



PNS SCHOOL OF ENGINEERING & TECHNOLOGY

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**LECTURE NOTES
ON
ESTIMATING & COSTING ENGINEERING**

DEPARTMENT OF CIVIL ENGINEERING

5TH SEMESTER

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SEPTIC TANK

In rural areas, in factories and in unsewered urban and semi-urban areas where adequate water supply is available from pipe, well or any other source, septic tank is suitable for disposal of night soil. Water is required for the flow of the night soil from latrine to the septic tank and for the functioning of septic tank. Septic tank is so designed that the sewage is retained in the tank for 24 hours during which period certain biological decomposition by the action of anaerobic bacteria takes place which breaks and liquifies the night soil leaving small quantity of solid which settles in the form of sludge at the bottom of the tank and clear water flows out of the septic tank. The effluent from the domestic septic tank is usually disposed by absorption in soil through soakpit or subsoil drains. In bigger septic tank the effluent from the tank should further be treated or purified by sprinkling or contact bed filter or by aeration, and then let off into 'nala' or drain. The effluent of the septic tank may also be discharged into open drain after disinfection by treating with chlorine or bleaching powder in a small chamber outside the septic tank. No disinfectant as bleaching powder, phenyl, etc., should be used in cleaning latrines as the disinfectant entering the septic tank kills the bacteria growth and retard the action of biological decomposition. After every use of the latrine it should be flushed with about 14 litres (3 gallons) of water from a flushing cistern or by sudden hand pouring of a bucket of water. Domestic water, paper, kitchen water and surface water should not be allowed to drain into the septic tank.

SEPTIC TANK FOR 50 USERS

All Dimensions are in Centimeter except otherwise mentioned

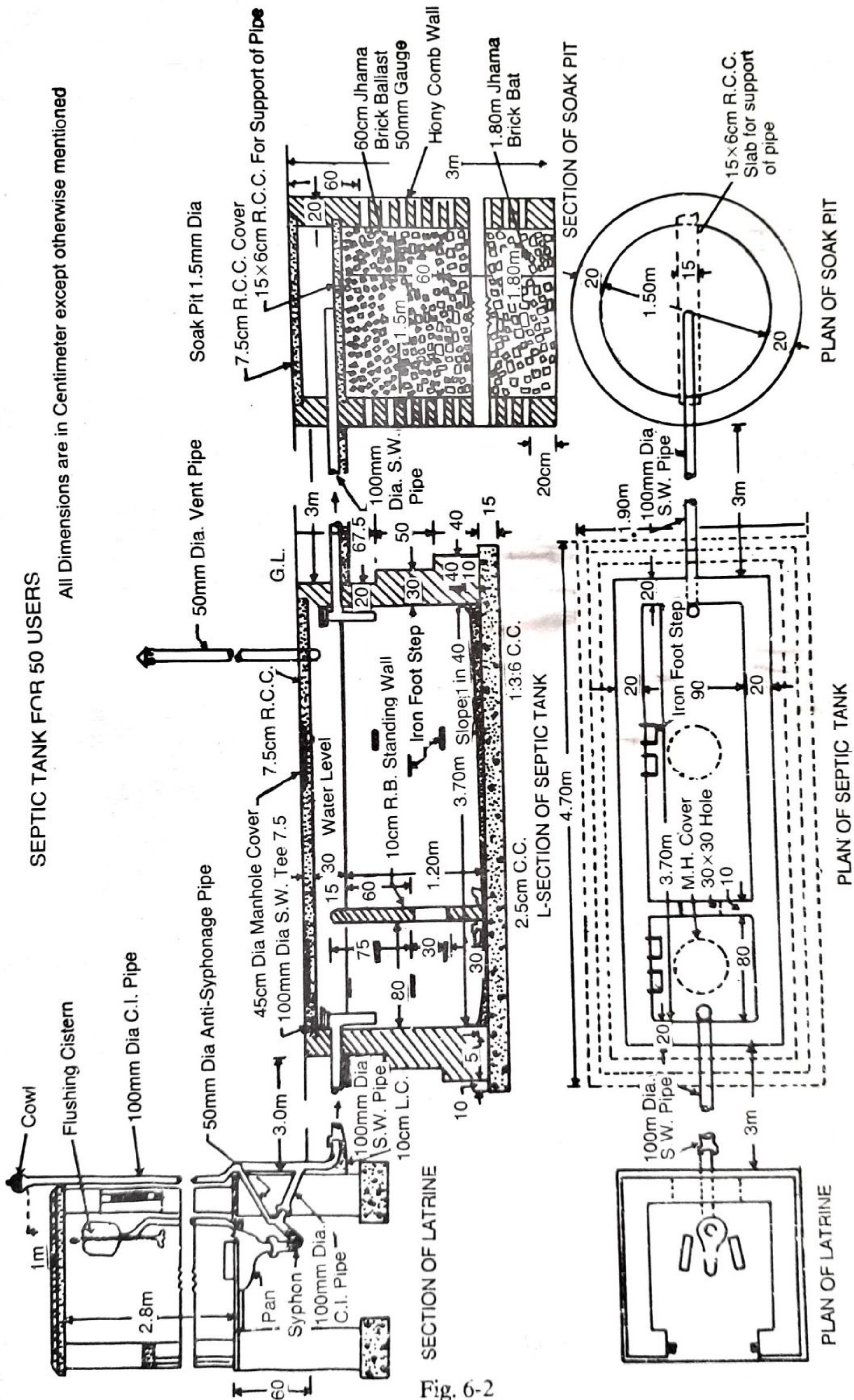


Fig. 6-2

Details of Measurement and Calculation of Quantities (Ex. 1)

Item No.	Particulars of items and details of works	No.	Length m	Breadth m	Height or Depth m	Quantity	Explanatory notes
1	Septic Tank and Soak-pit— Earthwork in Excavation— Septic Tank ...	1	4.70	1.90	1.725	15.41	cu m
	Soak pit ...	1	$\pi \times (1.9)^2$	$\times 3.00$	—	8.50	
			4		Total	23.91	
2	Cement concrete 1:3:6 in foundation of septic tank ...	1	4.70	1.90	0.15	1.34 cu m	
3	I-class brick-work in 1:4 cement mortar in septic tank— Long walls— 1st footing ...	2	4.50	0.40	0.40	1.44	No deduction for bearing of slab.
	2nd footing ...	2	4.30	0.30	0.50	1.29	
	3rd footing up to top ...	2	4.10	0.20	0.675	1.11	
	Short walls— 1st footing ...	2	0.90	0.40	0.40	0.29	
	2nd footing ...	2	0.90	0.30	0.50	0.27	
	3rd footing up to top ...	2	0.90	0.20	0.675	0.24	
					Total	4.64 cu m	
	4	R.B. work in partition wall with 1:3 cement mortar in septic tank including reinforcement complete work ...	1	0.90	0.10	1.35	
5	R.C.C. work in septic tank and soak-pit including reinforcement complete work— Slab cover of septic tank ...	1	3.90	1.10	0.075	0.322	

(Contd.)

SEPTIC TANK FOR 50 USERS

Item No.	Particulars of items and details of works	No.	Length m	Breadth m	Height or Depth m	Quantity	Explanatory notes
6	Slab cover of soak pit ...	1	$\pi \times (1.7)^2$	×	0.075	0.170	
	R.C.C. support of pipe in soak pit ...	1	4				
		1	1.70	0.15	0.06	0.015	
					Total	0.507 cu.m	
	12 mm plastering inside septic tank with 1:2 cement mortar mixed with water proofing compound—						
	Long walls ...	2	3.70	—	1.50	11.10	
Short walls ...	2	0.90	—	1.50	2.70		
Partition walls both sides ...	2	0.90	—	1.35	2.43		
Partition walls top	1	0.90	—	0.10	0.09		
				Total	16.32	sq m	
7	C.C. floor 1:2:4, 5 cm average thickness ...	1	3.70	0.90	—	3.33	sq m
8	II class brickwork in 1:6 cement mortar in soak-pit (Honey comb wall as solid) ...	1	$\pi \times 1.70$	$\times .20 \times$	3.00 =	3.20 cu m	Mean circumference.
9	Jhama brick ballast 10 mm size inside soak-pit (upper layer) ...	1	$\pi \times 1.5^2$	$\times 0.60$	—	1.06 cu m	
			4				
10	Jhama brick bats inside soak-pit (lower layer) ...	1	$\pi \times 1.5^2$	$\times 1.80$	—	3.18 cu m	
			4				
11	C.I. Manhole cover 45 cm Dia. over septic tank ...	2	—	—	—	2 Nos.	
12	Iron foot steps septic tank ...	8	—	—	—	8 Nos.	

ESTIMATING AND COSTING

Item No.	Particulars of items and details of works	No.	Length m	Breadth m	Height or Depth m	Quantity	Explanatory notes
13.	Sanitary works— W.C. Indian pattern 50 cm white glazed pan with Syphon and with 13.5-litre C.I. Flushing cistern (E.L.C.) with brackets and 32 mm Dia. G.I. telescopic flush pipe painted two coats and with chain foot rests complete supply and fixing ...	1	—	—	—	1 set	Flushing cistern telescopic pipe foot rests, etc., each may also be taken as separate items.
14.	S.W. (stone-ware) pipe 100 mm dia. laid over 10 cm. L.C. including digging, laying, jointing, testing, etc., complete— Connecting latrine with septic tank ...	1	3.00	—	—	3.00	
	Connecting septic tank with soak-pit ...	1	4.00	—	—	4.00	
15	S.W. Tee 100 mm dia. at the inlet and outlet of septic tank	2	—	—	Total	7.00 m	
16	C.I. Heavy Soil Pipe 100 mm dia. connecting latrine seat, vent pipe including fixing with lead jointing—	1	5.00	—	—	5.00 m	
17	C.I. Heavy Soil Pipe 50 mm dia. complete with lead jointing--connecting latrine pan with vent pipe ...	1	0.60	—	—	0.60	
	Vent pipe for septic tank ...	1	3.00	—	—	3.00	
18	C.I. Cowl 100 mm dia in latrine ...	1	—	—	Total	3.60 m	
19	C.I. Cowl 50 mm dia. for septic tank vent pipe ...	1	—	—	—	1 No.	
		1	—	—	—	1 No.	

SEPTIC TANK FOR 50 USERS

Item No.	Particulars of items and details of works	No.	Length m	Breadth m	Height or Depth m	Quantity	Explanatory notes
20	250-litre G.I. Tank of 20 B.W.G. Sheets with 45 cm dia. raised hinged cover with locking arrangement and fitted with 15 mm dia. brass ballcock supplying and fixing in position complete	1	—	—	—	1 No.	
21	15 mm dia. G.I. Pipe with fittings including digging, laying, clamping complete. Connecting G.I. tank with water main	1	15.00	—	—	15.00	L=10.00+.60+2.80 +1.00+.60 extra =15.00 m
	Connecting Flushing cistern from G.I. tank	1	2.00	—	—	2.00	
	Connecting water tap from G.I. tank	1	4.50	—	—	4.50	Top on outside wall.
					Total	21.50 m	
22	15 mm dia. Brass stop-cock (one for G.I. tank and one for flushing cistern) supplying and fixing	2	—	—	—	2 Nos.	
23	15 mm dia. Brass bib cock supplying and fixing	1	—	—	—	1 No.	
24	Brass Ferrule 6 mm dia. supplying and fixing	1	—	—	—	1 No.	

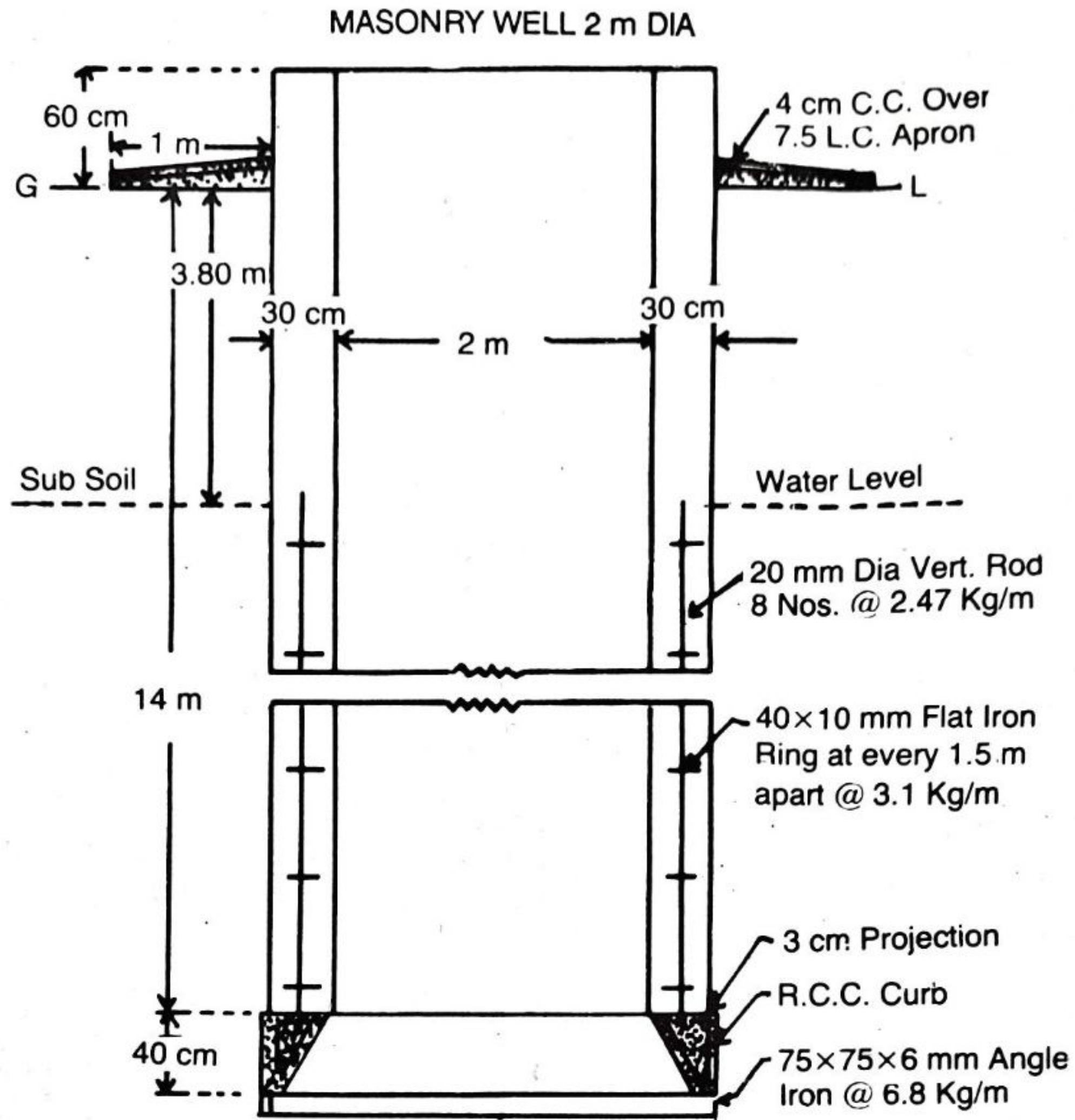


Fig. 8-15

Details of Measurement and Calculation of Quantities (Ex. 8)

Item No.	Particulars of items of works	No.	Length m	Breadth m	Ht. or Depth m	Quantity	Explanatory notes
1	Earthwork in excavation up to sub-soil water level						
	(i) up to 1.50 m depth ...	1	$\frac{\pi \times 2.66^2}{4}$	×	1.50	8.34 cu m	Outer diameter = 2.00 + .30 × 2 + .03 × 2 = 2.66 m
	(ii) 1.50m to 3.00m depth	1	$\frac{\pi \times 2.66^2}{4}$	×	1.50	8.34 cu m	
(iii) 3.00m to 3.80m depth	1	$\frac{\pi \times 2.66^2}{4}$	×	0.80	4.45 cu m		

Item No.	Particulars of items	No.	Length m	Breadth m	Ht. or Depth m	Quantity	Explanatory notes
2	R.C.C. Work in curb including steel— (Sectional area × mean length at (C.G.) ...	$\frac{1}{2} \times$	$(.33 \times .40)$	$\times (\pi \times 2.44) =$		0.506 cu m	Mean dia. of C.G. of triangular section = $2.00 + 2$ $\times \frac{2}{3} \times .33 = 2.44$ m
3	Iron Work— Angle iron 75×75×6 mm @ 6.8 kg in curb ...	1	$(\pi \times 2.66)$	$\times 6.8$ kg	=	56.84 kg	L = outer circumference 8 no. rods 40 cm extra
	Vertical tie rods 20 mm dia. @ 2.47 kg ...	8×	10.60×2	.47 kg	=	209.45 kg	L = 14 — 3.8 + .4 = 10.6 m
	Flat iron ring of 40×10 mm @ 3.1 kg ...	8×	$(\pi \times 2.30 \times 3.1)$		=	179.30 kg.	L = Mean circum- ference = $\pi \times 2.30$ m
	No. = $(\frac{14.0 - 3.8}{1.5}) + 1 = 8$				Total	445.6 kg = 4.46 q	
4	I-class brickwork in well steining in 1 : 6 cement mortar ...	1	$(\pi \times 2.30)$.30	14.60	31.67 cu m	S = Mean circumference = $\pi \times 2.30$ m
5	Cement pointing 1 : 6— inside ...	1	$(\pi \times 2.00)$	\times	14.60	91.80	
	Outside above G.L. ...	1	$(\pi \times 2.60)$	\times	0.485	3.96	Ht. above apron
	Top of wall ...	1	$(\pi \times 2.30)$	$\times .30$	=	2.17	L = Mean circumference
					Total	97.93	sq m
6	4 cm C.C. over 7.5 cm L.C. apron (floor) ...	1	$(\pi \times 3.60)$	\times	1.00	11.30	Mean diameter = 2.6 + 1.0 = 3.60 m
7	Sinking of well— below springing (sub-soil water) level—						
	(i) upto 1.50 m below springing level ...	1	—	—	1.50	1.50 r m	
	(ii) 1.50 m to 3.00 m below springing level	1	—	—	1.50	1.50 r m	
	(iii) 3.00 m to 6.00 m below springing level	1	—	—	3.00	3.00 r m	
	(iv) 6.00 m to 9.00 m below springing level	1	—	—	3.00	3.00 r m	
	(v) 9.00 m to 10.20 m below springing level	1	—	—	1.20	1.20 r m	

ABSTRACT OF COST (Ex. 8)

Item No.	Particulars of items of work	Quantity	Unit	Rate		Per	Cost	
				Rs.	P.		Rs.	P.
1	Earthwork in excavation—							
	(i) up to 1.5 m depth ...	8.34	cu m	350.00		% cu m		29.19
	(ii) 1.50 m to 3.00 m depth ...	8.34	cu m	400.00		% cu m		33.36
	(iii) 3.00 m to 3.80 m depth ...	4.45	cu m	450.00		% cu m		20.03
2	R.C.C. work including steel in curbs ...	0.506	cu m	675.00		/ cu m		341.55
3	Iron work—angle, tie rods and flat iron rings ...	4.46	q	515.00		/ quintal		2296.90
4	Ist class brickwork in 1 : 6 cement mortar ...	31.67	cu m	340.00		/ cu m		10767.80
5	Cement pointing 1 : 2 cement mortar ...	97.93	sq m	5.60		/ sq m		548.41
6	4 cm c.c. 1 : 2 : 4 over and including 7.5 cm L.C. apron ..	11.30	sq m	28.00		/ sq m		316.40
7	Sinking well below sub-soil water level—							
	(i) Up to 1.5 m below springing level	1.50 m	r m	150.00		/ r m		227.50
	(ii) 1.50 m to 3.00 m below springing level ...	1.50 m	r m	130.00		/ r m		195.00
	(iii) 3.00 m to 6.00 m below springing level ...	3.00 m	r m	175.00		/ r m		525.00
	(iv) 6.00 m to 9.00 m below springing level ...	3.00 m	r m	245.00		/ r m		735.00
	(v) 9.00 m to 10.20 m below springing level ...	1.20 m	r m	315.00		/ r m		378.00
						Total ...		16414.14
	Add 3% for Contingencies					...		492.42
	Add 2% for Workcharged Establishment					...		328.28
						Grand Total ...		17234.84

Note.—(1) Item 4 may also be calculated as a hollow cylinder, whole volume—inner volume

$$= \left(\frac{\pi \times 2.6^2}{4} - \frac{\pi \times 2.0^2}{4} \right) \times 14.6 = (5.31 - 3.14) \times 14.6 = 31.68 \text{ cu m.}$$

TUBE WELL

Tube well consists of galvanised iron pipe sunk into the water bearing strata of coarse sand with strainer of the required length placed in the water bearing strata. For construction of small dia. tube well in soft soil bore of bigger diameter than the tube well pipe is made by sinking casing pipe with a cutter at its end, to the required depth. During boring samples of soil of different nature as they come out are collected and the thickness of different layer is noted and a soil chart is prepared showing the different strata. When the proper water bearing strata is reached the strainer is lowered and then the tube well pipe is lowered gradually with proper jointing and the casing pipe is gradually withdrawn and removed. The sinking of casing pipe may be done either by percussion boring or by rotary boring each of them may be carried on in a number of ways. Percussion boring method is generally used when soil is soft as clay, loam, sand, etc. For hard soil special types of cutters are used to cut and drill hole. The strainer consists of perforated or slotted pipe wrapped with fine brass wire netting. Strainer allows water to enter into the well but not the sand. Coarse sand is usually inserted all round the strainer before the casing pipe is lifted. For ordinary tube well hand pump is fitted to draw water. When the sub-soil water level is at a greater depth deep well hand pump is used and the pump plunger is fitted in a gun metal or brass cylinder near the sub-soil water level with a long rod. Two illustrations on estimate of tube wells are given in pages 321-323, the following pages.

For large dia. tube well, bore of bigger diameter is made by drilling and sinking a pipe attached with a cutter at its end. The cutter cuts and makes a bore of bigger dia. than the tube well pipe and strainer. Cowdung mixed with mud and water is injected into the bore, if required, to keep the sides of bore intact. After the required depth having water bearing strata has been reached the boring pipe with cutter is lifted out and the tube well pipe with strainer and housing pipe is inserted in position.

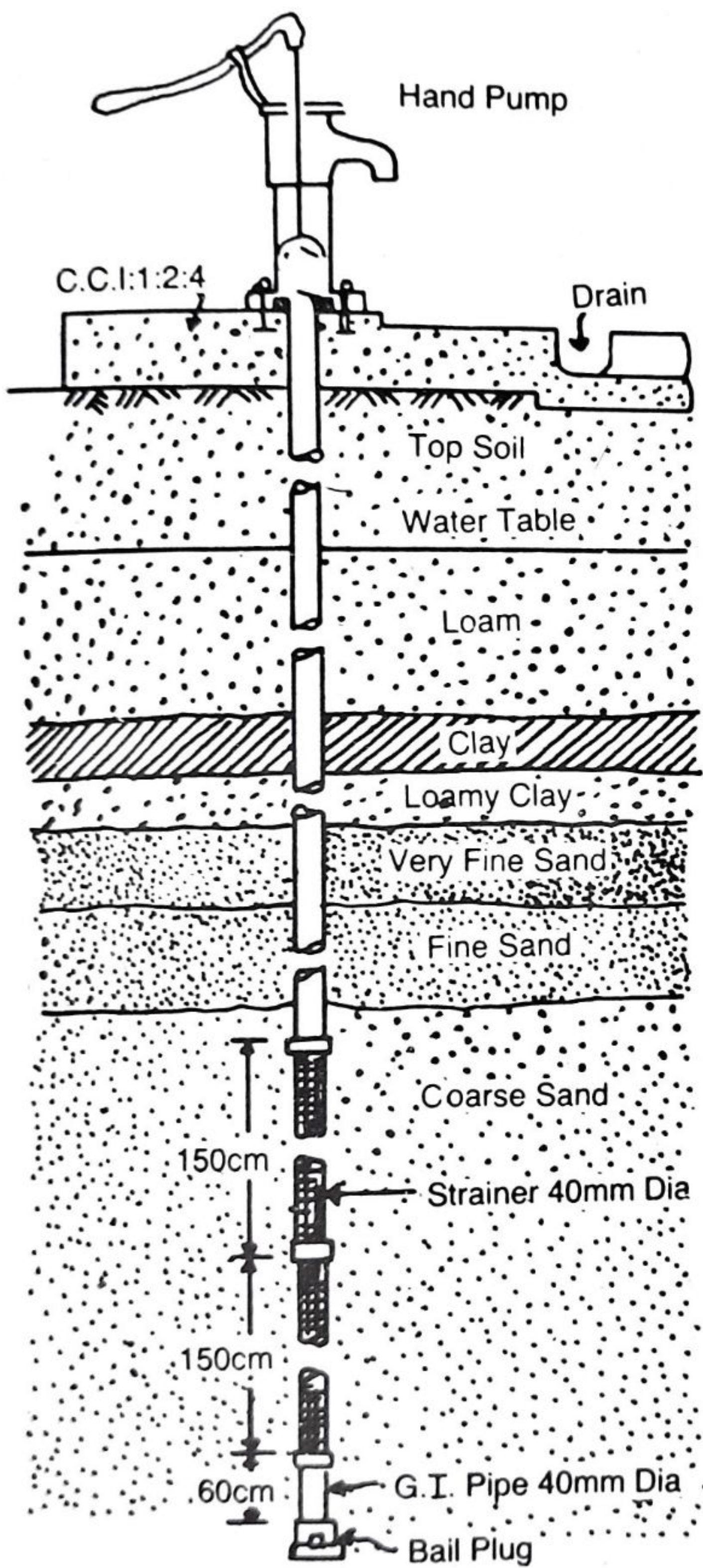


Fig. 6-18

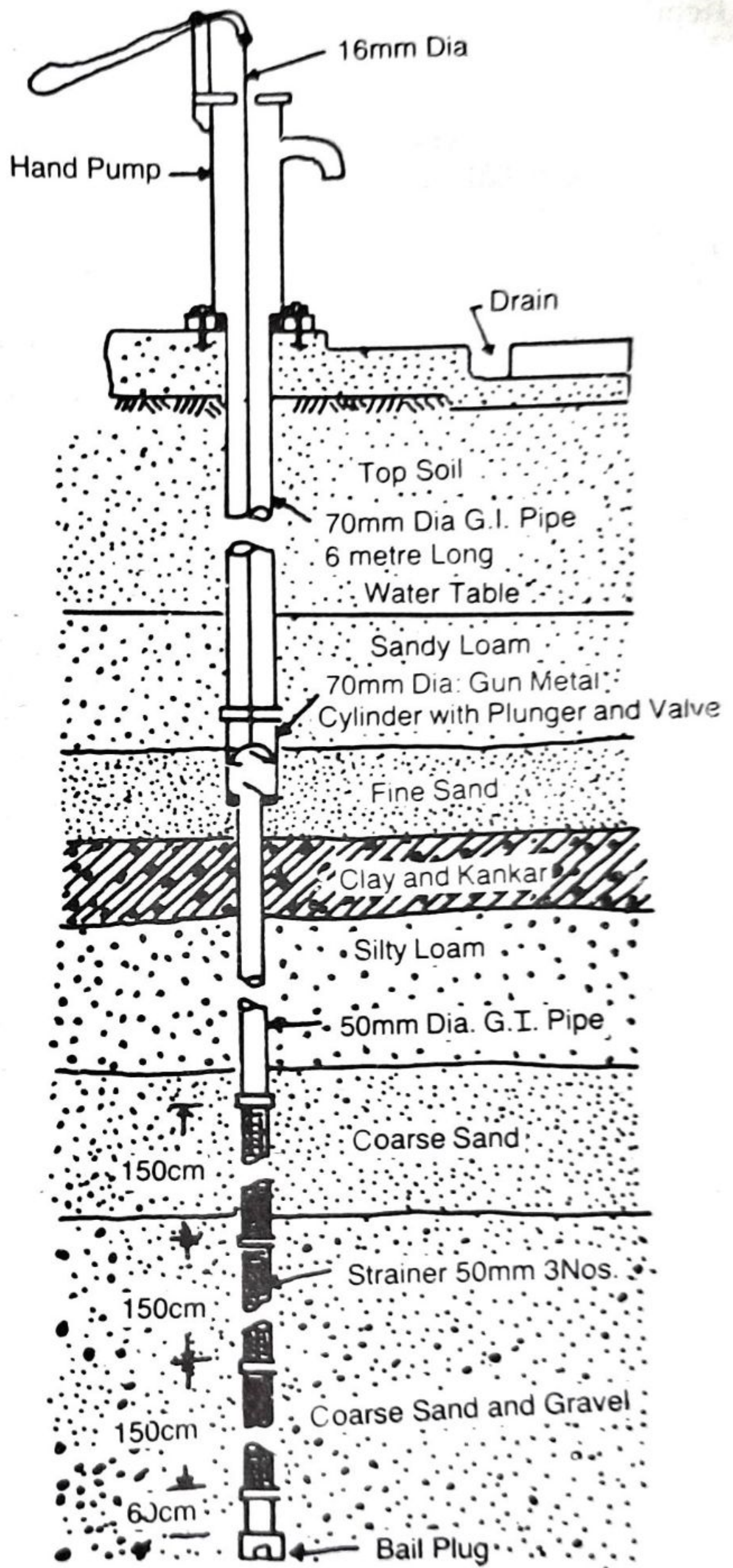


Fig. 6-19

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

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

Bill of Quantities and Cost (Ex. 9)

Item No.	Particulars of Items	Quantity	Rate		Amount	
			Rs.	P.	Rs.	P.
1	40 mm dia. Galvanised Iron (G.I.) Pipe including sockets (20 cm above G.L.) ...	37.20 m	8.50 per		316.10	
			r m			
2	40 mm dia. strainer 2 nos. 1.50 m each ...	2 nos	42.00 each		84.00	
3	Hand pump ordinary (No. 4 Hand pump) ...	1 no.	35.00 each		35.00	
4	Bail plug ...	1 no.	5.50 each		5.50	
5	Sockets 4 nos. extra ...	4 nos.	2.00 each		8.00	
6	Transport of materials to site of work ...	L.S.	10.00 L.S.		10.00	
7	Sinking —Boring with 60 mm dia. casing type including water arrangements lowering the 40 mm dia. tube well pipe and strainer including jointing and with drawing casing pipe —					
	(i) 0 to 20 metre ...	20.00 m	7.00 per		140.00	
			r m			
	(ii) Below 20 m to 30 m ...	10.00 m	11.00 per		110.00	
			r m			
	(iii) Below 30 m to 40 m ...	10.00 m	15.50 per		155.00	
			r m			
8	Inserting coarse sand surrounding the strainer including supply of sand ...	1 no.	11.00 each		11.00	
9	Fixing and erecting of hand pump in position including holding down bolts ...	1 no.	5.50 each		5.50	
10	Cement concrete platform and foundation surface finished smooth ...	1 no.	35.00 each		35.00	
11	Cement concrete drain 2 metre long finished smooth ...	2.00 m	6.50 per		13.00	
			r m			
12	Pumping out water till clear water is obtained ...	1 no.	11.00 each		11.00	
			Total ...		939.10	
Add 5% for Contingencies and Workcharged Establishment ...					46.95	
			Grand Total ...		986.05	

ESTIMATE OF 50 MM Dia. TUBE WELL WITH DEEP HAND PUMP

Example 10. — Prepare an estimate of 50 mm dia. tube well 100 metre deep with deep well pump from the given drawing (Fig. 6-19). The strainer will consist of 3 pieces of 1.50 metre each. The housing pipe consist of 70 mm dia. G.I. pipe 6 metre in length.

Assume suitable rates.

Bill of Quantities and Cost (Ex. 10)

Item No.	Particulars of Items	Quantity	Rate		Amount	
			Rs.	P.	Rs.	P.
1	50 mm dia. galvanised iron (G.I.) pipe ...	94.00 m	11.50 per r m		1081.00	
2	70 mm dia. G.I. housing pipe ...	6.00 m	23.00 per r m		138.00	
3	50 mm dia. strainer 3 nos. 1.50 m each ...	3 nos.	55.00 each		165.00	
4	74 mm dia. gun metal cylinder with valve and plunger ...	1 no.	100.00 each		100.00	
5	Head pump with extra length of 16 mm dia. connecting rod ...	1 no.	45.00 each		45.00	
6	Bail plug ...	1 no.	7.50 each		7.50	
7	Sockets 4 nos. extra ...	4 no.	2.50 each		10.00	
8	Transport of materials to site of work ...	1 Job	20.00 L.S.		20.00	
9	Sinking —Boring with 70 mm dia. casing pipe including water arrangements, lowering the 50 mm dia. tube well pipe and strainer including jointing and withdrawing of casing pipe —					
	(i) 0 to 20 metre ...	20 m	7.50 per r m		150.00	
	(ii) Below 20 m to 35 m ...	15 m	11.00 per r m		165.00	
	(iii) Below 35 m to 50 m ...	15 m	15.50 per r m		232.50	
	(iv) Below 50 m to 65 m ...	15 m	20.00 per r m		300.00	
	(v) Below 65 m to 80 m ...	15 m	24.00 per r m		360.00	
	(vi) Below 80 m to 95 m ...	15 m	28.50 per r m		427.50	
	(vii) Below 95 m to 100 m ...	5 m	33.00 per r m		165.00	
10	Inserting coarse sand surrounding the strainer including supply of sand ...	1 Job	20.00 L.S.		20.00	
11	Fixing and erecting hand pump in position including holding down bolts ...	1 Job	10.00 L.S.		10.00	
12	Cement concrete platform and foundation, surface finished smooth ...	1 Job	30.00 L.S.		30.00	
13	Cement concrete drain 3 metre long finished smooth ...	3.00 m	9.00 per r m		27.00	
14	Pumping out water till clear water is obtained ...	1 Job	15.00 L.S.		15.00	
			Total ...		3468.50	
	Add 5% for Contingencies and Workcharged Establishment ...				173.42	
			Grand Total ...		3641.92	