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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(Asst. Prof. in Civil Engineering)

Example 1. Prepare a detailed estimate of R.C.C. slab culvert of 1.50 metre span and 4 metre 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

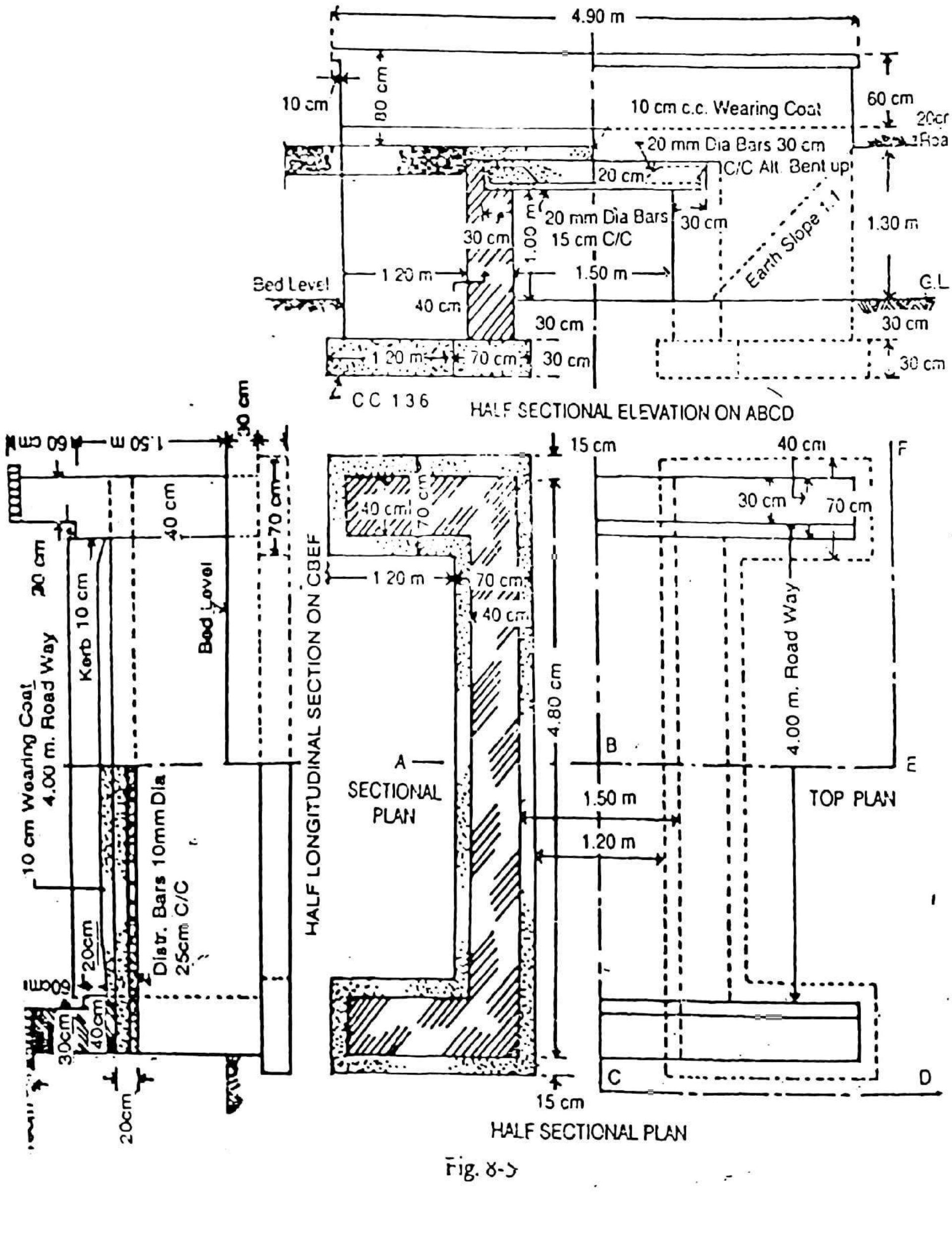

Fig. 8-5

I.N	Description of Item	N	L	B	H	Qty.	Explanotary Note
1.	Earth work in excavation						h = 0.3 + 0.3 = 0.6
	a - Abutment	2	5.1	0.7	0.6		l = 4.8 + 0.15 + 0.15 = 5.1
	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 - wingwall	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
	b - wing wall	4	1.2	0.4	1.5		L = 1.2 - 0.15 + 0.15 = 1.2
	c - parapet						
	(i) 1st footing	2	4.7	0.4	0.3		h = 0.2 + 0.1 = 0.3
	(ii) 2nd footing	2	4.7	0.3	0.5		L = 4.9 - 2x0.1 = 4.7
	(iii) coping	2	4.9	0.4	0.1		h = 0.6 - 0.1 = 0.5
	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 (0.1 = 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

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I.N	Description of item	N	L	B	H	Qty	Explanation of working 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 slab slope	4	1/2	X 1.3	X 1.3	0.845	
6.	10 cm CC wearing coat	1	4	2.3	0.1	0.92	B = 1.05+0.4+0.4 = 2.3

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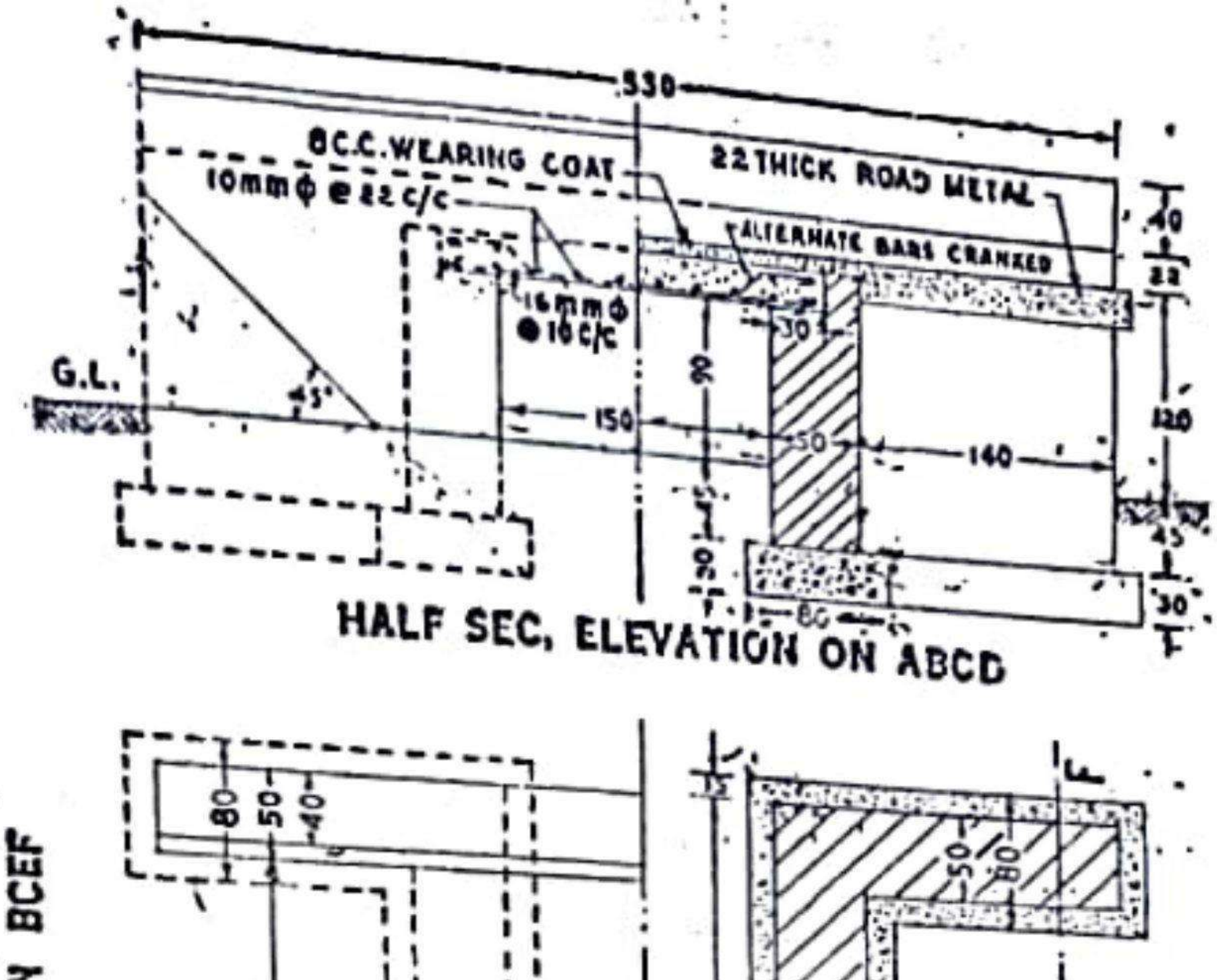

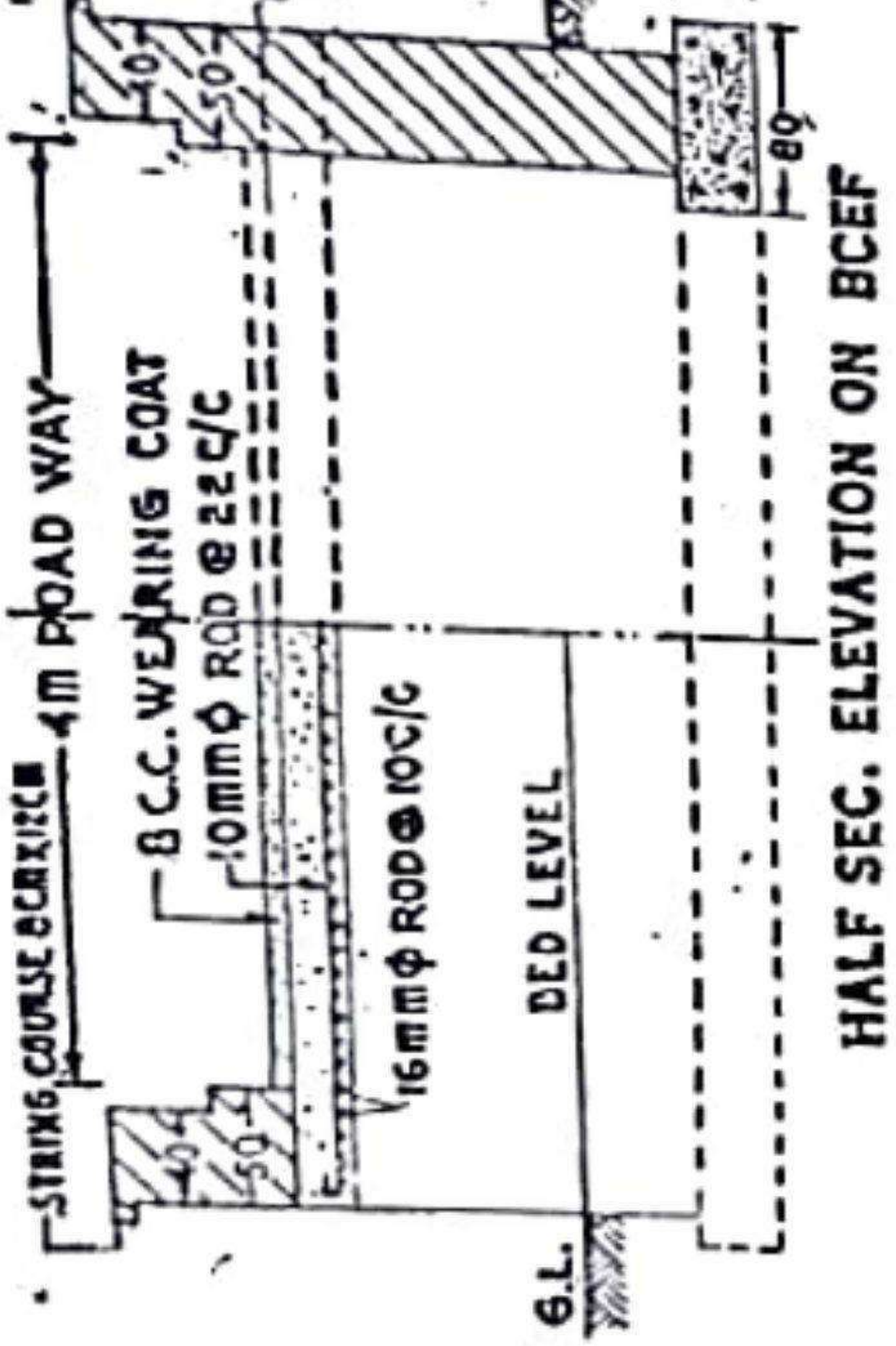

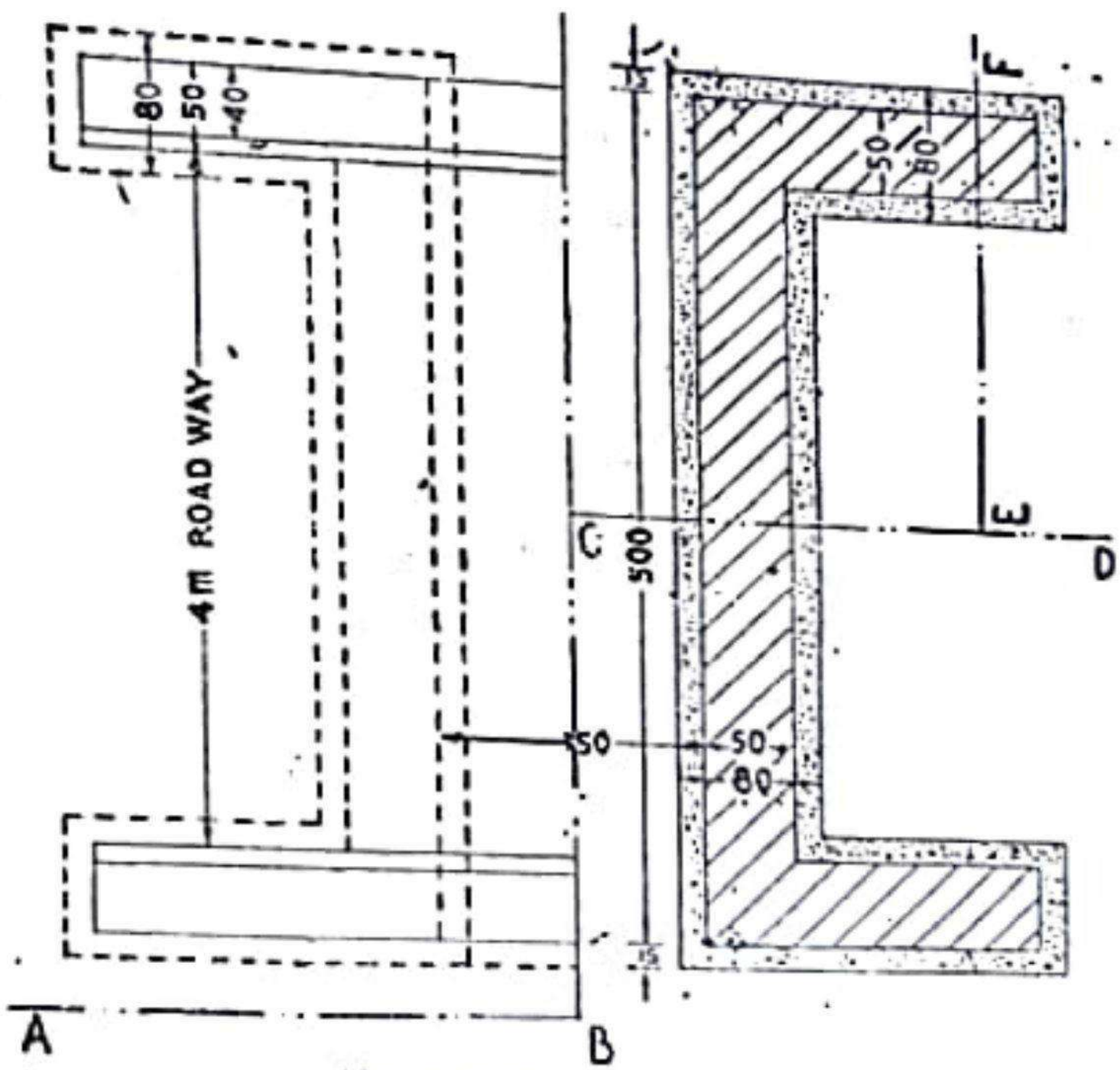

All dimensions in centimetre scale 1:75

FIG. 10-25

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I.N	Description of item	NO	L	B	H	Qty.	Explanotary, Note
1.	Earthwork in excavation						
	a. Abutment	2	5.3	0.8	0.75	6.36	L = 5+0.15+0.15
	b. wingwall	4	1.4	0.8	0.75	3.36	H = 0.75 (0.45+0.3)
2.	Cement concrete in foundation						
	a- Abutment	2	5.3	0.8	0.3	2.54	
	b- wingwall	4	1.4	0.8	0.3	1.34	
3.	Brickwork in foundation and superstructure						
	a- Abutment	2	5	0.5	1.57		H = 0.45+0.9+0.22
	b- wingwall	4	1.4	0.5	1.57		
	c- parapet	2					
	(i) 1st Footing	2	5.3	0.5	0.3	1.53	H = 0.22+0.08
	(ii) 2nd Footing	2	5.3	0.4	0.32	1.35	H = 0.4-0.08
	d. Deduction for projection of slab on Abutment	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	2	5		1.05	10.5	B = 0.9+0.15
	b- face wall including 15 C.M below Around Level. upto bottom of coping.	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)
	c. Inner side of parapet	2	5.3		0.64	6.78 M^2	H = 0.22+0.1+0.32
	d. coping (top, outer, inner, bottom projection)	2	5.3	0.8		8.48 M^2	B = 0.08+0.4+0.12+0.08+0.12

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I.N	Description of item	N	L	B	H	Qty	Explanotary 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	1.2	1.2	0.72 M^2	
g.	8CM CC wearing coat	1	4	2.5	0.08	0.8	B = 1.5 + 0.5 + 0.5
h.	String coarse ...	2	5.3	0.52	0.08	0.440	4M Road way = L.

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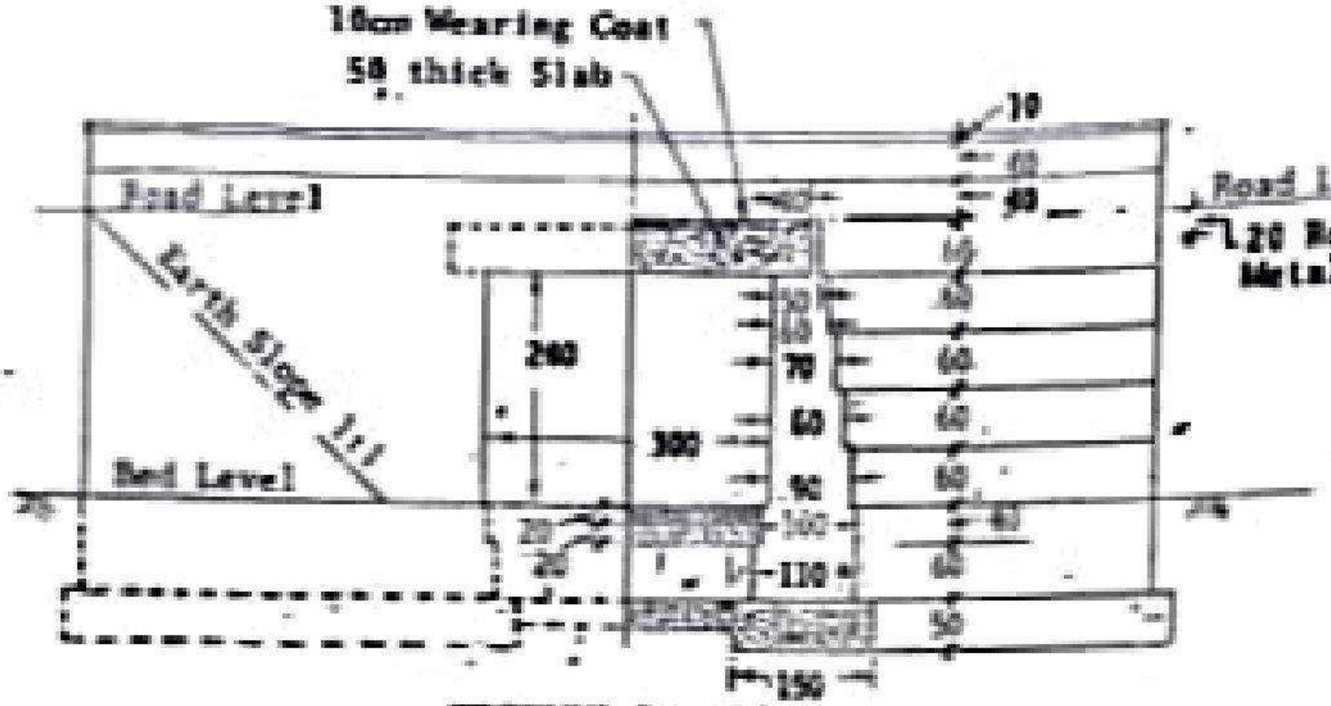
BRIDGES AND CULVERTS



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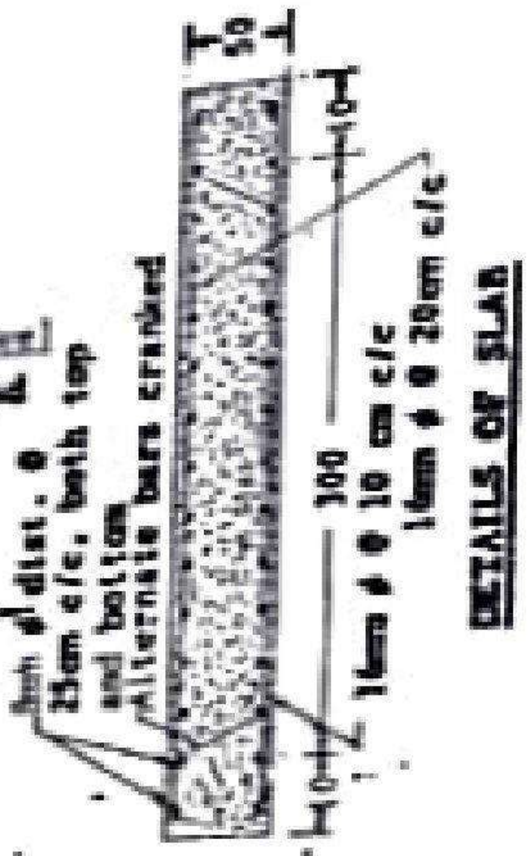
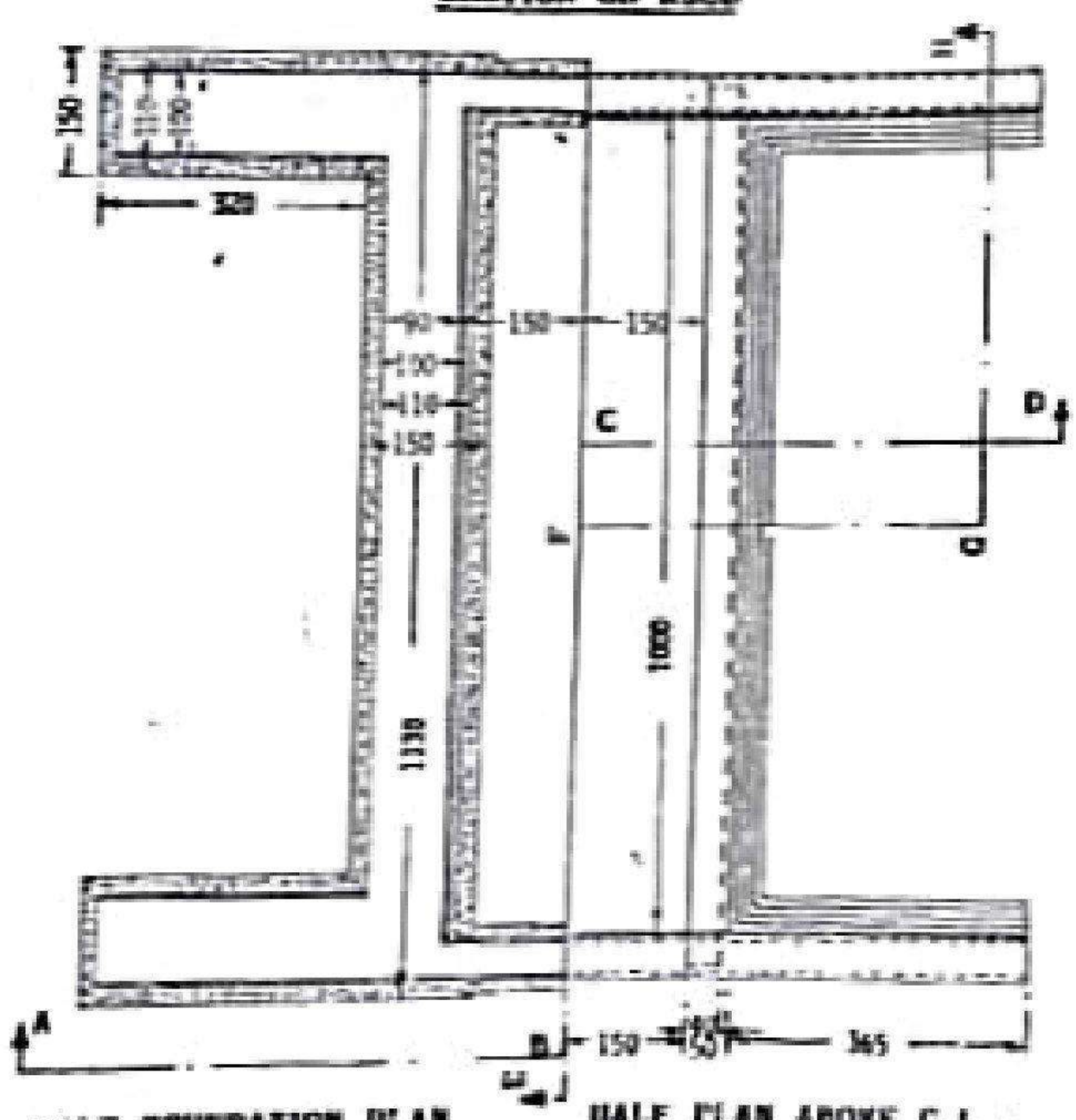
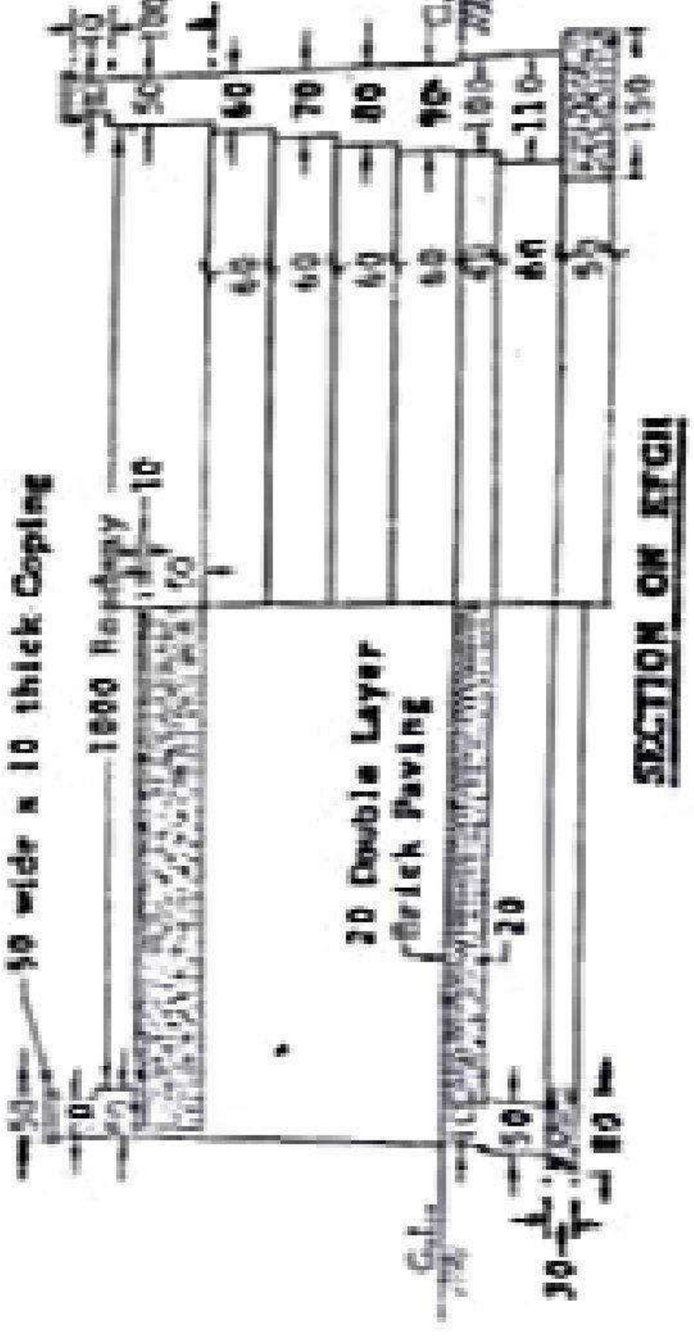




HALF FOUNDATION PLAN

HALF PLAN ABOVE G.L.



SECTION ON EFGH

ALL DIMENSIONS IN CENTIMETRE

I.N	Description of item	NO	L	B	H	Qty.	Explanatary Note
1.	Earthwork in Excavation						H = 0.5 + 0.6 + 0.4
	a- Abutment	2	11.5	1.5	1.5	51.75	
	b- wingwall	4	3.2	1.5	1.5	28.8	
	c- curtain wall	2	2.3	0.8	1.3	4.78	H = 0.3+0.6+0.4
	d- Base concrete Floor.	1	9.8	2.3	0.4	9.01	H = 0.2+0.2 L = $\frac{300-2(5+10+20)}{100}$ curtain wall L = $2\left(\frac{1000}{2}+50-40-5\right)$ 100 Base conc. floor B = $\frac{300-2\times5}{100}$ L = $2\left(\frac{1000}{2}+50-40\right)$ 100
2.	Cement concrete in Foundation						
	a- Abutment	2	11.5	1.5	0.5	17.25	
	b- wingwall	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 = $\frac{2\times\left(\frac{1000}{2}+50+5\right)}{100}$
	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						L = 3.2 - 0.2 + 0.2 = 3.2
	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	iii) L = 3.2+0.05 = 3.25
	iv) 4th footing	4	3.35	0.8	0.6	6.43	iv) L = 3.25+0.1 = 3.35

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		No	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						
	i) 1st Footing	2	2.7	0.5	0.6	1.62	or L = 300-2x(5+10)/100 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 or = 300-2x5/100 = 2.9
	d) Parapet						
	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+2x0.05 = 11.4M
	e) Deduction for projection of slab on Abutment	2	10.8	0.4	0.5		L = 11-2x0.1
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+0.6x5+0.4x2 (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+2x0.05+2x0.
	) sides of parapet coping						
	a) 1st Footing	4		0.5	0.5		H = 1-0.5 = 0.5
	b) and Footing	4		0.4	0.4		
	c) Coping	4		0.5	0.1		

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I.N	Description of item	NO	L	B	H	Qty.	Explanatory Note
	d) Deduction						
	i) Rectangular opening in face-wall	1	3		2.5		H = 2.4 + 0.1 = 2.5
	ii) Triangular portion below side slope	4	$\frac{1}{2}$	x3 x3		4.5	H = 5 x 0.6 = 3m.
6.	wearing coat	1	10	3.8	0.1		

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

Assume suitable rates.

PIPE CULVERT

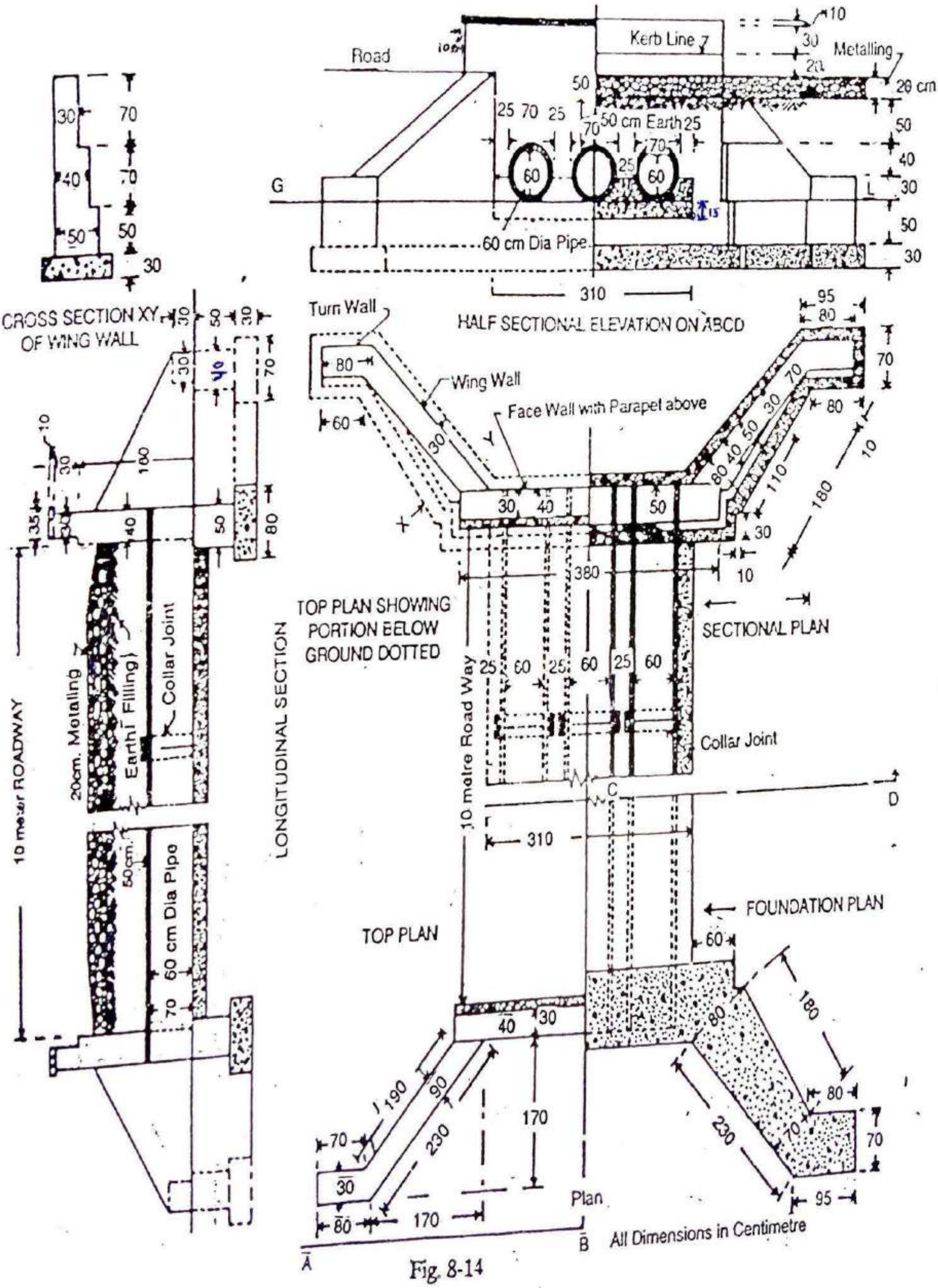

Fig. 8-14

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I.N	Description Of Item	NO	L	B	H	Qty.	Explanatary Note
	Earth work in excavation						
	1) a) Face wall	2	3.1	0.8	0.8		H = 0.5+0.3 = 0.8
	b) wing wall						
	i) Triangular portion	4	1/2	0.8	0.8		H = 0.5+0.3 = 0.8
	ii) Trapizodal 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		$H = 0.5^{2}+0.3 = 0.8$
							$L = \frac{0.8+0.95}{2} = 0.87$
	d) Base concrete floor	1	9.5	3.1	0.15		L = 10 - 2 x (0.1+0.15) = 9
2.	Cement concrete in foundation						
	a) face wall	2	3.1	0.8	0.3		
	b) wing wall						
	i) Triangular portion	4	1/2	0.8	0.3		
	ii) Trapizodal 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		

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I.N	Description of items	NO	L	B	H	Qty.	Explanatory note
	(iv) Coping :	2	3.9	0.35	0.1		L = 3.8 + 2×0.05 = 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	4	1.1	0.1	0.2		
	Above 80 cm height						
	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 facewall	2×3	$\frac{\pi}{4}\times(0.7)^2$		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 up to 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

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I.N	Description of Item	NO	L	B	H	Qty.	Explanatary Note
	iv) coping	2	3.9	0.6			B = 0.1+0.35+0.1+0.6
	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 Facewall	6	$\frac{\pi}{4}\times(0.6)^2$				Area = $\frac{\pi}{4}\times(0.6)^2$
							$= 0.28M^2$

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(i)

(Straight bar with end hooks)

(ii)

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

(iii)

Bent up bar (two side crank with end hooks)

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

Lx = length of short span. (Breadth)

→ If, $\frac{Ly}{Lx}$ greater than two, $\left(\frac{Ly}{Lx} > 2\right)$ then the slab is one way.

→ If, $\frac{Ly}{Lx} \leq 2$, 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 6 MM, 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

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→ 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 qtn no (1).

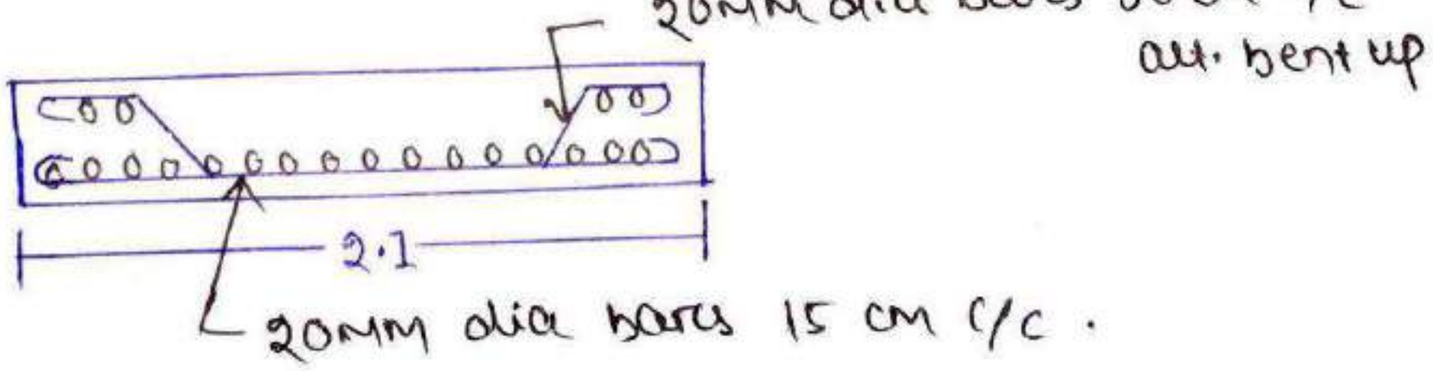
Ans → Here, long span (L_y) = 4.8m

short span (L_x) = 2.1m

Thickness (T) = 0.2m

Here, $\frac{L_y}{L_x} = \frac{4.8}{2.1} = 2.28m > 2$ (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.

" " " " " bentup bar = 30cm.

" " " " Main straight and bentup = 15cm

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No. of spac 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 x 0.04 + 2 x 9ϕ

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

$\Rightarrow$ 2.38 m.

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

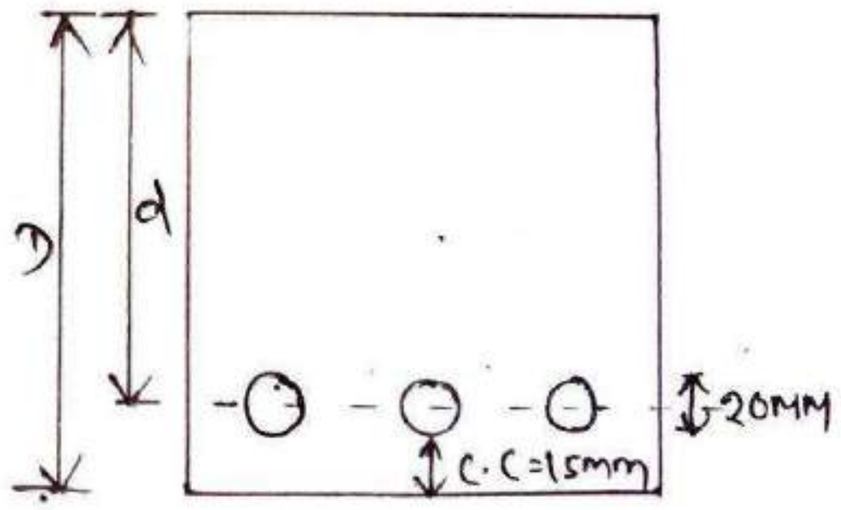
$\Rightarrow$ 2.38 + 2 x $\frac{0.175}{2}$

$\Rightarrow$ 2.55m

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

$\Rightarrow$ 175 MM

$\Rightarrow$ 0.175 M



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

$\Rightarrow$ 17 x 2.38 = 40.46 M

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

$\Rightarrow$ 16 x 2.55 = 40.8 m

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

$\Rightarrow$ 81.26M

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

$\Rightarrow 2.466$ kg

$\Rightarrow 2.47$ kg

So, total weight of main bar $= 2.47 \times 81.26$

$\Rightarrow 200.71$ kg

Calculation of reinforcement along long span (Distribution ba

NO. of spacing of 10MM dia bottom distribution bar @250

$$= \frac{\text{short span}}{\text{spacing of longspan bar}}$$

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

So, NO. of bar $= 8 + 1 = 9$ 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 =

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

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

$\Rightarrow 4.9$M

Total length of bottom distribution bar $= 4.9 \times 9$

$= 44.1$m

Total length of top distribution bar $= 4.9 \times 4$

$= 19.6$m

Total length of 10MM dia distribution bar =

$(44.1 + 19.6)$m

$\Rightarrow 63.7$m

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Weight of 10MM dia rod per meter length = $7850 \times \frac{\pi}{4} \times (0.01)^2$

$\Rightarrow 0.616 kg$.

$\Rightarrow 0.62 kg$.

So, total weight of distribution bar

$\Rightarrow 0.62 \times 63.7$

$\Rightarrow 39.49 kg$

2. The dimension of a RCC slab is (4M x 5M x 12CM) depth. Reinforcement of the total number of rods 16 Numbers have been cranked and hooked at the ends. Other rods are straight and hooked that 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 0.62kg/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 → Data given,

Short span (l_x) = 4M, long span (l_y) = 5M

Overall depth (D) = 12CM = 0.12M

Centre to centre spacing bet^n short span bares = 15 cm

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 bet^n long span bar = 20 CM

weight/M length of 10MM dia bar = 0.62 kg.

clear cover from bottom of slab = 1.8CM

Side cover = 2.5 CM

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Here, $\frac{Ly}{lx} = \frac{5}{4} = 1.25 >2$ (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 bet^n 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 shortspan bar = 33 + 1 = 34 NOS.

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

Number of 12 MM dia straight " " = 34 − 16 = 18 NOS

Length of 12MM dia straight bar with end hooks =

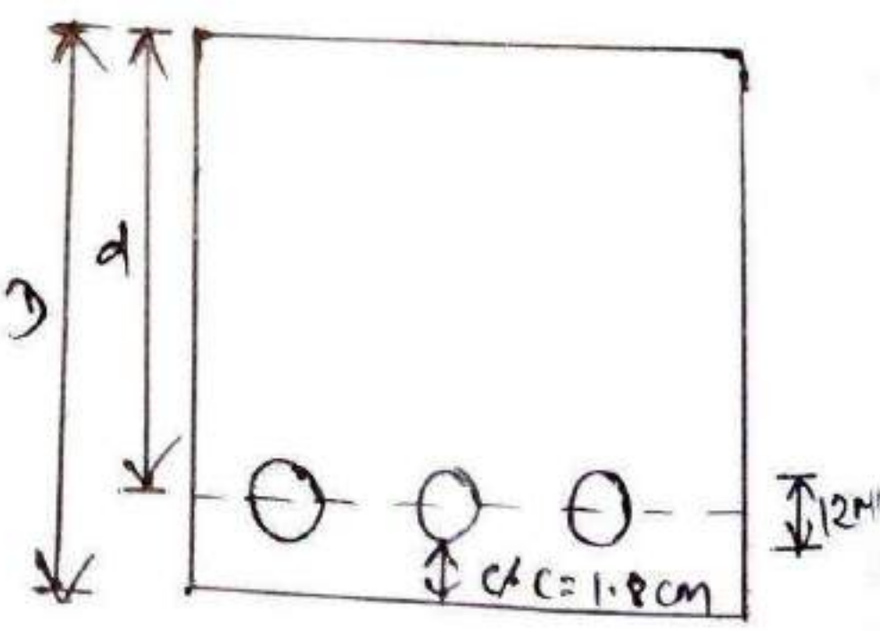
$\Rightarrow$ 4 - 2 x side cover + 2x hook length

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

$\Rightarrow$ 4.16M.

d = D - effective cover

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



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 x d/2.

$$\Rightarrow \left(4.16 + 2 \times \frac{0.096}{2}\right) = 4.256\text{M}$$

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Total length of straight bar = 18 x 4.16 = 74.88 M.

" " " cranked bar = 16 x 4.256 68.096

Total length of short span bar = 74.88 + 68.096 = 142.976 M

Weight / M length of short span bar = 0.89 kg.

So, total weight of short span bar = 0.89 x 142.976

⇒ 127.248 kg.

Calculation of Reinforcement along long span (10MM dia Main bar)

Here, c/c spacing of long span bar = 20CM = 0.2 m.

Number of spacing of bottom long span bar = $\frac{\text{short span}}{\text{spacing of long span bar}}$

⇒ $\frac{4}{0.2}$ = 20 M.

Number of bars = 20 + 1 = 21 NOS.

Number of top long span bar = 4 NOs.

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

⇒ 5 - 2 x side cover + 2 x hook length.

⇒ 5 - (2 x 0.025) + 2 x (9 x 0.010)

⇒ 5.13 M.

Total length of bottom long span bar ⇒ 21 x 5.13

⇒ 107.73m

Total length of top long span bar ⇒ 5.13 x 4

⇒ 20.52m.

Total length of long span bar = (107.73 + 20.52) M

⇒ 128.25 m.

Weight / M length of bar = 0.62 kg.

So, total weight = (0.62 x 128.25)

⇒ 79.51 kg.

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3) Calculate the quantity of reinforcement required for a R.C.C slab of size (3.5M x 5m x 12CM) thick. 8mm dia rods are placed in short span @ 20 cm 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 6 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 bet^n short span bar = 20cm.

Dia of short span bar = 8mm

c/c spacing bet^n 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. = $\frac{\text{Long span}}{\text{spacing of short span bar}}$

$\Rightarrow \frac{5}{0.2} = 25M.$

No. of 8MM dia short span bar @ 20 CM c/c crank at one end placed at bottom = 25 + 1 = 26 NOS.

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

$\Rightarrow 3.5 - (2 \times 0.04) + 2 \times (9 \times 0.008)$

$\Rightarrow 3.56M.$

d = D - effective cover

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

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Length of bent up bar :

= Length of straight bar + $d/2$

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

Total length of 8MM dia short span bar placed at top

$= 6 \times 3.56 = 21.36 m$.

Total length of cranked bar with end hooks

$= 26 \times 3.605 = 93.73m$.

Total length of 8MM dia short span bar $= (93.73 + 21.36)$ m

$= 115.09$ m

weight of 8mm dia rod per meter length =

$7850 \times \frac{\pi}{4} \times (0.008)^2 \times 1$

$\Rightarrow 0.394$ kg.

So, total weight of 8MM dia short span bar $= 0.394 \times 115.09$

$\Rightarrow 45.412$ kg.

calculation of reinforcement along long span :-

NO. of spacing of 8mm dia long span bar @ 25 cm c/c placed at bottom

$$= \frac{\text{short span}}{\text{spacing of long span bar}}$$

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

Number of long span bars $= 14 + 1 = 15$ NOs.

Number of top long span bar $= 6$ NOs.

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

$= 5 - 2 \times$ side cover $+ 2 \times$ HOOK length.

$= 5 - (2 \times 0.04) + 2 \times (9 \times 0.008) = 5.064m$.

$d = 0.091$ m

~~Total length of bottom bar~~

~~$= 15 \times 5.064 = 75.96m$~~

~~Total length of top bar~~

~~$= 6 \times 5.064 = 30.384m$~~

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

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

$\Rightarrow 5.109$ m.

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

$= 15 \times 5.109$

$\Rightarrow 76.635$ m

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

$= 6 \times 5.064$

$\Rightarrow 30.384$ m

Total length of long span bar = $(76.635 + 30.384)$ m

$\Rightarrow 107.019$ m.

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

So, total weight = 0.394×107.019

$\Rightarrow 42.165$ kg.

So, total quantity of reinforcement required

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

$\Rightarrow (45.412 + 42.165)$ kg

$\Rightarrow 87.57$ kg

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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 @ 30 CM 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 = NO. of spacing + 1 = 16 + 1 = 17 NOS. L = 2.1 - (2 x 0.04) + 2 x (9 x 0.02) ⇒ 2.38M
	b) 20MM dia short span bar @ 30 CM C/C crank and hooked at end	16	2.55	⟶		40.8	L = Length of straight bar + 9/2 (for each bent up). $d = \frac{200 - (15 + \frac{20}{2})}{1000}$ ⇒ 0.175 m L = 2.38 + 0.175 = 2.555 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 x 0.04) + 2 x (9 x 0.01) = 4.9m
	a) 10MM dia distribution bar @ 25 cm C/C straight and hooked at end placed at bottom						
	b) 10MM dia distribution bar all are straight and hooked at end	4	4.9	⟶		19.6	MINIMUM NO = 50% total NO. OF bottom bars.

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placed on top.

Total 63.7 m
@ 0.62 kg/m^3
= 39.49 kg.

S.N	Particulars of Item	NO	Length	Breadth	Height	Quantity	Explanatory Note.
1)	Calculation of reinforcement along short span. (Main bar) 12 M.M dia short span bar @ 15 cm c/c placed at bottom $NO = \frac{5}{0.15} + 1 = 34.33 \simeq 34$ NOs.	34					
	a) 12MM dia short span bar all are straight and hooked at end. placed at bottom.	18	4.16	⌐¬		74.88	NO = 34 - 16 = 18 $L = 4 - (2 \times 0.025) + 2 \times (9 \times 0.012)$ $\Rightarrow 4.16m$
	b) 12MM dia short span bar all are crank and hooked at the end placed at bottom	16	4.256	⌐¬		68.096	L = length of straight bar + 2 x d/2 for each bent up $\Rightarrow \left(4.16 + 2 \times \frac{0.096}{2}\right) = 4.256m$ $d = \frac{120 - (18 + \frac{12}{2})}{1000} = 0.096m$
					Total	142.97	
					@0.89 kg/m		
					$\Rightarrow$ 127.24 kg		
2)	Calculation of reinforcement along long span (Main bar)						$N = \frac{4}{0.2} + 1 = 21$ NOs.
	a) 10 MM dia long span bar @ 20 CM c/c all are straight and hooked placed at bottom.	21	5.13	⌐¬		107.73	$L = 5 - (2 \times 0.025) + 2 \times (9 \times 0.010)$ $\Rightarrow 5.13m$
	b) 10MM dia long span bar all are straight and hooked at end placed at top	4	5.13	⌐¬		20.52	
					Total:	128.25 kg	
					@0.62 kg/m		
					$\Rightarrow$ 79.51 kg.		

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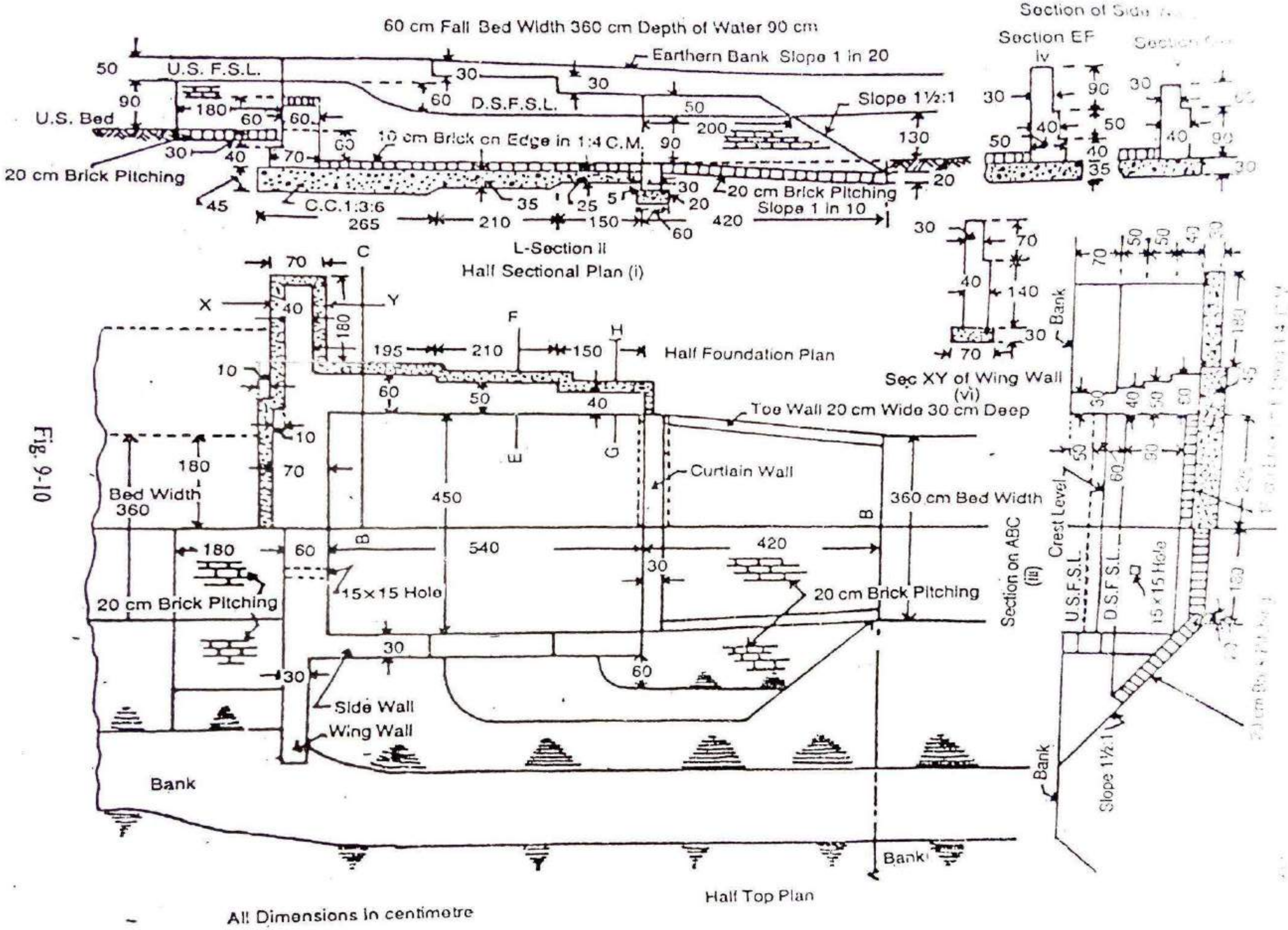
60 cm Fall Bed Width 360 cm Depth of Water 90 cm
Earthern Bank Slope 1 in 20
U.S. F.S.L.
U.S. Bed
D.S.F.S.L.
Slope 1½:1
10 cm Brick on Edge in 1:4 C.M.
20 cm Brick Pitching
C.C.1:3:6
20 cm Brick Pitching
Slope 1 in 10
L-Section II
Section EF
Half Sectional Plan (i)
Half Foundation Plan
Toe Wall 20 cm Wide 30 cm Deep
Curtain Wall
Sec XY of Wing Wall (vi)
Bed Width 360
360 cm Bed Width
15×15 Hole
20 cm Brick Pitching
Side Wall
Wing Wall
Bank
Section on ABC (iii)
U.S.F.S.L.
D.S.F.S.L.
15×15 Hole
Slope 1½:1
Half Top Plan
All Dimensions in centimetre

Fig. 9-10

CHAPTER-2

ESTIMATION OF IRRIGATION STRUCTURE

Nos	particulars of Item	NO	Length	Breadth	Height	Quantity	Explanatory Note
1)	Earth work in excavation						
	a) Creast wall including inner to inner of 60 cm 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 50 cm side wall	1	2.1	5.8	1.05	12.78	H = 0.6 + 0.1 + 0.35 = 1.05 B = 4.50 + 0.5 + 0.15 + 0.5 + 0.15 = 5.8
	c) Outer to Outer of 40 cm 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
2)	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) Trapizodal portion between Toe walls along the down-stream side	1	3.9	$(Bd + Sd^2) \times L$ $= \{(4.05 \times 0.8) + (1.5 \times 0.8^2)\} \times 3.9$ $= 6.98$			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						L = 4.2 - 0.3 $B = \frac{3.2 - 4.1}{2} = 3.65$
	→ Bed	1	3.9	3.65	0.2		
	→ side slope	2	3.1	1.62	0.2		$L = \frac{4.2 + 2}{2} = 3.1$ $B = d\sqrt{1.5^2+1} = 1.622$
	j) Circular portion of Brick pitching	2	$\frac{\pi}{4} \times (0.6)^2 \times 0.2 = 0.22$			0.45	

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I.N	Particulars of Item	NO	length	Breadth	Height	quantity	explanatary Note
	→ Deduction for rectangular portion behind creast wall	2	0.1	0.6	1.15		
2)	Cement concrete in foundation						
	a) creast wall including inner to inner of 60cm side wall	1	2.65	5	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	0.3		
	e) curtain wall	1	4.5	0.6	0.2		
	f) Deduction for rectangular portion behind creast wall	2	0.1	0.6	0.45		
3)	Brick work in foundation & superstructure						
	a) creast 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		

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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	6					
i) 1st footing						
→ 1st 40cm height above concrete	2	1.8	0.4	0.4	L = 1.8 + 0.15 − 0.15 = 1.8M	
→ 2nd 50cm height	2	1.9	0.4	0.5	L = 1.8 + 0.1 = 1.9M	
→ 3rd 50cm height	2	2	0.4	0.5	L = 1.9 + 0.1 = 2M	
ii) 2nd footing	2	2.1	0.3	0.7	L = 2 + 0.1 = 2.1M	
f) curtain wall	1	4.5	0.3	0.4	H = 0.1 + 0.25 + 0.05 = 0.4M	
4) plastering and painting wall						
a) Creast wall (inner, top and other)	1	4.5	—	1.8	H = 0.6 + 0.3 + 0.6 + 0.3 = 1.8M	
b) Inner side of 1st side wall	2	1.8	—	2	L = 1.95 − 0.15 = 1.8M H = 0.9 + 0.6 + 0.5 = 2M	
c) Inner side of 2nd side wall	2	2.1	—	1.7	H = 0.4 + 0.5 + 0.9 − 0.1 = 1.7m	
d) Inner side of 3rd side wall	2	1.5	—	1.4	H = 0.9 + 0.6 − 0.1 = 1.4m	
e) Top of 1st side wall	2	2.35	0.3		L = 1.95 + 0.4 = 2.35 m.	
f) Top of 2nd side wall	2	2.1	0.3			

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i) Top of 3rd side wall	2	1.5	0.3			
ii) Top of wing wall	2	2.1	0.3			
iii) i) vertical side of 1st side wall	2	–	0.3	0.3		H = 2.1 − 1.8 = 0.3 2.1 - Height of 1st side 1.8 - " " 2nd "
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		03	0.6		
→ wall portion above creast wall	2		0.6	1.1		H = 2.1 − 1 = 1.1m
4) wing wall triangular portion above slope upstream side.	2	$\frac{\pi}{4}$ × 1.4 × 2.1				(0.9 + 0.6 + 0.3 + 0.1) = 2. $\frac{V}{H} = \frac{1.5}{1}$ ⇒ $\frac{2.1}{H} = \frac{1.5}{1}$ ⇒ $H = \frac{2.1}{1.5}$ = 1.
5) 10 c.m brick on edge in 1:4 c.m.	1	5.4	4.5	–		
6) 20 c.m 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	$\frac{\pi}{4}$ × (0.6)² ×				

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DRAINAGE SYPHON ACROSS A MINOR

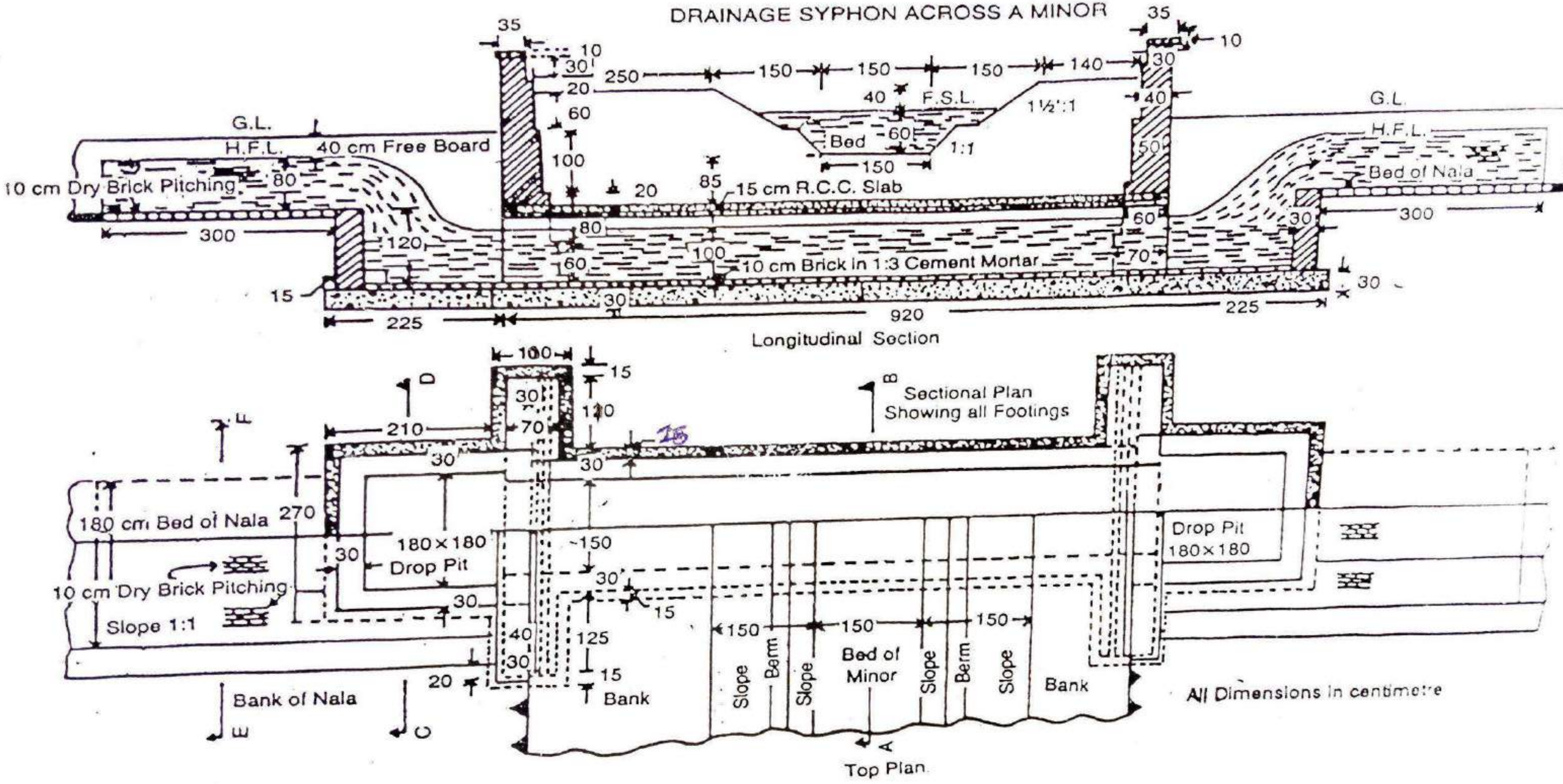

Fig. 9.9

... levels where it is required to lower the bed of the irrigation channel or the ... channel at their crossing. When the bed of the irrigation channel is depressed and taken under 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 Drinage Syphon. The Syphon crossing may be of rectangular closed masonry channel or of circular brickwork of 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.

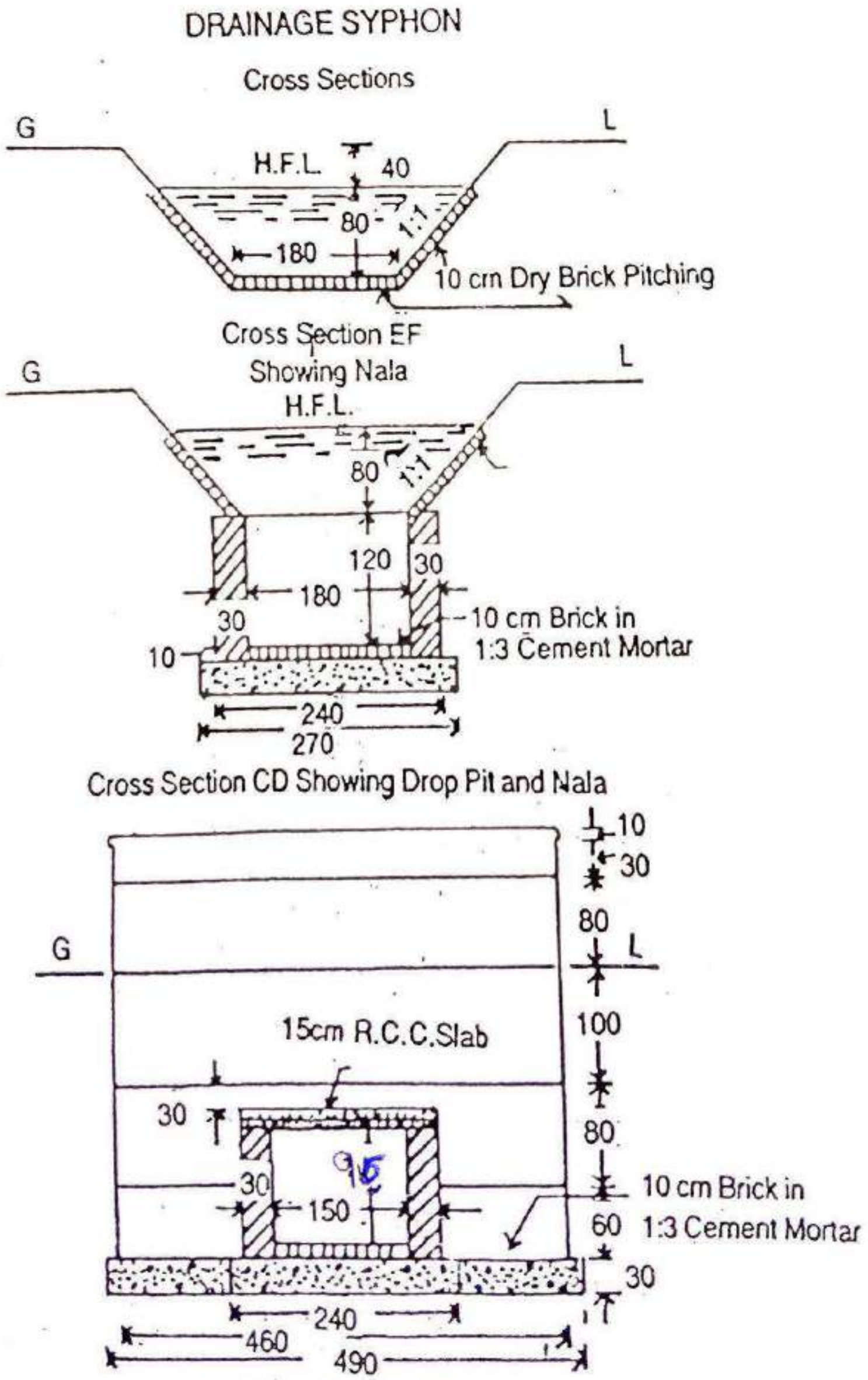

Fig. 9-8

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S.N	Description of item	NO	L	B	H	Qty.	explanatary NOte
1.	Earth work in excavation						L = 9.2 + 2×0.15 = 9.5 B = 1.5 + 2×(0.3+0.15) = 2 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	2×2	2.1	0.3	1.3		L = 1.8 + 0.3 = 2.1 H = 1.2 + 0.1 = 1.3
ii)	Front wall	2	1.8	0.3	1.3		
c)	wing wall						
i)	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.

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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 c.m brick in 1:3 cement mortar over bed slab.						
	a) In between syphon duct side wall	1	9.2	1.5	–	13.8	
	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 x 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	4		0.5	1		
	iii) 3rd footing	4		0.4	0.8		

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	iv) 4th footing	4		0.3	0.3		
	v) coping	4		0.35	0.1		
	vi) trapizodal portion of parapet outside below Ground level.	2	$\frac{1}{2}\times(1.8+4.2)$		1.2		Top width = 1.2+1.8+1.2
7.	10 c.m dry brick pitching						
	a) bed	2	3	1.8	–		D = ~~0.8~~ 0.8 S = 1
	b) side slope	4	3	1.13	–		B = D$\sqrt{S^2+1}$ = 0.8 $\sqrt{(1)^2+1}$ = 1.13

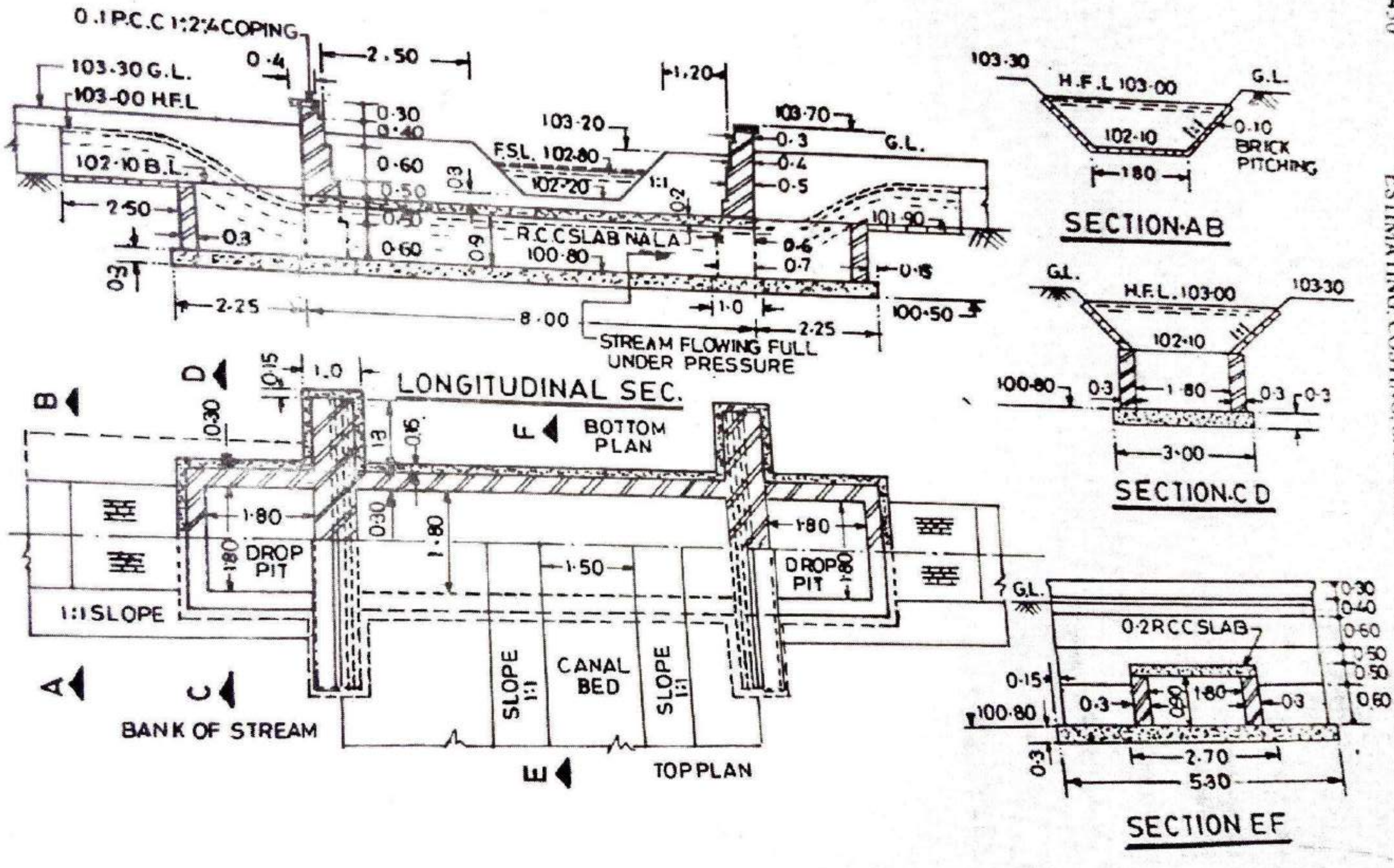
0.1 P.C.C 1:2:4 COPING
103·30 G.L.
103·00 H.F.L
102·10 B.L.
0·4
2·50
0·30
0·40
0·60
0·50
0·50
0·60
0·3
2·50
0·3
2·25
8·00
103·20
F.S.L. 102·80
102·20
1:1
0·2
1·20
103·70
0·3
G.L.
0·4
0·5
101·90
R.C.C SLAB NALA
100·80
0·6
0·7
0·15
1·0
2·25
100·50
STREAM FLOWING FULL
UNDER PRESSURE
LONGITUDINAL SEC.
D
B
0·15
1·0
0·30
1·3
0·15
F
BOTTOM
PLAN
1·80
0·30
1·80
1·80
DROP
PIT
1·80
1·50
1·80
DROP
PIT
1·80
1:1 SLOPE
A
C
BANK OF STREAM
SLOPE
1:1
CANAL
BED
SLOPE
1:1
E
TOP PLAN
103·30
H.F.L 103·00
G.L.
102·10
1:1
0·10
BRICK
PITCHING
1·80
SECTION·AB
G.L.
H.F.L. 103·00
103·30
102·10
1:1
100·80
0·3
1·80
0·3
0·3
3·00
SECTION·C D
G.L.
0·2 RCC SLAB
0·30
0·50
0·60
0·50
0·50
0·60
0·15
100·80
0·3
0·60
1·80
0·3
0·3
2·70
5·30
SECTION EF
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 × (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 & superstructure						
	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. L = 1.8 + 0.3 = 2.1
	ii) Front wall	1	1.8	0.3	1.3		
	c- Drop pit (downstream)						
	i) side wall	2	2.1	0.3	1.1		H = 101.90 - 100.80 = 1.1
	ii) Front wall	1	1.8	0.3	1.1		
	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					0.5	
	i) 1st Footing	2	5	0.6			

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	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 Pointing wall						
	a) Innerside of syphon duct side wall	2	8		0.9		
	b) vertical side of drop pit (upstream)	1	5.4		1.3		L = 1.8 × 3 = 5.4 H = 102.10 − 100.80 = 1.3
	c) Top of droppit						
	→ Top of side	2×2	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) Outerside of parapet upto G.L						
	g) ~~sides~~						
	c) vertical side of drop pit (downstream)	1	5.4	—	1.1		L = 1.8 × 3 = 5.4 H = 101.90 − 100.80 = 1.1

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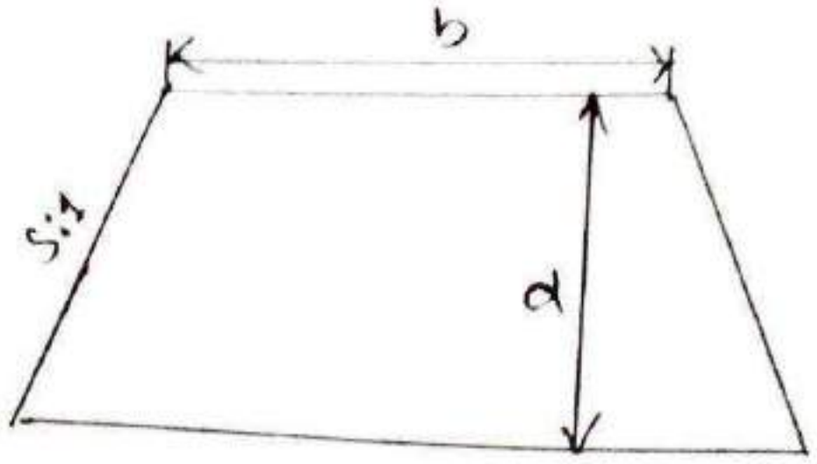
CHAPTER-3

ROAD ESTIMATE



(Cross section of road).

S:1 = H:V

b = formation width of road.

d = depth of road.

volume = V = $(b \cdot d + Sd^2) \times L$

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) Prismodal sectional area

Mid sectional area:

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

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

So volume (V) = $(bd_M + S.d_M^2) \times L$

Mean sectional area:-

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

Here, $A_1 = bd_1 + S.d_1^2$

$A_2 = bd_2 + S.d_2^2$

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

Volume (V) = ~~axl~~ $A_m \times L$

Prismodal sectional Area :-

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

Here, $A_1 = bd_1 + s.d_1^2$

$A_2 = bd_2 + s.d_2^2$

$A_m = bd_M + s.d_M^2$

$d_M = \frac{d_1 + d_2}{2}$, Volume (V) $= \frac{L}{6}\{A_1 + A_2 + 4.A_M\}$

Area of side slope :-

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

) 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

Length of road (L) = 200m

Depth of road at one end (d_1) = 1m.

Depth " " other end (d_2) = 1.6m.

Formation width (b) = 10m.

side slope (s:1) = 2:1 ⇒ s = 2.

Method-I (Mid sectional area method)

Mid depth (d_M) = $\frac{d_1 + d_2}{2} = \frac{1 + 1.6}{2} = 1.3m.$

Mid area (A_m) = $(bd_M + s.d_M^2)$

$= [(10 \times 1.3) + (2 \times (1.3)^2]$

$= 16.38 m^2$

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Volume = Mid area x L

$\Rightarrow 16.38 \times 200 = 3276\ M^3$

Method- II (Mean sectional area)

$A_1 = bd_1 + s.d_1^2 = [(10\times1) + (2\times(1)^2] = 12m$

$A_2 = bd_2 + s.d_2^2 = [(10\times1.6) + (2\times(1.6)^2] = 21.12m$

Mean area $(a_M) = \frac{A_1 + A_2}{2} = \frac{12 + 21.12}{2} = 16.56\ M^2$

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

Method- III (Prismodal sectional area)

$A_1 = bd_1 + s.d_1^2 = [(10\times1) + (2\times(1)^2] = 12m$

$A_2 = bd_2 + s.d_2^2 = [(10\times1.6) + (2\times(1.6)^2] = 21.12m$

$A_M = bd_M + s.d_M^2$

$= [(10\times1.3) + (2\times(1.3)^2] = 16.38m$

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

Volume (V) = $\frac{L}{6}\{A_1 + A_2 + 4.A_M\}$

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

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

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Ans → Data given,

Length of road (L) = 200m.

Depth of road at one end (d_1) = 2.5 m

" " " " other end (d_2) = 3.5 m.

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

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

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

$\Rightarrow 2683.28\ m^2$

volume (v) = Area x thickness → thickness of stone pitching = 15 CM = 0.15M

$\Rightarrow 2683.28 \times 0.15$

$\Rightarrow 402.492\ m^3$

∴ volume of stone pitching = $402.492\ m^3$

Cost of stone pitching ~~@ $402.492\ m^3$~~ @ 150 per cu.m =

$402.492 \times 150 = Rs\ 6373.8$

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 140 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.

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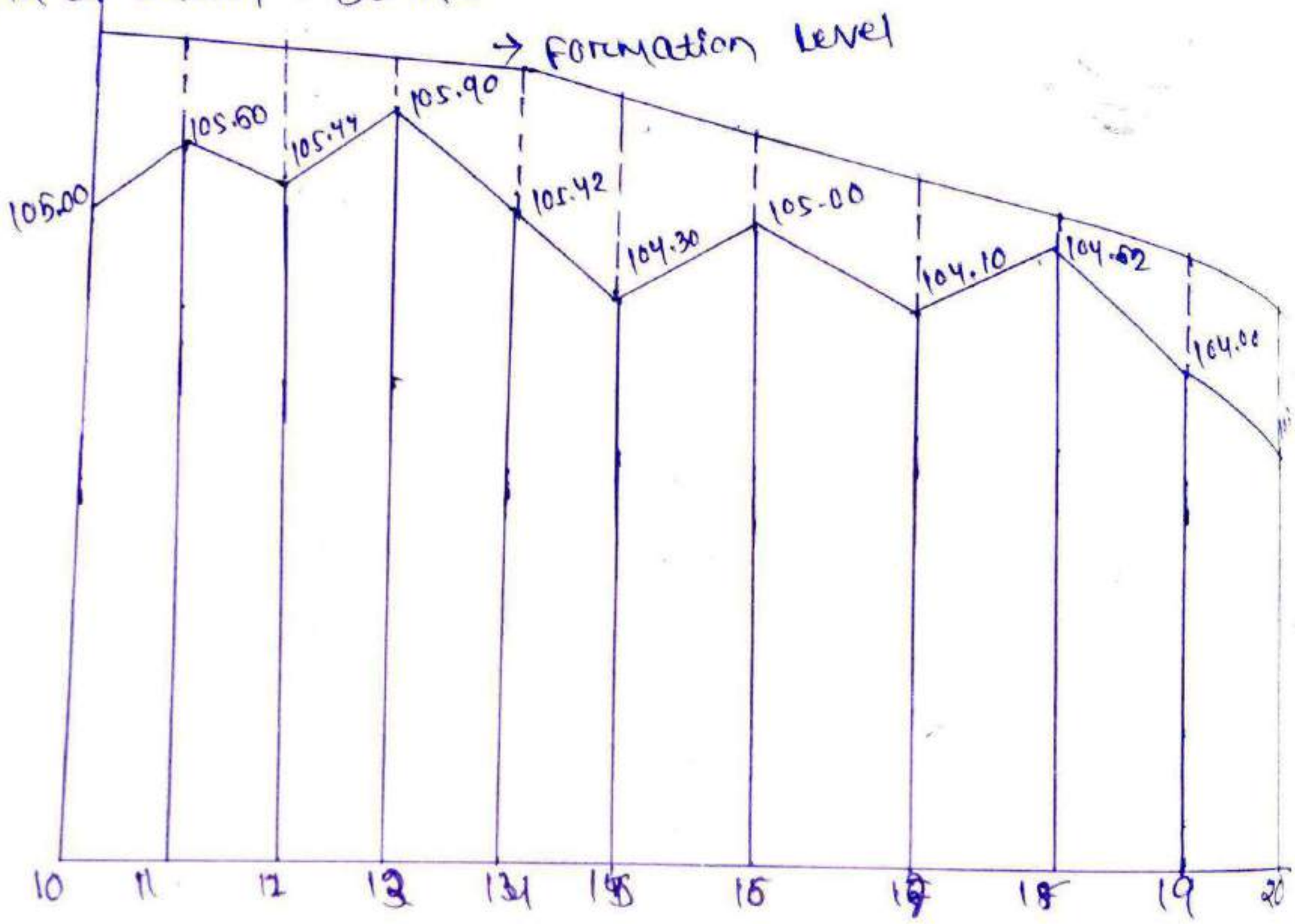
Chainage	10	11	12	13	14	15	16	17	18	19	20
R.L of ground	105.00	105.60	105.44	105.90	105.42	104.30	105.00	104.10	104.62	104.00	103.3
R.L of formation	107.00										

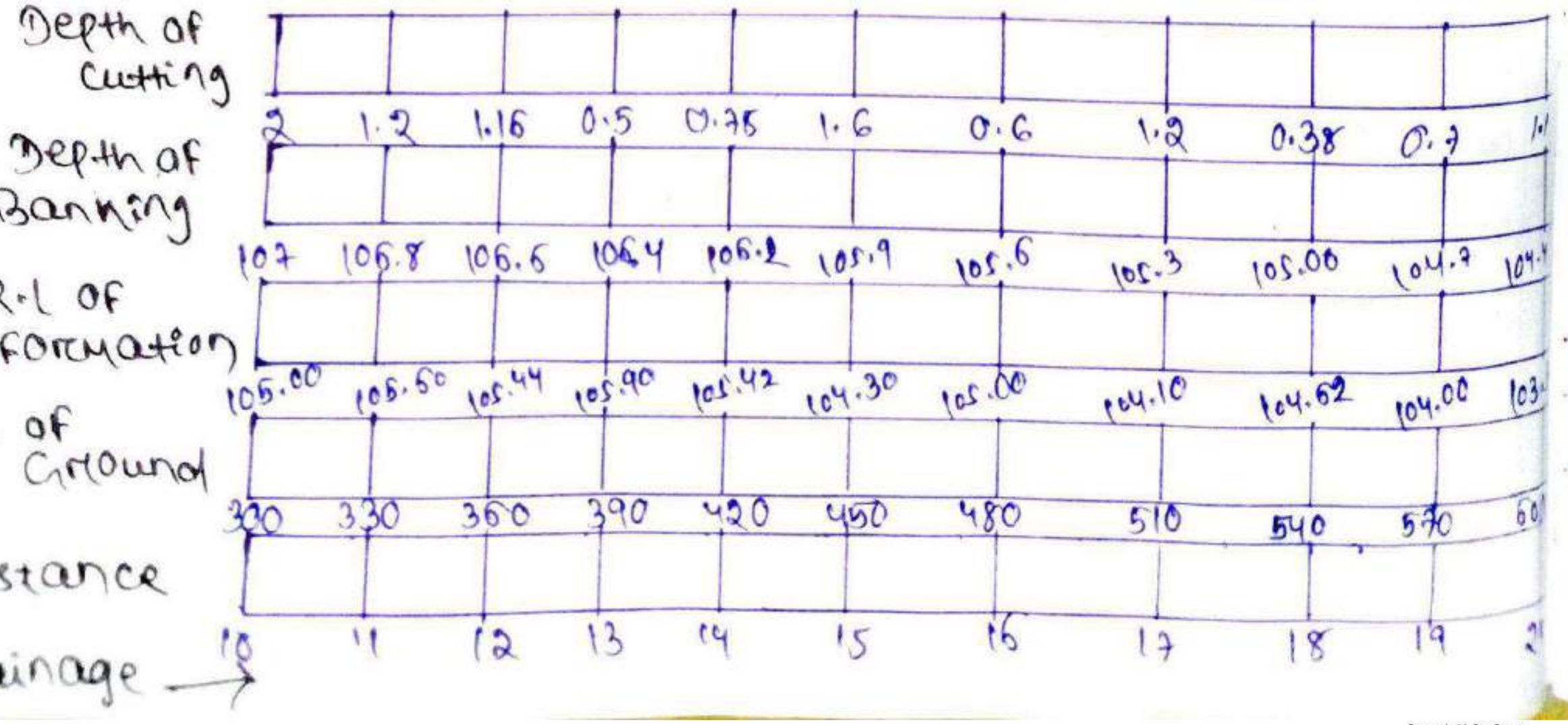
Downward 1 in 150

Downward 1 in 100

Ans →

Length of chain = 30 m.





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station	chainage	distance	length	(d) depth of cutting or banking	mid depth (dm)	central area b·dm	side area s·dm²	total area d·m + s·m²	volume V = bdm + sdm² xL Cutting	volume V = bdm + sdm² xL 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% CU.M =

4) Estimate the cost of earthwork for a portion of road of 400 mt. length from the following data. Formation width of road is 10mt. 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 →									

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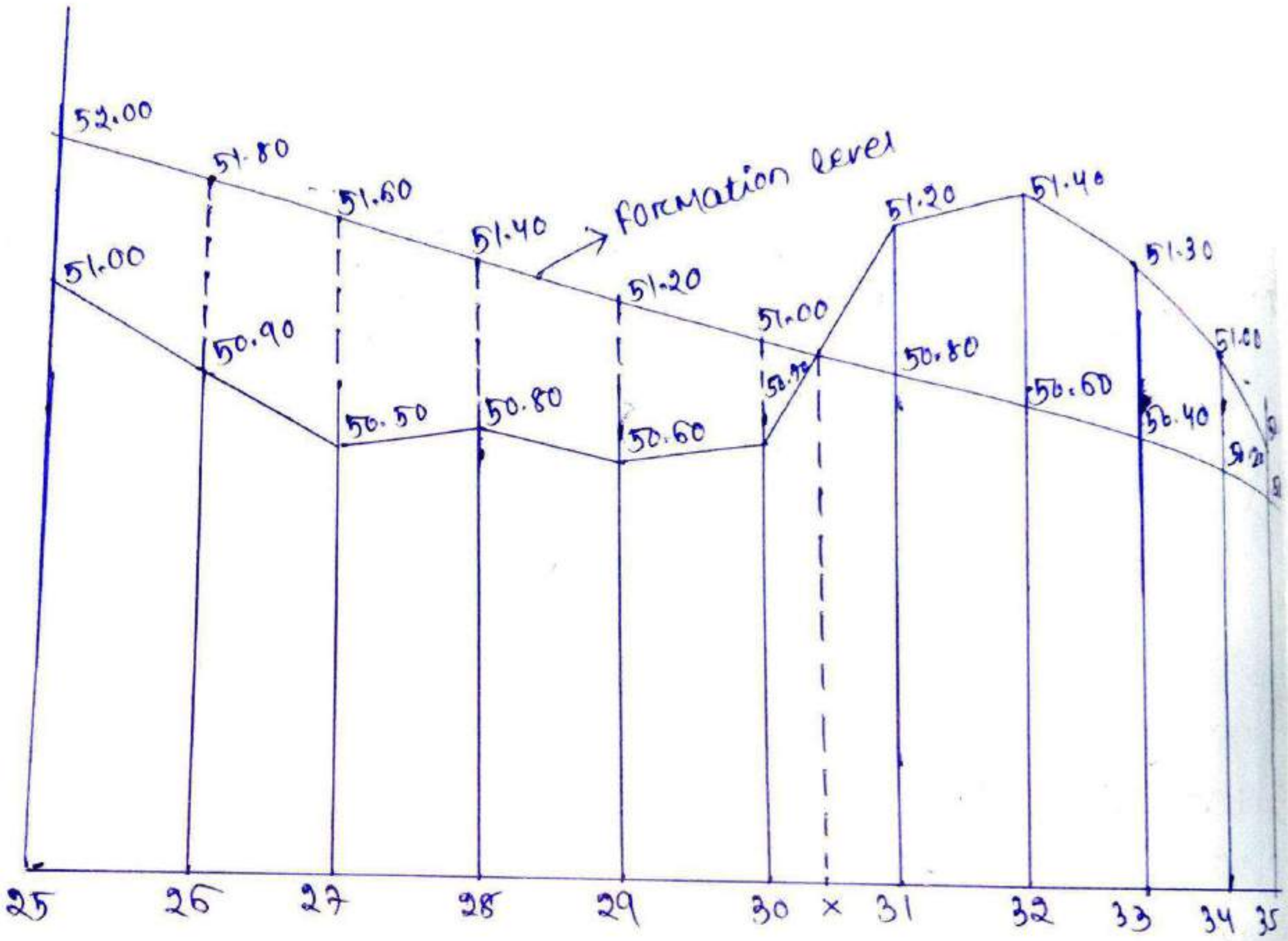

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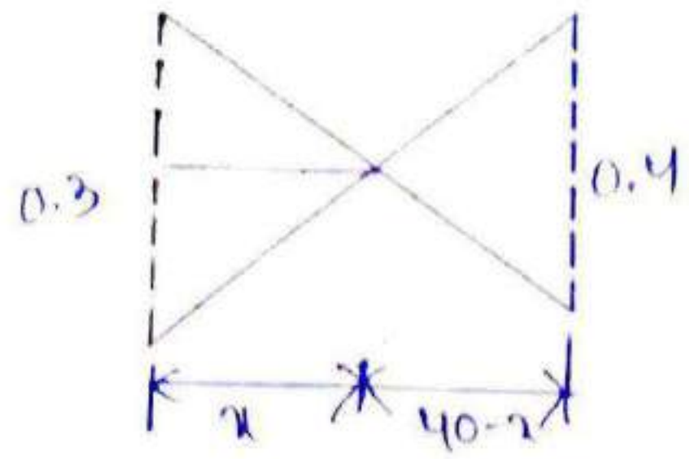
position of point of zero cutting and o banking



51.00 - 50.20 : 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	(a) depth of cutting or banking	mid depth (dm)	central area b d_M	side area s.d_M²	total area b d_M + s.d_M²	Volume (v) = b d_M + s d_M² x 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	201.6	
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.

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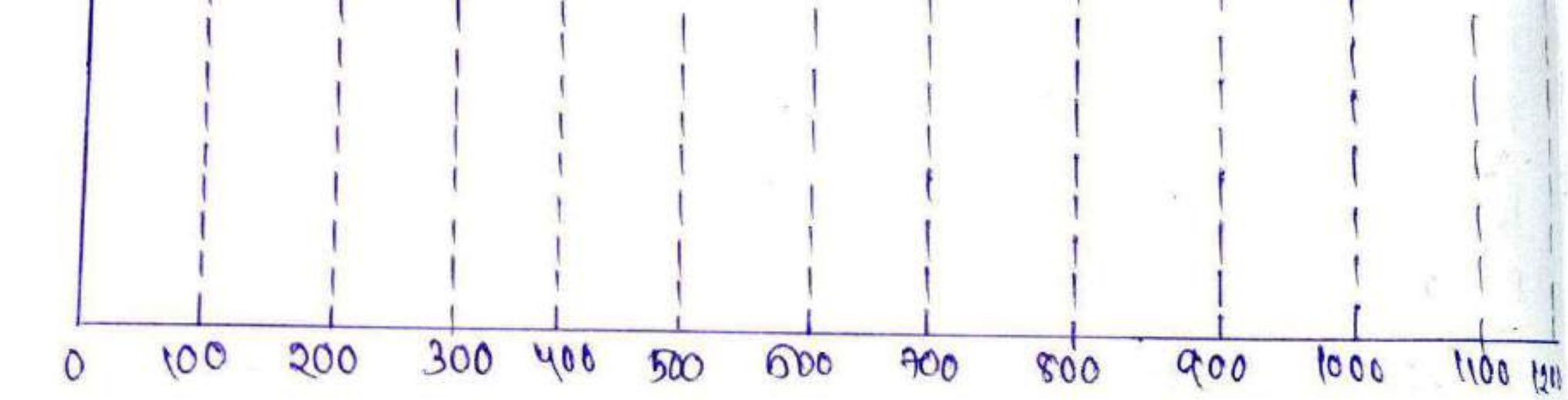
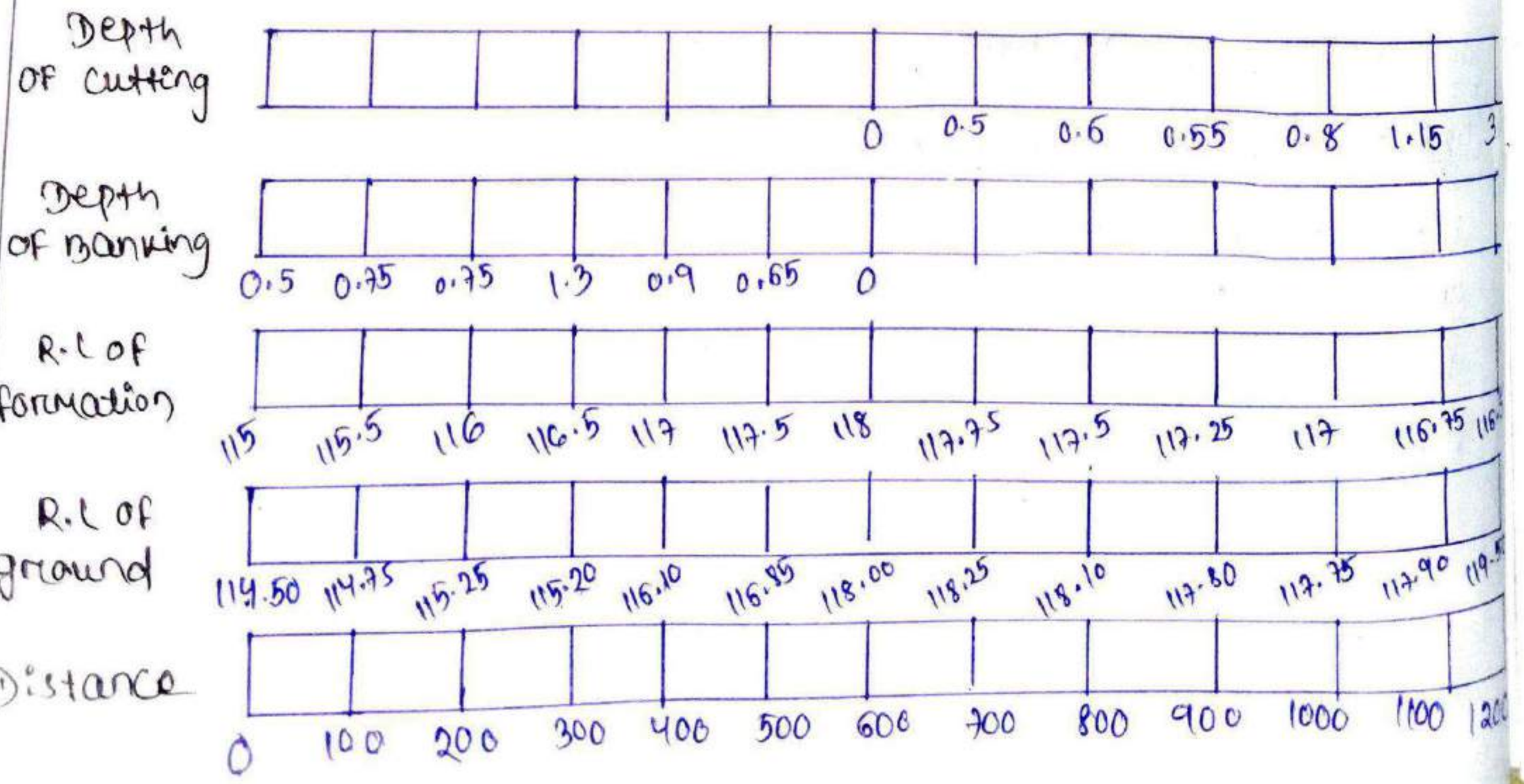
Distance	0	100	200	300	400	500	600	700	800	900	1000	1100	1200
R.L of ground	114.50	114.75	115.25	115.20	116.10	116.85	118.00	118.25	118.10	117.80	117.75	117.90	119.50
R.L of formation	115												

Upward gradient
1 in 200
upto 600m

Downward gradient
1 in 400





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station	Distance	Length	(a) depth of cutting or banking	mid depth (dM)	central area b.dM	side area $s.dM^2$	Total area $bdM + s.dM^2$	Volume (v) = $bdM + s.dM^2 \times L$	
								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		852.5
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	-0.975	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 a the following data. Formation width of road is 8mtr. 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.

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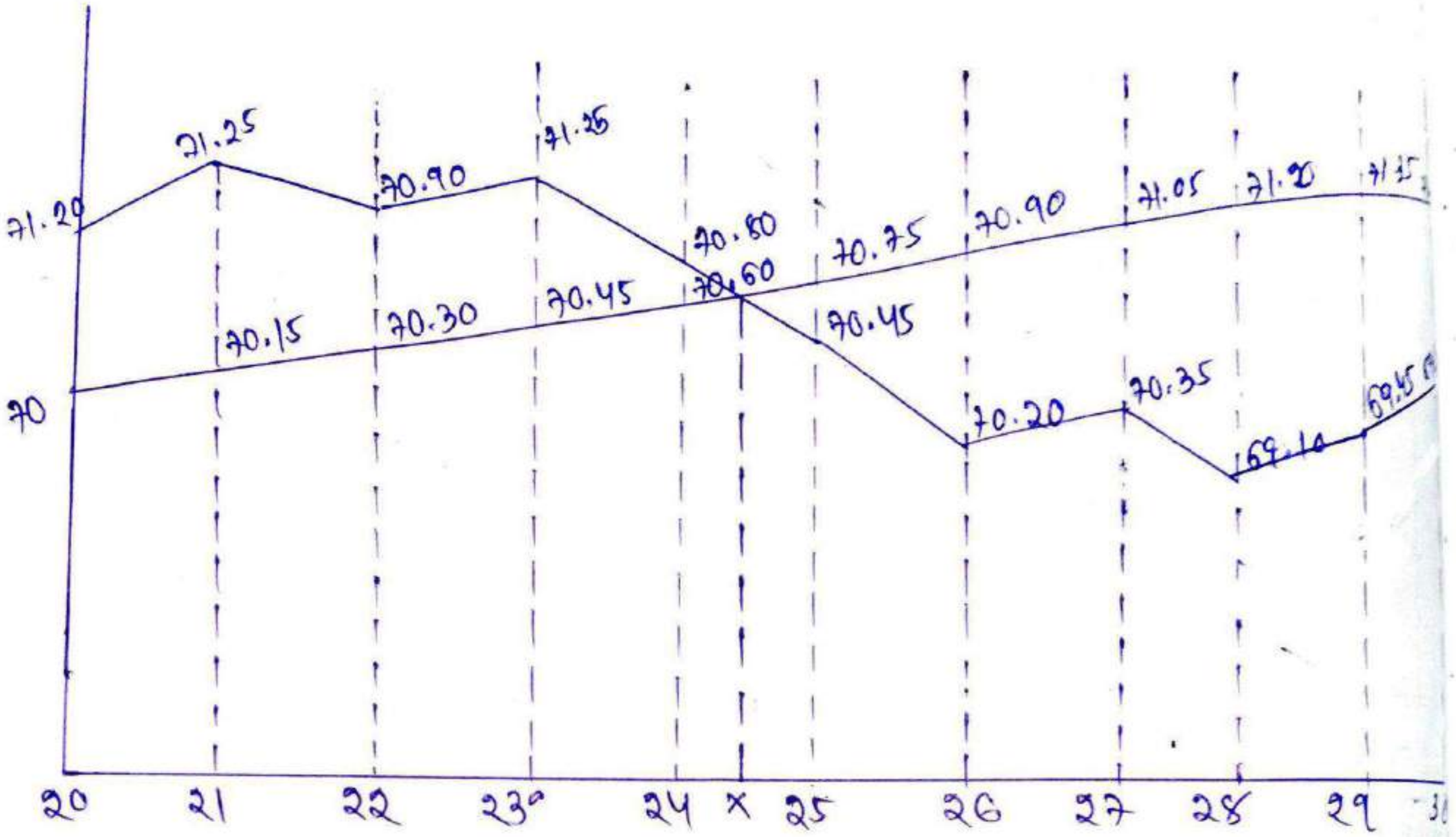

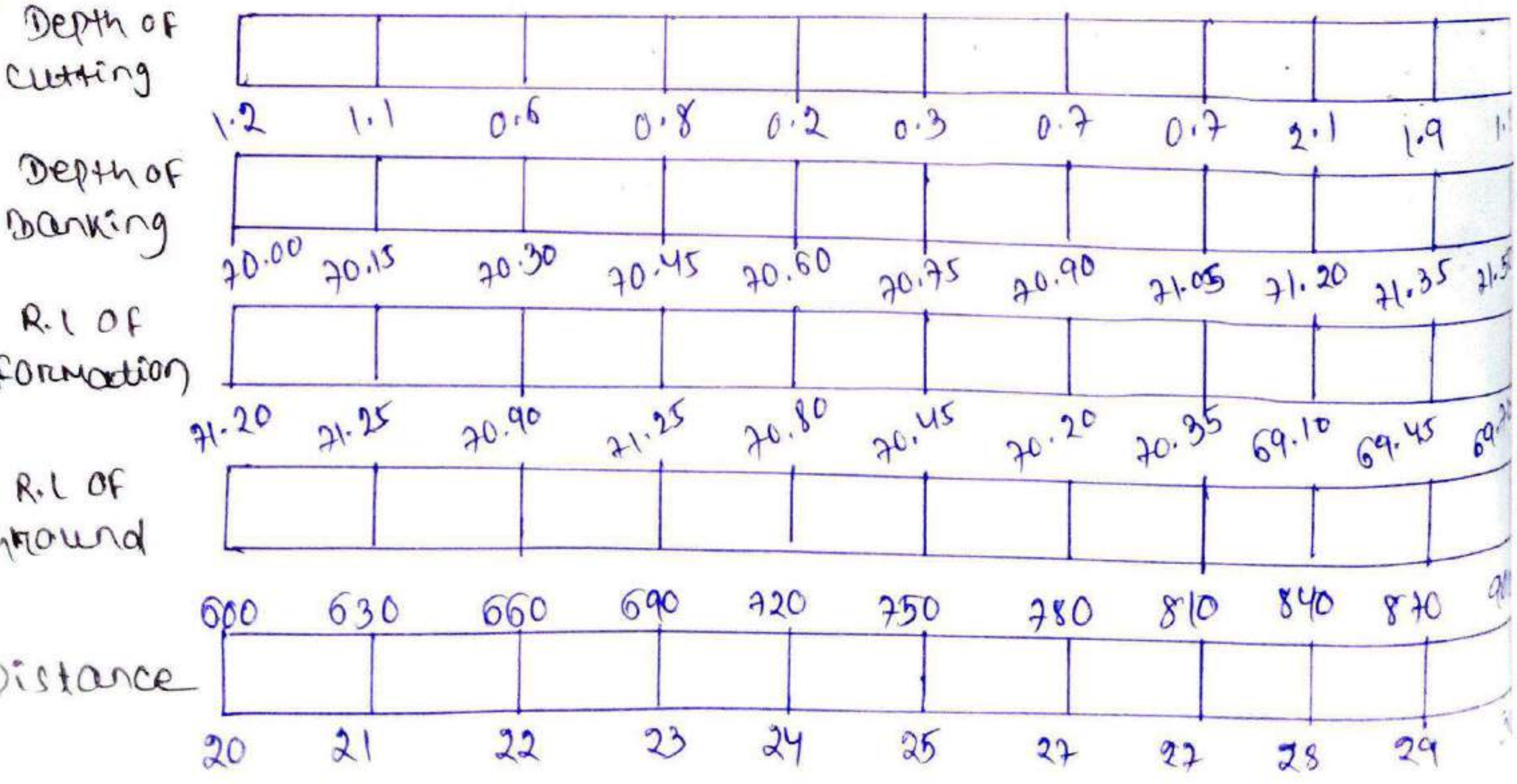

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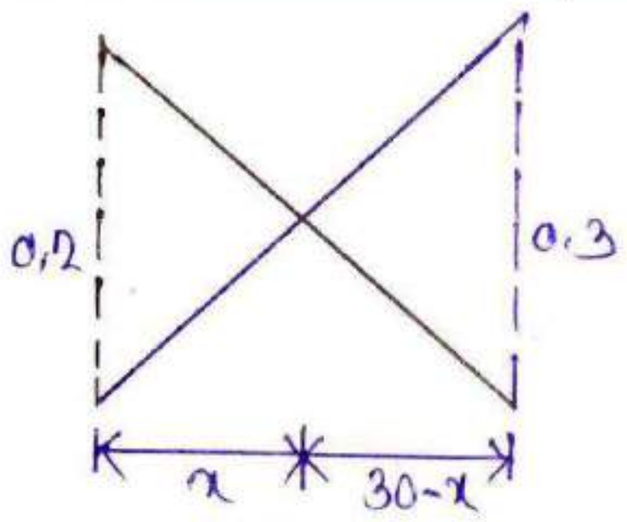
station	Chainage	Distance	Length	(d) depth of cutting on boring	mid depth (dm)	central area bdm	side area s.dm²	Total area bdm+s.dm²	Volume(v)=b[M+s.dm²] x l	
									Cutting	Banking
P_1	20	600	30	1.2	—	—	—	—		
P_2	21	630	30	-1.1	-1.15	9.2	1.983	11.183	335.49	
P_3	22	660	30	-0.6	-0.85	6.8	1.083	7.883	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

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

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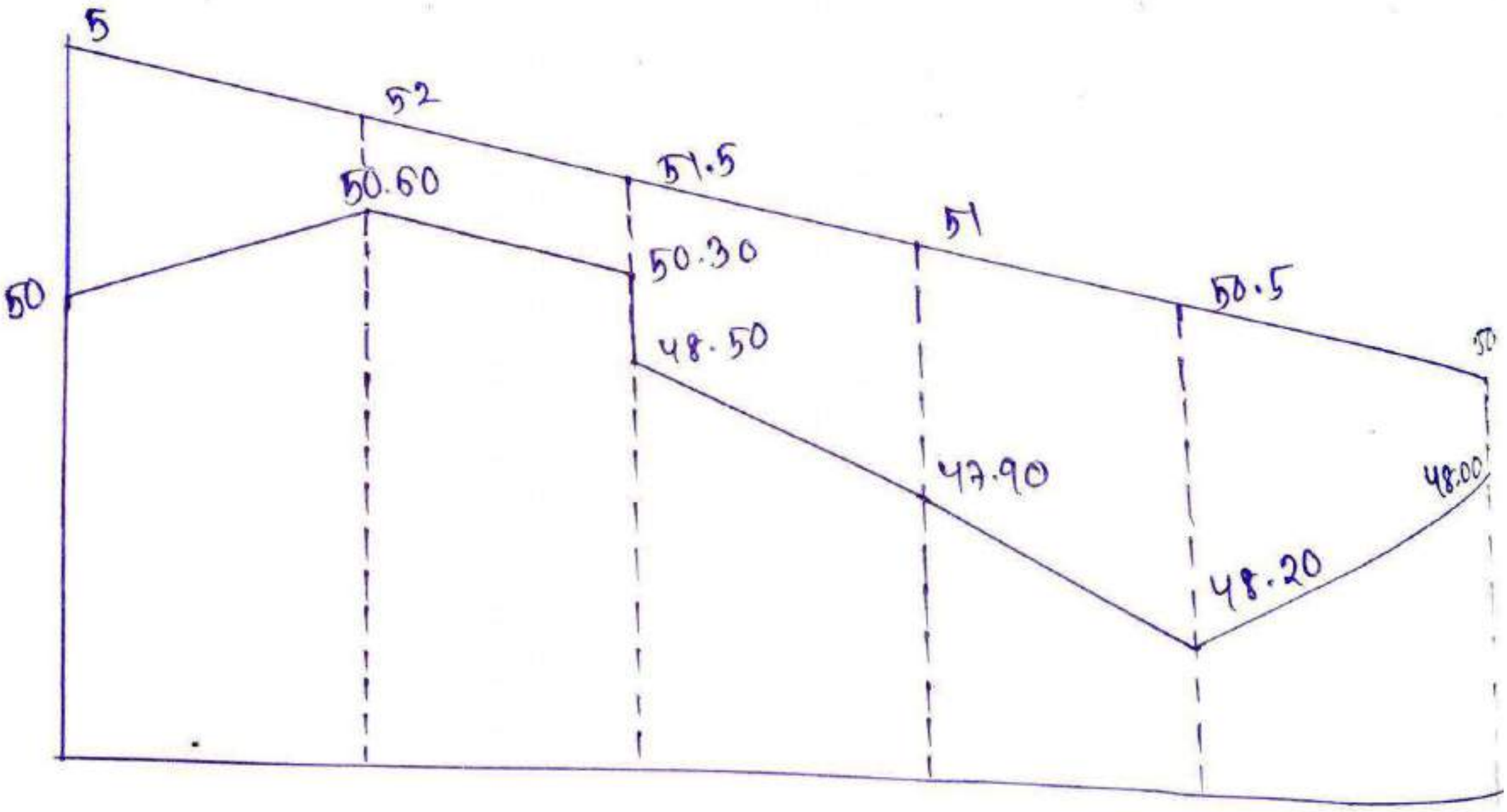
VERTICAL DROP

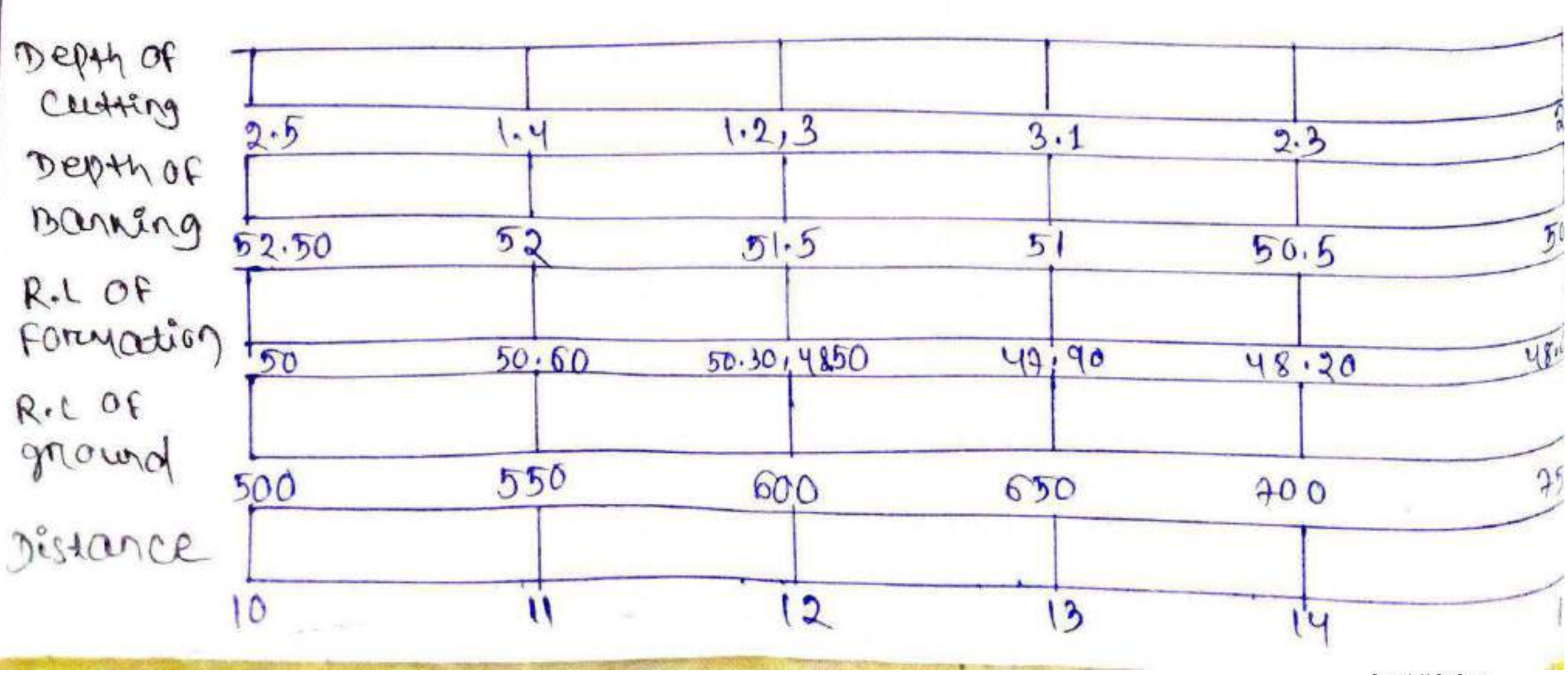
→ It represents sudden rise on sudden fall of ground at a point.

→ At this point ground has 2 R.L.

1) Calculate the quantity of earthwork from the following data. The formation width of road is 8 mtr., 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 50 mtr.

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





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station	chainage	Distance	Length	(a) depth of cutting or banking	mid depth (dM)	central area b×dM	side area s.dM²	total area b×dM+s.dM²	Volume(v)= b×dM+s.dM²×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 :-

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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.

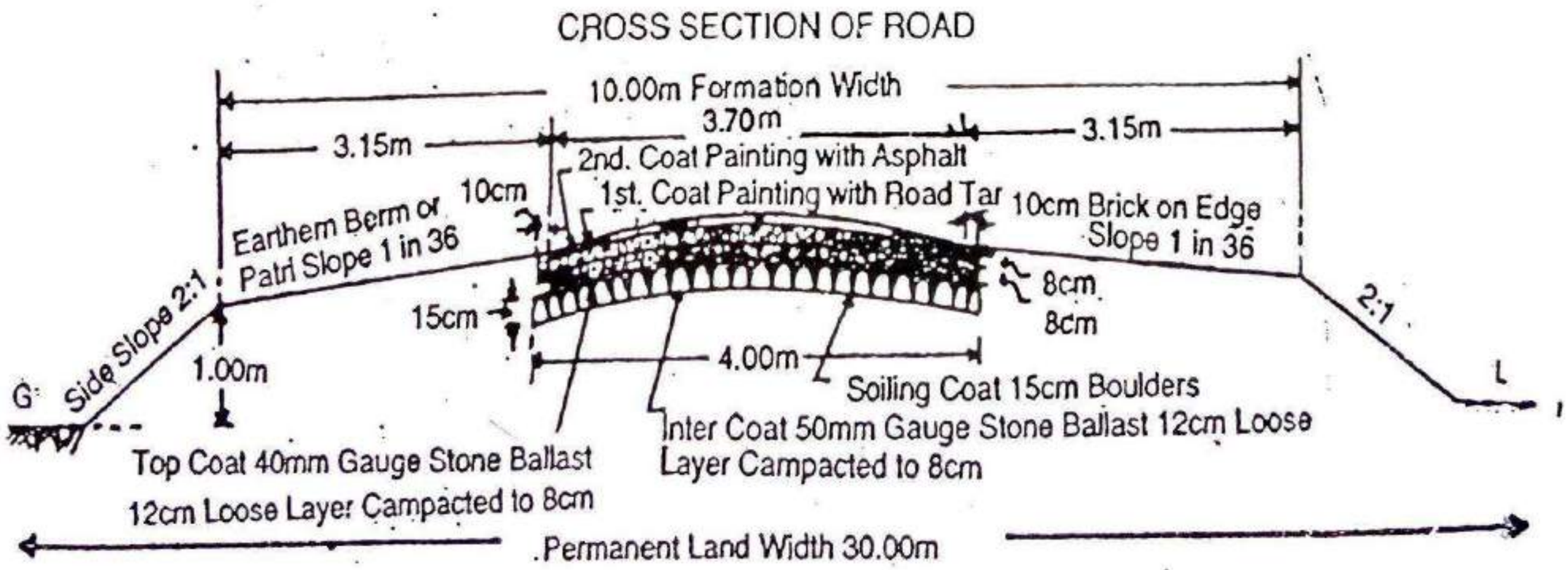

Fig. 7-23

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The painting shall be as follows:

1st coat of painting (i) stone grit 20mm gauge @ 1.35 cu.m per percentage sq.mtr.

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

2nd coat of painting: (i) stone brick 12mm gauge @ 0.75 cu.m per percentage sq.m.

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

I.N	Particulars of item	NO	L	B	H	Quantity	Explanatory Note
1)	Surveying and dagbelling	1	1000			1000 M	L = 1km
2)	Acquisition of Permanent Land	1	1000	30		30000	M^3
3)	Volume of Earthwork	1	1000	$[(10\times1)+2\times(1)^2]$		12000 M^3	B.H = bdM + S.dM^2 = $[(10\times1)+2\times(1)^2]$
4)	Acquisition of temporary land	1	Area of land = Qty. of earth work / Depth of borrow-pit = 12000 / 0.3			40,000 M^2	Assume depth of borrow pit = 30cm.
5)	Preparation of subgrade. metaling	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		

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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 consolidation with locally sandy soil.	1	1000	3.7	0.12		
8)	3rd coat of Metaling (Top coat)						
	a) 40mm Gauge stone Ballast 12cm loose compacted to 8 cm	1	1000	3.7	0.12		
	b) Laying and consolidation 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	M^3
	ii) Binder @ 220 kg per percentage square meter.	1	1000	3.7	$\frac{220}{100}$	8140	kg
	iii) Laying	1	1000	3.7		3700	M^2
	b) 2nd coat of painting						
	a) stone grit 12MM gauge @ 0.7CMCum						

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per percentage square meter.	1	1000	3.7	0.75/100		
ii) Binder @ 120 kg per percentage square meter	1	1000	3.7	120/kg		

2)

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

a) Length of road = 100m

b) Metaled width = 5.5M = 6M

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

d) Wearing coat of grade-II Metal loose consolidated to 80MM thick = 120cm. 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.

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

i) length of Road = 2km

ii) formation width = 12m

iii) metalled width = 8m

iv) width of permanent land = 35m

v) Depth of borrow pit = 30cm

vi) Avg. height of bank = 1.5m

vii) side slope = (2:1)

viii) Thickness of grade-I Metal soiling = 90mm

ix) Wearing coat of grade - II Metal soiling = 12cm loose & Compacted to 8cm.

x) Surface to be finished with two coats of Bitumen as follows

→ 1st finishing coat

12MM Chips @ $0.025 M^3$ and Bitumen @ 1.25 kg per sq.m of road surface.

→ 2nd finishing coat

6MM 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.

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IN	Description of item	NO	L	B	H	Qty.	Explanatory Note
1)	Surveying and dagbelling	1	2000			2000	
2)	Acquisition of Permanent land	1	2000	35			
3)	Volume of earth-work	1.	2000	[(35×1.5)+(2×1.5²)]			B.H = bdM + 3.dM² ⇒ [(12×1.5)+(2×1.5²)] ⇒ 22.5 m³
4)	Acquisition of temporary land	1	Area of land / Qty. of earth work / Depth of borrow pit ⇒ 45000 / 0.3				
5)	Preparation of subgrade	1	2000	10		20000	
	Metaling						
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		

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8)	Painting						
	1st coat :						
	a) 12mm chips @ 0.025 M^3 per meter sq. of road surface	1	2000	8	0.025	400	M^3
	b) Bitumen @ 1.25 kg per M. sq. of of road surface.	1	2000	8	1.25	20000	kg.
	c) Laying	1	2000	8		16000	M^2
a)	2nd coat :						
	a) 6MM chips @ 0.020 M^3 per M. sq. of road surface	1	2000	8	0.020	320	M^3
	b) Bitumen @ 1.24 kg per sq. M of road surface	1	2000	8	1.24	19840	kg
	c) Laying	1	2000	8		16000	M^2
10)	Consumption of fuel @ 0.45 kg per kg of Bitumen.	1	0.45 × (20000 + 19840)			179.28	kg.

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S.N	Description of item	NO	L	B	H	Qty	Note
1)	Surveying and alag. belling	1	100			100	
2)	Preparation of sub-grade	1	100	6		600	M^2
	Metaling						
3)	1st Coat of Metaling						
	a) Grade-I Metal soiling of 80mm thick	1	100	5.5	0.08	$44M^3$	
	b) laying and consolid-ation with locally sandy soil.	1	100	5.5	0.08	$44M^3$	
4)	2nd Coat						
	a) Grade-II Metal soiling of 120 MM loose compacted to 80 mm.	1	100	5.5	0.12	$66M^3$	Loose soil = $1.5 \times 80 = 120MM$
	b) Laying and consolid-ation with locally sandy soil.	1	100	5.5	0.12	$66M^3$	
5)	Painting						
	1st Coat						
	a) 12 MM chips @ $0.018M^3$ per M^2 of road surface	1	100	5.5	0.018	$9.90M^3$	
	b) Bitumen @ 1.22 kg per $M.Sq^2$ of road surface	1	100	5.5	1.22	671kg	
6)	2nd Coat (c) Laying	1	100	5.5	—	$550.M^2$	
	a) 6MMchips @ $0.01M^3$ per $M.Sq^2$ of road surface	1	100	5.5	0.01	$5.5M^3$	
	b) Bitumen @ 1.22 kg per M^2 of road surface	1	100	5.5	1.22	671kg	

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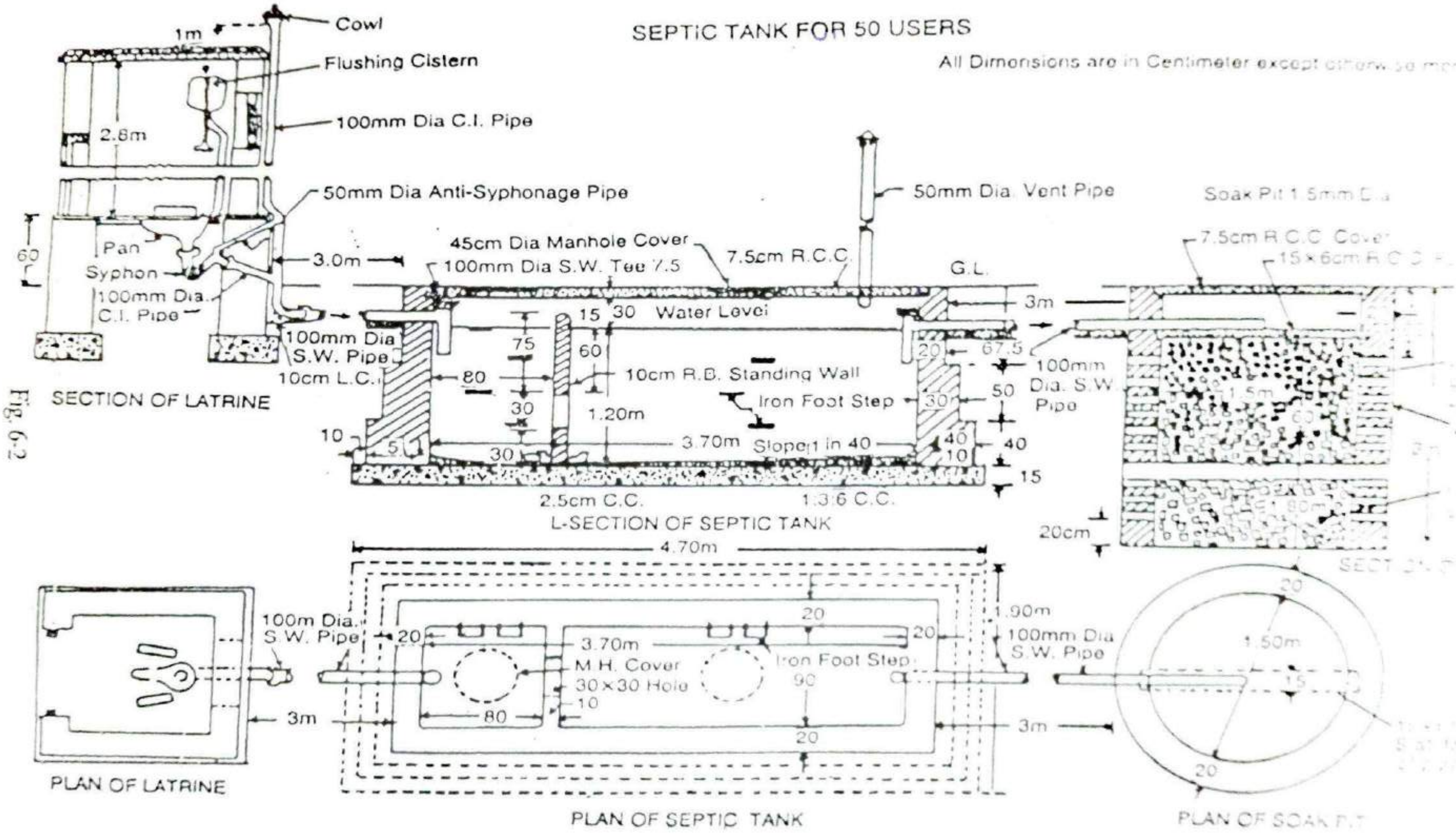
SEPTIC TANK FOR 50 USERS

All Dimensions are in Centimeter except otherwise mentioned



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7.	Consumption of fuel @ 0.42 kg of Bitumen	I	0.42(671+671)			563.64	m^3
6.c	Laying	I	100	5.5	—	550.M^2	

SEPTIC TANK

I.N	Description of item	NO	L	B	H	Qty.	Explanotary 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	$M = dia = 1.5 + 2 \times 0.2$
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		$L = 4.7 - (2 \times 0.1) = 4.5m$ or $3.7 + (0.4 \times 2)$
	→ short wall	2	0.9	0.4	0.4		
	ii) 2nd Footing						
	→ long wall	2	4.3	0.3	0.5		$L = 4.7 - (4 \times 0.1) = 4.3m$ or $3.7 + (0.3 \times 2)$
	→ short wall	2	0.9	0.3	0.5		
	iii) 3rd Footing						
	→ long wall	2	4.1	0.2	0.675		$L = 4.7 - (6 \times 0.1) = 4.1m$ or $3.7 + (0.2 \times 2)$
	→ short wall	2	0.9	0.2	0.675		
	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		$L = (3.7 \times 2) + (0.9 \times 2) = 9.2$ $H = 1.2 + 0.3 = 1.5m$

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	b. Both side 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						
	a. 7.5 cm R.C.C cover over septic tank	1	3.9	1.1	0.075		L = 3.7+0.1+0.1 = 3.9m 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 Jhama Brick Ballast 50 mm Gauge	1	$\frac{\pi}{4}\times(1.5)^2$		0.6		
9.	1.8 m Jhama Brick bat	1	$\frac{\pi}{4}\times(1.5)^2$		1.8		
10.	Manhole cover	2					
11.	Iron foot step in septic tank	2×4					

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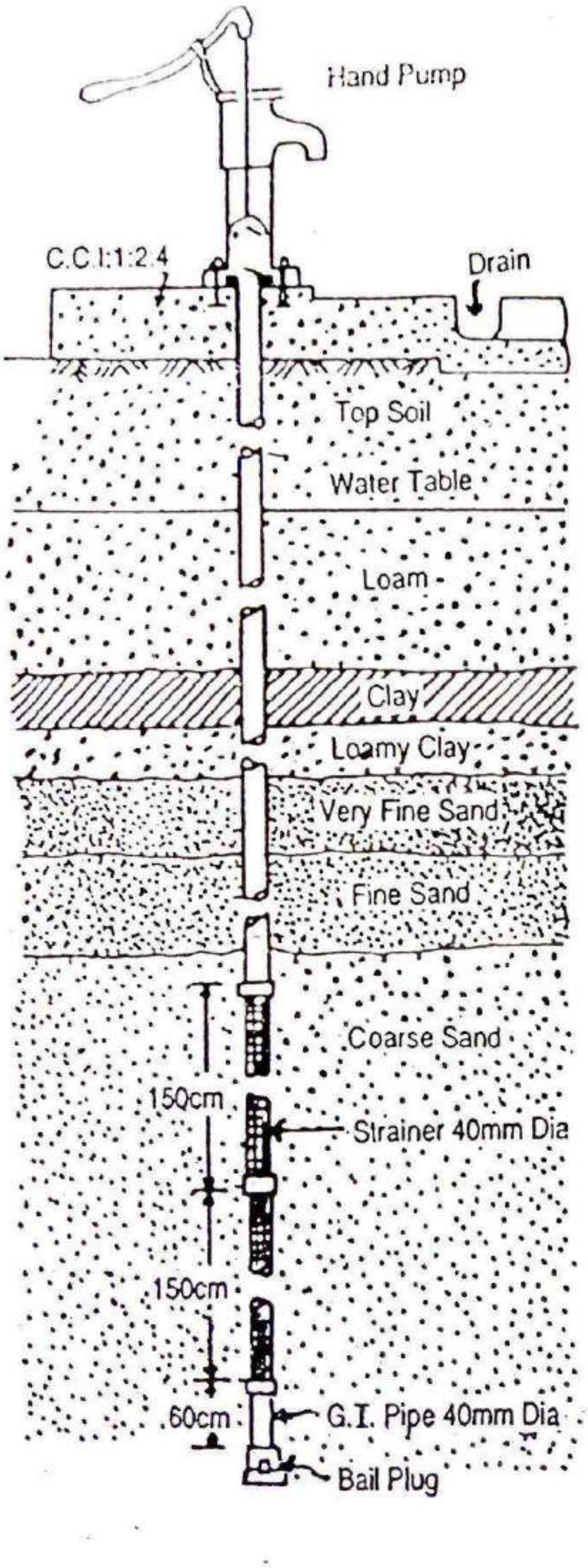

Fig. 6-18

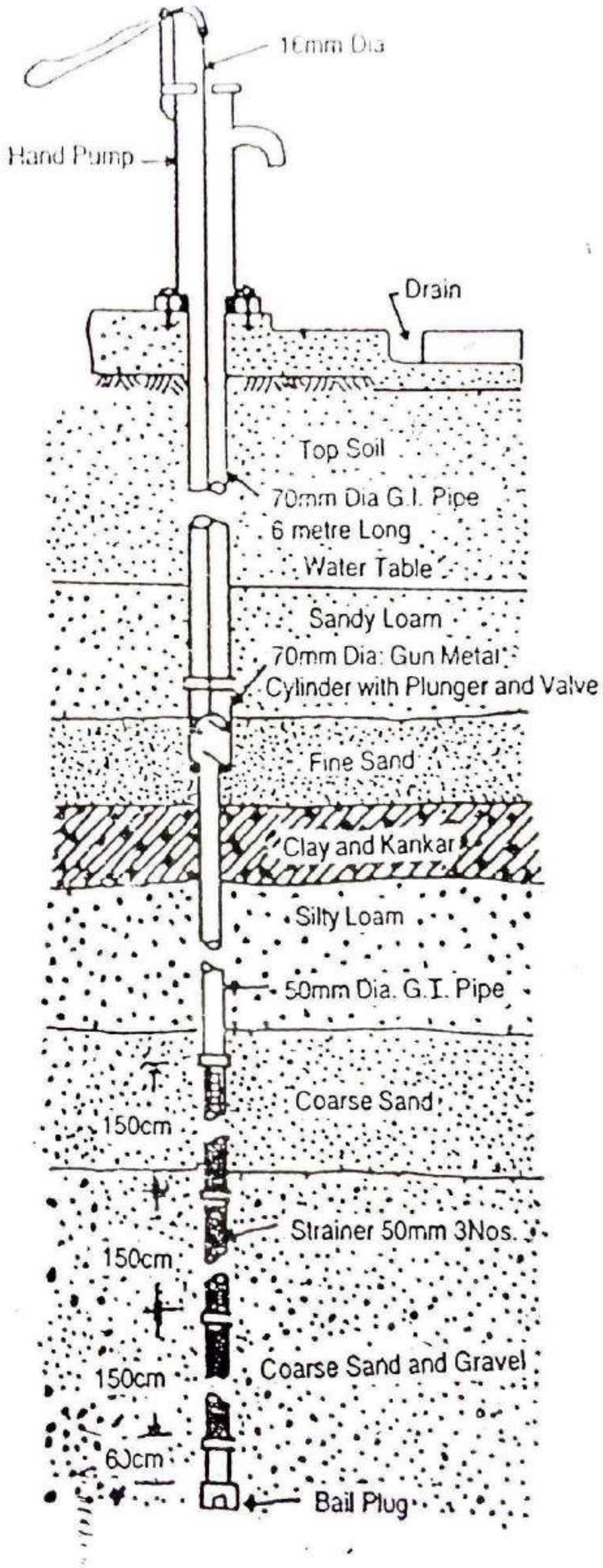

Fig. 6-19

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.

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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	Explanatary 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)			
		⇒ 946.785			

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S.N	Particulars of item	NO/ quantity	Rate	cost	Explanatary NOte
1.	50MM dia G.I pipe	89.7M	11.5/M	1031.55	L = 100 - 6 - (3×1.5) +
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 platfrom for hand-Pump	1	30	30	
11.	70 MM dia Gun metal cyclinders 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 contigencies and work charged establishment :-		$\frac{5}{100} \times 3386.05 = 169.3025$		
			Total Cost =	3555.3525	

(Assume suitable rate)

Prepare an Estimate of 50 MM 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 70MM dia G.I pipe of 6 meter length.

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CHAPTER-5

PWD ACCOUNTS WORKS

Adminstrative Approval :-

For any work or project required by department an approval or sanction of the compitent authorities of the department with respect to cost or work is necessary at the first instants, this is called Adminstrative Approval.

→ It denotes the formal acceptance by the department of the proposal after Adminstrative approval is geven the engineering department take up the work and preparies details design, plan, estimate, execute the work.

→ If a building is to be constructed for health department the adminstrative approval is to be given by health department.

Technical sanction :-

Technical sanction means sanction of detailed estimate, design calculations, quantities of work by the compitent 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 ~~techi~~ 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.

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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 grand 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 amelities as per service rule.

→ The temporary establishments are employeed ~~to~~ 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 excution of a specific work on form the super vision of the departmental labours, stone and Machinary etc.

→ Usually worm super-vision, chaukidar, Mistries etc are employeed 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 worm charged establishment are of both pay role and acquittance role

→ The services of the worm charge establishment can be terminated at any time without giving any notice.

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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 Acquitance Rule.

→ It is a receipt in evidance of payment in a prescribed form having 5 column as Item NO.- Designation, net amount payable, data and signeture

→ 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 credited to a work it means that the amount is to be shown as receipt under the work.

Cash :-

→ Cash includes legal tendar coins notes, cheques payale on demand, remittance transfer recipts 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 R.s 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.

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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 oneden.
4) Lumpsum contract
5) Lumpsum and scheduled contract.
6) Scheduled Contract on 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 attandance 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 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 alone 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 payble and the quantity of work alone.

→ 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.

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→ 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 aggrement 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.

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

→ The quantities or schedule of different items of work a 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 qualities 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 ra is also provided in the contract agreement.

→ In this system, the contractor undertakes the execution o 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 amou to be paid or deducted for any addition and alterations

→ In this case no measurement of various items of works 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 under takes 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 & amou for various item of works total amount of contract, plans and detailed drawings, detailed specifications & deposit of security money, penalty, progress, date of

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Labour Contract :-

→ In this contract the contractor undertakes contract for the labour portion. All materials for the construction are arranged and supplied by the act the site of work 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

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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 bet^n 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 as and when required, is known as special Repair work.

Example :- Repair of damaged road during Earthquake or Flood, Repair of sanitary & electrical establition in a buildi

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 installtion.

Important Terms :-

Contigency 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.

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