \times (2.031 + 2.016) \times 0.60 & = & 1.214 \\
 & 0.30 \times (0.23 \times 2 + 0.10) & = & 0.168 \\
 & 0.30 \times (2.213 + 2.016) & = & 1.269 \\
 \textcircled{2} \quad & 0.30 \times 8.20 & = & 2.46 \\
 & 0.30 \times \sqrt{2} \times 8.20 & = & 3.479 \\
 & \frac{1}{2} \times (0.30 + 0.60) \times 0.30 & = & 0.135
 \end{aligned}$$

wall

$$\begin{aligned}
 \textcircled{3} \quad & \frac{1}{2} \times (0.353 + 0.618) \times 10.60 & = & 5.146 \\
 & \frac{1}{2} \times (0.376 + 0.596) \times 8.80 & = & 4.277 \\
 & 1.10 \times (0.353 + 0.618) & = & 1.068 \\
 \textcircled{4} \quad & 0.30 \times \sqrt{2} \times \frac{1}{2} \times (9.40 + 8.80) & = & 3.861 \\
 & 0.10 \times \sqrt{2} \times 9.40 & = & 1.329 \\
 & \frac{1}{2} \times 0.40 \times 0.40 \times 2 & = & 0.16 \\
 \textcircled{5} \quad & 4.119 \times 10.60 & = & 43.661 \\
 & 3.719 \times 8.80 & = & 32.727
 \end{aligned}$$

$$0.70 \times 4.119 \times 2 = 5.767$$

footing

$$⑥ (4.50 + 10.60) \times 2 \times 1.00 = 30.20$$

wing (right)

$$⑦ \frac{1}{2} \times (1.00 + 2.858) \times 2.80 \times 2 = 10.802$$

$$(1.00 + \sqrt{2.80^2 + 1.867^2}) \times 0.60 = 2.619$$

$$⑧ \frac{1}{2} \times (6.76 + 6.754) \times 1.90 \times 2 = 25.677$$

$$- 0.30 \times (2.419 + 1.90) = -1.296$$

$$3.902 \times 0.60 = 2.341$$

$$⑨ \frac{1}{2} \times (4.119 + 3.719) \times 0.40 = 1.568$$

$$\frac{1}{2} \times (3.819 + 3.719) \times 0.10 = 0.377$$

wing (left)

$$(4.70 \times 2 + 0.30) \times 0.10 = 0.97$$

$$⑦ \frac{1}{2} \times (0.90 + 2.758) \times 2.80 \times 2 = 10.242$$

$$(0.90 + \sqrt{2.80^2 + 1.867^2}) \times 0.60 = 2.559$$

$$⑧ \frac{1}{2} \times (6.592 + 6.586) \times 1.90 \times 2 = 25.038$$

$$- 0.30 \times (2.459 + 1.90) = -1.308$$

$$⑨ \frac{1}{2} \times (4.119 + 3.719) \times 0.40 = 1.568$$

$$\frac{1}{2} \times (3.819 + 3.719) \times 0.10 = 0.377$$

haunch

$$\begin{aligned}
 \textcircled{10} \quad 0.30 \times \sqrt{2} \times 1.419 &= 0.602 \\
 \textcircled{11} \quad 0.30 \times \sqrt{2} \times 2.459 &= 1.043 \\
 \textcircled{12} \quad 0.30 \times \sqrt{2} \times 4.019 \times 2 &= 3.41 \\
 \textcircled{13} \quad 0.30 \times \sqrt{2} \times 2.30 \times 2 &= 1.952
 \end{aligned}$$

$$\Sigma A = 258.065 \text{ m}^2$$

blinding concrete form area

$$(4.70 + 10.80) \times 2 \times 0.20 = 6.20 \text{ m}^2$$

grand total

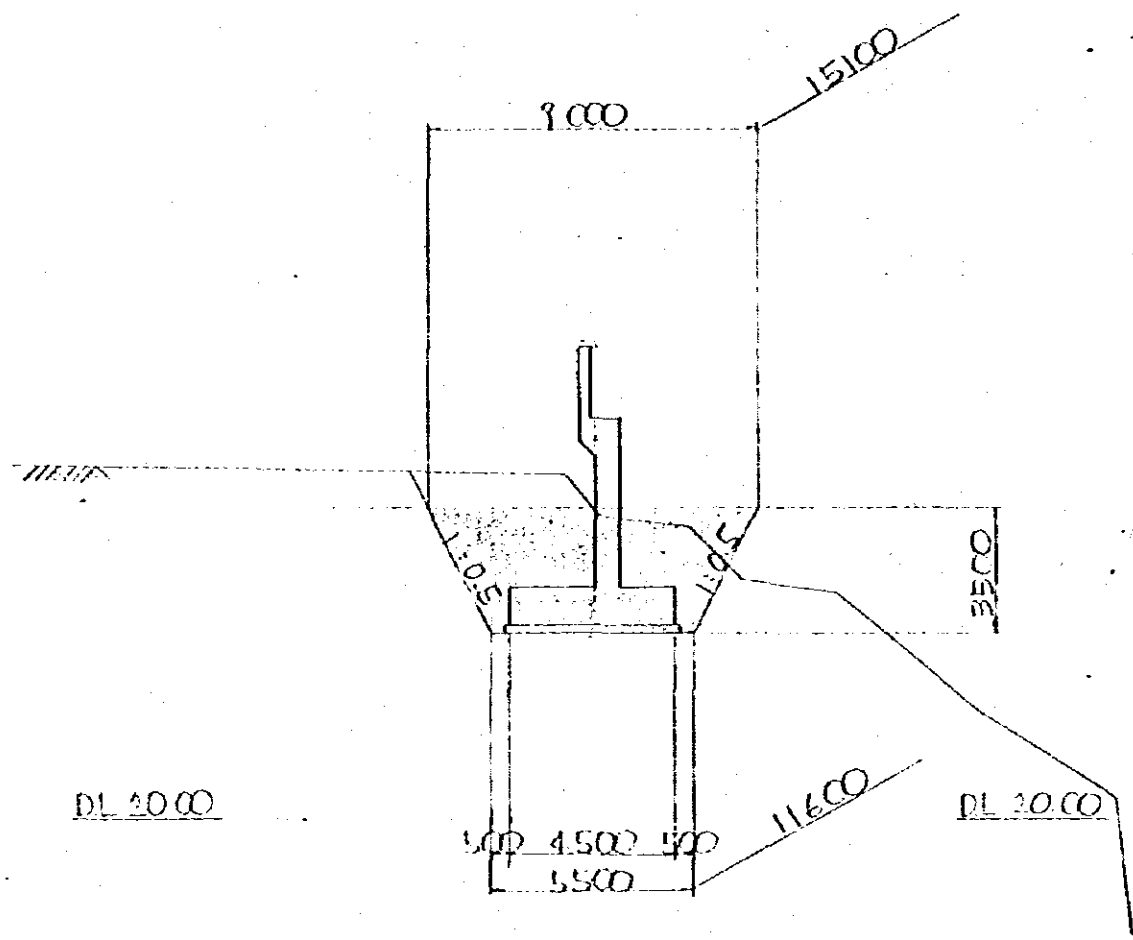
type - A (plane formworks)

$$A = 227.865 \text{ m}^2$$

type - E (rough finish formworks)

$$A = 36.40 \text{ m}^2$$

§ 4 EARTH WORKS



(1) EXCAVATION

common

$$\frac{1}{2} \times 3.50 \times \{ 9.00 \times 15.10 + (9.00 + 5.50) \times (15.10 + 11.60) + 5.50 \times 11.60 \} = 342.329 \text{ m}^3$$

wall

$$0.70 \times 2.30 \times 10.60 = 17.066$$

$$\text{footing} = 47.70$$

$$\text{blinding} = 10.152$$

$$\Sigma V = 74.918 \text{ m}^3$$

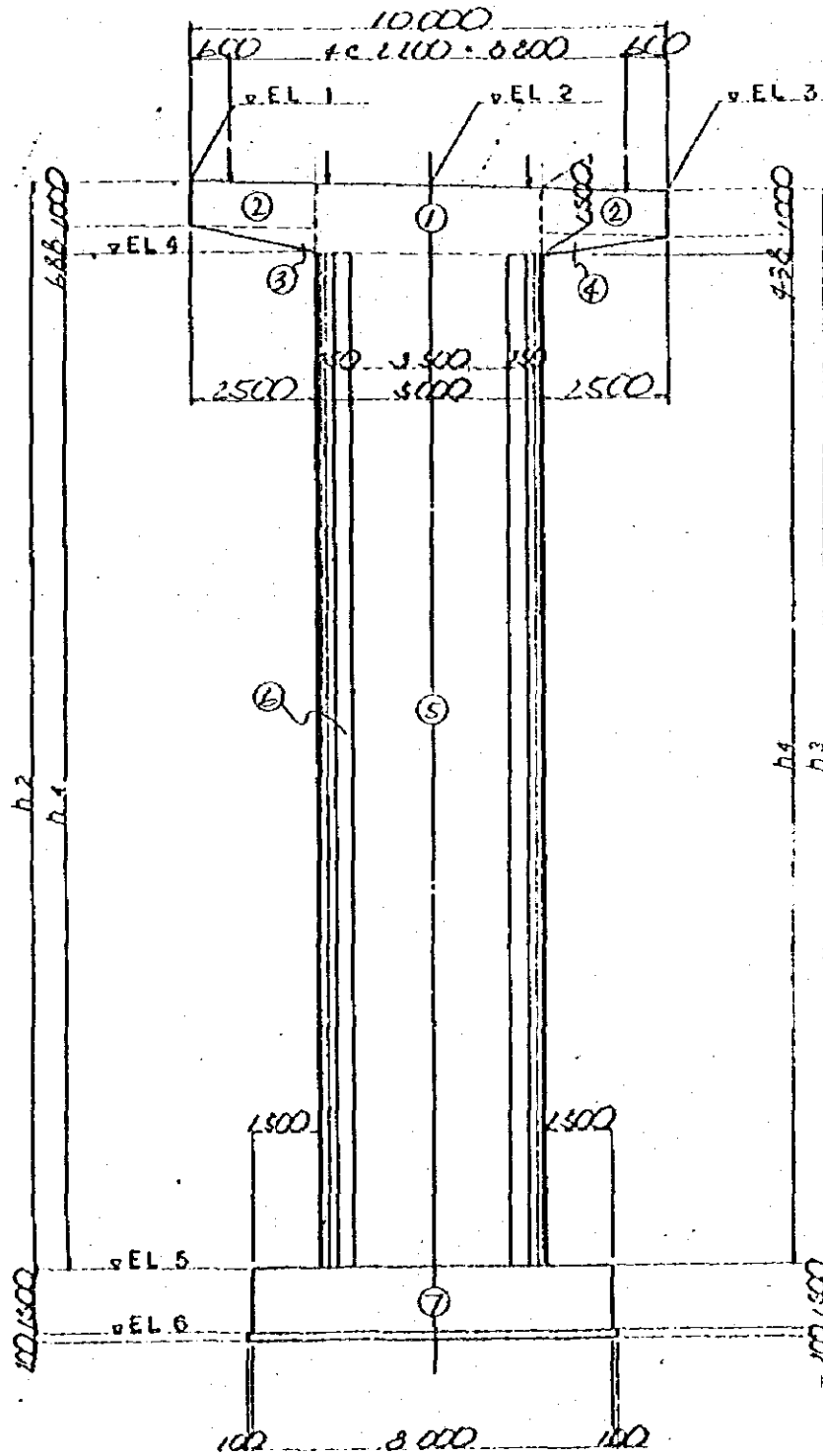
(2) BACK FILL

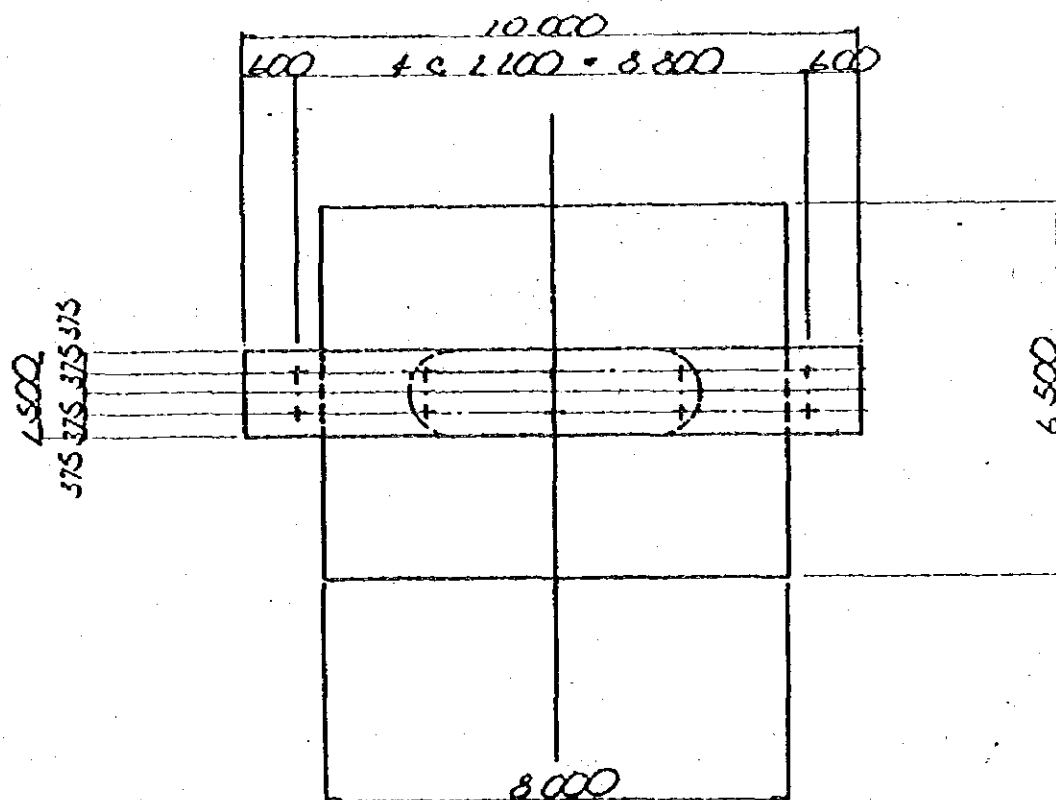
$$342.329 - 74.918 = 267.411 \text{ m}^3$$

G. R. N. W.

$P_1 \sim P_2 - \text{PIER}$

§ 1 STRUCTURAL FIGURE





	P ₁	P ₂	P ₃	P ₄	P ₅	P ₆
STA	61+15.115	61+42.775	61+70.315	61+97.875	62+15.425	62+42.975
P.H	32.828	32.886	32.969	33.056	33.134	33.217
EL 1	31.056	31.119	31.197	31.280	31.362	31.445
2	30.931	30.989	31.072	31.155	31.137	31.320
3	30.806	30.864	30.947	31.030	31.112	31.195
4	29.368	29.426	29.509	29.592	29.674	29.757
5	9.931	6.989	6.572	6.155	6.737	9.320
6	7.931	4.989	5.072	5.155	5.137	7.810
h 1	11.500	14.500	14.500	14.500	14.500	12.000
2	21.625	24.625	24.625	24.625	24.625	22.125
3	21.375	24.375	24.375	24.375	24.375	21.875
4	19.937	12.937	12.937	12.937	12.937	10.437

§ 2 concrete volume

beam

$$\textcircled{1} \quad \frac{1}{2} \times (1.50 + 1.625) \times 5.00 \times 1.50 = 11.719$$

$$\textcircled{2} \quad 2.50 \times 1.00 \times 1.50 \times 2 = 7.50$$

$$\textcircled{3} \quad \frac{1}{2} \times 1.50 \times 0.625 \times 2.50 = 1.172$$

$$\textcircled{4} \quad \frac{1}{2} \times 1.50 \times 0.50 \times 2.50 = 0.938$$

column

$$\textcircled{5} \quad V = A \cdot H \quad V = 1.50 \times 3.50 \times H \\ = 5.25 \cdot H$$

$$\textcircled{6} \quad V = A \cdot H \quad V = \frac{\pi}{4} \times 1.50^2 \cdot H \\ = 1.767 \cdot H$$

		P ₁	P ₂	P ₃	P ₄	P ₅	P ₆
	H	19.937	22.937	22.937	22.937	22.937	20.437
⑤	V	104.669	120.419	120.419	120.419	120.419	107.294
⑥	V	35.229	40.53	40.53	40.53	40.53	36.112

footing

$$\textcircled{7} \quad 8.00 \times 1.50 \times 6.50 = 78.00$$

blinding concrete volume

$$8.20 \times 6.70 \times 0.20 = 10.988 \text{ m}^3$$

grand total

= m³

P ₁	P ₂	P ₃	P ₄	P ₅	P ₆
239.227	260.278	260.278	260.278	260.278	242.735

§ 3. form area

beam

$$\textcircled{1} \quad \frac{1}{2} \cdot (1.50 + 1.625) \times 5.00 \times 2 = 15.625$$

$$\textcircled{2} \quad (2.50 \times 2 + 1.50) \times 1.00 \times 2 = 13.00$$

$$\textcircled{3} \quad \frac{1}{2} \times 2.50 \times 0.625 \times 2 = 1.563$$

$$\sqrt{2.50^2 + 0.688^2} \times 1.50 = 3.889$$

$$\textcircled{4} \quad \frac{1}{2} \times 2.50 \times 0.50 \times 2 = 1.25$$

$$\sqrt{2.50^2 + 0.438^2} \times 1.50 = 3.807$$

column

$$\textcircled{5} \quad A = 3.50 \cdot H \cdot 2$$

$$= 7.00 \cdot H$$

$$\textcircled{6} \quad A = \pi \cdot 1.50 \cdot H$$

$$= 4.712 \cdot H$$

		P ₁	P ₂	P ₃	P ₄	P ₅	P ₆
	H	19.937	22.937	22.937	22.937	22.937	20.437
⑤	A	139.559	160.559	160.559	160.559	160.559	143.059
⑥	A	93.943	108.079	108.079	108.079	108.079	96.299

footing

$$\textcircled{7} (4.50 + 8.00) \times 2 \times 1.50 = 43.50$$

blinding concrete form area

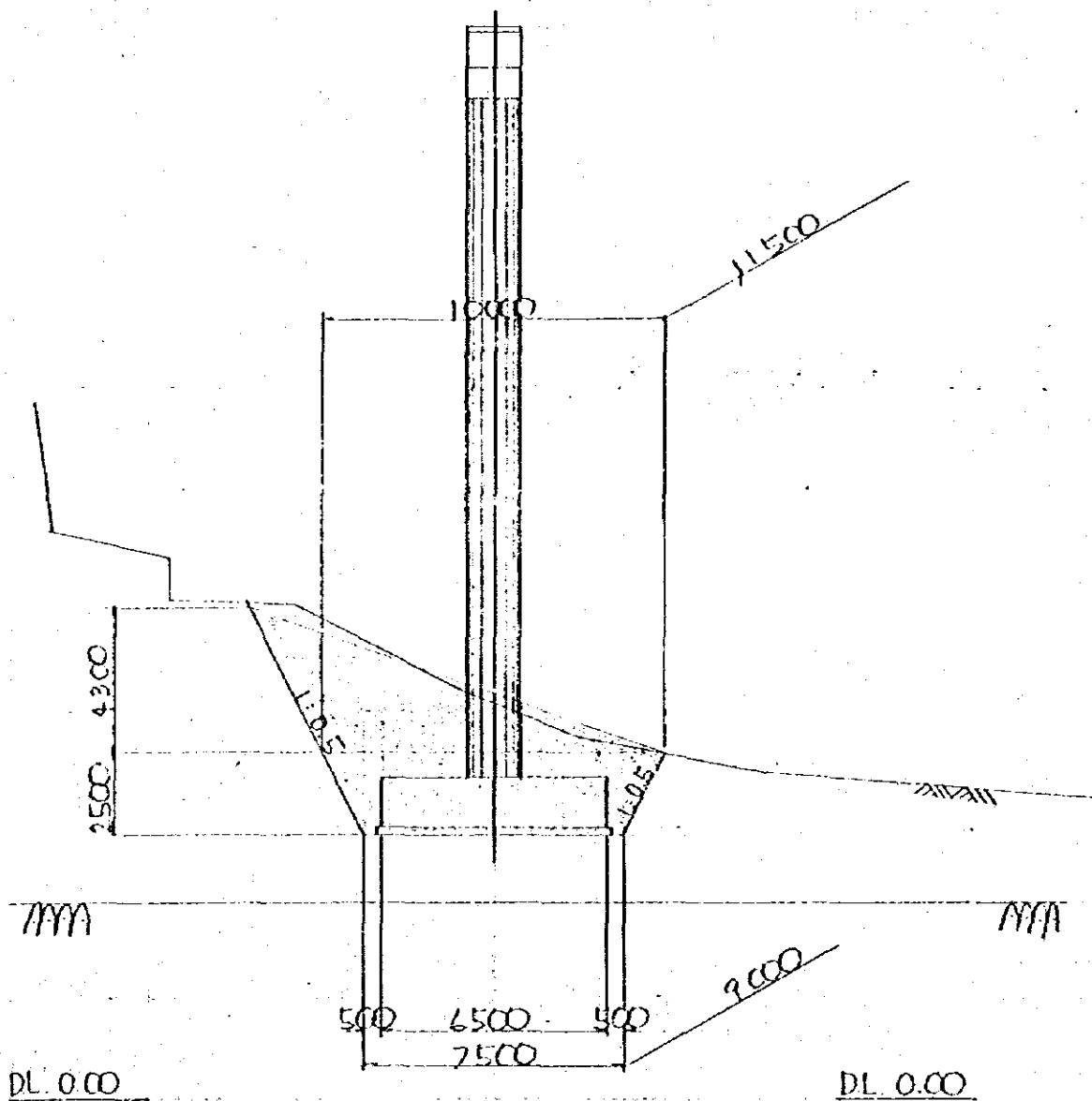
$$(8.20 + 6.70) \times 2 \times 0.20 = 5.96$$

grand total

: m²

	type-A	type-B	type-E	total
P ₁	178.693	93.943	49.46	322.096
P ₂	199.693	108.079	49.46	357.232
P ₃	199.693	108.079	49.46	357.232
P ₄	199.693	108.079	49.46	357.232
P ₅	199.693	108.079	49.46	357.232
P ₆	182.193	96.299	49.46	327.952

§ 4 EARTH WORKS (P)



(1) EXCAVATION

common

$$\frac{1}{6} \times 250 \times [10.00 \times 11.50 + (10.00 + 7.50) \times (11.50 + 9.00) + 7.50 \times 9.00] = 225.521$$

$$\frac{1}{6} \times 10.00 \times 4.30 \times (15.80 + 2 \times 11.50) = 278.067$$

$$\Sigma V = 503.588 \text{ m}^3$$

column

$$150 \times 3.50 \times 2.20 = 11.55$$

$$\frac{1}{4} \times \pi \times 1.50^2 \times 2.20 = 3.888$$

$$\text{footing} = 78.00$$

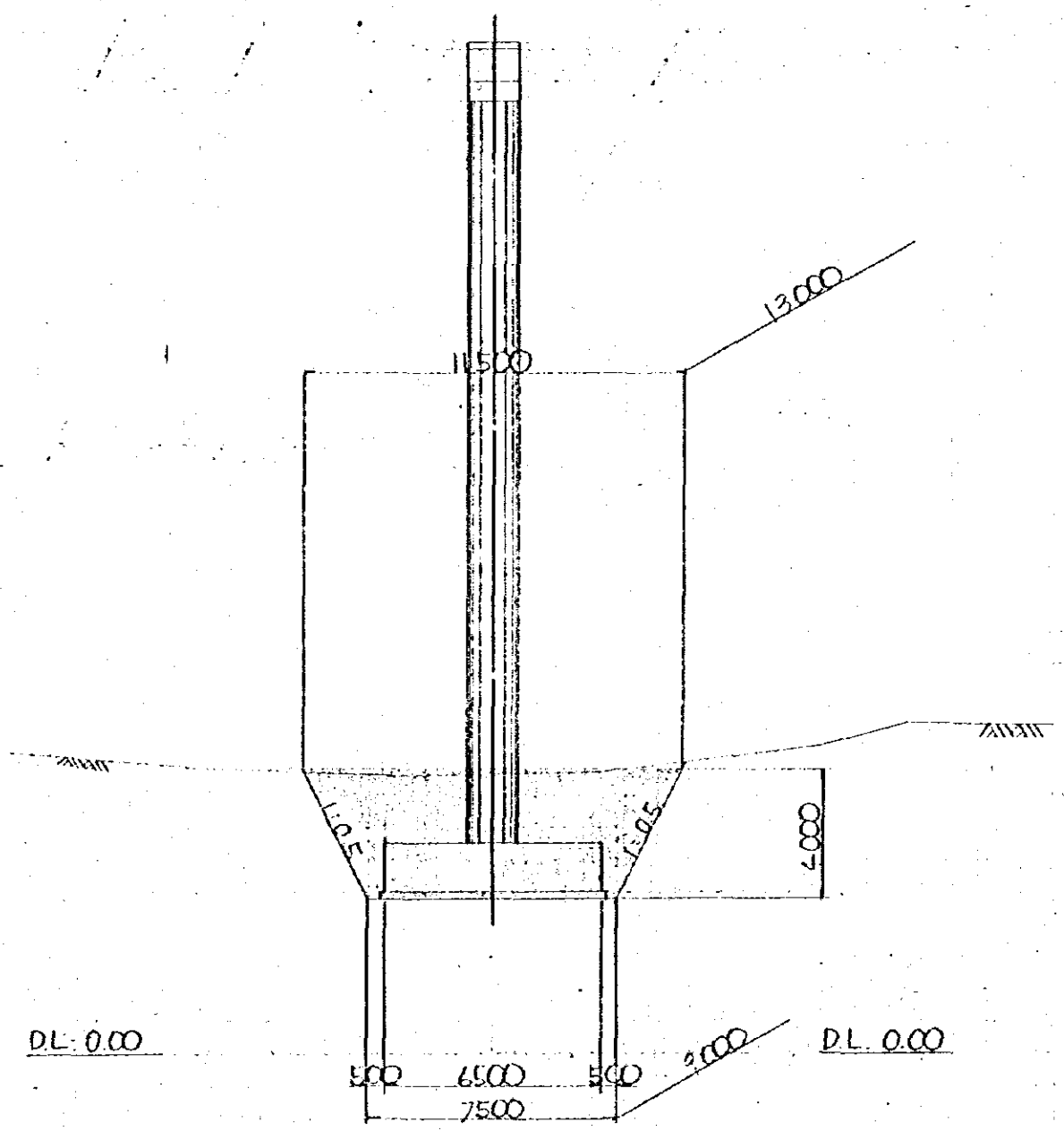
$$\text{blinding concrete} = 10.988$$

$$\Sigma V = 104.426 \text{ m}^3$$

(2) BACK FILL

$$503.588 - 104.426 = 399.162 \text{ m}^3$$

EARTH WORKS (P2)



(1) EXCAVATION

common

$$\frac{1}{6} \times 4.00 \times \{11.50 \times 13.00 + (11.50 + 7.50) \times (13.00 + 9.00) + 7.50 \times 9.00\} = 423.333 \text{ m}^3$$

column

$$1.50 \times 3.50 \times 2.30 = 12.075$$

$$\frac{1}{4} \times \pi \times 1.50^2 \times 2.30 = 4.064$$

$$\text{footing} = 78.00$$

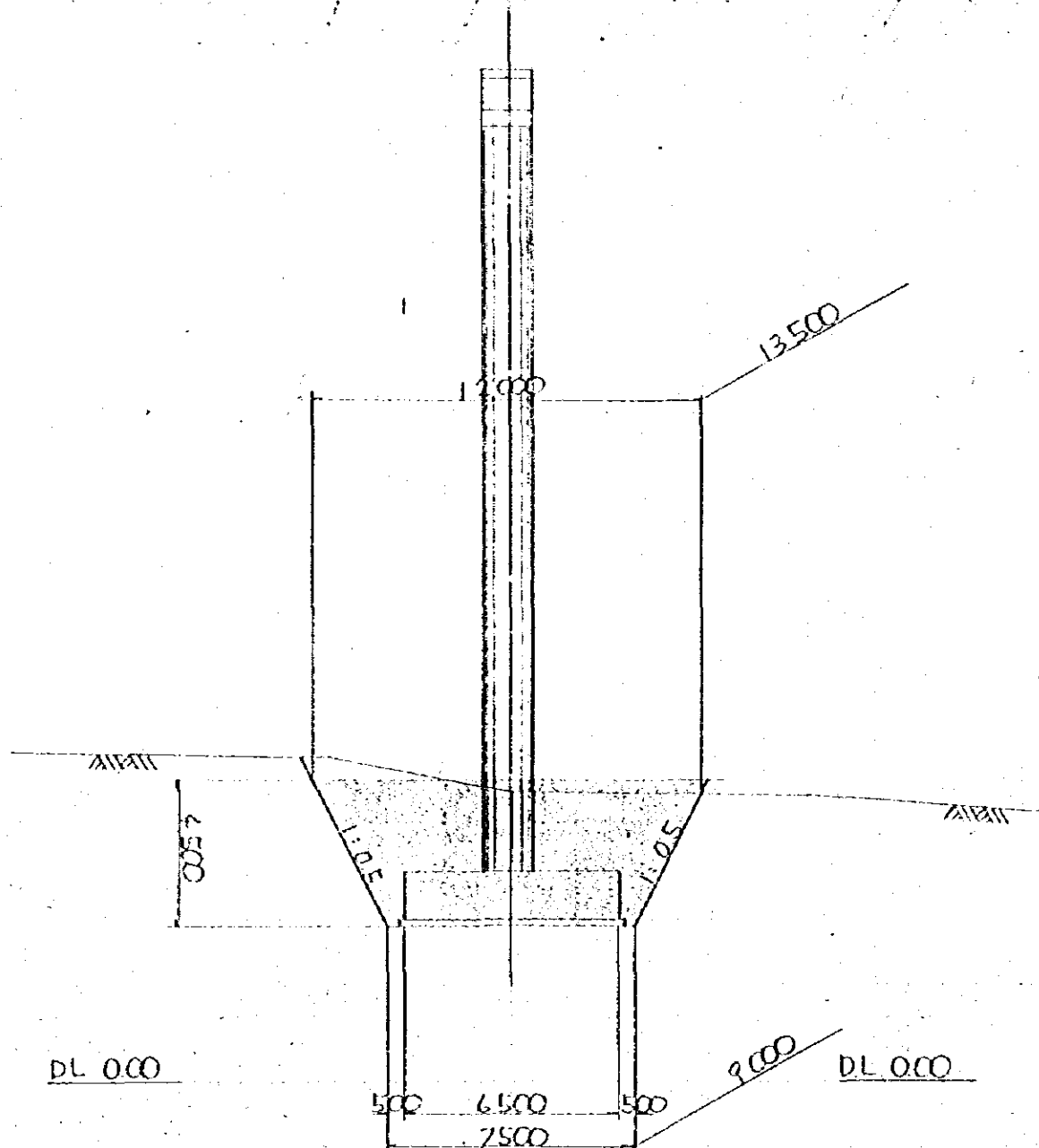
$$\text{blinding concrete} = 10.988$$

$$\Sigma V = 105.127 \text{ m}^3$$

(2) BACK FILL

$$423.333 - 105.127 = 318.206 \text{ m}^3$$

EARTH WORK (P₃)



(1) EXCAVATION

common

$$\frac{1}{6} \times 4.50 \times \{12.00 \times 13.50 + (12.00 + 7.50) \times (13.50 + 9.00) + 7.50 \times 9.00\} = 501.188 \text{ m}^3$$

column

$$1.50 \times 3.50 \times 2.80 = 14.70$$

$$\frac{1}{4} \times \pi \times 1.50^2 \times 2.80 = 4.948$$

$$\text{footing} = 78.00$$

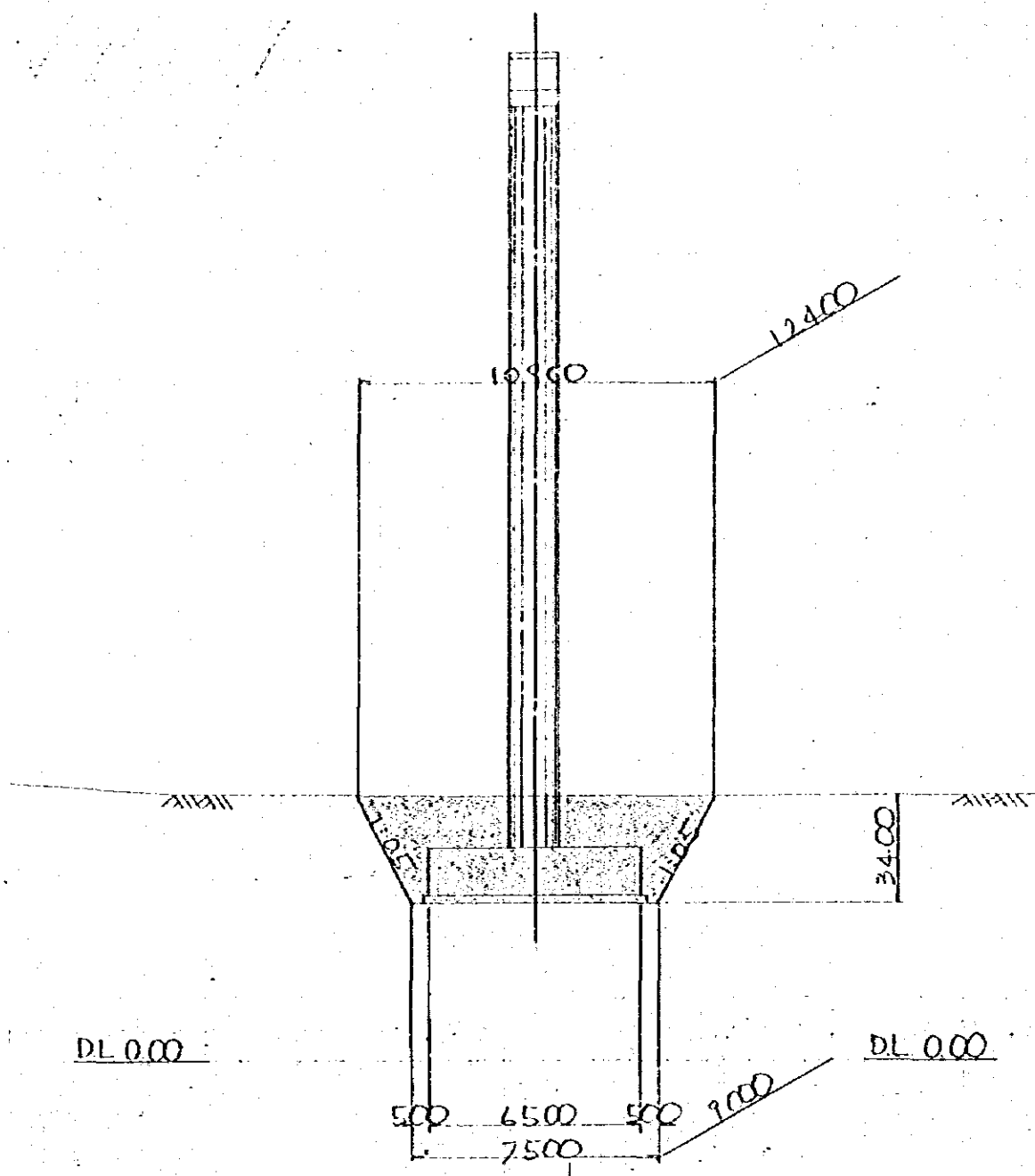
$$\text{blinding concrete} = 10.988$$

$$\Sigma V = 108.636 \text{ m}^3$$

(2) BACK FILL

$$501.188 - 108.636 = 392.552 \text{ m}^3$$

EARTH WORKS (P₄)



(1) EXCAVATION

common

$$\frac{1}{6} \times 3.40 \times [10.90 \times 12.40 + (10.90 + 7.50) \times (12.40 + 9.00) + 7.50 \times 9.00] = 337.971 \text{ m}^3$$

column

$$1.50 \times 3.50 \times 1.70 = 8.925$$

$$\frac{1}{4} \times \pi \times 1.50^2 \times 1.70 = 3.004$$

$$\text{footing} = 78.00$$

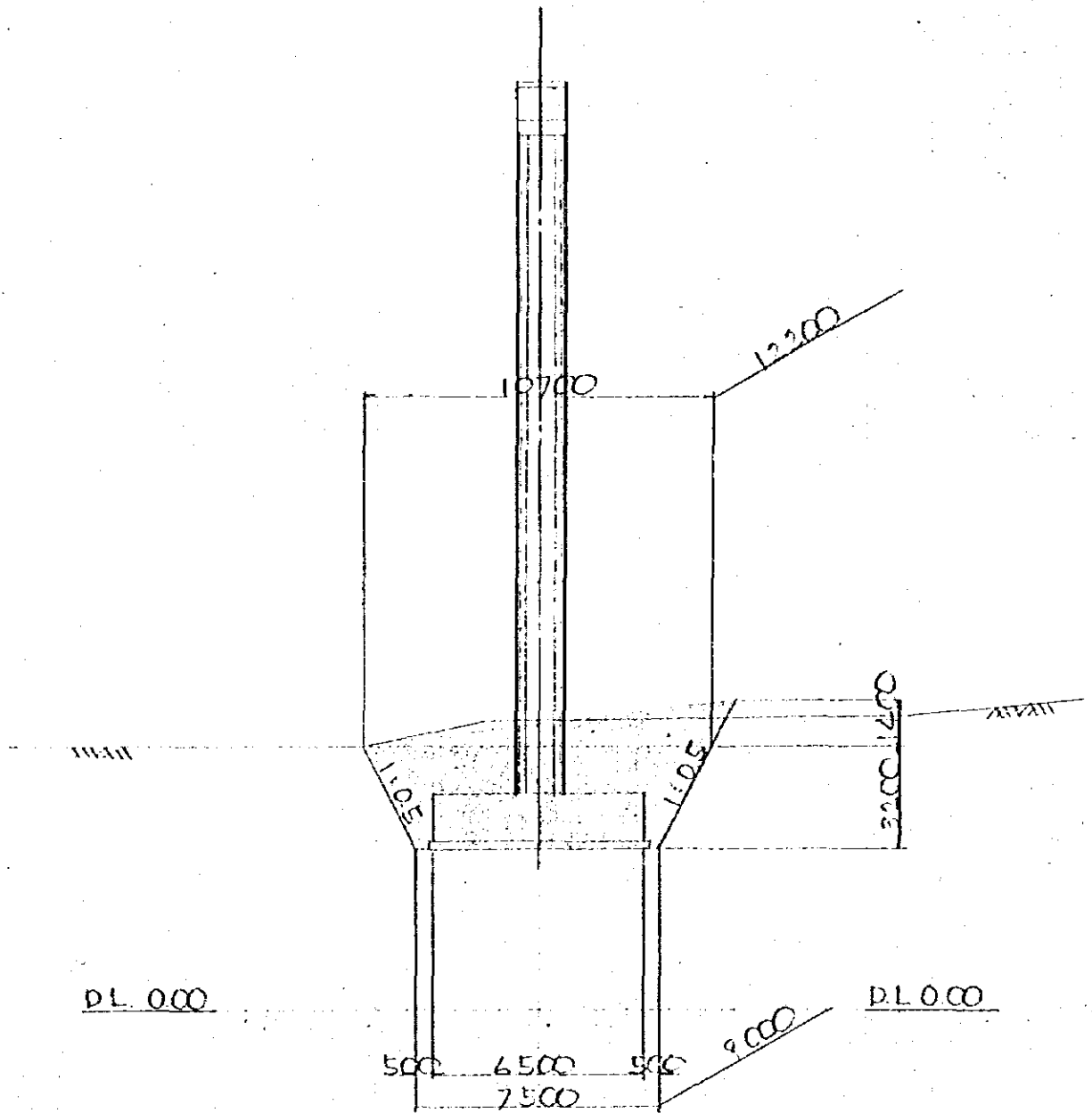
$$\text{blinding concrete} = 10.988$$

$$\Sigma V = 100.917 \text{ m}^3$$

(2) BACK FILL

$$337.971 - 100.917 = 237.054 \text{ m}^3$$

EARTH WORKS (P₅)



(1) EXCAVATION

common

$$\frac{1}{6} \times 3.20 \times [10.70 \times 12.20 + (10.70 + 7.50) \times (12.20 + 9.00) + 7.50 \times 9.00] = 311.403$$

$$\frac{1}{6} \times 10.70 \times 1.40 \times (13.60 + 2 \times 12.20) = 94.873$$

$$\Sigma V = 406.276 \text{ m}^3$$

column

$$1.50 \times 3.50 \times 2.30 = 12.075$$

$$\frac{1}{4} \times \pi \times 1.50^2 \times 2.30 = 4.064$$

$$\text{footing} = 78.00$$

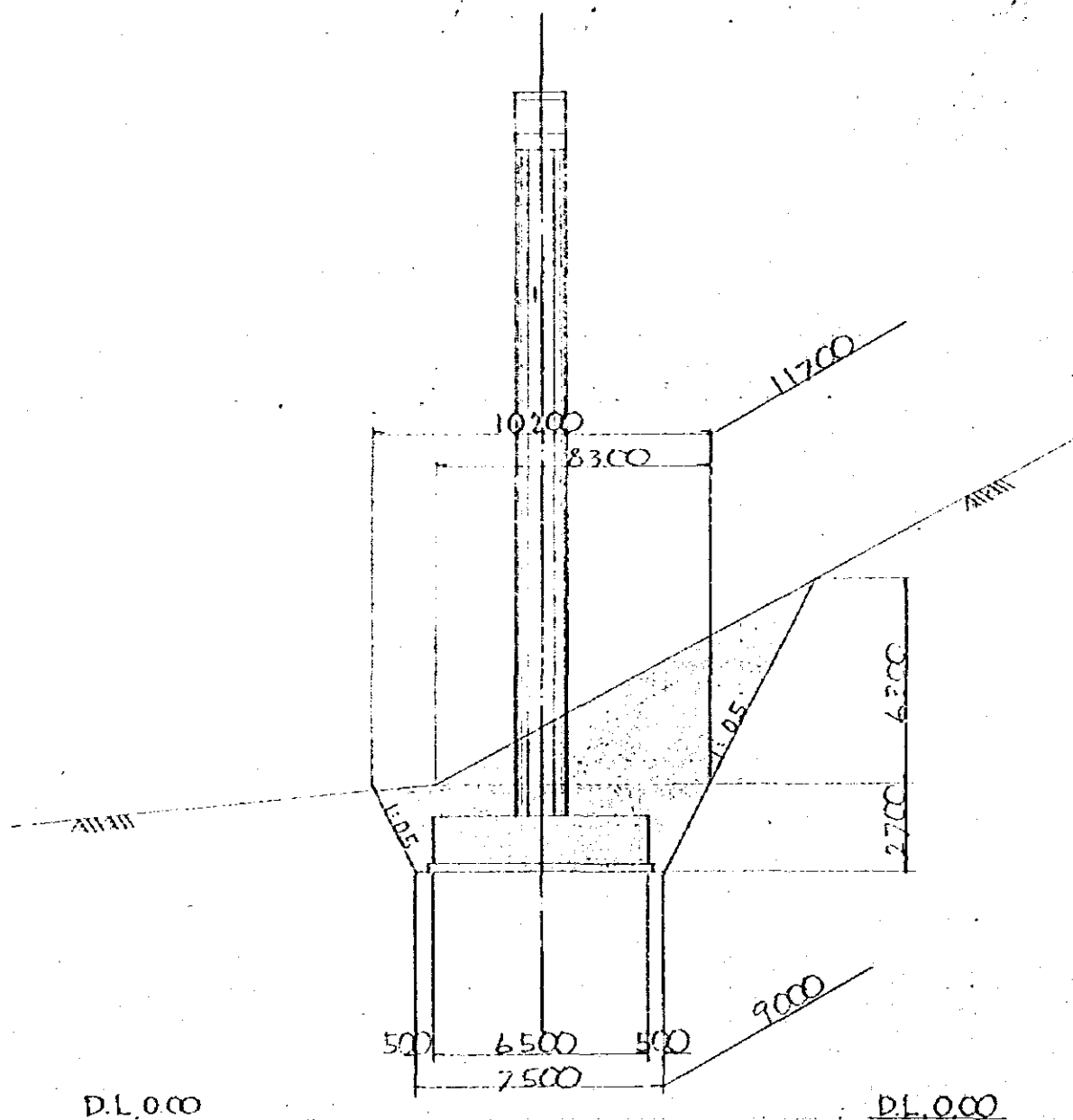
$$\text{blinding concrete} = 10.988$$

$$\Sigma V = 105.127 \text{ m}^3$$

(2) BACK FILL

$$406.276 - 105.127 = 301.149 \text{ m}^3$$

EARTH WOKS (P8)



(1) EXCAVATION

common

$$\frac{1}{6} \times 2.70 \times [10.20 \times 11.70 + (10.20 + 7.50) \times (11.70 + 9.00) + 7.50 \times 9.00] = 248.954$$

$$\frac{1}{6} \times 8.30 \times 6.30 \times (18.00 + 2 \times 11.70) = 360.801$$

$$\Sigma V = 609.755 \text{ m}^3$$

column

$$1.50 \times 3.50 \times 2.70 = 14.175$$

$$\frac{1}{4} \times \pi \times 1.50^2 \times 2.70 = 4.771$$

$$\text{footing} = 78.00$$

$$\text{blinding concrete} = 10.988$$

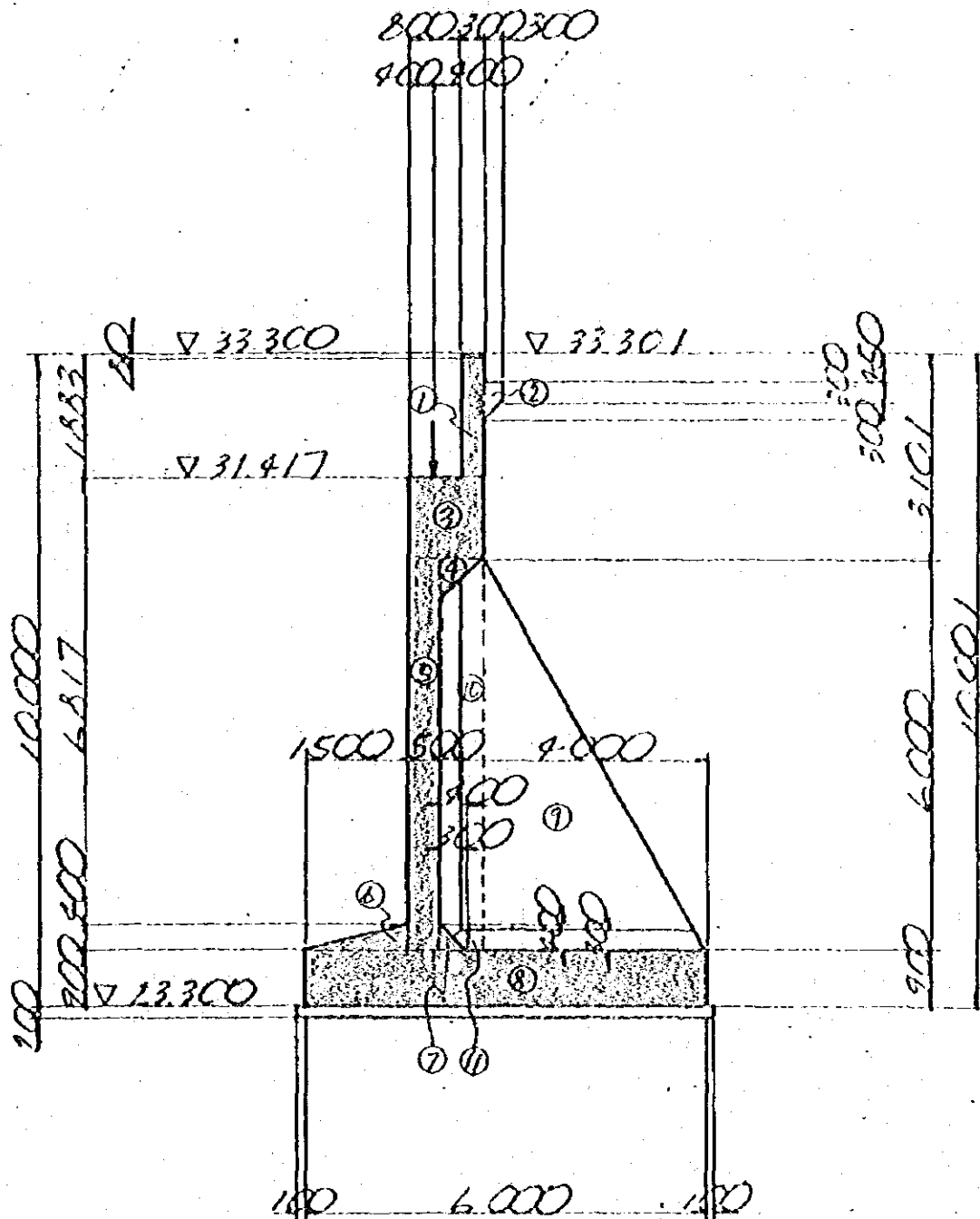
$$\Sigma V = 107.934 \text{ m}^3$$

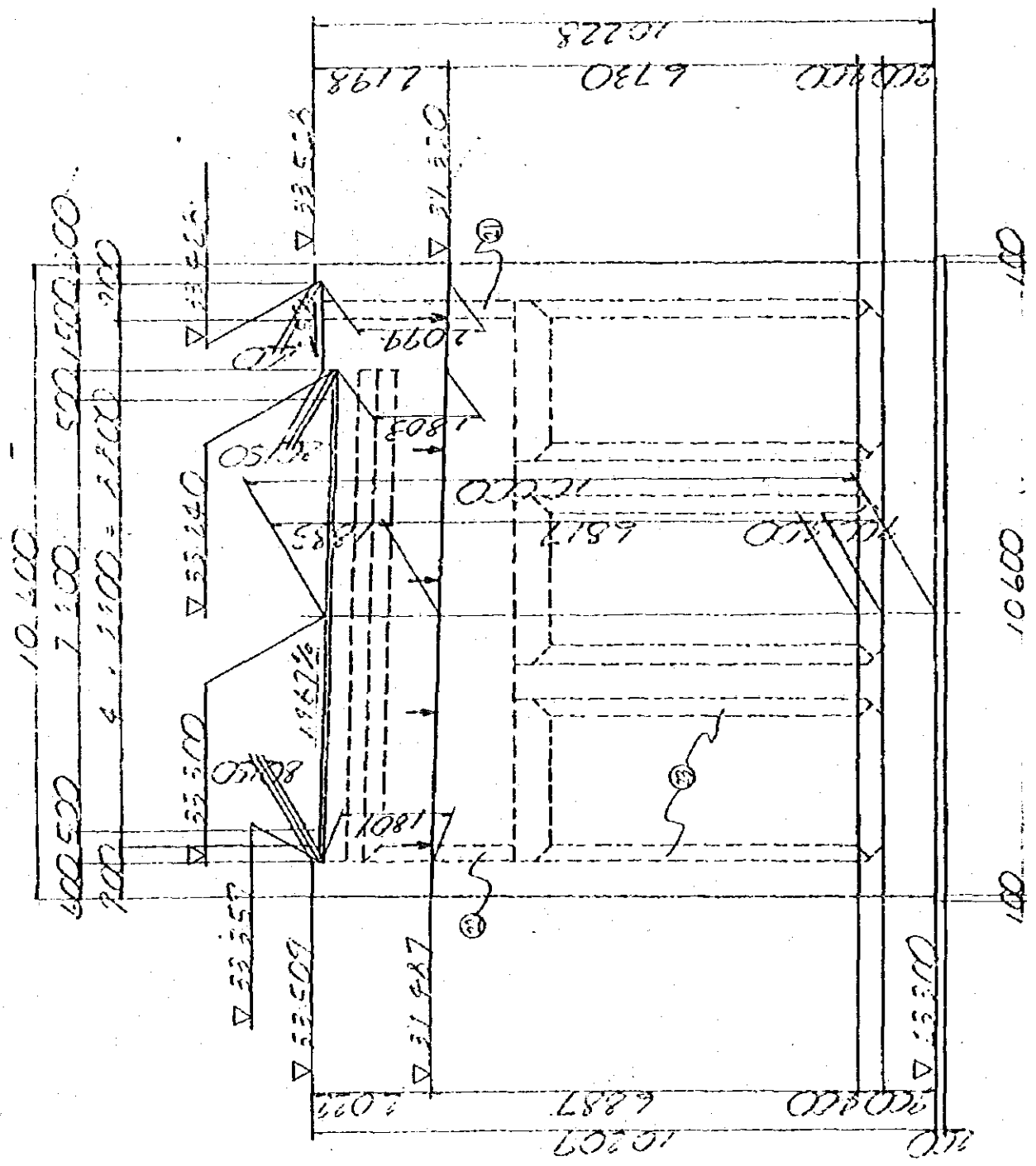
(2) BACK FILL

$$609.755 - 107.934 = 501.821 \text{ m}^3$$

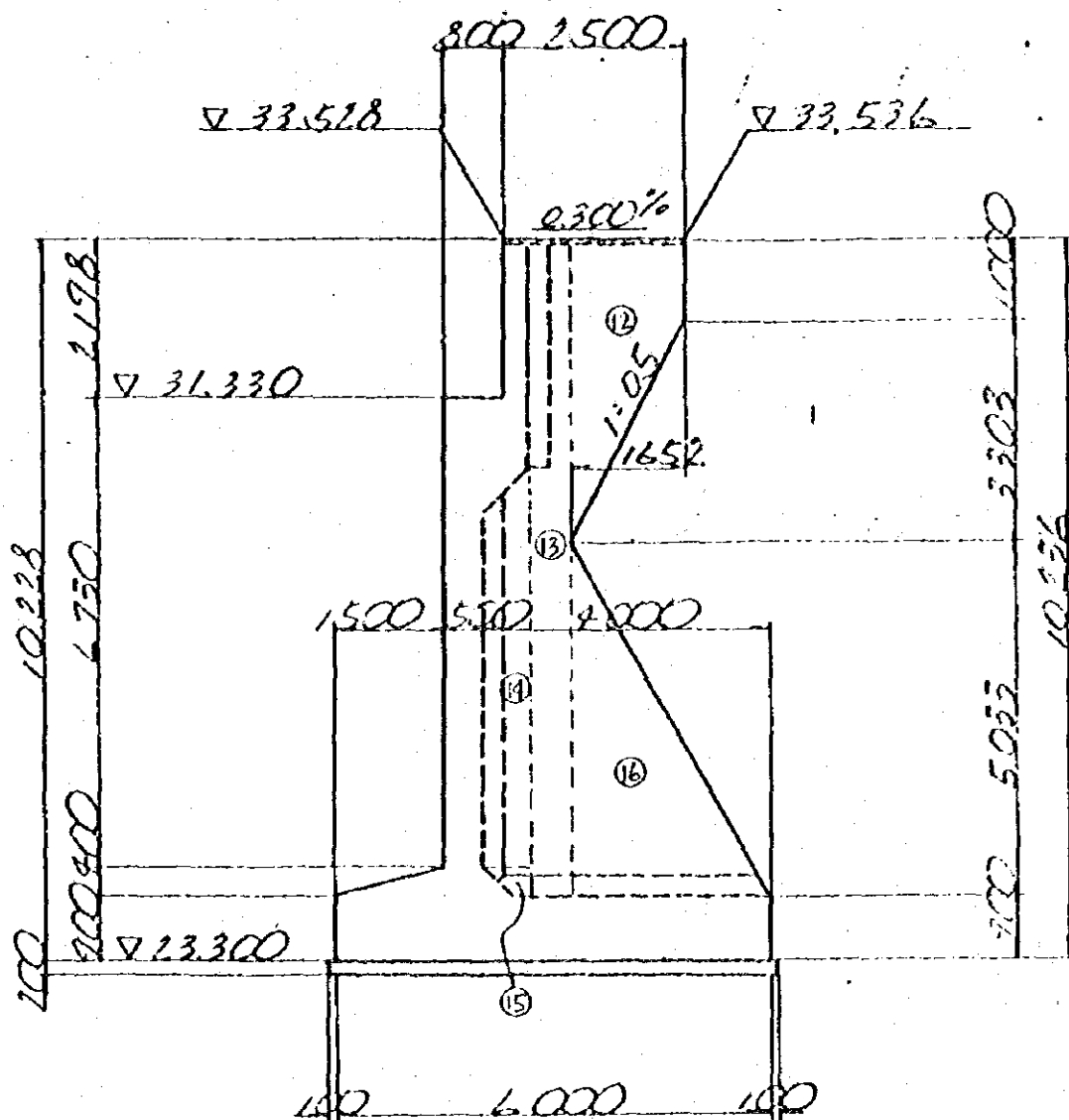
G. R. N. W.
A₂ - ABUTMENT.

§ 1 STRUCTURAL FIGURE

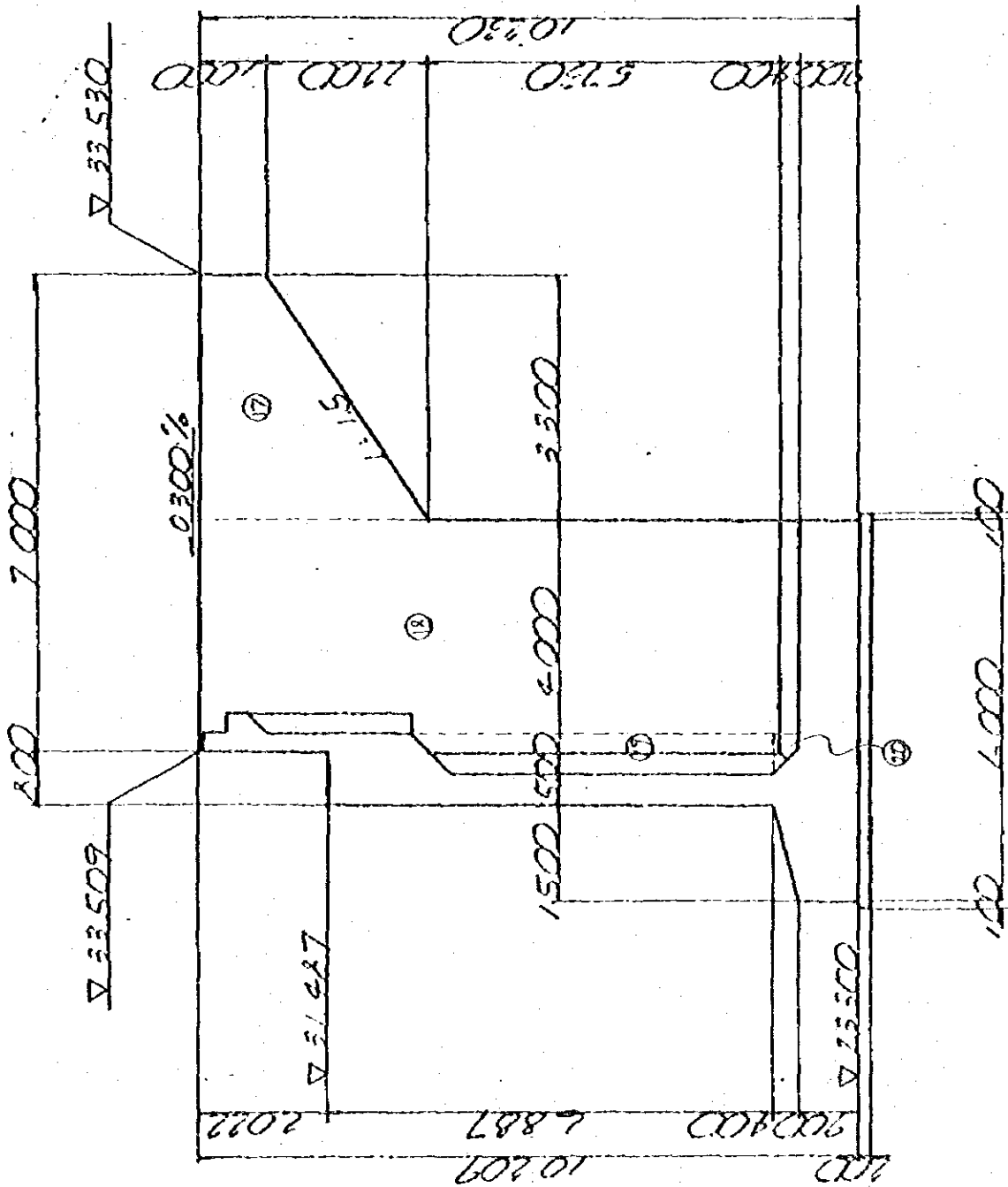




WING (RIGHT)



WING (LEFT)



§ 2 concrete volume

Parapet

- ① $\frac{1}{2} \times (2.194 + 2.198) \times 0.30 \times 0.30 = 0.198$
 $\frac{1}{2} \times (2.033 + 2.094) \times 1.50 \times 0.30 = 0.929$
 $\frac{1}{2} \times (1.801 + 1.803) \times 8.20 \times 0.30 = 4.433$
 $\frac{1}{2} \times (2.022 + 2.031) \times 0.60 \times 0.30 = 0.365$
- ② $\frac{1}{2} \times (0.30 + 0.60) \times 0.30 \times 8.20 = 1.107$

Wall

- ③ $\frac{1}{2} \times (1.287 + 1.13) \times 1.10 \times 10.60 = 14.091$
 ④ $\frac{1}{2} \times 0.60 \times 0.60 \times 10.60 = 1.908$
 ⑤ $6.00 \times 0.50 \times 10.60 = 31.8$

footing

- ⑥ $\frac{1}{2} \times 1.50 \times 0.40 \times 10.60 = 3.18$
 ⑦ $\frac{1}{2} \times 0.40 \times 0.40 \times 10.60 = 0.848$
 ⑧ $0.90 \times 6.00 \times 10.60 = 57.24$

buttress

- ⑨ $\frac{1}{2} \times 6.00 \times 3.40 \times 0.60 \times 2 = 12.24$
 ⑩ $\frac{1}{2} \times (5.00 + 5.60) \times 0.60 \times 0.60 \times 2 = 3.816$
 ⑪ $\frac{1}{2} \times (0.60 + 0.20) \times 0.40 \times 0.60 \times 2 = 0.192$

Wing (Pight)

- $2.20 \times 0.10 \times 0.30 = 0.066$
 ⑫ $\frac{1}{2} \times (0.90 + 4.198) \times 1.652 \times 0.60 = 2.257$

$$\begin{aligned}
 (13) \quad & \frac{1}{2} \times (9.231 + 9.229) \times 0.548 \times 0.60 = 3.035 \\
 (14) \quad & \frac{1}{2} \times (5.00 + 5.60) \times 0.60 \times 0.60 = 1.908 \\
 (15) \quad & \frac{1}{2} \times (0.20 + 0.60) \times 0.40 \times 0.60 = 0.096 \\
 (16) \quad & \frac{1}{2} \times 1.852 \times 5.033 \times 0.60 = 4.306
 \end{aligned}$$

Wing (left)

$$\begin{aligned}
 (17) \quad & \frac{1}{2} \times (1.00 + 3.19) \times 3.30 \times 0.60 = 4.148 \\
 (18) \quad & \frac{1}{2} \times (9.32 + 9.31) \times 3.40 \times 0.60 = 19.003 \\
 (19) \quad & \frac{1}{2} \times (5.00 + 5.60) \times 0.60 \times 0.60 = 1.908 \\
 (20) \quad & \frac{1}{2} \times (0.20 + 0.60) \times 0.40 \times 0.60 = 0.096
 \end{aligned}$$

haunch

$$\begin{aligned}
 (21) \quad & \frac{1}{2} \times 0.30 \times 0.30 \times 3.221 = 0.145 \\
 (22) \quad & \frac{1}{2} \times 0.30 \times 0.30 \times 2.679 = 0.121 \\
 (23) \quad & \frac{1}{2} \times 0.30 \times 0.30 \times 5.30 \times 6 = 1.431 \\
 (24) \quad & \frac{1}{2} \times 0.30 \times 0.30 \times 3.70 \times 6 = 0.999
 \end{aligned}$$

$$\Sigma V = 171.866 \text{ m}^3$$

grand total

$$V = 171.866$$

blinding concrete volume

$$6.20 \times 10.80 \times 0.20 = 13.392 \text{ m}^3$$

§ 3. form area

Parapet

$$\begin{aligned}
 \textcircled{1} \quad & \frac{1}{2} \times (2.194 + 2.198) \times 0.30 = 0.659 \\
 & \frac{1}{2} \times (2.033 + 2.094) \times 1.50 = 3.095 \\
 & \frac{1}{2} \times (1.801 + 1.803) \times 8.20 \times 2 = 29.553 \\
 & \frac{1}{2} \times (2.022 + 2.031) \times 0.60 = 1.216 \\
 & \frac{1}{2} \times (2.033 + 2.070) \times 0.90 = 1.846 \\
 & - 0.60 \times 8.20 + 0.30 \times 0.801 = - 5.16 \\
 & 0.60 \times (0.23 \times 2 + 0.10) = 0.336 \\
 & 0.30 \times (2.022 + 2.198) = 1.266
 \end{aligned}$$

$$\begin{aligned}
 \textcircled{2} \quad & 0.30 \times 8.20 = 2.46 \\
 & 0.30 \times \sqrt{2} \times 8.20 = 3.479 \\
 & \frac{1}{2} \times (0.30 + 0.60) \times 0.30 = 0.135
 \end{aligned}$$

wall

$$\begin{aligned}
 \textcircled{3} \quad & \frac{1}{2} \times (1.287 + 1.13) \times 10.60 = 12.81 \\
 & \frac{1}{2} \times (1.274 + 1.146) \times 8.80 = 10.648 \\
 & (2.022 + 2.198) \times 1.10 = 4.642 \\
 \textcircled{4} \quad & 0.30 \times \sqrt{2} \times (2 \times 3.00 - 2.80) = 3.734 \\
 & \frac{1}{2} \times (3.00 + 2.40) \times 0.30 \times \sqrt{2} \times 2 = 2.291 \\
 & \frac{1}{2} \times (2.20 + 2.80) \times 0.30 \times \sqrt{2} = 1.06 \\
 & \frac{1}{2} \times 0.60 \times 0.60 \times 2 = 0.36 \\
 \textcircled{5} \quad & 6.00 \times 10.60 = 63.60 \\
 & 5.00 \times (2.40 \times 2 + 2.20) = 35.0
 \end{aligned}$$

$$0.50 \times 6.00 \times 2 = 6.00$$

footing

$$\textcircled{6} \quad \frac{1}{2} \times 1.50 \times 0.40 \times 2 = 0.60$$

$$\textcircled{7} \quad 0.40 \times \sqrt{2} \times (2 \times 2.40 + 2.50) = 4.13$$

$$\frac{1}{2} \times 0.40 \times 0.40 \times 2 = 0.16$$

$$\textcircled{8} \quad 0.90 \times (6.00 + 10.60) \times 2 = 29.88$$

buttress

$$\textcircled{9} \quad \frac{1}{2} \times 5.70 \times 3.23 \times 2 \times 2 = 36.882$$

$$\textcircled{10} \quad \frac{1}{2} \times (5.70 + 5.40) \times 0.30 \times 2 \times 2 = 6.66$$

$$\sqrt{6.00^2 + 3.40^2} \times 0.60 \times 2 = 8.276$$

Wing (right)

$$(2.20 \times 2 + 0.30) \times 0.10 = 0.47$$

$$\textcircled{12} \quad \frac{1}{2} \times (0.90 + 4.198) \times 1.652 \times 2 = 8.422$$

$$(0.90 + \sqrt{3.033^2 + 1.652^2}) \times 0.60 = 2.612$$

$$\textcircled{13} \quad \frac{1}{2} \times (9.231 + 9.229) \times 0.548 \times 2 = 10.116$$

$$-0.30 \times (3.221 + 0.548) = -1.131$$

$$\textcircled{14} \quad \frac{1}{2} \times (5.00 + 5.60) \times 0.60 \times 2 = 6.36$$

$$-\frac{1}{2} \times (5.00 + 5.30) \times 0.30 = -1.54$$

$$\textcircled{15} \quad \frac{1}{2} \times (0.20 + 0.60) \times 0.40 = 0.16$$

$$0.30 \times 0.10 = 0.03$$

$$\textcircled{16} \quad \frac{1}{2} \times 2.852 \times 5.033 + \frac{1}{2} \times 2.682 \times 4.733 = 13.524$$

$$\sqrt{2.852^2 + 5.033^2} \times 0.60 = 3.471$$

Wing (left)

$$\begin{aligned}
 (17) \quad & \frac{1}{2} \times (1.00 + 3.19) \times 3.30 \times 2 & = & 13.827 \\
 & 0.00 + \sqrt{3.30^2 + 2.20^2} \times 0.60 & = & 2.980 \\
 (18) \quad & \frac{1}{2} \times (9.32 + 9.31) \times 3.40 \times 2 & = & 63.342 \\
 & -0.30 \times (2.769 + 3.40) & = & -1.851 \\
 & 6.13 \times 0.60 & = & 3.678 \\
 (19) \quad & \frac{1}{2} \times (5.00 + 5.60) \times 0.60 \times 2 & = & 6.36 \\
 & -\frac{1}{2} \times (5.60 + 5.30) \times 0.30 & = & -1.54 \\
 (20) \quad & \frac{1}{2} \times (0.20 + 0.60) \times 0.40 & = & 0.16 \\
 & 0.30 \times 0.10 & = & 0.03
 \end{aligned}$$

haunch

$$\begin{aligned}
 (21) \quad & 0.30 \times \sqrt{2} \times 3.221 & = & 1.367 \\
 (22) \quad & 0.30 \times \sqrt{2} \times 2.679 & = & 1.137 \\
 (23) \quad & 0.30 \times \sqrt{2} \times 5.30 \times 6 & = & 13.492 \\
 (24) \quad & 0.30 \times \sqrt{2} \times 3.70 \times 6 & = & 9.419 \\
 & \frac{1}{2} \times 0.30 \times 0.30 & = & 0.045 \\
 & \frac{1}{2} \times 0.30 \times 0.345 \times 5 & = & 0.259
 \end{aligned}$$

$$\Sigma A = 420.817 \text{ m}^2$$

blinding concrete form area

$$(6.20 + 10.80) \times 0.20 \times 2 = 6.80 \text{ m}^2$$

grand total

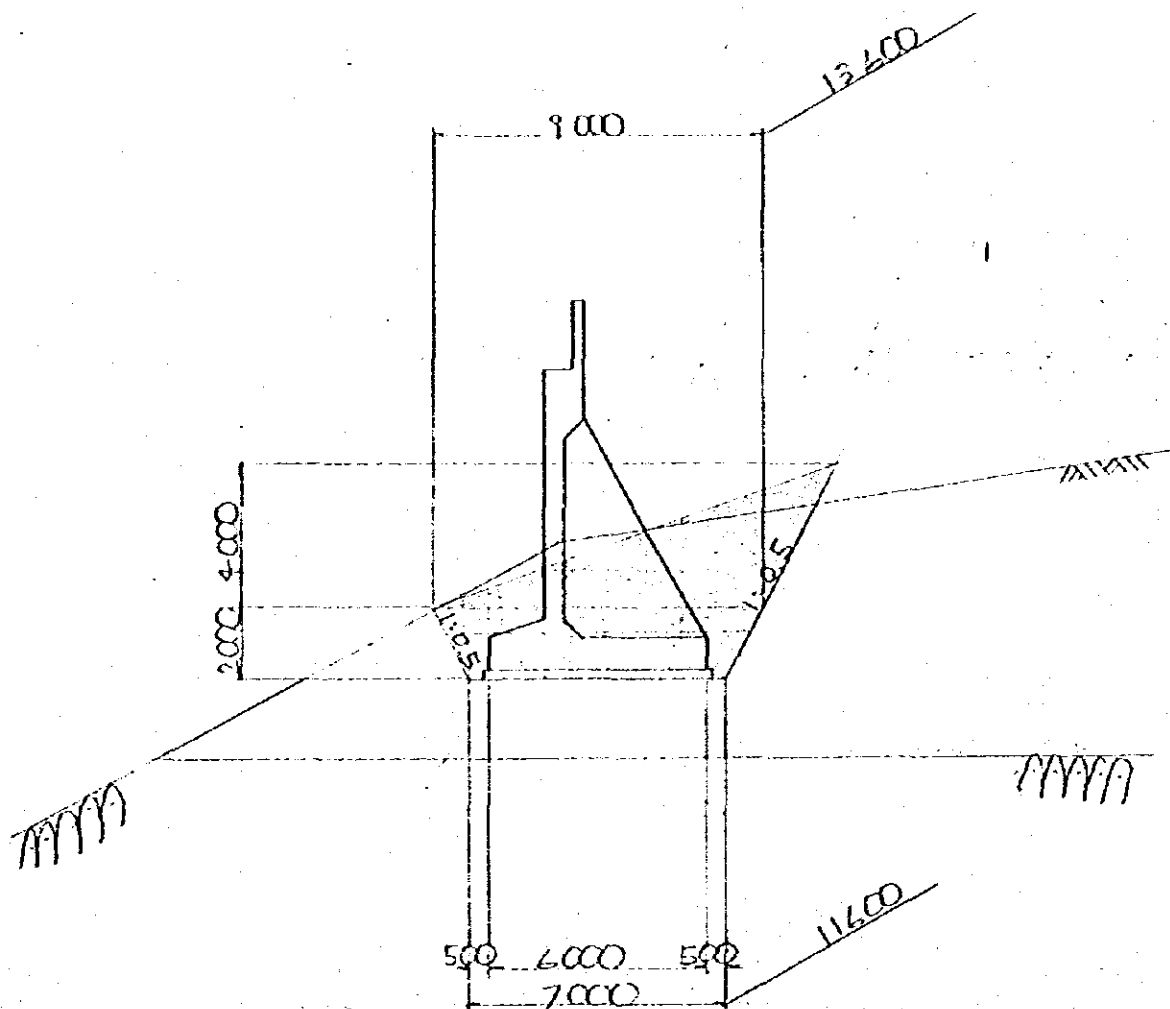
type - A (plane formworks)

$$A = 386.047 \text{ m}^2$$

type - E (rough finish formworks)

$$A = 41.57 \text{ m}^2$$

§ 4 EARTH WORKS



DL 1000

DL 1000

(1) EXCAVATION

common

$$\begin{aligned} & \frac{1}{2} \times 2.00 \times \{ 9.00 \times 13.60 + (9.00 + 7.00) \times (13.60 + 11.60) + 7.00 \times 11.60 \} = 202.267 \\ & \frac{1}{6} \times 9.00 \times 4.00 \times (17.60 + 2 \times 13.60) = 268.80 \end{aligned}$$

wall

$$\Sigma V = 471.067 \text{ m}^3$$

$$0.50 \times 2.55 \times 10.60 = 13.515$$

buttress

$$\frac{1}{2} \times (2.385 + 4.00) \times 2.85 \times 0.60 \times 3 = 16.378$$

$$4.00 \times 2.85 \times 0.60 = 6.84$$

$$-\frac{1}{2} \times 0.40 \times 0.40 \times 0.60 \times 4 = -0.702$$

haunch

$$\frac{1}{2} \times 0.30 \times 0.30 \times 2.75 \times 6 = 0.747$$

$$= 0.999$$

$$\text{footing} = 61.428$$

$$\text{blinding concrete} = 13.392$$

$$\Sigma V = 112.597 \text{ m}^3$$

(2) BACK FILL

$$471.067 - 112.597 = 358.47 \text{ m}^3$$

}} 4. MISCELLANEOUS WORK

G.R.N.W. A-LINE

A₁ Abutment

Excavation

$$V = 4.09\% \cdot [7.50 \cdot 15.6 + (7.50 + 3.50)(15.6 + 11.6) + 3.50 \cdot 11.6] \\ = 8.5 \cdot 1.777 \cdot 4.00 = 244.1 \text{ m}^3$$

Selected Material

$$V = \frac{1}{2} \cdot (0.50 + 2.25) \cdot 3.50 \cdot 9.70 = 46.7 \text{ m}^3$$

fillter

$$V = 0 \text{ m}^3$$

A₂ Abutment

Excavation

$$V = \frac{1}{2} \cdot (0.50 + 2.50) \cdot 4.00 \cdot 8.50 = 51.0 \text{ m}^3$$

Selected Material

$$V = \frac{1}{2} \cdot (0.50 + 2.10) \cdot 3.20 \cdot 9.70 = 40.4 \text{ m}^3$$

S.L.R. - A-LINE

A₁ Abutment (A₂ Abutment)

Excavation

$$V = \frac{1}{2} \cdot (0.50 + 2.50) \cdot 4.00 \cdot 10.60 = 63.6 \text{ m}^3$$

Selected Material

$$V = \frac{1}{2} \cdot (0.5 + 2.25) \cdot 3.50 \cdot 9.7 = 46.7 \text{ m}^3$$

G.R.N.W. B-LINE

A₁ Abutment

Selected Material

$$V = \left[\frac{1}{2} \times (2.80 + 5.0) \times 4.60 + \frac{1}{2} \times (4.70 + 9.20) \times 2.80 \right] \times 9.70$$

$$= 2.30 \times 1.20 \times 9.70$$

$$= 336.0 \text{ m}^3$$

filler

$$V = 3.50 \times 0.50 \times 9.70$$

$$= 17.0 \text{ m}^3$$

A₂ Abutment

Selected Material

$$V = \frac{1}{2} \times (4.50 + 6.80) \times 4.80 \times 9.70 + \frac{1}{2} \times (6.20 + 13.7) \times 5.10 \times 9.70$$

$$- \frac{1}{2} \times 3.40 \times 6.30 \times 0.60 \times 2 - 4.00 \times 1.20 \times 9.70$$

$$= 695.9 \text{ m}^3$$

filler

$$V = 4.00 \times 0.50 \times (9.70 + 0.60 \times 2) = 17.0 \text{ m}^3$$

S. L. R. B-LINE

A₁ Abutment

Selected Material

$$V = \left\{ \frac{1}{2} \times (4.0 + 7.80) \times 8.00 + \frac{1}{2} \times (7.70 + 11.0) \times 2.10 \right\} \times 9.70 \\ - \frac{1}{2} \times 3.50 \times 6.30 \times 0.60 \times 2 - 3.50 \times 1.20 \times 9.70 = 594.3 \text{ m}^3$$

fillter

$$V = 3.00 \times 0.50 \times (9.70 - 0.6 \times 2) = 12.8 \text{ m}^3$$

A₂ Abutment

Selected Material

$$V = \left\{ \frac{1}{2} \times (4.50 + 7.30) \times 5.70 + \frac{1}{2} \times (6.70 + 12.70) \times 4.20 \right\} \times 9.70 \\ - \frac{1}{2} \times 3.40 \times 6.00 \times 0.60 \times 2 - 4.00 \times 1.10 \times 9.70 = 666.4 \text{ m}^3$$

fillter

$$V = 3.30 \times 0.50 \times (9.70 - 0.6 \times 2) = 16.2 \text{ m}^3$$

4-2 APPROACH SLAB

(1) Concrete Volume

- G.R.N.W. A-Le. Br.

$$V = (3.6 \times 0.35 + 1.5 \times 0.23) \times 8.2 = 13.2 \text{ m}^3$$

- G.R.N.W. B-Le. Br.

$$V = (3.6 \times 0.35 + 1.5 \times 0.23) \times 8.2 \times 2 = 26.3 \text{ m}^3$$

- St. L. Ri. A-Le. Br.

$$V = 26.3 \text{ m}^3$$

- St. L. Ri. B-Le. Br.

$$V = 26.3 \text{ m}^3$$

(2) Formworks Area

- G.R.N.W. A-Le. Br.

$$A = (3.6 \times 0.35 + 1.5 \times 0.23 + 0.35 \times 8.2) \times 2 = 9.0 \text{ m}^2$$

both side

- G.R.N.W. B-Le. Br.

$$A = (3.6 \times 0.35 + 1.5 \times 0.23 + 0.35 \times 8.2) \times 2 \times 2 = 17.9 \text{ m}^2$$

- St. L. Ri. A-Le. Br.

$$A = 17.9 \text{ m}^2$$

- St. L. Ri. B-Le. Br.

$$A = 17.9 \text{ m}^2$$

4-4 NEWELL POST.

(1) Concrete Volume

(a) near the carriage way

$$V = (0.85 \times 1.8 - 0.3 \times 0.5 \times \frac{1}{2}) \times 0.3 = 0.44 \text{ m}^3$$

(b) near the foot way

$$V = (0.90 \times 1.8 - 0.3 \times 0.5 \times \frac{1}{2}) \times 0.3 = 0.46 \text{ m}^3$$

(2) Formworks Area

(a) near the carriage way

$$A = (0.85 \times 1.8 - 0.3 \times 0.5 \times \frac{1}{2}) \times 2 + (0.55 + \sqrt{0.3^2 + 0.5^2} + 0.85) \times 0.3 = 3.5 \text{ m}^2$$

(b) near the foot way

$$A = (0.9 \times 1.8 - 0.3 \times 0.5 \times \frac{1}{2}) \times 2 + (0.60 + \sqrt{0.3^2 + 0.5^2} + 0.90) \times 0.3 = 3.7 \text{ m}^2$$

(3) Total

Each bridge (G.R.N.W. A, B-le. Br, St.L. Ri A, B-le Br.)

Concrete Volume

$$V = (0.44 + 0.46) \times \textcircled{A_1} \textcircled{A_2} = 1.8 \text{ m}^3$$

Formwork Area

$$A = (3.5 + 3.7) \times 2 = 14.4 \text{ m}^2$$

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5. Pedestrian Bridge and Aquaduct

Contents

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SUMMARY OF QUANTITIES

Sheet /

NOTE ; Materials for STA.22 AQUEDUCT is included in the QUANTITIES of STA.22 Over bridge

BRIDGE NAME			Hin. TEMPLE Ped. Br.					B. B. Ped. Br.				STA.57 AQUEDUCT				
Item no.	Description	Unit	A1	P1	A2	RW-U	TOTAL	A1	A2	RW-U	TOTAL		A1	P1	A2	TOTAL
C C 02 01	EARTHWORKS Structure Excavation Structure Excavation, Common	m ³	206.4	49.5	56.7	36.2	349	137.3	260.4	40.5	438		37.1	—	37.1	74
02	Structure Excavation, Rock	m ³	—	—	—	—	—	—	—	—	—		—	56.8	—	57
03	Structure backfill, Selected Materials	m ³	—	—	19.9	35.8	56	—	60.5	54.6	115		—	—	—	—
D D 01 03	STRUCTURAL CONCRETE Concrete Concrete, Grade 25	m ³	(3.1) 40.5	14.6	26.6	(6.1) 19.2	110	41.1	(9.5) 50.3	26.8	128		4.8	26.8	4.8	36
05	Concrete, Grade 15	m ³	(0.5) 4.0	2.7	2.7	(2.5) 4.7	17	3.3	(1.4) 3.5	4.9	13		0.4	3.0	0.4	4
D 02 01	Formworks Fair finish plane formworks type-A	m ²	(6.4) 108.8	24.0	70.4	(10.7) 61.8	282	110.8	(7.4) 158.6	98.1	375		3.3	41.8	3.3	48
02	Fair finish curved formworks type-B	m ²	—	—	—	—	—	—	—	—	—		—	—	—	—
05	Plane rough finish formworks type-E	m ²	(5.6) 19.3	13.9	15.1	14.3	68	19.4	(7.7) 19.8	14.8	62		10.5	21.2	10.5	42
D 03 03	Reinforcing steel H.y.s., D.b., not exceeding $\phi 16$ mm	t	1.828	0.597	1.153	(0.502) 1.292	5.4	1.647	2.275	1.565	5.5		—	0.517	—	0.5
04	H.y.s., D.b., $\phi 20$ mm or greater	t	0.141	0.539	—	—	0.7	0.266	0.269	—	0.5		—	2.44	—	2.4
	Filter material	m ³	4.2	—	21.3	—	26	8.6	31.0	—	40		—	—	—	—
	Bedding material	m ³	—	—	—	—	—	—	—	—	—		1	—	1	2
B B 02 02	DEMOLITION Removal of Structures Concrete structures	m ³														
03	Existing metal structures	t														
	REMARKS		() shows quantities of gravity type Retaining wall.			() shows quantities of stone's material		() shows quantities of gravity type retaining wall								

§ 2. Hin. Temple Ped. Br.

A₁ Abutment

Concrete Volume

Parapet	$\{ \frac{1}{2} \times (1.208 + 1.190) - 0.030 \} \times 2.4 \times 0.3 =$	0.89 ^{m³}
	$0.3 \times 2 \times 1.290 \times 0.3 =$	0.23
Wall	$(6.40 - 1.208 - 0.90) \times 0.9 \times 3.0 =$	11.59
Footing	$7.0 \times 7.5 \times 0.9 =$	16.20
Wing (1)	$\{ 5.50 + 0.082 + \frac{1}{2} (0.015 + 0.271) \} \times 2.287 \times 0.4 =$	5.24
	$\{ (4.6 - 0.257) + 1.0 \} \times \frac{1}{2} \times 1.8 \times 0.4 =$	1.92
Wing (2)	$(5.50 + 0.082) \times (1.453 + 0.700) \times 0.3 =$	3.61
	$\{ (2.6 + 1.0 - 0.113) + 1.0 \} \times \frac{1}{2} \times 1.3 \times 0.3 =$	0.87
		<hr/> 40.50 ^{m³}

Form Area

Parapet	$\{ \frac{1}{2} \times (1.208 + 1.190) - 0.030 \} \times 2.4 \times 2 =$	5.61 ^{m²}
	$1.290 \times 0.3 \times 2 \times 2 =$	1.55 "
	$1.290 \times 0.3 \times 2 + 0.10 \times 0.3 \times 2 =$	0.83 "
Wall	$7.292 \times 3.0 \times 2 + 7.292 \times 0.9 \times 2 =$	33.48 "
Wing (1)	$\{ 5.50 + 0.082 + \frac{1}{2} (0.015 + 0.271) \} \times 2.287 \times 2 =$	26.19
	$\{ (4.6 - 0.257) + 1.0 \} \times \frac{1}{2} \times 1.8 \times 2 =$	9.62
	$(1.5 + \sqrt{1.8^2 + 3.6^2} + 1.0) \times 0.4 =$	2.61
Wing (2)	$(5.50 + 0.082) \times (1.453 + 0.700) \times 2 =$	24.04
	$(2.6 + 1.0 - 0.113 + 1.0) \times \frac{1}{2} \times 1.3 =$	2.92
	$(2.5 + \sqrt{1.3^2 + 2.6^2} + 1.0) \times 0.3 =$	1.92
		<hr/> 108.77 ^{m²}

$$\text{Footing} \quad (4.0 + 4.5) \times 2 \times 0.9 = 15.3 \text{ m}^2$$

Blinding concrete

$$7.2 \times 4.7 \times 0.2 = 3.95 \text{ m}^3$$

Pier

Concrete Volume

$$\text{Wall} \quad 1.4 \times 0.6 \times 6.0 = 5.04 \text{ m}^3$$

$$\text{Footing} \quad 4.0 \times 3.0 \times 0.8 = 9.60 \text{ m}^3$$

Form area

$$\text{Wall} \quad (1.4 + 0.6) \times 2 \times 6.0 = 24.0 \text{ m}^2$$

$$\text{Footing} \quad (4.0 + 3.0) \times 2 \times 0.8 = 11.2 \text{ m}^2$$

Blinding concrete

$$7.2 \times 3.2 \times 0.2 = 2.69 \text{ m}^3$$

A2 Abutment

1) Concrete Volume

$$\text{Parapet} = 1.07 \text{ m}^3$$

$$\text{Wall} \quad (5.8 - 1.208 - 0.90) \times 3.0 \times 0.9 = 9.97$$

$$\text{Footling} \quad 3.0 \times 3.795 \times 0.9 = 10.25$$

$$\text{Wing} \quad \{ (15.8 + 0.082 - 0.90) \times 0.395 + 1.5 (4.982 + 4.232) \times \frac{1}{2} \} \times 0.3 \times 2 = 5.33$$

$$V_1 = 1.07 + 9.97 + 5.33 = 16.37 \text{ m}^3$$

$$V_2 = 10.25$$

2) Form Area

$$\text{Parapet} = 7.99 \text{ m}^2$$

$$\text{Wall} \quad 3.692 \times (3.0 + 0.3) \times 2 = 24.37$$

$$\begin{aligned} \text{Wing} \quad & \{ 4.982 \times 0.395 + \frac{1}{2} (4.982 + 4.232) \times 1.5 \} \\ & \times 2 \times 2 + 4.232 \times 0.3 \times 2 = 38.05 \\ & \hline & 70.41 \text{ m}^2 \end{aligned}$$

$$\text{Footling} \quad (3.0 + 3.795) \times 0.9 \times 2 = 12.23$$

$$\text{Form for blinding} \quad (3.2 + 3.795) \times 2 \times 0.2 = 2.88 \text{ m}^2$$

3) Blinding concrete

$$3.2 \times 3.795 \times 0.2 = 2.56 \text{ m}^3$$

U - Type Retaining Wall

1) Concrete Volume

$$A_1 = \{ 0.3 \times 1.5 + \frac{1}{2} \times (0.3 + 0.5) \times 2.0 \} \times 2 + 0.5 \times 3.0 = 7.0 \text{ m}^2$$

$$A_2 = \{ 0.3 \times 1.5 + \frac{1}{2} \times (0.3 + 0.34) \times 0.8 \} \times 2 + 0.5 \times 3.0 = 2.91 \text{ m}^2$$

$$k = 2.4 \text{ m}$$

$$V = (7.0 + 2.91) \times \frac{1}{2} \times 2.4 = 8.29 \text{ m}^3$$

$$A_3 = \{ 0.3 \times 1.5 + \frac{1}{2} \times (0.3 + 0.382) \times 0.9 \} \times 2 + 0.4 \times 3.0 = 2.71 \text{ m}^2$$

$$A_4 = 1.3 \times 1.5 \times 2 + 0.4 \times 3.0 = 2.10 \text{ m}^2$$

$$A_5 = 0.3 \times 0.6 \times 2 + 0.4 \times 3.0 = 1.56 \text{ m}^2$$

$$s = 1.2 + 1.8 + 1.8 \text{ m}$$

$$V_1 = 2.71 \times 1.2 = 3.25$$

$$V_2 = \frac{1}{2} \times (2.71 + 2.10) \times 1.8 = 4.33$$

$$V_3 = \frac{1}{2} \times (2.10 + 1.56) \times 1.8 = 3.29$$

$$\left. \begin{array}{l} V_1 \\ V_2 \\ V_3 \end{array} \right\} V = 10.87 \text{ m}^3$$

2) Form Area

$$(3.5 + 2.3) \times \frac{1}{2} \times 2.4 \times 4 + 0.5 \times 2 \times 2.4 = 27.84 + 2.4 = 30.24 \text{ m}^2$$

$$= 4.00 \text{ m}^2$$

$$2.4 \times 1.2 \times 4 + \frac{1}{2} (2.4 + 0.6) \times 3.6 \times 4 + 0.4 \times 3.6 \times 2 = 11.52 + 21.6 + 2.88 = 36.00 \text{ m}^2$$

$$= 1.56 \text{ m}^2$$

$$71.8 \text{ m}^2$$

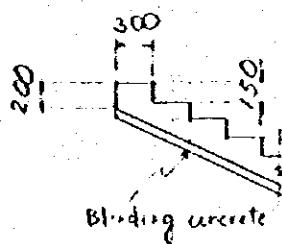
$$\begin{array}{l} \text{Footings } (2.4 + 3.0) \times 2 \times 0.5 + (4.8 + 4.8 + 2.0) \times 0.4 = 10.04 \text{ m}^2 \\ \text{Form for blinding concrete } (7.4 + 3.2) \times 2 \times 0.2 = 4.24 \text{ m}^2 \end{array} \quad (+ 61.76 \text{ m}^2)$$

3) Blinding concrete

$$7.4 \times 3.2 \times 0.2 = 4.74 \text{ m}^3$$

Stair

Concrete



$$V = \left\{ \frac{1}{2} \times (0.20 + 0.35) \times 0.3 \times 25 \right.$$

$$+ 0.2 \times 1.2 + 0.3 \times 0.3$$

$$+ 0.5 \times 0.3 \left. \right\} \times 2.4 = 6.102 \text{ m}^3$$

Blinding concrete

$$V = \left(\sqrt{3.9^2 + 2.6^2} + 1.2 + \sqrt{3.6^2 + 2.4^2} + 0.3 \right) \times 2.4 \times 0.1 = 2.5 \text{ m}^3$$

Formworks

$$A = 0.15 \times 2.4 \times 2.5$$

$$+ 0.2 \times 2.4 + 0.5 \times 2.4 = 10.7 \text{ m}^2$$

§ § 3 B.B. Ped. Br.

A, Abutment

1) Concrete Volume

$$\begin{array}{lcl}
 \text{Parapet} & & = 1.07 \text{ m}^3 \\
 \text{Wall} & (8.2 - 1.0 - 1.208) \times 3.0 \times 0.9 & = 16.18 \text{ m}^3 \\
 \text{Footing} & 5.0 \times 3.0 \times 1.0 & = 15.00 \text{ m}^3 \\
 \text{Wing} & \left\{ 1.5 \times 7.282 + \frac{1}{2} (4.0 + 1.0) \times 1.5 \right\} \times 0.3 & = 1.40 \text{ m}^3 \\
 & & = 44.0 \text{ m}^3 \\
 & & \hline
 & & 41.05 \text{ m}^3
 \end{array}$$

2) Form Area

$$\begin{array}{lcl}
 \text{Parapet} & & = 7.99 \text{ m}^2 \\
 \text{Wall} & 5.992 \times (3.0 + 0.3) \times 2 & = 39.55 \\
 \text{Wing} & 14.673 \times 1 + (3.2 + \sqrt{15^2 + 3.0^2} \cdot 1.0) \cdot 0.3 \cdot 2 & = 63.22 \\
 & & \hline
 & & 110.76 \text{ m}^2 \\
 \text{Footing} & (5.0 + 3.0) \times 1.0 \times 2 & = 16.00 \text{ m}^2 \\
 \text{blinding concrete} & (5.2 + 3.2) \times 2 \times 0.2 & = 3.36 \text{ m}^2
 \end{array}$$

3) Blinding concrete

$$5.2 \times 3.2 \times 0.2 = 3.3 \text{ m}^3$$

A2 Abutment

1) Concrete Volume

Parapet		1.07 m ³
Wall		16.18
Footing	$5.2 \times 3.0 \times 1.0$	15.60
Wall (1)	$1.1 \times 7.282 \times 0.3$	2.40
Wall (2)	$3.5 \times 7.282 \times 0.3$	7.65
Wall (3)	$\{0.3 \times 2.0 + \frac{1}{2} \times (0.3 + 0.54) \times 5.247\} \times 2.7$	7.40
		<hr/> 30.30

2) Form work

Parapet		7.99 m ²
Wall		39.55
Wall (1)	$1.1 \times 7.282 \times 2 + 7.282 \times 0.3$	18.21
" (2)	$3.5 \times 7.282 \times 2$	50.97
" (3)	$7.247 \times 2.7 \times 2 + 2.739$	41.87
		<hr/> 158.59 m ²

footing	$(5.2 + 3.0) \times 2 \times 1.0$	=	16.4 m ²
blinding	$(5.4 + 3.2) \times 2 \times 0.2$	=	3.4 m ²

3) Blinding concrete

$$5.4 \times 3.2 \times 0.2 = 3.46 m^3$$

U - Type Retaining Wall

1) Concrete Volume

$$A_1 = 4.0 \text{ m}^2$$

$$A_2 = \{ 0.3 \times 1.5 + \frac{1}{2} (0.3 + 0.407) \times 1.065 \} \times 2$$

$$+ 0.5 \times 3.0 = 3.15 \text{ m}^2$$

$$V = \frac{1}{2} \times (4.0 + 3.15) \times 7.5 = 26.81 \text{ m}^3$$

2) Form works

$$\text{Wall} \quad \frac{1}{2} (3.5 + 2.565) \times 7.5 \times 4$$

$$+ 4.0 + 3.15 = 98.13 \text{ m}^2$$

$$\text{Footing} \quad (7.5 + 3.0) \times 2 \times 0.5 = 10.5 \text{ m}^2$$

$$\text{Blinding concrete} \quad (7.6 + 3.2) \times 2 \times 0.2 = 4.3 \text{ m}^2$$

3) Blinding concrete

$$V = 7.6 \times 3.2 \times 0.2 = 4.86 \text{ m}^3$$

§ 4. Earth work
and Miscellaneous work

4-1 Earthworks

Hindu Temple

Excavation

$$(A_1) \quad V = (3.6 + 6.2) \times \frac{1}{2} \times 5.2 \times 8.1 = 206.4$$

$$(P_1) \quad V = \frac{1}{2} (5.7 \times 6.7 + 7.0 \times 5.0) \times 1.7 = 49.5$$

$$(A_2) \quad V = \frac{1}{2} \times (7.8 + 5.9) \times 2.1 \times 5.05 = 56.7$$

$$(U) \quad V = 6.7 \times 4.5 \times 1.2 = 36.2$$

348.8

Selected Material

$$(A_2) \quad 4.9 \times 2.4 \times 0.3 + \frac{1}{2} \times (4.9 + 4.2) \times 1.5 \times 2.4 = 19.91 \text{ m}^3$$

$$(P_1) \quad (3.5 + 2.3) \times \frac{1}{2} \times 2.4 \times 2.4 + 2.3 \times 1.2 \times 2.4 + (2.3 + 0.6) \times \frac{1}{2} \times 3.6 \times 2.4 = 35.8 \text{ m}^3$$

55.71

Filler material

$$(A_1) \quad 3.5 \times 7.4 \times 0.5 = 4.2 \text{ m}^3$$

$$(A_2) \quad 2.0 \times 2.4 \times 0.5 + 2.0 \times 7.2 \times 1.0 = 21.3 \text{ m}^3$$

25.5 m³

Beau Bossin

Excavation

$$\begin{aligned}
 (A_1) \quad \frac{1}{2} \times (6.0 \times 4.0 + 9.1 \times 7.1) \times 3.1 &= 137.3 \text{ m}^3 \\
 (A_2) \quad (6.2 \times 4.0 + 10.7 \times 8.3) \times \frac{1}{2} \times 4.5 &= 260.9 \text{ m}^3 \\
 (U) \quad \frac{1}{2} (5.0 + 4.0) \times 1.5 \times 6.0 &= 40.5 \text{ m}^3 \\
 \hline
 &= 438.2 \text{ m}^3
 \end{aligned}$$

Selected Material

$$\begin{aligned}
 (A_1) \quad 2.4 \times (1.1 + 2.4) \times 7.2 &= 60.5 \text{ m}^3 \\
 (U) \quad (3.3 + 2.5(5)) \times \frac{1}{2} \times 2.4 \times 7.5 &= 54.6 \text{ m}^3 \\
 &= 115.1 \text{ m}^3
 \end{aligned}$$

Idle Material

$$\begin{aligned}
 (A_1) \quad 7.2 \times 2.4 \times 0.5 &= 8.6 \text{ m}^3 \\
 (A_2) \quad 7.2 \times (2.4 + 3.5 + 2.7) \times 0.5 &= 31.0 \text{ m}^3
 \end{aligned}$$

4 - 2. Gravity Type Retaining wall

Hir. Temple Pod. Br. (A) side
Concrete Volume

$$(Right) V = \frac{1}{2} (0.4 + 0.8) \times 1.0 \times 2.2 = 1.3 \text{ m}^3$$

$$(Left) V = \frac{1}{2} (0.4 + 0.8) \times 1.0 \times 3.0 = 1.8 \text{ m}^3$$

Blinding concrete Volume

$$(Right) V = 1.0 \times 0.1 \times 2.2 = 0.2 \text{ m}^3$$

$$(Left) V = 1.0 \times 0.1 \times 3.0 = 0.3 \text{ m}^3$$

Formworks Area

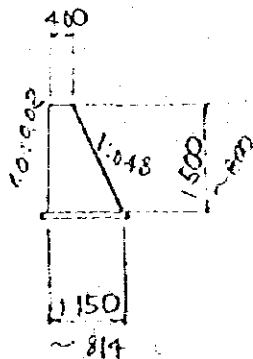
$$Right \quad A_1 = \frac{1}{2} (0.4 + 0.8) \times 1.0 + 1.0 \times 2.2 = 2.8 \text{ m}^2$$

$$A_2 = \sqrt{0.4^2 + 1.0^2} \times 2.2 = 2.4 \text{ m}^2$$

$$Left \quad A_1 = \frac{1}{2} (0.4 + 0.8) \times 1.0 + 1.0 \times 3.0 = 3.6 \text{ m}^2$$

$$A_2 = \sqrt{0.4^2 + 1.0^2} \times 3.0 = 3.2 \text{ m}^2$$

B.B. Pod. Br. (A2) side



Concrete Volume

$$V = \frac{1}{2} (0.4 + 0.982) \times 1.15 \times 6.0 \times 2 = 9.5 \text{ m}^3 \quad \text{Right and Left}$$

Blinding concrete

$$V = 1.182 \times 0.1 \times 6.1 \times 2 = 1.4 \text{ m}^3$$

Formworks

$$A_1 = \frac{1}{2} (0.4 + 0.982) \times 0.8 + 1.15 \times 6.0 = 7.9 \text{ m}^2$$

$$A_2 = \sqrt{(0.982 - 0.4)^2 + 1.15^2} \times 6.0 = 7.7 \text{ m}^2$$

4 § 5. STA 57. AQUEDUCT

A₁ Abutment (A₂ Abutment)

(1) Concrete Volume

$$V = \frac{1}{2} (1.0 + 2.0) \times 2.0 \times 1.6 = 4.8 \text{ m}^3$$

(2) Blinding Concrete

$$V = 1.8 \times 2.2 \times 0.1 = 0.4 \text{ m}^3$$

(3) Bedding Material

$$V = 1.8 \times 2.2 \times 0.15 = 0.6 \text{ m}^3$$

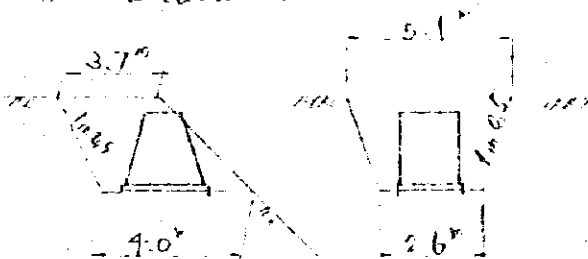
(4) Form work

$$A_1 = \frac{1}{2} (1.0 + 2.0) \times 2.0 \times 2 + \sqrt{0.5^2 + 2.0^2} \times 1.6 = 9.3 \text{ m}^2 \text{ (Rough)}$$

$$A_2 = \sqrt{0.5^2 + 2.0^2} \times 1.6 = 3.3 \text{ m}^2 \text{ (Fair)}$$

$$\text{for Blinding } (1.8 + 2.2) \times 0.15 \times 2 = 1.2 \text{ (Rough)}$$

(5) Excavation



$$V = \frac{1}{2} \times (5.1 + 2.6) \times 2.5 \times \frac{1}{2} (3.7 + 4.0) = 27.1 \text{ m}^3$$

P₁ Pier

(1) Concrete Volume

$$V = 1.4 \times 0.8 \times 9.5 + 1.5 \times 3.0 \times 1.2 = 26.8 \text{ m}^3$$

(2) Blinding Concrete

$$V = 4.7 \times 3.2 \times 0.2 = 3.0 \text{ m}^3$$

(3) Formwork

$$A_1 = (1.4 + 0.8) \times 2 \times 9.5 = 41.8 \text{ m}^2 \text{ (Fair Finish)}$$

$$A_2 = (1.5 + 3.0) \times 2 \times 1.2 = 18.0 \text{ m}^2 \text{ (Rough Finish)}$$

$$\text{for blinding } (4.7 + 3.2) \times 0.2 \times 2 = 3.2 \text{ m}^2 \text{ (Rough Finish)}$$

(4) Excavation Depth = 2.0 m (Rock)

$$V = \{(5.5 \times 4.0) + (6.7 \times 5.2)\} \times \frac{1}{2} \times 2.0 = 56.8 \text{ m}^3$$

