State Council for Technical Education & Vocational Training

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LECTURE NOTES
ON
Estimation and Cost Evaluation-II (Th.5)
Diploma 5th Semester

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SYLLABUS

1. **Detailed estimate of culverts and bridges**
    1.1 Detailed estimate of a RCC slab culvert with right angled wing walls with bar bending schedule.
    1.2 RCC Hume pipe culvert with splayed angled wing wall

2. **Estimate of irrigation structures**
    2.1 Detailed estimate of simple type of vertical fall to given specification
    2.2 Detailed estimate of drainage siphon to given specification.

3. **Detailed estimate of roads**
    3.1 Detail estimate of a water bound macadam road
    3.2 Detailed estimate of a flexible pavement in cutting / filling
    3.3 Detailed estimate of septic tank and soak pit for 50 users

4. **Miscellaneous estimates**
    4.1 Tube well, Piles and Pile cap, Isolated and combined footings.

5. **PWD Accounts works**
    5.1 Works
        5.1.1 Classification of work-original, major, petty, repair work, annual repair, special repair, quadrantal repair.
        5.1.2 Concept of Method of execution of works through the contractors and department, contract and agreement, work order, types of contract, piece work agreement.
    5.2 Accounts of works –
        5.2.1 Explanation of various terms Administrative approval, technical sanction, tender, preparation of notice inviting tender, quotations, earnest money, E-tendering, security deposit, advance payment, intermediate payment, final payment, running bill, final bill, regular and temporary establishment, cash, major & subhead of account, temporary advance (imprest money),supervision charges, suspense account, debit, credit, book transfer, voucher and related accounts .
        5.2.2 Measurement book use & maintenance, procedure of marking entries of measurement of work and supply of materials, labour employed, standard measurement books and common irregularity
        5.2.3 Muster roll : Its preparation & use for making payment of pay & wages
        5.2.4 Acquittance Roll : Its preparation & use for making payment of pay & wages
        5.2.5 Labour & labour report, method of labour payment, use of forms and necessity of Submission
        5.2.6 Classification of stores, receipt / issue statement on standard form, method of preparation of stock account, preparation and submission of returns, verification of stocks, shortage and excess
    5.3 Building BYLAWS and REGULATORY Bodies, Development authorities, types and their levels, RERA etc.

1. DETAILED ESTIMATE OF CULVERTS AND BRIDGES

Culvert

What is a Culvert?
- ❖ *Culvert* is a tunnel carrying a stream under a road or railway. A culvert may act as a bridge for traffic to pass on it. They are typically found in a natural flow of water and serves the purpose of a bridge or a current flow controller.
- ❖ Culvert is provided under roads and highways for a crossing of water, as road embankment cannot be allowed to obstruct the water flow. The culvert is ideally suited for a road to limit water flow in a controlled way.
- ❖ The culvert mainly consists of abutment, wing walls, arches or desk slab, parapet and foundation. Floor pitching from inside the culvert in the bed of drain may or may not be provided, it depends on the soil condition and flow velocity of the stream water.

Types of Culvert:

Culverts are available in many and shape like round, elliptical, flat-bottomed, pear-shaped, and box-like constructions. Culverts are by their load and water flow capacities, lifespan and installation of bedding and backfill. The type is based on a number of factors including hydraulic, upstream elevation, and roadway height and other conditions.

Following are the different types of Culvert:
- ❖ Pipe culvert (single or multiple)
- ❖ Pipe-Arch culvert (single or multiple)
- ❖ Box culvert (single or multiple)
- ❖ Arch culvert
- ❖ Bridge culvert
- ❖ Metal box culvert

Pipe Culvert

Pipe culverts are the most common types of culverts due to competitive price and easy installation. They are found in different shapes such as circular, elliptical and pipe arch. Generally, their shapes depend on site conditions and constraints. Pipe culverts on a small scale represent normal pipes like concrete pipes.

Pipe-Arch Culvert (Single or Multiple)

Arch culverts are suitable for large waterway opening where fishes can be provided with a greater hydraulic advantage. Moreover, they provide low clearance and are definitely, much artistic. Pipe arches are particularly useful for sites where headroom is limited and also have a hydraulic advantage at low flows.

Box Culvert

Box culverts are made up of concrete and especially, RCC (Reinforced Concrete). The most challenging part in constructing a box culvert is that dry surface is needed for installing it. However, due to the strength of the concrete floor, water direction can be changed when a large amount of water is expected. This feature makes box culverts, one of the most commonly found types of the culvert.

Arch Culvert

An arch culvert is made up of metal, stone masonry, concrete, RCC etc. Construction does not take a lot of time and unlike box culvert, water diversion is not necessary, as it can be installed without disturbing the water current. Thus, it can be termed as a Low Profile Culvert. This type of culvert maintains the natural integrity of the wash bed.

Bridge Culvert

Bridge culverts serve a dual purpose. It acts both as a bridge and a culvert. Generally, rectangular in shape, bridge culverts are constructed on rivers and canals. A foundation is laid under the ground level and pavement surface is laid on top of the series of culverts. Generally, we can term it as a Multi-Purpose culvert.

Metal Box Culvert

The metal box culvert is the economic alternative of the bridge. These bridges are manufactured from a standard structural plate or deep-corrugated structural plate. They are the perfect bridge replacement maintaining the same road grade level.
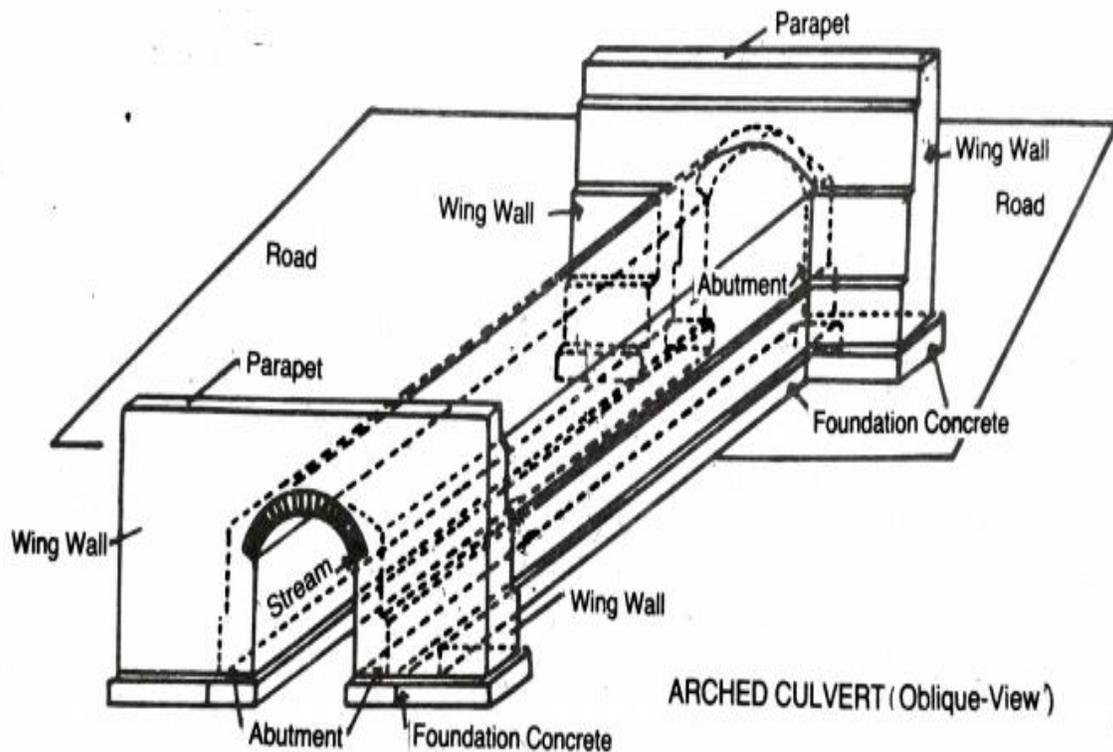

Fig: Component of Arch Culvert

Example:

Prepare a detailed estimate of a slab of a culvert of 1.5 m span and 4.00 m roadway from the given drawing. The general specifications are as follows:-

Foundation concrete shall be of cement 1:3:6 with stone ballast and coarse sand. Masonry shall be of first class brickwork in 1:4 cement coarsed 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 other suitable data.
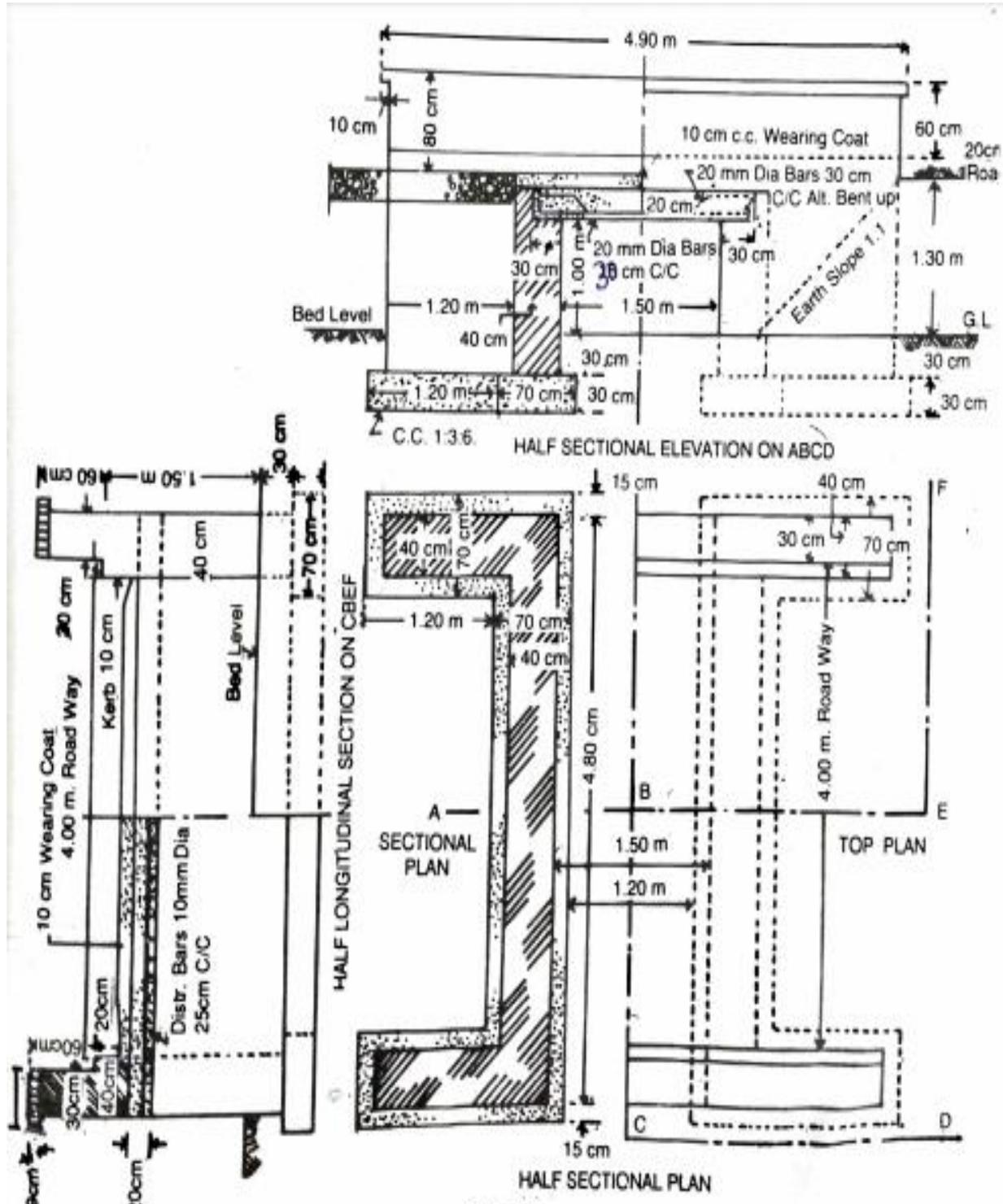
Fig. 8-5

Details of Measurement and Calculation of Quantities:-

Item No.	Particulars of Items of works	No.	Length	Breadth	Height or Depth	Quantity	Explanatory notes
1	Earthwork in excavation in foundation						
	Abutments	2	5.1	0.7	0.6	4.28	
	Wings walls	4	1.2	0.7	0.6	2.02	
					Total	6.30	cu m
2	Cement concrete 1:3:6 in foundation with stone ballast						
	Abutments	2	5.1	0.7	0.3	2.14	
	Wings walls	4	1.2	0.7	0.3	1.01	
					Total	3.15	cu m
3	I-class brick work in 1:4 cement mortar						
	Abutments	2	4.8	0.4	1.5	5.76	Upto top of R.C.C slab
	Wings walls	4	1.2	0.4	1.5	2.88	
	Parapets upto kerb	2	4.7	0.4	0.3	1.13	Above R.C.C slab up to kerb
	Parapets above kerb	2	4.7	0.3	0.5	1.41	Above kerb excluding coping
	Parapet coping	2	4.9	0.4	0.1	0.39	
					Total	11.57	
	Deduction-						
	Bearing of R.C.C slab in abutment	2	4.8	0.3	0.2	0.58	
					Net Total	10.99	cu m
4	R.C.C work 1:2:4 inslab excluding steel and its bending but including centering, shuttering and binding steel	1	4.8	2.1	0.2	2.02	cu m
5	Steel bars including bending in R.C.C work-						
	20 mm dia. Bars -						
	Main straight bars 30 cm c/c	17	2.38			40.46 m	L=2.1-2 side covers+2 hooks =2.1-(2*.04)+(18*0.02)=2.38 m
	Main bent up bars 30 cm c/c	16	2.54			40.64	Adding one depth , 16 cm for two bent ups L=2.38+0.16=2.54m
			Total	81.10m	2.47 kg / m	200.32 kg	
	10 mm dia. Bars-						
	Distributing bottom bars 25 cm	9	4.9			44.10 m	L=4.8-(2*0.04)+(18*0.01)=4.9m
	Distributing top bars	4	4.9			19.6 m	
			Total	0 m @ 0.62 kg		39.49 kg	

|					Total	239.81 kg	
6	Cement concrete 1:2:4 wearing	1	4	2.3	0.1	0.92	cum
7	Cement pointing 1:2 in walls						
	Face wall from 10 cm below G.L up to bottom of coping	2	4.7		2.1	19.74	
	Inner side of parapet excluding coping	2	4.7		0.8	7.52	H=20+10+50=80 cm
	Coping (inner edge, top , outer edge and outer and side)	2	4.9	0.7		6.86	
	Ends of parapet	4		0.4	0.2	0.32	
	Ends of parapet	4		0.3	0.5	0.6	
	Ends of coping	4		0.4	0.2	0.32	
					Total	35.36	
	Deduction-						
	Rectangular opening	2	1.5		1.3	3.9	
	Triangular portion below earth slope	2	5*1.3*1.3			1.69	
					Total deduction	5.59	
					Net Total	29.77 sqm	

Detailed estimate of a RCC Hume pipe culvert with splayed angled wing wall:-
 Example:-
  Prepare a detailed estimate of Hume pipe Culvert of three pipes each of 60 cm diameter from the given plan and elevations . Foundation concrete shall be of 1:4:8 shall be pointed with 1:2 cement sand mortar .
  Assume suitable data.
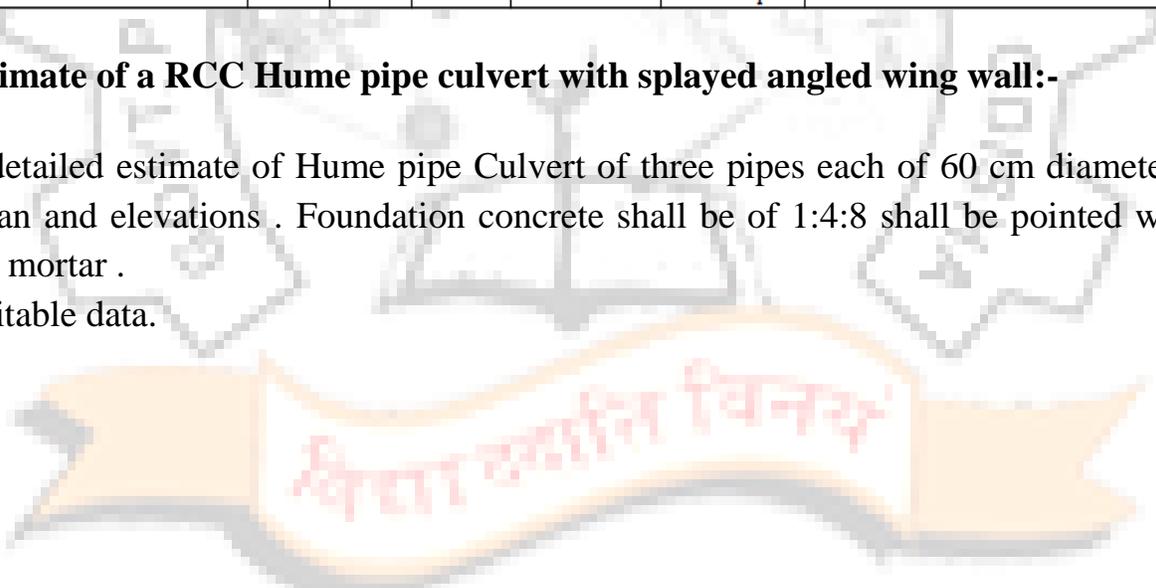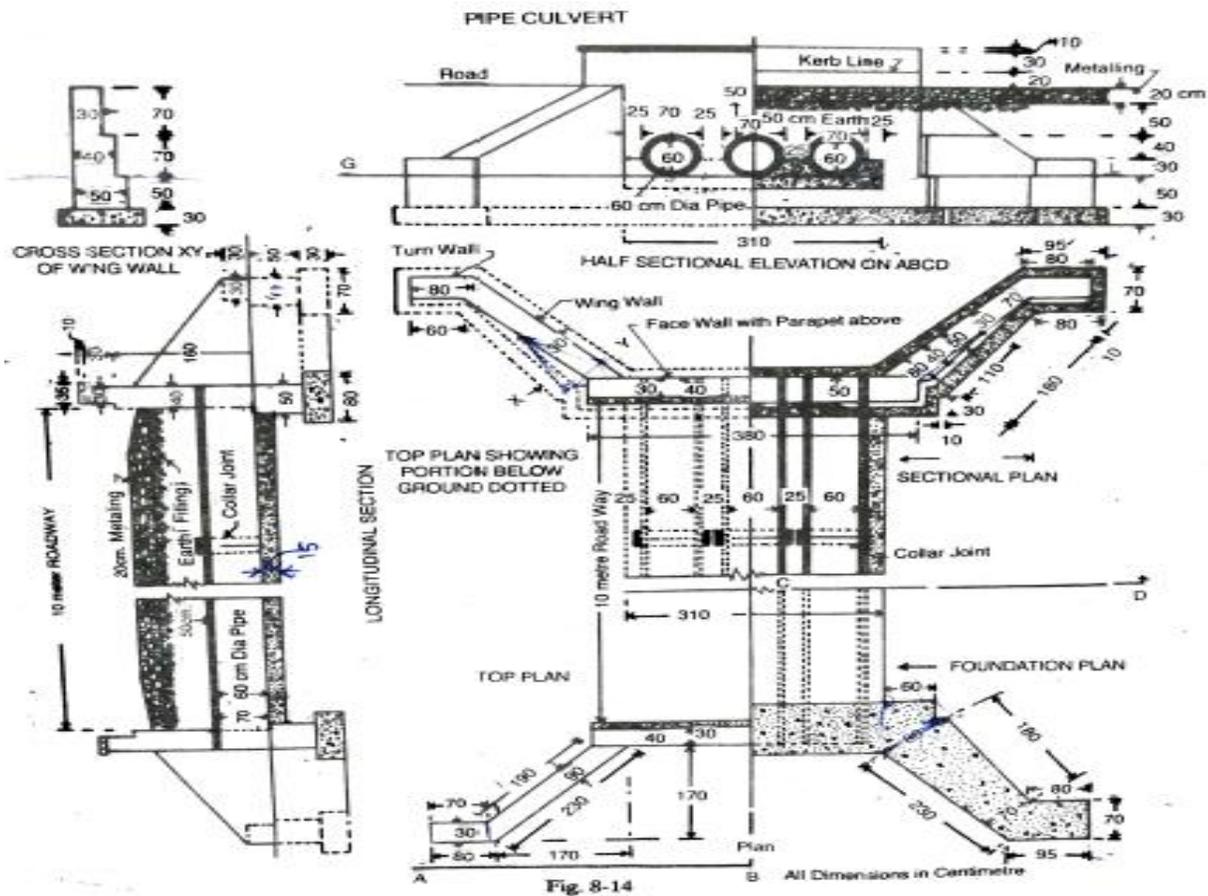
PIPE CULVERT

Fig. 8-14

Details of Measurement and Calculation of Quantities:-

Item No.	Particulars of Items of works	No.	Length	Breadth	Height or Depth	Quantity	Explanatory notes
1	**Earthwork in excavation in foundation**						
	Face walls	2	3.10	0.80	0.80	3.97	
	Wing walls inclinded portion	4	(2.3+1.8)/2	(0.8+0.7)/2	0.80	4.92	Avg. length and avg. breadth
	Wing walls triangular corner	4	(0.5*0.6*0.8)		0.80	0.77	Area of triangle
	Turn walls	4	(0.95+0.80)/2	0.70	0.80	1.96	Avg. length
	Under pipe	1	9.80	3.10	0.15	4.56	
					Total	16.18	cum

2	**Cement concrete 1:4:8 in foundation**					
	Face walls	2	3.10	0.80	0.30	1.49	
	Wing walls inclinded portion	4	(2.3+1.8)/2	(0.8+0.7)/2	0.30	1.85	
	Wing walls inclinded portion	4	(0.5*0.6*0.8)		0.30	0.29	
	Turn walls	4	(0.95+0.80)/2	0.70	0.30	0.74	
	Under pipe and in between pipe up to half height	1	9.80	3.10	0.50	15.19	Thickness=15+70/2 = 50cm =0.50m
					Total	19.56	cum
	Deduct half of pipes	3	9.80*0.5*3.14*.7^2/4			5.66	
					Net Total	**13.90**	cum
3	**First class brickwork in 1:6 cement sand mortar-**						
	Face walls-						
	Footing-50 cm breadth	2	4.00	0.50	0.50	2.00	Breadth means thickness of wall.
	Above footing 40 cm breadth	2	3.80	0.40	1.60	4.86	
	Parapet-30 cm breadth	2	3.80	0.30	0.30	6.86	
	Coping-35 cm breadth	2	3.90	0.35	0.10	0.28	
	Wing walls-						
	1st step-50cm breadth	4	1.10	(0.5+0)/2	0.50	0.55	
	2nd step- 40 cm breadth						
	(i)Straight portion	4	1.80	0.40	0.30	0.86	
	(ii) Sloping portion	4	1.80	0.40	(0.4+0)/2	0.58	
	3rd step- 30cm breadth	4	1.90	0.30	(0.70+0)/2	0.80	
	Turn walls - 40cm breadth	4	(0.8+0.7)/2	0.40	0.50	0.60	
	Turn walls - 30cm breadth	4	(0.8+0.65)	0.30	0.30	0.28	
					Total	**11.49**	cum

4	Cement pointing 1:2 in expose surface above G.L-					
	Face walls outer sides	2	3.10		1.40	8.68	
	Face walls parapet outer si	2	3.80		0.65	4.94	
	Parapet inner faces	2	3.80		0.7	5.32	
	Wing walls vertical face	4	2.30		(1.40+0.50)/2	8.74	
	Wing walls top	4	2.30	0.30		2.76	cum
	Turn walls vertical face three sides	4	1.80		0.30	2.16	L = Perimeter = 80+30+70=180cm =1.8 m
	Turn walls top	4	(0.8+0.7)/2	0.30		0.90	
					Total	33.50	sqm
5	Hume pipe heavy type 60 cm dia. Including collar joint	3	10.80			32.4 m	L = 10 + 0.4 + 0.4 = 10.8 m

2. Estimate of irrigation structures

Fall:-

- ❖ Irrigation channel are given certain longitudinal slope to develop certain velocities depending on the nature of soil and silt content in water.
- ❖ Steeper longitudinal slope develops higher velocities causing scour in the bed of the channel .
- ❖ If the general ground has a steep slope and the channel is given a flatter slope, the channel may meet the ground level and further may move the ground level necessitating high bank .
- ❖ To obviate the difficulty , falls or drops are given in the channel at suitable points where it tends to go near or above the ground level. At falls masonry structures are constructed to prevent scouring and to confined to direct the channel water along its course

Canal Fall:-

Irrigation canals are constructed with some permissible bed slopes so that there is no silting or scouring in the canal bed. But it is not always possible to run the canal at the desired bed slope throughout the alignment due to the fluctuating nature of the country slope.

Generally, the slope of the natural ground surface is not uniform throughout the alignment. Sometimes, the ground surface may be steep and sometimes it ma be very irregular with abrupt change of grade. In such cases, a vertical drop is provided to step down the canal bed and then it is continued with permissible slope until another step down is necessary. This is done to avoid unnecessary huge earth work in filling. Such vertical drops are known as *canal falls or simply falls*.

Necessity of Canal fall:-

When the slope of the ground suddenly changes to steeper slope, the permissible bed slope can not be maintained. It requires excessive earthwork in filling to maintain the slope. In such a case falls are provided to avoid excessive earth work in filling When the slope of the ground is more or less uniform and the slope is greater than the permissible bed slope of canal.

In that case also the canal falls are necessary. In cross-drainage works, when the difference between bed level of canal and that of drainage is small or when the F.S.L of the canal is above the bed level of drainage then the canal fall is necessary to carry the canal water below the stream or drainage.

Detailed estimate of simple type of vertical fall to given specification:

Example:

Prepare a detailed estimate of a 60 cm fall for a distributory of 360 cm bed width and 90 cm depth of water , from the drawing given . Side slope of bank and channel are 1.5:1 . The general specifications are as follows:-

Foundation and apron concrete- Cement concrete 1:3:6 with stone ballast

Masonry- All brick work shall be of 1-class in 1:4 cement mortar.

Pointing- All exposed surface shall be pointed with 1:4 cement and sand mortar.

Pitching- Pitching shall be of dry brick with straight over burnt bricks.

60 cm Fall Bed Width 360 cm Depth of Water 90 cm

Section of Side Walls

Fig. 9-10

L-Section ii

Half Sectional Plan (i)

Half Foundation Plan

Sec XY of Wing Wall (vi)

Section on ABC (iii)

FALL

All Dimensions in centimetre

Half Top Plan

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Details of Measurement and Calculation of Quantities

Item No.	Particulars of Items of works	No.	Length	Breadth	Height or Depth	Quantity	Explanatory notes
1	**Earthwork in excavation** Crest wall, side walls and floor (taken together)-						
	(i)	1	2.65	6.00	1.15	18.29	B = 4.5 + 2*0.6+2*0.15 = 6.00 m
	(ii)	1	2.10	5.80	1.05	12.79	B = 4.5 + 2*0.5+2*0.15 = 5.80 m
	(iii)	1	1.5	5.6	0.95	7.98	B = 4.5 + 2*0.4+2*0.15 = 5.60 m
	Wing walls beyond side walls	2	1.80	0.70	1.00	2.52	
	Curtain walls	1	4.5	0.60	1.2	3.24	
	Up stream pitching 20 cm 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	
	Down stream channel beyond curtain wall trapezium section (Bd + sd^2)xL		(4.05x0.8x1.5x0.8^2)x3.90			16.38	
	L=4.20-0.30=3.90 m						
	Down stream pitching 20 cm depth, excluding toe wall-						
	Bed	1	3.9	(4.1+3.2)/2	0.2	2.85	
	Side slopes up to F.S.L (Upper length = 2.0m)	2	(4.2+2.0)/2	1.62	0.2	1.79	
	Curved portion	2	3.14*0.6^2	(area)	0.2	0.45	
	Toe wall	2	3.90	0.20	0.30	0.47	
					Total	69.22	
	Deduction for set back of wing wall	2	0.6	0.1	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**
	Deduction for set back of wing wall	2	0.60	0.10	0.45	0.05
					Net Total	**13.77 cum**
3	**I-class brickwork** in 1:4 cement mortar-					
	Crest wall-					
	1st step	1	4.50	0.70	0.40	1.26
	2nd step	1	4.50	0.60	0.90	2.43
	Side wall-					
	(i) 1st step	2	2.35	0.60	0.40	1.13
	2nd step	2	2.35	0.50	0.50	1.18
	3rd step	2	2.35	0.40	0.50	0.94
	4th step	2	2.35	0.30	0.70	0.99
	(ii) 1st step	2	2.10	0.50	0.40	0.84
	2nd step	2	2.10	0.40	0.50	0.84
	3rd step	2	2.10	0.30	0.90	1.13
	(iii) 1st step	2	1.50	0.40	0.90	1.08
	2nd step	2	1.50	0.30	0.60	0.54
	Wing walls beyond side walls	2	1.80	0.40	0.40	0.58
		2	1.90	0.40	0.50	0.76
		2	2.00	0.40	0.50	0.80
		2	2.10	0.30	0.70	0.88

	Curtain wall	1	4.50	0.30	0.40	0.54	
	Toe wall	2	3.90	0.20	0.30	0.47	
					Total	16.38	cum
4	**Brick-on-edge floor in 1:8 cement mortar including pointing**	1	5.40	4.50		24.30 sqm	
							Down stream in between walls
5	**Cement pointing in 1:3 cement mortar- Crest wall (up stream face top and down stream face)**	1	4.50		2.40	10.8	
							Ht. = 0.6 + 0.6 + 1.2 = 2.40 m
	Side wall inner face						
	(i)…..	2	1.80		2	7.2	
	(ii)…..	2	2.10		1.70	7.14	
	(iii)…..	2	1.50		1.40	4.2	
	Side wall portion above crest wall	2	0.60		0.80	0.96	
	Vertical faces of steppings	2x2		0.30	0.30	0.36	
	Vertical face of end	2		0.40	0.90	0.72	
		2		0.30	0.60	0.36	
	Top of side walls	2	6.00	0.30		3.60	
	Top of curtain wall	1	4.50	0.30		1.35	
	Top of toe walls	2	3.90	0.20		1.56	
	Wing wall top face	2	2.10	0.30		1.26	
	Wing wall up-stream side triangular portion above slope-	2	0.5(2.10x1.10)			2.94	
					Total	42.45	sqm
6	**Brick -pitching-**						
	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	
	Down - stream bed	1	3.90 x	0.50(4.1+3.2)	x0.20	2.85	
	Down - stream side slopes	2	0.5(4.2+2.0)x1.62		x0.20	1.79	
	Side curved portions	2	3.14x0.6^2		x0.20	0.45	
					Total	7.56	cum

What is Cross Drainage Works?
- ❖ In an Irrigation project, when the network of main canals, branch canals, distributaries, etc.. are provided, then these canals may have to cross the natural drainages like rivers, streams, nallahs, etc. at different points within the command area of the project. The crossing of the canals with such obstacle cannot be avoided. So, suitable structures must be constructed at the crossing point for the easy flow of water of the canal and drainage in the respective directions. These structures are known as cross-drainage works.
- ❖ Irrigational Canals while carrying water from headworks to crop field, have to cross few natural drainage streams, nallaha, etc.. To cross those drainages safely by the canals, some suitable structures are required to construct. Works required to construct, to cross the drainage are called Cross Drainage Works (CDWs). At the meeting point of canals and drainages, bed levels may not be same. Depending on their bed levels, different structures are constructed and accordingly they are designated by different names.

Necessity of Cross Drainage Works :-
- ➢ The water-shed canals do not cross natural drainages. But in actual orientation of the canal network, this ideal condition may not be available and the obstacles like natural drainages may be present across the canal. So, the cross drainage works must be provided for running the irrigation system.
- ➢ At the crossing point, the water of the canal and the drainage get intermixed. So, for the smooth running of the canal with its design discharge the cross drainage works are required.
- ➢ The site condition of the crossing point may be such that without any suitable structure, the water of the canal and drainage cannot be diverted to their natural directions. So, the cross drainage works must be provided to maintain their natural direction of flow.

Types of Cross Drainage Works

Type I (Irrigation canal passes over the drainage)
(a) Aqueduct (b) Siphon Aqueduct

Type II (Drainage passes over the irrigation canal)
(a) Super passage (b) Siphon super passage

Type III (Drainage and canal intersection each other of the same level)
(a) Level crossing (b) Inlet and outlet

Selection of Type of Cross Drainage Works
- ➢ Relative bed levels
- ➢ Availability of suitable foundation
- ➢ Economical consideration
- ➢ Discharge of the drainage
- ➢ Construction problems

Due to relative levels sometimes it is required to lower the bed of the irrigation channel or the drainage channel at their crossing.

When the bed of the irrigation channel is depressed and taken under nala or stream it is known as **Irrigation Syphon**.

When the bed of nala or stream is depressed and taken under the irrigation channel it is known **as Drainage Syphon**.

The Syphon crossing may be of rectangular closed masonry channel or circular brick of R.C.C or Hume pipe of the required diameter and number. Approach and exit may be through masonry drop pit or of masonry sloped channel.
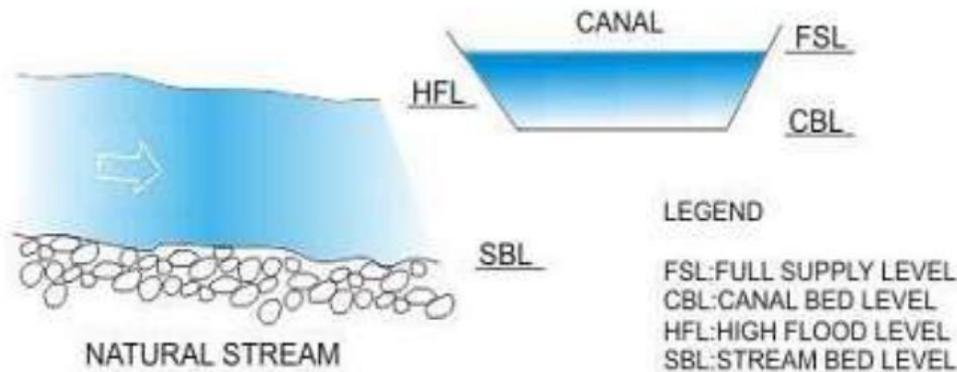
Fig: Cross Drainage Work
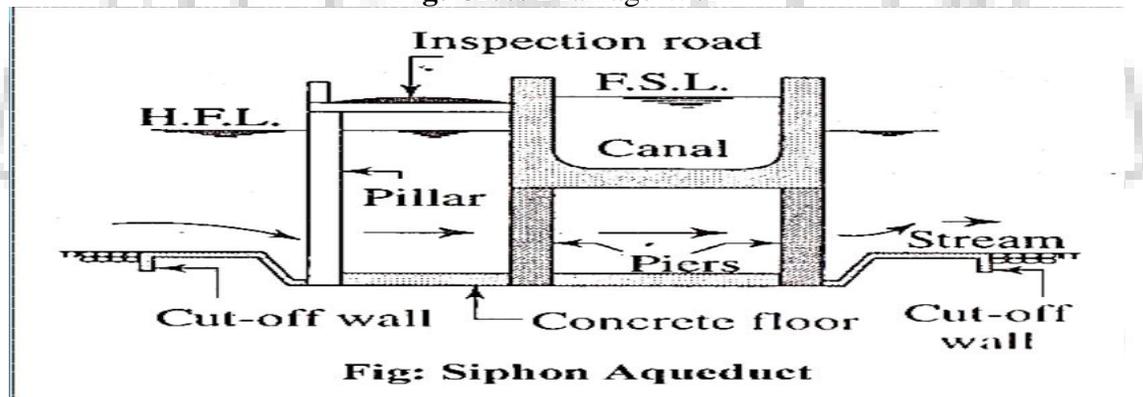
Fig: Siphon Aqueduct

Detailed estimate of drainage siphon to given specification.

Example:

Prepare a detailed estimate of a Drainage Syphon across a minor from the given drawing.

The general specifications are as follows:-

Foundation concrete shall be of 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 struck pointed with 1:2 cement mortar . Brick pitching shall be of dry brick with straight over burnt bricks.

Assume suitable rates for the different items of work.

DRAINAGE SYPHON ACROSS A MINOR

Longitudinal Section

G.L. H.F.L. 40 cm Free Board
10 cm Dry Brick Pitching
300
225
920
225
15
30
30
60
80
120
60
100
20
85
15 cm R.C.C. Slab
10 cm Brick in 1:3 Cement Mortar
70
100
60
30
250
150
150
150
140
40
F.S.L.
Bed
60
150
1½':1
1:1
G.L. H.F.L.
Bed of Nala
35
10
30
20
60
100
35
10
30
40
50

Sectional Plan
Showing all Footings

180 cm Bed of Nala
10 cm Dry Brick Pitching
Slope 1:1
Bank of Nala
210
270
110
15
30
70
120
180×180
Drop Pit
30
30
30
30
40
30
20
15
125
15
70
30
Bank
150
Slope
Berm
150
Bed of Minor
150
Slope
Berm
Slope
Bank
150
150
Drop Pit
180×180

All Dimensions in centimetre

Top Plan

Fig. 9 9

435

DRAINAGE SYPHON
Cross Sections

G
L
H.F.L.
40
80
1:1
180
10 cm Dry Brick Pitching

Cross Section EF
Showing Nala

G
L
H.F.L.
80
1:1
120
30
180
30
10
240
270
10 cm Brick in 1:3 Cement Mortar

Cross Section CD Showing Drop Pit and Nala

G
L
10
30
80
100
80
60
30
15cm R.C.C. Slab
30
30
100
150
240
460
490
10 cm Brick in 1:3 Cement Mortar

Cross Section AB
Showing Duct and Wing Walls

Fig. 9-8

Details of Measurement and Calculation of Quantities

Item No.	Particulars of Items of works	No.	Length	Breadth	Height or Depth	Quantity	Explanatory notes
1	**Earthwork in excavation in foundation-**						
	Syphon duct	1	9.50	2.40	1.60	36.48	
	Drop pit	2	2.10	2.70	1.60	18.14	
	Wing walls	4	1.35	1.10	1.60	9.50	
					Total	64.13	cum
2	**Cement concrete 1:4:8 with brick ballast-**						
	Syphon duct	1	9.50	2.40	0.30	6.84	
	Drop pit	2	2.10	2.70	0.30	3.40	
	Wing walls	4	1.35	1.10	0.30	1.78	
					Total	12.02	cum
3	**Ist class brickwork in 1:4 cement mortar-**						
	Syphon duct side walls	2	9.20	0.30	1.30	7.18	
	Drop pit walls	2 x 2	2.10	0.30	1.30	3.28	
		2	1.80	0.30	1.30	1.40	
	Wing walls-						
	1st step 70 cm walls	4	1.25	0.70	0.70	2.45	
	2nd step 60 cm walls	4	1.25	0.60	0.60	1.80	Upto slab
	3rd step 60 cm walls above	2	4.60	0.60	0.20	1.10	
	3rd step 50 cm walls	2	4.60	0.50	1.00	4.60	
	4th step 40 cm wall	2	4.60	0.40	0.80	2.94	
	5th step 30 cm wall (parape	2	4.60	0.30	0.30	0.83	
	Coping	2	4.70	0.35	0.10	0.33	
					Total	25.92	cum

4	**R.C.C slab of syphon duct** including steel reinforcement complete work	1	9.20	2.10	0.15	**2.90**	cum
5	**10 cm thick brick floor in 1:3 cement mortar including 1:2 cement pointing-**						
	Floor of syphon duct	1	9.20	1.50		13.80	
	Floor of drop pit	2	1.80	1.80		6.48	
					Total	20.28	sqm
6	**Cement struck pointing 1:2 -**						
	Syphon duct inner faces	2	9.20		1.00	18.4	
	Drop pit 3 verticla faces	2 X 3	1.80		1.20	12.96	
	Drop pit 3 top faces	2	5.70		0.30	3.42	L = 2 x 1.80 + 2.10 = 5.70 m
	Parapet wall inner face top and outer face upto G.L	2	4.60		2.30	21.16	Ht. = 20 + 10 + 30 + 10 + 35 + 10 + 5 + 110 = 230 cm
	Outer face of wing wall above slab	2	1.80		1.20	4.32	
	Triangular portion of outer face of wing wall	2 x 2	5*0.8*0.8			1.28	
					Total	61.54	sqm
7	**10 cm dry brick pitching with straight over burnt bricks -**						
	Bed of nala	2	3.00	1.80		10.80	
	Side slopes of nala	2 x 2	3	1.13		13.56	
					Total	24.36	sqm

3. Detailed estimate of roads

Water Bound Macadam Roads:

➢ WBM road is known after John Macadam, Surveyor General of Road in England in 1827, who was the first to introduce this particular road.

➢ In the present day, the term macadam means the pavement base course constructed by broken aggregates that are interlocked mechanically by rolling and voids filled with screening and binding materials with the help of water.

➢ The WBM is used as a sub-base, base course or surface course.

➢ The thickness of each layer ranges from 7.5 cm to 10 cm depending on the size of aggregates used.

➢ To prolong the life of WBM road, a bituminous surfacing is provided. Construction procedure involves preparation of foundation, provision of literal confinement, spreading of coarse aggregates, rolling, application of screening, sprinkling and grouting, application of binding material, and setting and drying.
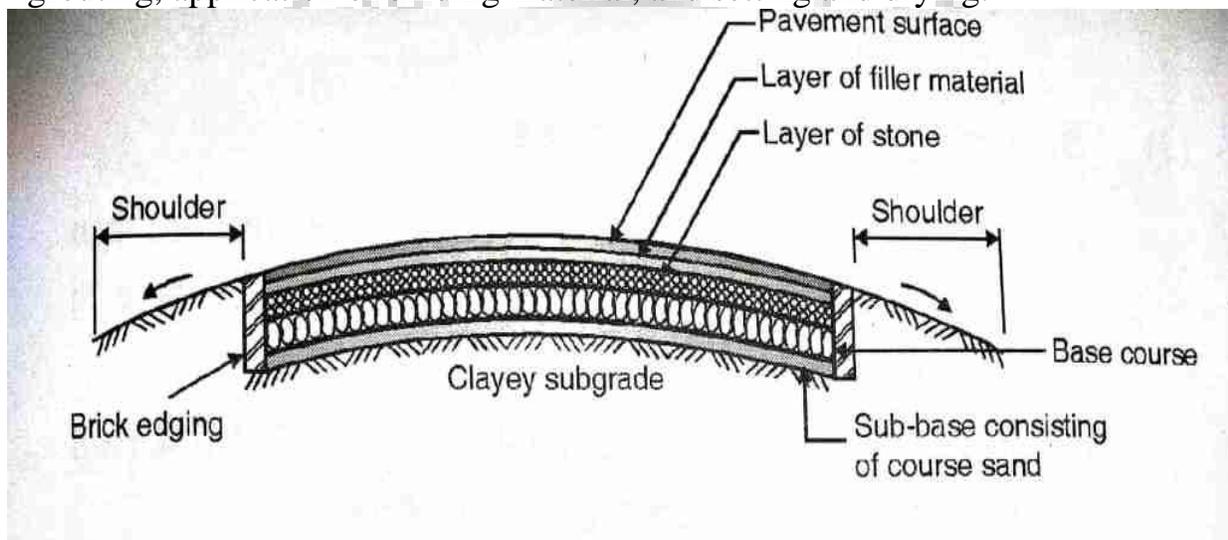
Fig: Component of WBM Road

Construction Procedure:

1. Prepare the foundation for receiving the WBM course.
2. Lateral confinement may be done by compacting the shoulder to advance, to a thickness equal to that of the compacted WBM layer and by trimming the inner side vertically.
3. Spreading of Coarse Aggregate.

4. Compaction of coarse aggregate is done by wheeled power roller of capacity 6 to 10 tonnes or alternately by an equivalent vibratory roller.

Compaction of WBM Road

5. Dry screening is applied gradually over the surface to fill the interstices in these.
6. The surface is sprinkled with water, swept and rolled.
7. Binding material is applied at a uniform and slow rate at two and more layers.
8. WBM Coarse is allowed to set overnight.

3.1 Detail estimate of a water bound macadam road

Example:

Prepare a detailed estimate for the construction of a new State Highway for one kilometre length . The formation width of road is 10 metre , average height of bank is 1 metre and side slope 2:1 . The metalled width is 3.70 m and three coats of metalling are to be provided as per cross section . The surface shall be finished with two coats of painting.

Assume other data if required.
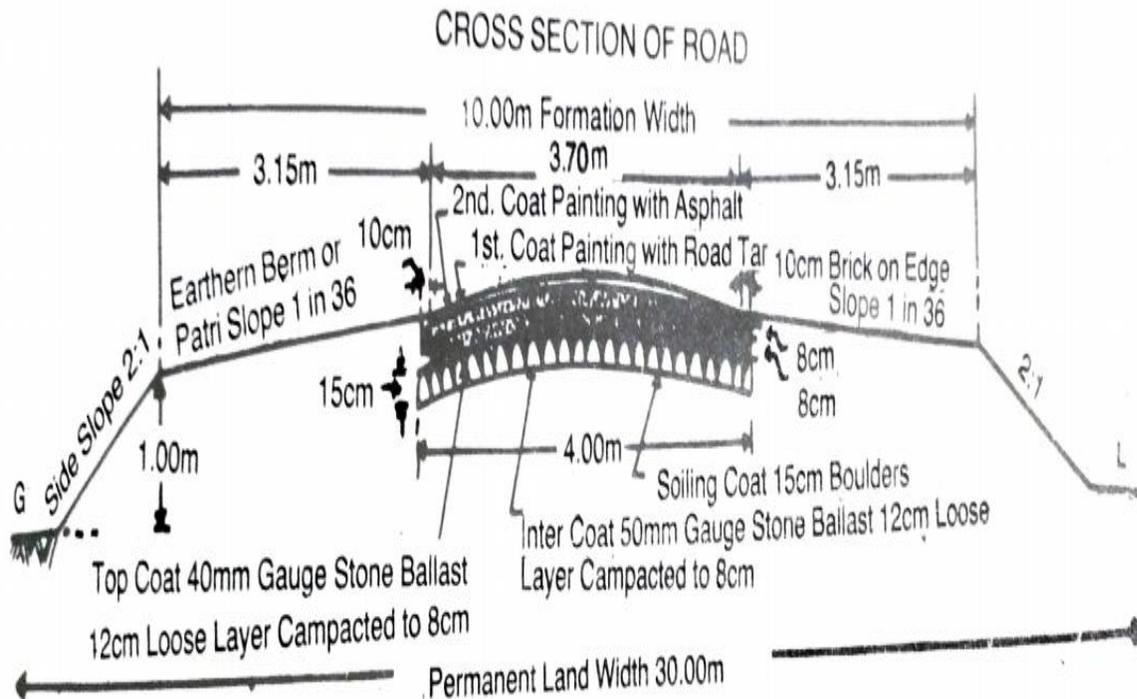
CROSS SECTION OF ROAD

10.00m Formation Width
3.70m
3.15m
3.15m
2nd. Coat Painting with Asphalt
1st. Coat Painting with Road Tar
Earthern Berm or 10cm
Patri Slope 1 in 36
10cm Brick on Edge
Slope 1 in 36
Side Slope 2:1
G
15cm
8cm
8cm
2:1
1.00m
4.00m
Soiling Coat 15cm Boulders
Inter Coat 50mm Gauge Stone Ballast 12cm Loose
Layer Campacted to 8cm
Top Coat 40mm Gauge Stone Ballast
12cm Loose Layer Campacted to 8cm
Permanent Land Width 30.00m

Details of Measurement and Calculation of Quantities

Item No.	Particulars of Items of works	No.	Length	Breadth	Height or Depth	Quantity	Explanatory notes
1	Surveying , dagbelling etc	1	1 km			1 km	
2	Land acquisition permanent	1	1000 m	30 m		30000 sqm	30 m width
3	Land acquisition temporary	Quantity of earthwork in embankment Depth of borrowpit					
					12000/0.30	40000 sqm	
4	Earthwork in embankment	$(Bd + Sd^2) \times L$				12000 cum	B = 10 m d = 1 m
5	Plantation of grasses on the side slope	2	1000	$\sqrt{2^2 + 1}$		4500 sqm	Sloping breadth
6	Metalng- Preparation of Sub-grade (dressing to camber)	1	1000	4.00		4000 sqm	30 cm wider
6	Metalng- Preparation of Sub-grade (dressing to camber)	1	1000	4.00		4000 sqm	30 cm wider
7	Soling coat						
	(i) Stone boulders 15 cm size	1	1000	4.00	0.15	600 cum	30 cm wider
	(ii) Laying and consolidation of boulders including blinding with local sandy soil	me as above				600 cum	
8	Inter coat						
	(i) Stone ballast 50 mm gauge	1	1000	3.70	0.12	444 cum	12 cm thick loose layer compacted to 8 cm
	(ii) Laying and consolidation of ballast including blinding with local sandy soil	Same as above				444 cum	
9	Top coat						
	(i) Stone ballast 40 mm gauge	1	1000	3.70	0.12	444 cum	12 cm thick loose layer compacted to 8 cm
	(ii) Laying and consolidation of stone ballast including blinding with local sandy soil	Same as above				444 cum	

10	Beam or Patri dressing	1	1 km			1 km	
	PAINTING OR BLACK TOP SURFACING						
11	**Painting 1st coat with** Road tar						
	(i) Stone grit 20 mm gauge @ 1.35 cum % sqm	1	1000 m	x 3.70 m	x $\dfrac{1.35}{100}$	50 cum	
	(ii) Paint or binding Road tar @ 220 kg % sqm	1	1000 m	x 3.70 m	x 220/100	8140 kg	8.14 tones
	(iii) Laying	1	1000 m	x 3.70 m		3700 sqm	
12	**Painting 2nd coat with Asphalt**						
	(i) Stone grit 12 mm gauge @ 0.75 cum % sqm	1	1000	x 3.70 m	x $\dfrac{0.75}{100}$	27.75	
	(ii) Paint or binding Road tar @ 120 kg % sqm	1	1000	x 3.70 m	x 120/100	4440 kg	4.44 tones
	(iii) Laying	1	1000 m	x 3.70 m		3700 sqm	

3.2 Detailed estimate of a flexible pavement in cutting / filling

Example:

Reduced levels (R.L) of ground along the centre line of a proposed road from chianage 10 to 20 are given below. The formation level at the 10th chainage is 107 and the road is in downward gradient of 1 in 150 up to the chainage 14 and then the gradient changes to 1 in 100 downward. Formation width of road is 10 metre and side slopes of banking are 2:1 (Horinzontal :Vertical) . Length of the chain is 30 metre.

i. 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.
ii. Find the area of the side slope and the cost of turfing the side slopes at the rate Rs. 60.00% sqm.

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---------------->						

Formation

←10.00m→

2:1   2:1

G   d   L

CROSS SECTION OF BANKING

- R.L of Formation
- R.L of Ground
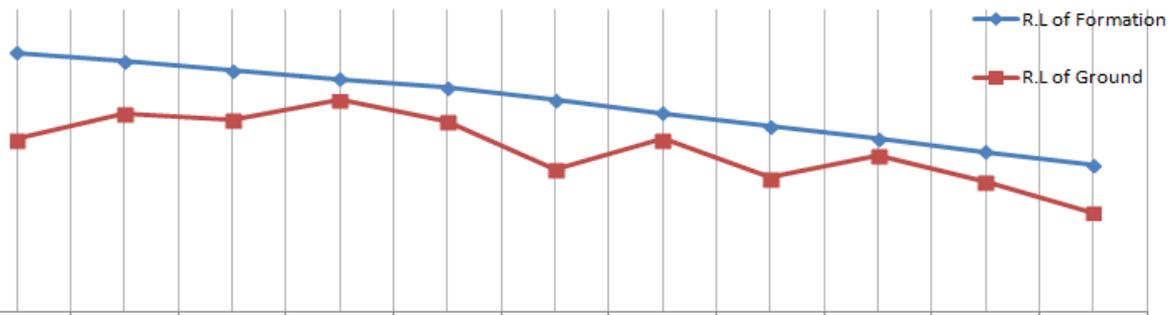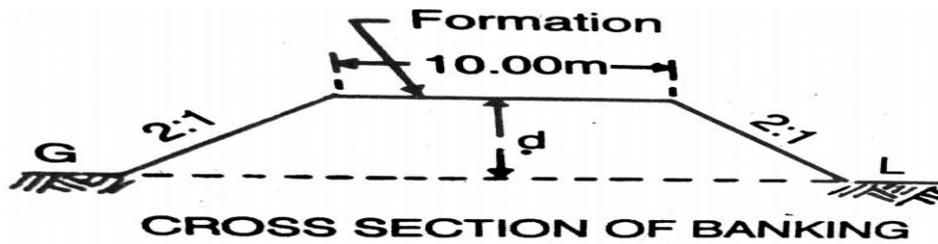
Depth											
Height of Bank	2.00	1.20	1.16	0.50	0.78	1.60	0.60	1.20	0.38	0.70	1.10
R.L of formatio	107.00	106.80	106.60	106.40	106.20	105.90	105.60	105.30	105.00	104.70	104.40
R.L of Ground	105.00	105.60	105.44	105.90	105.42	104.30	105.00	104.10	104.62	104.00	103.30
Distance in	300	330	360	390	420	450	480	510	540	570	600
Chainage	10	11	12	13	14	15	16	17	18	19	20

Calculation of Quantities of Earthwork

		B = 10 m	s = 2						

Chainage m	Length m	Height or Depth Diff. Of G.L and F.L m	Mean Height or Depth m	Central area m^2	Side area m^2	Total area m^2	Length between stations m	Quantity Banking m^3	Quantity Cutting m^3
10	300	2.00							
11	330	1.20	1.60	16.00	5.12	21.12	30	633.6	
12	360	1.16	1.18	11.80	2.78	14.58	30	437.5	
13	390	0.50	0.83	8.30	1.38	9.68	30	290.3	
14	420	0.78	0.64	6.40	0.82	7.22	30	216.6	
15	450	1.60	1.19	11.90	2.83	14.73	30	442.0	
16	480	0.60	1.10	11.00	2.42	13.42	30	402.6	
17	510	1.20	0.90	9.00	1.62	10.62	30	318.6	
18	540	0.38	0.79	7.90	1.25	9.15	30	274.4	
19	570	0.70	0.54	5.40	0.58	5.98	30	179.5	
20	600	1.10	0.90	9.00	1.62	10.62	30	318.6	
							Total	**3513.8**	**cum**

ABSTRACT OF ESTIMATED COST

Item No.	Particular of items	Quantity	Unit	Rate	Per	Cost
1	Earthwork in banking	3513.8	cum	275.00	% cum	9662.95
					Total	9662.95
		Add 5% (3% for Contigencies and 2% for Workcharged				483.15
					Grand Total	10146.10

Calculation of Areas of Side Slopes

s = 2

Station or Chainage	Height or Depth	Mean Height or Depth	Sloping breadth of side slope	Length	Area of both side slope	
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	
				Total	1297.80	sqm

Abstract of Cost of Turfing

Turfing side slopes 1297.80 **Rs. 60.00 per % sqm**	778.68
Add 5% for Contingencies, etc	38.93
Grand Total	**817.61**

Example:

Estimate the cost of earthwork for a portion of road for 400 metre length from the following data:-

Formation width of the road is 10 metre. Side slopes are 2:1 in banking 1.5:1 in cutting.

CROSS SECTION
Formation Level 10.00m
BANKING

Formation Level
10.00 m
CUTTING
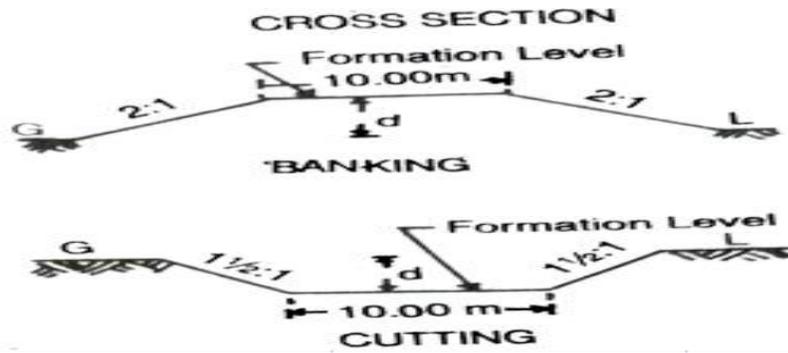
Station	Distance in metre	R.L of Ground	R.L of formation
25	1000	51.00	52.00
26	1040	50.90	Downward gradient of 1 in 200
27	1080	50.50	
28	1120	50.80	
29	1160	50.60	
30	1200	50.70	
31	1240	51.20	
32	1280	51.40	
33	1320	51.30	
34	1360	51.00	
35	1400	50.60	
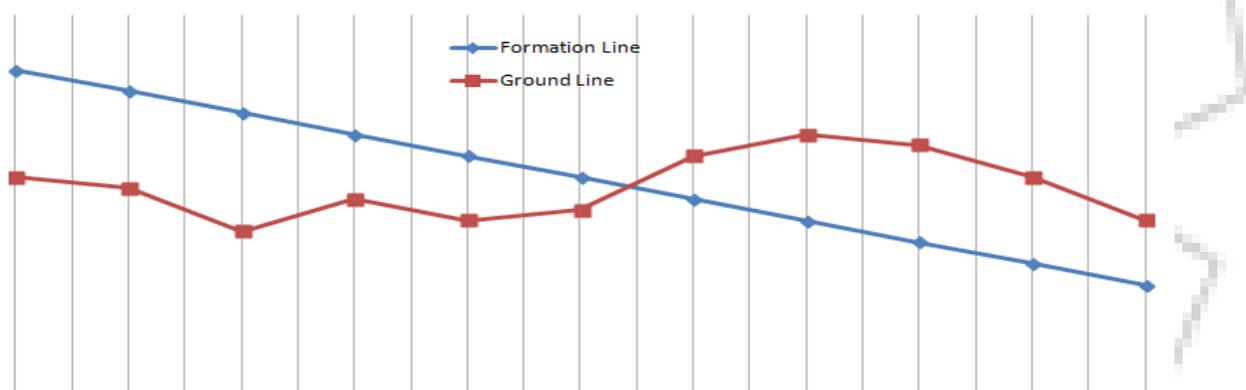
Depth of Cutting							0.40	0.80	0.90	0.80	0.60
Height of Bank	1.00	0.90	1.10	0.60	0.30						
R.L of Formation	52.00	51.80	51.60	51.40	51.20	51.00	50.80	50.60	50.40	50.20	50.00
R.L of Ground	51.00	50.90	50.50	50.80	50.60	50.70	51.20	51.40	51.30	51.00	50.60
Distance in metre	1000	1040	1080	1120	1160	1200	1240	1280	1320	1360	1400
Station	25	26	27	28	29	30	31	32	33	34	35

The road passes from banking to cutting in between the stations 30 (1200 m) and 31 (1240 m) . The distance where it passes through zero, i.e., ground level , may be determined as follows:-

The two traiangles on either side of zero point are symmetrical.

$$\frac{x}{0.3} = \frac{40-x}{0.4} \text{ or, } 0.4x = 0.3\,(40 - x)$$

Or, $0.4x = 12 - 0.3x$ or $0.7x = 12$

Therefore $x = \dfrac{12}{0.7} = 17.14 \text{ m} = 17 \text{ m say}$
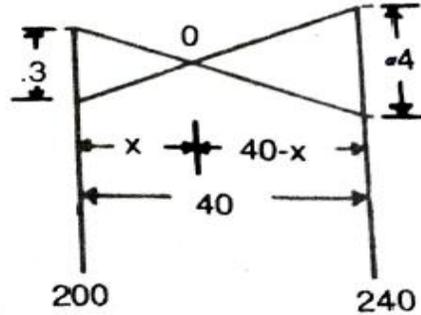
Therefore length of banking portion is 17 m, and the length of cutting portion is $40 - 17 = 23$ m

ESTIMATE OF EARTHWORK
Calculation of Quantities

B = 10 m   s = 2 for banki s = 1.5 for cutting

Station	Distance	Height or Depth Diff. Of G.L and F.L m	Mean Height or Depth m	Central area m^2	Side area m^2	Total area m^2	Length between stations m	Quantity Banking m^3	Quantity Cutting m^3
25	1000	1.00							
26	1040	0.90	0.95	9.50	1.81	11.31	40.00	452.40	
27	1080	1.10	1.00	10.00	2.00	12.00	40.00	480.00	
28	1120	0.60	0.85	8.50	1.45	9.95	40.00	398.00	
29	1160	0.60	0.60	6.00	0.72	6.72	40.00	268.80	
30	1200	0.30	0.45	4.50	0.41	4.91	40.00	196.40	
Passes from banking to cutting									
	1217	0.00	0.15	1.50	0.05	1.55	17.00	26.35	
31	1240	-0.40	-0.20	2.00	0.06	2.06	23.00		47.38
32	1280	-0.80	-0.60	6.00	0.54	6.54	40.00		261.60
33	1320	-0.90	-0.85	8.50	1.08	9.58	40.00		383.20
34	1360	-0.80	0.85	8.50	1.08	9.58	40.00		383.20
35	1400	-0.60	-0.70	7.00	0.74	7.74	40.00		309.60
(- sign indicates cutting)							Total	1821.95 cum	1384.98 cum

ABSTRACT OF ESTIMATED COST

Item No.	Particular of items	Quantity	Unit	Rate	Per	Cost
1	Earthwork in banking	1821.95	cum	275.00	% cum	5010.36
2	Earthwork in cutting	1384.98	cum	350.00	% cum	4847.43
					Total	9857.79
	Add 5% (3% for Contigencies and 2% for Workcharged					492.89
					Grand Total	10350.68

3.3 Detailed **estimate of septic tank and soak pit for 50 users**
Example:

Prepare a detailed estimate of a Septic tank with soak pit for 50 users together with sanitary fittings of a one seat of Latrine from the given drawings.

Septic tank shall be of I-class brick masonry 1:4 cement mortar over cement concrete 1:3:6 foundation base , with R.B partition wall and R.C.C. Slab cover . Inside of tank including floor shall be 12 mm cement plastered 1:2 mortar mixed with water proofing materials . Soak pit shall be of II-class brick masonry with 1:6 cement mortar.
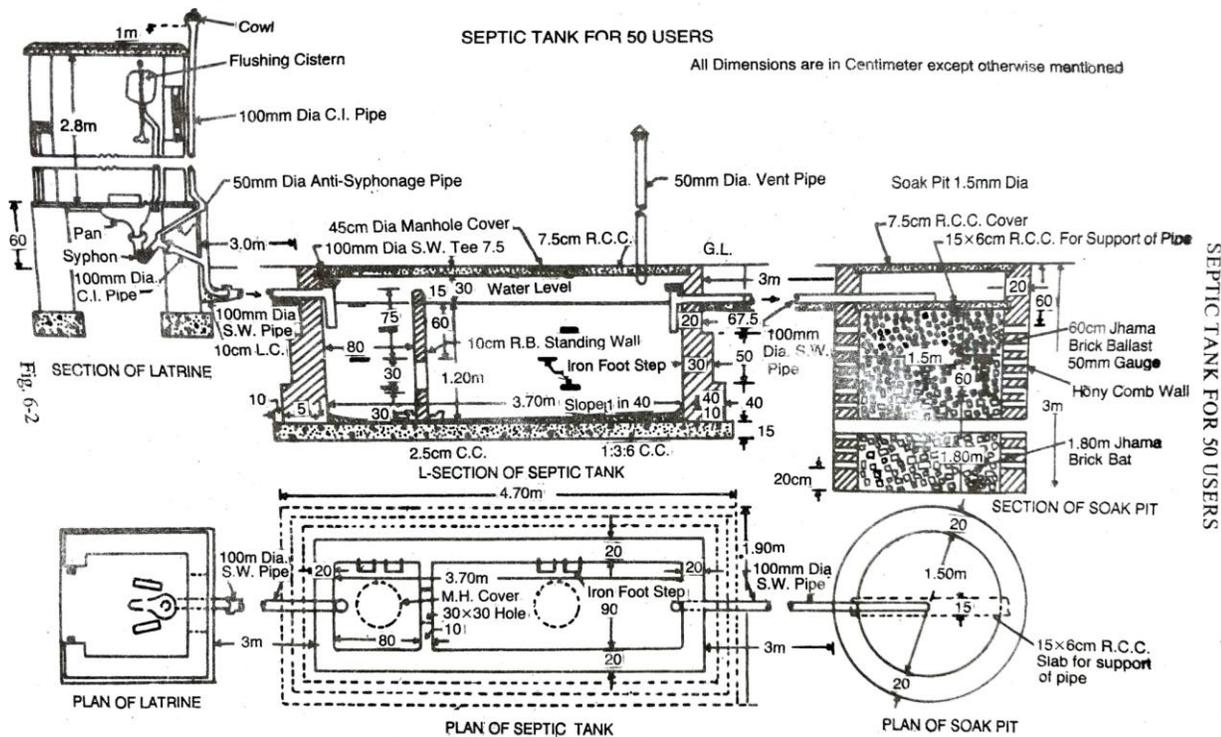
SEPTIC TANK FOR 50 USERS

All Dimensions are in Centimeter except otherwise mentioned

Details of Measurement and Calculation of Quantities

Item No.	Particulars of Items of works	No.	Length	Breadth	Height or Depth	Quantity	Explanatory notes
1	**Septic Tank and Soak-pit -**						
	Earthwork in Excavation -						
	Septic Tank	1	4.70	1.90	1.725	15.40	
	Soak pit	1	$\frac{\pi \times 1.9^2}{4}$	x 3.00		8.5	
					Total	23.90	cum
2	**Cement concrete** 1:3:6 in foundation of septic tank	1	4.7	1.9	0.15	**1.34**	cum
3	**I-class brickwork** in 1:4 cement mortar in septic tank-						
	Long walls-						
	1st footing	2	4.50	0.40	0.40	1.44	
	2nd footing	2	4.30	0.30	0.50	1.29	
	3rd footing upto 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 upto top	2	0.90	0.20	0.675	0.24	
					Total	4.638	No deduction for bearing of slab
						cum	
4	**R.B. Work in partition wall** with 1:3 cement mortar in septic tank including	1	0.90	0.10	1.35	**0.12**	cum
5	**R.C.C. Work in septic tank and soak-pit** including reinforcement complete work-	1	3.90	1.10	0.075	0.32	
	Slab cover of soak pit	1	$\frac{\pi \times 1.7^2}{4}$	X	0.075	0.17	
	R.C.C support of pipe in soak	1	1.7	0.15	0.06	0.02	
					Total	0.51	cum
6	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 wall both sides	2	0.90		1.35	2.43	
	Partition wall top	1	0.90		0.10	0.09	
					Total	16.32	sqm

No.	Description						
7	**C.C floor 1:2:4**, 5 cm average thickness	1	3.70	0.9		**3.33**	sqm
8	**II- class brickwork** in 1:6 cement mortar in soak pit	1	π	x 1.7 x 0.20	3.00	**3.20**	Mean circumference
						cum	
9	Jhama brick ballast 10 mm size inside soak-pit (upper layer)	1	$\dfrac{\pi \times 1.5^2}{4}$	x 0.60		**1.06**	cum
10	Jhama brick bats inside soak-pit (lower layer)	1	$\dfrac{\pi \times 1.5^2}{4}$	x 1.80		**3.18**	cum
11	C.I Manhole cover 45 cm Dia. Over septic tank	2				**2 Nos.**	
12	Iron foot steps septic tank	8				**8 Nos.**	

4. MISCELLANEOUS ESTIMATES

Calculating the volume of concrete in a triangular pile cap having 3-piles.

Let us calculate the volume of concrete in a triangular pile foundation having 3 nos. of the pile, as shown below.

Triangular pile cap
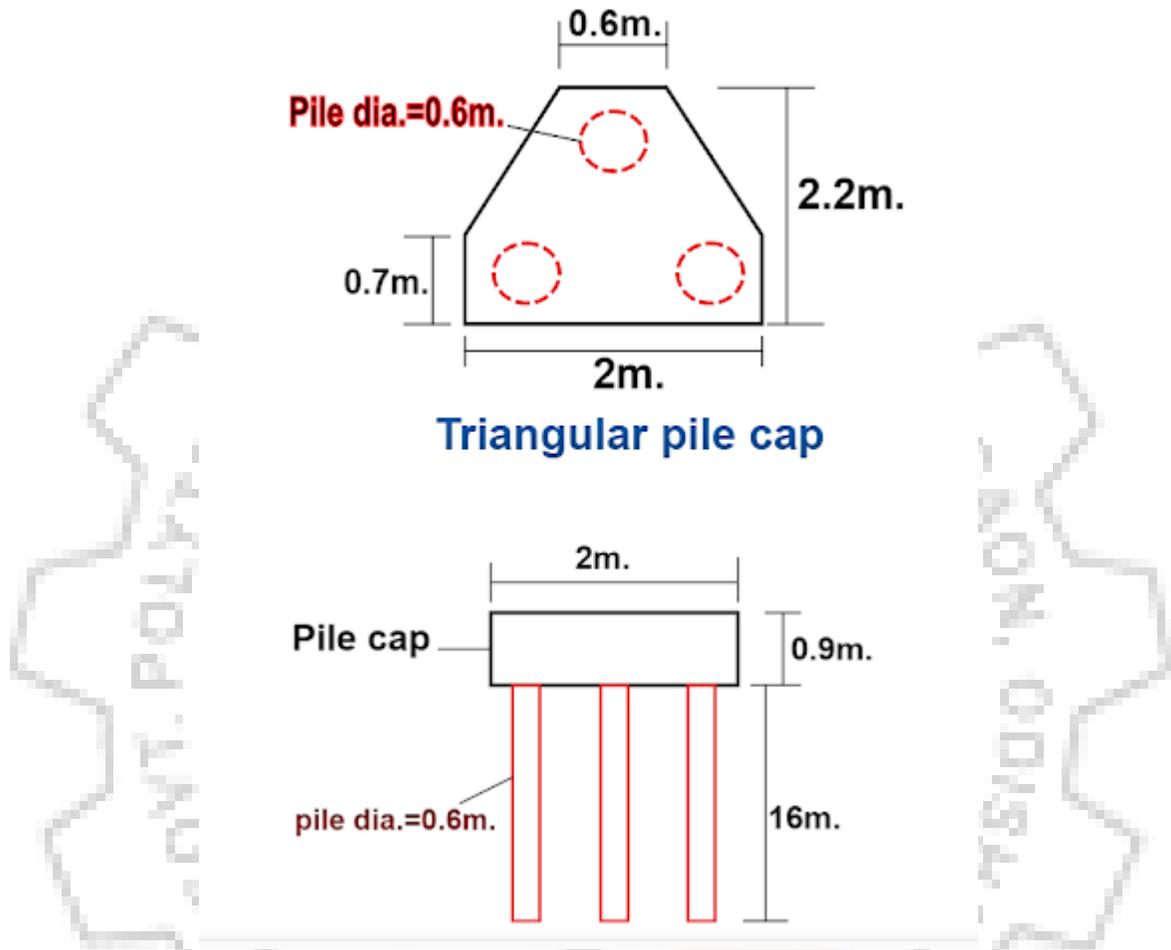
Given data:
Pile diameter = 0.6m. (d)
No. of piles = 3 nos.
Length of pile = 16m. (h)
Depth of the pile cap = 0.9m. (D)
The volume of concrete in the piles
= 3nos.× πr^2 h
Here,
r = radius of the pile.
= d ÷ 2
= 0.6m ÷ 2
= **0.3m.**
h = length of the pile.
The volume of concrete in piles
= 3nos. × 3.142 × $(0.3m)^2$ × 16m.

= **13.57 cum**.

The volume of concrete in the pile cap :

The volume of pile cap concrete
= Surface area (A) × depth (D)
First, let us calculate the sectional area (A1) of rectangle ABCD, as shown in the below drawing.
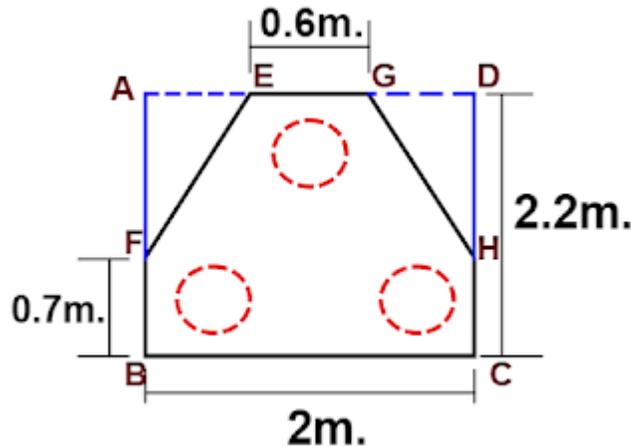
Area of rectangle ABCD (A1)
=L × B
= 2.2m × 2.0m
= **4.4 sqm.**

To get the surface area (A) of the pile cap, we have to deduct the area of triangles AEF & GDH from the rectangle area.
Here,
Triangle AEF = triangle GDH
Area of triangle AEF
= 0.5 × base × height.
= 0.5 × side AE × side AF
Side AE
= [(1/2 ×side BC) - (1/2 × side EG)]
= [(1/2 ×2m.) - (1/2 × 0.6m.)]
= [1m - 0.3 m]
= **0.7m.**

Side AF
= side AB - side FB
= 2.2m - 0.7m
= **1.5m.**

I have redrawn the triangle, with the calculated length of the sides AF & AE as shown below.
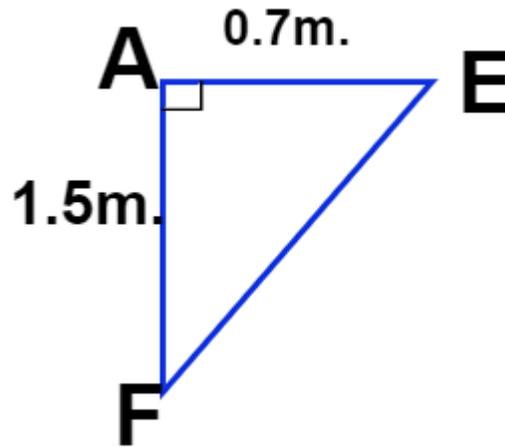
Area of triangle AEF
$= 0.5 \times$ side AE $\times$ side AF
$= 0.5 \times 0.7\text{m} \times 1.5\text{m}.$
= **0.525 sqm.**

The surface area of the pile cap (A)
= [area of rectangle ABCD - (2nos. $\times$ area of a triangle AEF)]
= [4.4 sqm. - (2nos. $\times$ 0.525sqm.)]
= [4.4 sqm. - 1.05 sqm.]
= **3.35 sqm.**

Now, the concrete vol. of pile cap
= surface area (A) $\times$ depth (D)
= 3.35 sqm. $\times$ 0.9m.
= **3.015 cum.**

The total concrete volume of 3-pile foundation
= The vol. of concrete in pile cap + total vol. of concrete in piles.
= 3.015 cum + 13.57 cum.
= **16.585 cum.**

Isolated & Combined Footing

Quantity of Reinforcement (Steel) required for footings / Bar Bending Schedule for footings:-

FOOTING PLAN

Plain Footing

Isolated Footing

Stepped Footing
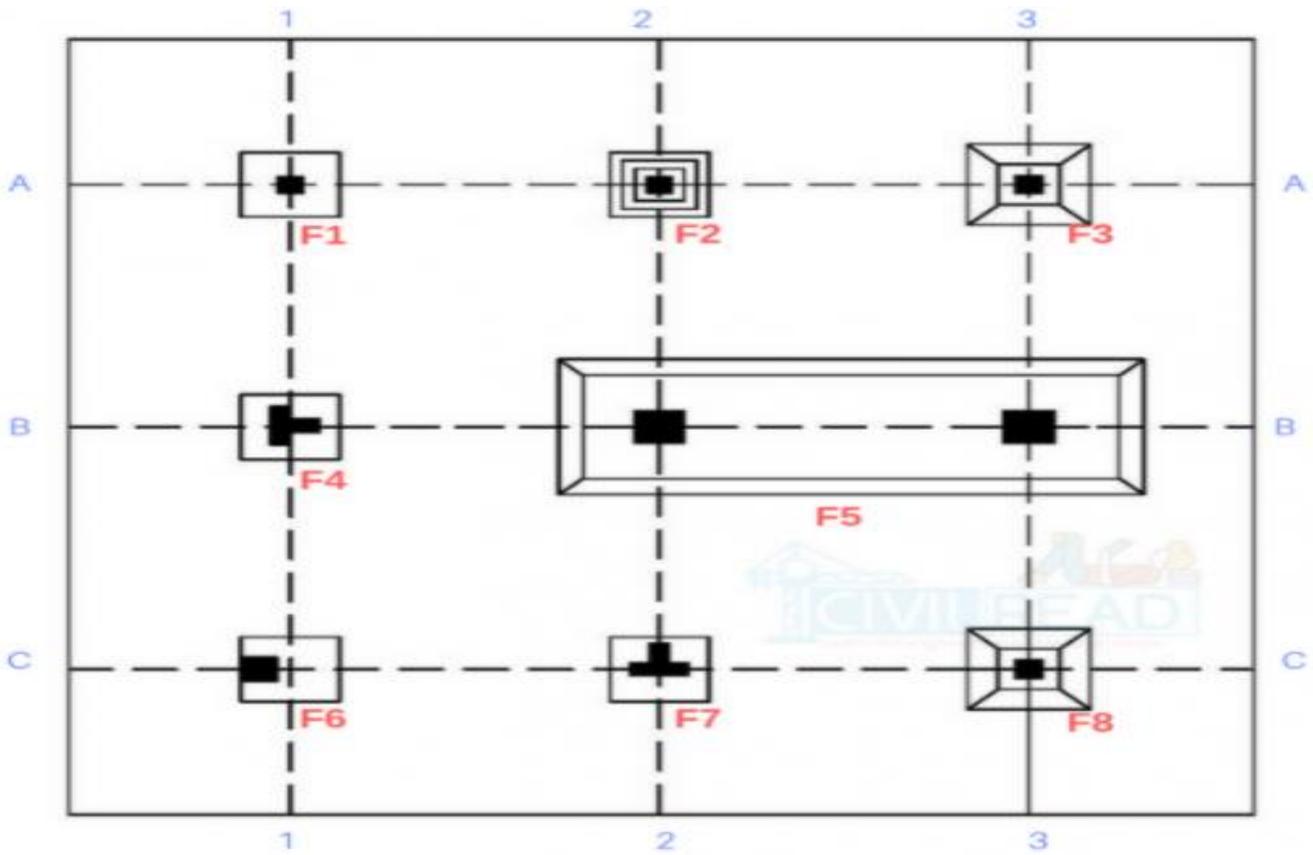
Combined Isolated Footing
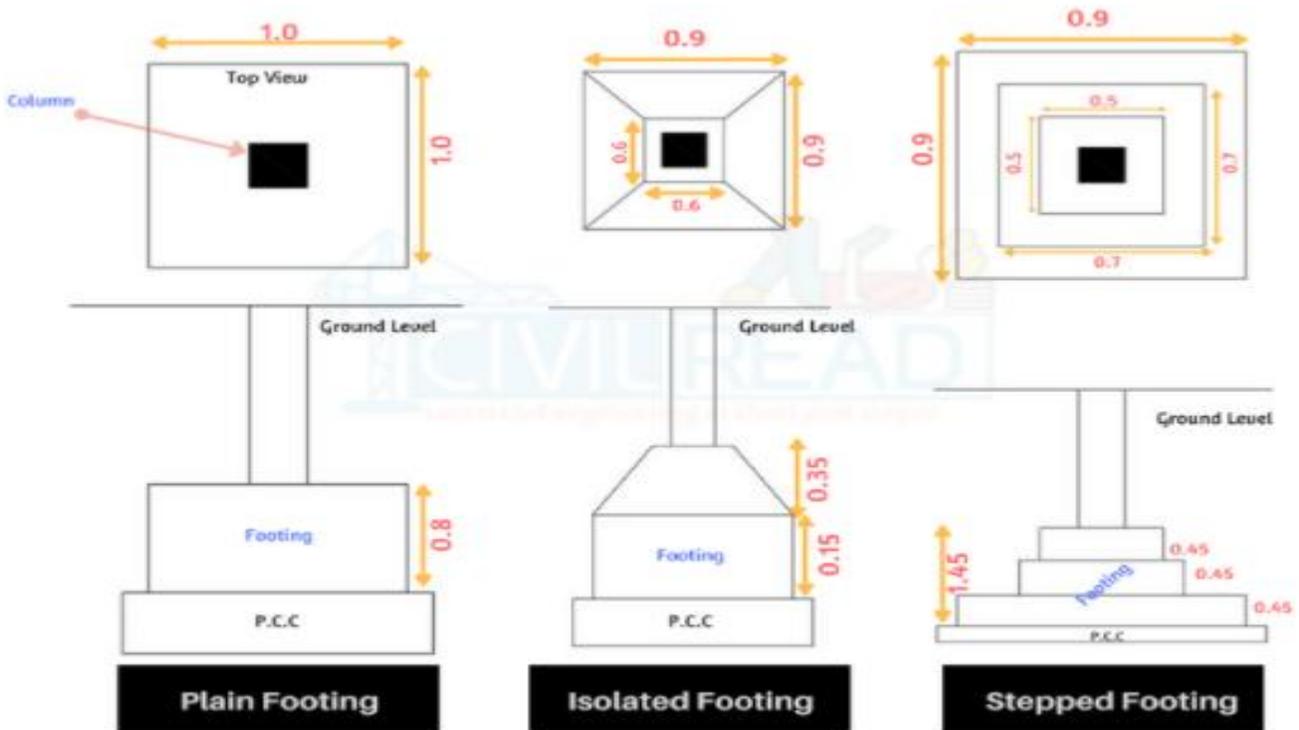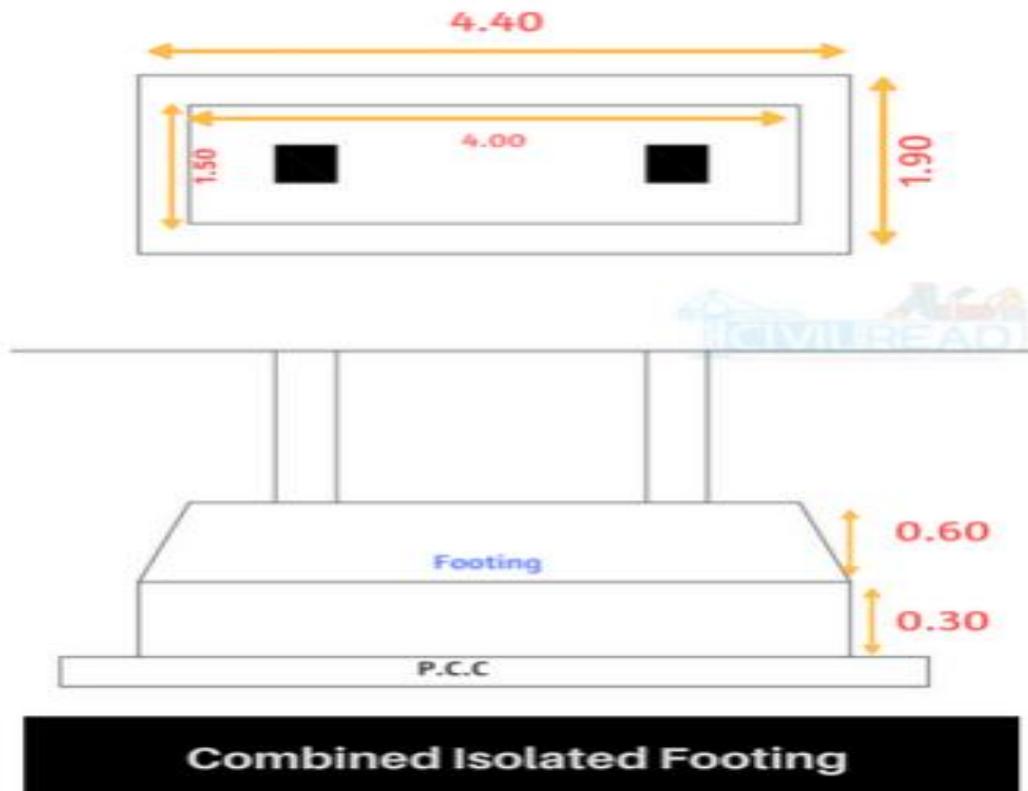
Observations from the above fig:
- ❖ F1, F4, F7 is Plain footing (1.0×1.0×0.8)
- ❖ F2 is Stepped Footing (0.9×0.9×1.35)
- ❖ F3, F8 is Isolated footing (0.9×0.9×0.5)
- ❖ F5 is Combined Isolated footing (4.2×1.7×0.9)
- ❖ F6 is Shoe footing (0.6×0.6×0.4)

Steps involved in calculating the bar bending schedule of a footings:-

Remember, Steel required for construction is ordered in Kgs or Number of Bars. The standard size of each bar is **12m. The final output of BBS calculation is in Kgs or in Number of "12m" Bars.**

To make it easier calculation is divided into two parts, X bar Calculations and Y bar calculations.

X Bars are Horizontal bars in X direction and Y Bars are vertical one projected in Y Direction.

- i.   Deduct the concrete cover to find the dimensions of bars.
- ii.   Find the Length of single X Bars & Y Bars
- iii.   Find the total length of X bars. & Y bars
- iv.   Calculate the weight of steel required per 1m
- v.   Calculate the total number of 12m bars required
- vi.   Find the total weight of steel required.
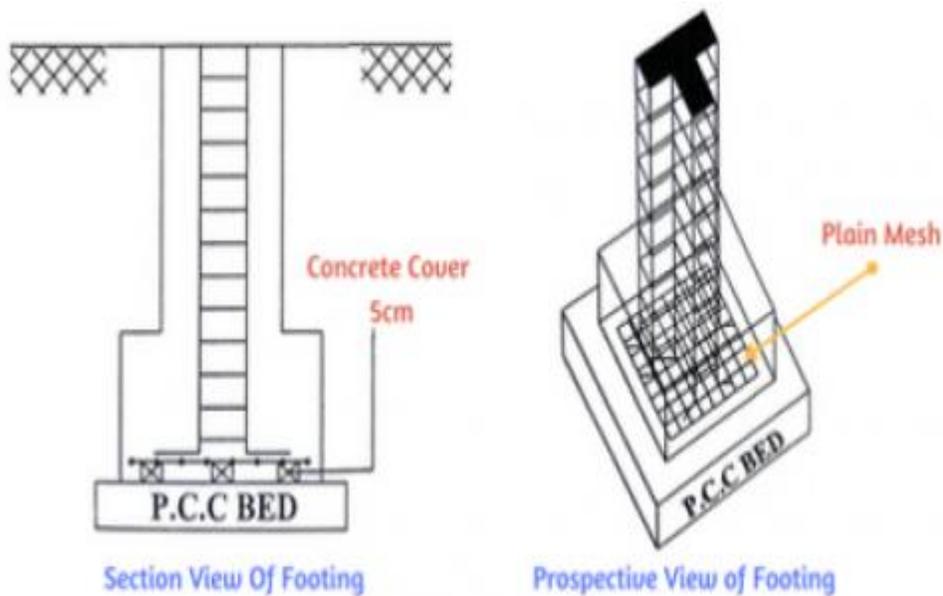
Section View Of Footing   **Prospective View of Footing**

For the calculation of the total quantity of steel required for the Plain footing, we are adopting these dimensions for bars.

Adopted:-

- ➢ Dimensions of Footing are $1.0 \times 1.0 \times 0.9$ (Length $\times$ Breadth $\times$ Depth)
- ➢ **Plain mesh** is adopted for F1, F4, F7 footings
- ➢ Dia of X Bars is **16mm** (Dia 16mm @ 100mm C/C)
- ➢ Dia of Y Bars is **12mm** (Dia 12mm @ 100mm C/C)
- ➢ which means Center to center spacing between X bars & Y bars is **100mm**

Remember, Proper Concrete cover should be adopted for the reinforcement in Footings to resist it from corrosion.

Concrete Cover deduction:

As per condition, concrete cover of **0.1m** is deducted from all sides of mesh. True dimensions post deducting is 0.8×0.8 (length and breadth)

Refer below image for more details:

X bar =Dia 16mm @100mm C/C   Y bar =Dia 12mm @100mm C/C
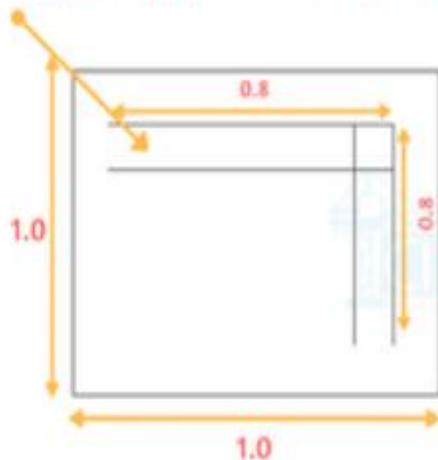
Finding the length of Mesh
(Deduction of Concrete Cover)
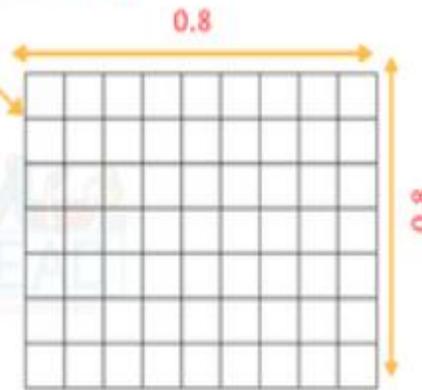
Length of Reinforcement
X Bars and Y Bars
(After Deduction of Concrete Cover)

Length of Each X bar	= 0.8m
Length of Each Y bar	= 0.8m
No. of X bars	**[(Y Bar Length)/Spacing]+1** = [0.8/0.1]+1 = 9 bars
No. of Y bars	**[(X Bar Length)/Spacing]+1** = [0.8/0.1]+1 = 9 bars
Total Length of X bars	= Length of each X bar × No. of X Bars = 0.8 × 9 =7.2m
Total Length of Y bars	= Length of each Y bar × No. of Y Bars = 0.8 × 9 =7.2m
Total No. of '12m' X bars	= 7.2/12 = 0.6bars
Total No. of '12m' Y bars	= 7.2/12 = 0.6bars
Weight of steel required for 1m of 16mm bar	= $D^2/162$ = $16^2/162$ = 1.58kg/m
Total weight of Steel required for X bars	= 1.58 × 7.2 = **11.37Kgs**
Weight of steel required for 1m of 12mm bar	= $D^2/162$ = $12^2/162$ = 0.88kg/m
Total weight of steel required for Y bars	= 0.88 × 7.2 = **6.33Kgs**

Total Weight of Plain Mesh
= Weight of steel required for X bars + Weight of steel required for Y bars
= 11.37Kgs+6.33Kgs =**17.70Kgs**

Isolated footings Bar Bending Schedule :-

Section view of Isolated footing
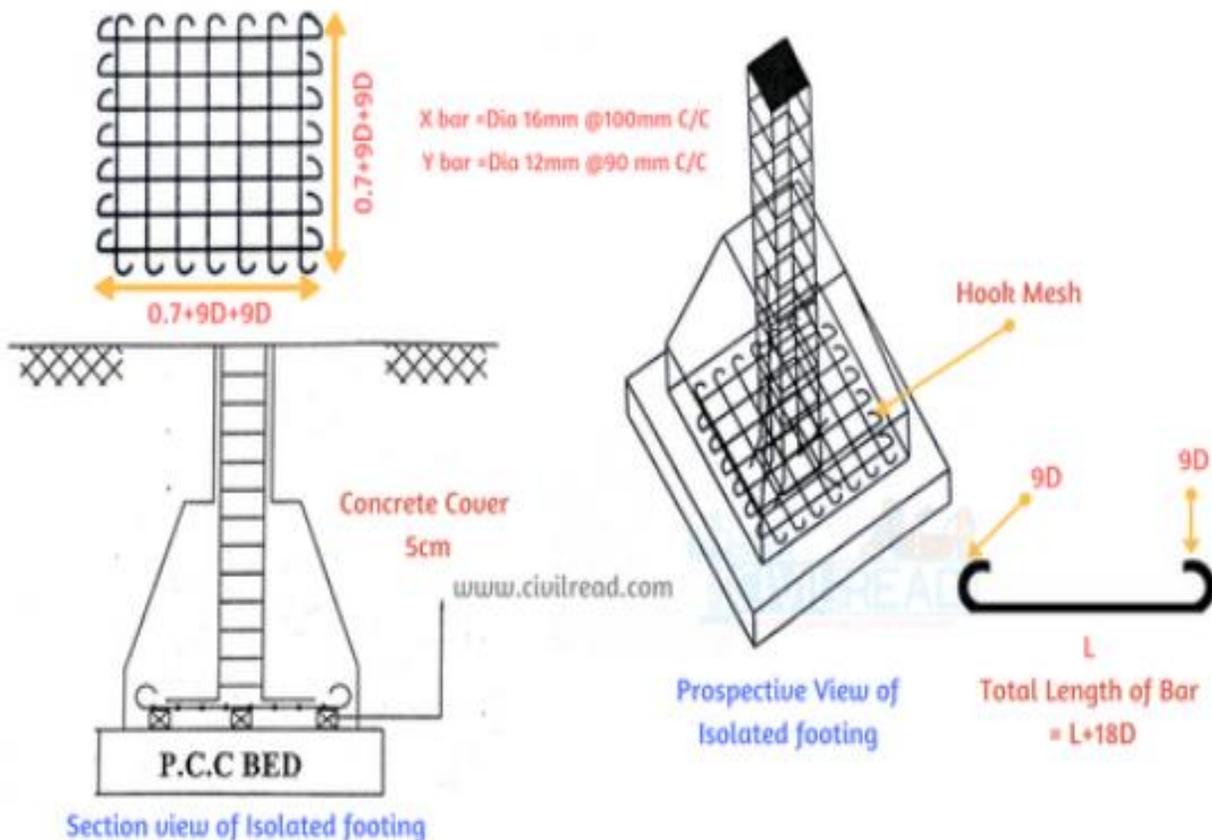
For the calculation of the total quantity of steel required for the Isolated footing, we are adopting below dimensions for bars.

Adopted:-

➢ **Hook mesh** is adopted for F3,F8 footings
➢ Dimensions of Footing are 0.9×0.9×0.5 (Length × Breadth × Depth)
➢ Dia of X Bars is **16mm** (Dia 16mm @ 100mm C/C)
➢ Dia of Y Bars is **12mm** (Dia 12mm @ 90mm C/C)
➢ which means Center to center spacing between X bars is **100mm** & Y bars is **90mm**

Remember Proper Concrete cover should be adopted for the reinforcement in Footings to resist it from corrosion.

Concrete Cover deduction:

As per condition, concrete cover of **0.1m** is deducted from all sides of mesh. In hook mesh, hook is provided at the end of each bar. Each bar has two ends and therefore, hook length is included in the calculation of length of bar

Hook Length = 9d (d is the dia of bar)

Total Hooks for each bar = 2

True dimensions post deducting concrete cover is length = (0.7m+2 x 9d) & breadth = (0.7m+2 x 9d)

Refer above image for more details

Length of Each X bar	= 0.7+2×9d d = 16mm = 0.016m = 0.7+2×9×0.016 = 0.988m
Length of Each Y bar	= 0.7+2×9d d = 12mm = 0.012m = 0.7+2×9×0.012 = 0.916m
No. of X bars	**[(Y Bar Length)/Spacing]+1** = [0.7/0.1]+1 = 8bars (Don't include hook length in calculating no. of bars)
No. of Y bars	**[(X Bar Length)/Spacing]+1** = [0.7/0.09]+1 = 9bars
Total Length of X bars	= Length of each X bar × No. of X Bars = 0.988 × 8 =7.9m
Total Length of Y bars	= Length of each Y bar × No. of Y Bars = 0.916 × 9 =8.24m
Total No. of '12m' X bars	= 7.9/12 = 0.65bars
Total No. of '12m' Y bars	= 8.24/12 = 0.68bars
Weight of steel required for 1m of 16mm bar	= $D^2/162$ = $16^2/162$ = 1.58kg/m
Total weight of Steel required for X bars	= 1.58 × 7.9 = **12.48Kgs**
Weight of steel required for 1m of 12mm bar	= $D^2/162$ = $12^2/162$ = 0.88kg/m
Total weight of steel required for Y bars	= 0.88 × 8.24 = **7.25Kgs**

Total Weight of Hook Mesh
= Weight of steel required for X bars + Weight of steel required for Y bars
= 12.48Kgs+7.25Kgs =**19.73Kgs**

Stepped footings Bar Bending Schedule:
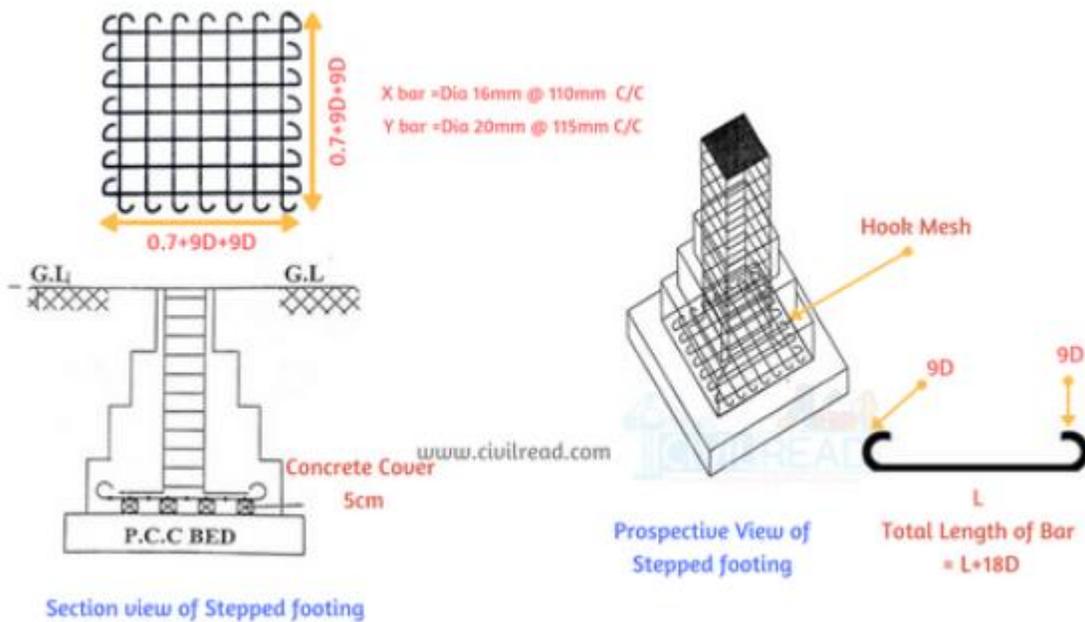
X bar =Dia 16mm @ 110mm C/C
Y bar =Dia 20mm @ 115mm C/C

0.7+9D+9D

0.7+9D+9D

Hook Mesh

9D

9D

Concrete Cover

5cm

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Section view of Stepped footing

**Prospective View of
Stepped footing**

L

**Total Length of Bar
= L+18D**

For the calculation of the total quantity of steel required for the Plain footing, we are adopting these dimensions for bars.

Adopted:-

➢ **Hook mesh** is adopted for F2 footings
➢ Dimensions of Footing are 0.9×0.9×1.35 (Length × Breadth × Depth)
➢ Dia of X Bars is **16mm** (Dia 16mm@110mm C/C)
➢ Dia of Y Bars is **20mm** (Dia 12mm@115mm C/C)
➢ which means Center to center spacing between X bars is **110mm** & Y bars is **115mm**

Remember Proper Concrete cover should be adopted for the reinforcement in Footings to resist it from corrosion.

Concrete Cover deduction:

As per condition, concrete cover of **0.1m** is deducted from all sides of mesh. In hook mesh, hook is provided at the end of each bar. Each bar has two ends and therefore, hook length is included in the calculation of length of bar

Hook Length = 9d (d is the dia of bar)

Total Hooks for each bar = 2

True dimensions post deducting concrete cover is length = (0.7m+2×9d) & breadth = (0.7m+2×9d)

Refer above image for more details

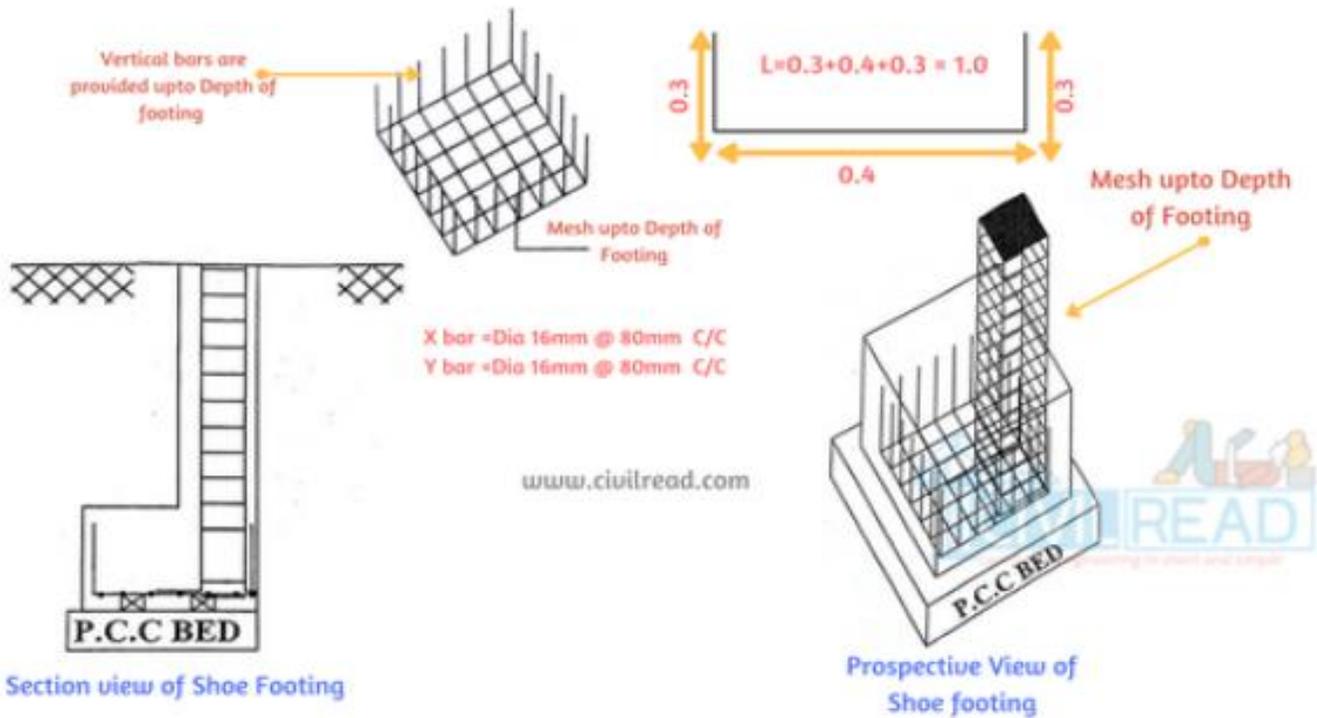| Length of Each X bar	= 0.7+2×9d
	d = 16mm = 0.016m
	   = 0.7+2×9×0.016
	   = 0.988m

Length of Each Y bar	= 0.7+2×9d
	d = 12mm = 0.012m
	   = 0.7+2×9×0.020
	   = 1.06m

No. of X bars	**[(Y Bar Length)/Spacing]+1** = [0.7/0.11]+1

|	
	= ~7bars (Don't include hook length in calculating no. of bars)
No. of Y bars	**[(X Bar Length)/Spacing]+1** = [0.7/0.115]+1 = ~ 6bars
Total Length of X bars	= Length of each X bar × No. of X Bars = 0.988 × 7 =7.9m
Total Length of Y bars	= Length of each Y bar × No. of Y Bars = 1.06 × 6 =6.36m
Total No. of '12m' X bars	= 7.9/12 = 0.65bars
Total No. of '12m' Y bars	= 6.36/12 = 0.53bars
Weight of steel required for 1m of 16mm bar	= $D^2/162$ = $16^2/162$ = 1.58kg/m
Total weight of steel required for X bars	= 1.58 × 7.9 = **12.48Kgs**
Weight of steel required for 1m of 12mm bar	= $D^2/162$ = $20^2/162$ = 2.46kg/m
Total weight of steel required for Y bars	= 2.46 × 6.36 = **15.64Kgs**

Total Weight of Hook Mesh

= Weight of steel required for X bars + Weight of steel required for Y bars
= 12.48Kgs + 15.64Kgs =**28.12Kgs**

Eccentric/Shoe footings Bar Bending Schedule:-

Vertical bars are provided upto Depth of footing

Mesh upto Depth of Footing

L=0.3+0.4+0.3 = 1.0

Mesh upto Depth of Footing

X bar =Dia 16mm @ 80mm C/C
Y bar =Dia 16mm @ 80mm C/C

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Section view of Shoe Footing

Prospective View of Shoe footing

For the calculation of the total quantity of steel required for the Plain footing, we are adopting these dimensions for bars.

Adopted:-

➢ **Mesh extended till Depth of Footing** is adopted for F5 footings
➢ Dimensions of Footing are 0.6×0.6×0.4 (Length × Breadth × Depth)
➢ Dia of X Bars is **16mm** (Dia 16mm@80mm C/C)
➢ Dia of Y Bars is **16mm** (Dia 16mm@80mm C/C)
➢ which means Center to center spacing between X bars & Y bars is **80mm**

Remember Proper Concrete cover should be adopted for the reinforcement in Footings to resist it from corrosion.

Concrete Cover deduction:

As per condition, concrete cover of **0.1m** is deducted from all sides of mesh. In Mesh extended till Depth of Footing, extra bar is bent towards the depth.

Length of Each X bar	= 0.4+0.3+0.3 = 1.0m
Length of Each Y bar	= 0.4+0.3+0.3 = 1.0m
No. of X bars	**[(Y Bar Length)/Spacing]+1** = [0.4/0.08]+1 = ~ 6bars (Don't include extra bar length in calculating no. of bars)
No. of Y bars	**[(X Bar Length)/Spacing]+1** = [0.4/0.08]+1

|	= ~6bars
Total Length of X bars	= Length of each X bar × No. of X Bars = 1.0 × 6 =6m
Total Length of Y bars	= Length of each Y bar × No. of Y Bars = 1.0 × 6 =6m
Total No. of '12m' X bars	= 6/12 = 0.5bars
Total No. of '12m' Y bars	= 6./12 = 0.5bars
Weight of steel required for 1m of 16mm bar	$= D^2/162$ $= 16^2/162$ = 1.58kg/m
Total weight of steel required for X bars	$= 1.58 \times 6$ **= 9.48Kgs**
Weight of steel required for 1m of 12mm bar	$= D^2/162$ $= 12^2/162$ = 1.58kg/m
Total weight of steel required for Y bars	$= 1.58 \times 6$ **= 9.48Kgs**

Total Weight of Mesh extended till Depth of Footing
= Weight of steel required for X bars + Weight of steel required for Y bars
=9.48Kgs+9.48Kgs =**18.96Kgs**

Combined Footing Bar Bending Schedule:-
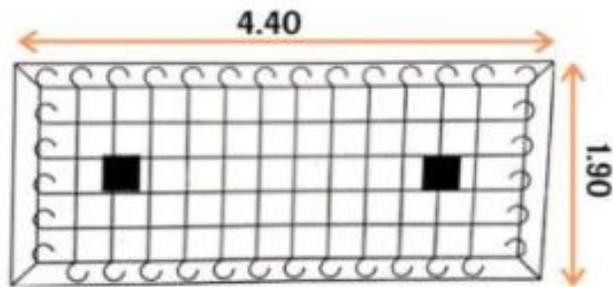
Top View of footing before concrete cover deduction
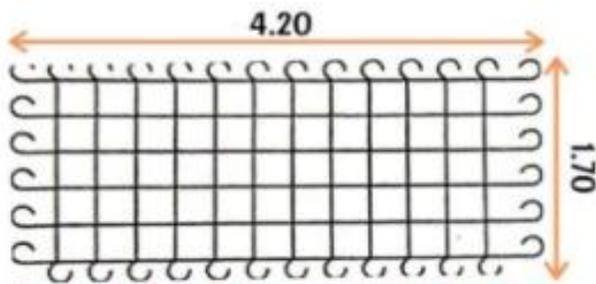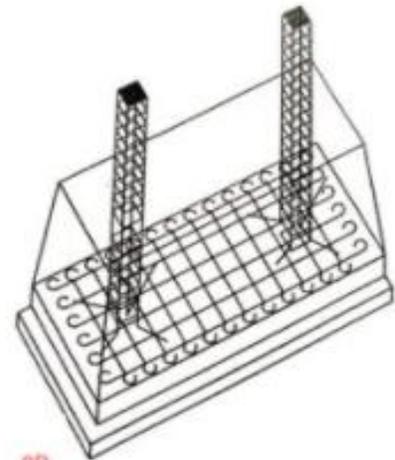
Top View of footing after concrete cover deduction

Total Length of Bar
= L+18D
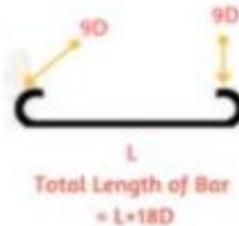
For the calculation of the total quantity of steel required for the combined footing, we are adopting these dimensions for bars.
Adopted:-

- ➢ **Hook Mesh** is usually adopted for F5 footing.
- ➢ Dimensions of Footing are 4.2×1.7×0.9(Length × Breadth × Depth)
- ➢ Dia of X Bars is **12mm** (Dia 12mm@100mm C/C)
- ➢ Dia of Y Bars is **12mm** (Dia 12mm@100mm C/C)
- ➢ which means Center to center spacing between X bars & Y bars is **100mm**

Remember Proper Concrete cover should be adopted for the reinforcement in Footings to resist it from corrosion.

Concrete Cover deduction:

As per condition, concrete cover of **0.1m** is deducted from all sides of mesh. In Mesh extended till Depth of Footing, extra bar is bent towards the depth.

Length of Each X bar	= 4.2+2×9d d = 12mm = 0.012m = 4+2×9×0.012 = 4.41m
Length of Each Y bar	= 1.7+2×9d d = 12mm = 0.012m = 1.7+2×9×0.012 = 1.91m
No. of X bars	**[(Y Bar Length)/Spacing]+1** = [1.7/0.1]+1 =18bars (Don't include hook length in calculating no. of bars)
No. of Y bars	**[(X Bar Length)/Spacing]+1** = [4.2/0.1]+1 = 43bars
Total Length of X bars	= Length of each X bar × No. of X Bars = 4.41 × 18 =79.38m
Total Length of Y bars	= Length of each Y bar × No. of Y Bars = 1.91 × 43 =82.13m
Total No. of '12m' X bars	= 79.38/12 = 6.6bars
Total No. of '12m' Y bars	= 82.13/12 = 6.84bars
Weight of steel required for 1m of 16mm bar	$=D^2/162$ $=12^2/162$ =0.88kg/m
Total weight of steel required for X bars	= 0.88 × 79.38 = **69.85Kgs**
Weight of steel required for 1m of 12mm bar	$=D^2/162$ $=12^2/162$ =0.88kg/m
Total weight of steel required for Y bars	= 0.88 ×82.13 = **72.27Kgs**

Total Weight of Hook Mesh

= Weight of steel required for X bars + Weight of steel required for Y bars

= 69.85Kgs+72.27Kgs =**142.12Kgs**

Abstract of above calculation:-

Footing BBS Abstract : Sheet1

S.No	Footing Type	Type of Mesh	Dia of Bar		Length of Bar		No. of Bar		Total Length of Bar		Wt of Steel in Kgs/m		Total wt in Kgs	
			X Bars in m	Y Bars in m	X Bars in m	Y Bars in m	X Bars	Y Bars	X Bars in m	Y Bars in m	X bar in Kg/m	Y bar in Kg/m	X Bars in Kgs	Y Bars in Kgs
1	F1	Plain Mesh	0.016	0.012	0.8	0.8	9	9	7.2	7.2	1.58	0.88	11.37	6.33
2	F2	Hook Mesh	0.016	0.02	0.988	1.06	7	6	7.9	6.36	1.58	2.46	12.48	15.64
3	F3	Hook Mesh	0.016	0.012	0.988	0.916	8	9	7.9	8.24	1.58	0.88	12.48	7.25
4	F4	Plain Mesh	0.016	0.012	0.8	0.8	9	9	7.2	7.2	1.58	0.88	11.37	6.33
5	F5	Hook Mesh	0.012	0.012	4.41	1.91	18	43	79.38	82.13	0.88	0.88	69.85	72.27
6	F6	Mesh extended	0.016	0.016	1	1	6	6	6	6	1.58	1.58	9.48	9.48
7	F7	Plain Mesh	0.016	0.012	0.8	0.8	9	9	7.2	7.2	1.58	0.88	11.37	6.33
8	F8	Hook Mesh	0.016	0.012	0.988	0.916	8	9	7.9	8.24	1.58	0.88	12.48	7.25
											Sub Total		**150.88**	**130.88**

4.0 PWD ACCOUNTS WORKS

Works :

Classification of work:

   Works are primarily divided into two classes— "Original works" and "Repairs or maintenance."

Original Work: Original works include all new constructions whether of entirely new works or of additions and alterations to existing works which increase the capital cost of a building or work. Repairs to newly purchase or previously abandoned buildings required to render them useable are also original works.

Repairs Work: Repairs or maintenance includes all operations required to maintain in proper condition buildings and works in ordinary use.

Petty Work, Minor Work and Major Work: A petty work is one the cost of which does not exceed Rs. 20,000, a minor work is one the cost of which exceeds Rs. 20,000, but does not exceed Rs. 1,00,000 and a major works is one the cost of which exceeds Rs. 1,00,000.

NOTES—(1) In the case of mixed estimates, if the amount debitable to the "Original Works" portion of the estimate is Rs. 20,000 or less then it should be treated as a petty work and not minor work although the total cost of such mixed work (including repairs) might exceed Rs. 20,000 and the departmental head should be responsible for the execution of such mixed work and for finding funds for the purpose from their own budgets. When the original works portion of a mixed estimate exceeds Rs. 20,000 then it should be treated as a minor work and the whole work including repairs should be entrusted to the Public Works Department for execution. Provision for such works should be made in the Public Works Department budget both under "Original Works" and "Repairs."

(2) When an existing building is to be re-modelled or a portion thereof is to be replaced, then, if a type of construction or material of a more costly nature than that which previously existed is to be adopted or if the proposed reconstruction will result in an increase of accommodation, only one estimate will be prepared but the estimate will be a mixed estimate part of which is chargeable to "Original Works" and part to "repairs." The amount to be charged to "Original Works" will be the total estimated cost of the work minus the original cost (estimated, if necessary) of that portion of the building which has been replaced.

Exception—When in any one estimate, the amount chargeable to "Original Works" is less than Rs. 2,000 the whole of the expenditure may be charged to repairs ; provided that if the work relates to a residential building the amount which is correctly chargeable to "Original Works" is added to capital value and taken into account in calculating the rent.

Repair work

The repair works are classified in under mentioned categories:

- Day to day repairs/service facilities
- Annual repairs
- Special repairs

Day to day repairs

   Day to day repairs are carried out by CPWD in all the buildings under its maintenance. The works which are to be attended on day to day basis such as removing chokage of drainage pipes, man holes, restoration of water supply, replacement of blown fuses, repairs to faulty switches, watering of plants, lawn mowing, hedge cutting, sweeping of leaf falls etc. are attended under day to day service facilities. The purpose of this facility is to ensure satisfactory continuous functioning of various services in the buildings. These services are provided after receipt of complaint from the users at the respective Service Centres. Complaints of periodical nature like white washing, painting etc.. which are usually got attended through contractors and cannot be attended on daily basis is transferred to register of periodical repairs.

Annual Repairs

The works of periodical nature like White washing, colour washing. distempering, painting etc. are called Annual Repair works and these are generally undertaken; through system of contracts.

The periodicity of applying white washing and colour washing for a building has been laid down by the Government. The periodicity is two years for white washing and colour washing and three years for painting. In addition, works such as patch repair to plaster, minor repairs to various items of work, replacement of glass panes, replacement of wiring damaged due to accident, replacement of switches, sockets tiles, Gap filling of hedges/perennial beds, Replacement/Replanting of trees, shrubs, painting of tree guards, planting of annual beds and trimming /pruning of plants etc., which are not emergent works and are considered to be of routine type, can be collected and attended to for a group of houses at a time and particular period of financial year, depending upon the exigency. Such works can be done under day to day repair also. The yard stick for annual repairs cover both the above facilities.

SPECIAL REPAIRS

As the building ages, there is deterioration to the various parts of the building and services. Major repairs and replacement of elements become inevitable. It becomes necessary to prevent the structure from deterioration and undue wear and tear as u.ell as to restore it back to its original conditions to the extent possible. The following types of works in general are undertaken under special repairs: -

   I. White Washing, Colour washing, distempering etc., after completely scrapping the existing finish and preparing the surface afresh.
  II. Painting after removing the existing old paint from various members.
 III. Provision of water proofing treatment to the roof. All the existing treatments known are supposed to last satisfactorily only for a period of about ten years.
  IV. Repairs of internal roads and pavements.
   V. Repairs/replacement of flooring, skirting, dado and plaster.
  VI. Replacement of doors, window frames and shutters. Replacement of door and window fittings.
 VII. Replacement of water supply and sanitary installation like water tanks, WC cistern, Wash basins, kitchen sinks, pipes etc..
VIII. Re-grassing of lawns/grass plots within 5-1 0 years.
  IX. Renovation of lawn in 5-6 years.
   X. Replanting of hedges in 8- 10 years.
  XI. Completely uprooting and removing hedges1 shrubbery.
 XII. Replanting of
   a)   Rose beds in 5-6 years.
   b)   Perennial beds in 5-6 years.
   c)   Cannal beds in 1-2 years.
XIII. Shifting of any garden feature from one site to another within building.

Quadrennial repair work

Besides annual repair work of white washing and colour washing , every fourth year special repair works are done for through repair as repainting of doors and windows, patch repair of plastering etc. Special repair work every fourth year is known as **Quadrennial Repair.**

Method of execution of works through the contractors

Contract and agreement

When two or more persons have common intention communicated to each other to create some obligation between them there is said to be an agreement. An agreement which is enforceable by law is a "**Contract**."

According to Section 10 of the Indian Contract Act, 1872 only thus agreements are enforceable by law which are made by the free consent of parties competent to contract, for a lawful consideration and with a lawful object and, are not expressly declared to be void. This is subject to any special law according to which a contract should be in writing and attested by witnesses.

The following are the essential ingredients of a contract:-
a) Offer made by one person called the "Promisor".
b) Acceptance of an offer made by the other person called the "Promisee".
c) Doing of an act or abstinence from doing a particular act by promisor for promisee called consideration.
d) The offer and acceptance should relate to something which is not prohibited by law.
e) Offer and acceptance constitute an agreement, which when enforceable by law, become a contract.
f) In order to make a valid and binding agreement, the party entering into such an agreement should be competent to make such agreement.

For the purpose of an agreement, there must be a communication of intention between the parties thereto. Hence in the forms of a Contract there is:
(a) A proposal.
(b) Communication of the proposal.
(c) A communication of the acceptance of the proposal.

The communication of acceptance of the proposal completes the agreement. An offer may lapse for want of acceptance or be revoked before acceptance. Acceptance produces something which cannot be recalled or undone. A contract springs up as soon as the offer is accepted and imposes an obligation upon the person making the offer. It has been opined by the Ministry of Law that before communication of acceptance of an offer the tenderer would be within his right to withdraw, alter and modify his tender before its acceptance, unless there is a specific promise to keep the offer open for a specific period backed by a valid consideration.

Work order

Small work up to Rs. 2000.00 may be carried out by work order. This is a contract and specifies the approximate quantities of different items of work , details specification of each item of work, time completion of the whole work , penalty that will be imposed for not fulfilling the terms and conditions etc. Payment is made on the measurement of work done and 10% of the bill amount is deducted from the running bill of the contractor as security money which amount is refunded in the final payment on the satisfactory completion of the work. Debitable agency can be engaged for bad work or for unsatisfactory progress. Cotractors are usually selected by taking quotations. (P.W.Agreement is used in P.W.D and Work Order is used in Irrigation Department)

Item rate contract

It is also knows as **Unit-price contract** or **Schedule contract.** For item rate contracts, contractors are required to quote rates for individual item of work on the basis of schedule of quantities furnished by the department. This schedule indicates full nomenclature of the item as per sanctioned estimate, estimated quantities and therein. While filling up the rates , the contractors are required to express the amount in figures 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 them . This type of contract is followed by Railway Department.

Lump sum contract

As its name indicates, is used for work in which contractors are required to quote a lump-sum figure for completing the works in accordance with the given designs, drawings, specification and functional requirements as the case may be. Lump-sum tender can be either for only executing the work as per given design, drawing and specification or it may include

element of doing design work and preparation of structural drawings as well which shall be in keeping with the given functional, structural and architectural parameters and subject to approval by the competent authority beforehand.

In cases where work is to be executed as per design and drawing of the department, all the detailed working drawings, both architectural and structural must be prepared before hand and should form part of the tender documents which should also contain complete and detailed specifications of the work. The tender documents must set out complete scope of the work. Only the drawings and the detailed specifications as contained and/or referred to in the tender documents shall form the basis of execution and payment. The extra payment or recovery over and above the accepted rate shall therefore be called for only in the event of authorized deviations from the drawings and specifications (as given and/or referred to in the tender documents) in course of execution and not otherwise.

In cases where the detailed architectural and structural drawings are to be provided by the Contractor, all the architectural and structural data/parameters necessary to work out the cost of the work, details of the functional requirement and complete/detailed specification thereof including preliminary drawings if any, must be finalised before call of tender and the tender documents must contain all these details so that there is little scope of guess work on the part of the contractor while tendering and chances of dispute at later stage are minimised.

A condition should be stipulated in the tender documents that the work shall be executed as per detailed design and architectural/structural drawings to be prepared by the successful contractor conforming to the given parameters and functional/design requirements as enunciated in the tender documents and submitted to the department within specified time after the award of work. The contractor shall accordingly get the design/drawings approved by the department before taking up execution of the work. In case any modification for any reason is ordered in course of execution, suitable adjustment for extra payment or recovery shall be effected only if such modification in the tender documents or any change from the specified parameters.

Labour contract

In Labour contract the contractors undertakes contract for the labour portion. All material for the construction are arranged and supplied at the site of work by the department or owner, the labour contract engages labour and gets the work done according to specifications. 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 item of work at the stipulated rate in the contract agreement. Materials for scaffolding, centering and shuttering and other similar materials are supplied by the department or owner ; contractor may also use his own materials for scaffolding, centering and shuttering, etc. if provided in the agreement. Contractor uses his own tools for working , but plants and machineries are arranged by the dept. Or   owner. An agreement with all conditions of contract, rates bill of quantities (BOQ) etc. is prepared before the work is given out to the contractor. This system of contract is not generally adopted in the Govt. Deptt. . Private buildings are however by labour contract system which is less troublesome.

Daily labour

Work may be executed by departmentally by employing daily labour as masons, coolies , bhisties, carpenters, etc. The materials required for the construction as bricks, cement, sand lime, timber, steel etc. and tools and plants required for the operation are, got issued from the store by indent or purchased directly chargeable to the authorised agent as work-supervisor , misty, mate, etc. The attendance of labour is checked and initialled by Assistant Engineer or Sub-Divisional Engineer   frequently during their inspections. The labour are paid weekly, fortnightly, monthly or at the completion of work according to the requirement.

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. 2000.00 may be carried out through contractors by Piece work agreement. The P.W.Agreement contains only the descriptions of different items 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 specification of the different items of work to be done are however included in the P.W.Agreement and the total cost of the whole work to be done is also mentioned. Contractors have to arranged all materials, labours, etc., required for the execution of work., P.W.Agreement are not contracts in the true sense , there is no penalty clause and no security money and the department may terminate the work at any time they like but a notice specifying the date of termination should be served to the piece worker. Separate agency may also be engaged chargeable to the contractor to complete the work if the contractor does not carry out the work satisfactorily to the specification or delays the work or leaves the work incomplete or used bad materials. Urgent small work are selected by taking quotations. Rates of different item should be within schedule of rates or within sanctioned estimated rates . Payment is made on the measurement of the work actually done.

Scheduled contract or Item Rate contract:

In Schedule contract , the contractor undertakes the execution or construction of a work on the item rate basis. The amount the contractor is to receive depends upon the quantities of various items of work actually done. The contract agreement includes quantities, rates and amounts for various item of work and the total amount of contract (BOQ with rate , amount and total amount), plans and detailed drawings, detailed specifications and deposit of 10% security money; penalty, progress, date of completion and other conditions of contract. The payment to the contractor is made by detailed measurement of different items of works actually done by the contractor. The system is used for all works.

Item Rate Contract may also be a percentage above or below the printed schedule of rates of the department

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 labours 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 beforehand. An 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 have to be exercised by the department or owner.

Accounts of works

Explanation of various terms

Administrative approval

For any work or project required by a department , an approval or sanction of the competent authority of the department, w.r.t the cost and work is necessary at the first instance. The approval authorise the engineering department to take up the work . Administrative approval denotes the formal acceptance by the department concern of the proposal , and after the administrative is given the engineer department (P.W.D) take up the work and prepare detailed designs, plans and 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

After receipt of administrative approval and expenditure sanction, detailed estimates are required to be prepared for technical sanction. As its name indicates, it amounts to no more than a guarantee that the proposals are structurally sound and that the estimates are accurately calculated and based on adequate data.

Before an estimate is technically sanctioned, the following shall be available.

(i)   Detailed architectural drawings and specifications
(ii)   Structural drawings for foundations
(iii)   Structural drawings of superstructure at least upto slab at level 2
(iv)   Detailed drawings of internal and external services.

Before according technical sanction to detailed estimates, the authority competent to accord such sanction shall ensure that the design and specification etc., of the building are rich enough to provide the desired life to it. In the 'Design and Scope' column of the estimate, it shall be specifically mentioned that, 'Under normal use and maintenance, the building is expected to have an economic life of .... years.'

For various types of buildings, the economic life shall be taken as below:

(a) Monumental structures 100 years
(b) RCC framed structures 75 years
(c) Load bearing structures 55 years
(d) Semi permanent structures 30 years

The technical sanction should be given by the competent authority before a work is taken in hand. In case of revised estimates, it is not necessary to wait for the revised administrative approval or the revised expenditure sanction to accord revised technical sanction.

Contingency budget

A contingency budget is money set aside to cover unexpected costs during the construction process. This money is on reserve and not allocated to one area of the work, and simply "insurance" against other costs.

In deterministic methods, contingency is estimated as a predetermined percentage of base cost depending on the project phase. In this technique, you take a percentage of the cost of the project and calculate the contingency amount.

The estimated costs of the known-unknowns is referred to by cost estimators as cost contingency. Contingency "refers to costs that will probably occur based on past experience, but with some uncertainty regarding the amount. The term is not used as a catchall to cover ignorance.

Tender

To tender is to invite bids for a project or accept a formal offer such as a takeover bid. Tendering usually refers to the process whereby governments and financial institutions invite bids for large projects that must be submitted within a finite deadline.

Before tenders for a work are invited a detailed estimate showing the quantities, rates and amounts of the various items of work and also the specifications to be adopted should be prepared. Before sanctioning, the draft of the detailed estimate, for works having involvement of Architect, should be sent to the Senior Architect to examine it vis-a-vis the specifications of various items provided by him.

In case of works for which tenders are to be invited, tender documents comprising of the following should be prepared and approved by an authority who is empowered to approve the Notice Inviting Tenders (NIT) before notice inviting tender is issued.

I.   The notice inviting tender in Form PWD 6.
II.   The form of tender to be used along with a set of conditions. Particular specifications and special conditions should not be repetitive and in contradiction with each other. Additional condition to be decided by NIT approving authority and he should be responsible for the same.
III.   The schedule of quantities of work.
IV.   A set of drawings referred to in the schedule of quantities of work.
V.   Specification of the work to be done.

Executive Engineer/Assistant Executive Engineer/Assistant Engineer issuing the tenders should invariably date and initial corrections, conditions and additions in the Schedule of Quantities, Schedule of Material to be issued and specifications and other essential parts of contract documents, and also date and initial on pages of the tender documents irrespective of fact whether they contain or do not contain any corrections or over writings etc. The officer concerned should record the fact in writing at the end of those pages individually.

Preparation of notice inviting tender

All notice calling for tenders should be in the standard form and be serially numbered, a proper register being maintained for the purpose. They should only be issued after the authority competent to accept the tender has approved the NIT papers. The notice inviting tenders should be carefully prepared, the use of symbols % and per thousand in the schedule of quantities accompanying the Notice Inviting Tenders is prohibited and the words hundred and thousand must be written e.g. "Per hundred sq. metre" must be written and not "% sq. metre". The units should thus be more specific.

In case of lump-sum tenders the Divisional Officer should see that detailed drawings and specifications duly authenticated by the competent authority form part of the notice inviting tenders and that the cost of various items forming part of the sanctioned estimate of the work is correctly assessed with reference to the relevant schedule of rates or in the case of non schedule items on the basis of rates supported by detailed analysis therefore, sanctioned by the competent authority.

The NIT papers are very important documents on which call of tenders and subsequent agreements with the contractors are based. It is, therefore, very necessary that each page and the correction slips as also other corrections and modifications made in the NIT papers are numbered and signed by the competent authority in token of approval so that all chances of tampering with such documents are avoided. Mere approval on forwarding letters would not serve the purpose. All corrections in the NITs and pages of the NITs approved by the Superintending Engineer and Chief Engineer should be attested by the Surveyor of Works. Thereafter the documents must be properly sealed to prevent any tempering.

It will be the responsibility of the Divisional Accountant to see that all forms issued to tenderers whether printed or otherwise, are clear, legible and unambiguous. The schedule of quantities attached to tender document other than Form PWD 7 must also contain a column for the "Amount" after the column "Rate" and the contractor must calculate the amount of each item and enter it in the column. The Contractor must also total these amounts both by sub-head and give a grand total in words and figures both.

It will also be the duty of the Divisional Accountant to ensure that the tenders are issued to only those contractors who satisfy the eligibility criteria for issue of tenders as inserted in the Press Notice. He should properly scrutinise the applications received for issue of tenders keeping in view the eligibility criteria and then put up to the Executive Engineer for a decision.

The NIT for all works for which tenders are invited on PWD form 7 should provide that the Contractor should quote the percentage above or below to two places of decimal only.

The Notice inviting tender should stipulate reasonable time for completion of work. For building works, the Schedule of Contract period should be decided in accordance with Appendix 16 of this Manual by the NIT approving authority.

It should be ensured that a specific reference to the number of correction slips is made while mentioning the schedule of the rates or the CPWD specifications for works at Delhi, e.g. "Schedule of Rates .... for Delhi with correction Slips .... to ...." and "CPWD Specifications for works at Delhi .... with correction Slips .... to ....". The name should include the year also.

Receiving of quotations

A quotation, or quote, is a document that a supplier submits to a potential client with a proposed price for the supplier's goods or services based on certain conditions. Therefore, a quotation is often required for services but is also commonly used by businesses that sell goods.

Earnest money

According to the practice in Central PWD, earnest money is paid by each tenderer to enable Government to ensure that a tenderer does not refuse to execute the work after it has been awarded to him. In case where a tenderer fails to commence the work awarded to him, the earnest money is absolutely forfeited to the President.

If only a part of the work as shown in the tender is awarded and the contractor does not commence the work, the amount of the earnest money to be forfeited to the Government should be worked out with reference to the estimated cost of the work so awarded.

Rates of Earnest Money

The amount of the earnest money which a contractor should deposit with the tender is regulated by the following scales. In case of petty works costing Rs. 5,000/- or less the Executive Engineer may, at his discretion, dispense with the conditions for calling for earnest money.

(i) For works estimated to cost upto   2% of the estimated cost .Rs. Twenty five crores

(ii) For works estimated to cost more Rs. fifty lakhs plus 1% of the excess of than Rs. twenty five crores estimated cost over Rs. twenty five crores.

Rules For Enlistment of Contractors in CPWD, 2001, do not provide for exemption of depositing earnest money with individual tenders by the contractors. Therefore, no exemption of earnest money against lump sum deposit is to be mentioned in the enlistment/revalidation orders.

Security deposit

The security deposit will be collected by deductions from the running bills of the contractors at the rate mentioned below and the earnest money, if deposited in cash at the time of tender, will be treated as part of security deposit. The security deposit will also be accepted in cash or in the form of Government Securities, Fixed Deposit Receipts. Performance security may be accepted as Bank Guarantee of Scheduled Banks and State Bank of India .

A sum @ 10% of the gross amount of the bill shall be deducted from each running bill of the contractor till the sum along with the sum already deposited as earnest money, will amount to Security Deposit of 5% of the tendered value of the work. In addition, the contractor shall be required to deposit an amount equal to 5% of the tendered value of the contract as Performance Security within the period prescribed for commencement of work in the letter of award issued to him.

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 case when the work is sufficiently progressed but measurement cannot be taken for certain valid reasons, on the certificates of Assistant Engineer in-charge of work that the value of work done is 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 payment

Means a payment made on a running account, to a contractor in respect of work done or supplied made by him and duly measured. Such a payment may or may not be for the full value of work or supplied; if it is subject to the final settlement of running account on the completion of the contract for the work or supplies.

Intermediate payment

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

Final payment/ Final Bill

This means 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"**

Running bill

Denotes the account with a contractor when payment for work or supplies is made to him at convenient intervals subject to final settlement of the accounts on the completion or determination of his contract.

Regular and temporary establishment

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 a acknowledgement of receipts) may be kept as part of cash balance.

Major & subhead of account

- 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 subheads are further divided into detailed heads. Sometimes major heads may be divided into 'sub-major heads' before their further division into minor heads.

- The Sectors, Major heads, Minor heads, Sub-heads and Detailed heads together constitute a five tier arrangement of the classification structure of Government Accounts.

- The Major Heads corresponds to 'Functions' of the Government.

- Minor Heads subordinate to the Major Head shall identify the 'Programme' undertaken to achieve the objectives of the function.

- The sub head below the Minor Head represents various schemes or activities under the programme. Detailed Head is termed as object classification.

- The detailed classification of account heads in Government Accounts and the order n which the Major and Minor Head shall appear in all the account records shall be such as prescribed by the Central Government from time to time on the advice of C&AG of India.

- The 'List of Major and Minor Heads of Account of Union and States contains the classification prescribed in this regard.

- The classification prescribed should be strictly followed.

Temporary advance

An accountable advance that substitutes for credit or other payment arrangements that would ordinarily be used under similar circumstances (e.g., advancing cash to a construction contractor for materials received on site instead of only paying for work that has already been erected, inspected, accepted, and invoiced).

Issue rate

Issue rate denotes cost per unit fixed on the article of stock for the purpose of calculating the amount creditable to the subhead concerned of stack account 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.

Storage charges

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

Supervision charges

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

Suspense account

A suspense account is a general ledger account in which amounts are temporarily recorded. The suspense account is used because the appropriate general ledger account could not be determined at the time that the transaction was recorded.

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. 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.

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 the account of the payee when both accounts are with the same bank.

Voucher and related accounts

A voucher is an accounting document representing an internal intent to make a payment to an external entity, such as a vendor or service provider. A voucher is produced usually after receiving a vendor invoice, after the invoice is successfully matched to a purchase order.

They are:

➢ Debit or Payment voucher.

➢ Credit or Receipt voucher.

➢ Non-cash or Transfer Voucher.

➢ Supporting Voucher.

Measurement book use & maintenance, procedure of marking entries of measurement of work and supply of materials, labour employed, standard measurement books and common irregularity

The measurement book is the basis of all accounts of quantities whether of works done by Contractors or by Labourers employed departmentally or materials received. It should be so written that the transactions are readily traceable.

These books should be considered as very important accounts records and maintained very carefully and accurately as these may have to be produced as evidence in a court of law, if and when required.

All the Measurement Books belonging to a Division, should be numbered serially. A register should be maintained in form CPWA 92 showing the serial number of each book, on receipt, Sub-Division to which it is issued, the date of issue, date of its return to the Divisional Office and date of its record after the required review in the Divisional Office has been completed.

A similar register should be maintained in the Sub-Divisional Office showing the names of person i.e. Assistant Engineer/Assistant Executive Engineer and Junior Engineer whom the measurement books are issued.

The Books, no longer to be used in the Sub-Division or with the Junior Engineer should be withdrawn promptly even though not completely written up and re-issued.

The Measurement Books are required to be reviewed by Divisional Accountant under the supervision of Executive Engineer. The Assistant Engineers are required to submit the Measurement Books in use in the Sub-Divisions to the Divisional Office, from time to time, so that at least once a year the entries recorded in each of the Books are subjected to a percentage check. The Divisional Officer should ensure that this annual review is conducted regularly and positively every year.

When an Assistant Engineer or Junior Engineer in charge of the work or stores is transferred he should hand over the Measurement Books issued to him to his successor and these should be shown as received back from him and reissued to the relieving Officer. The transfer should also be recorded in the Measurement Book after the last entry in each book under dated signature of the relieving Officer and relieved Officer. Recording of Measurement

Each set of measurements to be recorded should commence with entries stating:-

(i) In the case of bills for works done:
    a) Full name of work as given in the agreement/Estimate.
    b) Situation of work.
    c) Name of contractor.
    d) Number and date of agreement.
    e) Date of written order to commence work.
    f) Date of actual completion of work.
    g) Date of recording measurements.
    h) Reference to previous measurements.

(ii) In the case of bills for supply of materials:
    a) Name of supplier.
    b) Number and date of supply order/agreement.
    c) Purpose of supply in one of the following forms as applicable to the case.
    d) Stock (for all supplies for stock purpose).
    e) "Purchase" for direct issue to the work (full name of the work as given in the estimate may be mentioned).
    f) "Purchase" for (full name of work as given in estimate) for issue to contractor ...... on...... (d) Date of written order to commence the supply.
    g) Date of actual supply; and
    h) Date of recording measurements.

A suitable abstract should then be prepared which should collect in the case of measurement for works done, the total quantities of each distinct item of work relating to each sanctioned sub-head. The measurement books meant for this purpose contain pages in singleton. Details of quantities, rate and amount of each item for every bill are entered in this Measurement Book in a tabular form.

For recording measurements and also for preparing abstract, the agreement item No. both in words as well as in figure should be given neatly, instead of writing the description of the item in full or in abbreviated form which would not be necessary.

In case of extra/substituted item of work that is not covered in the agreement, the full nomenclature shall be reproduced in the M.B. and the bill form.

The full nomenclature of the items shall be adopted in preparing abstract of final bill in the measurement book and also in the bill form for final bills.

If the measurements are taken in connection with a running contract, a reference to the last set of measurements, if any, should be recorded. If the entire job or contract has been completed, the date of completion should be duly noted in the prescribed place. If the measurements taken are the first set of measurements on a running account, or the first and final measurements, this fact should be suitably noted against the entries in the Measurement Book and in the latter case, the actual date of completion should be noted in the prescribed place.

All measurements should be recorded neatly in the Measurement Book. The signature of the contractor or his authorised representative should be obtained in the measurement book for each set of measurements.

Muster roll : Its preparation & use for making payment of pay & wages

Muster Roll is used for keeping a complete record of attendance, payment made , unpaid wages and work done by daily labour engaged on the execution of works. It is the basic records of payment made to daily labour. After the payment is made ,the Muster Roll is kept as a Voucher.

Muster rolls should be prepared and dealt with in accordance with the following rules :

1. One or more muster rolls should be kept for each work, but muster rolls should never be prepared in duplicate. It is permissible, however, to keep one muster roll for labourers employed upon several small works, in cases in which no harm can result if the total unpaid wages are regarded as relating only to the largest work in the group.
2. Labourers may be paid more than once a month and the period covered by each payment may be determined locally; but separate rolls must be prepared for each period of payment.
3. The daily attendances and absences of labourers and the fines inflicted on them should be recorded daily in part I of the muster roll in such a way as —
    (i) to facilitate the correct calculation of the net wages of each person for the period of payment;
    (ii) to render it difficult to tamper with or to make unauthorized additions to or alterations, in entries once made, and
    (iii) to facilitate the correct classification of the cost of labour by works and sub-heads of works where necessary.
4. After a muster roll has been passed by the local officer, payment thereon should be made as expeditiously as possible. Each payment should be made or witnessed by the official of highest standing available, who should certify to the payments individually or by groups, at the same time specifying both in words and in figures, at the foot of the muster roll, the total amount paid on each date. If any items remain unpaid, the details thereof should be recorded in part II of the register of arrears, before the memorandum at the foot of the muster roll is completed by the person who made the payment.
5. Unpaid items should subsequently be carried forward from muster roll to muster roll until they are paid, the payments being recorded and certified in part II in the same way as payments of current items. It is optional, however, with the local officer to adopt any other alternative method of making payments of unpaid wages, provided that a systematic record of items remaining unpaid is maintained on the basis of the original entries made in part II of the muster roll and that suitable precautions are taken to prevent double payments.
6. Wages remaining unpaid for three months should be refunded into Treasury.
7. The payment of daily labour through a contractor instead of by muster roll in the usual way, is objectionable in principle. In a case of great emergency it may sometimes be found impossible to employ labour otherwise than through a contractor. Should it be

possible in such a case, to determine the quantities of work done after its completion or at intervals during its progress, it is expedient to pay the contractor, at suitable rates, on the basis of work actually executed. To avoid disputes with the contractors, they should be encouraged to sign the daily reports in token of their acceptance as correct.

N.B.—The use of the muster roll is not permissible in such cases.

8. When it is necessary to bring labourers and artificers from a distance they may be allowed wages for the number of days occupied in the journey to and from the site of the work, if they join the work with proper despatch. At the discretion of the local officer, bona fide travelling expenses may also be allowed to them. The above charges must be borne by the estimate of the work.

Acquittance Roll : Its preparation & use for making payment of pay & wages
Labour & labour report, method of labour payment, use of forms and necessity of submission

The payment of salary to persons of regular establishment working outstation is drawn on the regular pay-bill , but 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 and Date signature. The Acquittance Roll is prepared for the total amount as per Establishment Bill are passed 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.

Classification of stores, receipt / issue statement on standard form, method of preparation of stock account, preparation and submission of returns, verification of stocks, shortage and excess

The stores of the W.D. are divided into the following classes:-

(i) **Stock –** Consumable materials like cement, steel, pipes, paints, spare parts of machinery, P.O.L (Petroleum, Oil, & Lubricants)., tyres, tubes etc. fall in this category.

(ii) **Tools and Plants.-** Such equipments which can be shifted from one work site to another work site as and when required for the construction activities fall under this category e.g., spades, pickaxes, vehicles, road rollers, drilling rigs, concrete mixer /vibrator, compressor, jack hammer etc**.**

(iii) **Road materials. –** Metal, moorum, gravel etc. fall in this category.

(iv) **Material charged direct to work. –** Materials, which are accounted for in "Materials at Site Account" fall in this category. Also the machinery which shall be fixed or embedded at one place permanently shall fall in this category e.g. electric motor or pump to be fixed in pump house, electric switches etc.

(v) **Materials charged to office contingencies.–** Stationery, furniture, typewriters, calculators, duplicating machines, copying machines, air conditioners, air coolers, water coolers, office cycle, three wheelers, blankets, warm clothing etc. fall in this category.

Receipt / issue statement on standard form

(i) The indent books should be machine-numbered and kept in stock by the Executive Engineer, In-charge of Central Stores. He issues these indent books stamped with the stamp of his office to the various indenting Divisions and only the indents issued from such books are accepted by the Central Stores Divisions.

(ii)   The Executive Engineer in charge of the work is required to send three sets of the specimen signatures of the Junior Engineer and Assistant Engineer in charge of the work at the work site and that of the work Assistant, if any, authorised by the Executive Engineer for receiving stores in the Junior Engineer's absence, duly attested by him to the Central Stores. One set thereof will be kept by the Junior Engineer security and the other two sets will be in the Office under the personal custody of the Assistant Engineer (Indents) and Executive Engineer, Central Stores Division.The specimen signature of the EE shall be attested by the outgoing EE. For new Division, it is to be done by the SE.

(iii)The signatures of the contractors or their authorised Agents to whom the materials are required to be issued are attested by the Asstt. Engineer and the indent is countersigned by the Executive Engineer of the indenting Division.

(iv)The Contractors are required to obtain identity photopasses for themselves or their authorised agents, duly attested by the Executive Engineer of the Indenting Divisions and of the Central Stores Division. On the photopass or identity card, the name of the work, for which the contractor or his agent is authorised to draw the materials is mentioned and the contractor or his agent is allowed to draw materials only for that work.

(v) While sending the photographs of the Contractors or their authorised agents for drawal of the materials from the Central Stores, the following certificate should be recorded by the Executive Engineer of the Indenting Division :—
Shri .... whose signature and photograph are attested by me is an authorised agent of Messers .... The indent placed on the Central Stores in the name of the above mentioned contractors for the works being carried out by them under this Division may please be honoured and the materials handed over to the authorised representative, i.e. Shri .... His photograph duly attested and his specimen signatures are given underneath.

(vi)The authorisation letter with identity cards duly signed and attested should be sent through the authorised Junior Engineer of the Division in a closed cover in the name of the Executive Engineer, Central Stores Division so that there may be no change or tampering with the original identity card etc.

(vii) The indent shall be presented at the Central Stores within 15 days of EE signing the same.

(viii) The EE shall have the option to send advance payment for every indent or a lump sum advance for 2-3 months.

Verification of stocks

E.E. should have store verified throughout his Division at least once a year. It is not necessary that all the stores of a Division or of a Sub-Division should be checked and counted at the same time, but the dates on which articles are checked should be entered in the store returns. Stores should be counted by an officer not below the rank of an S.D.O. E.E. should ensure confidential check of store by selecting articles for check by S.D.O. monthly and obtain the result. In addition A.E. attached in Circle Office shall also carry out checking of stores at least once in a year or as and when directed by the S.E.

The Office Superintendent of E.-in-C./C.E./S.E, Head Clerk/establishment clerk in E.E.'s office and Sub-Divisional Clerk in S.D.O's office shall maintain the numerical account of furniture of his office. The physical verification will also be conducted by him and results intimated to Head of the Office.

Building BYLAWS and REGULATORY Bodies:

Building Bye-Laws are legal tools used to regulate coverage, height, building bulk, and architectural design and construction aspects of buildings so as to achieve orderly development of an area. They are mandatory in nature and serve to protect buildings against fire, earthquake, noise, structural failures and other hazards. In India, there are still many small and medium sized towns which do not have building bye-laws and in the absence of

any regulatory mechanism, such towns are confronted with excessive coverage, encroachment and haphazard development resulting in chaotic conditions, inconvenience for the users, and disregard for building aesthetics, etc. It is in this context, Town and Country Planning Organisation (TCPO) has made an effort to prepare "Model Building Bye-Laws-2016" for the guidance of the State Governments, Urban Local Bodies, Urban Development Authorities, etc which is an improvement over the previous Model Building Bye Laws brought out in 2004.

In 2003, the Ministry of Urban Development desired that Model Building Bye Laws be prepared, in view of Bhuj Earthquake that occurred in 2001, to lay focus on structural safety of buildings and for the guidance of the State Governments. Accordingly, the Model Building Bye Laws (MBBL) 2004 incorporated the provisions of structural safety and other provisions like rainwater harvesting and waste water recycling, solar assisted heating, barrier free public buildings and fire safety. The Bye-Laws were circulated to all the State Governments and Union territories and out of 36 States and UTs, wherein 22 States and UTs have undertaken comprehensive revision of their respective Building Bye-Laws since 2004.

The reasons for revising the Bye-Laws are as under:

i. **Growing Environmental concern**s: this provision was to ensure all buildings incorporated green construction and sustainability mechanisms such as reuse of wastewater, rainwater harvesting, recycling, solar rooftop installations and more.

ii. **Increased Safety and Security measures:** this included the structural safety, prevention measures, disaster management, etc. related to a building's architectural design

iii. **Technological Developments:** this provision was to ensure higher adoption of technologies that can increase efficiencies in structural safety, fire safety, disaster management and more

iv. **Swachh Bharat Mission:** this provision was to ensure hygienic sanitation facilities for women and the general public at large

v. **Focus on Ease of Doing Business:** this provision was to ensure that commercial building plans were adequately adhering to compliance requirements and reporting the same regularly

In 2015, it was further desired by the Ministry of Urban Development that the Model Building Bye-Laws, 2004 needs to be revised and updated keeping in view the emerging issues like Norms for Rooftop Solar PV Installation, Segregated sanitation facilities for visitors in public buildings, Additional provisions in Building regulations for natural hazard prone areas, Conservation of heritage sites including heritage buildings, heritage precincts and natural feature areas, Bye-laws for safe use of glass, barrier free environment for disabled, children and old persons and Mitigation of the effects of electromagnetic radiation on built spaces.

Purpose of building bye laws:

➢ Ensure uniform development of buildings in societies as well as towns

➢ Affirm public safety against noise, fire, health hazards and structural failures

➢ Ensure optimum utilization of space

➢ Follow approaches which safeguard complete health, safety and comfort of residents, such as proper ventilation, air, light and other essentials

Building bye laws include norms related to the following:

❖ Floor Area Ratio (FAR) and ground coverage
❖ Density
❖ Basement and parking spaces
❖ Setbacks and projections
❖ Area and its usage

- ❖ Building height and other service spaces
- ❖ Provision for lifts and basement area
- ❖ Site design and service design– sewerage, electrical design, and water, among others

REGULATORY Bodies:-

Development Control Regulations (DCR) in India

Development Control Regulations are a set of rules that are planned to ensure the proper and effective development of a city, as well as the general welfare of the public. Regulation is necessary to ensure planned development. It depends on a "plan-led system" whereas development plans are made and the public is consulted.

It is a mechanism that controls the development and use of land. This involves the construction of new buildings, the extension of the existing ones, and the change of use of the building or land to another use. Developing new houses/industrial buildings/shops are important for supporting economic progress. At the same time, it is also necessary to protect or improve the quality of towns, villages, countryside, etc.

Under the DCR, the Metropolitan Commissioner is the supreme authority for review of its provisions and his decision would be final. The Metropolitan Commissioner could use his power to approve provisions of these regulations excluding the provisions associated with Forest Survey of India (FSI).

What are the motives of the Development Control Regulations (DCR)?

The motive of Development Control Regulations (DCR) is that any approved plan is implemented by individuals and by corporate or by public-sector developers and thus all new developments should adhere to the terms of the plan.

Why is Development Control Regulations necessary?

Development Control Regulations are a must for every growing city because the area immediately beyond the city limits is often a source of health risk to the city and generally under no strict control of the effective local authority.

What are the objectives of the Development Control Regulations?

1. To stop the unfavourable demand and misuse of land.
2. To assist private interest along with public interest in all phases of development.
3. Development control is legal in nature and the planning authority has the power to punish the defaulters.
4. To control and limit overcrowding on land.
5. To control the private development as per the required rules in connection to public safety, health, and convenience.

How many types of Development Controls Regulations are there?

1. Town and Country Planning Act
2. Building Bye-laws
3. Land Acquisition Act
4. Zoning Regulations
5. Slum Clearance Act
6. Periphery Control Act

Development authorities:-

- (i) Bhubaneswar Development Authority
- (ii) Real Estate Regulatory Authority
- (iii) Rourkela Development Authority
- (iv) Cuttack Development Authority
- (v) Kalinganagar Development Authority
- (vi) Brahmapur Development Authority
- (vii) Puri Konark Development Authority
- (viii) TAMA Development Authority
- (ix) Paradip Development Authority

(x)　　Sambalpur Development Authority

THE REAL ESTATE (REGULATION AND DEVELOPMENT) ACT, 2016

An Act to establish the Real Estate Regulatory Authority for regulation and promotion of the real estate sector and to ensure sale of plot, apartment or building, as the case may be, or sale of real estate project, in an efficient and transparent manner and to protect the interest of consumers in the real estate sector and to establish an adjudicating mechanism for speedy dispute redressal and also to establish the Appellate Tribunal to hear appeals from the decisions, directions or orders of the Real Estate Regulatory Authority and the adjudicating officer and for matters connected therewith or incidental thereto.

Real estate sector plays a catalytic role in fulfilling the needs and demand for housing and infrastructure in the country and is an important pillar of the economy. While this sector has grown significantly in recent years, it has been largely unregulated, with absence of professionalism and standardisation and lack of adequate consumer protection. It has no sectoral regulator like there are for other specific sectors like insurance, telecom, stock markets etc. History is witness to the fact that whenever sectoral regulators like SEBI, IRDAI, TRAI etc have been formed, they have helped in deepening the market and made it more robust. Though the Consumer Protection Act, 1986 is available as a forum to the buyers in the real estate market, the recourse is only curative and is not adequate to address all the concerns of buyers and promoters in that sector. The lack of standardisation has been a constraint to the healthy and orderly growth of industry. Therefore, since more than a decade the need for regulating the sector was being emphasised in various forums.

In view of the above, Parliament enacted the Real Estate (Regulation and Development) Act, 2016 which aims at protecting the rights and interests of consumers and promotion of uniformity and standardization of business practices and transactions in the real estate sector. It attempts to balance the interests of consumers and promoters by imposing certain responsibilities on both. It seeks to establish symmetry of information between the promoter and purchaser, transparency of contractual conditions, set minimum standards of accountability and a fast-track dispute resolution mechanism.

This Act will be put in operation just like the Motor Vehicles Act passed by the Central Government, pursuant to which respective State Governments ("SG") and Union Territories ('UT") are required to notify their own Rules, which would be in the lines of the Central Act and accordingly administer their own State Rules. Accordingly, every SG and UT are to required to promulgate their own Real Estate Rules which would be based on the lines of the central Real Estate (Regulation and Development) Act 2016, and establish a Real Estate Regulatory Authority ("RERA") pursuant to the Rules, which will administer the respective Real Estate Rules of the State or UT. State Governments and UTs were required to notify and enforce RERA by 1st May 2017, which was the deadline set by the Central Government. But a few State Governments have missed the deadline of 1st May 2017. It is expected that most of the State Governments would meet the second deadline of 31st July 2017, by which the ongoing projects are to be registered with RERA.

The Purpose of this Act is :

- ➢ To establish the Real Estate Regulatory Authority for regulation and promotion of the Real Estate sector.
- ➢ To ensure transparency in projects.
- ➢ To protect the interest of consumers in the Real Estate Sector and to establish an adjudicating mechanism for speedy dispute redressal.
- ➢ To provide proper information about the Builder.
- ➢ Provide recommendations to appropriate Government on in matters relating to the development & promotion of real estate sector.

The objects and reasons for which the Act has been framed are :

- ➢ ensure accountability towards allottees and protect their interest

- ➤ infuse transparency, ensure fair-play and reduce frauds & delays
- ➤ introduce professionalism and pan India standardization
- ➤ establish symmetry of information between the promoter and allottee
- ➤ imposing certain responsibilities on both promoter and allottees
- ➤ establish regulatory oversight mechanism to enforce contracts
- ➤ establish fast- track dispute resolution mechanism
- ➤ promote good governance in the sector which in turn would create investor confidence

ORERA:

   Odisha Real Estate Regulatory Authority has been established with effect from 7 th October 2017 in accordance with the provision under Section-30 of the Real Estate (Regulation and Development) Act 2016 enacted through Parliamentary legislation coming into force with effect from 1st May 2017. The Act is designed to regulate and promote, real estate sector through a quasi-judicial institutional mechanism of the Authority. The mandate entrusted to the Authority is to bring in transparency in the real estate sector transactions with primary focus on protecting the interest of consumers. The Act, inter alia, provides:

- ➤ Mandatory registration of every real estate project (apartments, group housing, plotted scheme etc) with the Authority prior to advertisement, formally or informally vide Section-3 of the Act. Government of Odisha has now banned registration of sale deed of real estate project in the absence of registration of the Property with the Authority.
- ➤ Mandatory disclosure, to the Authority and public, of all the details of the property including approved building plan, layout plan, land details with encumbrances, if any, etc.
- ➤ Regulation by the Authority of all the financial transactions relating to the project.
- ➤ Redressal of complaints of the consumers, through the authority, relating to delay in project delivery, poor quality in construction, non-provision of promised facilities/ amenities, diversion of land for a purpose other than delineated in the layout plan, unilaterally escalating prices, not forming allottees association and handing over common areas to the association etc.
- ➤ Award of compensation for losses sustained by the allottees or promoter due to lapses on either side