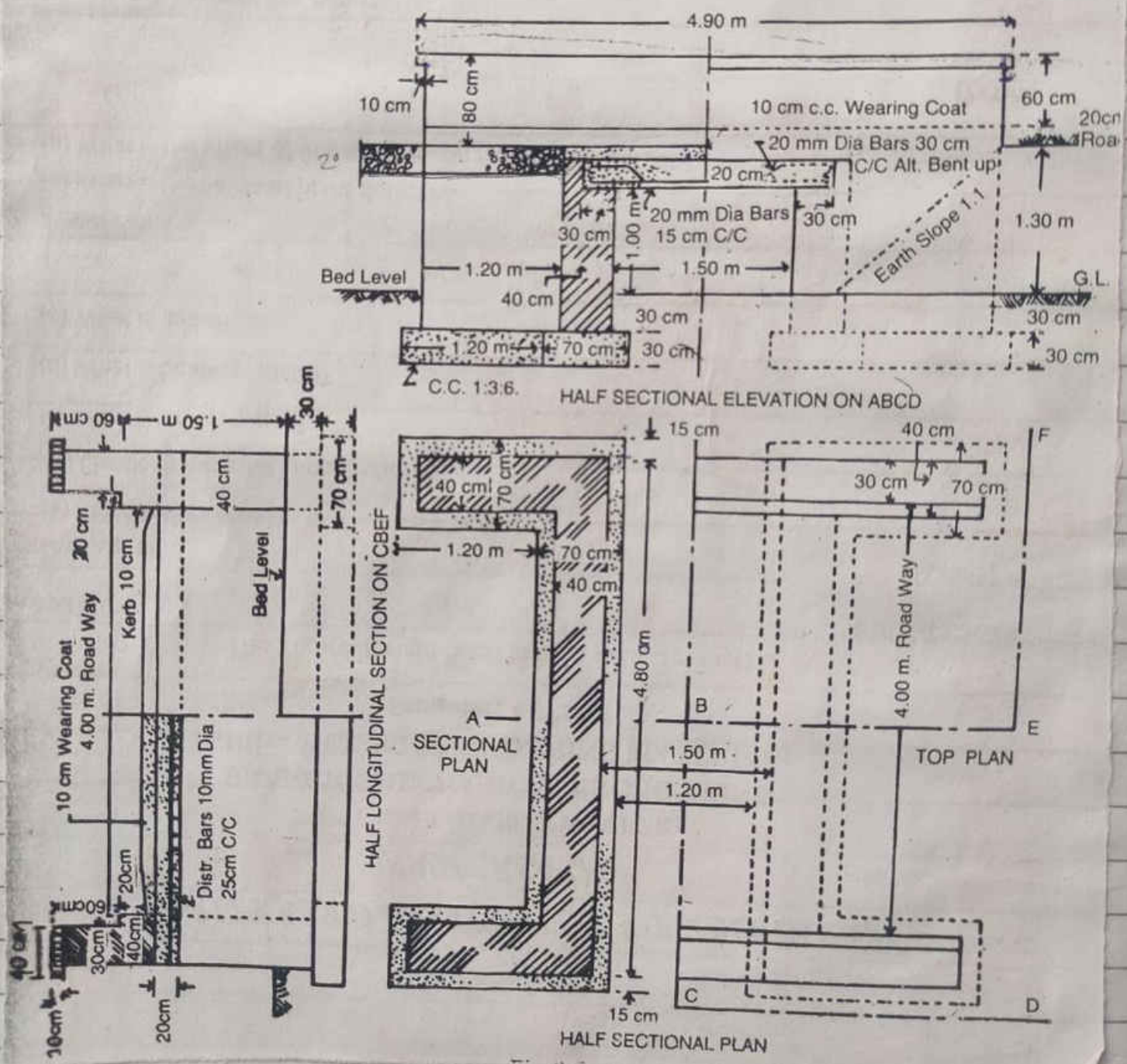
[redacted]. — Prepare a detailed estimate of a slab culvert of 1.50 metre span and 4.00 metre roadway from the given drawing (Fig. 8.5). The general specifications are as follows :—

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



S/No	Description of Item	No	Length	Breadth	Height	Quantity	Explanatory notes
1.	Earthwork excavation in foundation						
	(i) Abutment	2	5.10m	0.70m	0.60m	4.284m³	L = 4.80 + 2X0.15 = 5.10
	(ii) Wingwall	4	1.20m	0.70m	0.60m	2.016 m³	H = 0.30 + 0.30 = 0.60
					Total	6.300m³	
2.	Cement concrete in foundation 1:3:6						
	(i) Abutment	2	5.10m	0.70m	0.30m	2.142m³	
	(ii) Wingwall	4	1.20m	0.70m	0.30m	1.008	
					Total	3.150m³	
3.	First class brick work 1:4 in cement mortar						
	(i) Abutment	2	4.80m	0.40m	1.50m	5.760m³	H = 0.20 + 1.0 + 0.30 = 1.5
	(ii) Wingwall	4	1.20m	0.40m	1.50m	2.880 m³	
	(iii) Parapet upto kerb 40cm layers	2	4.70m	0.40m	0.30m	1.128m³	H = 0.20 + 0.10 = 0.30

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No	Description of item	No	Length	Breadth	Height	Quantity	Explanatory notes
(iv)	Parapet above kerb 30cm layers	2	4.70m	0.30m	0.50m	1.410m³	L = 4.90 − 2×0.10 = 4.70
(v)	Parapet coping	2	4.90m	0.40m	0.10m	0.392m³	
					Total	11.560m³	
	Deduction						
	Bearing of R.C.C slab in Abutment	2	4.80m	0.30m	0.20	0.576m³	
					Total	10.994 m³	
(4)	R.C.C slab 1:2:4 with reinforcement shuttering and centering	1	4.80m	2.10m	0.20	2.016m³	B = 0.30 + 1.50 + 0.30 = 2.10
(5)	Wearing coat 1:2:4 Cement concrete	1	4.00m	2.30m	0.10	0.920 m³	B = 1.50 + 2×2.90 = 2.30

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Sl.No	Description of Item	No	Length	Breadth	Height	Quantity	Explanatory notes
(6)	Cement painting 1:2 in wall						H = 0.10 + 1.30 + 0.20 + 0.60 − 0.10 = 2.10
	(i) Face wall 10cm below upto ground level upto buttom of coping	2	4.70	—	2.10	19.740 m²	
	(ii) Innerside of parapet excluding coping	2	4.70	—	0.80	7.520 m²	H = 0.10 + 0.20 + 0.60 − 0.10 = 0.80
	(iii) Coping (1 mere edge top button)	2	4.90	0.70	—	6.86 m²	B = 0.10 + 0.40 + 0.10 + 0.10 = 0.70
	(iv) 14cm layer endup parapet	2×2	—	0.40	0.20	0.32 m²	
	(v) 30cm layere endup parapet	2×2	—	0.30	0.50	0.60 m²	
	(vi) 40cm layere end up parapet	2×2	—	0.40	0.10 (+)	0.16 m²	
					Total	37.	

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no	Description of item	No	Length	Breadth	Height	quantity	Explanatory notes
	Deduction						
(i)	Rectangular opening	2	1.50m	—	1.10m	(—) 3.3 m²	H = 1.0 + 0.10 = 1.10
(ii)	Triangular person opening	2	× ½ × 1.30	× 1.30		(—) 1.69 m²	
						30.21 m²	

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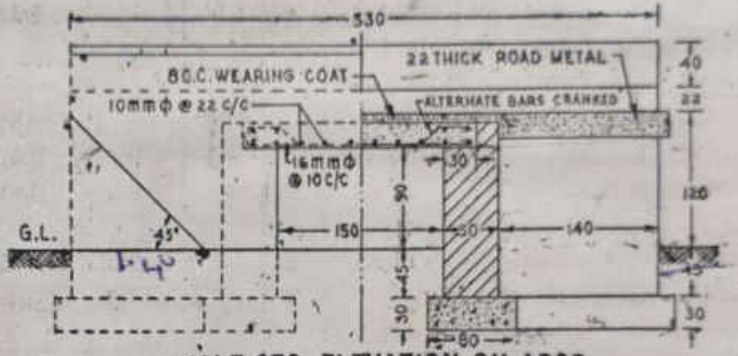
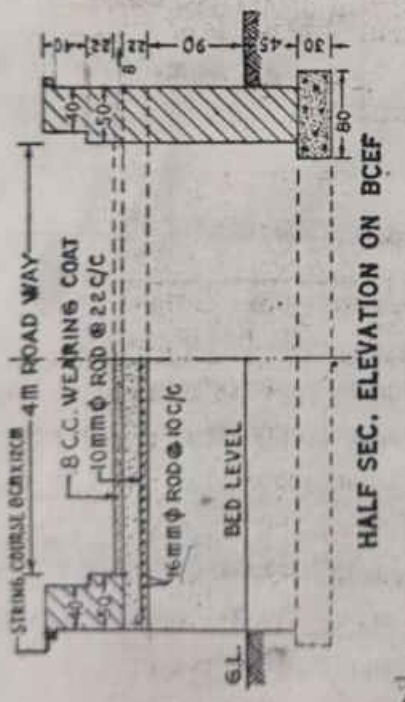
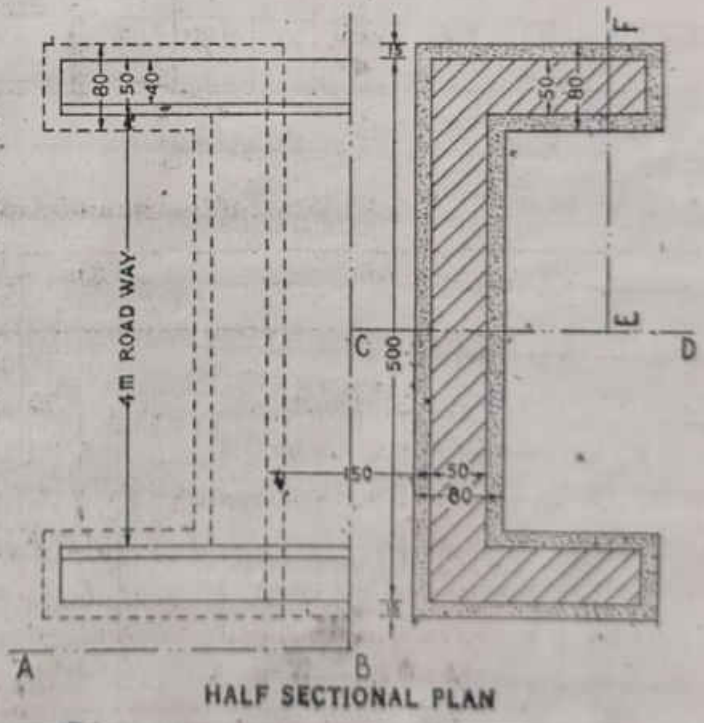
Example – 2. Estimate of a simple Slab Culvert. — Prepare a quantity survey for a slab culvert of 1·5 m clear span and 4 m road way as shown in the fig. 10–25.

The general specifications are as follows :—

Foundation shall be of cement concrete 1 : 2 : 4. Brickwork shall be of 1st. class in cement mortar 1 : 4. Exposed surfaces of brick masonry shall be cement pointed 1 : 3 carried up to 15 cm below G. L. The exposed surfaces of R. C. C. shall be given a smooth finish during centering, and no plastering shall be allowed. The string courses shall be 8 cm deep and 12 mm thick with cement mortar 1 : 3 finished with neat cement. (Wt. of 16 mm and 10 mm dia. bars are 1·58 kg and 0·62 kg respectively per r m.)







Sl no	Description of item	No	Length	Breadth	Height	Quantity	Explanatory notes
(1)	Earthwork excavation in foundation						
	(i) Abutment	2	5.30	0.80	0.75	6.36 m³	L = 5.00 + 2×0.15 = 5.30
	(ii) Wingwall	4	1.40	0.80	0.75	3.36 m³	H = 0.45 + 0.30 = 0.75
					Total	9.72 m³	
(2)	Cement concrete 1:2:4 in						
	(i) Abutment	2	5.30	0.80	0.30	2.544 m³	
	(ii) Wingwall	4	1.40	0.80	0.30	1.344 m³	
					Total	3.888 m³	
(3)	1st class brickwork 1:4 in cement mortar						
	(i) Abutment	2	5.00m	0.50m	1.57 m	7.850 m³	H = 0.45 + 0.90 + 0.22 = 1.57
	(ii) Wingwall	4	1.40m	0.50m	1.57 m	4.396 m³	H = 0.22 + 0.08 = 0.30

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sl no	Description of item	No	Length	Breadth	Height	quantity	Explanatory notes
	(iii) parapet 50cm layer	2	5.30m	0.50m	0.30m	1.590m³	H - 0.22 + 0.08 - 0.30
	(iv) parapet 40cm layer	2	5.30m	0.40m	0.40m	1.696m³	
					Total	15.932m³	
	Deduction						
	Bearing RCC slab in						
	(1) Abutment	2	5.00	0.30	0.22 (-)	0.660m³	
					Total	14.872m³	
(4)	The string courses shall be 8cm deep and 12n thick with cement mortar	2	5.00	-	-	10.60(rcm)	
(5)	R.C.C slab shuttering and centering	1	5.00	2.10	0.22	2.310m³	B - 0.30 + 1.50 + 0.30 = 2.10
(6)	Cement pointing 1:3 carried upto 15cm below ground level						

S/no	Description of item	No	Length	Breadth	Height	quantity	Explanatory notes
(i)	Facewall 15cm below ground level upto parcapet	2	5.30	-	1.97	20.882m²	H1 = 0.15 + 1.20 + 0.22 + 0.40 = 1.97
(ii)	Innerside of parapet	2	5.30	-	0.72	7.632m²	H = 0.22 + 0.10 + 0.40 = 0.72
(iii)	End of parcapet 50cm parcapet	2x2	-	0.50	0.22	0.44m²	
(iv)	End of parcapet 40cm layers	2x2	-	0.40	0.40	0.64m²	
						29.594m²	
	Deduction						
	Rectangular opening	2	1.50	-	1.05	(-) 3.150 m²	H = 0.9 + 0.15 = 1.05
(ii)	Triangular portion	2	x 1/2 x 1.40		x 1.40	(-) 1.96m²	
						24.484m²	
(9)	Wearing coat	1	4.00	2.50	0.08	0.8m³	B = 0.50 + 1.50 + 0.50 = 2.50

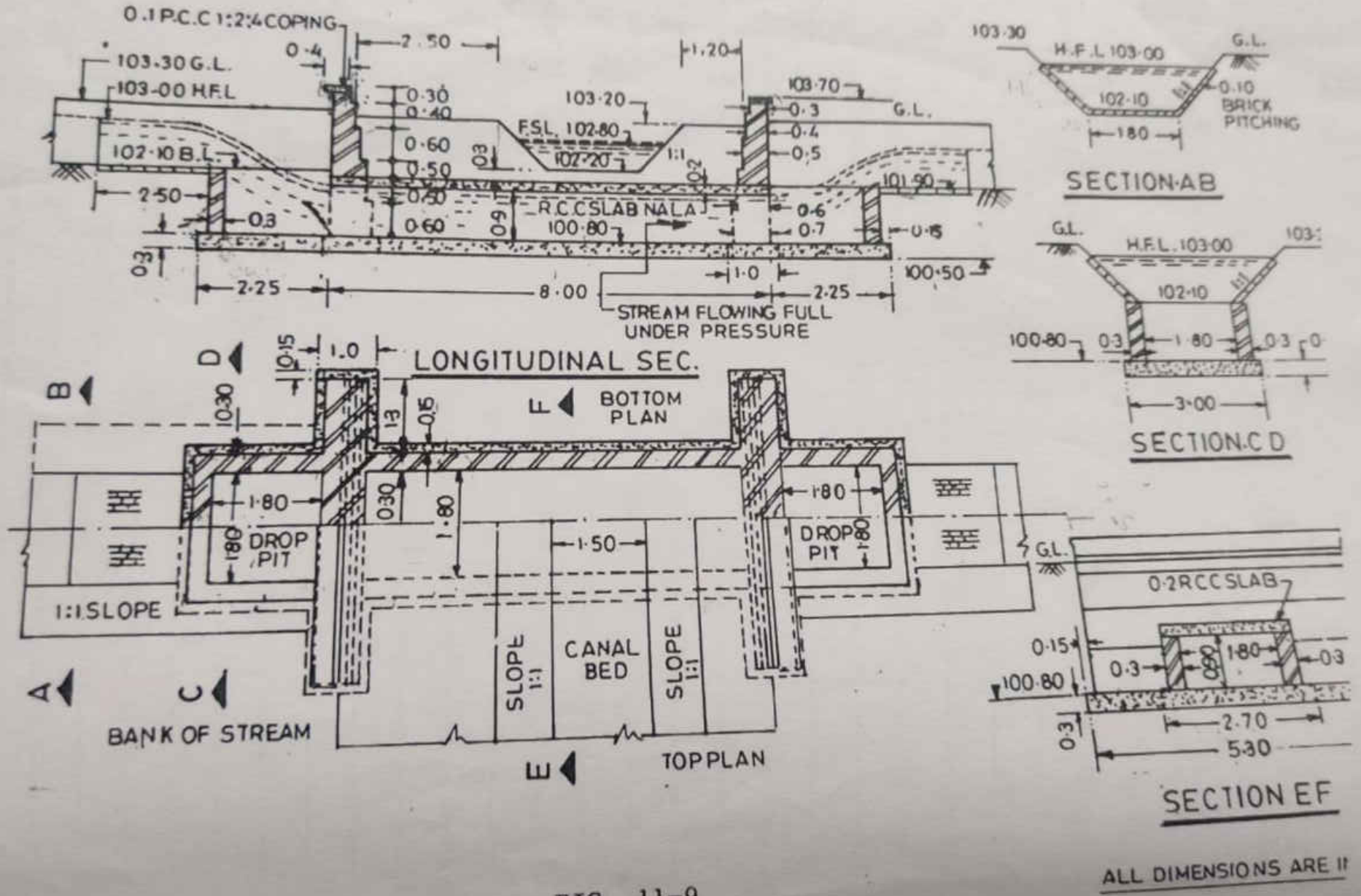

FIG. 11-9

Description of item	No	Length	Breadth	Height	Quantity	Explanatory

SECTION EF

ALL DIMENSIONS ARE IN

FIG. 11-9

Sl no	Description of item	No	Length	Breadth	Height	Quantity	Explanatory notes
(1)	Earthwork in excavation in foundation						
	(i) Syphon duct	1	8.00m	2.70m	1.60m	34.56m³	B = 1.80 + (2×0.30) + (2×0.15) = 2.70
	(ii) U/s droppit	1	2.25m	2.70m	1.60m	9.72m³	H = 102.10 − 100.50 = 1.60
	(iii) D/s drop pit	1	2.25m	2.70m	1.40m	8.505m³	(D/s) H = 101.90 − 100.50 = 1.40
	(iv) Wingwall	4	1.30m	1.00m	1.60m	8.32m³	
					Total	61.105m³	
(2)	Cement concrete 1:2:4 in						
	(i) Syphon duct	1	8.00m	2.70m	0.30m	6.48m³	
	(ii) U/s drop pit	1	2.25m	2.70m	0.30m	1.822m³	
	(iii) D/s drop pit	1	2.25m	2.70m	0.30m	1.822m³	
	(iv) Wingwall	4	1.30m	1.00m	0.30m	1.560m³	
					Total	11.684m³	

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S/no	Description of item	No	Length	Breadth	Height	Quantity	Explanatory notes
(3)	1st class brickwork						
	(i) Syphon duct wall	2	8.00	0.30	0.90	4.32m³	
	(ii) U/s drop pit						
	(a) Long side	2	2.10	0.30	1.30	1.638m³	
	(b) Short side	1	1.80	0.30	1.30	0.702m³	
	(iii) Downstream drop pit						
	(a) Long side	2	2.10	0.30	1.10	1.386m³	
	(b) Short side	1	1.80	0.30	1.10	0.594m³	
	(iv) Wing wall						
	(a) 1st footing toomwall	4	1.30	0.70	0.60	2.184m³	
	(b) 2nd footing toomwall top of deckslab	4	1.30	0.60	0.50	1.56m³	
	(c) 2nd footing toomwall above of deckslab	4	5.00	0.60	0.50	3.00 m³	

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sl no	Description of item	no	Length	Breadth	Height	Quantity	Explanatory notes
	(d) 3rd footing 50cm wall	2	5.00	0.50	0.60	3 cm^3	
	(e) 4th footing 40cm wall	2	5.00	0.40	0.40	1.6 m^3	
	(f) Parapet 30cm wall	2	5.00	0.30	0.20	0.6 m^3	
					Total	20.584 m^3	
(4)	R.C.C 1:2:4 deck slab including reinforced and shuttering	1	8.00	2.40	0.20	3.84 m^3	B = 1.80 + 2X0.30 = 2.40
(5)	P.C.C 1:2:4 coping	2	5.30	0.40	0.10	0.424 m^3	
(6)	Truck pointing with cement mortar 1:3						
(i)	Syphon duct wall inner side	2	8.00	—	0.90	14.4 m^2	
(ii)	U/s drop pit 3 inner vertical side	1X3	1.80	—	1.30	7.02 m^2	
(iii)	D/s drop pit 3 inner vertical side	1X3	1.80	—	1.10	5.94 m^2	

S/no	Description of work	No	Length	Breadth	Height	Quantity	Explanatory notes
	(iv) U/s and D/s drop pit surface slops	1×2	0.60	0.30	—	0.36m²	L = 1.80 + 0.30 + 1.80 + 0.30 + 1.80 = 6
	(v) Parapet wall above ground level						
	(a) Inner face	2	5.30	—	0.70	7.42m²	H1 = 0.40 + 0.10 + 0.20 = 0.70
	(b) Outer face	2	5.30	—	0.30	3.18m²	
	(vi) 40cm layer endup the parapet	2×2	0.40	0.40	—	0.64m²	
	(vii) 30cm layer endup parapet	2×2	0.30	0.20	—	0.24m²	
	Triangular for the outer face	2 × 2 × $\frac{1}{2}$	× 1.2	× 1.10		2.420m²	
					Total	49.900m²	
(7)	10cm thick.						
	(a) Bed level	2	2.50	1.80	—	9.00m²	B = 103.60 − 102.20 = 0.90
	(b) Slide slope	2×2	2.50	1.27	—	12.720m²	$\sqrt{(0.90)^2 + (0.90)^2}$ = 1.27
					Total	21.720m²	

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Slno	Decription of work	No	Length	Breadth	Height	Quantity	Explanatory notes
	(iv) U/s and D/s drop pit surface & top	1×2	0.60	0.30	—	0.36m²	L = 1.80 + 0.30 + 1.80 + 0.30 + 1.80 = 0.60
	(v) Parapet wall above ground level						
	(a) Inner face	2	5.30	—	0.70	7.42m²	H = 0.40 + 0.10 + 0.20 = 0.70
	(b) Outer face	2	5.30	—	0.30	3.18m²	
	(vi) 40cm layer endup the parapet	2×2	0.40	0.40	—	0.64m²	
	(vii) 30cm layer endup parapet	2×2	0.30	0.20	—	0.24m²	
	Triangular for the outer face	2	× 2 × $\frac{1}{2}$	× 1.2	× 1.20	2.420m²	
					Total	49.900m²	
(7)	10cm thick						
	(a) Bed level	2	2.50	1.80	—	9.00m²	B = 103.60 − 102.20 = 0.90
	(b) Slide slope	2×2	2.50	1.27	—	12.720m²	$\sqrt{(0.90)^2 + (0.90)^2}$ = 1.27
					Total	21.720m²	

ROADS A. EARTHWORK

Volume of earthwork -

Volume of earthwork shall be measured in cubic meters without any allowance for increase in bulk. The volume of earthwork shall be calculated by multiplying the length, breadth, height or depth measured from the ground from which soil has been taken out.

Lead :-

Lead shall be a horizontal straight practicable distance through which the earth can be carried or transported from the sources to the place of spreading and not necessary the route actually taken. The unit of lead is 50m for a distance 500m and shall be measured as a separate item for

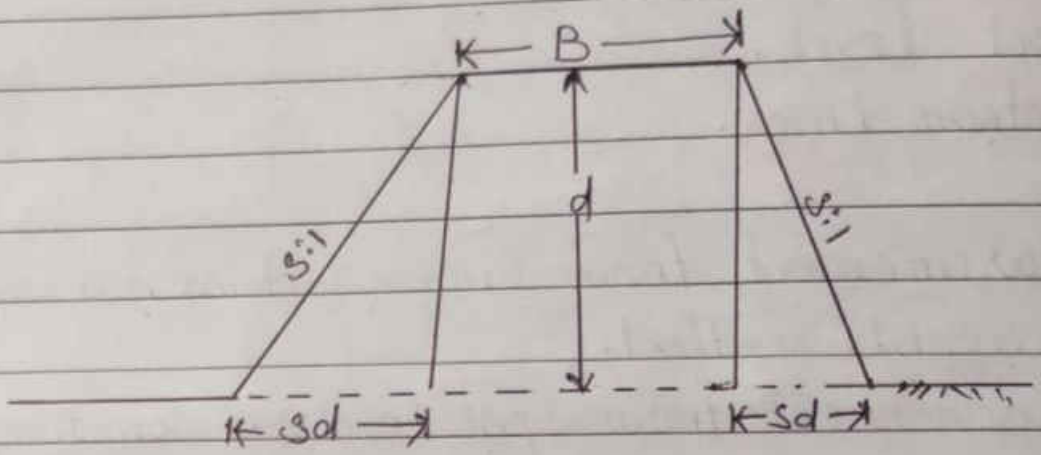
(i) 0m to a distance not exceeding 250m

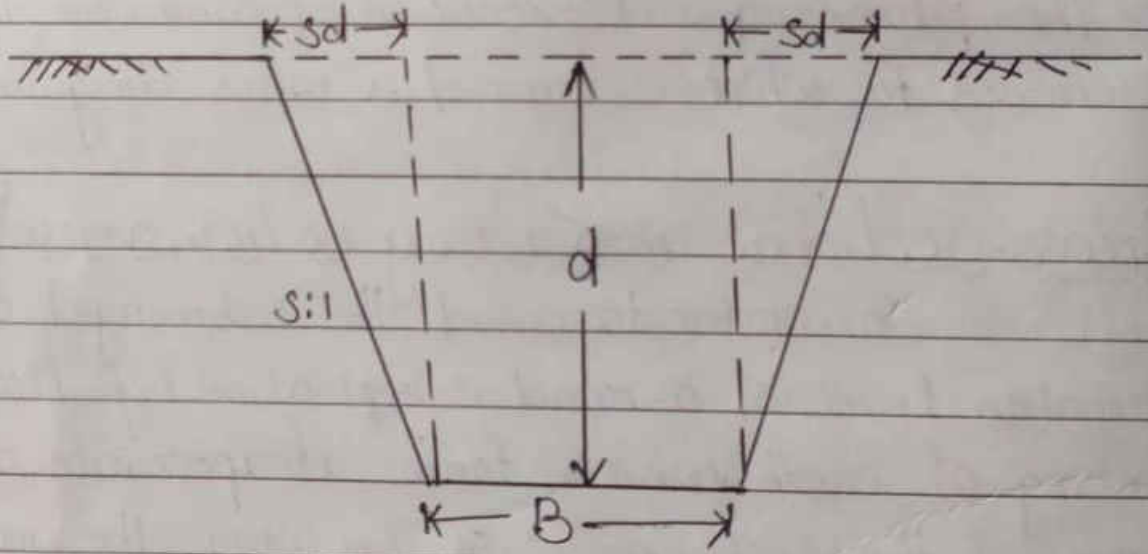
(ii) Distance exceeding 250m but not exceeding 500m

Lift :-

Lift shall be measured from ground level. Excavation upto 1.5m depth below ground level & depositing excavated material on the ground shall be included in the item of earthwork for various kinds of soil. Extra lift shall be measured in unit of 1.5m or part of. Inverse lifts shall be measured that is lift in the lead due to ground slope shall be not measured except for lead up to 250m. When earth has to be carried over a bank and dumped beyond it, the lift shall be the difference in level between the centre of gravity of the excavated earth and the top of bank.

The depth of earthwork either in banking or cutting at any place along to the road centre is the difference between the formation level and ground level. But the top width for banking. The side slope is measured in the form of Horizontal


B
d
S:1
S:1
Sd
Sd


Sd
Sd
d
S:1
B

vertical

s:1 is the ratio of side slope as horizontal : vertical for 1 vertical, s is horizontal for d vertical sd horizontal.

Cross sectional area for banking or cutting having no transverse slope = centre area, rectangular in shape + 2 x area of sides or triangular in shape.

$= B * d + 2 (\frac{1}{2} \cdot sd \times d)$

$= Bd + sd^2$

Where,

B = rest width of road

d = depth of banking or cutting

s:1 = Ratio of sides slope as horizontal : vertical

Volume of earthwork :-

Considering two adjacent cross sections forming plane ends of a solid of length L equal to the distance between the sections

Volume of earthwork = sectional area x L

A series of such solids are considered from the alingment of earthwork and the volumnes of these solids are to be determinded separately, the addition of these individual volumns is the estimated volume of earthwork either in cutting or banking.

(a) Volume of earthwork:

When the ground is levelled and the formation level of the road after cutting and Banking has no gradient.

Volume of earthwork = $V = (Bd + sd^2)L$

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(b) Volume of earthwork when the ground is in a longitudinal dinal slope or the formation level has a uniform gradient for a length 'l' quantity of earthwork may be calculated by any one of the following method.

(i) Formula of mid-section method
(ii) Formula of Trapezoidal also known as average end area or mean-sectional area method
(iii) Formula of prizomidal method according to simon's one-third Rule.

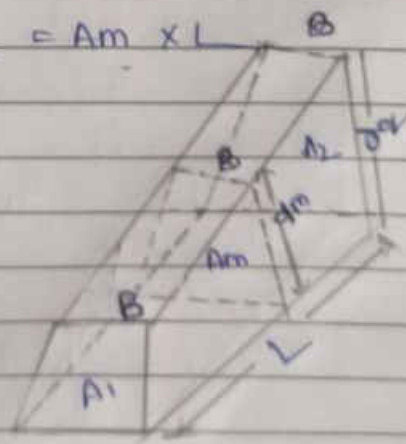
Method -1 (mid-section method)

In this formula the mean depth is to be calculated first by averaging the depths of two consecutive sections from the mean depth the area of mid-section is to be worked out and volume of earthwork to be computed by multiplying the area of mid-section by the distance between the two original sections.

Volume of earthwork = Am × L

where,

Am area of mid-section
L - Length or distance between two consecutive section.



To calculate Am:
Calculate first

$$\frac{dm}{} = \frac{d_1 + d_2}{2}$$

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Am = area of mid section + area of the two sides

$Bdm + \frac{1}{2} sdm^2 + \frac{1}{2} Sdm^2$

$\therefore Am = Bdm + sdm^2$

$\therefore V = (Bdm + sd^2m) L$

To estimate the quantity of earthwork for a road whose level sections have been taken at a common length 'L' or one chain interval a tabular from should be followed as shown below.

General methods for computation of earthwork:

The method of computation of earthwork may be classified according to the form of the sorel as defined by.

(a) cross sections.

(b) Spot level

(c) contour lines

(a) Measurement form cross-sections is a universally ~~applicable to large excavation~~ applicable method

(b) Measurement from sport levels is sometimes applied to large excavation

(c) Rough estimates of volume may be made by treatment of the countain line and is not much used in protice except in the determination of the capacity of reservoirs

The planning and execution of earthwork is studies by reference to what is termed as mass diagram

Signature.....

Cross-sectional area having no transverse slope :-

In order to avoid the submerged condition, the formation level of a road is kept above high flood level by banking of earth which forms a trapezium due to side slopes of the embankment. Thus where the ground level is higher than the formation level. cutting is required providing side slopes at both sides to prevent collapsing of of earth ~~form~~ from the sides in the from of trapezium. The height of banking and the depth of cutting is designed considering the high flood level, ruling gradient and to achieve maximum economy in earthwork. Earth obtained by utilised in banking provide it is economical to carry the earth for the distance from cutting to filling places. The study of such cases has been made in a separate article at the end of this sub-chart.

Q-1

Estimate the quantity of earthwork for an embankment, 120m long, 8m wide at crest and whose side slopes 2:1. The central hight from '0' to at every 30m interval are 0.60 m, 1.2m, 1.6m, 2.0m & 1.3m.

Data Given,

crest wicle (B) = 8m

side slope (S) = 2:1 (2)

station or chainage	Depthorr height of station	mean depth orr height (dm)	Arrea of central portion (Bdm)	arreaof sicles S/m²	Total area sd+sdm²	Distance betwon station	Quantity Am x L embank	cutting
0	0.60	-	—	—	—	-		
1	1.20	0.90	7.20	1.62	8.82	30	264.60	
2	1.60	1.40	11.20	3.92	15.12	30	453.60	
3	2.00	1.80	14.40	6.48	20.88	30		
4	1.30	1.65	13.20	5.45	18.65	30		

Q2

Preparre an estimate forr the portion of a road from chainage 14 to 82 from the data given below. Drraw also the longitudinal and typical cross-sections forr cutting and banking. The formation width of the proposed road is 12m side slopes 1½:1 in cutting and 2:1 in banking.

Chainage	14	15	16	17	18	19	20	21	22
RL of ground	108.60	109.20	108.40	108.85	105.50	107.25	106.80	107.25	107.20

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The road formation is proposed at uniform falling gradient 1 in 200 falling through G.L of chainage 14 Length of 1 chain 30m.

Solution.

Gradient 1 in 200 chainage of level per chain of

$$30m = \frac{30}{200} = 0.15m$$

width of road (B) = 12m
side slope in cutting 1½:1 (S) = 1.5
side slope in Banking 2:1 (S) = 2

chainage	R.L of ground	R.L of Formation	Depth of earthwork
14	108.60	108.60	0
15	109.25	108.45	- 0.80
16	109.40	108.30	- 1.10
17	108.85	108.15	- 0.70
18	108.50	108.00	- 0.50
19	107.25	107.85	0.60
20	106.80	107.70	0.90
21	107.15	107.55	0.40
22	107.20	107.40	0.20

chainage / station	Depth or height of GL & FL	mean depth or Height (dm)	Area of central portion (Bdm)	area of sides (Sdm²)	Total area (Bdm + Sdm²) (Bdm+Sdm²)	length between stations (L)	Quantity A m×L	Quantity A m×L
14	0	-						
15	-0.80	-0.40	-4.80	-0.24	-5.04	30	151.20	
16	-1.10	-0.95	-11.40	-1.35	-12.75	30	382.50	
17	-0.70	-0.90	-10.80	-1.22	-12.02	30	360.60	
18	-0.50	-0.60	-7.20	-0.54	-7.74	30	232.20	
0	0	-0.25	-3.00	-0.09	-3.09	14	43.26	
19	0.60	0.30	3.60	0.18	3.78	16		60.48
20	0.90	0.75	9.00	1.23	10.23	30		306.90
21	0.40	0.65	7.80	0.85	8.65	30		259.50
22	0.20	0.30	3.60	0.18	3.78	30		113.40
							1169.70 m³	740.28 m³

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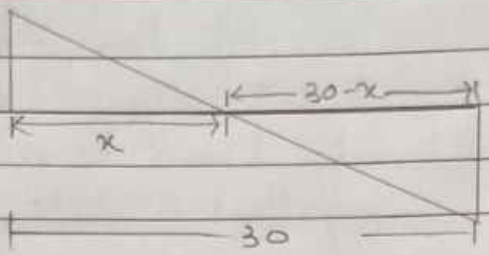
$$\frac{x}{0.50} = \frac{30-x}{0.60}$$



$\Rightarrow 0.60x = 0.50(30-x)$

$\Rightarrow 0.60x = 15 - 0.50x$

$\Rightarrow 0.60x + 0.50x = 15$

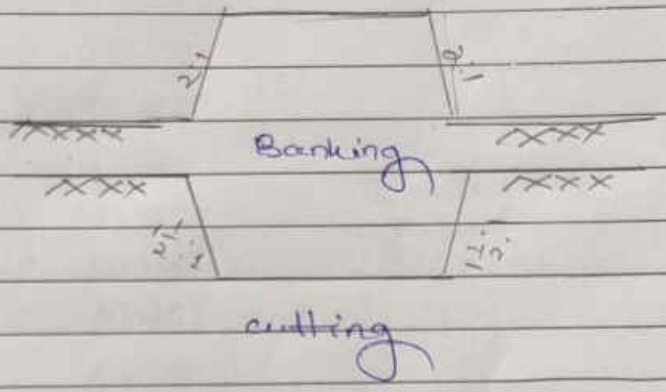
$\Rightarrow 1.1x = 15$

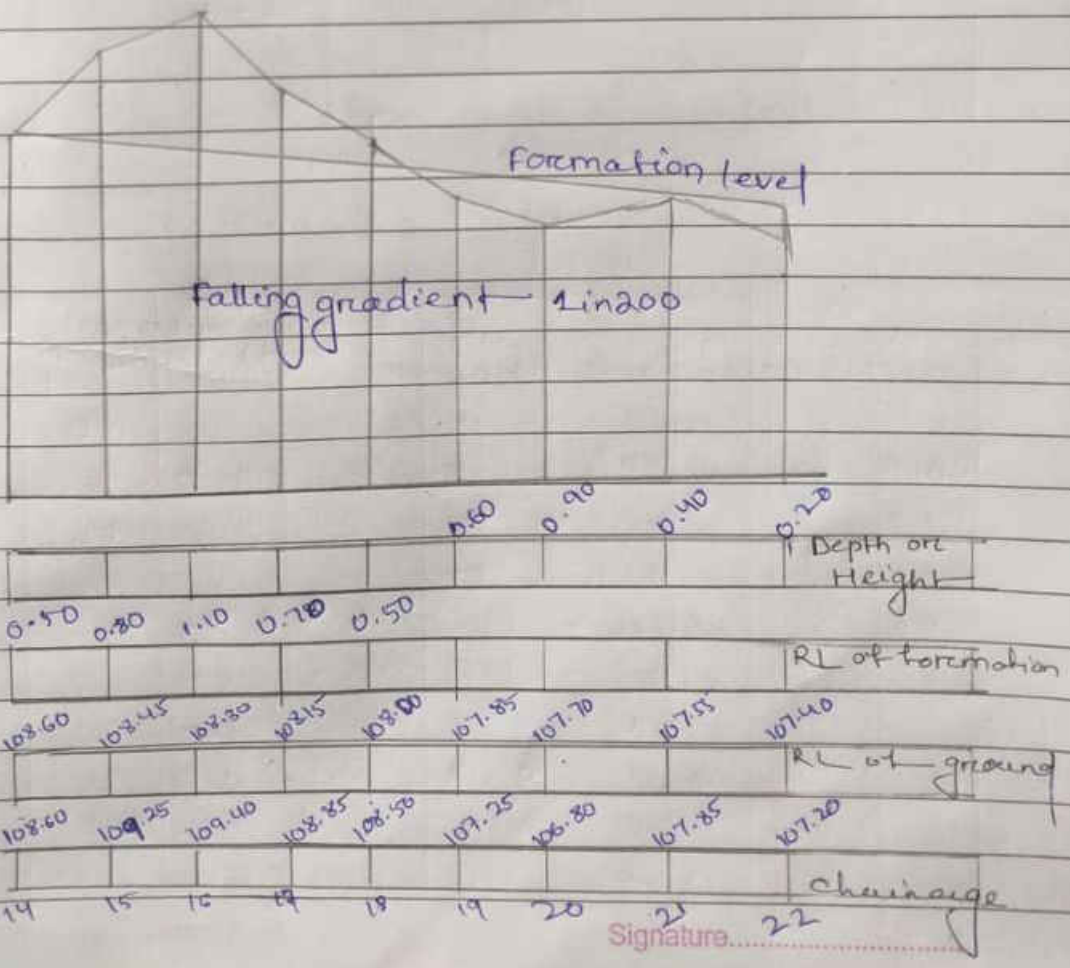
$\Rightarrow x = \frac{15}{1.1}$

$\Rightarrow x = 13.63 \simeq 14$

$(30-x) = 30 - 14$

$= 16\text{m}$





Signature.....

Q-3

Estimate the cost of earthwork for a portion of a road per 1 in 200 m length Following data given formation width of road is 10m side slope are 2:1 in banking 1½:1 is cutting

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

Downward gradient of 1 in 200

Draw the L section and ercoss-section diagram

L = 40

$$\frac{1}{200} \times 40 = 0.2$$

station	Distance inmeter	RL of ground	R.L of formation	Depth or Height
25	1000	51.00	52.00	1.00
26	1040	50.90	51.80	0.90
27	1080	50.50	51.60	1.10
28	1120	50.80	51.40	0.60
29	1160	50.60	51.20	0.60
30	1200	50.70	50.00	0.30
31	1240	51.20	50.80	− 0.40
32	1280	51.40	50.60	− 0.80
33	1320	51.30	50.40	− 0.90
34	1360	51.00	50.20	− 0.80
35	1400	50.60	50.00	− 0.60

Data given.

Breadth = 10m Length = 40m

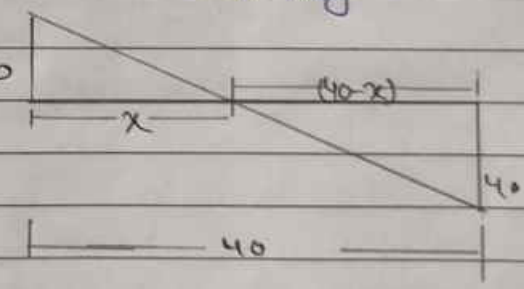
side slope in Banking: 2:1 = (2)

side slope in Cutting: 1½:1 = (1.5)

Station	Distance	Depth or Height	mean depth or Height (dm)	Area of side Bdm	areas sdm^2	Total area Bdmt sdm	Distance between station	quantity embank Amxl	quantity Cutting Amxl
25	1000	1.00	–	–	–	–	–	–	
26	1040	0.90	0.95	9.50	1.805	11.305	40		
27	1080	1.10	1.00	10.00	2.00	12.00	40		
28	1120	0.60	0.85	8.50	1.445	9.945	40		
29	1160	0.60	0.60	6.00	0.72	6.720	40		
30	1200	0.30	0.45	4.50	0.405	4.905	40		
0	0	0	0.15	1.50	0.045	1.545	17		
31	1240	-0.40	-0.20	-2.00	-0.06	-2.06	23		
32	1280	-0.80	-0.60	-6.00	-0.54	-6.54	40		
33	1320	-0.90	-0.85	-8.50	-1.083	-9.583	40		
34	1360	-0.80	-0.85	-8.50	-1.083	-9.583	40		
35	1400	-0.60	-0.70	-7.00	-0.735	-7.735	40		

Embanking = 1

Cutting =



$$\frac{x}{0.30} = \frac{(40-x)}{0.40}$$

$$0.40x = 0.30(40-x)$$

$$0.40x = 12 - 0.30x$$

$$0.40x + 0.30x = 12$$

$$0.70x = 12$$

$$x = \frac{12}{0.70}$$

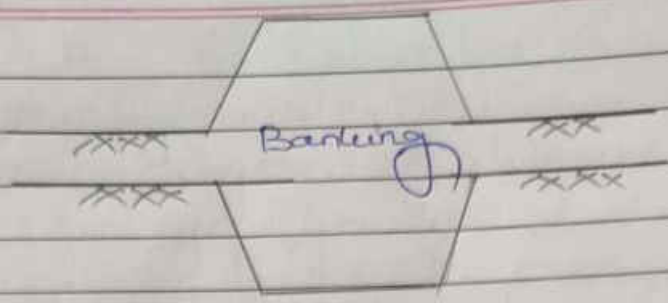
$$x = 17.14 \approx 17$$

$(40-x)$

$40 - 17$

23

Signature.....



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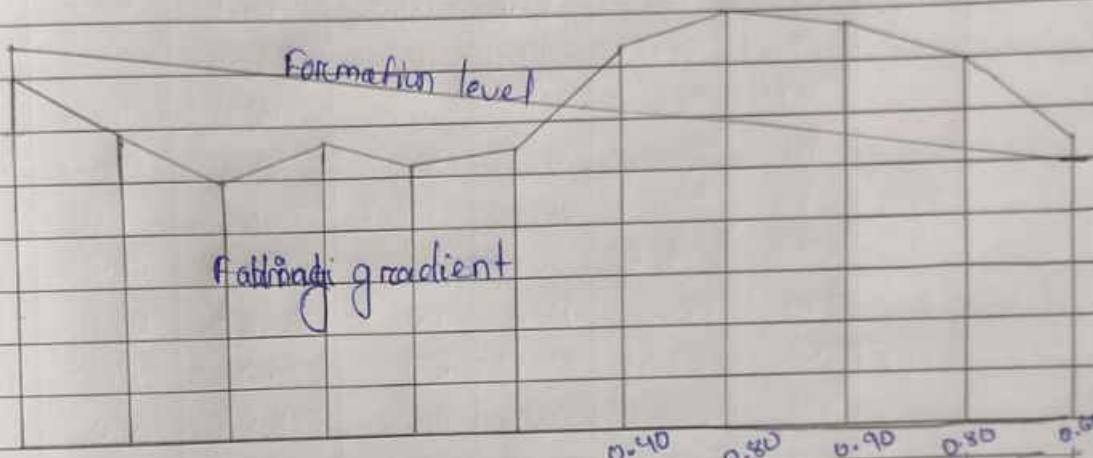


depth or Height						0.40	0.80	0.90	0.80	0.60
R.L of formation	1.00	0.90	1.10	0.60	0.60	0.30	0.40			
Rl of ground	52.00	51.80	51.60	51.40	51.20	51.00	50.80	50.60	50.40	50.20	50.00
Distance	51.00	50.90	50.50	50.40	50.60	50.70	50.90	51.40	51.30	51.00	50.40
	1000	1040	1080	1100	1160	1200	1240	1280	1320	1360	1400
station	25	26	27	28	29	30	31	32	33	34	35

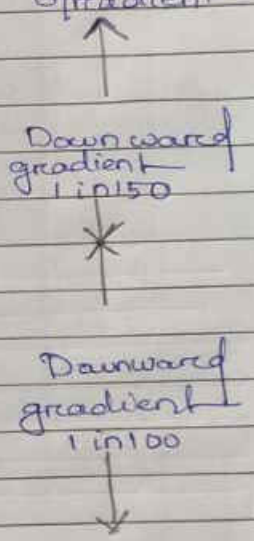
Signature.....

Q-4

Reduce level of ground along the centre line of a purpose road from chainage 10 to 20 are given below the formation level at the 10th chainage is 107 and the road is in down gradient of 1 in 150 of to the chainage to 1 in 100 down word and Formation width of road is 10m and side slope of banking are 2:1 length of chain is 30m

Draw the longitudinal section of the road and tritical cross-section and prepare a estimate of earthwork at the rate of Rs-275.00/m³

chainage	RL of ground	RL of formation
10	105.00	107.00
11	105.60	
12	105.44	
13	105.70	
14	105.42	
15	104.30	
16	105.00	
17	104.10	
18	104.62	
19	104.00	
20	103.30	



Data given,

Length = 30

Formation of Road (B) = 10m

Side slope of Banking (s) = 2:1 = 2

Side slope of cutting (s) = 0

Downward gradient 10 to 14 (L) = $\frac{30}{150} = 0.2$

Downward gradient 15 to 20 (L) = $\frac{30}{100} = 0.3$

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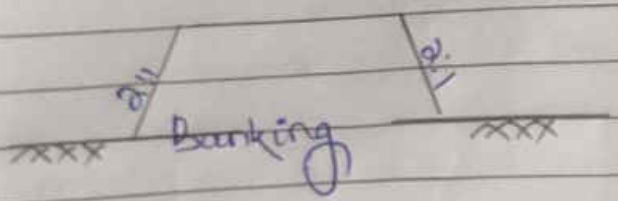
chainage	RL of ground	RL of formation	Depth or Height
10	105.00	107.00	2.00
11	105.60	106.80	1.20
12	105.44	106.60	1.16
13	105.90	106.40	0.50
14	105.40	106.20	0.80
15	104.30	105.90	1.60
16	105.00	105.60	0.60
17	104.10	105.30	1.20
18	104.62	105.00	0.38
19	104.00	104.70	0.70
20	103.30	104.40	1.10

chainage	Depth or Height	mean depth or height (dm)	area of centre (B×dm)	area of side $sd^2 m^2$	Total area B×dm+sdm^2	Distance between	Quantity embanking Am×L
10	2.00	—	—	—	—	—	—
11	1.20	1.60	16.00	5.12	21.12	30	633.6
12	1.160	1.18	11.80	2.78	14.58	30	437.4
13	0.50	0.83	8.30	1.37	9.67	30	290.1
14	0.80	0.64	6.40	0.81	7.21	30	216.3
15	1.60	1.19	11.9	2.83	14.73	30	441.9
16	0.60	1.10	11.00	2.42	13.42	30	402.6
17	1.20	0.90	9.00	1.62	10.62	30	318.6
18	0.38	0.79	7.90	1.24	9.14	30	274.2
19	0.70	0.54	5.40	0.58	5.98	30	179.4
20	1.10	0.90	9.00	1.62	10.62	30	318.6

Total 3512.7m³



Practice-1

Estimate the quantity of earthwork for a portion of a district road for 700m length with the following data

Distance	0	100	200	300	400	500	600	700
RL of ground	100.50	102.80	99.20	103.60	104.50	106.40	105.30	105.00

Data given,

width - 10m

Slope in Banking - 2:1 - 2

Slope in cutting - 1:1 - 1

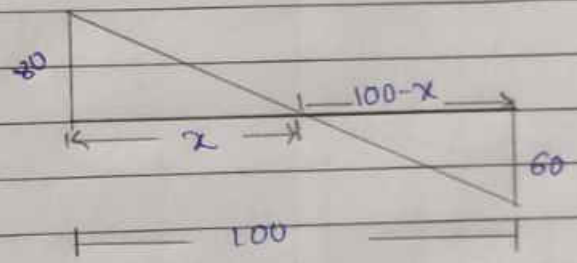
station Distance	RL of Ground	R.L of Formation	Gradient
0	100.50	104.00	
100	102.80		
200	99.20		
300	103.60		Downward gradient 1 in 100
400	104.50		
500	106.40		
600	105.30		
700	105.00		

Down-ward gradient 1 in 100 = $\frac{1}{100} \times 100 = 1$

Distance	RL of ground	RL of Formation	Depth or Height
0	100.50	104.00	3.50
100	102.80	103.00	0.20
200	99.80	102.00	2.80
300	103.60	101.00	-2.60
400	104.50	100.00	-4.50
500	106.40	99.00	-7.40
600	105.30	98.00	-7.30
700	105.00	97.00	-8.00

Signature.....

Distance	~~Depth of~~ ground Height	mean depth or Height	Area of central portion Bdm	Area of side sdm²	Total area Bdm+sdm	Distance	Quantity Embanking AmxL	Quantity banking AmxL
0	3.50	—	—	—	—	—		
100	0.20	1.85	18.50	6.845	25.345	100	2534.5	
200	2.80	1.50	15.00	4.50	19.50	100	1950.0	
0	0	1.40	14.00	3.920	17.920	52	931.84	
300	-2.60	-1.30	-13.00	-1.690	-14.690	48		705.12
400	-4.50	-3.55	-35.50	-12.60	-48.10	100		4810.0
500	-7.40	-5.95	-59.50	-35.40	-94.90	100		9490.0
600	-7.30	-7.35	-73.50	-54.02	-127.52	100		12752.0
700	-8.00	-7.65	-76.50	-58.522	-135.02	100		13502.0
							5416.34	
								41259.12



$$\Rightarrow \frac{x}{2.80} = \frac{(100-x)}{2.60}$$

$$\Rightarrow 2.60x = 2.80(100-x)$$

$$\Rightarrow 2.60x = 280 - 2.80x$$

$$\Rightarrow 2.60x + 2.80x = 280$$

$$\Rightarrow 5.40x = 280$$

$$\Rightarrow x = \frac{280}{5.40}$$

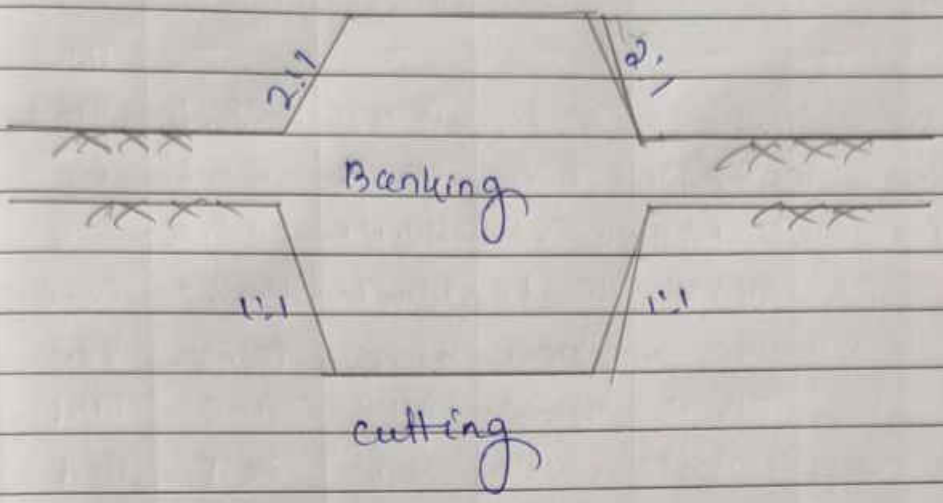
$$= 51.85 \cong 52$$

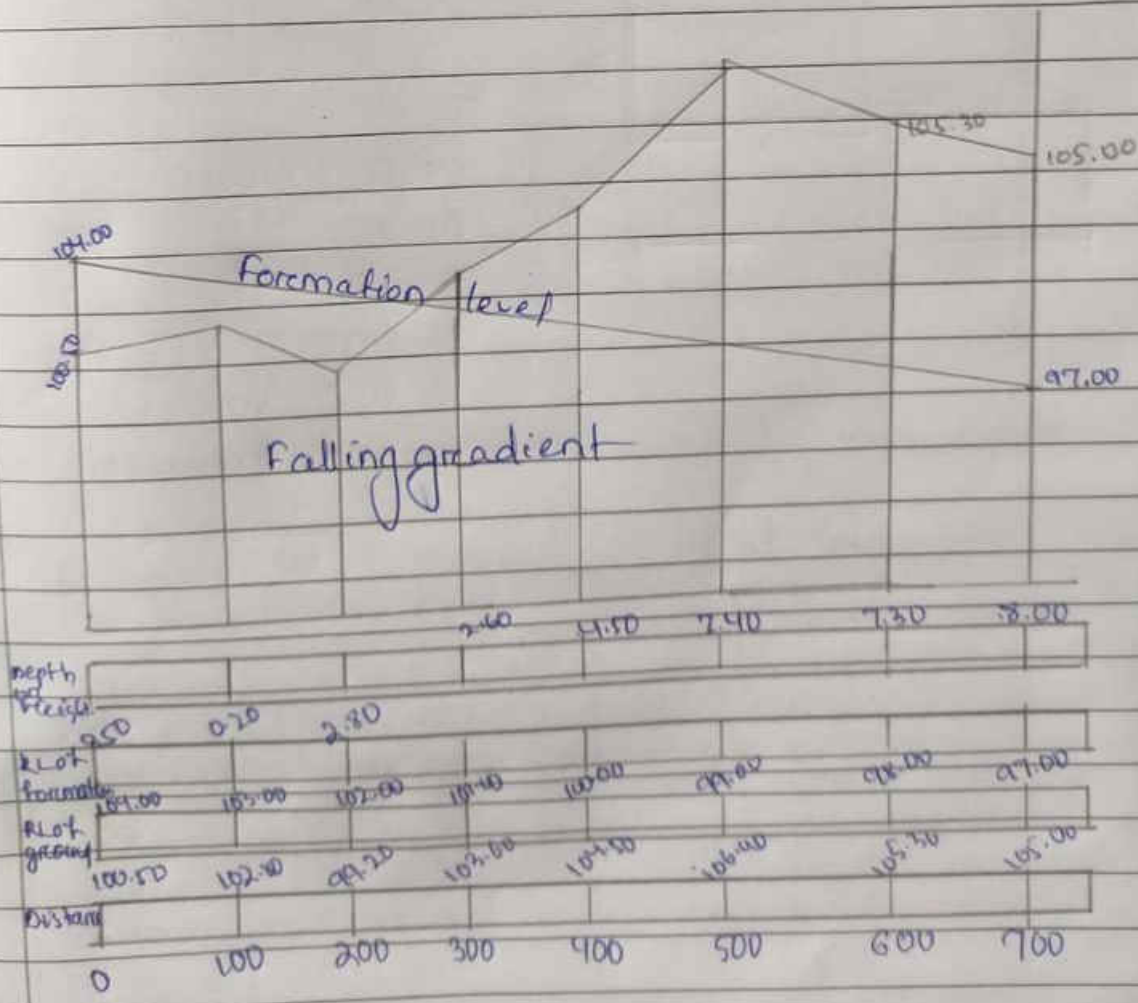
$(100-x)$

$\Rightarrow 100 - 52$

$\Rightarrow 48$

Signature.....


2:1
2:1
Banking
1:1
1:1
cutting


104.00
Formation level
100.00
105.30
105.00
97.00
Falling gradient
2.60
4.50
7.40
7.30
8.00
Depth of height
0.50
0.20
2.80
RL of formation
104.00
103.00
102.00
101.40
100.00
99.00
98.00
97.00
RL of ground
100.50
102.80
99.20
103.00
104.80
106.00
105.30
105.00
Distance
0
100
200
300
400
500
600
700

Practice-2

Workout the earthwork for the road from the the following data

Formation width = 8m (B = 8m)
Side slope of banking = 2:1 (S = 2)
side slope of cutting = 1½:1 (S = 1.5)
Falling gradient = 1 in 200
Formation chainage = 99.5m

Chainage	0	40	80	120	160	200	240
RL of ground	98.7	98.5	98.95	98.80	98.90	98.85	98.90

Chainage	RL of ground	RL of Formation	gradient
0	98.7	99.5	
40	98.5		
80	98.95		
120	98.80		~~Downward~~ gradient 1 in 200
160	98.90		
200	98.85		
240	98.90		

Downward gradient = $\frac{1}{200} \times 40 = 0.2$

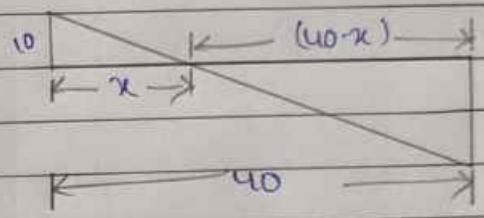
Chainage	RL of ground	RL of formation	gradient
0	98.7	99.5	0.80
40	98.5	99.3	0.80
80	98.95	99.1	0.15
120	98.80	98.9	0.10
160	98.90	98.7	-0.20
200	98.85	98.5	-0.35
240	98.90	98.3	-0.60

Signature.....

Chainage	Depth or Height	mean depth Height	area of centre portion	area of sides	Total area	Distance	Quantity	
							Embanking	cutting
0	0.80	-	-	-	-	-	-	
40	0.80	0.80	6.40	1.280	7.680	40	307.20	
80	0.15	0.47	3.76	0.441	4.201	40	168.04	
120	0.10	0.12	0.96	0.028	0.988	40	39.52	
0	0	0.05	0.40	0.005	0.405	13	5.265	
160	-0.20	-0.10	-0.80	-0.015	-0.815	27		22.005
200	-0.35	-0.275	-2.20	-0.113	-2.313	40		92.52
240	-0.60	-0.475	-3.80	-0.338	-4.138	40		165.52

520.025m³

280.045m³



$$\frac{x}{0.10} = \frac{40-x}{0.20}$$

$$0.20x = (40-x)0.10$$

$$0.20x = 4 - 0.10x$$

$$0.20x + 0.10x = 4$$

$$0.30x = 4$$

$$x = \frac{4}{0.30}$$

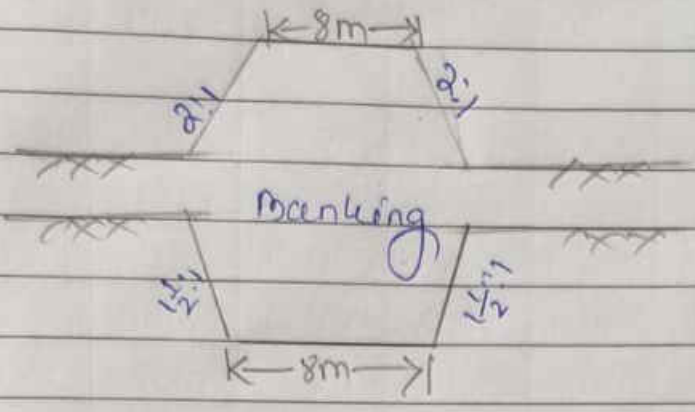
$$= 13.33 \cong 13$$

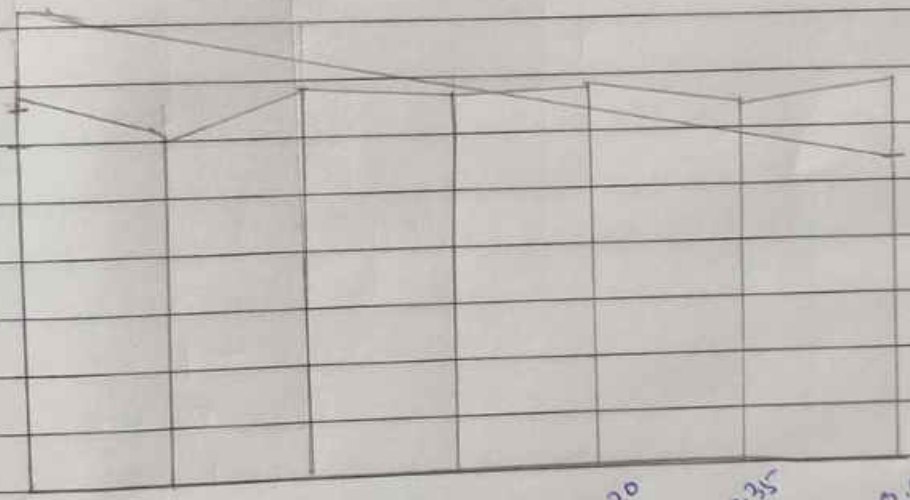
$(40 - x)$

$40 - 13$

27

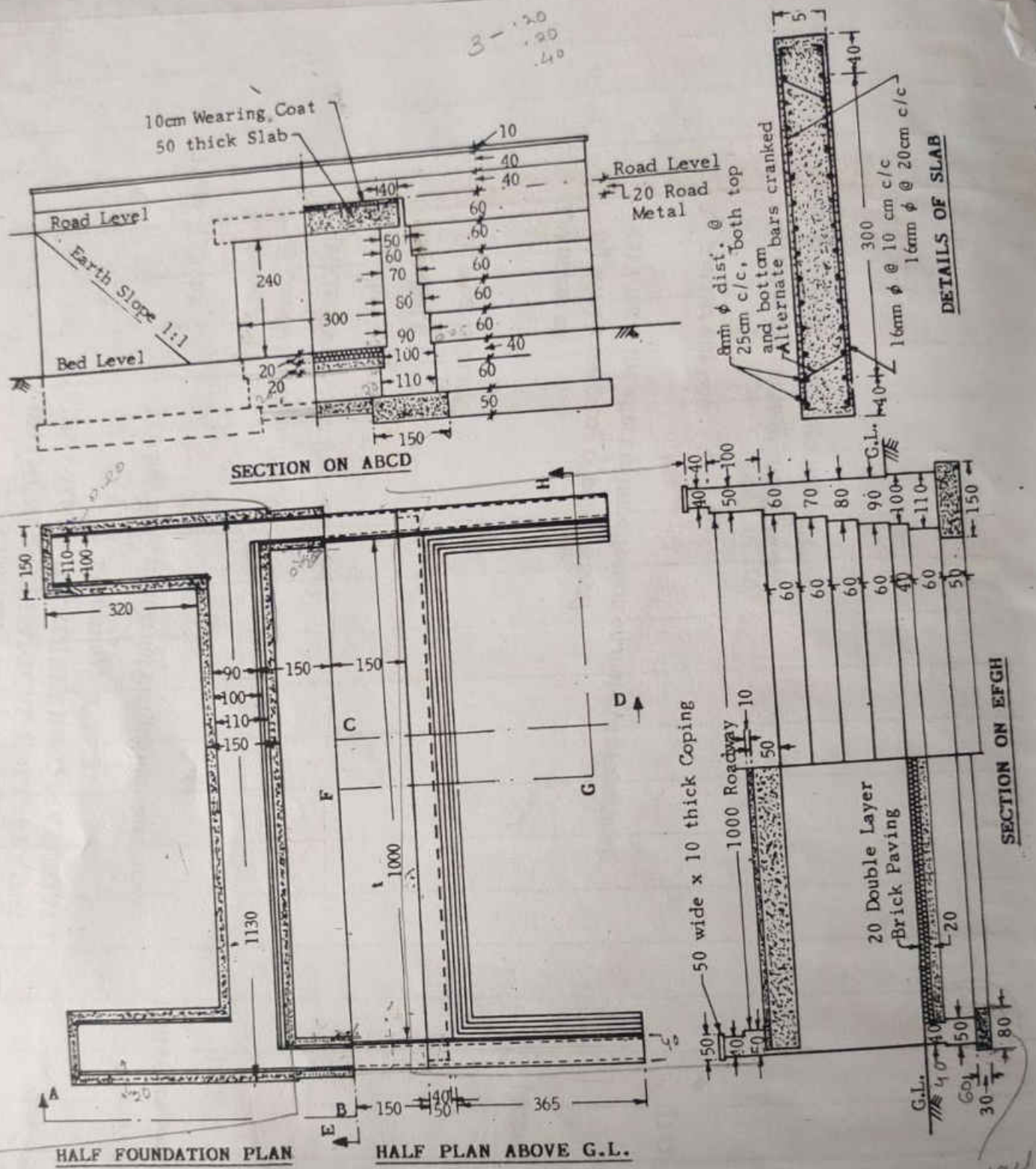
Signature.....





			0.20	0.35	0.60	Depth or Height
0.80	0.80	0.15	0.10			RL of formation
99.5	99.3	99.1	98.9	98.7	98.5	98.3
						RL of ground
98.7	98.5	98.95	98.80	98.90	98.85	98.90
chainage						
0	40	80	120	160	200	240

Signature.....



ALL DIMENSIONS IN CENTIMETRE

FIG. 10-27

Item No	Description of Item	No	Length	Breadth	Height	Quantity	Explanatory notes
1.	Earthwork excavation in foundation						
	(i) Abutment	2	11.30	1.50	1.50	50.850 m³	H = 0.40 + 0.60 + 0.50 = 1.50
	(ii) wingwall	4	3.20	1.50	1.50	28.80 m³	L = 3 − 2×0.05 − 2×0.10 − 2×0.20 = 2.30
	(iii) Curtain wall	2	2.30	0.80	1.30	4.784 m³	
	(iv) Floor	1	10.00	2.90	0.40	11.600 m³	B = 300 − 2×0.05 = 2.90
					Total	96.034 m³	
2.	Cement concrete in foundation						
	(i) Abutment	2	11.30	1.50	0.50	16.950 m³	
	(ii) wingwall	4	3.20	1.50	0.50	9.60 m³	
	(iii) Curtain wall	2	2.30	0.80	0.30	1.104 m³	
	(iv) Floor	1	10.00	2.90	0.20	5.800 m³	
					Total	33.454 m³	

Signature.....

Sl no	Description of item	No	length	Breadth	Height	Quantity	Explanatory notes
3.	1st class brickwork in foundation						
	(i) 1st footing	2	10.90	1.10	0.60	14.388 m^3	L = 11.30 − 2×0.2 = 10.90
	(ii) 2nd footing	2	10.90	1.00	0.40	8.720 m^3	
	(iii) 3rd footing	2	10.90	0.90	0.60	11.772 m^3	
	(iv) 4th footing	2	10.90	0.80	0.60	10.464 m^3	
	(v) 5th footing	2	10.90	0.70	0.60	9.156 m^3	
	(vi) 6th footing	2	10.90	0.60	0.60	7.848 m^3	
	(vii) 7th footing	2	10.90	0.50	0.60	6.540 m^3	
						68.888 m^3	

Signature.....

no	Description of Item	No	Length	Breadth	Height	Quantity	Explanatory notes
	wingwall						
(I)	1st footing	4	3.20	1.10	0.60	8.448m³	L = 3.20 - 0.20 + 0.20 = 3.20
(II)	2nd footing	4	3.20	1.00	0.60	5.120m³	
(III)	3rd footing	4	3.25	0.90	0.60	7.020m³	L = 3.20 + 0.05 = 3.25
(IV)	4th footing	4	3.35	0.80	0.60	6.432m³	L = 3.25 + 0.10 = 3.35
(V)	5th footing	4	3.45	0.70	0.60	5.796m³	L = 3.35 + 0.10 = 3.45
(VI)	6th footing	4	3.55	0.60	0.60	5.112m³	L = 3.45 + 0.10 = 3.55
(VII)	7th footing	4	3.65	0.50	0.60	4.380m³	L = 3.55 + 0.10 = 3.65
	Deduction						
(VIII)	Parapet 50cm wall	2	10.90	0.50	0.40	4.360m³	
(IX)	Parapet 40cm wall	2	10.90	0.40	0.40	3.488m³	H = 1.00 - 0.60 = 0.40
(X)	Parapet coping	2	11.00	0.50	0.10	1.100m³	
					Total	47.896m³	

Page No. 2 1 1
Date
Prepared

Sl no	Description of Item	No	Length	Breadth	Height	Quantity	Explanatory notes
					Total	51.256 m³	
	Deduction						
	Bearing R.C.C slab in Abutment	2	10.90	0.40	0.50	(-) 4.36 m³	
						46.896 m³	
	Curtain wall						
	(i) 1st footing	2	2.40	0.50	0.60	1.44 m³	L = 2.10 + 2×0.15 = 2.40
	(ii) 2nd footing	2	2.50	0.40	0.40	0.80 m³	L = 2.10 + 2×0.20 = 2.50
					Total	49.136 m³	
4.	Cement concrete M15 for R.C.C work	1	10.90	3.80	0.50	20.71 m³	B = 3 + 2×0.40 = 3.80
5.	shuttering and staging	1	10.90	3.00	—	32.70 m²	
6.	Double layer brick floore with brick joint with cement mortare	1	10.00	3.00	0.20	6.00 m³	

Signature.....

No	Description of item	No	Length	Breadth	Height	Quantity	Explanatory notes
7	Rule pointing with cement mortar 1:3						
	(i) Abutment inner side	2	10.90	—	3.00	65.40m²	H = 0.6 + 0.6 + 0.6 + 0.6 + 0.6 = 3.00
	(ii) facewall including parcapet	2	11.30	—	3.80	85.88m²	H = 0.6 + 0.6 + 0.6 + 0.6 + 0.6 + 0.4 + 0.4 + 0.4 + 0.4 + 0.6 + 0.4 = 3.80
	(iii) Inner side of parapet	2	11.30	—	3.90	88.14m²	
	(iv) End of parcapet 50cm wall	2×2	—	0.50	0.40	0.80m²	
	(v) End of parcapet 40cm wall	2×2	—	0.40	0.40	0.64m²	
					Total	240.86m²	
	Deduction						
	(i) Rectangular opening	2	3.00	—	2.40	(−) 14.40m²	
	(ii) Triangular portion of earth slope	2	$\frac{1}{2}$ × 3.20	×	3.20	(−) 10.24m²	
					Total	216.22m²	

Signature.....

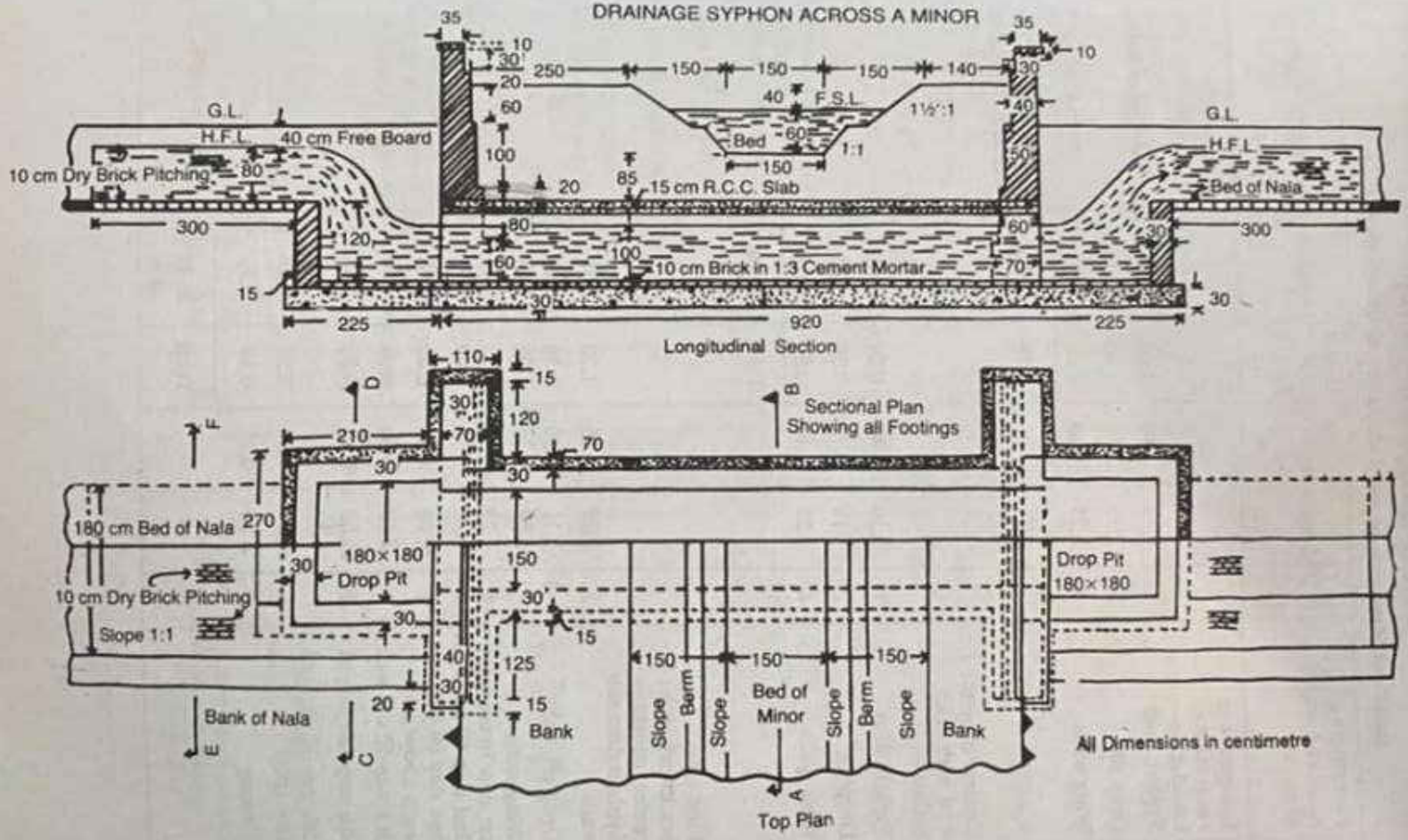

DRAINAGE SYPHON ACROSS A MINOR
G.L.
H.F.L.
40 cm Free Board
10 cm Dry Brick Pitching
F.S.L.
Bed
1½:1
1:1
15 cm R.C.C. Slab
10 cm Brick in 1:3 Cement Mortar
Bed of Nala
Longitudinal Section
Sectional Plan
Showing all Footings
180 cm Bed of Nala
10 cm Dry Brick Pitching
Slope 1:1
180×180
Drop Pit
Bank of Nala
Bank
Slope
Berm
Bed of
Minor
All Dimensions in centimetre
Top Plan

Fig. 9 9

Due to relative levels sometime it is required to lower the bed of the irrigation channel or ... drainage channel at their crossing. When the bed of the irrigation channel is depressed and ta... under nala or stream it is known as Irrigation Syphon. When the bed of the nala or stream ... depressed and taken under the irrigation channel it is known as Drinage Syphon. The Syph... crossing may be of rectangular closed masonry channel or of circular brickwork of of R.C.C. ... Hume pipe of the required diameter and number. Approach and exit may be through masonry dro... pit or of masonry sloped channel. The down stream end is kept lower than the up stream end by ... least 15 cm for better flow. An estimate of a small Drainage Syphon has been given in Example ...

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.

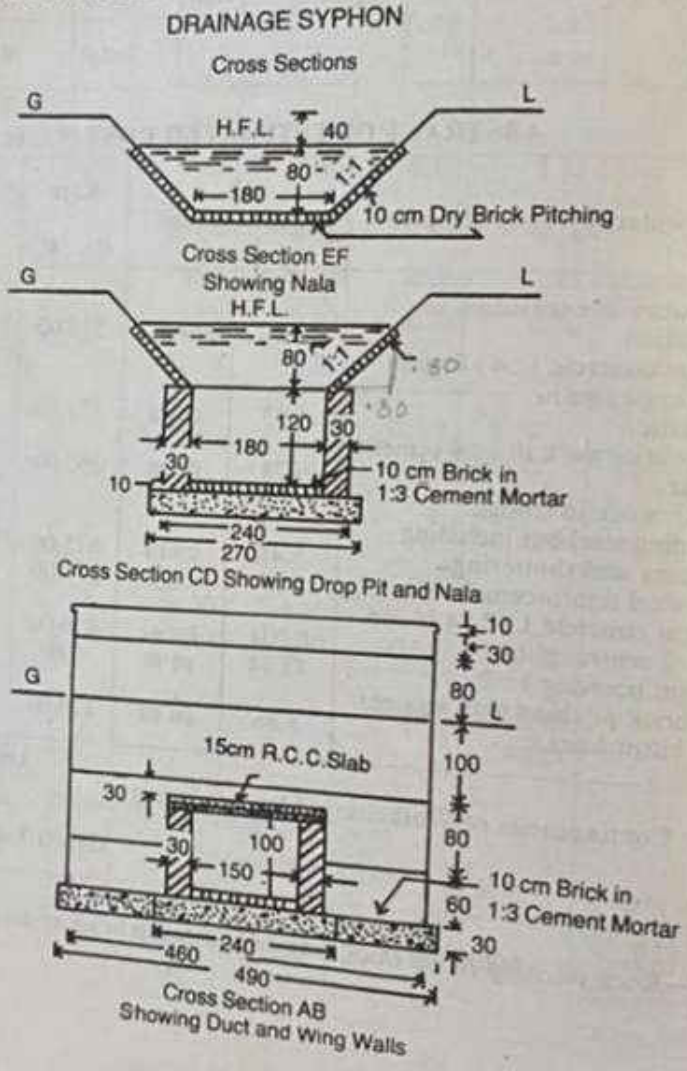


Fig. 9-8

Sl no	Description of item	No	Length	Breadth	Height	Quantity	Explanatory notes
1	Earthwork in excavation in foundation						
	(i) Septic tank	1	6.20m	2.70	2.00	33.48m³	H = 0.60 + 0.60 + 0.60 + 0.20 = 2.00
	(ii) Inseptic tank chamber	1	1.30m	1.30	0.45	0.760m³	H = 0.30 + 0.15 + 0.45
	(iii) Soak pit	1	$\frac{\pi}{4}(2.40)^2$		3.70	16.738m³	
					Total	50.978	
2.	Cement concrete in foundation						
	(i) Septic tank	1	6.20	2.70	0.20	3.348m³	
	(ii) Inseptic chamber	1	1.30	1.30	0.15	0.2535	
					Total	3.601m³	

Item no	Description of Item	No	Length	Breadth	Height	Quantity	Explanatory notes
3.	1st class brickwork						
	(i) septic tank						
	Longwall						
	1st footing	2	5.90	0.40	0.60	2.832 m^3	L = 6.10 − 2×0.15 = 5.90
	2nd footing	2	5.70	0.30	0.60	2.052 m^3	L = 6.20 − 2×0.15 − 2×0.10 = 5.70
	3rd footing	2	5.50	0.20	0.60	1.320 m^3	L = 6.20 − 2×0.15 − 2×0.10 − 2×0.10 = 5.50
	Shortwall						
	1st footing	2	2.40	0.40	0.60	1.152 m^3	L = 2.70 − 2×0.15 = 2.40
	2nd footing	2	2.20	0.30	0.60	0.792 m^3	L = 2.40 − 2×0.10 = 2.20
	3rd footing	2	2.00	0.20	0.60	0.480 m^3	L = 2.20 − 2×0.10 = 2.00
	Inspection chamber	2×2	1.00	0.30	0.50	0.60 m^3	L = 1.20 − 2×0.15 = 1.00
						9.228 m^3	

sl no	Description of item	No	Length	Breadth	Height	quantity	Explanatory notes
4	2nd class brick work in cement mortar 1:6						
	① Soak pit solid top part (mean dia)	1	π(2.20)	2.20	0.90	1.244m³	B = 2.00 + 2x 0.20/2 = 2.2
5.	20cm thick honeycomb brick in mortar in cement	1	π(2.20)	–	3.10	21.425m²	H = 2.80 + (0.90 - 0.60)
6.	Cement concrete 1:2:4 floor AV - 5cm thick	1	5.00	1.60	–	8.00m²	L = 3.30 + 1.70 = 1.60
7.	10cm thick brick work in bottle wall in cement mortar 1:3	1	1.60	–	1.60	2.560m²	H = 1.40 + 0.20 = 1.60
8.	R.C.C work 1:2:4 including reinforcement & shuttering						

Signature

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S no	Description of item	No	Length	Breadth	Height	Quantity	Explanatory notes
	(I) Septic tank.						
	(a) Roof slab	1	5.50	2.00	0.10	1.10 m^3	L = 0.20 + 0.30 + 0.10 + 1.70 + 0.20
	(b) Scumb Board	1	1.60	0.10	0.50	0.08 m^3	B = 1.60 + 2 × 0.20 = H = 0.30 + 0.10
	~~(II) Inception~~						
	(II) Inspection chamber	1	1.00	1.00	0.10	0.10 m^3	
	(III) Soak pit						
	(a) Roof slab	1	$\pi/4 (d^2)$				
			$\frac{\pi}{4}(2.40)^2$	-	0.10	4.523	

Signature

Administrative approval.

for every work it is necessary to obtain in the first instances the concurrence of the competent authority of the administrative department requiring the work. The formal acceptance of the proposals by that authority is termed "administrative approval" of the work. It is the duty of the engineering department requiring the work by the administrative to obtain the requisite approval to it. An approximate estimate and such preliminary plans as are necessary to explain the proposals are submitted by an engineering department to the administration to obtain administrative approval to take up the work within the sanctioned amount. After receiving the administrative approval detailed drawings, design and the estimated cost etc. are prepared by the engineering department and submitted to the administrative department for sanction.

✓Technical sanction.

Technical sanction means the sanction of the detailed estimate, design calculations, quantities of works, rates and cost of the work by the component authority of the engineering department. After the technical sanction of the estiamate is given, then only the work is taken up for construction. In case of original work the counter signature of the local head of the department should be obtained in the plan and estimate before technical sanction is accured by the engineering department. The power for technical sanction differs from state to state.

Muster Roll.

The wages of other day labourers are drawn on Muster Rolls and charged to the work's estimate on which they are employed.

Muster Roll from provides columns for recording attendance for a month but the roll may be closed for payment earlier on on Competion of the job. payment is made by the official of highest standing available at spot and proper acknowledgement obtained on the Roll. Unpaid items are recorded in the unpaid wages Register for subsequent payment on hand Receipt.

Acquitance Roll.

The payment of salary to persons of regular establishment working out-station is drawn on the regular pay-bill, but the payment is made on a separate receipt from known as Acquittance Roll. after taking duly stamped signature of the person. The Acquittance Roll is a receipt in evidence of payment in a perscribed form. The Acquittance Roll is prepared for the total amount as per establishment bill are passed by the drawing officer.

Security deposit.

Security deposit is an amount of money which shall be deposited by the Contractor whose tender has been accepted in order to tender himself liable to the department to pay Compensation amounting to the part or whole of his security deposit if the work is not carrried out according to the specification time limit and Conditions of Contract.

Annual Repair -

All works and structures are repaired and maintained in proper condition. The normal repair work done annually, come under A.R. work.

All buildings are white washed, Colour washed are repaired for minor repairs once in every building is provided A.R work is usually done by Contract by inviting tenders or quotations. Annual repair work are executed. For maintenance and repair, money is alloted in the budget under annual repair and maintenance head.

Special Repair -

Special repair work consist of renovations or renewals of structures or damaged work. It generally consists of renewal of floor, roofs, and other items of work involving replacements occurring at long intervals. Special repairs also comprise minor improvement in the building, etc. Repair of monsoons of flood damage works also come under special work.

Debit and Credit -

Debit means expenditure and credit means receipts. When the amount is to be debited to a work means that the amount is to be shown as expenditure on the work. Similarly when an amount is to be credited to a work it means that the amount is to be shown as receipt under the work.

The cost of stock materials issued is debited to the work concerned and a corresponding credit is given to the suspense head of stock amount.

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Estimation the items involved for construction of a WBM road from the following data:

Length of road = 150m.
formation width = 10 m.
Metalled width = 8m.

Thickness of grade-I metal soaling = 90mm
wearing coat of grade-II metal =
= 12cm thick loose and 8cm thick compacted.
Surface to be finished with 2 coats of bitumen as given below:
first finishing coat = 12mm chips @ 0.020 m^3 and bitumen @ 1.24 Kg per m^2 of road surface.
second finishing coat = 6mm chips @ 0.02m^3 and bitumen @ 1.24 Kg per m^2 of road surface.
Consumption of fuel @ 0.45 Kg per Kg of bitumen.

Length of the road = 150m.
formation width = 10 m.
Metalled width = 8m.

Area of road surface =
$150 \times 8 = 1200 m^2$
Thickness of grade-I metal soaling = 90mm = 0.09m.
Quantity required = $150 \times 8 \times 0.09$
= 108 cum.
Thickness of grade-II metal 12cm loose consolidated to 8cm thick compacted.
12cm = 0.12m.
Quantity required = $150 \times 8 \times 0.12$
= 144 cum.
1st coat of finishing = 12mm size chips @ 0.020 m^3 per sqm.

Signature

for 1200 square meters, chips required
= 1200 x 0.020
= 24 cum.

Bitumen required @ 1.24 kg/m² for road surface.

= 1200 x 1.24
= 1488 kg.

2nd Coat Finishing 6mm chips @ 0.02 m³ per sqm.

= 1200 x 0.02
= 24 cum.

Bitumen required @ 1.24 kg/m² of road surface.
= 1200 x 1.24
= 1488 kg.

for 1st Coat and 2nd Coat bitumen required.

= 1488 + 1488 =
= 2976 kg.

∴ Consumption of bitumen @ 0.45 kg.

= 2976 x 0.45
= 1339.2 kg.

Bill:-

It is the amount of work done or of supply of materials made, and includes the particulars and quantities of work done or materials supplied, their rates and amount due, It contains full and clear particulars of the claim or amount due. Reference to the agreement number is also given in the bill.

Voucher:-

Voucher is a written document with details which is kept to record as a proof of payment. per any payment first, a bill is prepared and payment is made on the bill duly checked and acknowledged by the payee, by signature on revenue stamp as required and after payment is made bill becomes voucher document which is kept in record.

Work Order:-

In case letter of acceptance is issued first to a Contractor intimating that his rate has been accepted and to perform a formal agreement within a specified number of days.

After the formal agreement is performed for the Contract a latter is issued to the Contractor known as work Order to take up the work and the date of Completion is treated from the date of issue of this letter. This is an Order of Commencement for a work and is issued to a Contractor by the Executive Engineer Concerned.

Signature.....

Tender :-

Tender is a written offer submitted by the Contractors in pursuance of the notification given, to execute certain work or supply of some specified articles or transport of materials at certain rates with the term and conditions laid down in the tender documents. The form in which it is to be submitted is supplied by the department to eligible contractors on usual payment of cost. The tender duly filled in is placed in the Tender Box with locking arrangement kept in the room of the officer inviting tender on or before the specified hours and date notified through the tender notice.