

**LEARNING MATERIAL OF**  
**ESTIMATION AND CONST EVALUATION-II**  
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**&**  
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# Detailed Estimate of Culverts and Bridges

## Detailed Estimate of a Simple Hump pipe culvert with right angled wing walls

Q) Estimate of a 90 cm dia double barrel Hume pipe culvert.

Prepare a quantity estimate for a barrel of 30 cm length (total length depends on the bank height) and the drop walls. In the estimate, the earth cushion whose depth has been indicated by  $a = 60$  cm minimum and the hand crest are not to be included. General specification of works are same as mentioned in the given drawing. Extra earth work in excavation shall be considered in the estimate to provide a side slope of 1:2 in order to prevent collapsing of earth work at water level.

Figure is given in page No-5.

Item No	Description of Item	Nos	Length in cm	B in cm	H in cm	Qty.	Total	Explanatory Note
A) For 30 cm length of Barrel :-								
1-	Earth work in Excavation	1	30	310	45	0.418	0.418 cum	$B = 310$ $= 265 + 2 \times 45/2$ Extra work for a side slope 1:2 to prevent collapsing of ear at water level.
2-	Earth work in filling and ramming complete.	2	30	45/2	45	0.061	0.061 cum	
3-	Single Brick flat Soling	1	30	265	-	0.795	0.795 sqm	
4-	Cement concrete (1:3:6) with brick	1	30	55	0.497			$H = 55 = 70 - 15$

No.	Item	NOS	L in c.m	B in c.m	H in c.m	Qty.	Total	Explanatory Note	
	Chambering portion	1	30	250	15	0.113			
	Deduction for pipes	2	80 x	1/2 x 79 x	1/2 (110) <sup>2</sup>	0.183 (c.c)		B = 1/2 (265 + 205 - 250 - 30)	
							0.417 cum		
5	90 cm dia 10 cm thick Hume pipe	2	30	-	-	0.60	0.60 cum		
6	Shuttering for concrete	2	30	-	70	0.42	0.42 sqm		
B) Quantities for drop walls								Extra excavation to provide a side slope of 1:2 all round.	
1	Earthwork in Excavation								
	Up-stream side	1	662	195	120	15.49		195 = 75 + 2 x 1/2 (10 + 90)	
	Down-stream side	1	695	250	150	25.75			
							Total = 41.44 cum		
2	Earth work in filling	= Item (1) - Items (3) (4) and portion of work upto G.L. from (5)							
							31.81 cum	All the items are from sub head (B).	
3	Single brick flat Soling								
	v/s side	1	535	75	-	4.01		0.94 = 9.36 x 0.1	
	D/s side	1	535	100	-	5.35			
							9.36 sqm		



No.	Description	No.	L. in c.m	B. in c.m	H. in c.m	Qty.	Total (C.N.)	
4	Cement concrete (1:3:6) with brick ballast							
	V/S side	1	535	75	30	1.20		
	D/S side	1	535	100	30	1.60		
						Total = 2.81		
5	First class brick work in cement mortar (1:4) V/S side for 60 cm layer.	1	535	60	40	1.28	<del>80 = 30 + 50</del>	
	50 cm layer	1	535	50	80	2.14	80 = 30 + 50	
	40 cm layer	1	535	40	65	1.39	65 = 40 + 10 +	
	D/S side for 70 cm layer	1	535	70	40	1.50		
	60 cm layer	1	535	60	30	0.96		
	50 cm layer	1	535	50	80	2.14		
	40 cm layer	1	535	40	65	1.39		
	Deduction for :- pipe opening both V/S & D/S sides	$2 \times 5 \times \frac{\pi \times 110^2}{4} \times 45$ (sq)				1.71	(-ve)	$45 = \frac{50 + 40}{2}$
	concreting under pipes	$2 \times 50 \times 0.417$				0.42	0.42	
							Total = 8.67	
6	12 mm cement plaster (1:2) V/S & D/S faces (upto 15 cm below G.L)	2	535	-	120	12.84	$120 = (80 + 10 + 15)$	
	Tops	2	525	40	-	4.20	(below G.L)	
	Deduction for pipe opening	$2 \times 2 \times \frac{\pi \times 110^2}{4}$				3.80	(-ve)	
							Total = 10.14 cum	



Q) Prepare a detailed estimate of a slab culvert of 1.50 meter span and 4.00 meter road way from the given drawing.

Figure is given in page no-9

SL NO	Description of Items	NOS	L	B	H/D	Qty.	
1	Earthwork in excavation in foundation.						
	Abutments	2	5.10	0.70	0.60	4.28	
	wing walls	4	1.20	0.70	0.60	2.02	
							Total = 6.30 cum
2	Cement concrete 1:3:6 in foundation with Stone ballast						
	Abutments	2	5.10	0.70	0.30	2.14	
	wing walls	4	1.20	0.70	0.30	1.01	
							Total = 3.15 cum
3	1st class brick work in 1:4 cement mortar.						
	Abutments	2	4.80	0.40	1.50	5.76	upto top of RCC slab
	wing walls	4	1.20	0.40	1.50	2.88	
	Parapets upto kerb	2	4.70	0.40	0.30	1.13	Above RCC slab upto kerb
	Parapets above kerb	2	4.70	0.30	0.50	1.41	Above kerb excluding coping
	Parapet coping	2	4.90	0.40	0.10	0.89	
							Total = 11.57 cum

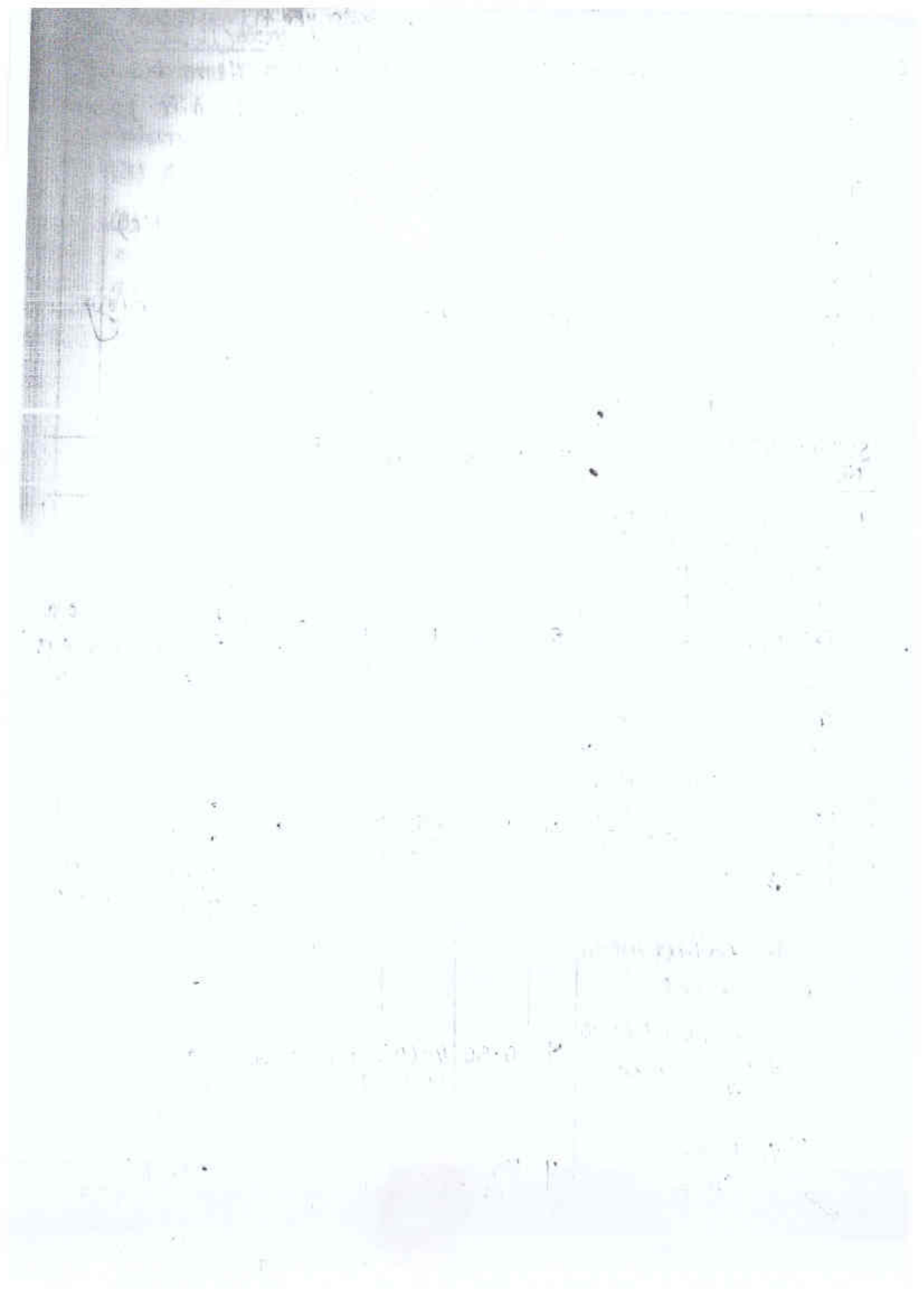


No	Items	No	Length	Area	Volume	Weight	Remarks
	<u>Deduction</u>						
	Bearing of RCC Slab in abutment	2	4.80	0.30	0.20	0.57	
					Net Total = 11.00 cum		
4	R.C.C work 1:2:4 in slab excluding steel and its bending but including centering shuttering & binding steel.	1	4.80	2.10	0.20	2.016 cum	No deduction for volume of steel.
5	Steel bars including bending in R.C.C. work -						
	20 mm dia bars Main straight bars 30cm C/C.	17	2.38	-	-	40.46 cum	$L = 2.10 - 2 \times 31 \text{ cover} + 2 \text{ hoc}$ $= 2.10 - (2 \times 41) + (18 \times 2)$ $= 2.38 \text{ m}$
	(No = $\frac{4.80}{0.30} + 1 = 17$ )						
	Main bent up bars 30 cm C/C.	16	2.54	-	-	40.64 m	Adding on depth, 16 c for two bent ups. $L = 2.38 + 0$ $= 2.54 \text{ m}$
	(No = $\frac{4.80}{0.30} = 16$ )						
	Total		81.10 m	@ 2.47 kg/m		200.32 kg	
	10 mm dia bars Distributing bottom bars 25 cm C/C	9	4.90	-	-	44.10 m	$L = 4.80 - 2 \text{ covers} +$ $= 4.80 - (2 \times 10) + (18 \times 10)$ $= 4.90 \text{ m}$
	Distributing top bars	4	4.90	-	-	19.60 m	
	Total		63.70 m	@ 0.62 kg		39.49 kg	
	Total of steel					239.81 kg	
						2.398 quintal	

170	Items	NO	L	B	H/D	Qty.	E.N
	<u>Deduction</u>						
	Bearing of RCC Slab in abutment	2	4.80	0.30	0.20	0.57	
						Net Total = 11.00 cum	
4	R.C.C work 1:2:4 in slab excluding steel and its bending but including centering shuttering & binding steel.	1	4.80	2.10	0.20	2.016 cum	No deduction for volume of steel.
5	Steel bars including bending in R.C.C. work - 20 mm dia bars Main straight bars 30 cm C/C. (NO = $\frac{4.80}{0.30} + 1 = 17$ )	17	2.38	-	-	40.46 cum	L = 2.10 - 2x side cover + 2 hooks = 2.10 - (2x4cm) + (18x20mm) = 2.38m
	Main bent up bars 30 cm C/C. (NO = $\frac{4.80}{0.30} = 16$ )	16	2.54	-	-	40.64m	Adding one depth, 16 cm for two bent ups. L = 2.38 + 0.16
	Total		81.10m			@ 2.47 kg/m = 200.32 kg	= 2.54m
	10 mm dia bars Distributing bottom bars 25 cm C/C	9	4.90	-	-	44.10m	L = 4.80 - 2 end covers + 2 hooks = 4.80 - (2x4cm) + (18x10mm) = 4.90m.
	Distributing top bars	4	4.90	-	-	19.60m	
	Total		63.70m			@ 0.62 kg = 39.49 kg	
	Total of steel					= 239.81 kg	
						= 2.398 quintal	



No	Items	Nos	L	B	H/D	Qty	E.N
6	Cement concrete 1:2:4 wearing coat	1	4.00	2.80	0.10	0.92 cum	In between parapets
7	Cement pointing 1:2 in walls.						
	Face wall from 10 cm below a.L upto bottom of coping	2	4.70	—	2.10	19.74	
	Inner side of parapet excluding coping	2	4.70	—	0.80	7.52	$H = (20 + 10 + 50) \times 10^{-3}$ $= 0.80 \text{ m}$
	Coping (inner edge top, outer edge and outer side)	2	4.90	0.70	—	6.86	$B = (10 + 40 + 10 + 10) \times 10^{-3}$ $= 0.70 \text{ m}$
	Ends of parapet	4	—	0.40	0.20	0.32	upto Kerb
	Ends of parapet	4	—	0.80	0.50	0.62	Above Kerb
	Ends of coping	4	—	0.40	0.20	0.32	Edge & under side
						Total = 35.86 cum	
	<u>Deduction</u>						
	Rectangular opening	2	1.50	—	1.30	3.90	Including 10cm below a.L & edge of R.C.C Slab.
	Triangular portion below earth Slope	2	$(\frac{1}{2} \times 1.30 \times 1.50)$			1.69	
						Total deduction = 5.59	
						Net total = 29.77 sqm	



RCC deck slab (curved) with splayed wing wall

2) Estimate the quantities of the following items from the drawing of a splayed wing wall shown in fig.

- 1) Earthwork in excavation
- 2) Cement concrete (1:3:6) in foundation.
- 3) First class Brickwork in cement mortar (1:6)
- 4) R.C.C M-15 deck slab.
- 5) 10 c.m thick cement concrete (1:1 1/2:3) wearing coat.

Figure is given in page No-14.

Sl No	Description of Item	Nos	Length	Breadth	Height	Quantity	E.N
1	Earthwork in excavation in foundation depth up to 2m below G.L.						
	(a) Abutment	2	8.80	1.60	1.80	50.69	$L = 2(3.5 + 0.40 + \frac{2.40}{12} + 0.10 + 0.05 + 0.15) = 8.80m$
	(b) wing walls upto end of return walls excavation	4	3.30	$\frac{1.60 + 1.28}{2}$	1.80	34.21	0.80 is trench width Inclined width upto end 1.28
	Deduct abutment end offset	4	0.50	$\frac{1}{2}(1.60 + 1.60 - 0.50)$	1.80	4.86	0.80 x $\sqrt{1.25^2 + 1^2}$ Splay is 1.25:1
	(c) Return walls (remaining)	4	$\frac{1}{2}(0.12 + 0.22)$	0.80	1.80	0.97	$0.12 = [0.90 + 2(0.05 + 0.05) + 0.1] - 1.28$ Inside = 0.12 + 0.12 x $\frac{2.4}{2.0}$
Total =						81.01	



No	Description of Item	No	Length	Breadth	Height	Quantity	E.V
2	Cement concrete (1:3:6) in foundation						
	(a) Abutments	2	8.80	1.60	0.60	16.90	
	(b) wing walls upto end of return wall	4	8.30	$\frac{1.60+1.20}{2}$	0.60	11.40	
	Deduct abutment end offsets	4	0.50	$\frac{1}{2}(1.60 + 1.60 - 0.50)$	0.60 (-)	1.62	Total offset 0.50 = $\frac{0.40}{2} + 0.10 + 0.05 + 0.15$
	(c) Return walls (remaining)	4	$\frac{1}{2}(0.22 + 0.22)$	0.80	0.60	0.32	Inner length = $0.22 = 0.12 + 0.10$ $\frac{2.4}{30}$
						Total = 27.00 cum	
3	Brick work in cement mortar (1:6)						
	(a) Abutments						
	Below G.L 1st footing	2	8.50	1.30	0.60	13.26	$L = 8.80 - 2 \times 0.15 = 8.50$
	Below G.L 2nd footing	2	8.40	1.20	0.60	12.10	
	Above G.L 1st offset						
	Top width = $0.9 + \frac{1.60}{12} = 1.03$	2	7.80	$\frac{1.03+1.10}{2}$	0.80	13.29	$7.80 = 2(3.50 + 0.40)$ Extra length for battering is accounted in wing wall
	Above G.L 2nd offset	2	7.80	$\frac{0.37+0.95}{2}$	0.80	11.23	
	Bottom width = $0.80 + \frac{1.60}{12} = 0.93$						
	Top width = $0.80 + \frac{0.30}{2} = 0.87$						
						B.F = 49.88	
	Above G.L top wall	2	7.80	$\frac{0.77+0.7}{2}$	1.40	16.05	
	Bottom width = $0.70 + 0.80 = 0.77$						

No	Item	Qty	L	B	H	Qty.	E.N
	Deduct bearing of deck slab	2	7.80	0.60	0.60	5.62 (-ve)	
b)	wing walls upto end of return wall						
	Below C.L 1st footing	4	3.15	$\frac{1.30+0.80}{2}$	0.60	7.94	$0.80 = 0.50 \sqrt{1.25^2 + 1^2}$
	Below C.L 2nd footing	4	3.10	$\frac{1.20+0.64}{2}$	0.60	6.84	$0.64 = 0.40 \sqrt{1.25^2 + 1^2}$
	Deduct abutment end offsets for 1st footing	4	0.35	$\frac{1}{2}(1.30 + 1.30 - 0.28)$	0.60	0.97 (-ve)	for display 2.40 x and 3.0 as 7 $0.28 = 0.35 \times \frac{2.4}{3.0}$
	for 2nd footing	4	0.30	$\frac{1}{2}(1.20 + 1.20 - 0.24)$	0.60	0.78 (-ve)	
	Above C.L						
	The whole section with parallel inclined width considered as frusta of pyramid						Top inclined width = $0.40 \times 1.6 = 0.64$
	Vol = $\frac{h}{3}(A_1 + A_2 + \sqrt{A_1 A_2})$						Bottom width at abutment = $0.64 + \frac{2.4}{12} \times 1.6 = 0.96$
	$A_1 = \frac{1}{2}(0.96 + 0.64) \times 2.4 = 1.92$	4	$\frac{2.70}{3}$	$\frac{(1.92 + 0.27) + \sqrt{1.92 \times 0.27}}{2}$		9.86	Bottom width at the end = $0.64 + \frac{0.30}{2} \times 0.3 = 0.68$
	$A_2 = \frac{1}{2}(0.68 + 0.64) \times 0.30 = 0.20$						

NO	Item					Qty	Unit
(c)	Return wall (remaining portion a trapezium) $1.54 = 0.90 + (0.90$ $- 0.4\sqrt{1^2 + 1.25^2}$	4	$\frac{0.90 + 1.54}{2}$	0.3	0.30	0.44	
						Total = 88.67 cum	
4	R.C.C M-15 deck slab	1	7.80	5.20	0.60	24.34	cum
5	10 cm thick cement concrete (1:1 1/2:3) wearing coat	1	7.00	4.40	0.10	3.08	cum



bar bending schedule of the above Job (BBS)

Ex-1 Estimate the

- Quantity of steel including 10% wastage.
- Quantity of binding wire.
- Quantity of steel per m<sup>2</sup> of concrete.

From the following data of RCC slab 4m x 4.5m x 12cm thick, 8mm dia rods are placed in short span @ 20cm c/c with one side 45° crank with end hooks. Rods are placed in long span @ 25cm c/c with one side 45° crank with end hook. 8mm dia straight bars with end hooks, 6 nos along long span & 6 nos along short span have been used cover = 25mm, K=2

SL No	Name of the Item	No	L	B	H	Qty.	E.N
(a)	<u>Main Bars</u> 8mm dia bar @ 20cm c/c Nos = $\frac{4.5 - 2 \times 0.025}{0.2} + 1$ = 23.25 ≈ 24 Nos	24	4.129	$\left(\frac{m}{4} \times 0.008^2\right)$		0.00498	L = 4 - 2 x side cover + 2 x hooks + 1/2 effective depth = 4 - 2 x 0.025 + 2 x 9 x 0.008 + $\frac{0.9}{2}$ = 4.129m
	<u>Distribution Bars</u> 8mm φ bar @ 25 cm c/c Nos = $\frac{4 - 2 \times 0.025}{0.25} + 1$ = 16.8 ≈ 17 Nos	17	4.629	$\left(\frac{m}{4} \times 0.008^2\right)$		0.00395	L = 4.5 - 2 x 0.025 + 2 x 9 x 0.008 + $\frac{0.07}{2}$ = 4.629m
	8mm dia hanger bar in short span	6	4.094	$\left(\frac{m}{4} \times 0.008^2\right)$		0.00123	L = 4 - 2 x (0.025) + 2 x 9 x 0.008 = 4.094m
	8mm dia hanger bar in long span	6	4.594	$\left(\frac{m}{4} \times 0.008^2\right)$		0.0018	L = 4.5 - 2 x 0.025 + 2 x 9 x 0.008 = 4.594m
						Total = 0.0119 cum	

$$\text{wt of steel} = 18.5 \text{ kg/cum} / \text{cum} = 0.01154 \times 18.5 = 0.21249 \text{ kg}$$

b) Add 10% wastage =  $9.059 \text{ kg} = 90.58 \text{ kg}$

Take binding wire  $2.7 \text{ kg} / 1032 \text{ m}$

wt of binding wire for  $(4 \times 4.5) = 18.32 \text{ m} = \frac{2.7}{10} \times 18 = 4.86 \text{ kg}$

Grand total =  $104.508 \text{ kg} \dots$

c) Volume of concrete =  $4.5 \times 4 \times 0.12 = 2.16 \text{ cum}$

For  $2.16 \text{ cum} = 0.01154 \text{ cum}$  steel is required

for  $1 \text{ cum} = \frac{0.01154}{2.16} = 0.00534 \text{ cum}$  steel is required.

Ex-2 Estimate :-

- i) Quantity of steel per  $\text{m}^3$  per concrete.
- ii) Quantity of steel including 10% of wastage.
- iii) Quantity of binding wire.

From the following data. from R.C.C slab  $5.5 \text{ m} \times 5.5 \text{ m} \times 15 \text{ cm}$  depth  $10 \text{ mm}$  dia rod are placed in short span @  $12 \text{ cm}$  C/C with one side  $45^\circ$  crank with end hook.  $8 \text{ mm}$  dia rods are placed on long span @  $15 \text{ cm}$  C/C with one side  $45^\circ$  crank with end hooks.  $8 \text{ mm}$  dia straight bars with end hooks. 6 nos are used in long span and 6 nos used in short span.

Assume cover =  $25 \text{ mm}$

$K = 2$

Sl. No	Name of Items	No	L	B	H	Qty	E.N
(a)	<u>Main Bars</u> 10 mm dia bars @ 12 cm C/C.						$L = 5.5 - 2 \times 0.025$ $+ 2 \times 9 \times 0.01 + \frac{0.1}{2}$ $= 5.63 \text{ m}$
	$\text{Nos} = \frac{5.5 - 2 \times 0.025}{0.12}$ $= 46.41 \approx 47 \text{ Nos}$	47	5.63	$(\frac{\pi}{4} \times 0.01^2)$		0.002	



SL NO	Name of the item	No	L	B	H	Qty	E.N
	<u>Distribution Bars</u> 8mm dia bar @ 15 cm c/c with one side crank						$L = 5.5 - 2 \times 0.025$ $+ 2 \times 9 \times 0.008 + \frac{0.1}{2}$ $= 5.644m$
	Nos = $\frac{5.5 - 2 \times 0.025}{0.15}$ $= 37.33 \approx 38$	38	5.644	$(\frac{\pi}{4} \times 0.008^2)$		0.010	
	8mm dia hanger bars in short span	6	5.594	$(\frac{\pi}{4} \times 0.008^2)$		0.00168	$L = 5.5 - 2 \times 0.025$ $+ 2 \times 9 \times 0.008$ $= 5.594m$
	8mm dia hanger bars in long span	6	5.594	$(\frac{\pi}{4} \times 0.008^2)$		0.00168	
						Total = 0.0336 cum	

wt of steel @  $78.5 \text{ kN/m}^3 = 78.5 \times 0.0336$

$$= 2.6192 \text{ cum} = 201.87 \text{ kg}$$

(2) Add 10% wastage = 20.187 kg

Add binding wire 2.7 kg / 1032m.

For  $(5.5 \times 5.5) = 30.25 \text{ sqm}$

wt. of binding wire is  $= 30.25 \times \frac{2.7}{10} = 8.167 \text{ kg}$

Total wt. of steel = 296.224 kg

(3) volume of the concrete =  $5.5 \times 5.5 \times 0.15 = 4.53 \text{ cum}$

For 4.53 cum ~~of~~ = 0.0336 cum steel is required

For 1 cum of conc. =  $\frac{0.0336}{4.53}$

= 0.0073 cum steel is required.



Detailed estimate of simple type of vertical fall to given specification

Q) Prepare a detailed estimate of a 60cm fall on a distributary of 360cm bed width and 90cm depth of water, from the given drawing side slope of bank and channel are 1 1/2 : 1.

Figure is given in page No-6

Sl No	Name of the items	No	Length	Breadth	Height	Qty.	E.N
1	Earthwork in excavation (rest wall, side walls and floor taken together)						
	(i)	1	2.65	6.00	1.15	18.29	$B = 4.5 + 2 \times 0.6 + 2 \times 0.15 = 6.00m$
	(ii)	1	2.10	5.80	1.05	12.79	$B = 4.5 + 2 \times 0.5 + 2 \times 0.15 = 5.80m$
	(iii)	1	1.50	5.60	0.95	7.93	$B = 4.5 + 2 \times 0.4 + 2 \times 0.15 = 5.60m$
	wing walls beyond						
	Side walls	2	1.80	0.70	1.00	2.52	
	Curtain walls	1	4.50	0.60	1.20	3.24	
	up streaming pitching 20cm depth						
	Bed	1	1.80	3.60	0.20	1.30	
	Side slopes (up to F.S.L)	2	1.80	1.62	0.20	1.17	$\text{Sloping breadth} = h\sqrt{s^2 + 1}$ $= 0.9\sqrt{(1\frac{1}{2})^2 + 1}$ $= 1.62m$
	Down stream channel beyond curtain wall fraze-ziem section						$\text{Average breadth} = \frac{4.5 + 3.6}{2} = 4.05m$

Sl. No.	Description of work items	Nos	L	B	H	Qty.	E.N
	(L = 4.20 - 0.30) = 3.90m						
	Down Stream pitching 20 cm depth, excluding toe wall Bed.	1	3.90	$\frac{4.05 \times 0.8 + 1.12 \times 0.8^2}{2}$	X 3.90	16.38	Average depth = $\frac{0.60 + 1.00}{2} = 0.80m$
	Side slopes upto F.S.L (upper length = 20m)	2	$\frac{4.2 + 2.0}{2}$	X 1.44	X 0.20	1.79	Sloping Broad Middle. $= d \sqrt{3^2 + 1}$ $= 8 \sqrt{(1.12)^2 + 1}$ $= 1.44m$ Taken as quadra of sphere.
	Curved portion	2	$\pi \times 0.6^2$ (area)	X 0.20		0.45	
	Top wall	2	3.90	0.20	0.30	0.47	
						Total = 69.28	
	Deduct for set back of wing wall	2	0.60	0.10	1.15	0.14	
						Net Total = 69.09 cum	
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	1.50	5.60	0.25	2.10	
	wing wall beyond						
	Side wall	2	1.80	0.70	0.30	0.76	
	Curtain wall	1	4.50	0.60	0.20	0.54	
						Total = 14.82 cum	
	Deduct for set Back of wing wall	2	0.60	0.10	1.15	0.14	
						Net total = 14.68	









Sl No	Name of the Item	Nos	L	B	H	Qty.	Est
6.	<u>Brick pitching</u>						
	Up-stream bed	1	1.80	3.60	0.20	1.30	
	Up-stream Side Slopes	2	1.80	1.62	0.20	1.17	
	<del>Down</del> Down stream bed	1	3.90	$\frac{4.1+3.2}{2}$	$\times 0.20$	2.85	
	Down stream Side slope	2	$\frac{4.2+2.0}{2}$	$\times 1.44$	$\times 0.20$	1.79	
	Side curved portions	2	$\pi \times 0.62$ (area)	$\times 0.20$		0.45	
						Total = 7.56 cum	

Detailed estimate of Siphon well drop to given  
specification

Q. Prepare a detailed estimate of a Drainage Siphon across a minor from the given drawings.

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

Sl. No	Name of the items	No	Length	Breadth	Height	Quantity	E.N
1	Earth work in excavation in foundation						For bed level of nala.
	Siphon duct	1	9.50	2.40	1.60	36.48	
	Drop pit	2	2.10	2.70	1.60	18.14	
	wing walls	4	1.25	1.10	1.60	8.80	
	Total = 83.42						
2	Cement concrete 1:4:8 with brick ballast.						
	Siphon duct	1	9.50	2.40	0.30	6.84	
	Drop pit	2	2.10	2.70	0.30	3.40	
	wing wall	4	1.25	1.10	0.30	1.65	
	Total = 11.89						cum
3	First class brick work in 1:4 cement mortar.						
	Siphon duct side walls	2	9.20	0.30	1.90	7.18	



S. No.	Name of the Items	No.	L	B	H	Qty.	E.N.
	Drop pit walls	2x2	2.10	0.30	1.30	3.28	up to top of slab
		2	1.80	0.30	1.30	1.40	
	<u>wing walls :-</u>						
	1st step 70 cm wall	4	1.25	0.70	0.70	2.45	
	2nd step 60 cm wall	4	1.25	0.60	0.60	1.80	
	2nd step 60 cm wall above slab	2	4.60	0.60	0.20	1.10	
	3rd step 50 cm wall	2	4.60	0.50	1.00	4.60	
	4th step 40 cm wall	2	4.60	0.40	0.80	2.97	
	5th step 30 cm wall (parapet)	2	4.60	0.30	0.30	0.83	
	coping	2	4.70	0.35	0.10	0.33	
						Total = 25.91 cum	
4	R.C.C Slab of Syphon duct including steel reinforcement.	1	9.20	2.10	0.15	2.90 cum	
5	10cm thick floor in 1:3 cement mortar including 1:2 cement pointing						
	Floor of syphon duct	1	9.20	1.50	—	19.80	
	Floor of drop pit	2	1.80	1.80	—	6.48	
						Total = 20.28 sqm	
6	<u>cement stuck pointing 1:2</u>						
	Syphon duct inner faces	2	9.20	—	1.00	18.40	

No	Description	No	L	B	H	Qty.	Est
	Drop pit 3 vertical faces	$2 \times \frac{1}{3}$	1.80	—	1.20	12.96	
	Drop pit 3 top faces	2	5.70	—	0.30	3.42	$L = 2 \times 180 + 210 = 570 \text{ cm}$
	Parapet wall inner face top & outer face upto G.L	2	4.60	—	2.30	21.16	$H = 20 + 10 + 30 + 10 + 35 + 10 + 5 + 10 = 230 \text{ cm}$
	outer face of wing wall above slab	2	1.80	—	1.20	4.32	
	Triangular portion of outer face of wing wall	$2 \times (\frac{1}{2} \times 1.80 \times 0.80)$				<del>1.20</del> 4.28	
						Total = 61.54 sqm	
7	10 cm dry brick pitching with straight over burnt bricks bed of nala	2	9.00	1.80	—	1.80	up & down stream
	Side slopes of nala	$2 \times 2$	9.00	1.13	—	13.56	Sloping - Breath = $\sqrt{(0.8)^2 + (0.8)^2} = 1.13 \text{ m}$
						Total = 24.36 sqm	



Detailed estimate of a National Highway in cutting/filling

Ex-1 Calculate the quantity of earthwork for 200 meter length for a portion of a road in an uniform ground the heights of banks at the two ends being 1.00m & 1.60m. The formation width is 10meter and side slopes 2:1 (H:V). Assume that there is no transverse slope.

Sol<sup>n</sup> given data :-

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

$$\text{Formation width (B)} = 10\text{m} \quad d_1 = 1\text{m}, d_2 = 1.6\text{m}$$

\* Mid Sectional Area Method (Method-1) :-

$$\text{Mean height (dm)} = \frac{d_1 + d_2}{2} = \frac{1 + 1.6}{2} = 1.3\text{m}$$

$$\begin{aligned} \text{Sectional Area (Bdm + 3d}^2) &= (10 \times 1.3 + 2 \times 1.3^2) \\ &= 16.38\text{m}^2 \end{aligned}$$

$$\begin{aligned} \text{Quantity of Earth work} &= \text{Area} \times \text{Length} \\ &= 16.38 \times 200 \\ &= 3276\text{cum} \end{aligned}$$

\* Mean Sectional Area Method (Method-2) :-

$$A_1 = Bd_1 + 3d_1^2 = (10 \times 1) + (2 \times 1^2) = 12\text{sqm}$$

$$A_2 = Bd_2 + 3d_2^2 = (10 \times 1.6) + (2 \times 1.6^2) = 21.12\text{sqm}$$

$$\begin{aligned} \text{Mean Sectional Area (A}_m) &= \frac{A_1 + A_2}{2} = \frac{12 + 21.12}{2} \\ &= 16.56\text{sqm} \end{aligned}$$

$$\begin{aligned} \text{Quantity of earthwork} &= A_m \times L \\ &= 16.56 \times 200 \\ &= 3312\text{cum} \end{aligned}$$



### Prismoidal Method (Method-3)

$$A_1 = Bd_1 + Sd_1^2 = (10 \times 1) + (2 \times 1^2) = 12.59 \text{ m}^2$$

$$A_2 = Bd_2 + Sd_2^2 = (10 \times 1.6) + (2 \times 1.6^2) = 21.12 \text{ m}^2$$

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

$$A_m = Bd_m + Sd_m^2 = (10 \times 1.3) + (2 \times 1.3^2) = 16.38 \text{ m}^2$$

$$\begin{aligned} \text{Quantity of Earthwork} &= \frac{L}{6} (A_1 + A_2 + 4A_m) \\ &= \frac{200}{6} \{ 12 + 21.12 + (4 \times 16.38) \} \\ &= 3288 \text{ cum} \end{aligned}$$

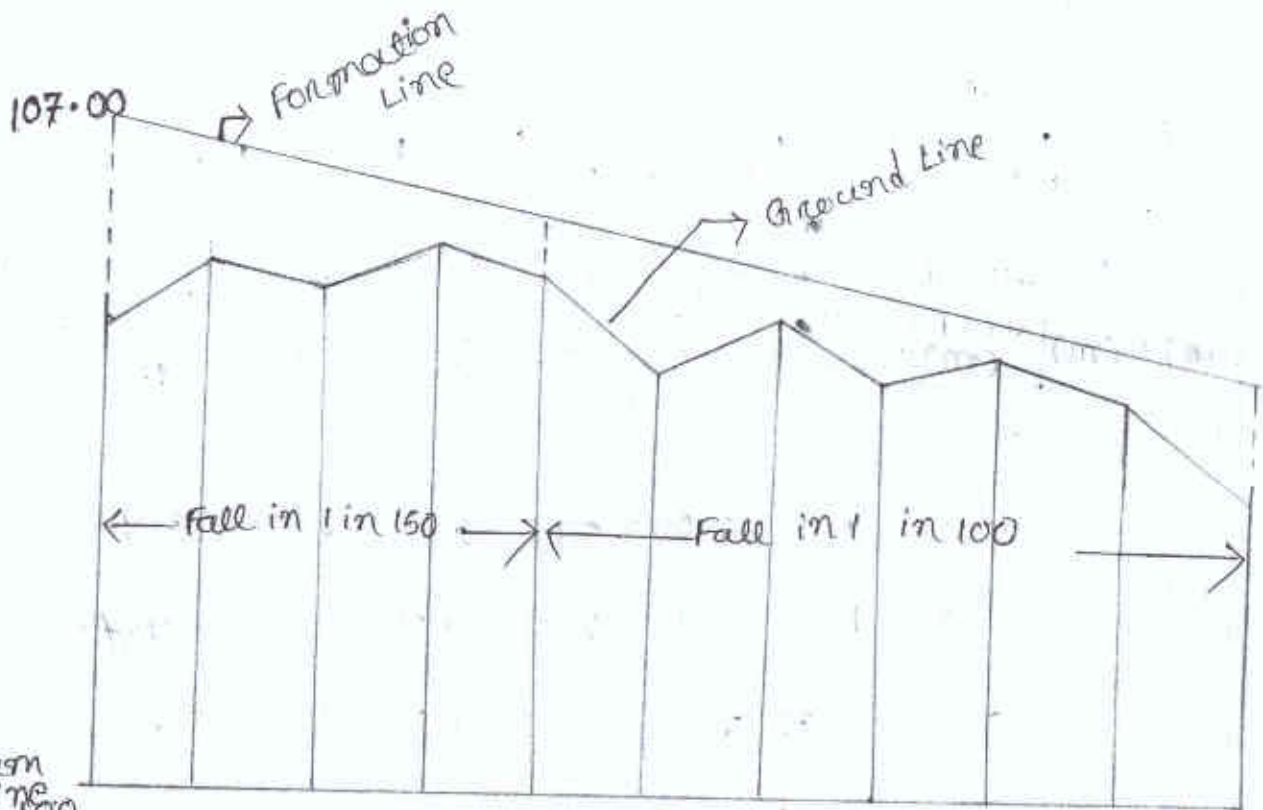
Ex-2

Reduced level 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 the Chainage 14 and then the gradient changes to 1 in 100 downward. Formation width of road is 10 meters and side slopes of banking are 2:1 (H:V). Length of 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 fencing the side slopes at the rate of Rs. 60.00/cum.

Chainage	10	11	12	13	14	15	16	17	18	19	20
R.L of Ground	105.00	105.60	105.44	105.90	105.42	104.30	105.00	104.10	104.62	104.00	103.30
R.L of formation	107.00										
Gradient	Down Gradient 1 in 150 → ← Down Gradient 1 in 100 →										



Bottom line 100

Dept of cutting

Height of Bank

R.L of formation

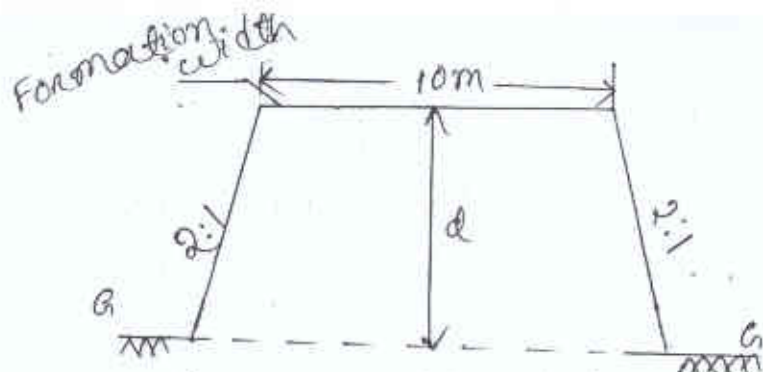
R.L of ground

Dist. in meter  
Chainage

Dept of cutting											
Height of Bank	2.00	1.20	1.16	0.50	0.78	1.60	0.60	1.20	0.38	0.70	1.10
R.L of formation	107.00	106.30	106.60	106.40	106.20	105.90	105.60	105.30	105.00	104.70	104.40
R.L of ground	105.00	105.60	105.44	105.90	105.42	104.30	105.00	104.10	104.62	104.00	103.30
Dist. in meter	300	330	360	390	420	450	480	510	540	570	600
Chainage	10	11	12	13	14	15	16	17	18	19	20

(L-section)





Calculation of Quantities of earth work

$B = 10m, S = 2$

Stations or Chainage (m)	Length (m)	Height or Depth of G.L. & F.L. (m)	Mean height or depth (m)	Central Area (Bd) (m <sup>2</sup> )	Side Area (Sd <sup>2</sup> ) (m <sup>2</sup> )	Total sec. Area (Bd + Sd <sup>2</sup> ) (m <sup>2</sup> )	Length in bet <sup>n</sup> stations (L) (m)	Quantity (Bd + Sd <sup>2</sup> ) * L	
								Banking (m <sup>3</sup> )	Cutting (m <sup>3</sup> )
10	300	2.00	-	-	-	-	-	-	-
11	330	1.20	1.60	16.00	5.12	21.12	30	633.60	
12	360	1.16	1.18	11.80	2.78	14.58	30	437.4	
13	390	0.50	0.83	8.90	1.38	9.68	30	290.4	
14	420	0.78	0.64	<del>4.90</del> 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	0.30	0.79	7.90	1.25	9.15	30	274.5	
19	570	0.70	0.54	5.40	0.58	5.98	30	179.4	
20	600	1.10	0.90	9.00	1.62	10.62	30	318.6	

Total = 3513.6



## Abstract of Estimated Cost

Item No.	Particulars of Items	Quantity	Unit	Rate Rs. p.	Per	Cost
						R.S P.
1	Earthwork in Banking	3513.6	Cum	275.00	1cum	9662.40
Total						9662.40
Add 5% (3% for Contingencies and 2% for work charged Establishment)						483.12
Gross Total =						Rs 10145.52

### Calculation of Areas of Side Slopes

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

Station or Chainage	Height or Depth	Mean Ht. or depth (d) (m)	Sloping breadth of side slope $d\sqrt{S^2 + 1}$ (m)	Length L (m)	Area of both side slopes $2Ld\sqrt{S^2 + 1}$ (m <sup>2</sup> )
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	0.79	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

# Abstract of Cost of Trestling

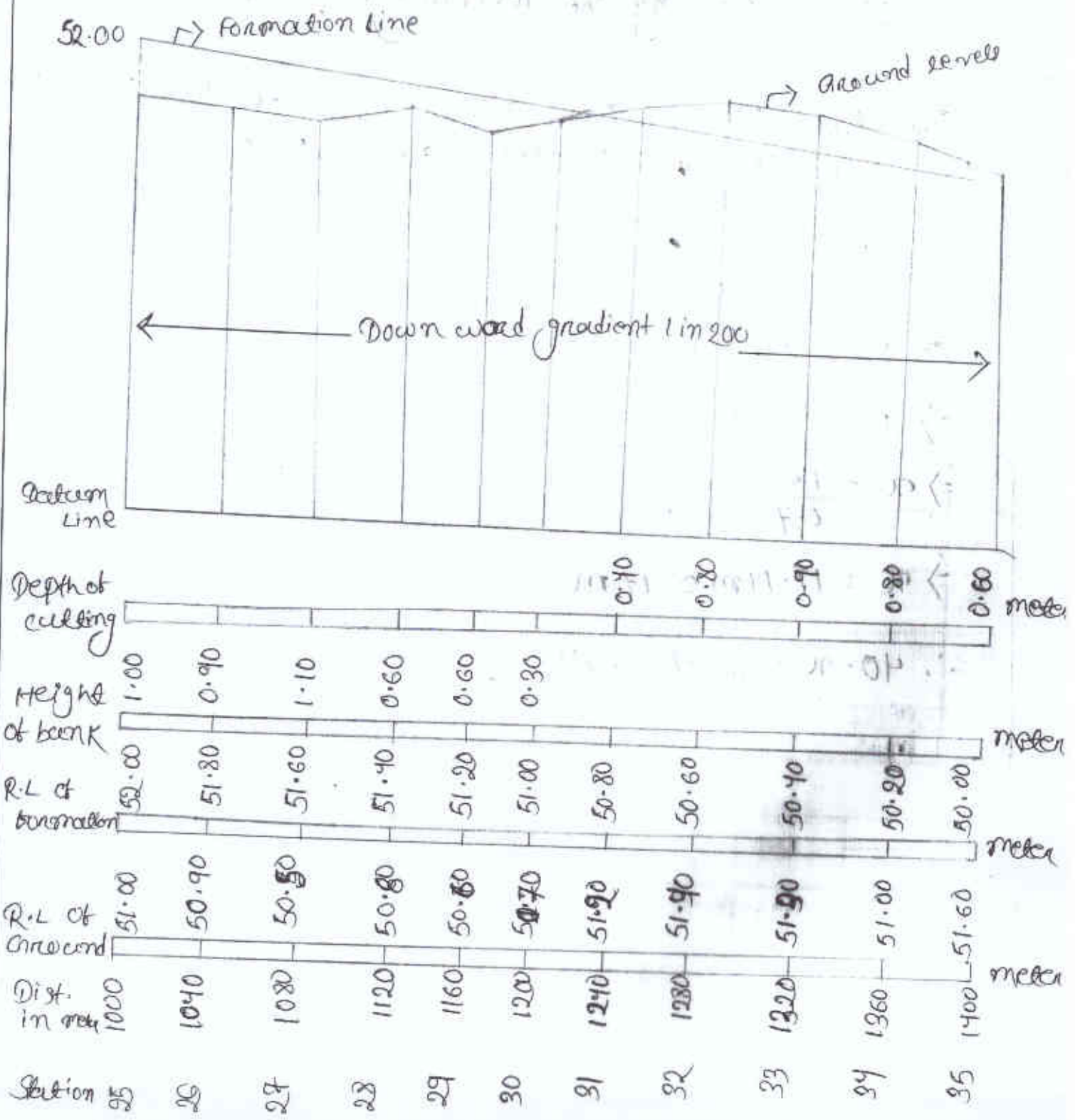
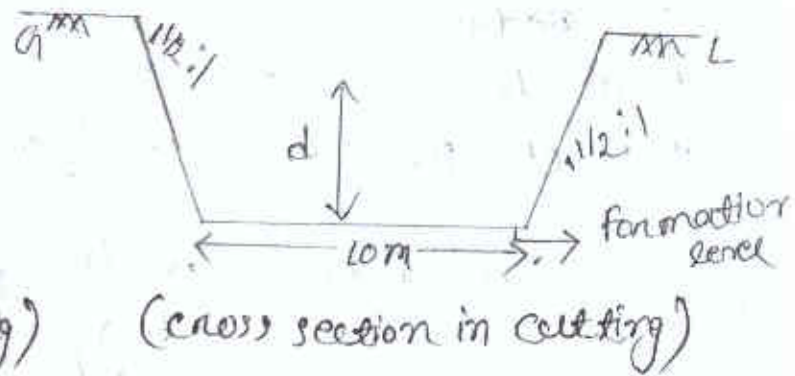
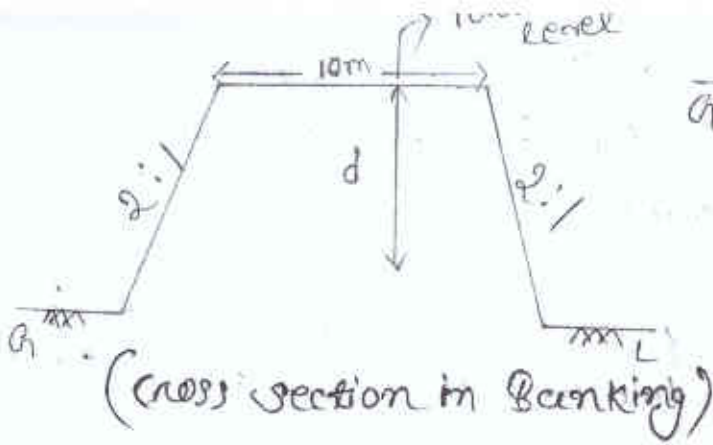
Item No	Particulars of Items	Quantity	Unit	Rate Rs. P	Per	Cost	
						Rs.	P
1	Trestling in both Sides	1297.80	sqm	60.00	1.52m	778.68	
Total =						778.68	
Add 5% (3% for contingencies and 2% for work charged establishment)							38.93
Grand Total =						RS 817.61	

Ex Estimate the cost of earthwork for a portion of road for 400 meter length from the following data -  
 Formation width of the road is 10 meter side slopes are 2:1 in banking 1/2 in 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





(L-section)

The road passes from banking to cutting in bet<sup>n</sup> the stations 30 (1200m) and 31 (1240m). when it passes from banking to cutting the R.L at ground & the R.L of formation is same.

The distance of the point where it changes from banking to cutting from station no 30 (1200) is determined by the following Method

The two triangles on either side of the zero of the zero (0) point are symmetrical.

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

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

$$\Rightarrow 12 = 0.7x$$

$$\Rightarrow x = \frac{12}{0.7}$$

$$\Rightarrow x = 17.14m \approx 17m$$

$$\therefore 40 - x = 40 - 17 = 23m$$



Calculation of Quantities of Earthwork

$B = 10\text{ m}$ ,  $S = 2$  for banking  $S = 1\frac{1}{2}$  (for cutting)

Station	Distance m (m)	Height on depth Diff. of G.L & F.L (m)	mean height on depth (d) (m)	Central Area (Bd) (m <sup>2</sup> )	Side Area (Sd <sup>2</sup> ) (m <sup>2</sup> )	Total sec. Area (Bd + Sd) (m <sup>2</sup> )	Length in bed Station (L) (m)	Quantity (Bd + Sd)L	
								Banking (m <sup>3</sup> )	Cutting (m <sup>3</sup> )
25	1000	1.00	-	-	-	-	-	-	-
26	1040	0.90	0.95	9.50	1.81	11.81	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	398.00	
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	
passes from banking to cutting									
-	1214	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
(ve sign indicates cutting)						Total = 1821.95		1384.98	
						cum		cum	

Abstract of cost

Item NO	Name of Items	Quantity	Unit	Rate RS. P	per	Cost	
						Rs.	P.
1	Earthwork in banking	1821.95	cum	275.00	1/cum	5010.36	
2	Earthwork in cutting	1384.98	cum	350.00	1/cum	4847.43	

Total = 9857.79

Add 3% for contingencies

295.73

Add 2% for work charged Establishment

197.16



## (Road Material calculation)

Ex-1 Estimates the item involved in construction of a road from the following data.

Length of the road = 150m

Formation width = 10m

Metel width = 8m

Thickness of grade - I metal sooling = 90mm, wearing coat of grade - 2 metal = 120mm thick loose end 8cm thick compacted surface to be finish with two coats of bitumen as given below.

First finishing coat = 12mm chips @  $0.020\text{m}^3$  and bitumen @  $1.24\text{kg}/\text{m}^2$  of road surface.

Second finishing coat = 6mm chips @  $0.020\text{m}^3$  and bitumen @  $1.24\text{kg}/\text{m}^2$  of road surface.

Consumption of fuel @  $0.45\text{kg}/\text{kg}$  of bitumen.

Sr No	Name of the Items	No	Length	Breadth	Height	Quantity	E.N
01	Clearing of site	1	150	10	-	1500sqm	
02	Grade-I Metal sooling	1	150	8	0.09	108.0cum	
03	Grade-II metal sooling	1	150	8	0.12	144.0cum	
04	12mm size chips at 1st wearing coat @ $0.020\text{m}^3/\text{m}^2$ at road.	1	150	8	@ $0.020\text{m}^3/\text{m}^2$	24cum	
5	Quantity of bitumen in first finishing coat road surface.	1	150	8	@ $1.24\text{kg}/\text{m}^2$	1488kg	
6	6mm size chips in second finishing & @ $0.020\text{m}^3/\text{m}^2$ of	1	150	8	@ $0.020\text{m}^3/\text{m}^2$	24kg	

S.No	Name of the Item	Nos	Length	Breadth	Height	Quantity	E.N
7	Quantity of bitumen in 2nd finishing coat @ 1.24 kg/m <sup>2</sup> at road surface.	1	150	8		@ 1.24 kg/m <sup>2</sup> 1488 kg	
8	Quantity of fuel @ 0.45 kg/kg of bitumen.		(1488 + 1488) = 2976 kg			@ 0.45 kg/kg of bitumen 1339.2 kg	

Ex-2 Estimate the required quantity of dry materials required for the construction of road length 2km metal width 3.8m, thickness of metal Scaffing is 100mm Thickness of wearing coat considered is 80mm. The Surface of the road is to be finished with 2 coats of bitumen. First coat finish is 12mm size chips @ 0.018 m<sup>3</sup> and bitumen @ 1.2 kg/m<sup>2</sup> of road surface. Second coat finishing is 6mm size chips @ 0.009 m<sup>3</sup> and bitumen @ 1.2 kg/m<sup>2</sup> of road surface fuel is 0.3 kg/kg of bitumen.

S.No	Name of the Item	Nos	Length	Breadth	Height	Quantity	E.N
1	Clearing of site	1	2000	5.3	—	10600 sqm	B = 3.8 + 2 x 0.7 = 5.3m
2	Metal Scaffing	1	2000	3.8	0.1	7600 cum	"
3	wearing coat	1	2000	3.8	0.12	9120 cum	80 mm consoid daret of the loose it is 120mm
4	12mm size chips in 1st finishing coat @ 0.018 m <sup>3</sup> /m <sup>2</sup> of road surface	1	2000	3.8	@ 0.018 m <sup>3</sup> /m <sup>2</sup> of road surface	136.8 cum	
5	Quantity of bitumen in 1st finishing coat @ 1.2 kg/m <sup>2</sup> at road	1	2000	3.8	@ 1.2 kg/m <sup>2</sup> of road	9120 kg	



6	6mm size chips in 2nd finishing coat @ 0.009 m <sup>3</sup> /m <sup>2</sup> of road surface.	1	2000	3.8	@ 0.009 m <sup>3</sup> /m <sup>2</sup> of road	68.4 cum
7	Quantity of bitumen in 2nd finishing coat @ 1.2 kg/m <sup>2</sup> of road surface	1	2000	3.8	@ 1.2 kg/m <sup>2</sup> of road surface	9120 kg
8	Quantity of fuel @ 0.3 kg/kg of bitumen.	(2 × 9120 = 18240 kg)			@ 0.31 kg per kg of bitumen	5472 kg

Ex-3 Estimate the items involved for construction of a W.B.M Road for the following data.

Length of Road = 120m

Metal Sealing = 5m

Thickness of grade - I metal Sealing = 80mm wearing coat of grade - II metal - 120mm loose consolidated to 80mm thick surface of road is to be finish with two coat of bitumen as given below.

1st finishing coat = 12mm chips @ 0.018 m<sup>3</sup> and bitumen @ 1.22 kg/m<sup>2</sup> of road surface.

2nd finishing coat is 6mm chips @ 0.01 m<sup>3</sup> and bitumen @ 1.22 kg/m<sup>2</sup> of road surface.

consumption of fuel @ 0.45 kg/kg of bitumen.

S. NO	Name of the Items	NOs	L	B	H	Qty.	E.N
1	Cleaning of site	1	120	8	—	960 m <sup>2</sup>	B = 5.2 × 1.5 = 8m
2	Grade - I Metal Sealing	1	120	5	0.08	48 cum	
3	Grade - II Metal Sealing	1	120	5	0.12	72 cum	

No	Description	Qty	L	B	H	Qty	Unit
4	12mm size chips @ $0.08 \text{ m}^3/\text{m}^2$ .	1	120	5	0.08	108 cum	
5	Quantity of bitumen in 1st finishing coat @ $1.22 \text{ kg}/\text{m}^2$ of road surface.	1	120	5	$1.22 \text{ kg}/\text{m}^2$ of road surface	732 kg	
6	6mm size chips @ $0.01 \text{ m}^3/\text{m}^2$ of road surface	1	120	5	$0.01 \text{ m}^3/\text{m}^2$ of road surface	6 cum	
7	Quantity of bitumen in 2nd finishing coat @ $1.22 \text{ kg}/\text{m}^2$ of road surface.	1	120	5	$1.22 \text{ kg}/\text{m}^2$ of road surface	732 kg	
8	Quantity of fuel @ $0.45 \text{ kg}/\text{kg}$ of bitumen.	1	$(732 + 732) = 1464 \text{ kg}$		@ $0.45 \text{ kg}/\text{kg}$ of bitumen	658.8 kg	

Ex-4

Estimate the following quantity for construction of a WBM road for 1 km length having following specifications.

Formation width of the road = 10m

Avg. height of bank = 1m

Side slope of bank = 2:1

Metal width of road = 13.8m

Sealing coat of overburnt brick laid flats is 10cm thick. Inner coat of metalling shall be of stone ballast of 12cm thick loose layer compacted



8 cm top layer is necessarily under or in the area  
of 9 cm thick loose layer compacted to 6 cm (4 cm to  
5 cm gauge)

- (1) Earth work in Excavation
- (2) Number of brick for Sealing
- (3) Quantity of bitumen.

Sol<sup>n</sup> Given data

Road length (L) = 1 km = 1000 m

Formation width (B) = 10 m

Agg. height of bank (d) = 1 m

Side slope = 2:1, 3:2

Metal width of road = 3.8 m

Thickness of brick = 10 cm

Inner coat = 12 cm loose compacted to 8 cm.

Top coat = 9 cm loose compacted to 6 cm.

- (i) Earth work in Excavation

$$Q = V = (Bd + Sd^2) \times L$$

$$= (10 \times 1 + 2 \times 1^2) \times 1000$$

$$= (10 + 2) \times 1000$$

$$= 12000 \text{ cum.}$$

- (2) Number of Brick

Quantity of brick Sealing

$$= 1 \times 1000 \times 3.8 \times 0.10$$

$$= 38000 \text{ cum}$$

1 cum = 500 Nos of brick

For 500 cum = 190000 nos of brick

Inner coat Stone ballast 12 cm compacted to 8 cm.  
 $= 1 \times 1000 \times 3.8 \times 0.2$   
 $= 456 \text{ cum}$

Top coat of stone ballast 9 cm compacted to 6 cm  
 $= 1 \times 1000 \times 3.8 \times 0.09$   
 $= 342 \text{ cum}$

(3) Quantity of Bitumen

Quantity of bitumen @ 220 kg / 100 sqm of road surface.

Area of road surface =  $1000 \times 3.8$   
 $= 3800 \text{ sqm}$

Quantity of bitumen =  $3800 \times \frac{220}{100}$   
 $= 8360 \text{ Kg}$



Works

For any original work, the engineering Dept. prepares a proposal on the basis of preliminary estimate, from the requirements and information supplied by the department concerned. The Department after due consideration approves the proposal with respect to the work and found and convey their approval or administrative sanction to the Engineering dept.

Ex For a hospital building the medical dept. will first initiate the proposal and will ask P.W.D for preparing a preliminary estimate. The P.W.D. will prepare the preliminary estimate which shall be formally approved by the medical dept.

The engineering Dept. then prepares the detailed estimate after necessary surveying, preparing plan and designing. The detailed estimate is then technically sanctioned by the competent authority of the Engineering Dept. The detailed estimate is prepared by the Asst Engineer with the help of the J.E and with the guidance of the Executive Engineer. The estimate is then checked by the computer and technically sanctioned by the Executive Engineer, if within his competence or otherwise sent to the higher authorities for technical sanction.

Classification of works according to their Nature

The works according to their nature are classified under the two main categories.

- 1- Original work :- The original work may be of different types.



i) carrying new work -  
bridge, road, dam, project etc.

ii) Additions and alterations to the existing work will increase the value of the property as - Addition of room or rooms, conversion of verandah into room, dividing a big room into two rooms etc.

iii) Special repairs for renovation or for through repairs of the damaged work - as changing of roof, changing of floor, changing of doors and windows etc.

2) Repair work :-

The repair works may be of the following types.

i) The repairs required to maintain the work in proper condition as annual repairs to buildings, roads etc.  
as - Annual repairs, white washing, colour washing etc.

ii) Minor additions and alterations, within certain monetary limit, which will not increase the value of the property as - opening a door, providing sunshade, providing shelves etc.

iii) Special repair monsoon damage repair etc.

Classification of work according to their cost

With respect to the cost, the original work is classified as Major work, Minor work and petty work.

Major work

The work costing more than Rs. 2 lakhs is termed as major work and the estimate for such work is known as major estimate.

Minor work

The work costing more than Rs. 50,000.00% but not exceeding Rs 2 lakhs is known as minor work and



the estimate for such work is known as minor estimate.

### Petty work

The work whose cost does not exceed Rs. 50,000.00/- is known as petty work and the estimate is known as petty estimate.

According to the C.P.W.D Account rule, the work costing more than Rs. 75,000.00/- is termed as major work and major estimate and the work costing upto Rs. 75,000.00/- is termed as minor work or minor estimate.

### Different types of Repair work

#### 1) Annual repair or Maintenance work (A.R work)

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

All buildings are white washed, colour washed & repaired for minor repairs once in every year. For annual repair of building 1 to 1 1/2 percent of the original constructional cost of the whole building is provided. A.R work is usually done by contract. By inviting tenders or quotations. For maintenance and repair, money is allotted in the budget under Annual Repair and Maintenance Head. Annual repair works are executed by the dept concerned as - Medical dept buildings are maintained by the Medical dept, police dept buildings are maintained by police dept.

#### 2) Quadrantal / Quadrennial Repair :-

Besides annual repair work of white washing and colour washing, every fourth year special thorough repair is



repairing of walls and windows, plastering etc. Special repair work every fourth year is known as Quadrennial Repair.

### (3) Special Repair (S.R) -

Special repair work consist of renovations or renewal of structures or damaged works. It generally consists of renewal of floor, roofs and other items of working involving replacements occurring at long intervals. Special repairs also comprise minor improvements in the building etc.

Repair of monsoon or flood damage works also come under special repair work.

### Contract

An agreement enforceable by law in contract. The contract invariably follows a proposal from one party and its acceptance by the other. In absence of any of the above elements of a contract it becomes void. i.e without a legal effect or voidable i.e which can be avoided by any of the parties to it.

Contract is or an undertaking by a person or firm to do any work under certain terms and conditions. The work may be for the construction or maintenance and repairs, for the supply of materials for the supply of labour, for the transport of materials etc.

### Contractor :-

The term contractor means a person or firm who undertakes any type of contract usually this term is confined to the contractors engaged for the construction or execution of work of repairs.



## Contract system :-

In contract system the work is got done through contractors who arrange all material required and employ the workers required for the completion of the work in time. A contract agreement is a bond, the contractor and the Dept. are bound by the terms and conditions of the contract.

The contract agreement stipulates the quantities of works and rates, the detailed specifications of various items of work to be done, the time limit within which the whole work shall have to be completed and various other conditions. Contracts are usually arranged by inviting sealed tenders and entrusting the work to the lowest tender usually.

## work order

Small work up to 2,000.00/- may be carried out by work order. This is a contract and specifies the approximate quantities of different items of work, detailed specifications of each item of work, time for completion of the whole work, penalty that will be imposed for not fulfilling terms and conditions, etc. Payment is made on the measurement of the work done and 10% of the bill amount is deducted from the running account bill of the contractor as security. Money which amount is returned in the final payment on the satisfactory completion of the work.

## Piece work Agreement (P.W.A)

P.W Agreement is that where only rates are agreed upon without reference to the total quantity of work or time, and that involves payment of work done at the stipulated rate. Small work or piece-work up to Rs. 2,000.00/- may be carried



The p.w Agreement contains only the descriptions of different of works to be done and the rate to be paid for but does not provide the quantities of different items to be executed nor the time within which the work is to be completed. Detailed specifications of the different items of work to be completed. Detailed specifications of the different items of work to be done are however included in the p.w Agreements and the total cost of the whole work to be done is also mentioned. Contractors have to arrange all materials, labours etc, required for the execution of the work p.w. Agreements are not contracts in the true sense there is no penalty, clause and no security money, and the Dept. may terminate the work at any time they like but a notice specifying the date of termination shall be served to the piece worker. Payment is made on the measurement of the work actually done.

Under special circumstances work up to Rs. 7500.00/- can also be executed by p.w.A

### Different types of contracts

#### 1) Item rate Contract :-

It is also known as unit-price contract or schedule contract for item rate contracts, contractors are required to quote rates for individual items of work on the basis of schedule of quantities furnished by the Dept. This schedule indicates full nomenclature of the items as per sanctioned estimate, estimated quantities and unit therein. While filling up the rates, the contractor are required to express the amount in figures and words and also to work out the cost against each item. The final total of the amount tendered for the work is also drawn up by item. This type of contract is followed by Railway Dept.



## 2) Lumpsum Contract

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

The detailed specification of all items of work pertaining to the whole work, plans and detailed drawings and deposit of 10% security money, penalty progress and other conditions of contract are included in the contract agreement. The general specification and description of different part of the building with dimensions where required are included. The quantities or schedule of different items of work are not provided, the contractor shall have to complete the work as per plan and specification within the contract fixed sum, within a fixed time irrespective of qualities of different items. On completion of work no detailed measurement of different items and checked with plans and drawings.

## 3) Labour Contract :-

In this type of contract the contractor undertakes contract for the labour portion. All materials for the construction are arranged and supplied at the site of work by department or owner, the labour contractor engages labour and gets the work done according to the specification. The contract is on item rate basis for labour portion only and contractor is paid for the quantities of work done on measurement of the different items of work at the stipulated rate in the contract agreement. Materials for scaffolding, centering and shuttering and other similar materials are supplied by the dept or owner; contractor may also use



his own ~~arrangements~~ in ~~carrying~~,  
Sheltering etc, It provided in the agreement. Contractor  
uses his own tools for working, but plants and machin-  
eries are arranged by the dept. or owner.

This system of contract is not generally adopted in  
the Govt. Dept.

#### 4) Schedule contract :-

This is similar to lumpsum contract but the  
schedule of rates is also provided in the contract  
agreement. In this system the contractor under takes  
the execution or construction of a particular work  
at a fixed sum within a specified time as per  
plans and the detailed specification and conditions,  
and the schedule of rates for various items of  
work are also provided which regulates the extra  
amount to be paid or deducted for any additions  
and alteration. In this case also no measurement of  
various items of work involved in the original work  
is required, but measurement of extra items only  
shall have to be taken.

#### 5) Cost plus percentage contract

In this system contractor is given certain  
percentage over the actual cost of the construction  
as his profit. Contractor arranges materials and  
labour at his cost and keeps proper account and  
he is paid by the department or owner the whole  
cost together with certain percentage, say 10% as  
his profit as agreed upon before hand.

An ~~agreement~~ agreement is prepared with all conditions  
of contract in advance. In this case proper control  
in the purchase of the materials and in labour  
shall ~~be~~ to be exercised by the department or  
owner.



# ACCOUNTS OF WORKS

## Administrative approval

For any work or project required by the department an approval or sanction of the competent authority of the department, with respect to the cost and work is necessary at the first instance. The approval is given by the authorities of the engineering department to take up the work.

Administrative approval denotes the formal acceptance by the department concerned of the proposal and after the administrative approval is given the engineering department (P.W.D) take up the work and prepares detailed design, plans & estimates and then executes the work. The engineering department prepares approximate estimate and preliminary plans and submits to the department concerned for administrative approval.

## Technical sanction

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

## Contingencies

The term "contingencies" indicates incidental expenses of miscellaneous character which cannot be classified



under any estimate for the work as a whole.

In an estimate a certain amount in the form of contingencies of 3% to 5% of estimated cost, is provided to allow for the expenses for miscellaneous petty items which do not fall under any sub-head of items of work.

### Tender:-

Tender is an offer in writing to execute some specified work or to supply some specified articles at certain rates, within a fixed time under certain conditions of contract and agreement between the contractor and the department or owner or party. The constructions of work is usually done by contract. Sealed tenders are invited and the work is usually entrusted to the lowest tenders the bill of quantities, detailed specifications, conditions of contract and plans and drawings are supplied on payment of the requisite costs to the contractors who tender or quote their rates.

### Tender Notice

Tender for work or supply are invited by issuing tender notice in prescribed form. In the tender notice the following particulars are given.

- i) Name of the authorities inviting tender.
- ii) Name of work, and its location.
- iii) Estimated cost.
- iv) Time of completion.
- v) Cost of complete set of tender forms & conditions.
- vi) Date, time and place of tender.
- vii) Amount of earnest money and security money.
- viii) Validity of tender etc.

Tender notice is posted in the notice board of the department and for major work the tender notice in brief is also given in the newspaper.



## Earnest Money :-

While submitting a tender the contractor is to deposit a certain amount about 2% of the estimated cost, with the department, as earnest money as guarantee of the tender. This amount is for a chek so that the contractor may not refuse to accept the work his earnest money is forfeited. Earnest money of the tenderer whose tender has not been accepted is refundable. The amount of earnest money depends on the estimated cost. Earnest money should be in cash or encashable, at any time. It may be in the form of deposit in Treasury or state bank or other approved bank or government security or saving certificate or post office, saving pass-book or cash certificate, pledged to the Executive Engineer.

## Security Money / Deposit :-

On acceptance of the tender, the contractor has to deposit 10% of the tendered amount as security money with the department which is inclusive of the already deposited. This amount is kept as a chek so that the contractor fulfills all the terms and conditions of the contract and carries out the work satisfactorily according to the specifications & maintain progress and completes the work in time. If the contractor fails to fulfill the terms of contract his whole or part of the security money is forfeited by the department. The security money is refunded to the contractor after the satisfactory completion of the whole work after a specified time, usually after one rainy season or six months of the completion of the work.



## Payment

The payment to the contractor may be made finally by one payment when the work or the supply complete or by number of payments by running account bills during the progress of the work. Usually payment are made on running account bills and the final payment is made on the completion of the work for small work payment is made by one payment.

## Advance payment :-

This means payment made on a running account to a contractor for work done by him but not measured. Advance payment is not generally made to the contractor, but may be made under special cases when the work is sufficiently progressed but measurement cannot be taken for certain valid reason, on the certificate of the Asst Engineer in charge of work that the value of work done is in no case less than the advance payment made or proposed to be made and detailed measurement will be taken as soon as possible.

## On account / Running / Interim payment

This means payment made on a running account to a contractor for works done or supplies made by him duly measured and entered in M.B when only a part of the whole work or supply is in progress. During the progress of work the contractor is paid time to time and when the contractor has done some progress he is paid upto the extent of work done by him.

## Intermediate payment :-

The term applied to a disbursement of any kind of a running account not being the final payment. It includes an "Advance payment" a "Secured payment" (other than the final payment on a running account).



or a combination of these.

### Final payment

This means the payment made on running account made to a contractor on the completion or determination of his contract and in full settlement of the account. The bill on which final payment is made is known as "final bill".

### Bill

Bill is the account of work done or of supply of materials made and includes the particulars & 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 No is also given in the bill.

### Running Bill

Running account Bill, means a Bill for the payment of "on account" moneys to the contractor as per the terms and conditions of agreement made between the ministry and the tenderer.

### First & Final Bill

This term is used for making payment to the contractor both for works and supplies, when a single payment is to be made on the completion of the whole work or supply as final payment. This type of bill is generally adopted for petty works or split up works in projects.

### Regular establishment

More than five years of service in the work-charged establishment or to any work-charged employee, who has completed different nature, such as permanent establishment, commonly known as



## Temporary establishment

It means an establishment the operates for a period of no more than fourteen (14) consecutive days in conjunction with a single event.

## Cash

The term cash includes legal tender coins, notes, cheques payable on demand, remittance transfer receipts and demand drafts. A small supply of revenue stamps (required for an acknowledgement of receipts) may be kept as part of the cash balance.

## Major & Sub-head accounts

The main unit of classification in accounts shall be the "major head" which shall be divided into minor heads, each of which shall have a number of subordinate heads, generally shown as sub-heads. The sub-heads are further divided into detailed heads.

Major head account - : Establishment charges, cost of purchases.

Sub-head account - : Rent, Rates and Taxes, Electricity charges, Telephone.

## Temporary advance :-

It is also known as "Temporary Imprest" is the amount which is advanced by a Disbursing officer to a sub-ordinate officer to enable him to make a number of specific payments out of a muster-roll or any other voucher which has already been passed for payment. The amount of temporary advance should be closed as soon as possible.

## Issue Rate :-

This term denotes the cost per unit fixed on the article or material as calculating the amount.



when issued from stock.

An issue rate is fixed for each article of stock on the basis of actual cost plus other expenses including storage charges. The issue rate is fixed on the principle that there may not be ultimate profit or loss in the stock account and the rate should include the actual cost of materials in procuring, handling them and storage charges.

The issue rate should include the actual cost, cost of transport, expenditure on work charged establishment for handling and keeping initial record expenditure on the custody of stock, watch and ward, expenditure on the maintenance of stores godown or yard, losses for depreciation or wastage etc. Issue rate is the rate of supply of stock godown plus the storage charge.

### Storage charges :-

This means expenditure incurred on store materials after the acquisition of stores, on work charged establishment employed on handling and keeping initial accounts, the custody of stock and the maintenance of store godown or yards etc and added on a percentage basis of the cost so as to form part of the issue rate.

### Supervision charges :-

This term is ordinarily applied to the charges which are levied, in addition to book value and storage charge (issue rates) in respect of stock materials sold or transferred and are intended to cover such items of expenditure incurred on the stores as do not enter in their book value and are not included in storage charges. When the stock materials are sold or transferred a certain percentage about 10% is charged over issue rate as supervision charges.



establishment.

## Suspense Account

A suspense account is an account used to temporarily store transactions for which there is uncertainty about where they should be recorded. Once the accounting staff investigates and clarifies the purpose of this type of transactions, it shifts the transaction out of the suspense account and in to the correct account.

## Debit and Credit :-

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

## Cash Book :-

The transactions relating to the actual receipt and payment of cash are recorded in a register made of P.W.A form No. 1 known as cash book. The cash book is one of the most important record and posted and maintained correctly day to day in the divisional office and sub-divisional office.

## Book transfer :-

A book transfer is the transfer of the legal right of ownership of an asset, without physically shifting the asset to the new owner. The most common use of the concept is when a bank transfers funds from the account of the payer to account of the payee when both accounts are with the same bank.

## Voucher :-

Voucher is a written document with details which is kept as a record as a proof of payment for any payment. First, a bill is prepared and payment is made



on the bill duly checked and signed by the payee, by signature on revenue stamp as required. and after the payment is made bill becomes voucher document which is kept in neward.

### Measurement Book (M-B) :-

The measurements of all works and supplies are recorded in the measurement Book from No-23 and payment of all works and supplies are made on the basis of measurement recorded. The measurement books are very important account records.

#### Form-23 Measurement Book

Particulars	Detail of Actual Measurement				Contents of area
	No	L	B	D	

All measurement book are numbered serially and a register is maintained in the divisional office showing the serial number of each book, the name of the sub-division or officer to whom issued, the date of issue, the date of return and remark. A similar register is maintained in the sub-divisional office showing the names of the officers to whom issued, date of issue, date of return etc.

### Points to be observed in newarding Measurement

→ The measurements are recorded by the executive or asst. engineer; or sectional officers (overseers) to whom measurement books have been issued for the purpose. The measurement of the works are taken accurately and newarded ready for different items of works for the different respective units.

→ For the supplies of materials, the quantities received are measured, weighed or counted as applicable and recorded in the measurement book. The description of



Items or works on supply, there may not be ambiguity.

→ All measurements should be recorded in Ink directly in the measurement book and no where else. Entries with Indelible pencil is admissible but the pencil entries should not be inked over. The entries in the content or area column should be made in Ink after necessary calculations. No entry should be erased if a mistake is made it should be corrected by crossing out and inserting the corrections and the correction thus made being initialled and dated.

→ The pages of M.B are machine numbered. Entries should be recorded continuously and no blank pages left or pages torn out. Any pages left blank through mistake should be cancelled by diagonal lines and cancellation being initialled and attested and dated.

→ Separate M.B should be used for the works done by the contractor and by the department labour.

→ Each M.B should be provided with an Index of the contents of different entries at the space provided at the beginning, which should be kept up-to-date.

→ Loss of M.B is a serious matter and is to be reported to the higher authorities. When a M.B can not be traced for a month the fact should be reported to the S.E. who has to take suitable action in the matter.

### Standard Measurement Book (S.M.B)

A measurement Book where the detailed measurement of certain items of works of a building is recorded correctly in ink on the completion of the construction and the accuracy of which is certified by a Asst. Engineer is known as the "Standard measurement Book". The book is maintained as record, to facilitate the preparation of estimate for periodical repairs and their execution.



In case of annual white washing, colour washing etc. no detailed measurements need be taken, the contractor's bills are prepared and the payments to the contractors are made on the basis of measurements in the Standard measurement Book. S.M.B is checked every five years and alteration if any are entered in the S.M.B which is known as quinquennial checking. The S.M.B is mainly used for annual repair and maintenance works. S.M.B is used and maintained in the same manner as ordinary Measurement Book.

### Master Roll

work may be executed departmentally by employing daily labour, as masons coolies, bhisties, carpenters etc. The attendance of the labourers is kept in muster roll. The wages of other day labourers are down on muster rolls.

M.R. form provides columns for recording attendance for a month both the roll may be closed for payment earlier or on completion of the job. payment is made by the official of highest standing available at spot and proper acknowledgement obtained on the Roll.

→ The categories of skilled and unskilled workers employed on works are daily rated Master Roll labour whose daily attendance and output are recorded for the purpose of payment. The work is executed under direct supervision of the sectional officer or sub-divisional officer concerned and may be inspected by higher officers.

→ The muster Roll being the initial record of employment and payment in deal with and preserved carefully at all levels on receipt of a requisition from the Sub-Divisional officer, the divisional officer after considering the necessity and urgency of the work



and ~~strength~~ strength of labour required in his office  
blank form duly registered and numbered in his office  
indicating the period, the maximum number of labourers  
to be employed and their corresponding daily wages  
on it.

### Rules for preparation of Master Roll

The master Rolls are prepared and dealt in accordance with the following rules:-

- i) One or more master rolls may be kept for each work but M.R. should not be prepared in duplicate. It is permissible to keep one M.R. for labourers employed on several small works in near about places.
- ii) The daily attendance and absence of labourers and times, if any imposed on them should be recorded in in daily in the M.R. so that the calculations may be done correctly and it may not be possible to ~~temer~~ with the attendance and entries and classification of cost on works and sub heads of works may be kept separately.
- iii) Labourers may be paid more than once in a month, but separate M.R. must be prepared for each period of payment.
- iv) After a M.R. has been passed, payment should be made as quickly as possible, and each payment is initialled and dated by the paying officer. If any item remains unpaid the details of such items shall be recorded in the Register of unpaid wages.
- v) The amount of unpaid wages is deposited in the cash and the amount is kept as deposit. The amount may be paid later on hand receipt.



## Acquittance Roll

The payment of Salary to persons of regular establishment working outstation is drawn on the regular pay-bill, but the payment is made on a separate receipt form known as "Acquittance Roll", after taking duly stamped signature of the person. The Acquittance Roll is a receipt in evidence of payment in a prescribed form having five columns as Item No, Name, Designation, Net amount payable & Date of signature. The Acquittance Roll is prepared for the total amount as per Establishment Bill are passed by the drawing officer. After the payment has been made the paying officer returns it after certifying that proper receipt (signature) has been taken from the person entitled to receive payment, which is then attached to the original Establishment Bill as a record of payment.

## Labour Report

For large work or a group of works which is done through daily labour, a consolidated labour report showing the labourers employed day to day is prepared by the overseer from the muster roll in a prescribed form and is submitted daily to the S.D.O or Executive Engineer for control and check. The report shows the name for the work, the number of each class of labourer employed on each work, the rate of wages, and the approximate quantity of work done. The labour report is compared with the M.R. as soon as it is received in the S.D.O or Divisional office and discrepancies, if any are investigated and necessary action taken. Labour report form in duplicate in book form one copy is submitted and the



Component is returned by the overseer.

### Labour Report

Daily report of the day

Labour work on which employed	Class of Labour	No. of each	Rate	Approx. quantity of work done

Signature \_\_\_\_\_ Date \_\_\_\_\_

### Classification of Stores:-

The stores are divided into the following cases:-

- i) Stock of General Stone.
- ii) Materials Charged direct to the works.
- iii) Road Metal &
- iv) Tools and plants.

The four classes of stores fall in to two categories with respect to accounts, as given below.

- i- Stone charged to suspense - (i) Stock.
- ii- Stone directly charged of  $\left\{ \begin{array}{l} \text{ii) Materials charged direct to work.} \\ \text{iii) Road Metal} \\ \text{iv) Tools and plants.} \end{array} \right.$

For convenience and quick execution of works each division maintains stock of materials as cement, steel, timber, fittings etc. required for works from time to time. Materials from the stock are issued to the works or to the contractors, cost recoverable as and when required on an indent on the stock. One Asst. Engineer or S.D.O and one overseer remain in-charge of stock. A store keeper is also employed for all time work issue, receipt and recording stock account is maintained in the sub-divisional office and a separate account is also maintained in the divisional office.



## Stock Account

→ All transactions of receipt and issues of materials are recorded day to day in the 'Register of Stock Receipts and Issues' in form 8 in the order of their occurrence as soon as they take place. The account maintained separately for every month and closed once in a month usually 25th of every month, except in the month of March when it closed on the 31st March for a big stock when there are large number of transactions of receipts issues may be maintained, one for receipts and one for issues, instead of making entries in the same register in continuation.

→ On closing of the monthly account "Abstract of Stock Receipts" is prepared in form 9 and a single "Abstract of Stock Issues" is prepared in form 10 & submitted by S.D.O or A.E in charge of store to the Divisional Officer for inclusion in the monthly Divisional account. The monthly returns (Abstract) of stock receipts and issues are then posted in the division in the "Half-yearly Register of Stock" in form 12.

→ Half-yearly balance returns of stock for every six months for the periods ending 30th Sept and 31st March are also prepared in form 11 by the S.D.O or A.E in charge of store from the monthly accounts.