

C.V. RAMAN POLYTECHNIC, BHUBANESWAR



C.V.Raman Polytechnic

Quality Education for the New Millenium

LECTURE NOTE

ESTIMATION & COST EVALUATION- II,

(Th.5)

SEM-5th

BRANCH-CIVIL ENGINEERING

Prepared by

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Example 1. Prepare a detailed estimate of a slab culvert of 1.50 metre span and 4.00 m wide roadway from the given drawing (Fig. 8-5). The general specifications are as follows:

Foundation concrete shall be of cement concrete 1 : 3 : 6 with stone ballast and coarse sand. Masonry shall be of first class brickwork in 1 : 4 cement coarse sand mortar. Slab shall be of R.C.C. 1 : 2 : 4 with reinforcement as per drawing. Exposed surface of brick masonry shall be cement pointed 1 : 2. Road shall be provided with 10 cm thick wearing coat of 1 : 2 : 4 cement concrete. Assume suitable rates.

R.C.C. SLAB CULVERT 1.50 m SPAN with standard modular bricks

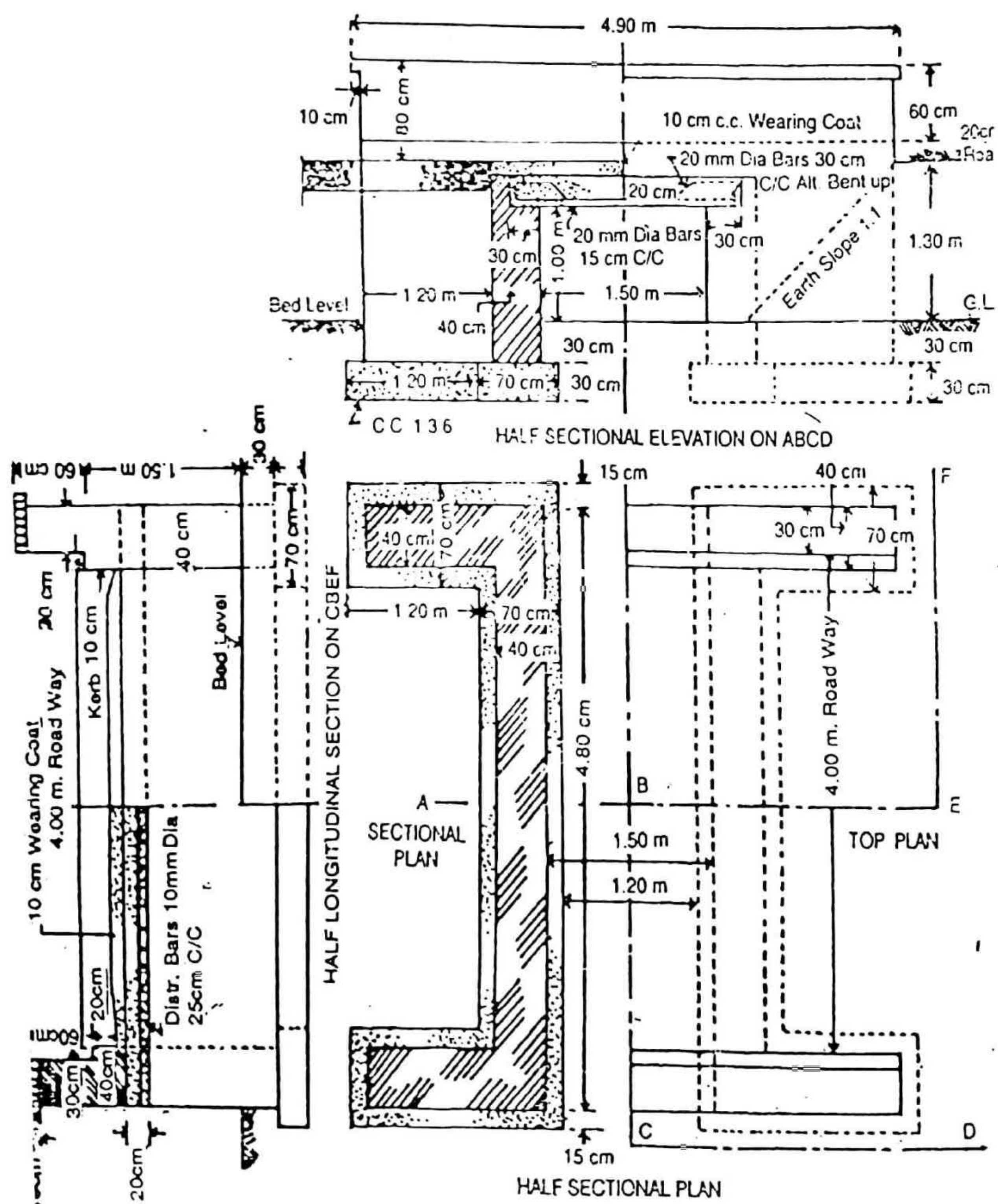
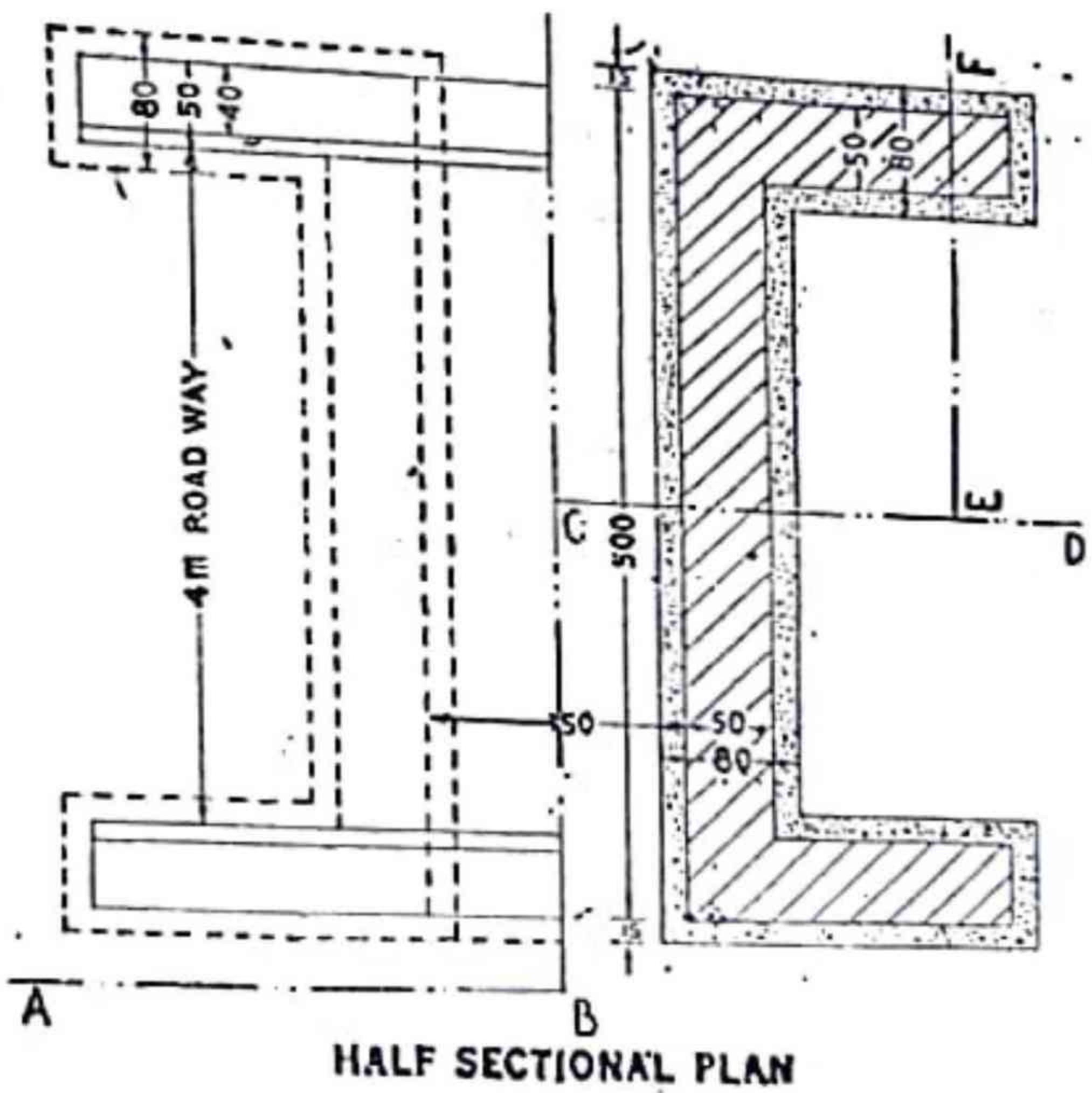
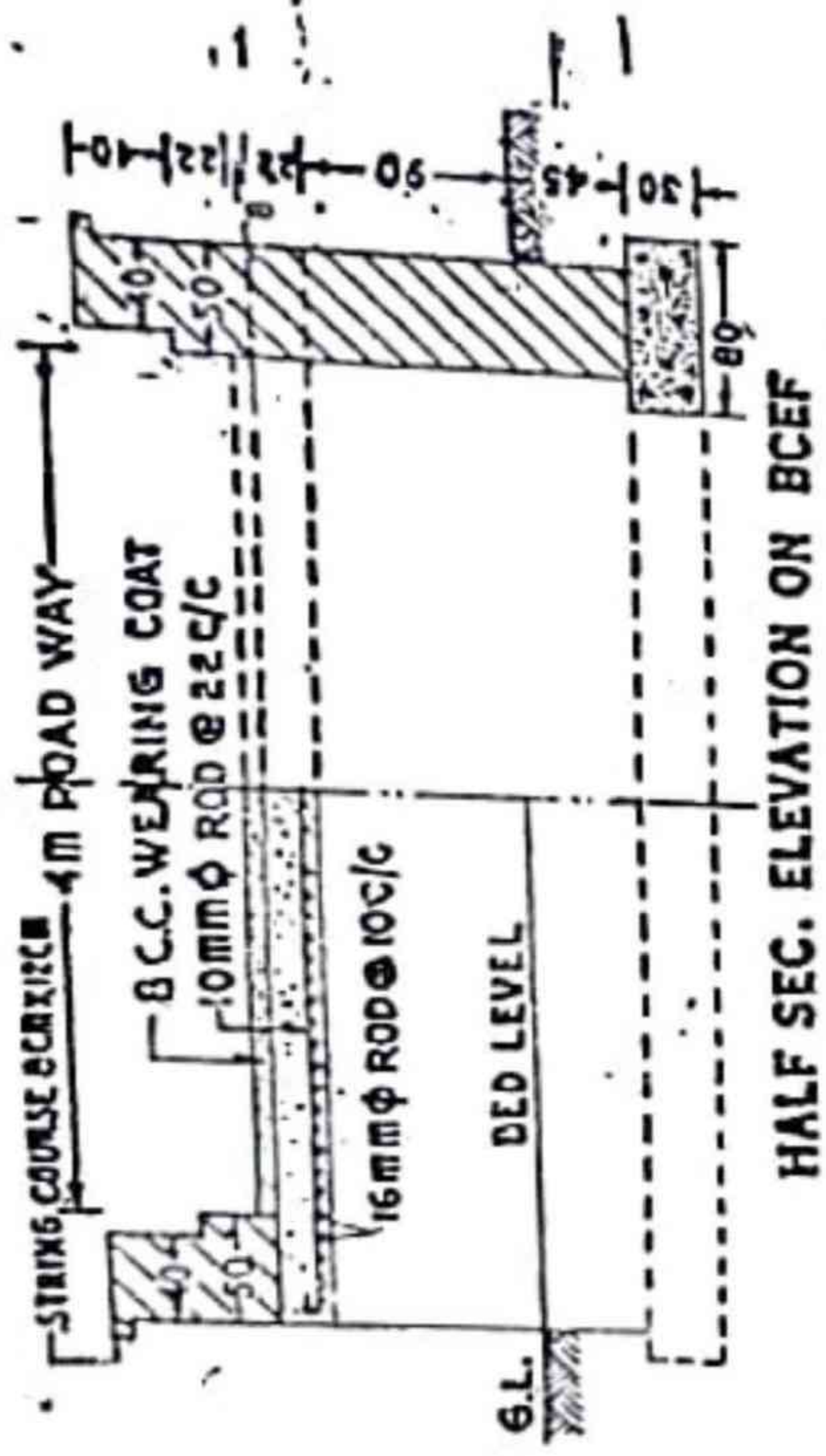
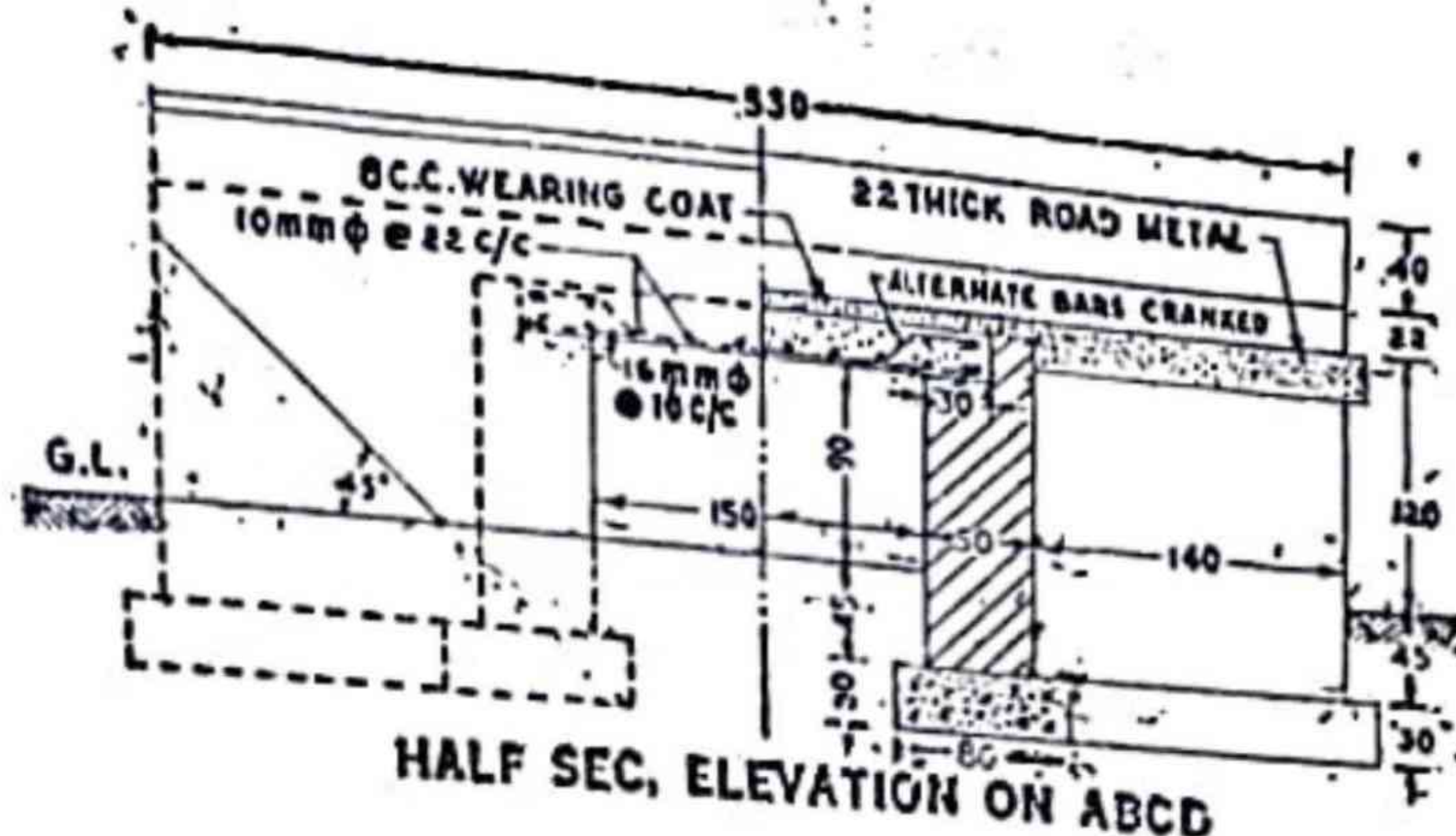


Fig. 8-5

I.N	Description of item	N	L	B	H	Qty	Explanatory Note
1.	Earth work in excavation						$h = 0.3 + 0.3 = 0.6$ $L = 4.8 + 0.15 + 0.15 = 5.1$
	a - Abutment	2	5.1	0.7	0.6		
	b - wing wall	4	1.2	0.7	0.6		
2.	Cement concrete in foundation						
	a - Abutment	2	5.1	0.7	0.3		
	b - wing wall	4	1.2	0.7	0.3		
3.	Brickwork						
	a - Abutment	2	4.8	0.4	1.5		$h = 1 + 0.3 + 0.2 = 1.5$ $L = 1.2 - 0.15 + 0.15 = 1.2$
	b - wing wall	4	1.2	0.4	1.5		
	c - Parapet						
	(i) 1st footing	2	4.7	0.4	0.3		$h = 0.2 + 0.1 = 0.3$ $L = 4.9 - 2 \times 0.1 = 4.7$
	(ii) 2nd footing	2	4.7	0.3	0.5		$h = 0.6 - 0.1 = 0.5$
	(iii) coping	2	4.9	0.4	0.1		
	d - Deduction for projection of slab on Abutment	2	4.8	0.3	0.2	0.57	
4.	RCC work in slab	1	4.8	2.1	0.2		$B = 1.5 + 0.3 + 0.3 = 2.1$
5.	Plastering & pointing work						
	a - inner side of Abutment	2	4.8		1.1		$h = 1 + 0.1 = 1.1$ (G.L. = G.L.)
	b - Face wall including 10 cm below G.L. upto bottom of coping	2	4.7		2.1		$L = 4.9 - 0.1 - 0.1 = 4.7$ $H = 0.1 + 1.3 + 0.2 + 0.5 = 2.1$
	c - inner side of Parapet	2	4.7		0.8		$H = 0.2 + 0.1 + 0.5 = 0.8$
	d - Coping (top, outer, inner, bottom projection)	2	4.9	0.7			$B = 0.4 + 0.1 + 0.1 + 0.1 = 0.7$

I.N	Description of item	N	L	B	H	Qty	Exploratory note
	e) sides of parapet & coping						
	i - 1st footing	4		0.4	0.3		
	ii - 2nd footing	4		0.3	0.5		
	iii - coping	4		0.4	0.1		
	f) Deduction						
	(i) Rectangular opening	2	1.5		1.1		$H = 1 + 0.1 = 1.1$
	(ii) Triangular portion below side slope	4	$\frac{1}{2} \times 1.3 \times 1.3$			0.845	
G.	10 cm CC wearing coat	1	4	2.3	0.1	0.92	$B = 1.05 + 0.4 + 0.4 = 2.3$

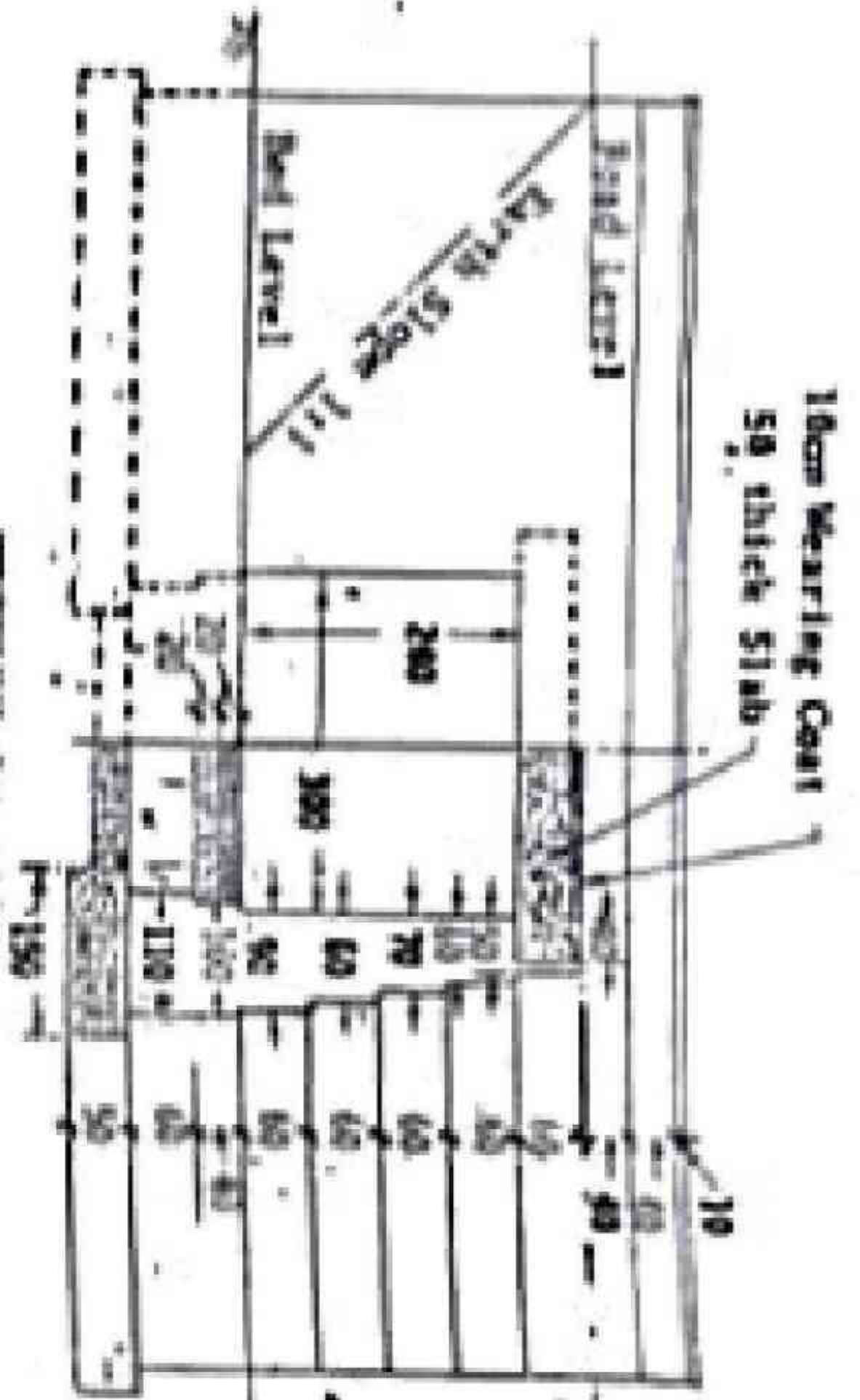


All dimensions in centimetre scale 1:75

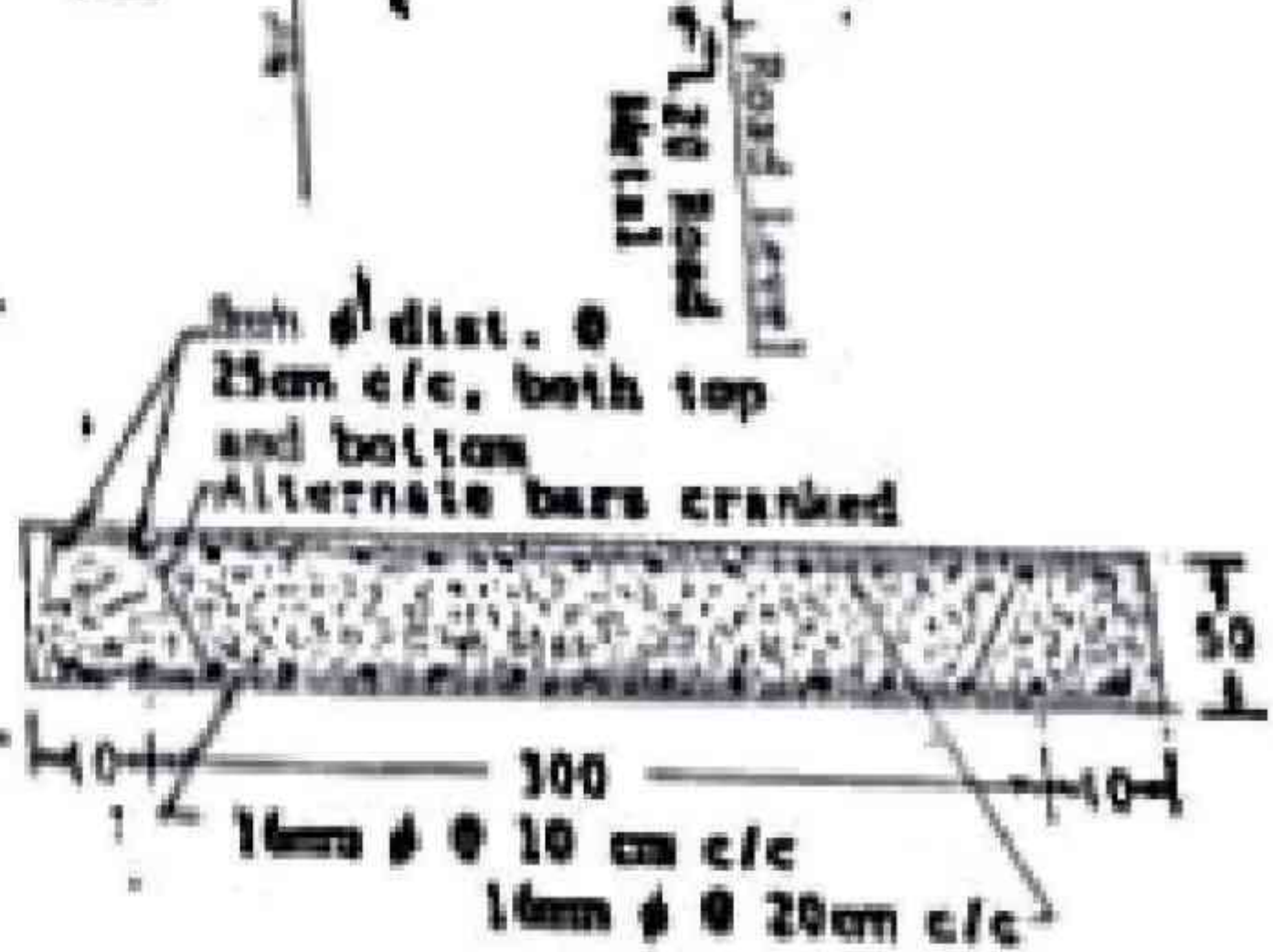
FIG. 10-25

I.N	Description of item	NO	L	B	H	Qty.	Explanatory, Note
1.	Earthwork in excavation a. Abutment b. wing wall	2	5.3	0.8	0.75	6.36	$L = 5 + 0.15 + 0.15$
		4	1.4	0.8	0.75	3.36	$H = 0.75 (0.45 + 0.3)$
2.	Cement concrete in foundation a- Abutment b- wing wall	2	5.3	0.8	0.3	2.54	
		4	1.4	0.8	0.3	1.34	
3.	Brickwork in foundation and super structure a- Abutment b- wing wall c- parapet (i) 1st footing (ii) 2nd footing d. Deduction for projecti- on of slab on Abutment	2	5	0.5	1.57		$H = 0.45 + 0.9 + 0.22$
		4	1.4	0.5	1.57		
		2					
		2	5.3	0.5	0.3	1.53	$H = 0.22 + 0.08$
		2	5.3	0.4	0.32	1.35	$H = 0.4 - 0.08$
		2	5	0.3	0.22	0.66	
4.	RCC work in slab	1	5	2.1	0.22	2.31	$B = 1.5 + 0.3 + 0.3$
5.	Plastering & pointing a- Inner side of Abutment b- face wall including 15cm below ground level upto bottom of coping. c- Inner side of parapet d- coping (top, outer, inner, bottom projection)	2	5		1.05	10.5	$B = 0.9 + 0.15$
		2	5.3		1.89	20.03	$H = 0.15 + 1.2 + 0.22 + 0.32$ (If not given take 10 cm below G.L.)
		2	5.3		0.64	6.78 m ²	$H = 0.22 + 0.1 + 0.32$
		2	5.3	0.8		8.48 m ²	$B = 0.08 + 0.4 + 0.12 +$ $0.08 + 0.12$

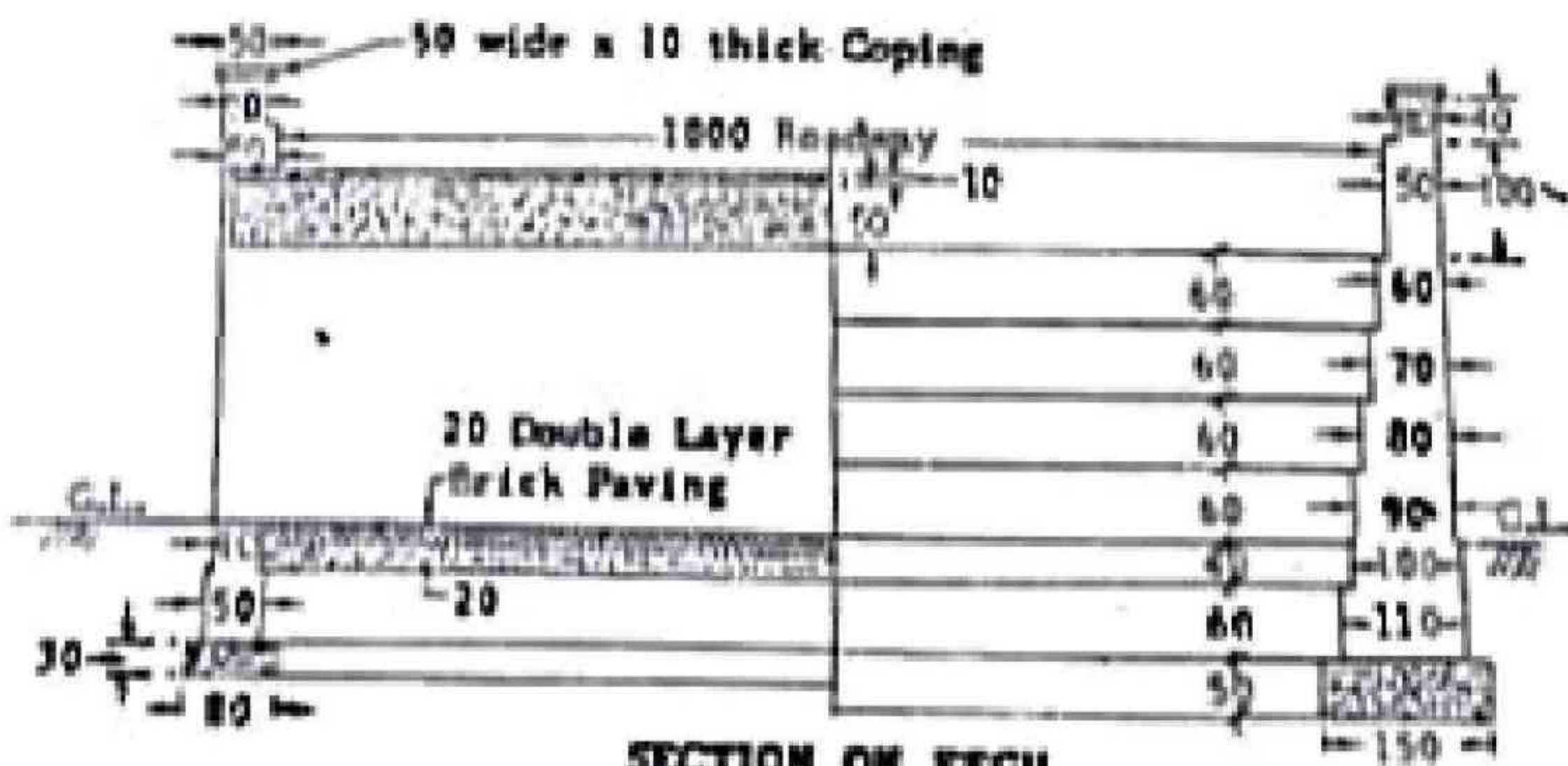
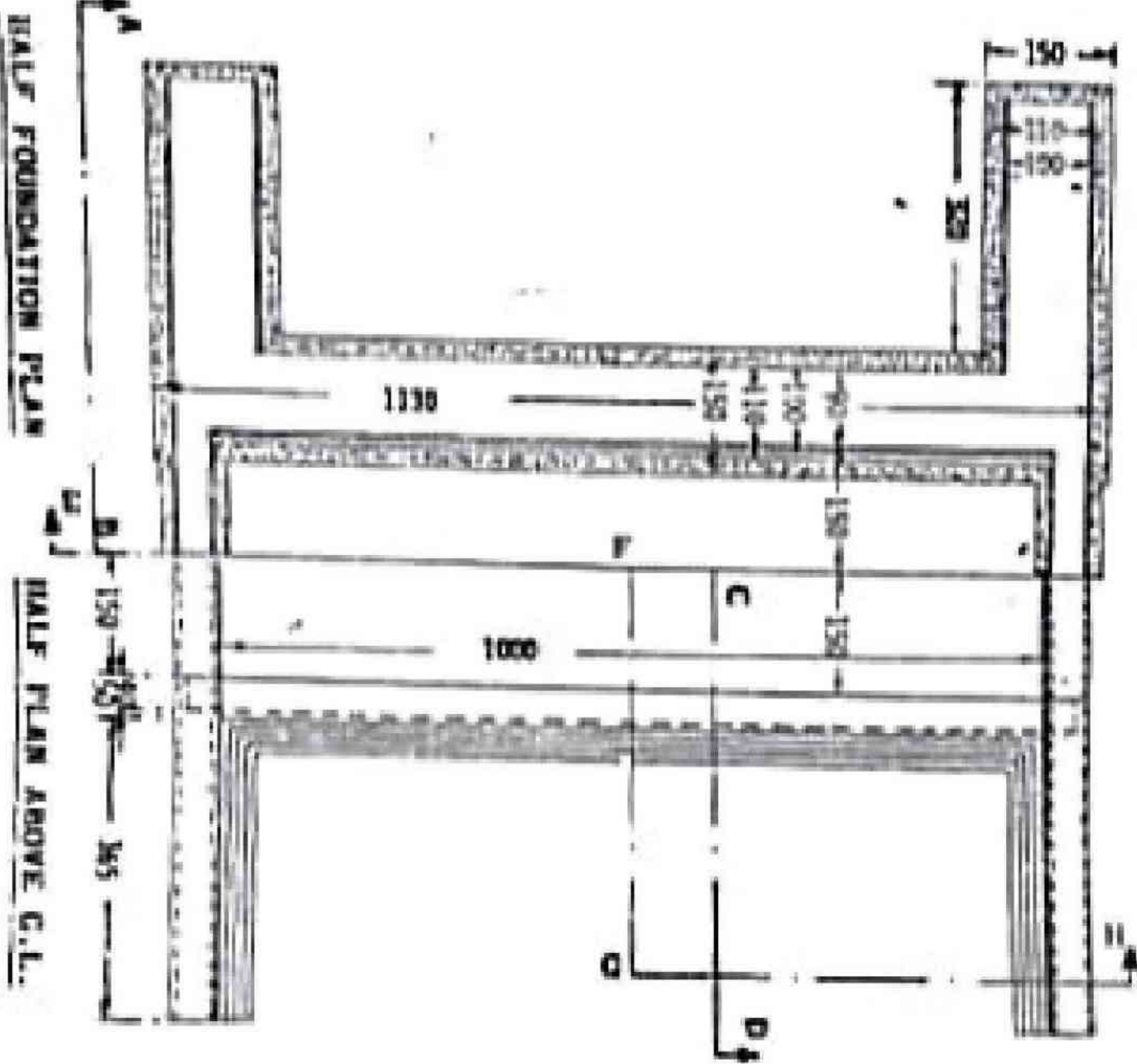
S. No	Description of item	N	L	B	H	Qty	Explanatory Note
	e. sides of parapet coping						
	(i) 1st footing	4		0.5	0.3	0.6 m ²	
	(ii) 2nd footing	4		0.4	0.32	0.512 m ²	
	(iii) coping	4		0.52	0.08	0.166 m ²	
	f. Deduction						
	(i) Rectangular opening	2	1.5		1.05	3.15	H = 0.9 + 0.15
	(ii) Triangular portion below side slope	4	1/2 x 1.2 x 1.2			0.72 m ²	
	8 CM CC wearing coat	1	4	2.5	0.08	0.8	B = 1.5 + 0.5 + 0.5 4 M Road way = L.
	String course	2	5.3	0.52	0.08	0.440	



SECTION ON ABCD



DETAILS OF SLAB



SECTION ON EFGH

S.N	Description of item	NO	L	B	H	Qty.	Explanatory Note
1. Earthwork in excavation							
	a- Abutment	2	11.5	1.5	1.5	51.75	$H = 0.5 + 0.5 + 0.4$ $H = 0.3 + 0.6 + 0.4$ $H = 0.2 + 0.2$ $L = \frac{300 - 2(5 + 10 + 20)}{100}$ Curtain wall $L = \frac{2(\frac{1000}{2} + 50 - 40 - 5)}{100}$ Base conc. floor $B = \frac{300 - 2 \times 5}{100}$ $L = \frac{2(\frac{1000}{2} + 50 - 40)}{100}$
	b- wing wall	4	3.2	1.5	1.5	28.8	
	c- curtain wall	2	2.3	0.8	1.3	4.78	
	d- Base concrete floor	1	9.8	2.3	0.4	9.01	
2. Cement concrete in foundation							
	a- Abutment	2	11.5	1.5	0.5	17.25	$L = \frac{2(\frac{1000}{2} + 50 + 5)}{100}$ $L = 3.2 - 0.2 + 0.2 = 3.2$
	b- wing wall	4	3.2	1.5	0.5	9.6	
	c- curtain wall	2	2.3	0.8	0.3	1.10	
	d- Base concrete floor	1	10.2	2.9	0.2	5.91	
3. Brick work :-							
	a) Abutment						$L = \frac{2(\frac{1000}{2} + 50 + 5)}{100}$
	i) 1st footing	2	11.1	1.1	0.6	14.65	
	ii) 2nd footing	2	11.1	1.0	0.4	8.88	
	iii) 3rd footing	2	11.1	0.9	0.6	11.98	
	iv) 4th footing	2	11.1	0.8	0.6	10.65	
	v) 5th footing	2	11.1	0.7	0.6	9.32	
	vi) 6th footing	2	11.1	0.6	0.6	7.99	
	vii) 7th footing	2	11.1	0.5	0.6	6.66	
	b) wing wall						
	i) 1st footing	4	3.2	1.1	0.6	8.44	
	ii) 2nd footing	4	3.2	1.0	0.4	5.12	
	iii) 3rd footing	4	3.25	0.9	0.6	7.02	
	iv) 4th footing	4	3.35	0.9	0.6	6.43	

	Qty.	Length	Breadth	Height	Qty.	Explanatory Note
v) 5th Footing	4	3.45	0.7	0.6	5.79	v) $L = 3.35 + 0.1 = 3.45$
vi) 6th Footing	4	3.55	0.6	0.6	5.11	vi) $L = 3.45 + 0.1 = 3.55$
vii) 7th Footing	4	3.65	0.5	0.6	4.38	vii) $L = 3.55 + 0.1 = 3.65$
c) Curtain wall						$L = \frac{300 - 2 \times (5 + 10)}{100}$
i) 1st Footing	2	2.7	0.5	0.6	1.62	$L = 2.3 + 0.2 + 0.2 = 2.7$
ii) 2nd Footing	2	2.9	0.4	0.4	0.92	$L = 2.7 + 0.1 + 0.1 = 2.9$
d) parapet						$= \frac{300 - 2 \times 5}{100} = 2.9$
i) 1st Footing	2	11.3	0.5	0.6		$L = \frac{2(365 + 50 + 150)}{100}$
ii) 2nd Footing	2	11.3	0.4	0.4		$= 11.3M$
) Coping.	2	11.4	0.5	0.1		$L = 11.3 + 2 \times 0.05 = 11.4M$
e) Deduction for projection of slab on Abutment	2	10.8	0.4	0.5		$L = 11 - 2 \times 0.1$
4. RCC work in slab	1	10.8	3.8	0.5		$B = \frac{300 + 40 + 40}{100} = 3.8$
5. Plastering and pointing						
i) Inner side of Abutment	2	11		2.4		
ii) Face wall including 10cm below G.L. upto bottom of coping.	2	11.3		3.9		$H = 0.1 + 0.6 \times 5 + 0.4 \times 2$ (0.1 - below G.L.)
iii) Inner side of parapet	2	11.3		0.9		$h = 0.4 + 0.1 + 0.4$
iv) Coping (top, outer, inner, bottom projection)	2	11.4	0.8			$B = 0.5 + 2 \times 0.05 + 2 \times 0.$
v) sides of parapet coping						
a) 1st Footing	4		0.5	0.5		$H = 1 - 0.5 = 0.5$
b) 2nd Footing	4		0.4	0.4		
c) Coping	4		0.5	0.1		

I.N	Description of item	NO	L	B	H	Qty.	Explanatory Note
	d) Deduction i) Rectangular opening in face-wall ii) Triangular portion below side slope	2 4	3 $\frac{1}{2} \times 3 \times 3$	2.5 3	2.5 4.5	2.5 3m.	$H = 2.4 + 0.1 = 2.5$ $H = 5 \times 0.6 = 3m.$
6.	wearing coat	1	10	3.8	0.1		

Draw the plan and elevations of the structure shown in the given plan and elevations Fig. 8-14. Foundation concrete shall be of 1:4:8 cement concrete and brickwork shall be of first class in 1:6 cement sand mortar. Exposed surfaces shall be pointed with 1:2 cement sand mortar.

Assume suitable rates.

PIPE CULVERT

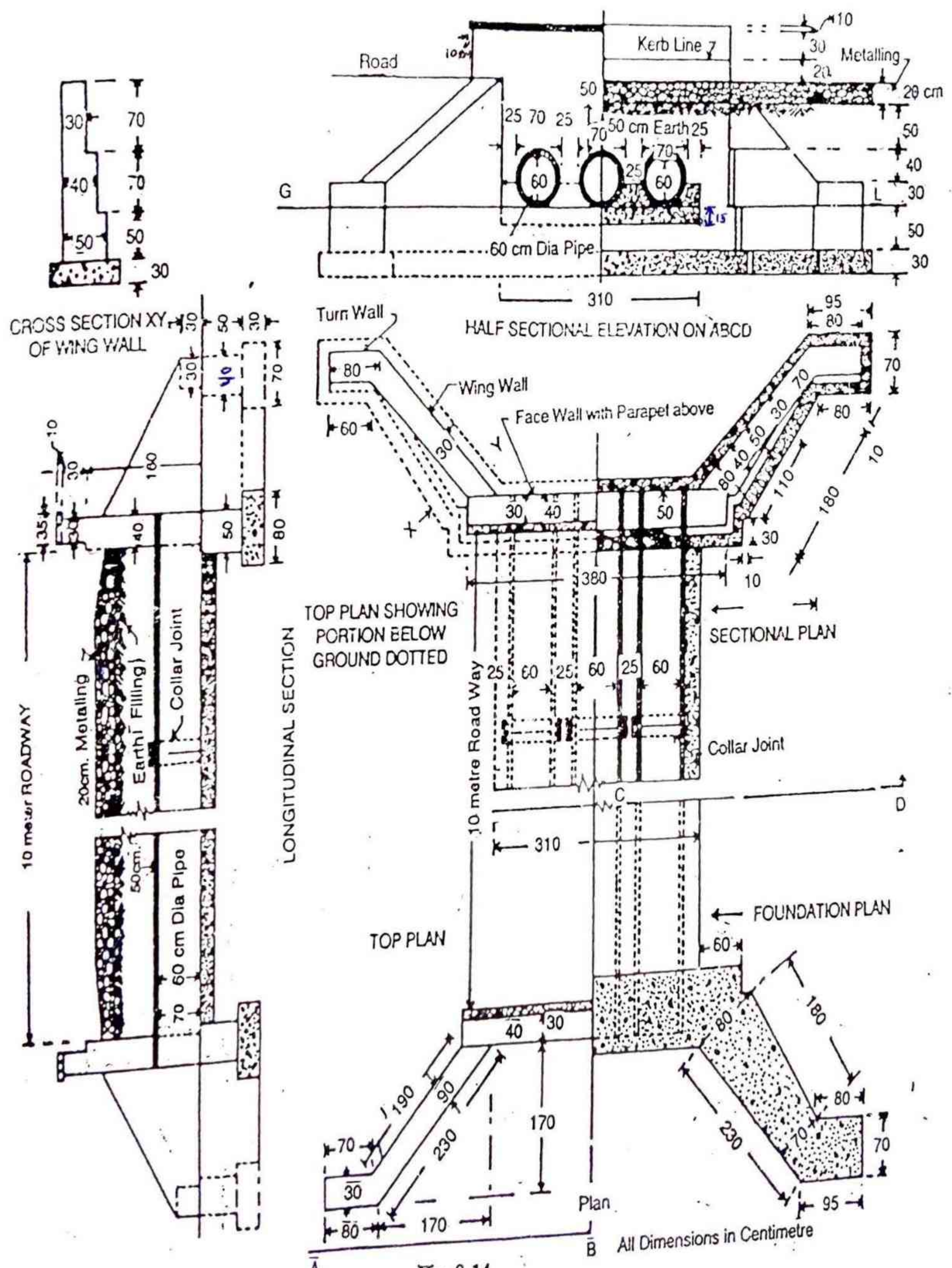


Fig. 8-14

IN	Description of Item	NO	L	B	H	Qty.	Explanatory Note	IN
	1) Earth work in excavation							
	a) Face wall	2	3.1	0.8	0.8		$H = 0.5 + 0.3 = 0.8$	
	b) Wing wall							
	i) Triangular portion	4	$\frac{1}{2} \times 0.8 \times 0.8$				$H = 0.5 + 0.3 = 0.8$	
	ii) Trapezoidal portion	4	2.05	0.75	0.8		$L = \frac{2.3 + 1.8}{2} = 2.05$	
							$B = \frac{0.8 + 0.7}{2} = 0.75$	
	c) Turn wall	4	0.87	0.7	0.8		$H = 0.5 + 0.3 = 0.8$	
							$L = \frac{0.8 + 0.95}{2} = 0.87$	
	d) Base concrete floor	1	9.5	3.1	0.15		$L = 10 - 2 \times (0.1 + 0.15) = 9.5$	
2.	Cement concrete in foundation							
	a) Face wall	2	3.1	0.8	0.3			
	b) Wing wall							
	i) Triangular portion	4	$\frac{1}{2} \times 0.8 \times 0.3$					
	ii) Trapezoidal portion	4	2.05	0.75	0.3			
	c) Turn wall	4	0.87	0.7	0.3			
	d) Base concrete floor	1	9.8	3.1	0.5		$L = 10 - 0.1 - 0.1 = 9.8$	
							$H = 0.15 + 0.7/2 = 0.5$	
	e) Deduction for opening of pipe	3	9.8	$\frac{\pi \times (0.35)^2}{2}$		5.65	$\frac{\pi \times (0.35)^2}{2} = 0.192$	
3.	Brickwork in foundation and super structure							
	a) Face wall with parapet above							
	(i) 1st footing	2	4	0.5	0.5		$L = 3.8 + 0.1 + 0.1 = 4$	
	(ii) 2nd footing	2	3.8	0.4	1.6			
	(iii) 3rd footing	2	3.8	0.3	0.3			

IN Description of items

No	L	B	H	Qty.	Explanatory Note
(iv) Coping	2	3.9	0.35	0.1	$L = 3.8 + 2 \times 0.05 = 3.9$
b) wing wall					
i) 1st 30cm width wall from top to bottom	4	2.1	0.3	1.35	$L = \frac{230 + 190}{2} = 210/100 = 2.1$ $H = \frac{190 + 80}{2} = 135/100 = 1.35$
ii) 10 cm projection for 40 cm wall					
→ 1st 80 cm height	4	1.1	0.1	0.8	$h = \frac{0.4 + 0}{2} = 0.2$
→ 40 cm height above 80 cm height	4	1.1	0.1	0.2	
iii) 10 cm projection for 50 cm wall.	4	1.8	0.1	0.5	
c) Turn wall					
i) 1st footing	4	0.77	0.4	0.5	$L = \frac{0.8 + 0.75}{2} = 0.77$
ii) 2nd footing	4	0.75	0.3	0.3	$L = \frac{0.7 + 0.8}{2} = 0.75$
d) Deduction for opening of pipe in face wall	2x3	$\frac{\pi}{4} \times (0.7)^2$		0.4	$\frac{\pi}{4} \times (0.7)^2 = 0.38$
4. plastering and pointing work					
i) face wall with including 10 cm below ground level upto top of wing wall	2	3.1	-	1.5	$H = 0.3 + 0.4 + 0.5 + 0.2 + 0.1 = 1.5m$
ii) Outer side of Parapet	2	3.8	-	0.5	$H = 0.2 + 0.3 = 0.5$
iii) Inner side of Parapet	2	3.8		0.6	$H = 0.2 + 0.1 + 0.3 = 0.6$

I.N	Description of Item	NO	L	B	H	Qty.	Explanatory Note
	iv) coping	2	3.9	0.6			$B = 0.1 + 0.35 + 0.1 + 0.05$
	v) sides of parapet and coping						
	a) 1st footing	4		0.4	0.2		
	b) 2nd footing	4		0.3	0.3		
	c) sides of coping	4		0.35	0.1		
	vi) wing wall						
	(a) Inner side	4	2.3		0.95		$H = \frac{1.5 + 0.4}{2} = 0.95$
	(b) Top	4	2.1	0.3			$(0.1 + 0.3 + 0.4 + 0.5 + 0.2) = 1.5$ $L = \frac{2.3 + 1.9}{2} = 2.1$
	vii) turn wall						
	a) Inner and side	4	1.1		0.4		$L = 0.8 + 0.3 = 1.1$
	b) Top	4	0.75	0.3			$H = 0.3 + 0.1 = 0.4$ $L = \frac{0.8 + 0.7}{2} = 0.75$
	viii) Deduction for circular opening in face wall	6	$\frac{\pi}{4} \times (0.6)^2$				$\text{Area} = \frac{\pi}{4} \times (0.6)^2$ $\approx 0.28 \text{ M}^2$

(i)



(Straight bar with end hooks)

(ii)



Bent up bar (one side cranked) with end hook.

(iii)



Bent up bar (two side cranked with end hooks)

In a slab, L_y = length of long span. (Length)

L_x = length of short span. (Breadth)

→ If, $\frac{L_y}{L_x}$ greater than two, ($\frac{L_y}{L_x} > 2$) then the slab is one way.

→ If $\frac{L_y}{L_x} \leq 2$, then the slab is two way.

→ In a one way slab main bar is provided parallel to short span and distribution bar is provided parallel to long span over the main bar.

→ In a two way slab main bar is provided parallel to both short and long span, long span bar is provided above the short span bar.

→ The dia of bar used as main bar is 6mm, 8mm, 10mm & 12mm.

→ The dia of bar used as distribution bar is 6mm, and 8mm.

→ The length of one end hook = 9ϕ (ϕ = cranked), diameter of bar

→ Length of bent up bar = Length of straight bar + $\frac{d}{2}$ (for each bent up)

d = effective depth of slab = overall depth (D) - effective cover

→ No. of straight bar = No. of spacing + 1.

→ No. of spacing of short span bar = $\frac{\text{Length of long span}}{\text{spacing of short span bar}}$

→ No. of top distribution bar = maximum 50% of number of bottom distribution bar.

1) SLAB CULVERT OF B.N. DUTTA

Calculate the quantity of steel required for the slab given in qth no (1).

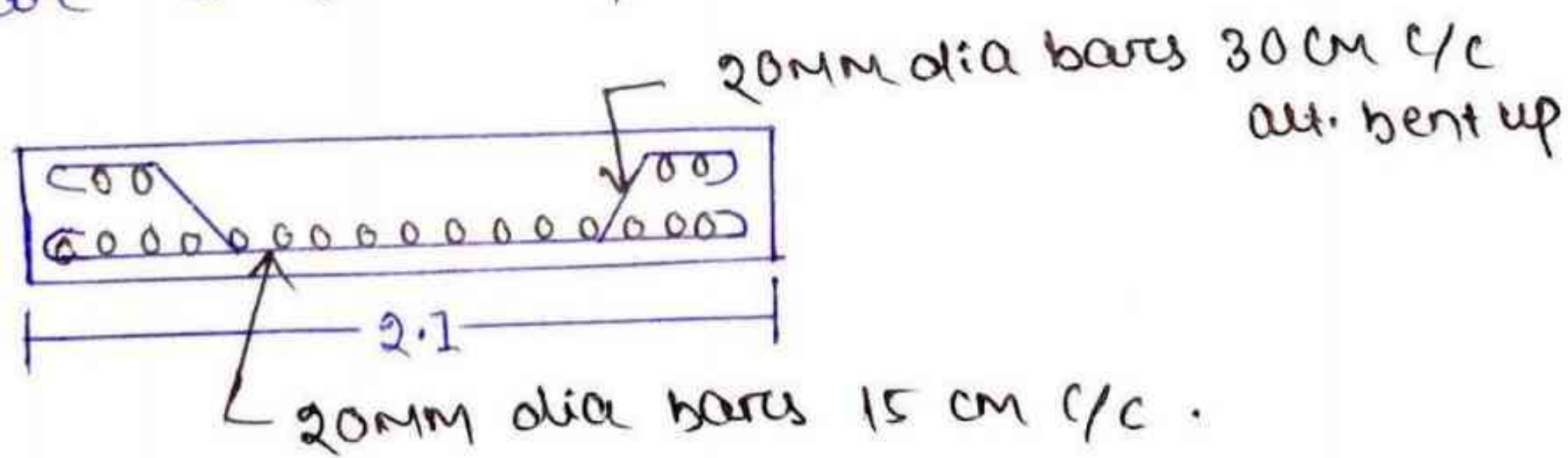
Ans → Here, long span (L_y) = 4.8 m

short span (L_x) = 2.1 m

Thickness (D) = 0.2 m

Here, $\frac{L_y}{L_x} = \frac{4.8}{2.1} = 2.28 > 2$ (So, it is an one way slab)

So, main bar is provided parallel to short span and distribution bar is provided parallel to long span.



Here, Dia of main bar = 20mm

Dia of distribution bar = 10mm

Center to center spacing between main straight bar = 30cm.

" " " " " bent up bar = 30cm.

" " " " " main straight and bent up = 15cm.

~~No. of store~~ Calculation of reinforcement along short span (main bar)

No. of spacing of straight bar of 20mm dia @ 30 c/c =

$$\frac{\text{Long span}}{\text{spacing of short span bar}}$$

$$\Rightarrow \frac{4.8}{0.3} = 16$$

No. of straight bar = 16 + 1 = 17 nos.

No. of bent up bar = 16 nos.

Length of straight bar = 2.1 - 2 x side cover + 2 x hook length

$$\Rightarrow 2.1 - 2 \times 0.04 + 2 \times 9\phi$$

$$\Rightarrow 2.1 - (2 \times 0.04) + 2 \times (9 \times 0.02)$$

$$\Rightarrow 2.38 \text{ m.}$$

Length of main bent up bar = Length of straight bar + $(2 \times \frac{d}{2})$

$$\Rightarrow 2.38 + 2 \times \frac{0.175}{2}$$

$$\Rightarrow 2.55 \text{ m}$$

$$d = 200 - (15 + \frac{20}{2})$$

$$\Rightarrow 175 \text{ mm}$$

$$\Rightarrow 0.175 \text{ m}$$

Total length of main straight bar

= No. of main straight bar x length of one straight bar

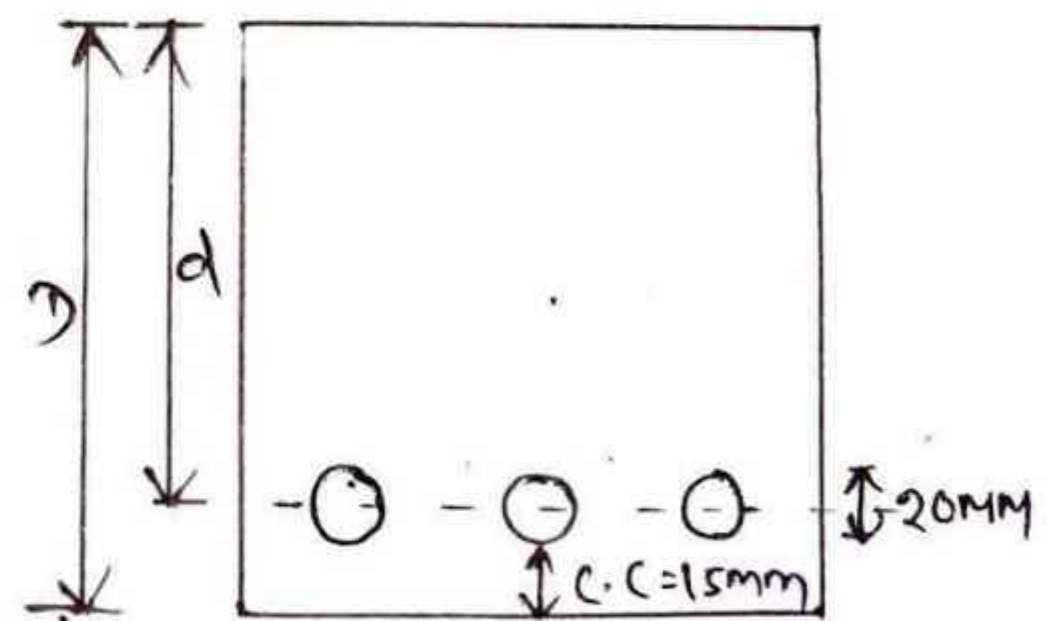
$$\Rightarrow 17 \times 2.38 = 40.46 \text{ m}$$

Total length of main bent up bar = No. of main bent up bar x length of one bent up bar

$$\Rightarrow 16 \times 2.55 = 40.8 \text{ m}$$

Total length of 20mm dia main bar = (40.46 + 40.8) m

$$\Rightarrow 81.26 \text{ m}$$



Weight of 20mm dia rod per meter length = $7850 \times \frac{\pi}{4} \times (0.02)^2$

$$\Rightarrow 2.466 \text{ kg}$$

$$\Rightarrow 2.47 \text{ kg}$$

So, total weight of main bar = 2.47×81.26

$$\Rightarrow 200.71 \text{ kg}$$

Calculation of reinforcement along long span (Distribution bar)

No. of spacing of 10mm dia bottom distribution bar @ 250mm

$$= \frac{\text{Short span}}{\text{Spacing of long span bar}}$$

$$\Rightarrow \frac{2.1}{0.25} = 8.4 \Rightarrow 8 \text{ NOS.}$$

So, No. of bar = $8 + 1 = 9 \text{ NOS.}$

Maximum no. of top distribution bar = 50% of bottom distribution bar

$$\Rightarrow \frac{50}{100} \times 9 = 4.5 \text{ NOS.}$$

So, Number of top distribution bar = 4 NO.

Length of 10mm dia distribution bar =

$4.8 - 2 \times \text{side cover} + 2 \times \text{hook length.}$

$$\Rightarrow 4.8 - (2 \times 0.04) + 2 \times (9 \times 0.01)$$

$$\Rightarrow 4.9 \text{ m}$$

Total length of bottom distribution bar = 4.9×9
= 44.1m

Total length of top distribution bar = 4.9×4
= 19.6m

Total length of 10mm dia distribution bar =

$$(44.1 + 19.6) \text{ m}$$

$$\Rightarrow 63.7 \text{ m}$$

Weight of 10mm dia rod per meter length = $7850 \times \frac{\pi}{4} \times (0.01)^2$
 $\Rightarrow 0.616 \text{ kg}$
 $\Rightarrow 0.62 \text{ kg}$

So, total weight of distribution bar
 $\Rightarrow 0.62 \times 63.7$
 $\Rightarrow 39.49 \text{ kg}$

2. The dimension of a RCC slab is (4m x 5m x 12cm) depth. Reinforcement of 12mm dia rods are placed in short span @ 15cm c/c of the total number of rods 16 numbers have been cranked and hooked at the ends. Other rods are straight and hooked at ends. The 12mm dia rods weights 0.89 kg/m. To hold the crank portion 4 numbers 10mm dia straight and hook rods have been used. The 10mm dia rods are placed in a direction of long span @ 20cm c/c and all are straight and hooked at ends. The 10mm dia rod weights 0.62 kg/m. The covers are 1.8cm at bottom and 2.5cm on all sides. Assume any other data if required. Estimate the total weight of steel required for reinforcement of the slab.

Ans \rightarrow Data given,

Short span (l_x) = 4m, Long span (l_y) = 5m

Overall depth (D) = 12cm = 0.12m

Centre to centre spacing betⁿ short span bars = 15cm

Dia of short span bar = 12mm

Number of cranked short span bar = 16 nos.

Weight/m length of 12mm dia bar = 0.89 kg

Dia of long span bar = 10mm

c/c spacing betⁿ long span bar = 20cm

Weight/m length of 10mm dia bar = 0.62 kg

Clear cover from bottom of slab = 1.8cm

Side cover = 2.5cm

Here, $\frac{L_y}{L_x} = \frac{5}{4} = 1.25 > 2$ (Two way slab).

So, main bars should be provided parallel to both long and short span.

Calculation of reinforcement along short span (12mm dia main bar)

Here,

c/c spacing betⁿ short span bars = 15 cm = 0.15 m

So, number of spacing =

$\frac{\text{Long span}}{\text{Spacing of short span bar}}$

$$\Rightarrow \frac{5}{0.15} = 33.33 = 33 \text{ NOS.}$$

Number of short span bar = 33 + 1 = 34 NOS.

" " 12mm dia cranked short span bar = 16 NOS.

Number of 12mm dia straight " " = 34 - 16 = 18 NOS.

Length of 12mm dia straight bar with end hooks =

$\Rightarrow 4 - 2 \times \text{side cover} + 2 \times \text{hook length}$

$$\Rightarrow 4 - (2 \times 0.025) + 2 \times (9 \times 0.012)$$

$$\Rightarrow 4.16 \text{ m.}$$

$d = 3 - \text{effective cover}$

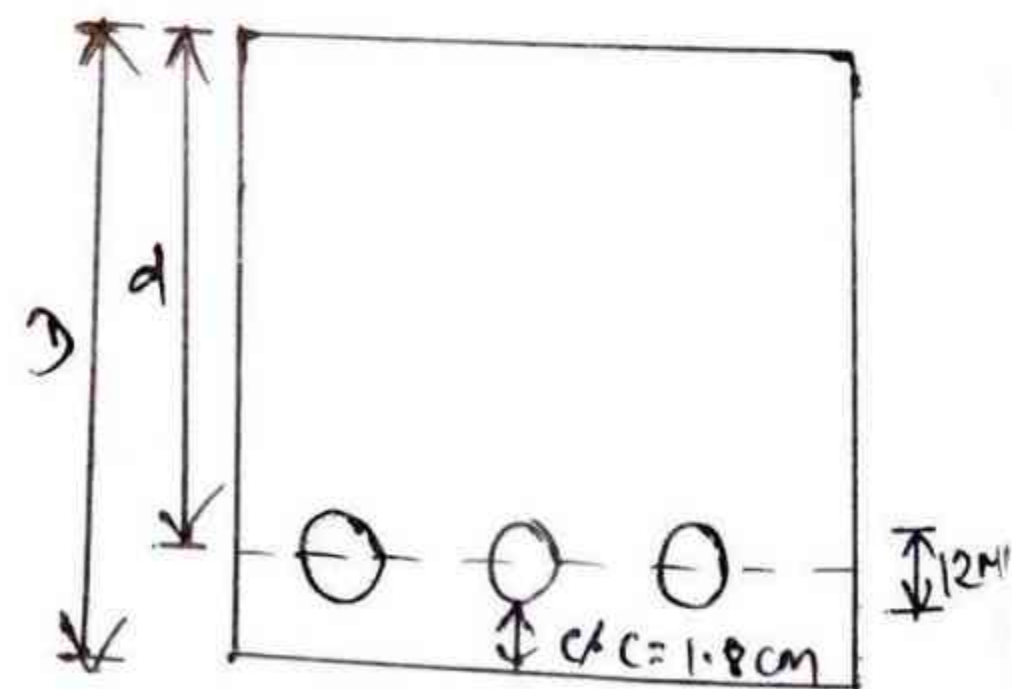
$$\Rightarrow \frac{120 - (18 + \frac{12}{2})}{1000} = 0.096 \text{ m.}$$

So, length of 12mm dia main bar cranked at both ends with hook at

ends = length of straight bar + $d/2$ for each bent up.

\Rightarrow Length of straight bar + $2 \times d/2$.

$$\Rightarrow \left(4.16 + 2 \times \frac{0.096}{2} \right) = 4.25 \text{ m}$$



$$\text{Total length of straight bar} = 18 \times 4.16 = 74.88 \text{ m.}$$

$$\text{" " " cranked bar} = 16 \times 4.256 = 68.096$$

$$\text{Total length of shortspan bar} = 74.88 + 68.096 = 142.976 \text{ m}$$

$$\text{Weight/m length of shortspan bar} = 0.89 \text{ kg.}$$

$$\text{So, total weight of short span bar} = 0.89 \times 142.976$$

$$\Rightarrow 127.248 \text{ kg.}$$

Calculation of reinforcement along long span (10mm dia main bar)

$$\text{Here, c/c spacing of long span bar} = 20 \text{ cm} = 0.2 \text{ m.}$$

$$\text{Number of spacing of } \underset{\text{bottom}}{\text{long span bar}} = \frac{\text{Short span}}{\text{Spacing of long span bar}}$$

$$\Rightarrow \frac{4}{0.2} = 20 \text{ m.}$$

$$\text{Number of bars} = 20 + 1 = 21 \text{ nos.}$$

$$\text{Number of top long span bar} = 4 \text{ nos.}$$

Length of 10mm dia long span bar = straight and hooked at ends

$$\Rightarrow 5 - 2 \times \text{side cover} + 2 \times \text{hook length.}$$

$$\Rightarrow 5 - (2 \times 0.025) + 2 \times (\alpha \times 0.010)$$

$$\Rightarrow 5.13 \text{ m.}$$

$$\text{Total length of bottom long span bar} \Rightarrow 21 \times 5.13$$

$$\Rightarrow 107.73 \text{ m}$$

$$\text{Total length of top long span bar} \Rightarrow 5.13 \times 4$$

$$\Rightarrow 20.52 \text{ m.}$$

$$\text{Total length of long span bar} = (107.73 + 20.52) \text{ m}$$

$$\Rightarrow 128.25 \text{ m.}$$

$$\text{Weight/m length of bar} = 0.62 \text{ kg.}$$

$$\text{So, total weight} = (0.62 \times 128.25)$$

$$\Rightarrow 79.51 \text{ kg.}$$

3) Calculate the quantity of reinforcement required for an R.C.C slab of size $(3.5\text{m} \times 5\text{m} \times 12\text{cm})$ thick. 8mm dia rods are placed in short span @ 20cm c/c with one side 45° crank with end hooks. Rods are placed in long span @ 25cm c/c with one side 45° crank with end hooks. 6 Numbers 8mm dia short span and 5 Numbers along long span top bars are provided. Clear cover = 25mm.

Ans → Data given,

Short span (L_x) = 3.5m, Long span (L_y) = 5m.

Overall depth (D) = 12cm.

c/c spacing betⁿ short span bar = 20cm.

Dia of short span bar = 8mm

c/c spacing betⁿ long span ^{bar} = 25cm

Dia of long span bar = 8mm

Here, $\frac{L_y}{L_x} = \frac{5}{3.5} = 1.42 < 2$ (one way slab)

Calculation of reinforcement along short span

No. of spacing of 8mm dia short span bar @ 20cm c/c crank at one end placed at bottom = $\frac{\text{Long span}}{\text{spacing of short span bar}}$

$$\Rightarrow \frac{5}{0.2} = 25\text{m.}$$

No. of 8mm dia short span bar @ 20cm c/c crank at one end placed at bottom = 25 + 1 = 26 Nos.

Length of straight bar = 3.5 - 2x side cover + 2x Hook length

$$\Rightarrow 3.5 - (2 \times 0.04) + 2 \times (9 \times 0.08)$$

$$\Rightarrow 3.56\text{m.}$$

$d = D - \text{Effective cover}$

$$= \frac{120 - \left(25 + \frac{8}{2}\right)}{1000} = 0.091\text{m.}$$

Length of bent up bar =
 = Length of straight bar + $d/2$

$$\Rightarrow 3.56 + \frac{0.091}{2} = 3.605 \text{ m}$$

Total length of \dots 8mm dia short span bar placed at top
 = $6 \times 3.56 = 21.36 \text{ m}$

Total length of cranked bar with end hooks
 = $25 \times 3.605 = 93.73 \text{ m}$

Total length of ^{8mm dia} short span bar = $(93.73 + 21.36) \text{ m}$
 = 115.09 m

Weight of 8mm dia rod per meter length =
 $7850 \times \frac{\pi}{4} \times (0.008)^2 \times 1$

$$\Rightarrow 0.394 \text{ kg}$$

So, total weight of ^{8mm dia short span} bar = 0.394×115.09

$$\Rightarrow 45.412 \text{ kg}$$

Calculation of reinforcement along long span :-

No. of spacing of 8mm dia long span bar @ 25cm c/c ~~crank~~
 placed at bottom = $\frac{\text{short span}}{\text{spacing of long span bar}}$

$$\Rightarrow \frac{3.5}{0.25} = 14 \text{ m}$$

Number of ^{long span} bars = $14 + 1 = 15 \text{ nos.}$

Number of top long span bar = 6 nos.

Length of 8mm dia ^{long span bar} straight and hooked at end =

$$= 5 - 2 \times \text{side cover} + 2 \times \text{hook length}$$

$$= 5 - (2 \times 0.04) + 2 \times (9 \times 0.008) = 5.064 \text{ m}$$

$$d = 0.091 \text{ m}$$

~~Total length of bottom bar~~

~~$$= 15 \times 5.064 = 75.96 \text{ m}$$~~

~~Total length of top bar~~

~~$$= 6 \times 5.064 = 30.384 \text{ m}$$~~

length of 8mm dia long span bar cranked at 45° at one end with end hooks = length of straight bar + $\frac{d}{2}$

$$> 5.064 + \frac{0.091}{2}$$

$$\Rightarrow 5.109 \text{ m}$$

Total length of 8mm dia long span bar placed at bottom

$$= 15 \times 5.109$$

$$\Rightarrow 76.635 \text{ m}$$

Total length of 8mm dia long span bar placed at top

$$= 6 \times 5.064$$

$$\Rightarrow 30.384 \text{ m}$$

Total length of long span bar = $(76.635 + 30.384) \text{ m}$

$$\Rightarrow 107.019 \text{ m}$$

weight per meter length of 8mm dia bar = 0.394 kg.

$$\text{So, total weight} = 0.394 \times 107.019$$

$$\Rightarrow 42.165 \text{ kg}$$

So, total quantity of reinforcement required

\Rightarrow quantity of short span bar + quantity of long span bar.

$$\Rightarrow (45.412 + 42.165) \text{ kg}$$

$$\Rightarrow 87.57 \text{ kg}$$

TABULATION FORM:-

Question NO-1

I.N	Particulars of Item	NO	Length	Breadth	Height	Quantity	Remarks
1)	Calculation of reinforcement short span (Main bar) No. of spacing of straight bar of 20mm @ 30cm c/c = $\frac{4.8}{0.3}$	16		1			
	a) 20mm dia short span bar @ 30cm c/c straight and hooked at ends placed at bottom	17	2.38	↪		40.46	$N = \text{NO. OF spacing} + 1$ $= 16 + 1 = 17 \text{ NOS.}$ $L = 2.1 - (2 \times 0.04) + 2 \times (9 \times 0.02)$ $\Rightarrow 2.38 \text{ m}$
	b) 20mm dia short span bar @ 30cm c/c crank and hooked at end	16	2.55	↪		40.8	$L = \text{Length of straight bar} + d/2 \text{ (for each bent up)}$ $d = 200 - \left(15 + \frac{20}{2}\right)$ $\frac{\quad}{1000}$ $\Rightarrow 0.175 \text{ m}$ $L = 2.38 + 0.175 = 2.555 \text{ m}$
					Total	81.26M @ 2.47 kg/m = 200.71 kg	
2)	Calculation of reinforcement along long span. (Distribution bar)	9	4.9	↪		44.1	$N = 2.1 / 0.25 + 1$ $L = 4.8 - (2 \times 0.04) + 2 \times (9 \times 0.01)$ $= 4.9 \text{ m}$
	a) 10mm dia distribution bar @ 25cm c/c straight and hooked at end placed at bottom	4	4.9	↪		19.6	Minimum NO = 50% total NO. OF bottom bars.
	b) 10mm dia distribution bar all are straight and hooked at end						

Placed at top.

•

Total 63.7 m

@ 0.62 kg/m³

= 39.49 kg.

S.N	Particulars of Item	NO	Length	Breadth	Height	Quantity	Explanation
1)	<p>Calculation of reinforcement along short span. (Main bar)</p> <p>12mm dia short span bar @ 15cm c/c placed at bottom</p> $NO = \frac{5}{0.15} + 1 = 34.33 \approx 34 \text{ NOS.}$ <p>a) 12mm dia short span bar all are straight and hooked at end. placed at bottom.</p> <p>b) 12mm dia short span bar all are crank and hooked at the end placed at bottom</p>	34				74.88	<p>NO = 34 - 16 = 18</p> $L = 4 - (2 \times 0.025) + 2 \times (9 \times 0.012)$ <p>→ 4.16m</p> <p>L = length of straight bar + 2 x d/2 for each bent up</p> $\rightarrow (4.16 - 2 \times \frac{0.012}{2}) = 4.256m$ $d = \frac{120 - (18 + \frac{12}{2})}{1000} = 0.096m$
2)	<p>Calculation of reinforcement along long span. (Main bar)</p> <p>a) 10mm dia long span bar @ 20cm c/c all are straight and hooked placed at bottom.</p> <p>b) 10mm dia long span bar all are straight and hooked at end placed at top</p>	21	5.13			109.73	<p>NO = $\frac{4}{0.2} + 1 = 21 \text{ NOS.}$</p> $L = 5 - (2 \times 0.025) + 2 \times (9 \times 0.010)$ <p>→ 5.13m</p>
						<p>Total: 172.97</p> <p>@ 0.89 kg/m</p> <p>→ 127.24 kg</p>	
						<p>Total: 128.25 kg</p> <p>@ 0.62 kg/m</p> <p>→ 79.51 kg.</p>	

ESTIMATION OF IRRIGATION STRUCTURE

No	Particulars of Item	No	Length	Breadth	Height	Quantity	Explanatory Note
1)	Earth work in excavation						
	a) crest wall including inner to inner of 60cm side wall	1	2.65	6	1.15	18.28	$H = 0.6 + 0.1 + 0.45 = 1.15$ $B = 4.5 + 0.6 + 0.15 + 0.6 + 0.15 = 6$
	b) outer to outer of 50cm side wall	1	2.1	5.8	1.05	12.98	$H = 0.6 + 0.1 + 0.35 = 1.05$ $B = 4.5 + 0.5 + 0.15 + 0.5 + 0.15 = 5.8$
	c) outer to outer of 40cm side wall	1	1.5	5.6	0.95	7.98	$H = 0.6 + 0.1 + 0.25 = 0.95$ $B = 4.5 + 0.4 + 0.15 + 0.4 + 0.15 = 5.6$
	d) wing wall	2	1.8	0.7	1	2.52	$H = 0.6 + 0.1 + 0.3 = 1$
	e) curtain wall	1	4.5	0.6	1.2	3.24	$H = 0.6 + 0.1 + 0.25 + 0.05 + 0.2 = 1.2$
	f) Toe wall	2	3.9	0.2	0.3		$L = 4.2 - 0.3 = 3.9$
	g) trapezoidal portion between toe walls along the downstream side	1	3.9			6.98	$L = 4.2 - 0.3 = 3.9$ $B = \frac{4.5 + 3.6}{2} = 4.05$ $d = \frac{0.6 + 1}{2} = 0.8$
	h) upstream brick pitching						
	→ Bed	1	1.8	3.6	0.2		
	→ side slope	2	1.8	1.62	0.2		$B = d\sqrt{s^2 + 1} = 0.9\sqrt{(1.5)^2 + 1} = 1.62$
	i) Down stream brick pitching						
	→ Bed	1	3.9	3.65	0.2		$L = 4.2 - 0.3$ $B = \frac{3.2 - 4.1}{2} = 3.65$
	→ side slope	2	3.1	1.62	0.2		$L = \frac{4.2 + 2}{2} = 3.1$ $B = d\sqrt{s^2 + 1} = 1.622$
	j) circular portion of brick pitching	2	$\frac{\pi}{4} \times (0.6)^2 \times 0.2 = 0.22$			0.44	

2)
m
nt
p
6m
m.

I.N	Particulars of Item	No	Length	Breadth	Height	Quantity	Explanatory Note
	→ Deduction for rectangular portion behind crest wall	2	0.1	0.6	1.15		
2)	Cement concrete in foundation						
	a) crest wall including inner to inner of 60cm side wall	1	2.65	6	0.45		
	b) Outer to outer of 50cm side wall	1	2.1	5.8	0.35		
	c) Outer to outer of 40cm side wall	1	1.5	5.6	0.25		
	d) wing wall	2	1.8	0.7	0.2		
	e) curtain wall	1	4.5	0.6	0.2		
	→ Deduction for rectangular portion behind crest wall	2	0.1	0.6	0.45		
3)	Brick work in foundation & superstructure						
	a) crest wall						
	i) 1st footing	1	4.5	0.7	0.4		
	ii) 2nd footing	1	4.5	0.6	0.6		
	b) i) 1st side wall						
	→ 1st footing	2	2.35	0.6	0.4		$L = 1.95 + 0.4 = 2.35$
	→ 2nd footing	2	2.35	0.5	0.5		
	→ 3rd footing	2	2.35	0.4	0.5		
	→ 4th footing	2	2.35	0.3	0.7		

c) 2nd side wall

→ 1st footing

2 2.1 0.5 0.4

→ 2nd footing

2 2.1 0.4 0.5

→ 3rd footing

2 2.1 0.3 0.9

d) 3rd side wall

→ 1st footing

2 1.5 0.4 0.9

→ 2nd footing

2 1.5 0.3 0.6

e) wing wall

i) 1st footing

→ 1st 40cm height

2 1.8 0.4 0.4

above concrete

→ 2nd 50cm height

2 1.9 0.4 0.5

→ 3rd 50cm height

2 2 0.4 0.5

ii) 2nd footing

2 2.1 0.3 0.9

f) curtain wall

1 4.5 0.3 0.4

4) plastering and painting wall

a) creast wall

(inner, top and other)

1 4.5 - 1.8

b) inner side of 1st side wall

2 1.8 - 2

c) inner side of 2nd side wall

2 2.1 - 1.7

d) inner side of 3rd side wall

2 1.5 - 1.4

e) top of 1st side wall

2 2.35 0.3

f) top of 2nd side wall

2 2.1 0.3

$$L = 1.8 + 0.15 - 0.15 = 1.8m$$

$$L = 1.8 + 0.1 = 1.9m$$

$$L = 1.9 + 0.1 = 2m$$

$$L = 2 + 0.1 = 2.1m$$

$$H = 0.1 + 0.25 + 0.05 = 0.4m$$

$$H = 0.6 + 0.3 + 0.6 + 0.3 = 1.8m$$

$$L = 1.95 - 0.15 = 1.8m$$

$$H = 0.9 + 0.6 + 0.5 = 2m$$

$$H = 0.4 + 0.5 + 0.9 + 0.1 = 1.7m$$

$$H = 0.9 + 0.6 - 0.1 = 1.4m$$

$$L = 1.95 + 0.4 = 2.35m$$

3) Top of 3rd side wall	2	1.5	0.3	
4) Top of wing wall	2	2.1	0.3	
i) vertical side of 1st side wall	2	-	0.3	0.3
ii) vertical side of 2nd side wall	2	-	0.3	0.3
iii) vertical side of 3rd side wall				
→ 1st footing	2		0.4	0.9
→ 2nd footing side	2		0.3	0.6
→ wall portion above crest wall	2		0.6	1.1
4) Wing wall triangular portion above slope upstream side.	2	$\frac{\pi}{4} \times 1.4 \times 2.1$		
5) 10 cm brick on edge in 1:4 c.m.	1	5.4	4.5	-
6) 20 cm dry brick pitching				
a) upstream				
i) Bed.	1	1.8	3.6	
ii) side slope	2	1.8	1.62	
b) down stream				
i) Bed	1	3.9	3.63	
ii) side slope	2	3.1	1.62	
c) circular portion of brick pitching	2	$\frac{\pi}{4} \times (0.6)^2 \times 2$		

$H = 2.1 - 1.8 = 0.3$
 2.1 - Height of 1st side
 1.8 - " " 2nd "

$H = 2.1 - 1 = 1.1 \text{ m}$

$(0.9 + 0.6 + 0.3 + 0.1) = 2.1$
 $\frac{V}{H} = \frac{1.5}{1}$
 $\Rightarrow \frac{2.1}{H} = \frac{1.5}{1} \Rightarrow H = \frac{2.1}{1.5} = 1.4$

When the bed levels of the irrigation channel and the nala or stream are not the same, sometime it is required to lower the bed of the irrigation channel or the nala or stream at their crossing. When the bed of the irrigation channel is depressed and taken under the nala or stream it is known as Irrigation Syphon. When the bed of the nala or stream is depressed and taken under the irrigation channel it is known as Drainage Syphon. The Syphon crossing may be of rectangular closed masonry channel or of circular brickwork or of R.C.C. or Hume pipe of the required diameter and number. Approach and exit may be through masonry drop pit or of masonry sloped channel. The down stream end is kept lower than the up stream end by at least 15 cm for better flow. An estimate of a small Drainage Syphon has been given in Example 7.

DRAINAGE SYPHON ACROSS A MINOR

Example 7. — Prepare a detailed estimate of a Drainage Syphon across a minor from the given drawing, Figs. 9-8 and 9-9.

Foundation concrete shall be of 1 : 4 : 8 cement concrete with brick ballast. All brickwork shall be of 1 : 4 cement mortar. Exposed surfaces of brickwork shall be struck pointed with 1 : 2 cement mortar. Brick pitching shall be of dry brick with straight over burnt bricks.

Assume suitable rates for the different items of work.

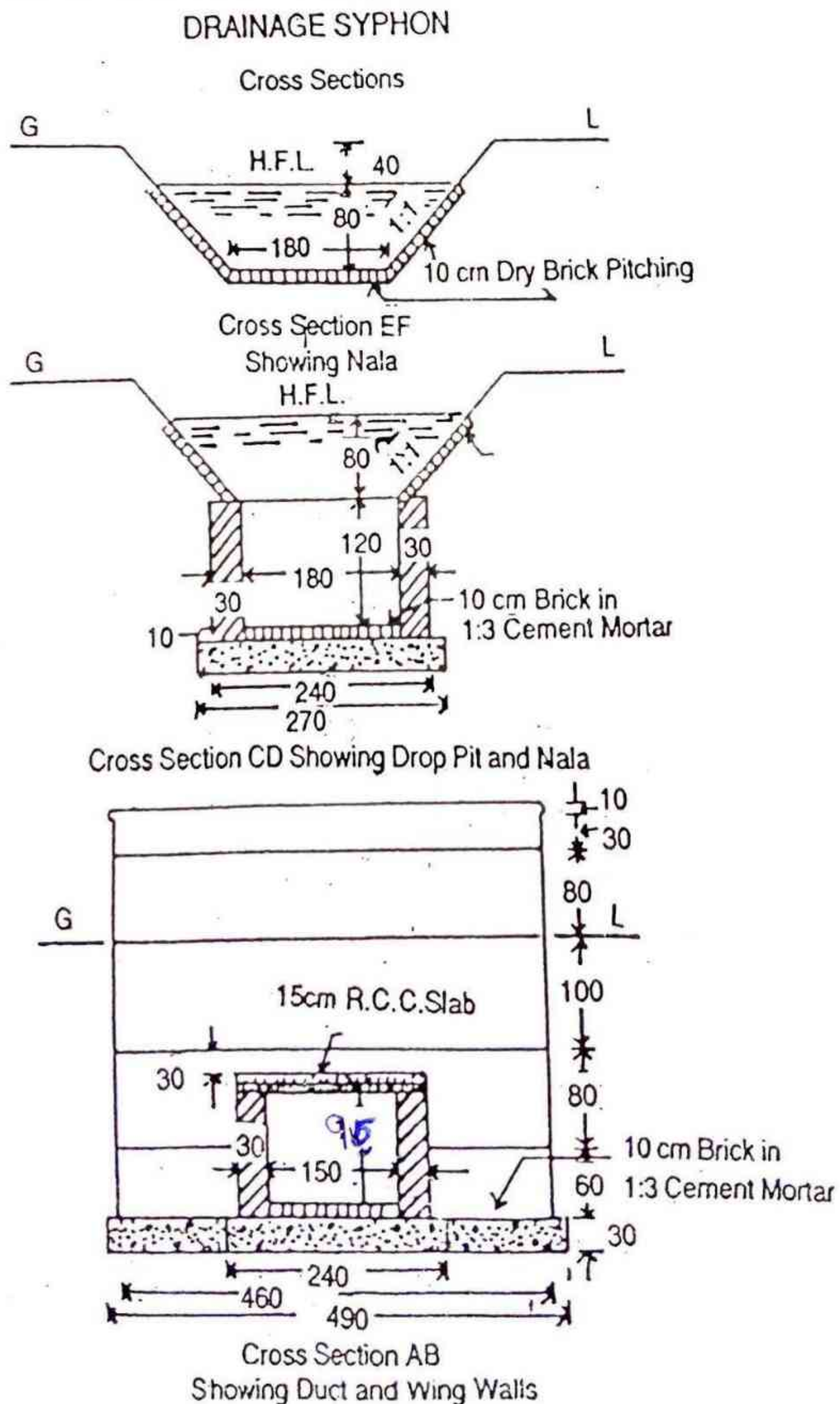


Fig. 9-8

S.No	Description of item	No	L	B	H	Qty.	Explanatory Note
1. Earth work in excavation							$L = 9.2 + 2 \times 0.15 = 9.5$ $B = 1.5 + 2 \times (0.3 + 0.15) = 2.1$ $H = 1.2 + 0.1 + 0.3$
	a) Syphon duct.	1	9.5	2.4	1.6		
	b) drop pit	2	2.1	2.7	1.6		$L = 2.25 - 0.15 = 2.1$
	c) wing wall	4	1.25	1	1.6		$L = 1.1 + 0.15$
2. Cement concrete in foundation.							
	a) syphon duct	1	9.5	2.4	0.3		
	b) drop pit	2	2.1	2.7	0.3		
	c) wing wall	4	1.25	1	0.3		
3. Brick work in foundation and superstructure.							
	a) syphon duct side wall	2	9.2	0.3	1.05		$H = 0.95 + 0.1 = 1.05$
	b) drop pit						
	i) side wall	2x2	2.1	0.3	1.3		$L = 1.8 + 0.3 = 2.1$
	ii) front wall	2	1.8	0.3	1.3		$H = 1.2 + 0.1 = 1.3$
	c) wing wall						
	e) 1st footing	4	1.25	0.7	0.6		$L = 1.1 + 0.15 = 1.25$
	ii) 2nd footing	4	1.25	0.6	0.6		$H = 0.8 - 0.2 = 0.6$
	d) parapet						
	i) 1st footing	2	4.6	0.6	0.2		
	ii) 2nd footing	2	4.6	0.5	1		
	iii) 3rd footing	2	4.6	0.4	0.8		$H = 0.6 + 0.2 = 0.8$
	iv) 4th footing	2	4.6	0.3	0.3		
	e) coping	2	4.7	0.35	0.1		$L = 4.6 + 0.05 + 0.05 = 4.7$

5
2.4

4. R.C.C slab	1	9.2	2.1	0.15	2.89	$B = 1.5 + 0.3 + 0.3 = 2.1M$
5. 10 cm brick in 1:3 cement mortar over bed slab.						
a) In between syphon duct side wall	1	9.2	1.5	-	13.9	
b) In between drop pit.	2	1.8	1.8	-	6.48	
6. plastering and pointing work.						
a) inner side of syphon duct side wall	2	9.2	-	0.95	17.48	
b) vertical side of drop pit.	2	5.4	-	1.2	12.96	$L = 1.8 \times 3 = 5.4M$
c) Top of drop pit						
i) top of side wall	2x2	2.1	0.3	-	2.52	$L = 1.8 + 0.3 = 2.1M$
ii) top of front wall	2	1.8	0.3	-	1.08	
d) parapet inner side	2	4.6	-	0.6	5.52	$H = 0.2 + 0.1 + 0.3 = 0.6$
e) coping (top, bottom, inner, outer).	2	4.7	0.6	-	5.64	$B = 0.1 + 0.35 + 0.1 + 0.05 = 0.6$
f) parapet outer side upto G.L.	2	4.6	-	1.1	10.12	$H = 0.6 + 0.2 + 0.3 = 1.1$
g) sides of parapet and coping						
i) 1st footing	4		0.6	0.2		
ii) 2nd footing	2		0.5	1		
iii) 3rd footing	1		0.4	0.8		

ii) with footing	2		0.3	0.3	
v) coping	2		0.35	0.1	
ii) Trapezoidal portion of Parapet outside below ground level.	2	$\frac{1}{2} \times (1.8 + 1.2)$		1.2	
f. 10 cm dry brick Pitching					
a) bed	2	3	1.8	-	
b) side slope	4	3	1.13	-	

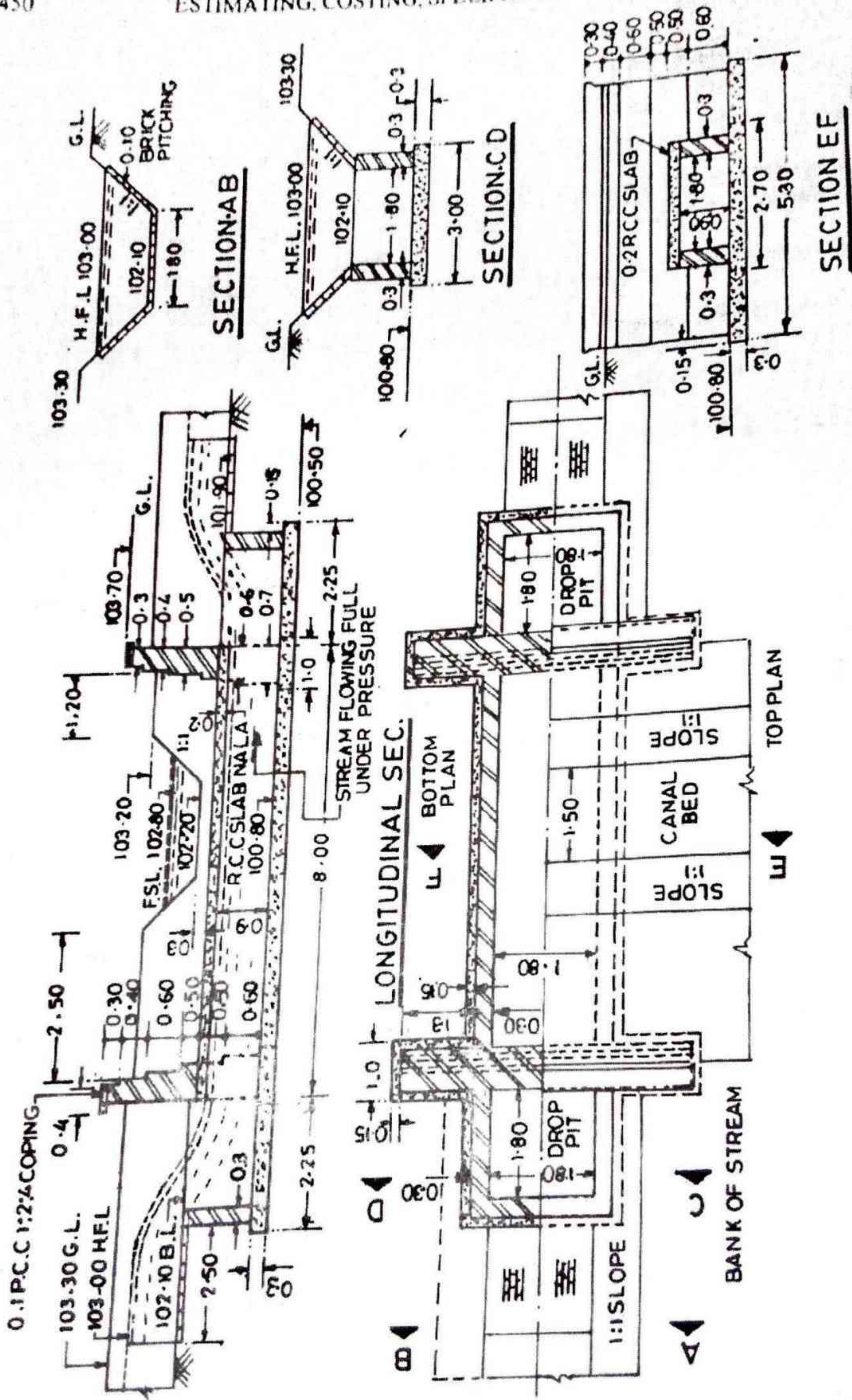
TOP width = $1.2 + 1.8 + 1.2$

$$\textcircled{1} = \text{0.8}$$

$$S = 1$$

$$B = \textcircled{1} \sqrt{S^2 + 1}$$

$$= 0.8 \sqrt{1^2 + 1} = 1.13$$



ALL DIMENSIONS ARE IN METRES

FIG. 11-9

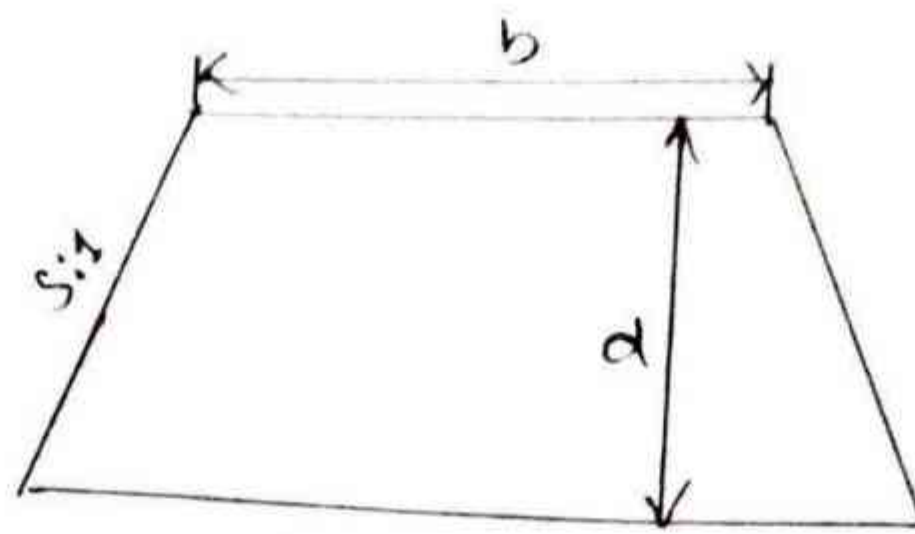
11-9

S.N	Description of item	NO	L	B	H	Qty.	Explanatory Note
1.	Earthwork in excavation						
	a- syphon duct	1	8	2.7	1.6	34.56	$B = 1.8 + 2 \times (0.3 + 0.15)$
	b- Drop pit						
	i) upstream	1	2.25	2.7	1.6	9.72	$H = 102.10 - 100.50 = 1.6$
	ii) downstream	1	2.25	2.7	1.4	8.50	$H = 101.90 - 100.5 = 1.4$
	c- wing wall	4	1.3	1	1.6	8.32	
2.	Cement concrete in foundation						
	a- syphon duct	1	8	2.7	0.3	6.48	
	b- Drop pit						
	i) upstream	1	2.25	2.7	0.3	1.82	
	ii) downstream	1	2.25	2.7	0.3	1.82	
	c- wing wall	4	1.3	1	0.3	1.56	
3.	Brick work in foundation & super structure						
	a- syphon duct side wall	2	8	0.3	0.9		
	b- Drop pit (upstream)						
	i) side wall	2	2.1	0.3	1.3		$H = 102.10 - 100.80 = 1.3$
	ii) front wall	1	1.8	0.3	1.3		$L = 1.8 + 0.3 = 2.1$
	c- Drop pit (downstream)						
	i) side wall	2	2.1	0.3	1.3		$H = 101.90 - 100.80 = 1.1$
	ii) front wall	1	1.8	0.3	1.3		
	d. wing wall						
	i) 1st footing	4	1.3	0.7	0.6		
	ii) 2nd footing	4	1.3	0.6	0.5		
	e. parapet						
	i) 1st footing	2	5	0.5	0.5		

2.2

ii) 2nd footing	2	5	0.5	0.5	
iii) 3rd footing	2	5	0.4	0.4	
iv) 4th footing	2	5	0.3	0.2	
4. R.C.C work in slab	1	8	2.4	0.2	$B = 1.8 + 0.3 + 0.3$
5. plastering and painting wall					
a) inner side of syphon duct side wall	2	8		0.9	
b) vertical side of drop pit (upstream)	1	5.4		1.3	$L = 1.8 \times 3 = 5.4$ $H = 102.10 - 100.80 = 1.3$
c) top of drop pit					
→ top of side	2x2	2.1	0.3	-	$L = 1.8 + 0.3 = 2.1$
→ top of front wall	2	1.8	0.3	-	
d) inner side of parapet					
e) coping (top, inner, bottom, outer)					
f) outside of parapet upto G.L					
g) sides					
c) vertical side of drop pit (downstream)	1	5.4	-	1.1	$L = 1.8 \times 3 = 5.4$ $H = 101.90 - 100.80 = 1.1$

CHAPTER-3
ROAD ESTIMATE



(Cross-section of road).

$$S:1 = H:V$$

b = formation width of road.

d = depth of road.

$$\text{Volume} = V = (b \cdot d + s d^2) \times L$$

L = length of road.

If a road has longitudinal slope then the volume of road is calculated by using the following three methods:

- i) mid sectional area.
- ii) mean sectional area.
- iii) prismoidal sectional area.

Mid sectional area:-

Let, d_1 & d_2 is the depth of road at its two ends.

$$\text{Here the mid depth} = d_m = \frac{d_1 + d_2}{2}$$

$$\text{So Volume (V)} = (b d_m + s \cdot d_m^2) \times L$$

Mean sectional area:-

Let, d_1 & d_2 is the depth of road at its two ends.

$$\text{Here, } A_1 = b d_1 + s \cdot d_1^2$$

$$A_2 = b d_2 + s \cdot d_2^2$$

$$\text{Mean area} = (a_m) = \frac{a_1 + a_2}{2}$$

$$\text{Volume (V)} = \text{Area} \times \text{Length}$$

Prismoidal sectional Area:

Let, d_1 & d_2 is the depth of road at its two ends

$$\text{Here, } A_1 = b d_1 + s \cdot d_1^2$$

$$A_2 = b d_2 + s \cdot d_2^2$$

$$A_m = b d_m + s \cdot d_m^2$$

$$d_m = \frac{d_1 + d_2}{2}, \quad \text{Volume (V)} = \frac{L}{6} \{ A_1 + A_2 + 4 \cdot A_m \}$$

Area of side slope:

$$\text{Area of side slopes} = 2 \times L \times d \times (\sqrt{s^2 + 1})$$

- 1) Calculate the quantity of earthwork for a 200m length for a portion of road in an uniform ground, the height of Banks at the two ends being 1m & 1.6m. Formation width is 10m. side slope is 2:1. Assume there is no transverse load.

Ans → Data given

$$\text{Length of road (L)} = 200\text{m}$$

$$\text{Depth of road at one end (d}_1\text{)} = 1\text{m}$$

$$\text{Depth " " " other end (d}_2\text{)} = 1.6\text{m}$$

$$\text{Formation width (b)} = 10\text{m}$$

$$\text{side slope (s:1)} = 2:1 \Rightarrow s = 2$$

Method-1 (Mid sectional area method)

$$\text{Mid depth (d}_m\text{)} = \frac{d_1 + d_2}{2} = \frac{1 + 1.6}{2} = 1.3\text{m}$$

$$\begin{aligned} \text{Mid area (A}_m\text{)} &= (b d_m + s \cdot d_m^2) \\ &= [(10 \times 1.3) + (2 \times (1.3)^2)] \\ &= 16.38\text{m}^2 \end{aligned}$$

$$\text{Volume} = \text{mid area} \times L$$

$$\Rightarrow 16.38 \times 200 = 3276 \text{ m}^3$$

Method-II (Mean sectional area)

$$A_1 = b d_1 + s \cdot d_1^2 = [(10 \times 1) + (2 \times (1)^2)] = 12 \text{ m}^2$$

$$A_2 = b d_2 + s \cdot d_2^2 = [(10 \times 1.6) + (2 \times (1.6)^2)] = 21.12 \text{ m}^2$$

$$\text{Mean area (a}_m) = \frac{A_1 + A_2}{2} = \frac{12 + 21.12}{2} = 16.56 \text{ m}^2$$

$$\text{Volume (V)} = A_{\text{mean}} \times L = 16.56 \times 200 = 3312 \text{ m}^3$$

Method-III (Prismoidal sectional area)

$$A_1 = b d_1 + s \cdot d_1^2 = [(10 \times 1) + (2 \times (1)^2)] = 12 \text{ m}^2$$

$$A_2 = b d_2 + s \cdot d_2^2 = [(10 \times 1.6) + (2 \times (1.6)^2)] = 21.12 \text{ m}^2$$

$$A_m = b d_m + s \cdot d_m^2 \\ = [(10 \times 1.3) + (2 \times (1.3)^2)] = 16.38 \text{ m}^2$$

$$d_m = \frac{d_1 + d_2}{2} = \frac{1 + 1.6}{2} = 1.3 \text{ m}$$

$$\text{Volume (V)} = \frac{L}{6} \{ A_1 + A_2 + 4 \cdot A_m \}$$

$$= \frac{200}{6} \{ (12 + 21.12 + 4 \times (16.38)) \} = 3288 \text{ m}^3$$

- 3) Calculate the area of side slopes of portion of bank for a length of 200m. The heights of banks at the two ends being 2.5m & 3.5m. The ratio for side slopes is 2:1. If the side slopes are to be provided with 15cm thick stone pitching, calculate the cost of pitching @ 150 per cum.

Ans → Data given,

Length of road (L) = 200m.

Depth of road at one end (d₁) = 2.5m

" " " " other end (d₂) = 3.5m.

$$d_m = \frac{d_1 + d_2}{2} = \frac{2.5 + 3.5}{2} = 3m$$

Area of side slope = $2 \times L \times d (\sqrt{s^2 + 1})$

$$\Rightarrow 2 \times 200 \times 3 (\sqrt{2^2 + 1})$$

$$\Rightarrow 2683.28 \text{ m}^2$$

Volume (V) = Area × thickness

→ thickness of stone pitching

$$= 15 \text{ cm} = 0.15 \text{ m}$$

$$\Rightarrow 2683.28 \times 0.15$$

$$\Rightarrow 402.492 \text{ m}^3$$

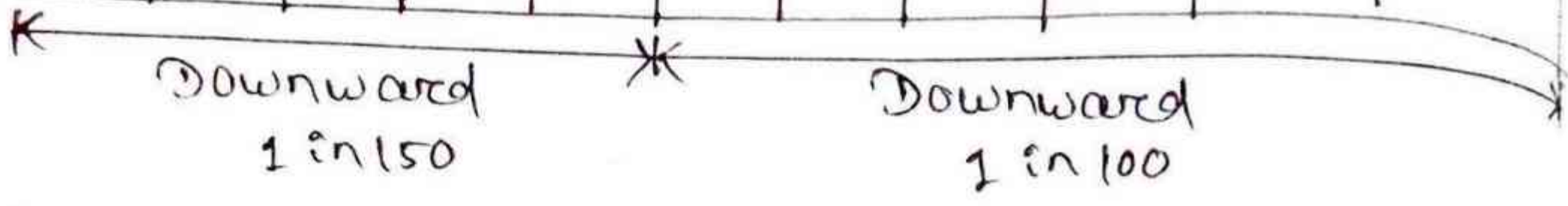
∴ volume of stone pitching = 402.492 m³

Cost of stone pitching @ ~~402.492 m³~~ @ 150 per cu.m =

$$402.492 \times 150 = \text{Rs } 60373.8$$

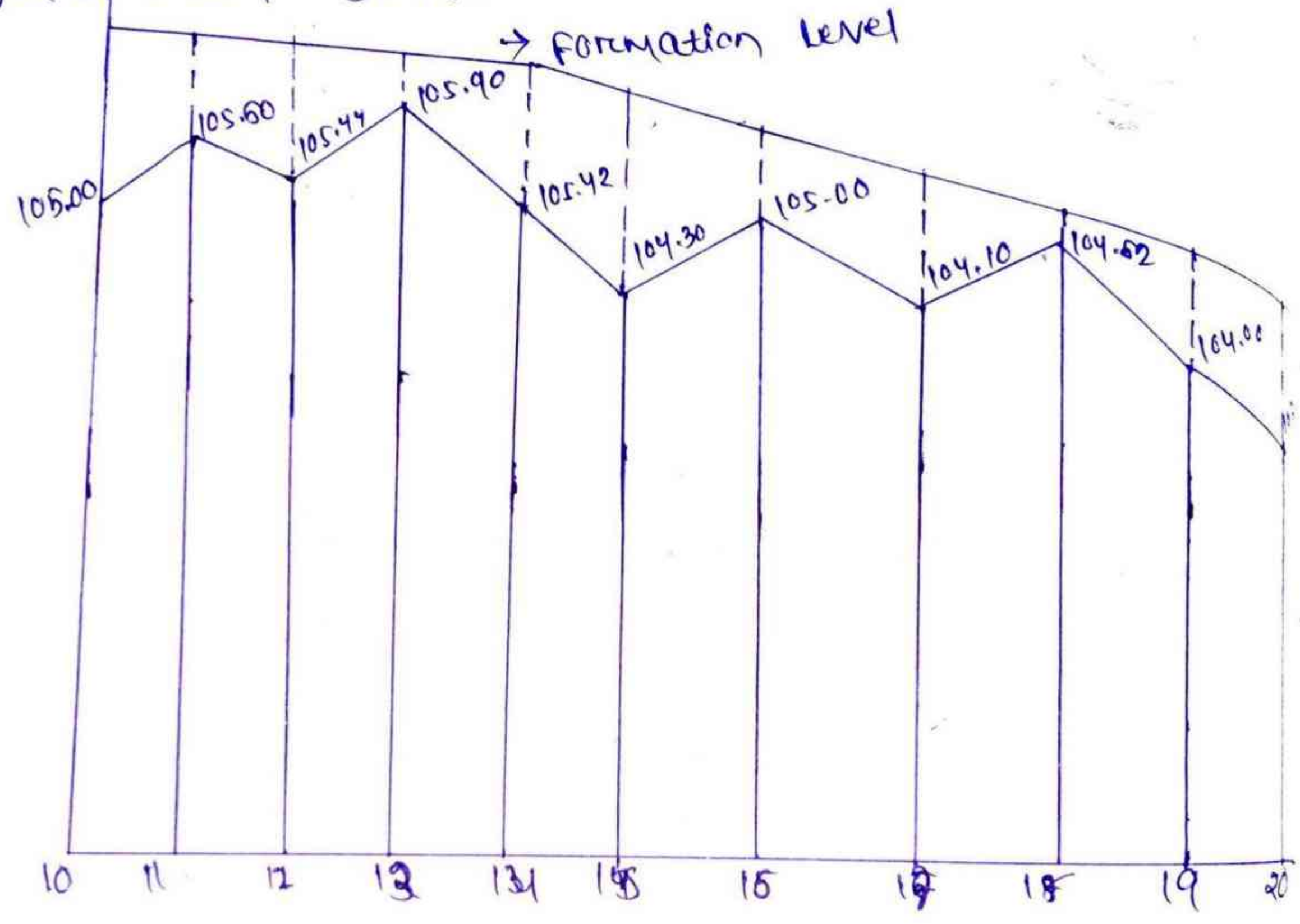
3) The reduce level (RL) of ground along the centerline of a proposed road from chainage 10 to chainage 20 are given below. The formation level at the 10 chainage is 107 and the road is ⁱⁿ downward gradient of 1 in 150 upto chainage 14 and then the gradient changes to 1 in 100 gradient. Formation width is 10m. The side slopes are 2:1 (Horizontal: vertical). Draw a typical cross-section and longitudinal section of road also calculate the quantity of earth work and cost of earthwork @ 275 per percentage cu.m. Length of chain is 30m.

Chainage	10	11	12	13	14	15	16	17	18	19	20
R.L of ground	105.00	105.60	105.44	105.90	105.42	104.30	105.00	104.10	104.62	104.00	103.3
R.L of Formation	107.00										



Ans →

Length of chain = 30 m.



Depth of cutting											
Depth of Banking	2	1.2	1.16	0.5	0.75	1.6	0.6	1.2	0.38	0.7	1.1
R.L of Formation	107	106.8	106.6	106.4	106.2	105.9	105.6	105.3	105.00	104.7	104.4
R.L of Ground	105.00	105.60	105.44	105.90	105.42	104.30	105.00	104.10	104.62	104.00	103.3
Distance	300	330	360	390	420	450	480	510	540	570	600
chainage →	10	11	12	13	14	15	16	17	18	19	20

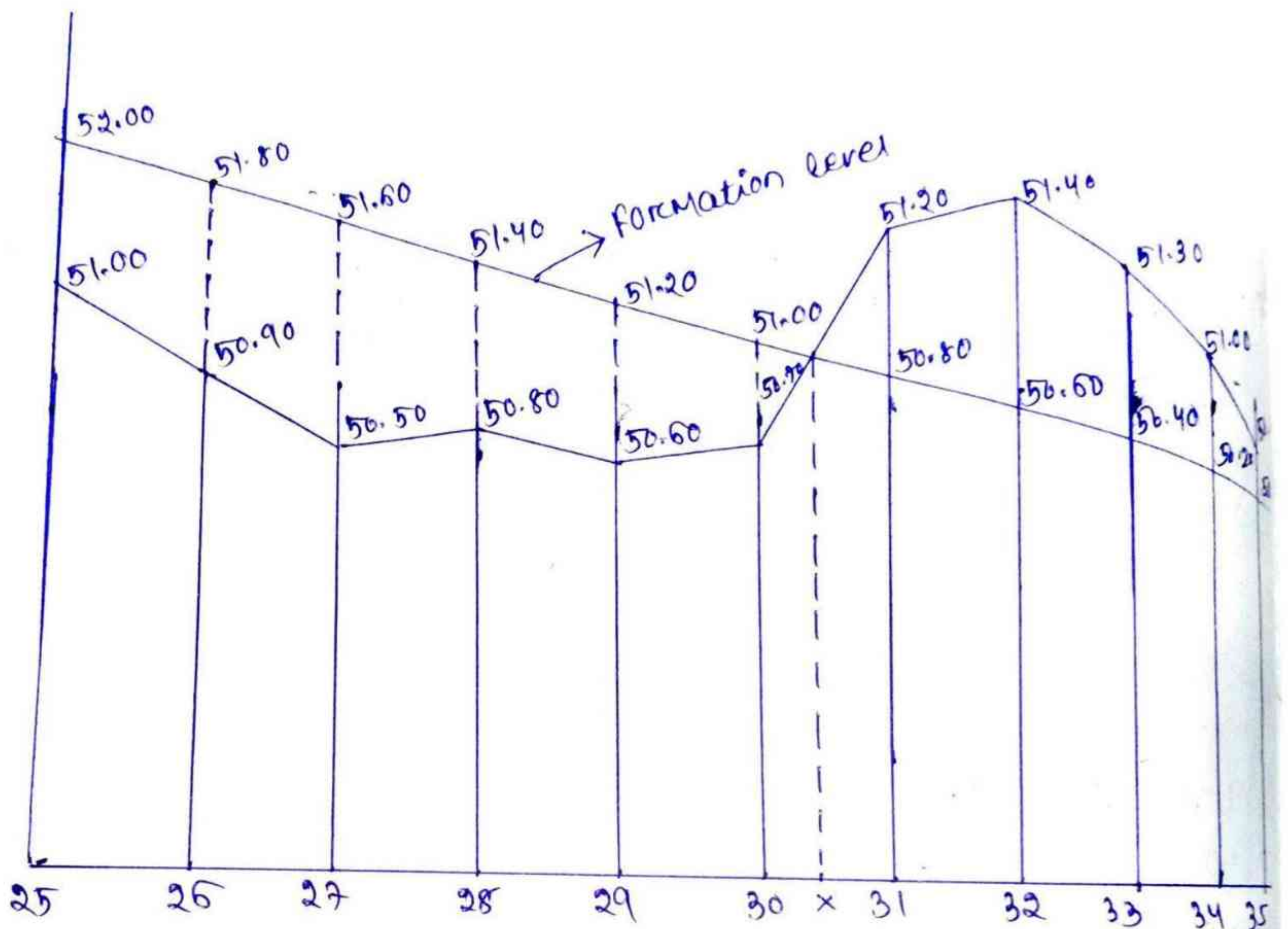
Station	Chainage	Distance	Length	(d) depth of cutting on banking	Mid depth (d _m)	Central area b.d.m	Side area s.d.m ²	Total area cut + s.d.m ²	Volume Cutting	Volume s.d.m ² x L Banking
P ₁	10	300	—	2.0	—	—	—	—	—	—
P ₂	11	330	30	1.2	1.6	16	5.12	21.12		633.6
P ₃	12	360	30	1.16	1.18	11.8	2.78	14.58		437.4
P ₄	13	390	30	0.5	0.83	8.3	1.37	9.67		290.1
P ₅	14	420	30	0.78	0.64	6.4	0.81	7.21		216.3
P ₆	15	450	30	1.6	1.19	11.9	2.83	14.72		441.6
P ₇	16	480	30	0.6	1.1	11	2.42	13.42		402.6
P ₈	17	510	30	1.2	0.9	9	1.62	10.62		318.6
P ₉	18	540	30	0.38	0.79	7.9	1.24	9.14		274.2
P ₁₀	19	570	30	0.7	0.54	5.4	0.58	5.98		179.4
P ₁₁	20	600	30	1.1	0.9	9	1.62	10.62		318.6

Total = 3512.4

Total cost of earthwork @ 275% C.U.M =

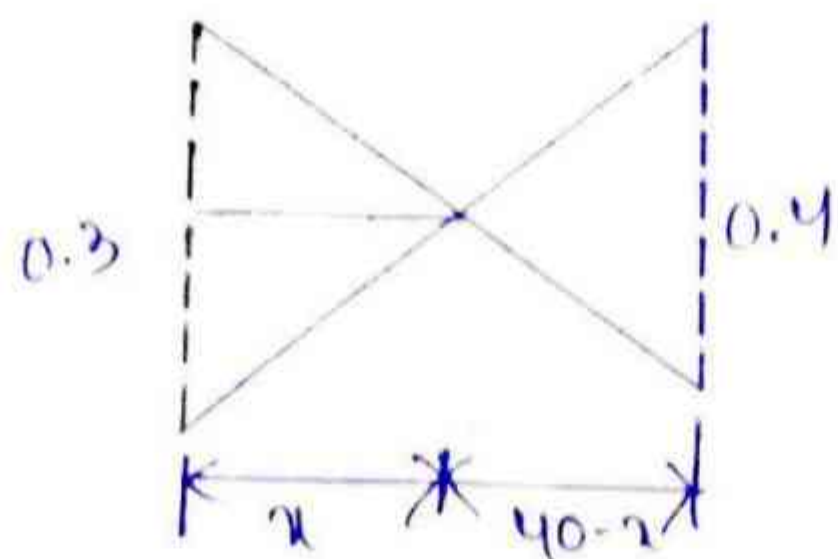
4) Estimate the cost of earthwork for a portion of road of 400 m length from the following data. Formation width of road is 10m. Side slopes are 2:1 in banking and 1.5:1 in cutting.

Chainage	25	26	27	28	29	30	31	32	33	34	35
Distance	1000	1040	1080	1120	1160	1200	1240	1280	1320	1360	1400
R.L of ground	51.00	50.90	50.50	50.80	50.60	50.70	51.20	51.40	51.30	51.00	50.60
R.L of formation	52.00	Downward Gradient 1 in 200									



Depth of cutting	1	0.9	1.1	0.6	0.6	0.3	0.4	0.8	0.9	0.8	0.4
Depth of banking											
R.L of formation	52.00	51.80	51.60	51.40	51.20	51.00	50.80	50.60	50.40	50.20	50.00
R.L of ground	51.00	50.90	50.50	50.80	50.60	50.70	51.20	51.40	51.30	51.00	50.80
Distance	1000	1040	1080	1120	1160	1200	1240	1280	1320	1360	1400
Chainage	25	26	27	28	29	30	31	32	33	34	35

Position of Point of Zero Cutting and Banking



$$51.00 - 50.70 = 0.3$$

$$51.20 - 50.80 = 0.4$$

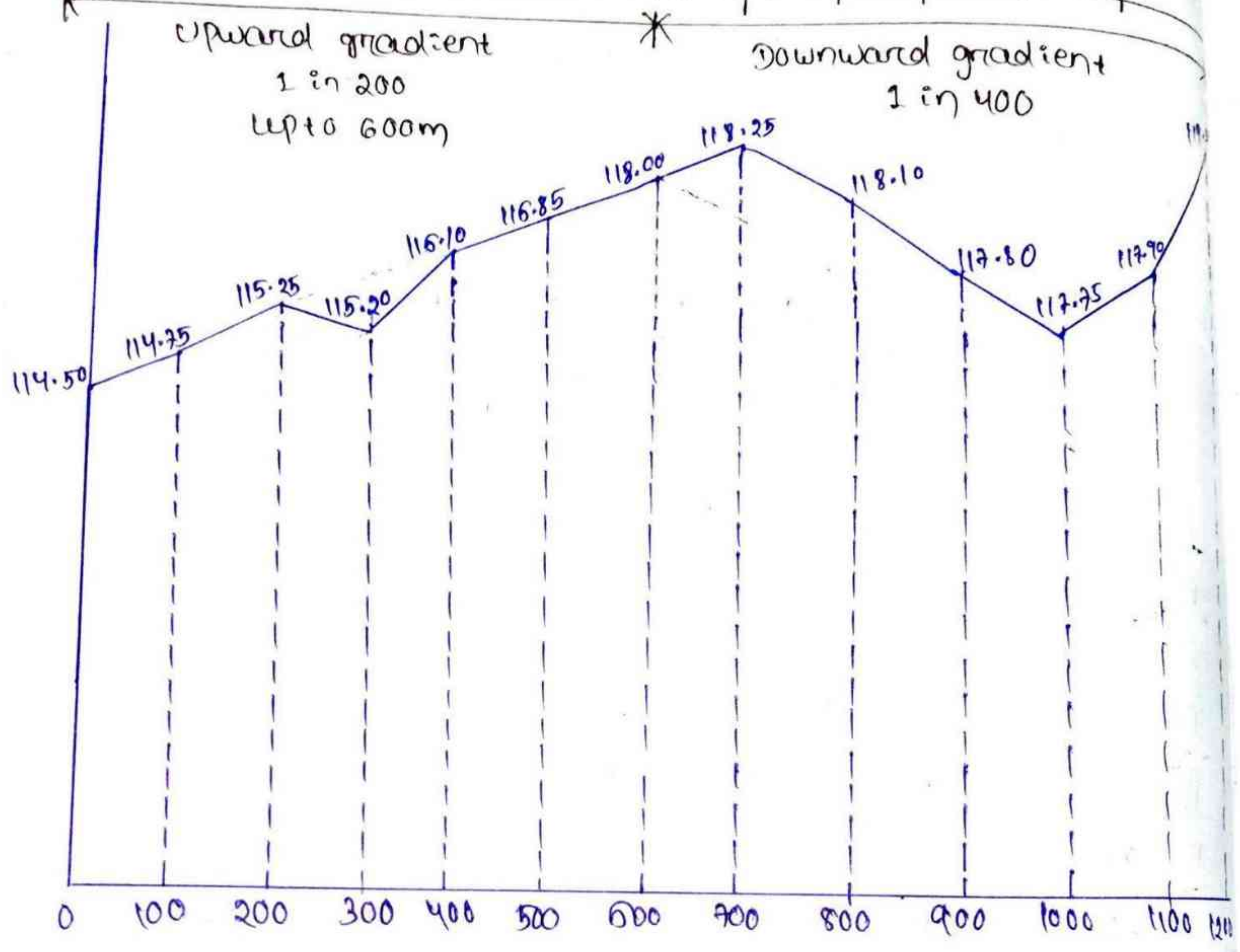
Due to similarity of Δs

$$\Rightarrow \frac{x}{40-x} = \frac{0.3}{0.4} \Rightarrow x = 17.14$$

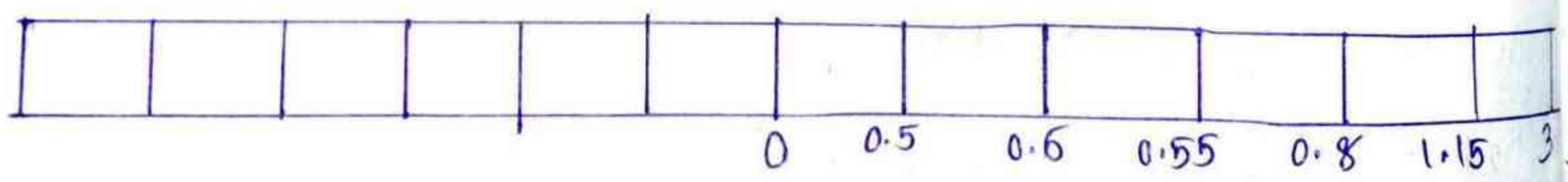
Station	Chainage	Distance	Length	(d) depth of cutting or banking	Mid depth (dm)	Central area both	Side area s. cut	Total area both s. cut	Volume (v) = both s. cut \times l	
									Cutting	Banking
P ₁	25	1000	—	1	—	—	—	—	—	—
P ₂	26	1040	40	+0.9	+0.95	9.5	1.805	11.305		452.2
P ₃	27	1080	40	+1.1	+1	10	2	12		480
P ₄	28	1120	40	+0.6	+0.85	8.5	1.445	9.945		397.8
P ₅	29	1160	40	+0.6	+0.6	6	0.72	6.72		268.8
P ₆	30	1200	40	+0.3	+0.45	4.5	0.405	4.905		196.2
P ₇	X	1217.14	17.14	0	+0.15	1.5	0.045	1.545		26.48
P ₈	31	1240	22.86	-0.4	-0.2	2	0.06	2.06	47.09	
P ₉	32	1280	40	-0.8	-0.6	6	0.54	6.54	261.6	
P ₁₀	33	1320	40	-0.9	-0.85	8.5	1.083	9.583	383.32	
P ₁₁	34	1360	40	-0.8	-0.85	8.5	1.083	9.583	383.32	
P ₁₂	35	1400	40	-0.6	-0.7	7	0.735	7.735	309.4	
Total = 1384.73									Total = 18.8	

4) Prepare a detailed estimate of earthwork for a portion of road from the following data. Formation width of the road is 10m, and the side slopes are 2:1 in banking and 1.5:1 in cutting.

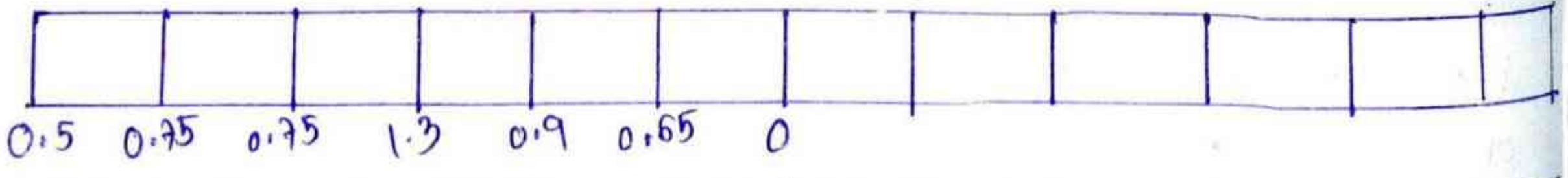
Distance	0	100	200	300	400	500	600	700	800	900	1000	1100	1200
R.L of ground	114.50	114.75	115.25	115.20	116.10	116.85	118.00	118.25	118.10	117.80	117.75	117.90	119.50
R.L of formation	115												



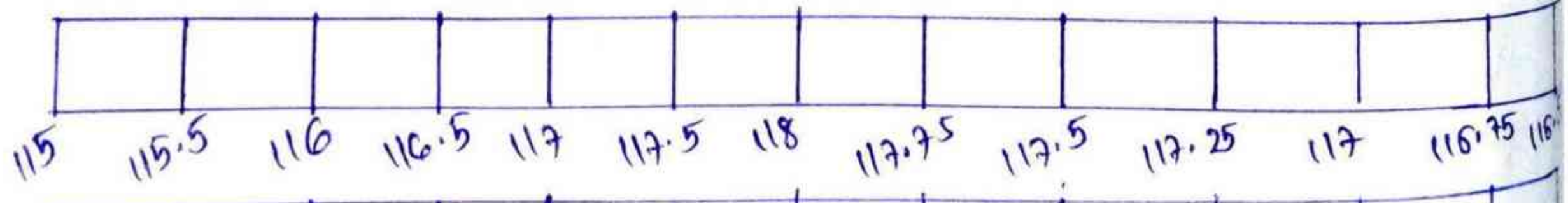
Depth of cutting



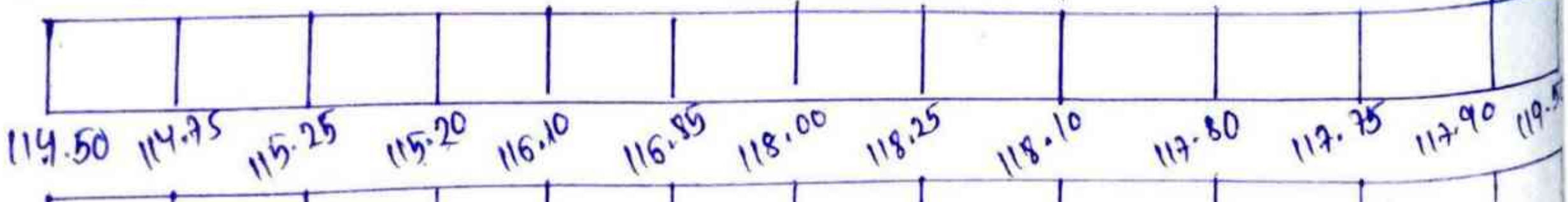
Depth of banking



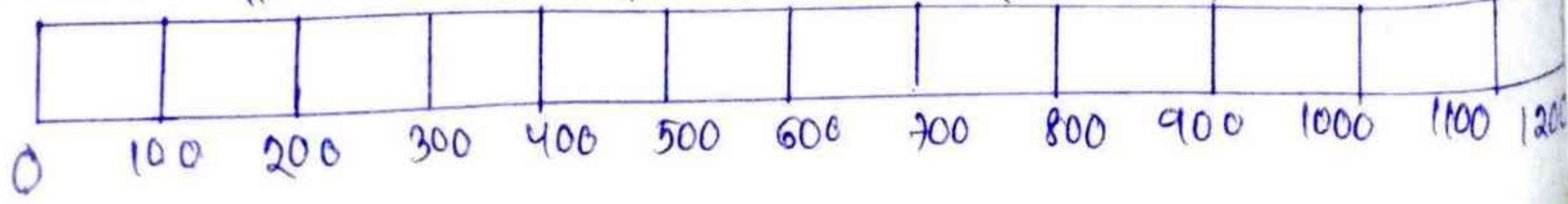
R.L of formation



R.L of ground



Distance



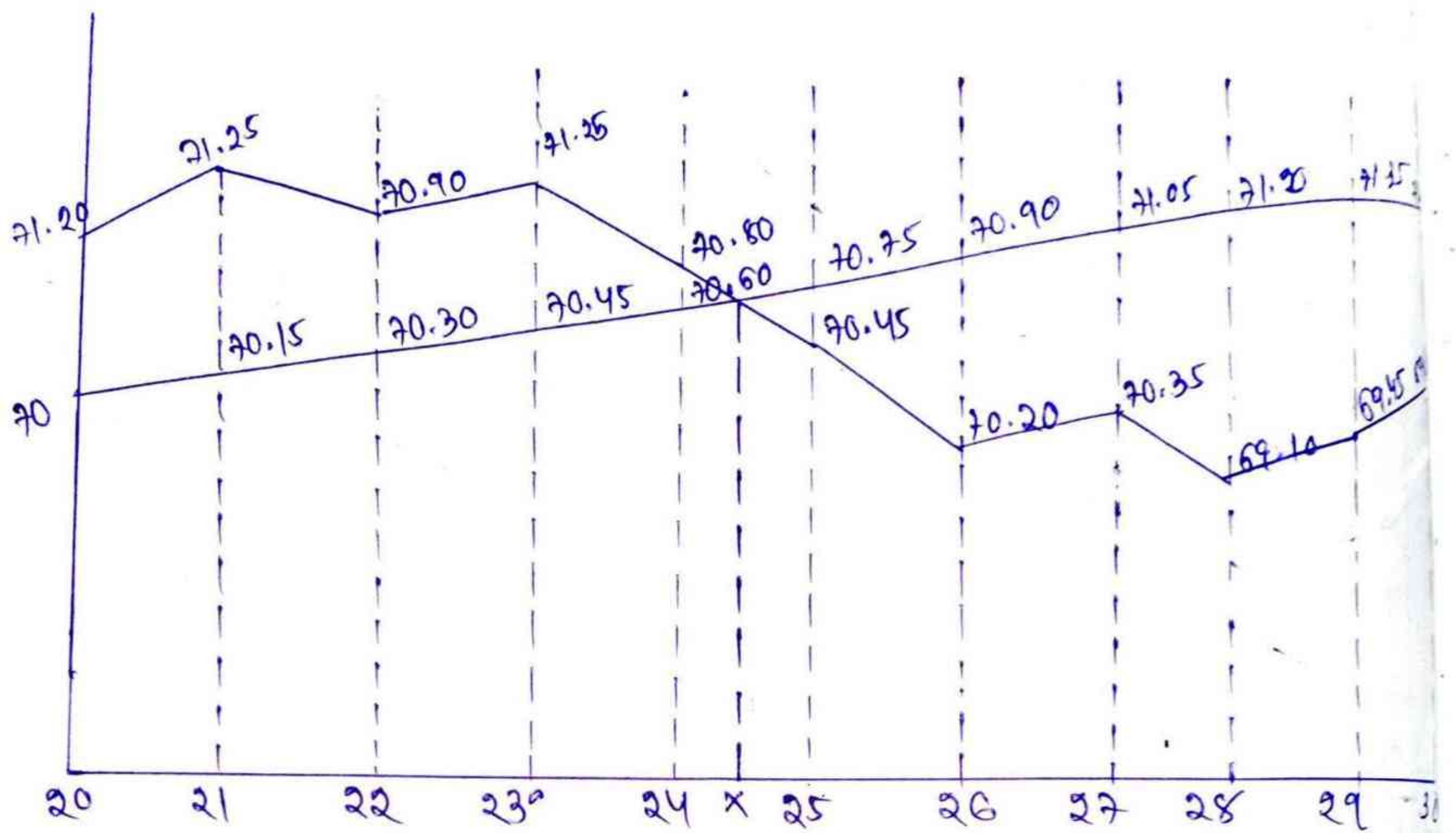
Station	Distance	Length	Cut depth of cutting or banking	Mid depth (dm)	Central area b.dm	Side area s.dm ²	Total area b.dm + s.dm ²	Volume (cu) = b.dm + s.dm ² × L	
								Cutting	Banking
P ₁	0		0.5	—	—	—	—		
P ₂	100	100	0.75	0.625	6.25	0.781	7.031		703.1
P ₃	200	100	0.75	0.75	7.5	1.125	8.625		862.5
P ₄	300	100	1.3	1.025	10.25	2.101	12.351		1235.1
P ₅	400	100	0.9	1.1	11	2.42	13.42		1342
P ₆	500	100	0.65	0.775	7.75	1.201	8.951		895.1
P ₇	600	100	0	0.325	3.25	0.211	3.461		346.1
P ₈	700	100	-0.5	-0.25	2.5	0.125	2.625	262.5	
P ₉	800	100	-0.6	-0.55	5.5	0.605	6.105	610.5	
P ₁₀	900	100	-0.55	-0.575	5.75	0.661	6.411	641.1	
P ₁₁	1000	100	-0.8	-0.675	6.75	0.911	7.661	766.1	
P ₁₂	1100	100	-1.15	-0.925	9.75	1.901	11.651	1165.1	
P ₁₃	1200	100	-3	-2.075	20.75	8.611	29.361	2936.1	

5) Estimate the cost of earthwork for the following data. Formation width of road is 8m and the slope is 2:1 in banking and 1.5:1 in cutting.

Chainage	20	21	22	23	24	25	26	27	28	29	30
R.L of ground	71.20	71.25	70.90	71.25	70.80	70.45	70.20	70.35	69.10	69.45	69.70
R.L of formation	70.00										

← Upward gradient 1 in 200. →

Length of chain is 30m. The rate of earthwork is 275% cu.m for banking and 350% cu.m for cutting.



Depth of cutting

1.2	1.1	0.6	0.8	0.2	0.3	0.7	0.7	2.1	1.9	1.1
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Depth of banking

70.00	70.15	70.30	70.45	70.60	70.75	70.90	71.05	71.20	71.35	71.50
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R.L of formation

71.20	71.25	70.90	71.25	70.80	70.45	70.20	70.35	69.10	69.45	69.75
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R.L of ground

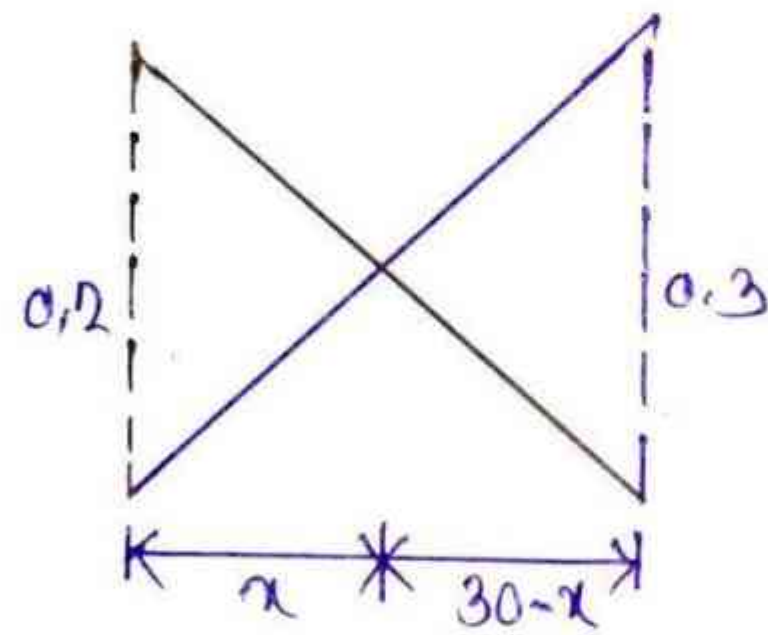
600	630	660	690	720	750	780	810	840	870	900
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Distance

20	21	22	23	24	25	27	27	28	29	30
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Station	Chainage	Distance	Length	(d) depth of cutting	Mid depth (dm)	Central area bdm	side area s.dm ²	Total area bdm + s.dm ²	Volume (v) = bdm + s.dm ² × l	
									Cutting	Banking
P ₁	20	600	30	1.2	—	—	—	—		
P ₂	21	630	30	-1.1	-1.15	9.2	1.983	11.183	335.49	
P ₃	22	660	30	-0.6	-0.85	6.8	1.083	7.883	236.49	
P ₄	23	690	30	-0.8	-0.7	5.6	1.735	6.335	190.05	
P ₅	24	720	30	-0.2	-0.5	4	0.375	4.375	131.25	
P ₆	X	732	12	0	-0.1	0.8	0.015	0.815	9.78	
P ₇	25	750	18	0.3	0.15	1.2	0.0045	1.245		22.41
P ₈	26	780	30	0.7	0.5	4	0.5	4.5		135
P ₉	27	810	30	0.7	0.7	5.6	0.98	6.58		197.4
P ₁₀	28	840	30	2.1	1.4	11.2	3.92	15.12		453.6
P ₁₁	29	870	30	1.9	2	16	8	24		720
P ₁₂	30	900	30	1.8	1.85	14.8	6.845	21.645		649.35

Total = 903.06 Total = 2177.76



Due to similarity of Δs .

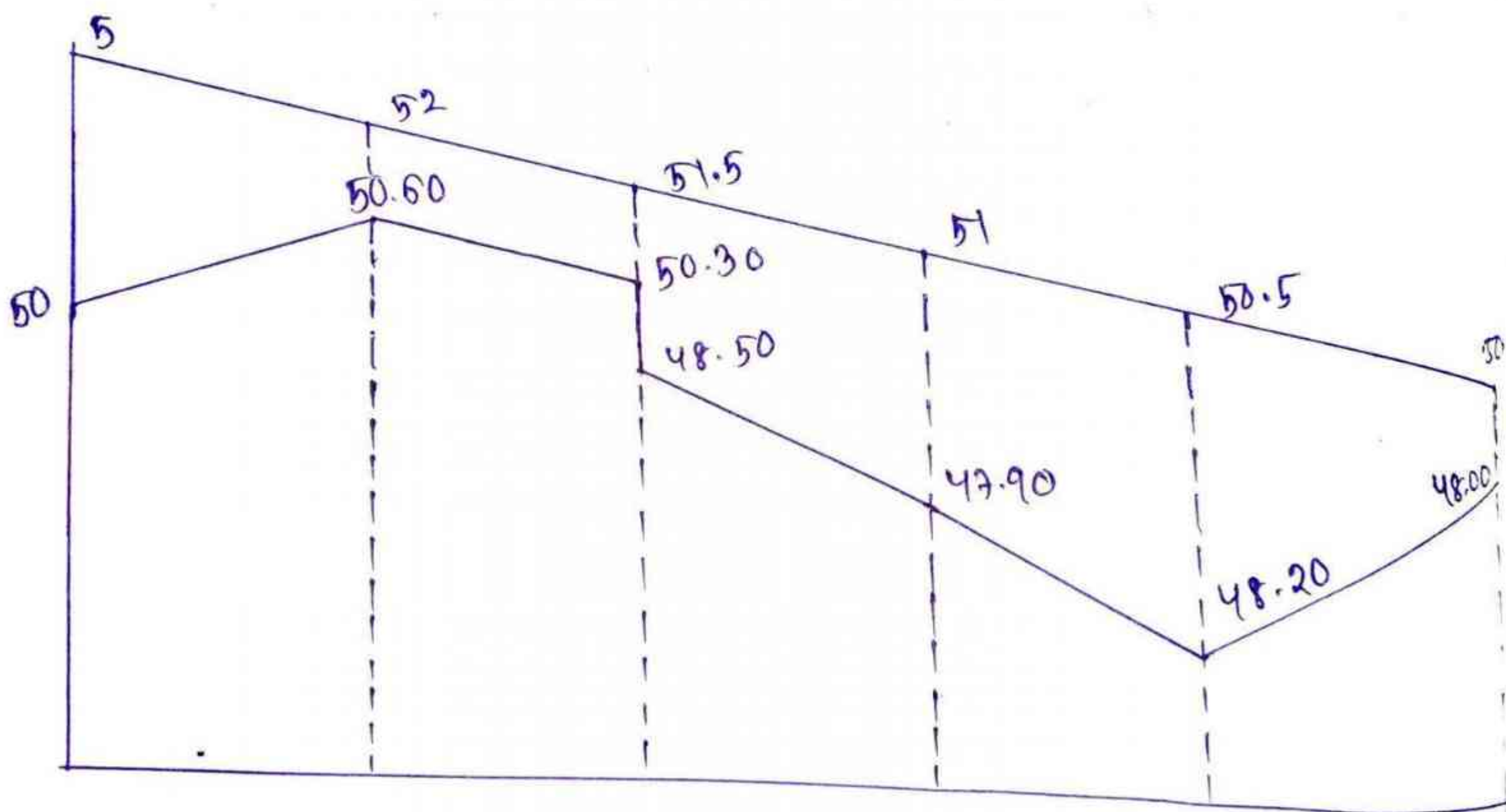
$$\Rightarrow \frac{x}{30-x} = \frac{0.2}{0.3} \Rightarrow \boxed{x = 12}$$

VERTICAL DROP

- It represents sudden rise or sudden fall of ground at a point.
- At this point ground has 2 R.L.

1) Calculate the quantity of earthwork from the following data. The formation width of road is 8mtr. The side slope is 2:1 in banking 1.5:1 in cutting. The formation is in downward gradient of 1 in 100. The length of chain is 50mtr.

Chainage	10	11	12	13	14	15
R.L of ground	50	50.60	50.30	47.90	48.20	48.00
R.L of Formation	52.50		48.50			48.00



Depth of cutting						
Depth of banking						
R.L of Formation						
R.L of ground						
Distance						
	10	11	12	13	14	15

Station	Chainage	Distance	Length	(d ₁) depth of cutting or banking	mid depth (d _m)	Central area b ₁ d ₁	side area, s ₁ d ₁	total area, t ₁ d ₁	Volume (C) = $b_1 d_1^2 \times L$	
									Cutting	Banking
P ₁	10	500	—	2.5	—	—	—	—		
P ₂	11	550	50	1.4	1.95					
P ₃	12	600	50	1.2 & 3	1.3					
P ₄	13	650	50	3.1	3.05					
P ₅	14	700	50	2.3	2.7					
P ₆	15	750	50	2	2.15					

ESTIMATION OF METAL ROAD OR WBM ROAD :-

Miscellaneous Items—

For a new construction some preliminary work as fixing, alignment, surveying, dagbelling, etc., are required for which lump sum provision per kilometre is made in the estimate.

Kilometre stone, half kilometre stone and boundary stones are also required to be fixed and shall be included in the estimate on the basis of lump sum amount per kilometre. Boundary stones are fixed on both sides at every hecto metre (100 metre) and at changes in land width.

Similarly road sign and direction posts are required to be fixed and shall be included in the estimate on kilometre basis.

Provision for making formation level pillars should be made on kilometre basis.

During construction traffic should not be allowed to pass on the road, diversion or service road should be made and the cost of diversion or service road should be included in the estimate on kilometre basis.

Provision should also be made for arboriculture by the road side and their maintenance for three years.

Provision for Ganghuts, Overseer's Rest House and Inspection House should also be made. Detailed estimate for these should be prepared and included in the estimate of the road project.

Example 7.—Prepare a detailed estimate for the construction of a new State Highway for one kilometre length. The formation width of road is 10 metre, average height of bank is 1 metre and side slope 2:1. The metalled width is 3.70 m and three coats of metalling are to be provided as per cross section (Fig. 7.23). The surface shall be finished with two coats of painting.

Assume other data required and suitable rates.

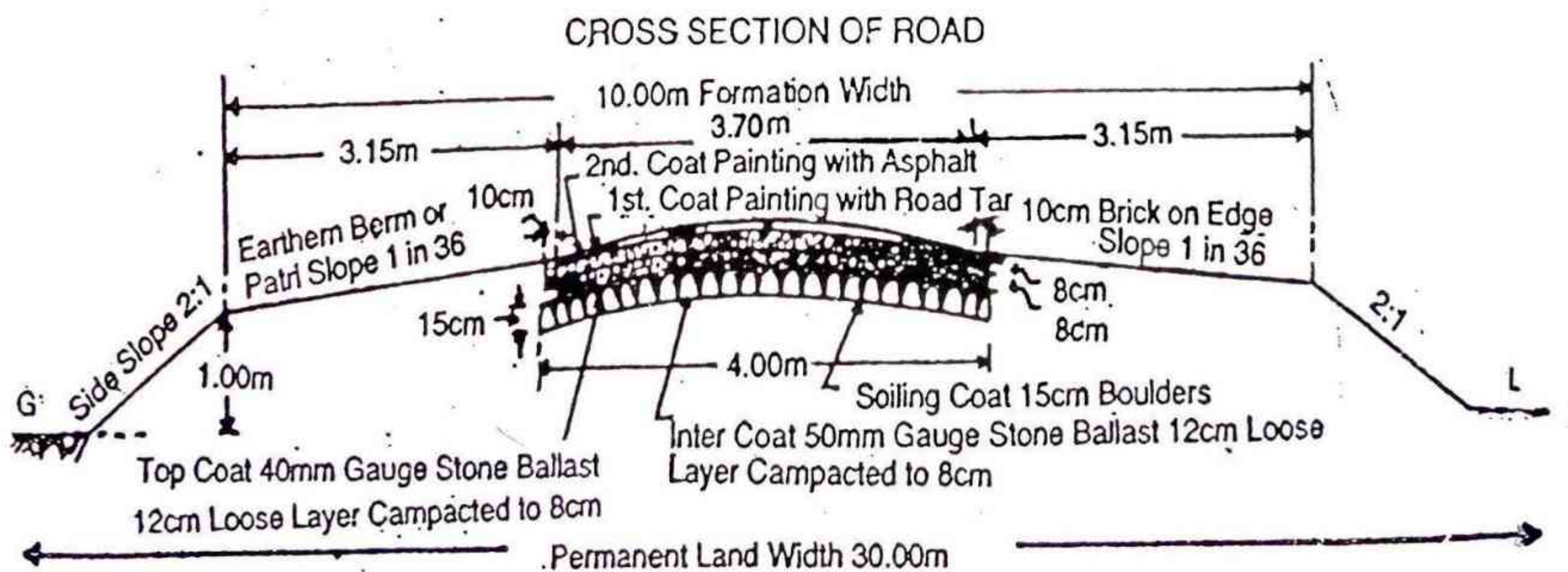


Fig. 7-23

The painting shall be as follows:

1st coat of painting (i) stone dust 20mm gauge @ 1.35 cum

per percentage sq.m.

(ii) Binder @ 220 kg per percentage sq.m.

2nd coat of painting (i) stone brick 15mm gauge @ 0.75 cum

per percentage sq.m.

(ii) Binder @ 120 kg per percentage sq.m.

S.N	Particulars of item	NO	L	B	H	Quantity	Explanatory Note
1)	Surveying and dug boring	1	1000			1000 M	L = 1km
2)	Acquisition of Permanent Land	1	1000	30		30000 M ³	
3)	Volume of earthwork	1	1000	$[(10 \times 1) + 2 \times (1)^2]$		12000 M ³	$B.H = b \times l + 3 \times d \times l^2$ $= [(10 \times 1) + 2 \times (1)^2]$
4)	Acquisition of temporary land	1	Area of Land = Qty. of earth work <hr/> Depth of borrow pit $\Rightarrow \frac{12000}{0.3}$			40,000 M ²	Assume depth of borrow pit = 30cm.
5)	Preparation of subgrade. <u>metaling</u>	1	1000	4		4000	
6)	1st coat of metaling (soiling coat)						
a)	15 cm Boulders	1	1000	3.7	0.15		
b)	Laying and consolidation with locally sandy soil.	1	1000	3.7	0.15		

7) 2nd coat of Metaling
(Inter coat)

a) 50mm Gauge stone
ballast 12 cm loose
layer compacted to
8 cm

1 1000 3.7 0.12

b) Laying and consolidat
ation with locally
sandy soil.

1 1000 3.7 0.12

8) 3rd coat of Metaling
(Top coat)

a) 40mm Gauge stone
Ballast 12 cm loose
compacted to 8 cm

1 1000 3.7 0.12

b) Laying and consolidat
ation with locally
sandy soil

1 1000 3.7 0.12

9) Painting

a) 1st coat of painting

i) stone grit 20mm
gauge @ 1.35 cu.m
per percentage
square meter.

1 1000 3.7 $\frac{1.35}{100}$ 49.95 m³

ii) Binder @ 220 kg
per percentage
square meter.

1 1000 3.7 $\frac{220}{100}$ 8140 kg

iii) Laying

1 1000 3.7 3700 m²

b) 2nd coat of
painting

a) stone grit 12mm
gauge @ 0.70 cu.m

per percentage square meter.

1

1000

3.7

$\frac{0.75}{100}$

ii) Binder @ 120 kg

per percentage square meter

1

1000

3.7

$\frac{120}{kg}$

3) Estimate the items involved for the construction of a WBM road from the following data.

a) Length of road = 100m

b) Metalled width = 5.5m = 6m

c) Thickness of grade-I metal soiling = 80mm

d) Wearing coat of grade-II metal loose consolidated to 80mm thick = 120mm loose

e) Surface of the road is to be finished with two coats of Bitumen, as given below.

1st finishing coat

12 mm chips @ $0.018 m^3$ and Bitumen @ 1.22 kg per sq.m of road surface.

2nd finishing coat

6mm chips @ $0.01 m^3$ and Bitumen @ 1.22 kg per sq.m of road surface.

→ Consumption of fuel @ 0.42 kg per kg of Bitumen.

2) Estimate the items involved for the construction of a new state highway of WBM Road from the following data.

- i) length of road = 2 km
- ii) formation width = 12 m
- iii) metalled width = 8 m
- iv) width of permanent land = 35 m
- v) depth of borrow pit = 30 cm
- vi) Avg. height of bank = 1.5 m
- vii) side slope = (2:1)
- viii) thickness of grade-I metal soiling = 90 mm
- ix) wearing coat of grade-II metal soiling = 12 cm loose & compacted to 8 cm.
- x) surface to be finished with two coats of Bitumen as follows

→ 1st finishing coat

12 mm chips @ 0.025 m^3 and Bitumen @ 1.25 kg per sq. m of road surface.

→ 2nd finishing coat

6 mm chips @ 0.020 m^3 and Bitumen @ 1.24 kg per m. sq. of road surface.

→ consumption of fuel @ 0.45 kg per kg of Bitumen.

IN	Description of item	NO	L	B	H	Qty.	Explanatory Note
1)	Surveying and dogbelling	1	2000			2000	
2)	Acquisition of Permanent land	1	2000	35			
3)	Volume of earth-work	1	2000	[(35x1.5)+(2x1.5)]			B.H = $b \cdot d \cdot m + s \cdot d \cdot m^2$ $\Rightarrow [(12 \times 1.5) + (2 \times 1.5)]$ $\Rightarrow 22.5 \cdot m^3$
4)	Acquisition of temporary land	1	Area of land Qty. of earth work <hr/> Depth of borrow pit $\Rightarrow \frac{45000}{0.3}$				
5)	Preparation of subgrade	1	2000	10		20000	
	<u>Metaling</u>						
6)	1st coat of metaling (soiling coat)						
a)	Grade-I metal soiling of 90mm thick	1	2000	8	0.09		
b)	Laying and consolidation with locally sandy soil	1	2000	8	0.09		
7)	2nd coat						
a)	Grade-II metal 12cm loose compacted to 8cm.	1	2000	8	0.12		
b)	Laying and consolidation with locally sandy soil	1	2000	8	0.12		

8) Painting

1st coat:

a) 12mm chips @ 0.025 m³ per meter sq. of road surface

1 2000 8 0.025 400 m³

b) Bitumen @ 1.25 kg per m. sq. of road surface.

1 2000 8 1.25 20000 kg

c) Laying

1 2000 8 16000 m²

9) 2nd coat:

a) 6mm chips @ 0.020 m³ per m. sq. of road surface

1 2000 8 0.020 320 m³

b) Bitumen @ 1.24 kg per sq. m of road surface

1 2000 8 1.24 19840 kg

c) Laying

1 2000 8 16000 m²

10) Consumption of fuel @ 0.45 kg per kg of bitumen.

1 $0.45 \times (20000 + 19840)$ 179.28 kg

1) Surveying and dog-belling	1	100			100
2) Preparation of sub-grade	1	100	6		600 M ²
<u>Metaling</u>					
3) 1st coat of metaling					
a) Grade-I metal soiling of 80mm thick	1	100	5.5	0.08	44M ³
b) Laying and consolidation with locally sandy soil.	1	100	5.5	0.08	44M ³
4) 2nd coat					
a) Grade-II metal soiling of 120mm loose compacted to 80mm.	1	100	5.5	0.12	66M ³
b) Laying and consolidation with locally sandy soil.	1	100	5.5	0.12	66M ³
5) <u>Painting</u>					
<u>1st coat</u>					
a) 12mm chips @ 0.018M ³ per M ² of road surface	1	100	5.5	0.018	9.90M ³
b) Bitumen @ 1.22kg per M ² of road surface	1	100	5.5	1.22	671kg
6) <u>2nd coat</u>					
a) Laying	1	100	5.5	-	550.4 ²
b) 6mm chips @ 0.01M ³ per M ² of road surface	1	100	5.5	0.01	5.5M ³
c) Bitumen @ 1.22kg per M ² of road surface	1	100	5.5	1.22	671kg

Loose soil =
1.5 x 80 = 120mm

SEPTIC TANK FOR 50 USERS

All Dimensions are in Centimeter except where so mentioned

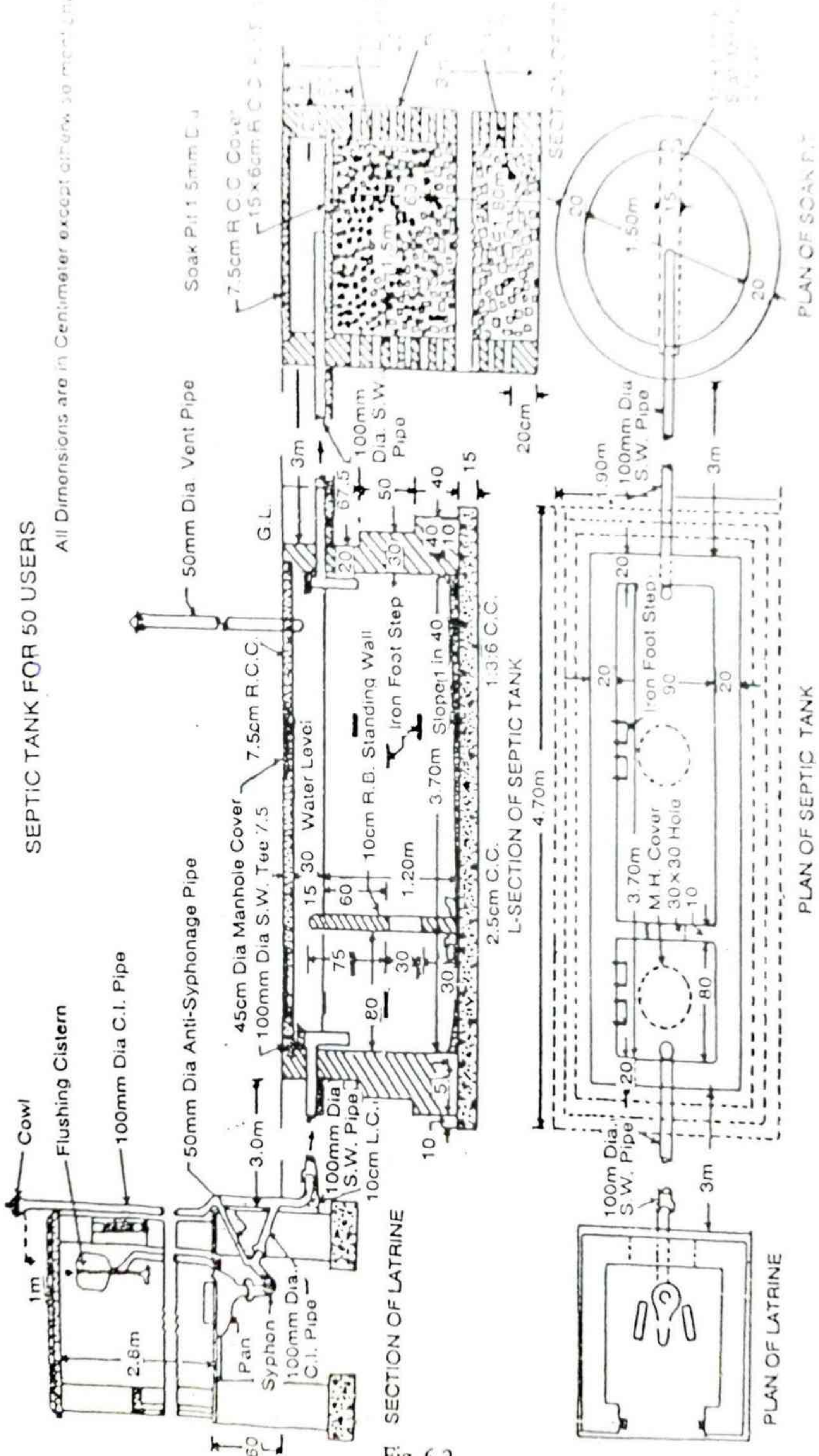


Fig. 6-2

7.	Consumption of fuel @ 0.42 kg of Bitumen	1	0.42(671+671)	563.64 m ³
6.C	Laying	1	100 5.5 -	550.4 ²

SEPTIC TANK

I.N	Description of item	NO	L	B	H	Qty.	Explanatory Note
1.	Earthwork in excavation						
	a. septic tank	1	4.7	1.9	1.725	15.404	$H = \frac{67.5 + 50 + 40 + 15}{100} = 1.725$
	b. Soak pit	1	$\frac{\pi}{4} \times (1.9)^2$		3	8.505	$H = dia = 1.5 + 2 \times 0.2$
2.	Cement concrete in foundation.						
	a. septic tank	1	4.7	1.9	0.15	1.339	
3.	Brick work						
	a. septic tank						
	i) 1st footing						
	→ long wall	2	4.5	0.4	0.4		$L = 4.7 - (2 \times 0.1) = 4.5m$
	→ short wall	2	0.9	0.4	0.4		OR $3.7 + (0.4 \times 2)$
	ii) 2nd footing						
	→ long wall	2	4.3	0.3	0.5		$L = 4.7 - (4 \times 0.1) = 4.3m$
	→ short wall	2	0.9	0.3	0.5		OR $3.7 + (0.3 \times 2)$
	iii) 3rd footing						
	→ long wall	2	4.1	0.2	0.675		$L = 4.7 - (6 \times 0.1) = 4.1m$
	→ short wall	2	0.9	0.2	0.675		OR $3.7 + (0.2 \times 2)$
	b. Deduction for projection of slab on wall						
	→ Long wall	2	3.9	0.1	0.075		$L = 3.7 + 0.1 + 0.1 = 3.9m$
	→ short wall	2	0.9	0.1	0.075		
4.	Plastering and pointing work						
	a. septic tank inner side	1	9.2		1.5		$L = (3.7 \times 2) + (0.9 \times 2) = 9.2$ $H = 1.2 + 0.3 = 1.5m$

	b. Bothside of R.B. standing wall	2	0.9	-	1.35		$H = 0.3 + 0.3 + 0.75$
	c. Top of standing wall	1	0.9	0.1	-		
5.	R.C.C work						$L = 3.7 + 0.1 + 0.1 = 3.9m$
	a. 7.5 cm R.C.C cover over septic tank	1	3.9	1.1	0.075		$B = 0.9 + 0.1 + 0.1 =$
	b. 7.5 cm R.C.C cover over soak pit	1	$\frac{\pi}{4} \times (1.7)^2$		0.075		$d = 1.5 + 0.1 + 0.1 = 1.7m$
	c. R.C.C slab for supporting of pipe over soak pit.	1		0.15	0.06		
6.	2.5 cm cement concrete floor of septic tank	1	3.7	0.9			
7.	Hony Comb wall of soak pit	1	$\pi \times 1.7$	3	16.02		$d = \frac{1.5 + 1.9}{2} = 1.7$
8.	60 cm Thama Brick Ballast 50mm Gauge	1	$\frac{\pi}{4} \times (1.5)^2$		0.6		
9.	1.8 m Thama Brick bat	1	$\frac{\pi}{4} \times (1.5)^2$		1.8		
10.	Manhole cover	2					
11.	Iron foot step in septic tank	2x4					

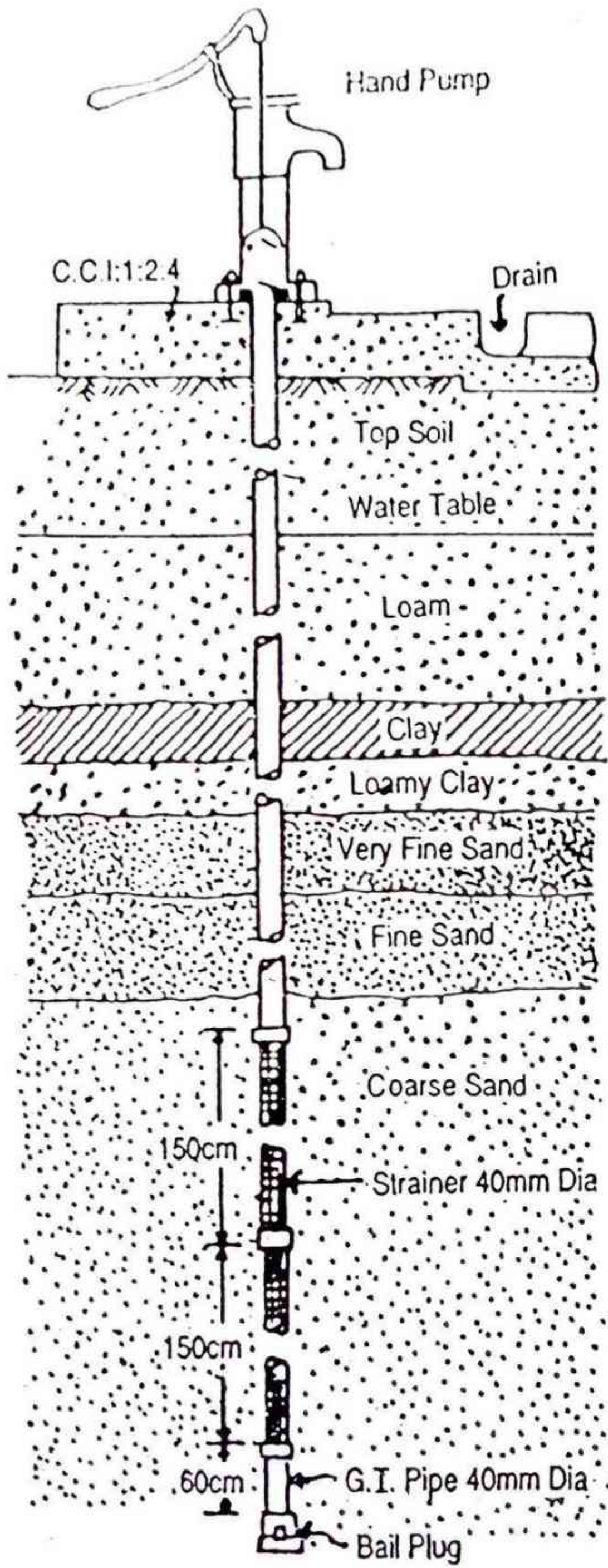


Fig. 6-18

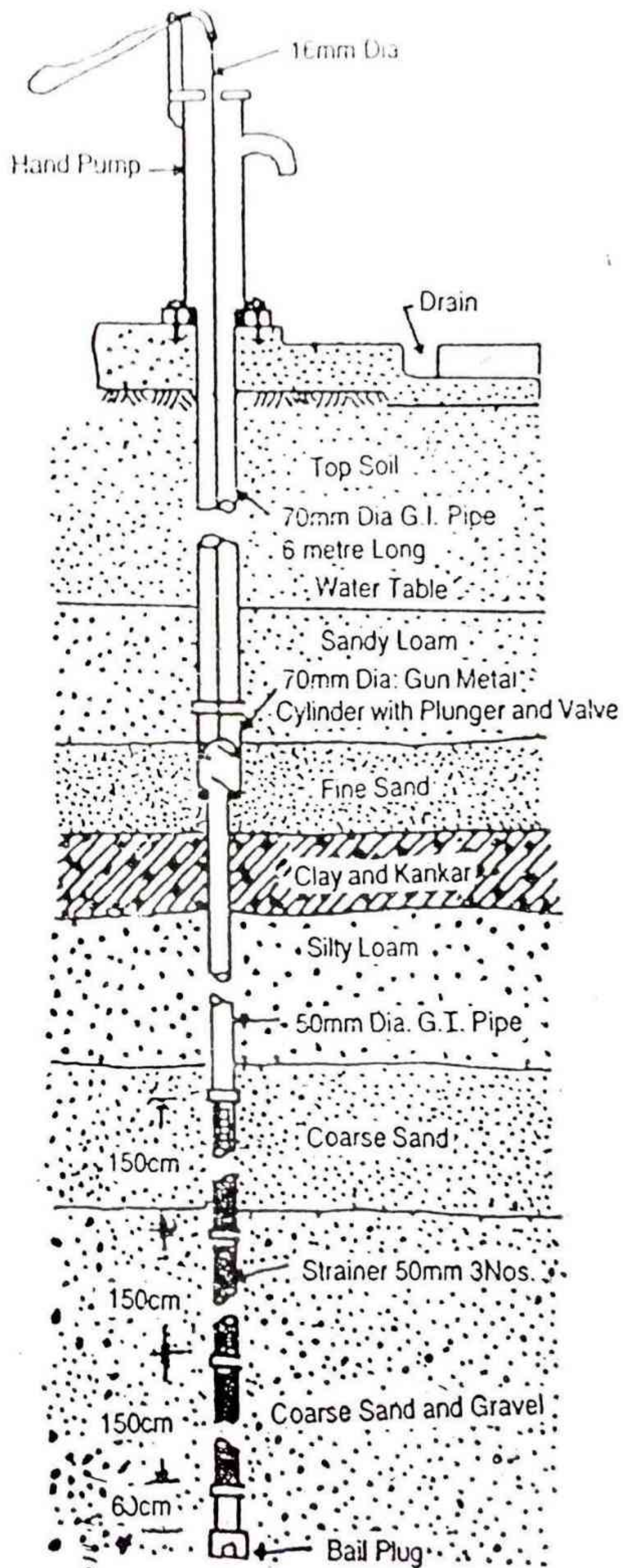


Fig. 6-19

ESTIMATE OF 40 MM DIA. TUBE WELL WITH ORDINARY HAND PUMP

Example 9.—Prepare an estimate of a 40 mm dia. tube well 40 metre deep from the given drawing (Fig. 6-18). The length of the strainer is 3 metre. Assume suitable rates.

Prepare a detailed estimate of a 40mm dia tube well of 40m deep. The strainer is of 3 meter long.

I.N	Particulars of item	No/quantity	Rate	Cost	Explanatory Note
1.	40mm dia G.I. pipe of 40 meter length (20cm above G.L)	37.2m	8.5	316.2	$L = (40 - 3) + 0.2$
2.	40mm dia strainer	3m	28 PER M.	84	
3.	Hand pump	1 NOS.	35	35	
4.	socket	4 NOS.	2	8	
5.	Bail plug	1 NOS.	5.5	5.5	
6.	side Drain	1	13	13	
7.	Concrete Bed for Hand pump	1	35	35	
8.	Earthwork in excavation				
	a - (0-20) m	20m	7	140	
	b - (20-30) m	10m	11	110	
	c - (30-40) m	10m	15.50	155	
			Total =	901.7	
	Add 5% for contingencies and work charged establishment :-		$\frac{5}{100} \times 901.7 =$	45.085	
			Total cost =	$(901.7 + 45.085)$ $\Rightarrow 946.785$	

I.N	Particulars of item	No/ Quantity	Rate	Cost	Explanatory Note
1.	50MM dia G.I pipe	89.7m	11.5/m	1031.55	L = 100 - 6 - (3 x 1.5) = 91.5
2.	Housing pipe	6m	23/m	138	
3.	Strainer	4.5m	38/m	171	
4.	Hand pump	1 NOS.	45	45	
5.	Socket	4 NOS.	2	8	
6.	Bail plug	1	5.5	5.5	
7.	Transport of material to the site		20	20	
8.	Earthwork in excavation				
	i) (0-20)m	20m	7.5/m	150	
	ii) (20-35)m	15m	11/m	165	
	iii) (35-50)m	15m	15.5/m	232.5	
	iv) (50-65)m	15m	20/m	300	
	v) (65-80)m	15m	24/m	360	
	vi) (80-95)m	15m	28.5/m	427.5	
	vii) (95-100)m	5m	33/m	165	
9.	side drain	1	27	27	
10.	Cement concrete platform for hand-pump	1	30	30	
11.	20mm dia gun metal cylinder with plunger & valve	1	100	100	
12.	Fixing and erecting hand pump in position including tools	1	10	10	
				Total =	3386.05
Add 5% for contingencies and work charged establishment :-				$\frac{5}{100} \times 3386.05 = 169.3025$	
				Total cost =	3555.3525

(Assume suitable rate)

Prepare an estimate of 50mm dia tubewell 100m deep with deep well pump from given drawing. The strainer is consist of 3 pieces of 1.5m each. The housing pipe consist of 20mm dia G.I pipe of 6 meter length.

PWD ACCOUNTS WORKSAdministrative Approval:-

For any work or project required by department an approval or sanction of the competent authorities of the department with respect to cost or work is necessary at the first instance. This is called Administrative Approval.

- It denotes the formal acceptance by the department of the proposal after administrative approval is given the engineering department take up the work and prepares details design, plan, estimate, execute the work.
- If a building is to be constructed for health department the administrative approval is to be given by health department.

Technical sanction:-

Technical sanction means sanction of detailed estimate, design calculations, quantities of work by the competent authorities of the engineering department.

- After the technical sanction of the estimate is given then only the work is taken up for construction.
- In case of original work counter signature of the local head of the department should be obtained in the plan and estimate, before the technical sanction approved by engineering department.
- The power of technical sanction varies from state to state.
- If a building is to be constructed for health department by PWD department then the technical sanction is to be given by PWD.

Types of Establishment:-

There are two types of Establishment of a project or work.

- 1) Regular
- 2) Work charged.

Regular Establishment :-

- Both permanent and temporary employee of the department are included in the Regular Establishment.
- Their salaries and allowances are drawn monthly on regular paybills from the treasury in prescribed form - detailed pay bill for regular establishment.
- Their salaries are met from the budget grant under the head establishment. Their services are governed by civil service rules of the state or union government.
- The permanent employees are liable for retirement their entitled for leave, Pension and other amenities as per service rule.
- The temporary establishments are employed ^{when} the work is increase and their services can be terminated with proper notice as per rules.

Work charged Establishment :-

- These are the employees which are employed directly on work for the actual execution of a specific work or for the supervision of the departmental labours, store and machinery etc.
- Usually work supervisor, chaukidar, mistries etc are employed as workcharged establishment.
- Their pay is directly charged to the work for which provision is made in the estimate of the work by adding 2% to 3% over the estimated amount of the work.
- The paybill of the work charged establishment are of both pay role and acquire role.
- The services of the work charge establishment can be terminated at any time without giving any notice.

Acquittance role :-

- The payment of salary to the persons of regular establishment working at station is drawn on the regular pay bill on a receipt form known as Acquittance Rule.
- It is a receipt in evidence of payment in a prescribed form having 5 columns as Item No., - Designation, net amount payable, date and signature.
- It is prepared for the total amount as per establishment bill and passed by drawing officer.

Debit and credit :-

- Debit means expenditure. When an amount is to be debited to a work means that the amount is to be shown as expenditure on the work.
- Credits means receipt. When an amount is to be credited to a work it means that the amount is to be shown as receipt under the work.

Cash :-

- Cash includes legal tender coins notes, cheques payable on demand, remittance transfer receipts and demand drafts.
- A small supply of revenue stamps may be kept as part of the cash balance.

Temporary advance or Temporary imprest :-

- It is the amount which is advanced by a Disbursing officer to a subordinate officer to enable him to make a number of specific payment out of a Muster-roll or any other voucher which has already been passed for payment.
- This account should be closed as soon as possible. The maximum amount of the temporary advance depends upon the security of the sub-ordinate officers usually upto Rs 2500.
- It is an advance amount for payment of passed bill, while the permanent imprest amount is advanced for payment of unpassed bills as and when required.

Different methods for carrying out work :-

The different methods used for execution of a work are as follows:-

- 1) Employment of daily labour on muster roll.
- 2) Piece work agreement.
- 3) Work order.
- 4) Lumpsum contract.
- 5) Lumpsum and scheduled contract.
- 6) Scheduled contract or item rate contract.
- 7) Labour contract.
- 8) Cost plus percentage contract.

1. Daily labour on muster roll system:-

- Work may be executed departmentally by employing daily labour as masons, coolies, bhisties, carpenters etc.
- The attendance of the labours is kept in muster roll by the overseer or by his authorised agent as work-supervisor, mistry, mate etc. The muster roll is checked and initialled by the assistant engineer or divisional engineer or subdivisional engineer frequently during their inspection.
- The labourers are paid weekly, fortnightly, monthly or at the completion of work according to the requirement. When the muster roll is closed for payment the work done during the period are measured and entered in the measurement book and the muster roll is completed by the overseer showing the amount payable to each labourer, total amount payable and the quantity of work done.
- The maintenance and repair work for road, canals are usually done by this system.

2. Piece work agreement :-

- It is an agreement where only rates are agreed upon with reference to the total quantity of work on time and that involves payment of work done at the stipulated rate.

- Small works or piece works upto Rs 2000.00 are carried out by piece work agreement system.
- It contains only the description of different items of work to be done and rates to be paid for but does not provide the quantities of different items to be executed nor the time within which the work is to be completed.
- Detailed specification of different items of work to be done are included in the piece work agreement and the total cost of the whole work to be done is also mentioned.
- There is no penalty clause, no security money and department may terminate the work at any time they like but a notice specifying the date of termination should be informed to piece worker.
- Under special circumstances works up to Rs 7,500.00 can also be carried out by P.W.A by the executive engineer, but the reasons and urgency should be mentioned in the agreement.

3. Work order :-

- Small works up to Rs 2,000.00 may be carried out by work order.
- This is a contract and specifies approximate quantities of different items of work, detailed specification of each item of work, time of completion for whole work, penalty for violation of terms and conditions etc.
- P.W agreement is used in P.W.D and work order is used in Irrigation Department,
- In this system payment is made on the measurement of the work done.

4. Lumpsum Contract :-

- In lumpsum contract, the contractor undertakes the execution or construction of a specific work with all its contingencies to complete it in all respects within a specified time for a fixed amount.

→ The detailed specification of all items of work pertaining to the whole work, plans and detailed drawing and deposit of 10% security money, penalty, progress and other terms and conditions of contract are included in the contract agreement.

→ The quantities on schedule of different items of work are not provided. The contractor shall have to complete the work as per plan and specification within the contract fixed sum within a fixed time irrespective of quantities of different items.

→ On completion of the work no detailed measurement of different items of work is required but the whole work is compared and checked with plans and drawings.

Lumpsum and schedule contract :-

→ This is similar to lumpsum contract but the schedule of rates is also provided in the contract agreement.

→ In this system, the contractor undertakes the execution of construction of a particular work at a fixed sum within a specified time as per plans and detailed specifications and conditions. The schedule of rates for various items of work are also provided which regulates the extra amount to be paid or deducted for any addition and alterations.

→ In this case no measurement of various items of work involved in original work are required, but measurement of extra items only shall have to be taken.

Schedule contract or item rate contract :-

→ In this contract, the contractor undertakes the execution or construction of a work on item rate basis.

→ The contractor receives amount according to quantities of various items of work actually done.

→ The contract agreement includes quantities, rates & amount for various item of works total amount of contract, plans and detailed drawings, detailed specifications & deposit of security money, penalty, progress, date of

Labour Contract :-

- In this contract the contractor undertakes contract for the labour portion. All materials for the construction are arranged and supplied by the dept. or owner.
- The contract is on item rate basis for labour only & contractor is paid for the quantities of work done on measurement of different items of work at the stipulated rate in the contract agreement.
- Contractor uses his own tools for working but plants and machineries are arranged by the dept. or owner.
- This system isn't adopted in govt dept. Private buildings are constructed in this system.

Cost plus percentage contract :-

- In this system contractor is given certain percent over the actual cost of construction as his profit.
- Contractor arranges materials and labour at his cost & keeps proper a/c & he is paid by the dept. or owner the whole cost together with certain %, % say 10% as his profit as agreed before.
- An agreement is prepared with all condition of contract in advance.
- In this case proper control in the purchase of material & labour shall have to be exercised by the dept. or owner.

Types of work :-

There are 3 types of work according to amount of sanction.

- i) Major work
- ii) Minor work
- iii) Petty work

Major work:

If the cost of the work exceeds 2 lakh, then it will be called as major work.

Minor work:

If the cost of the work is betⁿ 2 lakh and 50,000, then it will be termed as minor work.

Petty work:

If the cost of the work is below 50,000, then it will be termed as petty work.

→ Again is of 2 types according to its nature.

i) original work.

ii) Repair work.

Original work:

Any type of new construction work, is known as original work.

Example :- New Road, New Bridge, New Building construction

Repair work:

Repair work is of 3 types.

i) Annual Repair work.

ii) special " "

iii) Quadrantal " "

Annual Repair work:-

The repair work which is taken up annually is known as Annual Repair work.

Example :- Repair of pot holes on the road, white washing or painting of building.

Special Repair work:

Certain repair works which is taken up occasionally or and when required, is known as special Repair work.

Example :- Repair of damaged road during Earthquake or Flood, Repair of Sanitary & electrical establishment in a building.

Quadrantal Repair work:-

The repair works taken up once in every 3 months in a year is known as Quadrantal Repair work.

Example:- cleaning of sewer lines in a building, repair of electrical installation.

Important Terms:-

Contingency Budget:-

It is a money set aside to cover unexpected cost during the construction process. This money is reserve and it is an insurance against other cost.

Earnest Money deposit:-

It is the amount which accompanies the tender form while submitting it, which is usually 1% to 2% of the total estimated cost of the work. The main objective of collecting the EMD with the tender are as follows;

- a. Restriction of unnecessary competition :- If no EMD is collected, unnecessary competition will start. Those contractors who don't have any sound financial position to complete the work will submit their tenders at low rates, which may cause difficulties in completing the work.
- b. Punishment :- In case the contractor quotes lower rates, without intention of doing the work, the EMD shall be forfeited by the department as a punishment to such contractors.
- c. Compensation :- In case the lowest contractor refuses to do the work, the work can be allotted to the second lowest contractor. The EMD forfeited from the first contractor compensates to great extent the loss of the department.

After accepting the tender of the qualified contractor, EMD of other contractors are refunded.