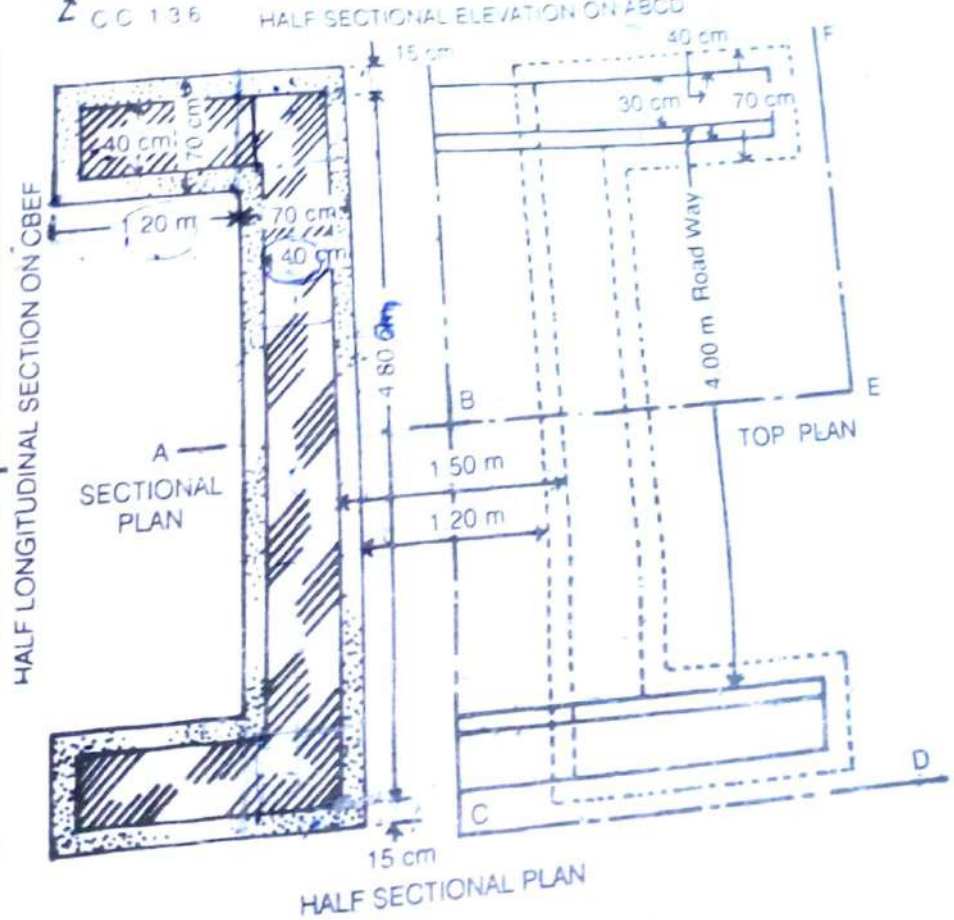
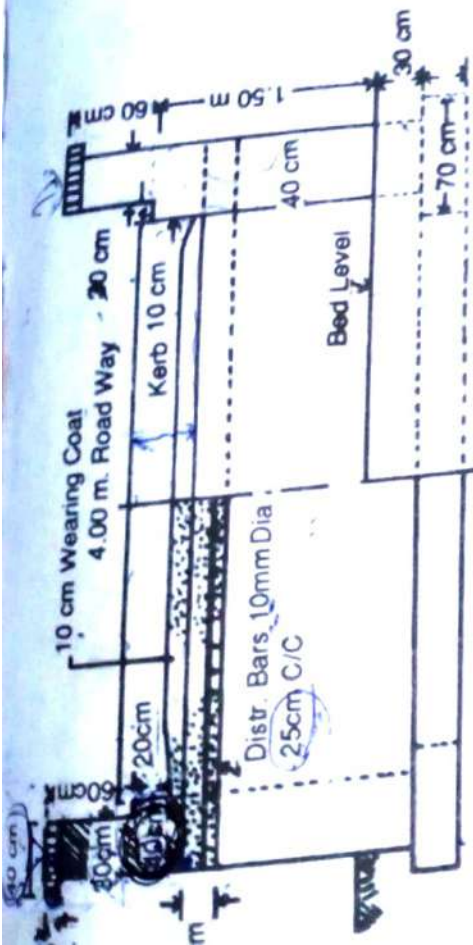
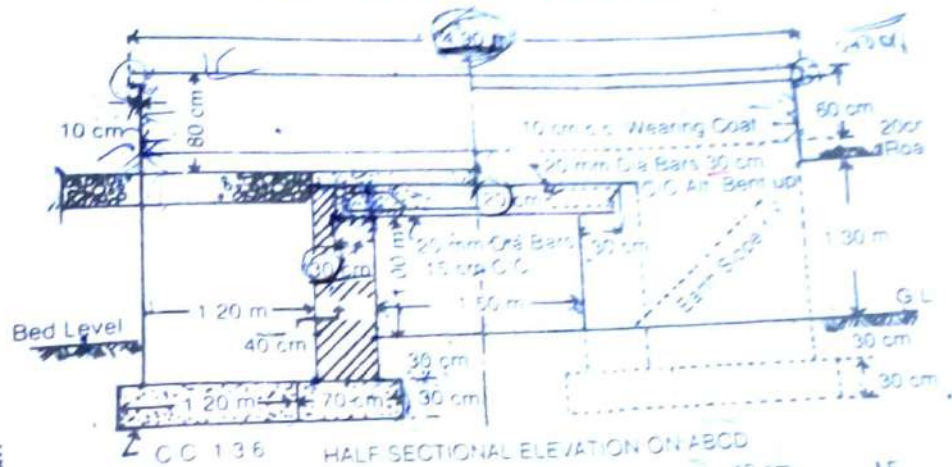


Example 1. Prepare a detailed estimate of a slab culvert of 1.50 metre span and 4.00 metre roadway from the given drawing (Fig. 8.5). The general specifications are as follows:

Foundation concrete shall be of cement concrete 1 : 3 : 6 with stone ballast and coarse sand. Masonry shall be of first class brick work 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



Details of Measurement and Calculation of Quantities:

Item No	Particulars of Item	No	Length (m)	Breadth (m)	Height (m)	Quantity (cum)	Remark
1.	Earthwork in excavation in foundation						
	Abutment	2	5.1	0.7	0.6	4.28	$L = 4.8 + 0.3$
	Wing wall	4	1.2	0.7	0.6	2.02	$H = 0.3 + 0.3$
						<u>Total</u>	<u>6.30 m³</u>
2.	Cement concrete 1:3:6 in foundation with stone ballast						
	Abutment	2	5.1	0.7	0.3	2.14	$L = 4.8 +$
	Wing wall	4	1.2	0.7	0.3	1.01	$0.15 +$
						<u>Total</u>	<u>3.15 m³</u>
3.	I-Class B.W in 1:4 cement mortar						
	Abutment	2	4.8	0.4	1.5	5.76	{ upto H of slab }
	Wing walls	4	1.2	0.4	1.5	2.88	
	Parapet up to kerb	2	4.7	0.4	0.3	1.13	{ Above R.C. slab upto kerb }
	Parapet Above kerb	2	4.7	0.3	0.5	1.41	
	Coping	2	4.9	0.4	0.1	0.39	{ Above kerb excluding coping }
						<u>Total</u>	<u>11.57 m³</u>
	<u>Deduct</u>						
	Bearing of R.C. slab in Abutment	2	4.8	0.3	0.2	0.57	
						<u>Net Total =</u>	<u>11.00 m³</u>
4.	R.C. work 1:2:4 in slab excluding steel & its bending but including centering shutter and binding	1	4.8	2.1	0.2	2.016 m ³	$\text{Breadth} = 1.5 + 0.3 + 0.3$

No	Particulars of item	Nos	Length (m)	Breadth (m)	Height (m)	Quantity	Remark
5.	Cement concrete 1:2:4 wearing coat	1	4.0	2.3	0.1	0.92 m ³	B = 1.5 + 0.4 + 0.4 (In between parapet)
6.	Cement pointing 1:2 in wash						
	Face wall from 10cm below GL up to bottom of coping on one side of parapet excluding coping	2	4.7	—	2.1	19.74	
	Coping	2	4.7	—	0.8	7.52	Ht = (20 + 10) / 50 = 0.80
	Coping	2	4.9	0.7	—	6.86	B = (10 + 40 + 10 + 10cm) = 0.7m
	End of parapet (40cm width)	4	—	0.4	0.20	0.32	up to kerb
	End of parapet (30cm width)	4	—	0.3	0.5	0.60	Above kerb
	End of parapet (40cm width)	4	—	0.4	0.20	0.32	edge & under side.
Total						35.36 m ²	
<u>Deduct</u>							
	Rectangular opening	2	1.5	—	1.3	3.9	
	Triangular portion below eave line	2	(1/2 × 1.3 × 1.3)			1.69	
Total deduction						5.59 m ²	
Net Total						29.77 m ²	

PIPE CULVERT

399

Example 7.—Prepare a detailed estimate of Hume pipe Culvert of three pipes each of 60 cm diameter from 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.

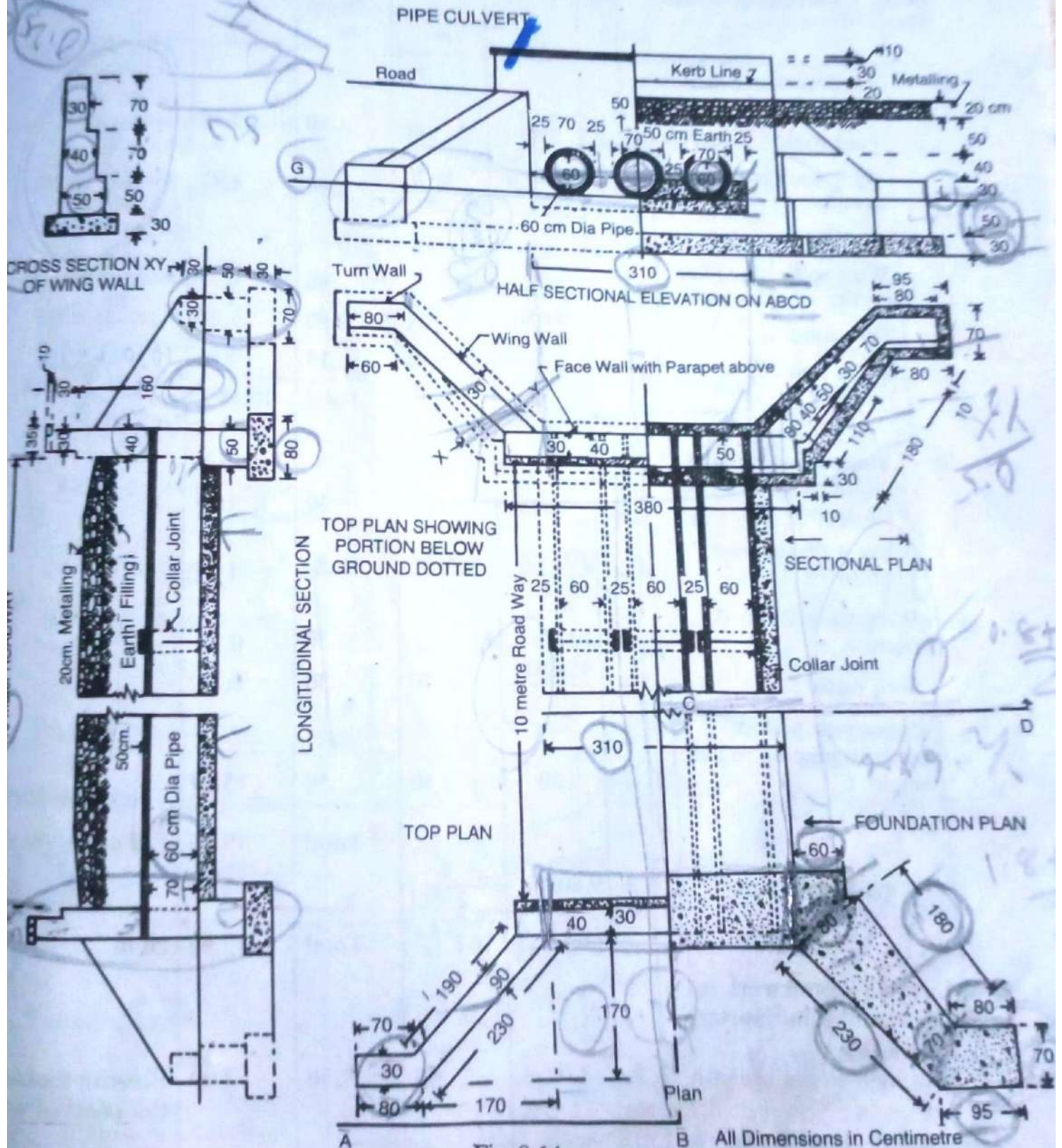


Fig. 8-14

Details of Measurements and Calculation of Quantities.

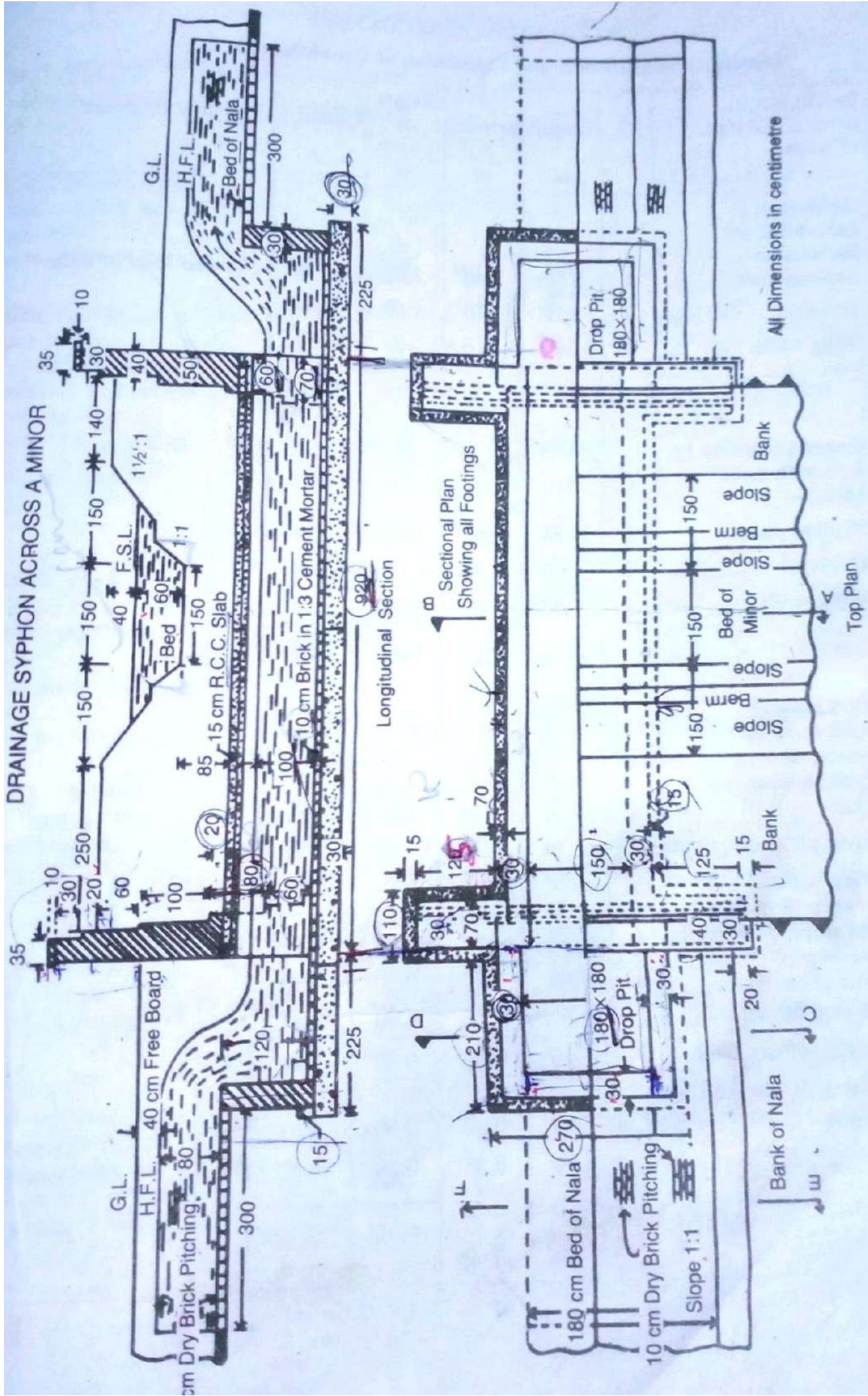
Item No	Particulars of item	No	Length (m)	Breadth (m)	Height (cm)	Quantity	Remark
1	Earthwork in excavation of foundation						
	Face wall	2	3.1	0.8	0.8	3.97	
	Wing wall inclining portion	4	$\frac{2.3+1.8}{2}$	$\frac{1.8+0.7}{2}$	0.8	4.92	Avg length & Avg breadth
	Wing wall triangular corner	4	$(\frac{1}{2} \times 1.6 \times 1.8)$		0.8	0.77	
	Turn wall	4	$\frac{1.95+1.8}{2}$	0.7	0.8	1.96	
	Under pipe	1	9.80	3.1	0.15	4.86	Ht = $\frac{0.25 \times 9.8}{0.25 \times 9.8} = 0.15$
						Total	16.18 m³
2.	Cement concrete 1:4:8 in foundation.						
	Face wall	2	3.1	0.8	0.3	1.49	
	Wing wall inclining portion	4	$\frac{2.3+1.8}{2}$	$\frac{0.8+0.7}{2}$	0.3	1.85	
	Wing wall triangular corner	4	$(\frac{1}{2} \times 1.6 \times 1.8)$		0.3	0.29	
	Turn wall	4	$\frac{1.95+1.8}{2}$	0.7	0.3	0.74	
	Upper pipe and in both pipe up to half height	1	9.8	3.1	0.5	15.19	Thickness $\frac{15+7.5}{2} = 80 \text{ cm}$
						Total	19.56 m³
	<u>Deduct</u> half of pipe	3	$9.8 \times \frac{1}{2}$	$\frac{\pi \times 7.2}{4}$		8.66	
						Net Total	13.90 m³
3.	First class B.W in 1:6 Cement sand Mortar						
	Face wall - Footing (50cm breadth)	2	4.00	0.5	0.5	2.00	Thickness of wall = 80cm
	Above footing (40cm broad)	2	3.80	0.4	1.6	4.86	
	Parapet (30cm broad)	2	3.80	0.3	0.3	0.68	
	Coping (35cm broad)	2	4.00	0.25	0.1	0.28	
	Wing walls - 1st Step - 50cm br	4	1.100	$\frac{0.5+0.4}{2}$	$\frac{0.5+0.4}{2}$	0.88	
	2nd Step - 40cm	4	1.8	0.4	0.3	0.86	Avg Ht

D. COURSE

Item No	Particulars of Item	No	Length (m)	Breadth (m)	Height (m)	Quantity	Remark
	3rd step (30cm broad)	4	1.9	0.3	$\frac{0.7+0}{2}$	0.80	(Avg Ht)
	Turn wall - 40cm width	4	$\frac{0.8+0.7}{2}$	0.4	0.5	0.60	
	Turn wall - 30cm width	4	$\frac{0.80+0.75}{2}$	0.3	0.3	0.28	
Total						11.49 m ³	
4.	Cement pointing 1:2 in expose surfaces above H- face wall						
	outside	2	3.10	—	1.40	8.68	Ht = 20+30 +10+5 = 65m
	face wall parapet outside	2	3.80	—	0.65	4.99	
	parapet inside	2	3.80	—	0.70	5.32	includes offset 10cm.
	wing wall vertical face	4	2.30	—	$\frac{1.4+0.5}{2}$	8.74	Avg Ht
	Wing wall top	4	2.30	0.3	—	2.76	
	turn walls vertical face three side	4	1.8	—	0.3	2.16	L = perimeter = 80+30+70 = 180m 1.8m
	Turn wall top	4	$\frac{0.8+0.7}{2}$	0.3	—	0.90	
Total						33.80 m ²	
5.	Home pipe heavy type 60 cm dia including concave joint	3	10.8	—	—	32.40	L = 10+4 +4 = 10.8m

Item No	Particulars of Item	Nos	Length (m)	Breadth (m)	Height (m)	Quantity	Remark
2.	Cement concrete 1:3:6 in foundation and floor - Crest wall side walls and floor						
	(i)	1	2.65	6.00	0.45	7.16	
	(ii)	1	2.10	5.80	0.35	4.26	
	(iii)	1	1.80	5.60	0.25	2.10	
	Wing wall beyond side wall	2	1.80	0.70	0.3	0.76	
	Curfew wall	1	4.80	0.60	0.20	0.58	
						Total	14.82 m ³
	Deduct forced back of wing wall	2	0.6	0.10	1.15	0.14	
						Net Total	14.68 m ³
3.	I-class Brickwork in 1:4 cement mortar Crest wall						
	1st step	1	4.5	0.7	0.4	1.26	
	2nd step	1	4.5	0.6	0.9	2.70	
	Side wall						
	(i) 1st step	2	2.35	0.6	0.4	1.13	As per section B
	2nd step	2	2.35	0.5	0.5	1.18	
	3rd step	2	2.35	0.4	0.5	0.94	
	4th step	2	2.35	0.3	0.7	0.99	
	(ii) 1st step	2	2.10	0.5	0.4	0.84	As per section C
	2nd step	2	2.10	0.4	0.5	0.84	
	3rd step	2	2.10	0.3	0.9	1.13	
	(iii) 1st step	2	1.50	0.4	0.9	1.08	As per section xy.
	2nd step	2	1.50	0.3	0.6	0.54	
	3rd step						
	Wing wall beyond side wall	2	1.8	0.4	0.4	0.58	
		2	1.9	0.4	0.5	0.76	As per section xy.
		2	2.0	0.4	0.5	0.80	
		2	2.1	0.3	0.7	0.88	

Item No	Particulars of item	No	Length (m)	Breadth (m)	Height (m)	Quantity	Remark
	Curtain wall	1	4.5	0.3	0.4	0.54	
	Toe wall	2	3.9	0.2	0.3	0.47	
						Total = 16.66 cum	
4.	Brick flooring including pointing	1	5.4	4.5	—	24.30 sqm	MS betn walls
5.	Cement pointing						
	Crest wall (up stream face top and down stream face)	1	4.5	—	2.40	10.80	Ht = .6 + .6 + 1.2 = 2.4
	Side wall inner face (i)	2	1.8	—	2.40	7.20	
	(ii)	2	2.1	—	1.70	7.14	
	(iii)	2	1.5	—	1.40	4.20	
	Side wall portion above crest wall	2	0.60	—	0.80	0.96	
	Vertical faces of stepping	2x2	—	0.3	0.3	0.36	
	Vertical face end	2	—	0.4	0.90	0.72	
		2	—	0.3	0.60	0.36	
	Top of side wall	2	6.0	0.3	—	3.60	Full length of bottom
	Top of curtain wall	1	4.50	0.3	—	1.35	
	Top of toe wall	2	3.90	0.2	—	1.56	
	Wing wall top face	2	2.10	0.3	—	1.26	
	Wing wall up stream side triangular portion above slope	2	$\frac{1}{2} (2.1 \times 1.4)$	—	—	2.94	
						Total	42.45 m ²



Example 7. — Prepare a detailed estimate of a Drainage Syphon across a minor from the given wing, 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.

DRAINAGE SYPHON

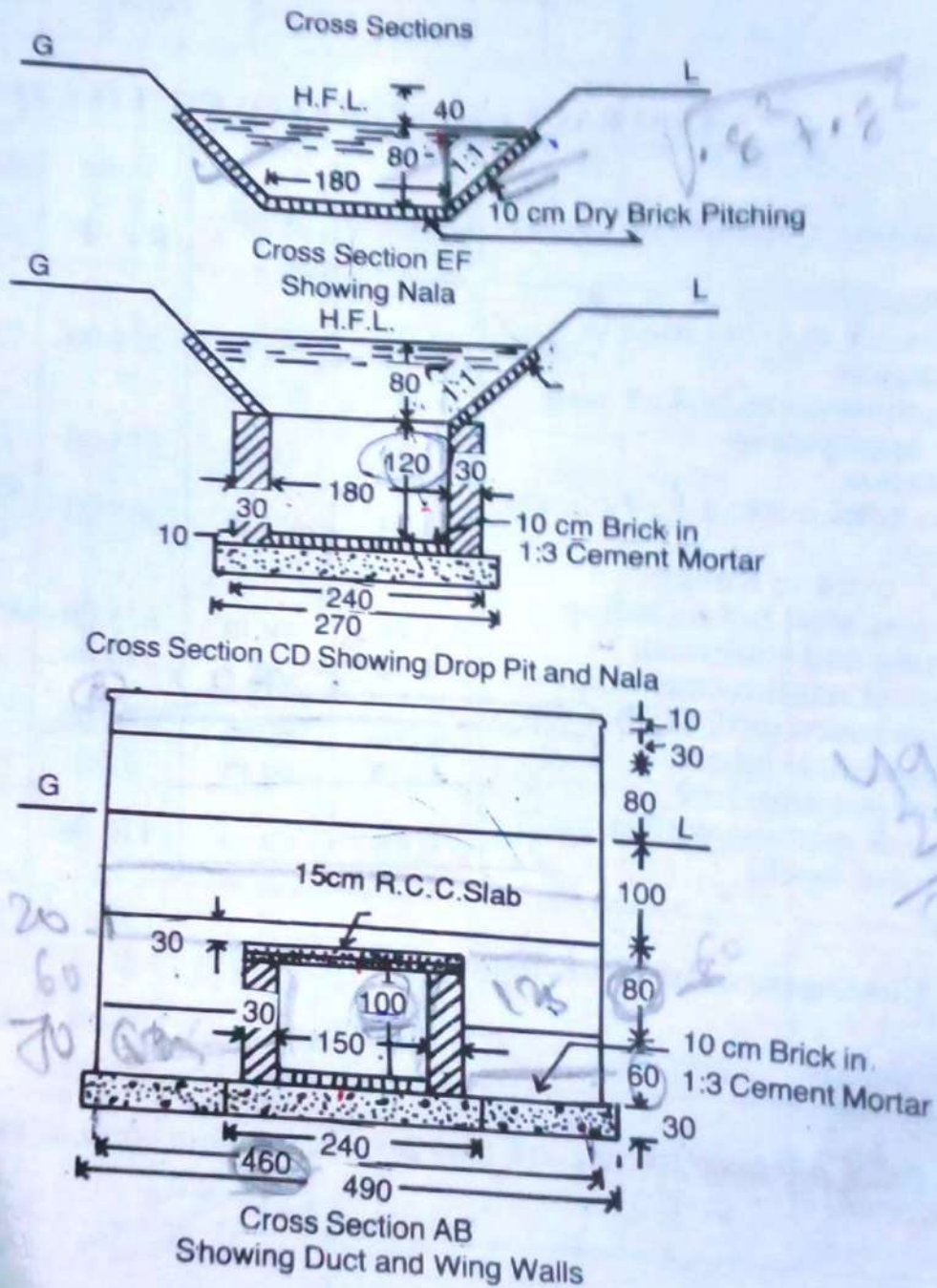


Fig 9-8

Details of Measurement and Calculation of Quantities.

Item No	Particulars of Item	No	Length (m)	Breadth (m)	Height (m)	Quantity	Remarks
1.	Earthwork in excavation in foundation						
	syphon duct	1	9.5	2.4	1.60	36.48	$L=9.2$ $+0.3$
	drop pit	2	2.10	2.70	1.60	18.14	$B=1.5$ $+0.2$
	wing wall	4	1.25	1.10	1.60	8.80	$+0.5$ $+0.5$
						<u>Total</u>	63.40 m ³
2.	Cement concrete 1:4:8 with brick ballast						
	Syphon duct	1	9.50	2.40	0.20	6.84	
	Drop pit	2	2.10	2.70	0.20	3.40	
	Wing walls	4	1.25	1.10	0.2	1.65	
						<u>Total</u>	11.89 m ³
3.	first class B.W						
	Syphon duct side wall	2	9.2	0.3	1.30	7.18	
	Drop pit wall	4	2.1	0.3	1.30	3.28	
		2	1.80	0.3	1.30	1.40	
	Wing walls						
	1st step (Footwall)	4	1.25	0.70	0.70	2.45	
	2nd step (60cm)	4	1.25	0.60	0.60	1.80	up to 100 mm
	2nd step (60cm) above slab	2	4.60	0.60	0.20	1.10	
	3rd step (80cm)	2	4.60	0.80	1.00	4.60	
	4th step (40cm)	2	4.60	0.40	0.80	2.94	
	5th step (20cm wall) (Parapet)	2	4.60	0.30	0.30	0.83	
	Coping	2	4.70	0.25	0.10	0.33	
						<u>Total</u>	Quantity 25.91 m ³
4.	R.C.C slab of syphon duct	1	9.20	2.10	0.15	2.90	$B=1.5$ $F=1.3$

5. 10 cm thick
brick floor
including party

Floor of symmetrical	1	9.2	1.5	—	13.80
Drop pit	2	1.8	1.8	—	6.48
Total					20.28 m ²

6. Cement pointing

Symmetrical inner faces	2	9.2	—	1.00	18.40
Drop pit 3 vertical face	6	1.8	—	1.20	12.96
Drop pit 3 top face	2	6.00	—	0.3	3.42
parapet wall inner face to and outer face up to 10	2	4.6	—	2.30	21.16
Outer face of wing wall above base	2	1.8	—	1.2	4.32
Triangular portion of outer face of wing wall	$2 \times 2 \left(\frac{1}{2} \times 0.8 \times 0.8 \right) = 1.28$				
Total					61.54 m ²

H = 20 + 1
+ 20 + 10
+ 35 + 10
+ 110
= 230

7. Dry Brick
pitching.

Bed of rate	2	3.00	1.80	—	10.80
side slopes of rate	4	3.00	1.13	—	13.56
Total					24.36 sqm

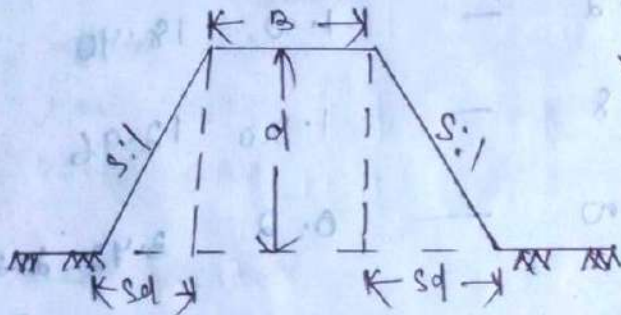
Slope = $\frac{1}{\sqrt{1.13^2 + 1.8^2}}$

3. Detailed estimate of Road.

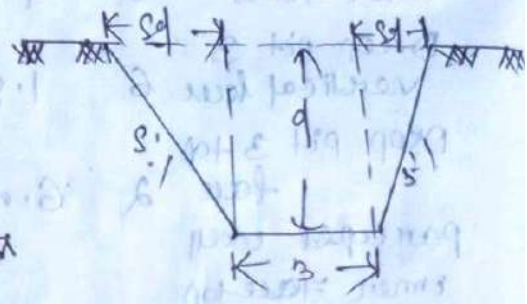
Cross-section of earthwork of road in banking or in cutting is always in the form of trapezium, and the quantity of earthwork may be calculated by the following method.

$$\text{Quantity or Volume} = \text{Sectional Area} \times \text{Length}$$

B = Formation width of the road
 d = Mean depth

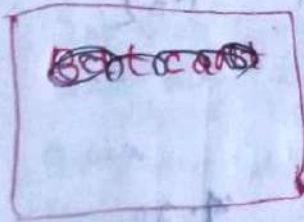


(Banking)



(Cutting)

Sectional Area = Area of central rectangular part
+
Area of side triangular part

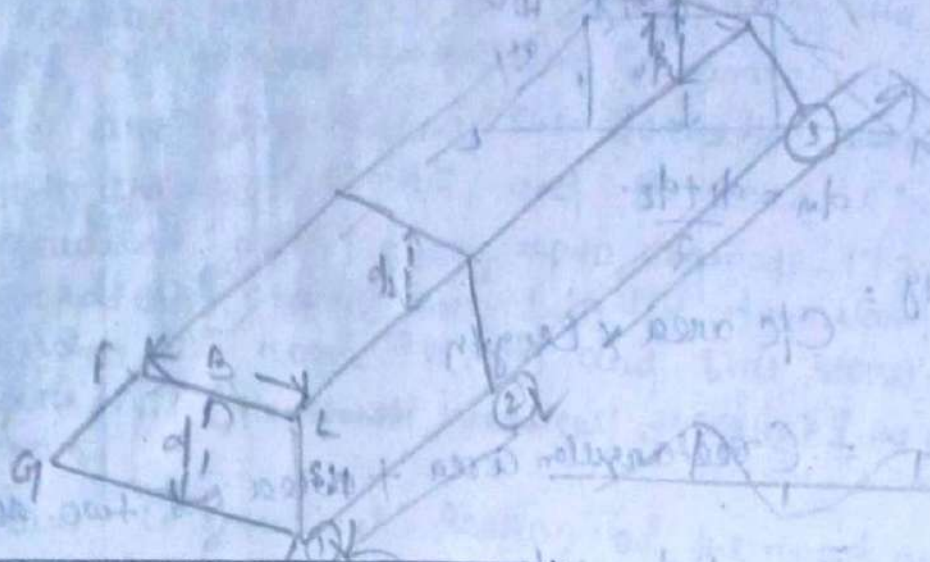


$$= Bd + 2\left(\frac{1}{2}sd \times d\right)$$
$$= Bd + sd^2$$

$$\text{Quantity} = (Bd + sd^2) \times L$$

$S:1$ is the ratio of side slope as horizontal:vertical.

For 1 vertical, horizontal is S .



$$\text{Mean height} = \frac{d_1 + d_2}{2}$$

Area of side sloping here fall.

The area of sides which may required for turning or pitching may be found by multiplying the mean sloping breadth by the length. The mean sloping breadth $= \sqrt{(s^2 + d^2)} = d\sqrt{s^2 + 1}$

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

Tabular form of side slope

Station or chainage	Depth or Height	Mean depth or height	Breadth of side slope $d\sqrt{s^2 + 1}$	Length between station	Total Area of both side slope $(2Ld\sqrt{s^2 + 1})$

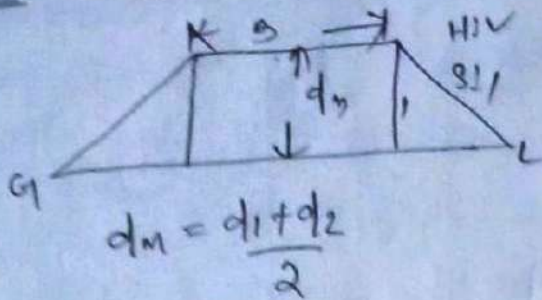
The quantities of earthwork may be calculated by the various methods of measurement but

Method-I - Mid-Sectional Area method

Method-II - Mean Sectional Area method

Method-III - Prismoidal formula method.

Method - I Mid - Sectional Method



Quantity = C/c area \times Length

= (Rectangular area + area of two Δ s) \times

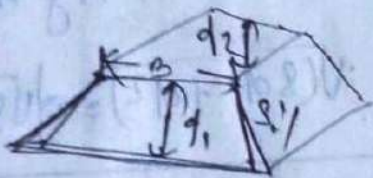
$$= B d_m + \frac{1}{2} \times \text{Base} \times \text{height} \times 2 \times L$$

$$= (B d_m + \text{base} \times \text{height}) \times L$$

$$= (B d_m + S d_m \times d_m) \times L$$

Quantity by Mid section = $(B d_m + S d_m^2) \times L$

Method - II Mean - Sectional Area method



$$\text{Quantity} = A_m \times L$$

$$\text{Mean Area } A_m = \frac{A_1 + A_2}{2}$$

$$A_1 = B d_1 + S d_1^2$$

$$A_2 = B d_2 + S d_2^2$$

Method - III

Prismoidal Method or Accurate method

$$\text{Quantity} = \frac{1}{6} (A_1 + A_2 + 4 A_m')$$

$$A_1 = B d_1 + S d_1^2$$

$$A_2 = B d_2 + S d_2^2$$

$$A_m' = B d_m + S d_m^2$$

Road Numerical

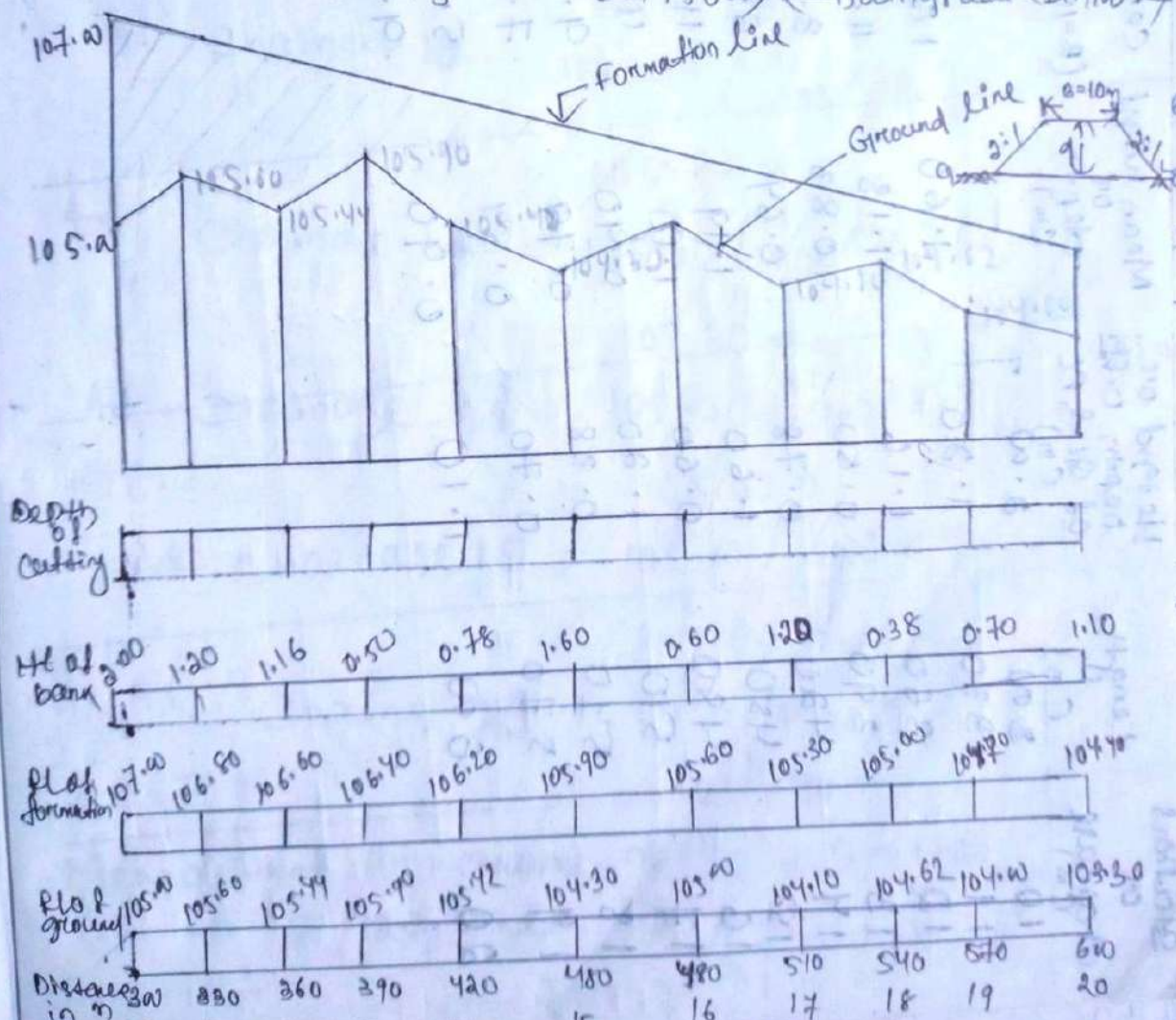
Q.1 Reduced level (RL) of ground along the centre line of a proposed road from chainage 10 to chainage 20 are given below. The formation level at the 10th chainage is 107 and the road is in downward gradient of 1 in 150 upto chainage 14 and then the gradient changes to 1 in 100 downward. Formation width of road is 10m and side slopes of banking are 2:1 (Horizontal:vertical). Length of the chain is 30m.

Draw longitudinal section of the road and a typical cross-section and prepare an estimate of earthwork at the rate of Rs 275.00/cum.

Find also the area of the side slopes and the cost of turning the side slopes at the rate of Rs 60.00/m².

	10	11	12	13	14	15	16	17	18	19	20
RL of GL	105.00	105.60	105.44	105.90	105.42	104.30	105.00	104.10	104.62	104.00	103.30
RL of FL	107.00										
Gradient											

Down gradient 1 in 150 → ← Down gradient 1 in 100



Stations or Chainage (m)	Length (m)	Height or Depth Ditch of GL & FL (m)	Mean height or depth (m)	Central Area ($B=10$) m^2	Side Area d^2 (m^2)	Total Area ($Bd + d^2/2$)	Length between stations (m)	Quantity
								Running Cutting
10	300	2.00	—	—	—	—	—	—
11	330	1.20	1.60	16.00	5.12	21.12	30	633.6
12	360	1.16	1.18	11.80	2.78	14.58	30	427.4
13	390	0.80	0.83	8.30	1.38	9.68	30	290.4
14	420	0.78	0.64	6.40	0.82	7.22	30	216.6
15	450	1.60	1.19	11.90	2.83	14.73	30	441.9
16	480	0.60	1.10	11.00	2.42	13.42	30	402.6
17	510	1.20	0.90	9.00	1.62	10.62	30	318.6
18	540	0.38	0.79	7.90	1.28	9.15	30	274.5
19	570	0.70	0.54	5.40	0.88	6.28	30	179.4
20	600	1.10	0.90	9.00	1.62	10.62	30	318.6
Total								3513.6 m ³

Abstract of Estimated cost

Item No	Particulars of item	Quantity	Unit	Rate Rs p	Per	Cost	
						Rs	p
1.	Footwork in banking	3513.6	ceem	275.00	% cum	9662.40	
Total						9662.40	
Add 5% C 3% for Contingencies and 2% for work charged establishment)						483.12	
Grand Total Rs						10145.52	

Calculation of Areas of side slope

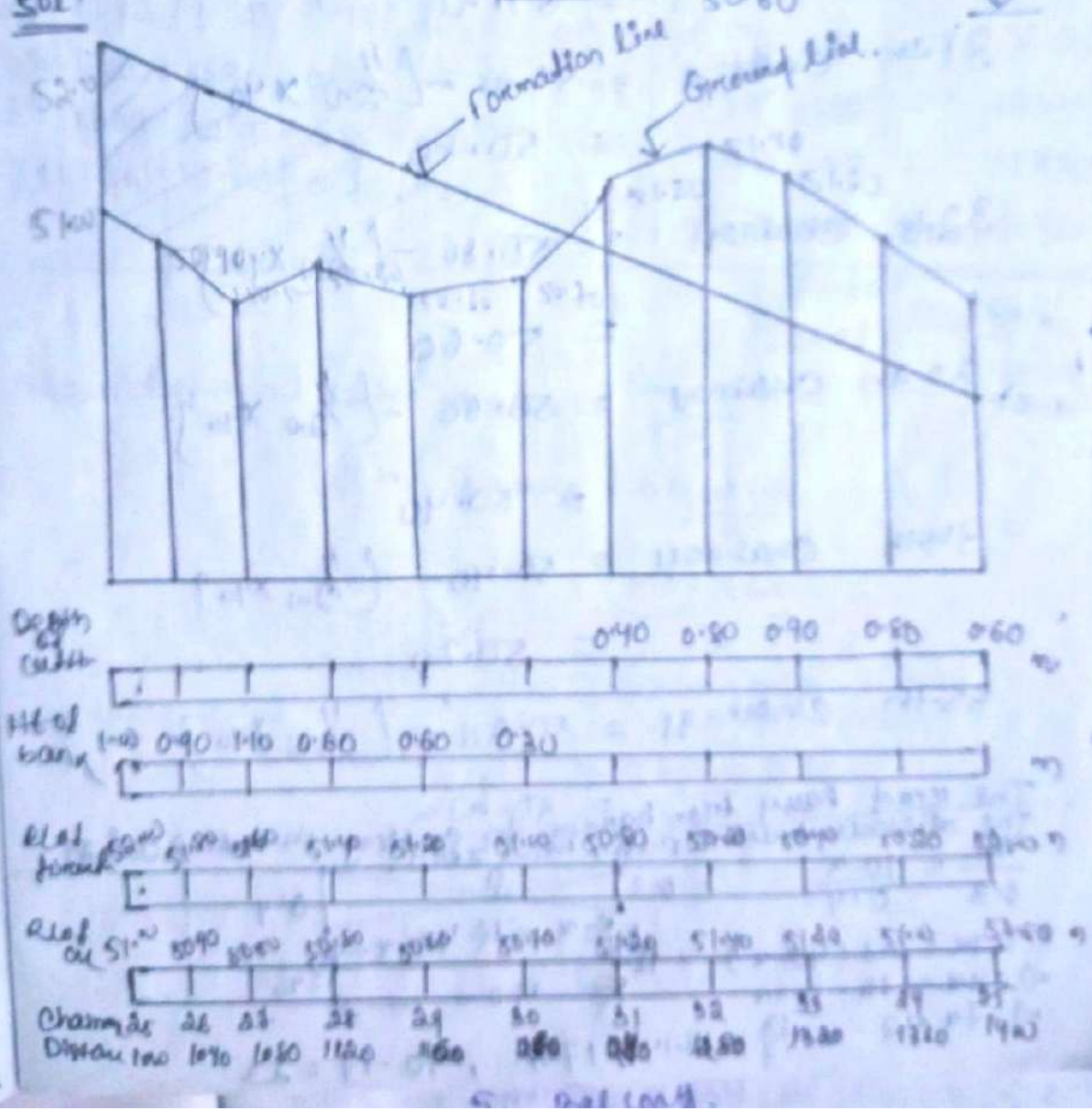
$$S = 2, \sqrt{S^2 + 1} = 2.236$$

Station or chainage	Height or Depth	Mean Ht or Depth d	Sloping breadth of side slope $d\sqrt{S^2+1}$ m	Length m	Area of both side slopes $(2Ld\sqrt{S^2+1})$
10	2.00	—	—	—	—
11	1.20	1.60	3.58	30	214.80
12	1.16	1.18	2.64	30	158.40
13	0.50	0.83	1.86	30	111.60
14	0.78	0.64	1.43	30	85.80
15	1.60	1.19	2.66	30	159.60
16	0.60	1.10	2.46	30	147.60
17	1.20	0.90	2.01	30	120.60
18	0.38	0.70	1.77	30	106.20
19	0.70	0.54	1.21	30	72.60
20	1.10	0.90	2.01	30	120.60
Total					1297.80 m ²

2.2

Diamond
gradient
of 117200

501?



Formation level at 26th chainage
previous RL - [slope x chain length]

$$= 52 - (\frac{1}{20} \times 40)$$

$$\text{RL of PL} = 51.80 \text{ m.}$$

$$27\text{th chainage} = 51.80 - (\frac{1}{20} \times 40)$$

$$\text{RL of PL} = 51.6 \text{ m.}$$

$$28\text{th chainage} = 51.6 - (\frac{1}{20} \times 40)$$

$$= 51.4$$

$$29\text{th chainage} = 51.4 - (\frac{1}{20} \times 40)$$

$$= 51.2 \text{ m.}$$

$$30\text{th chainage} = 51.2 - (\frac{1}{20} \times 40)$$

$$= 51.0$$

$$31\text{th chainage} = 51.0 - (\frac{1}{20} \times 40)$$

$$= 50.80$$

$$32\text{th chainage} = 50.80 - (\frac{1}{20} \times 40)$$

$$= 50.60$$

$$33\text{th chainage} = 50.60 - (\frac{1}{20} \times 40)$$

$$= 50.40$$

$$34\text{th chainage} = 50.40 - (\frac{1}{20} \times 40)$$

$$= 50.20$$

$$35\text{th chainage} = 50.20 - (\frac{1}{20} \times 40)$$

The road passes from bank to cutting in bet 30 & 31.

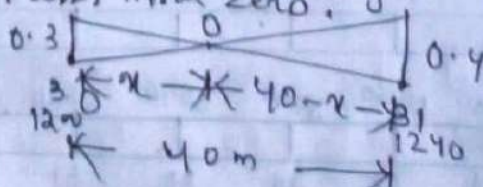
The distance where it passes from zero.

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

$$\Rightarrow 0.4x = 0.3(40-x)$$

$$\Rightarrow 0.4x = 12 - 0.3x$$

$$\Rightarrow 0.7x = 12 \quad x = \frac{12}{0.7} = 17.14 \approx 17 \text{ m.}, 40 - 17 = 23$$



$B = 10$, $S = 2$ for banking and $S = 1\frac{1}{2}$ for cutting

Station	Distance	Height or depth of cut or SPL	Mean depth (d)	Central area (Bd)	Area of side slope (Sd ²)	Total sel. area Bd + Sd ²	Distance between stations	Quantity (Bd + Sd ²) x L	Banking	Cutting
25	1000	1.00	—	—	—	—	—	—	—	—
26	1040	0.90	0.95	9.50	1.81	11.31	40	452.40		
27	1080	1.10	1.00	10.00	2.00	12.00	40	480.00		
28	1120	0.60	0.85	8.50	1.45	9.95	40	298.00		
29	1160	0.60	0.60	6.00	0.72	6.72	40	268.80		
30	1200	0.30	0.45	4.50	0.41	4.91	40	196.40		
Panel from banking to cutting										
	1217	0.00	0.15	1.50	0.05	1.55	17	26.35		
31	1240	0.40	0.20	2.00	0.06	2.06	23	—	47.38	
32	1280	0.80	0.60	6.00	0.54	6.54	40	—	261.60	
33	1320	0.90	0.85	8.50	1.08	9.58	40	—	383.20	
34	1360	0.80	0.85	8.50	1.08	9.58	40	—	383.20	
35	1400	0.60	0.70	7.00	0.74	7.74	40	—	309.60	
Total								1821.95 cum		
Total =								1384.98	m ³	

Item No	Particulars of Item	Quantity	Unit	Rate		Per	Cost
				Rs	P.		Rs
1.	Earthwork embankment	1821.95	cum	275.00		0% Cum	501037.25
2.	Earthwork mcut	1384.98	cum	350.00		0% Cum	484743.00
Total							985780.25
Add 3% for Contingencies							29573.43
Add 2% for work charges & establishment							19715.61
Grand Total Rs							1035069.29

WBM ROAD PROBLEM

Q Estimate the items involved for construction of WBM Road from the following data.

Length of road 100m, metalled width = 5.5m

Thickness of grade - I metal solving = 80mm

Wearing coat of grade - II metal loose consolidated to 80mm thick, surface of road is to be

finished with a coat of bitumen as given below

1st finishing coat: 12mm chips @ 0.018 m³ and bitumen @ 1.22 kg per sqm of road surface.

2nd finishing coat: 6mm chips @ 0.01 m³ and bitumen @ 1.22 kg per sqm of road surface.

Consumption of fuel @ 0.42 kg per kg of bitumen

Ans

Length of the road = 100m

Metalled width = 5.5m

Area of road surface = 5.5 x 100 = 550 sqm

Thickness of grade I metal solving

= 80mm = 0.08m

Quantity required = 5.5 x 0.08 x 100

= 44 cum

Thickness of grade II metal solving

80mm = 0.08m

Quantity required = $5.5 \times 0.08 \times 100 = 44 \text{ m}^3$

1st Finishing coat : 12 mm chips @ 0.018 m^3 per sqm

For 550 sqm , chips required

= $550 \times 0.018 = 9.9 \text{ m}^3$

Bitumen required

= @ 1.22 kg per m^2 of road surface

= $550 \times 1.22 \text{ kg} = 671 \text{ kg}$

2nd Finishing coat : 6 mm chips @ 0.01 m^3 per sqm road surface

= $550 \times 0.01 = 5.5 \text{ m}^3$

Bitumen required

= @ 1.22 kg per m^2 of road surface,

= $550 \times 1.22 \text{ kg} = 671 \text{ kg}$

For 1st and 2nd coat bitumen required

= $671 + 671 = 1342 \text{ kg}$

Consumption of fuel @ 0.42 kg per kg of bitumen.

Consumption of fuel

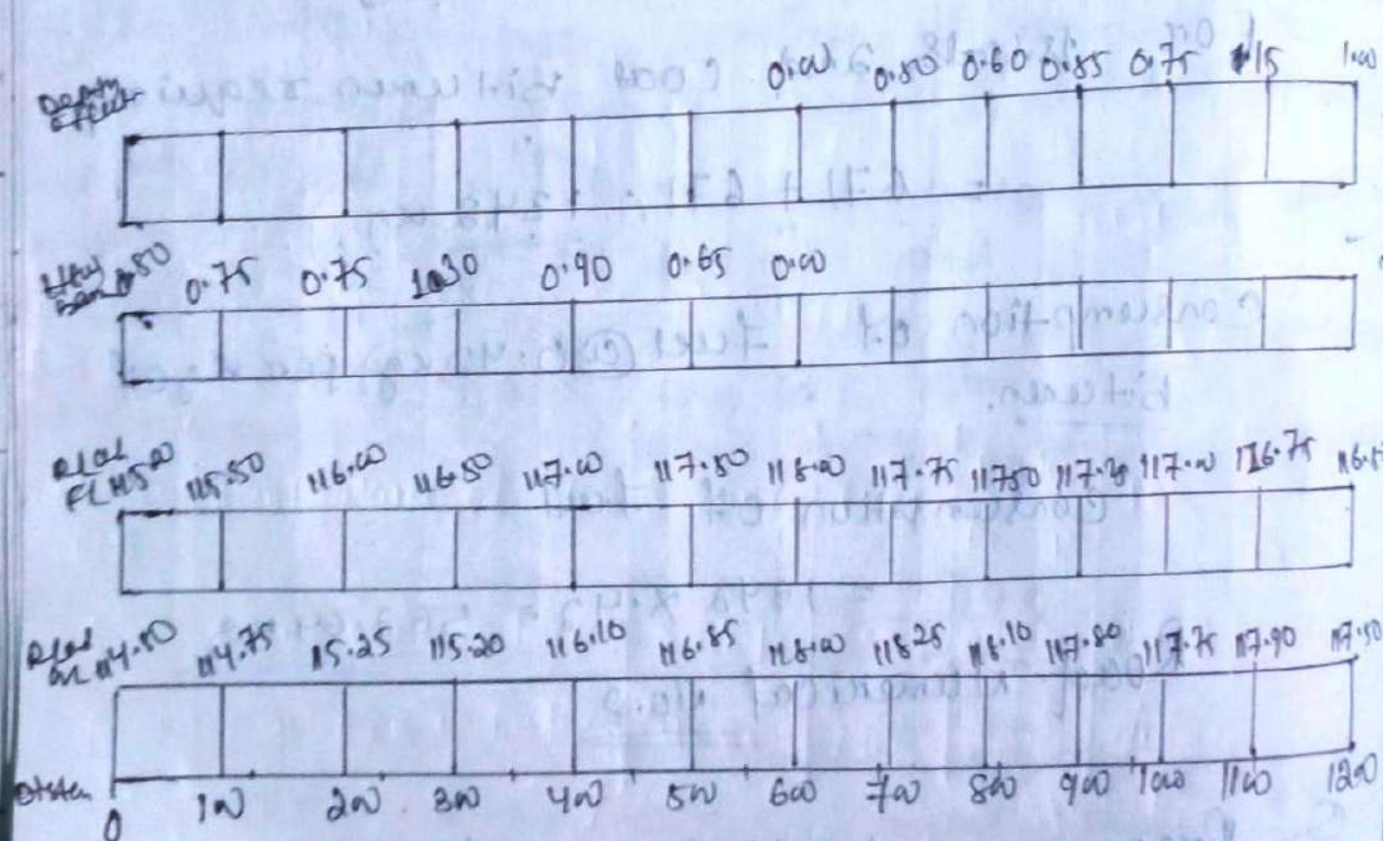
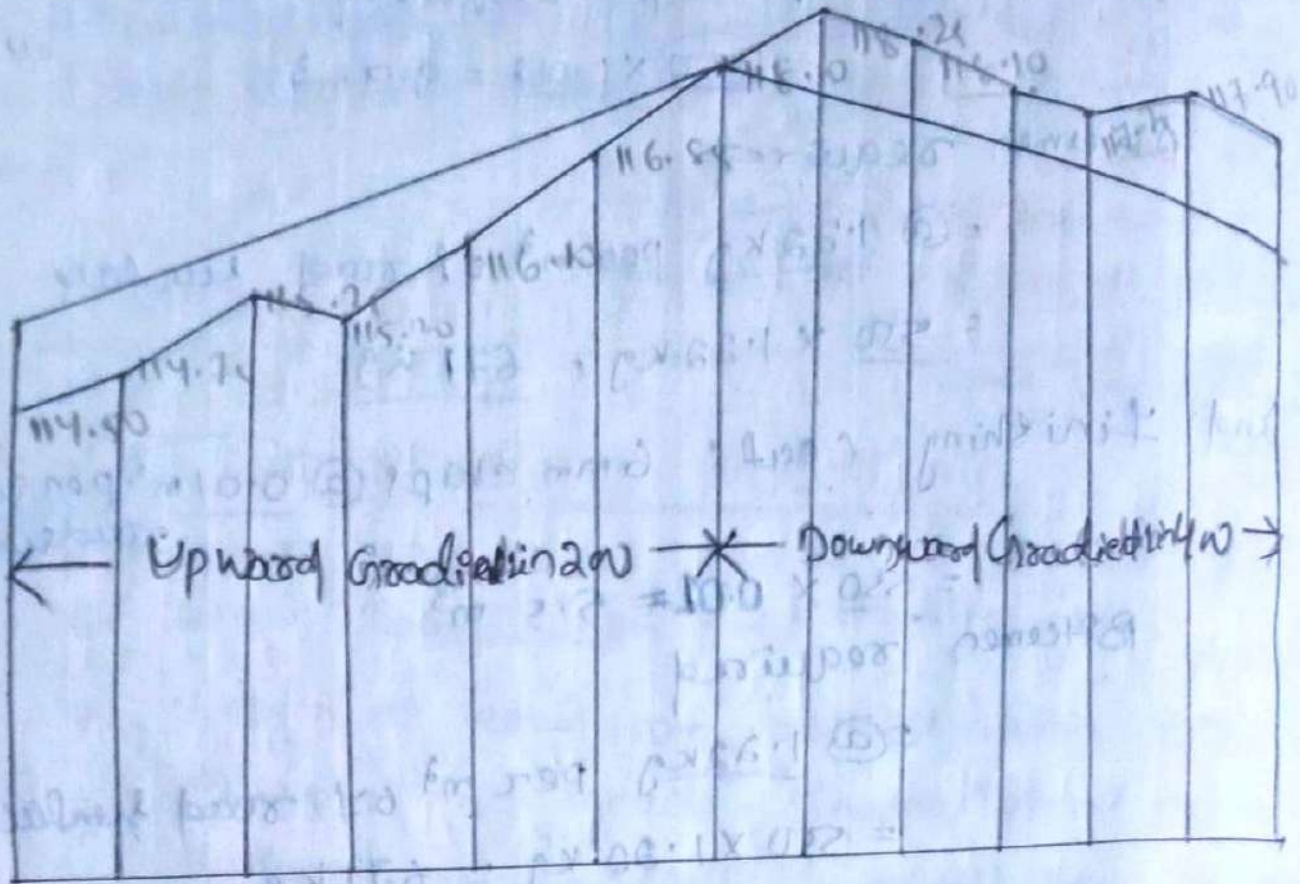
= $1342 \times 0.42 = 563.64 \text{ kg}$

Road Numerical No. 2

Prepare a detailed estimate for earthwork for a portion of road from the following data.

Distance	0	10	20	30	40	50	60	70	80	90	100	110	120
Red GL	114.00	114.21	115.25	115.20	116.10	116.85	118.10	118.25	118.10	117.85	117.5	117.4	117.50
Red RL	115.00	upward	graded	1 in 20	up to 60 mm	4 The	downward	light					

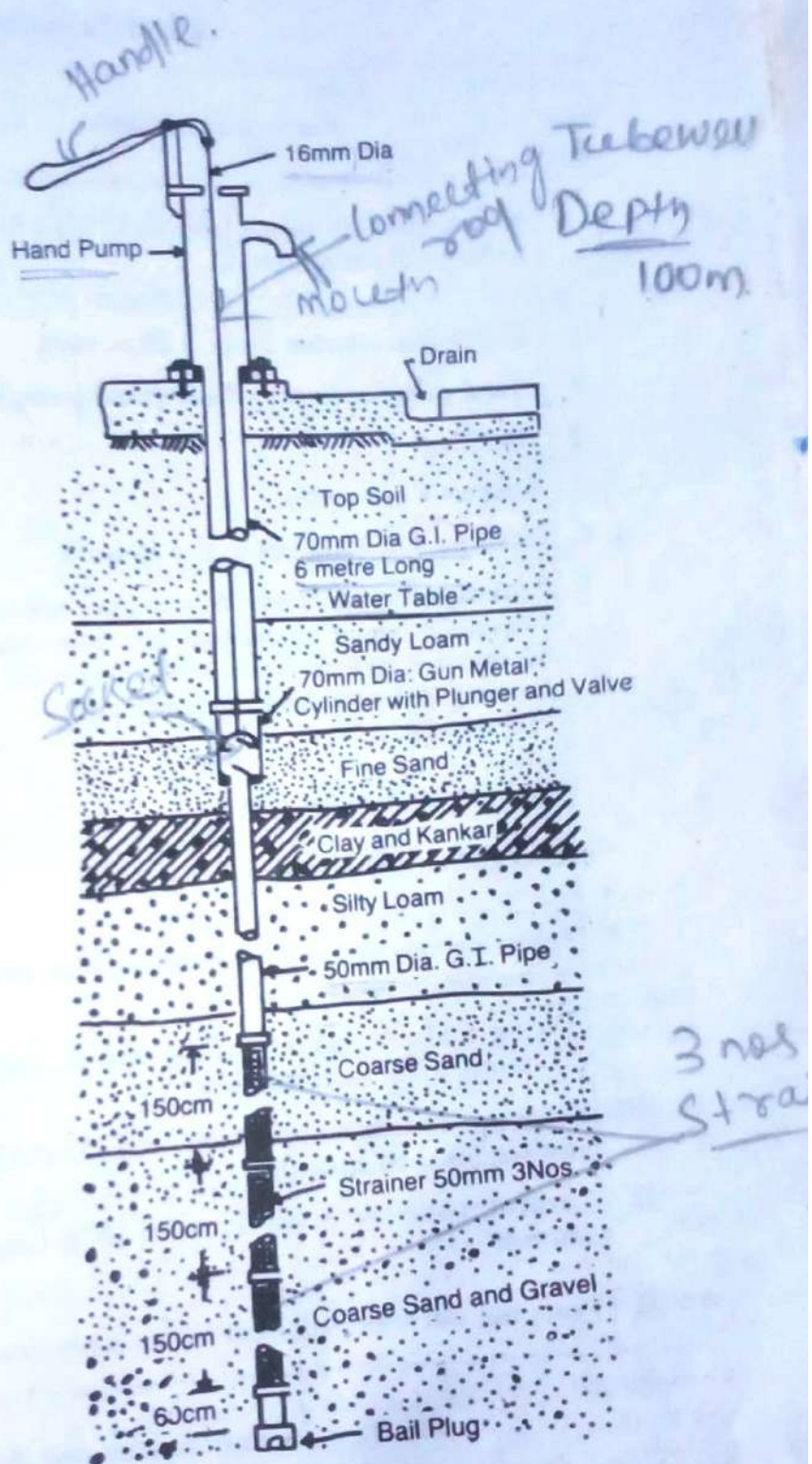
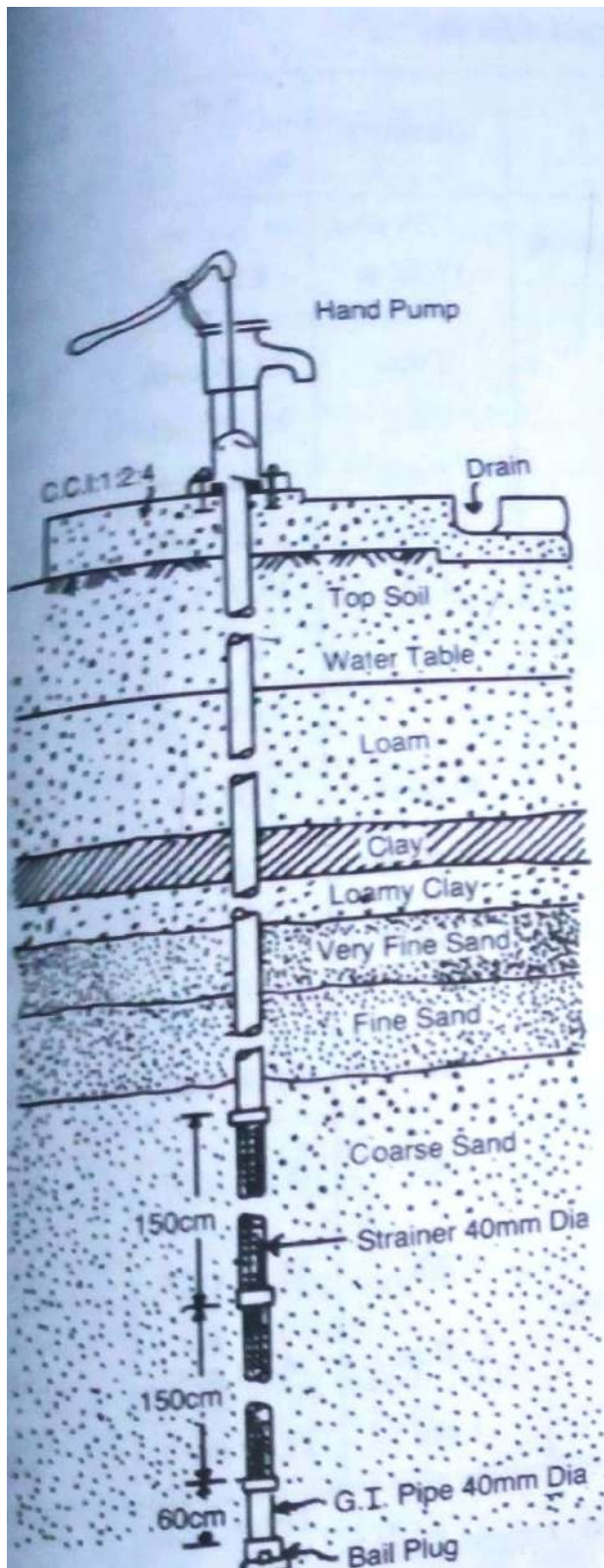
Formulation sketch of road is 10m. Side slope all in bank & $1\frac{1}{2}:1$ in cutting.



Station	Distance Km	Height on depth of H.O.I m	Height on depth d m	Central area sq m	Area of sides sq m	Total see area sq + sq m	Dist in bed stage m	Quantity (cubic) Banking m
0	0	0.50	-	-	-	7.03	100	703
1	100	0.75	0.625	6.25	0.78	8.63	100	863
2	200	0.75	0.750	7.50	1.13	12.35	100	1235
3	300	1.30	1.025	10.25	2.10	13.42	100	1342
4	400	0.90	1.100	11.00	2.42	8.95	100	895
5	500	0.65	0.775	7.75	1.20	3.46	100	346
6	600	0.00	0.325	3.25	0.21	2.59	100	- 259
7	700	-0.80	0.250	2.50	0.09	5.95	100	- 595
8	800	-0.60	0.850	5.50	0.45	6.25	100	- 625
9	900	-0.55	0.575	5.75	0.80	7.13	100	- 713
10	1000	-0.75	0.680	6.50	0.63	10.55	100	- 1055
11	1100	-1.15	0.980	9.50	1.35	12.48	100	- 1248
12	1200	-1.00	1.075	10.75	1.73	Total	5384 m	4525

ABSTRACT OF ESTIMATED COST

Item no	Description of item	Quantity	Unit	Rate Rs	Per %	Cost Rs
1.	Banking in banking	5384	Cum	275.00	0%	14806
2.	Banking in cutting	4525	Cum	350.00	0%	15837.5
Total						30643.5
Add 5% (3% for Contingent and 2% for workmen establishment)						1532.175
Grand Total						Rs 32175.675

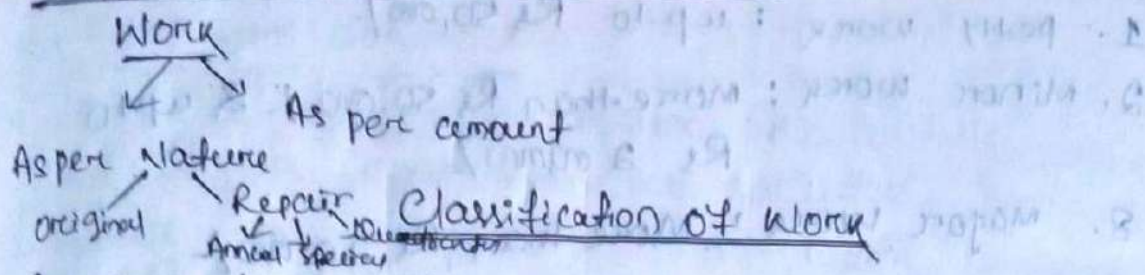


Prepare an estimate of 50mm dia tubewell 12m deep with deep well pump from the given drawing. The strainer will consist of 2 pieces of 1.50 m each. The housing pipe consist of 70mm dia c.s. pipe 6m in length. Assume suitable rates.

Bill of Quantities and cost

Item no	Particulars of item	Quantity	Rate Rs	Amount Rs
1.	50mm dia galvanised iron c.s. pipe	94.00 m	11.50 per m	1081.00
2.	70mm dia h.s. housing pipe	6.00 m	23.00 per m	138.00
3.	50mm dia strainer 3 nos. 1.50m each	3 nos	55.00 each	165.00
4.	74mm dia gun metal cylinder with valve and plungers	1 nos	100.00 each	100.00
5.	Head pump with extra length of 16mm dia connection rod	1 nos	45.00 each	45.00
6.	Ball plug	1 nos	7.50 each	7.50
7.	Sockets 4 nos extra	4 nos	2.50 each	10.00
8.	Transport of materials to site of work	1 Job	20.00	20.00
9.	Sinking - Boring with 70mm dia casing pipe including water arrangements, lower the 50mm dia, tube well pipe and strainer including jointing and with drawing of casing pipe -			
	(i) 0 to 20 metre	20 m	7.50 per m	150.00
	(ii) Below 20m to 35m	15 m	11.00 per m	165.00
	(iii) Below 35m to 50m	15 m	15.50 per m	232.50
	(iv) Below 50m to 65m	15 m	20.00 per m	300.00

Item No	Particulars of Item	Quantity	Rs	P	Rs	P
	(v) Below 50m to 80m	15 m	24.00 per m		360.00	
	(vi) Below 80m to 95m	15 m	28.80 per m		427.80	
	(vii) Below 95m to 100m	5 m	33.00 per m		165.00	
10.	Inserting coarse sand surrounding the strainer including supply of sand	1 Job	20.00		20.00	
11.	Fixing and erecting hand pump in position including holding down bolts	1 Job	10.00		10.00	
12.	Cement concrete platform and foundation surface finished smooth	1 Job	30.00		30.00	
13.	Cement concrete drain 3 m long finished smooth	3.00 m	9.00 per m		27.00	
14.	Pumping out water till clear water is obtained	1 Job	15.00		15.00	
Total					3468.80	
Add 5% for contingencies and workchard establishment					173.42	
Grand Total					3641.92	



As per Nature of work →

1. Original work: Any type of new construction work is known as original work. Example may be construction of new road, new bridge, new building etc.
2. Repair work →
 - a. Annual Repair work: The repair work which is taken up annually is known as annual repair work. Examples may be repairing of pot holes on the road, white washing / colour washing / painting of building etc.
 - b. Special Repair work: Certain repair works which is taken up occasionally as & when required is known as special repair work. Examples may be repair of roads damaged during flood / earthquake, damaged pipe lines, sewer line, repair to damaged plaster, replacement of door or glass panes in building, patch repair of road etc.
 - c. Quadrantal Repair work: Repair works taken up once in every 3 months in a year is known as Quadrantal repair work. Examples may be cleaning of sewer lines in building, repair of sanitary & electrical installations in a building etc.

As per amount of work →

1. Petty work : up to Rs 50,000/-
2. Minor work : more than Rs 50,000/- & up to Rs 2,00,000/-
3. Major work : More than Rs 2,00,000/-

Method of Execution of work.

Departmentary → In case of emergency / urgent nature of work, the department can execute the work by arranging labour and materials under their own supervision.

Through Contractors → Normally the works are executed through contractors who procure materials and engage the required labour under the supervision of departmental engineer.

Various Methods of Carrying out the work.

1. Item Rate Contract → This contract is based on units put in place rather than a single price. The contractor quotes rates of individual items involved in a particular project. The payment is calculated at the specific quoted rate of individual items after taking measurements of the quantities executed by the contractor.

→ This type of contract is normally utilized where the quantity of work cannot be established such as civil Engineering construction work where excavation of soil and rock are involved.

→ The contractor is paid based on the units that have been put in place and verified by the owner. Unit cost contracts provide more flexibility in discrepancies in field quantities and because of this, it is always

2. Lump sum contract →

In a lump sum contract an owner agrees to pay a contractor a specified lump sum after the completion of work without a cost breakdown. After work no detailed measurements is required.

3. Labour contract →

In this type of contract, the contractor quotes the rate for supplying labour only for execution of the work and gets payment for the labour actually engaged.

4. Daily labour or muster Roll system →

→ When the work is carried out by the department directly by employing the daily labour such as masons, beldars, carpenters, coolies, blacksmiths, plumbers etc.

→ It is known as daily labour or muster roll system.

→ All the materials required for the construction are issued from stores or purchased directly chargeable to the concerned work.

5. Piece work agreement →

→ It is the agreement for doing the work at the agreed rates, without reference to the total quantity of work or time.

→ Such work or piece works upto Rs 200/- are got done through the contractors by piece work agreement.

6. Scheduled Contract →

- It is like lump sum contract. Here the complete work as per plan and specification is carried out by contractor for certain fixed amount as per agreement.
- The owner provides required information and contractor charges certain amount.
- This contract is suitable when the no of items is limited or when it is possible to work out exact quantities of work to be executed.
- The detailed specifications of all item of work, plans and detailed drawings, security deposit, penalty, progress and other condition of contract are included in agreement.
- Though it is lump sum and scheduled contract, contractor will be paid at regular interval of 2-3 months as per progress of work on the basis of certificate issued by engineer in charge. A schedule of rate is included in agreement for making payment of extra items.

7. Cost Plus Percentage contract →

- In cost plus percentage, the owner pays greater than 100 percent of the documented cost, usually requiring detailed expense accounting.
- In this type of contract, contractor is paid the actual cost of work plus certain percentage as profit.
- Various contract documents, drawing, time of ~~signing~~ signing the agreement.
- Contractor has to keep an record for cost of material.

contractor will be paid accordingly to engineer in-charge.

→ This type of contract is suitable for emergency work like difficulties in foundation work construction of expensive structure etc.

8. Work order →

→ This method of getting the work done is employed for doing small works upto Rs 500/-.

→ This is a type of contract and is done without calling quotations or tenders.

→ The work order is done on the prescribed terms and conditions of the department.

→ Every department has printed work order books for doing such works.

Explanation of Various Terms

1. Administrative Approval → This is an approval given by the competent authority of the parent department whose construction project work is to be taken up by the P.W.D. department.
→ The parent department after ascertaining the funds position, technical feasibility of the project usually gives the approval.
→ After getting the administrative approval the executing department proceeds for preparing detail drawings & estimates for actual execution.

2. Technical Sanction →

→ This is a sanction usually accorded by the competent authority of the executing department i.e. P.W.D. after proper verification of detail estimate, detailed drawing and specification of the project.

→ After getting technical sanction the executing authority

of the department calls for tender process.

3. Contingency budget →

→ A contingency budget is money set aside to cover unexpected costs during the construction process.

→ This money is on reserve and not allocated to one area of the work, and simply "insurance" against other cost.

4. Tender →

→ It is an offer in writing to execute some specified works or to supply some specified articles subject to certain terms and conditions like rates, time limits etc.

→ Depending upon the type of contract, the tender may be lump sum tender, item rate tender, cost-plus tender, labour tender, demolition tender etc.

→ Tenders which is always sealed in manner should be invited in the most open and public manner possible by advertisements in news papers or notices pasted in public places.

→ The tenders after receiving date & time is over, are opened at the fixed time and date by the authorized officers in the presence of the intending contractors or their agents.

5. Preparation of Notice inviting tender →

Tender notice is issued in the prescribed form for calling tenders for the construction works or supply works etc. in the prescribed form of the department.

Following particulars are given in the tender notice.

a. Name of the authority dept. inviting tender.

- b. Name of the work & its location.
- c. Estimated cost
- d. Time of completion
- e. Cost of tender forms & condition of contracts
- f. Date, place & time of receiving & opening of tender.
- g. Earnest money & security money.
- h. Validity of tender etc.

6. Earnest Money Deposit (EMD)

→ 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 EDM with the tender are as follows:

a. Restriction of Unnecessary competition: If no EMD is collected, unnecessary competition will start. Those contractors who do not have any sound financial position to complete the work will submit their tenders at low rates which may cause difficulties in completing the work.

7. Security Deposit (SD) →

→ After calling the tenders, they are scrutinized and the department accepts the reasonable tender usually the lowest.

→ After accepting the tender the contractor whose tender is accepted is asked to deposit the SD which is usually 2.5 to 10% of

the total cost of the work.
The main objective of SD are as follows:

a. deposit for loans: The SD serves as security against the materials or the plants and machineries supplied by the department to the contractor on loan.

b. punishment: In case the contractor does not complete the work in time, uses inferior quality material or has left the work incomplete, the SD amount is forfeited as punishment to the contractor as well as in view of getting compensation of the damages done by the contractor to the department.

When the contractor completes the work as per drawings, specifications and direction of the department within specified time, the SD is refunded to the contractor.

Normally it is refunded after the maintenance period which usually six months after completion and handing over of the work.

8. Advance payment →

→ Advances to the contractors are as a rule prohibited, but in exceptional case it is permitted. Cases in which a contractor whose contract is for finished work, requires an advance on the security of materials brought to site, Divisional officer may, in such case make advances up to an amount not exceeding 25% of the current value of the materials provided that they are of an imperishable nature.

→ But the department people should be very sure that this advance amount will not put the department in trouble if the contractor leaves the work between.

9. On Account payment →

→ On account payment may be done to the contractor as per actual measurements done in the field for the completed portion of the work as per the norms of the Contract.

10. Intermediate Payment →

→ Intermediate payments may be done to the contractor as per the terms & conditions of the Contract basing on actual measurements in the field against the work done by the contractor.

→ But it should not be the whole amount measured rather less percentage of actual measurement calculated.

→ This type of payment is done subject to prepare of running bill.

11. Final payment →

→ Final payment is usually done to the contractor after successful completion of the work done and final measurements taken and checked by the competent authorities of the department and subject to preparation of final bill.

12. Running Bill →

→ This is otherwise known as running account bill (Form No. 26) which is used for all running and final payments to contractors and suppliers including cases where advance payments are proposed to be made or are already outstanding in respect of the same work against the contract.

13. Final Bill →

→ This is also known as first & final bill (Form No. 24) which is used for making payments to contractors for work and to suppliers, where a single payment is made for a job contract on its completion.

→ A single form may be used for making payments.

to several payees, if they relate to the same work and are billed for at same time.

14. Regular & Temporary Establishment →

→ All the regular staff of the department are known as regular establishment and the staff assigned to a specific project for completion of the project is known as temporary establishment.

15. Measurement Book → (MB)

→ Payments to contractors and suppliers for all the work done by them which requires measurement are done on the basis of measurement recorded in a book known as Measurement Book (MB) in accordance with the rules.

→ It is a very important account of record.

→ Usually Junior Engineer (JE) who is actually assigned to supervise the quality & progress of the work is authorized to make the entry of detailed measurements of the work.

→ He records all the measurements after completion of the work or interim as required and puts his dated signature in the book.

→ The same is being checked measured by his Superior authorities time to time and they also put their dated signature in it. When the bill is prepared (running/final) the measurements are taken from this book.

16. Standard Measurement Book (SMB) →

→ A set of measurement books which is used to maintain standard measurement books of buildings in order to facilitate the preparation of estimates for periodical repairs are known as standard measurement book (SMB).

→ Where such SMB are maintained, it is also

permissible to utilize them for the purpose of preparing for contractor's bill for such repairs, so that it may not be necessary to take detailed measurements on each occasion.

17. Musters Roll →

→ The attendance of the labourers is maintained in a muster roll.

→ The presence of each labourer in muster roll should be marked by the proper officer at the starting hour of the day.

→ Periodic inspections by the higher authority are done to check the actual labourers working.

→ On the basis of the muster roll payment is made to the labourers, weekly, fortnightly, monthly or at the completion of the work according to the requirement.

→ In the muster roll names of the workers, designation, date of attendance, rate of wages, total amount due to each worker, signature of person taking the attendance, signature of the officer checking, making payment etc are entered.

18. Acquittance Roll →

→ The workers actually paid the due charges after signing in the acquittance roll.

→ In this roll the name of the worker, no. of days worked, rate of wage, total amount received, signature of acquittance of the worker are recorded.

→ This is used as a paid voucher or bill in the department for official record of payments to the workers and is supported by the muster roll.

19. Temporary Advance →

→ While a disbursing officer makes a remittance to a subordinate officer to enable him to make a number of specific petty payments on a master roll or other voucher which has already been passed for payment, the amount remitted is known as temporary advance and accounted for as imprest.
→ This account should be closed as soon as possible.

20. Cash →

The term 'Cash' as defined in the CPWD code includes legal coins, notes, cheques, deposit at call receipts of scheduled banks, drafts and payments on demand.

Cash charges on works consists of payment to:

a. Labourers and members of the workcharged establishment, of their wages.

b. Contractors and others for work done for other services rendered.

The cost of materials procured specially for works is charged to the accounts of works by transfer credit to the purchases account. But payment to suppliers are governed by the same rules as payments to the Contractors for work done.

21. Major & Subhead of Accounts →

→ All the expenditure related to a work are known as major head of Accounts. Further these expenditures are divided into different subheads as applicable. Examples may be follows.

Major head of accounts

Construction of a building

Establishment charges

Sub head of accounts

Material cost, labour cost, rent of tools & plants, supervision charges etc.

Salary, Allowances, Travelling expenses

22. Supervision charges

→ It is the amount kept in the estimate to meet the expenses towards supervision of the project work. Usually 5% amount on the cost of estimate is kept for this purpose.

23. Debit → Expenses made in executing the work is known as debit.

24. Credit → Payments received for expenses towards work is known as credit.

STORE

Classification of store:

The PWB classify the stores into the following types.

1. Stock
2. Machinery and equipment
3. Road metal
4. materials charged to works.

Stock →

→ Items of common use in construction work, such as bricks, aggregates, cement, steel etc, are kept in the stock of a division and are issued as and when required for the execution of works.

The following are the advantages of keeping a stock of materials.

- a. The procedure for the procurement of the same item is not repeated for different works.
- b. The use of approved materials of the prescribed specifications is ensured.

→ 'Stock' is a suspense head of account. When an item of stock is purchased, its cost is debited to the suspense head 'stock'. When the item is issued for use in a work, the cost of the item issued is credited to the suspense head 'stock' and

debited to the final head of the work concerned.

Machinery and equipment →

→ The machinery, equipment, vehicles, furniture and instruments required for use in construction work are known as machinery and equipment.

The machinery and equipment are of two kinds.

a. General machinery and equipment.

They are required for general use in the division.

b. Special machinery and equipment.

These are not required for general use in the division, but are procured for use in the specific works.

Road metal →

→ A record of Road metal is kept in measured books and claims for payment examined on the basis of the recorded measurements.

→ Road metal is often kept by the road side before use and account of its quantity is kept in the sub-divisional office in Form 16, Statement of receipts, issues and balance of road metal.

→ Copies of these statements are submitted to the divisional office.

→ Road metal found surplus, as a result of physical verification or otherwise should immediately be brought an account, treating it as a receipt, shortage should be noted in the form of a remark in red ink and should be carried forward from month to month, until the discrepancy is right by recovery, write-off or other means.

Materials charged to works →

→ In addition to the charges falling under the main classes namely, Cash and Stock, there are other transactions affecting the cost of work.

→ They may be charges incurred in other divisions or departments, materials received from them

or services rendered by them or there may be cash receipt that are taken in reduction of expenditure in accordance with the rules.

Issue of stores Materials →

Materials are issued from stock for the following purposes.

- for use on works either by contractors or departmentary.
- for dispatch to other subdivision or department.
- for sale to contractors, employees and other outside parties.

Bin card →

This is a card, which is attached to each Bin or the container for stores a record of all materials entering or leaving the bin and balance of materials in hand is kept in this card.

Verification of stocks, shortage and excess →

→ The stock is verified by the competent authority at least once in a year and physical position of the materials are checked with the stock register & bin card.

→ Then the articles found in shortage or excess are recorded properly.

→ Normally no steps are taken if found excess but the value of the stores found shortage or deficit should, however, not be debited to the relevant final head of account, kept under 'Miscellaneous P.W. Advance per recovery or adjustment.'

[illegible]

SEPTIC TANK FOR 50 USERS

All Dimensions are in Centimeters except otherwise mentioned

The diagram illustrates a septic tank system for 50 users, consisting of a latrine, a septic tank, and a soak pit. The **SECTION OF LATRINE** shows a structure with a 1m wide cowl, a 2.8m long flushing cistern, and a 100mm dia C.I. pipe leading to a 50mm dia anti-siphonage pipe. The **SECTION OF SEPTIC TANK** is a rectangular tank with a 4.70m length and 2.50m width, featuring a 10cm R.B. standing wall, an iron foot step, and a 3.70m slope. It includes a 45cm dia manhole cover, a 100mm dia S.W. tee, and a 7.5cm R.C.C. cover. The **SECTION OF SOAK PIT** is a circular pit with a 1.50m diameter, constructed with 15x6cm R.C.C. slabs and 50mm gauges. The **PLAN OF LATRINE** shows the layout of the latrine structure, and the **PLAN OF SEPTIC TANK** shows the rectangular layout of the tank with its internal partitions and pipes.

Fig. 6-2

SEPTIC TANK FOR 50 USERS

All Dimensions are in Centimeters except otherwise mentioned

The diagram illustrates a septic tank system for 50 users, consisting of a latrine, a septic tank, and a soak pit. The latrine section shows a cowl, flushing cistern, and a syphon leading to a pan. The septic tank section shows a 10cm L.C. pipe, a 100mm Dia. S.W. pipe, a 10cm R.B. standing wall, and a 13.6 C.C. tank. The soak pit section shows a 15x6cm R.C.C. cover, a 7.5cm R.C.C. cover, and a 1.50m Jhama brick wall. The plan of the septic tank shows a 4.70m length and a 1.90m width. The plan of the soak pit shows a 1.50m diameter and a 1.50m length. The plan of the latrine shows a 2.8m width and a 1m length.

SECTION OF LATRINE

SECTION OF SEPTIC TANK

SECTION OF SOAK PIT

PLAN OF SEPTIC TANK

PLAN OF LATRINE

PLAN OF SOAK PIT

Fig. 6-2

Item No	Particulars of items and details of work	Nos	Length (m)	Breadth (m)	Height (m)	Quantity	Remarks
1.	Septic Tank and soak pit.						
	Earthwork in excavation Septic tank	1	4.70	1.90	1.725	15.41	
	Soak pit	1	$\frac{\pi \times (0.9)^2}{4}$	$\times 3.0$	—	8.80	
					Total	23.91 m ³	
2.	Cement concrete 1:3:6 in foundation of Septic tank	1	4.70	1.90	0.15	1.34 m ³	Filler Septic tank
3.	I-Class brick work in 1:4 Cement mortar Septic tank						
	Long wall						
	1st footing	2	4.80	0.4	0.40	1.44	
	2nd footing	2	4.30	0.3	0.80	1.29	
	3rd footing up to top	2	4.10	0.2	0.675	1.11	
	Short wall						
	1st footing	2	0.90	0.40	0.40	0.29	
	2nd footing	2	0.90	0.20	0.80	0.27	
	3rd footing up to top	2	0.90	0.20	0.675	0.24	
					Total	4.64 m ³	1 block for offset
4.	R.C work in partition wall with 1:3 cement mortar in Septic tank including reinforcement complete work	1	0.9	0.10	1.25	0.122 m ³	

5. R.C work in
septic tank and
soak pit including
reinforced concrete
work

Slab cover of
septic tank

1

3.90

1.10

0.075

0.322

Slab cover of
soak pit ~~soak~~

1

$\frac{\pi \times (1.7)^2}{4}$

X

0.075

0.170

Reinforced of pipe
in soak pit

1

1.70

0.15

0.06

0.015

Total 0.507 m³

6. 12mm plastering
inside septic tank
mixed with water
proofing compound
long wall

2

3.70

—

1.80

11.10

short wall

2

0.90

—

1.80

2.70

partition wall
both sides

2

0.90

—

1.35

2.43

partition wall top

1

0.90

—

0.10

0.09

Total 16.32 m²

7. Ce floor

1

3.70

0.90

—

3.33 m²

8. 11 Blax B.W
in cement mortar
in soak pit
(Heavy concrete wall
soak)

1

$\pi \times 1.70 \times 0.20 \times 3.0 = 3.20$

m³ Mean
Circumference

9. Thana brick
ballast 10mm size
inside soak pit
(top layer)

1

$\frac{\pi \times 1.5^2}{4}$

X

0.60

1.06 m³

10. Thana brick
balls inside
soak pit
(Lower layer)

1

$\frac{\pi \times 1.5^2}{4} \times 1.80$

—

2.18 m³

11. CS manhole
cover used
dia over
septic tank

2

—

—

—

2 Nos

12. Iron food step
septic tank

8

—

—

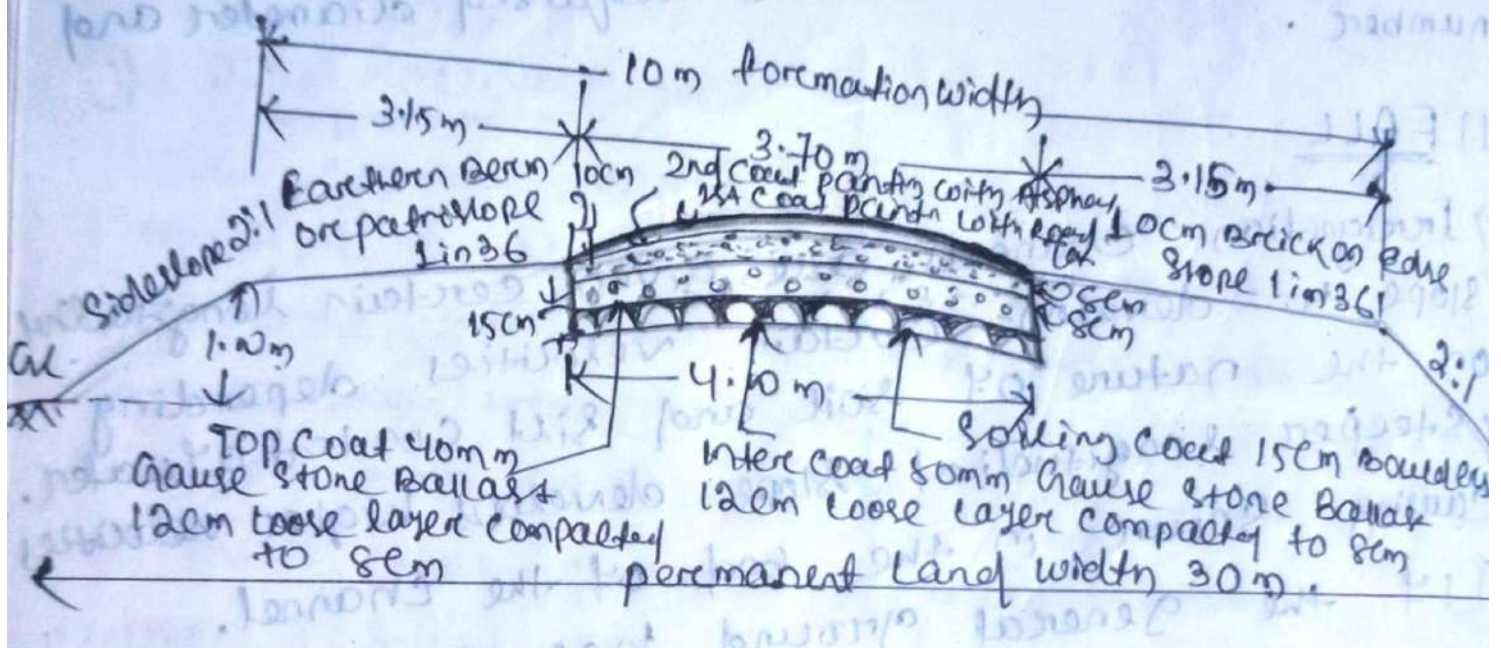
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8 Nos

Siem No	Particulars of item	Qty	Length (m)	Breadth (m)	Height (m)	Quantity	Remark
13	Sandling work - K.H.C. Indian pattern 50cm white glazed pan with syphon & with 1.25 ltr of flushing cistern on bracketed 25mm dia or telescopic flush pipe painted two coats and with chain fast rest complete supplying fixing	1	—	—	—	1.25	
14	S.W. pipe 100mm dia latrine overloam including digging, laying, jointing, etc. complete - connecting latrine with septic tank connecting septic tank with soak pit	1	3.0	—	—	3.0	
		1	4.0	—	—	4.0	
15	S.W. Tee 100mm dia at the inlet and outlet of septic tank	2	—	—	—	2 Nos	
16	C.I. Heavy bore Pipe 100mm dia connecting latrine seal, vent pipe including fixing with lead jointing	1	5.0	—	—	5.0 m	
17	C.I. Heavy bore pipe 50mm dia complete with lead jointing connecting latrine pan with vent pipe vent pipe for septic tank	1	0.60	—	—	0.60	
		1	3.0	—	—	3.0	
18	C.I. Cowl 100mm dia for latrine	1	—	—	—	1 Nos	
19	C.I. Cowl 50mm dia for septic tank vent	1	—	—	—	1 Nos	
Total						7.0 m	

0	250 litre G.I Tank of 20 B. with sheet with 45cm diameter hinged cover with locking arrangement and fitted with 15mm dia. brass supplying and fixing in position complete	1	—	—	—	1 No
21.	15 mm dia G.I Pipe with fittings including digging laying, clamping complete, Connecting G.I Tank with water main	1	15.00	—	—	15.00
	Connecting Plumbing Cistern from G.I tank	1	2.00	—	—	2.00
	Connecting water tap from G.I tank	1	4.50	—	—	4.50
Total						21.50 m
22.	15 mm dia. Brass Stop-cock supplying and fixing	2	—	—	—	2 Nos
23.	15 mm dia brass bib cock supplying and fixing	1	—	—	—	1 No
24.	Brass ferrule 6mm dia supply and fixing	1	—	—	—	1 No

Cross-section of Road



	Particulars of Items of works	No.	Length m	Breadth m	Ht. or Depth m	Quantity	Remarks
1	✓ Surveying, dagbelling etc	1	1 km		—	1 km	
2	✓ Land acquisition permanent	1	1000 m	30 m	—	30000 sq m = 3 hectare	30 m width
3	Land acquisition temporary	...	Quantity of earthwork in embankment Depth of borrowpit				Quantity of earthwork same as in item (4) Depth of borrowpit 30 cm.
					12000 .30	40000 sq m	
4	✓ Earthwork in embankment	...	$(Bd + sd^2) \times L$ $= (10 \times 1 + 2 \times 1^2)$		$\times 1000 =$	= 4 hectare 12000 cu m	B = 10 m d = 1 m
5	✓ Plantation of grasses on the side slope	1	1000 m	$\times 2 \times$	$\sqrt{2^2 + 1}$	4500 sq m	Sloping breadth $d = s^2 + 1$
METALLING—							
6	Preparation of sub-grade (dressing to camber)	1	1000 m	4.00 m	—	4000 sq m	30 cm wider.
7	Soling coat						
	(i) Stone boulders 15 cm size	1	1000 m	4.00 m	0.15 m	600 cu m	30 cm wider
	(ii) Laying and consolidation of boulders including blinding with local sandy soil	...	Same	as	above	600 cu m	
8	Inter coat						
	(i) Stone ballast 50 mm gauge	1	1000 m	3.70 m	0.12 m	444 cu m	12 cm thick loose layer compacted to 8 cm.
	(ii) Laying and consolidation of ballast including blinding with local sandy soil	...	Same	as	above	444 cu m	
9	Top coat						
	(i) Stone ballast 40 mm gauge	1	1000 m	3.70 m	0.12 m	444 cu m	12 cm thick loose layer compacted to 8 cm.

Item No.	Particulars of items of works	No.	Length m	Breadth m	Ht. or Depth m	Quantity	Remarks
10	(ii) Laying and consolidation of stone ballast including blinding with local sandy soil ... Beam or Patri dressing	1	Same 1 km	as —	above —	444 1 km	cu m
11	PAINTING OR BLACK TOP SURFACING Painting 1st coat with Road Tar No. 3— (i) Stone grit 20 mm gauge @ 1.35 cu m % sq m	1	1000 m	× 3.70 m	× $\frac{1.35}{100}$	= 50 cu m	
	(ii) Paint or binding Road Tar No. 3 @ 220 kg % sq m	1	1000 m	× 3.70 m	× $\frac{220}{100}$	= 8140 kg = 8.14 3700	tonne sq m
12	(iii) Laying Painting 2nd coat with Asphalt (i) Stone grit 12 mm gauge @ .75 cu m % sq m	1	1000 m	× 3.70 m	—		
	(ii) Paint or binder Asphalt @ 120 kg % sq m	1	1000 m	× 3.70 m	× $\frac{.75}{100}$	= 27.75 = 28 cu m	
	(iii) Laying	1	1000 m	× 3.70 m	—		
13	Brick edging on both sides including bricks and labour ...	1	1 km	—	—	1 km	
14	Bridges (minor) and culverts	1	1 km	—	—	1 km	
15	MIC, ITEMS— Km, half km and boundary stones	1	1 km	—	—	1 km	
16	Formation level pillars	1	1 km	—	—	1 km	
17	Road direction posts caution signs, etc.	1	1 km	—	—	1 km	
18	Traffic diversion, service road, etc.	1	1 km	—	—	1 km	
19	Arboriculture	1	1 km	—	—	1 km	

Item No.	Particulars of items of work	Quantity	Unit	Rate Rs. P.	Per	Amount	
						Rs.	P.
1	Surveying dagbelling, etc. ...	1	km	300.00	/km		300.00
2	Land Acquisition permanent ...	3.00	hectare	3000.00	/hectare		9000.00
3	Land Acquisition temporary ...	4.00	hectare	700.00	/hectare		2800.00
4	Earthwork in embankment ...	12000	cu m	275.00	% cu m		33000.00
5	Plantation of grasses on the side slopes ...	4500	sq m	1.00	/sq m		4500.00
METALLING—							
6	Preparation of sub-grade ...	4000	sq m	0.50	/sq m		2000.00
7	Soling Coat —						
	(i) Stone boulders 15 cm size (supply) ...	600	cu m	100.00	/cu m		60000.00
	(ii) Laying and consolidation of boulders including blinding with sandy soil ...	600	cu m	18.00	/cu m		10800.00
8	Inter Coat—						
	(i) Stone ballast 50 mm gauge (supply) ...	444	cu m	150.00	/cu m		66600.00
	(ii) Laying and consolidation of ballast including blinding with sandy soil ...	444	cu m	20.00	/cu m		8880.00
9	Top Coat—						
	(i) Stone ballast 40 mm gauge (supply) ...	444	cu m	155.00	/cu m		68820.00
	(ii) Laying and consolidation of ballast including blinding with sandy soil ...	444	cu m	20.00	/cu m		8880.00
10	Beam or patri dressing (Twice)	1	km	1500.00	/km		1500.00
PAINTING OR BLACK TOP SURFACING							
Painting 1st coat with Road Tar No. 3.							
	(i) Stone grit 20 mm gauge (supply) ...	50.00	cu m	220.00	/cu m		11000.00
	(ii) Paint or binder, Road Tar No. 3 (supply) ...	8.14	tonne	600.00	/tonne		4884.00
	(iii) Laying ...	3700	sq m	0.90	/sq m		3330.00
C. O.							296294.00

Item No.	Particulars of items of work	Quantity	Unit	Rate		Per	Amount	
				Rs.	P.		Rs.	P.
21	Painting 2nd coat with Asphalt—					B.F.		296294.00
	(i) Stone grit 12 mm gauge (supply)	28.00	cu m	220.00		/cu m	6160.00	
	(ii) Paint or binder, Asphalt (supply)	4.44	tonne	600.00		/tonne	2664.00	
	(iii) Laying ...	3700	sq m	0.45		/sq m	1665.00	
13	Brick edging on both sides with brick and labour complete ...	1	km	3500.00		/km	3500.00	
14	Bridges (minor) and culverts	1	km	100000.00		/km	100000.00	
	MISC ITEMS—							
15	Km stone, half km stone and boundary stones ...	1	km	600.00		/km	600.00	
16	Formation level pillars ...	1	km	500.00		/km	500.00	
17	Road direction posts, road, signs etc. ...	1	km	300.00		/km	300.00	
18	Traffic diversion, service road, etc. ...	1	km	500.00		/km	500.00	
19	Arboriculture ...	1	km	3500.00		/km	3500.00	
Total ...							415683.00	
Add 3% for Contingencies ...							12470.50	
Add 2% for Workcharged Establishment ...							8313.66	
Grand Total ...							436467.16	
Say Rs. ...							436467.00	
Estimated cost comes to Rs. 436467/- per km								